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检测
TESTING
CNAS L2264

SAR TEST REPORT

Applicant	Lenovo (Shanghai) Electronics Technology Co., Ltd
FCC ID	O57TBX704V
Product	Portable Tablet Computer
Brand	Lenovo
Model	TB-X704V
Report No.	RXA1704-0095SAR
Issue Date	June 16, 2017

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **IEEE 1528- 2013, ANSI/ IEEE C95.1-1992.** The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.

Performed by: Jiangpeng Lan *Approved by: Kai Xu*

TA Technology (Shanghai) Co., Ltd.

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1 Test Laboratory

1.1 Notes of the Test Report

This report shall not be reproduced in full or partial, without the written approval of **TA technology (shanghai) co., Ltd.**The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein .Measurement Uncertainties were not taken into account and are published for informational purposes only. This report is written to support regulatory compliance of the applicable standards stated above. This report must not be used by the client to claim product certification, approval, or endorsement by any government agencies.

1.2 Test facility

CNAS (accreditation number:L2264)

TA Technology (Shanghai) Co., Ltd. has obtained the accreditation of China National Accreditation Service for Conformity Assessment (CNAS).

FCC (recognition number is 428261)

TA Technology (Shanghai) Co., Ltd. has been listed on the US Federal Communications Commission list of test facilities recognized to perform electromagnetic emissions measurements.

IC (recognition number is 8510A)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Canada to perform electromagnetic emission measurement.

VCCI (recognition number is C-4595, T-2154, R-4113, G-10766)

TA Technology (Shanghai) Co., Ltd. has been listed by industry Japan to perform electromagnetic emission measurement.

A2LA (Certificate Number: 3857.01)

TA Technology (Shanghai) Co., Ltd. has been listed by American Association for Laboratory Accreditation to perform electromagnetic emission measurement.

1.3 Testing Location

Company: TA Technology (Shanghai) Co., Ltd.

Address: No.145, Jintang Rd, Tangzhen Industry Park, Pudong Shanghai, China

City: Shanghai

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1.4 Laboratory Environment

Temperature	Min. = 18°C, Max. = 25 °C
Relative humidity	Min. = 30%, Max. = 70%
Ground system resistance	< 0.5 Ω
Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surrounding objects is minimized and in compliance with requirement of standards.	

2 Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for the EUT are as follows:

Table 2.1: Highest Reported SAR

Mode	Highest Reported SAR (W/kg)	
	1g SAR Body-worn (Separation 0mm)	**1g SAR Body-worn (Separation 14mm)**
LTE FDD 12	0.758	0.228
LTE FDD 13	0.504	0.427
Wi-Fi 5G U-NII-1	0.313	0.257
Wi-Fi 5G U-NII-2C	0.341	0.245
Wi-Fi, U-NII-3	0.103	0.135
Date of Testing:	May 19, 2017 ~ June 6, 2017	
Note: The device is in compliance with SAR for Uncontrolled Environment limits (1.6 W/kg) specified in ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.		

Table 2.2: Highest Simultaneous Transmission SAR

Exposure Configuration	1g SAR Body-worn (Separation 0mm)	1g SAR Body-worn (Separation 14mm)
Highest Simultaneous Transmission SAR (W/kg)	0.981	0.564
Note: 1. The detail for simultaneous transmission consideration is described in chapter 10.3.		

3 Description of Equipment under Test

Client Information

Applicant	Lenovo (Shanghai) Electronics Technology Co., Ltd
Applicant address	NO.68 BUILDING, 199 FENJU RD, Pilot Free Trade Zone, Shanghai, 200131, China
Manufacturer	Lenovo PC HK Limited
Manufacturer address	23/F, Lincoln House, Taikoo Place 979 King's Road, Quarry Bay, Hong Kong

General Technologies

Application Purpose:	Original Grant
EUT Stage	Identical Prototype
Model:	TB-X704V
IMEI:	863923030014046
Hardware Version:	Lenovo Tablet TB-X704V
Software Version:	TB-X704V_RF01_20170301
Antenna Type:	Internal Antenna
Device Class:	B
Power Class:	LTE FDD 12/13:3
Power Level	LTE FDD 12/13:max power
EUT Accessory	
Battery	Manufacturer: Lenovo Mobile Communication Technology Ltd. Model: L16D2P31
Adapter 1	Manufacturer: Acbel Model: C-P35
Adapter 2	Manufacturer: Shenzhen Huntkey Electric Co., Ltd. Model: C-P35

Wireless Technology and Frequency Range

Wireless Technology		Modulation	Operating mode	Tx (MHz)
LTE	FDD 12	QPSK, 16QAM	Rel.11	699 ~ 716
	FDD 13			777 ~ 787
	Does this device support Carrier Aggregation (CA) ☐Yes ☒No			
	Does this device support SV-LTE (1xRTT-LTE)? ☐Yes ☒No			
Wi-Fi	5G	OFDM	802.11a/n 20M/40M/ ac 20M/40M/80M	5150 ~ 5350 5470 ~ 5825
	Does this device support MIMO ☐Yes ☒No			

4 Test Specification, Methods and Procedures

The tests documented in this report were performed in accordance with FCC 47 CFR § 2.1093, IEEE 1528- 2013, ANSI/IEEE C95.1-1992, the following FCC Published RF exposure KDB procedures:

248227 D01 802.11 Wi-Fi SAR v02r02
447498 D01 General RF Exposure Guidance v06
865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
865664 D02 RF Exposure Reporting v01r02
941225 D05 SAR for LTE Devices v02r05
616217 D04 SAR for laptop and tablets v01r02

5 Operational Conditions during Test

5.1 Test Positions

5.1.1 Body Configuration

The overall diagonal dimension of the display section of a tablet is 24.7 cm > 20 cm, Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. SAR evaluation for the front surface of tablet display screens are generally not necessary. The SAR Exclusion Threshold in KDB 447498 D01 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.

5.2 Measurement Variability

Per FCC KDB Publication 865664 D01, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.

2) A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).

3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

5.3 Test Configuration

5.3.1 LTE Test Configuration

LTE modes were tested according to FCC KDB 941225 D05 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 was used for LTE output power measurements and SAR testing. Max power control was used so the UE transmits with maximum output power during SAR testing. SAR must be measured with the maximum TTI (transmit time interval) supported by the device in each LTE configuration.

A) Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

B) MPR

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

C) A-MPR

A-MPR (Additional MPR) has been disabled for all SAR tests by setting NS=01 on the base station simulator.

D) Largest channel bandwidth standalone SAR test requirements

1) QPSK with 1 RB allocation

Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and required test channel combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each required test channel. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required for 1 RB allocation; otherwise, SAR is required for the remaining required test channels and only for the RB offset configuration with the highest output power for that channel. When the reported SAR of a required test channel is > 1.45 W/kg, SAR is required for all three RB offset configurations for that required test channel.

2) QPSK with 50% RB allocation

The procedures required for 1 RB allocation in 1) are applied to measure the SAR for QPSK with 50% RB allocation.

3) QPSK with 100% RB allocation

For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest reported SAR for 1 RB and 50% RB allocation in 1) and 2) are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel and if the reported SAR is > 1.45 W/kg, the remaining required test channels must also be tested.

4) Higher order modulations

For each modulation besides QPSK; e.g., 16-QAM, 64-QAM, apply the QPSK procedures in above sections to determine the QAM configurations that may need SAR measurement. For each configuration identified as required for testing, SAR is required only when the highest maximum output power for the configuration in the higher order modulation is > ½ dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is > 1.45 W/kg.

E) Other channel bandwidth standalone SAR test requirements

For the other channel bandwidths used by the device in a frequency band, apply all the procedures required for the largest channel bandwidth in section A) to determine the channels and RB configurations that need SAR testing and only measure SAR when the highest maximum output power of a configuration requiring testing in the smaller channel bandwidth is > ½ dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the *reported* SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg.

5.3.2 Wi-Fi Test Configuration

SAR test reduction for 802.11 Wi-Fi transmission mode configurations are considered separately for DSSS and OFDM. An initial test position is determined to reduce the number of tests required for certain exposure configurations with multiple test positions. An initial test configuration is determined for each frequency band and aggregated band according to maximum output power, channel bandwidth, wireless mode configurations and other operating parameters to streamline the measurement requirements. For 2.4 GHz DSSS, either the initial test position or DSSS procedure is applied to reduce the number of SAR tests; these are mutually exclusive. For OFDM, an initial test position is only applicable to next to the ear, UMPC mini-tablet and hotspot mode configurations, which is tested using the initial test configuration to facilitate test reduction. For other exposure conditions with a fixed test position, SAR test reduction is determined using only the initial test configuration.

The multiple test positions require SAR measurements in head, hotspot mode or UMPC mini-tablet configurations may be reduced according to the highest reported SAR determined using the *initial test position(s)* by applying the DSSS or OFDM SAR measurement procedures in the required wireless mode test configuration(s). The *initial test position(s)* is measured using the highest measured maximum output power channel in the required wireless mode test configuration(s). When the *reported* SAR for the *initial test position* is:

- ≤ 0.4 W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and wireless mode combination within the frequency band or aggregated band. DSSS and OFDM configurations are considered separately according to the required SAR procedures.
- 0.4 W/kg, SAR is repeated using the same wireless mode test 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 *reported* SAR is ≤ 0.8 W/kg or all required test positions are tested.
    - ✧ For subsequent test positions with equivalent test separation distance or when exposure is dominated by coupling conditions, the position for maximum coupling

condition should be tested.

  - ✧ When it is unclear, all equivalent conditions must be tested.

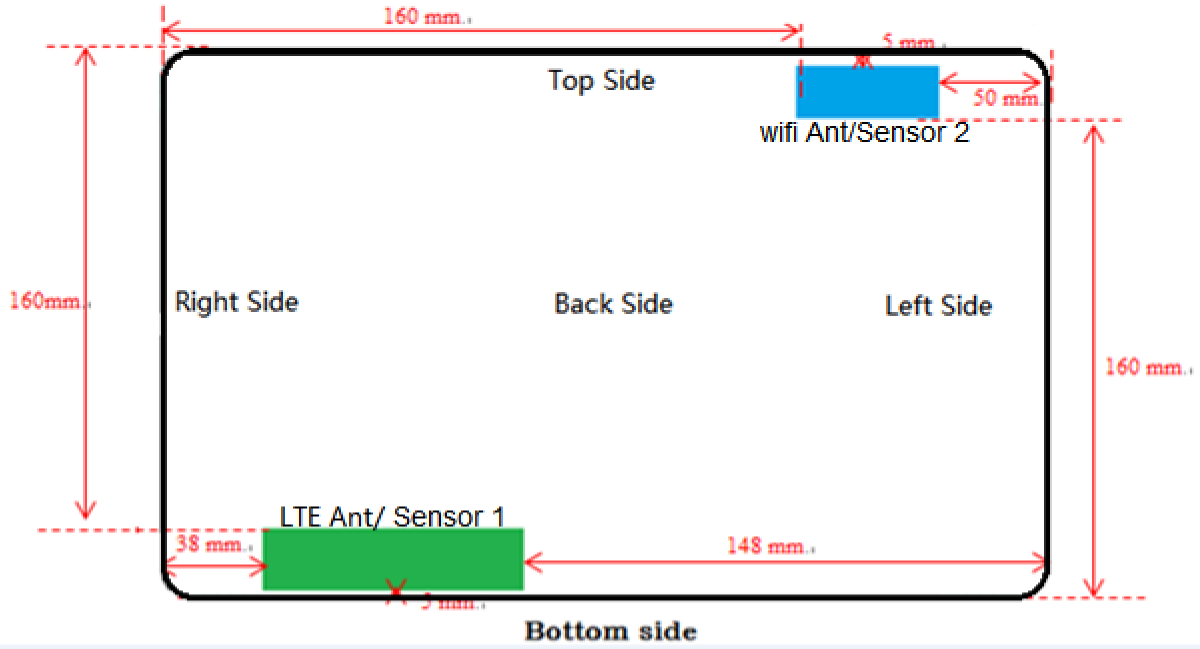
- For all positions/configurations tested using the *initial test position* and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or all required test channels are considered.
  - ✧ The additional power measurements required for this step should be limited to those necessary for identifying subsequent highest output power channels to apply the test reduction.

To determine the initial test position, Area Scans were performed to determine the position with the Maximum Value of SAR (measured). The position that produced the highest Maximum Value of SAR is considered the worst case position; thus used as the initial test position.

A Wi-Fi device must be configured to transmit continuously at the required data rate, channel bandwidth and signal modulation, using the highest transmission duty factor supported by the test mode tools for SAR measurement. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

5.3.3 Proximity sensor Configuration

The device uses a proximity sensor that share the same metallic electrode as the transmitting antenna to facilitate triggering in typical user interactivity with the device.



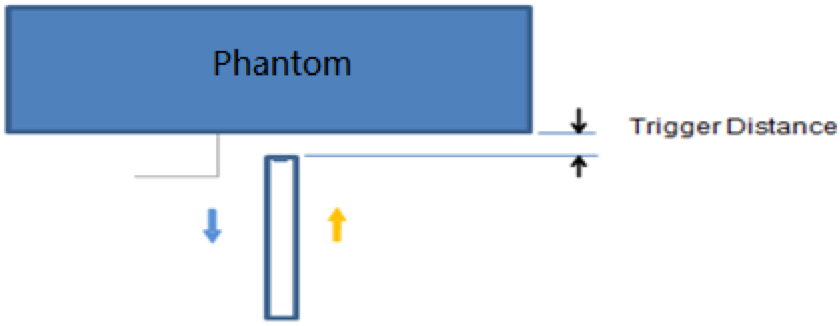
Tx Antenna	Antenna/Sensor-to- DUT sides separation distances					
	Front side	Back side	Left Edge	Right Edge	Top Edge	Bottom Edge
LTE Antenna	NA	NA	148mm	38mm	160mm	NA
Sensor 1 (LTE Antenna)	NA	NA	148mm	38mm	160mm	NA
Wi-Fi Antenna	NA	NA	50mm	160mm	NA	160mm
Sensor 2 (LTE Antenna)	NA	NA	50mm	160mm	NA	160mm

The proximity sensor and LTE antenna/ Wi-Fi Antenna use same metallic electrode, so the location is same.

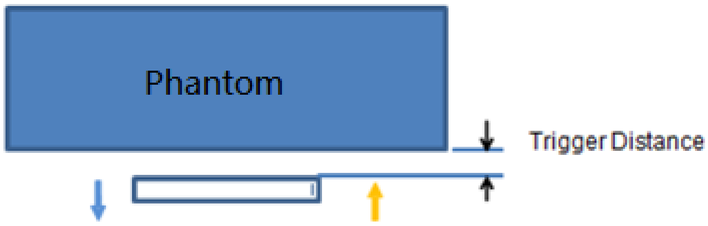
FCC KDB 616217 D04 section 6 was used as guideline for selecting SAR test distance for this device at these additional exposure conditions. Since the proximity sensor activation distance for the Back Side/Top Edge/Bottom Edge of the device is 15mm, a conservation distance 14mm was tested for SAR on the Back Side/ Top Edge/Bottom Edge at maximum power.

Proximity Sensor Triggering Distance (Per KDB 616217 D04 §6.2)

Proximity sensor triggering distance testing was performed according to the procedures outlined in KDB 616217 D04 section 6.2, and EUT moving further away from the phantom were both assessed.



Picture: Proximity sensor triggering distances assessment (Top Edge/Bottom Edge)



Picture: Proximity sensor triggering distances assessment (Back side)

Table: Summary of Trigger Distances

Liquid Type (MHz)	Trigger distance –Top Edge/Bottom Edge		Trigger distance – Back side	
	Moving toward phantom	Moving from phantom	Moving toward phantom	Moving from phantom
5250 Body	**15mm**	**15mm**	**15mm**	**15mm**
5600 Body	**15mm**	**15mm**	**15mm**	**15mm**
5750 Body	**15mm**	**15mm**	**15mm**	**15mm**

Table: KDB 616217 D04 § 6.2.6(Reduced power)

LTE 12 Measure Power [dBm]											
Distance[mm]	20	19	18	17	16	15	14	13	12	11	10
Bottom Edge	25.09	25.09	25.09	25.09	25.09	19.14	19.14	19.14	19.14	19.14	19.14
Back side	25.09	25.09	25.09	25.09	25.09	19.14	19.14	19.14	19.14	19.14	19.14
LTE 13 Measure Power [dBm]											
Distance[mm]	20	19	18	17	16	15	14	13	12	11	10
Bottom Edge	23.97	23.97	23.97	23.97	23.97	18.17	18.17	18.17	18.17	18.17	18.17
Back side	23.97	23.97	23.97	23.97	23.97	18.17	18.17	18.17	18.17	18.17	18.17
WIFI 5G Measure Power [dBm]											
Distance[mm]	20	19	18	17	16	15	14	13	12	11	10
Top Edge	13.02	13.02	13.02	13.02	13.02	6.41	6.41	6.41	6.41	6.41	6.41
Back side	13.02	13.02	13.02	13.02	13.02	6.41	6.41	6.41	6.41	6.41	6.41

Table: KDB 616217 D04 § 6.2.8(Full power)

LTE 12 Measure Power [dBm]															
Distance[mm]	26	23	20	19	18	17	16	15	14	13	12	11	10	5	0
Bottom Edge	25.09	25.09	25.09	25.09	25.09	25.09	25.09	19.14	19.14	19.14	19.14	19.14	19.14	19.14	19.14
Back side	25.09	25.09	25.09	25.09	25.09	25.09	25.09	19.14	19.14	19.14	19.14	19.14	19.14	19.14	19.14
LTE 13 Measure Power [dBm]															
Distance[mm]	26	23	20	19	18	17	16	15	14	13	12	11	10	5	0
Bottom Edge	23.97	23.97	23.97	23.97	23.97	23.97	23.97	18.17	18.17	18.17	18.17	18.17	18.17	18.17	18.17
Back side	23.97	23.97	23.97	23.97	23.97	23.97	23.97	18.17	18.17	18.17	18.17	18.17	18.17	18.17	18.17
wifi 5G Measure Power [dBm]															
Distance[mm]	26	23	20	19	18	17	16	15	14	13	12	11	10	5	0
Top Edge	13.02	13.02	13.02	13.02	13.02	13.02	13.02	6.41	6.41	6.41	6.41	6.41	6.41	6.41	6.41
Back side	13.02	13.02	13.02	13.02	13.02	13.02	13.02	6.41	6.41	6.41	6.41	6.41	6.41	6.41	6.41

Proximity sensor triggering coverage (Per KDB 616217 D04 §6.3)

The proximity sensor and LTE antenna/ Wi-Fi Antenna use same metallic electrode, so there is no spatial offset.

