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CNAS L2264

SAR TEST REPORT

Applicant	Huawei Technologies Co., Ltd.
FCC ID	QISR218H
Product	Mobile WiFi
Model	R218h
Report No.	RHA1705-0045SAR01
Issue Date	July 5, 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.

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1 Test Laboratory

1.1 Notes of the Test Report

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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-766)

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 (Separation 10mm)
GSM 850	1.341
GSM 1900	0.976
LTE FDD 7	1.170
Wi-Fi (2.4G)	0.319
Date of Testing:	May 15, 2017~ May 18, 2017 and June 23, 2017
Note: The device is in compliance with SAR for Uncontrolled Environment /General Population exposure 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 (Separation 10mm)
Highest Simultaneous Transmission SAR (W/kg)	1.341
Note: 1. The detail for simultaneous transmission consideration is described in chapter 10.3.	

3 Description of Equipment under Test

Client Information

Applicant	Huawei Technologies Co., Ltd.
Applicant address	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District Shenzhen 518129 P.R.China
Manufacturer	Huawei Technologies Co., Ltd.
Manufacturer address	Administration Building, Headquarters of Huawei Technologies Co., Ltd., Bantian, Longgang District Shenzhen 518129 P.R.China

General Technologies

Application Purpose:	Original Grant
EUT Stage	Identical Prototype
Model:	R218h
IMEI:	004401729918462
Hardware Version:	CL1E5573CSM16
Software Version:	21.326.06.00.11
Antenna Type:	Internal Antenna
Power Class:	GSM 850:4 GSM 1900:1 LTE FDD 7:3
Power Level	GSM 850:level 5 GSM 1900:level 0 LTE FDD 7:max power
EUT Accessory	
Battery 1	Manufacturer: Sunwoda Electronic Co.,LTD Model: HB434666RBC Power Rating: DC 3.8V, 1500mAh, Li-ion
Battery 2	Manufacturer: SCUD (Fujian) Electronics Co., LTD Model: HB434666RBC Power Rating: DC 3.8V, 1500mAh, Li-ion
Remark: The information of the EUT is declared by the manufacturer. Please refer to the specifications or user manual for details.	

Wireless Technology and Frequency Range

Wireless Technology		Modulation	Operating mode	Tx (MHz)
GSM	850	Voice(GMSK) GPRS(GMSK) EGPRS(GMSK,8PSK)	☐Multi-slot Class:8-1UP ☐Multi-slot Class:10-2UP ☒Multi-slot Class:12-4UP ☐Multi-slot Class:33-4UP	824 ~ 849
	1900			1850 ~ 1910
LTE	FDD 7	QPSK, 16QAM	Rel.10 /Category 6	2500 ~ 2570
	Does this device support Carrier Aggregation (CA) ☐Yes downlink only ☒No			
Wi-Fi	2.4G	DSSS, OFDM	802.11b/g/n (HT20/HT40)	2412 ~2457
	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:

447498 D01 General RF Exposure Guidance v06
648474 D04 Handset SAR v01r03
865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
865664 D02 RF Exposure Reporting v01r02
941225 D05 SAR for LTE Devices v02r05
941225 D06 Hotspot Mode v02r01
248227 D01 802.11 Wi-Fi SAR v02r02

5 Operational Conditions during Test

5.1 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

The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

5.2 Test Configuration

5.2.1 GSM Test Configuration

According to specification 3GPP TS 51.010, the maximum power of the GSM can do the power reduction for the multi-slot. The allowed power reduction in the multi-slot configuration is as following:

Output power of reductions:

Table 5.1: The allowed power reduction in the multi-slot configuration

Number of timeslots in uplink assignment	Permissible nominal reduction of maximum output power,(dB)
1	0
2	0 to 3,0
3	1,8 to 4,8
4	3,0 to 6,0

5.2.2 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.

5.2.3 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.

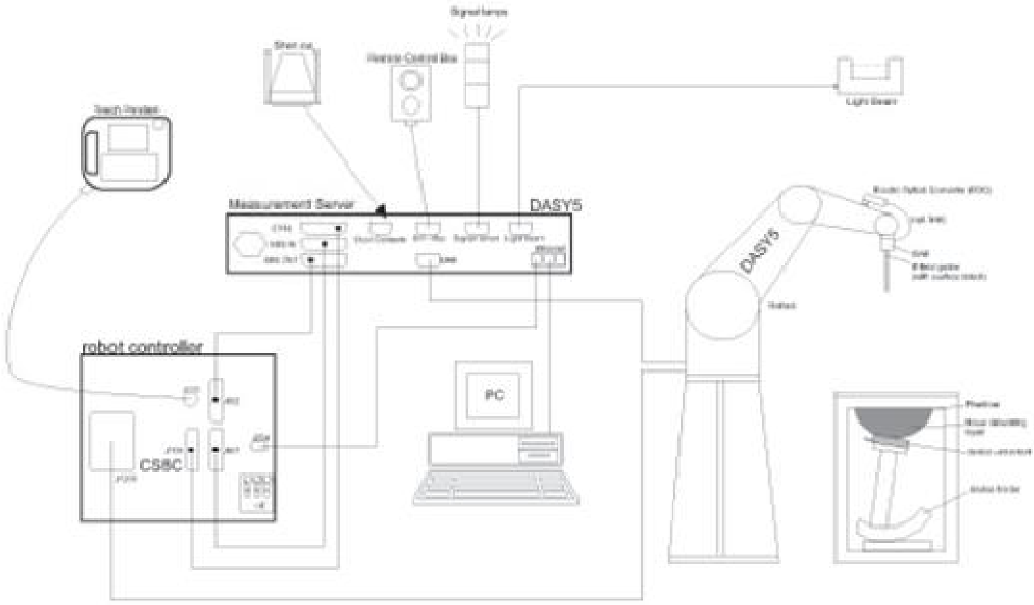
- For all positions/configurations tested using the *initial test position* and subsequent test positions, when the *reported* SAR is > 0.8 W/kg, measure the SAR for these positions/configurations on the subsequent next highest measured output power channel(s) until the *reported* SAR is ≤ 1.2 W/kg or 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.

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.

$$SAR=C\Delta T/\Delta t$$

Where: Δt = Exposure time (30 seconds),

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

ΔT = Temperature increase due to RF exposure.

Or

$$SAR=|E|^2\sigma/\rho$$

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.

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

Zoom Scan

Zoom scans are used 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.

<table>
<tr><td colspan="3"></td><td>≤3GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: $\triangle x_{zoom}$ $\triangle y_{zoom}$</td><td>≤2GHz: ≤8mm
2 – 3GHz: ≤5mm*</td><td>3 – 4GHz: ≤5mm*
4 – 6GHz: ≤4mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">Uniform grid: $\triangle z_{zoom}(n)$</td><td>≤5mm</td><td>3 – 4GHz: ≤4mm
4 – 5GHz: ≤3mm
5 – 6GHz: ≤2mm</td></tr>
<tr><td rowspan="2">Graded grid</td><td>$\triangle z_{zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤4mm</td><td>3 – 4GHz: ≤3mm
4 – 5GHz: ≤2.5mm
5 – 6GHz: ≤2mm</td></tr>
<tr><td>$\triangle z_{zoom}(n>1)$: between subsequent points</td><td colspan="2">$\leq 1.5 \bullet \triangle z_{zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">X, y, z</td><td>≥30mm</td><td>3 – 4GHz: ≥28mm
4 – 5GHz: ≥25mm
5 – 6GHz: ≥22mm</td></tr>
<tr><td colspan="5">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 <u>reported</u> 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.</td></tr>
</table>

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	2017-05-14	2018-05-13
Dielectric Probe Kit	HP	85070E	US44020115	2017-05-14	2018-05-13
Power meter	Agilent	E4417A	GB41291714	2017-05-14	2018-05-13
Power sensor	Agilent	N8481H	MY50350004	2017-05-14	2018-05-13
Power sensor	Agilent	E9327A	US40441622	2017-05-14	2018-05-13
Dual directional coupler	Agilent	778D-012	50519	2017-05-14	2018-05-13
Dual directional coupler	Agilent	777D	50146	2017-05-14	2018-05-13
Amplifier	INDEXSAR	IXA-020	0401	2017-05-14	2018-05-13
Wideband radio communication tester	R&S	CMW 500	150415	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 835MHz	SPEAG	D835V2	4d020	2014-08-28	2017-08-27
Validation Kit 1900MHz	SPEAG	D1900V2	5d060	2014-09-01	2017-08-31
Validation Kit 2450MHz	SPEAG	D2450V2	786	2014-09-01	2017-08-31
Validation Kit 2600MHz	SPEAG	D2600V2	1025	2014-12-08	2017-12-07
Temperature Probe	Tianjin jinming	JM222	AA1009129	2017-05-14	2018-05-13
Hygrothermograph	Anymetr	NT-311	20150732	2017-05-14	2018-05-13

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

Frequency (MHz)		Water (%)	Salt (%)	Sugar (%)	Glycol (%)	Preventol (%)	Cellulose (%)	ε_r	σ(s/m)
Body	835	52.5	1.4	45	0	0.1	1.0	55.2	0.97
	1900	69.91	0.13	0	29.96	0	0	53.3	1.52
	2450	73.2	0.1	0	26.7	0	0	52.7	1.95
	2600	72.6	0.1	0	27.3	0	0	52.5	2.16

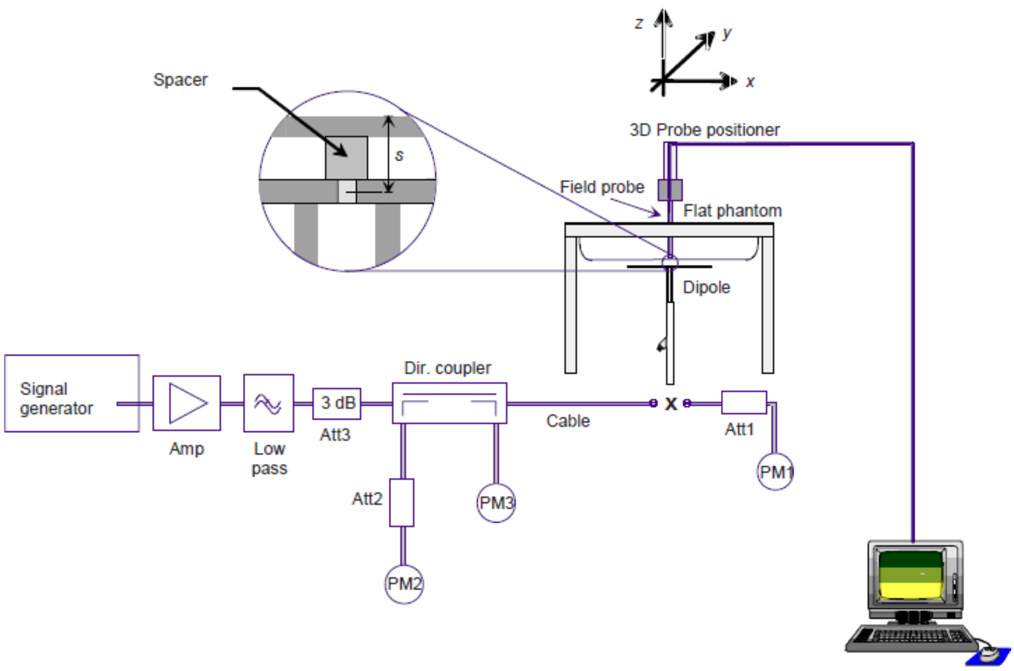
Measurements results

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(%)
835	Body	5/16/2017	21.5	55.4	1.01	55.2	0.97	0.36	4.12
1900	Body	5/15/2017	21.5	51.6	1.49	53.3	1.52	-3.19	-1.97
2450	Body	6/23/2017	21.5	51.1	1.95	52.7	1.95	-3.04	0.00
2600	Body	5/18/2017	21.5	51.5	2.23	52.5	2.16	-3.43	-1.39
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 D835V2 SN: 4d020	Body Liquid	8/28/2014	-23.3	/	54.0	/
		8/27/2015	-23.9	2.6%	53.5	0.5Ω
		8/26/2016	-24.2	-1.2%	53.1	0.4Ω
Dipole D1900V2 SN: 5d060	Body Liquid	9/1/2014	-21.6	/	57.6	/
		8/31/2015	-20.8	3.8%	57.3	0.3Ω
		8/30/2016	-20.8	3.5%	57.0	0.3Ω
Dipole D2450V2 SN: 786	Body Liquid	9/1/2014	-23.7	/	56.0	/
		8/31/2015	-24.0	1.3%	55.8	0.2Ω
		8/30/2016	-24.4	-1.6%	55.1	0.7Ω
Dipole D2600V2 SN: 1025	Body Liquid	12/8/2014	-23.6	/	46.6	/
		12/7/2015	-24.0	1.7%	47.2	0.6Ω

System Check results

Frequency (MHz)		Test Date	Temp ℃	250mW Measured SAR_{1g} (W/kg)	1W Normalized SAR_{1g} (W/kg)	1W Target SAR_{1g} (W/kg)	Δ % (Limit ±10%)	Plot No.
835	Body	5/16/2017	21.5	2.41	9.64	9.54	1.05	1
1900	Body	5/15/2017	21.5	9.93	39.72	40.00	-0.70	2
2450	Body	6/23/2017	21.5	12.50	50.00	52.40	-4.58	3
2600	Body	5/18/2017	21.5	13.50	54.00	56.40	-4.26	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 GSM Mode

