FCC SAR - TEST REPORT

Report Number	:	**68.950.015.284.01**	Date of Issue:	2015-10-22
Model	:	**NM204**		
Product Type	:	Video Baby Monitor (Parent Unit)		
Applicant	:	Cvision (HK) Limited		
Address	:	Rm 902, Wilson House, 19-27 Wyndham Street, Central, Hong Kong.		
Production Facility	:	TATUNG COMPANY		
Address	:	22 Chungshan N. Rd. 3rd Sec. Taipei 104 Taiwan.		
FCC ID	:	2AC9F-204PU		
Test Result	:	■ **Positive** ☐ **Negative**		
Total pages including Appendices	:	73		

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1 Report Version

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	2015-10-22	Valid	Original Report

2 General Information

2.1 Notes

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Prepared By	2015-10-22	Alan Xiong	
Project Engineer	Date	Name	Signature
Approved by	2015-10-22	John Zhi	
Project Engineer	Date	Name	Signature

2.2 Testing Laboratory

Test Laboratory:

Attestation of Global Compliance(Shenzhen) Co., Ltd.

Address: 2 F, Building 2, No.1-No.4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang Street, Bao'an District, Shenzhen, China.

Test location:

Attestation of Global Compliance(Shenzhen) Co., Ltd.

Address: 2 F, Building 2, No.1-No.4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang Street, Bao'an District, Shenzhen, China.

2.3 Details of Applicant

CLIENT:	Cvision (HK) Limited.
PRODUCT DESCRIPTION:	Video Baby Monitor (Parent Unit)
MANUFACTURERS MODEL NUMBER:	NM204
LISTED MODELS:	N/A

2.4 Application Details

Date of receipt of order:	29 Sep 2015
Date of receipt of test item:	29 Sep 2015
Date of test:	30 Sep 2015 to 15 Oct 2015

2.5 Applied Standard

IEEE Std.1528:2013
FCC 47CFR § 2.1093
IEEE/ANSI C95.1:1992

2.6 Test Summary

The maximum results of Specific Absorption Rate (SAR) found during testing for EUT are as follows:

Frequency Band	Highest Reported 1g-SAR(W/Kg)
	Body-worn(with 0mm separation)
2.4 GHz	0.547

This device is compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6W/Kg) specified in IEEE Std. 1528:2013; FCC 47CFR § 2.1093; IEEE/ANSI C95.1:1992 and the following specific FCC Test Procedures:

· KDB 447498 D01 General RF Exposure Guidance v05r02
· KDB 648474 D04 Handset SAR v01r02
· KDB 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04

3 EUT Information

3.1 EUT Description

General Information	
Product Designation	Video Baby Monitor (Parent Unit)
Test Model	NM204
Listed Model	N/A
Hardware Version	N/A
Software Version	N/A
Device Category	Portable
RF Exposure Environment	Uncontrolled
Antenna Type	Internal
2.4GHz	
Operation Frequency	2402~2479MHz
Type of modulation	☒GFSK ☐Π/4-DQPSK ☐8-DPSK
Average Burst Power	18.23 dBm
Antenna Gain	0 dBi
Li-ion Battery	
Brand Name	N/A
Model Name	N/A
Capacitance	2100 mAh
Rated Voltage	DC 3.7V (Li-ion Battery)
Charging Voltage	DC 5 V

Product	Type
	☒ Production unit ☐ Identical Prototype

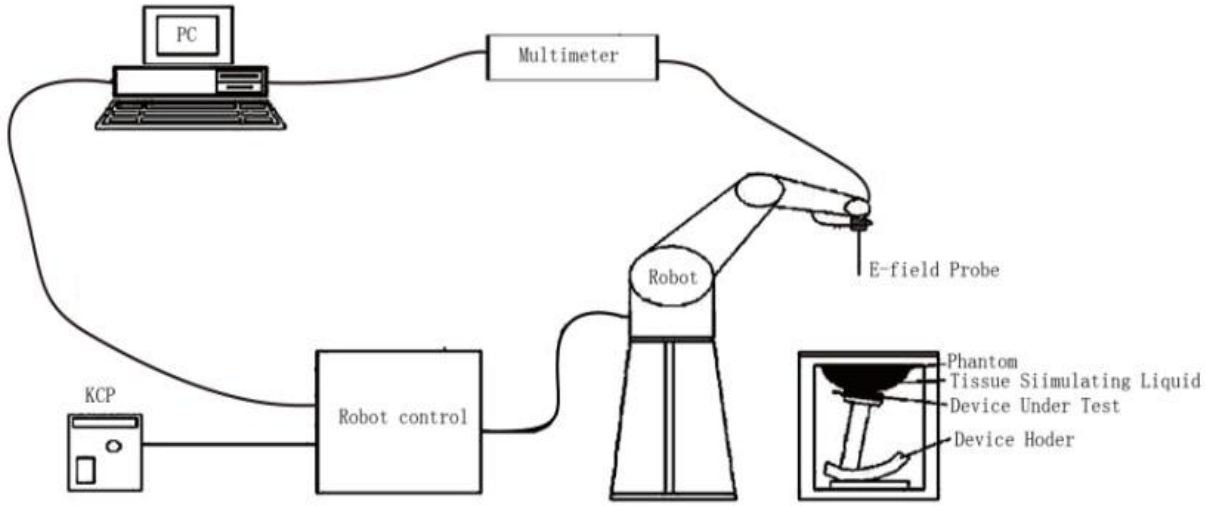
Remark: The above EUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

3.2 EUT Appearance

Apparence of EUT

4 SAR MEASUREMENT SYSTEM

4.1 The SATIMO system used for performing compliance tests consists of following items



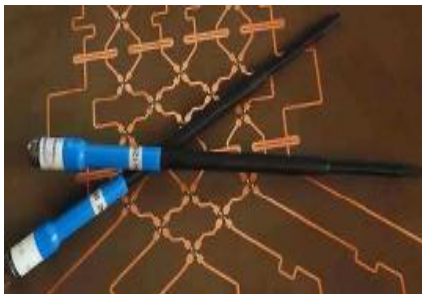
The COMOSAR system for performing compliance tests consists of the following items:

- The PC. It controls most of the bench devices and stores measurement data.A computer running WinXP and the Opensar software.
- The E-Field probe. The probe is a 3-axis system made of 3 distinct dipoles. Each dipole returns a voltage in function of the ambient electric field.
- The Keithley multimeter measures each probe dipole voltages.
- The SAM phantom simulates a human head. The measurement of the electric field is made inside the phantom.
- The liquids simulate the dielectric properties of the human head tissues.
- The network emulator controls the mobile phone under test.
- The validation dipoles are used to measure a reference SAR. They are used to periodically check the bench to make sure that there is no drift of the system characteristics over time.
- The phantom, the device holder and other accessories according to the targeted measurement.

4.2 COMOSAR E-Field Probe

The SAR measurement is conducted with the dosimetric probe manufactured by SATIMO. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency. SATIMO conducts the probe calibration in compliance with international and national standards (e.g. IEEE 1528, EN62209, IEC 62209, etc.)Under ISO17025.The calibration data are in Appendix D.

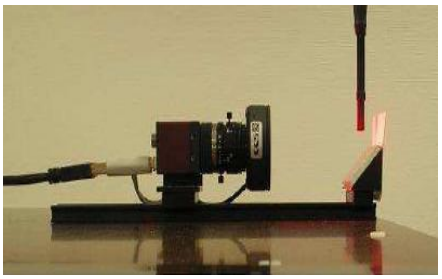
Isotropic E-Field Probe Specification

Model	SSE5	
Manufacture	SATIMO	
Frequency	0.3GHz-3GHz Linearity:±0.09dB(300MHz-3GHz)	
Dynamic Range	0.01W/Kg-100W/Kg Linearity:±0.09dB	
Dimensions	Overall length:330mm Length of individual dipoles:4.5mm Maximum external diameter:8mm Probe Tip external diameter:5mm Distance between dipoles/ probe extremity:2.7mm	
Application	High precision dosimetric measurements in any exposure scenario (e.g., very strong gradient fields). Only probe which enables compliance testing for frequencies up to 3 GHz with precision of better 30%.	

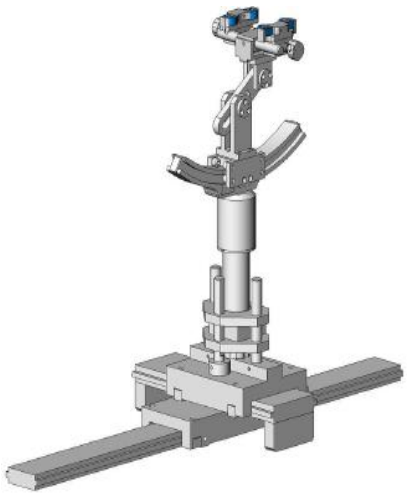
4.3 Robot

The COMOSAR system uses the KUKA robot from SATIMO SA (France).For the 6-axis controller COMOSAR system, the KUKA robot controller version from SATIMO is used. The XL robot series have many features that are important for our application: - High precision (repeatability 0.02 mm) - High reliability (industrial design) - Jerk-free straight movements - Low ELF interference (the closed metallic construction shields against motor control fields) - 6-axis controller	

4.4 Video Positioning System

The video positioning system is used in OpenSAR to check the probe. Which is composed of a camera, LED, mirror and mechanical parts.The camera is piloted by the main computer with firewire link. During the process, the actual position of the probe tip with respect to the robot arm is measured, as well as the probe length and the horizontal probe offset. The software then corrects all movements, such that the robot coordinates are valid for the probe tip. The repeatability of this process is better than 0.1 mm. If a position has been taught with an aligned probe, the same position will be reached with another aligned probe within 0.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position.	

4.5 Device Holder

The COMOSAR device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR). Thus the device needs no repositioning when changing the angles. The COMOSAR device holder has been made out of low-loss POM material having the following dielectric parameters: relative permittivity εr =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.	

4.6 SAM Twin Phantom

The SAM twin phantom is a fiberglass shell phantom with 2mm shell thickness (except the ear region where shell thickness increases to 6mm). It has three measurement areas: Left head Right head Flat phantom	

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

5 SAR MEASUREMENT PROCEDURE

5.1 Specific Absorption Rate (SAR)

SAR is related to the rate at which energy is absorbed per unit mass in 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 occupational/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.

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 given mass density (ρ). The equation description is as below:

$$\mathrm{SAR} = \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}W}{\mathrm{d}m}\right) = \frac{\mathrm{d}}{\mathrm{d}t}\left(\frac{\mathrm{d}W}{\rho \mathrm{d}V}\right)$$

SAR is expressed in units of Watts per kilogram (W/Kg)
SAR can be obtained using either of the following equations:

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

$$\mathrm{SAR} = c_h \left.\frac{\mathrm{d}T}{\mathrm{d}t}\right|_{t=0}$$

Where

SAR is the specific absorption rate in watts per kilogram;
E is the r.m.s. value of the electric field strength in the tissue in volts per meter;
σ is the conductivity of the tissue in siemens per metre;
ρ is the density of the tissue in kilograms per cubic metre;
c_h is the heat capacity of the tissue in joules per kilogram and Kelvin;

$\frac{\mathrm{dT}}{\mathrm{dt}} \mid \mathrm{t} = 0$ is the initial time derivative of temperature in the tissue in kelvins per second

5.2 SAR Measurement Procedure

Step 1: Power Reference Measurement

The Power Reference Measurement and Power Drift Measurement are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface is 2.7mm This distance cannot be smaller than the distance os sensor calibration points to probe tip as `defined in the probe properties,

Step 2: Area Scan

The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in SATIMO software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in db) is specified in the standards for compliance testing. For example, a 2db range is required in IEEE Standard 1528 and IEC62209 standards, whereby 3db is a requirement when compliance is assessed in accordance with the ARIB standard (Japan) If one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximum are detected, the number of Zoom Scan has to be increased accordingly.

Area Scan Parameters extracted from KDB 865664 D01 SAR Measurement 100MHz to 6GHz

	≤ 3 GHz	> 3 GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	5 ± 1 mm	½·δ·ln(2) ± 0.5 mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	30° ± 1°	20° ± 1°
Maximum area scan spatial resolution: Δx_{Area}, Δy_{Area}	≤ 2 GHz: ≤ 15 mm 2 – 3 GHz: ≤ 12 mm	3 – 4 GHz: ≤ 12 mm 4 – 6 GHz: ≤ 10 mm
	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	

Step 3: Zoom Scan

Zoom Scan are used to assess the peak spatial SAR value within a cubic average volume containing 1g abd 10g of simulated tissue. The Zoom Scan measures points(refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1g and 10g and displays these values next to the job's label.

