SAMSUNG ELECTRONICS Co., Ltd.,
Regulatory Compliance Group
IT R&D Center

416, Maetan-3dong,
Yeongtong-gu, Suwon-si,
Gyeonggi-do, Korea 443-742

TEST REPORT ON SAR

Model Tested:	**GT-S5698**
FCC ID (Requested):	**A3LGTS5698**
Job No:	**FJ-131**
Report No:	**FJ-131-S1**

- Abstract –

This document reports on SAR Tests carried out in accordance with FCC/OET Bulletin 65, Supplement C(June 2001).

Prepared By

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Authorized By

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1. GENERAL INFORMATION

Test Dates :	May.14, 2012 ~ May.15, 2012
Manufacturer :	SAMSUNG ELECTRONICS Co., Ltd.
Address :	416 Maetan3-Dong, Suwon City, Korea
Test Standard :	§2.1093; FCC/OET Bulletin 65, Supplement C(June 2001)
FCC Classification :	Licensed Portable Transmitter Held to Ear (PCE) Digital Transmitter System (DTS)
Tested for :	FCC/TCB Certification

2. DESCRIPTION OF DEVICE

Test Sample :	1900 GSM/GPRS/EDGE Phone with Bluetooth and WLAN
Model Number :	GT-S5698
Serial Number :	Identical prototype (S/N : # FJ-131-A)
Tx Freq. Range :	1850.20 ~ 1909.80 MHz (GSM1900) 2412 ~ 2462 MHz (WLAN) 2402 ~ 2480 MHz (Bluetooth)
Rx Freq. Range :	1930.20 ~ 1989.80 MHz (GSM1900) 2412 ~ 2462 MHz (WLAN) 2402 ~ 2480 MHz (Bluetooth)
Antenna Manufacturer :	Ethertronics Model No.: 3001292
Antenna Dimensions :	48.52 X 16.26 X 7.28 (mm)
Separation distance between Main and Bluetooth antenna :	10mm

3. DESCRIPTION OF TEST EQUIPMENT

3.1 SAR Measurement Setup

Robotic System

Measurements are performed using the DASY4 (or DASY5) automated dosimetric assessment system. Which is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Stäubli), robot controller, measurement server, Samsung computer, near-field probe, probe alignment sensor, and the SAM twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 3.1).

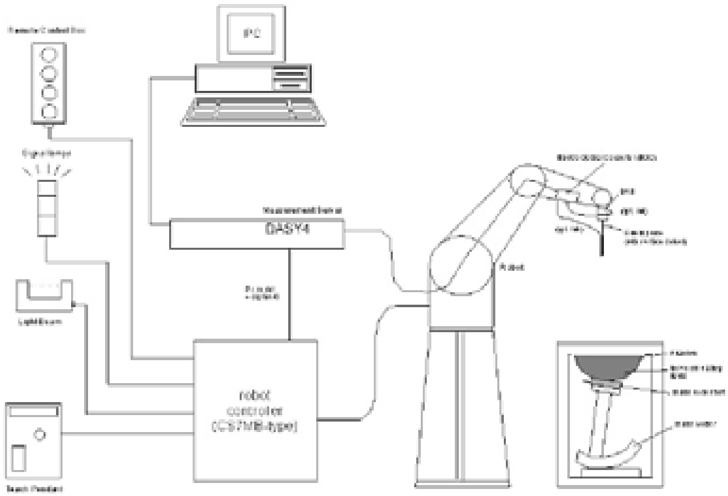

Figure 3.1 SAR Measurement System Setup

System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control is used to drive the robot motors. The PC consists of the Samsung computer with Windows XP system and SAR Measurement Software DASY4 (or DASY5), LCD monitor, mouse and keyboard. The Stäubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the measurement server.

System Electronics

The DAE4(or DAE3) consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16-bit AD-converter and a command decoder and control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

3.2 E-field Probe

Figure 3.2 DAE System

The SAR measurement were conducted with the dosimetric probe ES3DV2, ES3DV3, EX3DV4 and ET3DV6, designed in the classical triangular configuration (see Fig.3.3) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting (see Fig.3.2). The approach is stopped at reaching the maximum.

Probe Specifications

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	Basic Broad Band Calibration in air: 10-3000 MHz Conversion Factors (CF) for HSL 900 and HSL 1800

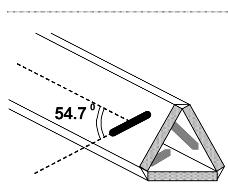

Figure 3.3 Triangular Probe Configuration

Additional CF for other liquids and frequencies upon request

Frequency	10 MHz to > 6 GHz; Linearity: ± 0.2 dB (30 MHz to 3 GHz)
Directivity	**[ES3DV3], [ET3DV6]** ± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis) **[EX3DV4]** ± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	**[ES3DV3], [ET3DV6]** 5μW/g to > 100mW/g; Linearity: ± 0.2dB **[EX3DV4]** 10 μW/g to > 100 mW/g; Linearity: ± 0.2 dB
Dimensions	**[ES3DV3], [ES3DV2]** Overall length: 330 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.1 mm **[EX3DV4]** Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm **[ET3DV6]** Overall length: 330mm Tip length: 16mm Body diameter: 12mm Tip diameter: 6.8mm Distance from probe tip to dipole centers: 2.7mm

[ES3DV3] ,[ES3DV2]

[EX3DV4]

Application **[ES3DV3], [ES3DV2]**

General dosimetry up to 5 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones

[ET3DV6]

[EX3DV4]

High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields).Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30 %.

[ET3DV6]

General dosimetry up to 3 GHz

Compliance tests of mobile phones

Fast automatic scanning in arbitrary phantoms

Optical Surface Detection **[ET3DV6]**

± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces

3.3 Phantom

SAM Twin Phantom

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid.

Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (See Figure 3.5)

Figure3.5 SAM Twin Phantom

SAM Twin Phantom Specification

Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528-2003, EN 50361:2001 and IEC 62209. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents evaporation of the liquid.
Shell Thickness	2 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Height: 810 mm; Length: 1000 mm; Width: 500 mm

Modular Flat Phantom

The Modular Flat Phantom V5.1 is constructed of a fiberglass shell integrated in a wooden table. Also It consists of three identical flat phantoms (modules) which can be installed and removed separately without emptying the liquid, as well as a wooden support.. It enables the dosimetric evaluation of body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid.

Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (See Figure 3.6)

Figure 3.6 Modular Flat Phantom

Modular Flat Phantom Specification

Construction	The shell corresponds to the specifications of IEEE 1528-2003. It enables the dosimetric evaluation of body mounted usage above 800 MHz at the flat phantom region. A cover prevents evaporation of the liquid
Shell Thickness	2 ± 0.2 mm
Filling Volume	Approx. 10 liters
Dimension	Wooden support - Height: 810 mm; Length: 830 mm; Width: 500 mm Each Module - Height:190 mm; Length: 200 mm; width: 300 mm

3.4 Brain Simulating Mixture Characterization

The brain mixtures consist of a viscous gel using hydroxethylcellullose (HEC) gelling agent and saline solution (see Table 3.1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue.

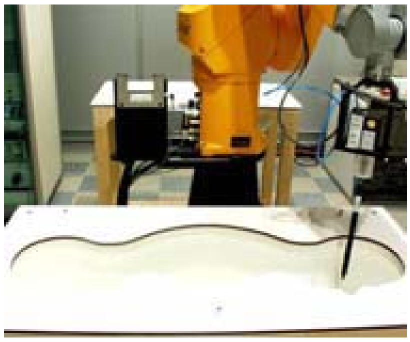

Figure 3.7 Simulated Tissue

Table 3.1 Composition of the Brain Tissue Equivalent Matter

INGREDIENTS	1900MHz Brain	1900MHz Muscle	2450MHz Brain	2450MHz Muscle
WATER	55.24%	70.23%	62.7%	73.2%
SUGAR	-	-	-	-
SALT	0.24%	0.21%	-	0.04%
TWEEN20	44.52%	29.56%	37.3%	26.76%
BACTERIACIDE	-	-	-	-
HEC	-	-	-	-
Dielectric Constant Target	40.00	53.30	39.2	52.7
Conductivity Target (S/m)	1.400	1.520	1.80	1.95

3.5 Device Holder for Transmitters

In combination with the Twin SAM Phantom V4.0, the Mounting Device (see Fig. 3.7) enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately and repeatedly be positioned according to the EN 50360:2001 and FCC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

*Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configuration. To produce worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

Figure 3.8 Device Holder

3.6 Validation Dipole

The reference dipole should have a return loss better than –20 dB (measured in the setup) at the resonant frequency to reduce the uncertainty in the power measurement.

Frequency	1900, 2450 MHz
Return Loss	< -20 dB at specified validation position
Dimensions	D1900V2: dipole length: 68 mm; overall height: 300 mm D2450V2: dipole length: 51.8 mm; overall height: 300 mm

Note:

Usage of SAR dipoles calibrated less than 2 years ago but more than 1 year ago were confirmed in maintaining return loss (< -20dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibration in KDB 450824

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3.7 Equipment Calibration

Table 3.2 Test Equipment Calibration

Type	Calibration Due Date	Serial No.
SPEAG E-Field Probe ES3DV3	Jan.25, 2013	3080
SPEAG DAE4	Feb.21, 2013	670
SPEAG Validation Dipole D1900V2	Jan.26, 2014	5d023
SPEAG Validation Dipole D2450V2	Feb.23, 2014	807
Stäubli Robot TX90XL	Not Required	F06/546ZA1/A/01
SPEAG SAM Twin Phantom	Not Required	TP-1603
SPEAG SAM Twin Phantom	Not Required	TP-1425
Modular Phantom	Not Required	MP-1007
E4438C Signal Generator	Jan.19, 2013	MY45094010
NRVD Dual Channel Power Meter	Feb.10, 2013	836416/028
NRV-Z53 Thermal Power Sensor	Feb.10, 2013	835324/001
NRV-Z53 Thermal Power Sensor	Feb.10, 2013	835324/006
E4419B Power Meter	Nov.08, 2012	GB43312299
E9300B Power Sensor	Feb.13, 2013	MY41495557
BBS3Q7ECK Power Amp	Jan.18, 2013	1052
HP-8753ES Network Analyzer	Apr.16, 2013	US39173712
HP85070C Dielectric Probe Kit	Not Required	US99360087
Digital thermo-hygrometer	Feb.10, 2013	1367
Digital thermo-hygrometer	Feb.10, 2013	1375
DASY5 S/W (ver 5.0)	Unknown	-
E4440A Spectrum Analyzer	Feb.20, 2013	MY45304704
778D Dual Directional Coupler	May.20, 2012	18862
777D Dual Directional Coupler	Feb.20, 2013	07526
Base Station Simulator	Jan.18, 2013	GB45360270
Spectrum Analyzer	Mar.08,2013	MY46187454
Communication tester(E5515C)	Nov.27,2012	GB42230535
11636B	Jul.05,2012	51942

NOTE:
The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Validation measurement is performed by Samsung Lab. before each test. (see § 7.2) The brain simulating material is calibrated by Samsung using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material. (see § 7.1)

4. SAR MEASUREMENT PROCEDURE

The evaluation was performed using the following procedure.

STEP 1

The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed location point was measured and used as a reference value.

STEP 2

The SAR distribution at the exposed side of the head was measured at a distance of 3.9mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 20mm x 20mm. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation.

STEP 3

Around this point, a volume of 32mm x 32mm x 30mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure:

The data at the surface was extrapolated, since the center of the dipoles is 2.7mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluated the points between the surface and the probe tip. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the “Not a knot” condition (in x, y, and z directions). The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

STEP 4

The SAR value at the same location as in step 1 was again measured.

(If the value changed by more than 5%, the evaluation is repeated.)

5. DESCRIPTION OF TEST POSITION

5.1 SAM Phantom Shape

Figure 5.1 shows the front, back and side views of SAM. The point “M” is the reference point for the center of mouth, “LE” is the left ear reference point (ERP), and “RE” is the right ERP. The ERPs are 15 mm posterior to the entrance to ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5.2.

Figure 5.1 Front, back and side view of SAM

The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 5.3). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines should be marked on the external phantom shell to facilitate handset positioning. Posterior to the N-F line, the thickness of the phantom shell with the shape of an ear is a flat surface 6 mm thick at the ERPs.

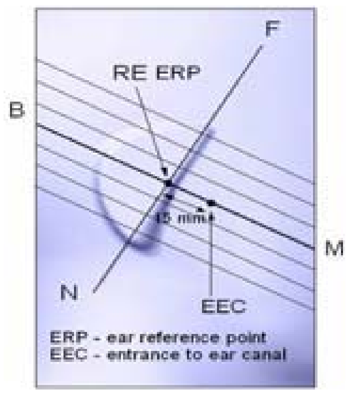
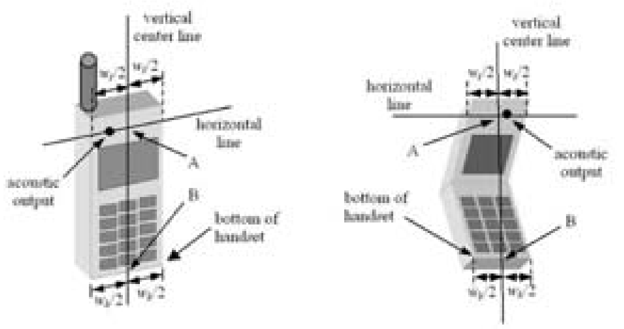


Figure 5.2 Close up side view

5.2 “cheek” Position

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (see Fig. 5.4). The “test device reference point” was than located at the same level as the center of the eat reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at it’s tip and bottom edges, positioning the “ear reference point” on the outer surface of the both the left and right head phantoms on the ear reference point



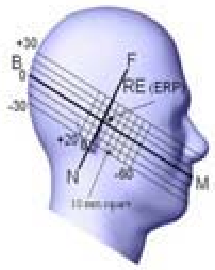


Figure 5.3 Side view of the phantom showing relevant markings

Figure 5.4 Handset vertical and horizontal reference lines

Step 1

The test device was positioned with the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 5.5), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom

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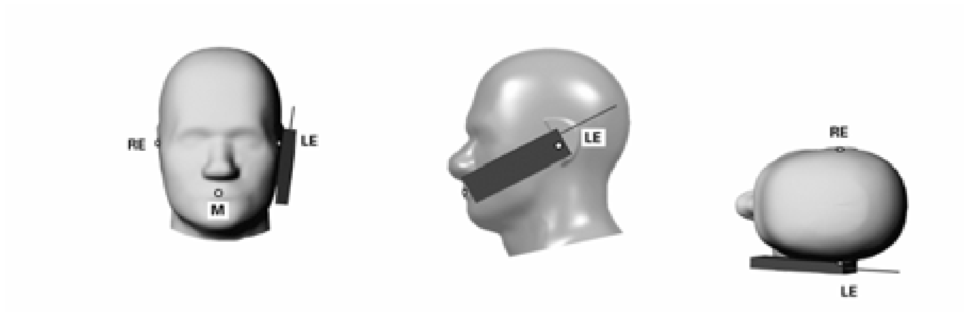

Figure 5.5 Front, Side and Top View of Cheek/Touch Position

Step 2

The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.

Step 3

While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).

Step 4

Rotate the handset around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.

Step 5

While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). See Figure 5.2.

5.3 "tilted" Position

With the test device aligned in the "cheek" position :

Step 1

Repeat steps 1 to 5 of 5.2 to place the device in the "Cheek/Touch Position"

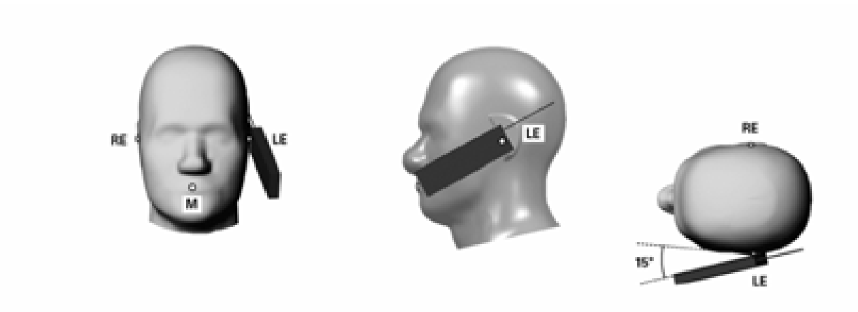

Figure 5.6 Front, side and Top View of Ear/Tilt 15° Position

Step 2

While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15 degree.

Step 3

The phone was then rotated around the horizontal line by 15 degree.

Step 4

While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head.

5.4 Body Holster/Belt Clip 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 (see Figure 5.7). A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that 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 supplied with the device, the device is tested with each accessory that contains unique metallic component. If multiple accessory 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 where a separation distance between the back of the device and the flat phantom is used.

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. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessory(ies), Including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst-case positioning is then documented and used to perform Body SAR testing. In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements must be included in the user's manual.

5.5 FCC Personal Wireless Router Configurations

5.5.1 Personal Wireless Router

Some battery-operated handsets have the capability to transmit and receive internet connectivity through simultaneous transmission of WIFI in conjunction with a separate licensed transmitter. The FCC has provided guidance in KDB Publication 941225 D06 for handsets greater than 9cm x 5cm where SAR test considerations are based on a composite test separation distance of 10mm from the edges, front and back of the device with antennas 2.5cm or closer to the edge of the device, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR test.

5.5.2 SAR test Setup for Personal Wireless Router Features

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus connot be evaluated for SAR under actual use conditions. Therefore, SAR must be evaluated for each frequency transmission and mode separately and summed with the WIFI transmitter according to KDB 648474 publication procedures. The “Portable Hotspot: feature on the handset was NOT activated, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal.

