

FCC SAR Test Report

APPLICANT : Acer Incorporated
EQUIPMENT : Tablet Computer
BRAND NAME : acer
MODEL NAME : N17H1
MARKETING NAME : Switch 3
FCC ID : HLZ7265D2W
STANDARD : FCC 47 CFR Part 2 (2.1093)
ANSI/IEEE C95.1-1992
IEEE 1528-2013

We, SPORTON International (ShenZhen) 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.

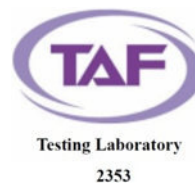
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Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA731501	Rev. 01	Initial issue of report	Apr. 25, 2017

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Acer Incorporated, Tablet Computer, N17H1** are as follows.

Equipment Class	Frequency Band	Highest SAR Summary	Highest Simultaneous Transmission 1g SAR (W/kg)
		Body (Separation 0mm)	
		1g SAR (W/kg)	
DTS	2.4GHz WLAN	1.09	1.11
NII	5GHz WLAN	1.16	1.16
DSS	Bluetooth		1.29
Date of Testing:		2017/04/01 ~ 2017/04/02	

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 (ShenZhen) INC.
Test Site Location	1/F, 2/F, Bldg 5, Shiling Industrial Zone, Xinwei Village, Xili, Nanshan District, Shenzhen City, Guangdong Province, China TEL: +86-755-8637-9589 FAX: +86-755-8637-9595

Applicant	
Company Name	Acer Incorporated
Address	8F ,88, Sec.1 Xintai 5th Rd. Xizhi, New Taipei City 221, Taiwan, R.O.C

Manufacturer	
Company Name	Acer Incorporated
Address	8F ,88, Sec.1 Xintai 5th Rd. Xizhi, New Taipei City 221, Taiwan, R.O.C

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	Tablet Computer
Brand Name	acer
Model Name	N17H1
Marketing Name	Switch 3
FCC ID	HLZ7265D2W
Wireless Technology and Frequency Range	WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5720MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	802.11b/g/n HT20/HT40 802.11a/ n HT20/HT40 802.11ac VHT20/VHT40/VHT80 Bluetooth v3.0+EDR, Bluetooth v4.0 LE
HW Version	T8202_MB_V4
SW Version	14393.5
EUT Stage	Pre-Production
Remark: This device has no voice function.	

4.2 Component list

Note: There are two types of EUT, the details refer the following table. According to the difference, we only chose sample 1 to perform full SAR test.

Name	N17H1	
	Sample 1	Sample 2
PCB--MB	T8202_mainboard PCB_V4.0 (HUAXIN)	T8202_mainboard PCB_V4.0 (RED BOARD)
CPU	N4200(INTEL)	N3350(INTEL)
Memory	4G+128G	4G+64G

5. RF Exposure Limits

5.1 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.

5.2 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.

6. Specific Absorption Rate (SAR)

6.1 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.

6.2 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:

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

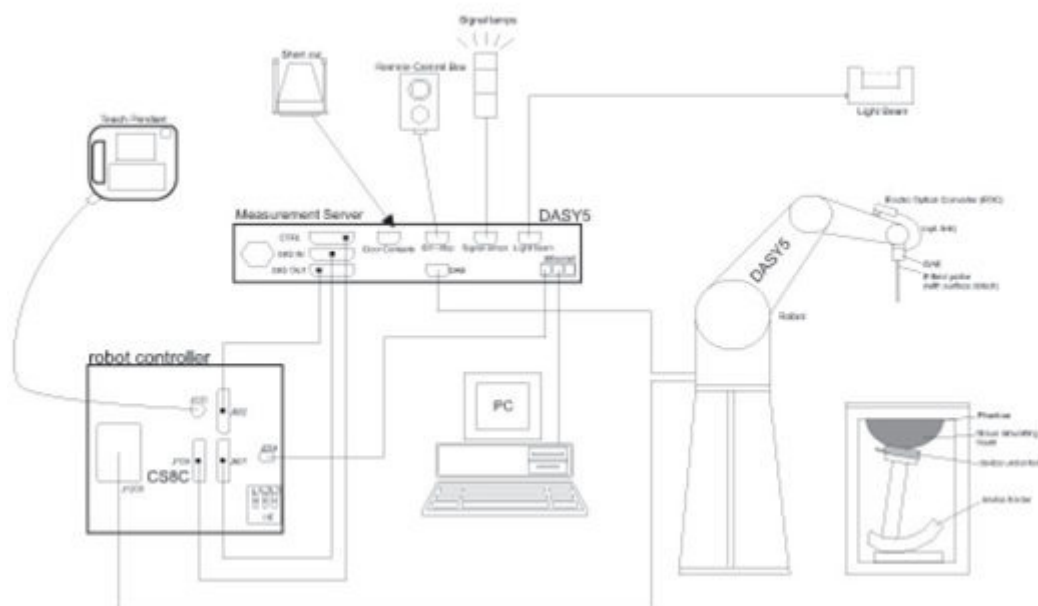
SAR is expressed in units of Watts per kilogram (W/kg)

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

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

7. 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.

7.1 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 μ W/g – >100 mW/g Linearity: ± 0.2 dB (noise: typically <1 μ W/g)	
Dimensions	Overall length: 337 mm (tip: 20 mm) Tip diameter: 2.5 mm (body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm	

7.2 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.



Fig 5.1 Photo of DAE

7.3 Phantom

<ELI Phantom>

Shell Thickness	2 $\pm$ 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.

7.4 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

8. Measurement Procedures

The measurement procedures are as follows:

<Conducted power measurement>

- (a) 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
- (b) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

<SAR measurement>

- (a) 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

8.1 Spatial Peak SAR Evaluation

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

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

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

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

8.2 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.

8.3 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 dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

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

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

8.4 Zoom Scan

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

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

			≤ 3 GHz	> 3 GHz
Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$			≤ 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: $\Delta z_{\text{Zoom}}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{\text{Zoom}}(1)$: between 1 st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{\text{Zoom}}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1)$	
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 <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> 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.				

8.5 Volume Scan Procedures

The volume scan is used to assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT 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.

8.6 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.

9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	2450MHz System Validation Kit	D2450V2	840	Nov. 25, 2016	Nov. 24, 2017
SPEAG	5000MHz System Validation Kit	D5GHzV2	1167	Jul. 27, 2016	Jul. 26, 2017
SPEAG	Data Acquisition Electronics	DAE4	1338	Nov. 22, 2016	Nov. 21, 2017
SPEAG	Dosimetric E-Field Probe	EX3DV4	3911	Sep. 29, 2016	Sep. 28, 2017
SPEAG	ELI4 Phantom	ELI5.0	1225	NCR	NCR
SPEAG	Phone Positioner	N/A	N/A	NCR	NCR
Agilent	Network Analyzer	E5071C	MY46523671	Oct. 11, 2016	Oct. 10, 2017
Speag	Dielectric Assessment KIT	DAK-3.5	1071	Nov. 23, 2016	Nov. 22, 2017
Agilent	Signal Generator	N5181A	MY50145381	Jan. 03, 2017	Jan. 02, 2018
Anritsu	Power Sensor	MA2411B	1306099	Jan. 03, 2017	Jan. 02, 2018
Anritsu	Power Meter	ML2495A	1349001	Jan. 03, 2017	Jan. 02, 2018
Anritsu	Power Sensor	MA2411B	1207253	Jan. 03, 2017	Jan. 02, 2018
Anritsu	Power Meter	ML2495A	1218010	Jan. 03, 2017	Jan. 02, 2018
R&S	Spectrum Analyzer	FSP7	101634	Jul. 16, 2016	Jul. 15, 2017
ARRA	Power Divider	A3200-2	N/A	Note1	
PASTERNAK	Dual Directional Coupler	PE2214-10	N/A	Note1	
Agilent	Dual Directional Coupler	778D	50422	Note1	
AR	Amplifier	5S1G4	333096	Note1	
mini-circuits	Amplifier	ZVE-3W-83+	162601250	Note1	
MCL	Attenuation1	BW-S10W5	N/A	Note1	
Weinschel	Attenuation2	3M-20	N/A	Note1	
Zhongjilianhe	Attenuation3	MVE2214-03	N/A	Note1	

General Note:

1. 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.

10. System Verification

10.1 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 (ϵ_r)
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. (°C)	Conductivity (σ)	Permittivity (ϵ_r)	Conductivity Target (σ)	Permittivity Target (ϵ_r)	Delta (σ) (%)	Delta (ϵ_r) (%)	Limit (%)	Date
2450	Body	22.5	1.991	52.320	1.95	52.70	2.10	-0.72	±5	2017/4/1
5250	Body	22.6	5.240	51.015	5.36	48.90	-2.24	4.33	±5	2017/4/2
5600	Body	22.7	5.825	50.395	5.77	48.50	0.95	3.91	±5	2017/4/2
5750	Body	22.9	6.051	50.049	5.94	48.30	1.87	3.62	±5	2017/4/2

10.2 System Performance Check Results

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

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 (%)
2017/4/1	2450	Body	250	840	3911	1338	13.40	50.90	53.6	5.30
2017/4/2	5250	Body	100	1167	3911	1338	7.75	75.80	77.5	2.24
2017/4/2	5600	Body	100	1167	3911	1338	8.25	78.40	82.5	5.23
2017/4/2	5750	Body	100	1167	3911	1338	7.69	75.90	76.9	1.32

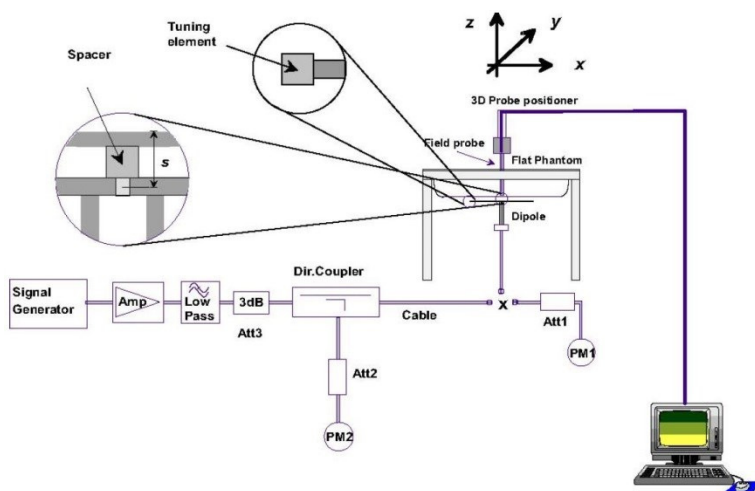


Fig 8.3.1 System Performance Check Setup

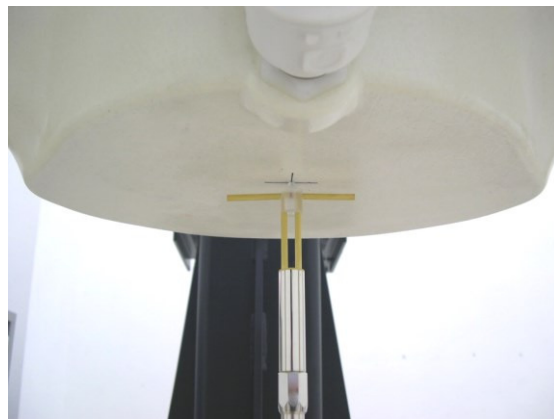


Fig 8.3.2 Setup Photo



11. RF Exposure Positions

11.1 SAR Testing for Tablet

This device can be used also in full sized tablet exposure conditions, due to its size. Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR exclusion threshold in KDB 447498 D01v06 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

12. 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, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is $< 1.6\text{W/kg}$ and SAR peak to location ratio ≤ 0.04 , no additional SAR measurements for MIMO.
3. 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.
4. 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).
5. 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.
6. 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 $\leq 0.4\text{ W/kg}$, 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 $> 0.4\text{ W/kg}$, 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 $\leq 0.8\text{ W/kg}$ or all required test position are tested.
 - c. For all positions/configurations, when the reported SAR is $> 0.8\text{ W/kg}$, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is $\leq 1.2\text{ W/kg}$ or all required channels are tested.

<2.4GHz WLAN ANT 1>

2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11b 1Mbps	1	2412	16.42	17.00	98.70
		6	2437	16.99	17.50	
		11	2462	16.30	16.50	
	802.11g 6Mbps	1	2412	13.51	14.00	98.60
		6	2437	16.97	17.50	
		11	2462	12.29	12.50	
	802.11n-HT20 MCS0	1	2412	13.75	14.00	98.88
		6	2437	16.85	17.00	
		11	2462	12.20	12.50	
	802.11n-HT40 MCS0	3	2422	13.37	13.50	96.85
		6	2437	16.24	16.50	
		9	2452	12.38	12.50	

<2.4GHz WLAN ANT 2>

2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11b 1Mbps	1	2412	14.01	14.50	98.64
		6	2437	13.97	14.50	
		11	2462	13.90	14.50	
	802.11g 6Mbps	1	2412	13.99	14.50	98.43
		6	2437	13.95	14.50	
		11	2462	12.29	12.50	
	802.11n-HT20 MCS0	1	2412	13.91	14.50	98.80
		6	2437	13.90	14.50	
		11	2462	12.12	12.50	
	802.11n-HT40 MCS0	3	2422	13.44	14.00	96.85
		6	2437	13.42	14.00	
		9	2452	11.19	11.50	

<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	14.89	15.00	98.88
		6	2437	19.52	20.00	
		11	2462	12.75	13.00	
	802.11n-HT40 MCS0	3	2422	12.39	12.50	96.85
		6	2437	19.02	19.50	
		9	2452	12.04	12.50	

<5GHz WLAN ANT1>

5.2GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	36	5180	12.08	12.50	98.12
		40	5200	12.30	12.50	
		44	5220	12.33	12.50	
		48	5240	12.26	12.50	
	802.11n-HT20 MCS0	36	5180	12.07	12.50	98.51
		40	5200	12.20	12.50	
		44	5220	12.28	12.50	
		48	5240	12.25	12.50	
	802.11n-HT40 MCS0	38	5190	11.71	12.00	96.55
		46	5230	12.15	12.40	
	802.11ac-VHT20 MCS0	36	5180	12.05	12.50	97.99
		40	5200	11.17	11.50	
		44	5220	12.27	12.50	
		48	5240	12.23	12.50	
	802.11ac-VHT40 MCS0	38	5190	11.69	12.00	97.03
		46	5230	12.13	12.40	
	802.11ac-VHT80 MCS0	42	5210	11.80	12.00	94.37

5.3GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	52	5260	13.16	13.50	98.12
		56	5280	13.61	14.00	
		60	5300	13.64	14.00	
		64	5320	13.60	14.00	
	802.11n-HT20 MCS0	52	5260	13.02	13.50	98.51
		56	5280	13.54	14.00	
		60	5300	13.62	14.00	
		64	5320	13.58	14.00	
	802.11n-HT40 MCS0	54	5270	12.63	13.00	96.55
		62	5310	13.09	13.50	
	802.11ac-VHT20 MCS0	52	5260	13.00	13.50	97.99
		56	5280	13.22	13.50	
		60	5300	13.59	14.00	
		64	5320	13.53	14.00	
	802.11ac-VHT40 MCS0	54	5270	12.61	13.00	97.03
		62	5310	13.08	13.50	
	802.11ac-VHT80 MCS0	58	5290	12.59	13.00	94.37

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	12.70	13.00	98.12
		116	5580	13.22	13.50	
		124	5620	12.68	13.50	
		132	5660	12.54	13.00	
		140	5700	12.11	12.50	
		144	5720	12.05	12.50	
	802.11n-HT20 MCS0	100	5500	12.67	13.00	98.51
		116	5580	13.12	13.50	
		124	5620	13.08	13.50	
		132	5660	12.45	13.00	
		140	5700	12.09	12.50	
		144	5720	11.93	12.50	
	802.11n-HT40 MCS0	102	5510	12.24	12.50	96.55
		110	5550	12.91	13.00	
		126	5630	12.12	12.50	
		134	5670	11.89	12.50	
		142	5710	11.50	12.00	
	802.11ac-VHT20 MCS0	100	5500	12.57	13.00	97.99
		116	5580	13.11	13.50	
		124	5620	12.60	13.00	
		132	5660	12.13	12.50	
		140	5700	13.07	13.50	
		144	5720	11.85	12.50	
	802.11ac-VHT40 MCS0	102	5510	12.19	12.50	97.03
		110	5550	12.85	13.00	
		126	5630	12.10	12.50	
		134	5670	11.87	12.50	
		142	5710	11.02	11.50	
	802.11ac-VHT80 MCS0	106	5530	12.49	13.00	94.37
		122	5610	12.63	13.00	
		138	5690	11.98	12.50	

5.8GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	149	5745	12.80	13.00	98.12
		157	5785	12.53	13.00	
		165	5825	12.68	13.00	
	802.11n-HT20 MCS0	149	5745	12.28	12.50	98.51
		157	5785	12.05	12.50	
		165	5825	12.04	12.50	
	802.11n-HT40 MCS0	151	5755	12.18	12.50	96.55
		159	5795	11.86	12.50	
	802.11ac-VHT20 MCS0	149	5745	12.26	12.50	97.99
		157	5785	11.99	12.50	
		165	5825	12.03	12.50	
	802.11ac-VHT40 MCS0	151	5755	12.15	12.50	97.03
		159	5795	11.84	12.50	
	802.11ac-VHT80 MCS0	155	5775	12.07	12.50	94.37