Zoom Scan Parameters extracted from KDB865664 d01 SAR Measurement 100MHz to 6GHz

Maximum zoom scan spatial resolution: Δx_{Zoom}, Δy_{Zoom}			≤ 2 GHz: ≤ 8 mm 2 – 3 GHz: ≤ 5 mm*	3 – 4 GHz: ≤ 5 mm* 4 – 6 GHz: ≤ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		≤ 5 mm	3 – 4 GHz: ≤ 4 mm 4 – 5 GHz: ≤ 3 mm 5 – 6 GHz: ≤ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	≤ 4 mm	3 – 4 GHz: ≤ 3 mm 4 – 5 GHz: ≤ 2.5 mm 5 – 6 GHz: ≤ 2 mm
		$\Delta z_{Zoom}(n>1)$: between subsequent points	$\leq 1.5 \cdot \Delta z_{Zoom}(n-1)$	
Minimum zoom scan volume	x, y, z		≥ 30 mm	3 – 4 GHz: ≥ 28 mm 4 – 5 GHz: ≥ 25 mm 5 – 6 GHz: ≥ 22 mm

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

* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 5 mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

Step 4: Power Drift Measurement

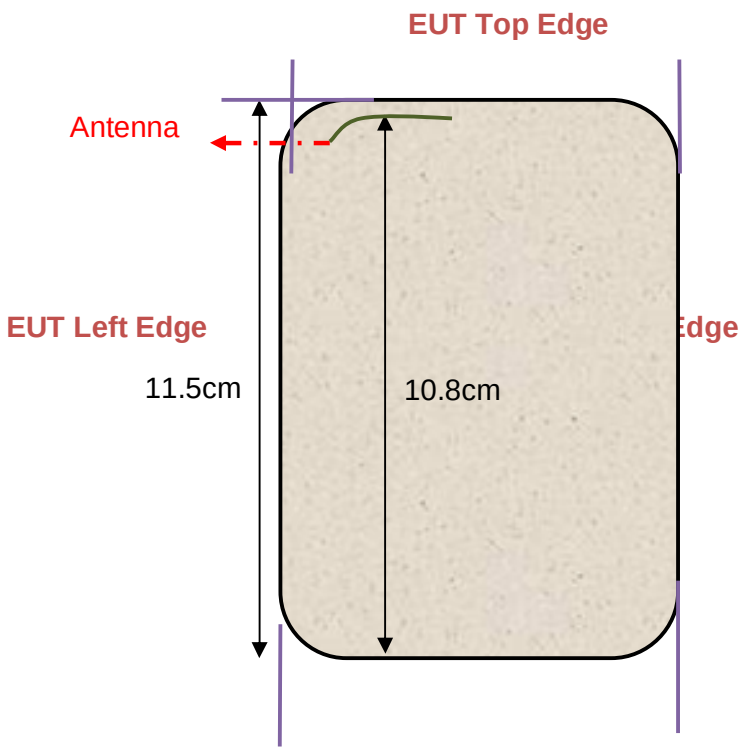
The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the same settings. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

5.3 RF Exposure Conditions

Test Configuration and setting:

The EUT is a model of Baby monitor. For SAR testing, the device was controlled by software.

Antenna Location: (front view)



6 TISSUE SIMULATING LIQUID

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15cm. For head SAR testing the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15cm For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15cm.The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in 5.3

6.1 The composition of the tissue simulating liquid

Ingredient	Water	Salt	Sugar	HEC	Preventol	DGBE	TWEEN	Triton X-100
2450MHz Body	√	√	--	--	--	√	--	--

6.2 Tissue Dielectric Parameters for Head and Body Phantoms

The head tissue dielectric parameters recommended by the IEEE 1528 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 variations in a human head. Other head and body tissue parameters that have not been specified in IEEE 1528 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 IEEE 1528.

Target Frequency (MHz)	head		body	
	εr	σ (S/m)	εr	σ (S/m)
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	1.01	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

(εr = relative permittivity, σ = conductivity and ρ = 1000 kg/m3)

6.3 Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using SATIMO Dielectric Probe Kit and R&S Network Analyzer ZVL6.

Tissue Stimulant Measurement for 2450MHz					
	Fr. (MHz)	Dielectric Parameters (±5%)		Tissue Temp [°C]	Test time
		εr52.7(50.065-55.335)	δ[s/m]1.95(1.8525-2.0475)		
Body	2402	53.24	1.89	21.2	Oct 15, 2015
	2440	52.77	1.92		
	2450	52.13	1.93		
	2479	51.94	1.95		

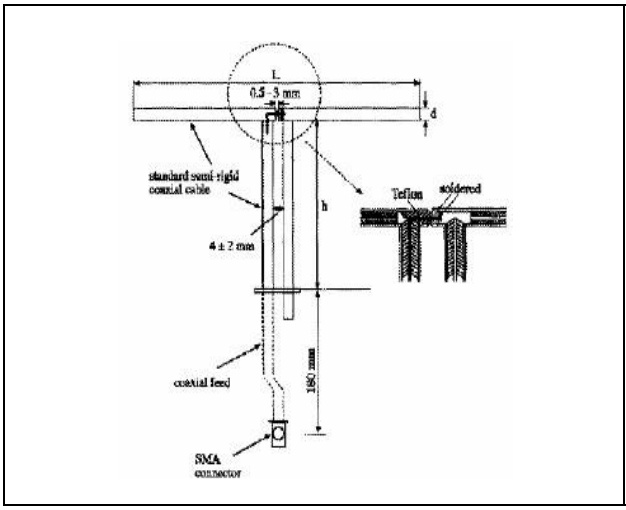
7 SAR SYSTEM CHECK PROCEDURE

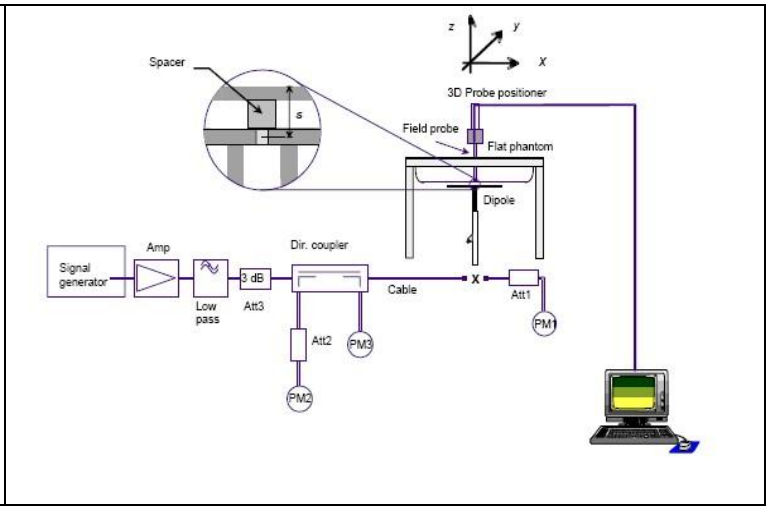
7.1 SAR System Check Procedures

SAR system check is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device. The same SAR probe(s) and tissue-equivalent media combinations used with each specific SAR system for system verification must be used for device testing. When multiple probe calibration points are required to cover substantially large transmission bands, independent system verifications are required for each probe calibration point. A system verification must be performed before each series of SAR measurements using the same probe calibration point and tissue-equivalent medium. Additional system verification should be considered according to the conditions of the tissue-equivalent medium and measured tissue dielectric parameters, typically every three to four days when the liquid parameters are remeasured or sooner when marginal liquid parameters are used at the beginning of a series of measurements.

Each SATIMO system is equipped with one or more system check kits. These units, together with the predefined measurement procedures within the SATIMO software, enable the user to conduct the system check and system validation. System kit includes a dipole, and dipole device holder.

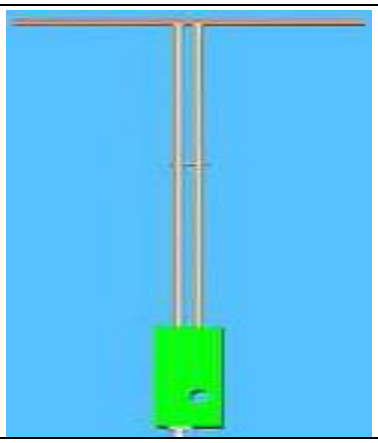
The system check verifies that the system operates within its specifications. It’s performed daily or before every SAR measurement. The system check uses normal SAR measurement in the flat section of the phantom with a matched dipole at a specified distance. The system check setup is shown as below.





7.2 SAR System Check

7.2.1. Dipoles

	The dipoles used is based on the IEC/EN62209-1/2 standard, the table below provides details for the mechanical and electrical Specifications for the dipoles.

Frequency	L (mm)	h (mm)	d (mm)
2450MHz	51.5	30.4	3.6

7.2.2. System Check Result

System Performance Check at 2450MHz for Body										
Validation Kit: SN 46/11 DIP 2G450-189										
Freq. [MHz]	Target Value(W/Kg)		Reference Result (± 10%)		Tested SAR Value(W/Kg) Input Power=18dBm		Normalized to 1W (W/Kg)		Tissue Temp. [°C]	Test time
	1g	10g	1g	10g	1g	10g	1g	10g		
2450	54.19	24.96	48.771-59.609	22.464-27.456	3.467	1.582	55.472	25.312	21.2	Oct. 15,2015

Note:

(1) We use a CW signal of 18dBm for system check, and then all SAR value are normalized to 1W forward power. The result must be within ± 10% of target value.

8 EUT TEST POSITION

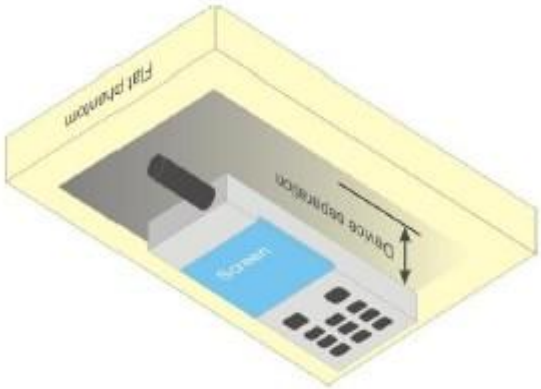
This EUT was tested in **Body back.**

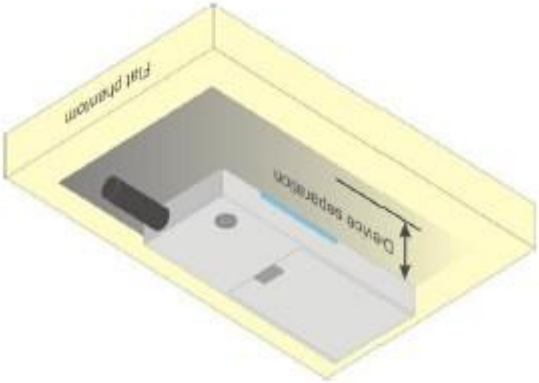
8.1 Body Worn Position

(1) To position the EUT parallel to the phantom surface.

(2) To adjust the EUT parallel to the flat phantom.

(3) To adjust the distance between the EUT surface and the flat phantom to **0mm.**





9 SAR EXPOSURE LIMITS

SAR assessments have been made in line with the requirements of IEEE-1528, FCC Supplement C, and comply with ANSI/IEEE C95.1-1992 “Uncontrolled Environments” limits. These limits apply to a location which is deemed as “Uncontrolled Environment” which can be described as a situation where the general public may be exposed to an RF source with no prior knowledge or control over their exposure.

Limits for General Population/Uncontrolled Exposure (W/kg)

Type Exposure	Uncontrolled Environment Limit (W/kg)
Spatial Peak SAR (1g cube tissue for brain or body)	1.60
Spatial Average SAR (Whole body)	0.08
Spatial Peak SAR (Limbs)	4.0

10 TEST EQUIPMENT LIST

Equipment description	Manufacturer/ Model	Identification No.	Current calibration date	Next calibration date
SAR Probe	MVG	SN 19/15 EP254	07/10/2015	07/09/2016
TISSUE Probe	SATIMO	SN 45/11 OCPG45	12/03/2014	12/02/2015
Phantom	SATIMO	SN_4511_SAM90	Validated. No cal required.	Validated. No cal required.
Liquid	SATIMO	-	Validated. No cal required.	Validated. No cal required.
Comm Tester	R&S - CMU200	069Y7-158-13-712	03/06/2015	03/05/2016
Comm Tester	Agilent-8960	GB46310822	03/06/2015	03/05/2016
Multimeter	Keithley 2000	1188656	03/06/2015	03/05/2016
Dipole	SATIMO SID2450	SN46/11 DIP 2G450-189	11/14/2013	11/13/2016
Signal Generator	Agilent-E4438C	MY44260051	03/06/2015	03/05/2016
Power Sensor	NRP-Z23	US38261498	03/06/2015	03/05/2016
Spectrum Analyzer E4440	Agilent	US41421290	07/25/2014	07/22/2016
Network Analyzer	Rhode & Schwarz ZVL6	SN100132	03/06/2015	03/05/2016
Attenuator	Warison /WATT-6SR1211	N/A	N/A	N/A
Attenuator	Mini-circuits / VAT-10+	N/A	N/A	N/A
Amplifier	EM30180	SN060552	03/06/2015	03/05/2016
Directional Couple	Werlatone/ C6026-10	SN99482	07/29/2015	07/28/2016
Power Sensor	NRP-Z21	1137.6000.02	10/20/2015	10/19/2016
Power Sensor	NRP-Z23	US38261498	03/06/2015	03/05/2016
Power Viewer	R&S	V2.3.1.0	N/A	N/A

Note: Per KDB 865664 Dipole SAR Validation, AGC Lab has adopted 3 years calibration intervals. On annual basis, every measurement dipole has been evaluated and is in compliance with the following criteria:
1. There is no physical damage on the dipole;
2. System validation with specific dipole is within 10% of calibrated value;
3. Return-loss is within 20% of calibrated measurement;
4. Impedance is within 5Ω of calibrated measurement.

