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SAR TEST REPORT

Applicant Name: **JVC KENWOOD CORPORATION** 1-16-2 Hakusan Midori-ku Yokohama-shi Kanagawa 226-8525 Japan	**Date of Issue: 05. 10, 2017** **Test Report No.: HCT-A-1704-F003-1** **Test Site: HCT CO., LTD.**

FCC ID: K44479000

Equipment Type:	**VHF DIGITAL TRANSCEIVER**
Model Name:	**NX-3220-K, NX-3220-K2, NX-3220-K3**
Testing has been carried out in accordance with:	**47CFR §2.1093** **ANSI/ IEEE C95.1 - 2005** **IEEE 1528-2013**
Date of Test:	**04/04/2017 ~ 04/06/2017**

This device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in FCC KDB procedures and had been tested in accordance with the measurement procedures specified in FCC KDB procedures.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them.

Tested By	**Reviewed By**
Parkinho	
In-Ho Park **Test Engineer / SAR Team** **Certification Division**	**Dong-Seob Kim** **Technical Manager / SAR Team** **Certification Division**

DOCUMENT HISTORY

Rev.	DATE	DESCRIPTION
HCT-A-1704-F003	04. 24, 2017	First Approval Report
HCT-A-1704-F003-1	05. 10, 2017	Revised a estimated BT SAR on the Report.

Table of Contents

1. Attestation of Test Result of Device Under Test

Test Laboratory	
Company Name:	HCT Co., LTD
Address	74, Seoicheon-ro 578beon-gil, Majang-myeon, Icheon-si, Gyeonggi-do, 17383, Rep. of Korea
Telephone	+82 31 645 6300
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Attestation of SAR test result	
Applicant Name:	JVC KENWOOD CORPORATION
FCC ID:	K44479000
Model:	NX-3220-K, NX-3220-K2, NX-3220-K3
EUT Type:	VHF DIGITAL TRANSCEIVER
Application Type:	Certification

The Highest Reported SAR					
Band	Tx. Frequency (MHz)	Equipment Class	Reported 1g SAR (W/kg)		
			Hand-held to Face	Body-Worn Belt clip	
VHF (FCC)	150 ~ 174	TNF	1.32	5.46	50% PTT duty cycle
Bluetooth	2 402 ~ 2 480	DSS/DTS	N/A		
Simultaneous SAR per KDB 690783 D01v01r03			5.59		
Date(s) of Tests:	04/04/2017 ~ 04/06/2017				

2. Test Methodology and Procedures

The tests documented in this report were performed in accordance with IEEE Standard 1528-2013 & IEEE 1528-2005 and the following published KDB procedures.

- FCC KDB Publication 447498 D01 General SAR Guidance v06
- FCC KDB Publication 648474 D04 Handset SAR v01r03
- FCC KDB Publication 865664 D01 SAR measurement 100 MHz to 6 GHz v01r04
- FCC KDB Publication 865664 D02 SAR Reporting v01r02
- FCC KDB Publication 643646 D01 SAR Test for PTT Radios v01r03

* DUT Description

NX-3220-K NX-3220-K2 NX-3220-K3 (Default EUT)

3. Output Power Specifications.

3.1 Nominal and Maximum Output Power Specifications

This device operates using the following maximum output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB publication 447498 D01v06.

3.2 Maximum Output Power

Band	Frequency	Power
VHF	150 MHz ~ 174 MHz	5.2 W
Bluetooth	2 402 MHz ~ 2 480 MHz	2.5 mW

3.3 Output Average Conducted Power

VHF				
Model	Antenna	Frequency (MHz)	Channel	Power (dBm)
NX-3220-K, NX-3220-K2, NX-3220-K3	KRA-22M, KRA-26M , KRA-41M, KRA-25, KRA-28	1	150.05	36.85
		7	158.05	36.82
	KRA-22M2, KRA-26M2, KRA-41M2, KRA-25, KRA-28	8	166.00	36.92
		3	173.95	36.98

For FCC Band:
Per KDB 447498 D01v06 Page 7 section 6) pages 7-8, the number of channels required to be tested is as follows.

F_{high}= 174 MHz
F_{c} = 162 MHz
F_{Low}= 150 MHz
N_{c} = Round $\{[100(f_{high} – f_{low}) / f_{c}]^{0.5}$ X $(f_{c} / 100)^{0.2}\}$ = Round $\{[100(174-150) / 162]^{0.5}$ X $(162/100)^{0.2}\}$ = 4
Therefore, for the frequency band from 150 MHz to 174, 4channels are required for testing.

3.4 SAR Summation Scenario

According to FCC KDB 447498 D01v06, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the EUT are shown below paths and are mode in same rectangle to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

Path 1 Path 2

Simultaneous transmission paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB 447498 D01v06.

Simultaneous Transmission Scenarios	
Applicable Combination	Body-Worn
VHF + 2.4 GHz Bluetooth	Yes

3.5 SAR Test Exclusions Applied

(A) Bluetooth

Per FCC KDB 447498 D01v06, The SAR exclusion threshold for distance < 50mm is defined by the following equation:

$$\frac{Max\ \ Power\ \ of\ \ Channel(mW)}{Test\ \ \ Separation\ \ Distance\ \ (mm)} * \sqrt{Frequency(GHz)} \leq\ \ 3.0\ \ \text{for}\ \ 1-\text{g}\ \ \text{SAR}$$

Mode	Frequency	Maximum Allowed Power	Separation Distance	≤ 3.0 for 1g SAR
	[MHz]	[mW]	[mm]	
Bluetooth	2 480	3	5	0.9

Based on the maximum conducted power of Bluetooth and antenna to use separation distance, Bluetooth SAR was not required [(3/5)*√2.480] = 0.9 < 3.0.

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v06 IV.C.1iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific a physical test configuration is ≤ 1.6W/kg. When standalone SAR is not required to be measured per FCC KDB 447498 D01v06 4.3.22, the following equation must be used to estimate the standalone 1-g SAR and 10g SAR for simultaneous transmission assessment involving that transmitter.

$$Estimated\ \ SAR = \frac{\sqrt{f(GHZ)}}{7.5} * \frac{(Max\ \ Power\ \ of\ \ channel\ \ mW)}{Min\ \ Seperation\ \ Distance}.$$

Estimated 1-g SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated 1g SAR (Body)
	[MHz]	[mW]	[mm]	[W/kg]
Bluetooth	2 480	3	5	0.126

Note:
Held-to ear configurations are not applicable to Bluetooth operations and therefore were not considered for simultaneous transmission. The Estimated SAR results were determined according to FCC KDB447498 D01v06.

4. Manufacturer's Accessory List

Part No.	Description	Accessory Type	Accessory
KRA-22M	VHF Low Profile Helical Antenna (146-162 MHz)	Antennas	1
KRA-22M2	VHF Low Profile Helical Antenna (162-174 MHz)		2
KRA-26M	VHF Helical Antenna (146-162 MHz)		3
KRA-26M2	VHF Helical Antenna (162-174 MHz)		4
KRA-25	VHF whip antenna (148-162 MHz)		5
KRA-28	VHF whip antenna (140-170 MHz)		6
KRA-41M	VHF Stubby antenna (146-162 MHz)		7
KRA-41M2	VHF Stubby antenna (162-174 MHz)		8
KNB-55L	Li-Ion Battery Pack (1480mA)	Battery	1
KNB-56N	Ni-MH Battery Pack (1400mA)		2
KNB-57L	Li-Ion Battery Pack (2000mA)		3
KNB-68LC	Li-Ion Battery Pack (2000mA)		4
KBP-5	AA Alkaline Battery Pack		5
KWR-1	Water Resistance Bag	Body-worn	1
KBH-11	Belt Clip		2
KLH-207K	Nylon Case (non Display)		3
KLH-207K2	Nylon Case (Std Keypad)		4
KLH-207K3	Nylon Case (Full Keypad)		5
KLH-206K	Leather Case (non Display)		6
KLH-206K2	Leather Case (Std Keypad)		7
KLH-206K3	Leather Case (Full Keypad)		8
KBH-13DS	Leather swivel belt loop		9
KLH-140SW	Swivel Belt Loop With D Ring		10
KLH-37BT	Leather Belt		11
KLH-38ST	Shoulder Strap		12
KMC-45D	Speaker Microphone	Microphones Audio Accessory	1
KMC-45	Speaker Microphone		2
KMC-21	Compact Speaker Microphone		3
KMC-21S	Compact Speaker Microphone		4
KEP-2	25mm Earphone kit for KMC-45		5
KHS-10-BH	Heavy-duty headset		6
KHS-10-OH	Heavy-duty headset		7
KHS-7	Single Muff Headset		8
KHS-7A	Single Muff Headset w/in-line PTT		9
KHS-8BL	2-Wire Palm Mic w/ Earphone		10
KHS-8BE	2-Wire Palm Mic w/ Earphone		11
KHS-8NC	2-Wire Palm Mic w/ Earphone, NC		12
KHS-9BL	3-Wire Lapel Mic w/ Earphone		13
KHS-9BE	3-Wire Lapel Mic w/ Earphone		14
KHS-22	Behind-the-head Headset w/PTT		15
KHS-23	2-Wire Palm Mic		16
KHS-25	D-Ring Ear Headset		17
KHS-26	Ear bund In-line PTT Headset		18
KHS-27	D-Ring In-line PTT Headset		19
KHS-27A	D-Ring In-line PTT Headset		20
KHS-31	C-Ring Headset		21
KHS-31C	C-Ring Headset		22
KHS-1	Headset with PTT/VOX		23
KHS-21	Headset		24
KHS-29F	Headset		25
EMC-11	Clip Microphone with Earphone		26
KHS-35F	Headset		27
EMC-12	Clip Microphone with Earphone		28

*** Note:** Battery Dimensions

No.	Battery Model	description	Size (mm)
1	KNB-55L	Li-Ion Battery Pack (1480mA)	WHD 56.0 x 100.5 x 15.5
2	KNB-56N	Ni-MH Battery Pack (1400mA)	WHD 56.0 x 100.5 x 20.2
3	KNB-57L	Li-Ion Battery Pack (2000mA)	WHD 56.0 x 100.5 x 20.2
4	KNB-68LC	Li-Ion Battery Pack (2000mA)	WHD 56.0 x 100.5 x 16.6
5	KBP-5	AA Alkaline Battery Pack	WHD 56.0 x 100.5 x 21.5

Radio Face Test (Hand-held to Face)

Battery 1							
Ant. 1	Ant. 2	Ant. 3	Ant. 4	Ant. 5	Ant. 6	Ant. 7	Ant. 8
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Battery 2							
Ant. 1	Ant. 2	Ant. 3	Ant. 4	Ant. 5	Ant. 6	Ant. 7	Ant. 8
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Battery 3							
Ant. 1	Ant. 2	Ant. 3	Ant. 4	Ant. 5	Ant. 6	Ant. 7	Ant. 8
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Battery 4							
Ant. 1	Ant. 2	Ant. 3	Ant. 4	Ant. 5	Ant. 6	Ant. 7	Ant. 8
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Battery 5							
Ant. 1	Ant. 2	Ant. 3	Ant. 4	Ant. 5	Ant. 6	Ant. 7	Ant. 8
Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Radio Body Test (Body-Worn)

Audio Accessory	Battery				
	1	2	3	4	5
1	No	No	No	No	No
2	No	No	No	No	No
3	Yes	Yes	Yes	Yes	Yes
4	No	No	No	No	No
5	No	No	No	No	No
6	No	No	No	No	No
7	No	No	No	No	No
8	No	No	No	No	No
9	No	No	No	No	No
10	No	No	No	No	No
11	No	No	No	No	No
12	No	No	No	No	No
13	No	No	No	No	No
14	No	No	No	No	No
15	No	No	No	No	No
16	No	No	No	No	No
17	No	No	No	No	No
18	No	No	No	No	No
19	No	No	No	No	No
20	No	No	No	No	No
21	No	No	No	No	No
22	No	No	No	No	No
23	No	No	No	No	No
24	No	No	No	No	No
25	No	No	No	No	No
26	No	No	No	No	No
27	No	No	No	No	No
28	No	No	No	No	No

*** Manufacture's disclosed accessory listing information provided by Kenwood corporation.**

*** Note:**
Audio Accessory KMC-21 was chosen for the testing body worn radio configuration.

5. INTRODUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on Aug. 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices.

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring SAR due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative of the incremental electromagnetic energy (d*W*) absorbed by (dissipated in) an incremental mass (d*m*) contained in a volume element (d*V*) of a given density (*r*). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body.

$$SAR = \frac{d}{dt}\left(\frac{dU}{dm}\right)$$

Figure 1. SAR Mathematical Equation

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

$$SAR = \sigma E^2 / \rho$$

Where:

σ = conductivity of the tissue-simulant material (S/m)

ρ = mass density of the tissue-simulant material (kg/㎥)

E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relations to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.

6. DESCRIPTION OF TEST EQUIPMENT

6.1 SAR MEASUREMENT SETUP

These measurements are performed using the DASY4 automated dosimetric assessment system. It is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland. It consists of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Figure.2).