<5GHz WLAN ANT2>

5.2GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	36	5180	13.73	14.00	98.74
		40	5200	13.90	14.50	
		44	5220	14.37	14.50	
		48	5240	14.60	15.00	
	802.11n-HT20 MCS0	36	5180	13.70	14.00	98.66
		40	5200	13.68	14.00	
		44	5220	14.36	14.50	
		48	5240	14.32	14.50	
	802.11n-HT40 MCS0	38	5190	12.35	12.50	97.28
		46	5230	14.10	14.40	
	802.11ac-VHT20 MCS0	36	5180	13.47	14.00	98.66
		40	5200	13.66	14.00	
		44	5220	14.32	14.50	
		48	5240	14.31	14.50	
	802.11ac-VHT40 MCS0	38	5190	12.25	12.50	97.32
		46	5230	14.08	14.40	
	802.11ac-VHT80 MCS0	42	5210	13.99	14.50	94.37

5.3GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	52	5260	14.97	15.50	98.74
		56	5280	14.32	15.00	
		60	5300	14.83	15.00	
		64	5320	13.00	13.50	
	802.11n-HT20 MCS0	52	5260	14.96	15.50	98.66
		56	5280	14.23	14.50	
		60	5300	14.81	15.00	
		64	5320	12.97	13.50	
	802.11n-HT40 MCS0	54	5270	14.27	14.50	97.28
		62	5310	13.27	13.50	
	802.11ac-VHT20 MCS0	52	5260	14.72	15.00	98.66
		56	5280	14.20	14.50	
		60	5300	14.79	15.00	
		64	5320	12.96	13.50	
	802.11ac-VHT40 MCS0	54	5270	14.26	14.50	97.32
		62	5310	13.25	13.50	
	802.11ac-VHT80 MCS0	58	5290	13.37	13.50	94.37

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.5GHz WLAN	802.11a 6Mbps	100	5500	13.64	14.00	98.74
		116	5580	13.93	14.50	
		124	5620	13.61	14.00	
		132	5660	13.40	14.00	
		140	5700	12.75	13.00	
		144	5720	12.98	13.50	
	802.11n-HT20 MCS0	100	5500	13.61	14.00	98.66
		116	5580	13.87	14.00	
		124	5620	13.52	14.00	
		132	5660	13.30	13.50	
		140	5700	12.73	13.00	
		144	5720	12.37	12.50	
	802.11n-HT40 MCS0	102	5510	13.02	13.50	97.28
		110	5550	13.86	14.00	
		126	5630	13.39	14.00	
		134	5670	12.77	13.00	
		142	5710	12.75	13.00	
	802.11ac-VHT20 MCS0	100	5500	13.58	14.00	98.66
		116	5580	13.84	14.00	
		124	5620	13.50	14.00	
		132	5660	13.26	13.50	
		140	5700	12.71	13.00	
		144	5720	12.18	12.50	
	802.11ac-VHT40 MCS0	102	5510	13.00	13.50	97.32
		110	5550	13.83	14.00	
		126	5630	13.36	14.00	
		134	5670	12.47	13.00	
		142	5710	12.35	13.00	
	802.11ac-VHT80 MCS0	106	5530	13.67	14.00	94.37
		122	5610	12.83	13.00	
		138	5690	12.53	13.00	

5.8GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a 6Mbps	149	5745	13.35	13.50	98.74
		157	5785	13.16	13.50	
		165	5825	12.90	13.50	
	802.11n-HT20 MCS0	149	5745	12.98	13.50	98.66
		157	5785	12.65	13.00	
		165	5825	12.51	13.00	
	802.11n-HT40 MCS0	151	5755	12.85	13.00	97.28
		159	5795	12.58	13.00	
	802.11ac-VHT20 MCS0	149	5745	12.96	13.50	98.66
		157	5785	12.64	13.00	
		165	5825	12.50	13.00	
	802.11ac-VHT40 MCS0	151	5755	12.83	13.00	97.32
		159	5795	12.57	13.00	
	802.11ac-VHT80 MCS0	155	5775	11.27	11.50	94.37

<5GHz WLAN ANT1+2>

	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
5.2GHz WLAN	802.11n-HT20 MCS0	36	5180	14.86	15.00	98.66
		40	5200	14.91	15.00	
		44	5220	14.97	15.00	
		48	5240	15.14	15.50	
	802.11n-HT40 MCS0	38	5190	13.61	14.00	97.28
		46	5230	14.73	15.00	
	802.11ac-VHT20 MCS0	36	5180	14.85	15.00	98.66
		40	5200	14.43	15.00	
		44	5220	14.84	15.00	
		48	5240	15.10	15.50	
	802.11ac-VHT40 MCS0	38	5190	13.38	13.50	97.32
		46	5230	14.68	15.00	
	802.11ac-VHT80 MCS0	42	5210	13.99	14.00	94.37

5.3GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11n-HT20 MCS0	52	5260	15.78	16.00	98.66
		56	5280	15.65	16.00	
		60	5300	16.25	16.50	
		64	5320	15.68	16.50	
	802.11n-HT40 MCS0	54	5270	15.40	16.00	97.28
		62	5310	14.91	15.50	
	802.11ac-VHT20 MCS0	52	5260	15.69	16.00	98.66
		56	5280	16.26	16.50	
		60	5300	15.95	16.50	
		64	5320	15.58	16.00	
	802.11ac-VHT40 MCS0	54	5270	15.15	15.50	97.32
		62	5310	14.90	15.00	
	802.11ac-VHT80 MCS0	58	5290	13.67	14.00	94.37

5.5GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11n-HT20 MCS0	100	5500	14.91	15.00	98.66
		116	5580	15.78	16.00	
		124	5620	15.87	16.00	
		132	5660	15.24	16.00	
		140	5700	14.31	16.00	
		144	5720	15.09	16.00	
	802.11n-HT40 MCS0	102	5510	14.97	16.00	97.28
		110	5550	15.46	16.00	
		126	5630	15.04	16.00	
		134	5670	14.74	16.00	
		142	5710	14.83	16.00	
	802.11ac-VHT20 MCS0	100	5500	14.22	16.00	98.66
		116	5580	15.73	16.00	
		124	5620	15.25	16.00	
		132	5660	15.02	16.00	
		140	5700	14.30	16.00	
		144	5720	14.94	16.00	
	802.11ac-VHT40 MCS0	102	5510	14.89	16.00	97.32
		110	5550	15.40	16.00	
		126	5630	15.01	16.00	
		134	5670	14.32	16.00	
		142	5710	14.24	16.00	
	802.11ac-VHT80 MCS0	106	5530	14.44	16.00	94.37
		122	5610	15.10	16.00	
		138	5690	14.94	16.00	

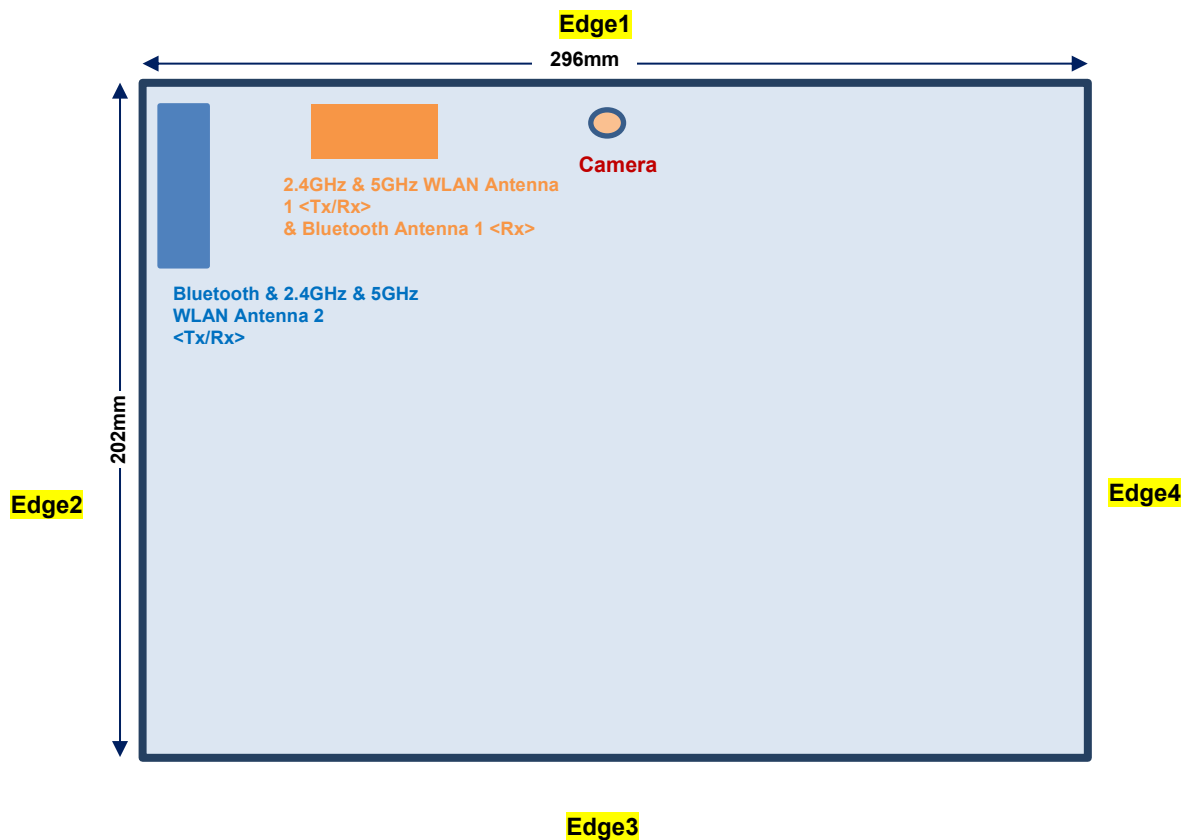
5.8GHz WLAN	Mode	Channel	Frequency (MHz)	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11n-HT20 MCS0	149	5745	14.77	15.00	98.66
		157	5785	14.60	15.00	
		165	5825	14.47	15.00	
	802.11n-HT40 MCS0	151	5755	14.64	15.00	97.28
		159	5795	14.73	15.00	
	802.11ac-VHT20 MCS0	149	5745	14.68	15.00	98.66
		157	5785	14.41	15.00	
		165	5825	14.14	15.50	
	802.11ac-VHT40 MCS0	151	5755	14.50	15.00	97.32
		159	5795	14.22	14.50	
	802.11ac-VHT80 MCS0	155	5775	13.95	14.00	94.37

<2.4GHz Bluetooth>

Mode	Channel	Frequency (MHz)	Average power (dBm)		
			1Mbps	2Mbps	3Mbps
v3.0 with EDR	CH 00	2402	2.88	-2.94	-2.88
	CH 39	2441	3.55	-2.29	-2.24
	CH 78	2480	3.80	-1.90	-1.89
Tune-up Limit			4.50		

Mode	Channel	Frequency (MHz)	Average power (dBm)	
			GFSK	
v4.0 with LE	CH 00	2402	1.58	
	CH 19	2440	2.23	
	CH 39	2480	2.28	
Tune-up Limit			2.50	

13. Antenna Location



Diagonal: 351 mm

Back View

General Note:

- The below table, when the distance is < 50 mm exclusion threshold is "Ratio", when the distance is > 50 mm exclusion threshold is "mW"
- Maximum power is the source-based time-average power and represents the maximum RF output power among production units
- 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.
- 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.
- 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:

$$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$$
 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
- 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
 - [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · (f(MHz)/150)] mW, at 100 MHz to 1500 MHz
 - [Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · 10] mW at > 1500 MHz and ≤ 6 GHz

Exposure Position	Wireless Interface	2.4GHz WLAN ANT 1	2.4GHz WLAN ANT 2	5GHz WLAN ANT 1	5GHz WLAN ANT 2	Bluetooth ANT 2
	Calculated Frequency	2462MHz	2462MHz	5825MHz	5825MHz	2480MHz
	Maximum power (dBm)	17.5	14.5	14	15.5	4.5
	Maximum rated power(mW)	56.0	28.0	25.0	35.0	3.0
Bottom Face	Separation distance(mm)	5.0	5.0	5.0	5.0	5.0
	exclusion threshold	17.6	8.8	12.1	16.9	0.9
	Testing required?	Yes	Yes	Yes	Yes	No
Edge 1	Separation distance(mm)	5.0	5.0	5.0	5.0	5.0
	exclusion threshold	17.6	8.8	12.1	16.9	0.9
	Testing required?	Yes	Yes	Yes	Yes	No
Edge 2	Separation distance(mm)	58.0	5.0	58.0	5.0	5.0
	exclusion threshold	176.0	8.8	142.0	16.9	0.9
	Testing required?	No	Yes	No	Yes	No
Edge 3	Separation distance(mm)	181.0	159.0	181.0	159.0	159.0
	exclusion threshold	1406.0	1186.0	1372.0	1152.0	1185.0
	Testing required?	No	No	No	No	No
Edge 4	Separation distance(mm)	207.0	281.0	207.0	281.0	281.0
	exclusion threshold	1666.0	2406.0	1632.0	2372.0	2405.0
	Testing required?	No	No	No	No	No

14. 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: 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 ≥ 0.8 W/kg.

WLAN Note:

1. Per KDB 248227 D01v02r02, for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
2. Per KDB 248227 D01v02r02, U-NII-1 SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is ≤ 1.2 W/kg, SAR is not required for U-NII-1 band.
3. 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.
4. 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.
5. For WLAN SAR testing was performed on single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
6. Per KDB 248227 D01v02r02, the simultaneous SAR provisions in KDB publication 447498 should be applied to determine simultaneous transmission SAR test exclusion for WiFi MIMO. If the sum of 1g single transmission chain SAR measurements is < 1.6 W/kg and SAR peak to location ratio ≤ 0.04 , no additional SAR measurements for MIMO.
7. During SAR testing the WLAN transmission was verified using a spectrum analyzer.
8. WLAN Antenna 1 SAR testing is evaluated for colocation analysis.

**14.1 Body SAR****<WLAN SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	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)
01	WLAN 2.4GHz	802.11b 1Mbps	Bottom Face	0	Ant 1	6	2437	16.99	17.5	1.125	98.7	1.013	0.07	0.040	0.046
	WLAN 2.4GHz	802.11b 1Mbps	Edge 1	0	Ant 1	6	2437	16.99	17.5	1.125	98.7	1.013	0.06	0.346	0.394
	WLAN 2.4GHz	802.11b 1Mbps	Edge 2	0	Ant 1	6	2437	16.99	17.5	1.125	98.7	1.013	0.08	0.023	0.026
	WLAN 2.4GHz	802.11b 1Mbps	Edge 1	0	Ant 1	1	2412	16.42	17	1.144	98.7	1.013	0.03	0.319	0.370
	WLAN 2.4GHz	802.11b 1Mbps	Edge 1	0	Ant 1	11	2462	16.30	16.5	1.048	98.7	1.013	0.06	0.317	0.337
02	WLAN 2.4GHz	802.11b 1Mbps	Bottom Face	0	Ant 2	1	2412	14.01	14.5	1.120	98.64	1.014	0.06	0.063	0.072
	WLAN 2.4GHz	802.11b 1Mbps	Edge 1	0	Ant 2	1	2412	14.01	14.5	1.120	98.64	1.014	0.09	0.051	0.058
	WLAN 2.4GHz	802.11b 1Mbps	Edge 2	0	Ant 2	1	2412	14.01	14.5	1.120	98.64	1.014	0.01	0.935	1.061
	WLAN 2.4GHz	802.11b 1Mbps	Edge 2	0	Ant 2	6	2437	13.97	14.5	1.130	98.64	1.014	-0.08	0.950	1.088
	WLAN 2.4GHz	802.11b 1Mbps	Edge 2	0	Ant 2	11	2462	13.9	14.5	1.148	98.64	1.014	0.06	0.913	1.063



Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	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)
	WLAN 5.3GHz	802.11a 6Mbps	Bottom Face	0	Ant 1	60	5300	13.64	14	1.086	98.12	1.019	0.08	0.057	0.063
	WLAN 5.3GHz	802.11a 6Mbps	Edge 1	0	Ant 1	60	5300	13.64	14	1.086	98.12	1.019	0.04	0.955	1.057
	WLAN 5.3GHz	802.11a 6Mbps	Edge 2	0	Ant 1	60	5300	13.64	14	1.086	98.12	1.019	0.09	0.017	0.019
	WLAN 5.3GHz	802.11a 6Mbps	Edge 1	0	Ant 1	52	5260	13.16	13.5	1.081	98.12	1.019	0.02	0.897	0.988
03	WLAN 5.3GHz	802.11a 6Mbps	Edge 1	0	Ant 1	56	5280	13.61	14	1.094	98.12	1.019	0.08	1.000	1.115
	WLAN 5.3GHz	802.11a 6Mbps	Edge 1	0	Ant 1	64	5320	13.60	14	1.096	98.12	1.019	0.01	0.853	0.953
	WLAN 5.3GHz	802.11a 6Mbps	Bottom Face	0	Ant 2	52	5260	14.97	15.5	1.129	98.74	1.013	0.02	0.070	0.080
	WLAN 5.3GHz	802.11a 6Mbps	Edge 1	0	Ant 2	52	5260	14.97	15.5	1.129	98.74	1.013	-0.02	0.362	0.414
04	WLAN 5.3GHz	802.11a 6Mbps	Edge 2	0	Ant 2	52	5260	14.97	15.5	1.129	98.74	1.013	0.03	0.651	0.744
	WLAN 5.3GHz	802.11a 6Mbps	Edge 2	0	Ant 2	56	5280	14.32	15	1.169	98.74	1.013	0.08	0.560	0.663
	WLAN 5.3GHz	802.11a 6Mbps	Edge 2	0	Ant 2	60	5300	14.83	15	1.039	98.74	1.013	-0.06	0.568	0.598
	WLAN 5.3GHz	802.11a 6Mbps	Edge 2	0	Ant 2	64	5320	13.00	13.5	1.121	98.74	1.013	0.04	0.345	0.392
	WLAN 5.5GHz	802.11a 6Mbps	Bottom Face	0	Ant 1	116	5580	13.22	13.5	1.066	98.12	1.019	0.06	0.026	0.028
	WLAN 5.5GHz	802.11a 6Mbps	Edge 1	0	Ant 1	116	5580	13.22	13.5	1.066	98.12	1.019	0.08	0.870	0.945
	WLAN 5.5GHz	802.11a 6Mbps	Edge 2	0	Ant 1	116	5580	13.22	13.5	1.066	98.12	1.019	0.08	0.060	0.065
	WLAN 5.5GHz	802.11a 6Mbps	Edge 1	0	Ant 1	100	5500	12.70	13	1.071	98.12	1.019	0.09	0.632	0.690
	WLAN 5.5GHz	802.11a 6Mbps	Edge 1	0	Ant 1	132	5660	12.54	13	1.112	98.12	1.019	-0.07	0.965	1.093
	WLAN 5.5GHz	802.11a 6Mbps	Edge 1	0	Ant 1	140	5700	12.11	12.5	1.093	98.12	1.019	0.01	0.935	1.042
05	WLAN 5.5GHz	802.11a 6Mbps	Edge 1	0	Ant 1	144	5720	12.05	12.5	1.109	98.12	1.019	-0.04	1.010	1.142
	WLAN 5.5GHz	802.11a 6Mbps	Bottom Face	0	Ant 2	116	5580	13.93	14.5	1.139	98.74	1.013	-0.09	0.031	0.036
	WLAN 5.5GHz	802.11a 6Mbps	Edge 1	0	Ant 2	116	5580	13.93	14.5	1.139	98.74	1.013	0.01	0.371	0.428
	WLAN 5.5GHz	802.11a 6Mbps	Edge 2	0	Ant 2	116	5580	13.93	14.5	1.139	98.74	1.013	0.03	0.467	0.539
	WLAN 5.5GHz	802.11a 6Mbps	Edge 2	0	Ant 2	100	5500	13.64	14	1.085	98.74	1.013	0.02	0.290	0.319
06	WLAN 5.5GHz	802.11a 6Mbps	Edge 2	0	Ant 2	132	5660	13.40	14	1.148	98.74	1.013	0.07	0.489	0.569
	WLAN 5.5GHz	802.11a 6Mbps	Edge 2	0	Ant 2	140	5700	12.75	13	1.058	98.74	1.013	0.03	0.336	0.360
	WLAN 5.5GHz	802.11a 6Mbps	Edge 2	0	Ant 2	144	5720	12.98	13.5	1.127	98.74	1.013	0.06	0.422	0.482



Plot No.	Band	Mode	Test Position	Gap (mm)	Antenna	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)
07	WLAN 5.8GHz	802.11a 6Mbps	Bottom Face	0	Ant 1	149	5745	12.80	13	1.047	98.12	1.019	0.07	0.050	0.053
	WLAN 5.8GHz	802.11a 6Mbps	Edge 1	0	Ant 1	149	5745	12.80	13	1.047	98.12	1.019	-0.05	1.090	1.162
	WLAN 5.8GHz	802.11a 6Mbps	Edge 2	0	Ant 1	149	5745	12.80	13	1.047	98.12	1.019	0.07	0.061	0.065
	WLAN 5.8GHz	802.11a 6Mbps	Edge 1	0	Ant 1	157	5785	12.53	13	1.114	98.12	1.019	0.06	0.990	1.123
	WLAN 5.8GHz	802.11a 6Mbps	Edge 1	0	Ant 1	165	5825	12.68	13	1.076	98.12	1.019	0.01	0.921	1.010
08	WLAN 5.8GHz	802.11a 6Mbps	Bottom Face	0	Ant 2	149	5745	13.35	13.5	1.034	98.74	1.013	0.09	0.022	0.023
	WLAN 5.8GHz	802.11a 6Mbps	Edge 1	0	Ant 2	149	5745	13.35	13.5	1.034	98.74	1.013	0.06	0.529	0.554
	WLAN 5.8GHz	802.11a 6Mbps	Edge 2	0	Ant 2	149	5745	13.35	13.5	1.034	98.74	1.013	-0.08	0.383	0.401
	WLAN 5.8GHz	802.11a 6Mbps	Edge 1	0	Ant 2	157	5785	13.16	13.5	1.080	98.74	1.013	0.08	0.509	0.557
	WLAN 5.8GHz	802.11a 6Mbps	Edge 1	0	Ant 2	165	5825	12.90	13.5	1.147	98.74	1.013	-0.05	0.507	0.589

14.2 Repeated SAR Measurement

No.	Band	Mode	Test Position	Gap (mm)	Antenna	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	WLAN2.4GHz	802.11b 1Mbps	Edge 2	0	Ant 2	6	2437	13.97	14.5	1.130	98.64	1.014	-0.08	0.950	1	1.088
2nd	WLAN2.4GHz	802.11b 1Mbps	Edge 2	0	Ant 2	6	2437	13.97	14.5	1.130	98.64	1.014	-0.04	0.896	1.060	1.027
1st	WLAN5.3GHz	802.11a 6Mbps	Edge 1	0	Ant 1	56	5280	13.61	14	1.094	98.12	1.019	0.08	1.000	1	1.115
2nd	WLAN5.3GHz	802.11a 6Mbps	Edge 1	0	Ant 1	56	5280	13.61	14	1.094	98.12	1.019	0.04	0.976	1.025	1.088
1st	WLAN5.5GHz	802.11a 6Mbps	Edge 1	0	Ant 1	144	5720	12.05	12.5	1.109	98.12	1.019	-0.04	1.010	1	1.142
2nd	WLAN5.5GHz	802.11a 6Mbps	Edge 1	0	Ant 1	144	5720	12.05	12.5	1.109	98.12	1.019	0.06	0.997	1.013	1.127
1st	WLAN5.8GHz	802.11a 6Mbps	Edge 1	0	Ant 1	149	5745	12.80	13	1.047	98.12	1.019	-0.05	1.090	1	1.162
2nd	WLAN5.8GHz	802.11a 6Mbps	Edge 1	0	Ant 1	149	5745	12.80	13	1.047	98.12	1.019	-0.05	1.040	1.048	1.109

General Note:

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is $\geq 0.8\text{W/kg}$.
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is ≤ 1.2 and the measured SAR $< 1.45\text{W/kg}$, 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.

15. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	Supported
1.	WLAN 2.4GHz Antenna 1 + WLAN 2.4GHz Antenna 2	Yes
2.	WLAN 5GHz Antenna 1 + WLAN 5GHz Antenna 2	Yes
3.	WLAN 2.4GHz Antenna 1 + Bluetooth Antenna 2	Yes
4.	WLAN 5GHz Antenna 1 + Bluetooth Antenna 2	Yes

General Note:

- Bluetooth antenna 2 and WLAN antenna 2 share the same antenna, and cannot transmit simultaneously.
- The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation.
- 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.
- For SAR testing was performed on single antenna RF power in SISO mode is larger or equal to the single antenna RF power in MIMO mode, and for RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode.
- WLAN RF exposure assessment of MIMO mode simultaneous transmission exclusion analysis was performed with SAR test results of each antenna in SISO mode. Therefore SPLSR calculation was choose worst case with SAR test results of each antenna in SISO mode perform evaluation.
- The reported SAR summation is calculated based on the same configuration and test position.
- Per KDB 447498 D01v06, simultaneous transmission SAR is compliant if,
 - Scalar SAR summation $< 1.6\text{W/kg}$.
 - $\text{SPLSR} = (\text{SAR}_1 + \text{SAR}_2)^{1.5} / (\text{min. separation distance, mm})$, and the peak separation distance is determined from the square root of $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$, where (x_1, y_1, z_1) and (x_2, y_2, z_2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
 - If $\text{SPLSR} \leq 0.04$, simultaneously transmission SAR measurement is not necessary.
 - Simultaneously transmission SAR measurement, and the reported multi-band SAR $< 1.6\text{W/kg}$.
- For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v06 based on the formula below.
 - $(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})} / x] \text{ W/kg}$ for test separation distances $\leq 50 \text{ mm}$; where $x = 7.5$ for 1-g SAR, and $x = 18.75$ for 10-g SAR.
 - When the minimum separation distance is $< 5\text{mm}$, the distance is used 5mm to determine SAR test exclusion.
 - 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is $> 50 \text{ mm}$.
 Bluetooth estimated SAR is conservatively determined by 5mm separation, for all applicable exposure positions.

Bluetooth Max Power	Exposure Position	All Positions
4.5 dBm	Estimated SAR (W/kg)	0.126 W/kg

15.1 Body Exposure Conditions
<WLAN 2.4GHz Antenna 1 + WLAN 2.4GHz Antenna 2>

Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)	SPLSR	Case No
	2.4GHz WLAN Ant 1	2.4GHz WLAN Ant 2			
	1g SAR (W/kg)	1g SAR (W/kg)			
Bottom Face	0.046	0.072	0.12		
Edge 1	0.394	0.058	0.45		
Edge 2	0.026	1.088	1.11		

<WLAN 5GHz Antenna 1 + WLAN 5GHz Antenna 2>

Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)	SPLSR	Case No
	5GHz WLAN Ant 1	5GHz WLAN Ant 2			
	1g SAR (W/kg)	1g SAR (W/kg)			
Bottom Face	0.063	0.080	0.14		
Edge 1	1.162	0.589	1.75	0.04	#1
Edge 2	0.065	0.744	0.81		

<WLAN 2.4GHz Antenna 1 + Bluetooth Antenna 2>

Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)	SPLSR	Case No
	2.4GHz WLAN Ant 1	Bluetooth Ant 2			
	1g SAR (W/kg)	Estimated 1g SAR (W/kg)			
Bottom Face	0.046	0.126	0.17		
Edge 1	0.394	0.126	0.52		
Edge 2	0.026	0.126	0.15		

<WLAN 5GHz Antenna 1 + Bluetooth Antenna 2>

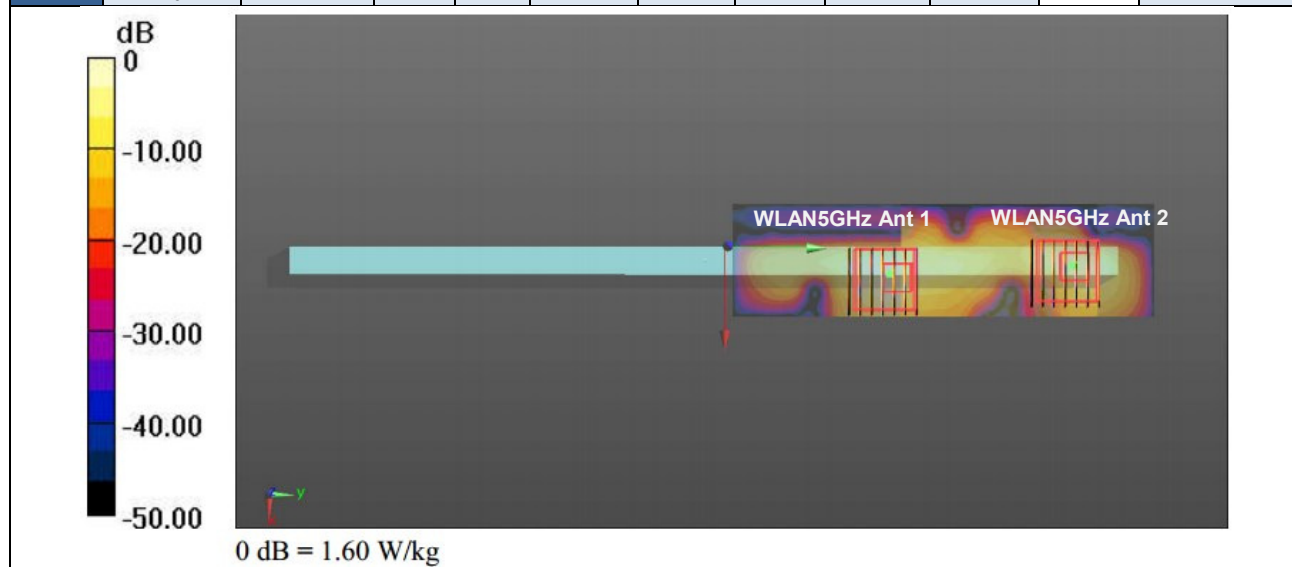
Exposure Position	1	2	1+2 Summed 1g SAR (W/kg)	SPLSR	Case No
	5GHz WLAN Ant 1	Bluetooth Ant 2			
	1g SAR (W/kg)	Estimated 1g SAR (W/kg)			
Bottom Face	0.063	0.126	0.19		
Edge 1	1.162	0.126	1.29		
Edge 2	0.065	0.126	0.19		

15.2 SPLSR Evaluation and Analysis

General Note:

$SPLSR = (SAR_1 + SAR_2)^{1.5} / (\text{min. separation distance, mm})$. If $SPLSR \leq 0.04$, simultaneously transmission SAR measurement is not necessary.

Case #1	Band	Position	SAR (W/kg)	Gap (cm)	SAR peak location (m)			3D distance (mm)	Summed SAR (W/kg)	SPLSR Results	Simultaneous SAR
					X	Y	Z				
	WLAN5GHz Ant 1	Edge 1	1.162	0	0.004	0.067	-0.183	65.1	1.75	0.04	Not required
	WLAN5GHz Ant 2		0.589	0	0.001	0.132	-0.183				



Test Engineer : Luke Lu

16. Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor ^(a)	1/ κ ^(b)	1/ $\sqrt{3}$	1/ $\sqrt{6}$	1/ $\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 16.1. Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.0	N	1	1	1	6.0	6.0
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	1.0	R	1.732	1	1	0.6	0.6
Linearity	4.7	R	1.732	1	1	2.7	2.7
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	2.9	R	1.732	1	1	1.7	1.7
Max. SAR Eval.	2.0	R	1.732	1	1	1.2	1.2
Test Sample Related							
Device Positioning	3.0	N	1	1	1	3.0	3.0
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.1	R	1.732	1	1	3.5	3.5
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						11.4%	11.4%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						22.9%	22.7%

Table 16.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz

Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
Measurement System							
Probe Calibration	6.55	N	1	1	1	6.6	6.6
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	2.0	R	1.732	1	1	1.2	1.2
Linearity	4.7	R	1.732	1	1	2.7	2.7
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	6.7	R	1.732	1	1	3.9	3.9
Max. SAR Eval.	4.0	R	1.732	1	1	2.3	2.3
Test Sample Related							
Device Positioning	3.0	N	1	1	1	3.0	3.0
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
Phantom and Setup							
Phantom Uncertainty	6.6	R	1.732	1	1	3.8	3.8
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
Combined Std. Uncertainty						12.5%	12.5%
Coverage Factor for 95 %						K=2	K=2
Expanded STD Uncertainty						25.1%	25.0%

Table 16.3. Uncertainty Budget for frequency range 3 GHz to 6 GHz

17. References

- [1] FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
- [2] ANSI/IEEE Std. C95.1-1992, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", September 1992
- [3] IEEE Std. 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", Sep 2013
- [4] SPEAG DASY System Handbook
- [5] FCC KDB 248227 D01 v02r02, "SAR Guidance for IEEE 802.11 (WiFi) Transmitters", Oct 2015.
- [6] FCC KDB 447498 D01 v06, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Oct 2015
- [7] FCC KDB 616217 D04 v01r02, "SAR Evaluation Considerations for Laptop, Notebook, Netbook and Tablet Computers", Oct 2015
- [8] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.
- [9] FCC KDB 865664 D02 v01r02, "RF Exposure Compliance Reporting and Documentation Considerations" Oct 2015.



Appendix A. Plots of System Performance Check

The plots are shown as follows.

