FCC SAR Test Report

APPLICANT	:	**Lenovo(Shanghai) Electronics Technology Co., Ltd.**
EQUIPMENT	:	**Notebook Computer**
BRAND NAME	:	**Lenovo**
MODEL NAME	:	**Lenovo YB-J912F**
FCC ID	:	**O57YBJ912F**
STANDARD	:	**FCC 47 CFR Part 2 (2.1093)** **ANSI/IEEE C95.1-1992** **IEEE 1528-2013**

We, Sporton International (Kunshan) Inc., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of Sporton International (Kunshan) Inc., the test report shall not be reproduced except in full.

Mark Qu

Approved by: Mark Qu / Manager

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TESTING
NVLAP LAB CODE 600155-0

Sporton International (Kunshan) Inc.
No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China

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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA7D2101-02	Rev. 01	Initial issue of report	Jun. 28, 2018

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Lenovo(Shanghai) Electronics Technology Co., Ltd., Notebook Computer, Lenovo YB-J912F,** are as follows.

Highest Standalone 1g SAR Summary			
Equipment Class	Frequency Band		Body 1g SAR (W/kg)
DTS	WLAN	2.4GHz WLAN	1.00
NII		5GHz WLAN	**1.35**
DSS	Bluetooth	Bluetooth	0.37
Highest SAR Summary Highest Simultaneous Transmission 1g SAR (W/kg)			
2.4GHz WLAN Ant.1+2.4GHz WLAN Ant.2		**1.47**	
5GHz WLAN Ant.1+5GHz WLAN Ant.2		1.35	
2.4GHz WLAN Ant.1+ Bluetooth Ant.2		1.38	
5GHz WLAN Ant.1+ Bluetooth Ant.2		1.35	
Date of Testing:		2018/6/2 ~ 2018/6/3	

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications.

2. Administration Data

Testing Laboratory	
Test Site	Sporton International (Kunshan) Inc.
Test Site Location	No.3-2 Ping-Xiang Rd, Kunshan Development Zone Kunshan City Jiangsu Province 215335 China TEL : +86-512-57900158 FAX : +86-512-57900958

Applicant	
Company Name	Lenovo(Shanghai) Electronics Technology Co., Ltd.
Address	NO.68 BUILDING, 199 FENJU RD, Pilot Free Trade Zone, 200131, China

Manufacturer	
Company Name	Lenovo PC HK Limited
Address	23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong

3. Guidance Applied

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r02
- FCC KDB 447498 D01 General RF Exposure Guidance v06
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r02
- FCC KDB 616217 D04 SAR for laptop and tablets v01r02

4. Equipment Under Test (EUT) Information

4.1 General Information

Product Feature & Specification	
Equipment Name	Notebook Computer
Brand Name	Lenovo
Model Name	Lenovo YB-J912F
FCC ID	O57YBJ912F
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2472 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	WLAN 2.4GHz : 802.11b/g/n HT20/HT40 WLAN 5GHz : 802.11a/n/ac HT20/HT40/VHT20/VHT40/VHT80 Bluetooth v3.0+EDR, Bluetooth v4.0 LE, Bluetooth v4.1 LE, Bluetooth v4.2 LE
HW Version	Lenovo YB-J912F
SW Version	Windows 10
EUT Stage	Identical Prototype

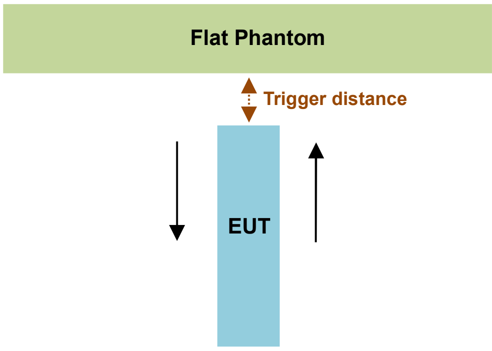
Remark:

1. This device has no voice function.
2. This EUT has two typical use conditions which are laptop mode and tablet mode.
3. This device implanted proximity sensor function at bottom, bottom face and edge 3, power reduction will be implemented immediately at all 5GHz WLAN bands and 2.4GHz WLAN band.
4. This is a variant report for Lenovo YB-J912F, the product equality declaration could be referred to Appendix E. Based on the similarity between two models, 2.4GHz WLAN performed full SAR testing, 5GHz WLAN only verified the worse cases from reference report (Sporton Report Number FA7D2101) were verified for difference.

5. Proximity Sensor Triggering Test

<Proximity Sensor Triggering Distance (KDB 616217 D04 section 6.2)>:

Proximity sensor triggering distance testing was performed according to the procedures outlined in KDB 616217 D04 section 6.2, and EUT moving further away from the flat phantom and EUT moving toward the flat phantom were both assessed. The details are illustrated in the exhibit “P-Sensor operational description”, and the shortest triggering distances were reported and used for SAR assessment.
In the preliminary triggering distance testing, the tissue-equivalent medium for different frequency bands were used for verification; and the tissue-equivalent medium for highest frequency (5800MHz) and lowest (2450MHz) frequency was used for proximity sensor triggering testing.



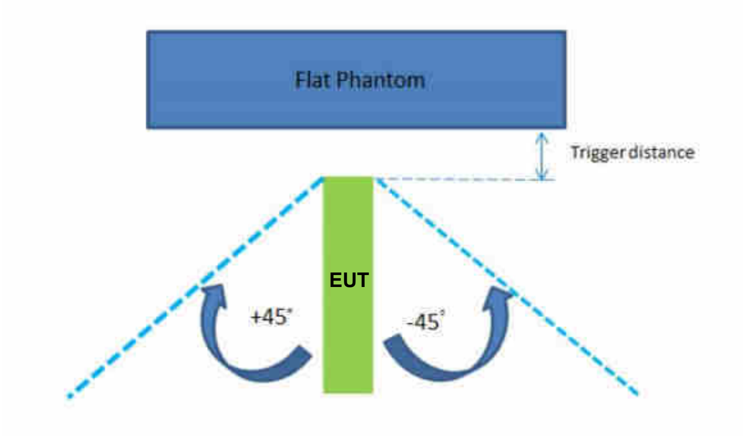
Proximity Sensor Trigger Distance (mm)			
Position	Bottom	Bottom Face	Edge 3
Minimum	11	13	13

<Proximity Sensor Triggering Coverage (KDB 616217 D04 section 6.3)>:

If a sensor is spatially offset from the antenna(s), it is necessary to verify sensor triggering for conditions where the antenna is next to the user but the sensor is laterally further away to ensure sensor coverage is sufficient for reducing the power to maintain compliance. For p-sensor coverage testing, the device is moved and “along the direction of maximum antenna and sensor offset”.
Illustrated in the internal photo exhibit, although the senor is spatially offset, there is no trigger condition where the antenna is next to the user but the sensor is laterally further away, therefore proximity sensor coverage testing is not required.
This procedure is not required because antenna and sensor are collocated and the peak SAR location is overlapping with the sensor.

<Tablet Tilt angle influences to proximity sensor triggering (KDB 616217 D04 section 6.4)>:

The influence of table tilt angles to proximity sensor triggering was determined by positioning each tablet edge that contains a transmitting antenna, perpendicular to the flat phantom, at 13 mm separation.
Rotating the tablet around the edge next to the phantom in ≤ 10° increments until the tablet is ± 45° from the vertical position at 0°, and the maximum output power remains in the reduced mode.



Proximity Sensor Trigger Distance (mm)	
Position	Edge 3
Minimum	13

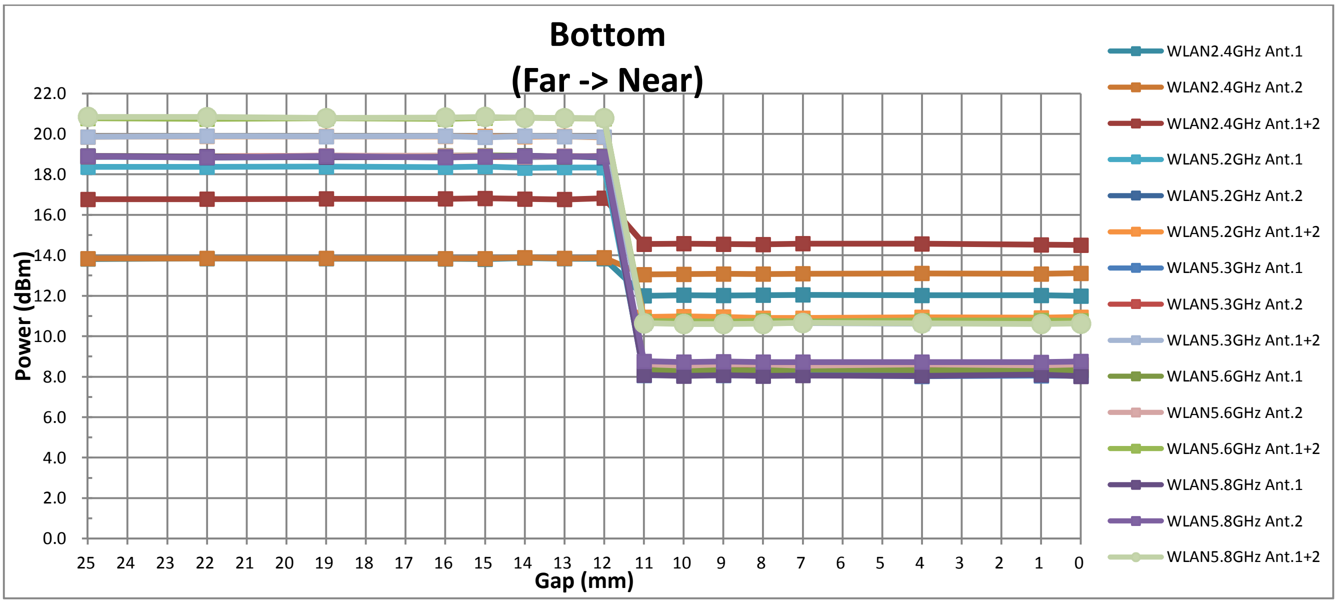
Proximity sensor power reduction

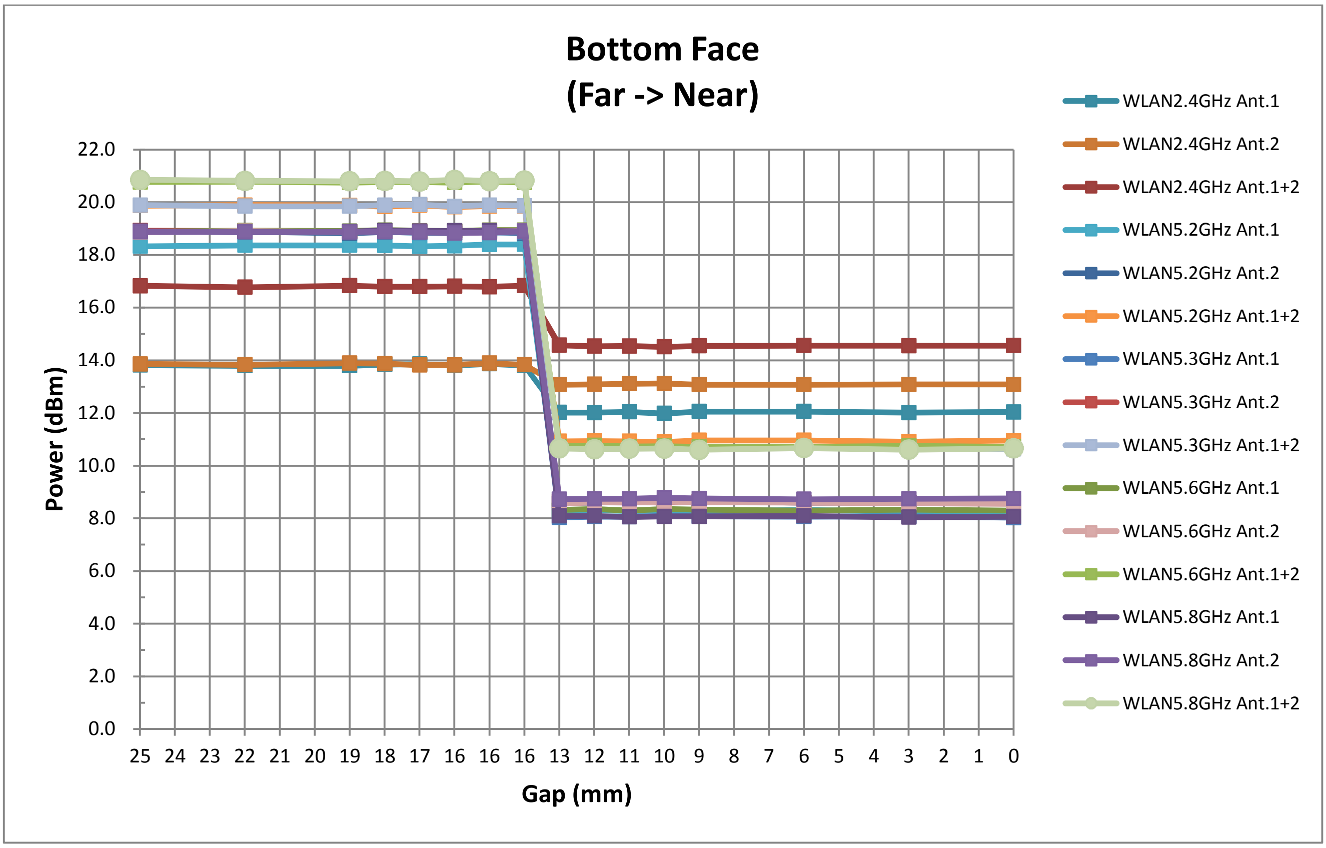
Exposure Position / wireless mode	Bottom[(1)]	Bottom Face[(1)]	Edge 1	Edge 2	Edge 3[(1)]	Edge 4
WLAN 2.4GHz Ant.1	1.5 dB	1.5 dB	0 dB	0 dB	1.5 dB	0 dB
WLAN 2.4GHz Ant.2	1.0 dB	1.0 dB	0 dB	0 dB	1.0 dB	0 dB
WLAN 2.4GHz Ant.1+2	1.5 dB	1.5 dB	0 dB	0 dB	1.5 dB	0 dB
WLAN 5.2GHz Ant.1	11.0 dB	11.0 dB	0 dB	0 dB	11.0 dB	0 dB
WLAN 5.2GHz Ant.2	10.5 dB	10.5 dB	0 dB	0 dB	10.5 dB	0 dB
WLAN 5.2GHz Ant.1+2	10.0 dB	10.0 dB	0 dB	0 dB	10.0 dB	0 dB
WLAN 5.3GHz Ant.1	11.0 dB	11.0 dB	0 dB	0 dB	11.0 dB	0 dB
WLAN 5.3GHz Ant.2	10.5 dB	10.5 dB	0 dB	0 dB	10.5 dB	0 dB
WLAN 5.3GHz Ant.1+2	10.0 dB	10.0 dB	0 dB	0 dB	10.0 dB	0 dB
WLAN 5.6GHz Ant.1	10.7 dB	10.7 dB	0 dB	0 dB	10.7 dB	0 dB
WLAN 5.6GHz Ant.2	10.5 dB	10.5 dB	0 dB	0 dB	10.5 dB	0 dB
WLAN 5.6GHz Ant.1+2	9.7 dB	9.7 dB	0 dB	0 dB	9.7 dB	0 dB
WLAN 5.8GHz Ant.1	10.5 dB	10.5 dB	0 dB	0 dB	10.5 dB	0 dB
WLAN 5.8GHz Ant.2	10.5 dB	10.5 dB	0 dB	0 dB	10.5 dB	0 dB
WLAN 5.8GHz Ant. 1+2	9.5 dB	9.5 dB	0 dB	0 dB	9.5 dB	0 dB

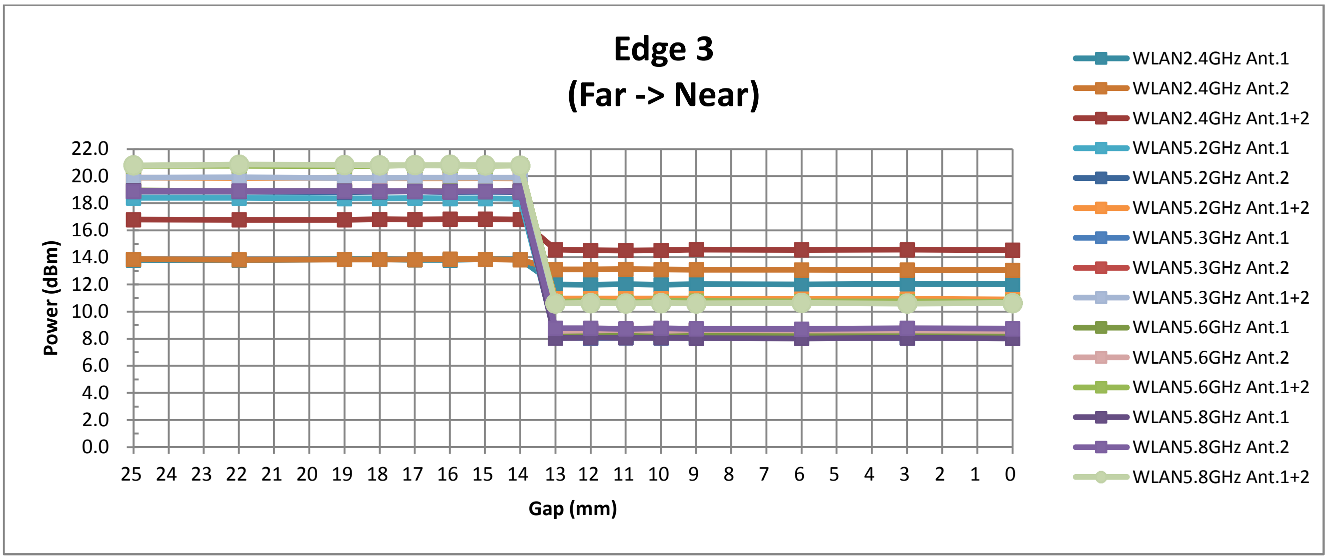
Remark:
1. [(1)]: Reduced maximum limit applied by activation of proximity sensor.
2. Power reduction is not applicable for Bluetooth.
3. Tests were performed in accordance with KDB 616217 D04 section 6.1, 6.2, 6.3, 6.4 and 6.5 and compliant results are shown and described in exhibit “P-Sensor operational description
4. According to the normal usage, we didn’t evaluate the distance SAR at laptop of bottom.

Power Measurement during Sensor Trigger distance testing

Band/Mode	Ch #	Measured power reduction (dBm)		Reduction Levels
		w/o power back-off	w/ power back-off	(dB)
WLAN 2.4GHz Ant.1	6	13.67	12.15	1.52
WLAN 2.4GHz Ant.2	6	13.72	12.78	0.94
WLAN 2.4GHz Ant.1+2	6	16.72	14.66	2.06
WLAN 5.2GHz Ant.1	44	18.82	8.42	10.40
WLAN 5.2GHz Ant.2	44	18.81	8.57	10.24
WLAN 5.2GHz Ant.1+2	44	19.76	10.77	8.99
WLAN 5.3GHz Ant.1	60	18.83	8.02	10.81
WLAN 5.3GHz Ant.2	60	18.80	8.64	10.16
WLAN 5.3GHz Ant.1+2	60	19.83	10.62	9.21
WLAN 5.6GHz Ant.1	116	18.86	8.28	10.58
WLAN 5.6GHz Ant.2	116	18.73	8.49	10.24
WLAN 5.6GHz Ant.1+2	116	19.75	10.75	9.00
WLAN 5.8GHz Ant.1	157	18.72	7.79	10.93
WLAN 5.8GHz Ant.2	157	18.76	8.74	10.02
WLAN 5.8GHz Ant. 1+2	157	20.73	10.56	10.17




Bottom Face
(Far -> Near)
Power (dBm)
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
25 24 23 22 21 20 19 18 17 16 16 16 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Gap (mm)
WLAN2.4GHz Ant.1
WLAN2.4GHz Ant.2
WLAN2.4GHz Ant.1+2
WLAN5.2GHz Ant.1
WLAN5.2GHz Ant.2
WLAN5.2GHz Ant.1+2
WLAN5.3GHz Ant.1
WLAN5.3GHz Ant.2
WLAN5.3GHz Ant.1+2
WLAN5.6GHz Ant.1
WLAN5.6GHz Ant.2
WLAN5.6GHz Ant.1+2
WLAN5.8GHz Ant.1
WLAN5.8GHz Ant.2
WLAN5.8GHz Ant.1+2


Edge 3
(Far -> Near)
Power (dBm)
22.0
20.0
18.0
16.0
14.0
12.0
10.0
8.0
6.0
4.0
2.0
0.0
25 24 23 22 21 20 19 18 17 16 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0
Gap (mm)
WLAN2.4GHz Ant.1
WLAN2.4GHz Ant.2
WLAN2.4GHz Ant.1+2
WLAN5.2GHz Ant.1
WLAN5.2GHz Ant.2
WLAN5.2GHz Ant.1+2
WLAN5.3GHz Ant.1
WLAN5.3GHz Ant.2
WLAN5.3GHz Ant.1+2
WLAN5.6GHz Ant.1
WLAN5.6GHz Ant.2
WLAN5.6GHz Ant.1+2
WLAN5.8GHz Ant.1
WLAN5.8GHz Ant.2
WLAN5.8GHz Ant.1+2

6. RF Exposure Limits

6.1 Uncontrolled Environment

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

6.2 Controlled Environment

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

Limits for Occupational/Controlled Exposure (W/kg)

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

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

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

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

7. Specific Absorption Rate (SAR)

7.1 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.

