



SAR TEST REPORT

Applicant Hot Pepper, Inc.
FCC ID 2APD4-A81C
Product 4G Smart Phone
Model HPP-GS1
Report No. R1903A0130-S1V2
Issue Date July 4, 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 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 (Designation number: CN1179, Test Firm Registration Number: 446626)

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

IC (recognition number is 8510A)

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

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

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

A2LA (Certificate Number: 3857.01)

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

1.3 Testing Location

Company: TA Technology (Shanghai) Co., Ltd.
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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 1: Highest Reported SAR

Mode	Highest Reported SAR (W/kg)	
	1g SAR Head	1g SAR Hotspot (Separation 10mm)
CDMA BC 10	0.326	0.336
LTE FDD 14	0.192	0.230
Date of Testing:	April 16, 2019	

Note: 1) The highest Reported SAR for head and hotspot, are 0.326 W/kg and 0.336 W/kg.

3) For body worn operation, this device has been tested and meets FCC RF exposure guidelines when used with any accessory that contains no metal and that positions the handset a minimum of 15mm from the body. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

The device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits according to the FCC rule § 2.1093, the ANSI C95.1: 1992/IEEE C95.1: 1991, and had been tested in accordance with the measurement methods and procedures specified in IEEE Std 1528-2013.

3 Description of Equipment under Test

Client Information

Applicant	Hot Pepper, Inc.
Applicant address	5151 California Ave., Suite 100, Irvine 92617, USA
Manufacturer	Hot Pepper, Inc.
Manufacturer address	5151 California Ave., Suite 100, Irvine 92617, USA

General Technologies

Application Purpose:	Original Grant
EUT Stage:	Identical Prototype
Model:	HPP-GS1
IMEI:	IMEI 1: 355490100001571 IMEI 2: 355490100001589
Hardware Version:	A81C_MAINBOARD_P1
Software Version:	HPP-GS1-V1.0.4-190121
Antenna Type:	Internal Antenna
Device Class:	B
Power Class:	CDMA BC 10:3 LTE FDD 14:3
Power Level:	CDMA BC 10:all up bits LTE FDD 14:max power
EUT Accessory	
Adapter	Manufacturer: Shenzhen Tianyin Electronics Co.,Ltd Model: TPA-23A050200UU01
Battery 1	Manufacturer: Shenzhen HUATIAN TONG TECHNOLOGY CO.LTD Model: H2019GS1
Battery 2	Manufacturer: Shenzhen Nine Liyuan Electronic Technology Co., Ltd. Model: H2019GS1A
USB Cable	120cm Cable, Shielded, Type C Micro USB

**Wireless Technology and Frequency Range**

Wireless Technology		Modulation	Operating mode	Tx (MHz)
CDMA	BC 10	QPSK	1xRTT Rev 0/ Rev A	817 ~ 824
LTE	FDD 14	QPSK, 16QAM, 64QAM	Rel.12 /Category 7	788 ~ 798
	Does this device support Carrier Aggregation (CA) <input type="checkbox"/> Yes downlink only <input checked="" type="checkbox"/> No			
	Does this device support SV-LTE (1xRTT-LTE)? <input type="checkbox"/> Yes <input checked="" type="checkbox"/> 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:

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 D01 3G SAR Procedures v03r01
941225 D05 SAR for LTE Devices v02r05
941225 D05A LTE Rel.10 KDB Inquiry Sheet v01r02
941225 D06 Hotspot Mode v02r01

5 Operational Conditions during Test

5.1 Test Positions

5.1.1 Against Phantom Head

Measurements were made in “cheek” and “tilt” positions on both the left hand and right hand sides of the phantom.

The positions used in the measurements were according to IEEE 1528 - 2013 "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate(SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques".

5.1.2 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 $> 1.2 \text{ W/kg}$, 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.

5.1.3 Phablet SAR test considerations

For smart phones, with a display diagonal dimension > 15.0 cm or an overall diagonal dimension > 16.0 cm, that can provide similar mobile web access and multimedia support found in mini-tablets or UMPC mini-tablets and support voice calls next to the ear, unless it is confirmed otherwise through KDB inquiries, the following phablet procedures should be applied to evaluate SAR compliance for each applicable wireless modes and frequency band. Devices marketed as phablets, regardless of form factors and operating characteristics must be tested as a phablet to determine SAR compliance.

- a) The normally required head and body-worn accessory SAR test procedures for handsets, including hotspot mode, must be applied.
- b) The UMPC mini-tablet procedures must also be applied to test the SAR of all surfaces and edges with an antenna located at ≤ 25 mm from that surface or edge, in direct contact with a flat phantom, for product specific 10-g SAR according to the body-equivalent tissue dielectric parameters in KDB Publication 865664 D01 to address interactive hand use exposure conditions. The 1-g SAR at 5 mm for UMPC mini-tablets is not required. When hotspot mode applies, product specific 10-g SAR is required only for the surfaces and edges with hotspot mode 1-g reported SAR > 1.2 W/kg; however, when power reduction applies to hotspot mode the measured SAR must be scaled to the maximum output power, including tolerance, allowed for phablet modes to compare with the 1.2 W/kg SAR test reduction threshold. The normal tablet procedures in KDB Publication 616217 are required when the overall diagonal dimension of the device is > 20.0 cm. Hotspot mode SAR is not required when normal tablet procedures are applied. Product specific 10-g SAR is also not required for the front (top) surface of larger form factor full size tablets. The more conservative normal tablet SAR results can be used to support phablet mode product specific 10-g SAR.
- c) The simultaneous transmission operating configurations applicable to voice and data transmissions for both phone and mini-tablet modes must be taken into consideration separately for 1-g and 10-g SAR to determine the simultaneous transmission SAR test exclusion and measurement requirements for the relevant wireless modes and exposure conditions.

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 performed 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 ($\sim 10\%$ 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 UMTS Test Configuration

5.3.1.1 3G SAR Test Reduction Procedure

The default test configuration is to measure SAR with an established radio link between the EUT and a communication test set using a 12.2 kbps RMC (reference measurement channel) configured in Test Loop Mode 1. SAR is selectively confirmed for other physical channel configurations modes according to output power, exposure conditions and device operating capabilities. Maximum output power is verified by applying the applicable versions of 3GPP TS 34.121.

5.3.1.2 Head SAR

SAR for next to the ear head exposure is measured using a 12.2 kbps RMC with TPC bits configured to all "1's". The 3G SAR test reduction procedure is applied to AMR configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for 12.2 kbps AMR in 3.4 kbps SRB (signaling radio bearer) using the highest SAR configuration in 12.2 kbps RMC for head exposure.

5.3.1.3 Body-worn accessory SAR

SAR for body-worn accessory configurations is measured using a 12.2 kbps RMC with TPC bits configured to all "1's". The 3G SAR test reduction procedure is applied to other spreading codes and multiple DPDCHn configurations supported by the EUT with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured using an applicable RMC configuration with the corresponding spreading code or DPDCHn, for the highest reported body-worn accessory exposure SAR configuration in 12.2 kbps RMC. When more than 2 DPDCHn are supported by the EUT, it may be necessary to configure additional DPDCHn using FTM (Factory Test Mode) or other chipset based test approaches with parameters similar to those used in 384 kbps and 768 kbps RMC

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 $> \frac{1}{2}$ dB higher than the same configuration in QPSK or when the reported SAR for the QPSK configuration is > 1.45 W/kg.

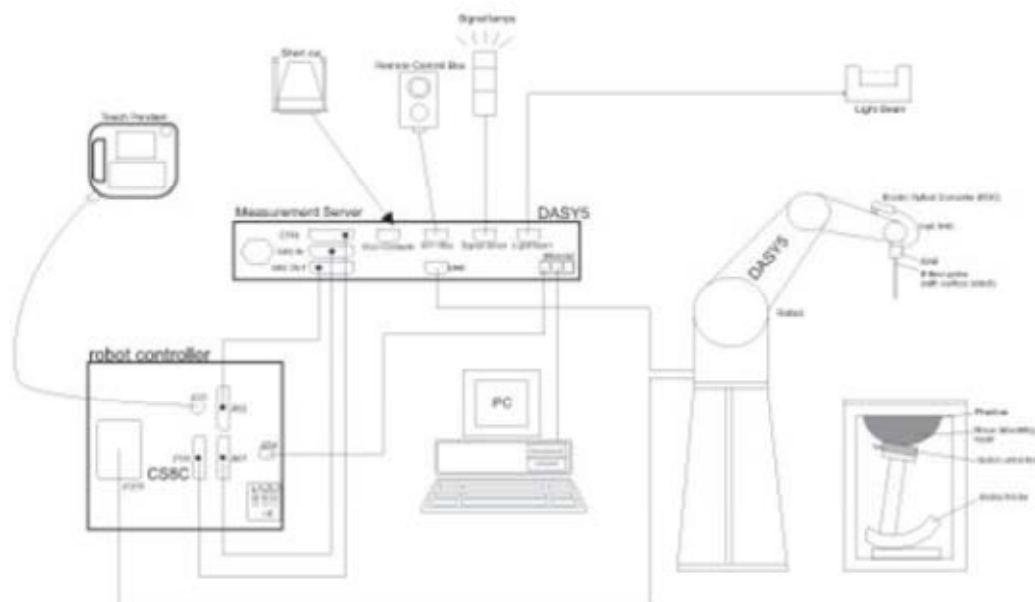
E) Other channel bandwidth standalone SAR test requirements

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 $> \frac{1}{2}$ 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.

