RF Exposure Lab

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CERTIFICATE OF COMPLIANCE
SAR EVALUATION

BK Technologies	Dates of Test: March 27-April 4, 2019
7100 Technology Dr.	Test Report Number: SAR.20190410
West Melbourne, FL 32904	Revision A

FCC ID:	K95BKR9000
IC Certificate:	2116A-BKR9000
Model(s):	BKR9000
Test Sample:	Engineering Unit Same as Production
Serial Number:	Eng 1
Equipment Type:	Push-To-Talk Handheld Radio for Occupational Use
Classification:	Portable Transmitter Next to Face and Body
TX Frequency Range:	136 – 174 MHz; 378 – 522 MHz; 806 – 824 MHz; 851 – 869 MHz; 896 – 901 MHz; 935 – 940 MHz; 2412 – 2462 MHz; 5180 – 5320 MHz; 5500 – 5700 MHz; 5745 – 5825 MHz
Frequency Tolerance:	± 0.5 ppm
Maximum RF Output:	150 MHz – 38.26 dBm; 450 MHz – 37.56 dBm; 800 MHz – 35.44 dBm; 900 MHz – 35.44 dBm; 2450 MHz (b) – 17.30 dBm, 2450 MHz (g) – 17.10 dBm, 2450 MHz (n20) – 16.10 dBm, 2450 MHz (n40) – 14.80 dBm, 5250 MHz (a) – 18.00 dBm, 5250 MHz (n20) – 18.00 dBm, 5250 MHz (n40) – 16.50 dBm, 5600 MHz (a) – 18.00 dBm, 5600 MHz (n20) – 18.00 dBm, 5600 MHz (n40) – 16.50 dBm, 5800 MHz (a) – 18.00 dBm, 5800 MHz (n20) – 18.00 dBm, 5800 MHz (n40) – 16.50 dBm Conducted
Signal Modulation:	FM, DSSS, OFDM
Body Worn Accessories:	Belt Clip
Audio Accessories:	None
Antenna:	Standard
Battery:	Model 4005-31131-600
Application Type:	Certification
FCC Rule Parts:	Part 2, 15C, 15E, 27, 90
KDB Test Methodology:	KDB 447498 DO1 v06, KDB 248227 v02r02, KDB 643646 D01 v01r03, KDB 865664 D01 v01r04, KDB 865664 D02 v01r01
Industry Canada:	RSS-102 Issue 5, Safety Code 6
Maximum SAR Value:	2.30 W/kg for Face; 3.75 W/kg for Body Reported
Simultaneous SAR Value:	0.34 for Face: 0.49 for Body Limit Ratio
Separation Distance:	25 mm for Face; 0 mm for Body

This wireless mobile and/or portable device has been shown to be compliant for localized specific absorption rate (SAR) for uncontrolled environment/general exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in IEEE 1528-2013 and EN/IEC 62209:2010 (See test report).

I attest to the accuracy of the data. All measurements were performed by myself 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.

RF Exposure Lab, LLC certifies that no party to this application is subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 853(a).

Jay M. Moulton
Vice President

ACCREDITED
Testing Cert. # 2387.01

Table of Contents

1. Introduction

This measurement report shows compliance of the BK Technologies, Inc. Model(s) BKR9000 FCC ID: K95BKF9000 with FCC Part 2, 1093, ET Docket 93-62 Rules for mobile and portable devices and IC Certificate: 2116A-BKR9000 with RSS102 Issue 5 & Safety Code 6. The FCC have adopted the guidelines for evaluating the environmental effects of radio frequency radiation in ET Docket 93-62 on August 6, 1996 to protect the public and workers from the potential hazards of RF emissions due to FCC regulated portable devices. [1], [6]

The test results recorded herein are based on a single type test of BK Technologies Inc. Model BKR9000 and therefore apply only to the tested sample.

The test procedures, as described in ANSI C95.1 – 1999 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [2], ANSI C95.3 – 2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields [3], , IEEE Std.1528 – 2013 Recommended Practice [4], and Industry Canada Safety Code 6 Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz were employed.

The following table indicates all the wireless technologies operating in the Model BKR9000 PTT. The table also shows the tolerance for the power level for each mode.

Band	Technology	3GPP Nominal Power dBm	Setpoint Nominal Power dBm	Tolerance dBm	Lower Tolerance dBm	Upper Tolerance dBm
136 - 174 MHz	LMR	N/A	N/A	N/A	N/A	38.26
378 - 522 MHz	LMR	N/A	N/A	N/A	N/A	37.56
806 - 824 MHz	LMR	N/A	N/A	N/A	N/A	35.44
851 - 869 MHz	LMR	N/A	N/A	N/A	N/A	35.44
896 - 901 MHz	LMR	N/A	N/A	N/A	N/A	35.44
935 - 940 MHz	LMR	N/A	N/A	N/A	N/A	35.44
WLAN – 2.4 GHz	802.11b	N/A	N/A	N/A	N/A	17.3
WLAN – 2.4 GHz	802.11g	N/A	N/A	N/A	N/A	17.1
WLAN – 2.4 GHz	802.11n20	N/A	N/A	N/A	N/A	16.1
WLAN – 2.4 GHz	802.11n40	N/A	N/A	N/A	N/A	14.8
WLAN – 5 GHz Band I	802.11an20	N/A	N/A	N/A	N/A	18.0
WLAN – 5 GHz Band I	802.11n40	N/A	N/A	N/A	N/A	16.5
WLAN – 5 GHz Band IIA	802.11an20	N/A	N/A	N/A	N/A	18.0
WLAN – 5 GHz Band IIA	802.11n40	N/A	N/A	N/A	N/A	16.5
WLAN – 5 GHz Band IIC	802.11an20	N/A	N/A	N/A	N/A	18.0
WLAN – 5 GHz Band IIC	802.11n40	N/A	N/A	N/A	N/A	16.5
WLAN – 5 GHz Band III	802.11an20	N/A	N/A	N/A	N/A	18.0
WLAN – 5 GHz Band III	802.11n40	N/A	N/A	N/A	N/A	16.5
BT – BR	Bluetooth	N/A	N/A	N/A	N/A	11.7
BT – EDR2 & EDR3	Bluetooth	N/A	N/A	N/A	N/A	7.2
BT – BLE	Bluetooth	N/A	N/A	N/A	N/A	7.0

SAR Definition [5]

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (*dW*) absorbed by (dissipated in) an incremental mass (*dm*) contained in a volume element (*dV*) of a given density (ρ).

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

SAR is expressed in units of watts per kilogram (W/kg). *SAR* can be related to the electric field at a point by

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

where:

σ = conductivity of the tissue (S/m)

ρ = mass density of the tissue (kg/m^3)

E = rms electric field strength (V/m)

2. SAR Measurement Setup

Robotic System

These measurements are performed using the DASY52 automated dosimetric assessment system. The DASY52 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Intel Core2 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 Fig. 2.1).

System Hardware

A cell controller system contains the power supply, robot controller teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the HP Intel Core2 computer with Windows XP system and SAR Measurement Software DASY52, 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 that 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.

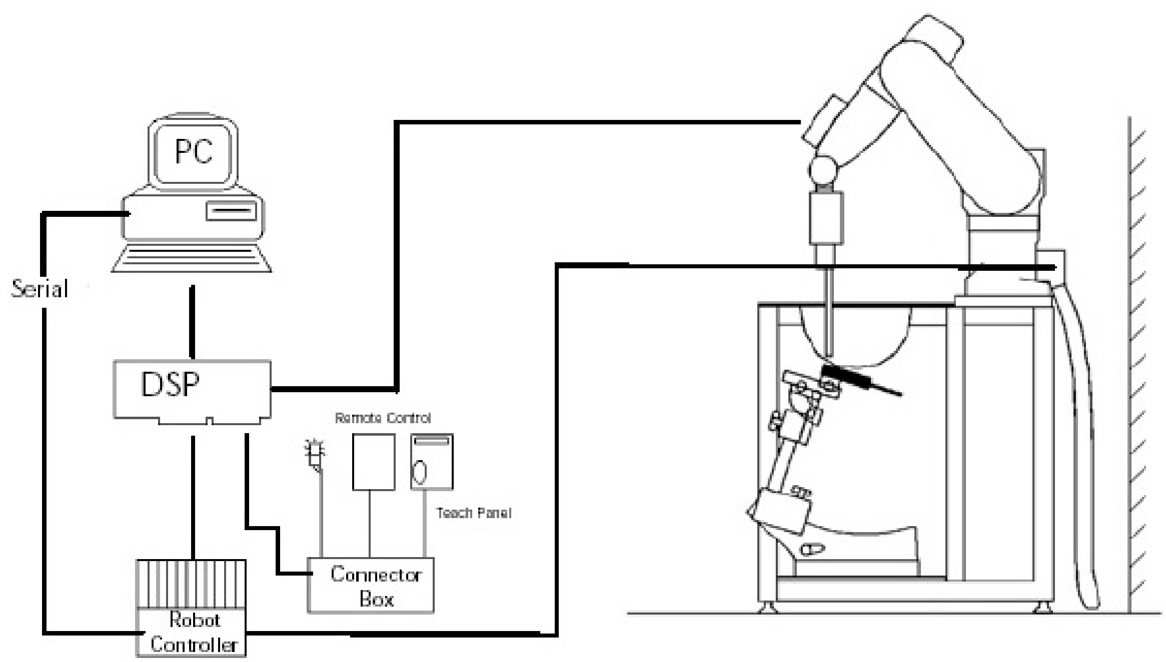

Figure 2.1 SAR Measurement System Setup

System Electronics

The DAE4 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.

Probe Measurement System

The SAR measurements were conducted with the dosimetric probe ES3DV3, designed in the classical triangular configuration (see Fig. 2.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi fiber line ending at the front of the probe tip. (see Fig. 2.3) It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY52 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting. The approach is stopped at reaching the maximum.

DAE System

Probe Specifications

Calibration: In air from 10 MHz to 6.0 GHz
In brain and muscle simulating tissue at Frequencies of 450 MHz, 835 MHz, 1750 MHz, 1900 MHz, 2450 MHz, 2600 MHz, 3500 MHz, 5200 MHz, 5300 MHz, 5600 MHz, 5800 MHz

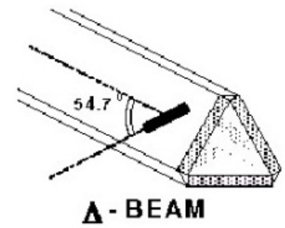

Figure 2.2 Triangular Probe Configurations

Frequency: 10 MHz to 6 GHz

Linearity: ±0.2dB (30 MHz to 6 GHz)

Dynamic: 10 mW/kg to 100 W/kg

Range: Linearity: ±0.2dB

Dimensions: Overall length: 330 mm

Tip length: 20 mm

Body diameter: 12 mm

Tip diameter: 2.5 mm

Distance from probe tip to sensor center: 1 mm

Figure 2.3 Probe Thick-Film Technique

Application: SAR Dosimetry Testing
Compliance tests of wireless device

Probe Calibration Process

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in with accuracy better than +/- 10%. The spherical isotropy was evaluated with the procedure described in and found to be better than +/-0.25dB. The sensitivity parameters (Norm X, Norm Y, Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz, and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm^2.

Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium, correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor based temperature probe is used in conjunction with the E-field probe

$$\text{SAR} = C\frac{\Delta T}{\Delta t}$$

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

where:

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm^3 for brain tissue)

SAR is proportional to $\Delta T / \Delta t$, the initial rate of tissue heating, before thermal diffusion takes place.
Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

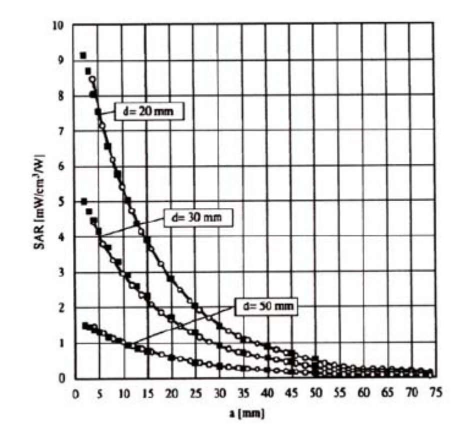

Figure 2.4 E-Field and Temperature Measurements at 900MHz

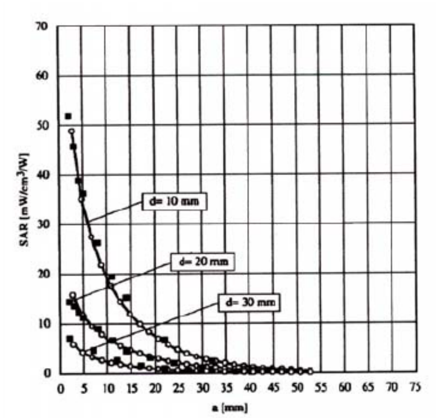

Figure 2.5 E-Field and Temperature Measurements at 1800MHz

Data Extrapolation

The DASY52 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given like below;

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with V_i = compensated signal of channel i (i=x,y,z)
U_i = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with V_i = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z) $\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
E_i = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermetian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with SAR = local specific absorption rate in W/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with P_{pwe} = equivalent power density of a plane wave in W/cm^2
E_{tot} = total electric field strength in V/m

Scanning procedure

- The DASY installation includes predefined files with recommended procedures for measurements and system check. They are read-only document files and destined as fully defined but unmeasured masks. All test positions (head or body-worn) are tested with the same configuration of test steps differing only in the grid definition for the different test positions.

- The „reference“ and „drift“ measurements are located at the beginning and end of the batch process. They measure the field drift at one single point in the liquid over the complete procedure. The indicated drift is mainly the variation of the DUT’s output power and should vary max. +/- 5 %.

- The highest integrated SAR value is the main concern in compliance test applications. These values can mostly be found at the inner surface of the phantom and cannot be measured directly due to the sensor offset in the probe. To extrapolate the surface values, the measurement distances to the surface must be known accurately. A distance error of 0.5mm could produce SAR errors of 6% at 1800 MHz. Using predefined locations for measurements is not accurate enough. Any shift of the phantom (e.g., slight deformations after filling it with liquid) would produce high uncertainties. For an automatic and accurate detection of the phantom surface, the DASY5 system uses the mechanical surface detection. The detection is always at touch, but the probe will move backward from the surface the indicated distance before starting the measurement.

- The „area scan“ measures the SAR above the DUT or verification dipole on a parallel plane to the surface. It is used to locate the approximate location of the peak SAR with 2D spline interpolation. The robot performs a stepped movement along one grid axis while the local electrical field strength is measured by the probe. The probe is touching the surface of the SAM during acquisition of measurement values. The scan uses different grid spacings for different frequency measurements. Standard grid spacing for head measurements in frequency ranges ≤ 2GHz is 15 mm in x - and y- dimension. For higher frequencies a finer resolution is needed, thus for the grid spacing is reduced according the following table:

Area scan grid spacing for different frequency ranges	
Frequency range	Grid spacing
≤ 2 GHz	≤ 15 mm
2 – 4 GHz	≤ 12 mm
4 – 6 GHz	≤ 10 mm

Grid spacing and orientation have no influence on the SAR result. For special applications where the standard scan method does not find the peak SAR within the grid, e.g. mobile phones with flip cover, the grid can be adapted in orientation. Results of this coarse scan are shown in annex B.

- A „zoom scan" measures the field in a volume around the 2D peak SAR value acquired in the previous „coarse" scan. It uses a fine meshed grid where the robot moves the probe in steps along all the 3 axis (x,y and z-axis) starting at the bottom of the Phantom. The grid spacing for the cube measurement is varied according to the measured frequency range, the dimensions are given in the following table:

Zoom scan grid spacing and volume for different frequency ranges			
Frequency range	Grid spacing for x, y axis	Grid spacing for z axis	Minimum zoom scan volume
≤ 2 GHz	≤ 8 mm	≤ 5 mm	≥ 30 mm
2 – 3 GHz	≤ 5 mm	≤ 5 mm	≥ 28 mm
3 – 4 GHz	≤ 5 mm	≤ 4 mm	≥ 28 mm
4 – 5 GHz	≤ 4 mm	≤ 3 mm	≥ 25 mm
5 – 6 GHz	≤ 4 mm	≤ 2 mm	≥ 22 mm

DASY is also able to perform repeated zoom scans if more than 1 peak is found during area scan. In this document, the evaluated peak 1g and 10g averaged SAR values are shown in the 2D-graphics in annex B. Test results relevant for the specified standard (see section 3) are shown in table form in section 7.

Spatial Peak SAR Evaluation

The spatial peak SAR - value for 1 and 10 g is evaluated after the Cube measurements have been done. The basis of the evaluation are the SAR values measured at the points of the fine cube grid consisting of all points in the three directions x, y and z. The algorithm that finds the maximal averaged volume is separated into three different stages.

- The data between the dipole center of the probe and the surface of the phantom are extrapolated. This data cannot be measured since the center of the dipole is 1 to 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is about 1 mm (see probe calibration sheet). The extrapolated data from a cube measurement can be visualized by selecting 'Graph Evaluated'.

- The maximum interpolated value is searched with a straight-forward algorithm. Around this maximum the SAR - values averaged over the spatial volumes (1g or 10 g) are computed using the 3d-spline interpolation algorithm. If the volume cannot be evaluated (i.e., if a part of the grid was cut off by the boundary of the measurement area) the evaluation will be started on the corners of the bottom plane of the cube.

- All neighbouring volumes are evaluated until no neighbouring volume with a higher average value is found.

Extrapolation

The extrapolation is based on a least square algorithm [W. Gander, Computermathematik, p.168-180]. Through the points in the first 3 cm along the z-axis, polynomials of order four are calculated. These polynomials are then used to evaluate the points between the surface and the probe tip. The points, calculated from the surface, have a distance of 1 mm from each other.

Interpolation

The interpolation of the points is done with a 3d-Spline. The 3d-Spline is composed of three one-dimensional splines with the "Not a knot"-condition [W. Gander, Computermathematik, p.141-150] (x, y and z -direction) [Numerical Recipes in C, Second Edition, p.123ff].

Volume Averaging

At First the size of the cube is calculated. Then the volume is integrated with the trapezoidal algorithm. 8000 points (20x20x20) are interpolated to calculate the average.

Advanced Extrapolation

DASY uses the advanced extrapolation option which is able to compensate boundary effects on E-field probes.

SAM PHANTOM

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 2.6)

Phantom Specification

Phantom: SAM Twin Phantom (V4.0)
Shell Material: Vivac Composite
Thickness: 2.0 ± 0.2 mm

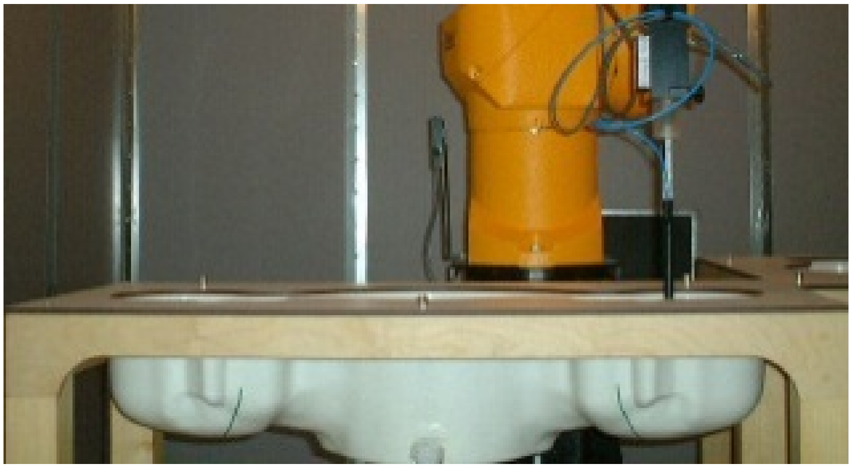

Figure 2.6 SAM Twin Phantom

Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0 the Mounting Device (see Fig. 2.7), enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately, and repeat ably be positioned according to the FCC, CENELEC, IEC and IEEE specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

Figure 2.7 Mounting Device

Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

3. Probe and Dipole Calibration

See Appendix D and E.

4. Phantom & Simulating Tissue Specifications

Head & Body Simulating Mixture Characterization

The head and body mixtures consist of the material based on the table listed below. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. Body tissue parameters that have not been specified in IEEE1528-2013 are derived from the issue dielectric parameters computed from the 4-Cole-Cole equations.

Table 4.1 Typical Composition of Ingredients for Tissue

Ingredients		Simulating Tissue					
		150 MHz Head	450 MHz Head	150 MHz Body	450 MHz Body	835 MHz Head	835 MHz Body
Mixing Percentage							
Water		Proprietary Procured from Speag	38.56	Proprietary Procured from Speag	51.16	40.92	52.50
Sugar			56.32		46.78	56.65	45.00
Salt			3.95		1.49	1.49	1.40
HEC			0.98		0.52	1.00	1.00
Bactericide			0.19		0.05	0.10	0.10
DGBE			0.00		0.00	0.00	0.00
Dielectric Constant	Target	41.94	43.50	55.53	56.70	41.50	55.20
Conductivity (S/m)	Target	0.89	0.87	0.96	0.94	0.90	0.97

Ingredients		Simulating Tissue			
		2450 MHz Body	5250 MHz Body	5600 MHz Body	5785 MHz Body
Mixing Percentage					
Water		73.20	Proprietary Mixture Procured from Speag		
Sugar		0.00			
Salt		0.04			
HEC		0.00			
Bactericide		0.00			
DGBE		26.70			
Dielectric Constant	Target	52.70	48.96	48.47	48.25
Conductivity (S/m)	Target	1.95	5.35	5.77	5.96

Ingredients		Simulating Tissue			
		2450 MHz Head	5200 MHz Head	5600 MHz Head	5800 MHz Head
Mixing Percentage					
Water		71.88.20	Proprietary Mixture Procured from Speag		
Sugar		0.00			
Salt		0.16			
HEC		0.00			
Bactericide		0.00			
DGBE		7.99			
Triton X-100		19.97			
Dielectric Constant	Target	39.20	35.99	35.53	35.30
Conductivity (S/m)	Target	1.80	4.65	5.07	5.27

5. ANSI/IEEE C95.1 – 1992 RF Exposure Limits [2]

Uncontrolled Environment

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 made 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 Environment

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.

Table 5.1 Human Exposure Limits

	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIROMENT Professional Population (W/kg) or (mW/g)
SPATIAL PEAK SAR[1] Head	1.60	8.00
SPATIAL AVERAGE SAR[2] Whole Body	0.08	0.40
SPATIAL PEAK SAR[3] Hands, Feet, Ankles, Wrists	4.00	20.00

[1] The Spatial Peak value of the SAR averaged over any 1 gram of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.
[2] The Spatial Average value of the SAR averaged over the whole body.
[3] The Spatial Peak value of the SAR averaged over any 10 grams of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

6. Measurement Uncertainty

Measurement uncertainty table is not required per KDB 865664 D01 v01r04 section 2.8.2 page 12. SAR measurement uncertainty analysis is required in the SAR report only when the highest measured SAR in a frequency band is ≥ 1.5 W/kg for 1-g SAR. The equivalent ratio (1.5/1.6) should be applied to extremity and occupational exposure conditions. The highest reported value is less than 1.5 W/kg. Therefore, the measurement uncertainty table is not required.

7. System Validation

Tissue Verification

Table 7.1 Measured Tissue Parameters

		150 MHz Head		150 MHz Body		450 MHz Head	
Date(s)		Apr. 3, 2019		Apr. 4, 2019		Apr. 3, 2019	
Liquid Temperature (˚C)	20.0	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ε		52.30	52.32	61.90	61.82	43.50	43.55
Conductivity: σ		0.76	0.78	0.80	0.81	0.87	0.88
		450 MHz Body		835 MHz Head		835 MHz Body	
Date(s)		Apr. 3, 2019		Mar. 29, 2019		Apr. 2, 2019	
Liquid Temperature (˚C)	20.0	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ε		56.70	56.66	41.50	41.33	55.20	55.91
Conductivity: σ		0.94	0.95	0.90	0.92	0.97	0.99
		2450 MHz Head		2450 MHz Body		5250 MHz Head	
Date(s)		Mar. 28, 2019		Mar. 28, 2019		Mar. 28, 2019	
Liquid Temperature (˚C)	20.0	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ε		39.20	39.14	52.70	52.64	35.93	35.95
Conductivity: σ		1.80	1.82	1.95	1.96	4.71	4.81
		5250 MHz Body		5600 MHz Head		5600 MHz Body	
Date(s)		Mar. 27, 2019		Mar. 28, 2019		Mar. 27, 2019	
Liquid Temperature (˚C)	20.0	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ε		48.95	48.96	35.53	35.53	48.47	48.43
Conductivity: σ		5.36	5.35	5.07	5.19	5.77	5.74
		5750 MHz Head		5750 MHz Body			
Date(s)		Mar. 28, 2019		Mar. 27, 2019			
Liquid Temperature (˚C)	20.0	Target	Measured	Target	Measured		
Dielectric Constant: ε		35.36	35.36	48.27	48.21		
Conductivity: σ		5.22	5.36	5.94	5.91		

See Appendix A for data printout.

Test System Verification

Prior to assessment, the system is verified to the ±10% of the specifications at the test frequency by using the system kit. Power is normalized to 1 watt. (Graphic Plots Attached)

Table 7.2 System Dipole Validation Target & Measured

	Test Frequency	Targeted SAR_{1g} (W/kg)	Measure SAR_{1g} (W/kg)	Tissue Used for Verification	Deviation (%)	Plot
03-Apr-2019	150 MHz	3.84	3.78	Head	- 1.56	1
04-Apr-2019	150 MHz	3.95	3.96	Body	+ 0.25	2
03-Apr-2019	450 MHz	4.48	4.55	Head	+ 1.56	3
03-Apr-2019	450 MHz	4.58	4.57	Body	- 0.22	4
29-Mar-2019	835 MHz	9.44	9.57	Head	+ 1.38	5
02-Apr-2019	835 MHz	9.57	9.61	Body	+ 0.42	6
28-Mar-2019	2450 MHz	51.70	52.20	Head	+ 0.97	7
28-Mar-2019	2450 MHz	51.00	52.00	Body	+ 1.96	8
28-Mar-2019	5250 MHz	82.80	82.10	Head	- 0.85	9
27-Mar-2019	5250 MHz	76.80	77.60	Body	+ 1.04	10
28-Mar-2019	5600 MHz	85.40	85.30	Head	- 0.12	11
27-Mar-2019	5600 MHz	79.50	79.10	Body	- 0.50	12
28-Mar-2019	5750 MHz	83.90	82.30	Head	- 1.91	13
27-Mar-2019	5750 MHz	76.20	76.60	Body	+ 0.52	14

See Appendix A for data plots.

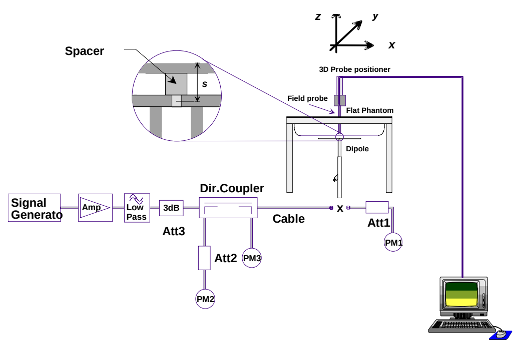

Figure 7.1 Dipole Validation Test Setup

8. SAR Test Data Summary

See Measurement Result Data Pages

See Appendix B for SAR Test Data Plots.
See Appendix C for SAR Test Setup Photos.

Procedures Used To Establish Test Signal

The device was either placed into simulated transmit mode using the manufacturer's test codes or the actual transmission is activated through a base station simulator or similar equipment. See data pages for actual procedure used in measurement.

Device Test Condition

The power drift of each test is measured at the start of the test and again at the end of the test. The drift is calculated returned in dBs. The drift is calculated into the resultant SAR value on the data sheet for each test.

The BKR9000 was tested in the face position with the front of the device 25 mm away from the flat phantom. The BKR9000 was then tested in the body position with the body accessory in contact with the flat phantom. No audio accessory was used for the body measurements. For each of the tests conducted, the device was set to continuously transmit at a maximum output power on the channel specified in the test data. The SAR was scaled to 50% duty cycle per KDB 643646 D01 v01r03. All test reductions were reduced based on the reductions in KDB 643646 D01 v01r03. See pages 26-27 for a table of test reductions.

The Bluetooth testing was excluded from SAR testing due to the low power of the transmitter. For the FCC, the exclusion was based on the calculation in KDB447498 v06 section 4.3.1 a). The following is the formula for the Bluetooth transmitter.

$[(16\ mW)/(17\ mm)]*\sqrt{2.48}=1.48$ which is equal to or less than 3.0

For ISED, the exclusion is based on RSS-102 Issue 5 section 2.5.1 table 1. For devices evaluated to the controlled environment limit of 8.0 W/kg, the numbers in the table are multiplied by 5. Therefore, for a separation distance of 15 mm in the table, the exclusion limit is (15mW*5)=75 mW. The Bluetooth transmitter has a maximum transmit power of 16 mW which is below the 75 mW threshold.

The Bluetooth transmitter does not simultaneously transmit with the WiFi transmitter. See pages 28-30 for a table of test reductions.

The data rates used when evaluating the WiFi transmitter were the lowest data rates for each mode. The device was operating at its maximum output power at the lowest data rate for all measurements.

The antenna was on a minimum of 10 cm of Styrofoam during each test. The following is a pictorial drawing of the locations and separation distances.

Accessory	Description	Part Number
Battery A	Li-Ion, 1880 mAh	4005-31131-600
Antenna A	½ Wave Whip (762-870 MHz)	Standard
Body Worn Accessory A	Belt Clip	Standard

The following tables shows all combinations with the tested combination marked yes.

Radio Face Test

Antenna A
Battery A
Yes

Radio Body Test

	Antenna A
Body Worn A	Bat A
	Yes

VHF/UHF		
Freq	Channel	Power (dB)
136	1	37.42
145.5	2	37.56
155	3	37.77
164.5	4	37.69
174	5	37.51
378	6	37.02
398.6	7	37.16
419.2	8	37.18
439.8	9	37.22
460.4	10	37.11
481	11	37.09
501.6	12	37.01
522	13	36.98
763	14	34.31
776	15	34.36
793	16	34.42
806	17	34.39
806	18	34.87
825	19	34.92
851	20	34.99
870	21	34.95
898.5	22	34.88
937.5	23	34.82

150 MHz Band
Per KDB 447498 D01 v06 page 7 section 6) pages 7-8, the number of channels required to be tested is as follows:

F_{high} = 174 MHz
F_c = 155 MHz
F_{low} = 136 MHz

N_c = Round $\{[100(f_{high} – f_{low})/f_c]^{0.5} \times (f_c/100)^{0.2}\}$ = Round $\{[100(174-136)/155]^{0.5} \times (155/100)^{0.2}\}$ = 5

Therefore, for the frequency band from 136 MHz to 174 MHz, 5 channels are required for testing.

450 MHz Band
Per KDB 447498 D01 v06 page 7 section 6) pages 7-8, the number of channels required to be tested is as follows:

F_{high} = 522 MHz
F_c = 450 MHz
F_{low} = 378 MHz

N_c = Round $\{[100(f_{high} – f_{low})/f_c]^{0.5} \times (f_c/100)^{0.2}\}$ = Round $\{[100(522-378)/450]^{0.5} \times (450/100)^{0.2}\}$ = 8

Therefore, for the frequency band from 378 MHz to 522 MHz, 8 channels are required for testing.

800 MHz Band

Per KDB 447498 D01 v06 page 7 section 6) pages 7-8, the number of channels required to be tested is as follows:

F_{high} = 870 MHz
F_c = 838 MHz
F_{low} = 806 MHz

N_c = Round $\{[100(f_{high} – f_{low})/f_c]^{0.5} \times (f_c/100)^{0.2}\}$ = Round $\{[100(870\text{-}806)/838]^{0.5} \times (838/100)^{0.2}\}$ = 4

Therefore, for the frequency band from 806 MHz to 870 MHz, 4 channels are required for testing.

900 MHz Band

Per KDB 447498 D01 v06 page 7 section 6) pages 7-8, the number of channels required to be tested is as follows:

F_{high} = 937.5 MHz
F_c = 918 MHz
F_{low} = 898.5 MHz

N_c = Round $\{[100(f_{high} – f_{low})/f_c]^{0.5} \times (f_c/100)^{0.2}\}$ = Round $\{[100(937.5\text{-}898.5)/918]^{0.5} \times (918/100)^{0.2}\}$ = 2

Therefore, for the frequency band from 898.5 MHz to 937.5 MHz, 2 channels are required for testing.