7.2 SAR Definition

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

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

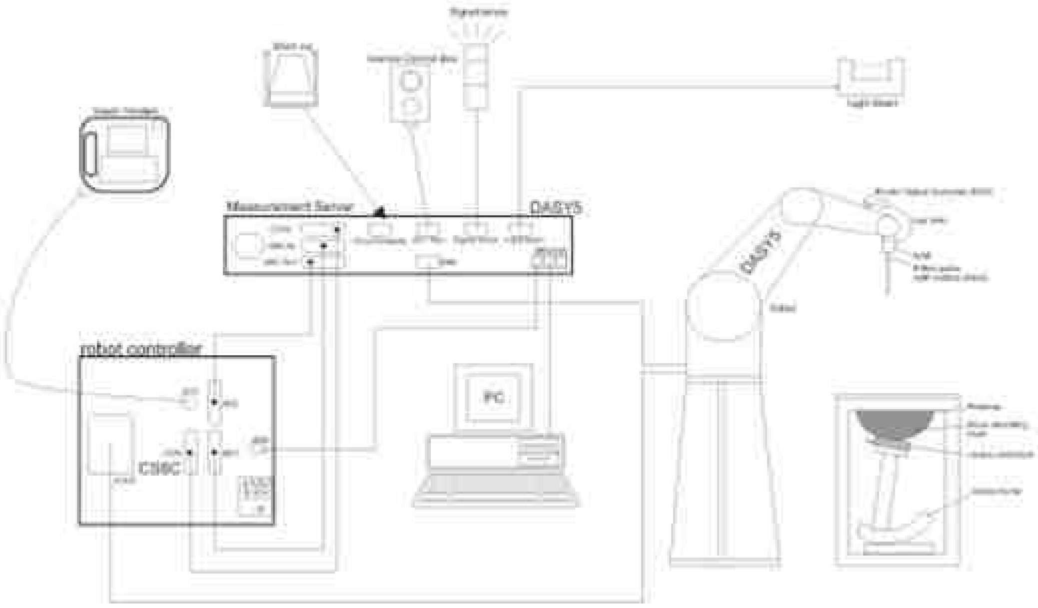
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

8. System Description and Setup

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



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

8.1 E-Field Probe

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

<EX3DV4 Probe>

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

8.2 Data Acquisition Electronics (DAE)

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

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

Photo of DAE

8.3 Phantom

<SAM Twin Phantom>

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

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

<ELI Phantom>

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

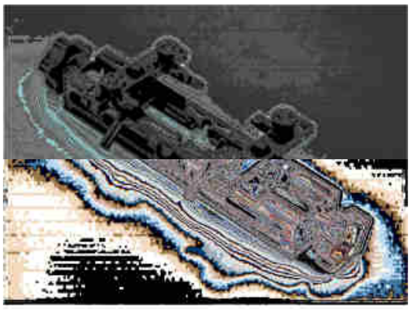
The ELI phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

8.4 Device Holder

<Mounting Device for Hand-Held Transmitter>

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

Mounting Device for Hand-Held Transmitters



Mounting Device Adaptor for Wide-Phones

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

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

Mounting Device for Laptops

9. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

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

<SAR measurement>

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

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

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

9.1 Spatial Peak SAR Evaluation

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

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

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

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

9.2 Power Reference Measurement

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

9.3 Area Scan

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

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

<table>
<tr><th></th><th>$\leq$ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td>Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td>Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td rowspan="2">Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}</td><td>$\leq$ 2 GHz: $\leq$ 15 mm
2 – 3 GHz: $\leq$ 12 mm</td><td>3 – 4 GHz: $\leq$ 12 mm
4 – 6 GHz: $\leq$ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
</table>

9.4 Zoom Scan

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

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

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	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
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. * When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

9.5 Volume Scan Procedures

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

9.6 Power Drift Monitoring

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

10. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	840	2017/12/7	2018/12/6
SPEAG	5000MHz System Validation Kit	D5GHzV2	1006	2017/9/26	2018/9/25
SPEAG	Data Acquisition Electronics	DAE4	910	2017/7/13	2018/7/12
SPEAG	Dosimetric E-Field Probe	EX3DV3	7357	2017/12/18	2018/12/17
SPEAG	SAM Twin Phantom	QD 000 P40 CB	TP-1127	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Anritsu	Radio communication analyzer	MT8820C	6201563814	2018/1/18	2019/1/17
Agilent	Wireless Communication Test Set	E5515C	MY52102706	2018/4/17	2019/4/16
Agilent	ENA Series Network Analyzer	E5071C	MY46111157	2018/4/17	2019/4/16
SPEAG	DAK Kit	DAK3.5	1146	2017/7/18	2018/7/17
R&S	Signal Generator	SML03	103818	2017/8/17	2018/8/16
Anritsu	Power Meter	ML2495A	1218006	2017/10/6	2018/10/5
Anritsu	Power Sensor	MA2411B	1207363	2017/10/6	2018/10/5
Testo	Hygrometer	608-H1	1241332096	2017/8/21	2018/8/20
FLUKE	DIGITAC THERMOMETER	51II	97240029	2017/8/3	2018/8/2
EXA	Spectrum Analyzer	FSV7	101742	2018/1/19	2019/1/18
ARRA	Power Divider	A3200-2	N/A	Note	
MCL	Attenuation1	BW-S10W5+	N/A	Note	
MCL	Attenuation2	BW-S10W5+	N/A	Note	
MCL	Attenuation3	BW-S10W5+	N/A	Note	
AR	Amplifier	5S1G4	333096	Note	
mini-circuits	Amplifier	ZVE-3W-83+	162601250	Note	
Agilent	Dual Directional Coupler	778D	50422	Note	
PASTERNACK	Dual Directional Coupler	PE2214-10	N/A	Note	

Note: Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.

11. System Verification

11.1 Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 10.1.

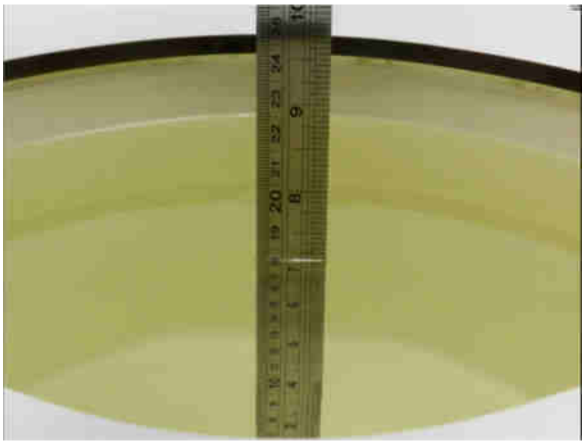


Fig 10.1 Photo of Liquid Height for Body SAR

11.2 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (εr)
For Body								
2450	68.6	0	0	0	0	31.4	1.95	52.7

Simulating Liquid for 5GHz, Manufactured by SPEAG

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

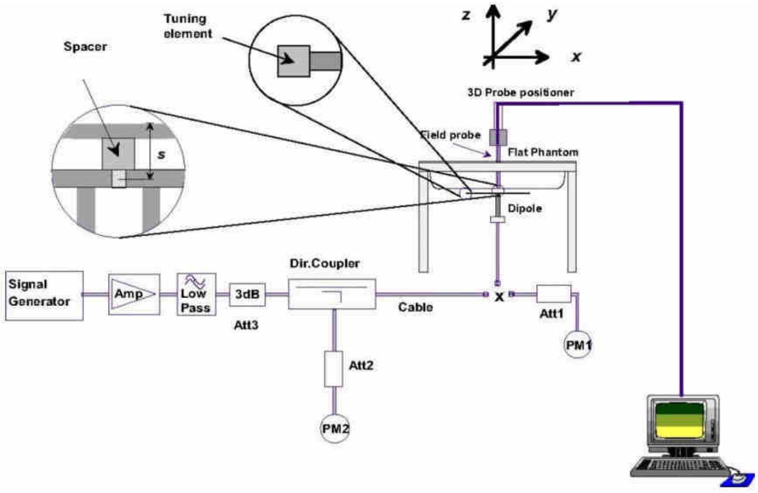
<Tissue Dielectric Parameter Check Results>

Frequency (MHz)	Tissue Type	Liquid Temp. (℃)	Conductivity (σ)	Permittivity (ε_r)	Conductivity Target (σ)	Permittivity Target (ε_r)	Delta (σ) (%)	Delta (ε_r) (%)	Limit (%)	Date
2450	Body	22.7	1.957	52.432	1.95	52.70	0.36	-0.51	±5	2018/6/2
5250	Body	22.8	5.548	47.011	5.36	48.90	3.51	-3.86	±5	2018/6/3
5600	Body	22.9	6.014	46.383	5.77	48.50	4.23	-4.36	±5	2018/6/3
5750	Body	22.6	6.226	46.149	5.94	48.30	4.81	-4.45	±5	2018/6/3

11.3 System Performance Check Results

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

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2018/6/2	2450	Body	250	840	7375	910	12.03	51.90	48.12	-7.28
2018/6/3	5250	Body	100	1006	7375	910	7.80	77.00	78.00	1.30
2018/6/3	5600	Body	100	1006	7375	910	7.54	80.10	75.40	-5.87
2018/6/3	5750	Body	100	1006	7375	910	7.42	75.10	74.20	-1.20



System Performance Check Setup

Setup Photo

12. RF Exposure Positions

This DUT has two typical use conditions which are laptop mode and tablet mode, so the DUT were tested in bottom and back of display screen were tested for laptop mode; bottom face and edge2 / edge3 / edge4 for tablet mode.

EUT has proximity sensor function, it would be on bottom, bottom face and edge3. The distance is 10 mm for 2.4GHz/5GHz WLAN frequency bands at bottom face and edge3 when EUT transmitting with full power was performed and 0mm with reduced power. According to the normal usage, we didn't evaluate the distance SAR at laptop of bottom. Additional the surface of EUT is touching with phantom 0mm with full power.

<EUT Setup Photos>

Please refer to Appendix D for the test setup photos.

13. Conducted RF Output Power (Unit: dBm)

<WLAN Conducted Power>

General Note:

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

<Maximum Average RF Power (Proximity Sensor Inactive)>

<2.4GHz WLAN Ant.1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	13.79	14.50	100
		6	2437	13.67	14.50	
		11	2462	13.66	14.50	
		12	2467	13.68	14.50	
		13	2472	8.19	10.00	
	802.11g 6Mbps	1	2412	13.76	14.00	94.63
		6	2437	13.62	14.00	
		11	2462	13.68	14.00	
		12	2467	11.39	12.00	
		13	2472	-2.57	-2.00	
	802.11n-HT20 MCS0	1	2412	13.71	14.00	95.08
		6	2437	13.68	14.00	
		11	2462	13.75	14.00	
		12	2467	10.80	11.00	
		13	2472	-2.70	-2.00	
	802.11n-HT40 MCS0	3	2422	13.77	14.00	83.94
		6	2437	13.68	14.00	
		9	2452	13.73	14.00	
		10	2457	12.32	13.00	
		11	2462	-2.82	-2.00	

<2.4GHz WLAN Ant.2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	13.81	14.50	100
		6	2437	13.72	14.50	
		11	2462	13.75	14.50	
		12	2467	13.64	14.50	
		13	2472	8.41	10.00	
	802.11g 6Mbps	1	2412	13.77	14.00	94.63
		6	2437	13.71	14.00	
		11	2462	13.65	14.00	
		12	2467	10.36	11.00	
		13	2472	-2.74	-2.00	
	802.11n-HT20 MCS0	1	2412	13.76	14.00	95.64
		6	2437	13.61	14.00	
		11	2462	13.67	14.00	
		12	2467	10.61	11.00	
		13	2472	-2.92	-2.00	
	802.11n-HT40 MCS0	3	2422	13.79	14.00	84.31
		6	2437	13.70	14.00	
		9	2452	13.62	14.00	
		10	2457	12.62	13.00	
		11	2462	-2.84	-2.00	

<2.4GHz WLAN Ant.1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11n-HT20 MCS0	1	2412	16.76	17.50	84.25
		6	2437	16.72	17.50	
		11	2462	16.69	17.50	
		12	2467	13.49	14.50	
		13	2472	-3.09	-2.50	
	802.11n-HT40 MCS0	3	2422	16.73	17.50	83.70
		6	2437	16.73	17.50	
		9	2452	16.67	17.50	
		10	2457	13.54	14.50	
		11	2462	-1.85	-1.50	

<5GHz WLAN Ant.1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	16.82	18.50	94.65
		40	5200	18.80	19.50	
		44	5220	18.82	19.50	
		48	5240	18.32	19.50	
	802.11n-HT20 MCS0	36	5180	16.73	18.00	95.65
		40	5200	18.78	19.00	
		44	5220	18.81	19.00	
		48	5240	18.25	19.00	
	802.11n-HT40 MCS0	38	5190	16.80	18.00	84.31
		46	5230	18.82	19.00	
	802.11ac-VHT20 MCS0	36	5180	16.68	18.00	95.31
		40	5200	18.75	19.00	
		44	5220	18.76	19.00	
		48	5240	18.22	19.00	
	802.11ac-VHT40 MCS0	38	5190	16.70	18.00	84.42
		46	5230	18.78	19.00	
	802.11ac-VHT80 MCS0	42	5210	12.79	14.00	83.82

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	18.80	19.50	94.65
		56	5280	18.77	19.50	
		60	5300	18.83	19.50	
		64	5320	14.85	16.00	
	802.11n-HT20 MCS0	52	5260	18.82	19.00	95.65
		56	5280	18.76	19.00	
		60	5300	18.80	19.00	
		64	5320	14.77	16.00	
	802.11n-HT40 MCS0	54	5270	18.79	19.00	84.31
		62	5310	13.26	15.00	
	802.11ac-VHT20 MCS0	52	5260	18.78	19.00	95.31
		56	5280	18.73	19.00	
		60	5300	18.75	19.00	
		64	5320	14.75	16.00	
	802.11ac-VHT40 MCS0	54	5270	18.75	19.00	84.42
		62	5310	13.25	15.00	
	802.11ac-VHT80 MCS0	58	5290	10.84	12.00	83.82

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	15.23	17.00	94.65
		116	5580	18.86	19.50	
		124	5620	18.77	19.50	
		132	5660	18.83	19.50	
		140	5700	14.81	16.00	
		144	5720	18.72	19.50	
	802.11n-HT20 MCS0	100	5500	15.27	17.00	95.65
		116	5580	18.74	19.00	
		124	5620	18.68	19.00	
		132	5660	18.84	19.00	
		140	5700	14.82	16.00	
		144	5720	18.83	19.00	
	802.11n-HT40 MCS0	102	5510	15.21	17.00	84.31
		110	5550	18.78	19.00	
		126	5630	18.80	19.00	
		134	5670	15.72	17.00	
		142	5710	18.82	19.00	
	802.11ac-VHT20 MCS0	100	5500	15.22	17.00	95.31
		116	5580	18.67	19.00	
		124	5620	18.59	19.00	
		132	5660	18.77	19.00	
		140	5700	14.77	16.00	
		144	5720	18.76	19.00	
	802.11ac-VHT40 MCS0	102	5510	15.09	17.00	84.42
		110	5550	18.66	19.00	
		126	5630	18.68	19.00	
		134	5670	15.67	17.00	
		142	5710	18.76	19.00	
	802.11ac-VHT80 MCS0	106	5530	12.24	14.00	83.82
		122	5610	16.23	18.00	
		138	5690	18.80	19.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a MCS0	149	5745	18.77	19.50	94.65
		157	5785	18.72	19.50	
		165	5825	18.85	19.50	
	802.11n-HT20 MCS0	149	5745	18.80	19.00	95.65
		157	5785	18.76	19.00	
		165	5825	18.85	19.00	
	802.11n-HT40 MCS0	151	5755	18.73	19.00	84.31
		159	5795	18.83	19.00	
	802.11ac-VHT20 MCS0	149	5745	18.72	19.00	95.31
		157	5785	18.69	19.00	
		165	5825	18.74	19.00	
	802.11ac-VHT40 MCS0	151	5755	18.70	19.00	84.42
		159	5795	18.76	19.00	
	802.11ac-VHT80 MCS0	155	5775	16.29	18.00	83.82

<5GHz WLAN Ant.2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	16.30	18.00	94.53
		40	5200	18.35	19.50	
		44	5220	18.81	19.50	
		48	5240	18.28	19.50	
	802.11n-HT20 MCS0	36	5180	16.26	18.00	95.86
		40	5200	18.31	19.00	
		44	5220	18.80	19.00	
		48	5240	18.29	19.00	
	802.11n-HT40 MCS0	38	5190	16.80	18.00	84.63
		46	5230	18.70	19.00	
	802.11ac-VHT20 MCS0	36	5180	16.23	18.00	95.51
		40	5200	18.27	19.00	
		44	5220	18.75	19.00	
		48	5240	18.25	19.00	
	802.11ac-VHT40 MCS0	38	5190	16.76	18.00	84.73
		46	5230	18.66	19.00	
	802.11ac-VHT80 MCS0	42	5210	12.81	14.00	83.68

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	18.83	19.50	94.53
		56	5280	18.75	19.50	
		60	5300	18.80	19.50	
		64	5320	15.23	17.00	
	802.11n-HT20 MCS0	52	5260	18.85	19.00	95.86
		56	5280	18.80	19.00	
		60	5300	18.84	19.00	
		64	5320	15.26	17.00	
	802.11n-HT40 MCS0	54	5270	18.74	19.00	84.63
		62	5310	13.77	15.00	
	802.11ac-VHT20 MCS0	52	5260	18.76	19.00	95.51
		56	5280	18.72	19.00	
		60	5300	18.71	19.00	
		64	5320	15.14	17.00	
	802.11ac-VHT40 MCS0	54	5270	18.67	19.00	84.73
		62	5310	13.70	15.00	
	802.11ac-VHT80 MCS0	58	5290	10.75	12.00	83.68

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	16.31	18.00	94.53
		116	5580	18.73	19.50	
		124	5620	18.78	19.50	
		132	5660	18.71	19.50	
		140	5700	14.76	16.00	
		144	5720	18.85	19.50	
	802.11n-HT20 MCS0	100	5500	16.25	18.00	95.86
		116	5580	18.77	19.00	
		124	5620	18.73	19.00	
		132	5660	18.72	19.00	
		140	5700	14.79	16.00	
		144	5720	18.74	19.00	
	802.11n-HT40 MCS0	102	5510	15.23	17.00	84.63
		110	5550	18.79	19.00	
		126	5630	18.78	19.00	
		134	5670	15.81	17.00	
		142	5710	18.74	19.00	
	802.11ac-VHT20 MCS0	100	5500	16.16	18.00	95.51
		116	5580	18.73	19.00	
		124	5620	18.72	19.00	
		132	5660	18.64	19.00	
		140	5700	14.73	16.00	
		144	5720	18.67	19.00	
	802.11ac-VHT40 MCS0	102	5510	15.17	17.00	84.73
		110	5550	18.76	19.00	
		126	5630	18.75	19.00	
		134	5670	15.74	17.00	
		142	5710	18.70	19.00	
	802.11ac-VHT80 MCS0	106	5530	12.78	14.00	83.68
		122	5610	17.34	18.00	
		138	5690	18.82	19.00	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a MCS0	149	5745	18.82	19.50	94.53
		157	5785	18.76	19.50	
		165	5825	18.83	19.50	
	802.11n-HT20 MCS0	149	5745	18.77	19.00	95.86
		157	5785	18.81	19.00	
		165	5825	18.83	19.00	
	802.11n-HT40 MCS0	151	5755	18.80	19.00	84.63
		159	5795	18.76	19.00	
	802.11ac-VHT20 MCS0	149	5745	18.72	19.00	95.51
		157	5785	18.76	19.00	
		165	5825	18.80	19.00	
	802.11ac-VHT40 MCS0	151	5755	18.74	19.00	84.73
		159	5795	18.67	19.00	
	802.11ac-VHT80 MCS0	155	5775	16.22	18.00	83.68

