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SAR TEST REPORT

Report No. 2017SAR344

FCC ID: TYD5X711
Applicant: LogicMark, LLC
Product: 3G mobile phone only call 911
Model Name: 30711B / 50711
Marketing Name: Guardian Alert 911 PLUS / notifi911+
HW Version: NAC115_MB_V1.0
SW Version: 3G911_B245_30711B_V01
Issue Date: 2017-07-06

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Standards

| | |
|------------------------------|--|
| Applicable Limit Regulations | <p>ANSI/IEEE C95.1-2005 Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields. 3 kHz to 300 GHz</p> <p>ANSI/IEEE C95.3-2002 Recommended Practice For Measurements and Computations of Radio Frequency Electromagnetic Fields with Respect to Human Exposure to such Fields. 100 kHz-300 GHz</p> |
| Applicable Standards | <p>IEEE Std 1528™-2013: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques</p> <p>KDB865664 D01v01r04: SAR Measurement 100 MHz to 6 GHz</p> <p>KDB865664 D02v01r02: RF Exposure Reporting</p> <p>KDB447498 D01v06: General RF Exposure Guidance</p> <p>KDB941225 D01v03r01: 3G SAR Procedures</p> |

Conclusion

Localized Specific Absorption Rate (SAR) of this equipment has been measured in all cases requested by the relevant standards above. Maximum localized SAR is below exposure limits as well.

Change History

| Version | Change Contents | Author | Date |
|---------|-----------------|----------|------------|
| V1.0 | First edition | Wang Wei | 2017-07-06 |
| | | | |
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Note: The last version will be invalid automatically while the new version is issued.

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1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **LogicMark, LLC 3G mobile phone only call 911 30711B / 50711** are as follows.

Highest standalone SAR Summary:

| Exposure Position | Frequency Band | Maximum reported 1g SAR (W/kg) | Highest reported 1g SAR (W/kg) |
|---------------------|----------------|--------------------------------|--------------------------------|
| Body-worn (10mm) | WCDMA BAND II | 1.43 | 1.43 |
| | WCDMA BAND IV | 0.673 | |
| | WCDMA BAND V | 0.715 | |

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits(1.6W/kg) specified in FCC 47 CFR part 2(2.1093) and ANSI/IEEE C95.1-2005, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013.

For body worn operation, this device had been tested and meet FCC RF exposure guidelines when used with any accessory that contains no metal and which provides a minimum separation distance of 10 mm between this device and the body of user. use of other accessories may not ensure compliance with FCC RF exposure guidelines.

2. Administrative Information

2.1 Project Information

Date of start test: 2017-07-04
Date of end test: 2017-07-05

2.2 Test Laboratory Information

Company: Shanghai Tejet Communications Technology Co., Ltd Testing Center
Address: Room 6205-6208, Building 6, No.399 Cailun Rd. Zhangjiang Hi-Tech Park, Shanghai, China
Post Code: 210203
Tel: +86-21-61650880
Fax: +86-21-61650881
Website: www.tejet.cn

2.3 Test Environment

Temperature: 20°C~25 °C
Relative Humidity: 20%~70%

3. Client Information

3.1 Applicant information

Company Name: LogicMark, LLC
Address: 10106 Bluegrass Pkwy, Louisville KY, 40299 USA
City: /
Postal Code: /
Country: /
Telephone: 703-934-7934 ext 119
Fax: 703-934-7935

3.2 Manufacturer Information

Company Name: APEX Global Electronics CO. Limited
Address: Unit M, 17/F, Block 2, Kin Ho Industrial Building, 14-24 Au Pui Wan Street, Fo Tan, N.T. Hong Kong
City: /
Postal Code: /
Country: /
Telephone: (852) 23344535
Fax: (852) 23344535

4. Equipment Under Test (EUT) and Accessory Equipment (AE)

4.1 Information of EUT

| | | |
|---------------------------------|---|---------------|
| Device Type | Portable device | |
| Product | 3G mobile phone only call 911 | |
| Model | 30711B/50711 | |
| Type | Identical Prototype | |
| Exposure Category | Uncontrolled environment / general population | |
| Device operation configuration: | | |
| Operating Mode(s): | WCDMA BAND II/IV/V | |
| Test Modulation | (WCDMA) QPSK | |
| Rated Output Power | WCDMA BAND II: 21.5dBm | |
| | WCDMA BAND IV: 22.0dBm | |
| | WCDMA BAND V: 22.0dBm | |
| WCDMA Release version | R99 | |
| Antenna Type: | Internal antenna | |
| Operating Frequency Range(s): | Band | Tx(MHz) |
| | WCDMA BAND II | 1852.4~1907.6 |
| | WCDMA BAND IV | 1712.4~1752.6 |
| | WCDMA BAND V | 826.4~846.6 |
| Power Class | WCDMA BAND II/IV/V: 3, test with maximum output power | |
| EUT size | length, width, height: 66mm*45mm*22mm | |

4.2 Identification of EUT

| EUT ID | SN or IMEI | HW Version | SW Version | Received Date |
|--------|---------------|----------------|-----------------------|---------------|
| TN07 | 35211109***** | NAC115_MB_V1.0 | 3G911_B245_30711B_V01 | 2017-07-03 |

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

4.3 Identification of AE

| AE ID* | Description |
|--------|----------------|
| AE1 | Battery |
| AE2 | Travel Adaptor |

AE1

| | |
|-----------------|-----------------------------------|
| Model | li-ion |
| Manufacturer | ZHUHAI GREAT POWER ENERGY CO.,LTD |
| Capacitance | 600mAh |
| Nominal Voltage | 3.7V |

AE2

| | |
|-------------------|---|
| Model | KA1508-0501000US |
| Manufacturer | SHENZHEN KEYU POWER SUPPLY TECHNOLOGY CO.,LTD |
| Length of DC line | 100cm |

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

5. Operational Conditions during Test

5.1 General description of test procedures

A communication link is set up with a system simulator by air link, and a call is established. The absolute radio frequency channel is allocated to low, middle and high respectively in the case of each band. The EUT is commanded to operate at maximum transmitting power.

Connection to the EUT is established via air interface with CMU200, and the EUT is set to maximum output power by CMU200. The antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the EUT. The signal transmitted by the simulator to the antenna feeding point shall be lower than the output power level of the EUT by at least 30dB.

5.2 WCDMA Test Configuration

SAR test for WCDMA BANDII/IV/V, a communication link is set up with a system simulator by air link. Using CMU200 the power level is set to “3” in SAR of WCDMA BAND II/IV/V. The tests in the band of WCDMA BAND II/IV/V are performed in the mode of RMC 12.2kbps transfer function.

SAR for body exposure configurations in voice and data modes is measured using 12.2kbps RMC with TPC bits configured to all “1’s”. SAR for other spreading codes and multiple DPDCHn , when supported by the DYT, are not required when the maximum average output of each RF channel, for each spreading code and DPDCHn configuration, are less than 1/4 dB higher than those measured in 12.2 kbps RMC. Otherwise , SAR is measured on the maximum output channel with an applicable RMC configuration for the corresponding spreading code or DPDCHn using the exposure configuration that results in the highest SAR with 12.2 kbps RMC. When more than 2 DPDCHn are supported by the DUT, it may be necessary to configure additional DPDCHn for a DUT using FTM(Factory Test Mode) or other chipset based test approaches with parameters similar to those used in 384kbps and 968 kbps RMC.

6. SAR Measurements system configuration

6.1 SAR Measurement set-up

The DASY5 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Staubli 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 generic twin phantom enabling the testing of left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- System validation dipoles allowing to validate the proper functioning of the system.

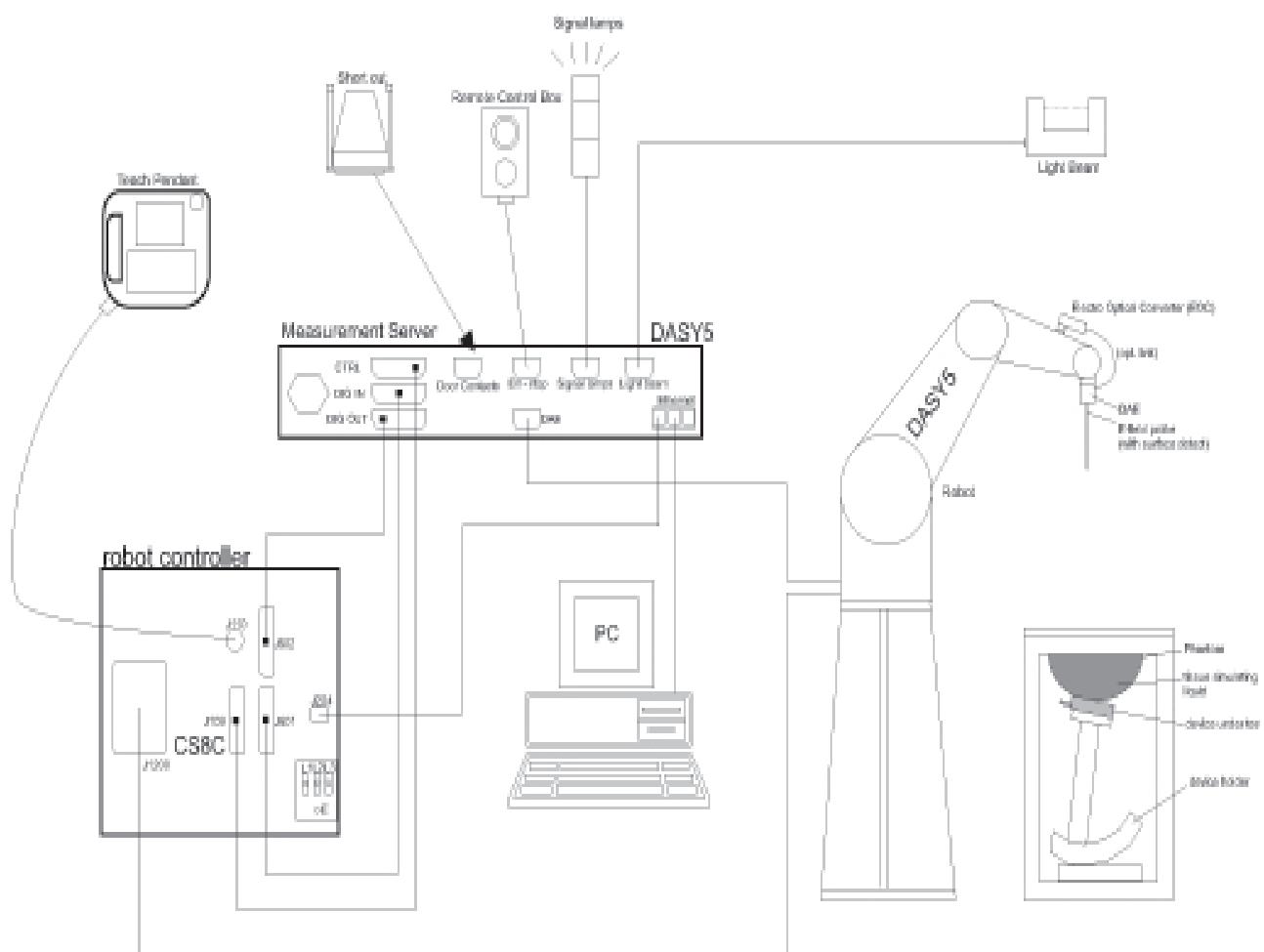


Figure 5-1 SAR Lab Test Measurement Set-up

6.2 DASY5 E-field Probe System

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

6.2.1 Ex3DV4 Probe Specification

| | |
|---------------|---|
| Construction | Symmetrical design with triangular core Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE) |
| Calibration | Basic Broad Band Calibration in air Conversion Factors (CF) for HSL 850 and HSL 1750 |
| | Additional CF for other liquids and frequencies upon request |
| Frequency | 10 MHz to > 6 GHz |
| | Linearity: ± 0.2 dB (30 MHz to 6 GHz) |
| Directivity | ± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis) |
| Dynamic Range | 10 μ W/g to > 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 μ W/g) |

| | |
|-------------|--|
| Dimensions | Overall length: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm |
| Application | High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 6 GHz with precision of better 30%. |



Figure 5-2.Ex3DV4 E-field Probe



Figure 5-3. Ex3DV4 E-field probe

6.2.2 E-field Probe Calibration

Each probe is calibrated according to a dosimetric assessment procedure with accuracy better than $\pm 10\%$. The spherical isotropy was evaluated and found to be better than $\pm 0.25\text{dB}$. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested.