Band	Mode	Bandwidth (MHz)	Channel	Frequency (MHz)	Data Rate	Avg Power (dBm)	Tune-up Pwr (dBm)
2450 MHz	802.11b	20	1	2412	1 Mbps	15.95	17.30
			6	2437		16.00	17.30
			11	2462		15.90	17.30
	802.11g	20	1	2412	6 Mbps	15.37	17.10
			6	2437		15.44	17.10
			11	2462		15.44	17.10
	802.11n	20	1	2412	HT0	14.95	16.10
			6	2437		14.87	16.10
			11	2462		14.90	16.10
	802.11n	40	3	2422	HT0	13.95	14.80
			6	2437		13.87	14.80
			10	2457		13.90	14.80
5.15-5.25 GHz	802.11a	20	36	5180	6 Mbps	16.42	18.00
			40	5200		16.50	18.00
			44	5220		16.50	18.00
			48	5240		16.47	18.00
	802.11n	20	36	5180	HT0	16.41	18.00
			40	5200		16.38	18.00
			44	5220		16.39	18.00
			48	5240		16.35	18.00
	802.11n	40	38	5190	HT0	15.42	16.50
			46	5230		15.44	16.50
5.25-5.35 GHz	802.11a	20	52	5260	6 Mbps	16.45	18.00
			56	5280		16.50	18.00
			60	5300		16.50	18.00
			64	5320		16.47	18.00
	802.11n	20	52	5260	HT0	16.42	18.00
			56	5280		16.39	18.00
			60	5300		16.38	18.00
			64	5320		16.40	18.00
	802.11n	40	54	5270	HT0	15.32	16.50
			62	5310		15.34	16.50

Band	Mode	Bandwidth (MHz)	Channel	Frequency (MHz)	Data Rate	Antenna	Avg Power (dBm)	Tune-up Pwr (dBm)
5600 MHz	802.11a	20	100	5500	6 Mbps	Chain A	16.42	18.00
			104	5520			16.50	18.00
			108	5540			16.45	18.00
			112	5560			16.47	18.00
			116	5580			16.50	18.00
			120	5600			16.41	18.00
			124	5620			16.50	18.00
			128	5640			16.48	18.00
			132	5660			16.44	18.00
			136	5680			16.50	18.00
			140	5700			16.40	18.00
	802.11n	20	100	5500	HT0	Chain A	16.38	18.00
			104	5520			16.33	18.00
			108	5540			16.35	18.00
			112	5560			16.36	18.00
			116	5580			16.34	18.00
			120	5600			16.40	18.00
			124	5620			16.41	18.00
			128	5640			16.44	18.00
			132	5660			16.31	18.00
			136	5680			16.39	18.00
			140	5700			16.38	18.00
	802.11n	40	102	5510	HT0	Chain A	15.45	16.50
			110	5550			15.40	16.50
			118	5580			15.42	16.50
			126	5610			15.37	16.50
			134	5670			15.38	16.50

Band	Mode	Bandwidth (MHz)	Channel	Frequency (MHz)	Data Rate	Antenna	Avg Power (dBm)	Tune-up Pwr (dBm)
5800 MHz	802.11a	20	149	5745	6 Mbps	Chain A	16.50	18.00
			153	5765			16.42	18.00
			157	5785			16.50	18.00
			161	5805			16.44	18.00
			165	5825			16.50	18.00
	802.11n	20	149	5745	HT0	Chain A	16.38	18.00
			153	5765			16.37	18.00
			157	5785			16.40	18.00
			161	5805			16.42	18.00
			165	5825			16.44	18.00
	802.11n	40	152	5760	HT0	Chain A	15.42	16.50
			159	5795			15.45	16.50

Band	Mode	Channel	Frequency (MHz)	Data Rate	Antenna	Avg Power (dBm)	Tune-up Pwr (dBm)
2450 MHz	Bluetooth v4.0	0	2402	Basic Rate GFSK	Chain B	10.40	11.70
		39	2441			10.47	11.70
		78	2480			10.42	11.70
		0	2402	EDR π/4 DQPSK		6.42	7.20
		39	2441			6.43	7.20
		78	2480			6.38	7.20
		0	2402	EDR 8-DPSK		6.44	7.20
		39	2441			6.41	7.20
		78	2480			6.43	7.20
		0	2402	Low Energy GFSK		5.99	7.00
		39	2441			5.88	7.00
		78	2480			5.93	7.00

Head SAR – In Front of Face (Handset)			
Antenna	Channel Freq. (MHz)	Battery A[1]	
		Measured Power (dBm)	Reported SAR (W/kg)
A[1] 136 – 174 MHz	136	37.42	0.16
	145.5	37.56	[2]
	155	37.77	0.24
	164.5	37.69	[2]
	174	37.51	0.17
A[1] 378 – 522 MHz	378	37.02	2.04
	398.6	37.16	[2]
	419.2	37.18	[2]
	439.8	37.22	2.28
	460.4	37.11	[2]
	481	37.09	[2]
	501.6	37.01	[2]
	522	36.98	2.30
A[1] 806 – 870 MHz	806	34.87	1.09
	825	34.92	[2]
	851	34.99	1.20
	870	34.95	1.15
A[1] 896 – 940 MHz	898.5	34.88	1.63
	937.5	34.82	1.31

[1]See Accessory table on page 21 of this report.
[2]Measurement was reduced.

Body SAR (Handset)			
Antenna	Channel Freq. (MHz)	Battery A[1]	
		Body Worn A[1]	
		Measured Power (dBm)	Reported SAR (W/kg)
A[1] 136 – 174 MHz	136	37.42	1.90
	145.5	37.56	[2]
	155	37.77	1.90
	164.5	37.69	[2]
	174	37.51	1.78
A[1] 378 – 522 MHz	378	37.02	3.36
	398.6	37.16	3.09
	419.2	37.18	3.11
	439.8	37.22	3.72
	460.4	37.11	3.18
	481	37.09	3.11
	501.6	37.01	3.36
	522	36.98	3.44
A[1] 806 – 870 MHz	806	34.87	2.73
	825	34.92	[2]
	851	34.99	2.93
	870	34.95	2.87
A[1] 896 – 940 MHz	898.5	34.88	3.75
	937.5	34.82	3.53

[1]See Accessory table on page 21 of this report.
[2]Measurement was reduced.

Figure 8.1 Test Reduction Table – 2.4 GHz

Mode	Side	Required Channel	Tested/Reduced
802.11b	Face	1 – 2412 MHz	Reduced[1]
		6 – 2437 MHz	Tested
		11 – 2462 MHz	Reduced[1]
	Body	1 – 2412 MHz	Reduced[1]
		6 – 2437 MHz	Tested
		11 – 2462 MHz	Reduced[1]
802.11g	Face	1 – 2412 MHz	Reduced[2]
		6 – 2437 MHz	Reduced[2]
		11 – 2462 MHz	Reduced[2]
	Body	1 – 2412 MHz	Reduced[2]
		6 – 2437 MHz	Reduced[2]
		11 – 2462 MHz	Reduced[2]
802.11n	Face	1 – 2412 MHz	Reduced[2]
		6 – 2437 MHz	Reduced[2]
		11 – 2462 MHz	Reduced[2]
	Body	1 – 2412 MHz	Reduced[2]
		6 – 2437 MHz	Reduced[2]
		11 – 2462 MHz	Reduced[2]

Reduced[1] – When the reported SAR is ≤ 0.4 W/kg, SAR is not required for the remaining test configuration per KDB 248227 D01 v02r02 section 5.1.1 1) page 9.
Reduced[2] – When the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is ≤ 1.2 W/kg, SAR is not required per KDB 248227 D01 v02r02 section 5.2.2 2) page 10.

Figure 8.2 Test Reduction Table – 5.1 GHz

Mode	Side	Required Channel	Tested/Reduced
802.11a 5150 MHz	Face	36 – 5180 MHz	Reduced[1]
		40 – 5200 MHz	Reduced[1]
		44 – 5220 MHz	Reduced[1]
		48 – 5240 MHz	Reduced[1]
	Body	36 – 5180 MHz	Reduced[1]
		40 – 5200 MHz	Reduced[1]
		44 – 5220 MHz	Reduced[1]
		48 – 5240 MHz	Reduced[1]
802.11n 5150 MHz	Face	36 – 5180 MHz	Reduced[1]
		40 – 5200 MHz	Reduced[1]
		44 – 5220 MHz	Reduced[1]
		48 – 5240 MHz	Reduced[1]
	Body	36 – 5180 MHz	Reduced[1]
		40 – 5200 MHz	Reduced[1]
		44 – 5220 MHz	Reduced[1]
		48 – 5240 MHz	Reduced[1]

Reduced[1] – When the adjusted SAR is ≤ 1.2 W/kg, SAR is not required for the UNII-1 with the same or lower maximum output power in that test configuration per KDB 248227 D01 v02r02 section 5.3.1 1) page 11.

Figure 8.3 Test Reduction Table – 5.2 GHz

Mode	Side	Required Channel	Tested/Reduced
802.11a 5250 MHz	Face	52 – 5260 MHz	Reduced[1]
		56 – 5280 MHz	Reduced[1]
		60 – 5300 MHz	Tested
		64 – 5320 MHz	Reduced[1]
	Body	52 – 5260 MHz	Reduced[1]
		56 – 5280 MHz	Reduced[1]
		60 – 5300 MHz	Tested
		64 – 5320 MHz	Reduced[1]
802.11n 5250 MHz	Face	52 – 5260 MHz	Reduced[1]
		56 – 5280 MHz	Reduced[1]
		60 – 5300 MHz	Reduced[1]
		64 – 5320 MHz	Reduced[1]
	Body	52 – 5260 MHz	Reduced[1]
		56 – 5280 MHz	Reduced[1]
		60 – 5300 MHz	Reduced[1]
		64 – 5320 MHz	Reduced[1]

Reduced[1] – When the reported SAR is ≤ 0.4 W/kg, SAR is not required for the remaining test configuration per KDB 248227 D01 v02r02 section 5.1.1 1) page 9.

Figure 8.4 Test Reduction Table – 5.6 GHz

Mode	Side	Required Channel	Tested/Reduced
802.11a 5600 MHz	Face	100 – 5500 MHz	Reduced[1]
		104 – 5520 MHz	Reduced[1]
		108 – 5540 MHz	Reduced[1]
		112 – 5560 MHz	Reduced[1]
		116 – 5580 MHz	Reduced[1]
		120 – 5600 MHz	Reduced[1]
		124 – 5620 MHz	Tested
		128 – 5640 MHz	Reduced[1]
		132 – 5660 MHz	Reduced[1]
		136 – 5680 MHz	Reduced[1]
		140 – 5700 MHz	Reduced[1]
	Body	100 – 5500 MHz	Reduced[1]
		104 – 5520 MHz	Reduced[1]
		108 – 5540 MHz	Reduced[1]
		112 – 5560 MHz	Reduced[1]
		116 – 5580 MHz	Reduced[1]
		120 – 5600 MHz	Reduced[1]
		124 – 5620 MHz	Tested
		128 – 5640 MHz	Reduced[1]
		132 – 5660 MHz	Reduced[1]
		136 – 5680 MHz	Reduced[1]
		140 – 5700 MHz	Reduced[1]

Reduced[1] – When the reported SAR is ≤ 0.4 W/kg, SAR is not required for the remaining test configuration per KDB 248227 D01 v02r02 section 5.1.1 1) page 9.

Figure 8.5 Test Reduction Table – 5.6 GHz

Mode	Side	Required Channel	Tested/Reduced
802.11n 5600 MHz	Face	100 – 5500 MHz	Reduced[1]
		104 – 5520 MHz	Reduced[1]
		108 – 5540 MHz	Reduced[1]
		112 – 5560 MHz	Reduced[1]
		116 – 5580 MHz	Reduced[1]
		120 – 5600 MHz	Reduced[1]
		124 – 5620 MHz	Reduced[1]
		128 – 5640 MHz	Reduced[1]
		132 – 5660 MHz	Reduced[1]
		136 – 5680 MHz	Reduced[1]
		140 – 5700 MHz	Reduced[1]
	Body	100 – 5500 MHz	Reduced[1]
		104 – 5520 MHz	Reduced[1]
		108 – 5540 MHz	Reduced[1]
		112 – 5560 MHz	Reduced[1]
		116 – 5580 MHz	Reduced[1]
		120 – 5600 MHz	Reduced[1]
		124 – 5620 MHz	Reduced[1]
		128 – 5640 MHz	Reduced[1]
		132 – 5660 MHz	Reduced[1]
		136 – 5680 MHz	Reduced[1]
		140 – 5700 MHz	Reduced[1]

Reduced[1] – When the reported SAR is ≤ 0.4 W/kg, SAR is not required for the remaining test configuration per KDB 248227 D01 v02r02 section 5.1.1 1) page 9.

Figure 8.6 Test Reduction Table – 5.8 GHz

Mode	Side	Required Channel	Tested/Reduced
802.11a 5800 MHz	Face	149 – 5745 MHz	Reduced[1]
		153 – 5765 MHz	Reduced[1]
		157 – 5785 MHz	Tested
		161 – 5805 MHz	Reduced[1]
		165 – 5825 MHz	Reduced[1]
	Body	149 – 5745 MHz	Reduced[1]
		153 – 5765 MHz	Reduced[1]
		157 – 5785 MHz	Tested
		161 – 5805 MHz	Reduced[1]
		165 – 5825 MHz	Reduced[1]
802.11n 5800 MHz	Face	149 – 5745 MHz	Reduced[1]
		153 – 5765 MHz	Reduced[1]
		157 – 5785 MHz	Reduced[1]
		161 – 5805 MHz	Reduced[1]
		165 – 5825 MHz	Reduced[1]
	Body	149 – 5745 MHz	Reduced[1]
		153 – 5765 MHz	Reduced[1]
		157 – 5785 MHz	Reduced[1]
		161 – 5805 MHz	Reduced[1]
		165 – 5825 MHz	Reduced[1]

Reduced[1] – When the reported SAR is ≤ 0.4 W/kg, SAR is not required for the remaining test configuration per KDB 248227 D01 v02r02 section 5.1.1 1) page 9.

SAR Data Summary – Head SAR Face Measurements

MEASUREMENT RESULTS

Gap	Plot	Conf.	Battery	Frequency		Mod.	Ant.	End Power	Drift (dB)	Measured SAR (W/kg)	Adjusted SAR (W/kg)	SAR (W/kg) 50% Duty Cycle
				MHz	Ch.			(dBm)				
25 mm	-----	Radio	A	136	1	FM	A	37.42	-0.42	0.242	0.32	0.16
	1			155	3	FM		37.77	-0.55	0.374	0.48	0.24
	-----			174	5	FM		37.51	-0.28	0.267	0.34	0.17
	-----			378	6	FM		37.02	-0.46	3.24	4.08	2.04
	3			439.8	9	FM		37.22	-0.43	3.82	4.56	2.28
	-----			522	13	FM		36.98	-0.47	3.61	4.60	2.30
	-----			806	18	FM		34.87	-0.44	1.73	2.18	1.09
	5			851	20	FM		34.99	-0.26	2.03	2.39	1.20
	-----			870	21	FM		34.95	-0.42	1.86	2.29	1.15
	7			898.5	22	FM		34.88	-0.55	2.52	3.25	1.63
	-----			937.5	23	FM		34.82	-0.51	2.02	2.62	1.31

Head
8.0 W/kg (mW/g)
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒Conducted ☐ERP ☐EIRP
2. SAR Measurement
   Phantom Configuration ☐Left Head ☒Eli4 ☐Right Head
   SAR Configuration ☒Head ☐Body
3. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
4. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

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 of the tolerance (varies depending on band) and the measured conducted power. The resultant value is then multiplied by 0.5 to give the SAR value at 50% duty cycle.

SAR Data Summary – Body SAR Measurements (Battery A, Body A)

MEASUREMENT RESULTS

Gap	Plot	Body Worn Acc.	Battery	Frequency MHz	Frequency Ch.	Mod.	Ant.	End Power (dBm)	Drift (dB)	Measured SAR (W/kg)	Adjusted SAR (W/kg)	SAR (W/kg) 50% Duty Cycle
0 mm	-----	A	A	136	1	FM	A	37.42	-0.49	2.79	3.79	1.90
	2			155	3	FM		37.77	-0.62	2.95	3.81	1.90
	-----			174	5	FM		37.51	-0.25	2.83	3.56	1.78
	-----			378	6	FM		37.02	-0.56	5.22	6.73	3.36
	-----			398.6	7	FM		37.16	-0.40	5.14	6.18	3.09
	-----			419.2	8	FM		37.18	-0.33	5.28	6.22	3.11
	4			439.8	9	FM		37.22	-0.54	6.08	7.45	3.72
	-----			460.4	10	FM		37.11	-0.42	5.21	6.37	3.18
	-----			481	11	FM		37.09	-0.39	5.11	6.23	3.11
	-----			501.6	12	FM		37.01	-0.50	5.28	6.72	3.36
	-----			522	13	FM		36.98	-0.41	5.47	6.87	3.44
	-----			806	18	FM		34.87	-0.45	4.32	5.46	2.73
	6			851	20	FM		34.99	-0.46	4.75	5.86	2.93
	-----			870	21	FM		34.95	-0.48	4.58	5.73	2.87
	8			898.5	22	FM		34.88	-0.50	5.87	7.49	3.75
	-----			937.5	23	FM		34.82	-0.45	5.51	7.05	3.53

Body
8.0 W/kg (mW/g)
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒Conducted ☐ERP ☐EIRP
2. SAR Measurement
   Phantom Configuration ☐Left Head ☒Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
3. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
4. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

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 of the tolerance (varies depending on band) and the measured conducted power. The resultant value is then multiplied by 0.5 to give the SAR value at 50% duty cycle.

SAR Data Summary – Face Measurements – WiFi

MEASUREMENT RESULTS								
Plot	**Gap**	**Position**	**Frequency**		**Modulation**	**End Power**	**Measured SAR (W/kg)**	**Reported SAR (W/kg)**
			MHz	**Ch.**		**(dBm)**		
9	25 mm	Face	2437	6	DSSS	16.00	0.0651	0.09
11			5300	60	OFDM	16.50	0.00209	0.01
13			5620	124	OFDM	16.50	0.00915	0.01
15			5785	157	OFDM	16.50	0.00826	0.01

Head
1.6 W/kg (mW/g)
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒Conducted ☐ERP ☐EIRP
2. SAR Measurement
   Phantom Configuration ☐Left Head ☒Eli4 ☐Right Head
   SAR Configuration ☒Head ☐Body
3. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
4. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

SAR Data Summary – Body Measurements – WiFi

MEASUREMENT RESULTS								
Plot	**Gap**	**Position**	**Frequency**		**Modulation**	**End Power**	**Measured SAR (W/kg)**	**Reported SAR (W/kg)**
			MHz	**Ch.**		**(dBm)**		
10	0 mm	Body	2437	6	DSSS	16.00	0.0212	0.03
12			5300	60	OFDM	16.50	0.0117	0.02
14			5620	124	OFDM	16.50	0.0164	0.02
16			5785	157	OFDM	16.50	0.0138	0.02

Body
1.6 W/kg (mW/g)
averaged over 1 gram

1. Battery is fully charged for all tests.
   Power Measured ☒Conducted ☐ERP ☐EIRP
2. SAR Measurement
   Phantom Configuration ☐Left Head ☒Eli4 ☐Right Head
   SAR Configuration ☐Head ☒Body
3. Test Signal Call Mode ☒Test Code ☐Base Station Simulator
4. Test Configuration ☐With Belt Clip ☐Without Belt Clip ☒N/A
5. Tissue Depth is at least 15.0 cm

Jay M. Moulton
Vice President

SAR Data Summary – Simultaneous Evaluation

MEASUREMENT RESULTS

Config.	Frequency		Modulation	Frequency		Modulation	SAR_1	SAR_2
	MHz	Ch.		MHz	Ch.			
Face	522	13	FM	2437	6	DSSS	2.30	0.09
Body	898.5	22	FM	2437	6	DSSS	3.75	0.03

For a device with one transmitter used in a controlled environment and the second transmitter used in an uncontrolled environment, the ratio of the two transmitters to the respective limit must be less than 1.0. Below are the calculations.

(2.30/8.0) + (0.09/1.6) = 0.34
(3.75/8.0) + (0.03/1.6) = 0.49

Both configurations are less than or equal to 1.0; therefore, simultaneous Tx meets the requirements of the FCC guidelines.

9. Test Equipment List

Table 9.1 Equipment Specifications

Type	Calibration Due Date	Calibration Done Date	Serial Number
Staubli Robot TX60L	N/A	N/A	F07/55M6A1/A/01
Measurement Controller CS8c	N/A	N/A	1012
ELI4 Flat Phantom	N/A	N/A	1065
Device Holder	N/A	N/A	N/A
Data Acquisition Electronics 4	04/13/2019	04/13/2018	1416
SPEAG E-Field Probe ES3DV3	02/26/2020	02/26/2019	3311
SPEAG E-Field Probe EX3DV4	04/20/2019	04/20/2018	3662
Speag Validation Loop CLA150	12/06/2019	12/06/2016	4002
Speag Validation Dipole D450V3	01/15/2020	01/15/2019	1085
Speag Validation Dipole D835V2	07/13/2019	07/13/2018	4d089
Speag Validation Dipole D2450V2	07/12/2019	07/12/2018	829
Speag Validation Dipole D5GHzV2	07/19/2019	07/19/2018	1085
Agilent N1911A Power Meter	03/20/2020	03/20/2019	GB45100254
Agilent N1922A Power Sensor	06/21/2019	06/21/2017	MY45240464
Advantest R3261A Spectrum Analyzer	03/25/2020	03/25/2019	31720068
Agilent (HP) 8350B Signal Generator	03/20/2020	03/20/2019	2749A10226
Agilent (HP) 83525A RF Plug-In	03/20/2020	03/20/2019	2647A01172
Agilent (HP) 8753C Vector Network Analyzer	03/20/2020	03/20/2019	3135A01724
Agilent (HP) 85047A S-Parameter Test Set	03/20/2020	03/20/2019	2904A00595
Anritsu MT8820C	03/19/2020	03/19/2019	MY48360364
Agilent 778D Dual Directional Coupler	07/20/2020	07/20/2019	MY48220184
MiniCircuits BW-N20W5+ Fixed 20 dB Attenuator	N/A	N/A	N/A
MiniCircuits SPL-10.7+ Low Pass Filter	N/A	N/A	R8979513746
Aprel Dielectric Probe Assembly	N/A	N/A	0011
Head Equivalent Matter (150 MHz)	N/A	N/A	N/A
Body Equivalent Matter (150 MHz)	N/A	N/A	N/A
Head Equivalent Matter (450 MHz)	N/A	N/A	N/A
Body Equivalent Matter (450 MHz)	N/A	N/A	N/A
Head Equivalent Matter (835 MHz)	N/A	N/A	N/A
Body Equivalent Matter (835 MHz)	N/A	N/A	N/A
Head Equivalent Matter (2450 MHz)	N/A	N/A	N/A
Body Equivalent Matter (2450 MHz)	N/A	N/A	N/A
Head Equivalent Matter (5 GHz)	N/A	N/A	N/A
Body Equivalent Matter (5 GHz)	N/A	N/A	N/A

10. Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC/IC. 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 tested device complies with the requirements in respect to all parameters subject to the test. The test results and statements relate only to the item(s) tested.

Please note that the absorption and distribution of electromagnetic energy in the body is a very complex phenomena that depends on the mass, shape, and size of the body; the orientation of the body with respect to the field vectors; and, the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

11. References

[1] Federal Communications Commission, ET Docket 93-62, Guidelines for Evaluating the Environmental Effects of Radio Frequency Radiation, August 1996

[2] ANSI/IEEE C95.1 – 1992, American National Standard Safety Levels with respect to Human Exposure to Radio Frequency Electromagnetic Fields, 300kHz to 100GHz, New York: IEEE, 1992.

[3] ANSI/IEEE C95.3 – 2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, 2002.

[4] International Electrotechnical Commission, IEC 62209-2 (Edition 1.0), Human Exposure to radio frequency fields from hand-held and body mounted wireless communication devices – Human models, instrumentation, and procedures – Part 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.

[5] IEEE Standard 1528 – 2013, IEEE Recommended Practice for Determining the Peak-Spatial Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communication Devices: Measurement Techniques, June 2013.

[6] Industry Canada, RSS – 102 Issue 5, Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), March 2015.

[7] Health Canada, Safety Code 6, Limits of Human Exposure to Radiofrequency Electromagnetic Fields in the Frequency Range from 3kHz to 300 GHz, 2009.

Appendix A – System Validation Plots and Data

Limits for Head

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************************************************************
Test Result for UIM Dielectric Parameter
Wed 03/Apr/2019
Freq    Frequency(GHz)
FCC_eH Limits for Head Epsilon
FCC_sH Limits for Head Sigma
Test_e Epsilon  of  UIM
Test_s Sigma of UIM
************************************************************
```

Freq	FCC_eH	FCC_sH	Test_e	Test_s
0.1300	53.23	0.75	53.12	0.76
0.1360	52.954	0.75	52.886	0.766*
0.1400	52.77	0.75	52.73	0.77
0.1455	52.512	0.756	52.505	0.776*
0.1500	52.30	0.76	52.32	0.78
0.1550	52.065	0.765	52.105	0.785*
0.1600	51.83	0.77	51.89	0.79
0.1645	51.623	0.77	51.706	0.79*
0.1700	51.37	0.77	51.48	0.79
0.1740	51.182	0.774	51.308	0.794*
0.1800	50.90	0.78	51.05	0.80
0.1900	50.43	0.79	50.64	0.81

* value interpolated

****
Test Result for UIM Dielectric Parameter
Wed 03/Apr/2019
Freq Frequency(GHz)
FCC_eH Limits for Head Epsilon
FCC_sH Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eH	FCC_sH	Test_e	Test_s
0.3600	44.58	0.87	44.61	0.86
0.3700	44.46	0.87	44.50	0.86
0.3780	42.636	0.87	42.676	0.86*
0.3800	44.34	0.87	44.38	0.86
0.3900	44.22	0.87	44.26	0.86
0.3986	44.17	0.87	44.157	0.869*
0.4000	44.10	0.87	44.14	0.87
0.4100	43.98	0.87	44.03	0.87
0.4192	44.117	0.87	44.178	0.87*
0.4200	43.86	0.87	43.90	0.87
0.4300	43.74	0.87	43.78	0.87
0.4398	43.622	0.87	43.662	0.88*
0.4400	43.62	0.87	43.66	0.88
0.4500	43.50	0.87	43.55	0.88
0.4600	43.45	0.87	43.47	0.88
0.4604	43.448	0.87	43.468	0.88*
0.4700	43.40	0.87	43.41	0.88
0.4800	43.34	0.87	43.35	0.89
0.4810	43.334	0.87	43.346	0.89*
0.4900	43.28	0.87	43.31	0.89
0.5000	43.22	0.87	43.27	0.89
0.5016	43.212	0.872	43.262	0.89*
0.5100	43.17	0.88	43.22	0.89
0.5200	43.12	0.88	43.18	0.90
0.5220	43.11	0.88	43.17	0.90*
0.5300	43.07	0.88	43.13	0.90
0.5400	43.03	0.88	43.09	0.90

* value interpolated

****
Test Result for UIM Dielectric Parameter
Fri 29/Mar/2019
Freq Frequency(GHz)
FCC_eH Limits for Head Epsilon
FCC_sH Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eH	FCC_sH	Test_e	Test_s
0.7500	41.94	0.89	41.73	0.89
0.7600	41.89	0.89	41.69	0.89
0.7630	41.875	0.89	41.675	0.89*
0.7700	41.84	0.89	41.64	0.89
0.7760	41.804	0.896	41.61	0.896*
0.7800	41.78	0.90	41.59	0.90
0.7900	41.73	0.90	41.54	0.90
0.7930	41.715	0.90	41.531	0.90*
0.8000	41.68	0.90	41.51	0.90
0.8060	41.65	0.90	41.48	0.906*
0.8100	41.63	0.90	41.46	0.91
0.8200	41.58	0.90	41.40	0.91
0.8250	41.555	0.90	41.375	0.91*
0.8300	41.53	0.90	41.35	0.91
0.8350	41.50	0.90	41.33	0.915*
0.8400	41.50	0.91	41.31	0.92
0.8500	41.50	0.92	41.28	0.93
0.8510	41.50	0.921	41.277	0.931*
0.8600	41.50	0.93	41.25	0.94
0.8700	41.50	0.94	41.23	0.95
0.8800	41.50	0.95	41.21	0.96
0.8900	41.50	0.96	41.19	0.97
0.8985	41.50	0.969	41.173	0.979*
0.9000	41.50	0.97	41.17	0.98
0.9100	41.50	0.98	41.15	0.98
0.9200	41.49	0.98	41.14	0.98
0.9300	41.47	0.99	41.12	0.99
0.9375	41.455	0.99	41.105	0.99*
0.9400	41.45	0.99	41.10	0.99
0.9500	41.43	0.99	41.08	1.00

* value interpolated

****
Test Result for UIM Dielectric Parameter
Thu 28/Mar/2019
Freq Frequency(GHz)
FCC_eH Limits for Head Epsilon
FCC_sH Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eH	FCC_sH	Test_e	Test_s
2.4100	39.26	1.76	39.21	1.77
2.4120	39.258	1.762	39.206	1.772*
2.4200	39.25	1.77	39.19	1.78
2.4300	39.24	1.78	39.18	1.80
2.4370	39.226	1.787	39.166	1.807*
2.4400	39.22	1.79	39.16	1.81
2.4420	39.216	1.792	39.156	1.812*
2.4500	39.20	1.80	39.14	1.82
2.4600	39.19	1.81	39.12	1.83
2.4620	39.186	1.812	39.116	1.832*
2.4700	39.17	1.82	39.10	1.84
2.4720	39.168	1.822	39.098	1.844*
2.4800	39.16	1.83	39.09	1.86

* value interpolated

****
Test Result for UIM Dielectric Parameter
Thu 28/Mar/2019
Freq Frequency(GHz)
FCC_eH Limits for Head Epsilon
FCC_sH Limits for Head Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eH	FCC_sH	Test_e	Test_s
5.1000	36.10	4.55	36.12	4.64
5.1200	36.08	4.57	36.10	4.66
5.1400	36.05	4.59	36.07	4.68
5.1600	36.03	4.61	36.05	4.71
5.1800	36.01	4.63	36.03	4.73
5.2000	35.99	4.65	36.00	4.75
5.2200	35.96	4.68	35.98	4.77
5.2400	35.94	4.70	35.96	4.79
5.2500	35.93	4.71	35.945	4.805*
5.2600	35.92	4.72	35.93	4.82
5.2800	35.89	4.74	35.90	4.84
5.3000	35.87	4.76	35.87	4.86
5.3200	35.85	4.78	35.85	4.88
5.3400	35.83	4.80	35.83	4.91
5.3600	35.80	4.82	35.81	4.93
5.3800	35.78	4.84	35.78	4.95
5.4000	35.76	4.86	35.76	4.97
5.4200	35.73	4.88	35.74	5.00
5.4400	35.71	4.90	35.73	5.02
5.4600	35.69	4.92	35.70	5.04
5.4800	35.67	4.94	35.67	5.06
5.5000	35.64	4.96	35.64	5.08
5.5200	35.62	4.98	35.62	5.10
5.5400	35.60	5.00	35.60	5.12
5.5600	35.57	5.02	35.58	5.15
5.5800	35.55	5.04	35.55	5.17
5.6000	35.53	5.07	35.53	5.19
5.6200	35.51	5.09	35.50	5.21
5.6400	35.48	5.11	35.48	5.24
5.6600	35.46	5.13	35.46	5.26
5.6800	35.44	5.15	35.44	5.28
5.7000	35.41	5.17	35.41	5.30
5.7200	35.39	5.19	35.39	5.33
5.7400	35.37	5.21	35.37	5.35
5.7450	35.365	5.215	35.365	5.355*
5.7500	35.36	5.22	35.36	5.36*
5.7600	35.35	5.23	35.35	5.37
5.7800	35.32	5.25	35.33	5.39
5.7850	35.315	5.255	35.32	5.395*
5.8000	35.30	5.27	35.29	5.41
5.8200	35.28	5.29	35.27	5.44
5.8250	35.273	5.295	35.265	5.445*
5.8400	35.25	5.31	35.25	5.46
5.8600	35.23	5.33	35.23	5.48

* value interpolated

Limits for Body

