**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-E3309** |
| **FCC ID (Requested):** | **A3LGTE3309** |
| **Job No:** | **FJ-186** |
| **Report No:** | **FJ-186-S1** |

- Abstract –

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

**Prepared By**

**JR LEE - Test Engineer**

**Authorized By**

**JD JANG - Technical Manager**

# Contents

1. GENERAL INFORMATION ..... 3
2. DESCRIPTION OF DEVICE ..... 3
3. DESCRIPTION OF TEST EQUIPMENT ..... 4
3.1 SAR Measurement Setup ..... 4
3.2 E-field Probe ..... 5
3.3 Phantom ..... 7
3.4 Brain Simulating Mixture Characterization ..... 9
3.5 Device Holder for Transmitters ..... 9
3.6 Validation Dipole ..... 10
3.7 Equipment Calibration ..... 11
4. SAR MEASUREMENT PROCEDURE ..... 12
5. DESCRIPTION OF TEST POSITION ..... 13
5.1 SAM Phantom Shape ..... 13
5.2 “cheek” Position ..... 13
5.3 “tilted” Position ..... 15
5.4 Body Holster/Belt Clip Configurations ..... 16
6. MEASUREMENT UNCERTAINTY ..... 17
7. SYSTEM VERIFICATION ..... 19
7.1 Tissue Verification ..... 19
7.2 Test System Validation ..... 19
8. SAR MEASUREMENT RESULTS ..... 20
8.1 GSM850 Head SAR Results ..... 24
8.2 GPRS850 Body SAR Results(Without Holster) ..... 25
8.3 GSM1900 Head SAR Results ..... 26
8.4 GPRS1900 Body SAR Results(Without Holster) ..... 27
9. CONCLUSION ..... 28
10. REFERENCES ..... 29
APPENDIX A SAR Definition ..... 31
APPENDIX B Probe Calibration Process ..... 32
APPENDIX C ANSI/IEEE C95.1 – 2005 RF EXPOSURE LIMITS ..... 33
APPENDIX D The Validation Measurements ..... 34
APPENDIX E Plots of The SAR Measurements ..... 39
APPENDIX F Probe Calibration ..... 62
APPENDIX G Calibration of The Validation Dipole ..... 74

## 1. GENERAL INFORMATION

| | |
|---|---|
| Test Dates : | Jul.13, 2012 ~ Jul.16, 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) |
| Tested for : | FCC/TCB Certification |

## 2. DESCRIPTION OF DEVICE

| | |
|---|---|
| Test Sample : | 850/1900 GSM/GPRS Phone with Bluetooth and EDGE Rx only |
| Model Number : | GT-E3309 |
| Serial Number : | Identical prototype (S/N : # FJ-186-C) |
| Tx Freq. Range : | 824.2 ~ 848.8 MHz (GSM850)<br>1850.20 ~ 1909.80 MHz (GSM1900) |
| Rx Freq. Range : | 869.2 ~ 893.8 MHz (GSM850)<br>1930.20 ~ 1989.80 MHz (GSM1900) |
| Antenna Manufacturer : | YOKOWO<br>Model No.: GT-E3309 |
| Antenna Dimensions : | 40.54 X 18.25 X 5.07 (mm) |
| Separation distance between Main and Bluetooth antenna : | 33mm |

# 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).

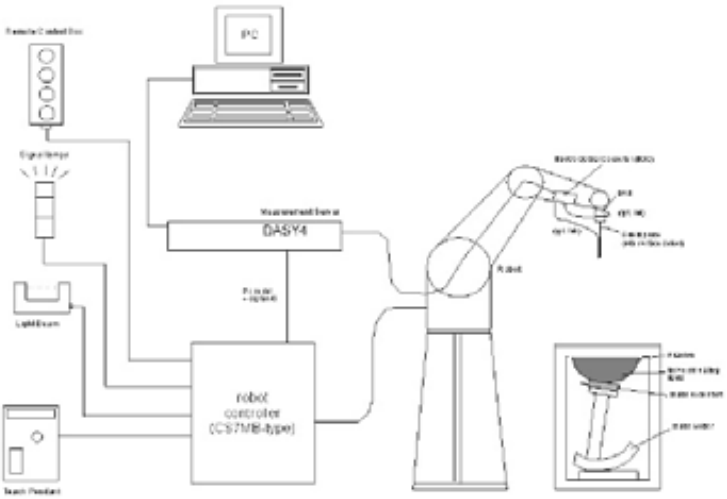



**Figure 3.1 SAR Measurement System Setup**

**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.

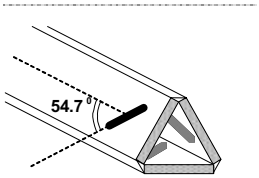
## 3.2 E-field Probe

**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 2$^{nd}$ order fitting (see Fig.3.2). The approach is stopped at reaching the maximum.

**Probe Specifications**

| | |
|---|---|
| Construction | Symmetrical design with triangular core<br>Interleaved sensors<br>Built-in shielding against static charges<br>PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration | Basic Broad Band Calibration in air: 10-3000 MHz<br>Conversion Factors (CF) for HSL 900 and HSL 1800 |




**Δ - BEAM**

**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

[ES3DV3] ,[ES3DV2]

**[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

[EX3DV4]

| | |
|---|---|
| Application | **[ES3DV3], [ES3DV2]**<br>General dosimetry up to 5 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones<br><br>**[EX3DV4]**<br>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 %.<br><br>**[ET3DV6]**<br>General dosimetry up to 3 GHz<br>Compliance tests of mobile phones<br>Fast automatic scanning in arbitrary phantoms |
| Optical Surface Detection | **[ET3DV6]**<br>± 0.2 mm repeatability in air and clear liquids over diffuse reflecting surfaces |

[ET3DV6]

## 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<br>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.

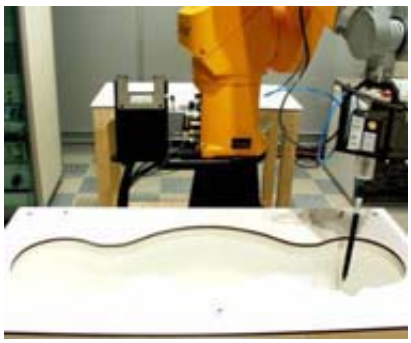


**Figure 3.7 Simulated Tissue**

**Table 3.1 Composition of the Brain Tissue Equivalent Matter**

| INGREDIENTS | 835MHz Brain | 835MHz Muscle | 1900MHz Brain | 1900MHz Muscle |
|---|---|---|---|---|
| WATER | 40.29% | 50.75% | 55.24% | 70.23% |
| SUGAR | 57.90% | 48.21% | - | - |
| SALT | 1.38% | 0.94% | 0.24% | 0.21% |
| TWEEN20 | - | - | 44.52% | 29.56% |
| BACTERIACIDE | 0.18% | 0.10% | - | - |
| HEC | 0.25% | - | - | - |
| Dielectric Constant Target | 41.50 | 55.20 | 40.00 | 53.30 |
| Conductivity Target (S/m) | 0.900 | 0.970 | 1.400 | 1.520 |

## 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).

**Figure 3.8 Device Holder**

*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.

### 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 | 835, 1900 MHz |
| Return Loss | < -20 dB at specified validation position |
| Dimensions | D835V2: dipole length: 161 mm; overall height: 330 mm<br>D1900V2: dipole length: 68 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

- End of page –

## 3.7 Equipment Calibration

### Table 3.2 Test Equipment Calibration

| Type | Calibration Due Date | Serial No. |
|---|---|---|
| SPEAG E-Field Probe EX3DV4 | May.23, 2013 | 3537 |
| SPEAG DAE4 | May.16, 2013 | 468 |
| SPEAG Validation Dipole D835V2 | Nov.18, 2013 | 4d111 |
| SPEAG Validation Dipole D1900V2 | Jan.26, 2014 | 5d023 |
| 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) | Not Required | - |
| E4440A Spectrum Analyzer | Feb.20, 2013 | MY45304704 |
| 778D Dual Directional Coupler | Dec.02, 2012 | 50189 |
| 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 | Apr.03,2013 | 58459 |

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)

- End of page -

# 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.

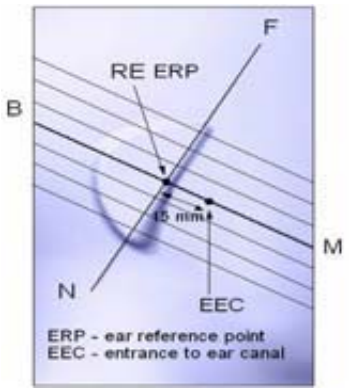



**Figure 5.2 Close up side view**

## 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

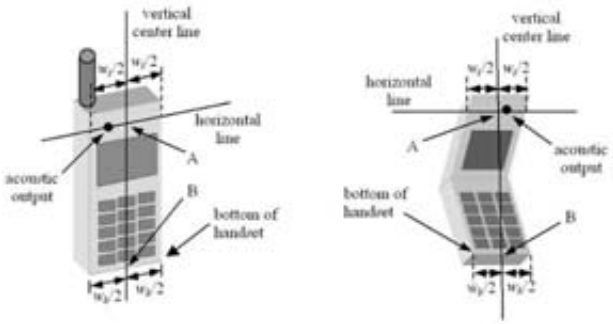



**Figure 5.4 Handset vertical and horizontal reference lines**

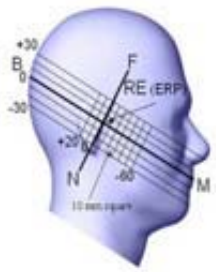



**Figure 5.3 Side view of the phantom showing relevant markings**

**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

.

**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.

# 6. MEASUREMENT UNCERTAINTY

## Table 6.1 Uncertainty Budget at 835MHz

| 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 | 1.73 | rectangular | 1.732 | 1 | 1.00 | ∞ |
| 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 | 1.12 | normal | 1.000 | 1 | 1.12 | 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 | 5.62 | normal | 1.000 | 1 | 5.62 | 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) | 0.38 | normal | 1.000 | 0.64 | 0.24 | ∞ |
| Liquid permittivity (deviation from target) | 5.00 | rectangular | 1.732 | 0.6 | 1.73 | ∞ |
| Liquid permittivity (measurement error) | 5.44 | normal | 1.000 | 0.6 | 3.26 | ∞ |
| **Combined Standard Uncertainty** | | Normal | - | - | **11.84** | **172776** |
| **Extended Standard Uncertainty(K=2.00)** | | | | | **23.69** | **172776** |

## Table 6.2 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** |

# 7. SYSTEM VERIFICATION

## 7.1 Tissue Verification

**Table 7.1 MEASURED TISSUE PARAMETERS**

| | 835MHz Head | | 835MHz Body | | 1900MHz Head | | 1900MHz Body | |
|---|---|---|---|---|---|---|---|---|
| | Target | Measured | Target | Measured | Target | Measured | Target | Measured |
| Date | Jul.13, 2012 | | Jul.13, 2012 | | Jul.16, 2012 | | Jul.16, 2012 | |
| Liquid Temperature(°C) | 22.4 | | 22.4 | | 22.1 | | 22.3 | |
| Dielectric Constant: å' | 41.5 | 41.3 | 55.2 | 55.5 | 40 | 39.8 | 53.3 | 52.8 |
| Conductivity: | 0.9 | 0.9 | 0.97 | 0.97 | 1.4 | 1.36 | 1.52 | 1.5 |
| Tissue Batch Number | 835DF4001C | | 835B2001N | | 1900F4001R | | 1900B2002L | |

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 835MHz and 1900MHz 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) |
|---|---|---|---|---|---|---|---|---|---|
| 4d111 | 835MHz Brain | 9.43 | 0.96 | 9.6 | 1.80 | Jul.13, 2012 | 22.4 | 22.7 | 100 |
| | 835MHz Body | 9.54 | 0.94 | 9.4 | -1.47 | Jul.13, 2012 | 22.4 | 22.6 | 100 |
| 5d023 | 1900MHz Brain | 39 | 3.72 | 37.2 | -4.62 | Jul.16, 2012 | 22.1 | 22.5 | 100 |
| | 1900MHz Body | 38.8 | 3.72 | 37.2 | -4.12 | Jul.16, 2012 | 22.3 | 22.6 | 100 |

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

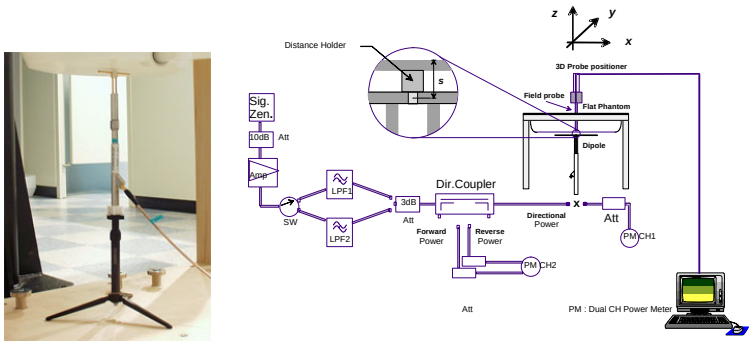



**Figure 7.1 Dipole Validation Test Setup**

## 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(1~4Tx) conducted power were also investigated for Body-Worn SAR Measurement

**Table 8.1 GPRS Power Table for GT-E3309**

| Band | Channel | Voice | 1Tx | 2Tx | 3Tx | 4Tx |
|---|---|---|---|---|---|---|
| 850 | 128 | 32.97 | 32.93 | 31.66 | 29.21 | 28.16 |
| | 190 | 32.62 | 32.56 | 31.27 | 29.2 | 28.28 |
| | 251 | 32.57 | 32.5 | 31.23 | 29.28 | 28.22 |
| 1900 | 512 | 29.69 | 29.65 | 28.55 | 26.74 | 25.62 |
| | 661 | 29.58 | 29.47 | 28.45 | 26.68 | 25.59 |
| | 810 | 29.83 | 29.7 | 28.85 | 26.61 | 25.53 |

**Table 8.2 Calculated Frame-Averaged Output Power Table for GT-E3309**

| Band | Channel | Voice | 1Tx | 2Tx | 3Tx | 4Tx |
|---|---|---|---|---|---|---|
| 850 | 128 | 23.94 | 23.90 | 25.64 | 24.95 | 25.15 |
| | 190 | 23.59 | 23.53 | 25.25 | 24.94 | 25.27 |
| | 251 | 23.54 | 23.47 | 25.21 | 25.02 | 25.21 |
| 1900 | 512 | 20.66 | 20.62 | 22.53 | 22.48 | 22.61 |
| | 661 | 20.55 | 20.44 | 22.43 | 22.42 | 22.58 |
| | 810 | 20.80 | 20.67 | 22.83 | 22.35 | 22.52 |

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

**GSM Class : B**

**GPRS Multislot Class : 12 (max 4 Tx Uplink slots)**

**EDGE Multislot class : EDGE Rx only**

**DTM Multislot Class : N/A**

**Table 8.3 Bluetooth Conducted Output Power**

| Operation Mode | Data Rate | Channel | Channel Frequency (MHz) | Average Power Result (dB m) | Peak Power Result (dB m) |
|---|---|---|---|---|---|
| GFSK | 1 Mbps | Low | 2 402 | 6.56 | 7.84 |
| | | Middle | 2 441 | 7.64 | 8.64 |
| | | High | 2 480 | 7.19 | 8.23 |
| π/4DQPSK | 2 Mbps | Low | 2 402 | 2.92 | 6.47 |
| | | Middle | 2 441 | 5.48 | 7.82 |
| | | High | 2 480 | 5.42 | 7.52 |
| 8DPSK | 3 Mbps | Low | 2 402 | 2.94 | 6.77 |
| | | Middle | 2 441 | 5.51 | 7.95 |
| | | High | 2 480 | 5.44 | 7.62 |

**Simultaneous Transmission**

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

**Table 8.4 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 8.5 Summary of SAR Evaluation Requirements for Cell phones with Multiple Transmitters**

| | **Individual Transmitter** | **Simultaneous Transmission** |
|---|---|---|
| **Licensed Transmitters** | **<u>Routine evaluation required</u>** | **SAR not required:**<br>**<u>Unlicensed only</u>**<br>o when stand-alone 1-g SAR is not required and antenna is > 5 cm from other antennas<br>**<u>Licensed & Unlicensed</u>**<br>o when the sum of the 1-g SAR is <1.6 W/kg for all simultaneous transmitting antennas<br>o when SAR to antenna separation ratio of simultaneous transmitting antenna pair is < 0.3<br><br>**SAR required:**<br>**<u>Licensed & Unlicensed</u>**<br>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<br>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 –**<br>o output < 60/f: SAR not required<br>o output ≥ 60/f: stand-alone SAR required<br><br>**When there is simultaneous transmission –**<br>**<u>Stand-alone SAR not required when</u>**<br>O output ≤ 2.$P_{Ref}$ and antenna is > 5.0 cm from other antennas<br>O output ≤ PRef and antenna is ≥ 2.5 cm from other antennas<br>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<br>**<u>Otherwise stand-alone SAR is required</u>**<br><br>**When stand-alone SAR is required**<br>o test SAR on highest output channel for each wireless mode and exposure condition<br>o if SAR for highest output channel is > 50% of SAR limit, evaluate all channels according to normal procedures | |

**Multiple Antenna/Transmission Information for GT-3309**

The separation between the main antenna and the Bluetooth antennas is 33mm.

