Certificate #3682.01

# TEST REPORT

## No. I19D00066-SAR01

***For***

**Client:** Doro AB

**Production:** 2G Clamshell Feature Phone

**Model Name:** DFC-0250

**Brand Name:** Doro

**FCC ID:** WS5DFC0250

**Hardware Version:** V01(HW code:3021/3051)

**Software Version** DFC0250_0240_UF290_N_S01A_V01_M190505_SMP

**Issued date:** 2019-08-22

# NOTE

1. The test results in this test report relate only to the devices specified in this report.
2. This report shall not be reproduced except in full without the written approval of East China Institute of Telecommunications.
3. KDB has not been approved by A2LA.
4. For the test results, the uncertainty of measurement is not taken into account when judging the compliance with specification, and the results of measurement or the average value of measurement results are taken as the criterion of the compliance with specification directly.

**Test Laboratory:**
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## Revision Version

| Report Number | Revision | Date | Memo |
|---|---|---|---|
| I19D00066-SAR01 | 00 | 2019-08-22 | Initial creation of test report |

# CONTENTS

# 1. Test Laboratory

## 1.1. Testing Location

| | |
|---|---|
| Company Name | East China Institute of Telecommunications |
| Address | 7-8/F., Area G, No.668, Beijing East Road, Shanghai, China |
| Postal Code | 200001 |
| Telephone | +86 21 63843300 |
| Fax | +86 21 63843301 |

## 1.2. Testing Environment

| | |
|---|---|
| Normal Temperature | 18℃-25℃ |
| Relative Humidity | 25%-75% |

## 1.3. Project Data

| | |
|---|---|
| Project Leader | Xu Yuting |
| Testing Start Date | 2019-07-24 |
| Testing End Date | 2019-08-02 |

## 1.4. Signature

**Yan Hang**
**(Prepared this test report)**

**Fu Erliang**
**(Reviewed this test report)**

**Zheng Zhongbin**
**(Approved this test report)**

## 2. Statement of Compliance

The **DFC-0250** manufactured by Doro AB is a parent model for testing

The maximum results of Specific Absorption Rate (SAR) found during testing for **DFC-0250** are as follows

**Table 2.1: Max. Reported SAR**

| Band | Reported SAR 1g(W/Kg) | |
|---|---|---|
| | Position | |
| | Head | Body(15mm) |
| GSM 1900 | 0.349 | 1.097 |

The SAR values found for the Mobile Phone are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1g tissue according to the ANSI C95.1-1999.

For body worn operation, this device has been tested and meets FCC RF exposure guidelines when used with any accessory that contains no metal. Use of other accessories may not ensure compliance with FCC RF exposure guidelines.

**Table 2.2: Simultaneous SAR**

| Highest Simultaneous Transmission SAR | Highest SAR 1g Body(15mm) (W/Kg) |
|---|---|
| | 1.196 |

# 3. Client Information

## 3.1. Applicant Information

| | |
|---|---|
| Company Name | Doro AB |
| Address | Doro AB, Jörgen Kocksgatan 1B, SE 211 20 MALMÖ, SWEDEN |
| Telephone | +46 46 280 50 76 |
| Postcode | N/A |

## 3.2. Manufacturer Information

| | |
|---|---|
| Company Name | Doro AB |
| Address | Doro AB, Jörgen Kocksgatan 1B, SE 211 20 MALMÖ, SWEDEN |
| Telephone | +46 46 280 50 76 |
| Postcode | N/A |

# 4. Equipment Under Test (EUT) and Ancillary Equipment (AE)

## 4.1. About EUT

| | |
|---|---|
| Description: | 2G Clamshell Feature Phone |
| Model name: | DFC-0250 |
| GSM Frequency Band: | GSM1900 |
| UMTS Frequency Band: | N/A |
| LTE Frequency Band: | N/A |
| Additional Communication Function: | BT3.0 |
| Tx Frequency: | 1850.2-1909.8MHz (GSM)<br>2402 – 2480 MHz (BT) |
| Test device Production information: | Production unit |
| GPRS Class Mode: | B |
| GPRS Multislot Class: | 12 |
| EDGE Multislot Class: | N/A |
| Device type: | Portable device |
| Antenna type: | Inner antenna |
| Accessories/Body-worn configurations: | N/A |
| Hotspot mode: | N/A |
| Dimensions: | 105*55*20mm |

## 4.2. Internal Identification of EUT used during the test

| EUT ID* | SN or IMEI | HW Version | SW Version | Date of receipt |
|---|---|---|---|---|
| N08 | 357508100008227<br>357508100008235 | V01(HW code:3021/3051) | DFC0250_0240_UF290_N_S01A_V01_M190505_SMP | 2019-05-17 |
| N11 | 357508100010994<br>357508100010892 | V01(HW code:3021/3051) | DFC0250_0240_UF290_N_S01A_V01_M190505_SMP | 2019-07-31 |

*EUT ID: is used to identify the test sample in the lab internally.

Note:The product has two SIM, SIM 1 and SIM 2 sharing a chipset does not support simultaneous work, only supports a single transmitter SIM1 or SIM 2, using SIM 1, SIM 2 will be suspended until select SIM 2, stop using the SIM 1, SIM 2 only would working. SIM1 is the worst case.

The N08 is a primary supply and the N11 is a secondary supply

## 4.3. Internal Identification of AE used during the test

| AE ID* | Description | Type | Manufacturer |
|---|---|---|---|
| BA10 | Battery | N/A | NINGBO VEKEN BATTERY CO., LTD |
| BA09 | Battery | N/A | NINGBO VEKEN BATTERY CO., LTD |

*AE ID: is used to identify the test sample in the lab internally.

## 4.4. Difference Between Main supply and Secondary supply

| Item | Configure 1 | Configure 2 |
|---|---|---|
| HW code | 3021 | 3051 |
| LCD | LCD SANLONG(28LS124-04) | LCD Holitech(QTB2D8096) |
| FLASH | Flash GD(GD25LQ128) | Flash DOS(FM25M4AA) |
| Note: Customer declaration, two configures is the same, except for LCD and FLASH. There are more than one Configure, each one should be applied throughout the compliance test respectively, however, only the worst case (Configure 1) will be recorded in this report. | | |

Main Supply

| Part Name | Model Name | supplier | Remark |
|---|---|---|---|
| ZIF connector | FP270H-025T1DM | JXT | / |
| Earphone jack | 11-0561136-A | LETCON | / |
| Memory card socket | T11-BB09F150 | HRD | / |
| Micro USB | U11-1B05G252 | HRD | / |
| Battery connector | BAC5540306 | VELA | / |

Secondary Supply

| Part Name | Model Name | supplier | Remark |
|---|---|---|---|
| ZIF connector | 4.001A0-025-1R0 | HAIWEISI | / |
| Earphone jack | PH20-0A38F38M<br>JAF00-05382-010101 | HRD<br>LCN | / |
| Micro USB | UBM9250516<br>UAF95-05254-S135-A | VELA<br>LCN | / |
| Memory card socket | TFJ1150903 | VELA | / |
| Battery connector | B29-BB03F540<br>02-032116B | HRD<br>LETCON | / |

# 5. Reference Documents

## 5.1. Documents supplied by applicant

All technical documents are supplied by the client or manufacturer, which is the basis of testing.

## 5.2. Reference Documents for testing

The following documents listed in this section are referred for testing.

| Reference | Title | Version |
|---|---|---|
| **ANSI C95.1** | IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. | **1999** |
| **IEEE 1528** | Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques. | **2013** |
| **KDB648474** | Handset SAR | **D04 v01r03** |
| **KDB447498** | General RF Exposure Guidance | **D01 v06** |
| **KDB865664** | SAR Measurement 100 MHz to 6 GHz | **D01 v01r04** |
| **KDB865664** | RF Exposure Reporting | **D02 v01r02** |

# 6. Specific Absorption Rate (SAR)

## 6.1. Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out bye xperimental techniques or numerical modeling. The standard recommends limits for two tiers of gr oups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposu re limits are higher than the limits for general population/uncontrolled.

## 6.2. SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy ($dW$) absorbed by (dissipated in) an incremental mass ($dm$) contained in a volume element ($dv$) of a given density ($\rho$). The equation description is as below:

$$SAR = \frac{d}{dt}\left(\frac{dW}{dm}\right) = \frac{d}{dt}\left(\frac{dW}{\rho dv}\right)$$

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

SAR measurement can be either related to the temperature elevation in tissue by

$$SAR = c\left(\frac{\delta T}{\delta t}\right)$$

Where: C is the specific head capacity, $\delta T$ is the temperature rise and $\delta t$ is the exposure duration, or related to the electrical field in the tissue by

$$SAR = \frac{\sigma |E|^2}{\rho}$$

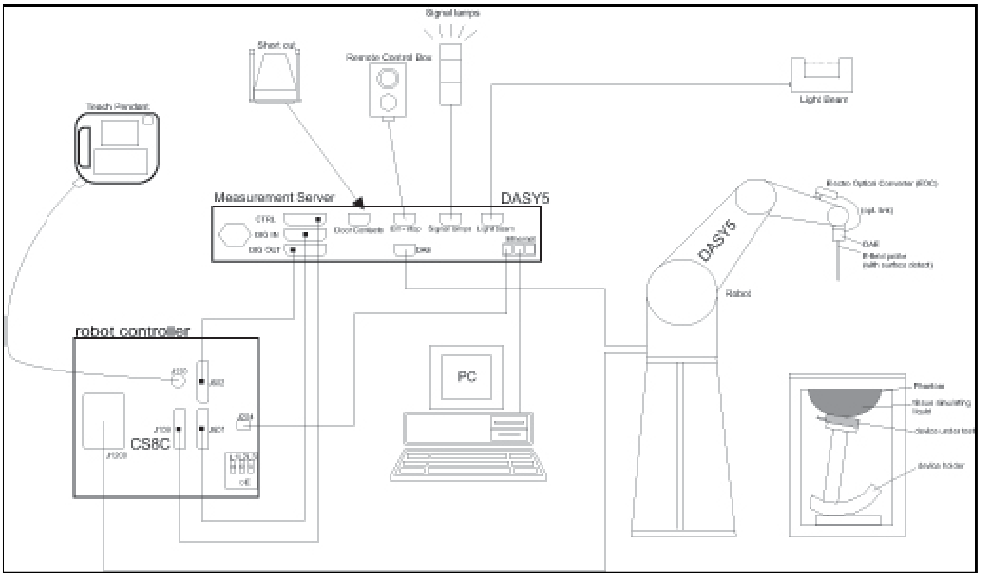
Where: $\sigma$ is the conductivity of the tissue, $\rho$ is the mass density of tissue and $E$ is the RMS electrical field strength.

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

# 7. SAR MEASUREMENT SETUP

## 7.1. Measurement Set-up

The DASY5 system for performing compliance tests is illustrated above graphically. This system consists of the following items:




**Picture 7-1 SAR Lab Test Measurement Set-up**

- A standard high precision 6-axis robot (Stäubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as
- warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

## 7.2. DASY5 E-field Probe System

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. 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 DASY5 software reads the reflection durning a software approach and looks for the maximum using 2$^{nd}$ ord curve fitting. The approach is stopped at reaching the maximum.

**Probe Specifications:**

| | |
|---|---|
| **Model:** | **ES3DV3,EX3DV4** |
| **Frequency Range:** | **10MHz — 6GHz(EX3DV4)** |
| | **10MHz — 4GHz(ES3DV3)** |
| **Calibration:** | **In head and body simulating tissue at** |
| | **Frequencies from 835 up to 5800MHz** |
| **Linearity:** | **± 0.2 dB(30 MHz to 4 GHz) for ES3DV3** |
| | **± 0.2 dB(30 MHz to 6 GHz) for EX3DV4** |
| **Dynamic Range:** | **10 mW/kg — 100W/kg** |
| **Probe Length:** | **330 mm** |
| **Probe Tip Length:** | **20 mm** |
| **Body Diameter:** | **12 mm** |
| **Tip Diameter:** | **2.5 mm (3.9 mm for ES3DV3)** |
| **Tip-Center:** | **1 mm (2.0mm for ES3DV3)** |
| **Application:** | **SAR Dosimetry Testing** |
| | **Compliance tests of mobile phones** |
| | **Dosimetry in strong gradient fields** |

**Picture7-2 Near-field Probe**

**Picture 7-3 E-field Probe**

## 7.3. E-field Probe Calibration

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm$^2$) using an RF Signal generator, TEM cell, and RF Power Meter.

