TEST REPORT

REPORT NUMBER：B19W50225-SAR-Rev1

ON

Type of Equipment:	LTE Tracker
Type of Designation:	AT Plus 4E
Manufacturer:	Micron Electronics LLC.
FCC ID:	ZKQ-ATP4E

ACCORDING TO

IEEE C95.1-2005
IEEE 1528–2013

Chongqing Academy of Information and Communication Technology

Month date, year

Sep,29, 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
B19W50225-SAR	00	2019-08-12	Initial creation of test report
B19W50225-SAR-Rev1	01	2019-09-29	First change of test report

CONTENTS

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:	2019-07-18
Testing End Date:	2019-08-01

1.4. Signature

2019-09-29

Ang Xinyu
(Prepared this test report)

Date

2019-09-29

Wang Lili
(Reviewed this test report)

Date

2019-09-29

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 **AT Plus 4E** are as follows (with expanded uncertainty 22.4%)

Table 2.1: Max. SAR Reported (1g)

Band	Position	SAR 1g (W/Kg)
GSM 850	Body(5mm)	0.599
GSM 1900	Body(5mm)	1.178
NB-Band 2	Body(5mm)	0.179
NB-Band 4	Body(5mm)	0.283
NB-Band 5	Body(5mm)	0.929
NB-Band 12	Body(5mm)	0.065
NB-Band 13	Body(5mm)	0.075
NB-Band 26	Body(5mm)	1.214
CATM Band 2	Body(5mm)	0.033
CATM Band 4	Body(5mm)	0.327
CATM Band 5	Body(5mm)	0.689
CATM Band 12	Body(5mm)	0.029
CATM Band 13	Body(5mm)	0.0515
CATM Band 26	Body(5mm)	0.730
WIFI	Body(5mm)	0.211

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**: 1.214 W/Kg (1g)**.

3. Client Information

3.1. Applicant Information

Company Name:	Micron Electronics LLC.
Address /Post:	1001 Yamato Road, Suite 400, Boca Raton, FL 33431, USA
Telephone:	+1 888 538 3489
Fax:	+1 888 550 1805
Email:	pcheng@micron-electronics.com
Contact Person:	YPing Cheng

3.2. Manufacturer Information

Company Name:	--
Address /Post:	--
Telephone:	--
Fax:	--
Email:	--
Contact Person:	--

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

4.1. About EUT

Description:	LTE Tracker
Model name:	AT Plus 4E
GSM Frequency Band	GSM850/PCS1900
NB-IOT Frequency Band	Band 2/4/5/12/13/26
CAT-M1 Frequency Band	Band 2/4/5/12/13/26
WIFI 2450	802.11b/g/n
Test device Production information:	Production unit
Voice mode	Not Support
GPRS Class Mode:	B
GPRS Multislot Class	12
EGPRS Multislot Class	12
Device type:	Portable device
Antenna type:	Inner antenna
Accessories/Body-worn configurations:	N/A
Hotspot mode:	N/A
Dimensions:	7.5cm×4.3cmx2.6cm

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**
S4	353081090309090	A502_V1_PCB	P51MAV01.01B01.I03	2019-06-11

*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:

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

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

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

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

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

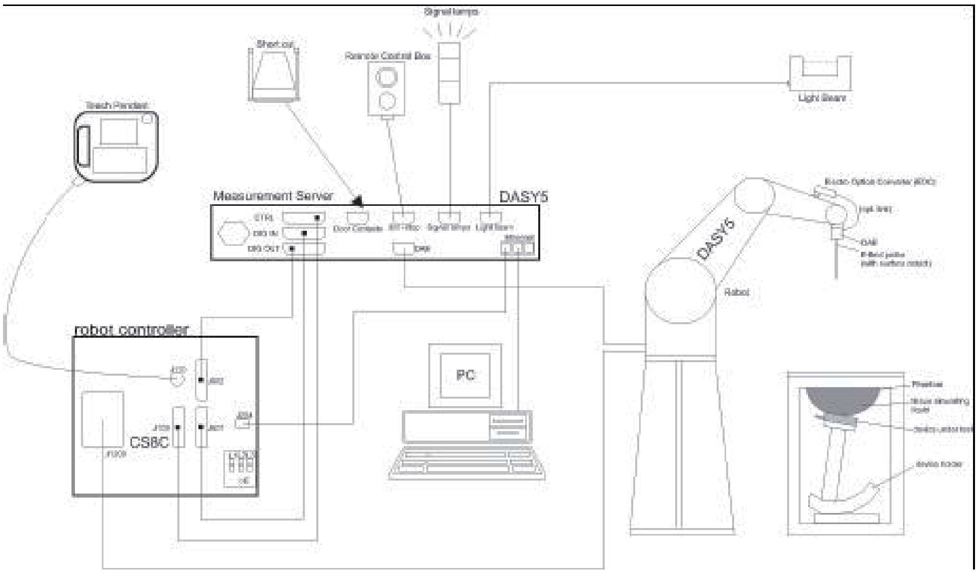
Where: σ is the conductivity of the tissue, ρ is the mass density of tissue and E is the RMS electrical field strength.

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 2ndord curve fitting. The approach is stopped at reaching the maximum.

Picture 7-2 Near-field Probe

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 7-3 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

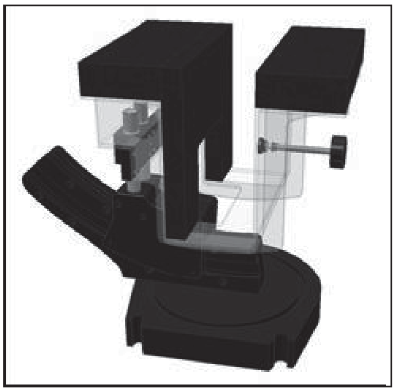
The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5mm distance, a positioning uncertainty of ±0.5mm would produce a SAR uncertainty of ±20%. Accurate device positioning is therefore crucial for accurate 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

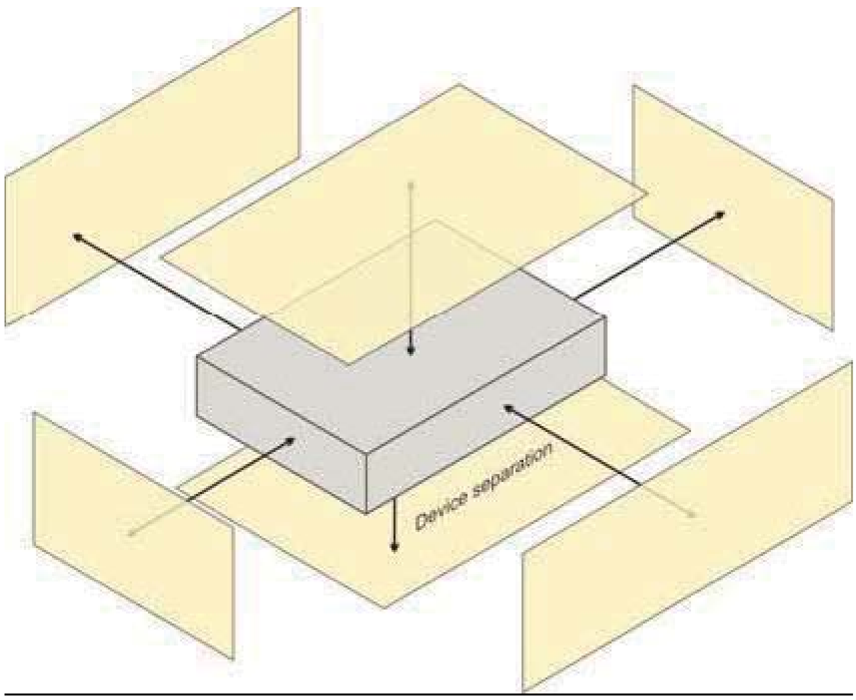
8. Position of the wireless device in relation to the phantom

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;

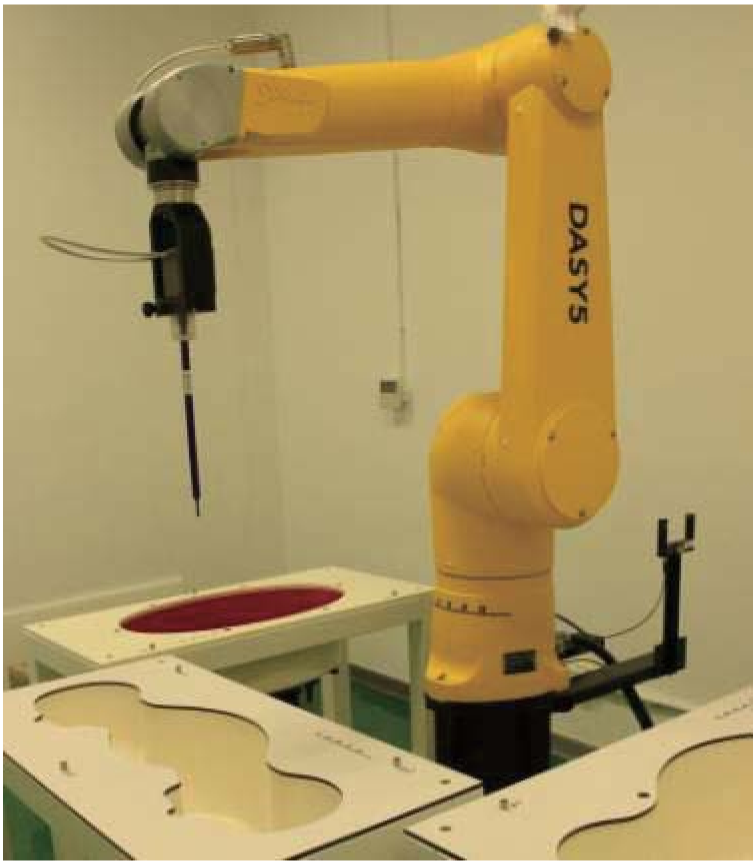
The SAR evaluation shall be performed for all surfaces of the DUT that are accessible during intended use, as indicated in Picture 8-1. The separation distance in testing shall correspond to the intended use distance as specified in the user instructions provided by the manufacturer. If the intended 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

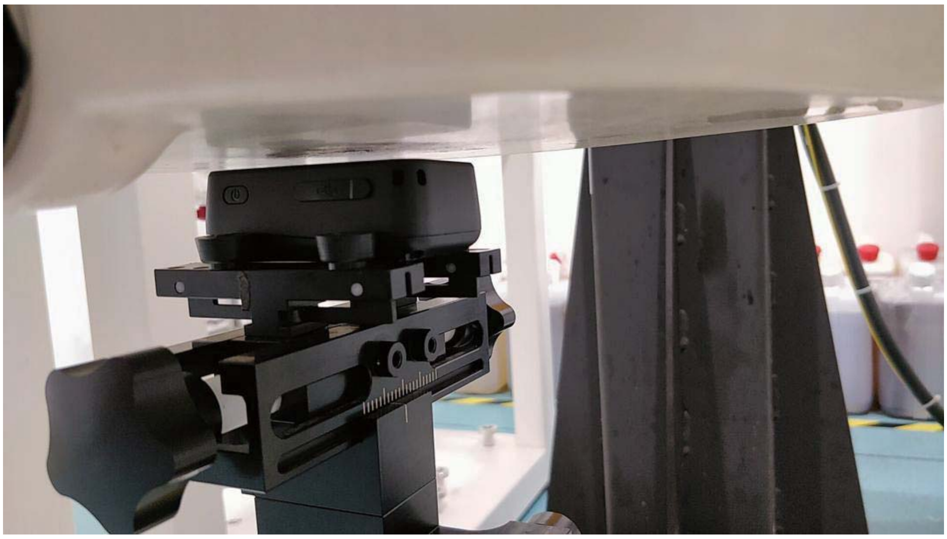
8.2. DUT Setup Photos



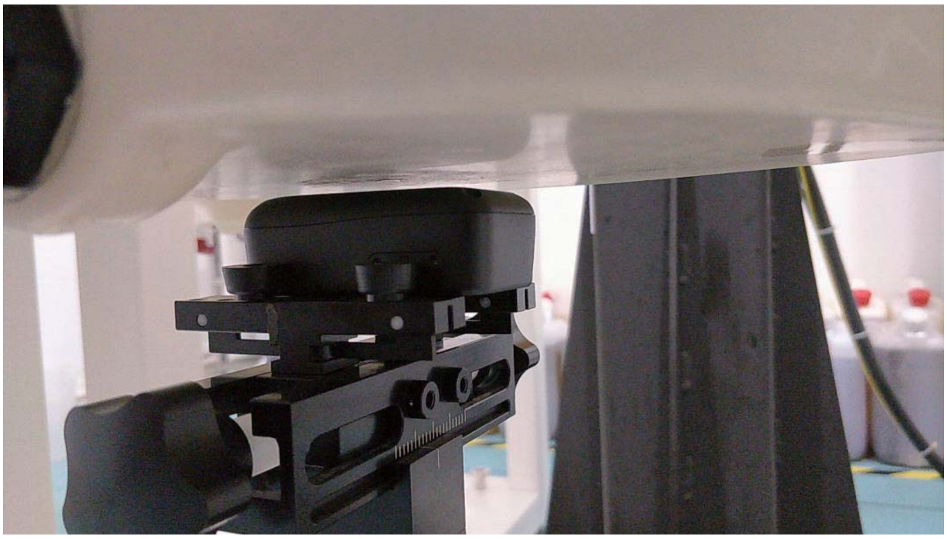
Picture 8-2: Specific Absorption Rate Test Layout

Test positions for body:

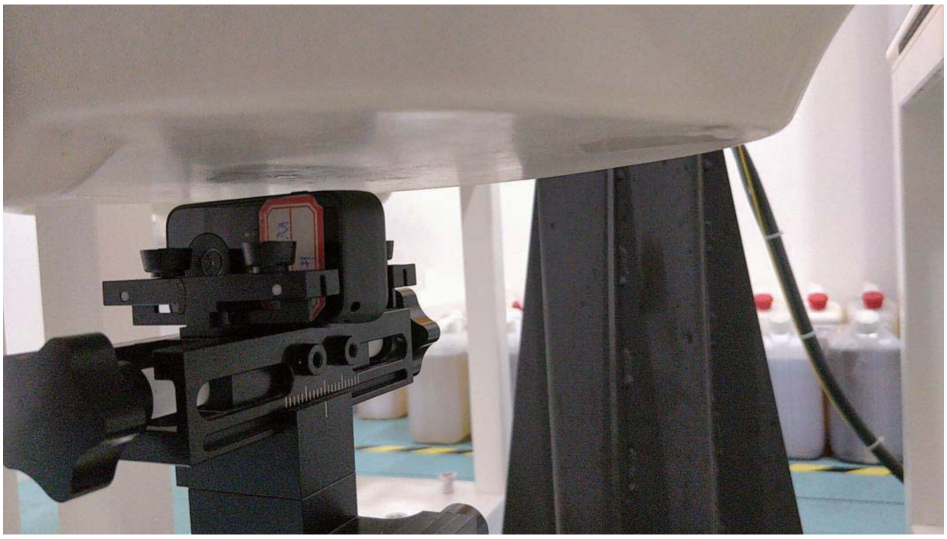
According to the antenna position, the Body SAR is tested at the following 6 test positions all with the distance =5mm between the EUT and the phantom bottom:



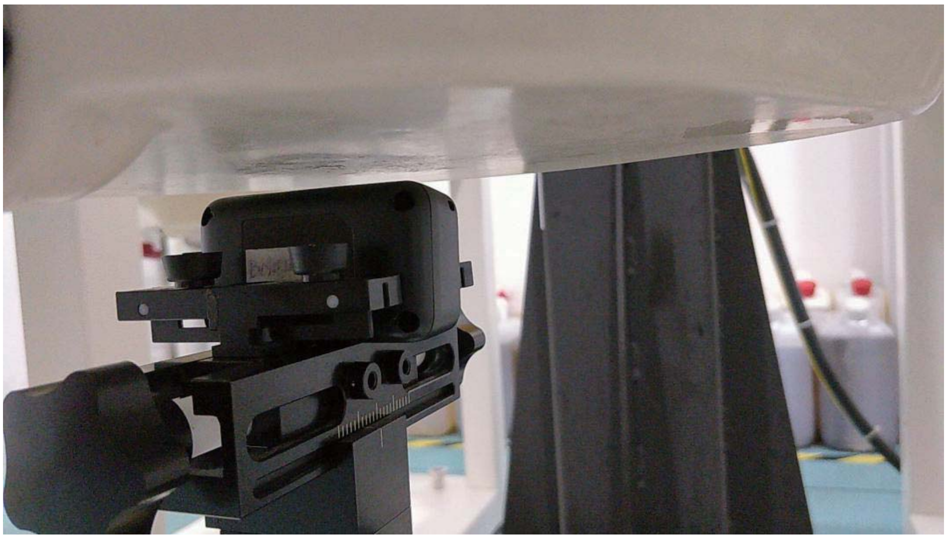
Picture 8-3: Toward Phantom (5mm)



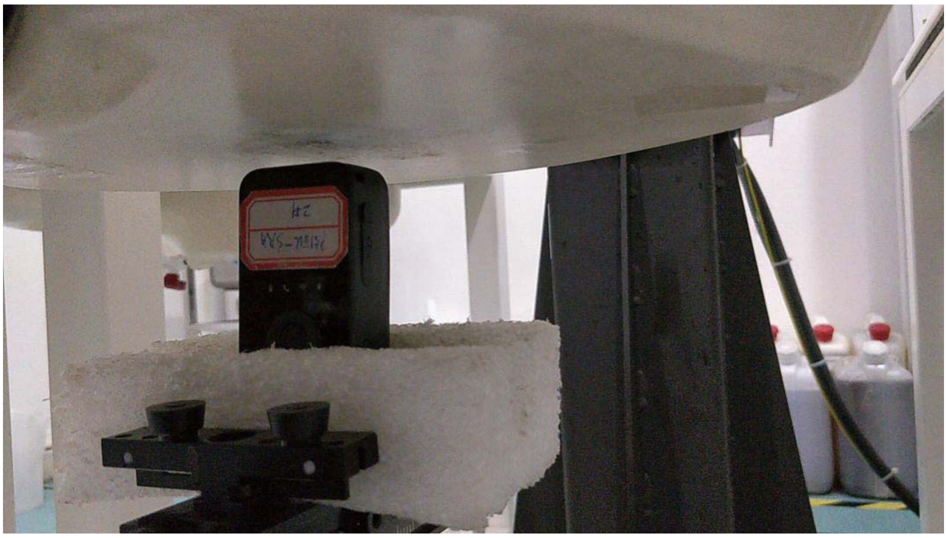
Picture 8-4: Toward Ground (5mm)



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)	835	1750	1900	2450
Ingredients (% by weight)				
Water	41.45	55.242	54.89	58.79
Sugar	56.0	/	/	/
Salt	1.45	0.306	0.18	0.06
Preventol	0.1	/	/	/
Cellulose	1.0	/	/	/
ClycolMonobutyl	/	44.452	44.93	41.15
Dielectric Parameters Target Value	f=850MHz ε=41.5 σ=0.90	f=1750MHz ε=40.8 σ=1.37	f=1950 MHz ε=40.0 σ=1.40	f=2450 MHz ε=39.2 σ=1.80

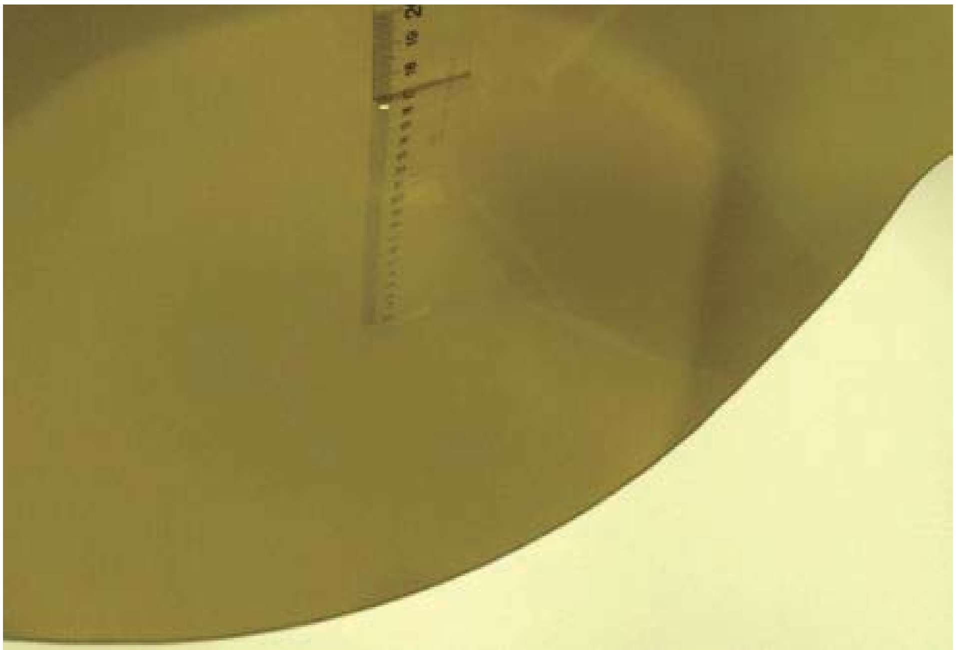
Table 9.2. Targets for tissue simulating liquid

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
835	Head	0.90	0.86～0.95	41.5	39.4～43.6
1750	Head	1.37	1.30～1.44	40.8	38.1～42.1
1900	Head	1.40	1.33～1.47	40.0	38.0～42.0
2450	Head	1.80	1.71～1.89	39.2	37.2～41.2

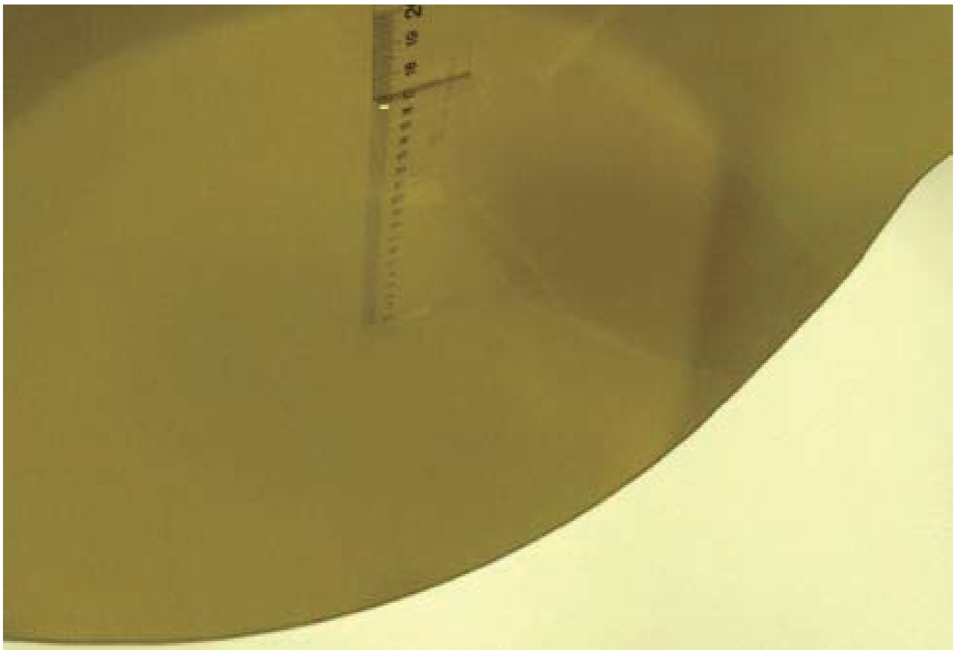
9.2. Dielectric Performance

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%	2019-07-31
Head	835	41.97	1.13%	0.915	1.67%	2019-07-30
Head	1750	39.33	-3.60%	1.384	1.02%	2019-07-18
Head	1900	38.98	-2.55%	1.44	2.86%	2019-07-30
Head	2450	38.26	-2.40%	1.83	1.67%	2019-08-01