<5GHz WLAN Ant.1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11n-HT20 MCS0	36	5180	17.79	19.50	84.75
		40	5200	19.76	21.50	
		44	5220	19.76	21.50	
		48	5240	19.73	21.50	
	802.11n-HT40 MCS0	38	5190	15.28	17.00	83.37
		46	5230	19.81	21.50	
	802.11ac-VHT20 MCS0	36	5180	17.75	19.50	91.17
		40	5200	19.70	21.50	
		44	5220	19.71	21.50	
		48	5240	19.63	21.50	
	802.11ac-VHT40 MCS0	38	5190	15.23	17.00	91.00
		46	5230	19.75	21.50	
	802.11ac-VHT80 MCS0	42	5210	13.79	14.00	89.89

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11n-HT20 MCS0	52	5260	19.76	21.50	84.75
		56	5280	19.75	21.50	
		60	5300	19.83	21.50	
		64	5320	17.24	19.00	
	802.11n-HT40 MCS0	54	5270	19.79	21.50	83.37
		62	5310	13.80	15.50	
	802.11ac-VHT20 MCS0	52	5260	19.72	21.50	91.17
		56	5280	19.71	21.50	
		60	5300	19.80	21.50	
		64	5320	17.17	19.00	
	802.11ac-VHT40 MCS0	54	5270	19.74	21.50	91.00
		62	5310	13.69	15.50	
	802.11ac-VHT80 MCS0	58	5290	12.28	14.00	89.89

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11n-HT20 MCS0	100	5500	17.75	19.50	84.75
		116	5580	19.75	21.50	
		124	5620	19.76	21.50	
		132	5660	19.75	21.50	
		140	5700	15.77	17.50	
		144	5720	19.80	21.50	
	802.11n-HT40 MCS0	102	5510	13.80	15.50	83.37
		110	5550	19.81	21.50	
		126	5630	19.75	21.50	
		134	5670	18.27	20.00	
		142	5710	19.80	21.50	
	802.11ac-VHT20 MCS0	100	5500	17.70	19.50	91.17
		116	5580	19.69	21.50	
		124	5620	19.73	21.50	
		132	5660	19.67	21.50	
		140	5700	15.68	17.50	
		144	5720	19.74	21.50	
	802.11ac-VHT40 MCS0	102	5510	13.70	15.50	91.00
		110	5550	19.77	21.50	
		126	5630	19.69	21.50	
		134	5670	18.19	20.00	
		142	5710	19.73	21.50	
	802.11ac-VHT80 MCS0	106	5530	12.24	14.00	89.89
		122	5610	19.79	21.50	
		138	5690	20.74	21.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11n-HT20 MCS0	149	5745	20.76	21.50	84.75
		157	5785	20.73	21.50	
		165	5825	20.78	21.50	
	802.11n-HT40 MCS0	151	5755	20.76	21.50	83.37
		159	5795	20.78	21.50	
	802.11ac-VHT20 MCS0	149	5745	20.69	21.50	91.17
		157	5785	20.66	21.50	
		165	5825	20.72	21.50	
	802.11ac-VHT40 MCS0	151	5755	20.70	21.50	91
		159	5795	20.68	21.50	
	802.11ac-VHT80 MCS0	155	5775	18.77	20.50	89.89

<Maximum Average RF Power (Proximity Sensor Active)>

<2.4GHz WLAN Ant.1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	11.98	13.00	100
		6	2437	12.15	13.00	
		11	2462	12.18	13.00	
		12	2467	12.13	13.00	
		13	2472	8.19	10.00	
	802.11g 6Mbps	1	2412	11.71	12.50	94.67
		6	2437	11.86	12.50	
		11	2462	11.92	12.50	
		12	2467	11.39	12.00	
		13	2472	-2.57	-2.00	
	802.11n-HT20 MCS0	1	2412	11.74	12.50	95.65
		6	2437	11.90	12.50	
		11	2462	11.92	12.50	
		12	2467	10.80	11.00	
		13	2472	-2.70	-2.00	
	802.11n-HT40 MCS0	3	2422	11.75	12.50	84.31
		6	2437	11.89	12.50	
		9	2452	11.92	12.50	
		10	2457	10.32	11.00	
		11	2462	-2.82	-2.00	

<2.4GHz WLAN Ant.2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11b 1Mbps	1	2412	13.05	13.50	100
		6	2437	12.78	13.50	
		11	2462	12.66	13.50	
		12	2467	12.21	13.50	
		13	2472	8.41	10.00	
	802.11g 6Mbps	1	2412	12.76	13.00	94.63
		6	2437	12.51	13.00	
		11	2462	12.43	13.00	
		12	2467	10.36	11.00	
		13	2472	-2.74	-2.00	
	802.11n-HT20 MCS0	1	2412	12.76	13.00	95.65
		6	2437	12.52	13.00	
		11	2462	12.41	13.00	
		12	2467	10.61	11.00	
		13	2472	-2.92	-2.00	
	802.11n-HT40 MCS0	3	2422	12.77	13.00	84.31
		6	2437	12.54	13.00	
		9	2452	12.42	13.00	
		10	2457	10.62	11.00	
		11	2462	-2.84	-2.00	

<2.4GHz WLAN Ant.1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
2.4GHz WLAN	802.11n-HT20 MCS0	1	2412	14.50	16.00	84.25
		6	2437	14.66	16.00	
		11	2462	14.65	16.00	
		12	2467	13.49	14.50	
		13	2472	-3.09	-2.50	
	802.11n-HT40 MCS0	3	2422	14.54	15.00	83.70
		6	2437	14.59	15.00	
		9	2452	14.66	15.00	
		10	2457	13.54	14.50	
		11	2462	-1.85	-1.50	

<5GHz WLAN Ant.1>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	8.30	8.50	94.65
		40	5200	8.38	8.50	
		44	5220	8.42	8.50	
		48	5240	8.25	8.50	
	802.11n-HT20 MCS0	36	5180	8.08	8.40	95.65
		40	5200	8.14	8.40	
		44	5220	8.17	8.40	
		48	5240	7.98	8.40	
	802.11n-HT40 MCS0	38	5190	8.10	8.40	84.31
		46	5230	8.16	8.40	
	802.11ac-VHT20 MCS0	36	5180	8.05	8.40	95.31
		40	5200	8.11	8.40	
		44	5220	8.16	8.40	
		48	5240	7.96	8.40	
	802.11ac-VHT40 MCS0	38	5190	8.09	8.40	84.42
		46	5230	8.14	8.40	
	802.11ac-VHT80 MCS0	42	5210	8.20	8.40	83.82

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	8.18	8.50	94.65
		56	5280	8.11	8.50	
		60	5300	8.02	8.50	
		64	5320	8.08	8.50	
	802.11n-HT20 MCS0	52	5260	7.90	8.40	95.65
		56	5280	7.88	8.40	
		60	5300	7.76	8.40	
		64	5320	7.80	8.40	
	802.11n-HT40 MCS0	54	5270	7.93	8.40	84.31
		62	5310	7.85	8.40	
	802.11ac-VHT20 MCS0	52	5260	7.89	8.40	95.31
		56	5280	7.86	8.40	
		60	5300	7.75	8.40	
		64	5320	7.78	8.40	
	802.11ac-VHT40 MCS0	54	5270	7.90	8.40	84.42
		62	5310	7.77	8.40	
	802.11ac-VHT80 MCS0	58	5290	7.93	8.40	83.82

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	8.45	8.80	94.65
		116	5580	8.28	8.80	
		124	5620	7.95	8.80	
		132	5660	8.11	8.80	
		140	5700	8.02	8.80	
		144	5720	7.93	8.80	
	802.11n-HT20 MCS0	100	5500	8.20	8.30	95.65
		116	5580	7.99	8.30	
		124	5620	7.67	8.30	
		132	5660	7.82	8.30	
		140	5700	7.76	8.30	
		144	5720	7.71	8.30	
	802.11n-HT40 MCS0	102	5510	8.27	8.30	84.31
		110	5550	8.23	8.30	
		126	5630	7.81	8.30	
		134	5670	7.85	8.30	
		142	5710	7.83	8.30	
	802.11ac-VHT20 MCS0	100	5500	8.19	8.30	95.31
		116	5580	7.98	8.30	
		124	5620	7.64	8.30	
		132	5660	7.81	8.30	
		140	5700	7.73	8.30	
		144	5720	7.69	8.30	
	802.11ac-VHT40 MCS0	102	5510	8.26	8.30	84.42
		110	5550	8.22	8.30	
		126	5630	7.79	8.30	
		134	5670	7.82	8.30	
		142	5710	7.80	8.30	
	802.11ac-VHT80 MCS0	106	5530	8.25	8.30	83.82
		122	5610	7.90	8.30	
		138	5690	7.74	8.30	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a 6Mbps	149	5745	7.75	9.00	94.65
		157	5785	7.79	9.00	
		165	5825	8.02	9.00	
	802.11n-HT20 MCS0	149	5745	7.48	8.50	95.65
		157	5785	7.52	8.50	
		165	5825	7.80	8.50	
	802.11n-HT40 MCS0	151	5755	7.57	8.50	84.31
		159	5795	7.77	8.50	
	802.11ac-VHT20 MCS0	149	5745	7.45	8.50	95.31
		157	5785	7.51	8.50	
		165	5825	7.78	8.50	
	802.11ac-VHT40 MCS0	151	5755	7.56	8.50	84.42
		159	5795	7.76	8.50	
	802.11ac-VHT80 MCS0	155	5775	7.71	8.50	83.82

<5GHz WLAN Ant.2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11a 6Mbps	36	5180	8.67	9.00	94.53
		40	5200	8.55	9.00	
		44	5220	8.57	9.00	
		48	5240	8.58	9.00	
	802.11n-HT20 MCS0	36	5180	8.45	8.50	95.86
		40	5200	8.40	8.50	
		44	5220	8.34	8.50	
		48	5240	8.37	8.50	
	802.11n-HT40 MCS0	38	5190	8.45	8.50	84.63
		46	5230	8.32	8.50	
	802.11ac-VHT20 MCS0	36	5180	8.43	8.50	95.51
		40	5200	8.38	8.50	
		44	5220	8.33	8.50	
		48	5240	8.34	8.50	
	802.11ac-VHT40 MCS0	38	5190	8.41	8.50	84.73
		46	5230	8.30	8.50	
	802.11ac-VHT80 MCS0	42	5210	8.20	8.50	83.68

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11a 6Mbps	52	5260	8.56	9.00	94.53
		56	5280	8.59	9.00	
		60	5300	8.64	9.00	
		64	5320	8.77	9.00	
	802.11n-HT20 MCS0	52	5260	8.33	8.60	95.64
		56	5280	8.37	8.60	
		60	5300	8.41	8.60	
		64	5320	8.53	8.60	
	802.11n-HT40 MCS0	54	5270	8.41	8.60	84.42
		62	5310	8.55	8.60	
	802.11ac-VHT20 MCS0	52	5260	8.32	8.60	95.67
		56	5280	8.36	8.60	
		60	5300	8.39	8.60	
		64	5320	8.52	8.60	
	802.11ac-VHT40 MCS0	54	5270	8.38	8.60	84.42
		62	5310	8.54	8.60	
	802.11ac-VHT80 MCS0	58	5290	7.93	8.60	84.13

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	8.56	9.00	94.53
		116	5580	8.49	9.00	
		124	5620	7.97	9.00	
		132	5660	8.65	9.00	
		140	5700	8.37	9.00	
		144	5720	8.55	9.00	
	802.11n-HT20 MCS0	100	5500	8.31	8.50	95.86
		116	5580	8.26	8.50	
		124	5620	7.72	8.50	
		132	5660	8.37	8.50	
		140	5700	8.17	8.50	
		144	5720	8.31	8.50	
	802.11n-HT40 MCS0	102	5510	8.35	8.50	84.63
		110	5550	8.38	8.50	
		126	5630	7.79	8.50	
		134	5670	8.44	8.50	
		142	5710	8.26	8.50	
	802.11ac-VHT20 MCS0	100	5500	8.30	8.50	95.51
		116	5580	8.23	8.50	
		124	5620	7.71	8.50	
		132	5660	8.36	8.50	
		140	5700	8.15	8.50	
		144	5720	8.28	8.50	
	802.11ac-VHT40 MCS0	102	5510	8.33	8.50	84.73
		110	5550	8.36	8.50	
		126	5630	7.77	8.50	
		134	5670	8.43	8.50	
		142	5710	8.24	8.50	
	802.11ac-VHT80 MCS0	106	5530	8.25	8.50	83.63
		122	5610	7.90	8.50	
		138	5690	7.74	8.50	

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11a MCS0	149	5745	8.77	9.00	94.53
		157	5785	8.74	9.00	
		165	5825	8.71	9.00	
	802.11n-HT20 MCS0	149	5745	8.54	8.60	95.86
		157	5785	8.51	8.60	
		165	5825	8.47	8.60	
	802.11n-HT40 MCS0	151	5755	8.53	8.60	84.63
		159	5795	8.55	8.60	
	802.11ac-VHT20 MCS0	149	5745	8.53	8.60	95.51
		157	5785	8.50	8.60	
		165	5825	8.45	8.60	
	802.11ac-VHT40 MCS0	151	5755	8.50	8.60	84.73
		159	5795	8.53	8.60	
	802.11ac-VHT80 MCS0	155	5775	7.71	8.60	83.63

<5GHz WLAN Ant.1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11n-HT20 MCS0	36	5180	10.93	11.50	84.75
		40	5200	10.90	11.50	
		44	5220	10.77	11.50	
		48	5240	10.73	11.50	
	802.11n-HT40 MCS0	38	5190	10.91	11.50	83.37
		46	5230	10.90	11.50	
	802.11ac-VHT20 MCS0	36	5180	10.89	11.50	91.17
		40	5200	10.88	11.50	
		44	5220	10.74	11.50	
		48	5240	10.70	11.50	
	802.11ac-VHT40 MCS0	38	5190	10.88	11.50	91.00
		46	5230	10.87	11.50	
	802.11ac-VHT80 MCS0	42	5210	10.97	11.50	89.89

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.3GHz WLAN	802.11n-HT20 MCS0	52	5260	10.65	11.50	84.75
		56	5280	10.59	11.50	
		60	5300	10.62	11.50	
		64	5320	10.66	11.50	
	802.11n-HT40 MCS0	54	5270	10.70	11.50	83.37
		62	5310	10.71	11.50	
	802.11ac-VHT20 MCS0	52	5260	10.63	11.50	91.17
		56	5280	10.57	11.50	
		60	5300	10.60	11.50	
		64	5320	10.65	11.50	
	802.11ac-VHT40 MCS0	54	5270	10.67	11.50	91.00
		62	5310	10.68	11.50	
	802.11ac-VHT80 MCS0	58	5290	10.68	11.50	89.89

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11n-HT20 MCS0	100	5500	10.86	11.80	84.75
		116	5580	10.75	11.80	
		124	5620	10.30	11.80	
		132	5660	10.79	11.80	
		140	5700	10.61	11.80	
		144	5720	10.68	11.80	
	802.11n-HT40 MCS0	102	5510	11.02	11.80	83.37
		110	5550	10.96	11.80	
		126	5630	10.42	11.80	
		134	5670	10.79	11.80	
		142	5710	10.71	11.80	
	802.11ac-VHT20 MCS0	100	5500	10.84	11.80	91.17
		116	5580	10.72	11.80	
		124	5620	10.28	11.80	
		132	5660	10.75	11.80	
		140	5700	10.58	11.80	
		144	5720	10.66	11.80	
	802.11ac-VHT40 MCS0	102	5510	10.99	11.80	91.00
		110	5550	10.94	11.80	
		126	5630	10.40	11.80	
		134	5670	10.78	11.80	
		142	5710	10.67	11.80	
	802.11ac-VHT80 MCS0	106	5530	10.97	11.80	89.89
		122	5610	10.51	11.80	
		138	5690	10.71	11.80	

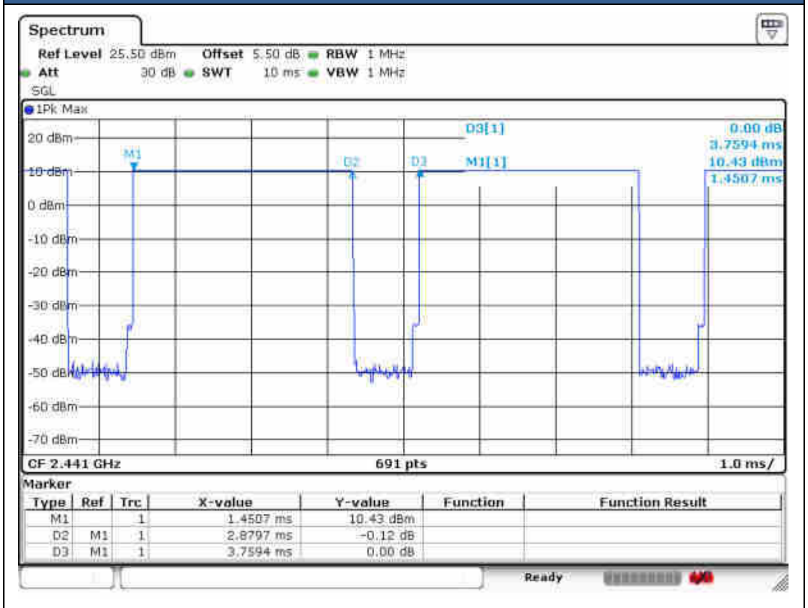
	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.8GHz WLAN	802.11n-HT20 MCS0	149	5745	10.57	12.00	84.75
		157	5785	10.56	12.00	
		165	5825	10.59	12.00	
	802.11n-HT40 MCS0	151	5755	10.54	12.00	83.37
		159	5795	10.59	12.00	
	802.11ac-VHT20 MCS0	149	5745	10.54	12.00	91.17
		157	5785	10.54	12.00	
		165	5825	10.58	12.00	
	802.11ac-VHT40 MCS0	151	5755	10.51	12.00	91.00
		159	5795	10.56	12.00	
	802.11ac-VHT80 MCS0	155	5775	10.49	12.00	89.89

<2.4GHz Bluetooth>

General Note:

1. For 2.4GHz Bluetooth SAR testing was selected 1Mbps, due to its highest average power.
2. The Bluetooth duty cycle is 76.6 % as following figure, according to 2016 Oct. TCB workshop for Bluetooth SAR scaling need further consideration and the theoretical duty cycle is 83.3%, therefore the actual duty cycle will be scaled up to the theoretical value of Bluetooth reported SAR calculation

