

RF Exposure Lab

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CERTIFICATE OF COMPLIANCE SAR EVALUATION

Attenti Group
1838 Gunn Hwy.
Odessa, FL 33556

Dates of Test: May 14-15, 2018
Test Report Number: SAR.20180504
Revision A

FCC ID:	NC3-24014VL
IC Certificate:	23669-24014VL
Model(s):	24014VL
Test Sample:	Engineering Unit Same as Production
Serial No.:	P25
Equipment Type:	Tracking Phone
Classification:	Portable Transmitter Next to Head and Body
TX Frequency Range:	777 – 787 MHz; 1710 – 1755 MHz; 1850 – 1910 MHz
Frequency Tolerance:	± 2.5 ppm
Maximum RF Output:	750 MHz (LTE) – 24.0 dBm, 1750 MHz (LTE) – 24.0 dBm, 1900 MHz (LTE) – 24.0 dBm Conducted
Signal Modulation:	QPSK, 16QAM
Antenna Type:	Internal Antenna
Application Type:	Certification
FCC Rule Parts:	Part 2, 22, 24, 27
KDB Test Methodology:	KDB 447498 D01 v06, KDB 941225 D05 v02r05, KDB 865664 D01 v01r04, KDB 865664 D02 v01r02, KDB 648474 D04 v01r03
Industry Canada:	RSS-102 Issue 5, Safety Code 6
Max. Stand Alone SAR Value:	1.27 W/kg Reported Head; 0.52 W/kg Reported Body
Max. Simultaneous SAR Value:	1.44 W/kg Reported Head; 0.68 W/kg Reported Body
Separation Distance:	0 mm

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 IEC 62209-2:2010 (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 has been denied 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



Testing Cert. # 2387.01

Table of Contents

1.	Introduction	3
	SAR Definition [5].....	4
2.	SAR Measurement Setup	5
	Robotic System	5
	System Hardware.....	5
	System Electronics.....	6
	Probe Measurement System	6
3.	Definition of Reference Points	14
	Ear Reference Point.....	14
	Device Reference Points.....	14
4.	Test Configuration Positions.....	15
	Positioning for Cheek/Touch [5]	15
	Positioning for Ear / 15° Tilt [5]	16
	Body Worn Configurations	17
5.	Probe and Dipole Calibration.....	18
6.	Phantom & Simulating Tissue Specifications.....	19
	Head & Body Simulating Mixture Characterization	19
7.	ANSI/IEEE C95.1 – 1999 RF Exposure Limits [2].....	20
	Uncontrolled Environment	20
	Controlled Environment.....	20
8.	Measurement Uncertainty	21
9.	System Validation.....	22
	Tissue Verification.....	22
	Test System Verification.....	22
10.	LTE Document Checklist	23
11.	SAR Test Data Summary	27
	Procedures Used To Establish Test Signal	27
	Device Test Condition	27
	11.1 SAR Measurement Conditions for LTE Bands	28
	SAR Data Summary – 750 MHz Body – LTE Band 13	50
	SAR Data Summary – 1750 MHz Body – LTE Band 4	51
	SAR Data Summary – 1900 MHz Body – LTE Band 2	52
	SAR Data Summary – Simultaneous Evaluation	53
12.	Test Equipment List.....	54
13.	Conclusion	55
14.	References.....	56
	Appendix A – System Validation Plots and Data	57
	Appendix B – SAR Test Data Plots	72
	Appendix C – SAR Test Setup Photos	79
	Appendix D – Probe Calibration Data Sheets.....	88
	Appendix E – Dipole Calibration Data Sheets	100
	Appendix F – Phantom Calibration Data Sheets	125
	Appendix G – Validation Summary.....	128

1. Introduction

This measurement report shows compliance of the Attenti Group Model 24014VL FCC ID: NC3-24014VL with FCC Part 2, 1093, ET Docket 93-62 Rules for mobile and portable devices and IC Certificate: 23669-24014VL 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 Attenti Group Model 24014VL 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 – 2003 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 24014VL wireless Tracking Phone. The table also shows the tolerance for the power level for each mode.

Band	Technology	Class	3GPP Nominal Power dBm	Setpoint Nominal Power dBm	Tolerance dBm	Lower Tolerance dBm	Upper Tolerance dBm
Band 2	LTE	3	22.0	22.5	±1.5	21.0	24.0
Band 4	LTE	3	22.0	22.5	±1.5	21.0	24.0
Band 13	LTE	3	22.0	22.5	±1.5	21.0	24.0
WiFi	802.11bgn	N/A	N/A	N/A	N/A	N/A	18.3
ISM	FM	N/A	N/A	N/A	N/A	N/A	20.0

Note: The WiFi and ISM band radio both operate at a low duty cycle which allows both to be excluded from SAR testing. The WiFi operates at a worst case of 3.94% duty cycle and the ISM band radio operates at a 3.55% duty cycle. Based on this, the maximum average power for each radio is calculated below.

WiFi: 18.3 dBm = 67.6 mW; $67.6 \text{ mW} \times 3.94\% = 2.66 \text{ mW}$ maximum average power.

ISM: 20.0 dBm = 100 mW; $100 \text{ mW} \times 3.55\% = 3.55 \text{ mW}$ maximum average power.

Both transmitters are excluded from SAR testing based on KDB447498 D01 v06 section 4.3.1 a) on page 12 and RSS-102 Issue 5 section 2.5.1 Table 1 on page 4.

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/m³)

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 EX3DV4, 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

Frequency: 10 MHz to 6 GHz

Linearity: $\pm 0.2\text{dB}$ (30 MHz to 6 GHz)

Dynamic: 10 mW/kg to 100 W/kg

Range: Linearity: $\pm 0.2\text{dB}$

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

Application: SAR Dosimetry Testing
Compliance tests of wireless device



Figure 2.2 Triangular Probe Configurations



Figure 2.3 Probe Thick-Film Technique

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/cm².

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

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

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

where:

where:

Δt = exposure time (30 seconds),

σ = simulated tissue conductivity,

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

ρ = Tissue density (1.25 g/cm³ for brain tissue)

ΔT = temperature increase due to RF exposure.

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/cm³

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

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

with P_{pwe} = equivalent power density of a plane wave in W/cm²
 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 repeatedly 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. Definition of Reference Points

Ear Reference Point

Figure 3.2 shows the front, back and side views of the SAM Phantom. The point “M” is the reference point for the center of the mouth, “LE” is the left ear reference point (ERP), and “RE” is the right ERP. The ERPs are 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 3.1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 3.1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].

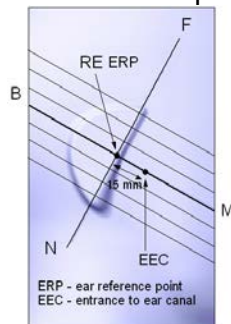


Figure 3.1 Close-up side view of ERP's



Figure 3.2 Front, back and side view of SAM

Device Reference Points

Two imaginary lines on the device need to be established: the vertical centerline and the horizontal line. The test device is placed in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Fig. 3.3). The “test device reference point” is then located at the same level as the center of the ear reference point. The test device is positioned so that the “vertical centerline” is bisecting the front surface of the device at it's top and bottom edges, positioning the “ear reference point” on the outer surface of both the left and right head phantoms on the ear reference point [5].

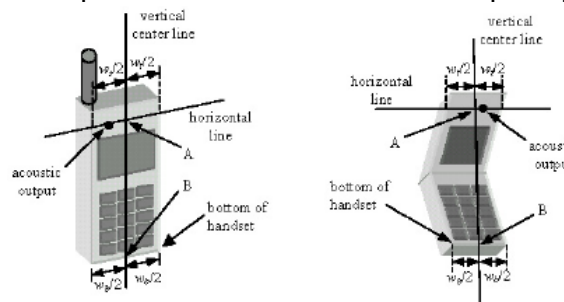


Figure 3.3 Handset Vertical Center & Horizontal Line Reference Points

4. Test Configuration Positions

Positioning for Cheek/Touch [5]

1. Position the device close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 4.1), such that the plane defined by the vertical center line and the horizontal line of the device is approximately parallel to the sagittal plane of the phantom.

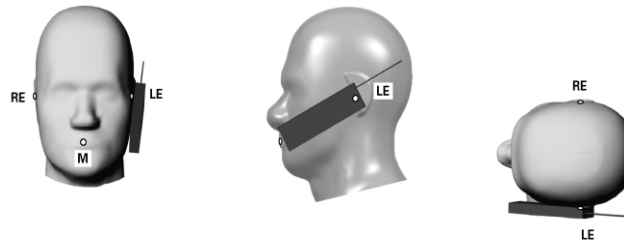


Figure 4.1 Front, Side and Top View of Cheek/Touch Position

2. Translate the device towards the phantom along the line passing through RE and LE until the device touches the ear.
3. While maintaining the device in this plane, rotate it around the LE-RE line until the vertical centerline is in the plane normal to MB-NF including the line MB (called the reference plane).
4. Rotate the device around the vertical centerline until the device (horizontal line) is symmetrical with respect to the line NF.
5. While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE and maintaining the device contact with the ear, rotate the device about the line NF until any point on the device is in contact with a phantom point below the ear (cheek). See Figure 4.2.

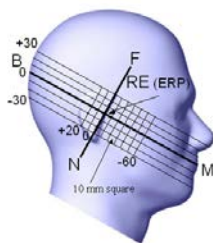


Figure 4.2 Side view w/ relevant markings

Positioning for Ear / 15° Tilt [5]

With the test device aligned in the Cheek/Touch Position”:

1. While maintaining the orientation of the device, retracted the device parallel to the reference plane far enough to enable a rotation of the device by 15 degrees.
2. Rotate the device around the horizontal line by 15 degrees.
3. While maintaining the orientation of the device, move the device parallel to the reference plane until any part of the device touches the head. (In this position, point A is located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact is at any location other than the pinna, the angle of the device shall be reduced. The tilted position is obtained when any part of the device is in contact with the ear as well as a second part of the device is in contact with the head (see Figure 4.3).

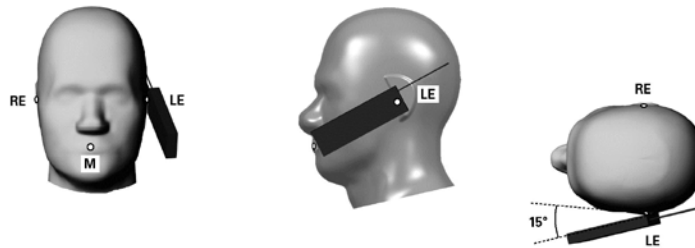


Figure 4.3 Front, Side and Top View of Ear/15° Tilt Position

Body Worn Configurations

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

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

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

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

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

In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.

5. Probe and Dipole Calibration

See Appendix D and E.

6. 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 6.1 Typical Composition of Ingredients for Tissue

Ingredients		Simulating Tissue					
		750 MHz Head	750 MHz Body	1750 MHz Head	1750 MHz Body	1900 MHz Head	1900 MHz Body
Mixing Percentage							
Water		Proprietary Purchased From Speag	Proprietary Purchased From Speag	Proprietary Purchased From Speag	Proprietary Purchased From Speag	54.88	69.91
Sugar						0.00	0.00
Salt						0.21	0.13
HEC						0.00	0.00
Bactericide						0.00	0.00
DGBE						44.91	29.96
Dielectric Constant	Target	41.94	55.53	40.08	53.43	40.00	53.30
Conductivity (S/m)	Target	0.89	0.96	1.37	1.49	1.40	1.52

7. ANSI/IEEE C95.1 – 1999 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 7.1 Human Exposure Limits

	UNCONTROLLED ENVIRONMENT General Population (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT Professional Population (W/kg) or (mW/g)
SPATIAL PEAK SAR ¹ Brain	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.

8. 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.

9. System Validation

Tissue Verification

Table 9.1 Measured Tissue Parameters

		750 MHz Head		750 MHz Body		1750 MHz Head	
Date(s)		May 15, 2018		May 15, 2018		May 15, 2018	
Liquid Temperature (°C)	20.0	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ϵ		41.94	41.46	55.53	55.57	40.08	39.76
Conductivity: σ		0.89	0.90	0.96	0.99	1.37	1.38
		1750 MHz Body		1900 MHz Head		1900 MHz Body	
Date(s)		May 15, 2018		May 14, 2018		May 14, 2018	
Liquid Temperature (°C)	20.0	Target	Measured	Target	Measured	Target	Measured
Dielectric Constant: ϵ		53.43	53.32	40.00	40.00	53.30	52.07
Conductivity: σ		1.49	1.52	1.40	1.43	1.52	1.47

See Appendix A for data printout.

Test System Verification

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

Table 9.2 System Dipole Validation Target & Measured

	Test Frequency	Targeted SAR _{1g} (W/kg)	Measure SAR _{1g} (W/kg)	Tissue Used for Verification	Deviation (%)	Plot Number
15-May-2018	750 MHz	8.03	8.13	Head	+ 1.25	1
15-May-2018	750 MHz	8.48	8.65	Body	+ 2.00	2
15-May-2018	1750 MHz	36.80	37.20	Head	+ 1.09	3
15-May-2018	1750 MHz	37.70	38.50	Body	+ 2.12	4
14-May-2018	1900 MHz	41.50	41.70	Head	+ 0.48	5
14-May-2018	1900 MHz	40.40	39.80	Body	- 1.49	6

See Appendix A for data plots.

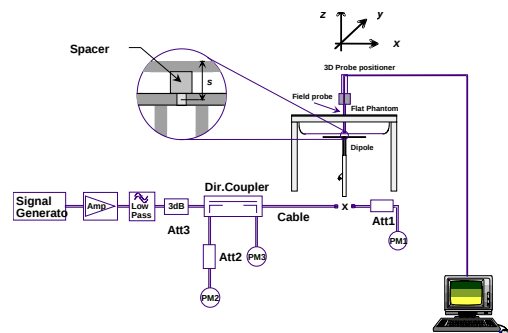


Figure 9.1 Dipole Validation Test Setup

10. LTE Document Checklist

- 1) Identify the operating frequency range of each LTE transmission band used by the device

LTE Operating Band	Uplink (transmit)	Downlink (Receive)	Duplex mode (FDD/TDD)
	Low - high	Low - high	
2	1850-1910	1930-1990	FDD
4	1710-1755	2110-2155	FDD
13	777-787	746-756	FDD

- 2) Identify the channel bandwidths used in each frequency band; 1.4, 3, 5, 10, 15, 20 MHz etc

LTE Band Class	Bandwidth (MHz)	Frequency or Freq. Band (MHz)
2	1.4, 3, 5, 10, 15, 20	1850-1910 MHz
4	1.4, 3, 5, 10, 15, 20	1710-1755 MHz
13	5, 10	777-787 MHz

- 3) Identify the high, middle and low (H, M, L) channel numbers and frequencies in each LTE frequency band

LTE Band Class	Bandwidth (MHz)	Frequency (MHz)/Channel #					
		Low		Mid		High	
2	1.4	1850.7	18607	1880.0	18900	1909.3	19193
2	3	1851.5	18615	1880.0	18900	1908.5	19185
2	5	1852.5	18625	1880.0	18900	1907.5	19175
2	10	1855.0	18650	1880.0	18900	1905.0	19150
2	15	1857.5	18675	1880.0	18900	1902.5	19125
2	20	1860.0	18700	1880.0	18900	1900.0	19100
4	1.4	1710.7	19957	1732.5	20175	1754.3	20393
4	3	1711.5	19965	1732.5	20175	1753.5	20385
4	5	1712.5	19975	1732.5	20175	1752.5	20375
4	10	1715.0	20000	1732.5	20175	1750.0	20350
4	15	1717.5	20025	1732.5	20175	1747.5	20325
4	20	1720.0	20050	1732.5	20175	1745.0	20300
13	5	779.5	23205	782.0	23230	784.5	23225
13	10	-----	-----	782.0	23230	-----	-----

- 4) Specify the UE category and uplink modulations used:

- UE Category: 3
- Uplink modulations: QPSK and 16QAM

- 5) Include descriptions of the LTE transmitter and antenna implementation; and also identify whether it is a standalone transmitter operating independently of other wireless transmitters in the device or sharing hardware components and/or antenna(s) with other transmitters etc

The device has 4 antennas:

- WWAN Main (Transmit and Receive) Antenna
- WWAN Aux (Receive) Diversity Antenna
- WiFi Main Antenna
- ISM Band Antenna

Transmission relationship

- All LTE transmission (TX) is limited to the WWAN antenna only
- Rx is on Main and Aux
- Simultaneous evaluation is conducted for the WWAN & WiFi, WWAN & ISM and WiFi & ISM

- 6) Identify the LTE voice/data requirements in each operating mode and exposure condition with respect to head and body test configurations, antenna locations, handset flip-cover or slide positions, antenna diversity conditions etc

The device is a voice/data device. Voice and data mode was tested in each operating mode and exposure condition in the head and body configuration. See test setup photos to see all configurations tested.

- 7) Identify if Maximum Power Reduction (MPR) is optional or mandatory, i.e. built-in by design:

- a) Only mandatory MPR may be considered during SAR testing, when the maximum output power is permanently limited by the MPR implemented within the UE; and only for the applicable RB (resource block) configurations specified in LTE standards

MPR is mandatory, built-in by design on all production units. It was enabled during testing.

Modulation	Channel Bandwidth/transmission Bandwidth Configuration (RB)						MPR (dB)
	1.4 MHz	3.0 MHz	5 MHz	10 MHz	15 MHz	20 MHz	
QPSK	> 5	> 4	> 8	> 12	> 16	> 18	≤ 1
16QAM	≤ 5	≤ 4	≤ 8	≤ 12	≤ 16	≤ 18	≤ 1
16QAM	> 5	> 4	> 8	> 12	> 16	> 18	≤ 2

- b) A-MPR (additional MPR) must be disabled
c) A-MPR was disabled during testing.

- 8) Include the maximum average conducted output power measured on the required test channels for each channel bandwidth and UL modulation used in each frequency band:

The maximum average conducted output power measured for the testing is listed on pages 29-42 of this report. The below table shows the factory set point with the allowable tolerance.

Band	Technology	Class	3GPP Nominal Power dBm	Setpoint Nominal Power dBm	Tolerance dBm	Lower Tolerance dBm	Upper Tolerance dBm
Band 2	LTE	3	22.0	22.5	±1.5	21.0	24.0
Band 4	LTE	3	22.0	22.5	±1.5	21.0	24.0
Band 13	LTE	3	22.0	22.5	±1.5	21.0	24.0

- 9) Identify all other U.S. wireless operating modes (3G, Wi-Fi, WiMax, Bluetooth etc), device/exposure configurations (head and body, antenna and handset flip-cover or slide positions, antenna diversity conditions etc.) and frequency bands used for these modes

Other wireless modes:

The device contains a WiFi and ISM transmitter as well. Both transmitters are low duty cycle and excluded from SAR testing per the KDB submitted to the FCC. Simultaneous Tx is evaluated below.

Band	Technology	Class	3GPP Nominal Power dBm	Setpoint Nominal Power dBm	Tolerance dBm	Lower Tolerance dBm	Upper Tolerance dBm
WiFi	802.11bgn	N/A	N/A	N/A	N/A	N/A	18.3
ISM	FM	N/A	N/A	N/A	N/A	N/A	20.0

Note: The WiFi and ISM band radio both operate at a low duty cycle which allows both to be excluded from SAR testing. The WiFi operates at a worst case of 3.94% duty cycle and the ISM band radio operates at a 3.55% duty cycle. Based on this, the maximum average power for each radio is calculated below.