GSM 850		Burst Average Power(dBm)			Division Factors (dB)	Frame-Average Power(dBm)			Burst Tune-up Limit (dBm)
Tx Channel		128	190	251		128	190	251	
Frequency(MHz)		824.2	836.6	848.8		824.2	836.6	848.8	
GSM(GMSK)		31.82	31.96	31.94	9.03	22.79	22.93	22.91	33.00
GPRS (GMSK)	1Txslot	31.83	31.92	32.06	9.03	22.80	22.89	23.03	33.00
	2Txslots	29.70	29.89	29.98	6.02	23.68	23.87	23.96	31.00
	3Txslots	27.59	27.70	27.83	4.26	23.33	23.44	23.57	29.00
	4Txslots	25.46	25.67	25.70	3.01	22.45	22.66	22.69	27.00
EGPRS (GMSK)	1Txslot	31.77	31.88	32.02	9.03	22.74	22.85	22.99	33.00
	2Txslots	29.59	29.84	29.90	6.02	23.57	23.82	23.88	31.00
	3Txslots	27.48	27.66	27.80	4.26	23.22	23.40	23.54	29.00
	4Txslots	25.34	25.62	25.65	3.01	22.33	22.61	22.64	27.00
EGPRS (8PSK)	1Txslot	26.08	26.18	25.92	9.03	17.05	17.15	16.89	27.00
	2Txslots	23.65	23.80	23.88	6.02	17.63	17.78	17.86	25.00
	3Txslots	21.67	21.79	21.75	4.26	17.41	17.53	17.49	23.00
	4Txslots	19.39	19.47	19.58	3.01	16.38	16.46	16.57	21.00

GSM 1900		Power(dBm)			Division Factors (dB)	Power(dBm)			Burst Tune-up Limit (dBm)
Tx Channel		512	661	810		512	661	810	
Frequency(MHz)		1850.2	1880	1909.8		1850.2	1880	1909.8	
GSM(GMSK)		28.78	28.77	29.02	9.03	19.75	19.74	19.99	30.00
GPRS (GMSK)	1Txslot	28.91	28.81	29.04	9.03	19.88	19.78	20.01	30.00
	2Txslots	26.81	26.64	26.98	6.02	20.79	20.62	20.96	28.00
	3Txslots	24.46	24.23	24.59	4.26	20.20	19.97	20.33	26.00
	4Txslots	22.89	22.65	23.00	3.01	19.88	19.64	19.99	24.00
EGPRS (GMSK)	1Txslot	28.85	28.77	29.00	9.03	19.82	19.74	19.97	30.00
	2Txslots	26.70	26.59	26.90	6.02	20.68	20.57	20.88	28.00
	3Txslots	24.35	24.19	24.56	4.26	20.09	19.93	20.30	26.00
	4Txslots	22.77	22.60	22.95	3.01	19.76	19.59	19.94	24.00
EGPRS (8PSK)	1Txslot	24.87	24.90	25.18	9.03	15.84	15.87	16.15	26.00
	2Txslots	22.61	22.66	22.87	6.02	16.59	16.64	16.85	24.00

	3Txslots	20.79	20.83	20.86	4.26	16.53	16.57	16.60	22.00
	4Txslots	18.88	18.76	18.88	3.01	15.87	15.75	15.87	20.00

Notes: The worst-case configuration and mode for SAR testing is determined to be as follows:

1. Standalone: GSM 850 GMSK (GPRS) mode with 2 time slots for Max power, GSM 1900 GMSK (GPRS) mode with 2 time slots for Max power, based on the output power measurements above.
2. SAR is not required for EGPRS (8PSK) mode because its output power is less than that of GPRS Mode.

9.2 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 configuration [RB]				Power (dBm)
	5MHz	10MHz	15MHz	20MHz	
QPSK	1	1	1	1	22.5+1/-1 dB
QPSK	≤8	≤12	≤16	≤18	22.5+1/-1 dB
QPSK	>8	>12	>16	>18	21+1/-1 dB
16QAM	≤8	≤12	≤16	≤18	21.5+1/-1 dB
16QAM	>8	>12	>16	>18	20.5+1/-1 dB

LTE FDD Band 7				Conducted Power(dBm)			Tune-up Limit (dBm)
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			
				20775/2502.5	21100/2535	21425/2567.5	
5MHz	QPSK	1	0	22.48	22.71	22.99	23.50
		1	13	22.81	22.99	22.36	
		1	24	22.50	22.81	22.47	
		12	0	21.32	21.52	21.37	22.50
		12	6	21.33	21.56	21.28	
		12	13	21.45	21.50	21.34	
		25	0	21.33	21.60	21.46	22.50
	16QAM	1	0	21.81	22.02	22.32	22.50
		1	13	21.96	22.18	21.50	
		1	24	21.81	22.09	21.77	
		12	0	20.39	20.50	20.54	21.50
		12	6	20.45	20.61	20.49	
		12	13	20.39	20.55	20.50	
		25	0	20.54	20.71	20.60	21.50
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit (dBm)
				20800/2505	21100/2535	21400/2565	
10MHz	QPSK	1	0	22.50	22.72	23.02	23.50
		1	25	22.84	23.04	22.40	
		1	49	22.52	22.85	22.50	
		25	0	21.35	21.57	21.41	22.50
		25	13	21.36	21.61	21.32	
		25	25	21.47	21.54	21.39	

Bandwidth	Modulation	RB size	RB offset				Tune-up Limit (dBm)
		50	0	21.41	21.62	21.50	22.50
	16QAM	1	0	21.83	22.05	22.34	22.50
		1	25	21.99	22.22	21.53	
		1	49	21.84	22.11	21.80	
		25	0	20.42	20.55	20.58	21.50
		25	13	20.47	20.65	20.52	
		25	25	20.42	20.60	20.54	
		50	0	20.57	20.76	20.64	21.50
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit (dBm)
				20825/2507.5	21100/2535	21375/2562.5	
15MHz	QPSK	1	0	22.49	22.68	23.00	23.50
		1	38	22.82	23.03	22.37	
		1	74	22.49	22.80	22.46	
		36	0	21.33	21.53	21.38	22.50
		36	18	21.33	21.56	21.28	
		36	39	21.44	21.51	21.35	
		75	0	21.39	21.58	21.45	22.50
	16QAM	1	0	21.78	22.03	22.32	22.50
		1	38	21.97	22.19	21.51	
		1	74	21.81	22.07	21.77	
		36	0	20.39	20.53	20.55	21.50
		36	18	20.44	20.60	20.48	
		36	39	20.40	20.56	20.51	
		75	0	20.54	20.71	20.60	21.50
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit (dBm)
				20850/2510	21100/2535	21350/2560	
20MHz	QPSK	1	0	22.46	22.64	22.97	23.50
		1	50	22.81	22.99	22.35	
		1	99	22.47	22.79	22.43	
		50	0	21.30	21.48	21.34	22.50
		50	25	21.31	21.52	21.25	
		50	50	21.41	21.46	21.31	
		100	0	21.36	21.53	21.41	22.50
	16QAM	1	0	21.76	21.99	22.27	22.50
		1	50	21.93	22.17	21.47	
		1	99	21.79	22.04	21.75	
		50	0	20.36	20.49	20.52	21.50
		50	25	20.41	20.58	20.45	
		50	50	20.37	20.51	20.47	
		100	0	20.52	20.67	20.57	21.50

9.3 WLAN Mode

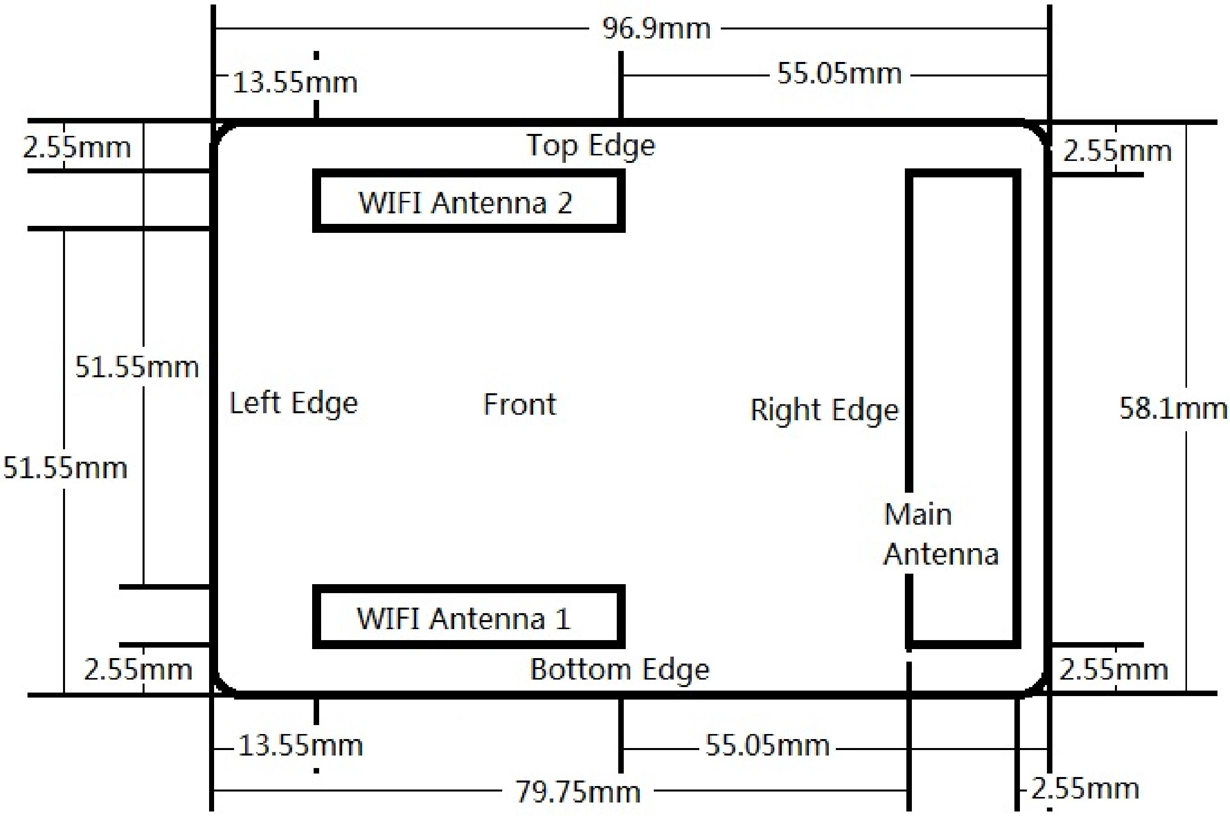
Wi-Fi 2.4G Mode	Antenna	Channel	Frequency (MHz)	Average Conducted Power (dBm) for Data Rates (bps) 1M	Tune-up Limit (dBm)	TX Power Setting level
802.11b	Antenna 1	1	2412	15.65	17.00	16
		6	2437	15.71	17.00	
		10	2457	15.73	17.00	
	Antenna 2	1	2412	15.66	17.00	
		6	2437	16.04	17.00	
		10	2457	15.73	17.00	
Mode	Antenna	Channel	Frequency (MHz)	6M	Tune-up Limit (dBm)	TX Power Setting level
802.11g	Antenna 1	1	2412	12.36	14.00	13
		6	2437	12.99	14.00	
		10	2457	12.98	14.00	
	Antenna 2	1	2412	11.40	14.00	
		6	2437	13.13	14.00	
		10	2457	12.29	14.00	
Mode	Antenna	Channel	Frequency (MHz)	6.5M	Tune-up Limit (dBm)	TX Power Setting level
802.11n (HT20)	Antenna 1	1	2412	11.51	13.00	12
		6	2437	12.03	13.00	
		10	2457	12.16	13.00	
	Antenna 2	1	2412	10.51	13.00	
		6	2437	12.02	13.00	
		10	2457	11.38	13.00	
Mode	Antenna	Channel	Frequency (MHz)	13.5M	Tune-up Limit (dBm)	TX Power Setting level
802.11n (HT40)	Antenna 1	3	2422	11.63	13.00	12
		5	2432	11.83	13.00	
		8	2447	11.70	13.00	
	Antenna 2	3	2422	12.18	13.00	
		5	2432	12.07	13.00	
		8	2447	12.30	13.00	
Mode	Antenna	Channel	Frequency (MHz)	13M	Tune-up Limit (dBm)	TX Power Setting level
802.11n (HT20) MIMO	Antenna 1	1	2412	8.51	/	12
		6	2437	9.10	/	
		10	2457	9.03	/	

	Antenna 2	1	2412	8.99	/	
		6	2437	10.21	/	
		10	2457	9.85	/	
	Sum	1	2412	11.76	13.00	
		6	2437	12.70	13.00	
		10	2457	12.46	13.00	
Mode	Antenna	Channel	Frequency (MHz)	27M	Tune-up Limit (dBm)	TX Power Setting level
802.11n (HT40) MIMO	Antenna 1	3	2422	7.74	/	12
		5	2432	7.96	/	
		8	2447	7.76	/	
	Antenna 2	3	2422	8.28	/	
		5	2432	8.51	/	
		8	2447	8.39	/	
	Sum	3	2422	11.03	13.00	
		5	2432	11.25	13.00	
		8	2447	11.10	13.00	

Note. 1. SAR is not required for OFDM when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

10 Measured and Reported (Scaled) SAR Results

10.1 EUT Antenna Locations



Distance of the Antenna to the EUT surface/edge						
Antenna	Back Side	Front side	Left Edge	Right Edge	Top Edge	Bottom Edge
Main-Antenna	0	0	79.75	2.55	2.55	2.55
Wi-Fi Antenna 1	0	0	13.55	55.05	51.55	2.55
Wi-Fi Antenna 2	0	0	13.55	55.05	2.55	51.55
Mode	Back Side	Front side	Left Edge	Right Edge	Top Edge	Bottom Edge
Main-Antenna						
GSM 850/1900	Yes	Yes	N/A	Yes	Yes	Yes
LTE 7	Yes	Yes	N/A	Yes	Yes	Yes
Wi-Fi Antenna						
Wi-Fi Antenna 1	Yes	Yes	Yes	N/A	N/A	Yes
Wi-Fi Antenna 2	Yes	Yes	Yes	N/A	Yes	N/A
Note: 1. Per KDB 941225 D06, when the overall device length and width are ≥ 9cm*5cm, the test distance is 10mm. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25mm from that surface or edge.						