Bluetooth time-domain plot

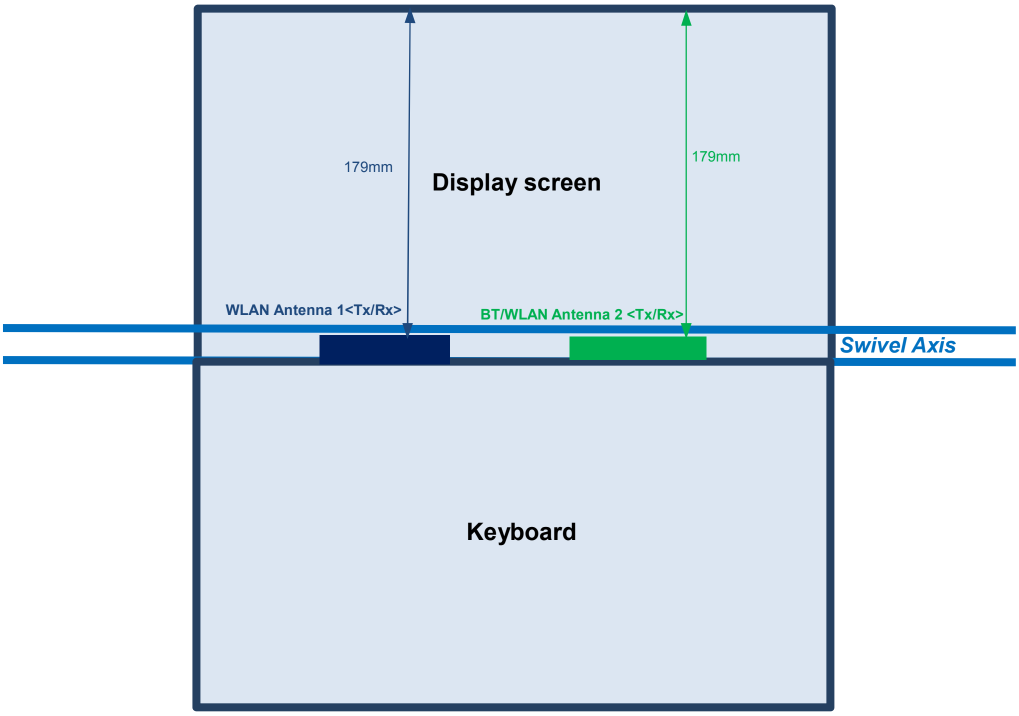


Mode	Channel	Frequency (MHz)	Average power (dBm)
			1Mbps
v3.0+EDR	CH 00	2402	9.49
	CH 39	2441	10.22
	CH 78	2480	8.83
Tune-up limit (dBm)			10.50

Mode	Channel	Frequency (MHz)	Average power (dBm)
			GFSK
v4.0/4.1/4.2 LE	CH 00	2402	4.70
	CH 19	2440	5.23
	CH 39	2480	4.12
Tune-up limit (dBm)			6.00

14. Antenna Location

<Laptop Mode>



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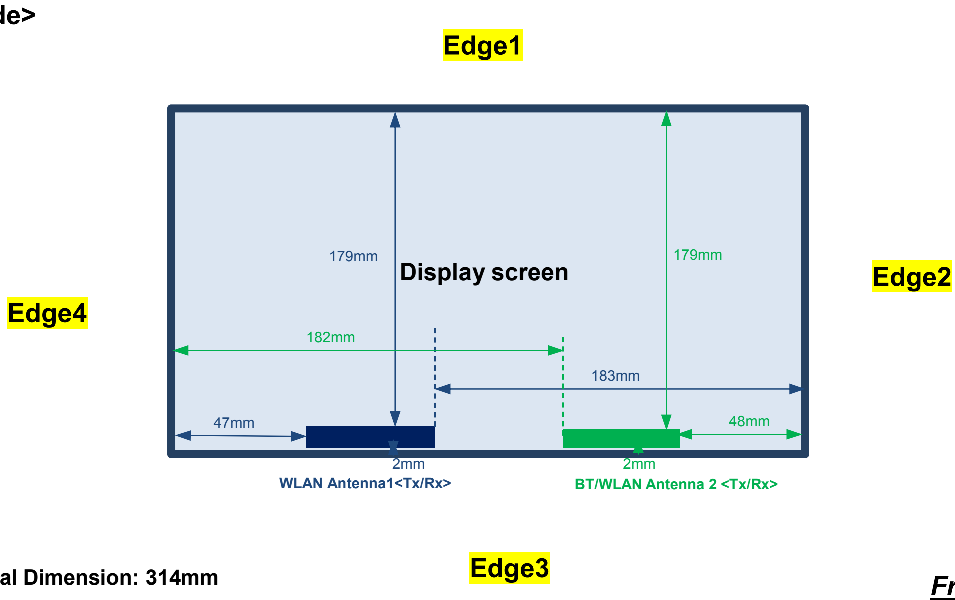


Diagonal Dimension: 314mm

Front View

General Note:

1. The below table, when the distance is < 50 mm exclusion threshold is "Ratio", when the distance is > 50 mm exclusion threshold is "mW"
2. Maximum power is the source-based time-average power and represents the maximum RF output power among production units
3. Per KDB 447498 D01v06, for larger devices, the test separation distance of adjacent edge configuration is determined by the closest separation between the antenna and the user.
4. Per KDB 447498 D01v06, standalone SAR test exclusion threshold is applied; If the test separation distance is < 5mm, 5mm is used to determine SAR exclusion threshold.
5. Per KDB 447498 D01v06, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances* ≤ 50 mm are determined by:
   [(*max. power of channel, including tune-up tolerance, mW*)/(*min. test separation distance, mm*)] ·[√f(GHz)] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR
   - f(GHz) is the RF channel transmit frequency in GHz
   - Power and distance are rounded to the nearest mW and mm before calculation
   - The result is rounded to one decimal place for comparison
6. Per KDB 447498 D01v06, at 100 MHz to 6 GHz and for *test separation distances* > 50 mm, the SAR test exclusion threshold is determined according to the following
   a) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·(f(MHz)/150)] mW, at 100 MHz to 1500 MHz
   b) [Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·10] mW at > 1500 MHz and ≤ 6 GHz

Exposure Position	Wireless Interface	WLAN2.4GHz Ant.1	WLAN5GHz Ant.1	WLAN2.4GHz Ant.2	WLAN5GHz Ant.2	Bluetooth Ant.2
	Calculated Frequency (MHz)	2472	5825	2472	5825	2480
	Maximum power (dBm)	14.50	19.50	14.50	19.50	10.50
	Maximum rated power(mW)	28	89	28	89	11
Bottom Face	Separation Distance(mm)	0		0		
	Exclusion Threshold	8.79	42.96	8.79	42.96	3.46
	Testing required?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Edge 1	Separation Distance(mm)	179		179		
	Exclusion Threshold	1386	1352	1386	1352	1385
	Testing required?	**No**	**No**	**No**	**No**	**No**
Edge 2	Separation Distance(mm)	183		48		
	Exclusion Threshold	1426	1392	0.92	4.48	0.36
	Testing required?	**No**	**No**	**No**	**Yes**	**No**
Edge 3	Separation Distance(mm)	2		2		
	Exclusion Threshold	8.79	42.96	8.79	42.96	3.46
	Testing required?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
Edge 4	Separation Distance(mm)	47		182		
	Exclusion Threshold	0.93	4.57	1416	1382	1415
	Testing required?	**No**	**Yes**	**No**	**No**	**No**
Bottom of Laptop	Separation Distance(mm)	0		0		
	Exclusion Threshold	8.79	42.96	8.79	42.96	3.46
	Testing required?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

15. SAR Test Results

General Note:

1. Per KDB 447498 D01v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
   b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
   c. For WLAN/Bluetooth: Reported SAR(W/kg)= Measured SAR(W/kg)* Duty Cycle scaling factor * Tune-up scaling factor
2. Per KDB 447498 D01v06, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
   - ≤ 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
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
4. This EUT has two typical use conditions which are laptop mode and tablet mode.
5. According to the normal usage, we didn’t evaluate the distance SAR at laptop of bottom.
6. This device implanted proximity sensor function at bottom, bottom face and edge 3, power reduction will be implemented immediately at all 5GHz WLAN bands and 2.4GHz WLAN band.
7. For WLAN2.4GHz tablet mode, bottom face and Edge 3 SAR testing with full power have been performed, so no need to consider reduced power SAR testing.

15.1 Body SAR

<WLAN2.4GHz SAR>

Plot No.	EUT Type	Ant. Port	Band	Mode	Test Position	Gap (mm)	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Laptop	1	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	On	6	2437	12.15	13.00	1.216	100	1.000	0.02	0.790	0.961
#01	Laptop	1	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	On	1	2412	11.98	13.00	1.265	100	1.000	0.05	0.795	1.005
	Laptop	1	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	On	11	2462	12.18	13.00	1.208	100	1.000	0.02	0.795	0.960
	Laptop	1	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	Off	13	2472	8.19	10.00	1.517	100	1.000	0.12	0.077	0.117
	Laptop	1	WLAN2.4GHz	802.11b 1Mbps	Back of Display Screen	25	Off	1	2412	13.79	14.50	1.178	100	1.000	-0.05	0.005	0.006
	Tablet	1	WLAN2.4GHz	802.11b 1Mbps	Curved surface of Edge3	0	On	11	2462	12.18	13.00	1.208	100	1.000	0.19	0.780	0.942
	Tablet	1	WLAN2.4GHz	802.11b 1Mbps	Curved surface of Edge3	0	On	6	2437	12.15	13.00	1.216	100	1.000	0.07	0.721	0.877
	Tablet	1	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	0	Off	1	2412	13.79	14.50	1.178	100	1.000	-0.08	0.532	0.626
	Tablet	1	WLAN2.4GHz	802.11b 1Mbps	Edge 3	0	Off	1	2412	13.79	14.50	1.178	100	1.000	-0.03	0.408	0.480
	Laptop	2	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	On	11	2462	12.66	13.50	1.213	100	1.000	0.03	0.646	0.784
	Laptop	2	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	On	1	2412	13.05	13.50	1.109	100	1.000	0.06	0.687	0.762
#02	Laptop	2	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	On	6	2437	12.78	13.50	1.180	100	1.000	0.09	0.674	0.796
	Laptop	2	WLAN2.4GHz	802.11b 1Mbps	Bottom	0	Off	13	2472	8.41	10.00	1.442	100	1.000	0.02	0.110	0.159
	Laptop	2	WLAN2.4GHz	802.11b 1Mbps	Back of Display Screen	25	Off	1	2412	13.81	14.50	1.172	100	1.000	-0.02	0.005	0.006
	Tablet	2	WLAN2.4GHz	802.11b 1Mbps	Curved surface of Edge3	0	Off	1	2412	13.81	14.50	1.172	100	1.000	0.04	0.451	0.529
	Tablet	2	WLAN2.4GHz	802.11b 1Mbps	Bottom Face	0	Off	1	2412	13.81	14.50	1.172	100	1.000	-0.09	0.503	0.590
	Tablet	2	WLAN2.4GHz	802.11b 1Mbps	Edge 3	0	Off	1	2412	13.81	14.50	1.172	100	1.000	0.05	0.308	0.361

<WLAN5G SAR>

Plot No.	EUT Type	Ant. Port	Band	Mode	Test Position	Gap (mm)	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Tablet	1	WLAN5.3GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	52	5260	8.18	8.50	1.076	94.65	1.057	0.02	1.010	1.149
	Tablet	1	WLAN5.3GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	56	5280	8.11	8.50	1.093	94.65	1.057	0.06	1.010	1.167
#03	Tablet	1	WLAN5.3GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	64	5320	8.08	8.50	1.100	94.65	1.057	0.06	1.020	1.186
	Laptop	2	WLAN5.3GHz	802.11a 6Mbps	Bottom	0	On	52	5260	8.56	9.00	1.106	94.53	1.058	0.05	0.631	0.738
	Laptop	2	WLAN5.3GHz	802.11a 6Mbps	Bottom	0	On	56	5280	8.59	9.00	1.098	94.53	1.058	0.02	0.725	0.842
#04	Laptop	2	WLAN5.3GHz	802.11a 6Mbps	Bottom	0	On	64	5320	8.77	9.00	1.053	94.53	1.058	0.07	0.784	0.874
	Tablet	1	WLAN5.5GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	100	5500	8.45	8.80	1.159	94.65	1.057	0.03	0.972	1.191
#05	Tablet	1	WLAN5.5GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	116	5580	8.28	8.80	1.126	94.65	1.057	0.01	1.130	1.345
	Tablet	1	WLAN5.5GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	140	5700	8.02	8.80	1.196	94.65	1.057	0.08	1.000	1.264
	Tablet	1	WLAN5.5GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	132	5660	8.11	8.80	1.172	94.65	1.057	-0.03	0.954	1.182
	Tablet	1	WLAN5.5GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	144	5720	7.93	8.80	1.222	94.65	1.057	-0.08	0.743	0.960
	Tablet	2	WLAN5.5GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	100	5500	8.56	9.00	1.127	94.53	1.058	0.05	0.654	0.780
#06	Tablet	2	WLAN5.5GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	116	5580	8.49	9.00	1.125	94.53	1.058	0.06	0.718	0.854
	Tablet	2	WLAN5.5GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	144	5720	8.55	9.00	1.109	94.53	1.058	0.09	0.677	0.794
	Tablet	1	WLAN5.8GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	149	5745	7.75	9.00	1.332	94.65	1.057	0.05	0.847	1.193
	Tablet	1	WLAN5.8GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	157	5785	7.79	9.00	1.320	94.65	1.057	0.05	0.900	1.256
#07	Tablet	1	WLAN5.8GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	165	5825	8.02	9.00	1.252	94.65	1.057	0.03	0.964	1.276
	Tablet	2	WLAN5.8GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	149	5745	8.77	9.00	1.074	94.53	1.058	0.06	0.847	0.962
	Tablet	2	WLAN5.8GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	157	5785	8.74	9.00	1.061	94.53	1.058	0.08	0.869	0.975
#08	Tablet	2	WLAN5.8GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	165	5825	8.71	9.00	1.068	94.53	1.058	0.01	0.874	0.988

<Bluetooth SAR>

Plot No.	EUT Type	Ant. Port	Band	Mode	Test Position	Gap (mm)	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	Laptop	2	Bluetooth	1Mbps	Bottom	0	39	2441	10.22	10.50	1.067	76.60	1.087	0.01	0.318	0.369
	Laptop	2	Bluetooth	1Mbps	Bottom	0	0	2402	9.49	10.50	1.262	76.60	1.087	0.02	0.226	0.310
#09	Laptop	2	Bluetooth	1Mbps	Bottom	0	78	2480	8.83	10.50	1.469	76.60	1.087	0.01	0.234	0.374

15.2 Repeated SAR Measurement

No.	EUT Type	Ant. Port	Band	Mode	Test Position	Gap (mm)	Power Reduction	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	Tablet	1	WLAN5.3GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	64	5320	8.08	8.50	1.100	94.65	1.057	0.06	1.020	1	1.186
2nd	Tablet	1	WLAN5.3GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	64	5320	8.08	8.50	1.100	94.65	1.057	0.09	1.000	1.020	1.163
1st	Tablet	1	WLAN5.5GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	116	5580	8.28	8.80	1.126	94.65	1.057	0.01	1.130	1	1.345
2nd	Tablet	1	WLAN5.5GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	116	5580	8.28	8.80	1.126	94.65	1.057	0.09	1.100	1.027	1.309
1st	Tablet	1	WLAN5.8GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	165	5825	8.02	9.00	1.252	94.65	1.057	0.03	0.964	1	1.276
2nd	Tablet	1	WLAN5.8GHz	802.11a 6Mbps	Curved surface of Edge3	0	On	165	5825	8.02	9.00	1.252	94.65	1.057	0.08	0.954	1.010	1.262

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/kg.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR <1.45W/kg, only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated *measured SAR*.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

16. Simultaneous Transmission Analysis

No.	Simultaneous Transmission Configurations	Body
1.	WLAN2.4GHz Ant.1(data) + WLAN2.4GHz Ant.2(data)	Yes
2.	WLAN5GHz Ant.1(data) + WLAN5GHz Ant.2(data)	Yes
3.	WLAN2.4GHz Ant.1(data) + Bluetooth Ant.2(data)	Yes
4.	WLAN5GHz Ant.1(data) + Bluetooth Ant.2(data)	Yes

General Note:

1. WLAN Ant.2 and Bluetooth share the same antenna, and cannot transmit simultaneously.
2. EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, 2.4GHz WLAN and 5GHz WLAN will not operate simultaneously at any moment.
3. The reported SAR summation is calculated based on the same configuration and test position.
4. The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation.
5. For simultaneous transmission analysis for exposure position of edge 3 / bottom face 10mm, Bluetooth/WLAN 2.4GHz SAR tested at 0mm separation is worse and the test data is used for conservative SAR summation.
6. Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg.
   ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
   iii) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.
   iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR < 1.6W/kg.
   v) The SPLSR calculated results please refer to section 16.2.

16.1 Body Exposure Conditions

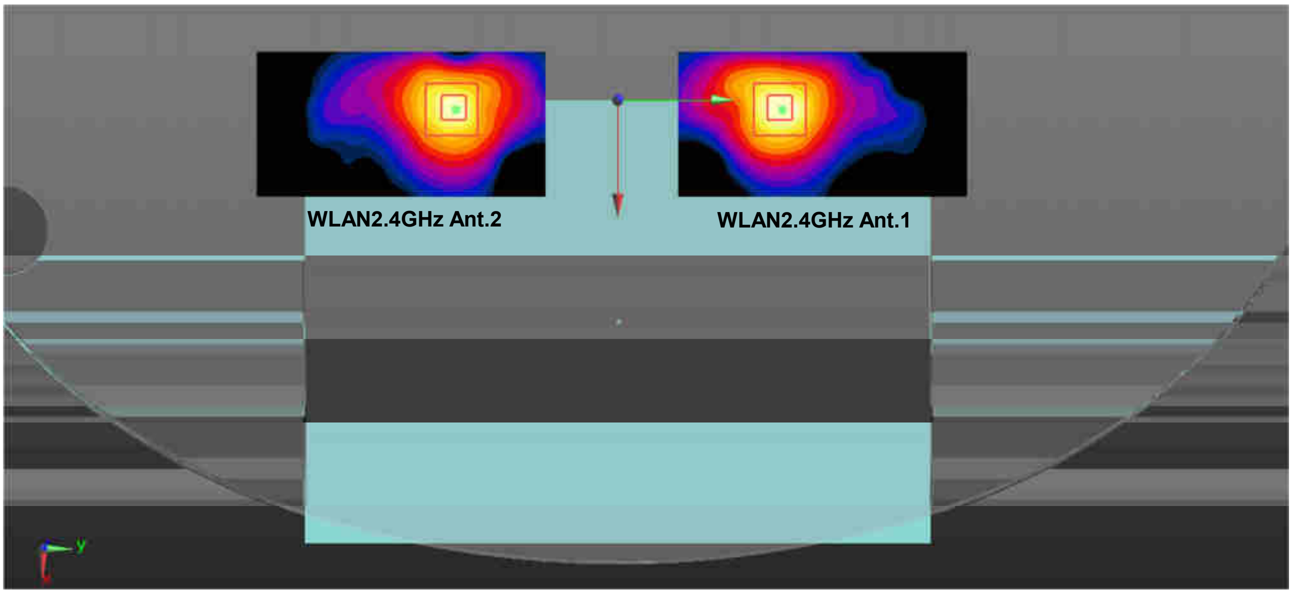
Exposure Position	1	2	3	4	5	1+2			3+4			1+5	3+5
	2.4GHz WLAN Ant 1	2.4GHz WLAN Ant 2	5GHz WLAN Ant 1	5GHz WLAN Ant 2	Bluetooth Ant 2								
	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)	Summed 1g SAR (W/kg)	SPLSR	Case No	Summed 1g SAR (W/kg)	SPLSR	Case No	Summed 1g SAR (W/kg)	Summed 1g SAR (W/kg)
Bottom at 0mm	1.005	0.796	-	0.874	0.374	**1.80**	**0.02**	**#1**	-	-	-	**1.38**	-
Bottom Face at 0mm	0.626	0.590	-	-	-	1.22	-	-	-	-	-	-	-
Edge 3 at 0mm	0.480	0.361	-	-	-	0.84	-	-	-	-	-	-	-
Back of Display Screen at 25mm	0.006	0.006	-	-	-	0.01	-	-	-	-	-	-	-
Curved surface of Edge3	0.942	0.529	1.345	0.988	-	**1.47**	-	-	**2.33**	**0.02**	**#2**	-	**1.35**

16.2 SPLSR Evaluation and Analysis

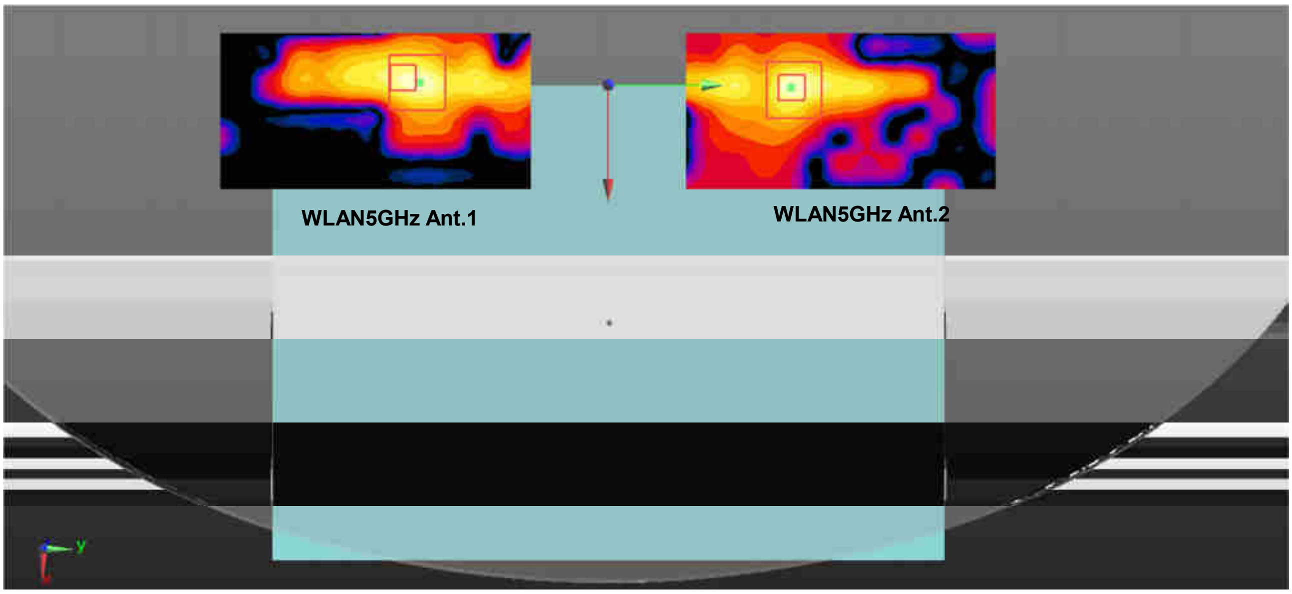
General Note:

1. When standalone SAR is measured for both antennas in the pair, the peak location separation distance is computed by the square root of [(x1−x2)2 + (y1−y2)2 + (z1−z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates in the area scans or extrapolated peak SAR locations in the zoom scans, as appropriate.
2. SPLSR = $(SAR_1 + SAR_2)^{1.5}$ / (*min. separation distance, mm*). If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.

