

## SAR TEST REPORT

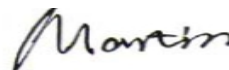
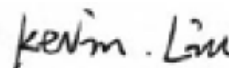
**Report Reference No.**..... : **MWR161000111**  
**FCC ID**..... : **RQQHLT-L55UTM**

Compiled by  
 ( position+printed name+signature)..: File administrators Martin Ao

Supervised by  
 ( position+printed name+signature)..: Test Engineer Kevin Liu

Approved by  
 ( position+printed name+signature)..: Manager Dixon Hao

Date of issue.....: October 24, 2016


**Representative Laboratory Name** : **Maxwell International Co., Ltd.**

Address.....: Room 509, Hongfa center building, Baoan District, Shenzhen, Guangdong, China

**Testing Laboratory Name** .....: **Shenzhen Sunway Communication Co., Ltd. Testing Center**

Address.....: 1/F., Building A, SDG Info Port, Kefeng Road, Hi-Tech Park, Nanshan District, Shenzhen, Guangdong, China

**Applicant's name** .....: **HYUNDAI CORPORATION**

Address.....: 140-2, Kye-dong, Chongro-ku, Seoul, South Korea

**Test specification** ..... :

Standard .....: **ANSI C95.1-1999**  
**47CFR §2.1093**

TRF Originator.....: **Maxwell International Co., Ltd.**

**Test item description** .....: Mobile Phone

Trade Mark .....: HYUNDAI

**Manufacturer**.....: **Shenzhen Rainbow Time Technology Co.,Ltd**

Model/Type reference.....: TITAN LTE

Listed Models .....: /

Operation Frequency..... GSM 850/PCS1900,WCDMA Band V/Band II,  
 LTE Band 2/4/7/17, WLAN2.4G, Bluetooth

Modulation Type ..... GSM(GMSK),WCDMA/HSDPA/HSUPA(QPSK),  
 LTE(QPSK,16QAM),WIFI(DSSS,OFDM),Bluetooth(GFSK,8DPSK,  
 π/4DQPSK),

Hardware version .....: 5101SP\_S52

Software version .....: V1.0

Rating .....: DC 3.70V

Result.....: **PASS**

**TEST REPORT**

<b>Test Report No. :</b>	<b>MWR161000111</b>	October 24, 2016
		Date of issue

Equipment under Test : Mobile Phone

Model /Type : TITAN LTE

Listed Models : /

**Applicant** : **HYUNDAI CORPORATION**

Address : 140-2, Kye-dong, Chongro-ku, Seoul, South Korea

**Manufacturer** : **Shenzhen Rainbow Time Technology Co.,Ltd**

Address : Room 905, ChangHong Technology Building, Science and Technology Park, Nanshan District, Shenzhen, China

<b>Test Result:</b>	<b>PASS</b>
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The test report merely corresponds to the test sample.

It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

**Revision History**

Revision	Issue Date	Revisions	Revised By
V1.0	2016-10-24	Initial Issue	Dixon Hao

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## 1. TEST STANDARDS

The tests were performed according to following standards:

[IEEE Std C95.1, 1999](#): IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 KHz to 300 GHz. It specifies the maximum exposure limit of 1.6 W/kg as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

[IEEE Std 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.

[FCC Part 2.1093 Radiofrequency Radiation Exposure Evaluation](#): Portable Devices

[KDB447498 D01 General RF Exposure Guidance v06](#) : Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies

[KDB648474 D04, Handset SAR v01r03](#): SAR Evaluation Considerations for Wireless Handsets

[KDB865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04](#) : SAR Measurement Requirements for 100 MHz to 6 GHz

[KDB865664 D02 RF Exposure Reporting v01r02](#): RF Exposure Compliance Reporting and Documentation Considerations

[KDB248227 D01 802.11 Wi-Fi SAR v02r02](#): SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS

[KDB941225 D01 3G SAR Procedures v03r01](#): 3G SAR MEASUREMENT PROCEDURES

[KDB 941225 D06 Hotspot Mode v02r01](#): SAR EVALUATION PROCEDURES FOR PORTABLE DEVICES WITH WIRELESS ROUTER CAPABILITIES

[KDB 941225 D05 SAR for LTE Devices v02r05](#): SAR EVALUATION CONSIDERATIONS FOR LTE DEVICES

## 2. SUMMARY

### 2.1. General Remarks

Date of receipt of test sample	:	October 15, 2016
Testing commenced on	:	October 16, 2016
Testing concluded on	:	October 22, 2016

### 2.2. Product Description

The **HYUNDAI CORPORATION's** Model: TITAN LTE or the "EUT" as referred to in this report; more general information as follows, for more details, refer to the user's manual of the EUT.

General Description	
Name of EUT	Mobile Phone
Model Number	TITAN LTE
Modulation Type	GMSK for GSM/GPRS; 8PSK for EDGE only downlink; QPSK for WCDMA; QPSK/16QAM for LTE; DSSS/OFDM for WIFI 2.4G; GFSK/8DPSK/π/4DQPSK for Bluetooth
Antenna Type	Internal
Device category	Portable Device
Exposure category	General population/uncontrolled environment
EUT Type	Production Unit
Rated Voltage	DC 3.80 Battery
Hotspot	Supported, power not reduced when Hotspot open
<i>The EUT is a LTE mobile phone. the mobile phone is intended for speech and Multimedia Message Service (MMS) transmission. It is equipped with GPRS/EDGE class 12 for GSM850, PCS1900, WCDMA Band II/V, LTE Band 2/4/7/17 and Bluetooth, WiFi, and camera functions. For more information see the following datasheet</i>	

Technical Characteristics	
2G	
Support Networks	GSM, GPRS, EDGE
Support Band	GSM850/PCS1900
Frequency	GSM850: 824.2~848.8MHz GSM1900: 1850.2~1909.8MHz
Type of Modulation	GMSK, 8PSK (only downlink)
Antenna Type	Internal Antenna
GPRS/EDGE Class	Class 12
GSM Release Version	R99
GPRS operation mode	Class B
DTM Mode	Not Supported
3G	
Support Networks	WCDMA RMC12.2K, HSDPA, HSUPA
Support Band	WCDMA Band II/V
Frequency Range	WCDMA Band V: 826.4~846.6MHz WCDMA Band II: 1852.4~1907.6MHz
Type of Modulation	QPSK
HSDPA UE Category	10
HSUPA UE Category	6
DC-HSDPA	Not Supported
Antenna Type	Internal Antenna
4G	
Support Networks	LTE
Support Band	LTE Band 2/4/7/17
Frequency Range	LTE Band 2: 1850.7~1909.3 MHz LTE Band 4: 1710.7~1754.3 MHz

	LTE Band 7: 2502.5~2567.5 MHz LTE Band 17: 706.5 MHz~713.5 MHz
Type of Modulation	QPSK, 16QAM
LTE Release	R7
Antenna Type	Internal Antenna
WiFi	
Support Standards	IEEE 802.11b, IEEE 802.11g, IEEE 802.11n
Frequency Range	2412-2462MHz for 11b/g/n(HT20) 2422-2452MHz for 11n(HT40)
Type of Modulation	CCK, OFDM, QPSK, BPSK, 16QAM, 64QAM
Data Rate	1-11Mbps, 6-54Mbps, up to 150Mbps
Quantity of Channels	11 for 11b/g/n(HT20), 7 for 11n(HT40)
Channel Separation	5MHz
Antenna Type	Internal Antenna
Bluetooth	
Bluetooth Version	V3.0+EDR/V4.0
Frequency Range	2402-2480MHz
Data Rate	1Mbps, 2Mbps, 3Mbps
Modulation	GFSK, $\pi/4$ QDPSK, 8DPSK
Quantity of Channels	79/40
Channel Separation	1MHz/2MHz
Antenna Type	Internal Antenna

### 2.3. Statement of Compliance

The maximum of results of SAR found during testing are follows:

<Highest Reported standalone SAR Summary>

Classment Class	Frequency Band	Head (Report 1g SAR(W/Kg)	Hotspot (Report 1g SAR(W/Kg)	Body-worn (Report 1g SAR(W/Kg)
PCE	GSM850	<b>0.348</b>	0.652	0.652
	GSM1900	0.119	0.798	0.798
	WCDMA Band V	0.220	0.379	0.379
	WCDMA Band II	0.322	<b>0.982</b>	<b>0.982</b>
	LTE Band 2	0.318	0.557	0.557
	LTE Band 4	0.073	0.329	0.329
	LTE Band 7	0.108	0.830	0.830
	LTE Band 17	0.134	0.323	0.323
DTS	WIFI2.4G	<b>0.127</b>	<b>0.407</b>	<b>0.407</b>

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

<Highest Reported simultaneous SAR Summary>

Exposure Position	Frequency Band	Reported 1-g SAR (W/kg)	Classment Class	Highest Reported Simultaneous Transmission 1-g SAR (W/kg)
Back	WCDMA Band II	0.982	PCE	<b>1.389</b>
	WLAN2.4G	0.407	DTS	



### 3. TEST ENVIRONMENT

#### 3.1. Address of the test laboratory

##### **Shenzhen Sunway Communication Co., Ltd. Testing Center**

1/F., Building A, SDG Info Port, Kefeng Road, Hi-Tech Park, Nanshan District, Shenzhen, Guangdong, China

#### 3.2. Test Facility

The test facility is recognized, certified, or accredited by the following organizations:

##### **CNAS-Lab Code: L6487**

The Shenzhen Sunway Communication Co., Ltd. Testing Center has been assessed and proved to be in compliance with CNAS-CL01 Accreditation Criteria for Testing and Calibration Laboratories (identical to ISO/IEC 17025: 2005 General Requirements) for the Competence of Testing and Calibration Laboratories, Date of Registration: Oct 14, 2016. Valid time is until Oct 15, 2019.

#### 3.3. Environmental conditions

During the measurement the environmental conditions were within the listed ranges:

Temperature:	18-25 ° C
Humidity:	40-65 %
Atmospheric pressure:	950-1050mbar

#### 3.4. SAR Limits

EXPOSURE LIMITS	FCC Limit (1g Tissue)	
	SAR (W/kg)	
	(General Population /Uncontrolled Exposure Environment)	(Occupational /Controlled Exposure Environment)
Spatial Average (averaged over the whole body)	0.08	0.4
Spatial Peak (averaged over any 1 g of tissue)	1.60	8.0
Spatial Peak (hands/wrists/feet/ankles averaged over 10 g)	4.0	20.0

Population/Uncontrolled Environments are defined as locations where there is the exposure of individual who have no knowledge or control of their exposure.

Occupational/Controlled Environments are defined as locations where there is exposure that may be incurred by people who are aware of the potential for exposure (i.e. as a result of employment or occupation).

### 3.5. Equipments Used during the Test

Test Equipment	Manufacturer	Type/Model	Serial Number	Calibration	
				Last Calibration	Calibration Interval
Data Acquisition Electronics DAEx	SPEAG	DAE4	760	2016/06/24	1
E-field Probe	SPEAG	EX3DV4	3836	2016/07/07	1
System Validation Dipole D750V3	SPEAG	D750V3	1133	2015/01/05	3
System Validation Dipole D835V2	SPEAG	D835V2	4d069	2016/07/20	3
System Validation Dipole D1750V2	SPEAG	D1750V2	1021	2016/07/01	3
System Validation Dipole 1900V2	SPEAG	D1900V2	5d194	2015/01/07	3
System Validation Dipole D2450V2	SPEAG	D2450V2	955	2015/01/08	3
System Validation Dipole D2600V2	SPEAG	D2600V2	1012	2016/07/25	3
Network analyzer	Agilent	8753E	US37390562	2016/03/11	1
Wideband Communication Tester	R&S	CMW500	116581	2016/06/18	1
Dielectric Probe Kit	Agilent	85070E	US44020288	/	/
Dual Directional Coupler	Agilent	778D	50127	2016/06/18	1
Dual Directional Coupler	Agilent	772D	50348	2016/06/18	1
Attenuator	PE	PE7005-10	E048	2016/06/18	1
Attenuator	PE	PE7005-3	E049	2016/06/18	1
Attenuator	Woken	WK0602-XX	E050	2016/06/18	1
Power meter	Agilent	E4417A	GB41292254	2016/06/18	1
Power Meter	Agilent	E7356A	GB54762536	2016/06/18	1
Power sensor	Agilent	8481H	MY41095360	2016/06/18	1
Power Sensor	Agilent	E9327A	Us40441788	2016/06/18	1
Signal generator	IFR	2032	203002/100	2016/06/18	1
Amplifier	AR	75A250	302205	2016/06/18	1

Note:

- 1) Per KDB865664D01 requirements for dipole calibration, the test laboratory has adopted three year extended calibration interval. Each measured dipole is expected to evaluate with following criteria at least on annual interval.
  - a) There is no physical damage on the dipole;
  - b) System check with specific dipole is within 10% of calibrated values;
  - c) The most recent return-loss results, measured at least annually, deviates by no more than 20% from the previous measurement;
  - d) The most recent measurement of the real or imaginary parts of the impedance, measured at least annually is within 5Ω from the previous measurement.
- 2) Network analyzer probe calibration against air, distilled water and a shorting block performed before measuring liquid parameters.

## 4. SAR Measurements System configuration

### 4.1. SAR Measurement Set-up

The DASY4 system for performing compliance tests consists of the following items:

A standard high precision 6-axis robot (Stäubli RX family) with controller and software. An arm extension for accommodating the data acquisition electronics (DAE).

A dosimetric probe, i.e. an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.

A data acquisition electronic (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.

A unit to operate the optical surface detector which is connected to the EOC.

The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY4 measurement server.

The DASY4 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2003.

DASY4 software and SEMCAD data evaluation software.

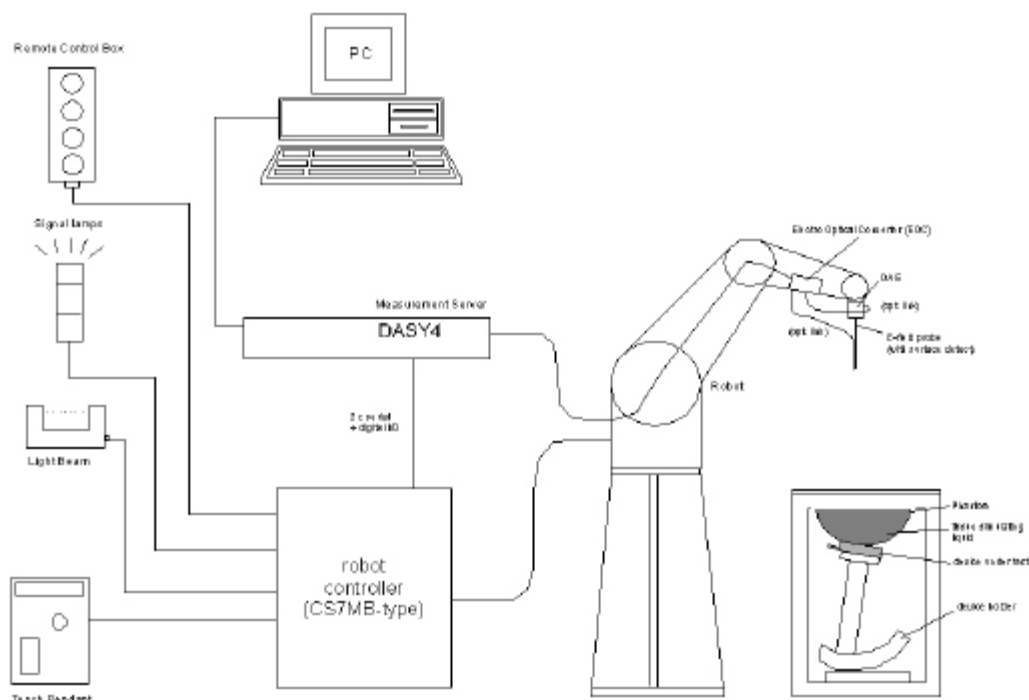
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

The generic twin phantom enabling the testing of left-hand and right-hand usage.

The device holder for handheld mobile phones.

Tissue simulating liquid mixed according to the given recipes.

System validation dipoles allowing to validate the proper functioning of the system.



## 4.2. DASY4 E-field Probe System

The SAR measurements were conducted with the dosimetric probe ES3DV3 (manufactured by SPEAG), designed in the classical triangular configuration and optimized for dosimetric evaluation.

### Probe Specification

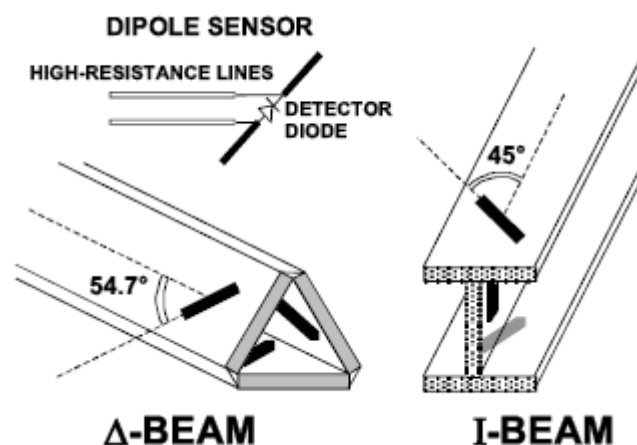
Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	10 MHz to 4 GHz; Linearity: $\pm 0.2$ dB (30 MHz to 4 GHz)
Directivity	$\pm 0.2$ dB in HSL (rotation around probe axis) $\pm 0.3$ dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 $\mu\text{W/g}$ to $> 100$ mW/g; Linearity: $\pm 0.2$ dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm
Application	General dosimetry up to 4 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones
Compatibility	DASY3, DASY4, DASY52 SAR and higher, EASY4/MRI



### Isotropic E-Field Probe

The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

The E-Field probe utilizes a triangular sensor arrangement as detailed in the diagram below:



### 4.3. Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SPEAG. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm). System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

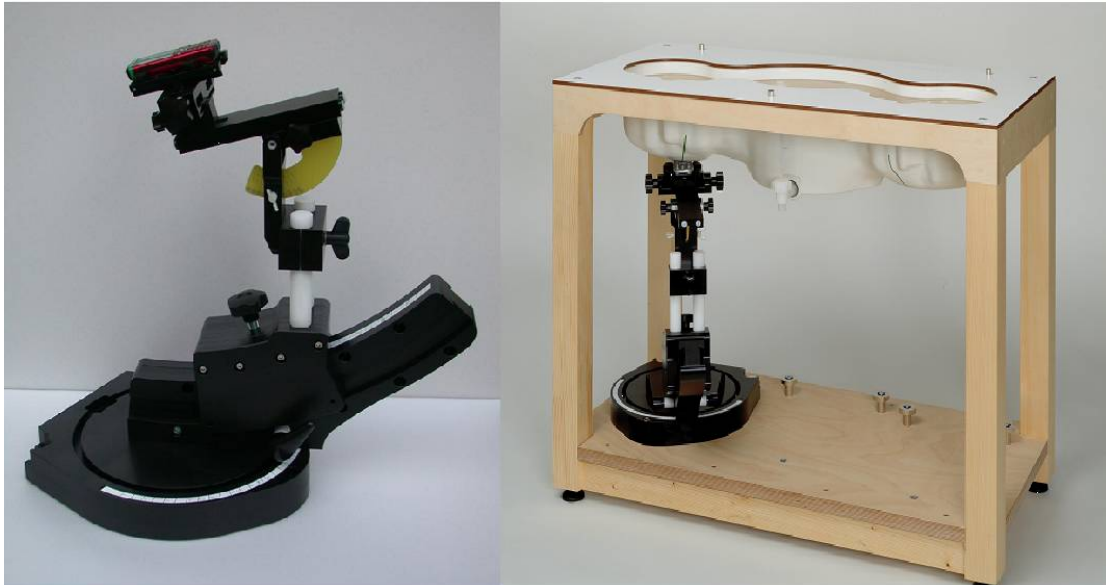


SAM Twin Phantom

### 4.4. Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.

The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder supplied by SPEAG

## 4.5. Scanning Procedure

The DASY4 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max.  $\pm 5\%$ .

The “surface check” measurement tests the optical surface detection system of the DASY4 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above  $\pm 0.1\text{ mm}$ ). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe (It does not depend on the surface reflectivity or the probe angle to the surface within  $\pm 30^\circ$ .)

### Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot. Before starting the area scan a grid spacing of  $15\text{ mm} \times 15\text{ mm}$  is set. During the scan the distance of the probe to the phantom remains unchanged. After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

	$\leq 3\text{ GHz}$	$> 3\text{ GHz}$
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	$5\text{ mm} \pm 1\text{ mm}$	$\frac{1}{2} \cdot \delta \cdot \ln(2)\text{ mm} \pm 0.5\text{ mm}$
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$	$\leq 2\text{ GHz}: \leq 15\text{ mm}$ $2 - 3\text{ GHz}: \leq 12\text{ mm}$	$3 - 4\text{ GHz}: \leq 12\text{ mm}$ $4 - 6\text{ GHz}: \leq 10\text{ mm}$
	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 estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by  $7 \times 7 \times 7$  points within a cube whose base is centered around the maxima found in the preceding area scan.

Maximum zoom scan spatial resolution: $\Delta x_{\text{Zoom}}, \Delta y_{\text{Zoom}}$			$\leq 2 \text{ GHz}: \leq 8 \text{ mm}$ $2 - 3 \text{ GHz}: \leq 5 \text{ mm}^*$	$3 - 4 \text{ GHz}: \leq 5 \text{ mm}^*$ $4 - 6 \text{ GHz}: \leq 4 \text{ mm}^*$
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{\text{Zoom}}(n)$		$\leq 5 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 4 \text{ mm}$ $4 - 5 \text{ GHz}: \leq 3 \text{ mm}$ $5 - 6 \text{ GHz}: \leq 2 \text{ mm}$
	graded grid	$\Delta z_{\text{Zoom}}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface	$\leq 4 \text{ mm}$	$3 - 4 \text{ GHz}: \leq 3 \text{ mm}$ $4 - 5 \text{ GHz}: \leq 2.5 \text{ mm}$ $5 - 6 \text{ GHz}: \leq 2 \text{ mm}$
		$\Delta z_{\text{Zoom}}(n>1)$ : between subsequent points	$\leq 1.5 \cdot \Delta z_{\text{Zoom}}(n-1) \text{ mm}$	
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: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.				
* When zoom scan is required and the <i>reported</i> SAR from the <i>area scan based 1-g SAR estimation</i> procedures of KDB Publication 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 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.				

#### Spatial Peak Detection

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY4 system allows evaluations that combine measured data and robot positions, such as: • maximum search • extrapolation • boundary correction • peak search for averaged SAR. During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space. They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

A Z-axis scan measures the total SAR value at the x-and y-position of the maximum SAR value found during the cube 7x7x7 scan. The probe is moved away in z-direction from the bottom of the SAM phantom in 5mm steps.

## 4.6. Data Storage and Evaluation

### Data Storage

The DASY4 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

### Data Evaluation

The SEMCAD software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software:

Probe parameters:	- Sensitivity	Normi, ai0, ai1, ai2
	- Conversion factor	ConvFi
	- Diode compression point	Dcpi
Device parameters:	- Frequency	f
	- Crest factor	cf
Media parameters:	- Conductivity	$\sigma$
	- Density	$\rho$

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY4 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

With	$V_i$	= compensated signal of channel i	(i = x, y, z)
	$U_i$	= input signal of channel i	(i = x, y, z)
	cf	= crest factor of exciting field	(DASY parameter)
	dcp <sub>i</sub>	= diode compression point	(DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

$$\text{E - fieldprobes : } E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

$$\text{H - fieldprobes : } H_i = \sqrt{V_i} \cdot \frac{a_{i0} + a_{i1}f + a_{i2}f^2}{f}$$

With	$V_i$	= compensated signal of channel i	(i = x, y, z)
	Norm <sub>i</sub>	= sensor sensitivity of channel i	(i = x, y, z)
		[mV/(V/m) <sup>2</sup> ] for E-field Probes	
	ConvF	= sensitivity enhancement in solution	
	a <sub>ij</sub>	= sensor sensitivity factors for H-field probes	
	f	= carrier frequency [GHz]	
	$E_i$	= electric field strength of channel i in V/m	
	$H_i$	= magnetic field strength of channel i in A/m	

The RSS value of the field components gives the total field strength (Hermitian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1'000}$$

with	SAR	= local specific absorption rate in mW/g
	$E_{tot}$	= total field strength in V/m
	$\sigma$	= conductivity in [mho/m] or [Siemens/m]
	$\rho$	= equivalent tissue density in g/cm <sup>3</sup>

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid.



#### 4.7. Tissue Dielectric Parameters for Head and Body Phantoms

The liquid is consisted of water,salt,Glycol,Sugar,Preventol and Cellulose.The liquid has previously been proven to be suited for worst-case.It's satisfying the latest tissue dielectric parameters requirements proposed by the KDB865664.

The composition of the tissue simulating liquid

Ingredient	835MHz		1900MHz		1750 MHz		2450MHz		2600MHz	
(% Weight)	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	41.45	52.5	55.242	69.91	55.782	69.82	62.7	73.2	62.3	72.6
Salt	1.45	1.40	0.306	0.13	0.401	0.12	0.50	0.10	0.20	0.10
Sugar	56	45.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Preventol	0.10	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
HEC	1.00	1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
DGBE	0.00	0.00	44.452	29.96	43.817	30.06	36.8	26.7	37.5	27.3

Target Frequency (MHz)	Head		Body	
	$\epsilon_r$	$\sigma(S/m)$	$\epsilon_r$	$\sigma(S/m)$
150	52.3	0.76	61.9	0.80
300	45.3	0.87	58.2	0.92
450	43.5	0.87	56.7	0.94
835	41.5	0.90	55.2	0.97
900	41.5	0.97	55.0	1.05
915	41.5	0.98	55.0	1.06
1450	40.5	1.20	54.0	1.30
1610	40.3	1.29	53.8	1.40
1800-2000	40.0	1.40	53.3	1.52
2450	39.2	1.80	52.7	1.95
2600	39.0	1.96	52.5	2.16
3000	38.5	2.40	52.0	2.73
5800	35.3	5.27	48.2	6.00

#### 4.8. Tissue equivalent liquid properties

Dielectric performance of Head and Body tissue simulating liquid

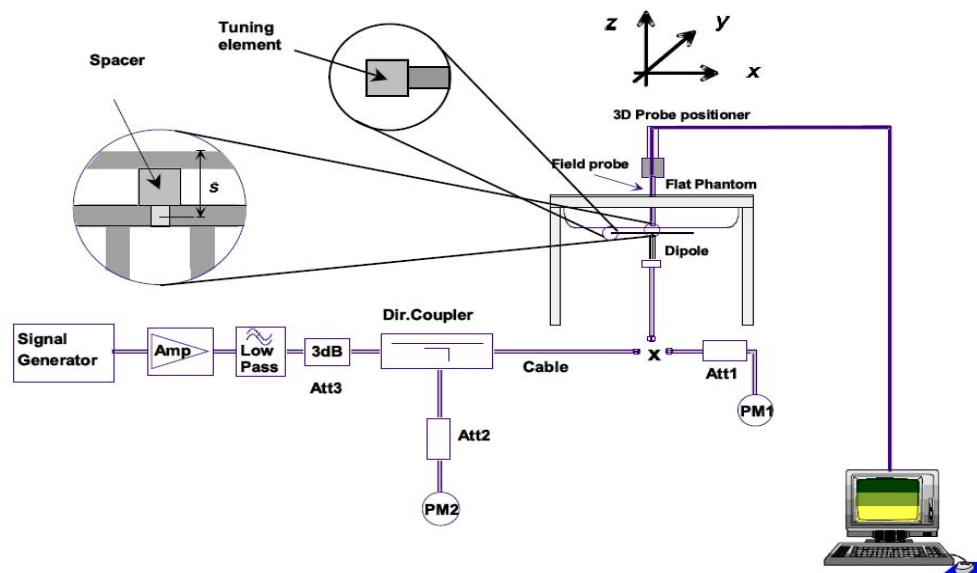
Tissue Type	Measured Frequency (MHz)	Target Tissue		Measured Tissue				Liquid Temp.	Test Data
		$\epsilon_r$	$\sigma$	$\epsilon_r$	Dev.	$\sigma$	Dev.		
750H	750	0.89	41.9	0.91	2.25%	41.79	-0.26%	22.2	10/16/2016
835H	835	0.97	41.5	0.95	-2.06%	42.80	3.13%	22.3	10/17/2016
1750H	1750	1.37	40.1	1.38	0.73%	39.83	-0.67%	22.2	10/18/2016
1900H	1900	1.40	40.0	1.44	2.86%	41.30	3.25%	22.2	10/19/2016
2450H	2450	1.80	39.2	1.83	1.67%	38.19	-2.58%	22.3	10/21/2016
2600H	2600	1.96	39.0	1.96	0.00%	38.09	-2.33%	22.3	10/22/2016
750B	750	0.96	55.5	0.97	1.04%	55.99	0.88%	22.2	10/16/2016
835B	835	1.05	55.0	1.02	-2.86%	57.01	3.65%	22.3	10/17/2016
1750B	1750	1.49	53.4	1.53	2.68%	54.57	2.19%	22.2	10/18/2016
1900B	1900	1.52	53.3	1.58	3.95%	55.20	3.56%	22.2	10/19/2016
2450B	2450	1.95	52.7	1.90	-2.56%	50.59	-4.00%	22.3	10/21/2016
2600B	2600	2.16	52.5	2.20	1.85%	51.09	-2.69%	22.3	10/22/2016

#### 4.9. System Check

The purpose of the system check is to verify that the system operates within its specifications at the device test frequency. The system check is simple check of repeatability to make sure that the system works correctly at the time of the compliance test;

System check results have to be equal or near the values determined during dipole calibration with the relevant liquids and test system ( $\pm 10\%$ ).

System check is performed regularly on all frequency bands where tests are performed with the DASY4 system.



The output power on dipole port must be calibrated to 24 dBm (250mW) before dipole is connected.



Photo of Dipole Setup

System Check in Head Tissue Simulating Liquid

Frequency	Test Date	Dielectric Parameters		Temp (°C)	250mW Measured SAR <sub>1g</sub>	1W Normalized SAR <sub>1g</sub> (W/Kg)	1W Target SAR <sub>1g</sub>	Limit ( $\pm 10\%$ Deviation)
		$\epsilon_r$	$\sigma$ (s/m)					
750 MHz	10/16/2016	0.91	41.79	22.2	1.92	7.68	8.02	-4.24%
835 MHz	10/17/2016	0.95	42.80	22.3	2.26	9.04	9.44	-4.24%
1750 MHz	10/18/2016	1.38	39.83	22.2	8.82	35.28	36.90	-4.39%
1900 MHz	10/19/2016	1.44	41.30	22.2	10.35	41.40	40.60	1.97%
2450 MHz	10/20/2016	1.83	38.19	22.3	13.30	53.20	52.40	1.53%
2600 MHz	10/22/2016	1.96	38.09	22.3	14.40	57.60	56.70	1.59%

## System Check in Body Tissue Simulating Liquid

Frequency	Test Date	Dielectric Parameters		Temp (°C)	250mW Measured SAR <sub>1g</sub>	1W Normalized SAR <sub>1g</sub>	1W Target SAR <sub>1g</sub>	Limit (±10% Deviation)
		$\epsilon_r$	$\sigma$ (s/m)					
750MHz	10/16/2016	0.97	55.99	22.2	2.21	8.84	8.46	4.49%
835MHz	10/17/2016	1.02	57.01	22.3	2.53	10.12	9.69	4.44%
1750MHz	10/18/2016	1.53	54.57	22.2	9.06	36.24	36.70	-1.25%
1900MHz	10/19/2016	1.58	55.20	22.2	9.95	39.80	40.10	-0.75%
2450MHz	10/20/2016	1.90	50.59	22.3	13.50	54.00	53.70	0.56%
2600MHz	10/22/2016	2.20	51.09	22.3	14.60	58.40	55.30	5.61%

Note:

1. The graph results see system check.
2. Target Values used derive from the calibration certificate

## Justification for Extended SAR Dipole Calibrations

Referring to KDB 865664D01V01r04, if dipoles are verified in return loss (<-20dB, within 20% of prior calibration), and in impedance (within 5 ohm of prior calibration), the annual calibration is not necessary and the calibration interval can be extended. While calibration intervals not exceed 3 years.