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 μ W/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/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 $\pm 10\%$. The spherical isotropy was evaluated and found to be better than ± 0.25 dB. 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 below 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

$$SAR = IEI^2 \sigma / \rho$$

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

Zoom Scan

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

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

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

Volume Scan Procedures

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

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	2018-05-20	2019-05-19
Dielectric Probe Kit	HP	85070E	US44020115	2018-05-20	2019-05-19
Power meter	Agilent	E4417A	GB41291714	2018-05-21	2019-05-20
Power sensor	Agilent	N8481H	MY50350004	2018-05-21	2019-05-20
Power sensor	Agilent	E9327A	US40441622	2018-05-20	2019-05-19
Dual directional coupler	Agilent	778D-012	50519	2018-05-21	2019-05-20
Dual directional coupler	Agilent	777D	50146	2018-05-20	2019-05-19
Amplifier	INDEXSAR	IXA-020	0401	2018-05-20	2019-05-19
Wideband radio communication tester	R&S	CMW 500	113645	2018-05-20	2019-05-19
E-field Probe	SPEAG	EX3DV4	3677	2018-05-29	2019-05-28
DAE	SPEAG	DAE4	1291	2018-12-04	2019-12-03
Validation Kit 750MHz	SPEAG	D750V3	1045	2017-08-27	2020-08-26
Validation Kit 835MHz	SPEAG	D835V2	4d020	2017-08-28	2020-08-27
Temperature Probe	Tianjin jinming	JM222	AA1009129	2018-05-17	2019-05-16
Hygrothermograph	Anymetr	NT-311	20150731	2018-05-17	2019-05-16
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 $\pm 2^\circ\text{C}$ 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	$\sigma(\text{s/m})$
Head	750	41.448	1.452	56	0	0.1	1.0	41.9	0.89
	835	41.45	1.45	56	0	0.1	1.0	41.5	0.90
Body	750	52.49	1.41	45	0	0.1	1.0	55.5	0.96
	835	52.5	1.4	45	0	0.1	1.0	55.2	0.97

Measurements results

Frequency (MHz)		Test Date	Temp $^\circ\text{C}$	Measured Dielectric Parameters		Target Dielectric Parameters		Limit (Within $\pm 5\%$)	
				ϵ_r	$\sigma(\text{s/m})$	ϵ_r	$\sigma(\text{s/m})$	Dev $\epsilon_r(\%)$	Dev $\sigma(\%)$
750	Head	4/16/2019	21.5	42.5	0.91	41.9	0.89	1.43	2.25
	Body	4/16/2019	21.5	56.9	0.97	55.5	0.96	2.52	1.04
835	Head	4/16/2019	21.5	42.0	0.91	41.5	0.90	1.20	1.11
	Body	4/16/2019	21.5	53.8	0.97	55.2	0.97	-2.54	0.00

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.

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.

The diagram illustrates the experimental setup for measuring the radiation pattern of a dipole antenna. The setup includes a Signal Generator, an Amplifier (Amp), a Low Pass Filter, a 3dB coupler, and a 3D Probe positioner. The antenna is a dipole antenna mounted on a Flat Phantom. The probe is a field probe. The diagram shows the signal path from the generator through the coupler and attenuators to the probe, and the probe's connection to a computer for data acquisition. A 3D coordinate system (x, y, z) is shown for the probe's position.

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**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)	$\Delta\Omega$
Dipole D750V3 SN: 1045	Head Liquid	8/27/2017	-28.5	/	52.5	/
		8/26/2018	-27.6	3.16	53.2	0.7
	Body Liquid	8/27/2017	-24.2	/	47.5	/
		8/26/2018	-24.0	0.83	45.6	1.9
Dipole D835V2 SN: 4d020	Head Liquid	8/28/2017	-31.9	/	50.3	/
		8/27/2018	-29.0	9.09	46.6	-3.7
	Body Liquid	8/28/2017	-24.8	/	46.8	/
		8/27/2018	-27.4	-10.48	48.1	1.3

System Check results

Frequency (MHz)		Test Date	Temp $^{\circ}\text{C}$	250mW Measured SAR_{1g} (W/kg)	1W Normalized SAR_{1g} (W/kg)	1W Target SAR_{1g} (W/kg)	Δ % (Limit $\pm 10\%$)	Plot No.
750	Head	4/16/2019	21.5	2.13	8.52	8.34	2.16	1
	Body	4/16/2019	21.5	2.22	8.88	8.78	1.14	2
835	Head	4/16/2019	21.5	2.44	9.76	9.45	3.28	3
	Body	4/16/2019	21.5	2.41	9.64	9.75	-1.13	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 CDMA Mode

The following tests were completed according to the test requirements outlined in the 3GPP TS34.121 specification.

CDMA BC10		Maximum Output Power (dBm)			
		Channel/Frequency(MHz)			Tune-up
		476/817.9	526/819.15	684/823.1	
RC1	SO55 (Loopback)	23.88	23.92	23.78	24.00
RC3	SO55 (Loopback)	23.78	23.95	23.80	24.00
	TDSO32 (FCH+SCH)	23.69	23.97	23.77	24.00
	TDSO32 (FCH)	23.14	23.21	23.18	24.00
1x Advanced	SO75	23.92	23.94	23.91	24.00
Rev 0	RTAP	23.89	23.97	23.90	24.00
Rev A	RETAP	23.84	23.88	23.82	24.00

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

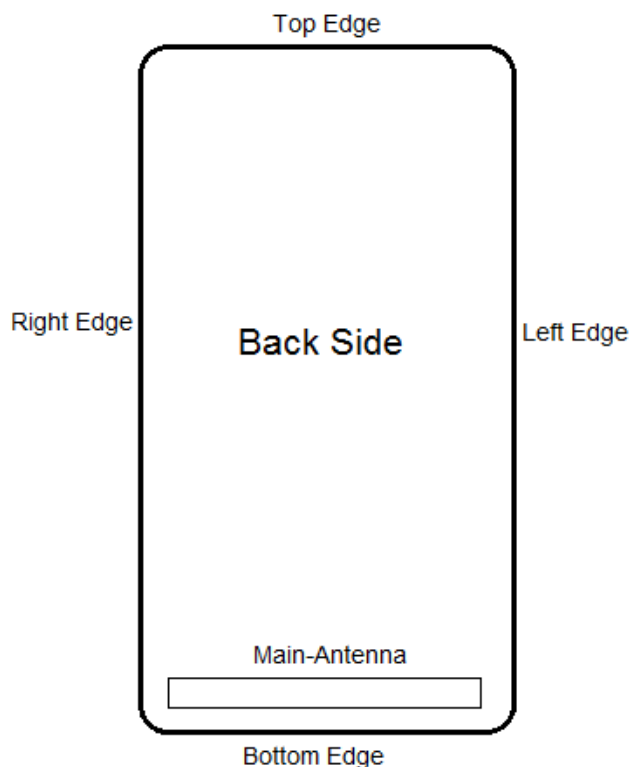
LTE Band 14				Maximum Output Power (dBm)			Tune-up Limit
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			
				23305/790.5	23330/793	23355/795.5	
5MHz	QPSK	1	0	24.48	24.51	24.42	25.00
		1	13	24.58	24.57	24.55	25.00
		1	24	24.44	24.46	24.40	25.00
		12	0	23.60	23.63	23.59	24.00
		12	6	23.62	23.56	23.53	24.00
		12	13	23.61	23.57	23.49	24.00
		25	0	23.65	23.60	23.58	24.00
	16QAM	1	0	23.45	23.88	23.39	24.00
		1	13	23.53	23.90	23.48	24.00
		1	24	23.40	23.77	23.35	24.00
		12	0	22.66	22.68	22.62	23.00
		12	6	22.63	22.55	22.54	23.00
		12	13	22.61	22.58	22.49	23.00
		25	0	22.73	22.64	22.66	23.00
	64QAM	1	0	22.51	22.55	22.48	23.00
		1	13	22.60	22.61	22.53	23.00
		1	24	22.47	22.56	22.55	23.00
		12	0	22.22	22.21	22.19	22.50
		12	6	22.19	22.17	22.08	22.50
		12	13	22.11	22.08	22.01	22.50
		25	0	22.24	22.26	22.15	22.50
Bandwidth	Modulation	RB size	RB offset	Channel/Frequency (MHz)			Tune-up Limit
				/	23330/793	/	
10MHz	QPSK	1	0	/	24.51	/	25.00
		1	25	/	24.74	/	25.00



		1	49	/	24.50	/	25.00
		25	0	/	23.70	/	24.00
		25	13	/	23.65	/	24.00
		25	25	/	23.57	/	24.00
		50	0	/	23.64	/	24.00
	16QAM	1	0	/	23.61	/	24.00
		1	25	/	23.74	/	24.00
		1	49	/	23.55	/	24.00
		25	0	/	22.83	/	23.00
		25	13	/	22.71	/	23.00
		25	25	/	22.69	/	23.00
		50	0	/	22.70	/	23.00
	64QAM	1	0	/	22.48	/	23.00
		1	25	/	22.56	/	23.00
		1	49	/	22.51	/	23.00
		25	0	/	22.20	/	22.50
		25	13	/	22.14	/	22.50
		25	25	/	22.04	/	22.50
		50	0	/	22.22	/	22.50

10 Measured and Reported (Scaled) SAR Results

10.1 EUT Antenna Locations



Overall (Length x Width): 163.32 mm x 77.74mm

Overall Diagonal: 172.76 mm/Display Diagonal: 152mm

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

Hotspot mode, Positions for SAR tests

Mode	Back Side	Front side	Left Edge	Right Edge	Top Edge	Bottom Edge
Main-Antenna	Yes	Yes	Yes	Yes	N/A	Yes

Note: 1. Per KDB 941225 D06, when the overall device length and width are $\geq 9\text{cm} \times 5\text{cm}$, 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. For smart phones with an overall diagonal dimension is 172.76mm. Per KDB 648474 D04, for smart phones with a display diagonal dimension $> 15.0\text{ cm}$ or an overall diagonal dimension $> 16.0\text{ cm}$, product specific 10-g SAR must be tested as a phablet to determine SAR compliance. For Phablet, Since hotspot mode 1-g *reported* SAR $< 1.2\text{ W/kg}$, product specific 10-g SAR is no required.

