# SAR TEST REPORT

| | |
|---|---|
| **Report Reference No.....:** | **LCS171204015AEB** |
| **FCC ID.....:** | **2AOA5CCCC0217002** |
| **Testing Laboratory Name**.....: | **Shenzhen LCS Compliance Testing Laboratory Ltd.** |
| Address.....: | 1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China |
| **Applicant's name**.....: | **Saturn Technology Group, LLC.** |
| Address.....: | 2664-B Saturn St. Brea, Ca. 92821 |
| **Test specification** ..... **:** | |
| | **IEEE 1528:2013** |
| Standard .....: | **47CFR §2.1093** |
| | **KDB 865664** |
| Test Report Form No .....: | LCSEMC-1.0 |
| TRF Originator.....: | Shenzhen LCS Compliance Testing Laboratory Ltd. |
| Master TRF.....: | Dec. 08, 2017 |

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| | |
|---|---|
| **Test item description .....:** | **Lingo** |
| Trade Mark .....: | Lingo |
| Manufacturer .....: | Saturn Technology Group, LLC. |
| Model/Type reference.....: | FYQ-I |
| Ratings.....: | DC 3.70V |
| EUT Type .....: | Production Unit |
| Exposure category.....: | General population / Uncontrolled environment |
| Device type.....: | Portable device |
| Result.....: | **PASS** |

| **Compiled by:** | **Supervised by:** | **Approved by:** |
|---|---|---|
| Aking Jin | Dick Su | Gavin Liang |
| Aking Jin/ File administrators | Dick Su/ Technique principal | Gavin Liang/ Manager |

# T E S T R E P O R T

| | |
|---|---|
| **Test Report No. : LCS171204015AEB** | Dec. 08, 2017<br>Date of issue |

| | | |
|---|---|---|
| Equipment under Test | : | Lingo |
| Model /Type | : | FYQ-I |
| **Applicant** | : | **Saturn Technology Group, LLC.** |
| Address | : | 2664-B Saturn St. Brea, Ca. 92821 |
| **Manufacturer** | : | **Saturn Technology Group, LLC.** |
| Address | : | 2664-B Saturn St. Brea, Ca. 92821 |

| | |
|---|---|
| **Test Result**: | **PASS** |

The test report merely corresponds to the test sample.
It is not permitted to copy extracts of these test result without the written permission of the test laboratory.

# ** Modifited History **

| Revison | Description | Issued Data | Remark |
|---|---|---|---|
| Revsion 1.0 | Initial Test Report Release | 2017-12-08 | Gavin Liang |
| | | | |

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# 1. TEST STANDARDS/PROCEDURES REFERENCE/FCC KDBs

The tests were performed according to following standards:

IEEE 1528-2013 (2014-06): Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques
IEEE Std. C95-3 (2002): IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave
IEEE Std. C95-1 (1991): IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.
KDB 865664D01v04 (August 7, 2015): SAR Measurement Requirements for 100 MHz to 6 GHz
KDB 865664D02v01r02 (October 23, 2015): RF Exposure Compliance Reporting and Documentation Considerations
KDB 447498D01v06 (October 23, 2015): RF Exposure Procedures and Equipment Authorization Policies for Mobile and Portable Devices
KDB 248227 D01v02r02 (October 23, 2015): SAR GUIDANCE FOR IEEE 802.11 (Wi-Fi) TRANSMITTERS
IEC 62209-2 (2010): Human exposure to radio frequency fields from hand-held and bodymounted wireless communication devices. Human models, instrumentation, and procedures. 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)

# 2. SUMMARY

## 2.1. General Remarks

| | | |
|---|---|---|
| EUT* Name | : | Lingo |
| Model Number | : | FYQ-I |
| EUTfunction description | : | Please reference user manual of this device |
| Power supply | : | DC 5V from external AC Adapter<br>DC 3.7V built-in battery |
| Radio Technology | : | IEEE802.11b/g/n |
| FCC Operation frequency | : | IEEE 802.11b: 2412MHz—2462MHz<br>IEEE 802.11g: 2412MHz—2462MHz<br>IEEE 802.11n HT20: 2412MHz—2462MHz<br>IEEE 802.11n HT40:2422MHz—2452MHz<br>BT Classic and BLE:2402-2480MHz |
| Modulation | : | IEEE 802.11b: DSSS(CCK,DQPSK,DBPSK)<br>IEEE 802.11g: OFDM(64QAM, 16QAM, QPSK, BPSK)<br>IEEE 802.11n HT20, HT40: OFDM (64QAM, 16QAM, QPSK,BPSK)<br>BT Classic and BLE : GFSK, PI /4 QPSK, 8-DPSK |
| Transmitter rate | : | IEEE 802.11b: 1, 2, 5.5, 11 Mbps<br>IEEE 802.11g: 6, 9, 12, 18, 24, 36, 48, 54 Mbps<br>IEEE 802.11n HT20: up to 150 Mbps, HT40: up to 300Mbps<br>BT Classic and BLE :1Mbps, 2Mbps, 3Mbps |
| Maximum Reported SAR Values | : | **Body: 0.926 mW/g (100% Duty Cycle)** |
| Antenna Type | : | Integrated antenna, maximum PK gain: 1.89dBi |
| Sample Type | : | Series production |
| Exposure category: | : | General population / Uncontrolled environment |

Note1: EUT is the ab.of equipment under test.

## 2.2. Accessories of EUT

N/A

## 2.3. Short description of the Equipment under Test (EUT)

The spatial peak SAR values were assessed for systems. Battery and accessories shell be specified by the manufacturer. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output.

The sample enter into 100% duty cycle continuous transmit controlled by software provied by application. The sample was use test software to control transmit.

## 2.4. TEST Configuration

**Face-Held Configuration**
Face-held Configuration- per FCC KDB447498 page 23: “A test separation distance of 25 mm must be applied for in-front-of the face SAR test exclusion and SAR measurements.”

## 2.5. EUT operation mode

The EUT has been tested under typical operating condition and The Transmitter was operated in the normal operating mode. The TX frequency was fixed which was for the purpose of the measurements.

## 2.6. EUT configuration

**The following peripheral devices and interface cables were connected during the measurement:**

●- supplied by the manufacturer
○ - supplied by the lab

**Battery1#:** 1600mAh Lithium-ion Battery

**The following peripheral devices and interface cables were connected during the measurement:**

| Accessory name | Internal Identification | Model | Description | Remark |
|---|---|---|---|---|
| Antenna | A1 | N/A | Inner Antenna and Ingrate antenna | performed |
| Battery | B1 | N/A | 1600mAh Lithium-ion Battery | performed |

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

# 3. TEST ENVIRONMENT

## 3.1. Address of the test laboratory

Shenzhen LCS Compliance Testing Laboratory Ltd

1/F., Xingyuan Industrial Park, Tongda Road, Bao'an Avenue, Bao'an District, Shenzhen, Guangdong, China
The sites are constructed in conformance with the requirements of ANSI C63.4 (2014) and CISPR Publication 22.

## 3.2. Test Facility

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

CNAS Registration Number. is L4595.
FCC Registration Number. is 899208.
Industry Canada Registration Number. is 9642A-1.
VCCI Registration Number. is C-4260 and R-3804.
ESMD Registration Number. is ARCB0108.
UL Registration Number. is 100571-492.
TUV SUD Registration Number. is SCN1081.
TUV RH Registration Number. is UA 50296516-001
NVLAP Registration Code is 600167-0

## 3.3. Environmental conditions

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

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

## 3.4. SAR Limits

FCC Limit (1g Tissue)

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

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

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

## 3.5. Equipments Used during the Test

| Test Equipment | Manufacturer | Type/Model | Serial Number | Calibration | |
|---|---|---|---|---|---|
| | | | | Last Calibration | Calibration Interval |
| Data Acquisition Electronics DAEx | SPEAG | DAE4 | 1267 | 2017/02/23 | 1 |
| E-field Probe | SPEAG | EX3DV4 | 3789 | 2017/01/13 | 1 |
| System Validation Dipole D2450V2 | SPEAG | D2450V2 | 733 | 2016/12/07 | 3 |
| Network analyzer | Agilent | 8753E | US37390562 | 2017/03/01 | 1 |
| Dielectric Probe Kit | Agilent | 85070E | US44020288 | / | / |
| Power meter | Agilent | E4417A | GB41292254 | 2016/12/13 | 1 |
| Power sensor | Agilent | 8481H | MY41095360 | 2016/12/13 | 1 |
| Power sensor | Agilent | 8481H | MY41095361 | 2016/12/13 | 1 |
| Signal generator | IFR | 2032 | 203002/100 | 2016/12/13 | 1 |
| Amplifier | AR | 75A250 | 302205 | 2016/12/13 | 1 |
| Attenuator | SHX | TS2-3dB | 30704 | NCR | NCR |
| RF Bi-Directional Coupler | Agilent | 86205-60001 | MY31400031 | NCR | NCR |

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

# 4. SAR Measurements System configuration

## 4.1. SAR Measurement Set-up

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

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

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

A data acquisition electronic (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.

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

The Electro-Optical Coupler (EOC) performs the conversion from the optical into a digital electric signal of the DAE. The EOC is connected to the DASY5 measurement server.

The DASY5 measurement server, which performs all real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operation. A computer operating Windows 2003.

DASY5 software and SEMCAD data evaluation software.

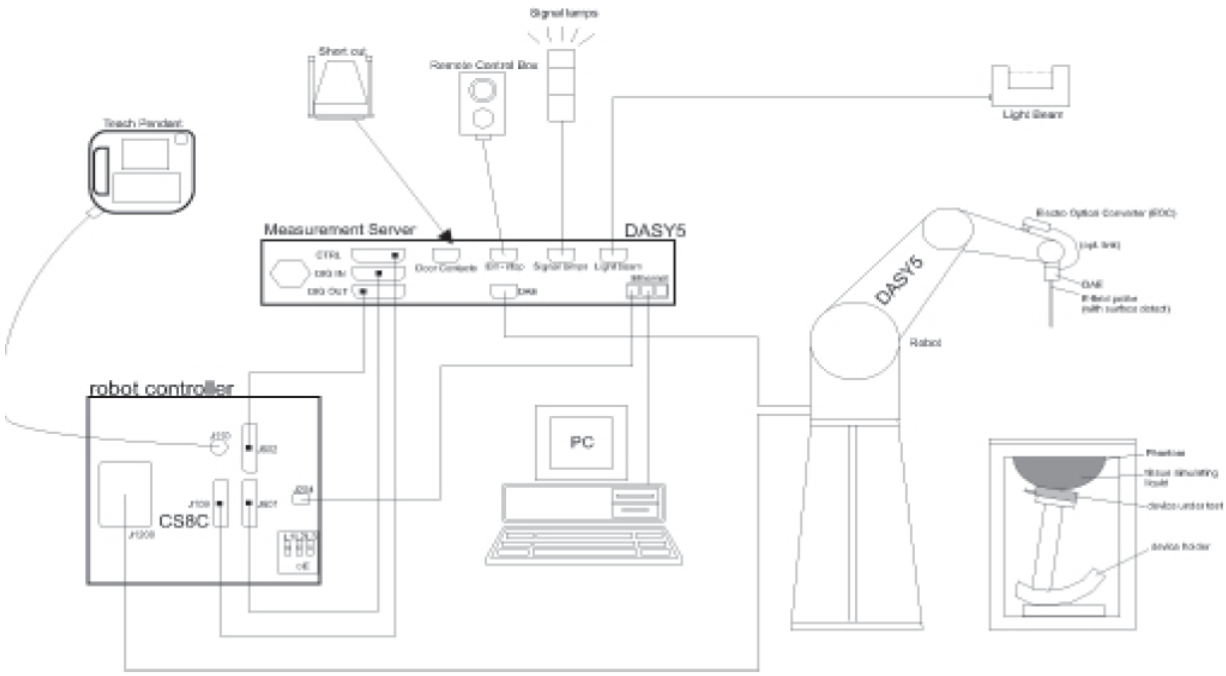
Remote control with teach panel and additional circuitry for robot safety such as warning lamps, etc.

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

The device holder for handheld mobile phones.

Tissue simulating liquid mixed according to the given recipes.