RF Conducted Power of Bluetooth Tx is 7.64 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 0.893 + 0 = 0.893, which is less than 1.6 W/Kg, therefore, a simultaneous SAR evaluation is not required.

## 8.1 GSM850 Head SAR Results

| Frequency | | Mode | Conducted | | Side | Test Position | Antenna Type | Battery | Drift (dB) | SAR Level (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| MHz | Ch | | Start | End | | | | | | |
| 836.6 | 190 | GSM850 | 32.60 | 32.67 | Right | Cheek/Touch | Intenna | Standard | -0.05 | **0.708** |
| 836.6 | 190 | GSM850 | 32.53 | 32.60 | Right | Ear/Tilt 15° | Intenna | Standard | -0.026 | 0.376 |
| 836.6 | 190 | GSM850 | 32.63 | 32.70 | Left | Cheek/Touch | Intenna | Standard | 0.035 | 0.667 |
| 836.6 | 190 | GSM850 | 32.63 | 32.60 | Left | Ear/Tilt 15° | Intenna | Standard | 0.013 | 0.345 |
| **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 GPRS850 Body SAR Results(Without Holster)

| Frequency | | Mode | Conducted | | Test Position | Antenna Type | Battery | Slots | Drift (dB) | SAR Level (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| MHz | Ch | | Start | End | | | | | | |
| 836.6 | 190 | GSM850 | 31.27 | 31.34 | 1.5 cm [w/o Holster] | Intenna | Standard | 2Tx | -0.0048 | 0.789 |
| 824.2 | 128 | GSM850 | 29.27 | 29.23 | 1.5 cm [w/o Holster] | Intenna | Standard | 3Tx | 0.197 | 0.255 |
| 836.6 | 190 | GSM850 | 29.29 | 29.29 | 1.5 cm [w/o Holster] | Intenna | Standard | 3Tx | 0.092 | 0.878 |
| 848.8 | 251 | GSM850 | 29.29 | 29.26 | 1.5 cm [w/o Holster] | Intenna | Standard | 3Tx | 0.065 | 0.838 |
| 824.2 | 128 | GSM850 | 28.17 | 28.24 | 1.5 cm [w/o Holster] | Intenna | Standard | 4Tx | 0.061 | 0.273 |
| 836.6 | 190 | GSM850 | 28.22 | 28.29 | 1.5 cm [w/o Holster] | Intenna | Standard | 4Tx | -0.039 | **0.893** |
| 848.8 | 251 | GSM850 | 28.24 | 28.21 | 1.5 cm [w/o Holster] | Intenna | Standard | 4Tx | -0.027 | 0.890 |
| **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 ☐ With Holster ☒ Without Holster
6. Justification for reduced test configurations: This model supports GPRS CLASS "12" (4Tx) So the burst power and timing period is more than 2dB higher in GPRS mode than in GSM850 mode. Hence, the GSM850 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).

## 8.3 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 | 29.53 | 29.60 | Right | Cheek/Touch | Intenna | Standard | 0.138 | **0.456** |
| 1880 | 661 | GSM1900 | 29.66 | 29.66 | Right | Ear/Tilt 15° | Intenna | Standard | -0.12 | 0.052 |
| 1880 | 661 | GSM1900 | 29.59 | 29.56 | Left | Cheek/Touch | Intenna | Standard | -0.058 | 0.342 |
| 1880 | 661 | GSM1900 | 29.62 | 29.49 | Left | Ear/Tilt 15° | Intenna | Standard | 0.1 | 0.072 |
| **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).

## 8.4 GPRS1900 Body SAR Results(Without Holster)

| Frequency | | Mode | Conducted | | Test Position | Antenna Type | Battery | Slots | Drift (dB) | SAR Level (W/kg) |
|---|---|---|---|---|---|---|---|---|---|---|
| MHz | Ch | | Start | End | | | | | | |
| 1880 | 661 | GSM1900 | 28.48 | 28.45 | 1.5 cm [w/o Holster] | Intenna | Standard | 2Tx | 0.097 | 0.307 |
| 1880 | 661 | GSM1900 | 26.77 | 26.65 | 1.5 cm [w/o Holster] | Intenna | Standard | 3Tx | -0.132 | **0.313** |
| 1880 | 661 | GSM1900 | 25.58 | 25.58 | 1.5 cm [w/o Holster] | Intenna | Standard | 4Tx | -0.136 | 0.311 |
| **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 ☐ With Holster ☒ Without Holster
6. Justification for reduced test configurations: This model supports GPRS CLASS "12" (4Tx) So the burst power and timing period is more than 2dB higher in GPRS mode than in GSM1900 mode. Hence, the GSM1900 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).

# 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:
GSM850: Head: 0.708W/Kg : Body-worn: 0.893W/Kg
GSM1900: Head: 0.456W/Kg : Body-worn: 0.313W/Kg

# 10. REFERENCES


[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radiofrequency Radiation, Aug. 1996.

[2] ANSI/IEEE C95.1-2005, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300kHz to 100GHz, New York: IEEE, 2006.

[3] ANSI/IEEE C95.1-1992, American National Standard safety levels with respect to human exposure to radio frequency electromagnetic fields, 300kHz to 100GHz, New York: IEEE, Sept. 1992.

[4] ANSI/IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave, New York: IEEE, December 2002.

[5] Federal Communications Commission, OET Bulletin 65 (Edition 97-01), Supplement C (Edition 01-01), Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, June 2001.

[6] IEEE Standards Coordinating Committee 34 – IEEE Std. 1528-2003, Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices.

[7] NCRP, National Council on Radiation Protection and Measurements, Biological Effects and Exposure Criteria for RadioFrequency Electromagnetic Fields, NCRP Report No. 86, 1986. Reprinted Feb. 1995.

[8] T. Schmid, O. Egger, N. Kuster, Automated E-field scanning system for dosimetric assessments, IEEE Transaction on Microwave Theory and Techniques, vol. 44, Jan. 1996, pp. 105-113.

[9] 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.

[10] K. Pokovic, T. Schmid, and N. Kuster, E-field Probe with improved isotropy in brain simulating liquids, Proceedings of the ELMAR, Zadar, Croatia, June 23-25, 1996, pp. 172-175.

[11] Schmid & Partner Engineering AG, Application Note: Data Storage and Evaluation, June 1998, p2.

[12] V. Hombach, K. Meier, M. Burkhardt, E. Kuhn, N. Kuster, The Dependence of EM Energy Absorption upon Human Head Modeling at 900 MHz, IEEE Transaction on Microwave Theory and Techniques, vol. 44 no. 10, Oct. 1996, pp. 1865-1873.

[13] N. Kuster and Q. Balzano, Energy absorption mechanism by biological bodies in the near field of dipole antennas above 300MHz, IEEE Transaction on Vehicular Technology, vol. 41, no. 1, Feb. 1992, pp. 17-23.

[14] G. Hartsgrove, A. Kraszewski, A. Surowiec, Simulated Biological Materials for Electromagnetic Radiation Absorption Studies, University of Ottawa, Bioelectromagnetics, Canada: 1987, pp. 29-36.

[15] Q. Balzano, O. Garay, T. Manning Jr., Electromagnetic Energy Exposure of Simulated Users of Portable Cellular Telephones, IEEE Transactions on Vehicular Technology, vol. 44, no.3, Aug. 1995.

[16] W. Gander, Computermathematick, Birkhaeuser, Basel, 1992.

[17] W.H. Press, S.A. Teukolsky, W.T. Vetterling, and B.P. Flannery, Numerical Recepies in C, The Art of Scientific Computing, Second edition, Cambridge University Press, 1992.

[18] Federal Communications Commission, OET Bulletin 65, Evaluating Compliance with FCC Guidelines for Human

Exposure to Radiofrequency Electromagnetic Fields. Supplement C, Dec. 1997.

[19] N. Kuster, R. Kastle, T. Schmid, Dosimetric evaluation of mobile communications equipment with known precision, IEEE Transaction on Communications, vol. E80-B, no. 5, May 1997, pp. 645-652.

[20] CENELEC CLC/SC111B, European Prestandard (prENV 50166-2), Human Exposure to Electromagnetic Fields High-frequency: 10kHz-300GHz, Jan. 1995.

[21] Prof. Dr. Niels Kuster, ETH, Eidgenössische Technische Hoschschule Zürich, Dosimetric Evaluation of the Cellular Phone.

[22] IEC 62209-1, Human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices - Human models, instrumentation, and procedures - Part 1: Procedure to determine the specific absorption rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz), Feb. 2005.

[23] Industry Canada RSS-102 Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands) Issue 4, March 2010.

[24] Health Canada Safety Code 6 Limits of Human Exposure to Radio Frequency Electromagnetic Fields in the Frequency Range from 3 kHz – 300 GHz, 2009

[25] FCC Public Notice DA-02-1438. Office of Engineering and Technology Announces a Transition Period for the Phantom Requirements of Supplement C to OET Bulletin 65, June 19, 2002

[26] FCC SAR Measurement Procedures for 3G Devices KDB 941225

[27] SAR Measurement procedures for IEEE 802.11a/b/g KDB 248227

[28] FCC SAR Considerations for Handsets with Multiple Transmitters and Antennas, KDB 648474

[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).**

$$SAR = \sigma E^2 / p$$

**Where :**

$\sigma$ = 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.

- End of page -

# 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)

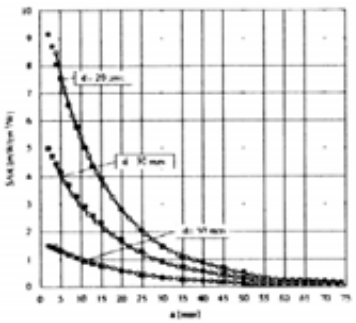


**Figure B.1. E-Field and Temperature measurements at 900MHz**

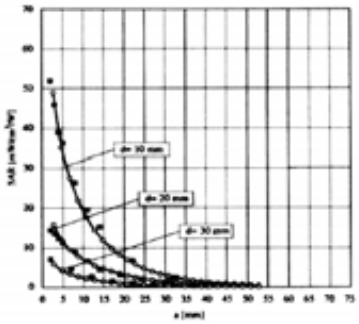


**Figure B.2. E-Field and temperature measurements at 1.9GHz**

# 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<br>General Population<br>(W/kg) or (mW/g) | CONTROLLED ENVIRONMENT<br>General Population<br>(W/kg) or (mW/g) |
|---|---|---|
| SPATIAL PEAK SAR[1]<br>Brain | 1.60 | 8.00 |
| SPATIAL PEAK SAR[2]<br>Whole Body | 0.08 | 0.40 |
| SPATIAL PEAK SAR[3]<br>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

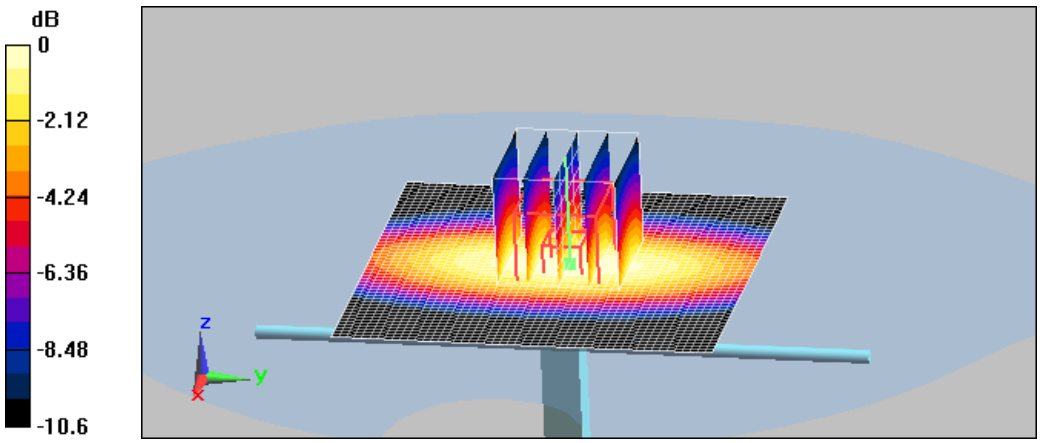
**DUT: Dipole 835 MHz; Serial: 4d111**
**Program Name: 835MHz Dipole Head Validation 2012.07.13**
**Procedure Name: 835MHz @ 100mW**
**Meas. Ambient Temp(celsius)-22.7,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1**
**Medium parameters used: f = 835 MHz; $\sigma$ = 0.9 mho/m; $\varepsilon_r$ = 41.3; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Flat Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.09, 8.09, 8.09); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603**
**- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125**

**835MHz @ 100mW/Area Scan (51x51x1):** Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 1.09 mW/g

**835MHz @ 100mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 35.1 V/m; Power Drift = 0.119 dB
Peak SAR (extrapolated) = 1.43 W/kg
**SAR(1 g) = 0.960 mW/g; SAR(10 g) = 0.631 mW/g**
Maximum value of SAR (measured) = 1.12 mW/g




0 dB = 1.12mW/g

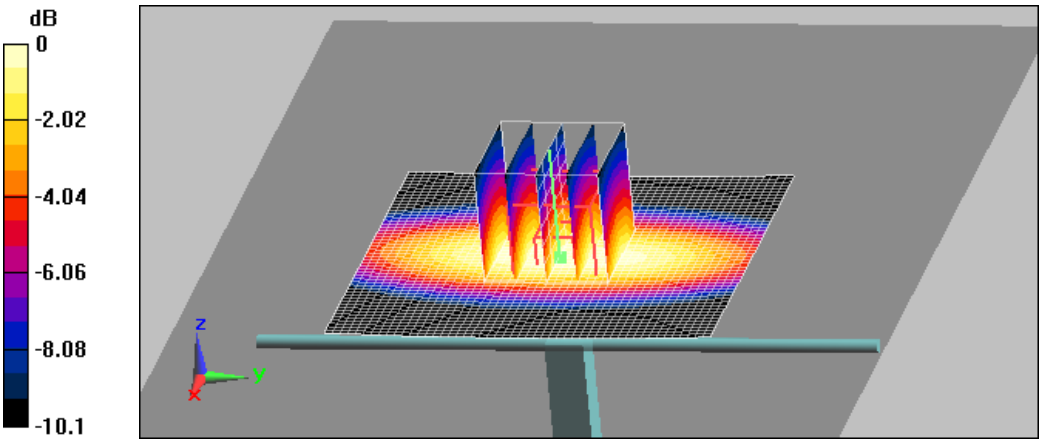
**DUT: Dipole 835 MHz; Serial: 4d111**
**Program Name: 835MHz Dipole Body Validation 2012.07.13**
**Procedure Name: 835MHz @ 100mW**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: CW; Frequency: 835 MHz;Duty Cycle: 1:1**
**Medium parameters used: f = 835 MHz; $\sigma$ = 0.97 mho/m; $\varepsilon_r$ = 55.5; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.05, 8.05, 8.05); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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**

**835MHz @ 100mW/Area Scan (51x51x1):** Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 1.1 mW/g

**835MHz @ 100mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 33.7 V/m; Power Drift = 0.028 dB
Peak SAR (extrapolated) = 1.36 W/kg
**SAR(1 g) = 0.940 mW/g; SAR(10 g) = 0.626 mW/g**
Maximum value of SAR (measured) = 1.09 mW/g