11 MEASUREMENT UNCERTAINTY

SATIMO Uncertainty Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram / 10 gram.									
Uncertainty Component	Sec.	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+- %)	10g Ui (+-%)	Vi
Measurement System									
Probe calibration	E.2.1	7.0	N	1	1	1	6.98	6.98	∞
Axial Isotropy	E.2.2	2.5	R	$\sqrt{3}$	1	1	1.16	1.16	∞
Hemispherical Isotropy	E.2.2	4.0	R	$\sqrt{3}$	1	1	2.33	2.33	∞
Boundary effect	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	E.2.4	5.0	R	$\sqrt{3}$	1	1	2.87	2.87	∞
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	E.2.6	0.02	N	1	1	1	0.03	0.03	∞
Response Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	1.70	1.70	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.16	1.16	∞
RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.71	1.71	∞
Probe positioner Mechanical Tolerance	E.6.2	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Probe positioning with respect to Phantom Shell	E.6.3	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation	E.5.2	5.0	R	$\sqrt{3}$	1	1	2.91	2.91	∞
Test sample Related									
Test sample positioning	E.4.2.1	0.03	N	1	1	1	0.05	0.05	N-1
Device Holder Uncertainty	E.4.1.1	5.00	N	1	1	1	4.95	4.95	∞
Output power Variation - SAR drift measurement	6.6.2	0.65	R	$\sqrt{3}$	1	1	0.36	0.36	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	0.05	R	$\sqrt{3}$	1	1	0.02	0.02	∞
Liquid conductivity deviation from target value	E.3.2	5.00	R	$\sqrt{3}$	0.64	0.43	1.83	1.23	∞
Liquid conductivity - measurement uncertainty	E.3.3	5.00	N	1	0.64	0.43	3.18	2.14	∞
Liquid permittivity - deviation from target value	E.3.2	0.03	R	$\sqrt{3}$	0.6	0.49	0.01	0.01	∞
Liquid permittivity - measurement uncertainty	E.3.3	10.00	N	1	0.6	0.49	6.06	4.95	M
Combined Standard Uncertainty			RSS				11.17	10.63	∞
Expanded Uncertainty (95% Confidence interval)			k				22.34	21.26	

SATIMO Uncertainty System uncertainty for 300 MHz to 3 GHz averaged over 1 gram / 10 gram.									
Uncertainty Component	Sec.	Tol (+- %)	Prob. Dist.	Div.	Ci (1g)	Ci (10g)	1g Ui (+-%)	10g Ui (+-%)	Vi
Measurement System									
Probe calibration	E.2.1	7.0	N	1	1	1	6.98	6.98	∞
Axial Isotropy	E.2.2	2.5	R	$\sqrt{3}$	1	1	1.16	1.16	∞
Hemispherical Isotropy	E.2.2	4.0	R	$\sqrt{3}$	1	1	2.33	2.33	∞
Boundary Effects	E.2.3	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Linearity	E.2.4	5.0	R	$\sqrt{3}$	1	1	2.87	2.87	∞
System detection limits	E.2.5	1.0	R	$\sqrt{3}$	1	1	0.58	0.58	∞
Readout Electronics	E.2.6	0.02	N	1	1	1	0.03	0.03	∞
Response Time	E.2.7	3.0	R	$\sqrt{3}$	1	1	1.70	1.70	∞
Integration Time	E.2.8	2.0	R	$\sqrt{3}$	1	1	1.16	1.16	∞
RF ambient Conditions	E.6.1	3.0	R	$\sqrt{3}$	1	1	1.71	1.71	∞
Probe positioner Mechanical Tolerance	E.6.2	2.0	R	$\sqrt{3}$	1	1	1.15	1.15	∞
Probe positioning with respect to Phantom Shell	E.6.3	0.05	R	$\sqrt{3}$	1	1	0.03	0.03	∞
Extrapolation, interpolation and integration Algoritms for Max. SAR Evaluation	E.5.2	5.0	R	$\sqrt{3}$	1	1	2.91	2.91	∞
Dipole									
Dipole axis to liquid Distance	8,E.4.2	1.00	N	$\sqrt{3}$	1	1	0.55	0.55	N-1
Input power and SAR drift measurement	8,6.6.2	0.65	R	$\sqrt{3}$	1	1	0.36	0.36	∞
Phantom and Tissue Parameters									
Phantom Uncertainty (Shape and thickness tolerances)	E.3.1	0.05	R	$\sqrt{3}$	1	1	0.02	0.02	∞
Liquid conductivity - deviation from target value	E.3.2	5.00	R	$\sqrt{3}$	0.64	0.43	1.83	1.23	∞
Liquid conductivity - measurement uncertainty	E.3.3	5.00	N	1	0.64	0.43	3.18	2.14	∞
Liquid permittivity - deviation from target value	E.3.2	0.03	R	$\sqrt{3}$	0.6	0.49	0.01	0.01	∞
Liquid permittivity - measurement uncertainty	E.3.3	10.00	N	1	0.6	0.49	6.06	4.95	M
Combined Standard Uncertainty			RSS				10.03	9.42	
Expanded Uncertainty (95% Confidence interval)			k				20.05	18.85	

12 CONDUCTED POWER MEASUREMENT

2.4GHz

Mode	Frequency(MHz)	Peak Power(dBm)
GFSK Modulation	2402	17.65
	2440	**18.23**
	2479	17.72

13 TEST RESULTS

13.1 SAR Test Results Summary

13.1.1. Test position and configuration

According to RSS-102(Issue 5) Radio Frequency (RF) Exposure Compliance of Radiocommunications Apparatu (All Frequency Bands), Due to the Max peak power for EUT is greater than 4mW, which have to be tested. Using the head liquid with a separation of 0mm at flat phantom to test, achieving actual usage.

13.1.2. Operation Mode

1. Per KDB 865664 D01 v01r03,for each frequency band, if the measured SAR is ⩾0.8W/Kg, testing for repeated SAR measurement is required , that the highest measured SAR is only to be tested. When the SAR results are near the limit, the following procedures are required for each device to verify these types of SAR measurement related variation concerns by repeating the highest measured SAR configuration in each frequency band.

   (1) When the original highest measured SAR is ⩾0.8W/Kg, repeat that measurement once.

   (2) Perform a second repeated measurement only if the ratio of largest to smallest SAR for the original and first repeated measurements is ＞1.20 or when the original or repeated measurement is ⩾1.45 W/Kg.

   (3) Perform a third repeated measurement only if the original, first and second repeated measurement is ⩾1.5 W/Kg and ratio of largest to smallest SAR for the original, first and second measurement is ⩾ 1.20.

2. Maximum Scaling SAR in order to calculate the Maximum SAR values to test under the standard Peak Power, Calculation method is as follows:

   Maximum Scaling SAR =tested SAR (Max.) × [maximum turn-up power (mw)/ maximum measurement output power(mw)]

13.1.3. SAR Test Results Summary

SAR MEASUREMENT									
Depth of Liquid (cm):>15				Relative Humidity (%): 48.0					
Product: BABY MONITOR									
Test Model:NM204									
Position	**Mode**	**Ch.**	**Fr. (MHz)**	**Power Drift (<±5%)**	**SAR (1g) (W/kg)**	**Max. Turn-up Power (dBm)**	**Meas. output Power (dBm)**	**Scaled SAR (W/Kg)**	**Limit W/kg**
Body Back	DTS	Middle	2440	-0.10	0.157	19	18.23	0.187	1.6
Body Front	DTS	Middle	2440	0.32	**0.458**	19	18.23	**0.547**	1.6
Edge 1 (Body – top)	DTS	Middle	2440	-0.55	0.434	19	18.23	0.518	1.6
Edge 2 (Body - right)	DTS	Middle	2440	0.01	0.298	19	18.23	0.356	1.6
Edge 3 (Body - bottom)	DTS	Middle	2440	0.63	0.036	19	18.23	0.043	1.6
Edge 4 (Body - left)	DTS	Middle	2440	-0.21	0.148	19	18.23	0.177	1.6

Note:
(1).When the 1-g Reported SAR is ≤ 0.8 W/kg, testing for low and high channel is optional. Refer to KDB 447498.
(2). All of above “DTS” means data transmitters.
(3). The test separation of all above table(body part) is 0mm, above test mode see the Photographs.

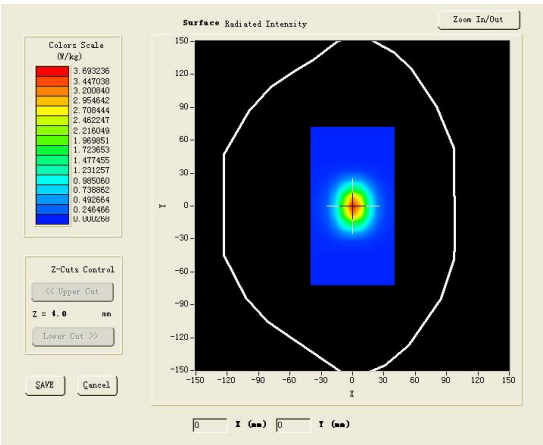
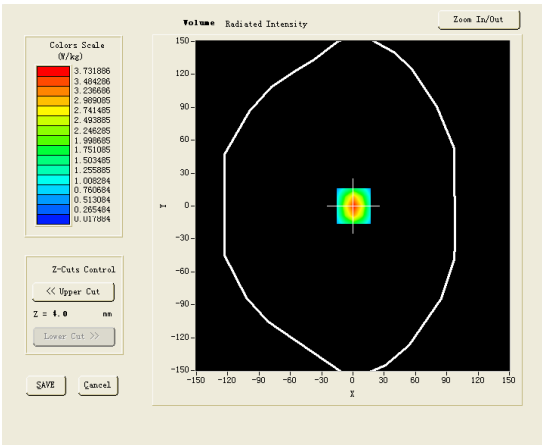
APPENDIX A. SAR SYSTEM CHECK DATA

Test Laboratory: AGC Lab **Date: Oct 15, 2015**
System Check Body 2450 MHz
DUT: Dipole 2450 MHz Type: SID 2450
Communication System CW; Communication System Band: D2450 (2450.0 MHz); Duty Cycle: 1:1; Conv.F=4.97
Frequency: 2450 MHz; Medium parameters used: f = 2450 MHz; σ=1.93 mho/m; εr =52.13; ρ= 1000 kg/m³ ;
Phantom section: Flat Section; Input Power=18dBm
Ambient temperature (℃):21.0, Liquid temperature (℃): 21.2

SATIMO Configuration

- Probe: SSE5; Calibrated: 07/10/2015; Serial No.: SN 19/15 EP254
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_01

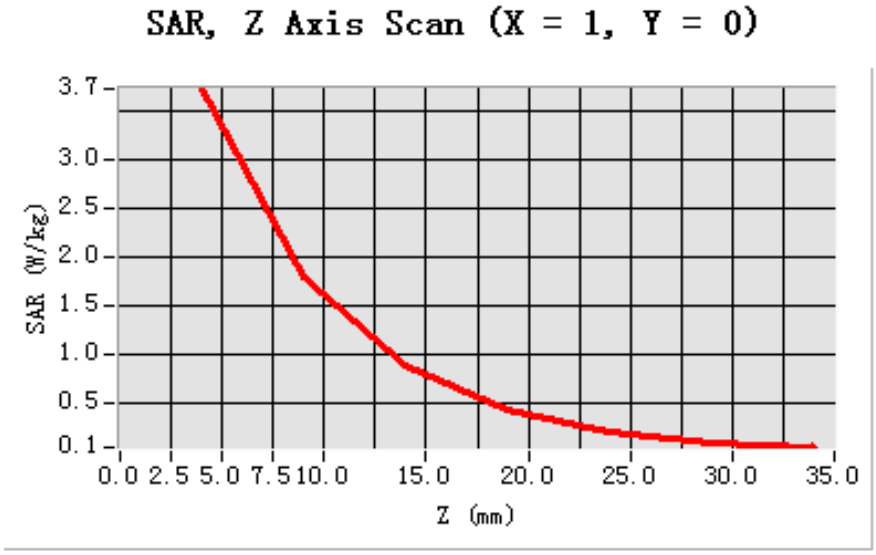
Configuration/System Check 2450MHz Body/Area Scan: Measurement grid: dx=8mm, dy=8mm
Configuration/System Check 2450MHz Body/Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm

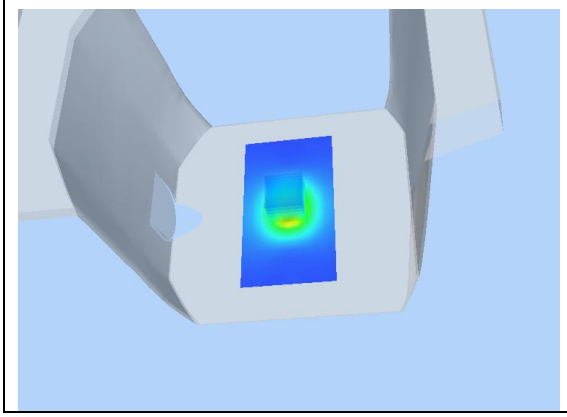
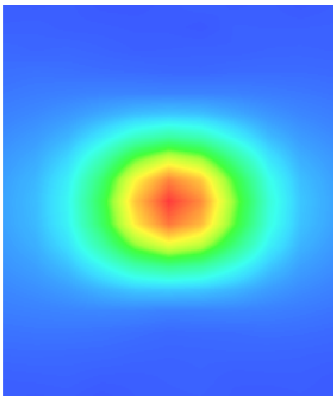
SURFACE SAR	VOLUME SAR
	

Maximum location: X=1.00, Y=0.00

SAR 10g (W/Kg)	1.582354
SAR 1g (W/Kg)	3.467201

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	3.7319	1.8110	0.8955	0.4446	0.2224	0.1116



3D screen shot	Hot spot position
	

APPENDIX B. SAR MEASUREMENT DATA

Test Laboratory: AGC Lab **Date: Oct 15, 2015**
2.4G Mid-Body- Worn- Back (DTS)
DUT: Video Baby Monitor (Parent Unit); Type: NM204

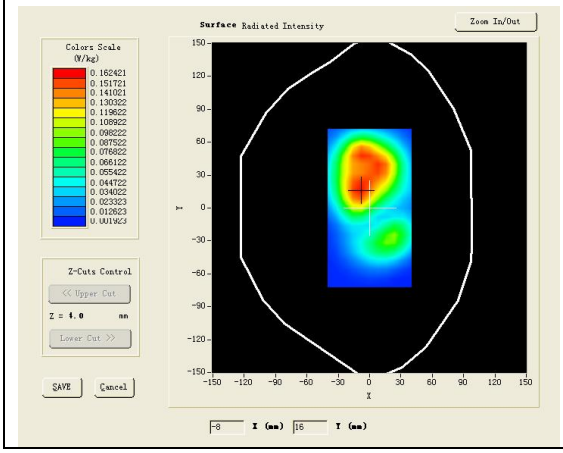
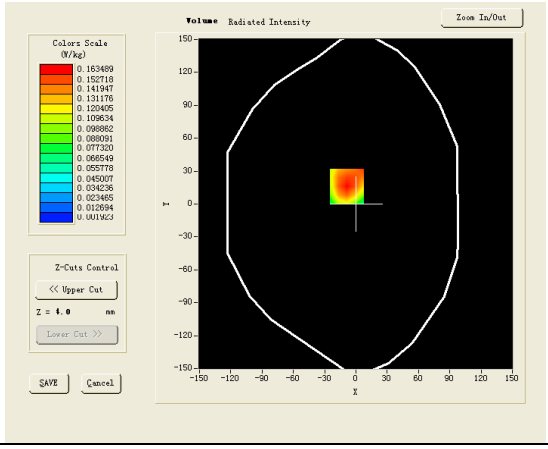
Communication System: 2.4G; Communication System Band: 2.4G; Duty Cycle: 0.33; Conv.F=4.97;
Frequency: 2440 MHz; Medium parameters used: f = 2450 MHz; σ=1.92 mho/m; εr =52.77; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):21.0, Liquid temperature (℃): 21.2