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



Picture 9-2: Liquid depth in the Flat Phantom (850 MHz)

Picture9-3:Liquid depth in the Flat Phantom (1800/1900 MHz Head)

Picture 9-4: Liquid depth in the Flat Phantom (2450 MHz Head)

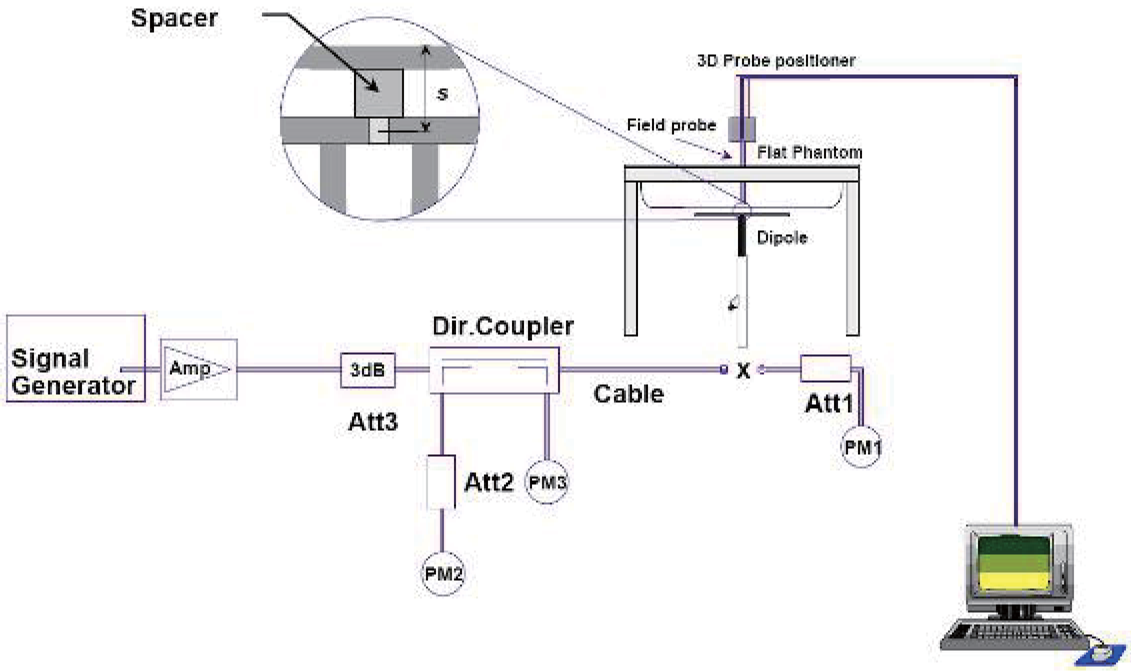
10. System Validation

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

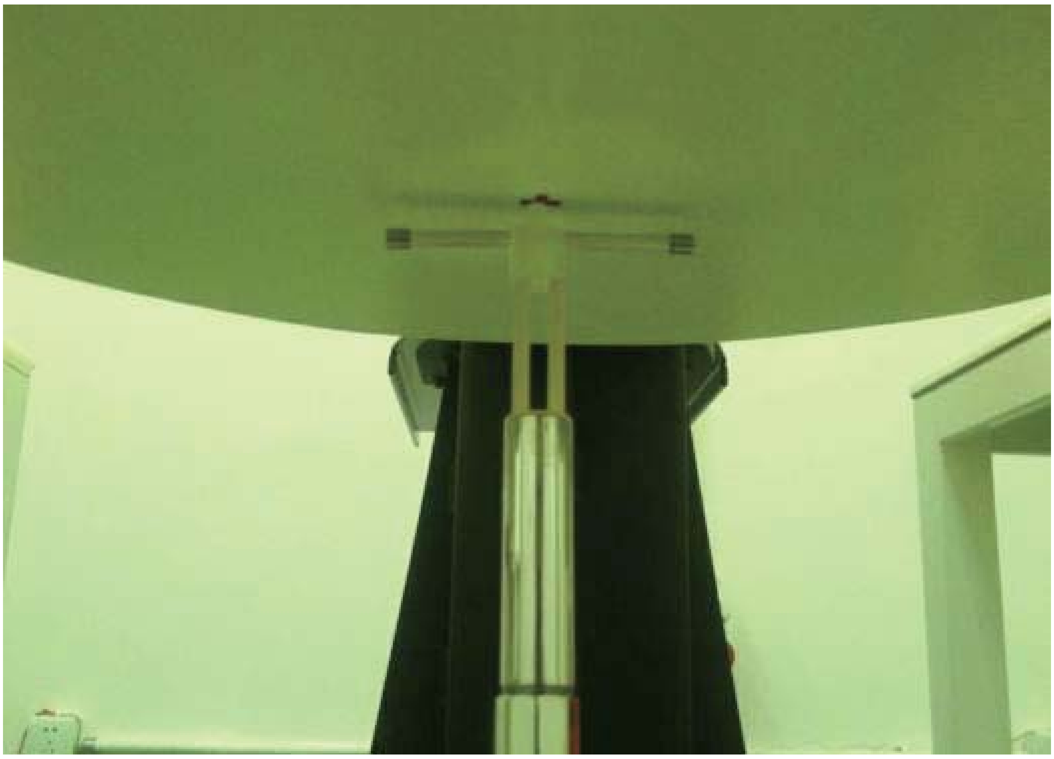
In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. 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	5.52	-0.95%	-1.08%	2019-07-31
835MHz	9.67	6.38	9.52	6.2	-1.55%	-2.82%	2019-07-30
1750MHz	37.6	20.1	36.88	19.8	-1.91%	-1.49%	2019-07-18
1900 MHz	39.8	20.7	39.0	20.28	-2.01%	-2.03%	2019-07-30
2450 MHz	52.5	24.8	55.2	25.52	5.14%	2.90%	2019-08-01

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),

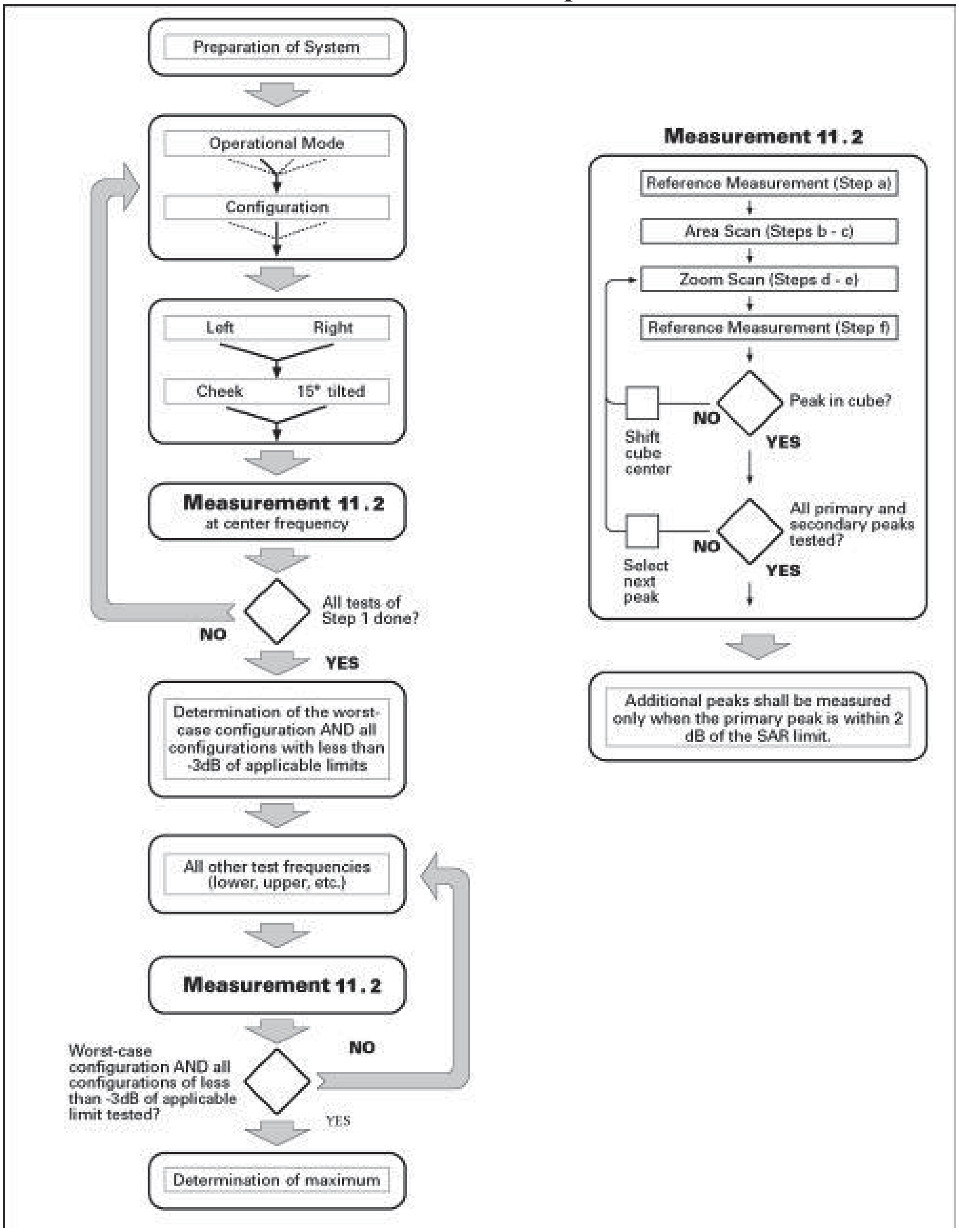
b) all configurations for each device position in a), e.g., antenna extended and retracted, and

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. SAR Measurement for NB-IOT

SAR tests for NB-IOT are performed with a base station simulator, SP 8315. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. All powers were measured with the SP 8315.

11.4. SAR Measurement for CAT-M1

SAR tests for CAT-M1 are performed with a base station simulator, SP 8315. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. All powers were measured with the SP 8315.

11.5. 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: GPRS/EGPRS (GMSK Modulation)

GSM 850				
Channel		128	190	251
1 Txslots	Maximum Target Value (dBm)	33.0±1	33.0±1	33.0±1
2 Txslots	Maximum Target Value (dBm)	33.0±1	33.0±1	33.0±1
3 Txslots	Maximum Target Value (dBm)	29.0±1	29.0±1	29.0±1
4 Txslots	Maximum Target Value (dBm)	27.0±1	27.0±1	27.0±1
GSM 1900				
Channel		512	661	810
1 Txslots	Maximum Target Value (dBm)	29.0±1	29.0±1	29.0±1
2 Txslots	Maximum Target Value (dBm)	29.0±1	29.0±1	29.0±1
3 Txslots	Maximum Target Value (dBm)	29.0±1	29.0±1	29.0±1
4 Txslots	Maximum Target Value (dBm)	28.0±1	28.0±1	28.0±1

Table 13.2: EGPRS (8PSK Modulation)

GSM 850				
Channel		128	190	251
1 Txslots	Maximum Target Value (dBm)	27.0±1	27.0±1	27.0±1
2 Txslots	Maximum Target Value (dBm)	27.0±1	27.0±1	27.0±1
3 Txslots	Maximum Target Value (dBm)	27.0±1	27.0±1	27.0±1
4 Txslots	Maximum Target Value (dBm)	27.0±1	27.0±1	27.0±1
GSM 1900				
Channel		512	661	810
1 Txslots	Maximum Target Value (dBm)	26.0±1	26.0±1	26.0±1
2 Txslots	Maximum Target Value (dBm)	26.0±1	26.0±1	26.0±1
3 Txslots	Maximum Target Value (dBm)	26.0±1	26.0±1	26.0±1
4 Txslots	Maximum Target Value (dBm)	25.5±1	25.5±1	25.5±1

Table 13.3: NB-IOT

Band	RB	Low	Middle	High
Band2	1	21.5±1	21.5±1	21.5±1
	12	21.0±1	21.0±1	21.0±1
Band4	1	21.0±1	21.0±1	21.0±1
	12	21.0±1	21.0±1	21.0±1
Band5	1	22.0±1	22.0±1	22.0±1
	12	22.0±1	22.0±1	22.0±1
Band	**Sub-carrier Spacing [kHz]**	**Low**	**Middle**	**High**
Band12	3.75	22.0±1	22.0±1	22.0±1
	15	21.0±1	21.0±1	21.0±1
Band13	3.75	22.0±1	22.0±1	22.0±1
	15	20.0±1	20.0±1	20.0±1
Band26	3.75	22.5±1	22.5±1	22.5±1
	15	22.0±1	22.0±1	22.0±1

Table 13.4: CAT-M1

Band	Bandwidth (MHz)	RB	Low	Middle	High
Band2	1.4\3\5\10\15\20	1#0	22.0±1	22.0±1	22.0±1
	1.4\3\5\10\20	6#0	21.0±1	21.0±1	21.0±1
	15	6#0	22.5±1	22.5±1	22.5±1
Band4	1.4\3\5\10\15\20	1#0	22.0±1	22.0±1	22.0±1
	1.4\3\5	6#0	21.0±1	21.0±1	21.0±1
	10\15\20	6#0	22.0±1	22.0±1	22.0±1
Band5	5\10	1#0	23.0±1	23.0±1	23.0±1
	5	6#0	22.0±1	22.0±1	22.0±1
	10	6#0	23.0±1	23.0±1	23.0±1
Band12	1.4\3\5\10	1#0	22.8±1	22.8±1	22.8±1
	1.4\3\5	6#0	21.0±1	21.0±1	21.0±1
	10	6#0	22.0±1	22.0±1	22.0±1
Band13	5\10	1#0	23.2±1	23.2±1	23.2±1
	5	6#0	21.0±1	21.0±1	21.0±1
	10	6#0	22.0±1	22.0±1	22.0±1
Band26	1.4\3\5\10\15	1#0	23.0±1	23.0±1	23.0±1
	1.4\3\5	6#0	22.0±1	22.0±1	22.0±1
	10\15	6#0	23.0±1	23.0±1	23.0±1

Table 13.5: WIFI

WiFi 802.11b			
Channel	Channel 1	Channel 6	Channel 11
Maximum Target Value (dBm)	16.5±1	16.5±1	16.5±1
WiFi 802.11g			
Channel	Channel 1	Channel 6	Channel 11
Maximum Target Value (dBm)	16.5±1	16.5±1	16.5±1
WiFi 802.11n 20M			
Channel	Channel 1	Channel 6	Channel 11
Maximum Target Value (dBm)	16.5±1	16.5±1	16.5±1
WiFi 802.11n 40M			
Channel	Channel 1	Channel 6	Channel 11
Maximum Target Value (dBm)	16.5±1	16.5±1	16.5±1

13.2. GSM Measurement result

During the process of testing, the EUT was controlled via R&S Digital Radio Communication tester (CMU200) to ensure the maximum power transmission and proper modulation. This result c ontains conducted output power for the EUT. In all cases, the measured Average output power sh ould be greater and within 5% than EMI measurement.

Table 13.1: The conducted power measurement results for GPRS/EGPRS（GMSK）

GSM 850	Measured Power (dBm)			calculation	Averaged Power (dBm)		
	128	**190**	**251**				
1 Txslot	33.1	33.2	32.8	-9.03dB	24.07	24.17	23.77
2 Txslots	33.0	33.1	33.4	-6.02dB	26.98	27.08	27.38
3 Txslots	29.6	29.7	29.6	-4.26dB	25.34	25.44	25.34
4 Txslots	27.5	27.5	27.4	-3.01dB	24.49	24.49	24.39
GSM 1900	Measured Power (dBm)			calculation	Averaged Power (dBm)		
	512	**661**	**810**				
1 Txslot	29.7	29.8	29.5	-9.03dB	20.67	20.77	20.47
2 Txslots	29.6	29.8	29.5	-6.02dB	23.58	23.78	23.48
3 Txslots	29.5	29.5	29.6	-4.26dB	25.24	25.24	25.34
4 Txslots	28.2	28.2	28.1	-3.01dB	25.19	25.19	25.09

NOTES:

1) Division Factors

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

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

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

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

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

According to the conducted power as above, the body measurements are performed with 2Txslots for 850MHz and 3Txslots for1900MHz.

Table 13.2: The conducted power measurement results for EGPRS（8PSK）

GSM 850	Measured Power (dBm)			calculation	Averaged Power (dBm)		
	128	**190**	**251**				
1 Txslot	27.6	27.6	27.5	-9.03dB	18.57	18.57	18.47
2 Txslots	27.7	27.6	27.5	-6.02dB	21.68	21.58	21.48
3 Txslots	27.7	27.7	27.4	-4.26dB	23.44	23.44	23.14
4 Txslots	27.4	27.4	27.2	-3.01dB	24.39	24.39	24.19
GSM 1900	Measured Power (dBm)			calculation	Averaged Power (dBm)		
	512	**661**	**810**				
1 Txslot	26.1	26.2	26.1	-9.03dB	17.07	17.17	17.07
2 Txslots	26.2	26.2	26.1	-6.02dB	20.18	20.18	20.08
3 Txslots	26.2	26.2	26.1	-4.26dB	21.94	21.94	21.84
4 Txslots	26.0	26.1	26.1	-3.01dB	22.99	23.09	23.09

13.3. NB-IOT Measurement result

Table 13.3: The conducted Power for NB

Maximum Average Conducted Power（dBm）						
Band2						
Sub-carrier Spacing [kHz]	**Modulation**	**N_{tones}**		**Channel**		
				Low	**Mid**	**High**
3.75	BPSK	1@0	Average	21.92	21.65	21.66
		1@47	Average	21.89	21.63	21.63
	QPSK	1@0	Average	21.87	21.60	21.66
		1@47	Average	21.87	21.59	21.58
15	BPSK	1@0	Average	22.11	21.94	21.81
		1@11	Average	22.04	21.88	21.76
	QPSK	1@0	Average	22.09	21.92	21.76
		1@11	Average	22.06	21.92	21.77
		12@0	Average	20.73	20.57	20.44
Band4						
Sub-carrier Spacing [kHz]	**Modulation**	**N_{tones}**		**Channel**		
				Low	**Mid**	**High**
3.75	BPSK	1@0	Average	21.41	21.34	21.40
		1@47	Average	21.43	21.33	21.41
	QPSK	1@0	Average	21.44	21.38	21.41
		1@47	Average	21.44	21.37	21.44
15	BPSK	1@0	Average	21.66	21.44	21.52
		1@11	Average	21.57	21.47	21.48
	QPSK	1@0	Average	21.64	21.55	21.54
		1@11	Average	21.61	21.49	21.46
		12@0	Average	20.82	20.77	20.53

Band5						
Sub-carrier Spacing [kHz]	Modulation	N_{tones}		Channel		
				Low	Mid	High
3.75	BPSK	1@0	Average	22.95	22.91	22.72
		1@47	Average	22.93	22.86	22.77
	QPSK	1@0	Average	22.96	22.85	22.74
		1@47	Average	22.96	22.88	22.74
15	BPSK	1@0	Average	22.16	22.97	21.94
		1@11	Average	22.18	22.95	21.94
	QPSK	1@0	Average	22.18	21.98	22.03
		1@11	Average	22.19	21.97	22.01
		12@0	Average	21.45	21.25	21.35
Band12						
Sub-carrier Spacing [kHz]	Modulation	N_{tones}		Channel		
				Low	Mid	High
3.75	BPSK	1@0	Average	22.44	22.36	22.26
		1@47	Average	22.47	22.34	22.25
	QPSK	1@0	Average	22.19	22.14	22.26
		1@47	Average	22.45	22.31	22.25
15	BPSK	1@0	Average	20.79	20.52	20.63
		1@11	Average	21.13	20.53	20.61
	QPSK	1@0	Average	20.67	20.70	20.69
		1@11	Average	21.19	20.60	20.67
		12@0	Average	21.09	21.12	21.19
Band13						
Sub-carrier Spacing [kHz]	Modulation	N_{tones}		Channel		
				Low	Mid	High
3.75	BPSK	1@0	Average	22.35	21.46	21.45

		1@47	Average	21.32	21.42	21.42
	QPSK	1@0	Average	21.30	21.36	21.33
		1@47	Average	21.30	21.42	21.46
15	BPSK	1@0	Average	20.50	20.61	20.53
		1@11	Average	20.41	20.43	20.35
	QPSK	1@0	Average	20.42	20.50	20.48
		1@11	Average	20.45	20.48	20.45
		12@0	Average	20.85	20.83	20.80
Band26						
Sub-carrier Spacing [kHz]	**Modulation**	**N_{tones}**		**Channel**		
				Low	**Mid**	**High**
3.75	BPSK	1@0	Average	23.08	22.93	22.92
		1@47	Average	23.09	22.89	22.88
	QPSK	1@0	Average	23.13	22.89	22.87
		1@47	Average	23.14	22.92	22.87
15	BPSK	1@0	Average	22.18	21.98	21.97
		1@11	Average	22.20	21.96	21.90
	QPSK	1@0	Average	22.26	22.03	22.01
		1@11	Average	22.23	22.01	21.97
		12@0	Average	21.58	21.43	21.38

13.4. CATM Measurement result

Table13.4: The output power of CATM Band 2

Mode	Bandwidth	Channel	RB	Index	Conducted Power	
					QPSK	16QAM
Band2	1.4MHz	18607	1#0	0	22.66	21.67
			6#0	0	20.83	20.89
		18900	1#0	0	22.61	21.63
			6#0	0	20.57	20.97
		19195	1#5	0	22.59	21.59
			6#0	0	20.72	20.64
	3MHz	18615	1#0	0	22.85	21.52
			6#0	0	20.69	20.91
		18900	1#0	0	22.73	21.66
			6#0	0	20.41	20.83
		19185	1#5	1	22.72	21.62
			6#0	1	20.55	20.94
	5MHz	18620	1#0	0	22.83	22.76
			6#0	0	21.58	21.11
		18900	1#0	0	22.66	22.45
			6#0	0	21.73	20.89
		19180	1#5	3	22.76	22.63
			6#0	3	21.62	21.05

	10MHz	18640	1#0	0	22.54	22.60
			4#0	0	21.63	21.11
		18900	1#0	0	22.79	22.59
			4#0	0	21.77	20.94
		19160	1#5	7	22.81	22.72
			4#2	7	21.60	20..87
	15MHz	18660	1#0	0	22.72	22.63
			6#0	0	22.61	23.10
		18900	1#0	0	22.72	22.63
			6#0	0	22.61	23.10
		19140	1#5	0	22.89	22.94
			6#0	0	22.77	22.89
	20MHz	18680	1#0	0	21.98	21.78
			6#0	0	21.12	20.94
		18900	1#0	0	22.26	22.16
			6#0	0	21.65	20.81
		19120	1#5	0	22.51	22.17
			6#0	0	21.12	20.89

Table13.5: The output power of CATM Band 4

Mode	Bandwidth	Channel	RB	Index	Conducted Power	
					QPSK	16QAM
Band4	1.4MHz	19957	1#0	0	22.52	21.61
			6#0	0	20.52	20.46
		20175	1#0	0	22.38	21.59
			6#0	0	20.48	20.54
		20393	1#5	0	22.38	21.60
			6#0	0	20.48	20.42
	3MHz	19965	1#0	0	22.42	21.65
			6#0	0	20.46	20.62
		20175	1#0	0	22.24	21.82
			6#0	0	20.40	20.56
		20385	1#5	1	22.13	21.81
			6#0	1	20.38	20.65
	5MHz	19975	1#0	0	21.95	21.58
			6#0	0	20.94	20.11
		20175	1#0	0	21.73	22.21
			6#0	0	20.96	20.03
		20375	1#5	3	21.93	21.89
			6#0	3	21.02	20.02