3. Per FCC KDB 447498 D01,

for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- a) $\leq 0.8\text{ W/kg}$ or 2.0 W/kg , for 1-g or 10-g respectively, when the transmission band is $\leq 100\text{MHz}$
- b) $\leq 0.6\text{ W/kg}$ or 1.5 W/kg , for 1-g or 10-g respectively, when the transmission band is between 100 MHz and



200 MHz.

c) ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz.

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

10.2 Measured SAR Results

Table 2: CDMA BC10

Test Position	Cover Type	Mode	Duty Cycle	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	
Head SAR											
Left Cheek	standard	SO55 (Loopback)	1:1	526/819.15	24.00	23.95	0.265	0.040	1.01	0.268	/
Left Tilt	standard	SO55 (Loopback)	1:1	526/819.15	24.00	23.95	0.180	0.070	1.01	0.182	/
Right Cheek	standard	SO55 (Loopback)	1:1	526/819.15	24.00	23.95	0.322	-0.050	1.01	0.326	5
Right Tilt	standard	SO55 (Loopback)	1:1	526/819.15	24.00	23.95	0.192	0.160	1.01	0.194	/
Right Cheek	SIM2	SO55 (Loopback)	1:1	526/819.15	24.00	23.95	0.319	0.058	1.01	0.323	/
Hotspot SAR(Distance 10mm)											
Back Side	Standard	TDSO32 (FCH)	1:1	526/819.15	24.00	23.21	0.280	0.130	1.20	0.336	6
Front Side	Standard	TDSO32 (FCH)	1:1	526/819.15	24.00	23.21	0.251	0.020	1.20	0.301	/
Left Edge	standard	TDSO32 (FCH)	1:1	526/819.15	24.00	23.21	0.260	0.090	1.20	0.312	/
Right Edge	standard	TDSO32 (FCH)	1:1	526/819.15	24.00	23.21	0.237	0.010	1.20	0.284	/
Top Edge	standard	TDSO32 (FCH)	1:1	526/819.15	24.00	23.21	0.013	0.070	1.20	0.016	/
Bottom Edge	standard	TDSO32 (FCH)	1:1	526/819.15	24.00	23.21	0.160	0.028	1.20	0.192	/
Back Side	SIM2	TDSO32 (FCH)	1:1	526/819.15	24.00	23.21	0.263	-0.070	1.20	0.315	/
Note: 1.The value with blue color is the maximum SAR Value of each test band.											
2. Accessories that do not contain RF transmitters and have been proven to increase the peak SAR by less than 5 %, such as hands-free kits, do not need SAR tests separate from the SAR tests attached to a main EUT configuration.											



Table 3: LTE Band 14

Test Position	Cover Type	Duty Cycle	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	
Head SAR												
Left Cheek	standard	1:1	1	25	23330/793	25.00	24.74	0.137	0.050	1.06	0.145	/
Left Tilt	standard	1:1	1	25	23330/793	25.00	24.74	0.077	0.031	1.06	0.081	/
Right Cheek	standard	1:1	1	25	23330/793	25.00	24.74	0.181	-0.120	1.06	0.192	7
Right Tilt	standard	1:1	1	25	23330/793	25.00	24.74	0.098	0.029	1.06	0.104	/
Left Cheek	standard	1:1	50%	0	23330/793	24.00	23.70	0.116	0.047	1.07	0.124	/
Left Tilt	standard	1:1	50%	0	23330/793	24.00	23.70	0.065	0.044	1.07	0.069	/
Right Cheek	standard	1:1	50%	0	23330/793	24.00	23.70	0.161	0.034	1.07	0.173	/
Right Tilt	standard	1:1	50%	0	23330/793	24.00	23.70	0.083	0.021	1.07	0.089	/
Right Cheek	SIM2	1:1	1	25	23330/793	25.00	24.74	0.175	0.020	1.06	0.186	/
Hotspot SAR(QPSK, Distance 10mm)												
Back Side	standard	1:1	1	25	23330/793	25.00	24.74	0.217	0.060	1.06	0.230	8
Front Side	standard	1:1	1	25	23330/793	25.00	24.74	0.194	-0.040	1.06	0.206	/
Left Edge	standard	1:1	1	25	23330/793	25.00	24.74	0.056	0.080	1.06	0.059	/
Right Edge	standard	1:1	1	25	23330/793	25.00	24.74	0.152	0.030	1.06	0.161	/
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	1:1	1	25	23330/793	25.00	24.74	0.134	0.024	1.06	0.142	/
Back Side	standard	1:1	50%	0	23330/793	24.00	23.70	0.176	0.040	1.07	0.189	/
Front Side	standard	1:1	50%	0	23330/793	24.00	23.70	0.167	0.020	1.07	0.179	/
Left Edge	standard	1:1	50%	0	23330/793	24.00	23.70	0.049	0.070	1.07	0.053	/
Right Edge	standard	1:1	50%	0	23330/793	24.00	23.70	0.130	0.050	1.07	0.139	/
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	1:1	50%	0	23330/793	24.00	23.70	0.111	0.023	1.07	0.119	/
Back Side	SIM2	1:1	1	25	23330/793	25.00	24.74	0.203	-0.073	1.06	0.216	/

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 $\geq 50\%$ limit(10g).

3. Accessories that do not contain RF transmitters and have been proven to increase the peak SAR by less than 5 %, such as hands-free kits, do not need SAR tests separate from the SAR tests attached to a main EUT configuration.

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 and Picture 4.



Picture 3: liquid depth in the head Phantom



Picture 4: Liquid depth in the flat Phantom

ANNEX B: System Check Results

Plot 1 System Performance Check at 750 MHz Head TSL

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3

Date: 4/16/2019

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

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.91 \text{ S/m}$; $\epsilon_r = 42.5$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.3°C Liquid Temperature: 21.5°C

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.40, 9.40, 9.40); Calibrated: 5/29/2018;

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

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

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

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

Maximum value of SAR (interpolated) = 2.29 W/kg

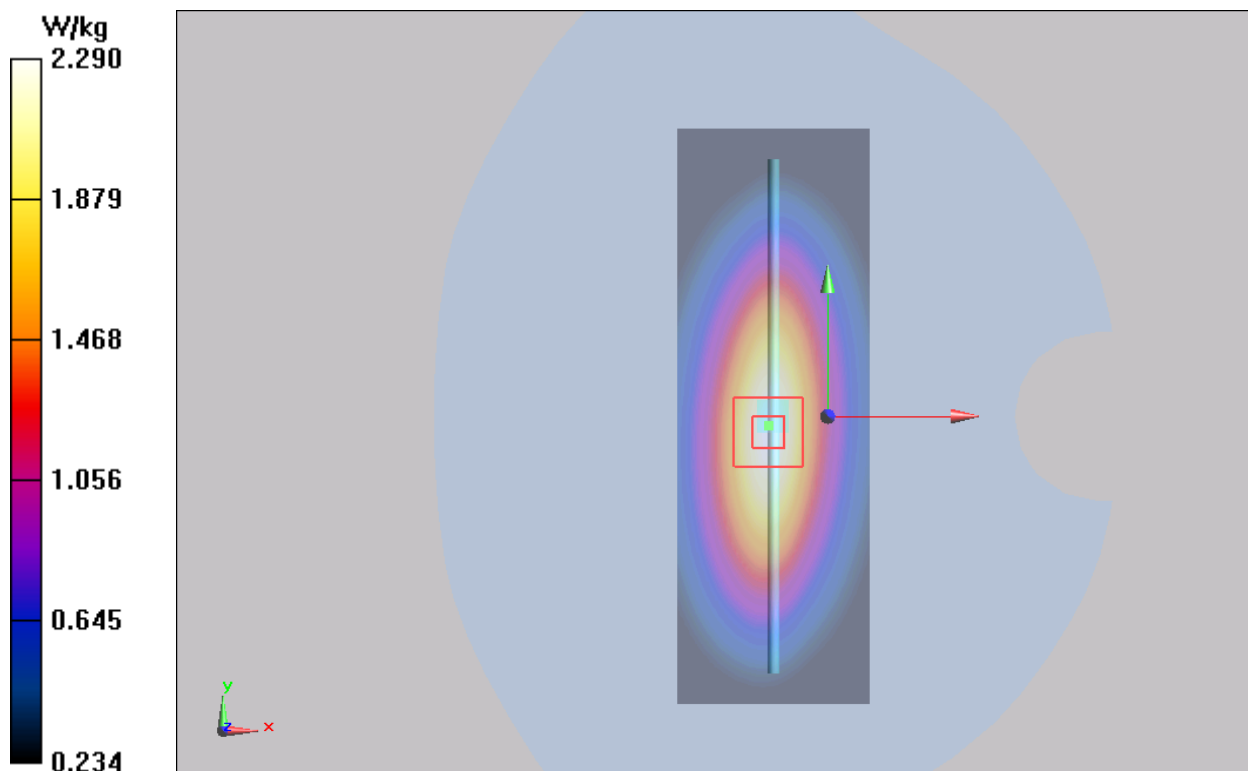
d=15mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 50.653 V/m; Power Drift = -0.08 dB