10.2 Measured SAR Results

Table 1: GSM 850

Test Position	Cover Type	Channel/ Frequency (MHz)	Time slot	Duty Cycle	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Measured SAR_{1g} (W/kg)	Scaling Factor	Reported SAR_{1g} (W/kg)	Plot No.
Body SAR (Distance 10mm)											
Back Side	standard	190/836.6	2Txslots	1:4.15	31.00	29.89	-0.090	0.611	1.29	0.789	/
Front Side	standard	251/848.8	2Txslots	1:4.15	31.00	29.98	0.050	1.060	1.26	1.341	5
		190/836.6	2Txslots	1:4.15	31.00	29.89	-0.030	0.884	1.29	1.141	/
		128/824.2	2Txslots	1:4.15	31.00	29.70	-0.030	0.700	1.35	0.944	/
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	190/836.6	2Txslots	1:4.15	31.00	29.89	-0.070	0.045	1.29	0.058	/
Top Edge	standard	190/836.6	2Txslots	1:4.15	31.00	29.89	0.010	0.283	1.29	0.365	/
Bottom Edge	standard	190/836.6	2Txslots	1:4.15	31.00	29.89	-0.080	0.269	1.29	0.347	/
Front Side	Battery 2	251/848.8	2Txslots	1:4.15	31.00	29.98	0.140	1.050	1.26	1.328	/
Front Side	Repeated	251/848.8	2Txslots	1:4.15	31.00	29.98	0.058	1.007	1.26	1.274	/

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. When multiple slots are used, SAR should be tested to account for the maximum source-based time-averaged output power.

Measurement Variability				
Test Position	Channel/ Frequency(MHz)	MAX Measured SAR_{1g} (W/kg)	1^{st} Repeated SAR_{1g} (W/kg)	Ratio
Front Side	251/848.8	1.060	1.007	1.05

Note: 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

Table 2: GSM 1900

Test Position	Cover Type	Channel/ Frequency (MHz)	Time slot	Duty Cycle	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Measured SAR_{1g} (W/kg)	Scaling Factor	Reported SAR_{1g} (W/kg)	Plot No.
Body SAR (Distance 10mm)											
Back Side	standard	661/1880	2Txslots	1:4.15	28.00	26.64	0.000	0.316	1.37	0.432	/
Front Side	standard	661/1880	2Txslots	1:4.15	28.00	26.64	-0.027	0.488	1.37	0.667	/
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	810/1909.8	2Txslots	1:4.15	28.00	26.98	-0.080	0.772	1.26	0.976	6
		661/1880	2Txslots	1:4.15	28.00	26.64	-0.080	0.676	1.37	0.925	/
		512/1850.2	2Txslots	1:4.15	28.00	26.81	-0.050	0.644	1.32	0.847	/
Top Edge	standard	661/1880	2Txslots	1:4.15	28.00	26.64	0.010	0.037	1.37	0.050	/
Bottom Edge	standard	661/1880	2Txslots	1:4.15	28.00	26.64	-0.020	0.382	1.37	0.522	/
Right Edge	Battery 2	810/1909.8	2Txslots	1:4.15	28.00	26.98	0.070	0.683	1.26	0.864	/

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. When multiple slots are used, SAR should be tested to account for the maximum source-based time-averaged output power.

Table 3: LTE Band 7 (20MHz)

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 SAR (QPSK, Distance 10mm)											
Back Side	standard	1RB	50	21100/2535	23.50	22.99	0.091	0.545	1.12	0.613	/
Front Side	standard	1RB	0	21350/2560	23.50	22.97	0.024	0.851	1.13	0.961	/
		1RB	50	21100/2535	23.50	22.99	-0.020	0.734	1.12	0.825	/
		1RB	50	20850/2510	23.50	22.81	0.027	0.814	1.17	0.954	/
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	50	21100/2535	23.50	22.99	-0.040	0.423	1.12	0.476	/
Top Edge	standard	1RB	0	21350/2560	23.50	22.97	0.170	0.914	1.13	1.033	/
		1RB	50	21100/2535	23.50	22.99	-0.180	0.821	1.12	0.923	/
		1RB	50	20850/2510	23.50	22.81	0.100	0.766	1.17	0.898	/
Bottom Edge	standard	1RB	50	21100/2535	23.50	22.99	0.130	0.224	1.12	0.252	/
Back Side	standard	50%RB	25	21100/2535	22.00	21.52	0.090	0.552	1.12	0.617	/
Front Side	standard	50%RB	0	21350/2560	22.00	21.34	0.038	0.822	1.16	0.957	/
		50%RB	25	21100/2535	22.00	21.52	0.029	0.688	1.12	0.768	/
		50%RB	50	20850/2510	22.00	21.41	0.040	0.843	1.15	0.966	/
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	21100/2535	22.00	21.52	-0.090	0.418	1.12	0.467	/
Top Edge	standard	50%RB	0	21350/2560	22.00	21.34	0.040	0.844	1.16	0.983	/
		50%RB	25	21100/2535	22.00	21.52	0.070	0.771	1.12	0.861	/
		50%RB	50	20850/2510	22.00	21.41	0.100	0.778	1.15	0.891	/
Bottom Edge	standard	50%RB	25	21100/2535	22.00	21.52	-0.100	0.221	1.12	0.247	/
Front Side	standard	100%RB	0	21350/2560	22.00	21.41	0.065	1.000	1.15	1.146	/
		100%RB	0	21100/2535	22.00	21.53	0.057	0.915	1.11	1.020	/
		100%RB	0	20850/2510	22.00	21.36	0.056	1.010	1.16	1.170	7
Top Edge	standard	100%RB	0	21100/2535	22.00	21.53	0.030	0.619	1.11	0.690	/
Front Side	Battery 2	100%RB	0	20850/2510	22.00	21.36	0.020	0.963	1.16	1.116	/
Front Side	Repeated	100%RB	0	20850/2510	22.00	21.36	0.037	0.986	1.16	1.143	/

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.

Measurement Variability				
Test Position	**Channel/ Frequency(MHz)**	**MAX Measured SAR_{1g} (W/kg)**	**1st Repeated SAR_{1g} (W/kg)**	**Ratio**
Front Side	20850/2510	1.010	0.986	1.024

Note: 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

Table 4: Wi-Fi (2.4G)

Test Position	Cover Type	Channel/ Frequency (MHz)	Mode	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 SAR (Antenna 1, 802.11b, Distance 10mm)												
Back Side	standard	10/2457	DSSS	1:1	0.146	17	15.73	0.160	0.147	1.34	0.197	/
Front Side	standard	10/2457	DSSS	1:1	0.239	17	15.73	-0.029	0.210	1.34	0.281	8
Left Edge	standard	10/2457	DSSS	1:1	0.074	17	15.73	0.110	0.074	1.34	0.098	/
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	N/A	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	10/2457	DSSS	1:1	0.240	17	15.73	-0.100	0.238	1.34	0.319	9
Front Side	Battery 2	10/2457	DSSS	1:1	0.233	17	15.73	0.030	0.214	1.34	0.287	/
Body SAR (Antenna 2, 802.11b, Distance 10mm)												
Back Side	standard	6/2437	DSSS	1:1	0.149	17	16.04	0.010	0.143	1.25	0.178	/
Front Side	standard	6/2437	DSSS	1:1	0.199	17	16.04	0.060	0.149	1.25	0.186	/
Left Edge	standard	6/2437	DSSS	1:1	0.140	17	16.04	0.041	0.138	1.25	0.172	/
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	6/2437	DSSS	1:1	0.134	17	16.04	-0.090	0.158	1.25	0.197	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
Front Side	Battery 2	6/2437	DSSS	1:1	0.121	17	16.04	-0.031	0.156	1.25	0.195	/
Body SAR (MIMO, 802.11n HT40, Distance 10mm)												
Back Side	standard	5/2432	OFDM	1:1	0.070	13	11.25	-0.023	0.057	1.50	0.085	/
Front Side	standard	5/2432	OFDM	1:1	0.084	13	11.25	0.097	0.085	1.50	0.127	11
Left Edge	standard	5/2432	OFDM	1:1	0.043	13	11.25	0.035	0.042	1.50	0.063	/
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	5/2432	OFDM	1:1	0.059	13	11.25	0.060	0.053	1.50	0.079	/
Bottom Edge	standard	5/2432	OFDM	1:1	0.079	13	11.25	0.021	0.077	1.50	0.115	/
Front Side	Battery 2	5/2432	OFDM	1:1	0.079	13	11.25	0.010	0.080	1.50	0.120	/
Note: 1. The value with blue color is the maximum SAR Value of each test band.												

MAX Adjusted SAR								
Antenna	**Mode**	**Test Position**	**Channel/ Frequency (MHz)**	**MAX Measured SAR_{1g} (W/kg)**	**802.11b Tune-up limit (dBm)**	**Tune-up limit (dBm)**	**Scaling Factor**	**Adjusted SAR_{1g} (W/kg)**
Antenna 1	802.11g	Bottom Edge	10/2457	0.238	17.00	14.00	0.50	0.119
	802.11n HT20	Bottom Edge	10/2457	0.238	17.00	13.00	0.40	0.095
	802.11n HT40	Bottom Edge	10/2457	0.238	17.00	13.00	0.40	0.095
Antenna 2	802.11g	Top Edge	6/2437	0.158	17.00	14.00	0.50	0.079
	802.11n HT20	Top Edge	6/2437	0.158	17.00	13.00	0.40	0.063
	802.11n HT40	Top Edge	6/2437	0.158	17.00	13.00	0.40	0.063
MIMO	802.11n HT20	Front Side	5//2432	0.085	13.00	13.00	1.00	0.085
Note: Specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.								

10.3 Simultaneous Transmission Analysis

Simultaneous Transmission Configurations	Body-worn
GPRS/EDGE + Wi-Fi-2.4GHz Antenna 1	Yes
GPRS/EDGE + Wi-Fi-2.4GHz Antenna 2	Yes
LTE + Wi-Fi-2.4GHz Antenna 1	Yes
LTE + Wi-Fi-2.4GHz Antenna 2	Yes
Wi-Fi-2.4GHz Antenna 1 + Wi-Fi-2.4GHz Antenna 2	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 Main- Antenna

Test Position \ SAR_{1g}(W/kg)		GSM 850	GSM 1900	LTE FDD 7	MAX. SAR_{1g}
Body SAR	Back Side	**0.789**	0.432	0.617	0.789
	Front Side	**1.341**	0.667	1.170	1.341
	Left Edge	N/A	N/A	N/A	N/A
	Right Edge	0.058	**0.976**	0.476	0.976
	Top Edge	0.365	0.050	**1.033**	1.033
	Bottom Edge	0.347	**0.522**	0.252	0.522

About Main Antenna and Wi-Fi Antenna 1

Test Position \ SAR_{1g}(W/kg)		Main Antenna	Wi-Fi 2.4G Antenna 1	MAX. ΣSAR_{1g}
Body SAR	Back Side	0.789	0.197	0.986
	Front Side	1.341	0.281	1.622
	Left Edge	N/A	0.098	0.098
	Right Edge	0.976	N/A	0.976
	Top Edge	1.033	N/A	1.033
	Bottom Edge	0.522	0.319	0.841

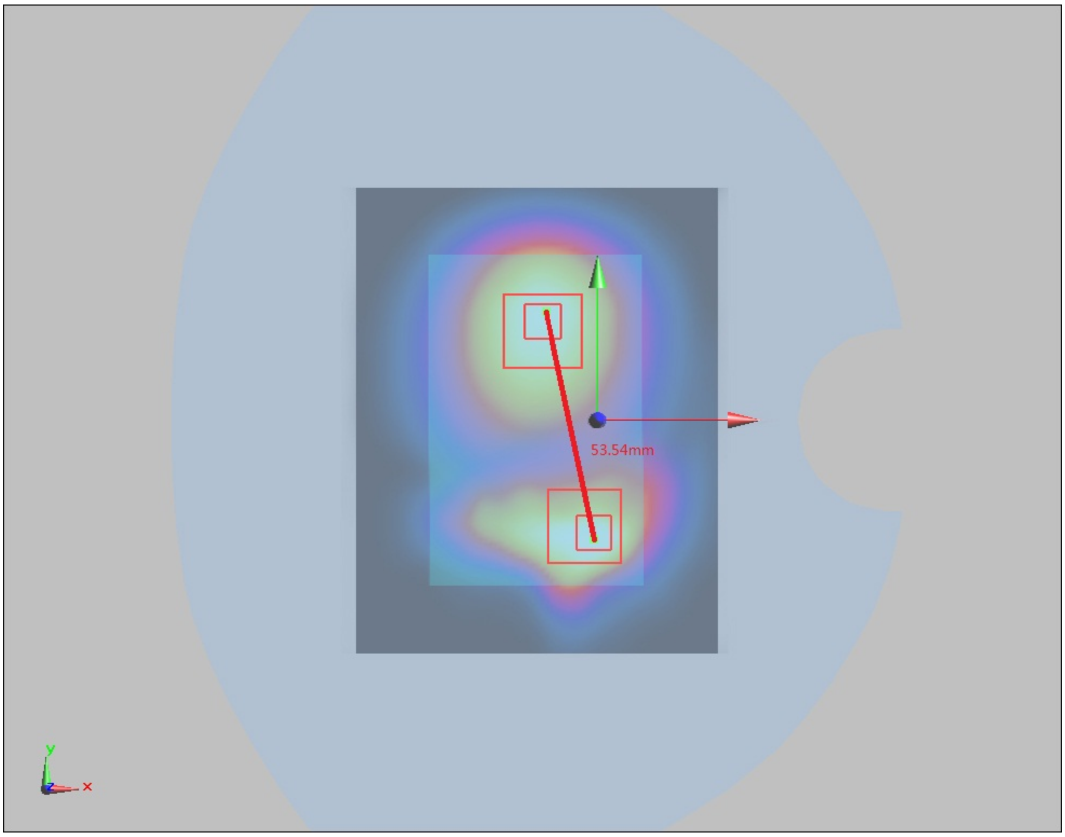
Note: 1.The value with blue color is the maximum ΣSAR_{1g} Value.
2. MAX. ΣSAR_{1g} =Unlicensed SAR_{MAX} +Licensed SAR_{MAX}

MAX. ΣSAR_{1g} = 1.622 W/kg >1.6 W/kg, so the SAR to peak location separation ratio should be considered

Test Position \ Reported SAR_{1g} (W/kg)	GSM 850	GSM 1900	LTE FDD 7	Wi-Fi 2.4G Antenna 1	MAX. ΣSAR_{1g}
Front Side	1.341	/	/	0.281	1.622
	/	0.667	/	0.281	0.948
	/	/	1.170	0.281	1.451

Note: 1.The value with blue color is the SAR_{1g} >1.6 W/kg.
2. When the MAX. Σ SAR_{1g} >1.6 W/kg in a position, Ratio need consideration in this position.