0 dB = 1.09mW/g

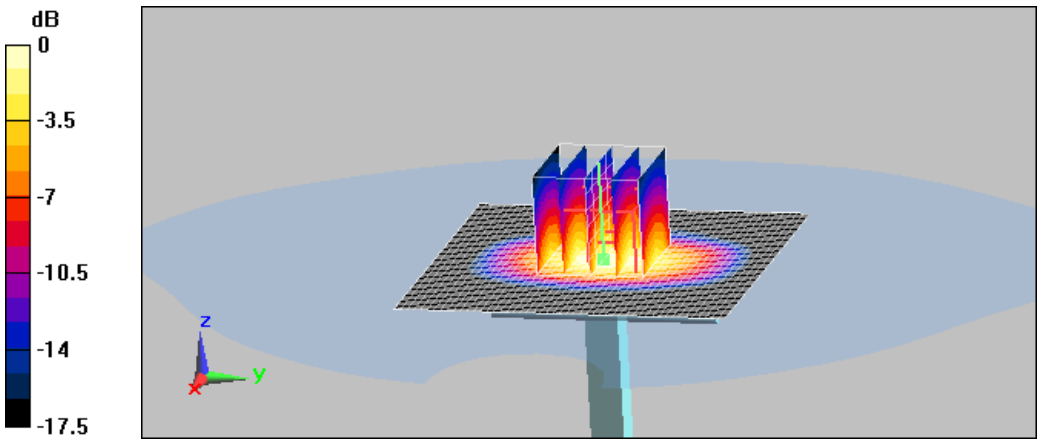
**DUT: Dipole 1900 MHz; Serial: 5d023**
**Program Name: 1900MHz Dipole Validation 2012.07.16**
**Procedure Name: 1900MHz @ 100mW**
**Meas. Ambient Temp(celsius)-22.5,Tissue Temp(celsius)-22.1;Test Date-16/Jul/2012**

**Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1**
**Medium parameters used: f = 1900 MHz; σ = 1.36 mho/m; $\varepsilon_r$ = 39.8; ρ = 1000 kg/m$^3$**
**Phantom section: Flat Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(7.11, 7.11, 7.11); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #3; Type: SAM; Serial: TP-1425**
**- 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) = 4.78 mW/g

**1900MHz @ 100mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 58.5 V/m; Power Drift = 0.059 dB
Peak SAR (extrapolated) = 6.62 W/kg
**SAR(1 g) = 3.72 mW/g; SAR(10 g) = 1.96 mW/g**
Maximum value of SAR (measured) = 4.68 mW/g




0 dB = 4.68mW/g

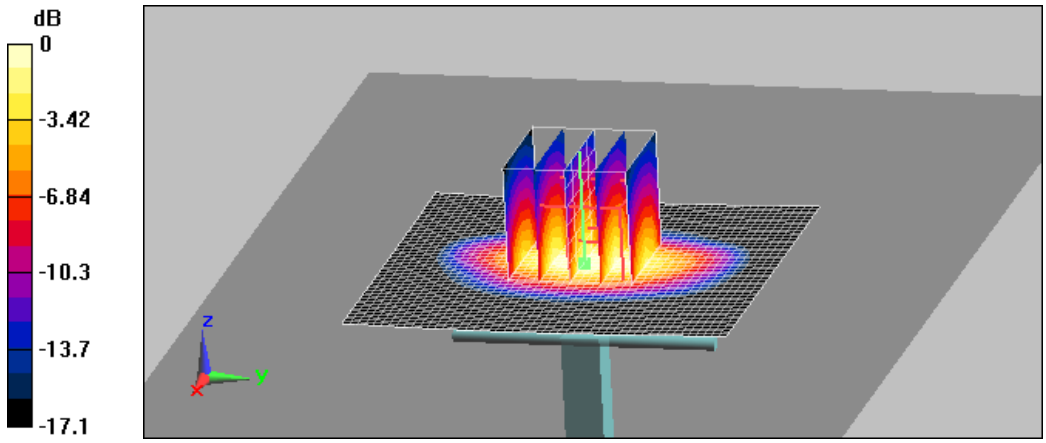
**DUT: Dipole 1900 MHz; Serial: 5d023**
**Program Name: 1900MHz Dipole Body Validation 2012.07.16**
**Procedure Name: 1900MHz @ 100mW**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-16/Jul/2012**

**Communication System: CW; Frequency: 1900 MHz;Duty Cycle: 1:1**
**Medium parameters used: f = 1900 MHz; $\sigma$ = 1.5 mho/m; $\varepsilon_r$ = 52.8; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(6.61, 6.61, 6.61); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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) = 5.17 mW/g

**1900MHz @ 100mW/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 52.7 V/m; Power Drift = 0.135 dB
Peak SAR (extrapolated) = 6.31 W/kg
**SAR(1 g) = 3.72 mW/g; SAR(10 g) = 1.98 mW/g**
Maximum value of SAR (measured) = 4.66 mW/g




0 dB = 4.66mW/g

# APPENDIX E

## Plots of The SAR Measurements

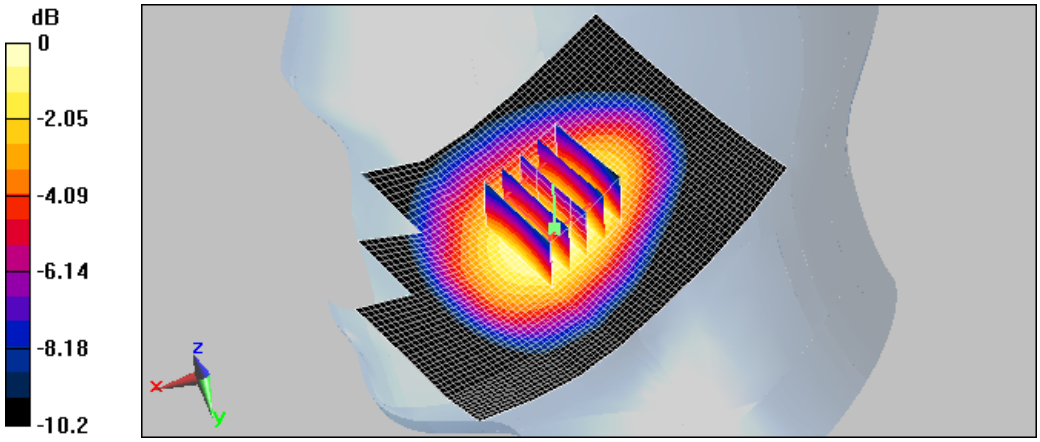
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GSM850 Right (Job No. : FJ-186)**
**Procedure Name: Cheek/Touch, Ch.190, Ant.Intenna, Bat.Standard**
**Meas. Ambient Temp(celsius)-22.7,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:8.3**
**Medium parameters used: f = 836.6 MHz; $\sigma$ = 0.9 mho/m; $\varepsilon_r$ = 41.3; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.09, 8.09, 8.09); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603**
**- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125**

**Cheek/Touch, Ch.190, Ant.Intenna, Bat.Standard/Area Scan (51x71x1):** Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.840 mW/g

**Cheek/Touch, Ch.190, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.6 V/m; Power Drift = -0.050 dB
Peak SAR (extrapolated) = 0.922 W/kg
**SAR(1 g) = 0.708 mW/g; SAR(10 g) = 0.508 mW/g**
Maximum value of SAR (measured) = 0.788 mW/g




0 dB = 0.788mW/g

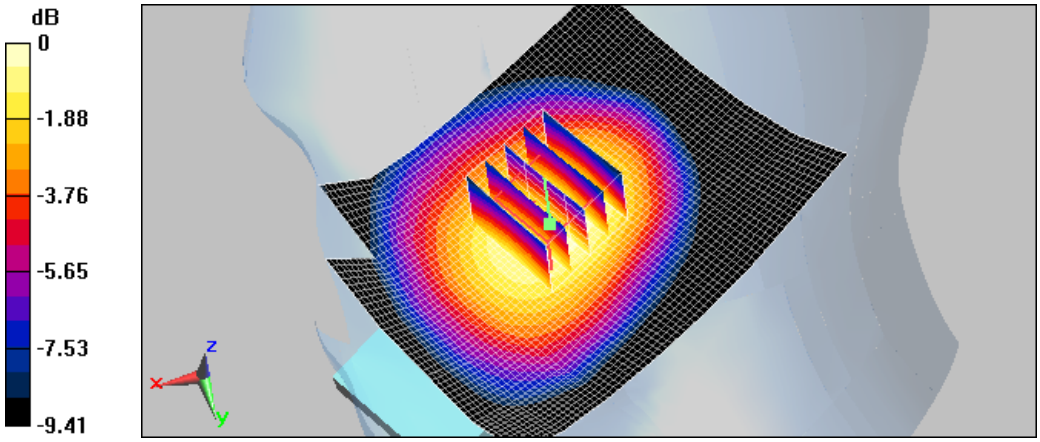
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GSM850 Right (Job No. : FJ-186)**
**Procedure Name: Ear/Tilt, Ch.190, Ant.Intenna, Bat.Standard**
**Meas. Ambient Temp(celsius)-22.7,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:8.3**
**Medium parameters used: f = 836.6 MHz; $\sigma$ = 0.9 mho/m; $\varepsilon_r$ = 41.3; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.09, 8.09, 8.09); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603**
**- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125**

**Ear/Tilt, Ch.190, Ant.Intenna, Bat.Standard/Area Scan (51x71x1):** Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.435 mW/g

**Ear/Tilt, Ch.190, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15 V/m; Power Drift = -0.026 dB
Peak SAR (extrapolated) = 0.494 W/kg
**SAR(1 g) = 0.376 mW/g; SAR(10 g) = 0.273 mW/g**
Maximum value of SAR (measured) = 0.419 mW/g




0 dB = 0.419mW/g

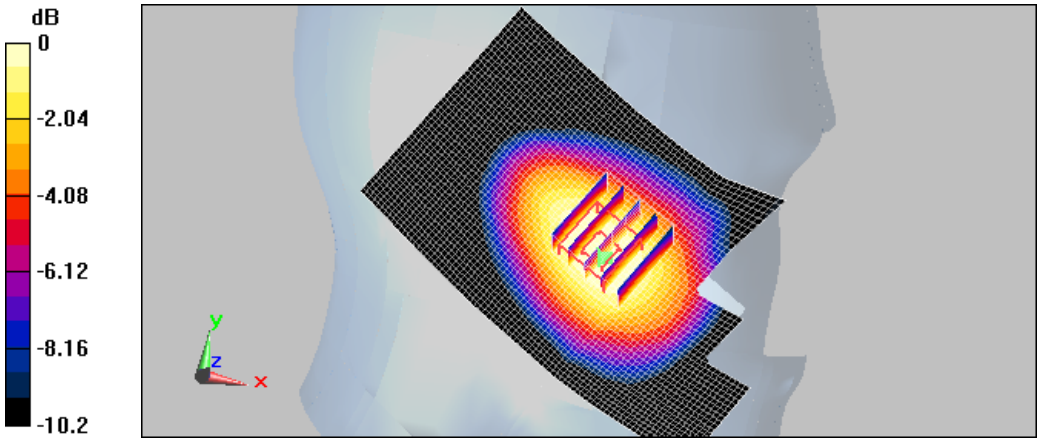
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GSM850 Left (Job No. : FJ-186)**
**Procedure Name: Cheek/Touch, Ch.190, Ant.Intenna, Bat.Standard**
**Meas. Ambient Temp(celsius)-22.7,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:8.3**
**Medium parameters used: f = 836.6 MHz; $\sigma$ = 0.9 mho/m; $\varepsilon_r$ = 41.3; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.09, 8.09, 8.09); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603**
**- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125**

**Cheek/Touch, Ch.190, Ant.Intenna, Bat.Standard/Area Scan (51x81x1):** Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.793 mW/g

**Cheek/Touch, Ch.190, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.8 V/m; Power Drift = 0.035 dB
Peak SAR (extrapolated) = 0.867 W/kg
**SAR(1 g) = 0.667 mW/g; SAR(10 g) = 0.479 mW/g**
Maximum value of SAR (measured) = 0.726 mW/g




0 dB = 0.726mW/g

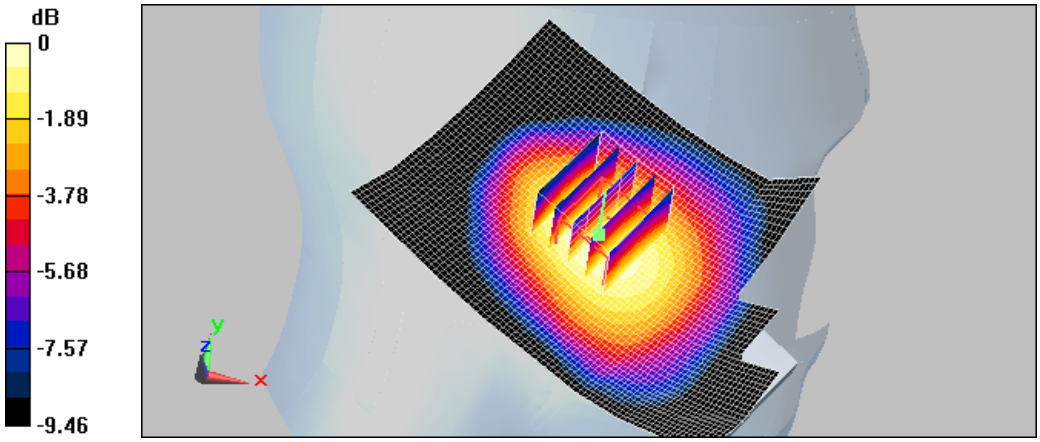
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GSM850 Left (Job No. : FJ-186)**
**Procedure Name: Ear/Tilt, Ch.190, Ant.Intenna, Bat.Standard**
**Meas. Ambient Temp(celsius)-22.7,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:8.3**
**Medium parameters used: f = 836.6 MHz; $\sigma$ = 0.9 mho/m; $\varepsilon_r$ = 41.3; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.09, 8.09, 8.09); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603**
**- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125**

**Ear/Tilt, Ch.190, Ant.Intenna, Bat.Standard/Area Scan (51x81x1):** Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.399 mW/g

**Ear/Tilt, Ch.190, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.6 V/m; Power Drift = 0.013 dB
Peak SAR (extrapolated) = 0.457 W/kg
**SAR(1 g) = 0.345 mW/g; SAR(10 g) = 0.251 mW/g**
Maximum value of SAR (measured) = 0.385 mW/g




0 dB = 0.385mW/g

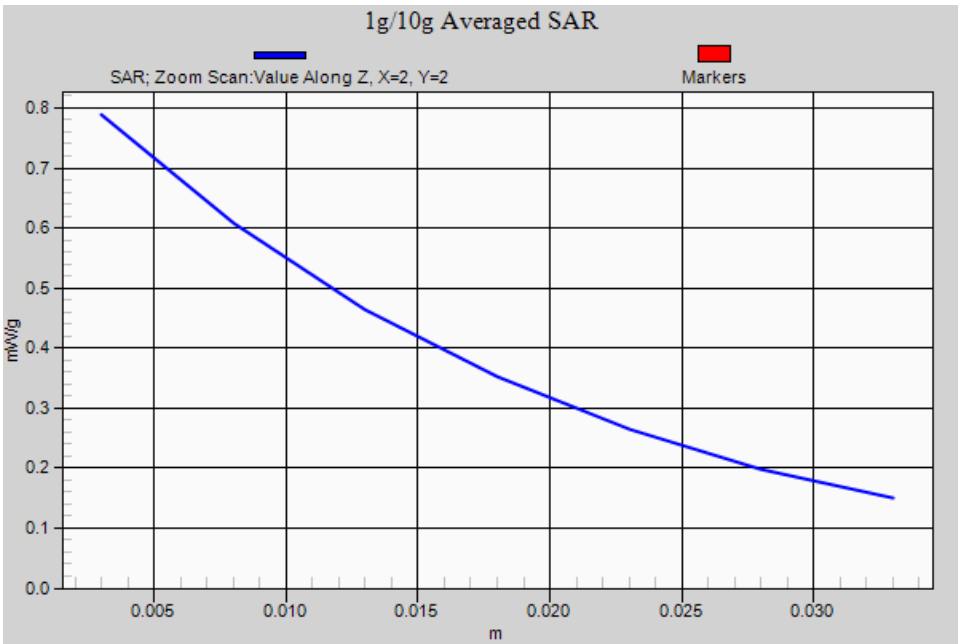
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GSM850 Right (Job No. : FJ-186)**
**Procedure Name: Cheek/Touch, Ch.190, Ant.Intenna, Bat.Standard**
**Meas. Ambient Temp(celsius)-22.7,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GSM 850; Frequency: 836.6 MHz;Duty Cycle: 1:8.3**
**Medium parameters used: f = 836.6 MHz; $\sigma$ = 0.9 mho/m; $\varepsilon_r$ = 41.3; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.09, 8.09, 8.09); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #1; Type: SAM; Serial: TP-1603**
**- Measurement SW: DASY5, V5.0 Build 125; Postprocessing SW: SEMCAD, V13.4 Build 125**