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

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

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

Where: Δt = Exposure time (30 seconds),
 C = Heat capacity of tissue (brain or muscle),
 ΔT = Temperature increase due to RF exposure.

Or

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

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m³).

6.3 Other Test Equipment

6.3.1 Device Holder for Transmitters

The DASY5 device holder is designed to cope with the die rent 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 are the ear reference point (ERP). Thus the device needs no repositioning when changing the angles. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the inference of the clamp on the test results could thus be lowered.

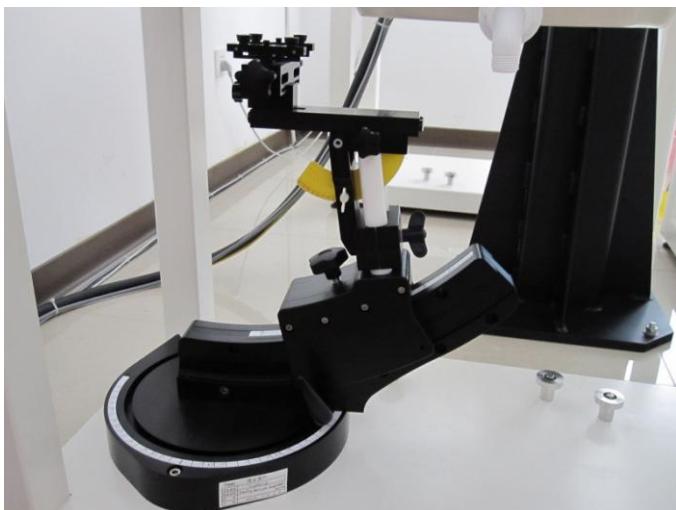


Figure 5-4.Device Holder

6.3.2 Phantom

The Generic Twin Phantom is constructed of a fiberglass shell integrated in a wooden Figure. 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.

Shell Thickness 2±0.1 mm

Filling Volume Approx. 20 liters

Dimensions 810 x 1000 x 500 mm (H x L x W)

Available

Special



Figure 5-5.Generic Twin Phantom

6.4 Scanning procedure

The DASY5 installation includes predefined files with recommended procedures for measurements and validation. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

- The “reference” and “drift” measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. $\pm 5\%$.
- The “surface check” measurement tests the optical surface detection system of the DASY5 system by repeatedly detecting the surface with the optical and mechanical surface detector and comparing the results. The output gives the detecting heights of both systems, the difference between the two systems and the standard deviation of the detection repeatability. Air bubbles or refraction in the liquid due to separation of the sugar-water mixture gives poor repeatability (above $\pm 0.1\text{mm}$). To prevent wrong results tests are only executed when the liquid is free of air bubbles. The difference between the optical surface detection and the actual surface depends on the probe and is specified with each probe. (It does not depend on the surface reflectivity or the probe angle to the surface within $\pm 30^\circ$.)

- **Area Scan**

The Area Scan is used as a fast scan in two dimensions to find the area of high field values before running a detailed measurement around the hot spot. Before starting the area scan a grid spacing of 15 mm x 15 mm is set. During the scan the distance of the probe to the phantom remains unchanged.

After finishing area scan, the field maxima within a range of 2 dB will be ascertained.

- Zoom Scan

Zoom Scans are used to estimate the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The default Zoom Scan is done by 7x7x7 points within a cube whose base is centered around the maxima found in the preceding area scan.

- Spatial Peak Detection

The procedure for spatial peak SAR evaluation has been implemented and can determine values of masses of 1g and 10g, as well as for user-specific masses. The DASY5 system allows evaluations that combine measured data and robot positions, such as:

- maximum search
- extrapolation
- boundary correction
- peak search for averaged SAR

During a maximum search, global and local maxima searches are automatically performed in 2-D after each Area Scan measurement with at least 6 measurement points. It is based on the evaluation of the local SAR gradient calculated by the Quadratic Shepard's method. The algorithm will find the global maximum and all local maxima within -2 dB of the global maxima for all SAR distributions.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. Several measurements at different distances are necessary for the extrapolation. Extrapolation routines require at least 10 measurement points in 3-D space.

They are used in the Zoom Scan to obtain SAR values between the lowest measurement points and the inner phantom surface. The routine uses the modified Quadratic Shepard's method for extrapolation. For a grid using 7x7x7 measurement points with 5mm resolution amounting to 343 measurement points, the uncertainty of the extrapolation routines is less than 1% for 1g and 10g cubes.

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

6.5 Data Storage and Evaluation

6.5.1 Data Storage

The DASY5 software stores the acquired data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all necessary software parameters

for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files with the extension ".DA4". The software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of incorrect parameter settings. For example, if a measurement has been performed with a wrong crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be re-evaluated. The measured data can be visualized or exported in different units or formats, depending on the selected probe type ([V/m], [A/m], [°C], [mW/g], [mW/cm²], [dBrel], etc.). Some of these units are not available in certain situations or show meaningless results, e.g., a SAR output in a lossless media will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

6.5.2 Data Evaluation by SEMCAD

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

| | | |
|--------------------|---------------------------|--|
| Probe parameters: | - Sensitivity | Normi, a _{i0} , a _{i1} , a _{i2} |
| | - Conversion factor | ConvFi |
| | - Diode compression point | Dcp _i |
| Device parameters: | - Frequency | f |
| | - Crest factor | cf |
| Media parameters: | - Conductivity | |
| | - Density | |

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY5 components. In the direct measuring mode of the multimeter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics.

If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given as:

$$V_i = U_i + U_i^2 \cdot c f / d c p_i$$

With V_i = compensated signal of channel i (i = x, y, z)

U_i = input signal of channel i (i = x, y, z)

cf = crest factor of exciting field (DASY parameter)

dcp_i = diode compression point (DASY parameter)

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

E-field probes: $E_i = (V_i / Norm_i \cdot ConvF)^{1/2}$

H-field probes: $H_i = (V_i)^{1/2} \cdot (a_{i0} + a_{i1}f + a_{i2}f^2) / f$

With V_i = compensated signal of channel i (i = x, y, z)

Norm_i = sensor sensitivity of channel i (i = x, y, z)

[mV/(V/m)²] for E-field Probes

ConvF = sensitivity enhancement in solution

a_{ij} = sensor sensitivity factors for H-field probes

f = carrier frequency [GHz]

E_i = electric field strength of channel i in V/m

H_i = magnetic field strength of channel i in A/m

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

$E_{tot} = (E_x^2 + E_y^2 + E_z^2)^{1/2}$

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

SAR = ($E_{tot}^2 \cdot \square$)^{1/2} / (· 1000)

with **SAR** = local specific absorption rate in mW/g

E_{tot} = total field strength in V/m

\square = conductivity in [mho/m] or [Siemens/m]

\square = equivalent tissue density in g/cm³

Note that the density is normally set to 1 (or 1.06), to account for actual brain density rather than the density of the simulation liquid. The power flow density is calculated assuming the excitation field to be a free space field.

$P_{pwe} = E_{tot}^2 / 3770$ or $P_{pwe} = H_{tot}^2 \cdot 37.7$

with P_{pwe} = equivalent power density of a plane wave in mW/cm²

E_{tot} = total electric field strength in V/m

H_{tot} = total magnetic field strength in A/m

6.6 System check

The manufacturer calibrates the probes annually. Dielectric parameters of the tissue simulates were measured every day using the dielectric probe kit and the network analyzer. A system check measurement was made following the determination of the dielectric parameters of the simulates, using the dipole validation kit. A power level of 250 mW was supplied to the dipole antenna, which was placed under the flat section of the twin SAM phantom. The system check results (dielectric parameters and SAR values) are given in the 6.2.1 and 6.2.2

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

System check is performed regularly on all frequency bands where tests are performed with the DASY 5 system.

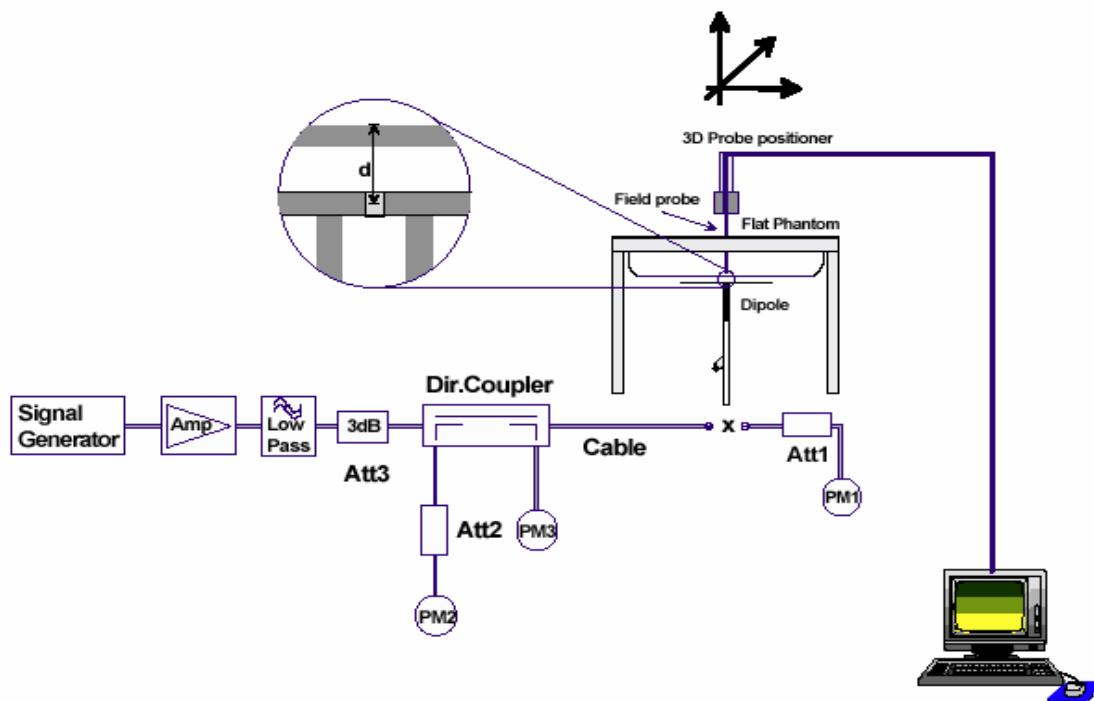


Figure 5-6. System Check Set-up

6.7 Equivalent Tissues

The liquid is consisted of water, salt, Glycol, Sugar, Preventol and Cellulose. The liquid has previously been proven to be suited for worst-case. The Table show the detail solution. It's

satisfying the latest tissue dielectric parameters requirements proposed by the OET 65.

