SAR Test Report

Report No.: AGC05395151101FH01

FCC ID	:	2AE6CEP3620U1
APPLICATION PURPOSE	:	Original Equipment
PRODUCT DESIGNATION	:	Digital Portable Radio
BRAND NAME	:	EXCERA
MODEL NAME	:	EP3620 U1
CLIENT	:	Shenzhen Excera Technology Co., Ltd.
DATE OF ISSUE	:	Dec. 17,2015
STANDARD(S)	:	IEEE Std. 1528:2013 FCC 47CFR § 2.1093 IEEE/ANSI C95.1:1992
REPORT VERSION	:	V1.0

A*ttestation of* ***G****lobal* ***C****ompliance(Shenzhen) Co., Ltd.*

Report Revise Record

Report Version	Revise Time	Issued Date	Valid Version	Notes
V1.0	/	Dec. 17,2015	Valid	Original Report

Test Report Certification

Applicant Name	Shenzhen Excera Technology Co., Ltd.
Applicant Address	3rd Floor, Jiada R&D Building, No.5 Songpingshan Road , Hi-Tech Park North Nanshan District , Shenzhen,518052,China
Manufacturer Name	Shenzhen Excera Technology Co., Ltd.
Manufacturer Address	3rd Floor, Jiada R&D Building, No.5 Songpingshan Road , Hi-Tech Park North Nanshan District , Shenzhen, 518052,China
Product Designation	Digital Portable Radio
Brand Name	EXCERA
Model Name	EP3620 U1
Different Description	N/A
EUT Voltage	DC7.4V by battery
Applicable Standard	IEEE Std. 1528:2013 FCC 47CFR § 2.1093 IEEE/ANSI C95.1:1992
Test Date	Dec. 14,2015
Performed Location	Attestation of Global Compliance(Shenzhen) Co., Ltd.
	2 F, Building 2, No.1-No.4, Chaxi Sanwei Technical Industrial Park, Gushu, Xixiang Street, Bao'an District, Shenzhen, China
Report Template	AGCRT-US-PTT/SAR (2014-12-01)

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1. SUMMARY OF MAXIMUM SAR VALUE

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

Highest tested and scaled SAR Summary（with 50% duty cycle）：

Exposure Position	Type of signal	Separation	Highest Reported 1g-SAR(W/Kg)
Face Up	Digital	12.5 KHz	**2.520**
	Analog	12.5 KHz	**4.946**
Back Touch	Digital	12.5 KHz	**3.099**
	Analog	12.5 KHz	**5.631**

This device is compliance with Specific Absorption Rate (SAR) for Occupational / Controlled Exposure Environment limits (8.0W/Kg) specified in 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1, and had been tested in accordance with measurement methods and procedures specified in IEEE 1528-2013 and the following specific FCC Test Procedures:
KDB447498 D01 General RF Exposure Guidance v06
KDB 865664 D01 SAR Measurement 100MHz to 6GHz v01r04
KDB 643646 D01 SAR Test for PTT Radios v01r03

2. GENERAL INFORMATION

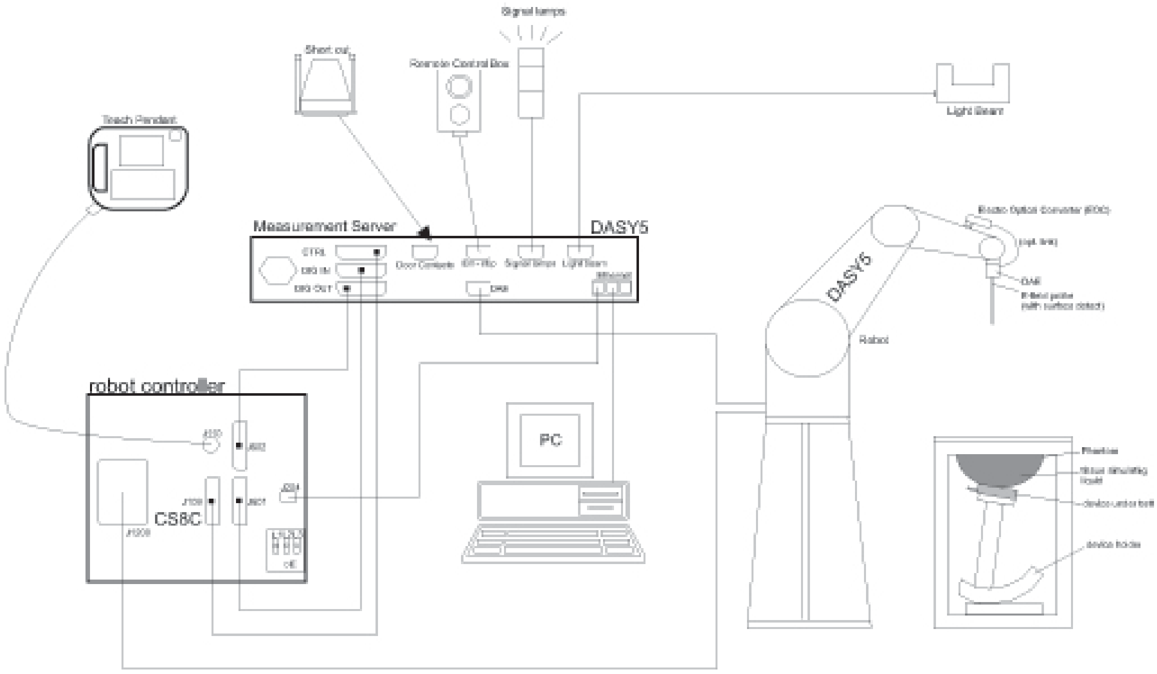
2.1. EUT Description

General Information	
Product Name	Digital Portable Radio
Test Model	EP3620 U1
Hardware Version	V1.0
Software Version	N/A
Exposure Category:	Occupational/Controlled Exposure
Device Category	FM&4FSK UHF Portable Transceiver
Modulation Type	FM&4FSK
TX Frequency Range	400-480MHz
Rated Power	5W
Max. Average Power	Analog: 36.57dBm Digital: 36.41dBm
Channel Spacing	12.5KHz
Antenna Type	External Antenna
Antenna Gain	2.15dBi
Body-Worn Accessories:	Belt Clip with headset
Face-Head Accessories:	None
Battery Type (s) Tested:	DC 7.4V, 2000mAh (by battery)

Product	Type	
	☒ Production unit	☐ Identical Prototype

3. SAR MEASUREMENT SYSTEM

3.1. The DASY5 system used for performing compliance tests consists of following items



- A standard high precision 6-axis robot with controller, teach pendant and software.
- Data acquisition electronics (DAE) which attached to the robot arm extension. The DAE consist of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder with a control logic unit. Transmission to the measurement server is accomplished through an optical downlink for data and status information, as well as an optical uplink for commands and the clock
- A dosimetric probe equipped with an optical surface detector system.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital Communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- A Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- Phantoms, device holders and other accessories according to the targeted measurement.

3.2. DASY5 E-Field Probe

The SAR measurement is conducted with the dosimetric probe manufactured by SPEAG. 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. SPEAG 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	ES3DV3	
Manufacture	SPEAG	
frequency	0.15GHz-3 GHz Linearity:±0.2dB(150 MHz-3 GHz)	
Dynamic Range	0.01W/Kg-100W/Kg Linearity:±0.2dB	
Dimensions	Overall length:337mm Tip diameter:4mm Typical distance from probe tip to dipole centers:2mm	
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%.	

3.3. Data Acquisition Electronics description

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

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

DAE4

Input Impedance	200MOhm	
The Inputs	Symmetrical and floating	
Common mode rejection	above 80 dB	

3.4. Robot

The DASY system uses the high precision robots (DASY5:TX60) type from Stäubli SA (France). For the 6-axis controller system, the robot controller version from 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

3.5. Light Beam Unit

The light beam switch allows automatic “tooling” of the probe. 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 prob.1 mm, even if the other probe has different dimensions. During probe rotations, the probe tip will keep its actual position. e, the same position will be reached with another aligned probe within 0

3.6. Device Holder

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

3.7. Measurement Server

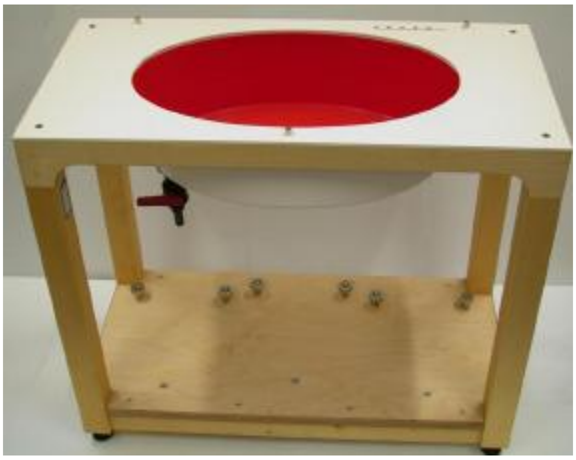
The measurement server is based on a PC/104 CPU board with CPU (DASY5: 400 MHz, Intel Celeron), chip-disk (DASY5: 128MB), RAM (DASY5: 128MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DAYS I/O board, which is directly connected to the PC/104 bus of the CPU board.
The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

3.8. PHANTOM
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.

ELI4 Phantom

Flat phantom a fiberglass shell flat phantom with 2mm+/- 0.2 mm shell thickness. It has only one measurement area for Flat phantom	

4. SAR MEASUREMENT PROCEDURE

4.1. 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;
$\frac{\mathrm{dT}}{\mathrm{dt}} \mid t = 0$	is the initial time derivative of temperature in the tissue in kelvins per second

4.2. 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 DASY 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	$\frac{1}{2}\cdot\delta\cdot\ln(2) \pm 0.5$ 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}			$\leq$ 2 GHz: $\leq$ 8 mm 2 – 3 GHz: $\leq$ 5 mm*	3 – 4 GHz: $\leq$ 5 mm* 4 – 6 GHz: $\leq$ 4 mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$		$\leq$ 5 mm	3 – 4 GHz: $\leq$ 4 mm 4 – 5 GHz: $\leq$ 3 mm 5 – 6 GHz: $\leq$ 2 mm
	graded grid	$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface	$\leq$ 4 mm	3 – 4 GHz: $\leq$ 3 mm 4 – 5 GHz: $\leq$ 2.5 mm 5 – 6 GHz: $\leq$ 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		$\geq$ 30 mm	3 – 4 GHz: $\geq$ 28 mm 4 – 5 GHz: $\geq$ 25 mm 5 – 6 GHz: $\geq$ 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 $\leq$ 1.4 W/kg, $\leq$ 8 mm, $\leq$ 7 mm and $\leq$ 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. 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 4.2

5.1. The composition of the tissue simulating liquid

Ingredient (% Weight) Tissue Type	450MHz Head	450MHz Body
Water	√	√
Salt (NaCl)	√	√
Sugar	--	--
HEC	--	--
Bactericide	--	--
Diacetin	--	--
1-2 propanediol	√	√

5.2 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)
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	51.6	2.73

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

5.3. Tissue Calibration Result

The dielectric parameters of the liquids were verified prior to the SAR evaluation using DASY5 Dielectric Probe Kit and R&S Network Analyzer ZVL6.

Tissue Stimulant Measurement for 450MHz				
Fr. (MHz)	Dielectric Parameters (±5%)		Tissue Temp [^{o}C]	Test time
	head			
	εr43.50(41.325 to 45.675)	δ[s/m] 0.87(0.8265 to 0.9135)		
400.025	44.77	0.84	21.1	Dec. 14,2015
416.025	44.25	0.85		
432.025	44.08	0.86		
448.025	43.76	0.86		
450.000	43.28	0.88		
464.025	42.94	0.89		
479.975	42.82	0.89		

Tissue Stimulant Measurement for 450MHz				
Fr. (MHz)	Dielectric Parameters (±5%)		Tissue Temp [^{o}C]	Test time
	Body			
	εr56.7(53.865 to 59.535)	δ[s/m] 0.94(0.893 to 0.987)		
400.025	57.91	0.92	21.3	Dec. 14,2015
416.025	57.66	0.92		
432.025	57.20	0.93		
448.025	56.82	0.94		
450.000	56.08	0.96		
464.025	55.93	0.96		
479.975	55.44	0.97		

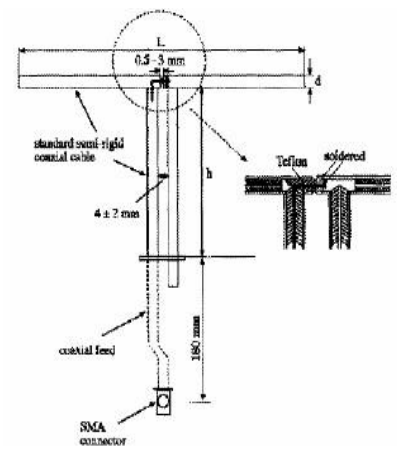
6. SAR SYSTEM CHECK PROCEDURE

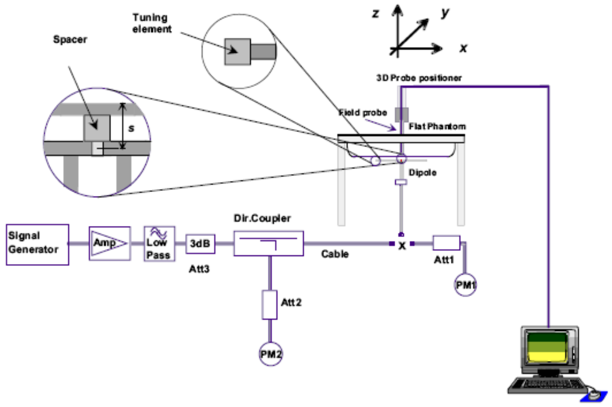
6.1. SAR System Check Procedures

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.

