TEST REPORT

REPORT NUMBER：B19W50651-SAR-Rev3

ON

Type of Equipment:	Tracker
Type of Designation:	PT200LSV
Manufacturer:	Micron Electronics LLC
Brand name:	Prime
FCC ID:	ZKQ-PT200LSV

ACCORDING TO

IEEE C95.1-2005
IEEE 1528–2013

Chongqing Academy of Information and Communication Technology

Month date, year

Dec,30, 2019

Signature

Zhang Yan

Director

Note:
The test results in this test report relate only to the devices specified in this report. This report shall not be reproduced except in full without the written approval of Chongqing Academy of Information and Communications Technology.

Revision Version

Report Number	Revision	Date	Memo
B19W50651-SAR	00	2019-12-30	Initial creation of test report
B19W50651-SAR-Rev1	01	2020-01-13	--
B19W50651-SAR-Rev2	02	2020-01-15	--
B19W50651-SAR-Rev3	03	2020-01-15	--

CONTENTS

ddress：No. 8,Yuma Road, Chayuan New City, Nan’an District, Chongqing, P. R. China,401336 Tel: 0086-23-88069965 FAX:0086-23-88608777

1. Test Laboratory

1.1. Testing Location

Company Name:	Chongqing Academy of Information andCommunications Technology
Address:	No. 8, Yuma Road, Chayuan New City, Nan'an District, Chongqing, P. R. China
Postal Code:	401336
Telephone:	0086-23-88069965
Fax:	0086-23-88608777

1.2. Testing Environment

Normal Temperature:	15-35℃
Relative Humidity:	20-75%
Ambient noise & Reflection:	< 0.012 W/kg

1.3. Project Data

Testing Start Date:	2019-12-23
Testing End Date:	2019-12-27

1.4. Signature

2019-12-30

Ang Xinyu
(Prepared this test report)

Date

2019-12-30

Wang Lili
(Reviewed this test report)

Date

2019-12-30

Zhang Yan
Director of the laboratory
(Approved this test report)

Date

2. Statement of Compliance

The maximum results of Specific Absorption Rate(SAR) found during testing for **PT200LSV** are as follows (with expanded uncertainty 22.4%)

Table 2.1: Max. SAR Reported (1g)

Band	Position	SAR 1g (W/Kg)
LTE Band 4	Body(5mm)	**0.806**
LTE Band 13	Body(5mm)	**0.769**
WiFi（2.4G）	Body(5mm)	**0.172**

The SAR values found for the Mobile Phone are below the maximum recommended levels of 1.6 W/Kg as averaged over any 1g tissue according to the IEEE C95.1–2005.

The maximum SAR value is obtained at the case of **(Table 2.1),** and the values are**: 0.806 W/Kg (1g)**.

3. Client Information

3.1. Applicant Information

Company Name:	Micron Electronics LLC.
Address /Post:	1001 Yamato Road,Suite 400,Boca Raton,Florida,United States 33431
Telephone:	+1 888 538 3489
Fax:	+1 888 550 1805
Email:	--
Contact Person:	Ping Cheng

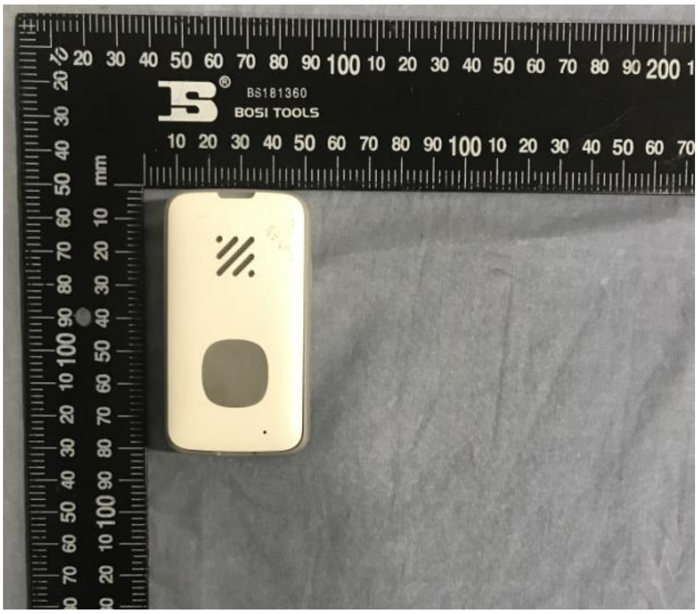
3.2. Manufacturer Information

Company Name:	Micron Electronics LLC.
Address /Post:	1001 Yamato Road,Suite 400,Boca Raton,Florida,United States 33431
Telephone:	+1 888 538 3489
Fax:	+1 888 550 1805
Email:	--
Contact Person:	Ping Cheng

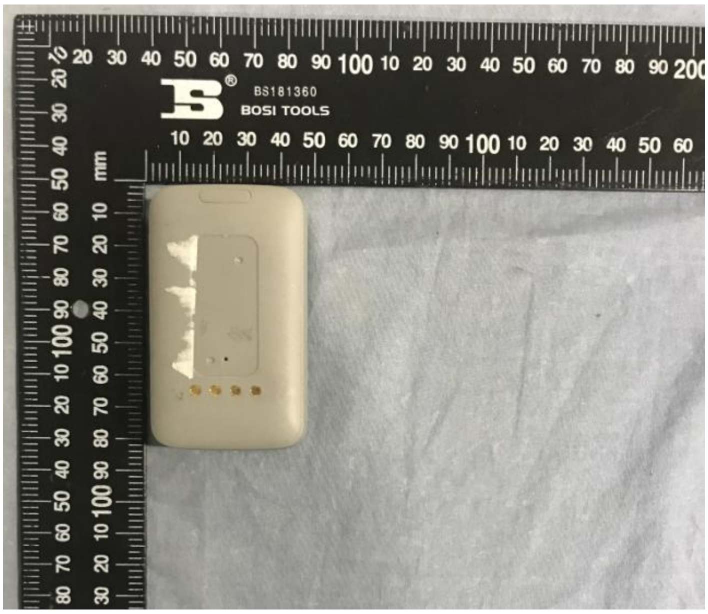
4. Equipment Under Test (EUT) and Ancillary Equipment (AE)

4.1. About EUT

Description:	Tracker
Model name:	PT200LSV
LTE Frequency Band	Band 4/13
WIFI 2450	802.11b/g/n
BT	BLE
Test device Production information:	Production unit
Voice mode	Not Support
Device type:	Portable device
Antenna type:	Inner antenna
Accessories/Body-worn configurations:	N/A
Hotspot mode:	N/A
Dimensions:	7.5cm×4.3cmx2.6cm
NOTE:--	



Picture 4-1: Constituents of the sample



Picture 4-2: Constituents of the sample

4.2. Internal Identification of EUT used during the test

EUT ID*	SN or IMEI	HW Version	SW Version	**Date of receipt**
S3	358152100076261	A506_V1_PCB	PT200V01.01B02.I07	2019-12-10

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

4.3. Internal Identification of AE used during the test

AE ID*	Description	Model	SN	Manufacturer
B1	N/A	N/A	N/A	N/A

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

5. Reference Documents

5.1. Applicable Limit Regulations

IEEE C95.1–2005: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

It specifies the maximum exposure limit of **1.6 W/kg** as averaged over any 1 gram of tissue for portable devices being used within 20 cm of the user in the uncontrolled environment.

5.2. Applicable Measurement Standards

IEEE 1528–2013: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques.

KDB447498 D01: General RF Exposure Guidance v06: Mobile and Portable Devices RF Exposure Procedures and Equipment Authorization Policies.

KDB941225 D06 Hotspot Mode SAR v02r01: SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities

KDB248227 D01 802.11 Wi-Fi SAR v02r02: SAR Measurement Procedures for IEEE 802.11 Wi-Fi Transmitters

KDB865664 D01SAR measurement 100 MHz to 6 GHz v01r04: SAR Measurement Requirements for 100 MHz to 6 GHz.

KDB865664 D02 RF Exposure Reporting v01r02: RF Exposure Compliance Reporting and Documentation Considerations

NOTE: KDB is not in A2LA Scope List.

6. Specific Absorption Rate (SAR)

6.1. Introduction

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

6.2. SAR Definition

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

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

SAR is expressed in units of Watts per kilogram (W/kg)
SAR measurement can be either related to the temperature elevation in tissue by

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

Where: C is the specific head capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

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

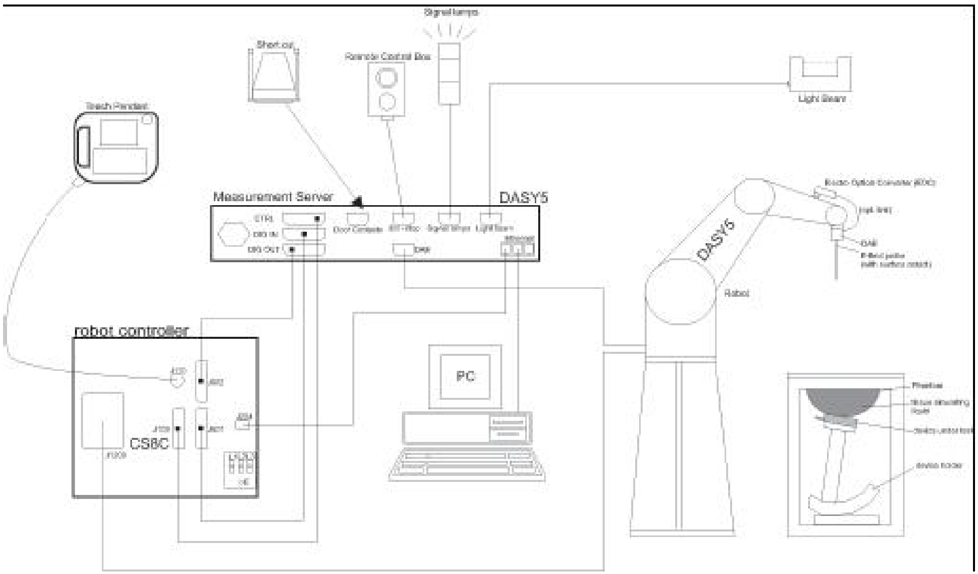
Where: σ is the conductivity of the tissue, ρ is the mass density of tissue and E is the RMS electrical field strength.

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

7. SAR MEASUREMENT SETUP

7.1. Measurement Set-up

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



Picture 7-1 SAR Lab Test Measurement Set-up

- A standard high precision 6-axis robot (Stäubli TX=RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and theDASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as
- warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.

7.2. DASY5 E-field Probe System

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

Probe Specifications:
Model: EX3DV4
Frequency 750MHz — 6GHz
Calibration: In head and body simulating tissue at Frequencies from 835 up to 5800MHz
Linearity: ± 0.2 dB

Dynamic Range: 10 mW/kg — 100W/kg
Probe Length: 330 mm
Probe Tip
Length: 20 mm
Body Diameter: 12 mm
Tip Diameter: 2.5mm
Tip-Center: 1 mm
Application: SAR Dosimetry Testing
Compliance tests of mobile phones
Dosimetry in strong gradient fields

Picture 7-2 Near-field Probe

Picture 7-3 E-field Probe

7.3. E-field Probe Calibration

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

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if thefrequency is below 1 GHz and inn a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/ cm^2..

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

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

Where:

Δt = Exposure time (30 seconds),

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

ΔT = Temperature increase due to RF exposure.

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

Where:

σ = Simulated tissue conductivity,

ρ = Tissue density (kg/m^3).

7.4. Other Test Equipment

7.4.1. Data Acquisition Electronics(DAE)

The data acquisition electronics consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock.

The mechanical probe mounting device includes two different sensor systems for frontal and sideways probe contacts. They are used for mechanical surface detection and probe collision detection.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Picture7-4: DAE

7.4.2. Robot

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

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

Picture7-5: DASY 5

7.4.3. Measurement Server

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

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

Picture 7-6: Server for DASY 5

7.4.4. Device Holder for Phantom

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

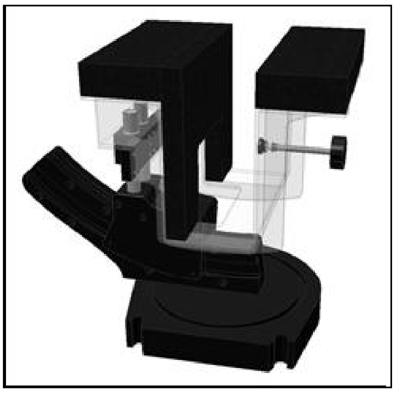
The DASY device holder is designed to cope with the different positions given in the standard. It has two scales for device rotation (with respect to the body axis) and device inclination (with respect to the line between the ear reference points). The rotation centers for both scales is the ear reference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

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

<Laptop Extension Kit>

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

Picture7-7: Device Holder



Picture 7-8: Laptop Extension Kit

7.4.5. Phantom

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

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

Shell Thickness: 2 ± 0. 2 mm

Filling Volume: Approx. 25 liters

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

Available: Special

Picture 7-9: SAM Twin Phantom

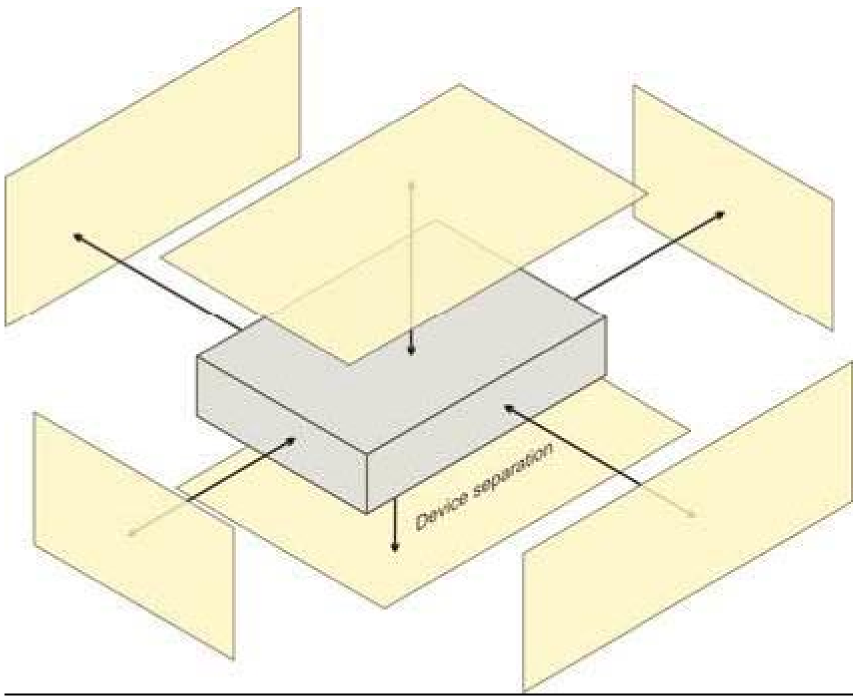
8. Position of the wireless device in relation to the phantom

8.1. Generic device

For a device that can not be categorized as any of the other specific device types, it shall be considered to be a generic device;

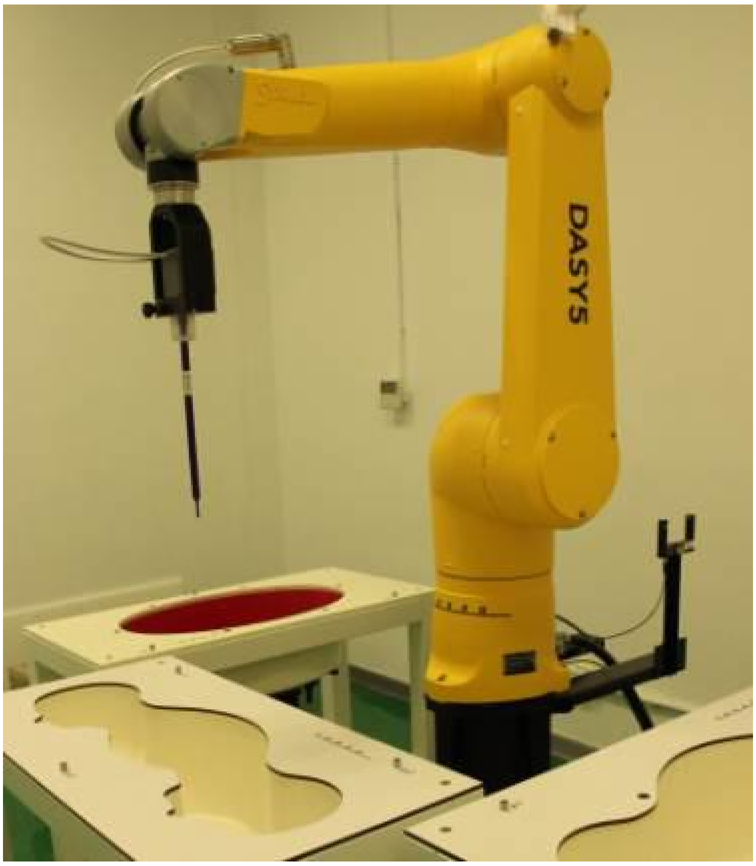
The SAR evaluation shall be performed for all surfaces of the DUT that are accessible during intended use, as indicated in Picture 8-1. The separation distance in testing shall correspond to the intended use distance as specified in the user instructions provided by the manufacturer. If the intended use is not specified, all surfaces of the DUT shall be tested directly against the flat phantom.