| MIXTURE% | FREQUENCY(body) 835MHz |
|---------------------------------------|---|
| Water | 52.5 |
| Sugar | 45 |
| Salt | 1.4 |
| Preventol | 0.1 |
| Cellulose | 1 |
| Dielectric Parameters Target Value | f=835MHz $\epsilon=55.2$ $\sigma=0.97$ |
| MIXTURE% | FREQUENCY(body)1750MHz |
| Water | 69.91 |
| Glycol monobutyl | 29.96 |
| Salt | 0.13 |
| Dielectric Parameters Target Value | f=1750MHz $\epsilon=53.4$ $\sigma=1.49$ |
| MIXTURE% | FREQUENCY(body)1900MHz |
| Water | 69.91 |
| Glycol monobutyl | 29.96 |
| Salt | 0.13 |
| Dielectric Parameters Target Value | f=1900MHz $\epsilon=53.3$ $\sigma=1.52$ |

7. Summary of Test Results

7.1 Conducted Output Power Measurement

7.1.1 Summary

The DUT is tested using CMU200/MT8820C communications tester as controller unit to set test channels and maximum output power to the DUT, as well as for measuring the conducted power.

Conducted output power was measured using an integrated RF connector and attached RF cable.

This result contains conducted output power for the EUT.

7.1.2 Conducted Power Results

| WCDMA BAND II | Conducted Output power (dBm) | | |
|---------------|------------------------------|---------|-----------|
| | low | middle | high |
| | CH9262 | CH9400 | CH9538 |
| | 1852.4MHz | 1800MHz | 1907.6MHz |
| 12.2kbps RMC | 21.44 | 20.92 | 21.35 |

| WCDMA BAND IV | Conducted Output power (dBm) | | |
|---------------|------------------------------|-----------|-----------|
| | low | middle | high |
| | CH1312 | CH1413 | CH1513 |
| | 1712.4 MHz | 1732.5MHz | 1752.6MHz |
| 12.2kbps RMC | 21.83 | 21.41 | 21.55 |

| WCDMA BAND V | Conducted Output power (dBm) | | |
|--------------|------------------------------|----------|----------|
| | low | middle | high |
| | CH4132 | CH4183 | CH4233 |
| | 826.4 MHz | 836.6MHz | 846.6MHz |
| 12.2kbps RMC | 21.57 | 21.56 | 21.46 |

Body-worn of WCDMA BAND II/IV/V are tested with 12.2kbps RMC.

7.2 Test Results

7.2.1. Dielectric Performance

Dielectric Performance of Tissue Simulating Liquid

| Frequency | Description | Dielectric Parameters ϵ_r | σ (s/m) | temp °C |
|-------------------|---------------------------------|------------------------------------|----------------|---------|
| 835MHz (body) | Target value | 55.2 | 0.97 | / |
| | 5% window | 52.44-57.96 | 0.92-1.02 | |
| | Measurement value 2017-07-04 | 54.84 | 0.95 | 21.7 |
| 1750MHz (body) | Target value | 53.4 | 1.49 | / |
| | 5% window | 50.63-55.96 | 1.42 -1.56 | |
| | Measurement value 2017-07-05 | 52.26 | 1.48 | 21.7 |
| 1900MHz (body) | Target value | 53.3 | 1.52 | / |
| | 5% window | 50.63-55.96 | 1.44 -1.60 | |
| | Measurement value 2017-07-05 | 52.64 | 1.50 | 21.7 |

7.2.2. System Check Results

System Check for tissue simulation liquid

| Frequency | Description | SAR(W/kg) | | Targeted SAR1g (W/kg) | Normalized SAR1g (W/kg) | Deviation (%) |
|-------------------|---|-------------------|--------------------|-----------------------|-------------------------|---------------|
| | | 10g | 1g | | | |
| 835MHz (body) | Recommended result ±10% window | 1.59 1.43-1.75 | 2.39 2.15-2.63 | / | / | / |
| | Measurement value 2017-07-04 (250mW) | 1.57 | 2.34 | 9.61 | 9.36 | -2.60 |
| 1750MHz (body) | Recommended result ±10% window | 5.15 4.64-5.67 | 9.32 8.39-10.25 | / | / | / |
| | Measurement value 2017-07-05 (250mW) | 5.13 | 9.46 | 37.1 | 37.84 | 1.99 |
| 1900MHz (body) | Recommended result ±10% window | 5.28 4.75-5.81 | 9.94 8.95-10.93 | / | / | / |
| | Measurement value 2017-07-05 (250mW) | 5.16 | 9.89 | 40.4 | 39.56 | -2.08 |

Note: 1. the graph results see ANNEX B.1.

2 .Recommended Values used derive from the calibration certificate and 250 mW is used as feeding power to the calibrated dipole.

7.2.3 Scaling Factor Calculation

| Operation Mode | Channel | Output Power(dBm) | Turn-up Limit (dBm) | Duty Cycle Factor | Scaling Factor |
|----------------|---------|-------------------|---------------------|-------------------|----------------|
| WCDMA Band II | 9262 | 21.44 | 21.5 | / | 1.014 |
| | 9400 | 20.92 | 21.5 | / | 1.143 |
| | 9538 | 21.35 | 21.5 | / | 1.035 |
| WCDMA Band IV | 1312 | 21.83 | 22 | / | 1.040 |
| | 1413 | 21.41 | 22 | / | 1.146 |
| | 1513 | 21.55 | 22 | / | 1.109 |
| WCDMA Band V | 4132 | 21.57 | 22 | / | 1.104 |
| | 4183 | 21.56 | 22 | / | 1.107 |
| | 4233 | 21.46 | 22 | / | 1.132 |

7.2.4 Test Results

7.2.4.1 Summary of Measurement Results (WCDMA BAND II)

SAR Values (WCDMA BAND II)

| Test Case | | Measurement Result(W/kg) | Scaled Factor | Scaled 1g SAR(W/Kg) | Note |
|--|---------|--------------------------|---------------|---------------------|---------|
| Different Test Position | Channel | 1g SAR Average | | | |
| Test position of Body hotspot (Distance 10 mm) | | | | | |
| front | low | 0.747 | 1.014 | 0.757 | |
| back | low | 1.41 | 1.014 | 1.43 | max |
| top | low | 0.460 | 1.014 | 0.466 | |
| bottom | low | 0.096 | 1.014 | 0.097 | |
| left side | low | 0.623 | 1.014 | 0.632 | |
| right side | low | 0.571 | 1.014 | 0.579 | |
| back | middle | 1.20 | 1.143 | 1.37 | |
| | high | 1.16 | 1.035 | 1.20 | |
| | low | 1.39 | 1.014 | 1.41 | Repeat1 |
| | low | 1.41 | 1.014 | 1.43 | Repeat2 |

Note: 1.The value with blue color is the maximum SAR Value of test case of head and body in each test band.

- 2.Per KDB Publication 941225 D01v03r01. RMC 12.2kbps was as primary mode SAR, when the primary mode SAR less than 1.2W/kg, secondary SAR (HSPA) was not required.
- 3.When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy the following conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v06)
 - $\leq 0.8 \text{ W/kg}$, when the transmission band is $\leq 100 \text{ MHz}$
 - $\leq 0.6 \text{ W/kg}$, when the transmission band is between 100 MHz and 200 MHz
 - $\leq 0.4 \text{ W/kg}$, when the transmission band is $\geq 200 \text{ MHz}$

7.2.4.2 Summary of Measurement Results (WCDMA BAND IV)

SAR Values (WCDMA BAND IV)

| Test Case | | Measurement Result(W/kg) | Scaled Factor | Scaled 1g SAR(W/Kg) | Note |
|--|---------|--------------------------|---------------|---------------------|------|
| Different Test Position | Channel | 1g SAR Average | | | |
| Test position of Body hotspot (Distance 10 mm) | | | | | |
| front | low | 0.372 | 1.040 | 0.387 | |
| back | low | 0.647 | 1.040 | 0.673 | max |
| top | low | 0.364 | 1.040 | 0.379 | |
| bottom | low | 0.076 | 1.040 | 0.079 | |
| left side | low | 0.127 | 1.040 | 0.132 | |
| right side | low | 0.271 | 1.040 | 0.282 | |

Note: 1.The value with blue color is the maximum SAR Value of test case of head and body in each test band.

2.Per KDB Publication 941225 D01v03r01. RMC 12.2kbps was as primary mode SAR, when the primary mode SAR less than 1.2W/kg, secondary SAR (HSPA) was not required.

3.When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy the following conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v06)

- ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg, when the transmission band is ≥ 200 MHz

7.2.4.3 Summary of Measurement Results (WCDMA BAND V)

SAR Values (WCDMA BAND V)

| Test Case | | Measurement Result(W/kg) | Scaled Factor | Scaled 1g SAR(W/Kg) | Note |
|--|---------|--------------------------|---------------|---------------------|------|
| Different Test Position | Channel | 1g SAR Average | | | |
| Test position of Body hotspot (Distance 10 mm) | | | | | |
| front | low | 0.512 | 1.104 | 0.565 | |
| back | low | 0.648 | 1.104 | 0.715 | max |
| top | low | 0.152 | 1.104 | 0.168 | |
| bottom | low | 0.021 | 1.104 | 0.023 | |
| left side | low | 0.302 | 1.104 | 0.333 | |
| right side | low | 0.395 | 1.104 | 0.436 | |

Note: 1.The value with blue color is the maximum SAR Value of test case of head and body in each test band.

2.Per KDB Publication 941225 D01v03r01. RMC 12.2kbps was as primary mode SAR, when the primary mode SAR less than 1.2W/kg, secondary SAR (HSPA) was not required.