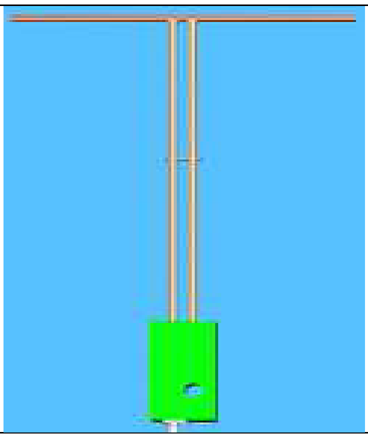
Each DASY system is equipped with one or more system check kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system check and system validation. System kit includes a dipole, and dipole device holder.

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.





6.2. SAR System Check
6.2.1. Dipoles

	The dipoles used is based on the IEEE-1528 standard, and is complied with mechanical and electrical specifications in line with the requirements of IEEE. the table below provides details for the mechanical and electrical Specifications for the dipoles

Frequency	R/L (mm)	R/h (mm)	d (mm)
450MHz	290	166.7	6.35

5.2.2. System check Result

System Performance Check at 450MHz								
Validation Kit: SN 46/11DIP 0G450-184								
Frequency [MHz]	Target Value(W/Kg)		Reference Result (± 10%)		Normalized to 1W(W/Kg)		Tissue Temp. [°C]	Test time
	1g	10g	1g	10g	1g	10g		
450 head	4.91	3.13	4.419-5.401	2.817-3.443	4.864	3.384	21.1	Dec. 14,2015
450 body	5.07	3.25	4.563-5.577	2.925-3.575	4.752	3.248	21.3	Dec. 14,2015

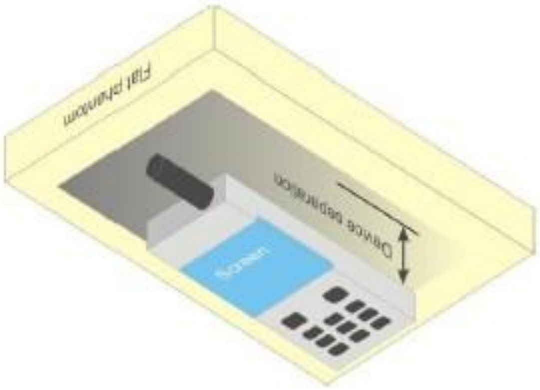
Note: The input power of system check is 21dBm.

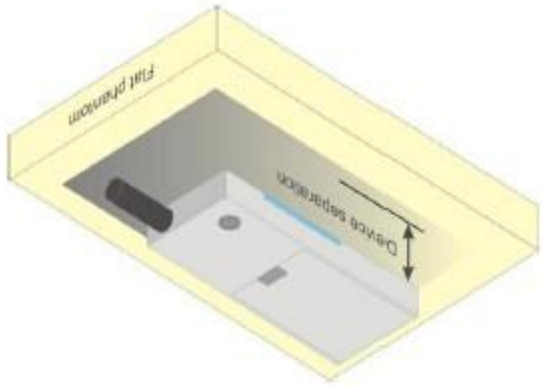
7. EUT TEST POSITION

This EUT was tested in **Front Face and Rear Face.**

7.1. 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 **25mm** while used in front of face, and body back touch with belt clip.





8. SAR EXPOSURE LIMITS

SAR assessments have been made in line with the requirements of IEEE-1528, and comply with ANSI/IEEE C95.1-1992 “Controlled Exposure Environment” limits. These limits apply to a location which is deemed as “Controlled Exposure 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 Occupational / Controlled Exposure Environment

Type Exposure Limits	Occupational / Controlled Exposure Environment(W/Kg)
Spatial Average SAR (whole body)	8.0

9. TEST EQUIPMENT LIST

Equipment description	Manufacturer/ Model	Identification No.	Current calibration date	Next calibration date
Stäubli Robot	Stäubli-TX60	F13/5Q2UD1/A/01	N/A	N/A
TISSUE Probe	SATIMO	SN 45/11 OCPG45	11/13/2015	11/12/2016
Robot Controller	Stäubli-CS8	139522	N/A	N/A
E-Field Probe	Speag- ES3DV3	SN:3337	10/01/2015	09/30/2016
ELI4 Phantom	ELI V5.0	1210	N/A	N/A
Device Holder	Speag-SD 000 H01 KA	SD 000 H01 KA	N/A	N/A
DAE4	Speag-SD 000 D04 BM	1398	3/11/2015	3/10/2016
SAR Software	Speag-DASY5	DASY52.8	N/A	N/A
Liquid	SATIMO	-	N/A	N/A
Radio Communication Tester	R&S-CMU200	069Y7-158-13-712	03/06/2015	03/05/2016
Dipole	SATIMO SID450	SN46/11 DIP 0G450-184	11/14/2013	11/13/2016
Signal Generator	Agilent-E4438C	MY44260051	03/06/2015	03/05/2016
Spectrum Analyzer E4440	Agilent	US41421290	07/23/2015	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/ C5571-10	SN99463	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 Verification, 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.

10. MEASUREMENT UNCERTAINTY

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table as follow.

Uncertainty Distributions	**Normal**	**Rectangular**	**Triangular**	**U-Shape**
Multi-plying Factor(a)	1/k(b)	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) Standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 13.1 Standard Uncertainty for Assumed Distribution (above table)

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual “root-sum-squares” (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.

DAYS5 Measurement Uncertainty Measurement uncertainty for 150 MHz to 3GHz averaged over 1 gram / 10 gram.							
Error Description	Uncertainty value(±10%)	Probability Distribution	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g)	Standard Uncertainty (10g)
Measurement System							
Probe Calibration	6.65	Normal	1	1	1	6.65	6.65
Axial Isotropy	0.25	Rectangular	$\sqrt{3}$	1	1	0.14	0.14
Hemispherical Isotropy	1.3	Rectangular	$\sqrt{3}$	1	1	0.75	0.75
Linearity	0.3	Rectangular	$\sqrt{3}$	1	1	0.17	0.17
Probe Modulation Response	1.65	Rectangular	$\sqrt{3}$	1	1	0.95	0.95
System Detection Limits	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52
Boundary Effects	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52
Readout Electronics	0.2	Normal	1	1	1	0.20	0.20
Response Time	0	Rectangular	$\sqrt{3}$	1	1	0.00	0.00
Integration Time	0	Rectangular	$\sqrt{3}$	1	1	0.00	0.00
RF Ambient Noise	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52
RF Ambient Reflection	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52
Probe Positioner	0.7	Rectangular	$\sqrt{3}$	1	1	0.40	0.40
Probe Positioning	6.5	Rectangular	$\sqrt{3}$	1	1	3.75	3.75
Post-processing	3.8	Rectangular	$\sqrt{3}$	1	1	2.19	2.19
Test Sample Related							
Device Positioning	3.6	Normal	1	1	1	3.60	3.60
Device Holder	2.9	Normal	1	1	1	2.90	2.90
Measurement SAR Drift	5.0	Rectangular	$\sqrt{3}$	1	1	2.89	2.89
Power Scaling	5.0	Rectangular	$\sqrt{3}$	1	1	2.89	2.89
Phantom and Setup							
Phantom Uncertainty (Shape and thickness tolerances)	0.05	Rectangular	$\sqrt{3}$	1	1	0.03	0.03
Uncertainty in SAR correction for deviations in permittivity and conductivity	1.9	Normal	1	1	0.84	1.90	1.6
Liquid conductivity measurement	5	Normal	1	0.78	0.71	3.90	3.55
Liquid permittivity measurement	5	Normal	1	0.23	0.26	1.15	1.30
Liquid conductivity – temperature uncertainty	5	Rectangular	$\sqrt{3}$	0.78	0.71	2.25	2.05
Liquid permittivity – temperature uncertainty	5	Rectangular	$\sqrt{3}$	0.23	0.26	0.66	0.75
Combined Standard Uncertainty						10.95	10.695
Coverage Factor for 95%						K=2	
Expanded Uncertainty						±21.91%	±21.39%

DAYS5 System Check Uncertainty for 150 MHz to 3GHz averaged range								
Error Description	Uncer. value (±10%)	Prob. Dist.	Div.	(Ci) 1g	(Ci) 10g	Std. Unc. (1g)	Std. Unc. (10g)	(v_i) V_{eff}
Measurement System								
Probe Calibration	6.65	Normal	1	1	1	6.65	6.65	∞
Axial Isotropy	0.25	Rectangular	$\sqrt{3}$	1	1	0.14	0.14	∞
Hemispherical Isotropy	1.3	Rectangular	$\sqrt{3}$	1	1	0.75	0.75	∞
Linearity	0.3	Rectangular	$\sqrt{3}$	1	1	0.17	0.17	∞
Probe Modulation Response	1.65	Rectangular	$\sqrt{3}$	1	1	0.95	0.95	∞
System Detection Limits	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52	∞
Boundary Effects	0.9	Rectangular	$\sqrt{3}$	0	0	0.52	0.52	∞
Readout Electronics	0.2	Normal	1	1	1	0.20	0.20	∞
Response Time	0	Rectangular	$\sqrt{3}$	1	1	0.00	0.00	∞
Integration Time	0	Rectangular	$\sqrt{3}$	1	1	0.00	0.00	∞
RF Ambient Noise	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52	∞
RF Ambient Reflection	0.9	Rectangular	$\sqrt{3}$	1	1	0.52	0.52	∞
Probe Positioner	0.7	Rectangular	$\sqrt{3}$	1	1	0.40	0.40	∞
Probe Positioning	6.5	Rectangular	$\sqrt{3}$	1	1	3.75	3.75	∞
Post-processing	3.8	Rectangular	$\sqrt{3}$	1	1	2.19	2.19	∞
Dipole Related								
Deviation of exp. dipole	5.3	Normal	1	1	1	3.06	3.06	∞
Dipole Axis to Liquid Dist.	2.0	Rectangular	$\sqrt{3}$	1	1	1.15	1.15	∞
Input power & SAR drift	3.3	Rectangular	$\sqrt{3}$	1	1	1.91	1.91	∞
Phantom and Setup								
Phantom Uncertainty (Shape and thickness tolerances)	0.05	Rectangular	$\sqrt{3}$	1	1	0.03	0.03	∞
Uncertainty in SAR correction for deviations in permittivity and conductivity	1.9	Rectangular	$\sqrt{3}$	1	0.84	1.90	1.6	∞
Liquid conductivity measurement	5	Normal	1	0.78	0.71	3.90	3.55	∞
Liquid permittivity measurement	5	Normal	1	0.23	0.26	1.15	1.30	∞
Liquid conductivity – temperature uncertainty	5	Rectangular	$\sqrt{3}$	0.78	0.71	2.25	2.05	∞
Liquid permittivity – temperature uncertainty	5	Rectangular	$\sqrt{3}$	0.23	0.26	0.66	0.75	∞
Combined Std. Uncertainty						9.81	9.522	
Expanded STD Uncertainty						±19.63%	±19.044 %	

11. CONDUCTED POWER MEASUREMENT

Type of signal: Digital

Frequency (MHz)	Channel Spacing	Measured Conducted Output power	
		Max. Peak Power (dBm)	Avg. Power (dBm)
400.025	12.5KHz	36.81	**36.41**
416.025		36.77	36.37
432.025		36.65	36.24
448.025		36.74	36.34
464.025		36.64	36.24
479.975		36.75	36.35

Type of signal: Analog

Frequency (MHz)	Channel Spacing	Measured Conducted Output power	
		Max. Peak Power (dBm)	Avg. Power (dBm)
400.025	12.5KHz	36.87	**36.57**
416.025		36.85	36.55
432.025		36.72	36.42
448.025		36.73	36.43
464.025		36.68	36.38
479.975		36.65	36.35

12. TEST RESULTS

12.1. SAR Test Results Summary

12.1.1. Test position and configuration

Head SAR was performed with the device configured in the positions according to KDB 643646 and Body SAR was performed with the device configurated with all accessories close to the Flat Phantom.

12.1.2. Operation Mode

- Set the EUT to maximum output power level and transmit on lower, middle and top channel with 100% duty cycle individually during SAR measurement.
- Per KDB 447498D01 v06 Chapter 4.1 6) the number of channels to be assessed is 5.
- Per KDB 643646 D01, Passive body-worn and audio accessories generally do not apply to the head SAR of PTT radios. Head SAR is measured with the front surface of the radio positioned at 2.5 cm parallel to a flat phantom.

  When testing antennas with the default battery:

  a. When the SAR≤ 3.5 W/kg, testing of all other required channels is not necessary for that antenna;
  b. When the SAR > 3.5 W/kg and ≤ 4.0 W/kg, testing of the required immediately channel(s) is not necessary; testing of the other required channels may still be required.
  c. When the SAR > 4.0 W/kg and ≤ 6.0 W/kg, SAR should be measured for that antenna on the all required channels;
  d. When the highest scaled SAR is ≤ 6.0 W/kg, PBA is not required
- Per KDB 643646 D01, Body SAR is measured with the radio placed in a body-worn accessory, positioned against a flat phantom, representative of the normal operating conditions expected by users and typically with a standard default audio accessory supplied with the radio.