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



## 4.2. 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.

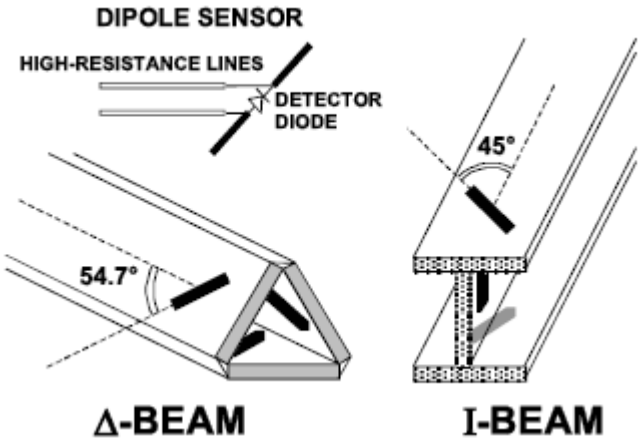
Probe Specification

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

Isotropic E-Field Probe

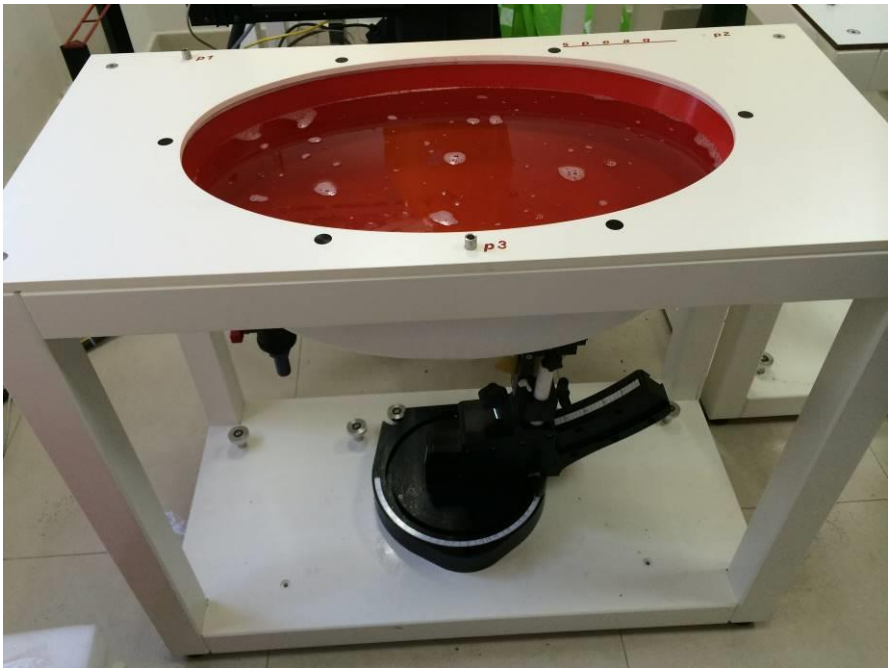
The isotropic E-Field probe has been fully calibrated and assessed for isotropicity, and boundary effect within a controlled environment. Depending on the frequency for which the probe is calibrated the method utilized for calibration will change.

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



## 4.3. Phantoms

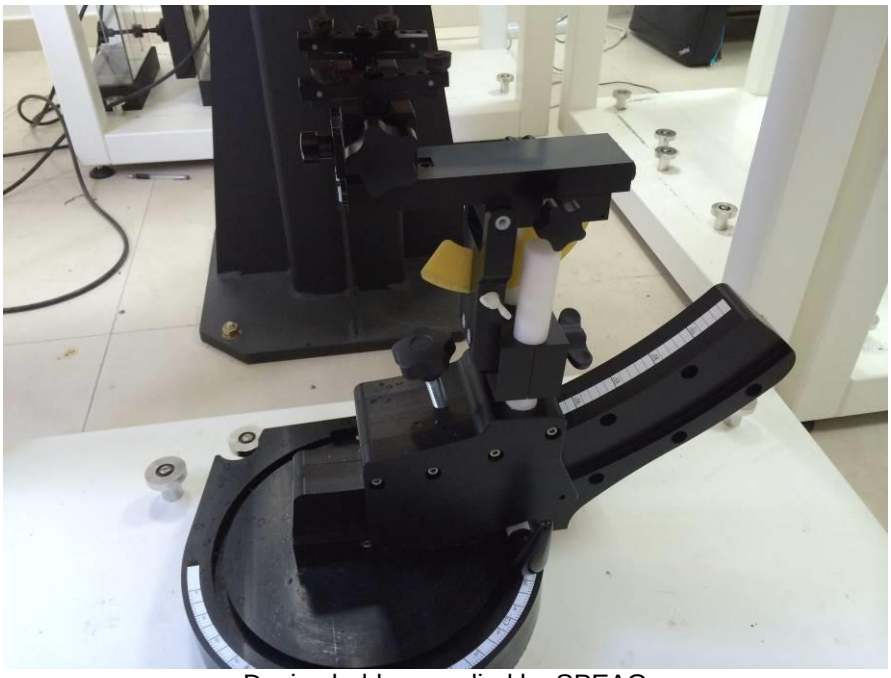
Phantom for compliance testing of handheld andbody-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI isfully compatible with the IEC 62209-2 standard and all known tissuesimulating liquids. ELI has been optimized regarding its performance and can beintegrated into our standard phantom tables. A cover prevents evaporation ofthe liquid. Reference markings on the phantom allow installation of thecomplete setup, including all predefined phantom positions and measurementgrids, by teaching three points. The phantom is compatible with all SPEAGdosimetric probes and dipoles.




ELI4 Phantom

## 4.4. Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SPEAG as an integral part of the DASY system.
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference point (ERP). Thus the device needs no repositioning when changing the angles.



Device holder supplied by SPEAG

## 4.5. Scanning Procedure

The 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. ± 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 ± 0.1mm). 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 ± 30°.)

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.

## 4.6. Data Storage and Evaluation

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

| | | |
|---|---|---|
| Probe parameters: | - Sensitivity | Normi, ai0, ai1, ai2 |
| | - Conversion factor | ConvFi |
| | - Diode compression point | Dcpi |
| Device parameters: | - Frequency | f |
| | - Crest factor | cf |
| Media parameters: | - Conductivity | σ |
| | - Density | ρ |

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:

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

With Vi = compensated signal of channel i ( i = x, y, z )
Ui = input signal of channel i ( i = x, y, z )
cf = crest factor of exciting field (DASY parameter)
dcpi = diode compression point (DASY parameter)

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

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

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

With Vi = compensated signal of channel i (i = x, y, z)
Normi = sensor sensitivity of channel i (i = x, y, z)
[mV/(V/m)2] for E-field Probes
ConvF = sensitivity enhancement in solution
aij = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
Ei = electric field strength of channel i in V/m
Hi = magnetic field strength of channel i in A/m

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

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

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

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

with SAR = local specific absorption rate in mW/g
Etot = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = 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.

## 4.7. SAR Measurement System

The SAR measurement system being used is the DASY5 system, the system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centred at that point to determine volume averaged SAR level.

### 4.7.1 Tissue Dielectric Parameters for Head and Body Phantoms

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

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

($\varepsilon_r$ = relative permittivity, σ = conductivity and ρ = 1000 kg/m$^3$)

## 4.8. Tissue equivalent liquid properties

Dielectric performance of Head and Body tissue simulating liquid.

| Ingredients (% by weight) | Frequency (MHz) | | | | | |
|---|---|---|---|---|---|---|
| | 835 | | 1800-2000 | | 2300-2600 | |
| **Tissue Type** | **Head** | **Body** | **Head** | **Body** | **Head** | **Body** |
| Water | 40.30 | 50.75 | 55.24 | 70.17 | 55.00 | 68.53 |
| Salt (NaCl) | 1.38 | 0.94 | 0.31 | 0.39 | 0.2 | 0.1 |
| Sucrose | 57.90 | 48.21 | 0 | 0 | 0 | 0 |
| HEC | 0.24 | 0 | 0 | 0 | 0 | 0 |
| Bactericide | 0.18 | 0.10 | 0 | 0 | 0 | 0 |
| Tween | 0 | 0 | 44.45 | 29.44 | 44.80 | 31.37 |

Salt: 99+% Pure Sodium Chloride Sucrose: 98+% Pure Sucrose
Water: De-ionized, 16 MΩ+ resistivity HEC: Hydroxyethyl Cellulose
Tween: Polyoxyethylene (20) sorbitan monolaurate

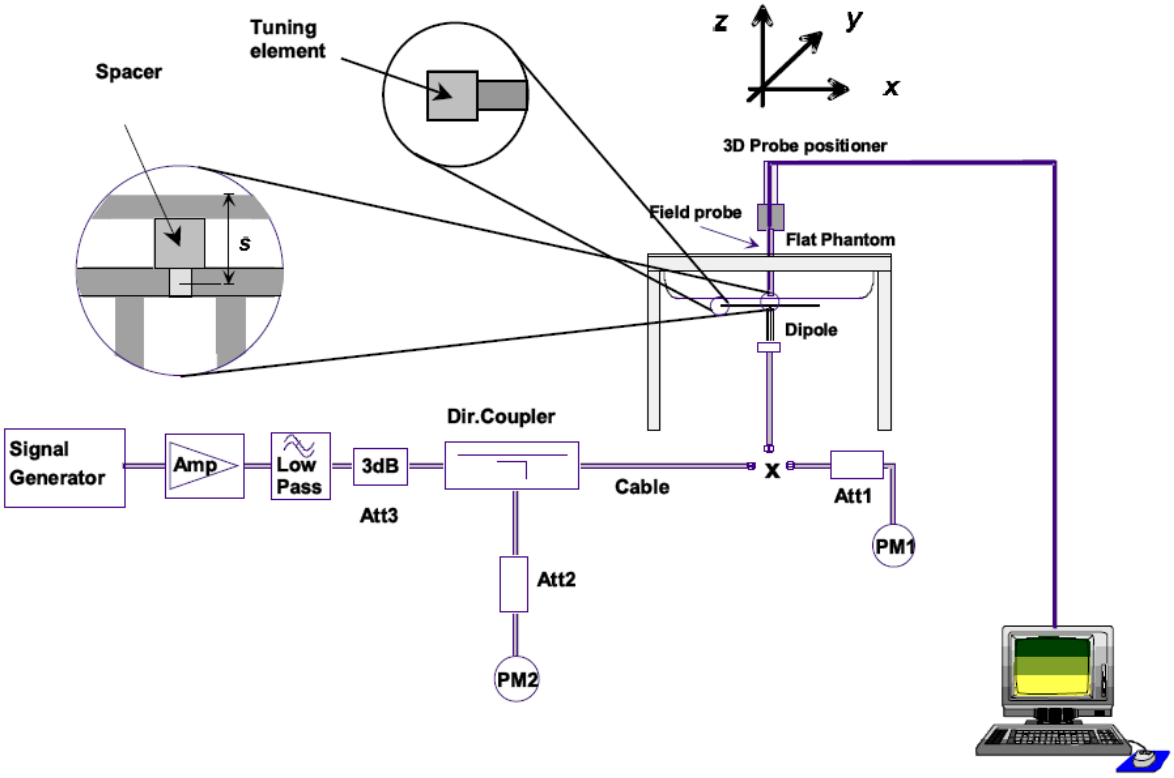
| Tissue Type | Measured Frequency (MHz) | Target Tissue | | Measured Tissue | | | | Liquid Temp. | Test Data |
|---|---|---|---|---|---|---|---|---|---|
| | | εr | σ | εr | Dev. % | σ | Dev. % | | |
| 2450B | 2450 | 52.70 | 1.95 | 51.68 | -1.94% | 1.951 | 0.05% | 22 degree | 2017/12/5 |

## 4.9. System Check

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

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

System check is performed regularly on all frequency bands where tests are performed with the DASY5 system.




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

**Justification for Extended SAR Dipole Calibrations**

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

| Liquid Type | Target Value: | | Measured Value: | | verdict | Measured date |
|---|---|---|---|---|---|---|
| | Impedance | Return Loss | Impedance | Return Loss | | |
| Head | 52.9Ω+4.11jΩ | -26.3 dB | 52.1Ω+4.21jΩ | -26.7 dB | Complied | 2017/12/6 |
| Body | 49.7Ω+5.9jΩ | -24.6 dB | 48.9Ω+5.3jΩ | -24.6 dB | Complied | 2017/12/6 |

**System Check in Body Tissue Simulating Liquid**

| Freq | Test Date | Dielectric Parameters | | Temp | 250mW Measured | | 1W Normalized | | 1W Target | | Limit (±10% Deviation) | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | $\varepsilon_r$ | σ(s/m) | | $SAR_{1g}$ | $SAR_{10g}$ | $SAR_{1g}$ | $SAR_{10g}$ | $SAR_{1g}$ | $SAR_{10g}$ | $SAR_{1g}$ | $SAR_{10g}$ |
| 2450MHz | 2017/12/5 | 51.68 | 1.951 | 22 | 11.7 | 5.73 | 46.8 | 22.92 | 51 | 23.5 | -8.24% | -2.47% |

## 4.10. SAR measurement procedure

### 4.10.1 Tests to be performed

In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in Picture 11.1.