Peak SAR (extrapolated) = 3.16 W/kg

SAR(1 g) = 2.13 W/kg; SAR(10 g) = 1.41 W/kg

Maximum value of SAR (measured) = 2.29 W/kg



Plot 2 System Performance Check at 750 MHz Body TSL

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3

Date: 4/16/2019

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

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 0.97 \text{ S/m}$; $\epsilon_r = 56.9$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.3°C Liquid Temperature: 21.5°C

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.79, 9.79, 9.79); Calibrated: 5/29/2018;

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

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

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

d=15mm, Pin=250mW/Area Scan (41x121x1): Interpolated grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

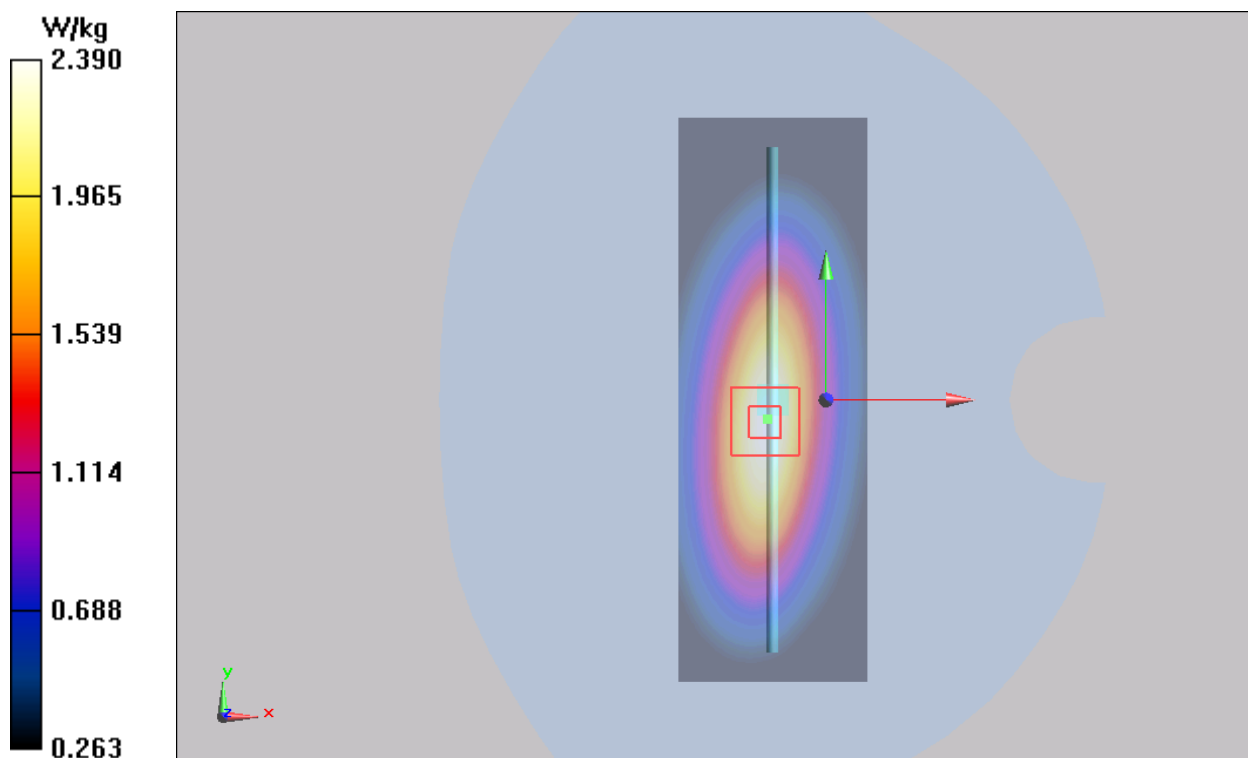
d=15mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

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

Peak SAR (extrapolated) = 3.24 W/kg

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

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



Plot 3 System Performance Check at 835 MHz Head TSL

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

Date: 4/16/2019

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.91 \text{ S/m}$; $\epsilon_r = 42.0$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.3°C

Liquid Temperature: 21.5°C

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.10, 9.10, 9.10); Calibrated: 5/29/2018;

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

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=15mm, dy=15mm

Maximum value of SAR (interpolated) = 2.64 mW/g

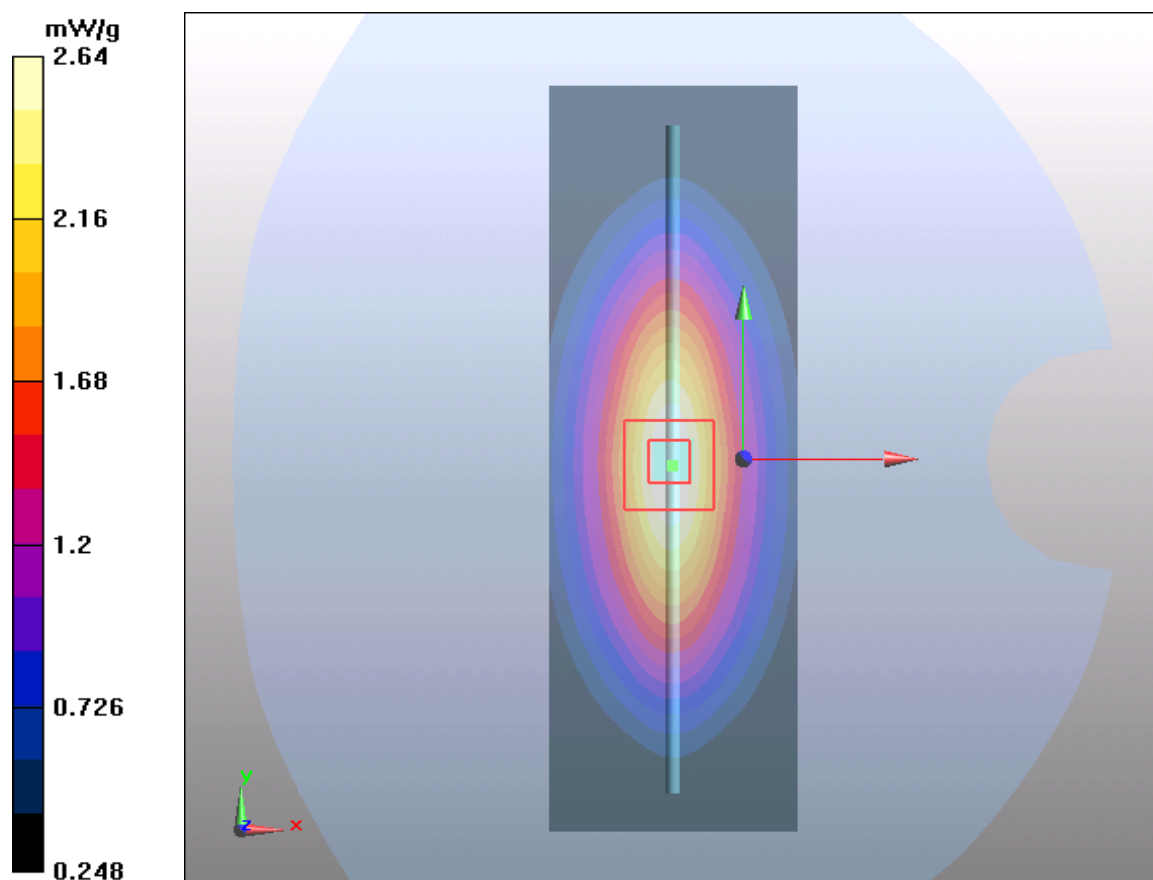
d=15mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 54.4 V/m; Power Drift = -0.076 dB

Peak SAR (extrapolated) = 3.67 W/kg

SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.6 mW/g

Maximum value of SAR (measured) = 2.64 mW/g



Plot 4 System Performance Check at 835 MHz Body TSL

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

Date: 4/16/2019

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

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.97 \text{ S/m}$; $\epsilon_r = 53.8$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.3°C Liquid Temperature: 21.5°C

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.32, 9.32, 9.32); Calibrated: 5/29/2018;

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

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: $dx=15\text{mm}$, $dy=15\text{mm}$