System Check_Body_2450MHz_170401**DUT: D2450V2-SN:840**

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

Medium: MSL_2450_170401 Medium parameters used: $f = 2450$ MHz; $\sigma = 1.991$ S/m; $\epsilon_r = 52.32$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.66, 7.66, 7.66); Calibrated: 2016.09.29;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=250mW/Area Scan (81x81x1): Interpolated grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 20.0 W/kg

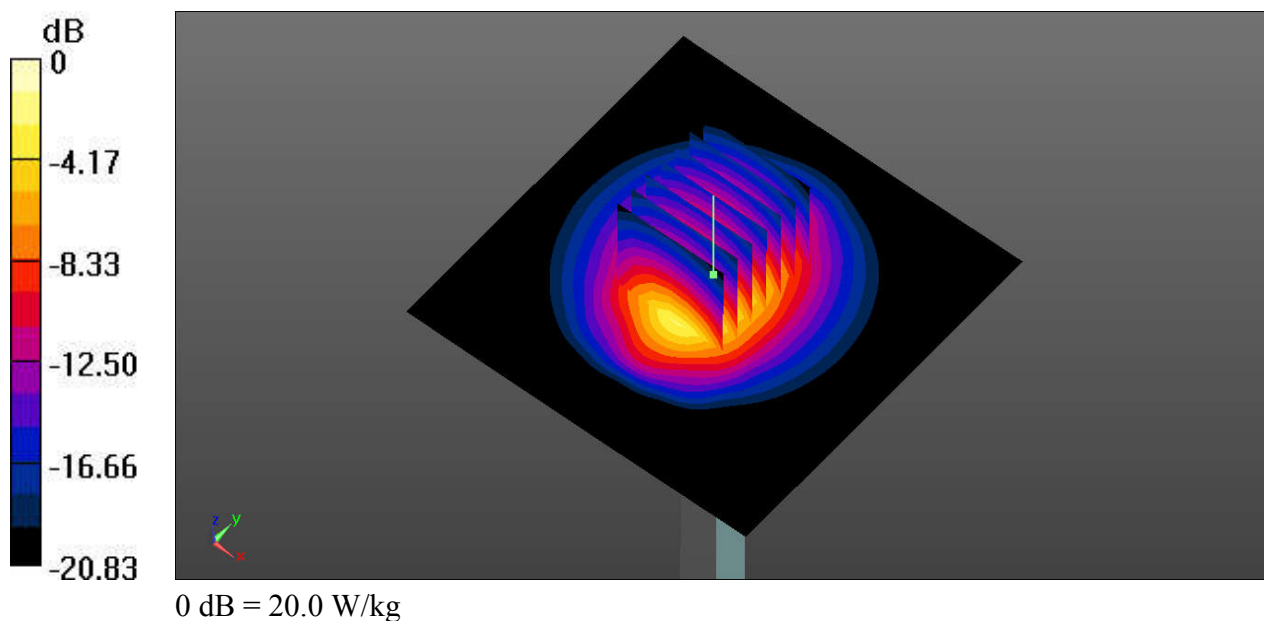
Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 85.50 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 26.7 W/kg

SAR(1 g) = 13.4 W/kg; SAR(10 g) = 6.32 W/kg

Maximum value of SAR (measured) = 20.2 W/kg



System Check_Body_5250MHz_170402**DUT: D5GHzV2-SN:1167**

Communication System: UID 0, CW (0); Frequency: 5250 MHz; Duty Cycle: 1:1

Medium: MSL_5250_170402 Medium parameters used: $f = 5250$ MHz; $\sigma = 5.24$ S/m; $\epsilon_r = 51.015$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(4.62, 4.62, 4.62); Calibrated: 2016.09.29;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 18.4 W/kg

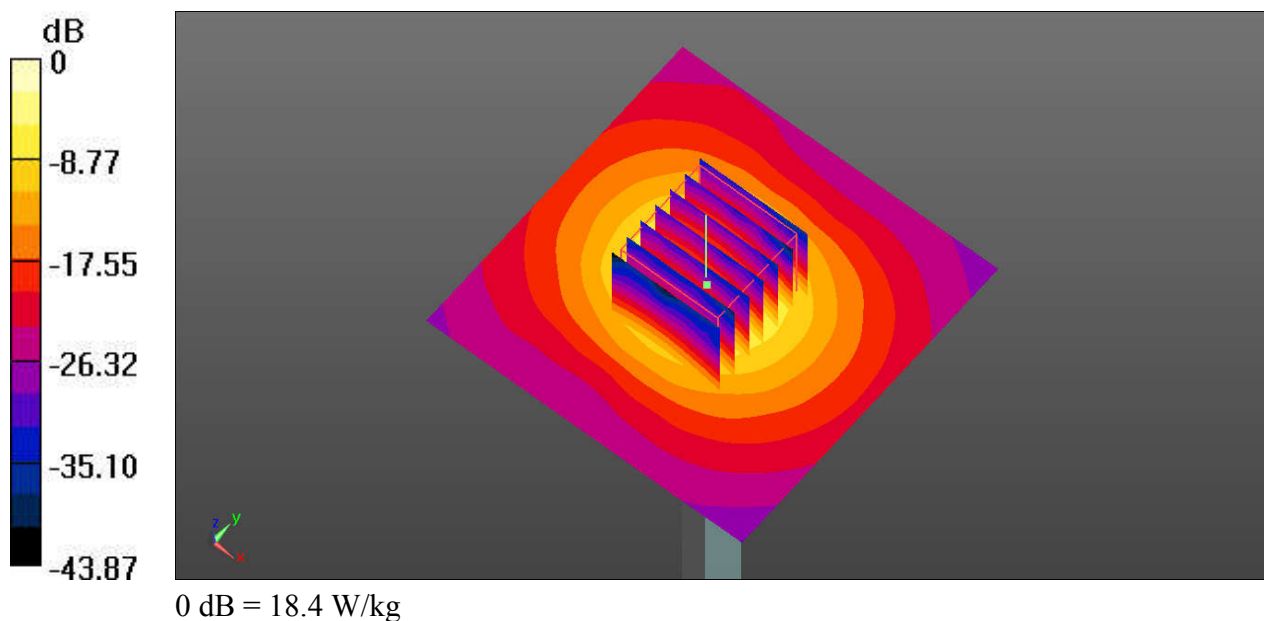
Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 47.92 V/m; Power Drift = 0.12 dB

Peak SAR (extrapolated) = 31.8 W/kg

SAR(1 g) = 7.75 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 19.3 W/kg



System Check_Body_5600MHz_170402**DUT: D5GHzV2-SN:1167**

Communication System: UID 0, CW (0); Frequency: 5600 MHz; Duty Cycle: 1:1

Medium: MSL_5600_170402 Medium parameters used: $f = 5600$ MHz; $\sigma = 5.825$ S/m; $\epsilon_r = 50.395$;
 $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(3.78, 3.78, 3.78); Calibrated: 2016.09.29;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 21.1 W/kg

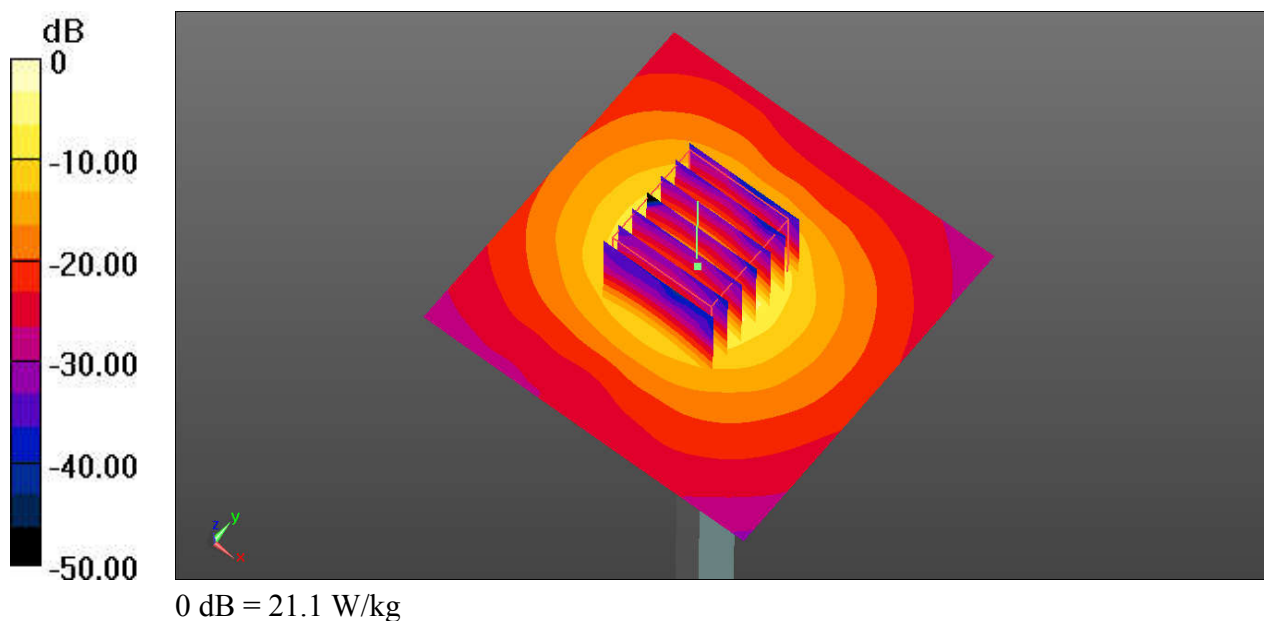
Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 44.82 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 35.0 W/kg

SAR(1 g) = 8.25 W/kg; SAR(10 g) = 2.27 W/kg

Maximum value of SAR (measured) = 20.0 W/kg



System Check_Body_5750MHz_170402**DUT: D5GHzV2-SN:1167**

Communication System: UID 0, CW (0); Frequency: 5750 MHz; Duty Cycle: 1:1

Medium: MSL_5750_170402 Medium parameters used: $f = 5750$ MHz; $\sigma = 6.051$ S/m; $\epsilon_r = 50.049$;
 $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.9 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(3.95, 3.95, 3.95); Calibrated: 2016.09.29;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Pin=100mW/Area Scan (71x71x1): Interpolated grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 18.9 W/kg

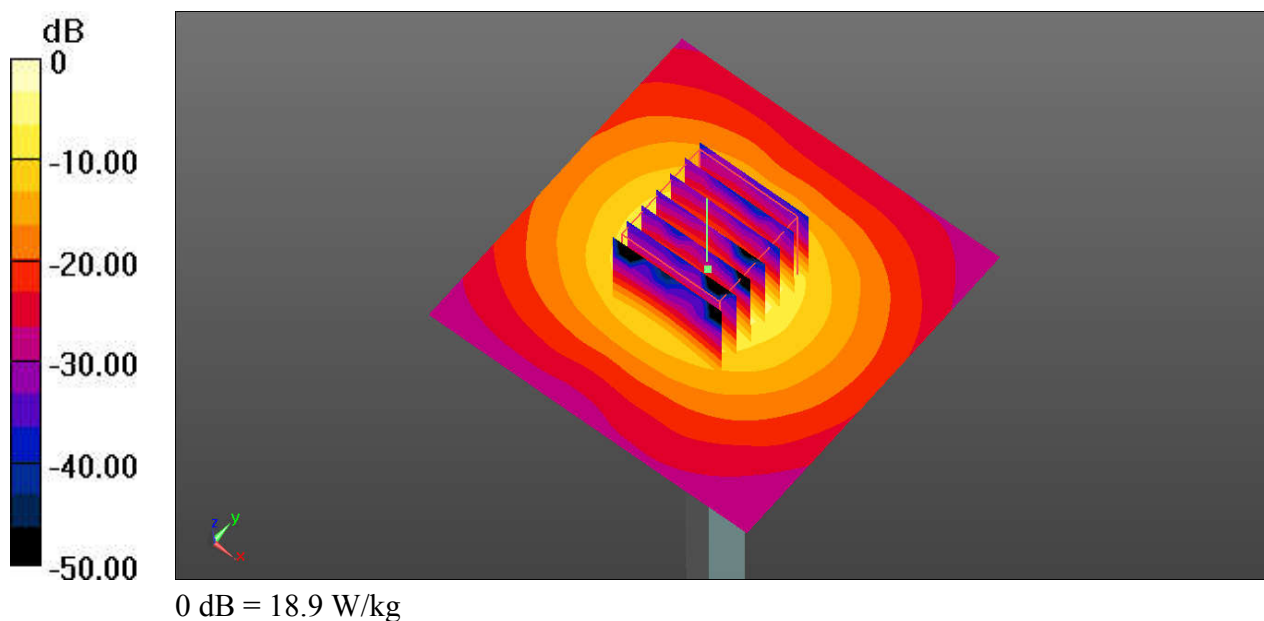
Pin=100mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 44.41 V/m; Power Drift = 0.09 dB

Peak SAR (extrapolated) = 32.4 W/kg

SAR(1 g) = 7.69 W/kg; SAR(10 g) = 2.12 W/kg

Maximum value of SAR (measured) = 19.0 W/kg





Appendix B. Plots of High SAR Measurement

The plots are shown as follows.

01_WLAN2.4GHz_802.11b 1Mbps_Edge 1_0mm_Ch6_Ant 1

Communication System: UID 0, WIFI (0); Frequency: 2437 MHz; Duty Cycle: 1:1.013
Medium: MSL_2450_170401 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.973$ S/m; $\epsilon_r = 52.403$;
 $\rho = 1000$ kg/m³
Ambient Temperature : 23.4 °C; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.66, 7.66, 7.66); Calibrated: 2016.09.29;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch6/Area Scan (41x121x1): Interpolated grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 0.601 W/kg

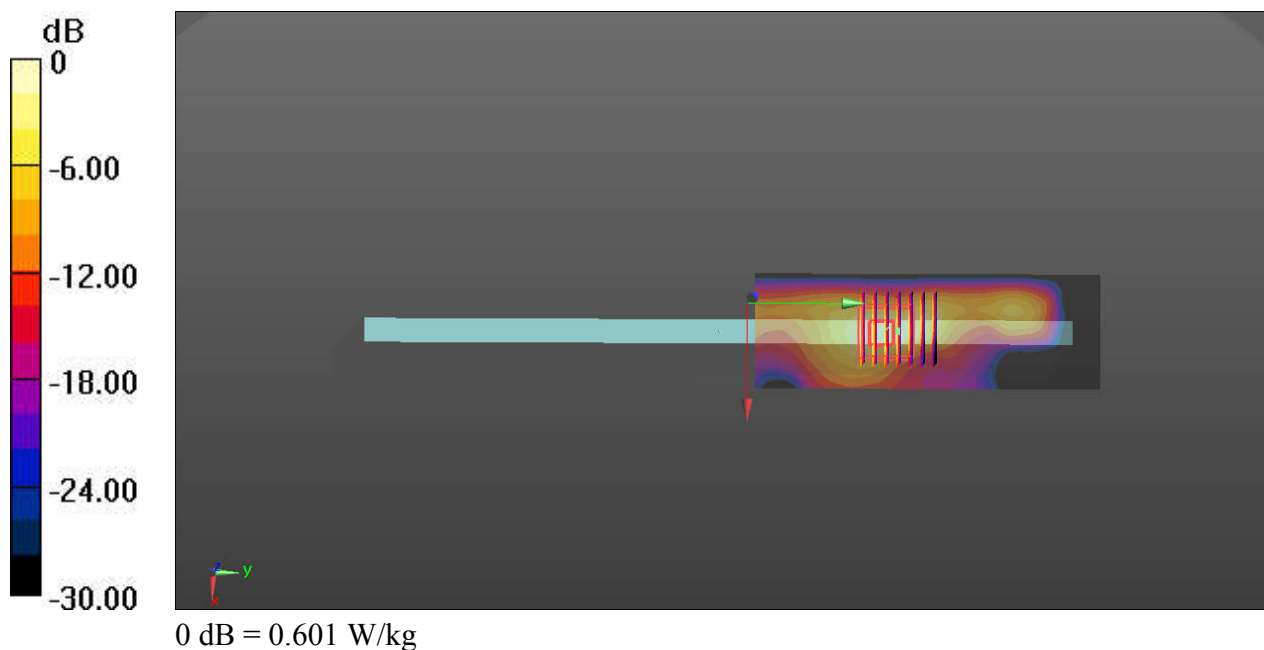
Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 0 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 1.01 W/kg

SAR(1 g) = 0.346 W/kg; SAR(10 g) = 0.132 W/kg

Maximum value of SAR (measured) = 0.646 W/kg



02_WLAN2.4GHz_802.11b 1Mbps_Edge 2_0mm_Ch6_Ant 2

Communication System: UID 0, WIFI (0); Frequency: 2437 MHz; Duty Cycle: 1:1.014
Medium: MSL_2450_170401 Medium parameters used: $f = 2437$ MHz; $\sigma = 1.973$ S/m; $\epsilon_r = 52.403$;
 $\rho = 1000$ kg/m³
Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.5 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(7.66, 7.66, 7.66); Calibrated: 2016.09.29;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch6/Area Scan (41x101x1): Interpolated grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 1.89 W/kg

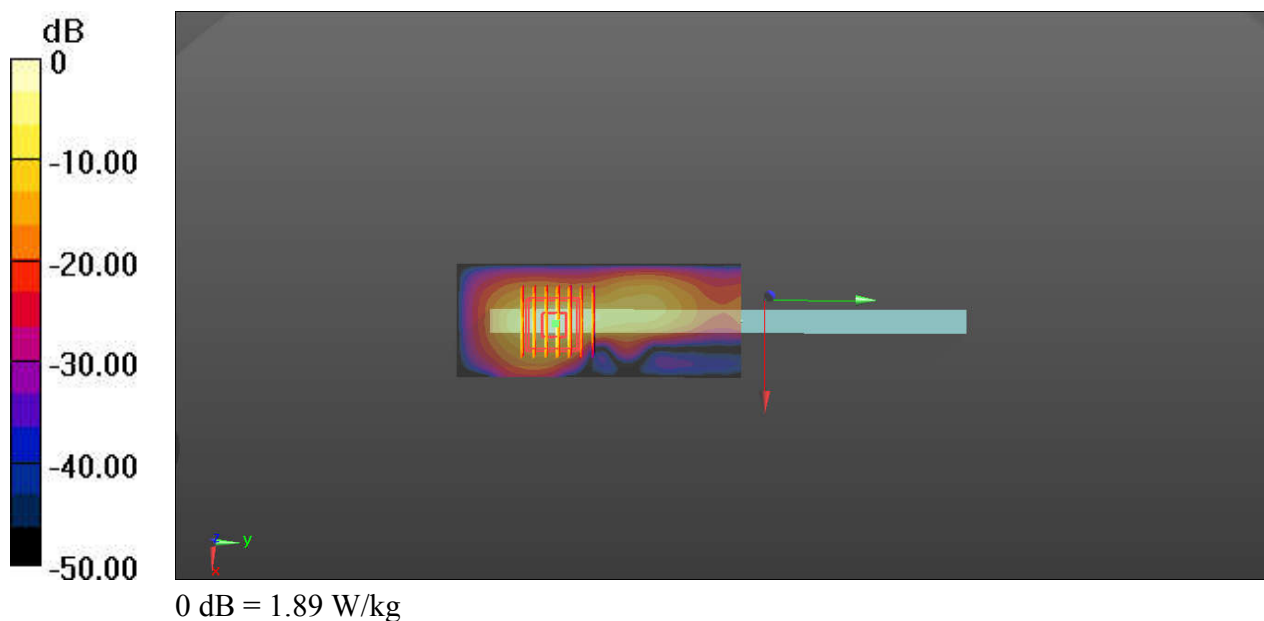
Ch6/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 0.4280 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 2.91 W/kg