**Cheek/Touch, Ch.190, Ant.Intenna, Bat.Standard/Area Scan (51x71x1):** Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.840 mW/g

**Cheek/Touch, Ch.190, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.6 V/m; Power Drift = -0.050 dB
Peak SAR (extrapolated) = 0.922 W/kg
**SAR(1 g) = 0.708 mW/g; SAR(10 g) = 0.508 mW/g**
Maximum value of SAR (measured) = 0.788 mW/g



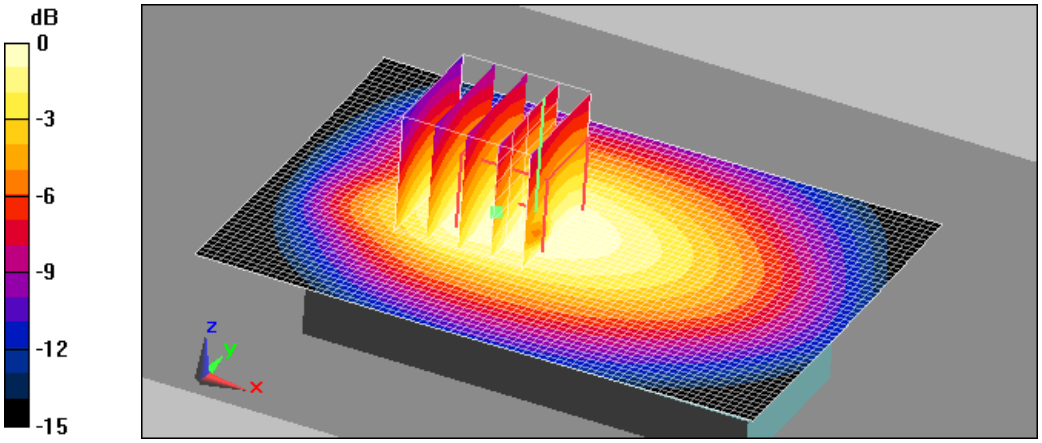
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS850 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.190, Ant.Intenna, Bat.Standard, 2Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GPRS 850; Frequency: 836.6 MHz;Duty Cycle: 1:4.15**
**Medium parameters used: f = 836.6 MHz; $\sigma$ = 0.97 mho/m; $\varepsilon_r$ = 55.5; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.05, 8.05, 8.05); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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.190, Ant.Intenna, Bat.Standard, 2Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.942 mW/g

**Body, Ch.190, Ant.Intenna, Bat.Standard, 2Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.9 V/m; Power Drift = -0.00482 dB
Peak SAR (extrapolated) = 1.37 W/kg
**SAR(1 g) = 0.789 mW/g; SAR(10 g) = 0.563 mW/g**
Maximum value of SAR (measured) = 0.865 mW/g




0 dB = 0.865mW/g

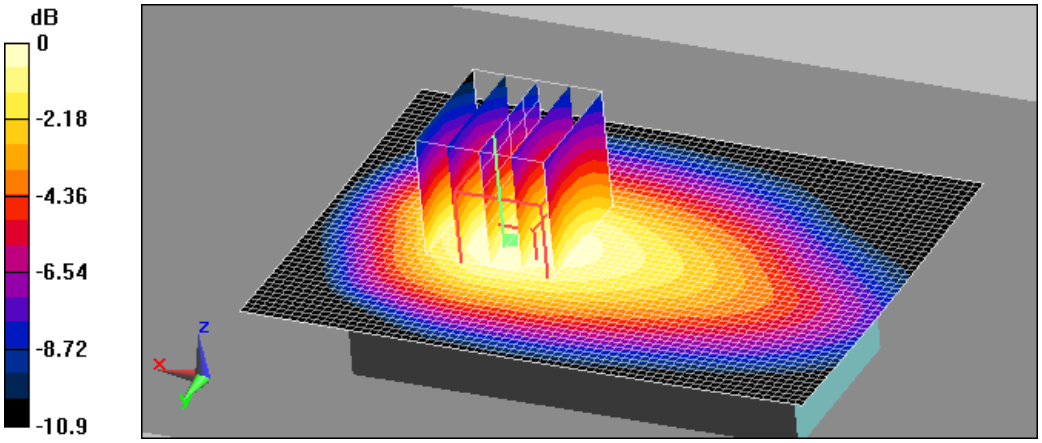
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS850 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.128, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GPRS 850; Frequency: 824.2 MHz;Duty Cycle: 1:2.767**
**Medium parameters used: f = 824.2 MHz; $\sigma$ = 0.97 mho/m; $\varepsilon_r$ = 55.5; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.05, 8.05, 8.05); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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.128, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.296 mW/g

**Body, Ch.128, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 15.3 V/m; Power Drift = 0.197 dB
Peak SAR (extrapolated) = 0.338 W/kg
**SAR(1 g) = 0.255 mW/g; SAR(10 g) = 0.183 mW/g**
Maximum value of SAR (measured) = 0.282 mW/g




0 dB = 0.282mW/g

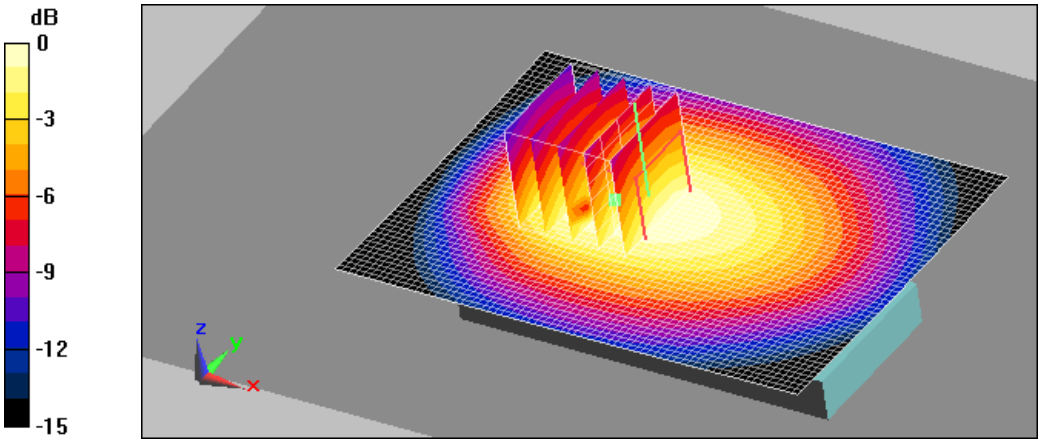
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS850 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.190, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GPRS 850; Frequency: 836.6 MHz;Duty Cycle: 1:2.767**
**Medium parameters used: f = 836.6 MHz; $\sigma$ = 0.97 mho/m; $\varepsilon_r$ = 55.5; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.05, 8.05, 8.05); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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.190, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 1.02 mW/g

**Body, Ch.190, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 30.1 V/m; Power Drift = 0.092 dB
Peak SAR (extrapolated) = 1.77 W/kg
**SAR(1 g) = 0.878 mW/g; SAR(10 g) = 0.590 mW/g**
Maximum value of SAR (measured) = 0.961 mW/g




0 dB = 0.961mW/g

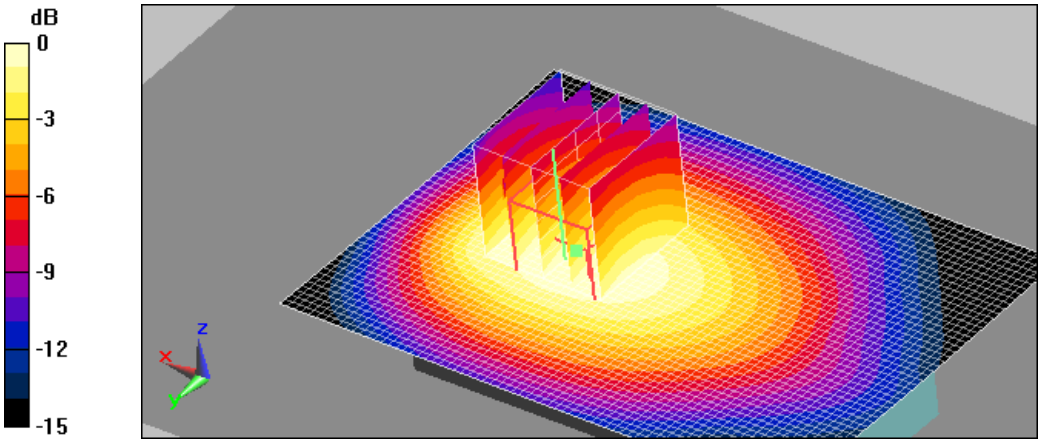
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS850 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.251, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GPRS 850; Frequency: 848.8 MHz;Duty Cycle: 1:2.767**
**Medium parameters used: f = 848.8 MHz; $\sigma$ = 0.97 mho/m; $\varepsilon_r$ = 55.5; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.05, 8.05, 8.05); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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.251, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.997 mW/g

**Body, Ch.251, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.2 V/m; Power Drift = 0.065 dB
Peak SAR (extrapolated) = 1.4 W/kg
**SAR(1 g) = 0.838 mW/g; SAR(10 g) = 0.597 mW/g**
Maximum value of SAR (measured) = 0.928 mW/g




0 dB = 0.928mW/g

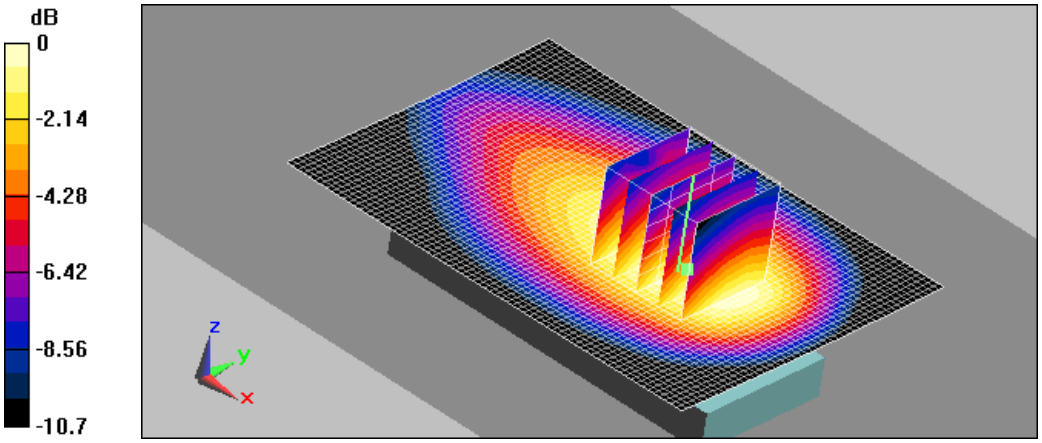
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS850 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.128, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GPRS 850; Frequency: 824.2 MHz;Duty Cycle: 1:2.075**
**Medium parameters used: f = 824.2 MHz; $\sigma$ = 0.97 mho/m; $\varepsilon_r$ = 55.5; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.05, 8.05, 8.05); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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.128, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.324 mW/g

**Body, Ch.128, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.3 V/m; Power Drift = 0.061 dB
Peak SAR (extrapolated) = 0.349 W/kg
**SAR(1 g) = 0.273 mW/g; SAR(10 g) = 0.189 mW/g**
Maximum value of SAR (measured) = 0.304 mW/g




0 dB = 0.304mW/g

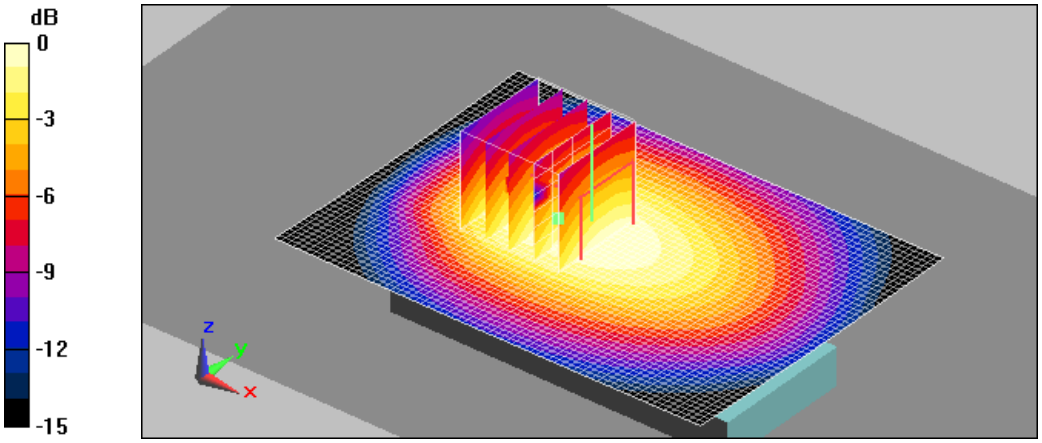
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS850 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.190, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GPRS 850; Frequency: 836.6 MHz;Duty Cycle: 1:2.075**
**Medium parameters used: f = 836.6 MHz; $\sigma$ = 0.97 mho/m; $\varepsilon_r$ = 55.5; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.05, 8.05, 8.05); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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.190, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 1.07 mW/g

**Body, Ch.190, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.2 V/m; Power Drift = -0.039 dB
Peak SAR (extrapolated) = 1.17 W/kg
**SAR(1 g) = 0.893 mW/g; SAR(10 g) = 0.630 mW/g**
Maximum value of SAR (measured) = 0.986 mW/g




0 dB = 0.986mW/g

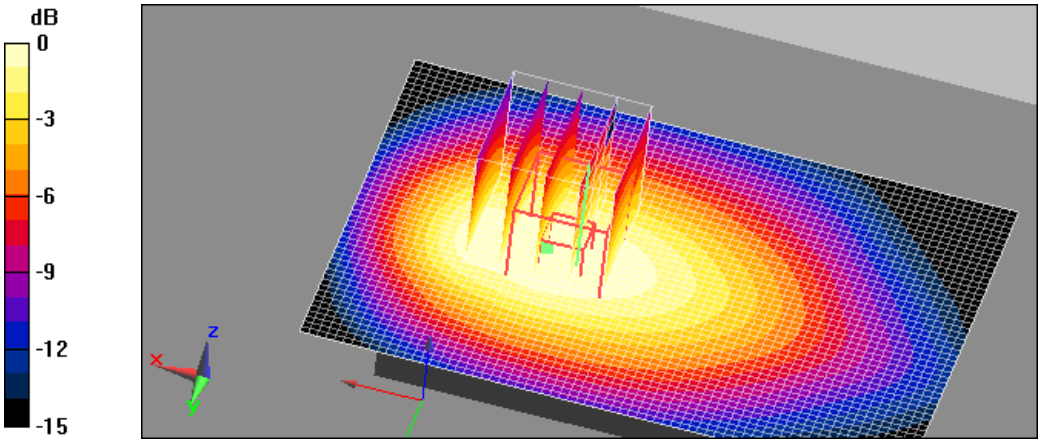
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS850 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.251, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GPRS 850; Frequency: 848.8 MHz;Duty Cycle: 1:2.075**
**Medium parameters used: f = 848.8 MHz; $\sigma$ = 0.97 mho/m; $\varepsilon_r$ = 55.5; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.05, 8.05, 8.05); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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.251, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 1.06 mW/g

**Body, Ch.251, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 28.4 V/m; Power Drift = -0.027 dB
Peak SAR (extrapolated) = 1.2 W/kg
**SAR(1 g) = 0.890 mW/g; SAR(10 g) = 0.632 mW/g**
Maximum value of SAR (measured) = 0.986 mW/g