Step 1: The tests described in 11.2 shall be performed at the channel that is closest to the centre of the transmit frequency band ($f_c$) for:

a). all device positions (cheek and tilt, for both left and right sides of the SAM phantom;

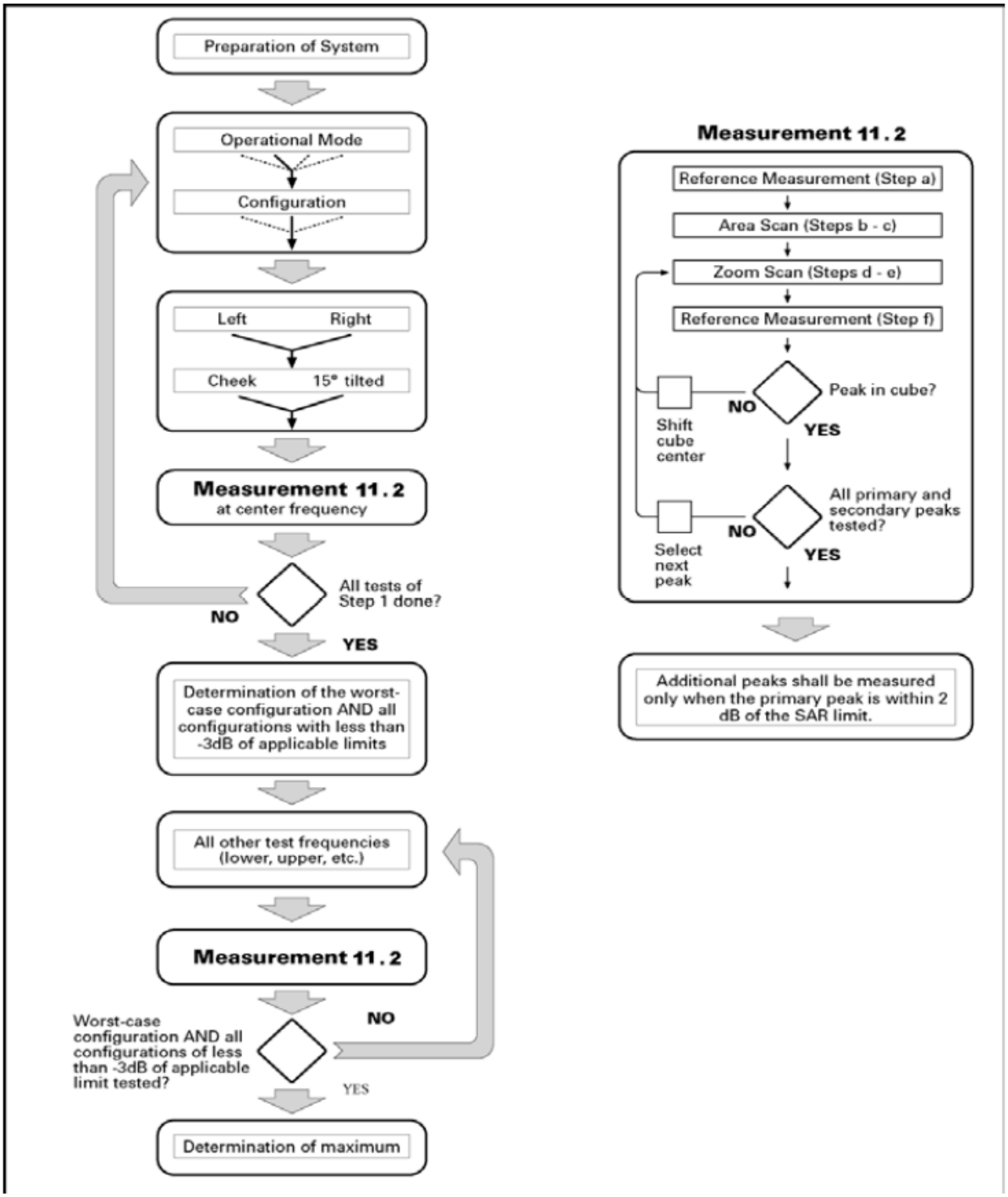
b). all configurations for each device position in a), e.g., antenna extended and retracted, and

c). all operational modes, e.g., analogue and digital, for each device position in a) and configuration in b) in each frequency band.

If more than three frequencies need to be tested according to 11.1 (i.e., $N_c > 3$), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

Step 2: For the condition providing highest peak spatial-average SAR determined in Step 1, perform all tests described in 11.2 at all other test frequencies, i.e., lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies shall be tested as well.

Step 3: Examine all data to determine the highest value of the peak spatial-average SAR found in Steps 1 to 2.




Picture 10.1 Block diagram of the tests to be performed

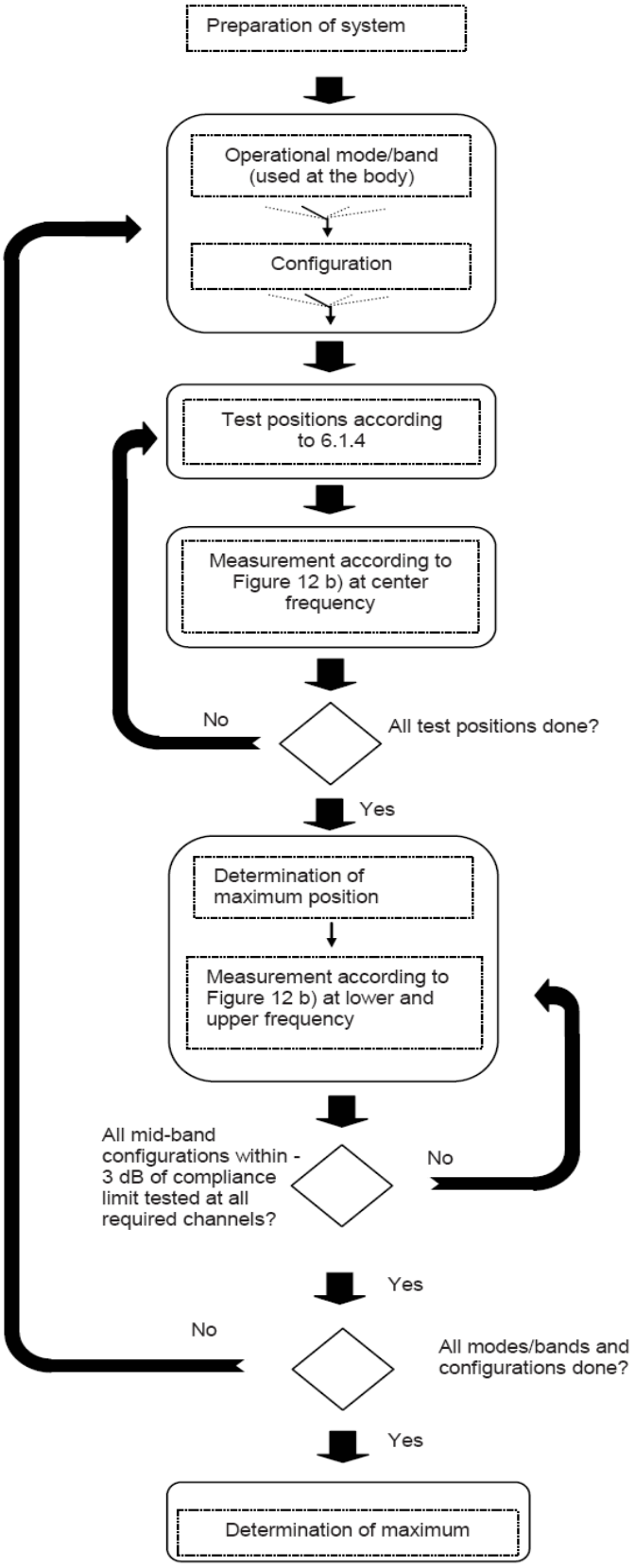



Figure 12a – Tests to be performed

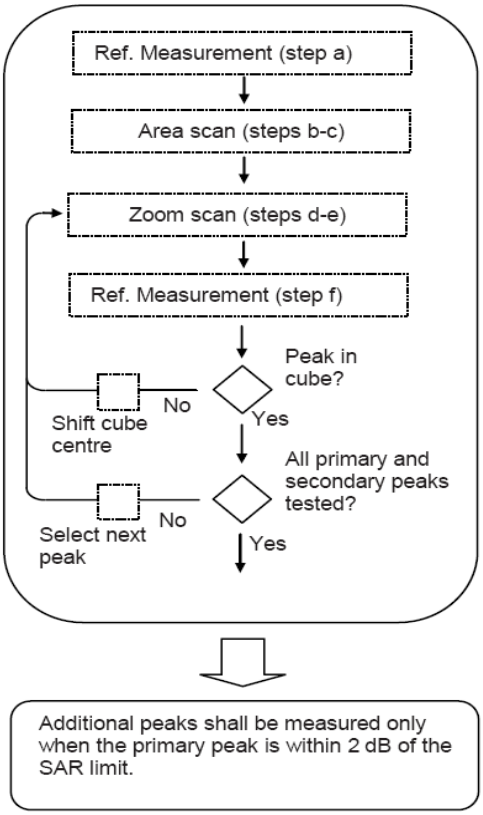



Figure 12b – General procedure

Picture 12 Block diagram of the tests to be performed

**Measurement procedure**

The following procedure shall be performed for each of the test conditions (see Picture 11) described in 11.1:

a) Measure the local SAR at a test point within 8 mm or less in the normal direction from the inner surface of the phantom.

b) Measure the two-dimensional SAR distribution within the phantom (area scan procedure). The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grip spacing of 20 mm for frequencies below 3 GHz and (60/f [GHz]) mm for frequencies of 3GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz andδln(2)/2 mm for frequencies of 3 GHz and greater, whereδis the plane wave skin depth and ln(x) is the natural logarithm. The maximum variation of the sensor-phantom surface shall be ±1 mm for frequencies below 3 GHz and ±0.5 mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than 5°. If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional measurement distance to the phantom inner surface shorter than the probe diameter, additional

c) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that are not within the zoom-scan volume; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR limit. This is consistent with the 2 dB threshold already stated;

d) Measure the three-dimensional SAR distribution at the local maxima locations identified in step

e) The horizontal grid step shall be (24 / f[GHz] ) mm or less but not more than 8 mm. The minimum zoom size of 30 mm by 30 mm and 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom size of 22 mm by 22 mm and 22 mm. The grip step in the vertical direction shall be ( 8-f[GHz] ) mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be (12 / f[GHz]) mm or less but not more than 4 mm, and the spacing between father points shall increase by an incremental factor not exceeding 1.5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δln(2)/2 mm for frequencies of 3 GHz and greater, where δis the plane wave skin depth and ln(x) is the natural logarithm. Separate grids shall be centered on each of the local SAR maxima found in step c). Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved is the distance between the phantom surface and physical tip of the probe is larger than probe tip diameter. Other methods may utilize correction procedures for these boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe with respect to the flat phantom surface shall be less than 5. If this cannot be achieved an additional uncertainty evaluation is needed.

f) Use post processing( e.g. interpolation and extrapolation ) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.

**Measurement procedure**

The following procedure shall be performed for each of the test conditions (see Picture 11) described in 11.1:

g) Measure the local SAR at a test point within 8 mm or less in the normal direction from the inner surface of the phantom.

h) Measure the two-dimensional SAR distribution within the phantom (area scan procedure). The boundary of the measurement area shall not be closer than 20 mm from the phantom side walls. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. A maximum grip spacing of 20 mm for frequencies below 3 GHz and (60/f [GHz]) mm for frequencies of 3GHz and greater is recommended. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz andδln(2)/2 mm for frequencies of 3 GHz and greater, whereδis the plane wave skin depth and ln(x) is the natural logarithm. The maximum variation of the sensor-phantom surface shall be ±1 mm for frequencies below 3 GHz and ±0.5 mm for frequencies of 3 GHz and greater. At all measurement points the angle of the probe with respect to the line normal to the surface should be less than 5°. If this cannot be achieved for a measurement distance to the phantom inner surface shorter than the probe diameter, additional measurement distance to the phantom inner surface shorter than the probe diameter, additional

i) From the scanned SAR distribution, identify the position of the maximum SAR value, in addition identify the positions of any local maxima with SAR values within 2 dB of the maximum value that are not within the zoom-scan volume; additional peaks shall be measured only when the primary peak is within 2 dB of the SAR limit. This is consistent with the 2 dB threshold already stated;
j) Measure the three-dimensional SAR distribution at the local maxima locations identified in step
k) The horizontal grid step shall be (24 / f[GHz] ) mm or less but not more than 8 mm. The minimum zoom size of 30 mm by 30 mm and 30 mm for frequencies below 3 GHz. For higher frequencies, the minimum zoom size of 22 mm by 22 mm and 22 mm. The grip step in the vertical direction shall be ( 8-f[GHz] ) mm or less but not more than 5 mm, if uniform spacing is used. If variable spacing is used in the vertical direction, the maximum spacing between the two closest measured points to the phantom shell shall be (12 / f[GHz]) mm or less but not more than 4 mm, and the spacing between father points shall increase by an incremental factor not exceeding 1.5. When variable spacing is used, extrapolation routines shall be tested with the same spacing as used in measurements. The maximum distance between the geometrical centre of the probe detectors and the inner surface of the phantom shall be 5 mm for frequencies below 3 GHz and δln(2)/2 mm for frequencies of 3 GHz and greater, where δis the plane wave skin depth and ln(x) is the natural logarithm. Separate grids shall be centered on each of the local SAR maxima found in step c). Uncertainties due to field distortion between the media boundary and the dielectric enclosure of the probe should also be minimized, which is achieved is the distance between the phantom surface and physical tip of the probe is larger than probe tip diameter. Other methods may utilize correction procedures for these boundary effects that enable high precision measurements closer than half the probe diameter. For all measurement points, the angle of the probe with respect to the flat phantom surface shall be less than 5. If this cannot be achieved an additional uncertainty evaluation is needed.
l) Use post processing( e.g. interpolation and extrapolation ) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.

### 4.10.2 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 1528-2003. 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.

| | | | ≤ 3 GHz | > 3 GHz |
|---|---|---|---|---|
| Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface | | | 5 ± 1 mm | ½·δ·ln(2) ± 0.5 mm |
| Maximum probe angle from probe axis to phantom surface normal at the measurement location | | | 30° ± 1° | 20° ± 1° |
| Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$ | | | ≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm | 3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 10 mm |
| | | | When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device. | |
| Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$ | | | ≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm* | 3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm* |
| Maximum zoom scan spatial resolution, normal to phantom surface | uniform grid: $\Delta z_{Zoom}(n)$ | | ≤ 5 mm | 3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 2 mm |
| | graded grid | $\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface | ≤ 4 mm | 3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm |
| | | $\Delta z_{Zoom}(n>1)$: between subsequent points | $\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$ | |
| Minimum zoom scan volume | x, y, z | | ≥ 30 mm | 3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 22 mm |

Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

* When zoom scan is required and the *reported* SAR from the area scan based *1-g SAR estimation* procedures of KDB 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.