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

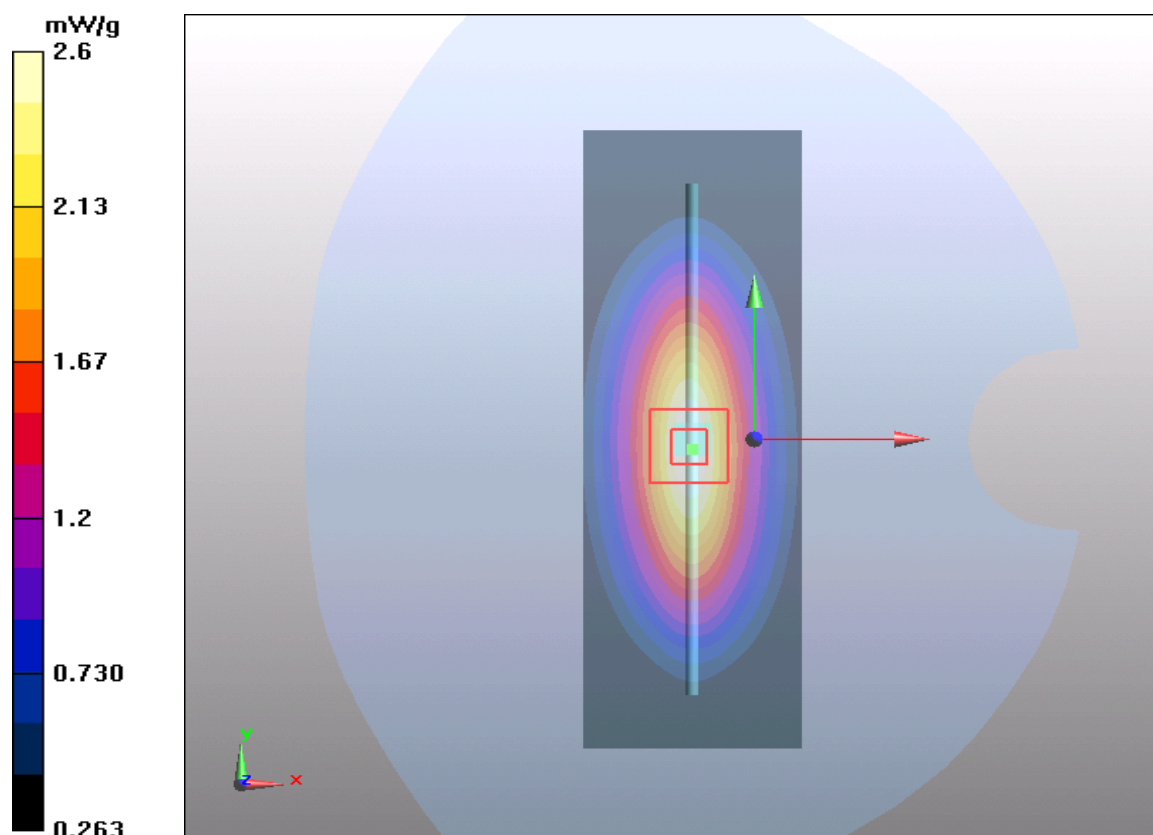
d=15mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

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



ANNEX C: Highest Graph Results

Plot 5 CDMA BC10 Right Cheek Middle

Date: 4/16/2019

Communication System: UID 0, CDMA (0); Frequency: 819.15 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 819.15$ MHz; $\sigma = 0.8992$ S/m; $\epsilon_r = 42.176$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.3 °C Liquid Temperature: 21.5 °C

Phantom section: Right Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.10, 9.10, 9.10); Calibrated: 5/29/2018;

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

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

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

Right Cheek Middle/Area Scan (71x121x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.340 W/kg

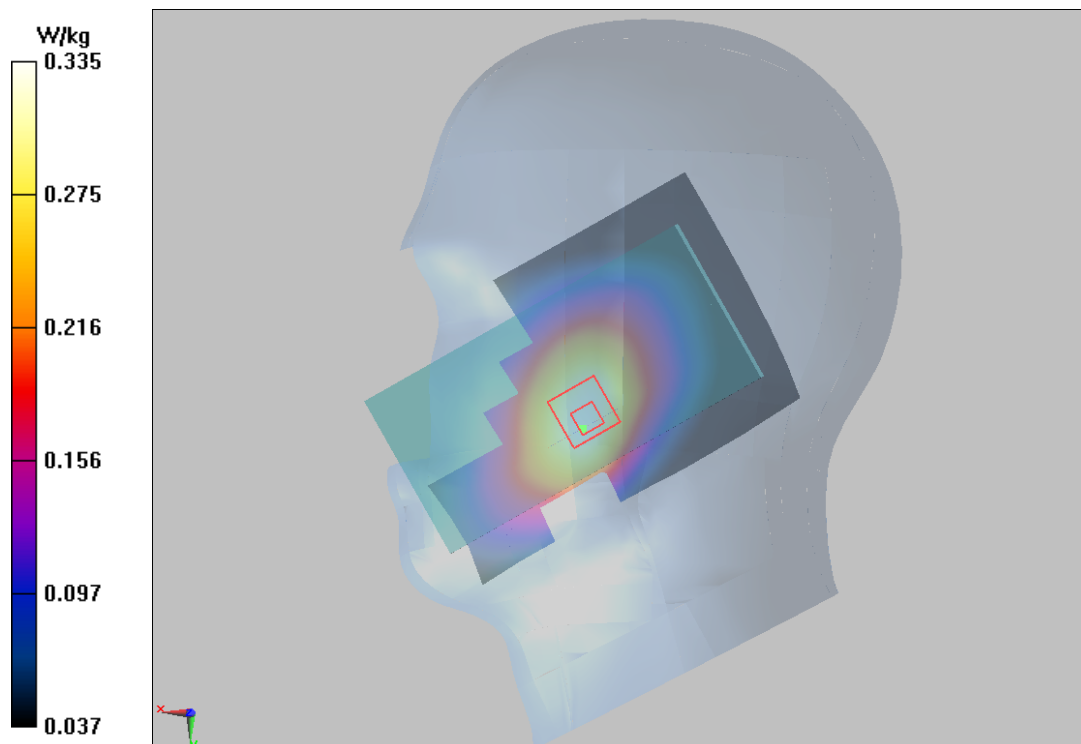
Right Cheek Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 7.542 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 0.403 W/kg

SAR(1 g) = 0.322 W/kg; SAR(10 g) = 0.245 W/kg

Maximum value of SAR (measured) = 0.335 W/kg



Plot 6 CDMA BC10 Back Side Middle (Distance 10mm)

Date: 4/16/2019

Communication System: UID 0, CDMA (0); Frequency: 819.15 MHz; Duty Cycle: 1:1

Medium parameters used (interpolated): $f = 819.15$ MHz; $\sigma = 0.958$ S/m; $\epsilon_r = 53.951$; $\rho = 1000$ kg/m³

Ambient Temperature: 22.3 °C Liquid Temperature: 21.5 °C

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.32, 9.32, 9.32); Calibrated: 5/29/2018;

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

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

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

Back Side Middle/Area Scan (71x121x1): Interpolated grid: dx=15 mm, dy=15 mm

Maximum value of SAR (interpolated) = 0.292 W/kg

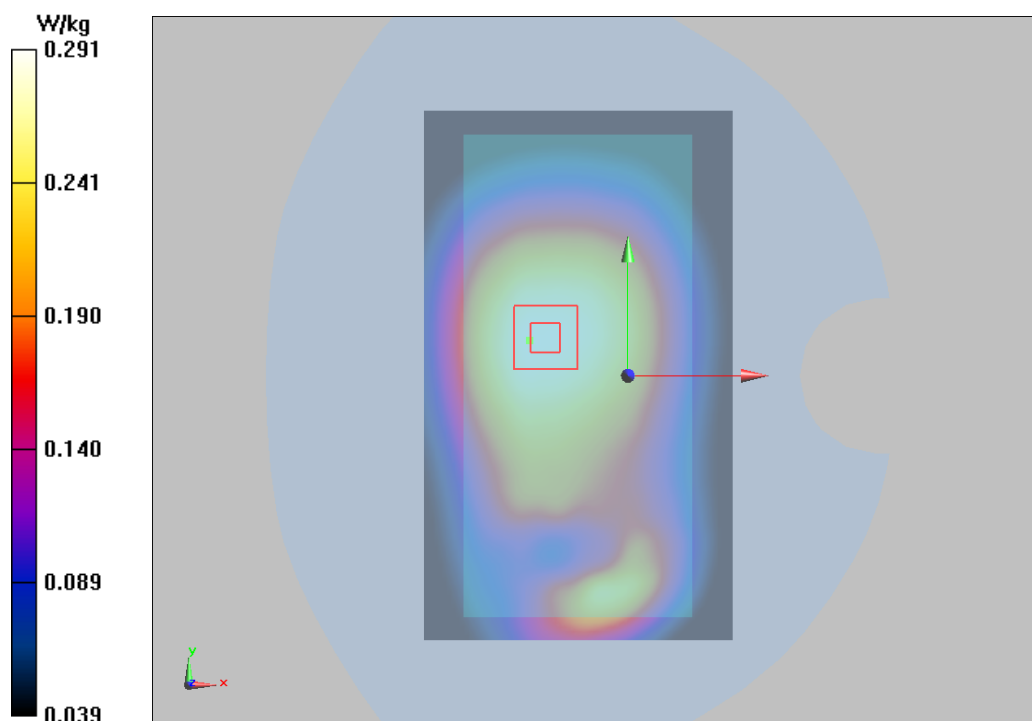
Back Side Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 16.66 V/m; Power Drift = 0.13 dB

