SAR TEST REPORT

Applicant	ZTE Corporation
FCC ID	SRQ-R219Z
Product	Vodafone Mobile WiFi
Marketing	R219z
Model	R219z
Report No.	R1911A0657-S1V2
Issue Date	December 24, 2019

TA Technology (Shanghai) Co., Ltd. tested the above equipment in accordance with the requirements in **IEEE 1528- 2013, ANSI C95.1: 1992,IEEE C95.1: 1991.** 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

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.

1.2 Testing Location

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

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1.3 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 1: Highest Reported SAR

Mode	Highest Reported SAR (W/kg) 1g SAR Hotspot (Separation 10mm)
GSM 850	0.711
GSM 1900	1.345
LTE FDD 7	1.372
Wi-Fi (2.4G)	0.173
Date of Testing:	November 19, 2019~ November 22, 2019

Table 2: Highest Simultaneous Transmission SAR

Exposure Configuration	1g SAR Hotspot (Separation 10mm)
Highest Simultaneous Transmission SAR (W/kg)	1.583
Note: 1. The detail for simultaneous transmission consideration is described in chapter 10.3.	

3 Description of Equipment under Test

Client Information

Applicant	ZTE Corporation
Applicant address	ZTE Plaza, Keji Road South, Shenzhen, China
Manufacturer	ZTE Corporation
Manufacturer address	ZTE Plaza, Keji Road South, Shenzhen, China

General Technologies

Application Purpose:	Original Grant
EUT Stage:	Identical Prototype
Model:	R219z
IMEI:	35337311000068
Hardware Version:	dwhA_G1
Software Version:	BD_R219zV1.0
Antenna Type:	Internal Antenna
Device Class:	C
Wi-Fi Hotspot:	Wi-Fi 2.4G
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	
Adapter 1	Manufacturer: SHENZHEN RUIJING INDUSTRIAL CO.,LTD. Model: STC-A51D-A
Adapter 2	Manufacturer: Jiangxi Jian Aohai Technology Co., Ltd. Model: STC-A51D-A
Battery	Manufacturer: Harbin Coslight Power Co., Ltd Model: Li3820T43P3h715345
USB Cable 1	Manufacturer: Shen Zhen Shi Yi HUA XING Electron Co.,Ltd Model: USB-MU5-W-100-M
USB Cable 2	Manufacturer: King Power Electronics Co., Ltd. Model: USB-MU5-W-100-M

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
	Does this device support DTM (Dual Transfer Mode)? ☐Yes ☒No			
LTE	FDD 7	QPSK, 16QAM, 64QAM	Rel.9 /Category 4	2500 ~ 2570
	Does this device support Carrier Aggregation (CA) ☐Yes ☒No			
	Does this device support SV-LTE (1xRTT-LTE)? ☐Yes ☒No			
Wi-Fi	2.4G	DSSS,OFDM	802.11b/g/n HT20	2412 ~ 2462
		OFDM	802.11n HT40	2422 ~ 2452
	Does this device support MIMO ☒Yes(2TX, 2RX) ☐ 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 C95.1: 1992,IEEE C95.1: 1991, the following FCC Published RF exposure KDB procedures:

IEC 62209-1
248227 D01 802.11Wi-Fi SAR v02r02
447498 D01 General RF Exposure Guidance v06
648474 D04 Handset SAR v01r03
690783 D01 SAR Listings on Grants 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

5 Operational Conditions during Test

5.1 Test Positions

5.1.1 Body Worn Configuration

Body-worn operating configurations should be tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in normal use configurations.

Per FCC KDB Publication 648474 D04, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is > 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that do contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented. Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

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

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.

5.3 Test Configuration

5.3.1 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 3: 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

SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power specified for production units, including tune-up tolerance. The data mode with highest specified time-averaged output power should be tested for SAR compliance in the applicable exposure conditions. For modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested. GSM voice and GPRS data use GMSK, which is a constant amplitude modulation with minimal peak to average power difference within the time-slot burst. For EDGE, GMSK is used for MCS 1 – MCS 4 and 8-PSK is used for MCS 5 – MCS 9; where 8-PSK has an inherently higher peak-to-average power ratio. The GMSK and 8-PSK EDGE configurations are considered separately for SAR compliance. The GMSK EDGE configurations are grouped with GPRS and considered with respect to time-averaged maximum output power to determine compliance. The 3G SAR test reduction procedure is applied to 8-PSK EDGE with GMSK GPRS/EDGE as the primary mode.

5.3.2 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.

5.3.3 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.

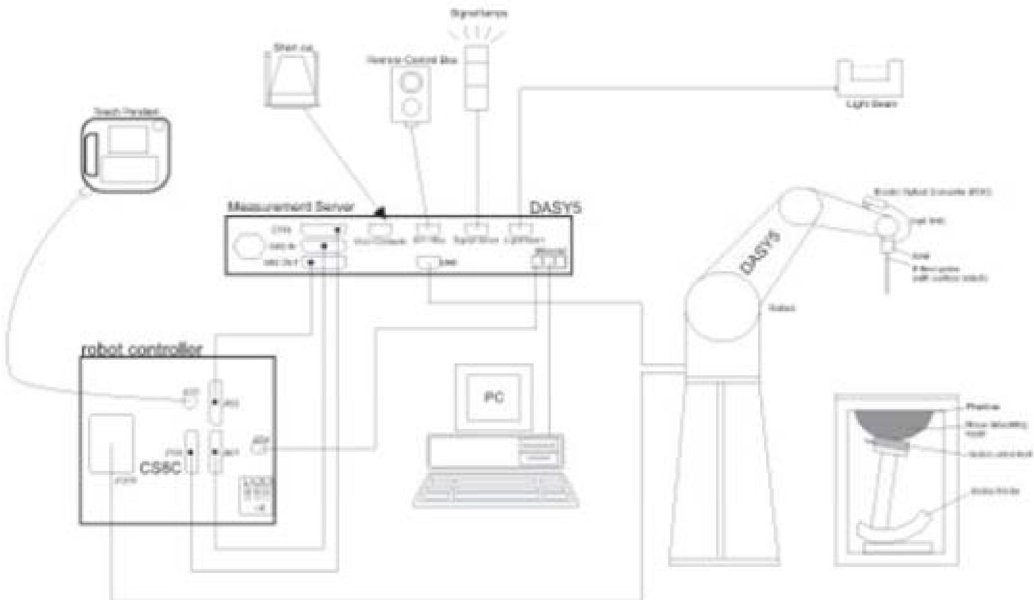
To determine the initial test position, Area Scans were performed to determine the position with the Maximum Value of SAR (measured). The position that produced the highest Maximum Value of SAR is considered the worst case position; thus used as the initial test position.

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.

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=IEI²σ/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.

<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">$\leq 1.5 \cdot \triangle z_{zoom}(n-1)$</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	2019-05-19	2020-05-18
Dielectric Probe Kit	HP	85070E	US44020115	2019-05-19	2020-05-18
Power meter	Agilent	E4417A	GB41291714	2019-05-19	2020-05-18
Power sensor	Agilent	N8481H	MY50350004	2019-05-19	2020-05-18
Power sensor	Agilent	E9327A	US40441622	2019-05-19	2020-05-18
Dual directional coupler	Agilent	778D-012	50519	2019-05-19	2020-05-18
Dual directional coupler	Agilent	777D	50146	2019-05-19	2020-05-18
Amplifier	INDEXSAR	IXA-020	0401	2019-05-19	2020-05-18
Wideband radio communication tester	R&S	CMW 500	113645	2019-05-19	2020-05-18
E-field Probe	SPEAG	EX3DV4	3677	2019-06-19	2020-06-18
DAE	SPEAG	DAE4	1291	2018-12-04	2019-12-03
Validation Kit 835MHz	SPEAG	D835V2	4d020	2017-08-28	2020-08-27
Validation Kit 1900MHz	SPEAG	D1900V2	5d060	2017-08-26	2020-08-25
Validation Kit 2450MHz	SPEAG	D2450V2	786	2017-08-29	2020-08-28
Validation Kit 2600MHz	SPEAG	D2600V2	1025	2018-05-02	2021-05-01
Temperature Probe	Tianjin jinming	JM222	AA1009129	2019-05-19	2020-05-18
Hygrothermograph	Anymetr	NT-311	20150731	2019-05-19	2020-05-18
Software for Test	Speag	DASY5	52.8.8.1222	/	/
Softwarefor Tissue	Agilent	85070	E06.01.36	/	/

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)
835	41.45	1.45	56	0	0.1	1.0	41.5	0.90
1900	55.242	0.306	0	44.452	0	0	40.0	1.40
2450	62.7	0.5	0	36.8	0	0	39.2	1.80
2600	55.242	0.306	0	44.452	0	0	39.0	1.96

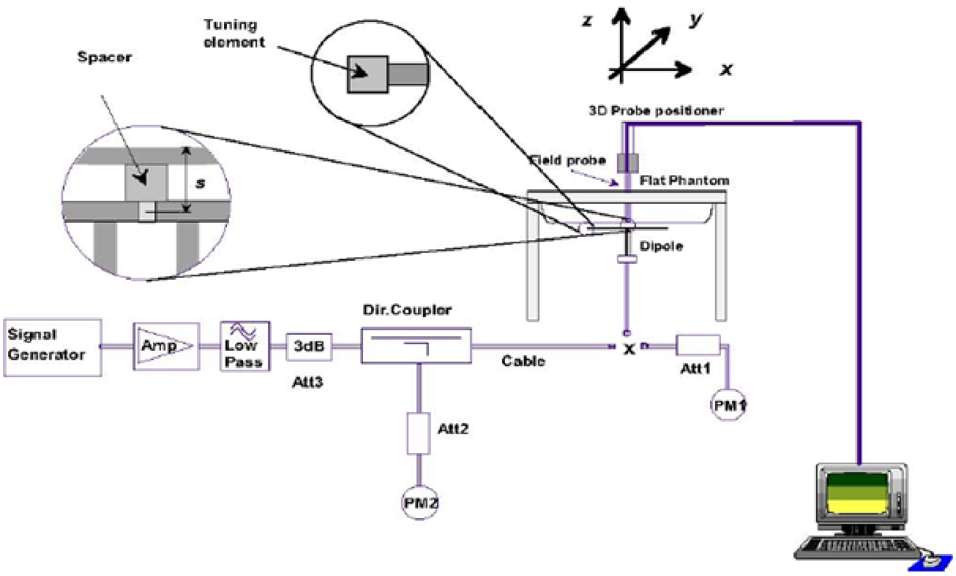
Measurements results

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	11/22/2019	21.5	41.3	0.87	41.5	0.90	-0.48	-3.33
1900	11/22/2019	21.5	40.1	1.41	40.0	1.40	0.25	0.71
2450	11/22/2019	21.5	38.6	1.81	39.2	1.80	-1.53	0.56
2600	11/19/2019	21.5	38.2	2.01	39.0	1.96	-2.05	2.55
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 1System 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	Head Liquid	8/28/2017	-31.9	/	50.3	/
		8/27/2018	-29.0	10.0	46.6	3.7
		8/26/2019	-29.4	-1.4	45.9	0.7
Dipole D1900V2 SN: 5d060	Head Liquid	8/26/2017	-23.4	/	52.0	/
		8/25/2018	-24.7	-5.3	54.4	-2.4
		8/24/2019	-24.9	-0.8	56.2	-1.8
Dipole D2450V2 SN: 786	Head Liquid	8/29/2017	-25.5	/	53.4	/
		8/28/2018	-23.0	10.9	57.2	-3.8
		8/27/2019	-22.2	3.6	56.4	0.8
Dipole D2600V2 SN: 1025	Head Liquid	5/2/2018	-22.0	/	48.1	/
		5/1/2019	-22.5	-2.2	48.7	-0.6

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	11/22/2019	21.5	2.46	9.84	9.45	4.13	1
1900	11/22/2019	21.5	9.88	39.52	40.10	-1.45	2
2450	11/22/2019	21.5	13.70	54.80	52.60	4.18	3
2600	11/19/2019	21.5	13.90	55.60	54.10	2.77	4
Note：Target Values used derive from the calibration certificate Data Storage and Evaluation.							