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Table 5.1 Mobile Hotspot Sides for SAR Testing

Mode	Back	Front	Right	Left	Top	Bottom
GPRS1900	Yes	Yes	No	Yes	No	Yes
WIFI	Yes	Yes	Yes	No	No	Yes

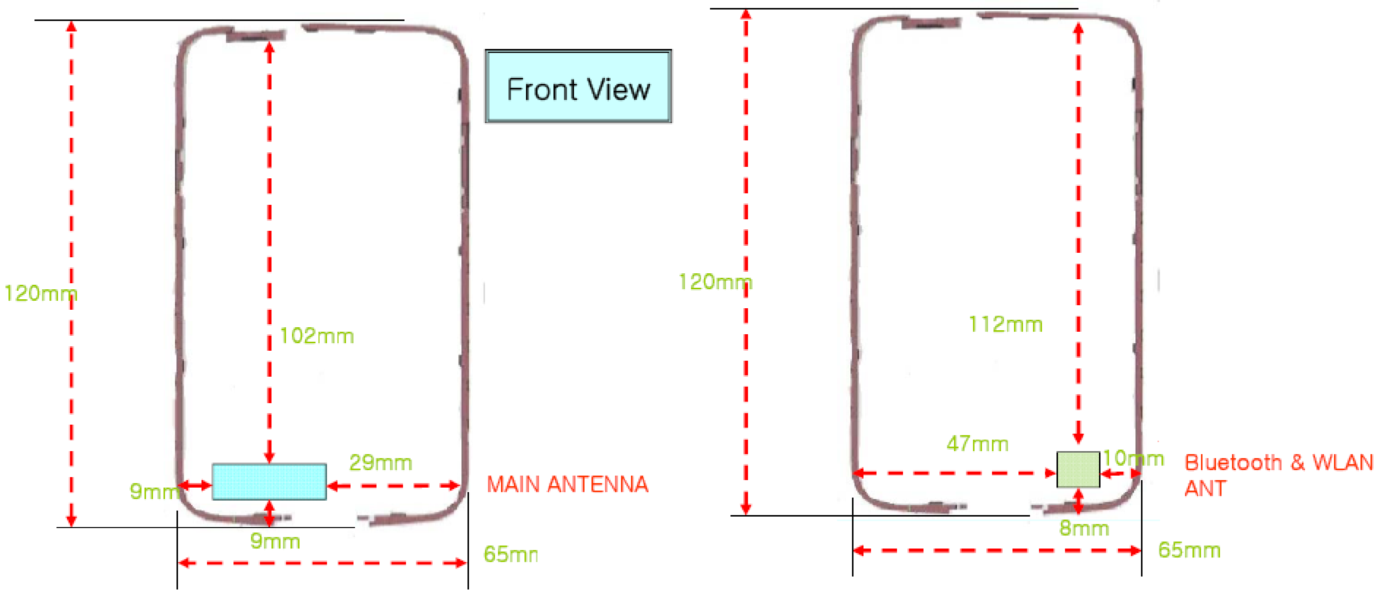

Figure 5.7 Identification of Sides for SAR Testing

Note : Particular DUT edges were not necessary to be evaluated for Wireless Router SAR if the edges were greater than 2.5cm from the transmitting antenna according to FCC KDB Publication 941225 D06 guidance.

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6. MEASUREMENT UNCERTAINTY

Table 6.1 Uncertainty Budget at 1900MHz

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	c_i	Standard uncertainty (±%)	v_i^2 or v_{eff}
Measurement System						
Probe Calibration	11.00	normal	2.000	1	5.50	∞
Axial Isotropy	4.70	rectangular	1.732	0.7	1.90	∞
Hemispherical Isotropy	9.60	rectangular	1.732	0.7	3.88	∞
Linearity	4.70	rectangular	1.732	1	2.71	∞
System Detection Limits	0.25	rectangular	1.732	1	0.14	∞
Boundary effects	1.00	rectangular	1.732	1	0.58	∞
Readout electronics	0.30	normal	1.000	1	0.30	∞
Response time	0.80	rectangular	1.732	1	0.46	∞
RF ambient conditions	3.00	rectangular	1.732	1	1.73	∞
Integration time	0.00	rectangular	1.732	1	0.00	∞
Mechanical constrains of robot	1.50	rectangular	1.732	1	0.87	∞
Probe positioning	2.90	rectangular	1.732	1	1.67	∞
Extrapolation and integration	1.00	rectangular	1.732	1	0.58	∞
Test Sample Related						
Test Sample positioning	1.50	normal	1.000	1	1.50	14
Device holded uncertainty	3.44	normal	1.000	1	3.44	∞
Power Drift	5.00	rectangular	1.732	1	2.89	∞
Phantom and Setup						
Modular Phantom uncertainty	6.02	normal	1.000	1	6.02	2
Phantom uncertainty	4.00	rectangular	1.732	1	2.31	∞
Liquid conductivity (deviation from target)	5.00	rectangular	1.732	0.64	1.85	∞
Liquid conductivity (measurement error)	1.84	normal	1.000	0.64	1.18	∞
Liquid permittivity (deviation from target)	5.00	rectangular	1.732	0.6	1.73	∞
Liquid permittivity (measurement error)	4.54	normal	1.000	0.6	2.73	∞
Combined Standard Uncertainty		Normal	-	-	**12.00**	**60176**
Extended Standard Uncertainty(K=2.00)					**24.00**	**60176**

Table 6.2 Uncertainty Budget at 2450MHz

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	c_i	Standard uncertainty (±%)	v_i^2 or v_{eff}
Measurement System						
Probe Calibration	11.00	normal	2.000	1	5.00	∞
Axial Isotropy	4.70	rectangular	1.732	0.7	1.90	∞
Hemispherical Isotropy	9.60	rectangular	1.732	0.7	3.88	∞
Linearity	4.70	rectangular	1.732	1	2.71	∞
System Detection Limits	0.25	rectangular	1.732	1	0.14	∞
Boundary effects	1.00	rectangular	1.732	1	0.58	∞
Readout electronics	0.30	normal	1.000	1	0.30	∞
Response time	0.80	rectangular	1.732	1	0.46	∞
RF ambient conditions	3.00	rectangular	1.732	1	1.73	∞
Integration time	0.00	rectangular	1.732	1	0.00	∞
Mechanical constrains of robot	1.50	rectangular	1.732	1	0.87	∞
Probe positioning	2.90	rectangular	1.732	1	1.67	∞
Extrapolation and integration	1.00	rectangular	1.732	1	0.58	∞
Test Sample Related						
Test Sample positioning	4.22	normal	1.000	1	4.22	14
Device holded uncertainty	3.44	normal	1.000	1	3.44	∞
Power Drift	5.00	rectangular	1.732	1	2.89	∞
Phantom and Setup						
Modular Phantom uncertainty	2.32	Normal	1.0001	1	2.32	2
Phantom uncertainty	4.00	rectangular	1.732	1	2.31	∞
Liquid conductivity (deviation from target)	5.00	rectangular	1.732	0.64	1.85	∞
Liquid conductivity (measurement error)	2.04	normal	1.000	0.64	1.30	∞
Liquid permittivity (deviation from target)	5.00	rectangular	1.732	0.6	1.73	∞
Liquid permittivity (measurement error)	4.27	normal	1.000	0.6	2.56	∞
Combined Standard Uncertainty		Normal	-	-	**11.32**	**728**
Extended Standard Uncertainty(K=2.00)					**22.64**	**728**

7. SYSTEM VERIFICATION

7.1 Tissue Verification

Table 7.1 MEASURED TISSUE PARAMETERS

	1900MHz Head		1900MHz Body		2450MHz Head		2450MHz Body	
	Target	Measured	Target	Measured	Target	Measured	Target	Measured
Date	May.14,2012		May.14,2012		May.15,2012		May.15,2012	
Liquid Temperature(°C)	22.1		22.3		21.9		21.8	
Dielectric Constant: å'	40	40.6	53.3	51.7	39.2	39.1	52.7	51.2
Conductivity:	1.4	1.39	1.52	1.51	1.8	1.85	1.95	1.95
Tissue Batch Number	1900F4001R		1900B2002K		2450MF4001H		2450B2001D	

The measured value must be within ±5% of the target value.

7.2 Test System Validation

Prior to assessment, the system is verified to the ±10% of the specification at 1900MHz and 2450MHz by using the system validation kit(s). (see Appendix D, Graphic Plot Attached)

Table 7.2 System Validation Results

System Validation Kit	Tissue	Targeted SAR_{1g} (mW/g)	Measured SAR_{1g} (mW/g)	Normalized SAR_{1g} (mW/g)	Deviation (%)	Date	Liquid Temperature(°C)	Ambient Temperature(°C)	Input Power (mW)
5d023	1900MHz Brain	39	3.78	37.8	-3.08	May.14, 2012	22.1	22.6	100
	1900MHz Body	38.8	3.96	39.6	2.06	May.14, 2012	22.3	22.6	100
807	2450MHz Brain	53.5	5.24	52.4	-2.06	May.15, 2012	21.8	22.4	100
	2450MHz Body	50.3	4.8	48	-4.57	May.15, 2012	21.9	22.4	100

*Validation was measured with input power 100 mW and normalized to 1W.

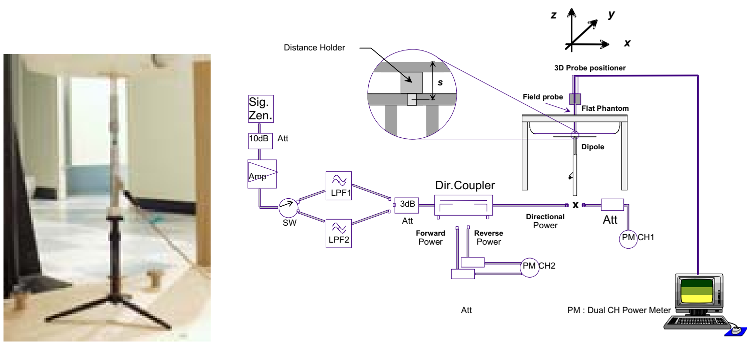

Figure 7.1 Dipole Validation Test Setup

8. SAR MEASUREMENT RESULTS

Procedures Used To Establish Test Signal

The handset was placed into simulated call mode using base station simulator. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR. When test modes are not available or inappropriate for testing a handset, the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

Device Test Conditions

The handset is battery operated. Each SAR measurement was taken with a fully charged battery. In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power. If a conducted power deviation of more than 5% occurred, the test was repeated. And all Tx(1~2Tx) conducted power were also investigated for Body-Worn SAR Measurement

Table 8.1 GPRS Power Table for GT-S5698

Band	Channel	Voice	GPRS/EDGE (GMSK)		EDGE (8-PSK)	
		GSM(dBm) CS(1 Tx)	1Tx (dBm)	2Tx (dBm)	1Tx (dBm)	2Tx (dBm)
1900	512	29.38	29.37	29.41	25.82	25.9
	661	29.37	29.34	29.38	26.01	26.24
	810	29.45	29.44	29.47	26.1	25.93

Table 8.2 Calculated Frame-Averaged Output Power Table for GT-S5698

Band	Channel	Voice	GPRS/EDGE (GMSK)		EDGE (8-PSK)	
		GSM(dBm) CS(1 Tx)	1Tx (dBm)	2Tx (dBm)	1Tx (dBm)	2Tx (dBm)
1900	512	20.35	20.34	23.39	16.79	19.88
	661	20.34	20.31	23.36	16.98	20.22
	810	20.42	20.41	23.45	17.07	19.91

Note:

1. Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.

2. CS1 coding scheme was used in GPRS output power measurements and SAR Testing, as a condition where GMSK modulation was ensured. It was investigated that CS1 – CS4 setting do not have any impact on the output levels in the GPRS modes.

3. MCS7 coding scheme was used to measure the output powers for EDGE since it was investigated that choosing MCS7 coding scheme will ensure 8-PSK modulation. Other MCS levels that produce 8-PSK do not affect output power.

4. The conducted powers are reported and measured by base station simulator E5515C when the equipment was calibrated.

GSM Class : B

GPRS Multislot Class : 10 (max 2 Tx Uplink slots)

EDGE Multislot class: 10 (max 2 Tx Uplink slots)

DTM Multislot Class : N/A

Table 8.3 Bluetooth Conducted Output Power

Channel	Frequency (MHz)	Output Power (GFSK)		Output Power (8DPSK)		Output Power (π/4DQPSK)		Limit (W)
		(dBm)	(mW)	(dBm)	(mW)	(dBm)	(mW)	
Low	2402	7.2	5.25	6.86	4.85	6.08	4.06	1
Mid	2441	6.95	4.95	6.78	4.76	6.01	3.99	
High	2480	6.46	4.43	6.43	4.4	5.63	3.66	

Table 8.4 802.11b Conducted Output average Power

802.11b Mode		Rate (Mbps)	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	1 Mbps	15.33	30
		2 Mbps	15.37	30
		5.5 Mbps	15.29	30
		11 Mbps	15.17	30
2437	6	1 Mbps	15.31	30
		2 Mbps	15.37	30
		5.5 Mbps	15.29	30
		11 Mbps	15.16	30
2462	11	1 Mbps	15.2	30
		2 Mbps	15.28	30
		5.5 Mbps	15.19	30
		11 Mbps	15.06	30

Table 8.5 802.11g Conducted Output average Power

802.11g Mode		Rate (Mbps)	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	6 Mbps	11.33	30
		9 Mbps	11.25	30
		12 Mbps	11.19	30
		18 Mbps	11.09	30
		24 Mbps	10.94	30
		36 Mbps	10.64	30
		48 Mbps	10.53	30
		54 Mbps	10.36	30
2437	6	6 Mbps	11.57	30
		9 Mbps	11.44	30
		12 Mbps	11.35	30
		18 Mbps	11.2	30
		24 Mbps	11.06	30
		36 Mbps	10.73	30
		48 Mbps	10.62	30
		54 Mbps	10.4	30
2462	11	6 Mbps	11.25	30
		9 Mbps	11.15	30
		12 Mbps	11.09	30
		18 Mbps	10.98	30
		24 Mbps	10.83	30
		36 Mbps	10.5	30
		48 Mbps	10.38	30
		54 Mbps	10.21	30

Table 8.6 802.11n Conducted Output average Power

802.11n Mode		Rate (Mbps)	Measured Power(dBm)	Limit (dBm)
Frequency[MHz]	Channel No.			
2412	1	6.5 Mbps	9.25	30
		13 Mbps	8.99	30
		19.5 Mbps	8.96	30
		26 Mbps	8.85	30
		39 Mbps	8.62	30
		52 Mbps	8.4	30
		58.5 Mbps	8.37	30
		65 Mbps	8.29	30
2437	6	6.5 Mbps	9.42	30
		13 Mbps	9.13	30
		19.5 Mbps	9.08	30
		26 Mbps	8.96	30
		39 Mbps	8.77	30
		52 Mbps	8.53	30
		58.5 Mbps	8.5	30
		65 Mbps	8.42	30
2462	11	6.5 Mbps	9.26	30
		13 Mbps	9.07	30
		19.5 Mbps	9.02	30
		26 Mbps	8.91	30
		39 Mbps	8.7	30
		52 Mbps	8.48	30
		58.5 Mbps	8.44	30
		65 Mbps	8.36	30

Simultaneous Transmission

Refer to the FCC OET document, 'SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas' (Feb 2008)

Table 8.7 Output Power Thresholds for Unlicensed Transmitters

	2.45	5.15 - 5.35	5.47 - 5.85	GHz
P Ref	**12**	**6**	**5**	**mW**
Device output power should be rounded to the nearest mW to compare with values specified in this table				

Table 8.8 Summary of SAR Evaluation Requirements for Cell phones with Multiple Transmitters

	Individual Transmitter	**Simultaneous Transmission**
Licensed Transmitters	**Routine evaluation required**	**SAR not required:** **Unlicensed only** o when stand-alone 1-g SAR is not required and antenna is > 5 cm from other antennas **Licensed & Unlicensed** o when the sum of the 1-g SAR is <1.6 W/kg for all simultaneous transmitting antennas o when SAR to antenna separation ratio of simultaneous transmitting antenna pair is < 0.3 **SAR required:** **Licensed & Unlicensed** antenna pairs with SAR to antenna separation ratio ≥ 0.3; test is only required for the configuration that results in the highest SAR in standalone configuration for each wireless mode and exposure condition Note: simultaneous transmission exposure conditions for head and body can be different for different style phones; therefore, different test requirements may apply
Unlicensed Transmitters	**When there is no simultaneous transmission –** o output < 60/f: SAR not required o output ≥ 60/f: stand-alone SAR required **When there is simultaneous transmission –** **Stand-alone SAR not required when** O output ≤ 2.P_{Ref} and antenna is > 5.0 cm from other antennas O output ≤ PRef and antenna is ≥ 2.5 cm from other antennas O output ≤ PRef and antenna is < 2.5 cm from other antennas, each with either output power ≤ PRef or 1-g SAR < 1.2 W/kg **Otherwise stand-alone SAR is required** **When stand-alone SAR is required** o test SAR on highest output channel for each wireless mode and exposure condition o if SAR for highest output channel is > 50% of SAR limit, evaluate all channels according to normal procedures	

Table 8.9 Simultaneous Transmission Summation for Held to Ear Voice Call

Simult Tx	Configuration	GSM1900 SAR (W/Kg)	WIFI SAR (W/Kg)	Σ SAR (W/Kg)
Head SAR	Right Cheek	0.256	0.146	0.402
	Right Tilt	0.088	0.047	0.135
	Left Cheek	0.232	0.118	0.350
	Left Tilt	0.089	0.028	0.117

Table 8.10 Simultaneous Transmission Summation for 2G Data and WIFI(Body-Worn)

Configuration	Mode	2G SAR (W/Kg)	WIFI SAR (W/Kg)	Σ SAR (W/Kg)
Back	GPRS1900 SAR	0.472	0.085	0.557

Table 8.11 Simultaneous Transmission Summation for 2G Data and WIFI(Hotspot)

Simult Tx	Configuration	GPRS1900 SAR (W/Kg)	WIFI SAR (W/Kg)	Σ SAR (W/Kg)
Body SAR	Back	0.472	0.085	0.557
	Front	0.434	0.134	0.568
	Right	-	0.034	0.034
	Left	0.075	-	0.075
	Top	-	-	-
	Bottom	0.393	0.142	0.535

Note :

1. Per FCC KDB Publication941225 D06, the edges with antennas more than 2.5cm are not required to be evaluated for SAR(”-“). The above tables represent a portable hotspot condition.

Multiple Antenna/Transmission Information for GT-S5698

The separation between the main antenna and the Bluetooth and WLAN antennas is 10mm.

RF Conducted Power of Bluetooth Tx is 7.2 dBm.

RF Conducted Power of WLAN is 15.37 dBm.

Conclusion

The above tables represent the worst-case simultaneous transmission scenarios possible with this device. The above numerical summed SAR was below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit. Therefore, no volumetric SAR summation is required since the numerical sums are below the limit.