### 4.10.3 Power Drift

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

# 5. TEST CONDITIONS AND RESULTS

## 5.1. Conducted Power Results

According KDB 447498 D01 General RF Exposure Guidance v06 Section 4.1 2) states that "Unless it is specified differently in the published RF exposure KDB procedures, these requirements also apply to test reduction and test exclusion considerations. Time-averaged maximum conducted output power applies to SAR and, as required by § 2.1091(c), time-averaged ERP applies to MPE.

### *5.1.1 Output Power Results Of WiFi*

| Mode | Channel | Frequence (MHz) | Tune-up | Average Power (dBm) |
|---|---|---|---|---|
| 802.11b | 1 | 2412 | 16.00 | 15.47 |
| | 6 | 2437 | 16.00 | 15.83 |
| | 11 | 2462 | 16.00 | 15.42 |
| 802.11g | 1 | 2412 | 13.00 | 10.20 |
| | 6 | 2437 | 13.00 | 12.72 |
| | 11 | 2462 | 13.00 | 11.79 |
| 802.11n (HT20) | 1 | 2412 | 13.00 | 10.06 |
| | 6 | 2437 | 13.00 | 12.53 |
| | 11 | 2462 | 13.00 | 11.29 |
| 802.11n (HT40) | 3 | 2422 | 11.00 | 10.05 |
| | 6 | 2437 | 11.00 | 10.17 |
| | 9 | 2452 | 11.00 | 10.58 |

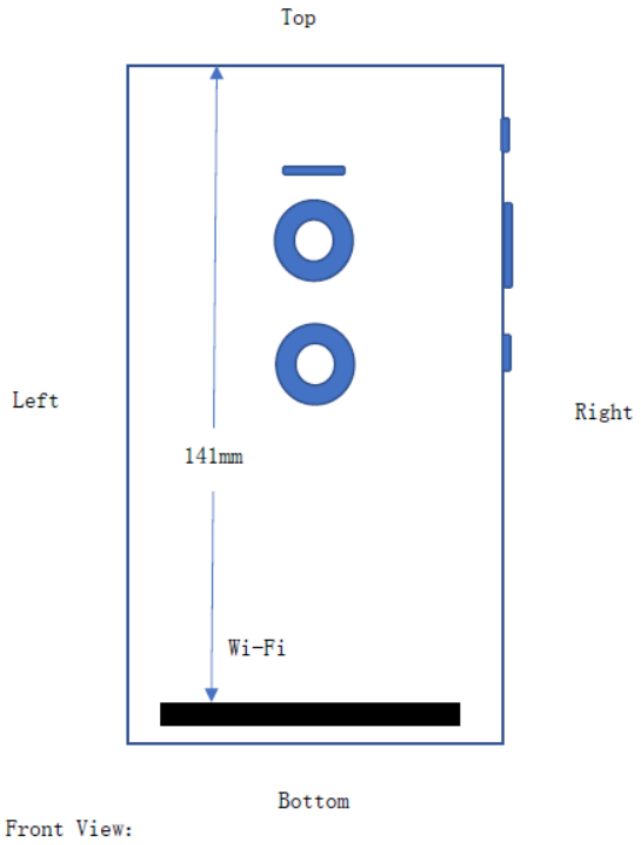
### *5.5.2 Output Power Results Of BT*

The output power of BT is as following:

| | Peak Output Power (dBm) | | | | |
|---|---|---|---|---|---|
| | Channel | Tune-up | Data Rates | | |
| | | | 1M | 2M | 3M |
| BT(3.0) | 0CH | 6.00 | 5.90 | 4.89 | 4.98 |
| | 39CH | 7.00 | 6.36 | 5.44 | 5.54 |
| | 78CH | 5.00 | 4.45 | 3.19 | 4.98 |

| | Channel | Tune-up | Peak Output Power (dBm) |
|---|---|---|---|
| BT(4.0) | 0CH | 0 | -1.46 |
| | 19CH | 1.00 | -0.22 |
| | 39CH | -1.00 | -2.87 |

## 5.2. Antenna Location




| Distance of the Antenna to the EUT surface/edge | | | | | | |
|---|---|---|---|---|---|---|
| Antennas | Front Side | Back Side | Left Side | Right Side | Top Side | Bottom Side |
| WLAN & BT | ≤ 50mm | ≤ 50mm | ≤ 50mm | ≤ 50mm | >50mm | ≤ 50mm |

## 5.3. SAR Measurement Results

### 5.3.1 BT SAR test Reduction

Per FCC KDB 447498D01, the 1-g SAR and 10-g SAR test exclusion thresholds 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)]·[$\sqrt{f_{(GHZ)}}$] ≤ 3.0 for 1-g SAR and ≤ 7.5 for 10-g extremity SAR, where:

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

When the minimum test separation distance is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion.

| Mode | $P_{max}$ (dBm) | $P_{max}$ (mW) | Distance (mm) | f (GHz) | Calculation Result | SAR Exclusion threshold | SAR test exclusion |
|---|---|---|---|---|---|---|---|
| BT | 7 | 5.01 | 5 | 2.480 | 1.58 | 3.0 | Yes |

NOTE: Standalone SAR test exclusion for BT

### 5.3.2 Wi-Fi Head SAR test Reduction

(1) The SAR exclusion threshold for distances <50mm is defined by the following equation:

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

(2) The SAR exclusion threshold for distances >50mm is defined by the following equation, as illustrated in KDB 447498 D01 Appendix B:

a) at 100 MHz to 1500 MHz

[Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm)·( f(MHz)/150)] mW

b) at > 1500 MHz and ≤ 6 GHz
[Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·10] mW

For *the head SAR, Head SAR is measured with the Top side of the radio positioned at 2.5 cm parallel to a flat phantom*
*The Top edge of the EUT towards the bottom of the flat phantom.*
*The threshold: 96+ (166-50)*10 = 1256mW=31.0 dBm>16 dBm*

*So SAR is not required for head SAR*

*Head SAR Test Considerations Note:*

1. ***In the top side of the device，there is a microphone ,the language will from here to translate, so it used as a "in front of face" device.****Passive body-worn and audio accessories generally do not apply to the head SAR of radios. Head SAR is measured with the Top side of the radio positioned at 2.5 cm parallel to a flat phantom. A phantom shell thickness of 2 mm is required. When the Top side of the radio has a contour or non-uniform surface with a variation of 1.0 cm or more, the average distance of such variations is used to establish the 2.5 cm test separation from the phantom.*

### 5.3.3 Wi-Fi Body SAR test

| EUT Sides for SAR Testing | | | | | | |
|---|---|---|---|---|---|---|
| Mode | Front | Back | Left | Right | Top | Bottom |
| Wi-Fi（2.4GHz） | Yes | Yes | Yes | Yes | No | Yes |

| Position | Test Frequency | | Mode | P_cond_high (W) | Carry Access. | Audio Access. | Belt Clip Distance (mm) | SAR_meas. (mW/g) | Power Drift (dB) |
|---|---|---|---|---|---|---|---|---|---|
| | Channel | MHz | | | | | | | |
| Front | 6 | 2437 | 802.11b | 0.0398 | A1, B1 | n/a | 0 | 0.513 | -0.13 |
| Back | 6 | 2437 | 802.11b | 0.0398 | A1, B1 | n/a | 0 | 0.561 | -0.15 |
| Left | 6 | 2437 | 802.11b | 0.0398 | A1, B1 | n/a | 0 | 0.476 | -0.11 |
| Right | 6 | 2437 | 802.11b | 0.0398 | A1, B1 | n/a | 0 | 0.213 | 0.12 |
| Bottom | 6 | 2437 | 802.11b | 0.0398 | A1, B1 | n/a | 0 | **0.891** | -0.17 |
| Bottom | 1 | 2412 | 802.11b | 0.0352 | A1, B1 | n/a | 0 | 0.813 | -0.11 |
| Bottom | 11 | 2462 | 802.11b | 0.0348 | A1, B1 | n/a | 0 | 0.807 | -0.13 |

*Body SAR Test Considerations Note:*

1. *Body SAR is measured positioned against a flat phantom, representative of the normal operating conditions expected by users and typically with a standard default audio accessory supplied with the radio. Since audio accessories, including any default audio accessories supplied with a radio, may be designed to operate with a subset of the combinations of antennas, batteries and body-worn accessories, when a default audio accessory does not fully support all the test configurations required in this section for body-worn accessories testing an alternative audio accessory must be selected to be the default audio accessory for body-worn accessories testing. If an alternative audio accessory cannot be identified, body-worn accessories should be tested without any audio accessory. In general, all sides of the radio that may be positioned facing the user when using a body-worn accessory must be considered for SAR compliance.*
2. *Testing of other required channels within the operating mode of a frequency band is not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:*
   a. *≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz*
   b. *≤ 0.6 W/kg or 1.5 W/kg, for 1-g or 10-g respectively, when the transmission band is between 100 MHz and 200 MHz*
   c. *≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz*
3. *Measured SAR based on 100% duty cycle*
4. (1) The SAR exclusion threshold for distances <50mm is defined by the following equation:

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

(2) The SAR exclusion threshold for distances >50mm is defined by the following equation, as illustrated in KDB 447498 D01 Appendix B:

a) at 100 MHz to 1500 MHz

[Power allowed at numeric threshold for 50 mm in step 1) + (test separation distance - 50 mm)·( f(MHz)/150)] mW

b) at > 1500 MHz and ≤ 6 GHz
[Power allowed at numeric Threshold at 50 mm in step 1) + (test separation distance - 50 mm)·10] mW

For *the Body SAR, SAR is measured with the Top side of the radio positioned at 0 cm parallel to a flat phantom. Then for the top edge of the EUT towards the bottom of the flat phantom.*
*The threshold: 96+ (141-50)*10 1006mW=30.03 dBm>16 dBm.*

## 5.4. SAR Reporting Results

These are not actual measurement SAR values, measurement SAR values taken from Section 5.3 SAR Measurement Results; we also take Section 5.2 formula to calculate maximum report SAR in 100% duty cycle.

**Max_Calc = SAR_Adju*DC*(P_max/P_cond)**

P_max = highest power including turn up tolerance (W)
P_cond_high = highest power in conduct measured (W)
DC = Transmission mode Duty Cycle in %
SAR_adju = Adjust 1-g and 10-g Average SAR from measured SAR (W/kg)

### 5.4.2 802.11b body SAR test

| Position | Test Frequency | | Mode | P_cond_ high (W) | P_max | Carry Access. | Audio Access. | Belt Clip Distance (mm) | SAR_mea. (mW/g) | Power Drift (dB) | Scaling Factor | Max Calc. $SAR_{1-g}$ (mW/g) | Plot |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Ch. | MHz | | | | | | | | | | | |
| Front | 6 | 2437 | 802.11b | 0.0383 | 0.0398 | A1, B1, | n/a | 0 | 0.513 | -0.13 | 1.039 | 0.533 | |
| Back | 6 | 2437 | 802.11b | 0.0383 | 0.0398 | | | 0 | 0.561 | -0.15 | 1.039 | 0.583 | |
| Left | 6 | 2437 | 802.11b | 0.0383 | 0.0398 | | | 0 | 0.476 | -0.11 | 1.039 | 0.495 | |
| Right | 6 | 2437 | 802.11b | 0.0383 | 0.0398 | | | 0 | 0.213 | 0.12 | 1.039 | 0.221 | |
| Bottom | 6 | 2437 | 802.11b | 0.0383 | 0.0398 | | | 0 | 0.891 | -0.17 | 1.039 | **0.926** | 1 |
| Bottom | 1 | 2412 | 802.11b | 0.0352 | 0.0398 | | | 0 | 0.813 | -0.11 | 1.129 | 0.918 | |
| Bottom | 11 | 2462 | 802.12b | 0.0348 | 0.0398 | | | 0 | 0.807 | -0.13 | 1.143 | 0.922 | |
| Bottom-repeat | 6 | 2437 | 802.12b | 0.0383 | 0.0398 | | | 0 | 0.871 | -0.13 | 1.039 | 0.905 | |

*Note：*

1. 2.4 GHz 802.11g/n OFDM SAR Test Exclusion Requirements, SAR is not required for the following 2.4 GHz OFDM conditions.
   a) When KDB Publication 447498 D01 SAR test exclusion applies to the OFDM configuration.
   b) When the highest *reported* SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg.

| Test Mode | Tune up(dBm) | Reported SAR (W/kg) | Adjusted SAR (W/kg) | SAR requied (Y/N) |
|---|---|---|---|---|
| 802.11b | 16 | 0.926 | / | / |
| 802.11g | 14 | / | 0.584 | N |
| 802.11n20 | 14 | / | 0.584 | N |
| 802.11n40 | 12 | / | 0.369 | N |

## 5.5. 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; steps 2) 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 ≥ 1.45 W/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.