8.3 SAR System Validation

Per FCC KDB 865664 D02v01, SAR system verification is required to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles are used with the required tissue-equivalent media for system validation, according to the procedures outlined in FCC KDB 865664 D01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point must be validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.
a tabulated summary of the system validation status, measurement frequencies, SAR probes, calibrated signal type(s) and tissue dielectric parameters has been included.

Frequency [MHz]	Date	Probe SN	Probe Type	Probe Cal Point		PERM (Er)	COND (Σ)	CW Validation			Mod. Validation		
								Sensitivity	Probe Linearity	Probe Isotropy	Mod. Type	Duty Factor	PAR
750	6/25/2019	3677	EX3DV4	750	Head	42.81	0.85	PASS	PASS	PASS	FDD	PASS	N/A
835	6/25/2019	3677	EX3DV4	835	Head	42.22	0.90	PASS	PASS	PASS	GMSK	PASS	N/A
1750	6/25/2019	3677	EX3DV4	1750	Head	39.91	1.32	PASS	PASS	PASS	NA	N/A	N/A
1900	6/25/2019	3677	EX3DV4	1900	Head	39.43	1.42	PASS	PASS	PASS	GMSK	PASS	N/A
2450	6/25/2019	3677	EX3DV4	2450	Head	38.19	1.83	PASS	PASS	PASS	OFDM	PASS	PASS
2600	6/25/2019	3677	EX3DV4	2600	Head	37.60	1.99	PASS	PASS	PASS	TDD	PASS	N/A
5250	6/25/2019	3677	EX3DV4	5250	Head	35.36	4.83	PASS	PASS	PASS	OFDM	N/A	PASS
5600	6/25/2019	3677	EX3DV4	5600	Head	34.43	5.29	PASS	PASS	PASS	OFDM	N/A	PASS
5750	6/25/2019	3677	EX3DV4	5750	Head	34.07	5.47	PASS	PASS	PASS	OFDM	N/A	PASS
750	6/25/2019	3677	EX3DV4	750	Body	55.35	0.99	PASS	PASS	PASS	FDD	PASS	N/A
835	6/25/2019	3677	EX3DV4	835	Body	54.88	0.98	PASS	PASS	PASS	GMSK	PASS	N/A
1750	6/25/2019	3677	EX3DV4	1750	Body	51.24	1.44	PASS	PASS	PASS	NA	N/A	N/A
1900	6/25/2019	3677	EX3DV4	1900	Body	50.98	1.56	PASS	PASS	PASS	GMSK	PASS	N/A
2450	6/25/2019	3677	EX3DV4	2450	Body	50.59	1.95	PASS	PASS	PASS	OFDM	PASS	PASS
2600	6/25/2019	3677	EX3DV4	2600	Body	50.14	2.13	PASS	PASS	PASS	TDD	PASS	N/A
5250	6/25/2019	3677	EX3DV4	5250	Body	47.37	5.44	PASS	PASS	PASS	OFDM	N/A	PASS
5600	6/25/2019	3677	EX3DV4	5600	Body	46.42	5.99	PASS	PASS	PASS	OFDM	N/A	PASS
5750	6/25/2019	3677	EX3DV4	5750	Body	46.02	6.23	PASS	PASS	PASS	OFDM	N/A	PASS

NOTE: While the probes have been calibrated for both CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5dB), such as OFDM according to KDB 865664.

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-Averaged output power(dBm)				Division Factors	Frame-Averaged output power(dBm)			
		Tune-up	Channel/Frenqucy(MHz)				Tune-up	Channel/Frenqucy(MHz)		
		MAX	128 /824.2	190 /836.6	251 /848.8		MAX	128 /824.2	190 /836.6	251 /848.8
GPRS/ EGPRS (GMSK)	1 Tx Slot	33.00	32.37	32.45	32.54	9.03	23.97	20.05	23.42	19.81
	2 Tx Slots	30.00	28.93	29.08	29.21	6.02	23.98	22.91	23.06	23.19
	3 Tx Slots	29.50	28.67	28.84	28.97	4.26	**25.24**	**24.41**	**24.58**	**24.71**
	4 Tx Slots	27.50	26.61	26.70	26.91	3.01	24.49	23.60	23.69	23.90
EGPRS (8PSK)	1 Tx Slot	27.50	26.79	26.77	26.94	9.03	18.47	17.76	17.74	17.91
	2 Tx Slots	24.00	23.36	23.48	23.47	6.02	17.98	17.34	17.46	17.45
	3 Tx Slots	23.50	23.04	23.12	23.15	4.26	19.24	18.78	18.86	18.89
	4 Tx Slots	21.50	20.89	21.15	21.23	3.01	18.49	17.88	18.14	18.22
GSM 1900		Burst-Averaged output power(dBm)				Division Factors	Frame-Averaged output power(dBm)			
		Tune-up	Channel/Frenqucy(MHz)				Tune-up	Channel/Frenqucy(MHz)		
		MAX	512 /1850.2	661 /1880	810 /1909.8		MAX	512 /1850.2	661 /1880	810 /1909.8
GPRS/ EGPRS (GMSK)	1 Tx Slot	30.00	29.65	29.45	29.48	9.03	20.97	20.62	20.42	20.45
	2 Tx Slots	27.00	26.24	26.09	26.08	6.02	20.98	20.22	20.07	20.06
	3 Tx Slots	26.50	25.90	25.76	25.93	4.26	**22.24**	**21.64**	**21.50**	**21.67**
	4 Tx Slots	24.50	23.78	23.58	23.58	3.01	21.49	20.77	20.57	20.57
EGPRS (8PSK)	1 Tx Slot	26.00	25.37	25.12	24.89	9.03	16.97	16.34	16.09	15.86
	2 Tx Slots	23.00	22.49	22.26	22.03	6.02	16.98	16.47	16.24	16.01
	3 Tx Slots	22.50	21.91	21.79	21.88	4.26	18.24	17.65	17.53	17.62
	4 Tx Slots	21.00	20.55	20.39	20.33	3.01	17.99	17.54	17.38	17.32

Notes: The worst-case configuration and mode for SAR testing is determined to be as follows:
1. Standalone: GSM 850 GMSK (GPRS) mode with 3 time slots for Max power, GSM 1900 GMSK (GPRS) mode with 3 time slots for Max power, based on the output power measurements above..

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 (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
64 QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 2
64 QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 3

LTE FDD Band 7				Conducted Power(dBm)			Tune-up Limit
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			
				20775/2502.5	21100/2535	21425/2567.5	
5MHz	QPSK	1	0	21.76	21.21	21.65	22.50
		1	13	21.51	20.64	21.05	22.50
		1	24	21.52	21.98	22.05	22.50
		12	0	20.53	19.88	19.67	21.50
		12	6	20.52	19.71	19.45	21.50
		12	13	20.51	19.99	19.40	21.50
		25	0	20.66	20.01	19.76	21.50
	16QAM	1	0	20.90	20.89	20.77	21.50
		1	13	20.88	20.32	20.74	21.50
		1	24	20.12	20.88	20.81	21.50
		12	0	20.16	19.79	19.68	21.00
		12	6	20.25	19.53	19.73	21.00
		12	13	20.36	19.87	19.97	21.00
		25	0	20.46	19.83	19.99	21.00
	64QAM	1	0	20.58	21.06	21.01	21.50
		1	13	20.54	20.05	20.52	21.50
		1	24	21.16	20.90	20.94	21.50
		12	0	20.07	19.73	19.70	20.50
		12	6	20.32	19.50	19.68	20.50
		12	13	20.32	19.84	19.89	20.50
		25	0	20.36	19.84	20.02	20.50
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit
				20800/2505	21100/2535	21400/2565	
10MHz	QPSK	1	0	21.78	21.22	21.68	22.50

		1	25	21.54	20.69	21.09	22.50
		1	49	21.54	22.02	22.08	22.50
		25	0	20.56	19.93	19.71	21.50
		25	13	20.55	19.76	19.49	21.50
		25	25	20.53	20.03	19.45	21.50
		50	0	20.70	20.03	19.80	21.50
	16QAM	1	0	20.92	20.92	20.79	21.50
		1	25	20.91	20.36	20.77	21.50
		1	49	20.15	20.90	20.84	21.50
		25	0	20.19	19.84	19.72	21.00
		25	13	20.27	19.57	19.76	21.00
		25	25	20.39	19.92	20.01	21.00
		50	0	20.49	19.88	20.03	21.00
	64QAM	1	0	20.60	21.05	21.03	21.50
		1	25	20.57	20.05	20.55	21.50
		1	49	21.15	20.92	20.97	21.50
		25	0	20.10	19.78	19.70	20.50
		25	13	20.34	19.54	19.71	20.50
		25	25	20.35	19.89	19.93	20.50
		50	0	20.39	19.89	20.06	20.50
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit
				20825/2507.5	21100/2535	21375/2562.5	
15MHz	QPSK	1	0	21.77	21.18	21.66	22.50
		1	38	21.52	20.68	21.06	22.50
		1	74	21.51	21.97	22.04	22.50
		36	0	20.54	19.89	19.68	21.50
		36	18	20.52	19.71	19.45	21.50
		36	39	20.50	20.00	19.41	21.50
		75	0	20.68	19.99	19.75	21.50
	16QAM	1	0	20.87	20.90	20.77	21.50
		1	38	20.89	20.33	20.75	21.50
		1	74	20.12	20.86	20.81	21.50
		36	0	20.16	19.82	19.69	21.00
		36	18	20.24	19.52	19.72	21.00
		36	39	20.37	19.88	19.98	21.00
		75	0	20.46	19.83	19.99	21.00
	64QAM	1	0	20.55	21.03	21.01	21.50
		1	38	20.55	20.02	20.53	21.50
		1	74	21.16	20.91	20.98	21.50
		36	0	20.09	19.80	19.71	20.50
		36	18	20.32	19.51	19.70	20.50
		36	39	20.33	19.85	19.90	20.50
		75	0	20.36	19.84	20.02	20.50

Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit
				20850/2510	21100/2535	21350/2560	
20MHz	QPSK	1	0	21.74	21.14	21.63	22.50
		1	50	21.51	20.64	21.04	22.50
		1	99	21.49	21.99	22.01	22.50
		50	0	20.51	19.84	19.64	21.50
		50	25	20.50	19.67	19.42	21.50
		50	50	20.47	19.95	19.37	21.50
		100	0	20.65	19.94	19.71	21.50
	16QAM	1	0	20.89	20.86	20.72	21.50
		1	50	20.85	20.31	20.71	21.50
		1	99	20.10	20.83	20.79	21.50
		50	0	20.13	19.78	19.66	21.00
		50	25	20.21	19.50	19.69	21.00
		50	50	20.34	19.83	19.94	21.00
		100	0	20.44	19.79	19.96	21.00
	64QAM	1	0	20.53	20.99	20.96	21.50
		1	50	20.51	20.00	20.49	21.50
		1	99	21.10	20.85	20.92	21.50
		50	0	20.04	19.72	19.64	21.00
		50	25	20.28	19.47	19.64	21.00
		50	50	20.30	19.80	19.86	21.00
		100	0	20.34	19.80	19.99	21.00