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if thefrequency is below 1 GHz and inn a waveguide or other methodologies 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 until the three channels show the maximum reading. The power density readings equates to 1 mW/ $cm^2$.

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

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

Where:

$\Delta$t = Exposure time (30 seconds),

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

$\Delta$T = Temperature increase due to RF exposure.

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

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density ($kg/m^3$).

## 7.4. Other Test Equipment

### 7.4.1. Data Acquisition Electronics(DAE)

The data acquisition electronics consist 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 with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.
The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.
The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

**Picture7-4: DAE**

### 7.4.2. Robot

The SPEAG DASY system uses the high precision robots (DASY5: TX90) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability 0.02mm)
- High reliability (industrial design)
- Low maintenance costs (virtually maintenance free due to direct drive gears; no belt drives)
- Jerk-free straight movements (brushless synchron motors; no stepper motors)
- Low ELF interference (motor control fields shielded via the closed metallic construction shields)

**Picture7-5: DASY 5**

### 7.4.3. Measurement Server

The Measurement server is based on a PC/104 CPU broad with CPU (DASY5: 400 MHz, Intel Celeron), chipdisk (DASY5: 128MB), RAM (DASY5: 128MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O broad, which is directly connected to the PC/104 bus of the CPU broad.

The measurement server performs all real-time data evaluation of field measurements and surface detection, controls robot movements and handles safety operation. The PC operating system cannot interfere with these time critical processes. All connections are supervised by a watchdog, and disconnection of any of the cables to the measurement server will automatically disarm the robot and disable all program-controlled robot movements. Furthermore, the measurement server is equipped with an expansion port which is reserved for future applications. Please note that this expansion port does not have a standardized pinout, and therefore only devices provided by SPEAG can be connected. Devices from any other supplier could seriously damage the measurement server.


**Picture 7-6: Server for DASY 5**

### 7.4.4. Device Holder for Phantom

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

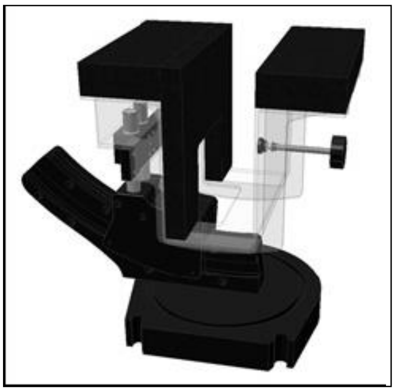
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference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

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity $\varepsilon$ =3 and loss tangent $\delta$ =0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the Mounting Device in place of the phone positioner. The extension is fully compatible with the Twin-SAM and ELI phantoms.

**Picture7-7: Device Holder**



**Picture 7-8: Laptop Extension Kit**

### 7.4.5. Phantom

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to

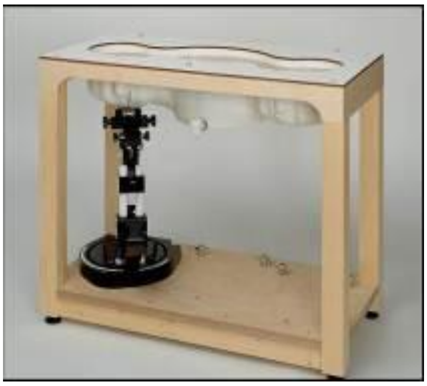
Represent the 90th percentile of the population. The phantom enables the dissymmetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

Shell Thickness: 2 ± 0. 2 mm

Filling Volume: Approx. 25 liters

Dimensions: 810 x l000 x 500 mm (H x L x W)

Available: Special

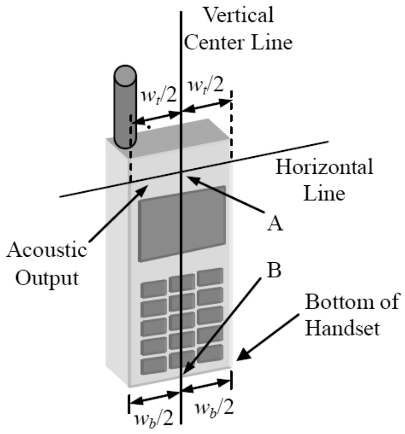


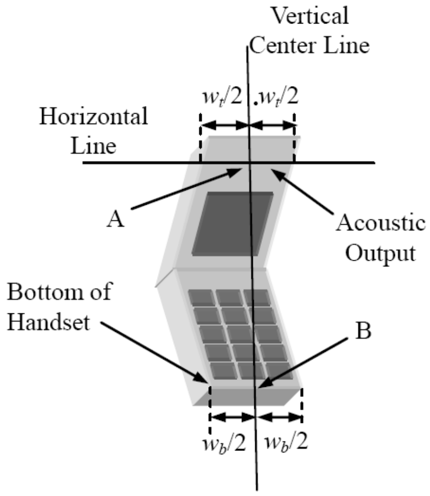
**Picture 7-9: SAM Twin Phantom**

# 8. Position of the wireless device in relation to the phantom

## 8.1. General considerations

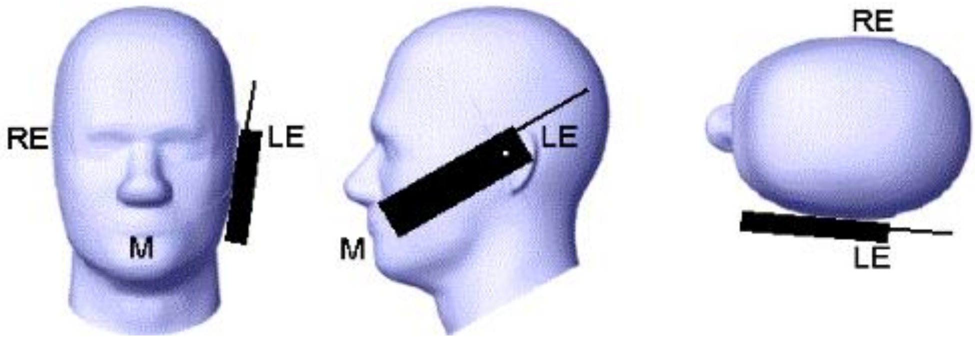
This standard specifies two handset test positions against the head phantom – the “cheek” position and the “tilt” position.



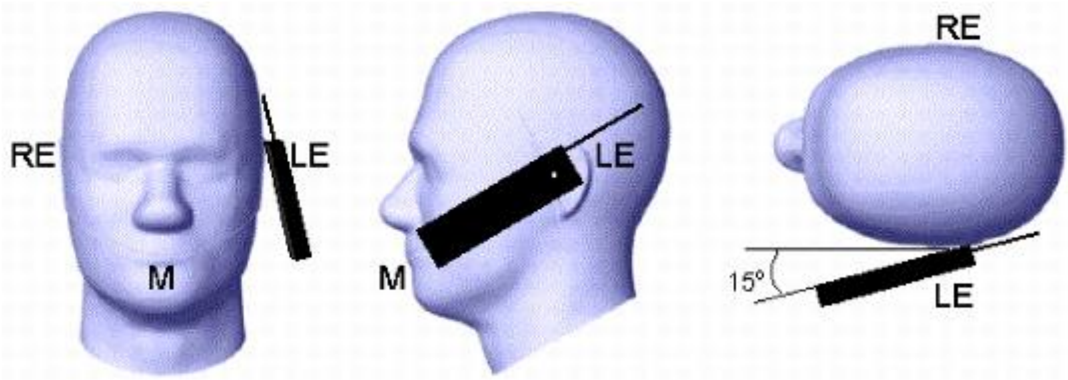




| | |
|---|---|
| $w_t$ | Width of the handset at the level of the acoustic |
| $w_b$ | Width of the bottom of the handset |
| A | Midpoint of the width $w_t$ of the handset at the level of the acoustic output |
| B | Midpoint of the width $w_b$ of the bottom of the handset |

**Picture 8-1 Typical “fixed” case handset** **Picture 8-2 Typical “clam-shell” case handset**



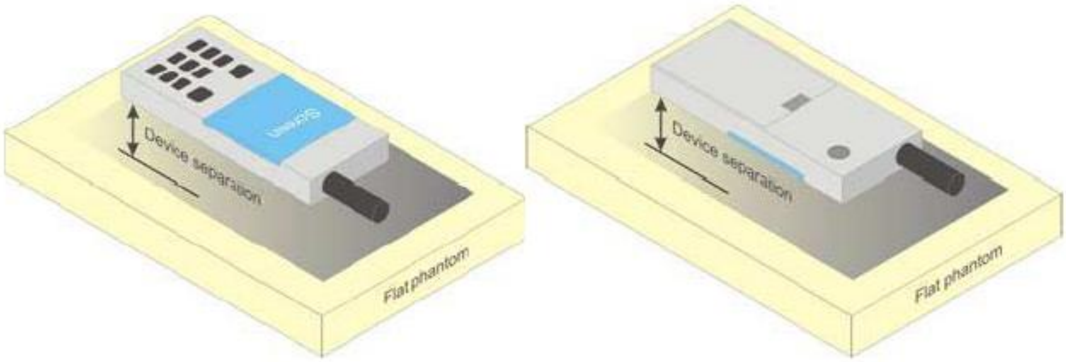

**Picture 8-3 Cheek position of the wireless device on the left side of SAM**




**Picture 8-4 Tilt position of the wireless device on the left side of SAM**

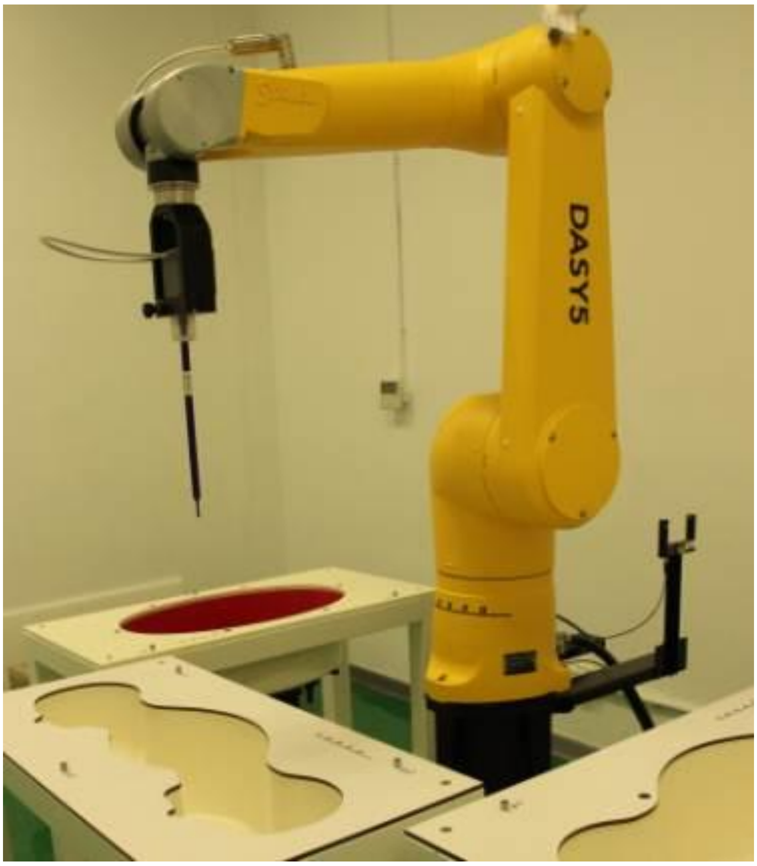
## 8.2. Body-worn device

A typical example of a body-worn device is a mobile phone, wireless enabled PDA or other battery operated wireless device with the ability to transmit while mounted on a person's body using a carry accessory approved by the wireless device manufacturer.