Tilt angle influences to proximity sensor triggering (Per KDB 616217 D04 §6.4)

The influence of table tilt angles to proximity sensor triggering was determined by positioning each side that contains a transmitting antenna, perpendicular to the phantom, at 15mm separation for Top Edge/Bottom Edge.

Rotating the phablet around the edge next to the phantom in ≦10° increments until the tablet is ±45° from the vertical position at 0°, and the maximum output power remains in the reduced mode.

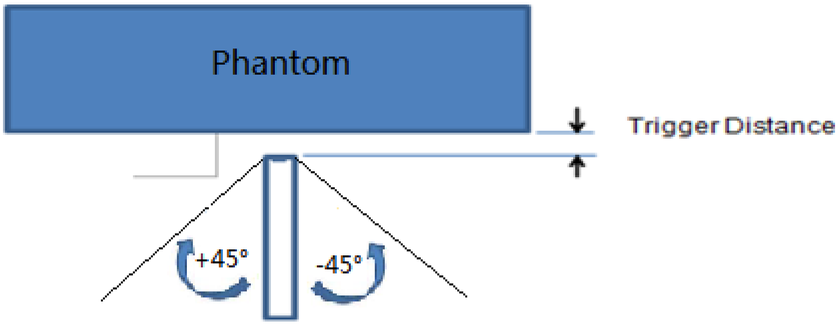


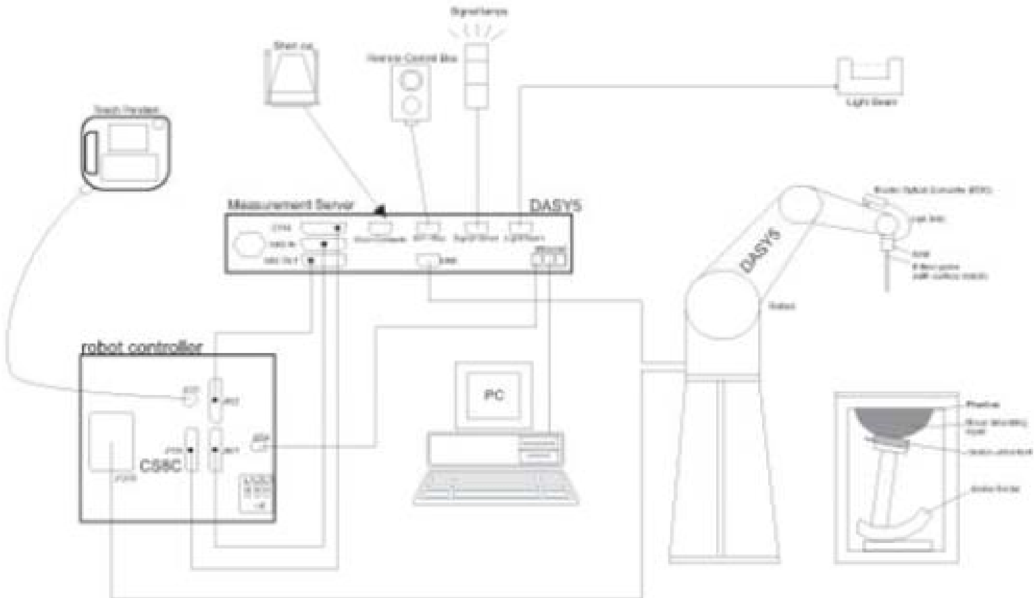
Table: KDB 616217 D04 § 6.4.1

LTE 12 Measure Power [dBm]											
Tilt angle	+45°	+40°	+30°	+20°	+10°	0°	-10°	-20°	-30°	-40°	-45°
Bottom Edge	19.14	19.14	19.14	19.14	19.14	19.14	19.14	19.14	19.14	19.14	19.14
LTE 13 Measure Power [dBm]											
Tilt angle	+45°	+40°	+30°	+20°	+10°	0°	-10°	-20°	-30°	-40°	-45°
Bottom Edge	18.17	18.17	18.17	18.17	18.17	18.17	18.17	18.17	18.17	18.17	18.17
WIFI 5G Measure Power [dBm]											
Tilt angle	+45°	+40°	+30°	+20°	+10°	0°	-10°	-20°	-30°	-40°	-45°
Top Edge	6.41	6.41	6.41	6.41	6.41	6.41	6.41	6.41	6.41	6.41	6.41
Note: The test distance is 15mm from Bottom Edge/ Top Edge.											

6 SAR Measurements System Configuration

6.1 SAR Measurement Set-up

The DASY system 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 DASY software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

6.2 DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe EX3DV4 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

EX3DV4 Probe Specification

Construction	Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available
Frequency	10 MHz to > 6 GHz Linearity: ± 0.2 dB (30 MHz to 6 GHz)
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 μW/g to > 100 mW/g Linearity: ± 0.2dB (noise: typically < 1 μW/g)
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm
Application	High precision dosimetric measurements in any exposure Scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%.

E-field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy was evaluated and found to be better than ± 0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 1 GHz, and in a wave guide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

SAR=CΔT/Δt

Where: Δt = Exposure time (30 seconds),

C = Heat capacity of tissue (brain or muscle),

ΔT = Temperature increase due to RF exposure.

Or

SAR=lEl^{2}σ/ρ

Where: σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m^3).

6.3 SAR Measurement Procedure

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.

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 D01 SAR measurement 100 MHz to 6 GHz.

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

Zoom Scan

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

Zoom scan parameters extracted from FCC KDB 865664 D01 SAR measurement 100 MHz to 6 GHz.

			≤3GHz	> 3 GHz
Maximum zoom scan spatial resolution: $\triangle x_{zoom}$ $\triangle y_{zoom}$			≤2GHz: ≤8mm 2 – 3GHz: ≤5mm*	3 – 4GHz: ≤5mm* 4 – 6GHz: ≤4mm*
Maximum zoom scan spatial resolution, normal to phantom surface	Uniform grid: $\triangle z_{zoom}(n)$		≤5mm	3 – 4GHz: ≤4mm 4 – 5GHz: ≤3mm 5 – 6GHz: ≤2mm
	Graded grid	$\triangle z_{zoom}(1)$: between 1st two points closest to phantom surface	≤4mm	3 – 4GHz: ≤3mm 4 – 5GHz: ≤2.5mm 5 – 6GHz: ≤2mm
		$\triangle z_{zoom}(n>1)$: between subsequent points	≤1.5•$\triangle z_{zoom}(n-1)$	
Minimum zoom scan volume	X, y, z		≥30mm	3 – 4GHz: ≥28mm 4 – 5GHz: ≥25mm 5 – 6GHz: ≥22mm
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details. * When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4W/kg, ≤8mm, ≤7mm and ≤5mm zoom scan resolution may be applied, respectively, for 2GHz to 3GHz, 3GHz to 4GHz and 4GHz to 6GHz.				

Volume Scan Procedures

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

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.

7 Main Test Equipment

Name of Equipment	Manufacturer	Type/Model	Serial Number	Last Cal.	Cal. Due Date
Network analyzer	Agilent	E5071B	MY42404014	2017-05-20	2018-05-19
Dielectric Probe Kit	HP	85070E	US44020115	2017-05-20	2018-05-19
Power meter	Agilent	E4417A	GB41291714	2017-05-21	2018-05-20
Power sensor	Agilent	N8481H	MY50350004	2017-05-21	2018-05-20
Power sensor	Agilent	E9327A	US40441622	2017-05-20	2018-05-19
Dual directional coupler	Agilent	778D-012	50519	2017-05-21	2018-05-20
Dual directional coupler	Agilent	777D	50146	2017-05-20	2018-05-19
Amplifier	INDEXSAR	IXA-020	0401	2017-05-20	2018-05-19
Wideband radio communication tester	R&S	CMW 500	113645	2017-05-20	2018-05-19
BT Base Station Simulator	R&S	CBT	100271	2017-05-14	2018-05-13
E-field Probe	SPEAG	EX3DV4	3677	2017-01-23	2018-01-22
DAE	SPEAG	DAE4	1317	2016-08-02	2017-08-01
Validation Kit 750MHz	SPEAG	D750V3	1017	2014-08-28	2017-08-27
Validation Kit 5GHz	SPEAG	D5GHzV2	1151	2017-01-05	2020-01-04
Temperature Probe	Tianjin jinming	JM222	AA1009129	2017-05-20	2018-05-19
Hygrothermograph	Anymetr	NT-311	20150732	2016-07-15	2017-07-14

8 Tissue Dielectric Parameter Measurements & System Verification

8.1 Tissue Verification

The temperature of the tissue-equivalent medium used during measurement must also be within 18°C to 25°C and within ± 2°C of the temperature when the tissue parameters are characterized. The dielectric parameters must be measured before the tissue-equivalent medium is used in a series of SAR measurements. The parameters should be re-measured after each 3 – 4 days of use; or earlier if the dielectric parameters can become out of tolerance.

Target values

<table>
<tr><th colspan="2">Frequency (MHz)</th><th>Water (%)</th><th>Salt (%)</th><th>Sugar (%)</th><th>Glycol (%)</th><th>Preventol (%)</th><th>Cellulose (%)</th><th>ε_r</th><th>σ(s/m)</th></tr>
<tr><td>Body</td><td>750</td><td>52.49</td><td>1.41</td><td>45</td><td>0</td><td>0.1</td><td>1.0</td><td>55.5</td><td>0.96</td></tr>
<tr><th colspan="2">Frequency (MHz)</th><th>Water (%)</th><th colspan="3">Diethylenglycol monohexylether</th><th colspan="2">Triton X-100</th><th>ε_r</th><th>σ(s/m)</th></tr>
<tr><td rowspan="3">Body</td><td>5250</td><td>72.52</td><td colspan="3">13.74</td><td colspan="2">13.74</td><td>48.9</td><td>5.36</td></tr>
<tr><td>5600</td><td>72.52</td><td colspan="3">13.74</td><td colspan="2">13.74</td><td>48.5</td><td>5.77</td></tr>
<tr><td>5750</td><td>72.52</td><td colspan="3">13.74</td><td colspan="2">13.74</td><td>48.3</td><td>5.94</td></tr>
</table>

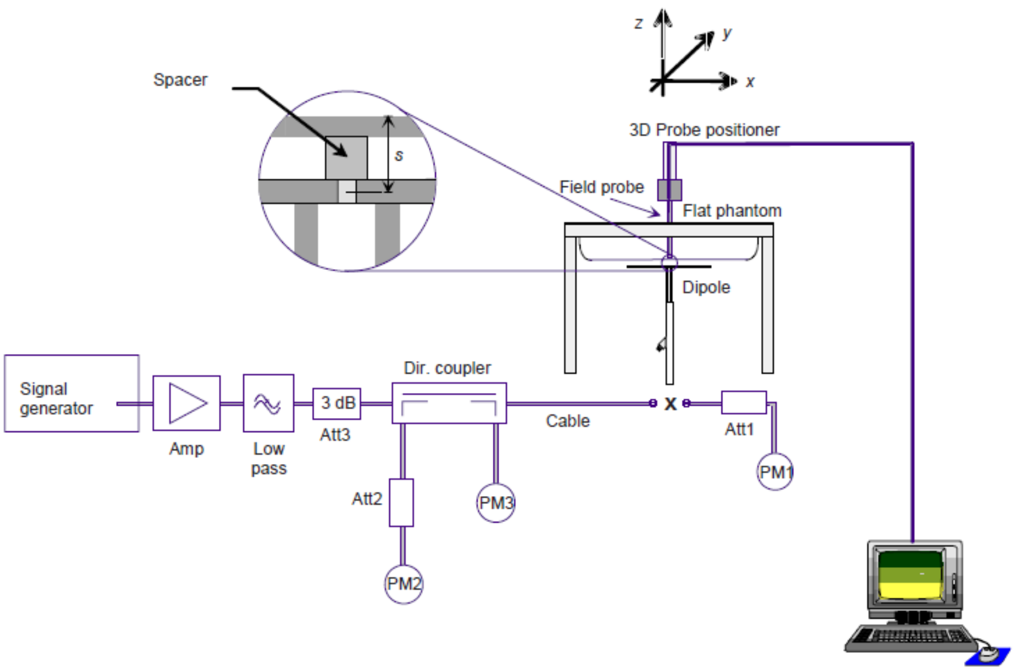
Measurements results

Frequency (MHz)		Test Date	Temp ℃	Measured Dielectric Parameters		Target Dielectric Parameters		Limit (Within ±5%)	
				ε_r	σ(s/m)	ε_r	σ(s/m)	Dev ε_r(%)	Dev σ(%)
750	Body	5/19/2017	21.5	57.0	0.95	55.5	0.96	2.70	-1.04
5250	Body	6/6/2017	21.5	46.9	5.34	48.9	5.36	-4.09	-0.37
5600	Body	6/6/2017	21.5	45.7	6.00	48.5	5.77	-5.77	3.99
5750	Body	6/6/2017	21.5	45.6	6.14	48.3	5.94	-5.59	3.37
Note: The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.									

8.2 System Performance Check

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulates were measured using the dielectric probe kit and the network analyzer. A system check measurement for every day was made following the determination of the dielectric parameters of the Tissue simulates, using the dipole validation kit. The dipole antenna was placed under the flat section of the twin SAM phantom.

System check is performed regularly on all frequency bands where tests are performed with the DASY system.



Picture 1 System Performance Check setup

Picture 2 Setup Photo

Justification for Extended SAR Dipole Calibrations

Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (< - 20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB 865664 D01:

Dipole		Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
Dipole D750V3 SN: 1017	Body Liquid	8/28/2014	-28.9	/	48.0	/
		8/27/2015	-29.3	1.4%	48.6	0.6Ω
		8/26/2016	-29.2	0.3%	48.7	0.1Ω
Dipole D5GHzV2 SN: 1151	Body Liquid	1/5/2017(5.25GHz)	-24.7	/	50.4	/
		1/5/2017(5.60GHz)	-23.3	/	57.2	/
		1/5/2017(5.75GHz)	-24.9	/	56.0	/

System Check results

Frequency (MHz)		Test Date	Temp ℃	250mW /100mW Measured SAR_{1g} (W/kg)	1W Normalized SAR_{1g} (W/kg)	1W Target SAR_{1g} (W/kg)	Δ % (Limit ±10%)	Plot No.
750	Body	5/19/2017	21.5	2.22	8.88	8.75	1.49	1
5250	Body	6/6/2017	21.5	7.46	74.6	75.6	-1.32	2
5600	Body	6/6/2017	21.5	8.10	81.0	80.2	1.00	3
5750	Body	6/6/2017	21.5	7.15	71.5	74.6	-4.16	4
Note：Target Values used derive from the calibration certificate Data Storage and Evaluation.								

9 Normal and Maximum Output Power

KDB 447498 D01 at the maximum rated output power and within the tune-up tolerance range specified for the product, but not more than 2 dB lower than the maximum tune-up tolerance limit.

9.1 LTE Mode

UE Power Class: 3 (23 +/- 2dBm). The allowed Maximum Power Reduction (MPR) for the maximum output power due to higher order modulation and transmit bandwidth configuration (resource blocks) is specified in Table 6.2.3-1 of the 3GPP TS36.101.

Table 6.2.3-1: Maximum Power Reduction (MPR) for Power Class 3

Modulation	Channel bandwidth / Transmission bandwidth (N_{RB})						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2

LTE FDD Band 12 For Sensor Off				Conducted Power(dBm)			Tune-up Limit (dBm)
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			
				23017/699.7	23095/707.5	23173/715.3	
1.4MHz	QPSK	1	0	24.41	24.52	24.75	25.50
		1	2	25.00	25.04	24.66	
		1	5	24.86	24.57	24.28	
		3	0	24.32	24.63	24.65	25.50
		3	2	24.37	24.61	24.44	
		3	3	24.63	24.65	24.26	
		6	0	23.54	23.76	23.64	24.00
	16QAM	1	0	23.36	23.21	23.68	24.00
		1	2	23.92	23.58	23.74	
		1	5	23.88	23.28	23.13	
		3	0	23.24	23.57	23.67	24.00
		3	2	23.50	23.61	23.54	
		3	3	23.72	23.54	23.23	
		6	0	22.54	22.72	22.59	23.00
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit (dBm)
				23025/700.5	23095/707.5	23165/714.5	
3MHz	QPSK	1	0	24.43	24.56	24.78	25.50
		1	7	25.03	25.09	24.70	
		1	14	24.89	24.62	24.32	

Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit (dBm)
		8	0	23.42	23.75	23.78	24.00
		8	4	23.49	23.71	23.56	
		8	7	23.73	23.76	23.36	
		15	0	23.57	23.80	23.67	24.00
	16QAM	1	0	23.39	23.23	23.71	24.00
		1	7	23.95	23.63	23.78	
		1	14	23.90	23.32	23.16	
		8	0	22.35	22.70	22.79	23.00
		8	4	22.61	22.74	22.66	
		8	7	22.82	22.66	22.36	
		15	0	22.57	22.76	22.62	23.00
Bandwidth	Modulation	RB size	RB offset	23035/701.5	23095/707.5	23155/713.5	Tune-up Limit (dBm)
5MHz	QPSK	1	0	24.40	24.54	24.74	25.50
		1	13	25.01	25.05	24.67	
		1	24	24.86	24.57	24.28	
		12	0	23.39	23.70	23.74	24.00
		12	6	23.47	23.67	23.51	
		12	13	23.71	23.74	23.32	
		25	0	23.55	23.79	23.65	24.00
	16QAM	1	0	23.36	23.19	23.68	24.00
		1	13	23.92	23.61	23.75	
		1	24	23.87	23.30	23.12	
		12	0	22.33	22.66	22.76	23.00
		12	6	22.58	22.69	22.62	
		12	13	22.79	22.61	22.32	
		25	0	22.55	22.72	22.57	23.00
Bandwidth	Modulation	RB size	RB offset	23060/704	23095/707.5	23130/711	Tune-up Limit (dBm)
10MHz	QPSK	1	0	24.38	24.47	24.72	25.50
		1	25	25.01	25.05	24.66	
		1	49	24.83	24.55	24.24	
		25	0	23.37	23.66	23.71	24.00
		25	13	23.45	23.63	23.48	
		25	25	23.67	23.70	23.29	
		50	0	23.58	23.72	23.60	24.00
	16QAM	1	0	23.31	23.16	23.63	24.00
		1	25	23.89	23.60	23.72	
		1	49	23.85	23.25	23.10	
		25	0	22.30	22.65	22.74	23.00
		25	13	22.54	22.66	22.58	