The surface of the generic device (or the surface of the carry accessory holding the DUT) pointing towards the flat phantom shall be parallel to the surface of the phantom.



Picture 8-1 Test positions for Generic device

8.2. DUT Setup Photos

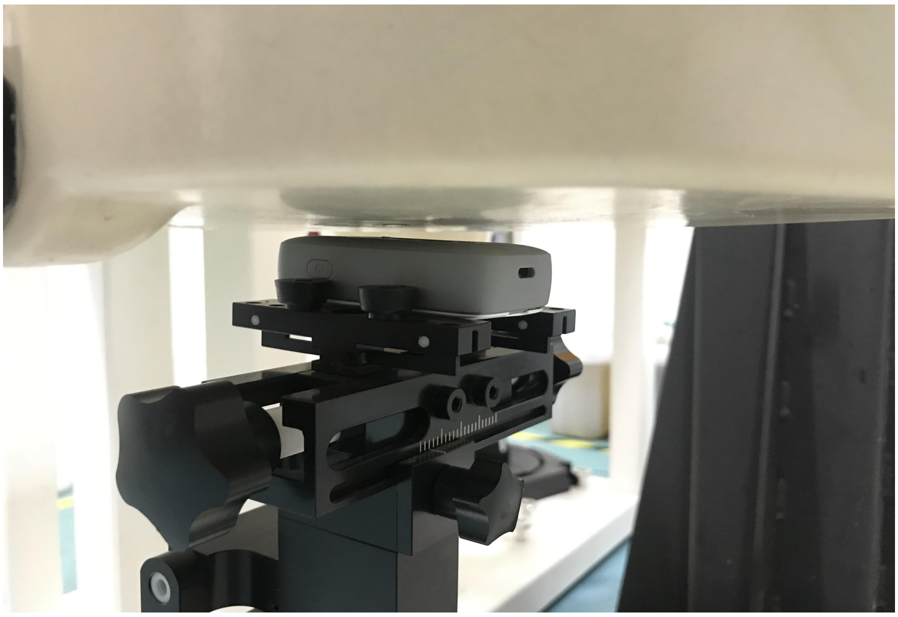


Picture 8-2: Specific Absorption Rate Test Layout

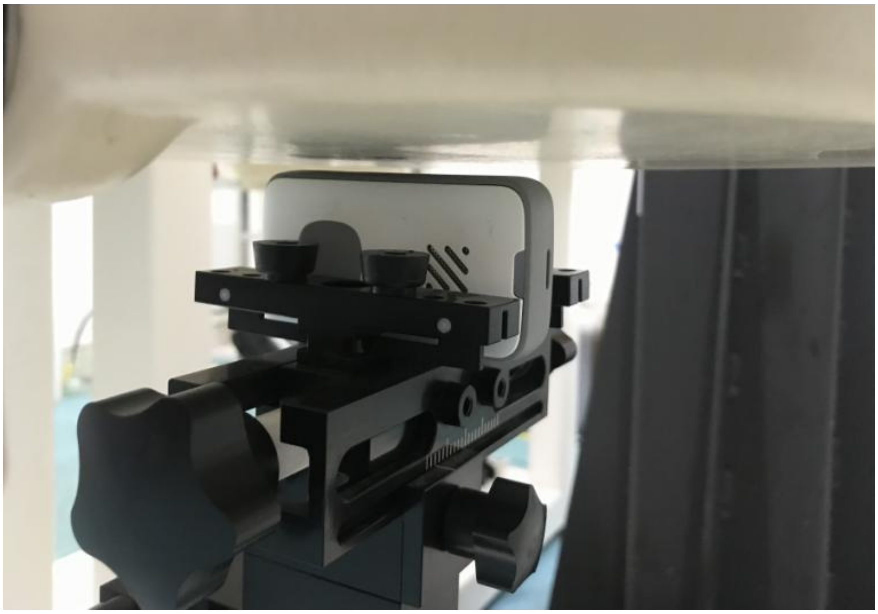
Test positions for body:

According to the antenna position, the Body SAR is tested at the following 6 test positions all with the distance =5mm between the EUT and the phantom bottom:

Picture 8-3: Toward Phantom (5mm)



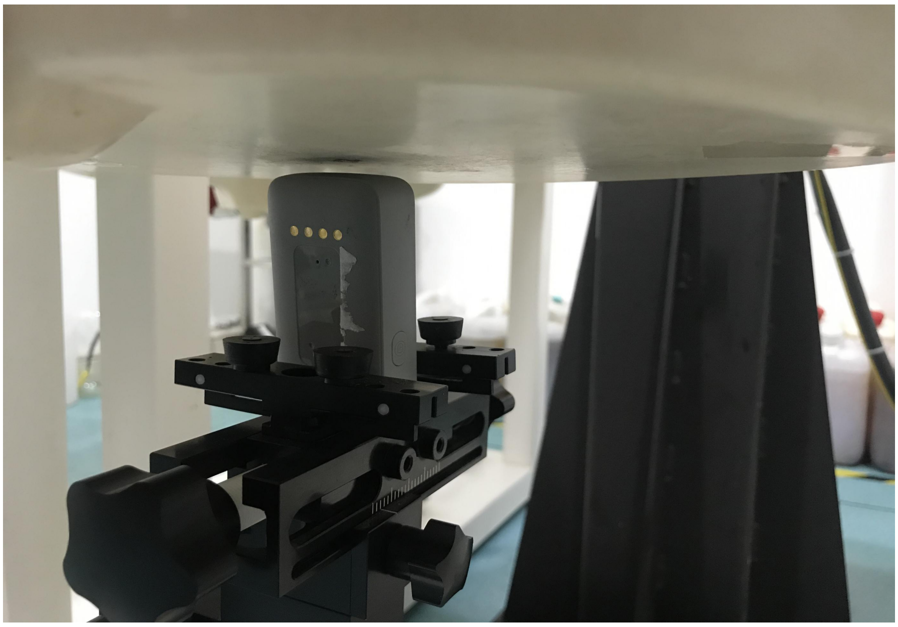
Picture 8-4: Toward Ground (5mm)



Picture 8-5: Toward Left (5mm)

Picture 8-6: Toward Right (5mm)

Picture 8-7: Toward Top (5mm)



Picture 8-8: Toward Bottom (5mm)

9. Tissue Simulating Liquids

9.1. Equivalent Tissues

The liquid used for the frequency range of 800-3000 MHz consisted of water, sugar, salt and Cellulose. The liquid has been previously proven to be suited for worst-case. The Table 3 and 4 shows the detail solution. The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Table 9.1. Composition of the Head Tissue Equivalent Matter

Frequency (MHz)	750	1750	2450
Ingredients (% by weight)			
Water	41.45	55.242	58.79
Sugar	56.0	/	/
Salt	1.45	0.306	0.06
Preventol	0.1	/	/
Cellulose	1.0	/	/
ClycolMonobutyl	/	44.452	41.15
Dielectric Parameters Target Value	f=750MHz ε=41.91 σ=0.87	f=1750MHz ε=40.8 σ=1.37	f=2450 MHz ε=39.2 σ=1.80

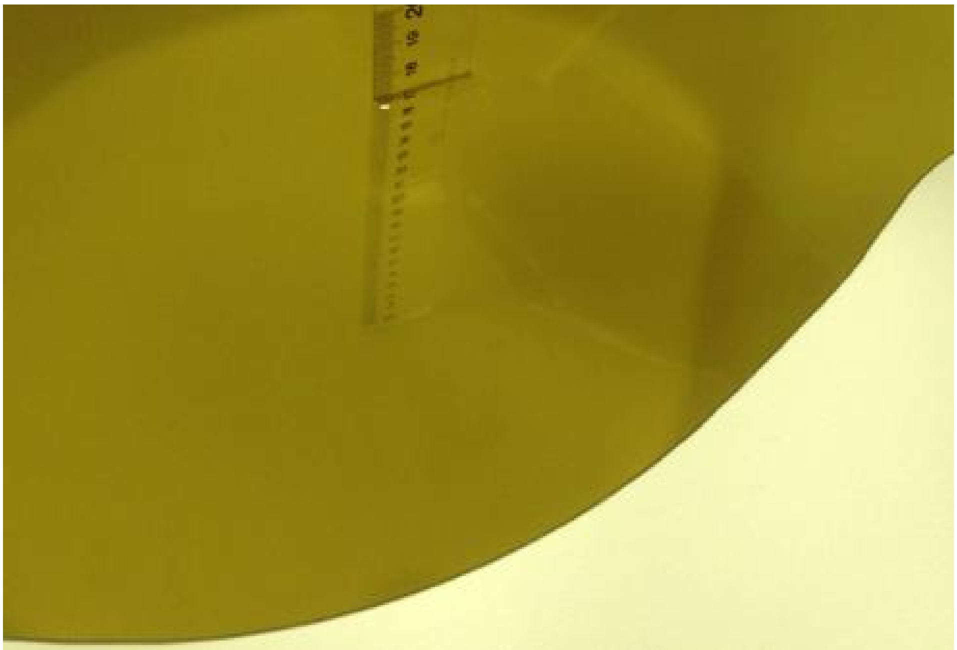
Table 9.2. Targets for tissue simulating liquid

Frequency (MHz)	Liquid Type	Conductivity (σ)	± 5% Range	Permittivity (ε)	± 5% Range
750	Head	0.89	0.85～0.93	41.9	39.8～44.0
1750	Head	1.37	1.30～1.44	40.8	38.1～42.1
2450	Head	1.80	1.71～1.89	39.2	37.2～41.2

9.2. Dielectric Performance

Table 9.3: Dielectric Performance of Head Tissue Simulating Liquid

Measurement Value						
Liquid Temperature: 22.5°C						
Type	**Frequency**	**Permittivity ε**	**Drift (%)**	**Conductivity σ**	**Drift (%)**	**Test Date**
Head	750	40.70	-2.86%	0.902	1.35%	2019-12-27
Head	1750	39.33	-3.60%	1.384	1.02%	2019-12-23
Head	2450	38.24	-2.40%	1.82	1.67%	2019-12-29



Picture 9-1: Liquid depth in the Flat Phantom (750 MHz Head)

Picture9-2: Liquid depth in the Flat Phantom (1750 MHz Head)

Picture 9-3: Liquid depth in the Flat Phantom (2450 MHz Head)

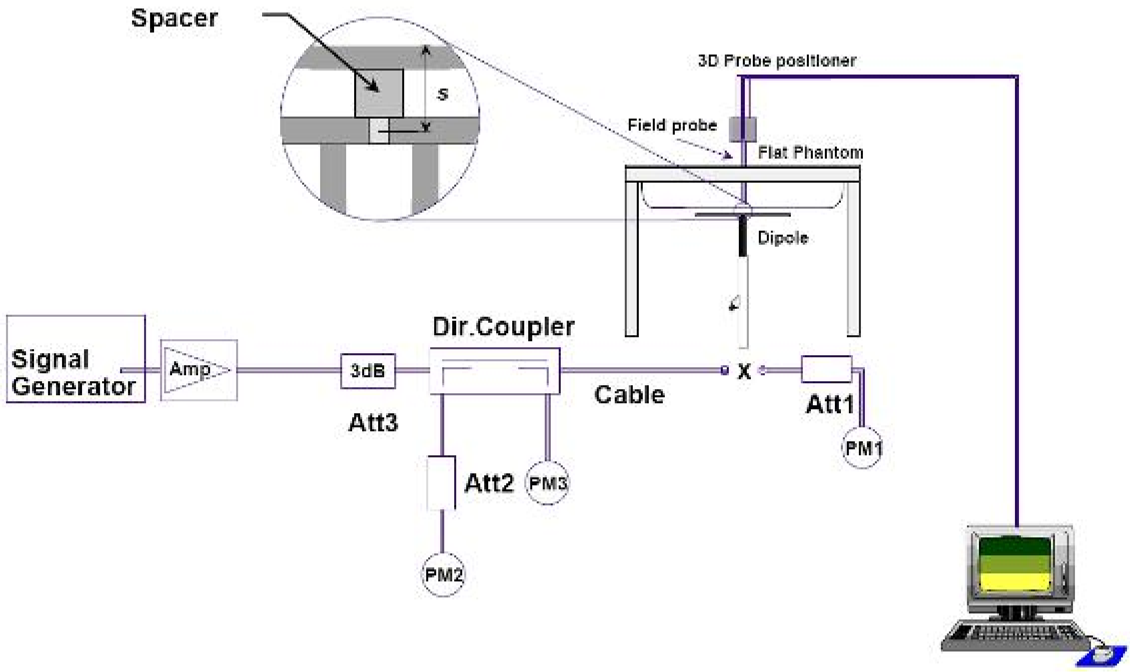
10. System Validation

10.1. System Validation

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

10.2. System Setup

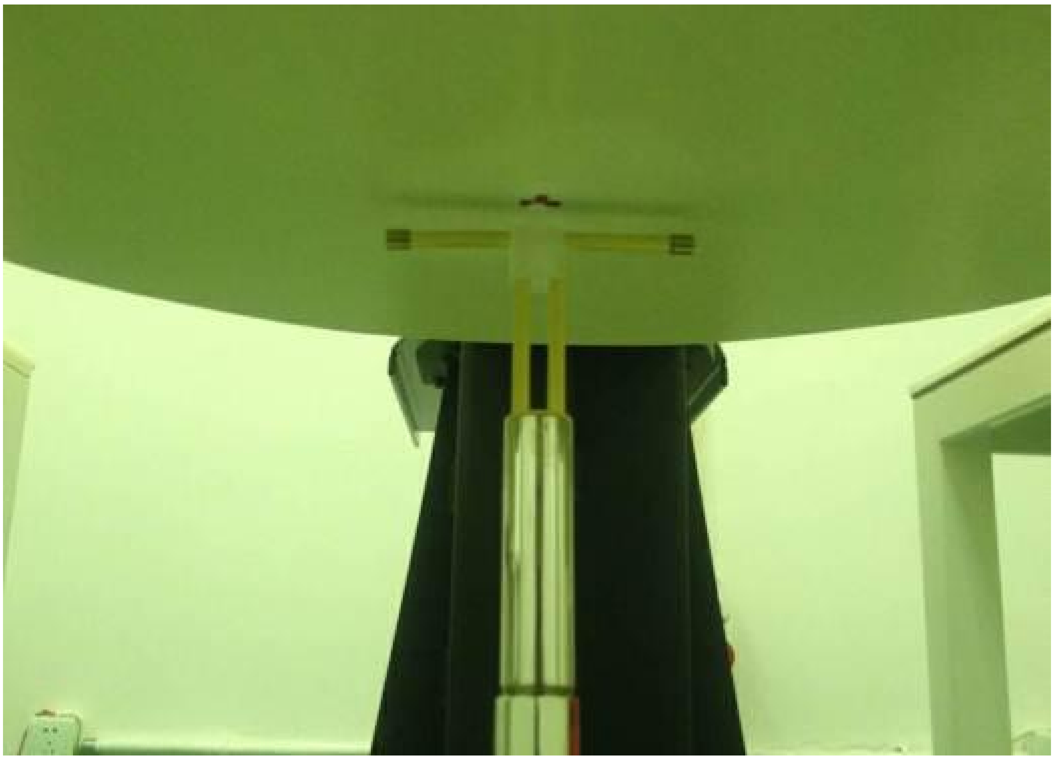
In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder.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



Picture 10-1 System Setup for System Evaluation

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

The results are normalized to 1 W input power.