SATIMO Configuration:

- Probe: SSE5; Calibrated: 07/10/2015; Serial No.: SN 19/15 EP254
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_01

Configuration/2.4G Mid- Body- Back /Area Scan: Measurement grid: dx=8mm, dy=8mm
Configuration/2.4G Mid- Body- Back /Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm;

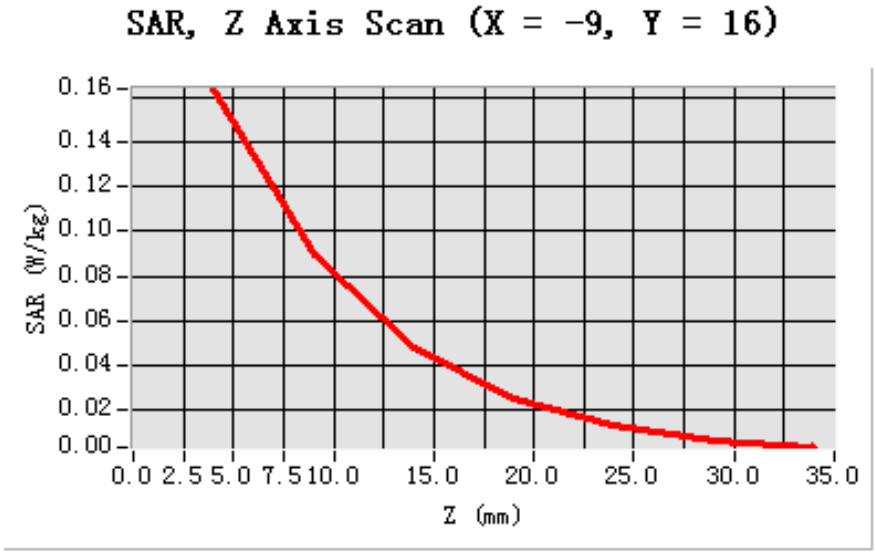
Area Scan	surf_sam_plan.txt
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	Validation plane
Device Position	Body Back
Band	2450MHz
Channels	Middle
Signal	Crest factor: 3.03

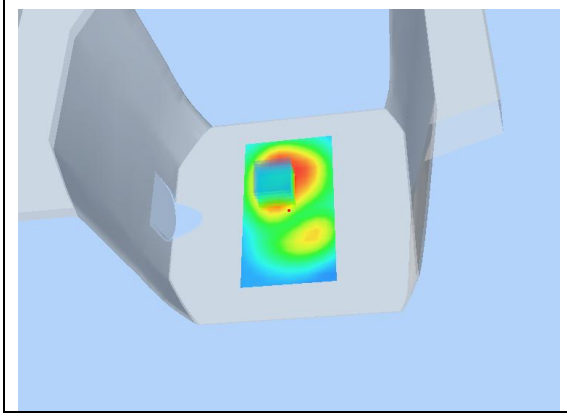
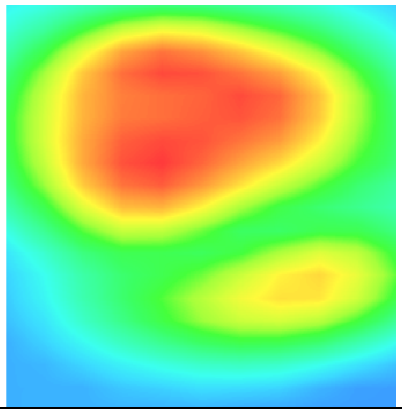
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-9.00, Y=16.00

SAR 10g (W/Kg)	0.085959
SAR 1g (W/Kg)	0.157107

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	0.1635	0.0893	0.0484	0.0257	0.0134	0.0065



3D screen shot	Hot spot position
	

Test Laboratory: AGC Lab **Date: Oct 15, 2015**
2.4G Mid-Body- Worn- Front (DTS)
DUT: Video Baby Monitor (Parent Unit); Type: NM204

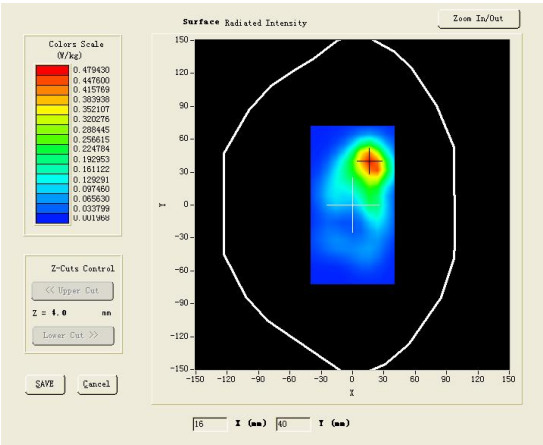
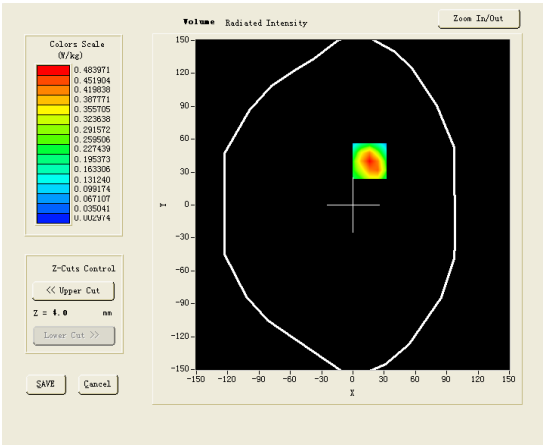
Communication System: 2.4G; Communication System Band: 2.4G; Duty Cycle: 0.33; Conv.F=4.97;
Frequency: 2440 MHz; Medium parameters used: f = 2450 MHz; σ=1.92 mho/m; εr =52.77; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):21.0, Liquid temperature (℃): 21.2

SATIMO Configuration:

- Probe: SSE5; Calibrated: 07/10/2015; Serial No.: SN 19/15 EP254
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_01

Configuration/2.4G Mid- Body- Front /Area Scan: Measurement grid: dx=8mm, dy=8mm
Configuration/2.4G Mid- Body- Front /Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm;

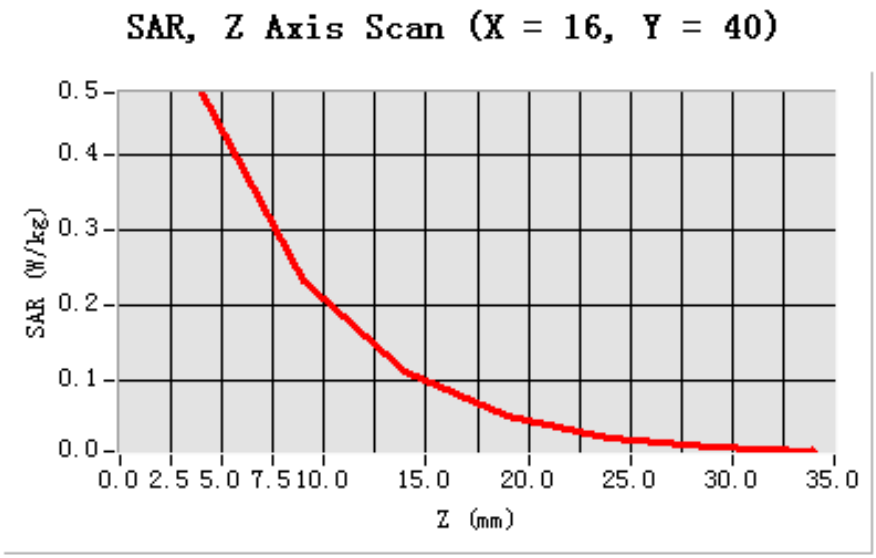
Area Scan	surf_sam_plan.txt
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	Validation plane
Device Position	Body Front
Band	2450MHz
Channels	Middle
Signal	Crest factor: 3.03

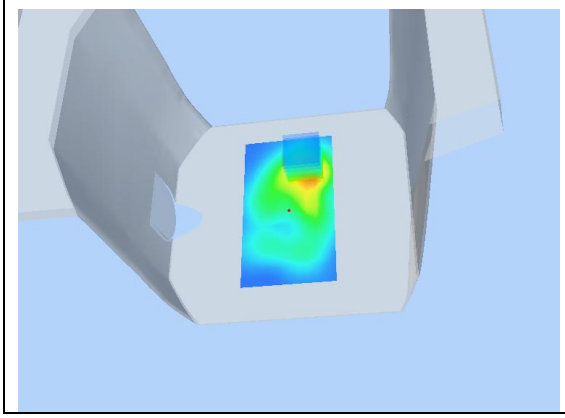
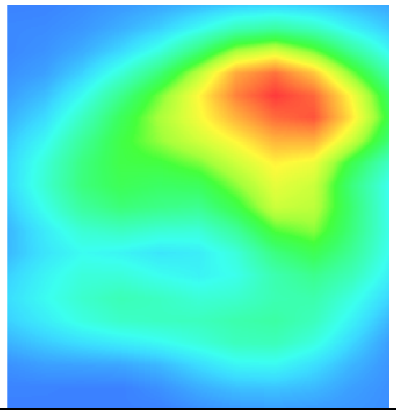
SURFACE SAR	VOLUME SAR
	

Maximum location: X=16.00, Y=40.00

SAR 10g (W/Kg)	0.221289
SAR 1g (W/Kg)	0.458001

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	0.4840	0.2332	0.1111	0.0522	0.0251	0.0129



3D screen shot	Hot spot position
	

Test Laboratory: AGC Lab **Date: Oct 15, 2015**
2.4G Mid- Eage 1(DTS)
DUT: Video Baby Monitor (Parent Unit); Type: NM204

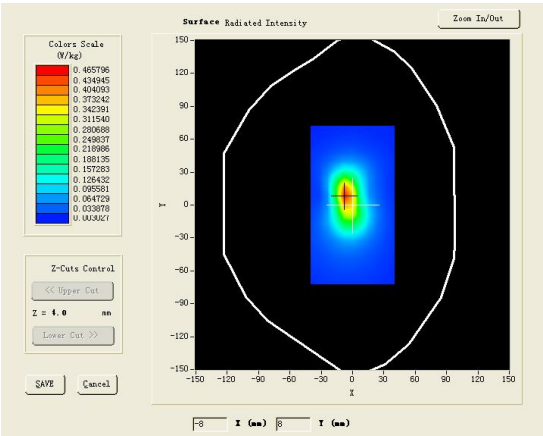
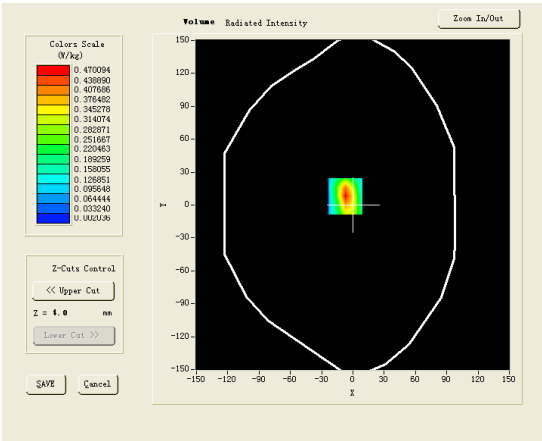
Communication System: 2.4G; Communication System Band: 2.4G; Duty Cycle: 0.33; Conv.F=4.97;
Frequency: 2440 MHz; Medium parameters used: f = 2450 MHz; σ=1.92 mho/m; εr =52.77; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):21.0, Liquid temperature (℃): 21.2

SATIMO Configuration:

- Probe: SSE5; Calibrated: 07/10/2015; Serial No.: SN 19/15 EP254
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_01

Configuration/2.4G Mid- Eage 1 /Area Scan: Measurement grid: dx=8mm, dy=8mm
Configuration/2.4G Mid- Eage 1 /Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm;

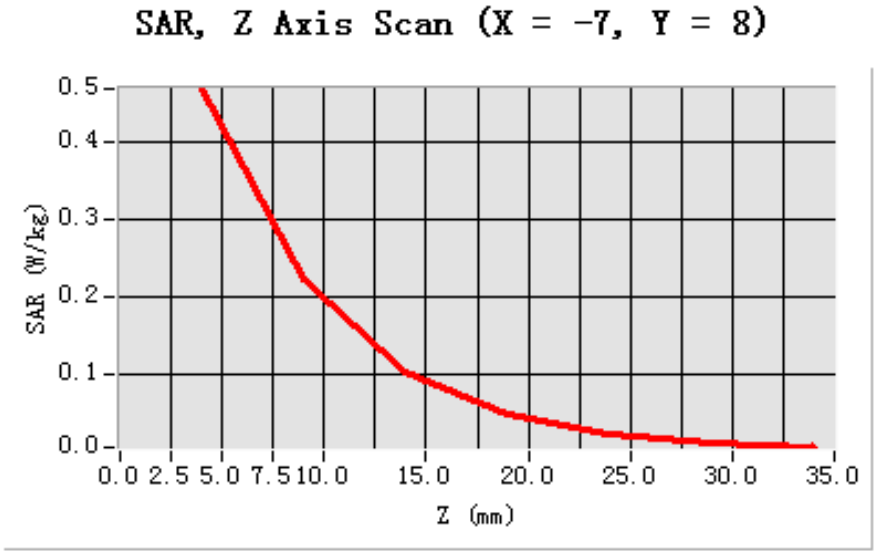
Area Scan	surf_sam_plan.txt
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	Validation plane
Device Position	Eage 1
Band	2450MHz
Channels	Middle
Signal	Crest factor: 3.03