## D750V3, Serial No.: 1133 Extend Dipole Calibrations

750 MHz Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2015-01-05	-26.9		54.400		-1.600	
2016-01-02	-26.5	-1.51%	54.100	-0.300	-1.600	0.000

## D1900V2, Serial No.: 5d194 Extend Dipole Calibrations

1900 MHz Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2015-01-07	-24.5		53.700		4.900	
2016-01-02	-24.5	0.00%	53.779	0.079	4.041	-0.859

## D2450V2, Serial No.: 955 Extend Dipole Calibrations

2450 MHz Head						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2015-01-08	-24.9		54.800		3.500	
2016-01-02	-25.559	-2.65%	54.985	0.185	2.411	-1.089

## D750V3, Serial No.: 1133 Extend Dipole Calibrations

750 MHz Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2015-01-05	-27.4		48.700		-4.00	
2016-01-02	-27.1	1.09%	48.300	-0.400	-3.80	0.200

## D1900V2, Serial No.: 5d194 Extend Dipole Calibrations

1900 MHz Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2015-01-07	-25.6		48.900		5.100	
2016-01-02	-25.972	-0.372	48.822	-0.078	3.677	-1.423

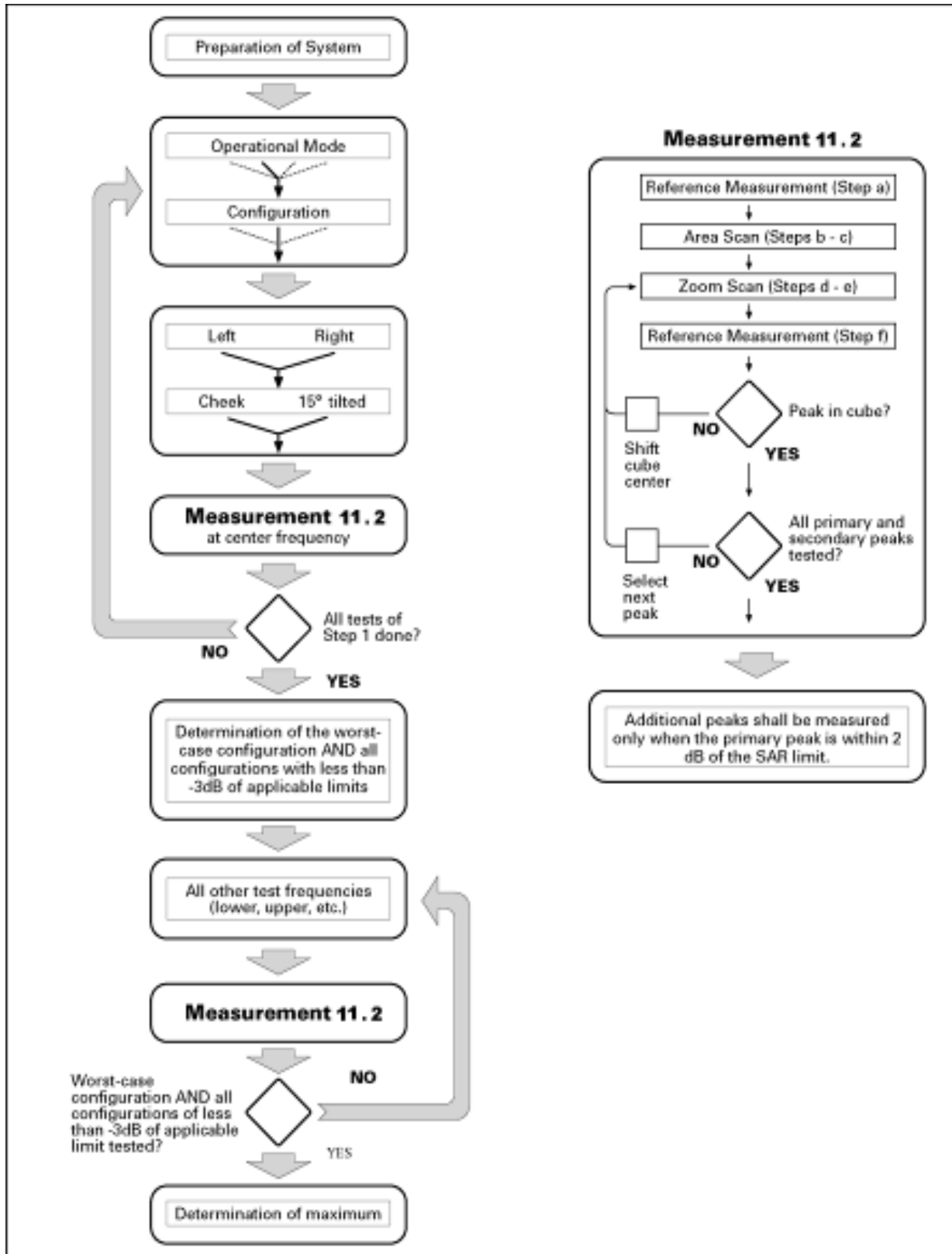
D2450V2, Serial No.: 955 Extend Dipole Calibrations

2450 MHz Body						
Date of Measurement	Return-Loss (dB)	Delta (%)	Real Impedance (ohm)	Delta (ohm)	Imaginary Impedance (ohm)	Delta (ohm)
2015-01-08	-26.0		51.200		4.900	
2016-01-02	-27.824	-7.02%	52.632	1.432	3.236	-1.664

#### 4.10. SAR measurement procedure

The procedure for assessing the average SAR value consists of the following steps:

- **Power Reference Measurement**  
The Power Reference Measurement and Power Drift Measurement jobs are useful jobs for monitoring the power drift of the device under test in the batch process. Both jobs measure the field at a specified reference position, at a selectable distance from the phantom surface. The reference position can be either the selected section's grid reference point or a user point in this section. The reference job projects the selected point onto the phantom surface, orients the probe perpendicularly to the surface, and approaches the surface using the selected detection method.
- **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 finer measurement around the hot spot. The sophisticated interpolation routines implemented in DASY4 software can find the maximum locations even in relatively coarse grids. The scanning area is defined by an editable grid. This grid is anchored at the grid reference point of the selected section in the phantom. When the Area Scan's property sheet is brought-up, grid settings can be edited by a user.
- **Zoom Scan**  
Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan measures 7 x 7 x 7 points (5mmE545mmE545mm) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure.
- **Power Drift Measurement**  
The Power Drift Measurement job measures the field at the same location as the most recent power reference measurement job within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement.



Block diagram of the tests to be performed

## 4.11. Operational Conditions during Test

### 4.11.1. General Description of Test Procedures

A communication link is set up with a System Simulator (SS) by air link, and a call is established. The EUT is commanded to operate at maximum transmitting power.

Connection to the EUT is established via air interface with CMU 200, and the EUT is set to maximum output power by CMU 200. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. The antenna connected to the output of the base station simulator shall be

placed at least 50 cm away from the EUT. The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the EUT by at least 30 dB.

#### 4.11.2. Test Positions

##### 4.11.2.1 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".

##### 4.11.2.2. 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  $> 1.2$  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.

#### 4.12. Test Configuration

##### 4.12.1. GSM Test Configuration

SAR tests for GSM 850 and GSM 1900, a communication link is set up with a System Simulator (SS) by air link. Using E5515C the power level is set to “5” for GSM 850, set to “0” for GSM 1900. Since the GPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslots is 5. Since the EGPRS class is 12 for this EUT, it has at most 4 timeslots in uplink and at most 4 timeslots in downlink, the maximum total timeslots is 5.

When SAR tests for EGPRS mode is necessary, GMSK modulation should be used to minimize SAR measurement error due to higher peak-to-average power (PAR) ratios inherent in 8-PSK.

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

The allowed power reduction in the multi-slot configuration

Number of timeslots in uplink assignment	Permissible nominal reduction of maximum output power,(dB)
1	0
2	0 to 3.0
3	1.8 to 4.8
4	3.0 to 6.0

#### 4.12.2.1. Output power Verification

Sub-set	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{hs}$ (note 1, note 2)	CM(dB) (note 3)	MPR(dB)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (note 4)	15/15 (note 4)	64	12/15 (note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note1:  $\Delta_{ACK}$ ,  $\Delta_{NACK}$  and  $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$   
Note2: CM=1 for  $\beta_c/\beta_d = 12/15$ ,  $\beta_{hs}/\beta_c = 24/15$ .  
Note3: For subtest 2 the  $\beta_c/\beta_d$  ratio of 12/15 for the TFC during the measurement period(TF1,TF0) is achieved by setting the signaled gain factors for the reference TFC (TFC1,TF1) to  $\beta_c=11/15$  and  $\beta_d=15/15$ .

### 4.12.2.5 HSUPA Test Configuration

The 3G SAR test reduction procedure is applied to HSPA (HSUPA/HSDPA with RMC) body-worn accessory configurations with 12.2 kbps RMC as the primary mode. Otherwise, SAR is measured for HSPA using the HSPA body SAR procedures in the "Release 6 HSPA Data Devices" section of this document, for the highest reported body-worn accessory exposure SAR configuration in 12.2 kbps RMC. When VOIP is applicable for next to the ear head exposure in HSPA, the 3G SAR test reduction procedure is applied to HSPA with 12.2 kbps RMC as the primary mode; otherwise, the same HSPA configuration used for body-worn accessory measurements is tested for next to the ear head exposure.

Due to inner loop power control requirements in HSPA, a communication test set is required for output power and SAR tests. The 12.2 kbps RMC, FRC H-set 1 and E-DCH configurations for HSPA are configured according to the  $\beta$  values indicated in Table 2 and other applicable procedures described in the 'WCDMA Handset' and 'Release 5 HSDPA Data Devices' sections of this document

**Table 3: Sub-Test 5 Setup for Release 6 HSUPA**

Sub-set	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{hs}^{(1)}$	$\beta_{ec}$	$\beta_{ed}$	$\beta_{ed}$ (SF)	$\beta_{ed}$ (codes)	CM <sup>(2)</sup> (dB)	MPR (dB)	AG <sup>(4)</sup> Index	E-TFCI
1	11/15 <sup>(3)</sup>	15/15 <sup>(3)</sup>	64	11/15 <sup>(3)</sup>	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{ed1}$ 47/15 $\beta_{ed2}$ 47/15	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 <sup>(4)</sup>	15/15 <sup>(4)</sup>	64	15/15 <sup>(4)</sup>	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1:  $\Delta_{ACK}$ ,  $\Delta_{NACK}$  and  $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$ .

Note 2: CM = 1 for  $\beta_c/\beta_d = 12/15$ ,  $\beta_{hs}/\beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the  $\beta_c/\beta_d$  ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 10/15$  and  $\beta_d = 15/15$ .

Note 4: For subtest 5 the  $\beta_c/\beta_d$  ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 14/15$  and  $\beta_d = 15/15$ .

Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Figure 5.1g.

Note 6:  $\beta_{ed}$  can not be set directly; it is set by Absolute Grant Value.

**Table 4: HSUPA UE category**

UE E-DCH Category	Maximum E-DCH Codes Transmitted	Number of HARQ Processes	E-DCH TTI (ms)	Minimum Spreading Factor	Maximum E-DCH Transport Block Bits	Max Rate (Mbps)
1	1	4	10	4	7110	0.7296
2	2	8	2	4	2798	1.4592
	2	4	10	4	14484	
3	2	4	10	4	14484	1.4592
4	2	8	2	2	5772	2.9185
	2	4	10	2	20000	2.00
5	2	4	10	2	20000	2.00
6 (No DPDCH)	4	8	2	2 SF2 & 2 SF4	11484	5.76
	4	4	10		20000	2.00
7 (No DPDCH)	4	8	2	2 SF2 & 2 SF4	22996	?
	4	4	10		20000	?

NOTE: When 4 codes are transmitted in parallel, two codes shall be transmitted with SF2 and two with SF4. UE Categories 1 to 6 supports QPSK only. UE Category 7 supports QPSK and 16QAM. (TS25.306-7.3.0)

### 4.12.2.6 HSPA, HSPA+ and DC-HSDPA Test Configuration

measurement is required for HSPA, HSPA+ or DC-HSDPA, a KDB inquiry is required to confirm that the wireless mode configurations in the test setup have remained stable throughout the SAR measurements.<sup>35</sup> Without prior KDB confirmation to determine the SAR results are acceptable, a PBA is required for TCB approval.



SAR test exclusion for HSPA, HSPA+ and DC-HSDPA is determined according to the following:

- 1) The HSPA procedures are applied to configure 3GPP Rel. 6 HSPA devices in the required sub-test mode(s) to determine SAR test exclusion.
- 2) SAR is required for Rel. 7 HSPA+ when SAR is required for Rel. 6 HSPA; otherwise, the 3G SAR test reduction procedure is applied to (uplink) HSPA+ with 12.2 kbps RMC as the primary mode. Power is measured for HSPA+ that supports uplink 16 QAM according to configurations in Table C.11.1.4 of 3GPP TS 34.121-1 to determine SAR test reduction.
- 3) SAR is required for Rel. 8 DC-HSDPA when SAR is required for Rel. 5 HSDPA; otherwise, the 3G SAR test reduction procedure is applied to DC-HSDPA with 12.2 kbps RMC as the primary mode. Power is measured for DC-HSDPA according to the H-Set 12, FRC configuration in Table C.8.1.12 of 3GPP TS 34.121-1 to determine SAR test reduction. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to be acceptable.
- 4) Regardless of whether a PBA is required, the following information must be verified and included in the SAR report for devices supporting HSPA, HSPA+ or DC-HSDPA: a) The output power measurement results and applicable release version(s) of 3GPP TS 34.121.

i) Power measurement difficulties due to test equipment setup or availability must be resolved between the grantee and its test lab.

b) The power measurement results are in agreement with the individual device implementation and specifications. When Enhanced MPR (E-MPR) applies, the normal MPR targets may be modified according to the Cubic Metric (CM) measured by the device, which must be taken into consideration.

c) The UE category, operating parameters, such as the  $\beta$  and  $\Delta$  values used to configure the device for testing, power setback procedures described in 3GPP TS 34.121 for the power measurements, and HSPA/HSPA+ channel conditions (active and stable) for the entire duration of the measurement according to the required E-TFCI and AG index values.

5) When SAR measurement is required, the test configurations, procedures and power measurement results must be clearly described to confirm that the required test parameters are used, including E-TFCI and AG index stability and output power conditions.

**Table 5: HS-DSCH UE category**

**Table 5.1a: FDD HS-DSCH physical layer categories**

HS-DSCH category	Maximum number of HS-DSCH codes received	Minimum inter-TTI interval	Maximum number of bits of an HS-DSCH transport block received within an HS-DSCH TTI NOTE 1	Total number of soft channel bits	Supported modulations without MIMO operation or dual cell operation	Supported modulations with MIMO operation and without dual cell operation	Supported modulations with dual cell operation
Category 1	5	3	7298	19200	QPSK, 16QAM	Not applicable (MIMO not supported)	Not applicable (dual cell operation not supported)
Category 2	5	3	7298	28800			
Category 3	5	2	7298	28800			
Category 4	5	2	7298	38400			
Category 5	5	1	7298	57600			
Category 6	5	1	7298	67200			
Category 7	10	1	14411	115200			
Category 8	10	1	14411	134400			
Category 9	15	1	20251	172800			
Category 10	15	1	27952	172800			
Category 11	5	2	3630	14400	QPSK		
Category 12	5	1	3630	28800	QPSK, 16QAM, 64QAM		
Category 13	15	1	35280	259200			
Category 14	15	1	42192	259200			
Category 15	15	1	23370	345600	QPSK, 16QAM		
Category 16	15	1	27952	345600	QPSK, 16QAM		
Category 17 NOTE 2	15	1	35280	259200	QPSK, 16QAM, 64QAM	–	
			23370	345600	–	QPSK, 16QAM	
Category 18 NOTE 3	15	1	42192	259200	QPSK, 16QAM, 64QAM	–	
			27952	345600	–	QPSK, 16QAM	
Category 19	15	1	35280	518400	QPSK, 16QAM, 64QAM		
Category 20	15	1	42192	518400	QPSK, 16QAM, 64QAM		
Category 21	15	1	23370	345600	-	-	QPSK, 16QAM
Category 22	15	1	27952	345600			
Category 23	15	1	35280	518400			
Category 24	15	1	42192	518400			

### 4.12.3 WIFI Test Configuration

For WiFi SAR testing, WiFi engineering testing software installed on the DUT can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

The SAR measurement and test reduction procedures are structured according to either the DSSS or OFDM transmission mode configurations used in each standalone frequency band and aggregated band. For devices that operate in exposure configurations that require multiple test positions, additional SAR test reduction may be applied. The maximum output power specified for production units, including tune-up tolerance, are used to determine initial SAR test requirements for the 802.11 transmission modes in a frequency band. SAR is measured using the highest measured maximum output power channel for the initial test configuration (section 5.1). SAR measurement and test reduction for the remaining 802.11 modes and test channels are determined according to measured or specified maximum output power and reported SAR of the initial measurements. The general test reduction and SAR measurement approaches are summarized in the following:

1. The maximum output power specified for production units are determined for all applicable 802.11 transmission modes in each standalone and aggregated frequency band. Maximum output power is measured for the highest maximum output power configuration(s) in each frequency band according to the default power measurement procedures.
2. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, an "initial test configuration" (section 5.3.2) is first determined for each standalone and aggregated frequency band according to the maximum output power and tune-up tolerance specified for production units.
  - a. When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel in the initial test configuration, for each frequency band (section 5.3.2)
  - b. SAR is measured for OFDM configurations using the initial test configuration procedures (section 5.3.3). Additional frequency band specific SAR test reduction may be considered for individual frequency bands (sections 5.2 and 5.3).
  - c. Depending on the reported SAR of the highest maximum output power channel tested in the initial test configuration, SAR test reduction may apply to subsequent highest output channels in the initial test configuration to reduce the number of SAR measurements.
3. The Initial test configuration does not apply to DSSS. The 2.4 GHz band SAR test requirements (section 3.1) and 802.11b DSSS procedures (section 5.2.1) are used to establish the transmission configurations required for SAR measurement.
4. An "initial test position" (section 5.1) is applied to further reduce the number of SAR tests for devices operating in next to the ear, UMPC mini-tablet or hotspot mode exposure configurations that require multiple test positions .
  - a. SAR is measured for 802.11b according to the 2.4 GHz DSSS procedure (section 5.2.1) using the exposure condition established by the initial test position.
  - b. SAR is measured for 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration. 802.11b/g/n operating modes are tested independently according to the service requirements in each frequency band. 802.11b/g/n modes are tested on the maximum average output channel.
5. The Initial test position does not apply to devices that require a fixed exposure test position. SAR is measured in a fixed exposure test position for these devices in 802.11b according to the 2.4 GHz DSSS procedure (section 5.2.1) or in 2.4 GHz and 5 GHz OFDM configurations using the initial test configuration procedures (section 5.3.3).
6. The "subsequent test configuration" (section 5.3.4) procedures are applied to determine if additional SAR measurements are required for the remaining OFDM transmission modes that have not been tested in the initial test configuration. SAR test exclusion is determined according to reported SAR in the initial test configuration and maximum output power specified or measured for these other OFDM configurations.

#### 2.4 GHz Band (§15.247)

The maximum output power permitted for devices authorized under §15.247 is 1 W conducted and 36 dBm EIRP.<sup>6</sup> Within the frequency range of 2400 – 2483.5 MHz, currently a total of 13 channels may be used in the U.S. However, non-overlapping frequency channels are necessary to minimize interference degradation; therefore, channels 1, 6 and 11 are used most often. Channels 12 and 13, in general, require reduced output power to satisfy bandedge radiated field strength requirements at 2483.5 MHz. Provided higher maximum output power is not specified for the other channels, channels 1, 6 and 11 are used to configure 22 MHz DSSS and 20 MHz OFDM channels for SAR measurements; otherwise, the closest adjacent channel with the highest maximum output power specified for production units should be tested instead of channels 1, 6 or 11.<sup>7</sup> When 40 MHz channels are supported, and provided higher maximum output power is not specified for other applicable 40 MHz channels, channel 6 is used to measure SAR; otherwise, the channel with highest specified maximum output power should be tested instead. In addition, SAR test reduction with respect to

reported SAR and transmission band width according to section 4.3.3 of KDB Publication 447498 may also be applied.

#### U-NII-1 and U-NII-2A Bands (§15.407)

The maximum output power permitted for devices authorized under §15.407 U-NII-1 band (5.15 – 5.25 GHz), is 250 - 1000 mW conducted and 21 – 36 dBm EIRP, depending on transmitter configurations and antenna operating requirements.<sup>8</sup> For U-NII-2A band (5.25 – 5.35 GHz), the maximum output power is 250 mW conducted and 30 dBm EIRP. When applicable, a lower maximum output power may be required to satisfy emission bandwidth restrictions for these bands. When both bands apply to a device, SAR test reduction may be considered for each exposure configuration according to procedures in section 5.3.1.

#### U-NII-2C, U-NII-3 Bands (§15.407) and 5.8 GHz Band (§15.247)

The maximum output power permitted for devices authorized under §15.407 U-NII-2C band (5.470 – 5.725) is 250 mW conducted and 30 dBm EIRP. For U-NII-3 band (5.725 – 5.850 GHz) the maximum output power permitted is 1 W conducted and 36 dBm EIRP.<sup>9</sup> When applicable, a lower maximum output power may be required due to emission bandwidth restrictions for these bands. In addition, when Terminal Doppler Weather Radar (TDWR) restriction applies, the channels at 5.60 – 5.65 GHz in U-NII-2C band must be disabled with acceptable mechanisms and documented in the equipment certification to avoid SAR requirements.<sup>10</sup> TDWR restriction does not apply under the new rules; all channels that operate at 5.60 – 5.65 GHz must be included to apply the SAR test reduction and measurement procedures.

#### 2.4 GHz SAR Procedures

Separate SAR procedures are applied to DSSS and OFDM configurations in the 2.4 GHz band to simplify DSSS test requirements. For 802.11b DSSS SAR measurements, DSSS SAR procedure applies to fixed exposure test position and initial test position procedure applies to multiple exposure test positions. When SAR measurement is required for an OFDM configuration, the initial test configuration, subsequent test configuration and initial test position procedures are applied. The SAR test exclusion requirements for 802.11g/n OFDM configurations are described in section 5.2.2.

#### 1. SAR TEST PROCEDURES

SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures (see section 5.3.2) are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s)

#### 1. Multiple Exposure Test Position SAR Test Reduction

The following procedures are applied to select an initial test position for handsets operating next to the ear, hotspot mode or UMPC mini-tablet configurations to minimize the number of SAR measurements normally required for the multiple test positions.<sup>14</sup> SAR is measured for the highest measured maximum output power channel using the initial test position. The reported SAR and power measurement results are used to determine if SAR measurements are required for the other exposure positions and test channels. The relative SAR levels of multiple exposure test positions can be established by area scan measurements on the highest measured output power channel to determine the initial test position.<sup>15</sup> The area scans must be measured using the same SAR measurement configurations, including test channel, maximum output power, probe sensor to phantom shell distance, scan resolution etc. for the results to be comparable. The highest SAR at each peak SAR location is extrapolated to the phantom surface. The exposure test position with the highest extrapolated SAR is used for the initial test position. Instead of extrapolated SAR, the 1-g estimated SAR procedures (fast SAR) in KDB Publication 447498 may be used instead. The extrapolated or 1-g estimated SAR must be scaled according to reported SAR requirements to determine the most conservative exposure test position.

- a. Head Exposure Configuration: The left, right, touch and tilt test positions for next to ear exposure testing using the SAM phantom may be considered collectively as one head exposure configuration to

facilitate initial test position SAR test reduction. The initial test position is determined according to area scans or by the side (left or right) of the SAM phantom and test position (touch or tilt) with the smallest test separation distance from the device outer surface, at the Wi-Fi antenna location, to the SAM phantom and maximum antenna to phantom RF coupling conditions.

- b. Hotspot mode and UMPC mini-tablets: The surfaces and edges that require SAR measurement in hotspot mode or UMPC mini-tablet configuration may be considered collectively as one exposure configuration to facilitate SAR test reduction. The initial test position is determined according to area scans or by the test position with the smallest test separation distance from the device outer surface, at the Wi-Fi antenna location, to the flat phantom and maximum antenna to phantom RF coupling conditions.

## 2. Initial Test Position SAR Test Reduction Procedure

DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures. The initial test position procedure is described in the following:

- a. When the reported SAR of the initial test position is  $\leq 0.4$  W/kg, further SAR measurement is not required for the other (remaining) test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band. SAR is also not required for that exposure configuration in the subsequent test configuration(s).
- b. When the reported SAR of the initial test position is  $> 0.4$  W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position using subsequent highest extrapolated or estimated 1-g SAR conditions determined by area scans or next closest/smallest test separation distance and maximum RF coupling test positions based on manufacturer justification, on the highest maximum output power channel, until the reported SAR is  $\leq 0.8$  W/kg or all required test positions (left, right, touch, tilt or subsequent surfaces and edges) are tested.
- c. For all positions/configurations tested using the initial test position and subsequent test positions, when the reported SAR is  $> 0.8$  W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is  $\leq 1.2$  W/kg or all required channels are tested.
  - a) Additional power measurements may be required for this step, which should be limited to those necessary for identifying the subsequent highest output power channels.

### 802.11b DSSS SAR Test Requirements

SAR is measured for 2.4 GHz 802.11b DSSS using either a fixed test position or, when applicable, the initial test position procedure. SAR test reduction is determined according to the following:

- a. When the reported SAR of the highest measured maximum output power channel (section 3.1) for the exposure configuration is  $\leq 0.8$  W/kg, no further SAR testing is required for 802.11b DSSS in that exposure configuration.
- b. When the reported SAR is  $> 0.8$  W/kg, SAR is required for that exposure configuration using the next highest measured output power channel. When any reported SAR is  $> 1.2$  W/kg, SAR is required for the third channel; i.e., all channels require testing.

### 3. 2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements

When SAR measurement is required for 2.4 GHz 802.11g/n OFDM configurations, the measurement and test reduction procedures for OFDM are applied (section 5.3). SAR is not required for the following 2.4 GHz OFDM conditions.

- a. When KDB Publication 447498 SAR test exclusion applies to the OFDM configuration
- b. When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg.

### 4. SAR Test Requirements for OFDM Configurations

When SAR measurement is required for 802.11 a/g/n/ac OFDM configurations, each standalone and frequency aggregated band is considered separately for SAR test reduction. When the same transmitter and antenna(s) are used for U-NII-1 and U-NII-2A bands, additional SAR test reduction applies. When band gap channels between U-NII-2C band and 5.8 GHz U-NII-3 or §15.247 band are supported, the highest maximum output power transmission mode configuration and maximum output power channel across the bands must be used to determine SAR test reduction, according to the initial test configuration and subsequent test configuration requirements.<sup>20</sup> In applying the initial test configuration and subsequent test configuration procedures, the 802.11 transmission configuration with the highest specified maximum output power and the channel within a test configuration with the highest measured maximum output power should be clearly distinguished to apply the procedures.

### 5. U-NII-1 and U-NII-2A Bands

For devices that operate in only one of the U-NII-1 and U-NII-2A bands, the normally required SAR procedures for OFDM configurations are applied. For devices that operate in both U-NII bands using the same transmitter and antenna(s), SAR test reduction is determined according to the following, with respect to the highest reported SAR and maximum output power specified for production units. The procedures are applied independently to each exposure configuration; for example, head, body, hotspot mode etc.

- a. When the same maximum output power is specified for both bands, begin SAR measurement in U-NII-2A band by applying the OFDM SAR requirements.<sup>21</sup> If the highest reported SAR for a test configuration is  $\leq 1.2$  W/kg, SAR is not required for U-NII-1 band for that configuration (802.11 mode and exposure condition); otherwise, both bands are tested independently for SAR.
- b. 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  $\leq 1.2$  W/kg, SAR is not required for the band with lower maximum output power in that test configuration; otherwise, both bands are tested independently for SAR.
- c. The two U-NII bands may be aggregated to support a 160 MHz channel on channel number 50. Without additional testing, the maximum output power for this is limited to the lower of the maximum output power certified for the two bands. When SAR measurement is required for at least one of the bands and the highest reported SAR adjusted by the ratio of specified maximum output power of aggregated to standalone band is  $> 1.2$  W/kg, SAR is required for the 160 MHz channel. This procedure does not apply to an aggregated band with maximum output higher than the standalone band(s); the aggregated band must be tested independently for SAR. SAR is not required when the 160 MHz channel is operating at a reduced maximum power and also qualifies for SAR test exclusion.

#### 6. OFDM Transmission Mode SAR Test Configuration and Channel Selection Requirements

The initial test configuration for 2.4 GHz and 5 GHz OFDM transmission modes is determined by the 802.11 configuration with the highest maximum output power specified for production units, including tune-up tolerance, in each standalone and aggregated frequency band. SAR for the initial test configuration is measured using the highest maximum output power channel determined by the default power measurement procedures (section 4). When multiple configurations in a frequency band have the same specified maximum output power, the initial test configuration is determined according to the following steps applied sequentially.

- a. The largest channel bandwidth configuration is selected among the multiple configurations with the same specified maximum output power.
- b. If multiple configurations have the same specified maximum output power and largest channel bandwidth, the lowest order modulation among the largest channel bandwidth configurations is selected.
- c. If multiple configurations have the same specified maximum output power, largest channel bandwidth and lowest order modulation, the lowest data rate configuration among these configurations is selected.
- d. When multiple transmission modes (802.11a/g/n/ac) have the same specified maximum output power, largest channel bandwidth, lowest order modulation and lowest data rate, the lowest order 802.11 mode is selected; i.e., 802.11a is chosen over 802.11n then 802.11ac or 802.11g is chosen over 802.11n.

After an initial test configuration is determined, if multiple test channels have the same measured maximum output power, the channel chosen for SAR measurement is determined according to the following. These channel selection procedures apply to both the initial test configuration and subsequent test configuration(s), with respect to the default power measurement procedures or additional power measurements required for further SAR test reduction. The same procedures also apply to subsequent highest output power channel(s) selection.

- a. When there are multiple test channels with the same measured maximum output power, the channel closest to mid-band frequency is selected for SAR measurement.
- b. When there are multiple test channels with the same measured maximum output power and equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

#### 7. Initial Test Configuration Procedures

An initial test configuration is determined for OFDM transmission modes according to the channel bandwidth, modulation and data rate combination(s) with the highest maximum output power specified for production units in each standalone and aggregated frequency band. SAR is measured using the highest measured maximum output power channel. For configurations with the same specified or measured maximum output power, additional transmission mode and test channel selection procedures are required (see section 5.3.2). SAR test reduction of subsequent highest output test channels is based on the reported SAR of the initial test configuration.

For next to the ear, hotspot mode and UMC mini-tablet exposure configurations where multiple test positions are required, the initial test position procedure is applied to minimize the number of test positions required for SAR measurement using the initial test configuration transmission mode.<sup>23</sup> For fixed exposure conditions that do not have multiple SAR test positions, SAR is measured in the transmission mode determined by the initial test configuration. When the reported SAR of the initial test configuration is  $> 0.8$  W/kg, SAR measurement is required for the subsequent next highest measured output power channel(s) in the initial test configuration until the reported SAR is  $\leq 1.2$  W/kg or all required channels are tested.

#### 8. Subsequent Test Configuration Procedures

SAR measurement requirements for the remaining 802.11 transmission mode configurations that have not been tested in the initial test configuration are determined separately for each standalone and aggregated frequency band, in each exposure condition, according to the maximum output power specified for production units. The initial test position procedure is applied to next to the ear, UMPC mini-tablet and hotspot mode configurations. When the same maximum output power is specified for multiple transmission modes, the

procedures in section 5.3.2 are applied to determine the test configuration. Additional power measurements may be required to determine if SAR measurements are required for subsequent highest output power channels in a subsequent test configuration. The subsequent test configuration and SAR measurement procedures are described in the following.

- a. When SAR test exclusion provisions of KDB Publication 447498 are applicable and SAR measurement is not required for the initial test configuration, SAR is also not required for the next highest maximum output power transmission mode subsequent test configuration(s) in that frequency band or aggregated band and exposure configuration.
- b. When the highest reported SAR for the initial test configuration (when applicable, include subsequent highest output channels), 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  $\leq 1.2$  W/kg, SAR is not required for that subsequent test configuration.
- c. The number of channels in the initial test configuration and subsequent test configuration can be different due to differences in channel bandwidth. When SAR measurement is required for a subsequent test configuration and the channel bandwidth is smaller than that in the initial test configuration, all channels in the subsequent test configuration that overlap with the larger bandwidth channel tested in the initial test configuration should be used to determine the highest maximum output power channel. This step requires additional power measurement to identify the highest maximum output power channel in the subsequent test configuration to determine SAR test reduction.
  - 1). SAR should first be measured for the channel with highest measured output power in the subsequent test configuration.
  - 2). SAR for subsequent highest measured maximum output power channels in the subsequent test configuration is required only when the reported SAR of the preceding higher maximum output power channel(s) in the subsequent test configuration is  $> 1.2$  W/kg or until all required channels are tested.
    - a) For channels with the same measured maximum output power, SAR should be measured using the channel closest to the center frequency of the larger channel bandwidth channel in the initial test configuration.
- d. SAR measurements for the remaining highest specified maximum output power OFDM transmission mode configurations that have not been tested in the initial test configuration (highest maximum output) or subsequent test configuration(s) (subsequent next highest maximum output power) is determined by applying the subsequent test configuration procedures in this section to the remaining configurations according to the following:
  - 1) replace "subsequent test configuration" with "next subsequent test configuration" (i.e., subsequent next highest specified maximum output power configuration)
  - 2) replace "initial test configuration" with "all tested higher output power configurations"

#### 4.13. Power Drift

To control the output power stability during the SAR test, DASY5 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Table 14.1 to Table 14.11 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

#### 4.14. Power Reduction

The product without any power reduction.

## 5. TEST CONDITIONS AND RESULTS

### 5.1. Conducted Power Results

#### <GSM Conducted Power>

General Note:

1. Per KDB 447498 D01v06, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. According to October 2013TCB Workshop, for GSM / GPRS / EGPRS, the number of time slots to test for SAR should correspond to the highest frame-average maximum output power configuration, considering the possibility of e.g. 3rd party VoIP operation for head and body-worn SAR testing, the EUT was set in GPRS (4Tx slot) for GSM850/GSM1900 band due to their highest frame-average power.
3. For hotspot mode SAR testing, GPRS / EDGE should be evaluated, therefore the EUT was set in GPRS (4 Tx slots) for GSM850/GSM1900 band due to its highest frame-average power.
4. Measured power at SIM 1 and SIM 2, recorded highest power (worst case) at SIM 1.

**Conducted Power Measurement Results(GSM 850/1900)**

GSM 850		Burst Conducted power (dBm)			/	Average power (dBm)		
		Channel/Frequency(MHz)				Channel/Frequency(MHz)		
		128/824.2	190/836.6	251/848.8		128/824.2	190/836.6	251/848.8
GSM		31.67	32.00	32.11	-9.03dB	22.64	22.97	23.08
GPRS (GMSK)	1TX slot	31.71	31.85	32.04	-9.03dB	22.68	22.82	23.01
	2TX slot	30.16	30.28	30.39	-6.02dB	24.14	24.26	24.37
	3TX slot	28.08	28.16	28.38	-4.26dB	23.82	23.90	24.12
	4TX slot	27.25	27.31	27.43	-3.01dB	24.24	24.30	24.42
GSM 1900		Burst Conducted power (dBm)			/	Average power (dBm)		
		Channel/Frequency(MHz)				Channel/Frequency(MHz)		
		512/ 1850.2	661/ 1880	810/ 1909.8		512/ 1850.2	661/ 1880	810/ 1909.8
GSM		29.01	29.42	29.91	-9.03dB	19.98	20.39	20.88
GPRS (GMSK)	1TX slot	29.03	29.48	29.97	-9.03dB	20.00	20.45	20.94
	2TX slot	27.25	27.32	27.41	-6.02dB	21.23	21.30	21.39
	3TX slot	26.08	26.26	26.37	-4.26dB	21.82	22.00	22.11
	4TX slot	25.01	25.28	25.35	-3.01dB	22.00	22.27	22.34

Notes:

1) Division Factors

To average the power, the division factor is as follows:

1TX-slot = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.03dB

2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.02dB

3TX-slots = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB

4TX-slots = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.01dB

2) According to the conducted power as above, the GPRS measurements are performed with 4Txslots for GPRS850 and GPRS1900.

#### <UMTS Conducted Power>

The following tests were conducted according to the test requirements outlines in 3GPP TS 34.121 specification. A summary of these settings are illustrated below:

#### HSDPA Setup Configuration:

- a. The EUT was connected to Base Station E5515C referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting:
  - i. Set Gain Factors ( $\beta_c$  and  $\beta_d$ ) and parameters were set according to each
  - ii. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
  - iii. Set RMC 12.2Kbps + HSDPA mode.
  - iv. Set Cell Power = -86 dBm
  - v. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
  - vi. Select HSDPA Uplink Parameters
  - vii. Set Delta ACK, Delta NACK and Delta CQI = 8
  - viii. Set Ack-Nack Repetition Factor to 3



- ix. Set CQI Feedback Cycle (k) to 4 ms
- x. Set CQI Repetition Factor to 2
- xi. Power Ctrl Mode = All Up bits
- d. The transmitted maximum output power was recorded.