Picture 10-2 Photo of Dipole Setup

Table 10.1: System Validation of Head

Verification Results							
Input power level: 1W							
Frequency	**Target value (W/kg)**		**Measured value (W/kg)**		**Deviation**		**Test date**
	1 g Average	**10 g Average**	**1 g Average**	**10 g Average**	**1 g Average**	**10 g Average**	
750MHz	8.44	5.58	8.36	5.49	-0.95%	-1.64%	2019-12-27
1750MHz	37.6	20.1	38.16	20.16	1.49%	-0.30%	2019-12-23
2450 MHz	52.5	24.8	55.2	25.52	5.14%	2.90%	2019-12-29

11. Measurement Procedures

11.1. 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 19

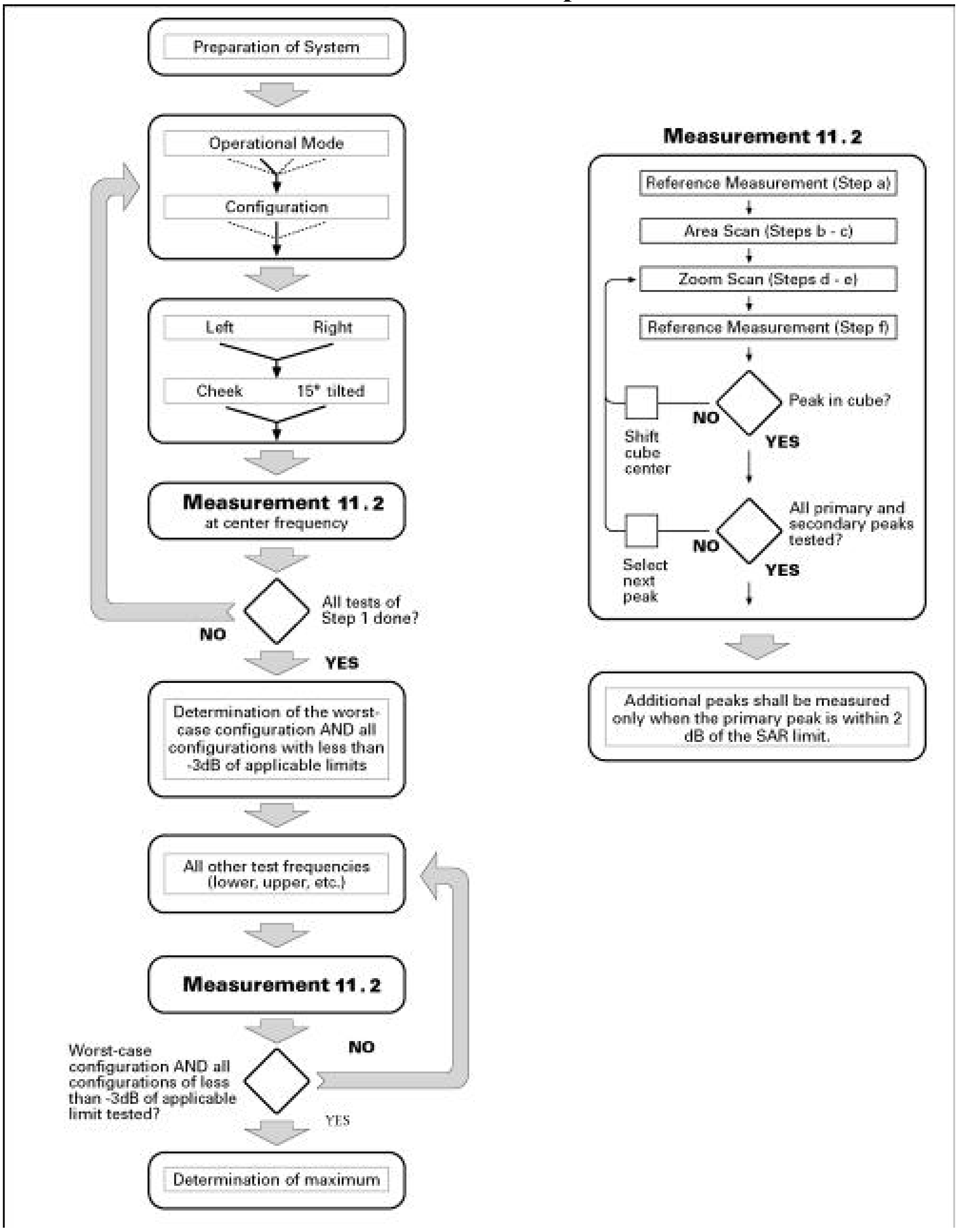
Step 1: The tests described in 11.2 shall be performed at the channel that is closest to the centre of the transmit frequency band (f_c) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom, as described in Chapter 8),
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 11-1Block diagram of the tests to be performed

11.2. Measurement procedure

The following procedure shall be performed for each of the test conditions (see Picture 19) 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 andδIn(2)/2 mm for frequencies of 3 GHz and greater, whereδis the plane wave skin depth and In(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 uncertainty evaluation is needed.
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 c). 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 andδIn(2)/2 mm for frequencies of 3 GHz and greater, where δis the plane wave skin depth and In(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.
e) Use post processing(e.g. interpolation and extrapolation) procedures to determine the local SAR values at the spatial resolution needed for mass averaging.

11.3. 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 Section 15 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

12. Area Scan Based 1-g SAR

12.1. Requirement of KDB

According to the KDB447498D01v05,when the implementation is based the specific polynomial it algorithm as presented at the 29th Bioelectromagnetics Society meeting (2007)and the estimated 1-g SARis≤1.2W/kg, a zoom scan measurement is not required provided it is also not needed For any other purpose ;for example, if the peak SAR location required for simultaneous transmission SAR test exclusion can be determined accurately by the SAR system or manually to discriminate between is tinctive peak sand scattered noisy SAR distributions from area scans.

There must not be any warning or alert messages due to various measurement concerns identified by the SAR system; for example, noise in measurements ,peaks too close to scan boundary, peaks are too sharp, spatial resolution and uncertainty issues etc. The SAR system verification must also demonstrate that the area scan estimated 1-gSAR is within 3%of the zoom scan 1-g SAR (See Annex A).When all the SAR results for each exposure condition in a frequency band and wireless mode are based on estimated 1-g SAR, the 1-g SAR for the highest SAR configuration must be determined by a zoom scan.

12.2. Fast SAR Algorithms

The approach is based on the area scan measurement applying a frequency dependent attenuation parameter. This attenuation parameter was empiri call determined by analyzing a large number of phones. The MOTOROLAFASTSAR was developed and validated by the MOTOROLA Research Group in Ft .Lauderdale.

In the initial study, an approximation algorithm based on Linearf it was developed. The accuracy of the algorithm has been demonstrated across abroad frequency range(136-2450 MHz)andforboth1-gand 10-g averaged SAR using a sample of 264SARmeasurementsfrom55 wireless handsets. For the sample size studied, the root-mean-squared errors of the algorithmare1.2%and 5.8%for1-g and 10-g averaged SAR, respectively. The paper describing the algorith min detail is expected to be published inAugust2004 within the Special Issue of Transactions on MTT.

In the second step, the same research group optimized the fitting algorithm to an Polynomia lf it where by the frequency validity was extended to cover the range 30-6000MHz.Detailsof this study can be found in the BEMS2007 Proceedings.

Both algorithms are implemented in DASY software.

13. Conducted Output Power

13.1. Manufacturing tolerance

Table 13.1: LTE

Band 4					
Bandwidth	Mode	RB Size	Channel19957 1710.7MHz	Channel 20175 1732.5MHz	Channel 20393 1754.3MHz
1.4MHz	QPSK	1	22.0±1	22.0±1	22.0±1
		3	21.5±1	21.5±1	21.5±1
		6	21.5±1	21.5±1	21.5±1
	16QAM	1	21.5±1	21.5±1	21.5±1
		3	20.5±1	20.5±1	20.5±1
		6	20.5±1	20.5±1	20.5±1
Bandwidth	Mode	RB Size	Channel 19965 1711.5MHz	Channel 20175 1732.5MHz	Channel 20385 1753.5MHz
3MHz	QPSK	1	22.0±1	22.0±1	22.0±1
		8	21.5±1	21.5±1	21.5±1
		15	21.5±1	21.5±1	21.5±1
	16QAM	1	21.5±1	21.5±1	21.5±1
		8	20.5±1	20.5±1	20.5±1
		15	20.5±1	20.5±1	20.5±1
Bandwidth	Mode	RB Size	Channel 19975 1712.5MHz	Channel 20175 1732.5MHz	Channel 20375 1752.5MHz
5MHz	QPSK	1	22.0±1	22.0±1	22.0±1
		12	21.5±1	21.5±1	21.5±1
		25	21.5±1	21.5±1	21.5±1
	16QAM	1	21.5±1	21.5±1	21.5±1
		12	20.5±1	20.5±1	20.5±1
		25	20.5±1	20.5±1	20.5±1
Bandwidth	Mode	RB Size	Channel 20000 1715MHz	Channel 20175 1732.5MHz	Channel 20350 1750MHz
10MHz	QPSK	1	22.0±1	22.0±1	22.0±1
		25	21.5±1	21.5±1	21.5±1
		50	21.5±1	21.5±1	21.5±1
	16QAM	1	21.5±1	21.5±1	21.5±1
		25	20.5±1	20.5±1	20.5±1
		50	20.5±1	20.5±1	20.5±1
Bandwidth	Mode	RB Size	Channel 20025 1717.5MHz	Channel 20175 1732.5MHz	Channel 20325 1747.5MHz
15MHz	QPSK	1	22.0±1	22.0±1	22.0±1

		36	21.5±1	21.5±1	21.5±1
		75	21.5±1	21.5±1	21.5±1
	16QAM	1	21.5±1	21.5±1	21.5±1
		36	20.5±1	20.5±1	20.5±1
		75	20.5±1	20.5±1	20.5±1
Bandwidth	Mode	RB Size	Channel 20050 1720MHz	Channel 20175 1732.5MHz	Channel 20300 1745MHz
20MHz	QPSK	1	22.0±1	22.0±1	22.0±1
		50	21.5±1	21.5±1	21.5±1
		100	21.5±1	21.5±1	21.5±1
	16QAM	1	21.5±1	21.5±1	21.5±1
		50	20.5±1	20.5±1	20.5±1
		100	20.5±1	20.5±1	20.5±1

Band13					
Bandwidth	Mode	RB Size	Channel 23205 799.5MHz	Channel 23230 782MHz	Channel 23254 784.5MHz
5MHz	QPSK	1	21.0±1	21.0±1	21.0±1
		12	20.5±1	20.5±1	20.5±1
		25	20.5±1	20.5±1	20.5±1
	16QAM	1	20.5±1	20.5±1	20.5±1
		12	19.5±1	19.5±1	19.5±1
		25	19.5±1	19.5±1	19.5±1
Bandwidth	Mode	RB Size	Channel 23230 782MHz	Channel 23230 782MHz	Channel 23230 782MHz
10MHz	QPSK	1	21.0±1	21.0±1	21.0±1
		25	20.5±1	20.5±1	20.5±1
		50	20.5±1	20.5±1	20.5±1
	16QAM	1	20.5±1	20.5±1	20.5±1
		25	20.0±1	20.0±1	20.0±1
		50	20.0±1	20.0±1	20.0±1

Table 13.2: BT

Mode	Conducted Power(dBm)		
	Channel 0(2402MHz)	Channel 19(2441MHz)	Channel 39(2480MHz)
BLE	-3.5±1	-3.5±1	-3.5±1

Table 13.3: WIFI

WiFi 802.11b			
Channel	Channel 1	Channel 6	Channel 11
Maximum Target Value (dBm)	16.0±2	16.0±2	16.0±2
WiFi 802.11g			
Channel	Channel 1	Channel 6	Channel 11
Maximum Target Value (dBm)	16.0±2	16.0±2	16.0±2
WiFi 802.11n 20M			
Channel	Channel 1	Channel 6	Channel 11
Maximum Target Value (dBm)	16.0±2	16.0±2	16.0±2
WiFi 802.11n 40M			
Channel	Channel 1	Channel 6	Channel 11
Maximum Target Value (dBm)	16.0±2	16.0±2	16.0±2

ddress：No. 8,Yuma Road, Chayuan New City, Nan’an District, Chongqing, P. R. China,401336 Tel: 0086-23-88069965
FAX:0086-23-88608777

13.2. LTE Measurement result

Table 13.2: The conducted Power for LTE

Band4						
Bandwidth	Mode	RB Size	RB Offset	Actual output power(dBm)		
				Channel 19957 1710.7MHz	Channel 20175 1732.5MHz	Channel 20393 1754.3MHz
1.4MHz	QPSK	1	0	22.243	22.192	22.272
		1	2	22.116	22.189	22.299
		1	5	22.056	22.183	22.319
		3	0	22.096	22.237	22.245
		3	1	22.184	22.219	22.328
		3	2	22.080	22.266	22.310
		6	0	21.078	21.081	21.214
	16QAM	1	0	21.356	21.375	21.685
		1	2	21.331	21.362	21.433
		1	5	21.298	21.514	21.356
		3	0	22.141	21.118	21.352
		3	1	21.212	21.087	21.436
		3	2	21.247	21.226	21.439
		6	0	20.165	20.161	20.248
Bandwidth	Mode	RB Size	RB Offset	Actual output power(dBm)		
				Channel 19965 1711.5MHz	Channel 20175 1732.5MHz	Channel 20385 1753.5MHz
3MHz	QPSK	1	0	22.136	22.172	22.376
		1	8	22.185	22.302	22.291
		1	14	22.185	22.145	22.204
		8	0	21.069	21.159	21.233
		8	4	21.021	21.168	21.283
		8	7	21.037	21.128	21.293
		15	0	21.037	21.179	21.180
	16QAM	1	0	21.396	21.581	21.491
		1	8	21.424	21.527	21.571
		1	15	21.308	21.545	21.586
		8	0	20.240	20.356	20.36
		8	4	20.113	20.307	20.409
		8	7	20.106	20.333	20.337
		15	0	20.187	20.189	20.290