9.3 WLAN Mode

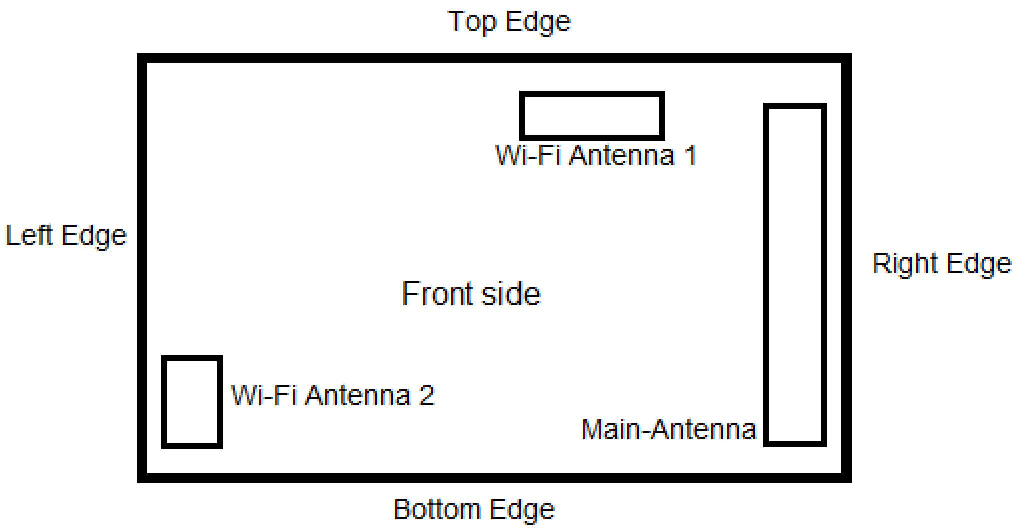
Wi-Fi 2.4G Antenna 1 Mode	Channel /Frequency(MHz)	Maximum Output Power (dBm)		
		Tune-up	Meas.	TP Set Level
802.11b (1M)	1/2412	15.00	14.19	32
	6/2437	15.00	14.89	32
	11/2462	15.00	14.47	32
802.11g (6M)	1/2412	13.00	12.45	40
	6/2437	13.00	12.72	40
	11/2462	13.00	12.27	40
802.11n-HT20 (MCS0)	1/2412	12.00	11.30	38
	6/2437	12.00	11.68	38
	11/2462	12.00	11.21	38
802.11n-HT40 (MCS0)	3/2422	12.00	11.58	42
	6/2437	12.00	11.65	42
	9/2452	12.00	11.32	42
Note: Initial test configuration is 802.11b mode.				

Wi-Fi 2.4G Antenna 2 Mode	Channel /Frequency(MHz)	Maximum Output Power (dBm)		
		Tune-up	Meas.	TP Set Level
802.11b (1M)	1/2412	15.00	14.41	37
	6/2437	15.00	14.95	33
	11/2462	15.00	14.33	34
802.11g (6M)	1/2412	13.00	11.78	43
	6/2437	13.00	11.98	38
	11/2462	13.00	11.45	39
802.11n-HT20 (MCS0)	1/2412	12.00	10.73	41
	6/2437	12.00	11.49	38
	11/2462	12.00	10.75	38
802.11n-HT40 (MCS0)	3/2422	12.00	11.05	44
	6/2437	12.00	11.06	42
	9/2452	12.00	11.11	42
Note: Initial test configuration is 802.11b mode.				

Wi-Fi 2.4G MIMO Mode	Channel /Frequency(MHz)	Maximum Output Power (dBm)		
		Tune-up	Meas.	TP Set Level
802.11b (1M)	1/2412	18.00	17.31	32
	6/2437	18.00	17.93	32
	11/2462	18.00	17.41	32
802.11g (6M)	1/2412	16.00	15.14	40
	6/2437	16.00	15.38	40
	11/2462	16.00	14.89	40
802.11n-HT20 (MCS0)	1/2412	15.00	14.03	38
	6/2437	15.00	14.60	38
	11/2462	15.00	14.00	38
802.11n-HT40 (MCS0)	3/2422	15.00	14.33	42
	6/2437	15.00	14.38	42
	9/2452	15.00	14.23	42
Note: Initial test configuration is 802.11b mode.				

10 Measured and Reported (Scaled) SAR Results

10.1 EUT Antenna Locations



Overall (Length x Width): 107 mm x 62 mm Overall Diagonal: 123mm						
Distance of the Antenna to the EUT surface/edge						
Antenna	Back Side	Front side	Left Edge	Right Edge	Top Edge	Bottom Edge
Main-Antenna	<25mm	<25mm	>25mm	<25mm	<25mm	<25mm
Wi-Fi Antenna 1	<25mm	<25mm	>25mm	>25mm	<25mm	>25mm
Wi-Fi Antenna 2	<25mm	<25mm	<25mm	>25mm	>25mm	<25mm
Hotspot mode, Positions for SAR tests						
Mode	Back Side	Front side	Left Edge	Right Edge	Top Edge	Bottom Edge
Main-Antenna	Yes	Yes	N/A	Yes	Yes	Yes
Wi-Fi Antenna 1	Yes	Yes	N/A	N/A	Yes	N/A
Wi-Fi Antenna 2	Yes	Yes	Yes	N/A	N/A	Yes

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.
2. Per FCC KDB 447498 D01,
for each exposure position, testing of other requised channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:
a) ≤0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100MHz
b) ≤0.6 W/kg or 1.5 W/kg, for1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz.
c) ≤ 0.4 W/kg or 1.0 Wkg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz.
3.When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.

10.2 Measured SAR Results

Table 4: GSM 850

Test Position	Cover Type	Time slot	Channel/ Frequency (MHz)	Tune-up (dBm)	Measured power (dBm)	Limit of SAR 1.6 W/kg (mW/g)				Plot No.
						Measured SAR1g	Power Drift (dB)	Scaling Factor	Report SAR1g	
Hotspot SAR(Distance 10mm)										
Back Side	standard	3Txslots	190/836.6	29.50	28.84	0.611	-0.170	1.16	0.711	5
Front Side	standard	3Txslots	190/836.6	29.50	28.84	0.543	-0.029	1.16	0.632	/
Left Edge	standard	3Txslots	190/836.6	29.50	28.84	0.022	0.028	1.16	0.026	/
Right Edge	standard	3Txslots	190/836.6	29.50	28.84	0.123	-0.140	1.16	0.143	/
Top Edge	standard	3Txslots	190/836.6	29.50	28.84	0.340	-0.160	1.16	0.396	/
Bottom Edge	standard	3Txslots	190/836.6	29.50	28.84	0.379	-0.080	1.16	0.441	/

Note: 1.The value with blue color is the maximum SAR Value of each test band.
2.When multiple slots are used, SAR should be tested to account for the maximum source-based time-averaged output power.

Table 5: GSM 1900

Test Position	Cover Type	Time slot	Channel/ Frequency (MHz)	Tune-up (dBm)	Measured power (dBm)	Limit of SAR 1.6 W/kg (mW/g)				Plot No.
						Measured SAR1g	Power Drift (dB)	Scaling Factor	Report SAR1g	
Hotspot SAR(Distance 10mm)										
Back Side	standard	3Txslots	512/1850.2	26.50	25.90	0.975	-0.021	1.19	1.119	/
	standard	3Txslots	661/1880	26.50	25.76	1.010	-0.027	1.11	1.198	/
	standard	3Txslots	810/1909.8	26.50	25.93	1.180	0.060	1.05	1.345	6
Front Side	standard	3Txslots	661/1880	26.50	25.76	0.970	0.080	1.11	1.150	/
Left Edge	standard	3Txslots	661/1880	26.50	25.76	0.042	-0.020	1.11	0.049	/
Right Edge	standard	3Txslots	661/1880	26.50	25.76	0.037	-0.180	1.11	0.044	/
Top Edge	standard	3Txslots	661/1880	26.50	25.76	0.447	-0.026	1.11	0.530	/
Bottom Edge	standard	3Txslots	661/1880	26.50	25.76	0.138	-0.043	1.11	0.164	/

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

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

Table 6: LTE Band 7

Test Position	Cover Type	RB allocation	RB offset	Channel/ Frequency (MHz)	Tune-up (dBm)	Measured power (dBm)	Limit of SAR 1.6 W/kg (mW/g)				Plot No.
							Measured SAR1g	Power Drift (dB)	Scaling Factor	Report SAR1g	
Hotspot SAR(QPSK, Distance 10mm)											
Back Side	standard	1	99	20850/2510	22.50	21.74	0.619	0.050	1.19	0.737	/
	standard	1	99	21100/2535	22.50	21.99	1.220	0.110	1.12	1.372	7
	standard	1	99	21350/2560	22.50	22.01	1.130	-0.180	1.12	1.265	/
Front Side	standard	1	99	20850/2510	22.50	21.74	0.945	0.028	1.19	1.126	/
	standard	1	99	21100/2535	22.50	21.99	1.130	-0.010	1.12	1.271	/
	standard	1	99	21350/2560	22.50	22.01	1.210	-0.010	1.12	1.355	/
Left Edge	standard	1	99	21350/2560	22.50	22.01	0.117	-0.022	1.12	0.131	/
Right Edge	standard	1	99	21350/2560	22.50	22.01	0.533	-0.075	1.12	0.597	/
Top Edge	standard	1	99	21350/2560	22.50	22.01	0.492	0.060	1.12	0.551	/
Bottom Edge	standard	1	99	21350/2560	22.50	22.01	0.116	-0.037	1.12	0.130	/
Back Side	standard	50%	0	20850/2510	21.00	20.51	0.418	0.027	1.12	0.468	/
Front Side	standard	50%	0	20850/2510	21.00	20.51	0.451	-0.132	1.12	0.505	/
Left Edge	standard	50%	0	20850/2510	21.00	20.51	0.068	0.033	1.12	0.076	/
Right Edge	standard	50%	0	20850/2510	21.00	20.51	0.326	-0.197	1.12	0.365	/
Top Edge	standard	50%	0	20850/2510	21.00	20.51	0.345	0.020	1.12	0.386	/
Bottom Edge	standard	50%	0	20850/2510	21.00	20.51	0.078	-0.100	1.12	0.088	/
Back Side	Standard	100%	0	20850/2510	21.00	20.65	0.511	-0.060	1.08	0.554	/
Back Side	Repeated	1	99	21100/2535	22.50	21.99	1.190	0.023	1.12	1.338	/

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

2.For QPSK with 100% RB allocation, SAR is required when and the highest reported SAR for 1 RB and 50% RB allocation in are ≥ 50% limit(1g).

Measurement Variability				
Test Position	Channel/ Frequency(MHz)	MAX Measured SAR_{1g} (W/kg)	1st Repeated SAR_{1g} (W/kg)	Ratio
Back Side	21100/2535	1.220	1.190	1.03

Note: 1) 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).

2) 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.

Table 7: Wi-Fi (2.4G)(Antenna 1)

Test Position	Cover Type	Mode 802.11b	Duty Cycle	Channel/ Frequency (MHz)	Tune-up dBm)	Measured power (dBm)	Limit of SAR 1.6 W/kg (mW/g)					Plot No.
							Area Scan SAR 1g	Zoom Scan SAR 1g	Power Drift (dB)	Scaling Factor	Report SAR 1g	
Hotspot SAR(Distance 10mm)												
Back Side	standard	DSSS	100.0%	6/2437	15.00	14.89	0.076	0.074	0.085	1.03	0.075	/
Front Side	standard	DSSS	100.0%	6/2437	15.00	14.89	0.057	0.054	0.067	1.03	0.055	/
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	standard	DSSS	100.0%	6/2437	15.00	14.89	0.016	0.012	0.099	1.03	0.013	/
Top Edge	standard	DSSS	100.0%	6/2437	15.00	14.89	0.088	0.108	-0.087	1.03	0.111	8
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.												