**Table C.10.1.4:  $\beta$  values for transmitter characteristics tests with HS-DPCCH**

Sub-test	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{HS}$ (Note 1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5
<p>Note 1: <math>\Delta_{ACK}</math>, <math>\Delta_{NACK}</math> and <math>\Delta_{CQI} = 30/15</math> with <math>\beta_{HS} = 30/15 * \beta_c</math>.</p> <p>Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA, <math>\Delta_{ACK}</math> and <math>\Delta_{NACK} = 30/15</math> with <math>\beta_{HS} = 30/15 * \beta_c</math>, and <math>\Delta_{CQI} = 24/15</math> with <math>\beta_{HS} = 24/15 * \beta_c</math>.</p> <p>Note 3: CM = 1 for <math>\beta_c/\beta_d = 12/15</math>, <math>\beta_{HS}/\beta_c = 24/15</math>. For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.</p> <p>Note 4: For subtest 2 the <math>\beta_c/\beta_d</math> ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to <math>\beta_c = 11/15</math> and <math>\beta_d = 15/15</math>.</p>							

**Setup Configuration****HSUPA Setup Configuration:**

- a. The EUT was connected to Base Station R&S CMU200 referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting \* :
  - i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
  - ii. Set the Gain Factors ( $\beta_c$  and  $\beta_d$ ) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
  - iii. Set Cell Power = -86 dBm
  - iv. Set Channel Type = 12.2k + HSPA
  - v. Set UE Target Power
  - vi. Power Ctrl Mode= Alternating bits
  - vii. Set and observe the E-TFCI
  - viii. Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
- d. The transmitted maximum output power was recorded.



Table C.11.1.3:  $\beta$  values for transmitter characteristics tests with HS-DPCCH and E-DCH

Sub-test	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{HS}$ (Note 1)	$\beta_{ec}$	$\beta_{ed}$ (Note 5) (Note 6)	$\beta_{ed}$ (SF)	$\beta_{ed}$ (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E-TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/25	1309/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{ed1}$ : 47/15 $\beta_{ed2}$ : 47/15	4 4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 (Note 4)	15/15 (Note 4)	64	15/15 (Note 4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81
Note 1: $\Delta_{ACK}$ , $\Delta_{NACK}$ and $\Delta_{CQI} = 30/15$ with $\beta_{HS} = 30/15 * \beta_c$ . Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$ , $\beta_{HS}/\beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference. Note 3: For subtest 1 the $\beta_c/\beta_d$ ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$ . Note 4: For subtest 5 the $\beta_c/\beta_d$ ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$ . Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g. Note 6: $\beta_{ed}$ can not be set directly, it is set by Absolute Grant Value.													

**Setup Configuration****General Note**

1. Per KDB 941225 D01, RMC 12.2kbps setting is used to evaluate SAR. If AMR 12.2kbps power is < 0.25dB higher than RMC 12.2kbps, SAR tests with AMR 12.2kbps can be excluded.
2. By design, AMR and HSDPA/HSUPA RF power will not be larger than RMC 12.2kbps, detailed information is included in Tune-up Procure exhibit.
3. It is expected by the manufacturer that MPR for some HSDPA/HSUPA subtests may differ from the specification of 3GPP, according to the chipset implementation in this model. The implementation and expected deviation are detailed in tune-up procedure exhibit.
4. Measured power at SIM 1 and SIM 2, recorded highest power (worst case) at SIM 1.

**Conducted Power Measurement Results(WCDMA Band V/II)**

Item	band	WCDMA Band V result (dBm)			WCDMA Band II result (dBm)		
		Channel/Frequency(MHz)			Channel/Frequency(MHz)		
	ARFCN	4132/826.4	4183/836.6	4233/846.6	9262/1852.4	9400/1880.0	9538/1907.6
RMC	12.2kbps	23.22	23.55	23.52	23.46	23.17	23.38
	64kbps	23.17	23.49	23.51	23.31	23.12	23.29
	144kbps	23.10	23.42	23.44	23.20	23.03	23.21
	384kbps	23.01	23.31	23.27	23.13	22.95	23.08
HSDPA	Sub - Test 1	22.51	22.86	22.82	22.63	22.83	22.41
	Sub - Test 2	22.48	21.93	22.78	22.75	22.15	22.62
	Sub - Test 3	22.55	21.85	22.96	22.71	21.96	22.85
	Sub - Test 4	21.45	22.03	21.84	21.71	22.34	21.64
HSUPA	Sub - Test 1	21.04	21.55	20.54	20.62	21.96	20.65
	Sub - Test 2	20.74	20.53	20.79	20.71	20.93	20.56
	Sub - Test 3	21.65	21.63	22.04	21.50	22.01	21.52
	Sub - Test 4	20.81	20.44	20.62	20.41	20.85	20.66
	Sub - Test 5	20.31	21.66	20.51	20.71	22.06	20.67

Note : When the maximum output power and tune-up tolerance specified for production units in a secondary mode is  $\leq 1/2$ dB higher than the primary mode (RMC12.2kbps) or when the highest reported SAR of the primary mode is scaled by the ratio of specified maximum output power and tune-up tolerance of secondary to primary mode and the adjusted SAR is  $\leq 1.2$  W/kg, SAR measurement is not required for the secondary mode.

## &lt;LTE Conducted Power&gt;

General Note:

1. Per KDB 447498 D01v06, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. Measured power at SIM 1 and SIM 2, recorded highest power (worst case) at SIM 1.

## LTE FDD Band 2

TX Channel Bandwidth	Frequency (MHz)	RB Configuration		Average Power [dBm]	
		Size	Offset	QPSK	16QAM
1.4 MHz	1850.7	1	0	22.44	21.65
		1	3	22.41	21.64
		1	5	22.28	21.51
		3	0	22.22	21.38
		3	2	22.19	21.27
		3	3	22.11	21.14
		6	0	21.21	20.21
	1880.0	1	0	22.53	21.81
		1	3	22.34	21.77
		1	5	22.52	21.80
		3	0	22.52	21.56
		3	2	22.51	21.47
		3	3	22.14	21.16
		6	0	21.51	20.48
	1909.3	1	0	22.39	21.49
		1	3	22.32	21.42
		1	5	22.40	21.53
		3	0	22.38	21.40
		3	2	22.43	21.35
		3	3	22.29	21.31
		6	0	21.52	20.56
3 MHz	1851.5	1	0	21.61	20.96
		1	7	21.65	20.94
		1	14	21.67	20.97
		8	0	21.77	19.82
		8	7	20.72	19.77
		8	14	20.45	19.72
		15	0	21.76	20.70
	1880.0	1	0	22.56	21.80
		1	7	22.55	21.75
		1	14	22.52	21.79
		8	0	21.56	20.54
		8	7	21.60	20.54
		8	14	21.51	20.39
		15	0	21.54	20.51
	1908.5	1	0	22.39	21.58
		1	7	22.30	21.44
		1	14	22.04	21.34
		8	0	21.55	20.51
		8	7	21.48	20.39
		8	14	21.51	20.46
		15	0	21.43	20.40
5 MHz	1852.5	1	0	21.52	20.78
		1	12	21.55	20.81
		1	24	21.61	20.84
		12	0	21.41	20.29
		12	6	21.36	20.24
		12	13	21.55	20.37
		25	0	21.27	20.25
	1880.0	1	0	22.66	21.80
		1	12	22.61	21.78
		1	24	22.56	21.72
		12	0	21.67	20.74
		12	6	21.59	20.68

		12	13	21.52	20.79
		25	0	21.56	20.58
	1907.5	1	0	22.54	21.63
		1	12	22.31	21.56
		1	24	21.98	21.14
		12	0	22.16	21.55
		12	6	21.56	20.57
		12	13	21.98	20.77
		25	0	21.97	21.16
10 MHz	1855.0	1	0	21.41	20.63
		1	24	21.81	21.01
		1	49	21.94	21.42
		25	0	21.56	20.36
		25	12	21.05	20.06
		25	25	21.71	20.49
		50	0	20.95	20.01
	1880.0	1	0	22.61	21.96
		1	24	22.39	21.87
		1	49	22.56	21.86
		25	0	21.78	20.92
		25	12	21.59	20.61
		25	25	21.66	20.88
		50	0	21.59	20.62
	1905.0	1	0	21.92	21.10
		1	24	21.68	21.24
		1	49	21.34	20.65
		25	0	21.64	20.34
		25	12	21.07	20.03
		25	25	21.88	20.55
		50	0	21.56	20.48
15 MHz	1857.5	1	0	21.41	20.68
		1	37	22.16	21.79
		1	74	22.41	21.67
		37	0	21.85	20.69
		37	18	21.12	20.06
		37	38	21.56	20.71
		75	0	20.96	19.98
	1880.0	1	0	22.68	21.19
		1	37	22.31	21.56
		1	74	22.58	21.74
		37	0	21.28	20.33
		37	18	21.73	20.68
		37	38	21.66	20.46
		75	0	21.74	20.67
	1902.5	1	0	22.23	21.39
		1	37	22.01	21.18
		1	74	21.60	20.92
		37	0	21.59	20.38
		37	18	21.26	20.17
		37	38	21.04	20.85
		75	0	21.19	20.08
20 MHz	1860.0	1	0	21.45	20.68
		1	49	22.47	21.80
		1	99	22.70	21.87
		50	0	21.91	20.95
		50	25	21.65	20.59
		50	50	21.16	20.66
		100	0	21.56	20.63
	1880.0	1	0	22.81	22.09
		1	49	22.06	22.00
		1	99	22.39	21.69
		50	0	21.59	20.42

		50	25	21.80	20.84
		50	50	21.62	20.42
		100	0	21.63	20.64
	1900.0	1	0	22.31	21.54
		1	49	21.98	21.56
		1	99	21.37	20.70
		50	0	21.26	20.16
		50	25	20.83	19.97
		50	50	21.38	20.22
		100	0	20.90	20.01

## LTE FDD Band 4

TX Channel Bandwidth	Frequency (MHz)	RB Configuration		Average Power [dBm]	
		Size	Offset	QPSK	16QAM
1.4 MHz	1710.07	1	0	22.37	21.72
		1	3	22.82	21.78
		1	5	22.36	21.67
		3	0	22.41	21.65
		3	2	22.36	21.36
		3	3	22.11	21.55
		6	0	21.37	20.33
	1732.5	1	0	22.48	21.73
		1	3	22.26	21.35
		1	5	22.50	21.75
		3	0	22.16	21.22
		3	2	22.52	21.58
		3	3	22.36	21.50
		6	0	21.51	20.66
	1754.3	1	0	22.45	21.58
		1	3	22.59	21.19
		1	5	22.43	21.60
		3	0	22.16	21.87
		3	2	22.42	21.48
		3	3	22.25	21.33
		6	0	21.46	20.42
3 MHz	1711.5	1	0	22.24	21.54
		1	7	22.24	21.54
		1	14	22.25	21.53
		8	0	21.36	20.49
		8	7	21.36	20.42
		8	14	21.36	20.42
		15	0	21.36	20.35
	1732.5	1	0	22.45	21.79
		1	7	22.38	21.79
		1	14	22.43	21.80
		8	0	21.71	20.69
		8	7	21.52	20.53
		8	14	21.66	20.77
		15	0	21.49	20.48
	1753.5	1	0	22.43	21.65
		1	7	22.28	21.61
		1	14	22.38	21.57
		8	0	21.85	20.88
		8	7	21.49	20.42
		8	14	21.78	20.88
		15	0	21.47	20.46
5 MHz	1712.0	1	0	22.46	21.69
		1	12	22.44	21.63
		1	24	22.38	21.64
		12	0	21.42	20.58
		12	6	21.42	20.46

		12	13	21.53	20.94
		25	0	21.38	20.37
	1732.5	1	0	22.58	21.78
		1	12	22.52	21.78
		1	24	22.53	21.77
		12	0	21.89	20.88
		12	6	21.54	20.66
		12	13	21.78	20.86
		25	0	21.50	20.53
	1752.5	1	0	22.59	21.75
		1	12	22.51	21.71
		1	24	22.49	21.64
		12	0	21.56	20.59
		12	6	21.53	20.51
		12	13	21.53	20.55
		25	0	21.48	20.50
10 MHz	1715.0	1	0	22.23	21.68
		1	24	22.31	21.65
		1	49	22.35	21.61
		25	0	21.52	20.71
		25	12	21.39	20.40
		25	25	21.46	20.68
		50	0	21.40	20.41
	1732.5	1	0	22.51	21.88
		1	24	22.50	21.90
		1	49	22.50	21.90
		25	0	21.64	20.71
		25	12	21.52	20.56
		25	25	21.60	20.71
		50	0	21.52	20.57
	1750.0	1	0	22.60	21.85
		1	24	22.55	21.77
		1	49	22.41	21.61
		25	0	21.34	20.66
		25	12	21.45	20.43
		25	25	21.26	20.58
		50	0	21.49	20.51
15 MHz	1717.5	1	0	22.41	21.70
		1	37	22.46	21.66
		1	74	22.40	21.67
		37	0	21.58	20.54
		37	18	21.50	20.46
		37	38	21.52	20.50
		75	0	21.51	20.49
	1732.5	1	0	22.52	21.79
		1	37	22.44	21.75
		1	74	22.51	21.80
		37	0	21.76	20.69
		37	18	21.62	20.61
		37	38	21.68	20.64
		75	0	21.62	20.58
	1747.5	1	0	22.66	21.91
		1	37	22.41	21.82
		1	74	22.45	21.65
		37	0	21.78	20.76
		37	18	21.57	20.52
		37	38	21.65	20.64
		75	0	21.62	20.60
20 MHz	1720.0	1	0	22.56	21.73
		1	49	22.58	21.72
		1	99	22.58	21.75
		50	0	21.48	20.49

		50	25	21.47	20.46
		50	50	21.68	20.33
		100	0	21.45	20.47
	1732.5	1	0	22.60	21.90
		1	49	22.62	21.95
		1	99	22.64	21.98
		50	0	21.56	20.68
		50	25	21.55	20.61
		50	50	21.46	20.65
		100	0	21.55	20.56
	1745.0	1	0	22.54	21.85
		1	49	22.74	21.88
		1	99	22.39	21.65
		50	0	21.88	20.74
		50	25	21.51	20.53
		50	50	21.82	20.68
		100	0	21.58	20.58

## LTE FDD Band 7

TX Channel Bandwidth	Frequency (MHz)	RB Configuration		Average Power [dBm]	
		Size	Offset	QPSK	16QAM
5 MHz	2502.5	1	0	21.56	20.78
		1	12	21.55	20.55
		1	24	21.41	20.64
		12	0	20.74	19.91
		12	6	20.56	19.68
		12	13	20.68	19.77
		25	0	20.48	19.57
	2535.0	1	0	21.59	20.86
		1	12	21.64	20.84
		1	24	21.53	20.79
		12	0	20.77	19.88
		12	6	20.58	19.76
		12	13	20.61	19.76
		25	0	20.53	19.60
	2567.5	1	0	21.41	20.59
		1	12	21.59	20.64
		1	24	21.26	20.29
		12	0	20.91	19.74
		12	6	20.71	19.78
		12	13	20.44	19.88
		25	0	20.67	19.72
10 MHz	2505.0	1	0	21.12	20.46
		1	24	20.88	20.11
		1	49	20.43	19.42
		25	0	20.64	19.74
		25	12	20.32	19.55
		25	25	20.88	19.28
		50	0	20.19	19.42
	2535.0	1	0	21.25	20.71
		1	24	21.06	20.33
		1	49	20.13	19.45
		25	0	20.24	19.55
		25	12	20.24	19.07
		25	25	20.86	19.27
		50	0	20.30	19.58
	2565.0	1	0	20.75	20.03
		1	24	20.34	20.03
		1	49	20.48	19.98
		25	0	20.88	19.77
		25	12	20.41	19.45

		25	25	20.61	19.77
		50	0	20.47	19.51
15 MHz	2507.5	1	0	21.12	20.49
		1	37	20.89	20.26
		1	74	20.68	19.72
		37	0	20.71	19.34
		37	18	20.19	19.18
		37	38	20.56	19.32
		75	0	20.09	19.01
		1	0	21.26	20.64
	2535.0	1	37	21.03	20.55
		1	74	20.74	20.11
		37	0	20.88	19.34
		37	18	20.08	19.06
		37	38	20.36	19.26
		75	0	20.28	19.26
		1	0	20.26	19.28
	2562.5	1	37	20.67	19.88
		1	74	20.52	19.91
		37	0	20.51	19.95
		37	18	20.53	19.49
		37	38	20.45	19.44
		75	0	20.22	19.19
20 MHz	2510.0	1	0	20.06	19.18
		1	49	20.25	19.18
		1	99	20.01	19.11
		50	0	19.99	19.05
		50	25	19.87	19.01
		50	50	19.94	19.09
		100	0	19.90	19.06
	2535.0	1	0	21.41	20.98
		1	49	21.23	20.65
		1	99	20.87	19.03
		50	0	20.34	19.71
		50	25	19.91	19.06
		50	50	20.26	19.68
		100	0	20.06	19.15
	2560.0	1	0	20.06	19.35
		1	49	20.44	19.77
		1	99	20.45	20.03
		50	0	20.56	19.89
		50	25	20.56	19.36
		50	50	20.43	19.33
		100	0	19.98	19.23

**LTE FDD Band 17**

TX Channel Bandwidth	Frequency (MHz)	RB Configuration		Average Power [dBm]	
		Size	Offset	QPSK	16QAM
5 MHz	706.5	1	0	22.67	21.91
		1	12	22.53	21.98
		1	24	22.66	21.94
		12	0	21.79	20.98
		12	6	21.66	20.75
		12	13	21.44	20.86
		25	0	21.65	20.67
	710.0	1	0	22.75	22.03
		1	12	22.68	21.85
		1	24	22.61	21.87
		12	0	21.26	20.94
		12	6	21.65	20.80
		12	13	21.78	20.91

	713.5	25	0	21.63	20.67
		1	0	22.76	21.94
		1	12	22.71	21.94
		1	24	22.56	21.75
		12	0	21.85	20.74
		12	6	21.59	20.58
		12	13	21.69	20.78
		25	0	21.57	20.63
10 MHz	709.0	1	0	22.62	22.05
		1	24	22.56	22.01
		1	49	22.51	21.95
		25	0	21.76	20.78
		25	12	21.62	20.67
		25	25	21.76	20.67
		50	0	21.63	20.71
		50	0	21.63	20.71
	710.0	1	0	22.70	22.01
		1	24	22.44	21.89
		1	49	22.53	21.80
		25	0	21.78	20.37
		25	12	21.58	20.60
		25	25	21.65	20.84
		50	0	21.62	20.67
		50	0	21.62	20.67
	711.0	1	0	22.65	21.96
		1	24	22.59	21.77
		1	49	22.49	21.77
		25	0	21.33	20.86
		25	12	21.60	20.62
		25	25	21.88	20.86
		50	0	21.64	20.66
		50	0	21.64	20.66

## &lt;WLAN 2.4GHz Conducted Power&gt;

Mode	Channel	Frequency (MHz)	Data rate (Mbps)	Average Output Power (dBm)
IEEE 802.11b	1	2412	1	15.12
			2	15.10
			5.5	15.01
			11	14.89
	6	2437	1	15.08
			2	15.00
			5.5	14.91
			11	14.76
	11	2462	1	15.07
			2	15.00
			5.5	14.89
			11	14.73
IEEE 802.11g	1	2412	6	13.35
			9	13.31
			12	13.26
			18	13.20
			24	13.15
			36	13.11
			48	13.05
			54	13.02
	6	2437	6	14.46
			9	14.40
			12	14.33
			18	14.27
			24	14.21
			36	14.17
			48	14.12
			54	14.08



	11	2462	6	13.38
			9	13.29
			12	13.25
			18	13.20
			24	13.16
			36	13.11
			48	13.08
			54	13.00
IEEE 802.11n HT20	1	2412	MCS0	13.24
			MCS1	13.22
			MCS2	13.18
			MCS3	13.18
			MCS4	13.12
			MCS5	13.07
			MCS6	13.06
			MCS7	13.03
	6	2437	MCS0	13.85
			MCS1	13.81
			MCS2	13.81
			MCS3	13.77
			MCS4	13.72
			MCS5	13.66
			MCS6	13.66
			MCS7	13.60
	11	2462	MCS0	13.09
			MCS1	13.05
			MCS2	13.03
			MCS3	13.03
			MCS4	12.97
			MCS5	12.92
			MCS6	12.92
			MCS7	12.90
IEEE 802.11n HT40	3	2422	MCS0	11.68
			MCS1	11.66
			MCS2	11.63
			MCS3	11.63
			MCS4	11.61
			MCS5	11.60
			MCS6	11.56
			MCS7	11.52
	6	2437	MCS0	11.97
			MCS1	11.94
			MCS2	11.94
			MCS3	11.90
			MCS4	11.88
			MCS5	11.85
			MCS6	11.81
			MCS7	11.80
	9	2452	MCS0	11.61
			MCS1	11.58
			MCS2	11.53
			MCS3	11.53
			MCS4	11.50
			MCS5	11.44
			MCS6	11.44
			MCS7	11.41

**Note:** SAR is not required for the following 2.4 GHz OFDM conditions as the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg.

## &lt;Bluetooth Conducted Power&gt;

Mode	Channel	Frequency (MHz)	Conducted Average Power (dBm)
BLE-GFSK	0	2402	-2.51
	19	2440	-2.04
	39	2480	-2.01
GFSK	0	2402	4.12
	39	2441	4.77
	78	2480	4.98
$\pi/4$ DQPSK	0	2402	3.55
	39	2441	3.76
	78	2480	3.98
8DPSK	0	2402	2.91
	39	2441	3.12
	78	2480	3.75

## Manufacturing tolerance

## GSM Speech

GSM 850 (GMSK) (Burst Average Power)			
Channel	Channel 128	Channel 190	Channel 251
Target (dBm)	32.0	32.0	32.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
GSM 1900 (GMSK) (Burst Average Power)			
Channel	Channel 512	Channel 661	Channel 810
Target (dBm)	29.0	29.0	29.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

GSM 850 GPRS (GMSK) (Burst Average Power)				
Channel		128	190	251
1 Txslot	Target (dBm)	32.0	32.0	32.0
	Tolerance $\pm$ (dB)	1.0	1.0	1.0
2 Txslot	Target (dBm)	30.0	30.0	30.0
	Tolerance $\pm$ (dB)	1.0	1.0	1.0
3 Txslot	Target (dBm)	28.0	28.0	28.0
	Tolerance $\pm$ (dB)	1.0	1.0	1.0
4 Txslot	Target (dBm)	27.0	27.0	27.0
	Tolerance $\pm$ (dB)	1.0	1.0	1.0
GSM 1900 GPRS (GMSK) (Burst Average Power)				
Channel		512	661	810
1 Txslot	Target (dBm)	29.0	29.0	29.0
	Tolerance $\pm$ (dB)	1.0	1.0	1.0
2 Txslot	Target (dBm)	27.0	27.0	27.0
	Tolerance $\pm$ (dB)	1.0	1.0	1.0
3 Txslot	Target (dBm)	26.0	26.0	26.0
	Tolerance $\pm$ (dB)	1.0	1.0	1.0
4 Txslot	Target (dBm)	25.0	25.0	25.0
	Tolerance $\pm$ (dB)	1.0	1.0	1.0

## UMTS

UMTS Band V			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	23.0	23.0	23.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band V HSDPA(sub-test 1)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band V HSDPA(sub-test 2)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

UMTS Band V HSDPA(sub-test 3)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band V HSDPA(sub-test 4)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 1)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	21.0	21.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 2)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	20.0	20.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 3)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 4)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	20.0	19.0	19.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band V HSUPA(sub-test 5)			
Channel	Channel 4132	Channel 4182	Channel 4233
Target (dBm)	21.0	21.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

UMTS Band II			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	23.0	23.0	23.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band II HSDPA(sub-test 1)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band II HSDPA(sub-test 2)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band II HSDPA(sub-test 3)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band II HSDPA(sub-test 4)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band II HSUPA(sub-test 1)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.0	21.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band II HSUPA(sub-test 2)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	20.0	20.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band II HSUPA(sub-test 3)			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
UMTS Band II HSUPA(sub-test 4)			

Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	20.0	20.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
<b>UMTS Band II HSUPA(sub-test 5)</b>			
Channel	Channel 9262	Channel 9400	Channel 9538
Target (dBm)	21.5	21.5	21.5
Tolerance $\pm$ (dB)	1.0	1.0	1.0

**LTE Band 2**

<b>BW:1.4MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 18607		Channel 18900		Channel 19193	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:1.4MHz [&lt;RB=3&gt;, &lt;RB=6&gt;]</b>						
Channel	Channel 18607		Channel 18900		Channel 19193	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:3MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 18615		Channel 18900		Channel 19185	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:3MHz [&lt;RB=8&gt;, &lt;RB=15&gt;]</b>						
Channel	Channel 18615		Channel 18900		Channel 19185	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:5MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 18625		Channel 18900		Channel 19175	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:5MHz [&lt;RB=12&gt;, &lt;RB=25&gt;]</b>						
Channel	Channel 18625		Channel 18900		Channel 19175	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:10MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 18650		Channel 18900		Channel 19150	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:10MHz [&lt;RB=25&gt;, &lt;RB=50&gt;]</b>						
Channel	Channel 18650		Channel 18900		Channel 19150	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:15MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 18675		Channel 18900		Channel 19125	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:15MHz [&lt;RB=37&gt;, &lt;RB=75&gt;]</b>						
Channel	Channel 18675		Channel 18900		Channel 19125	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:20MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 18700		Channel 18900		Channel 19100	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM

Target (dBm)	22.0	21.0	22.0	22.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:20MHz [&lt;RB=50&gt;, &lt;RB=100&gt;]</b>						
Channel	Channel 18700		Channel 18900		Channel 19100	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0

**LTE Band 4**

<b>BW:1.4MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 19957		Channel 20175		Channel 20393	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:1.4MHz [&lt;RB=3&gt;, &lt;RB=6&gt;]</b>						
Channel	Channel 19957		Channel 20175		Channel 20393	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:3MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 19965		Channel 20175		Channel 20385	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:3MHz [&lt;RB=8&gt;, &lt;RB=15&gt;]</b>						
Channel	Channel 19965		Channel 20175		Channel 20385	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:5MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 19965		Channel 20175		Channel 20385	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:5MHz [&lt;RB=12&gt;, &lt;RB=25&gt;]</b>						
Channel	Channel 19965		Channel 20175		Channel 20385	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:10MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 20000		Channel 20175		Channel 20350	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:10MHz [&lt;RB=25&gt;, &lt;RB=50&gt;]</b>						
Channel	Channel 20000		Channel 20175		Channel 20350	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:15MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 20025		Channel 20175		Channel 20325	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:15MHz [&lt;RB=37&gt;, &lt;RB=75&gt;]</b>						
Channel	Channel 20025		Channel 20175		Channel 20325	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:20MHz [&lt;RB=1&gt;]</b>						
Channel	Channel 20050		Channel 20175		Channel 20300	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM

Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:20MHz [&lt;RB=50&gt;, &lt;RB=100&gt;]</b>						
Channel	Channel 20050		Channel 20175		Channel 20300	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

**LTE Band 7**

BW:5MHz [ <b>&lt;RB=1&gt;</b> ]						
Channel	Channel 20775		Channel 21100		Channel 21425	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
BW:5MHz [ <b>&lt;RB=12&gt;</b> , <b>&lt;RB=25&gt;</b> ]						
Channel	Channel 20775		Channel 21100		Channel 21425	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	20.0	19.0	20.0	19.0	20.0	19.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
BW:10MHz [ <b>&lt;RB=1&gt;</b> ]						
Channel	Channel 20800		Channel 21100		Channel 21400	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
BW:10MHz [ <b>&lt;RB=25&gt;</b> , <b>&lt;RB=50&gt;</b> ]						
Channel	Channel 20800		Channel 21100		Channel 21400	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	20.0	19.0	20.0	19.0	20.0	19.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
BW:15MHz [ <b>&lt;RB=1&gt;</b> ]						
Channel	Channel 20825		Channel 21100		Channel 21375	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
BW:15MHz [ <b>&lt;RB=37&gt;</b> , <b>&lt;RB=75&gt;</b> ]						
Channel	Channel 20825		Channel 21100		Channel 21375	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	20.0	19.0	20.0	19.0	20.0	19.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
BW:20MHz [ <b>&lt;RB=1&gt;</b> ]						
Channel	Channel 20850		Channel 21100		Channel 21350	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
BW:20MHz [ <b>&lt;RB=50&gt;</b> , <b>&lt;RB=100&gt;</b> ]						
Channel	Channel 20850		Channel 21100		Channel 21350	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	20.0	19.0	20.0	19.0	20.0	19.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0

**LTE Band 17**

BW:5MHz [<RB=1>]						
Channel	Channel 23755		Channel 23790		Channel 23825	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	21.0	22.0	21.0	22.0	21.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
BW:5MHz [<RB=12>, <RB=25>]						
Channel	Channel 23755		Channel 23790		Channel 23825	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance ±(dB)	1.0	1.0	1.0	1.0	1.0	1.0
BW:10MHz [<RB=1>]						

Channel	Channel 23780		Channel 23790		Channel 23800	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	22.0	22.0	22.0	22.0	22.0	22.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0
<b>BW:10MHz [&lt;RB=25&gt;, &lt;RB=50&gt;]</b>						
Channel	Channel 23780		Channel 23790		Channel 23800	
	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM
Target (dBm)	21.0	20.0	21.0	20.0	21.0	20.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0	1.0	1.0	1.0

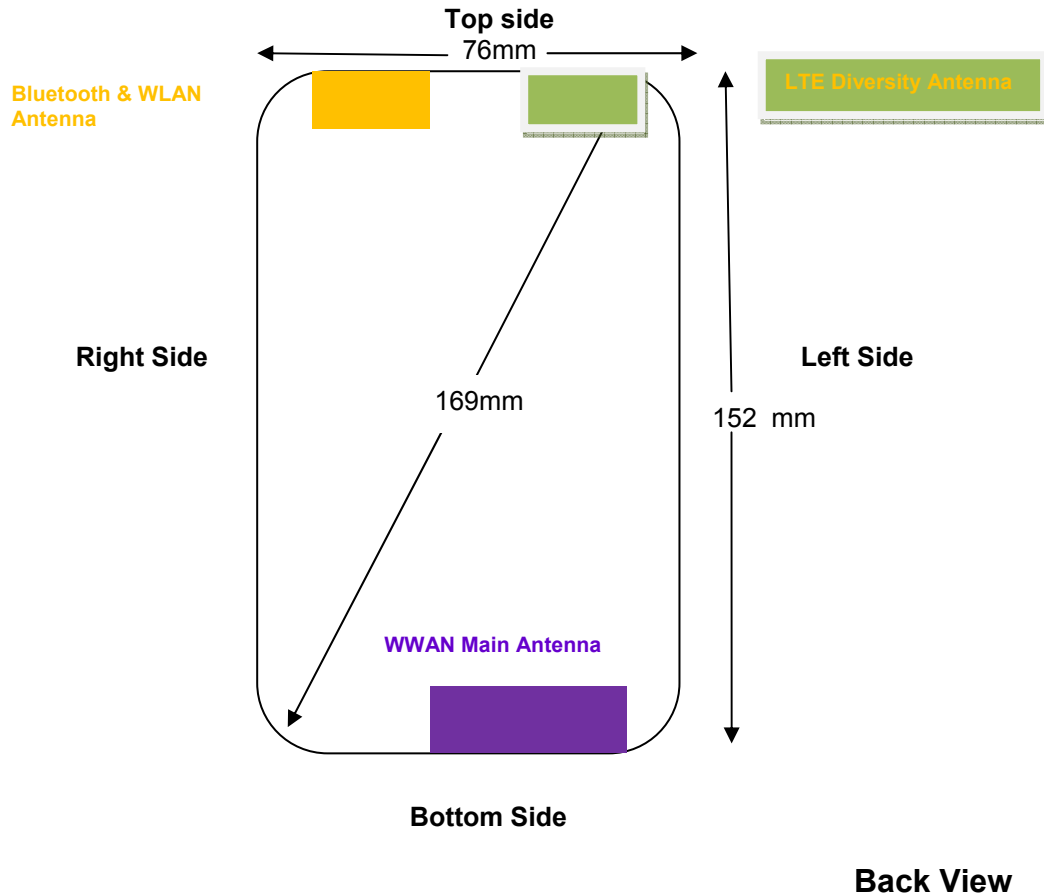
**WiFi**

<b>IEEE 802.11b (Average)</b>			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	15.0	15.0	15.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
<b>IEEE 802.11g (Average)</b>			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.0	14.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
<b>IEEE 802.11n HT20 (Average)</b>			
Channel	Channel 1	Channel 6	Channel 11
Target (dBm)	13.0	13.0	13.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
<b>IEEE 802.11n HT40 (Average)</b>			
Channel	Channel 3	Channel 6	Channel 9
Target (dBm)	11.0	11.0	11.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

**Bluetooth**

<b>BLE-GFSK (Average)</b>			
Channel	Channel 0	Channel 19	Channel 39
Target (dBm)	-2.0	-2.0	-2.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
<b>GFSK (Average)</b>			
Channel	Channel	Channel 39	Channel 78
Target (dBm)	4.0	4.0	4.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
<b>8DPSK (Average)</b>			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	3.0	3.0	3.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0
<b><math>\pi/4</math>DQPSK (Average)</b>			
Channel	Channel 0	Channel 39	Channel 78
Target (dBm)	3.0	3.0	3.0
Tolerance $\pm$ (dB)	1.0	1.0	1.0

## 5.2. Transmit Antennas and SAR Measurement Position



### Antenna information:

WWAN Main Antenna	GSM/UMTS/LTE TX/RX
LTEDiversity antenna	Only RX
WLAN/GPS/BT Antenna	WLAN/BT TX/RX

Distance of The Antenna to the EUT surface and edge						
Antennas	Front	Back	Top Side	Bottom Side	Left Side	Right Side
WWAN	<5mm	<5mm	>25mm	<5mm	<5mm	>25mm
BT&WLAN	<5mm	<5mm	<5mm	>25mm	>25mm	<10mm

Positions for SAR tests; Hotspot mode						
Antennas	Front	Back	Top Side	Bottom Side	Left Side	Right Side
WWAN	Yes	Yes	No	Yes	Yes	No
BT&WLAN	Yes	Yes	Yes	No	No	Yes

### Note:

- 1). Per KDB648474 D04, because the overall diagonal distance of this devices is 169mm > 160mm, it is considered a "Phablet" device.
- 2). Per KDB648474 D04, 10-g extremity SAR is not required when Body-Worn mode 1-g reported SAR < 1.2 W/Kg.
- 3). According to the KDB941225 D06 Hot Spot SAR v02, the edges with less than 2.5 cm distance to the antennas need to be tested for SAR.