Bandwidth	Mode	RB Size	RB Offset	Actual output power(dBm)		
				Channel 19975 1712.5MHz	Channel 20175 1732.5MHz	Channel 20375 1752.5MHz
5MHz	QPSK	1	0	22.257	22.196	22.373
		1	13	22.250	22.092	22.247
		1	24	22.123	22.086	22.119
		12	0	21.130	21.174	21.344
		12	6	21.124	21.228	21.243
		12	13	21.139	21.220	21.278
		25	0	21.083	21.184	21.347
	16QAM	1	0	21.604	21.367	21.696
		1	13	21.504	21.714	21.610
		1	24	21.296	21.246	21.614
		12	0	20.233	20.305	20.308
		12	6	20.120	20.238	20.399
		12	13	20.271	20.283	20.354
		25	0	20.151	20.212	20.317
Bandwidth	Mode	RB Size	RB Offset			
				Channel 20000 1715MHz	Channel 20175 1732.5MHz	Channel 20350 1750MHz
10MHz	QPSK	1	0	22.372	22.403	22.568
		1	25	22.209	22.224	22.316
		1	49	22.130	22.329	22.277
		25	0	21.193	21.254	21.354
		25	13	21.152	21.195	21.238
		25	25	21.036	21.217	21.245
		50	0	21.095	21.229	21.295
	16QAM	1	0	21.607	21.758	21.785
		1	25	21.041	21.443	21.572
		1	49	21.149	21.556	21.569
		25	0	20.186	20.340	20.443
		25	13	20.128	20.245	20.400
		25	25	20.072	20.230	20.361
		50	0	20.142	20.269	20.370
Bandwidth	Mode	RB Size	RB Offset	Actual output power(dBm)		
				Channel 20025 1717.5MHz	Channel 20175 1732.5MHz	Channel 20325 1747.5MHz
15MHz	QPSK	1	0	22.665	22.657	22.703

		1	38	22.180	22.273	22.432
		1	74	22.279	22.454	22.302
		36	0	21.260	21.329	21.489
		36	18	21.093	21.207	21.346
		36	39	21.108	21.255	21.295
		75	0	21.181	21.257	21.357
	16QAM	1	0	21.693	21.724	22.888
		1	38	21.373	21.564	21.649
		1	74	21.465	21.563	21.534
		36	0	20.312	20.390	20.516
		36	18	20.107	20.230	20.360
		36	39	20.123	20.276	20.362
		75	0	20.197	20.312	20.413

Bandwidth	Mode	RB Size	RB Offset	Actual output power(dBm)		
				Channel 20050 1720MHz	Channel 20175 1732.5MHz	Channel 20300 1745MHz
20MHz	QPSK	1	0	22.393	22.302	22.551
		1	50	21.924	22.041	22.127
		1	99	22.004	22.080	22.125
		50	0	21.291	21.301	21.470
		50	25	21.063	21.092	21.255
		50	50	21.068	21.157	21.265
		100	0	21.190	21.244	21.374
	16QAM	1	0	21.670	21.548	21.795
		1	50	21.309	21.237	21.390
		1	99	21.361	21.304	21.346
		50	0	20.329	20.352	20.498
		50	25	20.060	20.162	20.269
		50	50	20.104	20.211	20.384
		100	0	20.190	20.282	20.398

Band13						
Bandwidth	Mode	RB Size	RB Offset	Actual output power(dBm)		
				Channel 23205 799.5MHz	Channel 23230 782MHz	Channel 23254 784.5MHz
5MHz	QPSK	1	0	22.315	22.200	22.295
		1	13	22.212	22.263	22.194
		1	24	22.175	22.173	22.184
		12	0	21.650	21.250	21.645
		12	6	21.125	21.237	21.325

		12	13	21.165	21.231	21.120
		25	0	21.212	21.237	21.203
	16QAM	1	0	21.500	21.460	21.452
		1	13	21.486	21.507	21.153
		1	24	21.313	21.414	21.298
		12	0	20.215	20.394	20.195
		12	6	20.154	20.355	20.142
		12	13	20.244	20.374	20.514
		25	0	20.121	20.341	20.095
Bandwidth	Mode	RB Size	RB Offset	Actual output power(dBm)		
				Channel 23230 782MHz	Channel 23230 782MHz	Channel 23230 782MHz
10MHz	QPSK	1	0	21.926	21.926	21.926
		1	25	22.155	22.155	22.155
		1	49	21.611	21.611	21.611
		25	0	21.310	21.310	21.310
		25	13	21.381	21.381	21.381
		25	25	21.270	21.270	21.270
		50	0	21.292	21.292	21.292
	16QAM	1	0	21.207	21.207	21.207
		1	25	21.398	21.398	21.398
		1	49	20.859	20.859	20.859
		25	0	20.435	20.435	20.435
		25	13	20.386	20.386	20.386
		25	25	20.391	20.391	20.391
		50	0	20.384	20.384	20.384

13.3. BT Measurement result

Table 13.3: The conducted Power for BT antenna

Mode	Tune-up (dBm)	Conducted Power(dBm)		
		Channel 0(2402MHz)	Channel 19(2440MHz)	Channel 39(2480MHz)
BLE	-2.5	-3.32	-3.85	-3.86

13.4. WIFI Measurement result

Table 13.4: The average conducted power for WiFi

The average conducted power for WiFi is as following:

Mode	Data Rate(Mbps)	Teat Result(dBm)		
		Ch1	Ch6	Ch11
802.11b	1	14.14	15.06	15.66
	2	14.01	15.10	15.57
	5.5	13.88	14.87	15.42
	11	13.95	14.89	15.39
802.11g	6	16.53	17.67	17.16
	9	16.93	17.68	16.75
	12	16.24	17.03	16.76
	18	16.35	16.81	16.52
	24	16.68	16.84	16.77
	36	16.35	16.93	16.65
	48	16.21	17.36	16.33
	54	16.20	16.92	16.90

Mode	Data Rate(Mbps)	Teat Result(dBm)		
		Ch1	Ch6	Ch11
802.11n (20MHz)	MCS0	16.24	17.14	16.68
	MCS1	15.61	17.14	16.79
	MCS2	15.78	17.10	16.44
	MCS3	16.01	16.95	16.50
	MCS4	15.94	16.99	16.48
	MCS5	16.53	17.08	16.80
	MCS6	16.39	16.63	16.31
	MCS7	16.07	17.55	16.57
802.11n (40MHz)	MCS0	17.61	17.81	17.63
	MCS1	17.29	17.32	17.30
	MCS2	17.25	17.35	17.20
	MCS3	17.69	17.64	17.58
	MCS4	17.35	17.68	17.50
	MCS5	17.51	17.72	17.50
	MCS6	17.45	17.65	17.39
	MCS7	17.45	17.56	17.43

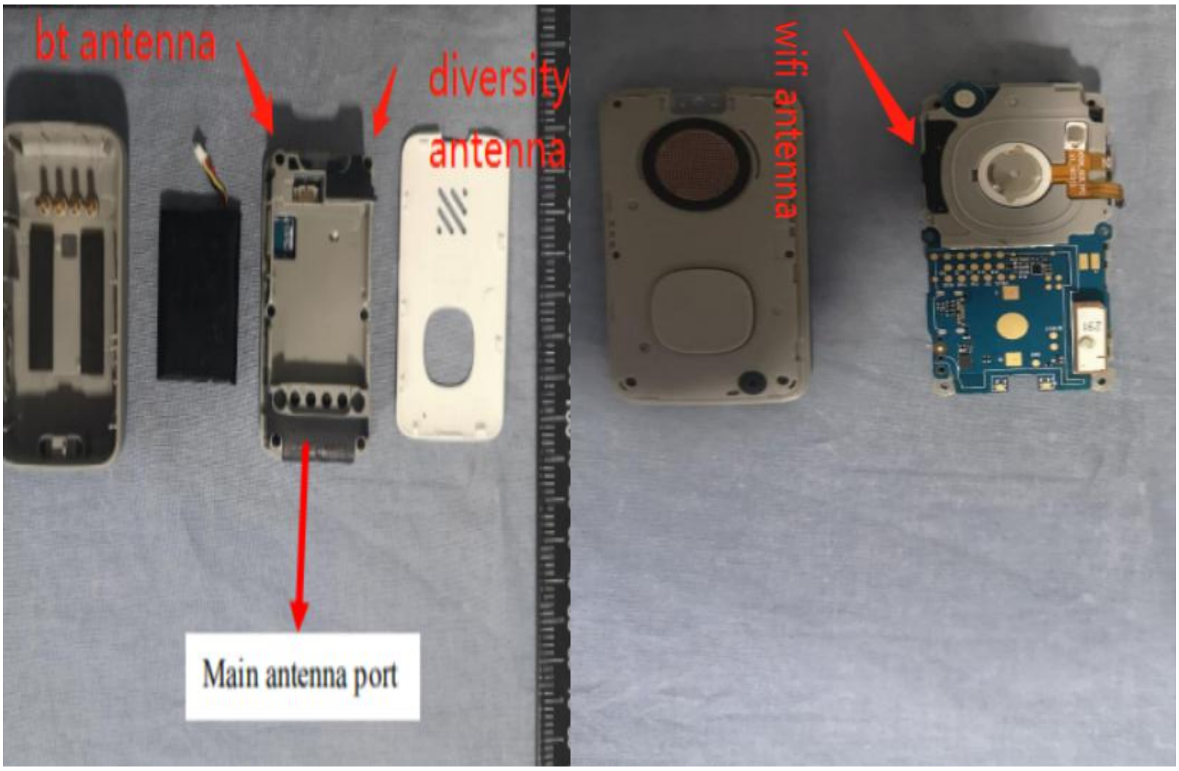
ddress：No. 8,Yuma Road, Chayuan New City, Nan’an District, Chongqing, P. R. China,401336 Tel: 0086-23-88069965 FAX:0086-23-88608777

14. Simultaneous TX SAR Considerations

14.1. Introduction

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

14.2. Transmit Antenna Separation



15. Standalone SAR Test Exclusion Considerations

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

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

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

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

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

$$\text{Estimated SAR}=\frac{\sqrt{f(GHz)}}{7.5}\cdot\frac{(\text{Max Power of chananel,mW})}{\text{Min.Separation Distance,mm}}$$

Mode	Frequency(MHz)	Max.Tune-up Power (dBm)	Separation Distance(mm)	Estimated SAR 1g(W/kg)
Bluetooth-Body	2441	-2.5	5	0.160

15.1. Simultaneous multi-band transmission

Standalone Report SAR(1g) for 4G(W/Kg)				
Test Position		LTE Band4	LTE Band13	Highest SAR
Body 5mm	Ground Side	0.724	0.574	0.724
	Phantom Side	0.657	0.769	0.769
	Left Side	0.309	0.587	0.587
	Right Side	0.488	0.652	0.652
	Bottom Side	0.790	0.419	0.790
	Top Side	0.088	0.278	0.278

Standalone Report SAR(1g) for WiFi+BT(W/Kg)			
Test Position		2.4GAntenna	Bluetooth
Body 5mm	Ground Side	0.053	0.160
	Phantom Side	0.172	0.160
	Left Side	0.015	0.160
	Right Side	0.028	0.160
	Bottom Side	0.014	0.160
	Top Side	0.099	0.160

Transmission SAR(W/Kg) 4G+WiFi(2.4G)				
Test Position		4G	WIFI 2.4G Antenna	SUM
Body 5mm	Ground Side	0.724	0.053	0.777
	Phantom Side	0.769	0.172	0.941
	Left Side	0.587	0.015	0.602
	Right Side	0.652	0.028	0.68
	Bottom Side	0.790	0.014	0.804
	Top Side	0.278	0.099	0.377

Transmission SAR(W/Kg) 4G+BT				
Test Position		4G	BT	SUM
Body 5mm	Ground Side	0.724	0.160	0.884
	Phantom Side	0.769	0.160	0.929
	Left Side	0.587	0.160	0.747
	Right Side	0.652	0.160	0.812
	Bottom Side	0.790	0.160	0.95
	Top Side	0.278	0.160	0.438

So no simultaneous multi-band transmission test is required.

16. Measured and Reported (Scaled) SAR Results

SAR Test Reduction criteria are as follows:

KDB 447498 D01 General RF Exposure Guidance:

Testing of other required channels wi thin the operating mode of a frequency band i s not required when the reported 1-g or 10-g SAR for the mid-band or highest output power channel is:

- ≤ 0.8 W/kg or 2.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≤ 100 MHz
- ≤ 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
- ≤ 0.4 W/kg or 1.0 W/kg, for 1-g or 10-g respectively, when the transmission band is ≥ 200 MHz

17. SAR Test Result

17.1. SAR results

Table 17.1: SAR Values(LTE Band 1-Body)

Frequency		Mode /Band	Service /Headset	Test Position	Spacing (mm)	Measured average power (dBm)	Maximum allowed Power (dBm)	Scaling factor	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
1745	20300	Band 4	1RB 0offset	Toward Phantom	5	22.55	23.0	1.109	0.592	0.657	0.12
1745	20300	Band 4	1RB 0offset	Toward Ground	5	22.55	23.0	1.109	0.653	0.724	-0.16
1745	20300	Band 4	1RB 0offset	Toward Left	5	22.55	23.0	1.109	0.279	0.309	0.17
1745	20300	Band 4	1RB 0offset	Toward Right	5	22.51	23.0	1.109	0.436	0.488	-0.05
1745	20300	Band 4	1RB 0offset	Bottom	5	22.55	23.0	1.109	0.712	0.790	0.19
1745	20300	Band 4	1RB 0offset	Top	5	22.55	23.0	1.109	0.0796	0.088	0.12
1732.5	20175	Band 4	1RB 0offset	Bottom	5	22.30	23.0	1.174	0.686	0.806	-0.18
1720	20050	Band 4	1RB 0offset	Bottom	5	22.39	23.0	1.150	0.494	0.568	0.18
1745	20300	Band 4	50RB 0offset	Toward Phantom	5	21.47	22.0	1.130	0.502	0.567	0.19
1745	20300	Band 4	50RB 0offset	Toward Ground	5	21.47	22.0	1.130	0.482	0.545	-0.02
1745	20300	Band 4	50RB 0offset	Toward Left	5	21.47	22.0	1.130	0.241	0.272	0.17
1745	20300	Band 4	50RB 0offset	Toward Right	5	21.47	22.0	1.130	0.337	0.381	-0.00
1745	20300	Band 4	50RB 0offset	Bottom	5	21.47	22.0	1.130	0.640	0.723	0.12
1745	20300	Band 4	50RB 0offset	Top	5	21.47	22.0	1.130	0.0672	0.076	0.15
1732.5	20175	Band 4	50RB 0offset	Bottom	5	21.30	22.0	1.175	0.546	0.641	0.12
1720	20050	Band 4	50RB 0offset	Bottom	5	21.29	22.0	1.178	0.448	0.528	0.12

Table 17.2: SAR Values(LTE Band 13-Body)