WiFi: 18.3 dBm = 67.6 mW; 67.6 mW * 3.94% = 2.66 mW maximum average power.

ISM: 20.0 dBm = 100 mW; 100 mW * 3.55% = 3.55 mW maximum average power.

Both transmitters are excluded from SAR testing based on KDB447498 D01 v06 section 4.3.1 a) on page 12 and RSS-102 Issue 5 section 2.5.1 Table 1 on page 4.

- 10) Include the maximum average conducted output power measured for the other wireless modes and frequency bands.

The maximum average conducted output power was not measured for this report. The table in item 9 shows the factory set point with the allowable tolerance.

- 11) Identify the simultaneous transmission conditions for the voice and data configurations supported by all wireless modes, device configurations and frequency bands, for the head and body exposure conditions and device operating configurations (handset flip or cover positions, antenna diversity conditions etc.)

The device is able to transmit simultaneously with the WWAN & WiFi, WWAN & ISM and WiFi & ISM.

- 12) When power reduction is applied to certain wireless modes to satisfy SAR compliance for simultaneous transmission conditions, other equipment certification or operating requirements, include the maximum average conducted output power measured in each power reduction mode applicable to the simultaneous voice/data transmission configurations for such wireless configurations and frequency bands; and also include details of the power reduction implementation and measurement setup

Power reduction is not required to satisfy SAR compliance.

- 13) Include descriptions of the test equipment, test software, built-in test firmware etc. required to support testing the device when power reduction is applied to one or more transmitters/antennas for simultaneous voice/data transmission

Power reduction is not required to satisfy SAR compliance.

- 14) When appropriate, include a SAR test plan proposal with respect to the above

Power reduction is not required to satisfy SAR compliance.

- 15) If applicable, include preliminary SAR test data and/or supporting information in laboratory testing inquiries to address specific issues and concerns or for requesting further test reduction considerations appropriate for the device; for example, simultaneous transmission configurations.

Not applicable.

11. 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 placed into simulated transmit mode using the manufacturer's test codes. Such test signals offer a consistent means for testing SAR and are recommended for evaluating SAR. When test modes are not available or inappropriate for testing a device, 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

In order to verify that the device was tested at full power, conducted output power measurements were performed before and after each SAR measurement to confirm the output power unless otherwise noted. If a conducted power deviation of more than 5% occurred, the test was repeated. The power drift of each test is measured at the start of the test and again at the end of the test. The drift percentage is calculated by the formula $((\text{end}/\text{start}) - 1) * 100$ and rounded to three decimal places. The drift percentage is calculated into the resultant SAR value on the data sheet for each test.

The EUT was tested next to the ear on the left and right side of the SAM phantom for all head measurements. The device was tested with the front of the phone installed towards the body in the holster as well as with the back installed towards the body. The device was tested with the holster installed next to the ELI Flat phantom for all body measurements. All measurements were conducted with the side of the device in direct contact with the phantom. All further test reductions are shown on pages 43-49. The device does allow for simultaneous Tx with the three radios. Please see the simultaneous evaluation below on page 53 of this report. See the photo in Appendix C for a pictorial of the setups.

The device was on a minimum of 10 cm of Styrofoam during each test.

11.1 SAR Measurement Conditions for LTE Bands

11.1.1 LTE Functionality

The follow table identifies all the channel bandwidths in each frequency band supported by this device.

LTE Band Class	Bandwidth (MHz)	Frequency or Freq. Band (MHz)
2	1.4, 3, 5, 10, 15, 20	1850-1910 MHz
4	1.4, 3, 5, 10, 15, 20	1710-1755 MHz
13	5, 10	777-787 MHz

11.1.2 Test Conditions

All SAR measurements for LTE were performed using the Anritsu MT8820C. A closed loop power control setting allowed the UE to transmit at the maximum output power during the SAR measurements. The Figure 11.1 table indicates all the test reduction utilized for this report.

MPR was enabled for this device. A-MPR was disabled for all SAR test measurements.

Table 11.1.2.1 LTE Power Measurements

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
2	QPSK	1.4 MHz	1	0	18607	1850.7	22.6
					18900	1880	22.7
					19193	1909.3	22.7
				3	18607	1850.7	22.7
					18900	1880	22.6
					19193	1909.3	22.7
				5	18607	1850.7	22.7
					18900	1880	22.6
					19193	1909.3	22.6
			3	0	18607	1850.7	22.6
					18900	1880	22.7
					19193	1909.3	22.7
				1	18607	1850.7	22.7
					18900	1880	22.6
					19193	1909.3	22.7
				3	18607	1850.7	22.5
					18900	1880	22.6
					19193	1909.3	22.5
			6	0	18607	1850.7	21.7
					18900	1880	21.6
					19193	1909.3	21.7
		3 MHz	1	0	18615	1851.5	22.7
					18900	1880	22.6
					19185	1908.5	22.6
				7	18615	1851.5	22.7
					18900	1880	22.6
					19185	1908.5	22.7
				14	18615	1851.5	22.7
					18900	1880	22.7
					19185	1908.5	22.7
			8	0	18615	1851.5	21.6
					18900	1880	21.7
					19185	1908.5	21.7
				3	18615	1851.5	21.7
					18900	1880	21.7
					19185	1908.5	21.6
				7	18615	1851.5	21.7
					18900	1880	21.6
					19185	1908.5	21.7
			15	0	18615	1851.5	21.6
					18900	1880	21.6
					19185	1908.5	21.7

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
2	QPSK	5 MHz	1	0	18625	1852.5	22.7
					18900	1880.0	22.6
					19175	1907.5	22.7
				12	18625	1852.5	22.6
					18900	1880.0	22.6
					19175	1907.5	22.7
				24	18625	1852.5	22.6
					18900	1880.0	22.5
					19175	1907.5	22.5
			12	0	18625	1852.5	21.7
					18900	1880.0	21.6
					19175	1907.5	21.7
				6	18625	1852.5	21.5
					18900	1880.0	21.5
					19175	1907.5	21.6
				13	18625	1852.5	21.5
					18900	1880.0	21.6
					19175	1907.5	21.6
			25	0	18625	1852.5	21.7
					18900	1880.0	21.6
					19175	1907.5	21.6
		10 MHz	1	0	18650	1855.5	23.0
					18900	1880.0	22.9
					19150	1905.0	22.9
				24	18650	1855.5	22.6
					18900	1880.0	22.6
					19150	1905.0	22.7
				49	18650	1855.5	22.5
					18900	1880.0	22.5
					19150	1905.0	22.6
			25	0	18650	1855.5	21.7
					18900	1880.0	21.7
					19150	1905.0	21.7
				13	18650	1855.5	21.7
					18900	1880.0	21.6
					19150	1905.0	21.6
				25	18650	1855.5	21.6
					18900	1880.0	21.6
					19150	1905.0	21.6
			50	0	18650	1855.5	21.7
					18900	1880.0	21.7
					19150	1905.0	21.8

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
2	QPSK	15 MHz	1	0	18675	1857.5	23.0
					18900	1880.0	23.0
					19125	1902.5	23.0
				37	18675	1857.5	22.6
					18900	1880.0	22.5
					19125	1902.5	22.6
				74	18675	1857.5	22.6
					18900	1880.0	22.6
					19125	1902.5	22.6
			36	0	18675	1857.5	21.9
					18900	1880.0	21.8
					19125	1902.5	21.9
				19	18675	1857.5	21.7
					18900	1880.0	21.7
					19125	1902.5	21.7
				39	18675	1857.5	21.6
					18900	1880.0	21.6
					19125	1902.5	21.6
			75	0	18675	1857.5	21.7
					18900	1880.0	21.7
					19125	1902.5	21.7
		20 MHz	1	0	18700	1860.0	22.4
					18900	1880.0	22.5
					19100	1900.0	22.5
				49	18700	1860.0	23.0
					18900	1880.0	23.0
					19100	1900.0	23.0
				99	18700	1860.0	22.5
					18900	1880.0	22.5
					19100	1900.0	22.5
			50	0	18700	1860.0	21.7
					18900	1880.0	21.7
					19100	1900.0	21.7
				24	18700	1860.0	21.7
					18900	1880.0	21.6
					19100	1900.0	21.6
				50	18700	1860.0	21.8
					18900	1880.0	21.8
					19100	1900.0	21.6
			100	0	18700	1860.0	21.7
					18900	1880.0	21.7
					19100	1900.0	21.6

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
2	16QAM	1.4 MHz	1	0	18607	1850.7	21.1
					18900	1880	21.2
					19193	1909.3	21.1
				3	18607	1850.7	21.2
					18900	1880	21.2
					19193	1909.3	21.2
				5	18607	1850.7	21.2
					18900	1880	21.2
					19193	1909.3	21.1
			3	0	18607	1850.7	20.6
					18900	1880	20.7
					19193	1909.3	20.6
				1	18607	1850.7	20.7
					18900	1880	20.7
					19193	1909.3	20.6
				3	18607	1850.7	20.6
					18900	1880	20.7
					19193	1909.3	20.7
			6	0	18607	1850.7	19.8
					18900	1880	19.9
					19193	1909.3	19.8
		3 MHz	1	0	18615	1851.5	21.0
					18900	1880	21.0
					19185	1908.5	20.9
				7	18615	1851.5	21.0
					18900	1880	21.1
					19185	1908.5	21.1
				14	18615	1851.5	21.1
					18900	1880	21.0
					19185	1908.5	21.0
			8	0	18615	1851.5	19.7
					18900	1880	19.7
					19185	1908.5	19.7
				3	18615	1851.5	19.7
					18900	1880	19.6
					19185	1908.5	19.6
				7	18615	1851.5	19.6
					18900	1880	19.6
					19185	1908.5	19.7
			15	0	18615	1851.5	19.6
					18900	1880	19.7
					19185	1908.5	19.7

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
2	16QAM	5 MHz	1	0	18625	1852.5	21.1
					18900	1880.0	21.2
					19175	1907.5	21.1
				12	18625	1852.5	21.1
					18900	1880.0	21.1
					19175	1907.5	21.0
				24	18625	1852.5	20.9
					18900	1880.0	21.0
					19175	1907.5	21.0
			12	0	18625	1852.5	19.7
					18900	1880.0	19.7
					19175	1907.5	19.6
				6	18625	1852.5	19.7
					18900	1880.0	19.6
					19175	1907.5	19.6
				13	18625	1852.5	19.7
					18900	1880.0	19.6
					19175	1907.5	19.6
			25	0	18625	1852.5	19.7
					18900	1880.0	19.6
					19175	1907.5	19.6
		10 MHz	1	0	18650	1855.5	21.3
					18900	1880.0	21.4
					19150	1905.0	21.3
				24	18650	1855.5	21.1
					18900	1880.0	21.1
					19150	1905.0	21.0
				49	18650	1855.5	21.0
					18900	1880.0	21.1
					19150	1905.0	21.0
			25	0	18650	1855.5	19.7
					18900	1880.0	19.7
					19150	1905.0	19.7
				13	18650	1855.5	19.7
					18900	1880.0	19.6
					19150	1905.0	19.6
				25	18650	1855.5	19.7
					18900	1880.0	19.7
					19150	1905.0	19.7
			50	0	18650	1855.5	19.7
					18900	1880.0	19.7
					19150	1905.0	19.6

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
2	16QAM	15 MHz	1	0	18675	1857.5	21.5
					18900	1880.0	21.5
					19125	1902.5	21.4
				37	18675	1857.5	21.1
					18900	1880.0	21.1
					19125	1902.5	21.0
				74	18675	1857.5	21.0
					18900	1880.0	21.1
					19125	1902.5	21.0
			36	0	18675	1857.5	19.8
					18900	1880.0	19.8
					19125	1902.5	19.7
				19	18675	1857.5	19.8
					18900	1880.0	19.7
					19125	1902.5	19.7
				39	18675	1857.5	19.7
					18900	1880.0	19.6
					19125	1902.5	19.6
			75	0	18675	1857.5	19.6
					18900	1880.0	19.7
					19125	1902.5	19.6
		20 MHz	1	0	18700	1860.0	21.5
					18900	1880.0	21.6
					19100	1900.0	21.5
				49	18700	1860.0	20.9
					18900	1880.0	20.9
					19100	1900.0	20.8
				99	18700	1860.0	20.9
					18900	1880.0	21.0
					19100	1900.0	21.0
			50	0	18700	1860.0	19.7
					18900	1880.0	19.8
					19100	1900.0	19.8
				24	18700	1860.0	19.6
					18900	1880.0	19.6
					19100	1900.0	19.6
				50	18700	1860.0	19.6
					18900	1880.0	19.6
					19100	1900.0	19.5
			100	0	18700	1860.0	19.7
					18900	1880.0	19.7
					19100	1900.0	19.6

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
4	QPSK	1.4 MHz	1	0	19957	1710.7	21.4
					20175	1732.5	21.5
					20393	1754.3	21.6
				3	19957	1710.7	21.6
					20175	1732.5	21.5
					20393	1754.3	21.5
				5	19957	1710.7	21.6
					20175	1732.5	21.5
					20393	1754.3	21.5
			3	0	19957	1710.7	21.6
					20175	1732.5	21.6
					20393	1754.3	21.5
				1	19957	1710.7	21.7
					20175	1732.5	21.6
					20393	1754.3	21.6
				3	19957	1710.7	21.5
					20175	1732.5	21.6
					20393	1754.3	21.4
			6	0	19957	1710.7	20.4
					20175	1732.5	20.5
					20393	1754.3	20.5
		3 MHz	1	0	19965	1711.5	21.6
					20175	1732.5	21.6
					20385	1753.5	21.5
				7	19965	1711.5	21.6
					20175	1732.5	21.5
					20385	1753.5	21.5
				14	19965	1711.5	21.5
					20175	1732.5	21.5
					20385	1753.5	21.6
			8	0	19965	1711.5	20.7
					20175	1732.5	20.6
					20385	1753.5	20.7
				3	19965	1711.5	20.6
					20175	1732.5	20.5
					20385	1753.5	20.5
				7	19965	1711.5	20.5
					20175	1732.5	20.5
					20385	1753.5	20.6
			15	0	19965	1711.5	20.7
					20175	1732.5	20.6
					20385	1753.5	20.7

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
4	QPSK	5 MHz	1	0	19975	1712.5	21.7
					20175	1732.5	21.6
					20375	1752.5	21.5
				12	19975	1712.5	21.5
					20175	1732.5	21.5
					20375	1752.5	21.6
				24	19975	1712.5	21.6
					20175	1732.5	21.5
					20375	1752.5	21.5
			12	0	19975	1712.5	20.6
					20175	1732.5	20.6
					20375	1752.5	20.7
				6	19975	1712.5	20.7
					20175	1732.5	20.6
					20375	1752.5	20.6
				13	19975	1712.5	20.6
					20175	1732.5	20.5
					20375	1752.5	20.5
			25	0	19975	1712.5	20.6
					20175	1732.5	20.6
					20375	1752.5	20.7
		10 MHz	1	0	20000	1715.0	21.9
					20175	1732.5	21.9
					20350	1750.0	21.8
				24	20000	1715.0	21.6
					20175	1732.5	21.5
					20350	1750.0	21.4
				49	20000	1715.0	21.5
					20175	1732.5	21.5
					20350	1750.0	21.6
			25	0	20000	1715.0	20.7
					20175	1732.5	20.7
					20350	1750.0	20.6
				13	20000	1715.0	20.6
					20175	1732.5	20.6
					20350	1750.0	20.6
				25	20000	1715.0	20.6
					20175	1732.5	20.6
					20350	1750.0	20.7
			50	0	20000	1715.0	20.7
					20175	1732.5	20.7
					20350	1750.0	20.6

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
4	QPSK	15 MHz	1	0	20025	1717.5	21.9
					20175	1732.5	21.9
					20325	1747.5	21.8
				37	20025	1717.5	21.6
					20175	1732.5	21.5
					20325	1747.5	21.5
				74	20025	1717.5	21.5
					20175	1732.5	21.4
					20325	1747.5	21.4
			36	0	20025	1717.5	20.8
					20175	1732.5	20.8
					20325	1747.5	20.7
				19	20025	1717.5	20.7
					20175	1732.5	20.6
					20325	1747.5	20.6
				39	20025	1717.5	20.6
					20175	1732.5	20.5
					20325	1747.5	20.5
			75	0	20025	1717.5	20.6
					20175	1732.5	20.6
					20325	1747.5	20.7
		20 MHz	1	0	20050	1720.0	21.4
					20175	1732.5	21.3
					20300	1745.0	21.5
				49	20050	1720.0	22.0
					20175	1732.5	22.1
					20300	1745.0	22.1
				99	20050	1720.0	21.5
					20175	1732.5	21.4
					20300	1745.0	21.5
			50	0	20050	1720.0	20.8
					20175	1732.5	20.8
					20300	1745.0	20.9
				24	20050	1720.0	20.5
					20175	1732.5	20.6
					20300	1745.0	20.6
				50	20050	1720.0	20.6
					20175	1732.5	20.6
					20300	1745.0	20.7
			100	0	20050	1720.0	20.7
					20175	1732.5	20.7
					20300	1745.0	20.7

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
4	16QAM	1.4 MHz	1	0	19957	1710.7	21.1
					20175	1732.5	21.1
					20393	1754.3	21.2
				3	19957	1710.7	21.2
					20175	1732.5	21.2
					20393	1754.3	21.1
				5	19957	1710.7	21.0
					20175	1732.5	21.1
					20393	1754.3	21.1
			3	0	19957	1710.7	20.7
					20175	1732.5	20.7
					20393	1754.3	20.7
				1	19957	1710.7	20.7
					20175	1732.5	20.7
					20393	1754.3	20.8
				3	19957	1710.7	20.8
					20175	1732.5	20.7
					20393	1754.3	20.7
			6	0	19957	1710.7	19.8
					20175	1732.5	19.9
					20393	1754.3	19.7
		3 MHz	1	0	19965	1711.5	21.0
					20175	1732.5	21.1
					20385	1753.5	21.1
				7	19965	1711.5	21.1
					20175	1732.5	21.2
					20385	1753.5	21.2
				14	19965	1711.5	21.0
					20175	1732.5	21.0
					20385	1753.5	20.9
			8	0	19965	1711.5	19.7
					20175	1732.5	19.7
					20385	1753.5	19.8
				3	19965	1711.5	19.8
					20175	1732.5	19.7
					20385	1753.5	19.7
				7	19965	1711.5	19.7
					20175	1732.5	19.7
					20385	1753.5	19.6
			15	0	19965	1711.5	19.8
					20175	1732.5	19.8
					20385	1753.5	19.7

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
4	16QAM	5 MHz	1	0	19975	1712.5	21.1
					20175	1732.5	21.2
					20375	1752.5	21.2
				12	19975	1712.5	21.2
					20175	1732.5	21.2
					20375	1752.5	21.2
				24	19975	1712.5	21.2
					20175	1732.5	21.1
					20375	1752.5	21.1
			12	0	19975	1712.5	19.8
					20175	1732.5	19.8
					20375	1752.5	19.7
				6	19975	1712.5	19.7
					20175	1732.5	19.7
					20375	1752.5	19.6
				13	19975	1712.5	19.6
					20175	1732.5	19.7
					20375	1752.5	19.7
			25	0	19975	1712.5	19.7
					20175	1732.5	19.6
					20375	1752.5	19.6
		10 MHz	1	0	20000	1715.0	21.3
					20175	1732.5	21.3
					20350	1750.0	21.3
				24	20000	1715.0	21.2
					20175	1732.5	21.1
					20350	1750.0	21.1
				49	20000	1715.0	21.1
					20175	1732.5	21.0
					20350	1750.0	21.0
			25	0	20000	1715.0	19.6
					20175	1732.5	19.7
					20350	1750.0	19.7
				13	20000	1715.0	19.7
					20175	1732.5	19.6
					20350	1750.0	19.6
				25	20000	1715.0	19.6
					20175	1732.5	19.6
					20350	1750.0	19.5
			50	0	20000	1715.0	19.8
					20175	1732.5	19.7
					20350	1750.0	19.7