Peak SAR (extrapolated) = 0.349 W/kg

SAR(1 g) = 0.280 W/kg; SAR(10 g) = 0.216 W/kg

Maximum value of SAR (measured) = 0.291 W/kg



Plot 7 LTE B14 1RB Right Cheek Middle

Date: 4/16/2019

Communication System: UID 0, LTE (0); Frequency: 793 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 793 \text{ MHz}$; $\sigma = 0.943 \text{ S/m}$; $\epsilon_r = 41.849$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.3°C Liquid Temperature: 21.5°C

Phantom section: Right Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.40, 9.40, 9.40); Calibrated: 5/29/2018;

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

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

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

Right Cheek Middle/Area Scan (71x131x1): Interpolated grid: $dx=15 \text{ mm}$, $dy=15 \text{ mm}$

Maximum value of SAR (interpolated) = 0.190 W/kg

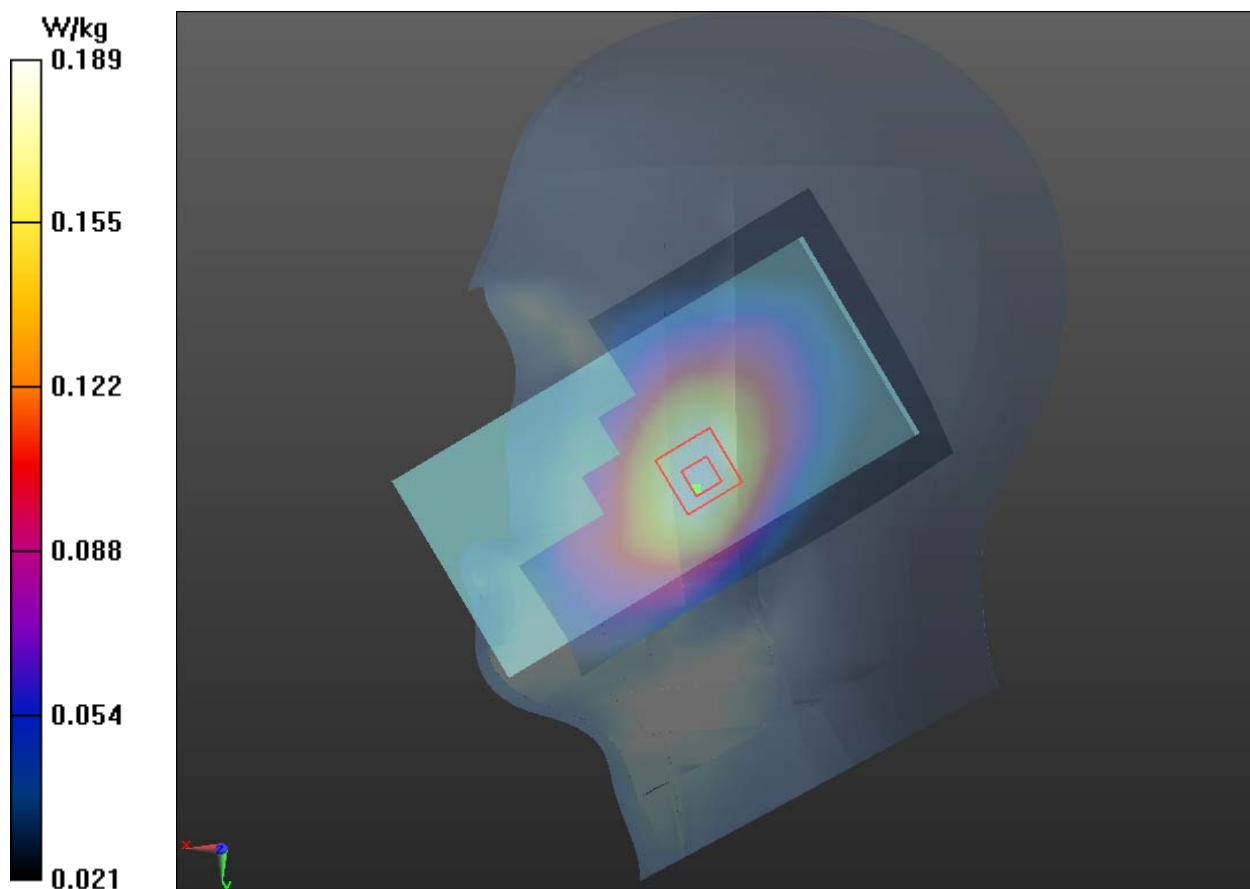
Right Cheek Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 6.742 V/m ; Power Drift = -0.12 dB

Peak SAR (extrapolated) = 0.233 W/kg

SAR(1 g) = 0.181 W/kg ; SAR(10 g) = 0.137 W/kg

Maximum value of SAR (measured) = 0.189 W/kg



Plot 8 LTE B14 1RB Back Side Middle (Distance 10mm)

Date: 4/16/2019

Communication System: UID 0, LTE (0); Frequency: 793 MHz; Duty Cycle: 1:1

Medium parameters used: $f = 793 \text{ MHz}$; $\sigma = 1.006 \text{ S/m}$; $\epsilon_r = 56.405$; $\rho = 1000 \text{ kg/m}^3$

Ambient Temperature: 22.3°C Liquid Temperature: 21.5°C

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(9.79, 9.79, 9.79); Calibrated: 5/29/2018;

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

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

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

Back Side Middle/Area Scan (71x131x1): Interpolated grid: $dx=15 \text{ mm}$, $dy=15 \text{ mm}$

Maximum value of SAR (interpolated) = 0.239 W/kg

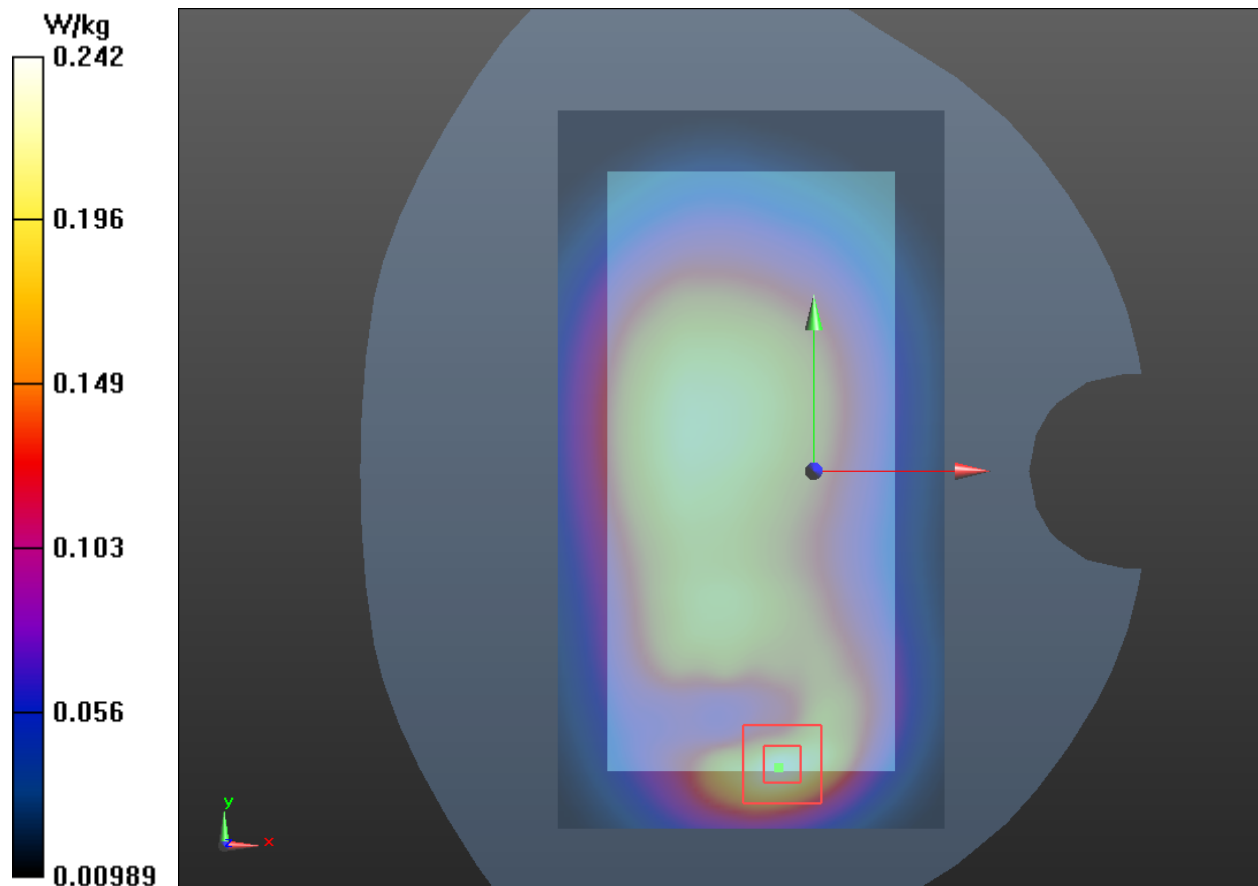
Back Side Middle/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Reference Value = 13.95 V/m ; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 0.373 W/kg