MAX Adjusted SAR							
Mode	Test Position	Channel/ Frequency (MHz)	MAX Reported SAR_{1g} (W/kg)	802.11b Tune-up limit (dBm)	Tune-up limit (dBm)	Scaling Factor	Adjusted SAR_{1g} (W/kg)
802.11g	Top Edge	6/2437	0.111	15.00	13.00	0.63	0.070
802.11n HT20	Top Edge	6/2437	0.111	15.00	12.00	0.50	0.056
802.11n HT40	Top Edge	6/2437	0.111	15.00	12.00	0.50	0.056
Note: 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.							

Table 8: Wi-Fi (2.4G)(Antenna 2)

Test Position	Cover Type	Mode 802.11b	Duty Cycle	Channel/ Frequency (MHz)	Tune-up dBm)	Measured power (dBm)	Limit of SAR 1.6 W/kg (mW/g)					Plot No.
							Area Scan SAR 1g	Zoom Scan SAR 1g	Power Drift (dB)	Scaling Factor	Report SAR 1g	
Hotspot SAR(Distance 10mm)												
Back Side	standard	DSSS	100.0%	6/2437	15.00	14.95	0.139	0.132	0.030	1.01	0.134	/
Front Side	standard	DSSS	100.0%	6/2437	15.00	14.95	0.144	0.171	0.021	1.01	0.173	9
Left Edge	standard	DSSS	100.0%	6/2437	15.00	14.95	0.019	0.023	-0.113	1.01	0.023	/
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	DSSS	100.0%	6/2437	15.00	14.95	0.100	0.108	-0.056	1.01	0.109	/
Note: 1. The value with blue color is the maximum SAR Value of each test band.												

MAX Adjusted SAR							
Mode	Test Position	Channel/ Frequency (MHz)	MAX Reported SAR_{1g} (W/kg)	802.11b Tune-up limit (dBm)	Tune-up limit (dBm)	Scaling Factor	Adjusted SAR_{1g} (W/kg)
802.11g	Front Side	6/2437	0.173	15.00	13.00	0.63	0.109
802.11n HT20	Front Side	6/2437	0.173	15.00	12.00	0.50	0.087
802.11n HT40	Front Side	6/2437	0.173	15.00	12.00	0.50	0.087
Note: 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.							

10.3 Simultaneous Transmission Analysis

Simultaneous Transmission Configurations	Hotspot
GSM + Wi-Fi-2.4GHz(Antenna 1)	Yes
LTE + Wi-Fi-2.4GHz(Antenna 1)	Yes
GSM + Wi-Fi-2.4GHz(Antenna 2)	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}
Hotspot	Back Side	0.711	1.345	1.372	1.372
	Front Side	0.632	1.150	1.355	1.355
	Left Edge	0.026	0.049	0.131	0.131
	Right Edge	0.143	0.044	0.597	0.597
	Top Edge	0.396	0.530	0.551	0.551
	Bottom Edge	0.441	0.164	0.130	0.441

About Wi-Fi and Main-Antenna

Test Position \ SAR_{1g} (W/kg)		Main-antenna	Wi-Fi 2.4G (Antenna 1)	Wi-Fi 2.4G (Antenna 2)	MAX. ΣSAR_{1g}
Hotspot	Back Side	1.372	0.075	0.134	1.581
	Front Side	1.355	0.055	0.173	1.583
	Left Edge	0.131	N/A	0.023	0.154
	Right Edge	0.597	0.013	N/A	0.610
	Top Edge	0.551	0.111	N/A	0.662
	Bottom Edge	0.441	N/A	0.109	0.550

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} = 1.583W/kg<1.6W/kg, so the Simultaneous transimition SAR with volum scan are not required for Wi-Fi and Main-Antenna.

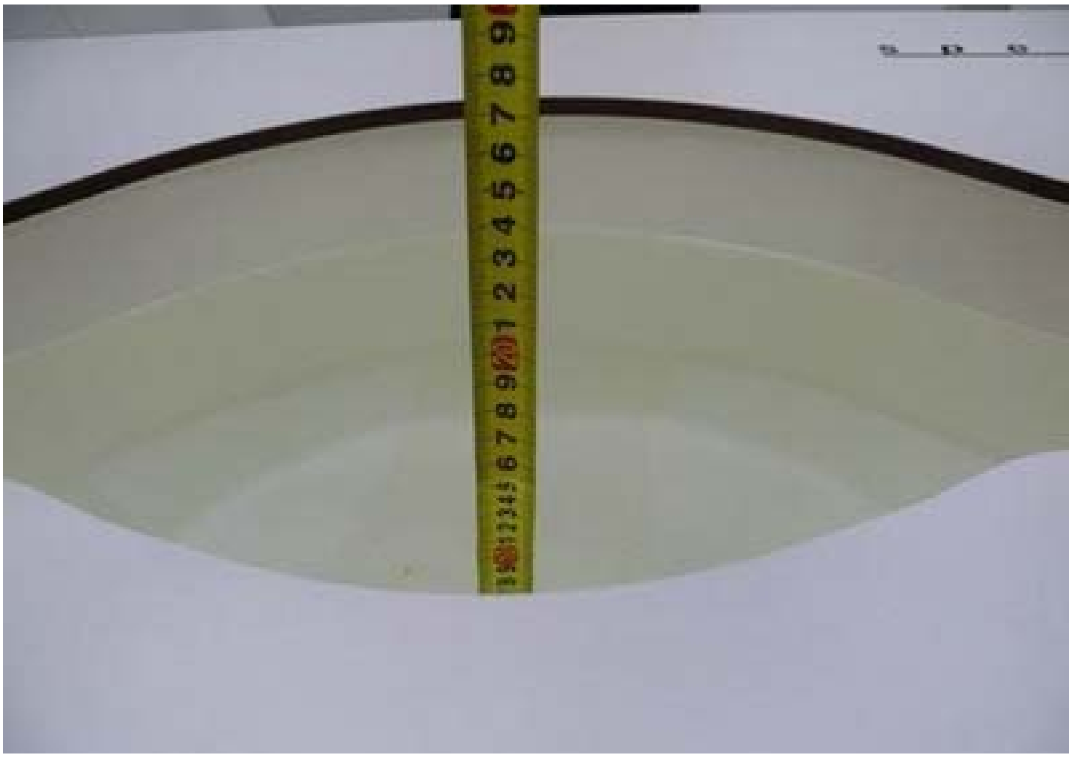
11 Measurement Uncertainty

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

Tissue Simulating Liquids

For the measurement of the field distribution inside the flat phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. For Head and Body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Picture 3.



Picture 3: Liquid depth in the flat Phantom

ANNEX B: System Check Results

Plot 1 System Performance Check at 835 MHz TSL

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2

Date: 11/22/2019

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

Medium parameters used: f = 835 MHz; σ =0.87 S/m; ε_r = 41.3; 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(9.20, 9.20, 9.20); Calibrated: 6/19/2019;

Electronics: DAE4 SN1291; Calibrated: 12/4/2018

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

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

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

Maximum value of SAR (interpolated) = 2.59 mW/g

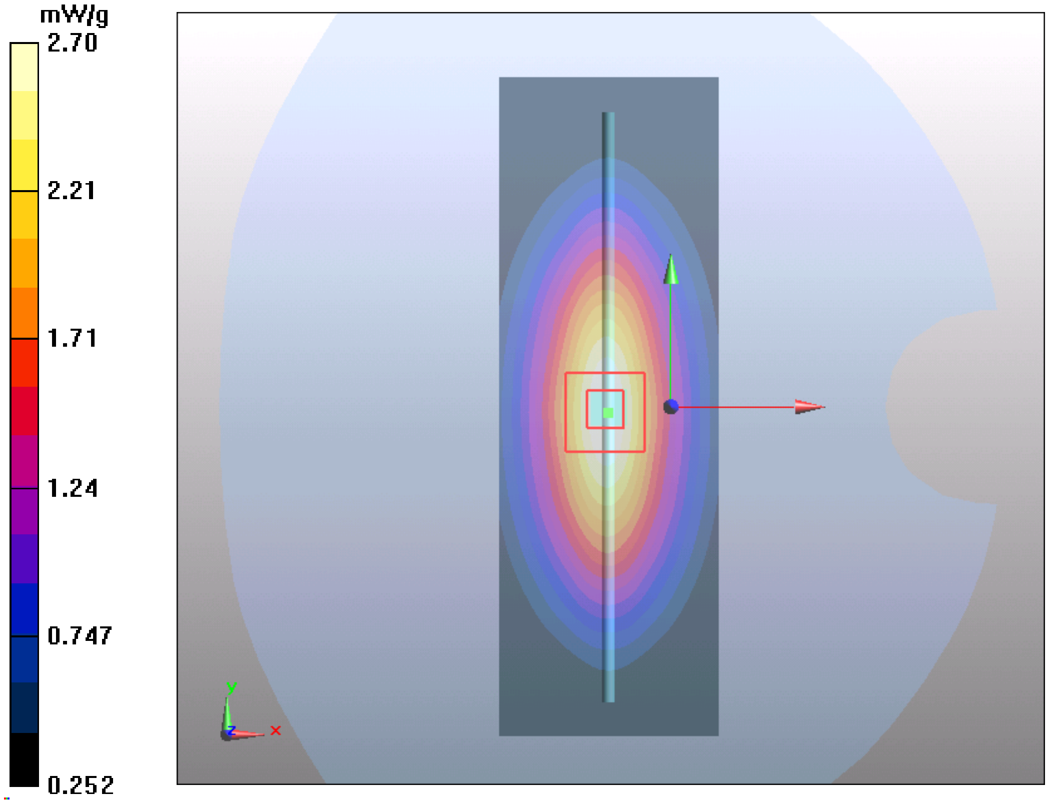
d=15mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 54.3 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 3.67 W/kg

SAR(1 g) = 2.46 mW/g; SAR(10 g) = 1.65 mW/g

Maximum value of SAR (measured) = 2.70 mW/g



Plot 2 System Performance Check at 1900 MHz TSL

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2

Date: 11/22/2019

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

Medium parameters used: f = 1900 MHz; σ = 1.41 S/m; ε_r = 40.1; 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(7.79, 7.79, 7.79); Calibrated: 6/19/2019;