**Hotspot mode SAR measurement positions**

Hotspot mode SAR measurement positions						
mode	front	back	left egde	right egde	top egde	bottom egde
GSM 850	yes	yes	yes	no	no	yes
GSM 1900	yes	yes	yes	no	no	yes
UMTS FDD Band V	yes	yes	yes	no	no	yes
UMTS FDD Band II	yes	yes	yes	no	no	yes
LTE FDD Band 2	yes	yes	yes	no	no	yes
LTE FDD Band 4	yes	yes	yes	no	no	yes
LTE FDD Band 7	yes	yes	yes	no	no	yes
LTE FDD Band 17	yes	yes	yes	no	no	yes
WiFi2450	yes	yes	no	yes	yes	no

**5.3. Standalone SAR Test Exclusion Considerations**

Per KDB447498 for standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at test separation distances  $\leq 50$  mm are determined by::

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for 10-g extremity SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison
- 3.0 and 7.5 are referred to as the numeric thresholds in the step 2 below

**Standalone SAR test exclusion considerations**

Communication system	Frequency (MHz)	Configuration	Maximum Average Power (dBm)	Separation Distance (mm)	Calculation Result	SAR Exclusion Thresholds	Standalone SAR Exclusion
GSM 850	850	Head	23.97	5	45.9	3.0	no
		Body*	24.99	10	75.2	3.0	no
GSM 1900	1900	Head	20.97	5	34.5	3.0	no
		Body*	22.99	10	27.5	3.0	no
UMTS Band V	850	Head	24.00	5	46.2	3.0	no
		Body*	24.00	10	23.1	3.0	no
UMTS Band II	1900	Head	24.00	5	69.3	3.0	no
		Body*	24.00	10	34.7	3.0	no
LTE Band 2	1900	Head	23.00	5	55.1	3.0	no
		Body*	23.00	10	27.5	3.0	no
LTE Band 4	1750	Head	23.00	5	52.6	3.0	no
		Body*	23.00	10	26.3	3.0	no
LTE Band 7	2600	Head	22.00	5	51.0	3.0	no
		Body*	22.00	10	25.5	3.0	no
LTE Band 17	750	Head	23.00	5	34.7	3.0	no
		Body*	23.00	10	17.4	3.0	no

**Remark:**

1. WiFi 2450 and Bluetooth Standalone SAR Test Exclusion Considerations for another table per KDB248227 D01.
2. Maximum average power including tune-up tolerance;
3. When the minimum test separation distance is  $< 5$  mm, a distance of 5 mm is applied to determine SAR test exclusion
4. Body including Hotspot mode as body use distance is 10mm from manufacturer declaration of user manual.

Standalone SAR test exclusion considerations							
Modulation	Frequency (MHz)	Configuration	Maximum Average Power (dBm)	Separation Distance (mm)	Calculation Result	SAR Exclusion Thresholds	Standalone SAR Exclusion
IEEE 802.11b	2450	Head	16.00	5	12.4	3.0	no
		Body*	16.00	10	6.2	3.0	no
IEEE 802.11g	2450	Head	15.00	5	9.9	3.0	no
		Body*	15.00	10	4.9	3.0	no
IEEE 802.11n HT20	2450	Head	14.00	5	7.8	3.0	no
		Body*	14.00	10	3.9	3.0	no
IEEE 802.11n HT40	2450	Head	12.00	5	4.9	3.0	no
		Body*	12.00	10	2.5	3.0	yes
Bluetooth*	2450	Head	5.00	5	1.0	3.0	yes
		Body*	5.00	10	0.5	3.0	yes

Remark:

1. Maximum average power including tune-up tolerance;
2. Bluetooth including Lower Energy Bluetooth and classical Bluetooth;
3. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion
4. Body including Hotspot mode as body use distance is 10mm from manufacturer declaration of user manual.

## 5.4. Estimated SAR

Per KDB447498 requires when the standalone SAR test exclusion of section 4.3.1 is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion;

- (max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [ √ f(GHz)/x] W/kg for test separation distances ≤ 50 mm;  
where x = 7.5 for 1-g SAR, and x = 18.75 for 10-g SAR.
- 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is > 50 mm

Per FCC KD B447498 D01, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the transmitting antenna in a specific a physical test configuration is ≤1.6 W/Kg. When the sum is greater than the SAR limit, SAR test exclusion is determined by the SAR to peak location separation ratio.

$$\text{Ratio} = \frac{(\text{SAR}_1 + \text{SAR}_2)^{1.5}}{(\text{peak location separation, mm})} < 0.04$$

Estimated stand alone SAR					
Communication system	Frequency (MHz)	Configuration	Maximum Power (dBm)	Separation Distance (mm)	Estimated SAR <sub>1-g</sub> (W/kg)
Bluetooth*	2450	Head	5.00	5	0.132
Bluetooth*	2450	Hotspot	5.00	10	0.066
Bluetooth*	2450	Body Worn	5.00	10	0.066

Remark:

1. Maximum average power including tune-up tolerance;
2. Bluetooth including Lower Energy Bluetooth and classical Bluetooth;
3. When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion
4. Body including Hotspot mode as body use distance is 10mm from manufacturer declaration of user manual.

## 5.5. SAR Measurement Results

It is determined by user manual for the distance between the EUT and the phantom bottom.

The distance is 10mm and just applied to the condition of body worn accessory.

The calculated SAR is obtained by the following formula:

$$\text{Reported SAR} = \text{Measured SAR} \times 10^{(P_{\text{Target}} - P_{\text{Measured}})/10}$$

Where  $P_{\text{Target}}$  is the power of manufacturing upper limit;

$P_{\text{Measured}}$  is the measured power

SAR measured at SIM 1 as power highest at SIM 1;

Duty Cycle

Mode	Duty Cycle
Speech for GSM850/1900	1:8
GPRS for GSM850	1:4
GPRS for GSM1900	1:2
WCDMA850/1900	1:1
LTE	1:1
WiFi	1:1

SAR Values [GSM 850]

Ch.	Freq. (MHz)	Time slots	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power drift	Scaling Factor	SAR <sub>1-g</sub> results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Head										
251	848.8	GSM	Right Cheek	32.11	33.00	-0.04	1.227	0.284	0.348	#1
251	848.8	GSM	Right Tilt	32.11	33.00	-0.12	1.227	0.203	0.249	
251	848.8	GSM	Left Cheek	32.11	33.00	-0.04	1.227	0.267	0.328	
251	848.8	GSM	Left Tilt	32.11	33.00	-0.08	1.227	0.184	0.226	
measured / reported SAR numbers - Body (hotspot open, distance 10mm)										
251	848.8	4Txslots	Front	27.43	28.00	-0.01	1.140	0.343	0.391	
251	848.8	4Txslots	Back	27.43	28.00	-0.16	1.140	0.572	0.652	#2
251	848.8	4Txslots	Left Side	27.43	28.00	-0.05	1.140	0.312	0.356	
251	848.8	4Txslots	Bottom Side	27.43	28.00	-0.17	1.140	0.184	0.210	

SAR Values [GSM 1900]

Ch.	Freq. (MHz)	time slots	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power drift	Scaling Factor	SAR <sub>1-g</sub> results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Head										
810	1909.8	GSM	Right Cheek	29.91	30.00	-0.10	1.021	0.117	0.119	#3
810	1909.8	GSM	Right Tilt	29.91	30.00	0.11	1.021	0.016	0.016	
810	1909.8	GSM	Left Cheek	29.91	30.00	0.03	1.021	0.079	0.081	
810	1909.8	GSM	Left Tilt	29.91	30.00	-0.04	1.021	0.026	0.027	
measured / reported SAR numbers – Body (hotspot open, distance 10mm)										
810	1909.8	4Txslots	Front	25.35	26.00	-0.10	1.161	0.412	0.478	
810	1909.8	4Txslots	Back	25.35	26.00	0.10	1.161	0.687	0.798	#4
810	1909.8	4Txslots	Left Side	25.35	26.00	-0.14	1.161	0.157	0.182	
810	1909.8	4Txslots	Bottom Side	25.35	26.00	0.04	1.161	0.579	0.672	

## SAR Values [WCDMA Band V]

Ch.	Freq. (MHz)	Channel Type	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power drift	Scaling Factor	SAR <sub>1-g</sub> results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Head										
4183	836.6	RMC	Right Cheek	23.55	24.00	-0.16	1.109	0.198	0.220	#5
4183	836.6	RMC	Right Tilt	23.55	24.00	-0.18	1.109	0.141	0.156	
4183	836.6	RMC	Left Cheek	23.55	24.00	0.14	1.109	0.172	0.191	
4183	836.6	RMC	Left Tilt	23.55	24.00	-0.13	1.109	0.132	0.146	
measured / reported SAR numbers - Body (hotspot open, distance 10mm)										
4183	836.6	RMC	Front	23.55	24.00	-0.11	1.109	0.204	0.226	
4183	836.6	RMC	Back	23.55	24.00	0.05	1.109	0.342	0.379	#6
4183	836.6	RMC	Left Side	23.55	24.00	-0.14	1.109	0.231	0.256	
4183	836.6	RMC	Bottom Side	23.55	24.00	-0.12	1.109	0.117	0.130	
measured / reported SAR numbers – Body worn (distance 10mm)										

## SAR Values [WCDMA Band II]

Ch.	Freq. (MHz)	Channel Type	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power drift	Scaling Factor	SAR <sub>1-g</sub> results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Head										
9262	1852.4	RMC	Right Cheek	23.46	24.00	-0.19	1.133	0.284	0.322	#7
9262	1852.4	RMC	Right Tilt	23.46	24.00	0.16	1.333	0.114	0.152	
9262	1852.4	RMC	Left Cheek	23.46	24.00	0.10	1.133	0.231	0.262	
9262	1852.4	RMC	Left Tilt	23.46	24.00	-0.18	1.333	0.106	0.141	
measured / reported SAR numbers - Body (hotspot open, distance 10mm)										
9262	1852.4	RMC	Front	23.46	24.00	-0.06	1.133	0.449	0.509	
9262	1852.4	RMC	Back	23.46	24.00	0.06	1.133	0.745	0.844	#8
9400	1880.0			23.17	24.00	0.11	1.211	0.811	0.982	
9538	1907.6			23.38	24.00	-0.04	1.154	0.575	0.664	
9262	1852.4	RMC	Left Side	23.46	24.00	0.09	1.133	0.072	0.082	
9262	1852.4	RMC	Bottom Side	23.46	24.00	-0.19	1.133	0.547	0.729	
9400*	1880.0	RMC	Back	23.17	24.00	-0.05	1.211	0.805	0.975	

Remark:

1. \* states first repeat measurement.

## SAR Values [LTE Band 2]

Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power drift	Scaling Factor	SAR <sub>1-g</sub> results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Head										
18900	1880	1RB	Right Cheek	22.81	23.00	-0.11	1.045	0.304	0.318	#9
18900	1880	1RB	Right Tilt	22.81	23.00	-0.06	1.045	0.124	0.130	
18900	1880	1RB	Left Cheek	22.81	23.00	-0.12	1.045	0.187	0.195	
18900	1880	1RB	Left Tilt	22.81	23.00	-0.15	1.045	0.098	0.102	
18700	1860	50%RB	Right Cheek	21.91	22.00	0.13	1.021	0.275	0.281	
18700	1860	50%RB	Right Tilt	21.91	22.00	0.11	1.021	0.101	0.103	
18700	1860	50%RB	Left Cheek	21.91	22.00	0.18	1.021	0.163	0.166	
18700	1860	50%RB	Left Tilt	21.91	22.00	-0.06	1.021	0.071	0.072	
measured / reported SAR numbers - Body (hotspot open, distance 10mm)										
18900	1880	1RB	Front	22.81	23.00	-0.02	1.045	0.378	0.395	#10
18900	1880	1RB	Back	22.81	23.00	-0.10	1.045	0.533	0.557	
18900	1880	1RB	Left Side	22.81	23.00	-0.06	1.045	0.115	0.120	
18900	1880	1RB	Bottom Side	22.81	23.00	0.11	1.045	0.312	0.326	
18700	1860	50%RB	Front	21.91	22.00	0.09	1.021	0.312	0.319	
18700	1860	50%RB	Back	21.91	22.00	0.08	1.021	0.448	0.457	
18700	1860	50%RB	Left Side	21.91	22.00	0.04	1.021	0.102	0.104	
18700	1860	50%RB	Bottom Side	21.91	22.00	-0.07	1.021	0.331	0.338	

## SAR Values [LTE Band 4]

Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power drift	Scaling Factor	SAR <sub>1-g</sub> results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Head										
20300	1745.0	1RB	Right Cheek	22.74	23.00	-0.11	1.062	0.069	0.073	#11
20300	1745.0	1RB	Right Tilt	22.74	23.00	-0.06	1.062	0.042	0.045	
20300	1745.0	1RB	Left Cheek	22.74	23.00	-0.12	1.062	0.062	0.066	
20300	1745.0	1RB	Left Tilt	22.74	23.00	-0.15	1.062	0.038	0.040	
20300	1745.0	50%RB	Right Cheek	21.88	22.00	0.13	1.028	0.058	0.060	
20300	1745.0	50%RB	Right Tilt	21.88	22.00	0.11	1.028	0.033	0.034	
20300	1745.0	50%RB	Left Cheek	21.88	22.00	0.18	1.028	0.056	0.058	
20300	1745.0	50%RB	Left Tilt	21.88	22.00	-0.06	1.028	0.030	0.031	
measured / reported SAR numbers - Body (hotspot open, distance 10mm)										
20300	1745.0	1RB	Front	22.74	23.00	-0.02	1.062	0.176	0.187	
20300	1745.0	1RB	Back	22.74	23.00	-0.10	1.062	0.310	0.329	#12
20300	1745.0	1RB	Left Side	22.74	23.00	-0.06	1.062	0.087	0.092	
20300	1745.0	1RB	Bottom Side	22.74	23.00	0.11	1.062	0.214	0.227	
20300	1745.0	50%RB	Front	21.88	22.00	0.09	1.028	0.137	0.141	
20300	1745.0	50%RB	Back	21.88	22.00	0.08	1.028	0.241	0.248	
20300	1745.0	50%RB	Left Side	21.88	22.00	0.04	1.028	0.064	0.066	
20300	1745.0	50%RB	Bottom Side	21.88	22.00	-0.07	1.028	0.184	0.189	

## SAR Values [LTE Band 7]

Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power drift	Scaling Factor	SAR <sub>1-g</sub> results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Head										
21100	2535.0	1RB	Right Cheek	21.41	22.00	-0.11	1.146	0.094	0.108	#13
21100	2535.0	1RB	Right Tilt	21.41	22.00	-0.06	1.146	0.057	0.065	
21100	2535.0	1RB	Left Cheek	21.41	22.00	-0.12	1.146	0.083	0.095	
21100	2535.0	1RB	Left Tilt	21.41	22.00	-0.11	1.146	0.051	0.058	
21350	2560	50%RB	Right Cheek	20.56	21.00	-0.06	1.107	0.087	0.097	
21350	2560	50%RB	Right Tilt	20.56	21.00	-0.12	1.107	0.05	0.055	
21350	2560	50%RB	Left Cheek	20.56	21.00	-0.15	1.107	0.075	0.083	
21350	2560	50%RB	Left Tilt	20.56	21.00	-0.06	1.107	0.046	0.051	
measured / reported SAR numbers - Body (hotspot open, distance 10mm)										
21100	2535.0	1RB	Front	21.41	22.00	-0.02	1.146	0.178	0.204	#14
21100	2535.0	1RB	Back	21.41	22.00	0.11	1.146	0.724	0.830	
20050	2510.0			20.25	22.00	-0.09	1.497	0.514	0.769	
20300	2560.0			20.45	22.00	0.01	1.429	0.572	0.817	
21100	2535.0	1RB	Left Side	21.41	22.00	0.09	1.146	0.103	0.118	
21100	2535.0	1RB	Bottom Side	21.41	22.00	0.11	1.146	0.561	0.643	
21350	2560	50%RB	Front	20.56	21.00	0.09	1.107	0.146	0.162	
21350	2560	50%RB	Back	20.56	21.00	0.08	1.107	0.657	0.727	
21350	2560	50%RB	Left Side	20.56	21.00	0.04	1.107	0.089	0.098	
21350	2560	50%RB	Bottom Side	20.56	21.00	-0.07	1.107	0.445	0.492	

## SAR Values [LTE Band 17]

Ch.	Freq. (MHz)	Channel Type (20M)	Test Position	Conducted Power (dBm)	Maximum Allowed Power (dBm)	Power drift	Scaling Factor	SAR <sub>1-g</sub> results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Head										
23790	710.0	1RB	Right Cheek	22.70	23.00	-0.06	1.072	0.125	0.134	#15
23790	710.0	1RB	Right Tilt	22.70	23.00	0.11	1.072	0.091	0.098	
23790	710.0	1RB	Left Cheek	22.70	23.00	-0.11	1.072	0.112	0.120	
23790	710.0	1RB	Left Tilt	22.70	23.00	-0.06	1.072	0.085	0.091	
23800	711.0	50%RB	Right Cheek	21.88	22.00	0.09	1.028	0.095	0.098	
23800	711.0	50%RB	Right Tilt	21.88	22.00	-0.06	1.028	0.064	0.066	
23800	711.0	50%RB	Left Cheek	21.88	22.00	0.11	1.028	0.102	0.105	
23800	711.0	50%RB	Left Tilt	21.88	22.00	-0.06	1.028	0.075	0.077	
measured / reported SAR numbers - Body (hotspot open, distance 10mm)										
23790	710.0	1RB	Front	22.70	23.00	-0.10	1.072	0.212	0.227	#16
23790	710.0	1RB	Back	22.70	23.00	0.09	1.072	0.301	0.323	
23790	710.0	1RB	Left Side	22.70	23.00	0.08	1.072	0.257	0.275	
23790	710.0	1RB	Bottom Side	22.70	23.00	0.11	1.072	0.077	0.083	
23800	711.0	50%RB	Front	21.88	22.00	0.09	1.028	0.158	0.162	
23800	711.0	50%RB	Back	21.88	22.00	0.08	1.028	0.178	0.183	
23800	711.0	50%RB	Left Side	21.88	22.00	0.04	1.028	0.166	0.171	
23800	711.0	50%RB	Bottom Side	21.88	22.00	-0.07	1.028	0.061	0.063	

## SAR Values [WIFI2.4G]

Ch.	Freq. (MHz)	Service	Test Position	Maximum Allowed Power (dBm)	Conducted Power (dBm)	Power drift	Scaling Factor	SAR <sub>1-g</sub> results(W/kg)		Graph Results
								Measured	Reported	
measured / reported SAR numbers - Head										
1	2412	DSSS	Right Cheek	15.12	16.00	0.03	1.225	0.104	0.127	#17
1	2412	DSSS	Right Tilt	15.12	16.00	-0.16	1.225	0.075	0.092	
1	2412	DSSS	Left Cheek	15.12	16.00	0.12	1.225	0.051	0.062	
1	2412	DSSS	Left Tilt	15.12	16.00	-0.09	1.225	0.021	0.026	
measured / reported SAR numbers - Body (hotspot open, distance 10mm)										
1	2412	DSSS	Front	15.12	16.00	-0.12	1.225	0.314	0.385	
1	2412	DSSS	Back	15.12	16.00	0.10	1.225	0.407	0.499	#18
1	2412	DSSS	Right Side	15.12	16.00	-0.08	1.225	0.046	0.056	
1	2412	DSSS	Top Side	15.12	16.00	-0.01	1.225	0.203	0.249	

Note:

1. The value with black color is the maximum Reported SAR Value of each test band.
2. Per FCC KDB Publication 447498 D01, if the reported (scaled) SAR measured at the middle channel or highest output power channel for each test configuration is  $\leq 0.8$  W/kg then testing at the other channels is optional for such test configuration(s).
3. Per KDB 941225 D02, RMC 12.2kbps setting is used to evaluate SAR. If HSDPA/HSUPA output power is  $< 0.25$  dB higher than RMC, or reported SAR with RMC 12.2kbps setting is  $\leq 1.2$  W/kg, HSDPA/HSUPA SAR evaluation can be excluded.
4. Per KDB 941225 D05, 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
5. Per KDB 941225 D05, 50% RB allocation for QPSK SAR testing follows 1RB QPSK allocation procedure.
6. Per KDB 941225 D05, 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 are  $\leq 0.8$  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.
7. Per KDB 941225 D05, 16QAM output power for each RB allocation configuration is  $>$  not  $\frac{1}{2}$  dB higher than the same configuration in QPSK and the reported SAR for the QPSK configuration is  $\leq 1.45$  W/kg; Per KDB 941225 D05, 16QAM SAR testing is not required.
8. Per KDB 941225 D05, Smaller bandwidth output power for each RB allocation configuration is  $>$  not  $\frac{1}{2}$  dB higher than the same configuration in the largest supported bandwidth, and the reported SAR for the largest supported bandwidth is  $\leq 1.45$  W/kg; Per KDB 941225 D05, smaller bandwidth SAR testing is not required.

9. Per KDB 248227-SAR is measured using the highest measured maximum output power channel for the initial test configuration.

10. Per KDB 248227- Channels with measured maximum output power within ¼ dB of each other are considered to have the same maximum output, When there are multiple test channels with the same measured maximum output power, the channel closest to mid-band frequency is selected for SAR measurement. And when there are multiple test channels with the same measured maximum output power and equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.

11. Per KDB 248227- When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2$  W/kg.

12. Per KDB 648474 D04, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is  $\leq 1.2$  W/kg, SAR testing with a headset connected to the handset is not required.

13. Per KDB648474 D04 require when the separation distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, using the same wireless mode test configuration for voice and data, such as UMTS, LTE and Wi-Fi, and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface)

## 5.6. Simultaneous TX SAR Considerations

### 5.6.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

For the DUT, the BT and WiFi modules sharing same antenna, GSM and WCDMA module sharing a single antenna;

Application Simultaneous Transmission information:

Air-Interface	Band (MHz)	Type	Simultaneous Transmissions	Voice over Digital Transport(Data)
GSM	850	VO	Yes, WLAN or BT/BLE	N/A
	1900	VO		
	GPRS/EDGE	DT	Yes, WLAN or BT/BLE	N/A
WCDMA	Band V/II	DT	Yes, WLAN or BT/BLE	N/A
LTE	Band 2/4/7/17	DT	Yes, WLAN or BT/BLE	N/A
WLAN	2450	DT	Yes, GSM, GPRS, EDGE, UMTS	Yes
BT/BLE	2450	DT	Yes, GSM, GPRS, EDGE, UMTS	N/A

Note: VO-Voice Service only; DT-Digital Transport

Note: BT and WLAN can be active at the same time, but only with interleaving of packages switched on board level. That means that they don't transmit at the same time.

BLE-Bluetooth low energy;

BT- Classical Bluetooth

### 5.6.2 Evaluation of Simultaneous SAR

#### Head Exposure Conditions

Simultaneous transmission SAR for WiFi and GSM/WCDMA

Test Position	GSM850 Reported SAR <sub>1-g</sub> (W/Kg)	GSM1900 Reported SAR <sub>1-g</sub> (W/Kg)	WCDMA Band V Reported SAR <sub>1-g</sub> (W/Kg)	WCDMA Band II Reported SAR <sub>1-g</sub> (W/Kg)	WiFi Reported SAR <sub>1-g</sub> (W/Kg)	MAX. $\Sigma$ SAR <sub>1-g</sub> (W/Kg)	SAR <sub>1-g</sub> Limit (W/Kg)	Peak location separation ratio	Simut. Meas. Required
Right Cheek	0.348	0.119	0.220	0.322	0.127	0.475	1.6	no	no
Right Tilt	0.249	0.016	0.156	0.152	0.092	0.341	1.6	no	no
Left Cheek	0.328	0.081	0.191	0.262	0.062	0.390	1.6	no	no
Left Tilt	0.226	0.027	0.146	0.141	0.026	0.252	1.6	no	no

## Simultaneous transmission SAR for WiFi and LTE

Test Position	LTE Band2 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band4 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band7 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band17 Reported SAR <sub>1-g</sub> (W/Kg)	WiFi Reported SAR <sub>1-g</sub> (W/Kg)	MAX. ΣSAR <sub>1-g</sub> (W/Kg)	SAR <sub>1-g</sub> Limit (W/Kg)	Peak location separation ratio	Simut. Meas. Required
Right Cheek	<b>0.318</b>	<b>0.073</b>	<b>0.108</b>	<b>0.134</b>	<b>0.127</b>	<b>0.445</b>	1.6	no	no
Right Tilt	0.130	0.045	0.065	0.098	0.092	0.222	1.6	no	no
Left Cheek	0.195	0.066	0.095	0.120	0.062	0.257	1.6	no	no
Left Tilt	0.102	0.040	0.058	0.091	0.026	0.128	1.6	no	no

## Simultaneous transmission SAR for Bluetooth and GSM/WCDMA

Test Position	GSM850 Reported SAR <sub>1-g</sub> (W/Kg)	GSM1900 Reported SAR <sub>1-g</sub> (W/Kg)	WCDMA Band V Reported SAR <sub>1-g</sub> (W/Kg)	WCDMA Band II Reported SAR <sub>1-g</sub> (W/Kg)	Bluetooth Estimated SAR <sub>1-g</sub> (W/Kg)	MAX. ΣSAR <sub>1-g</sub> (W/Kg)	SAR <sub>1-g</sub> Limit (W/Kg)	Peak location separation ratio	Simut. Meas. Required
Right Cheek	<b>0.348</b>	<b>0.119</b>	<b>0.220</b>	<b>0.322</b>	0.132	<b>0.480</b>	1.6	no	no
Right Tilt	0.249	0.016	0.156	0.152	0.132	0.381	1.6	no	no
Left Cheek	0.328	0.081	0.191	0.262	0.132	0.460	1.6	no	no
Left Tilt	0.226	0.027	0.146	0.141	0.132	0.358	1.6	no	no

## Simultaneous transmission SAR for Bluetooth and LTE

Test Position	LTE Band2 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band4 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band7 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band17 Reported SAR <sub>1-g</sub> (W/Kg)	Bluetooth Estimated SAR <sub>1-g</sub> (W/Kg)	MAX. ΣSAR <sub>1-g</sub> (W/Kg)	SAR <sub>1-g</sub> Limit (W/Kg)	Peak location separation ratio	Simut. Meas. Required
Right Cheek	<b>0.318</b>	<b>0.073</b>	<b>0.108</b>	<b>0.134</b>	0.132	<b>0.450</b>	1.6	no	no
Right Tilt	0.130	0.045	0.065	0.098	0.132	0.262	1.6	no	no
Left Cheek	0.195	0.066	0.095	0.120	0.132	0.327	1.6	no	no
Left Tilt	0.102	0.040	0.058	0.091	0.132	0.234	1.6	no	no

**Hotspot Exposure Conditions**

## Simultaneous transmission SAR for WiFi and GSM/WCDMA

Test Position	GSM850 Reported SAR <sub>1-g</sub> (W/Kg)	GSM1900 Reported SAR <sub>1-g</sub> (W/Kg)	WCDMA Band V Reported SAR <sub>1-g</sub> (W/Kg)	WCDMA Band II Reported SAR <sub>1-g</sub> (W/Kg)	WiFi Reported SAR <sub>1-g</sub> (W/Kg)	MAX. ΣSAR <sub>1-g</sub> (W/Kg)	SAR <sub>1-g</sub> Limit (W/Kg)	Peak location separation ratio	Simut. Meas. Required
Front	0.391	0.478	0.226	0.509	0.385	0.894	1.6	no	no
Back	<b>0.652</b>	<b>0.798</b>	<b>0.379</b>	<b>0.982</b>	<b>0.407</b>	<b>1.389</b>	1.6	no	no
Left Side	0.356	0.182	0.256	0.082	/	0.356	1.6	no	no
Right Side	/	/	/	/	0.056	0.056	1.6	no	no
Bottom Side	0.210	0.672	0.130	0.729	/	0.729	1.6	no	no
Top Side	/	/	/	/	0.249	0.249	1.6	no	no

## Simultaneous transmission SAR for WiFi and LTE

Test Position	LTE Band2 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band4 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band7 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band17 Reported SAR <sub>1-g</sub> (W/Kg)	WiFi Reported SAR <sub>1-g</sub> (W/Kg)	MAX. ΣSAR <sub>1-g</sub> (W/Kg)	SAR <sub>1-g</sub> Limit (W/Kg)	Peak location separation ratio	Simut. Meas. Required
Front	0.395	0.187	0.204	0.227	0.385	0.780	1.6	no	no
Back	<b>0.557</b>	<b>0.329</b>	<b>0.830</b>	<b>0.323</b>	<b>0.407</b>	<b>1.237</b>	1.6	no	no
Left Side	0.120	0.092	0.118	0.275	/	0.275	1.6	no	no
Right Side	/	/	/	/	0.056	0.056	1.6	no	no
Bottom Side	0.338	0.227	0.643	0.083	/	0.643	1.6	no	no
Top Side	/	/	/	/	0.249	0.249	1.6	no	no



**Simultaneous transmission SAR for Bluetooth and GSM/WCDMA**

Test Position	GSM850 Reported SAR <sub>1-g</sub> (W/Kg)	GSM1900 Reported SAR <sub>1-g</sub> (W/Kg)	WCDMA Band V Reported SAR <sub>1-g</sub> (W/Kg)	WCDMA Band II Reported SAR <sub>1-g</sub> (W/Kg)	Bluetooth Estimated SAR <sub>1-g</sub> (W/Kg)	MAX. ΣSAR <sub>1-g</sub> (W/Kg)	SAR <sub>1-g</sub> Limit (W/Kg)	Peak location separation ratio	Simut. Meas. Required
Front	0.391	0.478	0.226	0.509	0.066	0.575	1.6	no	no
Back	<b>0.652</b>	<b>0.798</b>	<b>0.379</b>	<b>0.982</b>	<b>0.066</b>	<b>1.048</b>	1.6	no	no
Left Side	0.356	0.182	0.256	0.082	/	0.356	1.6	no	no
Right Side	/	/	/	/	0.066	0.066	1.6	no	no
Bottom Side	0.210	0.672	0.130	0.729	/	0.729	1.6	no	no
Top Side	/	/	/	/	0.066	0.066	1.6	no	no

**Simultaneous transmission SAR for Bluetooth and LTE**

Test Position	LTE Band2 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band4 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band7 Reported SAR <sub>1-g</sub> (W/Kg)	LTE Band17 Reported SAR <sub>1-g</sub> (W/Kg)	Bluetooth Estimated SAR <sub>1-g</sub> (W/Kg)	MAX. ΣSAR <sub>1-g</sub> (W/Kg)	SAR <sub>1-g</sub> Limit (W/Kg)	Peak location separation ratio	Simut. Meas. Required
Front	0.395	0.187	0.204	0.227	0.066	0.461	1.6	no	no
Back	<b>0.557</b>	<b>0.329</b>	<b>0.830</b>	<b>0.323</b>	<b>0.066</b>	<b>0.896</b>	1.6	no	no
Left Side	0.120	0.092	0.118	0.275	/	0.892	1.6	no	no
Right Side	/	/	/	/	0.066	0.066	1.6	no	no
Bottom Side	0.338	0.227	0.643	0.083	/	0.643	1.6	no	no
Top Side	/	/	/	/	0.066	0.066	1.6	no	no

Note:

1. The WiFi and BT share same antenna, so cannot transmit at same time.
2. The value with block color is the maximum values of standalone
3. The value with blue color is the maximum values of ΣSAR<sub>1-g</sub>

**5.7. General description of test procedures**

1. The DUT is tested using CMU 200 communications testers as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted peak power.
2. Test positions as described in the tables above are in accordance with the specified test standard.
3. Tests in body position were performed in that configuration, which generates the highest time based averaged output power (see conducted power results).
4. Tests in head position with GSM were performed in voice mode with 1 timeslot unless GPRS/EGPRS/DTM function allows parallel voice and data traffic on 2 or more timeslots.
5. UMTS was tested in RMC mode with 12.2 kbit/s and TPC bits set to 'all 1'.
6. WiFi was tested in 802.11b/g/n mode with 1 Mbit/s and 6 Mbit/s. According to KDB 248227 the SAR testing for 802.11g/n is not required since When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.
7. Required WiFi test channels were selected according to KDB 248227
8. According to FCC KDB pub 248227 D01, When there are multiple test channels with the same measured maximum output power, the channel closest to mid-band frequency is selected for SAR measurement and when there are multiple test channels with the same measured maximum output power and equal separation from mid-band frequency; for example, high and low channels or two mid-band channels, the higher frequency (number) channel is selected for SAR measurement.
9. According to FCC KDB pub 941225 D06 this device has been tested with 10 mm distance to the phantom for operation in WiFi hot spot mode.
10. Per FCC KDB pub 941225 D06 the edges with antennas within 2.5 cm are required to be evaluated for SAR to cover WiFi hot spot function.
11. According to IEEE 1528 the SAR test shall be performed at middle channel. Testing of top and bottom channel is optional.
12. According to KDB 447498 D01 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:
  - ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
  - ≤ 0.6 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
  - ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz
13. IEEE 1528-2013 require the middle channel to be tested first. This generally applies to wireless devices that are designed to operate in technologies with tight tolerances for maximum output power variations across channels in the band. When the maximum output power variation across the required test channels is > ½ dB, instead of the middle channel, the highest output power channel must be used.

14. Per KDB648474 D04 require when the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is  $< 1.2$  W/kg.
15. Per KDB648474 D04 require when the separation distance required for body-worn accessory testing is larger than or equal to that tested for hotspot mode, using the same wireless mode test configuration for voice and data, such as UMTS, LTE and Wi-Fi, and for the same surface of the phone, the hotspot mode SAR data may be used to support body-worn accessory SAR compliance for that particular configuration (surface)
16. 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g SAR  $> 1.2$  W/kg.
17. Per KDB648474 D04 require for phablet SAR test considerations, For smart phones with a display diagonal dimension  $> 15.0$  cm or an overall diagonal dimension  $> 16.0$  cm, 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.
18. 10-g extremity SAR is required only for the surfaces and edges with hotspot mode 1-g SAR  $> 1.2$  W/kg.

## 5.8. SAR Measurement Variability

According to KDB865664, Repeated measurements are required only when the measured SAR is  $\geq 0.80$  W/kg. If the measured SAR value of the initial repeated measurement is  $< 1.45$  W/kg with  $\leq 20\%$  variation, only one repeated measurement is required to reaffirm that the results are not expected to have substantial variations, which may introduce significant compliance concerns. A second repeated measurement is required only if the measured result for the initial repeated measurement is within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties. The following procedures are applied to determine if repeated measurements are required. 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.<sup>19</sup> The repeated measurement results must be clearly identified in the SAR report. All measured SAR, including the repeated results, must be considered to determine compliance and for reporting according to KDB 690783. Repeated measurement is not required when the original highest measured SAR is  $< 0.80$  W/kg; steps 2) through 4) do not apply.