**Picture 8-5 Test positions for body-worn devices**

## 8.3. DUT Setup Photos




**Picture 8-6: Specific Absorption Rate Test Layout**

# 9. Tissue Simulating Liquids

## 9.1. Equivalent Tissues

The liquid used for the frequency range of 800-3000 MHz consisted of water, sugar, salt, preventol, glycol monobutyl and Cellulose. The liquid has been previously proven to be suited for worst-case. The Table 9.1 shows the detail solution. It's satisfying the latest tissue dielectric parameters requirements proposed by the IEEE 1528 and IEC 62209.

**Table 9.1. Composition of the Head Tissue Equivalent Matter**

| Frequency (MHz) | 835 Head | 1900 Head | 2450 Head |
|---|---|---|---|
| Ingredients (% by weight) | | | |
| Water | 41.45 | 55.242 | 58.79 |
| Sugar | 56.0 | \ | \ |
| Salt | 1.45 | 0.306 | 0.06 |
| Preventol | 0.1 | \ | \ |
| Cellulose | 1.0 | \ | \ |
| Glycol Monobutyl | \ | 44.452 | 41.15 |
| Dielectric Parameters<br>Target Value | ε=41.5<br>σ=0.90 | ε=40.0<br>σ=1.40 | ε=39.2<br>σ=1.80 |

**Table 9.2: Targets for tissue simulating liquid**

| Frequency(MHz) | Liquid Type | Conductivity(σ) | ± 5% Range | Permittivity(ε) | ± 5% Range |
|---|---|---|---|---|---|
| 1900 | Head | 1.40 | 1.33～1.47 | 40.0 | 38.0～42.0 |

## 9.2. Dielectric Performance

**Table 9.3: Dielectric Performance of Head Tissue Simulating Liquid**

| **Measurement Value** | | | | | | |
|---|---|---|---|---|---|---|
| Liquid Temperature: 22.5 ℃ | | | | | | |
| **Type** | **Frequency** | **Permittivity ε** | **Drift (%)** | **Conductivity σ** | **Drift (%)** | Test Date |
| Head | 1900 MHz-1 | 39.330 | -1.68% | 1.450 | 3.57% | 2019-07-24 |
| Head | 1900 MHz-2 | 41.157 | 2.89% | 1.338 | -4.43% | 2019-08-02 |

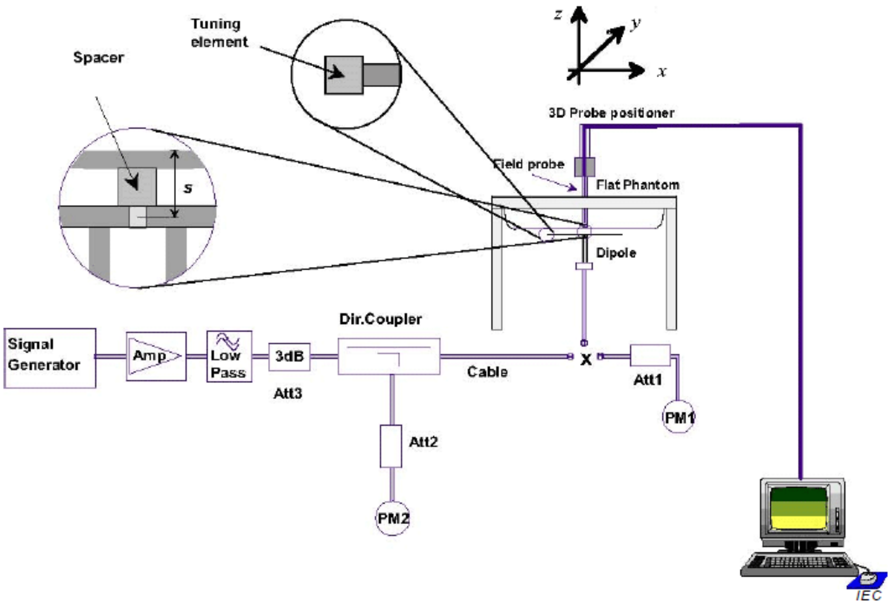
# 10. System Validation

## 10.1. System Validation

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performace check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

## 10.2. System Setup

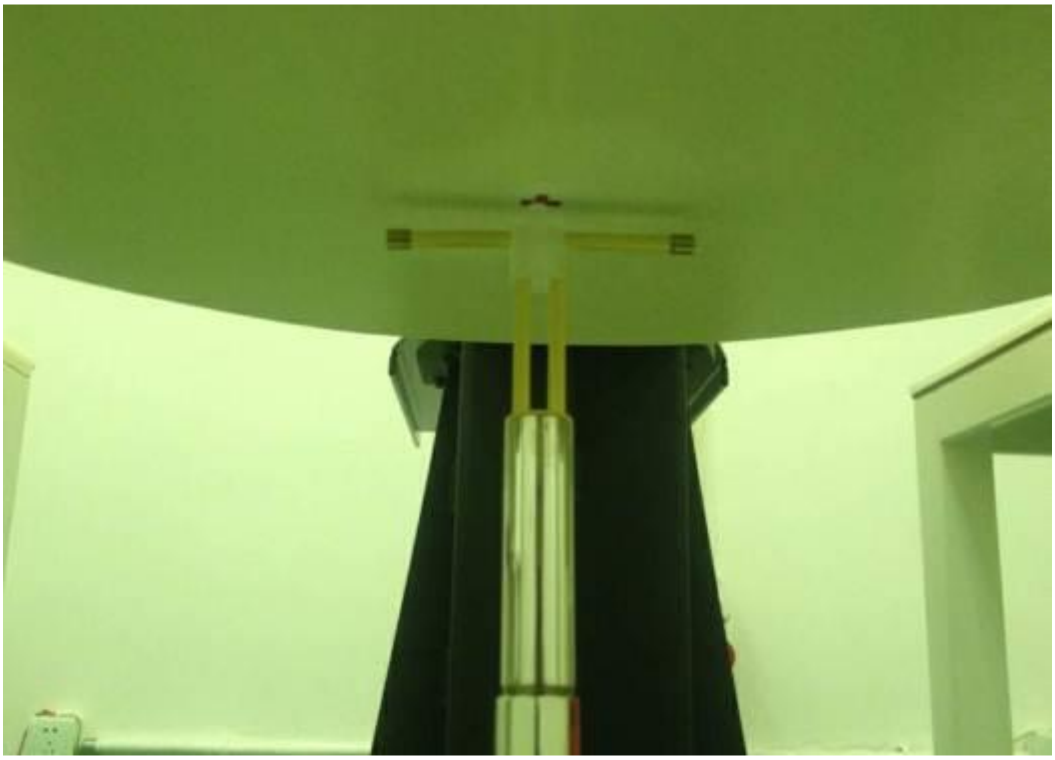
In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:




**Picture 10-1 System Setup for System Evaluation**

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

The results are normalized to 1 W input power.



**Picture 10-2 Photo of Dipole Setup**

**Table 10.1: System Verification of Head**

| **Verification Results** | | | | | | | |
|---|---|---|---|---|---|---|---|
| Input power level: 1W | | | | | | | |
| **Frequency** | **Target value (W/kg)** | | **Measured value (W/kg)** | | **Deviation** | | **Test date** |
| | **10 g Average** | **1 g Average** | **10 g Average** | **1 g Average** | **10 g Average** | **1 g Average** | |
| 1900 MHz-1 | 21.1 | 40.5 | 21.04 | 41.2 | -0.28% | 1.73% | 2019-07-24 |
| 1900 MHz-2 | 21.1 | 40.5 | 21.44 | 42 | 1.61% | 3.70% | 2019-08-02 |

# 11. Measurement Procedures

## 11.1. Tests to be performed

According to the SAR test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

(a) Power reference measurement

(b) Area scan

(c) Zoom scan

(d) Power drift measurement

The SAR measurement procedures for each of test conditions are as follows:

(a) Make EUT to transm it maximum output power

(b) Measure conducted output power through RF cable

(c) Place the EUT in the specific position of phantom as Appendix D demonstrates.

(d) Measure SAR results for Middle channel or the highest power channel on each testing position.

(e) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

(f) Record the SAR value

## 11.2. General Measurement Procedure

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2013. The results should be documented as part of the system validation records and may be requested to support test results

when all the measurement parameters in the following table are not satisfied.

<table>
<tr><th colspan="3"></th><th>≤ 3 GHz</th><th>> 3 GHz</th></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 mm ± 1 mm</td><td>½·$\delta$·ln(2) mm ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$</td><td>≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$</td><td>≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$ mm</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: $\delta$ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see IEEE Std 1528-2013 for details.<br>* When zoom scan is required and the <u>*reported*</u> SAR from the *area scan based 1-g SAR estimation* procedures of KDB Publication 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.</td></tr>
</table>

## 11.3. Bluetooth & WiFi Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure that the results are consistent and reliable.

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

## 11.4. Power Drift

To control the output power stability during the SAR test, DASY4 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in Section 13 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

# 12. Conducted Output Power

## 12.1. Manufacturing tolerance

**Table 12.1: GSM Speech**

| GSM1900 | | | |
|---|---|---|---|
| Channel | Channel 512 | Channel 661 | Channel 810 |
| Maximum Target Value (dBm) | 30 | 30 | 30 |

**Table 12.2: GPRS (GMSK Modulation)**

| GSM 1900 | | | | |
|---|---|---|---|---|
| Channel | | **512** | **661** | **810** |
| 1 Txslots | Maximum Target Value (dBm) | 30 | 30 | 30 |
| 2 Txslots | Maximum Target Value (dBm) | 29 | 29 | 29 |
| 3 Txslots | Maximum Target Value (dBm) | 27 | 27 | 27 |
| 4 Txslots | Maximum Target Value (dBm) | 26 | 26 | 26 |

**Table 12.3: Bluetooth**

| Bluetooth | |
|---|---|
| Maximum Target Value (dBm) | 8.5 |

## 12.2. GSM Measurement result

**Table 12.4: The conducted power measurement results for GSM1900**

| GSM 1900MHZ | Conducted Power(dBm) | | |
|---|---|---|---|
| | Channel 512(1850.2MHz) | Channel 661(1880 MHz) | Channel 810(1909.8MHz) |
| | 29.37 | 29.23 | 29.07 |

**Table 12.5: The conducted power measurement results for GPRS**

| GSM 1900 GMSK | Measured Power (dBm) | | | calculation | Averaged Power (dBm) | | |
|---|---|---|---|---|---|---|---|
| | 512 | 661 | 810 | | 512 | 661 | 810 |
| 1 Txslot | 29.46 | 29.34 | 29.18 | -9.03dB | 20.43 | 20.31 | 20.15 |
| 2 Txslots | 28.65 | 28.62 | 28.55 | -6.02dB | 22.63 | 22.6 | 22.53 |
| 3 Txslots | 26.47 | 26.52 | 26.53 | -4.26dB | 22.21 | 22.26 | 22.27 |
| 4 Txslots | 25.37 | 25.43 | 25.65 | -3.01dB | 22.36 | 22.42 | 22.64 |

NOTES:

1) Division Factors

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

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

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

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

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

**According to the conducted power as above, the body measurements are performed with 4Txslots for 1900MHz;**

## 12.3. BT Measurement result

**Table12.6: The conducted power for Bluetooth**

| Mode | Channel | Frequence | Power(dBm) |
|---|---|---|---|
| GFSK | 0 | 2402 MHZ | 7.67 |
| | 39 | 2441 MHZ | 8.04 |
| | 78 | 2480 MHZ | 7.94 |
| DQPSK | 0 | 2402 MHZ | 6.39 |
| | 39 | 2441 MHZ | 6.70 |
| | 78 | 2480 MHZ | 6.60 |
| 8DPSK | 0 | 2402 MHZ | 6.36 |
| | 39 | 2441 MHZ | 6.74 |
| | 78 | 2480 MHZ | 6.64 |

**NOTE:** According to KDB447498 D01 BT standalone SAR are not required, because maximum average output power is less than 10mW.

When the standalone SAR test exclusion is applied to an antenna that transmits simultaneously with other antennas, the standalone SAR must be estimated according to the following to determine simultaneous transmission SAR test exclusion:

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

SAR head value of BT is 0.297 W/Kg. SAR body value of BT is 0.099 W/Kg for 1g.