```
**********************************************************
Test Result for UIM Dielectric Parameter
Thu 04/Apr/2019
Freq    Frequency(GHz)
FCC_eB Limits for Body Epsilon
FCC_sB Limits for Body Sigma
Test_e Epsilon  of  UIM
Test_s Sigma of UIM
**********************************************************
```

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.1300	62.39	0.78	62.13	0.79
0.1360	62.246	0.786	62.022	0.796*
0.1400	62.15	0.79	61.95	0.80
0.1455	62.013	0.796	61.879	0.806*
0.1500	61.90	0.80	61.82	0.81
0.1550	61.775	0.805	61.645	0.815*
0.1600	61.65	0.81	61.47	0.82
0.1700	61.41	0.82	61.23	0.83
0.1740	61.31	0.82	61.126	0.834*
0.1800	61.16	0.82	60.97	0.84
0.1900	60.91	0.83	60.76	0.85

* value interpolated

****
Test Result for UIM Dielectric Parameter
Wed 03/Apr/2019
Freq Frequency(GHz)
FCC_eB Limits for Body Epsilon
FCC_sB Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.3600	57.60	0.94	57.85	0.93
0.3700	57.50	0.94	56.94	0.93
0.3780	57.42	0.94	57.02	0.93*
0.3800	57.40	0.94	57.04	0.93
0.3900	57.30	0.94	57.14	0.93
0.3986	57.214	0.94	57.217	0.939*
0.4000	57.20	0.94	57.23	0.94
0.4100	57.10	0.94	57.11	0.94
0.4192	57.008	0.94	57.00	0.94*
0.4200	57.00	0.94	56.99	0.94
0.4300	56.90	0.94	56.88	0.92
0.4398	56.802	0.94	56.772	0.949*
0.4400	56.80	0.94	56.77	0.95
0.4500	56.70	0.94	56.66	0.95
0.4600	56.66	0.94	56.58	0.95
0.4604	56.658	0.94	56.578	0.95*
0.4700	56.62	0.94	56.52	0.96
0.4800	56.58	0.94	56.47	0.96
0.4810	56.576	0.94	56.466	0.96*
0.4900	56.54	0.94	56.43	0.96
0.5000	56.51	0.94	56.40	0.97
0.5016	56.504	0.94	56.394	0.97*
0.5100	56.47	0.94	56.36	0.97
0.5200	56.43	0.95	56.33	0.97
0.5220	56.422	0.95	56.322	0.972*
0.5300	56.39	0.95	56.29	0.98
0.5400	56.35	0.95	56.26	0.98

* value interpolated

****
Test Result for UIM Dielectric Parameter
Tue 02/Apr/2019
Freq Frequency(GHz)
FCC_eB Limits for Body Epsilon
FCC_sB Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eB	FCC_sB	Test_e	Test_s
0.7550	55.51	0.96	56.23	0.96
0.7630	55.478	0.96	56.206	0.96*
0.7650	55.47	0.96	56.20	0.96
0.7750	55.43	0.97	56.17	0.97
0.7760	55.427	0.97	56.166	0.97*
0.7850	55.40	0.97	56.13	0.97
0.7930	55.368	0.97	56.098	0.97*
0.7950	55.36	0.97	56.09	0.97
0.8050	55.32	0.97	56.05	0.97
0.8060	55.316	0.97	56.045	0.971*
0.8150	55.28	0.97	56.00	0.98
0.8250	55.24	0.97	55.95	0.98
0.8350	55.20	0.97	55.91	0.99
0.8450	55.17	0.98	55.86	0.99
0.8510	55.152	0.986	55.848	0.996*
0.8550	55.14	0.99	55.84	1.00
0.8650	55.11	1.01	55.80	1.01
0.8700	55.095	1.015	55.79	1.015*
0.8750	55.08	1.02	55.78	1.02
0.8850	55.05	1.03	55.75	1.03
0.8950	55.02	1.04	55.73	1.04
0.8985	55.013	1.047	55.723	1.044*
0.9050	55.00	1.06	55.71	1.05
0.9150	55.00	1.06	55.69	1.07
0.9250	54.98	1.07	55.68	1.09
0.9350	54.96	1.07	55.66	1.10
0.9375	54.955	1.073	55.655	1.103*
0.9450	54.94	1.08	55.64	1.11

* value interpolated

****
Test Result for UIM Dielectric Parameter
Thu 28/Mar/2019
Freq Frequency(GHz)
FCC_eB Limits for Body Epsilon
FCC_sB Limits for Body Sigma
Test_e Epsilon of UIM
Test_s Sigma of UIM
****

Freq	FCC_eB	FCC_sB	Test_e	Test_s
2.4100	52.75	1.91	52.71	1.92
2.4120	52.742	1.918	52.706	1.922*
2.4200	52.74	1.92	52.69	1.93
2.4300	52.73	1.93	52.68	1.94
2.4370	52.716	1.937	52.666	1.947*
2.4400	52.71	1.94	52.66	1.95
2.4500	52.70	1.95	52.64	1.96
2.4600	52.69	1.96	52.63	1.98
2.4620	52.687	1.963	52.626	1.982*
2.4700	52.67	1.98	52.61	1.99
2.4800	52.66	1.99	52.60	2.00

* value interpolated