Electronics: DAE4 SN1291; Calibrated: 12/4/2018

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

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

d=10mm, Pin=250mW/Area Scan (41x71x1): Measurement grid: dx=15mm, dy=15mm

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

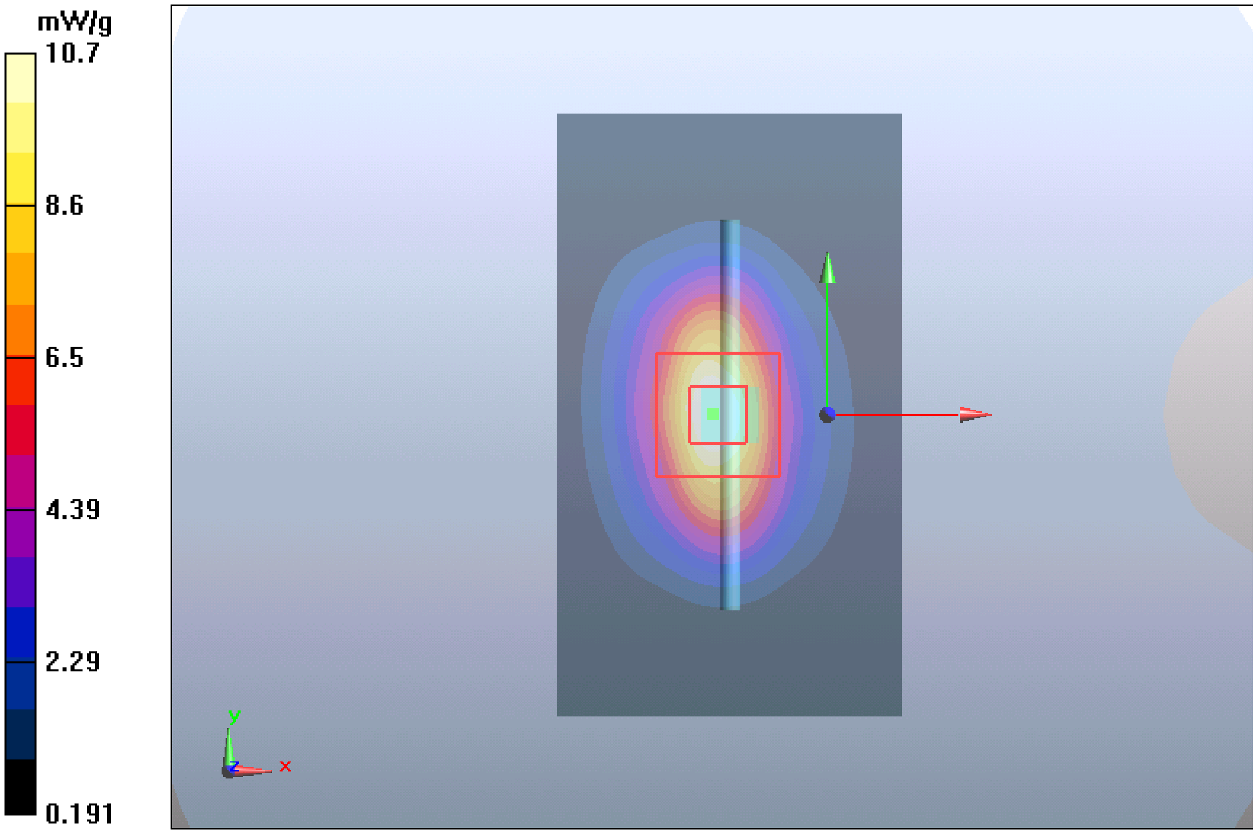
d=10mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 85.5 V/m; Power Drift = 0.028 dB

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 9.88 mW/g; SAR(10 g) = 4.9 mW/g

Maximum value of SAR (measured) = 10.7 mW/g



Plot 3 System Performance Check at 2450 MHz TSL

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2

Date: 11/22/2019

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

Medium parameters used: f = 2450 MHz; σ = 1.81 S/m; ε_r = 38.6; 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(7.50, 7.50, 7.50); Calibrated: 6/19/2019;

Electronics: DAE4 SN1291; Calibrated: 12/4/2018

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

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

d=10mm, Pin=250mW/Area Scan (41x71x1): Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 18.2 mW/g

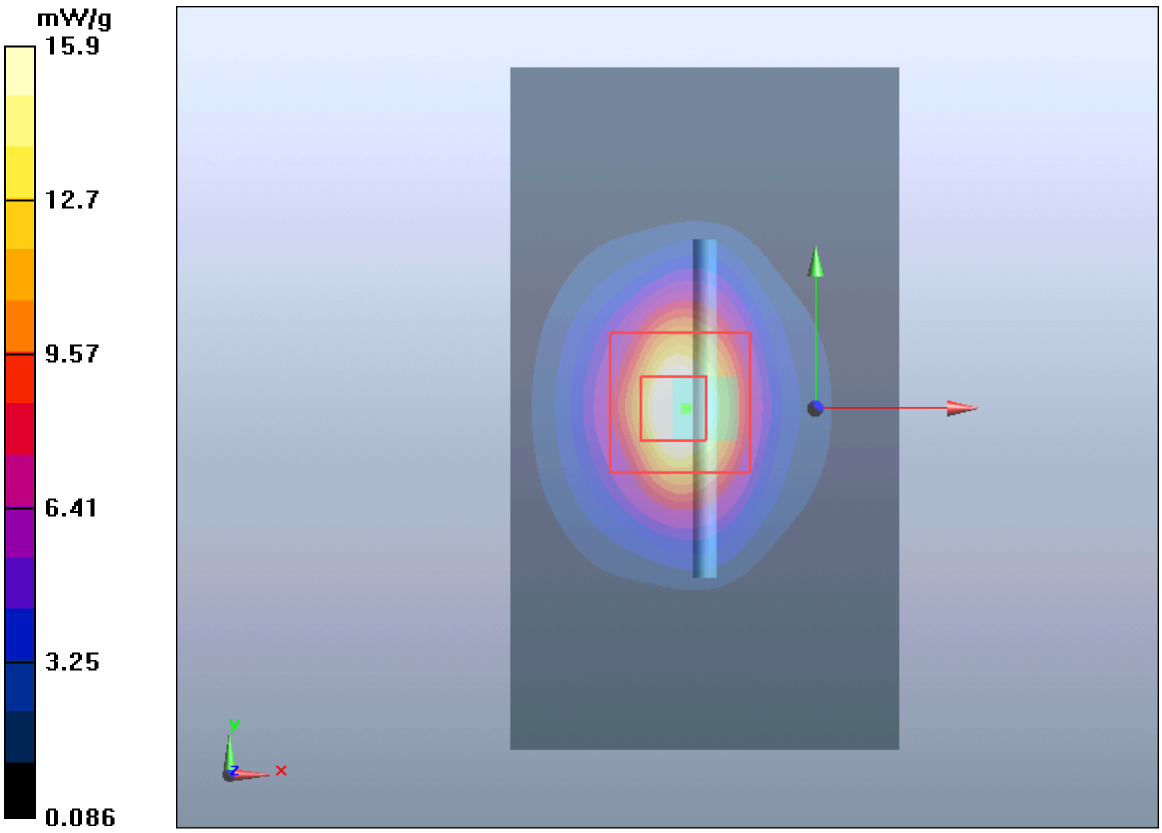
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 88.8 V/m; Power Drift = 0.075 dB

Peak SAR (extrapolated) = 30 W/kg

SAR(1 g) = 13.7 mW/g; SAR(10 g) = 6.22 mW/g

Maximum value of SAR (measured) = 15.9 mW/g



Plot 4 System Performance Check at 2600 MHz TSL

DUT: Dipole 2600 MHz; Type: D2600V2; Serial: D2600V2

Date: 11/19/2019

Communication System: CW; Frequency: 2600 MHz

Medium parameters used: f = 2600 MHz; σ = 2.01 S/m; ε_r = 38.2; ρ = 1000 kg/m^3

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(7.20, 7.20, 7.20); Calibrated: 6/19/2019;

Electronics: DAE4 SN1291; Calibrated: 12/4/2018

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

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

d=10mm, Pin=250mW/Area Scan (41x71x1): Measurement grid:dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 17.439 mW/g

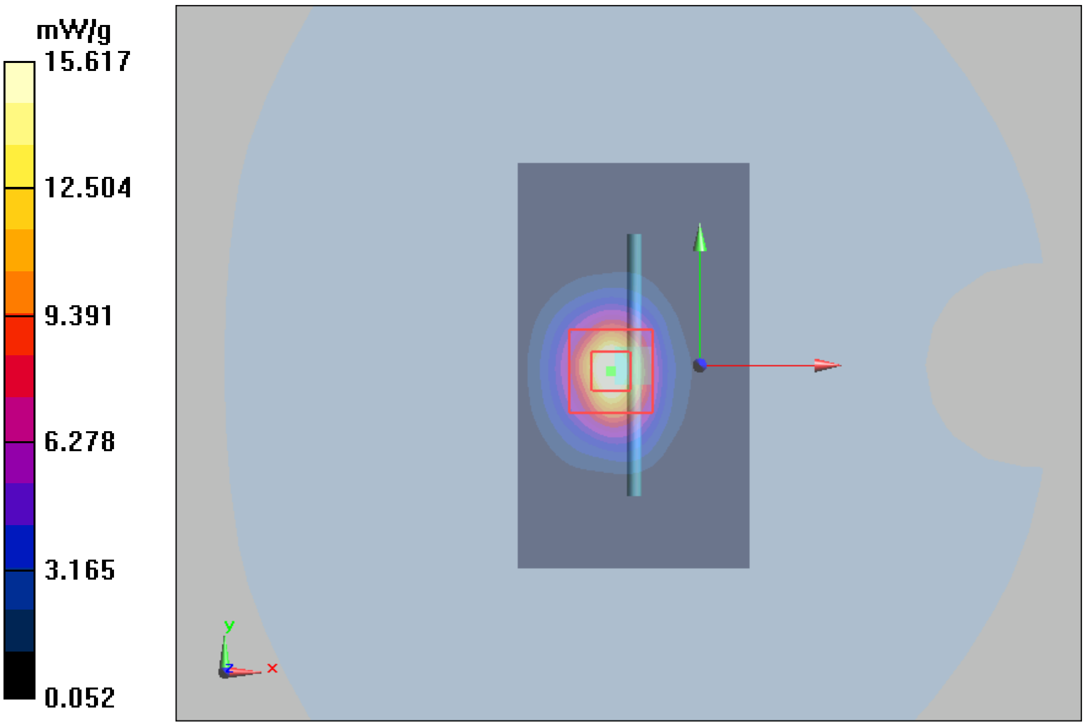
d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.998 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 31.858 W/kg

SAR(1 g) = 13.9 mW/g; SAR(10 g) = 6.07 mW/g

Maximum value of SAR (measured) = 15.617 mW/g



ANNEX C: Highest Graph Results

Plot 5 GSM 850 GPRS (3Txslots) Back Side Middle (Distance 10mm)

Date: 11/22/2019

Communication System: UID 0, GPRS 3TX (0); Frequency: 836.6 MHz;Duty Cycle: 1:2.76694

Medium parameters used: f = 837 MHz; σ = 0.923 S/m; ε_r = 42.201; 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(9.20, 9.20, 9.20); Calibrated: 6/19/2019;

Electronics: DAE4 SN1291; Calibrated: 12/4/2018

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

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Back Side Middle/Area Scan (71x91x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.661 W/kg

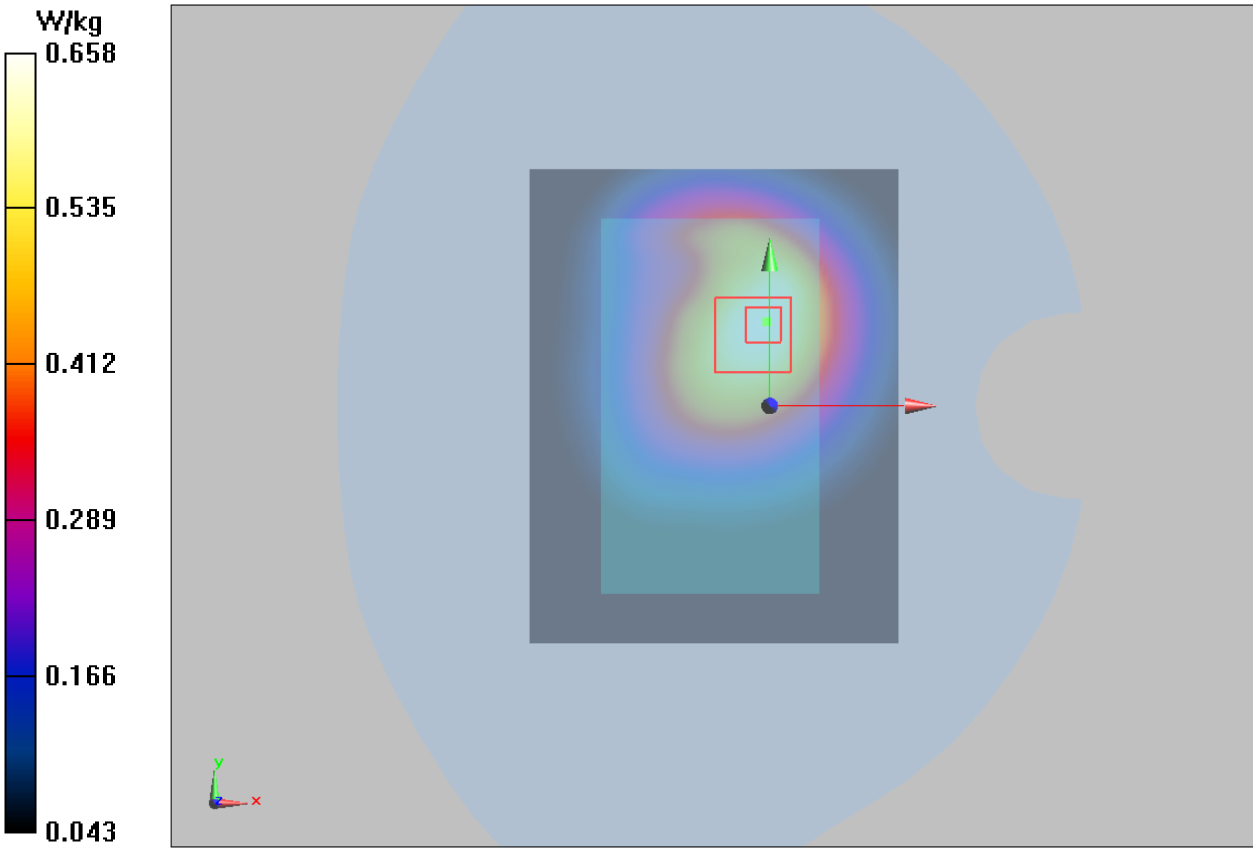
Back Side Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 22.04 V/m; Power Drift = -0.17 dB