Case #1	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
	WLAN2.4GHz Ant.1	Bottom	1.005	0	0.2	6.82	-0.27	139.41	1.80	0.02	Not required
	WLAN2.4GHz Ant.2		0.796	0	0	-7.12	-0.28				



Case #2	Band	Position	SAR (W/kg)	Gap	SAR peak location (cm)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
				(mm)	X	Y	Z				
	WLAN5GHz Ant.1	Curved surface of Edge3	1.345	0	-0.26	-8.02	-0.29	151.24	2.33	0.02	Not required
	WLAN5GHz Ant.2		0.988	0	0.10	7.10	-0.29				



Test Engineer: Nick Hu

17. Uncertainty Assessment

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

18. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] ANSI/IEEE Std. C95.1-1992, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, September 1992

[3] IEEE Std. 1528-2013, “IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques”, Sep 2013

[4] SPEAG DASY System Handbook

[5] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.

[6] FCC KDB 865664 D02 v01r02, “RF Exposure Compliance Reporting and Documentation Considerations” Oct 2015.

[7] FCC KDB 447498 D01 v06, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, Oct 2015

[8] FCC KDB 248227 D01 v02r02, “SAR Guidance for IEEE 802.11 (WiFi) Transmitters”, Oct 2015.

[9] FCC KDB 616217 D04 v01r02, “SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers”, Oct 2015

Appendix A. Plots of System Performance Check

The plots are shown as follows.

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab   Date: 2018.6.2

System Check_Body_2450MHz

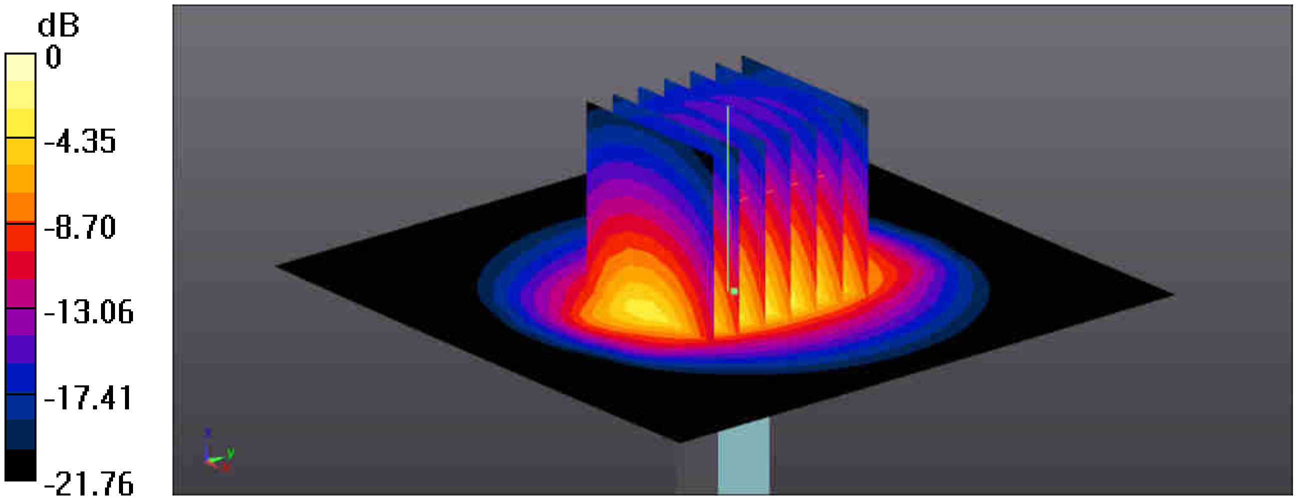
DUT: D2450V2 - SN:840

Communication System: UID 0, CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium: MSL_2450 Medium parameters used: f = 2450 MHz; σ = 1.957 S/m; ε_r = 52.432; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(7.83, 7.83, 7.83); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 24.9 W/kg

Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 76.98 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 19.8 W/kg
SAR(1 g) = 12.03 W/kg; SAR(10 g) = 5.68 W/kg
Maximum value of SAR (measured) = 25.0 W/kg



0 dB = 25.0 W/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.6.3

System Check_Body_5250MHz

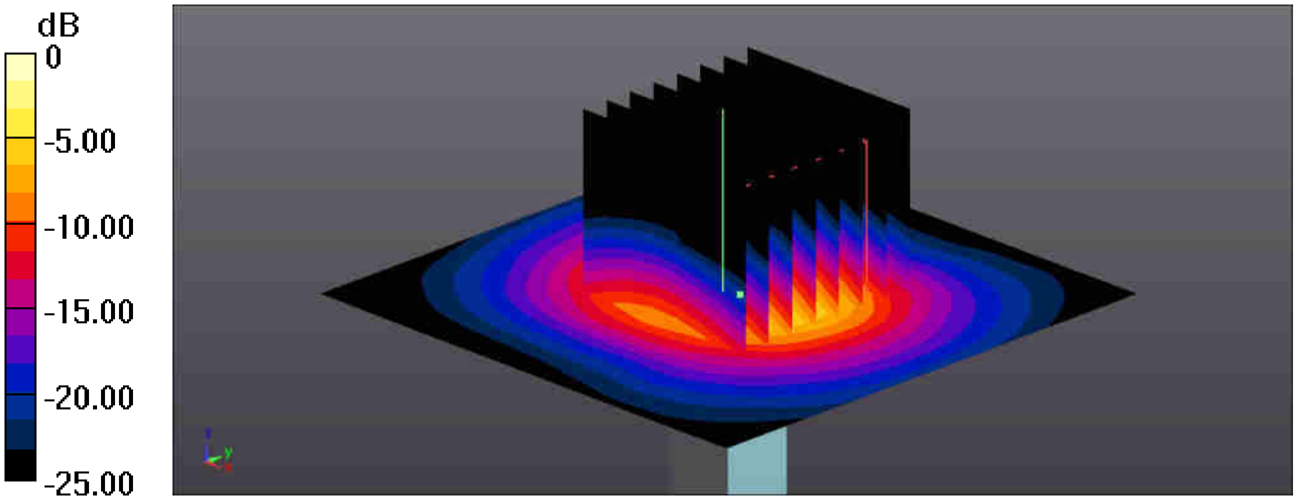
DUT: D5GHzV2-SN:1006

Communication System: UID 0, CW (0); Frequency: 5250 MHz;Duty Cycle: 1:1
Medium: MSL_5000 Medium parameters used: f = 5250 MHz; $\sigma = 5.548$ S/m; $\varepsilon_r = 47.011$; $\rho = 1000$ kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.8 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(4.84, 4.84, 4.84); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 13.2 W/kg

Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 30.27 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 17.3 W/kg
SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.23 W/kg
Maximum value of SAR (measured) = 15.1 W/kg



0 dB = 15.1 W/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.6.3

System Check_Body_5600MHz

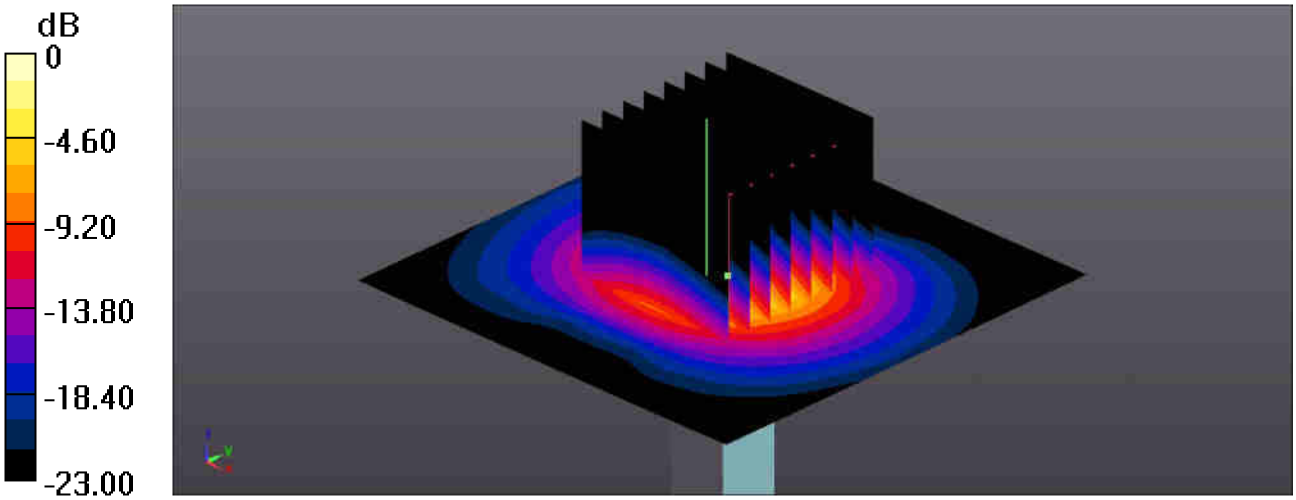
DUT: D5GHzV2-SN:1006

Communication System: UID 0, CW (0); Frequency: 5600 MHz;Duty Cycle: 1:1
Medium: MSL_5000 Medium parameters used: f = 5600 MHz; σ = 6.014 S/m; ε_r = 46.383; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(4.1, 4.1, 4.1); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 13.4 W/kg

Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 32.67 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 23.4 W/kg
SAR(1 g) = 7.54 W/kg; SAR(10 g) = 2.32 W/kg
Maximum value of SAR (measured) = 12.9 W/kg



0 dB = 12.9 W/kg

System Check_Body_5750MHz

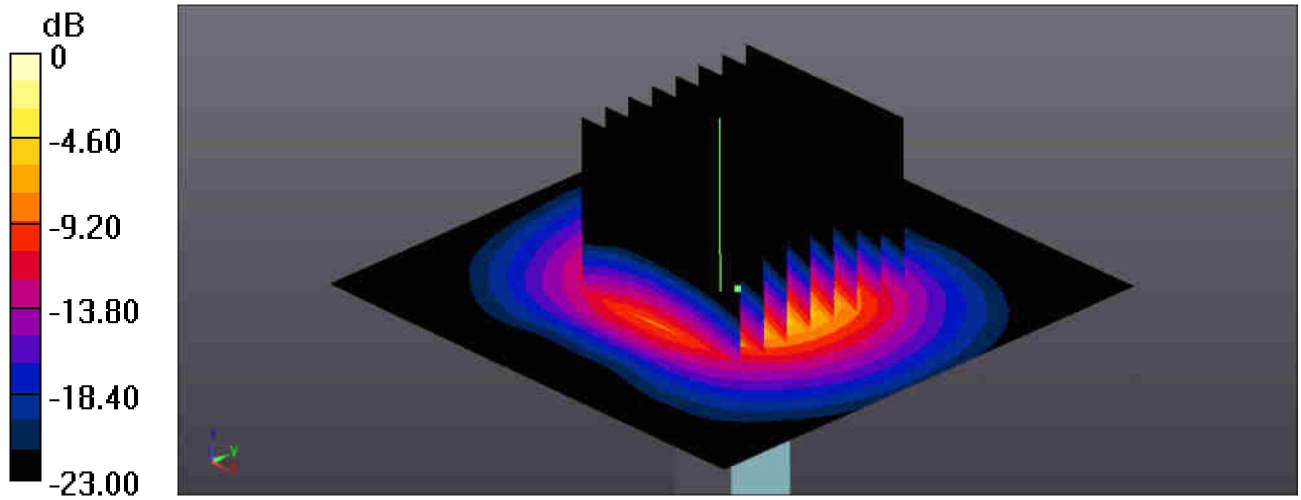
DUT: D5GHzV2-SN:1006

Communication System: UID 0, CW (0); Frequency: 5750 MHz;Duty Cycle: 1:1
Medium: MSL_5000 Medium parameters used: f = 5750 MHz; σ = 6.226 S/m; ε_r = 46.149; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(4.41, 4.41, 4.41); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 14.0 W/kg

Pin=100mW/Zoom Scan (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 27.91 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 21.5 W/kg
SAR(1 g) = 7.42 W/kg; SAR(10 g) = 2.26 W/kg
Maximum value of SAR (measured) = 16.2 W/kg



0 dB = 16.2 W/kg

Appendix B. Plots of High SAR Measurement

The plots are shown as follows.

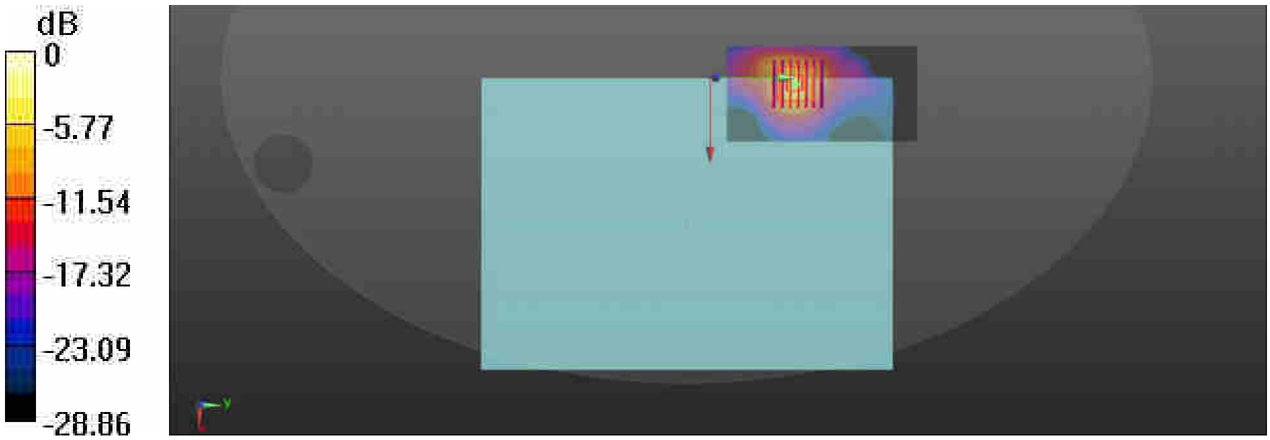
#01_WLAN 2.4GHz_802.11b 1Mbps_Bottom_0mm_Ant1_Ch1_Laptop_Reduced Power

Communication System: UID 0, 802.11b (0); Frequency: 2412 MHz;Duty Cycle: 1:1
Medium: MSL_2450 Medium parameters used: f = 2412 MHz; $\sigma = 1.905$ S/m; $\varepsilon_r = 52.557$; $\rho = 1000$ kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(7.83, 7.83, 7.83); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch1/Area Scan (51x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.09 W/kg

Ch1/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 1.318 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 1.90 W/kg
SAR(1 g) = 0.795 W/kg; SAR(10 g) = 0.289 W/kg
Maximum value of SAR (measured) = 1.37 W/kg



0 dB = 1.37 W/kg = 1.37 dBW/kg

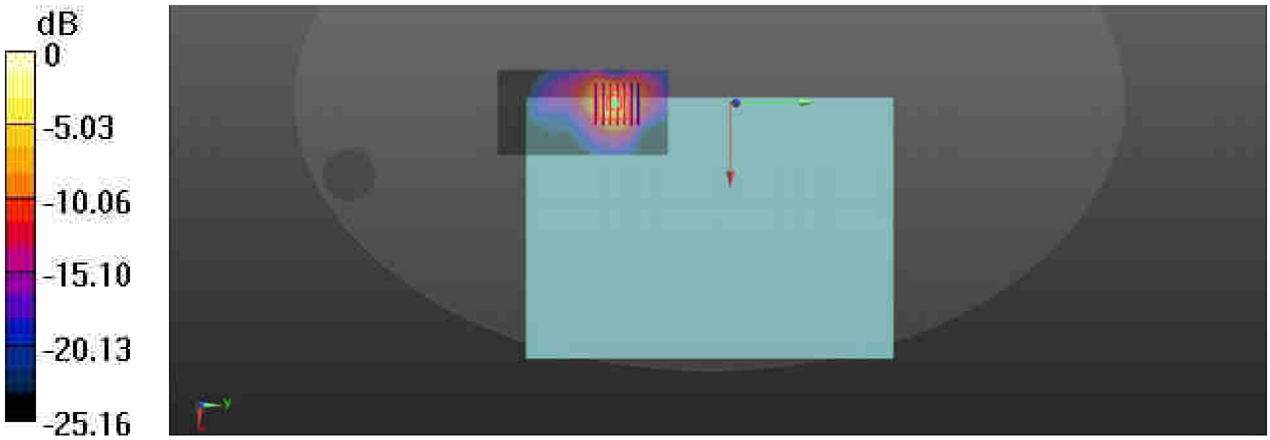
#02_WLAN 2.4GHz_802.11b 1Mbps_Bottom_0mm_Ant2_Ch6_Laptop_Reduced Power

Communication System: UID 0, 802.11b (0); Frequency: 2437 MHz;Duty Cycle: 1:1
Medium: MSL_2450 Medium parameters used: f = 2437 MHz; σ = 1.939 S/m; ε_r = 52.478; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(7.83, 7.83, 7.83); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch6/Area Scan (51x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 1.05 W/kg

Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.7730 V/m; Power Drift = 0.09 dB
Peak SAR (extrapolated) = 3.65 W/kg
SAR(1 g) = 0.674 W/kg; SAR(10 g) = 0.250 W/kg
Maximum value of SAR (measured) = 1.06 W/kg