	10MHz	20000	1#0	0	22.27	22.39
			4#0	0	22.21	21.38
		20175	1#0	0	22.20	22.36
			4#0	0	22.17	22.32
		20350	1#5	7	21.63	21.62
			4#2	7	21.82	20.87
	15MHz	20025	1#0	0	21.91	21.79
			6#0	0	22.04	22.12
		20175	1#0	0	21.84	22.24
			6#0	0	22.13	22.49
		20325	1#5	0	21.76	21.48
			6#0	0	21.96	22.27
	20MHz	20050	1#0	0	22.15	22.05
			6#0	0	21.97	22.00
		20175	1#0	0	21.98	22.29
			6#0	0	21.90	21.86
		20300	1#5	0	21.59	21.57
			6#0	0	21.86	21.96

Table13.6: The output power of CATM Band 5

Mode	Bandwidth	Channel	RB	Index	Conducted Power	
					QPSK	16QAM
Band5	5MHz	20425	1#0	0	23.18	23.16
			5#0	0	22.44	21.34
		20525	1#0	0	23.60	23.55
			5#0	0	22.52	21.65
		20624	1#5	3	23.73	23.60
			5#0	3	22.51	21.88
	10MHz	20450	1#0	0	23.49	23.90
			4#0	0	23.58	22.68
		20525	1#0	0	23.33	23.88
			4#0	0	23.66	22.77
		20599	1#5	7	23.53	23.97
			4#2	7	23.60	22.87

Table13.7: The output power of CATM Band 12

Mode	Bandwidth	Channel	RB	Index	Conducted Power	
					QPSK	16QAM
Band12	1.4MHz	20315	1#0	0	22.67	22.11
			5#0	0	20.72	20.69
		23095	1#0	0	22.74	22.09
			5#0	0	20.96	20.81
		23175	1#5	0	22.83	21.92
			5#0	0	21.16	20.91
	3MHz	20320	1#0	0	22.93	22.08
			5#0	0	21.07	20.93
		23095	1#0	0	22.78	22.02
			6#0	0	20.99	20.85
		23170	1#5	1	22.79	22.03
			6#0	1	20.90	21.08
	5MHz	20330	1#0	0	22.74	22.56
			5#0	0	21.89	21.37
		23095	1#0	0	22.82	22.64
			5#0	0	21.83	21.16
		23160	1#5	3	22.70	23.40
			5#0	3	21.88	20.87
	10MHz	23045	1#0	0	22.80	23.22
			4#0	0	22.39	21.72
		23095	1#0	0	22.11	23.40
			4#0	0	22.68	21.59
		23145	1#5	7	22.73	23.62
			4#2	7	22.64	21.63

Table13.8: The output power of CATM Band 13

Mode	Bandwidth	Channel	RB	Index	Conducted Power	
					QPSK	16QAM
Band13	5MHz	23200	1#0	0	22.84	22.96
			5#0	0	21.97	20.85
		23230	1#0	0	22.87	22.91
			5#0	0	21.89	20.78
		23254	1#5	3	22.58	23.15
			5#0	3	21.93	21.03
	10MHz	23225	1#0	0	22.87	22.75
			4#0	0	22.72	21.98
		23230	1#0	0	22.65	23.18
			4#0	0	22.72	21.81
		23235	1#5	7	22.75	23.21
			4#2	7	22.80	21.68

Table13.9: The output power of CATM Band 26

Mode	Bandwidth	Channel	RB	Index	Conducted Power	
					QPSK	16QAM
Band26	1.4MHz	26697	1#0	0	23.11	23.06
			6#0	0	22.52	21.87
		26865	1#0	0	23.14	23.29
			6#0	0	22.71	21.72
		27033	1#5	0	22.98	23.02
			6#0	0	22.61	21.55
	3MHz	26705	1#0	0	23.19	23.02
			6#0	0	22.54	21.40
		26865	1#0	0	23.21	23.42
			6#0	0	22.75	21.66
		27025	1#5	1	23.09	23.41
			6#0	1	22.33	21.54
	5MHz	26715	1#0	0	23.21	23.13
			6#0	0	22.33	21.53
		26865	1#0	0	23.30	23.67
			6#0	0	22.61	21.45
		27015	1#5	3	23.69	23.79
			6#0	3	22.49	21.40

	10MHz	26740	1#0	0	23.26	23.21
			4#0	0	23.48	22.38
		26865	1#0	0	23.33	23.73
			4#0	0	23.58	22.67
		26990	1#5	7	23.42	23.75
			4#2	7	23.57	22.63
	15MHz	26765	1#0	0	23.04	23.10
			6#0	0	23.20	23.23
		26865	1#0	0	23.16	23.52
			6#0	0	23.26	23.46
		26965	1#5	0	23.21	23.70
			6#0	0	23.33	23.66

13.5. WIFI Measurement result

Table 13.10: 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	16.83	17.06	17.09
	2	17.02	16.97	17.32
	5.5	16.76	16.95	17.11
	11	16.76	16.96	17.09
802.11g	6	17.09	16.94	16.36
	9	16.25	17.01	16.91
	12	16.85	17.00	16.23
	18	16.19	16.83	15.84
	24	16.40	17.14	15.76
	36	16.07	17.00	15.72
	48	16.26	16.92	16.08
	54	16.26	17.08	15.70

Mode	Data Rate(Mbps)	Teat Result(dBm)		
		Ch1	Ch6	Ch11
802.11n (20MHz)	MCS0	15.56	17.04	17.04
	MCS1	15.87	16.86	16.72
	MCS2	16.65	17.27	16.96
	MCS3	16.84	17.04	16.93
	MCS4	17.48	17.13	16.95
	MCS5	17.22	17.19	16.84
	MCS6	17.37	17.18	16.79
	MCS7	17.15	16.96	17.04
802.11n (40MHz)	MCS0	16.71	16.32	17.14
	MCS1	16.41	15.97	16.91
	MCS2	16.04	15.97	16.79
	MCS3	16.07	15.81	17.16
	MCS4	16.27	16.36	16.94
	MCS5	16.50	16.08	16.91
	MCS6	16.46	16.09	16.80
	MCS7	16.40	16.02	16.97

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. Simultaneous transmission SAR

Transmission SAR(W/Kg)										
Test Position		GSM 850	GSM 1900	NB Band2	NB Band4	NB Band5	NB Band12	NB Band13	NB Band26	Max SAR
Body 5mm	Phantom Side	0.599	0.492	0.13	0.283	0.929	0.039	0.075	1.214	1.214
	Ground Side	0.311	1.178	0.179	0.158	0.334	0.021	0.035	0.429	1.178
	Left Side	0.223	0.554	0.057	0.172	0.279	0.012	0.025	0.344	0.554
	Right Side	0.223	0.2	0.012	0.071	0.232	0.014	0.025	0.327	0.327
	Bottom Side	0.355	0.238	0.025	0.059	0.18	0.065	0.062	0.229	0.355
	Top Side	0.056	0.067	0.006	0.008	0.035	0.004	0.006	0.047	0.067

Table14.1 Simultaneous transmission SAR

Transmission SAR(W/Kg)										
Test Position		CATM Band2	CATM Band4	CATM Band5	CATM Band12	CATM Band13	CATM Band26	2G and NB Max SAR	WIFI	SUM
Body 5mm	Phantom Side	0.025	0.327	0.689	0.029	0.0515	0.73	1.214	0.211	1.425
	Ground Side	0.033	0.243	0.393	0.010	0.0232	0.405	1.178	0.034	1.212
	Left Side	0.022	0.239	0.368	0.008	0.0162	0.37	0.554	0.04	0.594
	Right Side	0.013	0.138	0.263	0.009	0.0190	0.314	0.327	0.033	0.36
	Bottom Side	0.017	0.067	0.123	0.028	0.044	0.181	0.355	0.013	0.368
	Top Side	0.0004	0.010	0.036	0.002	0.0045	0.034	0.067	0.092	0.159

So the simultaneous transmission SAR is not required for WiFi transmitter.

15. SAR Test Result

15.1. SAR results

Table 15.1: SAR Values(GSM 850 MHz Band-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.										
848.6	251	GPRS 2TS	Class12	Toward Phantom	5	33.4	34.0	1.148	0.522	0.599	0.16
848.6	251	GPRS 2TS	Class12	Toward Ground	5	33.4	34.0	1.148	0.271	0.311	0.13
848.6	251	GPRS 2TS	Class12	Toward Left	5	33.4	34.0	1.148	0.194	0.223	-0.14
848.6	251	GPRS 2TS	Class12	Toward Right	5	33.4	34.0	1.148	0.194	0.223	-0.08
848.6	251	GPRS 2TS	Class12	Toward Bottom	5	33.4	34.0	1.148	0.309	0.355	-0.03
848.6	251	GPRS 2TS	Class12	Toward Top	5	33.4	34.0	1.148	0.0491	0.056	0.17
836.8	190	GPRS 2TS	Class12	Toward Phantom	5	33.1	34.0	1.230	0.434	0.534	-0.13
824.2	128	GPRS 2TS	Class12	Toward Phantom	5	33.0	34.0	1.259	0.328	0.413	0.11
848.6	251	EGPRS 4TS	Class12	Toward Phantom	5	27.2	28.0	1.202	0.484	0.582	0.14

Table 15.2: SAR Values (GPRS 1900 MHz Band-Body)

Frequency MHz	Frequency Ch.	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)
1909.80	810	GPRS 3TS	Class12	Toward Phantom	5	29.6	30.0	1.096	0.449	0.492	0.03
1909.80	810	GPRS 3TS	Class12	Toward Ground	5	29.6	30.0	1.096	0.625	0.685	0.07
1909.80	810	GPRS 3TS	Class12	Toward Left	5	29.6	30.0	1.096	0.505	0.554	0.10
1909.80	810	GPRS 3TS	Class12	Toward Right	5	29.6	30.0	1.096	0.182	0.200	0.01
1909.80	810	GPRS 3TS	Class12	Toward Bottom	5	29.6	30.0	1.096	0.217	0.238	0.01
1909.80	810	GPRS 3TS	Class12	Toward Top	5	29.6	30.0	1.096	0.0607	0.067	0.17
1850.2	512	GPRS 3TS	Class12	Toward Ground	5	29.5	30.0	1.122	1.050	1.178	0.08
1880	661	GPRS 3TS	Class12	Toward Ground	5	29.5	30.0	1.122	0.734	0.824	0.08
1850.2	512	EGPRS 4TS	Class12	Toward Ground	5	26.0	26.5	1.122	0.962	1.079	-0.01
Retest											
1850.2	512	GPRS 3TS	Class12	Toward Ground	5	29.5	30.0	1.122	1.01	1.133	-0.01
1850.2	512	EGPRS 4TS	Class12	Toward Ground	5	26.0	26.5	1.122	1.02	1.144	0.06

Table 15.3: SAR Values (NB-Band 2-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.										
1850	18600	Band 2	15kbps_BPSK_1@0	Toward Phantom	5	22.11	22.5	1.094	0.119	0.130	0.09
1850	18600	Band 2	15kbps_BPSK_1@0	Toward Ground	5	22.11	22.5	1.094	0.164	0.179	0.16
1850	18600	Band 2	15kbps_BPSK_1@0	Toward Left	5	22.11	22.5	1.094	0.0524	0.057	0.04
1850	18600	Band 2	15kbps_BPSK_1@0	Toward Right	5	22.11	22.5	1.094	0.0111	0.012	0.05
1850	18600	Band 2	15kbps_BPSK_1@0	Toward Bottom	5	22.11	22.5	1.094	0.0231	0.025	0.01
1850	18600	Band 2	15kbps_BPSK_1@0	Toward Top	5	22.11	22.5	1.094	0.00524	0.006	0.06
1880	18900	Band 2	15kbps_BPSK_1@0	Toward Phantom	5	21.94	22.5	1.138	0.116	0.132	0.01
1909.9	19199	Band 2	15kbps_BPSK_1@0	Toward Phantom	5	21.81	22.5	1.172	0.112	0.131	-0.07

Table 15.4: SAR Values (NB-Band 4-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.										
1710	19950	Band 2	15kbps_BPSK_1@0	Toward Phantom	5	21.66	22.0	1.081	0.200	0.216	0.07
1710	19950	Band 2	15kbps_BPSK_1@0	Toward Ground	5	21.66	22.0	1.081	0.146	0.158	0.08
1710	19950	Band 2	15kbps_BPSK_1@0	Toward Left	5	21.66	22.0	1.081	0.159	0.172	0.07
1710	19950	Band 2	15kbps_BPSK_1@0	Toward Right	5	21.66	22.0	1.081	0.0656	0.071	0.01
1710	19950	Band 2	15kbps_BPSK_1@0	Toward Bottom	5	21.66	22.0	1.081	0.0546	0.059	0.08
1710	19950	Band 2	15kbps_BPSK_1@0	Toward Top	5	21.66	22.0	1.081	0.00694	0.008	0.08
1732.4	20174	Band 2	15kbps_BPSK_1@0	Toward Phantom	5	21.44	22.0	1.138	0.249	0.283	0.05
1754.9	20399	Band 2	15kbps_BPSK_1@0	Toward Phantom	5	21.52	22.0	1.117	0.175	0.195	0.04

Table 15.5: SAR Values (NB-Band 5-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.										
836.4	20524	Band 5	15kbps_BPSK_1@0	Toward Phantom	5	22.97	23.0	1.007	0.649	0.653	-0.02
836.4	20524	Band 5	15kbps_BPSK_1@0	Toward Ground	5	22.97	23.0	1.007	0.332	0.334	0.08
836.4	20524	Band 5	15kbps_BPSK_1@0	Toward Left	5	22.97	23.0	1.007	0.277	0.279	-0.04
836.4	20524	Band 5	15kbps_BPSK_1@0	Toward Right	5	22.97	23.0	1.007	0.230	0.232	0.17
836.4	20524	Band 5	15kbps_BPSK_1@0	Toward Bottom	5	22.97	23.0	1.007	0.179	0.180	0.14
836.4	20524	Band 5	15kbps_BPSK_1@0	Toward Top	5	22.97	23.0	1.007	0.0350	0.035	0.14
824	20400	Band 5	15kbps_BPSK_1@0	Toward Phantom	5	22.16	23.0	1.213	0.651	0.790	0.01
848.9	20649	Band 5	15kbps_BPSK_1@0	Toward Phantom	5	21.94	23.0	1.276	0.728	0.929	-0.08

Table 15.6: SAR Values (NB-Band 12-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.										
699	23010	Band 12	3.75kbpsBPSK 1@47	Toward Phantom	5	22.47	23.0	1.130	0.0346	0.039	-0.07
699	23010	Band 12	3.75kbpsBPSK 1@47	Toward Ground	5	22.47	23.0	1.130	0.0183	0.021	0.09
699	23010	Band 12	3.75kbpsBPSK 1@47	Toward Left	5	22.47	23.0	1.130	0.0110	0.012	0.09
699	23010	Band 12	3.75kbpsBPSK 1@47	Toward Right	5	22.47	23.0	1.130	0.0128	0.014	0.05
699	23010	Band 12	3.75kbpsBPSK 1@47	Toward Bottom	5	22.47	23.0	1.130	0.0483	0.055	0.11
699	23010	Band 12	3.75kbpsBPSK 1@47	Toward Top	5	22.47	23.0	1.130	0.00362	0.004	0.03
707.5	23095	Band 12	3.75kbpsBPSK 1@47	Toward Bottom	5	22.34	23.0	1.130	0.0489	0.057	0.19
715.9	23179	Band 12	3.75kbpsBPSK 1@47	Toward Bottom	5	22.25	23.0	1.130	0.0546	0.065	0.07

Table 15.7: SAR Values (NB-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.										
777	23180	Band 13	3.75kbpsBPSK 1@0	Toward Phantom	5	22.35	23.0	1.161	0.0572	0.066	-0.08
777	23180	Band 13	3.75kbpsBPSK 1@0	Toward Ground	5	22.35	23.0	1.161	0.0301	0.035	0.06
777	23180	Band 13	3.75kbpsBPSK 1@0	Toward Left	5	22.35	23.0	1.161	0.0211	0.025	0.17
777	23180	Band 13	3.75kbpsBPSK 1@0	Toward Right	5	22.35	23.0	1.161	0.0219	0.025	0.02
777	23180	Band 13	3.75kbpsBPSK 1@0	Toward Bottom	5	22.35	23.0	1.161	0.0537	0.062	0.08
777	23180	Band 13	3.75kbpsBPSK 1@0	Toward Top	5	22.35	23.0	1.161	0.0052	0.006	0.04
786.9	23279	Band 13	3.75kbpsBPSK 1@0	Toward Phantom	5	21.45	23.0	1.429	0.0528	0.075	-0.04
782	23230	Band 13	3.75kbpsBPSK 1@0	Toward Phantom	5	21.46	23.0	1.426	0.0425	0.061	-0.02

Table 15.8: SAR Values (NB-Band 26-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(10g) (W/kg)	Power Drift (dB)
MHz	Ch.										
814	26690	Band 26	3.75kbps_QPSK_1@47	Toward Phantom	5	23.14	23.5	1.086	0.759	0.824	-0.05
814	26690	Band 26	3.75kbps_QPSK_1@47	Toward Ground	5	23.14	23.5	1.086	0.395	0.429	0.18
814	26690	Band 26	3.75kbps_QPSK_1@47	Toward Left	5	23.14	23.5	1.086	0.317	0.344	-0.02
814	26690	Band 26	3.75kbps_QPSK_1@47	Toward Right	5	23.14	23.5	1.086	0.301	0.327	-0.01
814	26690	Band 26	3.75kbps_QPSK_1@47	Toward Bottom	5	23.14	23.5	1.086	0.211	0.229	0.18
814	26690	Band 26	3.75kbps_QPSK_1@47	Toward Top	5	23.14	23.5	1.086	0.0431	0.047	-0.03
831.4	26864	Band 26	3.75kbps_QPSK_1@47	Toward Phantom	5	22.92	23.5	1.143	0.833	0.952	-0.03
848.9	27039	Band 26	3.75kbps_QPSK_1@47	Toward Phantom	5	22.87	23.5	1.156	1.050	1.214	0.01
Retest											
831.4	26864	Band 26	3.75kbps_QPSK_1@47	Toward Phantom	5	22.92	23.5	1.143	0.948	1.083	-0.04
848.9	27039	Band 26	3.75kbps_QPSK_1@47	Toward Phantom	5	22.87	23.5	1.156	1.030	1.191	0.14

Table 15.9: SAR Values (CATM-Band 2-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.										
1880	18900	Band 2	15M_16QAM_6@0	Toward Phantom	5	23.10	23.5	1.096	0.0224	0.025	0.05
1880	18900	Band 2	15M_16QAM_6@0	Toward Ground	5	23.10	23.5	1.096	0.0305	0.033	0.12
1880	18900	Band 2	15M_16QAM_6@0	Toward Left	5	23.10	23.5	1.096	0.020	0.022	0.07
1880	18900	Band 2	15M_16QAM_6@0	Toward Right	5	23.10	23.5	1.096	0.0117	0.013	0.01
1880	18900	Band 2	15M_16QAM_6@0	Toward Bottom	5	23.10	23.5	1.096	0.0158	0.017	0.04
1880	18900	Band 2	15M_16QAM_6@0	Toward Top	5	23.10	23.5	1.096	0.000389	0.0004	-0.20
1857.5	18675	Band 2	15M_16QAM_6@0	Toward Phantom	5	23.10	23.5	1.096	0.0285	0.031	0.14
1902.5	19125	Band 2	15M_16QAM_6@0	Toward Phantom	5	22.89	23.5	1.151	0.0224	0.026	0.06

Table 15.10: SAR Values (CATM-Band 4-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.										
1732.5	20175	Band 4	20M_16QAM_1@0	Toward Phantom	5	22.29	23.0	1.178	0.262	0.309	0.01
1732.5	20175	Band 4	20M_16QAM_1@0	Toward Ground	5	22.29	23.0	1.178	0.206	0.243	0.01
1732.5	20175	Band 4	20M_16QAM_1@0	Toward Left	5	22.29	23.0	1.178	0.203	0.239	0.01
1732.5	20175	Band 4	20M_16QAM_1@0	Toward Right	5	22.29	23.0	1.178	0.117	0.138	0.02
1732.5	20175	Band 4	20M_16QAM_1@0	Toward Bottom	5	22.29	23.0	1.178	0.0569	0.067	0.19
1732.5	20175	Band 4	20M_16QAM_1@0	Toward Top	5	22.29	23.0	1.178	0.00835	0.010	0.01
1720	20050	Band 4	20M_16QAM_1@0	Toward Phantom	5	22.05	23.0	1.178	0.188	0.234	0.09
1745	20300	Band 4	20M_16QAM_1@0	Toward Phantom	5	21.57	23.0	1.399	0.235	0.327	0.04
1710.7	19957	Band 4	1.4M_QPSK_1@0	Toward Phantom	5	22.52	23.0	1.117	0.170	0.190	0.09

Table 15.11: SAR Values (CATM-Band 5-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.										
843.9	20599	Band 5	10M_16QAM_1@5	Toward Phantom	5	23.97	24.0	1.007	0.629	0.633	0.11
843.9	20599	Band 5	10M_16QAM_1@5	Toward Ground	5	23.97	24.0	1.007	0.390	0.393	0.18
843.9	20599	Band 5	10M_16QAM_1@5	Toward Left	5	23.97	24.0	1.007	0.365	0.368	0.08
843.9	20599	Band 5	10M_16QAM_1@5	Toward Right	5	23.97	24.0	1.007	0.261	0.263	0.06
843.9	20599	Band 5	10M_16QAM_1@5	Toward Bottom	5	23.97	24.0	1.007	0.122	0.123	0.05
843.9	20599	Band 5	10M_16QAM_1@5	Toward Top	5	23.97	24.0	1.007	0.0356	0.036	0.17
836.5	20525	Band 5	10M_16QAM_1@0	Toward Phantom	5	23.88	24.0	1.028	0.616	0.633	0.01
829	20450	Band 5	10M_16QAM_1@0	Toward Phantom	5	23.90	24.0	1.023	0.673	0.689	-0.09

Table 15.12: SAR Values (CATM-Band 12-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.										
712.5	23145	Band 12	10M 16QAM 1@5	Toward Phantom	5	23.62	23.8	1.042	0.0191	0.020	-0.01
712.5	23145	Band 12	10M 16QAM 1@5	Toward Ground	5	23.62	23.8	1.042	0.00941	0.010	-0.17
712.5	23145	Band 12	10M 16QAM 1@5	Toward Left	5	23.62	23.8	1.042	0.0074	0.008	0.04
712.5	23145	Band 12	10M 16QAM 1@5	Toward Right	5	23.62	23.8	1.042	0.00871	0.009	0.01
712.5	23145	Band 12	10M 16QAM 1@5	Toward Bottom	5	23.62	23.8	1.042	0.027	0.028	0.11
712.5	23145	Band 12	10M 16QAM 1@5	Toward Top	5	23.62	23.8	1.042	0.00194	0.002	0.01
702.5	23045	Band 12	10M 16QAM 1@5	Toward Phantom	5	23.22	23.8	1.143	0.025	0.029	0.02
707.5	23095	Band 12	10M 16QAM 1@5	Toward Phantom	5	23.40	23.8	1.096	0.0251	0.028	0.04

Table 15.13: SAR Values (CATM-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.										
782.5	23235	Band 13	10M 16QAM 1@5	Toward Phantom	5	23.21	24.2	1.256	0.0398	0.0499	0.06
782.5	23235	Band 13	10M 16QAM 1@5	Toward Ground	5	23.21	24.2	1.256	0.0185	0.0232	0.07
782.5	23235	Band 13	10M 16QAM 1@5	Toward Left	5	23.21	24.2	1.256	0.0129	0.0162	0.06
782.5	23235	Band 13	10M 16QAM 1@5	Toward Right	5	23.21	24.2	1.256	0.0151	0.0190	0.04
782.5	23235	Band 13	10M 16QAM 1@5	Toward Bottom	5	23.21	24.2	1.256	0.0354	0.044	0.02
782.5	23235	Band 13	10M 16QAM 1@5	Toward Top	5	23.21	24.2	1.256	0.00361	0.0045	0.09
782	23230	Band 13	10M 16QAM 1@5	Toward Phantom	5	23.18	24.2	1.264	0.0376	0.0475	-0.08
781.5	23225	Band 13	10M 16QAM 1@5	Toward Phantom	5	22.75	24.2	1.396	0.0369	0.0515	0.01