		25	25	22.77	22.57	22.29	
		50	0	22.53	22.68	22.54	23.00

LTE FDD Band 12 For Sensor On				Conducted Power(dBm)			Tune-up Limit (dBm)
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			
				23017/699.7	23095/707.5	23173/715.3	
1.4MHz	QPSK	1	0	18.20	18.09	18.14	19.00
		1	2	18.21	18.14	18.23	
		1	5	18.26	18.12	18.29	
		3	0	18.97	18.95	19.06	19.00
		3	2	18.97	19.10	19.14	
		3	3	18.98	18.99	19.07	
		6	0	18.04	17.96	18.07	19.00
	16QAM	1	0	17.93	18.03	17.61	19.00
		1	2	17.98	18.03	18.02	
		1	5	18.00	18.05	17.93	
		3	0	18.92	18.94	18.95	19.00
		3	2	18.87	19.06	18.85	
		3	3	18.96	18.95	18.98	
		6	0	18.01	17.93	18.07	19.00
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit (dBm)
				23025/700.5	23095/707.5	23165/714.5	
3MHz	QPSK	1	0	18.22	18.13	18.17	19.00
		1	7	18.24	18.19	18.27	
		1	14	18.29	18.17	18.33	
		8	0	18.07	18.07	18.19	19.00
		8	4	18.09	18.20	18.26	
		8	7	18.08	18.10	18.17	
		15	0	18.07	18.00	18.10	19.00
	16QAM	1	0	17.96	18.05	17.64	19.00
		1	7	18.01	18.08	18.06	
		1	14	18.02	18.09	17.96	
		8	0	18.03	18.07	18.07	19.00
		8	4	17.98	18.19	17.97	
		8	7	18.06	18.07	18.11	
		15	0	18.04	17.97	18.10	19.00
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit (dBm)
				23035/701.5	23095/707.5	23155/713.5	
5MHz	QPSK	1	0	18.19	18.11	18.13	19.00

Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit (dBm)
		1	13	18.22	18.15	18.24	
		1	24	18.26	18.12	18.29	
		12	0	18.04	18.02	18.15	19.00
		12	6	18.07	18.16	18.21	
		12	13	18.06	18.08	18.13	
		25	0	18.05	17.99	18.08	19.00
	16QAM	1	0	17.93	18.01	17.61	19.00
		1	13	17.98	18.06	18.03	
		1	24	17.99	18.07	17.92	
		12	0	18.01	18.03	18.04	19.00
		12	6	17.95	18.14	17.93	
		12	13	18.03	18.02	18.07	
		25	0	18.02	17.93	18.05	19.00
Bandwidth	Modulation	RB size	RB offset	23060/704	23095/707.5	23130/711	Tune-up Limit (dBm)
10MHz	QPSK	1	0	18.19	18.11	18.23	19.00
		1	25	18.22	18.25	18.21	
		1	49	18.16	18.12	18.20	
		25	0	18.04	18.02	18.21	19.00
		25	13	18.07	18.06	18.15	
		25	25	18.16	18.08	18.13	
		50	0	18.05	17.99	18.08	19.00
	16QAM	1	0	17.93	18.01	17.61	19.00
		1	25	17.98	18.06	18.03	
		1	49	17.99	18.07	17.92	
		25	0	18.01	18.03	18.04	19.00
		25	13	17.95	18.14	17.93	
		25	25	18.03	18.02	18.07	
		50	0	18.02	17.93	18.05	19.00

LTE FDD Band 13 For Sensor Off				Conducted Power(dBm)			Tune-up Limit (dBm)
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			
				23205/779.5	23230/782	23255/784.5	
5MHz	QPSK	1	0	23.77	23.23	23.42	24.50
		1	13	23.62	23.31	23.59	
		1	24	23.47	23.29	23.52	
		12	0	22.54	22.43	22.33	23.50
		12	6	22.48	22.45	22.43	
		12	13	22.46	22.39	22.41	
		25	0	22.38	22.49	22.32	23.50
	16QAM	1	0	22.42	22.34	22.09	23.50
		1	13	22.22	22.17	22.21	
		1	24	22.26	22.28	22.04	
		12	0	21.59	21.43	21.27	22.00
		12	6	21.23	21.17	21.15	
		12	13	21.29	21.36	21.23	
		25	0	21.38	21.51	21.27	22.00
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit (dBm)
				/	23230/782	/	
10MHz	QPSK	1	0	/	23.97	/	24.50
		1	25	/	23.83	/	
		1	49	/	23.68	/	
		25	0	/	22.42	/	23.50
		25	13	/	22.47	/	
		25	25	/	22.48	/	
		50	0	/	22.51	/	23.50
	16QAM	1	0	/	22.50	/	23.50
		1	25	/	22.59	/	
		1	49	/	22.54	/	
		25	0	/	21.43	/	22.00
		25	13	/	21.46	/	
		25	25	/	21.48	/	
		50	0	/	21.50	/	22.00

LTE FDD Band 13 For Sensor On				Conducted Power(dBm)			Tune-up Limit (dBm)
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			
				23205/779.5	23230/782	23255/784.5	
5MHz	QPSK	1	0	18.17	17.63	17.82	18.50
		1	13	18.06	17.75	18.03	
		1	24	18.04	17.86	18.09	
		12	0	17.70	17.59	17.49	18.50
		12	6	17.67	17.64	17.62	
		12	13	17.76	17.69	17.71	
		25	0	17.53	17.64	17.47	18.50
	16QAM	1	0	17.87	17.79	17.54	18.50
		1	13	17.80	17.75	17.79	
		1	24	17.80	17.82	17.58	
		12	0	17.79	17.63	17.47	18.50
		12	6	17.74	17.68	17.66	
		12	13	17.66	17.73	17.60	
		25	0	17.54	17.67	17.43	18.50
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit (dBm)
				/	23230/782	/	
10MHz	QPSK	1	0	/	17.96	/	18.50
		1	25	/	17.87	/	
		1	49	/	17.90	/	
		25	0	/	17.73	/	18.50
		25	13	/	17.65	/	
		25	25	/	17.77	/	
		50	0	/	17.82	/	18.50
	16QAM	1	0	/	17.72	/	18.50
		1	25	/	17.87	/	
		1	49	/	17.73	/	
		25	0	/	17.63	/	18.50
		25	13	/	17.59	/	
		25	25	/	17.84	/	
		50	0	/	17.68	/	18.50

9.2 WLAN Mode

Full Power

Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm) Data Rate (bps) 6M	Tune-up Limit (dBm)
802.11a (5GHz)	36	5180	13.02	13.50
	40	5200	12.81	
	44	5220	12.53	
	48	5240	12.62	
	52	5260	12.46	13.00
	56	5280	12.42	
	60	5300	12.34	
	64	5320	12.38	
	100	5500	12.00	13.00
	116	5580	11.64	
	132	5660	11.39	
	140	5700	11.15	
	149	5745	11.51	12.50
	157	5785	11.11	
	165	5825	11.21	
Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm) Data Rate (bps) MCS0	Tune-up Limit (dBm)
802.11n HT20 (5GHz)	36	5180	13.01	13.50
	40	5200	12.87	
	44	5220	12.68	
	48	5240	12.80	
	52	5260	12.66	13.00
	56	5280	12.67	
	60	5300	12.63	
	64	5320	12.53	
	100	5500	12.25	13.00
	116	5580	11.94	
	132	5660	11.73	
	140	5700	11.46	
	149	5745	11.72	12.50
	157	5785	11.33	
	165	5825	11.41	

Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm)	Tune-up Limit (dBm)
			Data Rate (bps)	
			MCS0	
802.11n HT40 (5GHz)	38	5190	12.88	13.50
	46	5230	12.85	
	54	5270	12.66	13.00
	62	5310	12.48	
	102	5510	12.42	13.00
	110	5550	12.06	
	118	5590	12.02	
	134	5670	11.81	
	151	5755	11.83	12.50
	159	5795	11.63	
Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm)	Tune-up Limit (dBm)
			Data Rate (bps)	
			MCS0	
802.11ac HT20 (5GHz)	36	5180	11.73	12.50
	40	5200	11.82	
	44	5220	11.58	
	48	5240	11.69	
	52	5260	11.61	12.50
	56	5280	11.43	
	60	5300	11.27	
	64	5320	11.38	
	100	5500	11.07	11.50
	116	5580	10.62	
	132	5660	10.54	
	140	5700	10.40	
	149	5745	10.51	11.50
	157	5785	10.28	
	165	5825	10.24	
Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm)	Tune-up Limit (dBm)
			Data Rate (bps)	
			MCS0	
802.11ac HT40 (5GHz)	38	5190	12.13	12.50
	46	5230	11.82	
	54	5270	11.73	12.50
	62	5310	11.58	
	102	5510	11.33	11.50
	110	5550	11.14	

Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm)	Tune-up Limit (dBm)
	118	5590	11.08	
	134	5670	10.86	
	151	5755	10.93	11.50
	159	5795	10.63	
Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm) Data Rate (bps) MCS0	Tune-up Limit (dBm)
802.11ac HT80 (5GHz)	42	5210	9.49	10.50
	58	5290	9.30	10.50
	106	5530	9.12	10.00
	122	5610	9.04	
	155	5775	9.01	10.00

Note. 1. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.
2. The Tx power is set to 14 for 802.11a /802.11n HT20 /802.11n HT40 mode, set to 13 for 802.11ac HT20 / 802.11ac HT40 / 802.11ac HT80 mode by software.

Sensor on

Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm) Data Rate (bps) 6M	Tune-up Limit (dBm)
802.11a (5GHz)	36	5180	6.41	7.00
	40	5200	6.37	
	44	5220	6.16	
	48	5240	6.25	
	52	5260	6.04	6.50
	56	5280	5.93	
	60	5300	5.83	
	64	5320	5.73	
	100	5500	5.53	6.00
	116	5580	5.29	
	132	5660	5.02	
	140	5700	4.74	
	149	5745	4.38	5.50
	157	5785	4.23	
	165	5825	4.44	
Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm) Data Rate (bps) MCS0	Tune-up Limit (dBm)

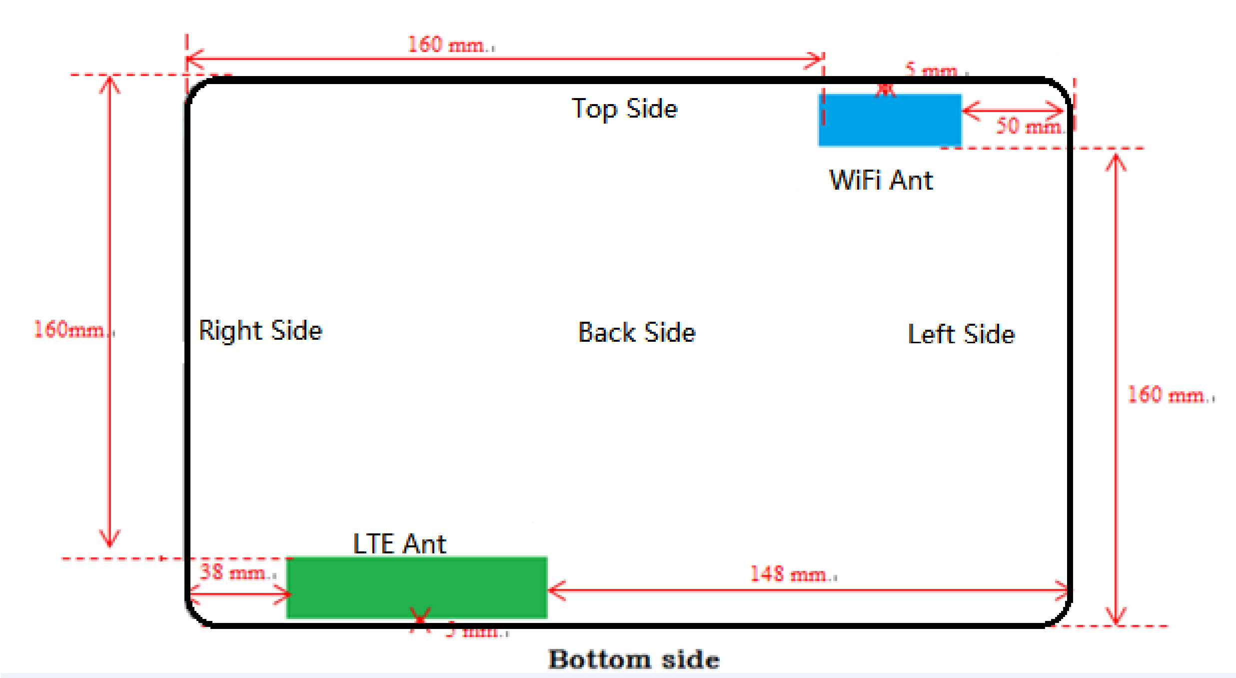
Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm)	Tune-up Limit (dBm)
802.11n HT20 (5GHz)	36	5180	6.26	7.00
	40	5200	6.46	
	44	5220	6.14	
	48	5240	6.22	
	52	5260	6.16	6.50
	56	5280	5.89	
	60	5300	5.93	
	64	5320	5.71	
	100	5500	5.59	6.00
	116	5580	5.31	
	132	5660	4.95	
	140	5700	4.66	
	149	5745	4.46	5.50
	157	5785	4.11	
	165	5825	4.54	
Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm)	Tune-up Limit (dBm)
			Data Rate (bps)	
			MCS0	
802.11n HT40 (5GHz)	38	5190	5.78	7.00
	46	5230	5.69	
	54	5270	5.62	6.50
	62	5310	5.57	
	102	5510	5.06	6.00
	110	5550	4.96	
	118	5590	5.04	
	134	5670	4.72	
	151	5755	4.30	5.50
	159	5795	4.03	
Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm)	Tune-up Limit (dBm)
			Data Rate (bps)	
			MCS0	
802.11ac HT20 (5GHz)	36	5180	6.16	7.00
	40	5200	6.22	
	44	5220	6.04	
	48	5240	6.18	
	52	5260	5.99	6.50
	56	5280	5.86	
	60	5300	5.97	
	64	5320	5.75	
	100	5500	5.64	6.00

Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm)	Tune-up Limit (dBm)
	116	5580	5.42	
	132	5660	5.07	
	140	5700	4.97	
	149	5745	4.35	5.50
	157	5785	3.96	
	165	5825	4.28	
Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm) / Data Rate (bps) / MCS0	Tune-up Limit (dBm)
802.11ac HT40 (5GHz)	38	5190	5.86	6.50
	46	5230	5.68	
	54	5270	5.45	6.00
	62	5310	5.05	
	102	5510	4.86	5.50
	110	5550	4.82	
	118	5590	3.93	
	134	5670	3.95	
	151	5755	3.68	5.00
	159	5795	3.82	
Mode	Channel	Frequency (MHz)	Average Conducted Power (dBm) / Data Rate (bps) / MCS0	Tune-up Limit (dBm)
802.11ac HT80 (5GHz)	42	5210	3.63	4.50
	58	5290	3.40	4.00
	106	5530	2.69	3.50
	122	5610	2.59	
	155	5775	1.52	3.00

Note. 1. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.
2. The Tx power is set to 6.5 for 802.11a /802.11n HT20 /802.11n HT40 mode/ 802.11ac HT20 / 802.11ac HT40 / 802.11ac HT80 mode by software.

10 Measured and Reported (Scaled) SAR Results

10.1 EUT Antenna Locations



Overall (Length x Width): 247 mm x 173 mm Overall Diagonal: 301mm/Display Diagonal: 257mm						
Distance of the Antenna to the EUT surface/edge						
Antenna	Back Side	Front side	Left Edge	Right Edge	Top Edge	Bottom Edge
LTE Antenna	0	0	148	38	160	5
Wi-Fi Antenna	0	0	50	160	5	160

(1) The SAR exclusion threshold for distances ≤50mm is defined by the following equation:

$$\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} * \sqrt{\text{Frequency (GHz)}} \le 3.0$$

We calculate mW of the exclusion threshold value (3.0) to be compared.

$$[3.0 * \text{(min.test separation distance, mm)} / \sqrt{\text{Frequency (GHz)}}\ ] \text{ mW}$$

(2) The SAR exclusion threshold for distances >50mm is defined by the following equation, as illustrated in KDB 447498 D01 Appendix B:

a) at 100 MHz to 1500 MHz

[(Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance - 50 mm) · (f $_{(MHz)}$/150)] mW

b) at > 1500 MHz and ≤ 6 GHz

[Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance - 50 mm) ·10] mW

Test separation distance 0mm

Band	Test Position	Frequency (MHz)	Separation Distance (mm)	Maximum Power (dBm)	Maximum Power (mW)	SAR Exclusion Thresholds (mW)	Standalone SAR
LTE 12	Back side	711	0	25.5	354.81	17.79	Yes
	Left Edge	711	148	25.5	354.81	642.41	No
	Right Edge	711	38	25.5	354.81	135.20	Yes
	Top Edge	711	160	25.5	354.81	699.29	No
	Bottom Edge	711	5	25.5	354.81	17.79	Yes
LTE 13	Back side	784.5	0	24.5	281.84	16.94	Yes
	Left Edge	784.5	148	24.5	281.84	681.89	No
	Right Edge	784.5	38	24.5	281.84	128.71	Yes
	Top Edge	784.5	160	24.5	281.84	744.65	No
	Bottom Edge	784.5	5	24.5	281.84	16.94	Yes
Wi-Fi Antenna	Back side	5775	0	13.5	22.39	6.24	Yes
	Left Edge	5775	50	13.5	22.39	62.42	No
	Right Edge	5775	160	13.5	22.39	1162.42	No
	Top Edge	5775	5	13.5	22.39	6.24	Yes
	Bottom Edge	5775	160	13.5	22.39	1162.42	No

10.2 Measured SAR Results

Table 1: LTE Band 12 (10MHz)

Test Position	Cover Type	RB size	RB offset	Channel/ Frequency (MHz)	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Drift (dB)	Measured SAR_{1g} (W/kg)	Scaling Factor	Reported SAR_{1g} (W/kg)	Plot No.
Body-worn (QPSK, Distance 0mm)											
Back Side	standard	1RB	25	23095/707.5	19.0	18.25	0.170	0.630	1.00	0.630	/
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	Standard	1RB	25	23095/707.5	25.5	25.05	0.030	0.061	1.11	0.067	/
Top Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bottom Edge	standard	1RB	25	23095/707.5	19.0	18.25	0.047	0.281	1.19	0.334	/
Back Side	standard	50%RB	0	23130/711	19.0	18.21	0.116	0.632	1.20	0.758	5
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	Standard	50%RB	0	23130/711	24.0	23.71	0.120	0.058	1.07	0.062	/
Top Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bottom Edge	standard	50%RB	0	23130/711	19.0	18.21	0.030	0.276	1.20	0.331	/
Body-worn (QPSK, Distance 14mm)											
Back Side	standard	1RB	25	23095/707.5	25.5	25.05	-0.029	0.206	1.11	0.228	6
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bottom Edge	standard	1RB	25	23095/707.5	25.5	25.05	0.033	0.120	1.11	0.133	/
Back Side	standard	50%RB	0	23130/711	24.0	23.71	-0.060	0.185	1.07	0.198	/
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bottom Edge	standard	50%RB	0	23130/711	24.0	23.71	0.100	0.094	1.07	0.100	/

Note: 1.The value with blue color is the maximum SAR Value of each test band.