SAR(1 g) = 0.950 W/kg; SAR(10 g) = 0.317 W/kg

Maximum value of SAR (measured) = 1.90 W/kg



03_WLAN5.3GHz_802.11a 6Mbps_Edge 1_0mm_Ch56_Ant 1

Communication System: UID 0, WIFI (0); Frequency: 5280 MHz; Duty Cycle: 1:1.019
Medium: MSL_5250_170402 Medium parameters used: $f = 5280$ MHz; $\sigma = 5.289$ S/m; $\epsilon_r = 50.988$;
 $\rho = 1000$ kg/m³
Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(4.62, 4.62, 4.62); Calibrated: 2016.09.29;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch56/Area Scan (41x151x1): Interpolated grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 2.82 W/kg

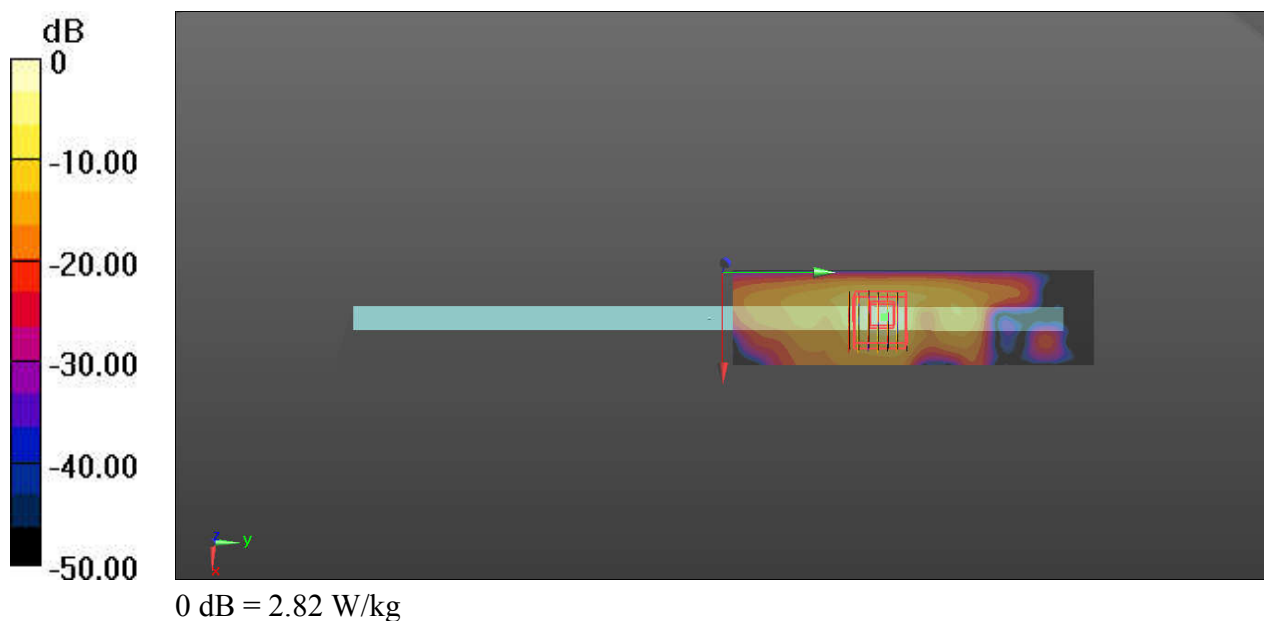
Ch56/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = 0.08 dB

Peak SAR (extrapolated) = 5.35 W/kg

SAR(1 g) = 1 W/kg; SAR(10 g) = 0.236 W/kg

Maximum value of SAR (measured) = 2.92 W/kg



04_WLAN5.3GHz_802.11a 6Mbps_Edge 2_0mm_Ch52_Ant 2

Communication System: UID 0, WIFI (0); Frequency: 5260 MHz; Duty Cycle: 1:1.013

Medium: MSL_5250_170402 Medium parameters used: $f = 5260$ MHz; $\sigma = 5.257$ S/m; $\epsilon_r = 51.01$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.6 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(4.62, 4.62, 4.62); Calibrated: 2016.09.29;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch52/Area Scan (41x111x1): Interpolated grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 1.59 W/kg

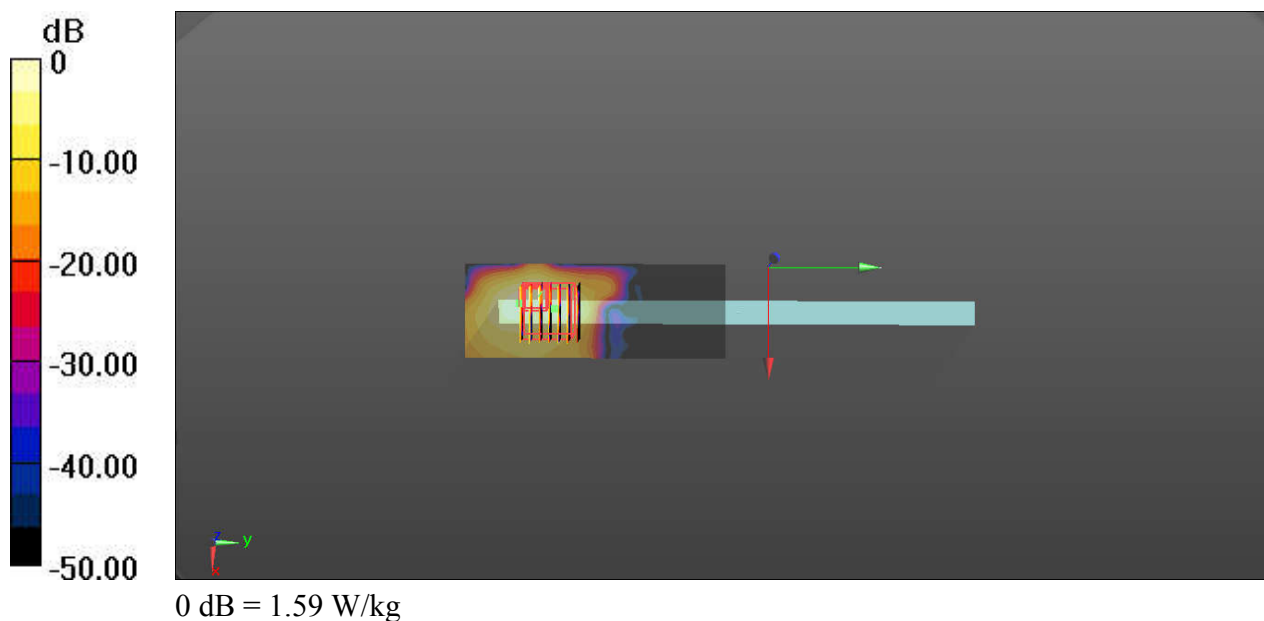
Ch52/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 3.36 W/kg

SAR(1 g) = 0.651 W/kg; SAR(10 g) = 0.177 W/kg

Maximum value of SAR (measured) = 1.90 W/kg



05_WLAN5.5GHz_802.11a 6Mbps_Edge 1_0mm_Ch144_Ant 1

Communication System: UID 0, WIFI (0); Frequency: 5720 MHz; Duty Cycle: 1:1.019

Medium: MSL_5600_170402 Medium parameters used: $f = 5720$ MHz; $\sigma = 6.01$ S/m; $\epsilon_r = 50.124$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(3.78, 3.78, 3.78); Calibrated: 2016.09.29;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch144/Area Scan (41x131x1): Interpolated grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 2.49 W/kg

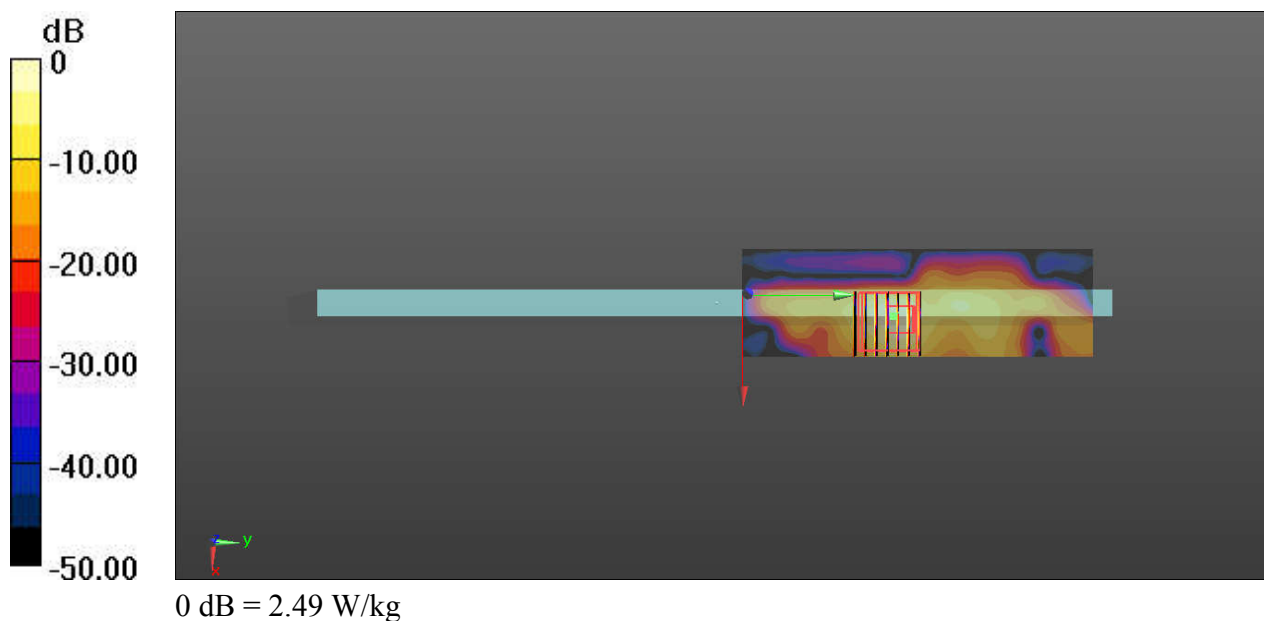
Ch144/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 5.91 W/kg

SAR(1 g) = 1.01 W/kg; SAR(10 g) = 0.225 W/kg

Maximum value of SAR (measured) = 2.97 W/kg



06_WLAN5.5GHz_802.11a 6Mbps_Edge 2_0mm_Ch132_Ant 2

Communication System: UID 0, WIFI (0); Frequency: 5660 MHz; Duty Cycle: 1:1.013

Medium: MSL_5600_170402 Medium parameters used: $f = 5660$ MHz; $\sigma = 5.91$ S/m; $\epsilon_r = 50.244$; $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.7 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(3.78, 3.78, 3.78); Calibrated: 2016.09.29;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch132/Area Scan (41x111x1): Interpolated grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 1.54 W/kg

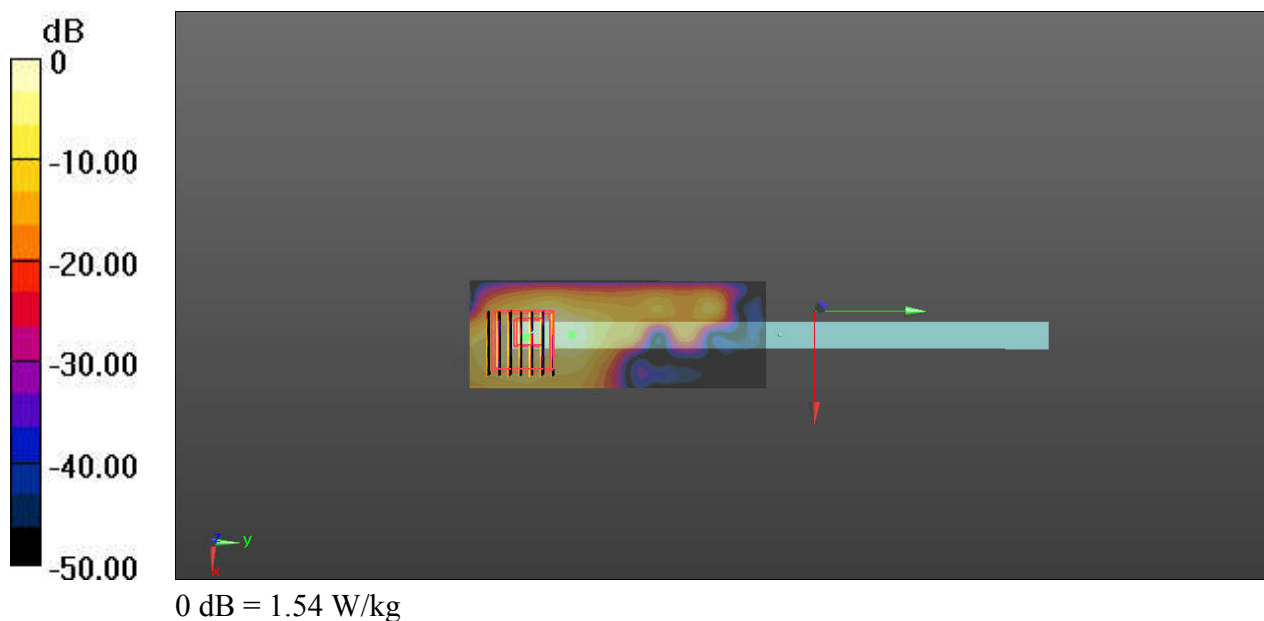
Ch132/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 2.53 W/kg

SAR(1 g) = 0.489 W/kg; SAR(10 g) = 0.126 W/kg

Maximum value of SAR (measured) = 1.40 W/kg



07_WLAN5.8GHz_802.11a 6Mbps_Edge 1_0mm_Ch149_Ant 1

Communication System: UID 0, WIFI (0); Frequency: 5745 MHz; Duty Cycle: 1:1.019

Medium: MSL_5750_170402 Medium parameters used: $f = 5745$ MHz; $\sigma = 6.044$ S/m; $\epsilon_r = 50.062$;

$\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.9 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(3.95, 3.95, 3.95); Calibrated: 2016.09.29;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch149/Area Scan (41x131x1): Interpolated grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 2.48 W/kg

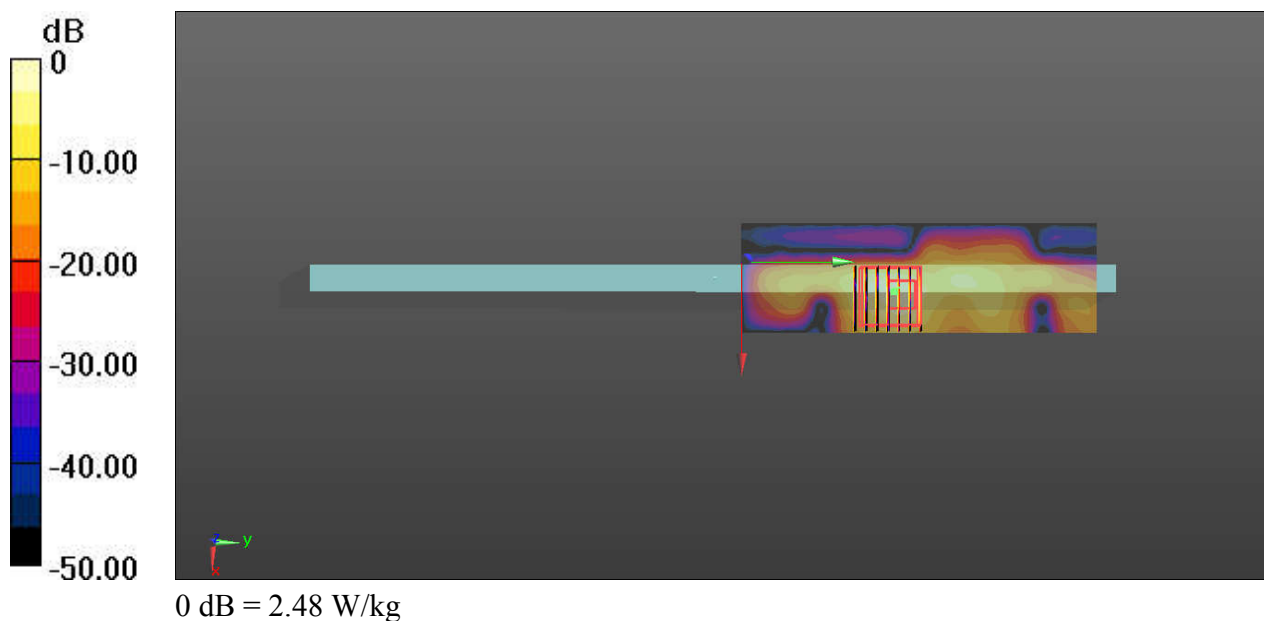
Ch149/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 5.44 W/kg

SAR(1 g) = 1.09 W/kg; SAR(10 g) = 0.238 W/kg

Maximum value of SAR (measured) = 3.01 W/kg



08_WLAN5.8GHz_802.11a 6Mbps_Edge 1_0mm_Ch165_Ant 2

Communication System: UID 0, WIFI (0); Frequency: 5825 MHz; Duty Cycle: 1:1.013

Medium: MSL_5750_170402 Medium parameters used: $f = 5825$ MHz; $\sigma = 6.166$ S/m; $\epsilon_r = 49.863$;
 $\rho = 1000$ kg/m³

Ambient Temperature : 23.4 °C ; Liquid Temperature : 22.9 °C

DASY5 Configuration:

- Probe: EX3DV4 - SN3911; ConvF(3.95, 3.95, 3.95); Calibrated: 2016.09.29;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1338; Calibrated: 2016.11.22
- Phantom: ELI v5.0(Right); Type: QDOVA001BB; Serial: TP:1225
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Ch165/Area Scan (41x91x1): Interpolated grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 1.60 W/kg