Based on the output power, antenna separation distance, and Body SAR, a stand-alone BT SAR test is not required. The summation of BT SAR and Licensed Transmitter SAR is 0.472 + 0 = 0.472, which is less than 1.6 W/Kg, therefore, a simultaneous SAR evaluation is not required.

8.1 GSM1900 Head SAR Results

Frequency		Mode	Conducted		Side	Test Position	Antenna Type	Battery	Drift (dB)	SAR Level (W/kg)
MHz	Ch		Start	End						
1880	661	GSM1900	29.30	29.46	Right	Cheek/Touch	Intenna	Standard	0.02	**0.256**
1880	661	GSM1900	29.28	29.36	Right	Ear/Tilt 15°	Intenna	Standard	0.069	0.088
1880	661	GSM1900	29.38	29.45	Left	Cheek/Touch	Intenna	Standard	0.043	0.232
1880	661	GSM1900	29.39	29.35	Left	Ear/Tilt 15°	Intenna	Standard	-0.0019	0.089
ANSI / IEEE C95.1 1992 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population						**1.6W/kg (mW/g)** averaged over 1 gram				

NOTES:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [June 2001].
2. Tissue parameters and temperatures are listed on the SAR plot.
3. Liquid tissue depth is 15.2 ± 0.2cm
4. Battery is fully charged for all readings.
5. Test Configuration ☐ Manu. Test Codes ☒ Base Station Simulator
6. Justification for reduced test configurations: Per FCC/OET Bulletin 65 Supplement C (June, 2001), if the SAR measured at the middle channel for each test configuration (left, right, cheek/touch, tilt/ear, extended and retracted) is least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).

8.2 GPRS1900 Body SAR Results

Frequency		Mode	Conducted		Separation Distance	Test Position	Antenna Type	Battery	Tx GPRS Slots	Drift (dB)	SAR Level (W/kg)
MHz	Ch		Start	End							
1880	661	GPRS1900	29.27	29.34	1.0 cm	Back	Intenna	Standard	2	-0.084	**0.472**
1880	661	GPRS1900	29.32	29.39	1.0 cm	Front	Intenna	Standard	2	-0.123	0.434
1880	661	GPRS1900	29.38	29.25	1.0 cm	Left	Intenna	Standard	2	-0.025	0.075
1880	661	GPRS1900	29.31	29.38	1.0 cm	Bottom	Intenna	Standard	2	0.133	0.393
ANSI / IEEE C95.1 1992 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population						**1.6W/kg (mW/g)** averaged over 1 gram					

NOTES:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [June 2001].
2. Tissue parameters and temperatures are listed on the SAR plot.
3. Liquid tissue depth is 15.2 ± 0.2cm
4. Battery is fully charged for all readings.
5. Test Configuration ☐ Manu. Test Codes ☒ Base Station Simulator
6. Justification for reduced test configurations: This model supports GPRS CLASS "10" (2Tx) So the burst power and timing period is more than 2dB higher in GPRS mode than in GSM1900, EDGE1900 mode. Hence, the GSM1900, EDGE1900 mode was not measured.
7. Justification for reduced test configurations: Per FCC/OET Bulletin 65 Supplement C (June 2001) and Public Notice DA-02-1438, if the SAR measured at the middle channel for each test configuration is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).
8. Body SAR was tested at 1cm distance because battery operated personal wireless routers(hotspots) enable multiple Wi-Fi connections, per KDB 941225 D06. But position 'Right, Top' was not tested because antenna distance was >2.5cm.
9. Per FCC KDB Publication 941225 D06, when the same wireless modes and device transmission configurations are required for body-worn accessories and hotspot mode, it is not necessary to additionally test body-worn accessory SAR for the same device orientation. Therefore, the hotspot data for the back side configuration additionally shows body-worn compliance.
10. During SAR Testing for the Wireless Router conditions per KDB 941225 D06, the actual Portable Hotspot operation (with actual simultaneous transmission with WIFI) was not activated.

8.3 WLAN Head SAR Results

Frequency		Mode	Conducted		Side	Test Position	Antenna Type	Battery	Drift (dB)	SAR Level (W/kg)
MHz	Ch		Start	End						
2412	1	WLAN	15.33	15.31	Right	Cheek/Touch	Intenna	Standard	0.177	**0.146**
2412	1	WLAN	15.34	15.36	Right	Ear/Tilt 15°	Intenna	Standard	0.103	0.047
2412	1	WLAN	15.30	15.31	Left	Cheek/Touch	Intenna	Standard	0.13	0.118
2412	1	WLAN	15.32	15.30	Left	Ear/Tilt 15°	Intenna	Standard	0.186	0.028
ANSI / IEEE C95.1 1992 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population						**1.6W/kg (mW/g)** averaged over 1 gram				

NOTES:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [June 2001].
2. Tissue parameters and temperatures are listed on the SAR plot.
3. Liquid tissue depth is 15.2 ± 0.2cm
4. Battery is fully charged for all readings.
5. Test Configuration ☒ Manu. Test Codes ☐ Base Station Simulator
6. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11g and n) were not investigated since the average output powers were not greater than 0.25dB than that of the corresponding channel in the lowest data rate IEEE 802.11b mode
7. WLAN Transmission was verified using a spectrum analyzer.
8. Since the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6W/Kg and the 1g averaged SAR is <0.8W/Kg, SAR testing on other default (and corresponding required) channels was not required.

8.4 WLAN Body SAR Results

Frequency		Mode	Conducted		Separation Distance	Test Position	Antenna Type	Battery	Data Rate (Mbps)	Drift (dB)	SAR Level (W/kg)
MHz	Ch		Start	End							
2412	1	WLAN	15.34	15.36	1.0 cm	Back	Intenna	Standard	1	0.138	0.085
2412	1	WLAN	15.38	15.37	1.0 cm	Front	Intenna	Standard	1	0.038	0.134
2412	1	WLAN	15.33	15.30	1.0 cm	Right	Intenna	Standard	1	0.054	0.034
2412	1	WLAN	15.34	15.33	1.0 cm	Bottom	Intenna	Standard	1	0.135	**0.142**
ANSI / IEEE C95.1 1992 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure / General Population						**1.6W/kg (mW/g)** averaged over 1 gram					

NOTES:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [June 2001].
2. Tissue parameters and temperatures are listed on the SAR plot.
3. Liquid tissue depth is 15.2 ± 0.2cm
4. Battery is fully charged for all readings.
5. Test Configuration ☒ Manu. Test Codes ☐ Base Station Simulator
6. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11g and n) were not investigated since the average output powers were not greater than 0.25dB than that of the corresponding channel in the lowest data rate IEEE 802.11b mode.
7. Body SAR was tested at 1cm distance because battery operated personal wireless routers(hotspots) enable multiple Wi-Fi connections, per KDB 941225 D06. But position 'Left, Top' was not tested because antenna distance was >2.5cm.
8. Per FCC KDB Publication 941225 D06, when the same wireless modes and device transmission configurations are required for body-worn accessories and hotspot mode, it is not necessary to additionally test body-worn accessory SAR for the same device orientation. Therefore, the hotspot data for the back side configuration additionally shows body-worn compliance.
9. During SAR Testing for the Wireless Router conditions per KDB 941225 D06, the actual Portable Hotspot operation (with actual simultaneous transmission with WIFI) was not activated.
10. WLAN Transmission was verified using a spectrum analyzer.
11. Since the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6W/Kg and the 1g averaged SAR is <0.8W/Kg, SAR testing on other default (and corresponding required) channels was not required.

9. CONCLUSION

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

The highest reported SAR values are as follows:
GSM1900: Head: 0.256W/Kg : Body-worn: 0.472W/Kg : Hotspot: 0.472 W/Kg
WLAN: Head: 0.146W/Kg : Body-worn: 0.085W/Kg : Hotspot: 0.142 W/Kg
Highest simultaneous transmission: Head: 0.402W/Kg : Body-worn: 0.557W/Kg : Hotspot: 0.568 W/Kg

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[29] FCC Application Note for SAR Probe Calibration and System Verification Consideration for Measurements at 150 MHz – 3 GHz, KDB 450824

[30] FCC SAR Evaluation Considerations for Laptop Computers with Antennas Built-in on Display Screens, KDB 616217

[31] FCC SAR Measurement Requirements for 3 – 6 GHz, KDB 865664

[32] FCC Mobile Portable RF Exposure Procedure, KDB 447498

[33] FCC SAR Procedures for Dongle Transmitters, KDB 447498

[34] Anexo à Resolução No. 533, de 10 de Septembro de 2009.

[35] FCC SAR Test Considerations for LTE Handsets and Data Modems, KDB Publication 941225

[36] IEC 62209-2, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 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), Mar. 2010.

[37] FCC Hot Spot SAR v01, KDB Publication 941225 D06.

APPENDIX A

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (p). It is also defined as the rate of RF energy absorption pet unit mass at a point in an absorbing body (see Fig. A.1) .

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right) = \frac{d}{dt}\left(\frac{dU}{pdv}\right)$$

Figure A.1 SAR Mathematical Equation

SAR is expressed in units of Watts per Kilogram (W/kg).

$$\text{SAR} = \sigma E^2 / p$$

Where :

σ = conductivity of the tissue-simulant material (S/m)

p = mass density of the tissue-simulant material (kg/m^3)

E = Total RMS electric field strength (V/m)

Note: The primary factors that control rate or energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

APPENDIX B

Probe Calibration Process

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in **K. Pokovic, T.Schmid, N. Kuster, *Robust setup for precise calibration of E-field probes in tissue simulating liquids at mobile communications frequencies*, ICECOM97, Oct. 1997, pp. 120-124** with an accuracy better than +/-10%. The spherical isotropy was evaluated with the procedure described in **K. Pokovic, T.Schmid, N. Kuster, *E-field Probe with improved isotropy in brain simulating liquids*, Proceedings of the ELMAR, Zadar, June 23-25, 1996, pp. 172-175** and found to be better than +/-0.25dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies bellow 1 GHz (see Fig. B.1), and in a waveguide above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees.

Temperature Assessment

E-field temperature correlation calibration is performed in a flat phantom flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe (see Fig. B.2).

$$\text{SAR} = C\frac{\Delta T}{\Delta t}$$

where:

Δt = exposure time (30 seconds)

C = heat capacity of tissue (brain or muscle).

ΔT = temperature increase due to RF exposure.

SAR is proportional to ΔT/ Δt, the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E-field;

$$\text{SAR} = \frac{|E|^2 \cdot \sigma}{p}$$

where:

σ = simulated tissue conductivity

p = Tissue density (1.25 g/cm^3 for brain tissue)

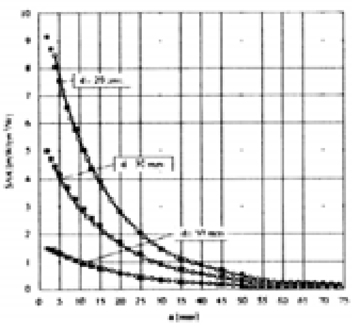


Figure B.1. E-Field and Temperature measurements at 900MHz

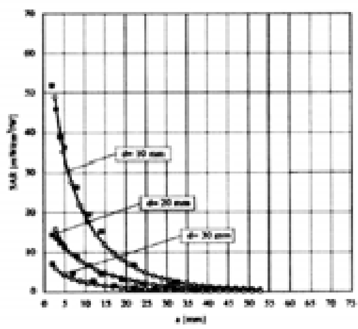


Figure B.2. E-Field and temperature measurements at 1.9GHz

APPENDIX C

ANSI/IEEE C95.1 – 2005 RF EXPOSURE LIMITS

Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is the exposure that may be incurred by persons who are aware of the potential for exposure,(i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table C.1 Safety Limits for Partial Body Exposure

	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)
SPATIAL PEAK SAR[1] Brain	1.60	8.00
SPATIAL PEAK SAR[2] Whole Body	0.08	0.40
SPATIAL PEAK SAR[3] Hands,Feet,Ankles, Wrists	4.00	20.00

1 The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as tissue volume in the shape of a cube) and over the appropriate averaging time.
2 The Spatial Average value of the SAR averaged over the whole body.
3 The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

APPENDIX D

The Validation Measurements

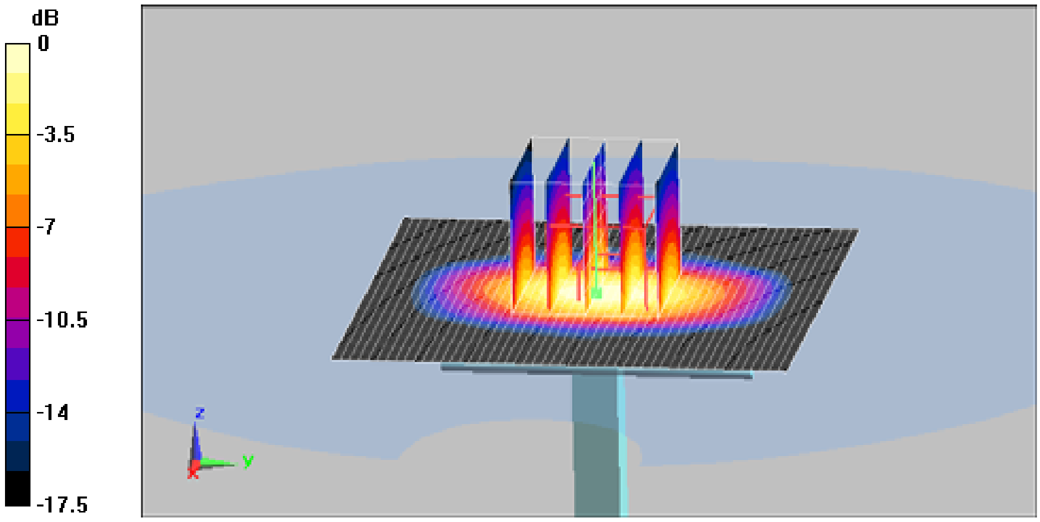
DUT: Dipole 1900 MHz; Serial: 5d023
Program Name: 1900MHz Dipole Validation 2012.05.14
Procedure Name: 1900MHz @ 100mW
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.1;Test Date-14/May/2012

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.39 mho/m; ε_r = 40.6; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.98, 4.98, 4.98); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

1900MHz @ 100mW/Area Scan (51x51x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 4.86 mW/g

1900MHz @ 100mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 59.9 V/m; Power Drift = 0.096 dB
Peak SAR (extrapolated) = 6.84 W/kg
SAR(1 g) = 3.78 mW/g; SAR(10 g) = 1.98 mW/g
Maximum value of SAR (measured) = 4.78 mW/g



0 dB = 4.78mW/g

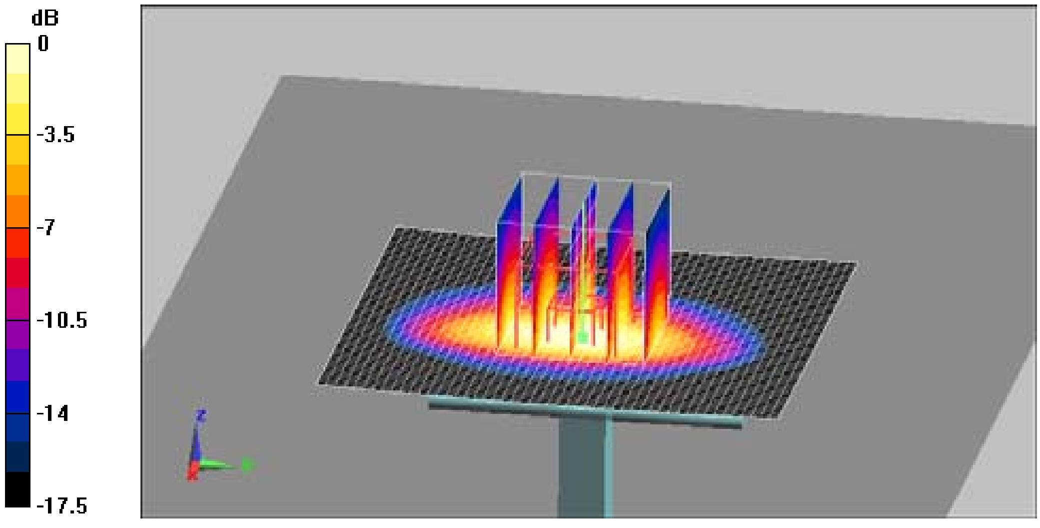
DUT: Dipole 1900 MHz; Serial: 5d023
Program Name: 1900MHz Dipole Validation 2012.05.14
Procedure Name: 1900MHz @ 100mW
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-14/May/2012

Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1
Medium parameters used: f = 1900 MHz; σ = 1.51 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.51, 4.51, 4.51); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

1900MHz @ 100mW/Area Scan (51x51x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 5.37 mW/g

1900MHz @ 100mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 53.7 V/m; Power Drift = 0.193 dB
Peak SAR (extrapolated) = 6.88 W/kg
SAR(1 g) = 3.96 mW/g; SAR(10 g) = 2.09 mW/g
Maximum value of SAR (measured) = 4.97 mW/g



0 dB = 4.97mW/g

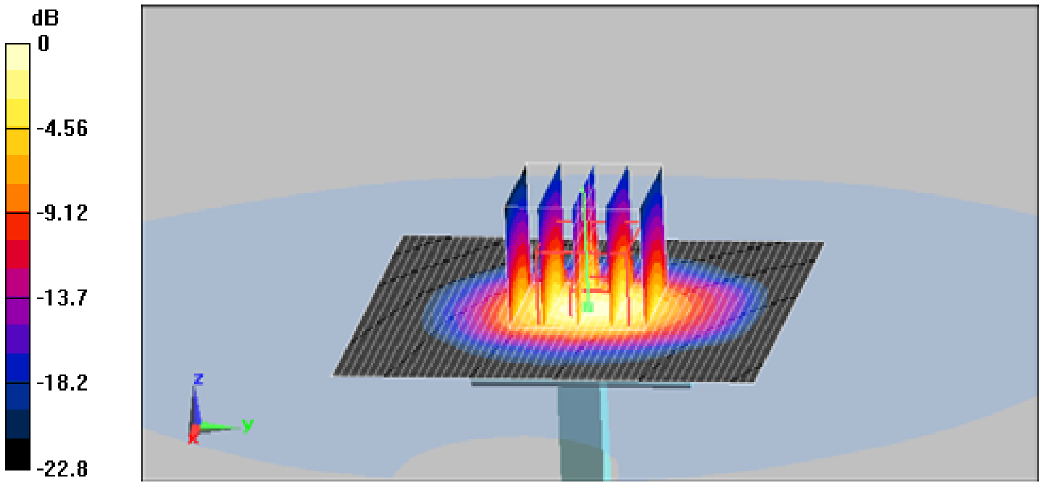
DUT: Dipole 2450 MHz; Serial: D2450V2 - SN:807
Program Name: 2450MHz Dipole Head Validation 2012.05.15
Procedure Name: 2450MHz @ 100mW
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.8;Test Date-15/May/2012