- 1) When the original highest measured SAR is  $\geq 0.80$  W/kg, repeat that measurement once.
- 2) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is  $> 1.20$  or when the original or repeated measurement is  $\geq 1.45$  W/kg ( $\sim 10\%$  from the 1-g SAR limit).
- 3) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$ .
- 4) Perform a third repeated measurement only if the original, first or second repeated measurement is  $\geq 1.5$  W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is  $> 1.20$

Frequency Band (MHz)	Air Interface	RF Exposure Configuration	Test Position	Repeated SAR (yes/no)	Highest Measured SAR <sub>1-g</sub> (W/Kg)	First Repeated	
						Measured SAR <sub>1-g</sub> (W/Kg)	Largest to Smallest SAR Ratio
750	LTE Band 17	Standalone	Body – Back	no	0.301	n/a	n/a
850	GSM850	Standalone	Body – Back	no	0.572	n/a	n/a
	WCDMA Band V	Standalone	Body – Back	no	0.342	n/a	n/a
1700	LTE Band 4	Standalone	Body – Back	no	0.310	n/a	n/a
1900	GSM1900	Standalone	Body – Back	no	0.687	n/a	n/a
	WCDMA Band II	Standalone	Body – Back	yes	0.811	0.805	0.99
	LTE Band 2	Standalone	Body – Back	no	0.557	n/a	n/a
2450	2.4GWLAN	Standalone	Body – Back	no	0.407	n/a	n/a
2600	LTE Band 7	Standalone	Body – Back	no	0.724	n/a	n/a

Remark:

1. Second Repeated Measurement is not required since the ratio of the largest to smallest SAR for the original and first repeated measurement is not  $> 1.20$  or 3 (1-g or 10-g respectively)

### **5.9. Measurement Uncertainty (300MHz-3GHz)**

Not required as SAR measurement uncertainty analysis is required in SAR reports only when the highest measured SAR in a frequency band is  $\geq 1.5$  W/kg for 1-g SAR according to KDB865664D01.

## 5.10. System Check Results

Date: 10/16/2016

**DUT: Dipole 750 MHz; Type: D750V3; Serial: 1133**

**Program Name: System Performance Check Head at 750 MHz**

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.91 \text{ mho/m}$ ;  $\epsilon_r = 41.79$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(9.43, 9.43, 9.43); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid:  $dx=1.5\text{mm}$ ,  $dy=1.5\text{mm}$

Maximum value of SAR (interpolated) = 2.03 mW/g

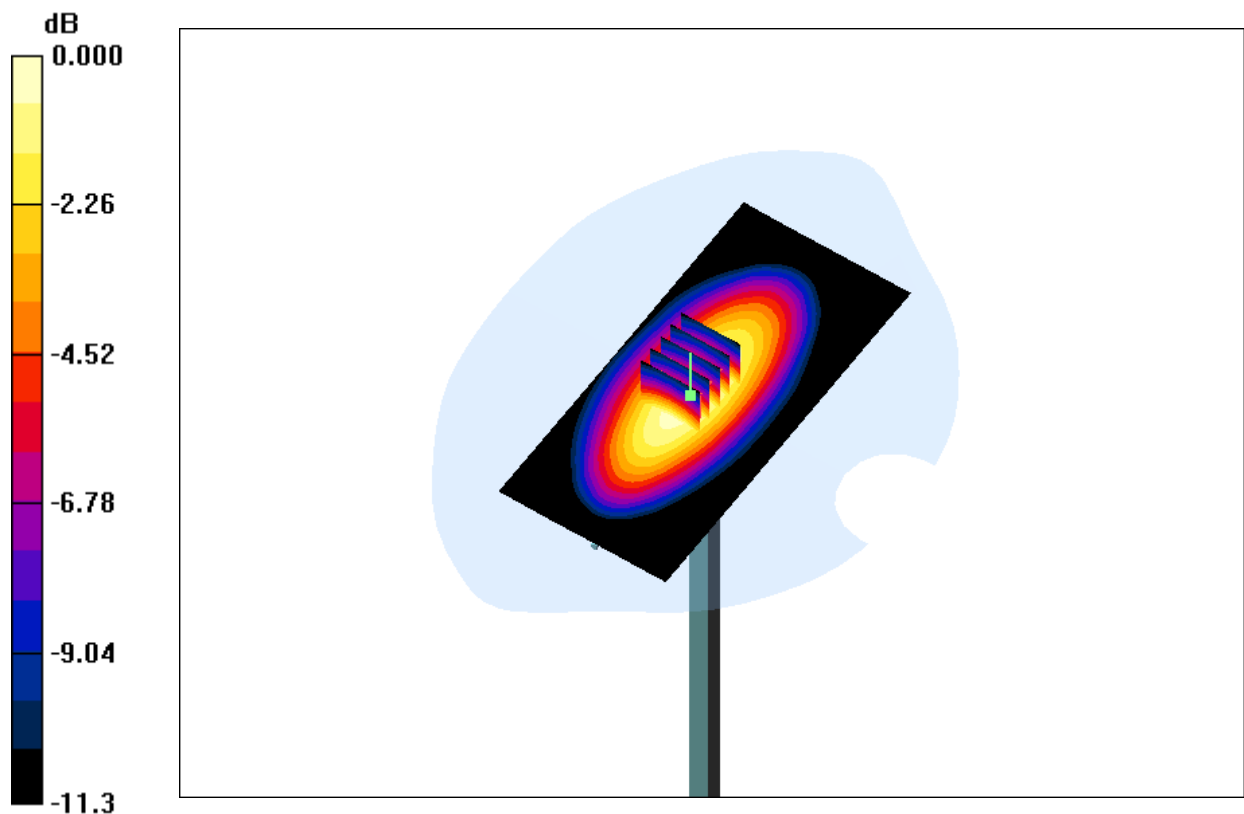
**d=15mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 47.4 V/m; Power Drift = -0.091 dB

Peak SAR (extrapolated) = 2.96 W/kg

**SAR(1 g) = 1.92 mW/g; SAR(10 g) = 1.23 mW/g**

Maximum value of SAR (measured) = 2.10 mW/g



0 dB = 2.10 mW/g

Date: 10/16/2016

**DUT: Dipole 750 MHz; Type: D750V3; Serial: 1133**

**Program Name: System Performance Check Body at 750 MHz**

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 750 \text{ MHz}$ ;  $\sigma = 0.97 \text{ mho/m}$ ;  $\epsilon_r = 55.99$ ;  $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(9.38, 9.38, 9.38); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid:  $dx=1.5\text{mm}$ ,  $dy=1.5\text{mm}$   
Maximum value of SAR (interpolated) = 2.31 mW/g

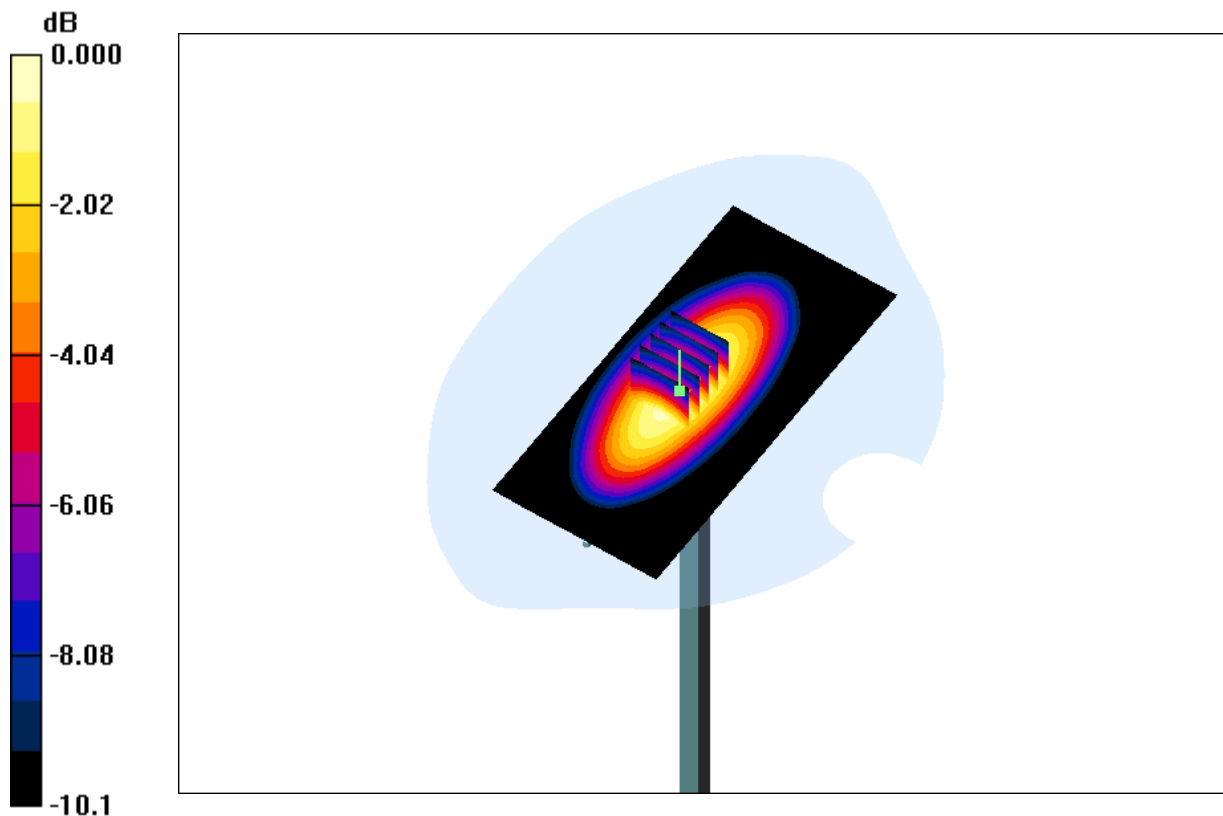
**d=15mm, Pin=250mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8\text{mm}$ ,  $dy=8\text{mm}$ ,  $dz=5\text{mm}$

Reference Value = 49.1 V/m; Power Drift = -0.141 dB

Peak SAR (extrapolated) = 3.20 W/kg

**SAR(1 g) = 2.21 mW/g; SAR(10 g) = 1.47 mW/g**

Maximum value of SAR (measured) = 2.41 mW/g



0 dB = 2.41 mW/g

Date: 10/17/2016

**DUT: Dipole 835MHz; Type: D835V2; Serial: D835V2 - SN: 4d069**  
**Program Name: System Performance Check Head at 835 MHz**

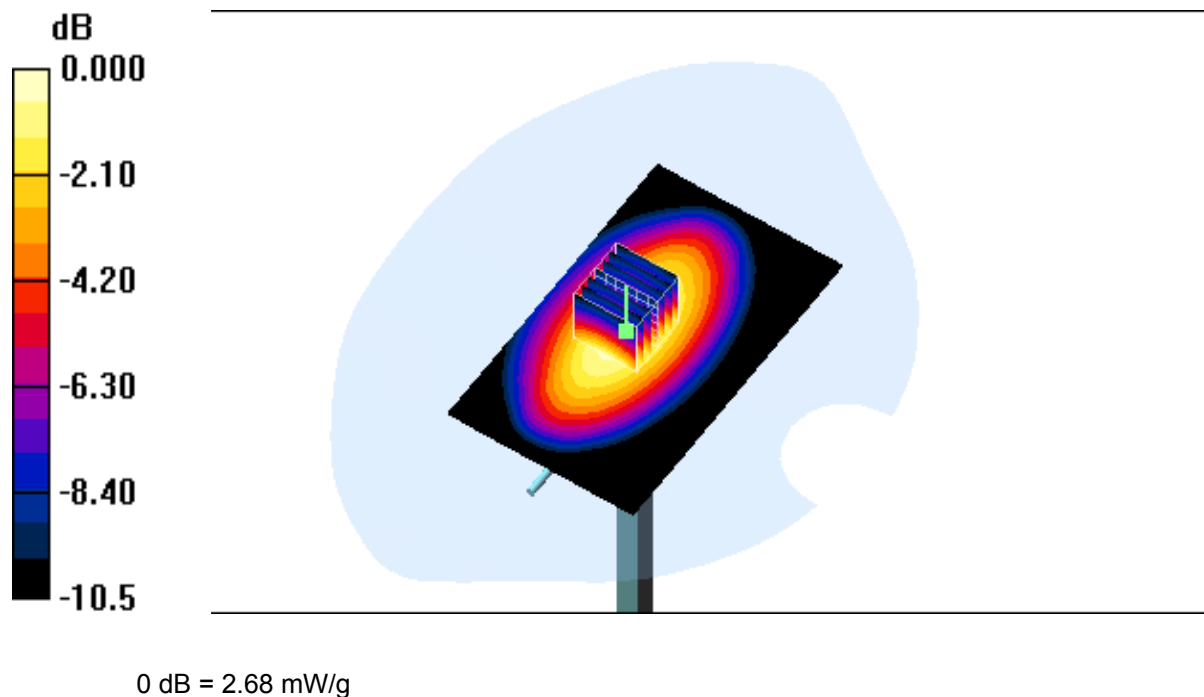
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 0.95 \text{ mho/m}$ ;  $\epsilon_r = 42.8$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(9.42, 9.42, 9.42); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid:  $dx=1.5\text{mm}$ ,  $dy=1.5\text{mm}$   
 Maximum value of SAR (interpolated) = 2.61 mW/g

**d=15mm, Pin=250mW/Zoom Scan (7X7x7) Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 50.235 V/m; Power Drift = 0.07dB  
 Peak SAR (extrapolated) = 3.43 W/kg  
**SAR(1 g) = 2.26 mW/g; SAR(10 g) = 1.50 mW/g**  
 Maximum value of SAR (measured) = 2.68 mW/g



Date: 10/17/2016

**DUT: Dipole 835MHz; Type: D835V2; Serial: D835V2 - SN: 4d069**  
**Program Name: System Performance Check at 835 MHz Body**

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 835 \text{ MHz}$ ;  $\sigma = 1.02 \text{ mho/m}$ ;  $\epsilon_r = 57.01$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(9.25, 9.25, 9.25); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

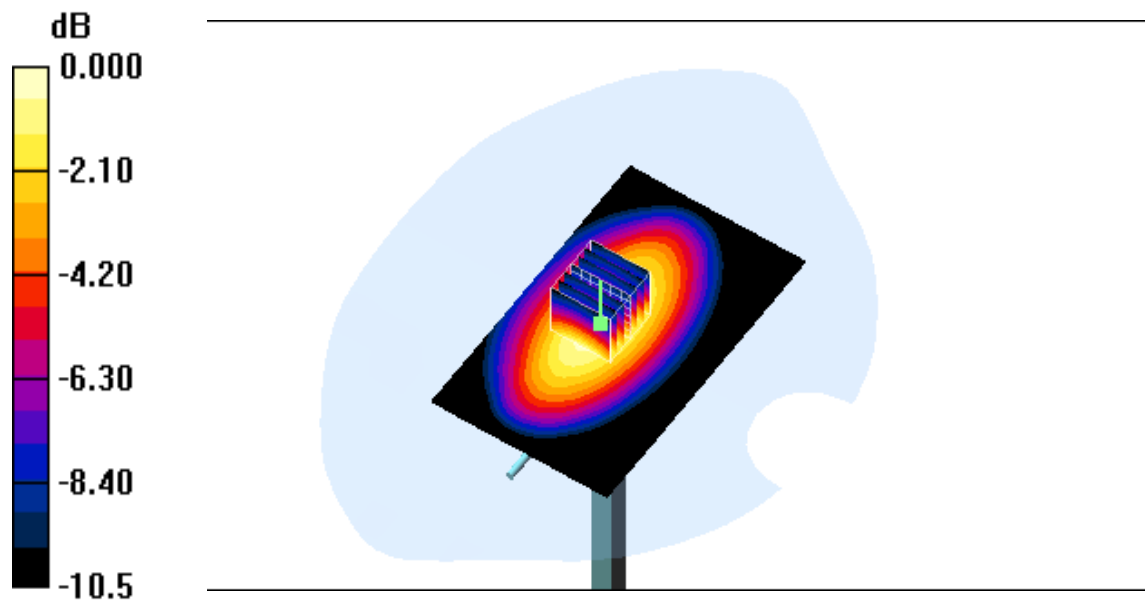
**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid:  $dx=1.5\text{mm}$ ,  $dy=1.5\text{mm}$   
 Maximum value of SAR (interpolated) = 2.849 mW/g

**d=15mm, Pin=250mW/Zoom Scan (7X7x7) /Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 57.585 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 3.871 W/kg

**SAR(1 g) = 2.53 mW/g; SAR(10 g) = 1.65 mW/g**

Maximum value of SAR (measured) = 3.302 mW/g



0 dB = 3.302 mW/g

Date: 10/18/2016

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1021**

**Program Name: System Performance Check Head at 1750 MHz**

Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.38$  mho/m;  $\epsilon_r = 39.83$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(8.04, 8.04, 8.04); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid: dx=1.5mm, dy=1.5mm

Maximum value of SAR (interpolated) = 8.60 mW/g

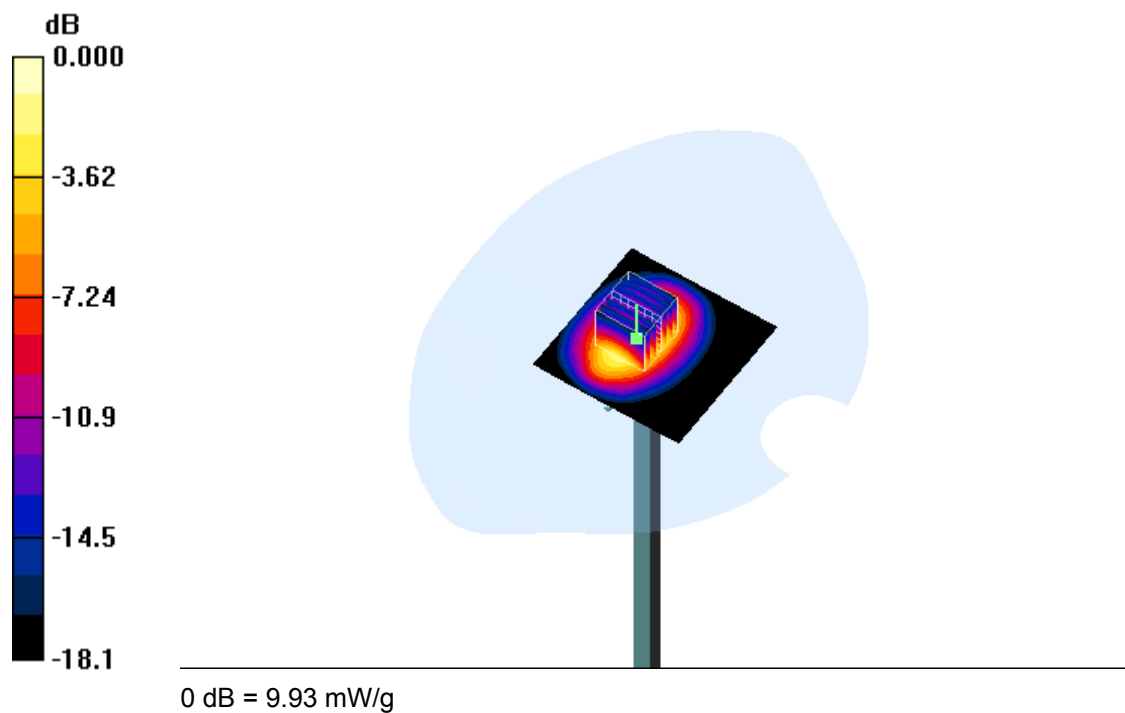
**d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 83.712 V/m; Power Drift = 0.03dB

Peak SAR (extrapolated) = 16.718 W/kg

**SAR(1 g) = 8.82 mW/g; SAR(10 g) = 4.56 mW/g**

Maximum value of SAR (measured) = 9.93 mW/g





Date: 10/18/2016

**DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1021**

**Program Name: System Performance Check Body at 1750 MHz**

Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used:  $f = 1750$  MHz;  $\sigma = 1.53$  mho/m;  $\epsilon_r = 54.57$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.64, 7.64, 7.64); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid: dx=1.5mm, dy=1.5mm

Maximum value of SAR (interpolated) = 12.60 mW/g

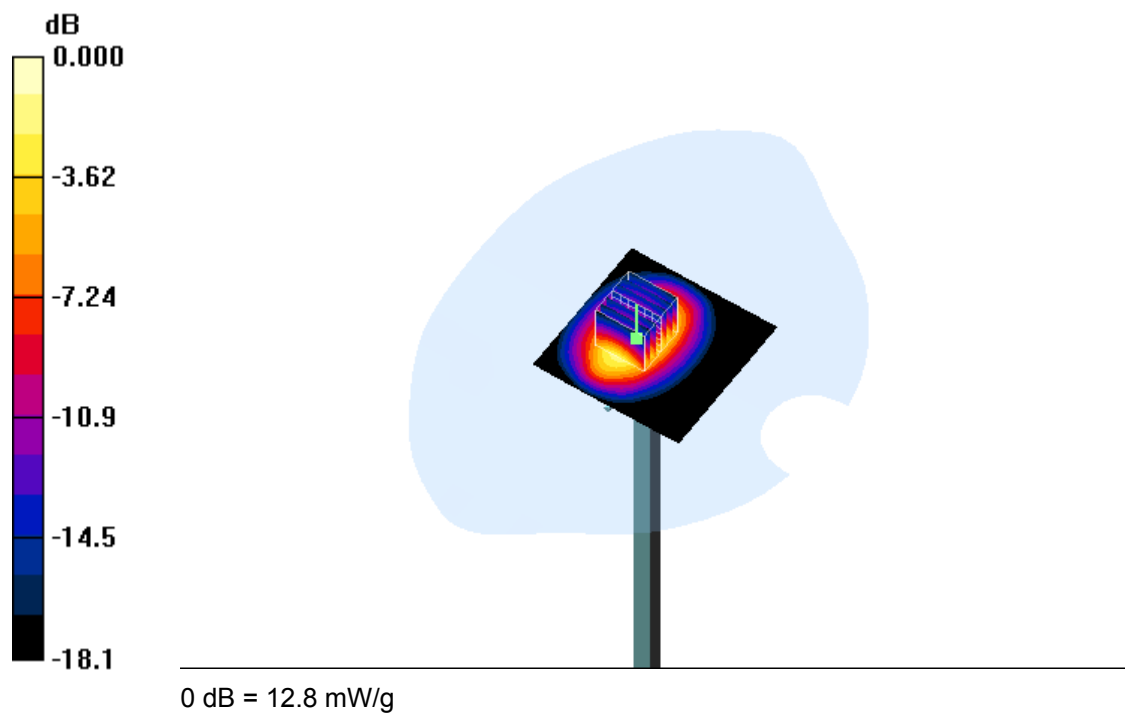
**d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 81.17 V/m; Power Drift = 0.03dB

Peak SAR (extrapolated) = 15.81 W/kg

**SAR(1 g) = 9.06 mW/g; SAR(10 g) = 4.85 mW/g**

Maximum value of SAR (measured) = 12.8 mW/g



Date: 10/19/2016

**DUT: Dipole 1900MHz; Type: D1900V2; Serial: 5d194**  
**Program Name: System Performance Check Head at 1900 MHz**

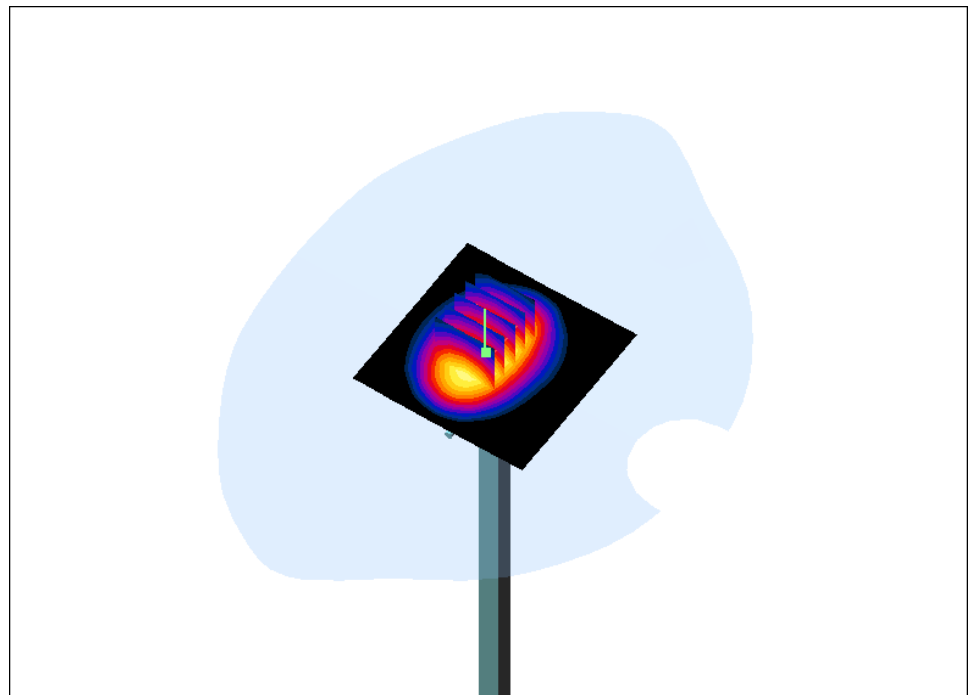
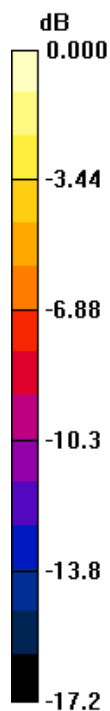
Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 1900 \text{ MHz}$ ;  $\sigma = 1.44 \text{ mho/m}$ ;  $\epsilon_r = 41.3$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.60, 7.60, 7.60); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid:  $dx=1.5\text{mm}$ ,  $dy=1.5\text{mm}$   
 Maximum value of SAR (interpolated) = 13.476 mW/g

**d=15mm, Pin=250mW/Zoom Scan Scan (7X7x7)/Cube 0:** Measurement grid:  $dx=5\text{mm}$ ,  $dy=5\text{mm}$ ,  $dz=5\text{mm}$   
 Reference Value = 93.267 V/m; Power Drift = -0.05 dB  
 Peak SAR (extrapolated) = 19.227 W/kg  
**SAR(1 g) = 10.35 mW/g; SAR(10 g) = 5.32 mW/g**  
 Maximum value of SAR (measured) = 13.5 mW/g



0 dB = 13.5 mW/g

Date: 10/20/2016

**DUT: Dipole 1900MHz; Type: D1900V2; Serial: 5d194**  
**Program Name: System Performance Check at Body 1900 MHz**

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 1900 \text{ MHz}$ ;  $\sigma = 1.58 \text{ mho/m}$ ;  $\epsilon_r = 55.2$ ;  $\rho = 1000 \text{ kg/m}^3$   
 Phantom section: Flat Section

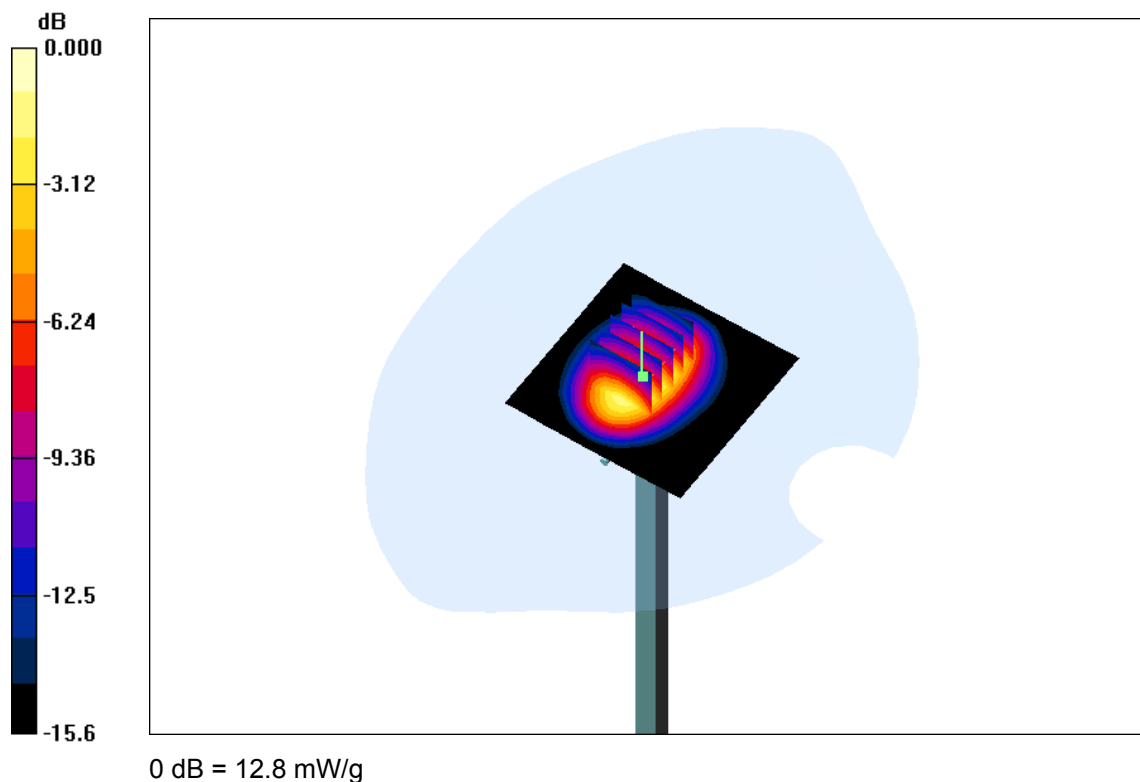
DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.33, 7.33, 7.33); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid:  $dx=1.5\text{mm}$ ,  $dy=1.5\text{mm}$   
 Maximum value of SAR (interpolated) = 13.4 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 = 91.52 V/m; Power Drift = -0.02 dB  
 Peak SAR (extrapolated) = 18.7 W/kg

**SAR(1 g) = 9.95 mW/g; SAR(10 g) = 5.09 mW/g**  
 Maximum value of SAR (measured) = 12.8 mW/g



Date: 10/21/2016

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 955**  
**Program Name: System Performance Check Head at 2450 MHz**

Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.83$  mho/m;  $\epsilon_r = 38.19$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.07, 7.07, 7.07); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (61x131x1):** Interpolated grid: dx=1.5mm, dy=1.5mm  
 Maximum value of SAR (interpolated) = 16.7 mW/g

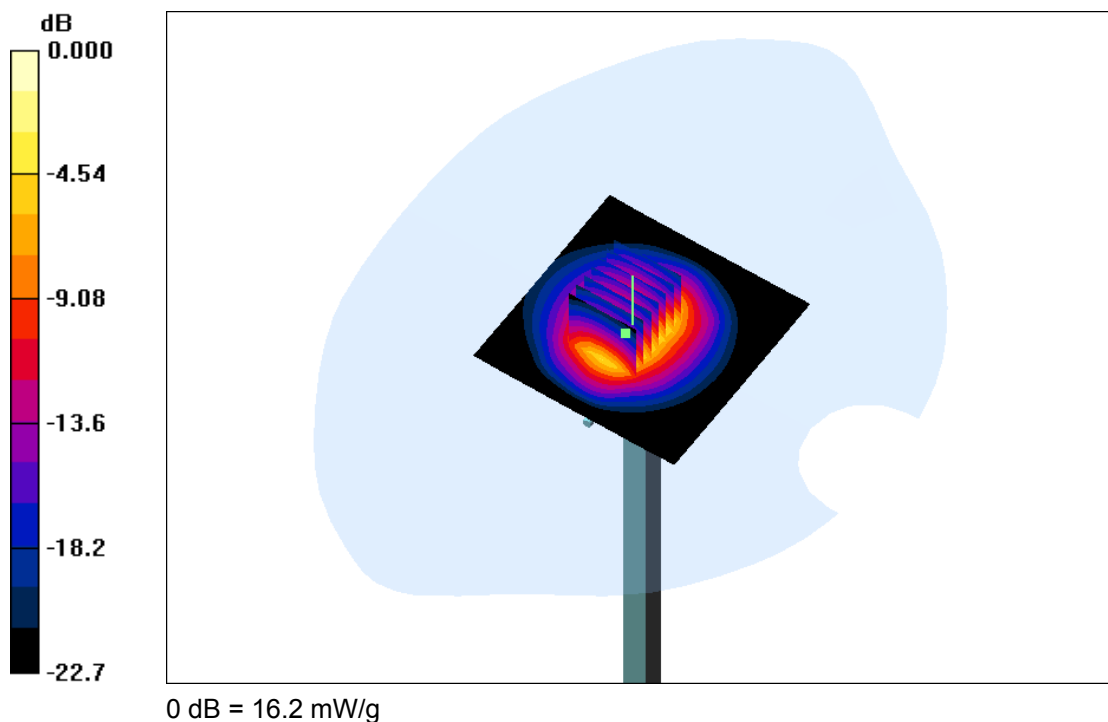
**d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 87.0 V/m; Power Drift = 0.019 dB

Peak SAR (extrapolated) = 30.7 W/kg

**SAR(1 g) = 13.3 mW/g; SAR(10 g) = 6.45 mW/g**

Maximum value of SAR (measured) = 16.2 mW/g



Date: 10/21/2016

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: 955**

**Program Name: System Performance Check Body at 2450 MHz**

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

Medium parameters used:  $f = 2450$  MHz;  $\sigma = 1.90$  mho/m;  $\epsilon_r = 50.59$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.20, 7.20, 7.20); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=10mm, Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=12mm, dy=12mm

Maximum value of SAR (interpolated) = 16.2 mW/g

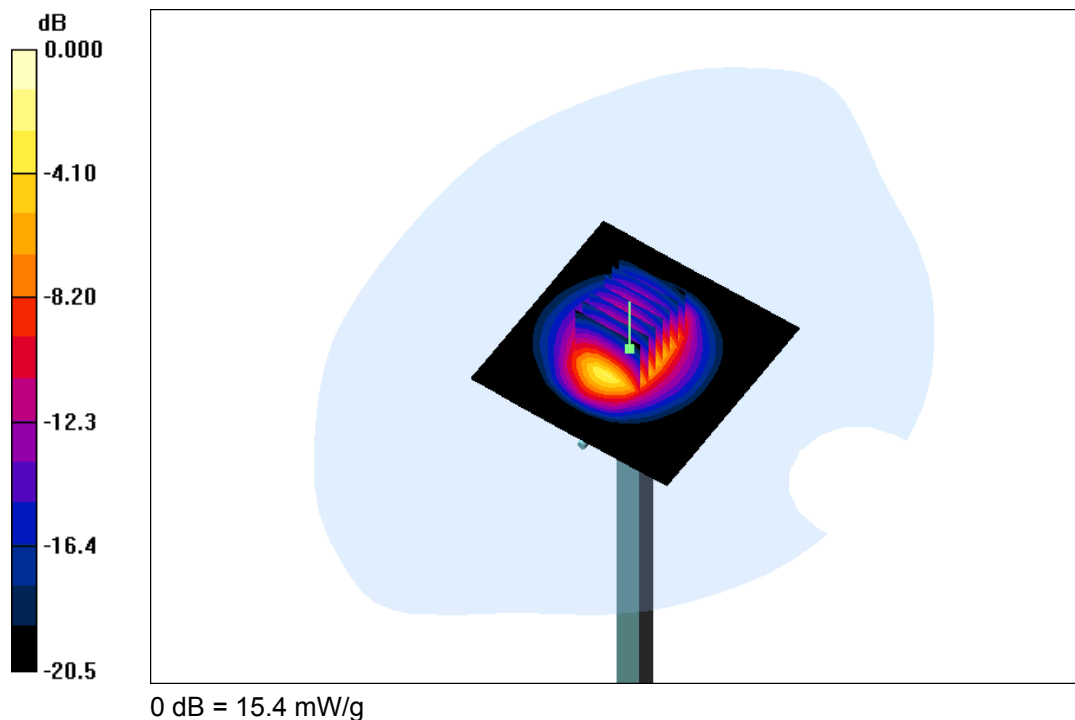
**d=10mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.5 V/m; Power Drift = 0.017 dB