0 dB = 0.986mW/g

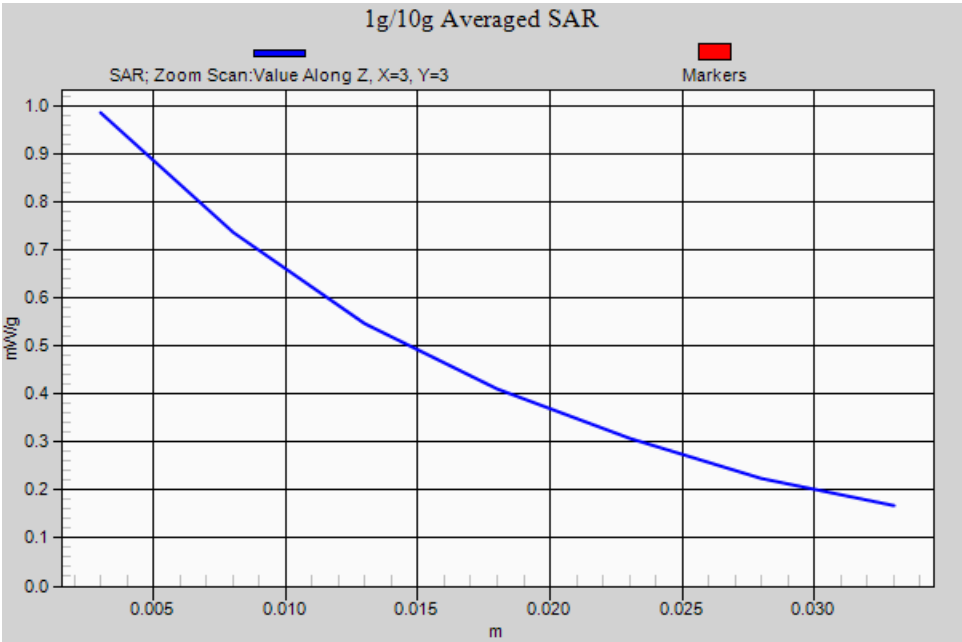
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS850 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.190, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.4;Test Date-13/Jul/2012**

**Communication System: GPRS 850; Frequency: 836.6 MHz;Duty Cycle: 1:2.075**
**Medium parameters used: f = 836.6 MHz; $\sigma$ = 0.97 mho/m; $\varepsilon_r$ = 55.5; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(8.05, 8.05, 8.05); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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.190, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 1.07 mW/g

**Body, Ch.190, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.2 V/m; Power Drift = -0.039 dB
Peak SAR (extrapolated) = 1.17 W/kg
**SAR(1 g) = 0.893 mW/g; SAR(10 g) = 0.630 mW/g**
Maximum value of SAR (measured) = 0.986 mW/g



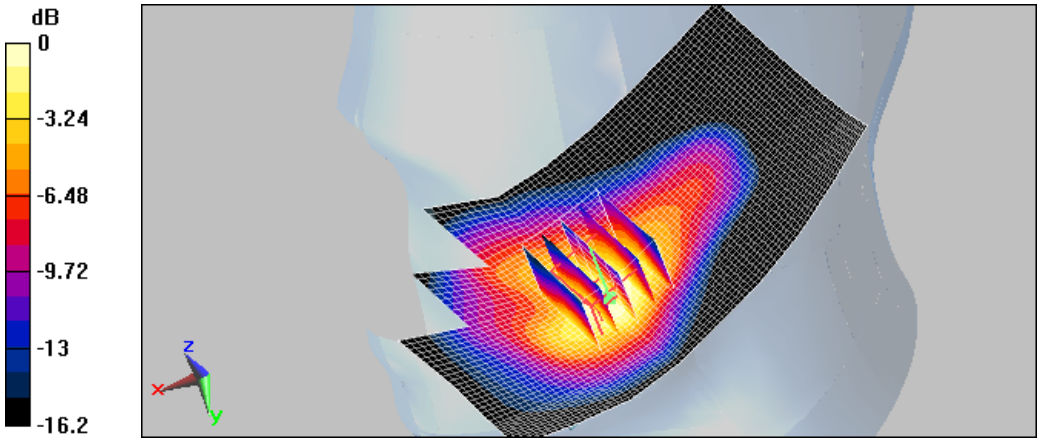
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GSM1900 Right (Job No. : FJ-186)**
**Procedure Name: Cheek, Ch.661, Ant.Intenna, Bat.Standard**
**Meas. Ambient Temp(celsius)-22.5,Tissue Temp(celsius)-22.1;Test Date-16/Jul/2012**

**Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3**
**Medium parameters used: f = 1880 MHz; $\sigma$ = 1.36 mho/m; $\varepsilon_r$ = 39.8; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(7.11, 7.11, 7.11); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #3; Type: SAM; Serial: TP-1425**
**- 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) = 0.532 mW/g

**Cheek, Ch.661, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.8 V/m; Power Drift = 0.138 dB
Peak SAR (extrapolated) = 0.669 W/kg
**SAR(1 g) = 0.456 mW/g; SAR(10 g) = 0.267 mW/g**
Maximum value of SAR (measured) = 0.527 mW/g




0 dB = 0.527mW/g

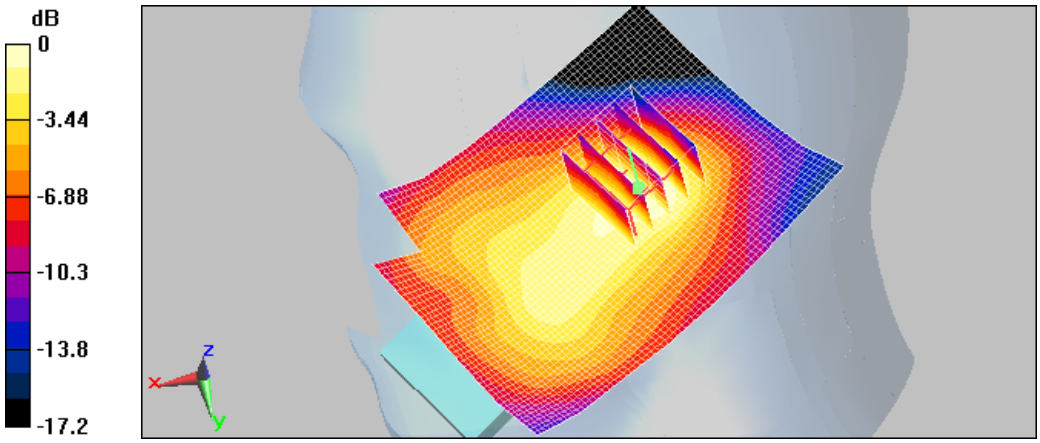
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GSM1900 Right (Job No. : FJ-186)**
**Procedure Name: Tilt, Ch.661, Ant.Intenna, Bat.Standard**
**Meas. Ambient Temp(celsius)-22.5,Tissue Temp(celsius)-22.1;Test Date-16/Jul/2012**

**Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3**
**Medium parameters used: f = 1880 MHz; $\sigma$ = 1.36 mho/m; $\varepsilon_r$ = 39.8; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(7.11, 7.11, 7.11); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #3; Type: SAM; Serial: TP-1425**
**- 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) = 0.069 mW/g

**Tilt, Ch.661, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.99 V/m; Power Drift = -0.120 dB
Peak SAR (extrapolated) = 0.076 W/kg
**SAR(1 g) = 0.052 mW/g; SAR(10 g) = 0.033 mW/g**
Maximum value of SAR (measured) = 0.062 mW/g




0 dB = 0.062mW/g

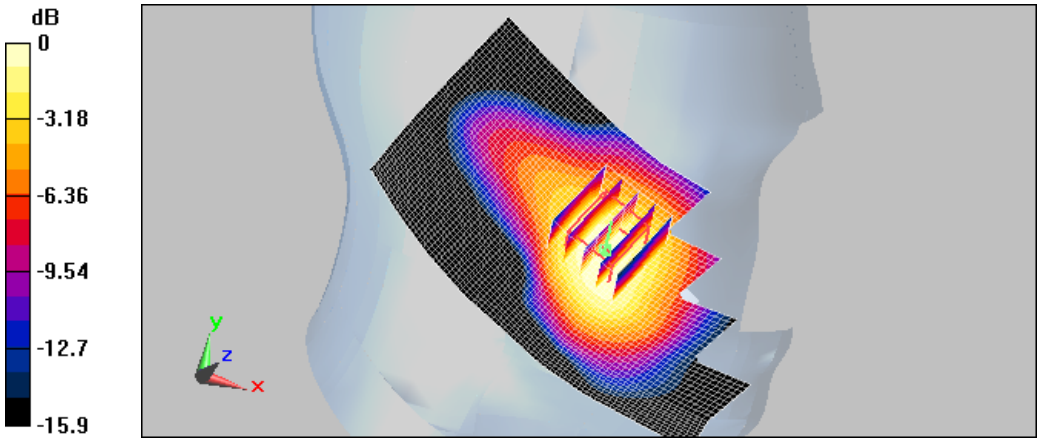
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GSM1900 Left (Job No. : FJ-186)**
**Procedure Name: Cheek, Ch.661, Ant.Intenna, Bat.Standard**
**Meas. Ambient Temp(celsius)-22.5,Tissue Temp(celsius)-22.1;Test Date-16/Jul/2012**

**Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3**
**Medium parameters used: f = 1880 MHz; $\sigma$ = 1.36 mho/m; $\varepsilon_r$ = 39.8; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(7.11, 7.11, 7.11); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #3; Type: SAM; Serial: TP-1425**
**- 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) = 0.363 mW/g

**Cheek, Ch.661, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.2 V/m; Power Drift = -0.058 dB
Peak SAR (extrapolated) = 0.488 W/kg
**SAR(1 g) = 0.342 mW/g; SAR(10 g) = 0.216 mW/g**
Maximum value of SAR (measured) = 0.385 mW/g




0 dB = 0.385mW/g

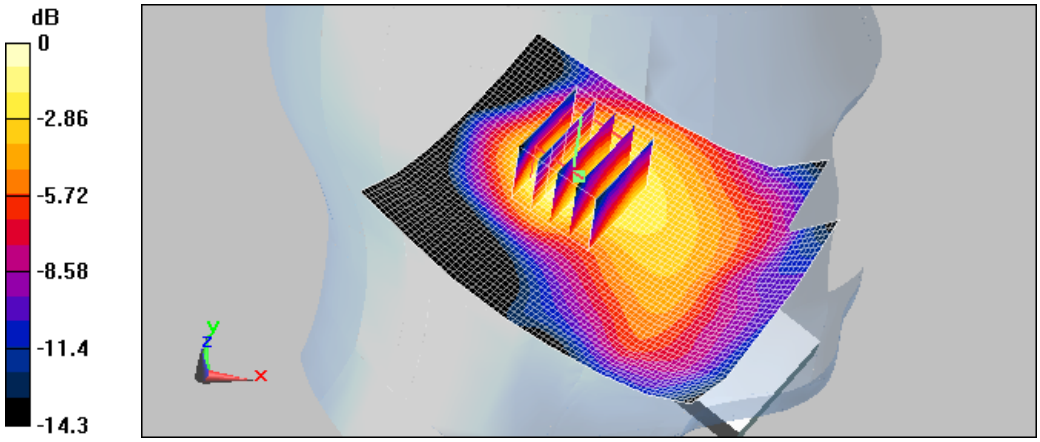
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GSM1900 Left (Job No. : FJ-186)**
**Procedure Name: Tilt, Ch.661, Ant.Intenna, Bat.Standard**
**Meas. Ambient Temp(celsius)-22.5,Tissue Temp(celsius)-22.1;Test Date-16/Jul/2012**

**Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3**
**Medium parameters used: f = 1880 MHz; $\sigma$ = 1.36 mho/m; $\varepsilon_r$ = 39.8; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Left Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(7.11, 7.11, 7.11); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #3; Type: SAM; Serial: TP-1425**
**- 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) = 0.087 mW/g

**Tilt, Ch.661, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.96 V/m; Power Drift = 0.100 dB
Peak SAR (extrapolated) = 0.106 W/kg
**SAR(1 g) = 0.072 mW/g; SAR(10 g) = 0.046 mW/g**
Maximum value of SAR (measured) = 0.084 mW/g




0 dB = 0.084mW/g

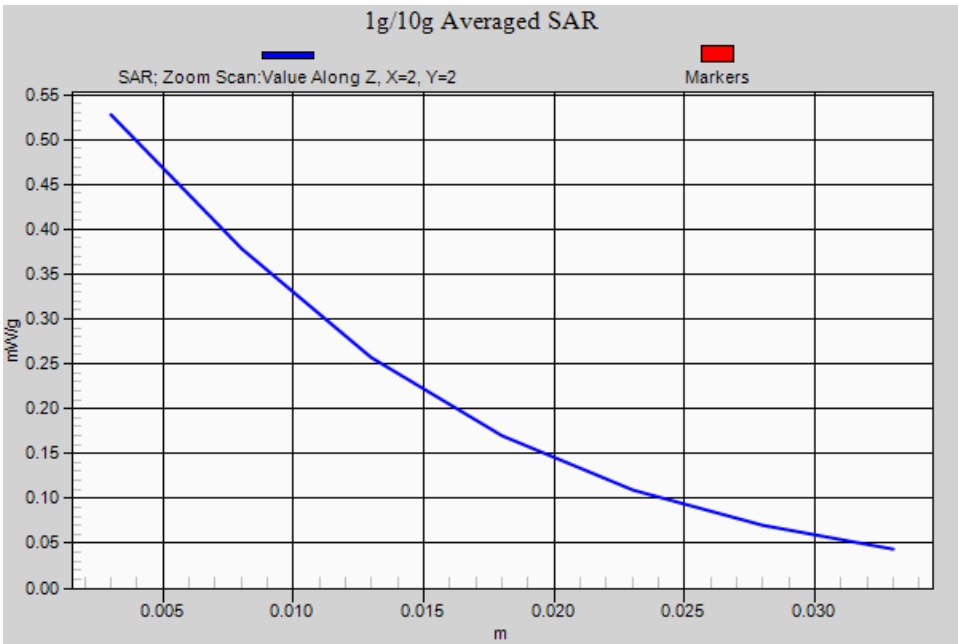
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GSM1900 Right (Job No. : FJ-186)**
**Procedure Name: Cheek, Ch.661, Ant.Intenna, Bat.Standard**
**Meas. Ambient Temp(celsius)-22.5,Tissue Temp(celsius)-22.1;Test Date-16/Jul/2012**

**Communication System: GSM 1900; Frequency: 1880 MHz;Duty Cycle: 1:8.3**
**Medium parameters used: f = 1880 MHz; $\sigma$ = 1.36 mho/m; $\varepsilon_r$ = 39.8; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(7.11, 7.11, 7.11); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- Phantom: SAM PHANTOM #3; Type: SAM; Serial: TP-1425**
**- 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) = 0.532 mW/g

**Cheek, Ch.661, Ant.Intenna, Bat.Standard/Zoom Scan (5x5x7)/Cube 0:** Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 16.8 V/m; Power Drift = 0.138 dB
Peak SAR (extrapolated) = 0.669 W/kg
**SAR(1 g) = 0.456 mW/g; SAR(10 g) = 0.267 mW/g**
Maximum value of SAR (measured) = 0.527 mW/g



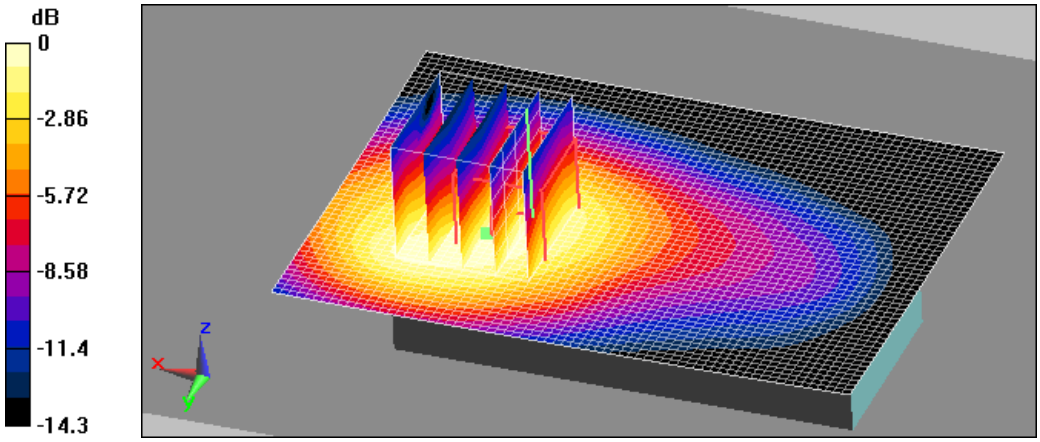
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS1900 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-16/Jul/2012**