Peak SAR (extrapolated) = 1.869 W/kg

SAR(1 g) = 0.611 W/kg; SAR(10 g) = 0.416 W/kg

Maximum value of SAR (measured) = 0.658 W/kg



Plot 6 GSM 1900 GPRS (3Txslots) Back Side High (Distance 10mm)

Date: 11/22/2019

Communication System: UID 0, GPRS 3TX (0); Frequency: 1909.8 MHz;Duty Cycle: 1:2.76694

Medium parameters used: f = 1910 MHz; σ = 1.417 S/m; ε_r = 38.262; 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(7.79, 7.79, 7.79); Calibrated: 6/19/2019;

Electronics: DAE4 SN1291; Calibrated: 12/4/2018

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

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Back Side High/Area Scan (61x91x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 1.301 W/kg

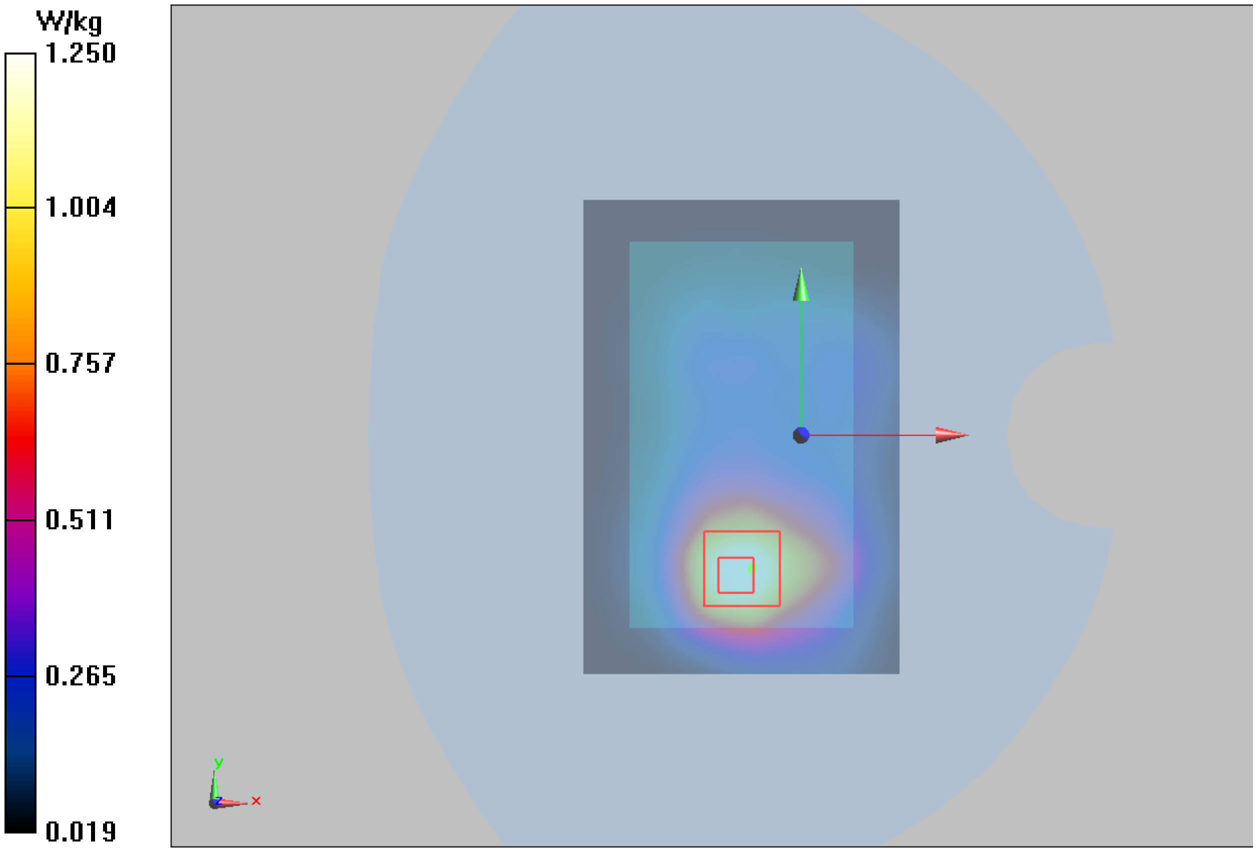
Back Side High/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.07 V/m; Power Drift = 0.060 dB

Peak SAR (extrapolated) = 2.11 W/kg

SAR(1 g) = 1.18 W/kg; SAR(10 g) = 0.655 W/kg

Maximum value of SAR (measured) = 1.250 W/kg



Plot 7 LTE Band 7 1RB Back Side Middle(Distance 10mm)

Date: 11/19/2019

Communication System: UID 0, LTE (0); Frequency: 2535 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2535 MHz; σ = 1.97 S/m; ε_r = 40.51; 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(7.20, 7.20, 7.20); Calibrated: 6/19/2019;

Electronics: DAE4 SN1291; Calibrated: 12/4/2018

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

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Back Side Middle/Area Scan (81x121x1): Interpolated grid: dx=12 mm, dy=12 mm

Maximum value of SAR (interpolated) = 1.330 W/kg

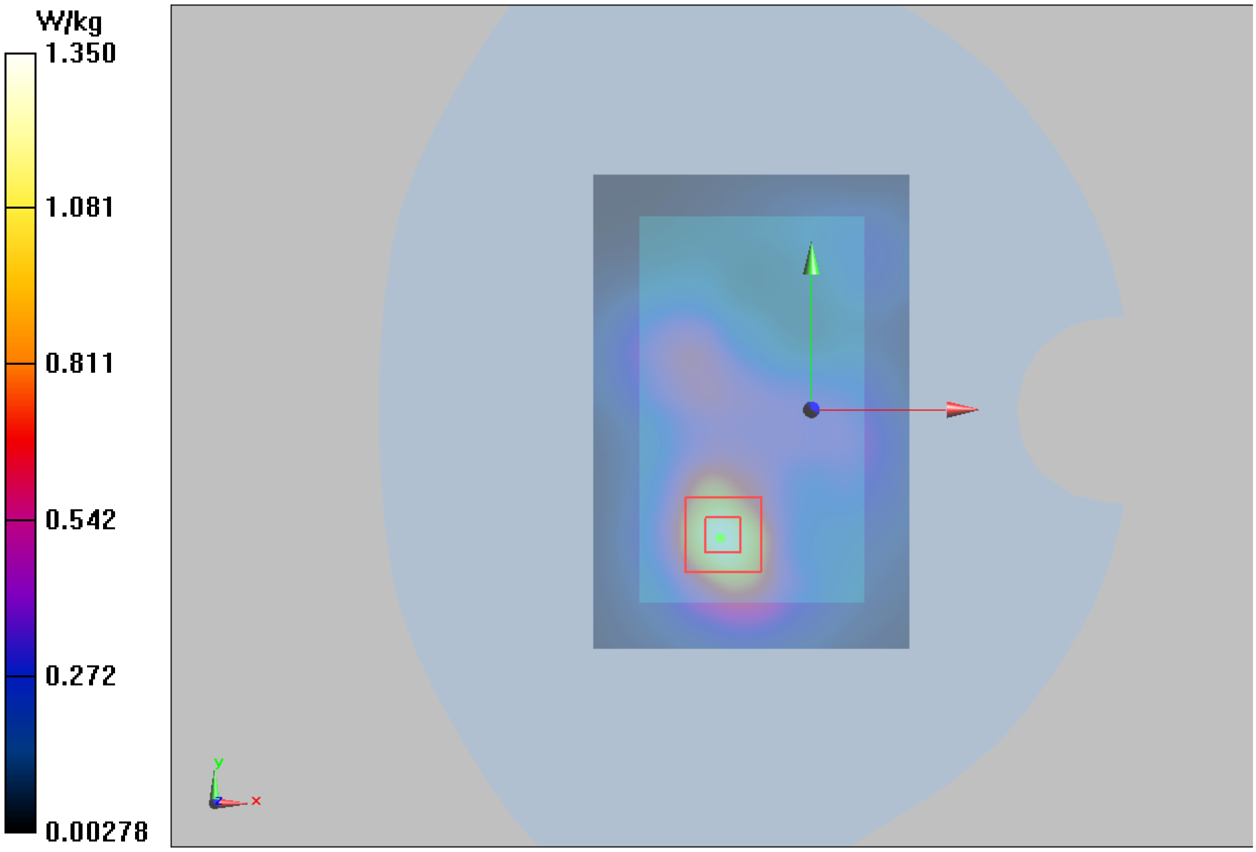
Back Side Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 15.27 V/m; Power Drift = 0.11 dB

Peak SAR (extrapolated) = 2.73 W/kg

SAR(1 g) = 1.22 W/kg; SAR(10 g) = 0.572 W/kg

Maximum value of SAR (measured) = 1.350 W/kg



Wi-Fi-Antenna

Plot 8 802.11b Top Edge Middle (Distance 10mm)(Antenna 1)

Date: 11/22/2019

Communication System: UID 0, 802.11b (0); Frequency: 2437 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2437 MHz; σ = 1.785 S/m; ε_r = 40.594; 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(7.50, 7.50, 7.50); Calibrated: 6/19/2019;

Electronics: DAE4 SN1291; Calibrated: 12/4/2018

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

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Top Edge Middle/Area Scan (51x141x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.101 W/kg