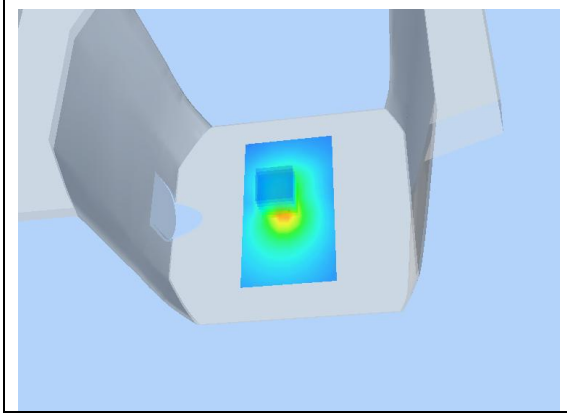
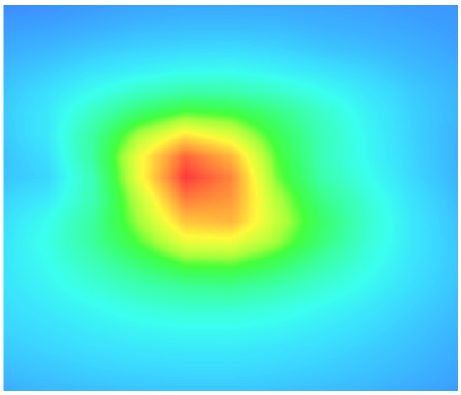
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-7.00, Y=8.00

SAR 10g (W/Kg)	0.194478
SAR 1g (W/Kg)	0.433728

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	0.4701	0.2221	0.1030	0.0477	0.0217	0.0098



3D screen shot	Hot spot position
	

Test Laboratory: AGC Lab **Date: Oct 15, 2015**
2.4G Mid- Eage 2(DTS)
DUT: Video Baby Monitor (Parent Unit); Type: NM204

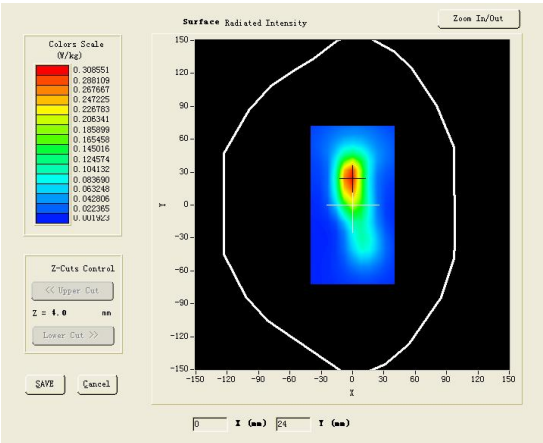
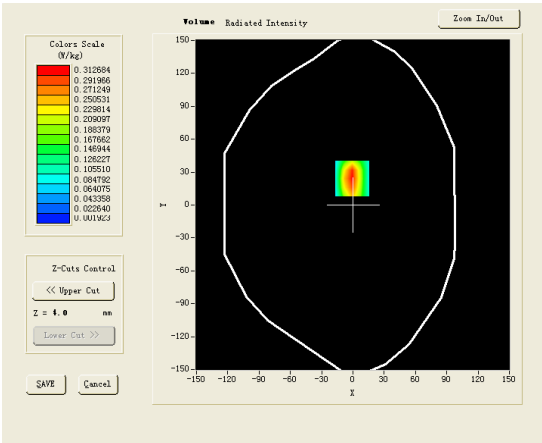
Communication System: 2.4G; Communication System Band: 2.4G; Duty Cycle: 0.33; Conv.F=4.97;
Frequency: 2440 MHz; Medium parameters used: f = 2450 MHz; σ=1.92 mho/m; εr =52.77; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):21.0, Liquid temperature (℃): 21.2

SATIMO Configuration:

- Probe: SSE5; Calibrated: 07/10/2015; Serial No.: SN 19/15 EP254
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_01

Configuration/2.4G Mid- Eage 2 /Area Scan: Measurement grid: dx=8mm, dy=8mm
Configuration/2.4G Mid- Eage 2 /Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm;

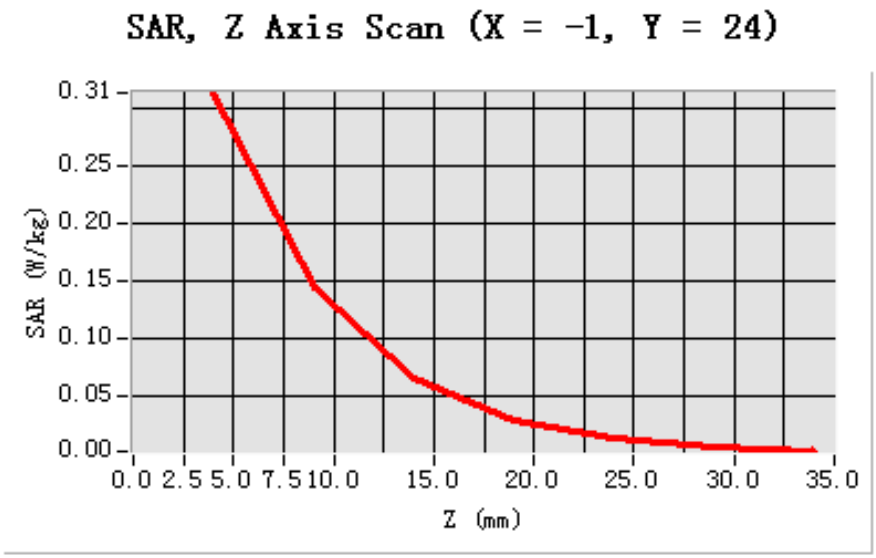
Area Scan	surf_sam_plan.txt
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	Validation plane
Device Position	Eage 2
Band	2450MHz
Channels	Middle
Signal	Crest factor: 3.03

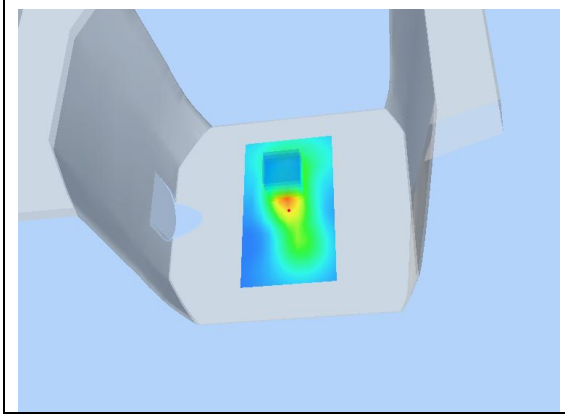
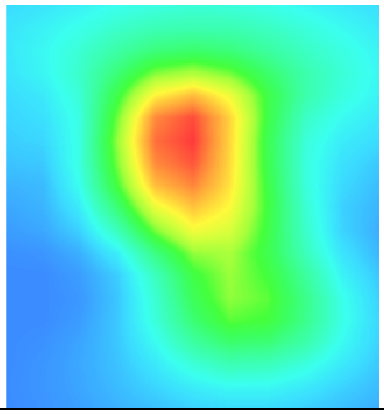
SURFACE SAR	VOLUME SAR
	

Maximum location: X=-1.00, Y=24.00

SAR 10g (W/Kg)	0.136405
SAR 1g (W/Kg)	0.297730

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	0.3127	0.1448	0.0667	0.0301	0.0139	0.0065



3D screen shot	Hot spot position
	

Test Laboratory: AGC Lab **Date: Oct 15, 2015**
2.4G Mid- Eage 3(DTS)
DUT: Video Baby Monitor (Parent Unit); Type: NM204

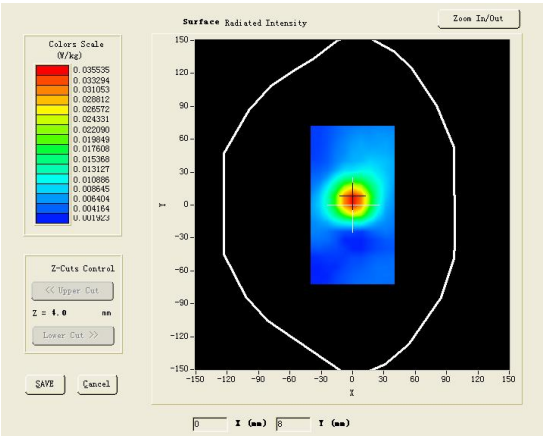
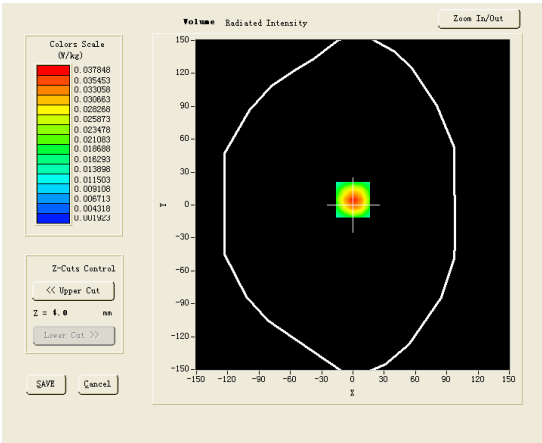
Communication System: 2.4G; Communication System Band: 2.4G; Duty Cycle: 0.33; Conv.F=4.97;
Frequency: 2440 MHz; Medium parameters used: f = 2450 MHz; σ=1.92 mho/m; εr =52.77; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):21.0, Liquid temperature (℃): 21.2

SATIMO Configuration:

- Probe: SSE5; Calibrated: 07/10/2015; Serial No.: SN 19/15 EP254
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_01

Configuration/2.4G Mid- Eage 3 /Area Scan: Measurement grid: dx=8mm, dy=8mm
Configuration/2.4G Mid- Eage 3 /Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm;

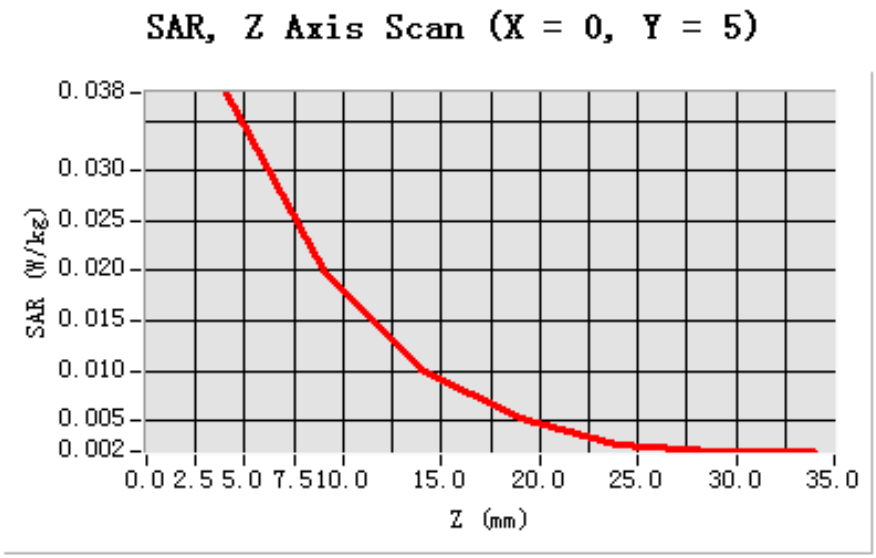
Area Scan	surf_sam_plan.txt
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	Validation plane
Device Position	Eage 3
Band	2450MHz
Channels	Middle
Signal	Crest factor: 3.03

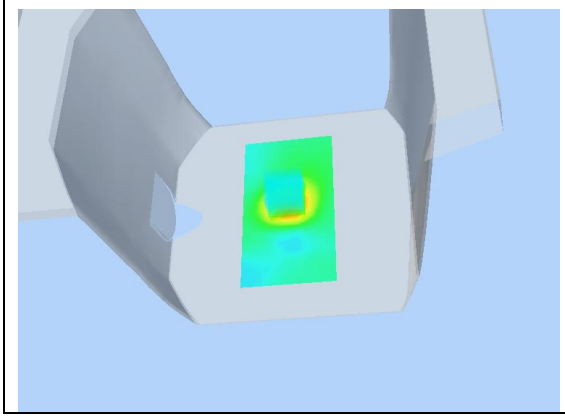
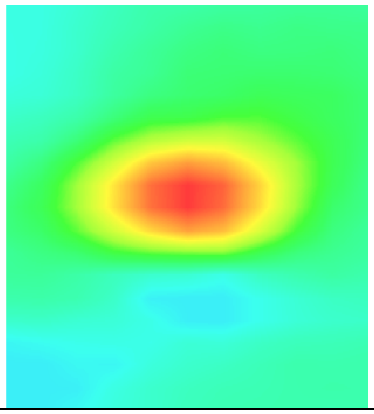
SURFACE SAR	VOLUME SAR
	

Maximum location: X=0.00, Y=5.00

SAR 10g (W/Kg)	0.017860
SAR 1g (W/Kg)	0.035568

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	0.0378	0.0201	0.0102	0.0053	0.0025	0.0019



3D screen shot	Hot spot position
	

Test Laboratory: AGC Lab **Date: Oct 15, 2015**
2.4G Mid- Eage 4(DTS)
DUT: Video Baby Monitor (Parent Unit); Type: NM204