Frequency		Mode /Band	Service /Headset	Test Position	Spacing (mm)	Measured average power (dBm)	Maximum allowed Power (dBm)	Scaling factor	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
782	23230	Band 13	1RB 25offset	Toward Phantom	5	22.16	23.0	1.213	0.634	0.769	-0.14
782	23230	Band 13	1RB 25offset	Toward Ground	5	22.16	23.0	1.213	0.473	0.574	-0.00
782	23230	Band 13	1RB 25offset	Toward Left	5	22.16	23.0	1.213	0.484	0.587	-0.02
782	23230	Band 13	1RB 25offset	Toward Right	5	22.16	23.0	1.213	0.537	0.652	0.10
782	23230	Band 13	1RB 25offset	Bottom	5	22.16	23.0	1.213	0.345	0.419	0.06
782	23230	Band 13	1RB 25offset	Toward Top	5	22.16	23.0	1.213	0.229	0.278	-0.02
782	23230	Band 13	25RB 13offset	Toward Phantom	5	21.38	22.0	1.153	0.512	0.591	-0.16
782	23230	Band 13	25RB 13offset	Toward Ground	5	21.38	22.0	1.153	0.495	0.571	0.03
782	23230	Band 13	25RB 13offset	Toward Left	5	21.38	22.0	1.153	0.469	0.541	-0.14
782	23230	Band 13	25RB 13offset	Toward Right	5	21.38	22.0	1.153	0.484	0.558	-0.00
782	23230	Band 13	25RB 13offset	Bottom	5	21.38	22.0	1.153	0.315	0.363	-0.18
782	23230	Band 13	25RB 13offset	Toward Top	5	21.38	22.0	1.153	0.186	0.215	0.03

Table 17.3: SAR Values(WIFI-Body)

Frequency		Mode /Band	Service /Headset	Test Position	Spacing (mm)	Measured average power (dBm)	Maximum allowed Power (dBm)	Scaling factor	Measured SAR(1g) (W/kg)	Reported SAR(1g) (W/kg)	Power Drift (dB)
MHz	Ch.										
2462	11	802.11b	1Mpsk	Toward Phantom	5	15.66	16.20	1.132	0.139	0.157	0.15
2462	11	802.11b	1Mpsk	Toward Ground	5	15.66	16.20	1.132	0.047	0.053	0.07
2462	11	802.11b	1Mpsk	Toward Left	5	15.66	16.20	1.132	0.013	0.015	0.09
2462	11	802.11b	1Mpsk	Toward Right	5	15.66	16.20	1.132	0.025	0.028	-0.16
2462	11	802.11b	1Mpsk	Toward Bottom	5	15.66	16.20	1.132	0.012	0.014	0.17
2462	11	802.11b	1Mpsk	Toward Top	5	15.66	16.20	1.132	0.087	0.099	0.02
2437	6	802.11b	1Mpsk	Toward Phantom	5	15.06	15.50	1.107	0.155	0.172	-0.08
2412	1	802.11b	1Mpsk	Toward Phantom	5	14.14	14.50	1.086	0.122	0.133	0.16

17.2.SAR Measurement Variability

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

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

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

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

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

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

Table 17.4 SAR Measurement Variability for Body (1g)

Frequency		Mode /band	Test Position	Spacing (mm)	Original SAR (W/kg)	First Repeated SAR (W/kg)	The Ratio
MHz	Ch.						
1732.5	20175	Band 4	Bottom	5	0.686	0.806	1.17
1745	20300	Band 4	Bottom	5	0.712	0.790	1.11
1720	20050	Band 4	Bottom	5	0.494	0.568	1.15

18. Measurement Uncertainty

Measurement uncertainty evaluation for SAR test

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

Measurement uncertainty evaluation for system validation

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

19. MAIN TEST INSTRUMENTS

Table 17.1: List of Main Instruments

No.	Name	Type	Serial Number	Calibration Date	Valid Period
01	Probe	EX3DV4	3844	2019-05-25	2020-05-24
02	DAE	DAE4	797	2019-08-22	2020-08-21
03	Power Meter	N1914A	MY50001660	2019-03-02	2020-03-01
04	Radio Communication Analyzer	CMW500	164483	2019-03-02	2020-03-01
06	Signal Generator	N5181A	MY50143363	2019-03-02	2020-03-01
07	Power Sensor	E8481H	MY51020011	2019-03-02	2020-03-01
08	Power Amplifier	ZHL	QA1202003	2019-03-02	2020-03-01
09	Attenuator	8491A	MY39267989	2019-03-02	2020-03-01
10	Probe kit	85070E	3G-S-00139	NA	NA
11	Network Analyzer	E5071C	US39175666	c	2020-03-01
12	D750V3	dipole	1037	2019-06-03	2020-06-02
14	D1750V2	dipole	1063	2019-01-18	2020-01-17

END OF REPORT BODY

ANNEX A. GRAPH RESULTS

LTE Band4 Body Bottom Middle

Date/Time: 2019/12/23
Electronics: DAE4 Sn797
Medium: Head 1750MHz
Medium parameters used (interpolated): f = 1732.5 MHz; σ = 1.371 S/m; εr = 39.357; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: LTE Band 4; Frequency: 1732.5 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(8.5, 8.5, 8.5); Calibrated: 2019/5/25
Middle Bottom LTE Band 4 20MHz/Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.784 W/kg
Middle Bottom LTE Band 4 20MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 14.86 V/m; Power Drift = -0.18 dB
Peak SAR (extrapolated) = 1.46 W/kg
SAR(1 g) = 0.686 W/kg; SAR(10 g) = 0.309 W/kg
Maximum value of SAR (measured) = 0.709 W/kg

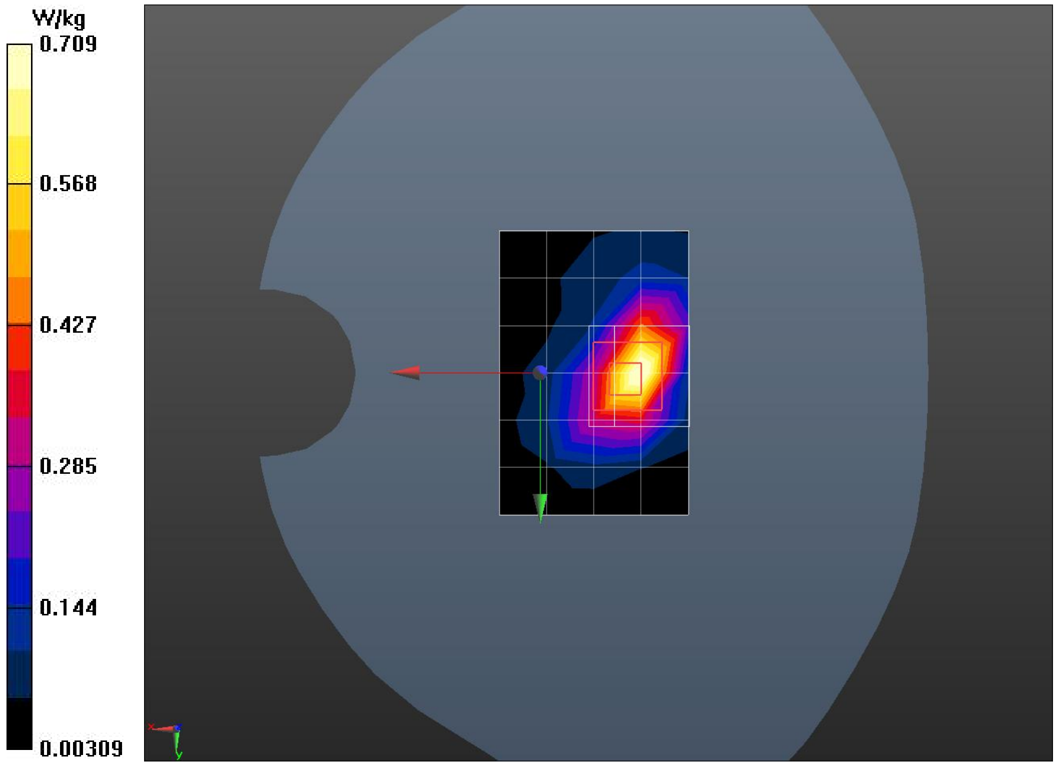


Fig.1 LTE Band4 Bottom Mode Middle

LTE Band13 Body Toward Toward Middle

Date/Time: 2019/12/27
Electronics: DAE4 Sn797
Medium: Head 750MHz
Medium parameters used: f = 782 MHz; σ = 0.936 S/m; εr = 41.227; ρ = 1000 kg/m3
Ambient Temperature:22.5°C   Liquid Temperature:22.5°C
Communication System: LTE Band 13; Frequency: 782 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(9.75, 9.75, 9.75); Calibrated: 2019/5/25
Middle Toward Phantom LTE Band 13 10MHz/Area Scan (6x8x1): Measurement grid:
dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.616 W/kg
Middle Toward Phantom LTE Band 13 10MHz/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.09 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 1.04 W/kg
SAR(1 g) = 0.634 W/kg; SAR(10 g) = 0.404 W/kg
Maximum value of SAR (measured) = 0.704 W/kg

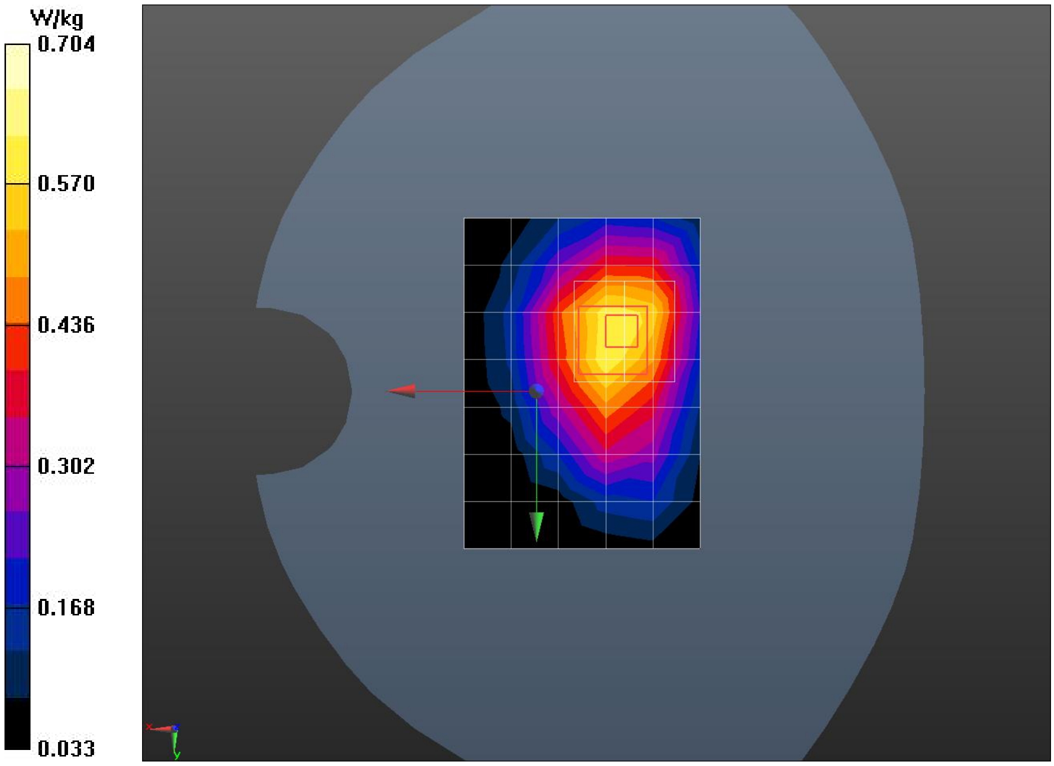


Fig.2 LTE Band 13 Phantom Mode Middle

WIFI 802.11b Body Toward Phantom Middle

Date/Time: 2019/12/30
Electronics: DAE4 Sn797
Medium: Head 2450MHz
Medium parameters used: f = 2437 MHz; σ = 1.816 S/m; εr = 38.293; ρ = 1000 kg/m3
Ambient Temperature:22.5°C   Liquid Temperature:22.5°C
Communication System: Wi-Fi ; Frequency: 2437 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(7.48, 7.48, 7.48); Calibrated: 2019/5/25
Middle Toward Phantom 11b With 5mm/Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.159 W/kg
Middle Toward Phantom 11b With 5mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 7.003 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.369 W/kg
SAR(1 g) = 0.155 W/kg; SAR(10 g) = 0.071 W/kg
Maximum value of SAR (measured) = 0.168 W/kg

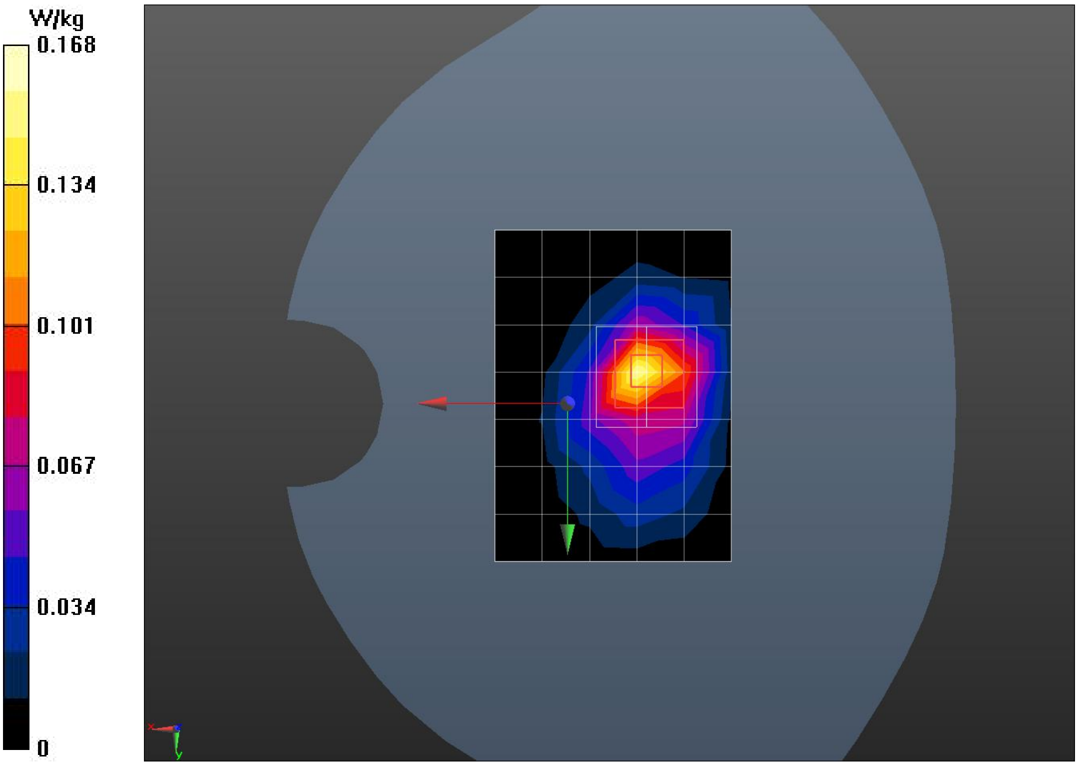
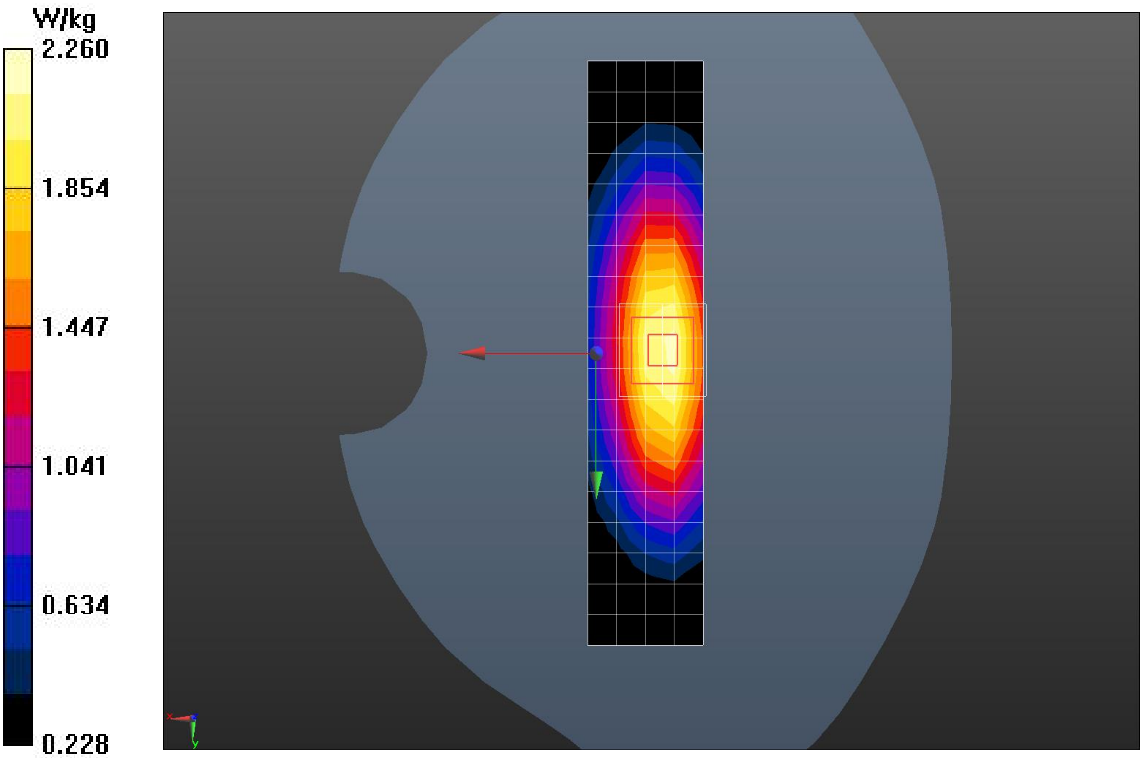