  When testing antennas with the default battery: the same test measurement with head part.
- The EUT only contains the Testing antenna, Standard battery and default body-worn accessory specified by customer. The earphone is only for testing

12.1.3. SAR Test Results Summary

SAR MEASUREMENT									
Depth of Liquid (cm):>15					Relative Humidity (%): 61.4				
Product: Digital Portable Radio									
Test Mode: Hold to Face with 2.5 cm separation & body back touch with clip(UHF)									
Position	**Freq. (MHz)**	**Separation (KHz)**	**Power Drift (<±0.2)**	**SAR 1g with 100% duty Cycle (W/kg)**	**SAR 1g with 50% duty cycle (W/Kg)**	**Max. Turn-up Power (dBm)**	**Meas. output Power (dBm)**	**Scaled SAR (W/Kg)**	**Limit W/kg**
Type of signal: Digital									
Face Up	400.025	12.5	-0.06	4.40	2.200	37	36.41	**2.520**	8.0
Back Touch	400.025	12.5	0.03	5.41	2.705	37	36.41	**3.099**	8.0
Type of signal: Analog									
Face Up	400.025	12.5	-0.12	8.96	**4.480**	37	36.57	**4.946**	8.0
Face Up	416.025	12.5	-0.11	5.86	2.930	37	36.55	3.250	8.0
Face Up	432.025	12.5	-0.19	5.69	2.845	37	36.42	3.251	8.0
Face Up	448.025	12.5	-0.02	5.02	2.510	37	36.43	2.862	8.0
Face Up	464.025	12.5	-0.19	6.17	3.085	37	36.38	3.558	8.0
Face Up	479.975	12.5	-0.09	5.04	2.520	37	36.35	2.927	8.0
Back Touch	400.025	12.5	-0.14	10.2	5.100	37	36.57	**5.631**	8.0
Back Touch	416.025	12.5	-0.11	9.09	4.545	37	36.55	5.041	8.0
Back Touch	432.025	12.5	-0.06	8.39	4.195	37	36.42	4.794	8.0
Back Touch	448.025	12.5	-0.19	7.51	3.755	37	36.43	4.282	8.0
Back Touch	464.025	12.5	-0.10	9.35	4.675	37	36.38	5.392	8.0
Back Touch	479.975	12.5	-0.11	8.12	4.060	37	36.35	4.715	8.0

Note:
1 During the test, EUT power is 5 W with 100% duty cycle;
2.There is just default battery and antenna in this project;
3 According to KDB 643646 D01, when testing antennas with the default battery:
a. When the SAR≤ 3.5 W/kg, testing of all other required channels is not necessary for that antenna;
b. When the SAR > 3.5 W/kg and ≤ 4.0 W/kg, testing of the required immediately adjacent channel(s) is not necessary; testing of the other required channels may still be required.
c. When the SAR > 4.0 W/kg and ≤ 6.0 W/kg, SAR should be measured for that antenna on the all required channels;
d. When the highest scaled SAR is ≤ 6.0 W/kg, PBA is not required

Repeated SAR								
Product: DMR Two Way Radio								
Test Mode: Body Back Touch with clip(UHF)								
Position	**Frequency (MHz)**	**Separation (KHz)**	**Power Drift (<±0.2db)**	**Once SAR 1g with 100% duty cycle (W/kg)**	**Once SAR 1g with 50% duty cycle (W/Kg)**	**Twice SAR 1g with 100% duty cycle (W/kg)**	**Twice SAR 1g with 50% duty cycle (W/kg)**	**Limit W/kg**
Type of signal: Digital								
Back Touch	416.025	12.5	-0.14	5.34	2.67	--	--	8.0
Type of signal: Analog								
Back Touch	400.025	12.5	-0.07	10.2	5.10	--	--	8.0

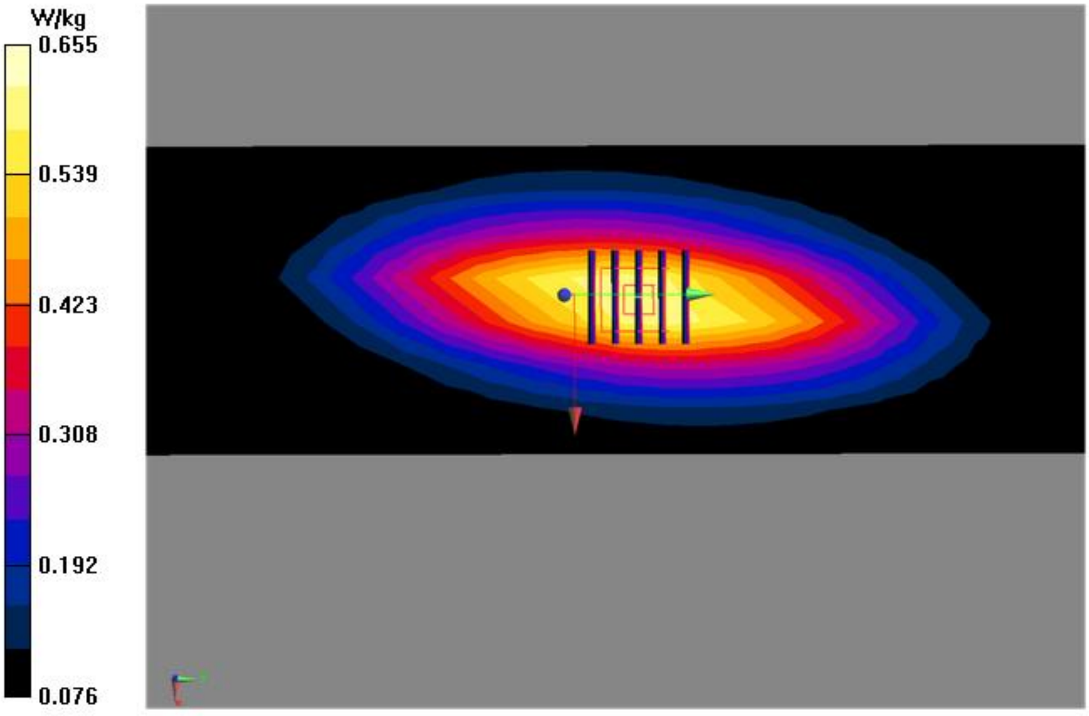
APPENDIX A. SAR SYSTEM CHECK DATA

Test Laboratory: AGC Lab **Test date: Dec. 14,2015**
System Check 450MHz
DUT: Dipole 450 MHz Type: SID 450
Communication System: CW; Communication System Band: CW; Duty Cycle: 1:1;
Frequency: 450MHz; Medium parameters used: f = 450MHz; σ= 0.88 mho/m; εr =43.28 ; ρ = 1000 kg/m³ ;
Phantom Type: Elliptical Phantom; Input Power=21dBm
Ambient temperature (℃): 21.3 , Liquid temperature (℃): 21.1

DASY Configuration:
- Probe: ES3DV3 – SN3337; ConvF(6.88, 6.88, 6.88); Calibrated:10/01/2015;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = 1.0,
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/System Check 450MHz Head/Area Scan (8x23x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.604 W/kg

Configuration/System Check 450MHz Head/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 27.006 V/m; Power Drift = -0.19 dB
Peak SAR (extrapolated) = 0.875 W/kg
SAR(1 g) = 0.564 W/kg; SAR(10 g) = 0.381 W/kg
Maximum value of SAR (measured) = 0.655 W/kg

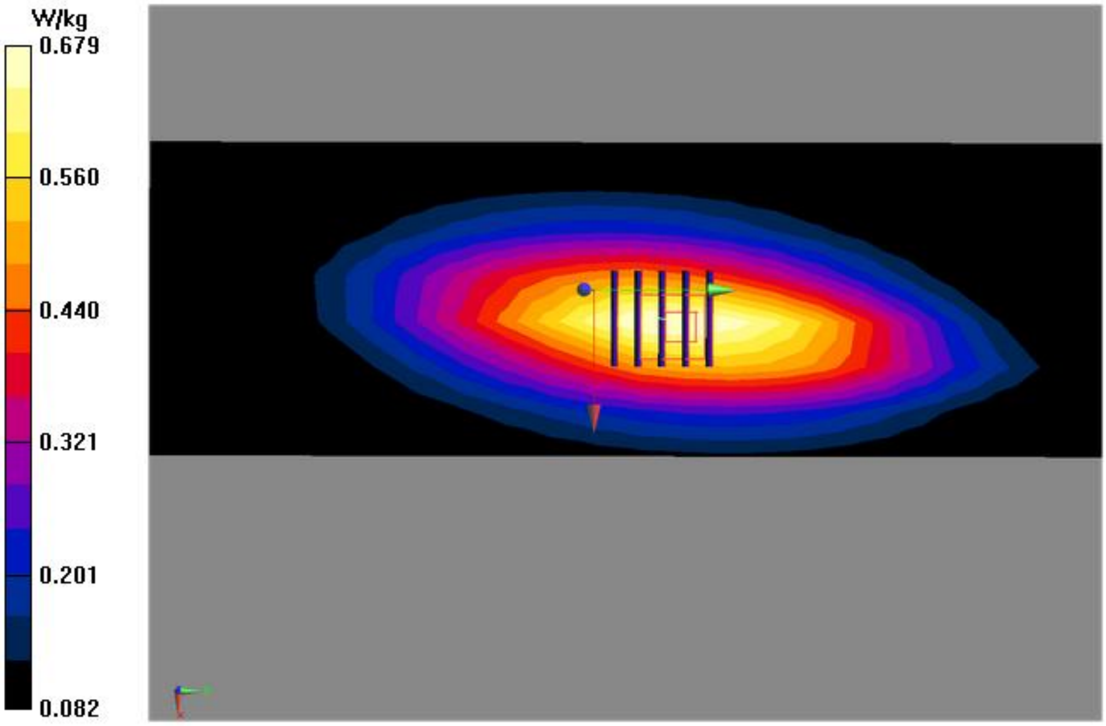


Test Laboratory: AGC Lab **Test date: Dec. 14,2015**
System Check Body 450MHz
DUT: Dipole 450 MHz Type: SID 450
Communication System: CW; Communication System Band: CW; Duty Cycle: 1:1;
Frequency: 450MHz; Medium parameters used: f = 450MHz; σ=0.96 mho/m; εr =56.08 ; ρ = 1000 kg/m³ ;
Phantom Type: Elliptical Phantom; Input Power=21dBm
Ambient temperature (℃): 21.3 , Liquid temperature (℃): 21.3

DASY Configuration:
- Probe: ES3DV3 – SN3337; ConvF(7.12, 7.12, 7.12); Calibrated:10/01/2015;;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = 1.0,
- Electronics: DAE4 Sn1398; Calibrated: 3/11/2015
  Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108 ;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Configuration/System Check 450MHz Body/ Area Scan (8x23x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.691 W/kg

Configuration/System Check 450MHz Body/ Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 25.237 V/m; Power Drift = -0.29 dB
Peak SAR (extrapolated) = 0.911 W/kg
SAR(1 g) = 0.594 W/kg; SAR(10 g) = 0.406 W/kg
Maximum value of SAR (measured) = 0.679 W/kg



APPENDIX B. SAR MEASUREMENT DATA

Type of signal: Digital
Test Laboratory: AGC Lab **Date: Dec. 14,2015**
CW450 face up 2.5cm (12.5 KHz)
DUT: Digital Portable Radio ; Type: EP3620 U1

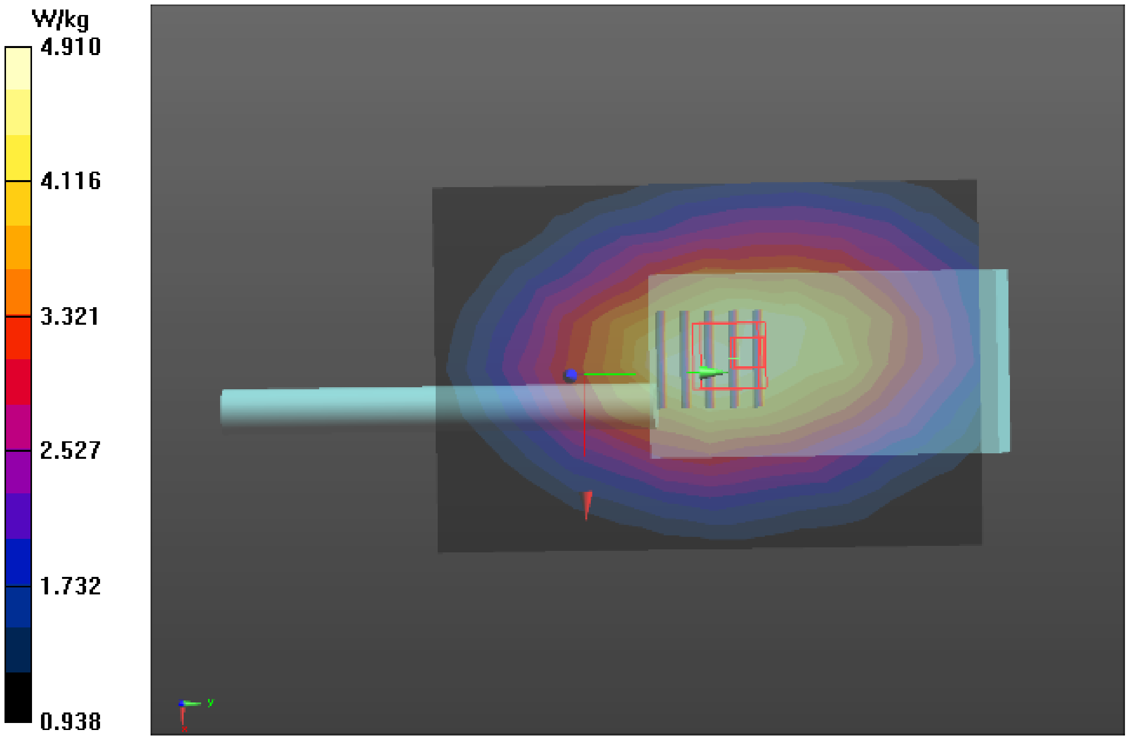
Communication System: CW; Communication System Band: CW 450MHz; Duty Cycle: 1:1;
Frequency:400.025 MHz; Medium parameters used: f = 450MHz; σ= 0.84 mho/m; εr =44.77; ρ= 1000 kg/m³ ;
Phantom Type: Elliptical Phantom
Ambient temperature (℃): 21.3 , Liquid temperature (℃): 21.1