3.When the 1-g SAR for the mid-band channel or the channel with the highest output power satisfy the following conditions, testing of the other channels in the band is not required. (Per KDB 447498 D01 General RF Exposure Guidance v06)

- ≤ 0.8 W/kg, when the transmission band is ≤ 100 MHz
- ≤ 0.6 W/kg, when the transmission band is between 100 MHz and 200 MHz
- ≤ 0.4 W/kg, when the transmission band is ≥ 200 MHz

7.2.5 Maximum SAR

| Band | Worst Position | | Channel | Reported 1g SAR (W/kg) |
|---------------|----------------|------|---------|------------------------|
| WCDMA Band II | body | back | low | 1.43 |
| WCDMA Band IV | body | back | low | 0.673 |
| WCDMA Band V | bosy | back | low | 0.715 |

General Judgment: PASS

8. Test Equipments Utilized

| No. | Name | Type | S/N | Calibration Date | Valid Period |
|-----|------------------------|----------------|------------|-----------------------------|--------------|
| 01 | Network analyzer | Agilent E5071E | MY46109425 | Oct 28 th , 2016 | One year |
| 02 | Dielectric Probe Kit | Agilent 85070E | MY44300524 | | N/A |
| 03 | Power meter | Agilent E4418B | MY50000852 | Oct 28 th , 2016 | One year |
| 04 | Power sensor | Agilent E9200B | MY50300011 | Oct 28 th , 2016 | One year |
| 05 | Power meter | Agilent E4419B | GB42420229 | May 17 th , 2017 | One year |
| 06 | Power sensor | Agilent 8482A | MY41091903 | May 17 th , 2017 | One year |
| 07 | Signal Generator | Agilent N5182A | MY49071248 | Oct 28 th , 2016 | One year |
| 08 | Amplifier | ZHL-42W | QA1020005 | | N/A |
| 09 | BTS | CMU200 | 121464 | Oct 28 th , 2016 | One year |
| 10 | E-field Probe | ES3DV3 | 3297 | Oct 14 th , 2016 | One year |
| 11 | DAE | DAE4 | 1226 | Sep 28 th , 2016 | One year |
| 12 | Validation Kit 835MHz | D835V2 | 4d100 | Oct 10 th , 2016 | One year |
| 13 | Validation Kit 1750MHz | D1750V2 | 1034 | Oct 11 th , 2016 | One year |
| 14 | Validation Kit 1900MHz | D1900V2 | 5d142 | Jun 21 th , 2017 | One year |

9. Measurement Uncertainty

| No | Source of Uncertainty | Type | Uncertainty value ± % | Probability Distribution | Div. | c_i (1 g) | c_i (10 g) | Standard Unc ± %, (1 g) | Standard Unc ± %, (10 g) | v_i or v_{eff} |
|----------------------------|---|------|--------------------------|-----------------------------|------------|----------------|-----------------|-------------------------------|--------------------------------|--------------------------|
| 1 | System repetitivity | A | 2.7 | N | 1 | 1 | 1 | 2.7 | 2.7 | 9 |
| <i>Measurement System</i> | | | | | | | | | | |
| 2 | Probe Calibration | B | 5.9 | N | 1 | 1 | 1 | 5.9 | 5.9 | ∞ |
| 3 | Isotropy | B | 4.7 | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.9 | 1.9 | ∞ |
| 4 | Boundary Effect | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 5 | Linearity | B | 4.7 | R | $\sqrt{3}$ | 1 | 1 | 2.7 | 2.7 | ∞ |
| 6 | Detection Limits | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| 7 | Readout Electronics | B | 0.3 | N | 1 | 1 | 1 | 0.3 | 0.3 | ∞ |
| 8 | Response Time | B | 0.8 | R | $\sqrt{3}$ | 1 | 1 | 0.5 | 0.5 | ∞ |
| 9 | Integration Time | B | 2.6 | R | $\sqrt{3}$ | 1 | 1 | 1.5 | 1.5 | ∞ |
| 10 | RF ambient conditions – noise | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 11 | RF ambient conditions – reflections | B | 0 | R | $\sqrt{3}$ | 1 | 1 | 0 | 0 | ∞ |
| 12 | Probe Positioner Mech. Restrictions | B | 0.4 | R | $\sqrt{3}$ | 1 | 1 | 0.2 | 0.2 | ∞ |
| 13 | Probe Positioning with respect to Phantom Shell | B | 2.9 | R | $\sqrt{3}$ | 1 | 1 | 1.7 | 1.7 | ∞ |
| 14 | Post-Processing | B | 1.0 | R | $\sqrt{3}$ | 1 | 1 | 0.6 | 0.6 | ∞ |
| <i>Test Sample Related</i> | | | | | | | | | | |

| | | | | | | | | | | |
|---|-------------------------------|--|------|---|------------|------|------|-------|-------|----------|
| 15 | Test Sample Positioning | A | 3.3 | N | 1 | 1 | 1 | 3.3 | 3.3 | 71 |
| 16 | Device Holder Uncertainty | A | 4.1 | N | 1 | 1 | 1 | 4.1 | 4.1 | 5 |
| 17 | Drift of Output Power | B | 5.0 | R | $\sqrt{3}$ | 1 | 1 | 2.9 | 2.9 | ∞ |
| <i>Phantom and Set-up</i> | | | | | | | | | | |
| 18 | Phantom Uncertainty | B | 4.0 | R | $\sqrt{3}$ | 1 | 1 | 2.3 | 2.3 | ∞ |
| 19 | Liquid Conductivity (target.) | B | 5.0 | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| 20 | Liquid Conductivity (meas.) | A | 2.06 | N | 1 | 0.64 | 0.43 | 1.7 | 1.4 | 43 |
| 21 | Liquid Permittivity (target.) | B | 5.0 | R | $\sqrt{3}$ | 0.6 | 0.49 | 1.7 | 1.4 | ∞ |
| 22 | Liquid Permittivity (meas.) | A | 1.6 | N | 1 | 0.6 | 0.49 | 1.0 | 0.8 | 521 |
| Combined standard uncertainty | | $u_c = \sqrt{\sum_{i=1}^{21} c_i^2 u_i^2}$ | | | | | | 10.54 | 10.34 | |
| Expanded uncertainty (95 % confidence interval) | | k=2 | | | | | | 21.08 | 20.68 | |

ANNEX A: Detailed Test Results

Annex A.1 System Check Results

System check 835body

Date: 04/07/2017

Communication System: UID 10000, CW; Communication System Band: D835 (835.0 MHz); Frequency: 835 MHz; Communication System PAR: 0 dB

Medium parameters used: $f = 835 \text{ MHz}$; $\sigma = 0.952 \text{ S/m}$; $\epsilon_r = 54.841$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE 1528-2013)

DASY5 Configuration:

- Probe: ES3DV3 - SN3297; ConvF(6.08, 6.08, 6.08); Calibrated: 14/10/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1226; Calibrated: 28/09/2016
- Phantom: SAM 1; Type: SAM; Serial: TP:1702
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

835body/d=15mm, Pin=250 mW/Area Scan (7x13x1): Measurement grid: $dx=10\text{mm}$, $dy=10\text{mm}$

Maximum value of SAR (measured) = 2.87 W/kg

835body/d=15mm, Pin=250 mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0:

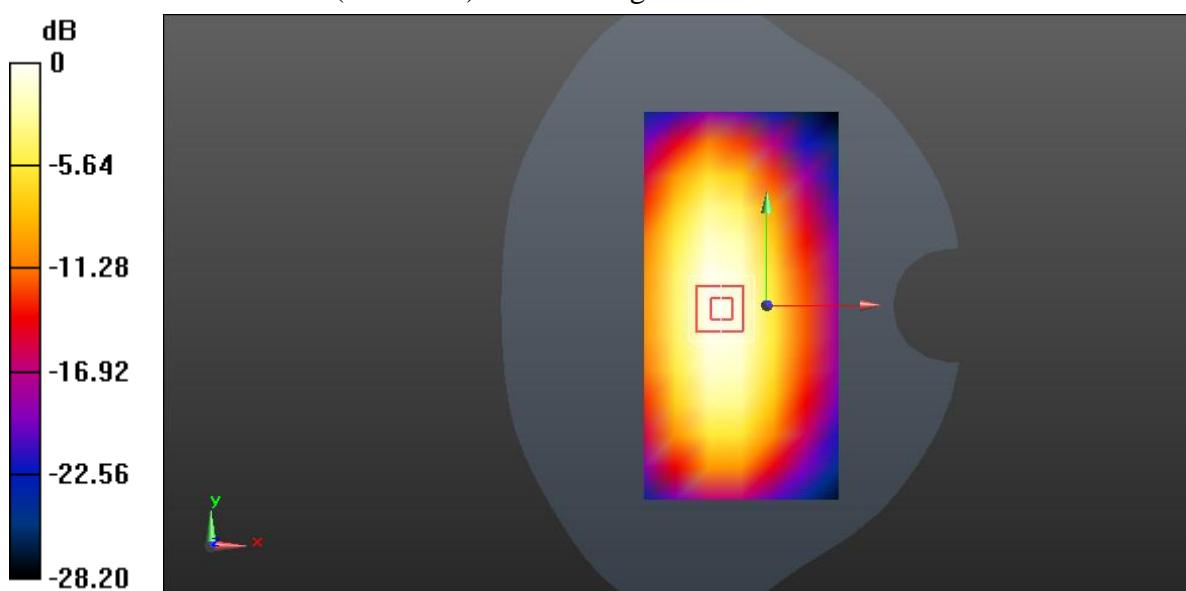
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 47.257 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 2.91 W/kg

SAR(1 g) = 2.34 W/kg; SAR(10 g) = 1.57 W/kg

Maximum value of SAR (measured) = 2.71 W/kg



System check 1750body

Date: 05/07/2017

Communication System: UID 10000, CW; Communication System Band: D1750 (17500.0 MHz); Frequency: 1750 MHz; Communication System PAR: 0 dB

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.477$ S/m; $\epsilon_r = 52.258$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013)

DASY5 Configuration:

- Probe: ES3DV3 - SN3297; ConvF(4.99, 4.99, 4.99); Calibrated: 14/10/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1226; Calibrated: 28/09/2016
- Phantom: SAM2; Type: SAM; Serial: TP-1575
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 body/d=10mm, Pin=250 mW/Area Scan (41x61x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 13.2 W/kg

1750 body/d=10mm, Pin=250 mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0:

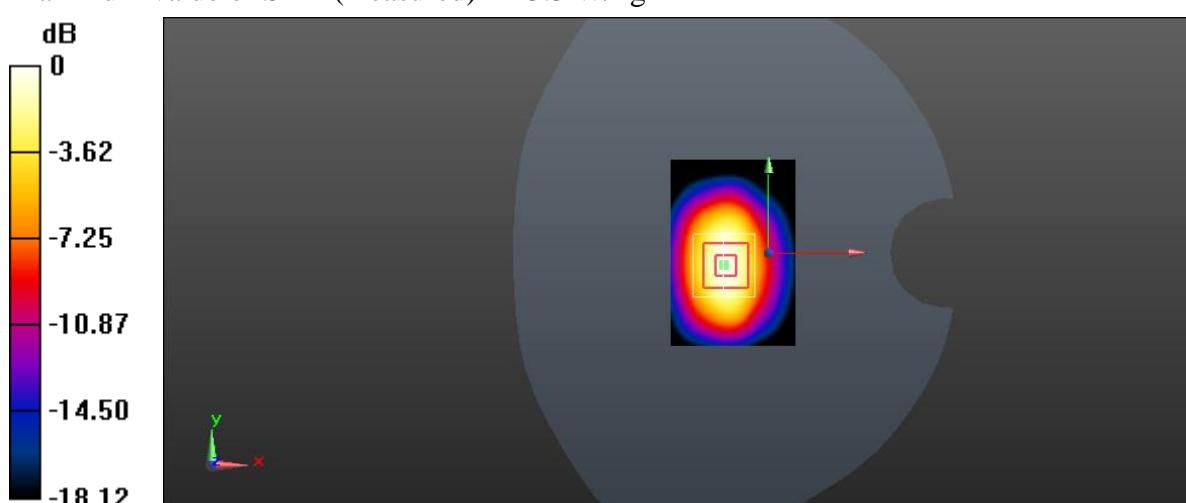
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 85.537 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 16.5 W/kg