Fig.3 WIFI Phantom Mode Middle

ANNEX B. SYSTEM VALIDATION RESULTS

Head 750MHz

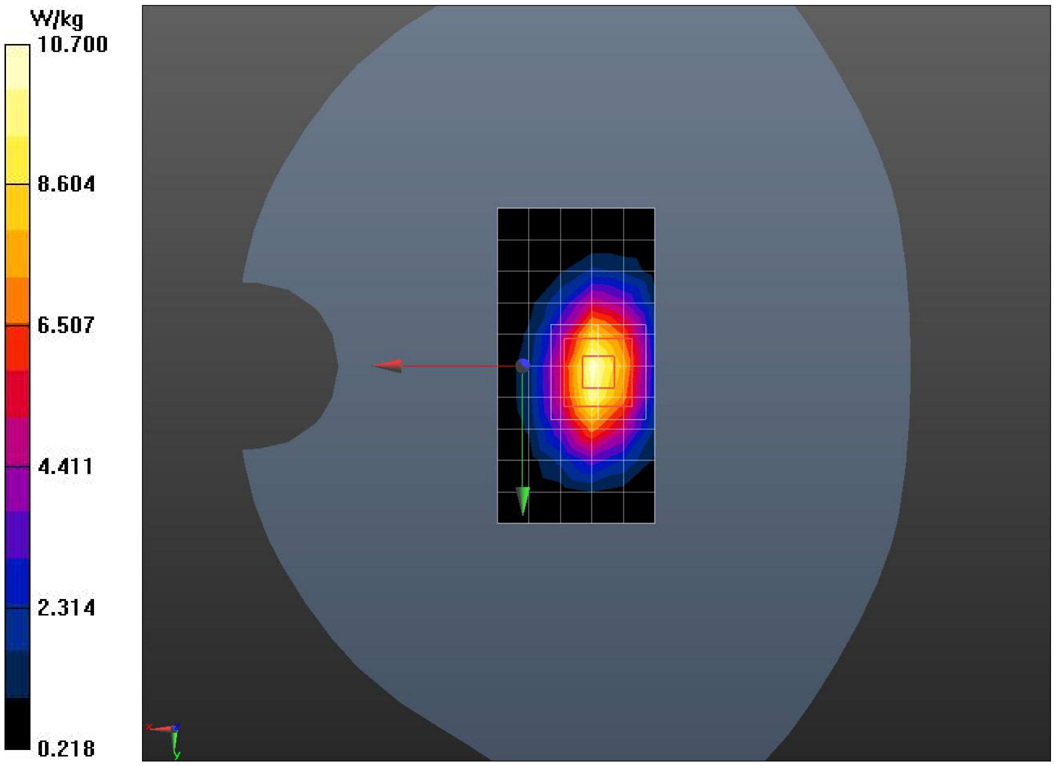
Date/Time: 2019/12/27
Electronics: DAE4 Sn797
Medium: Head 750MHz
Medium parameters used: f = 750 MHz; σ = 0.886 S/m; εr = 42.605; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(9.75, 9.75, 9.75);
System Check Dipole 750 MHz/Area Scan (5x20x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 2.16 W/kg
System Check Dipole 750 MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 48.27 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 3.14 W/kg
SAR(1 g) = 2.09 W/kg; SAR(10 g) = 1.38 W/kg
Maximum value of SAR (measured) = 2.26 W/kg



ddress: No. 8,Yuma Road, Chayuan New City, Nan'an District, Chongqing, P. R. China,401336 Tel: 0086-23-88069965
FAX:0086-23-88608777

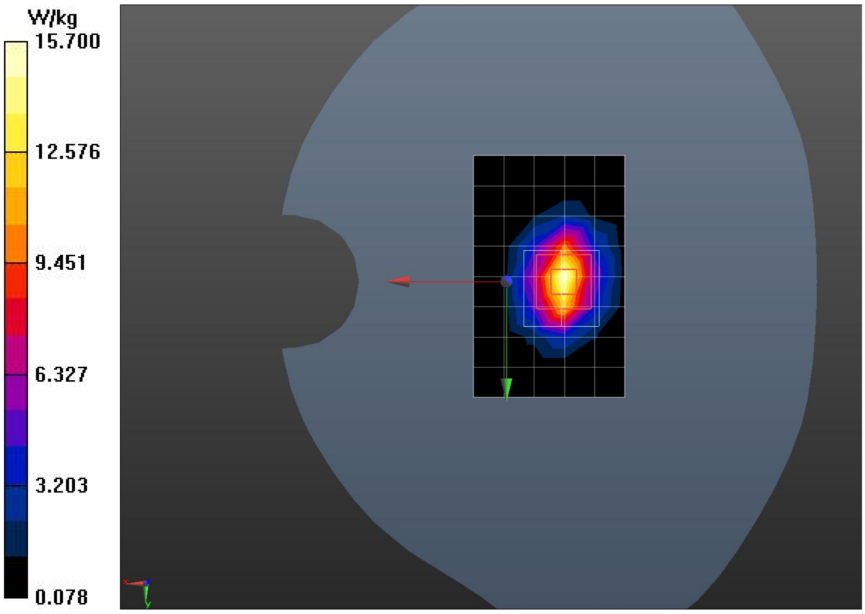
System 1750MHz

Date/Time: 2019/12/23
Electronics: DAE4 Sn797
Medium: Head 1750MHz
Medium parameters used: f = 1750 MHz; σ = 1.384 S/m; εr = 39.328; ρ = 1000 kg/m3
Ambient Temperature:22.5°C   Liquid Temperature:22.5°C
Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(8.5, 8.5, 8.5); Calibrated: 2019/5/25
System Head 1750MHz/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 10.5 W/kg
System Head 1750MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 76.88 V/m; Power Drift = 0.14 dB
Peak SAR (extrapolated) = 17.8 W/kg
SAR(1 g) = 9.54 W/kg; SAR(10 g) = 5.04 W/kg
Maximum value of SAR (measured) = 10.7 W/kg



System 2450MHz

Date/Time: 2019/12/30
Electronics: DAE4 Sn797
Medium: Head 2450MHz
Medium parameters used: f = 2450 MHz; σ = 1.831 S/m; εr = 38.258; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(7.48, 7.48, 7.48);
System Check Dipole 2450 MHz/Area Scan (6x9x1): Measurement grid: dx=12mm, dy=12mm
Maximum value of SAR (measured) = 15.8 W/kg
System Check Dipole 2450 MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 82.67 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 13.7 W/kg; SAR(10 g) = 6.35 W/kg
Maximum value of SAR (measured) = 15.7 W/kg



ANNEX C. SYSTEM VALIDATION RESULTS

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

中国认可
国际互认
校准
CALIBRATION
CNAS L0570

Client CATR(Chongqing) Certificate No: Z19-60145

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3844
Calibration Procedure(s)	FF-Z11-004-01 Calibration Procedures for Dosimetric E-field Probes
Calibration date:	May 25, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRP2	101919	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101547	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Power sensor NRP-Z91	101548	20-Jun-18 (CTTL, No.J18X05032)	Jun-19
Reference10dBAttenuator	18N50W-10dB	09-Feb-18(CTTL, No.J18X01133)	Feb-20
Reference20dBAttenuator	18N50W-20dB	09-Feb-18(CTTL, No.J18X01132)	Feb-20
Reference Probe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18/2)	Aug-19
DAE4	SN 1555	20-Aug-18(SPEAG, No.DAE4-1555_Aug18)	Aug -19
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
SignalGeneratorMG3700A	6201052605	21-Jun-18 (CTTL, No.J18X05033)	Jun-19
Network Analyzer E5071C	MY46110673	24-Jan-19 (CTTL, No.J19X00547)	Jan -20

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

Issued: May 27, 2019

In Collaboration with
speag
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Glossary:

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

Calibration is Performed According to the Following Standards:

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

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

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

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

Methods Applied and Interpretation of Parameters:

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

In Collaboration with
s p e a g
CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Probe EX3DV4

SN: 3844

Calibrated: May 25, 2019

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

Certificate No: Z19-60145 Page 3 of 11

In Collaboration with s p e a g CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3844

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm(μV/(V/m)²)[A]	0.48	0.41	0.19	±10.0%
DCP(mV)[B]	103.8	103.4	98.6	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	166.2	±2.4%
		Y	0.0	0.0	1.0		147.6	
		Z	0.0	0.0	1.0		86.9	

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.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3844

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	9.75	9.75	9.75	0.24	0.89	±12.1%
835	41.5	0.90	9.35	9.35	9.35	0.12	1.43	±12.1%
900	41.5	0.97	9.32	9.32	9.32	0.21	1.05	±12.1%
1750	40.1	1.37	8.50	8.50	8.50	0.24	1.01	±12.1%
1900	40.0	1.40	8.07	8.07	8.07	0.23	1.04	±12.1%
2000	40.0	1.40	8.01	8.01	8.01	0.24	1.10	±12.1%
2300	39.5	1.67	7.80	7.80	7.80	0.49	0.77	±12.1%
2450	39.2	1.80	7.48	7.48	7.48	0.63	0.69	±12.1%
2600	39.0	1.96	7.40	7.40	7.40	0.67	0.68	±12.1%

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

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

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

In Collaboration with
s p e a g
CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3844

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	9.92	9.92	9.92	0.40	0.80	±12.1%
835	55.2	0.97	9.51	9.51	9.51	0.19	1.38	±12.1%
900	55.0	1.05	9.51	9.51	9.51	0.24	1.11	±12.1%
1750	53.4	1.49	8.16	8.16	8.16	0.22	1.15	±12.1%
1900	53.3	1.52	7.91	7.91	7.91	0.23	1.13	±12.1%
2000	53.3	1.52	7.85	7.85	7.85	0.21	1.20	±12.1%
2300	52.9	1.81	7.71	7.71	7.71	0.55	0.83	±12.1%
2450	52.7	1.95	7.63	7.63	7.63	0.67	0.73	±12.1%
2600	52.5	2.16	7.48	7.48	7.48	0.68	0.71	±12.1%

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

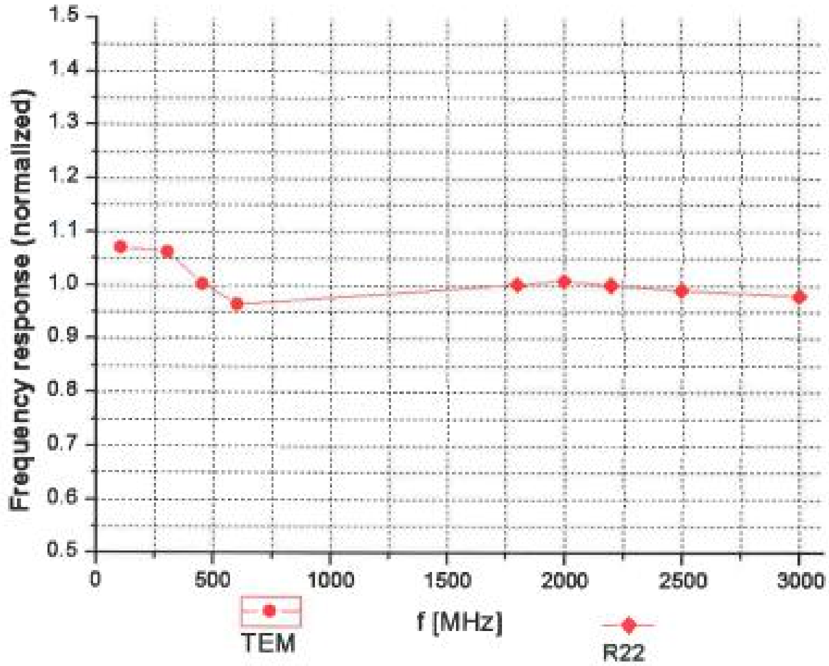
[F] At frequency below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ±10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ±5%. The uncertainty is the RSS of the ConvF uncertainty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

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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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



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

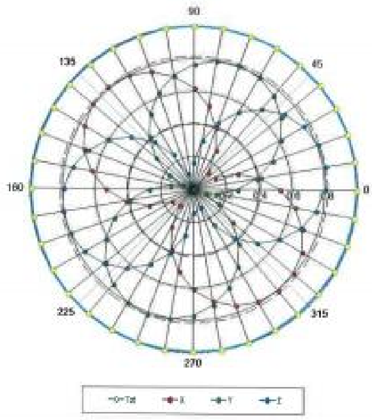
Certificate No: Z19-60145 Page 7 of 11

In Collaboration with
s p e a g
CALIBRATION LABORATORY

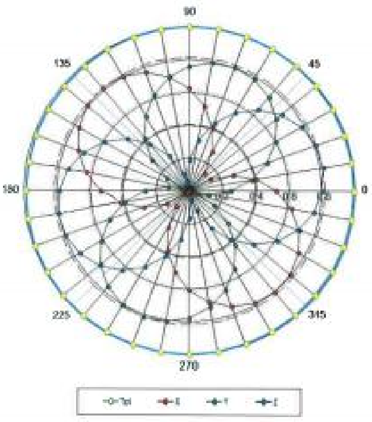
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