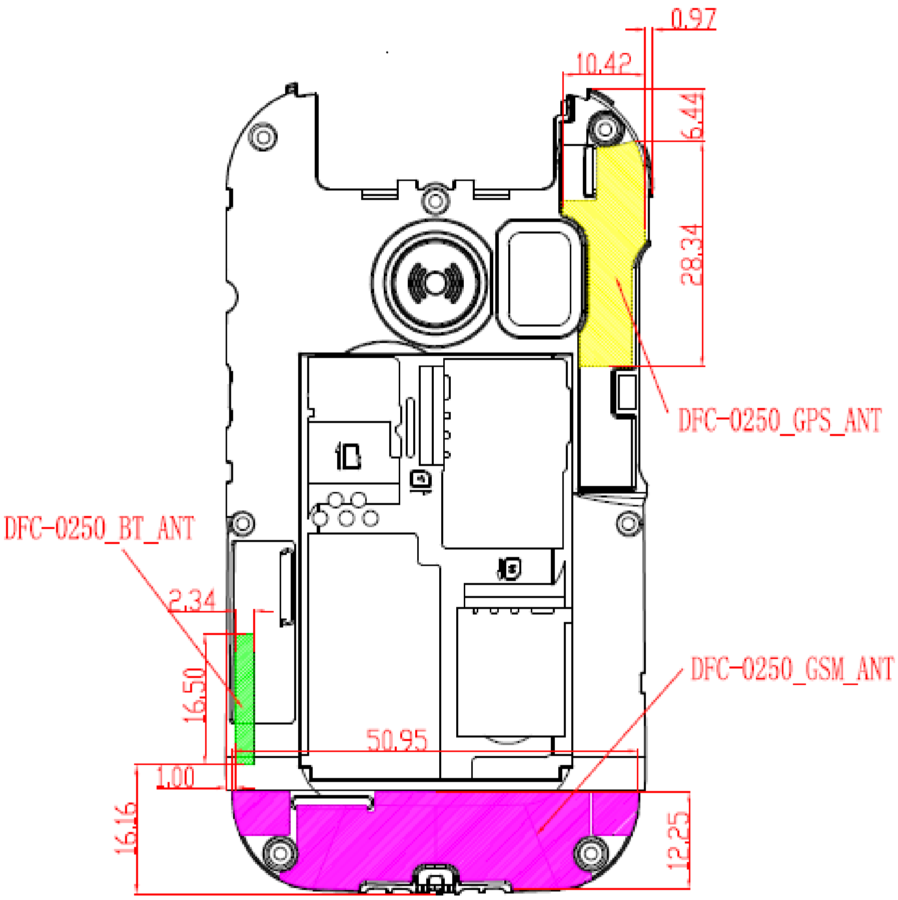
# 13. Simultaneous TX SAR Considerations

## 13.1. Introduction

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

For this device, the BT and WiFi can transmit simultaneous with other transmitters.

## 13.2. Transmit Antenna Separation Distances




**Picture 13.1 Antenna Locations**

## 13.3. Standalone SAR Test Exclusion Considerations

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

The 1-g SAR test exclusion threshold for 100 MHz to 6 GHz at test separation distances≤ 50 mm are determined by:

[(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, where

- f(GHz) is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

According to the KDB447498 appendix A, the SAR test exclusion threshold for 2450MHz at 5mm test separation distances is 10mW.

$$\frac{\text{(max. power of channel, including tune-up tolerance, mW)}}{\text{(min. test separation distance, mm)}} * \sqrt{\text{Frequency (GHz)}} \leqslant 3.0$$

Based on the above equation, Bluetooth SAR was not required:

Evaluation=2.23＜3.0

# 14. SAR Test Result

Table 14.1: SAR Values(GSM 1900 MHz Band-Head)

| Frequency | | Mode /Band | Side | Test Position | Figure No. | Measured average power (dBm) | Maximum allowed Power (dBm) | Scaling factor | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| MHz | Ch. | | | | | | | | | | |
| 1880 | 661 | GSM1900 | Left | Touch | / | 29.23 | 30 | 1.194 | 0.26 | 0.310 | 0.09 |
| 1880 | 661 | GSM1900 | Left | Tilt | / | 29.23 | 30 | 1.194 | 0.059 | 0.070 | 0.12 |
| 1880 | 661 | GSM1900 | Right | Touch | 1 | 29.23 | 30 | 1.194 | 0.292 | 0.349 | 0.14 |
| 1880 | 661 | GSM1900 | Right | Tilt | / | 29.23 | 30 | 1.194 | 0.12 | 0.143 | 0.02 |

Table 14.2: SAR Values (GSM 1900 MHz Band-Body)

| Frequency | | Mode /Band | Service /Headset | Test Position | Spacing (mm) | Figure No. | Measured average power (dBm) | Maximum allowed Power (dBm) | Scaling factor | Measured SAR(1g) (W/kg) | Reported SAR(1g) (W/kg) | Power Drift (dB) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| MHz | Ch. | | | | | | | | | | | |
| Body Close | | | | | | | | | | | | |
| 1880 | 661 | GPRS1900 4TS | Class12 | Toward Phantom | 15 | / | 25.43 | 26 | 1.140 | 0.152 | 0.173 | -0.05 |
| 1880 | 661 | GPRS1900 4TS | Class12 | Toward Ground | 15 | / | 25.43 | 26 | 1.140 | 0.663 | 0.756 | 0.10 |
| Body Open | | | | | | | | | | | | |
| 1880 | 661 | GPRS1900 4TS | Class12 | Toward Ground | 15 | 2 | 25.43 | 26 | 1.140 | 0.962 | 1.097 | 0.18 |
| 1850.2 | 512 | GPRS1900 4TS | Class12 | Toward Ground | 15 | / | 25.37 | 26 | 1.156 | 0.601 | 0.695 | 0.10 |
| 1909.8 | 810 | GPRS1900 4TS | Class12 | Toward Ground | 15 | / | 25.65 | 26 | 1.084 | 0.737 | 0.799 | 0.11 |
| Repeated (Body Open) | | | | | | | | | | | | |
| 1880 | 661 | GPRS1900 4TS | Class12 | Toward Ground | 15 | / | 25.43 | 26 | 1.140 | 0.905 | 1.032 | 0.16 |
| Headset (Body Open) | | | | | | | | | | | | |
| 1880 | 661 | GPRS1900 4TS | Class12 | Toward Ground | 15 | / | 25.43 | 26 | 1.140 | 0.565 | 0.664 | 0.14 |
| SIM2 (Body Open) | | | | | | | | | | | | |
| 1880 | 661 | GPRS1900 4TS | Class12 | Toward Ground | 15 | / | 25.43 | 26 | 1.140 | 0.62 | 0.707 | 0.11 |
| Secondary supply for N11 (Body Open) | | | | | | | | | | | | |
| 1880 | 661 | GPRS1900 4TS | Class12 | Toward Ground | 15 | 3 | 25.43 | 26 | 1.140 | 0.736 | 0.839 | 0.03 |

# 15. Evaluation of Simultaneous

**Table15.1 Simultaneous transmission SAR**

| Simultaneous multi-band transmission | | | | | |
|---|---|---|---|---|---|
| Test Position | | | WWAN | 2.4GHz | SUM |
| | | | 2G | BT | |
| Head(1g) | Left | Cheek | 0.310 | 0.297 | 0.607 |
| | | Tilt 15° | 0.070 | 0.297 | 0.367 |
| | Right | Cheek | 0.349 | 0.297 | 0.646 |
| | | Tilt 15° | 0.143 | 0.297 | 0.44 |
| **Body Close (15mm)** | Phantom Side | | 0.173 | 0.099 | 0.272 |
| | Ground Side | | 0.756 | 0.099 | 0.855 |
| **Body Open(15mm)** | Ground Side | | 1.097 | 0.099 | 1.196 |

According to the above table, the sum of reported SAR values for GSM and BT<1.6W/kg. So the simultaneous transmission SAR is not required for BT transmitter.

# 16. SAR Measurement Variability

SAR measurement variability must be assessed for each frequency band, which is determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media are required for SAR measurements in a frequency band, the variability measurement procedures should be applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium.

The following procedures are applied to determine if repeated measurements are required.

1) Repeated measurement is not required when the original highest measured SAR is < 0.80 W/kg; steps2) through 4) do not apply.

2) When the original highest measured SAR is ≥ 0.80 W/kg, repeat that measurement once.

3) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is > 1.20 or when the original or repeated measurement is ≥ 1.45W/kg (~ 10% from the 1-g SAR limit).

4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

**Table 16.1: SAR Measurement Variability for Body Value (1g)**

| Frequency | | Configuration | Test Position | Original SAR (W/kg) | First Repeated SAR (W/kg) | The Ratio |
|---|---|---|---|---|---|---|
| MHz | Ch. | | | | | |
| 1850.2 | 512 | GPRS 4TS | Ground | 0.962 | 0.905 | 1.063 |

**Note:** According to the KDB 865664 D01repeated measurement is not required when the original highest measured SAR is < 0.8 W/kg.

# 17. Test Equipments Utilized

**Table 17.1 SAR Test System**

| Item | Instrument Name | Type | Serial Number | Manufacturer | Cal. Date | Cal. interval |
|---|---|---|---|---|---|---|
| 1 | Network analyzer | N5242A | MY51221755 | Agilent | 2018-12-17 | 1 year |
| 2 | Power meter | NRVD | 102257 | RS | 2019-5-10 | 1 year |
| 3 | Power sensor | NRV-Z5 | 100241 | | | |
| | | | 100644 | | | |
| 4 | Signal Generator | E4438C | MY49072044 | Agilent | 2019-5-10 | 1 Year |
| 5 | Amplifier | NTWPA-0086010F | 12023024 | rflight | No Calibration Requested | |
| 6 | Coupler | 778D | MY4825551 | Agilent | 2019-5-10 | 1 year |
| 7 | BTS | E5515C | MY50266468 | Agilent | 2018-12-17 | 1 year |
| 8 | E-field Probe | ES3DV3 | 3252 | SPEAG | 2018-9-4 | 1 year |
| 9 | DAE | SPEAG DAE4 | 1244 | SPEAG | 2018-12-13 | 1 year |
| 10 | Dipole Validation Kit | SPEAG D1900V2 | 5d151 | SPEAG | 2017-12-6 | 3 year |

# 18. Measurement Uncertainty

**Measurement uncertainty evaluation for SAR test**

| Error Description | Unc. value, ±% | Prob. Dist. | Div. | $c_i$ 1g | $c_i$ 10g | Std.Unc. ±%,1g | Std.Unc. ±%,10g | $V_i$ $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | 6.0 | N | 1 | 1 | 1 | 6.0 | 6.0 | ∞ |
| Axial Isotropy | 0.5 | R | $\sqrt{3}$ | 0.7 | 0.7 | 0.2 | 0.2 | ∞ |
| Hemispherical Isotropy | 2.6 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.1 | 1.1 | ∞ |
| Boundary Effects | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| Linearity | 0.6 | R | $\sqrt{3}$ | 1 | 1 | 0.3 | 0.3 | ∞ |
| System Detection Limits | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| Readout Electronics | 0.7 | N | 1 | 1 | 1 | 0.7 | 0.7 | ∞ |
| Response Time | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| Integration Time | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| RF Ambient Noise | 3.0 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| RF Ambient Reflections | 3.0 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| Probe Positioner | 1.5 | R | $\sqrt{3}$ | 1 | 1 | 0.9 | 0.9 | ∞ |
| Probe Positioning | 2.9 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| Max. SAR Eval. | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device Positioning | 2.9 | N | 1 | 1 | 1 | 2.9 | 2.9 | 145 |
| Device Holder | 3.6 | N | 1 | 1 | 1 | 3.6 | 3.6 | 5 |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| Liquid Conductivity (target) | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| Liquid Conductivity (meas.) | 2.5 | N | 1 | 0.64 | 0.43 | 1.6 | 1.1 | ∞ |
| Liquid Permittivity (target) | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| Liquid Permittivity (meas.) | 2.5 | N | 1 | 0.6 | 0.49 | 1.5 | 1.2 | ∞ |
| **Combined Std. Uncertainty** | | RSS | | | | 9.27 | 9.07 | |
| **Expanded STD Uncertainty** | | k=2 | | | | 18.53 | 18.14 | |