SAR(1 g) = 0.217 W/kg ; SAR(10 g) = 0.124 W/kg

Maximum value of SAR (measured) = 0.242 W/kg





ANNEX D: Probe Calibration Certificate



In Collaboration with
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校准
CALIBRATION
CNAS L0570

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Client **TA(shanghai)**Certificate No: **Z18-60093****CALIBRATION CERTIFICATE**Object **EX3DV4 - SN:3677**

Calibration Procedure(s) **FF-Z11-004-01**
Calibration Procedures for Dosimetric E-field Probes

Calibration date: **May 29, 2018**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Power sensor NRP-Z91	101547	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
Power sensor NRP-Z91	101548	27-Jun-17 (CTTL, No.J17X05857)	Jun-18
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 3846	25-Jan-18(SPEAG, No.EX3-3846_Jan18)	Jan-19
DAE4	SN 777	15-Dec-17(SPEAG, No.DAE4-777_Dec17)	Dec -18
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	27-Jun-17 (CTTL, No.J17X05858)	Jun-18
Network Analyzer E5071C	MY46110673	14-Jan-18 (CTTL, No.J18X00561)	Jan -19

	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: May 31, 2018

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

Certificate No: Z18-60093

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Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,y,z}
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A,B,C,D	modulation dependent linearization parameters
Polarization Φ	Φ rotation around probe axis
Polarization θ	θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i $\theta=0$ is normal to probe axis

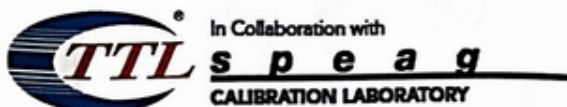
Connector Angle information used in DASY system to align probe sensor X to the robot coordinate system

Calibration is Performed According to the Following Standards:

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

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}:** Assessed for E-field polarization $\theta=0$ ($f \leq 900\text{MHz}$ in TEM-cell; $f > 1800\text{MHz}$: waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not effect the E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z} = NORM_{x,y,z} * frequency_response** (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- 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.
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; VR_{x,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 $f \leq 800\text{MHz}$) and inside waveguide using analytical field distributions based on power measurements for $f > 800\text{MHz}$. 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 NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from $\pm 50\text{MHz}$ to $\pm 100\text{MHz}$.
- Spherical isotropy (3D deviation from isotropy):** in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset:** The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle:** The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).



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Probe EX3DV4

SN: 3677

Calibrated: May 29, 2018

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: Z18-60093

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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($\mu\text{V}/(\text{V/m})^2$) ^A	0.41	0.46	0.41	±10.0%
DCP(mV) ^B	99.9	102.7	102.1	

Modulation Calibration Parameters

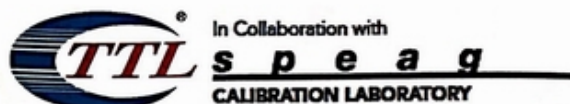
UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	152.4	±2.4%
		Y	0.0	0.0	1.0		161.7	
		Z	0.0	0.0	1.0		152.2	

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

^A The uncertainties of Norm X, Y, Z do not affect the E²-field uncertainty inside TSL (see Page 5 and Page 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



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

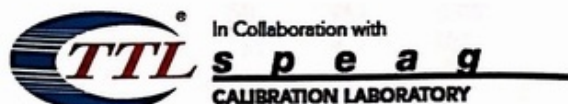
Calibration Parameter Determined in Head Tissue Simulating Media

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	9.40	9.40	9.40	0.40	0.80	± 12.1%
835	41.5	0.90	9.10	9.10	9.10	0.15	1.41	± 12.1%
1750	40.1	1.37	8.19	8.19	8.19	0.21	1.15	± 12.1%
1900	40.0	1.40	7.96	7.96	7.96	0.25	1.01	± 12.1%
2300	39.5	1.67	7.91	7.91	7.91	0.40	0.78	± 12.1%
2450	39.2	1.80	7.57	7.57	7.57	0.53	0.76	± 12.1%
2600	39.0	1.96	7.28	7.28	7.28	0.64	0.70	± 12.1%
5250	35.9	4.71	5.60	5.60	5.60	0.40	1.15	± 13.3%
5600	35.5	5.07	4.87	4.87	4.87	0.45	1.05	± 13.3%
5750	35.4	5.22	4.99	4.99	4.99	0.45	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

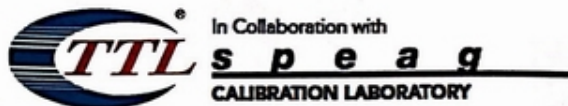
Calibration Parameter Determined in Body Tissue Simulating Media

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	9.79	9.79	9.79	0.40	0.80	±12.1%
835	55.2	0.97	9.32	9.32	9.32	0.15	1.51	±12.1%
1750	53.4	1.49	7.91	7.91	7.91	0.23	1.09	±12.1%
1900	53.3	1.52	7.70	7.70	7.70	0.20	1.18	±12.1%
2300	52.9	1.81	7.65	7.65	7.65	0.53	0.82	±12.1%
2450	52.7	1.95	7.53	7.53	7.53	0.37	1.10	±12.1%
2600	52.5	2.16	7.16	7.16	7.16	0.55	0.80	±12.1%
5250	48.9	5.36	5.04	5.04	5.04	0.50	1.55	±13.3%
5600	48.5	5.77	4.27	4.27	4.27	0.51	1.66	±13.3%
5750	48.3	5.94	4.43	4.43	4.43	0.50	1.81	±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.

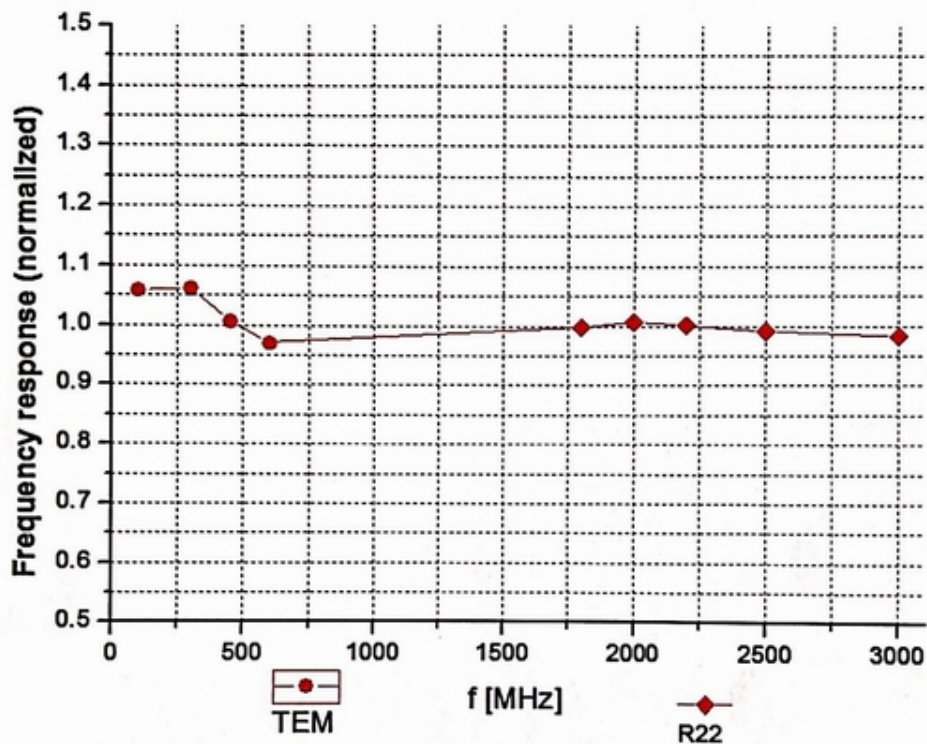
^F At frequency below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty 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.

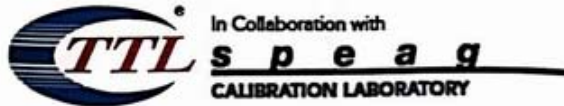


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Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: $\pm 7.4\%$ ($k=2$)