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
4	16QAM	15 MHz	1	0	20025	1717.5	21.5
					20175	1732.5	21.6
					20325	1747.5	21.6
				37	20025	1717.5	21.1
					20175	1732.5	21.2
					20325	1747.5	21.2
				74	20025	1717.5	21.2
					20175	1732.5	21.1
					20325	1747.5	21.1
			36	0	20025	1717.5	19.9
					20175	1732.5	19.9
					20325	1747.5	19.8
				19	20025	1717.5	19.8
					20175	1732.5	19.7
					20325	1747.5	19.7
				39	20025	1717.5	19.7
					20175	1732.5	19.7
					20325	1747.5	19.6
			75	0	20025	1717.5	19.7
					20175	1732.5	19.7
					20325	1747.5	19.7
		20 MHz	1	0	20050	1720.0	21.5
					20175	1732.5	21.5
					20300	1745.0	21.4
				49	20050	1720.0	21.1
					20175	1732.5	21.1
					20300	1745.0	21.2
				99	20050	1720.0	21.0
					20175	1732.5	20.9
					20300	1745.0	20.9
			50	0	20050	1720.0	19.6
					20175	1732.5	19.5
					20300	1745.0	19.5
				24	20050	1720.0	19.7
					20175	1732.5	19.6
					20300	1745.0	19.6
				50	20050	1720.0	19.8
					20175	1732.5	19.9
					20300	1745.0	19.9
			100	0	20050	1720.0	19.7
					20175	1732.5	19.7
					20300	1745.0	19.6

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
13	QPSK	5 MHz	1	0	23205	779.5	22.1
					23230	782.0	22.2
					23129	784.5	22.2
				12	23205	779.5	22.2
					23230	782.0	22.2
					23129	784.5	22.3
				24	23205	779.5	22.1
					23230	782.0	22.0
					23129	784.5	22.1
			12	0	23205	779.5	21.2
					23230	782.0	21.3
					23129	784.5	21.3
				6	23205	779.5	21.4
					23230	782.0	21.4
					23129	784.5	21.4
				13	23205	779.5	21.3
					23230	782.0	21.4
					23129	784.5	21.3
			25	0	23205	779.5	21.2
					23230	782.0	21.4
					23129	784.5	21.3
		10 MHz	1	0	23230	782.0	21.9
				24	23230	782.0	22.1
				49	23230	782.0	21.6
			25	0	23230	782.0	21.5
				13	23230	782.0	21.3
				25	23230	782.0	21.3
			50	0	23230	782.0	21.4

Band	Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
13	16QAM	5 MHz	1	0	23205	779.5	21.9
					23230	782.0	22.0
					23129	784.5	21.9
				12	23205	779.5	21.9
					23230	782.0	22.0
					23129	784.5	22.0
				24	23205	779.5	21.9
					23230	782.0	21.8
					23129	784.5	21.8
			12	0	23205	779.5	20.7
					23230	782.0	20.6
					23129	784.5	20.5
				6	23205	779.5	20.6
					23230	782.0	20.5
					23129	784.5	20.5
				13	23205	779.5	20.6
					23230	782.0	20.6
					23129	784.5	20.5
			25	0	23205	779.5	20.3
					23230	782.0	20.4
					23129	784.5	20.3
		10 MHz	1	0	23230	782.0	21.8
				24	23230	782.0	21.9
				49	23230	782.0	21.3
			25	0	23230	782.0	20.5
				13	23230	782.0	20.4
				25	23230	782.0	20.4
			50	0	23230	782.0	20.6

Table 11.1.2.2 Test Reduction Table – LTE

Band/ Frequency (MHz)	Pos.	Required Test Channel	Bandwidth	Modulation	RB Allocation	RB Offset	Tested/ Reduced	
Band 2 1850-1910 MHz	Right Touch	18700	20 MHz	QPSK	50	24	Tested	
		18900					Tested	
		19100					Tested	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ²	
		18900					Reduced ²	
		19100					Reduced ²	
		18700				49	Tested	
		18900					Tested	
		19100					Tested	
		18700		16QAM	50	24	Reduced ³	
		18900					Reduced ³	
		19100					Reduced ³	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		18700				49	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)						
	Right Tilt	18700	20 MHz	QPSK	50	24	Tested	
		18900					Tested	
		19100					Tested	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ²	
		18900					Reduced ²	
		19100					Reduced ²	
		18700				49	Tested	
		18900					Tested	
		19100					Tested	
		18700		16QAM	50	24	Reduced ³	
		18900					Reduced ³	
		19100					Reduced ³	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		18700				49	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)						

Reduced¹ – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 v02r05.

Reduced² - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced³ - If the SAR value in the 50% RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁴- If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁵- If the conducted power is within ±0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 v02r05.

Reduced⁶- If the SAR value measured on the middle channel is less than 0.8 W/kg and the conducted power is within ±0.5 dB, the remaining channels are reduced per KDB941225 D05 v02r05.

Band/ Frequency (MHz)	Pos.	Required Test Channel	Bandwidth	Modulation	RB Allocation	RB Offset	Tested/ Reduced	
Band 2 1850-1910 MHz	Left Touch	18700	20 MHz	QPSK	50	24	Tested	
		18900					Tested	
		19100					Tested	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ²	
		18900					Reduced ²	
		19100					Reduced ²	
		18700				49	Tested	
		18900					Tested	
		19100					Tested	
		18700		16QAM	50	24	Reduced ³	
		18900					Reduced ³	
		19100					Reduced ³	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		18700				49	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)						
	Left Tilt	18700	20 MHz	QPSK	50	24	Reduced ⁶	
		18900					Tested	
		19100					Reduced ⁶	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ²	
		18900					Reduced ²	
		19100					Reduced ²	
		18700				49	Reduced ⁶	
		18900					Tested	
		19100					Reduced ⁶	
		18700		16QAM	50	24	Reduced ³	
		18900					Reduced ³	
		19100					Reduced ³	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		18700				49	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)						

Reduced¹ – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 v02r05.

Reduced² - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced³ - If the SAR value in the 50% RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁴- If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁵- If the conducted power is within ±0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 v02r05.

Reduced⁶- If the SAR value measured on the middle channel is less than 0.8 W/kg and the conducted power is within ±0.5 dB, the remaining channels are reduced per KDB941225 D05 v02r05.

Band/ Frequency (MHz)	Pos.	Required Test Channel	Bandwidth	Modulation	RB Allocation	RB Offset	Tested/ Reduced	
Band 2 1850-1910 MHz	Body Front	18700	20 MHz	QPSK	50	24	Reduced ⁶	
		18900					Tested	
		19100					Reduced ⁶	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ²	
		18900					Reduced ²	
		19100					Reduced ²	
		18700				49	Reduced ⁶	
		18900					Tested	
		19100					Reduced ⁶	
		18700		16QAM	50	24	Reduced ³	
		18900					Reduced ³	
		19100					Reduced ³	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		18700				49	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
	All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)						Reduced ⁵	
	Body Back	18700	20 MHz	QPSK	50	24	Reduced ⁶	
		18900					Tested	
		19100					Reduced ⁶	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ²	
		18900					Reduced ²	
		19100					Reduced ²	
		18700				49	Reduced ⁶	
		18900					Tested	
		19100					Reduced ⁶	
		18700		16QAM	50	24	Reduced ³	
		18900					Reduced ³	
		19100					Reduced ³	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		18700				49	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)						Reduced ⁵

Reduced¹ – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 v02r05.

Reduced² - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced³ - If the SAR value in the 50% RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁴- If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁵- If the conducted power is within ± 0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 v02r05.

Reduced⁶- If the SAR value measured on the middle channel is less than 0.8 W/kg and the conducted power is within ± 0.5 dB, the remaining channels are reduced per KDB941225 D05 v02r05.

Band/ Frequency (MHz)	Pos.	Required Test Channel	Bandwidth	Modulation	RB Allocation	RB Offset	Tested/ Reduced	
Band 4 1710-1755 MHz	Right Touch	18700	20 MHz	QPSK	50	24	Tested	
		18900					Tested	
		19100					Tested	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ²	
		18900					Reduced ²	
		19100					Reduced ²	
		18700				49	Tested	
		18900					Tested	
		19100					Tested	
		18700		16QAM	50	24	Reduced ³	
		18900					Reduced ³	
		19100					Reduced ³	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		18700				49	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)						
	Right Tilt	18700	20 MHz	QPSK	50	24	Reduced ⁶	
		18900					Tested	
		19100					Reduced ⁶	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ²	
		18900					Reduced ²	
		19100					Reduced ²	
		18700				49	Reduced ⁶	
		18900					Tested	
		19100					Reduced ⁶	
		18700		16QAM	50	24	Reduced ³	
		18900					Reduced ³	
		19100					Reduced ³	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		18700				49	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)						

Reduced¹ – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 v02r05.

Reduced² - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced³ - If the SAR value in the 50% RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁴- If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁵- If the conducted power is within ±0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 v02r05.

Reduced⁶- If the SAR value measured on the middle channel is less than 0.8 W/kg and the conducted power is within ±0.5 dB, the remaining channels are reduced per KDB941225 D05 v02r05.

Band/ Frequency (MHz)	Pos.	Required Test Channel	Bandwidth	Modulation	RB Allocation	RB Offset	Tested/ Reduced	
Band 4 1710-1755 MHz	Left Touch	18700	20 MHz	QPSK	50	24	Tested	
		18900					Tested	
		19100					Tested	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ²	
		18900					Reduced ²	
		19100					Reduced ²	
		18700				49	Tested	
		18900					Tested	
		19100					Tested	
		18700		16QAM	50	24	Reduced ³	
		18900					Reduced ³	
		19100					Reduced ³	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
		18700				49	Reduced ⁴	
	18900	Reduced ⁴						
	19100	Reduced ⁴						
	All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)							Reduced ⁵
	Left Tilt	18700	20 MHz	QPSK	50	24	Reduced ⁶	
		18900					Tested	
		19100					Reduced ⁶	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ²	
		18900					Reduced ²	
		19100					Reduced ²	
		18700				49	Reduced ⁶	
		18900					Tested	
		19100					Reduced ⁶	
		18700		16QAM	50	24	Reduced ³	
		18900					Reduced ³	
		19100					Reduced ³	
		18700			100	0	Reduced ¹	
		18900					Reduced ¹	
		19100					Reduced ¹	
		18700			1	0	Reduced ⁴	
		18900					Reduced ⁴	
		19100					Reduced ⁴	
18700		49				Reduced ⁴		
18900	Reduced ⁴							
19100	Reduced ⁴							
All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)							Reduced ⁵	

Reduced¹ – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 v02r05.

Reduced² - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced³ - If the SAR value in the 50% RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁴- If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁵- If the conducted power is within ±0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 v02r05.

Reduced⁶- If the SAR value measured on the middle channel is less than 0.8 W/kg and the conducted power is within ±0.5 dB, the remaining channels are reduced per KDB941225 D05 v02r05.

Band/ Frequency (MHz)	Pos.	Required Test Channel	Bandwidth	Modulation	RB Allocation	RB Offset	Tested/ Reduced
Band 4 1710-1755 MHz	Body Front	18700	20 MHz	QPSK	50	24	Reduced ⁶
		18900					Tested
		19100					Reduced ⁶
		18700			100	0	Reduced ¹
		18900					Reduced ¹
		19100					Reduced ¹
		18700			1	0	Reduced ²
		18900					Reduced ²
		19100					Reduced ²
		18700				49	Reduced ⁶
		18900					Tested
		19100					Reduced ⁶
		18700		16QAM	50	24	Reduced ³
		18900					Reduced ³
		19100					Reduced ³
		18700			100	0	Reduced ¹
		18900					Reduced ¹
		19100					Reduced ¹
		18700			1	0	Reduced ⁴
		18900					Reduced ⁴
		19100					Reduced ⁴
		18700				49	Reduced ⁴
		18900					Reduced ⁴
		19100					Reduced ⁴
		All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)					Reduced ⁵
	Body Back	18700	20 MHz	QPSK	50	24	Reduced ⁶
		18900					Tested
		19100					Reduced ⁶
		18700			100	0	Reduced ¹
		18900					Reduced ¹
		19100					Reduced ¹
		18700			1	0	Reduced ²
		18900					Reduced ²
		19100					Reduced ²
		18700				49	Reduced ⁶
		18900					Tested
		19100					Reduced ⁶
		18700		16QAM	50	24	Reduced ³
		18900					Reduced ³
		19100					Reduced ³
		18700			100	0	Reduced ¹
		18900					Reduced ¹
		19100					Reduced ¹
		18700			1	0	Reduced ⁴
		18900					Reduced ⁴
		19100					Reduced ⁴
		18700				49	Reduced ⁴
		18900					Reduced ⁴
		19100					Reduced ⁴
		All lower bandwidths (15 MHz, 10 MHz, 5 MHz, 3 MHz, 1.4 MHz)					Reduced ⁵

Reduced¹ – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 v02r05.

Reduced² - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced³ - If the SAR value in the 50% RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁴- If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁵- If the conducted power is within ±0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 v02r05.

Reduced⁶- If the SAR value measured on the middle channel is less than 0.8 W/kg and the conducted power is within ±0.5 dB, the remaining channels are reduced per KDB941225 D05 v02r05.

Band/ Frequency (MHz)	Pos.	Required Test Channel	Bandwidth	Modulation	RB Allocation	RB Offset	Tested/ Reduced
Band 13 777-787 MHz	Right Touch	23230	10 MHz	QPSK	25	13	Tested
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ²
		23230				24	Tested
		23230		16QAM	25	13	Reduced ³
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ⁴
		23230				24	Reduced ⁴
		All lower bandwidths (5 MHz)					
	Right Tilt	23230	10 MHz	QPSK	25	13	Tested
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ²
		23230				24	Tested
		23230		16QAM	25	13	Reduced ³
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ⁴
		23230				24	Reduced ⁴
		All lower bandwidths (5 MHz)					
	Left Touch	23230	10 MHz	QPSK	25	13	Tested
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ²
		23230				24	Tested
		23230		16QAM	25	13	Reduced ³
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ⁴
		23230				24	Reduced ⁴
		All lower bandwidths (5 MHz)					
	Left Tilt	23230	10 MHz	QPSK	25	13	Tested
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ²
		23230				24	Tested
		23230		16QAM	25	13	Reduced ³
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ⁴
		23230				24	Reduced ⁴
		All lower bandwidths (5 MHz)					
	Body Front	23230	10 MHz	QPSK	25	13	Tested
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ²
		23230				24	Tested
		23230		16QAM	25	13	Reduced ³
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ⁴
		23230				24	Reduced ⁴
		All lower bandwidths (5 MHz)					
	Body Back	23230	10 MHz	QPSK	25	13	Tested
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ²
		23230				24	Tested
		23230		16QAM	25	13	Reduced ³
		23230			50	0	Reduced ¹
		23230			1	0	Reduced ⁴
		23230				24	Reduced ⁴
		All lower bandwidths (5 MHz)					

Reduced¹ – If the SAR value in the 50% RB testing is less than 1.45 W/kg, the 100% RB testing is reduced per KDB941225 D05 v02r05.

Reduced² - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced³ - If the SAR value in the 50% RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁴ - If the SAR value in the 1 RB testing is less than 1.45 W/kg, the remaining channels are reduced per KDB941225 D05 v02r05.

Reduced⁵ - If the conducted power is within ±0.5 dB, all testing where the SAR value is less than 1.45 W/kg is reduced per KDB941225 D05 v02r05.

Reduced⁶ - If the SAR value measured on the middle channel is less than 0.8 W/kg and the conducted power is within ±0.5 dB, the remaining channels are reduced per KDB941225 D05 v02r05.

SAR Data Summary – 750 MHz Body – LTE Band 13

MEASUREMENT RESULTS											
Gap	Plot	Position	Frequency		BW/ Modulation	RB Size	RB Offset	MPR Target	End Power (dBm)	Measured SAR (W/kg)	Reported SAR (W/kg)
			MHz	Ch.							
0 mm	1	Right	782.0	23230	10 MHz/QPSK	1	24	0	22.1	0.646	1.00
	-----	Touch	782.0	23230	10 MHz/QPSK	25	13	1	21.3	0.538	0.80
	-----	Right Tilt	782.0	23230	10 MHz/QPSK	1	24	0	22.1	0.597	0.93
	-----		782.0	23230	10 MHz/QPSK	25	13	1	21.3	0.446	0.66
	-----	Left Touch	782.0	23230	10 MHz/QPSK	1	24	0	22.1	0.584	0.91
	-----		782.0	23230	10 MHz/QPSK	25	13	1	21.3	0.506	0.75
	-----	Left Tilt	782.0	23230	10 MHz/QPSK	1	24	0	22.1	0.483	0.75
	-----		782.0	23230	10 MHz/QPSK	25	13	1	21.3	0.447	0.66
	2	Body	782.0	23230	10 MHz/QPSK	1	24	0	22.1	0.231	0.36
	-----	Front	782.0	23230	10 MHz/QPSK	25	13	1	21.3	0.159	0.24
	-----	Body Back	782.0	23230	10 MHz/QPSK	1	24	0	22.1	0.195	0.30
	-----		782.0	23230	10 MHz/QPSK	25	13	1	21.3	0.126	0.19
	-----	Repeat	782.0	23230	10 MHz/QPSK	1	24	0	22.1	0.625	0.97
Body 1.6 W/kg (mW/g) averaged over 1 gram											

1. SAR Measurement

Phantom Configuration

☐ Left Head

☒ Eli4

☐ Right Head

SAR Configuration

☐ Head

☒ Body

2. Test Signal Call Mode

☐ Test Code

☒ Base Station Simulator

3. Test Configuration

☐ With Belt Clip

☐ Without Belt Clip ☒ N/A

4. Tissue Depth is at least 15.0 cm



Jay M. Moulton
Vice President

SAR Data Summary – 1750 MHz Body – LTE Band 4

MEASUREMENT RESULTS											
Gap	Plot	Position	Frequency		BW/ Modulation	RB Size	RB Offset	MPR Target	End Power (dBm)	Measured SAR (W/kg)	Reported SAR (W/kg)
			MHz	Ch.							
0 mm	-----	Right Touch	1720.0	20050	20 MHz/QPSK	1	49	0	22.0	0.579	0.92
	-----		1732.5	20175	20 MHz/QPSK	1	49	0	22.1	0.603	0.93
	3		1745.0	20300	20 MHz/QPSK	1	49	0	22.1	0.630	0.98
	-----		1720.0	20050	20 MHz/QPSK	50	24	1	20.5	0.493	0.88
	-----		1732.5	20175	20 MHz/QPSK	50	24	1	20.6	0.484	0.84
	-----		1745.0	20300	20 MHz/QPSK	50	24	1	20.6	0.485	0.84
	-----	Right Tilt	1732.5	20175	20 MHz/QPSK	1	49	0	22.1	0.290	0.45
	-----		1732.5	20175	20 MHz/QPSK	50	24	1	20.6	0.235	0.41
	-----	Left Touch	1720.0	20050	20 MHz/QPSK	1	49	0	22.0	0.567	0.90
	-----		1732.5	20175	20 MHz/QPSK	1	49	0	22.1	0.591	0.92
	-----		1745.0	20300	20 MHz/QPSK	1	49	0	22.1	0.520	0.81
	-----		1720.0	20050	20 MHz/QPSK	50	24	1	20.5	0.499	0.89
	-----		1732.5	20175	20 MHz/QPSK	50	24	1	20.6	0.444	0.77
	-----		1745.0	20300	20 MHz/QPSK	50	24	1	20.6	0.439	0.76
	-----	Left Tilt	1732.5	20175	20 MHz/QPSK	1	49	0	22.1	0.317	0.49
	-----		1732.5	20175	20 MHz/QPSK	50	25	1	20.6	0.243	0.42
	-----	Body Front	1732.5	20175	20 MHz/QPSK	1	49	0	22.1	0.202	0.31
	-----		1732.5	20175	20 MHz/QPSK	50	25	1	20.6	0.159	0.28
	4	Body Back	1732.5	20175	20 MHz/QPSK	1	49	0	22.1	0.221	0.34
	-----		1732.5	20175	20 MHz/QPSK	50	25	1	20.6	0.182	0.32
	-----	Repeat	1745.0	20300	20 MHz/QPSK	1	49	0	22.1	0.618	0.96
Body 1.6 W/kg (mW/g) averaged over 1 gram											