**Measurement uncertainty evaluation for system validation**

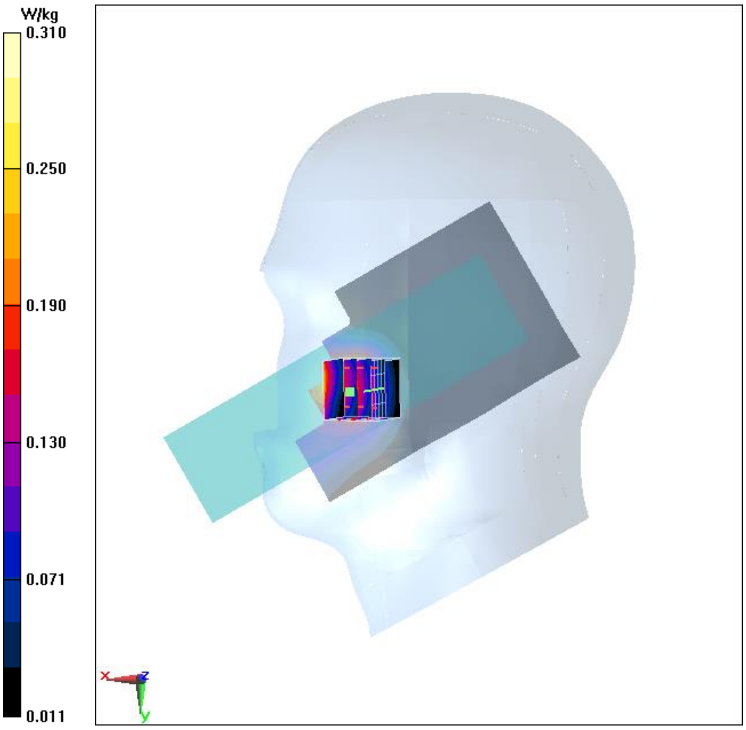
| Error Description | Unc. value, ±% | Prob. Dist. | Div. | $c_i$ 1g | $c_i$ 10g | Std.Unc. ±%,1g | Std.Unc. ±%,10g | $V_i$ $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | 6.0 | N | 1 | 1 | 1 | 6.0 | 6.0 | ∞ |
| Axial Isotropy | 0.5 | R | $\sqrt{3}$ | 0.7 | 0.7 | 0.2 | 0.2 | ∞ |
| Hemispherical Isotropy | 2.6 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.1 | 1.1 | ∞ |
| Boundary Effects | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| Linearity | 0.6 | R | $\sqrt{3}$ | 1 | 1 | 0.3 | 0.3 | ∞ |
| System Detection Limits | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| Readout Electronics | 0.7 | N | 1 | 1 | 1 | 0.7 | 0.7 | ∞ |
| Response Time | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| Integration Time | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| RF Ambient Noise | 3.0 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| RF Ambient Reflections | 3.0 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| Probe Positioner | 1.5 | R | $\sqrt{3}$ | 1 | 1 | 0.9 | 0.9 | ∞ |
| Probe Positioning | 2.9 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| Max. SAR Eval. | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| **Diople** | | | | | | | | |
| Power Drift | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |
| Dipole Positioning | 2.0 | N | 1 | 1 | 1 | 2.0 | 2.0 | ∞ |
| Dipole Input Power | 5.0 | N | 1 | 1 | 1 | 5.0 | 5.0 | ∞ |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| Liquid Conductivity (target) | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| Liquid Conductivity (meas.) | 2.5 | N | 1 | 0.64 | 0.43 | 1.6 | 1.1 | ∞ |
| Liquid Permittivity (target) | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| Liquid Permittivity (meas.) | 2.5 | N | 1 | 0.6 | 0.49 | 1.5 | 1.2 | ∞ |
| | | | | | | | | |
| **Combined Std Uncertainty** | | | | | | ±11.2% | ±10.9% | 387 |
| **Expanded Std Uncertainty** | | | | | | **±22.4%** | **±21.8%** | |

***END OF REPORT BODY***

# ANNEX A. Graph Results

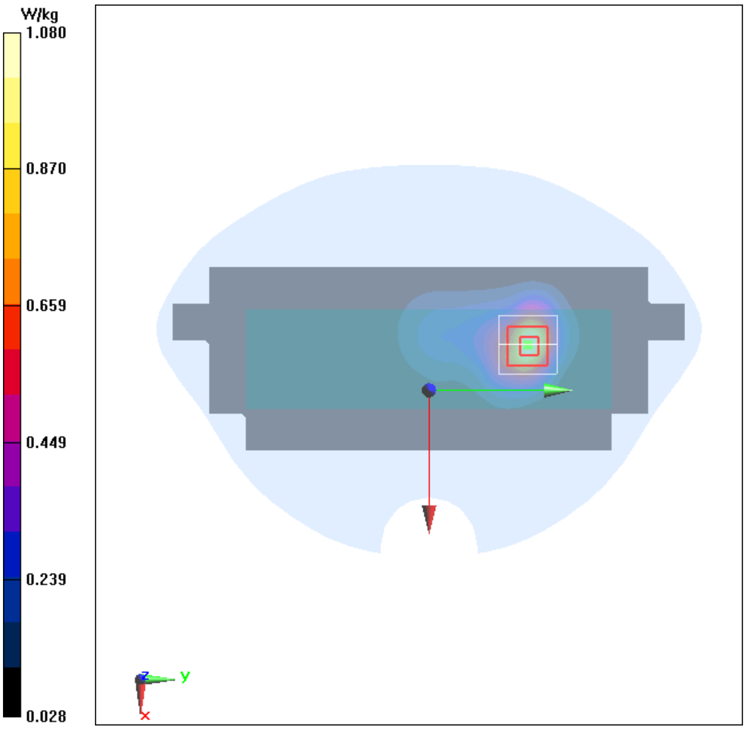
## Fig.1 GSM 1900 Right Cheek Middle

Date/Time: 2019/7/24
Electronics: DAE4 Sn1244
Medium parameters used: f = 1880 MHz; σ = 1.429 S/m; $\varepsilon_r$ = 39.407; ρ = 1000 kg/$m^3$
Ambient Temperature:22.5 ℃ Liquid Temperature:22.5 ℃
Communication System: GSM Professional 1900MHz; Frequency: 1880 MHz; Duty Cycle: 1:8.3
Probe: ES3DV3 - SN3252ConvF(5.18, 5.18, 5.18); Calibrated: 9/4/2018
**GSM 1900 Right Cheek Middle/Area Scan (121x51x1):**
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.352 W/kg
**GSM 1900 Right Cheek Middle/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 2.072 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 0.402 W/kg
SAR(1 g) = 0.292 W/kg; SAR(10 g) = 0.200 W/kg
Maximum value of SAR (measured) = 0.310 W/kg



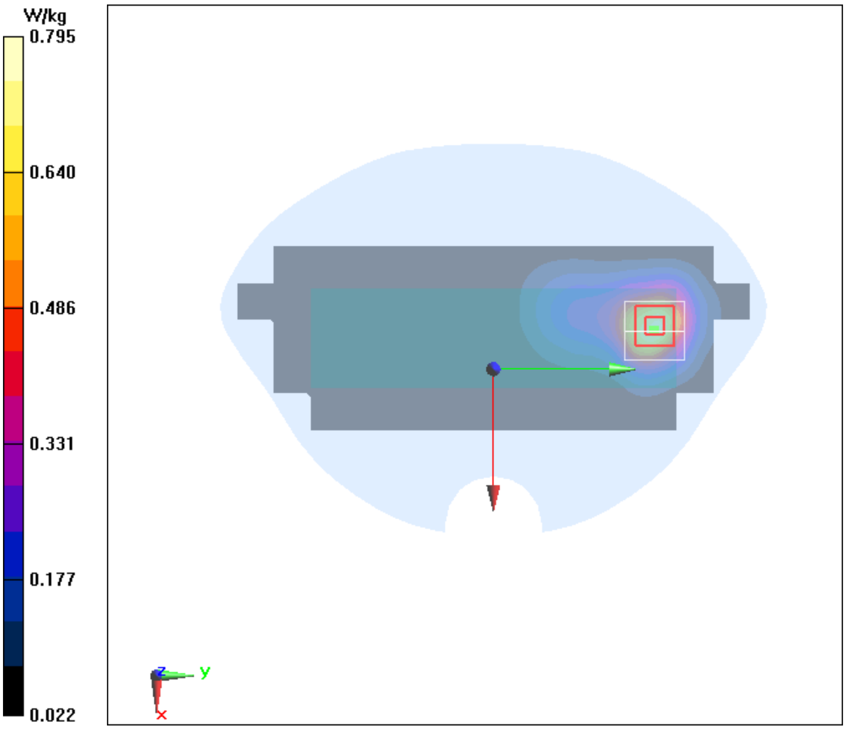
## Fig.2 GPRS 1900 4TS Ground Mode Middle 15mm

Date/Time: 2019/7/24
Electronics: DAE4 Sn1244
Medium parameters used: f = 1880 MHz; $\sigma$ = 1.429 S/m; $\varepsilon_r$ = 39.407; $\rho$ = 1000 kg/m$^3$
Ambient Temperature:22.5 ℃ Liquid Temperature:22.5 ℃
Communication System: GSM 1900MHz GPRS 4TS (0); Frequency: 1880 MHz; Duty Cycle: 1:2
Probe: ES3DV3 - SN3252ConvF(5.18, 5.18, 5.18); Calibrated: 9/4/2018
**GPRS 1900 4TS Ground Mode Middle 15mm/Area Scan (51x141x1):**
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 1.10 W/kg
**GPRS 1900 4TS Ground Mode Middle 15mm/Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 10.75 V/m; Power Drift = 0.18 dB
Peak SAR (extrapolated) = 1.64 W/kg
SAR(1 g) = 0.962 W/kg; SAR(10 g) = 0.536 W/kg
Maximum value of SAR (measured) = 1.08 W/kg



## Fig.3 GPRS 1900 4TS Ground Mode Middle 15mm

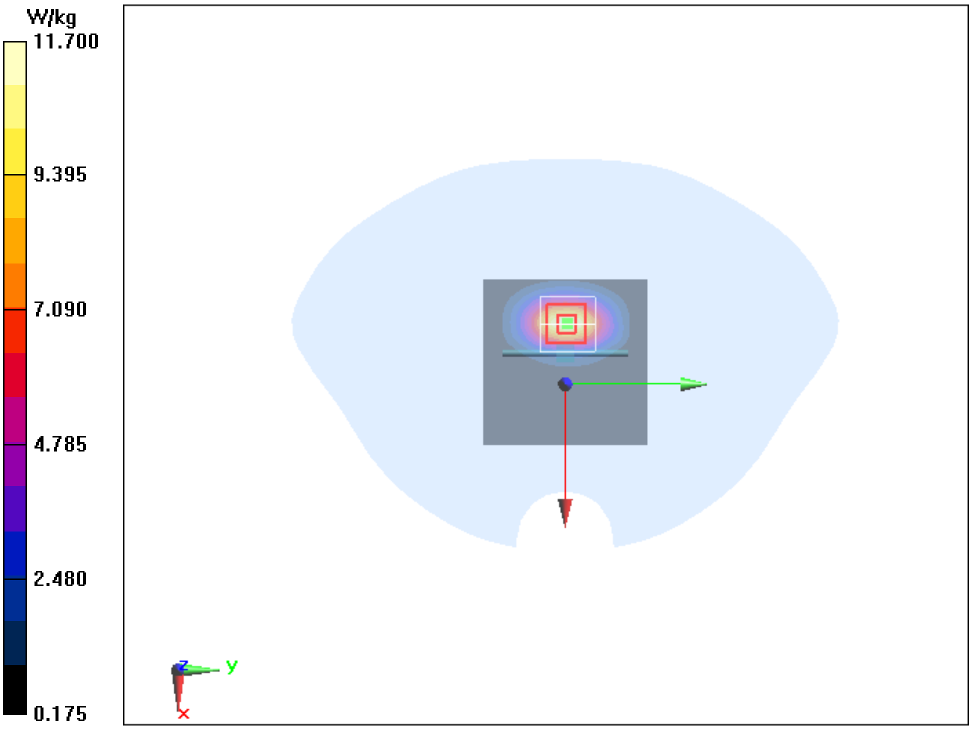
Date/Time: 2019/8/2
Electronics: DAE4 Sn1244
Medium parameters used: f = 1880 MHz; $\sigma$ = 1.319 S/m; $\varepsilon_r$ = 41.244; $\rho$ = 1000 kg/m$^3$
Ambient Temperature:22.5 ℃ Liquid Temperature:22.5 ℃
Communication System: GSM 1900MHz GPRS 4TS (0); Frequency: 1880 MHz; Duty Cycle: 1:2
Probe: ES3DV3 - SN3252ConvF(5.18, 5.18, 5.18); Calibrated: 9/4/2018
**GPRS 1900 4TS Ground Mode Middle 15mm /Area Scan (51x141x1):**
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 0.769 W/kg
**GPRS 1900 4TS Ground Mode Middle 15mm /Zoom Scan (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 3.722 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 1.19 W/kg
SAR(1 g) = 0.736 W/kg; SAR(10 g) = 0.436 W/kg
Maximum value of SAR (measured) = 0.795 W/kg