```
************************************************************
Test Result for UIM Dielectric Parameter
Wed 27/Mar/2019
Freq    Frequency(GHz)
FCC_eB Limits for Body Epsilon
FCC_sB Limits for Body Sigma
Test_e Epsilon  of  UIM
Test_s Sigma of UIM
************************************************************
```

Freq	FCC_eB	FCC_sB	Test_e	Test_s
5.1000	49.15	5.18	49.08	5.20
5.1200	49.12	5.21	49.05	5.22
5.1400	49.10	5.23	49.02	5.24
5.1600	49.07	5.25	48.99	5.26
5.1800	49.04	5.28	48.96	5.28
5.2000	49.01	5.30	48.93	5.30
5.2200	48.99	5.32	48.90	5.32
5.2400	48.96	5.35	48.97	5.34
5.2500	48.945	5.36	48.955	5.35*
5.2600	48.93	5.37	48.94	5.36
5.2800	48.91	5.39	48.91	5.38
5.3000	48.88	5.42	48.88	5.41
5.3200	48.85	5.44	48.85	5.43
5.3400	48.82	5.46	48.82	5.45
5.3600	48.80	5.49	48.79	5.47
5.3800	48.77	5.51	48.76	5.49
5.4000	48.74	5.53	48.73	5.51
5.4200	48.72	5.56	48.70	5.53
5.4400	48.69	5.58	48.67	5.56
5.4600	48.66	5.60	48.64	5.58
5.4800	48.63	5.63	48.61	5.60
5.5000	48.61	5.65	48.58	5.62
5.5200	48.58	5.67	48.55	5.65
5.5400	48.55	5.70	48.52	5.67
5.5600	48.53	5.72	48.49	5.69
5.5800	48.50	5.74	48.46	5.71
5.6000	48.47	5.77	48.43	5.74
5.6200	48.44	5.79	48.40	5.76
5.6400	48.42	5.81	48.37	5.78
5.6600	48.39	5.84	48.34	5.81
5.6800	48.36	5.86	48.31	5.83
5.7000	48.34	5.88	48.28	5.85
5.7200	48.31	5.91	48.25	5.88
5.7400	48.28	5.93	48.22	5.90
5.7450	48.273	5.935	48.213	5.905*
5.7500	48.265	5.94	48.205	5.91*
5.7600	48.25	5.95	48.19	5.92
5.7800	48.23	5.98	48.16	5.95
5.7850	48.223	5.985	48.153	5.955*
5.8000	48.20	6.00	48.13	5.97
5.8200	48.17	6.02	48.10	5.99
5.8250	48.165	6.028	48.093	5.998*
5.8400	48.15	6.05	48.07	6.02

* value interpolated

RF Exposure Lab

Plot 1

DUT: Loop 150 MHz CLA150; Type: CLA150; Serial: CLA150 - SN:4002

Communication System: CW; Frequency: 150 MHz; Duty Cycle: 1:1
Medium: HSL150; Medium parameters used: f = 150 MHz; σ = 0.78 S/m; ε_r = 52.32; ρ = 1000 kg/m^3
Phantom section: Flat Section

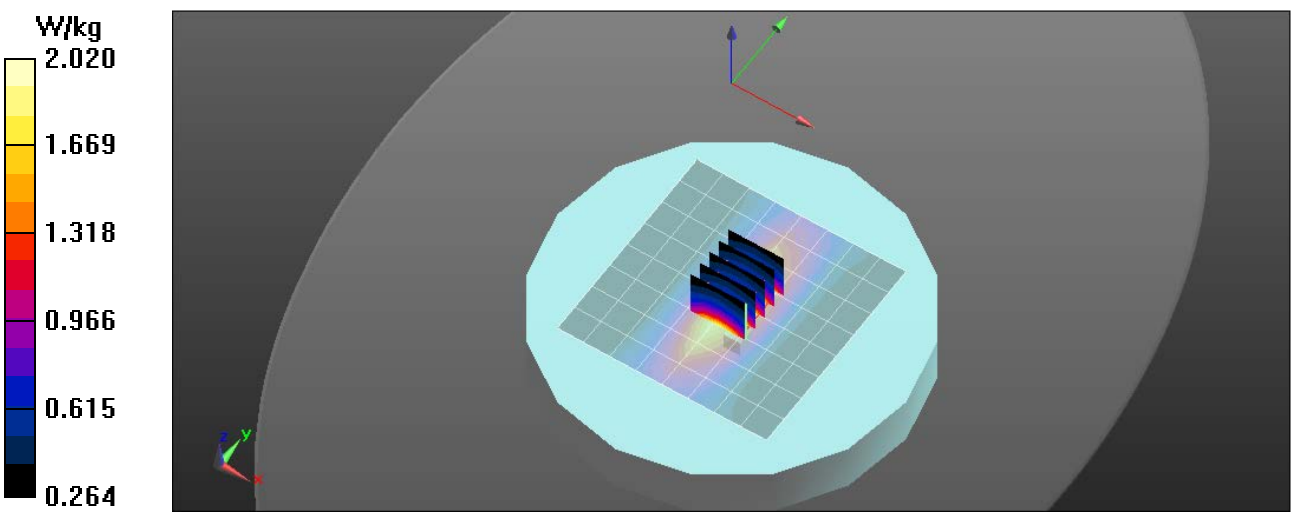
Test Date: Date: 4/3/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

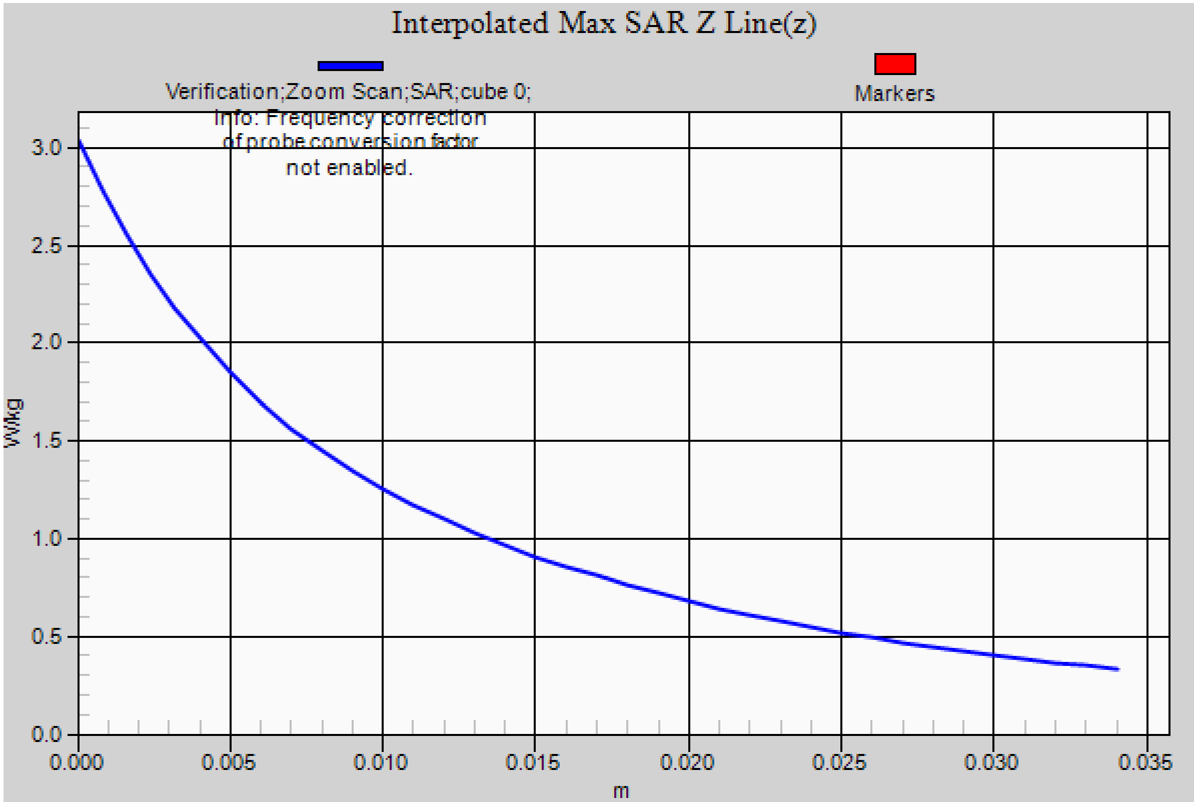
Probe: ES3DV3 - SN3311; ConvF(7.65, 7.65, 7.65); Calibrated: 2/26/2019;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

150 MHz Head/Verification/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.96 W/kg

150 MHz Head/Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 50.784 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 3.04 W/kg
P_{IN}=500 mW
SAR(1 g) = 1.89 W/kg; SAR(10 g) = 1.25 W/kg
Maximum value of SAR (measured) = 2.02 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0;
Info: Frequency correction
of probe conversion factor
not enabled.
Markers
W/kg
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
m

RF Exposure Lab

Plot 2

DUT: Loop 150 MHz CLA150; Type: CLA150; Serial: CLA150 - SN:4002

Communication System: CW; Frequency: 150 MHz; Duty Cycle: 1:1
Medium: MSL150; Medium parameters used: f = 150 MHz; σ = 0.81 S/m; ε_r = 61.82; ρ = 1000 kg/m^3
Phantom section: Flat Section

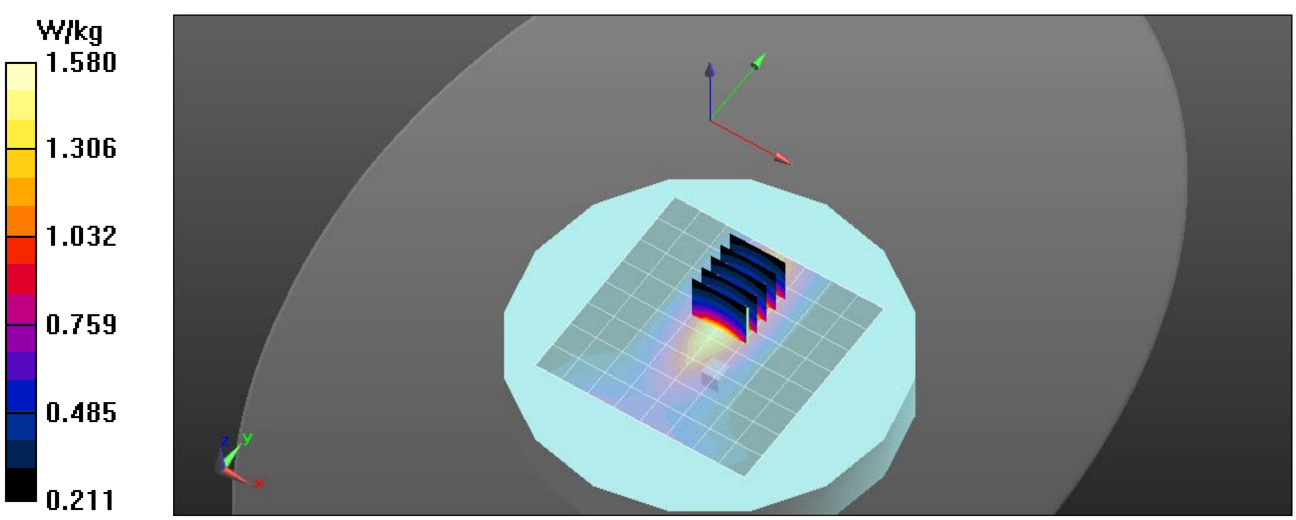
Test Date: Date: 4/4/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

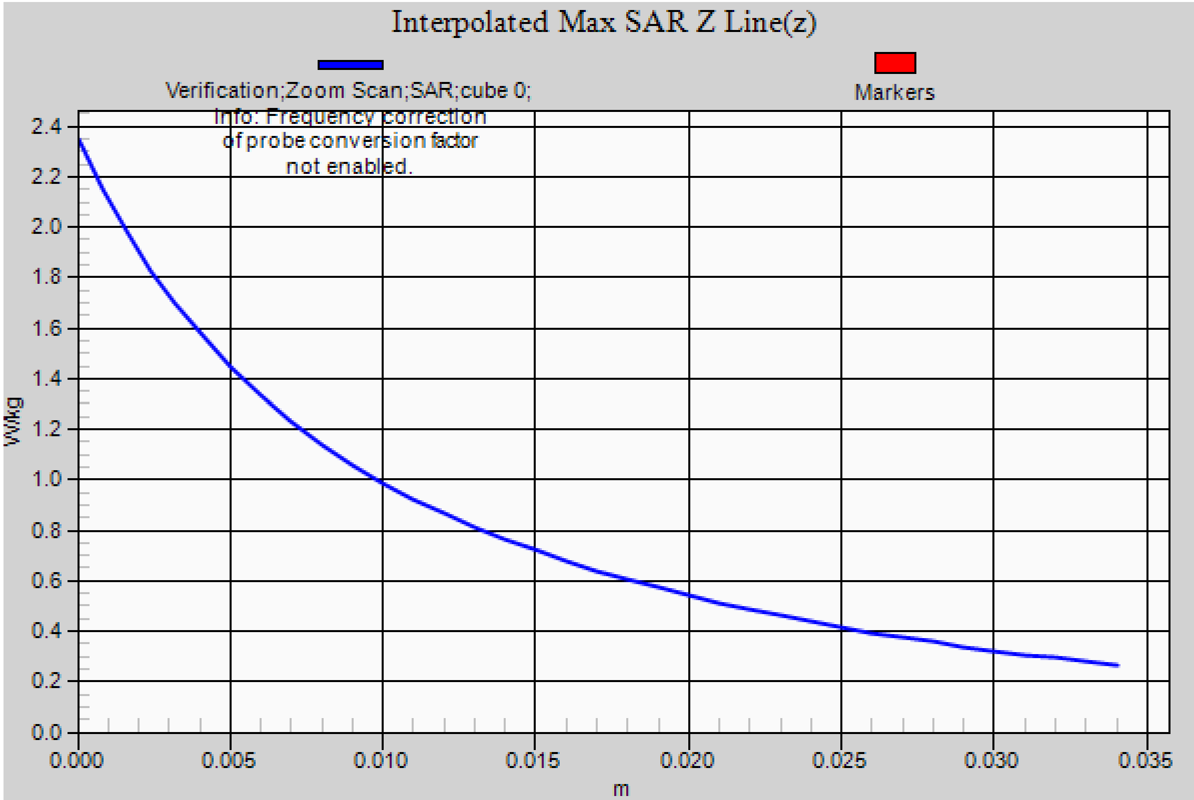
Probe: ES3DV3 - SN3311; ConvF(7.26, 7.26, 7.26); Calibrated: 2/26/2019;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

150 MHz Body/Verification/Area Scan (9x9x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.55 W/kg

150 MHz Body/Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 41.771 V/m; Power Drift = -0.00 dB
Peak SAR (extrapolated) = 2.35 W/kg
P_{IN}=500 mW
SAR(1 g) = 1.98 W/kg; SAR(10 g) = 1.32 W/kg
Maximum value of SAR (measured) = 1.58 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0;
Info: Frequency correction of probe conversion factor not enabled.
Markers
W/kg
m
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035

RF Exposure Lab

Plot 3

DUT: Dipole 450 MHz D450V2; Type: D450V2; Serial: D450V2 - SN:1085

Communication System: CW; Frequency: 450 MHz; Duty Cycle: 1:1
Medium: HSL450; Medium parameters used: f = 450 MHz; σ = 0.88 S/m; ε_r = 43.55; ρ = 1000 kg/m^3
Phantom section: Flat Section

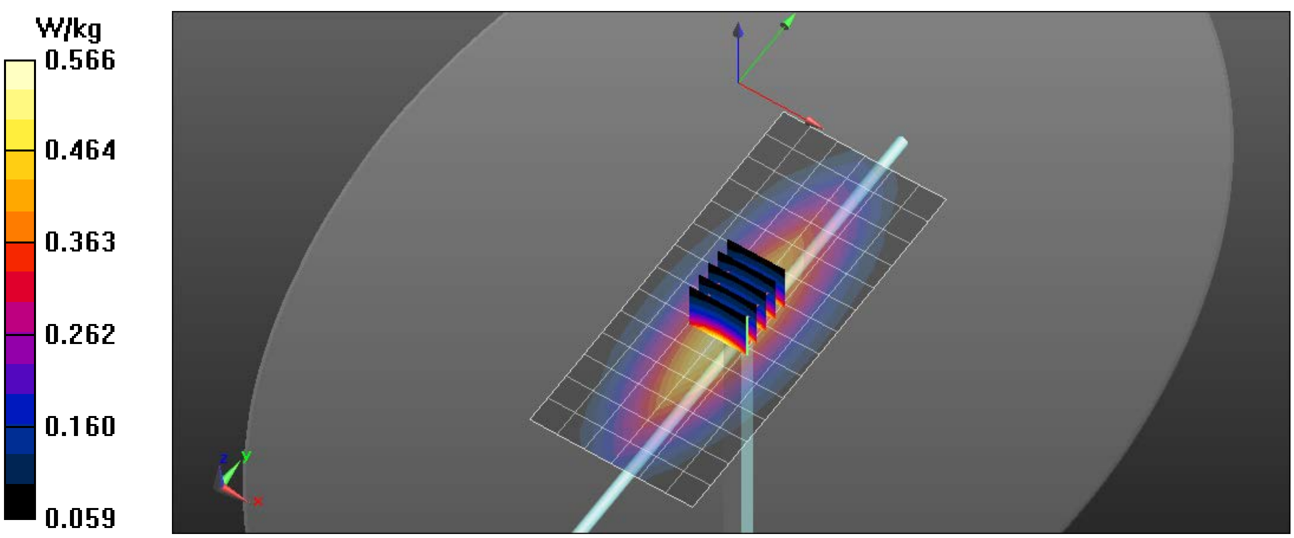
Test Date: Date: 4/3/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

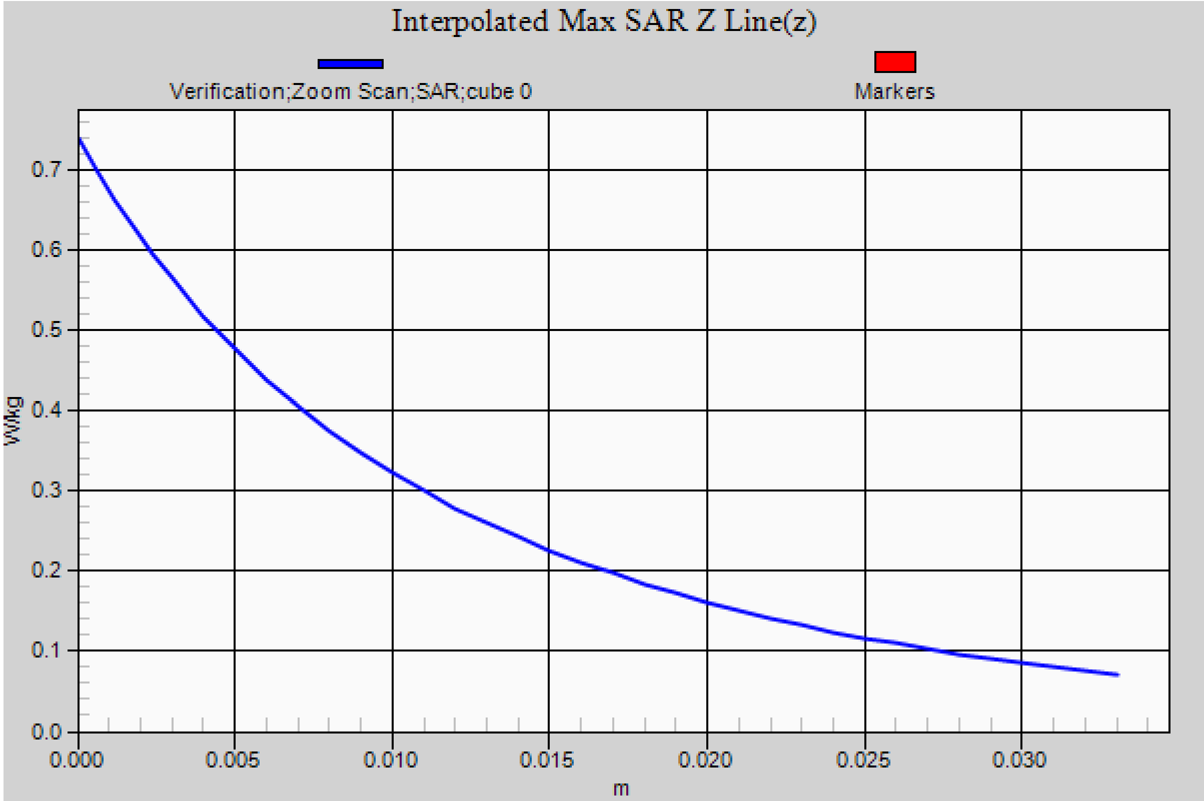
Probe: ES3DV3 – SN3311; ConvF(7.06, 7.06, 7.06); Calibrated: 2/26/2019;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

450 MHz Head/Verification/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.560 W/kg

450 MHz Head/Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.573 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.739 W/kg
P_{IN}=100 mW
SAR(1 g) = 0.455 W/kg; SAR(10 g) = 0.304 W/kg
Maximum value of SAR (measured) = 0.566 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
W/kg
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

RF Exposure Lab

Plot 4

DUT: Dipole 450 MHz D450V2; Type: D450V2; Serial: D450V2 - SN:1085

Communication System: CW; Frequency: 450 MHz; Duty Cycle: 1:1
Medium: MSL450; Medium parameters used: f = 450 MHz; σ = 0.93 S/m; ε_r = 56.66; ρ = 1000 kg/m^3
Phantom section: Flat Section

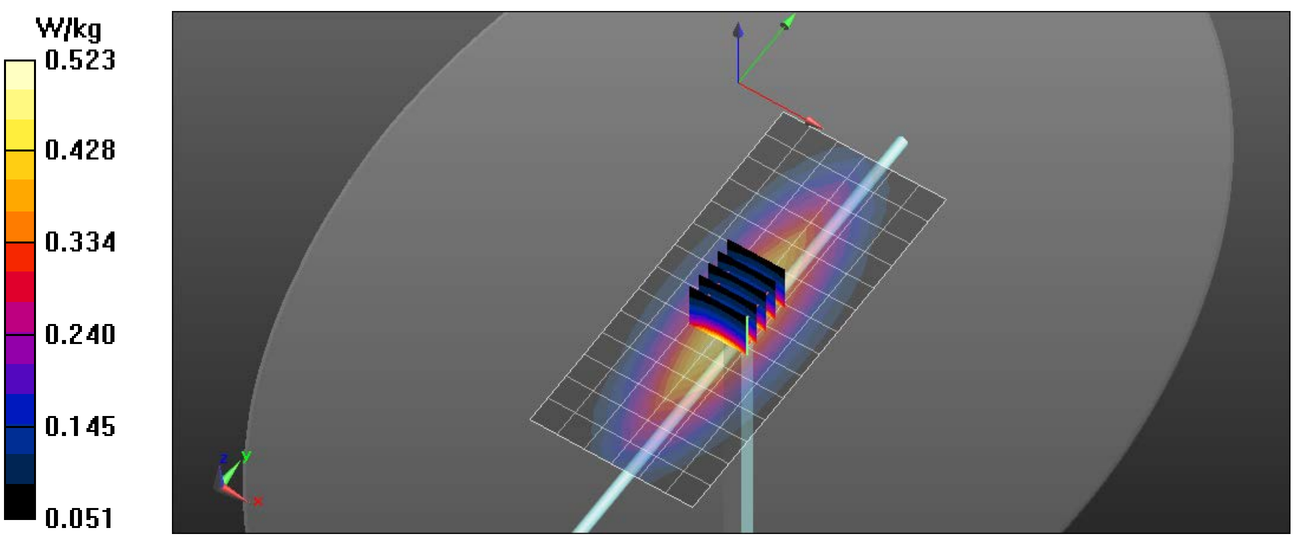
Test Date: Date: 4/3/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

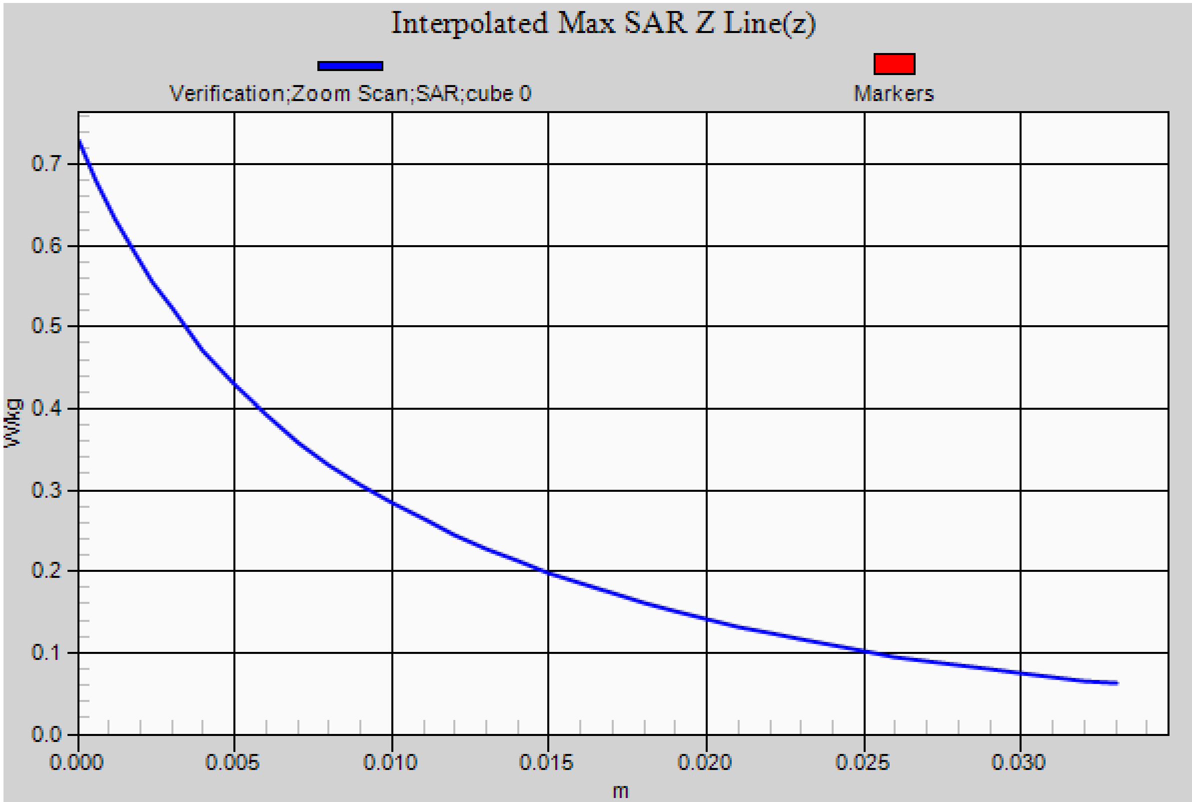
Probe: ES3DV3 – SN3311; ConvF(6.93, 6.93, 6.93); Calibrated: 2/26/2019;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

450 MHz Body/Verification/Area Scan (7x15x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.513 W/kg

450 MHz Body/Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.573 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 0.729 W/kg
P_{IN}=100 mW
SAR(1 g) = 0.457 W/kg; SAR(10 g) = 0.297 W/kg
Maximum value of SAR (measured) = 0.523 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
W/kg
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

RF Exposure Lab

Plot 5

DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:4d089

Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: HSL835; Medium parameters used (interpolated): f = 835 MHz; σ = 0.915 S/m; ε_r = 41.33; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 3/29/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C
Probe: EX3DV4 - SN3662; ConvF(9.29, 9.29, 9.29); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

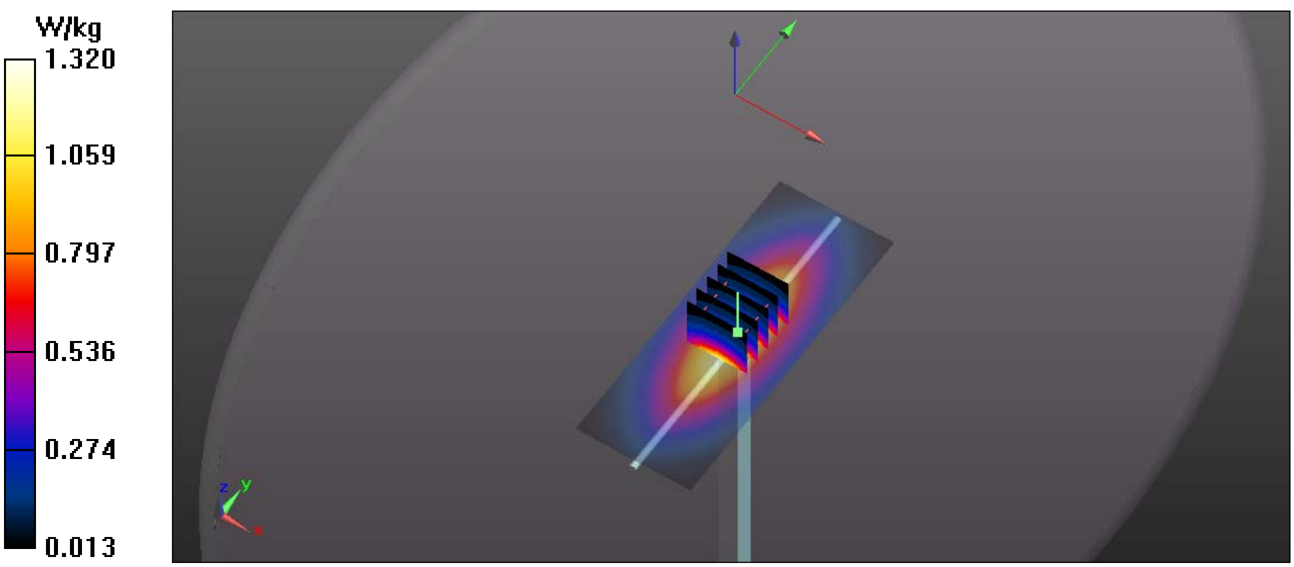
Procedure Notes:

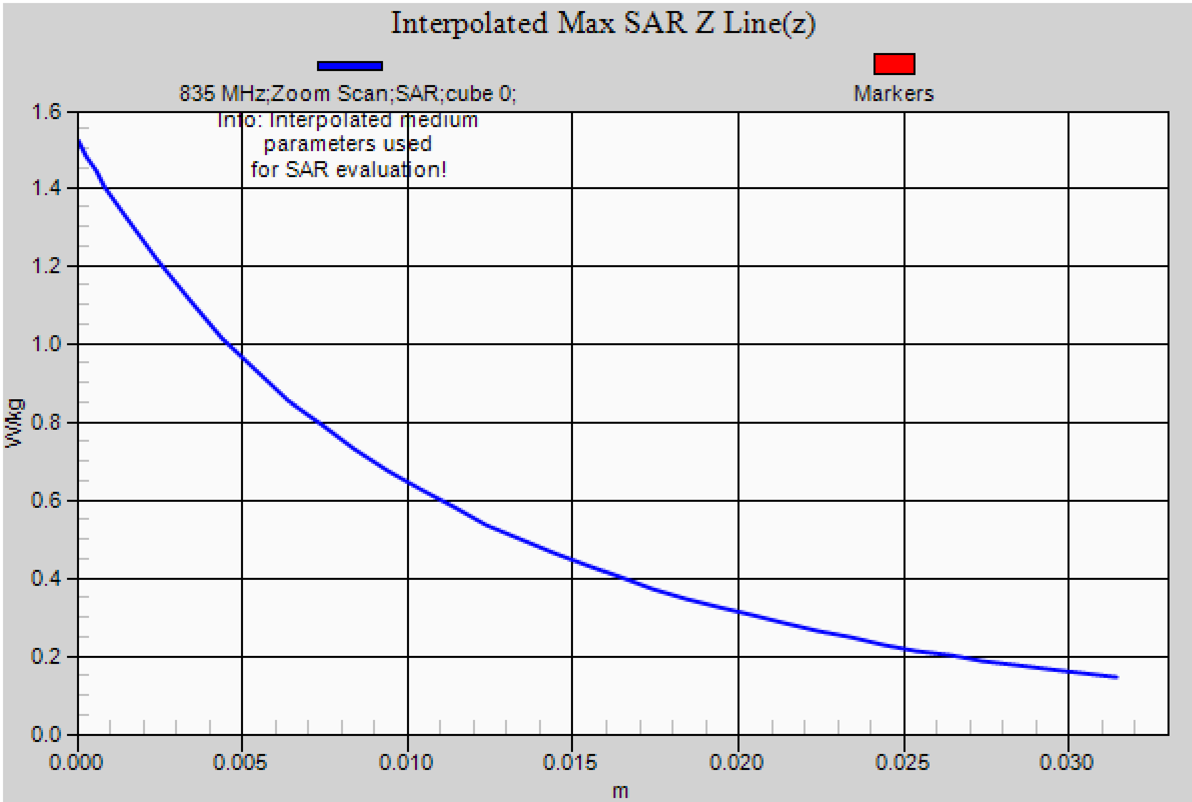
835 MHz Head Verification/Area Scan (61x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.32 W/kg

835 MHz Head Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 33.283 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 1.52 W/kg
P_{in}= 100 mW
SAR(1 g) = 0.957 W/kg; SAR(10 g) = 0.618 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.33 W/kg




Interpolated Max SAR Z Line(z)
835 MHz;Zoom Scan;SAR;cube 0;
Info: Interpolated medium parameters used for SAR evaluation!
Markers
W/kg
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

RF Exposure Lab

Plot 6

DUT: Dipole 835 MHz D835V2; Type: D835V2; Serial: D835V2 - SN:4d089

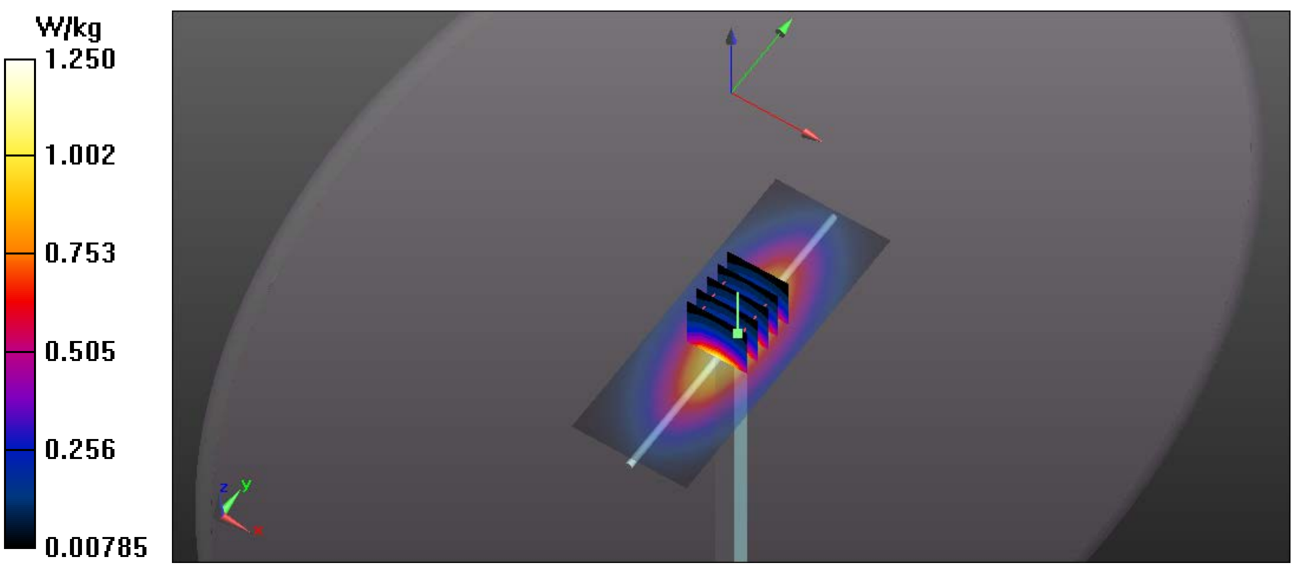
Communication System: CW; Frequency: 835 MHz; Duty Cycle: 1:1
Medium: MSL835; Medium parameters used: f = 835 MHz; σ = 0.99 S/m; ε_r = 55.91; ρ = 1000 kg/m^3
Phantom section: Flat Section

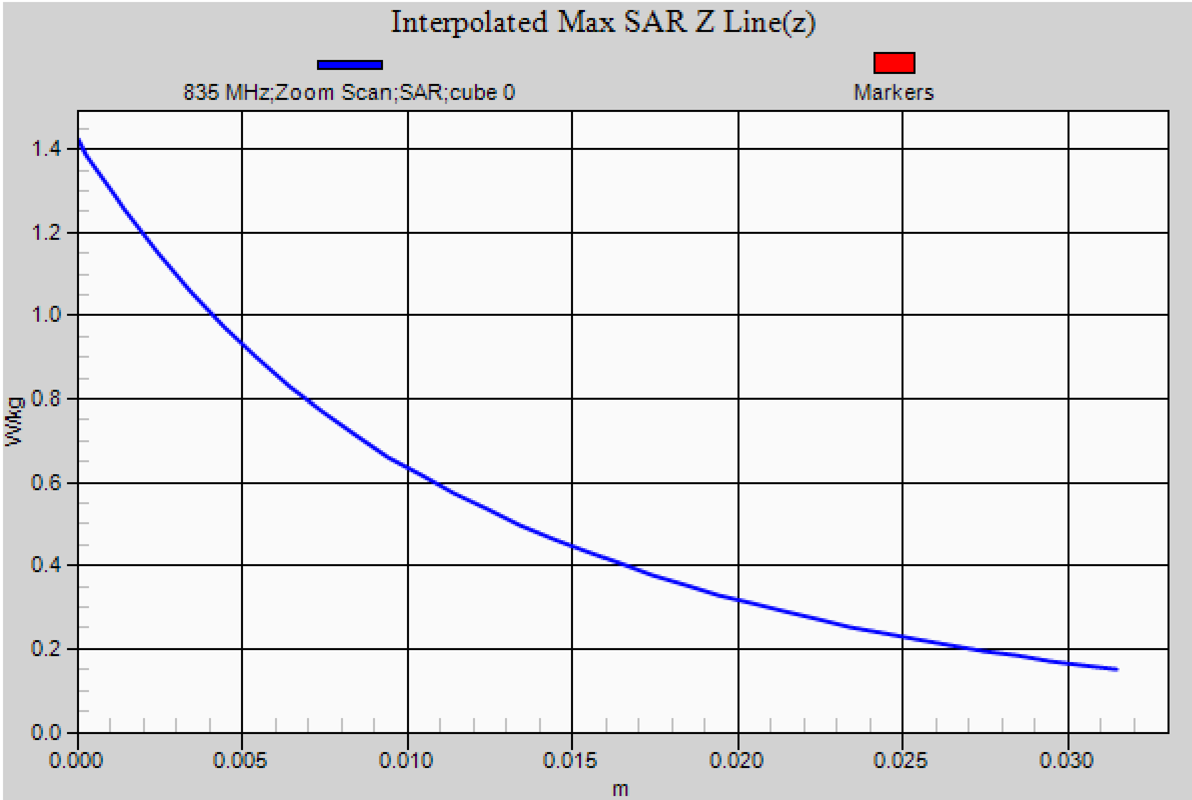
Test Date: Date: 4/2/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C
Probe: EX3DV4 - SN3662; ConvF(9.21, 9.21, 9.21); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

835 MHz Body Verification/Area Scan (61x161x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.25 W/kg

835 MHz Body Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 33.283 V/m; Power Drift = 0.01 dB
Peak SAR (extrapolated) = 1.42 W/kg
P_{in}= 100 mW
SAR(1 g) = 0.961 W/kg; SAR(10 g) = 0.628 W/kg
Maximum value of SAR (measured) = 1.25 W/kg




Interpolated Max SAR Z Line(z)
835 MHz;Zoom Scan;SAR;cube 0
Markers
W/kg
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

RF Exposure Lab

Plot 7

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN: 829

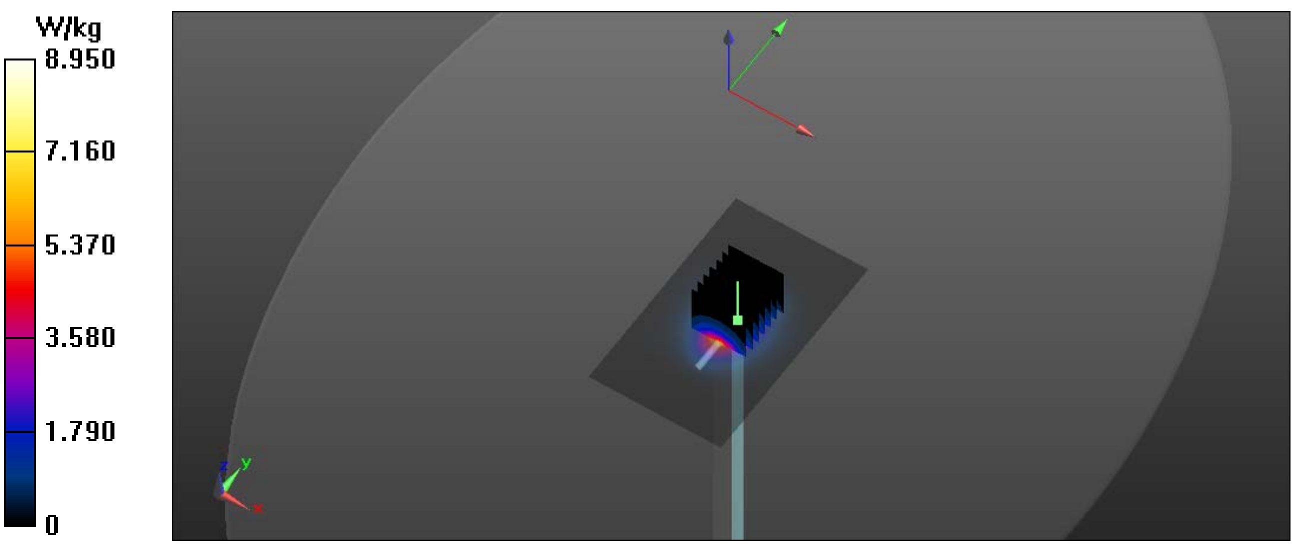
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: HSL2450; Medium parameters used: f = 2450 MHz; σ = 1.82 S/m; ε_r = 39.14; ρ = 1000 kg/m^3
Phantom section: Flat Section

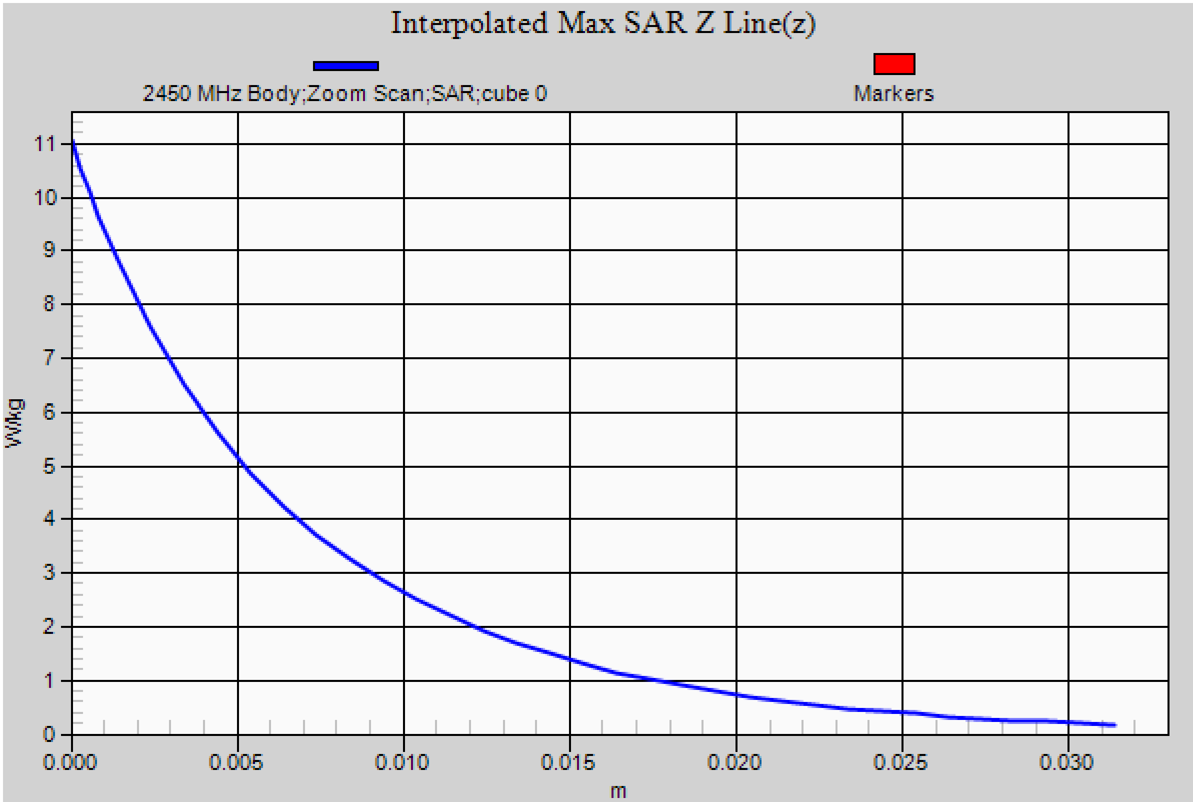
Test Date: Date: 3/28/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C
Probe: EX3DV4 - SN3662; ConvF(7.39, 7.39, 7.39); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI 4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

Head Verification/2450 MHz/Area Scan (61x101x1): Interpolated grid: dx=1.200 mm, dy=1.200 mm
Maximum value of SAR (interpolated) = 8.95 W/kg

Head Verification/2450 MHz/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 53.597 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 11.18 W/kg
P_{in}= 100 mW
SAR(1 g) = 5.22 W/kg; SAR(10 g) = 2.45 W/kg
Maximum value of SAR (measured) = 8.71 W/kg




Interpolated Max SAR Z Line(z)
2450 MHz Body;Zoom Scan;SAR;cube 0
Markers
W/kg
m
0
1
2
3
4
5
6
7
8
9
10
11
0.000
0.005
0.010
0.015
0.020
0.025
0.030

RF Exposure Lab

Plot 8

DUT: Dipole 2450 MHz D2450V2; Type: D2450V2; Serial: D2450V2 - SN:829

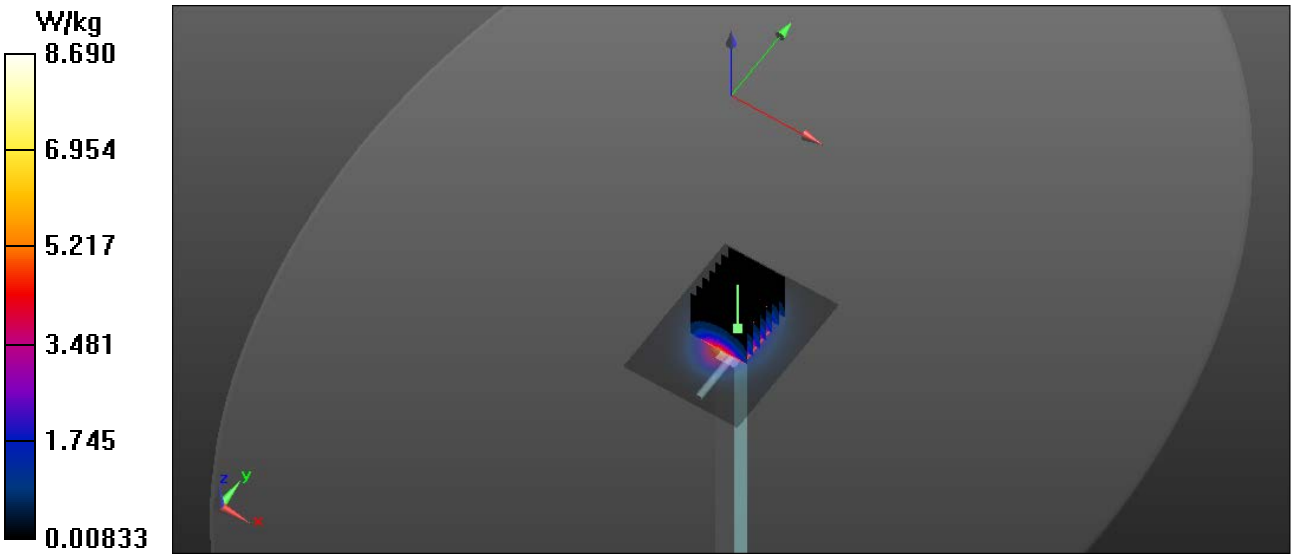
Communication System: CW; Frequency: 2450 MHz; Duty Cycle: 1:1
Medium: MSL2450; Medium parameters used: f = 2450 MHz; σ = 1.96 S/m; ε_r = 52.64; ρ = 1000 kg/m^3
Phantom section: Flat Section

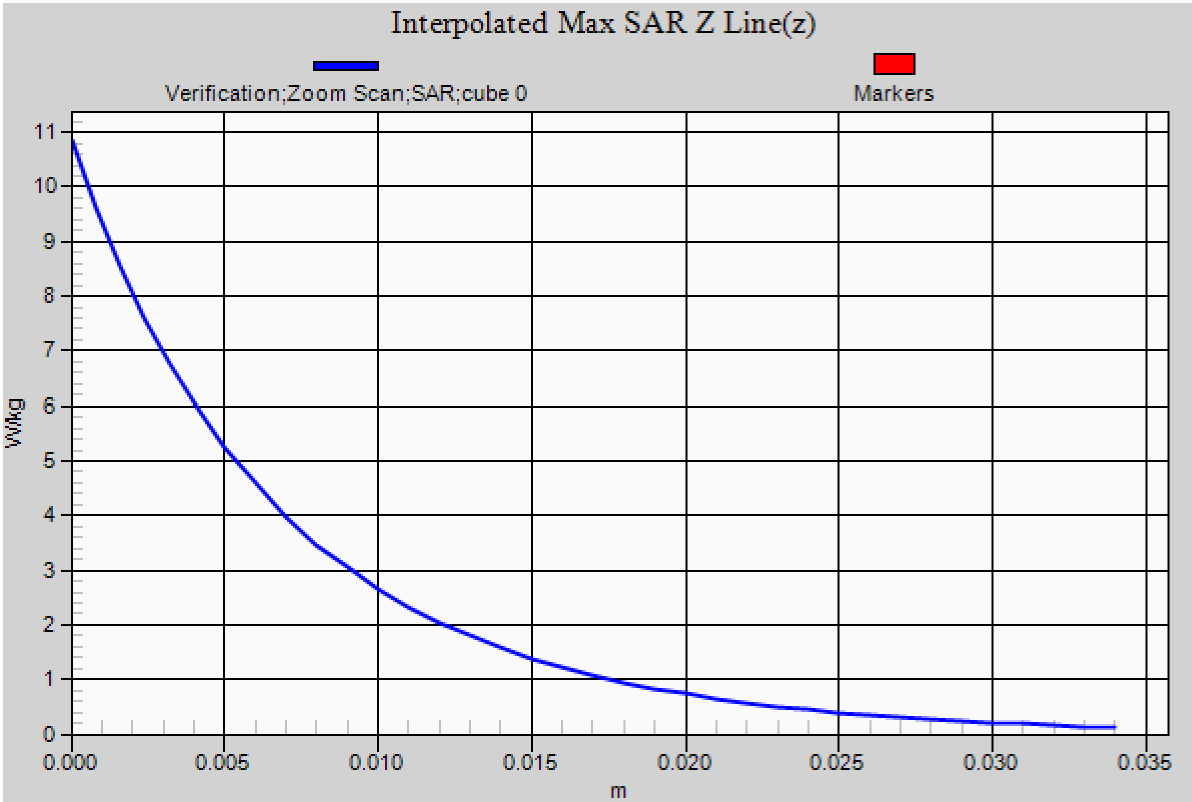
Test Date: Date: 3/28/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C
Probe: EX3DV4 - SN3662; ConvF(7.29, 7.29, 7.29); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI 4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