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and remote control, is used to drive the robot motors. The PC with Windows XP or Windows 7 is working with SAR Measurement system DASY4 & DASY5, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

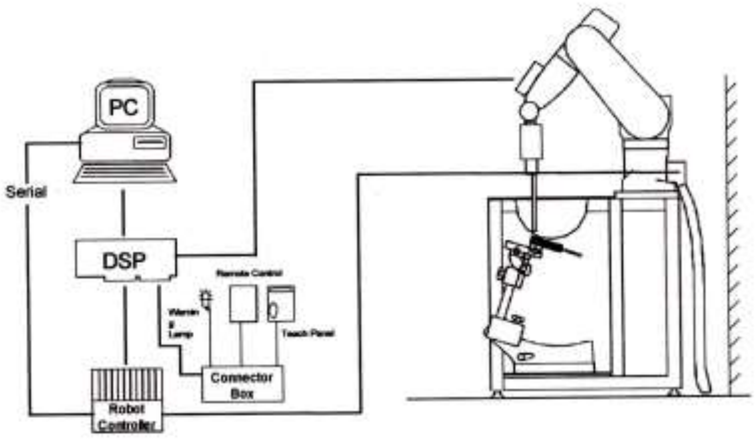


Figure 2. HCT SAR Lab. Test Measurement Set-up

The DAE consists 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 and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in.

6.2 Phantom

• ELI Phantom

Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG diametric probes and dipoles.

Figure 6.1 ELI Phantom

Shell Thickness	2.0 ± 0.2mm
Filling Volume	approx. 30 liters
Dimensions	Major axis: 600 mm, Minor axis: 400 mm

6.3 Device Holder for Transmitters

Device Holder – Mounting Device	
In combination with the SAM Phantom, the Mounting Device enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation points is the ear opening. The devices can be easily, accurately, and repeatable positioned according to the EN 50360:2001/A:2001 and FCC KDB specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom). Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produced infinite number of configurations. To produce the Worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.	

6.4 Validation Dipole

The reference dipole should have a return loss better than -20 dB (measured in the setup) at the resonant frequency to reduce the uncertainty in the power measurement.

CLA Dipole

System Validation Dipole		
Description	Narrowband antenna is used to simulate the 30-220 MHz range and calculates the SAR antenna system calibration value. A resonant loop antenna is integrated in a metal structure from the environment of the resonant structure.	
Frequency	150 MHz	
Return Loss	> 10 dB at specified validation position	
Power Capability	>10 W continuous	
Dimension	CLA150: dipole length : 222.0 mm; overall height : 95.0 mm	

6.5 Brain & Muscle Tissue Simulating Mixture Characterization

The brain and muscle mixtures consist of a viscous gel using hydrox-ethyl cellulose (HEC) gelling agent and saline solution (see Table 1). Preservation with a bactericide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrove.

Frequency (MHz)	**30**	**50**		**144**		**450**		**835**	**900**	
Recipe source number	3	3	2	2	3	2	4	2	2	4
Ingredients (% by weight)										
Deionised water	48,30	48,30	53,53	55,12	48,30	48,53	56	50,36	50,31	56
Tween			44,70	43,31		49,51		48,39	48,34	
Oxidised mineral oil							44			44
Diethylenglycol monohexylether										
Triton X-100										
Diacetin	50,00	50,00			50,00					
DGBE										
NaCl	1,60	1,60	1,77	1,57	1,60	1,96		1,25	1,35	
Additives and salt	0,10	0,10			0,10					
Measured dielectric parameters										
ε_r'	54,2	53,1	54,54	52,81	51,0	43,29	42,3	41,6	41,0	40,6
σ (S/m)	0,75	0,75	0,76	0,76	0,77	0,88	0,84	0,90	0,98	0,98
Temp. (°C)			21	21		21	20	21	21	20
ε_temp_liquid$_{uncertainty}$ (%)	0,8	0,1			0,1	0,1		0,04	0,04	
σ_temp_liquid$_{uncertainty}$ (%)	2,8	2,8			2,6	4,2		1,6	1,6	
Target values (from Table 1)										
ε_r'	55,0	54,5		52,4		43,5		41,5	41,5	
σ (S/m)	0,75	0,75		0,76		0,87		0,90	0,97	

Fig 4. Composition of the Tissue Equivalent Matter

7. SAR MEASUREMENT PROCEDURE

The evaluation was performed with the following procedure:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no more than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the DUT's head and body area and the horizontal grid resolution was depending on the FCC KDB 865664 D01v01r04 table 4-1 & IEEE 1528-2013.

2. Based on step, the area of the maximum absorption was determined by sophisticated interpolations routines implemented in DASY software. When an Area Scan has measured all reachable point. DASY system computes the field maximal found in the scanned are, within a range of the maximum. SAR at this fixed point was measured and used as a reference value.

3. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB 865664 D01v01r04 table 4-1 and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (reference from the DASY manual.)

   a. The data at the surface were extrapolated, since the center of the dipoles is no more than 2.7 mm away from the tip of the probe (it is different from the probe type) and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

   b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions. The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

   c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan. If the value changed by more than 5 %, the SAR evaluation and drift measurements were repeated.

Area scan and zoom scan resolution setting follow KDB 865664 D01v01r04 quoted below.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5±1 mm</td><td>$\frac{1}{2}\cdot\delta\cdot\ln(2)\pm0.5$ mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30°±1°</td><td>20°±1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan Spatial resolution: Δx_{Area}, Δy_{Area}</td><td>≤ 2 GHz: ≤15 mm
2-3 GHz: ≤12 mm</td><td>3-4 GHz: ≤12 mm
4-6 GHz: ≤10 mm</td></tr>
<tr><td colspan="2">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.</td></tr>
<tr><td colspan="3">Maximum zoom scan Spatial resolution: Δx_{zoom}, Δy_{zoom}</td><td>≤ 2 GHz: ≤8mm
2-3 GHz: ≤5mm*</td><td>3-4 GHz: ≤5 mm*
4-6 GHz: ≤4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan Spatial resolution normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{zoom}(n)$</td><td>≤ 5 mm</td><td>3-4 GHz: ≤4 mm
4-5 GHz: ≤3 mm
5-6 GHz: ≤2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{zoom}(1)$: between 1st two Points closest to phantom surface</td><td>≤ 4 mm</td><td>3-4 GHz: ≤3 mm
4-5 GHz: ≤2.5 mm
5-6 GHz: ≤2 mm</td></tr>
<tr><td>$\Delta z_{zoom}(n>1)$: between subsequent Points</td><td colspan="2">$\leq 1.5\cdot\Delta z_{zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3-4 GHz: ≥28 mm
4-5 GHz: ≥25 mm
5-6 GHz: ≥22 mm</td></tr>
<tr><td colspan="5">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.</td></tr>
</table>

8. DESCRIPTION OF TEST POSITION

8.1 Body Holster/Belt Clip Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration. A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are tested with each accessory. If multiple accessory share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some Devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used.

Since this EUT does not supply any body worn accessory to the end user a distance of 0 cm from the EUT back surface to the liquid interface is configured for the generic test.

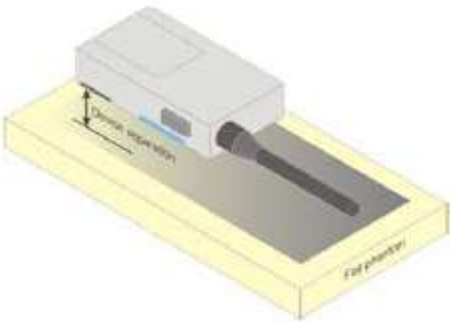
"See the Test SET-UP Photo"

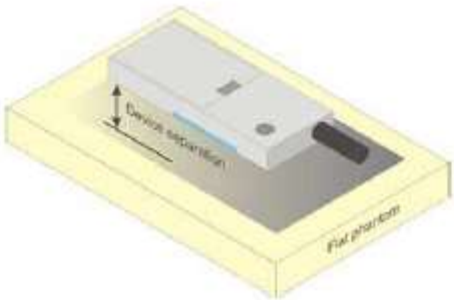
Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessory(ies), Including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst case positioning is then documented and used to perform Body SAR testing.

8.2 Hand-held to Face device

A typical example of a front-of-face device is a two-way radio that is held at a distance from the face of the user when transmitting. In these cases the device under test shall be positioned at the distance to the phantom surface that corresponds to the intended use as specified by the manufacturer in the user instructions. If the intended use is not specified, a separation distance of 25 mm[5] between the phantom surface and the device shall be used.





9. ANSI/ IEEE C95.1 - 2005 RF EXPOSURE LIMITS

HUMAN EXPOSURE	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Occupational (W/kg) or (mW/g)
SPATIAL PEAK SAR * (Brain)	1.60	8.00
SPATIAL AVERAGE SAR ** (Whole Body)	0.08	0.40
SPATIAL PEAK SAR *** (Hands / Feet / Ankle / Wrist)	4.00	20.00

Table 8.1 Safety Limits for Partial Body Exposure

NOTES:

* The Spatial Peak value of the SAR averaged over any 1 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

** The Spatial Average value of the SAR averaged over the whole-body.

******* The Spatial Peak value of the SAR averaged over any 10 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be mad fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e.as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

10. SYSTEM VERIFICATION

10.1 Tissue Verification

The Head/ body simulating material is calibrated by HCT using the DAKS 3.5 to determine the conductivity and permittivity.

Table for Head Tissue Verification

Date of Tests	Tissue Temp. (°C)	Tissue Type	Freq. (MHz)	Measured Conductivity σ (S/m)	Measured Dielectric Constant, ε	Target Conductivity σ (S/m)	Target Dielectric Constant, ε	% dev σ	% dev ε
04/06/2017	21.8	150H	100	0.721	55.298	0.756	54.630	-4.63%	1.22%
			150	0.748	50.332	0.760	52.300	-1.58%	-3.76%
			200	0.801	47.543	0.797	49.970	0.50%	-4.86%

Table for Body Tissue Verification

Date of Tests	Tissue Temp. (°C)	Tissue Type	Freq. (MHz)	Measured Conductivity σ (S/m)	Measured Dielectric Constant, ε	Target Conductivity σ (S/m)	Target Dielectric Constant, ε	% dev σ	% dev ε
04/04/2017	21.7	150B	100	0.735	64.148	0.760	63.130	-3.29%	1.61%
			150	0.783	62.358	0.800	61.900	-2.13%	0.74%
			200	0.808	60.262	0.840	60.670	-3.81%	-0.67%

10.2 System Verification

Prior to assessment, the system is verified to the ± 10 % of the specifications at 150 MHz by using the system Verification kit. (Graphic Plots Attached)

System Verification Results

Freq.	Date	Probe (S/N)	Dipole (S/N)	Liquid	Amb. Temp.	Liquid Temp.	1 W Target SAR_{1g} (SPEAG)	Measured SAR_{1g}	1 W Normalized SAR_{1g}	Deviation	Limit [%]
[MHz]					[°C]	[°C]	[W/kg]	[W/kg]	[W/kg]	[%]	[%]
150	04/06/2017	3968	4014	Head	21.9	21.8	3.68	0.373	3.73	+ 1.36	± 10
150	04/04/2017	3903	4014	Body	21.9	21.7	3.68	0.354	3.54	- 3.80	± 10

10.3 System Verification Procedure

SAR measurement was prior to assessment, the system is verified to the ± 10 % of the specifications at each frequency band by using the system Verification kit. (Graphic Plots Attached)

- Cabling the system, using the Verification kit equipments.
- Generate about 100 mW Input Level from the Signal generator to the Dipole Antenna.
- Dipole Antenna was placed below the Flat phantom.
- The measured one-gram SAR at the surface of the phantom above the dipole feed-point should be within 10 % of the target reference value.
- The results are normalized to 1 W input power.

NOTE;
SAR Verification was performed according to the FCC KDB 865664 D01v01r04.

11. SAR TEST DATA SUMMARY

11.1 Measurement Results (Hand-held to Face SAR)

Antenna	Frequency	Tune-Up Limit	Conducted Power	Power Drift	Battery	Separation Distance	Measured SAR	SAR 50% Duty	Reported SAR	Plot No.
	(MHz)	(dBm)	(dBm)	(dB)		(mm)	(mW/g)	(mW/g)	(mW/g)	
KRA-22M2	173.95	37.16	36.98	-1.56	KNB-57L	25	1.01	0.51	0.75	-
KRA-22M	150.05	37.16	36.85	-0.02	KNB-57L	25	0.877	0.439	0.473	-
KRA-26M2	173.95	37.16	36.98	-1.52	KNB-57L	25	1.79	0.90	**1.32**	1
KRA-26M2	173.95	37.16	36.98	-0.95	KNB-55L	25	1.92	0.96	1.25	2
KRA-26M2	173.95	37.16	36.98	-0.90	KNB-56N	25	1.75	0.88	1.12	-
KRA-26M2	173.95	37.16	36.98	-0.93	KNB-68LC	25	1.73	0.87	1.12	-
KRA-26M2	173.95	37.16	36.98	-2.48	KBP-5	25	1.17	0.59	1.08	-
KRA-26M	150.05	37.16	36.85	-0.35	KNB-57L	25	0.643	0.322	0.374	-
KRA-41M2	173.95	37.16	36.98	-0.71	KNB-57L	25	0.406	0.203	0.249	-
KRA-41M	150.05	37.16	36.85	-0.50	KNB-57L	25	0.538	0.269	0.324	-
KRA-25	150.05	37.16	36.85	-0.60	KNB-57L	25	0.951	0.476	0.587	-
KRA-28	166.00	37.16	36.92	0.48	KNB-57L	25	0.553	0.277	0.261	-
KRA-26M2	173.95	37.16	36.98	-0.53	KNB-57L	25	2.21	1.11	1.30 *	3
KRA-26M2	173.95	37.16	36.98	-0.61	KNB-57L	25	2.09	1.05	1.25 **	4
ANSI/ IEEE C95.1 - 2005 – Safety Limit Spatial Peak Controlled Exposure/ Occupational						Head 8 W/kg (mW/g) Averaged over 1 gram				

* Basic

** Standard

Note : Battery KNB-57L was selected as the default battery for assessments at the Face because it has the highest capacity (refer to Sec.4 Manufacturer's battery list).