2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s).

3. For QPSK with 100% RB allocation, SAR is required when and the highest reported SAR for 1 RB and 50% RB allocation in are ≥ 0.8 W/kg.

Table 2: LTE Band 13 (10MHz)

Test Position	Cover Type	RB size	RB offset	Channel/ Frequency (MHz)	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Drift (dB)	Measured SAR_{1g} (W/kg)	Scaling Factor	Reported SAR_{1g} (W/kg)	Plot No.
Body-worn (QPSK, Distance 0mm)											
Back Side	standard	1RB	0	23230/782	18.50	17.96	0.035	0.445	1.13	0.504	7
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	Standard	1RB	0	23230/782	24.50	23.97	0.020	0.191	1.13	0.216	/
Top Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bottom Edge	standard	1RB	0	23230/782	18.50	17.96	0.025	0.202	1.13	0.229	/
Back Side	standard	50%RB	25	23230/782	18.50	17.77	0.100	0.413	1.18	0.489	/
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	Standard	50%RB	25	23230/782	23.00	22.48	0.150	0.186	1.13	0.210	/
Top Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bottom Edge	standard	50%RB	25	23230/782	18.50	17.77	-0.160	0.199	1.18	0.235	/
Body-worn (QPSK, Distance 14mm)											
Back Side	standard	1RB	0	23230/782	24.50	23.97	-0.021	0.378	1.13	0.427	8
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bottom Edge	standard	1RB	0	23230/782	24.50	23.97	-0.022	0.042	1.13	0.048	/
Back Side	standard	50%RB	25	23230/782	23.00	22.48	0.000	0.301	1.13	0.339	/
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Bottom Edge	standard	50%RB	25	23230/782	23.00	22.48	0.150	0.045	1.13	0.051	/

Note: 1.The value with blue color is the maximum SAR Value of each test band.

2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is ≤ 0.8 W/kg then testing at the other channels is not required for such test configuration(s).

3. For QPSK with 100% RB allocation, SAR is required when and the highest reported SAR for 1 RB and 50% RB allocation in are ≥ 0.8 W/kg.

Table 3: Wi-Fi (5G, U-NII-1)

Test Position	Cover Type	Channel/ Frequency (MHz)	Mode 802.11a	Duty Cycle	Area Scan Max.SAR (W/Kg)	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Measured SAR_{1g} (W/kg)	Scaling Factor	Reported SAR_{1g} (W/kg)	Plot No.
Body-worn (Distance 0mm)												
Back Side	standard	38/5190	OFDM	1:1	0.0751	7.00	5.78	0.020	0.156	1.32	0.207	/
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top Edge	standard	38/5190	OFDM	1:1	0.214	7.00	5.78	0.021	0.236	1.32	0.313	9
Bottom Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Body-worn (Distance 14mm)												
Back Side	standard	38/5190	OFDM	1:1	0.176	13.50	12.88	0.000	0.119	1.15	0.137	/
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top Edge	standard	36/5180	OFDM	1:1	0.298	13.50	12.88	-0.022	0.223	1.15	0.257	10
Bottom Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note: 1. The value with blue color is the maximum SAR Value of each test band.

2. When different maximum output power is specified for U-NII-1 and U-NII-2A, begin SAR measurement in the band with higher specified maximum output power. The highest *reported* SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration;

Table 4: Wi-Fi (5G, U-NII-2C)

Test Position	Cover Type	Channel/ Frequency (MHz)	Mode 802.11a	Duty Cycle	Area Scan Max.SAR (W/Kg)	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Measured SAR_{1g} (W/kg)	Scaling Factor	Reported SAR_{1g} (W/kg)	Plot No.
Body-worn (Distance 0mm)												
Back Side	standard	102/5510	OFDM	1:1	0.105	6.00	5.06	0.000	0.180	1.24	0.223	/
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top Edge	standard	102/5510	OFDM	1:1	0.121	6.00	5.06	0.111	0.275	1.24	0.341	11
Bottom Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Body-worn (Distance 14mm)												
Back Side	standard	102/5510	OFDM	1:1	0.0554	13.00	12.42	0.034	0.115	1.14	0.131	/
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	/
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top Edge	standard	102/5510	OFDM	1:1	0.296	13.00	12.42	0.100	0.214	1.14	0.245	12
Bottom Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Note: 1. The value with blue color is the maximum SAR Value of each test band.												

Table 5: Wi-Fi (5G, U-NII-3)

Test Position	Cover Type	Channel/ Frequency (MHz)	Mode 802.11a	Duty Cycle	Area Scan Max.SAR (W/Kg)	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Measured SAR_{1g} (W/kg)	Scaling Factor	Reported SAR_{1g} (W/kg)	Plot No.
Body-worn (Distance 0mm)												
Back Side	standard	151/5755	OFDM	1:1	0.0507	5.50	4.30	-0.020	0.077	1.32	0.102	/
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top Edge	standard	151/5755	OFDM	1:1	0.0302	5.50	4.30	0.077	0.078	1.32	0.103	13
Bottom Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Body-worn (Distance 14mm)												
Back Side	standard	151/5755	OFDM	1:1	0.0107	12.50	11.83	0.000	0.011	1.17	0.013	/
Front Side	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	/
Left Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Top Edge	standard	151/5755	OFDM	1:1	0.0897	12.50	11.83	0.000	0.116	1.17	0.135	14
Bottom Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Note: 1. The value with blue color is the maximum SAR Value of each test band.												

10.3 Simultaneous Transmission Analysis

Simultaneous Transmission Configurations	Body-worn
LTE(Data) + Wi-Fi-5GHz(data)	Yes

General Note:

1. The Scaled SAR summation is calculated based on the same configuration and test position.
2. Per KDB 447498 D01, simultaneous transmission SAR is compliant if,
   i) Scalar SAR summation < 1.6W/kg, simultaneously transmission SAR measurement is not necessary.
   ii) SPLSR = (SAR1 + SAR2)^1.5 / (min. separation distance, mm), and the peak separation distance is determined from the square root of [(x1-x2)2 + (y1-y2)2 + (z1-z2)2], where (x1, y1, z1) and (x2, y2, z2) are the coordinates of the extrapolated peak SAR locations in the zoom scan.
   iii) If SPLSR ≤ 0.04, simultaneously transmission SAR measurement is not necessary.

The maximum SAR_{1g} Value for LTE Antenna

Test Position \ SAR_{1g}(W/kg)		LTE FDD 12	LTE FDD 13	MAX. SAR_{1g}
Body SAR (0mm)	Back Side	0.758	0.504	**0.758**
	Front Side	N/A	N/A	**0**
	Left Edge	N/A	N/A	**0**
	Right Edge	0.067	0.216	**0.216**
	Top Edge	N/A	N/A	**0**
	Bottom Edge	0.334	0.235	**0.334**
Body SAR (14mm)	Back Side	0.228	0.427	**0.427**
	Front Side	N/A	N/A	**0**
	Left Edge	N/A	N/A	**0**
	Right Edge	N/A	N/A	**0**
	Top Edge	N/A	N/A	**0**
	Bottom Edge	0.133	0.051	**0.133**

About Wi-Fi and LTE- Antenna

Test Position \ $SAR_{1g/10g}$(W/kg)		LTE-Antenna	Wi-Fi (U-NII-1)	Wi-Fi (U-NII-2C)	Wi-Fi (U-NII-3)	MAX. ΣSAR_{1g}
Body SAR (0mm)	Back Side	**0.758**	0.207	**0.223**	0.102	0.981
	Front Side	**0**	0	0	0	0
	Left Edge	**0**	0	0	0	0
	Right Edge	**0.216**	0	0	0	0.216
	Top Edge	**0**	0.313	**0.341**	0.103	0.341
	Bottom Edge	**0.334**	0	0	0	0.334
Body SAR (14mm)	Back Side	**0.427**	**0.137**	0.131	0.013	0.564
	Front Side	**0**	0	0	0	0
	Left Edge	**0**	0	0	0	0
	Right Edge	**0**	0	0	0	0
	Top Edge	**0**	**0.257**	0.245	0.135	0.257
	Bottom Edge	**0.133**	0	0	0	0.133

Note: 1.The value with blue color is the maximum ΣSAR1g Value.

2. MAX. ΣSAR_{1g} =Unlicensed SAR_{MAX} +Licensed SAR_{MAX}

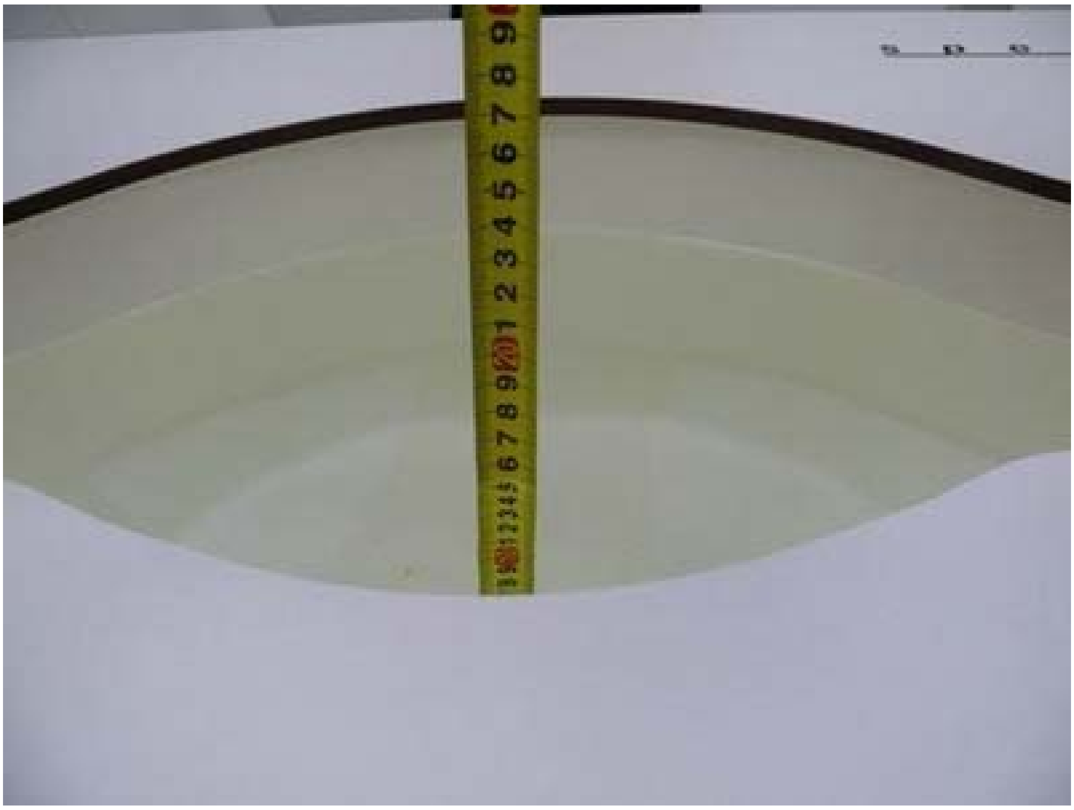
3. MAX. ΣSAR_{1g} = 0.981W/kg <1.6 W/kg, so the Simultaneous transimition SAR with volum scan are not required for BT and Main-Antenna.

11 Measurement Uncertainty

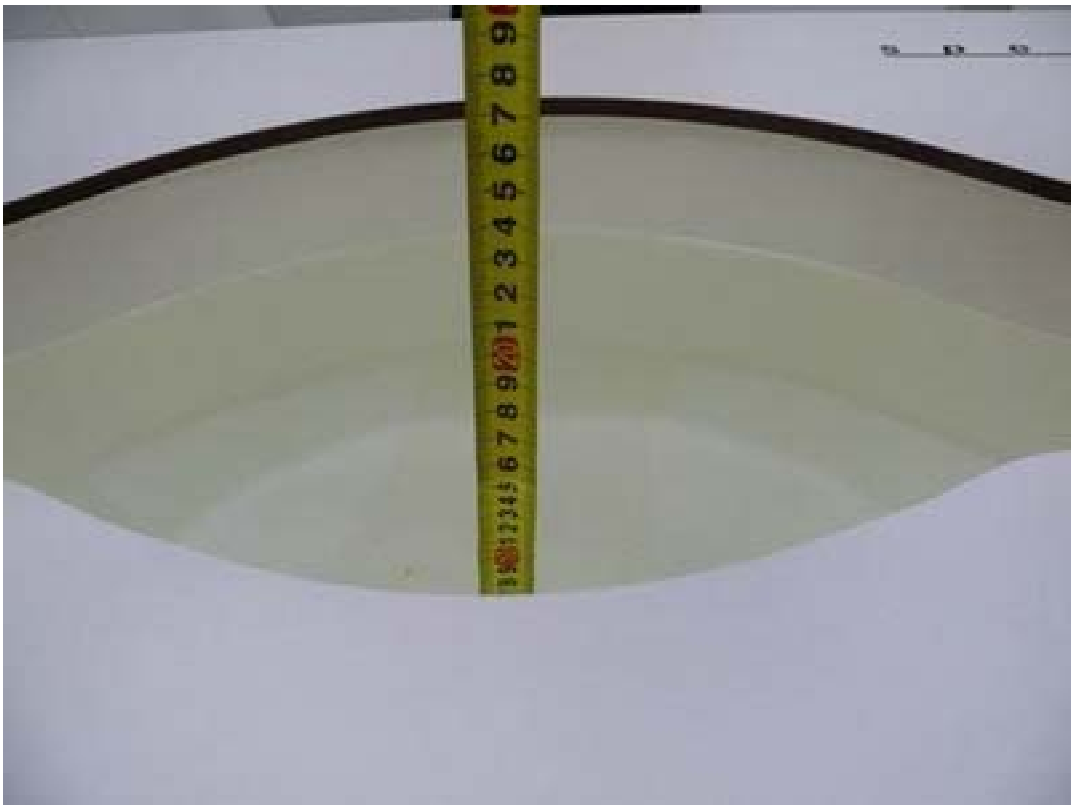
Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528- 2013 is not required in SAR reports submitted for equipment approval.

ANNEX A: Test Layout

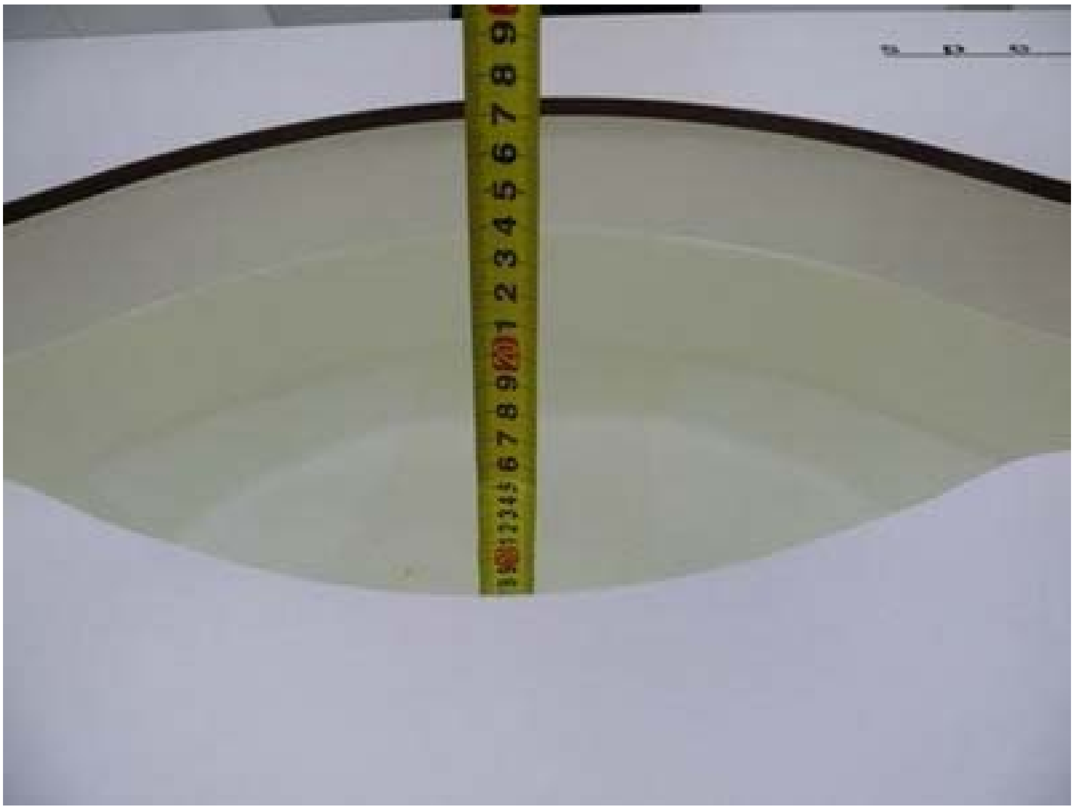
Picture 3: Liquid depth in the flat Phantom (750MHz, 15.4cm depth)



Picture 4: Liquid depth in the flat Phantom (5250 MHz, 15.3cm depth)



Picture 5: Liquid depth in the flat Phantom (5600 MHz, 15.3cm depth)



Picture 6: Liquid depth in the flat Phantom (5750 MHz, 15.0cm depth)

ANNEX B: System Check Results

Plot 1 System Performance Check at 750 MHz Body TSL

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1017

Date: 5/19/2017

Communication System:CW (0); Frequency: 750 MHz;Duty Cycle: 1:1

Medium parameters used: f = 750 MHz; σ = 0.95 S/m; ε_r = 57.0; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.99, 9.99, 9.99); Calibrated: 1/23/2017;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: SAM1; Type: SAM; Serial: TP-1534

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

d=15mm, Pin=250mW/Area Scan (41x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 2.36 W/kg