2450 MHz Body/Verification/Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 8.68 W/kg

2450 MHz Body/Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 55.751 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 10.7 W/kg
SAR(1 g) = 5.2 W/kg; SAR(10 g) = 2.4 W/kg
Maximum value of SAR (measured) = 5.91 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
W/kg
11
10
9
8
7
6
5
4
3
2
1
0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
0.035
m

RF Exposure Lab

Plot 9

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1085

Communication System: CW; Frequency: 5250 MHz; Duty Cycle: 1:1
Medium: HSL3-6GHz; Medium parameters used (interpolated): f = 5250 MHz; σ = 4.805 S/m; ε_r = 35.945; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 3/28/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C
Probe: EX3DV4 - SN3662; ConvF(5.04, 5.04, 5.04); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI 4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

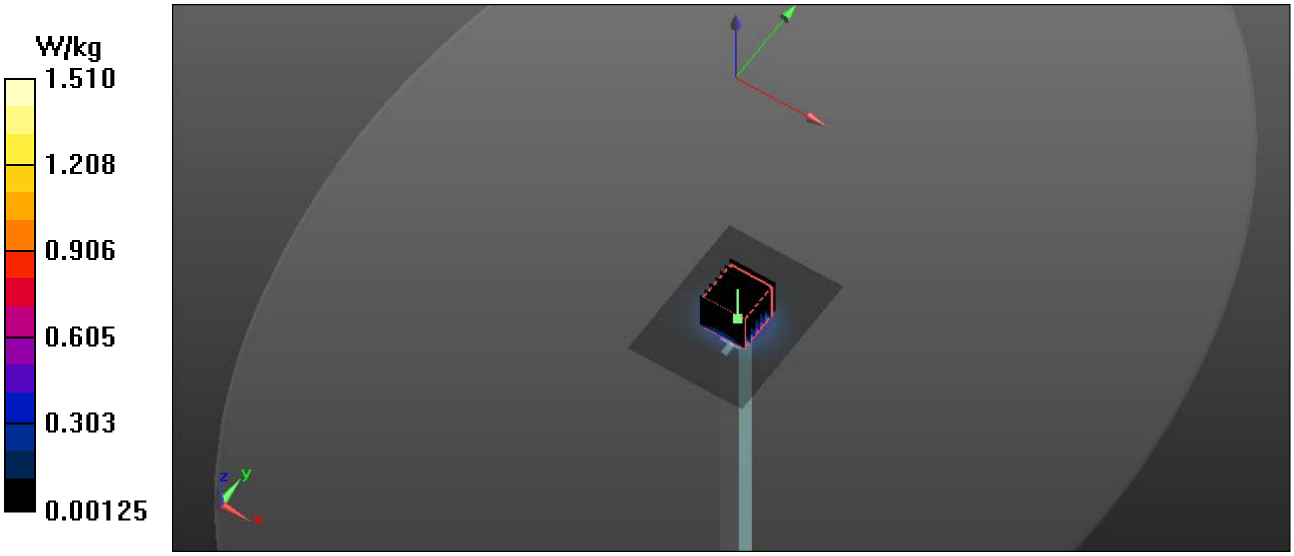
Procedure Notes:

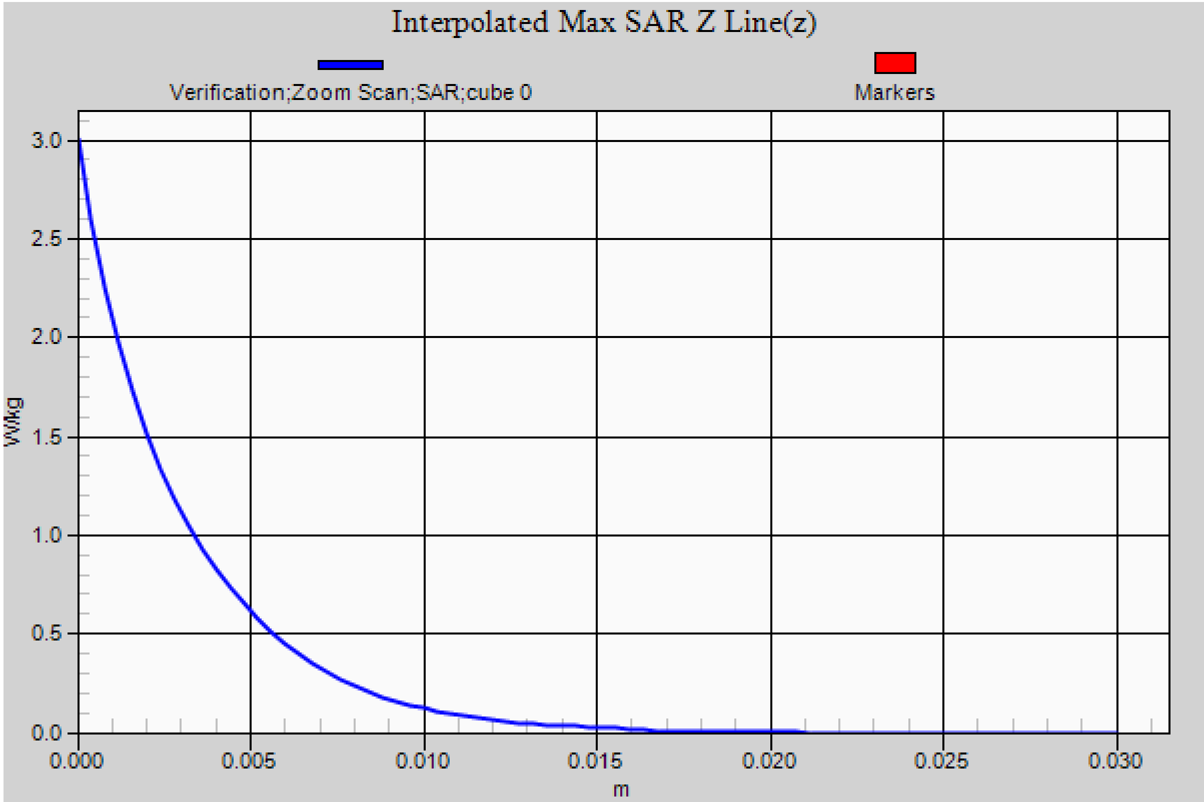
5250 MHz Head/Verification/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.5 W/kg

5250 MHz Head/Verification/Zoom Scan (8x8x15)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 58.697 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.06 W/kg
SAR(1 g) = 0.821 W/kg; SAR(10 g) = 0.240 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.96 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
W/kg
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

RF Exposure Lab

Plot 10

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1085

Communication System: CW; Frequency: 5250 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used (interpolated): f = 5250 MHz; σ = 5.35 S/m; ε_r = 48.955; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 3/27/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C
Probe: EX3DV4 - SN3662; ConvF(4.46, 4.46, 4.46); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI 4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

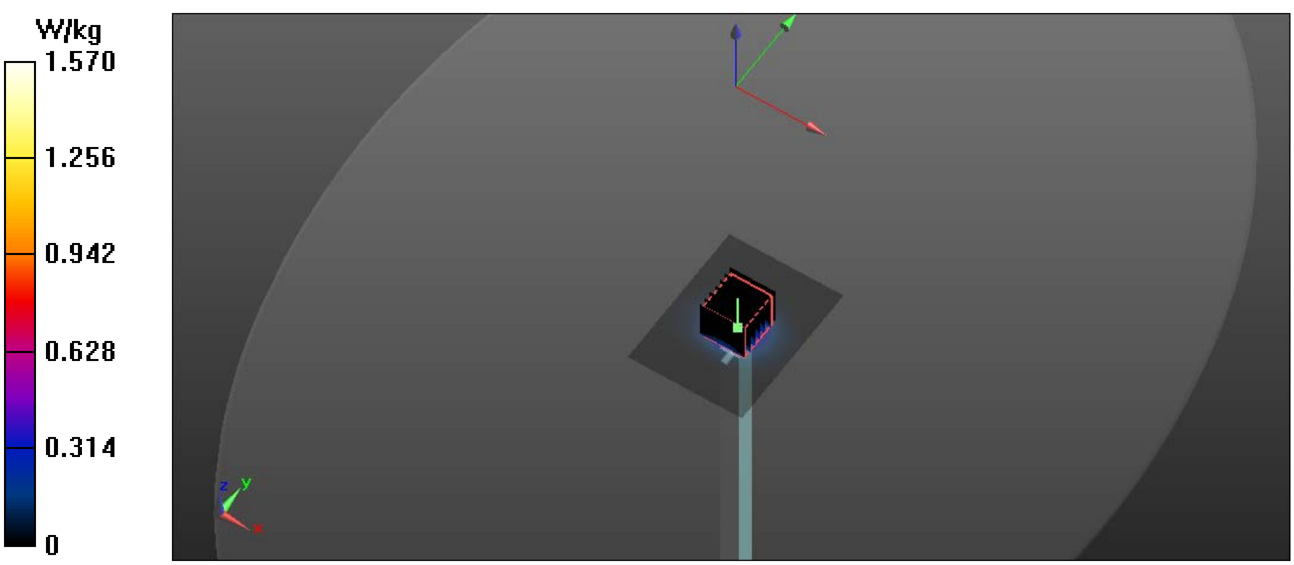
Procedure Notes:

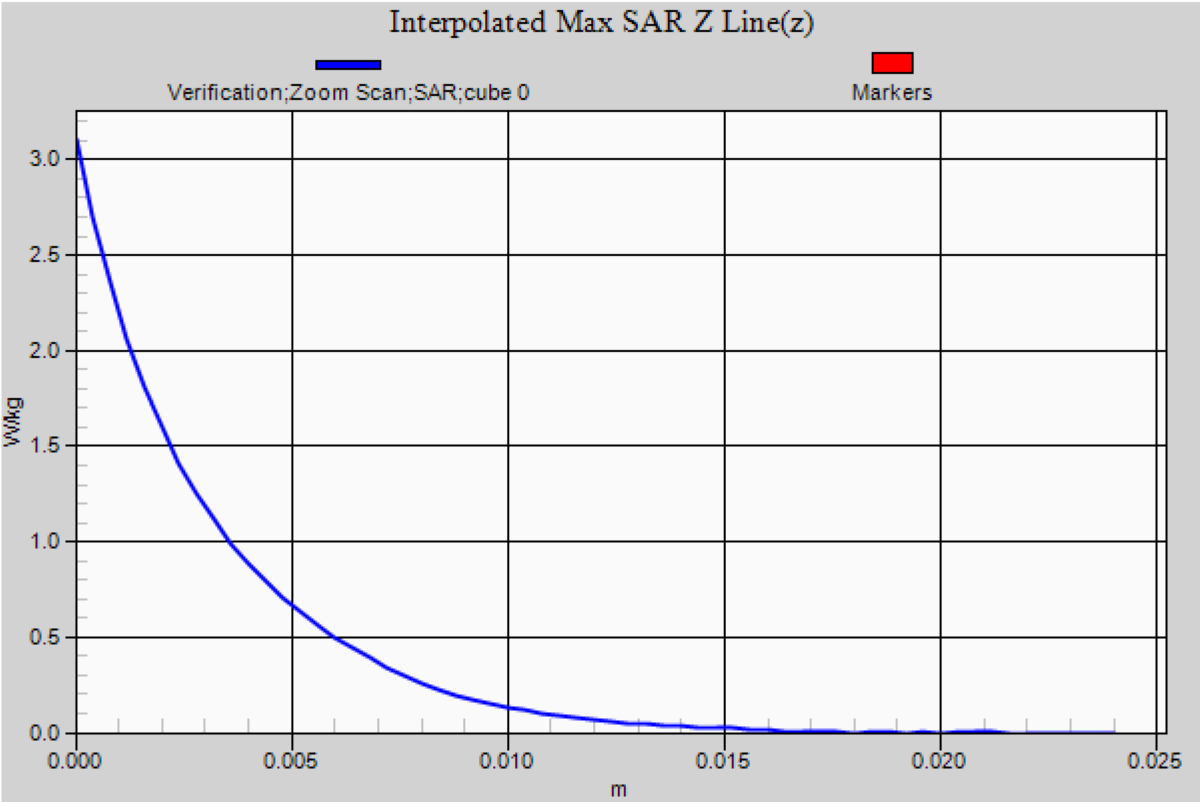
5250 MHz Body/Verification/Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.55 W/kg

5250 MHz Body/Verification/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 55.759 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 3.09 W/kg
SAR(1 g) = 0.776 W/kg; SAR(10 g) = 0.225 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.58 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
W/kg
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.000
0.005
0.010
0.015
0.020
0.025
m

RF Exposure Lab

Plot 11

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1085

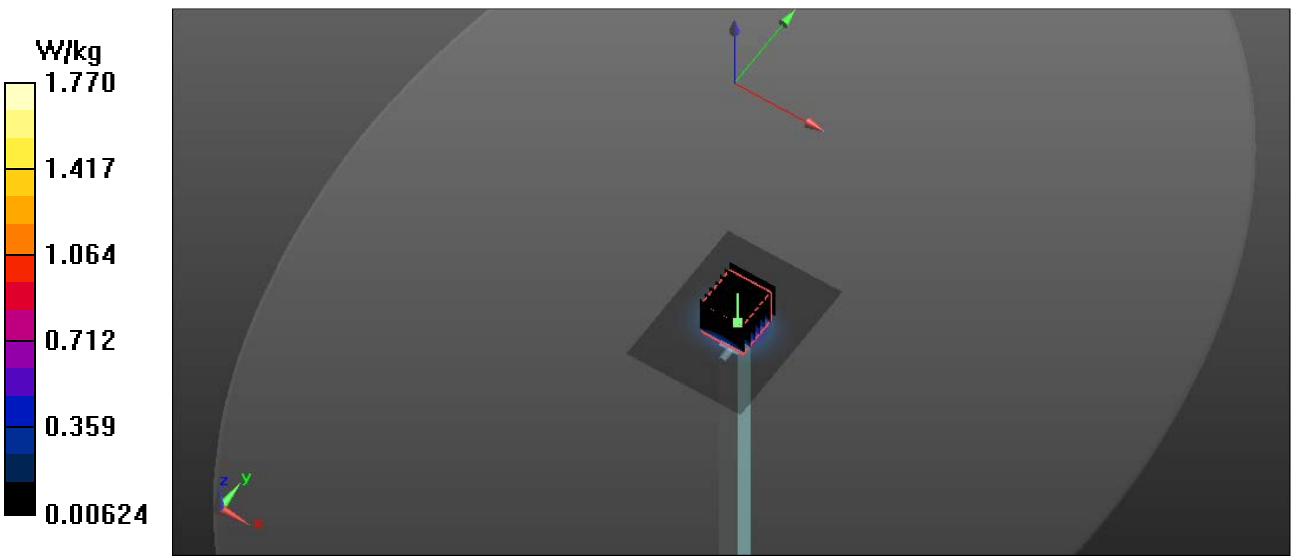
Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: HSL3-6GHz; Medium parameters used: f = 5600 MHz; σ = 5.19 S/m; ε_r = 35.53; ρ = 1000 kg/m^3
Phantom section: Flat Section

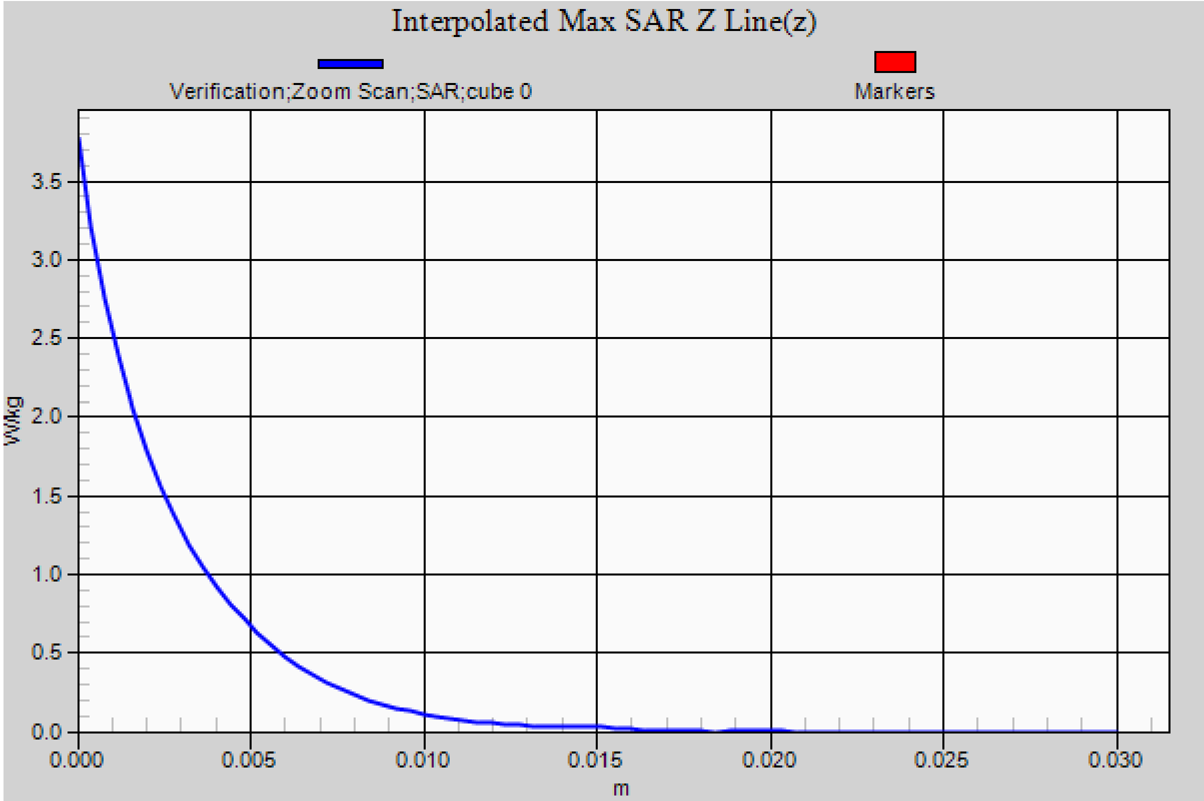
Test Date: Date: 3/28/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C
Probe: EX3DV4 - SN3662; ConvF(4.81, 4.81, 4.81); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI 4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

5600 MHz Head/Verification/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 1.75 W/kg

5600 MHz Head/Verification/Zoom Scan (8x8x15)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 13.798 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.79 W/kg
SAR(1 g) = 0.853 W/kg; SAR(10 g) = 0.241 W/kg
Maximum value of SAR (measured) = 2.03 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
W/kg
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

RF Exposure Lab

Plot 12

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1085

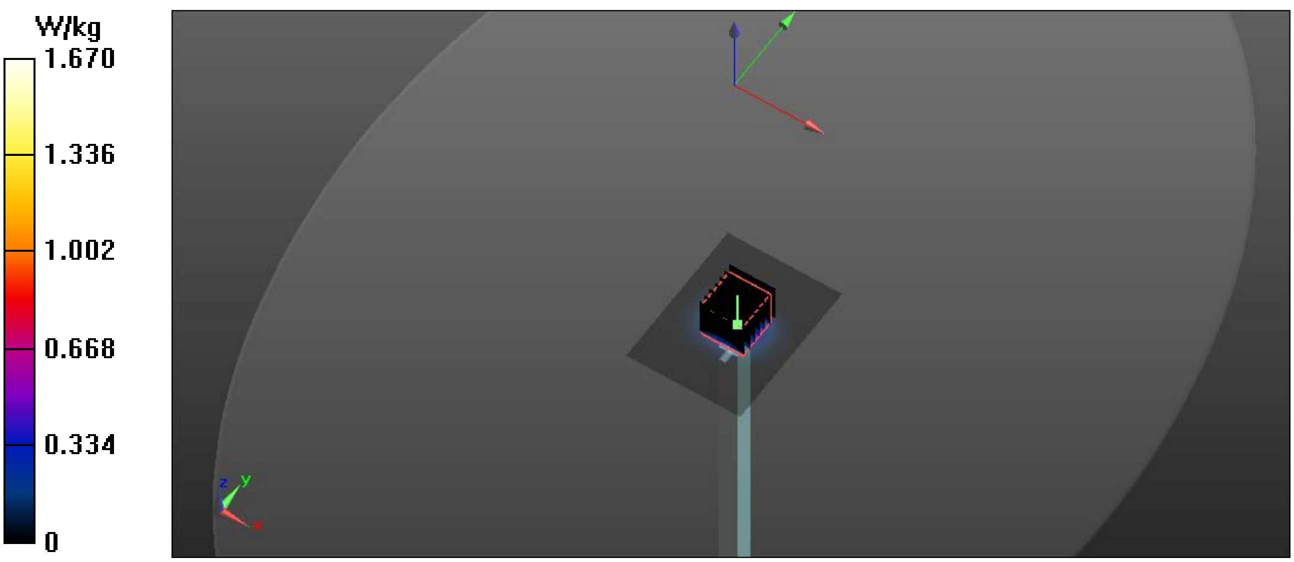
Communication System: CW; Frequency: 5600 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used: f = 5600 MHz; σ = 5.74 S/m; ε_r = 48.43; ρ = 1000 kg/m^3
Phantom section: Flat Section

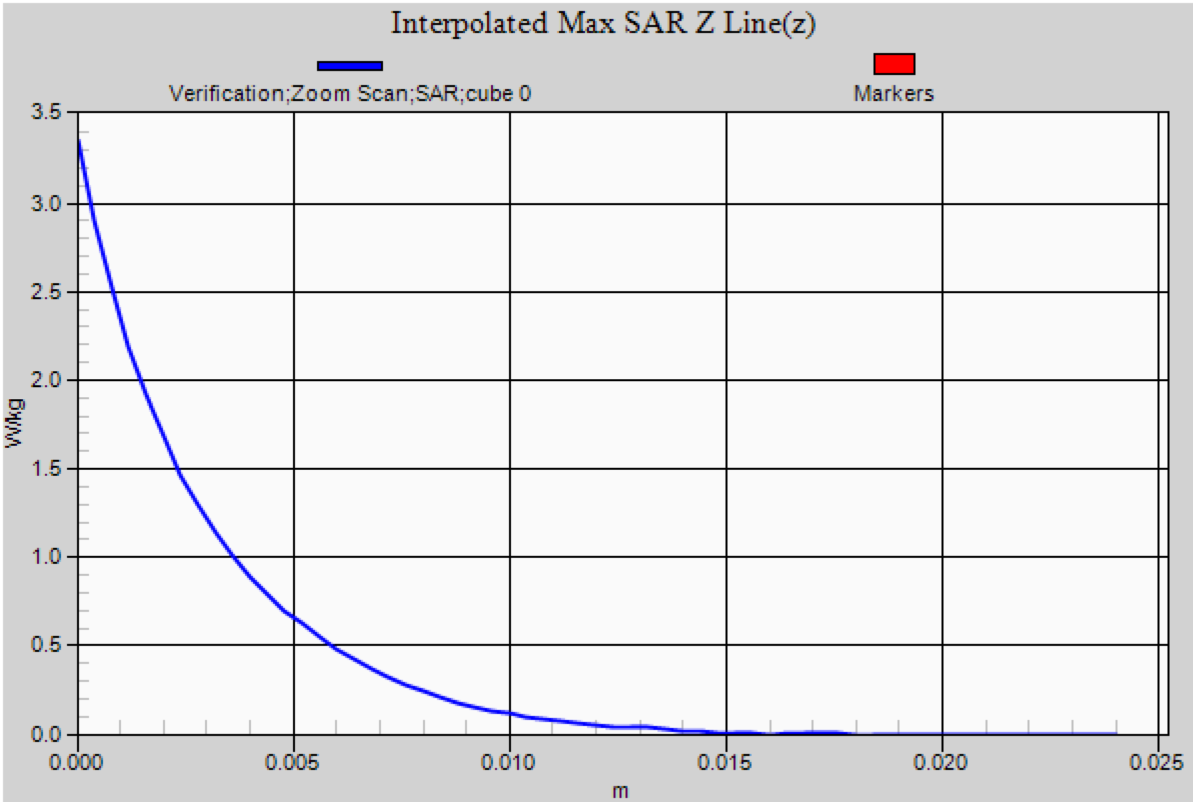
Test Date: Date: 3/27/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C
Probe: EX3DV4 - SN3662; ConvF(3.91, 3.91, 3.91); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI 4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

5600 MHz Body/Verification/Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm
Maximum value of SAR (interpolated) = 1.68 W/kg

5600 MHz Body/Verification/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 55.852 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 3.37 W/kg
SAR(1 g) = 0.791 W/kg; SAR(10 g) = 0.218 W/kg
Maximum value of SAR (measured) = 1.71 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
W/kg
0.000
0.005
0.010
0.015
0.020
0.025
m

RF Exposure Lab

Plot 13

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1085

Communication System: CW; Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: HSL3-6GHz; Medium parameters used (interpolated): f = 5750 MHz; σ = 5.36 S/m; ε_r = 35.36; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 3/28/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C
Probe: EX3DV4 - SN3662; ConvF(4.89, 4.89, 4.89); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI 4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

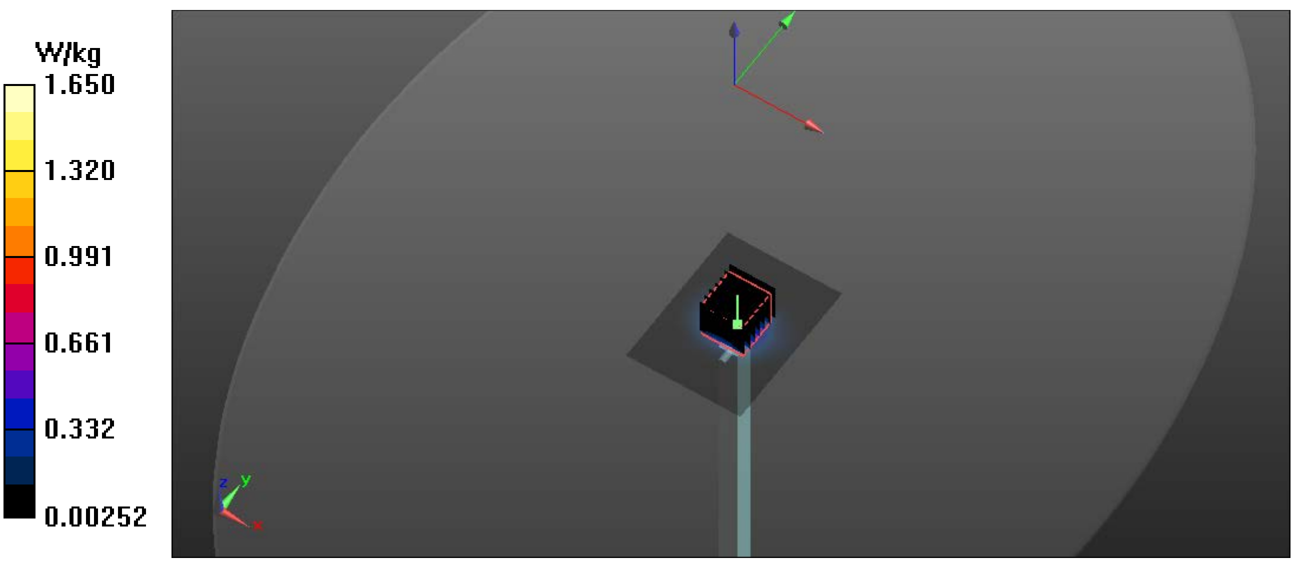
Procedure Notes:

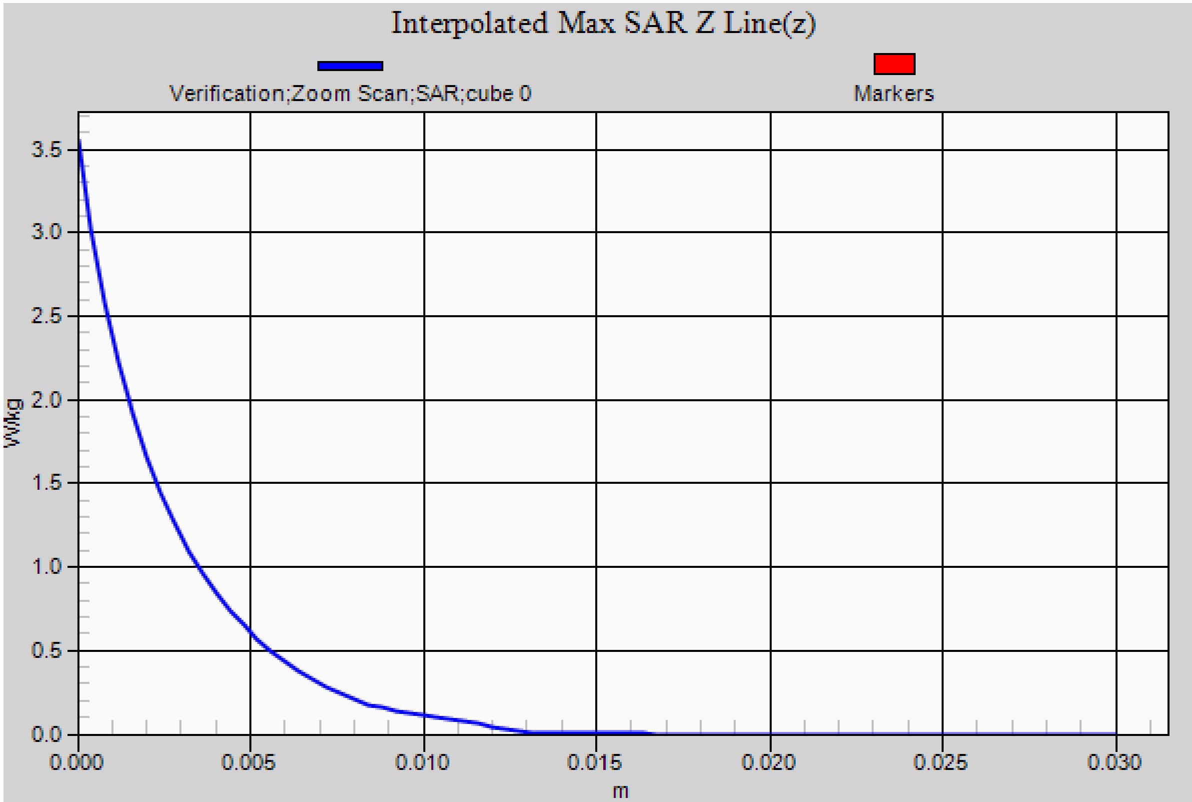
5750 MHz Head/Verification/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.67 W/kg

5750 MHz Head/Verification/Zoom Scan (8x8x15)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 12.942 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 3.59 W/kg
SAR(1 g) = 0.823 W/kg; SAR(10 g) = 0.239 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.86 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
W/kg
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.000
0.005
0.010
0.015
0.020
0.025
0.030
m

RF Exposure Lab

Plot 14

DUT: Dipole D5GHzV2; Type: D5GHzV2; Serial: D5GHzV2 - SN:1085

Communication System: CW; Frequency: 5750 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used (interpolated): f = 5750 MHz; σ = 5.91 S/m; ε_r = 48.205; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 3/27/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C
Probe: EX3DV4 - SN3662; ConvF(4.08, 4.08, 4.08); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI 4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

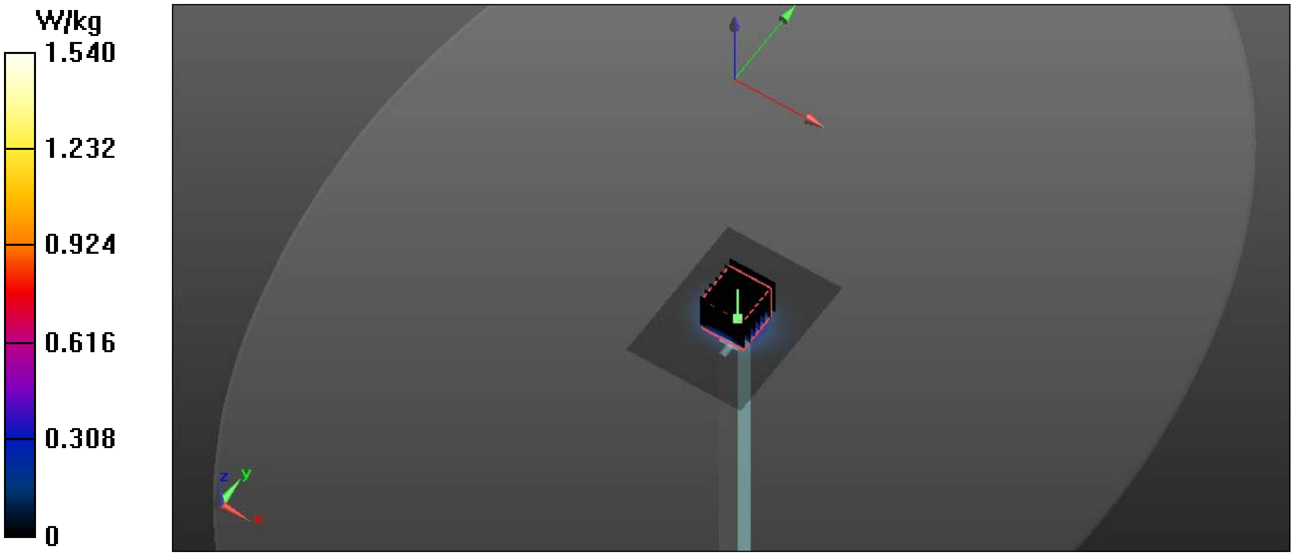
Procedure Notes:

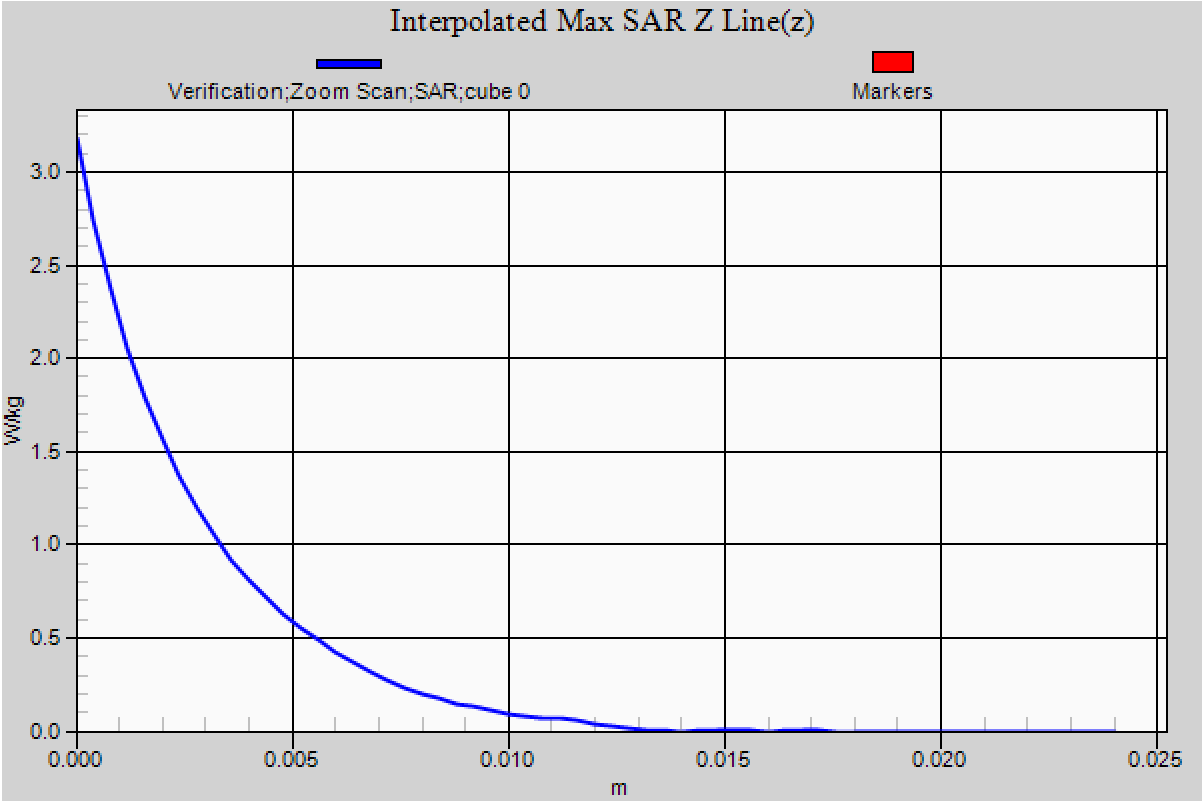
5750 MHz Body/Verification/Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 1.54 W/kg

5750 MHz Body/Verification/Zoom Scan (7x7x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 55.812 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 3.19 W/kg
SAR(1 g) = 0.766 W/kg; SAR(10 g) = 0.219 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.57 W/kg




Interpolated Max SAR Z Line(z)
Verification;Zoom Scan;SAR;cube 0
Markers
W/kg
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0.000
0.005
0.010
0.015
0.020
0.025
m

Appendix B – SAR Test Data Plots

RF Exposure Lab

Plot 1

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: FM; Frequency: 155 MHz; Duty Cycle: 1:1
Medium: HSL150; Medium parameters used (interpolated): f = 155 MHz; σ = 0.785 S/m; ε_r = 52.105; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 4/3/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: ES3DV3 - SN3311; ConvF(7.65, 7.65, 7.65); Calibrated: 2/26/2019;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

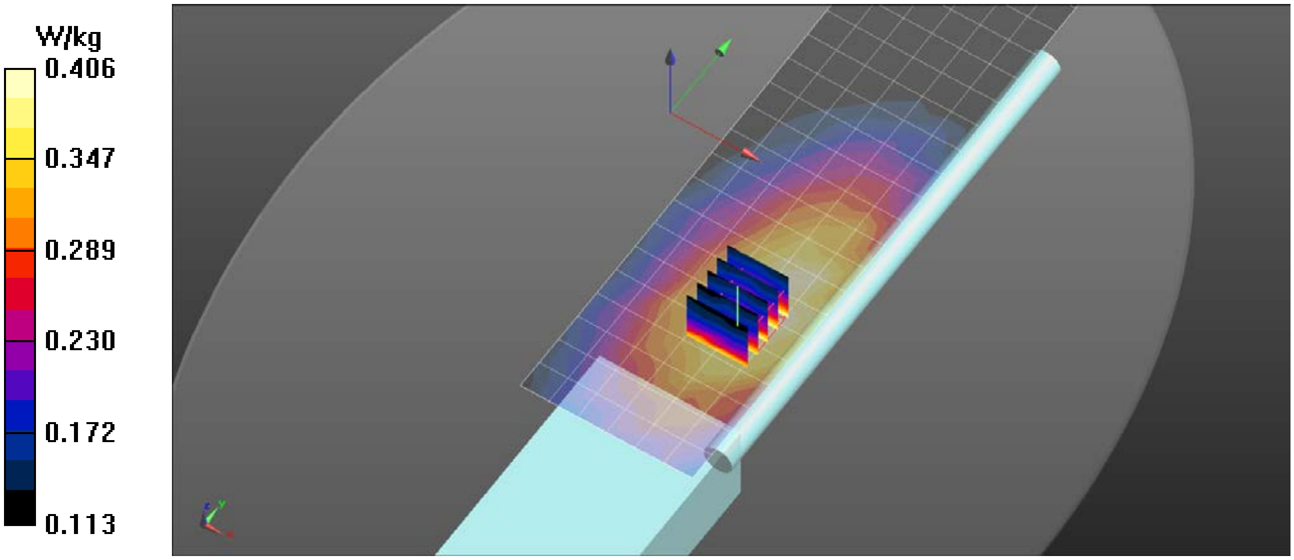
Procedure Notes:

150 MHz Head/Front 155 MHz/Area Scan (7x23x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.405 W/kg

150 MHz Head/Front 155 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 24.44 V/m; Power Drift = -0.55 dB
Peak SAR (extrapolated) = 0.477 W/kg
SAR(1 g) = 0.374 W/kg; SAR(10 g) = 0.298 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.406 W/kg



RF Exposure Lab

Plot 2

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: FM; Frequency: 155 MHz; Duty Cycle: 1:1
Medium: MSL150; Medium parameters used (interpolated): f = 155 MHz; σ = 0.815 S/m; ε_r = 61.645; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 4/4/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: ES3DV3 - SN3311; ConvF(7.26, 7.26, 7.26); Calibrated: 2/26/2019;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

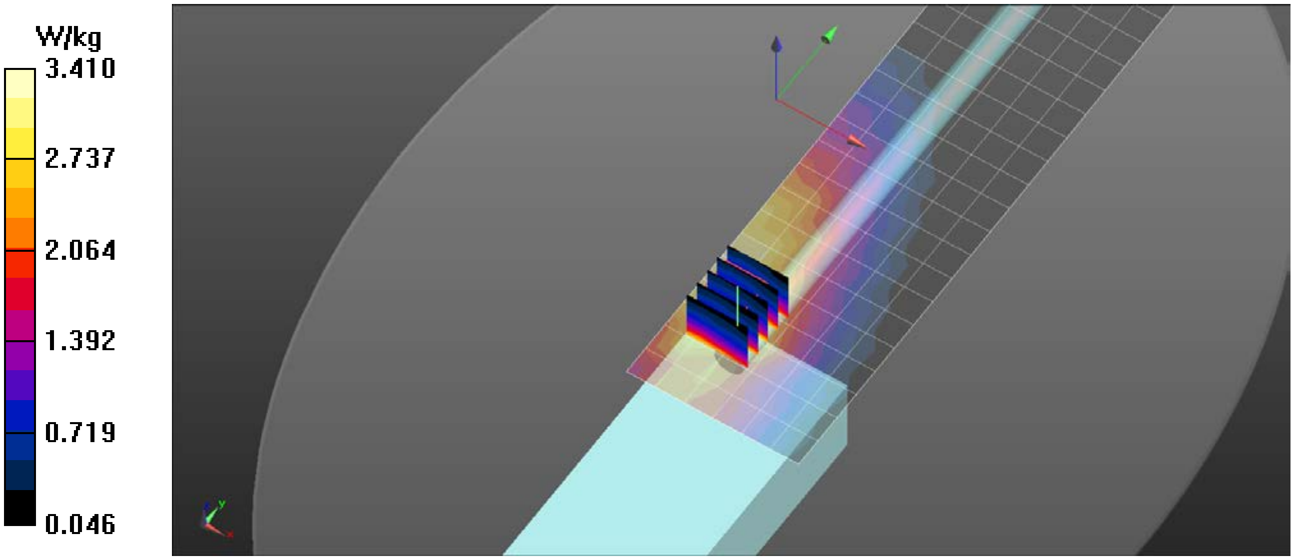
Procedure Notes:

150 MHz Body/Back 155 MHz/Area Scan (7x23x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.93 W/kg

150 MHz Body/Back 155 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 43.03 V/m; Power Drift = -0.62 dB
Peak SAR (extrapolated) = 10.0 W/kg
SAR(1 g) = 2.95 W/kg; SAR(10 g) = 0.969 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 3.41 W/kg



RF Exposure Lab

Plot 3

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: FM; Frequency: 439.8 MHz; Duty Cycle: 1:1
Medium: HSL450; Medium parameters used (interpolated): f = 439.8 MHz; σ = 0.88 S/m; ε_r = 43.662; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 4/3/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: ES3DV3 - SN3311; ConvF(7.06, 7.06, 7.06); Calibrated: 2/26/2019;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

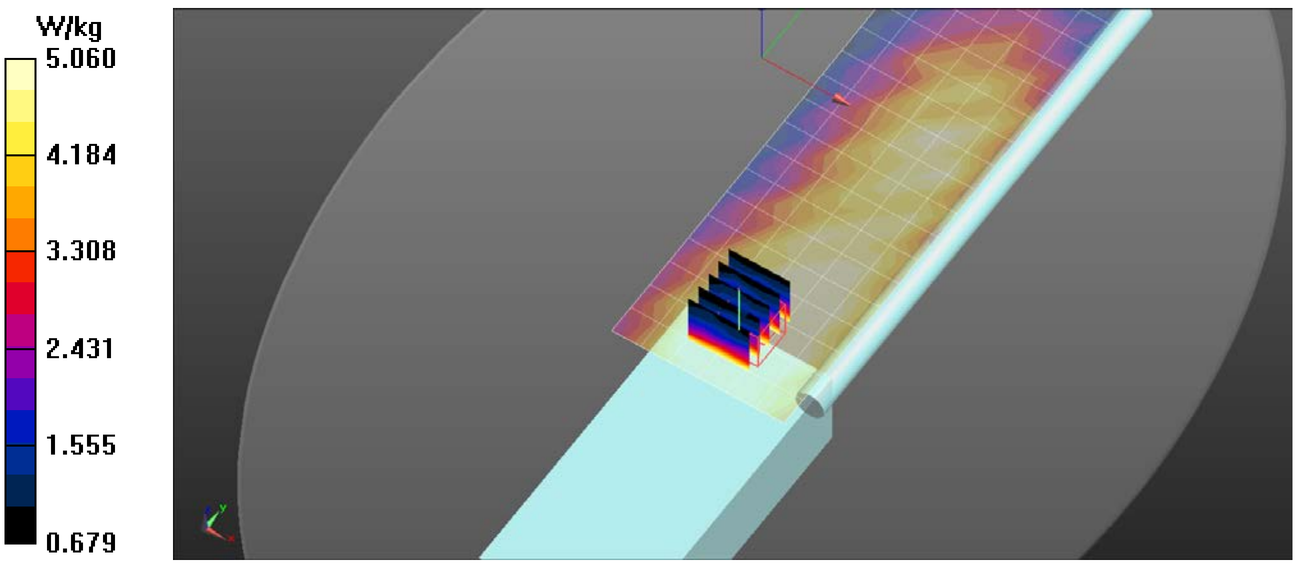
Procedure Notes:

450 MHz Head/Front 439.8 MHz/Area Scan (7x23x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 5.18 W/kg

450 MHz Head/Front 439.8 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 86.03 V/m; Power Drift = -0.43 dB
Peak SAR (extrapolated) = 5.36 W/kg
SAR(1 g) = 3.82 W/kg; SAR(10 g) = 2.68 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 4.42 W/kg



RF Exposure Lab

Plot 4