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.85 mho/m; ε_r = 39.1; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.38, 4.38, 4.38); Calibrated: 2012-01-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #2; Type: SAM; Serial: TP-1425
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

2450MHz @ 100mW/Area Scan (51x51x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 5.56 mW/g

2450MHz @ 100mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 57 V/m; Power Drift = 0.00773 dB
Peak SAR (extrapolated) = 11 W/kg
SAR(1 g) = 5.24 mW/g; SAR(10 g) = 2.41 mW/g
Maximum value of SAR (measured) = 5.89 mW/g



0 dB = 5.89mW/g

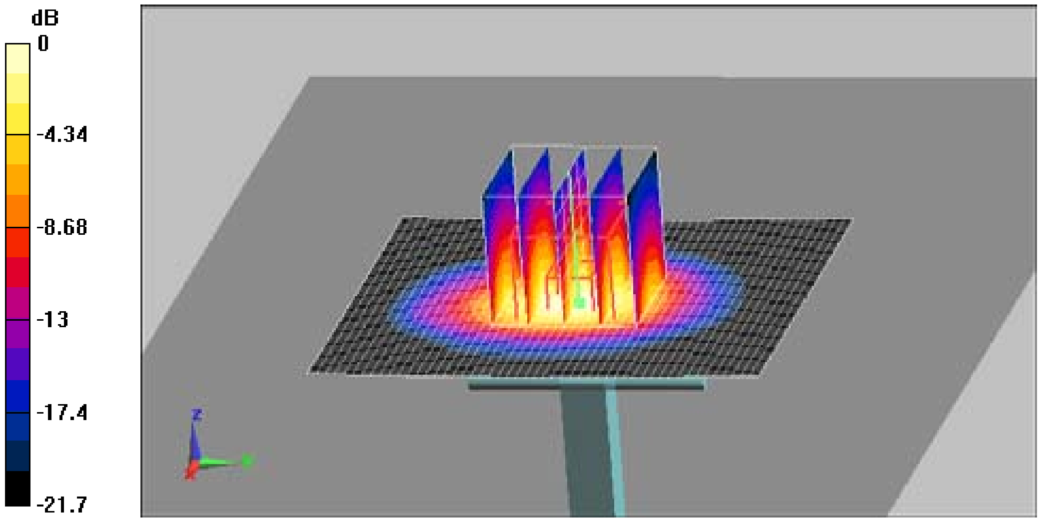
DUT: Dipole 2450 MHz; Serial: D2450V2 - SN:807
Program Name: 2450MHz Dipole Body Validation 2012.05.15
Procedure Name: 2450MHz @ 100mW
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.9;Test Date-15/May/2012

Communication System: CW; Frequency: 2450 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2450 MHz; σ = 1.95 mho/m; ε_r = 51.2; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:
- **Probe: ES3DV3 - SN3080; ConvF(4.19, 4.19, 4.19); Calibrated: 2012-01-25**
- **Sensor-Surface: 3mm (Mechanical Surface Detection)**
- **Electronics: DAE4 Sn670; Calibrated: 2012-02-21**
- **Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007**
- **Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125**

2450MHz @ 100mW/Area Scan (51x51x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 6.42 mW/g

2450MHz @ 100mW/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 57.7 V/m; Power Drift = 0.150 dB
Peak SAR (extrapolated) = 9.89 W/kg
SAR(1 g) = 4.8 mW/g; SAR(10 g) = 2.24 mW/g
Maximum value of SAR (measured) = 6.28 mW/g



0 dB = 6.28mW/g

APPENDIX E

Plots of The SAR Measurements

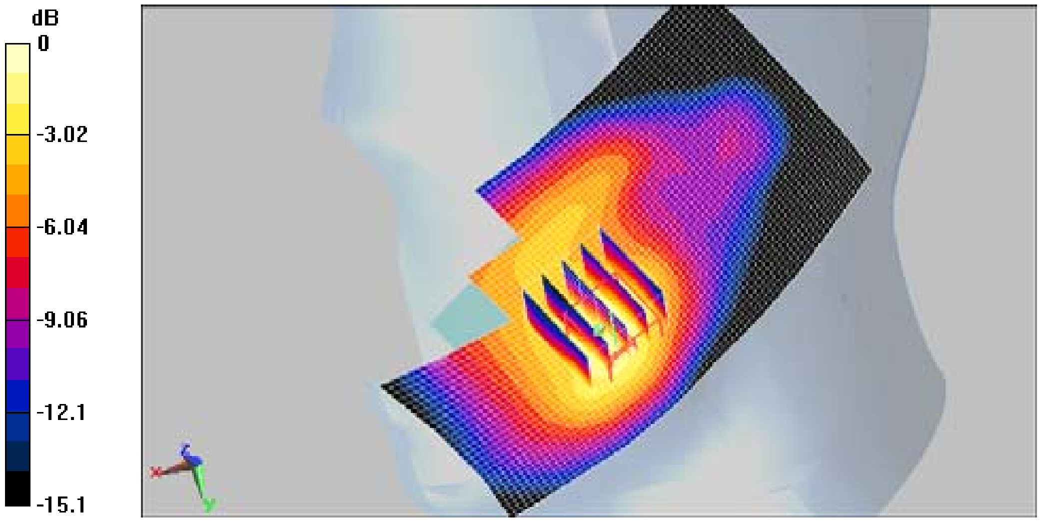
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 GSM1900 Right (Job No. : FJ-131)
Procedure Name: Cheek, Ch.661, Ant.Intenna, Bat.Standard
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.1;Test Date-14/May/2012

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1880 MHz; σ = 1.39 mho/m; ε_r = 40.6; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.98, 4.98, 4.98); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Cheek, Ch.661, Ant.Intenna, Bat.Standard/Area Scan (51x81x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.247 mW/g

Cheek, Ch.661, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.76 V/m; Power Drift = 0.020 dB
Peak SAR (extrapolated) = 0.408 W/kg
SAR(1 g) = 0.256 mW/g; SAR(10 g) = 0.146 mW/g
Maximum value of SAR (measured) = 0.311 mW/g



0 dB = 0.311mW/g

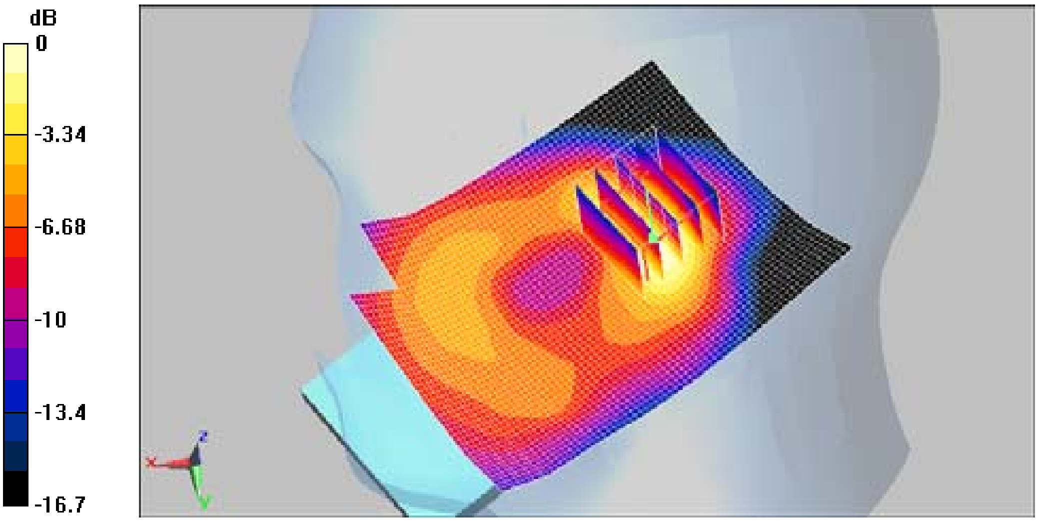
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 GSM1900 Right (Job No. : FJ-131)
Procedure Name: Tilt, Ch.661, Ant.Intenna, Bat.Standard
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.1;Test Date-14/May/2012

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1880 MHz; σ = 1.39 mho/m; ε_r = 40.6; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.98, 4.98, 4.98); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Tilt, Ch.661, Ant.Intenna, Bat.Standard/Area Scan (51x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.117 mW/g

Tilt, Ch.661, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.75 V/m; Power Drift = 0.069 dB
Peak SAR (extrapolated) = 0.139 W/kg
SAR(1 g) = 0.088 mW/g; SAR(10 g) = 0.051 mW/g
Maximum value of SAR (measured) = 0.106 mW/g



0 dB = 0.106mW/g

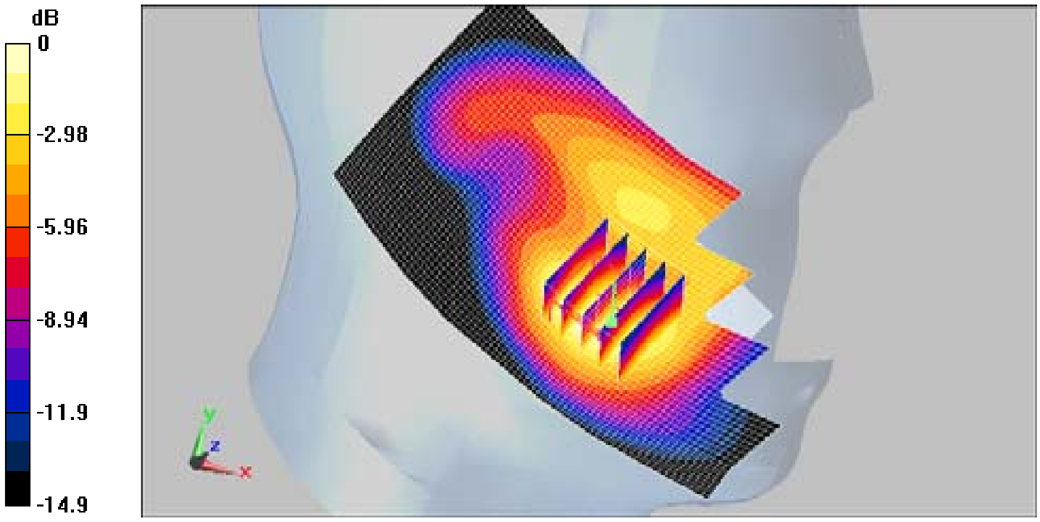
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 GSM1900 Left (Job No. : FJ-131)
Procedure Name: Cheek, Ch.661, Ant.Intenna, Bat.Standard
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.1;Test Date-14/May/2012

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1880 MHz; σ = 1.39 mho/m; ε_r = 40.6; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.98, 4.98, 4.98); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Cheek, Ch.661, Ant.Intenna, Bat.Standard/Area Scan (51x81x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.273 mW/g

Cheek, Ch.661, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.74 V/m; Power Drift = 0.043 dB
Peak SAR (extrapolated) = 0.350 W/kg
SAR(1 g) = 0.232 mW/g; SAR(10 g) = 0.141 mW/g
Maximum value of SAR (measured) = 0.259 mW/g



0 dB = 0.259mW/g

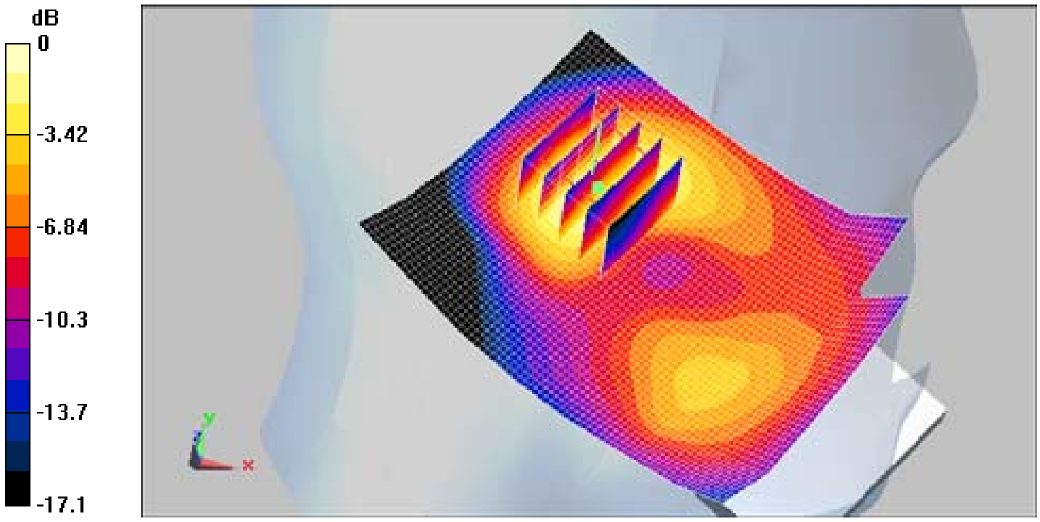
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 GSM1900 Left (Job No. : FJ-131)
Procedure Name: Tilt, Ch.661, Ant.Intenna, Bat.Standard
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.1;Test Date-14/May/2012

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1880 MHz; σ = 1.39 mho/m; ε_r = 40.6; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.98, 4.98, 4.98); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Tilt, Ch.661, Ant.Intenna, Bat.Standard/Area Scan (51x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.093 mW/g

Tilt, Ch.661, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.87 V/m; Power Drift = -0.00185 dB
Peak SAR (extrapolated) = 0.143 W/kg
SAR(1 g) = 0.089 mW/g; SAR(10 g) = 0.051 mW/g
Maximum value of SAR (measured) = 0.108 mW/g



0 dB = 0.108mW/g

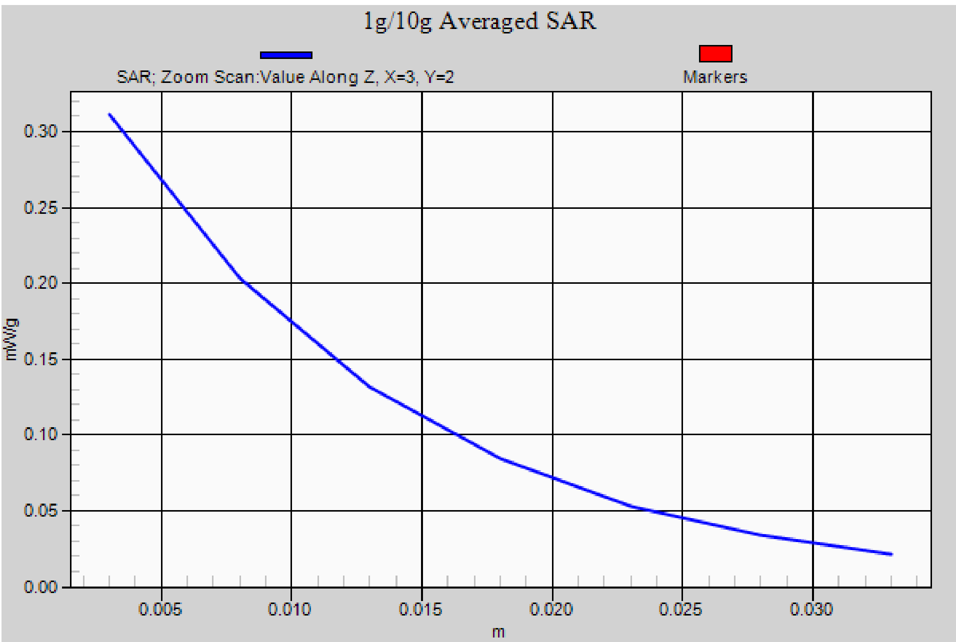
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 GSM1900 Right (Job No. : FJ-131)
Procedure Name: Cheek, Ch.661, Ant.Intenna, Bat.Standard
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.1;Test Date-14/May/2012

Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3
Medium parameters used: f = 1880 MHz; σ = 1.39 mho/m; ε_r = 40.6; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.98, 4.98, 4.98); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Cheek, Ch.661, Ant.Intenna, Bat.Standard/Area Scan (51x81x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.247 mW/g

Cheek, Ch.661, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.76 V/m; Power Drift = 0.020 dB
Peak SAR (extrapolated) = 0.408 W/kg
SAR(1 g) = 0.256 mW/g; SAR(10 g) = 0.146 mW/g.
Maximum value of SAR (measured) = 0.311 mW/g



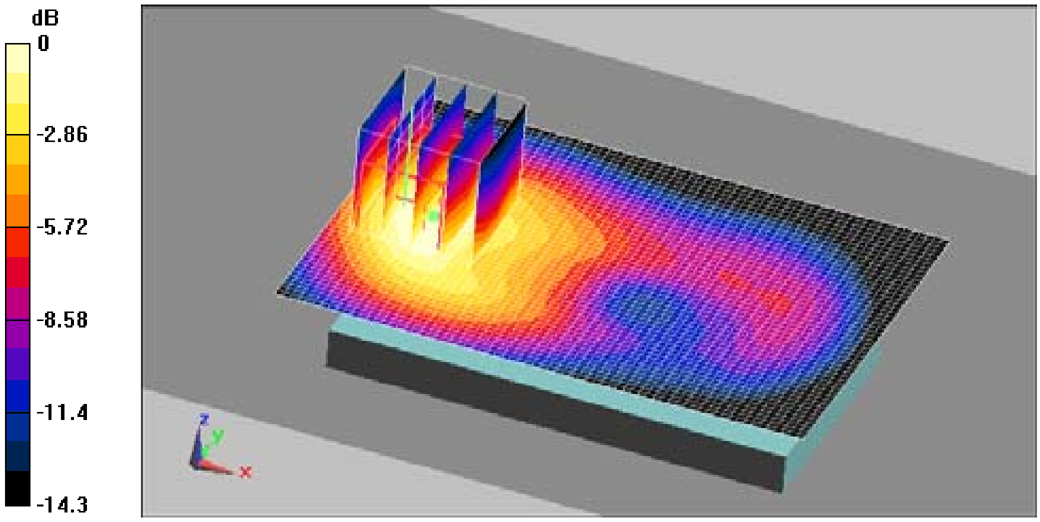
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 GPRS1900 Body (Job No. : FJ-131)
Procedure Name: Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Back, 10mm
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-14/May/2012