Table15.14 SAR Values (CATM-Band 26-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.										
841.5	26965	Band 26	15M_16QAM_1@5	Toward Phantom	5	23.70	24.0	1.072	0.591	0.633	-0.04
841.5	26965	Band 26	15M_16QAM_1@5	Toward Ground	5	23.70	24.0	1.072	0.378	0.405	0.10
841.5	26965	Band 26	15M_16QAM_1@5	Toward Left	5	23.70	24.0	1.072	0.345	0.370	0.03
841.5	26965	Band 26	15M_16QAM_1@5	Toward Right	5	23.70	24.0	1.072	0.293	0.314	0.16
841.5	26965	Band 26	15M_16QAM_1@5	Toward Bottom	5	23.70	24.0	1.072	0.169	0.181	0.08
841.5	26965	Band 26	15M_16QAM_1@5	Toward Top	5	23.70	24.0	1.072	0.0319	0.034	0.16
831.5	26865	Band 26	15M_16QAM_1@0	Toward Phantom	5	23.52	24.0	1.117	0.654	0.730	0.04
821.5	26765	Band 26	15M_16QAM_1@0	Toward Phantom	5	23.10	24.0	1.230	0.589	0.725	0.15
846.5	27015	Band 26	5M_16QAM_1@5	Toward Phantom	5	23.79	24.0	1.050	0.635	0.666	-0.08

Table 15.15: SAR Values (WIFI)

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	2Mpsk	Toward Phantom	5	17.32	17.5	1.042	0.149	0.155	0.04
2462	11	802.11b	2Mpsk	Toward Ground	5	17.32	17.5	1.042	0.033	0.034	0.01
2462	11	802.11b	2Mpsk	Toward Left	5	17.32	17.5	1.042	0.0383	0.040	-0.02
2462	11	802.11b	2Mpsk	Toward Right	5	17.32	17.5	1.042	0.0313	0.033	-0.05
2462	11	802.11b	2Mpsk	Toward Bottom	5	17.32	17.5	1.042	0.0121	0.013	0.07
2462	11	802.11b	2Mpsk	Toward Top	5	17.32	17.5	1.042	0.0887	0.092	0.13
2437	6	802.11b	2Mpsk	Toward Phantom	5	16.97	17.5	1.130	0.187	0.211	-0.08
2412	1	802.11b	2Mpsk	Toward Phantom	5	17.02	17.5	1.117	0.160	0.179	0.04

15.2. 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 15.14 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.						
1850.2	512	GPRS 3TS	Ground	5	1.05	1.01	1.04
1850.2	512	EGPRS 4TS	Ground	5	0.962	1.02	1.06
831.4	26864	Band 26	Ground	5	0.833	0.948	1.14
848.9	27039	Band 26	Ground	5	1.05	1.03	1.02

16.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%**	

17. 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	1329	2018-08-03	2019-08-02
03	Power Meter	N1914A	MY50001660	2019-03-02	2020-03-01
04	Radio Communication Analyzer	CMW500	164483	2019-03-02	2020-03-01
05	Radio Communication Analyzer	CMU200	122816	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
13	D835V2	dipole	4d135	2019-01-18	2020-01-17
14	D1750V2	dipole	1063	2019-01-18	2020-01-17
15	D1900V2	dipole	5d153	2019-01-18	2020-01-17
16	D2450V2	dipole	886	2019-01-17	2020-01-16

END OF REPORT BODY

ANNEX A. GRAPH RESULTS

GPRS 850MHz 2TS Body Toward Ground High

Date/Time: 2019/8/1
Electronics: DAE4 Sn1329
Medium: Head 850MHz
Medium parameters used: f = 849 MHz; σ = 0.928 S/m; εr = 41.81; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System:GPRS 2TS; Frequency: 848.6 MHz; Duty Cycle: 1:4.15
Probe: EX3DV4 - SN3844ConvF(9.35, 9.35, 9.35);
High Toward Phantom GPRS 850 2TS/Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.450 W/kg
High Toward Phantom GPRS 850 2TS/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.33 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 0.821 W/kg
SAR(1 g) = 0.522 W/kg; SAR(10 g) = 0.331 W/kg
Maximum value of SAR (measured) = 0.557 W/kg

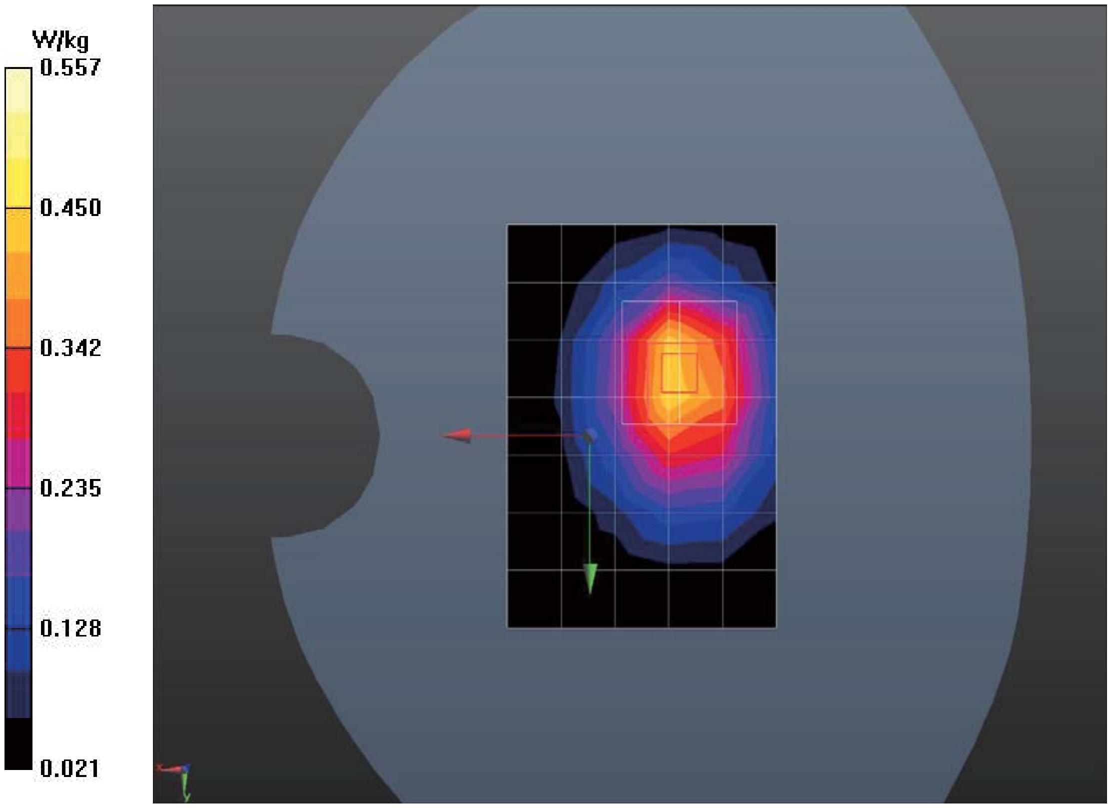


Fig.1 GPRS 850MHz Ground Mode High

GPRS 1900MHz 3TS Body Toward Ground Low

Date/Time: 2019/7/30
Electronics: DAE4 Sn1329
Medium: Head 1900MHz
Medium parameters used: f = 1850.2 MHz; σ = 1.377 S/m; εr = 39.154; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: GPRS 1900MHz 3TS; Frequency: 1850.2 MHz; Duty Cycle: 1:2.7
Probe: EX3DV4 - SN3844ConvF(8.07, 8.07, 8.07);
Low Toward Ground GPRS 1900MHz 3TS/Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.919 W/kg
Low Toward Ground GPRS 1900MHz 3TS/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.80 V/m; Power Drift = 0.08 dB
Peak SAR (extrapolated) = 2.14 W/kg
SAR(1 g) = 1.05 W/kg; SAR(10 g) = 0.557 W/kg
Maximum value of SAR (measured) = 0.938 W/kg

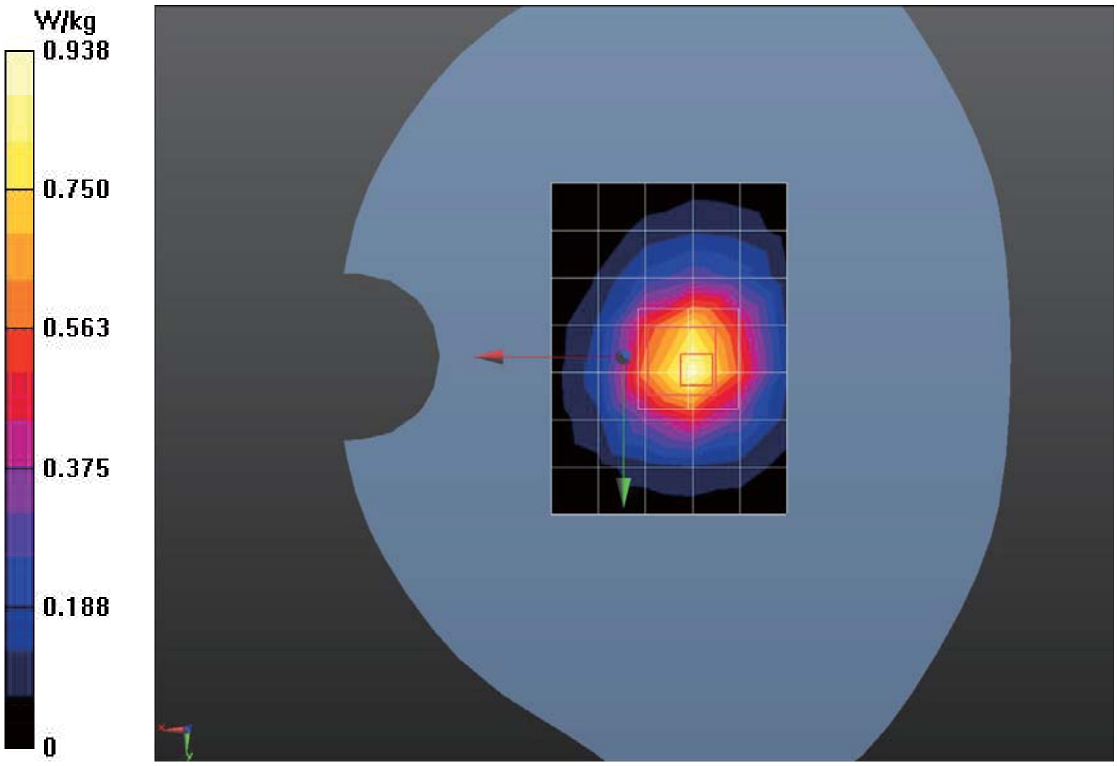


Fig.2 GPRS 1900MHz Ground Mode Low

NB-Band 2 BPSK 1RB Body Toward Ground Low

Date/Time: 2019/7/30
Electronics: DAE4 Sn1329
Medium: Head 1900MHz
Medium parameters used: f = 1850 MHz; σ = 1.377 S/m; εr = 39.156; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: NB-IOT Band 2; Frequency: 1850 MHz; Duty Cycle: 1:2.0
Probe: EX3DV4 - SN3844ConvF(8.07, 8.07, 8.07);
Low Toward Ground NB-IOT Band 2 15kbps BPSK 1RB/Area Scan (6x8x1):
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.167 W/kg
Low Toward Ground NB-IOT Band2 15kbps BPSK 1RB/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 10.39 V/m; Power Drift = 0.16 dB
Peak SAR (extrapolated) = 0.249 W/kg
SAR(1 g) = 0.164 W/kg; SAR(10 g) = 0.097 W/kg
Maximum value of SAR (measured) = 0.184 W/kg

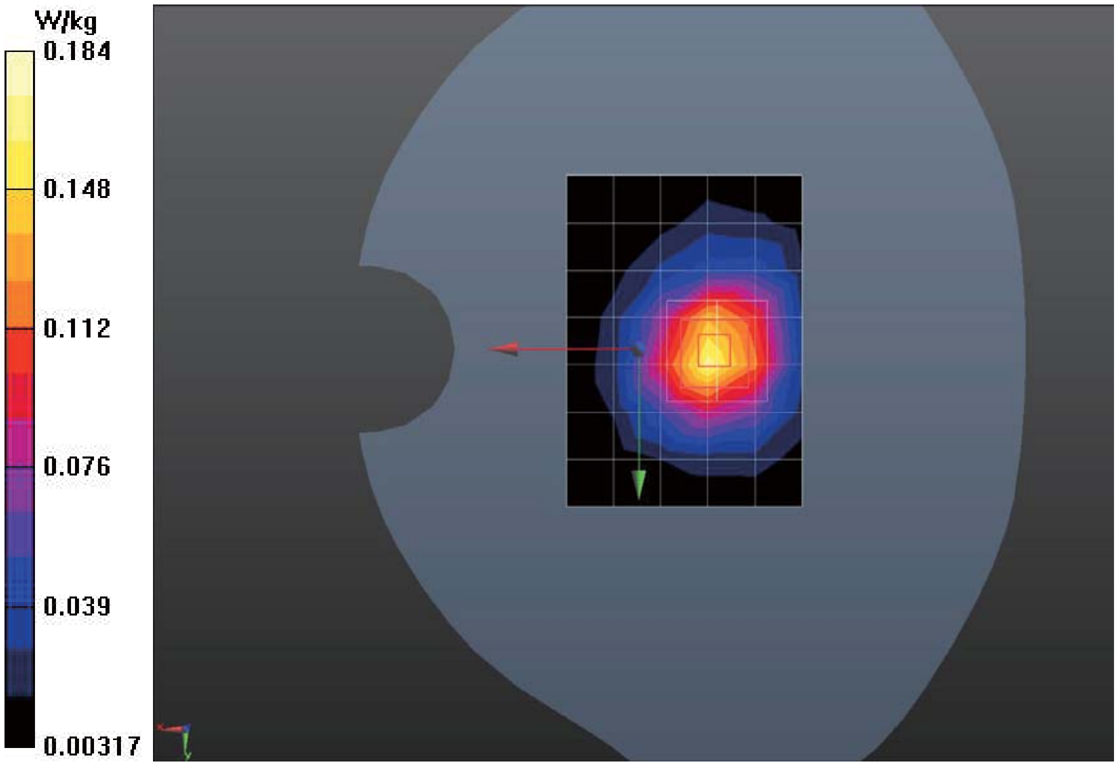


Fig.3 NB-IOT Band 2 Ground Mode Low

NB-Band 4 BPSK 1RB Body Toward Phantom Middle

Date/Time: 2019/7/18
Electronics: DAE4 Sn1329
Medium: Head 1750MHz
Medium parameters used: 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: NB-IOT Band 4; Frequency: 1732.5 MHz; Duty Cycle: 1:2.0
Probe: EX3DV4 - SN3844ConvF(8.5, 8.5, 8.5);
Middle Toward Phantom NB-IOT Band 4 15kbps BPSK 1RB/Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.265 W/kg
Middle Toward Phantom NB-IOT Band 4 15kbps BPSK 1RB/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.36 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 0.371 W/kg
SAR(1 g) = 0.249 W/kg; SAR(10 g) = 0.150 W/kg
Maximum value of SAR (measured) = 0.279 W/kg

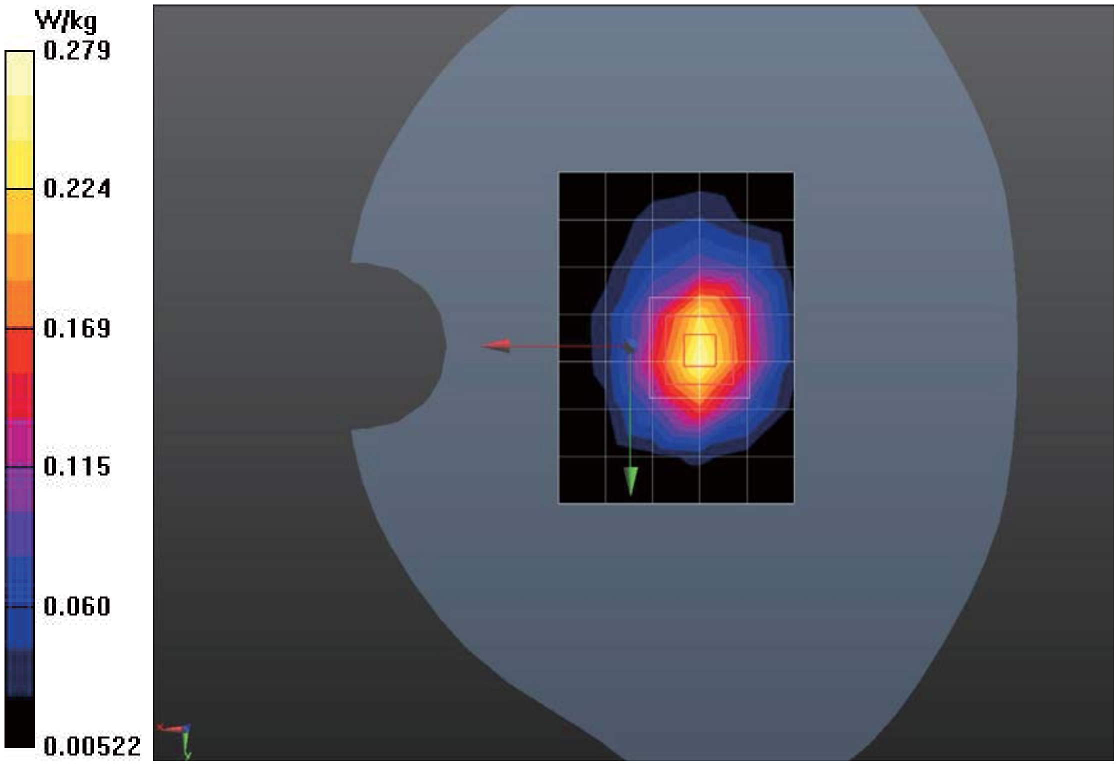


Fig.4NB-IOT Band 4 Phantom Mode Low

NB-Band 5 BPSK 1RB Body Toward Phantom High

Date/Time: 2019/7/30
Electronics: DAE4 Sn1329
Medium: Head 850MHz
Medium parameters used: f = 849 MHz; σ = 0.928 S/m; εr = 41.81; ρ = 1000 kg/m3
Ambient Temperature:22.5°C   Liquid Temperature:22.5°C
Communication System: NB-IOT Band 5; Frequency: 848.9 MHz; Duty Cycle: 1:2.0
Probe: EX3DV4 - SN3844ConvF(9.35, 9.35, 9.35);
High Toward Phantom NB-IOT Band 5 15kbps BPSK 1RB/Area Scan (6x8x1):
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.857 W/kg
High Toward Phantom NB-IOT Band 5 15kbps BPSK 1RB/Zoom Scan (5x5x7)/Cube 0:
Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.60 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 1.10 W/kg
SAR(1 g) = 0.728 W/kg; SAR(10 g) = 0.474 W/kg
Maximum value of SAR (measured) = 0.772 W/kg

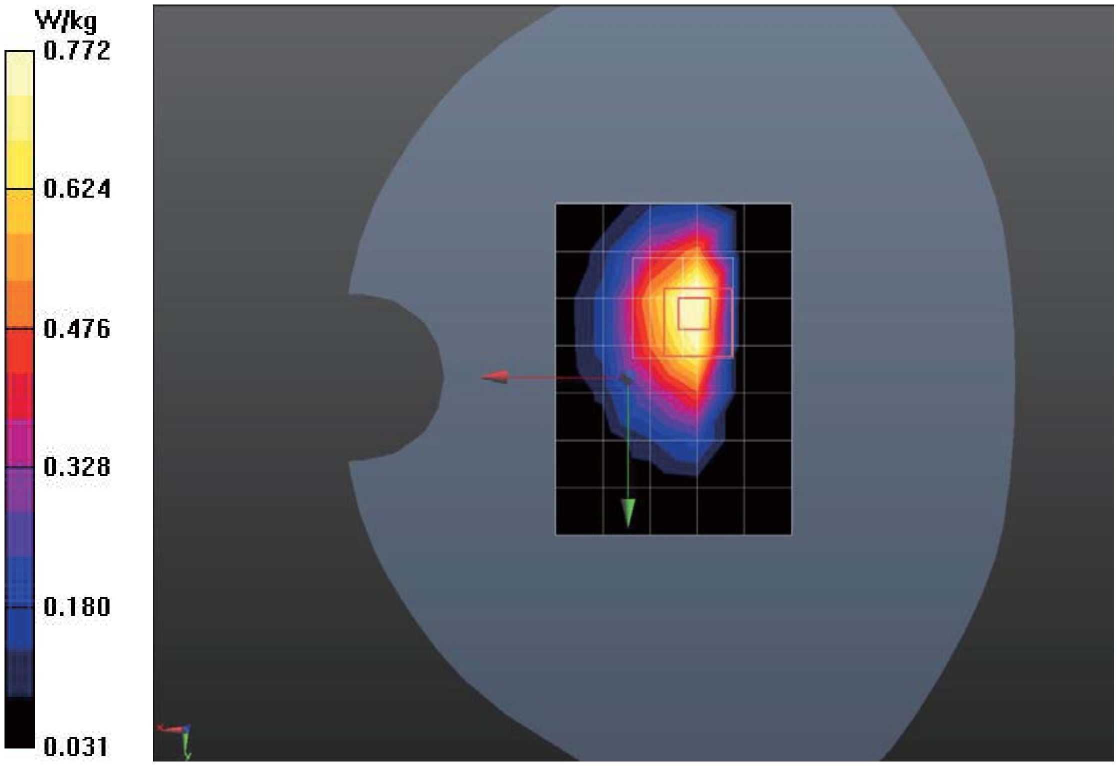


Fig.5 NB-IOT Band 5 Phantom Mode High

NB-Band 12 BPSK 1RB Body Bottom High

Date/Time: 2019/7/31
Electronics: DAE4 Sn1329
Medium: Head 750MHz
Medium parameters used: f = 716 MHz; σ = 0.877 S/m; εr = 40.243; ρ = 1000 kg/m3
Ambient Temperature:22.5°C   Liquid Temperature:22.5°C
Communication System: NB-IOT Band 12; Frequency: 715.9 MHz; Duty Cycle: 1:2.0
Probe: EX3DV4 - SN3844ConvF(9.75, 9.75, 9.75);
High Bottom NB-Band 12 3.75k BPSK 1@47 With 5mm/Area Scan (5x7x1):
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.0526 W/kg
High Bottom NB-Band 12 3.75k BPSK 1@47 With 5mm/Zoom Scan (7x7x7)/Cube 0:
Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 7.579 V/m; Power Drift = 0.07 dB
Peak SAR (extrapolated) = 0.119 W/kg
SAR(1 g) = 0.055 W/kg; SAR(10 g) = 0.030 W/kg
Maximum value of SAR (measured) = 0.0587 W/kg