**Communication System: Body GPRS ; Frequency: 1880 MHz;Duty Cycle: 1:4.15**
**Medium parameters used: f = 1880 MHz; $\sigma$ = 1.5 mho/m; $\varepsilon_r$ = 52.8; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(6.61, 6.61, 6.61); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.348 mW/g

**Body, Ch.661, Ant.Intenna, Bat.Standard, 2Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 9.45 V/m; Power Drift = 0.097 dB
Peak SAR (extrapolated) = 0.467 W/kg
**SAR(1 g) = 0.307 mW/g; SAR(10 g) = 0.188 mW/g**
Maximum value of SAR (measured) = 0.354 mW/g




0 dB = 0.354mW/g

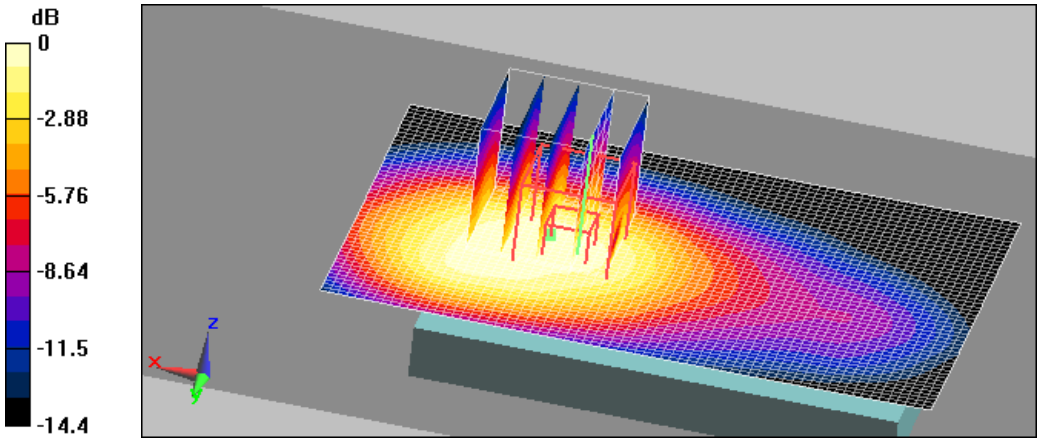
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS1900 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.661, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-16/Jul/2012**

**Communication System: Body GPRS ; Frequency: 1880 MHz;Duty Cycle: 1:2.767**
**Medium parameters used: f = 1880 MHz; $\sigma$ = 1.5 mho/m; $\varepsilon_r$ = 52.8; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(6.61, 6.61, 6.61); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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, 3Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.341 mW/g

**Body, Ch.661, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.3 V/m; Power Drift = -0.132 dB
Peak SAR (extrapolated) = 1.09 W/kg
**SAR(1 g) = 0.313 mW/g; SAR(10 g) = 0.187 mW/g**
Maximum value of SAR (measured) = 0.351 mW/g




0 dB = 0.351mW/g

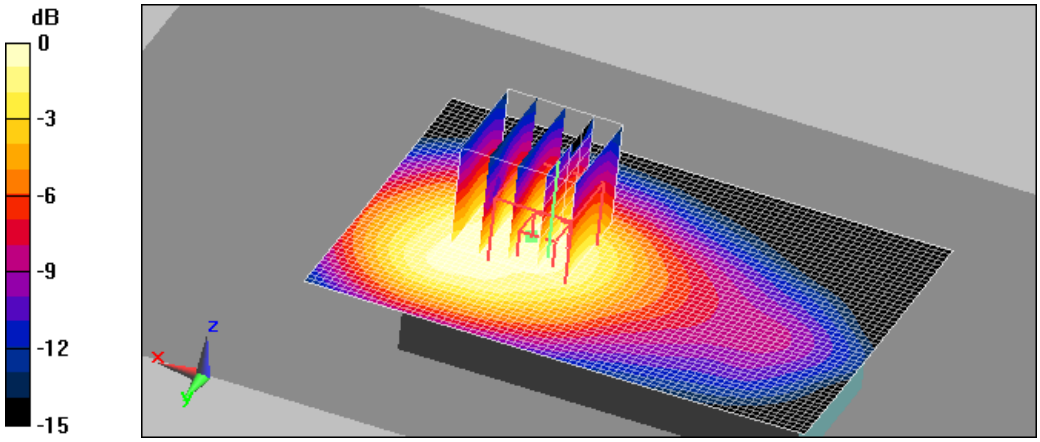
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS1900 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.661, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-16/Jul/2012**

**Communication System: Body GPRS ; Frequency: 1880 MHz;Duty Cycle: 1:2.075**
**Medium parameters used: f = 1880 MHz; $\sigma$ = 1.5 mho/m; $\varepsilon_r$ = 52.8; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(6.61, 6.61, 6.61); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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, 4Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.344 mW/g

**Body, Ch.661, Ant.Intenna, Bat.Standard, 4Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.3 V/m; Power Drift = -0.136 dB
Peak SAR (extrapolated) = 0.475 W/kg
**SAR(1 g) = 0.311 mW/g; SAR(10 g) = 0.190 mW/g**
Maximum value of SAR (measured) = 0.358 mW/g




0 dB = 0.358mW/g

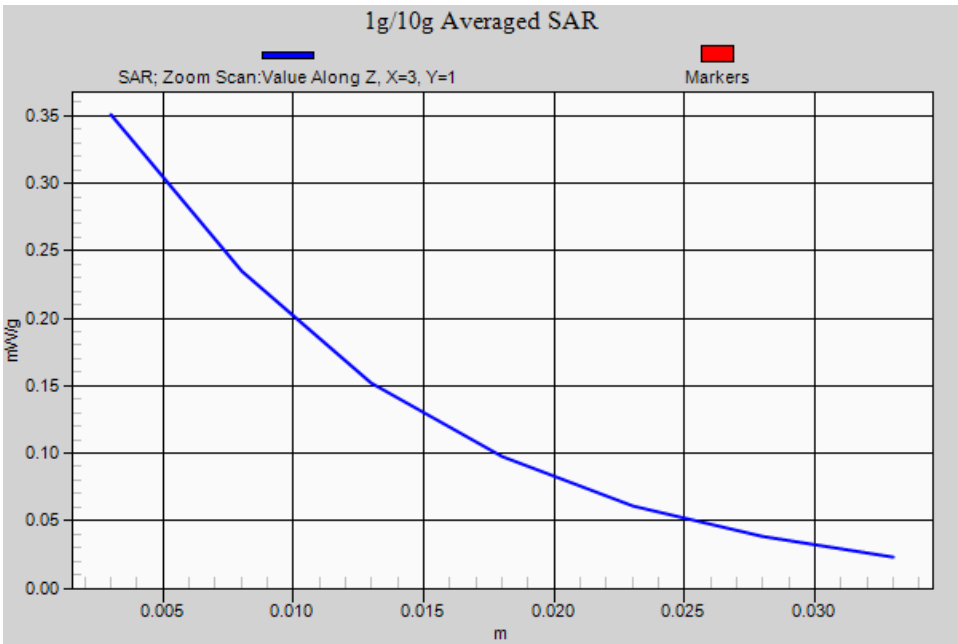
**DUT: GT-E3309; Serial: FJ-186-C**
**Program Name: GT-E3309 GPRS1900 Body (Job No. : FJ-186)**
**Procedure Name: Body, Ch.661, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm**
**Meas. Ambient Temp(celsius)-22.6,Tissue Temp(celsius)-22.3;Test Date-16/Jul/2012**

**Communication System: Body GPRS ; Frequency: 1880 MHz;Duty Cycle: 1:2.767**
**Medium parameters used: f = 1880 MHz; $\sigma$ = 1.5 mho/m; $\varepsilon_r$ = 52.8; $\rho$ = 1000 kg/m$^3$**
**Phantom section: Right Section**

**DASY5 Configuration:**
**- Probe: EX3DV4 - SN3537; ConvF(6.61, 6.61, 6.61); Calibrated: 2012-05-23**
**- Sensor-Surface: 3mm (Mechanical Surface Detection)**
**- Electronics: DAE4 Sn468; Calibrated: 2012-05-16**
**- 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, 3Tx, Back, 15mm/Area Scan (51x71x1):**
Measurement grid: dx=20mm, dy=20mm
Maximum value of SAR (interpolated) = 0.341 mW/g

**Body, Ch.661, Ant.Intenna, Bat.Standard, 3Tx, Back, 15mm/Zoom Scan (5x5x7)/Cube 0:**
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.3 V/m; Power Drift = -0.132 dB
Peak SAR (extrapolated) = 1.09 W/kg
**SAR(1 g) = 0.313 mW/g; SAR(10 g) = 0.187 mW/g**
Maximum value of SAR (measured) = 0.351 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: EX3-3537_May12**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:3537 |
| Calibration procedure(s) | QA CAL-01.v8, QA CAL-14.v3, QA CAL-23.v4, QA CAL-25.v4<br>Calibration procedure for dosimetric E-field probes |
| Calibration date: | May 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 E4419B | GB41293874 | 29-Mar-12 (No. 217-01508) | Apr-13 |
| Power sensor E4412A | MY41498087 | 29-Mar-12 (No. 217-01508) | Apr-13 |
| Reference 3 dB Attenuator | SN: S5054 (3c) | 27-Mar-12 (No. 217-01531) | Apr-13 |
| Reference 20 dB Attenuator | SN: S5086 (20b) | 27-Mar-12 (No. 217-01529) | Apr-13 |
| Reference 30 dB Attenuator | SN: S5129 (30b) | 27-Mar-12 (No. 217-01532) | Apr-13 |
| Reference Probe ES3DV2 | SN: 3013 | 29-Dec-11 (No. ES3-3013_Dec11) | Dec-12 |
| DAE4 | SN: 660 | 10-Jan-12 (No. DAE4-660_Jan12) | Jan-13 |
| | | | |
| 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: | Claudio Leubler | Laboratory Technician | |
| Approved by: | Katja Pokovic | Technical Manager | |

Issued: May 24, 2012

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

 O.K to use 2012.6.26

## 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 ϑ = 0 (f ≤ 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 ≤ 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 EX3DV4

## SN:3537

Manufactured: February 18, 2011
Calibrated: May 23, 2012

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

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3537

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm ($\mu V/(V/m)^2$)[A] | 0.54 | 0.55 | 0.52 | ± 10.1 % |
| DCP (mV)[B] | 99.8 | 86.9 | 98.0 | |

## Modulation Calibration Parameters

| UID | Communication System Name | PAR | | A dB | B dB | C dB | VR mV | Unc[E] (k=2) |
|---|---|---|---|---|---|---|---|---|
| 0 | CW | 0.00 | X | 0.00 | 0.00 | 1.00 | 126.9 | ±3.0 % |
| | | | Y | 0.00 | 0.00 | 1.00 | 117.9 | |
| | | | Z | 0.00 | 0.00 | 1.00 | 117.2 | |

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: EX3DV4 - SN:3537

## 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) |
|---|---|---|---|---|---|---|---|---|
| 850 | 41.5 | 0.92 | 8.09 | 8.09 | 8.09 | 0.37 | 0.87 | ± 12.0 % |
| 1750 | 40.1 | 1.37 | 7.27 | 7.27 | 7.27 | 0.10 | 2.99 | ± 12.0 % |
| 1900 | 40.0 | 1.40 | 7.11 | 7.11 | 7.11 | 0.15 | 1.40 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 6.31 | 6.31 | 6.31 | 0.63 | 0.67 | ± 12.0 % |
| 5200 | 36.0 | 4.66 | 4.66 | 4.66 | 4.66 | 0.40 | 1.80 | ± 13.1 % |
| 5300 | 35.9 | 4.76 | 4.35 | 4.35 | 4.35 | 0.40 | 1.80 | ± 13.1 % |
| 5500 | 35.6 | 4.96 | 4.27 | 4.27 | 4.27 | 0.40 | 1.80 | ± 13.1 % |
| 5600 | 35.5 | 5.07 | 4.09 | 4.09 | 4.09 | 0.40 | 1.80 | ± 13.1 % |
| 5800 | 35.3 | 5.27 | 4.06 | 4.06 | 4.06 | 0.45 | 1.80 | ± 13.1 % |

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

# DASY/EASY - Parameters of Probe: EX3DV4 - SN:3537

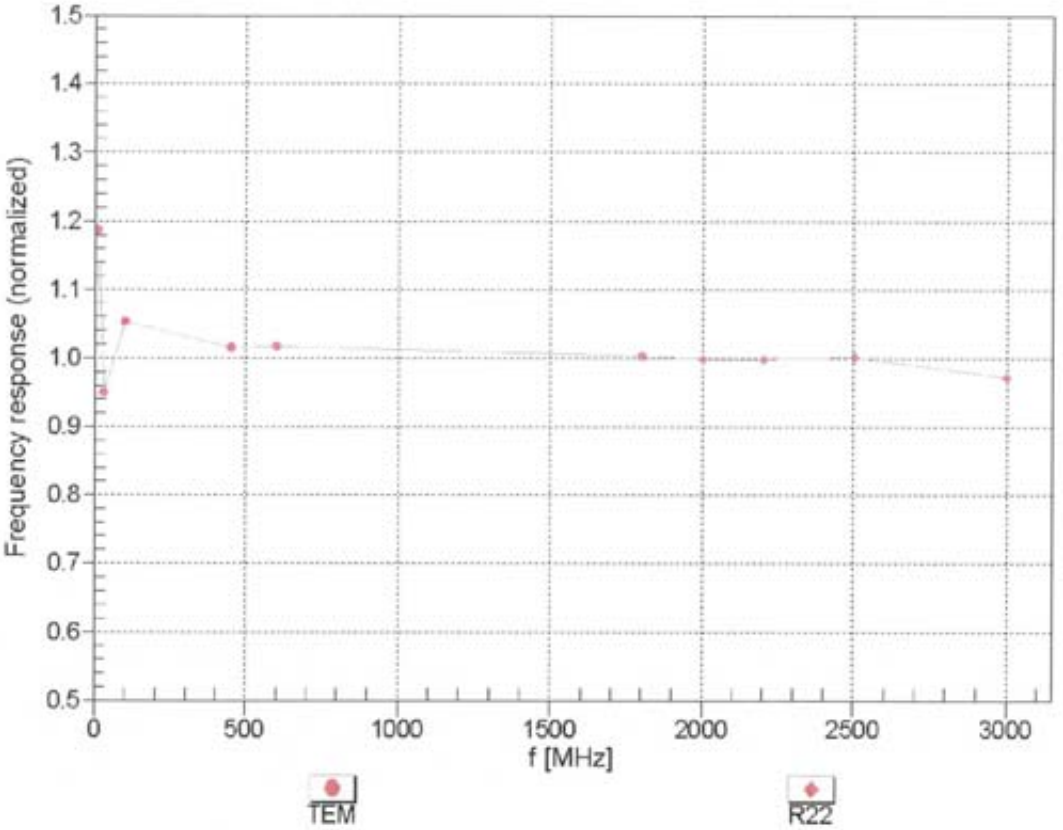
## Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 850 | 55.2 | 0.99 | 8.05 | 8.05 | 8.05 | 0.32 | 1.02 | ± 12.0 % |
| 1750 | 53.4 | 1.49 | 7.17 | 7.17 | 7.17 | 0.10 | 2.99 | ± 12.0 % |
| 1900 | 53.3 | 1.52 | 6.61 | 6.61 | 6.61 | 0.20 | 1.80 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 6.18 | 6.18 | 6.18 | 0.80 | 0.50 | ± 12.0 % |
| 5200 | 49.0 | 5.30 | 3.95 | 3.95 | 3.95 | 0.50 | 1.90 | ± 13.1 % |
| 5300 | 48.9 | 5.42 | 3.79 | 3.79 | 3.79 | 0.50 | 1.90 | ± 13.1 % |
| 5500 | 48.6 | 5.65 | 3.57 | 3.57 | 3.57 | 0.50 | 1.90 | ± 13.1 % |
| 5600 | 48.5 | 5.77 | 3.34 | 3.34 | 3.34 | 0.55 | 1.90 | ± 13.1 % |
| 5800 | 48.2 | 6.00 | 3.69 | 3.69 | 3.69 | 0.55 | 1.90 | ± 13.1 % |