The same procedures should be adapted for measurements according to extremity and occupational exposure limits by applying a factor of 2.5 for extremity exposure and a factor of 5 for occupational exposure to the corresponding SAR thresholds.

Thus the following procedures are applied to determine if repeated measurements are required for occupational exposure.

1) Repeated measurement is not required when the original highest measured SAR is < 4.00 W/kg; steps 6) through 8) do not apply.
2) When the original highest measured SAR is ≥ 4.00 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 > 6.00 or when the original or repeated measurement is ≥ 7.25 W/kg (~ 10% from the 1-g SAR limit).
4) Perform a third repeated measurement only if the original, first or second repeated measurement is ≥ 7.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20.

| Test Position | Channel/ Frequency (MHz) | Measured SAR (1g) | 1st Repeated SAR (1g) | Ratio | 2nd Repeated SAR (1g) | 3rd Repeated SAR (1g) |
|---|---|---|---|---|---|---|
| Bottom Side | 6/2437 | 0.891 | 0.871 | 1.02 | N/A | N/A |
| Note: 1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once. | | | | | | |
| 2) A second repeated measurement was preformed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit). | | | | | | |
| 3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20. | | | | | | |
| 4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg | | | | | | |

## 5.6. Measurement Uncertainty(300MHz-3GHz)

| ***According to IEC62209-1/IEEE 1528:2013*** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | Error Description | Type | Uncertainty Value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
| Measurement System | | | | | | | | | | |
| 1 | Probe calibration | B | 5.50% | N | 1 | 1 | 1 | 5.50% | 5.50% | ∞ |
| 2 | Axial isotropy | B | 4.70% | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.90% | 1.90% | ∞ |
| 3 | Hemispherical isotropy | B | 9.60% | R | $\sqrt{3}$ | 0.7 | 0.7 | 3.90% | 3.90% | ∞ |
| 4 | Boundary Effects | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.60% | 0.60% | ∞ |
| 5 | Probe Linearity | B | 4.70% | R | $\sqrt{3}$ | 1 | 1 | 2.70% | 2.70% | ∞ |
| 6 | Detection limit | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.60% | 0.60% | ∞ |
| 7 | RF ambient conditions-noise | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 8 | RF ambient conditions-reflection | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 9 | Response time | B | 0.80% | R | $\sqrt{3}$ | 1 | 1 | 0.50% | 0.50% | ∞ |
| 10 | Integration time | B | 5.00% | R | $\sqrt{3}$ | 1 | 1 | 2.90% | 2.90% | ∞ |
| 11 | RF ambient | B | 3.00% | R | $\sqrt{3}$ | 1 | 1 | 1.70% | 1.70% | ∞ |
| 12 | Probe positioned mech. restrictions | B | 0.40% | R | $\sqrt{3}$ | 1 | 1 | 0.20% | 0.20% | ∞ |
| 13 | Probe positioning with respect to phantom shell | B | 2.90% | R | $\sqrt{3}$ | 1 | 1 | 1.70% | 1.70% | ∞ |
| 14 | Max.SAR evalation | B | 3.90% | R | $\sqrt{3}$ | 1 | 1 | 2.30% | 2.30% | ∞ |
| Test Sample Related | | | | | | | | | | |
| 15 | Test sample positioning | A | 1.86% | N | 1 | 1 | 1 | 1.86% | 1.86% | ∞ |
| 16 | Device holder uncertainty | A | 1.70% | N | 1 | 1 | 1 | 1.70% | 1.70% | ∞ |
| 17 | Drift of output power | B | 5.00% | R | $\sqrt{3}$ | 1 | 1 | 2.90% | 2.90% | ∞ |
| Phantom and Set-up | | | | | | | | | | |
| 18 | Phantom uncertainty | B | 4.00% | R | $\sqrt{3}$ | 1 | 1 | 2.30% | 2.30% | ∞ |
| 19 | Liquid conductivity (target) | B | 5.00% | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.80% | 1.20% | ∞ |
| 20 | Liquid conductivity (meas.) | A | 0.50% | N | 1 | 0.64 | 0.43 | 0.32% | 0.26% | ∞ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 21 | Liquid permittivity (target) | B | 5.00% | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.80% | 1.20% | ∞ |
| 22 | Liquid cpermittivity (meas.) | A | 0.16% | N | 1 | 0.64 | 0.43 | 0.10% | 0.07% | ∞ |
| Combined standard uncertainty | $u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$ | | / | / | / | / | / | 10.20% | 10.00% | ∞ |
| Expanded uncertainty (confidence interval of 95 %) | $u_e = 2u_c$ | | / | R | K=2 | / | / | 20.40% | 20.00% | ∞ |

| ***According to IEC62209-2/2010*** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| No. | Error Description | Type | Uncertainty Value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
| Measurement System | | | | | | | | | | |
| 1 | Probe calibration | B | 6.20% | N | 1 | 1 | 1 | 6.20% | 6.20% | ∞ |
| 2 | Axial isotropy | B | 4.70% | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.90% | 1.90% | ∞ |
| 3 | Hemispherical isotropy | B | 9.60% | R | $\sqrt{3}$ | 0.7 | 0.7 | 3.90% | 3.90% | ∞ |
| 4 | Boundary Effects | B | 2.00% | R | $\sqrt{3}$ | 1 | 1 | 1.20% | 1.20% | ∞ |
| 5 | Probe Linearity | B | 4.70% | R | $\sqrt{3}$ | 1 | 1 | 2.70% | 2.70% | ∞ |
| 6 | Detection limit | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.60% | 0.60% | ∞ |
| 7 | RF ambient conditions-noise | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 8 | RF ambient conditions-reflection | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 9 | Response time | B | 0.80% | R | $\sqrt{3}$ | 1 | 1 | 0.50% | 0.50% | ∞ |
| 10 | Integration time | B | 5.00% | R | $\sqrt{3}$ | 1 | 1 | 2.90% | 2.90% | ∞ |
| 11 | RF Ambient | B | 3.00% | R | $\sqrt{3}$ | 1 | 1 | 1.70% | 1.70% | ∞ |
| 12 | Probe positioned mech. restrictions | B | 0.80% | R | $\sqrt{3}$ | 1 | 1 | 0.50% | 0.50% | ∞ |
| 13 | Probe positioning with respect to phantom shell | B | 6.70% | R | $\sqrt{3}$ | 1 | 1 | 3.90% | 3.90% | ∞ |
| 14 | Max.SAR Evalation | B | 3.90% | R | $\sqrt{3}$ | 1 | 1 | 2.30% | 2.30% | ∞ |
| 15 | Modulation Response | B | 2.40% | R | $\sqrt{3}$ | 1 | 1 | 1.40% | 1.40% | ∞ |
| Test Sample Related | | | | | | | | | | |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 16 | Test sample positioning | A | 1.86% | N | 1 | 1 | 1 | 1.86% | 1.86% | ∞ |
| 17 | Device holder uncertainty | A | 1.70% | N | 1 | 1 | 1 | 1.70% | 1.70% | ∞ |
| 18 | Drift of output power | B | 5.00% | R | $\sqrt{3}$ | 1 | 1 | 2.90% | 2.90% | ∞ |
| Phantom and Set-up | | | | | | | | | | |
| 19 | Phantom uncertainty | B | 6.10% | R | $\sqrt{3}$ | 1 | 1 | 3.50% | 3.50% | ∞ |
| 20 | SAR correction | B | 1.90% | R | $\sqrt{3}$ | 1 | 0.84 | 1.11% | 0.90% | ∞ |
| 21 | Liquid conductivity (target) | B | 5.00% | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.80% | 1.20% | ∞ |
| 22 | Liquid conductivity (meas.) | A | 0.50% | N | 1 | 0.64 | 0.43 | 0.32% | 0.26% | ∞ |
| 23 | Liquid permittivity (target) | B | 5.00% | R | $\sqrt{3}$ | 0.64 | 0.43 | 1.80% | 1.20% | ∞ |
| 24 | Liquid cpermittivity (meas.) | A | 0.16% | N | 1 | 0.64 | 0.43 | 0.10% | 0.07% | ∞ |
| 25 | Temp.Unc.-Conductivity | B | 3.40% | R | $\sqrt{3}$ | 0.78 | 0.71 | 1.50% | 1.40% | ∞ |
| 26 | Temp.Unc.-Permittivity | B | 0.40% | R | $\sqrt{3}$ | 0.23 | 0.26 | 0.10% | 0.10% | ∞ |
| Combined standard uncertainty | $u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$ | | / | / | / | / | / | 12.90% | 12.70% | ∞ |
| Expanded uncertainty (confidence interval of 95 %) | $u_e = 2u_c$ | | / | R | K=2 | / | / | 25.80% | 25.40% | ∞ |

| ***Uncertainty of a System Performance Check with DASY5 System*** | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| ***According to IEC62209-2/2010*** | | | | | | | | | | |
| No. | Error Description | Type | Uncertainty Value | Probably Distribution | Div. | (Ci) 1g | (Ci) 10g | Std. Unc. (1g) | Std. Unc. (10g) | Degree of freedom |
| Measurement System | | | | | | | | | | |
| 1 | Probe calibration | B | 6.00% | N | 1 | 1 | 1 | 6.00% | 6.00% | ∞ |
| 2 | Axial isotropy | B | 4.70% | R | $\sqrt{3}$ | 0.7 | 0.7 | 1.90% | 1.90% | ∞ |
| 3 | Hemispherical isotropy | B | 0.00% | R | $\sqrt{3}$ | 0.7 | 0.7 | 0.00% | 0.00% | ∞ |
| 4 | Boundary Effects | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.60% | 0.60% | ∞ |
| 5 | Probe Linearity | B | 4.70% | R | $\sqrt{3}$ | 1 | 1 | 2.70% | 2.70% | ∞ |
| 6 | Detection limit | B | 1.00% | R | $\sqrt{3}$ | 1 | 1 | 0.60% | 0.60% | ∞ |
| 7 | RF ambient conditions-noise | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 8 | RF ambient conditions-reflection | B | 0.00% | R | $\sqrt{3}$ | 1 | 1 | 0.00% | 0.00% | ∞ |
| 9 | Response time | B | 0.80% | R | $\sqrt{3}$ | 1 | 1 | 0.50% | 0.50% | ∞ |
| 10 | Integration time | B | 5.00% | R | $\sqrt{3}$ | 1 | 1 | 2.90% | 2.90% | ∞ |
| 11 | RF Ambient | B | 3.00% | R | $\sqrt{3}$ | 1 | 1 | 1.70% | 1.70% | ∞ |
| 12 | Probe positioned mech. restrictions | B | 0.80% | R | $\sqrt{3}$ | 1 | 1 | 0.50% | 0.50% | ∞ |
| 13 | Probe positioning with respect to phantom shell | B | 6.70% | R | $\sqrt{3}$ | 1 | 1 | 3.90% | 3.90% | ∞ |
| 14 | Max.SAR Evalation | B | 3.90% | R | $\sqrt{3}$ | 1 | 1 | 2.30% | 2.30% | ∞ |
| 15 | Modulation Response | B | 2.40% | R | $\sqrt{3}$ | 1 | 1 | 1.40% | 1.40% | ∞ |
| Test Sample Related | | | | | | | | | | |
| 16 | Test sample positioning | A | 0.00% | N | 1 | 1 | 1 | 0.00% | 0.00% | ∞ |
| 17 | Device holder uncertainty | A | 2.00% | N | 1 | 1 | 1 | 2.00% | 2.00% | ∞ |
| 18 | Drift of output power | B | 3.40% | R | $\sqrt{3}$ | 1 | 1 | 2.00% | 2.00% | ∞ |
| Phantom and Set-up | | | | | | | | | | |
| 19 | Phantom uncertainty | B | 4.00% | R | $\sqrt{3}$ | 1 | 1 | 2.30% | 2.30% | ∞ |
| 20 | SAR correction | B | 1.90% | R | $\sqrt{3}$ | 1 | 0.84 | 1.11% | 0.90% | ∞ |
| 21 | Liquid conductivity (meas.) | A | 0.50% | N | 1 | 0.64 | 0.43 | 0.32% | 0.26% | ∞ |
| 22 | Liquid cpermittivity (meas.) | A | 0.16% | N | 1 | 0.64 | 0.43 | 0.10% | 0.07% | ∞ |
| 23 | Temp.Unc.-Conductivity | B | 1.70% | R | $\sqrt{3}$ | 0.78 | 0.71 | 0.80% | 0.80% | ∞ |
| 24 | Temp.Unc.-Permittivity | B | 0.40% | R | $\sqrt{3}$ | 0.23 | 0.26 | 0.10% | 0.10% | ∞ |
| Combined standard uncertainty | $u_c = \sqrt{\sum_{i=1}^{22} c_i^2 u_i^2}$ | | / | / | / | / | / | 12.90% | 12.70% | ∞ |
| Expanded uncertainty (confidence interval of 95 %) | $u_e = 2u_c$ | | / | R | K=2 | / | / | 18.80% | 18.40% | ∞ |

## 5.7. System Check Results

**System Performance Check at 2450 MHz Body TSL**

DUT: Dipole2450 MHz; Type: D2450V2; Serial: 733

Date/Time: 12/05/2017 08:45:16 AM

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

Medium parameters used (interpolated): f = 2450 MHz; σ = 1.951 S/m; $\varepsilon_r$ = 51.68; ρ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