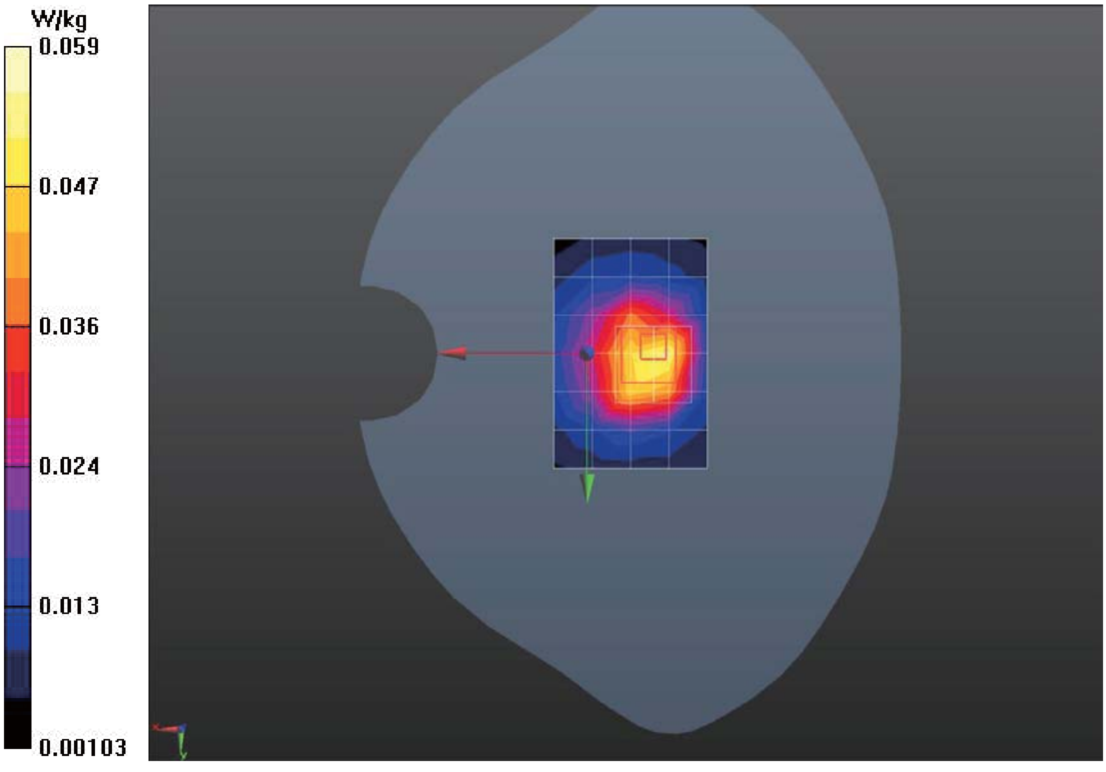


Fig.6 NB-IOT Band 12 Bottom Mode High

NB-Band 13 BPSK 1RB Body Toward Phantom High

Date/Time: 2019/7/31
Electronics: DAE4 Sn1329
Medium: Head 750MHz
Medium parameters used: f = 787 MHz; σ = 0.910 S/m; εr = 41.157; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: NB-IOT Band 13; Frequency: 786.9 MHz; Duty Cycle: 1:2.0
Probe: EX3DV4 - SN3844ConvF(9.75, 9.75, 9.75);
High Toward Phantom NB-Band 13 3.75k BPSK 1@0 With 5mm/Area Scan (6x8x1):
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.0585 W/kg
High Toward Phantom NB-Band 13 3.75k BPSK 1@0 With 5mm/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 7.265 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.0870 W/kg
SAR(1 g) = 0.053 W/kg; SAR(10 g) = 0.034 W/kg
Maximum value of SAR (measured) = 0.0561 W/kg

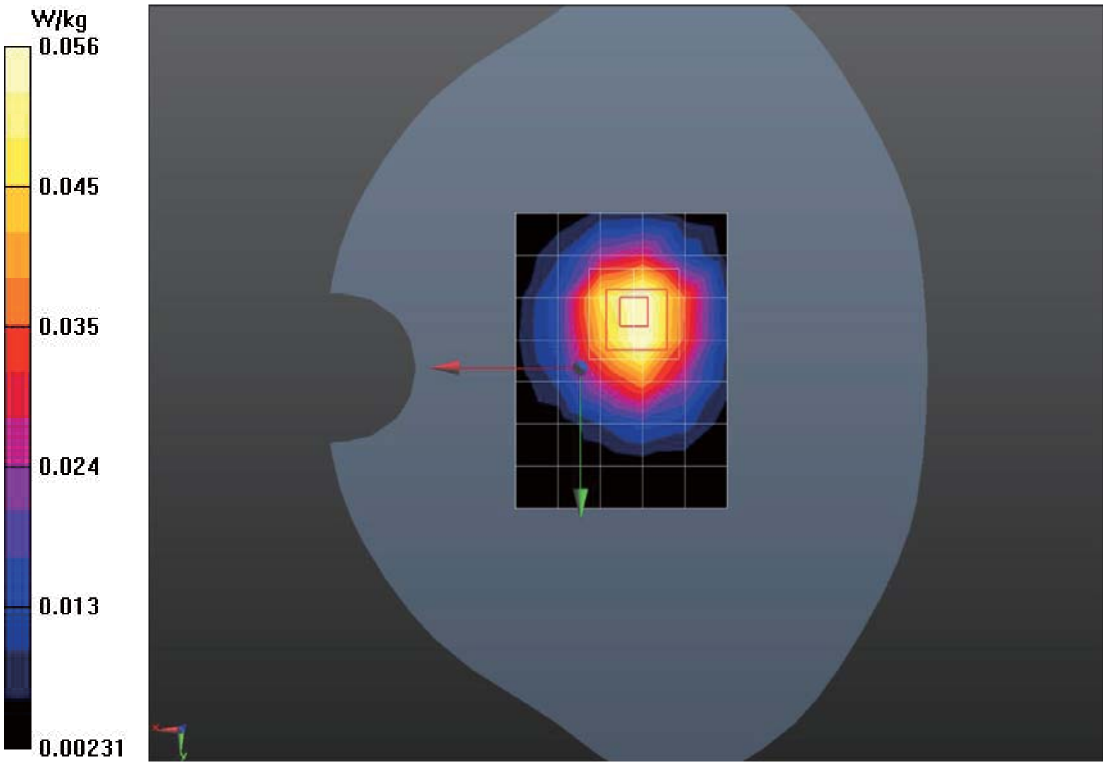


Fig.7 NB-IOT Band 13 Phantom Mode High

NB-Band 26 QPSK 1RB Body Toward Phantom High

Date/Time: 2019/7/30
Electronics: DAE4 Sn1329
Medium: Head 850MHz
Medium parameters used: f = 849 MHz; σ = 0.928 S/m; εr = 41.81; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: NB-IOT Band 26; Frequency: 848.9 MHz; Duty Cycle: 1:2.0
Probe: EX3DV4 - SN3844ConvF(9.35, 9.35, 9.35);
High Toward Phantom NB-IOT Band 26 3.75kbps QPSK 1RB/Area Scan (6x8x1):
Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.12 W/kg
High Toward Phantom NB-IOT Band 26 3.75kbps QPSK 1RB/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.64 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.61 W/kg
SAR(1 g) = 1.05 W/kg; SAR(10 g) = 0.675 W/kg
Maximum value of SAR (measured) = 1.09 W/kg

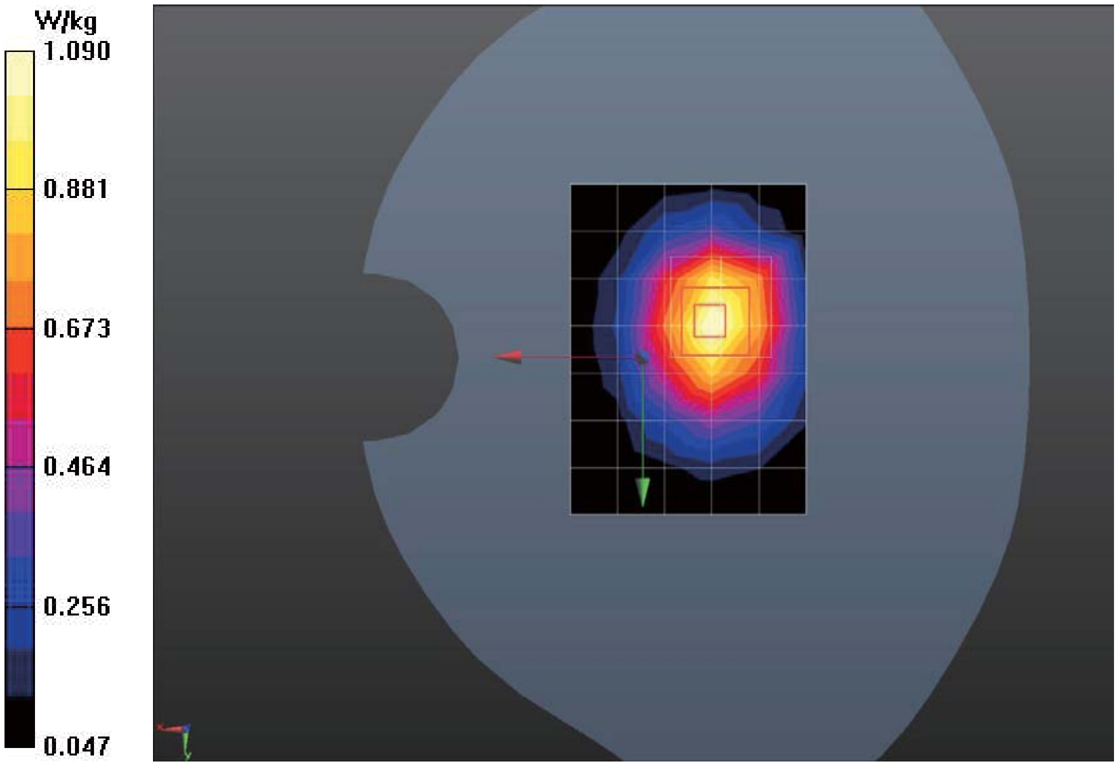


Fig.8 NB-IOT Band 26 Phantom Mode High

CATM Band 2 15MHz 6RB Body Toward Ground Middle

Date/Time: 2019/7/30
Electronics: DAE4 Sn1329
Medium: Head 1900MHz
Medium parameters used: f = 1880 MHz; σ = 1.412 S/m; εr = 38.997; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: CATM Band 2; Frequency: 1880 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(8.07, 8.07, 8.07);
Middle Toward Ground CATM Band 2 15MHz 6RB/Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.0295 W/kg
Middle Toward Ground CATM Band 2 15MHz 6RB/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 4.633 V/m; Power Drift = 0.12 dB
Peak SAR (extrapolated) = 0.0460 W/kg
SAR(1 g) = 0.030 W/kg; SAR(10 g) = 0.018 W/kg
Maximum value of SAR (measured) = 0.0330 W/kg

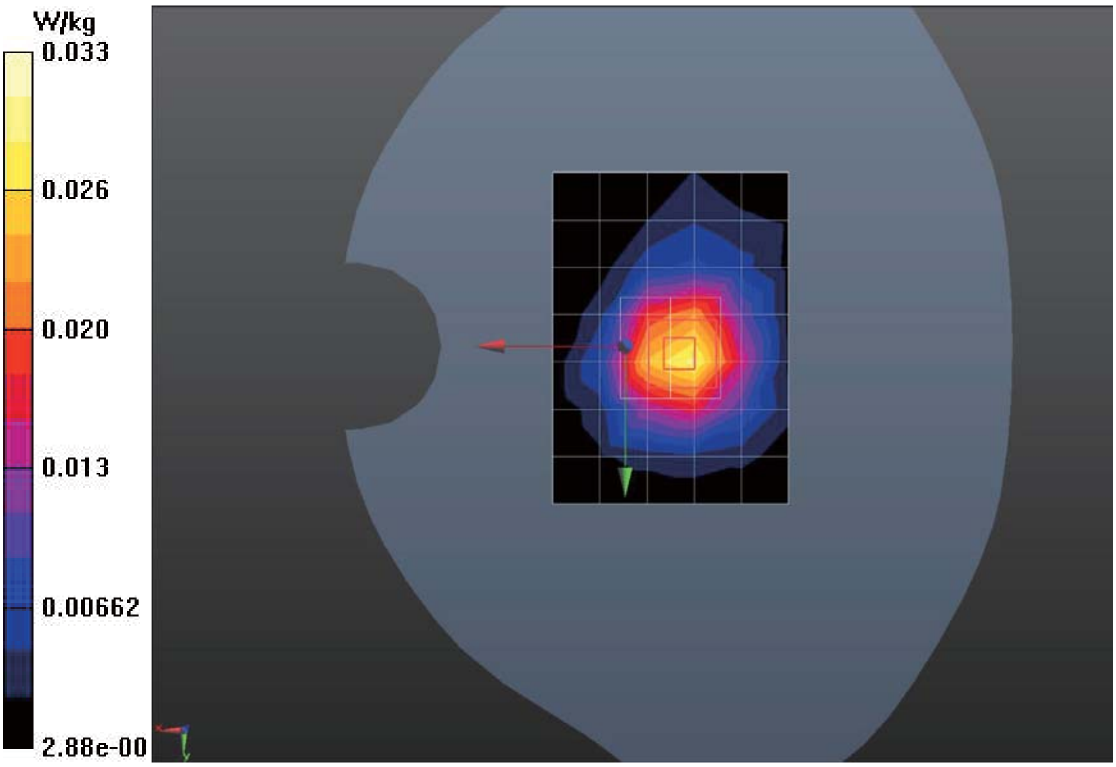


Fig.9 CATM Band 2 Ground Mode Middle

CATM Band 4 20MHz 1RB Body Toward Phantom High

Date/Time: 2019/7/18
Electronics: DAE4 Sn1329
Medium: Head 1800MHz
Medium parameters used: f = 1745 MHz; σ = 1.381 S/m; εr = 39.341; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: CATM Band 4; Frequency: 1745 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(8.5, 8.5, 8.5);
High Toward Phantom CATM Band 4 20MHz 1RB/Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.232 W/kg
High Toward Phantom CATM Band 4 20MHz 1RB/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 13.54 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 0.345 W/kg
SAR(1 g) = 0.235 W/kg; SAR(10 g) = 0.145 W/kg
Maximum value of SAR (measured) = 0.257 W/kg

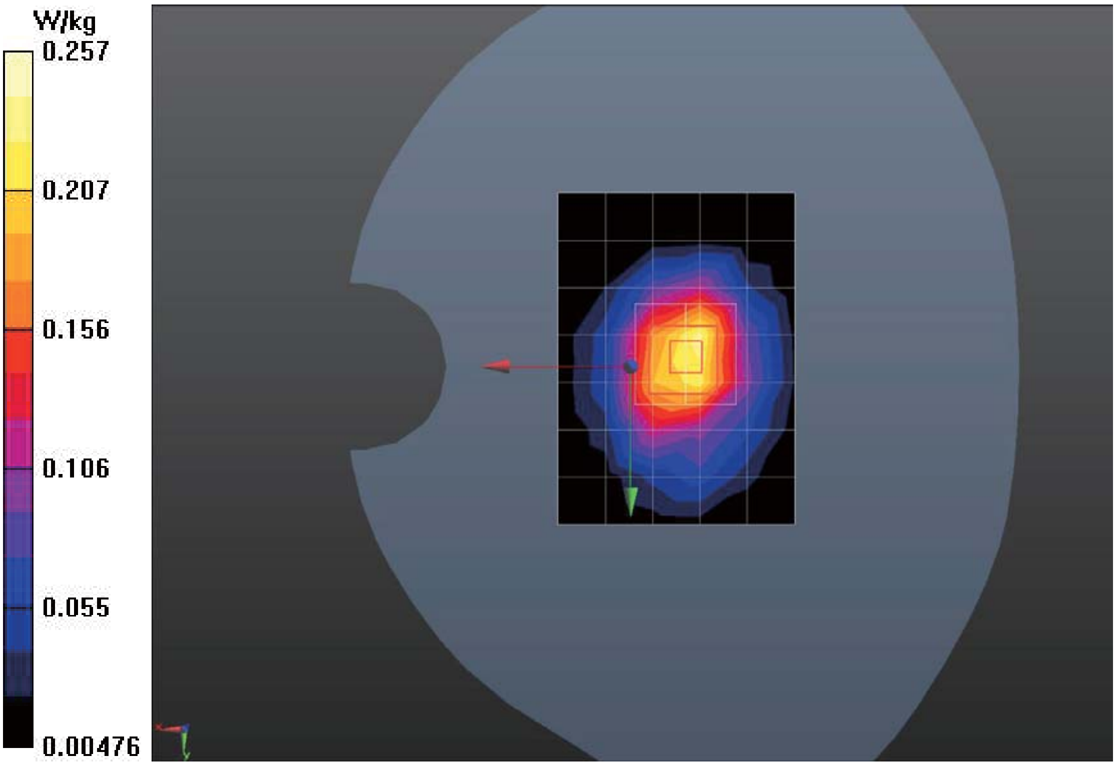


Fig.10 CATM Band 4 Phantom Mode High

CATM Band 5 10MHz 1RB Body Toward Phantom Low

Date/Time: 2019/7/30
Electronics: DAE4 Sn1329
Medium: Head 850MHz
Medium parameters used: f = 829 MHz; σ = 0.909 S/m; εr = 42.042; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: CATM band 5; Frequency: 829 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(9.35, 9.35, 9.35);
Low Toward Phantom CATM Band 5 10MHz 1RB/Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.705 W/kg
Low Toward Phantom CATM Band 5 10MHz 1RB/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.76 V/m; Power Drift = -0.09 dB
Peak SAR (extrapolated) = 1.01 W/kg
SAR(1 g) = 0.673 W/kg; SAR(10 g) = 0.440 W/kg
Maximum value of SAR (measured) = 0.706 W/kg

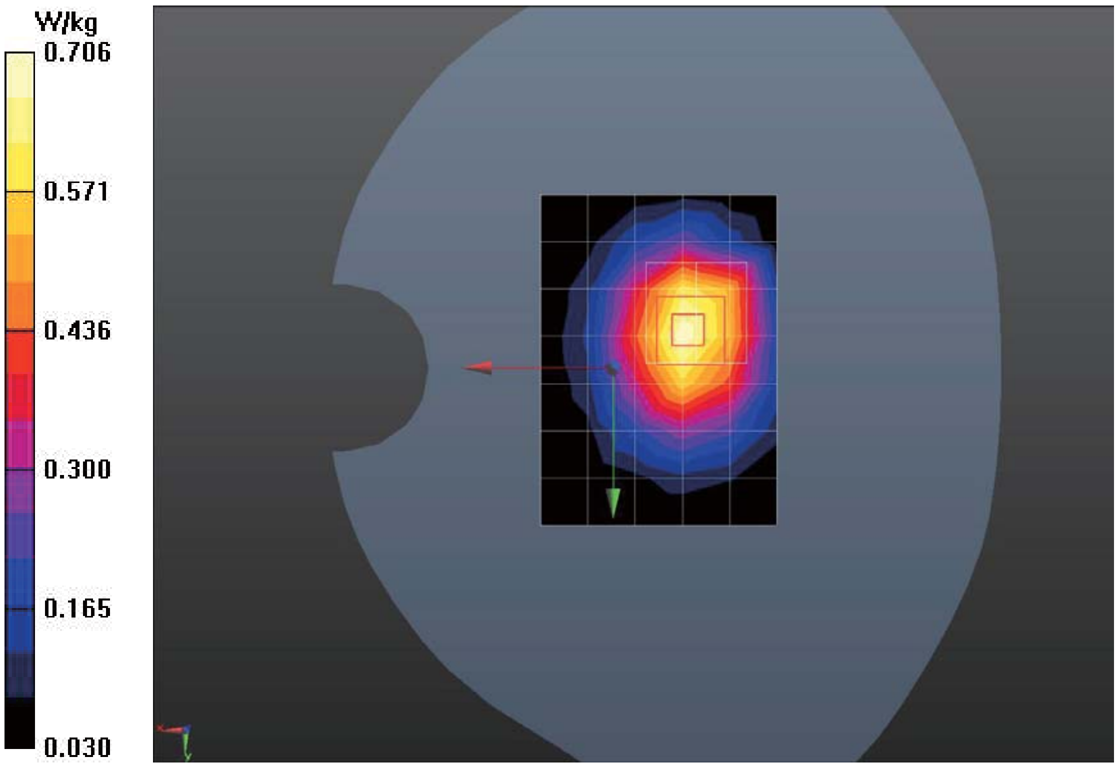


Fig.11 CATM Band 5 Phantom Mode Low

CATM Band 12 10MHz 1RB Body Bottom Low

Date/Time: 2019/7/31
Electronics: DAE4 Sn1329
Medium: Head 750MHz
Medium parameters used: f = 702.5 MHz; σ = 0.874 S/m; εr = 40.214; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: CATM band 12; Frequency: 702.5 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(9.75, 9.75, 9.75);
Low Bottom CATM Band 12 10MHz 1RB/Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.0276 W/kg
Low Bottom CATM Band 12 10MHz 1RB /Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 4.795 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 0.0530 W/kg
SAR(1 g) = 0.025 W/kg; SAR(10 g) = 0.013 W/kg
Maximum value of SAR (measured) = 0.0269 W/kg

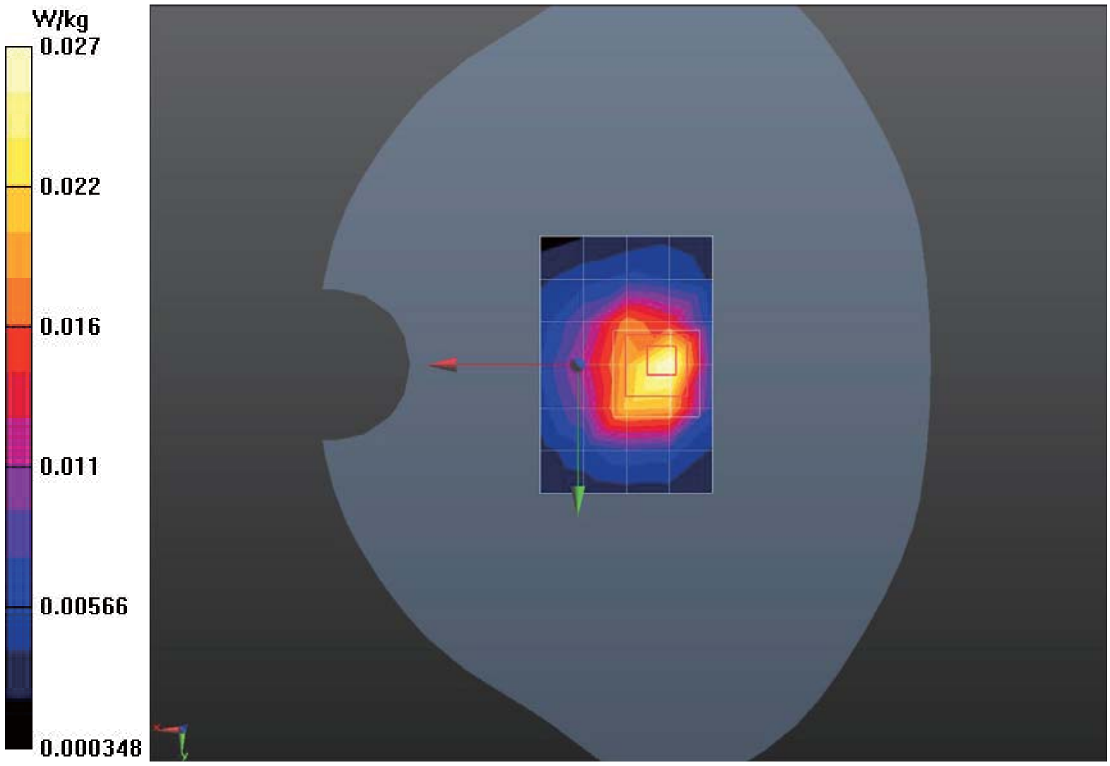


Fig.12 CATM Band 12 Bottom Mode Low

CATM Band 13 10MHz 1RB Body Toward Phantom Low

Date/Time: 2019/7/31
Electronics: DAE4 Sn1329
Medium: Head 750MHz
Medium parameters used: f = 781.5 MHz; σ = 0.905 S/m; εr = 41.055; ρ = 1000 kg/m3
Ambient Temperature:22.5°C   Liquid Temperature:22.5°C
Communication System: CATM band 13; Frequency: 781.5 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(9.75, 9.75, 9.75);
Low Toward Phantom CATM Band 13 10MHz 1RB /Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.0399 W/kg
Low Toward Phantom CATM Band 13 10MHz 1RB /Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 5.686 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 0.0600 W/kg
SAR(1 g) = 0.037 W/kg; SAR(10 g) = 0.024 W/kg
Maximum value of SAR (measured) = 0.0390 W/kg