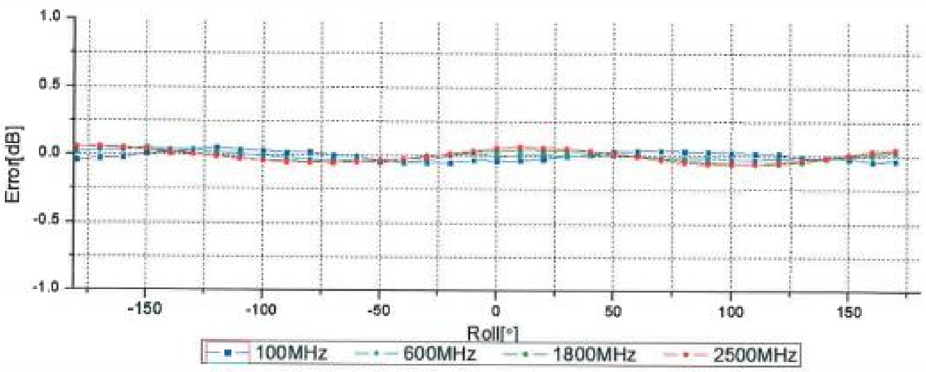
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM



f=1800 MHz, R22



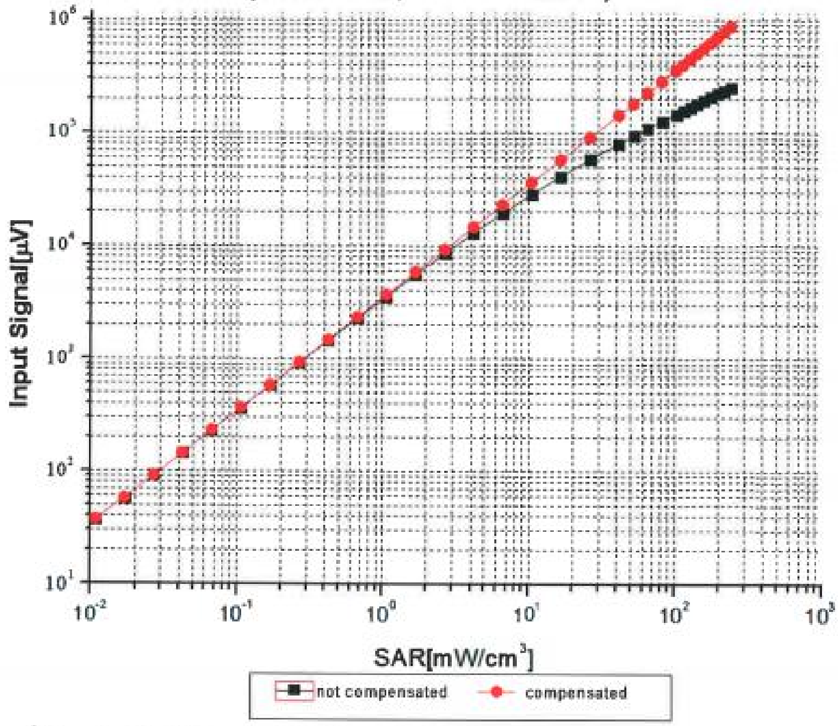


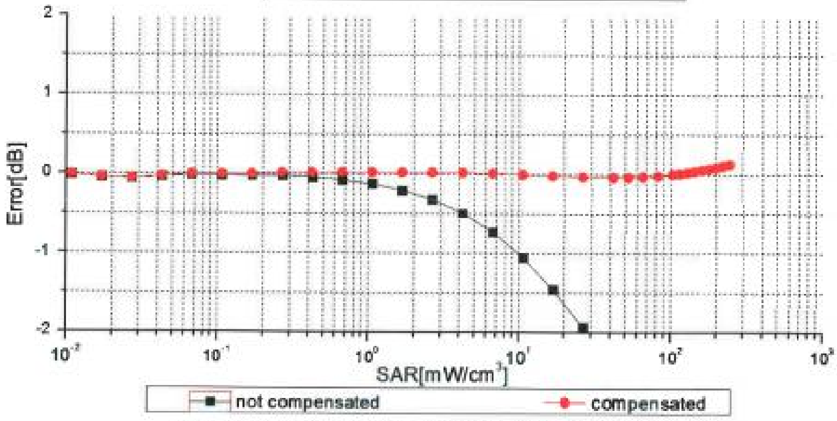
Uncertainty of Axial Isotropy Assessment: ±1.2% (k=2)

In Collaboration with s p e a g CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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





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

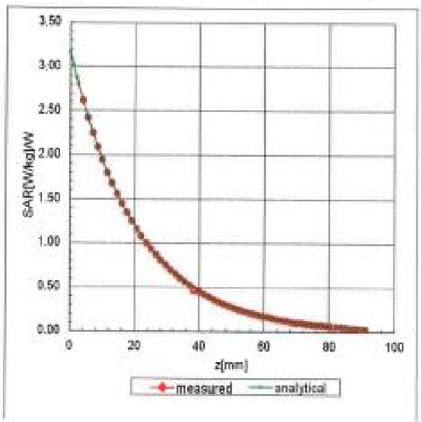
Certificate No: Z19-60145

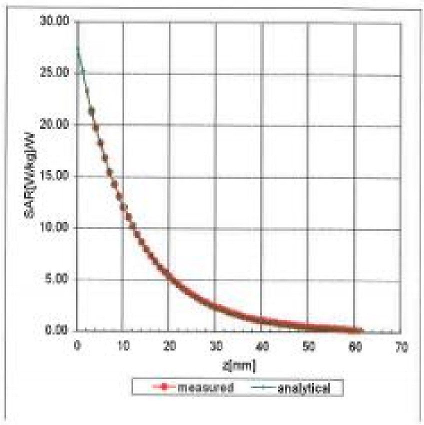
Page 9 of 11

In Collaboration with
s p e a g
CALIBRATION LABORATORY

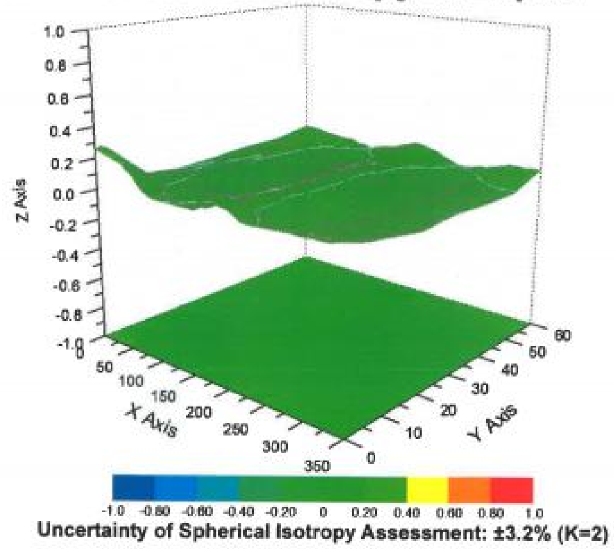
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

Conversion Factor Assessment





Deviation from Isotropy in Liquid



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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DASY/EASY – Parameters of Probe: EX3DV4 – SN: 3844

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	26.7
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

TTL In Collaboration with s p e a g CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

ilac-MRA CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client : CATR(Chongqing) Certificate No: Z19-60274

CALIBRATION CERTIFICATE

Object	DAE4 - SN: 797
Calibration Procedure(s)	FF-Z11-002-01 Calibration Procedure for the Data Acquisition Electronics (DAEx)
Calibration date:	August 22, 2019

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	24-Jun-19 (CTTL, No.J19X05126)	Jun-20

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

Issued: August 24, 2019

Certificate No: Z19-60274 Page 1 of 1

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

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.

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2512 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com Http://www.chinattl.cn

DC Voltage Measurement

A/D - Converter Resolution nominal
High Range: 1LSB = 6.1μV , full range = -100...+300 mV
Low Range: 1LSB = 61nV , full range = -1.......+3mV
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

Calibration Factors	X	Y	Z
High Range	403.879 ± 0.15% (k=2)	404.134 ± 0.15% (k=2)	403.854 ± 0.15% (k=2)
Low Range	3.95921 ± 0.7% (k=2)	3.96839 ± 0.7% (k=2)	3.97981 ± 0.7% (k=2)

Connector Angle

Connector Angle to be used in DASY system	43.5° ± 1 °

Certificate No: Z19-60274 Page 3 of 3

In Collaboration with speag CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client CATR(Chongqing) Certificate No: Z19-60162

CALIBRATION CERTIFICATE

Object: D750V3 - SN: 1037

Calibration Procedure(s): FF-Z11-003-01
Calibration Procedures for dipole validation kits

Calibration date: June 3, 2019

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	106277	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Power sensor NRP8S	104291	20-Aug-18 (CTTL, No.J18X06862)	Aug-19
Reference Probe EX3DV4	SN 7514	27-Aug-18(SPEAG,No.EX3-7514_Aug18)	Aug-19
DAE4	SN 1556	20-Aug-18(SPEAG,No.DAE4-1556_Aug18)	Aug-19
Secondary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Signal Generator E4438C	MY49071430	23-Jan-19 (CTTL, No.J19X00336)	Jan-20
NetworkAnalyzer E5071C	MY46116073	24-Jan-19 (CTTL, No.J19X00547)	Jan-20

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

Issued: June 5, 2019

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
Extrapolation	Advanced Extrapolation	
Phantom	Triple Flat Phantom 5.1C	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.0 ± 6 %	0.90 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	2.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**8.44 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**5.58 W/kg ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.3 ± 6 %	0.94 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	2.11 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**8.59 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**5.68 W/kg ±18.7 % (k=2)**

In Collaboration with
speag
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.7Ω- 0.98jΩ
Return Loss	- 28.7dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.1Ω- 3.67jΩ
Return Loss	- 26.4dB

General Antenna Parameters and Design

Electrical Delay (one direction)	0.901 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

CTTL In Collaboration with speag CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Head TSL Date: 06.03.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1037

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 750 MHz; σ = 0.896 S/m; ε_r = 42.02; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(9.47, 9.47, 9.47) @ 750 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

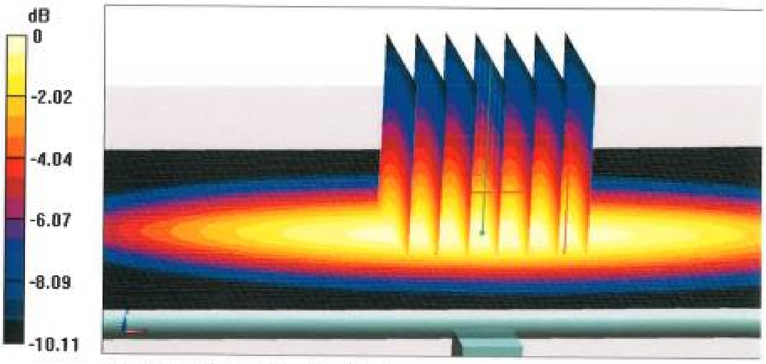
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.16 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.19 W/kg

SAR(1 g) = 2.12 W/kg; SAR(10 g) = 1.4 W/kg

Maximum value of SAR (measured) = 2.82 W/kg



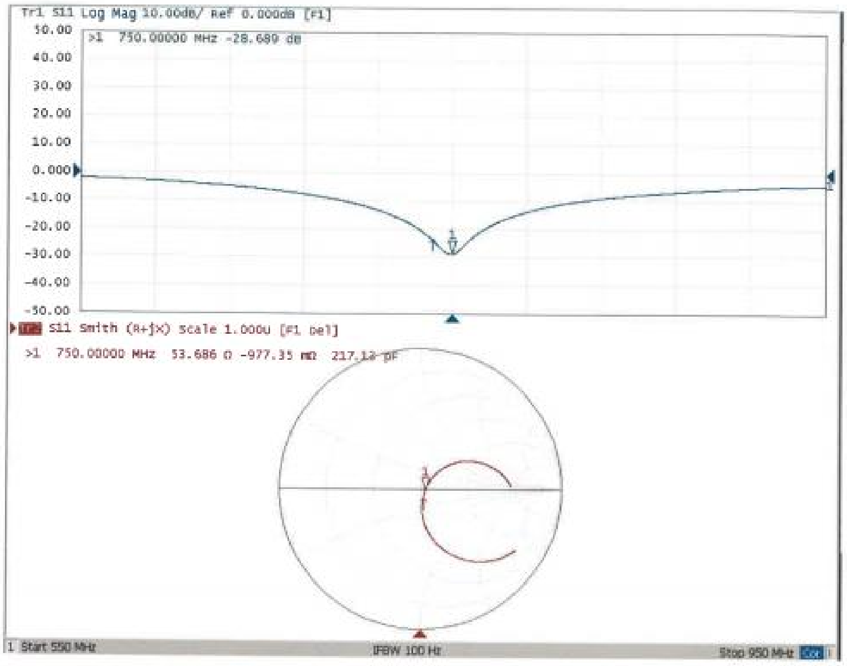
0 dB = 2.82 W/kg = 4.50 dBW/kg

Certificate No: Z19-60162 Page 5 of 8

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



Certificate No: Z19-60162 Page 6 of 8

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Body TSL Date: 06.03.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1037

Communication System: UID 0, CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 750 MHz; σ = 0.937 S/m; ε_r = 55.26; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7514; ConvF(9.68, 9.68, 9.68) @ 750 MHz; Calibrated: 8/27/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

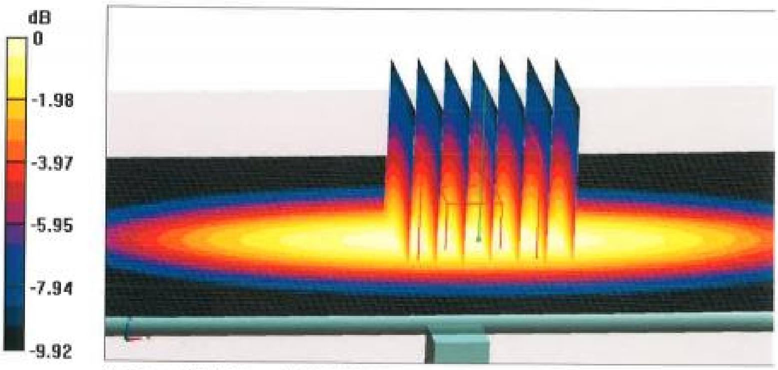
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.27 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 3.19 W/kg

SAR(1 g) = 2.11 W/kg; SAR(10 g) = 1.4 W/kg

Maximum value of SAR (measured) = 2.81 W/kg



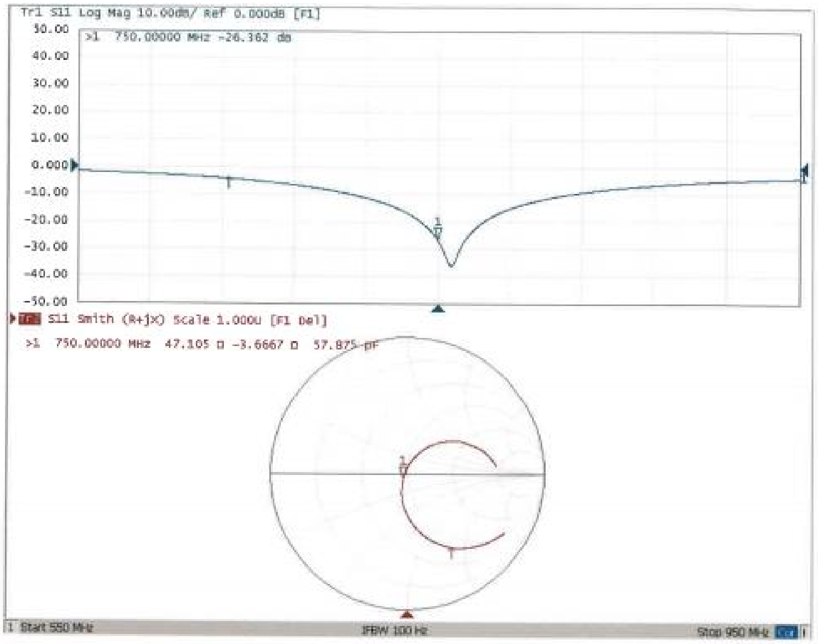
0 dB = 2.81 W/kg = 4.49 dBW/kg

Certificate No: Z19-60162 Page 7 of 8

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Body TSL



Certificate No: Z19-60162 Page 8 of 8

In Collaboration with speag CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client **CATR(Chongqing)** **Certificate No: Z19-60003**

