



SAR TEST REPORT

Applicant Datalogic S.r.l.

FCC ID U4GDL35US

Product Smartphone

Brand Datalogic

Model MEMOR 10

Report No. R1807A0326-S1V6

Issue Date November 13, 2018

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 2.1: Highest Reported SAR

Mode	Highest Reported SAR (W/kg)		
	1g SAR Head	1g Body SAR (Separation 10mm)	10g SAR Limb SAR (Separation 0mm)
Wi-Fi (5G)	0.770	0.762	0.901
Date of Testing:	October 30, 2018 ~ October 31, 2018		

Note: The device is in compliance with SAR for Uncontrolled Environment /General Population exposure limits (1.6 W/kg and 4.0 W/kg) specified in ANSI C95.1: 1992/IEEE C95.1: 1991, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.



3 Description of Equipment under Test

Client Information

Applicant	Datalogic S.r.l.
Applicant address	Via San Vitalino no. 13, Calderara di Reno – 40012 (BO) - Italy
Manufacturer	Datalogic S.r.l.
Manufacturer address	Via San Vitalino no. 13, Calderara di Reno – 40012 (BO) - Italy

General Technologies

Application Purpose:	Original Grant
EUT Stage	Identical Prototype
Model:	MEMOR 10
IMEI:	359737090202384
Hardware Version:	V00 (US)
Software Version:	0.02.06D.20180716-userdebug-customer1
Antenna Type:	Internal Antenna
Device Class:	B
EUT Accessory	
Adapter	Manufacturer: Ten Pao Model: S008ACM0500200
Battery	Manufacturer: SCUD (Fujian) Electronics Co., LTD. Model: BTDL35
Extend USB Cable	Manufacturer: JUWEI ELECTRONICS CO., LTD USB2.0 A/M TO TYPE C/M CABLE 1.2M

**Wireless Technology and Frequency Range**

Wireless Technology	Modulation	Operating mode	Tx (MHz)
Wi-Fi	5G	OFDM	802.11a/n 20M/40M/ ac 20M/40M/80M
Does this device support MIMO <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:

248227 D01 802.11 Wi-Fi SAR v02r02
447498 D01 General RF Exposure Guidance v06
648474 D04 Handset SAR v01r03
865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
865664 D02 RF Exposure Reporting v01r02
690783 D01 SAR Listings on Grants v01r03

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.

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration. 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, 10-g extremity 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. Extremity 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 10-g extremity 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 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 ($\sim 10\%$ 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 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 closest/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.

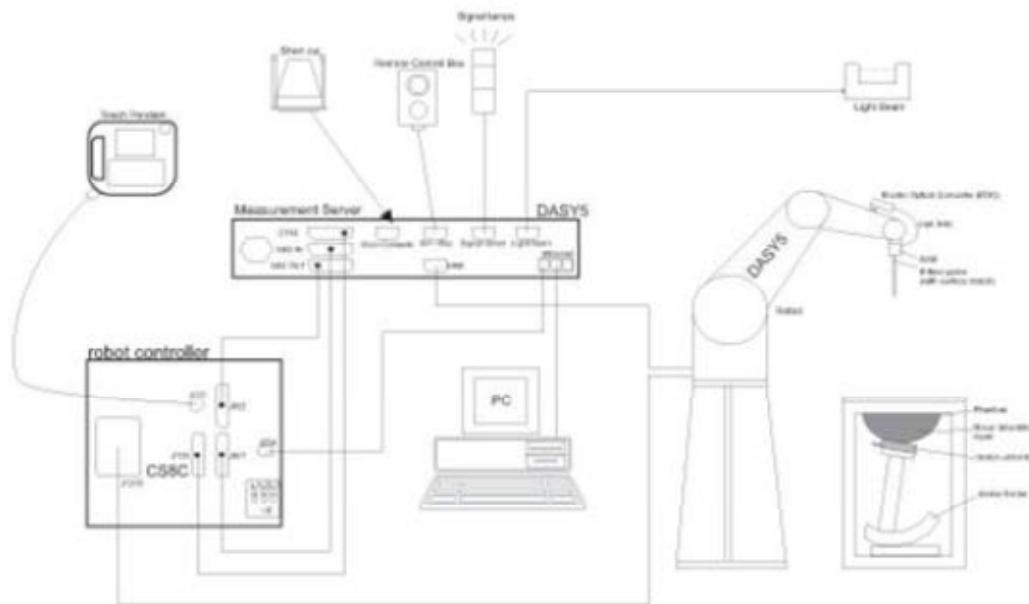
To determine the initial test position, Area Scans were performed to determine the position with the Maximum Value of SAR (measured). The position that produced the highest Maximum Value of SAR is considered the worst case position; thus used as the initial test position.

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 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.

$$\mathbf{SAR} = C \Delta T / \Delta t$$

Where: Δt = Exposure time (30 seconds),

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

ΔT = Temperature increase due to RF exposure.

Or

$$\mathbf{SAR} = IEI^2 \sigma / \rho$$

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.

	$\leq 3 \text{ GHz}$	$> 3 \text{ GHz}$
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	$5 \pm 1 \text{ mm}$	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5 \text{ mm}$
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
	$\leq 2 \text{ GHz}: \leq 15 \text{ mm}$ $2 - 3 \text{ GHz}: \leq 12 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 12 \text{ mm}$ $4 - 6 \text{ GHz}: \leq 10 \text{ mm}$
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$		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: Δx_{zoom} Δy_{zoom}		$\leq 2\text{GHz}: \leq 8\text{mm}$ $2 - 3\text{GHz}: \leq 5\text{mm}^*$	$3 - 4\text{GHz}: \leq 5\text{mm}^*$ $4 - 6\text{GHz}: \leq 4\text{mm}^*$
Maximum zoom scan spatial resolution, normal to phantom surface	Uniform grid: $\Delta z_{zoom}(n)$	$\leq 5\text{mm}$	$3 - 4\text{GHz}: \leq 4\text{mm}$ $4 - 5\text{GHz}: \leq 3\text{mm}$ $5 - 6\text{GHz}: \leq 2\text{mm}$
Graded grid	$\Delta z_{zoom}(1): \text{between 1}^{\text{st}} \text{ two points closest to phantom surface}$	$\leq 4\text{mm}$	$3 - 4\text{GHz}: \leq 3\text{mm}$ $4 - 5\text{GHz}: \leq 2.5\text{mm}$ $5 - 6\text{GHz}: \leq 2\text{mm}$
	$\Delta z_{zoom}(n > 1): \text{between subsequent points}$		$\leq 1.5 \cdot \Delta z_{zoom}(n-1)$
Minimum zoom scan volume	X, y, z	$\geq 30\text{mm}$	$3 - 4\text{GHz}: \geq 28\text{mm}$ $4 - 5\text{GHz}: \geq 25\text{mm}$ $5 - 6\text{GHz}: \geq 22\text{mm}$
Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.			
* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is $\leq 1.4\text{W/kg}$, $\leq 8\text{mm}$, $\leq 7\text{mm}$ and $\leq 5\text{mm}$ 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 remains 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
BT Base Station Simulator	R&S	CBT	100271	2018-05-14	2019-05-13
E-field Probe	SPEAG	EX3DV4	3677	2018-05-29	2019-05-28
DAE	SPEAG	DAE4	1317	2018-03-23	2019-03-22
Validation Kit 5GHz	SPEAG	D5GHzV2	1151	2017-01-05	2020-01-04
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	/	/
Software for 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 (%)	Diethylenglycol monohexylether (%)	Triton X-100 (%)	ϵ_r	$\sigma(\text{s/m})$
Head	5250	65.53	17.24	17.23	35.9	4.71
	5600	65.53	17.24	17.23	35.5	5.07
	5750	65.53	17.24	17.23	35.4	5.22
Body	5250	72.52	13.74	13.74	48.9	5.36
	5600	72.52	13.74	13.74	48.5	5.77
	5750	72.52	13.74	13.74	48.3	5.94

Measurements results

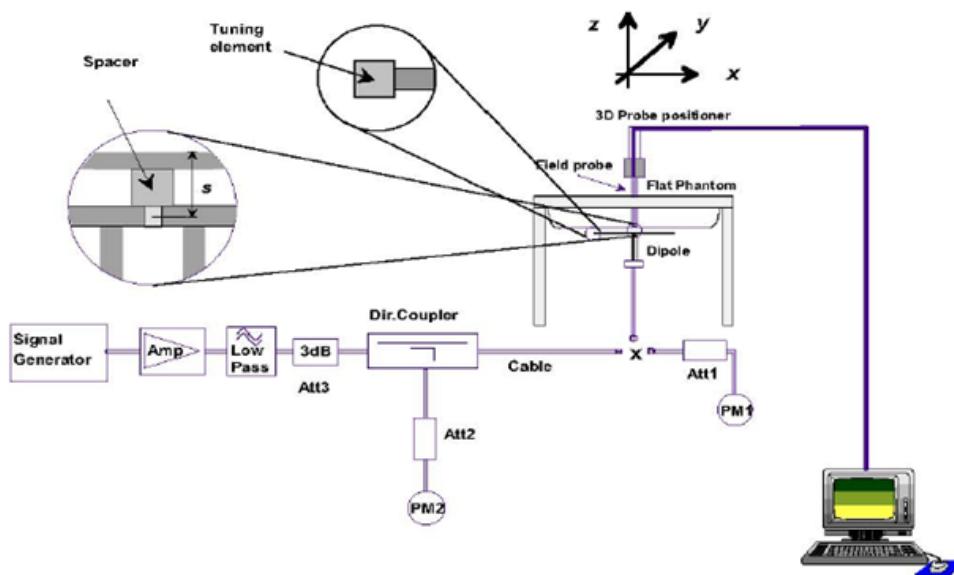
Frequency (MHz)		Test Date	Temp °C	Measured Dielectric Parameters		Target Dielectric Parameters		Limit (Within $\pm 5\%$)	
				ϵ_r	$\sigma(\text{s/m})$	ϵ_r	$\sigma(\text{s/m})$	Dev $\epsilon_r(\%)$	Dev $\sigma(\%)$
5250	Head	10/30/2018	21.5	36.0	4.75	35.9	4.71	0.28	0.85
	Body	10/30/2018	21.5	46.7	5.42	48.9	5.36	-4.50	1.12
5600	Head	10/31/2018	21.5	35.1	5.20	35.5	5.07	-1.13	2.56
	Body	10/30/2018	21.5	46.7	6.00	48.5	5.77	-3.71	3.99
5750	Head	10/31/2018	21.5	34.9	5.21	35.4	5.22	-1.41	-0.19
	Body	10/31/2018	21.5	47.6	6.14	48.3	5.94	-1.45	3.37

Note: The depth of tissue-equivalent liquid in a phantom must be ≥ 15.0 cm for SAR measurements ≤ 3 GHz and ≥ 10.0 cm for measurements > 3 GHz.

8.2 System Performance Check

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

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



Picture 1 System Performance Check setup



Picture 2 Setup Photo

**Justification for Extended SAR Dipole Calibrations**

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

Dipole		Date of Measurement	Return Loss(dB)	Δ %	Impedance (Ω)	ΔΩ
Dipole D5GHzV2 SN: 1151 (5250MHz)	Head	1/5/2017	-24.5	/	48.4	/
	Liquid	1/4/2018	-24.2	1.2%	48.7	0.3Ω
	Body	1/5/2017	-24.7	/	50.4	/
	Liquid	1/4/2018	-24.4	1.2%	49.9	-0.5Ω
Dipole D5GHzV2 SN: 1151 (5600MHz)	Head	1/5/2017	-22.8	/	55.5	/
	Liquid	1/4/2018	-22.4	1.8%	55.2	-0.3Ω
	Body	1/5/2017	-23.3	/	57.2	/
	Liquid	1/4/2018	-23.4	-0.4%	56.8	-0.4Ω
Dipole D5GHzV2 SN: 1151 (5750MHz)	Head	1/5/2017	-26.5	/	52.4	/
	Liquid	1/4/2018	-26.8	-1.1%	52.5	0.1Ω
	Body	1/5/2017	-24.9	/	56.0	/
	Liquid	1/4/2018	-25.2	-1.2%	56.4	0.4Ω

System Check results

Frequency (MHz)		Test Date	Temp °C	100mW Measured SAR _{1g} (W/kg)	1W Normalized SAR _{1g} (W/kg)	1W Target SAR _{1g} (W/kg)	Δ % (Limit ±10%)	Plot No.
5250	Head	10/30/2018	21.5	7.87	78.70	78.40	0.38	1
	Body	10/30/2018	21.5	7.46	74.60	75.60	-1.32	2
5600	Head	10/31/2018	21.5	7.67	76.70	81.50	-5.89	3
	Body	10/30/2018	21.5	8.10	81.00	80.20	1.00	4
5750	Head	10/31/2018	21.5	7.66	76.60	80.50	-4.84	5
	Body	10/31/2018	21.5	7.15	71.50	74.60	-4.16	6

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 WLAN Mode

5GHz Wi-Fi (U-NII-1)	Channel /Frequency (MHz)	Conducted Power (dBm)	
		Tune-up	Meas.
802.11a (6M)	36/5180	14.00	13.80
	40/5200	14.00	13.44
	44/5220	14.00	12.90
	48/5240	14.00	13.21
802.11n-HT20 (MCS0)	36/5180	14.00	13.67
	40/5200	14.00	13.32
	44/5220	14.00	12.81
	48/5240	14.00	13.05
802.11n-HT40 (MCS0)	38/5190	14.00	13.71
	46/5230	14.00	13.02
802.11ac-VHT20 (6M)	36/5180	14.00	13.69
	40/5200	14.00	13.32
	44/5220	14.00	12.87
	48/5240	14.00	13.06
802.11ac-VHT40 (MCS0)	38/5190	14.00	13.49
	46/5230	14.00	13.01
802.11ac-VHT80 (MCS0)	42/5210	14.50	14.34

Note: Initial test configuration is 802.11ac-VHT80 mode, since the highest maximum output power.