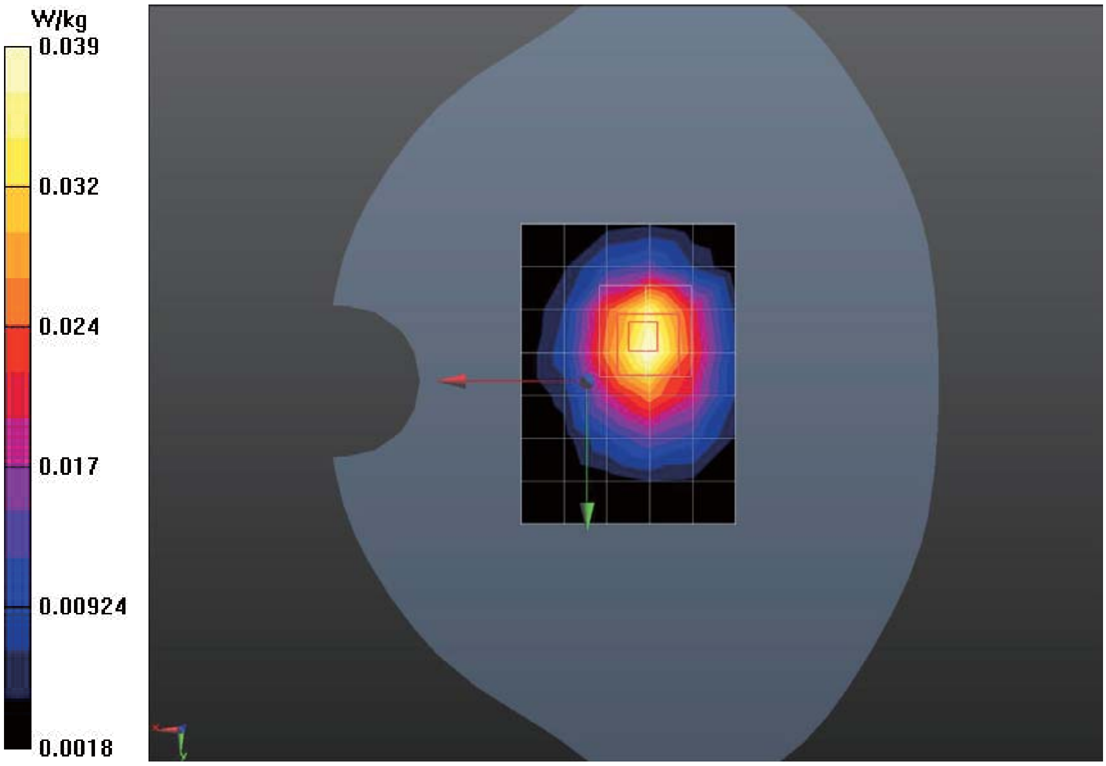


Fig.13 CATM Band 13 Phantom Mode Low

CATM Band 26 15MHz 1RB Body Toward Phantom Middle

Date/Time: 2019/7/30
Electronics: DAE4 Sn1329
Medium: Head 850MHz
Medium parameters used: f = 831.5 MHz; σ = 0.912 S/m; εr = 42.011; ρ = 1000kg/m3
Ambient Temperature:22.5°C   Liquid Temperature:22.5°C
Communication System: CATM Band 26; Frequency: 831.5 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(9.35, 9.35, 9.35);
Middle Toward Phantom CAT-M Band 26 15MHz 1RB/Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.662 W/kg
Middle Toward Phantom CAT-M Band 26 15MHz 1RB/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.49 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.00 W/kg
SAR(1 g) = 0.654 W/kg; SAR(10 g) = 0.424 W/kg
Maximum value of SAR (measured) = 0.695 W/kg

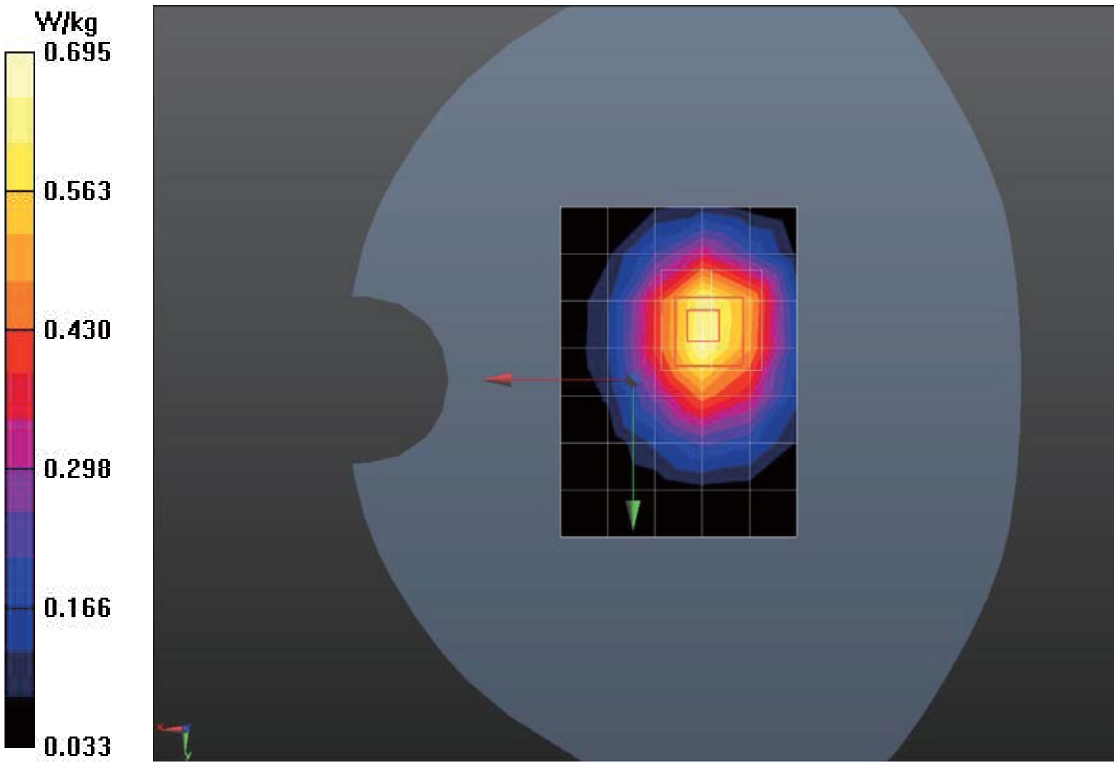


Fig.14 CATM Band 26 Phantom Mode Middle

WIFI 802.11b Body Toward Phantom Middle

Date/Time: 2019/8/1
Electronics: DAE4 Sn1329
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);
Middle Toward Phantom 802.11b/Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.169 W/kg
Middle Toward Phantom 802.11b/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 6.724 V/m; Power Drift = -0.08 dB
Peak SAR (extrapolated) = 0.405 W/kg
SAR(1 g) = 0.187 W/kg; SAR(10 g) = 0.087 W/kg
Maximum value of SAR (measured) = 0.209 W/kg

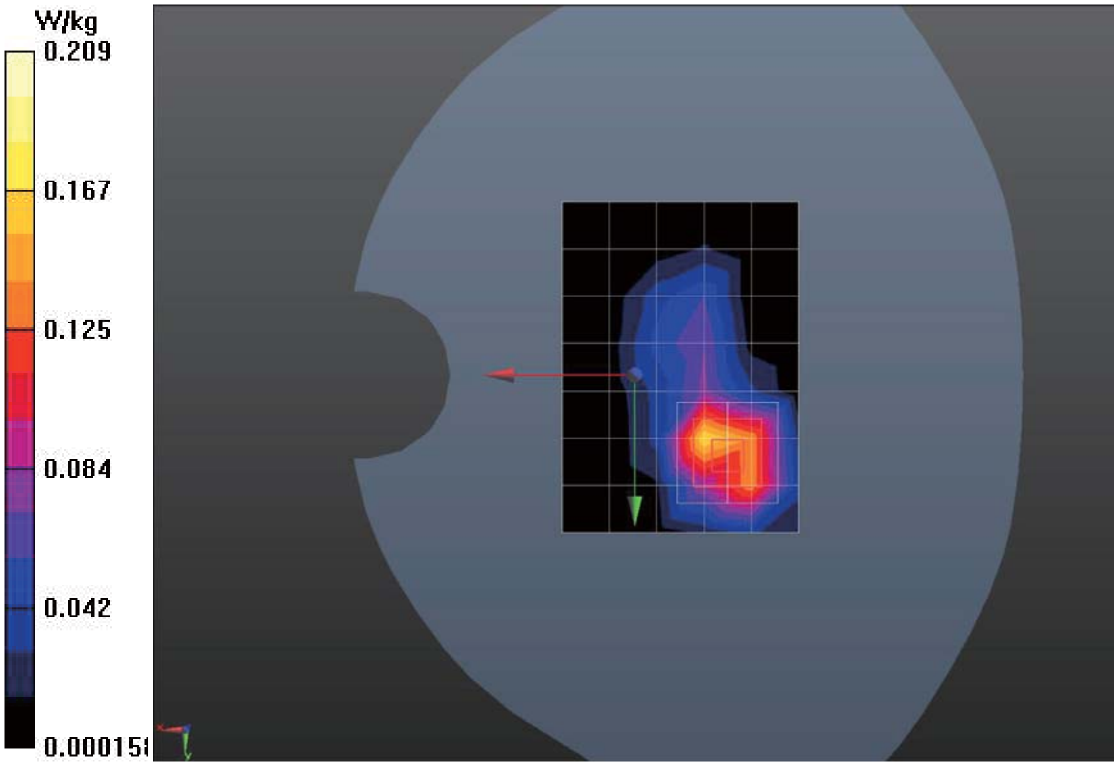
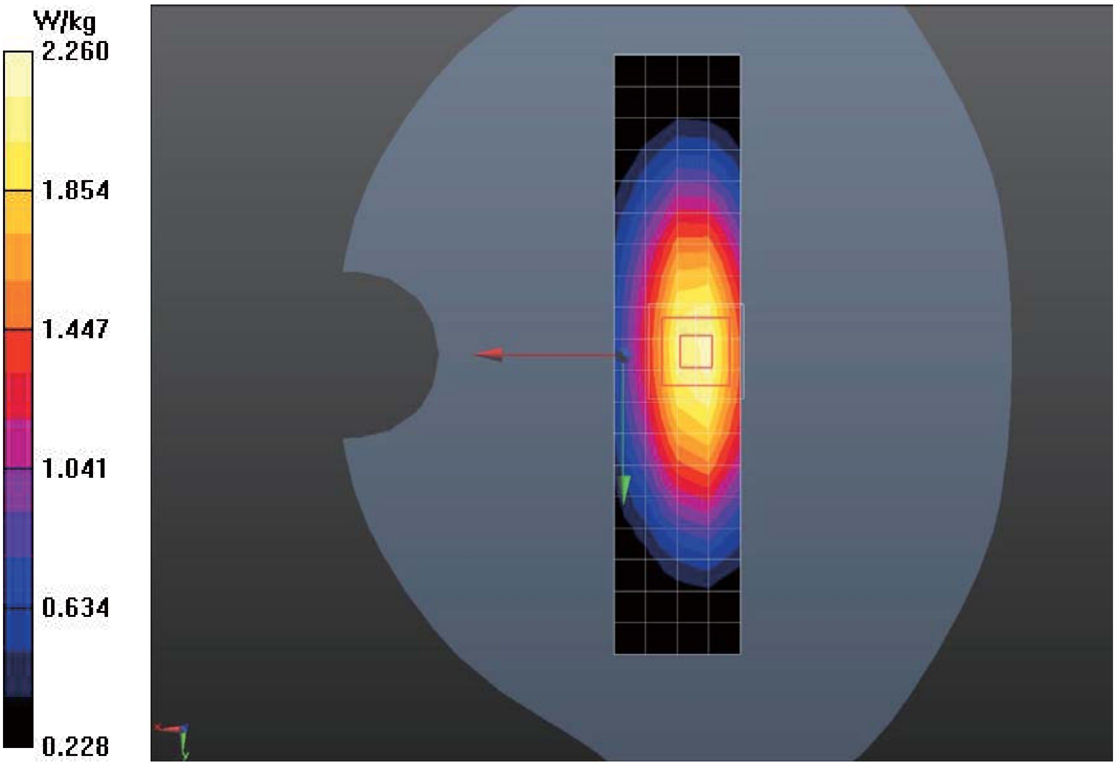


Fig.15 WIFI Phantom Mode Low

ANNEX B. SYSTEM VALIDATION RESULTS

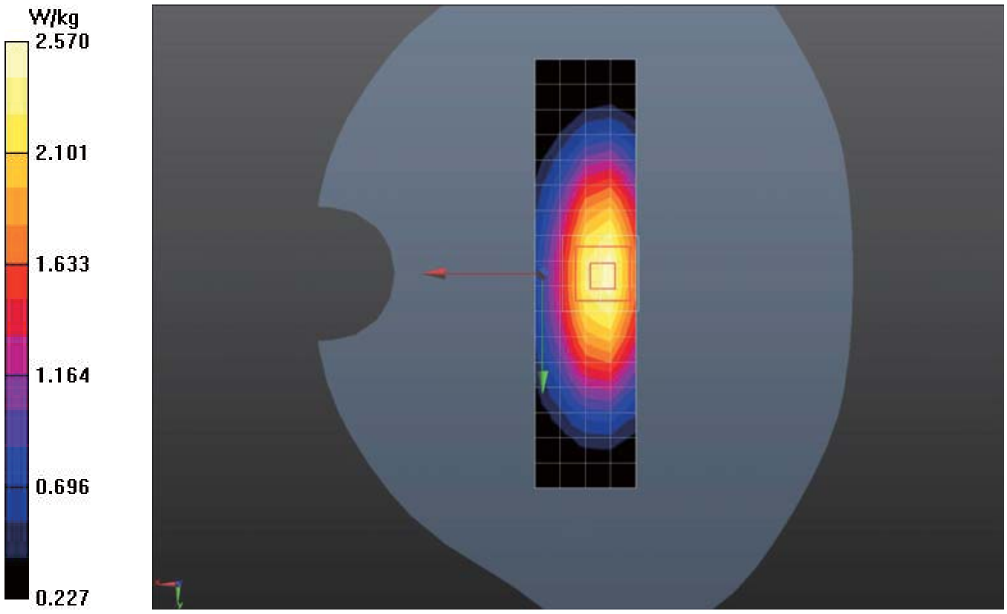
System 750MHz

Date/Time: 2019/7/31
Electronics: DAE4 Sn1329
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



System 835MHz

Date/Time: 2019/7/30
Electronics: DAE4 Sn1329
Medium: Head 850MHz
Medium parameters used: f = 835 MHz; σ = 0.915 S/m; εr = 41.97; ρ = 1000 kg/m3
Ambient Temperature:22.5°C Liquid Temperature:22.5°C
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(9.35, 9.35, 9.35);
System Check Dipole 835 MHz/Area Scan (5x18x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 2.49 W/kg
System Check Dipole 835 MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 50.16 V/m; Power Drift = 0.05 dB
Peak SAR (extrapolated) = 3.57 W/kg
SAR(1 g) = 2.38 W/kg; SAR(10 g) = 1.55 W/kg
Maximum value of SAR (measured) = 2.57 W/kg



System 1750MHz

Date/Time: 2019/7/18
Electronics: DAE4 Sn1329

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);

System Head 1750MHz/Area Scan (6x11x1): Measurement grid: dx=10mm, dy=10mm

Maximum value of SAR (measured) = 10.2 W/kg

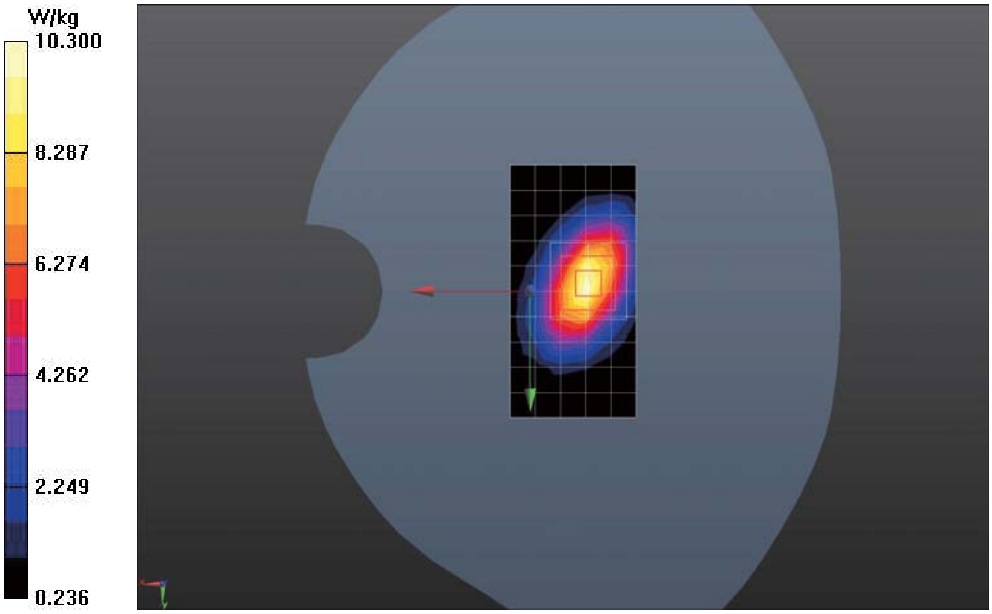
System Head 1750MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 81.63 V/m; Power Drift = 0.05 dB

Peak SAR (extrapolated) = 16.7 W/kg

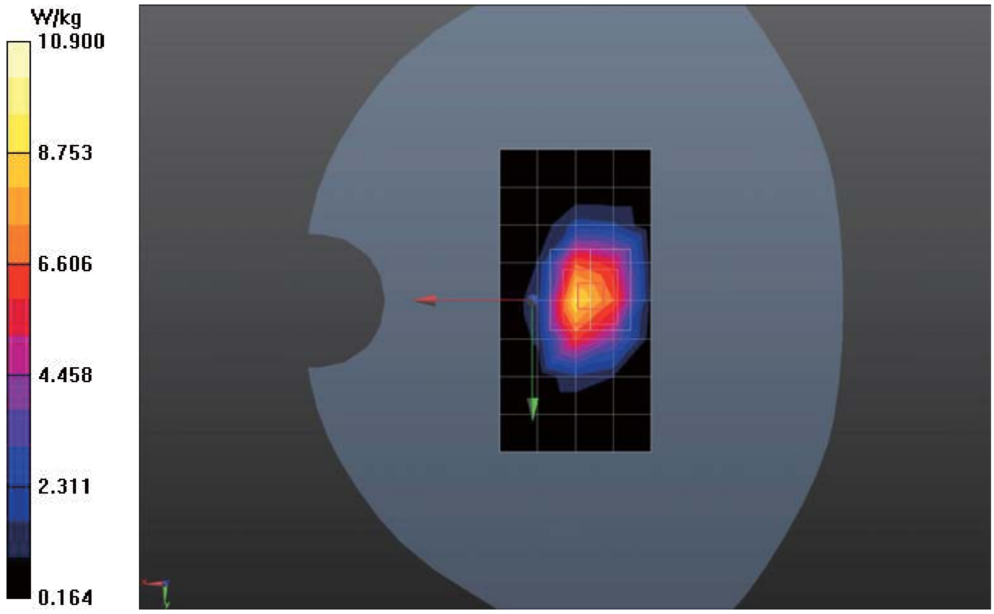
SAR(1 g) = 9.22 W/kg; SAR(10 g) = 4.95 W/kg

Maximum value of SAR (measured) = 10.3 W/kg



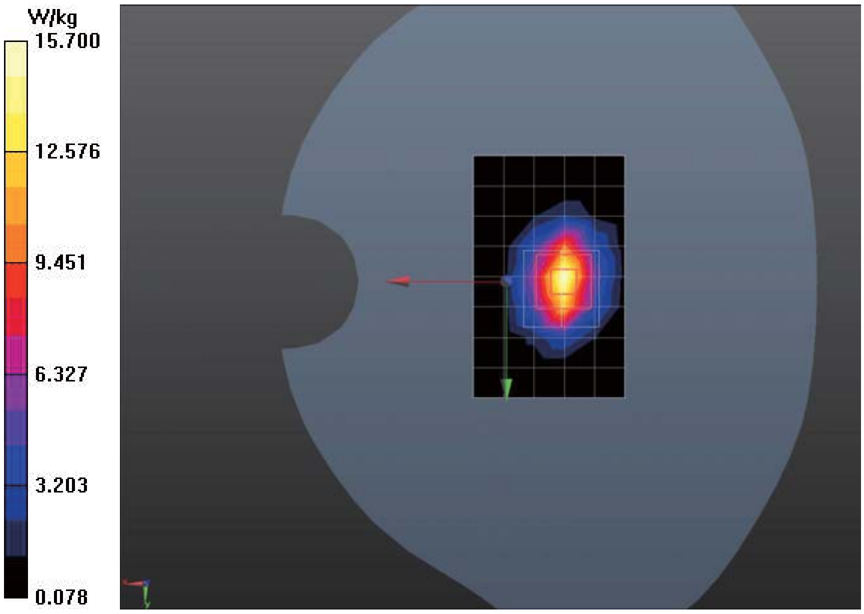
System 1900MHz

Date/Time: 2019/7/30
Electronics: DAE4 Sn1329
Medium: Head 1900MHz
Medium parameters used: f = 1900 MHz; σ = 1.44 S/m; εr = 38.984; ρ = 1000 kg/m3
Ambient Temperature:22.5°C   Liquid Temperature:22.5°C
Communication System: CW Frequency: 1900 MHz; Duty Cycle: 1:1
Probe: EX3DV4 - SN3844ConvF(8.07, 8.07, 8.07);
System Head 1900MHz/Area Scan (5x9x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 8.97 W/kg
System Head 1900MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 79.89 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 18.0 W/kg
SAR(1 g) = 9.75 W/kg; SAR(10 g) = 5.07 W/kg
Maximum value of SAR (measured) = 10.9 W/kg



System 2450MHz

Date/Time: 2019/8/1
Electronics: DAE4 Sn1329
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 = 0.15 dB
Peak SAR (extrapolated) = 29.1 W/kg
SAR(1 g) = 13.8 W/kg; SAR(10 g) = 6.38 W/kg
Maximum value of SAR (measured) = 15.7 W/kg



ANNEX C. SYSTEM VALIDATION RESULTS

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland
Phone +41 44 245 9700, Fax +41 44 245 9779
info@speag.com, http://www.speag.com

IMPORTANT NOTICE

USAGE OF THE DAE 4

The DAE unit is a delicate, high precision instrument and requires careful treatment by the user. There are no serviceable parts inside the DAE. Special attention shall be given to the following points:

Battery Exchange: The battery cover of the DAE4 unit is closed using a screw, over tightening the screw may cause the threads inside the DAE to wear out.

Shipping of the DAE: Before shipping the DAE to SPEAG for calibration, remove the batteries and pack the DAE in an antistatic bag. This antistatic bag shall then be packed into a larger box or container which protects the DAE from impacts during transportation. The package shall be marked to indicate that a fragile instrument is inside.

E-Stop Failures: Touch detection may be malfunctioning due to broken magnets in the E-stop. Rough handling of the E-stop may lead to damage of these magnets. Touch and collision errors are often caused by dust and dirt accumulated in the E-stop. To prevent E-stop failure, the customer shall always mount the probe to the DAE carefully and keep the DAE unit in a non-dusty environment if not used for measurements.