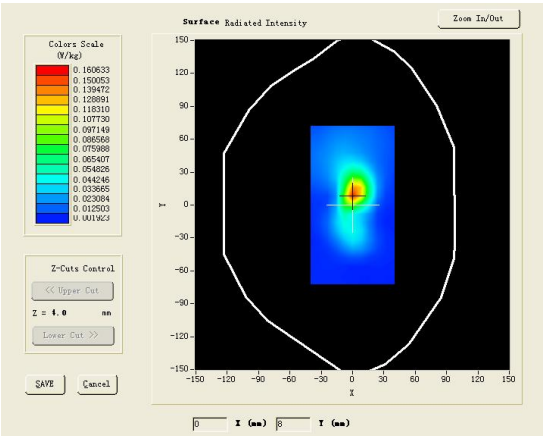
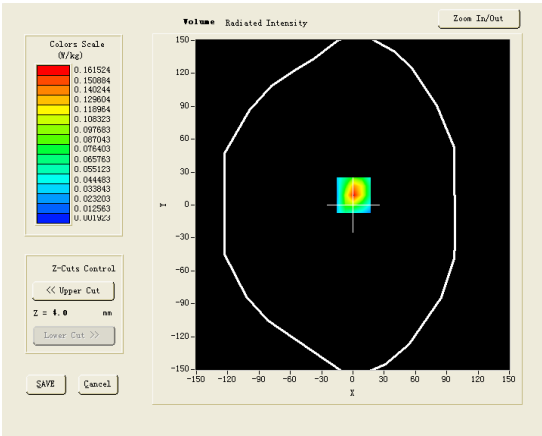
Communication System: 2.4G; Communication System Band: 2.4G; Duty Cycle: 0.33; Conv.F=4.97;
Frequency: 2440 MHz; Medium parameters used: f = 2450 MHz; σ=1.92 mho/m; εr =52.77; ρ= 1000 kg/m³ ;
Phantom section: Flat Section
Ambient temperature (℃):21.0, Liquid temperature (℃): 21.2

SATIMO Configuration:

- Probe: SSE5; Calibrated: 07/10/2015; Serial No.: SN 19/15 EP254
- Sensor-Surface: 4mm (Mechanical Surface Detection)
- Phantom: SAM twin phantom
- Measurement SW: OpenSAR V4_02_01

Configuration/2.4G Mid- Eage 4 /Area Scan: Measurement grid: dx=8mm, dy=8mm
Configuration/2.4G Mid- Eage 4 /Zoom Scan: Measurement grid: dx=5mm,dy=5mm, dz=5mm;

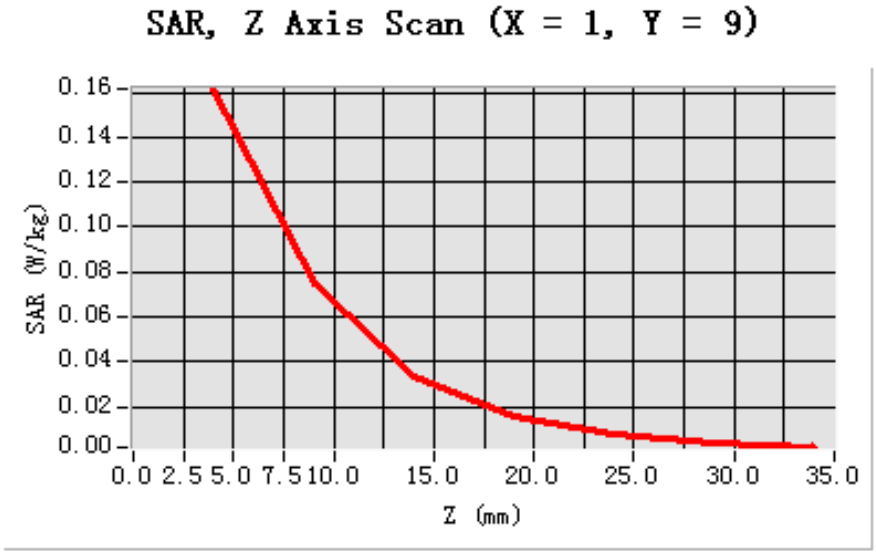
Area Scan	surf_sam_plan.txt
ZoomScan	7x7x7,dx=5mm dy=5mm dz=5mm
Phantom	Validation plane
Device Position	Eage 4
Band	2450MHz
Channels	Middle
Signal	Crest factor: 3.03

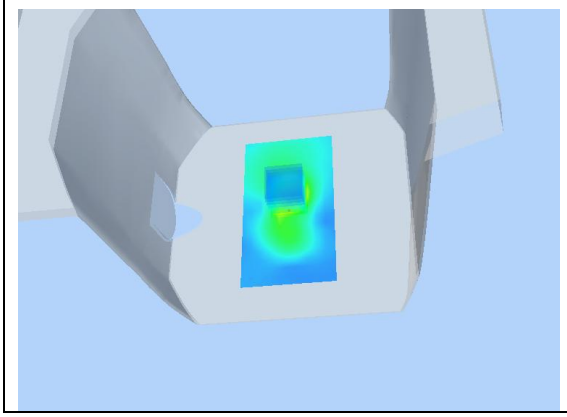
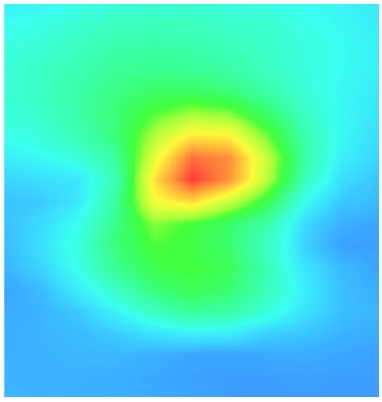
SURFACE SAR	VOLUME SAR
	

Maximum location: X=1.00, Y=9.00

SAR 10g (W/Kg)	0.065512
SAR 1g (W/Kg)	0.148154

Z (mm)	0.00	4.00	9.00	14.00	19.00	24.00	29.00
SAR (W/Kg)	0.0000	0.1615	0.0748	0.0334	0.0155	0.0076	0.0035

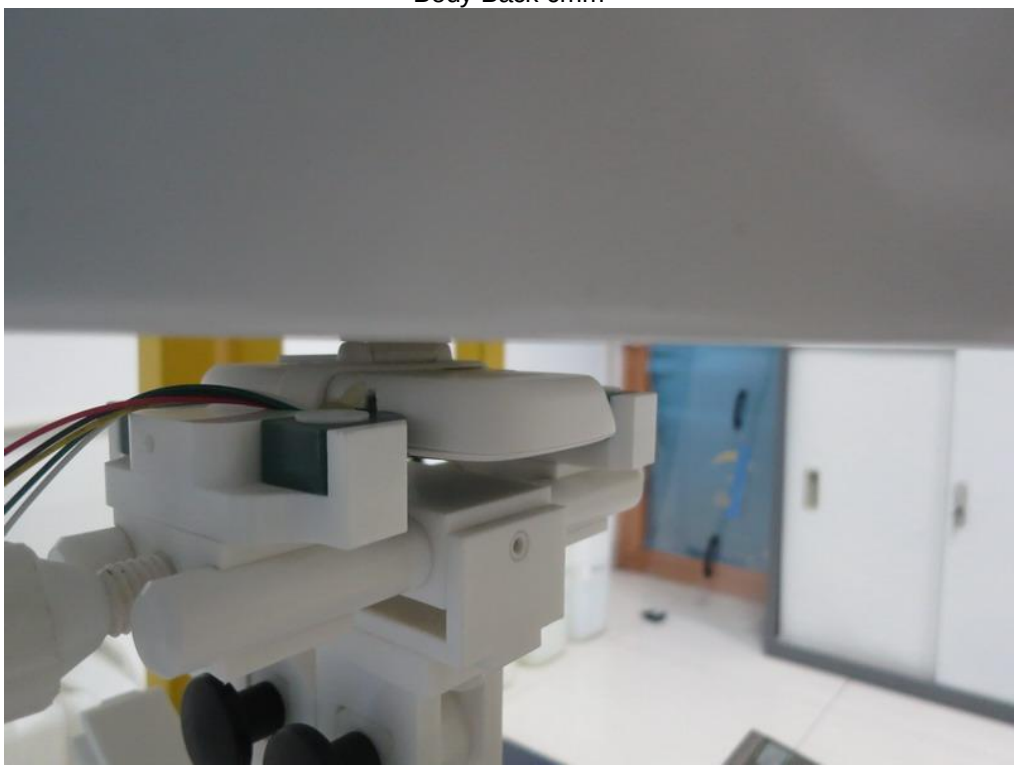


3D screen shot	Hot spot position
	

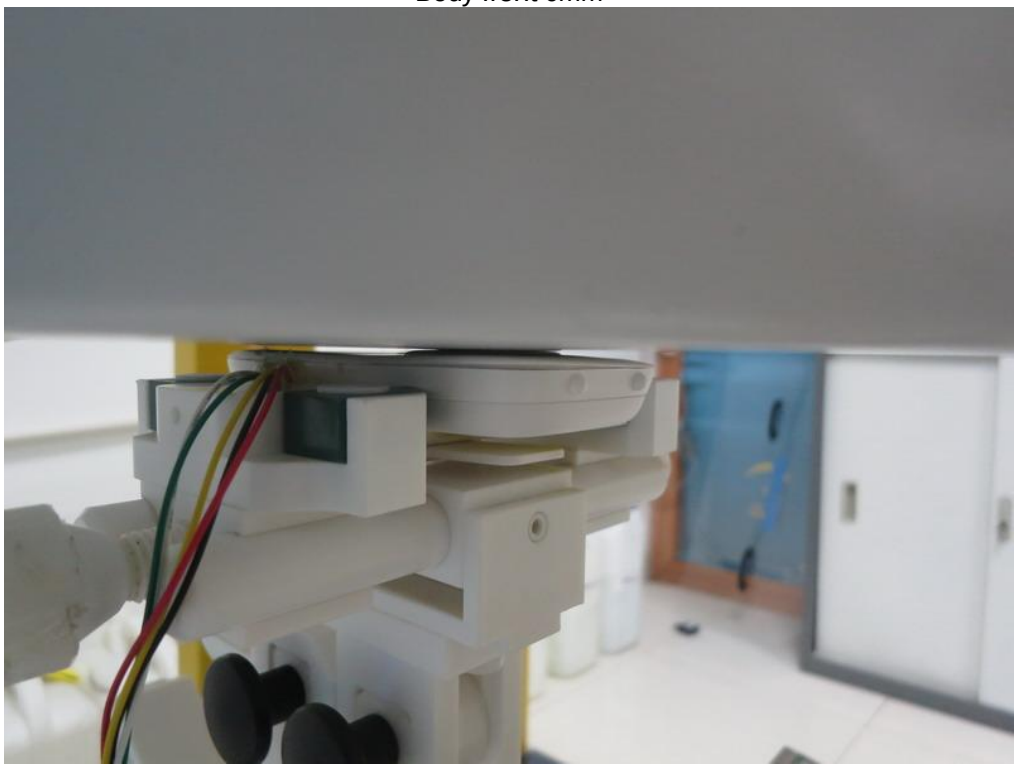
APPENDIX C. TEST SETUP PHOTOGRAPHS &EUT PHOTOGRAPHS

Test Setup Photographs

Body Back 0mm



Body front 0mm



Edge 1(Top)

Edge 2(Right)

Edge 3(Bottom)

Edge 4(Left)