5GHz Wi-Fi (U-NII-2A)	Channel /Frequency (MHz)	Conducted Power (dBm)	
		Tune-up	Meas.
802.11a (6M)	52/5260	14.00	13.21
	56/5280	14.00	13.15
	60/5300	14.00	13.03
	64/5320	14.00	13.22
802.11n-HT20 (MCS0)	52/5260	14.00	13.10
	56/5280	14.00	12.93
	60/5300	14.00	12.78
	64/5320	14.00	12.98
802.11n-HT40	54/5270	14.00	13.10



(MCS0)	62/5310	14.00	12.96
802.11ac-VHT20 (6M)	52/5260	14.00	13.06
	56/5280	14.00	12.78
	60/5300	14.00	12.95
	64/5320	14.00	12.96
	802.11ac-VHT40 (MCS0)	54/5270	14.00
		62/5310	14.00
802.11ac-VHT80 (MCS0)	58/5290	15.50	15.22
Note: Initial test configuration is 802.11ac-VHT80 mode, since the highest maximum output power.			

5GHz Wi-Fi (U-NII-2C)	Channel /Frequency (MHz)	Conducted Power (dBm)	
		Tune-up	Meas.
802.11a (6M)	100/5500	14.00	12.45
	116/5580	14.00	12.47
	132/5660	14.00	13.86
	140/5700	14.00	13.86
802.11n-HT20 (MCS0)	100/5500	14.00	12.40
	116/5580	14.00	12.30
	132/5660	14.00	13.71
	140/5700	14.00	13.44
802.11n-HT40 (MCS0)	102/5510	14.00	12.59
	110/5550	14.00	12.61
	118/5590	14.00	12.79
	134/5670	14.00	13.61
802.11ac-VHT20 (6M)	100/5500	14.00	12.44
	116/5580	14.00	12.29
	132/5660	14.00	13.66
	140/5700	14.00	13.44
802.11ac-VHT40 (MCS0)	102/5510	14.00	12.77
	110/5550	14.00	12.84
	118/5590	14.00	12.93
	134/5670	14.00	13.65
802.11ac-VHT80 (MCS0)	106/5530	15.00	14.57
	122/5610	15.00	14.53
Note: Initial test configuration is 802.11ac-VHT80 mode, since the highest maximum output power.			

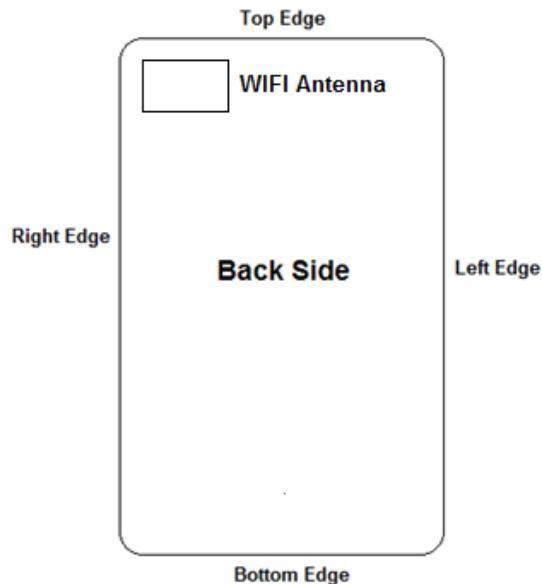


5GHz Wi-Fi (U-NII-3)	Channel /Frequency (MHz)	Conducted Power (dBm)	
		Tune-up	Meas.
802.11a (6M)	149/5745	14.00	13.65
	157/5785	14.00	13.53
	165/5825	14.00	13.34
802.11n-HT20 (MCS0)	149/5745	14.00	13.18
	157/5785	14.00	13.34
	165/5825	14.00	13.18
802.11n-HT40 (MCS0)	151/5755	14.00	13.40
	159/5795	14.00	13.11
802.11ac-VHT20 (6M)	149/5745	14.00	13.29
	157/5785	14.00	13.28
	165/5825	14.00	13.03
802.11ac-VHT40 (MCS0)	151/5755	14.00	13.34
	159/5795	14.00	13.17
802.11ac-VHT80 (MCS0)	155/5775	14.00	13.65

Note: Initial test configuration is 802.11a mode, since the highest maximum output power.

10 Measured and Reported (Scaled) SAR Results

10.1 EUT Antenna Locations



Overall (Length x Width): 156 mm x 78 mm

Overall Diagonal: 162mm/Display Diagonal: 156mm

Distance of the Antenna to the EUT surface/edge

Antenna	Back Side	Front side	Left Edge	Right Edge	Top Edge	Bottom Edge
Wi-Fi Antenna	0	0	>25mm	0	0	>25mm

Hotspot mode, Positions for SAR tests

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

Note: 1. SAR is measured for all sides and surfaces with a transmitting antenna located within 25 mm from that surface or edge.

2. Per 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:

- 1) $\leq 0.8 \text{ W/kg}$ or 2.0 W/kg , for 1-g or 10-g respectively, when the transmission band is $\leq 100 \text{ MHz}$
- 2) $\leq 0.6 \text{ W/kg}$ or 1.5 W/kg , for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz
- 3) $\leq 0.4 \text{ W/kg}$ or 1.0 W/kg , for 1-g or 10-g respectively, when the transmission band is $\geq 200 \text{ MHz}$
3. Per KDB 447498 D01, when the original highest measured SAR is $\geq 0.80 \text{ W/kg}$, the measurement was repeated once.
4. Per KDB 648474 D04, SAR was evaluated without a headset connected to the device. Since the reported SAR was $\leq 1.2 \text{ W/kg}$, no additional SAR evaluations using a headset cable were required.
5. Per KDB 648474 D04, for smart phones with a display diagonal dimension $> 15.0 \text{ cm}$ or an overall diagonal dimension $> 16.0 \text{ cm}$, 10-g extremity SAR must be tested as a phablet to determine SAR compliance. For phablet, when hotspot mode 1-g reported SAR $< 1.2 \text{ W/kg}$, 10-g extremity SAR is no required.



10.2 Measured SAR Results

Table 1: Wi-Fi (5G, U-NII-2A)

For band U-NII-1 and U-NII-2A, when different maximum output power is specified for the bands, begin SAR measurement in the band with higher specified maximum output power. The highest reported SAR for the tested configuration is adjusted by the ratio of lower to higher specified maximum output power for the two bands. When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, each band is tested independently for SAR.

Test Position	Cover Type	Channel/ Frequency (MHz)	Mode (802.11ac VHT80)	Duty Cycle	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Area Scan Max. SAR (W/Kg)	Measured SAR _{1g} (W/kg)	Scaling Factor	Reported SAR _{1g} (W/kg)	Plot No.
Head SAR												
Left Cheek	Standard	58/5290	OFDM	90.0%	15.50	15.22	0.136	0.704	0.700	1.07	0.747	7
Left Tilt	Standard	58/5290	OFDM	90.0%	15.50	15.22	0.033	0.412	0.437	1.07	0.466	/
Right Cheek	Standard	58/5290	OFDM	90.0%	15.50	15.22	0.021	0.681	0.691	1.07	0.737	/
Right Tilt	Standard	58/5290	OFDM	90.0%	15.50	15.22	0.120	0.435	0.461	1.07	0.492	/
Body-worn SAR (Distance 10mm)												
Back Side	Standard	58/5290	OFDM	90.0%	15.50	15.22	0.034	0.441	0.446	1.07	0.476	/
Front Side	Standard	58/5290	OFDM	90.0%	15.50	15.22	0.150	0.365	0.371	1.07	0.396	/
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	58/5290	OFDM	90.0%	15.50	15.22	-0.041	0.459	0.516	1.07	0.551	8
Top Edge	Standard	58/5290	OFDM	90.0%	15.50	15.22	0.036	0.298	0.301	1.07	0.321	/
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
Test Position	Cover Type	Channel/ Frequency (MHz)	Mode (802.11ac VHT80)	Duty Cycle	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Area Scan Max. SAR (W/Kg)	Measured SAR _{10g} (W/kg)	Scaling Factor	Reported SAR _{10g} (W/kg)	Plot No.
Limb SAR (Distance 0mm)												
Back Side	Standard	58/5290	OFDM	90.0%	15.50	15.22	0.138	0.284	0.282	1.07	0.301	/
Front Side	Standard	58/5290	OFDM	90.0%	15.50	15.22	0.010	0.241	0.238	1.07	0.254	/
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	58/5290	OFDM	90.0%	15.50	15.22	0.070	0.376	0.397	1.07	0.424	9
Top Edge	Standard	58/5290	OFDM	90.0%	15.50	15.22	0.012	0.168	0.159	1.07	0.170	/
Bottom Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	/
<p>Note: 1. The value with blue color is the maximum SAR Value of each test band.</p> <p>2. Initial test configuration is 802.11ac VHT80 mode, since the highest maximum output power.</p> <p>3. Since Wi-Fi 5G does not support hotspot function, 10-g extremity SAR is required.</p> <p>4. For Wi-Fi 5G OFDM mode, when the highest reported SAR for the initial test configuration, according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg (1g)/ 3 W/Kg (10g), SAR is not required for that subsequent test configuration.</p>												



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

Test Position	Cover Type	Channel/ Frequency (MHz)	Mode (802.11ac VHT80)	Duty Cycle	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Area Scan Max.SAR (W/Kg)	Measured SAR _{1g} (W/kg)	Scaling Factor	Reported SAR _{1g} (W/kg)	Plot No.
Head SAR												
Left Cheek	Standard	106/5530	OFDM	90.0%	15.00	14.57	-0.025	0.640	0.697	1.10	0.770	10
	Standard	122/5610	OFDM	90.0%	15.00	14.53	-0.070	0.533	0.580	1.11	0.646	/
Left Tilt	Standard	106/5530	OFDM	90.0%	15.00	14.57	0.120	0.319	0.321	1.10	0.355	/
Right Cheek	Standard	106/5530	OFDM	90.0%	15.00	14.57	0.091	0.612	0.617	1.10	0.682	/
	Standard	122/5610	OFDM	90.0%	15.00	14.53	0.060	0.527	0.560	1.11	0.624	/
Right Tilt	Standard	106/5530	OFDM	90.0%	15.00	14.57	0.017	0.281	0.274	1.10	0.303	/
Body-worn SAR (Distance 10mm)												
Back Side	Standard	106/5530	OFDM	90.0%	15.00	14.57	0.108	0.580	0.653	1.10	0.721	/
	Standard	122/5610	OFDM	90.0%	15.00	14.53	0.031	0.578	0.573	1.11	0.638	/
Front Side	Standard	106/5530	OFDM	90.0%	15.00	14.57	0.074	0.398	0.360	1.10	0.397	/
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	106/5530	OFDM	90.0%	15.00	14.57	0.070	0.477	0.662	1.10	0.731	11
	Standard	122/5610	OFDM	90.0%	15.00	14.53	-0.120	0.458	0.557	1.11	0.621	/
Top Edge	Standard	106/5530	OFDM	90.0%	15.00	14.57	0.048	0.364	0.357	1.10	0.394	/
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
Test Position	Cover Type	Channel/ Frequency (MHz)	Mode (802.11ac VHT80)	Duty Cycle	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Area Scan Max.SAR (W/Kg)	Measured SAR _{10g} (W/kg)	Scaling Factor	Reported SAR _{10g} (W/kg)	Plot No.
Limb SAR (Distance 0mm)												
Back Side	Standard	106/5530	OFDM	90.0%	15.00	14.57	0.023	0.595	0.816	1.10	0.901	12
	Standard	122/5610	OFDM	90.0%	15.00	14.53	0.110	0.545	0.561	1.11	0.625	/
Front Side	Standard	106/5530	OFDM	90.0%	15.00	14.57	0.010	0.438	0.413	1.10	0.456	/
Left Edge	N/A	N/A	OFDM	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Right Edge	Standard	106/5530	OFDM	90.0%	15.00	14.57	0.120	0.510	0.492	1.10	0.543	/
Top Edge	Standard	106/5530	OFDM	90.0%	15.00	14.57	0.037	0.316	0.337	1.10	0.372	/
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
<p>Note: 1. The value with blue color is the maximum SAR Value of each test band.</p> <p>2. Initial test configuration is 802.11n-HT80 mode, since the highest maximum output power.</p> <p>3. Since Wi-Fi 5G does not support hotspot function, 10-g extremity SAR is required.</p> <p>4. For Wi-Fi 5G OFDM mode, when the highest reported SAR for the initial test configuration, according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg (1g) / 3 W/Kg (10g), SAR is not required for that subsequent test configuration.</p>												