0 dB = 1.06 W/kg = 0.25 dBW/kg

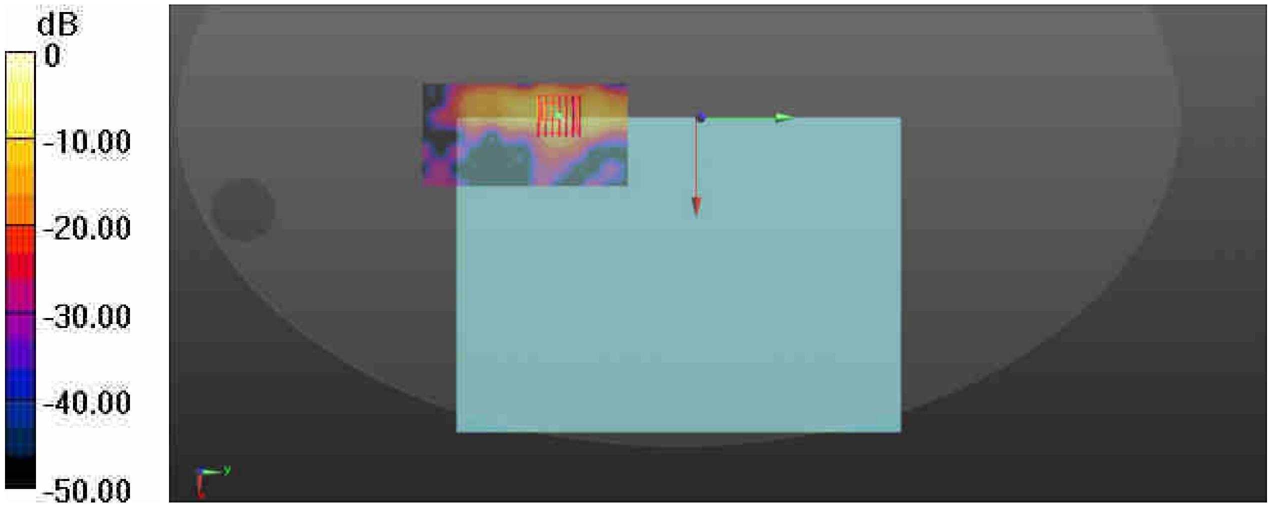
#03_WLAN5.3GHz_802.11a 6Mbps_Curved surface of Edge3_0mm_Ant1_On_Ch64_Tablet_Reduced Power

Communication System: UID 0, WIFI (0); Frequency: 5320 MHz;Duty Cycle: 1:1.057
Medium: MSL_5000 Medium parameters used: f = 5320 MHz; σ = 5.597 S/m; ε_r = 49.404; ρ = 1000kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.8 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(4.84, 4.84, 4.84); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch64/Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mmMaximum value of SAR (interpolated) = 1.15 W/kg

Ch64/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.954 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 8.24 W/kg
SAR(1 g) = 1.020 W/kg; SAR(10 g) = 0.191 W/kg
Maximum value of SAR (measured) = 2.89 W/kg



0 dB = 2.89 W/kg = 4.61 dBW/kg

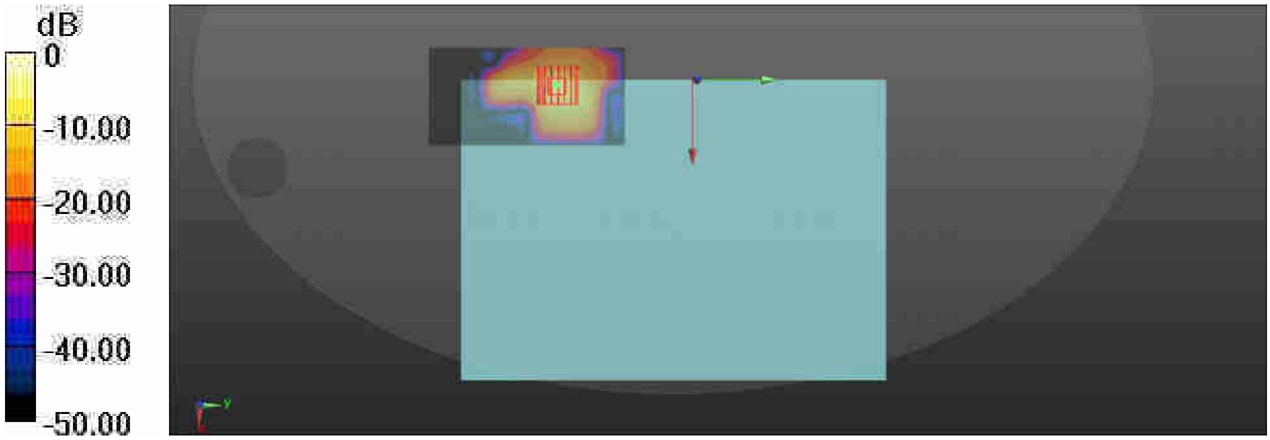
#04_WLAN5.3GHz_802.11a 6Mbps_Bottom _0mm_Ant2 _On_Ch64_Laptop_Reduced Power

Communication System: UID 0, 802.11a (0); Frequency: 5320 MHz;Duty Cycle: 1:1.058
Medium: MSL_5000 Medium parameters used: f = 5320 MHz; σ = 5.597 S/m; ε_r = 49.404; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.8 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(4.84, 4.84, 4.84); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

Ch64/Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.05 W/kg

Ch64/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 0.5220 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 4.49 W/kg
SAR(1 g) = 0.784 W/kg; SAR(10 g) = 0.193 W/kg
Maximum value of SAR (measured) = 2.31 W/kg



0 dB = 2.31 W/kg = 3.64 dBW/kg

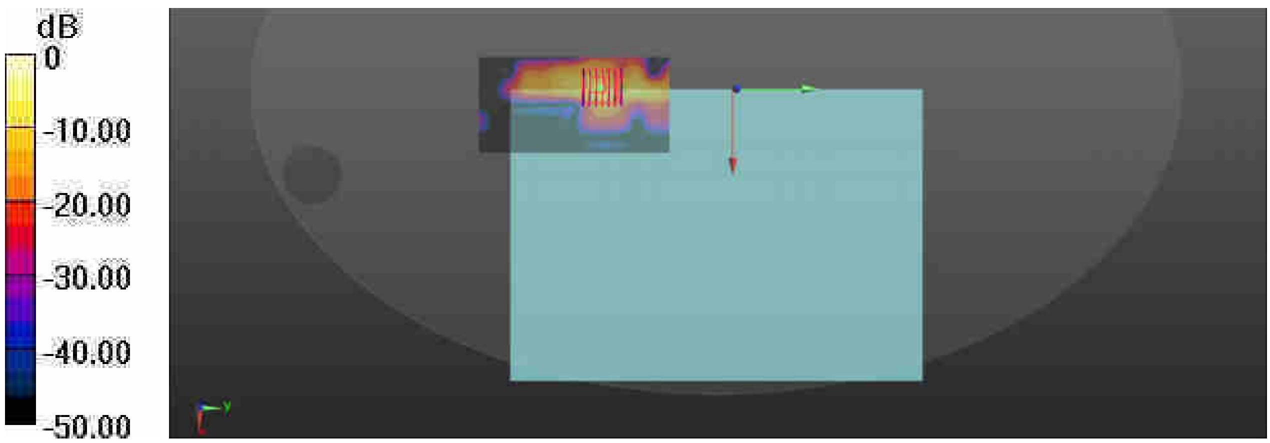
#05_WLAN5.5GHz_Band3 802.11a 6Mbps_Curved surface of Edge3_0mm_Ant 1_On_Ch116_Tablet_Reduced Power

Communication System: UID 0, 802.11a (0); Frequency: 5580 MHz;Duty Cycle: 1:1.057
Medium: MSL_5000 Medium parameters used: f = 5580 MHz; $\sigma = 5.942$ S/m; $\varepsilon_r = 48.987$; $\rho = 1000$ kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(4.1, 4.1, 4.1); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch116/Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.88 W/kg

Ch116/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 1.978 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 11.1 W/kg
SAR(1 g) = 1.130 W/kg; SAR(10 g) = 0.189 W/kg
Maximum value of SAR (measured) = 3.74 W/kg



0 dB = 3.74 W/kg = 5.73 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.6.3

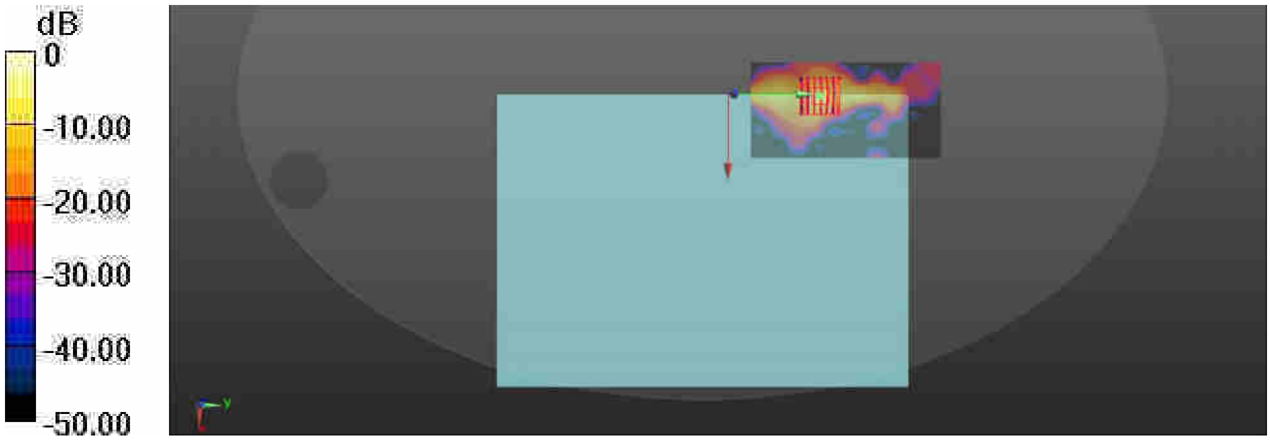
#06_WLAN5.5GHz_802.11a 6Mbps_Curved surface of Edge3_0mm_Ant 2_On_Ch116_Tablet_Reduced Power

Communication System: UID 0, 802.11a (0); Frequency: 5580 MHz;Duty Cycle: 1:1.058
Medium: MSL_5000 Medium parameters used: f = 5580 MHz; σ = 5.942 S/m; ε_r = 48.987; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.9 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(4.1, 4.1, 4.1); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch116/Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.75 W/kg

Ch116/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.339 V/m; Power Drift = 0.06 dB
Peak SAR (extrapolated) = 5.55 W/kg
SAR(1 g) = 0.718 W/kg; SAR(10 g) = 0.147 W/kg
Maximum value of SAR (measured) = 2.13 W/kg



0 dB = 2.13 W/kg = 3.28 dBW/kg

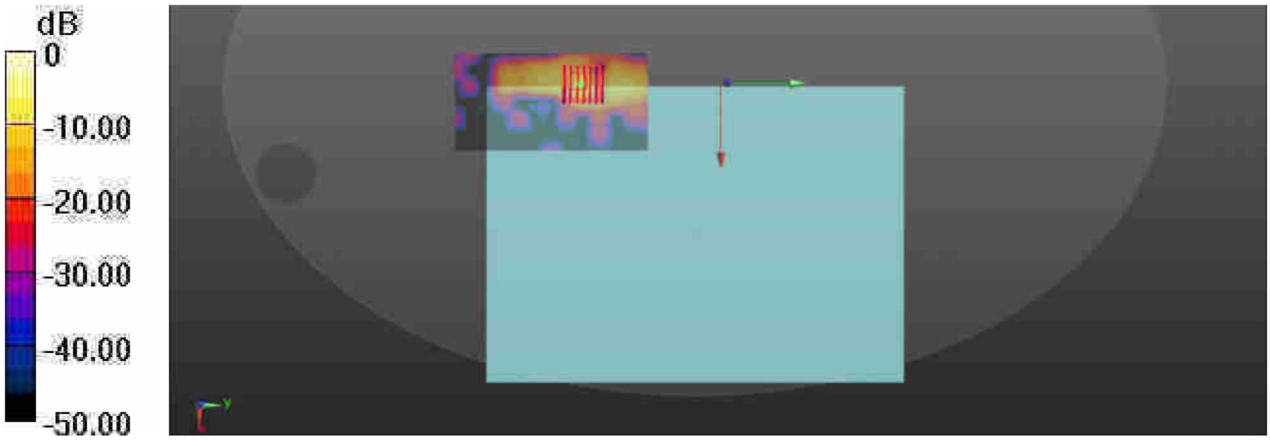
#07_WLAN5.8GHz_802.11a 6Mbps_Curved surface of Edge3_0mm_Ant 1_On_Ch165_Tablet_Reduced Power

Communication System: UID 0, 802.11a (0); Frequency: 5825 MHz;Duty Cycle: 1:1.057
Medium: MSL_5000 Medium parameters used: f = 5825 MHz; σ = 6.297 S/m; ε_r = 48.603; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(4.41, 4.41, 4.41); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch165/Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.75 W/kg

Ch165/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.087 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 5.94 W/kg
SAR(1 g) = 0.964 W/kg; SAR(10 g) = 0.168 W/kg
Maximum value of SAR (measured) = 2.41 W/kg



0 dB = 2.41 W/kg = 3.82 dBW/kg

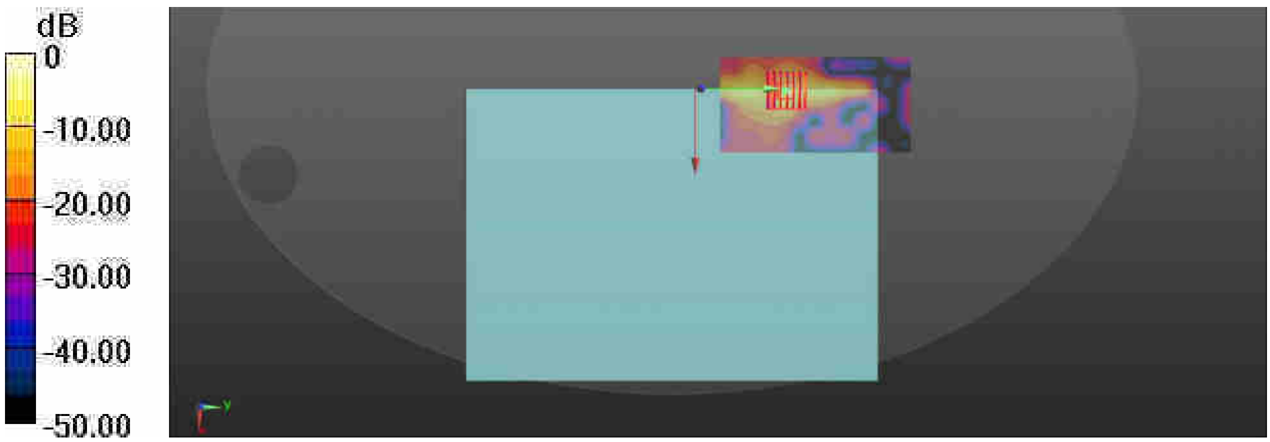
#08_WLAN5.8GHz_802.11a 6Mbps_Curved surface of Edge3_0mm_Ant 2_On_Ch165_Tablet_Reduced Power

Communication System: UID 0, 802.11a (0); Frequency: 5825 MHz;Duty Cycle: 1:1.058
Medium: MSL_5000 Medium parameters used: f = 5825 MHz; σ = 6.297 S/m; ε_r = 48.603; ρ = 1000 kg/m^3
Ambient Temperature：23.4 ℃; Liquid Temperature：22.6 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(4.41, 4.41, 4.41); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch165/Area Scan (61x121x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 2.57 W/kg

Ch165/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 2.401 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 7.41 W/kg
SAR(1 g) = 0.874 W/kg; SAR(10 g) = 0.174 W/kg
Maximum value of SAR (measured) = 2.62 W/kg



0 dB = 2.62 W/kg = 4.18 dBW/kg

Test Laboratory: Sporton International Inc. SAR/HAC Testing Lab Date: 2018.6.2

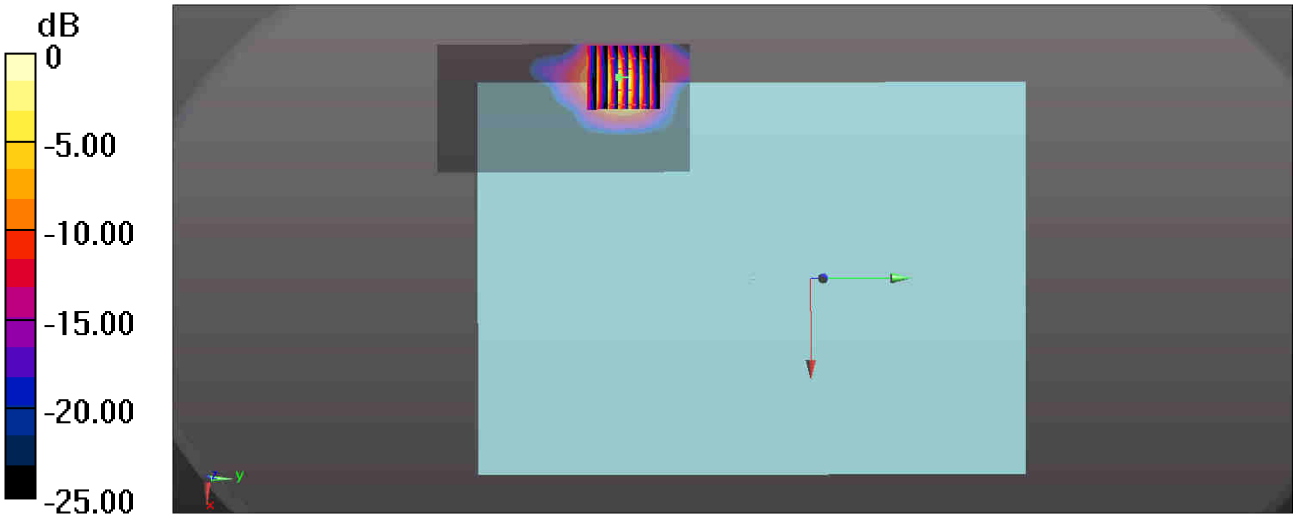
#09_ Bluetooth_1Mbps_Bottom_0mm_Ant 2_Off_Ch78_Laptop

Communication System: UID 0, Bluetooth (0); Frequency: 2480 MHz;Duty Cycle: 1:1.305
Medium: MSL_2450 Medium parameters used: f = 2480 MHz; σ = 2.003 S/m; ε_r = 52.326; ρ = 1000 kg/m^3
Ambient Temperature：23.3 ℃; Liquid Temperature：22.7 ℃

DASY5 Configuration:
- Probe: EX3DV4 - SN7375; ConvF(7.83, 7.83, 7.83); Calibrated: 2017.12.18;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn910; Calibrated: 2017.7.13
- Phantom: SAM4; Type: SAM; Serial: TP-1127
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch78/Area Scan (51x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 0.355 W/kg

Ch78/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.620 W/kg
SAR(1 g) = 0.234 W/kg; SAR(10 g) = 0.079 W/kg
Maximum value of SAR (measured) = 0.425 W/kg



0 dB = 0.425 W/kg = -3.72 dBW/kg

Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.