Communication System: Body GPRS ; Frequency: 1880 MHz;Duty Cycle: 1:4.15
Medium parameters used: f = 1880 MHz; σ = 1.51 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.51, 4.51, 4.51); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Back, 10mm/Area Scan (51x71x1):
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.564 mW/g

Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Back, 10mm/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.13 V/m; Power Drift = -0.084 dB
Peak SAR (extrapolated) = 0.747 W/kg
SAR(1 g) = 0.472 mW/g; SAR(10 g) = 0.273 mW/g
Maximum value of SAR (measured) = 0.556 mW/g



0 dB = 0.556mW/g

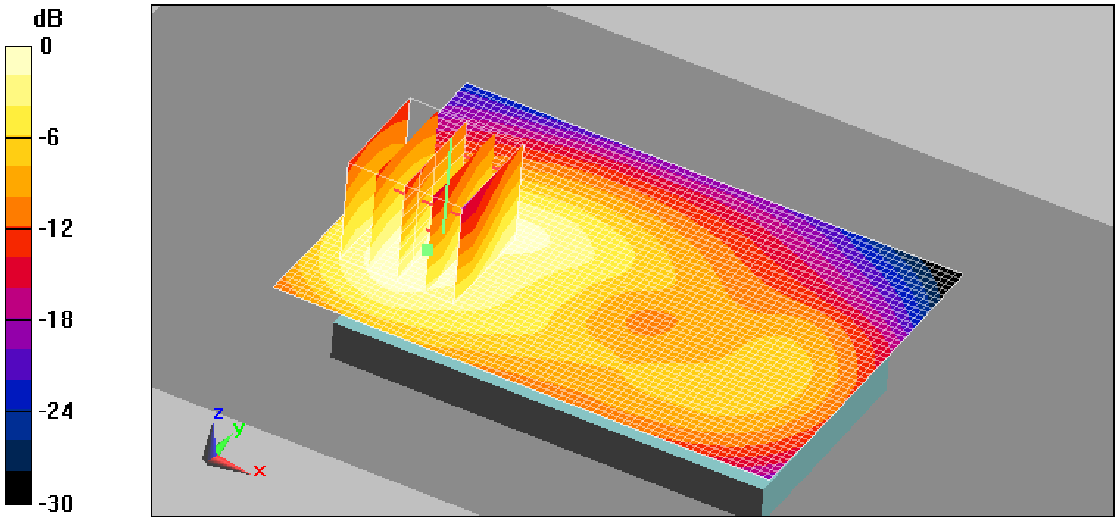
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 GPRS1900 Body (Job No. : FJ-131)
Procedure Name: Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Front, 10mm
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-14/May/2012

Communication System: Body GPRS ; Frequency: 1880 MHz;Duty Cycle: 1:4.15
Medium parameters used: f = 1880 MHz; σ = 1.51 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.51, 4.51, 4.51); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Front, 10mm/Area Scan (51x71x1):
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.565 mW/g

Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Front, 10mm/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.14 V/m; Power Drift = -0.123 dB
Peak SAR (extrapolated) = 0.673 W/kg
SAR(1 g) = 0.434 mW/g; SAR(10 g) = 0.265 mW/g
Maximum value of SAR (measured) = 0.508 mW/g



0 dB = 0.565mW/g

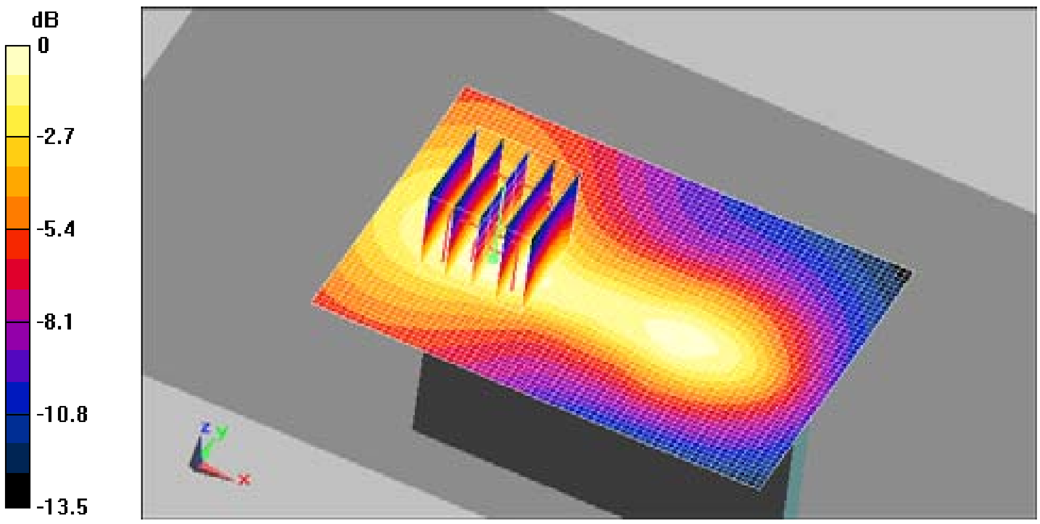
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 GPRS1900 Body (Job No. : FJ-131)
Procedure Name: Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Left, 10mm
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-14/May/2012

Communication System: Body GPRS ; Frequency: 1880 MHz;Duty Cycle: 1:4.15
Medium parameters used: f = 1880 MHz; σ = 1.51 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.51, 4.51, 4.51); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Left, 10mm/Area Scan (51x71x1):
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.088 mW/g

Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Left, 10mm/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.37 V/m; Power Drift = -0.025 dB
Peak SAR (extrapolated) = 0.114 W/kg
SAR(1 g) = 0.075 mW/g; SAR(10 g) = 0.047 mW/g
Maximum value of SAR (measured) = 0.088 mW/g



0 dB = 0.088mW/g

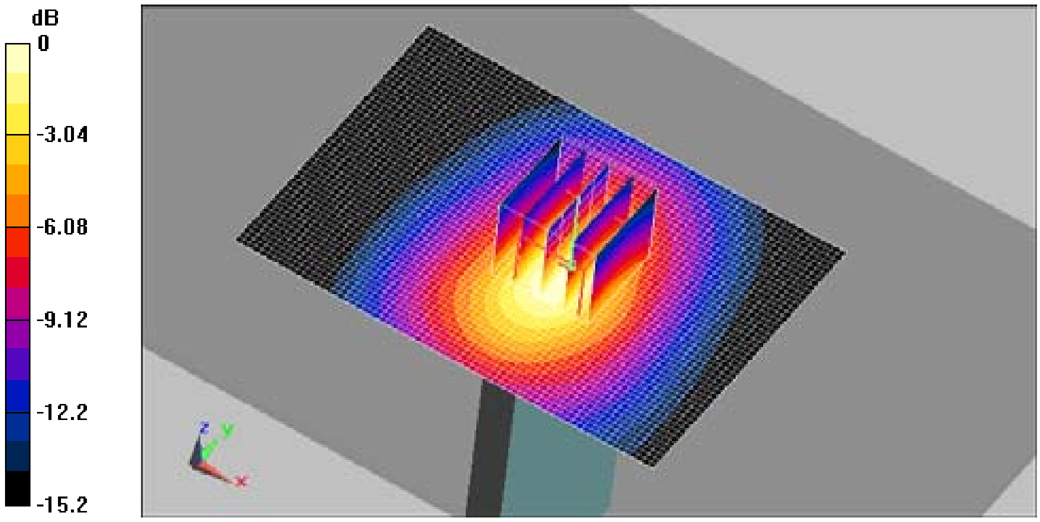
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 GPRS1900 Body (Job No. : FJ-131)
Procedure Name: Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Bottom, 10mm
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-14/May/2012

Communication System: Body GPRS ; Frequency: 1880 MHz;Duty Cycle: 1:4.15
Medium parameters used: f = 1880 MHz; σ = 1.51 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.51, 4.51, 4.51); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Bottom, 10mm/Area Scan (51x71x1):
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.458 mW/g

Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Bottom, 10mm/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.5 V/m; Power Drift = 0.133 dB
Peak SAR (extrapolated) = 0.617 W/kg
SAR(1 g) = 0.393 mW/g; SAR(10 g) = 0.231 mW/g
Maximum value of SAR (measured) = 0.474 mW/g



0 dB = 0.474mW/g

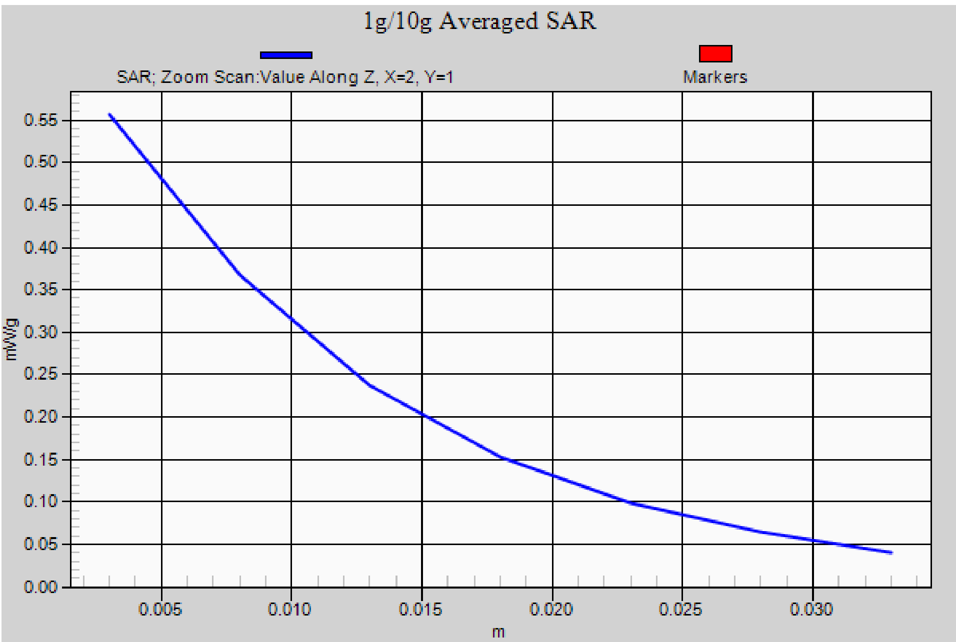
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 GPRS1900 Body (Job No. : FJ-131)
Procedure Name: Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Back, 10mm
Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-14/May/2012

Communication System: Body GPRS ; Frequency: 1880 MHz;Duty Cycle: 1:4.15
Medium parameters used: f = 1880 MHz; σ = 1.51 mho/m; ε_r = 51.7; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.51, 4.51, 4.51); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Back, 10mm/Area Scan (51x71x1):
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.564 mW/g

Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Back, 10mm/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.13 V/m; Power Drift = -0.084 dB
Peak SAR (extrapolated) = 0.747 W/kg
SAR(1 g) = 0.472 mW/g; SAR(10 g) = 0.273 mW/g
Maximum value of SAR (measured) = 0.556 mW/g



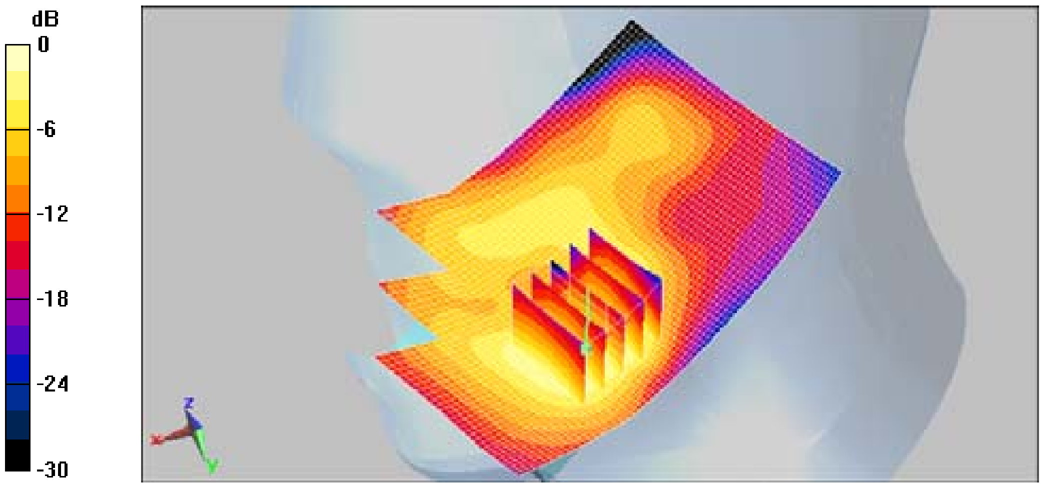
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 WLAN Right(Job No. : FJ-131)
Procedure Name: Cheek, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.8;Test Date-15/May/2012

Communication System: WLAN; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.85 mho/m; ε_r = 39.1; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.38, 4.38, 4.38); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #2; Type: SAM; Serial: TP-1425
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Cheek, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps/Area Scan (51x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.155 mW/g

Cheek, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.12 V/m; Power Drift = 0.177 dB
Peak SAR (extrapolated) = 0.250 W/kg
SAR(1 g) = 0.146 mW/g; SAR(10 g) = 0.078 mW/g
Maximum value of SAR (measured) = 0.178 mW/g



0 dB = 0.178mW/g

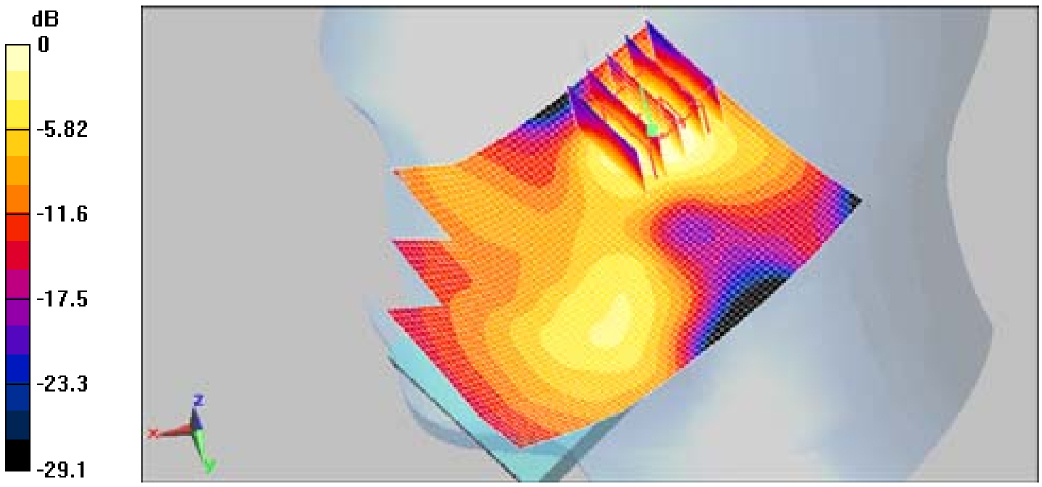
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 WLAN Right(Job No. : FJ-131)
Procedure Name: Tilted, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.8;Test Date-15/May/2012

Communication System: WLAN; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.85 mho/m; ε_r = 39.1; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.38, 4.38, 4.38); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #2; Type: SAM; Serial: TP-1425
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Tilted, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps/Area Scan (51x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.069 mW/g

Tilted, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 3.95 V/m; Power Drift = 0.103 dB
Peak SAR (extrapolated) = 0.084 W/kg
SAR(1 g) = 0.047 mW/g; SAR(10 g) = 0.024 mW/g
Maximum value of SAR (measured) = 0.056 mW/g



0 dB = 0.056mW/g

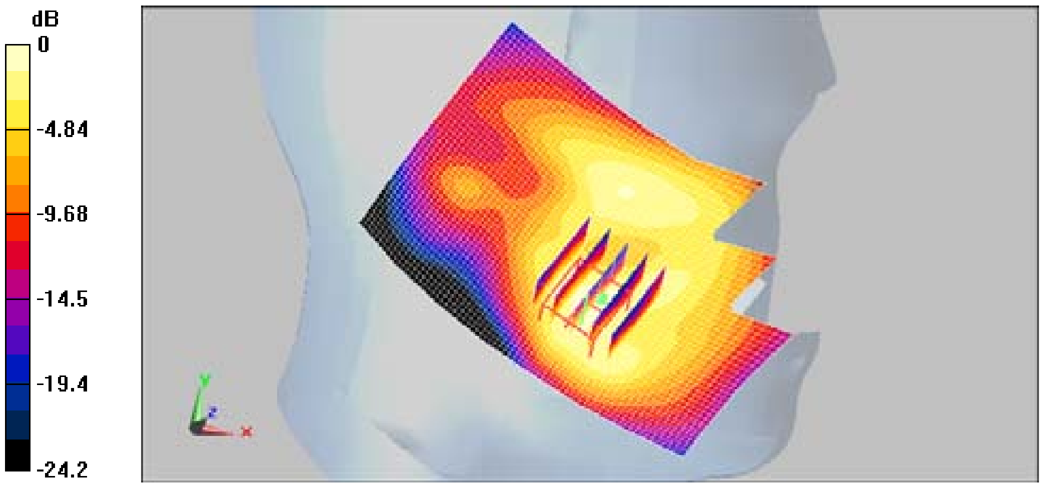
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 WLAN Left(Job No. : FJ-131)
Procedure Name: Cheek, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.8;Test Date-15/May/2012

Communication System: WLAN; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.85 mho/m; ε_r = 39.1; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.38, 4.38, 4.38); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #2; Type: SAM; Serial: TP-1425
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Cheek, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps/Area Scan (51x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.113 mW/g

Cheek, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps/Zoom Scan 2 (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.61 V/m; Power Drift = 0.130 dB
Peak SAR (extrapolated) = 0.224 W/kg
SAR(1 g) = 0.118 mW/g; SAR(10 g) = 0.059 mW/g
Maximum value of SAR (measured) = 0.145 mW/g