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

Test Position	Cover Type	Channel/ Frequency (MHz)	Mode (802.11ac VHT80)	Duty Cycle	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Area Scan Max.SAR (W/Kg)	Measured SAR _{1g} (W/kg)	Scaling Factor	Reported SAR _{1g} (W/kg)	Plot No.
Head SAR												
Left Cheek	Standard	155/5775	OFDM	90.0%	14.00	13.65	0.086	0.418	0.420	1.08	0.455	13
Left Tilt	Standard	155/5775	OFDM	90.0%	14.00	13.65	0.093	0.347	0.377	1.08	0.409	/
Right Cheek	Standard	155/5775	OFDM	90.0%	14.00	13.65	0.010	0.381	0.396	1.08	0.429	/
Right Tilt	Standard	155/5775	OFDM	90.0%	14.00	13.65	0.012	0.392	0.411	1.08	0.445	/
Body-worn SAR (Distance 10mm)												
Back Side	Standard	155/5775	OFDM	90.0%	14.00	13.65	-0.050	0.651	0.664	1.08	0.720	/
Front Side	Standard	155/5775	OFDM	90.0%	14.00	13.65	0.034	0.388	0.372	1.08	0.403	/
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	155/5775	OFDM	90.0%	14.00	13.65	0.024	0.783	0.703	1.08	0.762	14
Top Edge	Standard	155/5775	OFDM	90.0%	14.00	13.65	0.034	0.447	0.453	1.08	0.491	/
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
Test Position	Cover Type	Channel/ Frequency (MHz)	Mode (802.11ac VHT80)	Duty Cycle	Tune-up limit (dBm)	Conducted Power (dBm)	Drift (dB)	Area Scan Max.SAR (W/Kg)	Measured SAR _{10g} (W/kg)	Scaling Factor	Reported SAR _{10g} (W/kg)	Plot No.
Limb SAR (Distance 0mm)												
Back Side	Standard	155/5775	OFDM	90.0%	14.00	13.65	0.025	0.635	0.820	1.08	0.889	15
Front Side	Standard	155/5775	OFDM	90.0%	14.00	13.65	0.019	0.449	0.471	1.08	0.511	/
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	155/5775	OFDM	90.0%	14.00	13.65	0.170	0.696	0.753	1.08	0.816	/
Top Edge	Standard	155/5775	OFDM	90.0%	14.00	13.65	0.140	0.387	0.394	1.08	0.427	/
Bottom Edge	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

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

2. Initial test configuration is 802.11ac VHT80 mode, since the highest maximum output power.

3. Since Wi-Fi 5G does not support hotspot function, 10-g extremity SAR is required.

4. For Wi-Fi 5G OFDM mode, when the highest reported SAR for the initial test configuration, according to the initial test position or fixed exposure position requirements, is adjusted by the ratio of the subsequent test configuration to initial test configuration specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg (1g)/ 3 W/Kg (10g), SAR is not required for that subsequent test 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

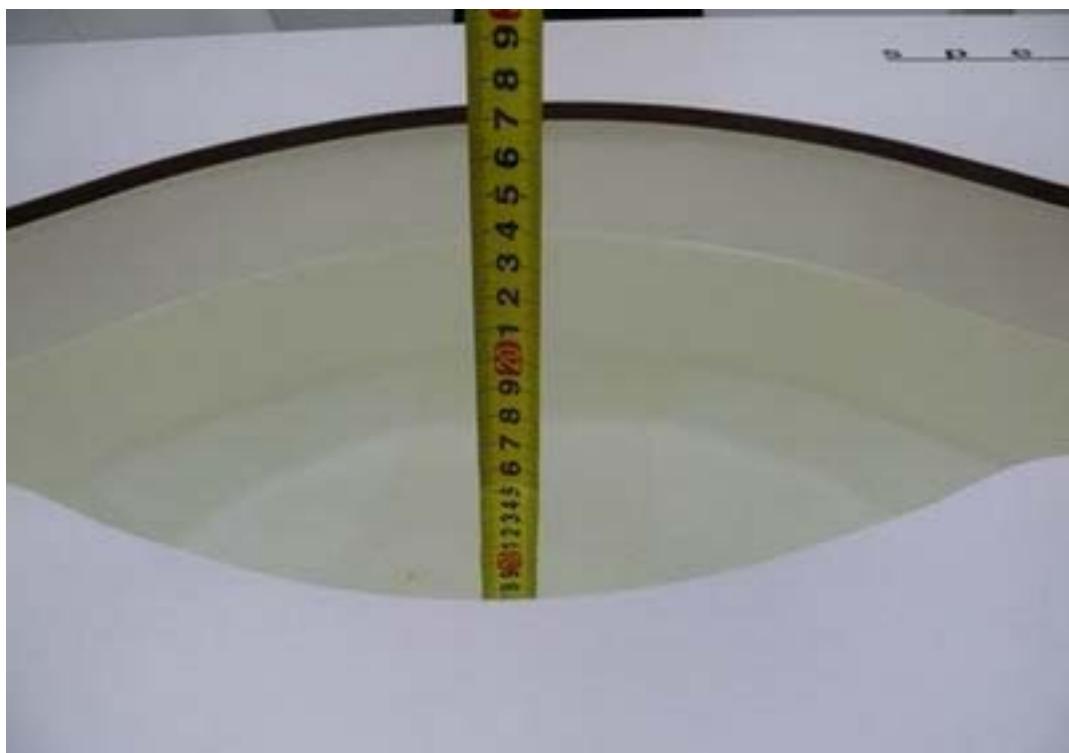


Tissue Simulating Liquids

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 5250 MHz Head TSL

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

Date: 10/30/2018

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

Medium parameters used: $f = 5250$ MHz; $\sigma = 4.75$ mho/m; $\epsilon_r = 36.0$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(5.60, 5.60, 5.60); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

d=10mm, Pin=100mW/Area Scan (61x101x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 9.14 mW/g

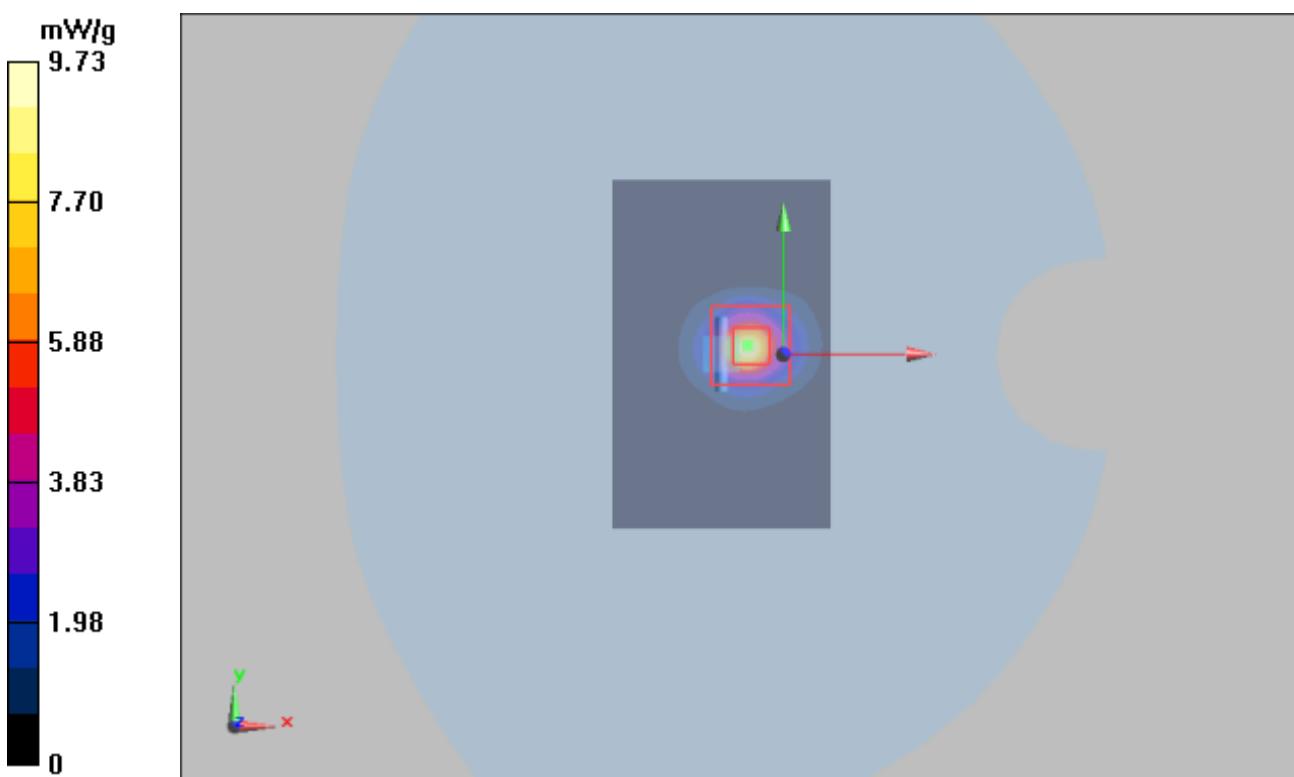
d=10mm, Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 33.6 V/m; Power Drift = -0.095 dB

Peak SAR (extrapolated) = 52.2 W/kg

SAR(1 g) = 7.87 mW/g; SAR(10 g) = 2.25 mW/g

Maximum value of SAR (measured) = 9.73 mW/g



Plot 2 System Performance Check at 5250 MHz Body TSL

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

Date: 10/30/2018

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

Medium parameters used: $f = 5250$ MHz; $\sigma = 5.42$ mho/m; $\epsilon_r = 46.7$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(5.04, 5.04, 5.04); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

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

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

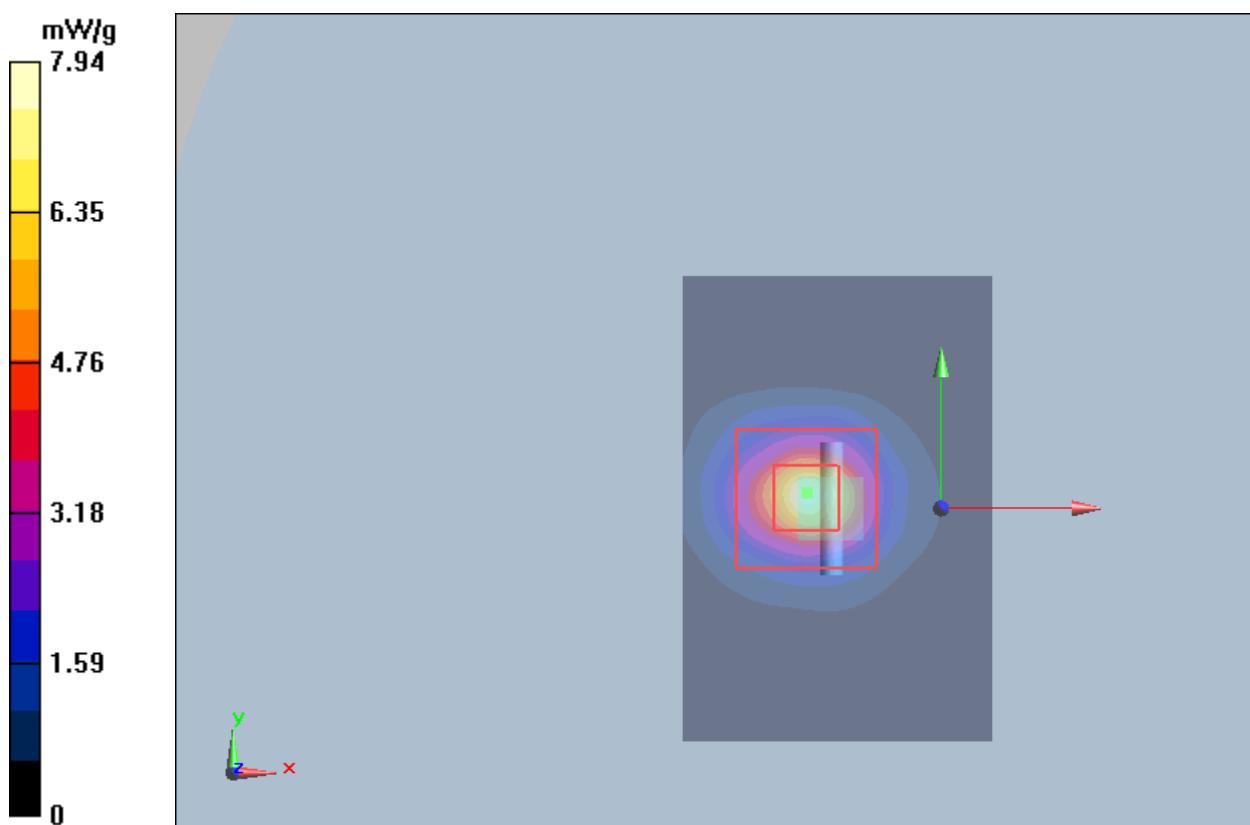
d=10mm, Pin=250mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

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

Peak SAR (extrapolated) = 47.7 W/kg

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

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



Plot 3 System Performance Check at 5600 MHz Head TSL

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

Date: 10/31/2018

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

Medium parameters used: $f = 5600$ MHz; $\sigma = 5.20$ mho/m; $\epsilon_r = 35.1$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.87, 4.87, 4.87); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

d=10mm, Pin=100mW/Area Scan (61x101x1): Measurement grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 8.25 mW/g