DEPTH OF THE LIQUID IN THE PHANTOM—ZOOM IN

Note：The position used in the measurement were according to IEEE 1528-2013

2450MHz body

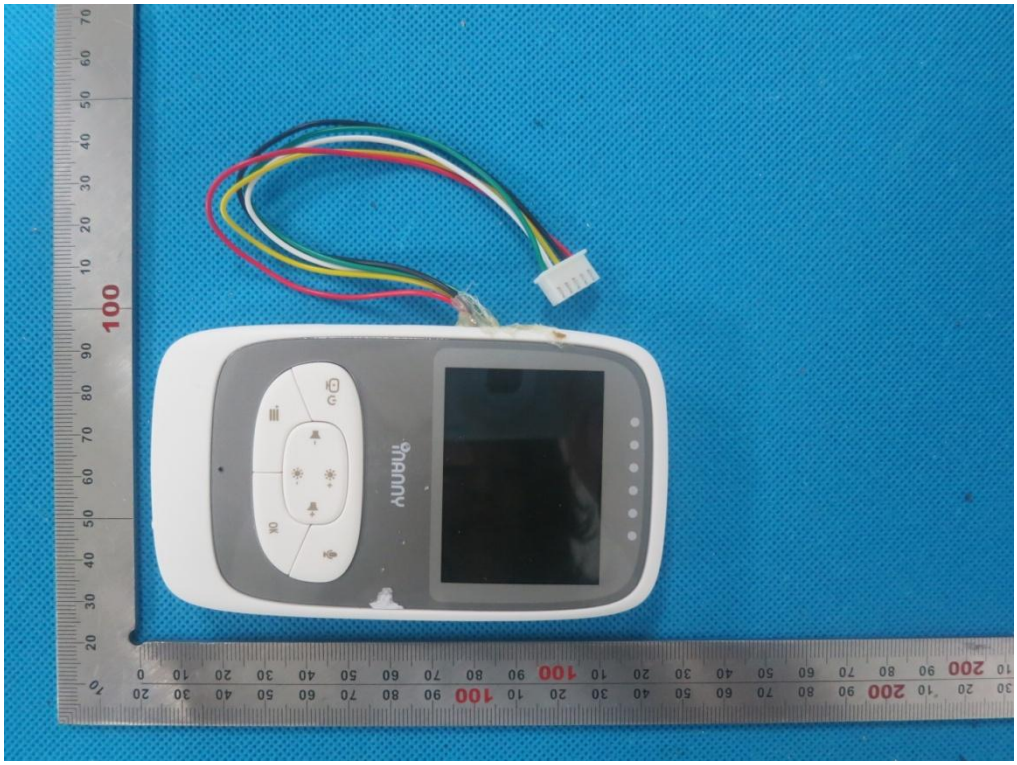
EUT PHOTOGRAPHS

All VIEW OF EUT

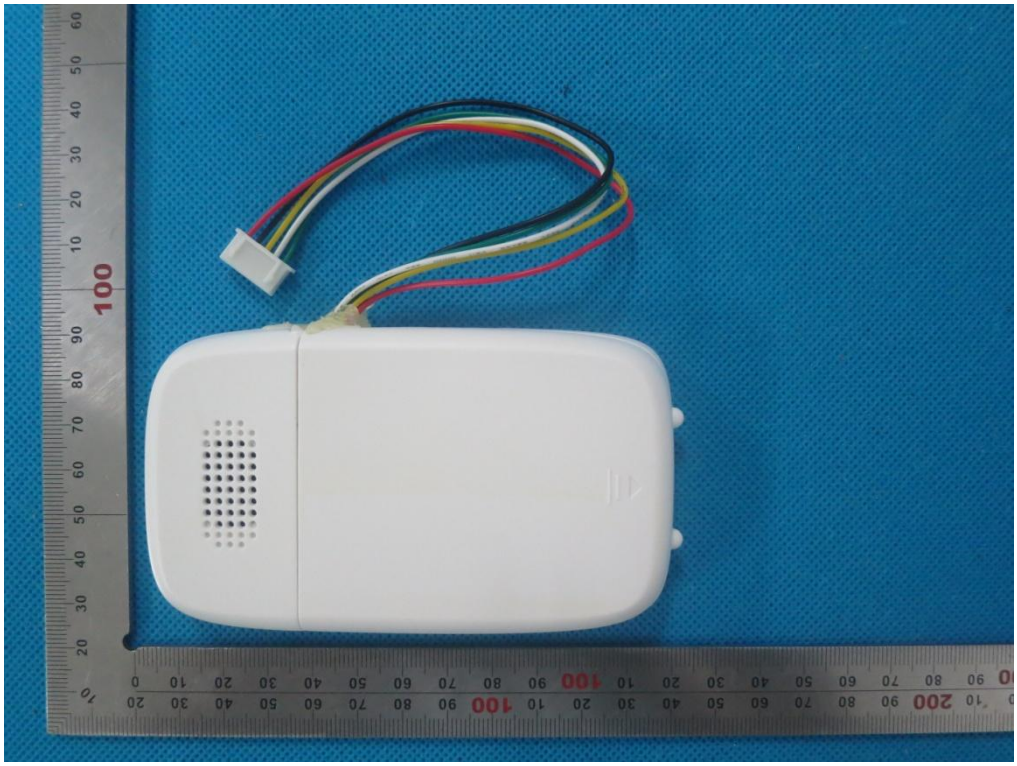
TOP VIEW OF EUT

BOTTOM VIEW OF EUT

FRONT VIEW OF EUT



BACK VIEW OF EUT

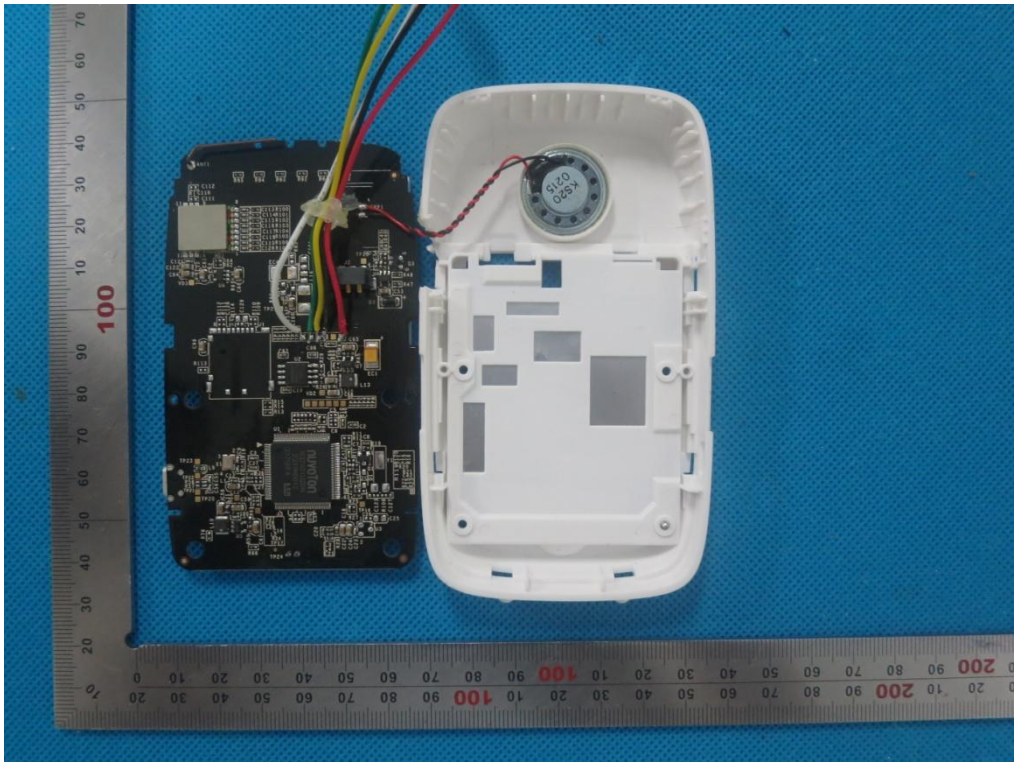


LEFT VIEW OF EUT

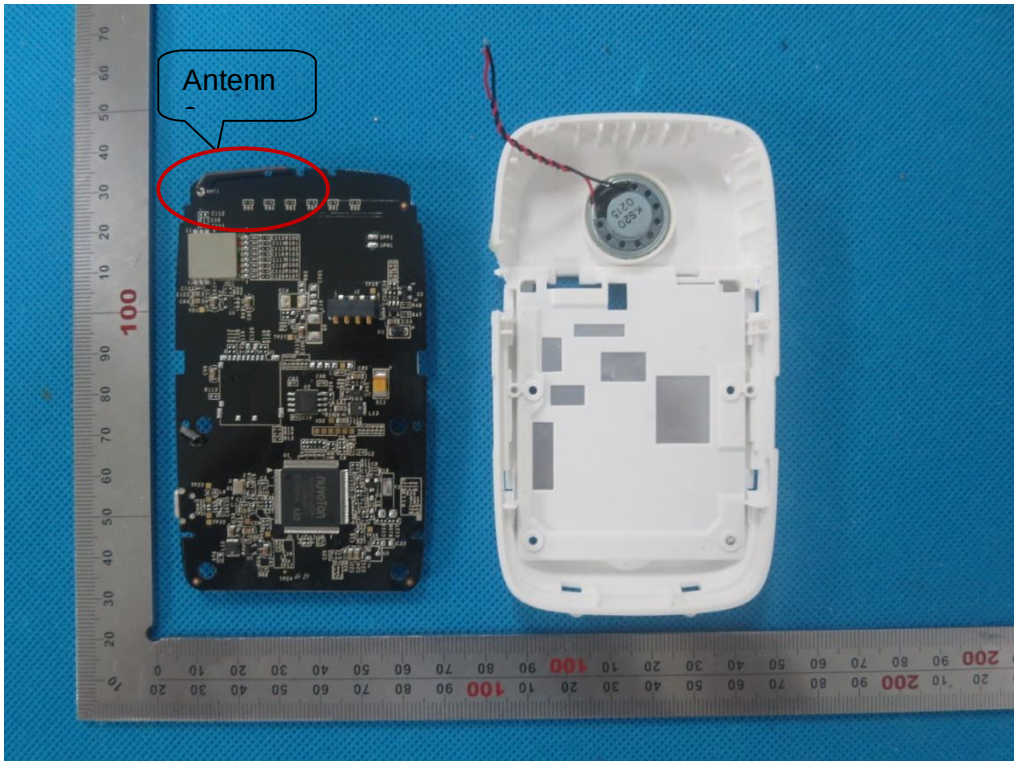
RIGHT VIEW OF EUT

OPEN VIEW OF EUT-1

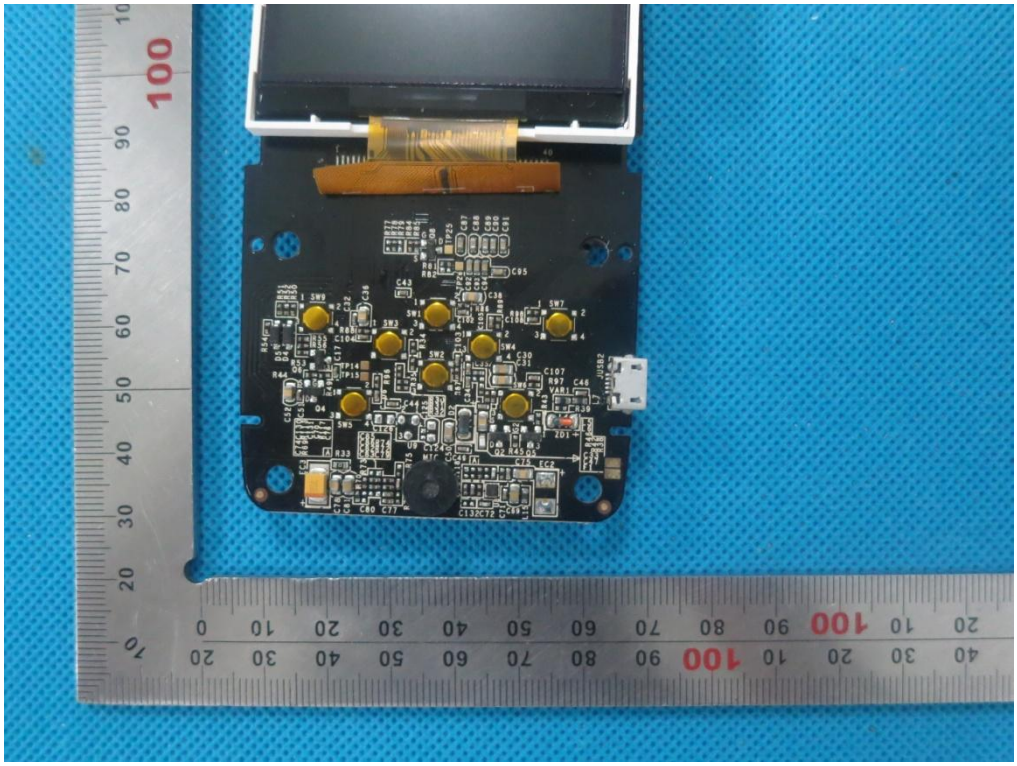
OPEN VIEW OF EUT-2



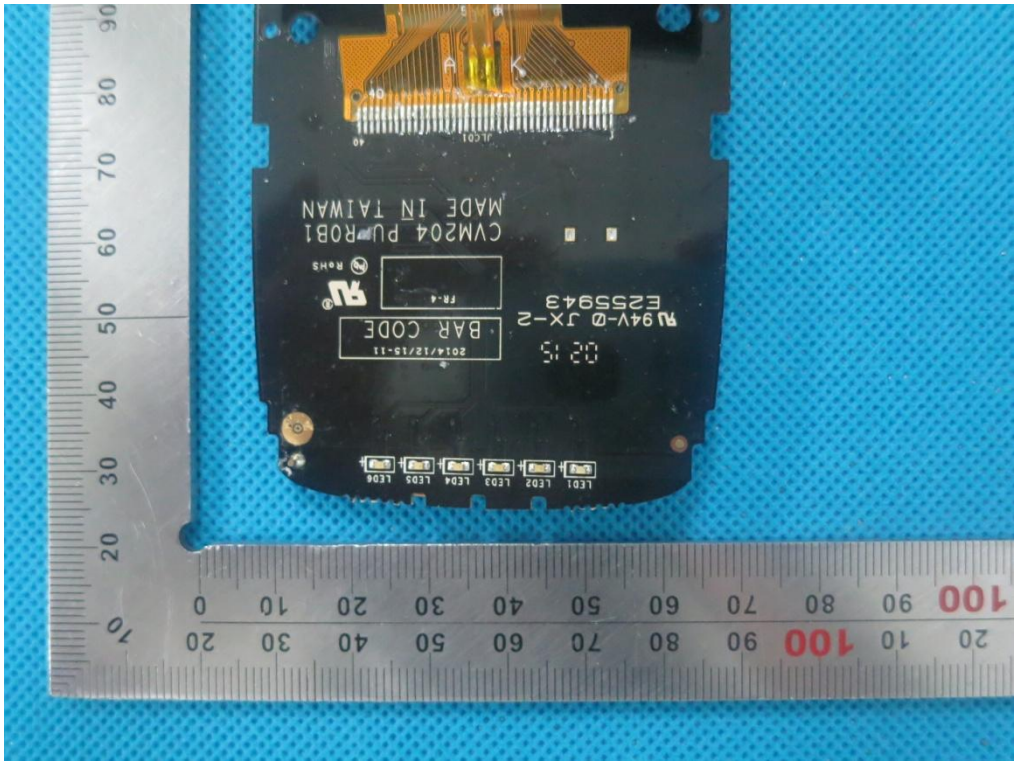
OPEN VIEW OF EUT-3



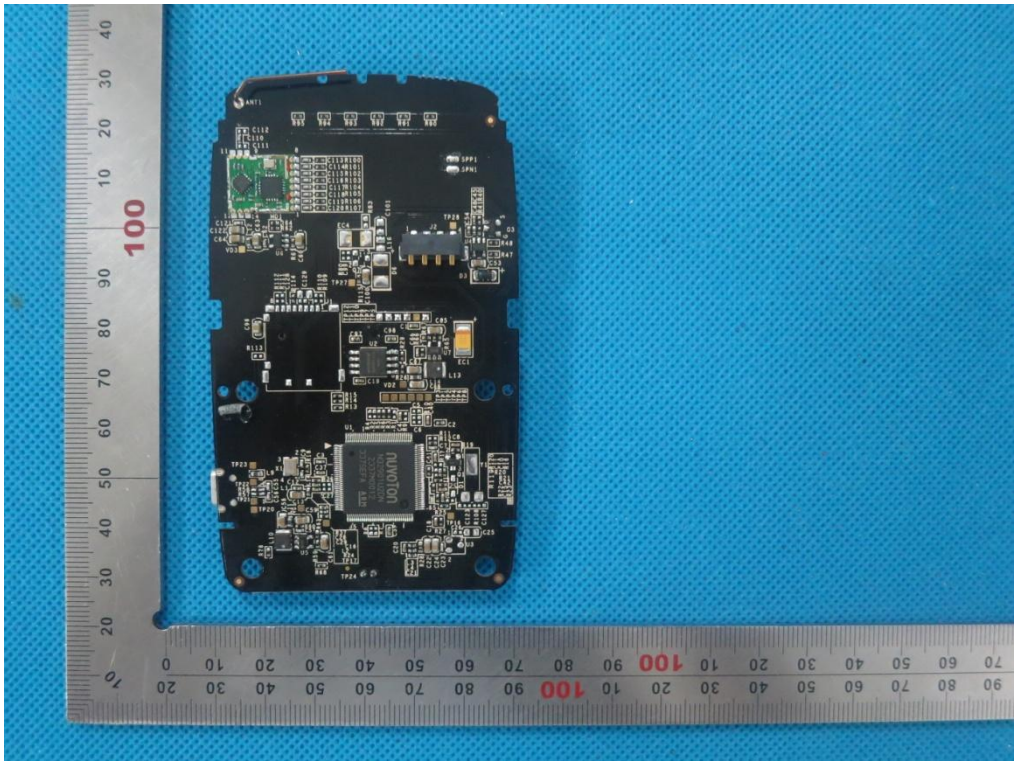
INTERNAL VIEW OF EUT-1



INTERNAL VIEW OF EUT-2



INTERNAL VIEW OF EUT-3



APPENDIX D. CALIBRATION DATA

PROBE CALIBRATION DATA

COMOSAR E-Field Probe Calibration Report

Ref : ACR.237.1.15.SATU.A

ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.