11.2 Measurement Results (Body-worn Belt clip SAR)

Antenna	Frequency (MHz)	Tune-Up Limit (dBm)	Conducted Power (dBm)	Power Drift (dB)	Battery	Measured SAR (mW/g)	SAR 50% Duty (mW/g)	Reported SAR (mW/g)	Plot No.
KRA-22M2	173.95	37.16	36.98	-0.28	KNB-55L	1.79	0.90	0.95	-
KRA-22M	150.05	37.16	36.85	-0.32	KNB-55L	5.88	2.94	3.40	-
KRA-26M2	173.95	37.16	36.98	-1.01	KNB-55L	1.83	0.92	1.20	-
KRA-26M	150.05	37.16	36.85	-0.71	KNB-55L	5.07	2.54	3.21	-
KRA-41M2	173.95	37.16	36.98	-0.28	KNB-55L	1.25	0.63	0.69	-
KRA-41M	150.05	37.16	36.85	-0.86	KNB-55L	4.18	2.09	2.74	-
KRA-25	150.05	37.16	36.85	-0.65	KNB-55L	6.31	3.16	3.94	-
KRA-25	158.05	37.16	36.82	-1.31	KBP-5	4.82	2.41	3.52	-
KRA-25	158.05	37.16	36.82	-0.54	KNB-56N	6.56	3.28	4.02	-
KRA-25	158.05	37.16	36.82	-0.51	KNB-57L	8.24	4.12	5.01	5
KRA-25	158.05	37.16	36.82	-0.74	KNB-68LC	6.78	3.39	4.35	-
KRA-25	158.05	37.16	36.82	-0.61	KNB-55L	6.88	3.44	4.28	-
KRA-28	166.00	37.16	36.92	0.27	KNB-55L	1.19	0.60	0.59	-
KRA-25	158.05	37.16	36.82	-0.11	KNB-57L	9.84	4.92	**5.46 ***	6
KRA-25	158.05	37.16	36.82	-0.28	KNB-57L	9.05	4.53	5.22 **	7
ANSI/ IEEE C95.1 - 2005 – Safety Limit Spatial Peak Controlled Exposure/ Occupational						Body 8 W/kg (mW/g) Averaged over 1 gram			

* Basic

** Standard

Note : Battery KNB-55L was selected as the default battery for assessments at the Body because it is the thinnest battery (refer to Sec.4 Manufacturer's battery list).

11.3 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2013, FCC KDB Procedure.
2. Batteries are fully charged at the beginning of the SAR measurements. A standard battery was used for all SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB 447498 D01v06.
6. Test signal call mode is Manual test cord.
7. The EUT was tested for face-held SAR with a 2.5 cm separation distance between the front of the EUT and the outer surface of the planer phantom
8. The Body-worn SAR evaluation was performed with the Balt-clip body-worn accessory attached to the DUT and touching the outer surface of the planar phantom.
9. The adjusted SAR value was calculated by first scaling the SAR value up by the drift. This value was then scaled up based on the difference of the upper end the tolerance (37.16 dBm) and the measured conducted power. The resultant value is then multiplied by 0.5 to give the SAR value at 50% duty cycle.
10. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB 447498 D01v06. Test Procedures applied in accordance with FCC KDB 643646 D01v01r03.
11. Measurement was reduced per KDB 643646 D01v01r03.
12. When the SAR for all antennas tested using the default battery is ≤3.5 W/kg, testing of all other required channels is not necessary.
13. When the SAR of an antenna tested on the highest output power using the default battery is >3.5 W/Kg and ≤4.0 W/Kg, testing of the immediately adjacent channel(s) is not necessary, but testing of other required channels may still be required.
14. When the SAR for all antennas tested using the default battery ≤ 4.0 W/kg, test additional batteries using the antenna and channel configuration that resulted in the highest SAR.
15. When the SAR of an antenna tested on the highest output power channel using the default battery is > 4.0 W/kg and ≤6.0 W/kg, testing of the required immediately adjacent channel(s) is necessary. For the remaining channels that cannot be excluded, this rule may be applied recursively with respect to the highest output power channel among the remaining channels.
16. Based on the SAR measured in the body-worn test sequence with default audio accessory, if the SAR for the antenna, body-worn accessory and battery combination(s) applicable to an audio accessory is/are >4.0 W/kg and <6.0 W/kg, test that audio accessory using the highest body-worn SAR combination (antenna, battery and body-worn accessory) and channel configuration previously identified that is applicable to the audio accessory.
17. When the SAR of an antenna tested is > 6.0 W/kg, test that battery and antenna combination with the default body-worn and audio accessory on the required immediately adjacent channels.
18. If the SAR measured > 7.0 W/kg, test that battery, antenna, body-worn and audio accessory combination on all required channels.

12. Simultaneous SAR Analysis

12.1 Simultaneous Transmission Summation for Body-Worn

Simultaneous Transmission Summation Scenario with Bluetooth					
Exposure condition	Distance (mm)	Band	VHF SAR (W/kg)	Bluetooth SAR (W/kg)	∑ 1-g SAR (W/kg)
Body-worn	5	Body-worn Belt clip	5.46	0.126	5.586

Note: Bluetooth SAR was not required to be measured per FCC KDB 447498 D01v06. Estimated SAR results were used for SAR summation for body-worn back side at 5 mm to determine simultaneous transmission SAR test exclusion.
The simultaneous transmission summation is applied only for body-worn case according to user condition. Bluetooth transmission is using for Bluetooth headset when DUT is on the body-worn case.

12.2 Simultaneous Transmission Conclusion

The above numerical summed SAR results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit. And therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v06 and IEEE 1528-2013.

13. MEASUREMENT UNCERTAINTY

Uncertainty (450 MHz)						
Error Description	Tol (± %)	Prob. dist.	Div.	c_i	Standard Uncertainty (± %)	v_{eff}
1. Measurement System						
Probe Calibration	6.65	N	1	1	6.65	∞
Axial Isotropy	4.70	R	1.73	0.70	1.90	∞
Hemispherical Isotropy	9.60	R	1.73	0.70	3.88	∞
Boundary Effects	1.00	R	1.73	1	0.58	∞
Linearity	4.70	R	1.73	1	2.71	∞
System Detection Limits	0.25	R	1.73	1	0.14	∞
Readout Electronics	0.30	N	1.00	1	0.30	∞
Response Time	0.80	R	1.73	1	0.46	∞
Integration Time	2.60	R	1.73	1	1.50	∞
RF Ambient Noise	3.00	R	1.73	1	1.73	∞
RF Ambient Conditions	3.00	R	1.73	1	1.73	∞
Probe Positioner	0.40	R	1.73	1	0.23	∞
Probe Positioning	2.90	R	1.73	1	1.67	∞
Max SAR Eval	2.00	R	1.73	1	1.15	∞
2.Test Sample Related						
Device Positioning	2.11	N	1.00	1	2.11	9
Device Holder	3.60	N	1.00	1	3.60	5
Power Drift	5.00	R	1.73	1	2.89	∞
Power Scaling	0.00	R	1.73	1	0.00	∞
3.Phantom and Setup						
Phantom Uncertainty	**7.50**	R	1.73	1	3.53	∞
Liquid Conductivity(target)	5.00	R	1.73	0.64	1.85	∞
Liquid Conductivity(meas.)	1.35	N	1	0.78	1.05	∞
Liquid Permittivity (target)	5.00	R	1.73	0.60	1.73	∞
Liquid Permittivity(meas.)	0.90	N	1	0.23	0.21	∞
Combined Standard Uncertainty					11.36	
Coverage Factor for 95 %					k=2	
Expanded STD Uncertainty					22.73	

14. SAR TEST EQUIPMENT

Manufacturer	Type / Model	S/N	Calib. Date	Calib.Interval	Calib.Due
SPEAG	ELI Phantom	-	N/A	N/A	N/A
HP	SAR System Control PC	-	N/A	N/A	N/A
Staubli	Robot ControllerCS7MB	F01/ 5K08A1/ C/ 01	N/A	N/A	N/A
Staubli	CS8Cspeag-TX60	F10/ 5D1CA1/ C/ 01	N/A	N/A	N/A
Staubli	RX90B L	F01/ 5K08A1/ A/ 01	N/A	N/A	N/A
Staubli	TX60 Xlspeag	F10/ 5D1CA1/ A/ 01	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D22134001 1	N/A	N/A	N/A
Staubli	Teach Pendant (Joystick)	D21142106	N/A	N/A	N/A
SPEAG	DAE3	504	07/26/2016	Annual	07/26/2017
SPEAG	DAE4	869	09/27/2016	Annual	09/27/2017
SPEAG	E-Field Probe EX3DV4	3968	05/31/2016	Annual	05/31/2017
SPEAG	E-Field Probe EX3DV4	3903	09/28/2016	Annual	09/28/2017
SPEAG	Dipole CLA150	4014	09/15/2016	Annual	09/15/2017
Agilent	Power Meter N1911A	MY45101406	09/28/2016	Annual	09/28/2017
HP	Power Sensor 8481A	2702A72055	05/27/2016	Annual	05/27/2017
SPEAG	DAKS-12	1026	04/26/2016	Annual	04/26/2017
HP	Directional Bridge	86205A	05/18/2016	Annual	05/18/2017
HP	Signal Generator N5182A	MY47070230	05/13/2016	Annual	05/13/2017
HP	11636B/Power Divider	58698	03/05/2017	Annual	03/05/2018
TESTO	175-H1/Thermometer	40331939309	02/10/2017	Annual	02/10/2018
HP	8447F amplifier	3113A05981	01/09/2017	Annual	01/09/2018
Agilent	Attenuator(3dB)	52744	10/16/2016	Annual	10/16/2017
Agilent	Attenuator(20dB)	52664	10/16/2016	Annual	10/16/2017
HP	Notebook(DAKS)	-	N/A	N/A	N/A
HP	Dual Directional Coupler	16072	10/20/2015	Annual	10/20/2016
HP	Network Analyzer 8753ES	JP39240221	02/27/2017	Annual	02/27/2018
Agilent	Power Sensor N1921A	MY55220026	08/24/2016	Annual	08/24/2017
Aeroflex	Fixed Coaxial Attenuator (30dB)	CE6106	11/23/2016	Annual	11/23/2017

NOTE:
1. The E-field probe was calibrated by SPEAG, by the waveguide technique procedure. Dipole Verification measurement is performed by HCT Lab. before each test. The brain/body simulating material is calibrated by HCT using the DAKS-12 to determine the conductivity and permittivity (dielectric constant) of the brain/body-equivalent material.

15. CONCLUSION

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the ANSI/ IEEE C95.1- 2005.

These measurements are taken to simulate the RF effects exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests.

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC and Industry Canada. These measurements were taken to simulate the RF effects of RF exposure under worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The results and statements relate only to the item(s) tested.