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: FM; Frequency: 439.8 MHz; Duty Cycle: 1:1
Medium: MSL450; Medium parameters used (interpolated): f = 439.8 MHz; σ = 0.949 S/m; ε_r = 56.772; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 4/4/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: ES3DV3 - SN3311; ConvF(6.93, 6.93, 6.93); Calibrated: 2/26/2019;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

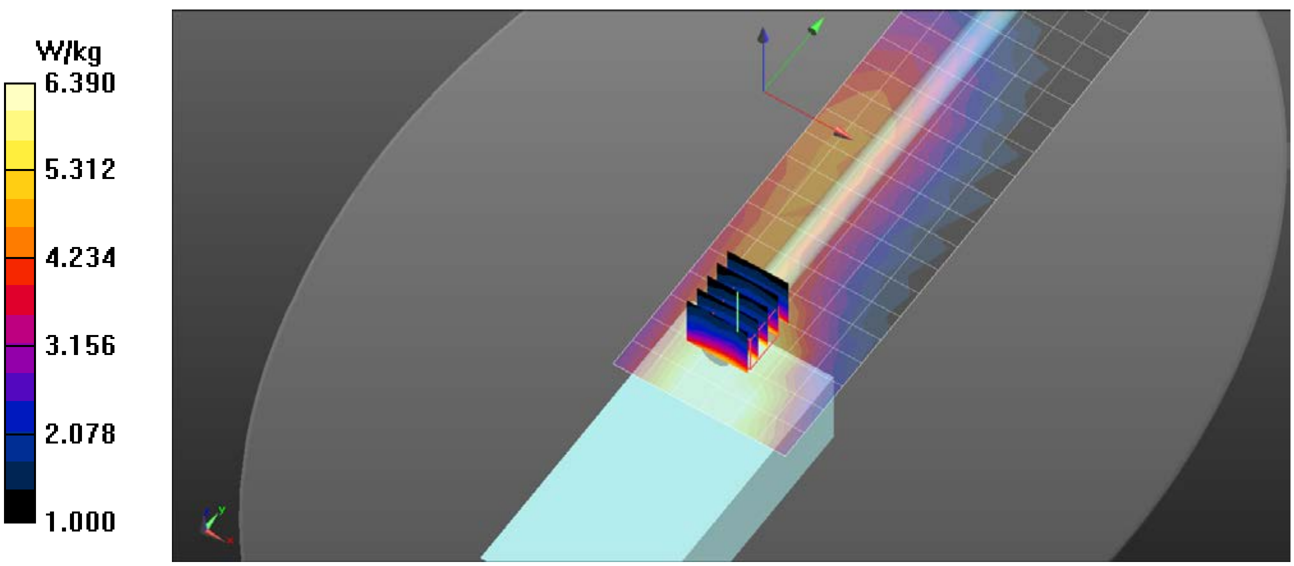
Procedure Notes:

450 MHz Body/Back 439.8 MHz/Area Scan (7x23x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 6.58 W/kg

450 MHz Body/Back 439.8 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 91.849 V/m; Power Drift = -0.54 dB
Peak SAR (extrapolated) = 7.96 W/kg
SAR(1 g) = 6.08 W/kg; SAR(10 g) = 4.51 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 6.39 W/kg



RF Exposure Lab

Plot 5

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: FM; Frequency: 851 MHz; Duty Cycle: 1:1
Medium: HSL835; Medium parameters used (interpolated): f = 851 MHz; σ = 0.931 S/m; ε_r = 41.277; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 4/1/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(9.29, 9.29, 9.29); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

800 MHz Head/Front 851 MHz/Area Scan (7x23x1): Measurement grid: dx=15mm, dy=15mm

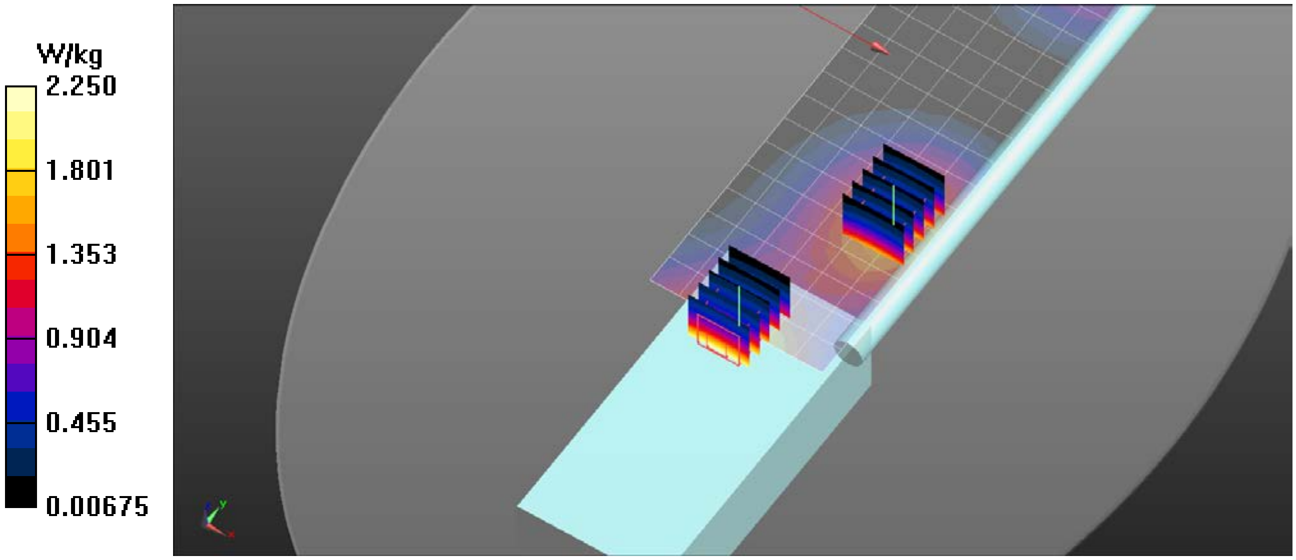
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 2.25 W/kg

800 MHz Head/Front 851 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.755 V/m; Power Drift = -0.26 dB
Peak SAR (extrapolated) = 2.819 mW/g
SAR(1 g) = 2.03 mW/g; SAR(10 g) = 1.5 mW/g

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.31 W/kg

800 MHz Head/Front 851 MHz/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.755 V/m; Power Drift = -0.26 dB
Peak SAR (extrapolated) = 2.268 W/kg
SAR(1 g) = 1.89 W/kg; SAR(10 g) = 1.41 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.06 W/kg


W/kg
2.250
1.801
1.353
0.904
0.455
0.00675

RF Exposure Lab

Plot 6

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: FM; Frequency: 851 MHz; Duty Cycle: 1:1
Medium: MSL835; Medium parameters used (interpolated): f = 851 MHz; σ = 0.996 S/m; ε_r = 55.848; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 4/2/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(9.21, 9.21, 9.21); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

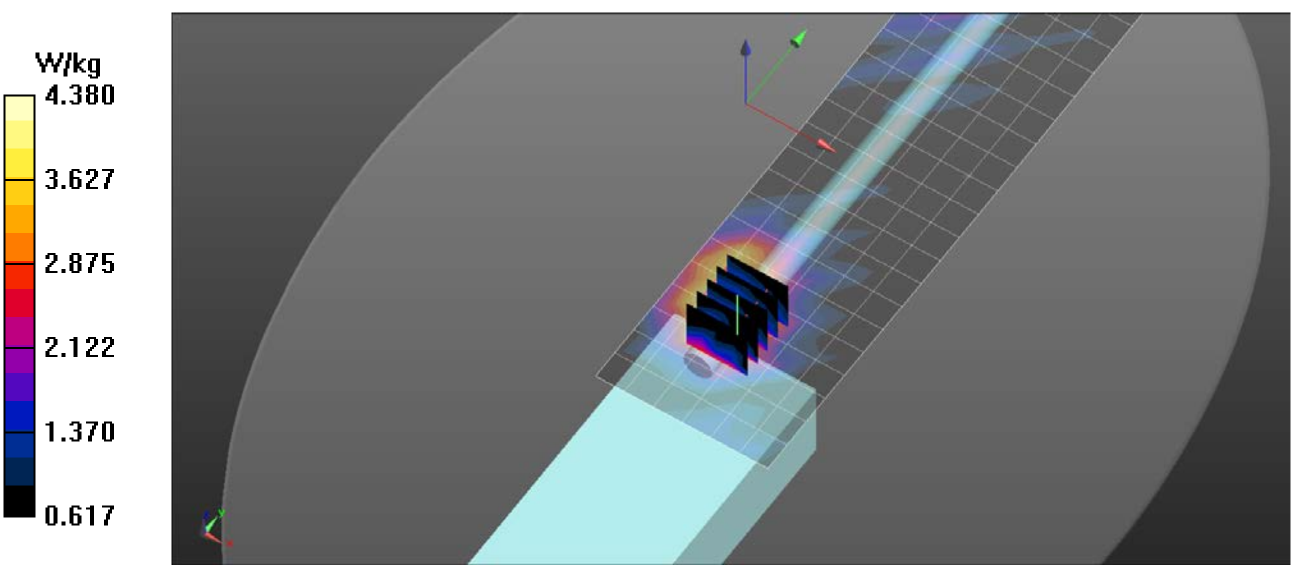
Procedure Notes:

800 MHz Body/Back 851 MHz/Area Scan (7x23x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (interpolated) = 3.99 W/kg

800 MHz Body/Back 851 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 50.111 V/m; Power Drift = -0.46 dB
Peak SAR (extrapolated) = 4.834 mW/g
SAR(1 g) = 4.75 mW/g; SAR(10 g) = 2.94 mW/g

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 4.38 W/kg



RF Exposure Lab

Plot 7

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: FM; Frequency: 898.5 MHz; Duty Cycle: 1:1
Medium: HSL835; Medium parameters used (interpolated): f = 898.5 MHz; σ = 0.979 S/m; ε_r = 41.173; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 4/1/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(9.29, 9.29, 9.29); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

900 MHz Head/Front 898.5 MHz/Area Scan (7x23x1): Measurement grid: dx=15mm, dy=15mm

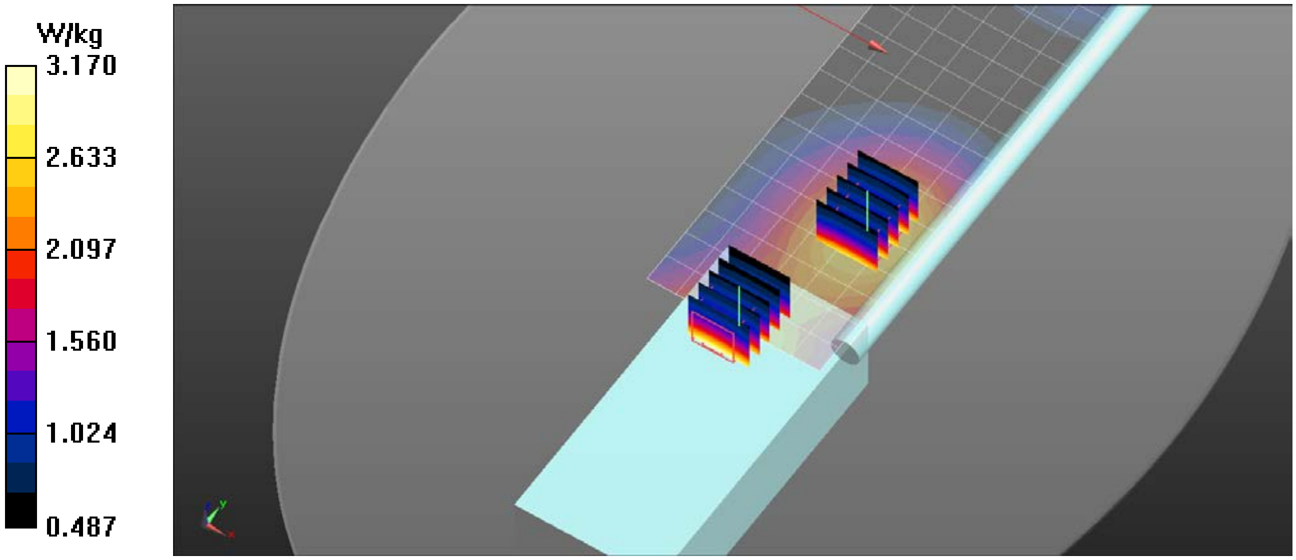
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 3.17 W/kg

900 MHz Head/Front 898.5 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 59.654 V/m; Power Drift = -0.55 dB
Peak SAR (extrapolated) = 3.70 W/kg
SAR(1 g) = 2.87 W/kg; SAR(10 g) = 2.16 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 3.17 W/kg

900 MHz Head/Front 898.5 MHz/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 59.654 V/m; Power Drift = -0.55 dB
Peak SAR (extrapolated) = 3.05 W/kg
SAR(1 g) = 2.52 W/kg; SAR(10 g) = 1.91 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 2.95 W/kg


W/kg
3.170
2.633
2.097
1.560
1.024
0.487

RF Exposure Lab

Plot 8

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: FM; Frequency: 898.5 MHz; Duty Cycle: 1:1
Medium: MSL835; Medium parameters used (interpolated): f = 898.5 MHz; σ = 1.044 S/m; ε_r = 55.723; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 4/2/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(9.21, 9.21, 9.21); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

900 MHz Body/Back 898.5 MHz/Area Scan (7x23x1): Measurement grid: dx=15mm, dy=15mm

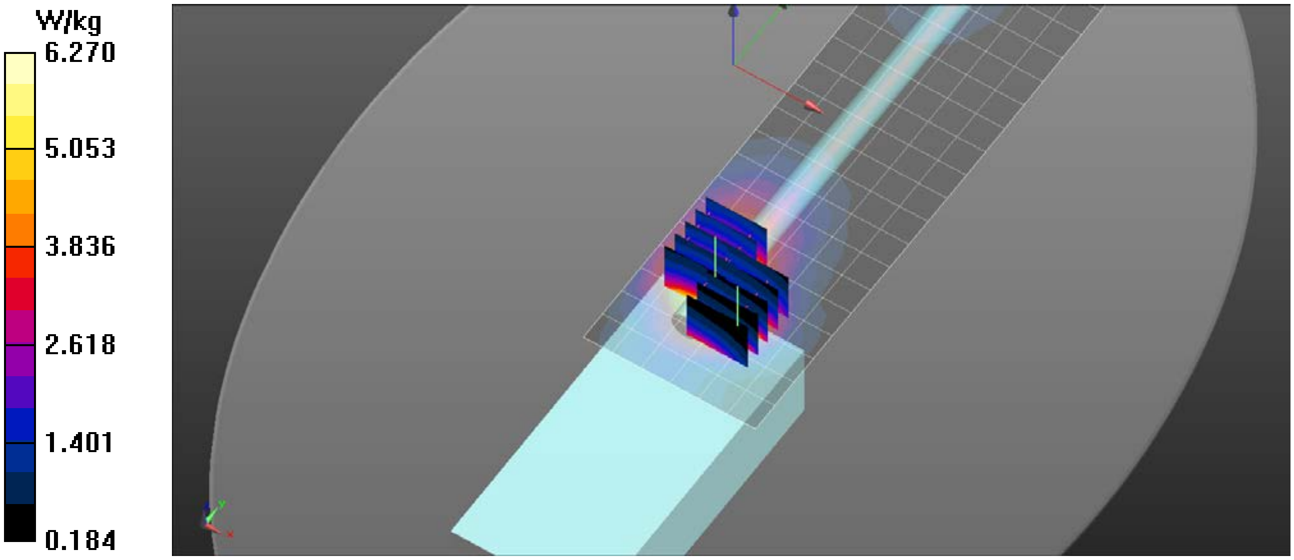
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 7.36 W/kg

900 MHz Body/Back 898.5 MHz/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 78.49 V/m; Power Drift = -0.50 dB
Peak SAR (extrapolated) = 8.36 W/kg
SAR(1 g) = 5.87 W/kg; SAR(10 g) = 3.99 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 7.17 W/kg

900 MHz Body/Back 898.5 MHz/Zoom Scan (5x5x7)/Cube 1: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 78.49 V/m; Power Drift = -0.50 dB
Peak SAR (extrapolated) = 8.60 W/kg
SAR(1 g) = 4.65 W/kg; SAR(10 g) = 3.04 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 6.27 W/kg


W/kg
6.270
5.053
3.836
2.618
1.401
0.184

RF Exposure Lab

Plot 9

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: WiFi 802.11b (DSSS, 1 Mbps); Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: HSL2450; Medium parameters used (interpolated): f = 2437 MHz; σ = 1.807 S/m; ε_r = 39.166; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 3/28/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(7.29, 7.29, 7.29); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

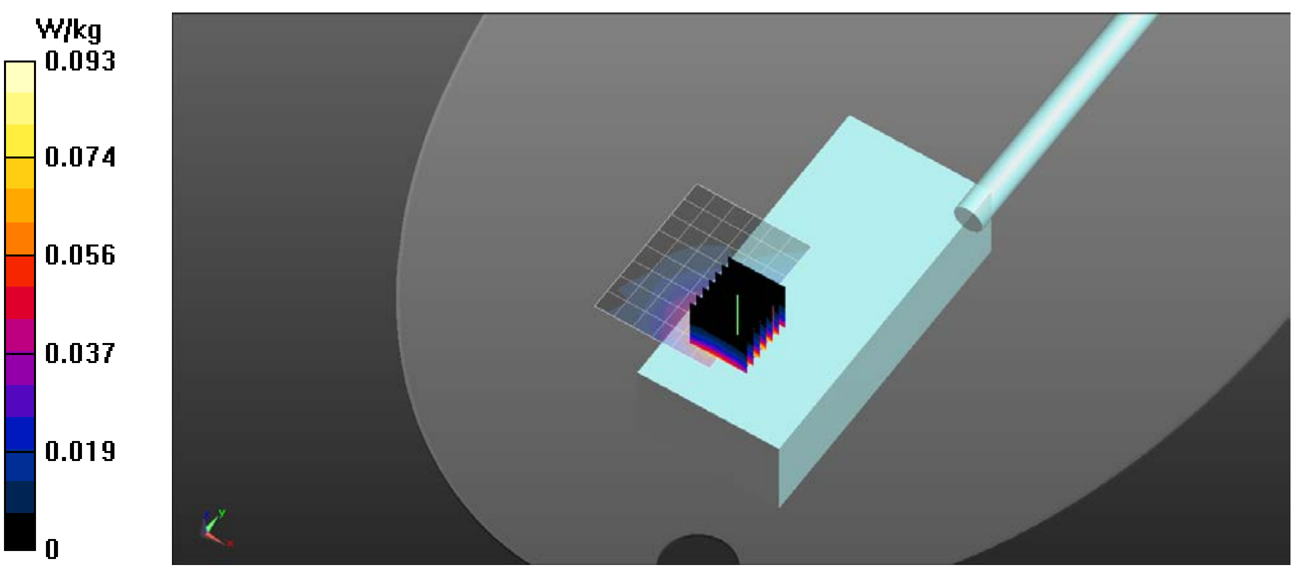
Procedure Notes:

2450 MHz Head/Front Mid/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0954 W/kg

2450 MHz Head/Front Mid/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.9580 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.124 W/kg
SAR(1 g) = 0.065 W/kg; SAR(10 g) = 0.034 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0931 W/kg



RF Exposure Lab

Plot 10

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: WiFi 802.11b (DSSS, 1 Mbps); Frequency: 2437 MHz; Duty Cycle: 1:1
Medium: MSL2450; Medium parameters used (interpolated): f = 2437 MHz; σ = 1.947 S/m; ε_r = 52.666; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 3/28/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(7.29, 7.29, 7.29); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

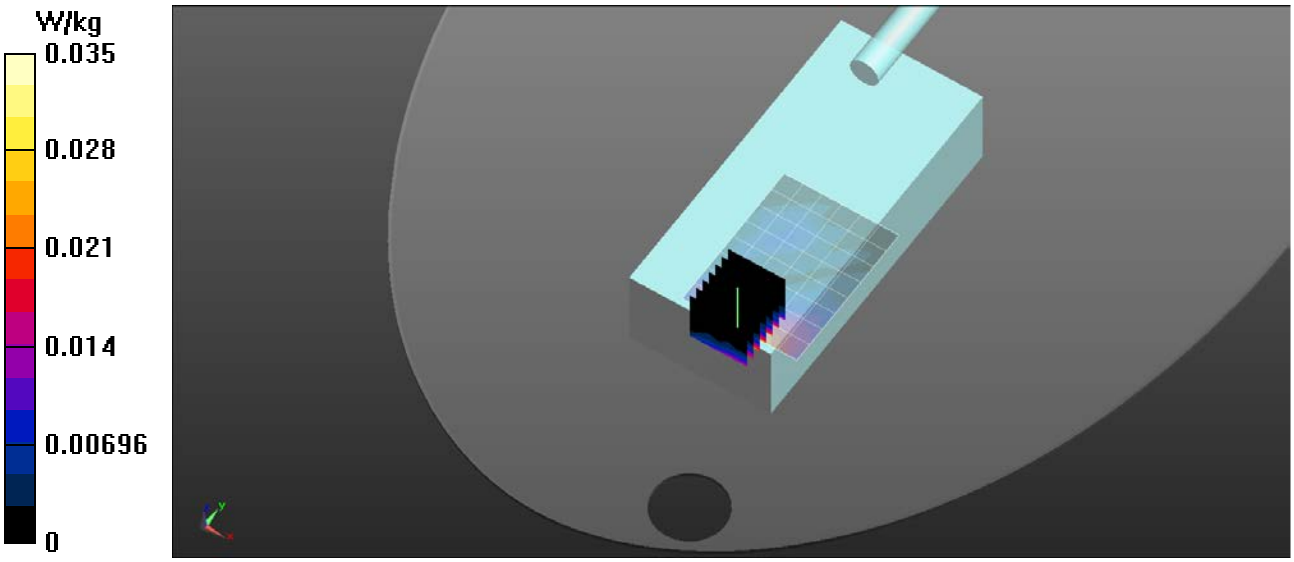
Procedure Notes:

2450 MHz Body/Back Mid/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0357 W/kg

2450 MHz Body/Back Mid/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 0.3540 V/m; Power Drift = -0.04 dB
Peak SAR (extrapolated) = 0.0500 W/kg
SAR(1 g) = 0.021 W/kg; SAR(10 g) = 0.00867 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0348 W/kg



RF Exposure Lab

Plot 11

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: HSL3-6GHz; Medium parameters used: f = 5300 MHz; σ = 4.86 S/m; ε_r = 35.87; ρ = 1000 kg/m^3
Phantom section: Flat Section

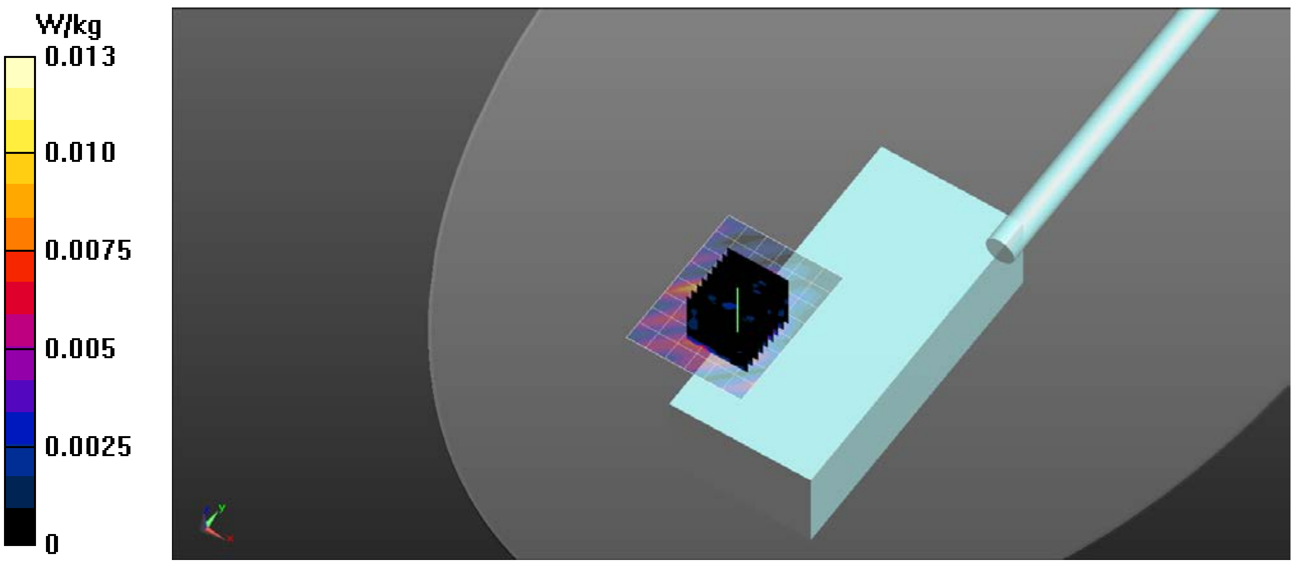
Test Date: Date: 3/28/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(5.04, 5.04, 5.04); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

5200 MHz Head/Front 60/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.0102 W/kg

5200 MHz Head/Front 60/Zoom Scan (9x9x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.0350 W/kg
SAR(1 g) = 0.00209 W/kg; SAR(10 g) = 0.000495 W/kg
Maximum value of SAR (measured) = 0.0125 W/kg



RF Exposure Lab

Plot 12

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5300 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used: f = 5300 MHz; σ = 5.41 S/m; ε_r = 48.88; ρ = 1000 kg/m^3
Phantom section: Flat Section

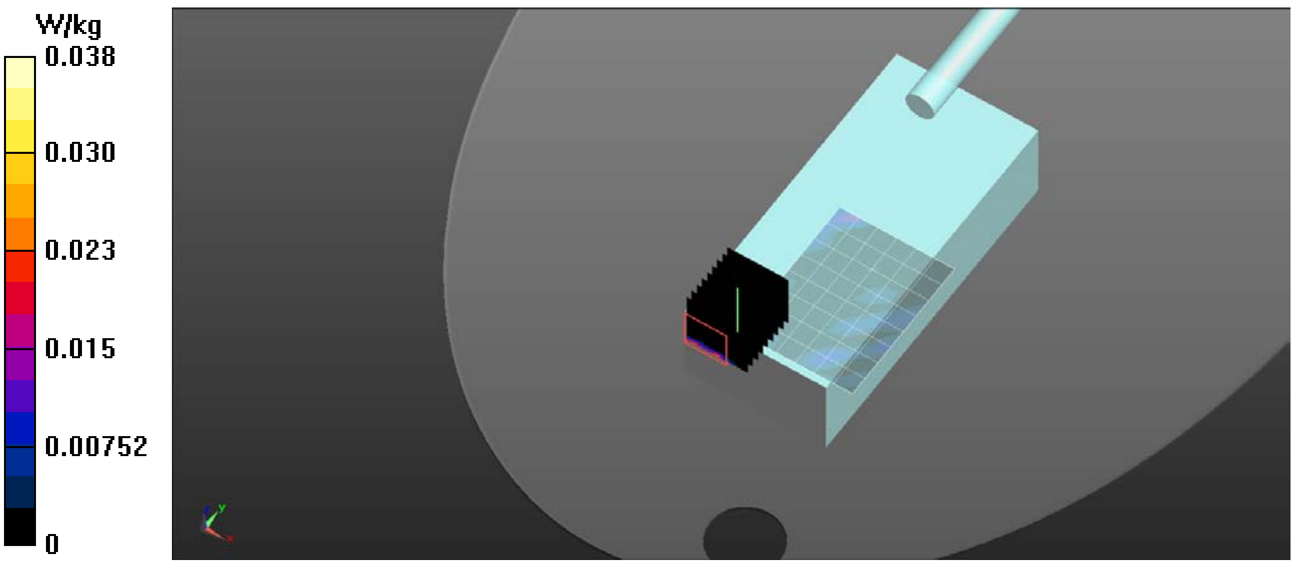
Test Date: Date: 3/27/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(3.91, 3.91, 3.91); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

5200 MHz Body/Back 60/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.0164 W/kg

5200 MHz Body/Back 60/Zoom Scan (9x9x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.124 W/kg
SAR(1 g) = 0.012 W/kg; SAR(10 g) = 0.00477 W/kg
Maximum value of SAR (measured) = 0.0376 W/kg



RF Exposure Lab

Plot 13

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5620 MHz; Duty Cycle: 1:1
Medium: HSL3-6GHz; Medium parameters used: f = 5620 MHz; σ = 5.21 S/m; ε_r = 35.5; ρ = 1000 kg/m^3
Phantom section: Flat Section

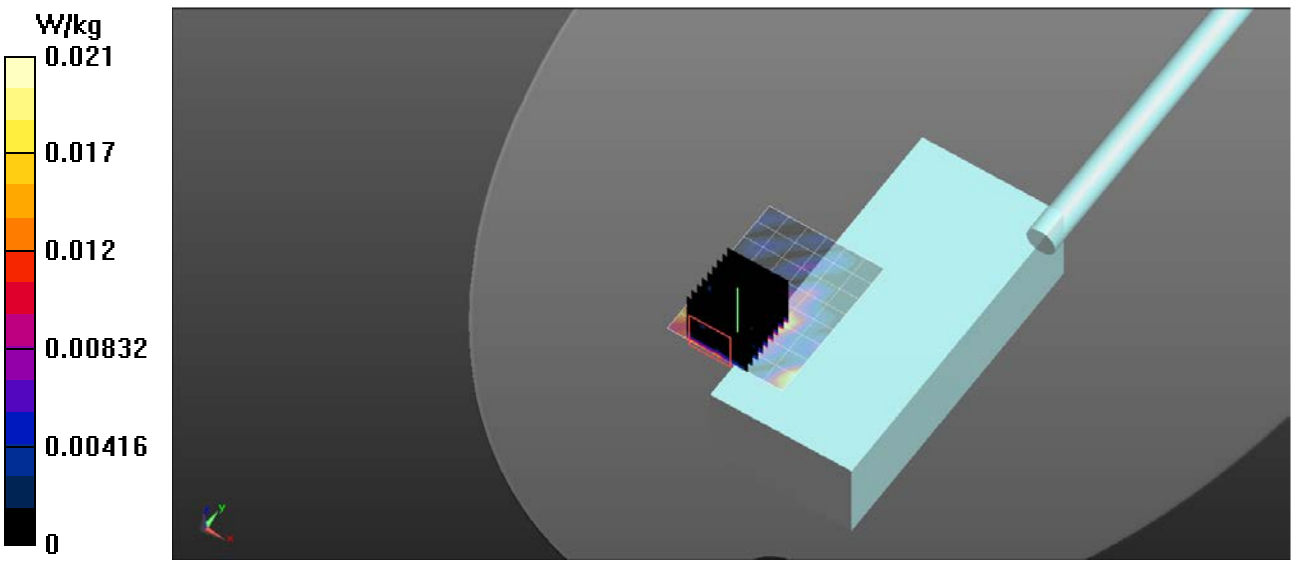
Test Date: Date: 3/28/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(4.81, 4.81, 4.81); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

5600 MHz Head/Front 124/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.0212 W/kg

5600 MHz Head/Front 124/Zoom Scan (9x9x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.0680 W/kg
SAR(1 g) = 0.00915 W/kg; SAR(10 g) = 0.0037 W/kg
Maximum value of SAR (measured) = 0.0208 W/kg



RF Exposure Lab

Plot 14

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5620 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used: f = 5620 MHz; σ = 5.76 S/m; ε_r = 48.4; ρ = 1000 kg/m^3
Phantom section: Flat Section

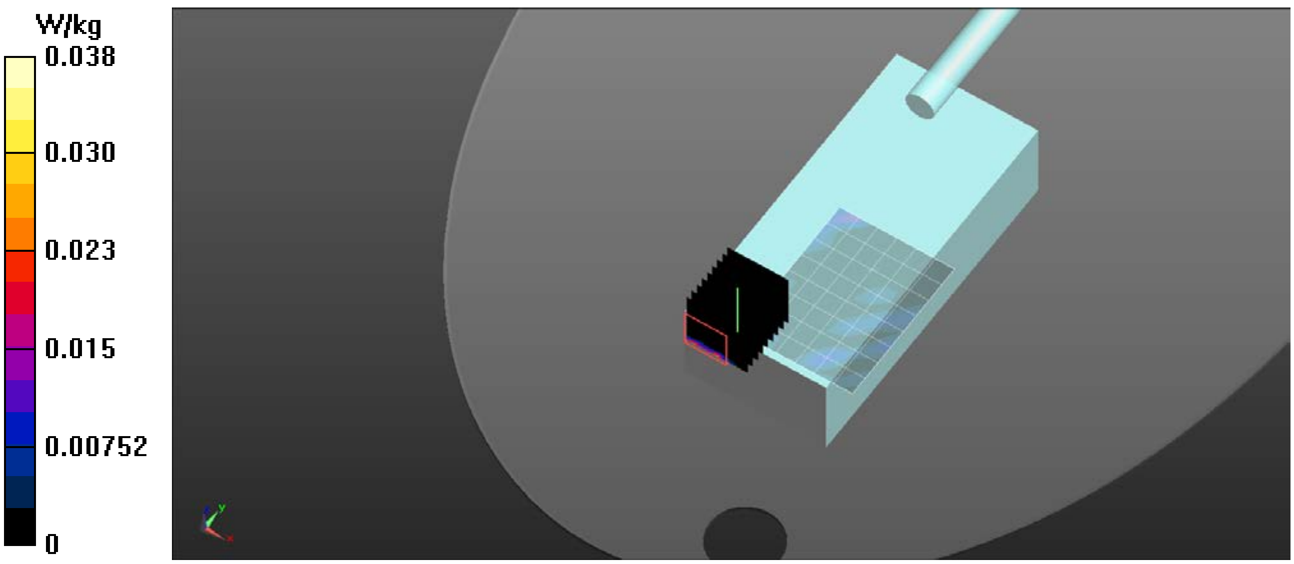
Test Date: Date: 3/27/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(3.91, 3.91, 3.91); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

5600 MHz Body/Back 124/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm
Maximum value of SAR (measured) = 0.0164 W/kg

5600 MHz Body/Back 124/Zoom Scan (9x9x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.124 W/kg
SAR(1 g) = 0.016 W/kg; SAR(10 g) = 0.00477 W/kg
Maximum value of SAR (measured) = 0.0376 W/kg



RF Exposure Lab

Plot 15