1&2F, NO.2 BUILDING, HUAFENG NO.1 INDUSTRIAL PARK, GUSHU COMMUNITY XIXIANG STREET BAOAN DISTRICT, SHENZHEN, P.R. CHINA

MVG COMOSAR DOSIMETRIC E-FIELD PROBE

SERIAL NO.: SN 19/15 EP254

Calibrated at MVG US

2105 Barrett Park Dr. - Kennesaw, GA 30144

Calibration Date: 07/10/15

Summary:

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

	Name	Function	Date	Signature
Prepared by :	Jérôme LUC	Product Manager	8/25/2015	
Checked by :	Jérôme LUC	Product Manager	8/25/2015	
Approved by :	Kim RUTKOWSKI	Quality Manager	8/25/2015	Kim Rutkowski

	Customer Name
Distribution :	ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.

Issue	Date	Modifications
A	8/25/2015	Initial release

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3 Measurement Method 4
3.1 Linearity 4
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3.3 Lower Detection Limit 5
3.4 Isotropy 5
3.5 Boundary Effect 5
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5.3 Sensitivity in liquid 7
5.4 Isotropy 8
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1 DEVICE UNDER TEST

Device Under Test	
Device Type	COMOSAR DOSIMETRIC E FIELD PROBE
Manufacturer	MVG
Model	SSE5
Serial Number	SN 19/15 EP254
Product Condition (new / used)	New
Frequency Range of Probe	0.3 GHz-3GHz
Resistance of Three Dipoles at Connector	Dipole 1: R1=0.178 MΩ Dipole 2: R2=0.182 MΩ Dipole 3: R3=0.182 MΩ

A yearly calibration interval is recommended.

2 PRODUCT DESCRIPTION

2.1 GENERAL INFORMATION

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

Figure 1 – *MVG 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.

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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%

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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 %

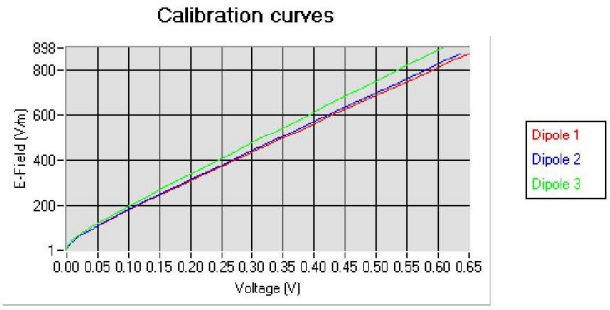
5.1 SENSITIVITY IN AIR

Normx dipole 1 (µV/(V/m)^2)	Normy dipole 2 (µV/(V/m)^2)	Normz dipole 3 (µV/(V/m)^2)
5.52	5.73	5.24

DCP dipole 1 (mV)	DCP dipole 2 (mV)	DCP dipole 3 (mV)
119	109	110

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

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



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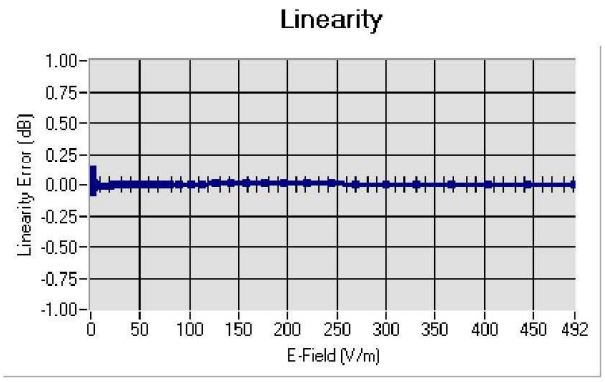
5.2 LINEARITY



Linearity: +/-2.81% (+/-0.12dB)

5.3 SENSITIVITY IN LIQUID

Liquid	Frequency (MHz +/- 100MHz)	Permittivity	Epsilon (S/m)	ConvF
HL450	450	43.68	0.87	7.22
BL450	450	58.34	0.99	7.49
HL750	750	41.82	0.90	5.84
BL750	750	56.28	0.98	6.06
HL850	835	42.59	0.90	6.36
BL850	835	53.19	0.97	6.56
HL900	900	42.05	0.98	5.79
BL900	900	56.41	1.08	5.91
HL1800	1800	41.82	1.38	4.77
BL1800	1800	53.00	1.52	4.91
HL1900	1900	40.38	1.41	5.40
BL1900	1900	53.93	1.55	5.61
HL2000	2000	40.12	1.43	4.97
BL2000	2000	53.65	1.54	5.14
HL2450	2450	38.34	1.80	4.84
BL2450	2450	52.70	1.94	4.97
HL2600	2600	38.16	1.93	4.62
BL2600	2600	51.55	2.21	4.73

LOWER DETECTION LIMIT: 7mW/kg

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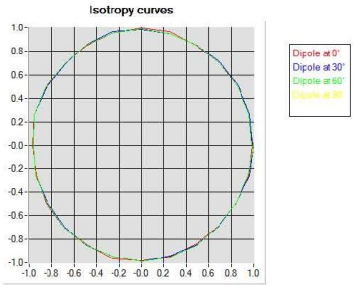
5.4 ISOTROPY

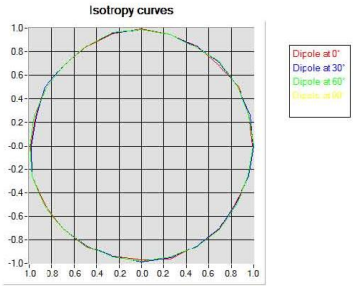
HL900 MHz

- Axial isotropy: 0.04 dB
- Hemispherical isotropy: 0.05 dB



HL1800 MHz

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



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6 LIST OF EQUIPMENT

Equipment Summary Sheet				
Equipment Description	**Manufacturer / Model**	**Identification No.**	**Current Calibration Date**	**Next Calibration Date**
Flat Phantom	MVG	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
Reference Probe	MVG	EP 94 SN 37/08	10/2014	10/2015
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	8/2012	8/2015

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DIPOLE CALIBRATION DATA

SAR Reference Dipole Calibration Report

Ref : ACR.318.9.13.SATU.A

ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.

1&2F, NO.2 BUILDING, HUAFENG NO.1 INDUSTRIAL PARK, GUSHU COMMUNITY XIXIANG STREET BAOAN DISTRICT, SHENZHEN, P.R. CHINA

SATIMO COMOSAR REFERENCE DIPOLE

FREQUENCY: 2450 MHZ

SERIAL NO.: SN 46/11 DIP 2G450-189

Calibrated at SATIMO US

2105 Barrett Park Dr. - Kennesaw, GA 30144

ACCREDITED

Calibration CERT #2246.02

11/14/13

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	11/14/2013	JS
Checked by :	Jérôme LUC	Product Manager	11/14/2013	JS
Approved by :	Kim RUTKOWSKI	Quality Manager	11/14/2013	Kim Rutkowski

	Customer Name
Distribution :	ATTESTATION OF GLOBAL COMPLIANCE CO. LTD.

Issue	Date	Modifications
A	11/14/2013	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 2450 MHz REFERENCE DIPOLE
Manufacturer	Satimo
Model	SID2450
Serial Number	SN 46/11 DIP 2G450-189
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*

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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 %

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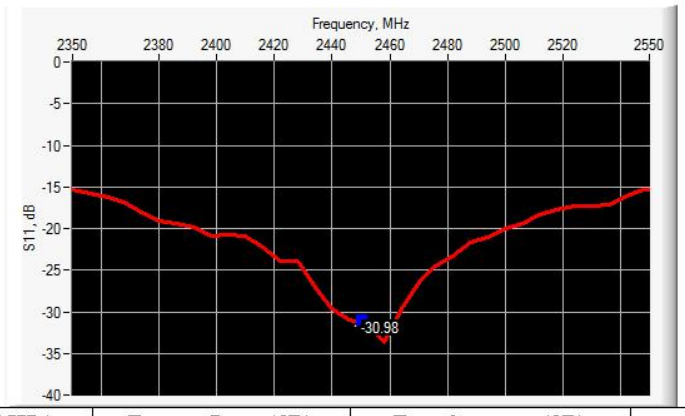
6 CALIBRATION MEASUREMENT RESULTS

6.1 RETURN LOSS AND IMPEDANCE



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
2450	-30.98	-20	47.3 Ω + 0.1 jΩ

6.2 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 %.		166.7 ±1 %.		6.35 ±1 %.	
750	176.0 ±1 %.		100.0 ±1 %.		6.35 ±1 %.	
835	161.0 ±1 %.		89.8 ±1 %.		3.6 ±1 %.	
900	149.0 ±1 %.		83.3 ±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 %.	PASS	30.4 ±1 %.	PASS	3.6 ±1 %.	PASS
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 %.	

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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 MEASUREMENT CONDITION

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 38.6 sigma : 1.82
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	2450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

7.2 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 %		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 %	PASS	1.80 ±5 %	PASS
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

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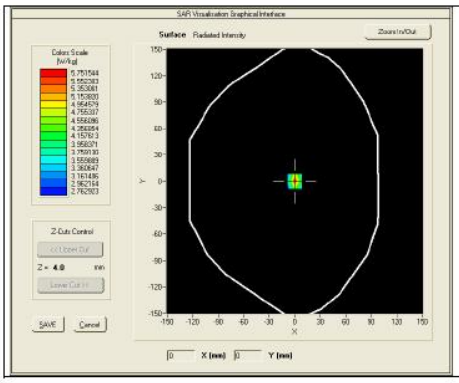
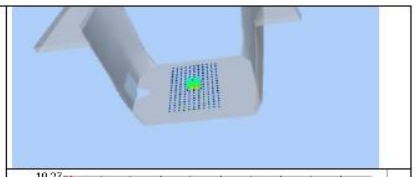
7.3 MEASUREMENT RESULT

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.

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		6.22	
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	54.40 (5.44)	24	23.75 (2.38)
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	





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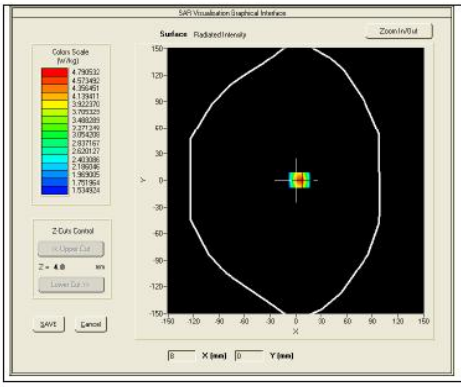
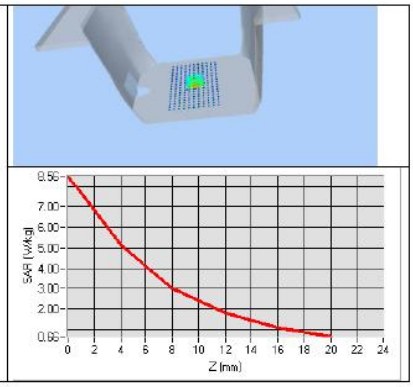
7.4 BODY MEASUREMENT RESULT

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 52.0 sigma : 1.94
Distance between dipole center and liquid	10.0 mm
Area scan resolution	dx=8mm/dy=8mm
Zoon Scan Resolution	dx=8mm/dy=8m/dz=5mm
Frequency	2450 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**
2450	54.19 (5.42)	24.96 (2.50)





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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	12/2010	12/2013
Reference Probe	Satimo	EPG122 SN 18/11	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Multimeter	Keithley 2000	1188656	11/2010	11/2013
Signal Generator	Agilent E4438C	MY49070581	12/2010	12/2013
Amplifier	Aethercomm	SN 046	Characterized prior to test. No cal required.	Characterized prior to test. No cal required.
Power Meter	HP E4418A	US38261498	11/2010	11/2013
Power Sensor	HP ECP-E26A	US37181460	11/2010	11/2013
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	3/2012	3/2014

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