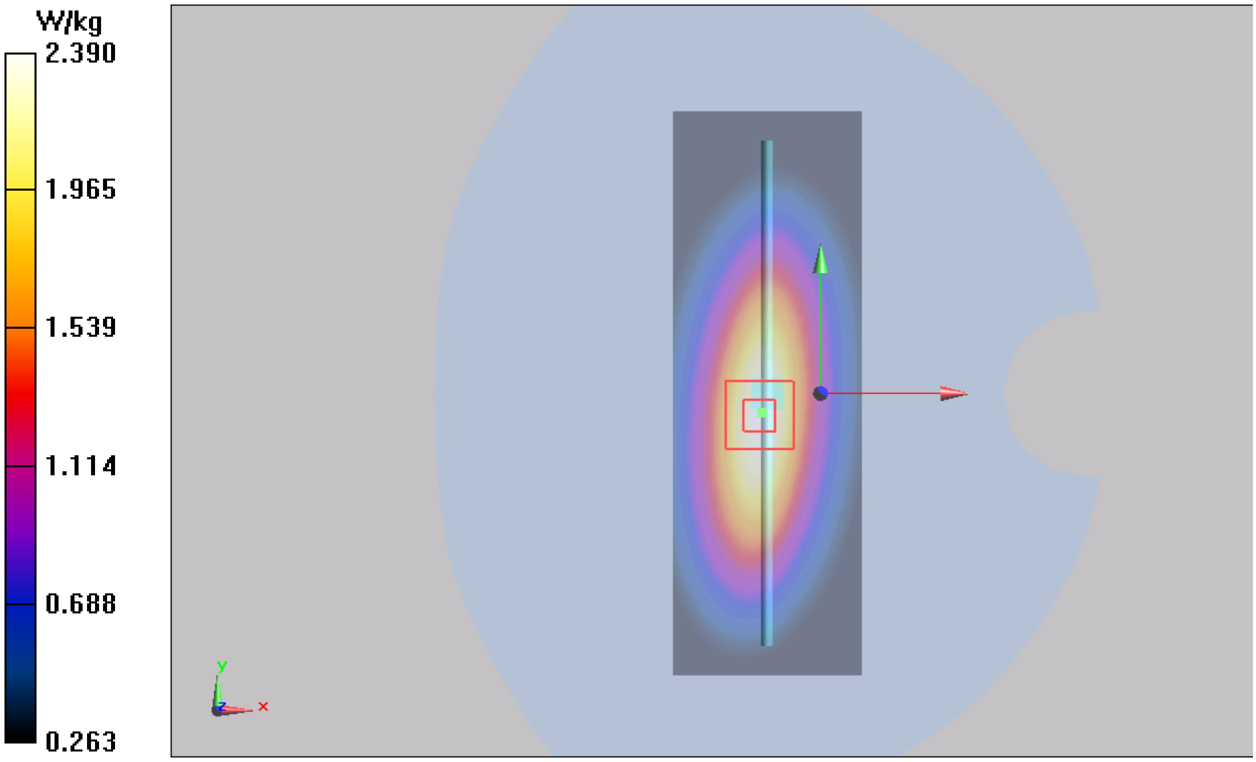
d=15mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 48.998 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 3.24 W/kg

SAR(1 g) = 2.22 W/kg; SAR(10 g) = 1.49 W/kg

Maximum value of SAR (measured) = 2.39 W/kg



Plot 2 System Performance Check at 5250 MHz Body TSL

DUT: Dipole 5250 MHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1151

Date: 6/6/2017

Communication System: CW; Frequency: 5250 MHz;Duty Cycle: 1:1

Medium parameters used: f = 5250 MHz; σ = 5.34mho/m; ε_r = 46.9; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(5.03, 5.03, 5.03); Calibrated: 1/23/2017;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA;

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

d=10mm, Pin=250mW/Area Scan (61x101x1): Measurement grid: dx=1.000mm, dy=1.000mm

Maximum value of SAR (interpolated) = 7.69 mW/g

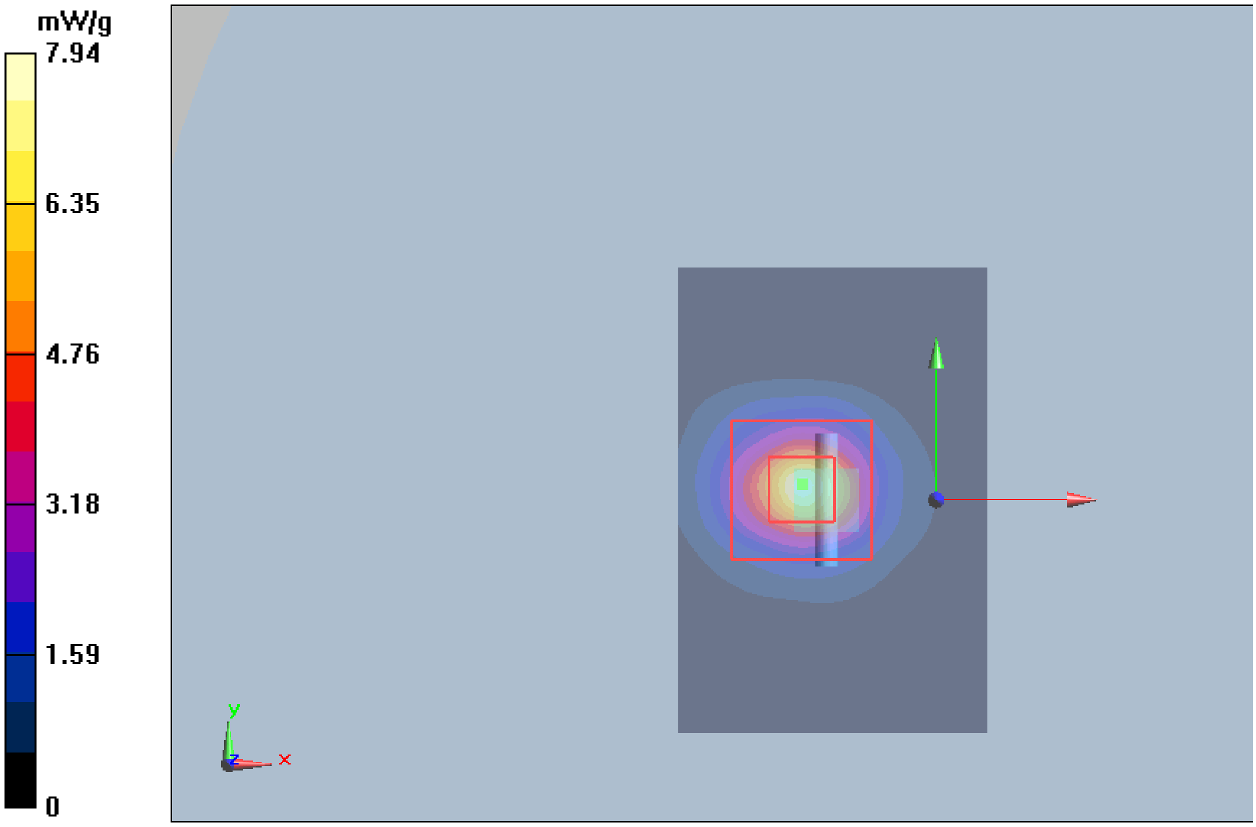
d=10mm, Pin=250mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 36.3 V/m; Power Drift = 0.0277 dB

Peak SAR (extrapolated) = 47.7 W/kg

SAR(1 g) = 7.46 mW/g; SAR(10 g) = 2.26 mW/g

Maximum value of SAR (measured) = 7.94 mW/g



Plot 3 System Performance Check at 5600 MHz Body TSL

DUT: Dipole 5600 MHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1151

Date: 6/6/2017

Communication System: CW; Frequency: 5600 MHz;Duty Cycle: 1:1

Medium parameters used: f = 5600 MHz; σ = 6.00 mho/m; ε_r = 45.7; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.34, 4.34, 4.34); Calibrated: 1/23/2017;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA;

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

d=10mm, Pin=250mW/Area Scan (61x101x1): Measurement grid: dx=1.000mm, dy=1.000mm

Maximum value of SAR (interpolated) = 7.84 mW/g

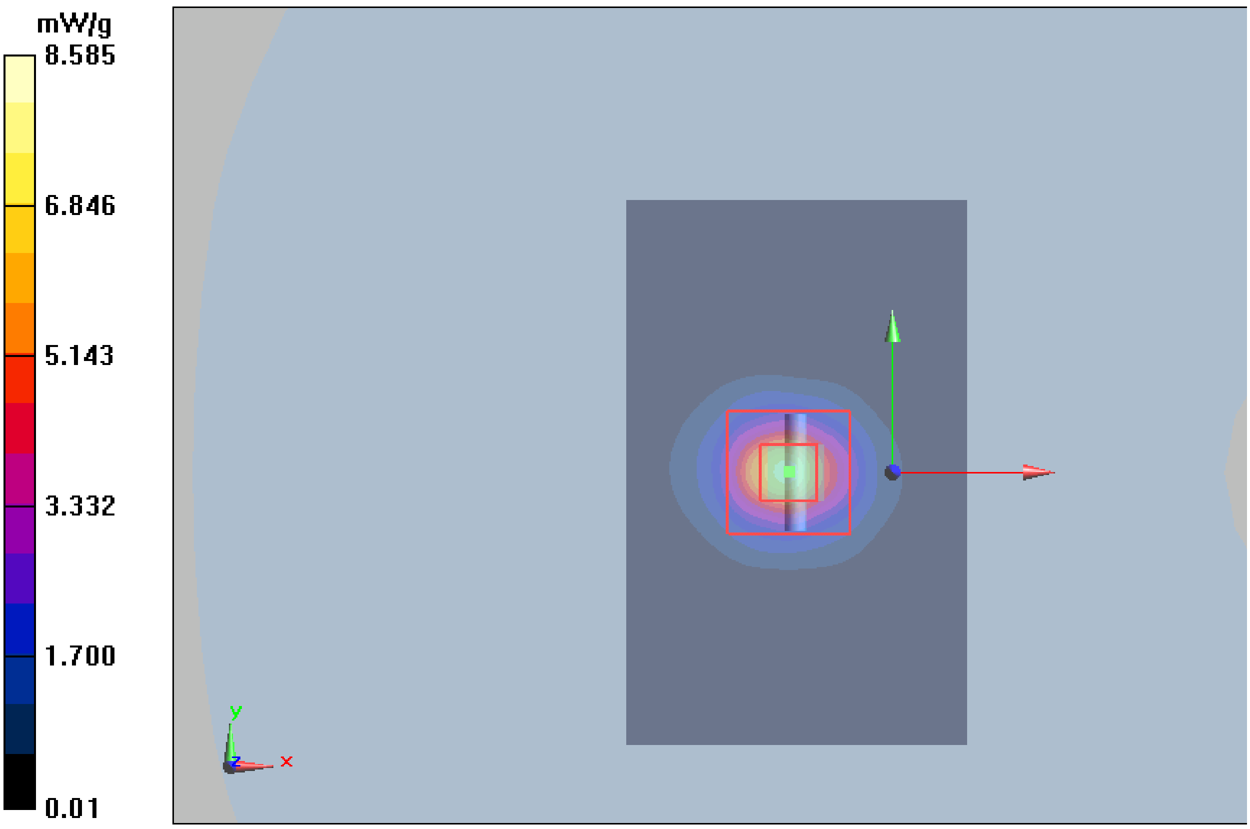
d=10mm, Pin=250mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 38 V/m; Power Drift = -0.018 dB

Peak SAR (extrapolated) = 22.6 W/kg

SAR(1 g) = 8.10 mW/g; SAR(10 g) = 2.11 mW/g

Maximum value of SAR (measured) = 8.585 mW/g



Plot 4 System Performance Check at 5750 MHz Body TSL

DUT: Dipole 5750 MHz; Type: D5GHzV2; Serial: D5GHzV2 - SN: 1151

Date: 6/6/2017

Communication System: CW; Frequency: 5750 MHz;Duty Cycle: 1:1

Medium parameters used: f = 5750 MHz; σ = 6.14 mho/m; ε_r = 45.6; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.52, 4.52, 4.52); Calibrated: 1/23/2017;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA;

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

d=10mm, Pin=250mW/Area Scan (61x101x1): Measurement grid: dx=1.000mm, dy=1.000mm

Maximum value of SAR (interpolated) = 7.84 mW/g

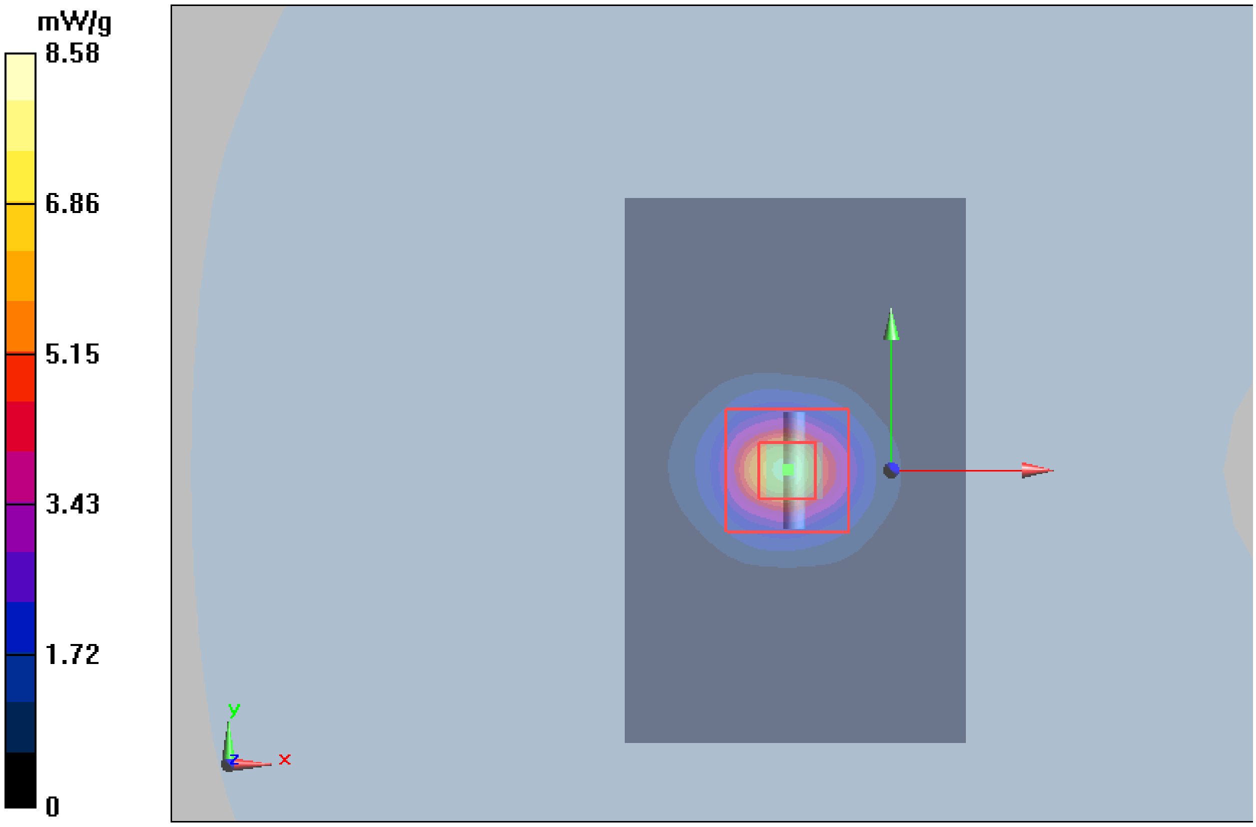
d=10mm, Pin=250mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 38 V/m; Power Drift = -0.018 dB

Peak SAR (extrapolated) = 22.6 W/kg

SAR(1 g) = 7.15 mW/g; SAR(10 g) = 1.99 mW/g

Maximum value of SAR (measured) = 8.58 mW/g



ANNEX C: Highest Graph Results

Plot 5 LTE Band 12 50%RB Back Side High (Distance 0mm)

Date: 5/19/2017

Communication System: UID 0, LTE (0); Frequency: 711 MHz;Duty Cycle: 1:1

Medium parameters used: f = 711 MHz; σ = 0.926 S/m; ε_r = 55.846; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.99, 9.99, 9.99); Calibrated: 1/23/2017;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA; Serial: TP:xxxx

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Back Side High/Area Scan (141x191x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.748 W/kg

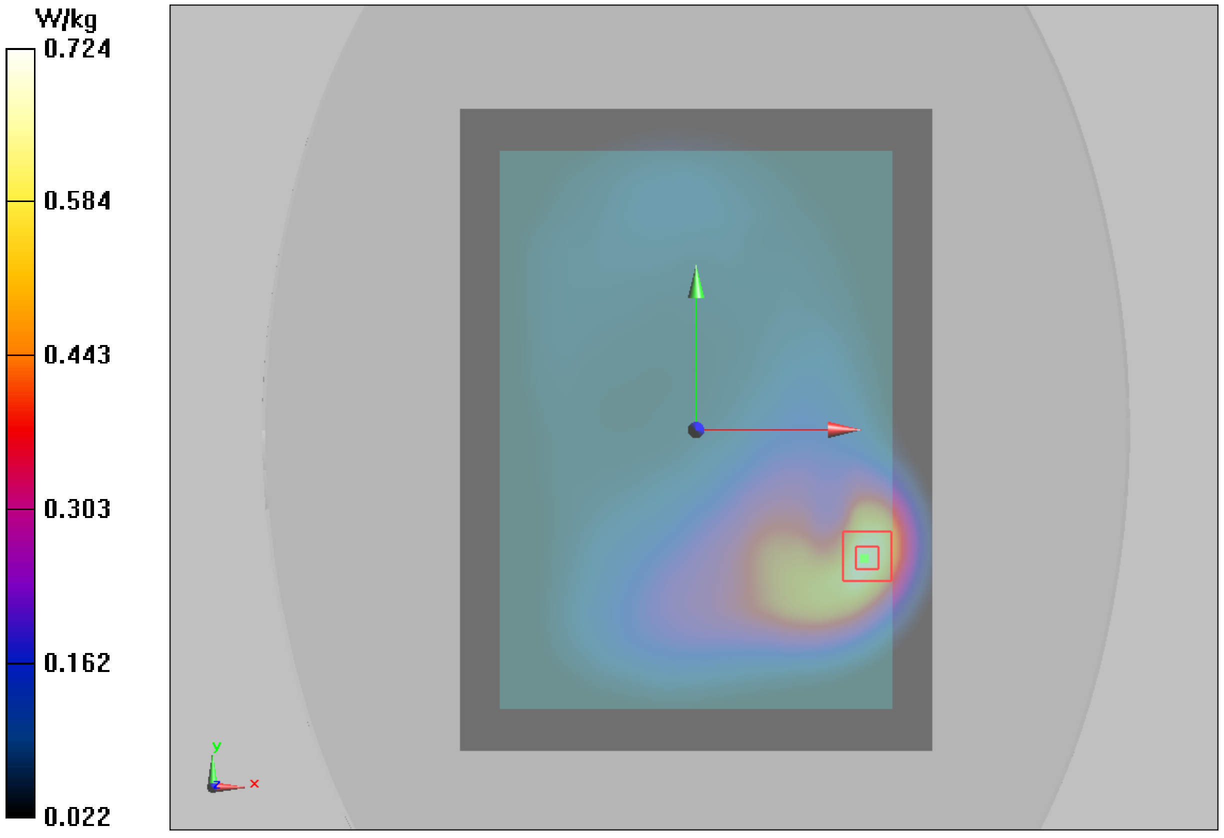
Back Side High/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 3.666 V/m; Power Drift = 0.116 dB