DASY Configuration:

- Probe: ES3DV3 – SN3337; ConvF(6.88, 6.88, 6.88); Calibrated:10/01/2015;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = 1.0,
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Face Up/7/Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 5.05 W/kg

Face Up/7/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 73.913 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 5.75 W/kg
SAR(1 g) = 4.4 W/kg; SAR(10 g) = 3.34 W/kg
Maximum value of SAR (measured) = 4.91 W/kg



Test Laboratory: AGC Lab **Date: Dec. 14,2015**
CW450Body –Touch (12.5 KHz)
DUT: Digital Portable Radio ; Type: EP3620 U1

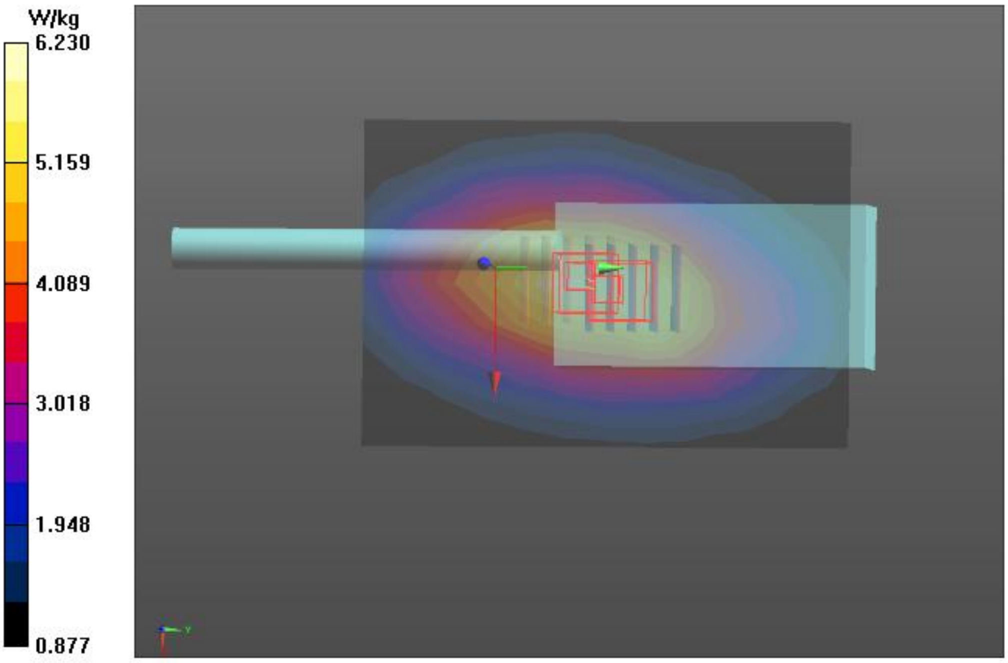
Communication System: CW; Communication System Band: CW 450 MHz; Duty Cycle: 1:1;
Frequency: 400.025 MHz; Medium parameters used: f = 450 MHz; σ=0.92 mho/m; εr = 57.91; ρ= 1000 kg/m ;
Phantom Type: Elliptical Phantom
Ambient temperature (℃): 21.3 , Liquid temperature (℃): 21.3

DASY Configuration:
- Probe: ES3DV3 – SN3337; ConvF(7.12, 7.12, 7.12); Calibrated:10/01/2015;;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = 1.0,
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108 ;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

BACK/7/Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 6.05 W/kg

BACK/7/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 79.332 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 7.83 W/kg
SAR(1 g) = 5.54 W/kg; SAR(10 g) = 4.05 W/kg
Maximum value of SAR (measured) = 6.27 W/kg

BACK/7/Zoom Scan 2 (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 79.332 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 8.01 W/kg
SAR(1 g) = 5.41 W/kg; SAR(10 g) = 3.87 W/kg
Maximum value of SAR (measured) = 6.23 W/kg



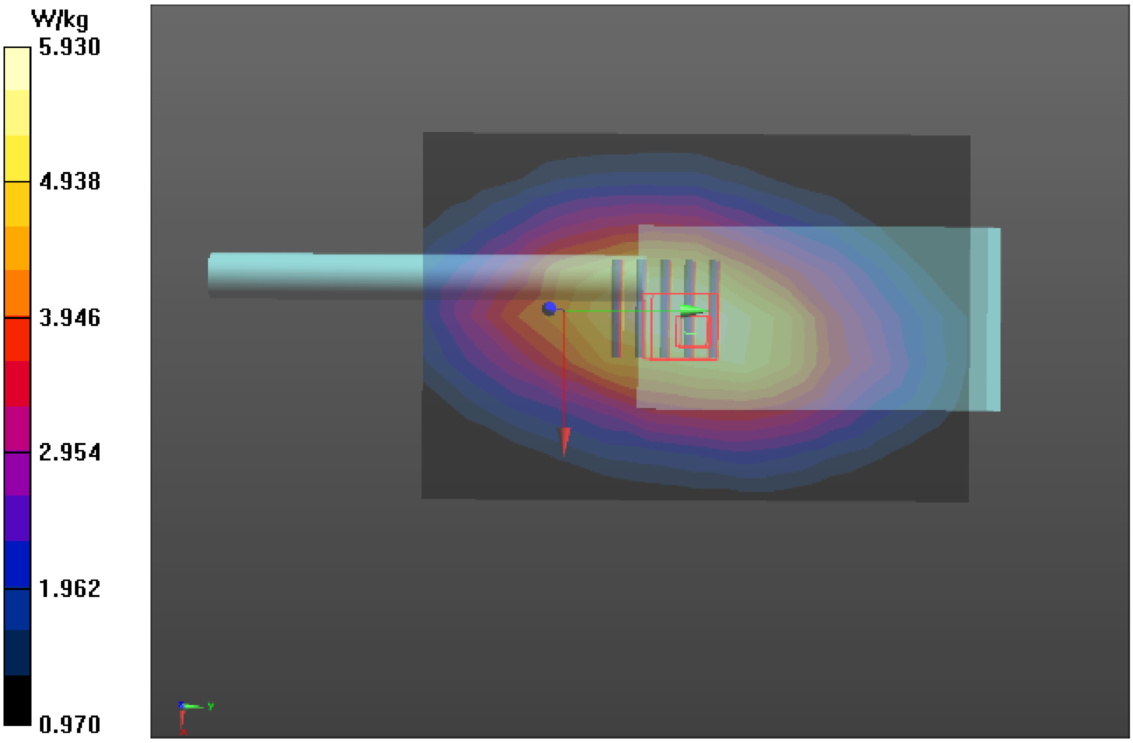
Repeated SAR
Test Laboratory: AGC Lab **Date: Dec. 14,2015**
CW450Body –Touch (12.5 KHz)
DUT: Digital Portable Radio ; Type: EP3620 U1

Communication System: CW; Communication System Band: CW 450 MHz; Duty Cycle: 1:1;
Frequency: 400.025 MHz; Medium parameters used: f = 450 MHz; σ=0.92 mho/m; εr = 57.91; ρ= 1000 kg/m ;
Phantom Type: Elliptical Phantom
Ambient temperature (℃): 21.3 , Liquid temperature (℃): 21.3

DASY Configuration:
- Probe: ES3DV3 – SN3337; ConvF(7.12, 7.12, 7.12); Calibrated:10/01/2015;;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = 1.0,
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108 ;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

BACK/REPEATED-7/Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 6.05 W/kg

BACK/REPEATED-7/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 77.659 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 7.39 W/kg
SAR(1 g) = 5.34 W/kg; SAR(10 g) = 3.94 W/kg
Maximum value of SAR (measured) = 5.93 W/kg



Type of signal: Analog
Test Laboratory: AGC Lab **Date: Dec. 14,2015**
CW450 face up 2.5cm (12.5 KHz)
DUT: Digital Portable Radio ; Type: EP3620 U1

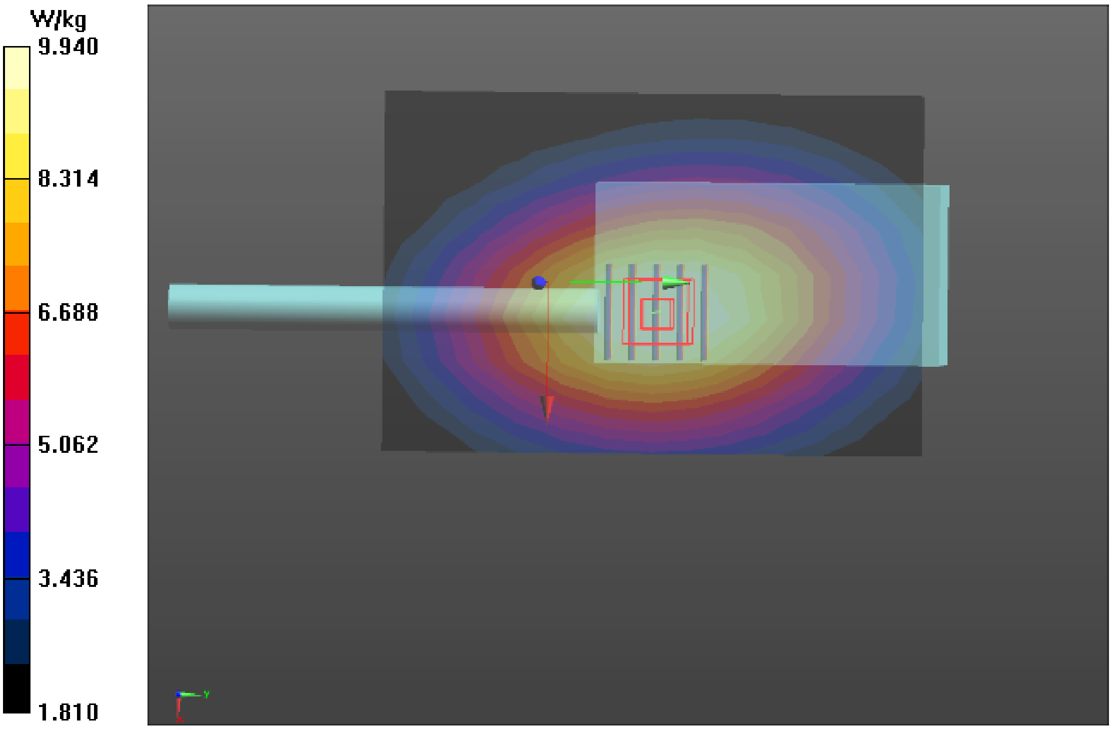
Communication System: CW; Communication System Band: CW 450MHz; Duty Cycle: 1:1;
Frequency:400.025 MHz; Medium parameters used: f = 450MHz; σ= 0.84 mho/m; εr =44.77; ρ= 1000 kg/m³ ;
Phantom Type: Elliptical Phantom
Ambient temperature (℃): 21.3 , Liquid temperature (℃): 21.1

DASY Configuration:

- Probe: ES3DV3 – SN3337; ConvF(6.88, 6.88, 6.88); Calibrated:10/01/2015;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = 1.0,
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

Face Up/1/Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 10.5 W/kg

Face Up/1/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 109.0 V/m; Power Drift = -0.12 dB
Peak SAR (extrapolated) = 11.7 W/kg
SAR(1 g) = 8.96 W/kg; SAR(10 g) = 6.73 W/kg
Maximum value of SAR (measured) = 9.94 W/kg