0 dB = 0.145mW/g

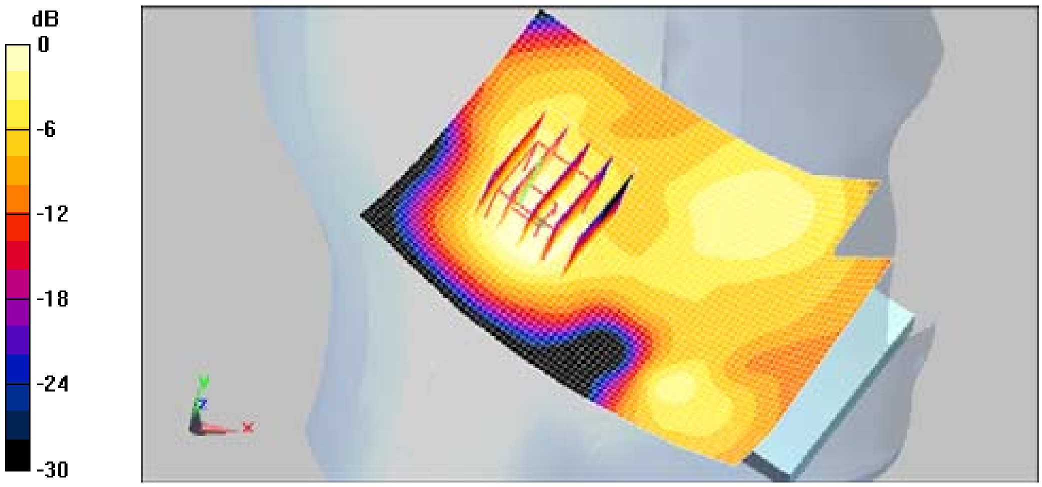
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 WLAN Left(Job No. : FJ-131)
Procedure Name: Tilted, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.8;Test Date-15/May/2012

Communication System: WLAN; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.85 mho/m; ϵ_r = 39.1; ρ = 1000 kg/m^3
Phantom section: Left Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.38, 4.38, 4.38); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #2; Type: SAM; Serial: TP-1425
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Tilted, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps/Area Scan (51x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.036 mW/g

Tilted, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.35 V/m; Power Drift = 0.186 dB
Peak SAR (extrapolated) = 0.051 W/kg
SAR(1 g) = 0.028 mW/g; SAR(10 g) = 0.015 mW/g
Maximum value of SAR (measured) = 0.033 mW/g



0 dB = 0.033mW/g

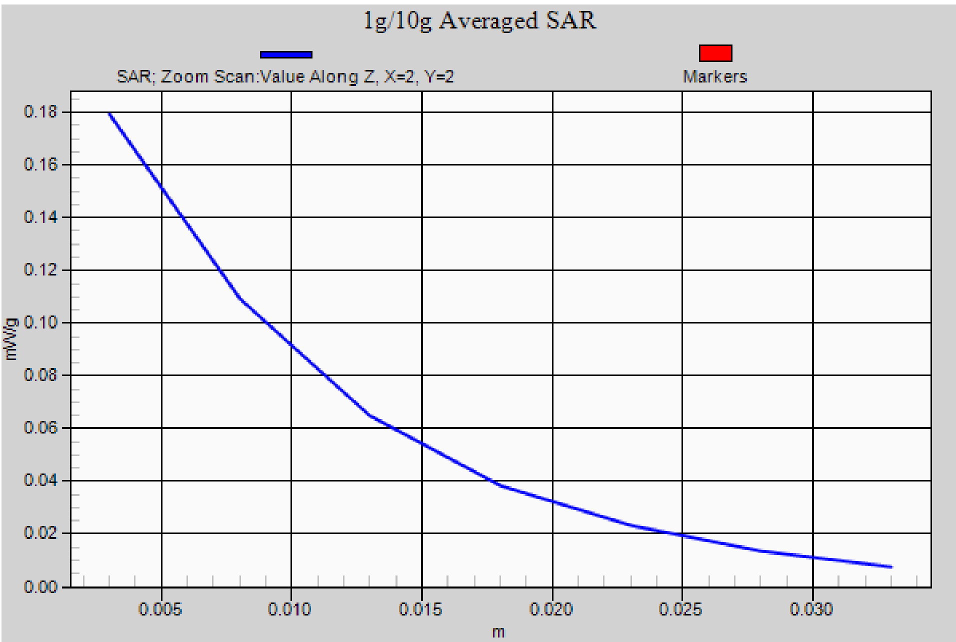
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 WLAN Right(Job No. : FJ-131)
Procedure Name: Cheek, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.8;Test Date-15/May/2012

Communication System: WLAN; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.85 mho/m; ε_r = 39.1; ρ = 1000 kg/m^3
Phantom section: Right Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.38, 4.38, 4.38); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: SAM PHANTOM #2; Type: SAM; Serial: TP-1425
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Cheek, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps/Area Scan (51x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.155 mW/g

Cheek, Ch.01, Ant.Intenna, Bat.Standard, 1Mbps/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.12 V/m; Power Drift = 0.177 dB
Peak SAR (extrapolated) = 0.250 W/kg
SAR(1 g) = 0.146 mW/g; SAR(10 g) = 0.078 mW/g
Maximum value of SAR (measured) = 0.178 mW/g



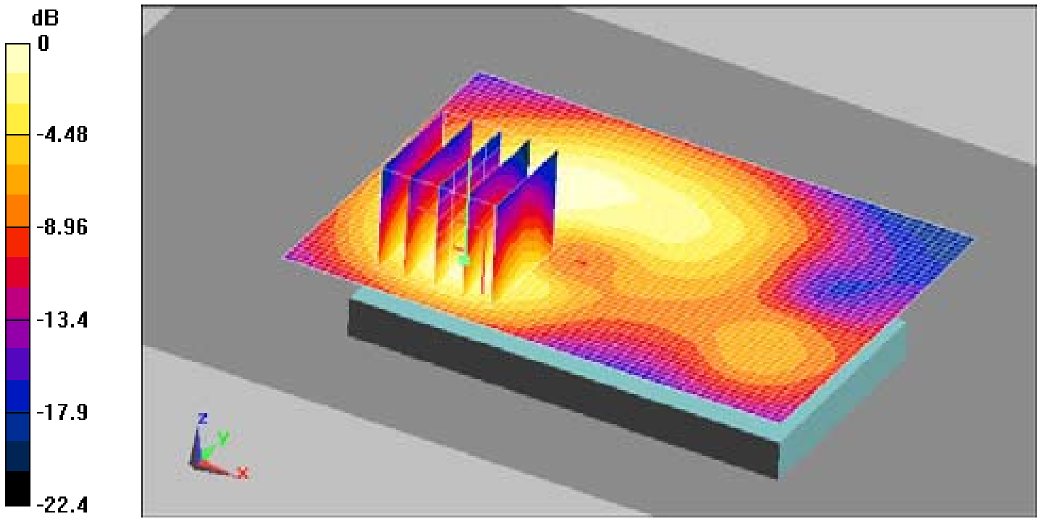
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 WLAN Body (Job No. : FJ-131)
Procedure Name: Body, Ch.01, Ant.Intenna, Bat.Standard, Back, 1Mbps, 10mm
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.9;Test Date-15/May/2012

Communication System: WLAN; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.95 mho/m; ε_r = 51.2; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:
- **Probe: ES3DV3 - SN3080; ConvF(4.19, 4.19, 4.19); Calibrated: 2012-01-25**
- **Sensor-Surface: 3mm (Mechanical Surface Detection)**
- **Electronics: DAE4 Sn670; Calibrated: 2012-02-21**
- **Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007**
- **Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125**

Body, Ch.01, Ant.Intenna, Bat.Standard, Back, 1Mbps, 10mm/Area Scan (51x71x1):
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.115 mW/g

Body, Ch.01, Ant.Intenna, Bat.Standard, Back, 1Mbps, 10mm/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.39 V/m; Power Drift = 0.138 dB
Peak SAR (extrapolated) = 0.170 W/kg
SAR(1 g) = 0.085 mW/g; SAR(10 g) = 0.043 mW/g
Maximum value of SAR (measured) = 0.110 mW/g



0 dB = 0.110mW/g

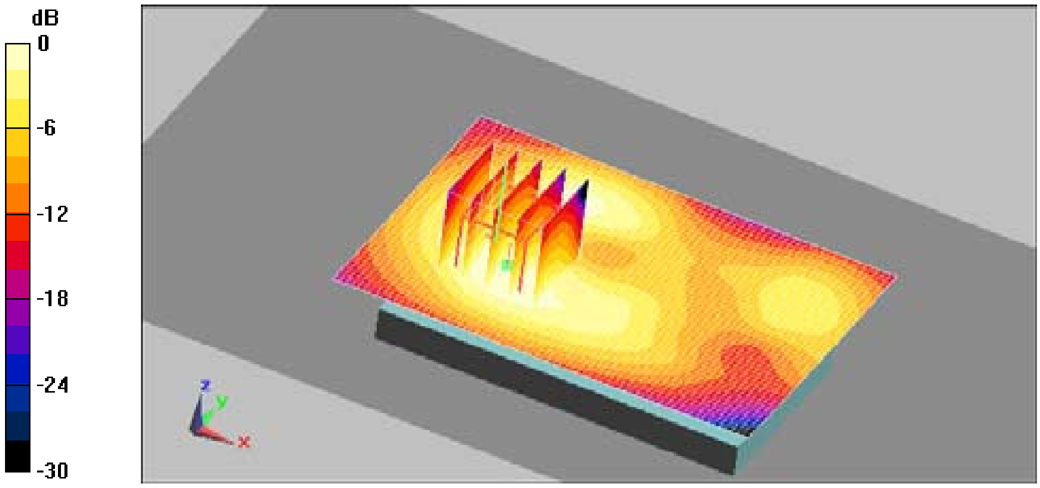
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 WLAN Body (Job No. : FJ-131)
Procedure Name: Body, Ch.01, Ant.Intenna, Bat.Standard, Front, 1Mbps, 10mm
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.9;Test Date-15/May/2012

Communication System: WLAN; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.95 mho/m; ε_r = 51.2; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.19, 4.19, 4.19); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Body, Ch.01, Ant.Intenna, Bat.Standard, Front, 1Mbps, 10mm/Area Scan (51x71x1):
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.171 mW/g

Body, Ch.01, Ant.Intenna, Bat.Standard, Front, 1Mbps, 10mm/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.82 V/m; Power Drift = 0.038 dB
Peak SAR (extrapolated) = 0.245 W/kg
SAR(1 g) = 0.134 mW/g; SAR(10 g) = 0.076 mW/g
Maximum value of SAR (measured) = 0.164 mW/g



0 dB = 0.164mW/g

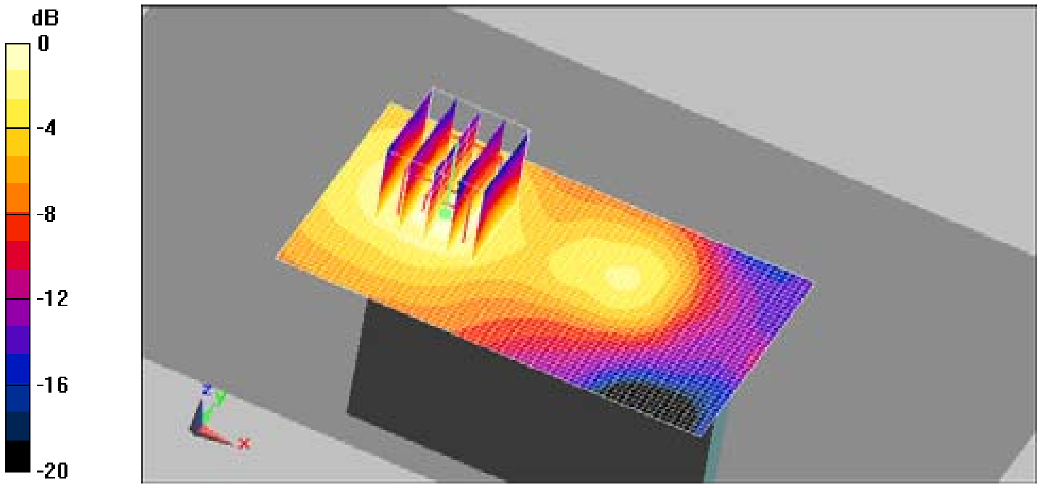
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 WLAN Body (Job No. : FJ-131)
Procedure Name: Body, Ch.01, Ant.Intenna, Bat.Standard, Right, 1Mbps, 10mm
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.9;Test Date-15/May/2012

Communication System: WLAN; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.95 mho/m; ε_r = 51.2; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.19, 4.19, 4.19); Calibrated: 2012-01-25
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Body, Ch.01, Ant.Intenna, Bat.Standard, Right, 1Mbps, 10mm/Area Scan (41x71x1):
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.032 mW/g

Body, Ch.01, Ant.Intenna, Bat.Standard, Right, 1Mbps, 10mm/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 2.56 V/m; Power Drift = 0.054 dB
Peak SAR (extrapolated) = 0.063 W/kg
SAR(1 g) = 0.034 mW/g; SAR(10 g) = 0.019 mW/g
Maximum value of SAR (measured) = 0.036 mW/g



0 dB = 0.036mW/g

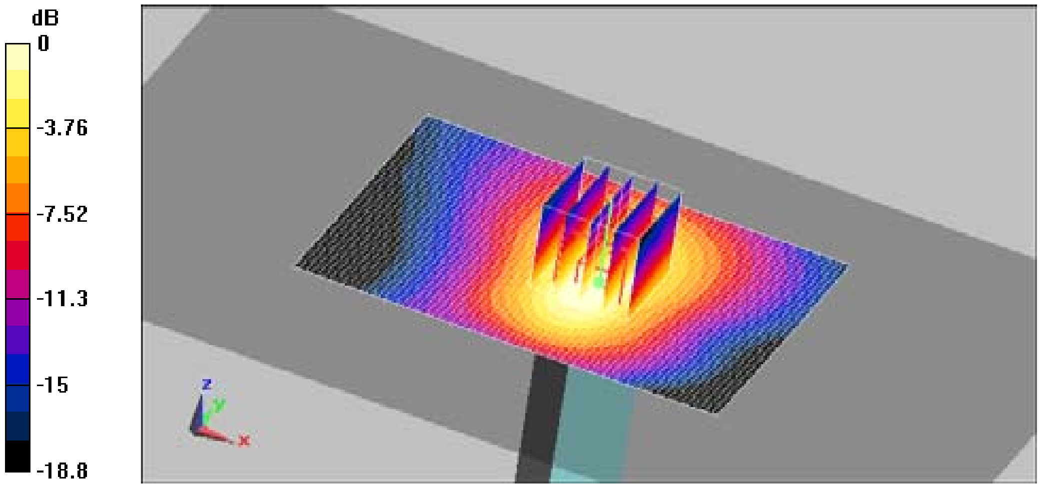
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 WLAN Body (Job No. : FJ-131)
Procedure Name: Body, Ch.01, Ant.Intenna, Bat.Standard, Bottom, 1Mbps, 10mm
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.9;Test Date-15/May/2012

Communication System: WLAN; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.95 mho/m; ε_r = 51.2; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.19, 4.19, 4.19); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Body, Ch.01, Ant.Intenna, Bat.Standard, Bottom, 1Mbps, 10mm/Area Scan (51x71x1):
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.195 mW/g

Body, Ch.01, Ant.Intenna, Bat.Standard, Bottom, 1Mbps, 10mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.72 V/m; Power Drift = 0.135 dB
Peak SAR (extrapolated) = 0.262 W/kg
SAR(1 g) = 0.142 mW/g; SAR(10 g) = 0.080 mW/g
Maximum value of SAR (measured) = 0.174 mW/g



0 dB = 0.174mW/g

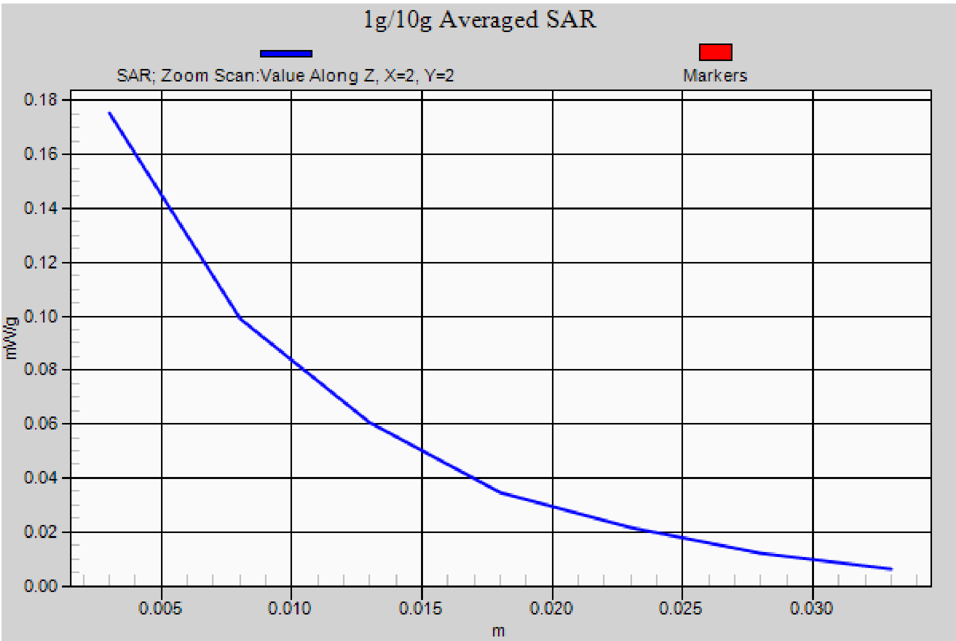
DUT: GT-S5698; Serial: FJ-131-A
Program Name: GT-S5698 WLAN Body (Job No. : FJ-131)
Procedure Name: Body, Ch.01, Ant.Intenna, Bat.Standard, Bottom, 1Mbps, 10mm
Meas. Ambient Temp(celsius)-22.4,Tissue Temp(celsius)-21.9;Test Date-15/May/2012

Communication System: WLAN; Frequency: 2412 MHz;Duty Cycle: 1:1
Medium parameters used: f = 2412 MHz; σ = 1.95 mho/m; ε_r = 51.2; ρ = 1000 kg/m^3
Phantom section: Center Section

DASY5 Configuration:
- Probe: ES3DV3 - SN3080; ConvF(4.19, 4.19, 4.19); Calibrated: 2012-01-25
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn670; Calibrated: 2012-02-21
- Phantom: Triple Flat Phantom 5.1; Type: Triple Flat Phantom 5.1; Serial: MP-1007
- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125

Body, Ch.01, Ant.Intenna, Bat.Standard, Bottom, 1Mbps, 10mm/Area Scan (51x71x1): Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.195 mW/g

Body, Ch.01, Ant.Intenna, Bat.Standard, Bottom, 1Mbps, 10mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.72 V/m; Power Drift = 0.135 dB
Peak SAR (extrapolated) = 0.262 W/kg
SAR(1 g) = 0.142 mW/g; SAR(10 g) = 0.080 mW/g
Maximum value of SAR (measured) = 0.174 mW/g



APPENDIX F

Probe Calibration

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Samsung (Dymstec)**

Certificate No: ES3-3080_Jan12

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3080
Calibration procedure(s)	QA CAL-01.v8, QA CAL-23.v4, QA CAL-25.v4 Calibration procedure for dosimetric E-field probes
Calibration date:	January 25, 2012

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 (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	31-Mar-11 (No. 217-01372)	Apr-12
Power sensor E4412A	MY41498087	31-Mar-11 (No. 217-01372)	Apr-12
Reference 3 dB Attenuator	SN: S5054 (3c)	29-Mar-11 (No. 217-01369)	Apr-12
Reference 20 dB Attenuator	SN: S5086 (20b)	29-Mar-11 (No. 217-01367)	Apr-12
Reference 30 dB Attenuator	SN: S5129 (30b)	29-Mar-11 (No. 217-01370)	Apr-12
Reference Probe ES3DV2	SN: 3013	29-Dec-11 (No. ES3-3013_Dec11)	Dec-12
DAE4	SN: 654	3-May-11 (No. DAE4-654_May11)	May-12
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-11)	In house check: Apr-13
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 25, 2012

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

O.K to use
2012.1.26

Glossary:

TSL	tissue simulating liquid
NORMx,y,z	sensitivity in free space
ConvF	sensitivity in TSL / NORMx,y,z
DCP	diode compression point
CF	crest factor (1/duty_cycle) of the RF signal
A, B, C	modulation dependent linearization parameters
Polarization φ	φ rotation around probe axis
Polarization ϑ	ϑ rotation around an axis that is in the plane normal to probe axis (at measurement center), i.e., ϑ = 0 is normal to probe axis

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z, VRx,y,z: A, B, C* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.