(SAR_{Max} =1.622W/Kg)
The position $SAR_{Max.\ GSM\ 850}$ is (x_1= -23, y_1= -31.5, z_1= -206.1),
The position $SAR_{Max.\ Wi\text{-}Fi\ Antenna\ 1}$ is (x_2= -12.5, y_2=21, z_2= -205.8)
so the distance is 53.54mm.



Ratio =[(Reported $SAR_{Max.GSM\ 850}$) 1.341 W/kg +(Reported $SAR_{Max.\ Wi\text{-}Fi\ Antenna\ 1}$) 0.281 W/kg]$^{3/2}$ /Peak SAR Location Separation =0.039 <0.04

so the Simultaneous transimition SAR with volum scan are not required for Main-Antenna and Wi-Fi Antenna 1.

About Main Antenna and Wi-Fi Antenna 2

Test Position \ SAR_{1g}(W/kg)		Main Antenna	Wi-Fi 2.4G Antenna 2	MAX. ΣSAR_{1g}
Body SAR	Back Side	0.789	0.178	0.967
	Front Side	1.341	0.186	1.527
	Left Edge	N/A	0.172	0.172
	Right Edge	0.976	N/A	0.976
	Top Edge	1.033	0.197	1.230
	Bottom Edge	0.522	N/A	0.522
Note: 1.The value with blue color is the maximum ΣSAR_{1g} Value. 2. MAX. ΣSAR_{1g} =Unlicensed SAR_{MAX} +Licensed SAR_{MAX}				

MAX. ΣSAR_{1g} = 1.527 W/kg <1.6 W/kg, so the Simultaneous transimition SAR with volum scan are not required for Main-Antenna and Wi-Fi Antenna 2.

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About Main Antenna and Wi-Fi Antenna 1 and Wi-Fi Antenna 2

Test Position \ SAR_{1g}(W/kg)		Main Antenna	Wi-Fi 2.4G MIMO	MAX. ΣSAR_{1g}
Body SAR	Back Side	0.789	0.085	0.874
	Front Side	1.341	0.127	1.468
	Left Edge	N/A	0.063	0.063
	Right Edge	0.976	N/A	0.976
	Top Edge	1.033	0.079	1.112
	Bottom Edge	0.522	0.115	0.637
Note: 1.The value with blue color is the maximum ΣSAR_{1g} Value. 2. MAX. ΣSAR_{1g} =Unlicensed SAR_{MAX} +Licensed SAR_{MAX}				

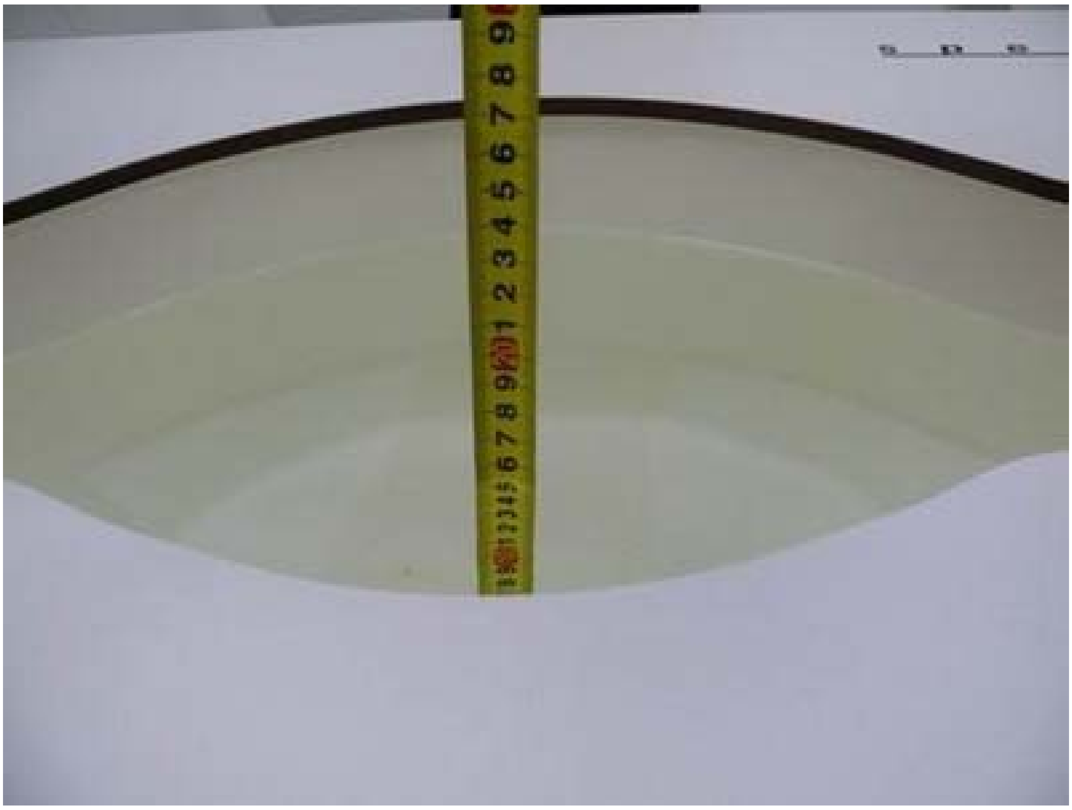
MAX. ΣSAR_{1g} = 1.468 W/kg <1.6 W/kg, so the Simultaneous transimition SAR with volum scan are not required for Main-Antenna and Wi-Fi Antenna 1 and Wi-Fi Antenna 2.

11 Measurement Uncertainty

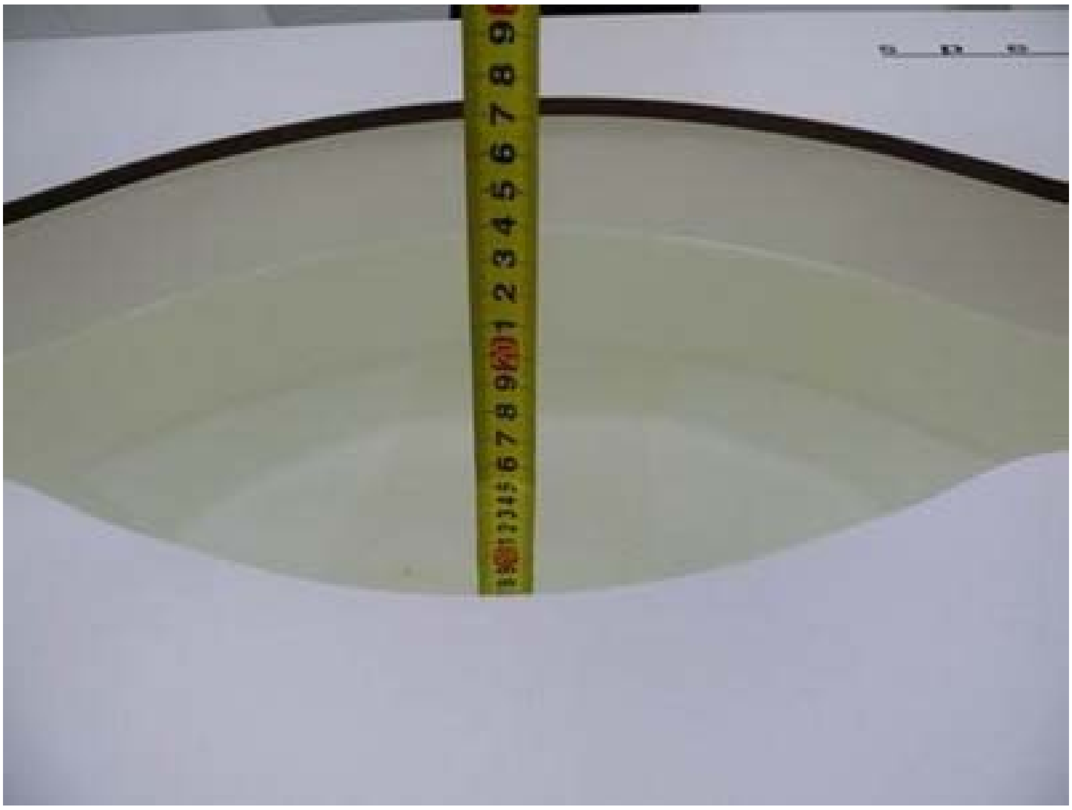
Per KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz, when the highest measured 1-g SAR within a frequency band is < 1.5 W/kg, the extensive SAR measurement uncertainty analysis described in IEEE Std 1528- 2013 is not required in SAR reports submitted for equipment approval.

ANNEX A: Test Layout

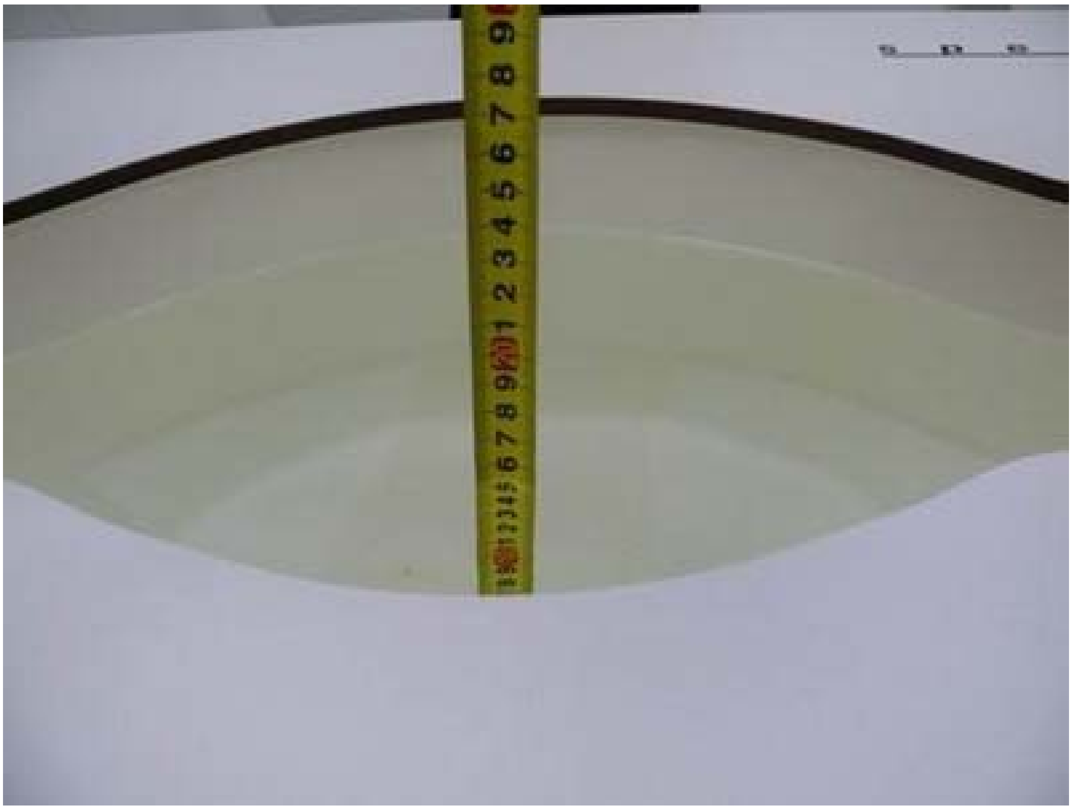
Picture 3: Liquid depth in the flat Phantom (835MHz, 15.4cm depth)



Picture 4: Liquid depth in the flat Phantom (1900 MHz, 15.2cm depth)



Picture 5: Liquid depth in the flat Phantom (2450 MHz, 15.3cm depth)



Picture 6: Liquid depth in the flat Phantom (2600 MHz, 15.3cm depth)

ANNEX B: System Check Results

Plot 1 System Performance Check at 835 MHz Body TSL

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d020

Date: 5/16/2017

Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1

Medium parameters used: f = 835 MHz; σ = 1.01 mho/m; ε_r = 55.4; 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(9.74, 9.74, 9.74); 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): Measurement grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 2.58 mW/g