16. REFERENCES

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Attachment 1. – SAR Test Plots

Test Laboratory:	HCT CO., LTD
EUT Type:	VHF DIGITAL TRANSCEIVER
Liquid Temperature:	21.8 ℃
Ambient Temperature:	21.9 ℃
Test Date:	04/06/2017
Plot No.:	1

DUT: K3220; Type: bar

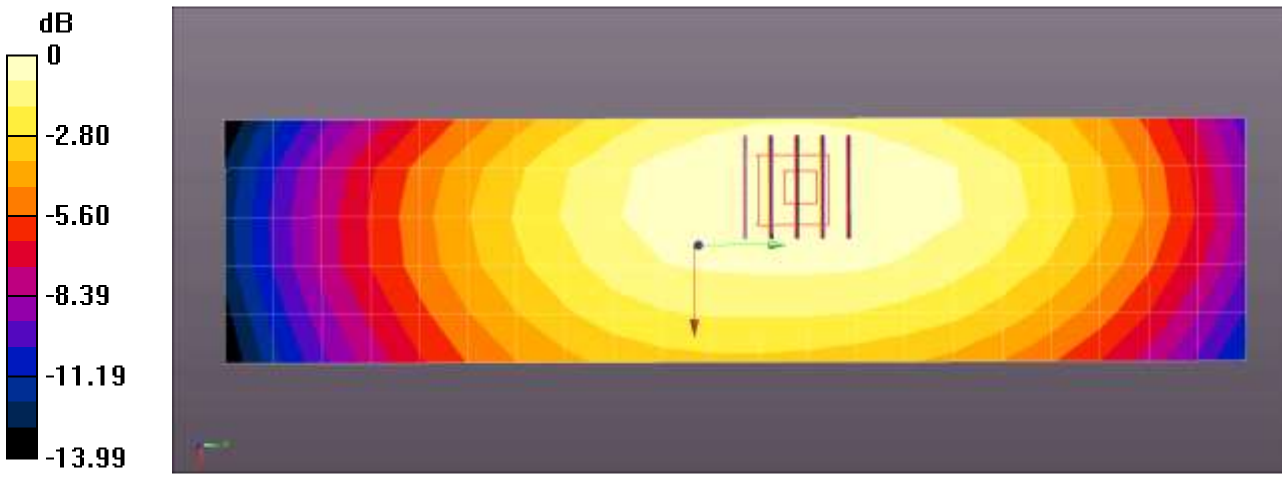
Communication System: UID 0, 150MHz(FCC); Frequency: 173.95 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 173.95 MHz; σ = 0.796 S/m; ε_r = 47.825; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(13.17, 13.17, 13.17); Calibrated: 2016-05-31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI4.0
- Measurement SW: DASY4, Version 4.7 (80);

Head front 3ch 26M2/Area Scan (6x22x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 2.23 W/kg

Head front 3ch 26M2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 54.89 V/m; Power Drift = -1.52 dB
Peak SAR (extrapolated) = 2.32 W/kg
SAR(1 g) = 1.79 W/kg; SAR(10 g) = 1.4 W/kg
Maximum value of SAR (measured) = 2.07 W/kg



0 dB = 2.23 W/kg = 3.49 dBW/kg

Test Laboratory:	HCT CO., LTD
EUT Type:	VHF DIGITAL TRANSCEIVER
Liquid Temperature:	21.8 ℃
Ambient Temperature:	21.9 ℃
Test Date:	04/06/2017
Plot No.:	2

DUT: K3220; Type: bar

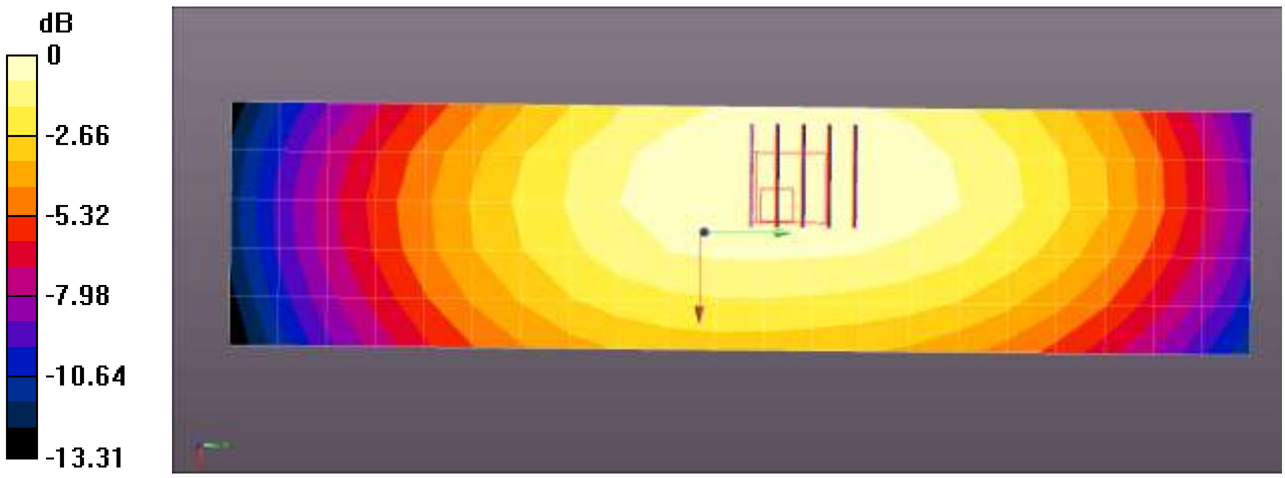
Communication System: UID 0, 150MHz(FCC); Frequency: 173.95 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 173.95 MHz; σ = 0.796 S/m; ε_r = 47.825; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(13.17, 13.17, 13.17); Calibrated: 2016-05-31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI4.0
- Measurement SW: DASY4, Version 4.7 (80);

Head front 3ch 26M2/Area Scan (6x22x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 2.29 W/kg

Head front 3ch 26M2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 53.24 V/m; Power Drift = -0.95 dB
Peak SAR (extrapolated) = 2.44 W/kg
SAR(1 g) = 1.92 W/kg; SAR(10 g) = 1.49 W/kg
Maximum value of SAR (measured) = 2.20 W/kg



0 dB = 2.29 W/kg = 3.60 dBW/kg

Test Laboratory:	HCT CO., LTD
EUT Type:	VHF DIGITAL TRANSCEIVER
Liquid Temperature:	21.8 ℃
Ambient Temperature:	21.9 ℃
Test Date:	04/06/2017
Plot No.:	3

DUT: K3220; Type: bar

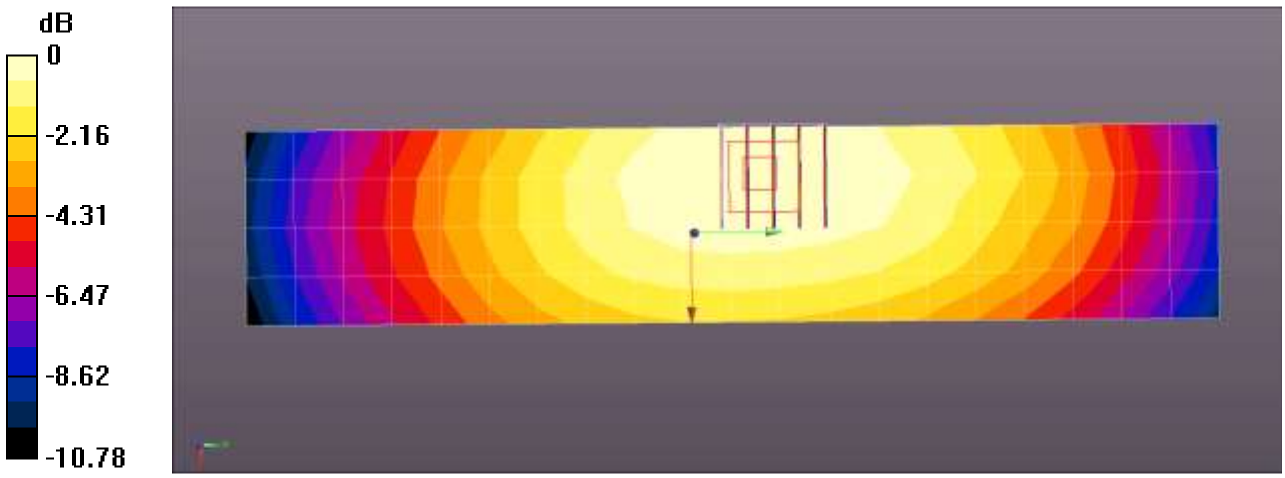
Communication System: UID 0, 150MHz(FCC); Frequency: 173.95 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 173.95 MHz; σ = 0.796 S/m; ε_r = 47.825; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(13.17, 13.17, 13.17); Calibrated: 2016-05-31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI4.0
- Measurement SW: DASY4, Version 4.7 (80);

Head front 3ch 26M2/Area Scan (5x21x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 2.56 W/kg

Head front 3ch 26M2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 55.92 V/m; Power Drift = -0.53 dB
Peak SAR (extrapolated) = 2.79 W/kg
SAR(1 g) = 2.21 W/kg; SAR(10 g) = 1.76 W/kg
Maximum value of SAR (measured) = 2.52 W/kg



0 dB = 2.56 W/kg = 4.09 dBW/kg

Test Laboratory: HCT CO., LTD
EUT Type: VHF DIGITAL TRANSCEIVER
Liquid Temperature: 21.8 ℃
Ambient Temperature: 21.9 ℃
Test Date: 04/06/2017
Plot No.: 4

DUT: K3220; Type: bar

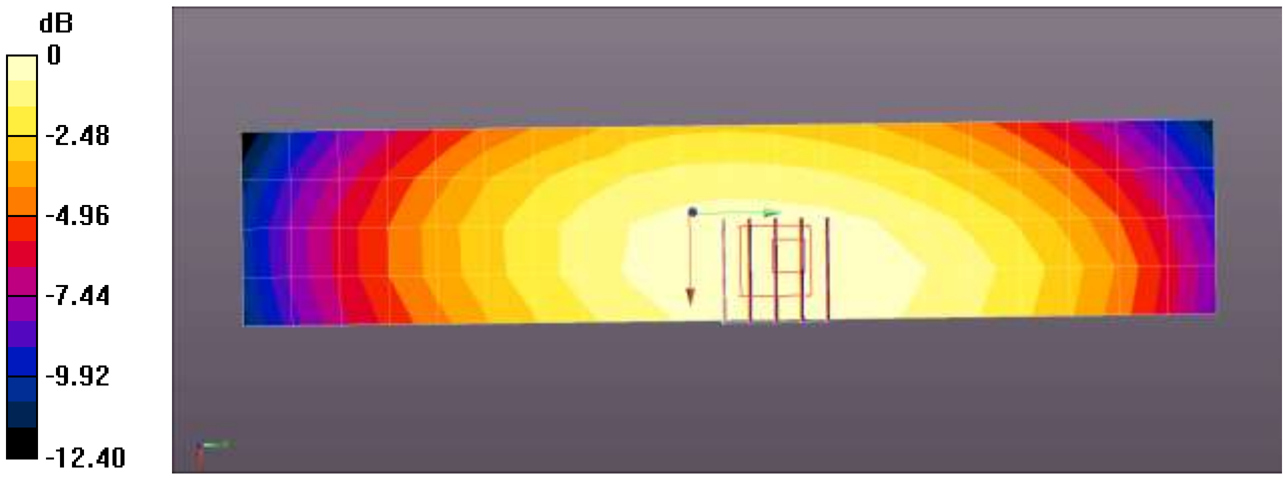
Communication System: UID 0, 150MHz(FCC); Frequency: 173.95 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 173.95 MHz; σ = 0.796 S/m; ε_r = 47.825; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(13.17, 13.17, 13.17); Calibrated: 2016-05-31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI4.0
- Measurement SW: DASY4, Version 4.7 (80);

Head front 3ch 26M2/Area Scan (5x21x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 2.50 W/kg

Head front 3ch 26M2/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 54.62 V/m; Power Drift = -0.61 dB
Peak SAR (extrapolated) = 2.71 W/kg
SAR(1 g) = 2.09 W/kg; SAR(10 g) = 1.64 W/kg
Maximum value of SAR (measured) = 2.41 W/kg



0 dB = 2.50 W/kg = 3.98 dBW/kg

Test Laboratory:	HCT CO., LTD
EUT Type:	VHF DIGITAL TRANSCEIVER
Liquid Temperature:	21.7 ℃
Ambient Temperature:	21.9 ℃
Test Date:	04/04/2017
Plot No.:	5

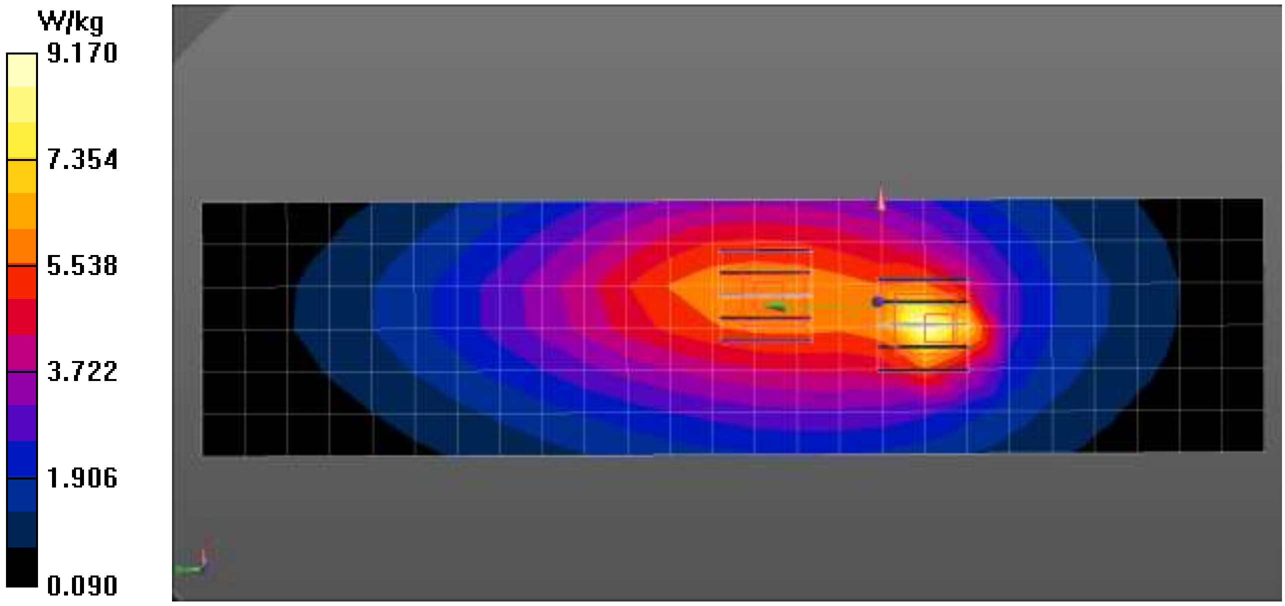
DUT: NX-3220; Type: bar

Communication System: UID 0, 150MHz (0); Frequency: 158.05 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 158.05 MHz; σ = 0.789 S/m; ε_r = 61.971; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(13.33, 13.33, 13.33); Calibrated: 2016-09-28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn869; Calibrated: 2016-09-27
- Phantom: ELI v4.0
- Measurement SW: DASY52, Version 52.10 (0);