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

# Frequency Response of E-Field

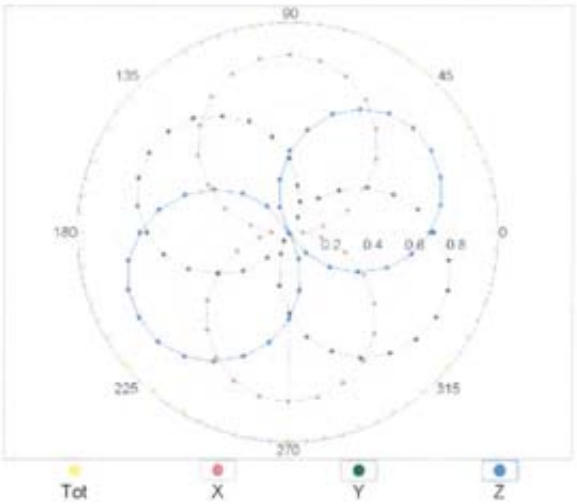
**(TEM-Cell:ifi110 EXX, Waveguide: R22)**



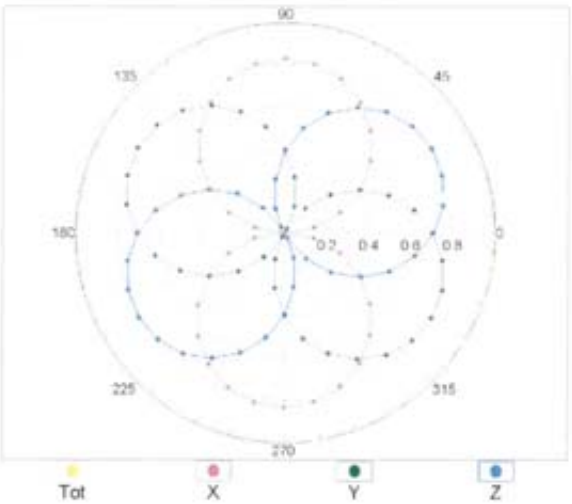

**Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)**

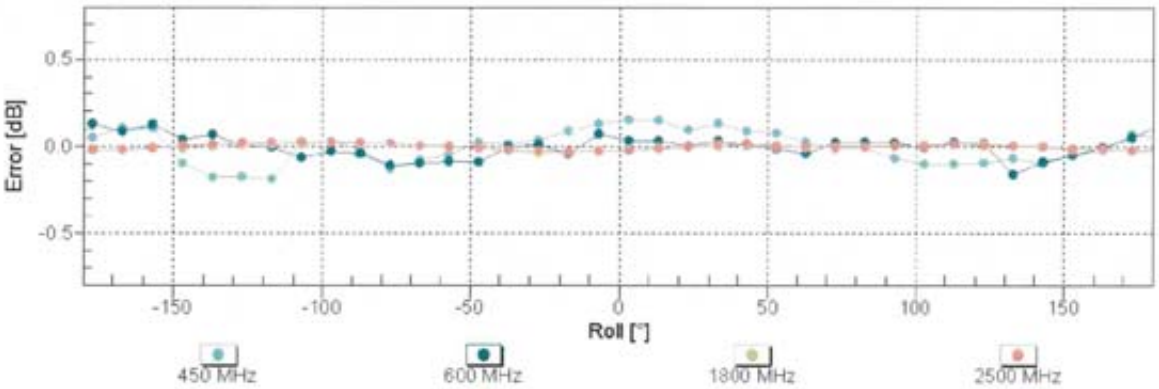
# Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



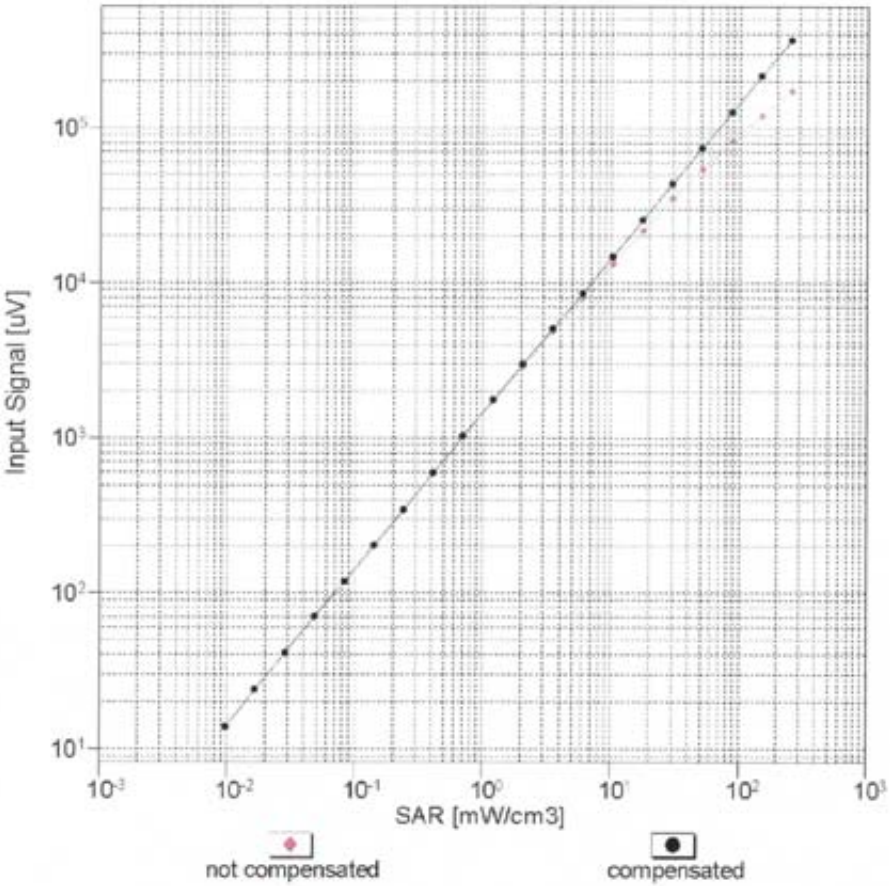

f=1800 MHz,R22

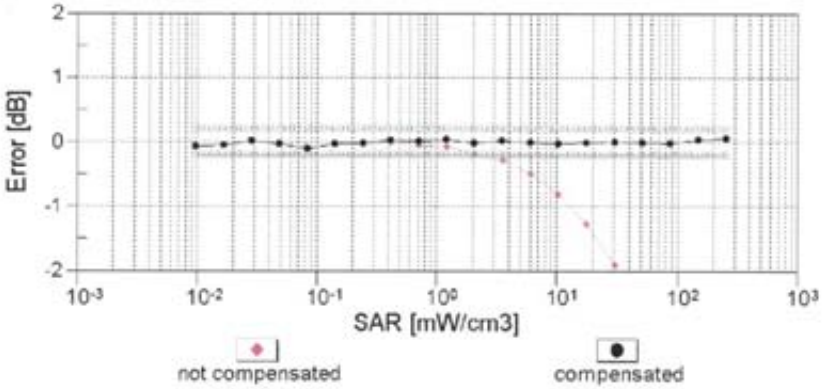



**Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)**

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

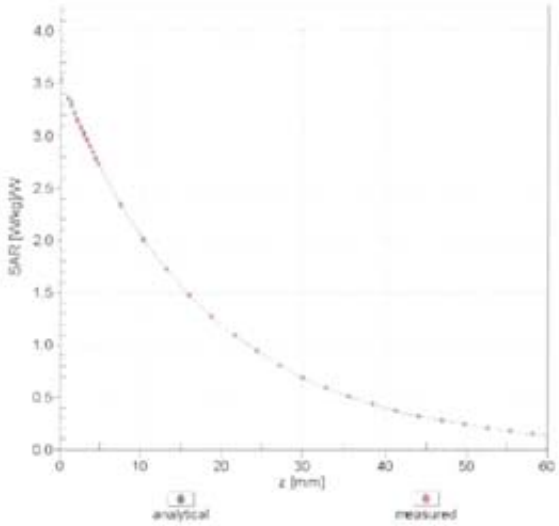


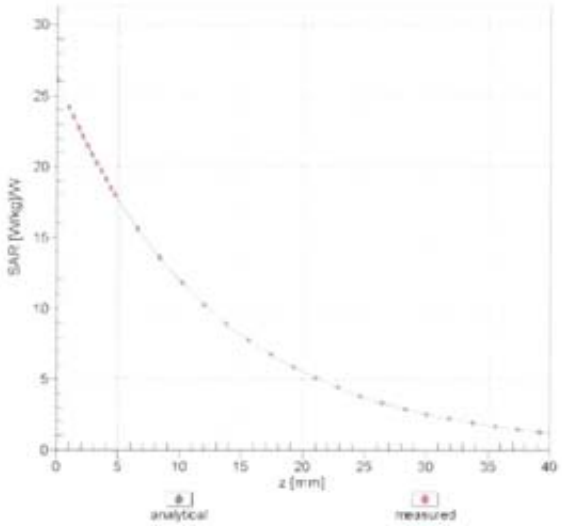

**Uncertainty of Linearity Assessment: ± 0.6% (k=2)**

# Conversion Factor Assessment

f = 850 MHz,WGLS R9 (H_convF)

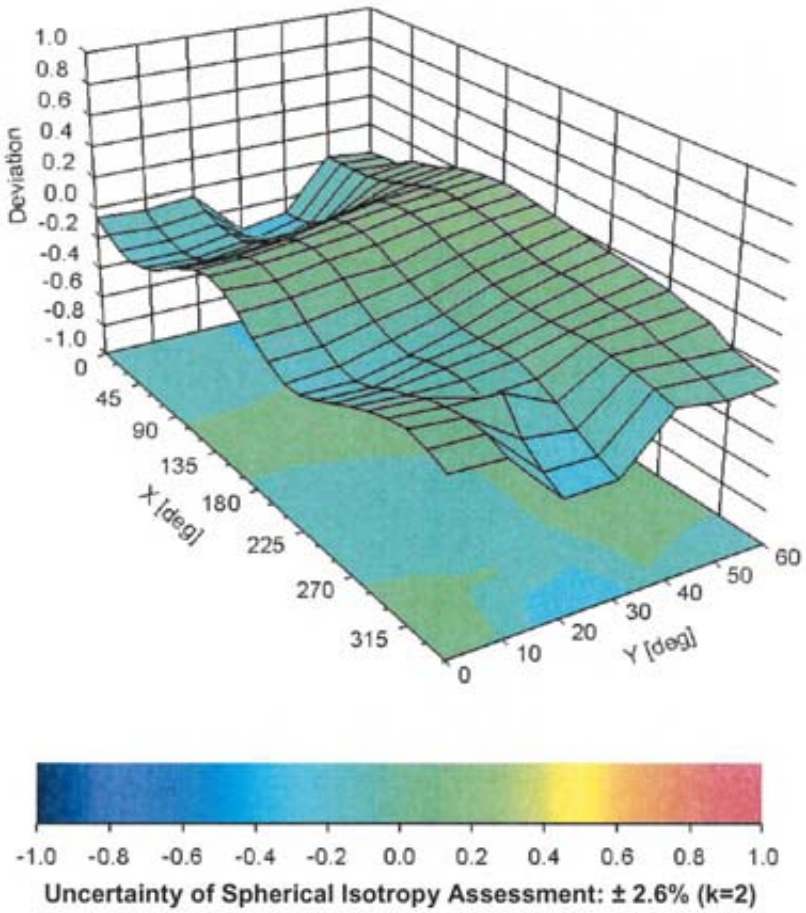



f = 1750 MHz,WGLS R22 (H_convF)




# 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: EX3DV4 - SN:3537

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 132.9 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disabled |
| Probe Overall Length | 337 mm |
| Probe Body Diameter | 10 mm |
| Tip Length | 9 mm |
| Tip Diameter | 2.5 mm |
| Probe Tip to Sensor X Calibration Point | 1 mm |
| Probe Tip to Sensor Y Calibration Point | 1 mm |
| Probe Tip to Sensor Z Calibration Point | 1 mm |
| Recommended Measurement Distance from Surface | 2 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: D835V2-4d111_Nov11**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D835V2 - SN: 4d111 |
| Calibration procedure(s) | QA CAL-05.v8<br>Calibration procedure for dipole validation kits above 700 MHz |
| Calibration date: | November 18, 2011 |

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 | 29-Apr-11 (No. ES3-3205_Apr11) | Apr-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: November 18, 2011

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



O.k to use
2011.11.21

## 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 | V52.6.2 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Modular Flat Phantom | |
| **Distance Dipole Center - TSL** | 15 mm | with Spacer |
| **Zoom Scan Resolution** | dx, dy, dz = 5 mm | |
| **Frequency** | 835 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | **Temperature** | **Permittivity** | **Conductivity** |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 41.5 | 0.90 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 41.4 ± 6 % | 0.90 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 | 2.36 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **9.43 mW /g ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.55 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **6.20 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 | 55.2 | 0.97 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 53.3 ± 6 % | 0.99 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 | 2.44 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **9.54 mW / g ± 17.0 % (k=2)** |

| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | condition | |
|---|---|---|
| SAR measured | 250 mW input power | 1.60 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **6.29 mW / g ± 16.5 % (k=2)** |

## Appendix

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 52.2 Ω - 3.1 jΩ |
| Return Loss | - 28.6 dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 48.1 Ω - 4.7 jΩ |
| Return Loss | - 25.6 dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.399 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.
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 | May 26, 2010 |

## DASY5 Validation Report for Head TSL

Date: 18.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d111**

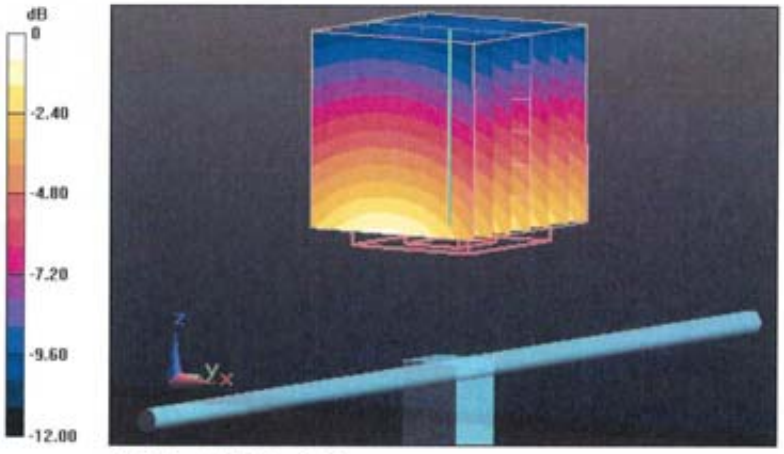
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 0.9 mho/m; $\varepsilon_r$ = 41.4; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.07, 6.07, 6.07); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