Probe: EX3DV4 - SN3789; ConvF(6.98, 6.98, 6.98); Calibrated: 1/13/2017;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1267; Calibrated: 02/23/2017

Phantom: SAM; Type: SAM V4.0;

Measurement SW: DASY52, Version 52.8 (2); SEMCAD X Version 14.6.6 (6824)

**System Performance Check at 2450MHz/Area Scan (61x201x1):** Interpolated grid: dx=1.200 mm, dy=1.20 mm

Maximum value of SAR (interpolated) = 11.8 mW/g

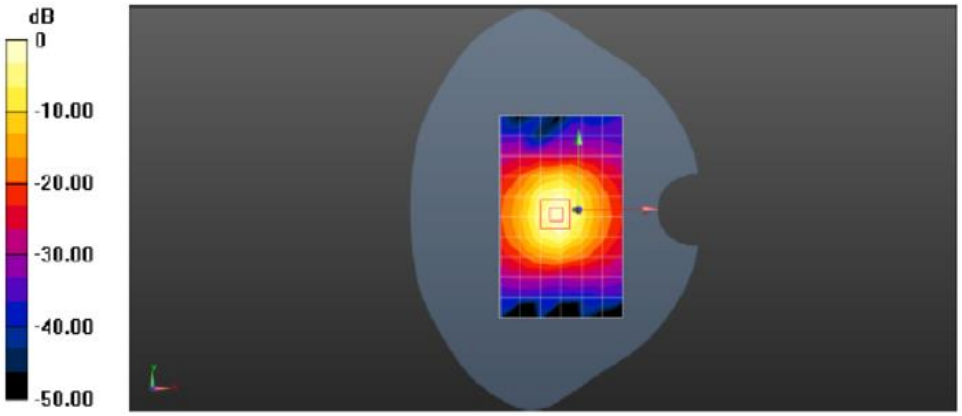
**System Performance Check at 2450MHz/Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 79.93 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 25.2 mW/g

**SAR(1 g) = 11.7 mW/g; SAR(10 g) =5.73 mW/g**

Maximum value of SAR (measured) = 12.9 mW/g




0 dB = 11.8W/Kg = 10.72 dB mW/g

System Performance Check 2450MHz Body 250mW

## 5.8. SAR Test Graph Results

**Body worn for 802.11b Bottom towards Phantom 0mm**

Communication System: Wi-Fi; Frequency: 2437 MHz;Duty Cycle: 1:1

Medium parameters used (interpolated): 2437 MHz; σ = 1.912 S/m; $\varepsilon_r$ = 51.87; ρ = 1000 kg/m$^3$

Phantom section: Flat Section

DASY5 Configuration:

Probe: EX3DV4 - SN3789; ConvF(6.98, 6.98, 6.98); Calibrated: 1/13/2017;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1267; Calibrated: 02/23/2017

Phantom: SAM; Type: SAM V4.0

Measurement SW: DASY52, Version 52.8.8 (1222); SEMCAD X Version 14.6.10 (7331)

**Area Scan (51x101x1):** Interpolated grid: dx=1.200 mm, dy=1.20 mm

Maximum value of SAR (interpolated) =0.886 mW/g

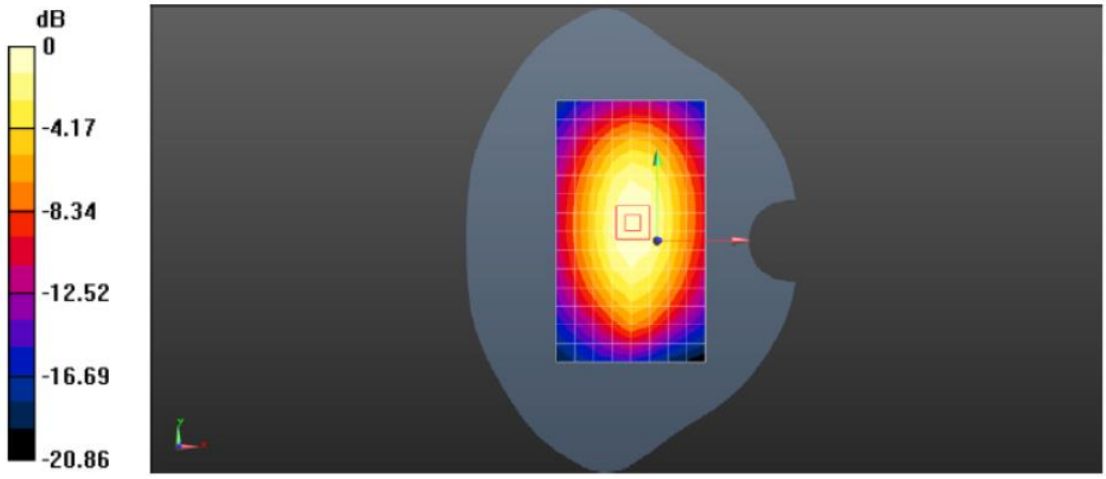
**Zoom Scan (7x7x7)/Cube 0:** Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 30.131 V/m; Power Drift = -0.17 dB

Peak SAR (extrapolated) = 0.971 mW/g

**SAR(1 g) = 0.891 mW/g; SAR(10 g) = 0.261 mW/g**

Maximum value of SAR (measured) = 0.91 mW/g




0 dB = 0.886 mW/g =-0.53 dB mW/g

Body worn for 802.11b Bottom towards Phantom 0mm

## 5.9. Simultaneous Transmission

There is only WiFi&BT antenna，they can't transmit simultaneously.
so there is no simultaneous transmission SAR consideration.

# 6. Calibration Certificate

## 6.1.Probe Calibration Ceriticate

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Client CIQ (Shenzhen) Certificate No: Z17-97003

### CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | EX3DV4 - SN:3789 |
| Calibration Procedure(s) | FD-Z11-004-01<br>Calibration Procedures for Dosimetric E-field Probes |
| Calibration date: | January 13, 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 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 7433 | 26-Sep-16(SPEAG,No.EX3-7433_Sep16) | Sep-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 |

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

Issued: January 14, 2017

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

Certificate No: Z17-97003 Page 1 of 11

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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, "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:**

- *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 EX3DV4

## SN: 3789

Calibrated: January 13, 2017

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: Z17-97003 Page 3 of 11

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# DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3789

## Basic Calibration Parameters

| | Sensor X | Sensor Y | Sensor Z | Unc (k=2) |
|---|---|---|---|---|
| Norm(μV/(V/m)$^2$) [A] | 0.45 | 0.50 | 0.51 | ±10.8% |
| DCP(mV) [B] | 102.6 | 100.7 | 98.5 | |

## 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 | 193.3 | ±2.7% |
| | | Y | 0.0 | 0.0 | 1.0 | | 195.3 | |
| | | Z | 0.0 | 0.0 | 1.0 | | 199.4 | |

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 $E^2$-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: EX3DV4 – SN: 3789

## 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 | 8.89 | 8.89 | 8.89 | 0.35 | 0.80 | ±12% |
| 835 | 41.5 | 0.90 | 8.61 | 8.61 | 8.61 | 0.16 | 1.40 | ±12% |
| 1750 | 40.1 | 1.37 | 7.55 | 7.55 | 7.55 | 0.26 | 1.07 | ±12% |
| 1900 | 40.0 | 1.40 | 7.37 | 7.37 | 7.37 | 0.28 | 1.02 | ±12% |
| 2000 | 40.0 | 1.40 | 7.19 | 7.19 | 7.19 | 0.26 | 1.05 | ±12% |
| 2300 | 39.5 | 1.67 | 7.12 | 7.12 | 7.12 | 0.57 | 0.72 | ±12% |
| 2450 | 39.2 | 1.80 | 6.85 | 6.85 | 6.85 | 0.57 | 0.74 | ±12% |
| 2600 | 39.0 | 1.96 | 6.70 | 6.70 | 6.70 | 0.69 | 0.68 | ±12% |
| 5250 | 35.9 | 4.71 | 5.00 | 5.00 | 5.00 | 0.45 | 1.20 | ±13% |
| 5600 | 35.5 | 5.07 | 4.48 | 4.48 | 4.48 | 0.45 | 1.30 | ±13% |
| 5750 | 35.4 | 5.22 | 4.68 | 4.68 | 4.68 | 0.45 | 1.40 | ±13% |

[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: EX3DV4 – SN: 3789

## 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 | 9.13 | 9.13 | 9.13 | 0.40 | 0.88 | ±12% |
| 835 | 55.2 | 0.97 | 8.80 | 8.80 | 8.80 | 0.16 | 1.58 | ±12% |
| 1750 | 53.4 | 1.49 | 7.36 | 7.36 | 7.36 | 0.25 | 1.09 | ±12% |
| 1900 | 53.3 | 1.52 | 7.06 | 7.06 | 7.06 | 0.21 | 1.21 | ±12% |
| 2000 | 53.3 | 1.52 | 7.20 | 7.20 | 7.20 | 0.19 | 1.44 | ±12% |
| 2300 | 52.9 | 1.81 | 7.19 | 7.19 | 7.19 | 0.61 | 0.78 | ±12% |
| 2450 | 52.7 | 1.95 | 6.98 | 6.98 | 6.98 | 0.56 | 0.84 | ±12% |
| 2600 | 52.5 | 2.16 | 6.83 | 6.83 | 6.83 | 0.46 | 0.94 | ±12% |
| 5250 | 48.9 | 5.36 | 4.64 | 4.64 | 4.64 | 0.50 | 1.45 | ±13% |
| 5600 | 48.5 | 5.77 | 3.86 | 3.86 | 3.86 | 0.50 | 1.76 | ±13% |
| 5750 | 48.3 | 5.94 | 4.27 | 4.27 | 4.27 | 0.56 | 1.95 | ±13% |

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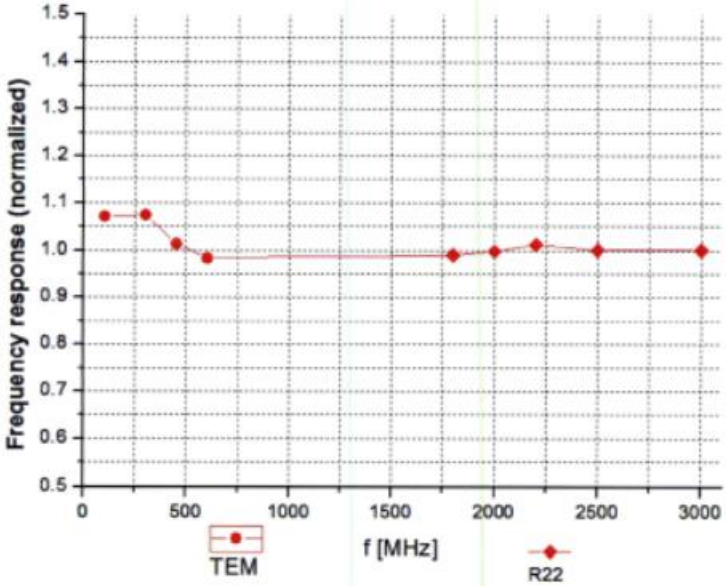
## Frequency Response of E-Field
### (TEM-Cell: ifi110 EXX, Waveguide: R22)




**Uncertainty of Frequency Response of E-field: ±7.5% (k=2)**

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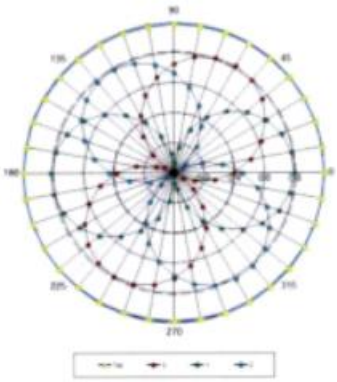
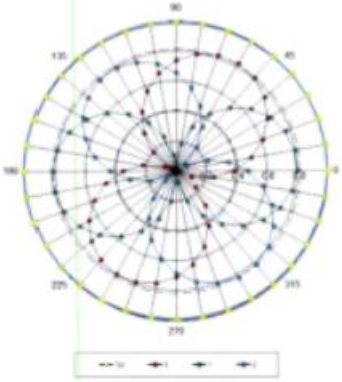
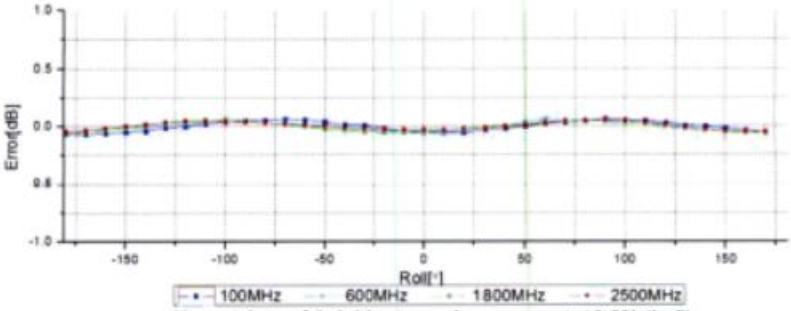
## Receiving Pattern (Φ), θ=0°