Repair: Minor repairs are performed at no extra cost during the annual calibration. However, SPEAG reserves the right to charge for any repair especially if rough unprofessional handling caused the defect.

DASY Configuration Files: Since the exact values of the DAE input resistances, as measured during the calibration procedure of a DAE unit, are not used by the DASY software, a nominal value of 200 MOhm is given in the corresponding configuration file.

Important Note:
Warranty and calibration is void if the DAE unit is disassembled partly or fully by the Customer.

Important Note:
Never attempt to grease or oil the E-stop assembly. Cleaning and readjusting of the E-stop assembly is allowed by certified SPEAG personnel only and is part of the annual calibration procedure.

Important Note:
To prevent damage of the DAE probe connector pins, use great care when installing the probe to the DAE. Carefully connect the probe with the connector notch oriented in the mating position. Avoid any rotational movement of the probe body versus the DAE while turning the locking nut of the connector. The same care shall be used when disconnecting the probe from the DAE.

Schmid & Partner Engineering

TN_BR040315AD DAE4.doc 11.12.2009

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
S Servizio svizzero di taratura
Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)
The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

Client **TMC-CQ (Auden)**

Certificate No: **DAE4-1329_Aug18**

CALIBRATION CERTIFICATE

Object: DAE4 - SD 000 D04 BM - SN: 1329

Calibration procedure(s): QA CAL-06.v29
Calibration procedure for the data acquisition electronics (DAE)

Calibration date: August 03, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	31-Aug-17 (No:21092)	Aug-18
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	04-Jan-18 (in house check)	In house check: Jan-19
Calibrator Box V2.1	SE UMS 006 AA 1002	04-Jan-18 (in house check)	In house check: Jan-19

	Name	Function	Signature
Calibrated by:	Dominique Steffen	Laboratory Technician	
Approved by:	Sven Kühn	Deputy Manager	i.V.

Issued: August 3, 2018

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

Certificate No: DAE4-1329_Aug18 Page 1 of 5

Calibration Laboratory of
Schmid & Partner
Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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The Swiss Accreditation Service is one of the signatories to the EA
Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 0108**

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 following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

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

DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	404.291 ± 0.02% (k=2)	404.409 ± 0.02% (k=2)	404.013 ± 0.02% (k=2)
Low Range	4.00018 ± 1.50% (k=2)	3.99514 ± 1.50% (k=2)	4.00222 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	102.0 ° ± 1 °

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

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	200031.45	-3.64	-0.00
Channel X	+ Input	20007.65	2.48	0.01
Channel X	- Input	-20003.51	1.60	-0.01
Channel Y	+ Input	200031.77	-3.11	-0.00
Channel Y	+ Input	20005.71	0.52	0.00
Channel Y	- Input	-20005.61	-0.53	0.00
Channel Z	+ Input	200033.81	-1.47	-0.00
Channel Z	+ Input	20006.28	1.18	0.01
Channel Z	- Input	-20006.97	-1.76	0.01

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2001.36	0.15	0.01
Channel X	+ Input	201.58	0.46	0.23
Channel X	- Input	-198.14	0.71	-0.36
Channel Y	+ Input	2001.52	0.36	0.02
Channel Y	+ Input	200.60	-0.53	-0.26
Channel Y	- Input	-199.56	-0.67	0.34
Channel Z	+ Input	2000.99	-0.15	-0.01
Channel Z	+ Input	200.13	-1.01	-0.50
Channel Z	- Input	-199.92	-1.03	0.52

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-2.30	-4.09
	- 200	6.02	3.84
Channel Y	200	12.38	12.19
	- 200	-13.37	-13.91
Channel Z	200	-13.87	-13.58
	- 200	11.44	11.33

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	3.51	-3.98
Channel Y	200	8.39	-	4.80
Channel Z	200	9.89	6.28	-

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4. **AD-Converter Values with inputs shorted**
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec

	High Range (LSB)	Low Range (LSB)
Channel X	15998	15980
Channel Y	16053	15978
Channel Z	16133	15759

5. **Input Offset Measurement**
DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	0.18	-0.71	1.08	0.36
Channel Y	0.89	0.10	1.51	0.34
Channel Z	0.35	-0.63	1.56	0.37

6. **Input Offset Current**
Nominal Input circuitry offset current on all channels: <25fA

7. **Input Resistance** (Typical values for information)

	Zeroing (kOhm)	Measuring (MOhm)
Channel X	200	200
Channel Y	200	200
Channel Z	200	200

8. **Low Battery Alarm Voltage** (Typical values for information)

Typical values	Alarm Level (VDC)
Supply (+ Vcc)	+7.9
Supply (- Vcc)	-7.6

9. **Power Consumption** (Typical values for information)

Typical values	Switched off (mA)	Stand by (mA)	Transmitting (mA)
Supply (+ Vcc)	+0.01	+6	+14
Supply (- Vcc)	-0.01	-8	-9

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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

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

Certificate No: Z19-60145 Page 1 of 11

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

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

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

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

Methods Applied and Interpretation of Parameters:

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

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Probe EX3DV4

SN: 3844

Calibrated: May 25, 2019

Calibrated for DASY/EASY Systems

(Note: non-compatible with DASY2 system!)

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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 E²-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.

Certificate No: Z19-60145 Page 4 of 11

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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.

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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.

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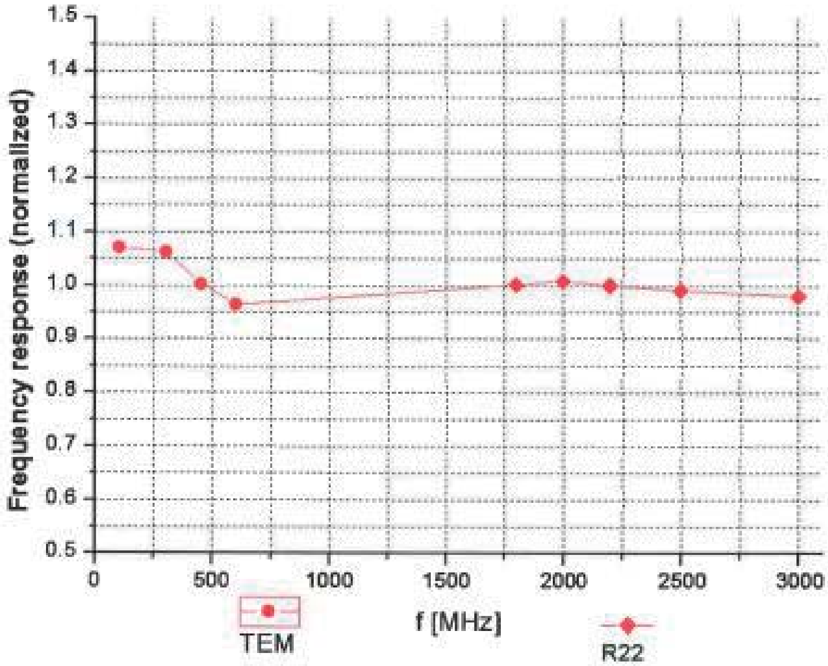
Frequency Response of E-Field
(TEM-Cell: ifi110 EXX, Waveguide: R22)



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

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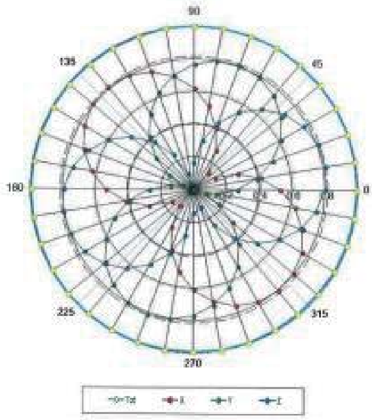
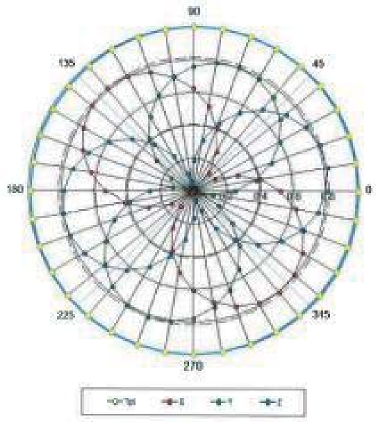
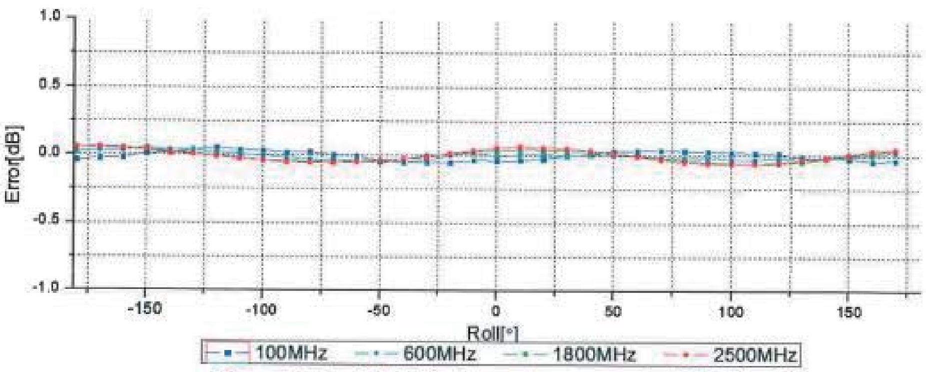
Receiving Pattern (Φ), θ=0°

f=600 MHz, TEM f=1800 MHz, R22







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

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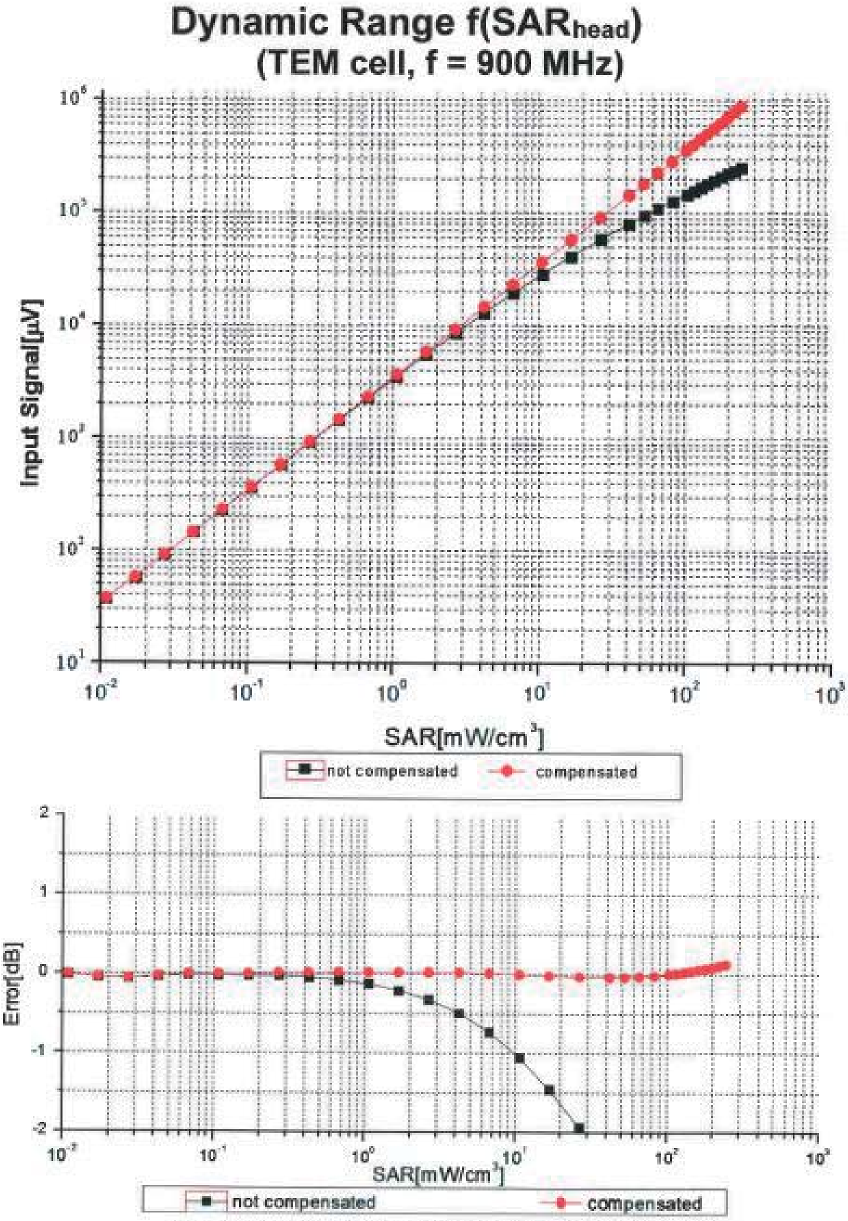

Uncertainty of Linearity Assessment: ±0.9% (k=2)

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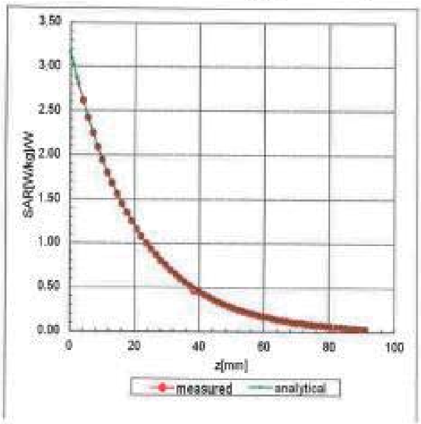
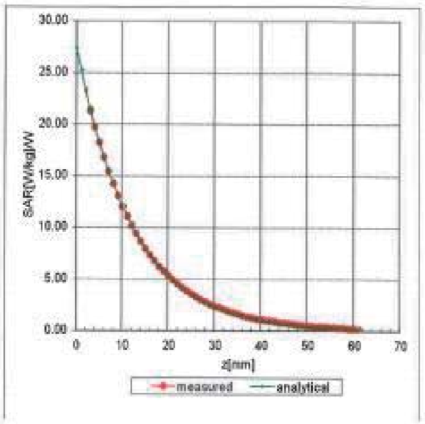
Conversion Factor Assessment

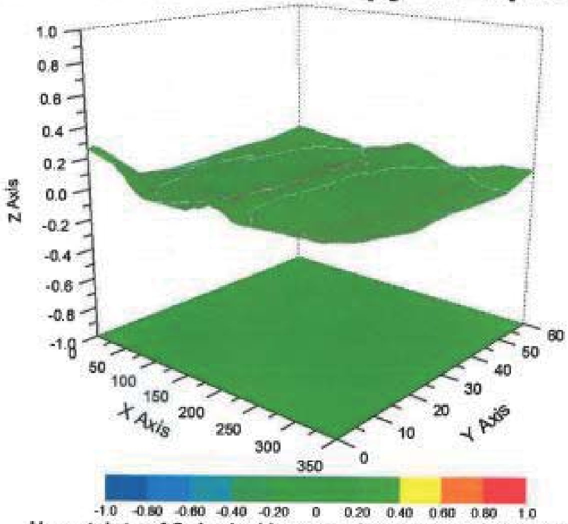
f=750 MHz, WGLS R9(H_convF)



f=1900 MHz, WGLS R22(H_convF)



Deviation from Isotropy in Liquid



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

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DASY/EASY – Parameters of Probe: 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

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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

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Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Measurement procedure for assessment of specific absorption rate of human exposure to radio frequency fields from hand-held and body-mounted wireless communication devices- Part 1: Device used next to the ear (Frequency range of 300MHz to 6GHz)", July 2016
c) IEC 62209-2, "Procedure to measure the Specific Absorption Rate (SAR) For wireless communication devices used in close proximity to the human body (frequency range of 30MHz to 6GHz)", March 2010
d) KDB865664, SAR Measurement Requirements for 100 MHz to 6 GHz

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
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)**

Certificate No: Z19-60162 Page 3 of 8

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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

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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)

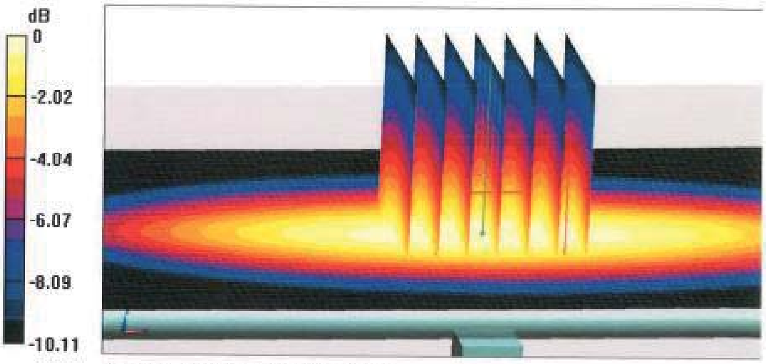
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

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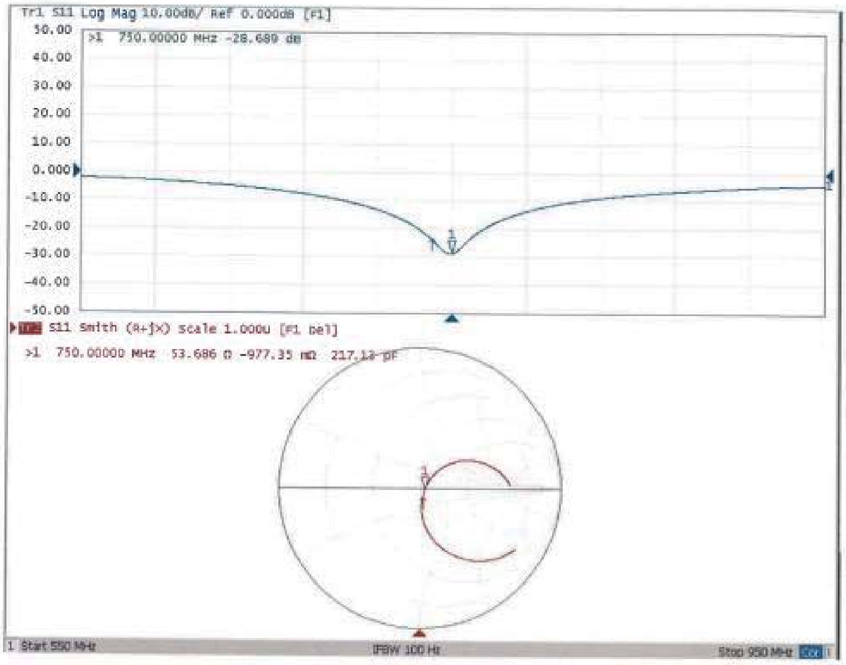
Impedance Measurement Plot for Head TSL



Certificate No: Z19-60162 Page 6 of 8

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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)

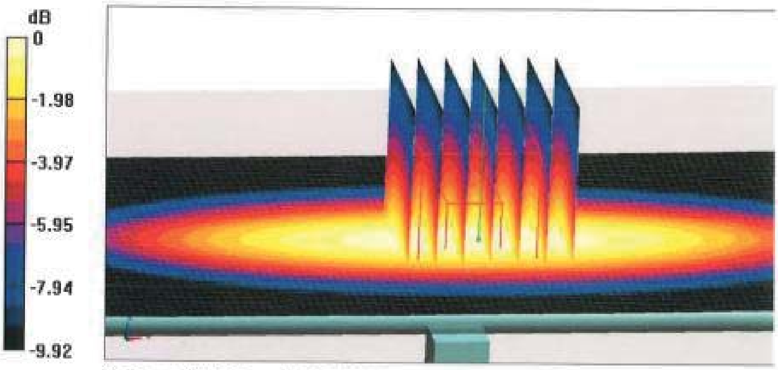
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

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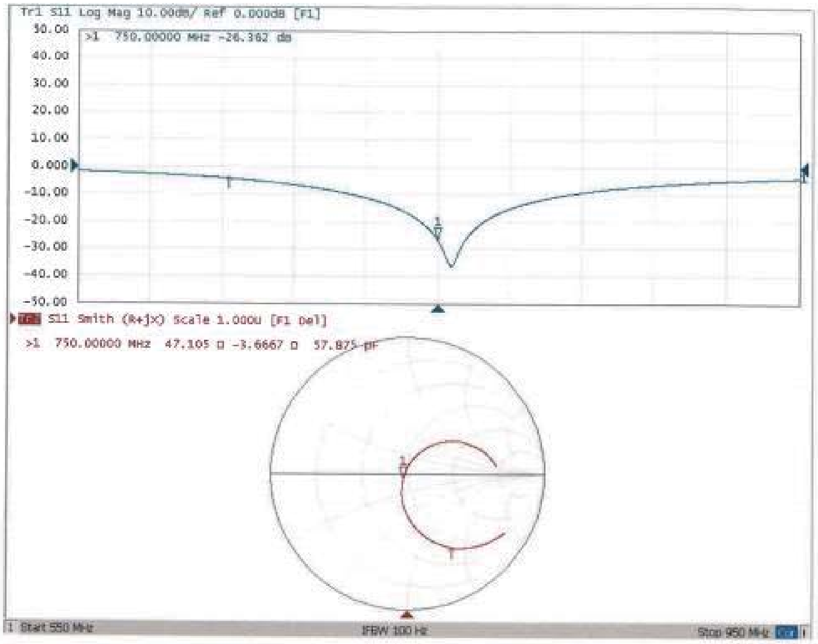
Impedance Measurement Plot for Body TSL



Certificate No: Z19-60162 Page 8 of 8

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Client CATR(Chongqing) Certificate No: Z19-60001

CALIBRATION CERTIFICATE

Object	D835V2 - SN: 4d135
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	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: January 20, 2019

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

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

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

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
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	835 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.5	0.90 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	42.7 ± 6 %	0.87 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	2.35 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**9.67 W/kg ± 18.8 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	1.56 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**6.38 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	55.2	0.97 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.4 ± 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	2.40 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**9.83 W /kg ± 18.8 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	1.59 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**6.48 W/kg ± 18.7 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	51.1Ω- 3.76jΩ
Return Loss	- 28.3dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.0Ω- 7.83jΩ
Return Loss	- 21.7dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.266 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 01.18.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d135

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: f = 835 MHz; σ = 0.874 S/m; ε_r = 42.74; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(9.84, 9.84, 9.84) @ 835 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)

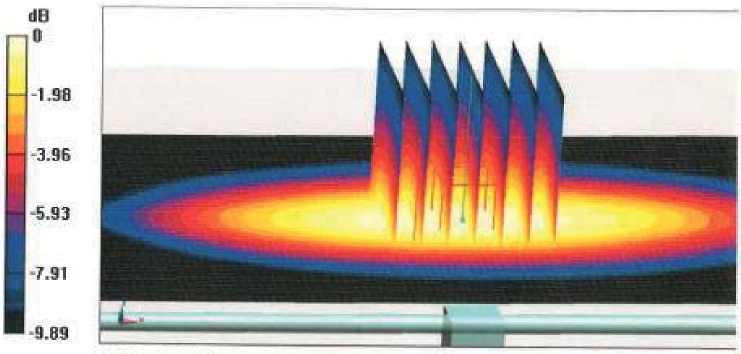
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 58.53 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 3.59 W/kg