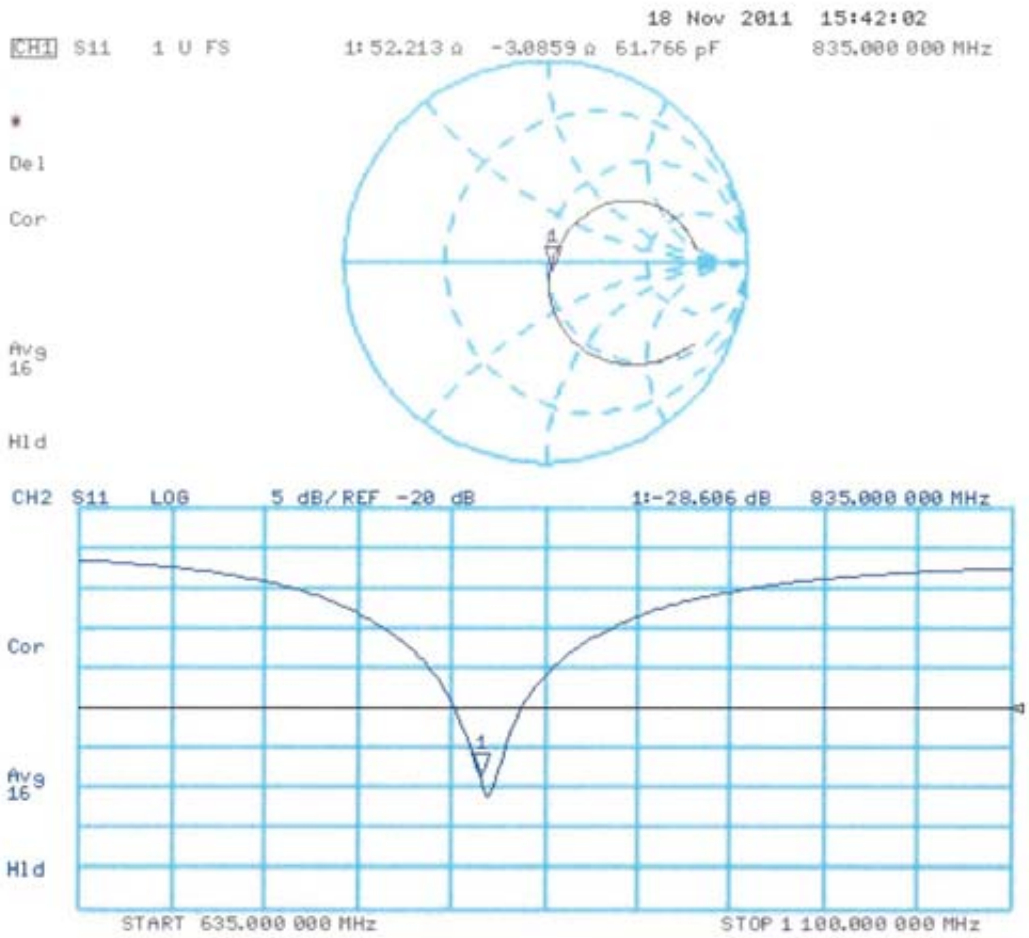
### Dipole Calibration for Head Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 57.200 V/m; Power Drift = 0.0057 dB
Peak SAR (extrapolated) = 3.474 W/kg
**SAR(1 g) = 2.36 mW/g; SAR(10 g) = 1.55 mW/g**
Maximum value of SAR (measured) = 2.755 mW/g




0 dB = 2.760mW/g

## Impedance Measurement Plot for Head TSL



## DASY5 Validation Report for Body TSL

Date: 18.11.2011

Test Laboratory: SPEAG, Zurich, Switzerland

**DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d111**

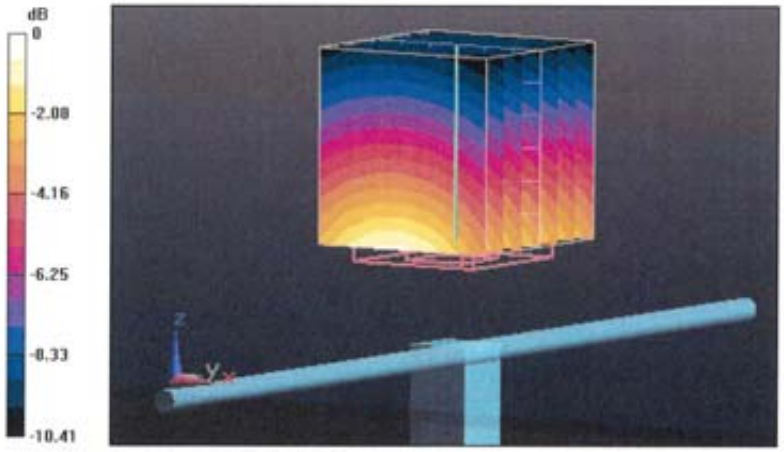
Communication System: CW; Frequency: 835 MHz
Medium parameters used: f = 835 MHz; $\sigma$ = 0.99 mho/m; $\varepsilon_r$ = 53.3; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.02, 6.02, 6.02); Calibrated: 29.04.2011
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 04.07.2011
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.6.2(482); SEMCAD X 14.4.5(3634)

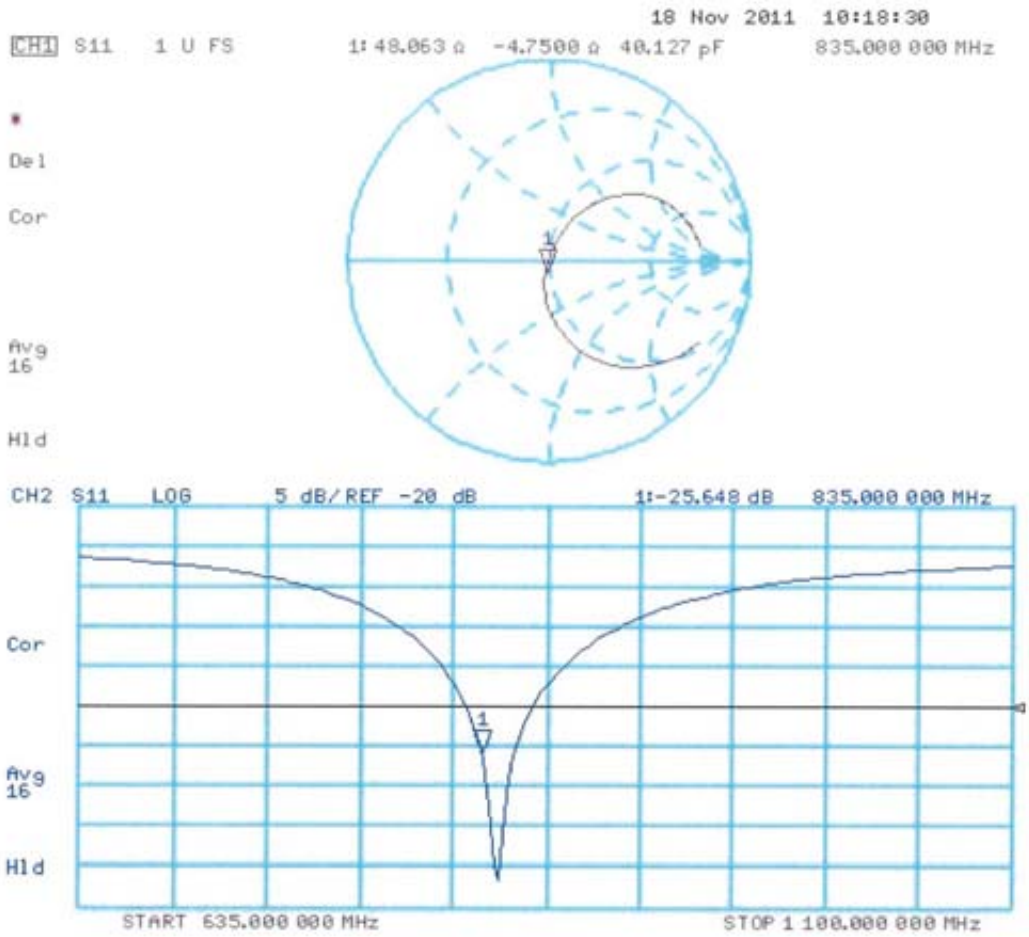
### Dipole Calibration for Body Tissue/Pin=250 mW, d=15mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.351 V/m; Power Drift = 0.009 dB
Peak SAR (extrapolated) = 3.538 W/kg
**SAR(1 g) = 2.44 mW/g; SAR(10 g) = 1.6 mW/g**
Maximum value of SAR (measured) = 2.821 mW/g




0 dB = 2.820mW/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: D1900V2-5d023_Jan12**

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1900V2 - SN: 5d023 |
| Calibration procedure(s) | QA CAL-05.v8<br>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**

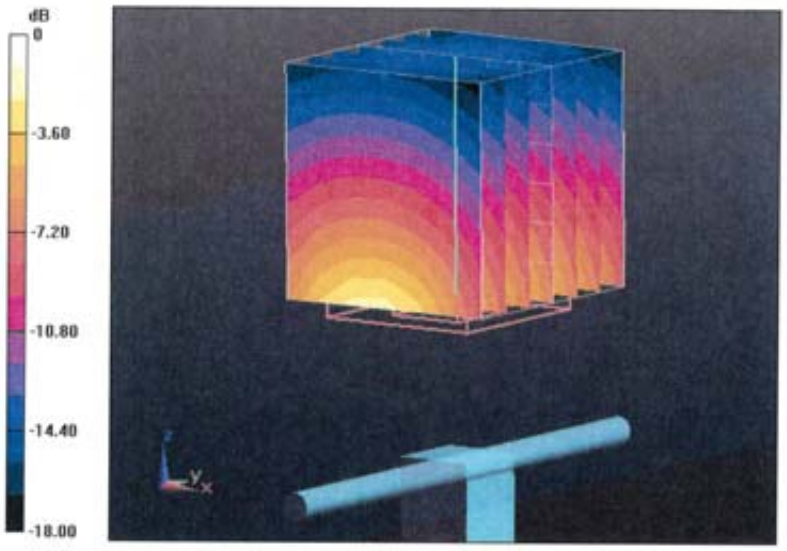
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.39 mho/m; $\varepsilon_r$ = 40.8; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

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)

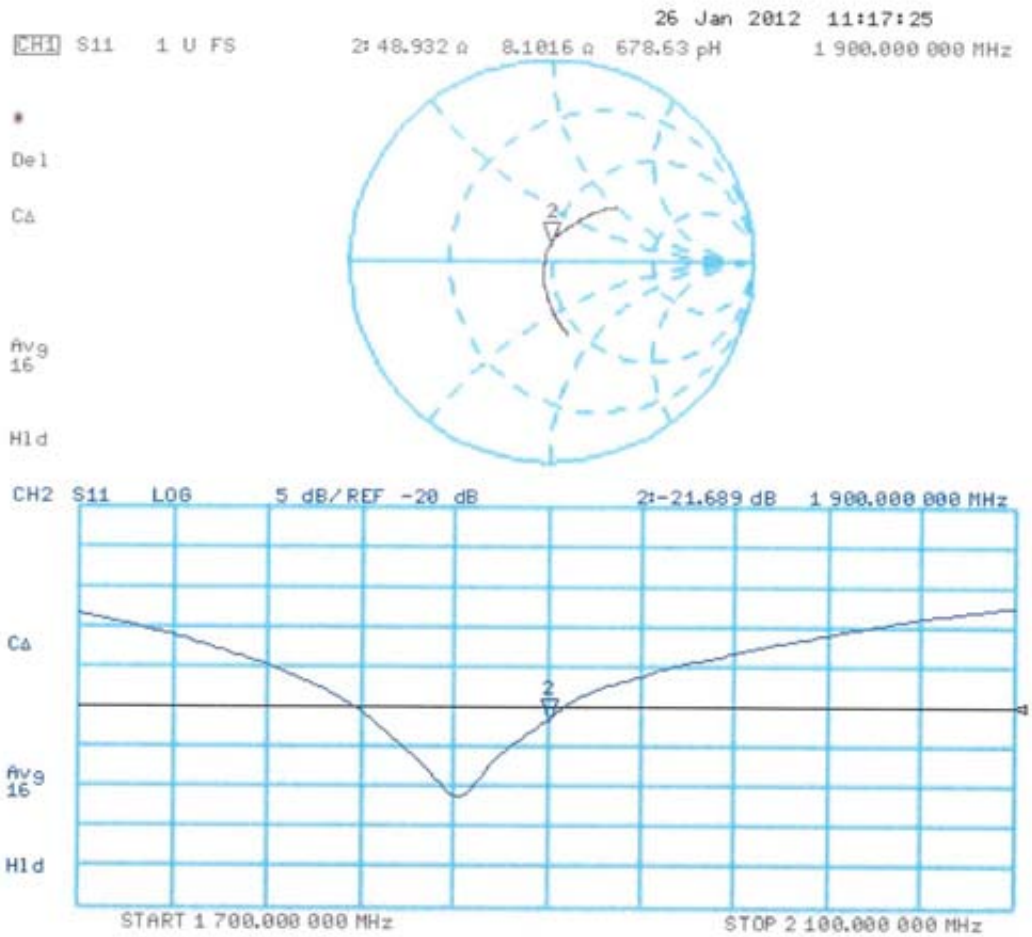
## Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

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**

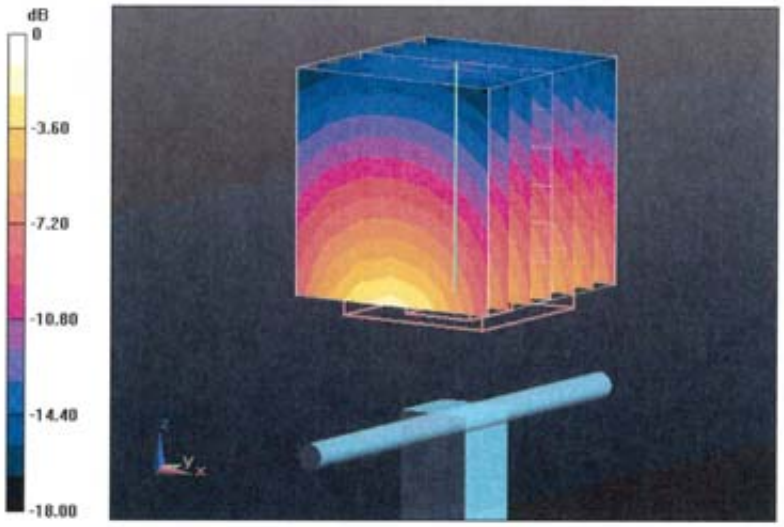
Communication System: CW; Frequency: 1900 MHz
Medium parameters used: f = 1900 MHz; $\sigma$ = 1.52 mho/m; $\varepsilon_r$ = 52.9; $\rho$ = 1000 kg/m$^3$
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

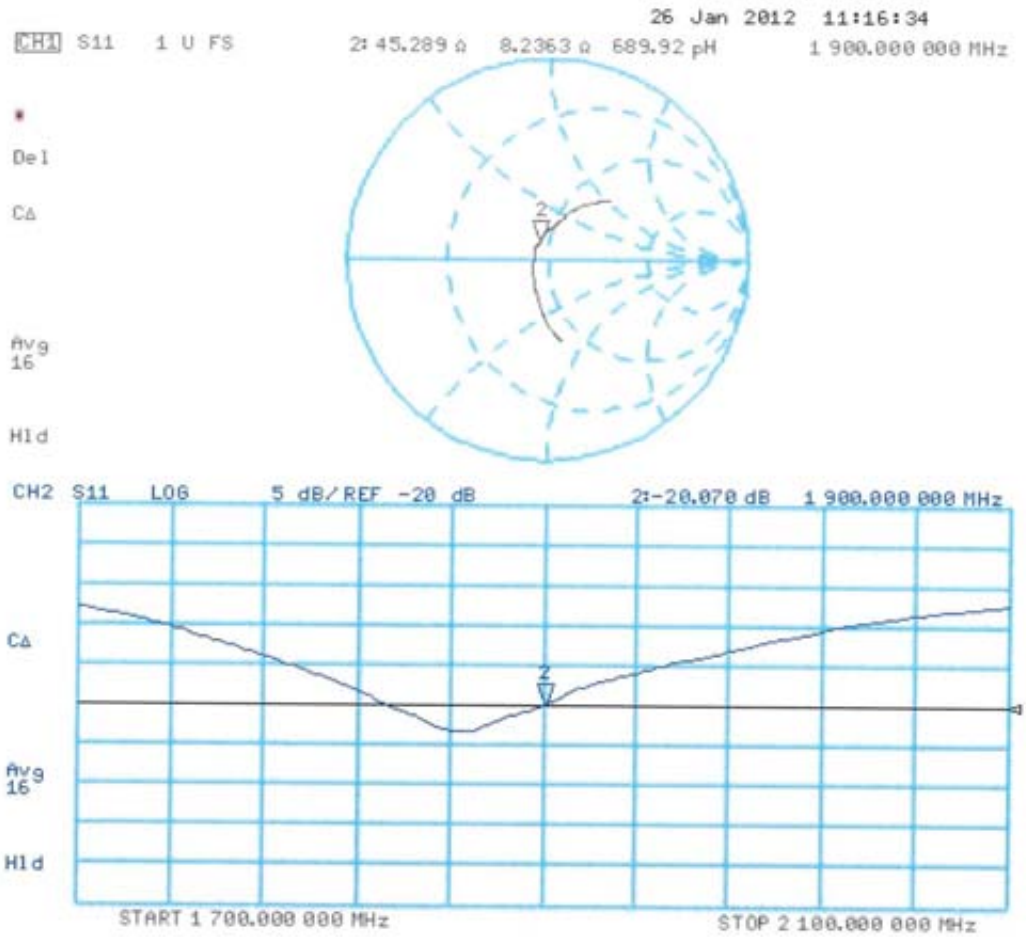
DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.62, 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