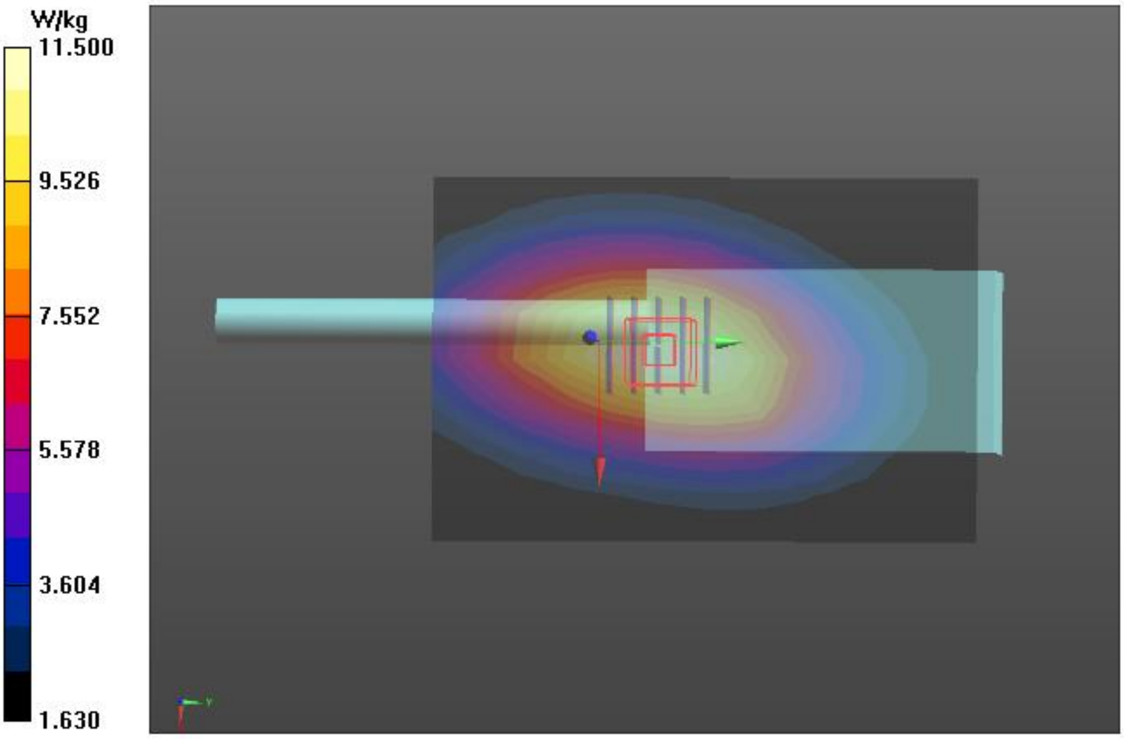
Test Laboratory: AGC Lab **Date: Dec. 14,2015**
CW450Body –Touch (12.5 KHz)
DUT: Digital Portable Radio ; Type: EP3620 U1

Communication System: CW; Communication System Band: CW 450 MHz; Duty Cycle: 1:1;
Frequency: 400.025 MHz; Medium parameters used: f = 450 MHz; σ=0.92 mho/m; εr = 57.91; ρ= 1000 kg/m ;
Phantom Type: Elliptical Phantom
Ambient temperature (℃): 21.3 , Liquid temperature (℃): 21.3

DASY Configuration:
- Probe: ES3DV3 – SN3337; ConvF(7.12, 7.12, 7.12); Calibrated:10/01/2015;;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = 1.0,
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108 ;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

BACK/1/Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 11.7 W/kg

BACK/1/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 111.6 V/m; Power Drift = -0.14 dB
Peak SAR (extrapolated) = 14.3 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 7.48 W/kg
Maximum value of SAR (measured) = 11.5 W/kg



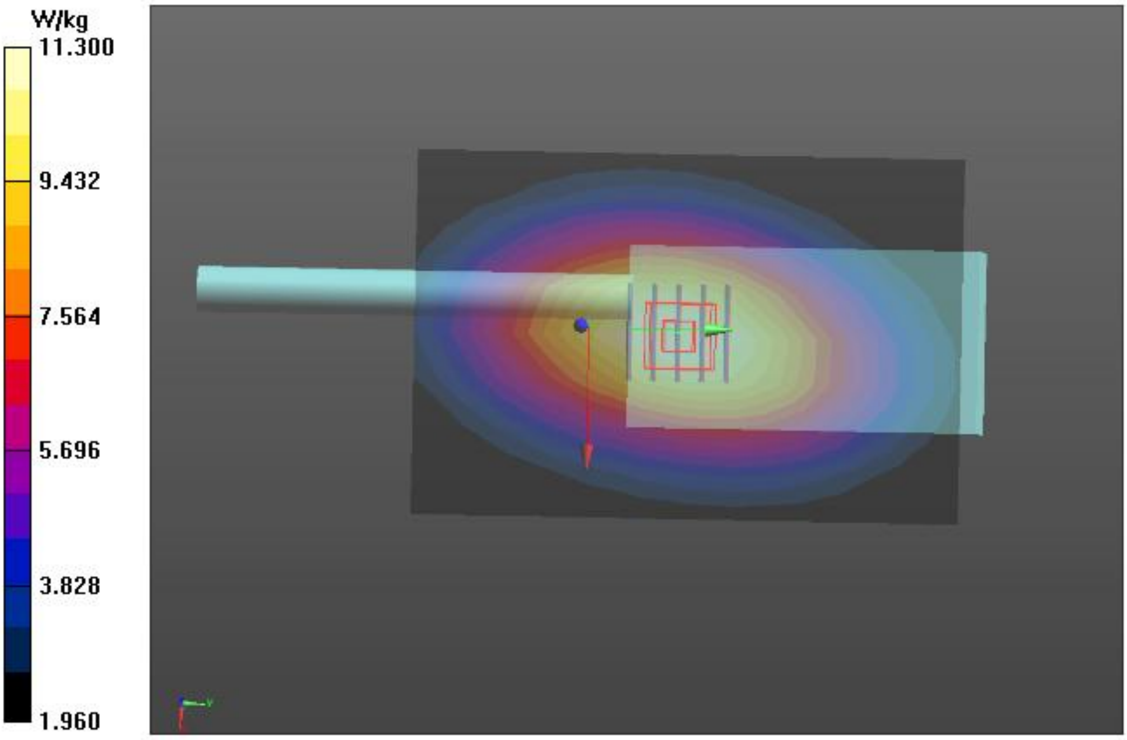
Repeated SAR
Test Laboratory: AGC Lab **Date: Dec. 14,2015**
CW450Body –Touch (12.5 KHz)
DUT: Digital Portable Radio ; Type: EP3620 U1

Communication System: CW; Communication System Band: CW 450 MHz; Duty Cycle: 1:1;
Frequency: 400.025 MHz; Medium parameters used: f = 450 MHz; σ=0.92 mho/m; ε_r = 57.91; ρ= 1000 kg/m ;
Phantom Type: Elliptical Phantom
Ambient temperature (℃): 21.3 , Liquid temperature (℃): 21.3

DASY Configuration:
- Probe: ES3DV3 – SN3337; ConvF(7.12, 7.12, 7.12); Calibrated:10/01/2015;;
- Sensor-Surface: 3mm (Mechanical Surface Detection), z = 1.0,
- Electronics: DAE4 Sn1398; Calibrated: 03/11/2015
- Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP:1108 ;
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

BACK/REPEATED-1/Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 11.6 W/kg

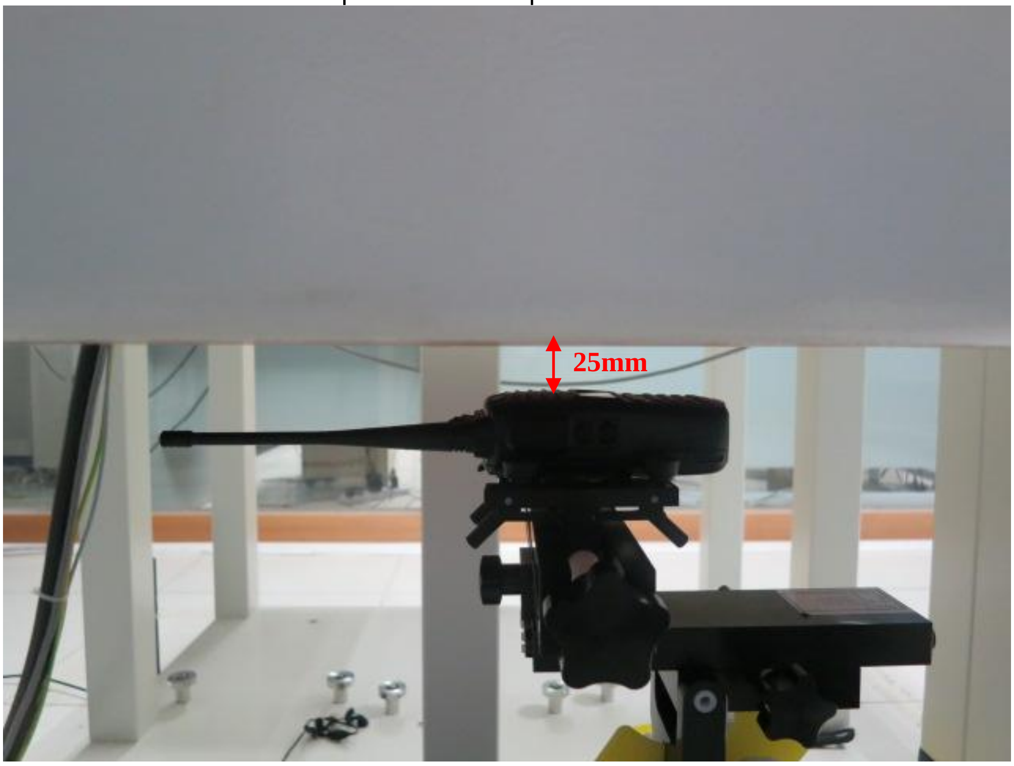
BACK/REPEATED-1/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 109.7 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 14.0 W/kg
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 7.56 W/kg
Maximum value of SAR (measured) = 11.3 W/kg



APPENDIX C. TEST SETUP PHOTOGRAPHS &EUT PHOTOGRAPHS

Test Setup Photographs

Face Up with 25mm Separation Distance.

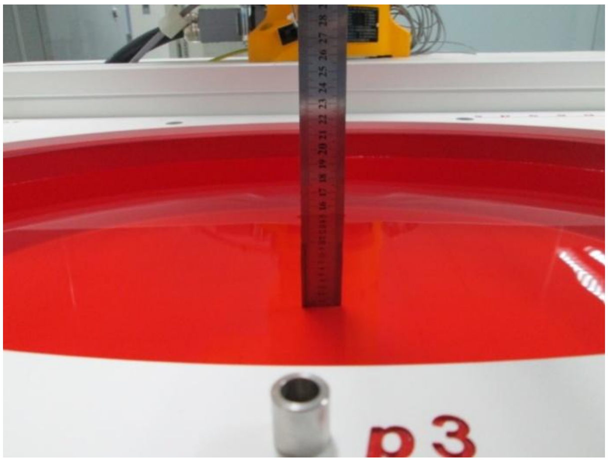


Body Back Touch with all accessories

Note : The headset is just for testing. This tested and electrically similar headsets may be used.