- SAR Measurement

Phantom Configuration

☐ Left Head
 ☒ Eli4
 ☐ Right Head

 SAR Configuration

☐ Head
 ☒ Body
- Test Signal Call Mode

☐ Test Code
 ☒ Base Station Simulator
- Test Configuration

☐ With Belt Clip
 ☐ Without Belt Clip
 ☒ N/A
- Tissue Depth is at least 15.0 cm



Jay M. Moulton
Vice President

SAR Data Summary – 1900 MHz Body – LTE Band 2

MEASUREMENT RESULTS											
Gap	Plot	Position	Frequency		BW/ Modulation	RB Size	RB Offset	MPR Target	End Power (dBm)	Measured SAR (W/kg)	Reported SAR (W/kg)
			MHz	Ch.							
0 mm	-----	Right Touch	1860.0	18700	20 MHz/QPSK	1	49	0	23.0	0.872	1.10
	-----		1880.0	18900	20 MHz/QPSK	1	49	0	23.0	0.975	1.23
	5		1900.0	19099	20 MHz/QPSK	1	49	0	23.0	1.01	1.27
	-----		1860.0	18700	20 MHz/QPSK	50	24	1	21.7	0.716	0.97
	-----		1880.0	18900	20 MHz/QPSK	50	24	1	21.6	0.789	1.09
	-----		1900.0	19099	20 MHz/QPSK	50	24	1	21.6	0.825	1.14
	-----	Right Tilt	1860.0	18700	20 MHz/QPSK	1	49	0	23.0	0.494	0.62
	-----		1880.0	18900	20 MHz/QPSK	1	49	0	23.0	0.525	0.66
	-----		1900.0	19099	20 MHz/QPSK	1	49	0	23.0	0.688	0.87
	-----		1880.0	18900	20 MHz/QPSK	50	24	1	21.6	0.437	0.60
	-----	Left Touch	1860.0	18700	20 MHz/QPSK	1	49	0	23.0	0.645	0.81
	-----		1880.0	18900	20 MHz/QPSK	1	49	0	23.0	0.580	0.73
	-----		1900.0	19099	20 MHz/QPSK	1	49	0	23.0	0.597	0.75
	-----		1860.0	18700	20 MHz/QPSK	50	24	1	21.7	0.724	0.98
	-----		1880.0	18900	20 MHz/QPSK	50	24	1	21.6	0.708	0.98
	-----		1900.0	19099	20 MHz/QPSK	50	24	1	21.6	0.418	0.58
	-----	Left Tilt	1880.0	18900	20 MHz/QPSK	1	49	0	23.0	0.398	0.50
	-----		1880.0	18900	20 MHz/QPSK	50	24	1	21.6	0.413	0.57
	6	Body Front	1880.0	18900	20 MHz/QPSK	1	49	0	23.0	0.411	0.52
	-----		1880.0	18900	20 MHz/QPSK	50	24	1	21.6	0.367	0.51
	-----	Body Back	1880.0	18900	20 MHz/QPSK	1	49	0	23.0	0.305	0.38
	-----		1880.0	18900	20 MHz/QPSK	50	24	1	21.6	0.255	0.35
	-----	Repeat	1900.0	19099	20 MHz/QPSK	1	49	0	23.0	0.994	1.25

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

1. SAR Measurement

Phantom Configuration

☐ Left Head

☒ Eli4

☐ Right Head

SAR Configuration

☐ Head

☒ Body

2. Test Signal Call Mode

☐ Test Code

☒ Base Station Simulator

3. Test Configuration

☐ With Belt Clip

☐ Without Belt Clip ☒ N/A

4. Tissue Depth is at least 15.0 cm



Jay M. Moulton
Vice President

SAR Data Summary – Simultaneous Evaluation

MEASUREMENT RESULTS – WWAN & WiFi									
Frequency		Modulation	Conf.	Frequency		Modulation	SAR ₁	SAR ₂	SAR Total
MHz	Ch.			MHz	Ch.				
1900	19099	QPSK	Head	2462	11	DSSS	1.27	0.17	1.44
1880	18900	QPSK	Body	2462	11	DSSS	0.51	0.17	0.68
							Body 1.6 W/kg (mW/g) averaged over 1 gram		

The WiFi SAR value was calculated per KDB447498 D01 v06 section 4.2.3 b) 1) on page 14.

The sum of the two transmitters is less than the limit; therefore, the simultaneous transmission meets the requirements of KDB447498 D01 v06 section 4.3.2 page 13.

MEASUREMENT RESULTS – WWAN & ISM									
Frequency		Modulation	Conf.	Frequency		Modulation	SAR ₁	SAR ₂	SAR Total
MHz	Ch.			MHz	Ch.				
1900	19099	QPSK	Head	433	1	FM	1.27	0.06	1.33
1880	18900	QPSK	Body	433	1	FM	0.51	0.06	0.57
							Body 1.6 W/kg (mW/g) averaged over 1 gram		

The ISM SAR value was calculated per KDB447498 D01 v06 section 4.2.3 b) 1) on page 14.

The sum of the two transmitters is less than the limit; therefore, the simultaneous transmission meets the requirements of KDB447498 D01 v06 section 4.3.2 page 13.

MEASUREMENT RESULTS – WiFi & ISM									
Frequency		Modulation	Conf.	Frequency		Modulation	SAR ₁	SAR ₂	SAR Total
MHz	Ch.			MHz	Ch.				
2462	11	DSSS	Head	433	1	FM	0.17	0.06	0.23
2462	11	DSSS	Body	433	1	FM	0.17	0.06	0.23
							Body 1.6 W/kg (mW/g) averaged over 1 gram		

The WiFi & ISM SAR value was calculated per KDB447498 D01 v06 section 4.2.3 b) 1) on page 14.

The sum of the two transmitters is less than the limit; therefore, the simultaneous transmission meets the requirements of KDB447498 D01 v06 section 4.3.2 page 13.

12. Test Equipment List

Table 12.1 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
Twin SAM Phantom	N/A	N/A	1416
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 EX3DV4	04/20/2019	04/20/2018	3662
Speag Validation Dipole D750V2	08/10/2018	08/10/2015	1053
Speag Validation Dipole D1750V2	08/13/2018	08/13/2015	1061
Speag Validation Dipole D1900V2	08/13/2018	08/13/2015	5d147
Agilent N1911A Power Meter	05/20/2019	03/20/2017	GB45100254
Agilent N1922A Power Sensor	06/21/2019	06/21/2017	MY45240464
Advantest R3261A Spectrum Analyzer	03/26/2019	03/20/2017	31720068
Agilent (HP) 8350B Signal Generator	03/26/2019	03/20/2017	2749A10226
Agilent (HP) 83525A RF Plug-In	03/26/2019	03/20/2017	2647A01172
Agilent (HP) 8753C Vector Network Analyzer	03/26/2019	03/20/2017	3135A01724
Agilent (HP) 85047A S-Parameter Test Set	03/26/2019	03/20/2017	2904A00595
Agilent (HP) 8960 Base Station Sim.	03/30/2019	03/30/2017	MY48360364
Anritsu MT8820C	07/27/2019	07/27/2017	6201176199
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
Apriel Dielectric Probe Assembly	N/A	N/A	0011
Head Equivalent Matter (750 MHz)	N/A	N/A	N/A
Body Equivalent Matter (750 MHz)	N/A	N/A	N/A
Head Equivalent Matter (1750 MHz)	N/A	N/A	N/A
Body Equivalent Matter (1750 MHz)	N/A	N/A	N/A
Head Equivalent Matter (1900 MHz)	N/A	N/A	N/A
Body Equivalent Matter (1900 MHz)	N/A	N/A	N/A

13. 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. [3]

14. 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 – 1992, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave, New York: IEEE, 1992.
- [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 Draft, Radio Frequency Exposure Compliance of Radiocommunication Apparatus (All Frequency Bands), March 2014.
- [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

Test Result for UIM Dielectric Parameter

Tue 15/May/2018

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
0.7300	42.05	0.89	41.57	0.89
0.7400	41.99	0.89	41.51	0.89
0.7500	41.94	0.89	41.46	0.90
0.7600	41.89	0.89	41.40	0.91
0.7700	41.84	0.89	41.34	0.92
0.7800	41.75	0.90	41.27	0.92
0.7820	41.746	0.90	41.26	0.92*
0.7900	41.73	0.90	41.22	0.92
0.8000	41.68	0.90	41.18	0.93
0.8100	41.63	0.90	41.14	0.93

* value interpolated

Test Result for UIM Dielectric Parameter

Tue 15/May/2018

Freq Frequency(GHz)

FCC_eH Limits for Head Epsilon

FCC_sH Limits for Head Sigma

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
0.7300	55.61	0.96	55.63	0.98
0.7400	55.57	0.96	55.60	0.99
0.7500	55.53	0.96	55.57	0.99
0.7600	55.49	0.96	55.54	0.99
0.7700	55.45	0.96	55.50	1.00
0.7800	55.41	0.97	55.46	1.00
0.7820	55.404	0.97	55.452	1.00*
0.7900	55.38	0.97	55.42	1.00
0.8000	55.34	0.97	55.38	1.01

* value interpolated

Test Result for UIM Dielectric Parameter

Tue 15/May/2018

Freq Frequency(GHz)

eH Limits for Head Epsilon

sH Limits for Head Sigma

Test_e Epsilon of UIM

Test_s Sigma of UIM

Freq	eH	sH	Test_e	Test_s
1.7000	40.16	1.34	39.86	1.34
1.7100	40.14	1.35	39.84	1.35
1.7200	40.13	1.35	39.82	1.36
1.7300	40.11	1.36	39.80	1.37
1.7325	40.105	1.363	39.795	1.37*
1.7400	40.09	1.37	39.78	1.37
1.7450	40.085	1.37	39.77	1.375*
1.7500	40.08	1.37	39.76	1.38
1.7600	40.06	1.38	39.74	1.39
1.7700	40.05	1.38	39.72	1.40
1.7750	40.04	1.385	39.71	1.40*
1.7800	40.03	1.39	39.70	1.40
1.7900	40.02	1.39	39.68	1.41

* value interpolated

Test Result for UIM Dielectric Parameter

Tue 15/May/2018

Freq Frequency(GHz)

FCC_eH Limits for Head Epsilon

FCC_sH Limits for Head Sigma

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
1.7100	53.53	1.47	53.55	1.48
1.7200	53.51	1.47	53.52	1.49
1.7300	53.48	1.48	53.38	1.50
1.7325	53.475	1.48	53.375	1.503*
1.7400	53.46	1.48	53.36	1.51
1.7450	53.445	1.485	53.34	1.515*
1.7500	53.43	1.49	53.32	1.52
1.7600	53.41	1.49	53.30	1.53
1.7700	53.38	1.50	53.27	1.55
1.7800	53.35	1.51	53.23	1.55

* value interpolated

Test Result for UIM Dielectric Parameter

Tue 14/May/2018

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
1.8300	40.00	1.40	40.11	1.38
1.8400	40.00	1.40	40.09	1.39
1.8500	40.00	1.40	40.08	1.39
1.8600	40.00	1.40	40.06	1.40
1.8700	40.00	1.40	40.05	1.40
1.8800	40.00	1.40	40.04	1.41
1.8900	40.00	1.40	40.02	1.42
1.9000	40.00	1.40	40.00	1.43
1.9100	40.00	1.40	39.98	1.43
1.9200	40.00	1.40	39.96	1.44
1.9300	40.00	1.40	39.95	1.44

* value interpolated

Test Result for UIM Dielectric Parameter

Mon 14/May/2018

Freq Frequency(GHz)

FCC_eH Limits for Head Epsilon

FCC_sH Limits for Head Sigma

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
1.8400	53.30	1.52	52.04	1.43
1.8500	53.30	1.52	52.03	1.44
1.8600	53.30	1.52	52.03	1.44
1.8700	53.30	1.52	52.14	1.45
1.8800	53.30	1.52	52.10	1.45
1.8900	53.30	1.52	52.17	1.46
1.9000	53.30	1.52	52.07	1.47
1.9100	53.30	1.52	52.12	1.50
1.9200	53.30	1.52	52.00	1.50

* value interpolated

RF Exposure Lab

Plot 1

DUT: Dipole 750 MHz D750V3; Type: D750V3; Serial: D750V3 - SN 1053

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1
Medium: HSL750; Medium parameters used (interpolated): $f = 750$ MHz; $\sigma = 0.9$ S/m; $\epsilon_r = 41.46$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

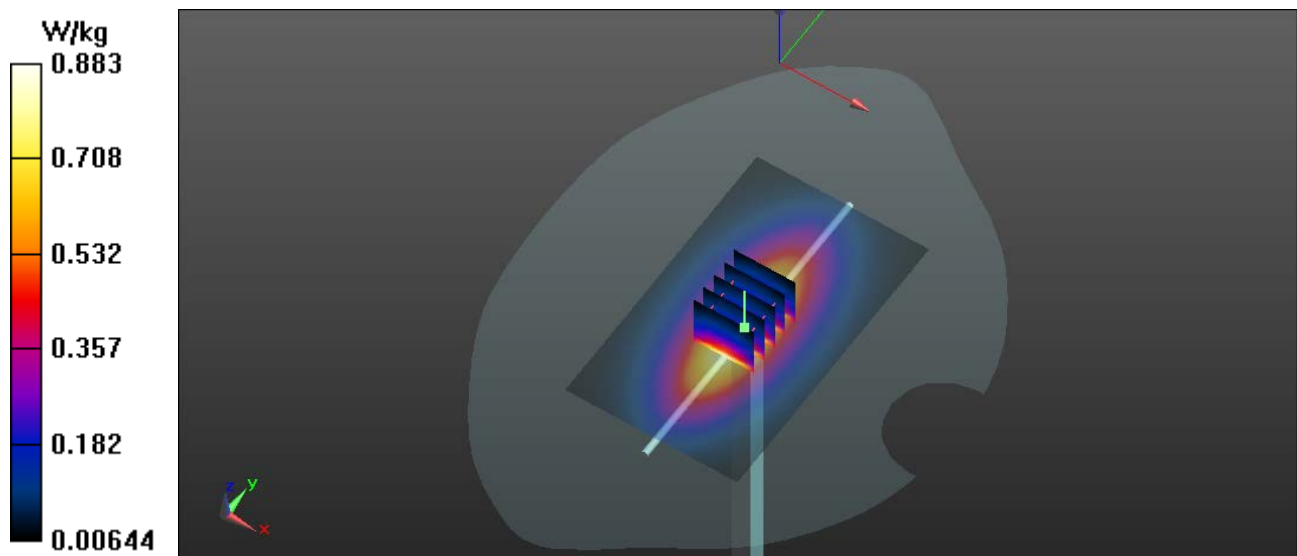
Test Date: Date: 5/15/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

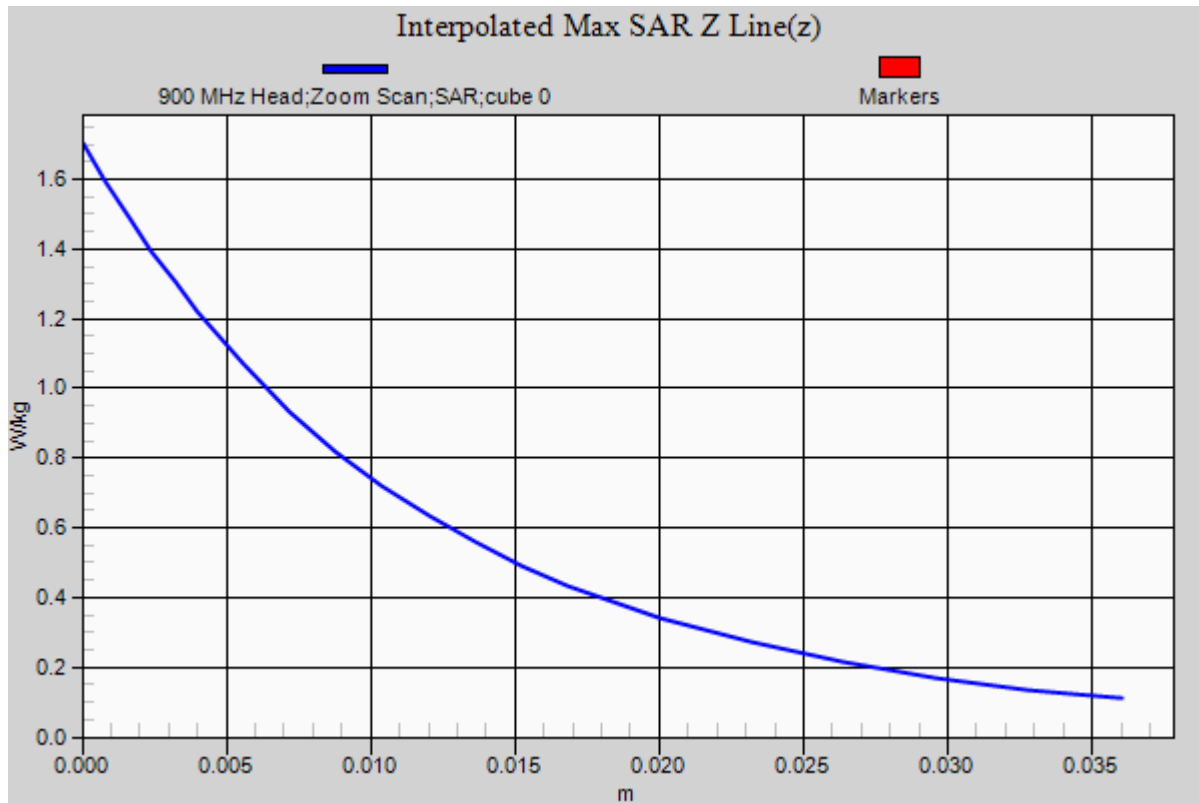
Probe: EX3DV4 - SN3662; ConvF(9.8, 9.8, 9.8); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1321; Calibrated: 1/10/2018
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 2037
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

750 MHz Head/Verification/Area Scan (41x121x1): Interpolated grid: dx=1.500 mm, dy=1.500 mm
Maximum value of SAR (interpolated) = 0.883 W/kg