Probe ES3DV3

SN:3080

Manufactured: March 14, 2005
Calibrated: January 25, 2012

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3080

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm (µV/(V/m)^2)[A]	1.19	1.14	1.15	± 10.1 %
DCP (mV)[B]	101.9	103.7	103.2	

Modulation Calibration Parameters

UID	Communication System Name	PAR		A dB	B dB	C dB	VR mV	Unc[E] (k=2)
10000	CW	0.00	X	0.00	0.00	1.00	107.3	±3.0 %
			Y	0.00	0.00	1.00	111.7	
			Z	0.00	0.00	1.00	102.2	

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

[A] The uncertainties of NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3080

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.01	6.01	6.01	0.58	1.38	± 12.0 %
850	41.5	0.92	5.78	5.78	5.78	0.32	1.94	± 12.0 %
1450	40.5	1.20	5.61	5.61	5.61	0.42	1.93	± 12.0 %
1750	40.1	1.37	5.17	5.17	5.17	0.65	1.39	± 12.0 %
1900	40.0	1.40	4.98	4.98	4.98	0.80	1.23	± 12.0 %
2000	40.0	1.40	4.92	4.92	4.92	0.80	1.22	± 12.0 %
2300	39.5	1.67	4.65	4.65	4.65	0.80	1.28	± 12.0 %
2450	39.2	1.80	4.38	4.38	4.38	0.79	1.36	± 12.0 %
2600	39.0	1.96	4.18	4.18	4.18	0.80	1.38	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3080

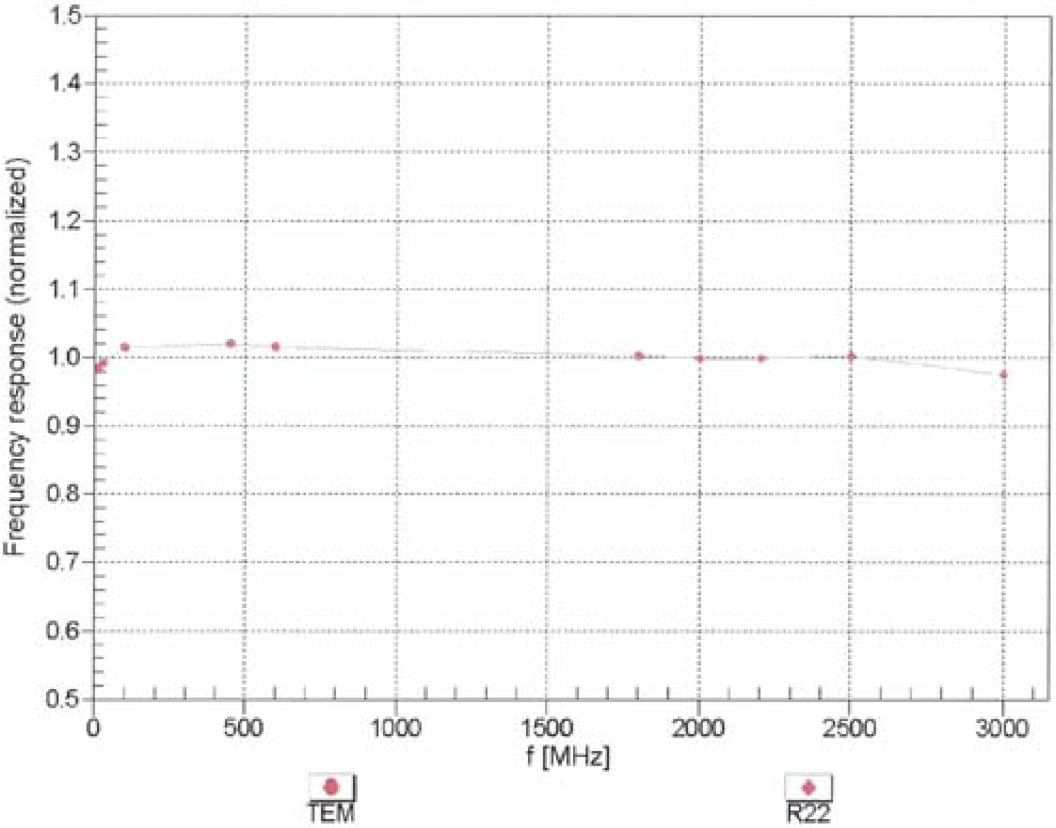
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	5.90	5.90	5.90	0.70	1.28	± 12.0 %
850	55.2	0.99	5.75	5.75	5.75	0.39	1.77	± 12.0 %
1750	53.4	1.49	4.71	4.71	4.71	0.80	1.29	± 12.0 %
1900	53.3	1.52	4.51	4.51	4.51	0.58	1.54	± 12.0 %
2300	52.9	1.81	4.30	4.30	4.30	0.80	1.26	± 12.0 %
2450	52.7	1.95	4.19	4.19	4.19	0.80	1.08	± 12.0 %
2600	52.5	2.16	3.99	3.99	3.99	0.80	1.06	± 12.0 %

[C] Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.

Frequency Response of E-Field

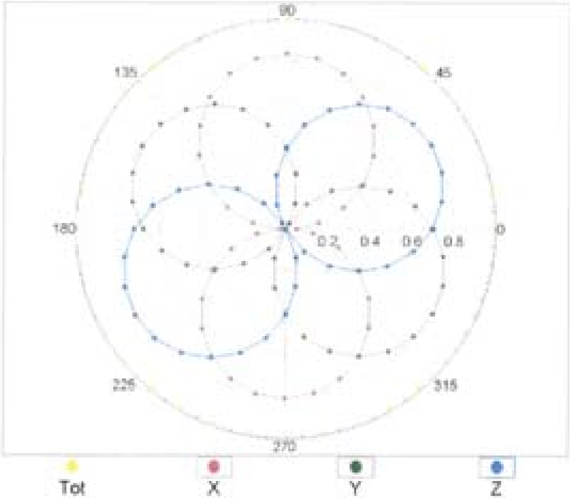
(TEM-Cell:ifi110 EXX, Waveguide: R22)



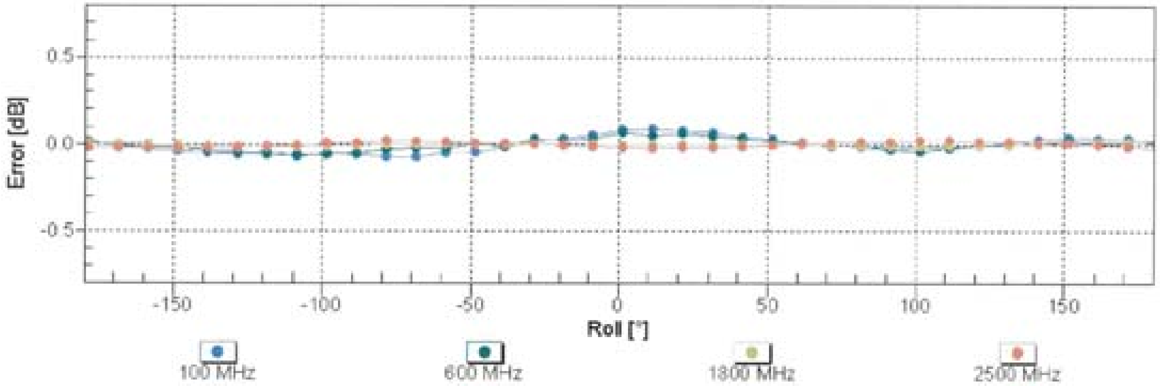
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Receiving Pattern (φ), ϑ = 0°

f=600 MHz,TEM

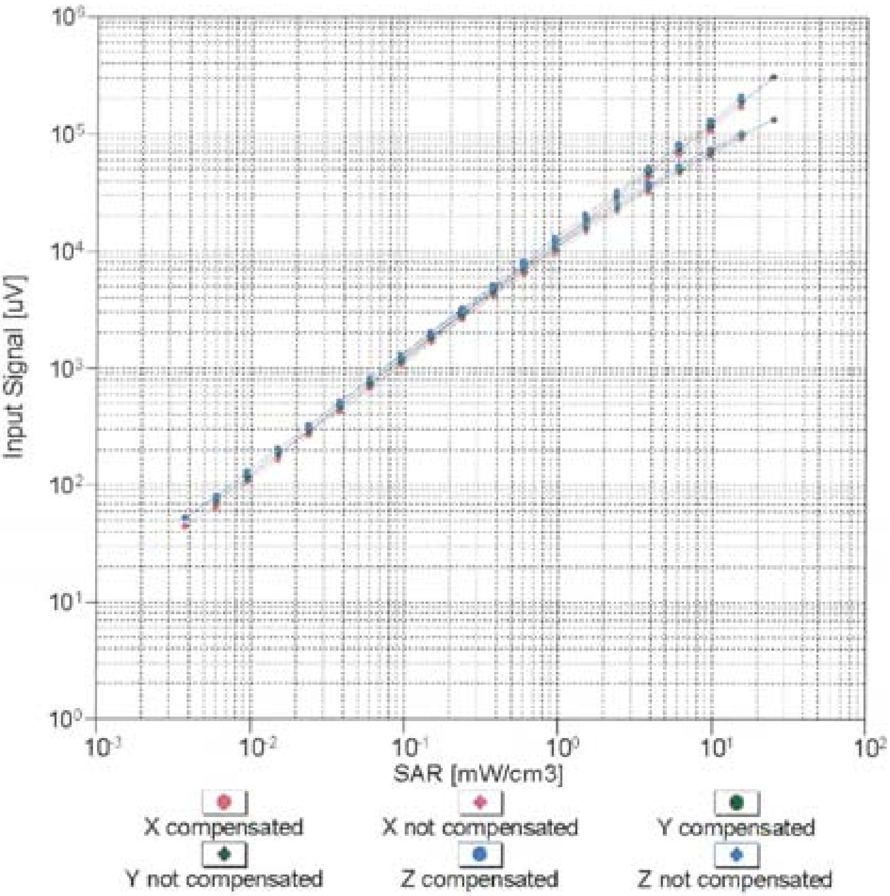


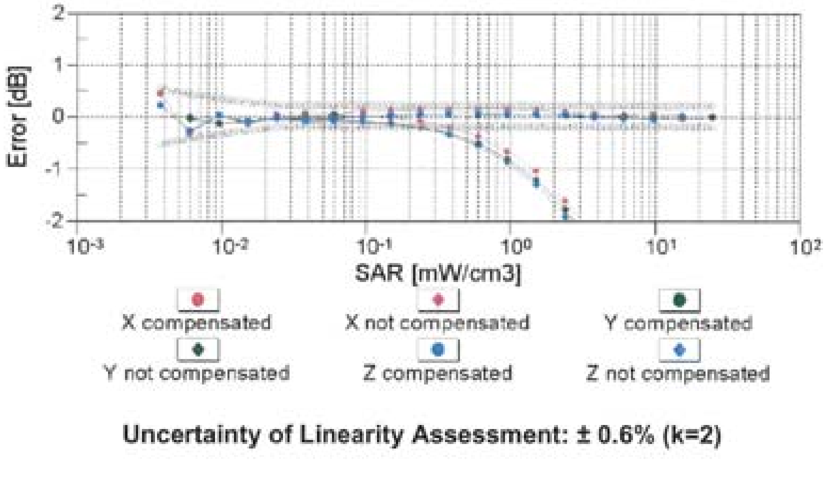
f=1800 MHz,R22



Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

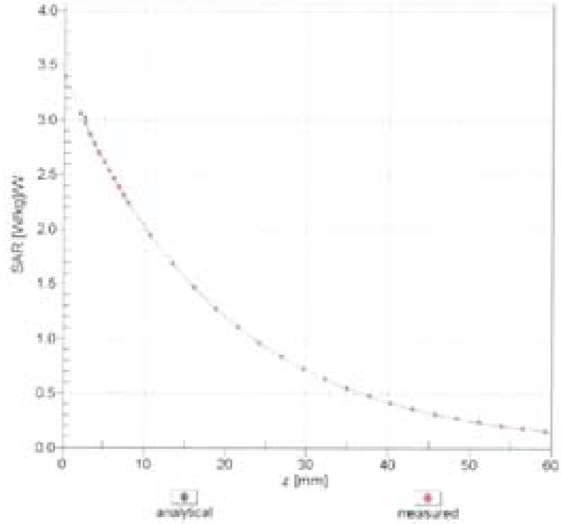




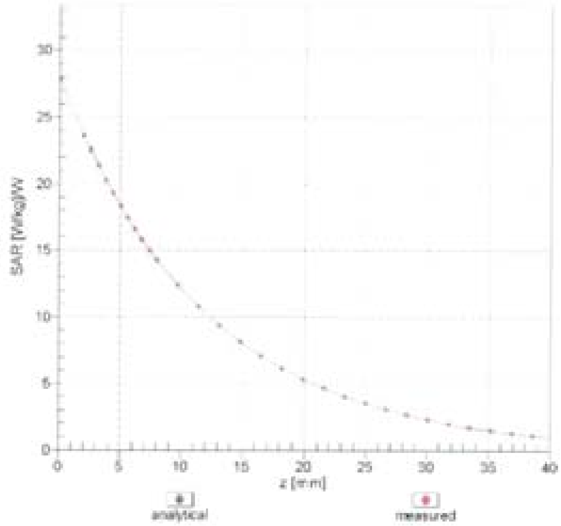
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 850 MHz,WGLS R9 (H_convF)

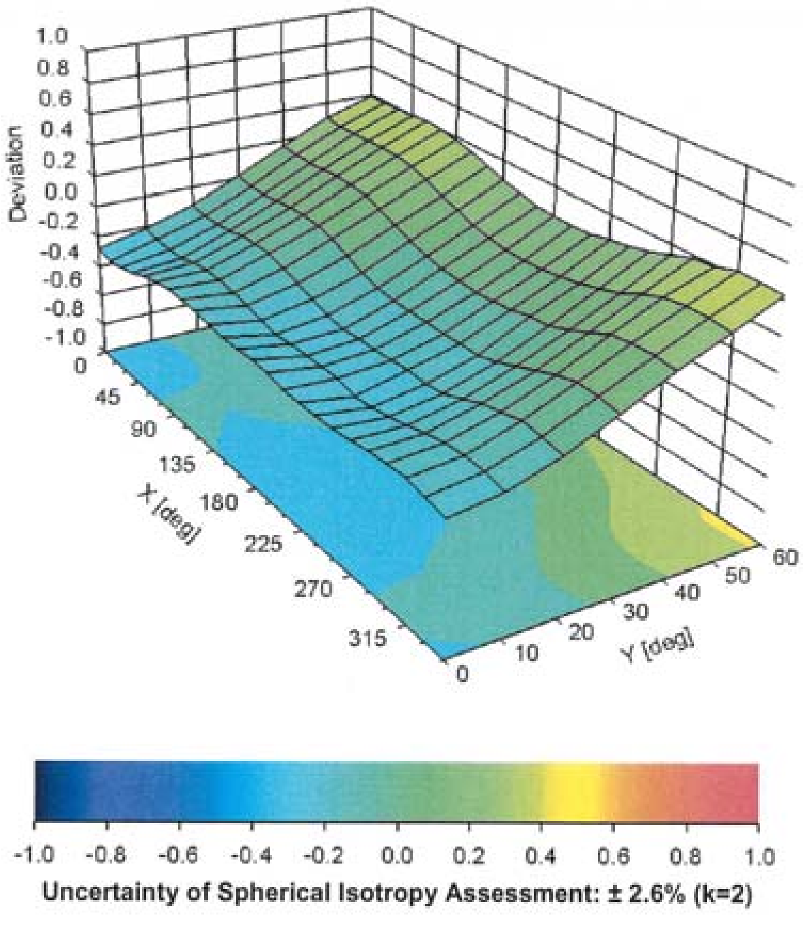


f = 1900 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3080

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	Not applicable
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

APPENDIX G

Calibration of The Validation Dipole

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Samsung (Dymstec)**

Certificate No: D1900V2-5d023_Jan12

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d023
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	January 26, 2012

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 (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Dimce Iliev	Laboratory Technician	D. Iliev
Approved by:	Katja Pokovic	Technical Manager	

Issued: January 26, 2012

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

O.K to use
2012.2.27

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	40.8 ± 6 %	1.39 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.66 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**39.0 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.07 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**20.4 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.9 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.72 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**38.8 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.10 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**20.4 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.9 Ω + 8.1 jΩ
Return Loss	- 21.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	45.3 Ω + 8.2 jΩ
Return Loss	- 20.1 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.203 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 28, 2008