Body Belt Clip KBH-11 7ch KNB-57L_KRA-25/Area Scan (7x26x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 9.17 W/kg
Body Belt Clip KBH-11 7ch KNB-57L_KRA-25/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 97.87 V/m; Power Drift = -0.51 dB
Peak SAR (extrapolated) = 21.7 W/kg
SAR(1 g) = 8.24 W/kg; SAR(10 g) = 4.67 W/kg
Maximum value of SAR (measured) = 13.6 W/kg
Body Belt Clip KBH-11 7ch KNB-57L_KRA-25/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 97.87 V/m; Power Drift = -0.51 dB
Peak SAR (extrapolated) = 6.82 W/kg
SAR(1 g) = 5.01 W/kg; SAR(10 g) = 3.87 W/kg
Maximum value of SAR (measured) = 5.91 W/kg



Test Laboratory: HCT CO., LTD
EUT Type: VHF DIGITAL TRANSCEIVER
Liquid Temperature: 21.7 ℃
Ambient Temperature: 21.9 ℃
Test Date: 04/04/2017
Plot No.: 6

DUT: NX-3220; Type: bar

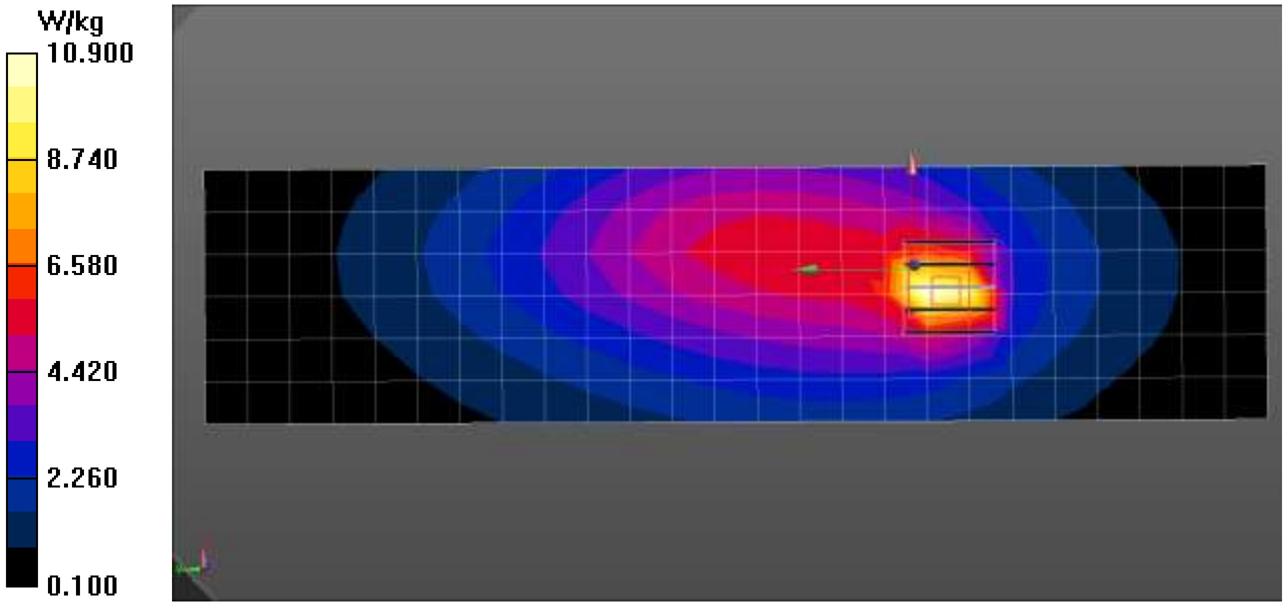
Communication System: UID 0, 150MHz (0); Frequency: 158.05 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 158.05 MHz; σ = 0.789 S/m; ε_r = 61.971; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(13.33, 13.33, 13.33); Calibrated: 2016-09-28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn869; Calibrated: 2016-09-27
- Phantom: ELI v4.0
- Measurement SW: DASY52, Version 52.10 (0);

Body Belt Clip KBH-11 7ch KNB-57L_KRA-25 std/Area Scan (7x26x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 10.9 W/kg

Body Belt Clip KBH-11 7ch KNB-57L_KRA-25 std/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 96.08 V/m; Power Drift = -0.11 dB
Peak SAR (extrapolated) = 27.7 W/kg
SAR(1 g) = 9.84 W/kg; SAR(10 g) = 5.16 W/kg
Maximum value of SAR (measured) = 17.3 W/kg



Test Laboratory:	HCT CO., LTD
EUT Type:	VHF DIGITAL TRANSCEIVER
Liquid Temperature:	21.7 ℃
Ambient Temperature:	21.9 ℃
Test Date:	04/04/2017
Plot No.:	7

DUT: NX-3220; Type: bar

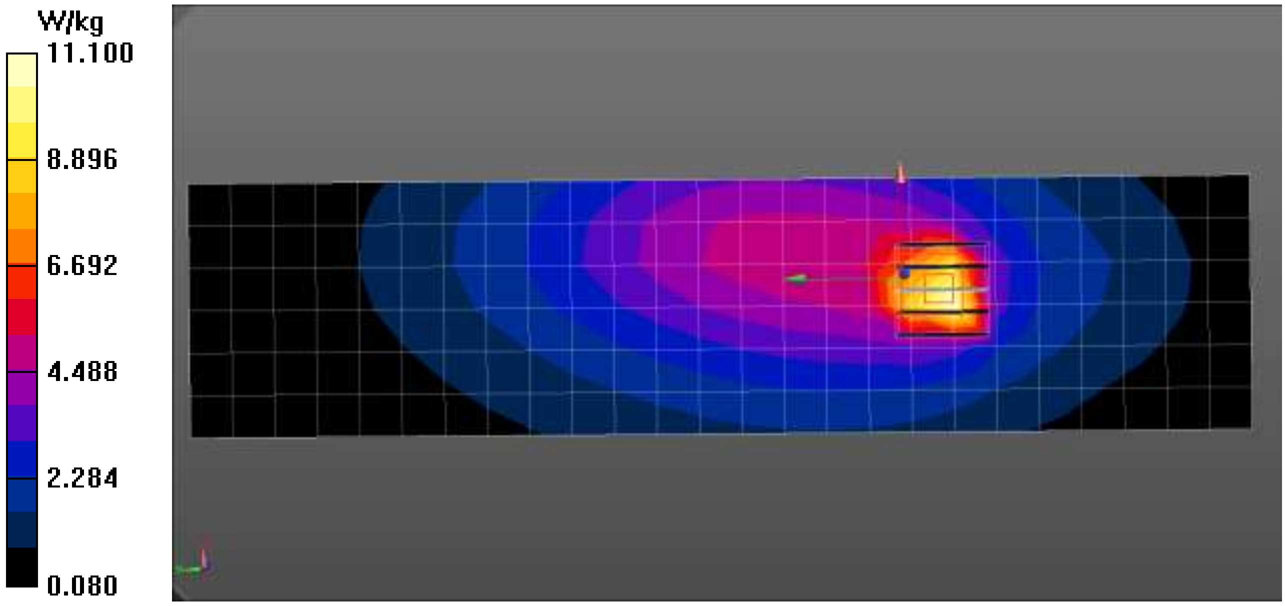
Communication System: UID 0, 150MHz (0); Frequency: 158.05 MHz;Duty Cycle: 1:1
Medium parameters used (interpolated): f = 158.05 MHz; σ = 0.789 S/m; ε_r = 61.971; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY5 Configuration:

- Probe: EX3DV4 - SN3903; ConvF(13.33, 13.33, 13.33); Calibrated: 2016-09-28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn869; Calibrated: 2016-09-27
- Phantom: ELI v4.0
- Measurement SW: DASY52, Version 52.10 (0);

Body Belt Clip KBH-11 7ch KNB-57L_KRA-25 basic/Area Scan (7x26x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 11.1 W/kg

Body Belt Clip KBH-11 7ch KNB-57L_KRA-25 basic/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 85.01 V/m; Power Drift = -0.28 dB
Peak SAR (extrapolated) = 25.3 W/kg
SAR(1 g) = 9.05 W/kg; SAR(10 g) = 4.75 W/kg
Maximum value of SAR (measured) = 15.9 W/kg



Attachment 2. – Dipole Verification Plots

■ Verification Data (150 MHz Head)

Test Laboratory:	HCT CO., LTD
Input Power	100 mW (20 dBm)
Liquid Temp:	21.8 ℃
Test Date:	04/06/2017

DUT: CLA-150; Type: CLA-150

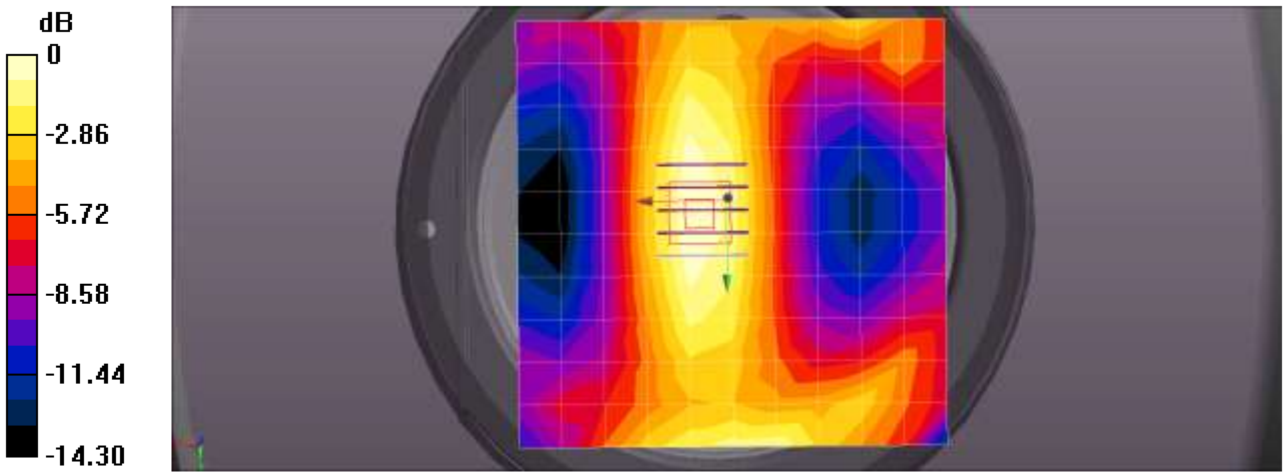
Communication System: UID 0, CW; Frequency: 150 MHz;Duty Cycle: 1:1
Medium parameters used: f = 150 MHz; σ = 0.748 S/m; ε_r = 50.332; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3968; ConvF(13.17, 13.17, 13.17); Calibrated: 2016-05-31;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn504; Calibrated: 2016-07-26
- Phantom: ELI4.0
- Measurement SW: DASY4, Version 4.7 (80);

150MHz Head Verification/Area Scan (11x11x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.441 W/kg

150MHz Head Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.47 V/m; Power Drift = -0.23 dB
Peak SAR (extrapolated) = 0.559 W/kg
SAR(1 g) = 0.373 W/kg; SAR(10 g) = 0.253 W/kg
Maximum value of SAR (measured) = 0.468 W/kg



0 dB = 0.441 W/kg = -3.55 dBW/kg

■ Verification Data (150 MHz Body)

Test Laboratory:	HCT CO., LTD
Input Power	100 mW (20 dBm)
Liquid Temp:	21.7 ℃
Test Date:	04/04/2017