SAR(1 g) = 9.46 W/kg; SAR(10 g) = 5.13 W/kg

Maximum value of SAR (measured) = 13.3 W/kg



System check 1900body

Date: 05/07/2017

Communication System: UID 0, CW (0); Communication System Band: D1900 (1900.0 MHz); Frequency: 1900 MHz; Communication System PAR: 0 dB

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.501$ S/m; $\epsilon_r = 52.644$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013)

DASY5 Configuration:

- Probe: ES3DV3 - SN3297; ConvF(4.82, 4.82, 4.82); Calibrated: 14/10/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1226; Calibrated: 28/09/2016
- Phantom: SAM2; Type: SAM; Serial: TP-1575
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900body/d=10mm, Pin=250 mW/Area Scan (61x71x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 14.3 W/kg

1900body/d=10mm, Pin=250 mW/Zoom Scan (7x7x7) (7x7x7)/Cube 0:

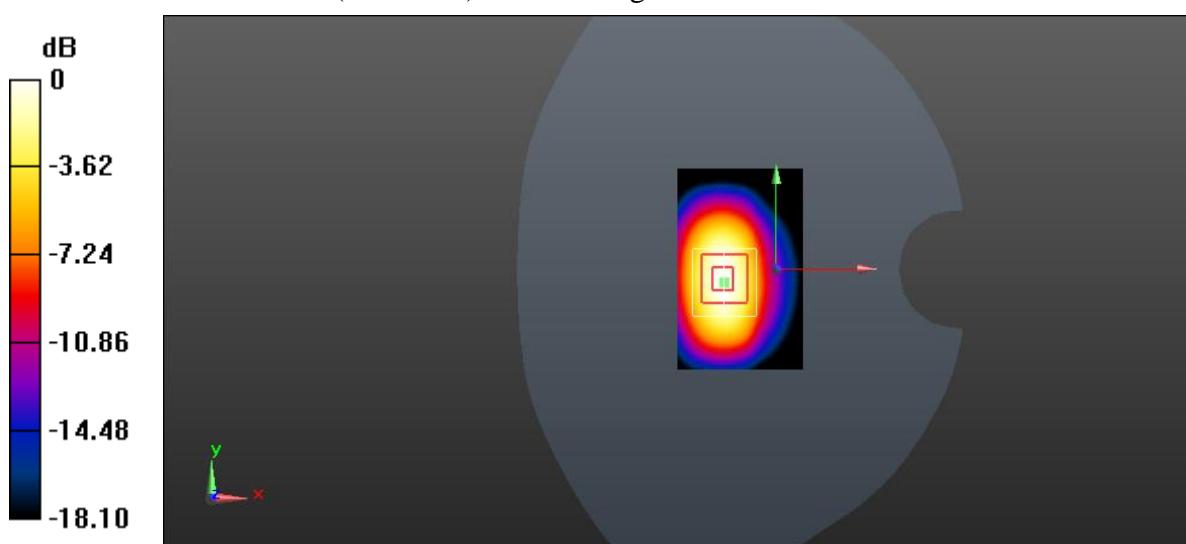
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 84.747 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 17.8 W/kg

SAR(1 g) = 9.89 W/kg; SAR(10 g) = 5.16 W/kg

Maximum value of SAR (measured) = 14.2 W/kg



Annex A.2 Graph Result

WCDMA BAND II back low

Date: 05/07/2017

Communication System: UID 0, WCDMA (0); Communication System Band: BAND 2;

Frequency: 1852.4 MHz; Communication System PAR: 0 dB

Medium parameters used (interpolated): $f = 1852.4$ MHz; $\sigma = 1.451$ S/m; $\epsilon_r = 52.481$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013)

DASY5 Configuration:

- Probe: ES3DV3 - SN3297; ConvF(4.82, 4.82, 4.82); Calibrated: 14/10/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1226; Calibrated: 28/09/2016
- Phantom: SAM2; Type: SAM; Serial: TP-1575
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/back low/Area Scan (8x10x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 1.63 W/kg

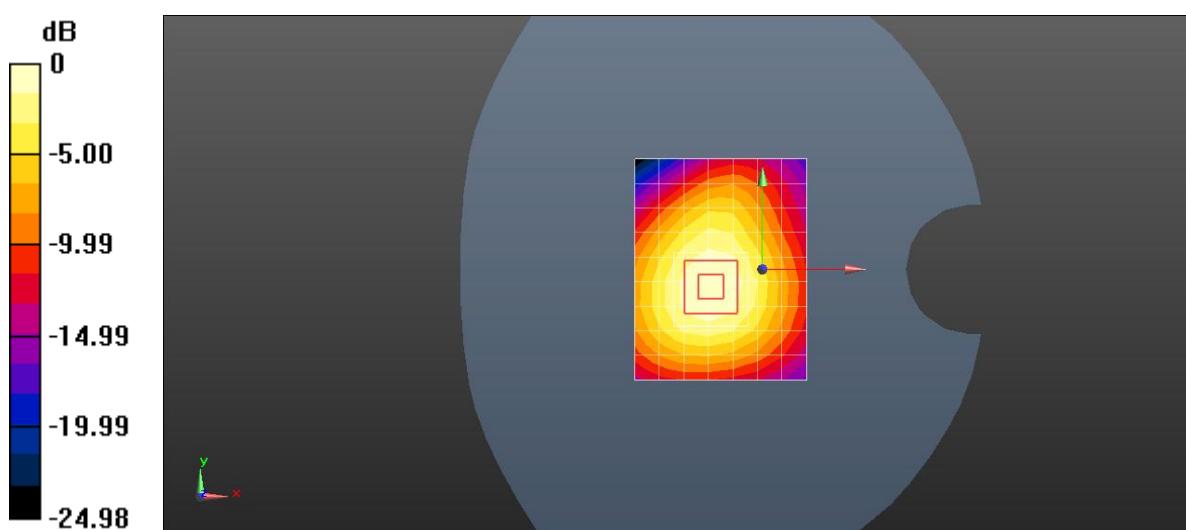
Configuration/back low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 33.39 V/m; Power Drift = 0.09 dB

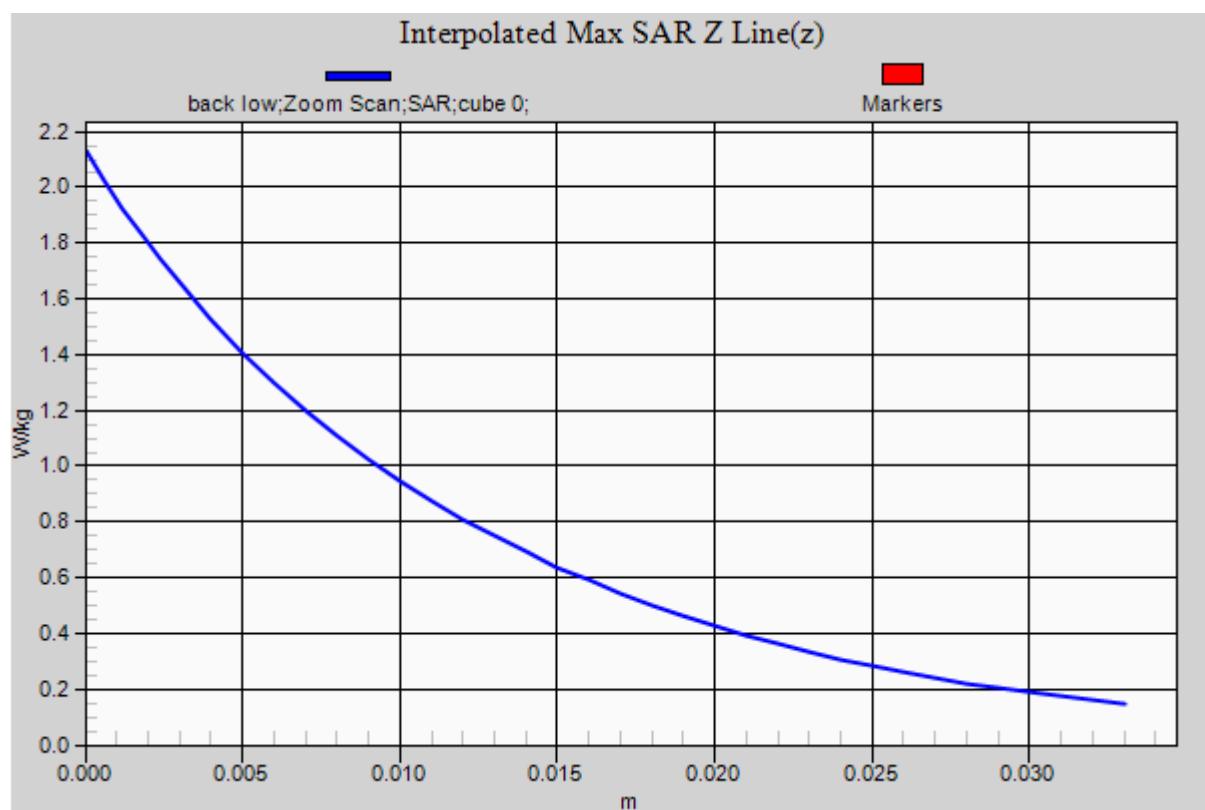
Peak SAR (extrapolated) = 2.13 W/kg

SAR(1 g) = 1.41 W/kg; SAR(10 g) = 0.877 W/kg

Maximum value of SAR (measured) = 1.66 W/kg



$$0 \text{ dB} = 1.63 \text{ W/kg} = 2.12 \text{ dBW/kg}$$



WCDMA BAND IV back low

Date: 05/07/2017

Communication System: UID 0, WCDMA (0); Communication System Band: BAND 4;
Frequency: 1712.4 MHz; Communication System PAR: 0 dB

Medium parameters used (interpolated): $f = 1712.4$ MHz; $\sigma = 1.476$ S/m; $\epsilon_r = 51.967$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013)

DASY5 Configuration:

- Probe: ES3DV3 - SN3297; ConvF(4.99, 4.99, 4.99); Calibrated: 14/10/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1226; Calibrated: 28/09/2016
- Phantom: SAM2; Type: SAM; Serial: TP-1575
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/back low/Area Scan (8x10x1): Measurement grid: $dx=10$ mm, $dy=10$ mm