# ANNEX B. System Validation Results

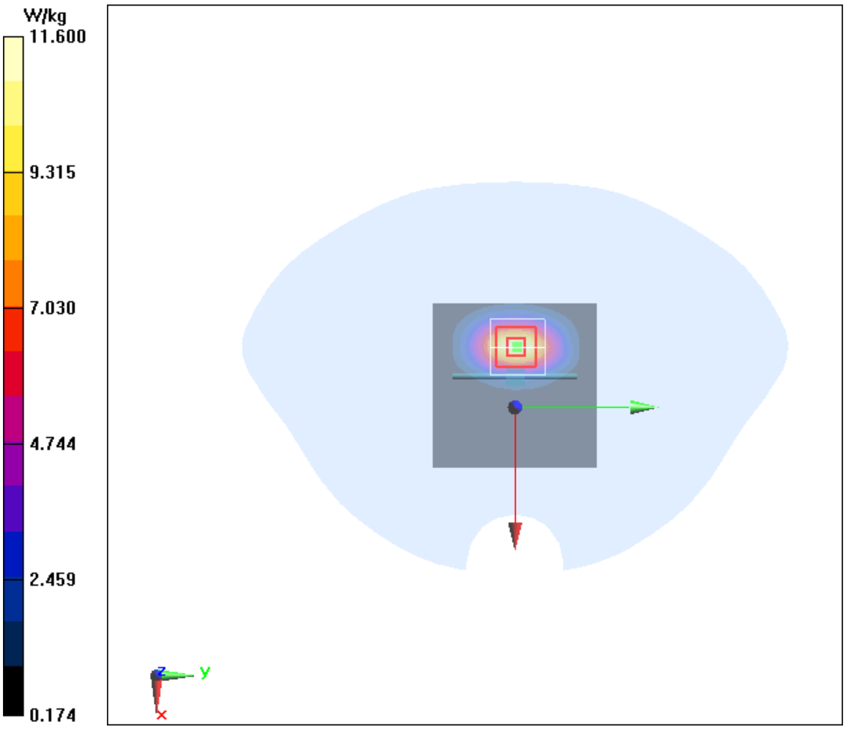
## Head 1900MHz

Date/Time: 2019/7/24
Electronics: DAE4 Sn1244
Medium parameters used: f = 1900 MHz; σ = 1.450 S/m; $\varepsilon_r$ = 39.330; ρ = 1000 kg/$m^3$
Ambient Temperature:22.5 ℃ Liquid Temperature:22.5 ℃
Communication System: CW 1900MHz; Frequency: 1900 MHz; Duty Cycle: 1:1
Probe: ES3DV3 - SN3252ConvF(5.18, 5.18, 5.18); Calibrated: 9/4/2018
**System Validation /Area Scan (61x61x1):**
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 11.2 W/kg
**System Validation /Zoom Scan (7x7x7) (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 47.52 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 19.8 W/kg
SAR(1 g) = 10.3 W/kg; SAR(10 g) = 5.26 W/kg
Maximum value of SAR (measured) = 11.7 W/kg



## Head 1900MHz-2

Date/Time: 2019/8/2
Electronics: DAE4 Sn1244
Medium parameters used: f = 1900 MHz; σ = 1.338 S/m; $\varepsilon_r$ = 41.157; ρ = 1000 kg/m$^3$
Ambient Temperature:22.5 ℃ Liquid Temperature:22.5 ℃
Communication System: CW 1900MHz; Frequency: 1900 MHz; Duty Cycle: 1:1
Probe: ES3DV3 - SN3252ConvF(5.18, 5.18, 5.18); Calibrated: 9/4/2018
**System Validation 2/Area Scan (61x61x1):**
Measurement grid: dx=10 mm, dy=10 mm
Maximum value of SAR (Measurement) = 11.2 W/kg
**System Validation 2/Zoom Scan (7x7x7) (7x7x7)/Cube 0:**
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 47.52 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 19.7 W/kg
SAR(1 g) = 10.5 W/kg; SAR(10 g) = 5.36 W/kg
Maximum value of SAR (measured) = 11.6 W/kg



# ANNEX C. System Validation

The SAR system must be validated against its performance specifications before it is deployed. When SAR probes, system components or software are changed, upgraded or recalibrated, these must be validated with the SAR system(s) that operates with such components.

**Table C.1: System Validation Part 1**

| System No. | Probe SN. | Liquid name | Validation date | Frequency point | **Permittivity ε** | **Conductivity σ (S/m)** |
|---|---|---|---|---|---|---|
| 1 | 3252 | Head 1900 MHz | 2019/7/24 | 1900 MHz-1 | 39.330 | 1.450 |
| 2 | 3252 | Head 1900 MHz | 2019/8/2 | 1900 MHz-2 | 41.157 | 1.338 |

**Table C.2: System Validation Part 2**

| | | | |
|---|---|---|---|
| CW Validation | Sensitivity | PASS | PASS |
| | Probe linearity | PASS | PASS |
| | Probe Isotropy | PASS | PASS |
| Mod Validation | MOD.type | GMSK | GMSK |
| | MOD.type | OFDM | OFDM |
| | Duty factor | PASS | PASS |
| | PAR | PASS | PASS |

# ANNEX D. Calibration Certification

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中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client : ECIT

Certificate No: Z18-60529

## CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SN: 1244 |
| Calibration Procedure(s) | FF-Z11-002-01<br>Calibration Procedure for the Data Acquisition Electronics (DAEx) |
| Calibration date: | December 03, 2018 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Process Calibrator 753 | 1971018 | 20-Jun-18 (CTTL, No.J18X05034) | June-19 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Yu Zongying | SAR Test Engineer | |
| Reviewed by: | Lin Hao | SAR Test Engineer | |
| Approved by: | Qi Dianyuan | SAR Project Leader | |

Issued: December 05, 2018

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**Glossary:**

| | |
|---|---|
| DAE | data acquisition electronics |
| Connector angle | information used in DASY system to align probe sensor X to the robot coordinate system. |

**Methods Applied and Interpretation of Parameters:**

- *DC Voltage Measurement*: Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The report provide only calibration results for DAE, it does not contain other performance test results.

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## DC Voltage Measurement

A/D - Converter Resolution nominal

High Range: 1LSB = 6.1μV , full range = -100…+300 mV

Low Range: 1LSB = 61nV , full range = -1…….+3mV

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

| Calibration Factors | X | Y | Z |
|---|---|---|---|
| High Range | 403.818 ± 0.15% (k=2) | 403.555 ± 0.15% (k=2) | 404.470 ± 0.15% (k=2) |
| Low Range | 3.95395 ± 0.7% (k=2) | 3.97087 ± 0.7% (k=2) | 3.97994 ± 0.7% (k=2) |

## Connector Angle

| | |
|---|---|
| **Connector Angle** to be used in DASY system | 22.5° ± 1 ° |

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Client ECIT Certificate No: Z18-60343

# CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3252

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

Calibration date: September 04, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power Meter NRP2 | 101919 | 20-Jun-18 (CTTL, No.J18X05032) | Jun-19 |
| Power sensor NRP-Z91 | 101547 | 20-Jun-18 (CTTL, No.J18X05032) | Jun-19 |
| Power sensor NRP-Z91 | 101548 | 20-Jun-18 (CTTL, No.J18X05032) | Jun-19 |
| Reference10dBAttenuator | 18N50W-10dB | 09-Feb-18(CTTL, No.J18X01133) | Feb-20 |
| Reference20dBAttenuator | 18N50W-20dB | 09-Feb-18(CTTL, No.J18X01132) | Feb-20 |
| Reference Probe EX3DV4 | SN 3846 | 25-Jan-18(SPEAG,No.EX3-3846_Jan18) | Jan-19 |
| DAE4 | SN 777 | 15-Dec-17(SPEAG, No.DAE4-777_Dec17) | Dec -18 |
| **Secondary Standards** | **ID #** | **Cal Date(Calibrated by, Certificate No.)** | **Scheduled Calibration** |
| SignalGeneratorMG3700A | 6201052605 | 21-Jun-18 (CTTL, No.J18X05033) | Jun-19 |
| Network Analyzer E5071C | MY46110673 | 14-Jan-18 (CTTL, No.J18X00561) | Jan -19 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Yu Zongying | SAR Test Engineer | |
| Reviewed by: | Lin Hao | SAR Test Engineer | |
| Approved by: | Qi Dianyuan | SAR Project Leader | |

Issued: September 06, 2018

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**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,D | modulation dependent linearization parameters |
| Polarization Φ | Φ rotation around probe axis |
| Polarization θ | θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i θ=0 is normal to probe axis |
| Connector Angle | information used in DASY system to align probe sensor X to the robot coordinate system |

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016

c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010

d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

**Methods Applied and Interpretation of Parameters:**

- *NORMx,y,z:* Assessed for E-field polarization θ=0 (f≤900MHz in TEM-cell; f>1800MHz: waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not effect 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 (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≤800MHz) and inside waveguide using analytical field distributions based on power measurements for f >800MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty valued are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to 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±50MHz to±100MHz.
- *Spherical isotropy (3D deviation from isotropy):* in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset:* The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle:* The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

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# Probe ES3DV3

## SN: 3252

Calibrated: September 04, 2018

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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# DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3252

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm(μV/(V/m)$^2$)[A] | 1.29 | 1.35 | 1.33 | ±10.0% |
| DCP(mV)[B] | 102.7 | 105.4 | 103.6 | |

## Modulation Calibration Parameters

| UID | Communication System Name | | A dB | B dB√μV | C | D dB | VR mV | Unc[E] (k=2) |
|---|---|---|---|---|---|---|---|---|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 268.8 | ±2.5% |
| | | Y | 0.0 | 0.0 | 1.0 | | 276.1 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 278.3 | |

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

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

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# DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3252

## Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz][C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha[G] | Depth[G] (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 41.9 | 0.89 | 6.51 | 6.51 | 6.51 | 0.40 | 1.42 | ±12.1% |
| 835 | 41.5 | 0.90 | 6.36 | 6.36 | 6.36 | 0.40 | 1.56 | ±12.1% |
| 900 | 41.5 | 0.97 | 6.31 | 6.31 | 6.31 | 0.45 | 1.48 | ±12.1% |
| 1750 | 40.1 | 1.37 | 5.39 | 5.39 | 5.39 | 0.61 | 1.28 | ±12.1% |
| 1900 | 40.0 | 1.40 | 5.18 | 5.18 | 5.18 | 0.67 | 1.26 | ±12.1% |
| 2000 | 40.0 | 1.40 | 5.17 | 5.17 | 5.17 | 0.71 | 1.20 | ±12.1% |
| 2300 | 39.5 | 1.67 | 4.92 | 4.92 | 4.92 | 0.90 | 1.14 | ±12.1% |
| 2450 | 39.2 | 1.80 | 4.74 | 4.74 | 4.74 | 0.90 | 1.15 | ±12.1% |
| 2600 | 39.0 | 1.96 | 4.46 | 4.46 | 4.46 | 0.72 | 1.37 | ±12.1% |

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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# DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3252

## Calibration Parameter Determined in Body Tissue Simulating Media

| f [MHz][C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha[G] | Depth[G] (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 55.5 | 0.96 | 6.53 | 6.53 | 6.53 | 0.40 | 1.50 | ±12.1% |
| 835 | 55.2 | 0.97 | 6.34 | 6.34 | 6.34 | 0.42 | 1.58 | ±12.1% |
| 900 | 55.0 | 1.05 | 6.29 | 6.29 | 6.29 | 0.47 | 1.51 | ±12.1% |
| 1750 | 53.4 | 1.49 | 4.99 | 4.99 | 4.99 | 0.65 | 1.28 | ±12.1% |
| 1900 | 53.3 | 1.52 | 4.77 | 4.77 | 4.77 | 0.75 | 1.23 | ±12.1% |
| 2000 | 53.3 | 1.52 | 4.95 | 4.95 | 4.95 | 0.67 | 1.28 | ±12.1% |
| 2300 | 52.9 | 1.81 | 4.63 | 4.63 | 4.63 | 0.90 | 1.15 | ±12.1% |
| 2450 | 52.7 | 1.95 | 4.41 | 4.41 | 4.41 | 0.90 | 1.17 | ±12.1% |
| 2600 | 52.5 | 2.16 | 4.19 | 4.19 | 4.19 | 0.90 | 1.15 | ±12.1% |

[C] Frequency validity above 300 MHz of ±100MHz only applies for DASY v4.4 and higher (Page 2), else it is restricted to ±50MHz. The uncertainty is the RSS of ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.