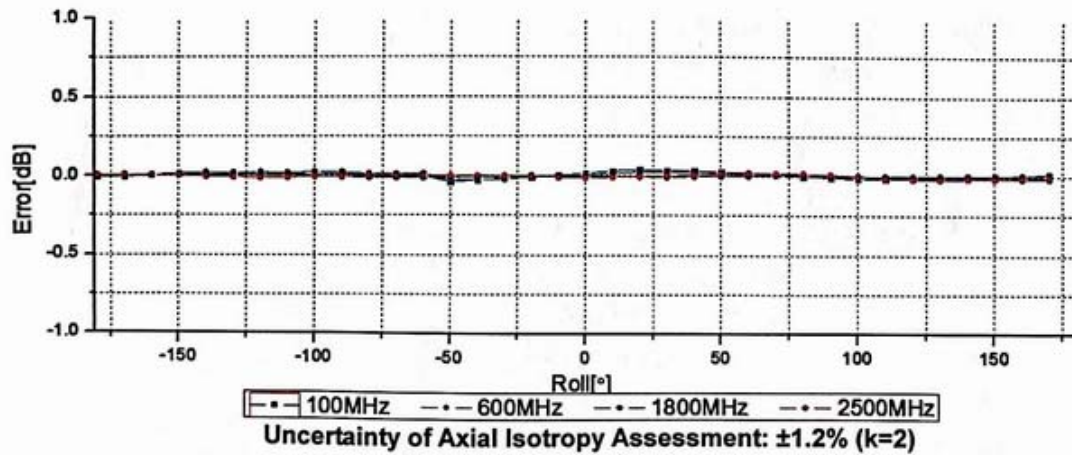
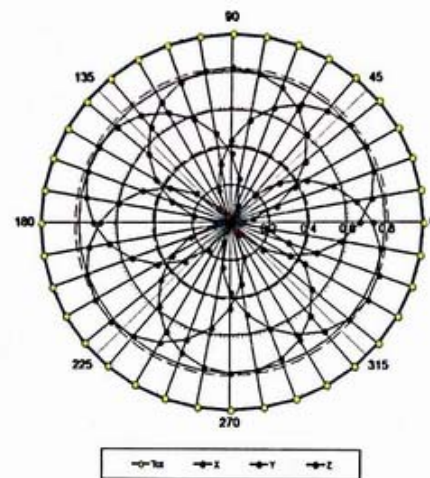
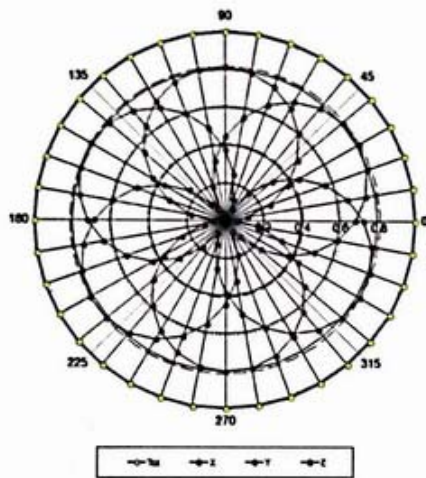


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Receiving Pattern (Φ), $\theta=0^\circ$

f=600 MHz, TEM

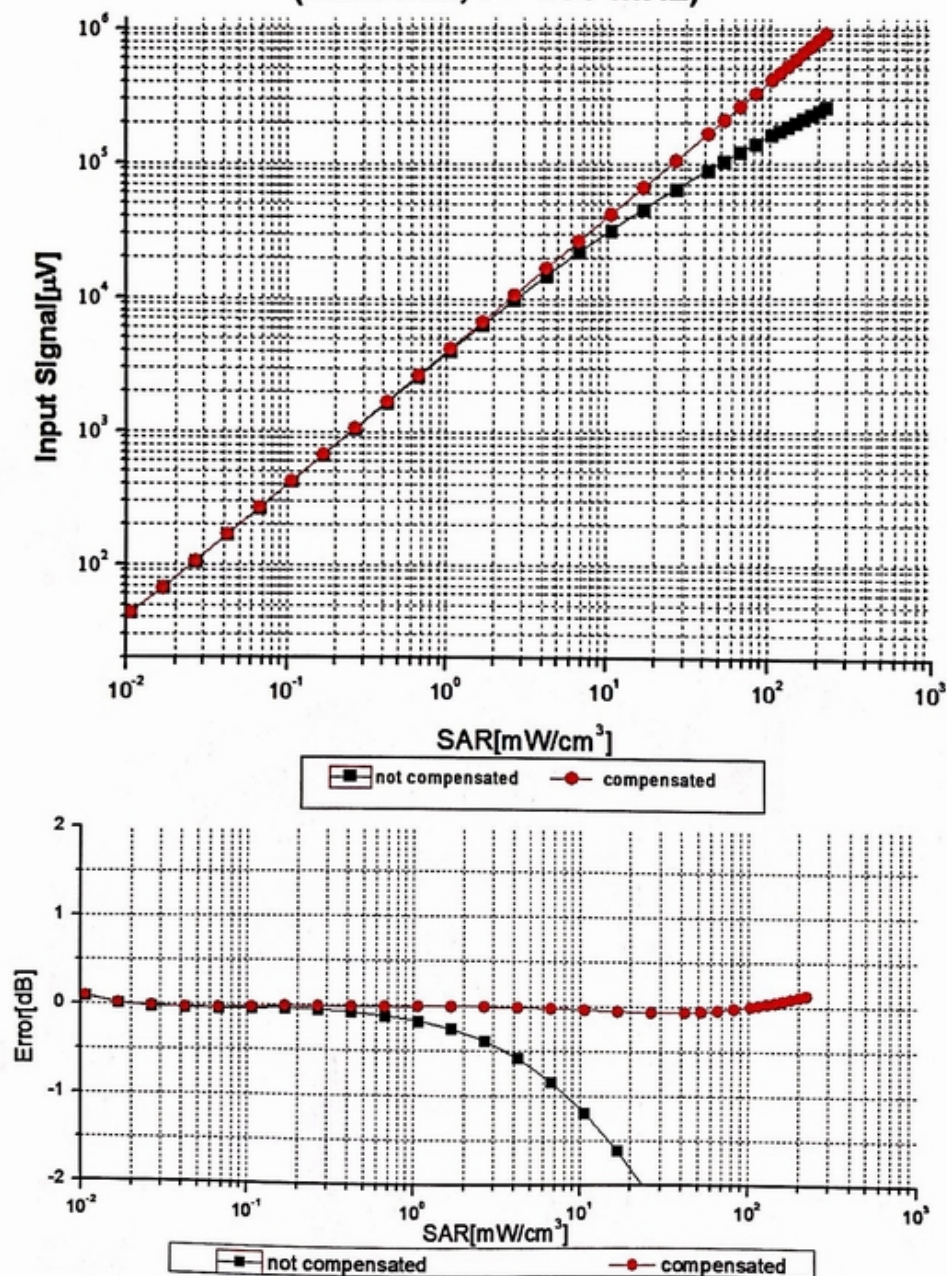
f=1800 MHz, R22





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



Uncertainty of Linearity Assessment: $\pm 0.9\%$ ($k=2$)

Certificate No: Z18-60093

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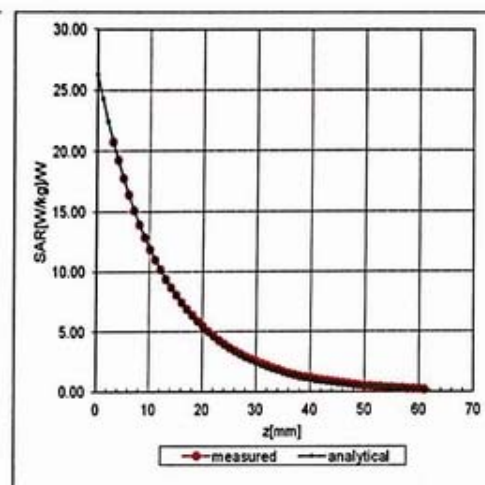
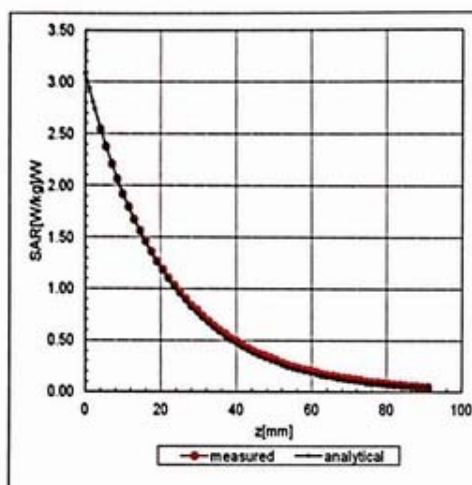


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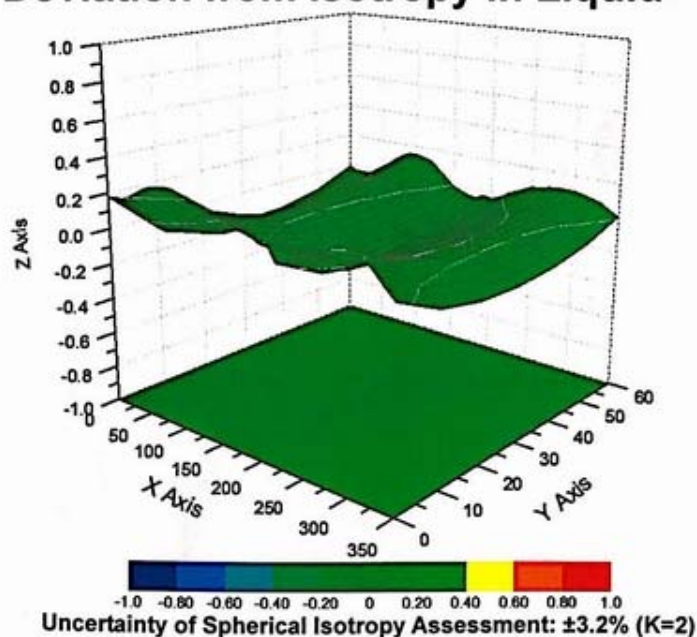
Conversion Factor Assessment

f=750 MHz, WGLS R9(H_convF)

f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



Uncertainty of Spherical Isotropy Assessment: $\pm 3.2\%$ (K=2)



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

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	118.3
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