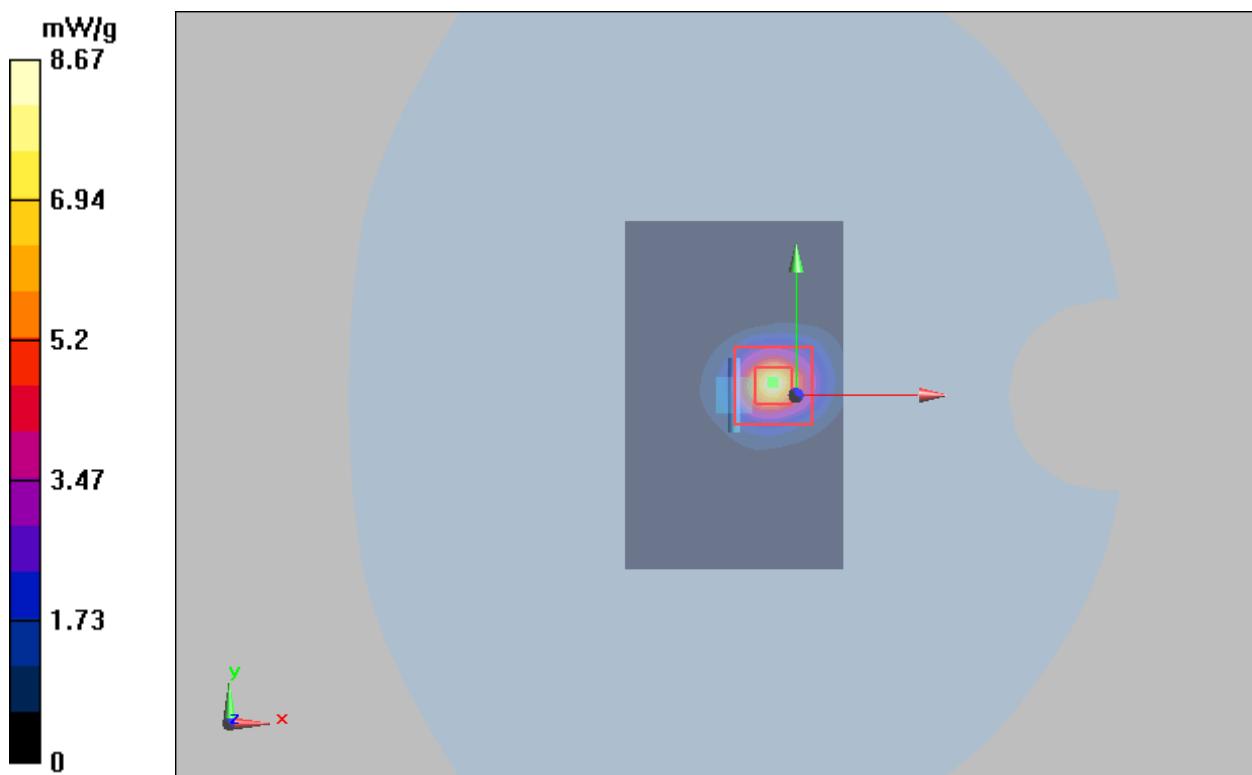
d=10mm, Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 23.1 V/m; Power Drift = -0.028 dB

Peak SAR (extrapolated) = 22.9 W/kg

SAR(1 g) = 7.67 mW/g; SAR(10 g) = 2.27 mW/g

Maximum value of SAR (measured) = 8.67 mW/g



Plot 4 System Performance Check at 5600 MHz Body TSL

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

Date: 10/30/2018

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

Medium parameters used: $f = 5600$ MHz; $\sigma = 6.00$ mho/m; $\epsilon_r = 46.7$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.27, 4.27, 4.27); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

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

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

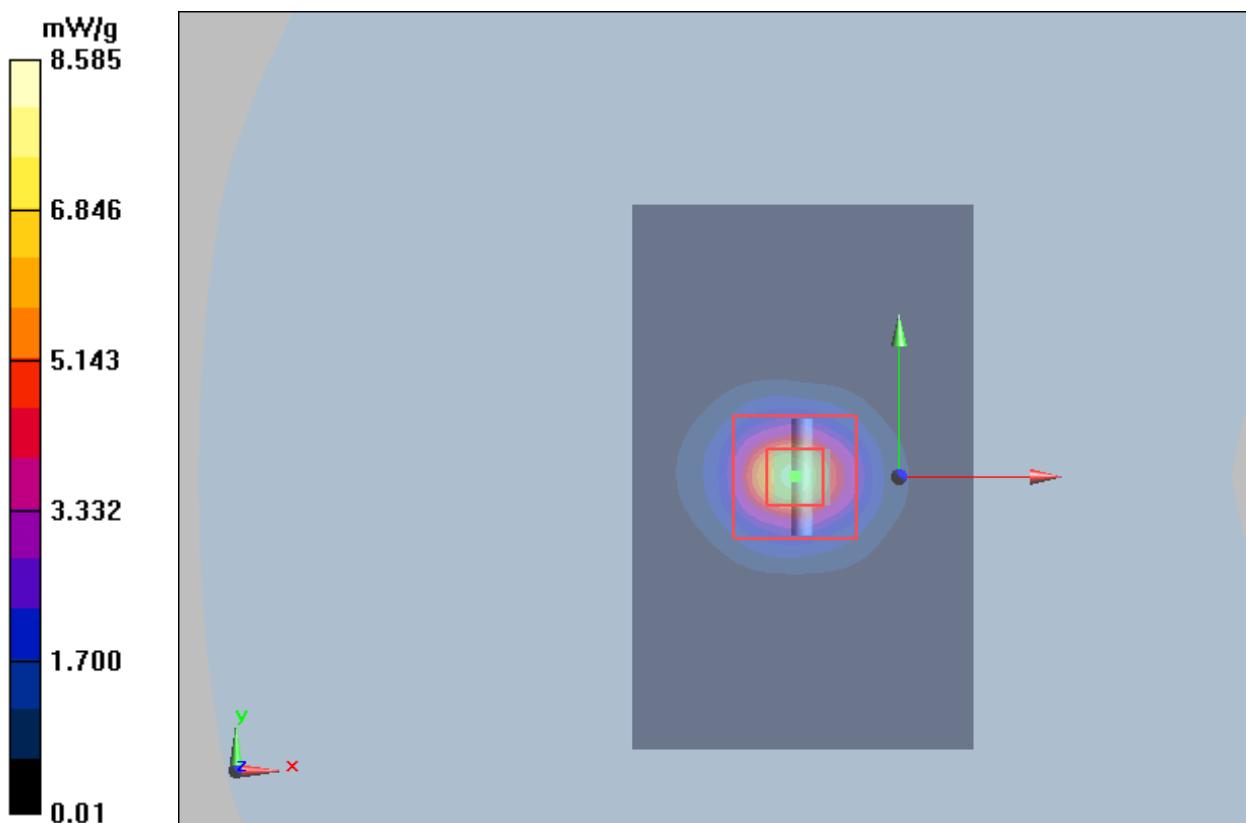
d=10mm, Pin=250mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

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

Peak SAR (extrapolated) = 22.6 W/kg

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

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



Plot 5 System Performance Check at 5750 MHz Head TSL

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

Date: 10/31/2018

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

Medium parameters used: $f = 5750$ MHz; $\sigma = 5.21$ mho/m; $\epsilon_r = 34.9$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.99, 4.99, 4.99); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

d=10mm, Pin=100mW/Area Scan (61x101x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (interpolated) = 8.31 mW/g

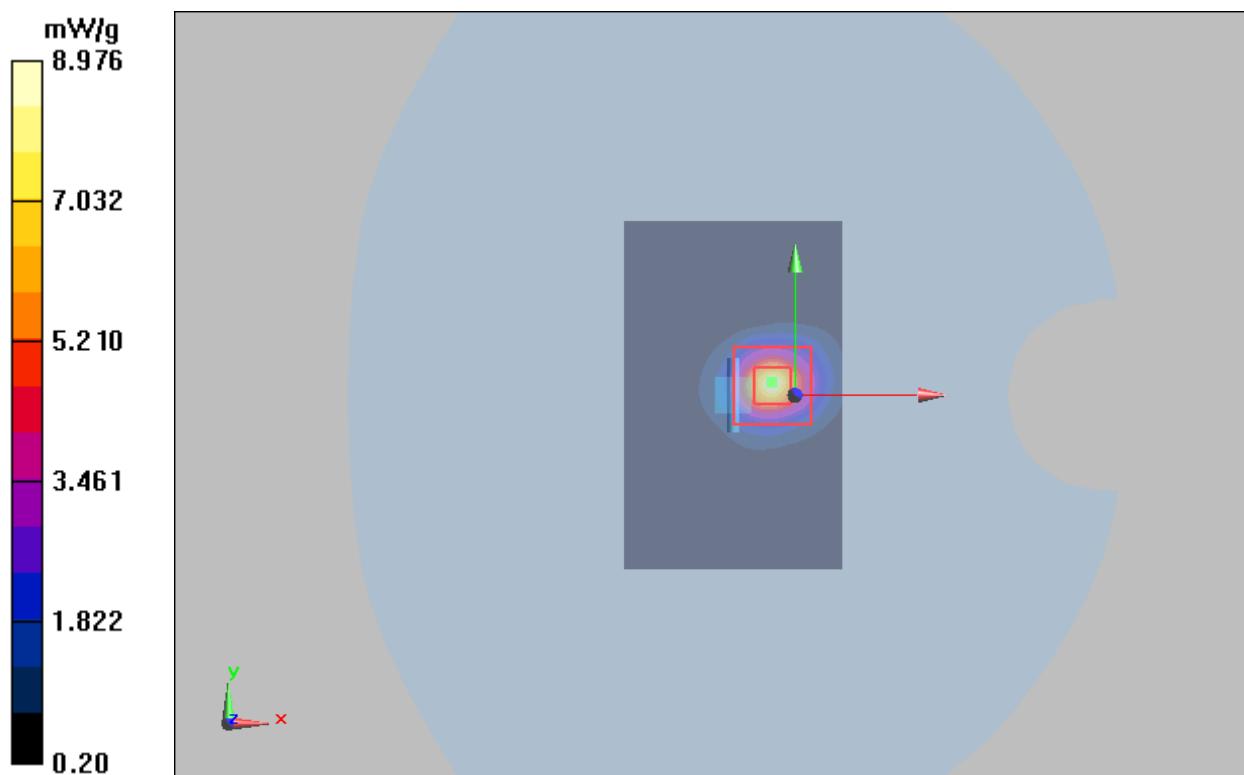
d=10mm, Pin=100mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 23.1 V/m; Power Drift = 0.044 dB

Peak SAR (extrapolated) = 23.4 W/kg

SAR(1 g) = 7.66 mW/g; SAR(10 g) = 2.27 mW/g

Maximum value of SAR (measured) = 8.976 mW/g



Plot 6 System Performance Check at 5750 MHz Body TSL

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

Date: 10/31/2018

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

Medium parameters used: $f = 5750$ MHz; $\sigma = 6.14$ mho/m; $\epsilon_r = 47.6$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.43, 4.43, 4.43); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

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

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

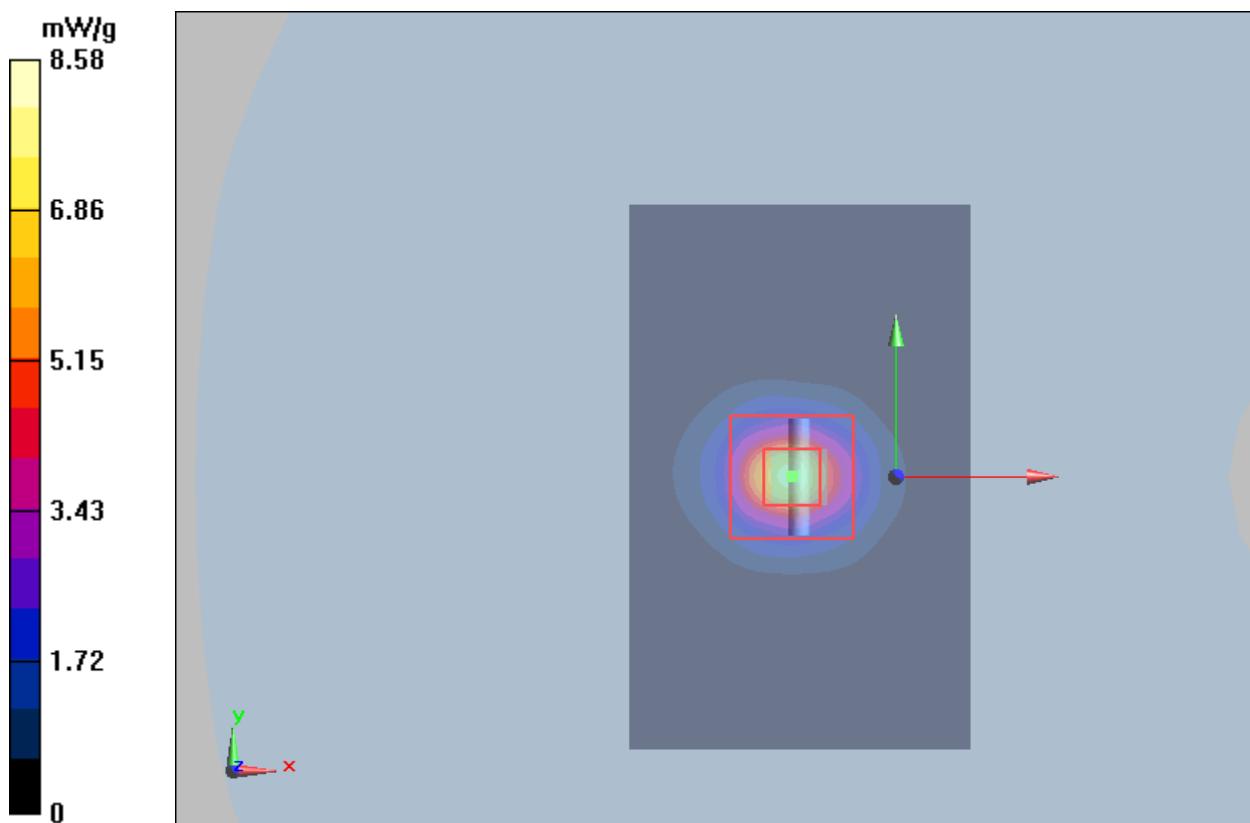
d=10mm, Pin=250mW/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