Peak SAR (extrapolated) = 27.0 W/kg

**SAR(1 g) = 13.5 mW/g; SAR(10 g) = 6.34 mW/g**

Maximum value of SAR (measured) = 15.4 mW/g



Date: 10/22/2016

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1012**

**Program Name: System Performance Check Head at 2600 MHz**

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

Medium parameters used:  $f = 2600$  MHz;  $\sigma = 1.96$  mho/m;  $\epsilon_r = 38.09$ ;  $\rho = 1000$  kg/m<sup>3</sup>

Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(6.96, 6.96, 6.96); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (91x91x1):** Interpolated grid: dx=1.2mm, dy=1.2mm  
Maximum value of SAR (interpolated) = 21.1 mW/g

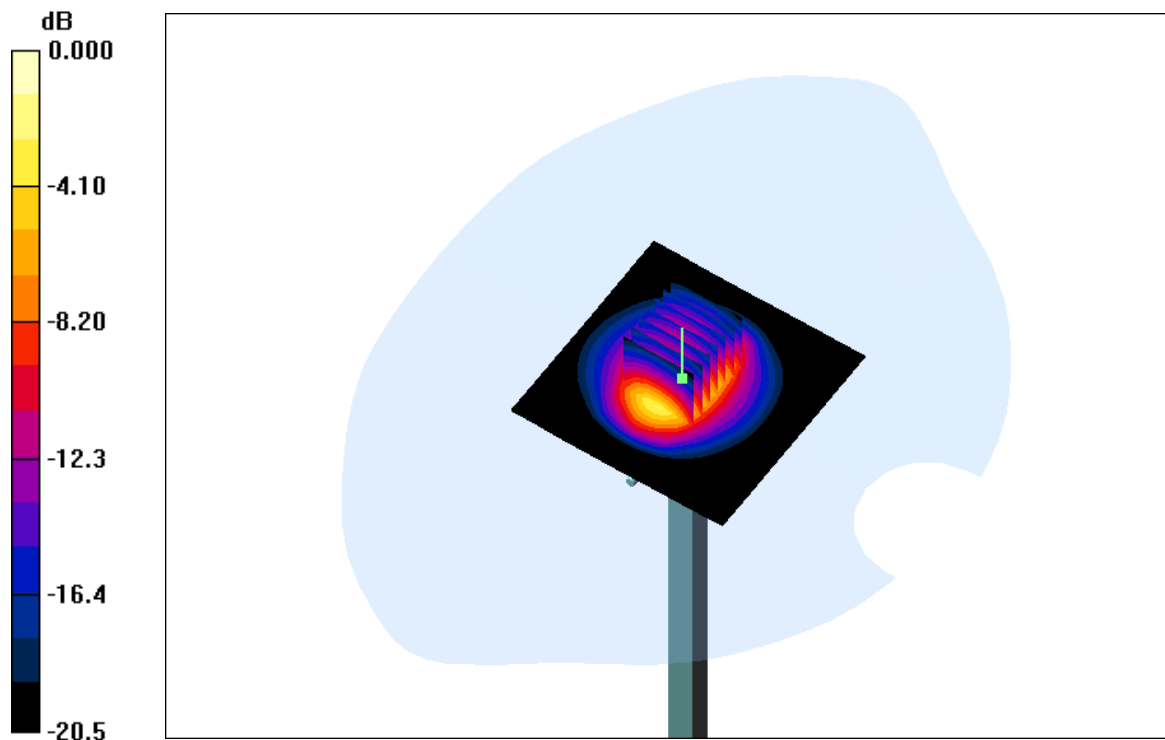
**d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 84.1 V/m; Power Drift = 0.032 dB

Peak SAR (extrapolated) = 30.2 W/kg

**SAR(1 g) = 14.4 mW/g; SAR(10 g) = 6.47 mW/g**

Maximum value of SAR (measured) = 19.7 mW/g



0 dB = 19.7 mW/g

Date: 10/22/2015

**DUT: Dipole 2600 MHz; Type: D2600V2; Serial: 1012**  
**Program Name: System Performance Check Body at 2600 MHz**

Communication System: CW; Frequency: 2600 MHz; Duty Cycle: 1:1  
 Medium parameters used:  $f = 2600$  MHz;  $\sigma = 2.20$  mho/m;  $\epsilon_r = 51.09$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(6.99, 6.99, 6.99); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**d=15mm, Pin=250mW/Area Scan (91x91x1):** Measurement grid: dx=1.2mm, dy=1.2mm  
 Maximum value of SAR (interpolated) = 25.1 mW/g

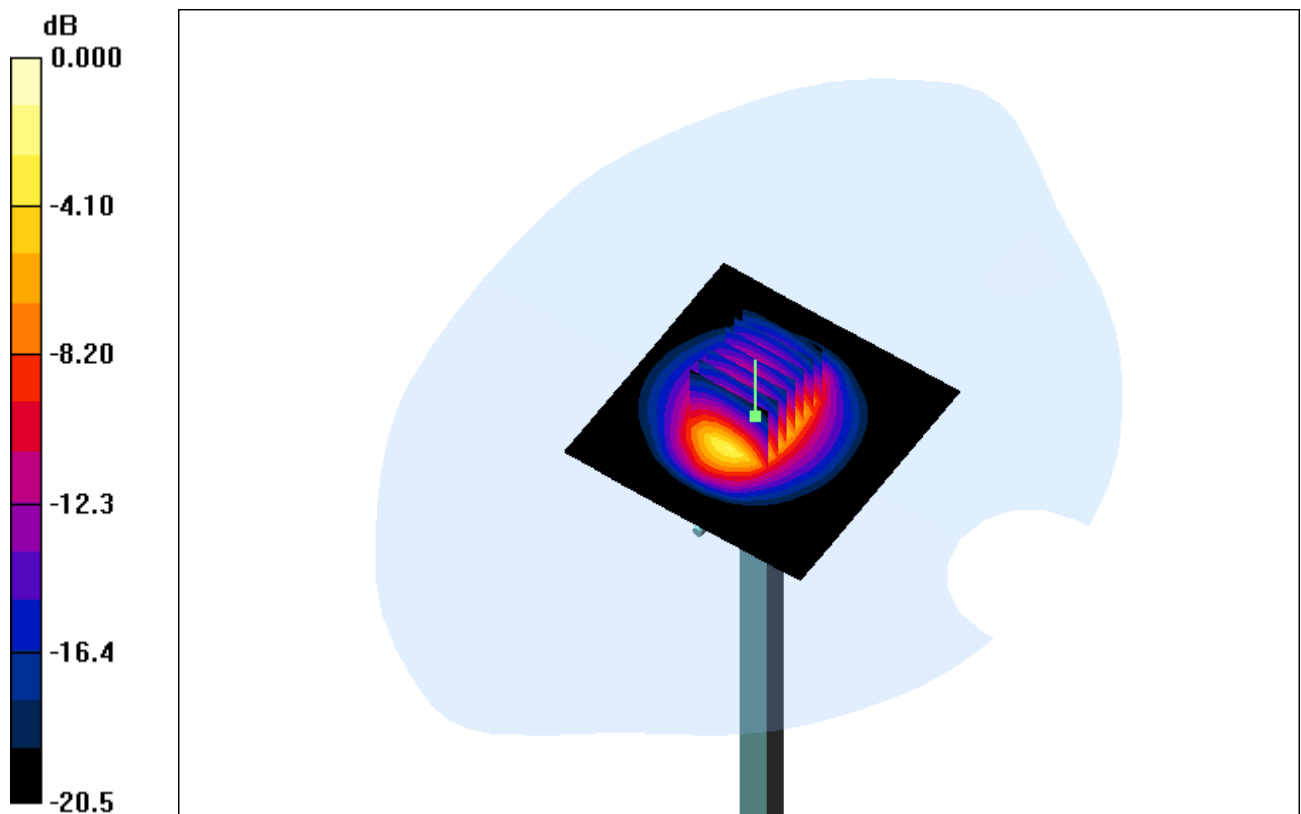
**d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.4 V/m; Power Drift = 0.018 dB

Peak SAR (extrapolated) = 34.1 W/kg

**SAR(1 g) = 14.6 mW/g; SAR(10 g) = 6.48 mW/g**

Maximum value of SAR (measured) = 23.2 mW/g



0 dB = 23.2 mW/g

### 5.11. SAR Test Graph Results

SAR plots for **the highest measured SAR** in each exposure configuration, wireless mode and frequency band combination according to FCC KDB 865664 D02

#1

Date: 10/17/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

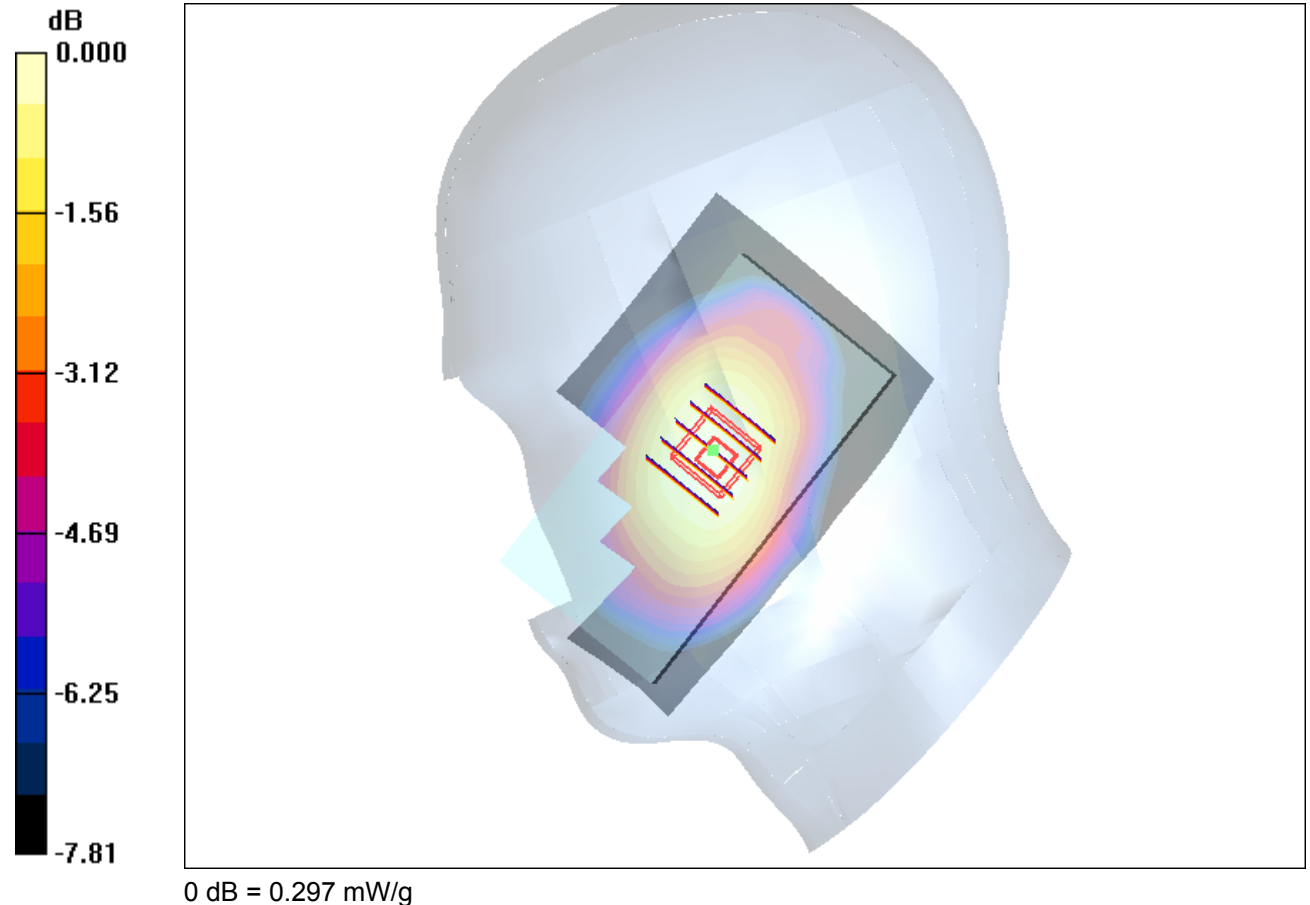
Communication System: GSM 850; Frequency: 848.8 MHz; Duty Cycle: 1:8.3  
 Medium parameters used (interpolated):  $f = 848.8$  MHz;  $\sigma = 0.96$  mho/m;  $\epsilon_r = 42.4$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(9.43, 9.43, 9.43); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Right Cheek/Area Scan (71x111x1):** Interpolated grid: dx=1.5mm, dy=1.5mm  
 Maximum value of SAR (interpolated) = 0.296 mW/g

**Right Cheek/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm  
 Reference Value = 9.84 V/m; Power Drift = -0.04 dB  
 Peak SAR (extrapolated) = 0.351 W/kg  
**SAR(1 g) = 0.284 mW/g; SAR(10 g) = 0.217 mW/g**  
 Maximum value of SAR (measured) = 0.297 mW/g





#2

Date: 10/17/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

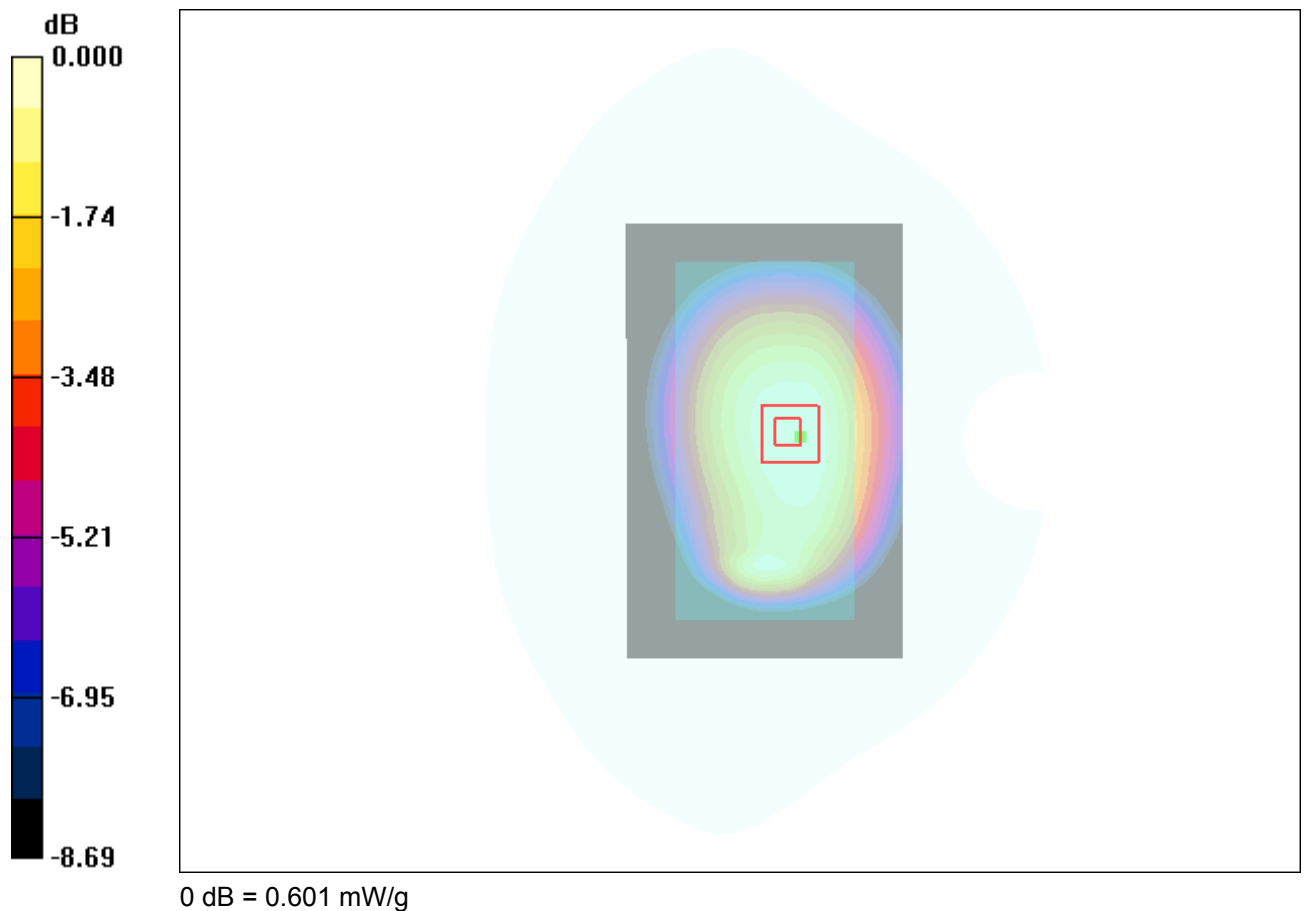
Communication System: GSM 850; Frequency: 848.8. MHz; Duty Cycle: 1:4  
Medium parameters used (interpolated):  $f = 848.8$  MHz;  $\sigma = 1.02$  mho/m;  $\epsilon_r = 56.92$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(9.25, 9.25, 9.25); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Back/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.594 mW/g

**Back/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
Reference Value = 25.1 V/m; Power Drift = -0.16 dB  
Peak SAR (extrapolated) = 0.719 W/kg  
**SAR(1 g) = 0.572 mW/g; SAR(10 g) = 0.432 mW/g**  
Maximum value of SAR (measured) = 0.601 mW/g



#3

Date: 10/19/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

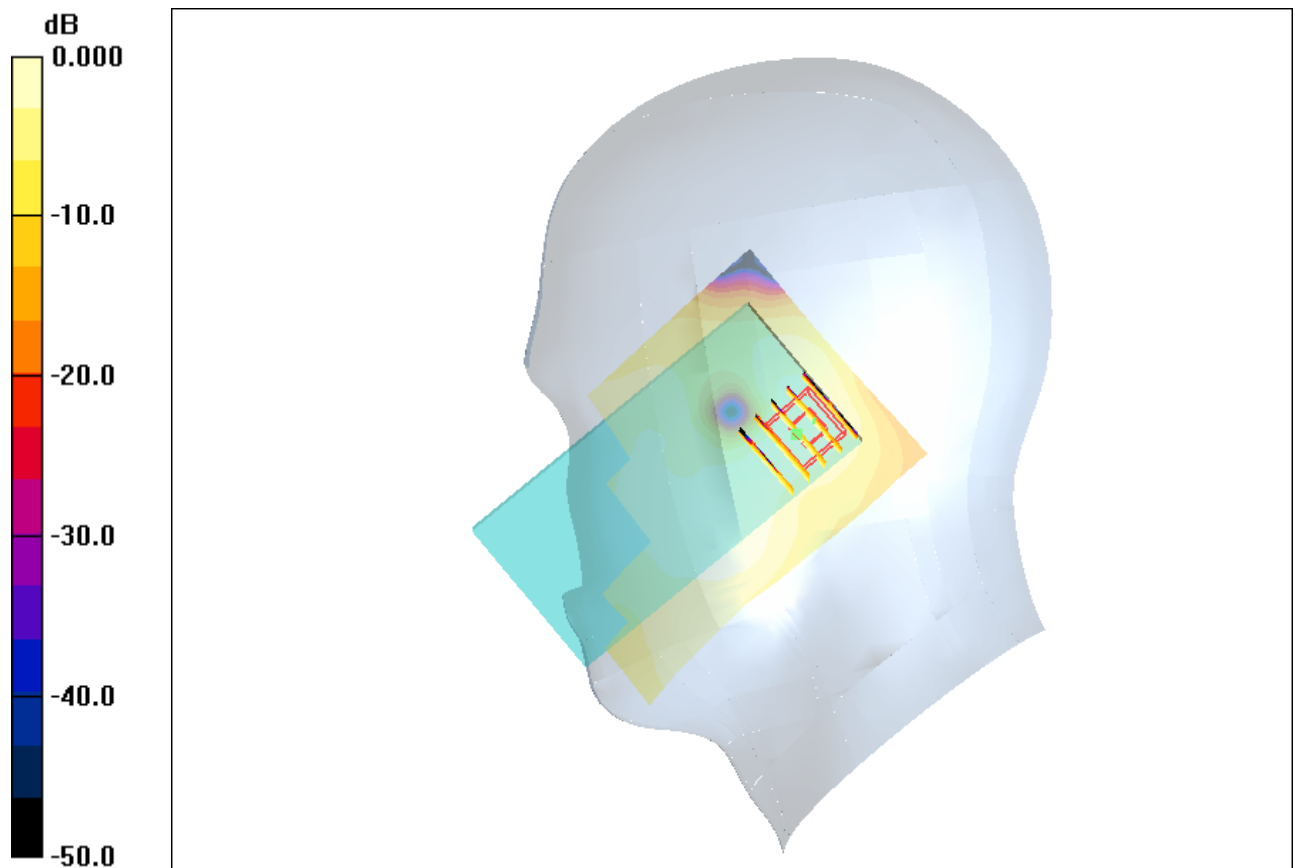
Communication System: GSM 1900; Frequency: 1909.8 MHz; Duty Cycle: 1:8.3  
 Medium parameters used (interpolated):  $f = 1909.8$  MHz;  $\sigma = 1.44$  mho/m;  $\epsilon_r = 41.30$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.60, 7.60, 7.60); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Right Tilt/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
 Maximum value of SAR (interpolated) = 0.129 mW/g

**Right Tilt/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
 Reference Value = 2.52 V/m; Power Drift = -0.10 dB  
 Peak SAR (extrapolated) = 0.142 W/kg  
**SAR(1 g) = 0.117 mW/g; SAR(10 g) = 0.085 mW/g**  
 Maximum value of SAR (measured) = 0.121 mW/g



0 dB = 0.121 mW/g

#4

Date: 10/20/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

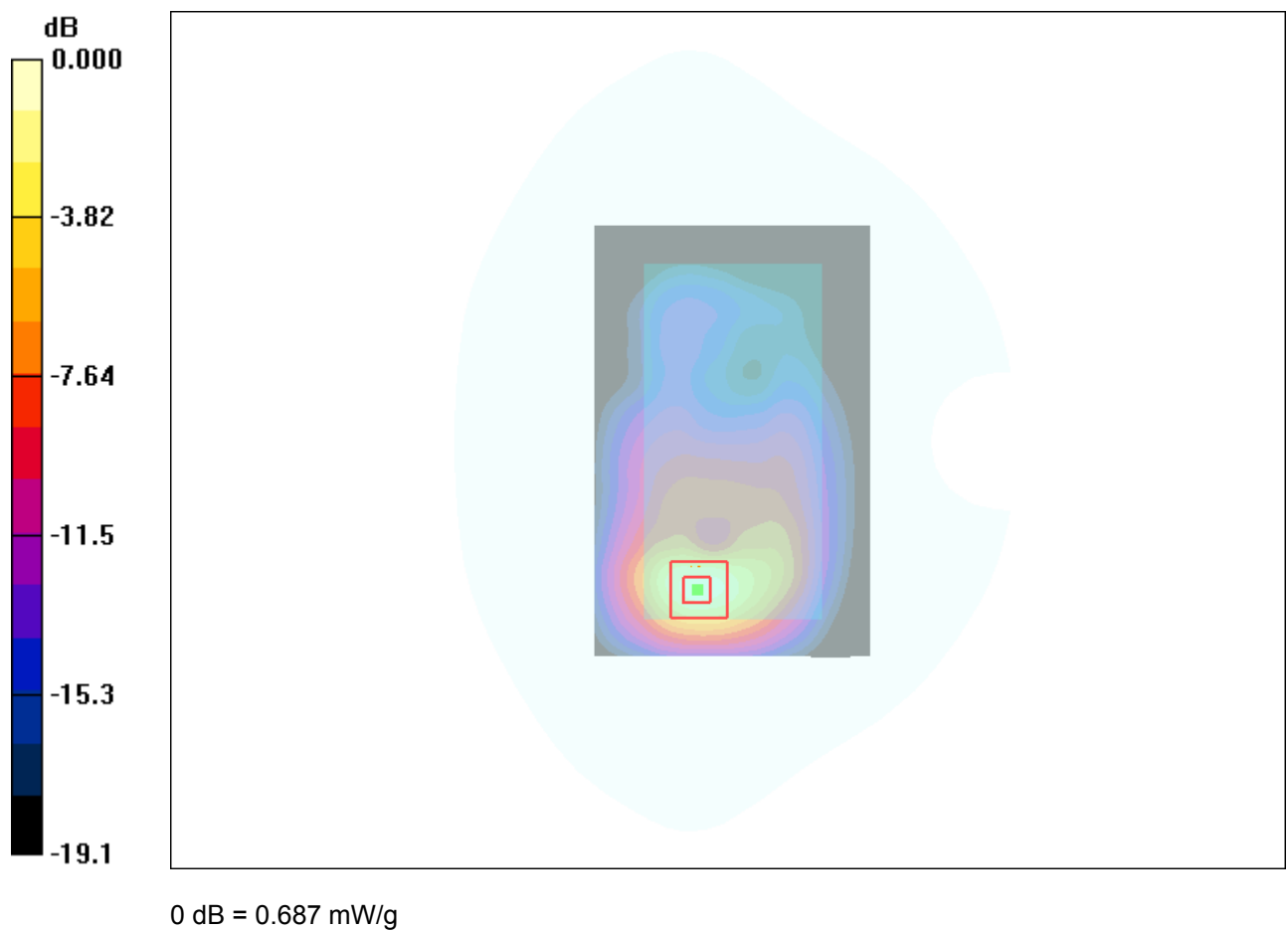
Communication System: GPRS1900; Frequency: 1909.8 MHz; Duty Cycle: 1:2  
Medium parameters used (interpolated):  $f = 1909.8$  MHz;  $\sigma = 1.58$  mho/m;  $\epsilon_r = 55.20$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.33, 7.33, 7.33); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Back/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.807 mW/g

**Back/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
Reference Value = 28.36 V/m; Power Drift = 0.10 dB  
Peak SAR (extrapolated) = 1.56 W/kg  
**SAR(1 g) = 0.687 mW/g; SAR(10 g) = 0.356 mW/g**  
Maximum value of SAR (measured) = 0.753 mW/g



#5

Date: 10/17/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

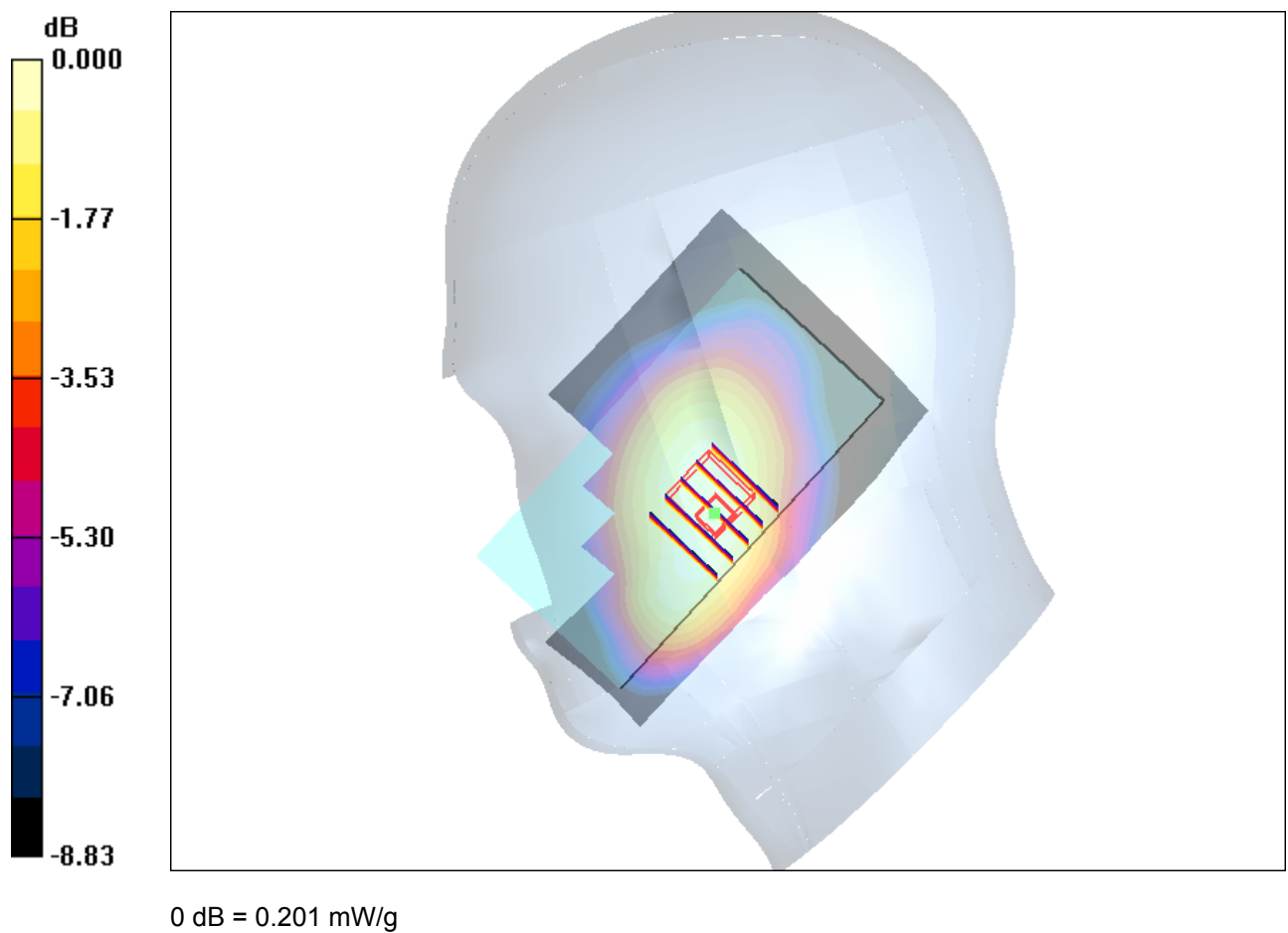
Communication System: W850; Frequency: 836.6MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 836.6$  MHz;  $\sigma = 0.95$  mho/m;  $\epsilon_r = 42.80$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(9.43, 9.43, 9.43); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Right Cheek/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.208 mW/g

**Right Cheek/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
Reference Value = 3.13 V/m; Power Drift = -0.16 dB  
Peak SAR (extrapolated) = 0.232 W/kg  
**SAR(1 g) = 0.198 mW/g; SAR(10 g) = 0.123 mW/g**  
Maximum value of SAR (measured) = 0.201 mW/g



#6

Date: 10/17/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

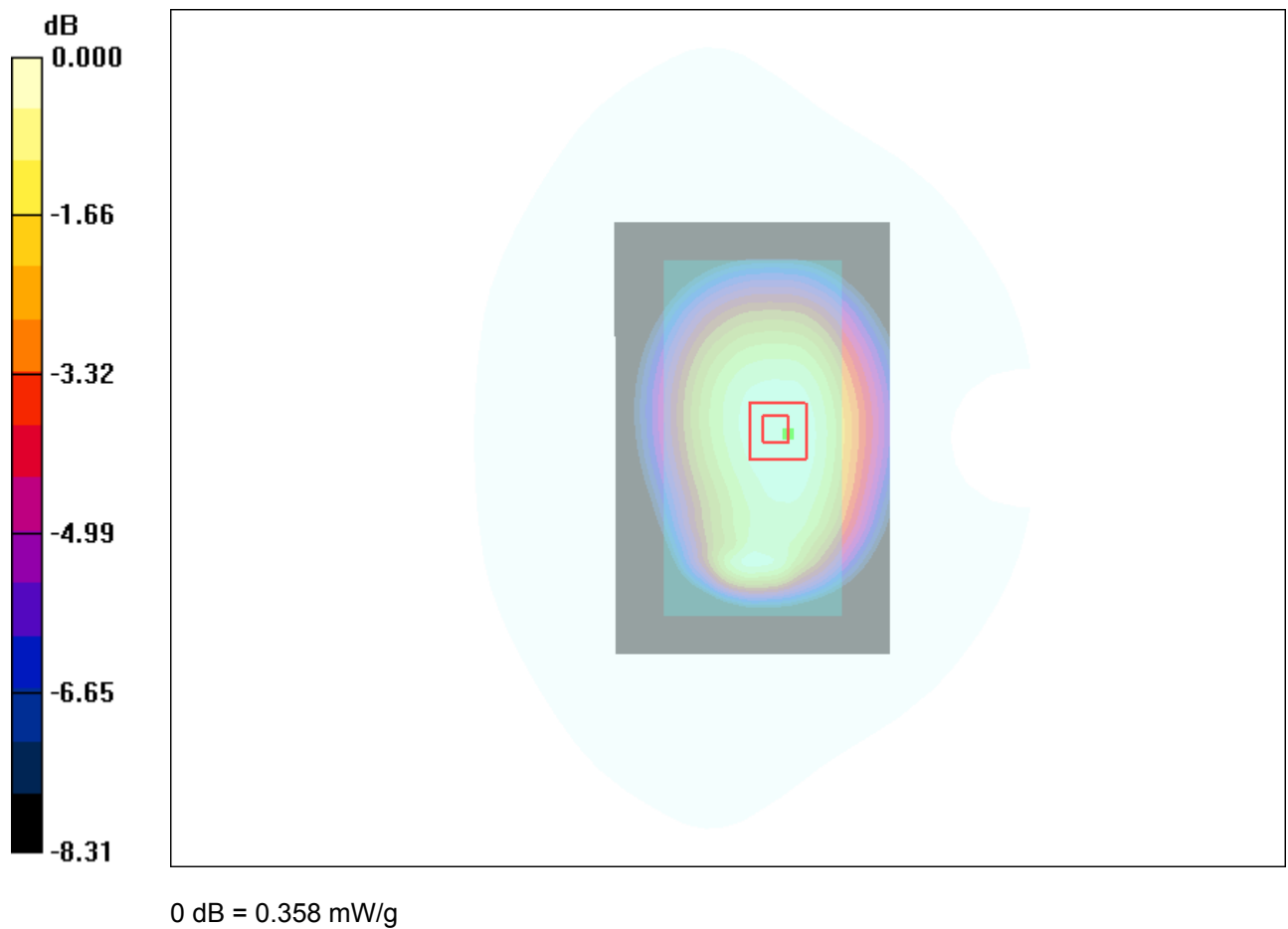
Communication System: W850; Frequency: 836.6 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 836.6$  MHz;  $\sigma = 1.02$  mho/m;  $\epsilon_r = 57.01$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(9.25, 9.25, 9.25); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Back 2/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.359 mW/g