**f=600 MHz, TEM**



**f=1800 MHz, R22**






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

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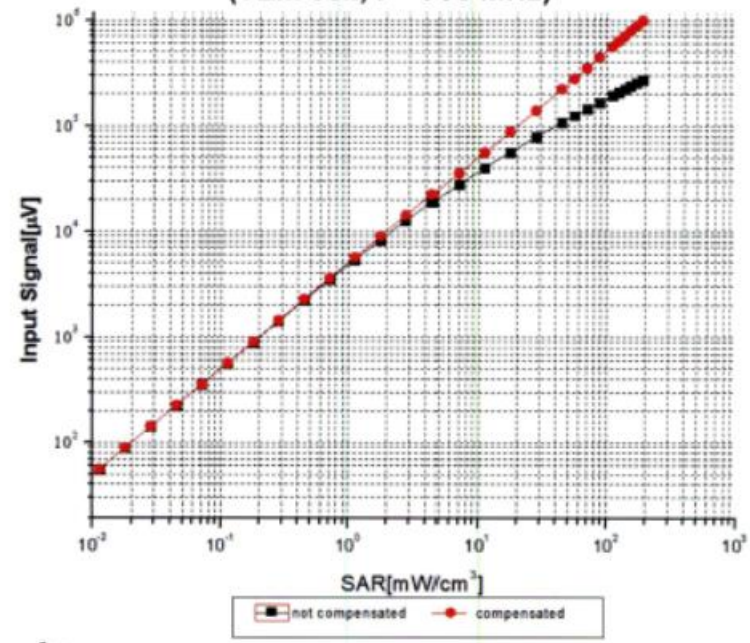
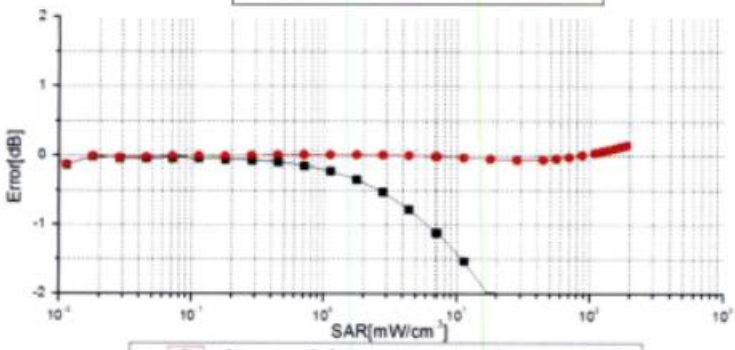
**Dynamic Range f(SAR$_{head}$)**
**(TEM cell, f = 900 MHz)**




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

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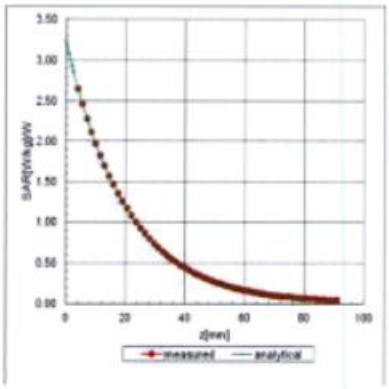
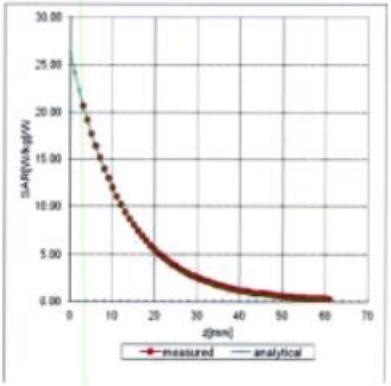
## Conversion Factor Assessment

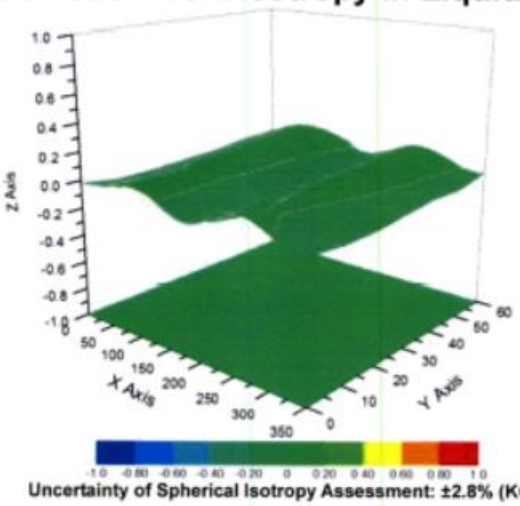
f=835 MHz, WGLS R9(H_convF)




f=1750 MHz, WGLS R22(H_convF)




## Deviation from Isotropy in Liquid




Uncertainty of Spherical Isotropy Assessment: ±2.8% (K=2)

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## DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3789

### Other Probe Parameters

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



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## 6.2. D2450V2 Dipole Calibration Certificate

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校准
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CNAS L0570

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Client Auden Certificate No: Z16-97242

### CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | D2450V2 - SN: 733 |
| Calibration Procedure(s) | FD-Z11-003-01<br>Calibration Procedures for dipole validation kits |
| Calibration date: | December 7, 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)℃ 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 |
| Reference Probe EX3DV4 | SN 7433 | 26-Sep-16(SPEAG,No.EX3-7433_Sep16) | Sep-17 |
| DAE4 | SN 771 | 02-Feb-16(CTTL-SPEAG,No.Z16-97011) | Feb-17 |
| **Secondary Standards** | **ID #** | **Cal Date(Calibrated by, Certificate No.)** | **Scheduled Calibration** |
| Signal Generator E4438C | MY49071430 | 01-Feb-16 (CTTL, No.J16X00893) | Jan-17 |
| Network Analyzer E5071C | MY46110673 | 26-Jan-16 (CTTL, No.J16X00894) | Jan-17 |

| | Name | Function | Signature |
|---|---|---|---|
| Calibrated by: | Zhao Jing | SAR Test Engineer | |
| Reviewed by: | Qi Dianyuan | SAR Project Leader | |
| Approved by: | Lu Bingsong | Deputy Director of the laboratory | |

Issued: December 11, 2016

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**Glossary:**

| | |
|---|---|
| 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, "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 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 | 52.8.8.1258 |
| **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** | 2450 MHz ± 1 MHz | |

## Head TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Head TSL parameters** | 22.0 °C | 39.2 | 1.80 mho/m |
| **Measured Head TSL parameters** | (22.0 ± 0.2) °C | 39.4 ± 6 % | 1.81 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 | 13.3 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **53.1 mW /g ± 20.8 % (k=2)** |
| **SAR averaged over 10 $cm^3$ (10 g) of Head TSL** | Condition | |
| SAR measured | 250 mW input power | 6.22 mW / g |
| SAR for nominal Head TSL parameters | normalized to 1W | **24.9 mW /g ± 20.4 % (k=2)** |

## Body TSL parameters

The following parameters and calculations were applied.

| | Temperature | Permittivity | Conductivity |
|---|---|---|---|
| **Nominal Body TSL parameters** | 22.0 °C | 52.7 | 1.95 mho/m |
| **Measured Body TSL parameters** | (22.0 ± 0.2) °C | 53.1 ± 6 % | 1.94 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 | 12.7 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **51.0 mW /g ± 20.8 % (k=2)** |
| **SAR averaged over 10 $cm^3$ (10 g) of Body TSL** | Condition | |
| SAR measured | 250 mW input power | 5.85 mW / g |
| SAR for nominal Body TSL parameters | normalized to 1W | **23.5 mW /g ± 20.4 % (k=2)** |



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## Appendix

### Antenna Parameters with Head TSL

| | |
|---|---|
| Impedance, transformed to feed point | 52.9Ω+ 4.11jΩ |
| Return Loss | - 26.3dB |

### Antenna Parameters with Body TSL

| | |
|---|---|
| Impedance, transformed to feed point | 49.7Ω+ 5.90jΩ |
| Return Loss | - 24.6dB |

### General Antenna Parameters and Design

| | |
|---|---|
| Electrical Delay (one direction) | 1.257 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: 11.07.2016

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 733**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; σ = 1.809 S/m; εr = 39.42; ρ = 1000 kg/m3

Phantom section: Center Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.45, 7.45, 7.45); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

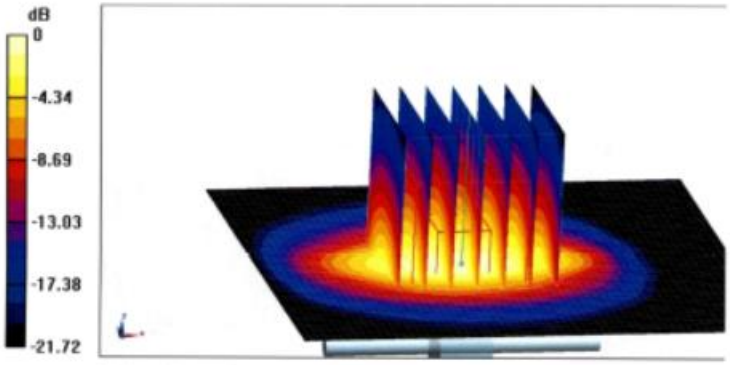
**Dipole Calibration**/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 106.8 V/m; Power Drift = 0.03 dB

Peak SAR (extrapolated) = 27.5 W/kg

**SAR(1 g) = 13.3 W/kg; SAR(10 g) = 6.22 W/kg**

Maximum value of SAR (measured) = 20.4 W/kg




**0 dB = 20.4 W/kg = 13.10 dBW/kg**

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**Impedance Measurement Plot for Head TSL**

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**DASY5 Validation Report for Body TSL** Date: 12.07.2016

Test Laboratory: CTTL, Beijing, China

**DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 733**

Communication System: UID 0, CW; Frequency: 2450 MHz; Duty Cycle: 1:1

Medium parameters used: f = 2450 MHz; $\sigma$ = 1.943 S/m; $\varepsilon_r$ = 53.12; $\rho$ = 1000 kg/m$^3$

Phantom section: Right Section

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

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.46, 7.46, 7.46); Calibrated: 9/26/2016;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn771; Calibrated: 2/2/2016
- Phantom: Triple Flat Phantom 5.1C; Type: QD 000 P51 CA; Serial: 1161/1
- Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7372)

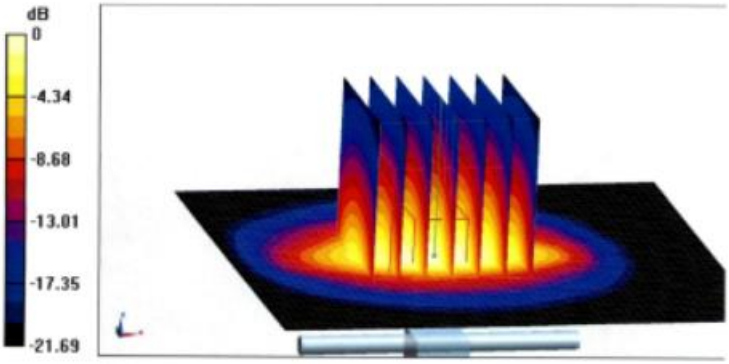
**Dipole Calibration**/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.60 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 26.0 W/kg

**SAR(1 g) = 12.7 W/kg; SAR(10 g) = 5.85 W/kg**

Maximum value of SAR (measured) = 19.2 W/kg




**0 dB = 19.2 W/kg = 12.83 dBW/kg**

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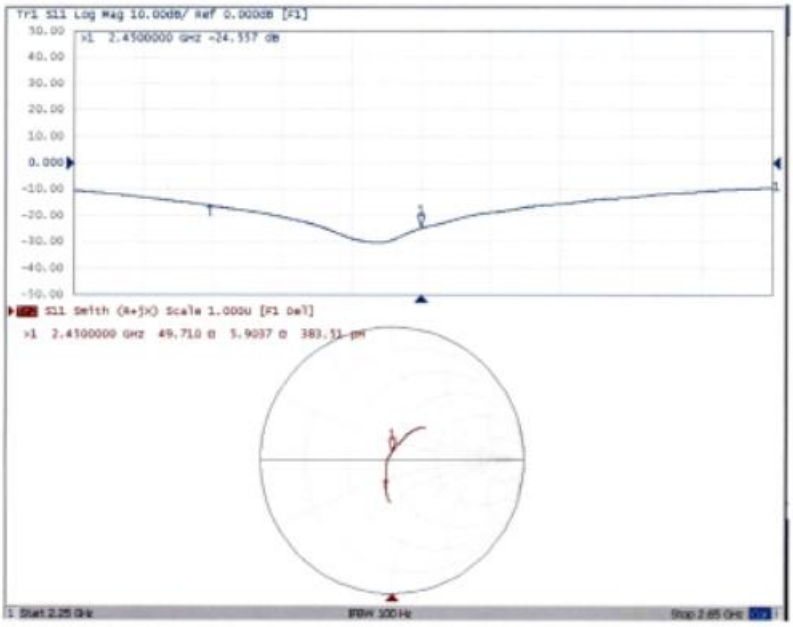
**Impedance Measurement Plot for Body TSL**

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## 6.3. DAE4 Calibration Certificate

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CNAS L0570

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E-mail: cttl@chinattl.com Http://www.chinattl.cn

Client : CIQ(Shenzhen) Certificate No: Z17-97025

### CALIBRATION CERTIFICATE

| | |
|---|---|
| Object | DAE4 - SN: 1267 |
| Calibration Procedure(s) | FD-Z11-002-01<br>Calibration Procedure for the Data Acquisition Electronics (DAEx) |
| Calibration date: | February 23, 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 |
|---|---|---|---|
| Process Calibrator 753 | 1971018 | 27-June-16 (CTTL, No:J16X04778) | June-17 |