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5785 MHz; Duty Cycle: 1:1
Medium: HSL3-6GHz; Medium parameters used (interpolated): f = 5785 MHz; σ = 5.395 S/m; ε_r = 35.32; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 3/28/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(4.89, 4.89, 4.89); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

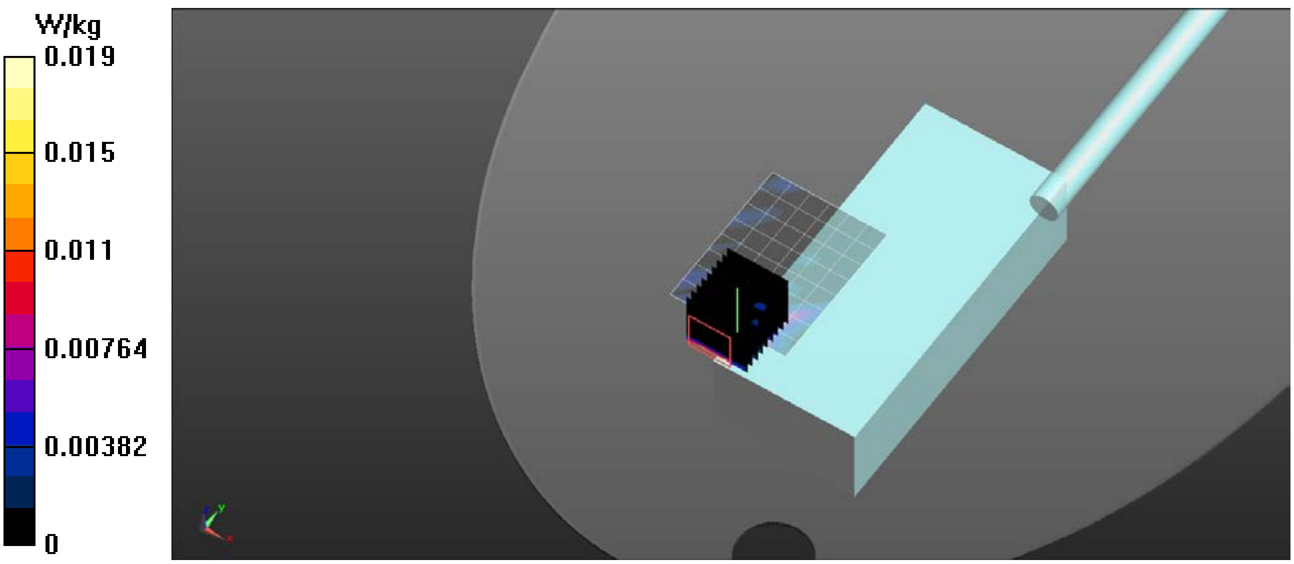
Procedure Notes:

5800 MHz Head/Front 157/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0144 W/kg

5800 MHz Head/Front 157/Zoom Scan (9x9x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 0 V/m; Power Drift = 0.00 dB
Peak SAR (extrapolated) = 0.0620 W/kg
SAR(1 g) = 0.00826 W/kg; SAR(10 g) = 0.00226 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0191 W/kg



RF Exposure Lab

Plot 16

DUT: BKR9000; Type: PTT; Serial: Eng 1

Communication System: WiFi 802.11a (OFDM, 6 Mbps); Frequency: 5785 MHz; Duty Cycle: 1:1
Medium: MSL 3-6 GHz; Medium parameters used (interpolated): f = 5785 MHz; σ = 5.955 S/m; ε_r = 48.153; ρ = 1000 kg/m^3
Phantom section: Flat Section

Test Date: Date: 3/27/2019; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(4.08, 4.08, 4.08); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: ELI v4.0; Type: QDOVA001BB; Serial: 1065
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

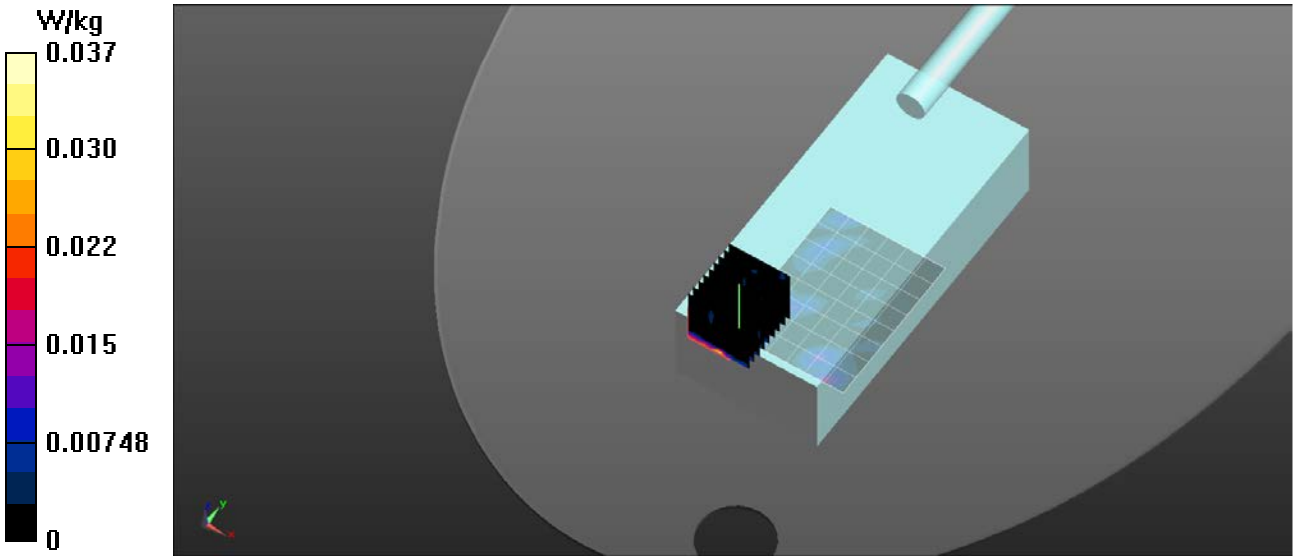
Procedure Notes:

5800 MHz Body/Back 157/Area Scan (7x9x1): Measurement grid: dx=10mm, dy=10mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0385 W/kg

5800 MHz Body/Back 157/Zoom Scan (9x9x12)/Cube 0: Measurement grid: dx=4mm, dy=4mm, dz=2mm
Reference Value = 0.5950 V/m; Power Drift = -0.02 dB
Peak SAR (extrapolated) = 0.108 W/kg
SAR(1 g) = 0.014 W/kg; SAR(10 g) = 0.00428 W/kg

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.0374 W/kg



Appendix C – SAR Test Setup Photos

Handset Face Ant A Configuration

Handset with Antenna Aand
Body A Accessories Configuration

Front of Device

Back of Device


BK
TECHNOLOGIES
Battery P/N: 4005-31131-600
7.2V/ 4900 mAh/ 35.28Wh
Li-ion Rechargeable Battery
NOTE
Do Not Short Circuit
Do Not Disassemble
Do Not Over Charge
Do Not Dispose of in Fire
RBKA18420003
Made in Taiwan

Battery (A)

Body Worn Accessories (A)

Antenna (A)

Antenna Locations

Appendix D – Probe Calibration Data Sheets

jm

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 RF Exposure Lab

Certificate No: ES3-3311_Feb19

CALIBRATION CERTIFICATE

Object: ES3DV3 - SN:3311

Calibration procedure(s): QA CAL-01.v9, QA CAL-12.v9, QA CAL-23.v5, QA CAL-25.v7
Calibration procedure for dosimetric E-field probes

Calibration date: February 26, 2019

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°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	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
DAE4	SN: 660	19-Dec-18 (No. DAE4-660_Dec18)	Dec-19
Reference Probe ES3DV2	SN: 3013	31-Dec-18 (No. ES3-3013_Dec18)	Dec-19
Secondary Standards	ID	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: February 26, 2019

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, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 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).

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3311

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.24	1.03	0.46	± 10.1 %
DCP (mV)[B]	103.0	105.8	97.0	

Calibration Results for Modulation Response

UID	Communication System Name		A dB	B dB√μV	C	D dB	VR mV	Max dev.	Unc[E] (k=2)
0	CW	X	0.0	0.0	1.0	0.00	184.8	±3.0 %	± 4.7 %
		Y	0.0	0.0	1.0		188.3		
		Y	0.0	0.0	1.0		174.1		

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

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3311

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	61
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3311

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	52.3	0.76	7.65	7.65	7.65	0.06	1.35	± 13.3 %
220	49.0	0.81	7.50	7.50	7.50	0.08	1.30	± 13.3 %
300	45.3	0.87	7.38	7.38	7.38	0.13	1.20	± 13.3 %
450	43.5	0.87	7.06	7.06	7.06	0.16	1.40	± 13.3 %
600	42.7	0.88	6.68	6.68	6.68	0.12	1.60	± 13.3 %
1640	40.2	1.31	5.59	5.59	5.59	0.55	1.39	± 12.0 %
2450	39.2	1.80	4.72	4.72	4.72	0.80	1.30	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3311

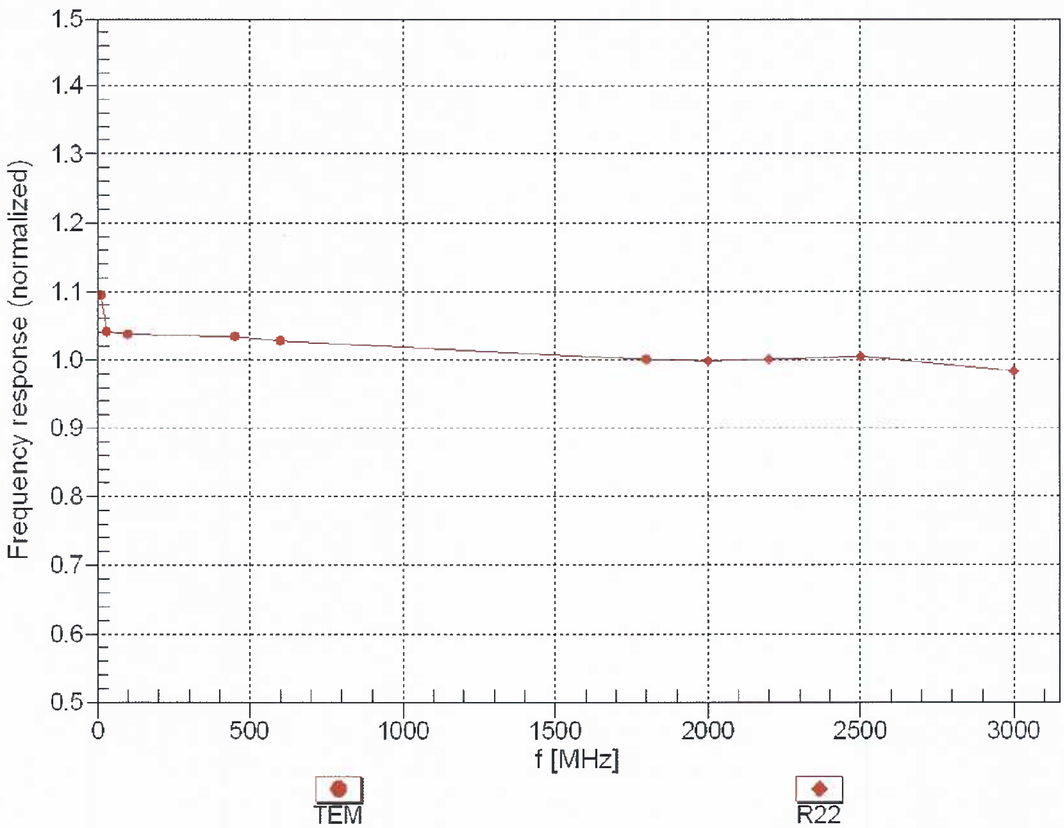
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) [C]	Relative Permittivity [F]	Conductivity (S/m) [F]	ConvF X	ConvF Y	ConvF Z	Alpha [G]	Depth [G] (mm)	Unc (k=2)
150	61.9	0.80	7.26	7.26	7.26	0.07	1.35	± 13.3 %
220	60.2	0.86	7.17	7.17	7.17	0.08	1.30	± 13.3 %
300	58.2	0.92	7.09	7.09	7.09	0.09	1.40	± 13.3 %
450	56.7	0.94	6.93	6.93	6.93	0.11	1.60	± 13.3 %
600	56.1	0.95	6.67	6.67	6.67	0.13	1.60	± 13.3 %
1640	53.7	1.42	5.37	5.37	5.37	0.56	1.42	± 12.0 %
2450	52.7	1.95	4.53	4.53	4.53	0.75	1.25	± 12.0 %

[C] Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 10, 25, 40, 50 and 70 MHz for ConvF assessments at 30, 64, 128, 150 and 220 MHz respectively. Validity of ConvF assessed at 6 MHz is 4-9 MHz, and ConvF assessed at 13 MHz is 9-19 MHz. Above 5 GHz frequency validity can be extended to ± 110 MHz.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

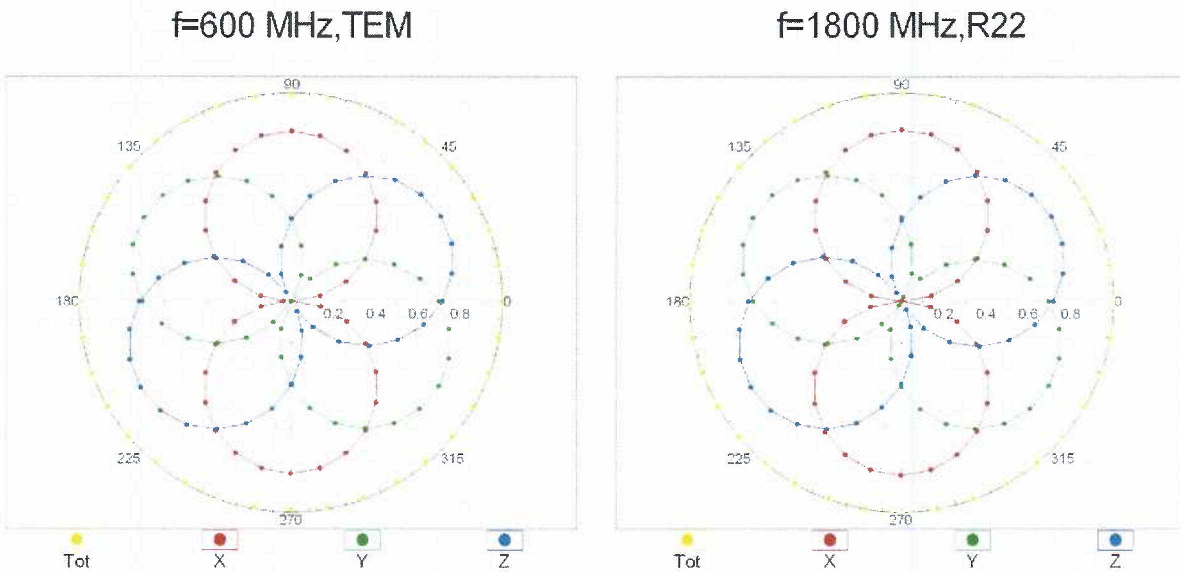
Frequency Response of E-Field

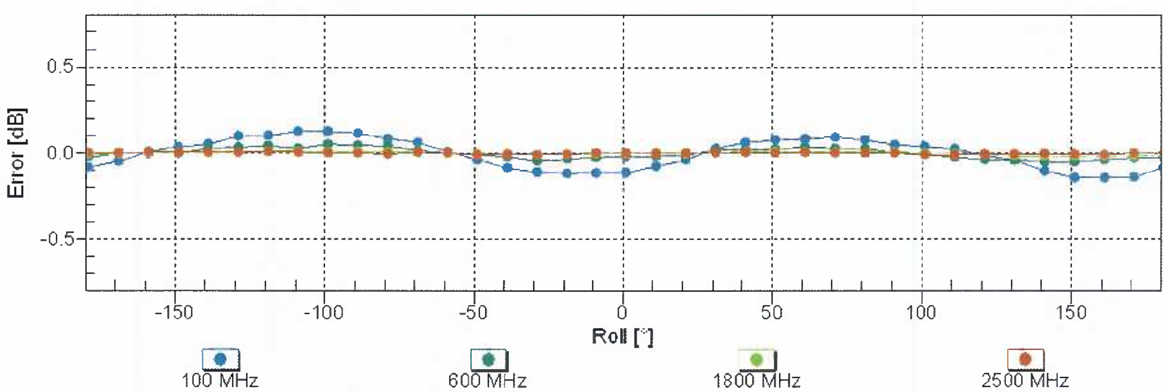
(TEM-Cell:ifi110 EXX, Waveguide: R22)



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

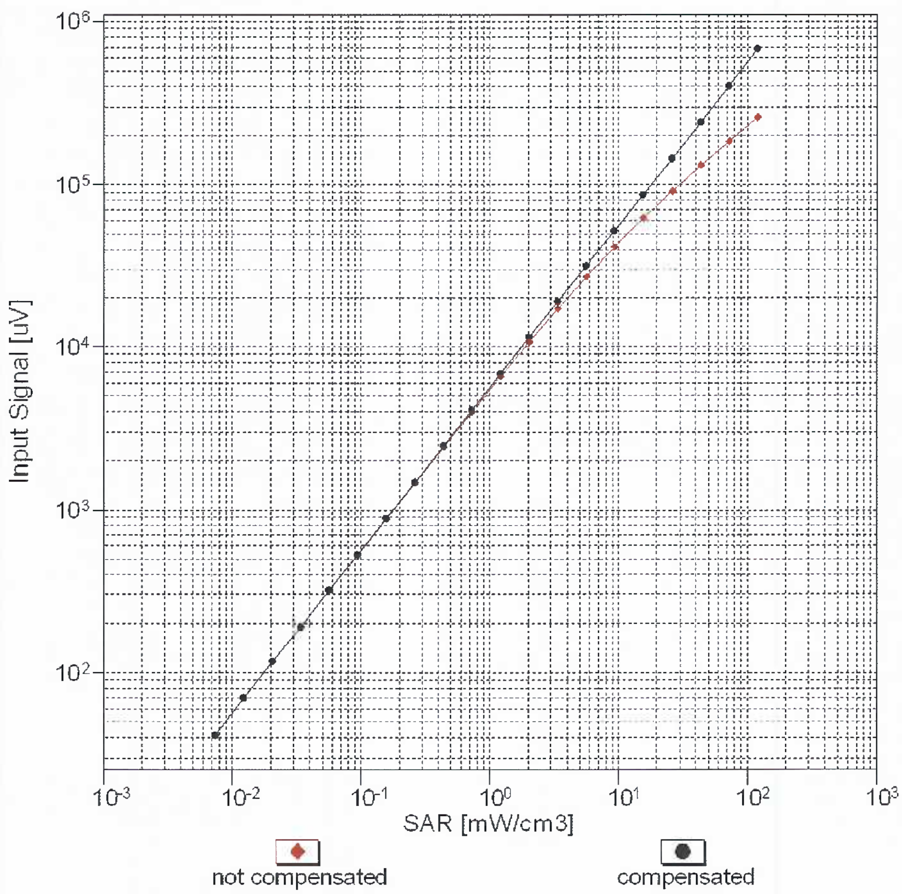
Receiving Pattern (ϕ), ϑ = 0°

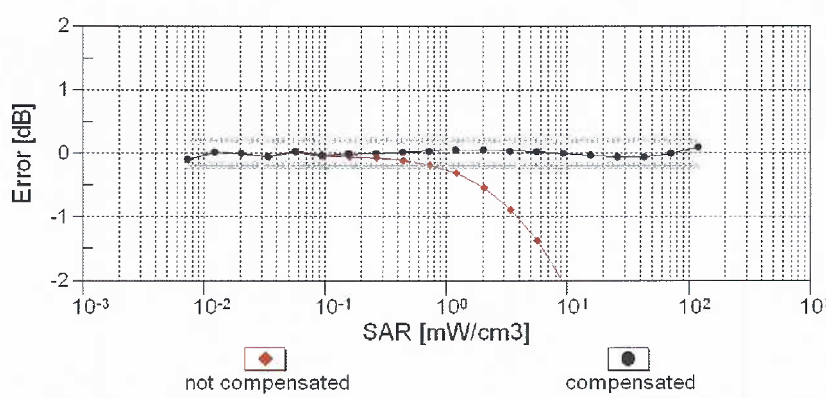




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

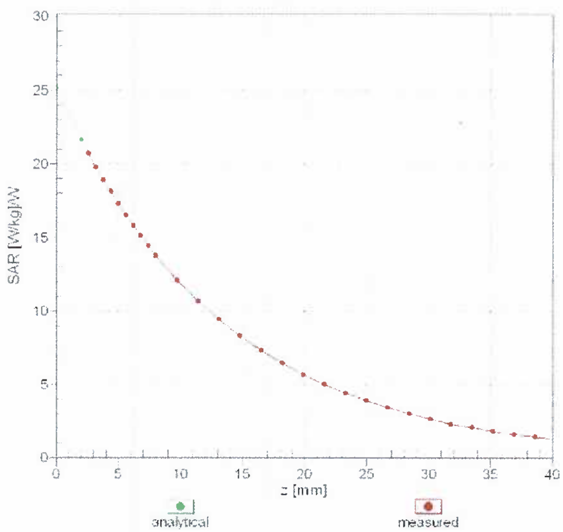




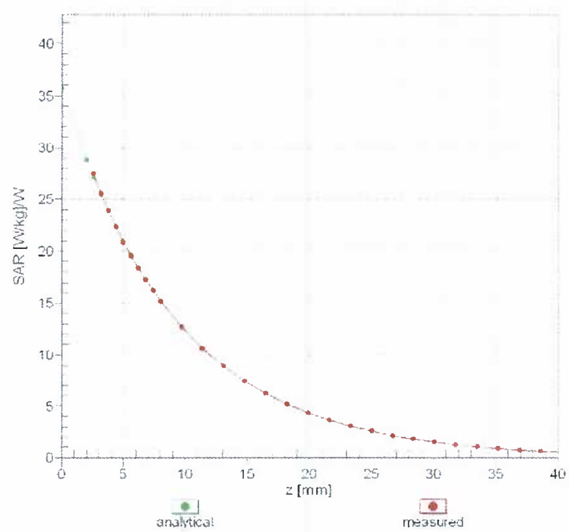
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 1640 MHz,WGLS R22 (H_convF)

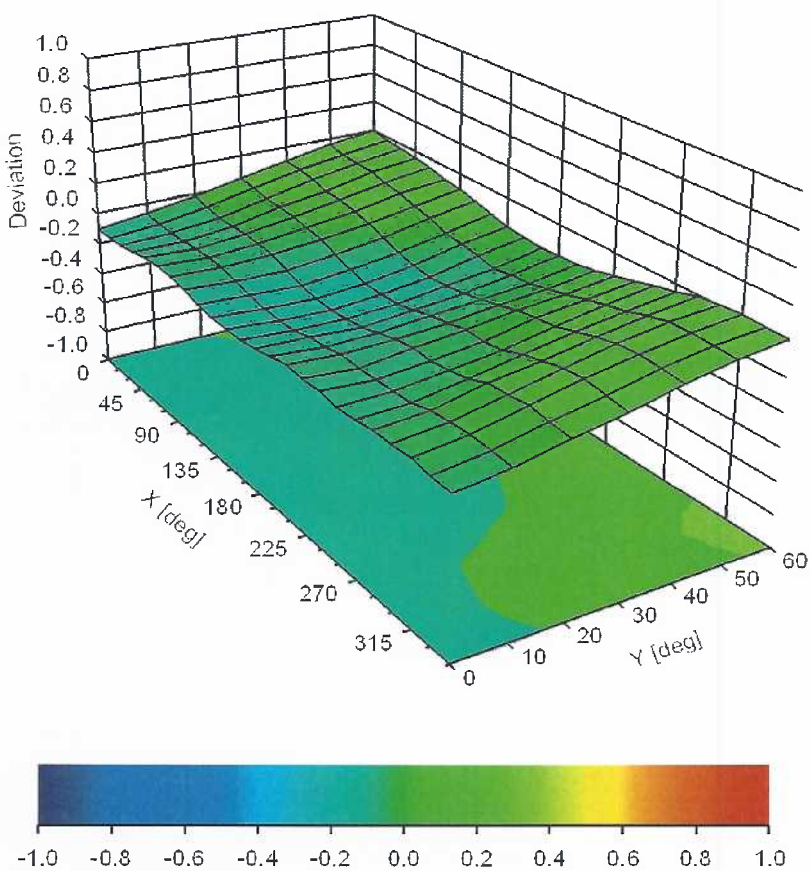


f = 2450 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz



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

gm

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Accreditation No.: SCS 0108

Client **RF Exposure Lab**

Certificate No: EX3-3662_Apr18

CALIBRATION CERTIFICATE

Object: EX3DV4 - SN:3662

Calibration procedure(s): QA CAL-01.v9, QA CAL-14.v4, QA CAL-23.v5, QA CAL-25.v6
Calibration procedure for dosimetric E-field probes

Calibration date: April 20, 2018

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter NRP	SN: 104778	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
Reference Probe ES3DV2	SN: 3013	30-Dec-17 (No. ES3-3013_Dec17)	Dec-18
DAE4	SN: 660	21-Dec-17 (No. DAE4-660_Dec17)	Dec-18
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-17)	In house check: Oct-18

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	Leif Klysner
Approved by:	Katja Pokovic	Technical Manager	

Issued: April 20, 2018

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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, ", "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- *NORMx,y,z:* Assessed for E-field polarization ϑ = 0 (f ≤ 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:3662

Manufactured: October 20, 2008
Calibrated: April 20, 2018

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

DASY/EASY - Parameters of Probe: EX3DV4 - SN:3662

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	0.44	0.45	0.48	± 10.1 %
DCP (mV)[B]	102.6	97.6	96.4	

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	136.8	±3.3 %
		Y	0.0	0.0	1.0		132.2	
		Z	0.0	0.0	1.0		148.8	

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:3662

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)
750	41.9	0.89	9.80	9.80	9.80	0.43	0.90	± 12.0 %
900	41.5	0.97	9.29	9.29	9.29	0.40	0.91	± 12.0 %
1750	40.1	1.37	8.29	8.29	8.29	0.29	0.84	± 12.0 %
1900	40.0	1.40	8.01	8.01	8.01	0.37	0.80	± 12.0 %
2300	39.5	1.67	7.71	7.71	7.71	0.35	0.80	± 12.0 %
2450	39.2	1.80	7.39	7.39	7.39	0.28	0.91	± 12.0 %
2600	39.0	1.96	7.14	7.14	7.14	0.36	0.85	± 12.0 %
3500	37.9	2.91	7.08	7.08	7.08	0.25	1.20	± 13.1 %
3700	37.7	3.12	6.99	6.99	6.99	0.25	1.20	± 13.1 %
5250	35.9	4.71	5.04	5.04	5.04	0.35	1.80	± 13.1 %
5600	35.5	5.07	4.81	4.81	4.81	0.40	1.80	± 13.1 %
5750	35.4	5.22	4.89	4.89	4.89	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.

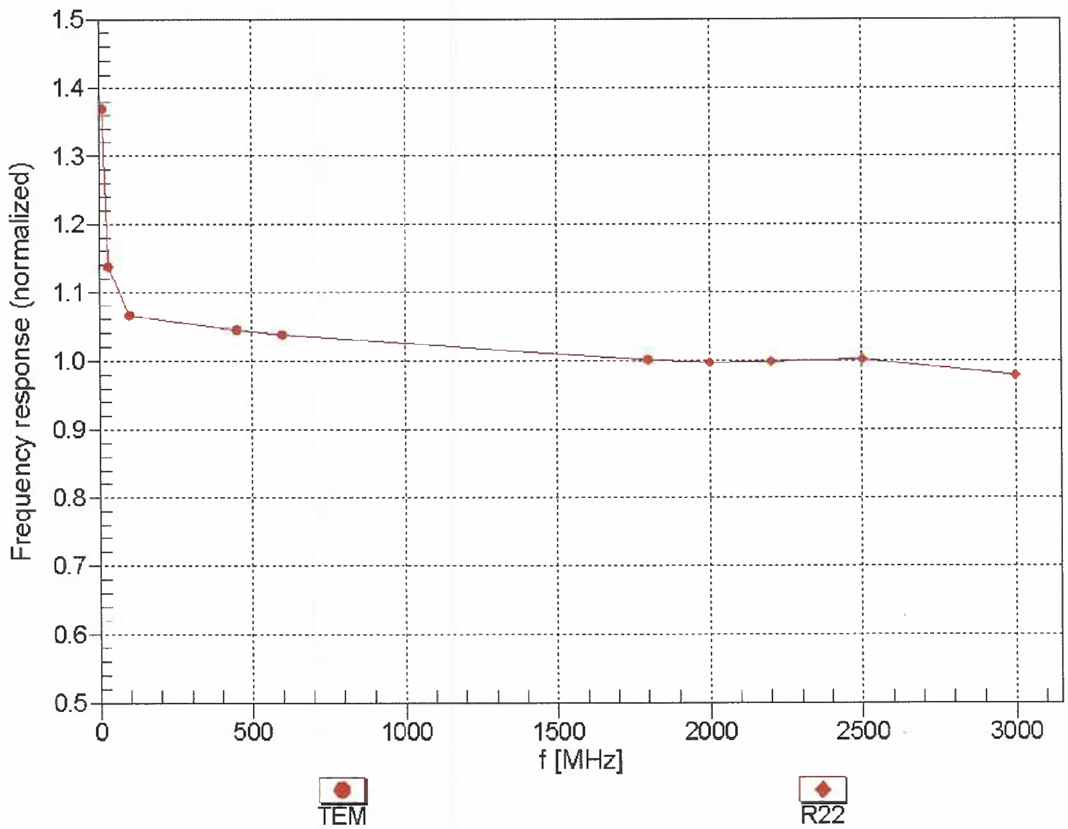
DASY/EASY - Parameters of Probe: EX3DV4 - SN:3662

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)
750	55.5	0.96	9.62	9.62	9.62	0.37	0.98	± 12.0 %
900	55.0	1.05	9.21	9.21	9.21	0.44	0.84	± 12.0 %
1750	53.4	1.49	7.96	7.96	7.96	0.45	0.80	± 12.0 %
1900	53.3	1.52	7.61	7.61	7.61	0.44	0.80	± 12.0 %
2300	52.9	1.81	7.33	7.33	7.33	0.41	0.80	± 12.0 %
2450	52.7	1.95	7.29	7.29	7.29	0.36	0.87	± 12.0 %
2600	52.5	2.16	7.15	7.15	7.15	0.26	0.99	± 12.0 %
3500	51.3	3.31	7.00	7.00	7.00	0.25	1.20	± 13.1 %
3700	51.0	3.55	6.71	6.71	6.71	0.23	1.20	± 13.1 %
5250	48.9	5.36	4.46	4.46	4.46	0.45	1.90	± 13.1 %
5600	48.5	5.77	3.91	3.91	3.91	0.50	1.90	± 13.1 %
5750	48.3	5.94	4.08	4.08	4.08	0.50	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.

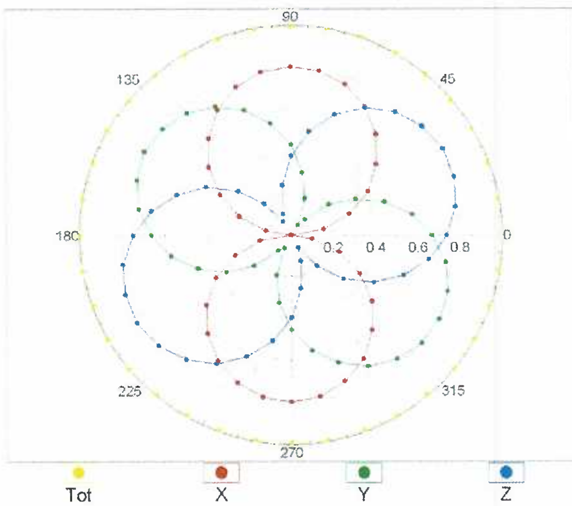
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



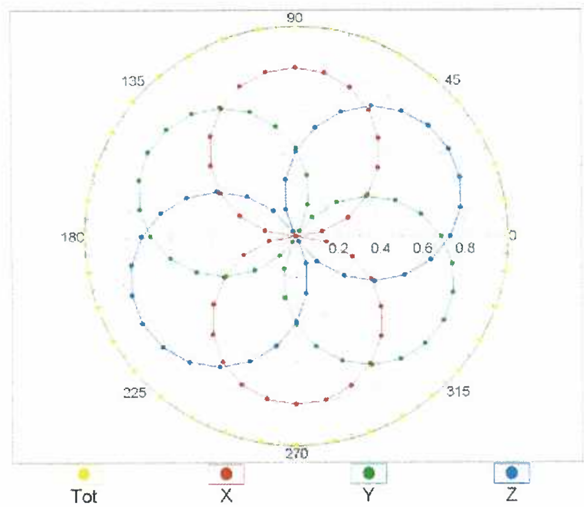
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

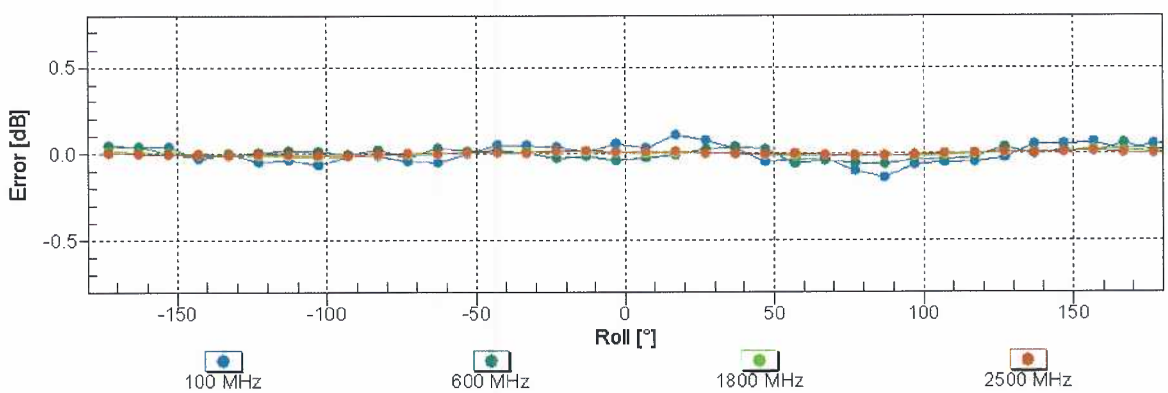
Receiving Pattern (ϕ), $\vartheta = 0°$

f=600 MHz,TEM



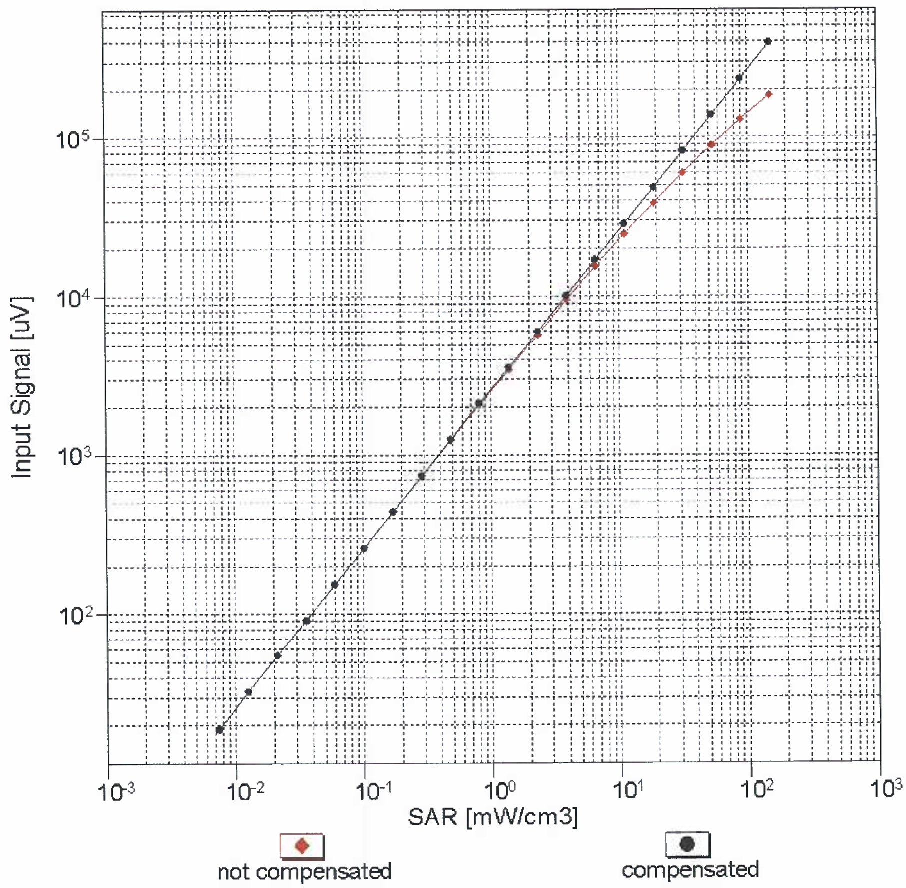
f=1800 MHz,R22

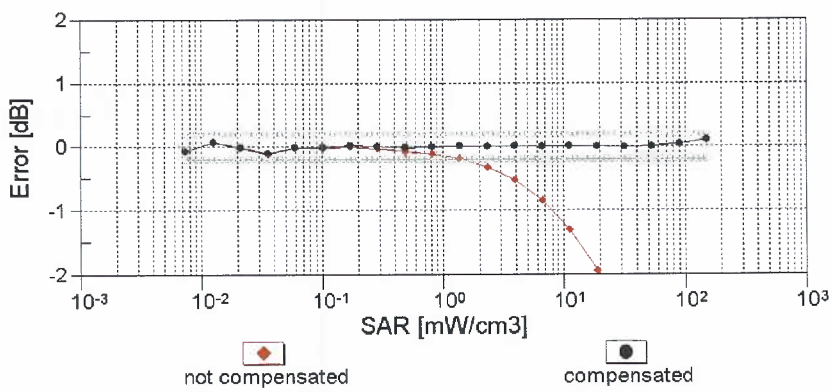




Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

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

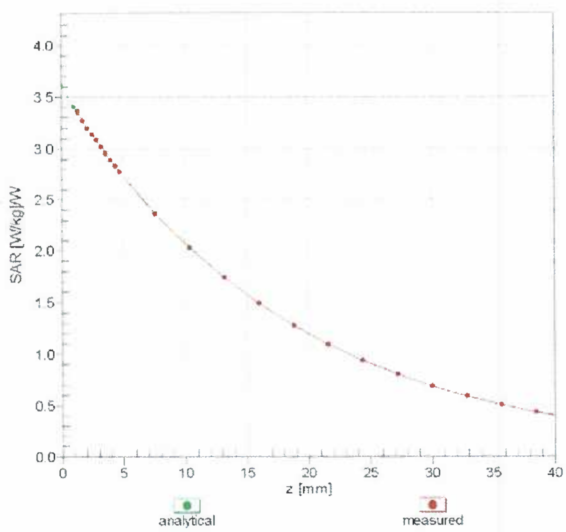




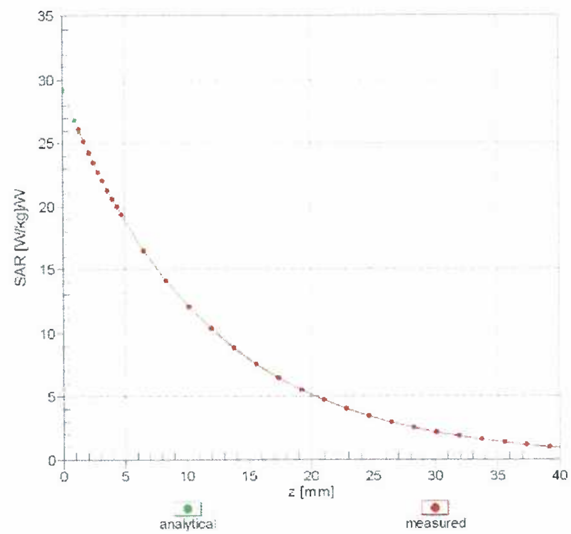
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 900 MHz,WGLS R9 (H_convF)

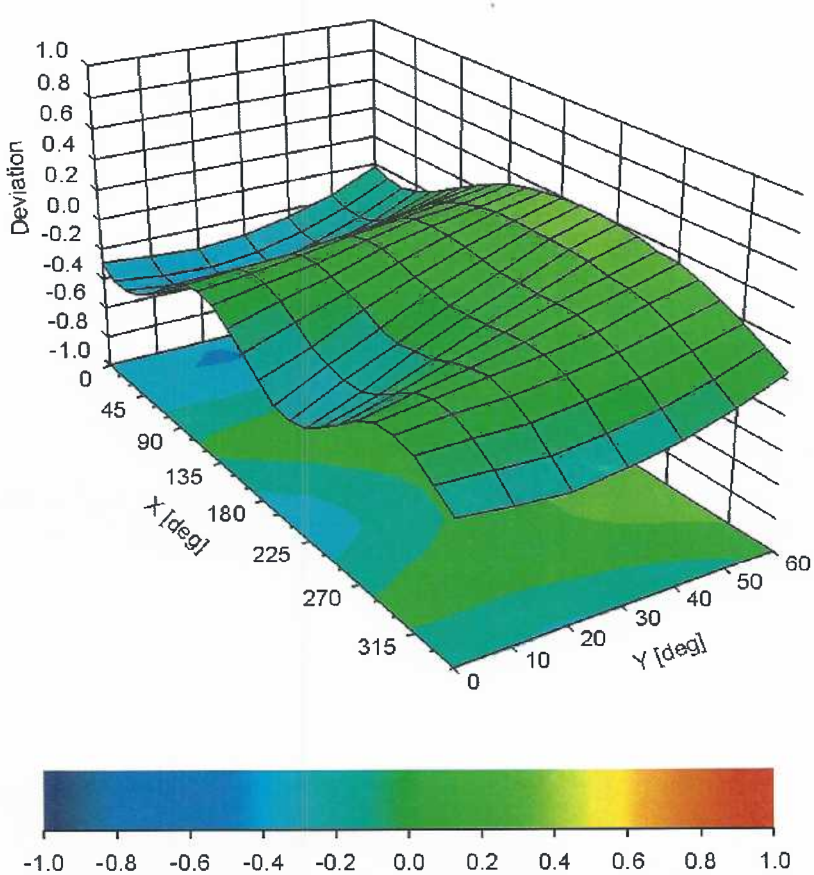


f = 1900 MHz,WGLS R22 (H_convF)



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:3662

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-22.9