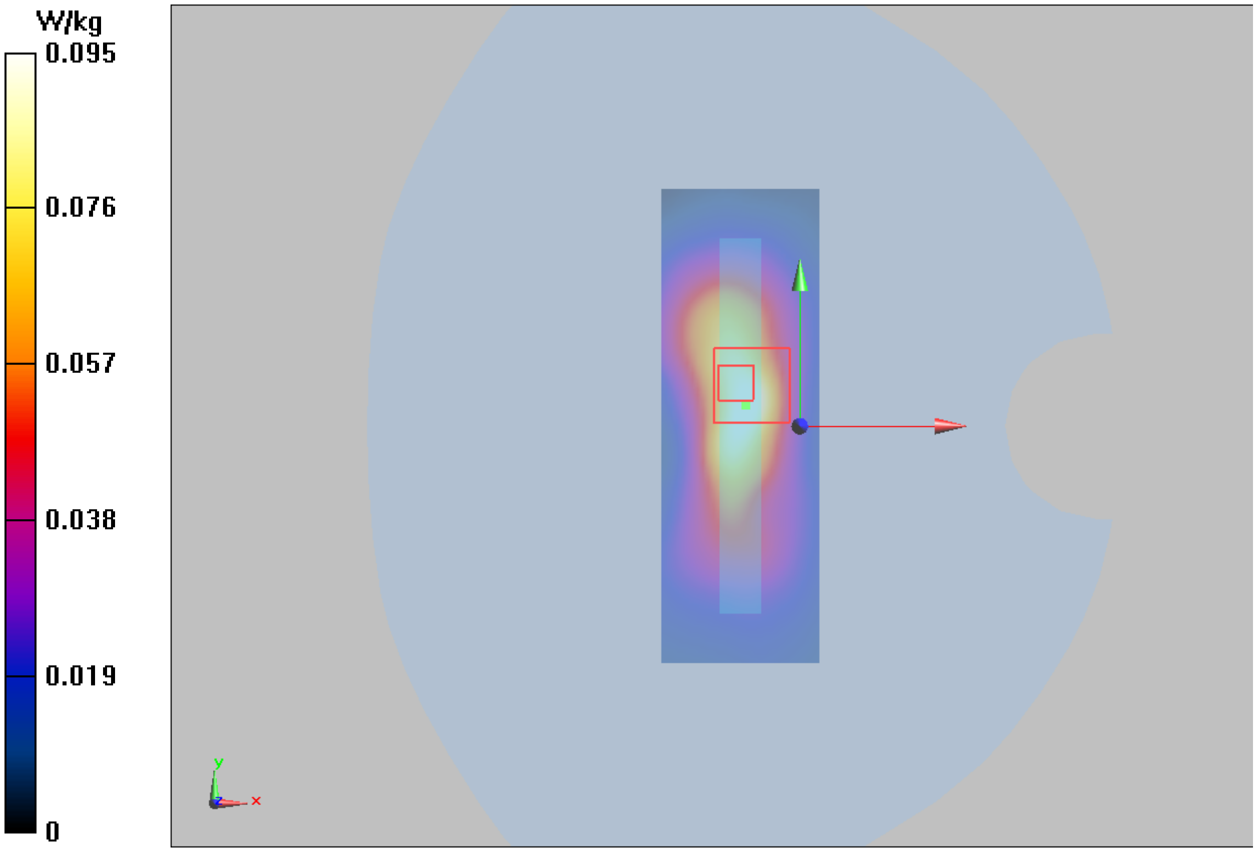
Top Edge Middle/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 7.452 V/m; Power Drift = -0.087 dB

Peak SAR (extrapolated) = 0.338 W/kg

SAR(1 g) = 0.108 W/kg; SAR(10 g) = 0.041 W/kg

Maximum value of SAR (measured) = 0.0950 W/kg



Plot 9 802.11b Front Side Middle (Distance 10mm)(Antenna 2)

Date: 11/22/2019

Communication System: UID 0, 802.11b (0); Frequency: 2437 MHz;Duty Cycle: 1:1

Medium parameters used: f = 2437 MHz; σ = 1.785 S/m; ε_r = 40.594; 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(7.50, 7.50, 7.50); Calibrated: 6/19/2019;

Electronics: DAE4 SN1291; Calibrated: 12/4/2018

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

Measurement SW: DASY52, Version 52.10 (1); SEMCAD X Version 14.6.11 (7439)

Front Side Middle/Area Scan (91x121x1): Interpolated grid: dx=12mm, dy=12 mm

Maximum value of SAR (interpolated) = 0.184 W/kg

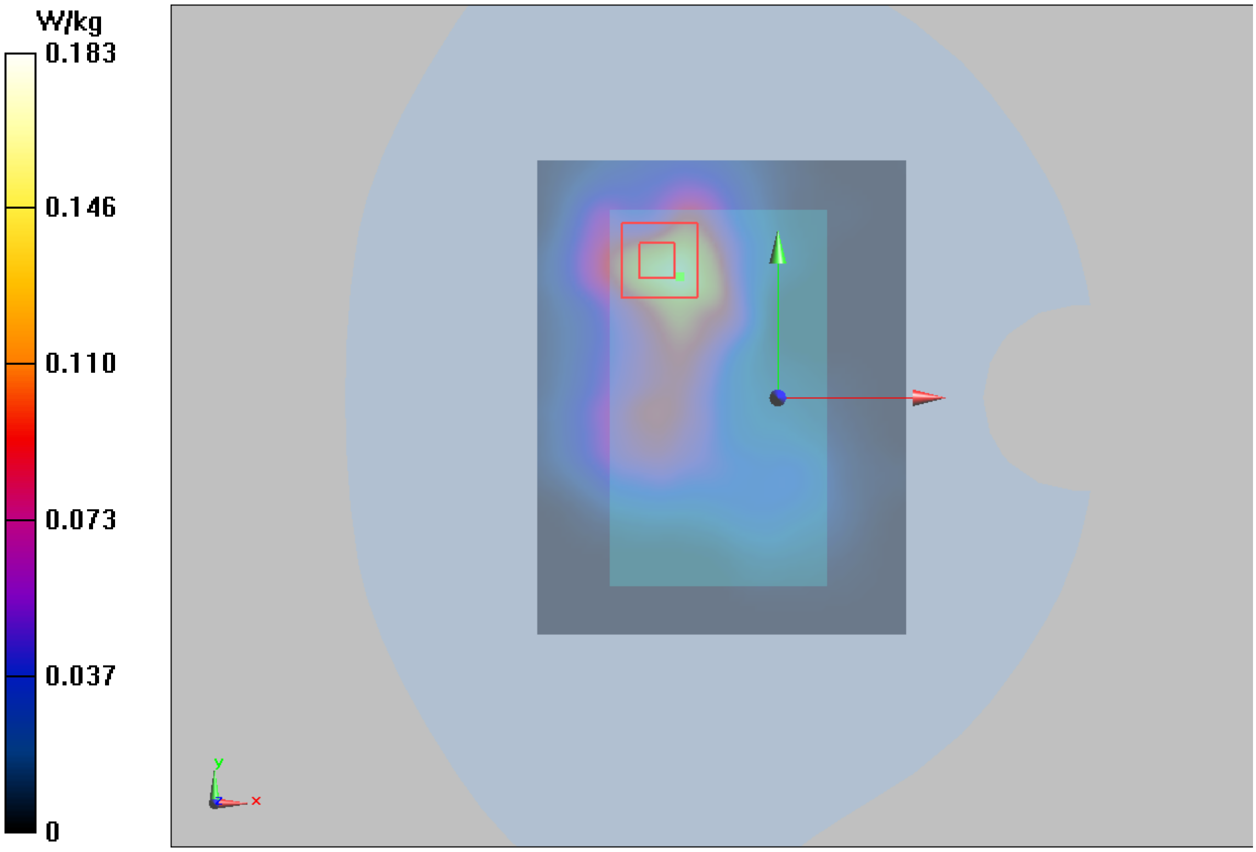
Front Side Middle /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 6.088 V/m; Power Drift = 0.021 dB

Peak SAR (extrapolated) = 0.343 W/kg

SAR(1 g) = 0.171 W/kg; SAR(10 g) = 0.085 W/kg

Maximum value of SAR (measured) = 0.183 W/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

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

Client TA(Shanghai) Certificate No: Z19-60169

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3677
Calibration Procedure(s)	FF-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	June 19, 2019

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	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101547	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101548	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Reference10dBAttenuator	18N50W-10dB	09-Feb-18(CTTL, No.J18X01133)	Feb-20
Reference20dBAttenuator	18N50W-20dB	09-Feb-18(CTTL, No.J18X01132)	Feb-20
Reference Probe EX3DV4	SN 3617	31-Jan-19(SPEAG,No.EX3-3617_Jan19)	Jan-20
DAE4	SN 1331	06-Feb-19(SPEAG, No.DAE4-1331_Feb19)	Feb -20
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	21-Jun-18 (CTTL, No.J18X05033)	Jun-19
Network Analyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan -20

	Name	Function	Signature
Calibrated by:	Yu Zongying	SAR Test Engineer	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: June 20, 2019

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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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

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

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

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization 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: June 19, 2019

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]	0.41	0.46	0.40	±10.0%
DCP(mV)[B]	101.1	102.9	101.9	

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	152.0	±2.6%
		Y	0.0	0.0	1.0		170.1	
		Z	0.0	0.0	1.0		147.7	

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	9.54	9.54	9.54	0.11	1.56	±12.1%
835	41.5	0.90	9.20	9.20	9.20	0.11	1.61	±12.1%
1750	40.1	1.37	8.21	8.21	8.21	0.22	1.11	±12.1%
1900	40.0	1.40	7.79	7.79	7.79	0.22	1.04	±12.1%
2300	39.5	1.67	7.66	7.66	7.66	0.57	0.72	±12.1%
2450	39.2	1.80	7.50	7.50	7.50	0.59	0.71	±12.1%
2600	39.0	1.96	7.20	7.20	7.20	0.65	0.68	±12.1%
5250	35.9	4.71	5.56	5.56	5.56	0.40	1.40	±13.3%
5600	35.5	5.07	4.90	4.90	4.90	0.45	1.40	±13.3%
5750	35.4	5.22	4.99	4.99	4.99	0.50	1.35	±13.3%

[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	9.75	9.75	9.75	0.40	0.75	±12.1%
835	55.2	0.97	9.40	9.40	9.40	0.18	1.38	±12.1%
1750	53.4	1.49	7.86	7.86	7.86	0.23	1.09	±12.1%
1900	53.3	1.52	7.62	7.62	7.62	0.22	1.15	±12.1%
2300	52.9	1.81	7.67	7.67	7.67	0.55	0.81	±12.1%
2450	52.7	1.95	7.57	7.57	7.57	0.59	0.75	±12.1%
2600	52.5	2.16	7.33	7.33	7.33	0.74	0.65	±12.1%
5250	48.9	5.36	4.93	4.93	4.93	0.45	1.55	±13.3%
5600	48.5	5.77	4.24	4.24	4.24	0.50	1.45	±13.3%
5750	48.3	5.94	4.35	4.35	4.35	0.50	1.50	±13.3%

[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: Z19-60169 Page 6 of 11

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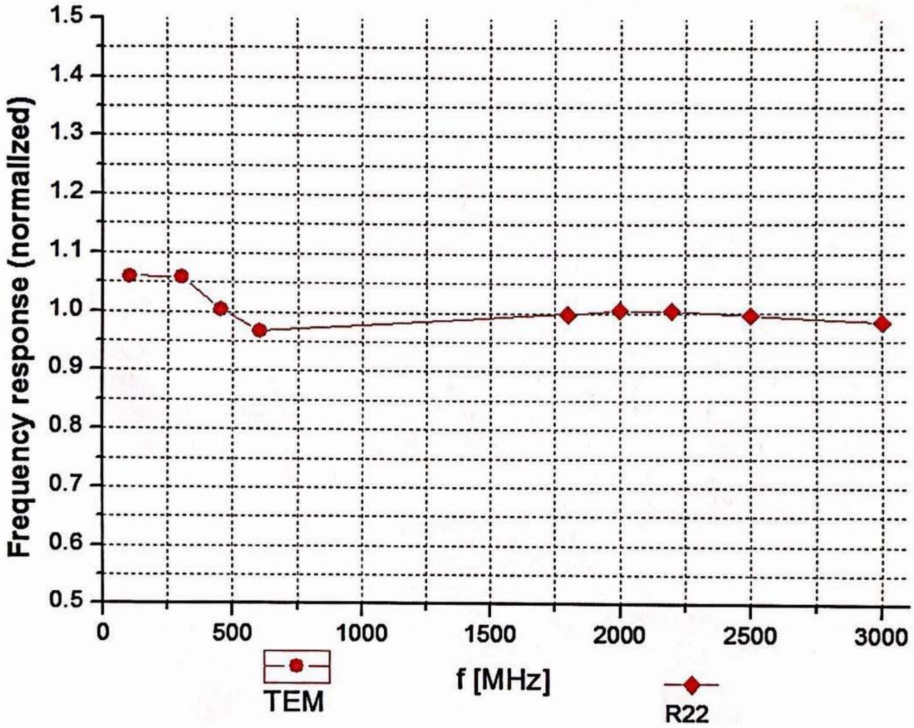
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ±7.4% (k=2)