DEPTH OF THE LIQUID IN THE PHANTOM—ZOOM IN

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

450MHz Head	450MHz Body
	

EUT PHOTOGRAPHS

TOTAL VIEW OF EUT

TOP VIEW OF EUT

BOTTOM VIEW OF EUT

FRONT VIEW OF EUT

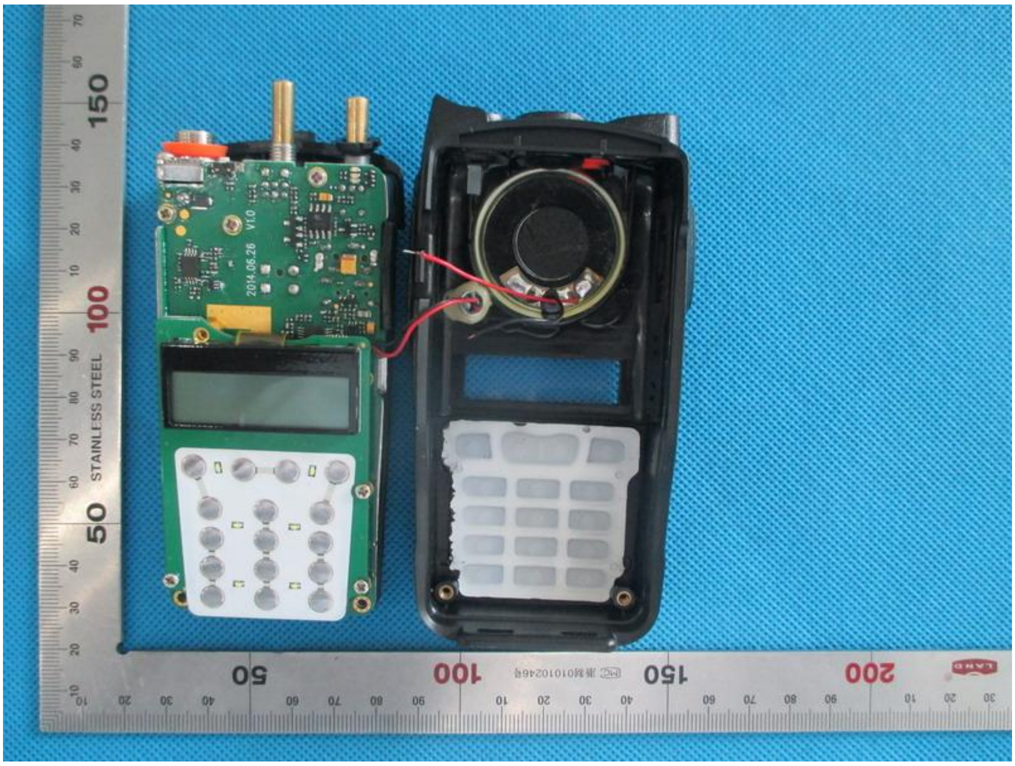
BACK VIEW OF EUT

LEFT VIEW OF EUT

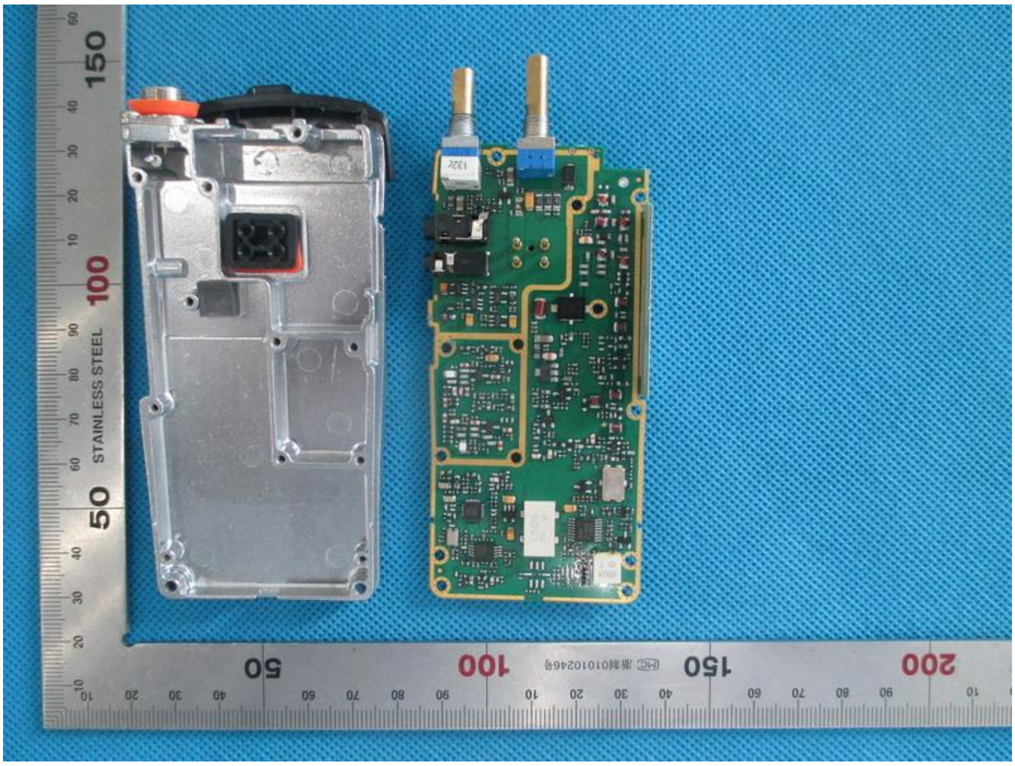
RIGHT VIEW OF EUT

OPEN VIEW-1 OF EUT

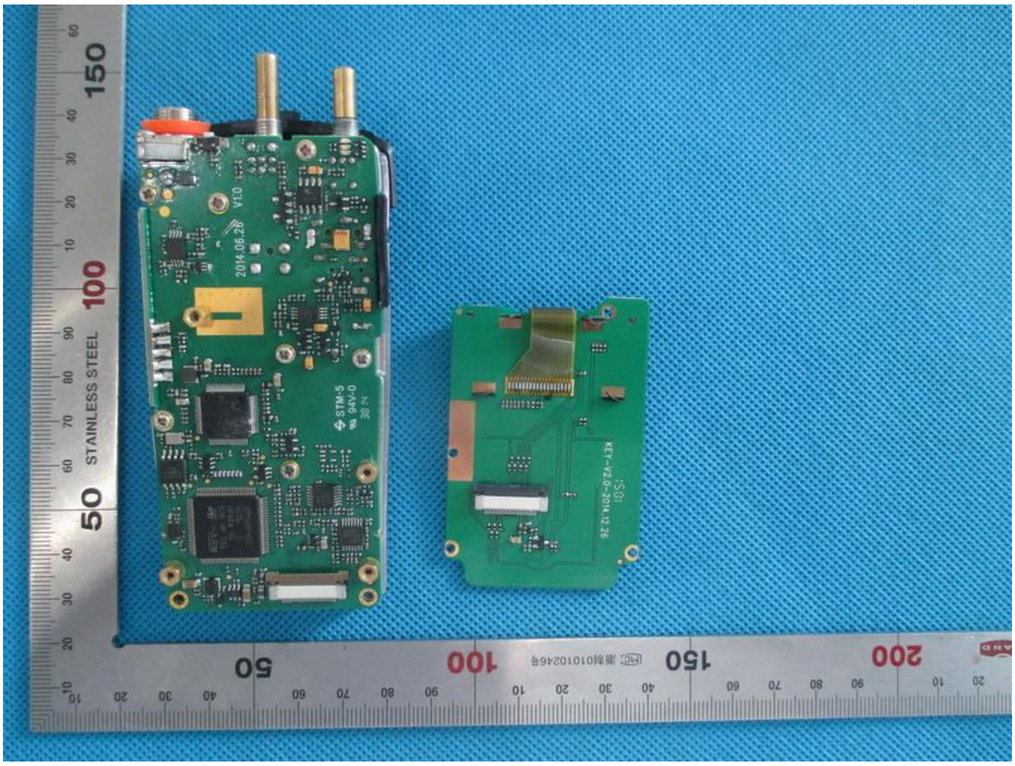
OPEN VIEW-2 OF EUT



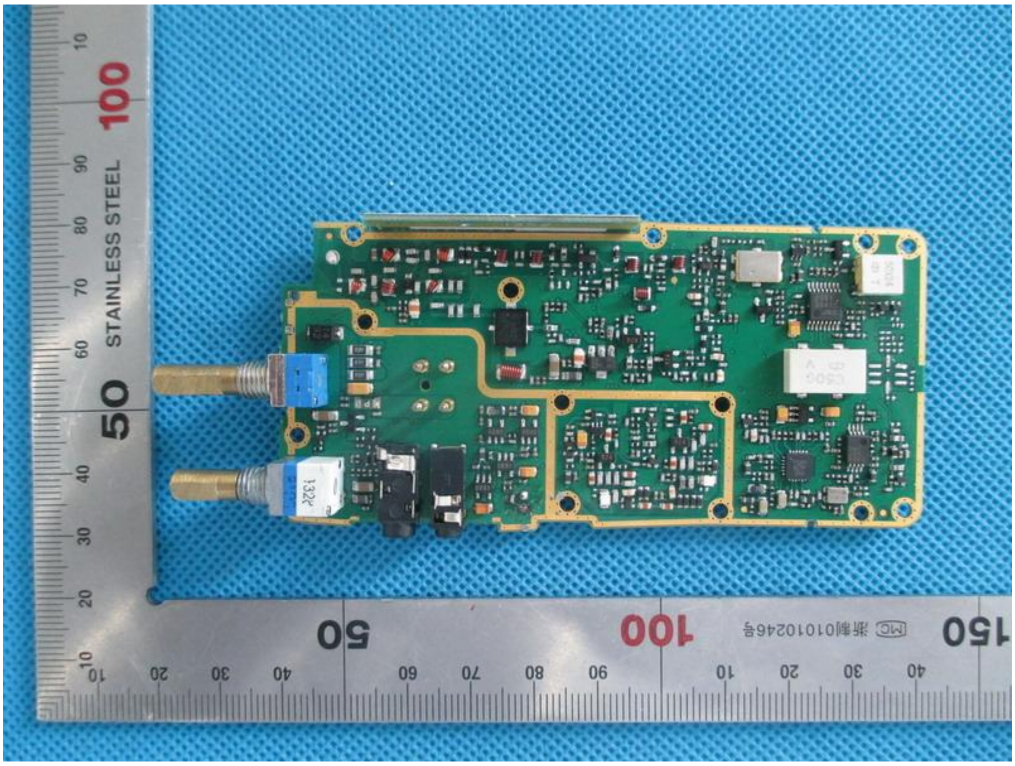
OPEN VIEW-3 OF EUT



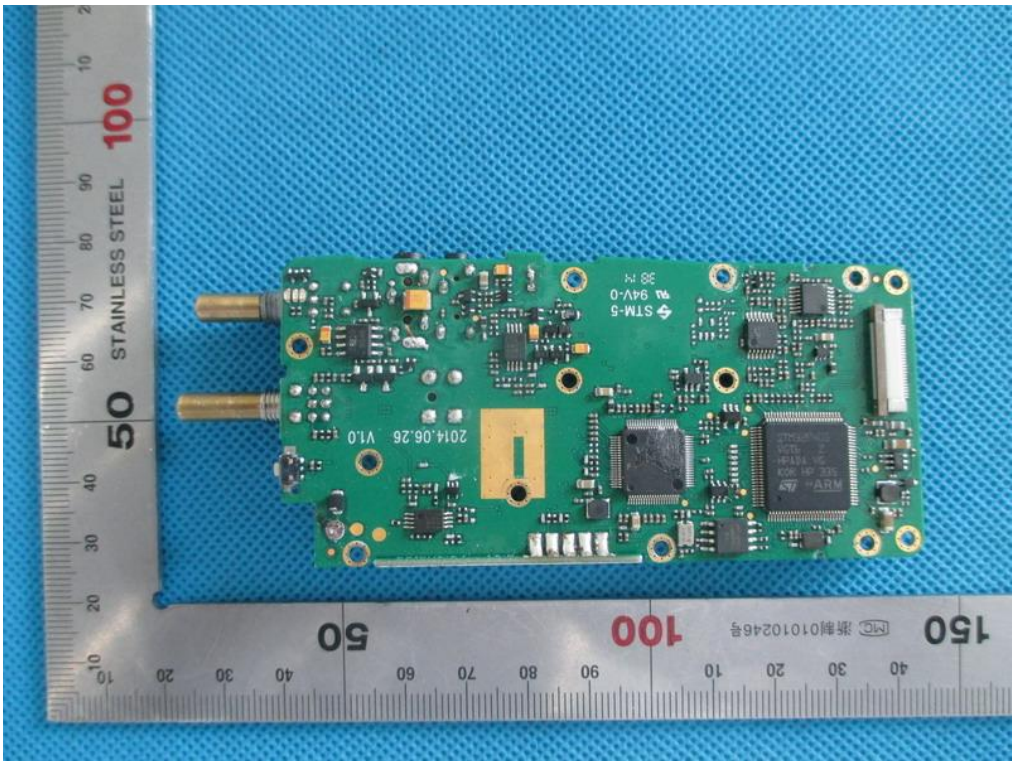
INTERNAL VIEW-1 OF EUT



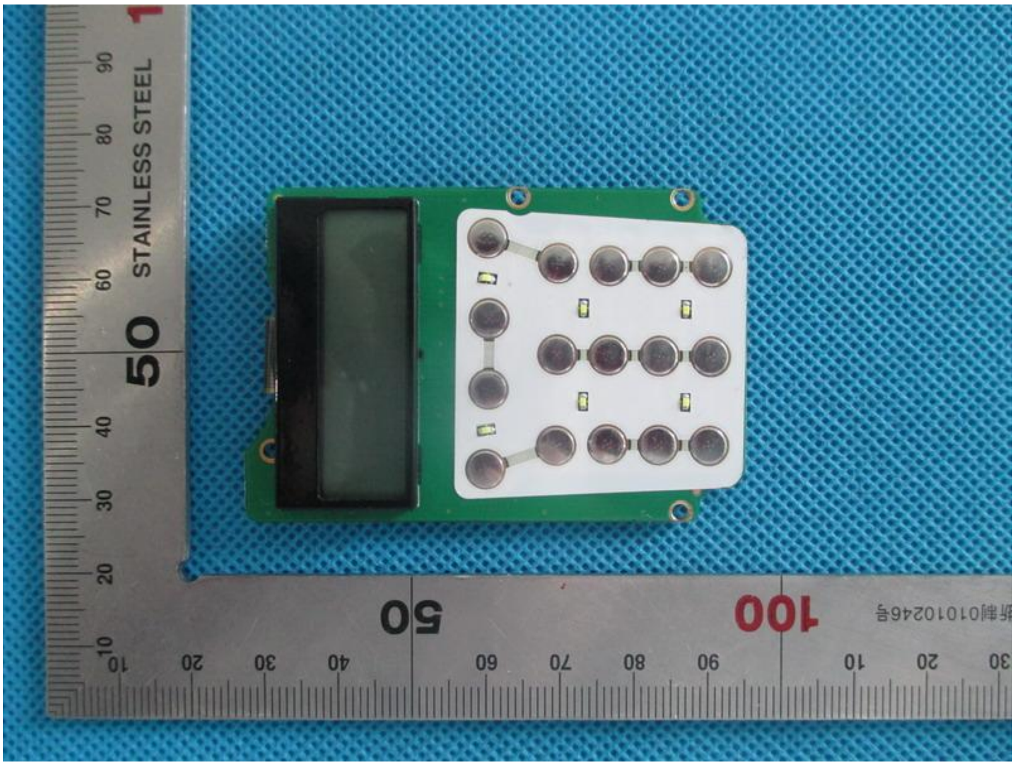
INTERNAL VIEW-2 OF EUT



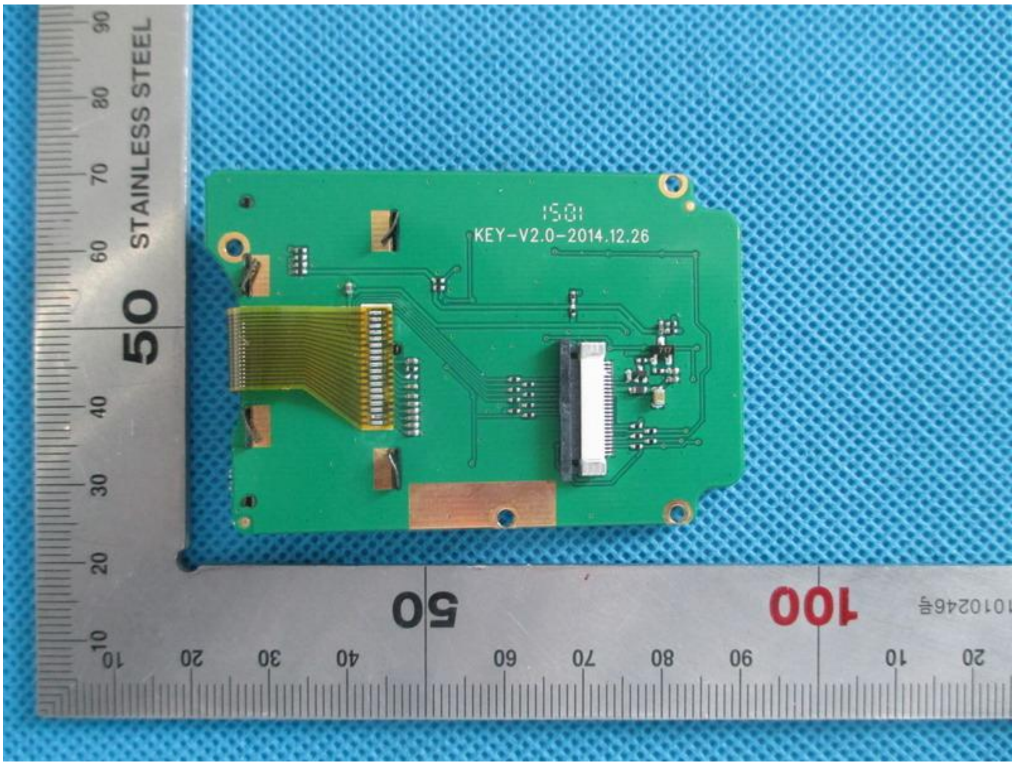
INTERNAL VIEW-3 OF EUT



INTERNAL VIEW-4 OF EUT



INTERNAL VIEW-5 OF EUT



APPENDIX D. PROBE CALIBRATION DATA

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

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

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

Accreditation No.: **SCS 0108**

Client **AGC-CERT (Auden)**

Certificate No: **ES3-3337_Oct15**

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3337
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	October 1, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	01-Apr-15 (No. 217-02128)	Mar-16
Power sensor E4412A	MY41498087	01-Apr-15 (No. 217-02128)	Mar-16
Reference 3 dB Attenuator	SN: S5054 (3c)	01-Apr-15 (No. 217-02129)	Mar-16
Reference 20 dB Attenuator	SN: S5277 (20x)	01-Apr-15 (No. 217-02132)	Mar-16
Reference 30 dB Attenuator	SN: S5129 (30b)	01-Apr-15 (No. 217-02133)	Mar-16
Reference Probe ES3DV2	SN: 3013	30-Dec-14 (No. ES3-3013_Dec14)	Dec-15
DAE4	SN: 660	14-Jan-15 (No. DAE4-660_Jan15)	Jan-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

	Name	Function	Signature
Calibrated by:	Israe Elnaouq	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: October 2, 2015

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

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 900 MHz in TEM-cell; f > 1800 MHz: R22 waveguide). NORMx,y,z are only intermediate values, i.e., the uncertainties of NORMx,y,z does not affect the E^2-field uncertainty inside TSL (see below *ConvF*).
- *NORM(f)x,y,z = NORMx,y,z * frequency_response* (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- *DCPx,y,z:* DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- *PAR:* PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- *Ax,y,z; Bx,y,z; Cx,y,z; Dx,y,z; VRx,y,z: A, B, C, D* are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. *VR* is the maximum calibration range expressed in RMS voltage across the diode.