Peak SAR (extrapolated) = 1.36 W/kg

SAR(1 g) = 0.632 W/kg; SAR(10 g) = 0.323 W/kg

Maximum value of SAR (measured) = 0.724 W/kg



Plot 6 LTE Band 12 1RB Back Side Middle (Distance 14mm)

Date: 5/19/2017

Communication System: UID 0, LTE (0); Frequency: 707.5 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): f = 707.5 MHz; σ = 0.922 S/m; ε_r = 55.88; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.99, 9.99, 9.99); Calibrated: 1/23/2017;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA; Serial: TP:xxxx

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Back Side Middle/Area Scan (141x191x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.243 W/kg

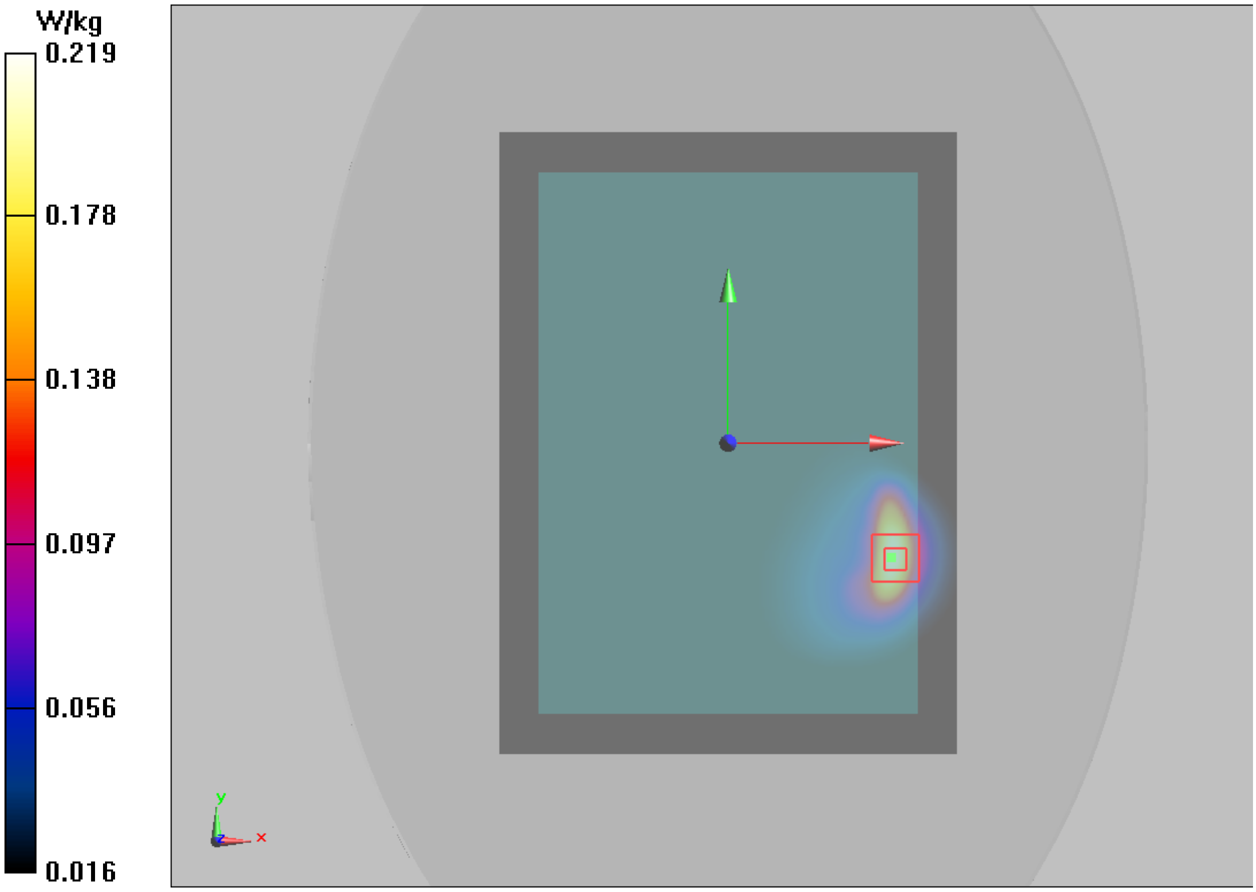
Back Side Middle /Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 5.038 V/m; Power Drift = -0.029 dB

Peak SAR (extrapolated) = 0.323 W/kg

SAR(1 g) = 0.206 W/kg; SAR(10 g) = 0.132 W/kg

Maximum value of SAR (measured) = 0.219 W/kg



Plot 7 LTE Band 13 1RB Back Side Middle (Distance 0mm)

Date: 5/19/2017

Communication System: UID 0, LTE (0); Frequency: 782 MHz;Duty Cycle: 1:1

Medium parameters used: f = 782 MHz; σ = 0.993 S/m; ε_r = 55.093; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.99, 9.99, 9.99); Calibrated: 2017/1/23;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA; Serial: TP:xxxx

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Back Side Middle/Area Scan (141x191x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 0.501 W/kg

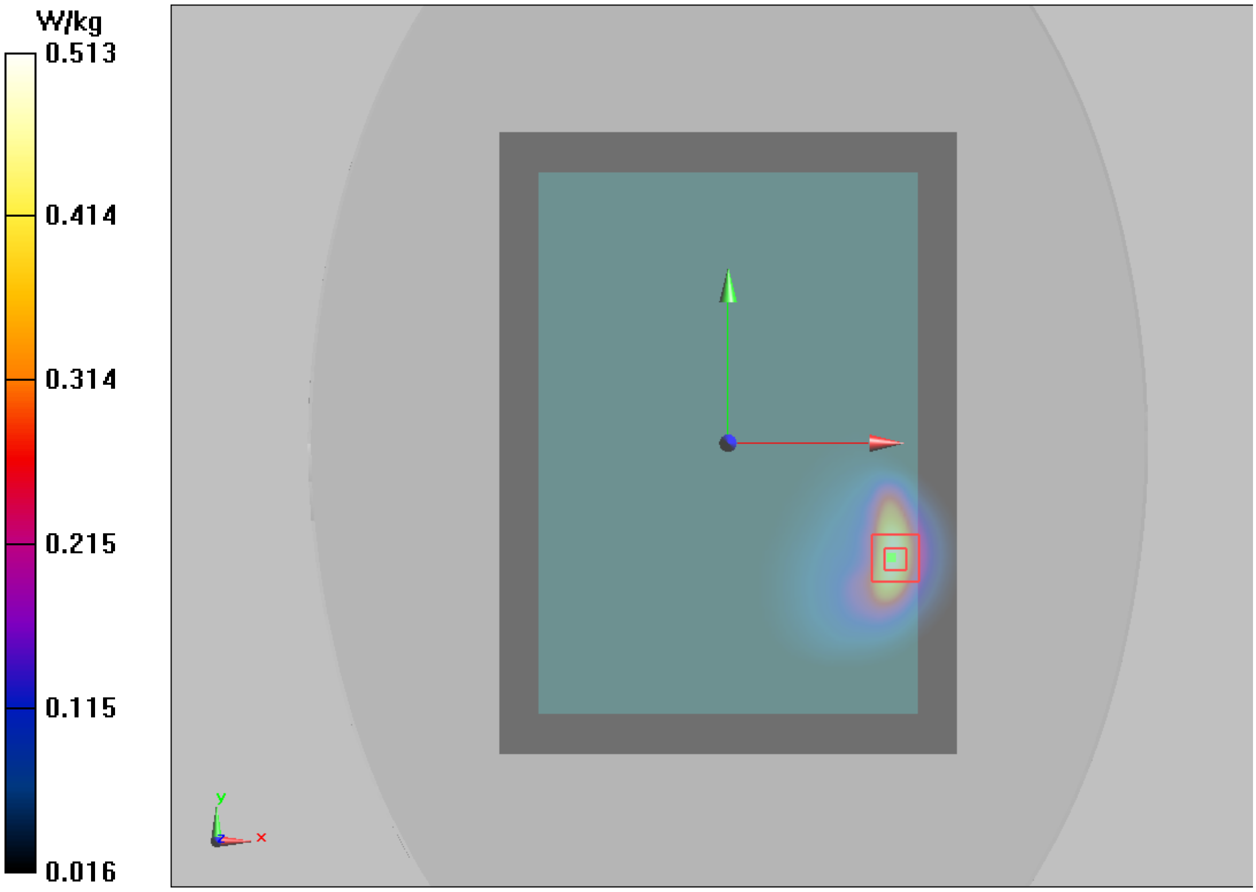
Back Side Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 1.140 V/m; Power Drift = 0.035 dB

Peak SAR (extrapolated) = 0.932 W/kg

SAR(1 g) = 0.445 W/kg; SAR(10 g) = 0.225 W/kg

Maximum value of SAR (measured) = 0.513 W/kg



Plot 8 LTE Band 13 1RB Back Side Middle (Distance 14mm)

Date: 5/19/2017

Communication System: UID 0, LTE (0); Frequency: 782 MHz;Duty Cycle: 1:1

Medium parameters used: f = 782 MHz; σ = 0.993 S/m; ε_r = 55.093; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.99, 9.99, 9.99); Calibrated: 2017/1/23;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA; Serial: TP:xxxx

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Back Side Middle/Area Scan (51x291x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm Maximum value of SAR (interpolated) = 0.399 W/kg

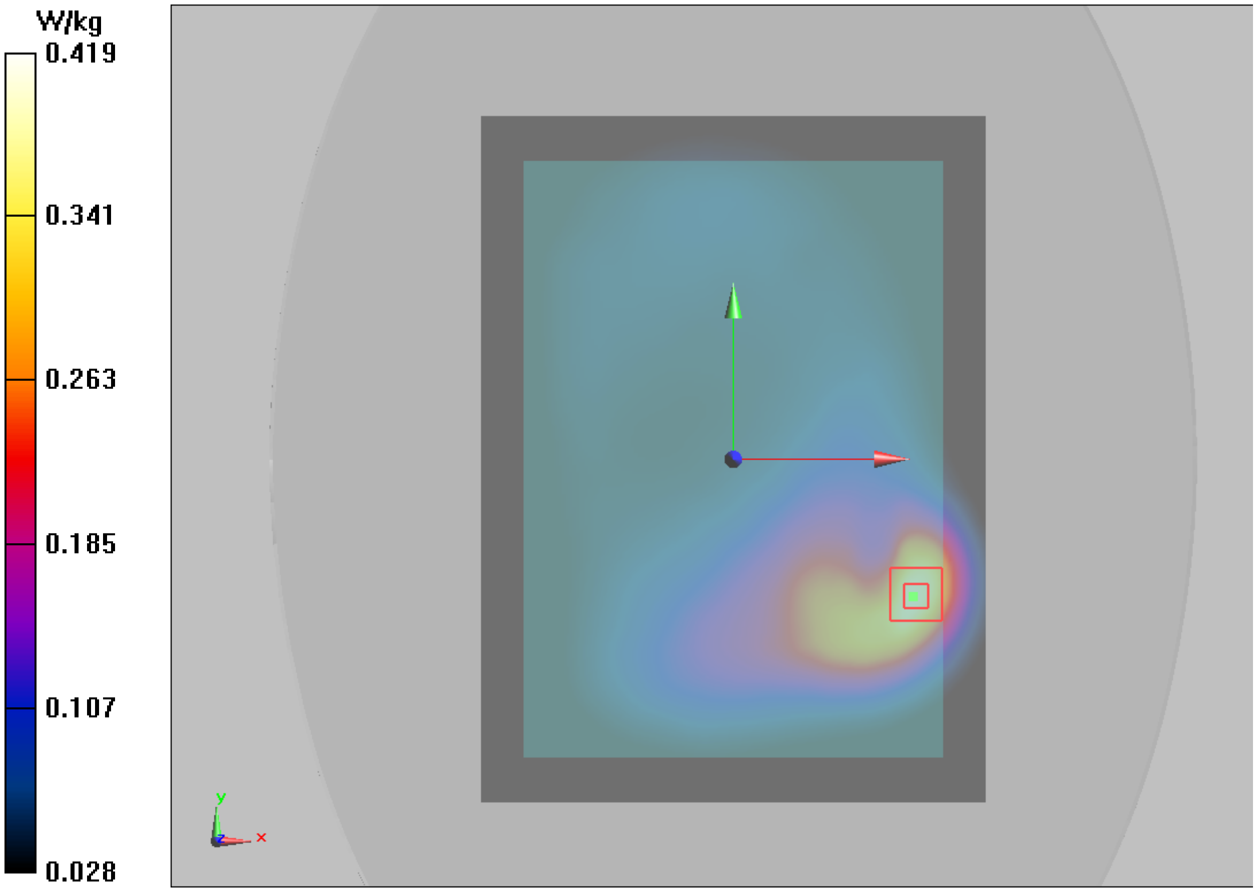
Back Side Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.065 V/m; Power Drift = -0.021 dB

Peak SAR (extrapolated) = 0.593 W/kg

SAR(1 g) = 0.378 W/kg; SAR(10 g) = 0.237 W/kg

Maximum value of SAR (measured) = 0.419 W/kg



Wi-Fi-Antenna

Plot 9 802.11a U-NII-1 Top Edge Low (Distance 0mm)

Date: 6/6/2017

Communication System: UID 0, 802.11n(40M) (0); Frequency: 5190 MHz;Duty Cycle: 1:1

Medium parameters used: f = 5190 MHz; σ = 5.304 S/m; ε_r = 48.069; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(5.03, 5.03, 5.03); Calibrated: 2017/1/23;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA; Serial: TP:xxxx

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Top Edge Low /Area Scan (211x291x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.421 W/kg

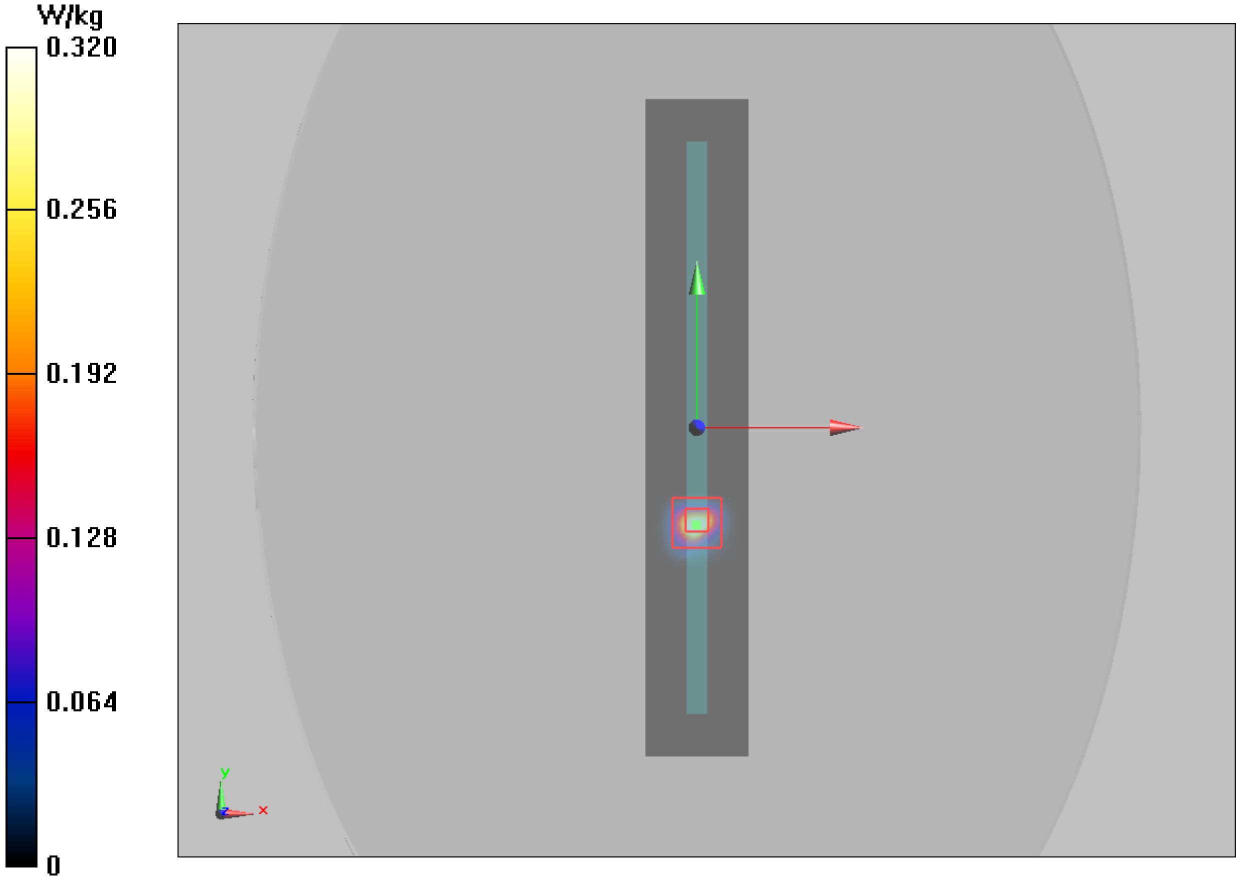
Top Edge Low/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.5180 V/m; Power Drift = 0.021 dB

Peak SAR (extrapolated) = 0.688 W/kg

SAR(1 g) = 0.236 W/kg; SAR(10 g) = 0.065 W/kg

Maximum value of SAR (measured) = 0.320 W/kg



Plot 10 802.11a U-NII-1 Top Edge Low (Distance 14mm)

Date: 6/6/2017

Communication System: UID 0, 802.11n(40M) (0); Frequency: 5190 MHz;Duty Cycle: 1:1

Medium parameters used: f = 5190 MHz; σ = 5.304 S/m; ε_r = 48.069; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(5.03, 5.03, 5.03); Calibrated: 2017/1/23;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA; Serial: TP:xxxx

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Top Edge Low/Area Scan (51x291x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.411 W/kg