Maximum value of SAR (measured) = 0.737 W/kg

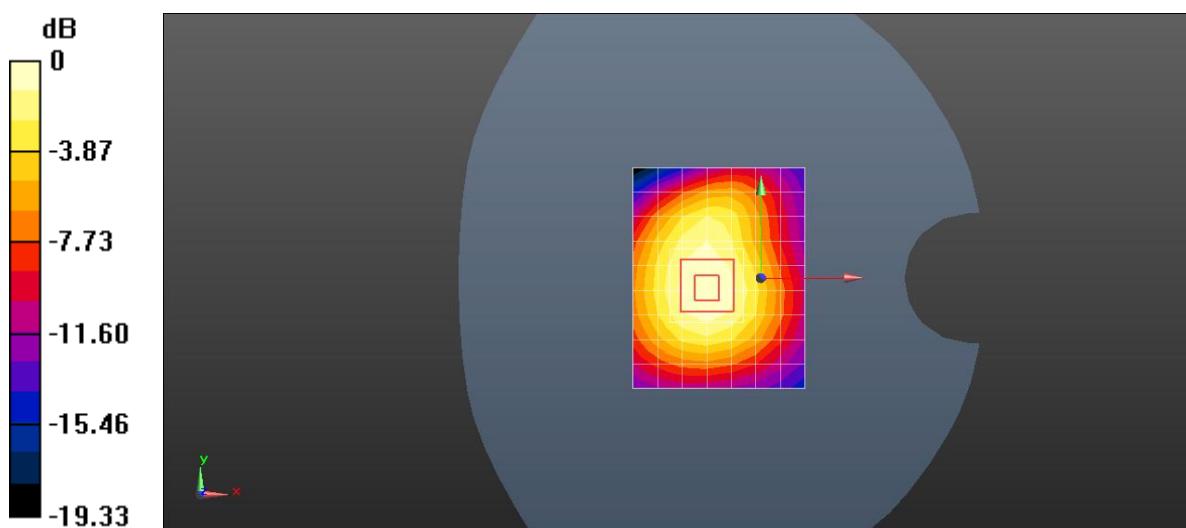
Configuration/back low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: $dx=5$ mm, $dy=5$ mm, $dz=5$ mm

Reference Value = 22.81 V/m; Power Drift = 0.07 dB

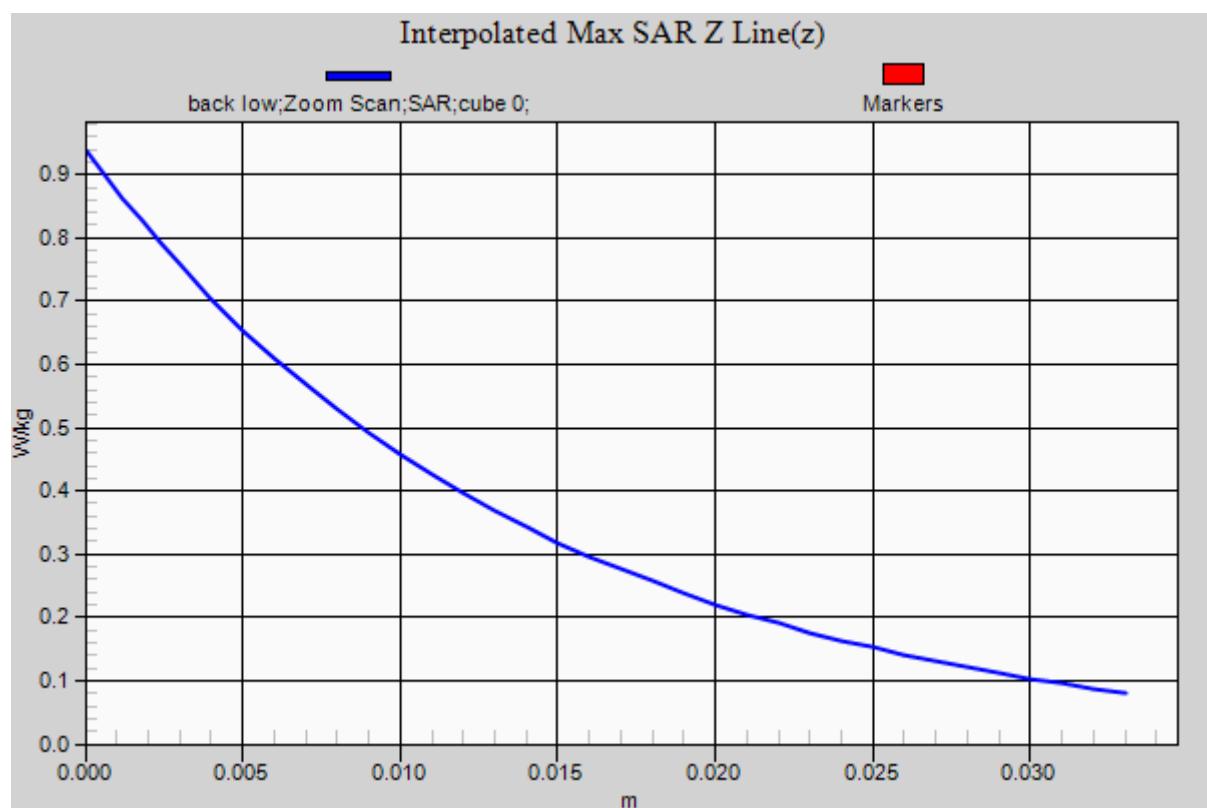
Peak SAR (extrapolated) = 0.938 W/kg

SAR(1 g) = 0.647 W/kg; SAR(10 g) = 0.418 W/kg

Maximum value of SAR (measured) = 0.759 W/kg



0 dB = 0.737 W/kg = -1.32 dBW/kg



WCDMA BAND V back low

Date: 04/07/2017

Communication System: UID 0, WCDMA (0); Communication System Band: BAND 5; Frequency: 826.4 MHz; Communication System PAR: 0 dB

Medium parameters used (interpolated): $f = 826.4$ MHz; $\sigma = 0.936$ S/m; $\epsilon_r = 54.3$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE1528-2013)

DASY5 Configuration:

- Probe: ES3DV3 - SN3297; ConvF(6.08, 6.08, 6.08); Calibrated: 14/10/2016;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1226; Calibrated: 28/09/2016
- Phantom: SAM 1; Type: SAM; Serial: TP:1702
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Configuration/back low/Area Scan (8x10x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 0.725 W/kg

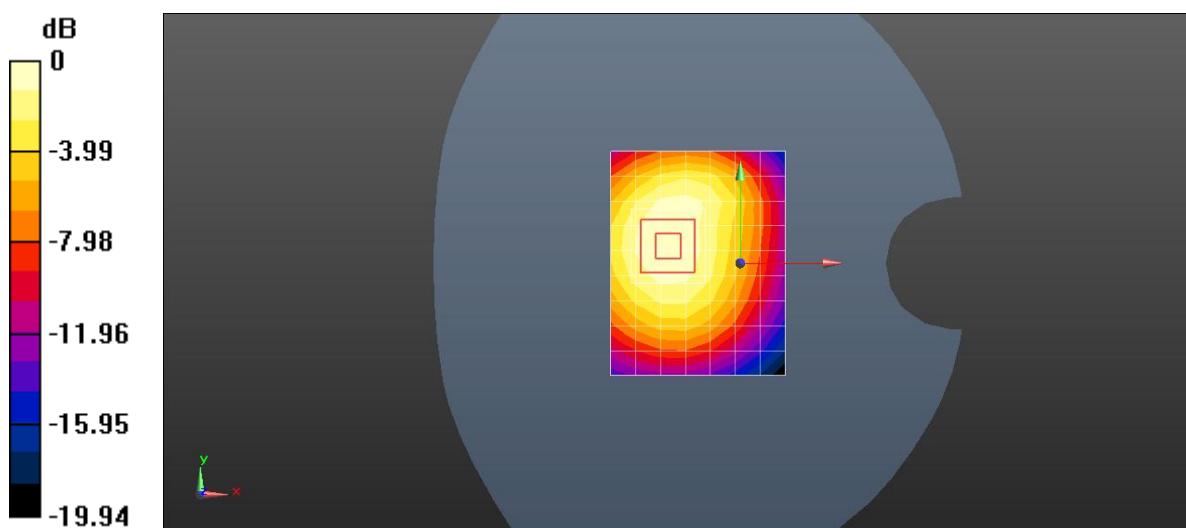
Configuration/back low/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 25.52 V/m; Power Drift = 0.05 dB

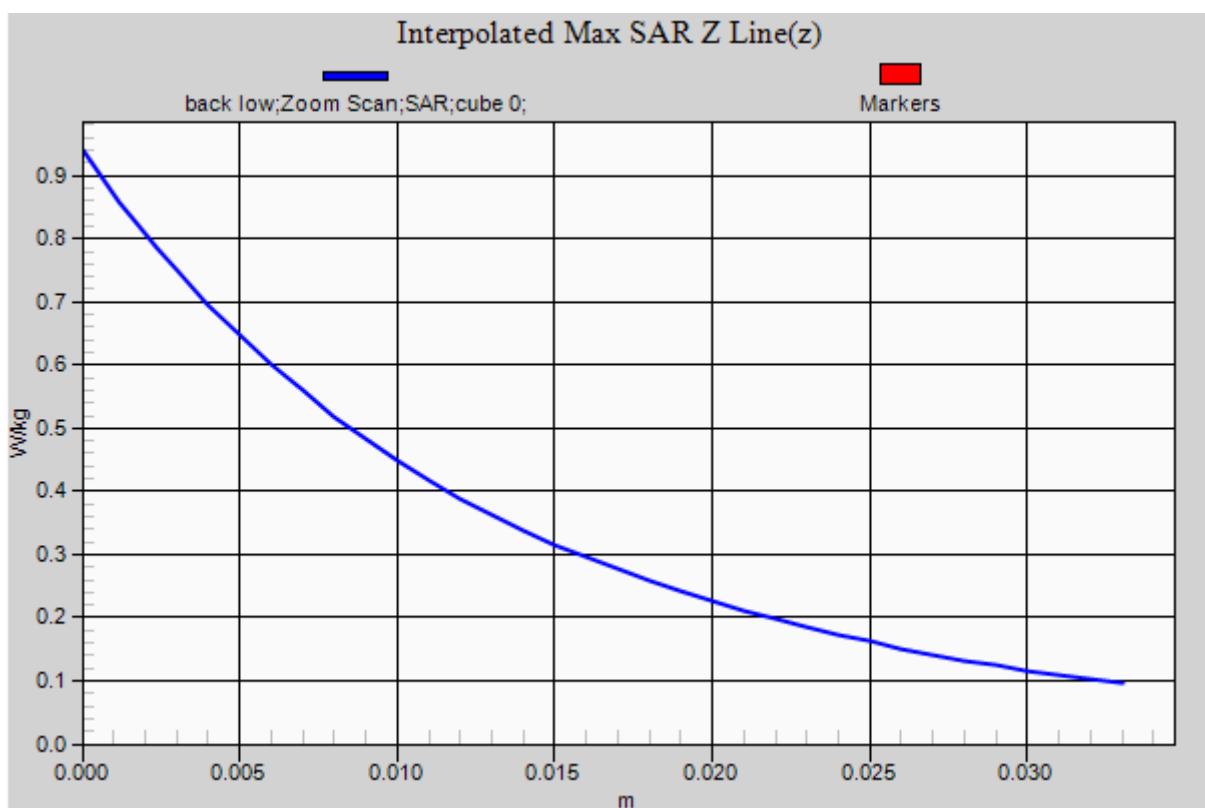
Peak SAR (extrapolated) = 0.939 W/kg

SAR(1 g) = 0.648 W/kg; SAR(10 g) = 0.432 W/kg

Maximum value of SAR (measured) = 0.750 W/kg



0 dB = 0.725 W/kg = -1.40 dBW/kg

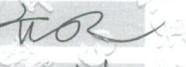
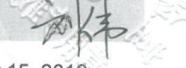