- *ConvF and Boundary Effect Parameters:* Assessed in flat phantom using E-field (or Temperature Transfer Standard for f ≤ 800 MHz) and inside waveguide using analytical field distributions based on power measurements for f > 800 MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to *NORMx,y,z * ConvF* whereby the uncertainty corresponds to that given for *ConvF*. A frequency dependent *ConvF* is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- *Spherical isotropy (3D deviation from isotropy)*: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- *Sensor Offset*: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- *Connector Angle*: The angle is assessed using the information gained by determining the *NORMx* (no uncertainty required).

Probe ES3DV3

SN:3337

Manufactured: January 24, 2012
Calibrated: October 1, 2015

Calibrated for DASY/EASY Systems
(Note: non-compatible with DASY2 system!)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3337

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.10	0.96	1.00	± 10.1 %
DCP (mV)[B]	106.0	105.9	103.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB$\sqrt{\mu V}$	C	D dB	VR mV	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	192.9	±3.3 %
		Y	0.0	0.0	1.0		183.2	
		Z	0.0	0.0	1.0		197.3	

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

[A] The uncertainties of Norm X,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 5 and 6).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3337

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	52.3	0.76	7.63	7.63	7.63	0.04	1.20	± 13.3 %
450	43.5	0.87	6.88	6.88	6.88	0.25	2.20	± 13.3 %
835	41.5	0.90	6.32	6.32	6.32	0.49	1.45	± 12.0 %
900	41.5	0.97	6.23	6.23	6.23	0.37	1.68	± 12.0 %
1810	40.0	1.40	5.28	5.28	5.28	0.51	1.53	± 12.0 %
1900	40.0	1.40	5.23	5.23	5.23	0.80	1.16	± 12.0 %
2100	39.8	1.49	5.28	5.28	5.28	0.62	1.35	± 12.0 %
2450	39.2	1.80	4.66	4.66	4.66	0.80	1.25	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3337

Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	61.9	0.80	7.24	7.24	7.24	0.06	1.20	± 13.3 %
450	56.7	0.94	7.12	7.12	7.12	0.15	1.74	± 13.3 %
835	55.2	0.97	6.31	6.31	6.31	0.43	1.63	± 12.0 %
900	55.0	1.05	6.29	6.29	6.29	0.35	1.81	± 12.0 %
1810	53.3	1.52	4.94	4.94	4.94	0.54	1.48	± 12.0 %
1900	53.3	1.52	4.83	4.83	4.83	0.45	1.78	± 12.0 %
2100	53.2	1.62	4.90	4.90	4.90	0.67	1.39	± 12.0 %
2450	52.7	1.95	4.36	4.36	4.36	0.80	1.14	± 12.0 %

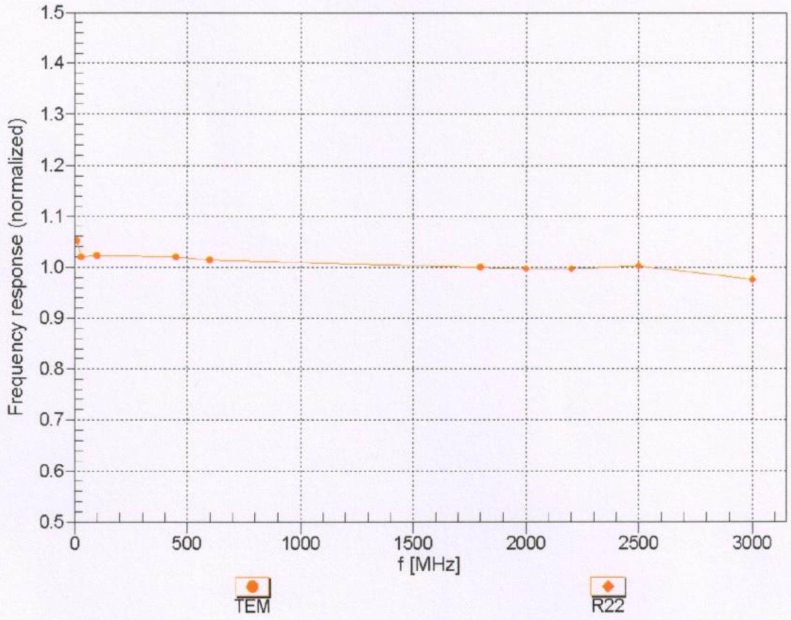
[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz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

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

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

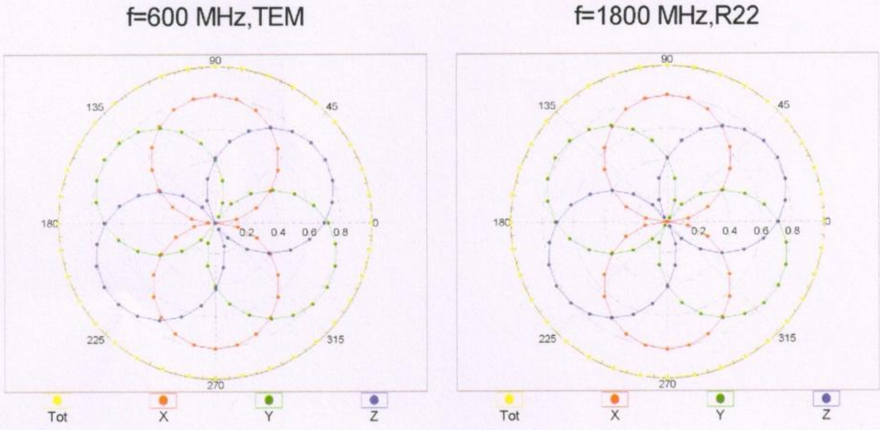
Frequency Response of E-Field

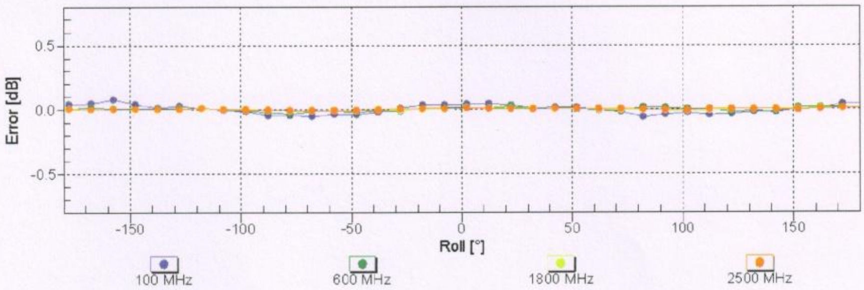
(TEM-Cell:ifi110 EXX, Waveguide: R22)



Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

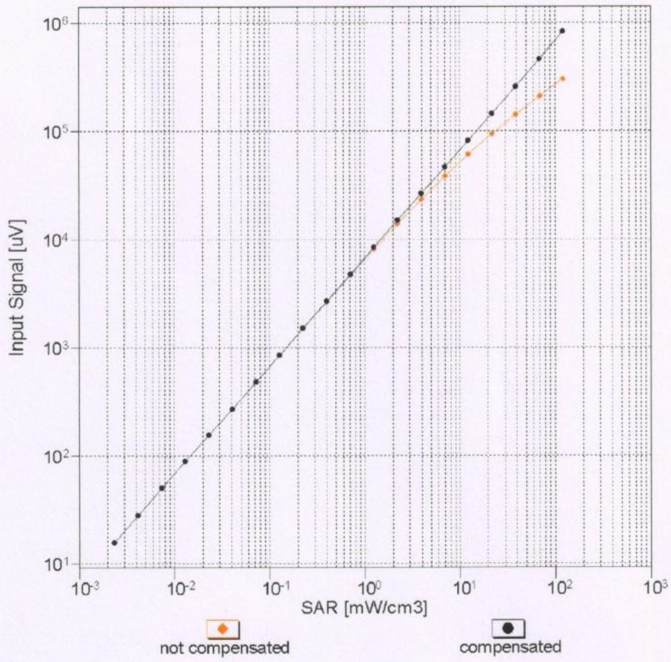
Receiving Pattern (ϕ), $\vartheta = 0°$

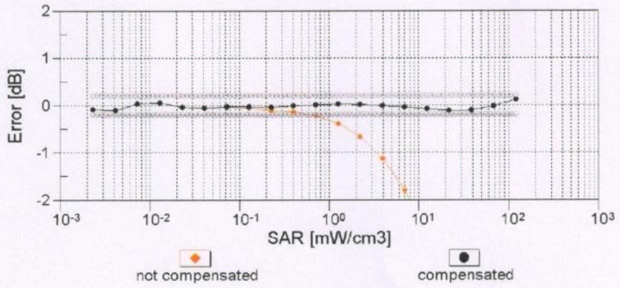




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

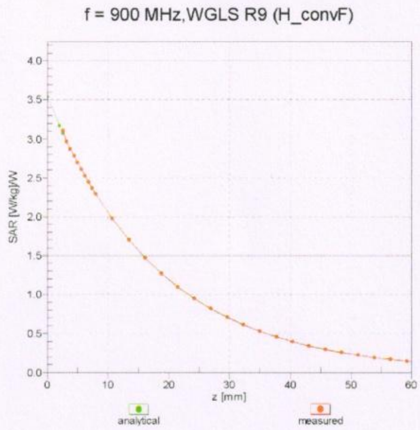
Dynamic Range f(SAR_{head})
(TEM cell , f_{eval}= 1900 MHz)