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

Peak SAR (extrapolated) = 22.6 W/kg

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

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



ANNEX C: Highest Graph Results

Plot 7 802.11ac VHT80 U-NII-2A Left Cheek CH58

Date: 10/30/2018

Communication System: UID 0, 802.11ac HT80M (0); Frequency: 5290 MHz; Duty Cycle: 1:1.111

Medium parameters used: $f = 5290$ MHz; $\sigma = 4.838$ S/m; $\epsilon_r = 36.795$; $\rho = 1000$ kg/m³

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

Phantom section: Left Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(5.60, 5.60, 5.60); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

Left Cheek CH58/Area Scan (111x181x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.789 W/kg

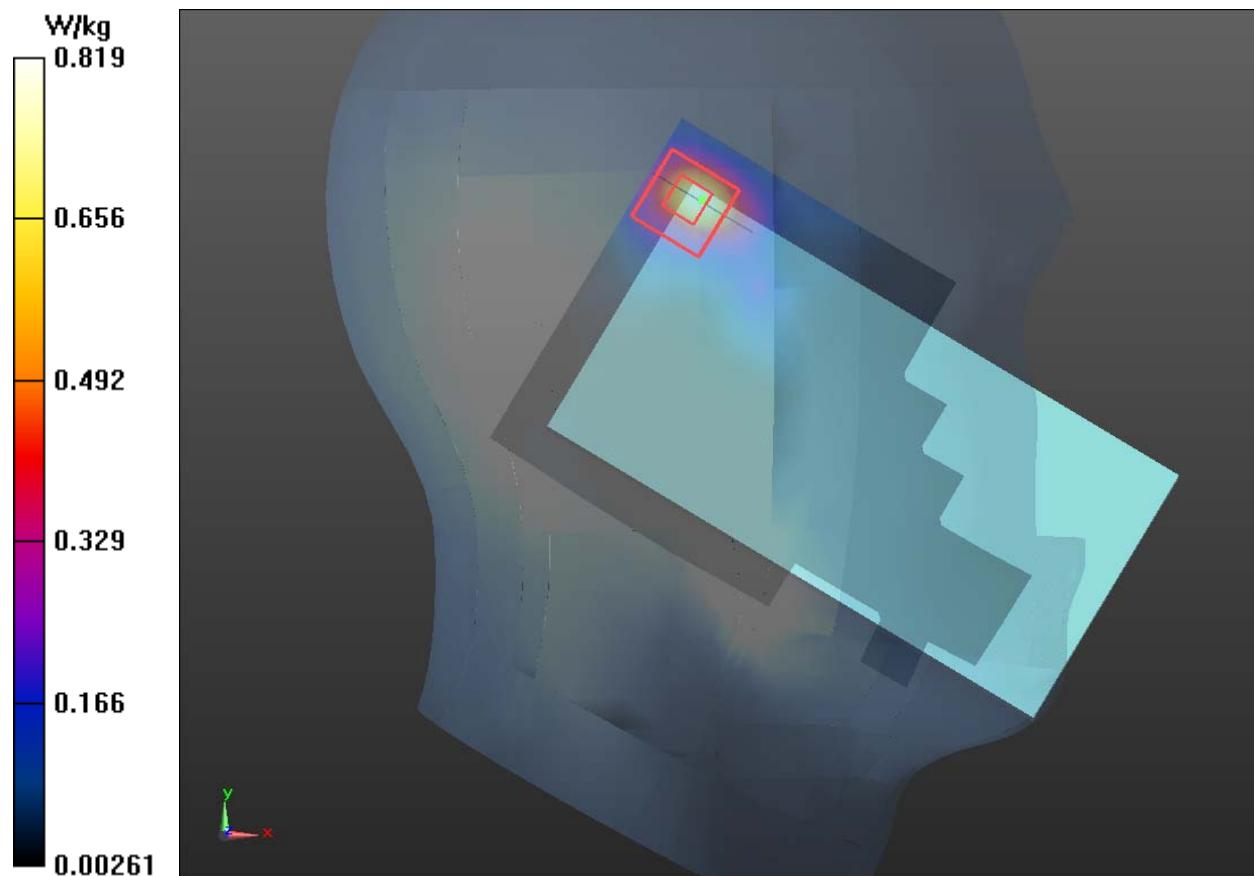
Left Cheek CH58/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 2.289 V/m; Power Drift = 0.136 dB

Peak SAR (extrapolated) = 1.99 W/kg

SAR(1 g) = 0.700 W/kg; SAR(10 g) = 0.247 W/kg

Maximum value of SAR (measured) = 0.819 W/kg



Plot 8 802.11ac VHT80 U-NII-2A Right Edge CH58 (Distance 10mm)

Date: 10/30/2018

Communication System: UID 0, 802.11ac HT80M (0); Frequency: 5530 MHz; Duty Cycle: 1:1.111

Medium parameters used: $f = 5530$ MHz; $\sigma = 5.85$ S/m; $\epsilon_r = 48.371$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(5.04, 5.04, 5.04); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

Right Edge CH58/Area Scan (51x181x1): Interpolated grid: dx=10mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.558 W/kg

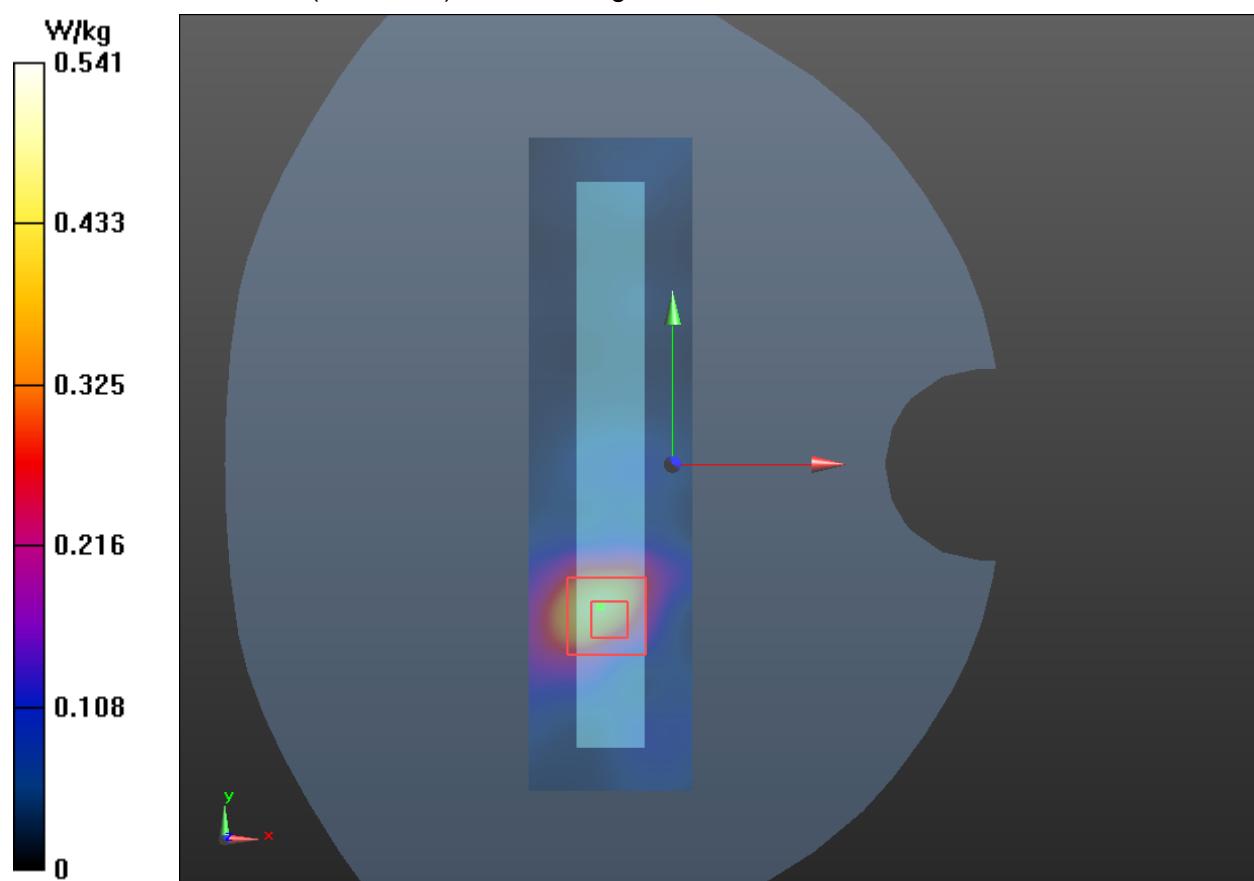
Right Edge CH58/Zoom Scan(7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 3.953 V/m; Power Drift = -0.041 dB

Peak SAR (extrapolated) = 2.34 W/kg

SAR(1 g) = 0.516 W/kg; SAR(10 g) = 0.298 W/kg

Maximum value of SAR (measured) = 0.541 W/kg



Plot 9 802.11ac VHT80 U-NII-2A Right Edge CH58 (Distance 0mm)

Date: 10/30/2018

Communication System: UID 0, 802.11ac HT80M (0); Frequency: 5290 MHz; Duty Cycle: 1:1.111

Medium parameters used: $f = 5290$ MHz; $\sigma = 5.461$ S/m; $\epsilon_r = 49.071$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(5.04, 5.04, 5.04); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

Right Edge CH58/Area Scan (51x181x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.798 W/kg

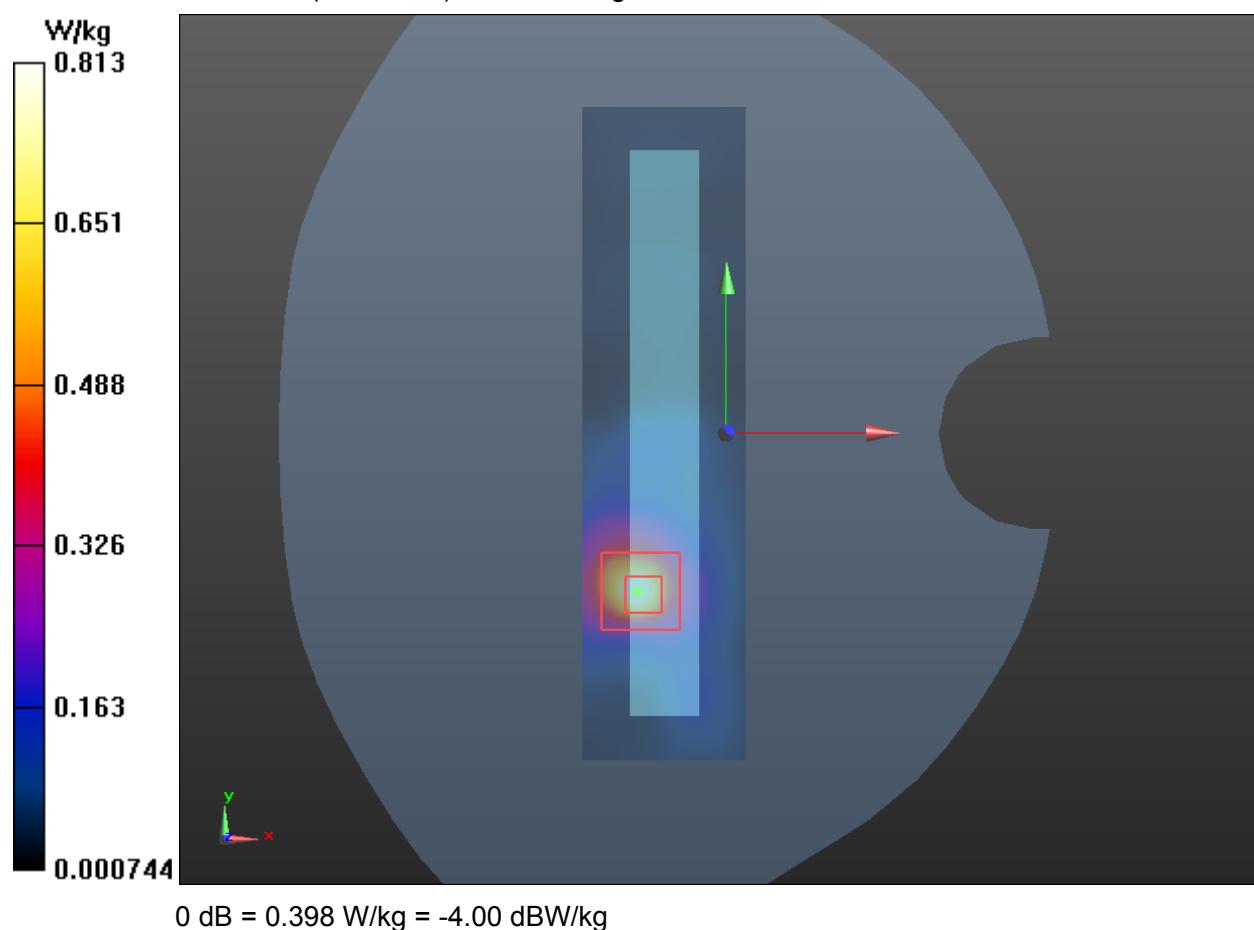
Right Edge CH58/Zoom Scan(7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 4.395 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 2.93 W/kg

SAR(1 g) = 0.616 W/kg; SAR(10 g) = 0.397 W/kg

Maximum value of SAR (measured) = 0.813 W/kg



Plot 10 802.11ac VHT80 U-NII-2C Left Cheek CH106

Date: 10/31/2018

Communication System: UID 0, 802.11ac HT80M (0); Frequency: 5530 MHz; Duty Cycle: 1:1.111