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

[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for the frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

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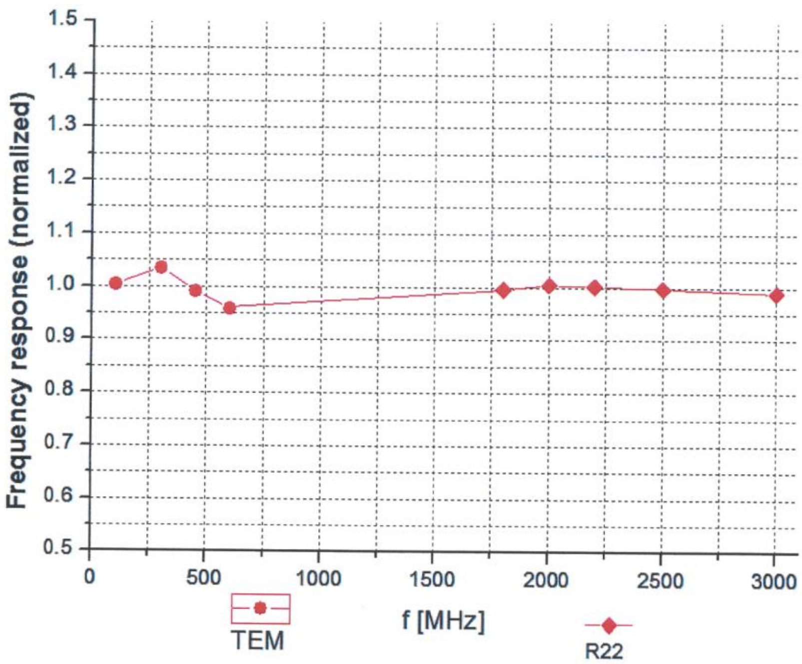
## Frequency Response of E-Field
### (TEM-Cell: ifi110 EXX, Waveguide: R22)




**Uncertainty of Frequency Response of E-field: ±7.4% (k=2)**

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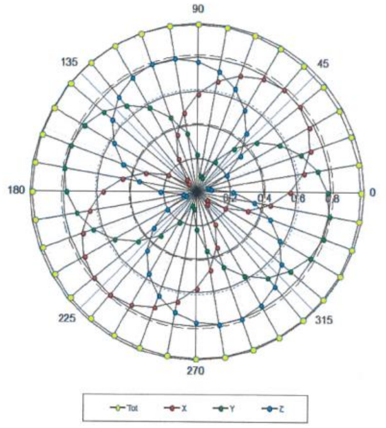
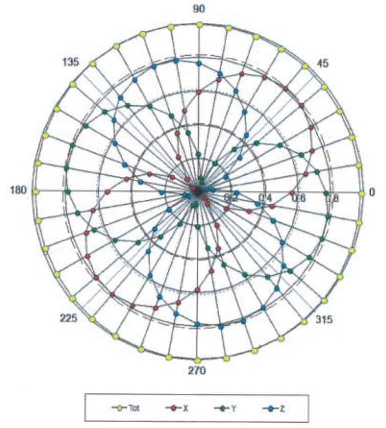
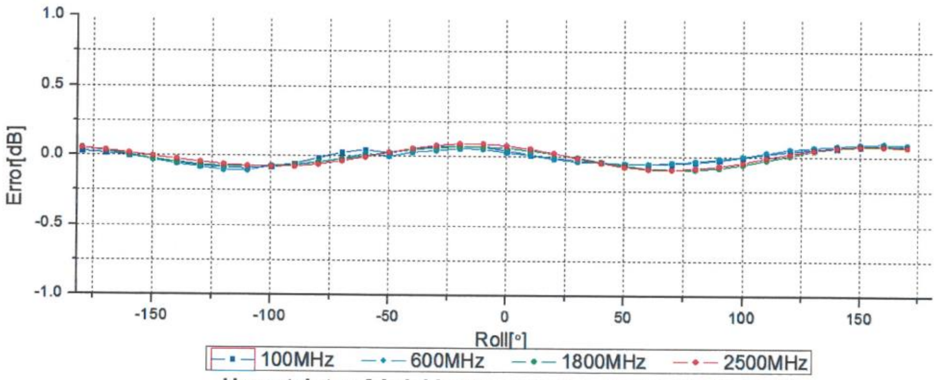
# Receiving Pattern (Φ), θ=0°

## f=600 MHz, TEM




## f=1800 MHz, R22




**Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)**

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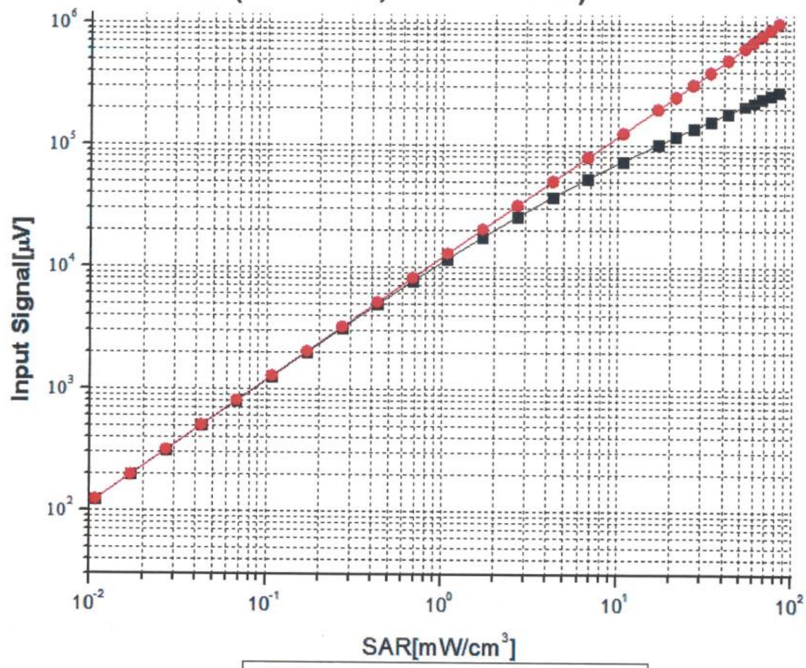
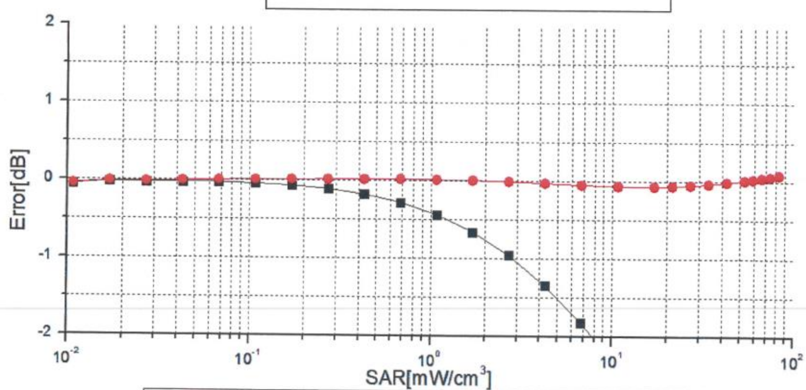
## Dynamic Range f($SAR_{head}$)
## (TEM cell, f = 900 MHz)




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

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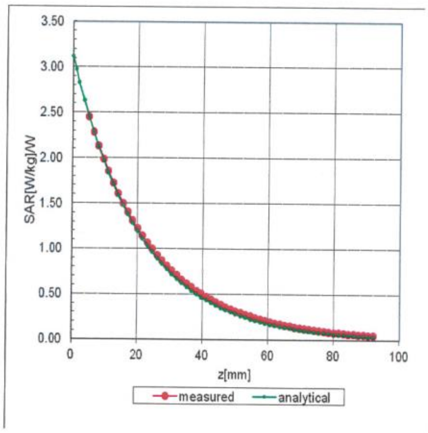
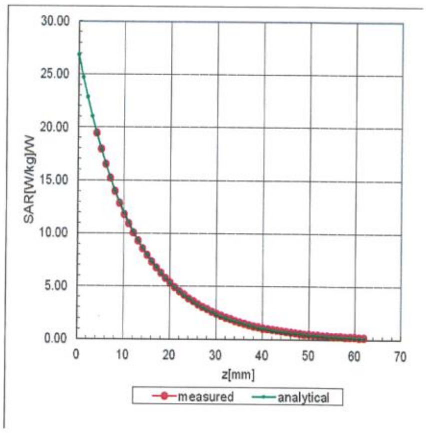
# Conversion Factor Assessment

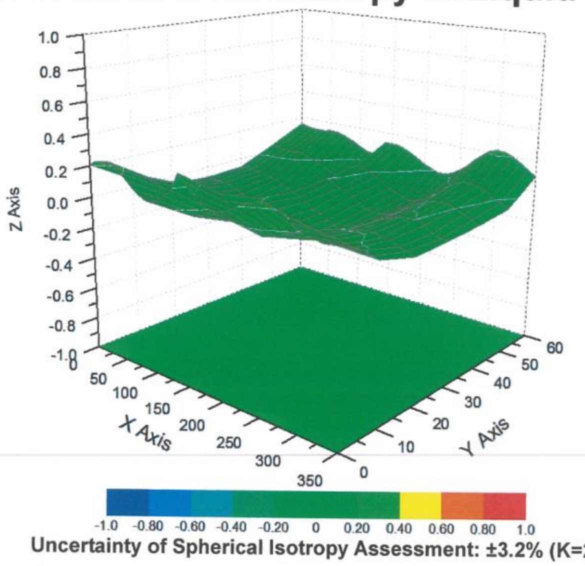
**f=750 MHz, WGLS R9(H_convF)**




**f=1750 MHz, WGLS R22(H_convF)**




# Deviation from Isotropy in Liquid




**Uncertainty of Spherical Isotropy Assessment: ±3.2% (K=2)**

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# DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3252

## Other Probe Parameters

| | |
|---|---|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 131.6 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disable |
| Probe Overall Length | 337mm |
| Probe Body Diameter | 10mm |
| Tip Length | 10mm |
| Tip Diameter | 4mm |
| Probe Tip to Sensor X Calibration Point | 2mm |
| Probe Tip to Sensor Y Calibration Point | 2mm |
| Probe Tip to Sensor Z Calibration Point | 2mm |
| Recommended Measurement Distance from Surface | 3mm |

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Client CTTL-CQ Certificate No: Z17-97253

# CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D1900V2 - SN: 5d151 |
| Calibration Procedure(s) | FF-Z11-003-01<br>Calibration Procedures for dipole validation kits |
| Calibration date: | December 6, 2017 |

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

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

Calibration Equipment used (M&TE critical for calibration)

| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
|---|---|---|---|
| Power Meter NRVD | 102196 | 02-Mar-17 (CTTL, No.J17X01254) | Mar-18 |
| Power sensor NRV-Z5 | 100596 | 02-Mar-17 (CTTL, No.J17X01254) | Mar-18 |
| Reference Probe EX3DV4 | SN 3617 | 23-Jan-17(SPEAG,No.EX3-3617_Jan17) | Jan-18 |
| DAE3 | SN 536 | 09-Oct-17(CTTL-SPEAG,No.Z17-97198) | Oct-18 |
| **Secondary Standards** | **ID #** | **Cal Date(Calibrated by, Certificate No.)** | **Scheduled Calibration** |
| Signal Generator E4438C | MY49071430 | 13-Jan-17 (CTTL, No.J17X00286) | Jan-18 |
| Network Analyzer E5071C | MY46110673 | 13-Jan-17 (CTTL, No.J17X00285) | Jan-18 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Zhao Jing | SAR Test Engineer | |
| Reviewed by: | Lin Hao | SAR Test Engineer | |
| Approved by: | Qi Dianyuan | SAR Project Leader | |

Issued: December 10, 2017

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**lossary:**

| | |
|---|---|
| TSL | tissue simulating liquid |
| ConvF | sensitivity in TSL / NORMx,y,z |
| N/A | not applicable or not measured |

**Calibration is Performed According to the Following Standards:**

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013

b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016

c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010

d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

**Additional Documentation:**

e) 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.