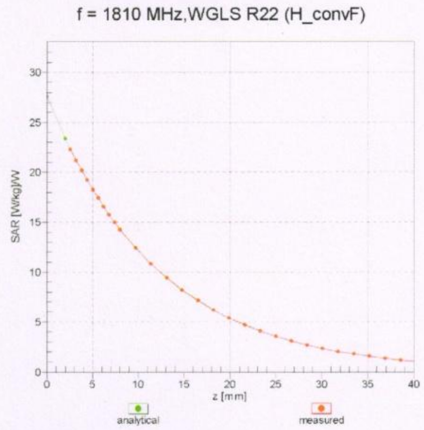




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

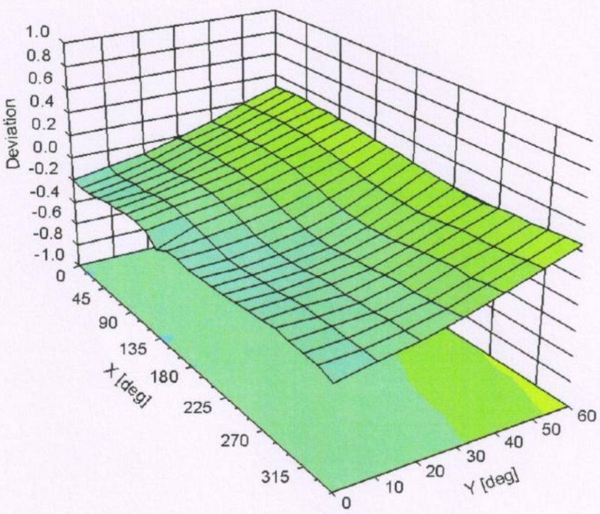
Conversion Factor Assessment

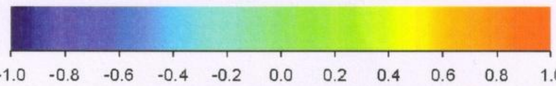




Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





Uncertainty of Spherical Isotropy Assessment: ± 2.6% (k=2)

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3337

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	2.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

APPENDIX E. DAE CALIBRATION DATA

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

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

Accreditation No.: SCS 0108

Client **AGC-CERT (Auden)**

Certificate No: DAE4-1398_Mar15

CALIBRATION CERTIFICATE

Object	DAE4 - SD 000 D04 BM - SN: 1398
Calibration procedure(s)	QA CAL-06.v29 Calibration procedure for the data acquisition electronics (DAE)
Calibration date:	March 11, 2015

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Keithley Multimeter Type 2001	SN: 0810278	03-Oct-14 (No:15573)	Oct-15
Secondary Standards	**ID #**	**Check Date (in house)**	**Scheduled Check**
Auto DAE Calibration Unit	SE UWS 053 AA 1001	06-Jan-15 (in house check)	In house check: Jan-16
Calibrator Box V2.1	SE UMS 006 AA 1002	06-Jan-15 (in house check)	In house check: Jan-16

	Name	Function	Signature
Calibrated by:	R.Mayoraz	Technician	F. Mayoraz
Approved by:	Fin Bomholt	Deputy Technical Manager	i.V.

Issued: March 11, 2015

Calibration Laboratory of
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Engineering AG
Zeughausstrasse 43, 8004 Zurich, Switzerland

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Accreditation No.: **SCS 0108**

Glossary

DAE	data acquisition electronics
Connector angle	information used in DASY system to align probe sensor X to the robot coordinate system.

Methods Applied and Interpretation of Parameters

- *DC Voltage Measurement:* Calibration Factor assessed for use in DASY system by comparison with a calibrated instrument traceable to national standards. The figure given corresponds to the full scale range of the voltmeter in the respective range.
- *Connector angle*: The angle of the connector is assessed measuring the angle mechanically by a tool inserted. Uncertainty is not required.
- The following parameters as documented in the Appendix contain technical information as a result from the performance test and require no uncertainty.
  - *DC Voltage Measurement Linearity:* Verification of the Linearity at +10% and -10% of the nominal calibration voltage. Influence of offset voltage is included in this measurement.
  - *Common mode sensitivity:* Influence of a positive or negative common mode voltage on the differential measurement.
  - *Channel separation:* Influence of a voltage on the neighbor channels not subject to an input voltage.
  - *AD Converter Values with inputs shorted:* Values on the internal AD converter corresponding to zero input voltage
  - *Input Offset Measurement*: Output voltage and statistical results over a large number of zero voltage measurements.
  - *Input Offset Current:* Typical value for information; Maximum channel input offset current, not considering the input resistance.
  - *Input resistance:* Typical value for information: DAE input resistance at the connector, during internal auto-zeroing and during measurement.
  - *Low Battery Alarm Voltage:* Typical value for information. Below this voltage, a battery alarm signal is generated.
  - *Power consumption:* Typical value for information. Supply currents in various operating modes.

DC Voltage Measurement

A/D - Converter Resolution nominal

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

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

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

Calibration Factors	X	Y	Z
High Range	404.177 ± 0.02% (k=2)	404.159 ± 0.02% (k=2)	403.623 ± 0.02% (k=2)
Low Range	3.97359 ± 1.50% (k=2)	3.99241 ± 1.50% (k=2)	3.96904 ± 1.50% (k=2)

Connector Angle

Connector Angle to be used in DASY system	195.5 ° ± 1 °

Appendix (Additional assessments outside the scope of SCS0108)

1. DC Voltage Linearity

High Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	199993.58	-1.10	-0.00
Channel X	+ Input	20001.61	1.19	0.01
Channel X	- Input	-19998.75	2.61	-0.01
Channel Y	+ Input	199994.17	-0.06	-0.00
Channel Y	+ Input	19999.73	-0.66	-0.00
Channel Y	- Input	-20002.27	-0.74	0.00
Channel Z	+ Input	199994.39	-0.01	-0.00
Channel Z	+ Input	19999.60	-0.65	-0.00
Channel Z	- Input	-20002.37	-0.85	0.00

Low Range		Reading (μV)	Difference (μV)	Error (%)
Channel X	+ Input	2000.37	-0.22	-0.01
Channel X	+ Input	201.03	-0.14	-0.07
Channel X	- Input	-198.68	0.01	-0.00
Channel Y	+ Input	2000.16	-0.39	-0.02
Channel Y	+ Input	199.64	-1.42	-0.71
Channel Y	- Input	-200.57	-1.84	0.93
Channel Z	+ Input	2000.33	-0.14	-0.01
Channel Z	+ Input	199.88	-1.17	-0.58
Channel Z	- Input	-200.01	-1.12	0.56

2. Common mode sensitivity

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

	Common mode Input Voltage (mV)	High Range Average Reading (μV)	Low Range Average Reading (μV)
Channel X	200	-13.00	-14.85
	- 200	16.87	14.74
Channel Y	200	8.85	8.14
	- 200	-11.30	-11.41
Channel Z	200	7.15	7.52
	- 200	-9.35	-9.51

3. Channel separation

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

	Input Voltage (mV)	Channel X (μV)	Channel Y (μV)	Channel Z (μV)
Channel X	200	-	-3.68	-0.69
Channel Y	200	5.01	-	-0.86
Channel Z	200	8.26	0.74	-

4. AD-Converter Values with inputs shorted

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

	High Range (LSB)	Low Range (LSB)
Channel X	15958	16128
Channel Y	15964	17962
Channel Z	15846	14478

5. Input Offset Measurement

DASY measurement parameters: Auto Zero Time: 3 sec; Measuring time: 3 sec
Input 10MΩ

	Average (μV)	min. Offset (μV)	max. Offset (μV)	Std. Deviation (μV)
Channel X	-0.22	-1.08	0.72	0.33
Channel Y	-1.19	-1.94	-0.30	0.32
Channel Z	-1.46	-2.11	0.01	0.32

6. Input Offset Current

Nominal Input circuitry offset current on all channels: <25fA

7. Input Resistance (Typical values for information)

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

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

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

9. Power Consumption (Typical values for information)

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

APPENDIX F DIPOLE CALIBRATION DATA

SATIMO
The microwave vision company

SAR Reference Dipole Calibration Report

Ref : ACR.318.4.13.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: 450 MHZ

SERIAL NO.: SN 46/11 DIP 0G450-184

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	
Checked by :	Jérôme LUC	Product Manager	11/14/2013	
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

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 450 MHz REFERENCE DIPOLE
Manufacturer	Satimo
Model	SID450
Serial Number	SN 46/11 DIP 0G450-184
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

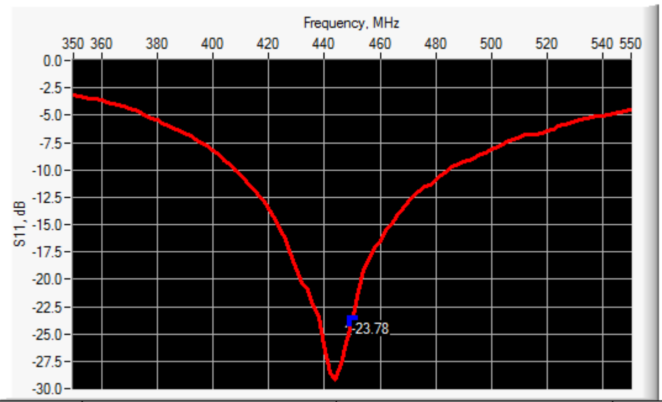
5.3 VALIDATION MEASUREMENT

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



Frequency (MHz)	Return Loss (dB)	Requirement (dB)	Impedance
450	-23.78	-20	54.9 Ω + 5.1 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 %.	PASS	166.7 ±1 %.	PASS	6.35 ±1 %.	PASS
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 %.		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 MEASUREMENT CONDITION

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Head Liquid Values: eps' : 42.5 sigma : 0.86
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	450 MHz
Input power	20 dBm
Liquid Temperature	21 °C
Lab Temperature	21 °C
Lab Humidity	45 %

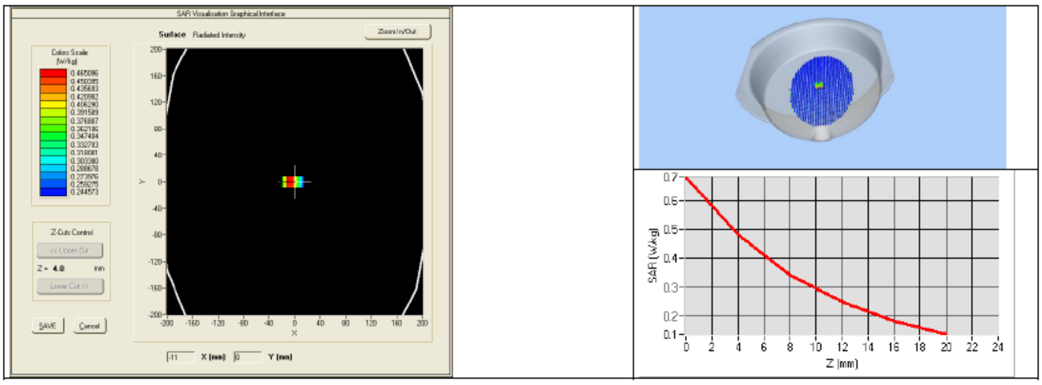
7.2 HEAD LIQUID MEASUREMENT

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 %	PASS	0.87 ±5 %	PASS
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 %		1.80 ±5 %	
2600	39.0 ±5 %		1.96 ±5 %	
3000	38.5 ±5 %		2.40 ±5 %	
3500	37.9 ±5 %		2.91 ±5 %	

7.3 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.

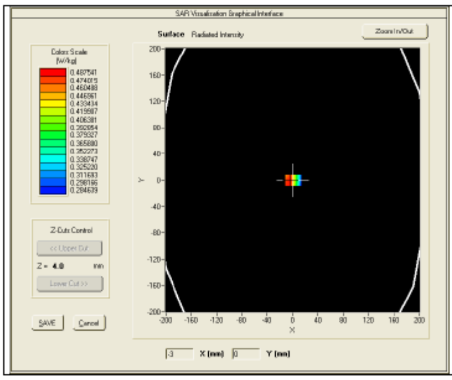
Frequency MHz	1 g SAR (W/kg/W)		10 g SAR (W/kg/W)	
	required	measured	required	measured
300	2.85		1.94	
450	4.58	4.91 (0.49)	3.06	3.13 (0.31)
750	8.49		5.55	
835	9.56		6.22	
900	10.9		6.99	
1450	29		16	
1500	30.5		16.8	
1640	34.2		18.4	
1750	36.4		19.3	
1800	38.4		20.1	
1900	39.7		20.5	
1950	40.5		20.9	
2000	41.1		21.1	
2100	43.6		21.9	
2300	48.7		23.3	
2450	52.4		24	
2600	55.3		24.6	
3000	63.8		25.7	
3500	67.1		25	

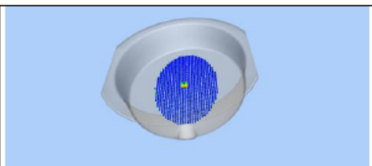


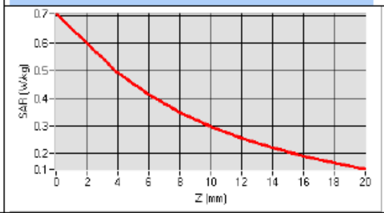
7.4 BODY MEASUREMENT RESULT

Software	OPENSAR V4
Phantom	SN 20/09 SAM71
Probe	SN 18/11 EPG122
Liquid	Body Liquid Values: eps' : 57.6 sigma : 0.98
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	450 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**
450	5.07 (0.51)	3.25 (0.33)







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