ANNEX B: Calibration Certificate

Annex B.1 Probe Calibration Certificate



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

| Client | Tejet | Certificate No: Z16-97170 | |
|---|---|--|---|
| CALIBRATION CERTIFICATE | | | |
| Object | ES3DV3 - SN:3297 | | |
| Calibration Procedure(s) | FD-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes | | |
| Calibration date: | October 14, 2016 | | |
| This calibration Certificate documents the traceability to national standards, which realize the physical units of measurements(SI). The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate. | | | |
| All calibrations have been conducted in the closed laboratory facility: environment temperature(22±3)°C and humidity<70%. | | | |
| Calibration Equipment used (M&TE critical for calibration) | | | |
| Primary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| Power Meter NRP2 | 101919 | 27-Jun-16 (CTTL, No.J16X04777) | Jun-17 |
| Power sensor NRP-Z91 | 101547 | 27-Jun-16 (CTTL, No.J16X04777) | Jun-17 |
| Power sensor NRP-Z91 | 101548 | 27-Jun-16 (CTTL, No.J16X04777) | Jun-17 |
| Reference10dBAttenuator | 18N50W-10dB | 13-Mar-16(CTTL, No.J16X01547) | Mar-18 |
| Reference20dBAttenuator | 18N50W-20dB | 13-Mar-16(CTTL, No.J16X01548) | Mar-18 |
| Reference Probe EX3DV4 | SN 7307 | 19-Feb-16(SPEAG, No.EX3-7307_Feb16) | Feb-17 |
| DAE4 | SN 1331 | 21-Jan-16(SPEAG, No.DAE4-1331_Jan16) | Jan -17 |
| Secondary Standards | ID # | Cal Date(Calibrated by, Certificate No.) | Scheduled Calibration |
| SignalGeneratorMG3700A | 6201052605 | 27-Jun-16 (CTTL, No.J16X04776) | Jun-17 |
| Network Analyzer E5071C | MY46110673 | 26-Jan-16 (CTTL, No.J16X00894) | Jan -17 |
| Calibrated by: | Name | Function | Signature |
| Calibrated by: | Yu Zongying | SAR Test Engineer |  |
| Reviewed by: | Qi Dianyuan | SAR Project Leader |  |
| Approved by: | Liu Wei | Deputy Director of SEM Department |  |
| Issued: October 15, 2016 | | | |
| This calibration certificate shall not be reproduced except in full without written approval of the laboratory. | | | |



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Glossary:

| | |
|-----------------------|--|
| TSL | tissue simulating liquid |
| NORM _{x,y,z} | sensitivity in free space |
| ConvF | sensitivity in TSL / NORM _{x,y,z} |
| DCP | diode compression point |
| CF | crest factor (1/duty_cycle) of the RF signal |
| A,B,C,D | modulation dependent linearization parameters |
| Polarization Φ | Φ rotation around probe axis |
| Polarization θ | θ rotation around an axis that is in the plane normal to probe axis (at measurement center), i $\theta=0$ is normal to probe axis |
| Connector Angle | information used in DASY system to align probe sensor X to the robot coordinate system |

Calibration is Performed According to the Following Standards:

- 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, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300MHz to 3GHz)", February 2005
- 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:

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



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Probe ES3DV3

SN: 3297

Calibrated: October 14, 2016

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)



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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3297

Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|----------|----------|----------|-----------|
| Norm(μ V/(V/m) ²) ^A | 0.94 | 1.03 | 1.26 | ±10.8% |
| DCP(mV) ^B | 103.8 | 103.8 | 102.4 | |

Modulation Calibration Parameters

| UID | Communication System Name | | A dB | B dB/ μ V | C | D dB | VR mV | Unc ^E (k=2) |
|-----|---------------------------|---|------|---------------|-----|------|-------|------------------------|
| 0 | CW | X | 0.0 | 0.0 | 1.0 | 0.00 | 230.2 | ±2.8% |
| | | Y | 0.0 | 0.0 | 1.0 | | 242.0 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 271.4 | |

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

^A The uncertainties of Norm X, Y, Z do not affect the E²-field uncertainty inside TSL (see Page 5 and Page 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.



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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3297

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) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 835 | 41.5 | 0.90 | 6.18 | 6.18 | 6.18 | 0.43 | 1.45 | ±12% |
| 900 | 41.5 | 0.97 | 6.21 | 6.21 | 6.21 | 0.40 | 1.55 | ±12% |
| 1750 | 40.1 | 1.37 | 5.22 | 5.22 | 5.22 | 0.56 | 1.49 | ±12% |
| 1900 | 40.0 | 1.40 | 5.09 | 5.09 | 5.09 | 0.60 | 1.44 | ±12% |
| 2000 | 40.0 | 1.40 | 4.93 | 4.93 | 4.93 | 0.45 | 1.77 | ±12% |
| 2450 | 39.2 | 1.80 | 4.53 | 4.53 | 4.53 | 0.83 | 1.26 | ±12% |

^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: 3297

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) |
|----------------------|------------------------------------|---------------------------------|---------|---------|---------|--------------------|-------------------------|-------------|
| 835 | 55.2 | 0.97 | 6.08 | 6.08 | 6.08 | 0.43 | 1.56 | ± 12% |
| 900 | 55.0 | 1.05 | 6.08 | 6.08 | 6.08 | 0.42 | 1.64 | ± 12% |
| 1750 | 53.4 | 1.49 | 4.99 | 4.99 | 4.99 | 0.56 | 1.59 | ± 12% |
| 1900 | 53.3 | 1.52 | 4.82 | 4.82 | 4.82 | 0.52 | 1.62 | ± 12% |
| 2000 | 53.3 | 1.52 | 4.65 | 4.65 | 4.65 | 0.44 | 2.03 | ± 12% |
| 2450 | 52.7 | 1.95 | 4.46 | 4.46 | 4.46 | 0.90 | 1.25 | ± 12% |

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

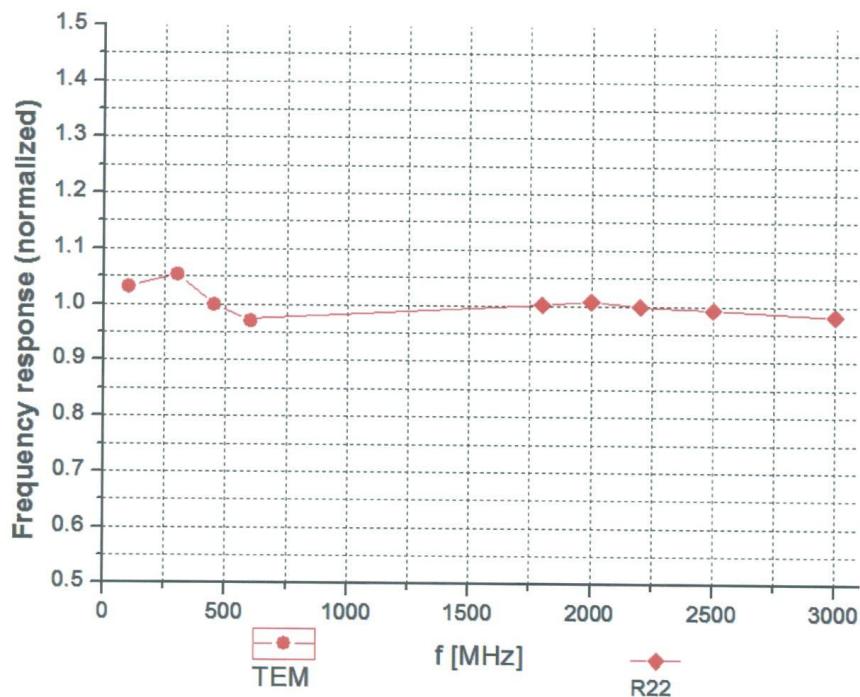
^F At frequency below 3 GHz, the validity of tissue parameters (ϵ and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ϵ and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty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

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



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



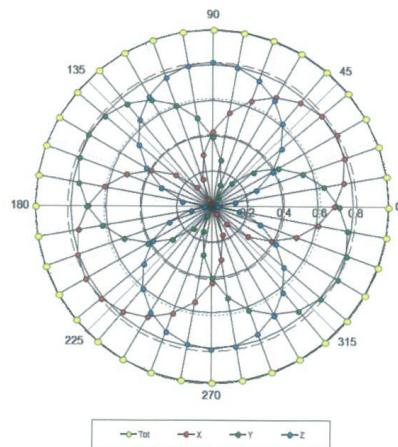
Uncertainty of Frequency Response of E-field: $\pm 7.5\%$ ($k=2$)



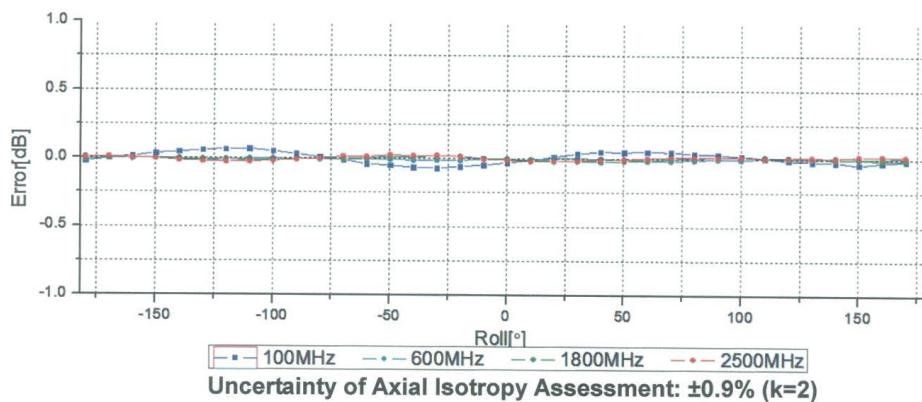
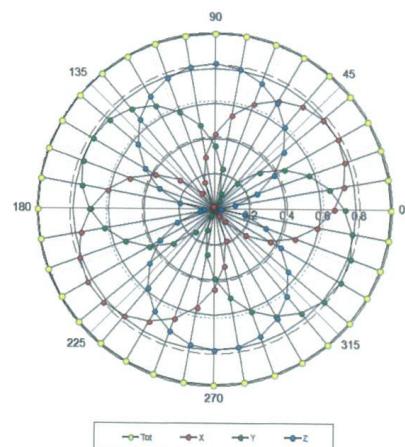
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Receiving Pattern (Φ), $\theta=0^\circ$