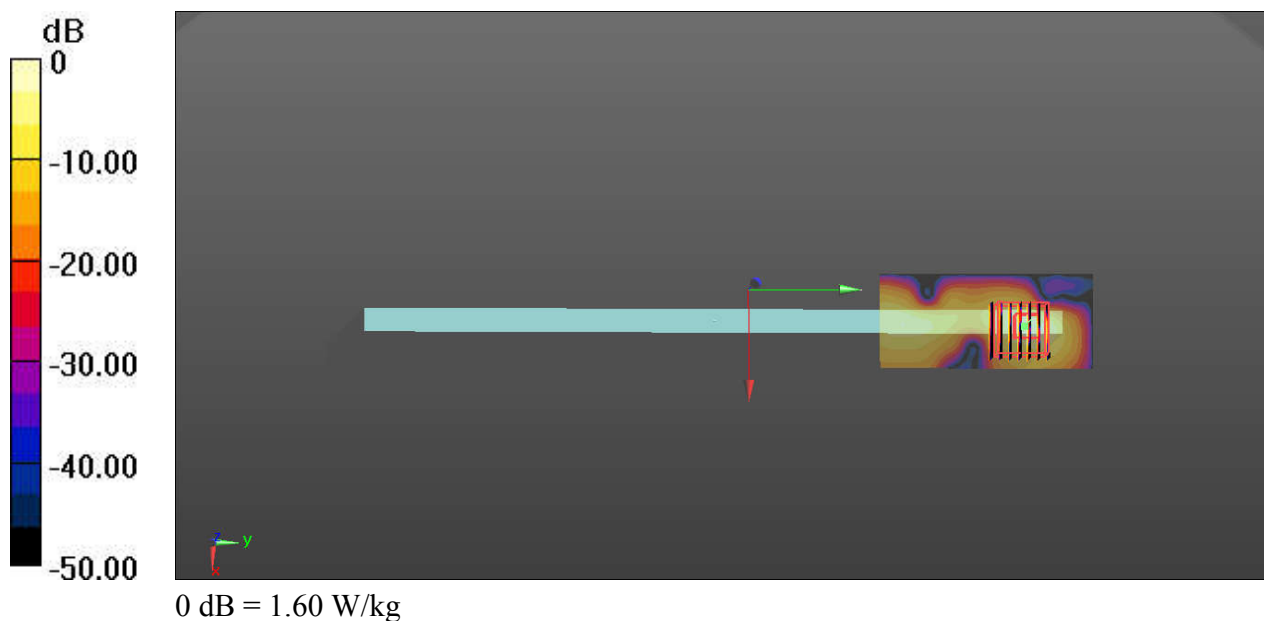
Ch165/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm

Reference Value = 0.1710 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 3.71 W/kg

SAR(1 g) = 0.507 W/kg; SAR(10 g) = 0.123 W/kg

Maximum value of SAR (measured) = 1.47 W/kg





Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.



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中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
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E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

Client

Sporton-CN

Certificate No: **Z16-97231**

CALIBRATION CERTIFICATE

Object **D2450V2 - SN: 840**

Calibration Procedure(s) **FD-Z11-003-01**
Calibration Procedures for dipole validation kits

Calibration date: **November 25, 2016**

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 NRP2	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG,No.Z16-97011)	Feb-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	
Reviewed by:	Qi Dianyuan	SAR Project Leader	
Approved by:	Lu Bingsong	Deputy Director of the laboratory	

Issued: November 27, 2016

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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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, "Procedure to measure the Specific Absorption Rate (SAR) For hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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

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Measurement Conditions

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

DASY Version	DASY52	52.8.8.1258
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 $\pm$ 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 $\pm$ 0.2) °C	38.9 $\pm$ 6 %	1.79 mho/m $\pm$ 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	13.5 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	54.0 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.33 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	25.3 mW / g $\pm$ 20.4 % (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 $\pm$ 0.2) °C	52.3 $\pm$ 6 %	1.97 mho/m $\pm$ 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	12.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	50.9 mW / g $\pm$ 20.8 % (k=2)
SAR averaged over 10 cm ³ (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	6.02 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	24.0 mW / g $\pm$ 20.4 % (k=2)



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Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$51.7\Omega + 5.54j\Omega$
Return Loss	- 24.9dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$49.8\Omega + 6.00j\Omega$
Return Loss	- 24.4dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.045 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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DASY5 Validation Report for Head TSL

Date: 11.25.2016

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; $\sigma = 1.793$ S/m; $\epsilon_r = 38.86$; $\rho = 1000$ kg/m³

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.45, 7.45, 7.45); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

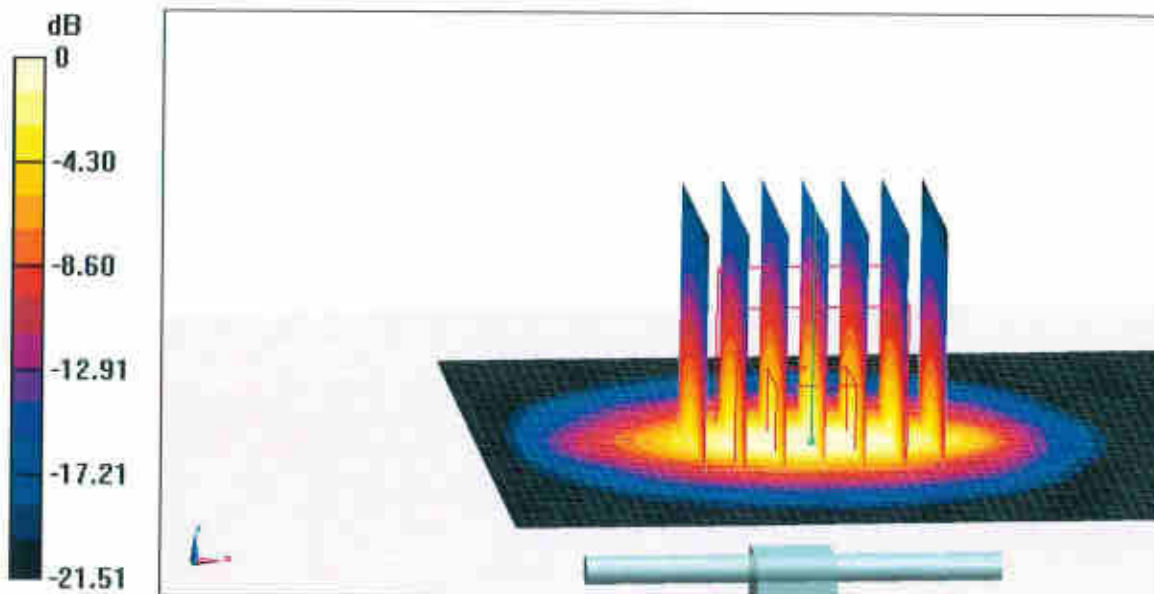
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 107.5 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 27.5 W/kg

SAR(1 g) = 13.5 W/kg; SAR(10 g) = 6.33 W/kg

Maximum value of SAR (measured) = 20.5 W/kg



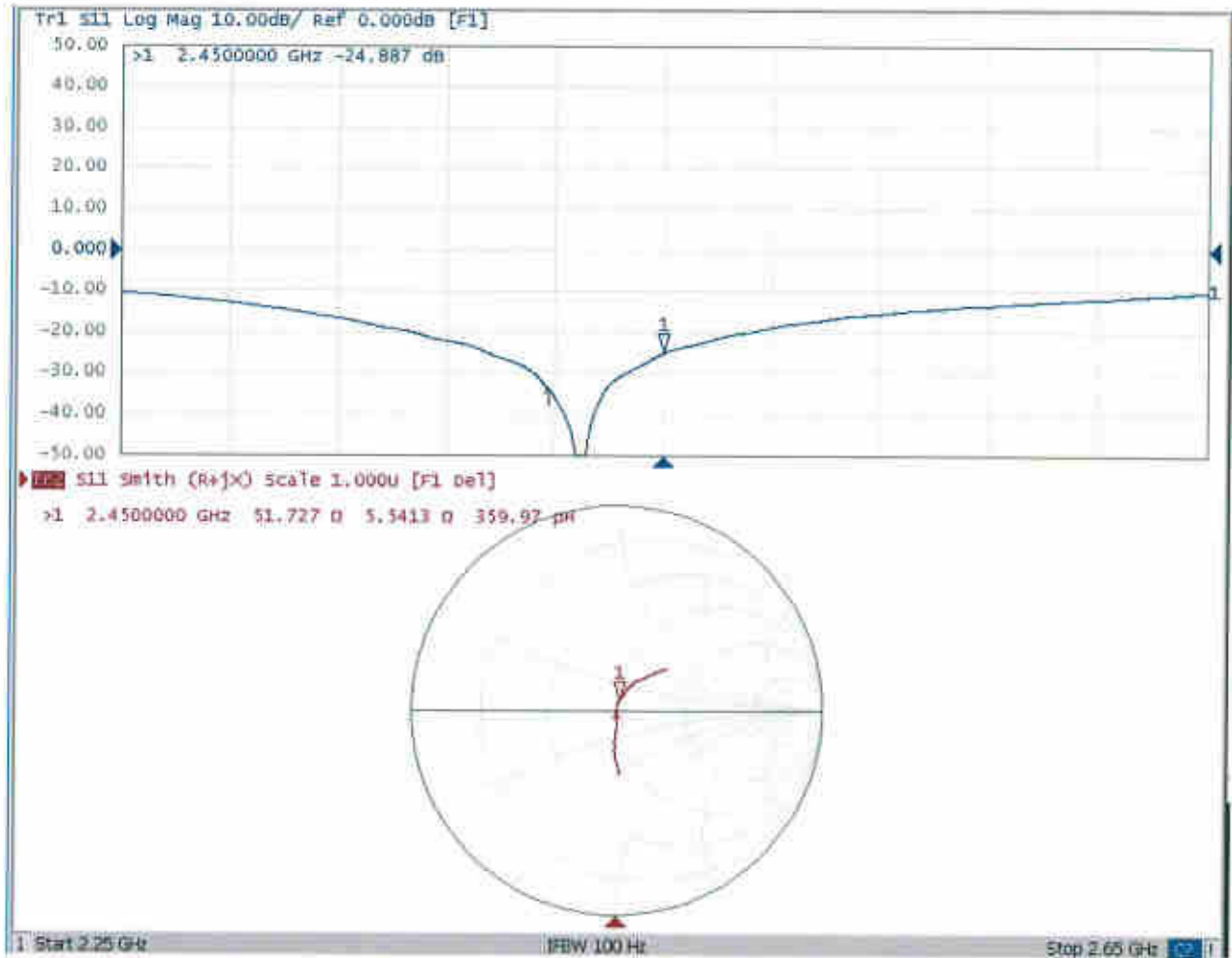
0 dB = 20.5 W/kg = 13.12 dBW/kg



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Impedance Measurement Plot for Head TSL





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DASY5 Validation Report for Body TSL

Date: 11.24.2016

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; $\sigma = 1.966$ S/m; $\epsilon_r = 52.29$; $\rho = 1000$ kg/m³

Phantom section: Left Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.46, 7.46, 7.46); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

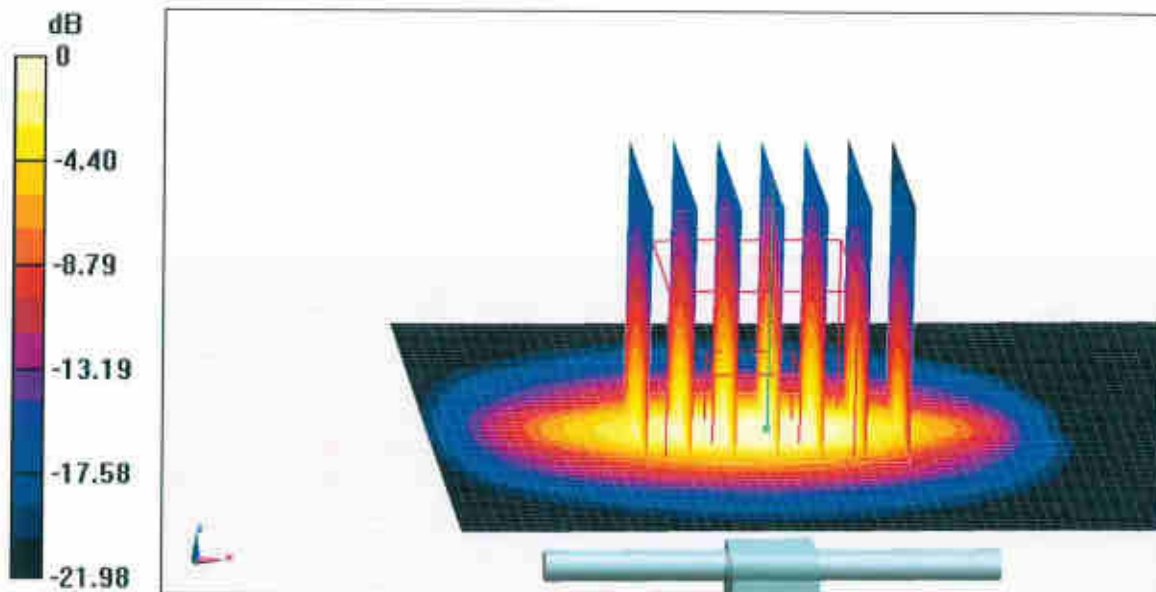
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 99.46 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 25.9 W/kg

SAR(1 g) = 12.8 W/kg; SAR(10 g) = 6.02 W/kg

Maximum value of SAR (measured) = 19.2 W/kg



0 dB = 19.2 W/kg = 12.83 dBW/kg



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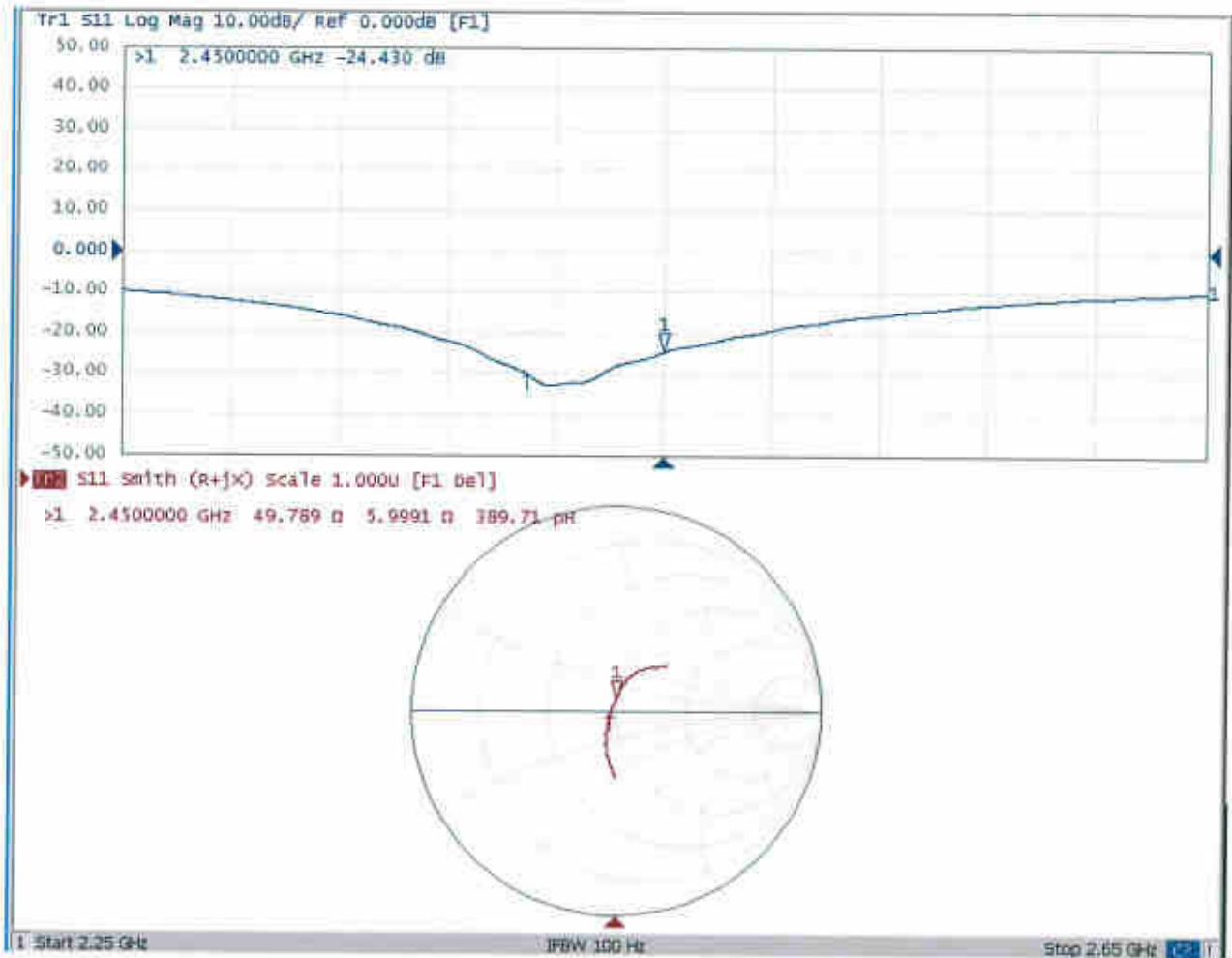
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Impedance Measurement Plot for Body TSL





Accredited by the Swiss Accreditation Service (SAS)
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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Sporton-SZ (Auden)**

Certificate No: **D5GHzV2-1167_Jul16**

CALIBRATION CERTIFICATE

Object **D5GHzV2 - SN:1167**

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

Calibration date: **July 27, 2016**

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	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: 5058 (20k)	05-Apr-16 (No. 217-02292)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 3503	30-Jun-16 (No. EX3-3503_Jun16)	Jun-17
DAE4	SN: 601	30-Dec-15 (No. DAE4-601_Dec15)	Dec-16

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

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: July 27, 2016

This calibration certificate shall not be reproduced except in full without written approval of the laboratory.