750 MHz Head/Verification /Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.949 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.691 mW/g
 $P_{in} = 100$ mW
SAR(1 g) = 0.813 mW/g; SAR(10 g) = 0.528 mW/g
Maximum value of SAR (measured) = 0.888 W/kg





RF Exposure Lab

Plot 2

DUT: Dipole 750 MHz D750V3; Type: D750V3; Serial: D750V3 - SN:1053

Communication System: CW; Frequency: 750 MHz; Duty Cycle: 1:1

Medium: MSL750; Medium parameters used: $f = 750$ MHz; $\sigma = 0.99$ S/m; $\epsilon_r = 55.57$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Test Date: Date: 5/15/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(9.62, 9.62, 9.62); Calibrated: 4/20/2018;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1321; Calibrated: 1/10/2018

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 2037

Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

750 MHz/Verification/Area Scan (5x11x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 1.08 W/kg

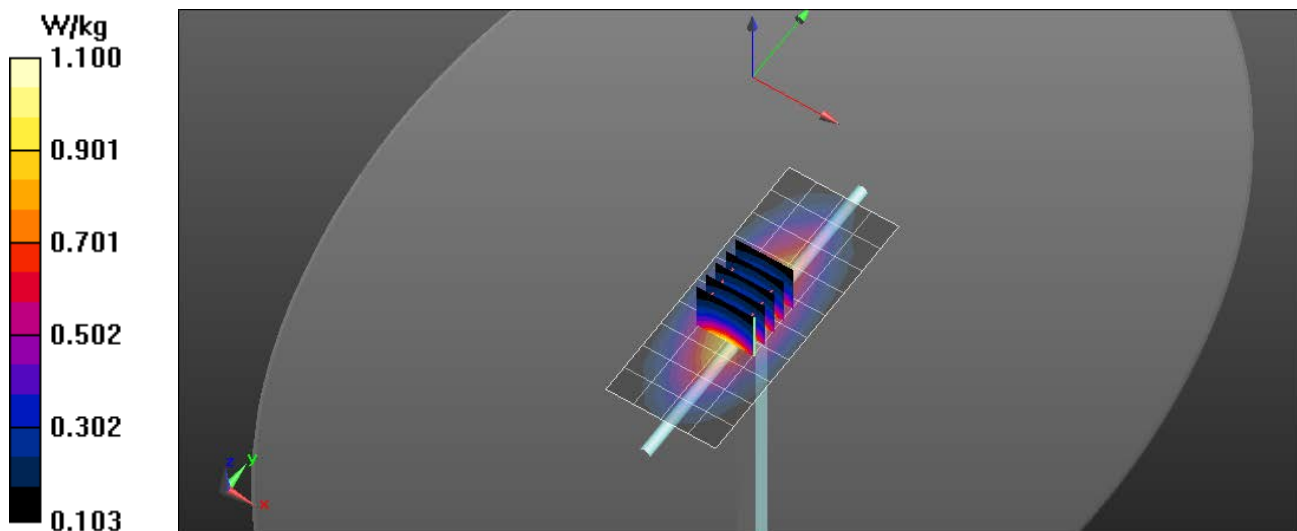
750 MHz/Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

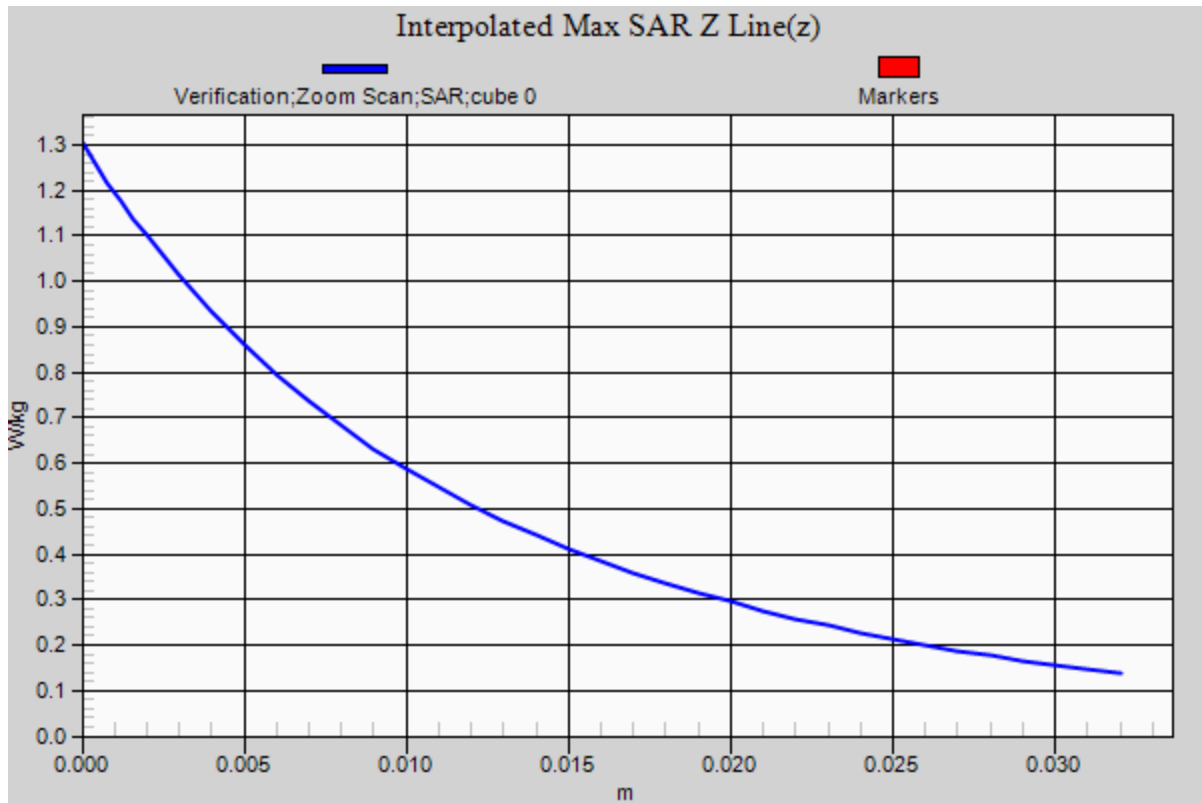
Reference Value = 31.227 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 1.30 W/kg

SAR(1 g) = 0.865 W/kg; SAR(10 g) = 0.569 W/kg

Maximum value of SAR (measured) = 1.10 W/kg





RF Exposure Lab

Plot 3

DUT: Dipole 1750 MHz D1750V2; Type: D1750V2; Serial: D1750V2 - SN:1061

Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: HSL1750; Medium parameters used: $f = 1750$ MHz; $\sigma = 1.38$ S/m; $\epsilon_r = 39.76$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

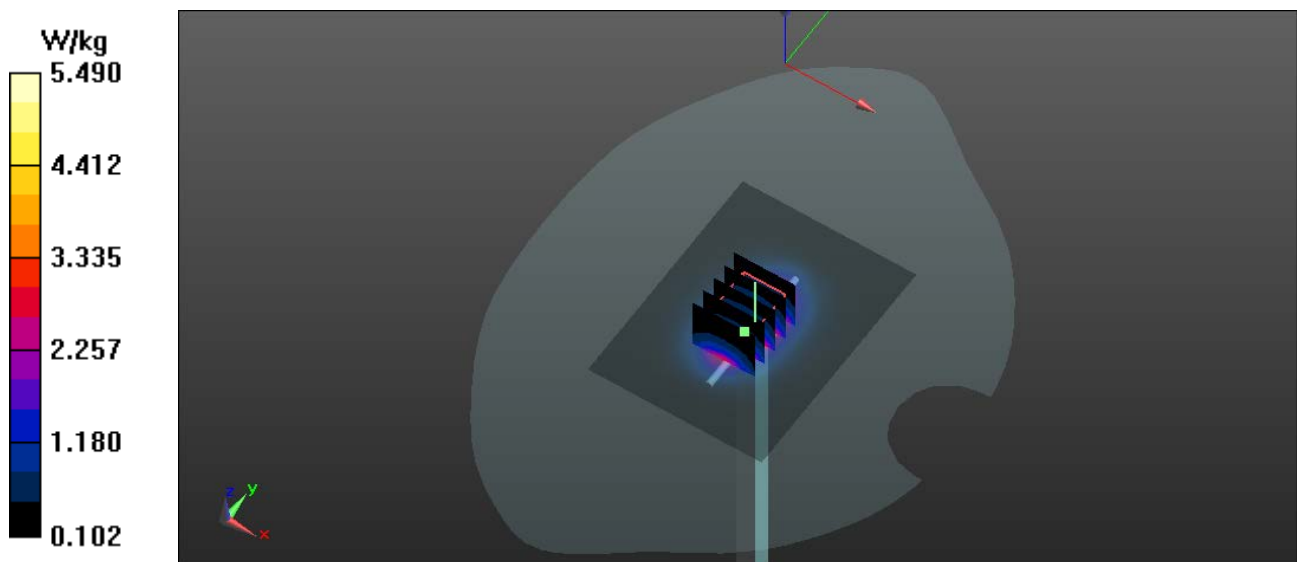
Test Date: Date: 5/15/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

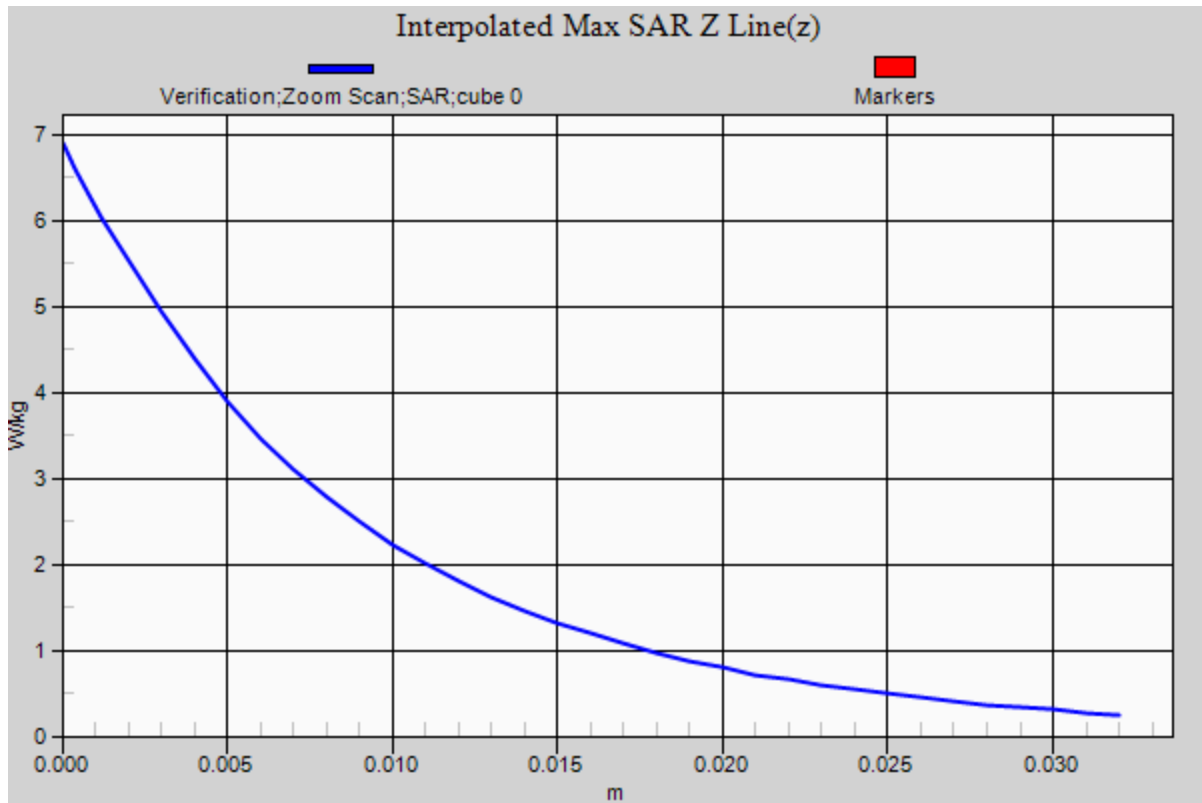
Probe: EX3DV4 - SN3662; ConvF(8.29, 8.29, 8.29); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1321; Calibrated: 1/10/2018
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 2037
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

1750 MHz/Verification/Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 5.37 W/kg

1750 MHz/Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 33.158 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 6.92 W/kg
SAR(1 g) = 3.72 W/kg; SAR(10 g) = 1.96 W/kg
Maximum value of SAR (measured) = 5.47 W/kg





RF Exposure Lab

Plot 4

DUT: Dipole 1750 MHz D1750V2; Type: D1750V2; Serial: D1750V2 - SN:1061

Communication System: CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: MSL1750; Medium parameters used: $f = 1750$ MHz; $\sigma = 1.52$ S/m; $\epsilon_r = 53.32$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

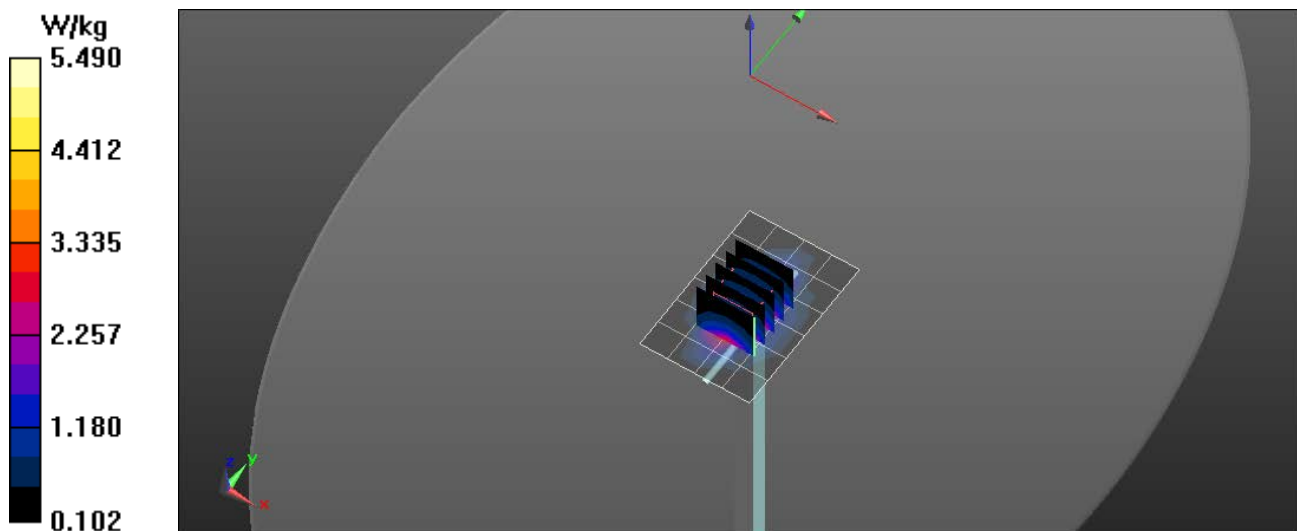
Test Date: Date: 5/15/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

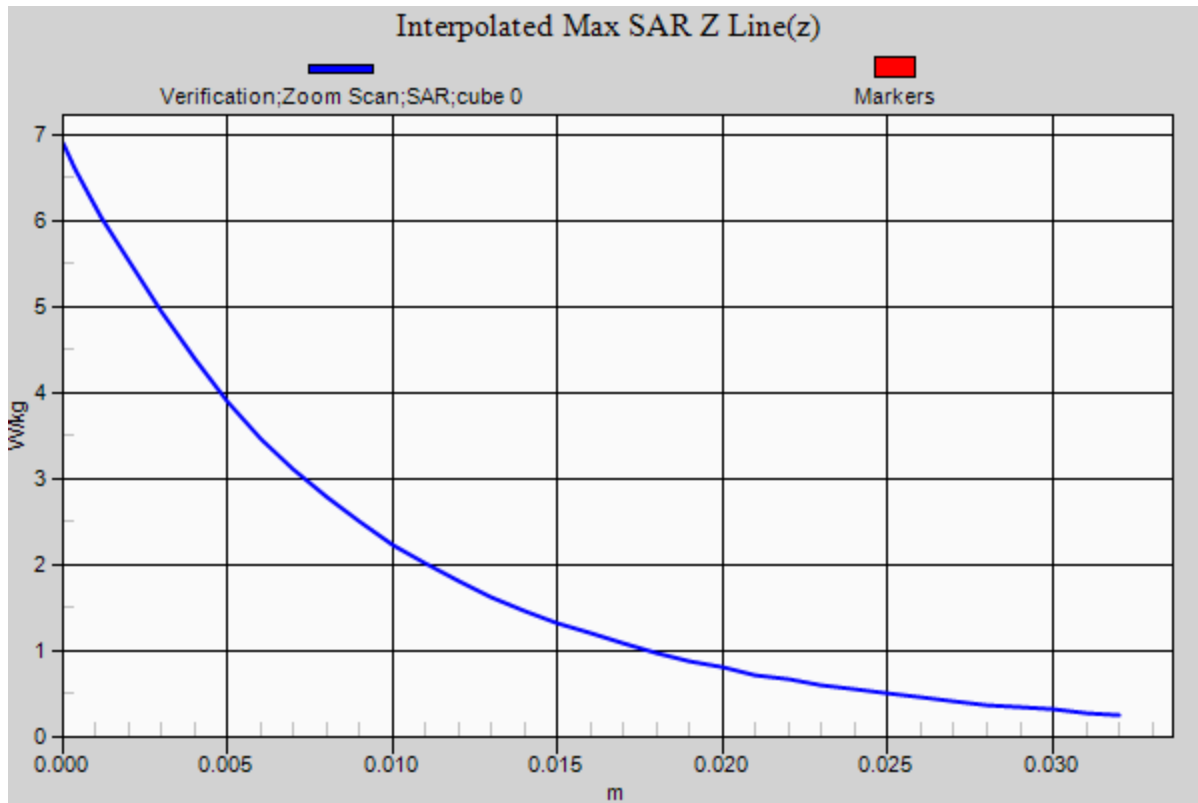
Probe: EX3DV4 - SN3662; ConvF(7.96, 7.96, 7.96); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1321; Calibrated: 1/10/2018
Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 2037
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

1750 MHz/Verification/Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 5.33 W/kg

1750 MHz/Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 31.227 V/m; Power Drift = -0.01 dB
Peak SAR (extrapolated) = 6.89 W/kg
SAR(1 g) = 3.85 W/kg; SAR(10 g) = 2.03 W/kg
Maximum value of SAR (measured) = 5.49 W/kg





RF Exposure Lab

Plot 5

DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN:5d147

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL1900; Medium parameters used: $f = 1900$ MHz; $\sigma = 1.43$ S/m; $\epsilon_r = 40$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Test Date: Date: 5/14/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(8.01, 8.01, 8.01); Calibrated: 4/20/2018;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1321; Calibrated: 1/10/2018