DUT: CLA-150; Type: CLA-150

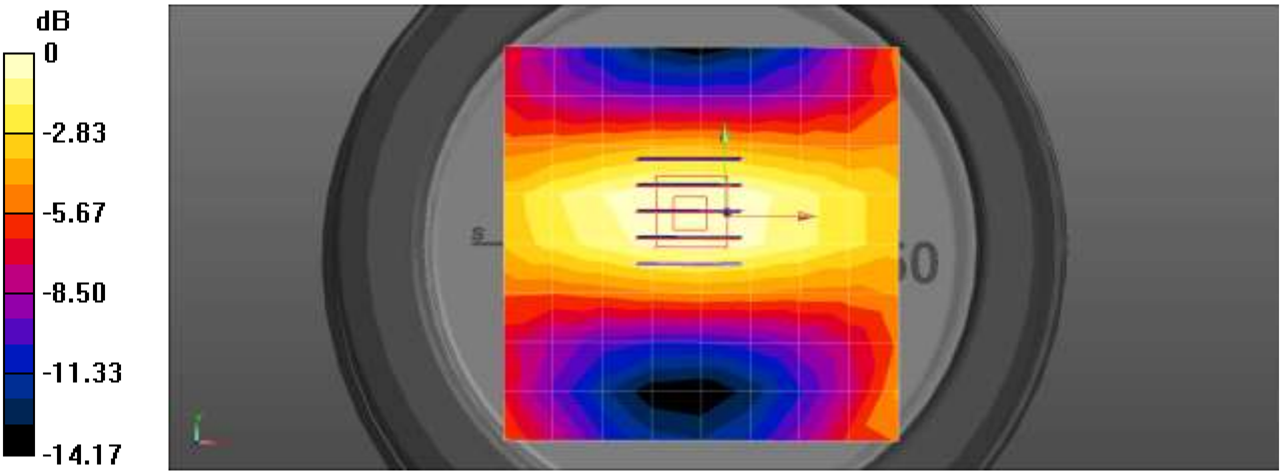
Communication System: UID 0, CW (0); Frequency: 150 MHz;Duty Cycle: 1:1
Medium parameters used: f = 150 MHz; σ = 0.783 S/m; ε_r = 62.358; ρ = 1000 kg/m^3
Phantom section: Flat Section

DASY Configuration:

- Probe: EX3DV4 - SN3903; ConvF(13.33, 13.33, 13.33); Calibrated: 2016-09-28;
- Sensor-Surface: 2mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn869; Calibrated: 2016-09-27
- Phantom: ELI v4.0
- Measurement SW: DASY52, Version 52.8 (8);

150MHz Body Verification/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.335 W/kg

150MHz Body Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 19.95 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 0.520 W/kg
SAR(1 g) = 0.354 W/kg; SAR(10 g) = 0.241 W/kg
Maximum value of SAR (measured) = 0.380 W/kg



0 dB = 0.335 W/kg = −4.75 dBW/kg

Attachment 3. – 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 **HCT (Dymstec)** Certificate No: **EX3-3903_Sep16**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3903
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	September 28, 2016

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-16)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Michael Weber	Laboratory Technician	M.Weber
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 29, 2016

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

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

Accreditation No.: **SCS 0108**

Glossary:

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).

Certificate No: EX3-3903_Sep16 Page 2 of 11

Probe EX3DV4

SN:3903

Manufactured: September 4, 2012
Calibrated: September 28, 2016

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3903

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.39	0.36	0.53	± 10.1 %
DCP (mV)[B]	102.5	106.2	103.1	

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	174.0	±3.5 %
		Y	0.0	0.0	1.0		184.6	
		Z	0.0	0.0	1.0		194.4	

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: EX3DV4 - SN:3903

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	13.42	13.42	13.42	0.00	1.00	± 13.3 %
300	45.3	0.87	12.68	12.68	12.68	0.10	1.10	± 13.3 %
450	43.5	0.87	11.00	11.00	11.00	0.20	1.25	± 13.3 %
750	41.9	0.89	11.35	11.35	11.35	0.33	1.14	± 12.0 %
835	41.5	0.90	10.72	10.72	10.72	0.51	0.80	± 12.0 %
900	41.5	0.97	10.30	10.30	10.30	0.35	1.01	± 12.0 %
1450	40.5	1.20	8.76	8.76	8.76	0.39	0.80	± 12.0 %
1750	40.1	1.37	8.75	8.75	8.75	0.28	0.85	± 12.0 %
1900	40.0	1.40	8.41	8.41	8.41	0.28	0.84	± 12.0 %
1950	40.0	1.40	8.22	8.22	8.22	0.32	0.80	± 12.0 %
2300	39.5	1.67	8.01	8.01	8.01	0.32	0.80	± 12.0 %
2450	39.2	1.80	7.54	7.54	7.54	0.31	0.84	± 12.0 %
2600	39.0	1.96	7.42	7.42	7.42	0.31	0.86	± 12.0 %
5250	35.9	4.71	5.51	5.51	5.51	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.78	4.78	4.78	0.45	1.80	± 13.1 %
5750	35.4	5.22	5.04	5.04	5.04	0.45	1.80	± 13.1 %

[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: EX3DV4 - SN:3903

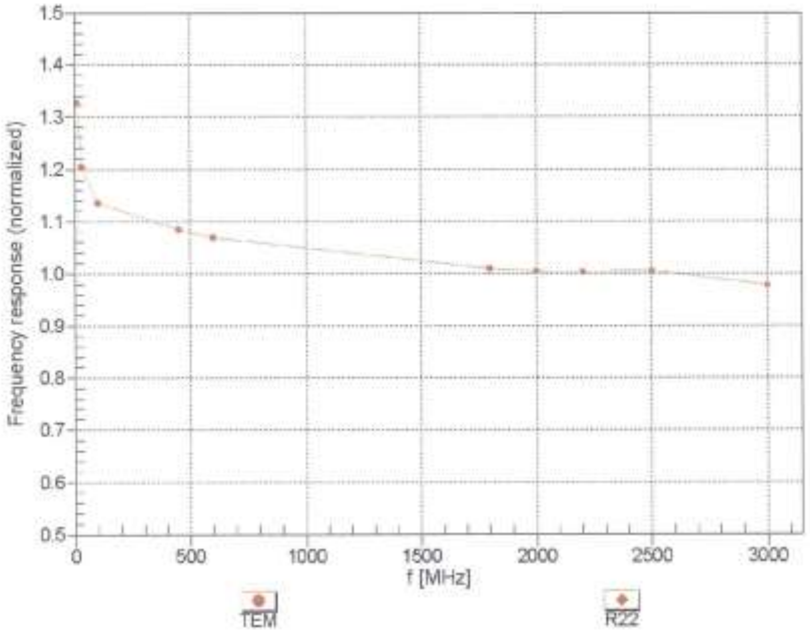
Calibration Parameter Determined in Body Tissue Simulating Media

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	13.33	13.33	13.33	0.00	1.00	± 13.3 %
300	58.2	0.92	12.07	12.07	12.07	0.08	1.10	± 13.3 %
450	56.7	0.94	11.95	11.95	11.95	0.10	1.20	± 13.3 %
750	55.5	0.96	10.50	10.50	10.50	0.29	1.13	± 12.0 %
835	55.2	0.97	10.42	10.42	10.42	0.55	0.80	± 12.0 %
1750	53.4	1.49	8.37	8.37	8.37	0.35	0.91	± 12.0 %
1900	53.3	1.52	8.10	8.10	8.10	0.37	0.80	± 12.0 %
2450	52.7	1.95	7.69	7.69	7.69	0.33	0.85	± 12.0 %
2600	52.5	2.16	7.45	7.45	7.45	0.33	0.90	± 12.0 %
5250	48.9	5.36	4.63	4.63	4.63	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.85	3.85	3.85	0.60	1.90	± 13.1 %
5750	48.3	5.94	4.13	4.13	4.13	0.60	1.90	± 13.1 %

[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.

EX3DV4-- SN:3903 September 28, 2016

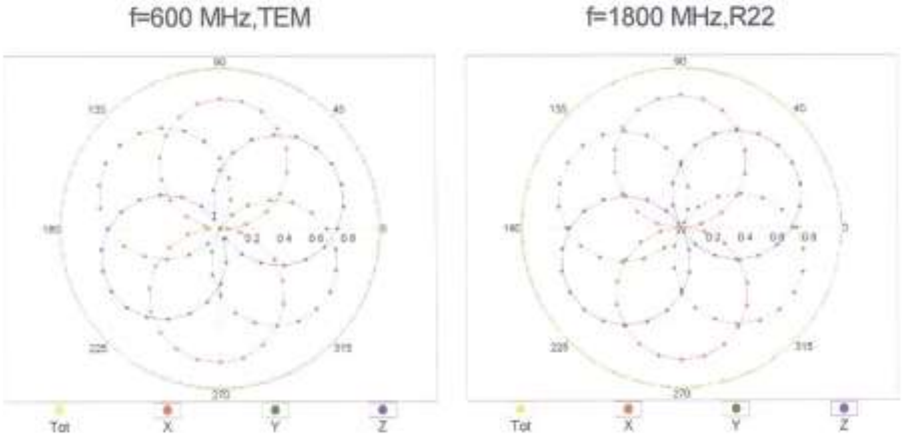
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)

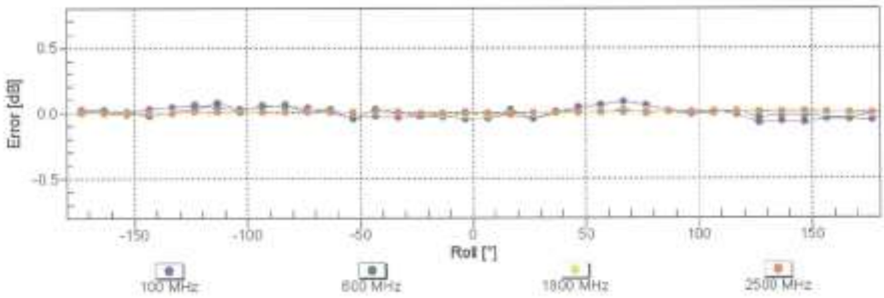


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

Certificate No: EX3-3903_Sep16 Page 7 of 11

Receiving Pattern (ϕ), ϑ = 0°

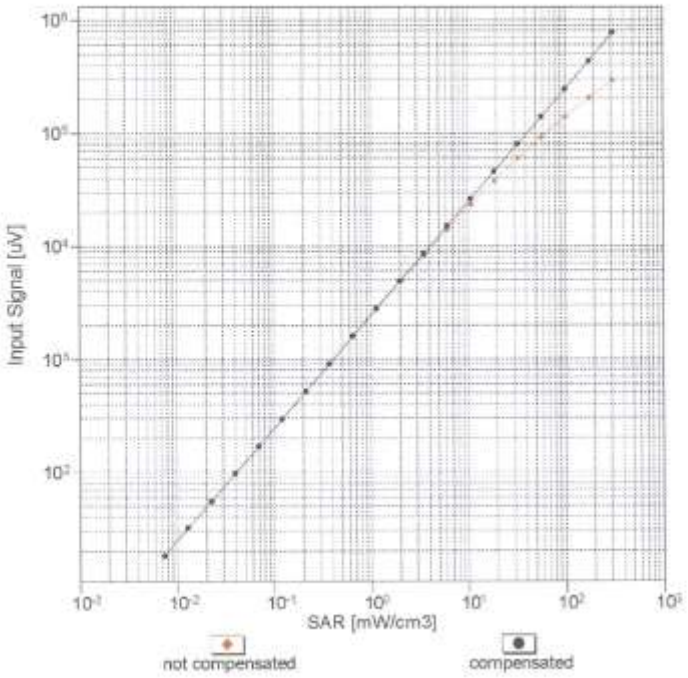


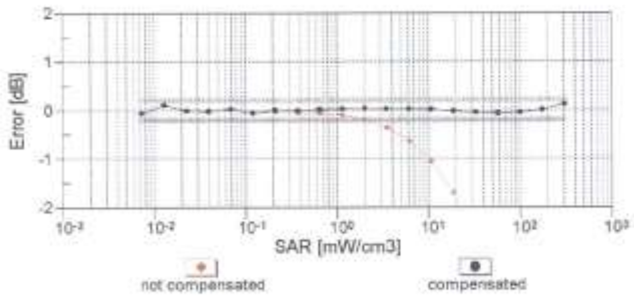


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

EX3DV4– SN:3903 September 28, 2016

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

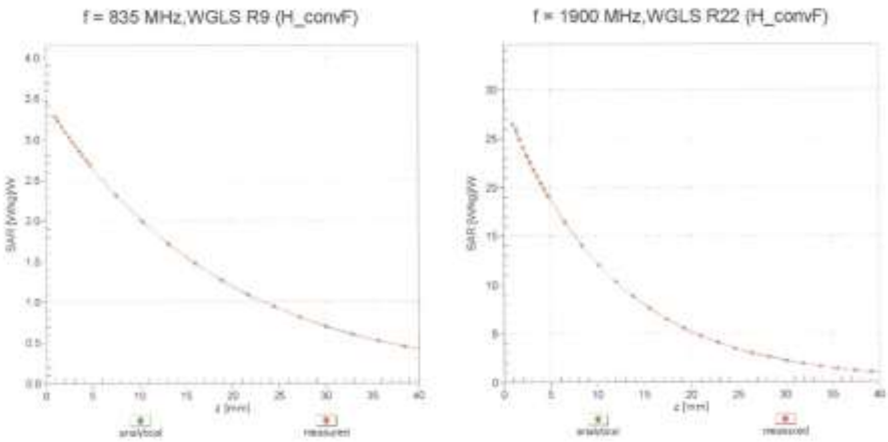




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

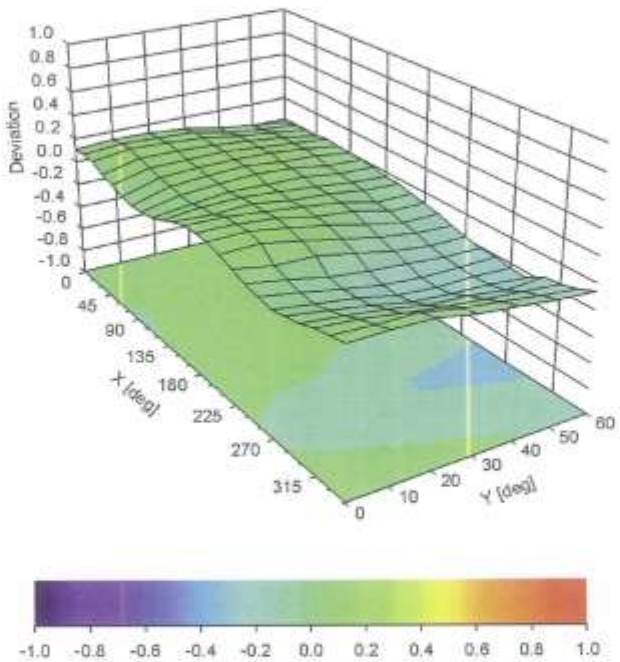
Certificate No: EX3-3903_Sep16 Page 9 of 11