**Back 2/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
Reference Value = 19.3 V/m; Power Drift = 0.05 dB  
Peak SAR (extrapolated) = 0.432 W/kg  
**SAR(1 g) = 0.342 mW/g; SAR(10 g) = 0.258 mW/g**  
Maximum value of SAR (measured) = 0.358 mW/g



#7

Date: 10/19/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

Communication System: W1900; Frequency: 1852.4 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 1852$  MHz;  $\sigma = 1.41$  mho/m;  $\epsilon_r = 39.70$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.60, 7.60, 7.60); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Right Cheek/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.334 mW/g

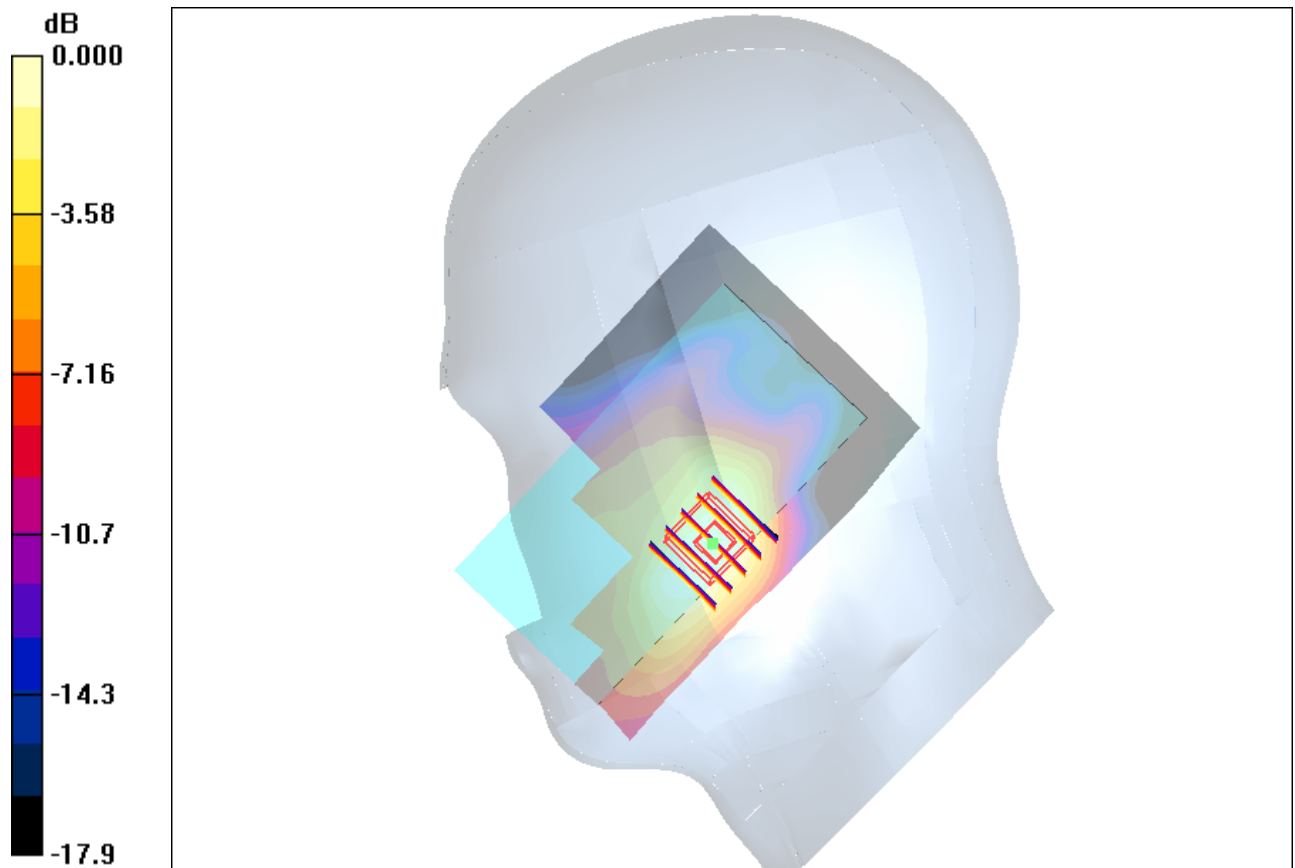
**Right Cheek/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm

Reference Value = 2.79 V/m; Power Drift = -0.19 dB

Peak SAR (extrapolated) = 0.472 W/kg

**SAR(1 g) = 0.284 mW/g; SAR(10 g) = 0.167 mW/g**

Maximum value of SAR (measured) = 0.313 mW/g



0 dB = 0.313 mW/g

#8

Date: 10/20/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

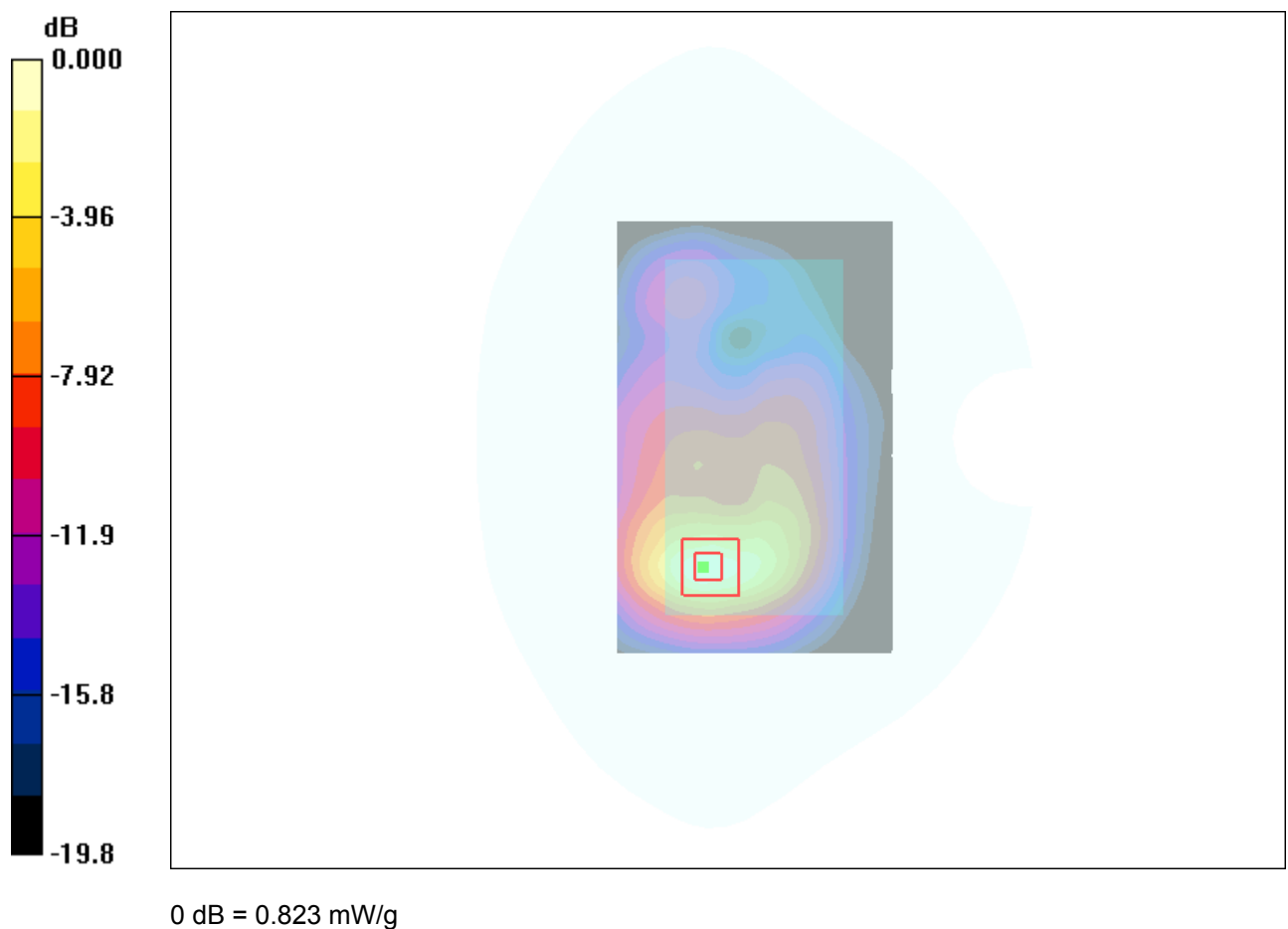
Communication System: W1900; Frequency: 1852.4 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 1852$  MHz;  $\sigma = 1.54$  mho/m;  $\epsilon_r = 53.80$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.33, 7.33, 7.33); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Back/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.838 mW/g

**Back/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
Reference Value = 26.0 V/m; Power Drift = 0.11 dB  
Peak SAR (extrapolated) = 1.67 W/kg  
**SAR(1 g) = 0.811 mW/g; SAR(10 g) = 0.704 mW/g**  
Maximum value of SAR (measured) = 0.823 mW/g



#9

Date: 10/19/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

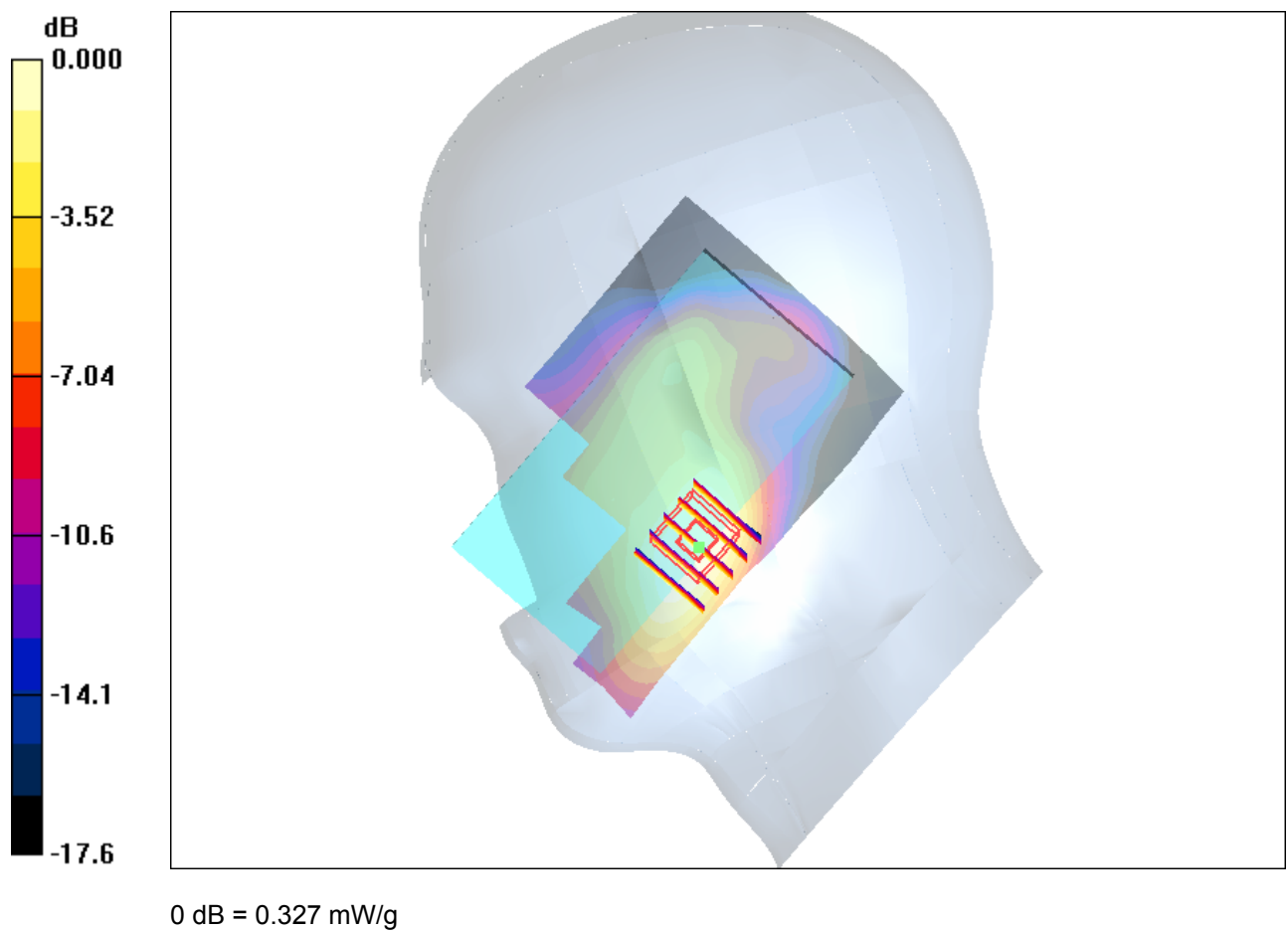
Communication System: LTE; Frequency: 1880 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.42$  mho/m;  $\epsilon_r = 40.10$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.60, 7.60, 7.60); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Right Cheek/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.364 mW/g

**Right Cheek/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
Reference Value = 9.13 V/m; Power Drift = -0.11 dB  
Peak SAR (extrapolated) = 0.486 W/kg  
**SAR(1 g) = 0.304 mW/g; SAR(10 g) = 0.185 mW/g**  
Maximum value of SAR (measured) = 0.327 mW/g





#10

Date: 10/20/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

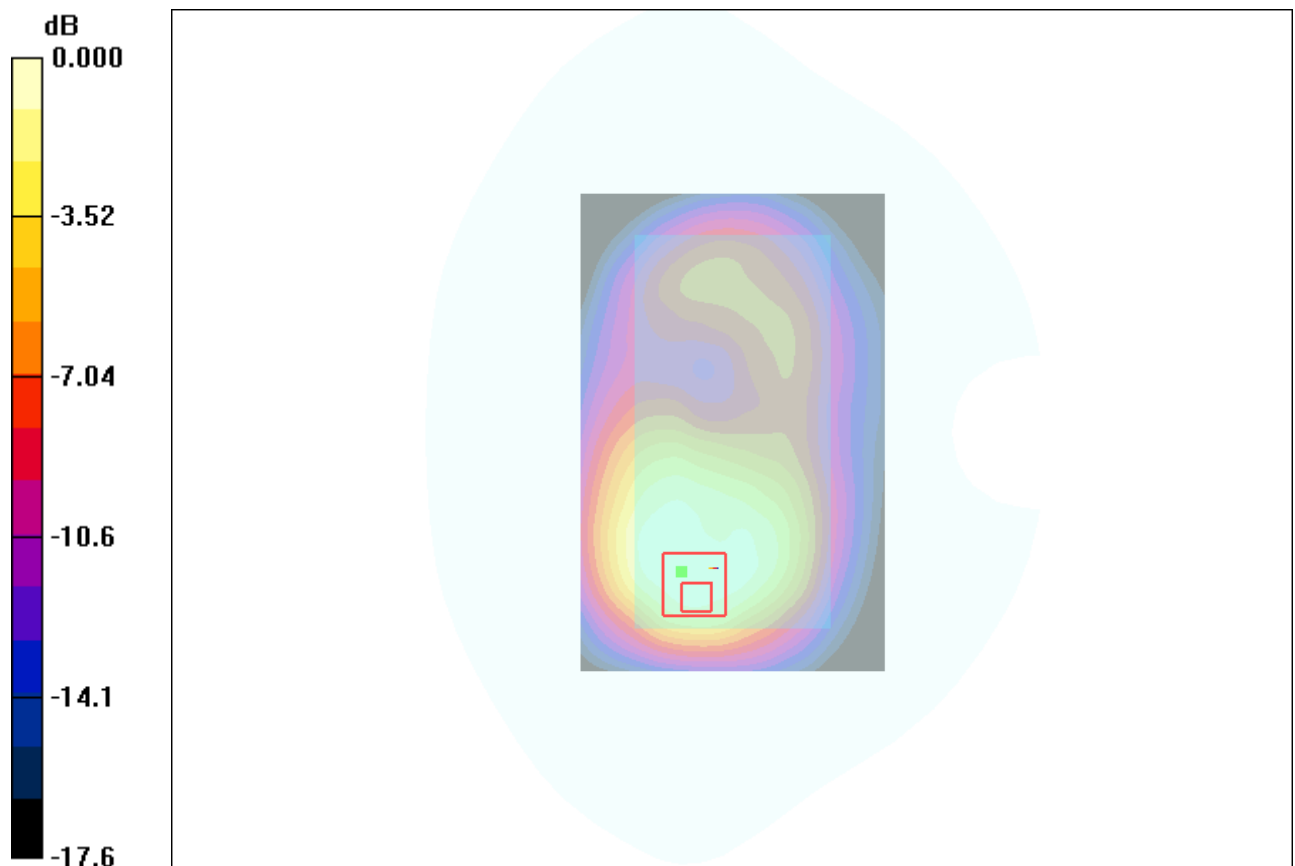
Communication System: LTE; Frequency: 1880 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 1880$  MHz;  $\sigma = 1.55$  mho/m;  $\epsilon_r = 54.70$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.33, 7.33, 7.33); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Back/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.624 mW/g

**Back/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
Reference Value = 9.43 V/m; Power Drift = -0.10 dB  
Peak SAR (extrapolated) = 0.935 W/kg  
**SAR(1 g) = 0.533 mW/g; SAR(10 g) = 0.298 mW/g**  
Maximum value of SAR (measured) = 0.601 mW/g



0 dB = 0.601 mW/g

#11

Date: 10/18/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

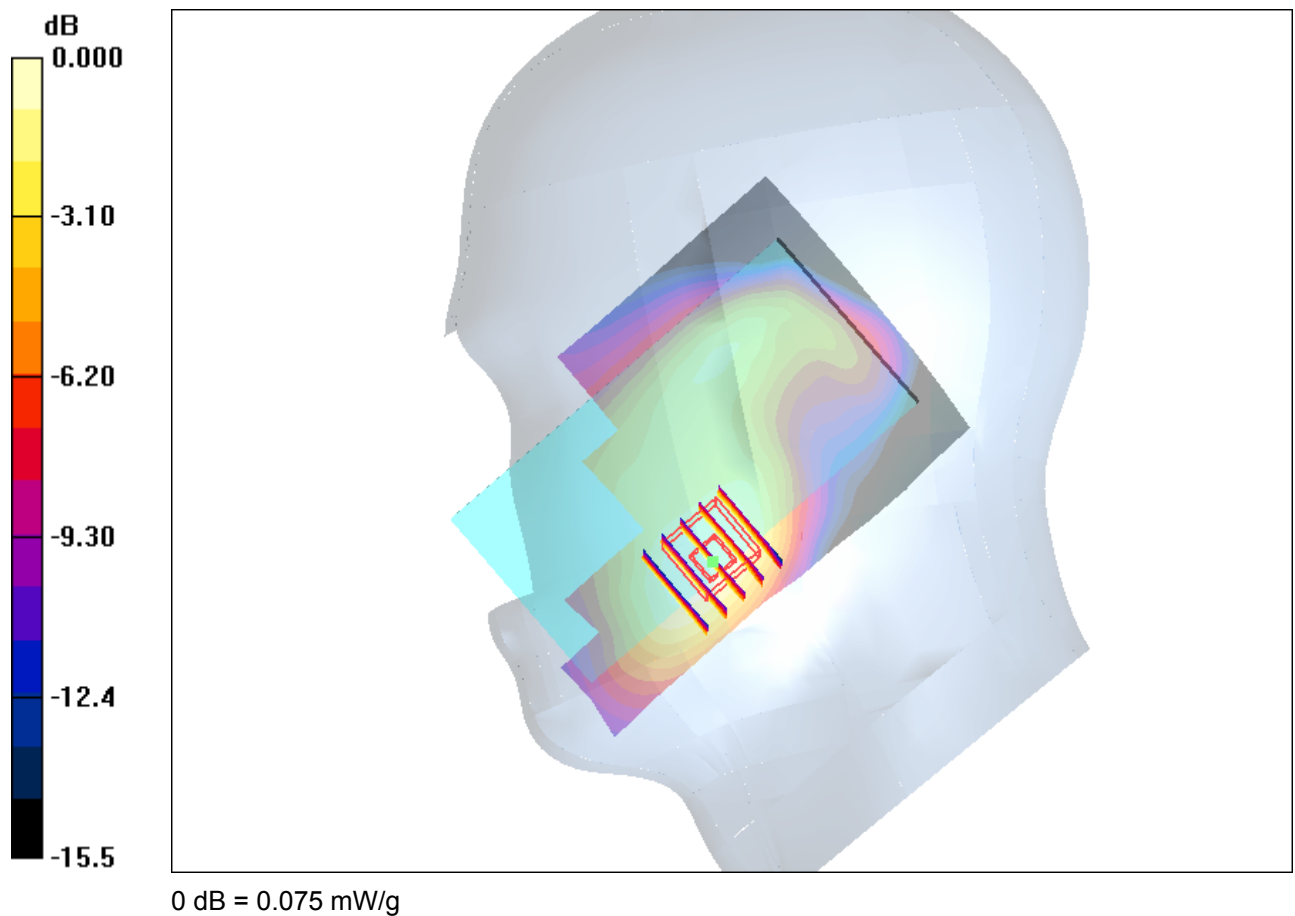
Communication System: LTE; Frequency: 1745.0 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 1745$  MHz;  $\sigma = 1.38$  mho/m;  $\epsilon_r = 39.83$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(8.04, 8.04, 8.04); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Right Cheek/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
 Maximum value of SAR (interpolated) = 0.075 mW/g

**Right Cheek/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
 Reference Value = 3.99 V/m; Power Drift = -0.11 dB  
 Peak SAR (extrapolated) = 0.104 W/kg  
**SAR(1 g) = 0.069 mW/g; SAR(10 g) = 0.044 mW/g**  
 Maximum value of SAR (measured) = 0.075 mW/g



#12

Date: 10/18/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

Communication System: LTE; Frequency: 1745 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 1745$  MHz;  $\sigma = 1.53$  mho/m;  $\epsilon_r = 54.57$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.64, 7.64, 7.64); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Back/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.346 mW/g

**Back/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
Reference Value = 8.91 V/m; Power Drift = -0.10 dB  
Peak SAR (extrapolated) = 0.555 W/kg  
**SAR(1 g) = 0.310 mW/g; SAR(10 g) = 0.177 mW/g**  
Maximum value of SAR (measured) = 0.330 mW/g



#13

Date: 10/22/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

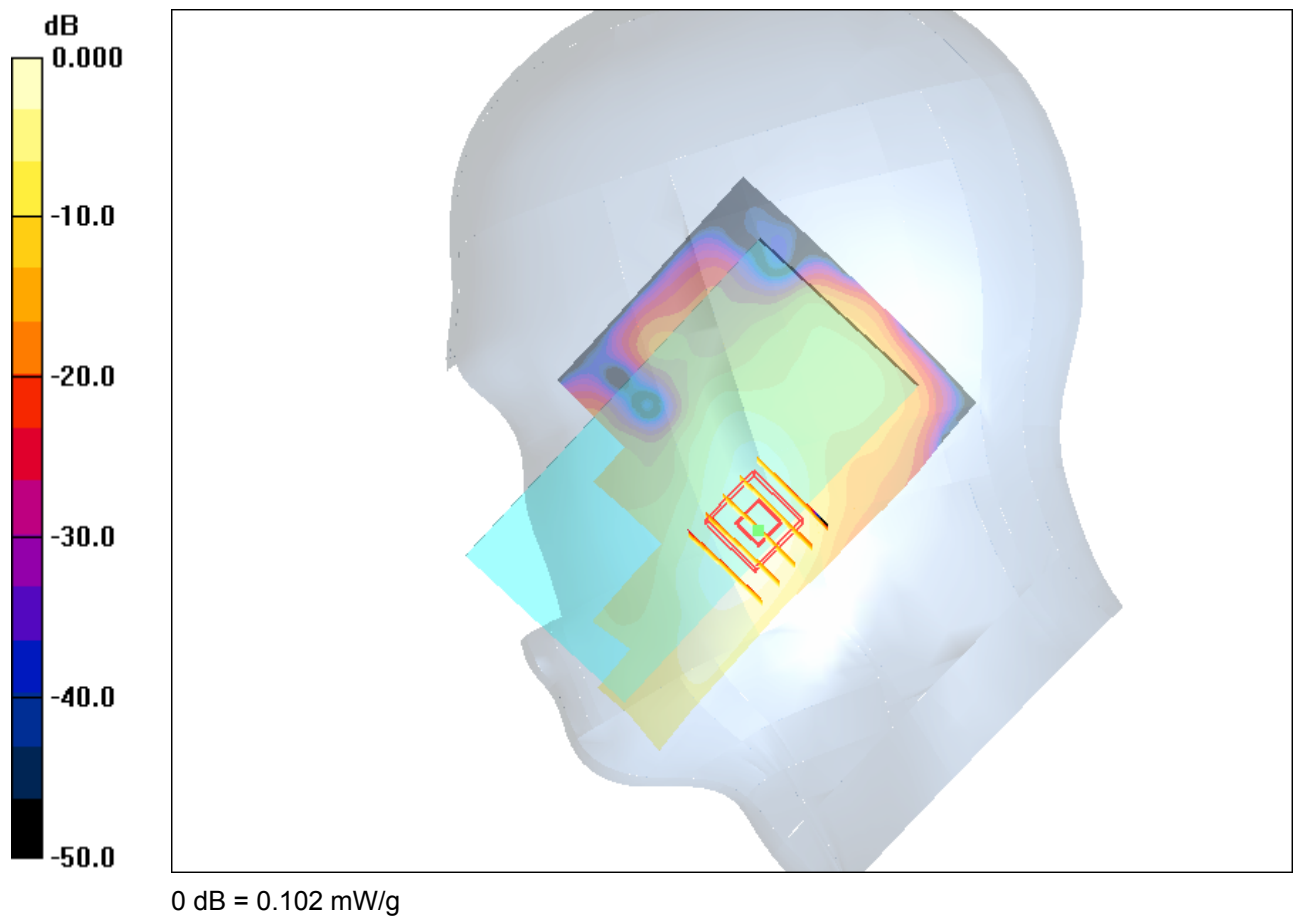
Communication System: LTE; Frequency: 2535 MHz; Duty Cycle: 1:1  
 Medium parameters used (interpolated):  $f = 2535$  MHz;  $\sigma = 1.93$  mho/m;  $\epsilon_r = 38.30$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
 Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(6.96, 6.96, 6.96); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Right Cheek/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
 Maximum value of SAR (interpolated) = 0.098 mW/g

**Right Cheek/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
 Reference Value = 1.74 V/m; Power Drift = - 0.11 dB  
 Peak SAR (extrapolated) = 0.158 W/kg  
**SAR(1 g) = 0.094 mW/g; SAR(10 g) = 0.053 mW/g**  
 Maximum value of SAR (measured) = 0.102 mW/g



#14

Date: 10/22/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

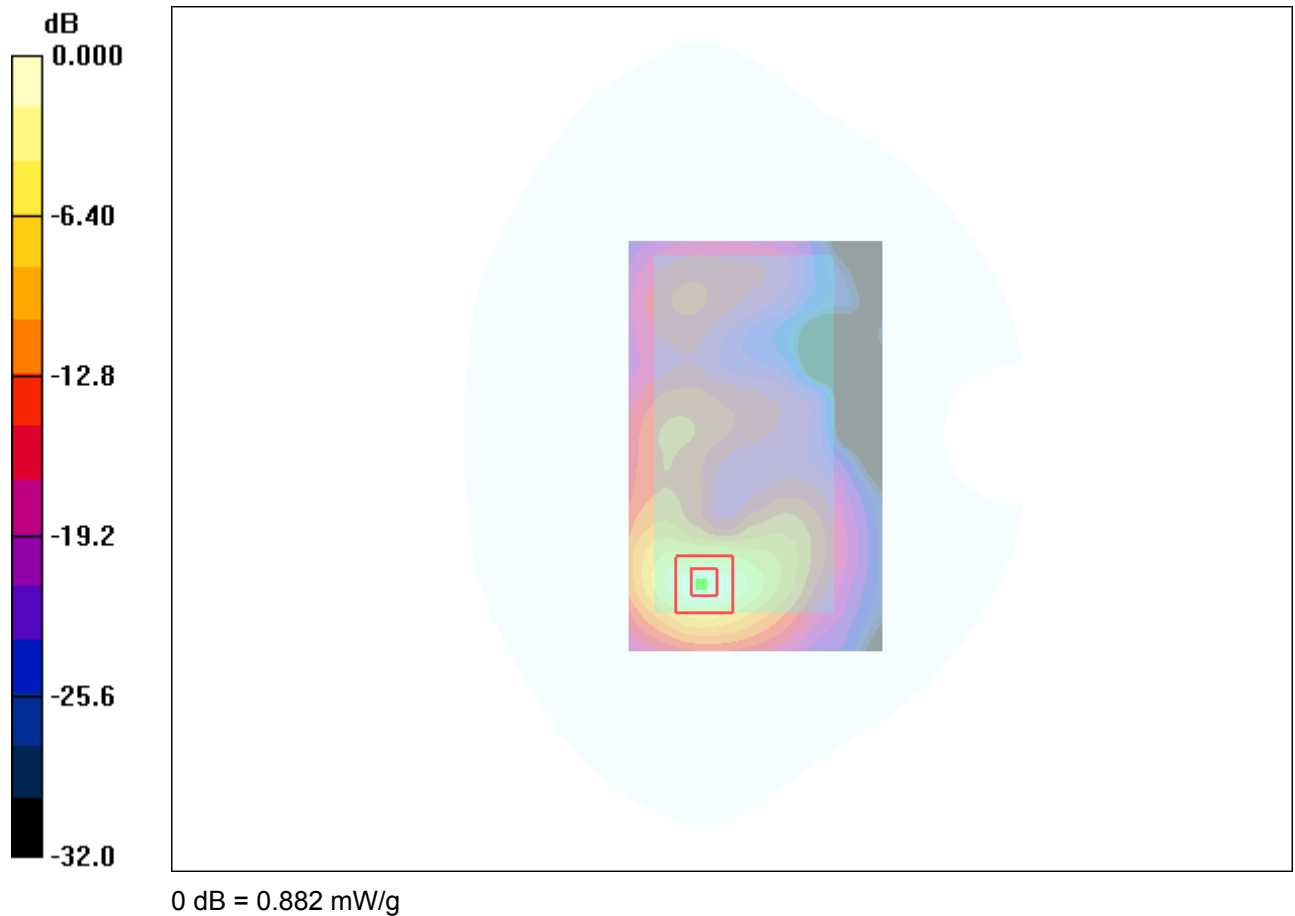
Communication System: LTE; Frequency: 2535 MHz; Duty Cycle: 1:1  
Medium parameters used (interpolated):  $f = 2535$  MHz;  $\sigma = 2.19$  mho/m;  $\epsilon_r = 50.50$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(6.99, 6.99, 6.99); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Back/Area Scan (81x131x1):** Interpolated grid:  $dx=1.2$ mm,  $dy=1.2$ mm  
Maximum value of SAR (interpolated) = 0.859 mW/g

**Back/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm  
Reference Value = 3.81 V/m; Power Drift = 0.11 dB  
Peak SAR (extrapolated) = 1.79 W/kg  
**SAR(1 g) = 0.724 mW/g; SAR(10 g) = 0.297 mW/g**  
Maximum value of SAR (measured) = 0.882 mW/g



#15

Date: 10/16/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

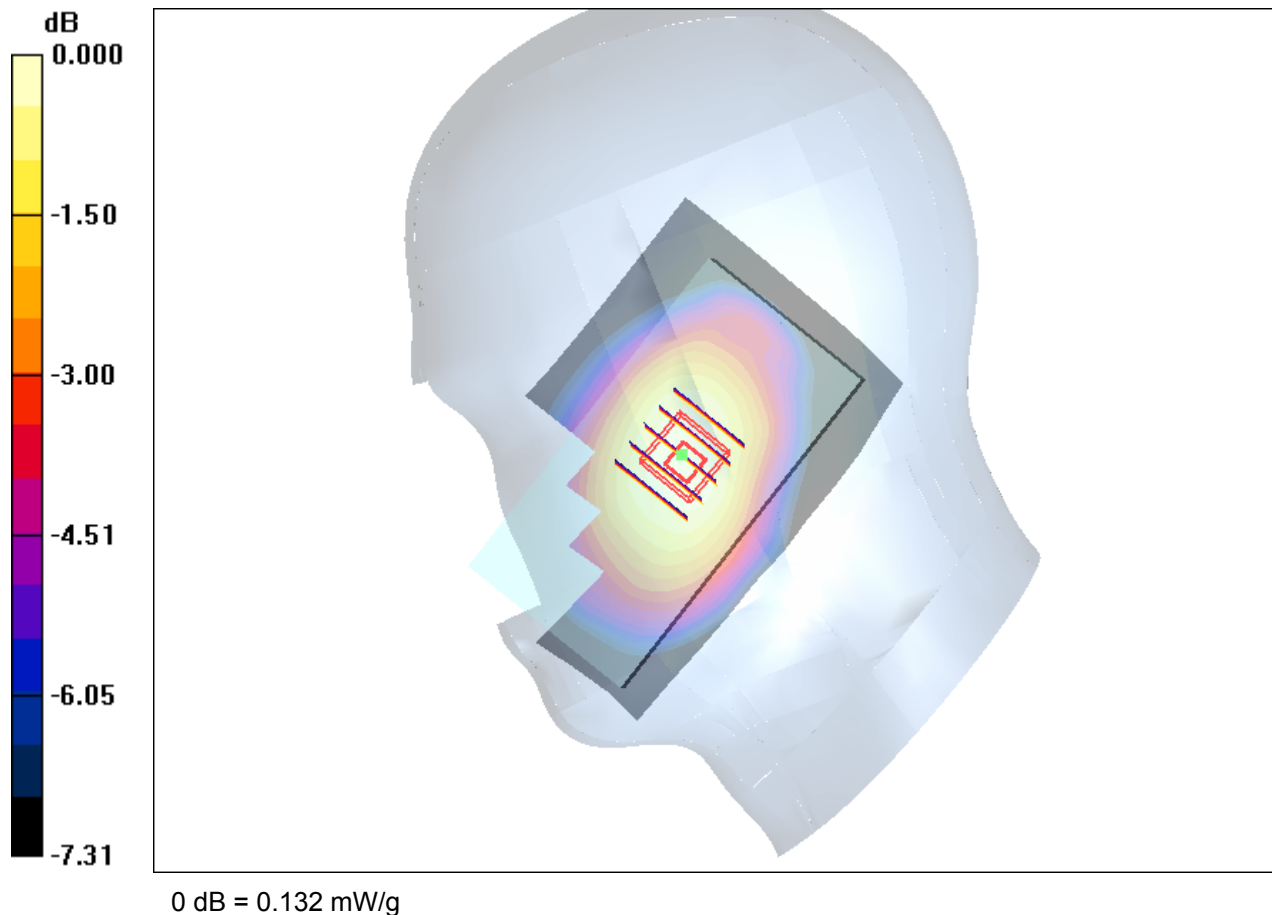
Communication System: LTE; Frequency: 710 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 710$  MHz;  $\sigma = 0.90$  mho/m;  $\epsilon_r = 41.28$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(9.43, 9.43, 9.43); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Right Cheek/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.296 mW/g