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%.

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## Measurement Conditions

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

| | | |
|---|---|---|
| **DASY Version** | DASY52 | 52.10.0.1446 |
| **Extrapolation** | Advanced Extrapolation | |
| **Phantom** | Triple Flat Phantom 5.1C | |
| **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 | 39.4 ± 6 % | 1.41 mho/m ± 6 % |
| **Head TSL temperature change during test** | <1.0 °C | ---- | ---- |

## SAR result with Head TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Head TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 10.2 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **40.5 mW /g ± 18.8 % (k=2)** |
| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | Condition | |
| SAR measured | 250 mW input power | 5.30 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **21.1 mW /g ± 18.7 % (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 % | 1.54 mho/m ± 6 % |
| **Body TSL temperature change during test** | <1.0 °C | ---- | ---- |

## SAR result with Body TSL

| **SAR averaged over 1 $cm^3$ (1 g) of Body TSL** | Condition | |
|---|---|---|
| SAR measured | 250 mW input power | 10.2 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **40.4 mW /g ± 18.8 % (k=2)** |
| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | Condition | |
| SAR measured | 250 mW input power | 5.34 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **21.2 mW /g ± 18.7 % (k=2)** |

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## Appendix (Additional assessments outside the scope of CNAS L0570)

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 51.8Ω+ 5.34jΩ |
| Return Loss | - 25.2dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 48.3Ω+ 5.41jΩ |
| Return Loss | - 24.8dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.057 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 |

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**DASY5 Validation Report for Head TSL** Date: 12.06.2017

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d151**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1900 MHz; σ = 1.409 S/m; εr = 39.36; ρ = 1000 kg/m3

Phantom section: Center Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(8.26, 8.26, 8.26); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

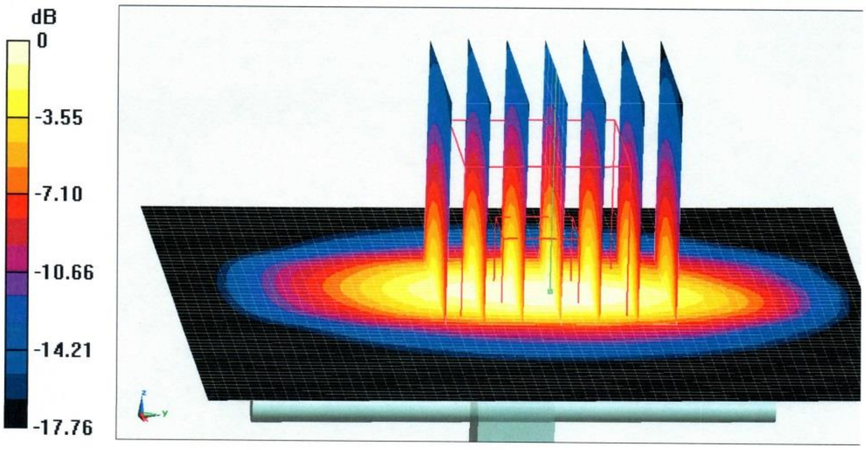
**System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 101.8 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 19.3 W/kg

**SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.3 W/kg**

Maximum value of SAR (measured) = 15.9 W/kg




**0 dB = 15.9 W/kg = 12.01 dBW/kg**

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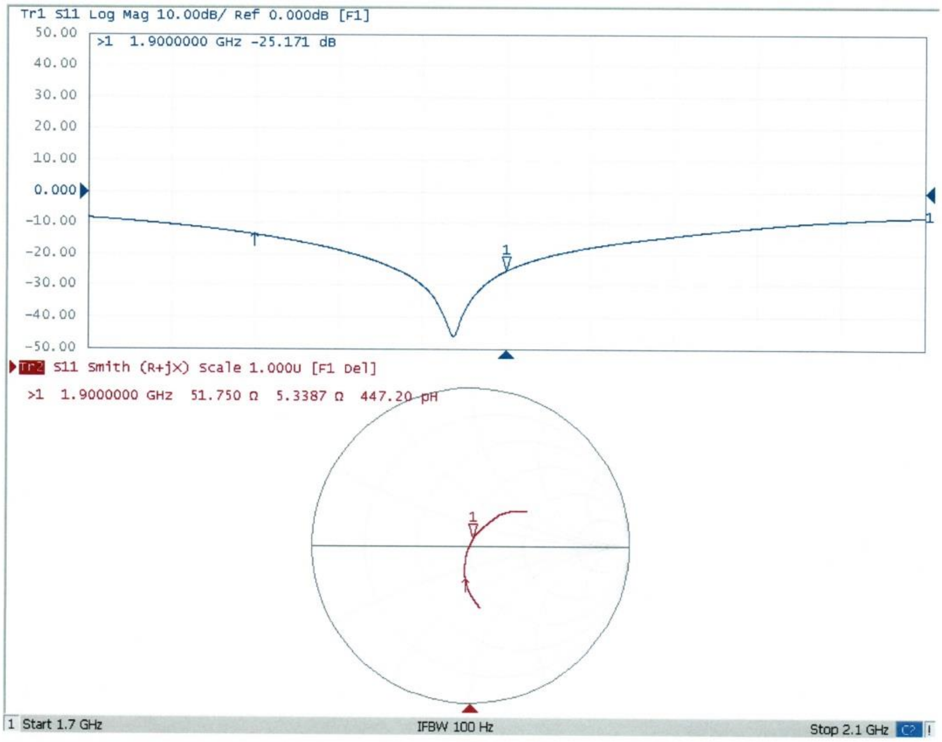
## Impedance Measurement Plot for Head TSL

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**DASY5 Validation Report for Body TSL** Date: 12.06.2017

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d151**

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1900 MHz; $\sigma$ = 1.542 S/m; $\varepsilon_r$ = 52.89; $\rho$ = 1000 kg/m$^3$

Phantom section: Left Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY5 Configuration:

- Probe: EX3DV4 - SN3617; ConvF(7.95, 7.95, 7.95); Calibrated: 1/23/2017;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn536; Calibrated: 10/9/2017
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

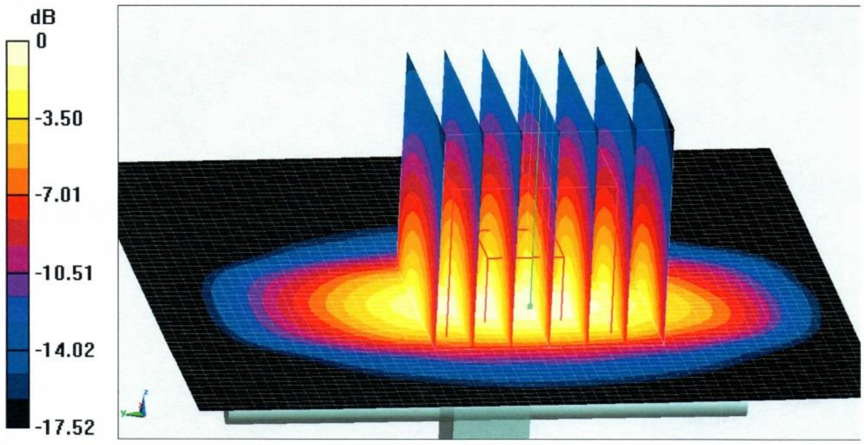
**System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.74 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 18.7 W/kg

**SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.34 W/kg**

Maximum value of SAR (measured) = 15.8 W/kg




**0 dB = 15.8 W/kg = 11.99 dBW/kg**

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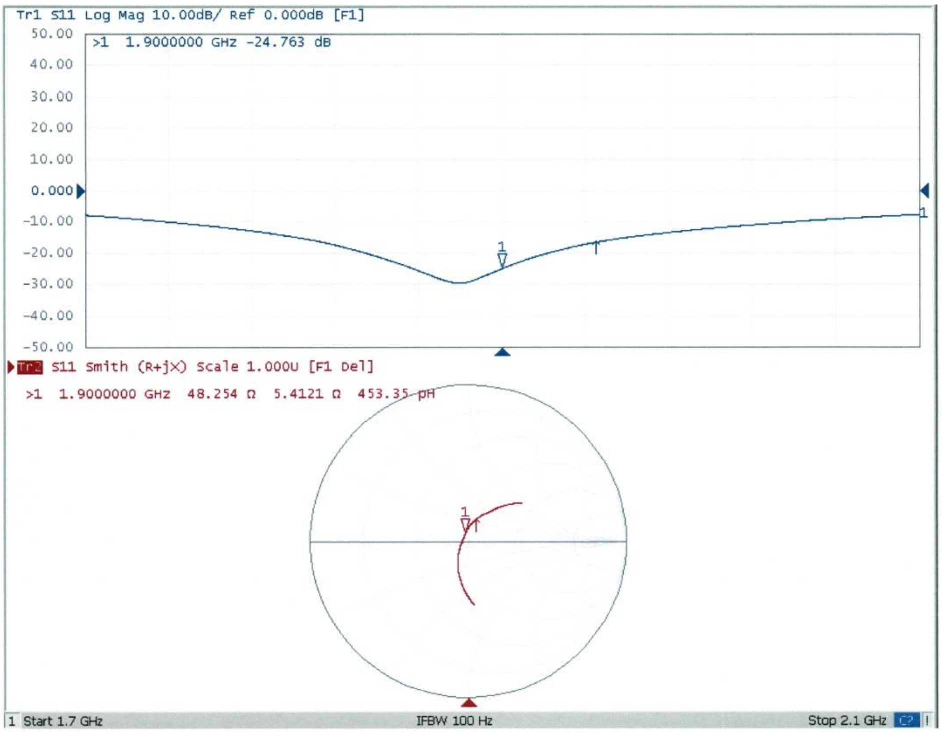
**Impedance Measurement Plot for Body TSL**

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# ANNEX E. Accreditation Certificate

## Accredited Laboratory

A2LA has accredited

**EAST CHINA INSTITUTE OF TELECOMMUNICATIONS**

*Shanghai, People's Republic of China*

for technical competence in the field of

Electrical Testing

This laboratory is accredited in accordance with the recognized International Standard ISO/IEC 17025:2017 *General requirements for the competence of testing and calibration laboratories*. This accreditation demonstrates technical competence for a defined scope and the operation of a laboratory quality management system (*refer to joint ISO-ILAC-IAF Communiqué dated April 2017*).

Presented this 6th day of May 2019.

Vice President, Accreditation Services
For the Accreditation Council
Certificate Number 3682.01
Valid to February 28, 2021

*For the tests to which this accreditation applies, please refer to the laboratory's Electrical Scope of Accreditation.*

************End of the Report************