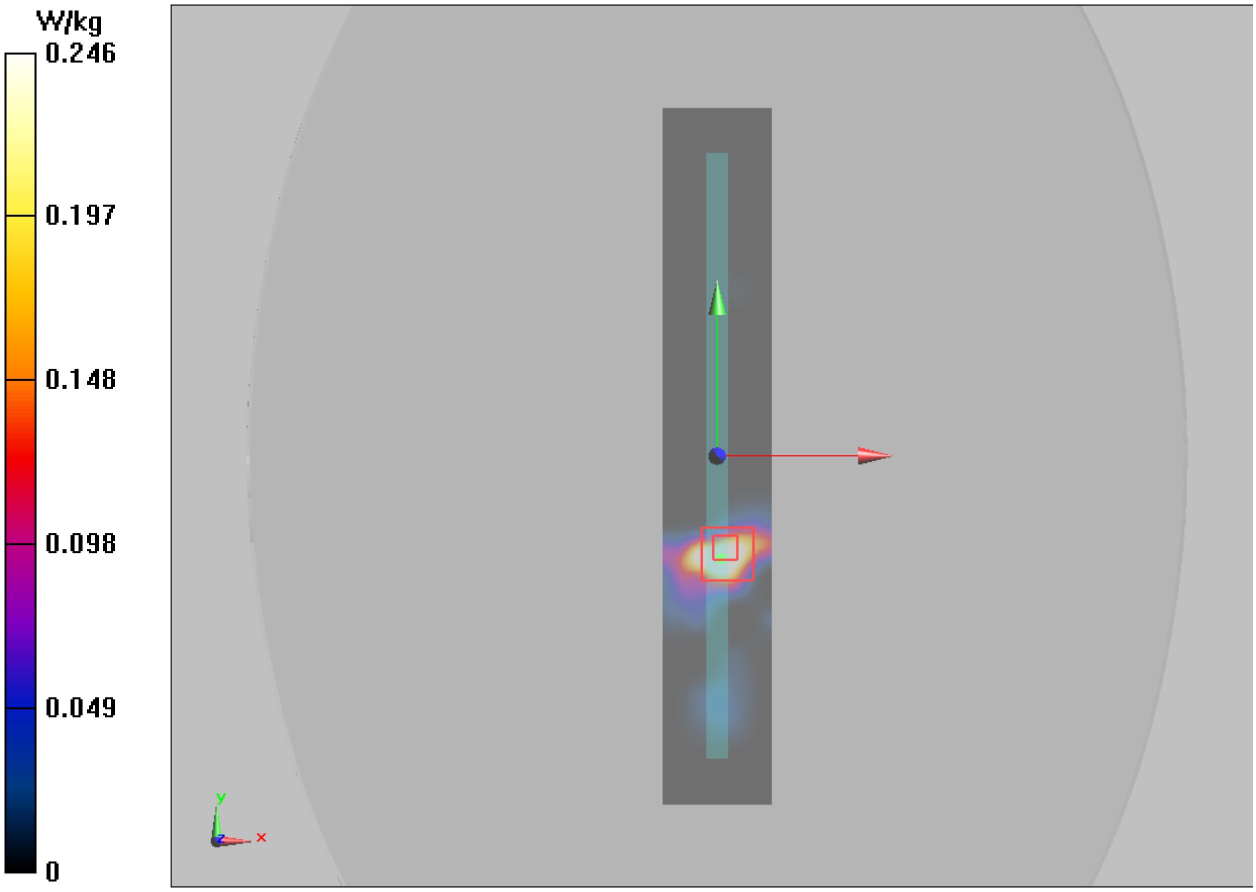
Top Edge Low/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.6020 V/m; Power Drift = -0.022 dB

Peak SAR (extrapolated) = 0.603 W/kg

SAR(1 g) = 0.223 W/kg; SAR(10 g) = 0.084 W/kg

Maximum value of SAR (measured) = 0.246 W/kg



Plot 11 802.11a U-NII-2C Top Edge Low (Distance 0mm)

Date: 6/6/2017

Communication System: UID 0, 802.11n(40M) (0); Frequency: 5510 MHz;Duty Cycle: 1:1

Medium parameters used: f = 5510 MHz; σ = 5.809 S/m; ε_r = 47.728; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.34, 4.34, 4.34); Calibrated: 2017/1/23;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA; Serial: TP:xxxx

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Top Edge Low/Area Scan (211x291x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.132 W/kg

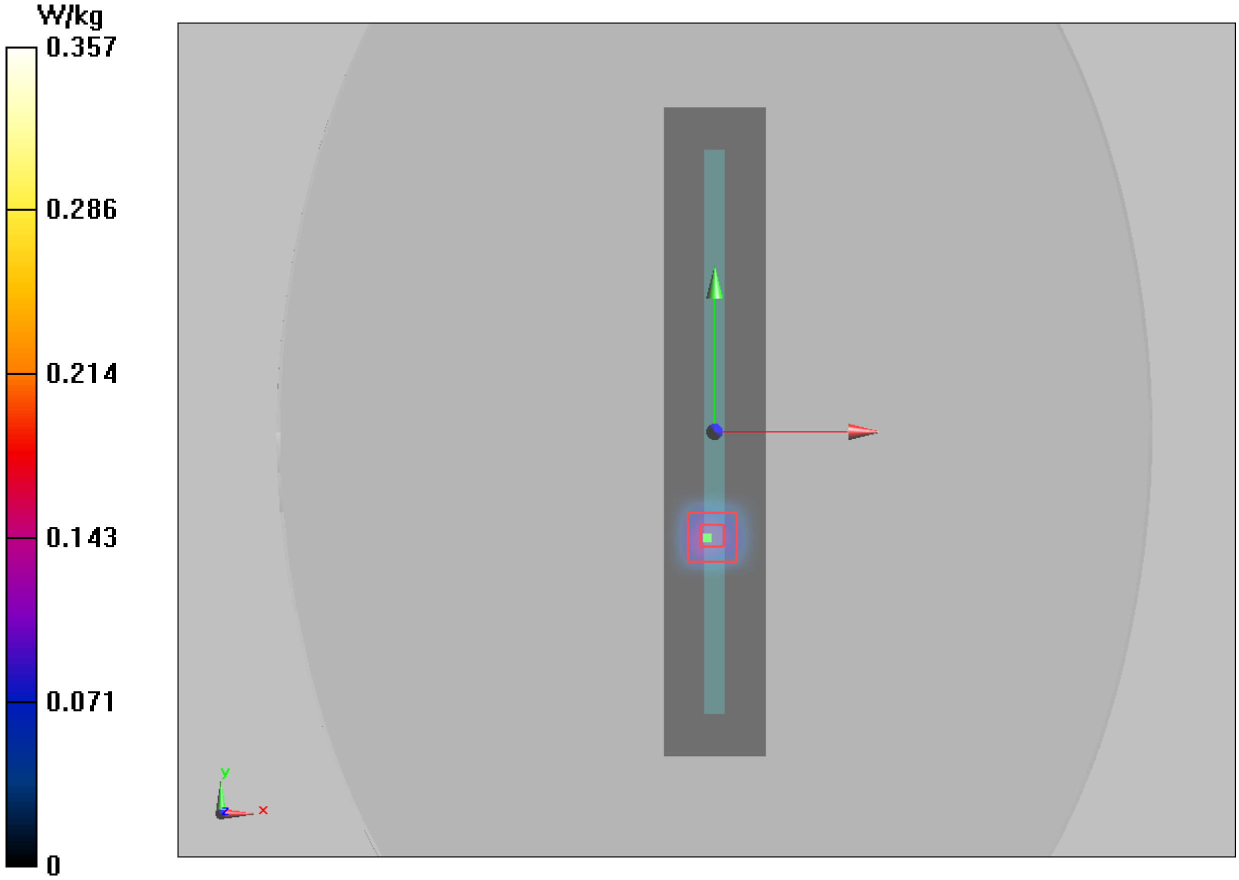
Top Edge Low/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.4310 V/m; Power Drift = 0.111 dB

Peak SAR (extrapolated) = 1.03 W/kg

SAR(1 g) = 0.275 W/kg; SAR(10 g) = 0.068 W/kg

Maximum value of SAR (measured) = 0.357 W/kg



Plot 12 802.11a U-NII-2C Top Edge Low (Distance 14mm)

Date: 6/6/2017

Communication System: UID 0, 802.11n(40M) (0); Frequency: 5510 MHz;Duty Cycle: 1:1

Medium parameters used: f = 5510 MHz; σ = 5.809 S/m; ε_r = 47.728; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.34, 4.34, 4.34); Calibrated: 2017/1/23;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA; Serial: TP:xxxx

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Top Edge Low /Area Scan (51x291x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.419 W/kg

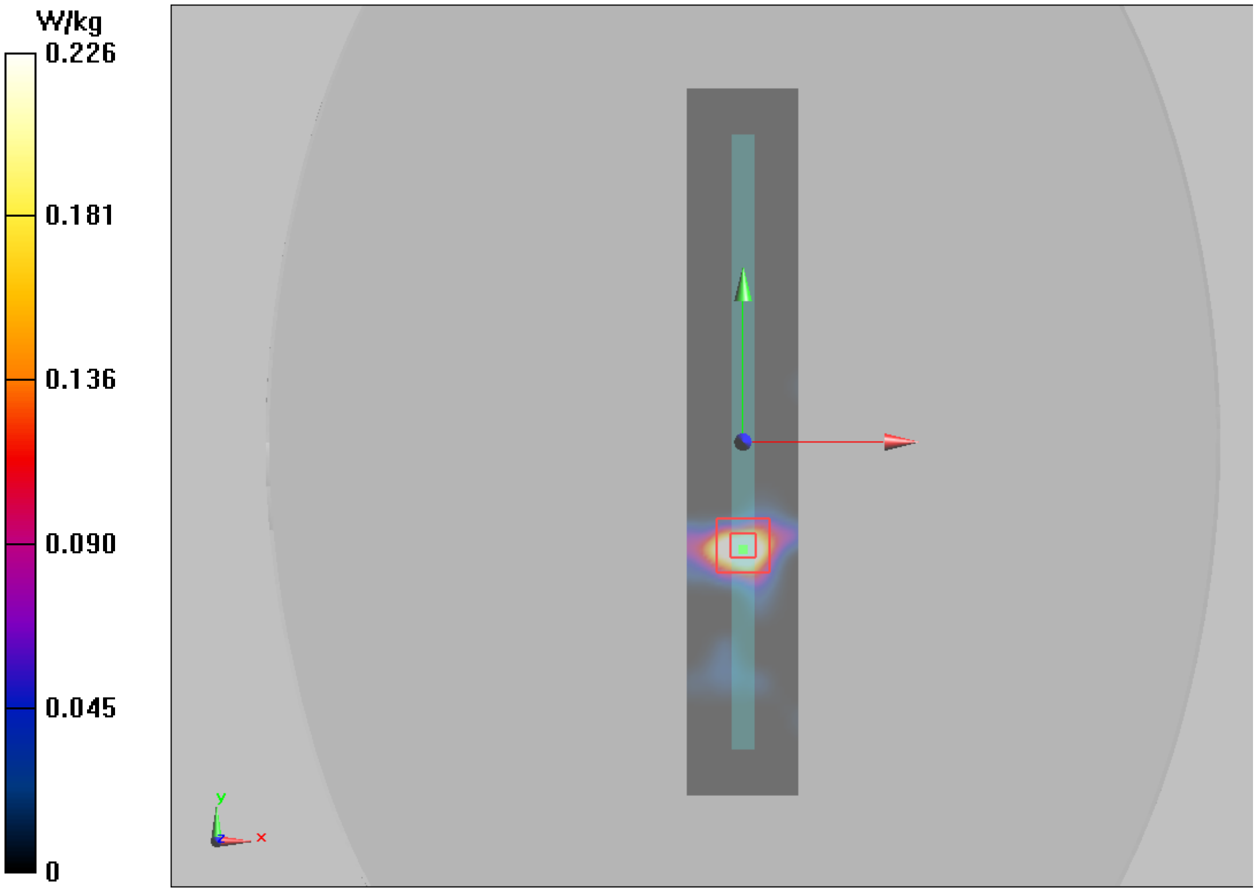
Top Edge Low/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.3740 V/m; Power Drift = 0.1 dB

Peak SAR (extrapolated) = 0.682 W/kg

SAR(1 g) = 0.214 W/kg; SAR(10 g) = 0.081 W/kg

Maximum value of SAR (measured) = 0.226 W/kg



Plot 13 802.11a U-NII-3 Top Edge Low (Distance 0mm)

Date: 6/6/2017

Communication System: UID 0, 802.11n(40M) (0); Frequency: 5755 MHz;Duty Cycle: 1:1

Medium parameters used: f = 5755 MHz; σ = 6.071 S/m; ε_r = 47.721; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.52, 4.52, 4.52); Calibrated: 2017/1/23;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA; Serial: TP:xxxx

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Top Edge Low/Area Scan (211x291x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.0559 W/kg

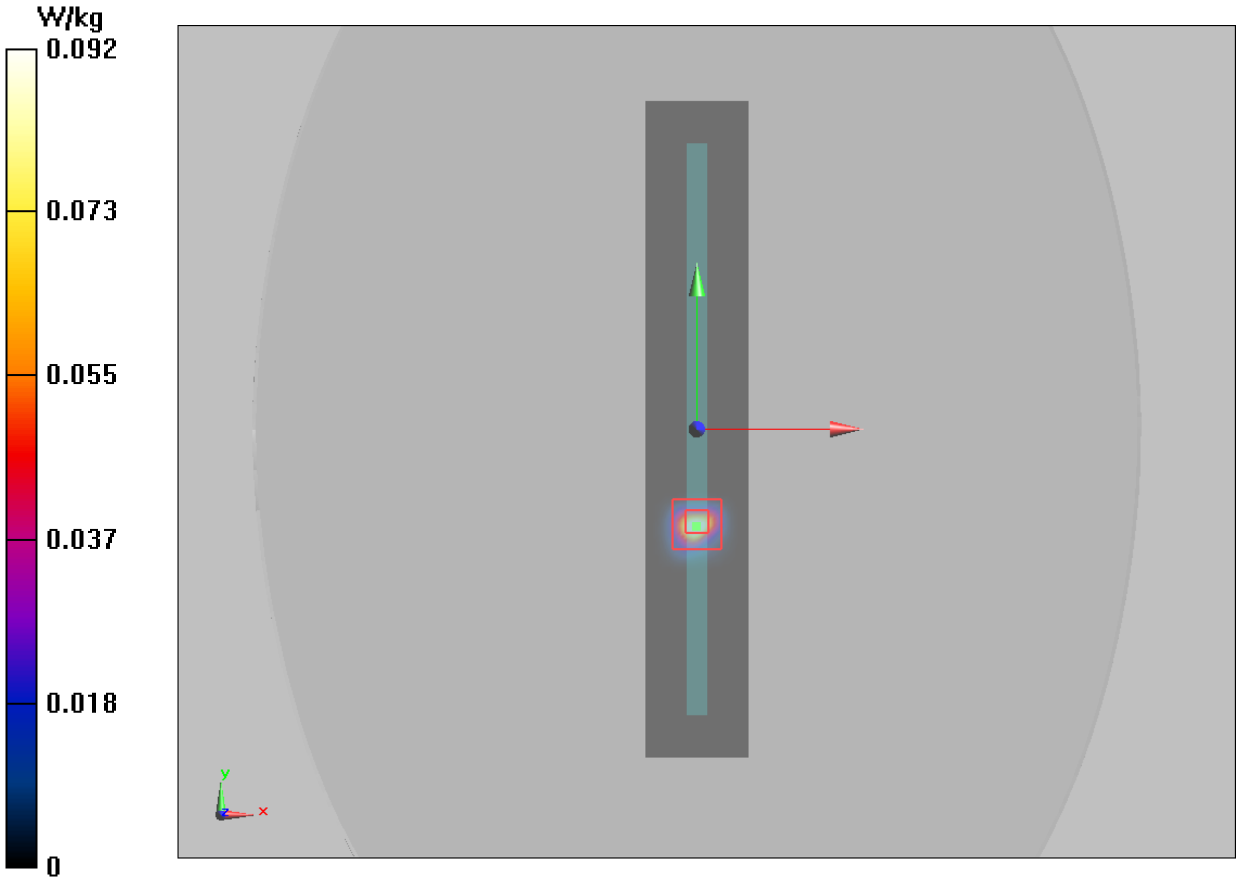
Top Edge Low/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.5160 V/m; Power Drift = 0.077 dB

Peak SAR (extrapolated) = 0.376 W/kg

SAR(1 g) = 0.078 W/kg; SAR(10 g) = 0.018 W/kg

Maximum value of SAR (measured) = 0.0917 W/kg



Plot 14 802.11a U-NII-3 Top Edge Low (Distance 14mm)

Date: 6/6/2017

Communication System: UID 0, 802.11n(40M) (0); Frequency: 5755 MHz;Duty Cycle: 1:1

Medium parameters used: f = 5755 MHz; σ = 6.071 S/m; ε_r = 47.721; ρ = 1000 kg/m^3

Ambient Temperature:22.3 ℃ Liquid Temperature: 21.5℃

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.52, 4.52, 4.52); Calibrated: 2017/1/23;

Electronics: DAE4 Sn1317; Calibrated: 8/2/2016

Phantom: ELI v5.0 (30deg probe tilt); Type: QDOVA002AA; Serial: TP:xxxx

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Top Edge Low/Area Scan (51x291x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.0929 W/kg