In Collaboration with
speag
CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Client **Sporton** **Certificate No: Z17-97263**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 840
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	December 7, 2017

This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)℃ and humidity<70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Power sensor NRV-Z5	100596	02-Mar-17 (CTTL, No.J17X01254)	Mar-18
Reference Probe EX3DV4	SN 3617	23-Jan-17(SPEAG,No.EX3-3617_Jan17)	Jan-18
DAE3	SN 536	09-Oct-17(CTTL-SPEAG,No.Z17-97198)	Oct-18
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	赵靖
Reviewed by:	Lin Hao	SAR Test Engineer	林浩
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: December 10, 2017

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORMx,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

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

b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY52	52.10.0.1446
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	39.8 ± 6 %	1.83 mho/m ± 6 %
Head TSL temperature change during test	<1.0 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.2 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**52.6 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.14 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.5 mW /g ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.5 ± 6 %	1.93 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.9 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**51.9 mW /g ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.99 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**24.0 mW /g ± 18.7 % (k=2)**

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CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.0Ω+ 4.51jΩ
Return Loss	- 26.3dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.1Ω+ 5.09jΩ
Return Loss	- 25.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.025 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

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Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Head TSL Date: 12.06.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 840

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.826 S/m; εr = 39.84; ρ = 1000 kg/m3

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.74, 7.74, 7.74); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

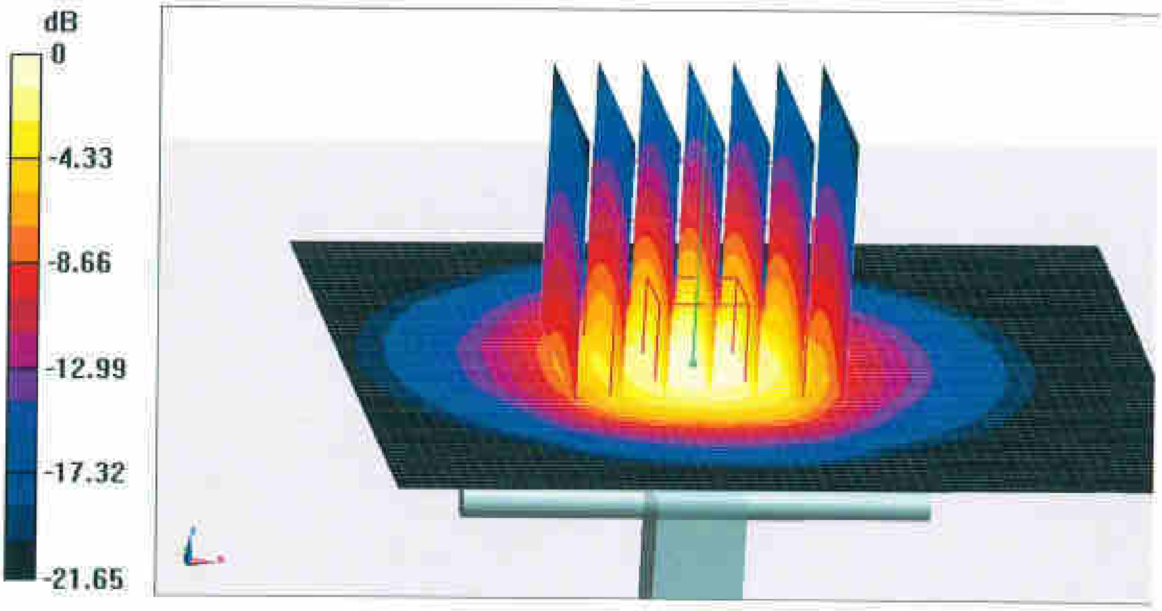
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.0 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 27.3 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.14 W/kg

Maximum value of SAR (measured) = 22.0 W/kg



0 dB = 22.0 W/kg = 13.42 dBW/kg

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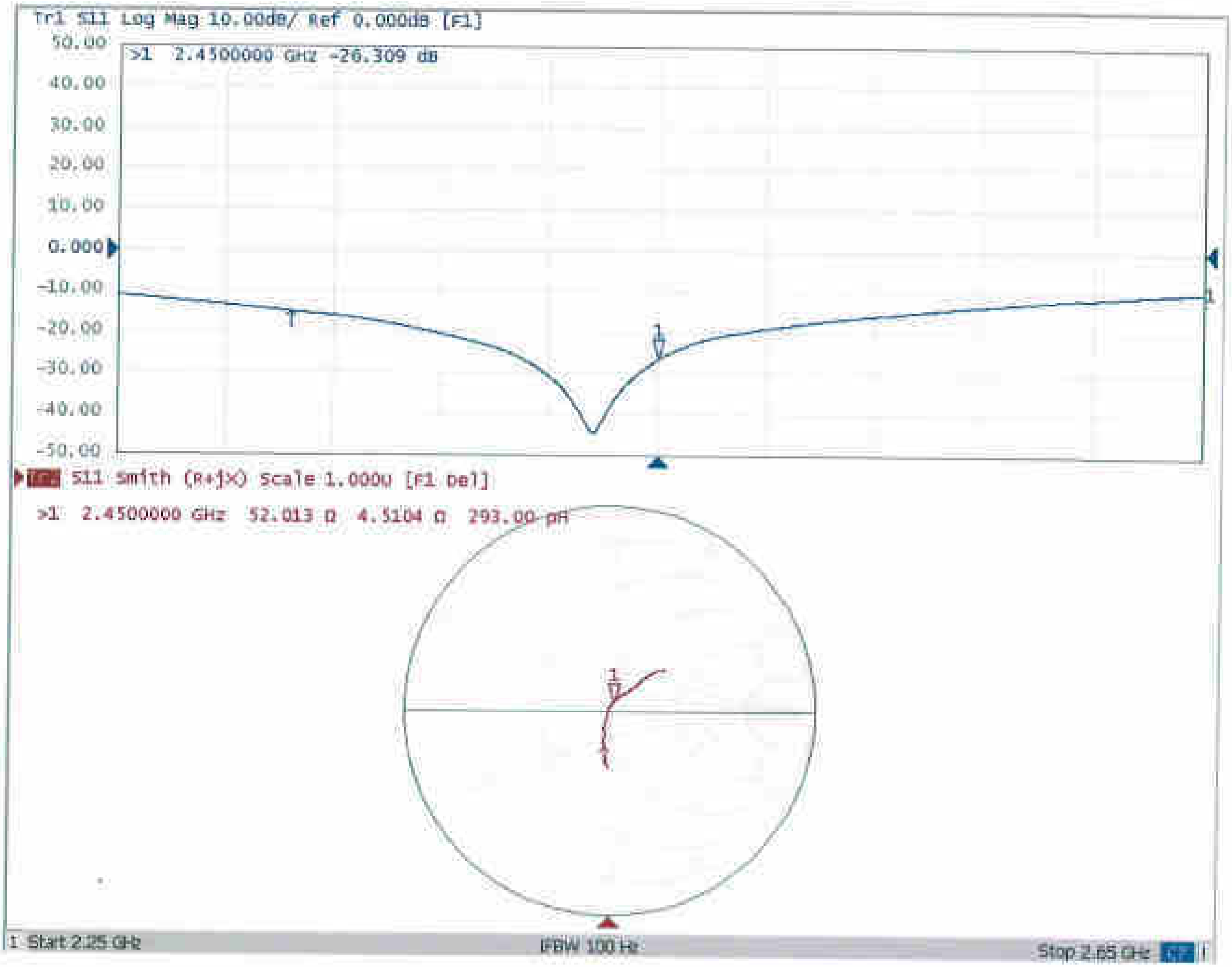
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



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Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
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DASY5 Validation Report for Body TSL Date: 12.07.2017

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 840

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.926 S/m; ε_r = 52.48; ρ = 1000 kg/m^3

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.8, 7.8, 7.8); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

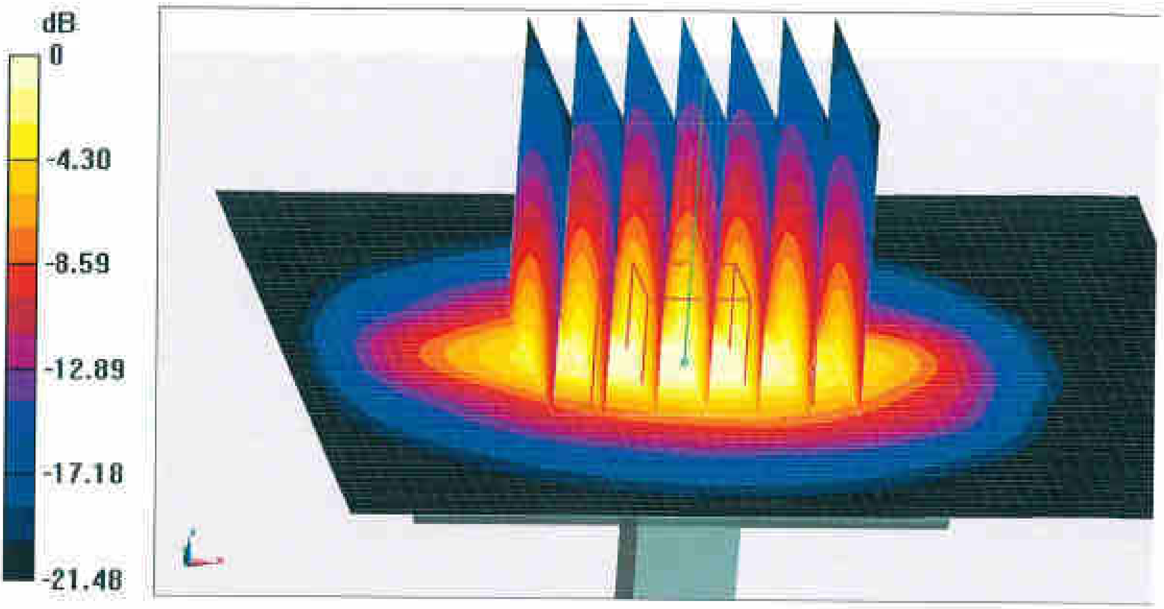
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.77 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 26.8 W/kg

SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.99 W/kg

Maximum value of SAR (measured) = 21.7 W/kg



0 dB = 21.7 W/kg = 13.36 dBW/kg

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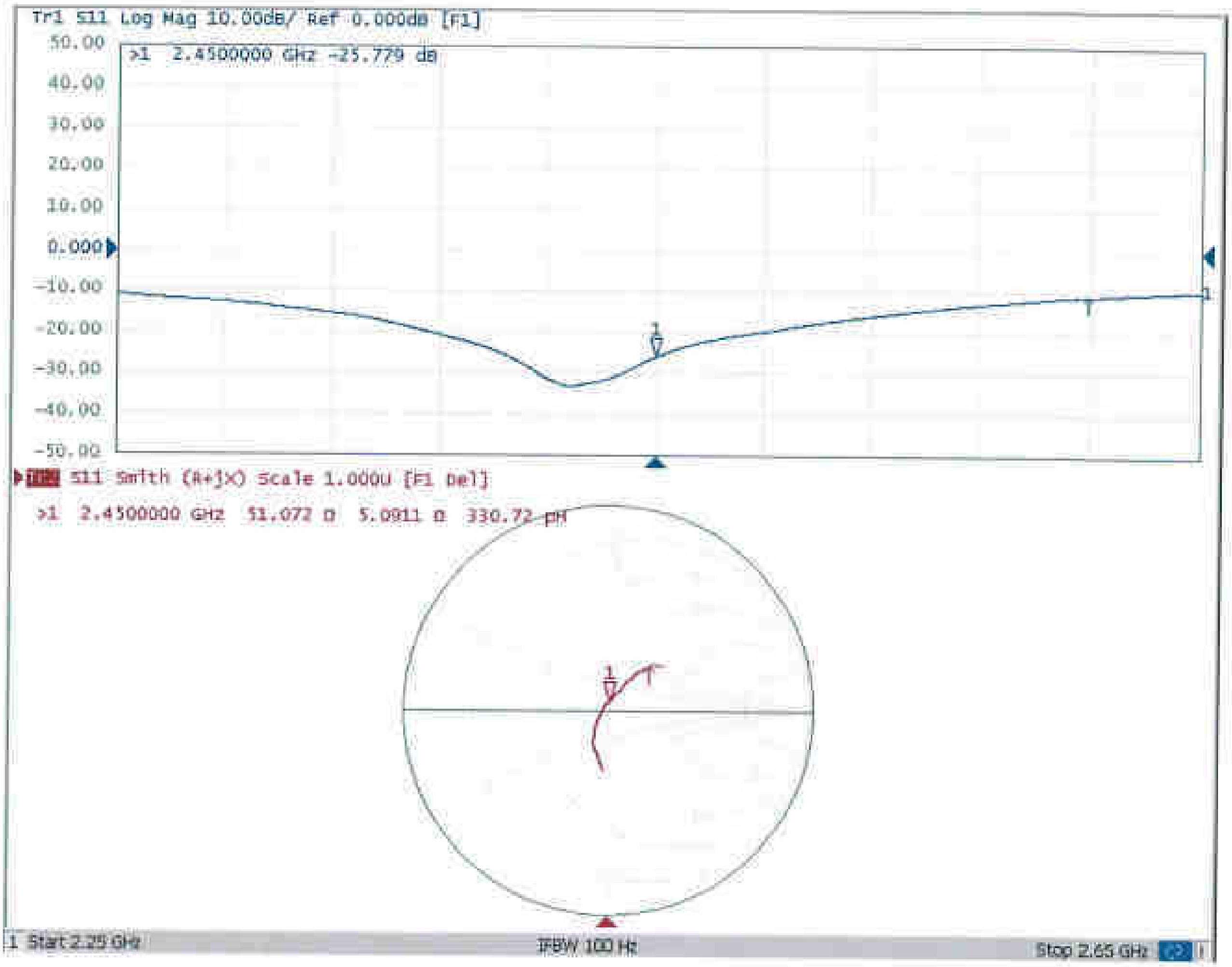
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
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Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

Client Sporton (Auden)

Certificate No: D5GHzV2-1006_Sep17

CALIBRATION CERTIFICATE

Object: D5GHzV2 - SN:1006

Calibration procedure(s): QA CAL-22.v2
Calibration procedure for dipole validation kits between 3-6 GHz

Calibration date: September 26, 2017

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02522)	Apr-18
Reference 20 dB Attenuator	SN: 5058 (20k)	07-Apr-17 (No. 217-02528)	Apr-18
Type-N mismatch combination	SN: 5047.2 / 06327	07-Apr-17 (No. 217-02529)	Apr-18
Reference Probe EX3DV4	SN: 3503	31-Dec-16 (No. EX3-3503_Dec16)	Dec-17
DAE4	SN: 601	28-Mar-17 (No. DAE4-601_Mar17)	Mar-18

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter EPM-442A	SN: GB37480704	07-Oct-16 (No. 217-02222)	In house check: Oct-18
Power sensor HP 8481A	SN: US37292783	07-Oct-16 (No. 217-02222)	In house check: Oct-18
Power sensor HP 8481A	SN: MY41092317	07-Oct-16 (No. 217-02223)	In house check: Oct-18
RF generator R&S SMT-06	SN: 100972	15-Jun-15 (in house check Oct-16)	In house check: Oct-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 26, 2017

Glossary:

TSL	tissue simulating liquid
ConvF	sensitivity in TSL / NORM x,y,z
N/A	not applicable or not measured

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The dipole is mounted with the spacer to position its feed point exactly below the center marking of the flat phantom section, with the arms oriented parallel to the body axis.
- *Feed Point Impedance and Return Loss:* These parameters are measured with the dipole positioned under the liquid filled phantom. The impedance stated is transformed from the measurement at the SMA connector to the feed point. The Return Loss ensures low reflected power. No uncertainty required.
- *Electrical Delay:* One-way delay between the SMA connector and the antenna feed point. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.10.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom V5.0	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	5250 MHz ± 1 MHz 5600 MHz ± 1 MHz 5750 MHz ± 1 MHz	

Head TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.9	4.71 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.7 ± 6 %	4.59 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.80 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.3 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.24 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.5 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	35.5	5.07 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.2 ± 6 %	4.95 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.48 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**85.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.42 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.3 W/kg ± 19.5 % (k=2)**

Head TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	35.4	5.22 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	36.0 ± 6 %	5.12 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.83 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**78.5 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**22.3 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5250 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.9	5.36 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	47.0 ± 6 %	5.49 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5250 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.76 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**77.0 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**21.3 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5600 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.5	5.77 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.4 ± 6 %	5.96 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5600 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	8.07 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**80.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.26 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**22.4 W/kg ± 19.5 % (k=2)**

Body TSL parameters at 5750 MHz

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	48.3	5.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	46.1 ± 6 %	6.17 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL at 5750 MHz

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	100 mW input power	7.57 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**75.1 W/kg ± 19.9 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.10 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.8 W/kg ± 19.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL at 5250 MHz

Impedance, transformed to feed point	53.8 Ω - 8.4 jΩ
Return Loss	- 21.0 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	55.8 Ω - 6.9 jΩ
Return Loss	- 21.4 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	60.0 Ω + 3.9 jΩ
Return Loss	- 20.2 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	54.1 Ω - 5.2 jΩ
Return Loss	- 24.0 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	58.5 Ω - 4.8 jΩ
Return Loss	- 20.9 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	59.8 Ω + 5.6 jΩ
Return Loss	- 19.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.201 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 28, 2003

DASY5 Validation Report for Head TSL

Date: 25.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1006

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 4.59 S/m; ε_r = 36.7; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 4.95 S/m; ε_r = 36.2; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 5.12 S/m; ε_r = 36; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

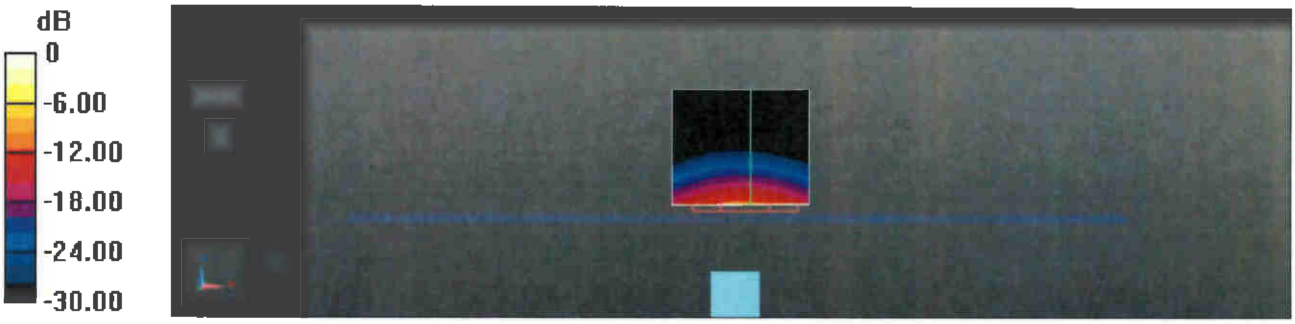
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.58, 5.58, 5.58); Calibrated: 31.12.2016, ConvF(5.09, 5.09, 5.09); Calibrated: 31.12.2016, ConvF(5.02, 5.02, 5.02); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 67.79 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 28.2 W/kg
SAR(1 g) = 7.8 W/kg; SAR(10 g) = 2.24 W/kg
Maximum value of SAR (measured) = 18.0 W/kg

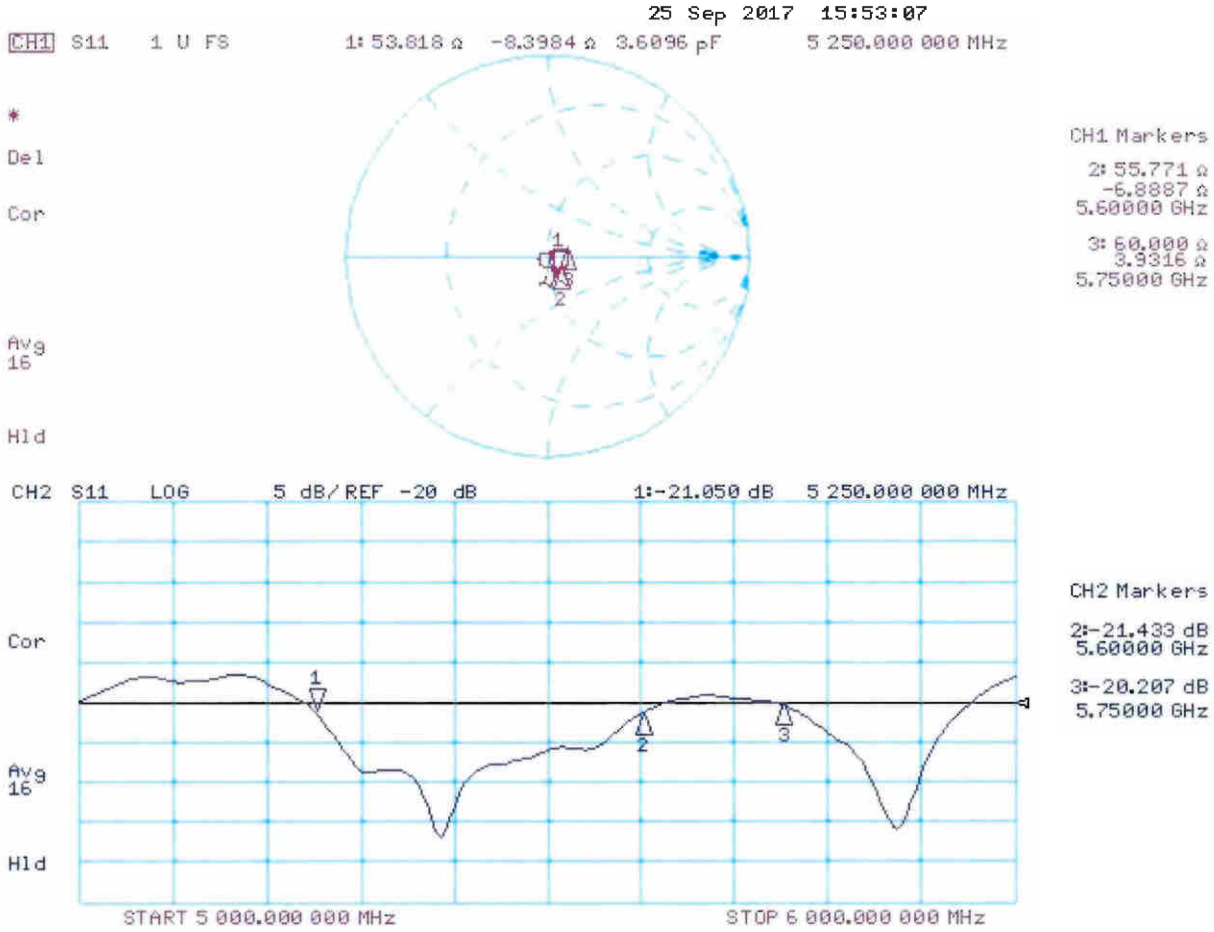
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 69.36 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 32.8 W/kg
SAR(1 g) = 8.48 W/kg; SAR(10 g) = 2.42 W/kg
Maximum value of SAR (measured) = 20.0 W/kg