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 2037

Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

1900 MHz/Verification/Area Scan (5x7x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 5.52 W/kg

1900 MHz/Verification/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

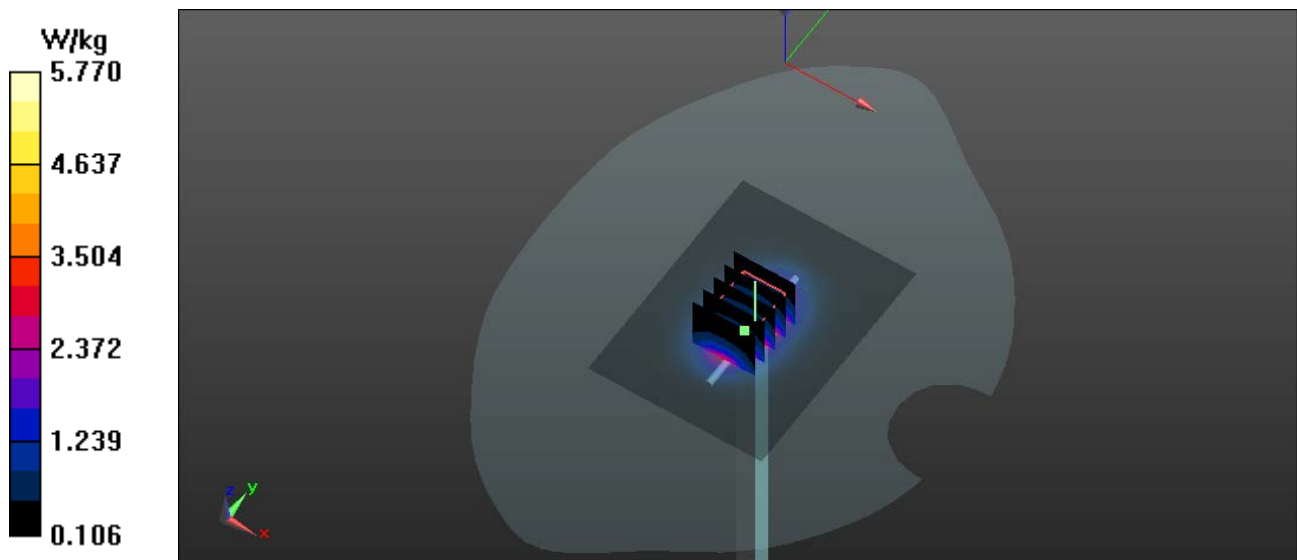
Reference Value = 31.453 V/m; Power Drift = -0.01 dB

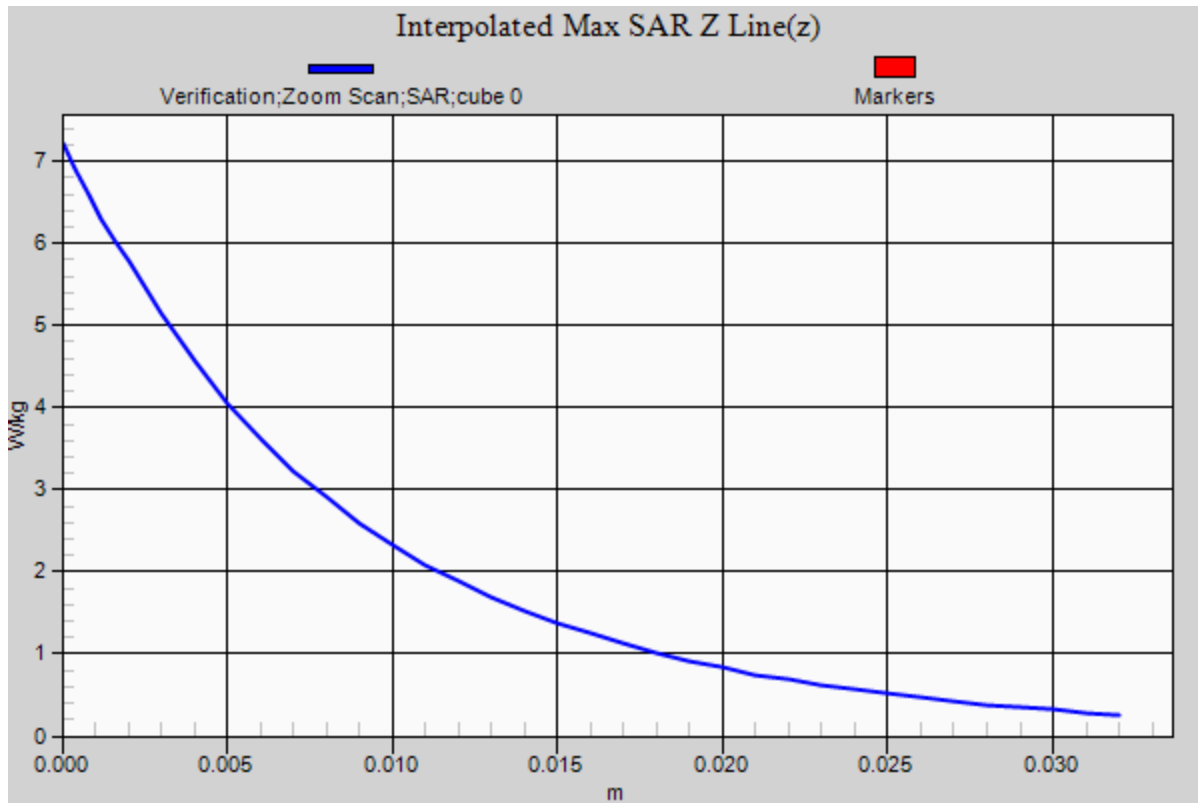
Peak SAR (extrapolated) = 7.23 W/kg

$P_{IN}=100$ mW

SAR(1 g) = 4.17 W/kg; SAR(10 g) = 2.13 W/kg

Maximum value of SAR (measured) = 5.76 W/kg





RF Exposure Lab

Plot 6

DUT: Dipole 1900 MHz D1900V2; Type: D1900V2; Serial: D1900V2 - SN:5d147

Communication System: CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: MSL1900; Medium parameters used: $f = 1900$ MHz; $\sigma = 1.47$ S/m; $\epsilon_r = 52.07$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Test Date: Date: 5/14/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(7.61, 7.61, 7.61); Calibrated: 4/20/2018;

Sensor-Surface: 2mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1321; Calibrated: 1/10/2018

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 2037

Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

1900 MHz Body/Verification/Area Scan (61x81x1): Interpolated grid: dx=1.000 mm, dy=1.000 mm

Maximum value of SAR (interpolated) = 5.63 W/kg

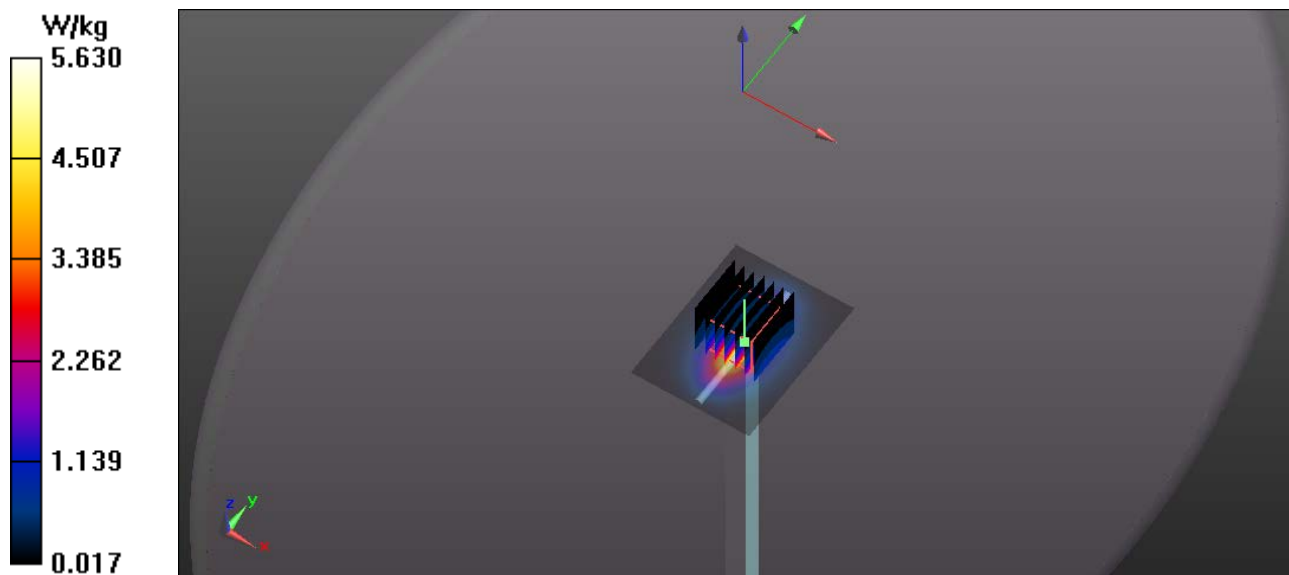
1900 MHz Body/Verification/Zoom Scan (7x7x7)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=5mm

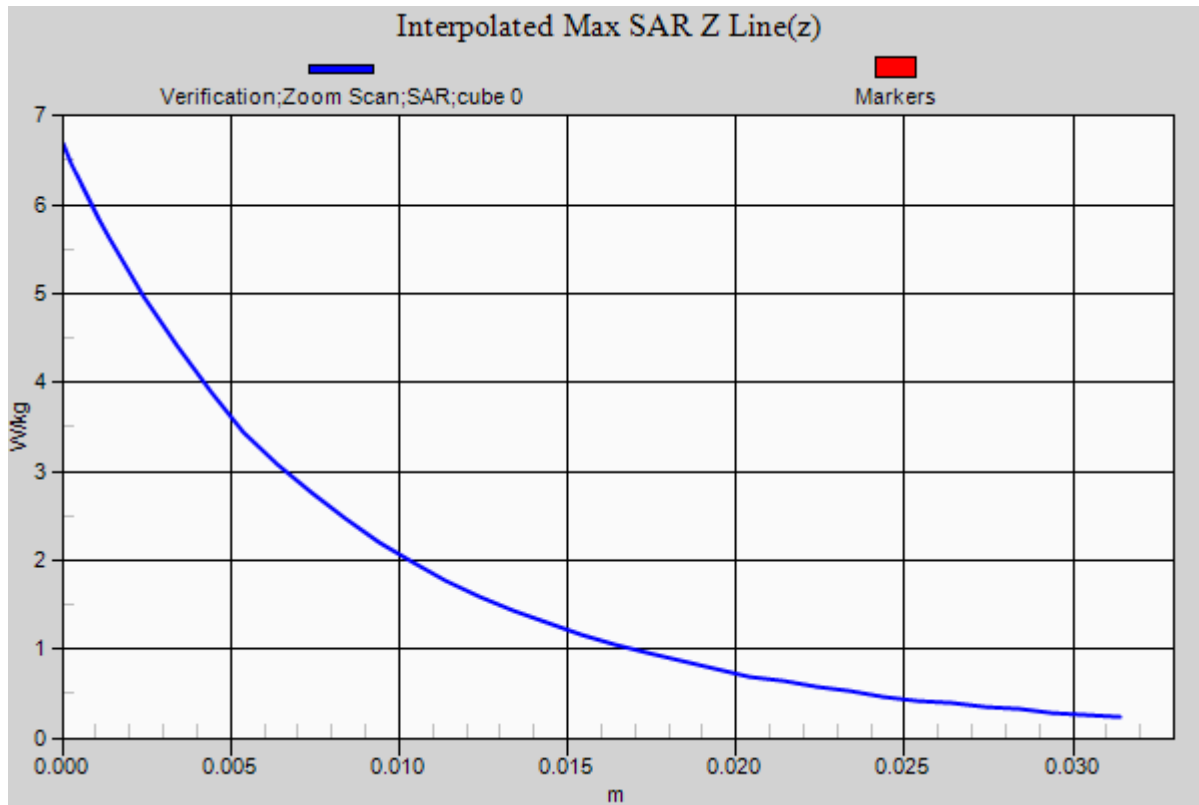
Reference Value = 52.612 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 6.68 W/kg

SAR(1 g) = 3.98 W/kg; SAR(10 g) = 1.92 W/kg

Maximum value of SAR (measured) = 5.63 W/kg





Appendix B – SAR Test Data Plots

RF Exposure Lab

Plot 1

DUT: 24014VL; Type: Cellular Phone; Serial: P25

Communication System: LTE (SC-FDMA, 1 RB, 10 MHz, QPSK); Frequency: 782 MHz; Duty Cycle: 1:1
Medium: HSL750; Medium parameters used (interpolated): $f = 782$ MHz; $\sigma = 0.92$ S/m; $\epsilon_r = 41.26$; $\rho = 1000$ kg/m³
Phantom section: Right Section

Test Date: Date: 5/15/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(9.8, 9.8, 9.8); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: SAM with CRP; Type: SAM; Serial: 1416
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

B13 Right Head/Touch 1 RB 24 Offest Mid/Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.678 W/kg

B13 Right Head/Touch 1 RB 24 Offest Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

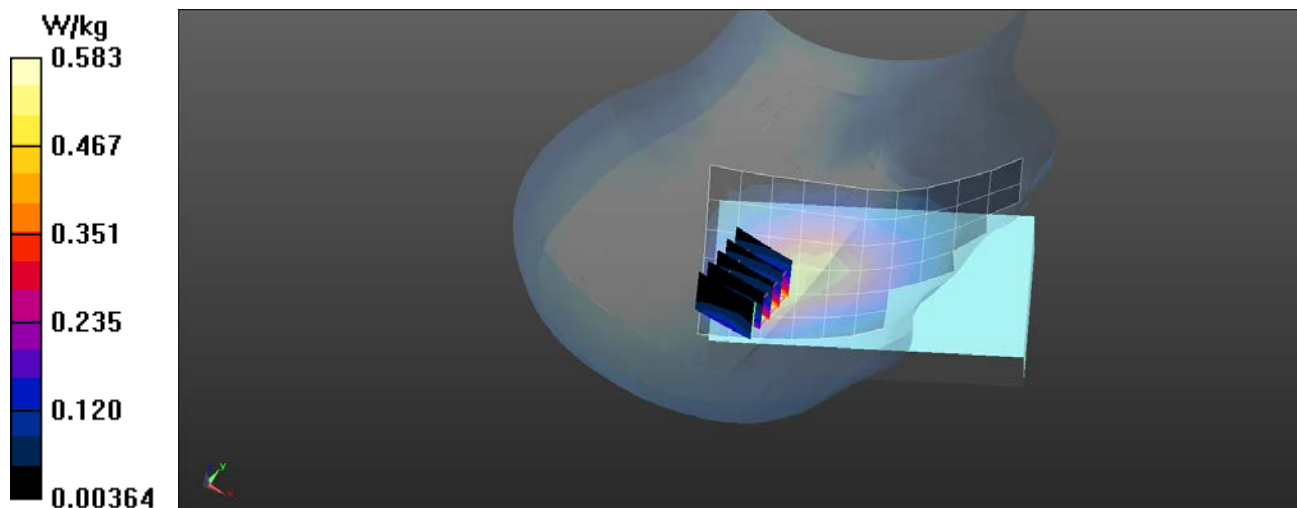
Reference Value = 22.65 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 1.07 W/kg

SAR(1 g) = 0.646 W/kg; SAR(10 g) = 0.274 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.583 W/kg



RF Exposure Lab

Plot 2

DUT: 24014VL; Type: Cellular Phone; Serial: P25

Communication System: LTE (SC-FDMA, 1 RB, 10 MHz, QPSK); Frequency: 782 MHz; Duty Cycle: 1:1
Medium: MSL750; Medium parameters used (interpolated): $f = 782 \text{ MHz}$; $\sigma = 1 \text{ S/m}$; $\epsilon_r = 55.452$; $\rho = 1000 \text{ kg/m}^3$
Phantom section: Flat Section

Test Date: Date: 5/15/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(9.8, 9.8, 9.8); 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:

B13 Body/Front 1 RB 24 Offset Mid/Area Scan (7x12x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.260 W/kg

B13 Body/Front 1 RB 24 Offset Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

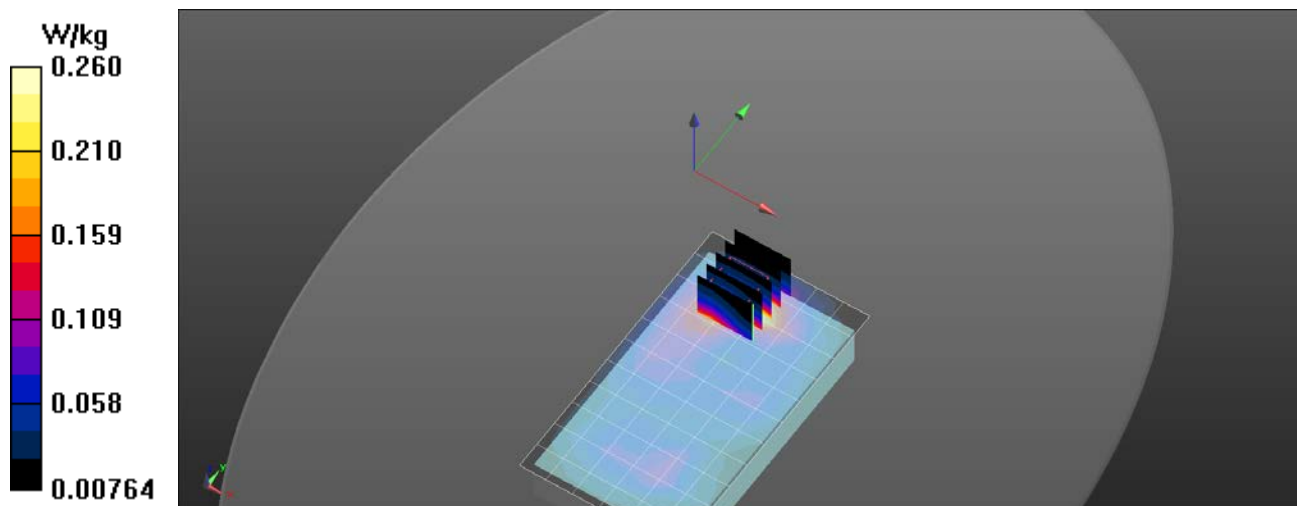
Reference Value = 20.74 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 0.0190 W/kg

SAR(1 g) = 0.213 W/kg; SAR(10 g) = 0.117 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.316 W/kg



RF Exposure Lab

Plot 3

DUT: 24014VL; Type: Cellular Phone; Serial: P25

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1745 MHz; Duty Cycle: 1:1
Medium: HSL1750; Medium parameters used (interpolated): $f = 1745$ MHz; $\sigma = 1.375$ S/m; $\epsilon_r = 39.77$; $\rho = 1000$ kg/m³
Phantom section: Right Section

Test Date: Date: 5/15/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(8.29, 8.29, 8.29); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: SAM with CRP; Type: SAM; Serial: 1416
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

B4 Right Head/Touch 1 RB 49 Offset High/Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.591 W/kg

B4 Right Head/Touch 1 RB 49 Offset High/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