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 0108

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:

- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- 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	V52.8.8
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 $\pm$ 1 MHz 5600 MHz $\pm$ 1 MHz 5750 MHz $\pm$ 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 $\pm$ 0.2) °C	34.4 $\pm$ 6 %	4.52 mho/m $\pm$ 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	7.79 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	77.1 W/kg $\pm$ 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	22.1 W/kg $\pm$ 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	33.9 ± 6 %	4.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5600 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	8.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	81.0 W / kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.34 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	23.1 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	33.7 ± 6 %	5.02 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL at 5750 MHz

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	100 mW input power	7.93 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	78.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	100 mW input power	2.25 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	22.2 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	47.1 ± 6 %	5.42 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	7.64 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.8 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 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	46.5 ± 6 %	5.88 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	7.90 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	78.4 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.21 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.9 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	46.2 ± 6 %	6.11 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	7.65 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	75.9 W/kg ± 19.9 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	100 mW input power	2.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.1 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	46.9 Ω - 13.4 j Ω
Return Loss	- 17.0 dB

Antenna Parameters with Head TSL at 5600 MHz

Impedance, transformed to feed point	53.9 Ω - 9.8 j Ω
Return Loss	- 19.9 dB

Antenna Parameters with Head TSL at 5750 MHz

Impedance, transformed to feed point	53.9 Ω - 11.8 j Ω
Return Loss	- 18.5 dB

Antenna Parameters with Body TSL at 5250 MHz

Impedance, transformed to feed point	45.5 Ω - 11.0 j Ω
Return Loss	- 18.2 dB

Antenna Parameters with Body TSL at 5600 MHz

Impedance, transformed to feed point	53.9 Ω - 8.9 j Ω
Return Loss	- 20.6 dB

Antenna Parameters with Body TSL at 5750 MHz

Impedance, transformed to feed point	52.7 Ω - 11.8 j Ω
Return Loss	- 18.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 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	October 30, 2013

DASY5 Validation Report for Head TSL

Date: 27.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1167

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used: $f = 5250 \text{ MHz}$; $\sigma = 4.52 \text{ S/m}$; $\epsilon_r = 34.4$; $\rho = 1000 \text{ kg/m}^3$

Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 4.86 \text{ S/m}$; $\epsilon_r = 33.9$; $\rho = 1000 \text{ kg/m}^3$

Medium parameters used: $f = 5750 \text{ MHz}$; $\sigma = 5.02 \text{ S/m}$; $\epsilon_r = 33.7$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(5.42, 5.42, 5.42); Calibrated: 30.06.2016, ConvF(4.89, 4.89, 4.89); Calibrated: 30.06.2016, ConvF(4.85, 4.85, 4.85); Calibrated: 30.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5250 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 73.17 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 28.5 W/kg

SAR(1 g) = 7.79 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: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 73.11 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 32.1 W/kg

SAR(1 g) = 8.19 W/kg; SAR(10 g) = 2.34 W/kg

Maximum value of SAR (measured) = 19.5 W/kg

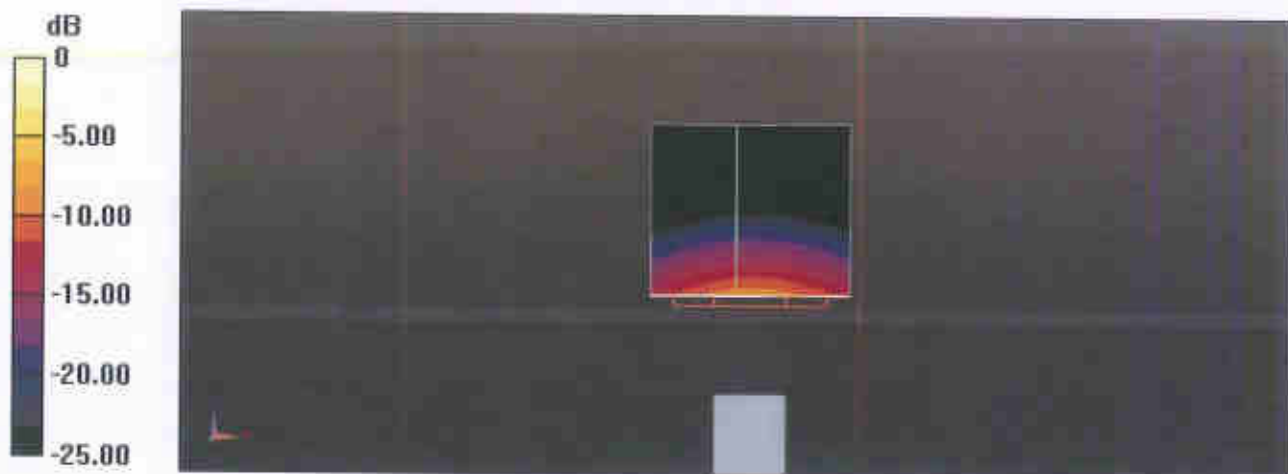
Dipole Calibration for Head Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 71.18 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 32.5 W/kg

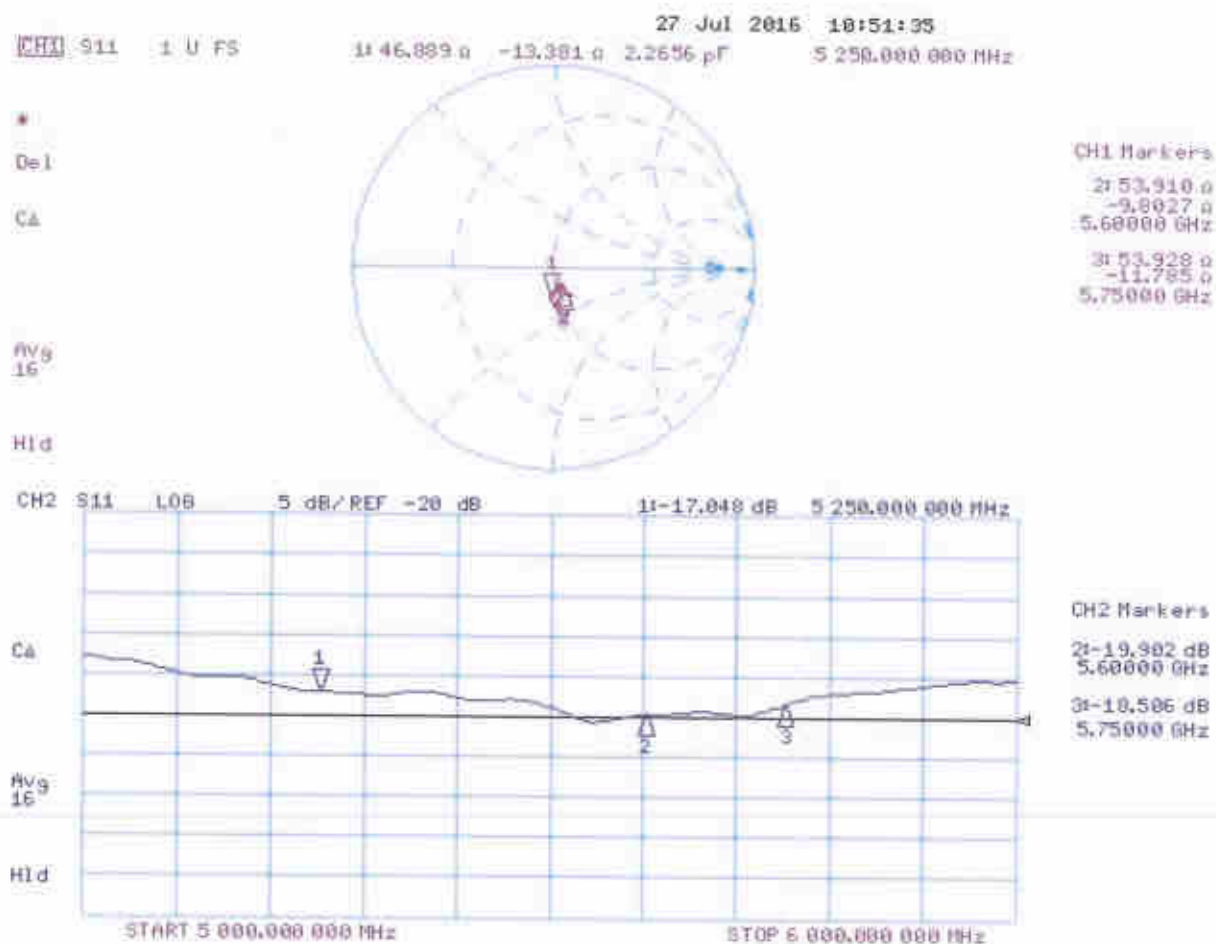
SAR(1 g) = 7.93 W/kg; SAR(10 g) = 2.25 W/kg

Maximum value of SAR (measured) = 19.3 W/kg



0 dB = 19.3 W/kg = 12.86 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 26.07.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1167

Communication System: UID 0 - CW; Frequency: 5250 MHz, Frequency: 5600 MHz, Frequency: 5750 MHz

Medium parameters used: $f = 5250 \text{ MHz}$; $\sigma = 5.42 \text{ S/m}$; $\epsilon_r = 47.1$; $\rho = 1000 \text{ kg/m}^3$

Medium parameters used: $f = 5600 \text{ MHz}$; $\sigma = 5.88 \text{ S/m}$; $\epsilon_r = 46.5$; $\rho = 1000 \text{ kg/m}^3$

Medium parameters used: $f = 5750 \text{ MHz}$; $\sigma = 6.11 \text{ S/m}$; $\epsilon_r = 46.2$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3503; ConvF(4.85, 4.85, 4.85); Calibrated: 30.06.2016, ConvF(4.35, 4.35, 4.35); Calibrated: 30.06.2016, ConvF(4.3, 4.3, 4.3); Calibrated: 30.06.2016;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 30.12.2015
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5250MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 68.19 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 29.0 W/kg

SAR(1 g) = 7.64 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 17.7 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5600 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 68.01 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 32.7 W/kg

SAR(1 g) = 7.9 W/kg; SAR(10 g) = 2.21 W/kg

Maximum value of SAR (measured) = 18.9 W/kg

Dipole Calibration for Body Tissue/Pin=100mW, dist=10mm, f=5750 MHz/Zoom Scan, dist=1.4mm (8x8x7)/Cube 0: Measurement grid: $dx=4\text{mm}$, $dy=4\text{mm}$, $dz=1.4\text{mm}$

Reference Value = 66.17 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 33.2 W/kg

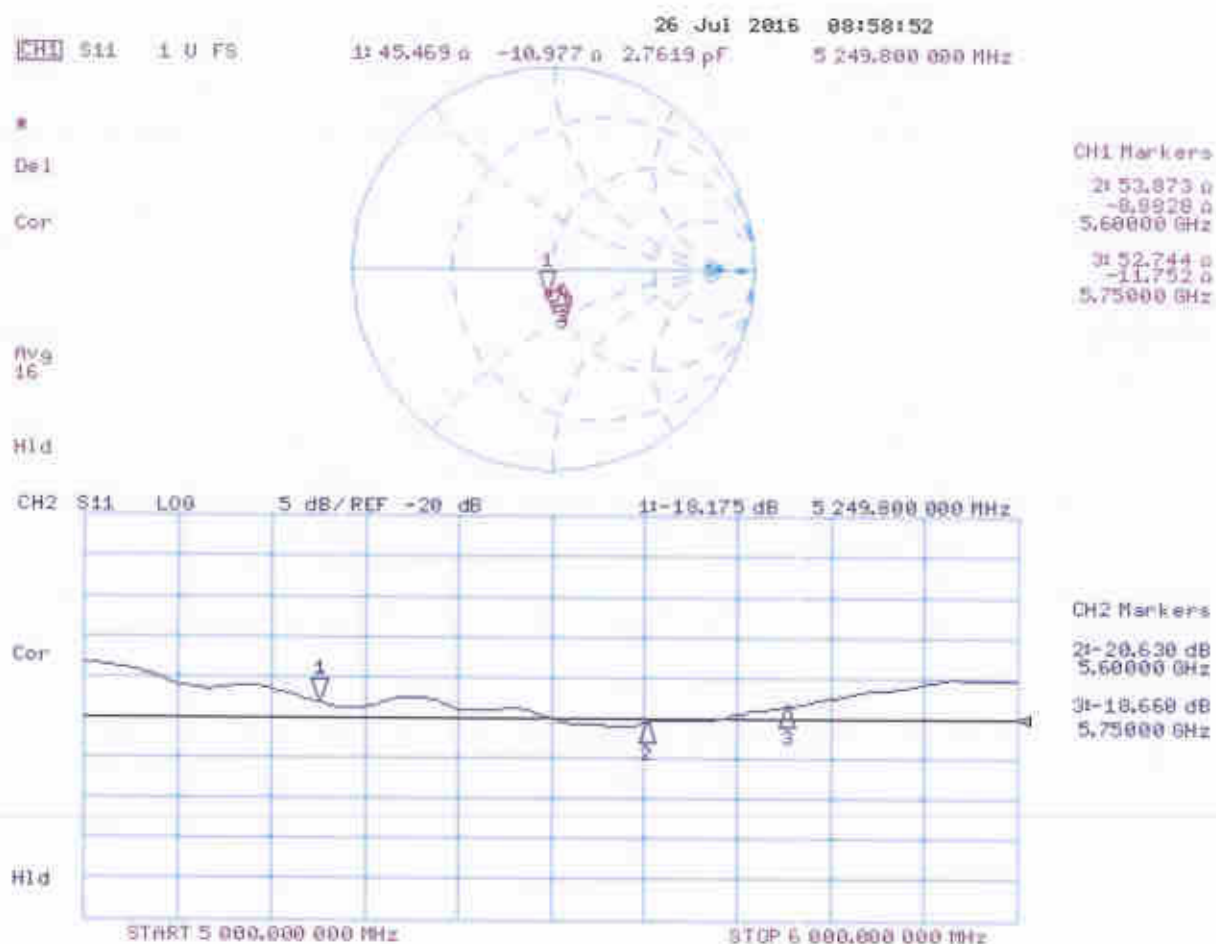
SAR(1 g) = 7.65 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 18.6 W/kg



0 dB = 18.6 W/kg = 12.70 dBW/kg

Impedance Measurement Plot for Body TSL



1338

IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:

Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:

Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:

To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.



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Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **Sporton - SZ (Auden)**

Certificate No: **DAE4-1338_Nov16**

CALIBRATION CERTIFICATE

Object **DAE4 - SD 000 D04 BM - SN: 1338**

Calibration procedure(s) **QA CAL-06.v29
Calibration procedure for the data acquisition electronics (DAE)**

Calibration date: **November 22, 2016**

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 $(22 \pm 3)^{\circ}\text{C}$ 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-16 (in house check)	In house check: Jan-17
Calibrator Box V2.1	SE UMS 006 AA 1002	05-Jan-16 (in house check)	In house check: Jan-17

Calibrated by:	Name Adrian Gehring	Function Technician	Signature
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Approved by:	Fin Bomholt	Deputy Technical Manager	
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Issued: November 22, 2016

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Accreditation No.: **SCS 0108**

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 = 6.1 μ V , 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	403.674 $\pm$ 0.02% (k=2)	404.250 $\pm$ 0.02% (k=2)	404.207 $\pm$ 0.02% (k=2)
Low Range	3.97238 $\pm$ 1.50% (k=2)	3.97905 $\pm$ 1.50% (k=2)	3.97471 $\pm$ 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	62.0 ° $\pm$ 1 °
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Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	199996.77	0.71	0.00
Channel X + Input	20002.26	0.91	0.00
Channel X - Input	-20000.38	0.70	-0.00
Channel Y + Input	199996.98	1.32	0.00
Channel Y + Input	19999.89	-1.32	-0.01
Channel Y - Input	-20003.36	-2.29	0.01
Channel Z + Input	199997.81	1.86	0.00
Channel Z + Input	20001.76	0.52	0.00
Channel Z - Input	-20002.73	-1.59	0.01

Low Range	Reading (μV)	Difference (μV)	Error (%)
Channel X + Input	2001.72	0.37	0.02
Channel X + Input	201.83	0.23	0.11
Channel X - Input	-197.67	0.66	-0.33
Channel Y + Input	2001.35	-0.07	-0.00
Channel Y + Input	200.56	-1.07	-0.53
Channel Y - Input	-199.76	-1.41	0.71
Channel Z + Input	2001.21	-0.12	-0.01
Channel Z + Input	200.89	-0.61	-0.30
Channel Z - Input	-199.38	-0.88	0.44

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	7.57	6.75
	- 200	-5.52	-6.95
Channel Y	200	-21.81	-21.79
	- 200	20.05	19.45
Channel Z	200	-2.35	-2.47
	- 200	0.80	0.82

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	-	2.79	-3.02
Channel Y	200	8.38	-	5.71
Channel Z	200	9.27	5.72	-

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	16201	15043
Channel Y	16281	15799
Channel Z	16108	15449

5. Input Offset Measurement

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

Input 10M Ω

	Average (μ V)	min. Offset (μ V)	max. Offset (μ V)	Std. Deviation (μ V)
Channel X	1.34	0.13	2.66	0.51
Channel Y	-0.17	-1.21	1.45	0.49
Channel Z	-0.51	-1.57	0.55	0.45

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



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Accreditation No.: **SCS 0108**

Client **Sporton-SZ (Auden)**

Certificate No: **EX3-3911_Sep16**

CALIBRATION CERTIFICATE

Object **EX3DV4 - SN:3911**

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: **September 29, 2016**

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 $(22 \pm 3)^\circ\text{C}$ 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	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
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: U53642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: U537390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: October 4, 2016			
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Accreditation No.: **SCS 0108**

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,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., $\theta = 0$ 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:

- 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
- IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\theta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,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.
- DCP_{x,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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,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 $f \leq 800$ 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 NORM_{x,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 NORM_x (no uncertainty required).