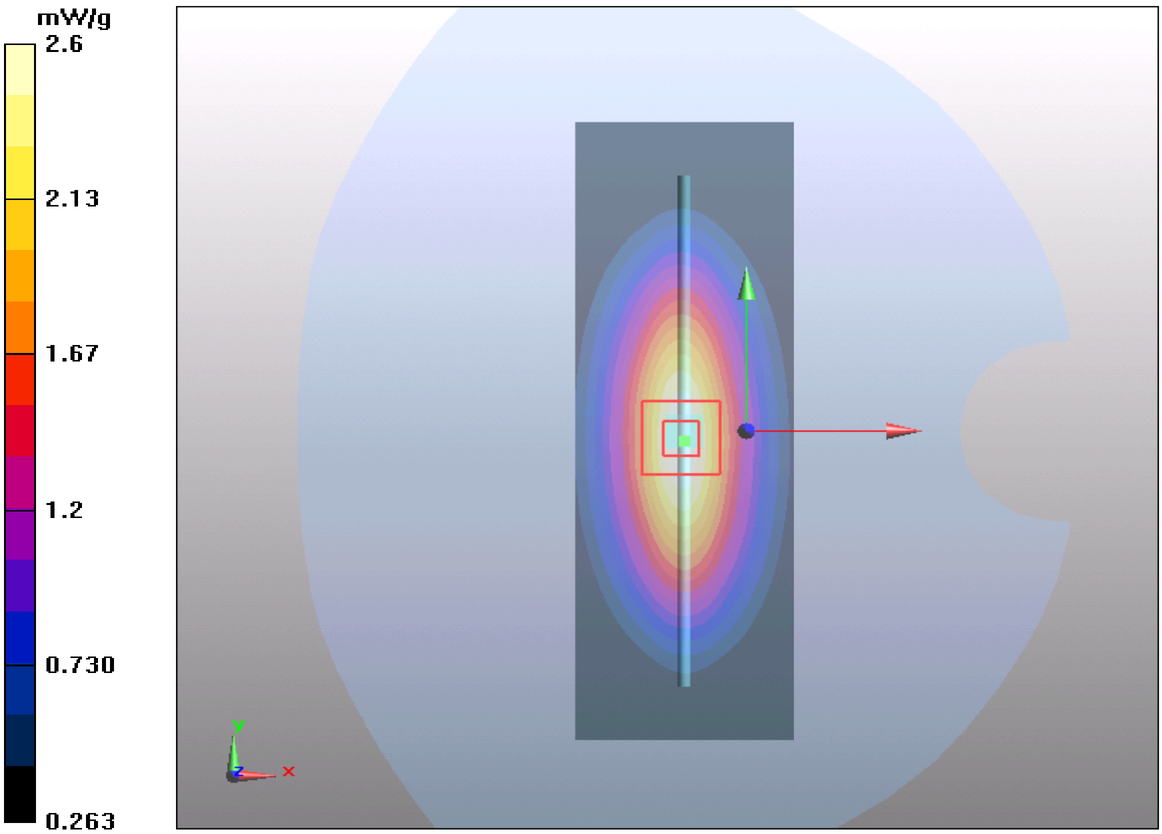
d=15mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 51.9 V/m; Power Drift = -0.058 dB

Peak SAR (extrapolated) = 3.5 W/kg

SAR(1 g) = 2.41 mW/g; SAR(10 g) = 1.6 mW/g

Maximum value of SAR (measured) = 2.6 mW/g



Plot 2 System Performance Check at 1900 MHz Body TSL

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d060

Date: 5/15/2017

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1

Medium parameters used: f = 1900 MHz; σ = 1.49 mho/m; ε_r = 51.6; 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(7.98, 7.98, 7.98); 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=10mm, Pin=250mW/Area Scan (41x71x1): Measurement grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 12.2 mW/g

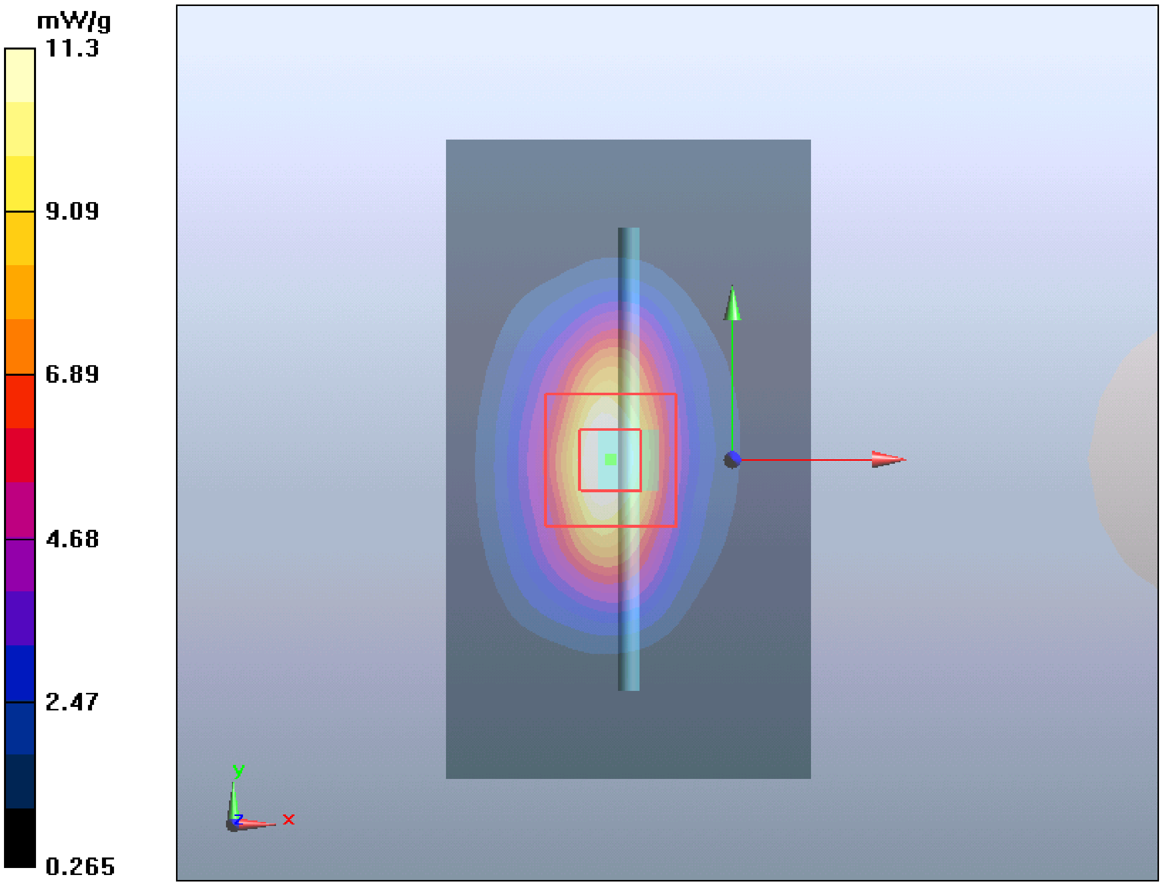
d=10mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 82.3 V/m; Power Drift = 0.068 dB

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 9.93 mW/g; SAR(10 g) = 5.25 mW/g

Maximum value of SAR (measured) = 11.3 mW/g



Plot 3 System Performance Check at 2450 MHz Body TSL

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 786

Date: 6/23/2017

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.95 mho/m; ε_r = 51.1; 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(7.85, 7.85, 7.85); 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=10mm, Pin=250mW/Area Scan (41x71x1): Measurement grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 16 mW/g

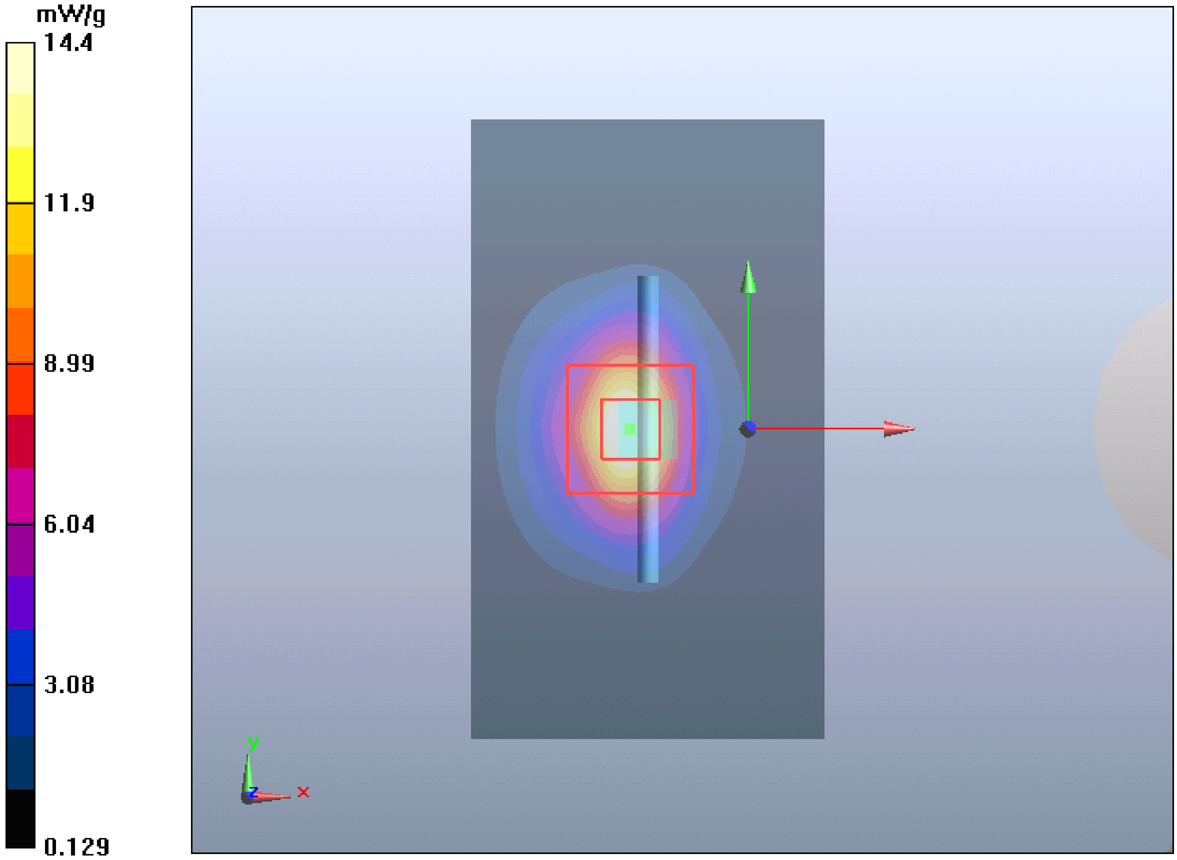
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 81.2 V/m; Power Drift = 0.003 dB

Peak SAR (extrapolated) = 25.4 W/kg

SAR(1 g) = 12.5 mW/g; SAR(10 g) = 6.20 mW/g

Maximum value of SAR (measured) = 14.4 mW/g



Plot 4 System Performance Check at 2600 MHz Body TSL

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2 - SN: 1025

Date: 5/18/2017

Communication System: CW; Frequency: 2600 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2600 MHz; σ = 2.23 mho/m; ε_r = 51.5; 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(7.63, 7.63, 7.63); 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=10mm, Pin=250mW /Area Scan (41x71x1): Measurement grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 17.7 mW/g

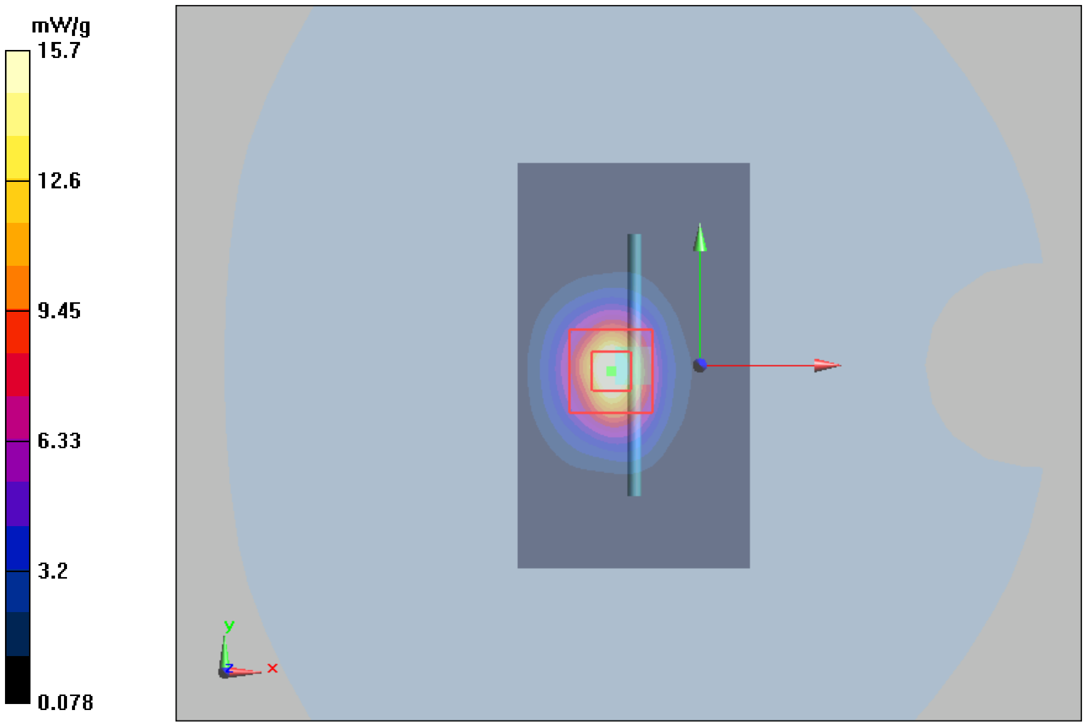
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 74 V/m; Power Drift = -0.0027 dB

Peak SAR (extrapolated) = 28.5 W/kg

SAR(1 g) = 13.5 mW/g; SAR(10 g) = 5.99 mW/g

Maximum value of SAR (measured) = 15.7 mW/g



ANNEX C: Highest Graph Results

Plot 5 GSM 850 GPRS (2Txslots) Front Side High (Distance 10mm)

Date: 5/16/2017

Communication System: UID 0, 2 slot GPRS (0); Frequency: 848.8 MHz;Duty Cycle: 1:4.14954

Medium parameters used (interpolated): f = 848.8 MHz; σ = 0.984 S/m; ε_r = 53.419; 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(9.74, 9.74, 9.74); Calibrated: 1/23/2017;

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

Phantom: SAM 2; Type: SAM; Serial:

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

Front Side High/Area Scan (71x91x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm

Maximum value of SAR (interpolated) = 1.21 W/kg

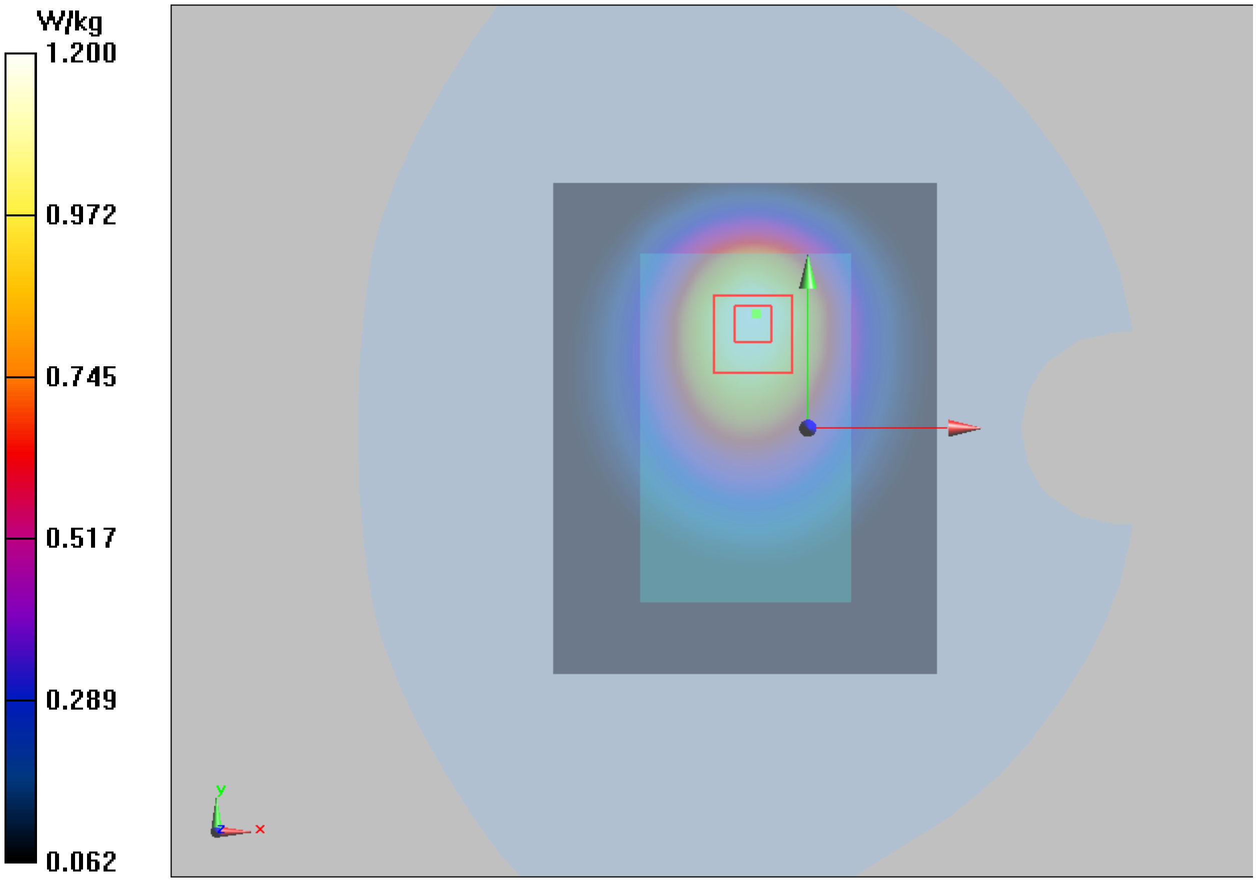
Front Side High/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 26.91 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 1.61 W/kg

SAR(1 g) = 1.06 W/kg; SAR(10 g) = 0.765 W/kg

Maximum value of SAR (measured) = 1.20 W/kg



Plot 6 GSM 1900 GPRS (2Txslots) Right Edge High (Distance 10mm)

Date: 5/15/2017

Communication System: UID 0, 2 slot GPRS (0); Frequency: 1909.8 MHz;Duty Cycle: 1:4.14954

Medium parameters used: f = 1910 MHz; σ = 1.503 S/m; ε_r = 51.512; 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(7.98, 7.98, 7.98); Calibrated: 1/23/2017;

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

Phantom: ELI v5.0; Type: QDOVA002AA;

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

Right Edge High/Area Scan (41x91x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.925 W/kg

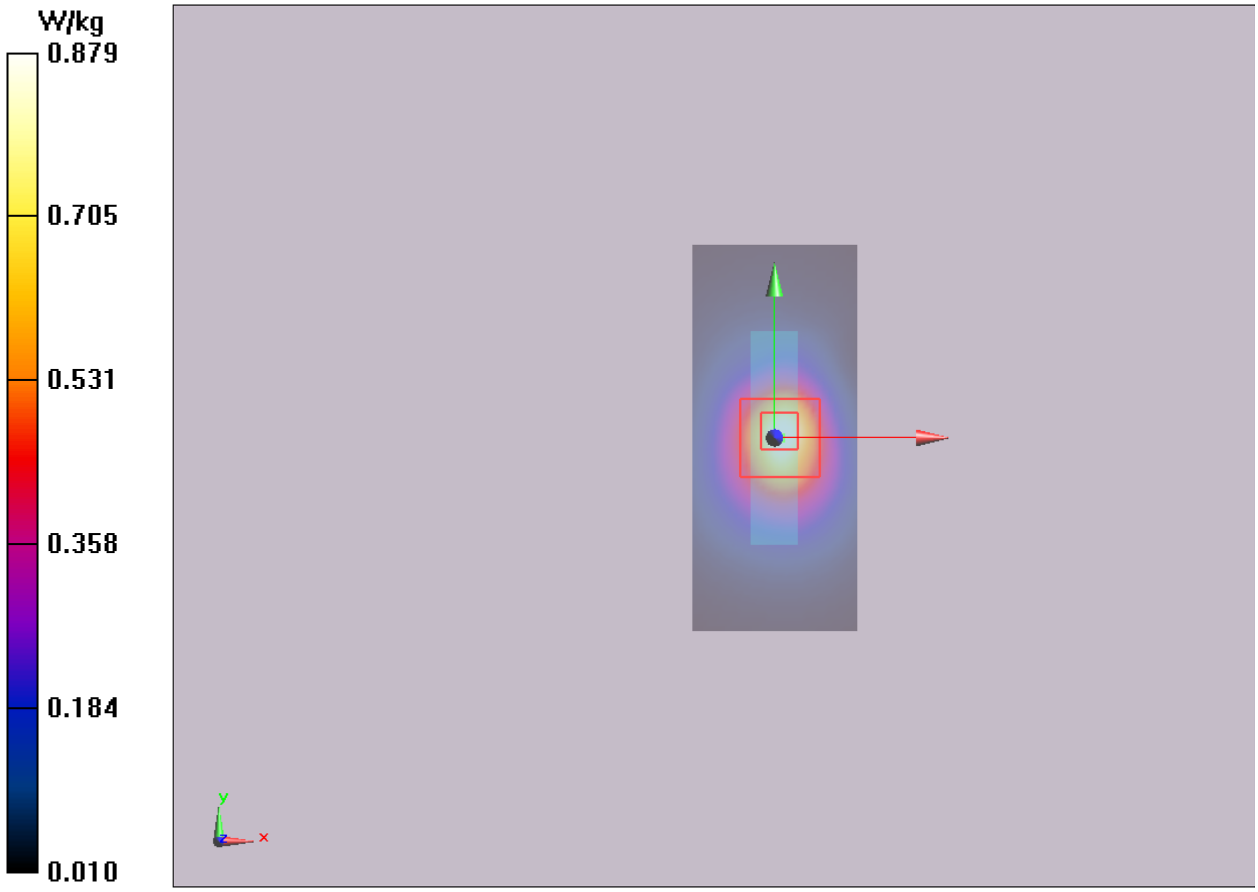
Right Edge High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 24.42 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 1.42 W/kg

SAR(1 g) = 0.772 W/kg; SAR(10 g) = 0.389 W/kg

Maximum value of SAR (measured) = 0.879 W/kg



Plot 7 LTE Band 7 100%RB Front Side Low (Distance 10mm)

Date: 5/16/2017

Communication System: UID 0, LTE_FDD (0); Frequency: 2510 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2510 MHz; σ = 2.029 S/m; ε_r = 53.5; 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(7.63, 7.63, 7.63); Calibrated: 1/23/2017;

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

Phantom: SAM 1; Type: QD000P40CD; Serial: TP:1666

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

Front Side Low/Area Scan (91x121x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 1.25 W/kg

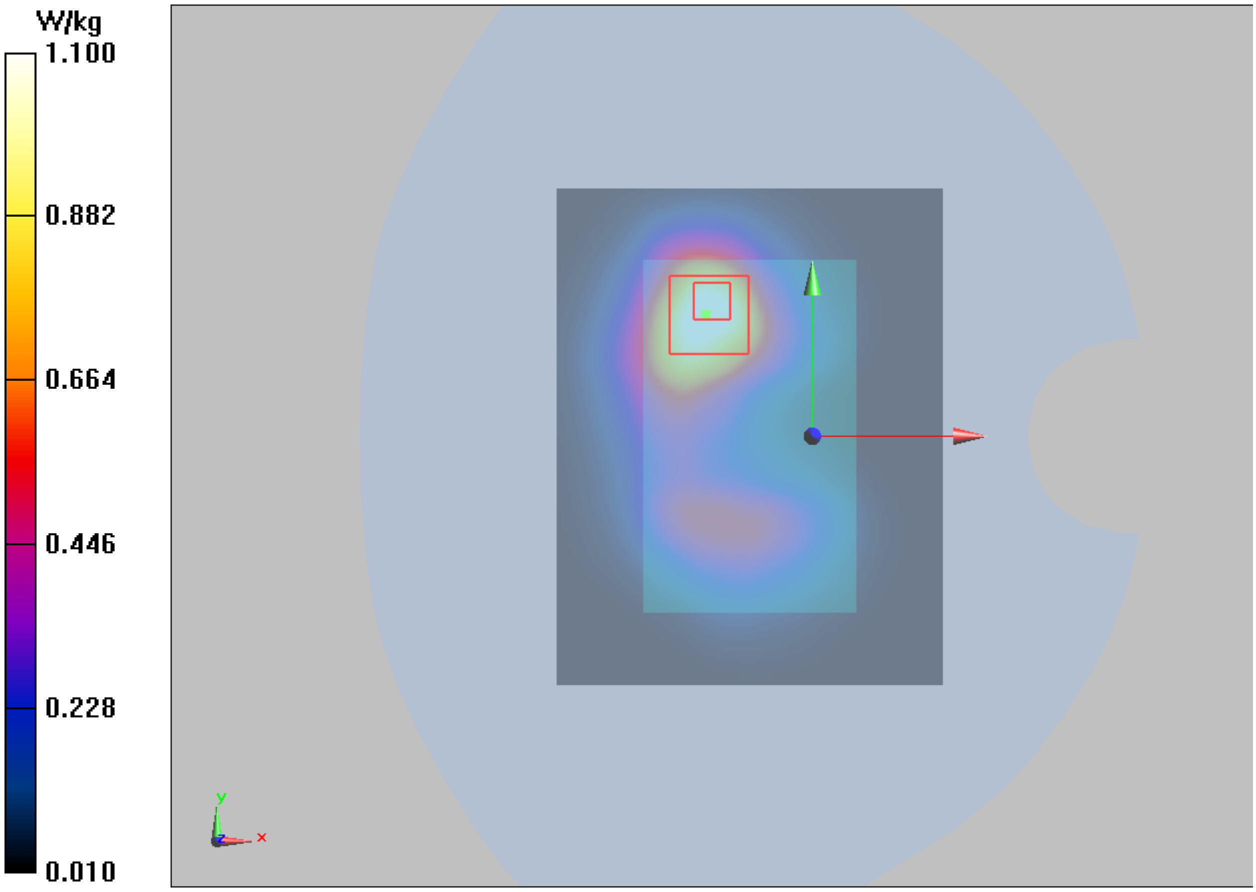
Front Side Low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 8.053 V/m; Power Drift = 0.056 dB

Peak SAR (extrapolated) = 2.07 W/kg

SAR(1 g) = 1.01 W/kg; SAR(10 g) = 0.532 W/kg

Maximum value of SAR (measured) = 1.10 W/kg



Plot 8 802.11b Front Side High (Antenna 1, Distance 10mm)

Date: 6/23/2017

Communication System: UID 0, WiFi (0); Frequency: 2457 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2457 MHz; σ = 1.964 S/m; ε_r = 53.588; 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(7.85, 7.85, 7.85); Calibrated: 1/23/2017;

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

Phantom: SAM 1; Type: QD000P40CD; Serial: TP:1666

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

Front Side High/Area Scan (91x121x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.280 W/kg