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: EX3DV4 - SN:3903

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-33.3
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

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Accreditation No.: **SCS 0108**

Client **HCT (Dymstec)**

Certificate No: **EX3-3968_May16**

CALIBRATION CERTIFICATE

Object	EX3DV4 - SN:3968
Calibration procedure(s)	QA CAL-01.v9, QA CAL-12.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	May 31, 2016

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 20 dB Attenuator	SN: S5277 (20x)	05-Apr-16 (No. 217-02293)	Apr-17
Reference Probe ES3DV2	SN: 3013	31-Dec-15 (No. ES3-3013_Dec15)	Dec-16
DAE4	SN: 660	23-Dec-15 (No. DAE4-660_Dec15)	Dec-16
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (No. 217-02285/02284)	In house check: Jun-16
Power sensor E4412A	SN: MY41498087	06-Apr-16 (No. 217-02285)	In house check: Jun-16
Power sensor E4412A	SN: 000110210	06-Apr-16 (No. 217-02284)	In house check: Jun-16
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Apr-13)	In house check: Jun-16
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: June 1, 2016

Calibration Laboratory of
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Zeughausstrasse 43, 8004 Zurich, Switzerland

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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 EX3DV4

SN:3968

Manufactured: September 30, 2013
Calibrated: May 31, 2016

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3968

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.36	0.35	0.42	± 10.1 %
DCP (mV)[B]	101.7	102.0	97.4	

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	134.4	±2.5 %
		Y	0.0	0.0	1.0		131.5	
		Z	0.0	0.0	1.0		146.5	

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: EX3DV4 - SN:3968

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	13.17	13.17	13.17	0.00	1.00	± 13.3 %
300	45.3	0.87	12.10	12.10	12.10	0.09	1.10	± 13.3 %
450	43.5	0.87	10.73	10.73	10.73	0.16	1.20	± 13.3 %
750	41.9	0.89	10.27	10.27	10.27	0.51	0.80	± 12.0 %
835	41.5	0.90	9.97	9.97	9.97	0.42	0.87	± 12.0 %
900	41.5	0.97	9.62	9.62	9.62	0.25	1.20	± 12.0 %
1450	40.5	1.20	8.55	8.55	8.55	0.34	0.80	± 12.0 %
1750	40.1	1.37	8.45	8.45	8.45	0.33	0.80	± 12.0 %
1900	40.0	1.40	8.14	8.14	8.14	0.31	0.80	± 12.0 %
1950	40.0	1.40	7.89	7.89	7.89	0.37	0.80	± 12.0 %
2300	39.5	1.67	7.72	7.72	7.72	0.30	0.89	± 12.0 %
2450	39.2	1.80	7.30	7.30	7.30	0.35	0.80	± 12.0 %
2600	39.0	1.96	7.24	7.24	7.24	0.37	0.80	± 12.0 %
5250	35.9	4.71	5.35	5.35	5.35	0.30	1.80	± 13.1 %
5600	35.5	5.07	4.66	4.66	4.66	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.78	4.78	4.78	0.40	1.80	± 13.1 %

[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: EX3DV4 - SN:3968

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	12.46	12.46	12.46	0.00	1.00	± 13.3 %
300	58.2	0.92	11.57	11.57	11.57	0.08	1.11	± 13.3 %
450	56.7	0.94	11.24	11.24	11.24	0.10	1.20	± 13.3 %
750	55.5	0.96	9.65	9.65	9.65	0.40	0.92	± 12.0 %
835	55.2	0.97	9.66	9.66	9.66	0.49	0.80	± 12.0 %
1750	53.4	1.49	8.16	8.16	8.16	0.34	0.80	± 12.0 %
1900	53.3	1.52	7.89	7.89	7.89	0.40	0.80	± 12.0 %
2450	52.7	1.95	7.31	7.31	7.31	0.41	0.80	± 12.0 %
2600	52.5	2.16	7.11	7.11	7.11	0.34	0.80	± 12.0 %
5250	48.9	5.36	4.37	4.37	4.37	0.50	1.90	± 13.1 %
5600	48.5	5.77	3.78	3.78	3.78	0.55	1.90	± 13.1 %
5750	48.3	5.94	3.92	3.92	3.92	0.60	1.90	± 13.1 %

[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.

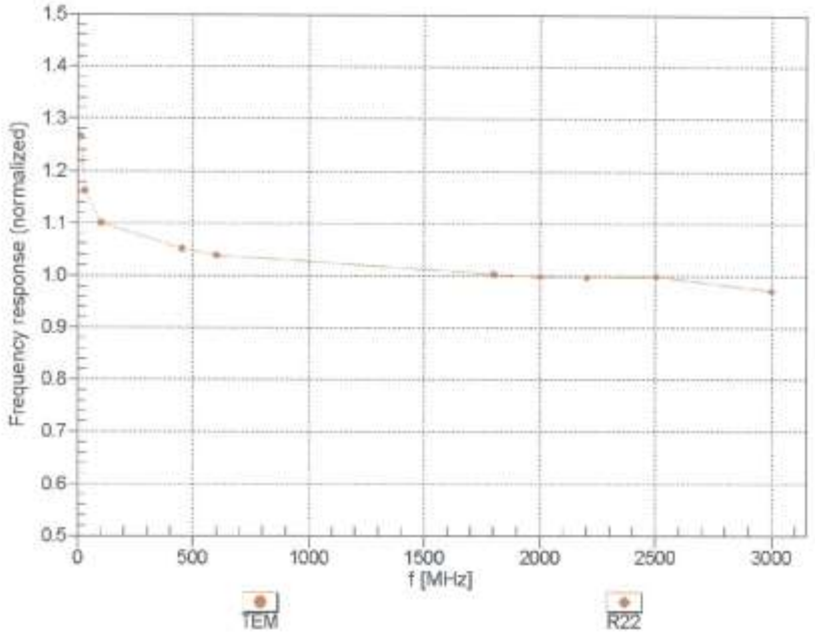
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF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

EX3DV4– SN:3968 May 31, 2016

Frequency Response of E-Field

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

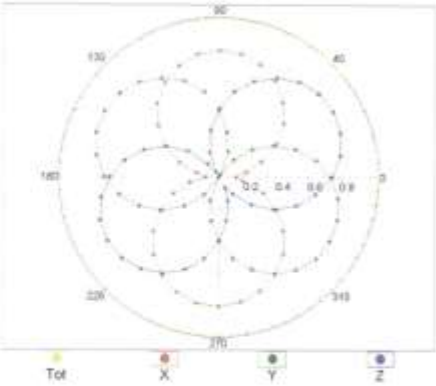


Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

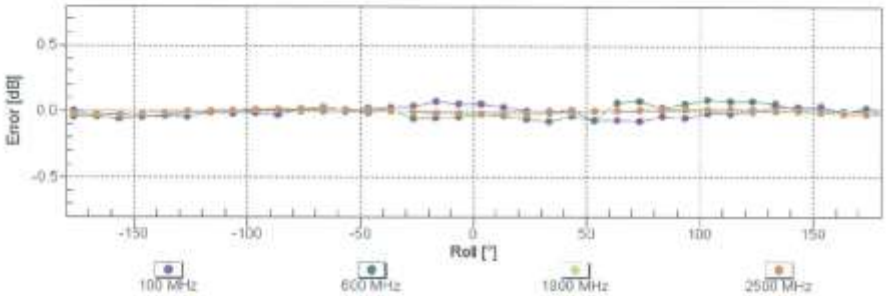
Certificate No: EX3-3968_May16 Page 7 of 11

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

f=600 MHz,TEM



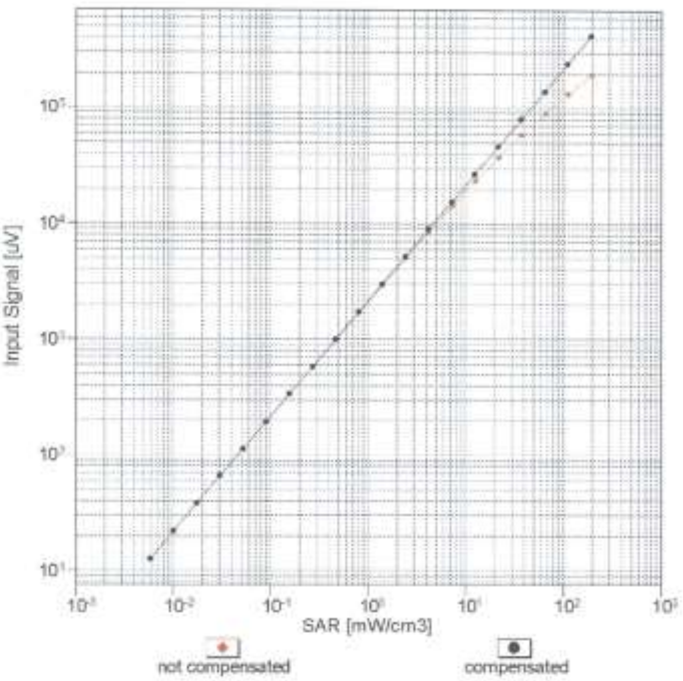
f=1800 MHz,R22

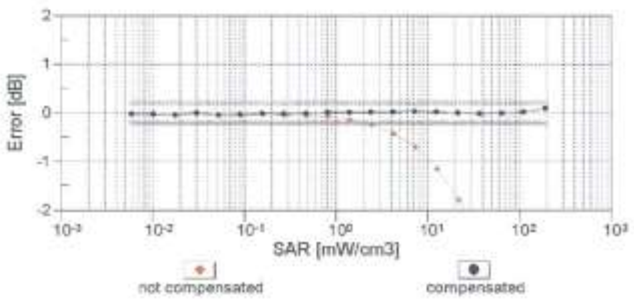


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

EX3DV4– SN:3968 May 31, 2016

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

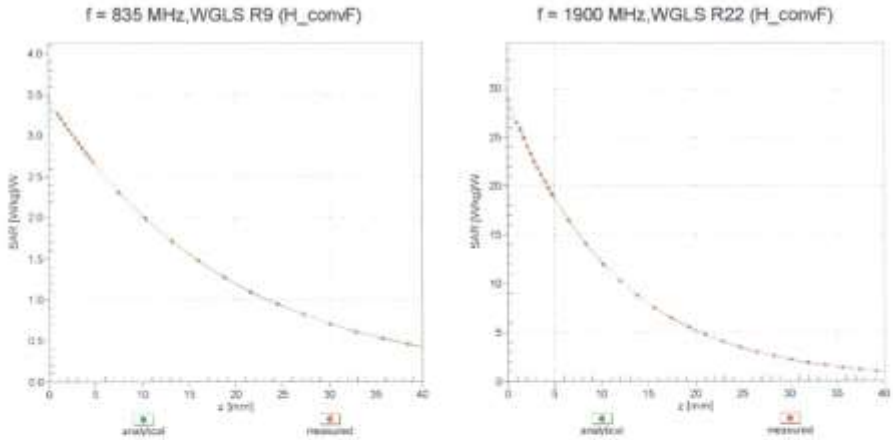




Uncertainty of Linearity Assessment: ± 0.6% (k=2)