CALIBRATION CERTIFICATE

Object	D1750V2 - SN: 1063
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	January 18, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	07-Mar-18 (CTTL, No.J18X01510)	Mar-19
Power sensor NRV-Z5	100596	07-Mar-18 (CTTL, No.J18X01510)	Mar-19
Reference Probe EX3DV4	SN 7433	12-Nov-18(CTTL-SPEAG,No.Z18-60401)	Nov-19
DAE4	SN 1556	20-Aug-18(SPEAG,No.DAE4-1556_Aug18)	Aug-19
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	赵静
Reviewed by:	Lin Hao	SAR Test Engineer	林浩
Approved by:	Qi Dianyuan	SAR Project Leader	[signature]

Issued: January 20, 2019

Certificate No: Z19-60003 Page 1 of 8

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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

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

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
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	1750 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.3 ± 6 %	1.33 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	9.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**37.6 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	4.95 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.1 W/kg ± 18.7 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	54.3 ± 6 %	1.45 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	9.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**38.5 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	4.95 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.1 W/kg ± 18.7 % (k=2)**

In Collaboration with
speag
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	48.9Ω- 0.73 jΩ
Return Loss	- 37.4 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.4Ω+ 1.52 jΩ
Return Loss	- 27.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.088 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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Head TSL Date: 01.17.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1063

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1750 MHz; σ = 1.33 S/m; ε_r = 41.28; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(8.06, 8.06, 8.06) @ 1750 MHz; Calibrated: 11/12/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

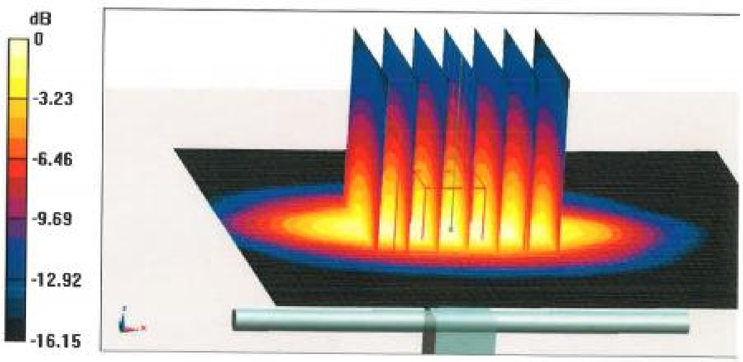
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.63 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 16.7 W/kg

SAR(1 g) = 9.17 W/kg; SAR(10 g) = 4.95 W/kg

Maximum value of SAR (measured) = 14.0 W/kg



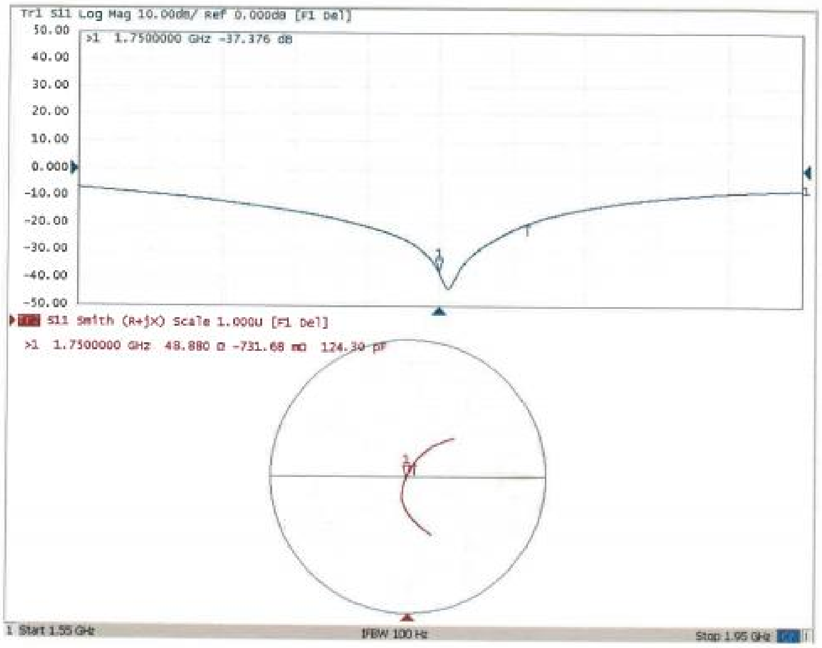
0 dB = 14.0 W/kg = 11.46 dBW/kg

Certificate No: Z19-60003 Page 5 of 8

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



In Collaboration with
speag
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Body TSL Date: 01.17.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1063

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium parameters used: f = 1750 MHz; σ = 1.447 S/m; ε_r = 54.29; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.8, 7.8, 7.8) @ 1750 MHz; Calibrated: 11/12/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

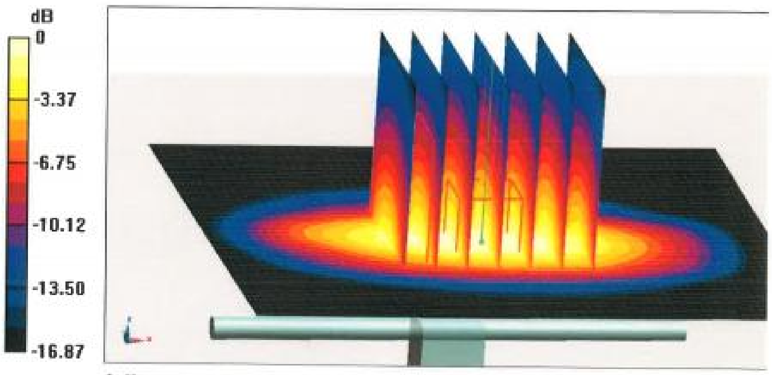
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 89.38 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 17.6 W/kg

SAR(1 g) = 9.41 W/kg; SAR(10 g) = 4.95 W/kg

Maximum value of SAR (measured) = 14.7 W/kg



0 dB = 14.7 W/kg = 11.67 dBW/kg

TTL In Collaboration with speag CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

ilac-MRA CNAS 中国认可 国际互认 校准 CALIBRATION CNAS L0570

Client CATR(Chongqing) **Certificate No: Z19-60007**

CALIBRATION CERTIFICATE

Object	D2450V2 - SN: 886
Calibration Procedure(s)	FF-Z11-003-01 Calibration Procedures for dipole validation kits
Calibration date:	January 17, 2019

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date(Calibrated by, Certificate No.)	Scheduled Calibration
Power Meter NRVD	102196	07-Mar-18 (CTTL, No.J18X01510)	Mar-19
Power sensor NRV-Z5	100596	07-Mar-18 (CTTL, No.J18X01510)	Mar-19
Reference Probe EX3DV4	SN 7433	12-Nov-18(CTTL-SPEAG,No.Z18-60401)	Nov-19
DAE4	SN 1556	20-Aug-18(SPEAG,No.DAE4-1556_Aug18)	Aug-19
Secondary Standards	**ID #**	**Cal Date(Calibrated by, Certificate No.)**	**Scheduled Calibration**
Signal Generator E4438C	MY49071430	23-Jan-18 (CTTL, No.J18X00560)	Jan-19
NetworkAnalyzer E5071C	MY46110673	24-Jan-18 (CTTL, No.J18X00561)	Jan-19

	Name	Function	Signature
Calibrated by:	Zhao Jing	SAR Test Engineer	[signature]
Reviewed by:	Lin Hao	SAR Test Engineer	[signature]
Approved by:	Qi Dianyuan	SAR Project Leader	[signature]

Issued: January 20, 2019

Certificate No: Z19-60007 Page 1 of 8

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

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

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

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z19-60007 Page 2 of 8

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
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	40.3 ± 6 %	1.84 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	13.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**52.5 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	6.22 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**24.8 W/kg ± 18.7 % (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	53.2 ± 6 %	1.98 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	12.9 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**51.3 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.97 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**23.8 W/kg ± 18.7 % (k=2)**

Certificate No: Z19-60007 Page 3 of 8

TTL In Collaboration with speag CALIBRATION LABORATORY
Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	52.6Ω+ 3.54 jΩ
Return Loss	- 27.3dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	50.5Ω+ 5.14 jΩ
Return Loss	- 25.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.025 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

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Head TSL Date: 01.16.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 886

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

Medium parameters used: f = 2450 MHz; σ = 1.843 S/m; ε_r = 40.34; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.36, 7.36, 7.36) @ 2450 MHz; Calibrated: 11/12/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

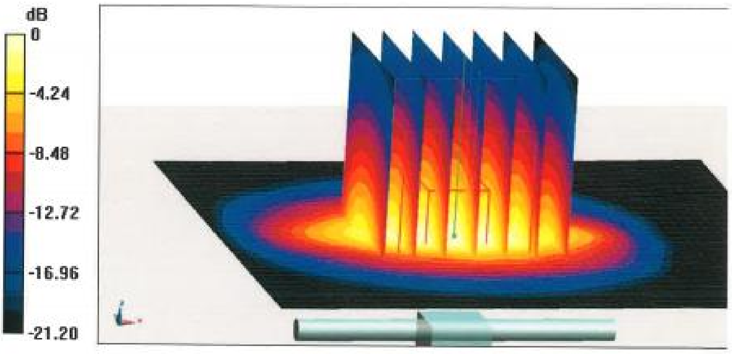
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 105.3 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 26.5 W/kg

SAR(1 g) = 13.2 W/kg; SAR(10 g) = 6.22 W/kg

Maximum value of SAR (measured) = 21.7 W/kg



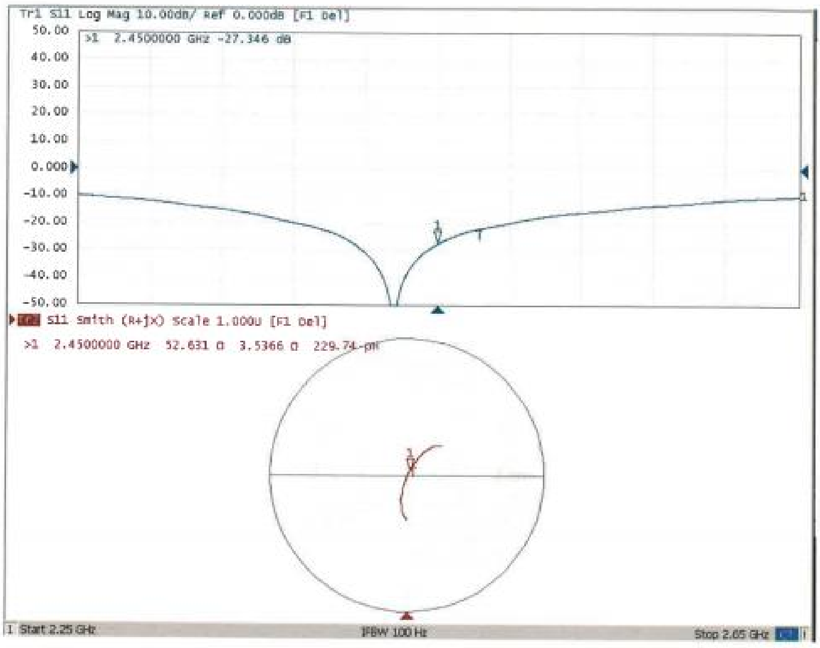
0 dB = 21.7 W/kg = 13.36 dBW/kg

Certificate No: Z19-60007 Page 5 of 8

In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Head TSL



In Collaboration with
s p e a g
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

DASY5 Validation Report for Body TSL Date: 01.16.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 2450 MHz; Type: D2450V2; Serial: D2450V2 - SN: 886

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

Medium parameters used: f = 2450 MHz; σ = 1.98 S/m; ε_r = 53.18; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.28, 7.28, 7.28) @ 2450 MHz; Calibrated: 11/12/2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn1556; Calibrated: 8/20/2018
- Phantom: MFP_V5.1C ; Type: QD 000 P51CA; Serial: 1062
- Measurement SW: DASY52, Version 52.10 (2); SEMCAD X Version 14.6.12 (7450)

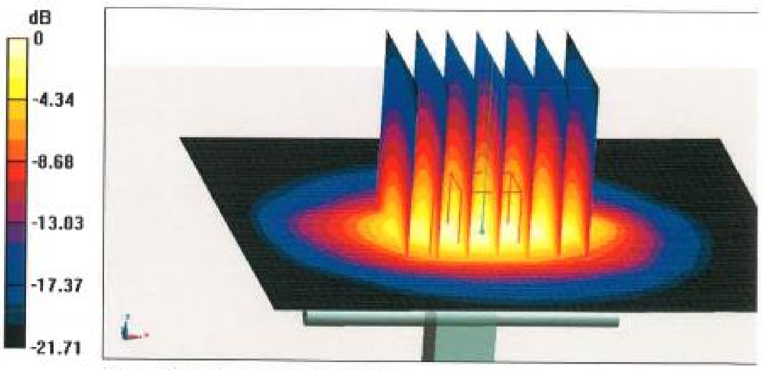
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.54 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 26.1 W/kg

SAR(1 g) = 12.9 W/kg; SAR(10 g) = 5.97 W/kg

Maximum value of SAR (measured) = 21.1 W/kg



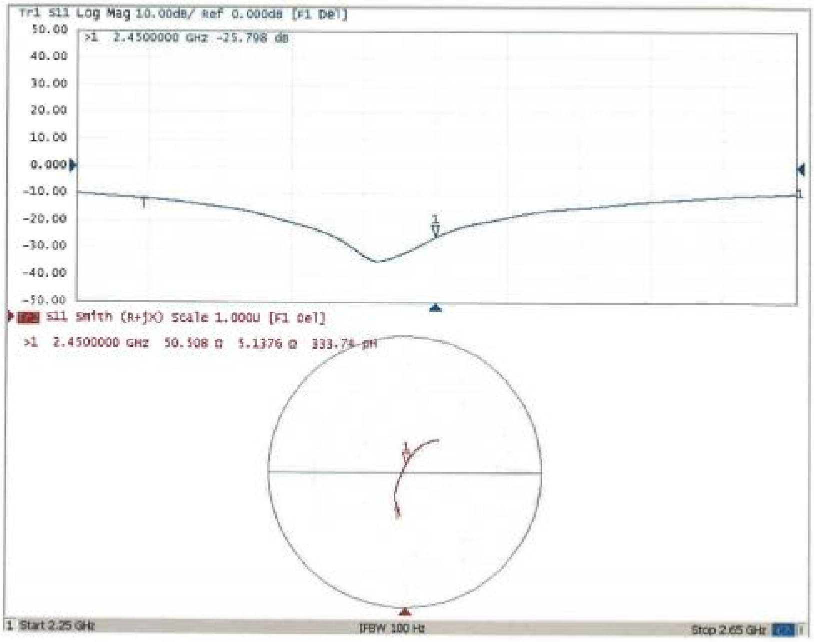
0 dB = 21.1 W/kg = 13.24 dBW/kg

Certificate No: Z19-60007 Page 7 of 8

In Collaboration with
speag
CALIBRATION LABORATORY

Add: No.51 Xueyuan Road, Haidian District, Beijing, 100191, China
Tel: +86-10-62304633-2079 Fax: +86-10-62304633-2504
E-mail: cttl@chinattl.com http://www.chinattl.cn

Impedance Measurement Plot for Body TSL



*****END OF REPORT*****