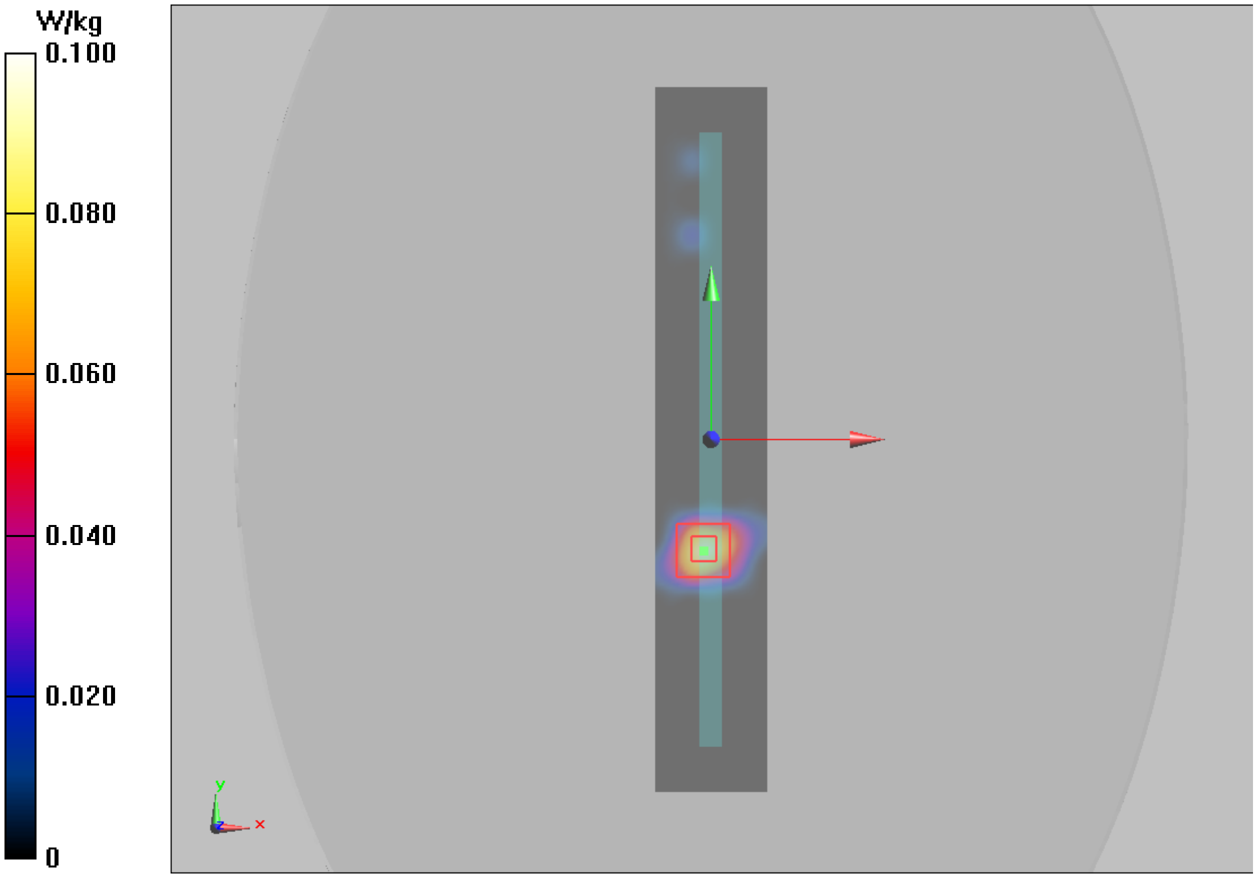
Top Edge Low/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 0.552 W/kg

SAR(1 g) = 0.116 W/kg; SAR(10 g) = 0.043 W/kg

Maximum value of SAR (measured) = 0.1W/kg



ANNEX D: Probe Calibration Certificate

In Collaboration with speag CALIBRATION LABORATORY

中国认可 国际互认 校准 CALIBRATION CNAS L0570

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Client TA(Shanghai) Certificate No: Z17-97012

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3677
Calibration Procedure(s)	FD-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	January 23, 2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101548	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference10dBAttenuator	18N50W-10dB	13-Mar-16(CTTL,No.J16X01547)	Mar-18
Reference20dBAttenuator	18N50W-20dB	13-Mar-16(CTTL, No.J16X01548)	Mar-18
Reference Probe EX3DV4	SN 7433	26-Sep-16(SPEAG,No.EX3-7433_Sep16)	Sep-17
DAE4	SN 549	13-Dec-16(SPEAG, No.DAE4-549_Dec16)	Dec -17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	27-Jun-16 (CTTL, No.J16X04776)	Jun-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan -17

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

Issued: January 24, 2017

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

Certificate No: Z17-97012 Page 1 of 11

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

b) IEC 62209-1, "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 determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

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

Methods Applied and Interpretation of Parameters:

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

Certificate No: Z17-97012 Page 2 of 11

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Probe EX3DV4

SN: 3677

Calibrated: January 23, 2017

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: Z17-97012 Page 3 of 11

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3677

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(µV/(V/m)^2)[A]	0.39	0.44	0.38	±10.8%
DCP(mV)[B]	97.3	102.2	101.1	

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	180.5	±2.0%
		Y	0.0	0.0	1.0		195.3	
		Z	0.0	0.0	1.0		177.9	

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

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

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3677

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)	Unct. (k=2)
750	41.9	0.89	9.58	9.58	9.58	0.30	0.75	±12%
835	41.5	0.90	9.31	9.31	9.31	0.11	1.55	±12%
1750	40.1	1.37	8.60	8.60	8.60	0.24	1.07	±12%
1900	40.0	1.40	8.39	8.39	8.39	0.23	1.10	±12%
2300	39.5	1.67	8.13	8.13	8.13	0.53	0.74	±12%
2450	39.2	1.80	7.90	7.90	7.90	0.61	0.71	±12%
2600	39.0	1.96	7.64	7.64	7.64	0.68	0.68	±12%
5250	35.9	4.71	5.66	5.66	5.66	0.40	1.20	±13%
5600	35.5	5.07	4.99	4.99	4.99	0.40	1.40	±13%
5750	35.4	5.22	5.00	5.00	5.00	0.40	1.40	±13%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of 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 frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Certificate No: Z17-97012 Page 5 of 11

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3677

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)	Unct. (k=2)
750	55.5	0.96	9.99	9.99	9.99	0.30	0.95	±12%
835	55.2	0.97	9.74	9.74	9.74	0.14	1.66	±12%
1750	53.4	1.49	8.39	8.39	8.39	0.21	1.16	±12%
1900	53.3	1.52	7.98	7.98	7.98	0.22	1.24	±12%
2300	52.9	1.81	7.97	7.97	7.97	0.55	0.80	±12%
2450	52.7	1.95	7.85	7.85	7.85	0.50	0.86	±12%
2600	52.5	2.16	7.63	7.63	7.63	0.44	0.91	±12%
5250	48.9	5.36	5.03	5.03	5.03	0.50	1.60	±13%
5600	48.5	5.77	4.34	4.34	4.34	0.54	1.66	±13%
5750	48.3	5.94	4.52	4.52	4.52	0.57	1.95	±13%

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of 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 frequency 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 the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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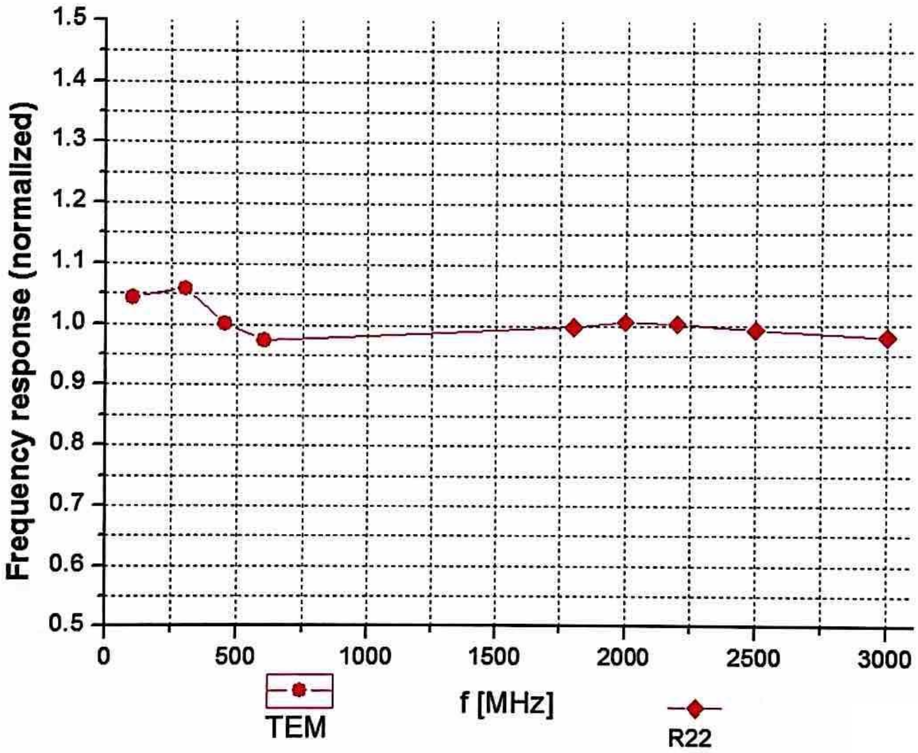
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.5% (k=2)

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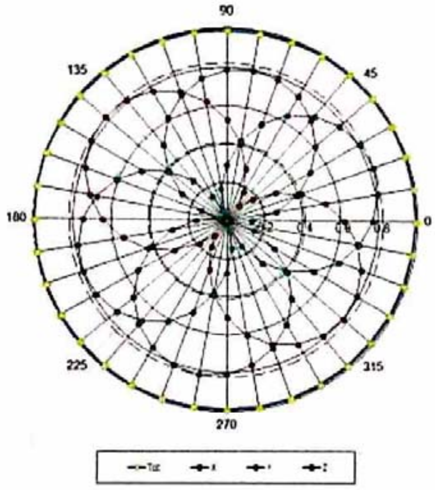
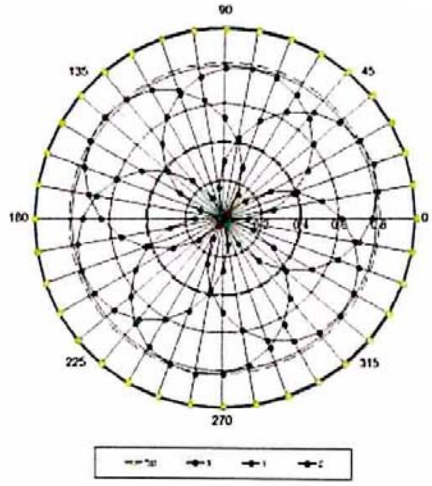
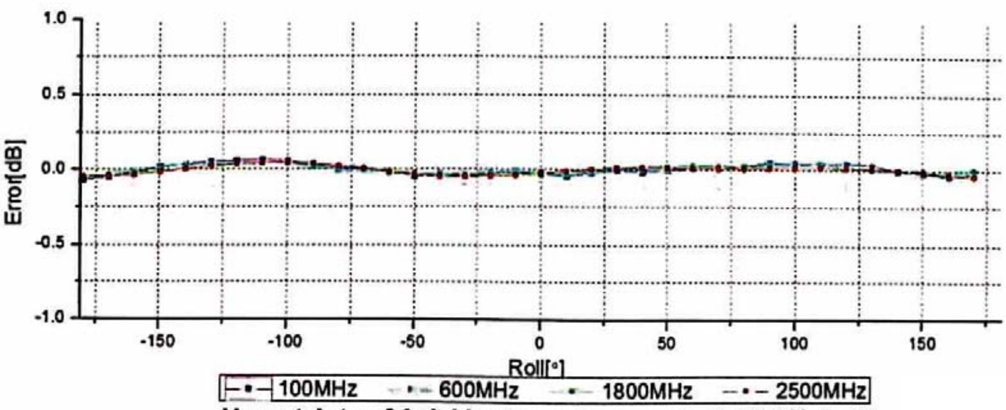
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





Uncertainty of Axial Isotropy Assessment: ±0.9% (k=2)

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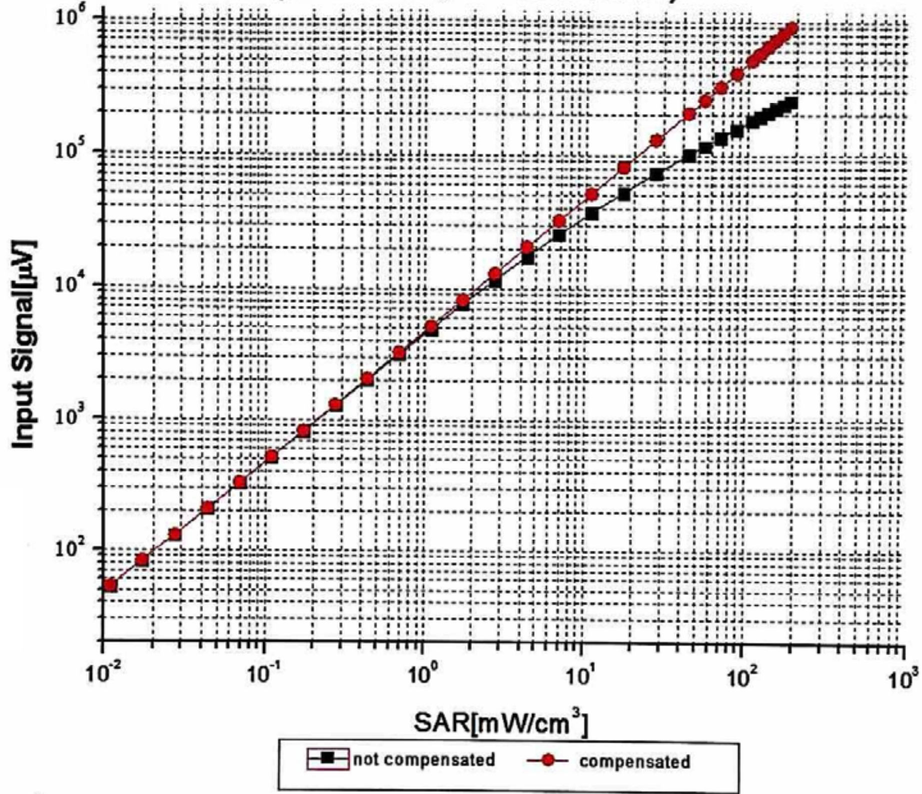
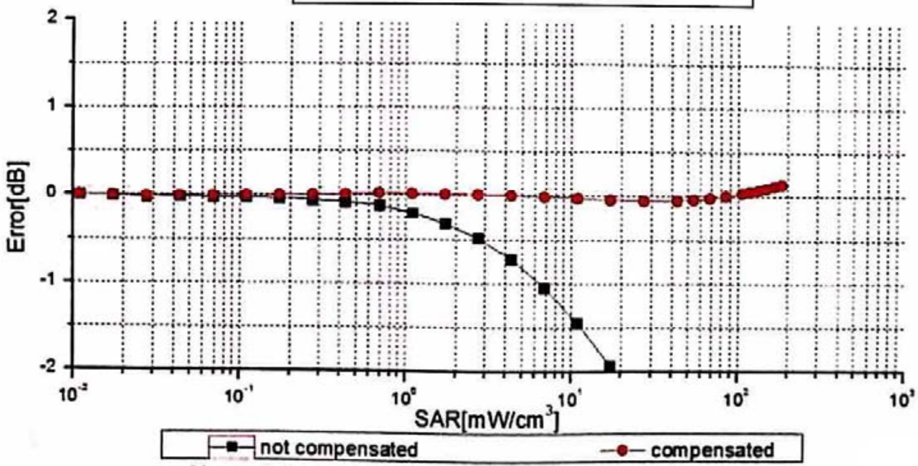
Dynamic Range f(SAR_{head})
(TEM cell, f = 900 MHz)





Uncertainty of Linearity Assessment: ±0.9% (k=2)

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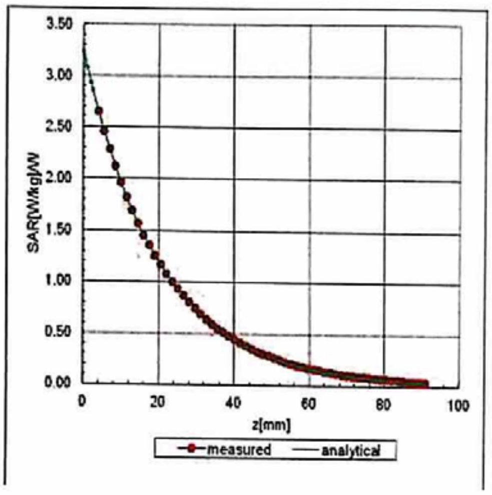
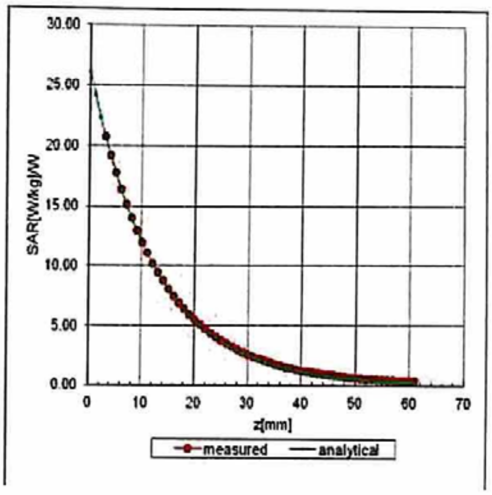
Conversion Factor Assessment

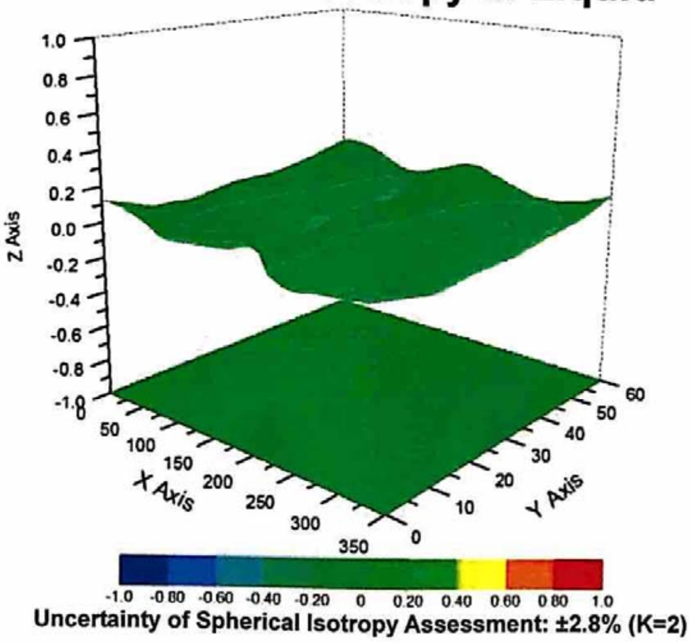
f=835 MHz, WGLS R9(H_convF)



f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±2.8% (K=2)

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DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3677

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	117.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm

ANNEX E: D750V3 Dipole Calibration Certificate

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: **SCS 108**

Client **CTTL (Auden)**

Certificate No: **D750V3-1017_Aug14**

CALIBRATION CERTIFICATE

Object: D750V3 - SN: 1017

Calibration procedure(s): QA CAL-05.v9
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: August 28, 2014

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 EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: August 28, 2014

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

Certificate No: D750V3-1017_Aug14 Page 1 of 8

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Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

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

Accreditation No.: **SCS 108**

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 300 MHz to 3 GHz)", February 2005
c) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

d) 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	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.2 ± 6 %	0.91 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.11 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.31 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.39 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.49 W/kg ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.4 ± 6 %	0.99 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.24 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.75 W/kg ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.49 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.85 W/kg ± 16.5 % (k=2)**

Appendix (Additional assessments outside the scope of SCS108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.2 Ω - 0.5 jΩ
Return Loss	- 30.1 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.0 Ω - 2.9 jΩ
Return Loss	- 28.9 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.034 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	March 22, 2010