SAR(1 g) = 2.35 W/kg; SAR(10 g) = 1.56 W/kg

Maximum value of SAR (measured) = 3.15 W/kg



0 dB = 3.15 W/kg = 4.98 dBW/kg

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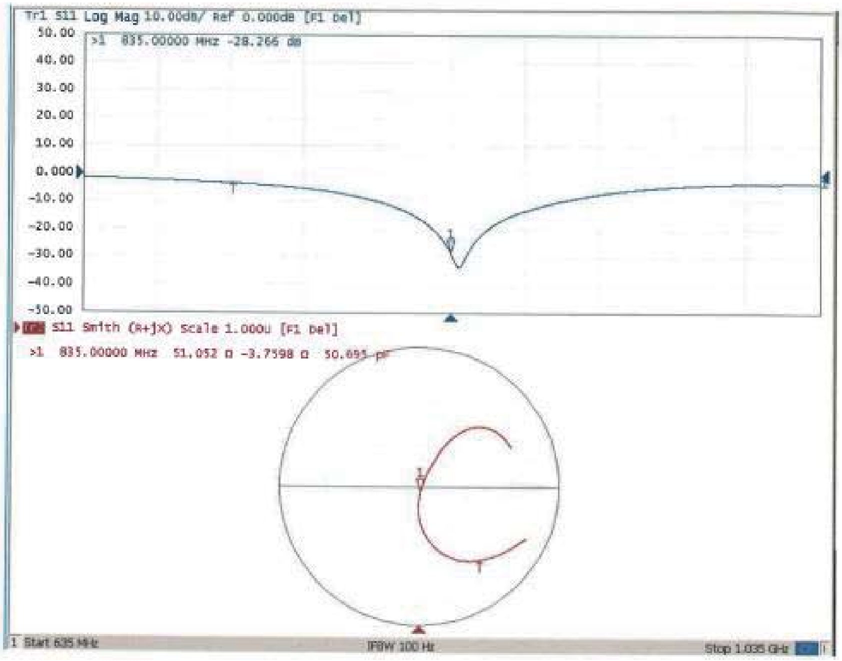
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 01.18.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 835 MHz; Type: D835V2; Serial: D835V2 - SN: 4d135

Communication System: UID 0, CW; Frequency: 835 MHz; Duty Cycle: 1:1

Medium parameters used: f = 835 MHz; σ = 0.941 S/m; ε_r = 55.35; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(9.93, 9.93, 9.93) @ 835 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)

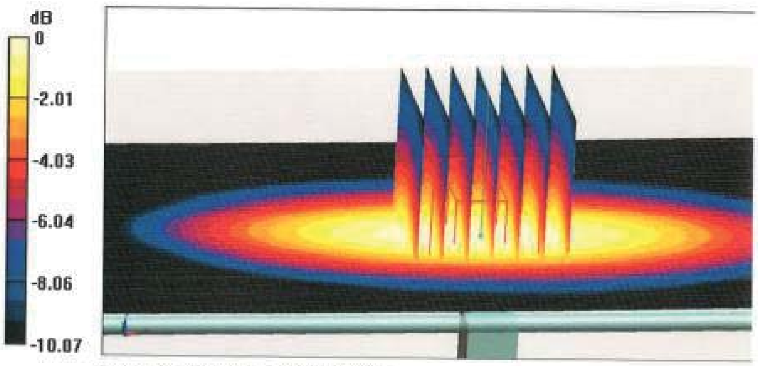
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 55.66 V/m; Power Drift = -0.07 dB

Peak SAR (extrapolated) = 3.67 W/kg

SAR(1 g) = 2.4 W/kg; SAR(10 g) = 1.59 W/kg

Maximum value of SAR (measured) = 3.22 W/kg



0 dB = 3.22 W/kg = 5.08 dBW/kg

Certificate No: Z19-60001 Page 7 of 8

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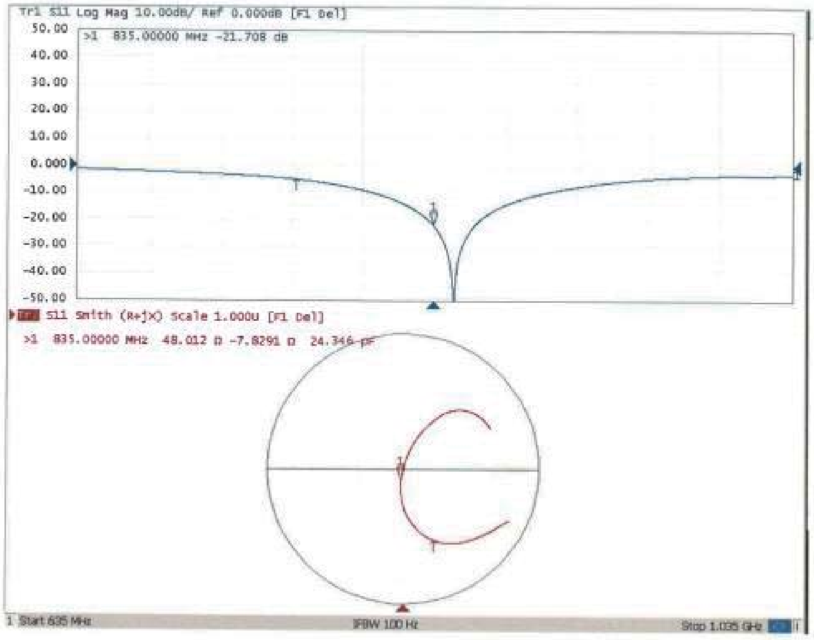
Impedance Measurement Plot for Body TSL



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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	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: January 20, 2019

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

b) IEC 62209-1, "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: Z19-60003 Page 2 of 8

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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)**

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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

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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)

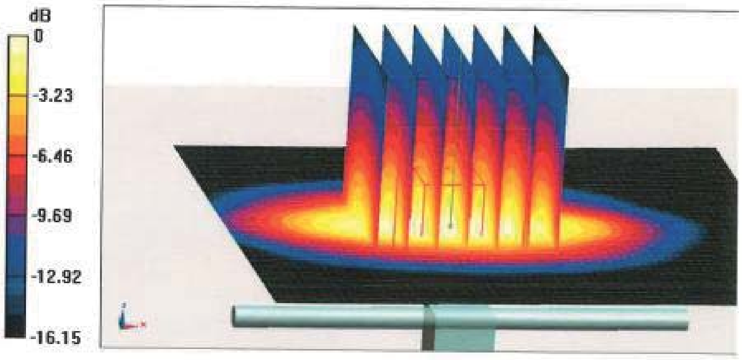
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

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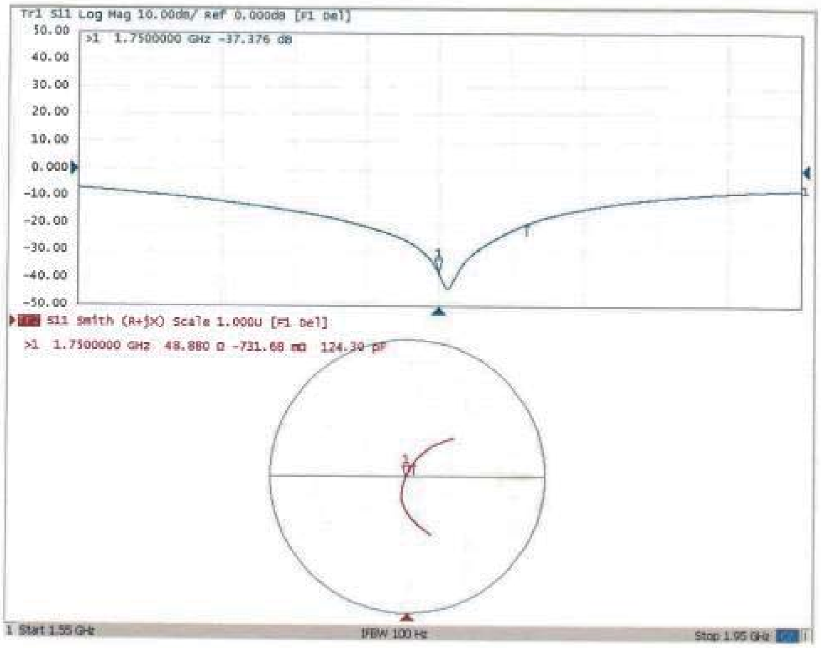
Impedance Measurement Plot for Head TSL



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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)

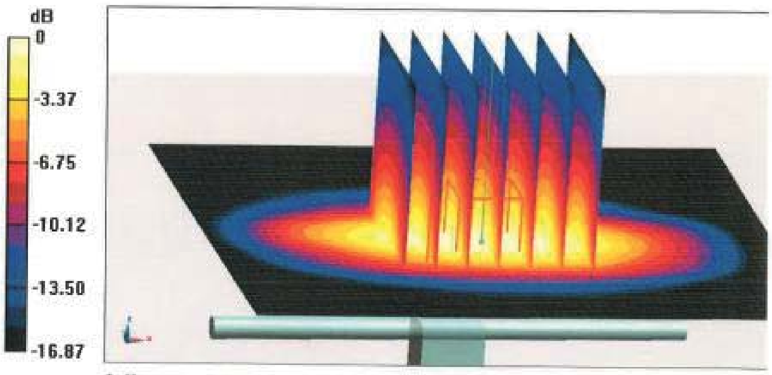
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Certificate No: Z19-60003 Page 7 of 8

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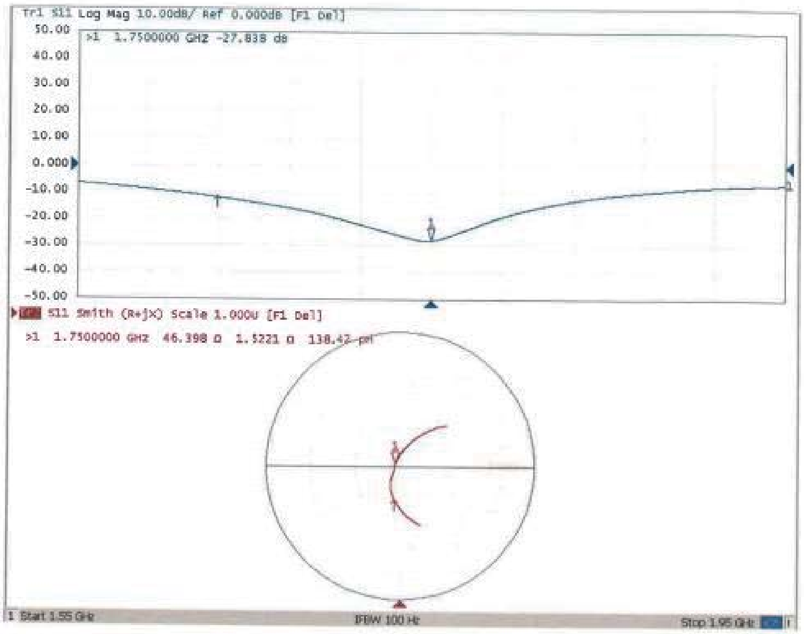
Impedance Measurement Plot for Body TSL



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Client CATR(Chongqing) Certificate No: Z19-60004

CALIBRATION CERTIFICATE

Object	D1900V2 - SN: 5d153
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	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: January 20, 2019

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lossary:

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

Calibration is Performed According to the Following Standards:

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

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

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

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Certificate No: Z19-60004 Page 2 of 8

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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	1900 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	41.2 ± 6 %	1.43 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	9.98 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**39.8 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Head TSL	Condition	
SAR measured	250 mW input power	5.19 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**20.7 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	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	53.9 ± 6 %	1.52 mho/m ± 6 %
Body TSL temperature change during test	<1.0 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**40.5 W/kg ± 18.8 % (k=2)**
SAR averaged over 10 cm^3 (10 g) of Body TSL	Condition	
SAR measured	250 mW input power	5.20 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**20.8 W/kg ± 18.7 % (k=2)**

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Appendix (Additional assessments outside the scope of CNAS L0570)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.8Ω+ 3.60jΩ
Return Loss	- 26.0dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	51.2Ω+ 5.71jΩ
Return Loss	- 24.8dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.062 ns

After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.
No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG

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DASY5 Validation Report for Head TSL Date: 01.17.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d153

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

Medium parameters used: f = 1900 MHz; σ = 1.425 S/m; ε_r = 41.19; ρ = 1000 kg/m3

Phantom section: Center Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.76, 7.76, 7.76) @ 1900 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)

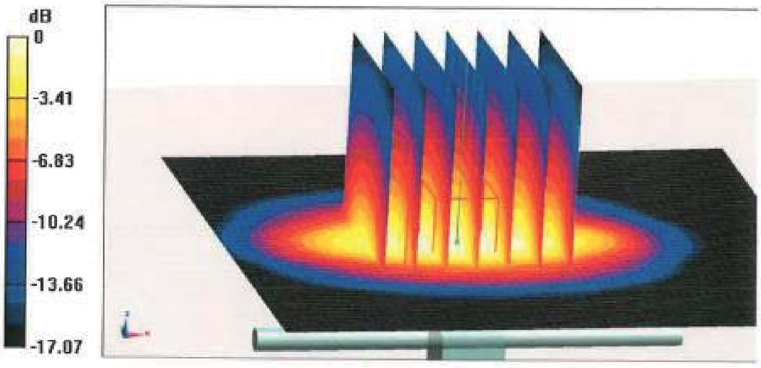
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.8 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 18.7 W/kg

SAR(1 g) = 9.98 W/kg; SAR(10 g) = 5.19 W/kg

Maximum value of SAR (measured) = 15.7 W/kg



0 dB = 15.7 W/kg = 11.96 dBW/kg

Certificate No: Z19-60004 Page 5 of 8

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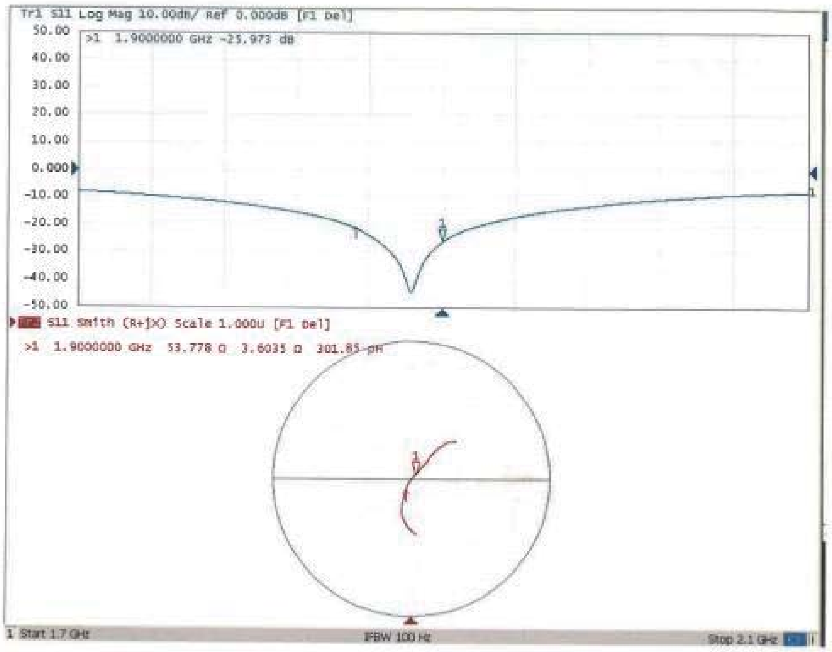
Impedance Measurement Plot for Head TSL



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DASY5 Validation Report for Body TSL Date: 01.17.2019

Test Laboratory: CTTL, Beijing, China

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d153

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

Medium parameters used: f = 1900 MHz; σ = 1.523 S/m; ε_r = 53.88; ρ = 1000 kg/m3

Phantom section: Right Section

DASY5 Configuration:

- Probe: EX3DV4 - SN7433; ConvF(7.6, 7.6, 7.6) @ 1900 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)

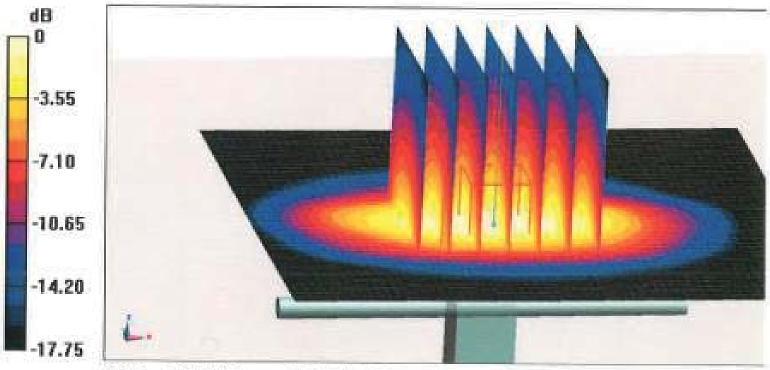
System Performance Check/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 92.12 V/m; Power Drift = -0.05 dB

Peak SAR (extrapolated) = 19.2 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.2 W/kg

Maximum value of SAR (measured) = 16.0 W/kg



0 dB = 16.0 W/kg = 12.04 dBW/kg

Certificate No: Z19-60004 Page 7 of 8

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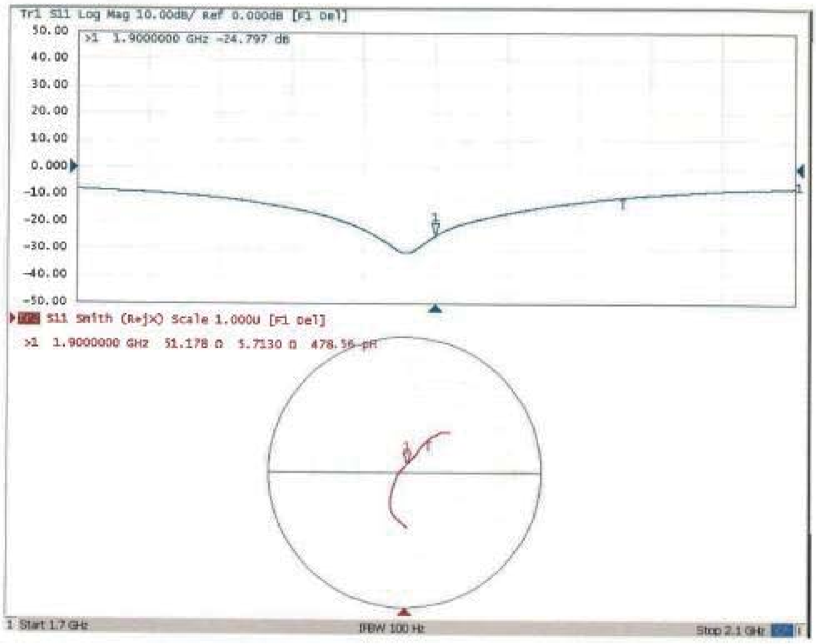
Impedance Measurement Plot for Body TSL



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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	
Reviewed by:	Lin Hao	SAR Test Engineer	
Approved by:	Qi Dianyuan	SAR Project Leader	

Issued: January 20, 2019

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Glossary:

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

Calibration is Performed According to the Following Standards:

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

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

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

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

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

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Measurement Conditions

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

DASY Version	DASY52	52.10.2.1495
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)**

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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

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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)

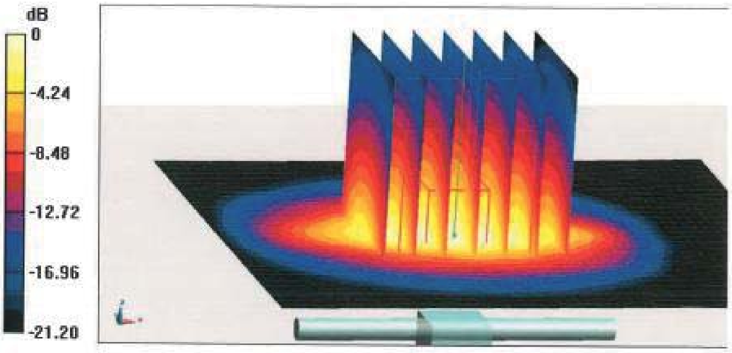
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

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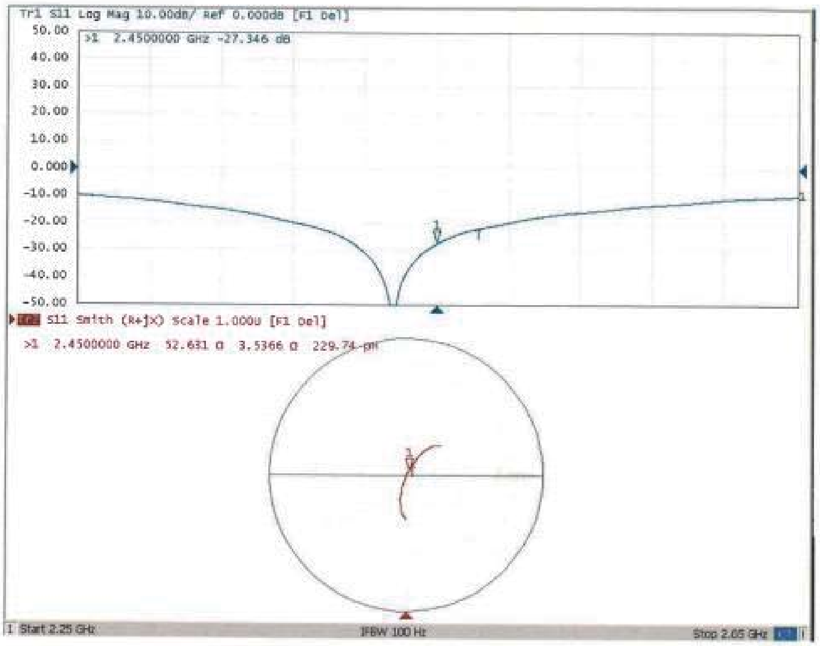
Impedance Measurement Plot for Head TSL



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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)

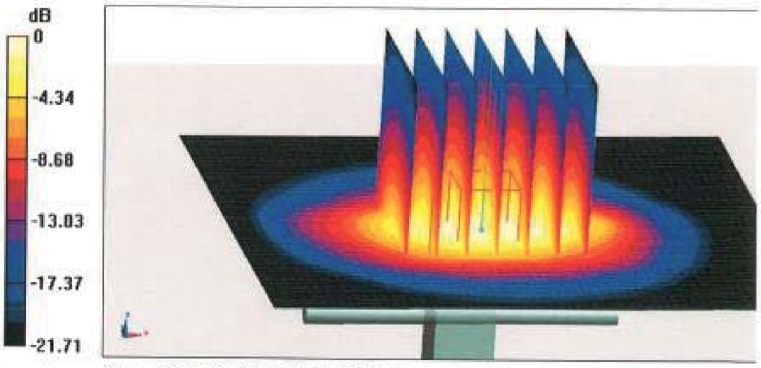
Dipole Calibration/Zoom Scan (7x7x7) (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

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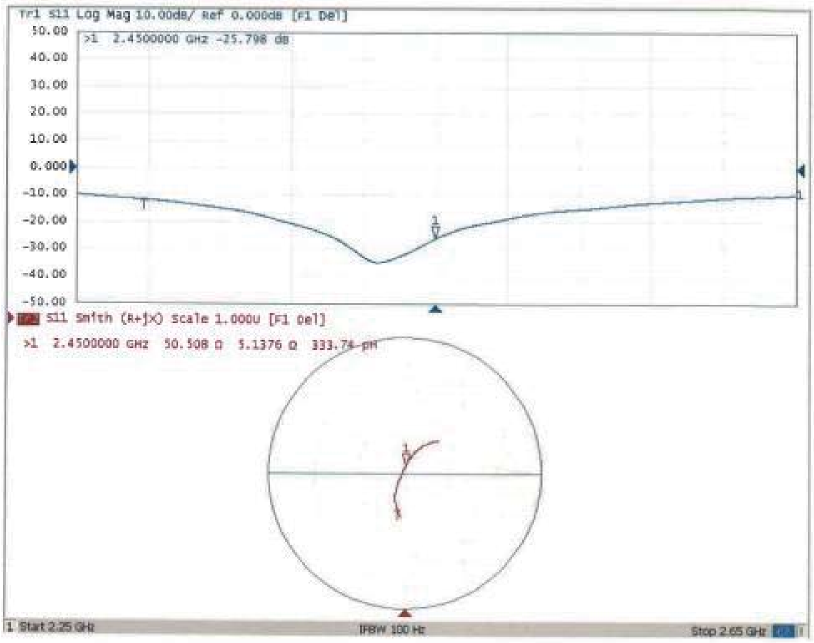
Impedance Measurement Plot for Body TSL



Certificate No: Z19-60007 Page 8 of 8

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