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

Appendix E – Dipole Calibration Data Sheets

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)
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Accreditation No.: SCS 0108

Client **RF Exposure Lab**

Certificate No: CLA150-4002_Dec16

CALIBRATION CERTIFICATE

Object	CLA150 - SN: 4002
Calibration procedure(s)	QA CAL-15.v8 Calibration procedure for system validation sources below 700 MHz
Calibration date:	December 06, 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-16)	In house check: Oct-17

	Name	Function	Signature
Calibrated by:	Claudio Leubler	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	

Issued: December 6, 2016

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

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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

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	50.1 ± 6 %	0.75 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	3.83 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.84 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	1 W input power	2.54 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**2.55 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	61.4 ± 6 %	0.82 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	4.03 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**3.95 W/kg ± 18.4 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	1 W input power	2.67 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**2.62 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	42.4 Ω - 3.9 jΩ
Return Loss	- 20.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	44.5 Ω - 6.9 jΩ
Return Loss	- 20.6 dB

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	August 23, 2013

Extended Calibration
Usage of SAR dipoles calibrated less than 3 years ago but more than 1 year ago were confirmed in maintaining return loss (<-20 dB, within 20% of prior calibration) and impedance (within 5 ohm from prior calibration) requirements per extended calibrations in KDB Publication 865664 D01 v01r04.

CLA150 SN: 4002 - Head

Date of Measurement	Return Loss (dB)	Δ%	Impedance Real (Ω)	ΔΩ	Impedance Imaginary (jΩ)	ΔΩ
12/6/2016	-20.7		42.4		-3.9	
12/6/2017	-21.1	1.9	43.6	1.2	-3.8	0.1
12/4/2018	-20.9	1.0	43.8	1.4	-3.7	0.2

CLA150 SN: 4002 - Body

Date of Measurement	Return Loss (dB)	Δ%	Impedance Real (Ω)	ΔΩ	Impedance Imaginary (jΩ)	ΔΩ
12/6/2016	-20.6		44.5		-6.9	
12/6/2017	-21.3	3.4	44.9	0.4	-6.8	0.1
12/4/2018	-20.9	1.5	44.7	0.2	-7.0	-0.1

Date: 05.12.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4002

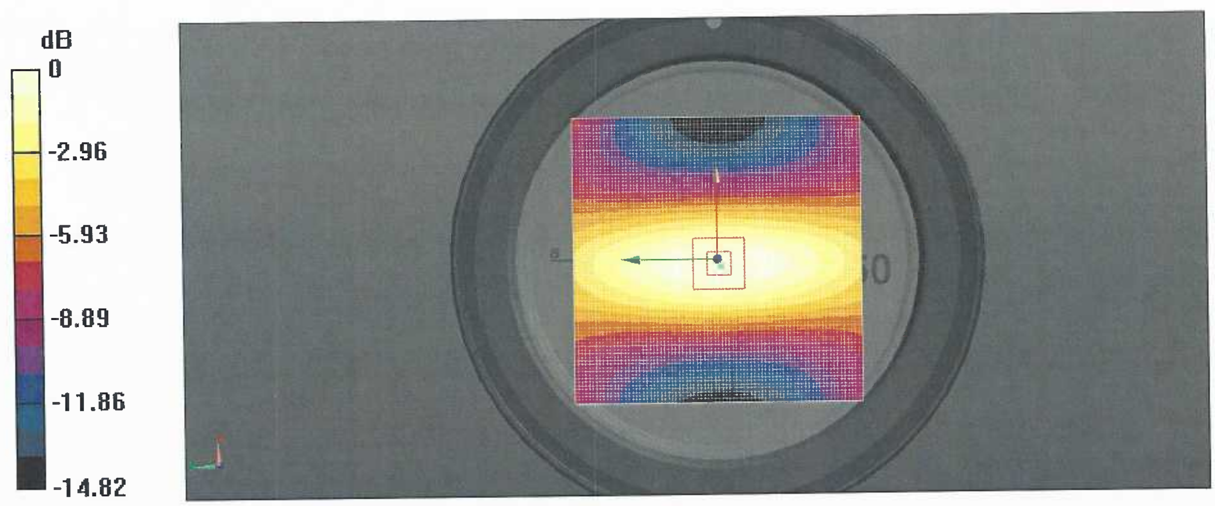
Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; σ = 0.75 S/m; ε_r = 50.1; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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)

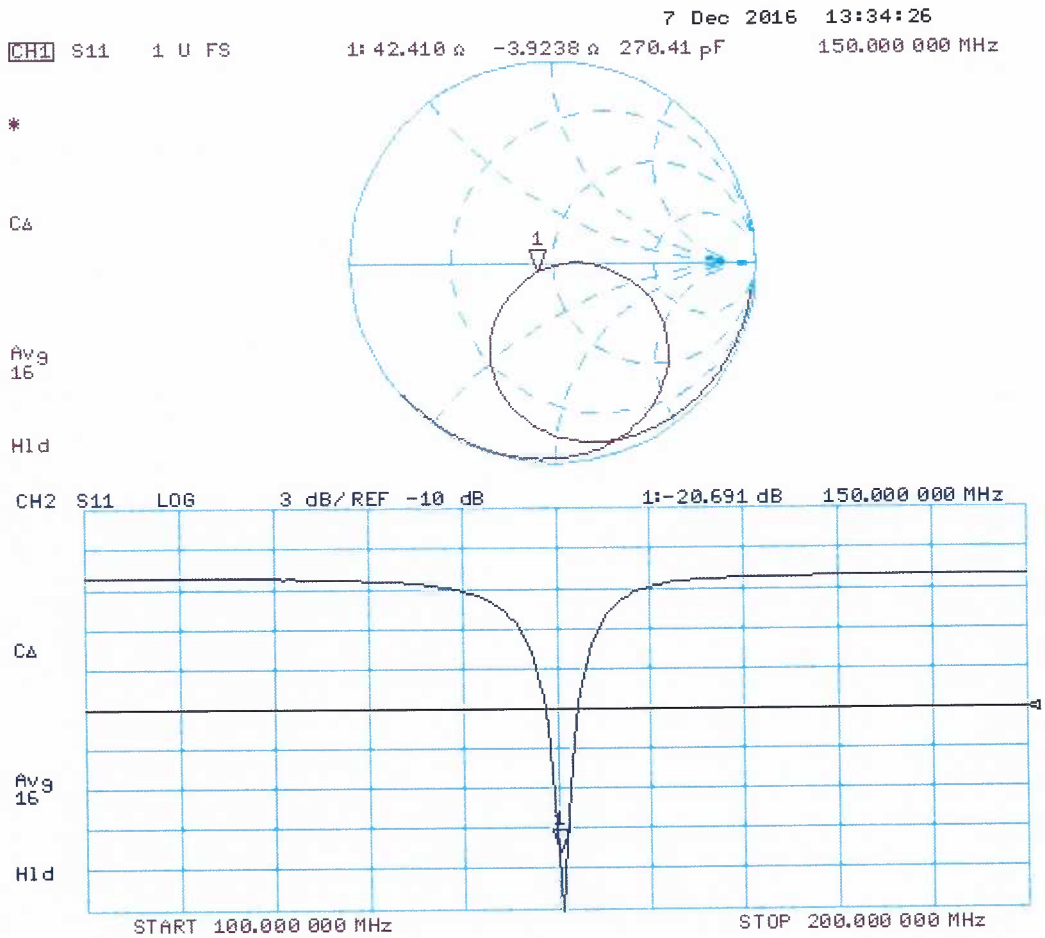
CLA Calibration for HSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.35 W/kg

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 = 84.04 V/m; Power Drift = 0.02 dB
Peak SAR (extrapolated) = 7.16 W/kg
SAR(1 g) = 3.83 W/kg; SAR(10 g) = 2.54 W/kg
Maximum value of SAR (measured) = 5.37 W/kg



0 dB = 5.35 W/kg = 7.28 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 06.12.2016

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: CLA150; Type: CLA150; Serial: CLA150 - SN: 4002

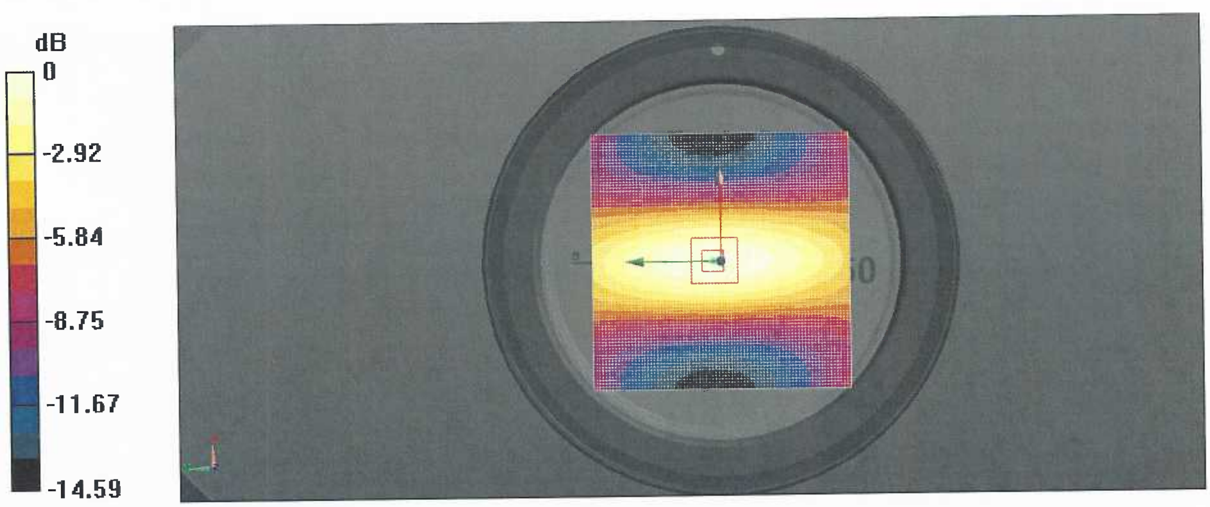
Communication System: UID 0 - CW; Frequency: 150 MHz
Medium parameters used: f = 150 MHz; σ = 0.82 S/m; ε_r = 61.4; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

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)

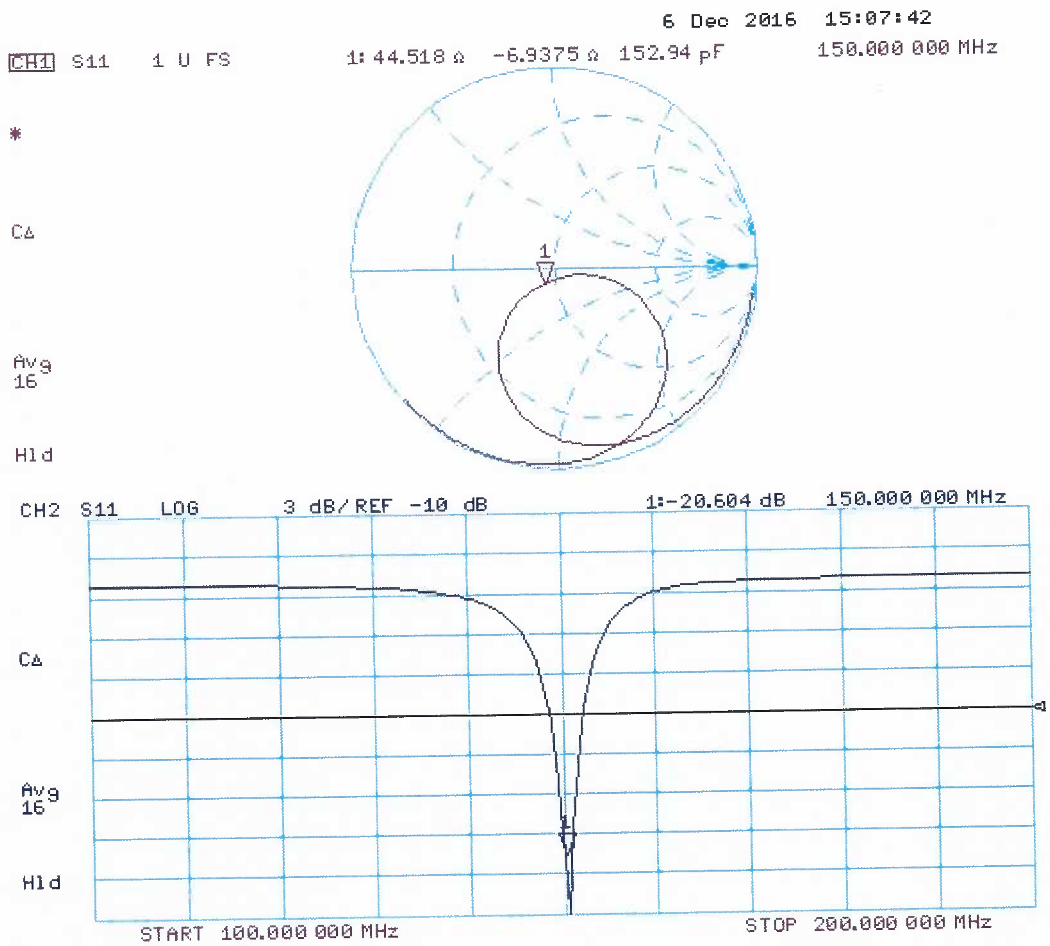
CLA Calibration for MSL-LF Tissue/CLA150, touch configuration, Pin=1W/Area Scan (81x81x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 5.72 W/kg

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 = 83.56 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 7.81 W/kg
SAR(1 g) = 4.03 W/kg; SAR(10 g) = 2.67 W/kg
Maximum value of SAR (measured) = 5.68 W/kg



0 dB = 5.72 W/kg = 7.57 dBW/kg

Impedance Measurement Plot for Body TSL



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Calibration Laboratory of
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Accreditation No.: SCS 0108

Client **RF Exposure Lab**

Certificate No: D450V3-1085_Jan19

CALIBRATION CERTIFICATE

Object	D450V3 - SN:1085
Calibration procedure(s)	QA CAL-15.v9 Calibration Procedure for SAR Validation Sources below 700 MHz
Calibration date:	January 15, 2019

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

All calibrations have been conducted in the closed laboratory facility: environment temperature (22 ± 3)°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	04-Apr-18 (No. 217-02672/02673)	Apr-19
Power sensor NRP-Z91	SN: 103244	04-Apr-18 (No. 217-02672)	Apr-19
Power sensor NRP-Z91	SN: 103245	04-Apr-18 (No. 217-02673)	Apr-19
Reference 20 dB Attenuator	SN: 5277 (20x)	04-Apr-18 (No. 217-02682)	Apr-19
Type-N mismatch combination	SN: 5047.2 / 06327	04-Apr-18 (No. 217-02683)	Apr-19
Reference Probe EX3DV4	SN: 3877	31-Dec-18 (No. EX3-3877_Dec18)	Dec-19
DAE4	SN: 654	05-Jul-18 (No. DAE4-654_Jul18)	Jul-19

Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power meter E4419B	SN: GB41293874	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: MY41498087	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
Power sensor E4412A	SN: 000110210	06-Apr-16 (in house check Jun-18)	In house check: Jun-20
RF generator HP 8648C	SN: US3642U01700	04-Aug-99 (in house check Jun-18)	In house check: Jun-20
Network Analyzer Agilent E8358A	SN: US41080477	31-Mar-14 (in house check Oct-18)	In house check: Oct-19

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

Issued: January 17, 2019

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, "Measurement procedure for the assessment of Specific Absorption Rate (SAR) from hand-held and body-mounted devices used next to the ear (frequency range of 300 MHz to 6 GHz)", July 2016
c) IEC 62209-2, "Procedure to determine the Specific Absorption Rate (SAR) for wireless communication devices used in close proximity to the human body (frequency range of 30 MHz to 6 GHz)", March 2010
d) KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

e) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.10.2
Extrapolation	Advanced Extrapolation	
Phantom	ELI4 Flat Phantom	Shell thickness: 2 ± 0.2 mm
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	450 MHz ± 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Head TSL parameters	22.0 °C	43.5	0.87 mho/m
Measured Head TSL parameters	(22.0 ± 0.2) °C	43.7 ± 6 %	0.87 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	250 mW input power	1.12 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**4.48 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Head TSL	condition	
SAR measured	250 mW input power	0.751 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	**3.01 W/kg ± 17.6 % (k=2)**

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	**Permittivity**	**Conductivity**
Nominal Body TSL parameters	22.0 °C	56.7	0.94 mho/m
Measured Body TSL parameters	(22.0 ± 0.2) °C	55.5 ± 6 %	0.92 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	250 mW input power	1.13 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**4.58 W/kg ± 18.1 % (k=2)**

SAR averaged over 10 cm^3 (10 g) of Body TSL	condition	
SAR measured	250 mW input power	0.761 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	**3.08 W/kg ± 17.6 % (k=2)**

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	59.4 Ω - 3.7 jΩ
Return Loss	- 20.7 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	55.5 Ω - 7.9 jΩ
Return Loss	- 20.8 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.349 ns

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

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

Additional EUT Data

Manufactured by	SPEAG

DASY5 Validation Report for Head TSL

Date: 15.01.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz D450V3; Type: D450V3; Serial: D450V3 - SN:1085

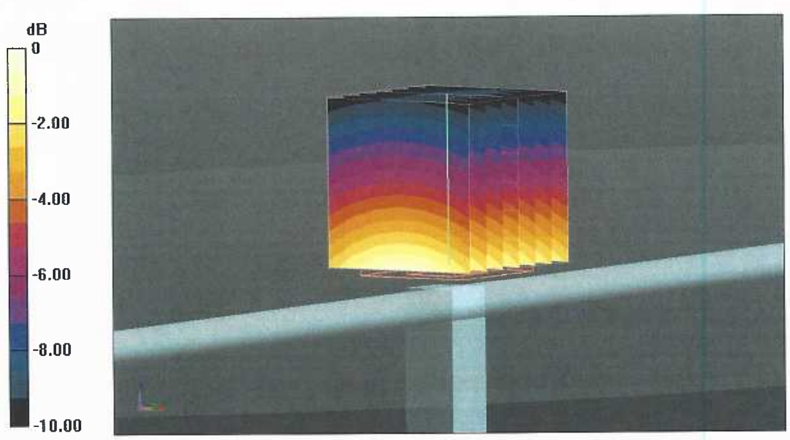
Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.87 S/m; ε_r = 43.7; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(10.5, 10.5, 10.5) @ 450 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 05.07.2018
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

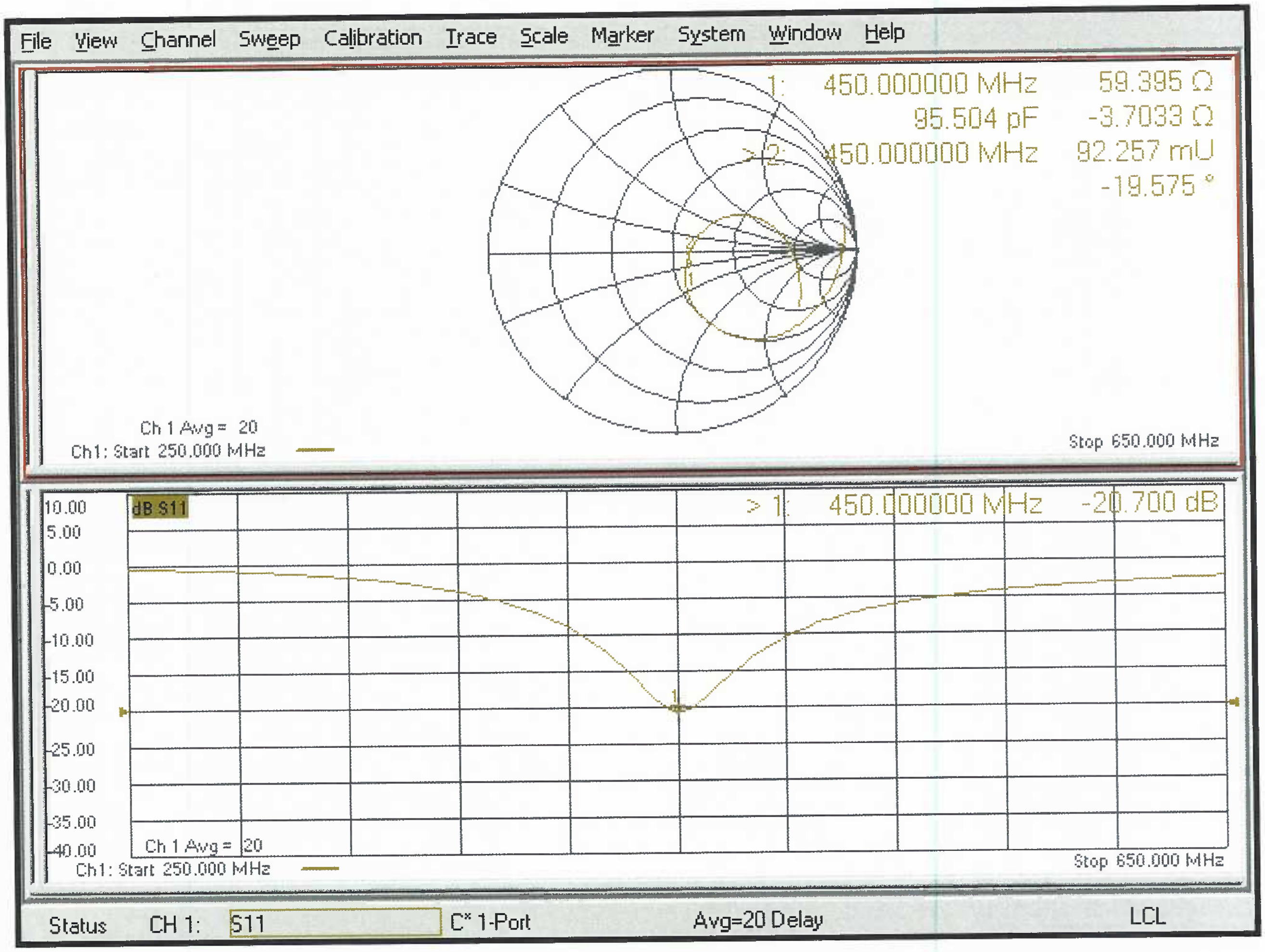
Dipole Calibration for Head Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 38.75 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 1.74 W/kg
SAR(1 g) = 1.12 W/kg; SAR(10 g) = 0.751 W/kg
Maximum value of SAR (measured) = 1.52 W/kg



0 dB = 1.52 W/kg = 1.82 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 15.01.2019

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 450 MHz; Type: D450V3; Serial: D450V3 - SN:1085

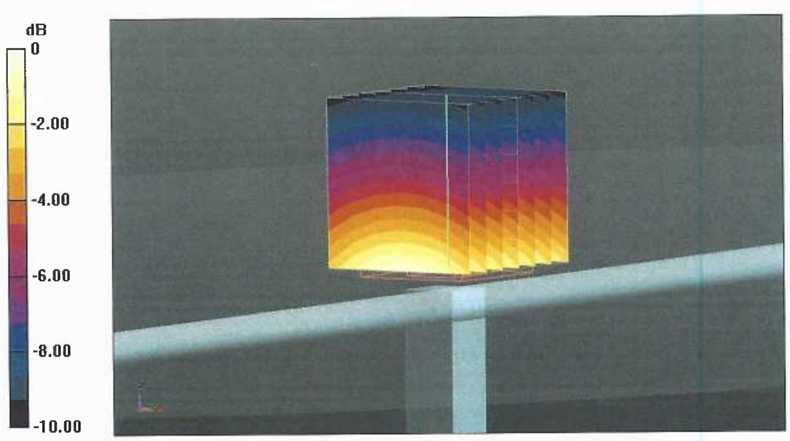
Communication System: UID 0 - CW; Frequency: 450 MHz
Medium parameters used: f = 450 MHz; σ = 0.92 S/m; ε_r = 55.5; ρ = 1000 kg/m^3
Phantom section: Flat Section
Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: EX3DV4 - SN3877; ConvF(10.7, 10.7, 10.7) @ 450 MHz; Calibrated: 31.12.2018
- Sensor-Surface: 1.4mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn654; Calibrated: 05.07.2018
- Phantom: ELI v4.0; Type: QDOVA001BB; Serial: TP:1003
- DASY52 52.10.2(1495); SEMCAD X 14.6.12(7450)

Dipole Calibration for Body Tissue/d=15mm, Pin=250mW/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm
Reference Value = 41.97 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 1.73 W/kg
SAR(1 g) = 1.13 W/kg; SAR(10 g) = 0.761 W/kg
Maximum value of SAR (measured) = 1.51 W/kg



0 dB = 1.51 W/kg = 1.79 dBW/kg