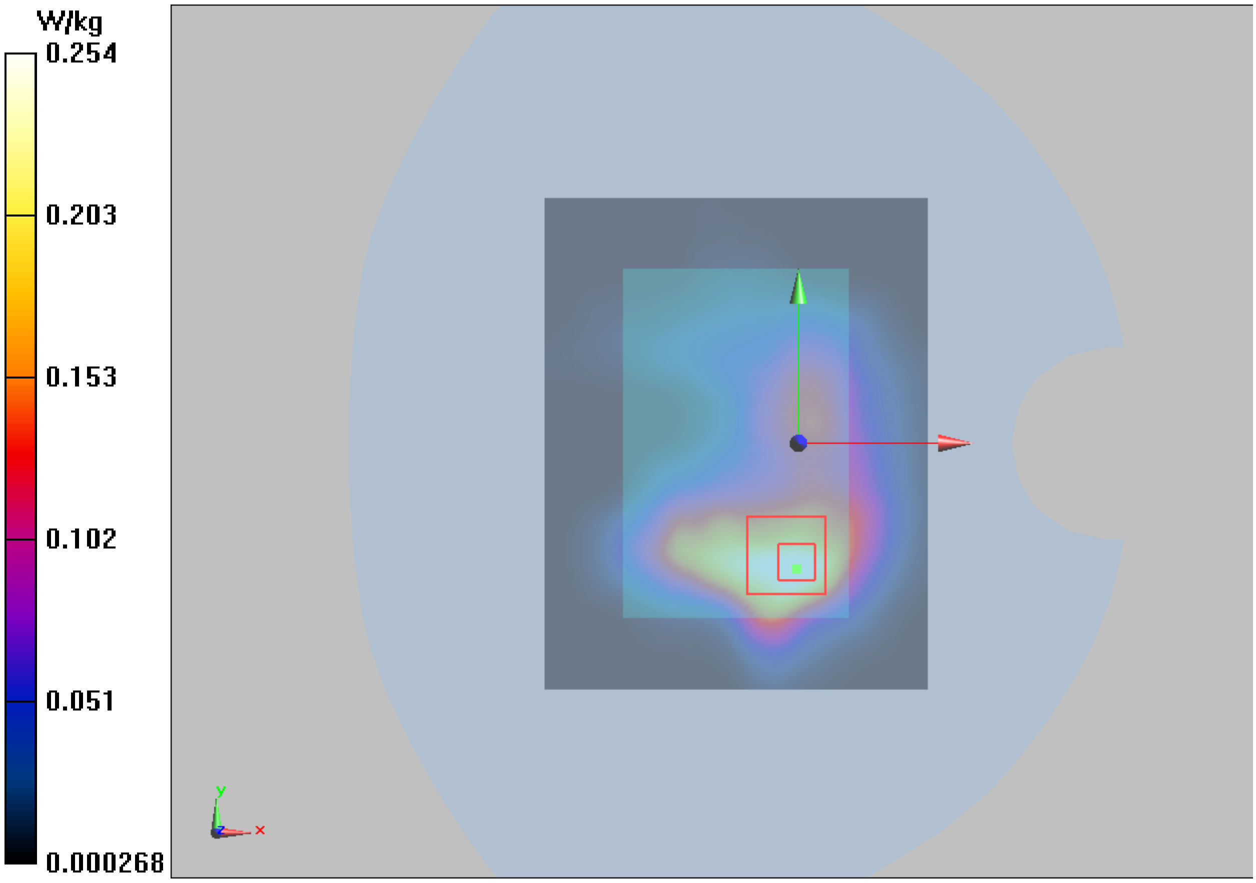
Front Side High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 5.051 V/m; Power Drift = -0.029 dB

Peak SAR (extrapolated) = 0.409 W/kg

SAR(1 g) = 0.210 W/kg; SAR(10 g) = 0.107 W/kg

Maximum value of SAR (measured) = 0.254 W/kg



Plot 9 802.11b Bottom Edge High (Antenna 1, Distance 10mm)

Date: 6/23/2017

Communication System: UID 0, WiFi (0); Frequency: 2457 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2457 MHz; σ = 1.964 S/m; ε_r = 53.588; 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(7.85, 7.85, 7.85); Calibrated: 1/23/2017;

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

Phantom: SAM 1; Type: QD000P40CD; Serial: TP:1666

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

Bottom Edge High/Area Scan (51x141x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.285 W/kg

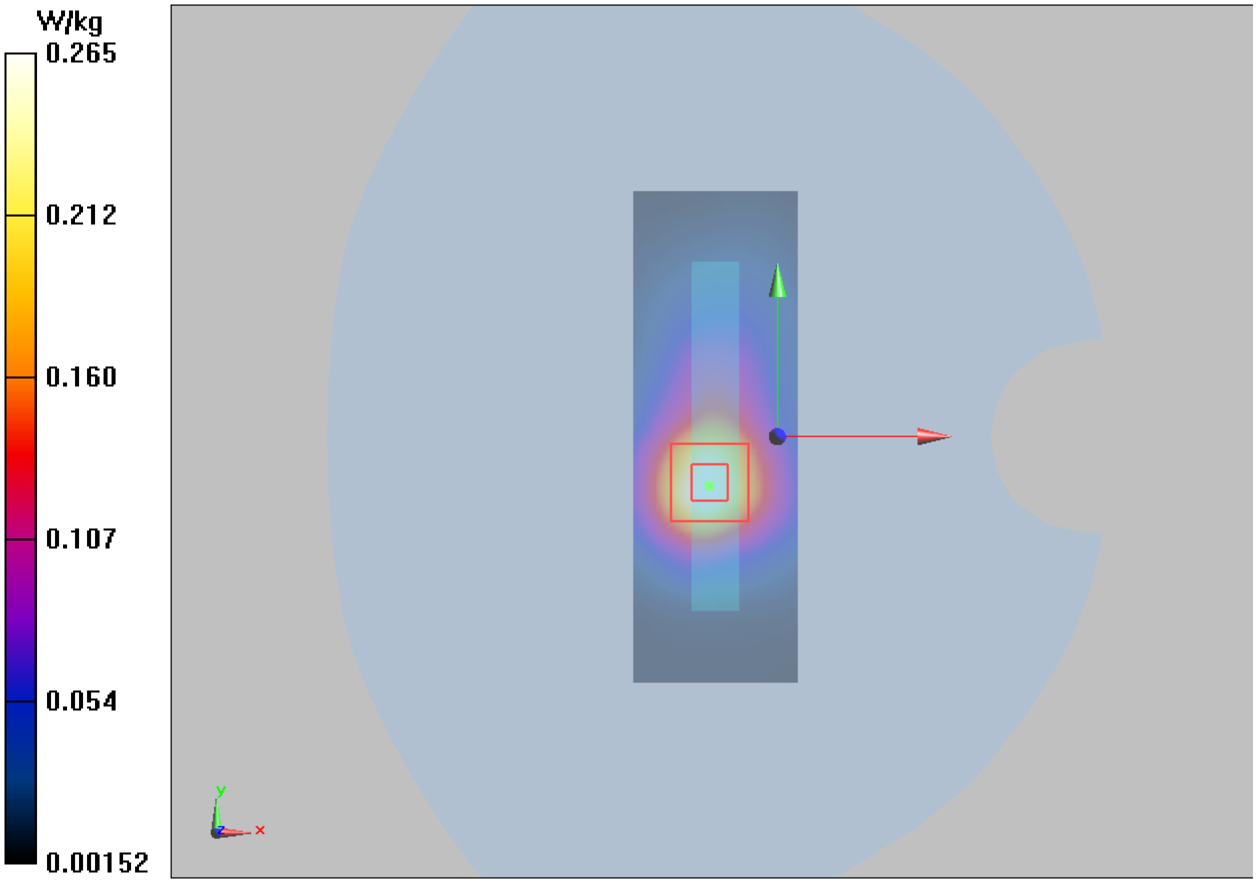
Bottom Edge High/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 10.14 V/m; Power Drift = -0.10 dB

Peak SAR (extrapolated) = 0.440 W/kg

SAR(1 g) = 0.238 W/kg; SAR(10 g) = 0.126 W/kg

Maximum value of SAR (measured) = 0.265 W/kg



Plot 10 802.11b Top Edge Middle (Antenna 2, Distance 10mm)

Date: 6/23/2017

Communication System: UID 0, WiFi (0); Frequency: 2437 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2437 MHz; σ = 1.94 S/m; ε_r = 53.67; 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(7.85, 7.85, 7.85); Calibrated: 1/23/2017;

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

Phantom: SAM 1; Type: QD000P40CD; Serial: TP:1666

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

Top Edge Middle/Area Scan (51x141x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 0.149 W/kg

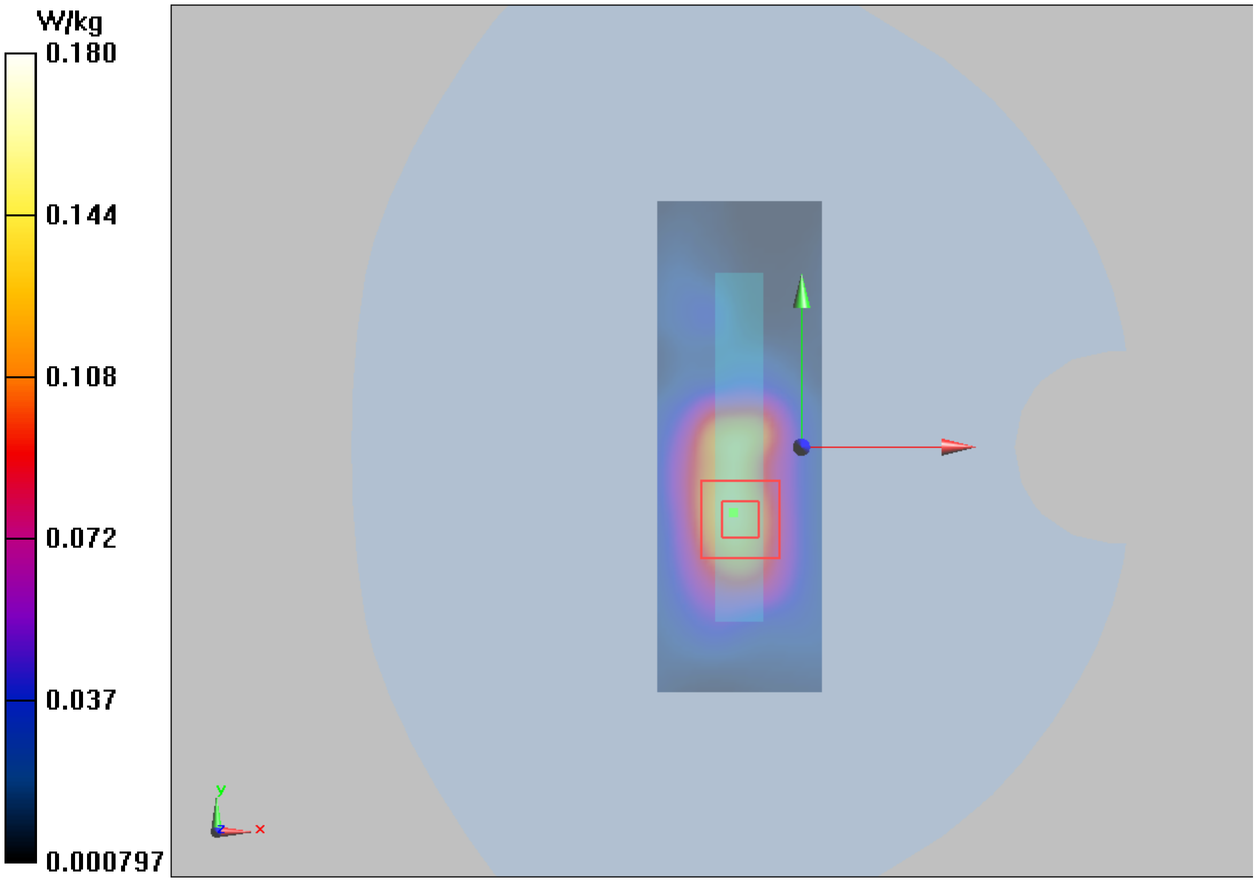
Top Edge Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 9.189 V/m; Power Drift = -0.09 dB

Peak SAR (extrapolated) = 0.291 W/kg

SAR(1 g) = 0.158 W/kg; SAR(10 g) = 0.077 W/kg

Maximum value of SAR (measured) = 0.180 W/kg



Plot 11 802.11n HT20 Front Side Middle (MIMO, Distance 10mm)

Date: 6/23/2017

Communication System: UID 0, WiFi (0); Frequency: 2432 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2432 MHz; σ = 1.934 S/m; ε_r = 53.691; 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(7.85, 7.85, 7.85); Calibrated: 1/23/2017;

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

Phantom: ELI v5.0; Type: QDOVA002AA;

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

Front Side Middle/Area Scan (91x121x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm

Maximum value of SAR (interpolated) = 0.102 W/kg

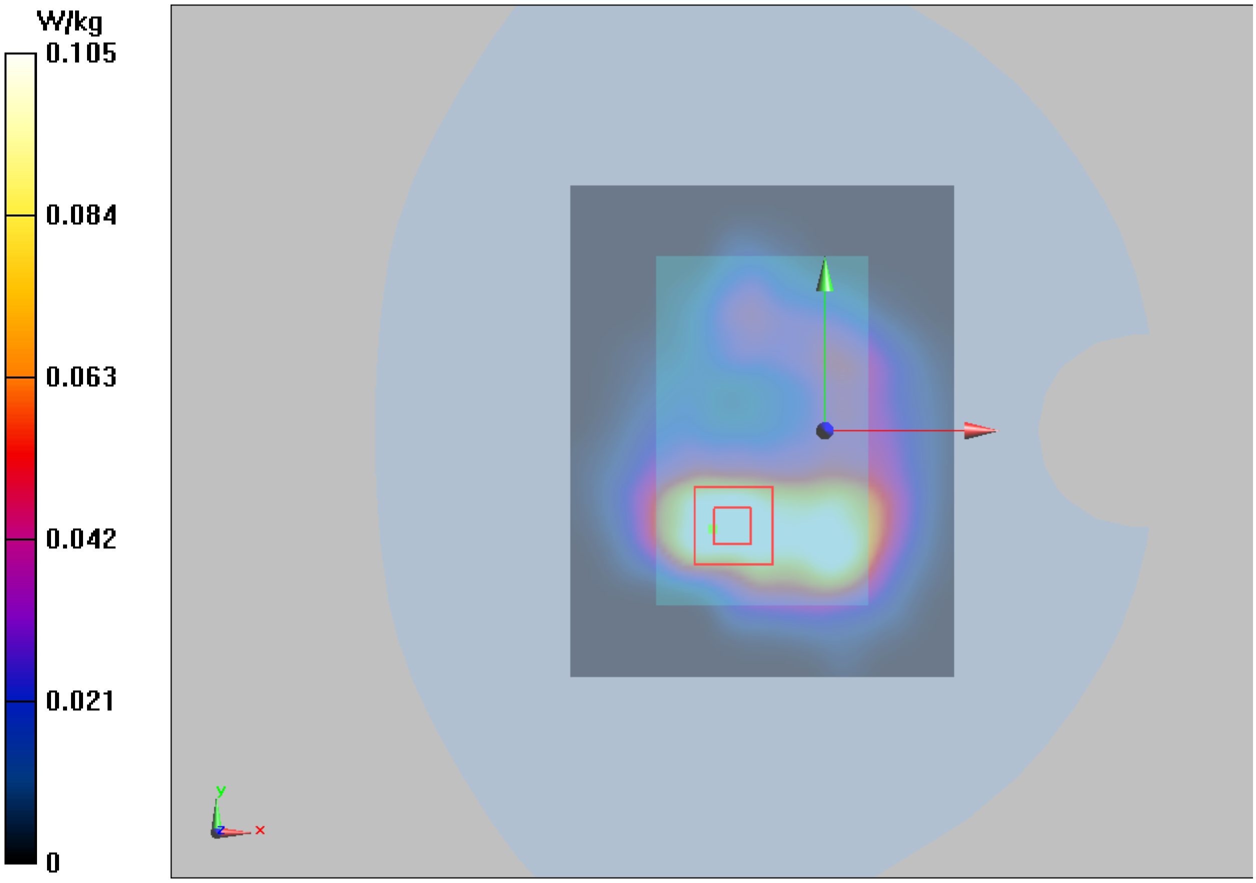
Front Side Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 3.393 V/m; Power Drift = 0.097 dB

Peak SAR (extrapolated) = 0.163 W/kg

SAR(1 g) = 0.085 W/kg; SAR(10 g) = 0.039 W/kg

Maximum value of SAR (measured) = 0.105 W/kg



ANNEX D: Probe Calibration Certificate

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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.