f=600 MHz, TEM



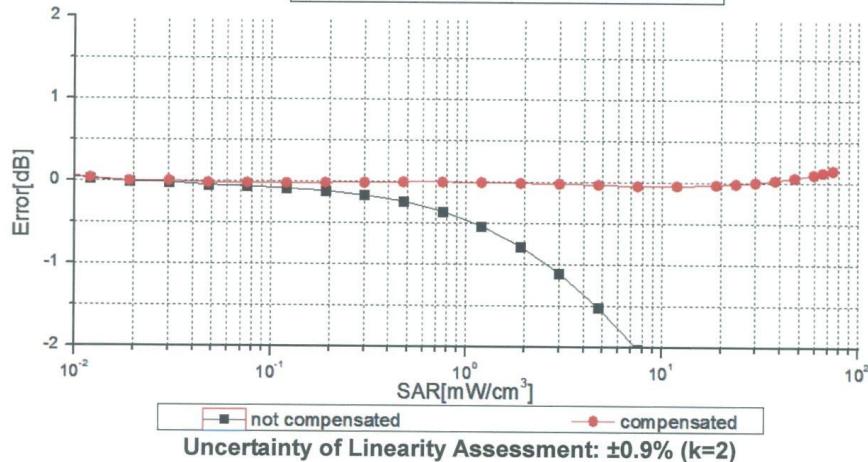
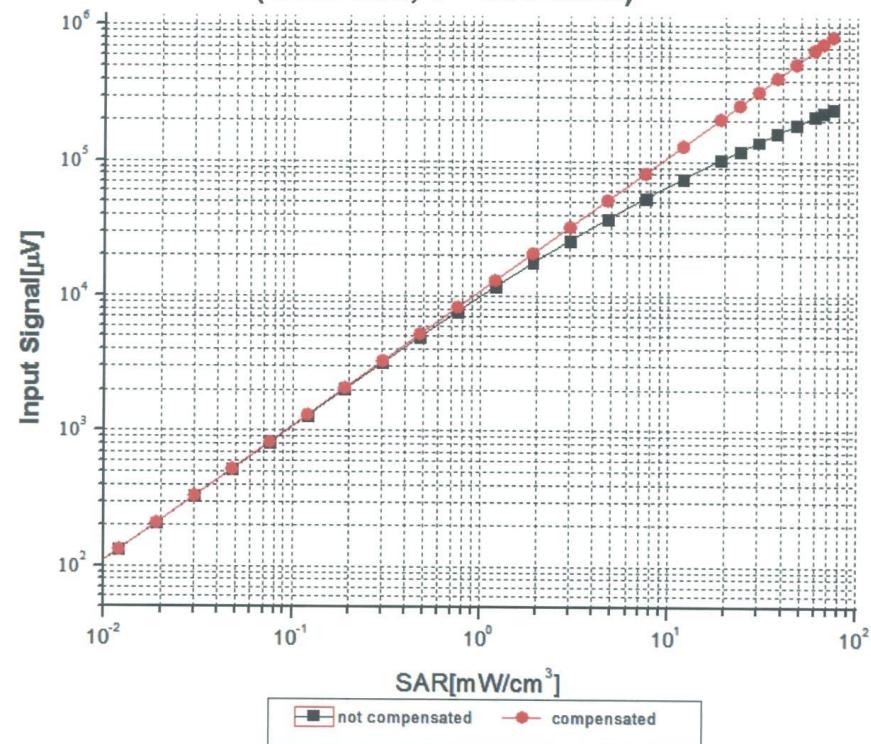
f=1800 MHz, R22





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

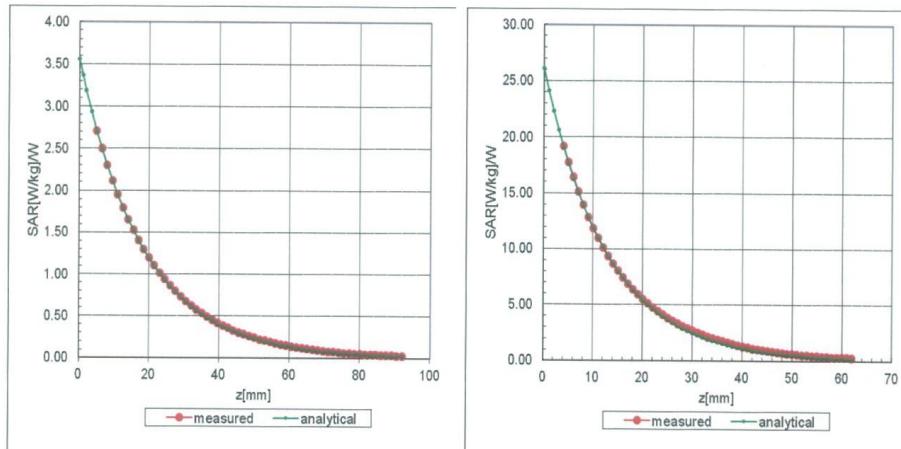




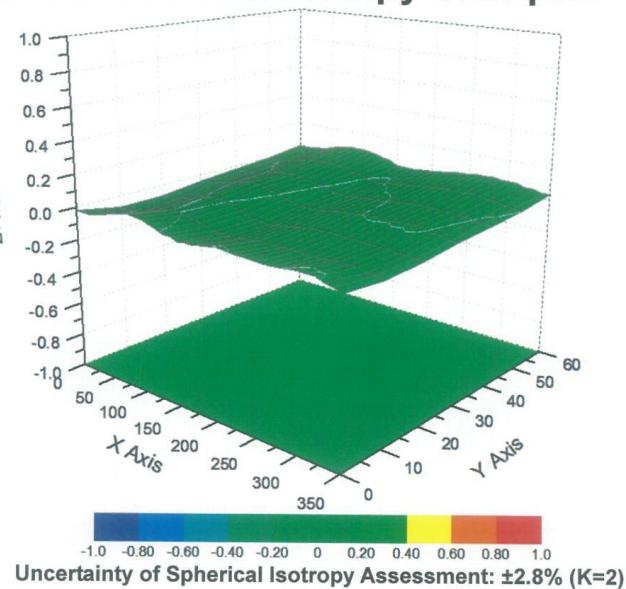
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Conversion Factor Assessment

f=900 MHz, WGLS R9(H_convF) f=1750 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



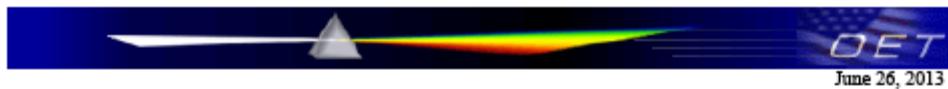


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DASY/EASY – Parameters of Probe: ES3DV3 - SN: 3297

Other Probe Parameters

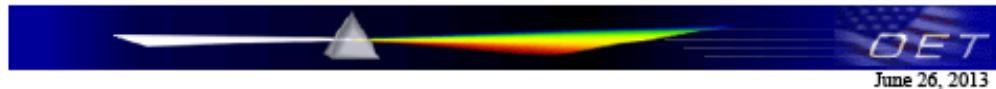
| | |
|---|------------|
| Sensor Arrangement | Triangular |
| Connector Angle (°) | 15.5 |
| Mechanical Surface Detection Mode | enabled |
| Optical Surface Detection Mode | disable |
| Probe Overall Length | 337mm |
| Probe Body Diameter | 10mm |
| Tip Length | 10mm |
| Tip Diameter | 4mm |
| Probe 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 |



**Acceptable Conditions for SAR Measurements Using Probes and Dipoles
Calibrated under the SPEAG-TMC Dual-Logo Calibration Program to
Support FCC Equipment Certification**

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by TMC (*Telecommunication Metrology Center of MITT in Beijing, China*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and TMC, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following.

- 1) The agreement established between SPEAG and TMC is only applicable to calibration services performed by TMC where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. This agreement is subject to renewal at the end of each calendar year between SPEAG and TMC. TMC shall inform the FCC of any changes or early termination to the agreement.
- 2) Only a subset of the calibration services specified in the SPEAG-TMC agreement, while it remains valid, are applicable to SAR measurements performed using such equipment for supporting FCC equipment certification. These are identified in the following.
 - a) Calibration of dosimetric (SAR) probes EX3DVx, ET3DVx and ES3DVx.
 - i) Free-space E-field and H-field probes, including those used for HAC (hearing aid compatibility) evaluation, temperature probes, other probes or equipment not identified in this document, when calibrated by TMC, are excluded and cannot be used for measurements to support FCC equipment certification.
 - ii) Signal specific and bundled probe calibrations based on PMR (probe modulation response) characteristics are handled according to the requirements of KDB 865664; that is, "Until standardized procedures are available to make such determination, the applicability of a signal specific probe calibration for testing specific wireless modes and technologies is determined on a case-by-case basis through KDB inquiries, including SAR system verification requirements."
 - b) Calibration of SAR system validation dipoles, excluding HAC dipoles.
 - c) Calibration of data acquisition electronics DAE3Vx, DAE4Vx and DAEasyVx.
 - d) For FCC equipment certification purposes, the frequency range of SAR probe and dipole calibrations is limited to 700 MHz - 6 GHz and provided it is supported by the equipment identified in the TMC QA protocol (a separate attachment to this document).
 - e) The identical system and equipment setup, measurement configurations, hardware, evaluation algorithms, calibration and QA protocols, including the format of calibration certificates and reports used by SPEAG shall be applied by TMC.
 - f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 or higher version systems.



- 3) The SPEAG-TMC agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by TMC under this SPEAG-TMC Dual-Logo calibration agreement are equivalent to the calibration services provided by SPEAG. TMC shall, upon request, provide copies of documentation to the FCC to substantiate program implementation.
 - a) The Inter-laboratory Calibration Evaluation (ILCE) stated in the TMC QA protocol shall be performed between SPEAG and TMC at least once every 12 months. The ILCE acceptance criteria defined in the TMC QA protocol shall be satisfied for the TMC, SPEAG and FCC agreements to remain valid.
 - b) Check of Calibration Certificate (CCC) shall be performed by SPEAG for all calibrations performed by TMC. Written confirmation from SPEAG is required for TMC to issue calibration certificates under the SPEAG-TMC Dual-Logo calibration program. Quarterly reports for all calibrations performed by TMC under the program are also issued by SPEAG.
 - c) The calibration equipment and measurement system used by TMC shall be verified before each calibration service according to the specific reference SAR probes, dipoles, and DAE calibrated by SPEAG. The results shall be reproducible and within the defined acceptance criteria specified in the TMC QA protocol before each actual calibration can commence. TMC shall maintain records of the measurement and calibration system verification results for all calibrations.
 - d) Quality Check of Calibration (QCC) certificates shall be performed by SPEAG at least once every 12 months. SPEAG shall visit TMC facilities to verify the laboratory, equipment, applied procedures and plausibility of randomly selected certificates.
- 4) A copy of this document, to be updated annually, shall be provided to TMC clients that accept calibration services according to the SPEAG-TMC Dual-Logo calibration program, which should be presented to a TCB (*Telecommunication Certification Body*), to facilitate FCC equipment approval.
- 5) TMC shall address any questions raised by its clients or TCBs relating to the SPEAG-TMC Dual-Logo calibration program and inform the FCC and SPEAG of any critical issues.

Change Note: Revised on June 26 to clarify the applicability of PMR and Bundled probe calibrations according to the requirements of KDB 865664.