Date: 26.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

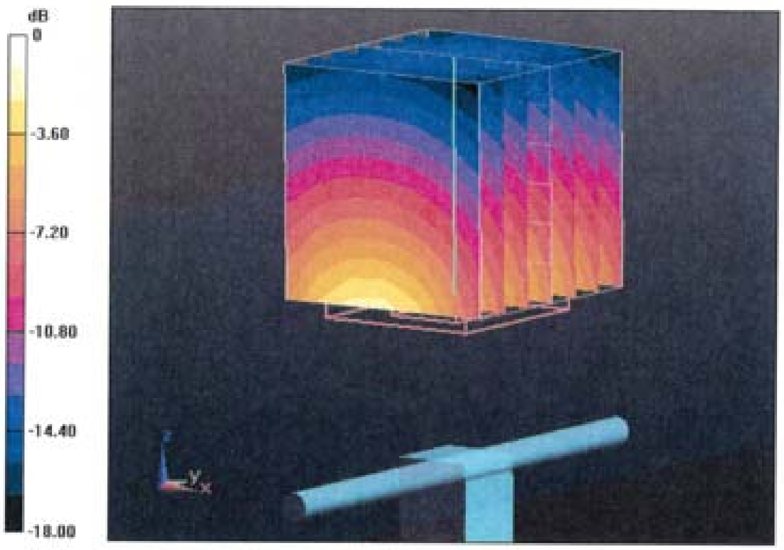
DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d023

Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.39 mho/m; ε_r = 40.8; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

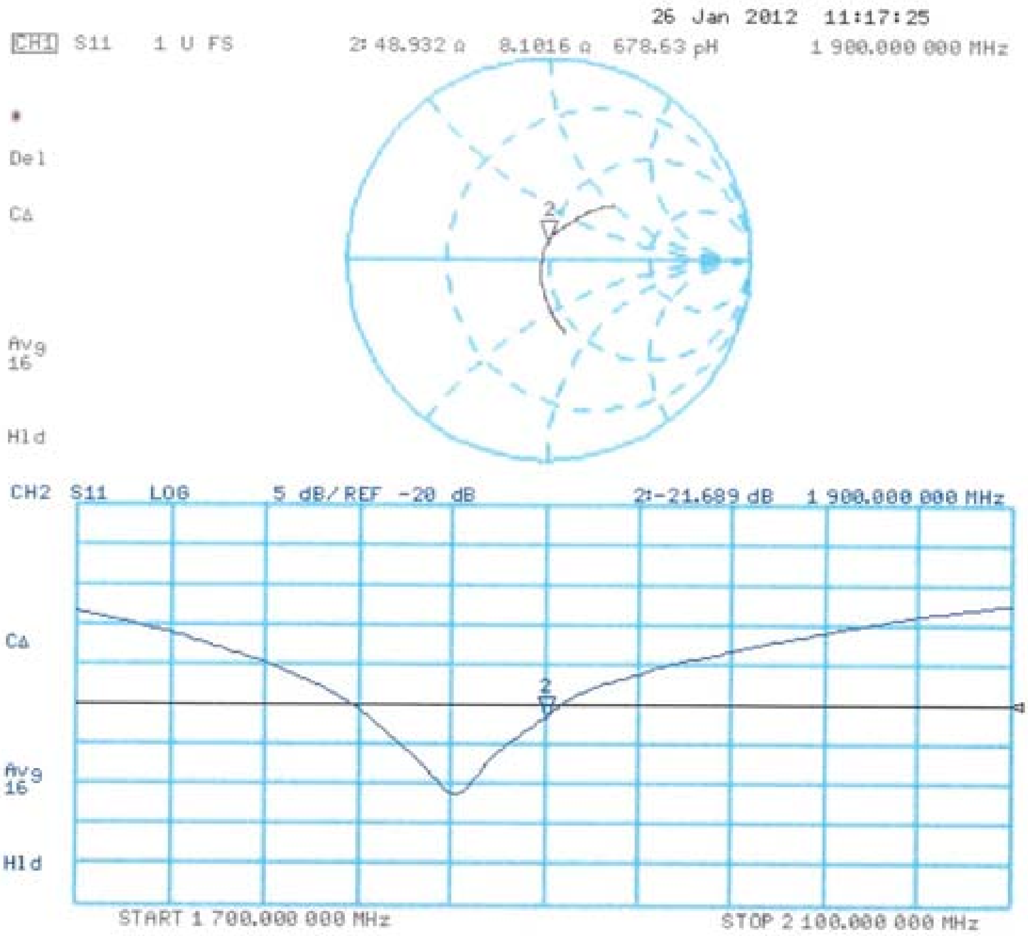
- Probe: ES3DV3 - SN3205; ConvF(5.01, 5.01, 5.01); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 96.841 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 17.2900
SAR(1 g) = 9.66 mW/g; SAR(10 g) = 5.07 mW/g
Maximum value of SAR (measured) = 11.991 mW/g



0 dB = 11.990mW/g = 21.58 dB mW/g

Impedance Measurement Plot for Head TSL



Date: 26.01.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d023

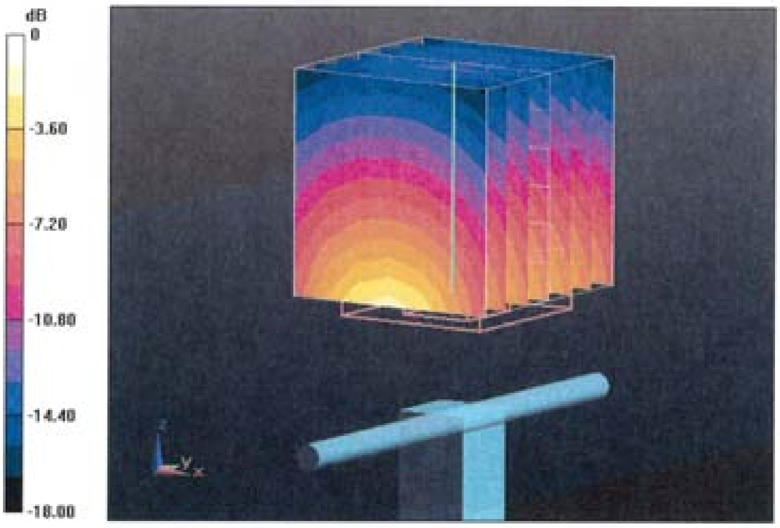
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; σ = 1.52 mho/m; ε_r = 52.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 4.62, 4.62); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

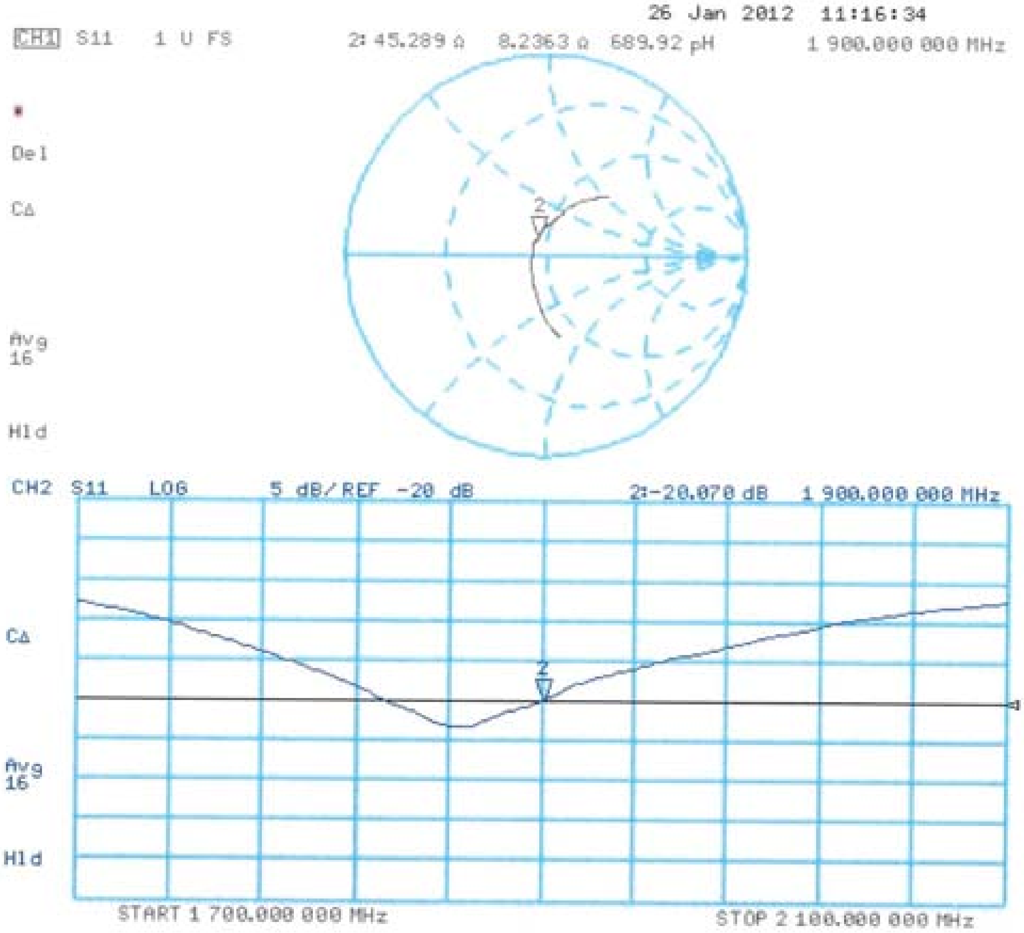
Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.052 V/m; Power Drift = -6.9e-005 dB
Peak SAR (extrapolated) = 17.0640
SAR(1 g) = 9.72 mW/g; SAR(10 g) = 5.1 mW/g
Maximum value of SAR (measured) = 12.349 mW/g



0 dB = 12.350mW/g = 21.83 dB mW/g

Impedance Measurement Plot for Body TSL



Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
Servizio svizzero di taratura
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: SCS 108

Client **Samsung (Dymstec)**

Certificate No: **D2450V2-807_Feb12**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 807
Calibration procedure(s)	QA CAL-05.v8 Calibration procedure for dipole validation kits above 700 MHz
Calibration date:	February 23, 2012

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 (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	05-Oct-11 (No. 217-01451)	Oct-12
Power sensor HP 8481A	US37292783	05-Oct-11 (No. 217-01451)	Oct-12
Reference 20 dB Attenuator	SN: 5086 (20g)	29-Mar-11 (No. 217-01368)	Apr-12
Type-N mismatch combination	SN: 5047.2 / 06327	29-Mar-11 (No. 217-01371)	Apr-12
Reference Probe ES3DV3	SN: 3205	30-Dec-11 (No. ES3-3205_Dec11)	Dec-12
DAE4	SN: 601	04-Jul-11 (No. DAE4-601_Jul11)	Jul-12
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-11)	In house check: Oct-12

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	[signature]

Issued: February 23, 2012

O.k. house 2012.4.21

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

Additional Documentation:

d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

Measurement Conditions

DASY system configuration, as far as not given on page 1.

DASY Version	DASY5	V52.8.0
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	2450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	39.2	1.80 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	38.9 ± 6 %	1.86 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	13.6 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**53.5 mW /g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	6.25 mW / g
SAR for nominal Head TSL parameters	normalized to 1W	**24.8 mW /g ± 16.5 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	52.7	1.95 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	52.3 ± 6 %	2.02 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	12.8 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**50.3 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.95 mW / g
SAR for nominal Body TSL parameters	normalized to 1W	**23.6 mW / g ± 16.5 % (k=2)**

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.3 Ω + 1.1 jΩ
Return Loss	- 29.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.6 Ω + 2.6 jΩ
Return Loss	- 31.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.160 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	November 02, 2006

DASY5 Validation Report for Head TSL

Date: 23.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 807

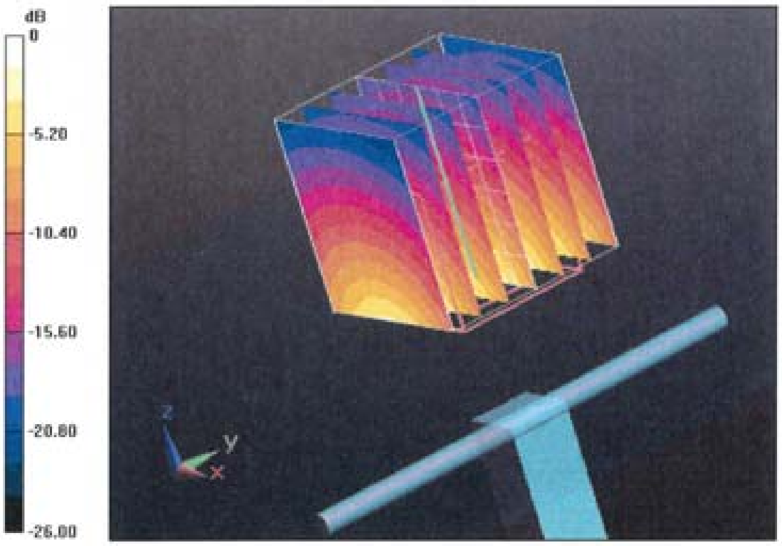
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; σ = 1.86 mho/m; ε_r = 38.9; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.45, 4.45, 4.45); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

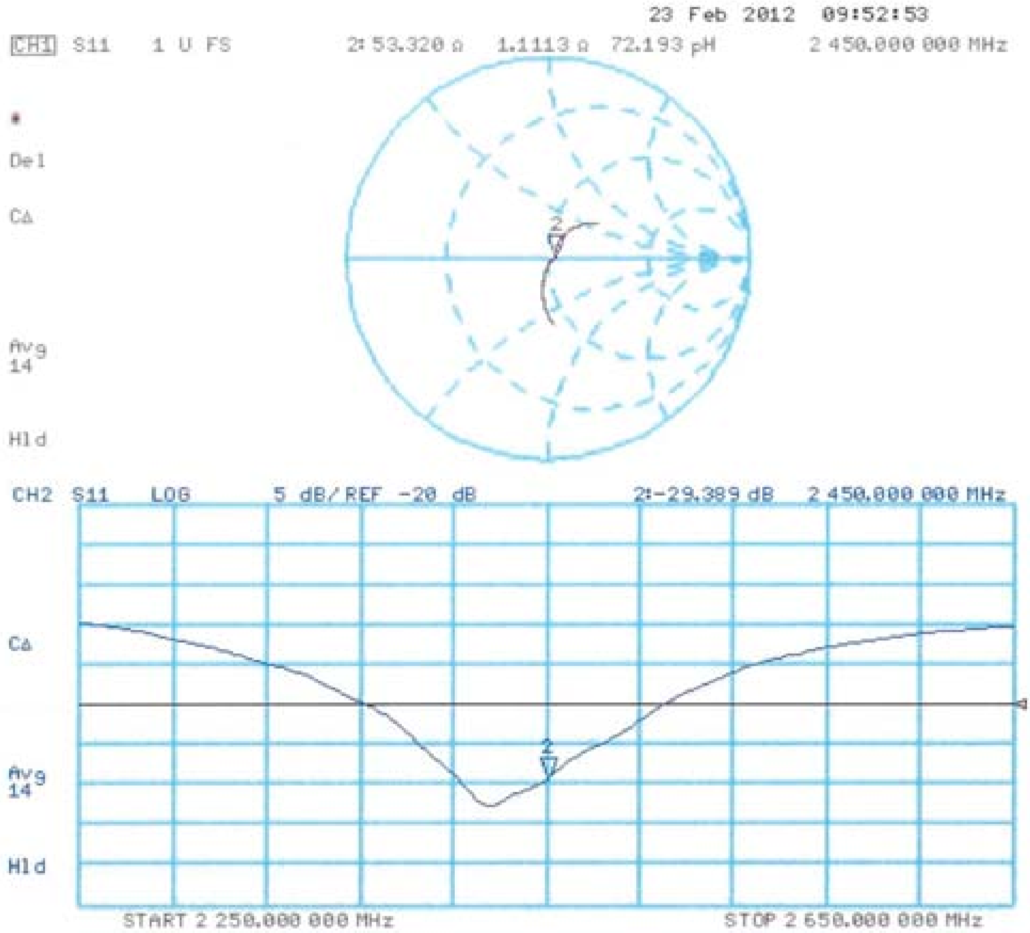
Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 100.1 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 28.6750
SAR(1 g) = 13.6 mW/g; SAR(10 g) = 6.25 mW/g
Maximum value of SAR (measured) = 17.500 mW/g



0 dB = 17.500mW/g = 24.86 dB mW/g

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 23.02.2012

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 807

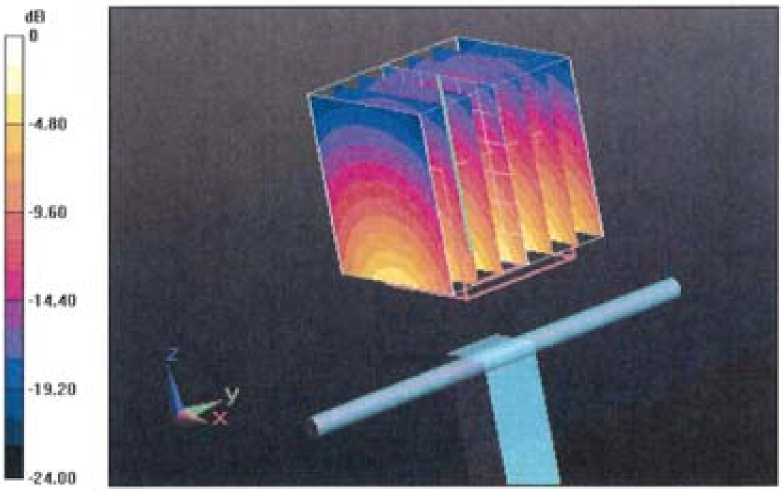
Communication System: CW; Frequency: 2450 MHz
Medium parameters used: f = 2450 MHz; $\sigma = 2.02$ mho/m; $\varepsilon_r = 52.3$; $\rho = 1000$ kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.26, 4.26, 4.26); Calibrated: 30.12.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.0(692); SEMCAD X 14.6.4(4989)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 94.815 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 26.1870
SAR(1 g) = 12.8 mW/g; SAR(10 g) = 5.95 mW/g
Maximum value of SAR (measured) = 16.868 mW/g



0 dB = 16.870mW/g = 24.54 dB mW/g

Impedance Measurement Plot for Body TSL