**Right Cheek/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
Reference Value = 9.84 V/m; Power Drift = -0.06 dB  
Peak SAR (extrapolated) = 0.132 W/kg  
**SAR(1 g) = 0.125 mW/g; SAR(10 g) = 0.089 mW/g**  
Maximum value of SAR (measured) = 0.132 mW/g



#16

Date: 10/16/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

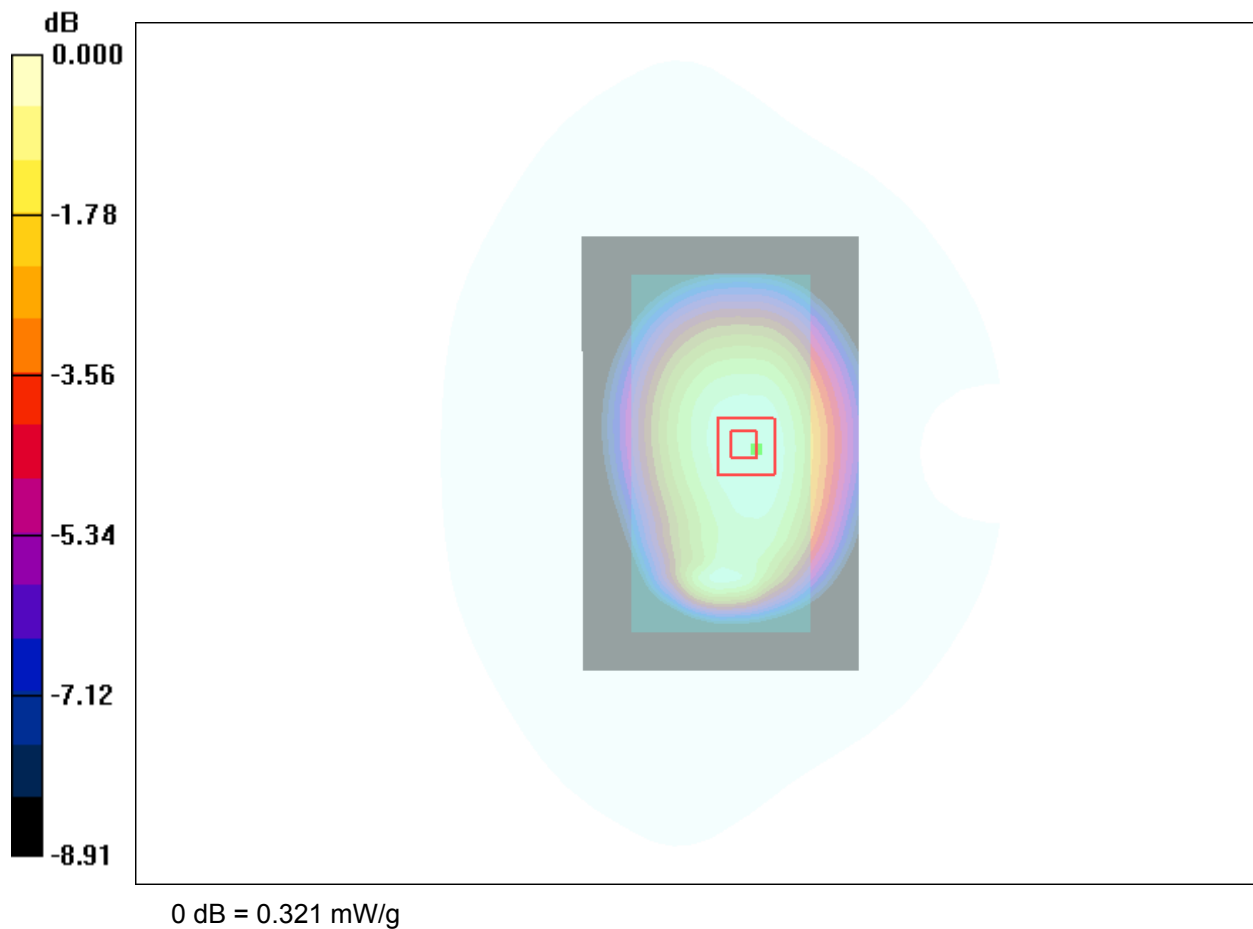
Communication System: LTE; Frequency: 710 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 710$  MHz;  $\sigma = 0.95$  mho/m;  $\epsilon_r = 54.17$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(9.38, 9.38, 9.38); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Back/Area Scan (71x111x1):** Interpolated grid:  $dx=1.5$ mm,  $dy=1.5$ mm  
Maximum value of SAR (interpolated) = 0.336 mW/g

**Back/Zoom Scan (5x5x7)/Cube 0:** Measurement grid:  $dx=8$ mm,  $dy=8$ mm,  $dz=5$ mm  
Reference Value = 8.91 V/m; Power Drift = 0.09 dB  
Peak SAR (extrapolated) = 0.371 W/kg  
**SAR(1 g) = 0.301mW/g; SAR(10 g) = 0.187 mW/g**  
Maximum value of SAR (measured) = 0.321 mW/g



#17

Date: 10/21/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

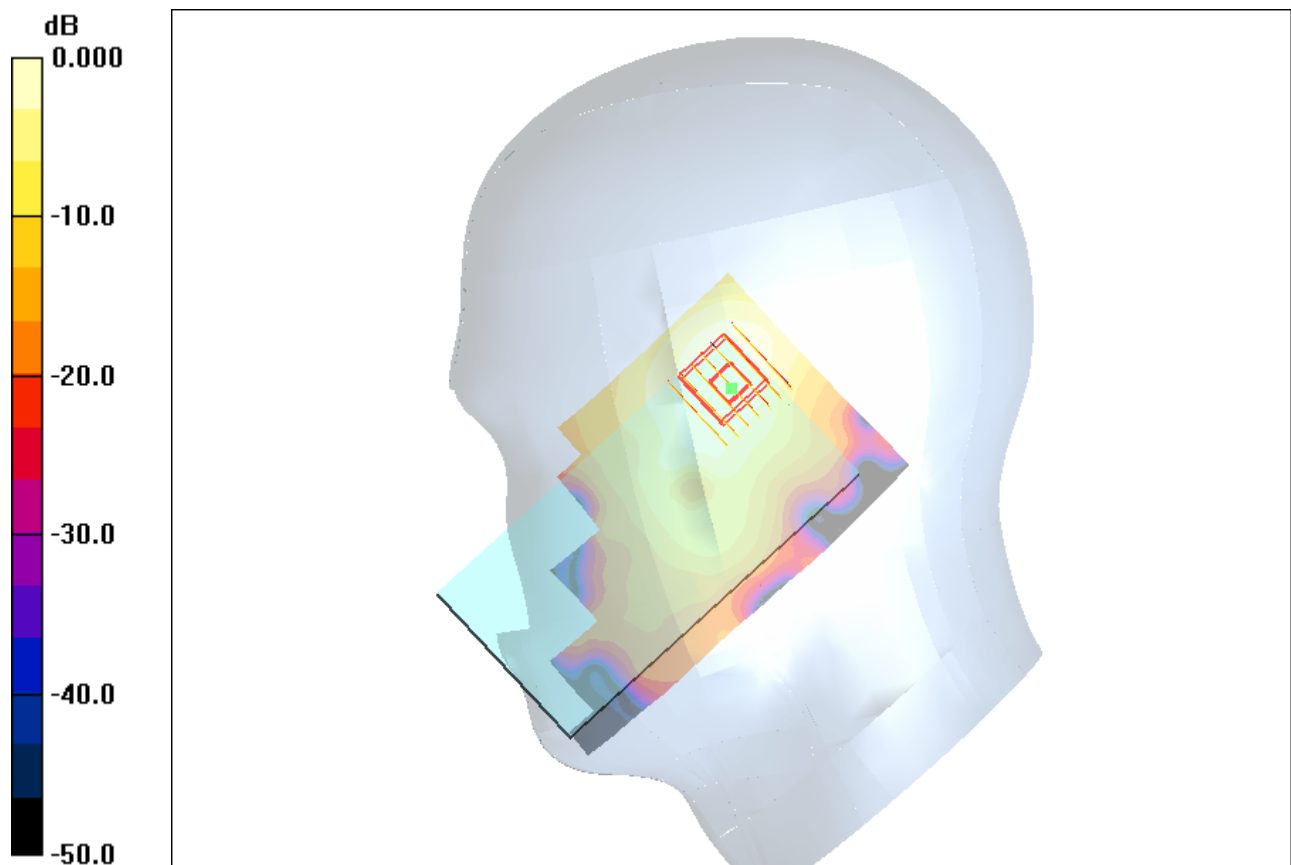
Communication System: 802.11; Frequency: 2412 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.81$  mho/m;  $\epsilon_r = 37.80$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.07, 7.07, 7.07); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172

**Right Cheek/Area Scan (81x131x1):** Interpolated grid:  $dx=1.2$ mm,  $dy=1.2$ mm  
Maximum value of SAR (interpolated) = 0.118 mW/g

**Right Cheek/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm  
Reference Value = 2.56 V/m; Power Drift = 0.03 dB  
Peak SAR (extrapolated) = 0.211 W/kg  
**SAR(1 g) = 0.104 mW/g; SAR(10 g) = 0.051 mW/g**  
Maximum value of SAR (measured) = 0.115 mW/g



0 dB = 0.115 mW/g



#18

Date: 10/21/2016

**DUT: TITAN LTE; Type: SI PIN; Serial: IMEI Number**  
**Program Name: TITAN LTE**

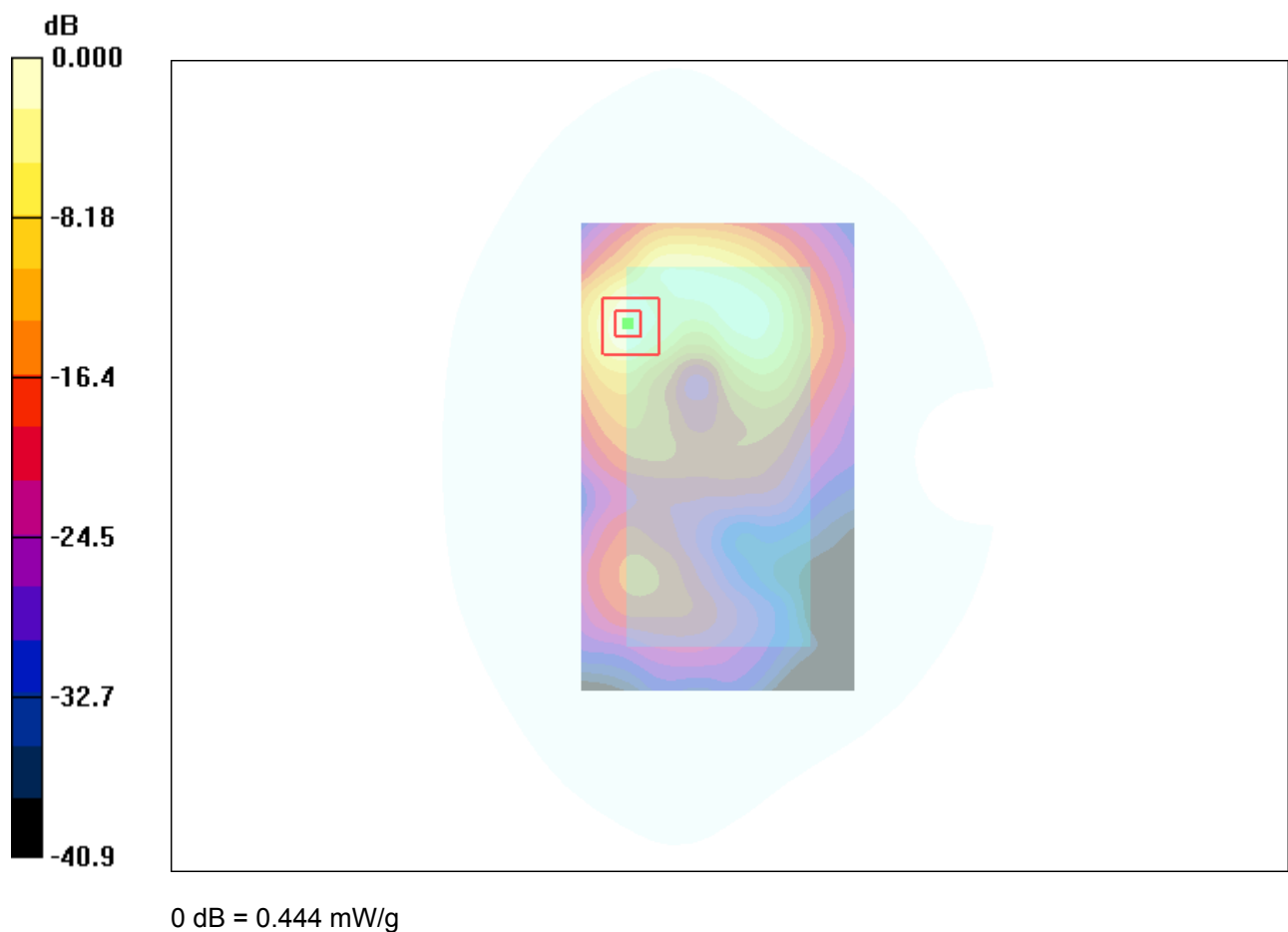
Communication System: 802.11; Frequency: 2412 MHz; Duty Cycle: 1:1  
Medium parameters used:  $f = 2412$  MHz;  $\sigma = 1.88$  mho/m;  $\epsilon_r = 52.18$ ;  $\rho = 1000$  kg/m<sup>3</sup>  
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 – SN3836; ConvF(7.20, 7.20, 7.20); Calibrated: 07/07/2016
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn760; Calibrated: 06/24/2016
- Phantom: SAM 2; Type: SAM; Serial: TP-1432
- Measurement SW: DASY5, V4.7 Build 53; Postprocessing SW: SEMCAD, V1.8 Build 172





**Back/Area Scan (81x131x1):** Interpolated grid:  $dx=1.2$ mm,  $dy=1.2$ mm  
Maximum value of SAR (interpolated) = 0.424 mW/g

**Back/Zoom Scan (7x7x7)/Cube 0:** Measurement grid:  $dx=5$ mm,  $dy=5$ mm,  $dz=5$ mm  
Reference Value = 5.42 V/m; Power Drift = 0.10 dB  
Peak SAR (extrapolated) = 0.612 W/kg  
**SAR(1 g) = 0.407 mW/g; SAR(10 g) = 0.286 mW/g**  
Maximum value of SAR (measured) = 0.444 mW/g



## 6. Calibration Certificate

### 6.1. Probe Calibration Certificate


In Collaboration with

CALIBRATION LABORATORY



中国认可  
国际互认  
校准  
CALIBRATION  
CNAS L0570

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
 E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

Client **Sunway** Certificate No: **Z16-97101**

### CALIBRATION CERTIFICATE

Object: **EX3DV4 - SN:3836**

Calibration Procedure(s): **FD-Z11-2-004-01**  
**Calibration Procedures for Dosimetric E-field Probes**

Calibration date: **July 07, 2016**

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.



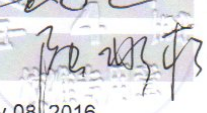
All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%.

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
Power sensor NRP-Z91	101548	27-Jun-16 (CTTL, No.J16X04777)	Jun-17
Reference10dBAttenuator	18N50W-10dB	13-Mar-16(CTTL,No.J16X01547)	Mar-18
Reference20dBAttenuator	18N50W-20dB	13-Mar-16(CTTL, No.J16X01548)	Mar-18
Reference Probe EX3DV4	SN 3617	26-Aug-15(SPEAG,No.EX3-3617_Aug15)	Aug-16
DAE4	SN 1331	21-Jan-16(SPEAG, No.DAE4-1331_Jan16)	Jan -17

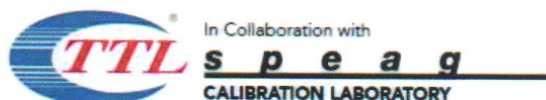
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
SignalGeneratorMG3700A	6201052605	27-Jun-16 (CTTL, No.J16X04776)	Jun-17
Network Analyzer E5071C	MY46110673	26-Jan-16 (CTTL, No.J16X00894)	Jan -17

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

Issued: July 08, 2016

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





Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
 E-mail: [ctl@chinattl.com](mailto:ctl@chinattl.com) <http://www.chinattl.cn>

### Glossary:

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

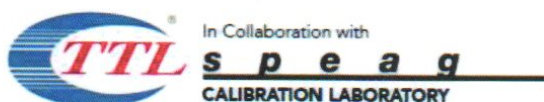
Connector Angle information used in DASY system to align probe sensor X to the robot coordinate system

### 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, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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<sub>x,y,z</sub>: Assessed for E-field polarization  $\theta=0$  ( $f \leq 900\text{MHz}$  in TEM-cell;  $f > 1800\text{MHz}$ : waveguide). NORM<sub>x,y,z</sub> are only intermediate values, i.e., the uncertainties of NORM<sub>x,y,z</sub> does not effect the  $E^2$ -field uncertainty inside TSL (see below ConvF).
- NORM( $f$ )<sub>x,y,z</sub> = NORM<sub>x,y,z</sub> \* 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.
- DCP<sub>x,y,z</sub>: 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<sub>x,y,z</sub>; B<sub>x,y,z</sub>; C<sub>x,y,z</sub>; VR<sub>x,y,z</sub>; 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<sub>x,y,z</sub> \* 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<sub>x</sub> (no uncertainty required).



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
E-mail: [cttl@chinattl.com](mailto:cttl@chinattl.com) [Http://www.chinattl.cn](http://www.chinattl.cn)

# Probe EX3DV4

## SN: 3836

Calibrated: July 07, 2016

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
 E-mail: cttl@chinattl.com [Http://www.chinattl.cn](http://www.chinattl.cn)

## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3836

### Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm( $\mu V/(V/m)^2$ ) <sup>A</sup>	0.40	0.46	0.43	±10.8%
DCP(mV) <sup>B</sup>	93.2	100.2	98.0	

### Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB· $\mu V$	C	D dB	VR mV	Unc <sup>E</sup> (k=2)
0	CW	X	0.0	0.0	1.0	0.00	167.8	±2.0%
		Y	0.0	0.0	1.0		182.5	
		Z	0.0	0.0	1.0		176.7	

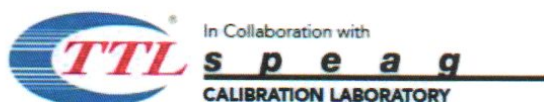
The reported uncertainty of measurement is stated as the standard uncertainty of Measurement multiplied by the coverage factor k=2, which for a normal distribution Corresponds to a coverage probability of approximately 95%.

<sup>A</sup> The uncertainties of Norm X, Y, Z do not affect the E<sup>2</sup>-field uncertainty inside TSL (see Page 5 and Page 6).

<sup>B</sup> Numerical linearization parameter: uncertainty not required.

<sup>E</sup> 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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 Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
 E-mail: [ctl@chinatl.com](mailto:ctl@chinatl.com) [Http://www.chinatl.cn](http://www.chinatl.cn)

## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3836

### Calibration Parameter Determined in Head Tissue Simulating Media

f [MHz] <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unct. (k=2)
750	41.9	0.89	9.43	9.43	9.43	0.30	0.80	±12%
835	41.5	0.90	9.42	9.42	9.42	0.15	1.58	±12%
900	41.5	0.97	9.03	9.03	9.03	0.15	1.46	±12%
1750	40.1	1.37	8.04	8.04	8.04	0.14	1.63	±12%
1900	40.0	1.40	7.60	7.60	7.60	0.16	1.59	±12%
2300	39.5	1.67	7.45	7.45	7.45	0.53	0.68	±12%
2450	39.2	1.80	7.07	7.07	7.07	0.54	0.71	±12%
2600	39.0	1.96	6.96	6.96	6.96	0.61	0.66	±12%
5200	36.0	4.66	5.32	5.32	5.32	0.40	1.42	±13%
5300	35.9	4.76	5.13	5.13	5.13	0.40	1.40	±13%
5500	35.6	4.96	4.85	4.85	4.85	0.40	1.35	±13%
5600	35.5	5.07	4.59	4.59	4.59	0.40	1.45	±13%
5800	35.3	5.27	4.71	4.71	4.71	0.40	1.45	±13%

<sup>C</sup> 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.

<sup>F</sup> At frequency below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) 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 ( $\epsilon$  and  $\sigma$ ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> 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.



Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China  
 Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
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## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3836

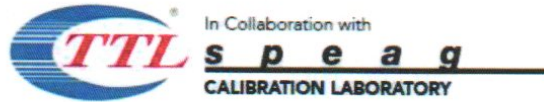
### Calibration Parameter Determined in Body Tissue Simulating Media

f [MHz] <sup>C</sup>	Relative Permittivity <sup>F</sup>	Conductivity (S/m) <sup>F</sup>	ConvF X	ConvF Y	ConvF Z	Alpha <sup>G</sup>	Depth <sup>G</sup> (mm)	Unct. (k=2)
750	55.5	0.96	9.38	9.38	9.38	0.30	0.85	± 12%
835	55.2	0.97	9.25	9.25	9.25	0.17	1.44	± 12%
900	55.0	1.05	8.95	8.95	8.95	0.14	1.60	± 12%
1750	53.4	1.49	7.64	7.64	7.64	0.17	1.71	± 12%
1900	53.3	1.52	7.33	7.33	7.33	0.18	1.80	± 12%
2300	52.9	1.81	7.45	7.45	7.45	0.51	0.80	± 12%
2450	52.7	1.95	7.20	7.20	7.20	0.62	0.70	± 12%
2600	52.5	2.16	6.99	6.99	6.99	0.52	0.79	± 12%
5200	49.0	5.30	4.83	4.83	4.83	0.50	1.25	± 13%
5300	48.9	5.42	4.60	4.60	4.60	0.50	1.35	± 13%
5500	48.6	5.65	4.32	4.32	4.32	0.50	1.35	± 13%
5600	48.5	5.77	4.20	4.20	4.20	0.50	1.40	± 13%
5800	48.2	6.00	4.30	4.30	4.30	0.50	1.30	± 13%

<sup>C</sup> 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.

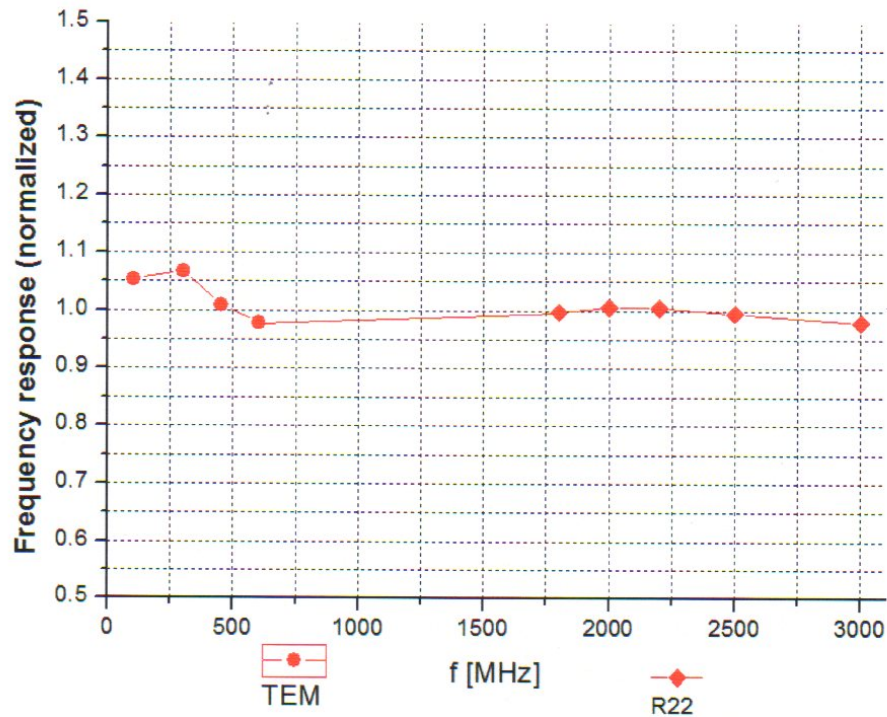
<sup>F</sup> At frequency below 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters ( $\epsilon$  and  $\sigma$ ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

<sup>G</sup> 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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Tel: +86-10-62304633-2218 Fax: +86-10-62304633-2209  
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### Frequency Response of E-Field (TEM-Cell: ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field:  $\pm 7.5\%$  ( $k=2$ )

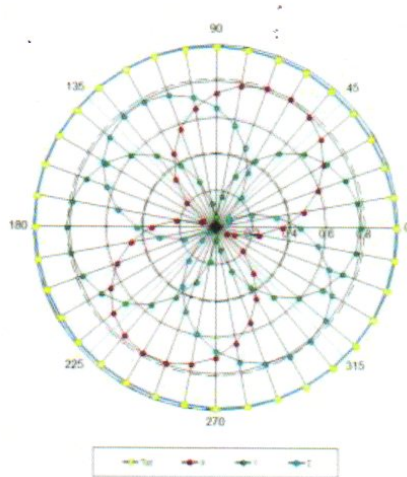




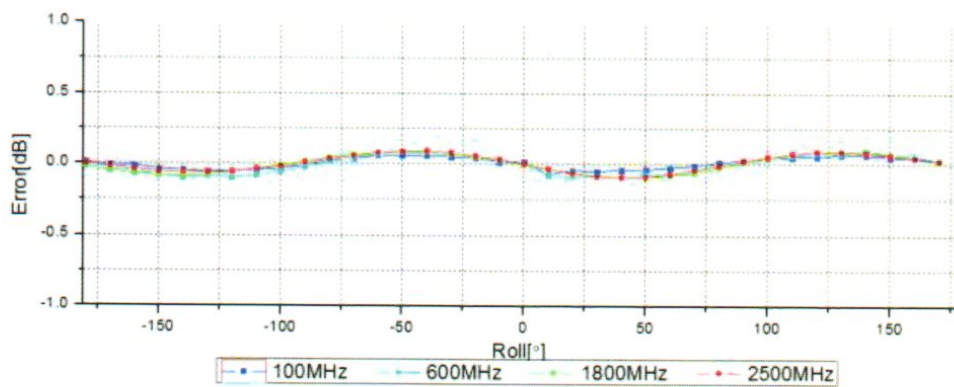
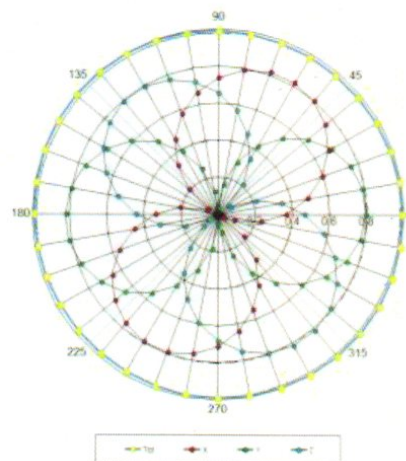
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## Receiving Pattern ( $\Phi$ ), $\theta=0^\circ$

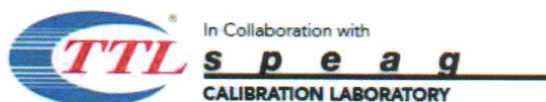
**f=600 MHz, TEM**



**f=1800 MHz, R22**

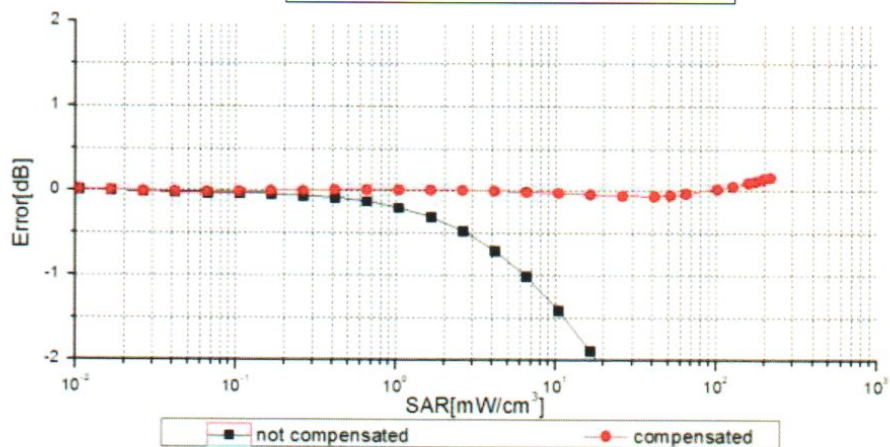
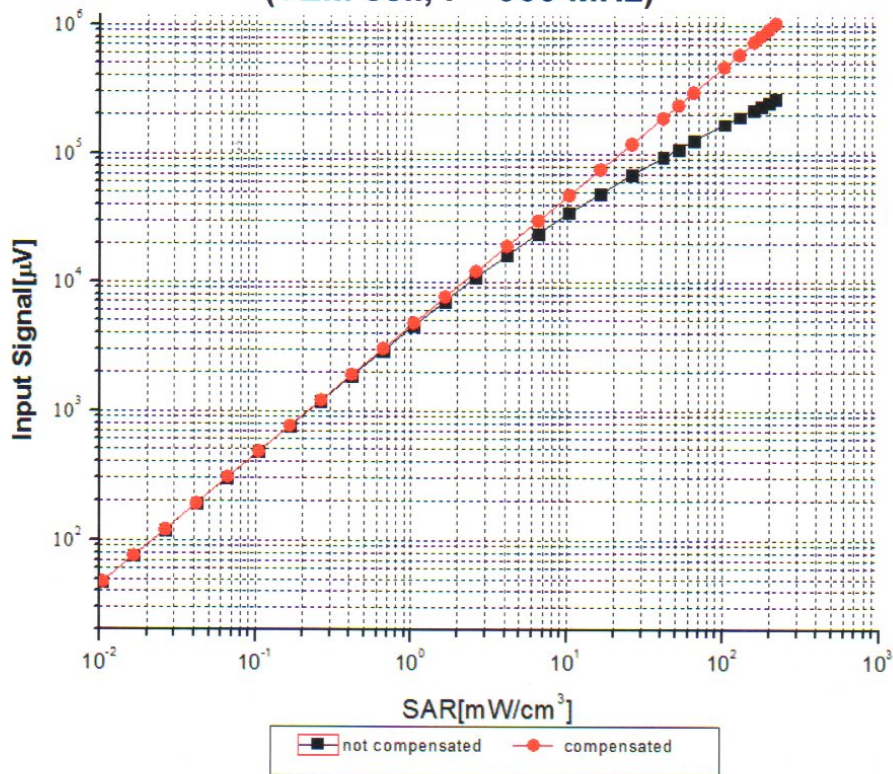


Uncertainty of Axial Isotropy Assessment:  $\pm 0.9\%$  ( $k=2$ )



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



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

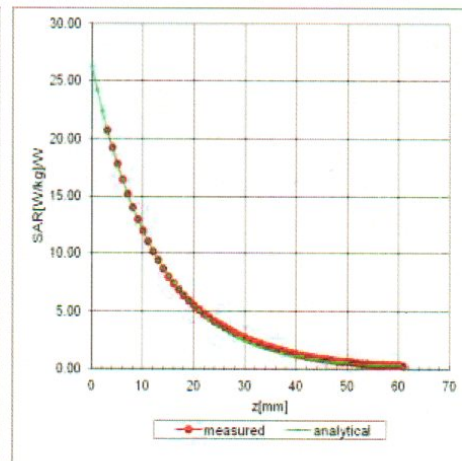
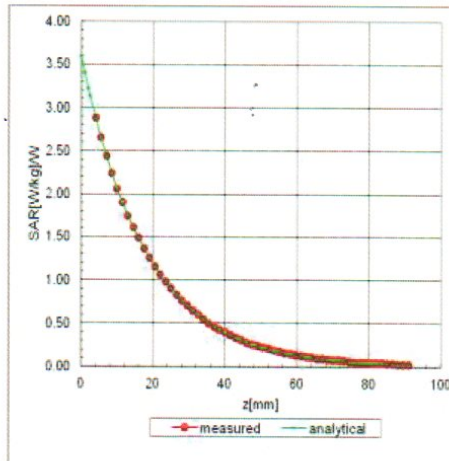


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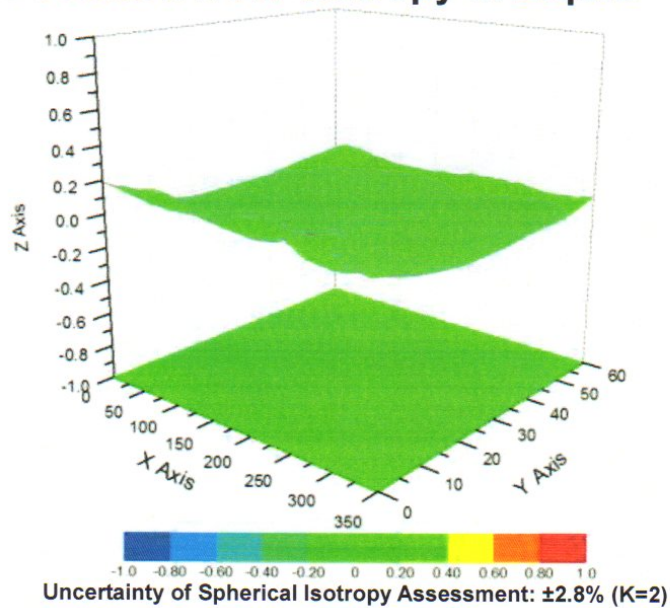
## Conversion Factor Assessment

f=900 MHz, WGLS R9(H\_convF)

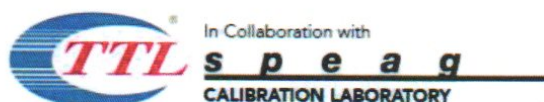
f=1900 MHz, WGLS R22(H\_convF)



## Deviation from Isotropy in Liquid







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## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3836

### Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	47.9
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disable
Probe Overall Length	337mm
Probe Body Diameter	10mm
Tip Length	9mm
Tip Diameter	2.5mm
Probe Tip to Sensor X Calibration Point	1mm
Probe Tip to Sensor Y Calibration Point	1mm
Probe Tip to Sensor Z Calibration Point	1mm
Recommended Measurement Distance from Surface	1.4mm