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

Issued: February 24, 2017

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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 | 404.393 ± 0.15% (k=2) | 403.962 ± 0.15% (k=2) | 404.196 ± 0.15% (k=2) |
| Low Range | 3.99704 ± 0.7% (k=2) | 3.96717 ± 0.7% (k=2) | 3.99451 ± 0.7% (k=2) |

## Connector Angle

| | |
|---|---|
| **Connector Angle** to be used in DASY system | 165° ± 1 ° |

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OET

February 24, 2015

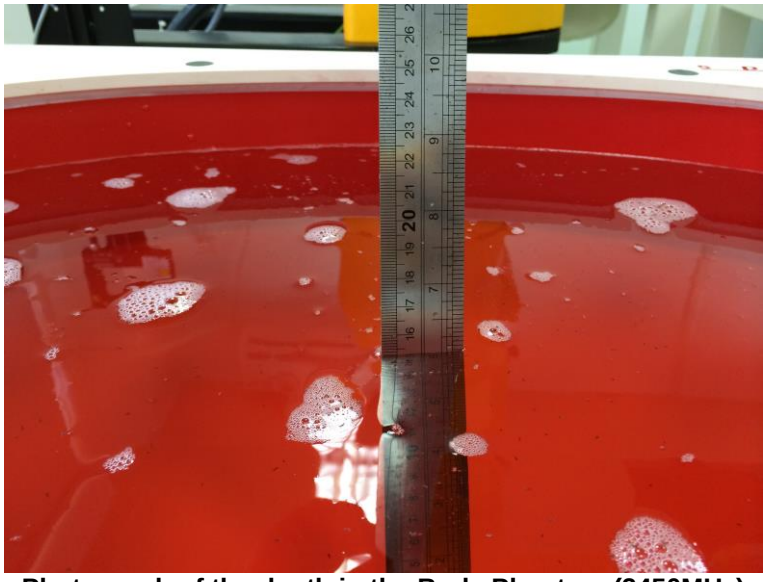
**Acceptable Conditions for SAR Measurements Using Probes and Dipoles Calibrated under the SPEAG-CTTL Dual-Logo Calibration Program to Support FCC Equipment Certification**

The acceptable conditions for SAR measurements using probes, dipoles and DAEs calibrated by CTTL (*China Telecommunication Technology Labs*), under the Dual-Logo Calibration Certificate program and quality assurance (QA) protocols established between SPEAG (*Schmid & Partner Engineering AG, Switzerland*) and CTTL, to support FCC (*U.S. Federal Communications Commission*) equipment certification are defined and described in the following. The conditions in this KDB are valid until December 31, 2015.

1) The agreement established between SPEAG and CTTL is only applicable to calibration services performed by CTTL where its clients (companies and divisions of such companies) are headquartered in the Greater China Region, including Taiwan and Hong Kong. CTTL 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-CTTL 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 CTTL, 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 or probe sensor model based linearization methods that are not fully described in SAR standards are excluded and cannot be used for measurements to support FCC equipment certification.
   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 CTTL 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 CTTL. Equivalent test equipment and measurement configurations may be considered only when agreed by both SPEAG and the FCC.
   f) The calibrated items are only applicable to SPEAG DASY 4 and DASY 5 systems or higher version systems that satisfy the requirements of this KDB.
3) The SPEAG-CTTL agreement includes specific protocols identified in the following to ensure the quality of calibration services provided by CTTL under this SPEAG-

1

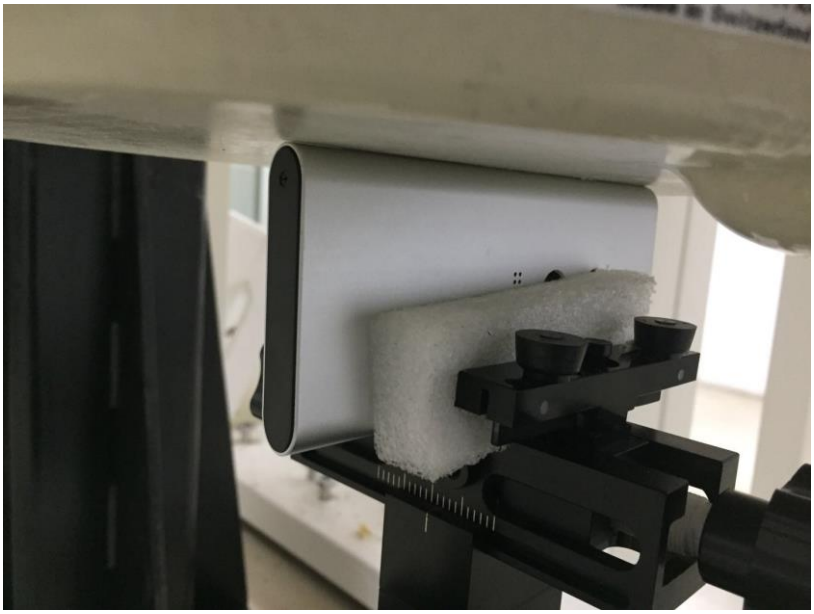
# 7. Test Setup Photos



**Photograph of the depth in the Body Phantom (2450MHz)**

**Body Front side 0mm**

**Body Back side 0mm**



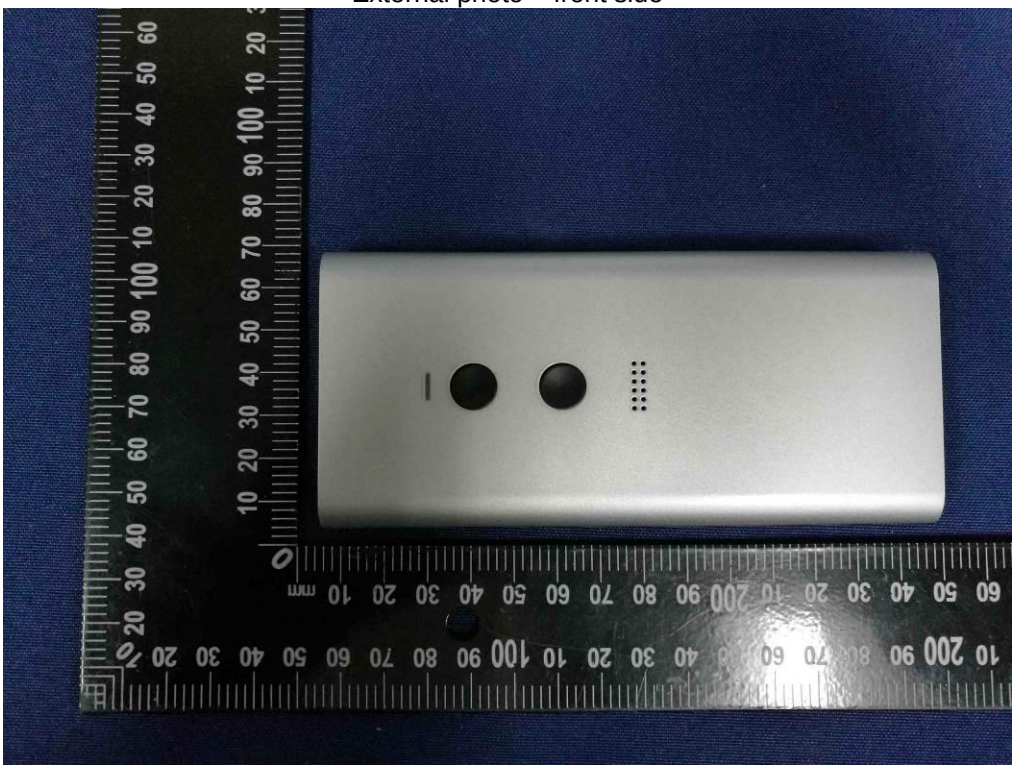
**Body Left side 0mm**

**Body Right side 0mm**

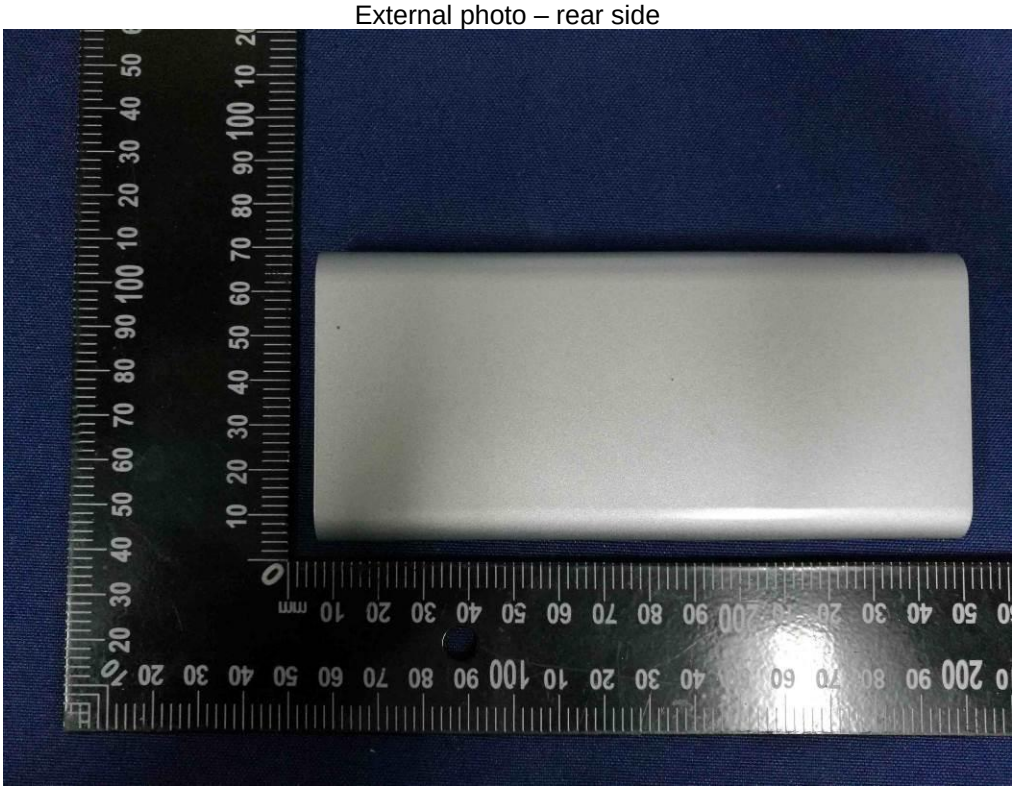
**Body Bottom side 0mm**

# 8. External Photos of the EUT

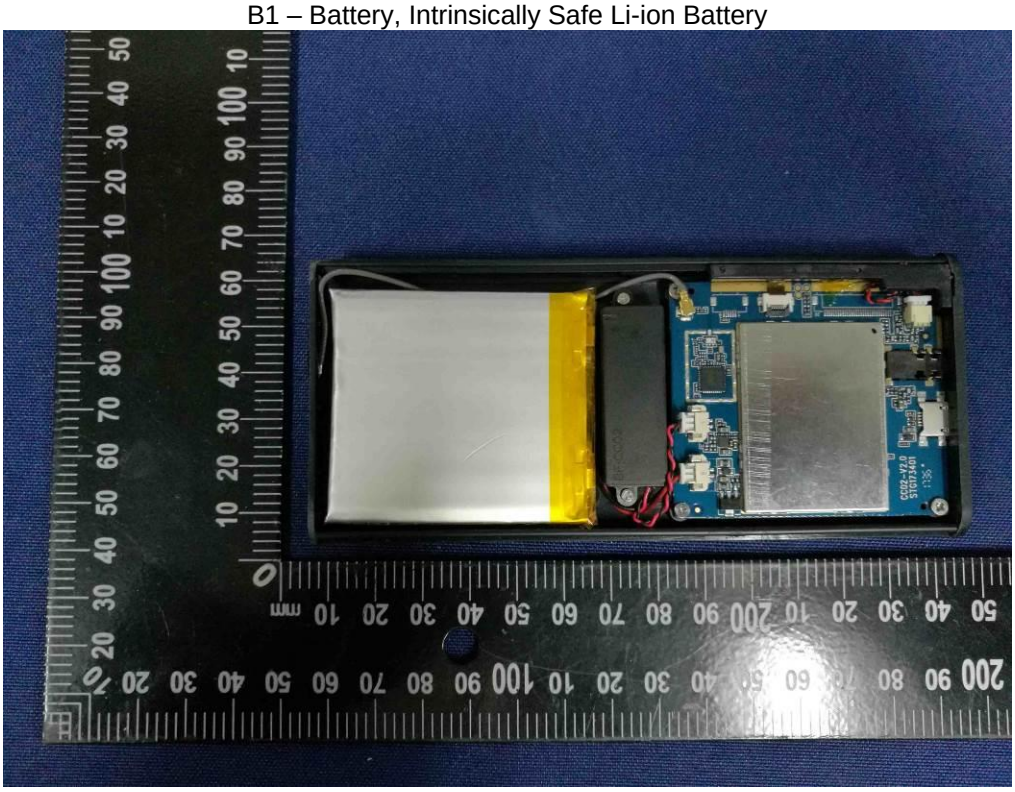
External photo – front side



External photo – rear side



B1 – Battery, Intrinsically Safe Li-ion Battery



**.....End of Report.....**