Medium parameters used: $f = 5530$ MHz; $\sigma = 5.156$ S/m; $\epsilon_r = 36.179$; $\rho = 1000$ kg/m³

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

Phantom section: Left Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.87, 4.87, 4.87); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

Left Cheek CH106/Area Scan (111x181x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.721 W/kg

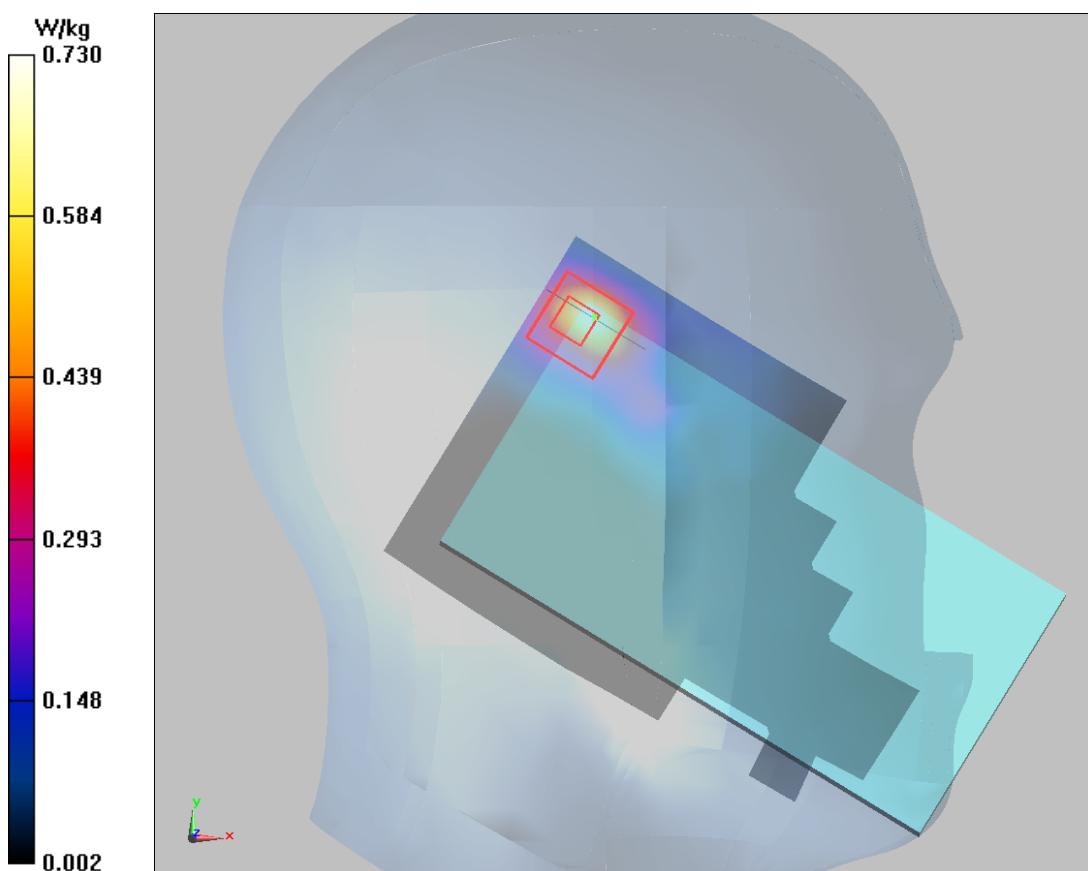
Left Cheek CH106/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.984 V/m; Power Drift = -0.025 dB

Peak SAR (extrapolated) = 1.950 W/kg

SAR(1 g) = 0.697 W/kg; SAR(10 g) = 0.241 W/kg

Maximum value of SAR (measured) = 0.730 W/kg



Plot 11 802.11ac VHT80 U-NII-2C Right Edge CH106 (Distance 10mm)

Date: 10/30/2018

Communication System: UID 0, 802.11ac HT80M (0); Frequency: 5530 MHz; Duty Cycle: 1:1.111

Medium parameters used: $f = 5530$ MHz; $\sigma = 5.85$ S/m; $\epsilon_r = 48.371$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.27, 4.27, 4.27); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

Right Edge CH106/Area Scan (51x181x1): Interpolated grid: dx=10 mm, dy=10mm

Maximum value of SAR (interpolated) = 0.481 W/kg

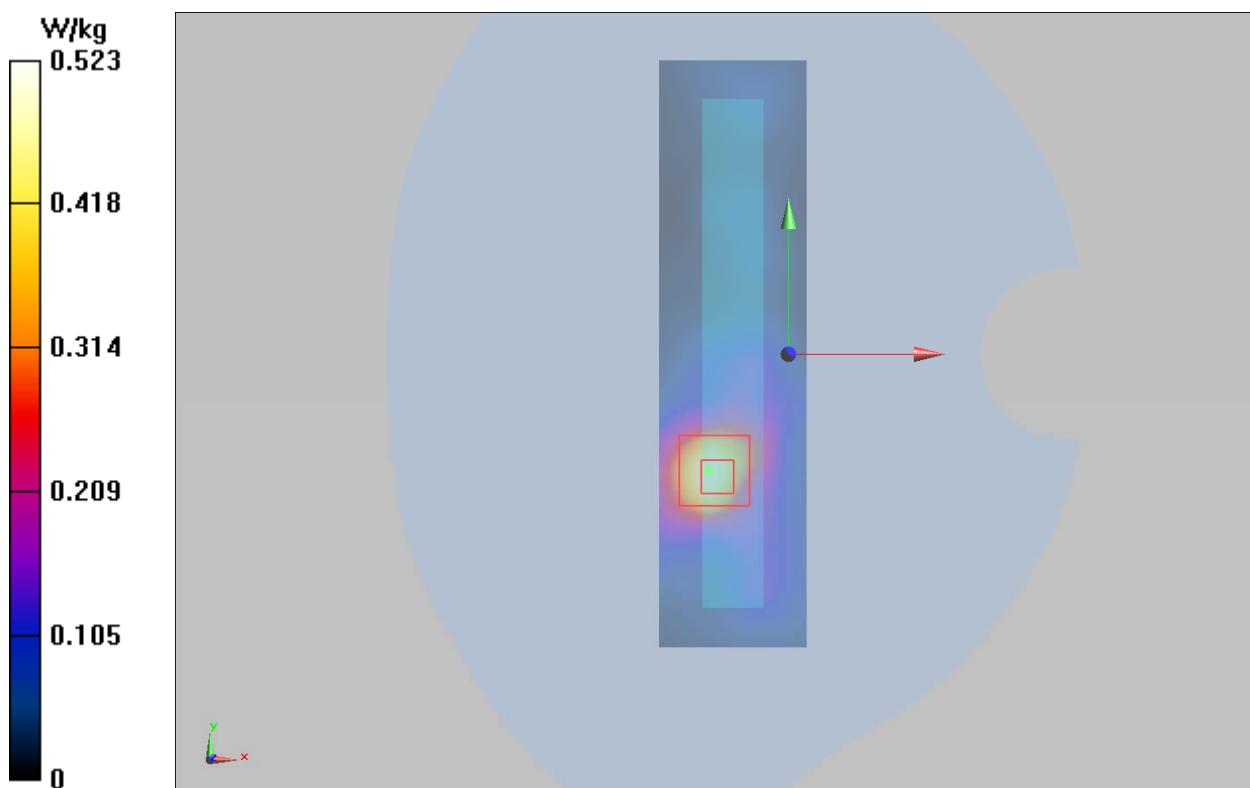
Right Edge CH106/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 4.689 V/m; Power Drift = 0.07 dB

Peak SAR (extrapolated) = 3.44 W/kg

SAR(1 g) = 0.662 W/kg; SAR(10 g) = 0.236 W/kg

Maximum value of SAR (measured) = 0.523 W/kg



Plot 12 802.11ac VHT80 U-NII-2C Back Side CH106 (Distance 0mm)

Date: 10/30/2018

Communication System: UID 0, 802.11ac HT80M (0); Frequency: 5530 MHz; Duty Cycle: 1:1.111

Medium parameters used: $f = 5530$ MHz; $\sigma = 5.85$ S/m; $\epsilon_r = 48.371$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.27, 4.27, 4.27); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

Back Side CH106/Area Scan (111x181x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 4.50 W/kg

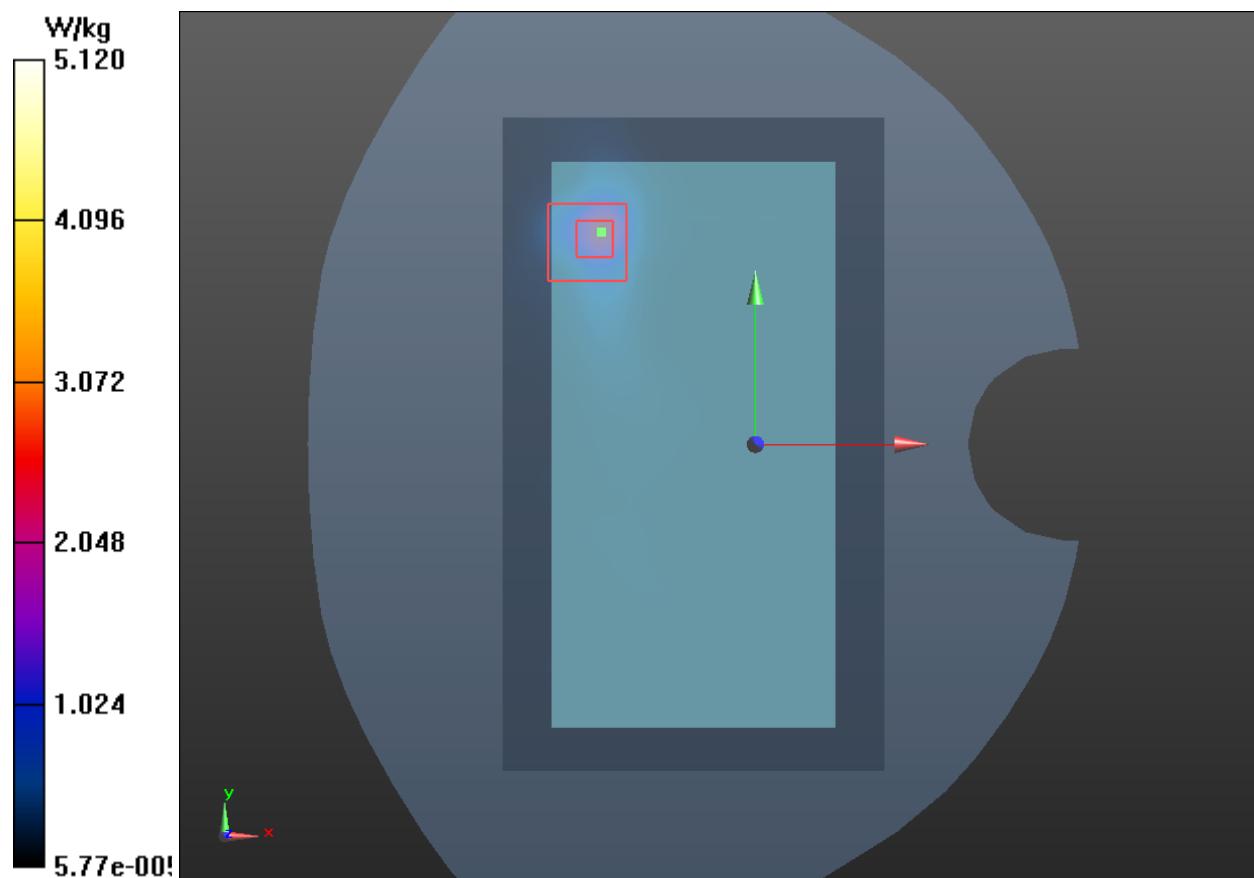
Back Side CH106/Zoom Scan(7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.915 V/m; Power Drift = 0.023 dB

Peak SAR (extrapolated) = 10.1 W/kg

SAR(1 g) = 3.280 W/kg; SAR(10 g) = 0.816 W/kg

Maximum value of SAR (measured) = 5.120 W/kg



Plot 13 802.11ac VHT80 U-NII-3 Left Cheek CH155

Date: 10/31/2018

Communication System: UID 0, 802.11ac HT80M (0); Frequency: 5775 MHz; Duty Cycle: 1:1.111

Medium parameters used: $f = 5775$ MHz; $\sigma = 5.481$ S/m; $\epsilon_r = 35.526$; $\rho = 1000$ kg/m³

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

Phantom section: Left Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.99, 4.99, 4.99); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

Left Cheek CH155/Area Scan (111x181x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.436 W/kg

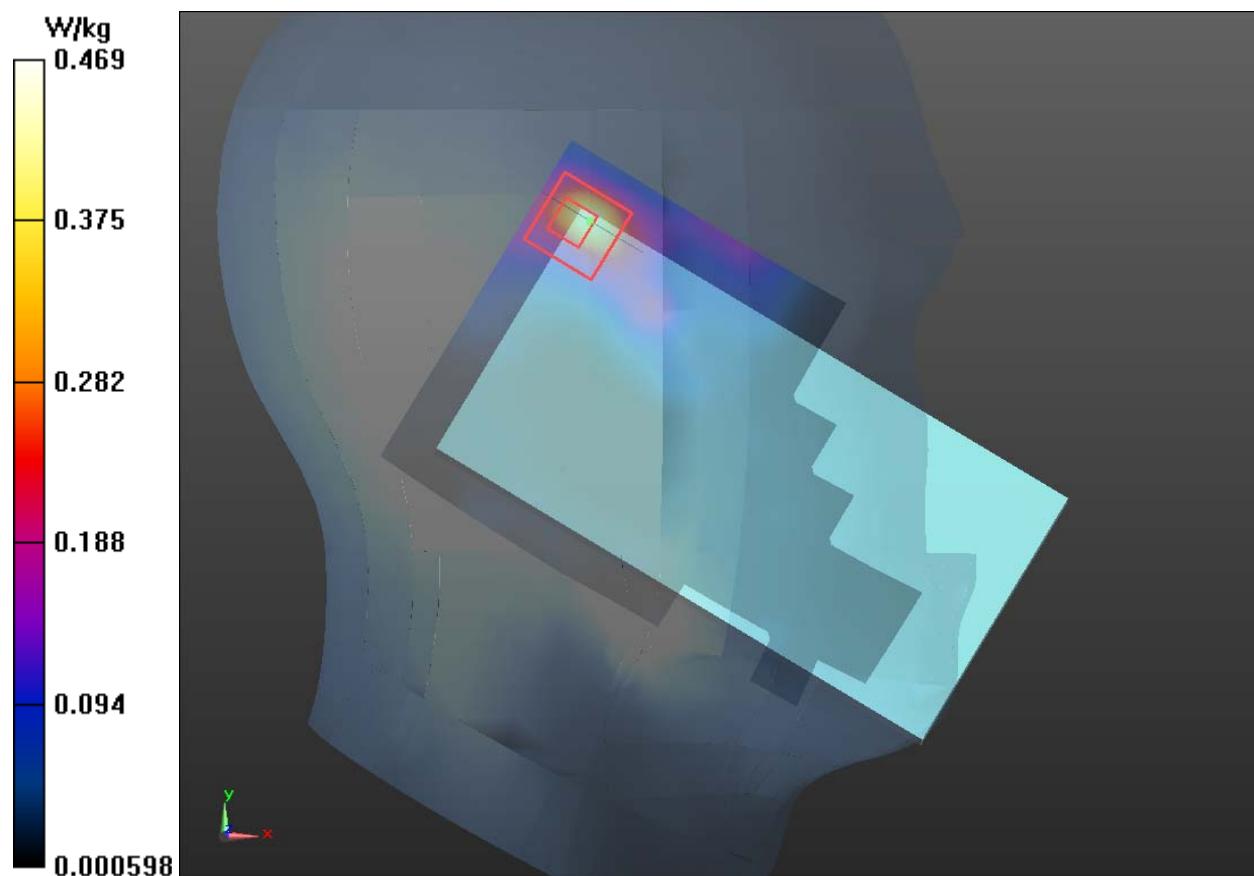
Left Cheek CH155/Zoom Scan(7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 0.9590 V/m; Power Drift = 0.086 dB

Peak SAR (extrapolated) = 1.25 W/kg

SAR(1 g) = 0.420 W/kg; SAR(10 g) = 0.154 W/kg

Maximum value of SAR (measured) = 0.469 W/kg



Plot 14 802.11ac VHT80 U-NII-3 Right Edge CH155 (Distance 10mm)

Date: 10/31/2018

Communication System: UID 0, 802.11ac HT80M (0); Frequency: 5775 MHz; Duty Cycle: 1:1.111

Medium parameters used: $f = 5775$ MHz; $\sigma = 6.244$ S/m; $\epsilon_r = 47.749$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.43, 4.43, 4.43); Calibrated: 5/29/2018;

Electronics: DAE4 SN1317; Calibrated: 3/23/2018

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

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

Right Edge CH155/Area Scan (51x181x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 0.844 W/kg

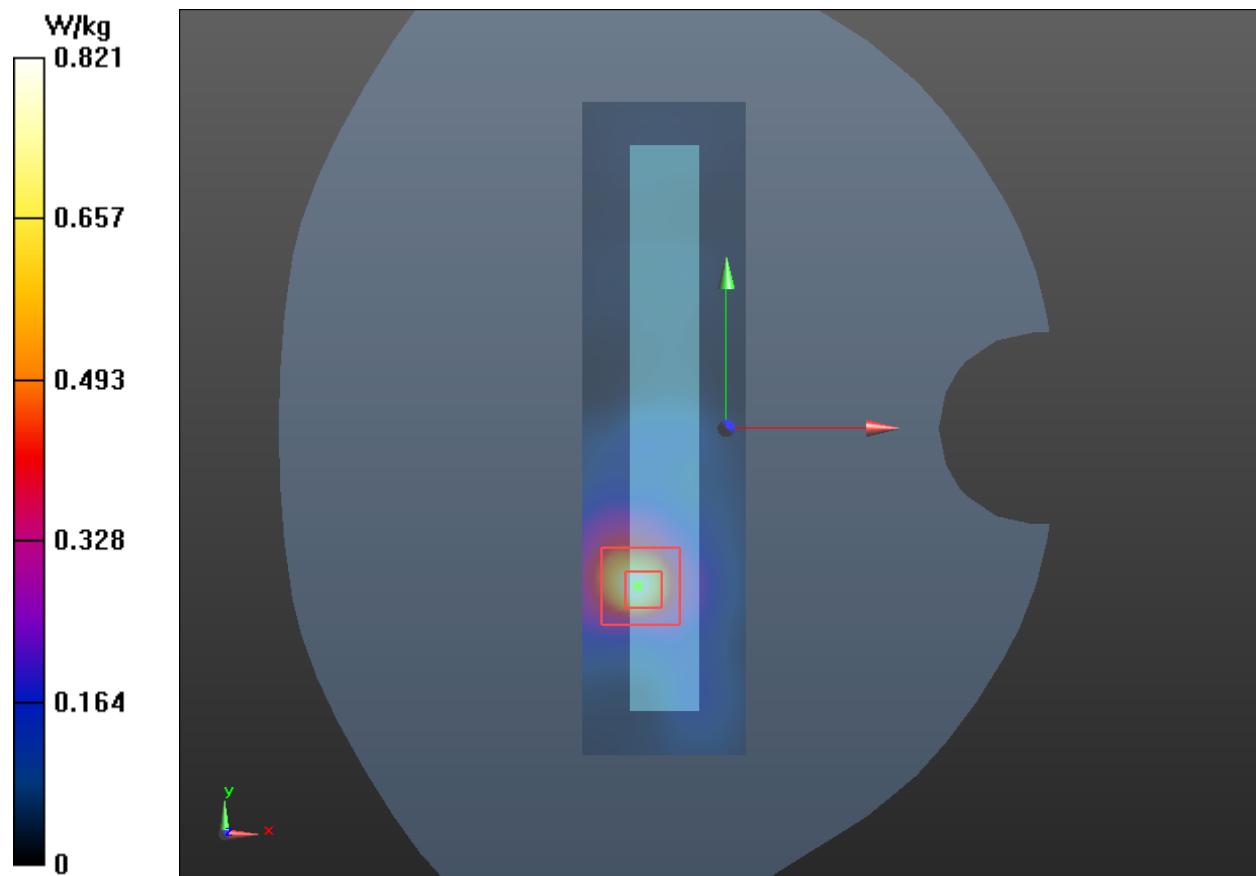
Right Edge CH155/Zoom Scan(7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 4.517 V/m; Power Drift = 0.024 dB

Peak SAR (extrapolated) = 2.10 W/kg

SAR(1 g) = 0.703 W/kg; SAR(10 g) = 0.260 W/kg

Maximum value of SAR (measured) = 0.821 W/kg



Plot 15 802.11ac VHT80 U-NII-3 Back Side CH155 (Distance 0mm)

Date: 10/31/2018

Communication System: UID 0, 802.11ac HT80M (0); Frequency: 5775 MHz; Duty Cycle: 1:1.111

Medium parameters used: $f = 5775$ MHz; $\sigma = 6.244$ S/m; $\epsilon_r = 47.749$; $\rho = 1000$ kg/m³

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

Phantom section: Flat Section

DASY5 Configuration:

Sensor-Surface: 1.4mm (Mechanical Surface Detection)

Probe: EX3DV4 - SN3677; ConvF(4.43, 4.43, 4.43) @ 5775 MHz; Calibrated: 2018/5/29

Electronics: DAE4 Sn1317; Calibrated: 2018/3/23

Phantom: SAM 2; Type: SAM

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

Back Side CH155/Area Scan (111x181x1): Interpolated grid: dx=10 mm, dy=10 mm

Maximum value of SAR (interpolated) = 1.69 W/kg

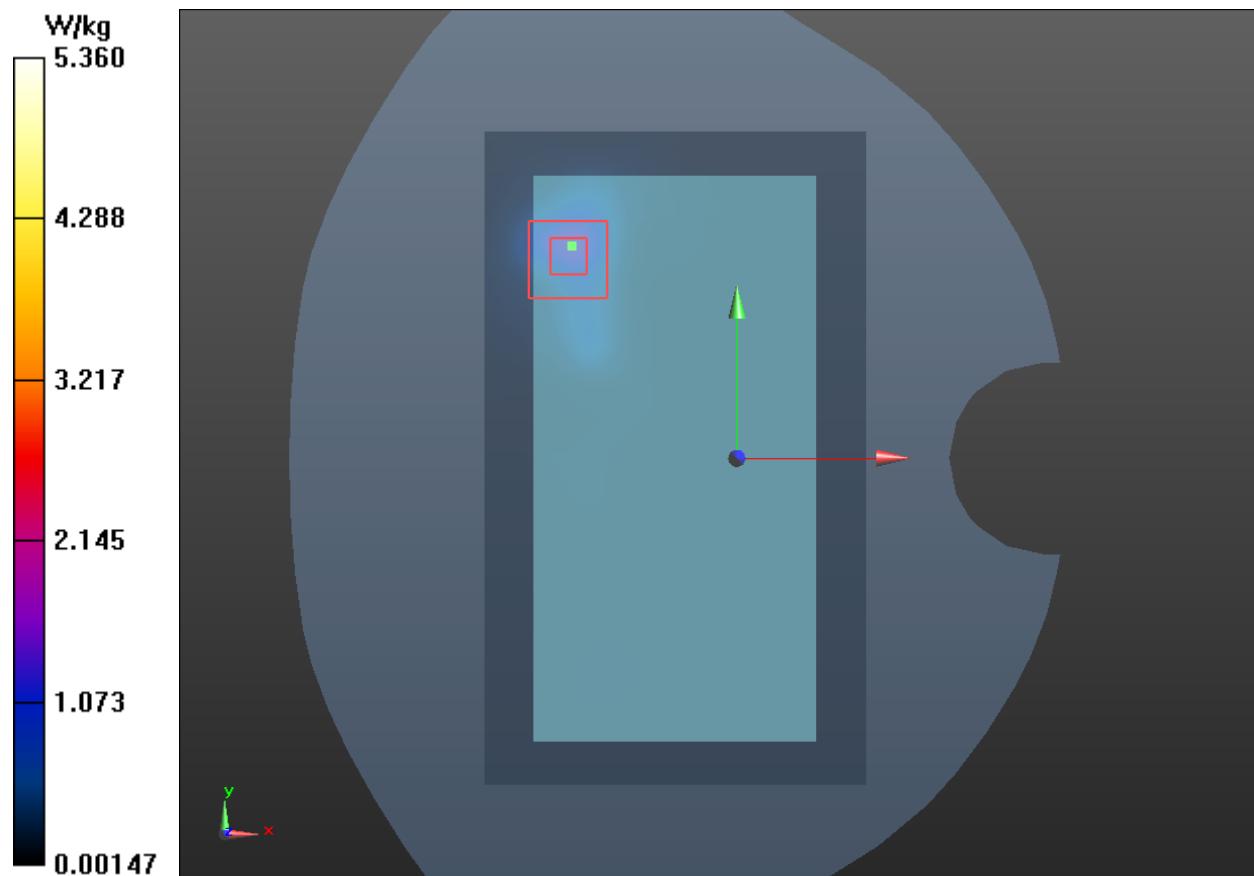
Back Side CH155/Zoom Scan(7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm

Reference Value = 1.499 V/m; Power Drift = 0.025 dB

Peak SAR (extrapolated) = 10.6 W/kg

SAR(1 g) = 3.35 W/kg; SAR(10 g) = 0.820 W/kg

Maximum value of SAR (measured) = 5.36 W/kg





ANNEX D: Probe Calibration Certificate



In Collaboration with
S p e a g
CALIBRATION LABORATORY

Add: No.51 Xucyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: ctll@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)



中国认可
国际互认
校准
CALIBRATION
CNAS L0570

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

Calibrated by:	Name	Function	Signature
	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.



Add: No.51 Xucyuan Road, Haidian District, Beijing, 100191, China
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E-mail: cttl@chinattl.com <http://www.chinattl.cn>

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), $\theta=0$ is normal to probe axis

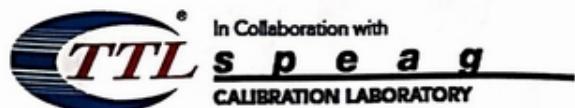
Connector Angle information used in DASY system to align probe sensor X to the robot coordinate system

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 $\theta=0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ 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.
- $Ax,y,z; Bx,y,z; Cx,y,z; VRx,y,z; A,B,C$ 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 $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to $NORM_{x,y,z} * ConvF$ whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle*: The angle is assessed using the information gained by determining the $NORM_x$ (no uncertainty required).



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Probe EX3DV4

SN: 3677

Calibrated: May 29, 2018

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(μ V/(V/m) ²) ^A	0.41	0.46	0.41	\pm 10.0%
DCP(mV) ^B	99.9	102.7	102.1	

Modulation Calibration Parameters

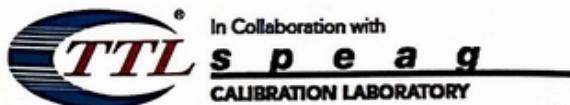
UID	Communication System Name		A dB	B dB/ μ V	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	152.4	\pm 2.4%
		Y	0.0	0.0	1.0		161.7	
		Z	0.0	0.0	1.0		152.2	

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.

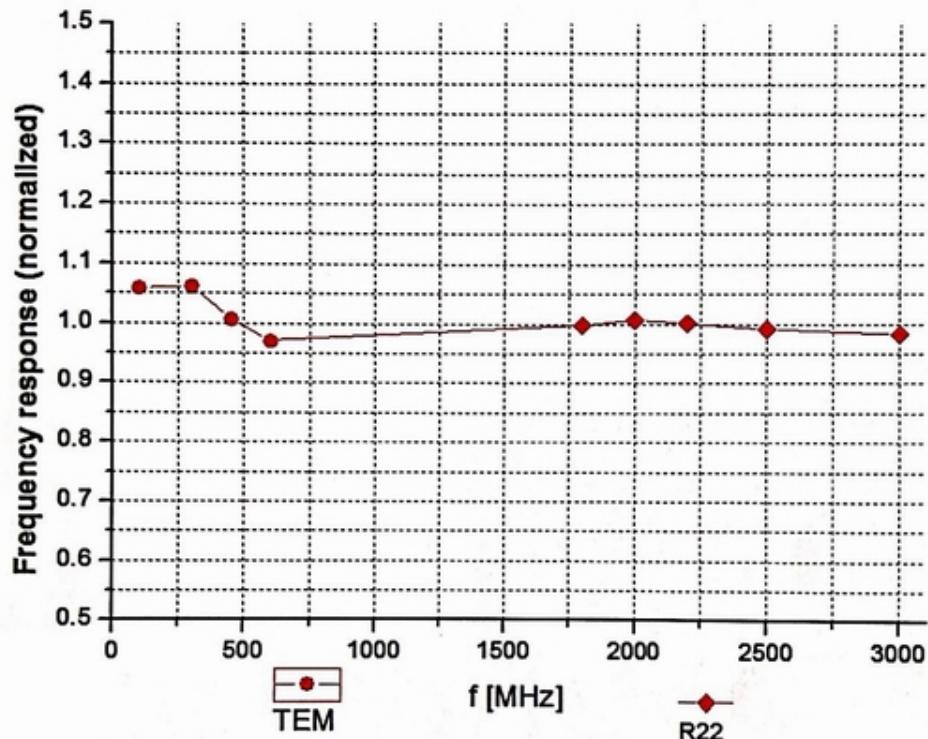
^f At frequency below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty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



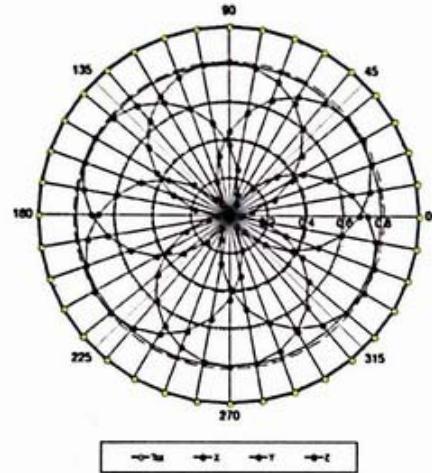
Uncertainty of Frequency Response of E-field: $\pm 7.4\%$ (k=2)



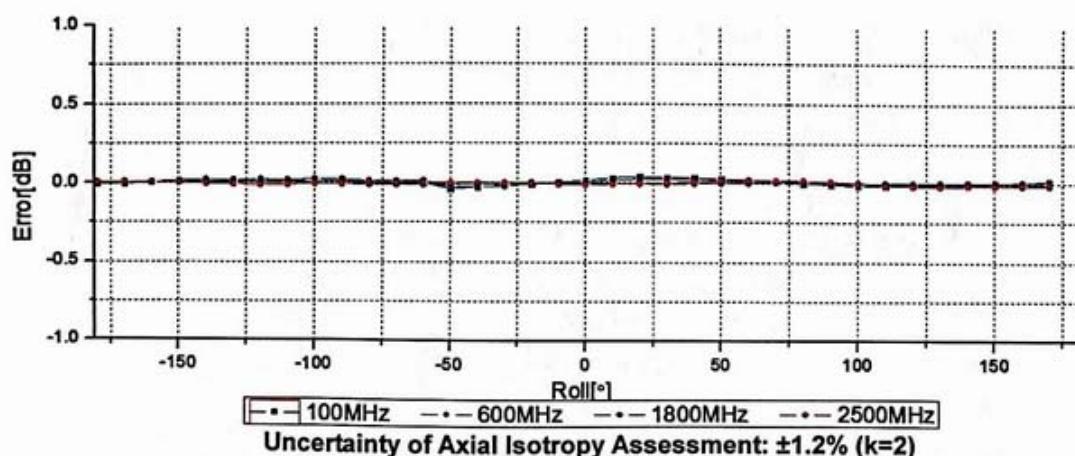
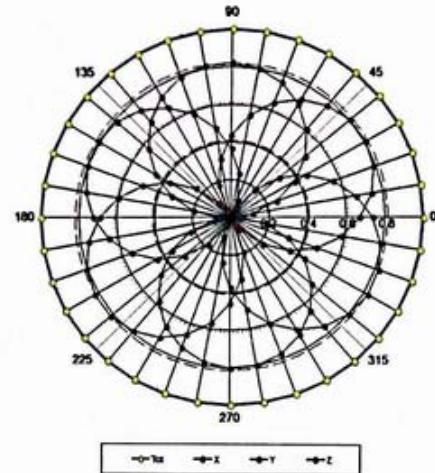
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Receiving Pattern (Φ), $\theta=0^\circ$

f=600 MHz, TEM



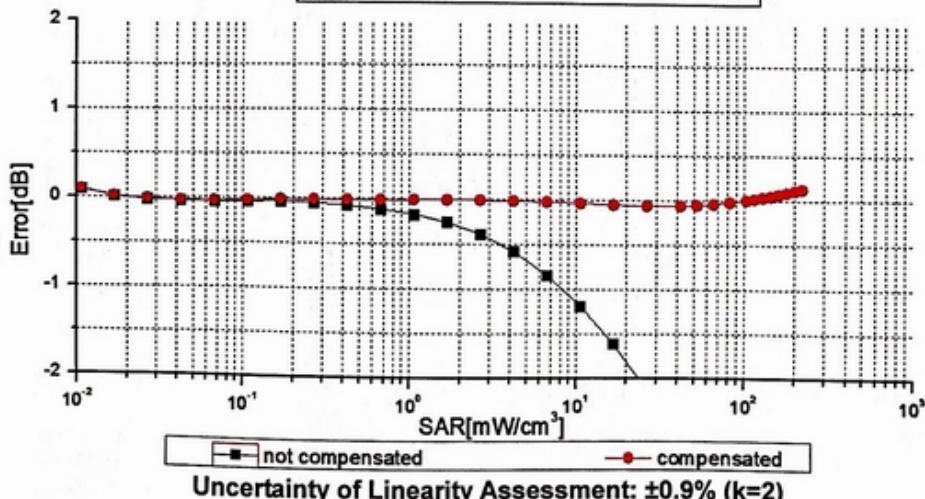
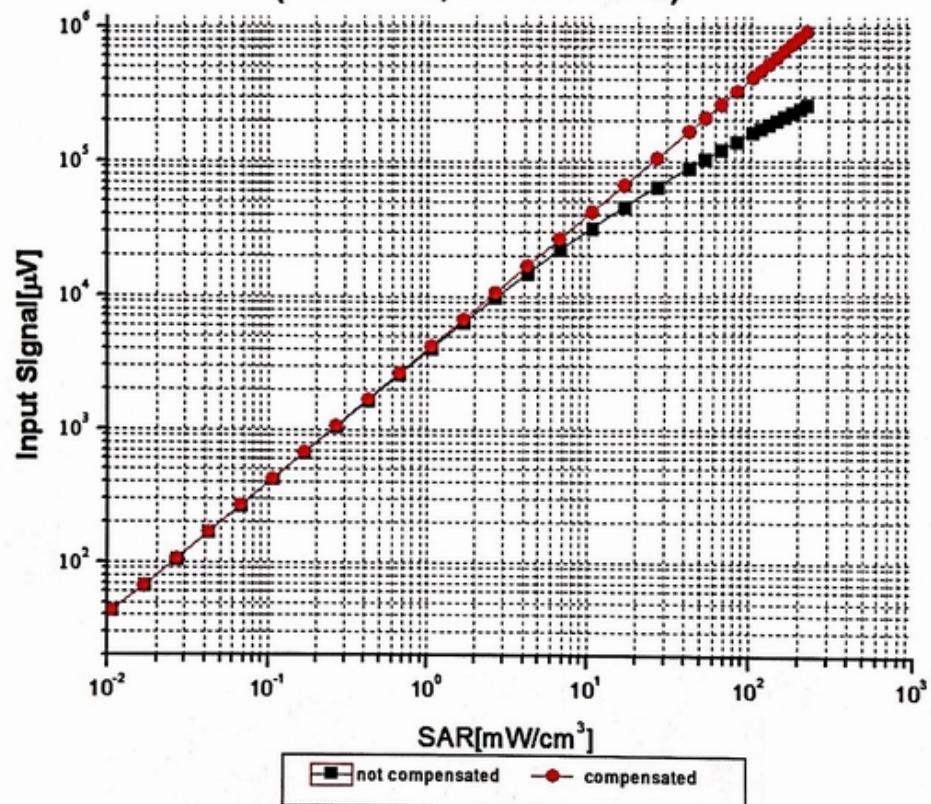
f=1800 MHz, R22





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



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

Certificate No: Z18-60093

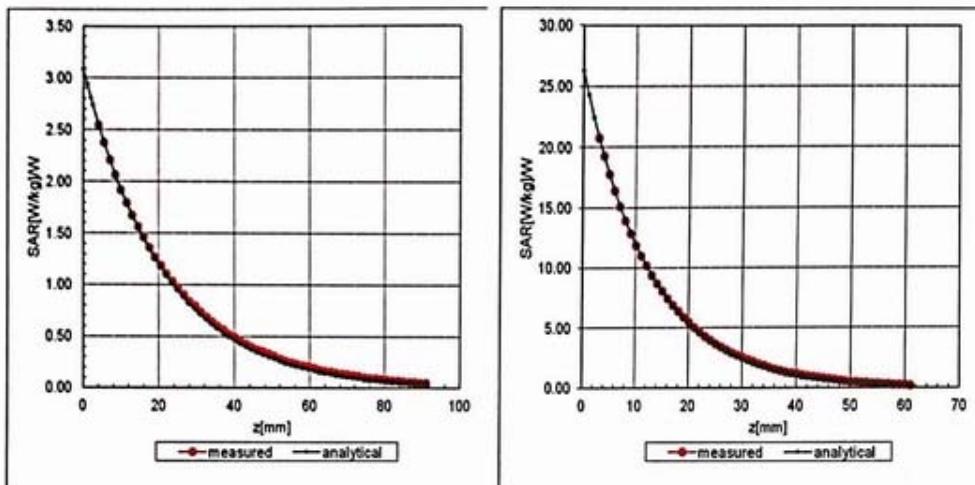
Page 9 of 11



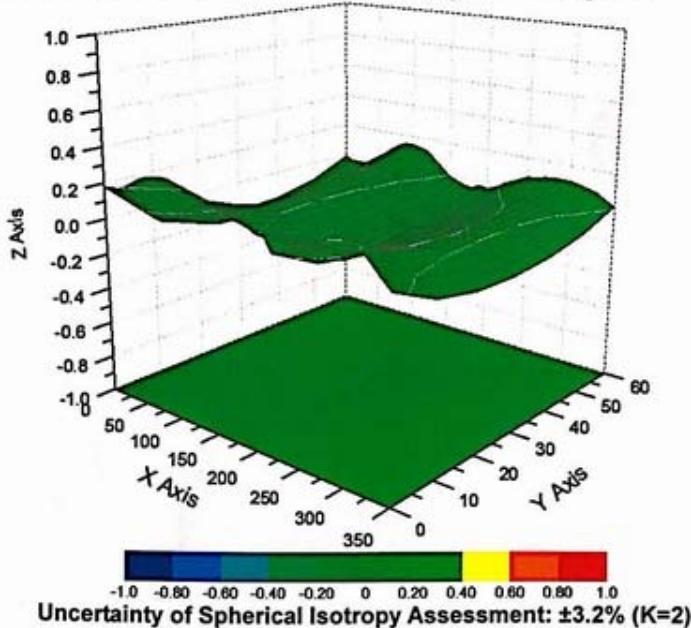
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Conversion Factor Assessment

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



Deviation from Isotropy in Liquid





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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



ANNEX E: D5GHzV2 Dipole Calibration Certificate



In Collaboration with
s p e a g
CALIBRATION LABORATORY

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CALIBRATION
CNAS L0570

Client

TA(Shanghai)

Certificate No: Z17-97001

CALIBRATION CERTIFICATE

Object D5GHzV2 - SN: 1151

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

Calibration date: January 5, 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)°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-16 (CTTL, No.J16X04777)	Jun-17
Power sensor NRP-Z91	101547	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
ReferenceProbe EX3DV4	SN 7433	26-Sep-16(SPEAG, No.EX3-7433_Sep16)	Sep-17
DAE4	SN 771	02-Feb-16(CTTL-SPEAG, No.Z16-97011)	Feb-17
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	01-Feb-16 (CTTL, No.J16X00893)	Jan-17
NetworkAnalyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan-17

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

Issued: January 7, 2017

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