Probe EX3DV4

SN:3911

Manufactured: September 4, 2012
Calibrated: September 29, 2016

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3911

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.30	0.33	0.47	± 10.1 %
DCP (mV) ^B	101.9	102.3	100.2	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB/ μV	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	138.8	±3.5 %
		Y	0.0	0.0	1.0		138.9	
		Z	0.0	0.0	1.0		138.4	

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 E²-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:3911

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	10.99	10.99	10.99	0.57	0.81	± 12.0 %
835	41.5	0.90	10.54	10.54	10.54	0.26	1.26	± 12.0 %
900	41.5	0.97	10.05	10.05	10.05	0.38	0.93	± 12.0 %
1750	40.1	1.37	8.88	8.88	8.88	0.31	0.93	± 12.0 %
1900	40.0	1.40	8.50	8.50	8.50	0.40	0.80	± 12.0 %
2000	40.0	1.40	8.48	8.48	8.48	0.35	0.85	± 12.0 %
2300	39.5	1.67	7.93	7.93	7.93	0.36	0.80	± 12.0 %
2450	39.2	1.80	7.43	7.43	7.43	0.29	0.98	± 12.0 %
2600	39.0	1.96	7.39	7.39	7.39	0.45	0.80	± 12.0 %
5250	35.9	4.71	5.25	5.25	5.25	0.40	1.80	± 13.1 %
5600	35.5	5.07	4.49	4.49	4.49	0.50	1.80	± 13.1 %
5750	35.4	5.22	4.75	4.75	4.75	0.50	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:3911

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	10.43	10.43	10.43	0.42	0.80	± 12.0 %
835	55.2	0.97	10.19	10.19	10.19	0.20	1.33	± 12.0 %
1750	53.4	1.49	8.46	8.46	8.46	0.42	0.80	± 12.0 %
1900	53.3	1.52	8.17	8.17	8.17	0.35	0.97	± 12.0 %
2300	52.9	1.81	7.93	7.93	7.93	0.33	0.98	± 12.0 %
2450	52.7	1.95	7.66	7.66	7.66	0.43	0.80	± 12.0 %
2600	52.5	2.16	7.38	7.38	7.38	0.33	0.80	± 12.0 %
5250	48.9	5.36	4.62	4.62	4.62	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.78	3.78	3.78	0.60	1.90	± 13.1 %
5750	48.3	5.94	3.95	3.95	3.95	0.60	1.90	± 13.1 %

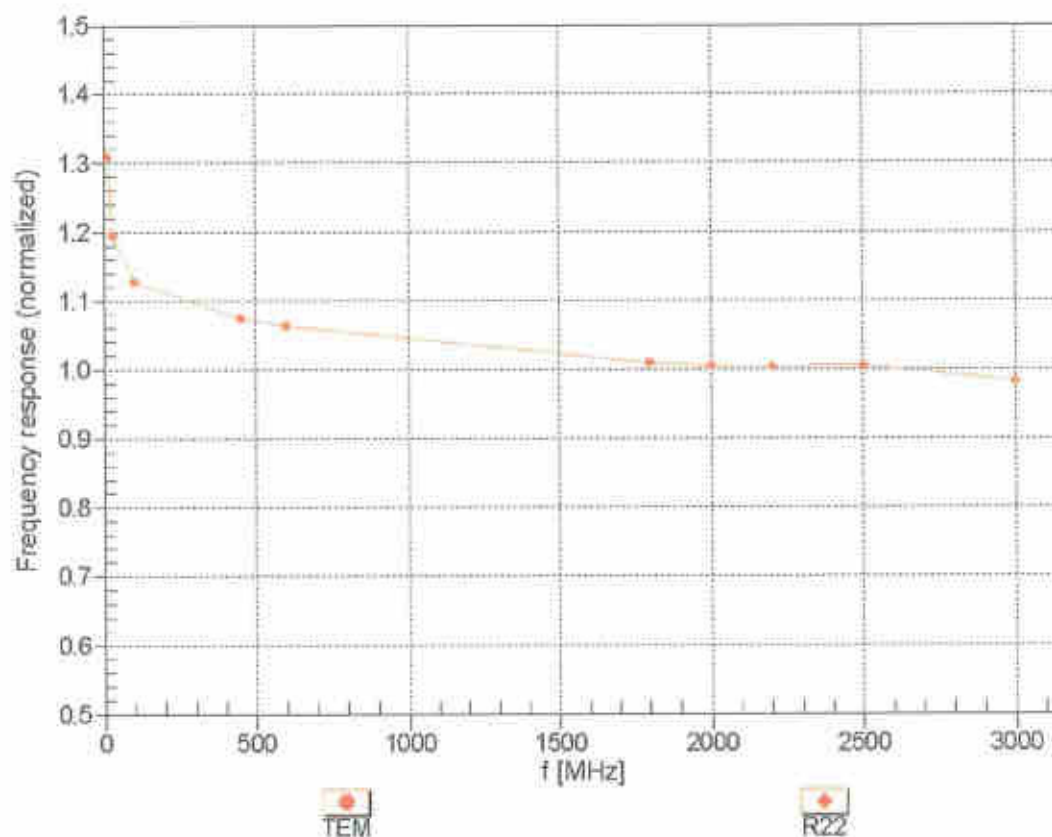
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 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

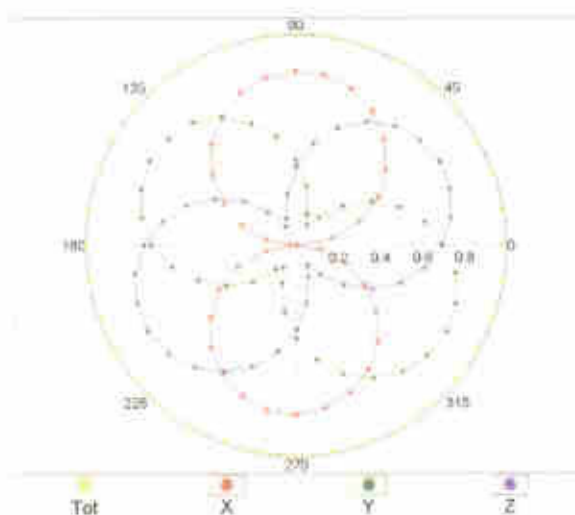
(TEM-Cell:ifi110 EXX, Waveguide: R22)



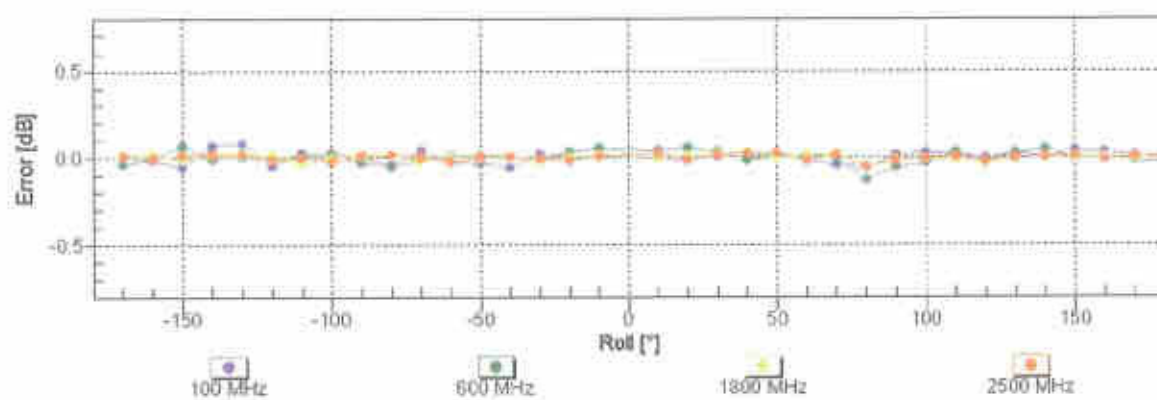
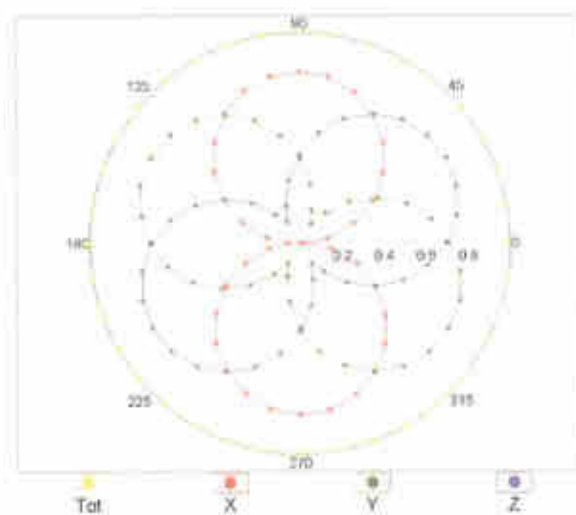
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\vartheta = 0^\circ$

f=600 MHz,TEM

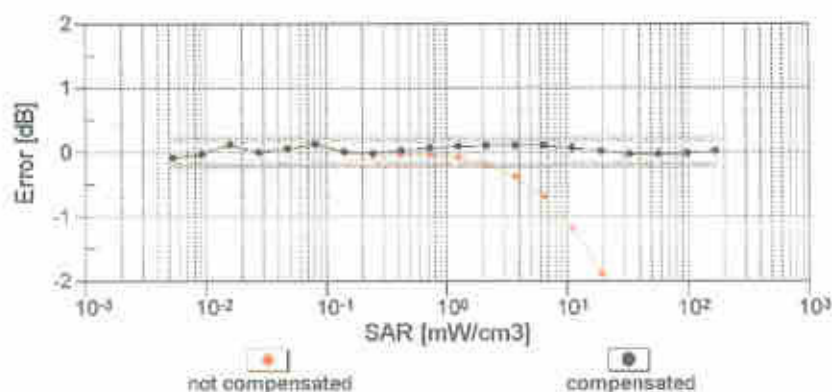
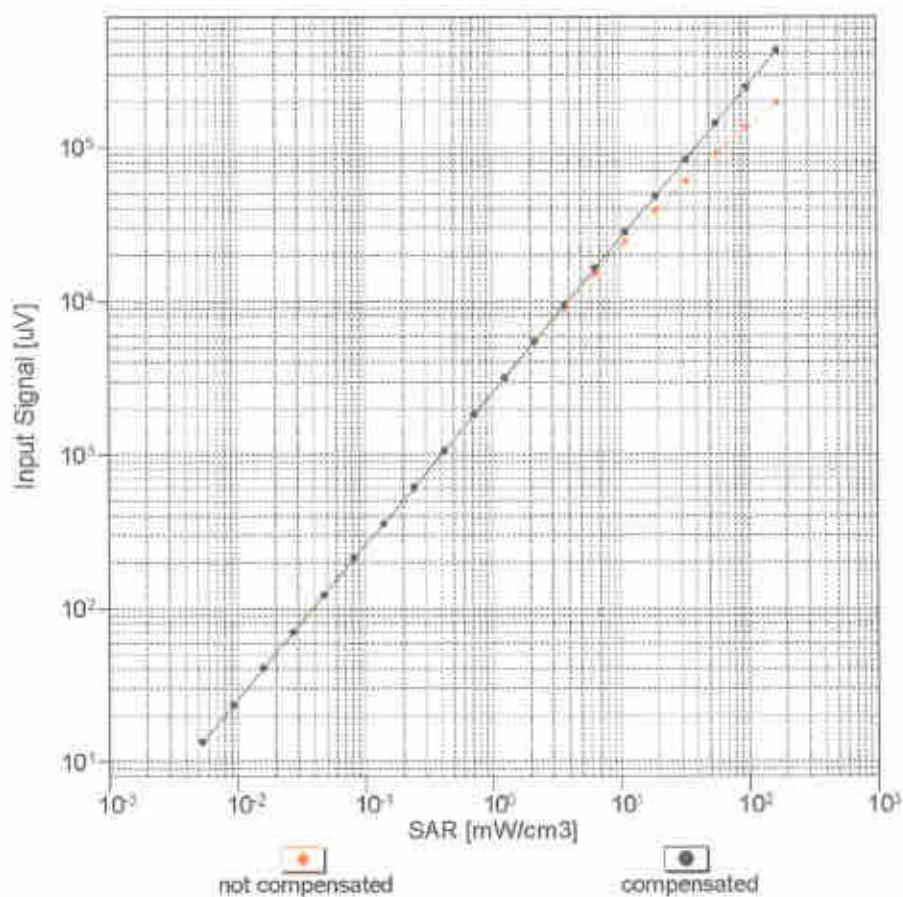


f=1800 MHz,R22



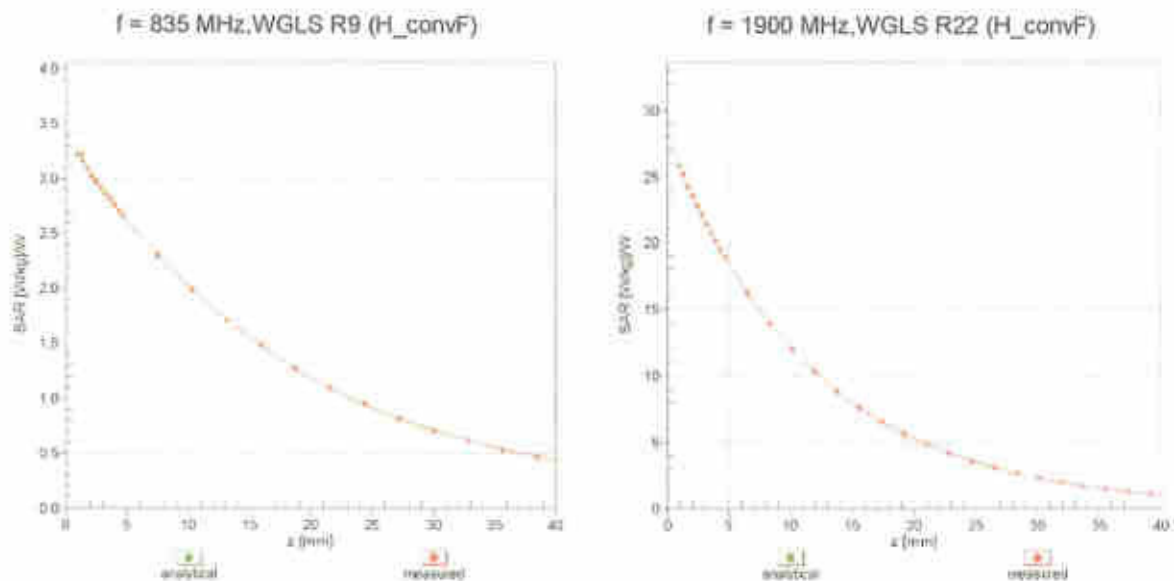
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ (k=2)

Dynamic Range $f(\text{SAR}_{\text{head}})$ (TEM cell, $f_{\text{eval}} = 1900 \text{ MHz}$)



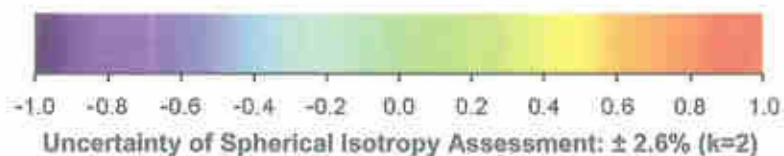
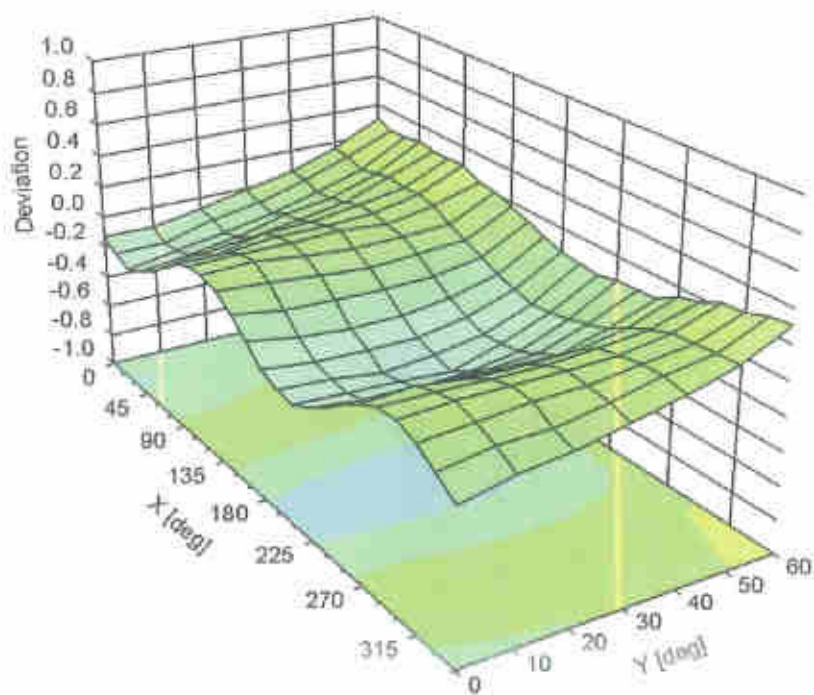
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: EX3DV4 - SN:3911

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	80
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm