SAR TEST REPORT

Report No.：	SET2017-09247
Product：	PPM 360 Meter
Model No.：	DA120
Brand Name：	Nielsen
FCC ID：	IGKDA120
Applicant：	Nielsen Audio, inc.
Address：	7000 Columbia Gateway Drive, Suite 200, Columbia Maryland, USA 21046.
Issued by：	CCIC-SET
Lab Location：	Electronic Testing Building, Shahe Road，Xili, Nanshan District, Shenzhen, 518055, P. R. China
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Test Report

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Manufacturer.....:	Nielsen Audio, inc.
Manufacturer Address.....:	7000 Columbia Gateway Drive, Suite 200, Columbia Maryland, USA 21046.
Test Standards.....:	**47CFR § 2.1093-**Radiofrequency Radiation Exposure Evaluation: Portable Devices; **ANSI C95.1–2005:**Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz – 300 GHz.(IEEE Std C95.1-2005)
Test Result.....:	Pass

Tested by .....: Mei Chun 2017-06-23

Chun Mei, Test Engineer

Reviewed by.....: Shuangwen Zhang 2017-06-23

Shuangwen Zhang,Senior Egineer

Approved by.....: Wu Lian 2017-06-23

Wu Li'an , Manager

Contents

This Test Report consists of the following Annexes:

1. GENERAL CONDITIONS

1.1 This report only refers to the item that has undergone the test.

1.2 This report standalone does not constitute or imply by its own an approval of the product by the certification Bodies or competent Authorities.

1.3 This document is only valid if complete; no partial reproduction can be made without written approval of CCIC-SET.

1.4 This report cannot be used partially or in full for publicity and/or promotional purposes without previous written approval of CCIC-SET and the Accreditation Bodies, if it applies.

2. Administrative Date

2.1. Identification of the Responsible Testing Laboratory

Company Name:	CCIC-SET
Department:	EMC & RF Department
Address:	Building 28/29, East of Shigu, Xili Industrial Zone, Xili Road, Nanshan District, Shenzhen, Guangdong, China
Telephone:	+86-755-26629676
Fax:	+86-755-26627238
Responsible Test Lab Managers:	Mr. Wu Li'an

2.2. Identification of the Responsible Testing Location(s)

Company Name:	CCIC-SET
Address:	Building 28/29, East of Shigu, Xili Industrial Zone, Xili Road, Nanshan District, Shenzhen, Guangdong, China

2.3. Organization Item

CCIC-SET Report No.:	SET2017-09247
CCIC-SET Project Leader:	Mr. Chun Mei,
CCIC-SET Responsible for accreditation scope:	Mr. Wu Li'an
Start of Testing:	2017-06-20
End of Testing:	2017-06-23

2.4. Identification of Applicant

Company Name:	Nielsen Audio, inc.
Address:	7000 Columbia Gateway Drive, Suite 200, Columbia Maryland, USA 21046.

2.5. Identification of Manufacture

Company Name:	Nielsen Audio, inc.
Address:	7000 Columbia Gateway Drive, Suite 200, Columbia Maryland, USA 21046.

Notes: This data is based on the information by the applicant.

3. General Information

3.1. Description Of Equipment Under Test (EUT)

Sample Name:	PPM 360 Meter	
Type Name:	DA120	
Brand Name:	Nielsen	
Mobile phone capability	Class B	
Dual Transfer Mode (DTM) per 3GPP 51.010	Not supported	
General description:	Support Band and Frequency Range	GSM 850MHz: 824.2MHz -848.8MHz GSM 1900MHz: 1850.2MHz-1909.8MHz WCDMA/HSPA Band V: 826.4MHz-846.6MHz WCDMA/HSPA Band II: 1852.4MHz-1907.6MHz Bluetooth: 2402MHz-2480MHz
	Development Stage	Identical Prototype
	Accessories	Power Supply, Belt-clip
	Battery type	Lithium-ion Battery
	Battery specification	980mAh 3.7V
	Antenna type	Internal
	Modulation mode	GSM: GMSK, 8PSK; WCDMA: QPSK; Bluetooth: GFSK/ π /4-DQPSK/ 8-DPSK
MAX. SAR Value:	Body: 1.139W/Kg (Back)	

NOTE:

a. The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

b. This device supports GPRS/EGPRS operation up to class12.

4 Specific Absorption Rate (SAR)

4.1 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 ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

4.2 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 (). The equation description is as below:

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

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

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

$$\mathbf{SAR} = C\frac{\delta T}{\delta t}$$

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

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

where σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the rms electrical field strength.

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

4.3 Phantoms

The phantom used for all tests i.e. for both system checks and device testing, was the twin-headed "SAM Phantom", manufactured by SATIMO. The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region, where shell thickness increases to 6mm).

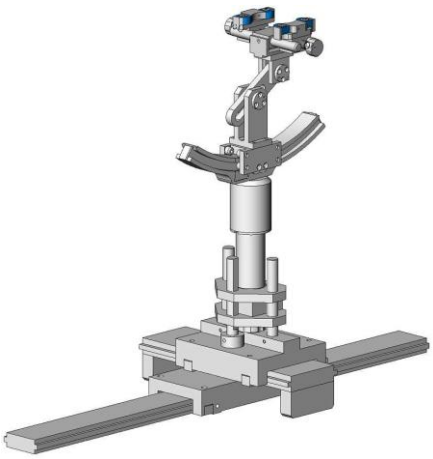
System checking was performed using the flat section, whilst Head SAR tests used the left and right head profile sections. Body SAR testing also used the flat section between the head profiles.

SAM Twin Phantom

4.4 Device Holder

The device was placed in the device holder (illustrated below) that is supplied by SATIMO as an integral part of the COMOSAR test system.

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



Device holder

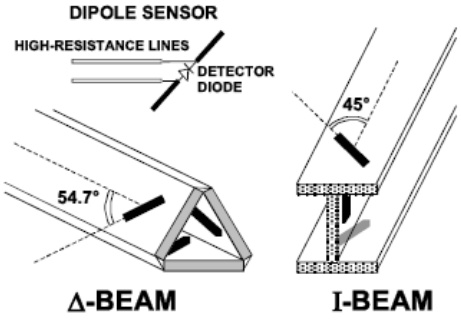
4.5 Probe Specification

Construction	Symmetrical design with triangular core Interleaved sensors Built-in shielding against static charges PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Calibration	ISO/IEC 17025 calibration service available.
Frequency	700 MHz to 3 GHz; Linearity: ± 0.5 dB (700 MHz to 3 GHz)
Directivity	± 0.25 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	1.5 µW/g to 100 mW/g; Linearity: ± 0.5 dB
Dimensions	Overall length: 330 mm (Tip: 20 mm) Tip diameter: 5 mm (Body: 8 mm) Distance from probe tip to dipole centers: <2.7 mm
Application	General dosimetry up to 3 GHz Dosimetry in strong gradient fields Compliance tests of mobile phones
Compatibility	COMOSAR

Isotropic E-Field Probe

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

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



5. OPERATIONAL CONDITIONS DURING TEST

5.1 Schematic Test Configuration

During SAR test, EUT was operating in Traffic Mode (Channel Allocated) at Normal Voltage Condition. A communication link is set up with a System Simulator (SS) by air link, and a call is established.

The Absolute Radio Frequency Channel Number (ARFCN) was allocated to 128, 190 and 251 respectively in the case of GSM 850MHz, or to 512, 661 and 810 respectively in the case of PCS 1900MHz, or to 4132, 4183 and 4233 respectively in the case of WCCDMA 850MHz, or to 9262, 9400 and 9538 respectively in the case of WCDMA 1900 MHz. The EUT was commanded to operate at maximum transmitting power.

The EUT should use its internal transmitter. The antenna(s), battery and accessories shall be those specified by the manufacturer. The EUT battery must be fully charged and checked periodically during the test to ascertain uniform power output. If a wireless link was used, the antenna connected to the output of the base station simulator shall be placed at least 50 cm away from the handset.

The signal transmitted by the simulator to the antenna feeding point should be lower than the output power level of the handset by at least 35 dB

5.2 SAR Measurement System

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

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

5.2.1 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in P1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness Power drifts in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations described in Reference [12] and extrapolated according to the head parameters specified in P1528.

Recommended Dielectric Performance of Tissue

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (Nacl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton x-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (s/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Recommended Tissue Dielectric Parameters

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

5.2.2 Simulant liquids

For measurements against the phantom head, the “cheek” and “tilt” position on both the left hand and the right hand sides of the phantom. For body-worn measurements, the EUT was tested against flat phantom representing the user body. The EUT was put on in the belt holder. Simulant liquids that are used for testing at frequencies of GSM 850MHz, GSM 1900MHz, WCDMA 850MHz, WCDMA 1900MHz, which are made mainly of sugar, salt and water solutions may be left in the phantoms.

Dielectric Performance of Body Tissue Simulating Liquid

Temperature: 23.2°C; Humidity: 64%;			
/	Frequency	Permittivity ε	Conductivity σ (S/m)
Target value	835MHz	55.2±5%	0.97±5%
Validation value(2017-06-19)	835MHz	55.23	0.98
Target value	1900MHz	53.3±5%	1.52±5%
Validation value(2017-06-20)	1900MHz	53.26	1.50

Dielectric Performance of Tissue Simulating Liquid at test channel

Band	Channel	Frequency (MHz)	Permittivity ε		Conductivity σ (S/m)	
			Head	Body	Head	Body
GSM 850	128	824.2	/	55.48	/	0.95
	189	836.4	/	55.65	/	0.98
	251	848.8	/	55.71	/	0.99
GSM 1900	512	1850.2	/	53.18	/	1.5
	661	1880.0	/	53.27	/	1.51
	810	1909.8	/	53.44	/	1.53
WCDMA 850	4132	826.4	/	55.48	/	0.95
	4183	836.6	/	55.65	/	0.98
	4233	846.6	/	55.71	/	0.99
WCDMA 1900	9262	1852.4	/	53.18	/	1.5
	9400	1880.0	/	53.27	/	1.51
	9538	1907.6	/	53.44	/	1.53

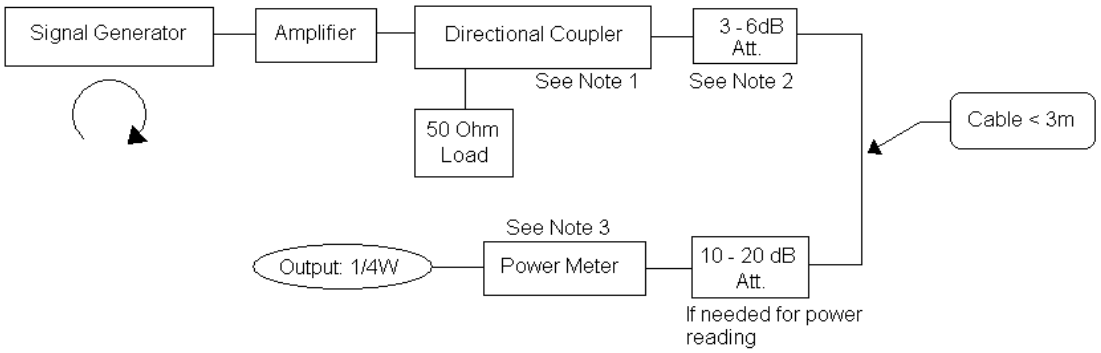
5.2.3 Equipments and results of validation testing

Important equipments :

Equipment description	Manufacturer/Model	Identification No.
SAR Probe	SATIMO	SN_0913_EP169
Phantom	SATIMO	SN_0913_SAM97
Liquid	SATIMO	-
Dipole	SATIMO-SID835	SN_0913_DIP0G835-217
Dipole	SATIMO-SID18iple1010.08r k Analyzere the 2450 MHz bandoperation mode. following table, for more information, please refer the RF test report00	SN_0913_DIP1G800-216
Dipole	SATIMO-SID1900	SN_0913_DIP1G900-218
Dipole	SATIMO-SID2450	SN_0913_DIP2G450-220
Vector Network Analyzer	Rohde & Schwarz - ZVB8	1145.1010.08
Amplifier	Nucletudes	143060
Power Meter	Rohde & Schwarz - NRVS	1020.1809.02
Multimeter	Keithley - 2000	4014020

Prior to the assessment, the system validation kit was used to test whether the system was operating within its specifications of ±10%. The validation results are tabulated below. And also the corresponding SAR plot is attached as well in the SAR plots files.

The following procedure, recommended for performing validation tests using box phantoms is based on the procedures described in the draft IEEE standard P1528. Setup according to the setup diagram below :



With the SG and Amp and with directional coupler in place, set up the source signal at the relevant frequency and use a power meter to measure the power at the end of the SMA cable that you intend to connect to the balanced dipole. Adjust the SG to make this, say, 0.25W (24 dBm). If this level is too high to read directly with the power meter sensor, insert a calibrated attenuator (e.g. 10 or 20 dB) and make a suitable correction to the power meter reading.

Note 1: In this method, the directional coupler is used for monitoring rather than setting the exact feed power level. If, however, the directional coupler is used for power measurement, you should check the frequency range and power rating of the coupler and measure the coupling factor (referred to output) at the test frequency using a VNA.

Note 2: Remember that the use of a 3dB attenuator (as shown in Figure 8.1 of P1528) means that you need an RF amplifier of 2 times greater power for the same feed power. The other issue is the cable length. You might get up to 1dB of loss per meter of cable, so the cable length after the coupler needs to be quite short.

Note 3: For the validation testing done using CW signals, most power meters are suitable. However, if you are measuring the output of a modulated signal from either a signal generator or a handset, you must ensure that the power meter correctly reads the modulated signals.

The measured 1-gram averaged SAR values of the device against the phantom are provided in Tables 5 and Table 6. The humidity and ambient temperature of test facility were 64% and 23.2°C respectively. The body phantom were full of the body tissue simulating liquid. The EUT was supplied with full-charged battery for each measurement.

The distance between the back of the EUT and the bottom of the flat phantom is 10 mm (taking into account of the IEEE 1528-2013 and the place of the antenna).

Body Liquid Verification Results (1g)

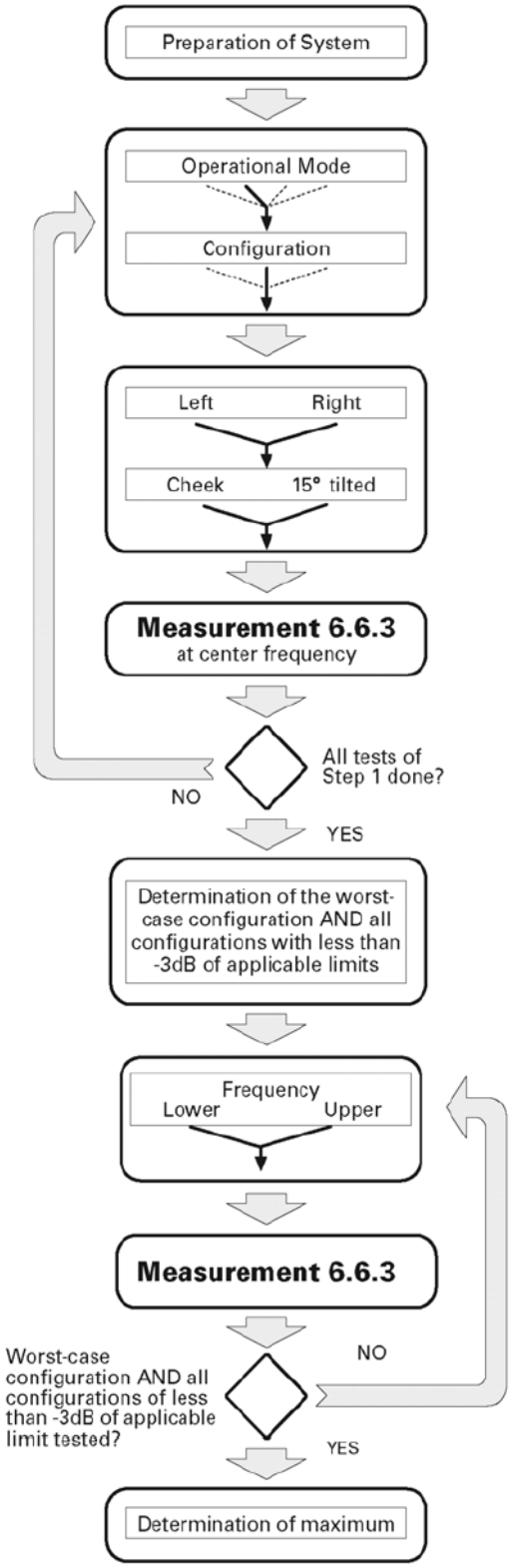
Frequency	Duty cycle	Target value （W/kg）	Test value (W/kg)	
			10 mW	1W
835MHz(2017-06-19)	1:1	10.31±10%	0.1031	10.31
1900MHz(2017-06-20)	1:1	40.81±10%	0.4074	40.74

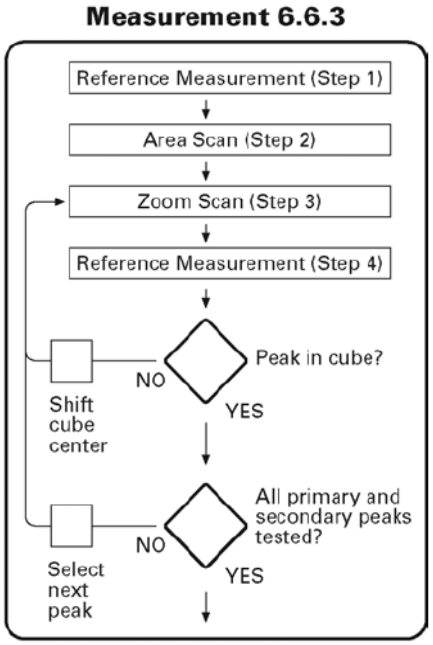
Note: Target value was referring to the required value in the calibration certificate of reference dipole.

Note: All SAR values are normalized to 1W forward power.

5.2.4 SAR measurement procedure

The SAR test against the head phantom was carried out as follow:





Establish a call with the maximum output power with a base station simulator, the connection between the EUT and the base station simulator is established via air interface.

After an area scan has been done at a fixed distance of 2mm from the surface of the

phantom on the source side, a 3D scan is set up around the location of the maximum spot SAR. First, a point within the scan area is visited by the probe and a SAR reading taken at the start of testing. At the end of testing, the probe is returned to the same point and a second reading is taken. Comparison between these start and end readings enables the power drift during measurement to be assessed.

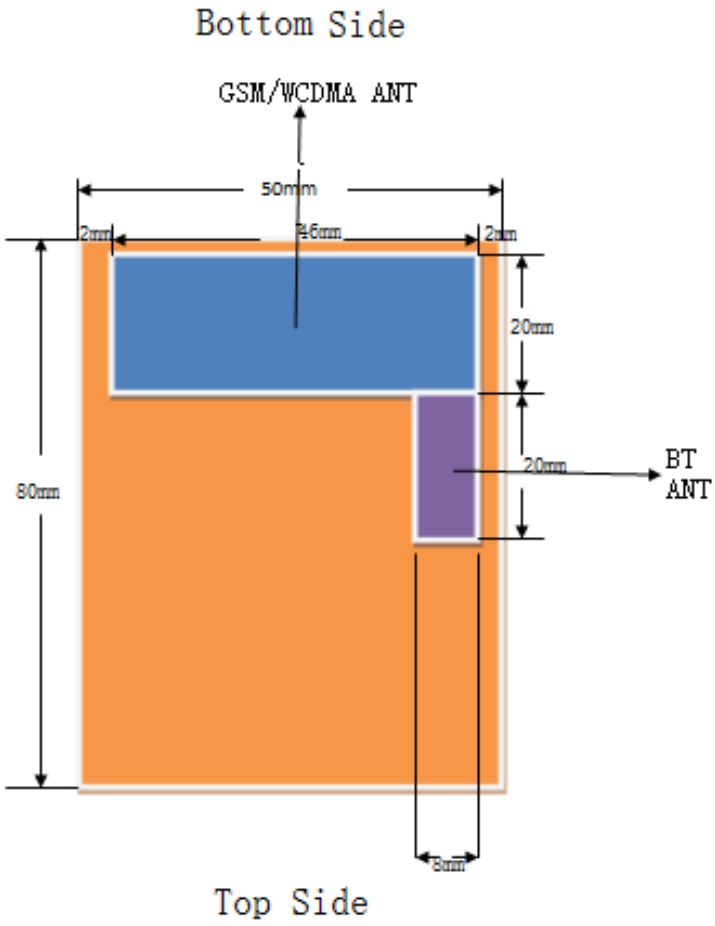
Above is the scanning procedure flow chart and table from the IEEE1528-2013 standard. This is the procedure for which all compliant testing should be carried out to ensure that all variations of the device position and transmission behavior are tested.

For SAR measurement, the liquid deep max more than 15cm as below photo

Head Liquid	Body Liquid
	

5.2.5 Transmitting antenna information

There are four antennas (GSM/WCDMA antenna, WLAN antenna, BT antenna and GPS antenna) inside the EUT, the former three antennas are the transmitting source, and they are a type of PIFA antenna, the following picture shows the position of the antennas.



Note: The back of this device has a belt-clip, and the thickness of the clip is greater than 5mm. So the SAR close test not need to do.

6 CHARACTERISTICS OF THE TEST

6.1 Applicable Limit Regulations

47CFR § 2.1093- Radiofrequency Radiation Exposure Evaluation: Portable Devices;

RSS-102-2015: Radio Frequency (RF) Exposure Compliance of Radio communication Apparatus (All Frequency Bands);

ANSI 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.

6.2 Applicable Measurement Standards

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this is in accordance with the following standards:

FCC 47 CFR Part2 (2.1093)
ANSI/IEEE C95.1-2005
IEEE 1528-2013
FCC KDB 865664 DO1 SAR Measurement 100MHz to 6GHz v01r04
FCC KDB 865664 DO2 Exposure Reporting v01r02
FCC KDB 447498 DO1 General RF Exposure Guidance v06
FCC KDB 648474 DO4 Handset SAR v01r04
FCC 941225 D01 3G SAR Procedures v03r01

7 LABORATORY ENVIRONMENTS

The Ambient Conditions during SAR Test

Temperature	Min. = 20 ° C, Max. = 30 ° C
Atmospheric pressure	Min.=86 kPa, Max.=106 kPa
Relative humidity	Min. = 30%, Max. = 70%
Ground system resistance	< 0.5 Ω
Ambient noise is checked and found very low and in compliance with requirement of standards. Reflection of surrounding objects is minimized and in compliance with requirement of standards.	

8. Conducted RF Output Power

Band		Burst Average Power (dBm)			Frame-Average Power (dBm)		
GSM850	TX Channel	128	190	251	128	190	251
	Frequency(MHz)	824.2	836.4	848.8	824.2	836.4	848.8
	GPRS(GMSK, 1 Tx slot) CS1	31.91	32.01	31.68	22.91	23.01	22.68
	GPRS(GMSK, 2 Tx slot) CS1	31.80	31.72	31.63	25.80	25.72	25.63
	GPRS(GMSK, 3 Tx slot) CS1	31.71	31.60	31.57	27.41	27.60	27.57
	GPRS(GMSK, 4 Tx slot) CS1	30.59	30.70	30.52	27.59	27.70	27.52
	EGPRS(GMSK, 1 Tx slot)MCS1	31.72	31.97	31.64	22.72	22.97	22.64
	EGPRS(GMSK, 2 Tx slot)MCS1	31.66	31.68	31.56	25.66	25.68	25.56
	EGPRS(GMSK, 3 Tx slot)MCS1	31.57	31.57	31.49	27.57	27.57	27.49
	EGPRS(GMSK, 4 Tx slot)MCS1	30.58	30.62	30.47	27.58	27.62	27.47
	EGPRS(8PSK, 1 Tx slot) MCS5	27.50	27.40	27.32	18.50	18.40	18.32
	EGPRS(8PSK, 2 Tx slot) MCS5	26.94	26.82	26.74	20.94	20.82	20.74
	EGPRS(8PSK, 3 Tx slot) MCS5	26.89	26.77	26.68	22.89	22.77	22.68
	EGPRS(8PSK, 4 Tx slot) MCS5	26.30	26.24	26.14	23.30	23.24	23.14

	TX Channel	512	661	810	512	661	810
	Frequency(MHz)	1850.2	1880	1909.8	1850.2	1880	1909.8
GSM1900	GPRS(GMSK, 1 Tx slot) CS1	29.22	30.07	29.72	20.22	21.07	20.72
	GPRS(GMSK, 2 Tx slot) CS1	29.20	29.94	29.69	23.20	23.94	23.69
	GPRS(GMSK, 3 Tx slot) CS1	29.17	29.84	29.64	25.17	25.84	25.64
	GPRS(GMSK, 4 Tx slot) CS1	28.20	29.49	28.64	25.20	26.49	25.64
	EGPRS(GMSK, 1 Tx slot)MCS1	29.20	29.96	29.67	20.20	20.96	20.67
	EGPRS(GMSK, 2 Tx slot)MCS1	29.15	29.88	29.61	23.15	23.88	23.61
	EGPRS(GMSK, 3 Tx slot)MCS1	29.11	29.78	29.55	25.11	25.78	25.55
	EGPRS(GMSK, 4 Tx slot)MCS1	28.12	29.28	28.61	25.12	26.28	25.61
	EGPRS(8PSK, 1 Tx slot) MCS5	25.84	27.24	26.30	16.84	18.24	17.30
	EGPRS(8PSK, 2 Tx slot) MCS5	25.32	26.70	25.76	19.32	20.70	19.76
	EGPRS(8PSK, 3 Tx slot) MCS5	25.29	26.63	25.73	21.29	22.63	21.73
	EGPRS(8PSK, 4 Tx slot) MCS5	24.78	26.08	25.20	21.78	23.08	22.20

Conducted Power (Unit: dBm)						
Band	WCDMA Band II			WCDMA Band V		
Channel	9262	9400	9538	4132	4183	4233
Frequency	1852.4	1880	1907.6	826.4	836.6	846.6
RMC 12.2Kbps	23.37	**23.77**	23.67	23.34	**23.82**	23.65
HSDPA Subtest-1	23.24	23.48	23.58	23.31	23.74	23.45
HSDPA Subtest-2	23.21	23.41	23.57	23.27	23.68	23.38
HSDPA Subtest-3	23.22	23.38	23.51	23.29	23.71	23.37
HSDPA Subtest-4	23.18	23.41	23.55	23.19	23.72	23.36

Note: Per KDB 447498 D01 v06, the maximum output power channel is used for SAR testing and for further SAR test reduction.

Bluetooth Average Power (dBm)				
Channel	Frequency (MHz)	Modulation Type		
		GFSK	**Π /4-DQPSK**	**8-DPSK**
CH 0	2402	4.7	**5.4**	4.9
CH 39	2441	4.9	5.2	5.1
CH 78	2480	5.0	5.0	5.1

Note:

1. Per KDB 447498 D01 v06, the 1-g and 10-g SAR test exclusion thresholds for 100MHz to 6GHz at test separation distances ≤ 50mm are determined by:
   [(max. power of channel, including tune-up tolerance, mW)/(min. test separation distance, mm)] • [$\sqrt{f}$ (GHz)] ≤3.0 for 1-g SAR and ≤7.5 for 10-g extremity SAR
   (1) f(GHz) is the RF channel transmit frequency in GHz
   (2) Power and distance are round to the nearest mW and mm before calculation
   (3) The result is rounded to one decimal place for comparison
   (4) If the test separation distance(antenna-user) is < 5mm, 5mm is used for excluded SAR calculation

Bluetooth Max Power (dBm)	mW	Test Distance (mm)	Frequency(GHz)	Exclusion Thresholds
6	3.98	5	2.402	1.234

2. Per KDB 447498 D01 v06 exclusion thresholds 1.234<3.0, RF exposure evaluation is not required.

9. SAR DATA SUMMARY

9.1 General Note

1. Per KDB 447498 D01 v06, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
   Tune-up scaling Factor = tune-up limit power(mW)/EUT RF power(mW), where tune-up limit is the maximum rated power among all production units.
2. Per KDB 447498 D01v06, for each exposure position, if the highest output channel reported SAR≤0.8W/kg, other channels SAR testing is not necessary.
3. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is ≥0.8W/Kg; if the deviation among the repeated measurement is ≤ 20%, and the measured SAR <1.45W/Kg, only one repeated measurement is required.
4. Per KDB865664 D02 v01r02, SAR plot is only required for the highest measured SAR in each exposure configuration, wireless mode and frequency band combination; Plots are also required when the measured SAR is > 1.5 W/kg, or > 7.0 W/kg for occupational exposure. The published RF exposure KDB procedures may require additional plots; for example, to support SAR to peak location separation ratio test exclusion and/or volume scan post-processing(Refer to appendix D for details).
5. Per KDB 648474 D04v01r01, when the reported SAR for a body-worn accessory measured without a headset connected to the handset is ≤1.2W/kg, SAR testing with a headset connected to the handset is not required.

9.2 Scaling Factor calculation

Operation Mode	Channel	Output Power (dBm)	Tune up Power in tolerance (dBm)	Output Power (Watt)	Tune up Power in tolerance (Watt)	Scaling Factor
GPRS 850 4Tx	190	30.70	32.5	1.17	1.78	1.51
GPRS 1900 4Tx	512	28.20	29.5	0.67	0.89	1.32
	661	29.49	29.5	0.89	0.89	1.00
	810	28.64	29.5	0.73	0.89	1.22
WCDMA Band II	9400	23.77	24	0.24	0.25	1.05
WCDMA Band V	4132	23.34	24	0.22	0.25	1.14
	4183	23.82	24	0.24	0.25	1.04
	4233	23.65	24	0.23	0.25	1.08

10. TEST RESULTS

10.1 Standalone body Worn SAR DATA

Summary of SAR Measurement Results

Mode	Test Positions	Channel /Frequency (MHz)	SAR(W/Kg), 1.6 (1g average)			Plot No.	Repeated SAR Specific value
			SAR(W/Kg)1g	Scaled Factor	Scaled SAR(W/Kg),1g		
GPRS 850 4Tx	FACE	190/836.4	0.341	1.51	0.515	--	
	BACK	190/836.4	**0.754**		**1.139**	**1**	
	TOP	190/836.4	0.312		0.471	--	
	Body-Right	190/836.4	0.26		0.393	--	
	DOWN	190/836.4	0.112		0.169	--	
	Body-Left	190/836.4	0.24		0.362	--	
GPRS 1900 4Tx	FACE	661/1880	0.642	1	0.642	--	
	BACK	512/1850.2	0.711	1.32	0.938		
		661/1880	**0.963**	1	**0.963**	**2**	1.057
		661/1880	0.911	1	0.911		
		810/1909.8	0.735	1.22	0.897		
	TOP	661/1880	0.485	1	0.485	--	
	Body-Right	661/1880	0.387	1	0.387	--	
	DOWN	661/1880	0.208	1	0.208	--	
	Body-Left	661/1880	0.516	1	0.516	--	
WCDMA Band V	FACE	4183/836.6	0.753	1.04	0.783	--	
	BACK	4132/826.4	0.912	1.14	1.039		1.01
		4132/826.4	0.903	1.14	1.029		
		4183/836.6	**1.011**	1.04	**1.051**	**3**	1.014
		4183/836.6	0.997	1.04	1.037		
		4233/846.6	0.886	1.08	0.957		1.006
		4233/846.6	0.891	1.08	0.962		
	TOP	4132/826.4	0.876	1.14	0.999		1.02
		4132/826.4	0.859	1.14	0.979		
		4183/836.6	1.007	1.04	1.047	--	1.006
		4183/836.6	1.001	1.04	1.041		
		4233/846.6	0.904	1.08	0.976		1.007
		4233/846.6	0.898	1.08	0.97		
	Body-Right	4183/836.6	0.523	1.04	0.544	--	
	DOWN	4183/836.6	0.286	1.04	0.297	--	
	Body-Left	4183/836.6	0.791	1.04	0.823	--	
WCDMA Band II	FACE	9400/1880	0.567	1.05	0.595	--	
	BACK	9400/1880	**0.604**		**0.634**	**4**	
	TOP	9400/1880	0.152		0.16	--	
	Body-Right	9400/1880	0.599		0.629	--	
	DOWN	9400/1880	0.287		0.301	--	
	Body-Left	9400/1880	0.551		0.589	--	

10.2 System Performance Check Data

TYPE	BAND	Liquid	
Validation	CW850	Body	Measurement 4: Validation Plane with Body device position on Middle Channel in CW mode
Validation	CW1900	Body	Measurement 5: Validation Plane with Body device position on Middle Channel in CW mode

MEASUREMENT 1

Type: Validation measurement

Date of measurement: 19/6/2017

Measurement duration: 22 minutes 11 seconds

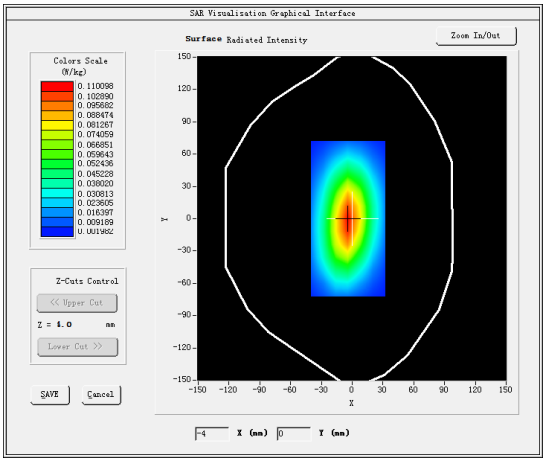
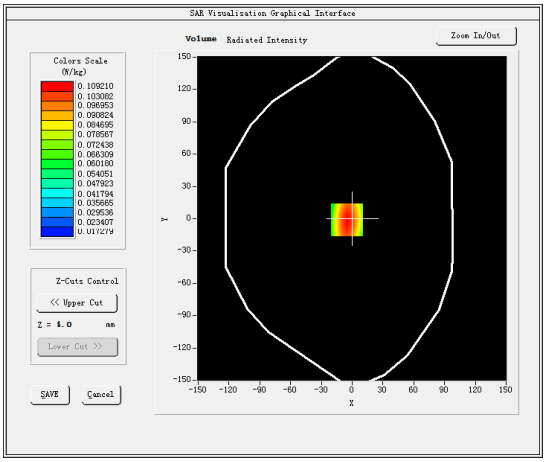
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	CW835
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

E-Field Probe	SATIMO SN_43/15_EP276
Frequency (MHz)	835.0
Relative permittivity (real part)	55.229698
Relative permittivity (imaginary part)	21.130150
Conductivity (S/m)	0.980204
Variation (%)	-0.230000
Temperature:	21.3℃
ConvF:	7.07

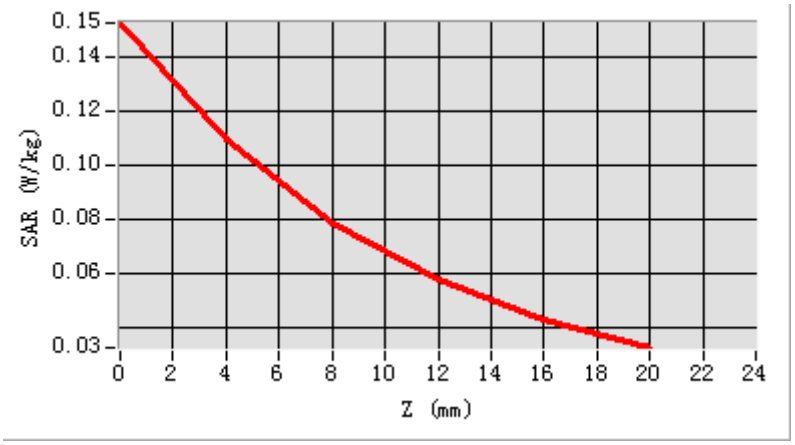
SURFACE SAR	**VOLUME SAR**
	

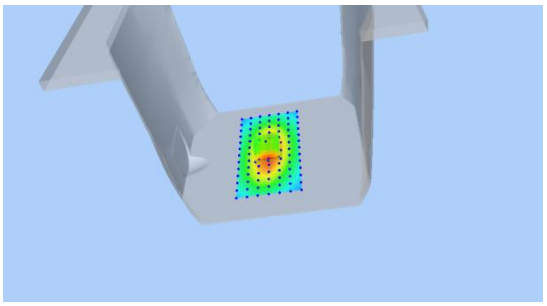
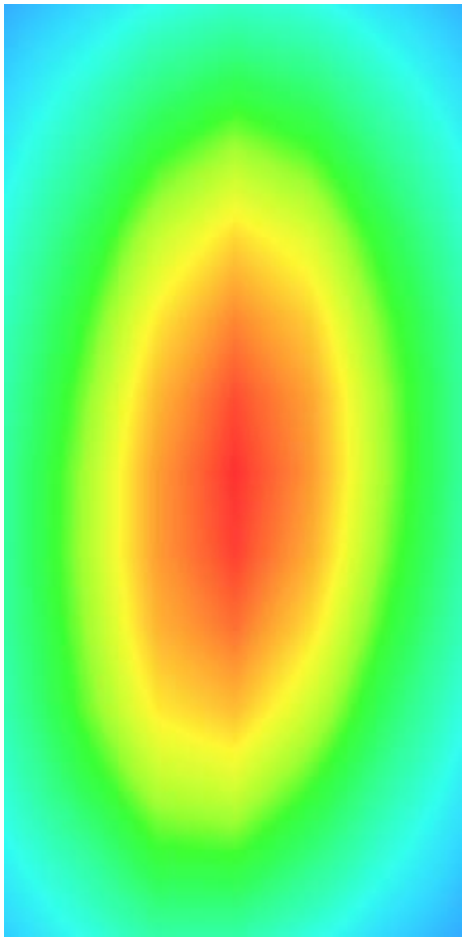
Maximum location: X=-5.00, Y=-1.00

SAR Peak: 0.15 W/kg

SAR 10g (W/Kg)	0.066449
SAR 1g (W/Kg)	0.103121

Z (mm)	0.00	4.00	8.00	12.00	16.00
SAR (W/Kg)	0.1524	0.1092	0.0785	0.0575	0.0432



3D screen shot	Hot spot position
	

MEASUREMENT 2

Type: Validation measurement

Date of measurement: 20/6/2017

Measurement duration:22 minutes 27 seconds

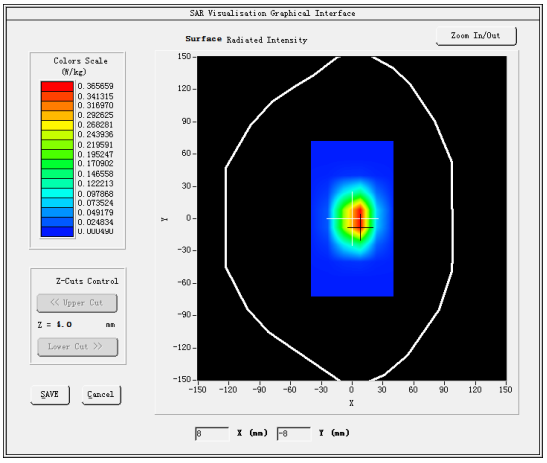
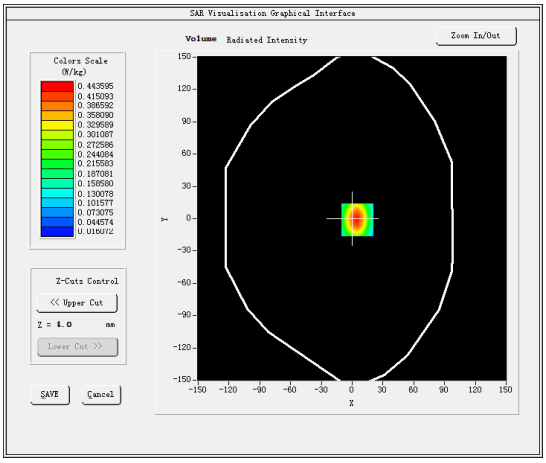
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	CW1900
Channels	Middle
Signal	CW (Crest factor: 1.0)

B. SAR Measurement Results

E-Field Probe	SATIMO SN_43/15_EP276
Frequency (MHz)	1900.0
Relative permittivity (real part)	53.258598
Relative permittivity (imaginary part)	14.210900
Conductivity (S/m)	1.500039
Variation (%)	-0.680000
Temperature:	21.3℃
ConvF:	6.05

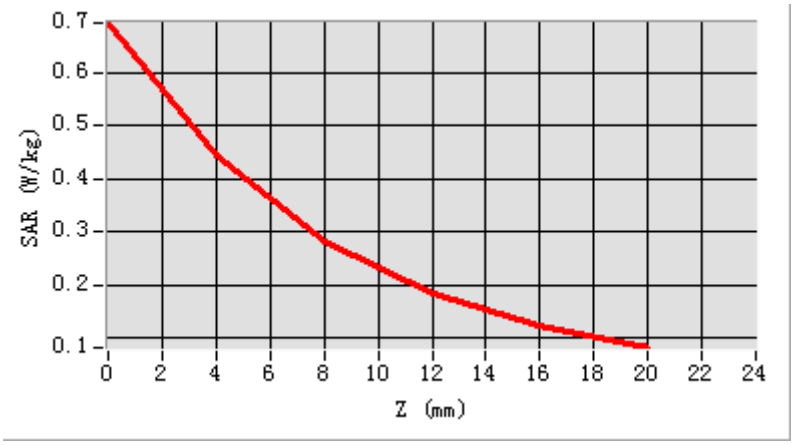
SURFACE SAR	**VOLUME SAR**
	

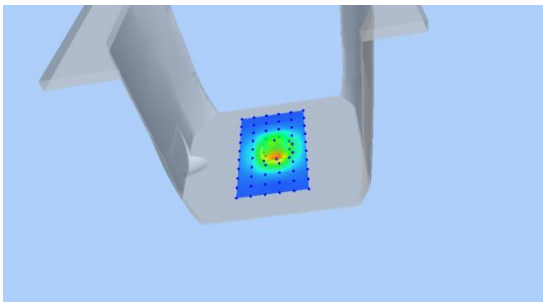
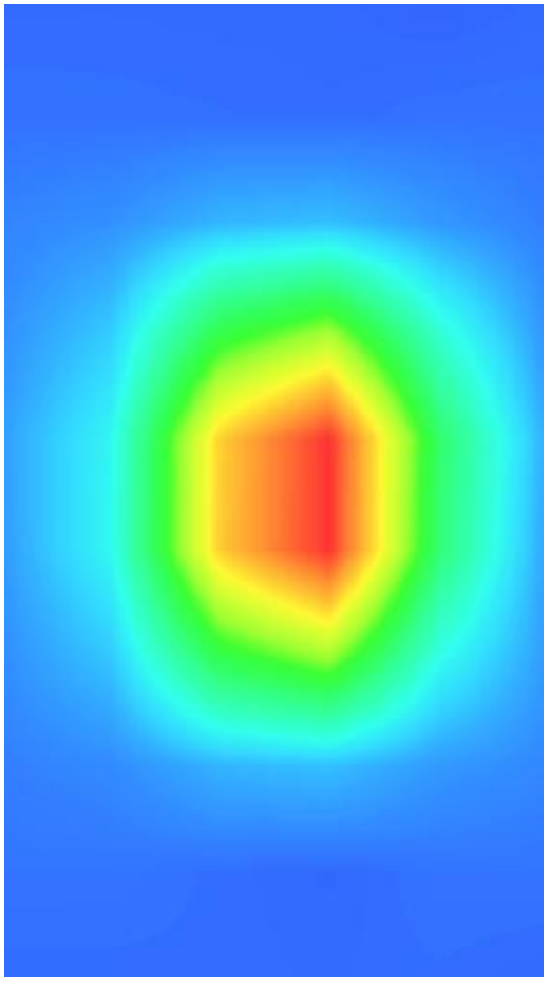
Maximum location: X=5.00, Y=-1.00

SAR Peak: 0.69 W/kg

SAR 10g (W/Kg)	0.215880
SAR 1g (W/Kg)	0.406011

Z (mm)	0.00	4.00	8.00	12.00	16.00
SAR (W/Kg)	0.6927	0.4436	0.2819	0.1826	0.1230



3D screen shot	Hot spot position
	

10.3 Highest SAR Plots

Plot No	Band	Mode	Test Position	Channel
1	G850	GPRS	Back	190

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 20/06/2017

Measurement duration: 22minutes 25 seconds

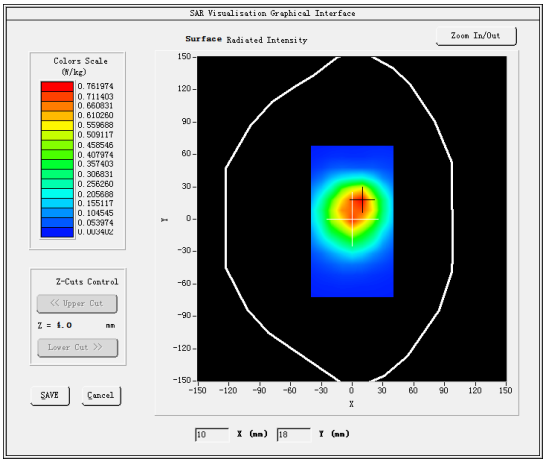
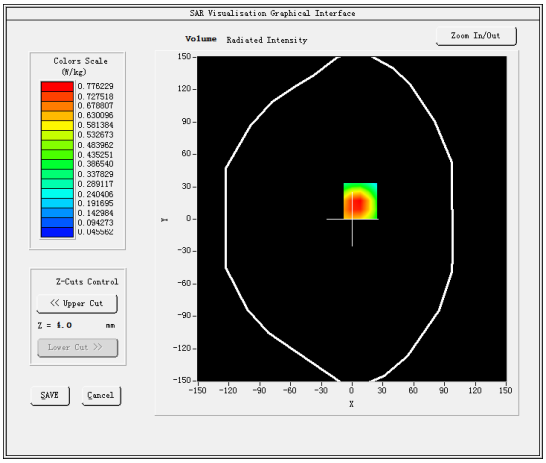
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	Gsm850
Channels	Middle
Signal	Duty Cycle: 2.00 (Crest factor: 2.0)

B. SAR Measurement Results

E-Field Probe	SATIMO SN_43/15_EP276
Frequency (MHz)	835.0
Relative permittivity (real part)	55.229698
Relative permittivity (imaginary part)	21.130150
Conductivity (S/m)	0.980204
Variation (%)	-0.640000

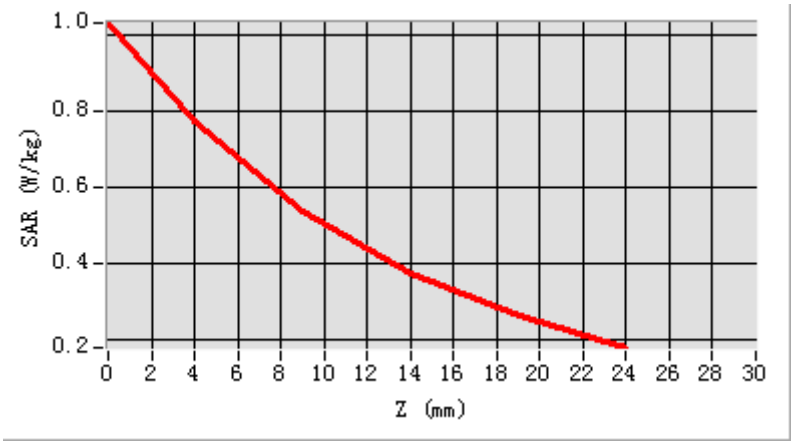
SURFACE SAR	**VOLUME SAR**
	

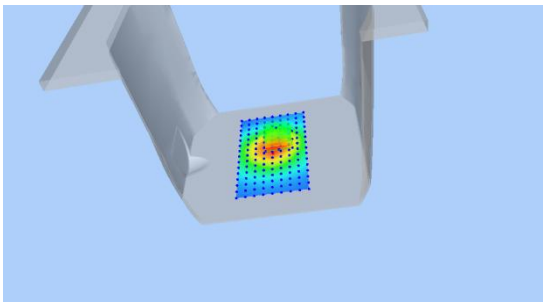
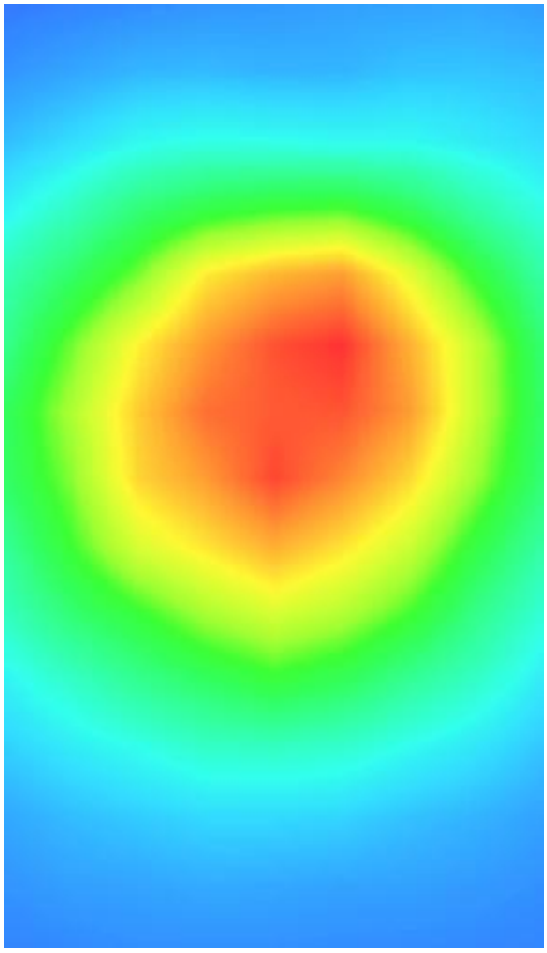
Maximum location: X=8.00, Y=17.00

SAR Peak: 1.07W/kg

SAR 10g (W/Kg)	0.480215
SAR 1g (W/Kg)	0.754420

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.0336	0.7762	0.5391	0.3753	0.2629



3D screen shot	Hot spot position
	

Plot No	Band	Mode	Test Position	Channel
2	G1900	GSM	Back	661

Date of measurement: 20/06/2017

Measurement duration:22 minutes 33 seconds

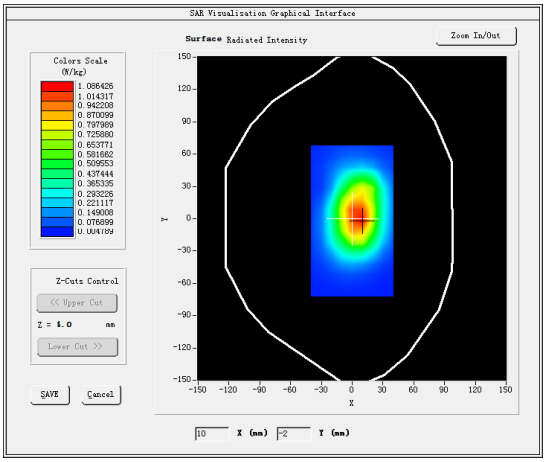
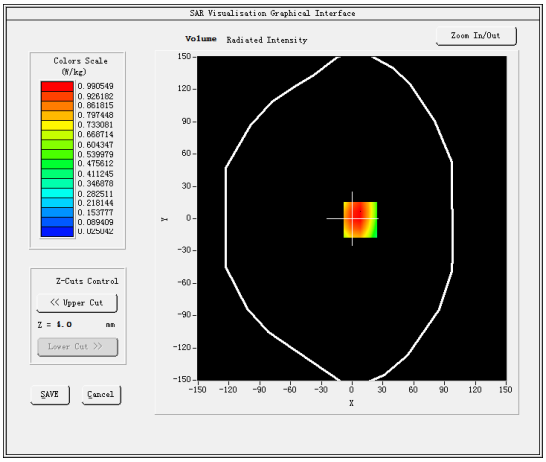
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	Gsm1900
Channels	Middle
Signal	Duty Cycle: 2.00 (Crest factor: 2.0)

B. SAR Measurement Results

E-Field Probe	SATIMO SN_43/15_EP276
Frequency (MHz)	1880.000000
Relative permittivity (real part)	53.258598
Relative permittivity (imaginary part)	14.210900
Conductivity (S/m)	1.500039
Variation (%)	3.220000

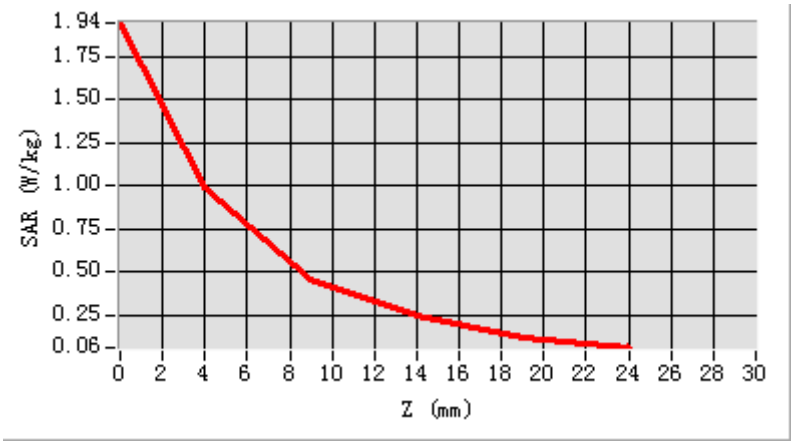
SURFACE SAR	VOLUME SAR
	

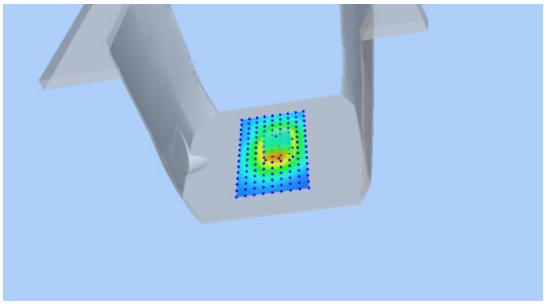
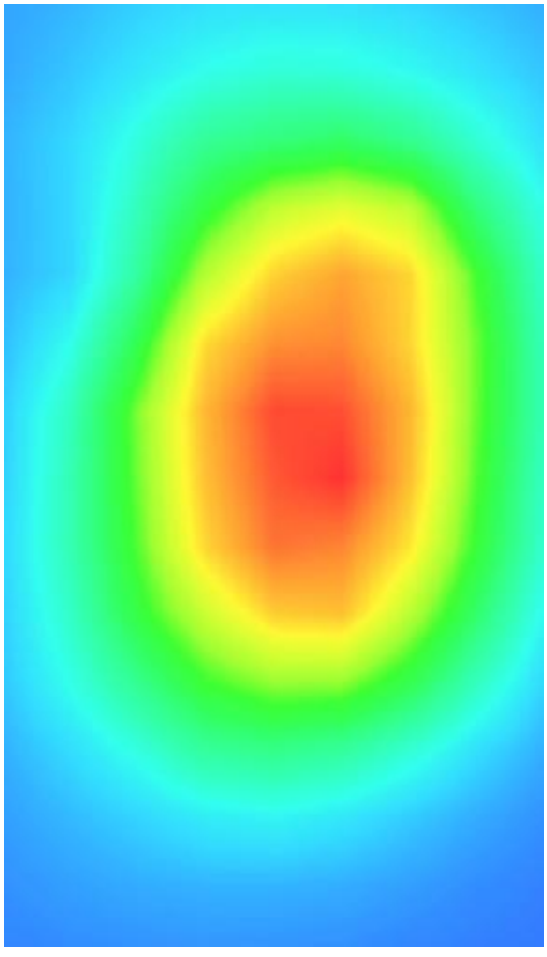
Maximum location: X=-8.00, Y= -1.00

SAR Peak: 1.70 W/kg

SAR 10g (W/Kg)	0.519315
SAR 1g (W/Kg)	0.962992

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.9432	0.9905	0.4555	0.2400	0.1123



3D screen shot	Hot spot position
	

Plot No	Band	Mode	Test Position	Channel
3	W850	RMC12.2K	Back	836.6

Type: Phone measurement (Very fast, 11 points in the volume)

Date of measurement: 20/6/2017

Measurement duration: 22 minutes 26 seconds

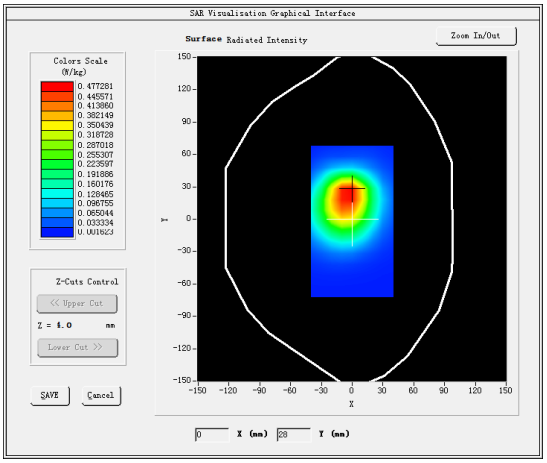
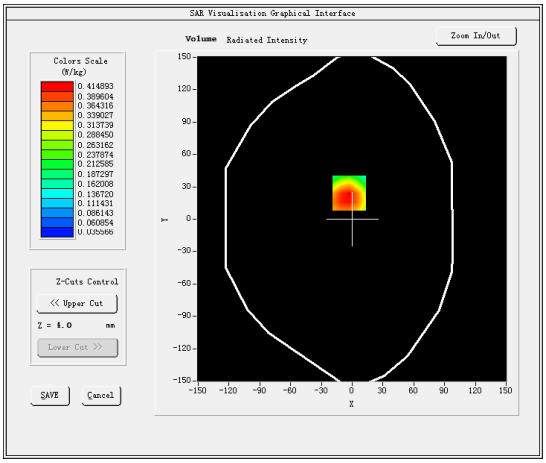
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	WCDMA850
Channels	Middle
Signal	WCDMA: (Crest factor: 1.0)

B.SAR Measurement Results

E-Field Probe	SATIMO SN_43/15_EP276
Frequency (MHz)	55.229698
Relative permittivity (real part)	21.130150
Relative permittivity (imaginary part)	0.980204
Conductivity (S/m)	-0.230000
Variation (%)	-3.830000

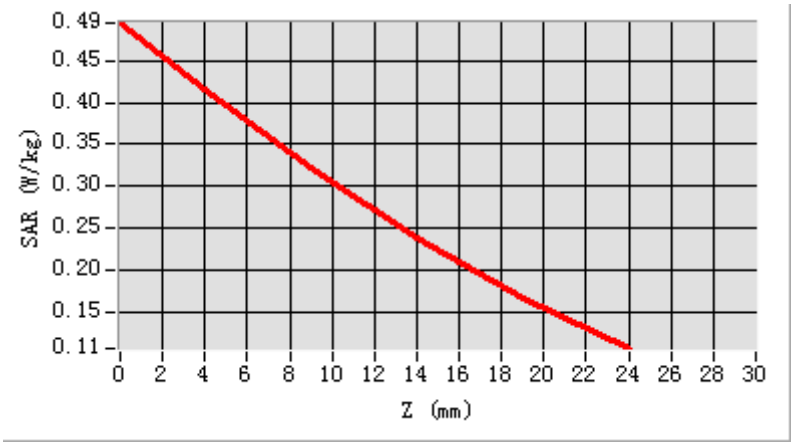
SURFACE SAR	VOLUME SAR
	

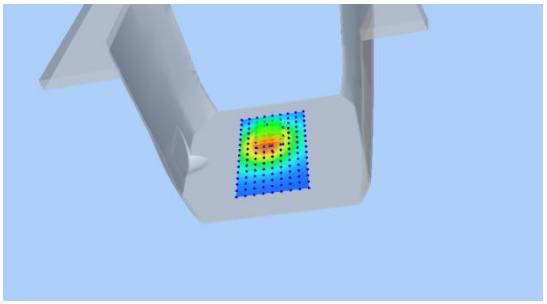
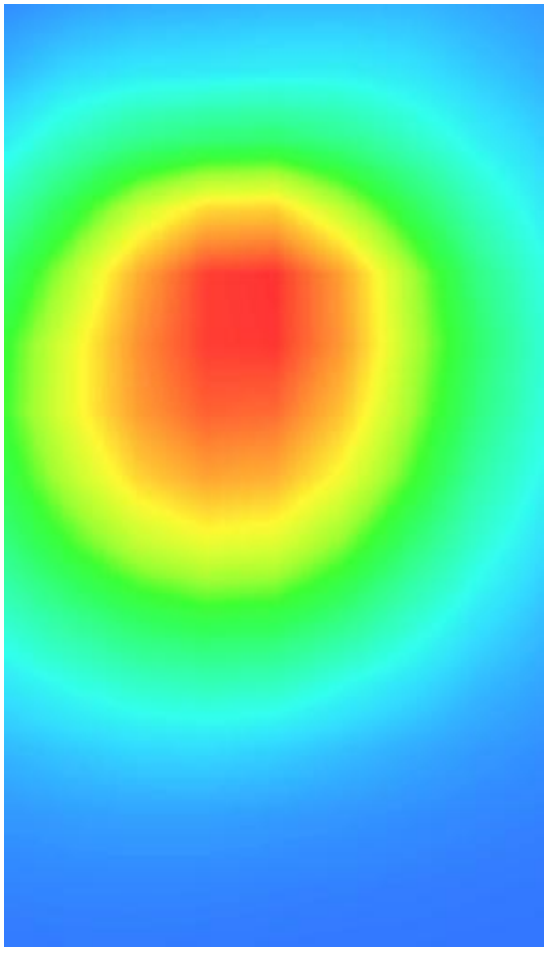
Maximum location: X=-3.00, Y=24.00

SAR Peak: 0.51 W/kg

SAR 10g (W/Kg)	0.477245
SAR 1g (W/Kg)	0.604216

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	0.4943	0.4149	0.3228	0.2399	0.1676



3D screen shot	Hot spot position
	

Plot No	Band	Mode	Test Position	Channel
4	W1900	RMC12.2K	Back	9400

Date of measurement: 20/6/2017

Measurement duration: 22 minutes 13 seconds

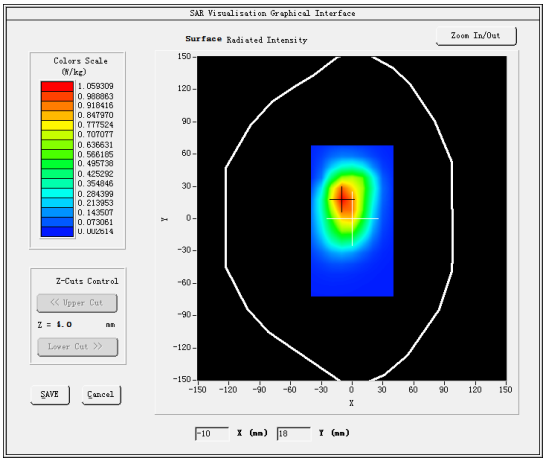
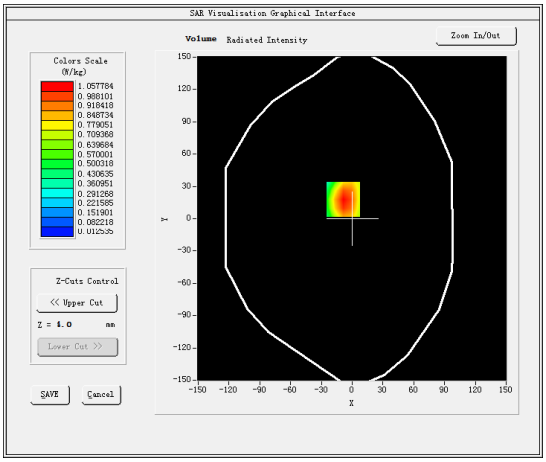
Mobile Phone IMEI number: --

A. Experimental conditions.

Area Scan	dx=8mm dy=8mm
ZoomScan	5x5x7,dx=8mm dy=8mm dz=5mm
Phantom	Validation plane
Device Position	Body
Band	WCDMA1900
Channels	Middle
Signal	WCDMA (Crest factor: 1.0)

B.SAR Measurement Results

E-Field Probe	SATIMO SN_43/15_EP276
Frequency (MHz)	1900.0
Relative permittivity (real part)	53.258598
Relative permittivity (imaginary part)	14.210900
Conductivity (S/m)	1.500039
Variation (%)	0.560000

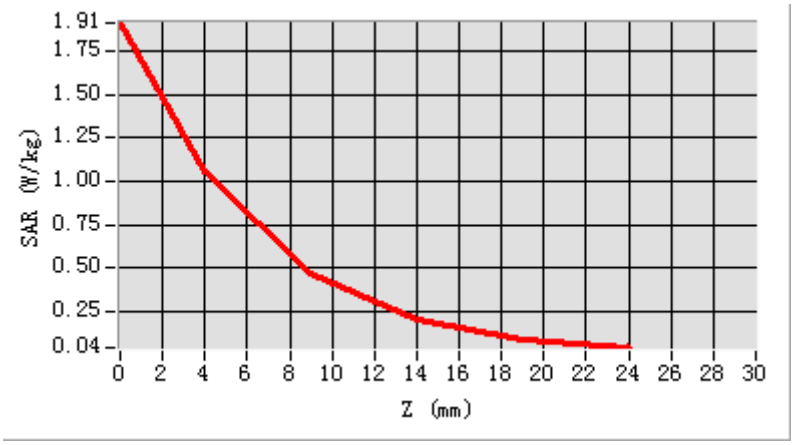
SURFACE SAR	VOLUME SAR
	

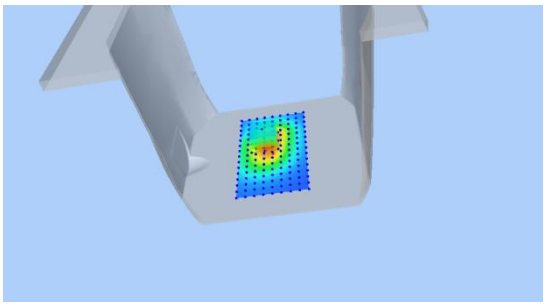
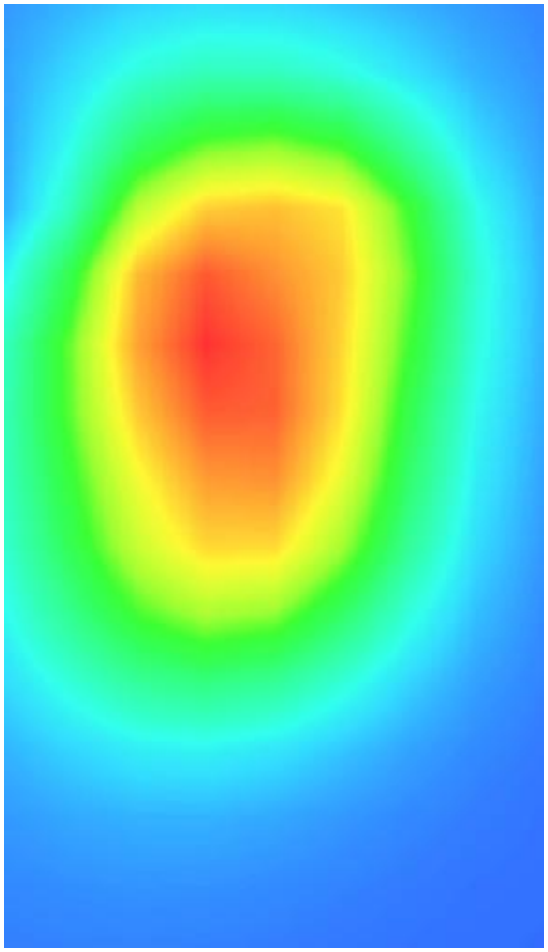
Maximum location: X=-9.00, Y=18.00

SAR Peak: 1.92 W/kg

SAR 10g (W/Kg)	0.505646
SAR 1g (W/Kg)	1.011364

Z (mm)	0.00	4.00	9.00	14.00	19.00
SAR (W/Kg)	1.9129	1.0578	0.4663	0.1980	0.0896



3D screen shot	Hot spot position
	

11. MEASUREMENT UNCERTAINTY

Measurement Uncertainty according to IEEE 1528

No.	Uncertainty Component	Reference	Uncertainty Value (%)	Probability Distribution	k	ci	Standard Uncertainty (%) ui(%)	Degree of freedom Veff or vi
	Measurement System							
1	Probe Calibration(k=1)	E2.1	4.8	N	1	1	4.8	∞
2	Axial isotropy	E2.2	4.7	R	√3	√0.5	1.9	∞
3	Hemispherical Isotropy	E2.2	9.6	R	√3	√0.5	3.9	∞
4	Boundary Effect	E2.3	8.3	R	√3	1	4.8	∞
5	Linearity	E2.4	4.7	R	√3	1	2.7	∞
6	System Detection Limits	E2.4	1.0	R	√3	1	0.6	∞
8	Modulation response	E2.5	4.0	R	√3	1	2.3	∞
9	Readout Electronics	E2.6	1.0	N	1	1	1.0	∞
10	Response Time	E2.7	0.8	R	√3	1	0.5	∞
11	Integration Time	E2.8	1.4	R	√3	1	0.8	∞
12	RF Ambient Conditions-noise	E6.1	3.0	R	√3	1	1.7	∞
13	RF Ambient Conditions-reflections	E6.1	3.0	R	√3	1	1.7	∞
14	Probe Position Mechanical tolerance	E6.2	0.4	R	√3	1	0.2	∞
15	Probe Position with respect to Phantom Shell	E6.3	2.9	R	√3	1	1.7	∞
16	Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation	E5	3.9	R	√3	1	2.3	∞

	Test sample related							
17	Test sample positioning	E4.2	6.0	N	1	1	6.0	11
18	Device holder uncertainty	E4.1	5.0	N	1	1	5.0	7
19	Output Power Variation-SAR drift measurement	E2.9	5.0	R	√3	1	2.9	∞
20	SAR scaling	E6.5	2.0	R	√3	1	1.2	∞
	Phantom and Tissue Parameters							
21	Phantom Uncertainty-shape, thickness and permittivity	E3.1	4.0	R	√3	1	2.3	∞
22	Uncertainty in SAR correction for deviations in permittivity and conductivity	E3.2	1.9	N	1	1	1.9	∞
23	Liquid Conductivity measurement	E3.3	5.5	N	1	0.78	4.3	5
24	Liquid Permittivity measurement	E3.3	2.9	N	1	0.23	0.7	5
25	Liquid conductivity-temperature uncertainty	E3.4	1.7	R	√3	0.78	0.8	∞
26	Liquid permittivity -temperature uncertainty	E3.4	2.7	R	√3	0.23	0.4	∞
Combined Standard Uncertainty				RSS			13.9	135
Expanded uncertainty (95 % confidence interval)				K=2			±27.8	

Measurement Uncertainty for DUT SAR Test according to IEC 62209-2

No.	Source of Uncertainty	Description	Uncertainty Value (%)	Probability Distribution	k	ci	Standard Uncertainty (%) ui(%)	Degree of freedom Veff or vi
	Measurement System							
1	Probe Calibration	7.2.2.1	6	N	1	1	3.5	∞
2	Isotropy	7.2.2.2	14.1	R	√3	1	4.1	∞
3	Linearity	7.2.2.3	4.7	R	√3	1	2.7	∞
4	Probe modulation response	7.2.2.4	3.2	R	√3	1	1.6	
5	Detection Limits	7.2.2.5	1.0	R	√3	1	0.6	∞
6	Boundary Effect	7.2.2.6	11.0	R	√3	1	6.4	∞
7	Readout Electronics	7.2.2.7	1.0	N	1	1	1.00	∞
8	Response Time	7.2.2.8	0.00	R	√3	1	0.00	∞
9	Integration Time	7.2.2.9	0.00	R	√3	1	0.00	∞
10	RF Ambient Conditions-noise	7.2.4.5	3.0	R	√3	1	1.73	∞
11	RF Ambient Conditions-reflections	7.2.4.5	3.0	R	√3	1	1.73	∞
12	Probe Positioner Mech.restrictions	7.2.3.1	0.4	R	√3	1	0.2	∞
13	Probe Positioning with respect to Phantom Shell	7.2.3.3	2.9	R	√3	1	1.7	∞
14	Post-processing	7.2.5	5.0	R	√3	1	2.9	∞

	Test sample related							
15	Device holder uncertainty	7.2.3.4.2	7.1	N	1	1	7.1	5
16	Test sample positioning	7.2.3.4.3	4.8	N	1	1	4.8	5
17	Power Scaling	L3	1.0	R	$\sqrt{3}$	1	0.6	∞
18	Drift of output power(measured SAR drift)	7.2.2.10	5.0	R	$\sqrt{3}$	1	2.9	∞
	Phantom and set-up							
19	Phantom Uncertainty(shape and thickness tolerances)	7.2.3.2	1.0	R	$\sqrt{3}$	1	0.6	∞
20	Algorithm for correcting SAR for deviations in permittivity and conductivity	7.2.4.3	1.9	N	1	1	1.9	∞
21	Liquid Conductivity (meas.)	7.2.4.3	5.5	N	1	0.78	4.3	5
22	Liquid Permittivity (meas.)	7.2.4.3	2.9	N	1	0.23	0.7	5
23	Liquid Conductivity-temperature uncertainty	7.2.4.4	1.7	R	$\sqrt{3}$	0.78	0.8	∞
24	Liquid Permittivity -temperature uncertainty	7.2.4.4	2.7	R	$\sqrt{3}$	0.23	0.4	∞
Combined Standard Uncertainty		7.3.1		RSS			13.12	44.15
Expanded uncertainty (Confidence interval of 95 %)		7.3.2		K=2			26.24	

System Repeatability Measurement Uncertainty

No.	Uncertainty Component	Type	Uncertainty Value (%)	Probability Distribution	k	ci	Standard Uncertainty (%) ui(%)	Degree of freedom Veff or vi
	Measurement System							
1	－Probe Calibration	B	5.8	N	1	1	5.8	∞
2	－Axial isotropy	B	3.5	R	$\sqrt{3}$	0.5	1.43	∞
3	- Hemispherical Isotropy	B	5.9	R	$\sqrt{3}$	0.5	2.41	∞
4	－Boundary Effect	B	1	R	$\sqrt{3}$	1	0.58	∞
5	－Linearity	B	4.7	R	$\sqrt{3}$	1	2.71	∞
6	－System Detection Limits	B	1.0	R	$\sqrt{3}$	1	0.58	∞
7	Modulation response	B	3	N	1	1	3.00	
8	－Readout Electronics	B	0.5	N	1	1	0.50	∞
9	－Response Time	B	1.4	R	$\sqrt{3}$	1	0.81	∞
10	－Integration Time	B	3.0	R	$\sqrt{3}$	1	1.73	∞
11	－RF Ambient Conditions	B	3.0	R	$\sqrt{3}$	1	1.73	∞
12	－Probe Position Mechanical tolerance	B	1.4	R	$\sqrt{3}$	1	0.81	∞
13	－Probe Position with respect to Phantom Shell	B	1.4	R	$\sqrt{3}$	1	0.81	∞
14	－Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation	B	2.3	R	$\sqrt{3}$	1	1.33	∞

	Uncertainties of the DUT							
15	－Position of the DUT	A	2.6	N	$\sqrt{3}$	1	2.6	5
16	－Holder of the DUT	A	3	N	$\sqrt{3}$	1	3.0	5
17	－Output Power Variation –SAR drift measurement	B	5.0	R	$\sqrt{3}$	1	2.89	∞
Phantom and Tissue Parameters								
18	－Phantom Uncertainty(shape and thickness tolerances)	B	4	R	$\sqrt{3}$	1	2.31	∞
19	Uncertainty in SAR correction for deviation(in permittivity and conductivity)	B	2	N	1	1	2.00	
20	－Liquid Conductivity Target –tolerance	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
21	－Liquid Conductivity –measurement Uncertainty)	B	4	N	$\sqrt{3}$	1	0.92	9
22	－Liquid Permittivity Target tolerance	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
22	－Liquid Permittivity –measurement uncertainty	B	5	N	$\sqrt{3}$	1	1.15	∞
Combined Standard Uncertainty				RSS			10.63	
Expanded uncertainty (Confidence interval of 95 %)				K=2			21.26	

System Validation Uncertainty

No.	Uncertainty Component	Type	Uncertainty Value (%)	Probability Distribution	k	ci	Standard Uncertainty (%) ui(%)	Degree of freedom Veff or vi
	Measurement System							
1	－Probe Calibration	B	5.8	N	1	1	5.8	∞
2	－Axial isotropy	B	3.5	R	$\sqrt{3}$	0.5	1.43	∞
3	- Hemispherical Isotropy	B	5.9	R	$\sqrt{3}$	0.5	2.41	∞
4	－Boundary Effect	B	1	R	$\sqrt{3}$	1	0.58	∞
5	－Linearity	B	4.7	R	$\sqrt{3}$	1	2.71	∞
6	－System Detection Limits	B	1	R	$\sqrt{3}$	1	0.58	∞
7	Modulation response	B	0	N	1	1	0.00	
8	－Readout Electronics	B	0.5	N	1	1	0.50	∞
9	－Response Time	B	0.00	R	$\sqrt{3}$	1	0.00	∞
10	－Integration Time	B	1.4	R	$\sqrt{3}$	1	0.81	∞
11	－RF Ambient Conditions	B	3.0	R	$\sqrt{3}$	1	1.73	∞
12	－Probe Position Mechanical tolerance	B	1.4	R	$\sqrt{3}$	1	0.81	∞
13	－Probe Position with respect to Phantom Shell	B	1.4	R	$\sqrt{3}$	1	0.81	∞
14	－Extrapolation, Interpolation and Integration Algorithms for Max. SAR evaluation	B	2.3	R	$\sqrt{3}$	1	1.33	∞

	Uncertainties of the DUT							
15	Deviation of experimental source from numberical source	A	4	N	1	1	4.00	5
16	Input Power and SAR drift measurement	A	5	R	$\sqrt{3}$	1	2.89	5
17	Dipole Axis to Liquid Distance	B	2	R	$\sqrt{3}$	1	1.2	∞
Phantom and Tissue Parameters								
18	－Phantom Uncertainty(shape and thickness tolerances)	B	4	R	$\sqrt{3}$	1	2.31	∞
19	Uncertainty in SAR correction for deviation(in permittivity and conductivity)	B	2	N	1	1	2.00	
20	－Liquid Conductivity Target –tolerance	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
21	－Liquid Conductivity –measurement Uncertainty)	B	4	N	$\sqrt{3}$	1	0.92	9
22	－Liquid Permittivity Target tolerance	B	2.5	R	$\sqrt{3}$	0.6	1.95	∞
22	－Liquid Permittivity –measurement uncertainty	B	5	N	$\sqrt{3}$	1	1.15	∞
Combined Standard Uncertainty				RSS			10.15	
Expanded uncertainty (Confidence interval of 95 %)				K=2			20.29	

12. MAIN TEST INSTRUMENTS

EQUIPMENT	TYPE	Series No.	Calibration Date	calibration period
System Simulator	CMW500	130805	2016/08/10	1 Year
SAR Probe	SATIMO	SN04/13EP166	2016/08/10	1 Year
Dipole	SID835	SN09/13 DIP0G835-217	2014/08/28	3 Year
Dipole	SID1900	SN09/13 DIP1G900-218	2014/08/28	3 Year
Vector Network Analyzer	ZVB8	A0802530	2016/06/07	1 Year
Signal Generator	SMR27	A0304219	2016/06/07	1 Year
Power Meter	NRP2	A140401673	2017/03/09	1 Year
Power Sensor	NPR-Z11	1138.3004.02-114072-nq	2017/03/09	1 Year
Amplifier	Nucletudes	143060	2017/03/09	1 Year
Directional Coupler	DC6180A	305827	2017/03/09	1 Year
Power Meter	NRVS	A0802531	2017/03/09	1 Year
Power Sensor	NRV-Z4	100069	2017/03/09	1 Year
Multimeter	Keithley-2000	4014020	2017/03/09	1 Year

ANNEX A

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2017-09247

Nielsen Audio, inc.

PPM 360 Meter

Type Name: DA120

Hardware Version： **8420439T000**

Software Version： **TF_QCT1050_G2V2_VER_2.10C_PP_20161212**

TEST LAYOUT

This Annex consists of 4 pages

Date of Report: 2017-06-23

Fig.1 Body-Left

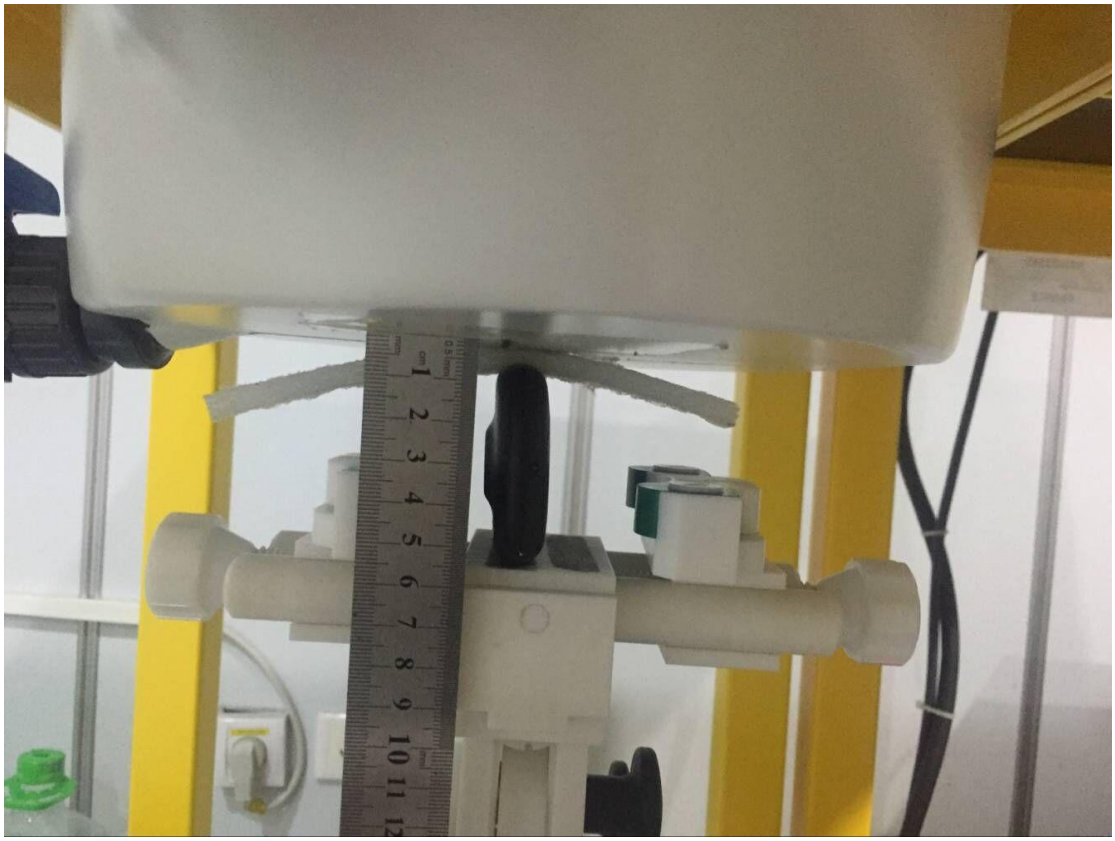


Fig.2 Body-Right

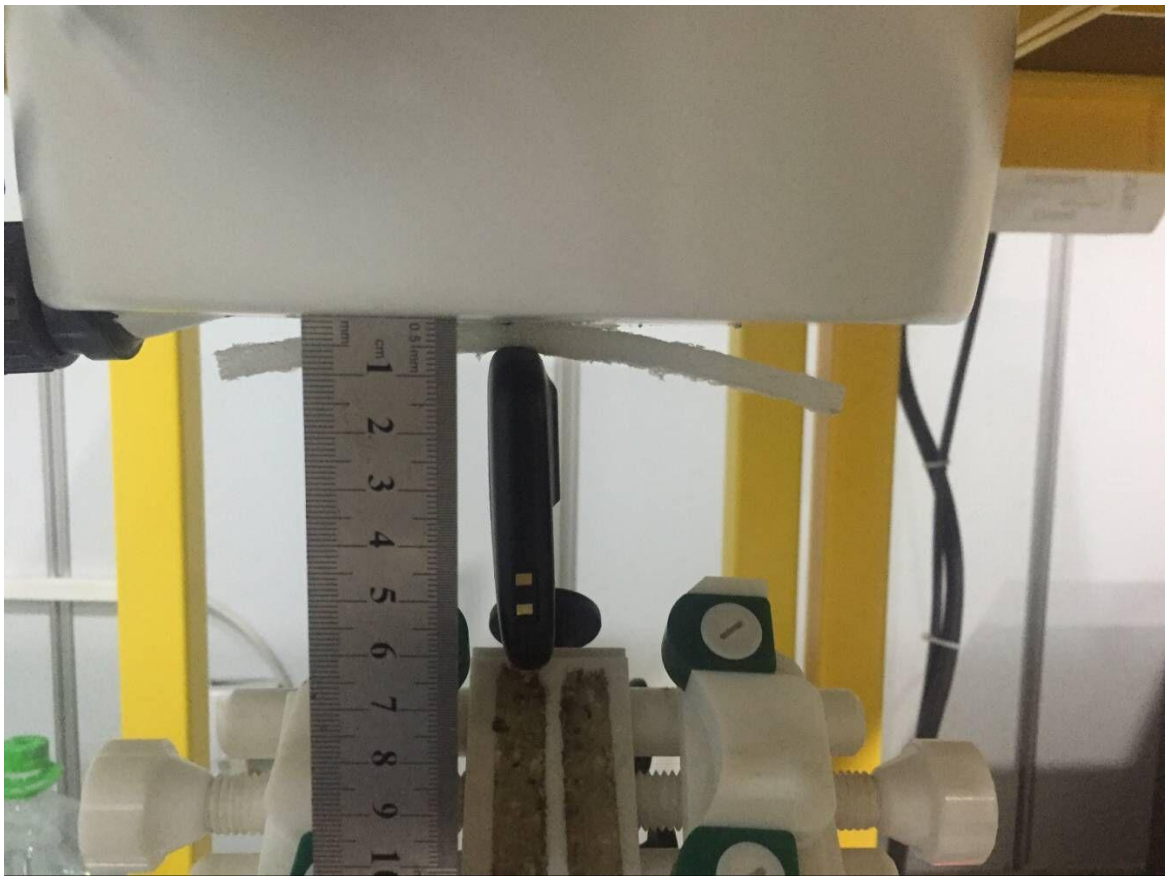


Fig.3 Top

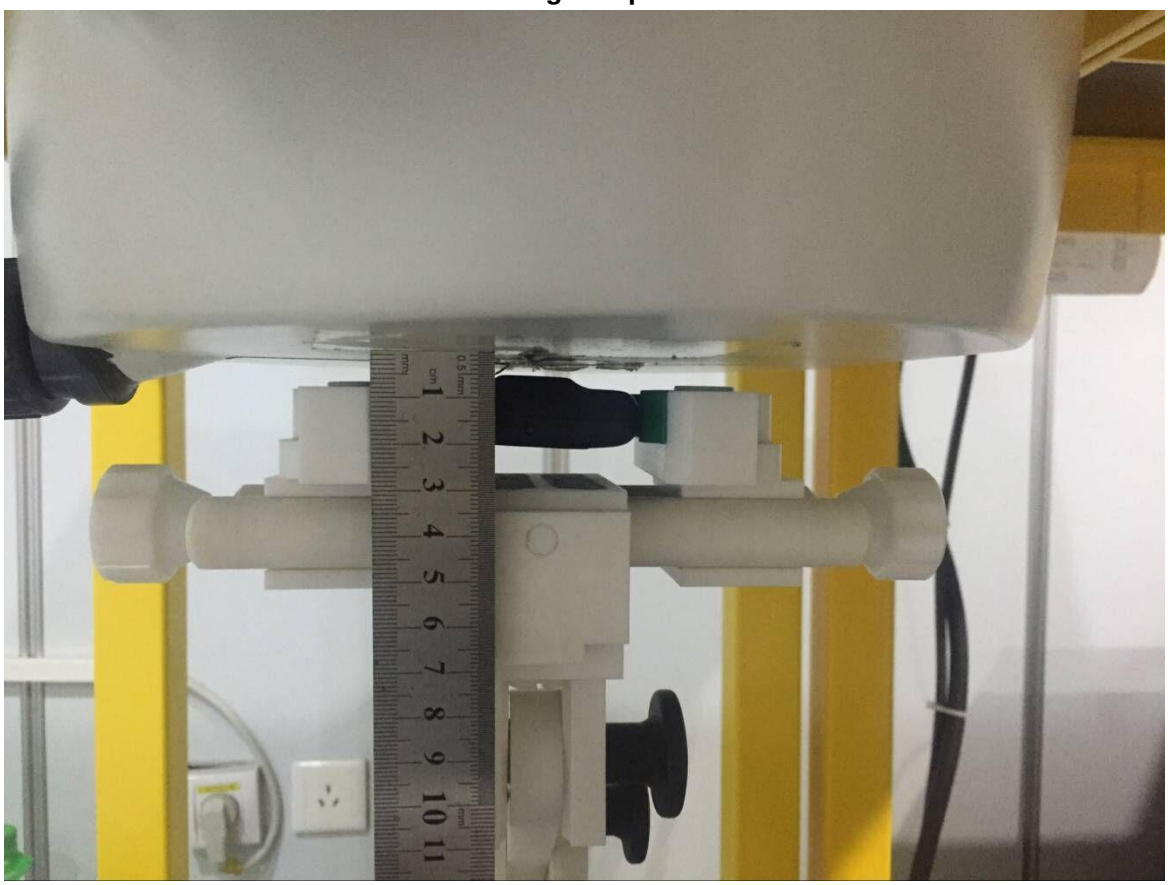


Fig.4 Back

Fig.5 Face

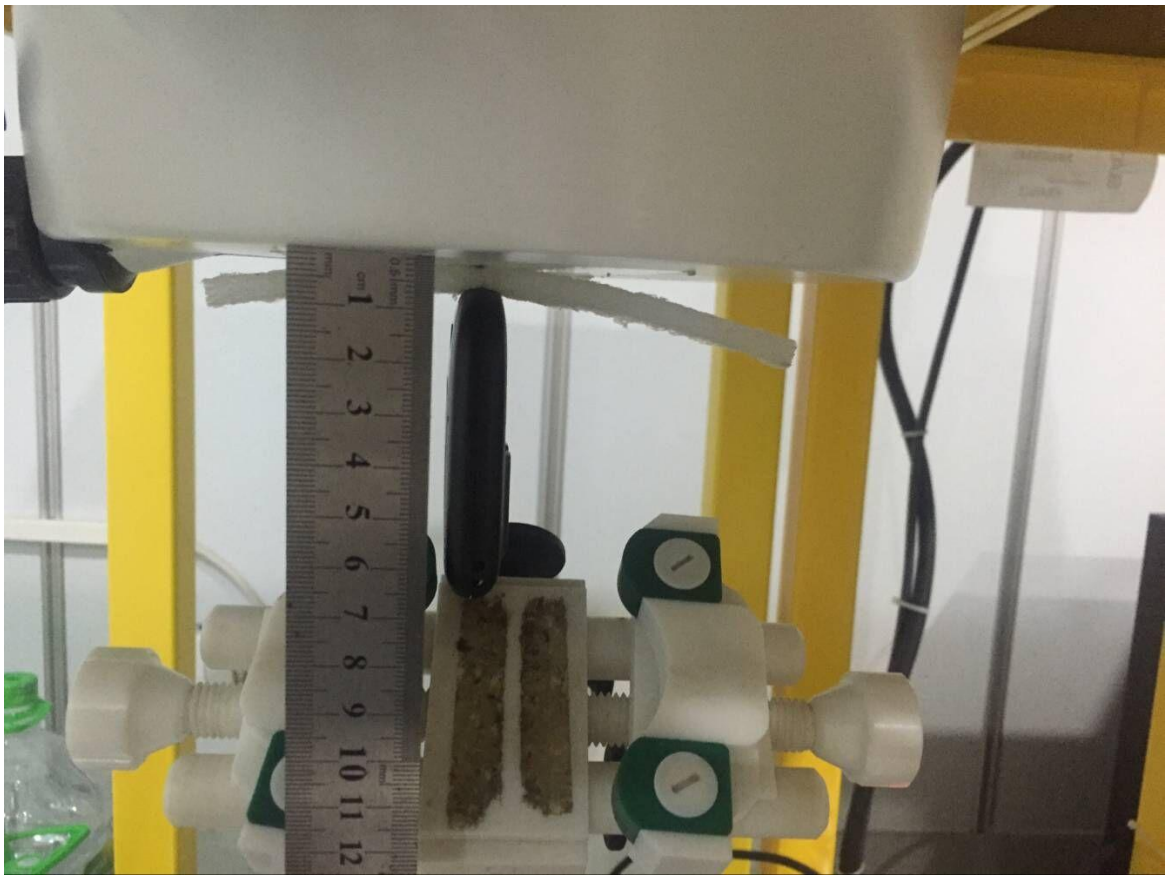


Fig.6 Down

ANNEX B

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2017-09247

Nielsen Audio, inc.

PPM 360 Meter

Type Name: DA120

Hardware Version： 8420439T000

Software Version： TF_QCT1050_G2V2_VER_2.10C_PP_20161212

Sample Photographs

This Annex consists of 4 pages

Date of Report: 2017-06-23

1. Appearance

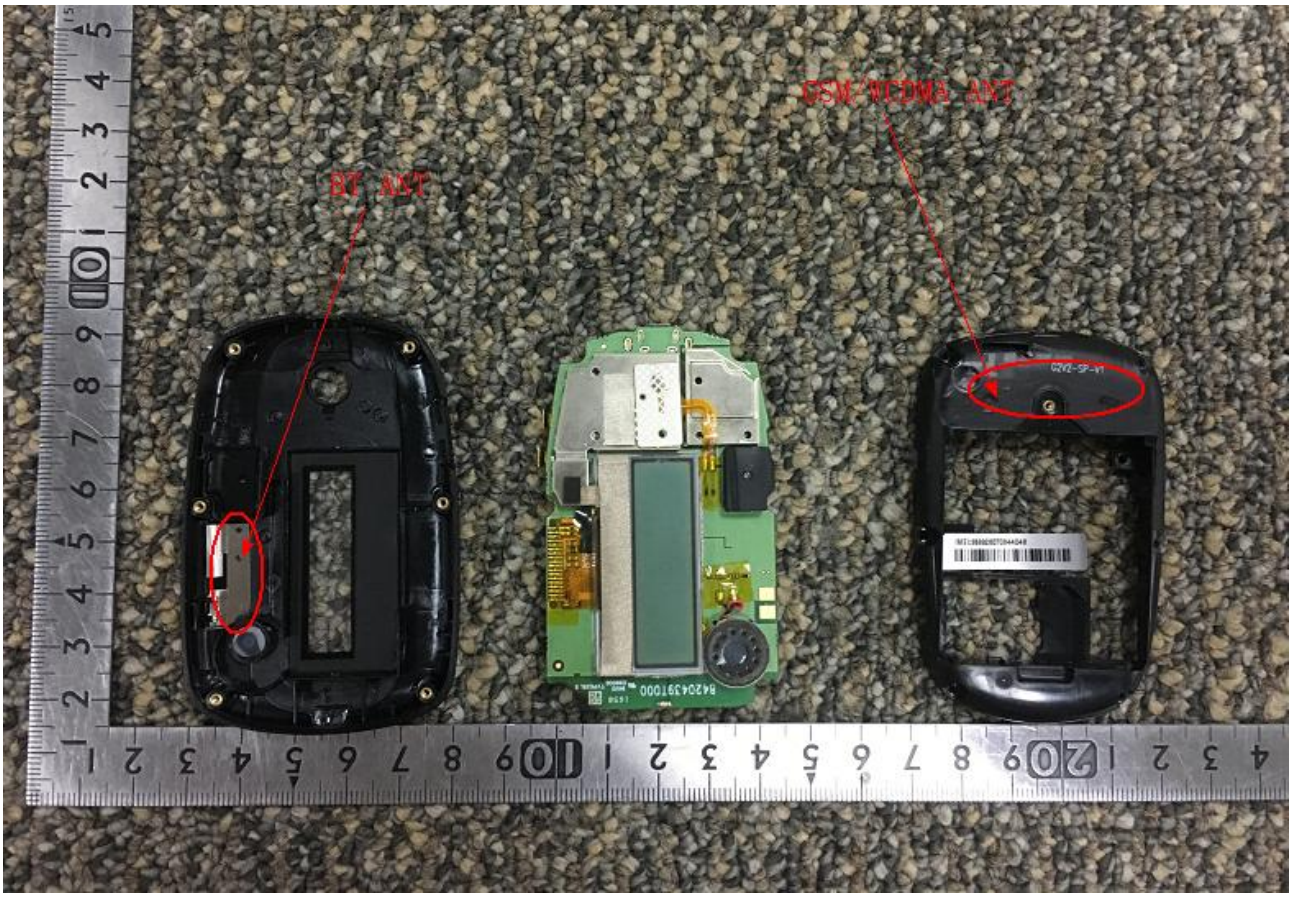
Appearance and size (obverse)

Appearance and size (reverse)

3. Inside

4. Battery

4. Position of antennas



ANNEX C

of

CCIC-SET

CONFORMANCE TEST REPORT FOR

HUMAN EXPOSURE TO ELECTROMAGNETIC FIELDS

SET2017-09247

Nielsen Audio, inc.

PPM 360 Meter

Type Name: DA120

Hardware Version： **8420439T000**

Software Version： **TF_QCT1050_G2V2_VER_2.10C_PP_20161212**

Calibration Certificate of Probe and Dipoles

This Annex consists of 32 pages

Date of Report：2017-06-23

Probe Calibration Ceriticate

COMOSAR E-Field Probe Calibration Report

Ref : ACR.227.15.14.SATU.A

CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) CO., LTD

ELECTRONIC TESTING BUILDING, SHAHE ROAD, XILI TOWN

SHENZHEN, P.R. CHINA (POST CODE:518055)

SATIMO COMOSAR DOSIMETRIC E-FIELD PROBE

SERIAL NO.: SN 04/13 EP166

Calibrated at SATIMO US

2105 Barrett Park Dr. - Kennesaw, GA 30144

ACCREDITED

Calibration CERT #2246.02

08/10/2016

Summary:

This document presents the method and results from an accredited COMOSAR Dosimetric E-Field Probe calibration performed in SATIMO USA using the CALISAR / CALIBAIR test bench, for use with a SATIMO COMOSAR system only. All calibration results are traceable to national metrology institutions.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	8/11/2016	
Checked by :	Jérôme LUC	Product Manager	8/11/2016	
Approved by :	Kim RUTKOWSKI	Quality Manager	8/11/2016	

	Customer Name
Distribution :	CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) Co., Ltd

Issue	Date	Modifications
A	8/11/2016	Initial release

TABLE OF CONTENTS

1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	Satimo
Model	SSE5
Serial Number	SN 04/13 EP166
Product Condition (new / used)	Used
Frequency Range of Probe	0.7 GHz-3GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.231 MΩ Dipole 2: R2=0.225 MΩ Dipole 3: R3=0.228 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

Satimo's COMOSAR E field Probes are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards.

Figure 1 – *Satimo COMOSAR Dosimetric E field Dipole*

Probe Length	330 mm
Length of Individual Dipoles	4.5 mm
Maximum external diameter	8 mm
Probe Tip External Diameter	5 mm
Distance between dipoles / probe extremity	2.7 mm

3 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards provide recommended practices for the probe calibrations, including the performance characteristics of interest and methods by which to assess their affect. All calibrations / measurements performed meet the fore mentioned standards.

3.1 LINEARITY

The evaluation of the linearity was done in free space using the waveguide, performing a power sweep to cover the SAR range 0.01W/kg to 100W/kg.

3.2 SENSITIVITY

The sensitivity factors of the three dipoles were determined using a two step calibration method (air and tissue simulating liquid) using waveguides as outlined in the standards.

3.3 LOWER DETECTION LIMIT

The lower detection limit was assessed using the same measurement set up as used for the linearity measurement. The required lower detection limit is 10 mW/kg.

3.4 ISOTROPY

The axial isotropy was evaluated by exposing the probe to a reference wave from a standard dipole with the dipole mounted under the flat phantom in the test configuration suggested for system validations and checks. The probe was rotated along its main axis from 0 - 360 degrees in 15 degree steps. The hemispherical isotropy is determined by inserting the probe in a thin plastic box filled with tissue-equivalent liquid, with the plastic box illuminated with the fields from a half wave dipole. The dipole is rotated about its axis (0°–180°) in 15° increments. At each step the probe is rotated about its axis (0°–360°).

3.5 BOUNDARY EFFECT

The boundary effect is defined as the deviation between the SAR measured data and the expected exponential decay in the liquid when the probe is oriented normal to the interface. To evaluate this effect, the liquid filled flat phantom is exposed to fields from either a reference dipole or waveguide. With the probe normal to the phantom surface, the peak spatial average SAR is measured and compared to the analytical value at the surface.

4 MEASUREMENT UNCERTAINTY

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty associated with an E-field probe calibration using the waveguide technique. All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

Uncertainty analysis of the probe calibration in waveguide					
ERROR SOURCES	**Uncertainty value (%)**	**Probability Distribution**	**Divisor**	**ci**	**Standard Uncertainty (%)**
Incident or forward power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Reflected power	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Liquid conductivity	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Liquid permittivity	4.00%	Rectangular	$\sqrt{3}$	1	2.309%
Field homogeneity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%
Field probe positioning	5.00%	Rectangular	$\sqrt{3}$	1	2.887%
Field probe linearity	3.00%	Rectangular	$\sqrt{3}$	1	1.732%

Combined standard uncertainty					5.831%
Expanded uncertainty 95 % confidence level k = 2					12.0%

5 CALIBRATION MEASUREMENT RESULTS

Calibration Parameters	
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

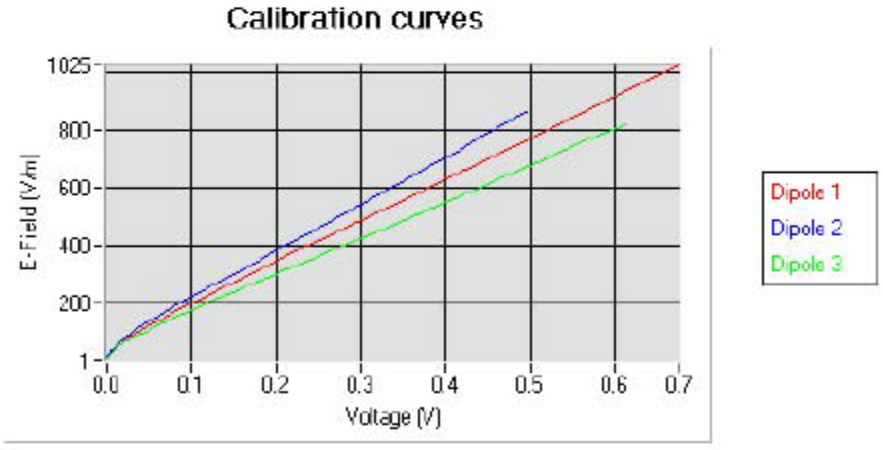
5.1 SENSITIVITY IN AIR

Normx dipole 1 ($\mu V/(V/m)^2$)	Normy dipole 2 ($\mu V/(V/m)^2$)	Normz dipole 3 ($\mu V/(V/m)^2$)
8.57	4.83	7.15

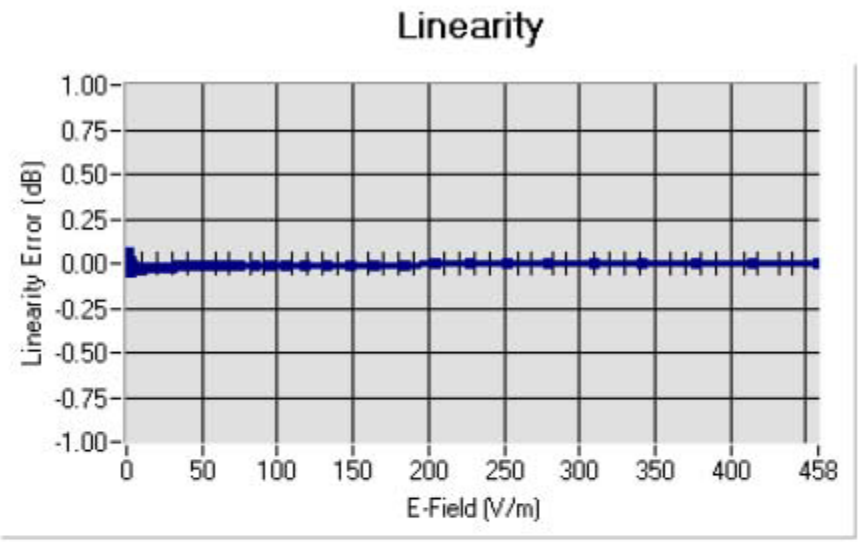
DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
92	90	95

Calibration curves ei=f(V) (i=1,2,3) allow to obtain H-field value using the formula:

$$E = \sqrt{E_1^2 + E_2^2 + E_3^2}$$



5.2 LINEARITY



Linearity: +/-1.55% (+/-0.07dB)

5.3 SENSITIVITY IN LIQUID

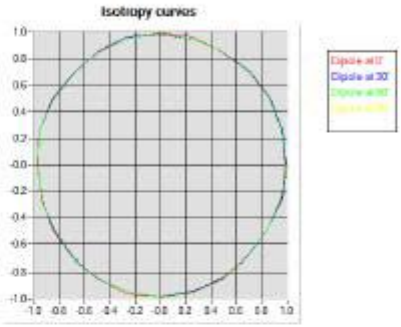
Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL850	835	42.80	0.89	5.69
BL850	835	53.45	0.96	5.82
HL900	900	42.47	0.96	5.34
BL900	900	56.68	1.08	5.55
HL1800	1800	41.30	1.38	4.75
BL1800	1800	53.27	1.51	4.96
HL1900	1900	41.09	1.42	5.25
BL1900	1900	54.20	1.54	5.43
HL2000	2000	39.72	1.43	4.81
BL2000	2000	53.90	1.53	4.95
HL2450	2450	39.05	1.77	4.93
BL2450	2450	52.98	1.93	5.09
HL2600	2600	38.35	1.92	5.08
BL2600	2600	51.82	2.19	5.22

LOWER DETECTION LIMIT: 7mW/kg

5.4 ISOTROPY

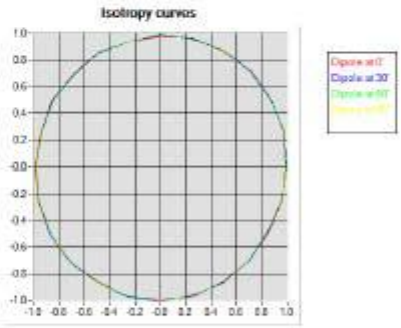
HL900 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.07 dB



HL1800 MHz

- Axial isotropy: 0.05 dB
- Hemispherical isotropy: 0.07 dB



6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2016	02/2019
Reference Probe	Satimo	EP 94 SN 37/08	10/2015	10/2016
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Waveguide	Mega Industries	069Y7-158-13-712	Validated. No cal required.	Validated. No cal required.
Waveguide Transition	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Waveguide Termination	Mega Industries	069Y7-158-13-701	Validated. No cal required.	Validated. No cal required.
Temperature / Humidity Sensor	Control Company	11-661-9	7/2016	7/2019

SID835 Dipole Calibration Ceriticate

SAR Reference Dipole Calibration Report

Ref : ACR.240.1.14.SATU.A

CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) CO., LTD

ELECTRONIC TESTING BUILDING, SHAHE ROAD, XILI TOWN

SHENZHEN, P.R. CHINA (POST CODE:518055)

SATIMO COMOSAR REFERENCE DIPOLE

FREQUENCY: 835 MHZ

SERIAL NO.: SN 09/13 DIP0G835-217

Calibrated at SATIMO US

2105 Barrett Park Dr. - Kennesaw, GA 30144

08/28/14

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in SATIMO USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

SATIMO

SAR REFERENCE DIPOLE CALIBRATION REPORT

Ref: ACR.249.1.14.SATU.A

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	8/29/2014	
Checked by :	Jérôme LUC	Product Manager	8/29/2014	
Approved by :	Kim RUTKOWSKI	Quality Manager	8/29/2014	

	Customer Name
Distribution :	CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) Co., Ltd

Issue	Date	Modifications
A	8/29/2014	Initial release

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1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 835 MHz REFERENCE DIPOLE
Manufacturer	Satimo
Model	SID835
Serial Number	SN 09/13 DIP0G835-217
Product Condition (new / used)	used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.

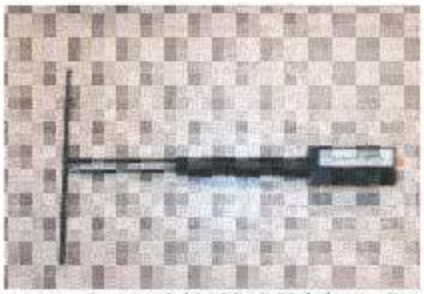


Figure 1 – *Satimo COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constucted as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k = 2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements.

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

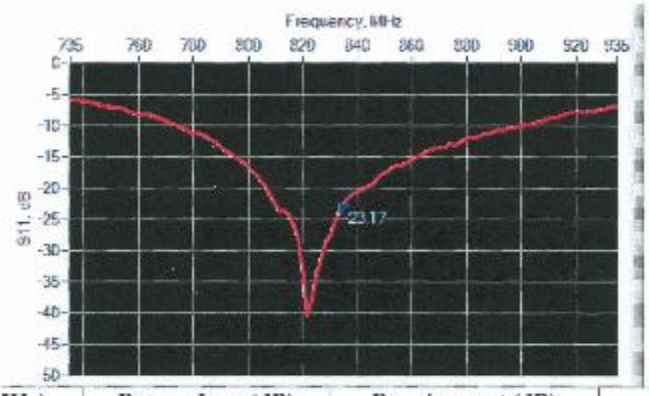
5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %
10 g	20.1 %

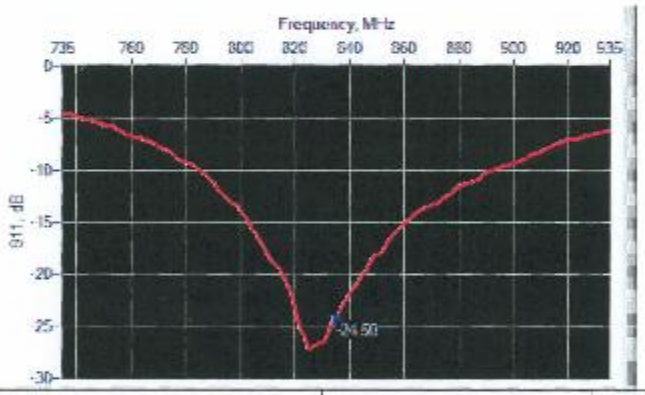
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-23.17	-20	57.4 Ω - 0.2 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
835	-24.50	-20	55.0 Ω + 3.9 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L mm		h mm		d mm	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %.		6.35 ±1 %.	
450	290.0 ±1 %.		156.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.	PASS	89.8 ±1 %.	PASS	3.6 ±1 %.	PASS

900	149.0 ±1 %.		89.3 ±1 %.		3.6 ±1 %.	
1450	89.1 ±1 %.		51.7 ±1 %.		3.6 ±1 %.	
1500	80.5 ±1 %.		50.0 ±1 %.		3.6 ±1 %.	
1640	79.0 ±1 %.		45.7 ±1 %.		3.6 ±1 %.	
1750	75.2 ±1 %.		42.9 ±1 %.		3.6 ±1 %.	
1800	72.0 ±1 %.		41.7 ±1 %.		3.6 ±1 %.	
1900	68.0 ±1 %.		39.5 ±1 %.		3.6 ±1 %.	
1950	66.3 ±1 %.		38.5 ±1 %.		3.6 ±1 %.	
2000	64.5 ±1 %.		37.5 ±1 %.		3.6 ±1 %.	
2100	61.0 ±1 %.		35.7 ±1 %.		3.6 ±1 %.	
2300	55.5 ±1 %.		32.6 ±1 %.		3.6 ±1 %.	
2450	51.5 ±1 %.		30.4 ±1 %.		3.6 ±1 %.	
2600	48.5 ±1 %.		28.8 ±1 %.		3.6 ±1 %.	
3000	41.5 ±1 %.		25.0 ±1 %.		3.6 ±1 %.	
3500	37.0±1 %.		26.4 ±1 %.		3.6 ±1 %.	
3700	34.7±1 %.		26.4 ±1 %.		3.6 ±1 %.	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %	PASS	0.90 ±5 %	PASS
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	
1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %		1.40 ±5 %	
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	

2100	39.8 ± 5 %		1.49 ± 5 %	
2300	39.5 ± 5 %		1.67 ± 5 %	
2450	39.2 ± 5 %		1.80 ± 5 %	
2600	39.0 ± 5 %		1.96 ± 5 %	
3000	38.5 ± 5 %		2.40 ± 5 %	
3500	37.9 ± 5 %		2.91 ± 5 %	

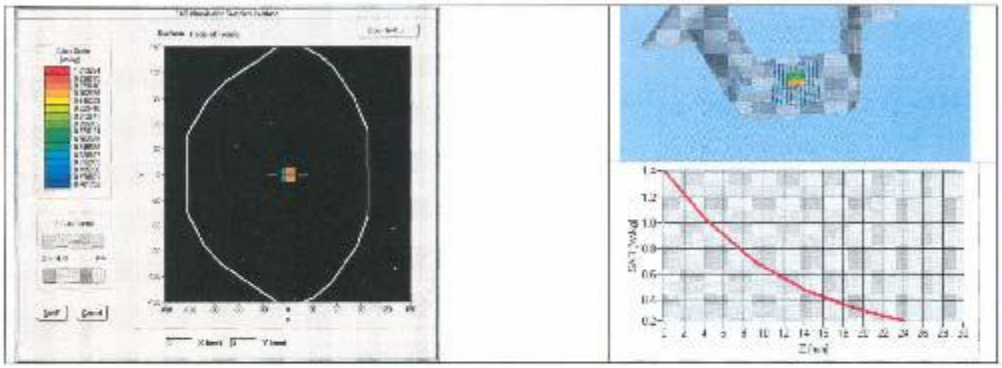
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CEI/IEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 42.3 sigma : 0.92
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoom Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	835 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56	9.77 (0.98)	6.22	6.30 (0.63)
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	

2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

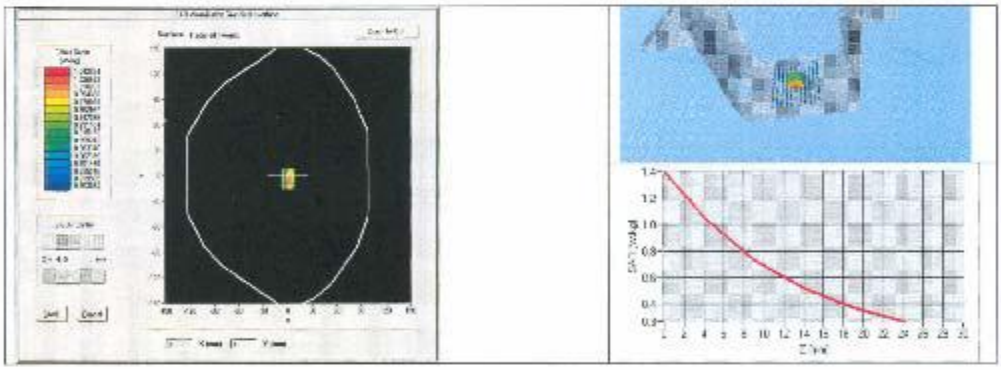
Frequency MHz	Relative permittivity (ε,')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %	PASS	0.97 ±5 %	PASS
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30 ±5 %	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %		1.52 ±5 %	
2000	53.3 ±5 %		1.52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	

5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 38/11 EPG122
Liquid	Body Liquid Values: eps' : 54.1 sigma : 0.97
Distance between dipole center and liquid	15.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	835 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

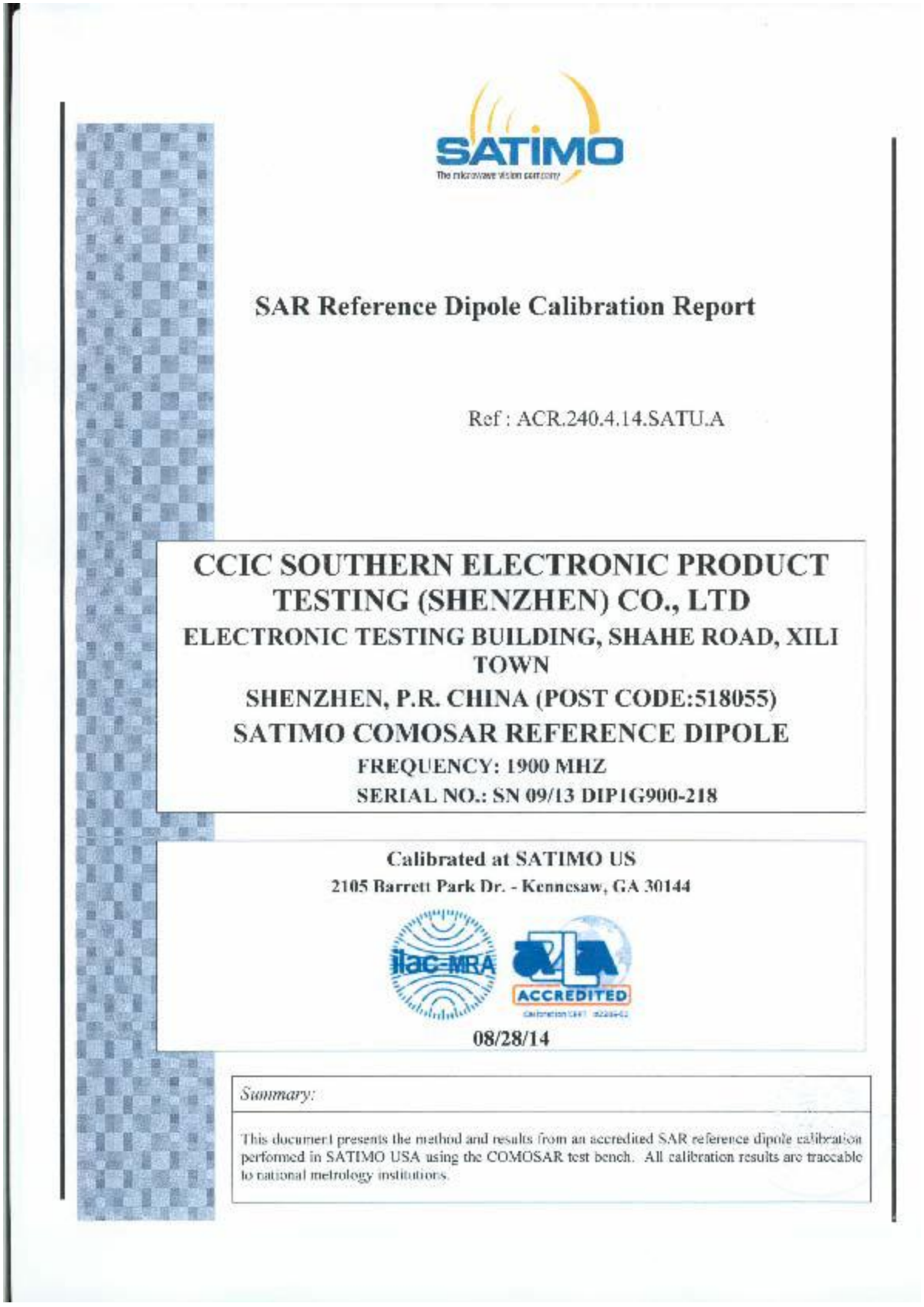
Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
835	10.31 (1.03)	6.74 (0.67)



8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
SAM Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	Satimo	EPG122 SN 18/11	10/2013	10/2014
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY4907058?	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11-661-9	8/2012	8/2015

SID1900 Dipole Calibration Ceriticate



SATIMO
The microwave vision company

SAR Reference Dipole Calibration Report

Ref : ACR.240.4.14.SATU.A

CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) CO., LTD

ELECTRONIC TESTING BUILDING, SHAHE ROAD, XILI TOWN

SHENZHEN, P.R. CHINA (POST CODE:518055)

SATIMO COMOSAR REFERENCE DIPOLE

FREQUENCY: 1900 MHZ

SERIAL NO.: SN 09/13 DIP1G900-218

Calibrated at SATIMO US

2105 Barrett Park Dr. - Kennesaw, GA 30144

ilac-MRA

A2LA ACCREDITED

08/28/14

Summary:

This document presents the method and results from an accredited SAR reference dipole calibration performed in SATIMO USA using the COMOSAR test bench. All calibration results are traceable to national metrology institutions.

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	8/29/2014	
Checked by :	Jérôme LUC	Product Manager	8/29/2014	
Approved by :	Kim RUTKOWSKI	Quality Manager	8/29/2014	

	Customer Name
Distribution :	CCIC SOUTHERN ELECTRONIC PRODUCT TESTING (SHENZHEN) Co., Ltd

Issue	Date	Modifications
A	8/29/2014	Initial release

TABLE OF CONTENTS

1 INTRODUCTION

This document contains a summary of the requirements set forth by the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards for reference dipoles used for SAR measurement system validations and the measurements that were performed to verify that the product complies with the fore mentioned standards.

2 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR 1900 MHz REFERENCE DIPOLE
Manufacturer	Satimo
Model	SID1900
Serial Number	SN 09/13 DIP1G900-218
Product Condition (new / used)	Used

A yearly calibration interval is recommended.

3 PRODUCT DESCRIPTION

3.1 GENERAL INFORMATION

Satimo's COMOSAR Validation Dipoles are built in accordance to the IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards. The product is designed for use with the COMOSAR test bench only.

Figure 1 – *Satimo COMOSAR Validation Dipole*

4 MEASUREMENT METHOD

The IEEE 1528, OET 65 Bulletin C and CEI/IEC 62209 standards provide requirements for reference dipoles used for system validation measurements. The following measurements were performed to verify that the product complies with the fore mentioned standards.

4.1 RETURN LOSS REQUIREMENTS

The dipole used for SAR system validation measurements and checks must have a return loss of -20 dB or better. The return loss measurement shall be performed against a liquid filled flat phantom, with the phantom constucted as outlined in the fore mentioned standards.

4.2 MECHANICAL REQUIREMENTS

The IEEE Std. 1528 and CEI/IEC 62209 standards specify the mechanical components and dimensions of the validation dipoles, with the dimensions frequency and phantom shell thickness dependent. The COMOSAR test bench employs a 2 mm phantom shell thickness therefore the dipoles sold for use with the COMOSAR test bench comply with the requirements set forth for a 2 mm phantom shell thickness.

5 MEASUREMENT UNCERTAINTY

All uncertainties listed below represent an expanded uncertainty expressed at approximately the 95% confidence level using a coverage factor of k=2, traceable to the Internationally Accepted Guides to Measurement Uncertainty.

5.1 RETURN LOSS

The following uncertainties apply to the return loss measurement:

Frequency band	Expanded Uncertainty on Return Loss
400-6000MHz	0.1 dB

5.2 DIMENSION MEASUREMENT

The following uncertainties apply to the dimension measurements:

Length (mm)	Expanded Uncertainty on Length
3 - 300	0.05 mm

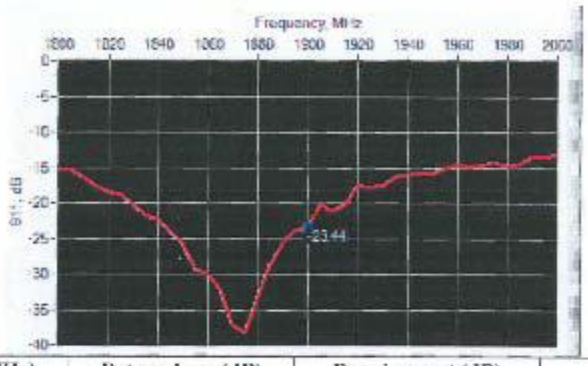
5.3 VALIDATION MEASUREMENT

The guidelines outlined in the IEEE 1528, OET 65 Bulletin C, CENELEC EN50361 and CEI/IEC 62209 standards were followed to generate the measurement uncertainty for validation measurements.

Scan Volume	Expanded Uncertainty
1 g	20.3 %
10 g	20.1 %

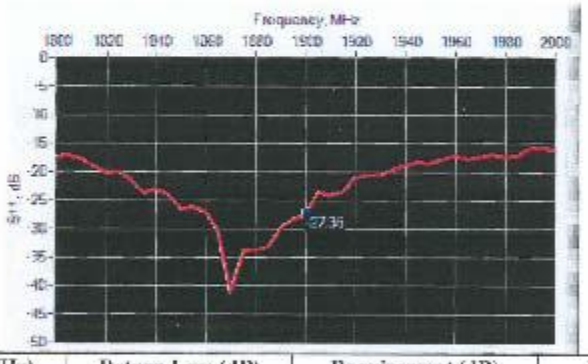
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE IN HEAD LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-23.44	-20	55.4 Ω - 5.2 jΩ

6.2 RETURN LOSS AND IMPEDANCE IN BODY LIQUID



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
1900	-27.36	-20	51.7 Ω - 4.4 jΩ

6.3 MECHANICAL DIMENSIONS

Frequency MHz	L m/m		h m/m		d m/m	
	required	measured	required	measured	required	measured
300	420.0 ±1 %.		250.0 ±1 %.		6.35 ±1 %.	
450	250.0 ±1 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.		89.8 ±1 %.		3.5 ±1 %.	

900	149.3 ±1 %		83.3 ±1 %		3.6 ±1 %	
1450	89.1 ±1 %		51.7 ±1 %		3.6 ±1 %	
1500	83.5 ±1 %		50.0 ±1 %		3.6 ±1 %	
1640	79.0 ±1 %		45.7 ±1 %		3.6 ±1 %	
1750	75.2 ±1 %		42.9 ±1 %		3.6 ±1 %	
1800	72.0 ±1 %		41.7 ±1 %		3.6 ±1 %	
1900	68.0 ±1 %	PASS	39.5 ±1 %	PASS	3.6 ±1 %	PASS
1950	66.3 ±1 %		38.5 ±1 %		3.6 ±1 %	
2000	64.5 ±1 %		37.5 ±1 %		3.6 ±1 %	
2100	61.3 ±1 %		35.7 ±1 %		3.6 ±1 %	
2300	55.5 ±1 %		32.6 ±1 %		3.6 ±1 %	
2450	51.5 ±1 %		30.4 ±1 %		3.6 ±1 %	
2600	48.5 ±1 %		28.8 ±1 %		3.6 ±1 %	
3000	41.5 ±1 %		25.0 ±1 %		3.6 ±1 %	
3500	37.0±1 %		26.4 ±1 %		3.6 ±1 %	
3700	34.7±1 %		26.4 ±1 %		3.6 ±1 %	

7 VALIDATION MEASUREMENT

The IEEE Std. 1528, OET 65 Bulletin C and CEI/IEC 62209 standards state that the system validation measurements must be performed using a reference dipole meeting the fore mentioned return loss and mechanical dimension requirements. The validation measurement must be performed against a liquid filled flat phantom, with the phantom constructed as outlined in the fore mentioned standards. Per the standards, the dipole shall be positioned below the bottom of the phantom, with the dipole length centered and parallel to the longest dimension of the flat phantom, with the top surface of the dipole at the described distance from the bottom surface of the phantom.

7.1 HEAD LIQUID MEASUREMENT

Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
300	45.3 ±5 %		0.87 ±5 %	
450	43.5 ±5 %		0.87 ±5 %	
750	41.9 ±5 %		0.89 ±5 %	
835	41.5 ±5 %		0.90 ±5 %	
900	41.5 ±5 %		0.97 ±5 %	
1450	40.5 ±5 %		1.20 ±5 %	
1500	40.4 ±5 %		1.23 ±5 %	
1640	40.2 ±5 %		1.31 ±5 %	
1750	40.1 ±5 %		1.37 ±5 %	
1800	40.0 ±5 %		1.40 ±5 %	
1900	40.0 ±5 %	PASS	1.40 ±5 %	PASS
1950	40.0 ±5 %		1.40 ±5 %	
2000	40.0 ±5 %		1.40 ±5 %	

2100	39.8 ±5 %		1.49 ±5 %	
2300	39.5 ±5 %		1.67 ±5 %	
2450	39.2 ±5 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

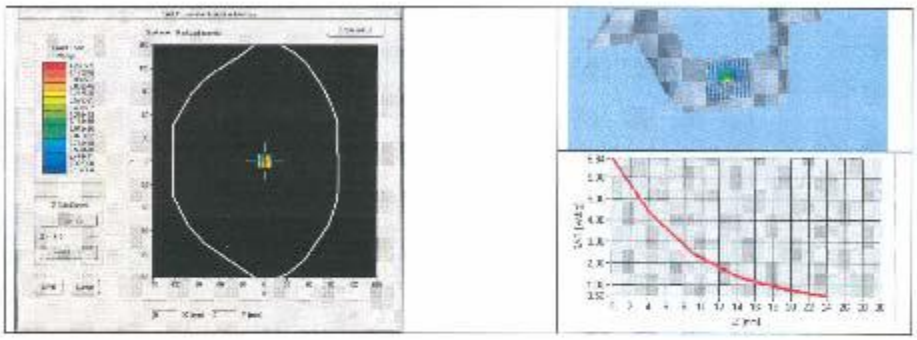
7.2 SAR MEASUREMENT RESULT WITH HEAD LIQUID

The IEEE Std. 1528 and CENELEC 62209 standards state that the system validation measurements should produce the SAR values shown below (for phantom thickness of 2 mm), within the uncertainty for the system validation. All SAR values are normalized to 1 W forward power. In bracket, the measured SAR is given with the used input power.

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 41.1 sigma : 1.42
Distance between dipole center and liquid	13.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoom Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	1900 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58		3.06	
750	8.49		5.55	
835	9.56		6.27	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7	40.37 (4.04)	20.5	20.62 (2.06)
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.2		23.3	

2450	52.4		24	
2500	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	



7.3 BODY LIQUID MEASUREMENT

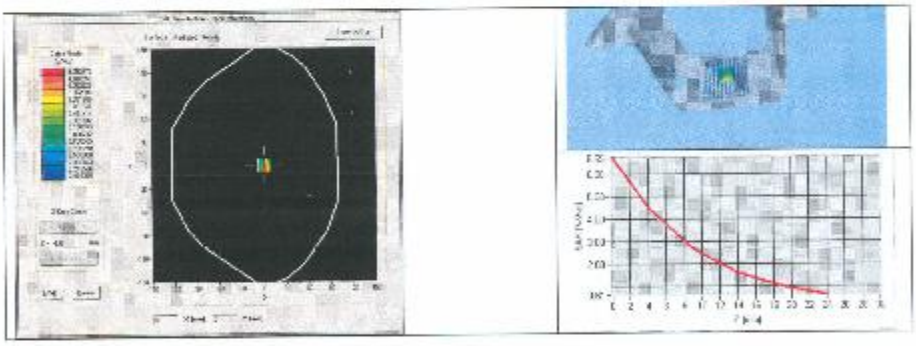
Frequency MHz	Relative permittivity (ε_r')		Conductivity (σ) S/m	
	required	measured	required	measured
150	61.9 ±5 %		0.80 ±5 %	
300	58.2 ±5 %		0.92 ±5 %	
450	56.7 ±5 %		0.94 ±5 %	
750	55.5 ±5 %		0.96 ±5 %	
835	55.2 ±5 %		0.97 ±5 %	
900	55.0 ±5 %		1.05 ±5 %	
915	55.0 ±5 %		1.06 ±5 %	
1450	54.0 ±5 %		1.30 ±5 %	
1610	53.8 ±5 %		1.40 ±5 %	
1800	53.3 ±5 %		1.52 ±5 %	
1900	53.3 ±5 %	PASS	1.52 ±5 %	PASS
2000	53.3 ±5 %		1.52 ±5 %	
2100	53.2 ±5 %		1.62 ±5 %	
2450	52.7 ±5 %		1.95 ±5 %	
2600	52.5 ±5 %		2.16 ±5 %	
3000	52.0 ±5 %		2.73 ±5 %	
3500	51.3 ±5 %		3.31 ±5 %	
5200	49.0 ±10 %		5.30 ±10 %	
5300	48.9 ±10 %		5.42 ±10 %	
5400	48.7 ±10 %		5.53 ±10 %	

5500	48.6 ±10 %		5.65 ±10 %	
5600	48.5 ±10 %		5.77 ±10 %	
5800	48.2 ±10 %		6.00 ±10 %	

7.4 SAR MEASUREMENT RESULT WITH BODY LIQUID

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 54.2 sigma : 1.54
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoom Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	1900 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

Frequency MHz	1 g SAR (W/kg/W)	10 g SAR (W/kg/W)
	measured	measured
1900	40.81 [4.08]	21.21 [2.12]



8 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	Manufacturer / Model	Identification No.	Current Calibration Date	Next Calibration Date
SAM Phantom	Satimo	SN-20/09-SAM71	Validated. No cal required.	Validated. No cal required.
COMOSAR Test Bench	Version 3	NA	Validated. No cal required.	Validated. No cal required.
Network Analyzer	Rhode & Schwarz ZVA	SN100132	02/2013	02/2016
Calipers	Carrera	CALIPER-01	12/2013	12/2016
Reference Probe	Satimo	EPG122 SN 18/11	10/2013	10/2014
Multimeter	Keithley 2000	1188656	12/2013	12/2016
Signal Generator	Agilent E4438C	MY49070581	12/2013	12/2016
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required
Power Meter	HP E4418A	US38261498	12/2013	12/2016
Power Sensor	HP ECP-E26A	US37181460	12/2013	12/2016
Directional Coupler	Narda 4216-20	01386	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Temperature and Humidity Sensor	Control Company	11 661 9	8/2012	8/2015

———End of the Report———