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 66.53 V/m; Power Drift = -0.05 dB
Peak SAR (extrapolated) = 31.0 W/kg
SAR(1 g) = 7.83 W/kg; SAR(10 g) = 2.22 W/kg
Maximum value of SAR (measured) = 18.7 W/kg



0 dB = 18.0 W/kg = 12.55 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 26.09.2017

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1006

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz
Medium parameters used: f = 5250 MHz; σ = 5.49 S/m; ε_r = 47; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5600 MHz; σ = 5.96 S/m; ε_r = 46.4; ρ = 1000 kg/m^3 ,
Medium parameters used: f = 5750 MHz; σ = 6.17 S/m; ε_r = 46.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

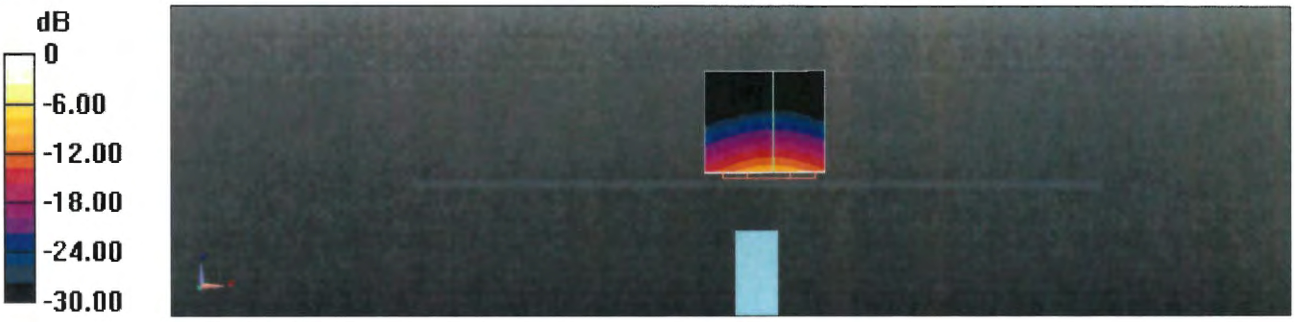
DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.14, 5.14, 5.14); Calibrated: 31.12.2016, ConvF(4.57, 4.57, 4.57); Calibrated: 31.12.2016, ConvF(4.51, 4.51, 4.51); Calibrated: 31.12.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 28.03.2017
- Phantom: Flat Phantom 5.0 (back); Type: QD 000 P50 AA; Serial: 1002
- DASY52 52.10.0(1446); SEMCAD X 14.6.10(7417)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.96 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 30.6 W/kg
SAR(1 g) = 7.76 W/kg; SAR(10 g) = 2.15 W/kg
Maximum value of SAR (measured) = 18.7 W/kg

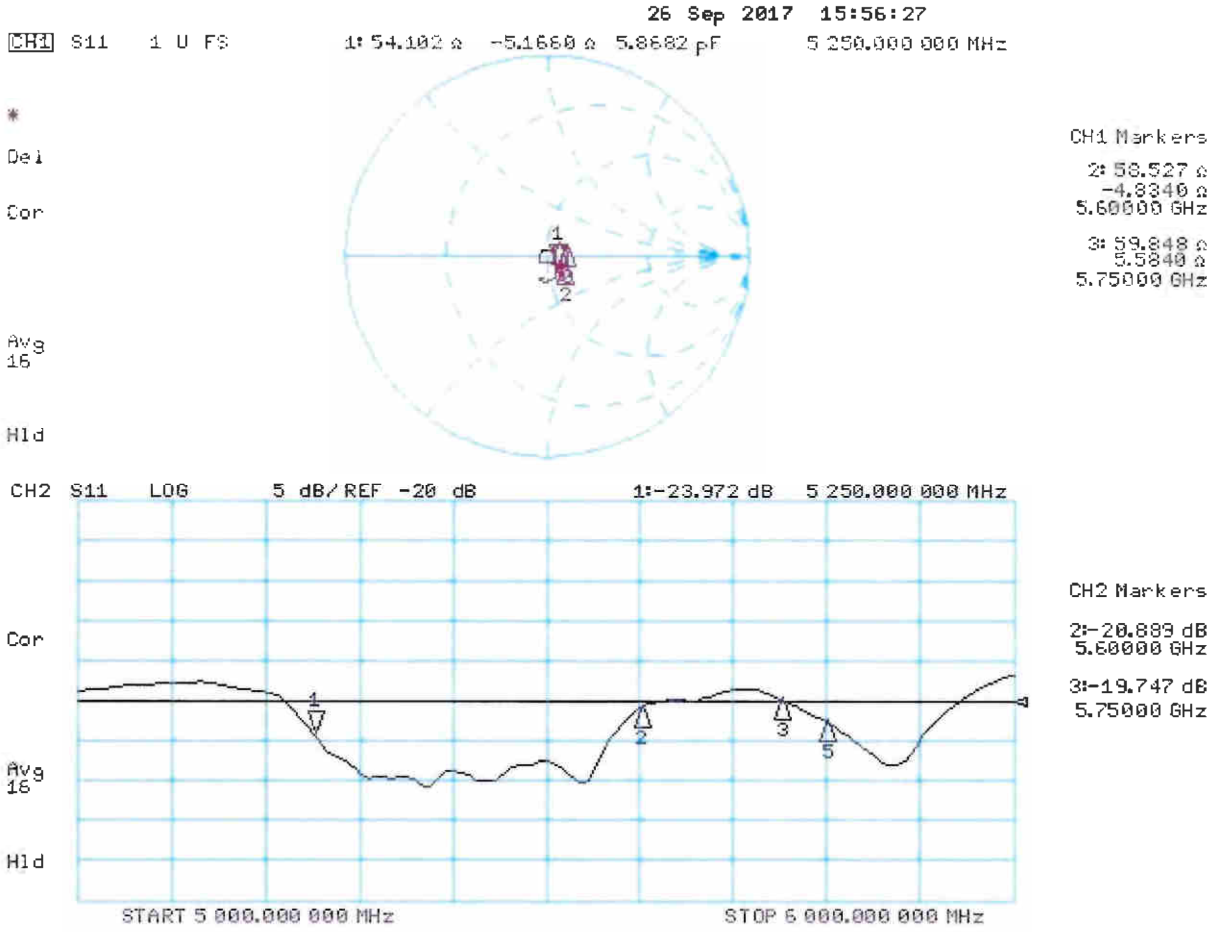
Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 64.94 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 34.0 W/kg
SAR(1 g) = 8.07 W/kg; SAR(10 g) = 2.26 W/kg
Maximum value of SAR (measured) = 19.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 61.76 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 33.5 W/kg
SAR(1 g) = 7.57 W/kg; SAR(10 g) = 2.1 W/kg
Maximum value of SAR (measured) = 18.9 W/kg



0 dB = 18.7 W/kg = 12.72 dBW/kg

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S **Schweizerischer Kalibrierdienst**
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Accreditation No.: SCS 0108

Client **Auden**

Certificate No: DAE4-910_Jul17

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BK - SN: 910
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	July 13, 2017

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	09-Sep-16 (No:19065)	Sep-17
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	05-Jan-17 (in house check)	In house check: Jan-18
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-17 (in house check)	In house check: Jan-18

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	i.V. Blemur

Issued: July 13, 2017

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100...+300 mV

Low Range: 1LSB = 61nV , full range = -1.......+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.334 ± 0.02% (k=2)	402.753 ± 0.02% (k=2)	403.237 ± 0.02% (k=2)
Low Range	3.98292 ± 1.50% (k=2)	3.94291 ± 1.50% (k=2)	3.95052 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	314.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200041.03	2.05	0.00
Channel X	+ Input	20007.58	1.82	0.01
Channel X	- Input	-20002.98	2.20	-0.01
Channel Y	+ Input	200040.02	1.21	0.00
Channel Y	+ Input	20005.15	-0.63	-0.00
Channel Y	- Input	-20006.28	-1.10	0.01
Channel Z	+ Input	200037.04	-2.06	-0.00
Channel Z	+ Input	20005.67	0.05	0.00
Channel Z	- Input	-20003.93	1.44	-0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.98	0.38	0.02
Channel X	+ Input	201.29	-0.33	-0.16
Channel X	- Input	-199.23	-0.91	0.46
Channel Y	+ Input	2002.19	0.63	0.03
Channel Y	+ Input	200.31	-1.21	-0.60
Channel Y	- Input	-199.63	-1.19	0.60
Channel Z	+ Input	2001.61	0.17	0.01
Channel Z	+ Input	200.09	-1.31	-0.65
Channel Z	- Input	-201.44	-2.88	1.45

2. Common mode sensitivity

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-12.83	-14.46
	- 200	16.33	14.63
Channel Y	200	6.01	5.68
	- 200	-6.91	-7.34
Channel Z	200	-12.16	-12.11
	- 200	9.79	9.86

3. Channel separation

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	4.30	-3.56
Channel Y	200	9.53	-	4.89
Channel Z	200	10.35	8.14	-

4. AD-Converter Values with inputs shorted

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	16196	16895
Channel Y	15382	16517
Channel Z	16727	17469

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.83	-0.49	2.69	0.64
Channel Y	0.36	-0.92	1.37	0.54
Channel Z	-1.12	-2.44	0.17	0.55

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. Low Battery Alarm Voltage (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. Power Consumption (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	–0.01	-8	-9

Calibration Laboratory of
Schmid & Partner
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: SCS 0108

Client **Auden**

Certificate No: EX3-7375_Dec17

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:7375
Calibration procedure(s)	QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	December 18, 2017

This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-17 (No. 217-02521/02522)	Apr-18
Power sensor NRP-Z91	SN: 103244	04-Apr-17 (No. 217-02521)	Apr-18
Power sensor NRP-Z91	SN: 103245	04-Apr-17 (No. 217-02525)	Apr-18
Reference 20 dB Attenuator	SN: S5277 (20x)	07-Apr-17 (No. 217-02528)	Apr-18
Reference Probe ES3DV2	SN: 3013	31-Dec-16 (No. ES3-3013_Dec16)	Dec-17
DAE4	SN: 654	24-Jul-17 (No. DAE4-654_Jul17)	Jul-18
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: December 21, 2017

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C, D	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., $\vartheta = 0$ is normal to probe axis
Connector Angle	information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ ($f \le 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \le 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe EX3DV4

SN:7375

Manufactured: April 13, 2015
Calibrated: December 18, 2017

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7375

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.49	0.42	0.46	± 10.1 %
DCP (mV)[B]	97.7	95.2	96.1	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B $dB\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	139.8	±3.3 %
		Y	0.0	0.0	1.0		142.5	
		Z	0.0	0.0	1.0		131.3	

The reported uncertainty of measurement is stated as the standard uncertainty of measurement multiplied by the coverage factor k=2, which for a normal distribution corresponds to a coverage probability of approximately 95%.

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: EX3DV4 - SN:7375

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	41.9	0.89	10.59	10.59	10.59	0.46	0.88	± 12.0 %
835	41.5	0.90	10.31	10.31	10.31	0.39	0.94	± 12.0 %
900	41.5	0.97	10.02	10.02	10.02	0.50	0.80	± 12.0 %
1750	40.1	1.37	8.81	8.81	8.81	0.35	0.86	± 12.0 %
1900	40.0	1.40	8.41	8.41	8.41	0.34	0.84	± 12.0 %
2000	40.0	1.40	8.34	8.34	8.34	0.38	0.84	± 12.0 %
2300	39.5	1.67	7.88	7.88	7.88	0.35	0.84	± 12.0 %
2450	39.2	1.80	7.65	7.65	7.65	0.40	0.80	± 12.0 %
2600	39.0	1.96	7.34	7.34	7.34	0.38	0.88	± 12.0 %
5200	36.0	4.66	5.34	5.34	5.34	0.40	1.80	± 13.1 %
5300	35.9	4.76	5.15	5.15	5.15	0.40	1.80	± 13.1 %
5500	35.6	4.96	4.94	4.94	4.94	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.72	4.72	4.72	0.40	1.80	± 13.1 %
5800	35.3	5.27	4.80	4.80	4.80	0.40	1.80	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

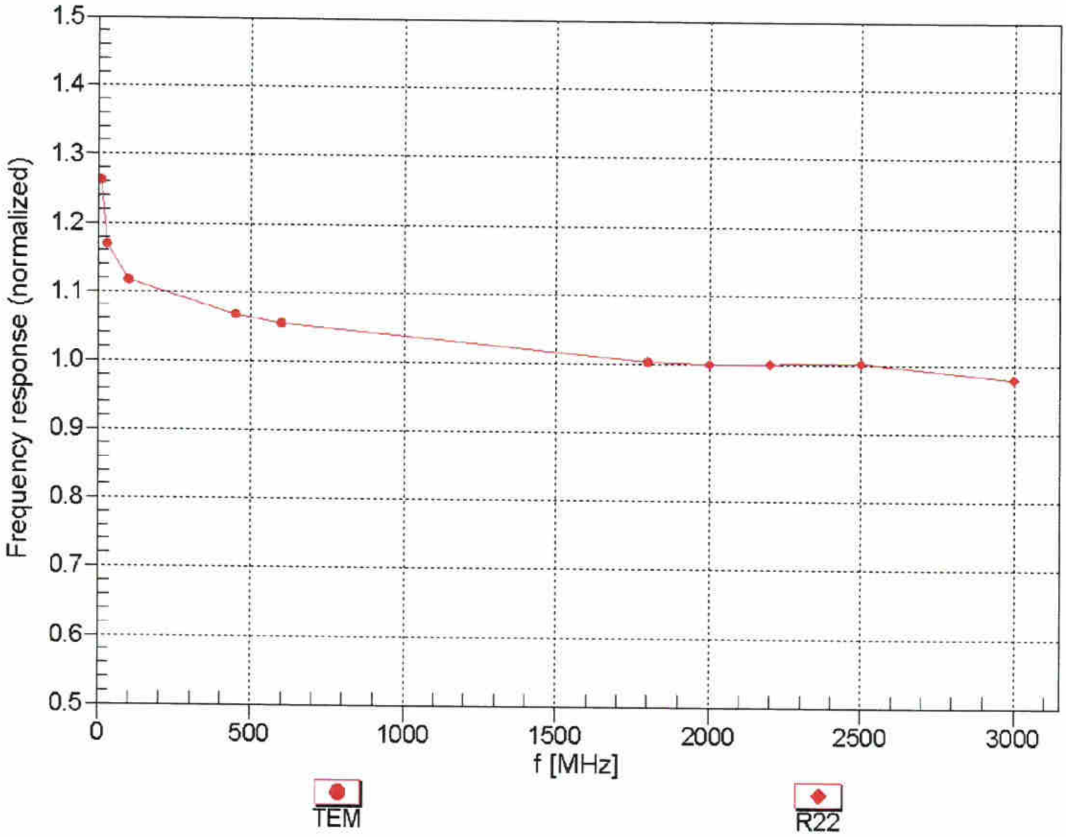
DASY/EASY - Parameters of Probe: EX3DV4 - SN:7375

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
750	55.5	0.96	10.49	10.49	10.49	0.53	0.94	± 12.0 %
835	55.2	0.97	10.14	10.14	10.14	0.44	1.00	± 12.0 %
900	55.0	1.05	10.06	10.06	10.06	0.58	0.82	± 12.0 %
1750	53.4	1.49	8.99	8.99	8.99	0.39	0.84	± 12.0 %
1900	53.3	1.52	8.44	8.44	8.44	0.47	0.80	± 12.0 %
2000	53.3	1.52	8.38	8.38	8.38	0.43	0.83	± 12.0 %
2300	52.9	1.81	7.93	7.93	7.93	0.44	0.80	± 12.0 %
2450	52.7	1.95	7.83	7.83	7.83	0.38	0.89	± 12.0 %
2600	52.5	2.16	7.43	7.43	7.43	0.44	0.83	± 12.0 %
5200	49.0	5.30	4.84	4.84	4.84	0.45	1.90	± 13.1 %
5300	48.9	5.42	4.64	4.64	4.64	0.45	1.90	± 13.1 %
5500	48.6	5.65	4.22	4.22	4.22	0.45	1.90	± 13.1 %
5600	48.5	5.77	4.10	4.10	4.10	0.45	1.90	± 13.1 %
5800	48.2	6.00	4.41	4.41	4.41	0.45	1.90	± 13.1 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

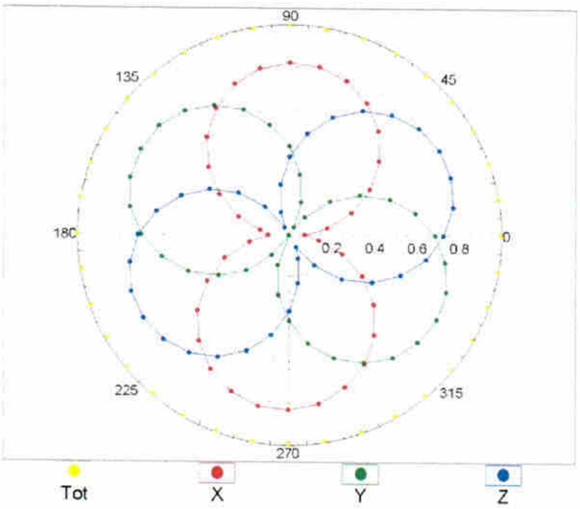
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



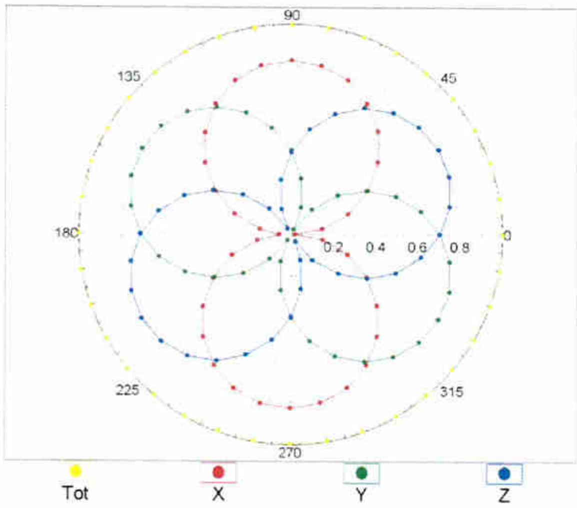
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

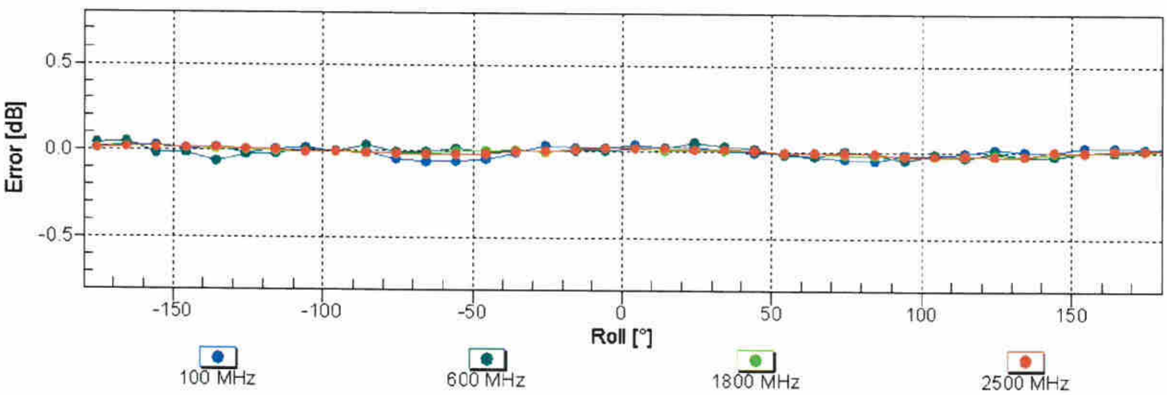
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22





Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)