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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).

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Probe EX3DV4

SN: 3677

Calibrated: January 23, 2017

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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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.

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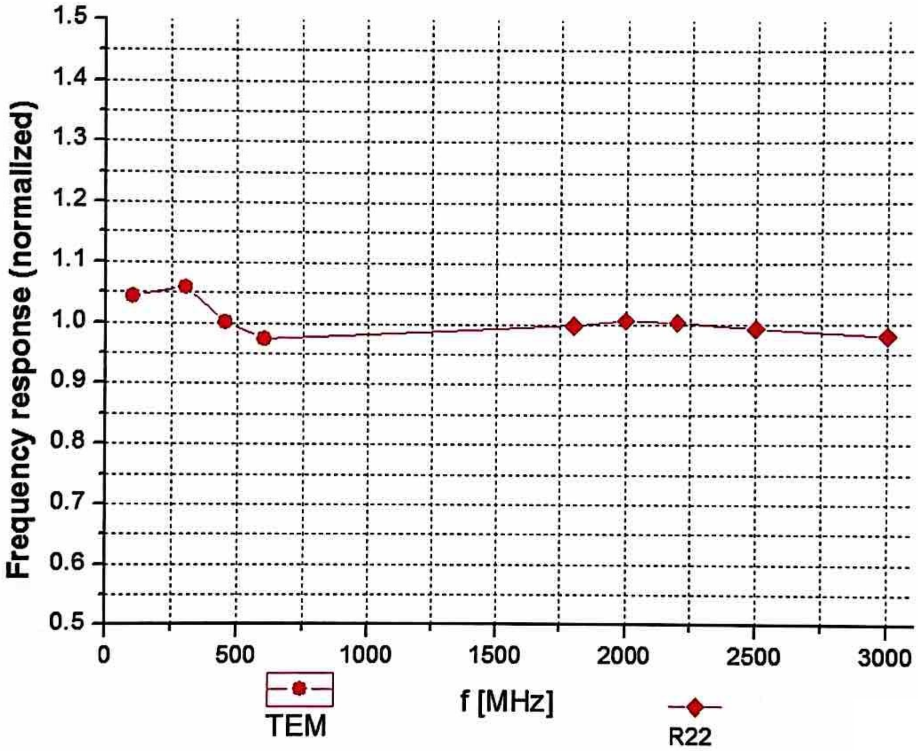
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



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

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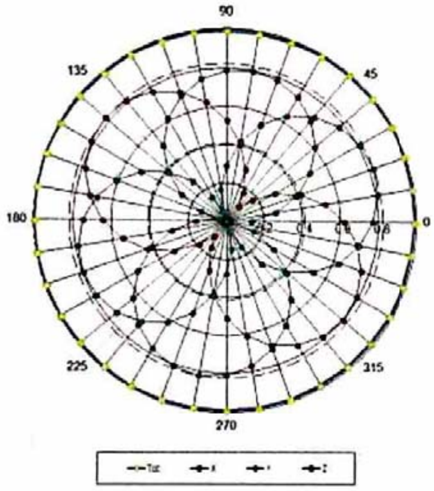
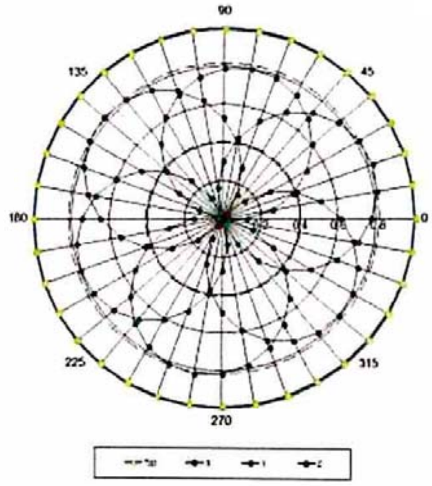
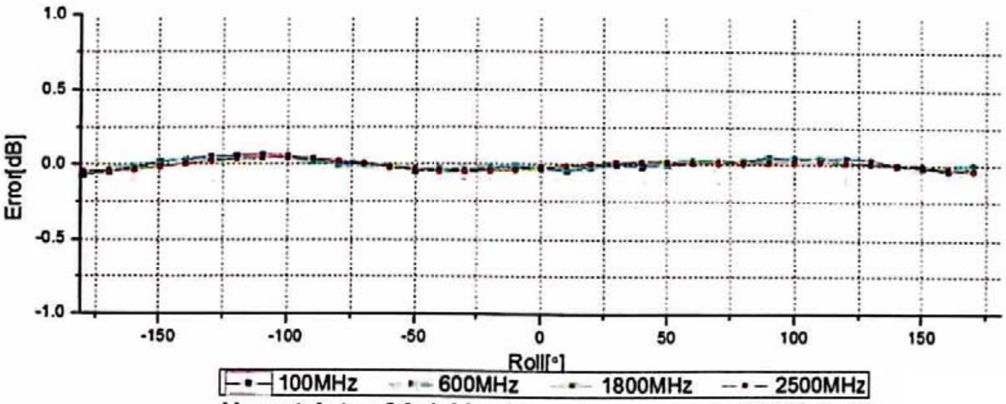
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22





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

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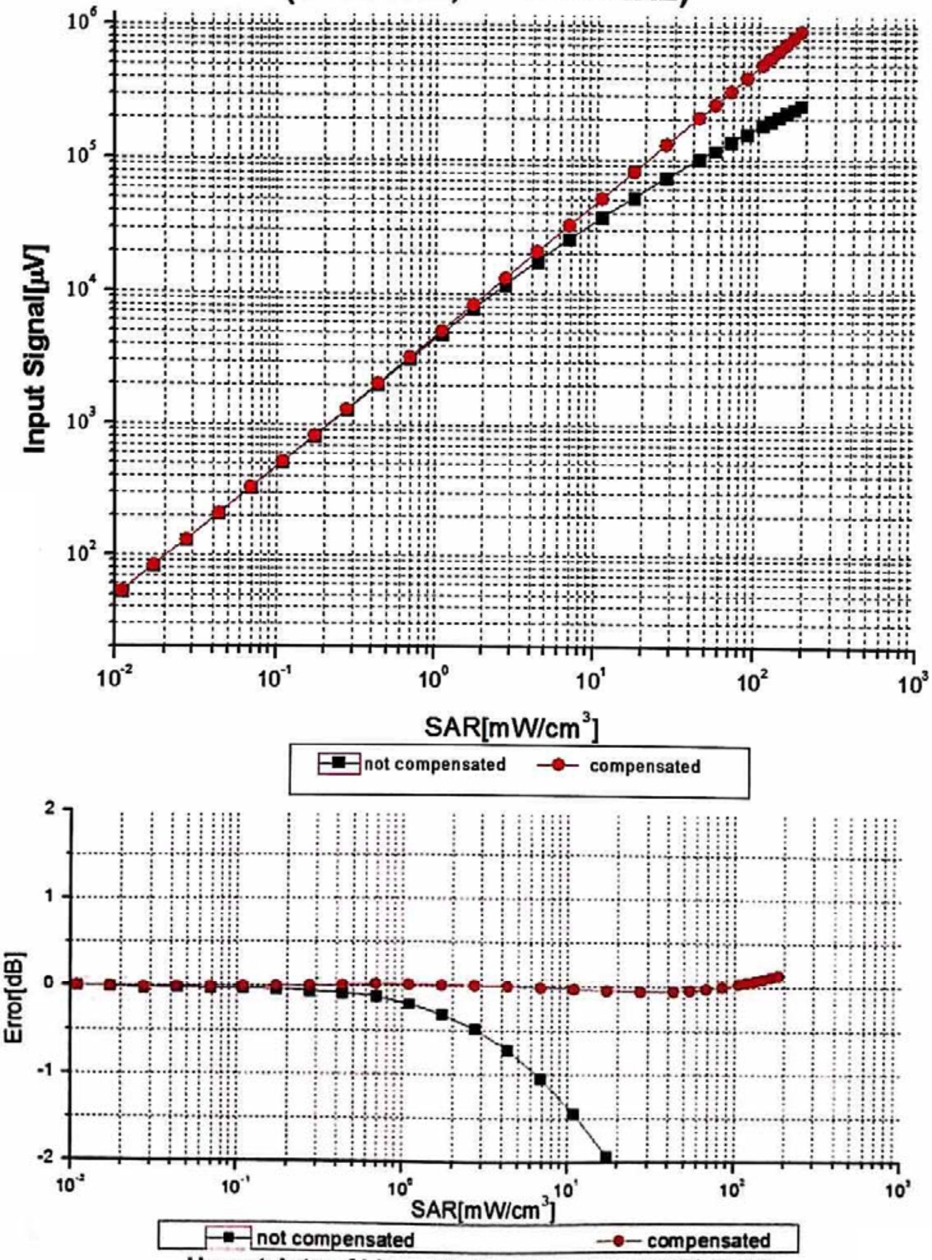
Dynamic Range f(SAR$_{head}$)
(TEM cell, f = 900 MHz)



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

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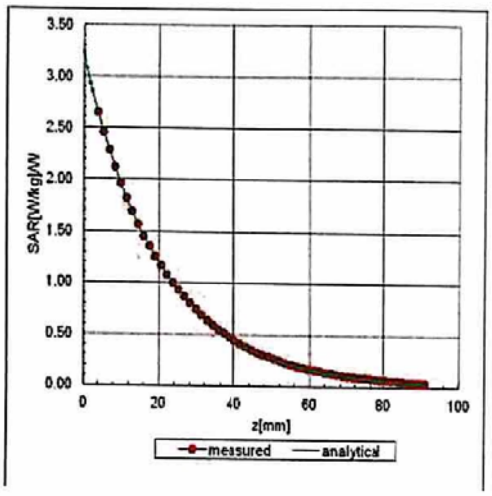
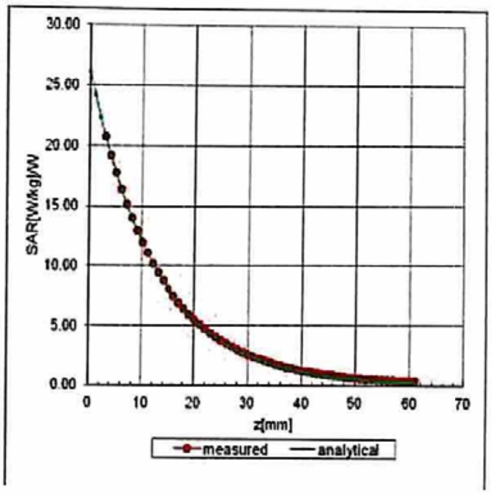
Conversion Factor Assessment

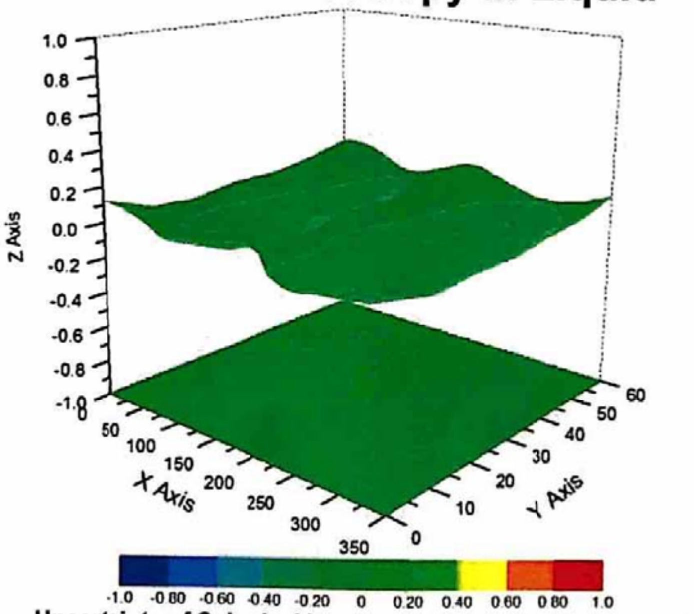
f=835 MHz, WGLS R9(H_convF)



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