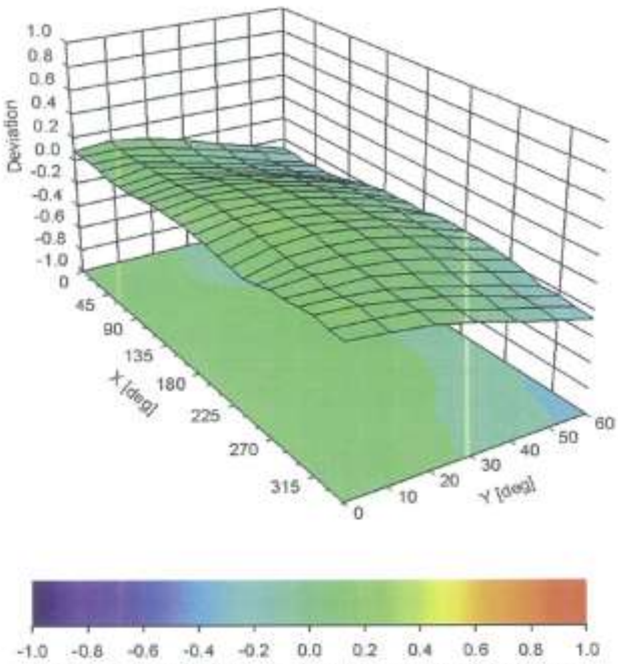
EX3DV4– SN:3968 May 31, 2016

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

Certificate No: EX3-3968_May16 Page 10 of 11

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3968

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	63.4
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	9 mm
Tip Diameter	2.5 mm
Probe Tip to Sensor X Calibration Point	1 mm
Probe Tip to Sensor Y Calibration Point	1 mm
Probe Tip to Sensor Z Calibration Point	1 mm
Recommended Measurement Distance from Surface	1.4 mm

Attachment 4. – Dipole Calibration Data

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Accreditation No.: SCS 0108

Client HCT (Dymstec)

Certificate No: CLA150-4014_Sep16

CALIBRATION CERTIFICATE

Object	CLA150 - SN: 4014
Calibration procedure(s)	QA CAL-15.v8 Calibration procedure for system validation sources below 700 MHz
Calibration date:	September 15, 2016

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 NRP	SN: 104778	06-Apr-16 (No. 217-02288/02289)	Apr-17
Power sensor NRP-Z91	SN: 103244	06-Apr-16 (No. 217-02288)	Apr-17
Power sensor NRP-Z91	SN: 103245	06-Apr-16 (No. 217-02289)	Apr-17
Reference 30 dB Attenuator	SN: 5129 (30b)	05-Apr-16 (No. 217-02294)	Apr-17
Type-N mismatch combination	SN: 5047.2 / 06327	05-Apr-16 (No. 217-02295)	Apr-17
Reference Probe EX3DV4	SN: 3877	31-Dec-15 (No. EX3-3877_Dec15)	Dec-16
DAE4	SN: 654	12-Aug-16 (No. DAE4-654_Aug16)	Aug-17

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (No. 217-02285/02284)	In house check: Jun-18
Power sensor E4412A	SN: MY41498087	06-Apr-16 (No. 217-02285)	In house check: Jun-18
Power sensor E4412A	SN: 000110210	06-Apr-16 (No. 217-02284)	In house check: Jun-18
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-16)	In house check: Jun-18
Network Analyzer HP 8753E	SN: US37390585	18-Oct-01 (in house check Oct-15)	In house check: Oct-16

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: September 16, 2016

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

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S Swiss Calibration Service

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

Accreditation No.: **SCS 0108**

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "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"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

- *Measurement Conditions:* Further details are available from the Validation Report at the end of the certificate. All figures stated in the certificate are valid at the frequency indicated.
- *Antenna Parameters with TSL:* The source is mounted in a touch configuration below the center marking of the flat phantom.
- *Return Loss:* This parameter is measured with the source positioned under the liquid filled phantom (as described in the measurement condition clause). The Return Loss ensures low reflected power. No uncertainty required.
- *SAR measured:* SAR measured at the stated antenna input power.
- *SAR normalized:* SAR as measured, normalized to an input power of 1 W at the antenna connector.
- *SAR for nominal TSL parameters:* The measured TSL parameters are used to calculate the nominal SAR result.

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
EUT Positioning	Touch Position	
Zoom Scan Resolution	dx, dy = 4.0 mm, dz = 1.4 mm	Graded Ratio = 1.4 (Z direction)
Frequency	150 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	52.3	0.76 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	50.2 ± 6 %	0.76 mho/m ± 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm^3 (1 g) of Head TSL	Condition	
SAR measured	1 W input power	3.71 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.68 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	1 W input power	2.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**2.45 W/kg ± 18.0 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	61.9	0.80 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	60.6 ± 6 %	0.84 mho/m ± 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm^3 (1 g) of Body TSL	Condition	
SAR measured	1 W input power	3.84 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**3.68 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	1 W input power	2.55 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.45 W/kg ± 18.0 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	47.0 Ω + 6.9 jΩ
Return Loss	- 22.2 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.0 Ω + 6.5 jΩ
Return Loss	- 23.6 dB

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	June 30, 2014

DASY5 Validation Report for Head TSL

Date: 15.09.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA-150; Type: CLA-150; Serial: 4014

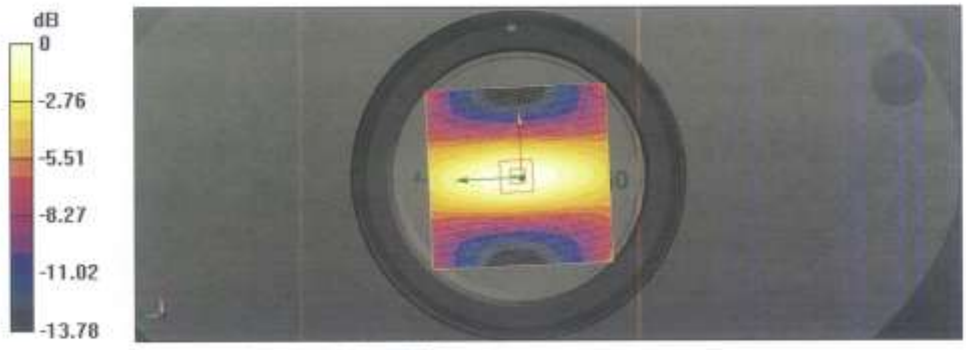
Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; σ = 0.76 S/m; ε_r = 50.2; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(12.02, 12.02, 12.02); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 12.08.2016
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

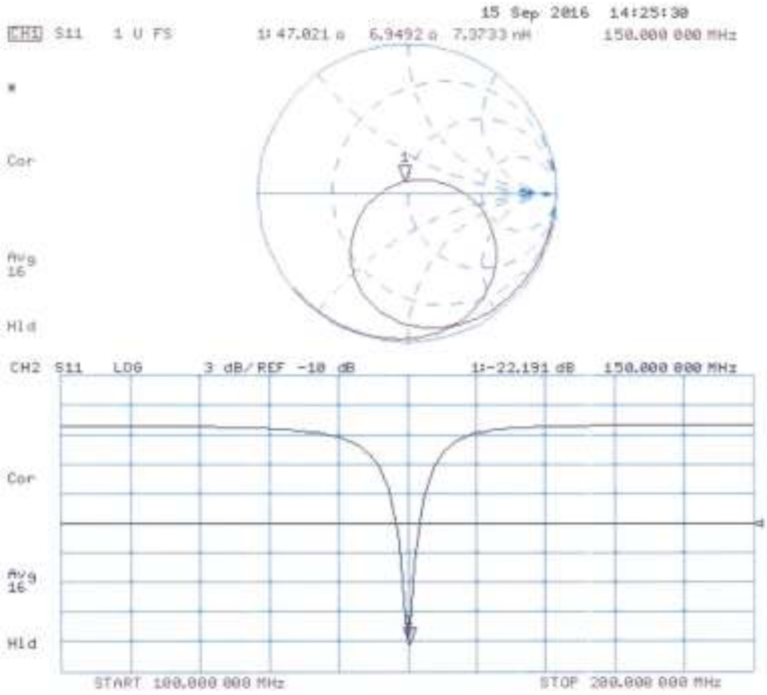
CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.22 W/kg

CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 82.90 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 6.97 W/kg
SAR(1 g) = 3.71 W/kg; SAR(10 g) = 2.47 W/kg
Maximum value of SAR (measured) = 5.18 W/kg



0 dB = 5.22 W/kg = 7.18 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 15.09.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA-150; Type: CLA-150; Serial: 4014

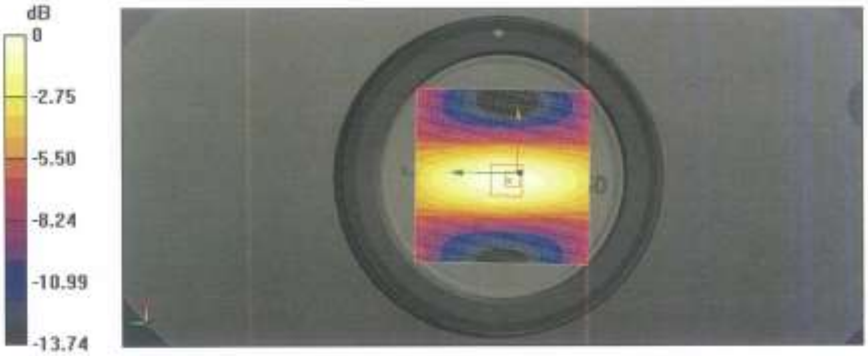
Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; σ = 0.84 S/m; ε_r = 60.6; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(11.44, 11.44, 11.44); Calibrated: 31.12.2015;
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 12.08.2016
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.8.8(1258); SEMCAD X 14.6.10(7372)

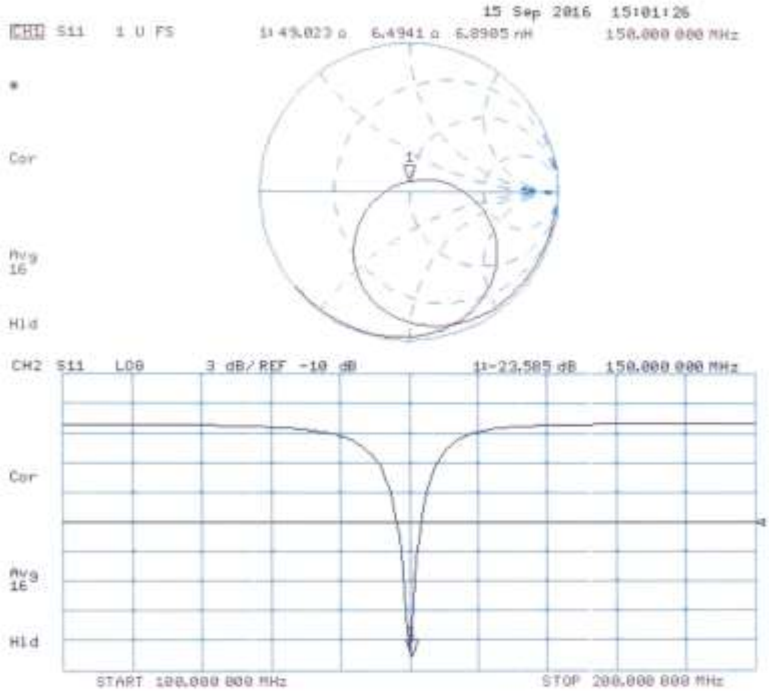
CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.42 W/kg

CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Zoom Scan, dist=1.4mm (8x10x7)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=1.4mm
Reference Value = 79.46 V/m; Power Drift = -0.06 dB
Peak SAR (extrapolated) = 7.21 W/kg
SAR(1 g) = 3.84 W/kg; SAR(10 g) = 2.55 W/kg
Maximum value of SAR (measured) = 5.37 W/kg



0 dB = 5.42 W/kg = 7.34 dBW/kg

Impedance Measurement Plot for Body TSL



Attachment 5. – SAR Tissue Characterization

The brain and muscle mixtures consist of a viscous gel using hydrox-ethyl cellulose (HEC) gelling agent and saline solution (see Table 3.1). Preservation with a bacteriacide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrove.

Ingredients	Frequency (MHz)	
(% by weight)	150	
Tissue Type	Head	Body
Water	38.35 %	46.6 %
Salt (NaCl)	5.15 %	2.6 %
Sugar	55.5 %	49.7 %
HEC	0.9 %	1.0 %
Bactericide	0.1 %	0.1 %
Triton X-100	-	-
DGBE	-	-
Diethylene glycol hexyl ether	-	-

Salt: 99 % Pure Sodium Chloride Sugar: 98 % Pure Sucrose

Water: De-ionized, 16M resistivity HEC: Hydroxyethyl Cellulose

DGBE: 99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono[4-(1,1,3,3-tetramethylbutyl)phenyl] ether

Composition of the Tissue Equivalent Matter

Attachment 6. – SAR SYSTEM VALIDATION

Per FCC KCB 865664 D02v01r02, SAR system validation status should be document to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in IEEE 1528-2003 and FCC KDB 865664 D01v01r04. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

A tabulated summary of the system validation status including the validation date(s), measurement frequencies, SAR probes and tissue dielectric parameters has been included.

SAR System No.	Probe	Probe Type	Probe Calibration Point		Dipole	Date	Dielectric Parameters		CW Validation			Modulation Validation		
							Measured Permittivity	Measured Conductivity	Sensitivity	Probe Linearity	Probe Isotropy	MOD. Type	Duty Factor	PAR
9	3968	EX3DV4	Head	150	4014	2016.09.23	51.4	3.78	PASS	PASS	PASS	N/A	N/A	N/A
5	3903	EX3DV4	Body	150	4014	2016.09.23	62.2	3.77	PASS	PASS	PASS	N/A	N/A	N/A

SAR System Validation Summary

Note;

All measurement were performed using probes calibrated for CW signal only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01r04. SAR system were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664 D01v01r04.