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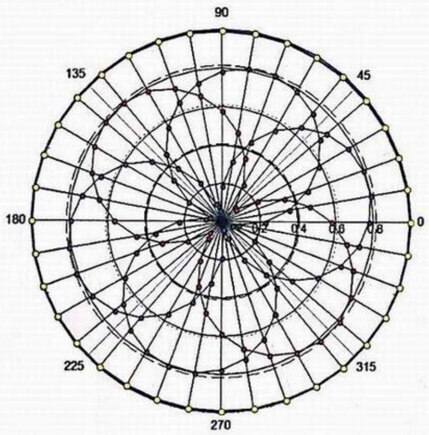
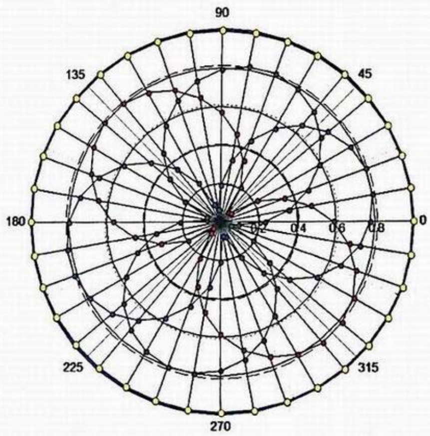
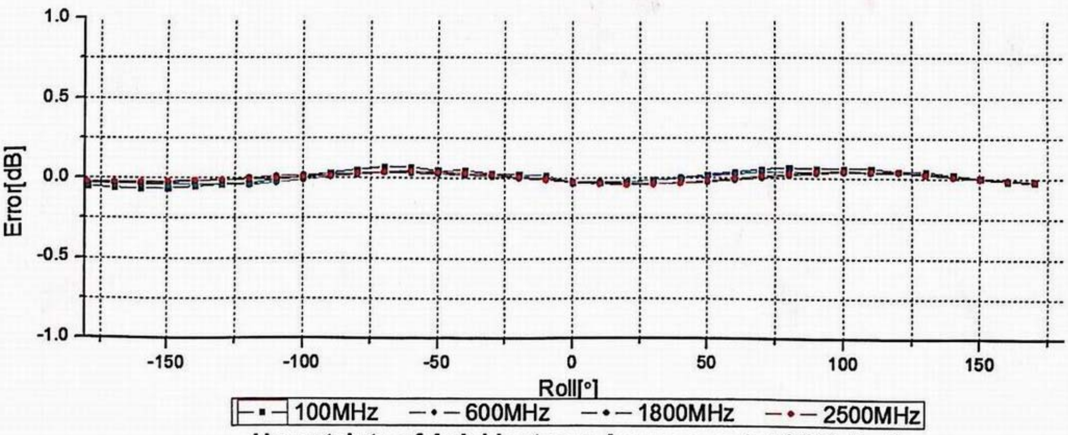
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM

f=1800 MHz, R22







Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)

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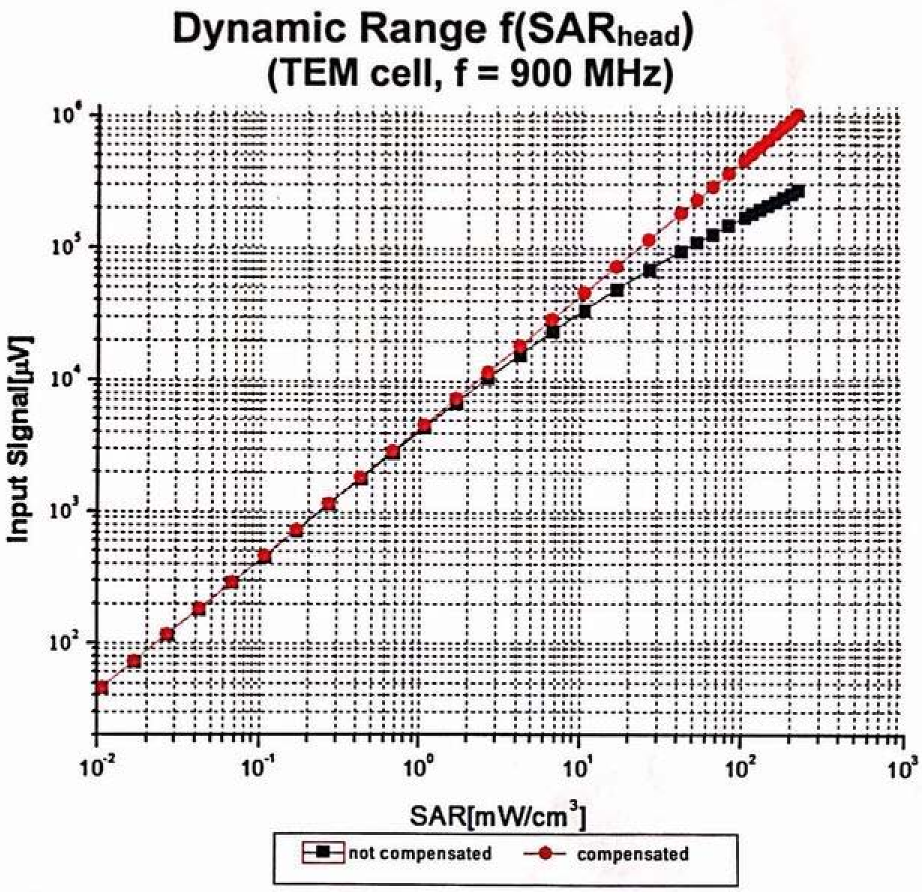

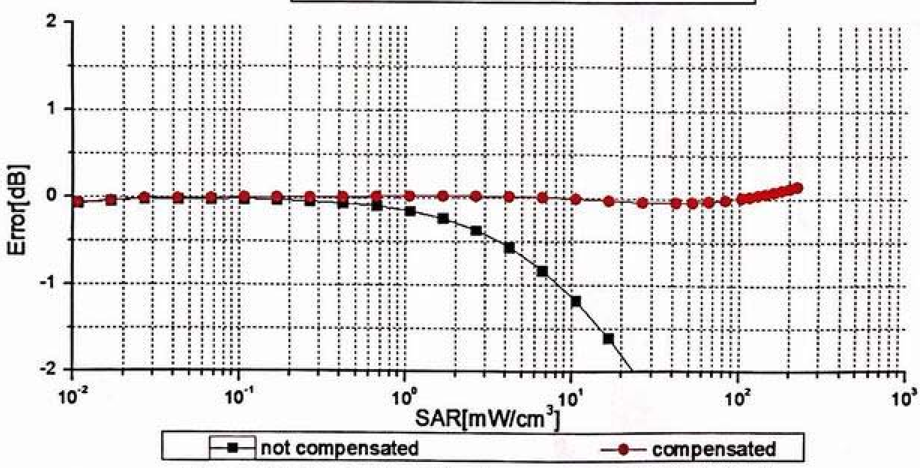

Uncertainty of Linearity Assessment: ±0.9% (k=2)

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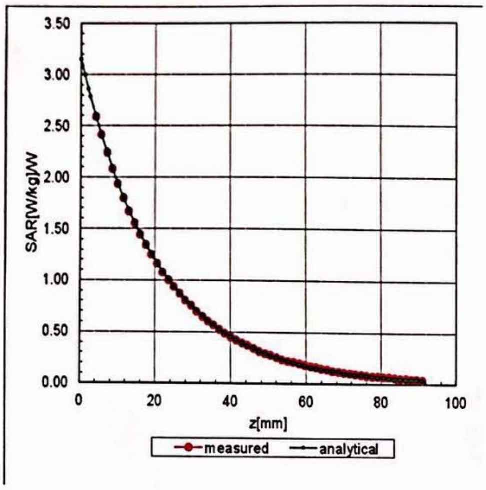
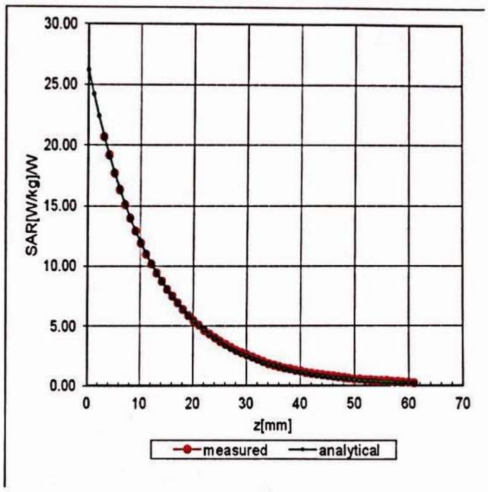
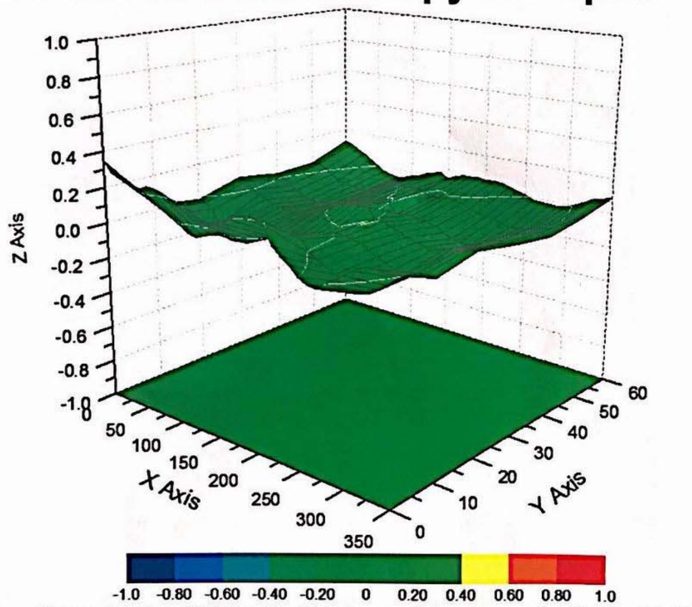
Conversion Factor Assessment

f=750 MHz, WGLS R9(H_convF) **f=1750 MHz, WGLS R22(H_convF)**





Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: ±3.2% (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: D835V2 Dipole Calibration Certificate

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中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client TA(Shanghai) Certificate No: Z17-97114

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d020
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	August 28, 2017

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102083	22-Sep-16 (CTTL, No.J16X06809)	Sep-17
Power sensor NRV-Z5	100595	22-Sep-16 (CTTL, No.J16X06809)	Sep-17
Reference Probe EX3DV4	SN 3617	23-Jan-17(SPEAG,No.EX3-3617_Jan17)	Jan-18
DAE4	SN 1331	19-Jan-17(CTTL-SPEAG,No.Z17-97015)	Jan-18
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	13-Jan-17 (CTTL, No.J17X00286)	Jan-18
Network Analyzer E5071C	MY46110673	13-Jan-17 (CTTL, No.J17X00285)	Jan-18

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

Issued: August 31, 2017

Certificate No: Z17-97114 Page 1 of 8

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

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

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

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z17-97114 Page 2 of 8