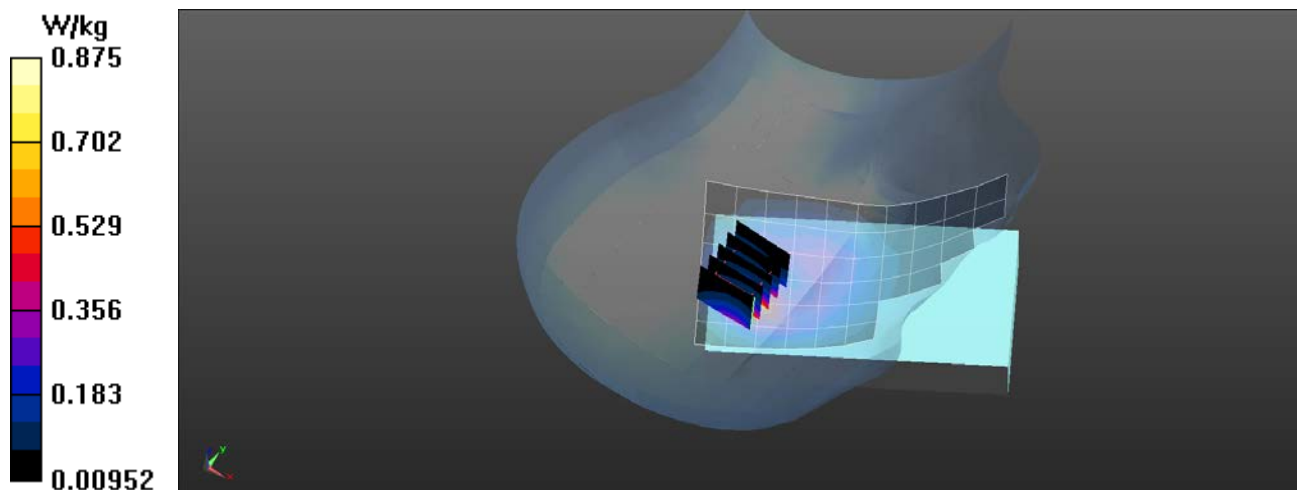
Reference Value = 18.37 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 1.17 W/kg

SAR(1 g) = 0.630 W/kg; SAR(10 g) = 0.330 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.875 W/kg



RF Exposure Lab

Plot 4

DUT: 24014VL; Type: Cellular Phone; Serial: P25

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: MSL1750; Medium parameters used (interpolated): $f = 1732.5$ MHz; $\sigma = 1.503$ S/m; $\epsilon_r = 53.375$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

Test Date: Date: 5/15/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(7.96, 7.96, 7.96); 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:

B4 Body/Back 1 RB 49 Offset Mid/Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.288 W/kg

B4 Body/Back 1 RB 49 Offset Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

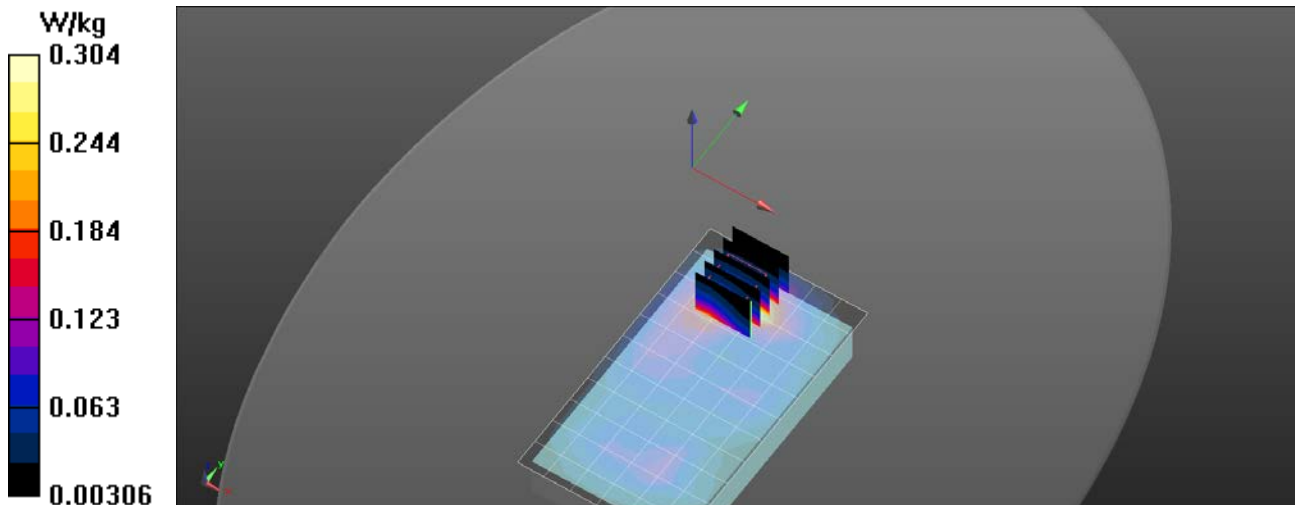
Reference Value = 9.570 V/m; Power Drift = -0.03 dB

Peak SAR (extrapolated) = 0.380 W/kg

SAR(1 g) = 0.221 W/kg; SAR(10 g) = 0.124 W/kg

[Info: Interpolated medium parameters used for SAR evaluation.](#)

Maximum value of SAR (measured) = 0.304 W/kg



RF Exposure Lab

Plot 5

DUT: 24014VL; Type: Cellular Phone; Serial: P25

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: HSL1900; Medium parameters used: $f = 1900$ MHz; $\sigma = 1.43$ S/m; $\epsilon_r = 40$; $\rho = 1000$ kg/m³
Phantom section: Right Section

Test Date: Date: 5/14/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(8.01, 8.01, 8.01); Calibrated: 4/20/2018;
Sensor-Surface: 2mm (Mechanical Surface Detection)
Electronics: DAE4 Sn1416; Calibrated: 4/13/2018
Phantom: SAM with CRP; Type: SAM; Serial: 1416
Measurement SW: DASY52, Version 52.10 (0); SEMCAD X Version 14.6.10 (7417)

Procedure Notes:

B2 Right Head/Touch 1 RB 49 Offset High/Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 1.15 W/kg

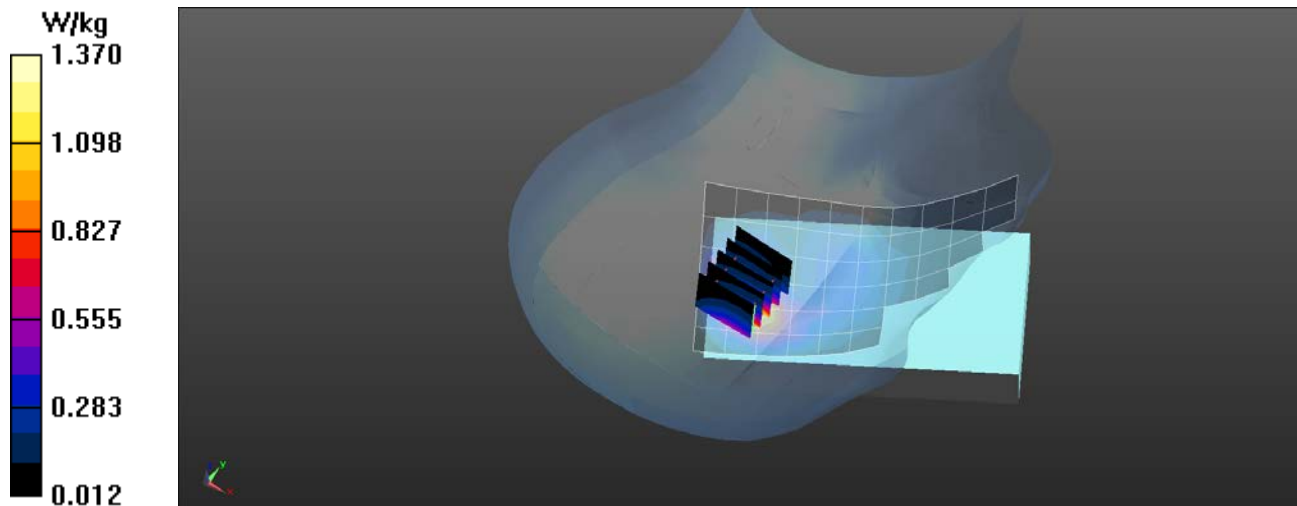
B2 Right Head/Touch 1 RB 49 Offset High/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Reference Value = 14.18 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 1.80 W/kg

SAR(1 g) = 1.01 W/kg; SAR(10 g) = 0.551 W/kg

Maximum value of SAR (measured) = 1.37 W/kg



RF Exposure Lab

Plot 6

DUT: 24014VL; Type: Cellular Phone; Serial: P25

Communication System: LTE (SC-FDMA, 1 RB, 20 MHz, QPSK); Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: MSL1900; Medium parameters used: $f = 1880$ MHz; $\sigma = 1.45$ S/m; $\epsilon_r = 52.1$; $\rho = 1000$ kg/m³
Phantom section: Flat Section

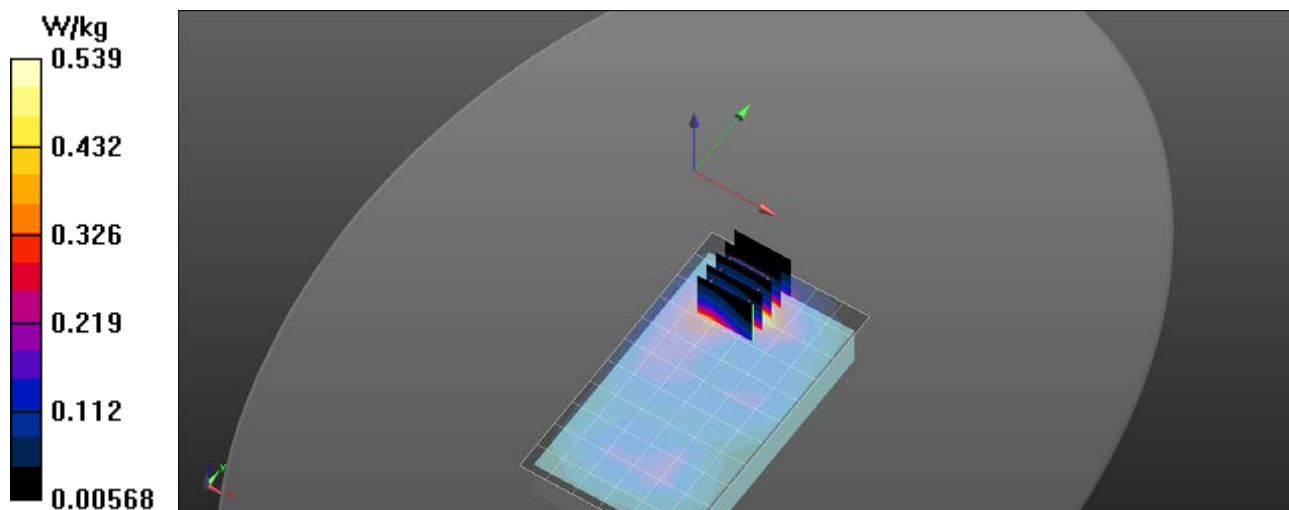
Test Date: Date: 5/14/2018; Ambient Temp: 23 °C; Tissue Temp: 21 °C

Probe: EX3DV4 - SN3662; ConvF(7.61, 7.61, 7.61); 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:

B2 Body/Front 1 RB 49 Offset Mid/Area Scan (7x12x1): Measurement grid: dx=15mm, dy=15mm
Maximum value of SAR (measured) = 0.487 W/kg

B2 Body/Front 1 RB 49 Offset Mid/Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 8.099 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 0.715 W/kg
SAR(1 g) = 0.411 W/kg; SAR(10 g) = 0.232 W/kg
Maximum value of SAR (measured) = 0.539 W/kg



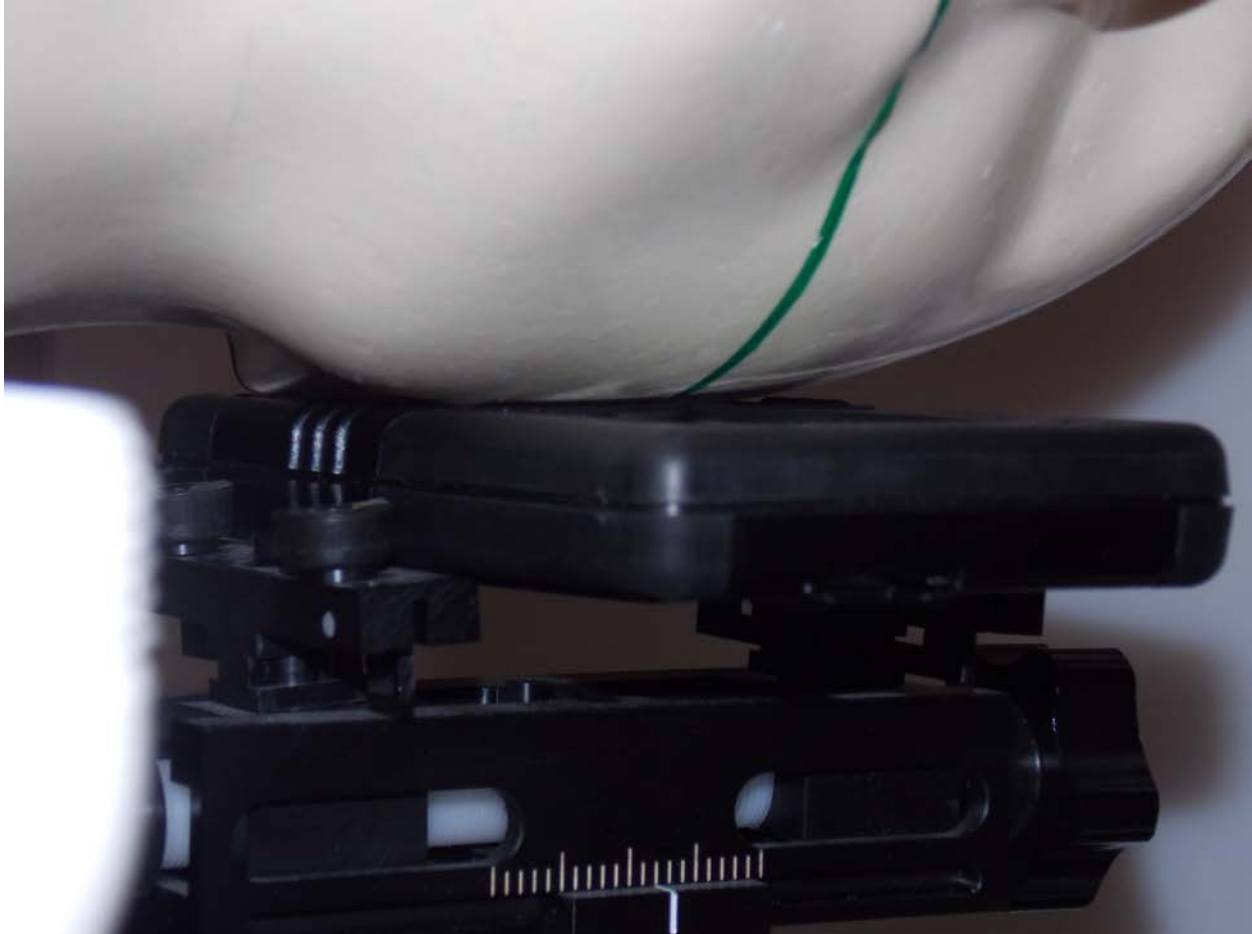
Appendix C – SAR Test Setup Photos



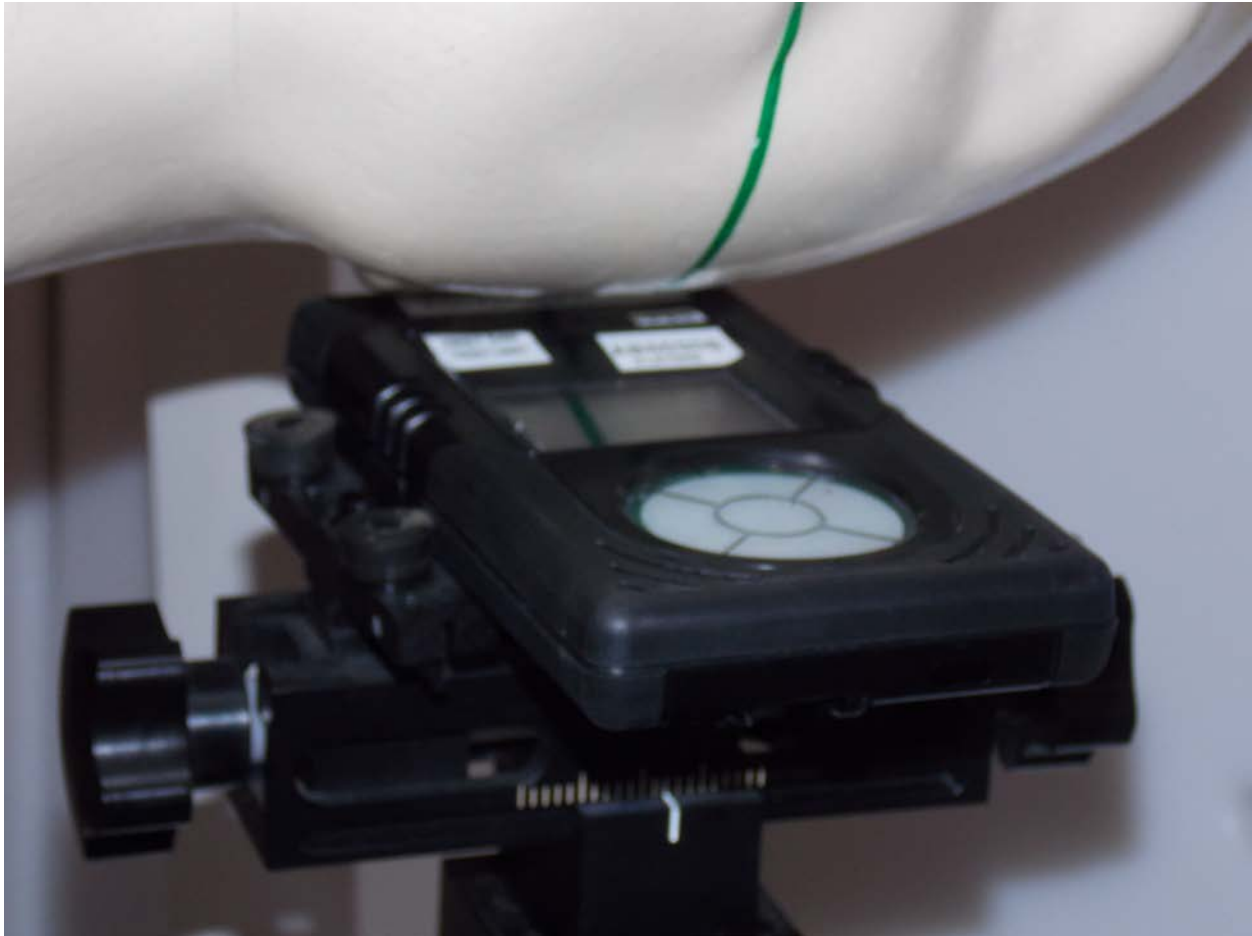
Test Position Right Head Touch 0 mm Gap



Test Position Right Head Tilt 0 mm Gap



Test Position Left Head Touch 0 mm Gap



Test Position Left Head Tilt 0 mm Gap



Test Position Eli Flat Front Facing Phantom 0 mm Gap



Test Position Eli Flat Back Facing Phantom 0 mm Gap



Front of Device



Back of Device



Holster

Appendix D – Probe Calibration Data Sheets

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



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

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

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

Calibrated by:	Name Leif Klysner	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	
			Issued: April 20, 2018
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Glossary:

TSL	tissue simulating liquid
NORM _{x,y,z}	sensitivity in free space
ConvF	sensitivity in TSL / NORM _{x,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., $\vartheta = 0$ 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:

- 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
- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Methods Applied and Interpretation of Parameters:

- NORM_{x,y,z}**: Assessed for E-field polarization $\vartheta = 0$ ($f \leq 900$ MHz in TEM-cell; $f > 1800$ MHz: R22 waveguide). NORM_{x,y,z} are only intermediate values, i.e., the uncertainties of NORM_{x,y,z} does not affect the E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,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*.
- DCP_{x,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
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,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 $f \leq 800$ 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 NORM_{x,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 NORM_x (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 ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.44	0.45	0.48	$\pm 10.1 \%$
DCP (mV) ^B	102.6	97.6	96.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB/ μV	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	136.8	$\pm 3.3 \%$
		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 E²-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 %

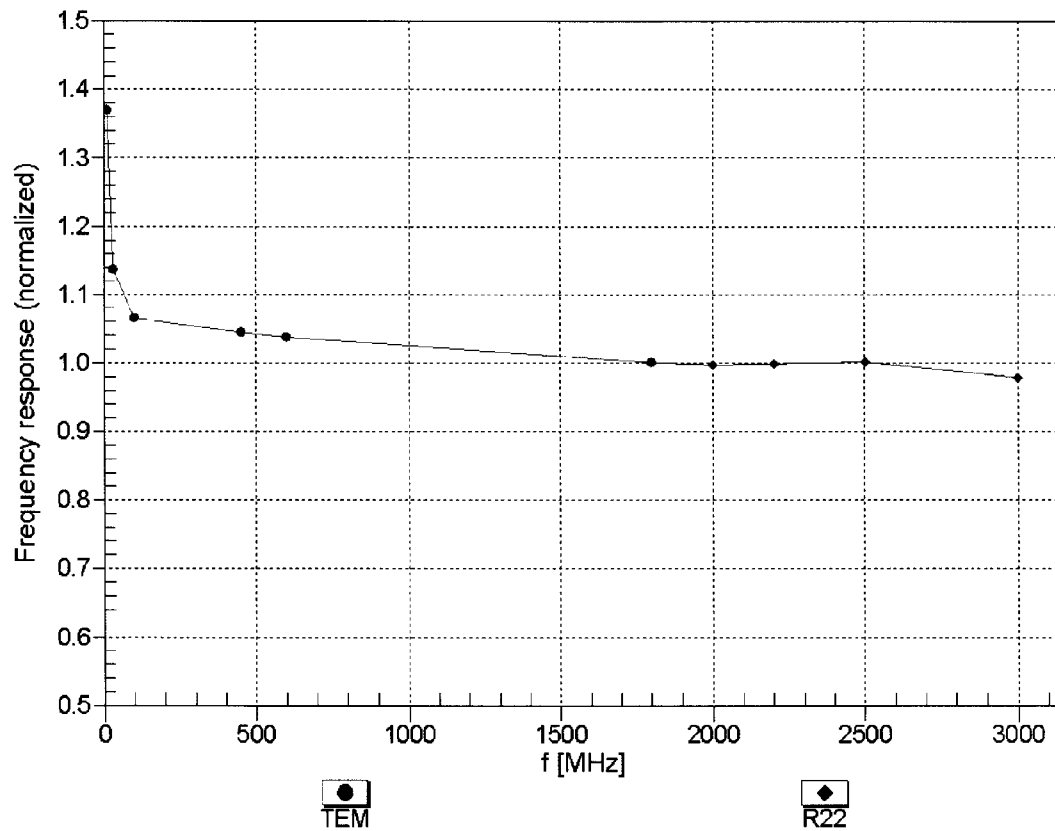
^C Frequency validity above 300 MHz of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band. Frequency validity below 300 MHz is ± 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.

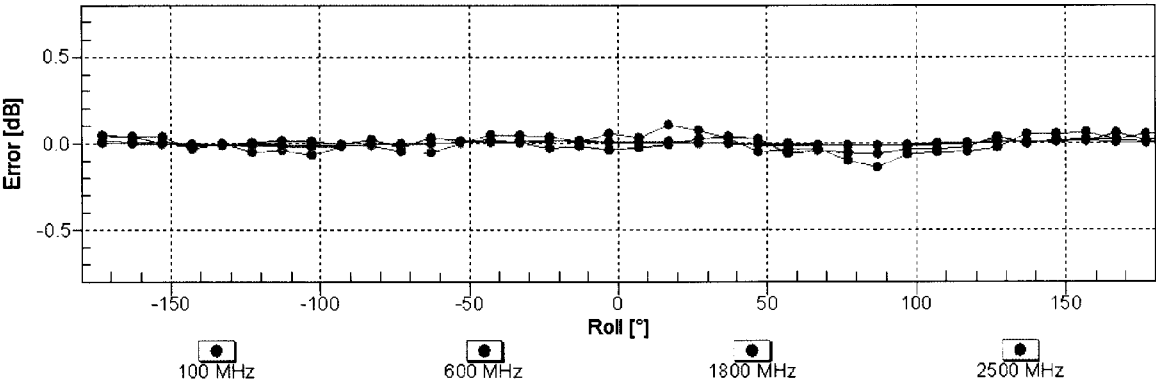
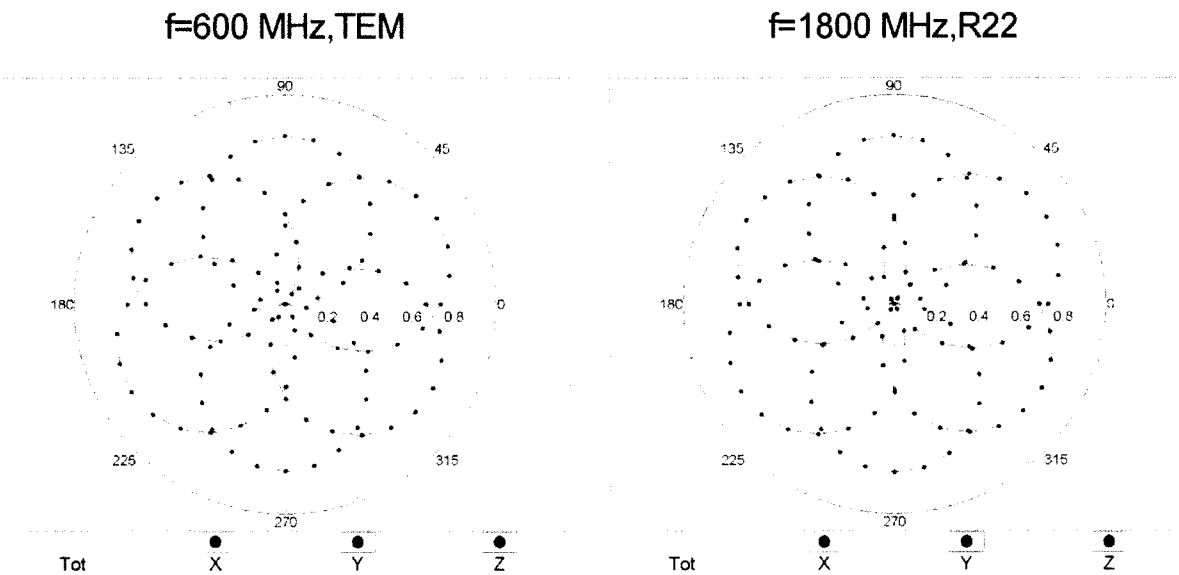
Frequency Response of E-Field

(TEM-Cell:ifi1110 EXX, Waveguide: R22)



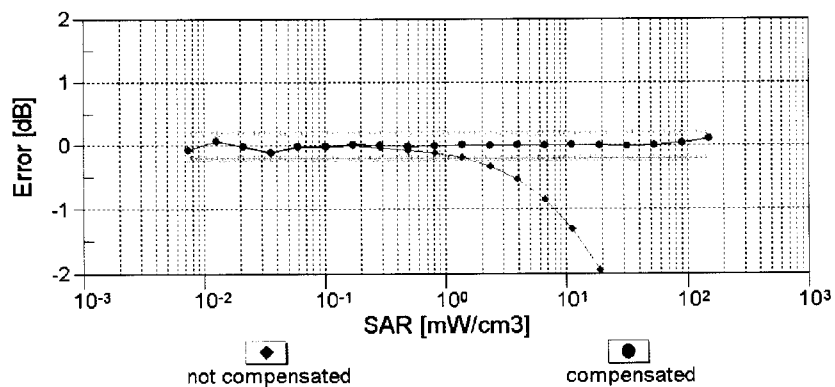
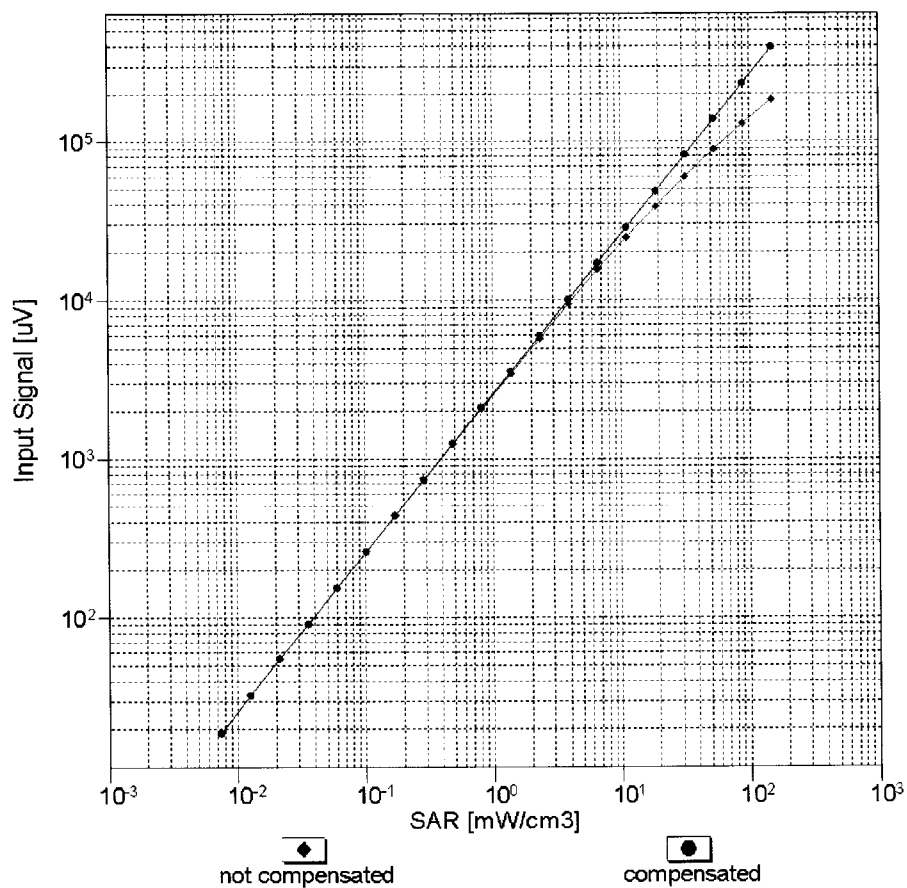
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

Receiving Pattern (ϕ), $\theta = 0^\circ$



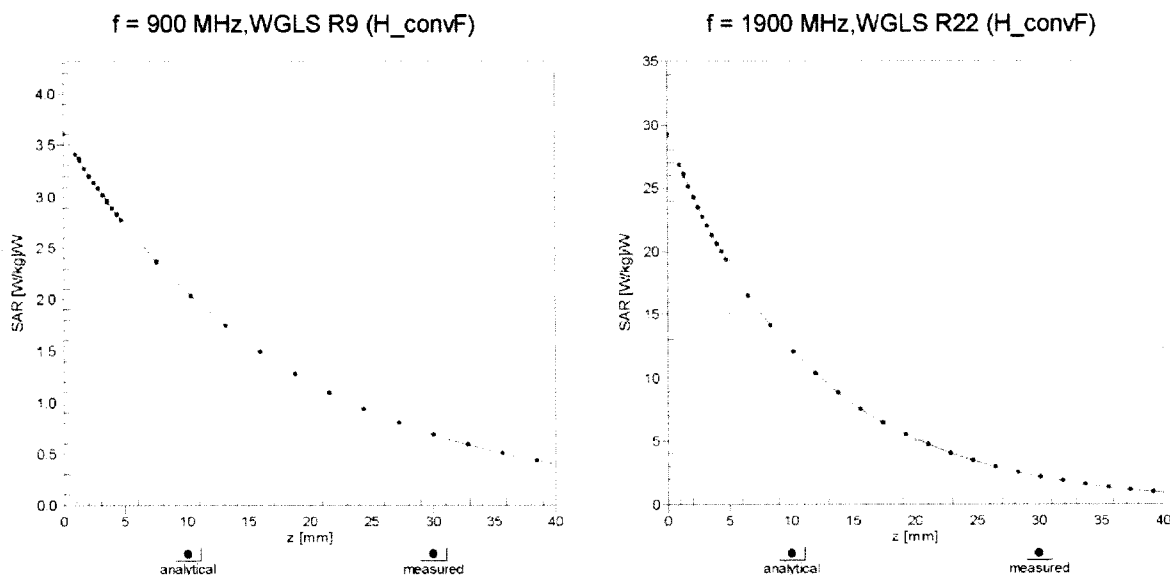
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



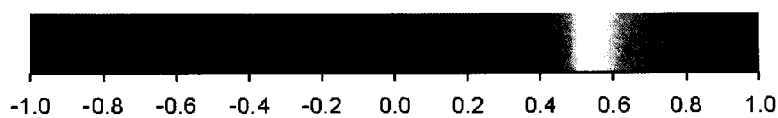
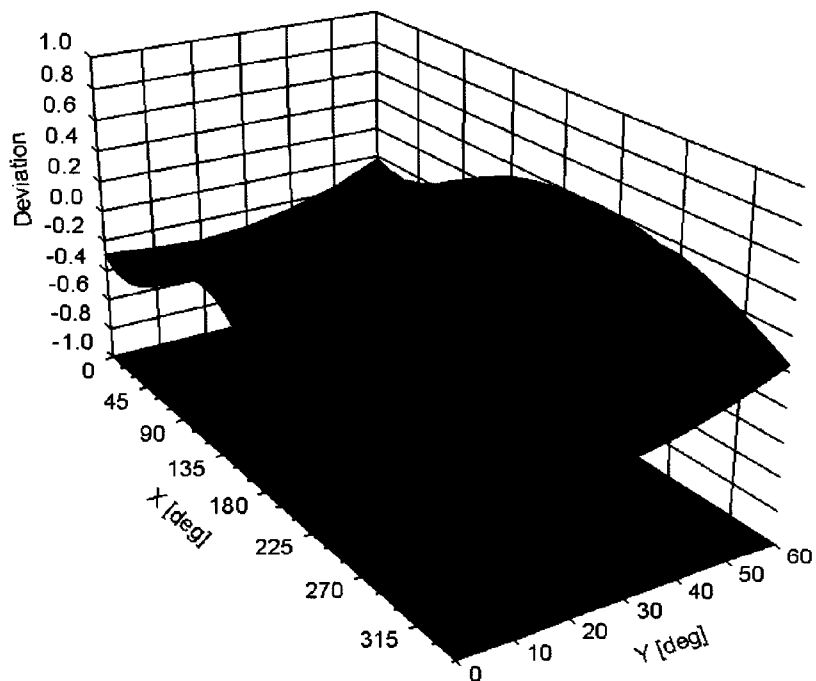
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



Uncertainty of Spherical Isotropy Assessment: $\pm 2.6\%$ ($k=2$)

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

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**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
S Swiss Calibration Service

Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

Client **RF Exposure Lab**

Certificate No: **D750V3-1053_Aug15**

CALIBRATION CERTIFICATE

Object **D750V3 - SN: 1053**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 10, 2015**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Name** **Michael Weber** **Function** **Laboratory Technician**

Signature

Approved by: **Katja Pokovic** **Technical Manager**

Issued: August 12, 2015

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



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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:

- 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
- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- 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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	15 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	41.9	0.89 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	42.1 $\pm$ 6 %	0.91 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	2.04 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	8.03 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	1.33 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	5.25 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	55.5	0.96 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	56.3 $\pm$ 6 %	1.00 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	2.18 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	8.48 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	1.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	5.59 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	54.4 Ω - 0.4 j Ω
Return Loss	- 27.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	49.5 Ω - 2.5 j Ω
Return Loss	- 32.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.035 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
Manufactured on	November 08, 2011

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.

D750V3 SN: 1053 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real (Ω)	$\Delta\Omega$	Impedance Imaginary (j Ω)	$\Delta\Omega$
8/10/2015	-27.5		54.4		-0.4	
8/9/2016	-25.9	-5.8	54.3	-0.1	-0.5	-0.1
8/10/2017	-26.9	-2.2	54.1	-0.3	-0.3	0.1

D750V3 SN: 1053 - Body						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real (Ω)	$\Delta\Omega$	Impedance Imaginary (j Ω)	$\Delta\Omega$
8/10/2015	-32.0		49.5		-2.5	
8/9/2016	-31.5	-1.6	51.0	1.5	-2.9	-0.4
8/10/2017	-31.2	-2.5	50.3	0.8	-2.8	-0.3

DASY5 Validation Report for Head TSL

Date: 10.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1053

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750$ MHz; $\sigma = 0.91$ S/m; $\epsilon_r = 42.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.44, 6.44, 6.44); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

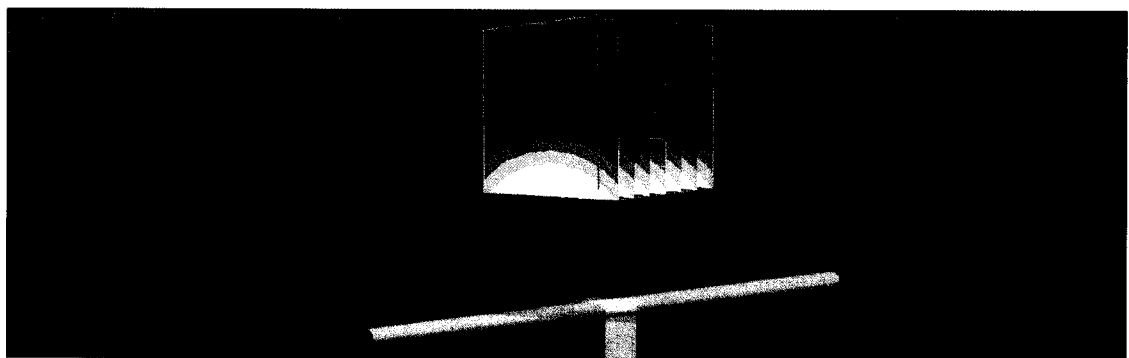
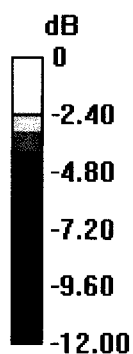
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 53.03 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 3.06 W/kg

SAR(1 g) = 2.04 W/kg; SAR(10 g) = 1.33 W/kg

Maximum value of SAR (measured) = 2.39 W/kg



0 dB = 2.39 W/kg = 3.78 dBW/kg

Impedance Measurement Plot for Head TSL

10 Aug 2015 11:47:25
 CH1 S11 1 U FS 1: 54.371 Ω -375.00 m Ω 565.88 pF 750.000 000 MHz

*

De1

CA

Avg
16

H1d

CH2 S11 L06 5 dB/REF -20 dB 1:-27.524 dB 750.000 000 MHz

De1

CA

Avg
16

H1d

START 550.000 000 MHz

STOP 950.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 10.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 750 MHz; Type: D750V3; Serial: D750V3 - SN: 1053

Communication System: UID 0 - CW; Frequency: 750 MHz

Medium parameters used: $f = 750 \text{ MHz}$; $\sigma = 1 \text{ S/m}$; $\epsilon_r = 56.3$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(6.21, 6.21, 6.21); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 4.9L; Type: QD000P49AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

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

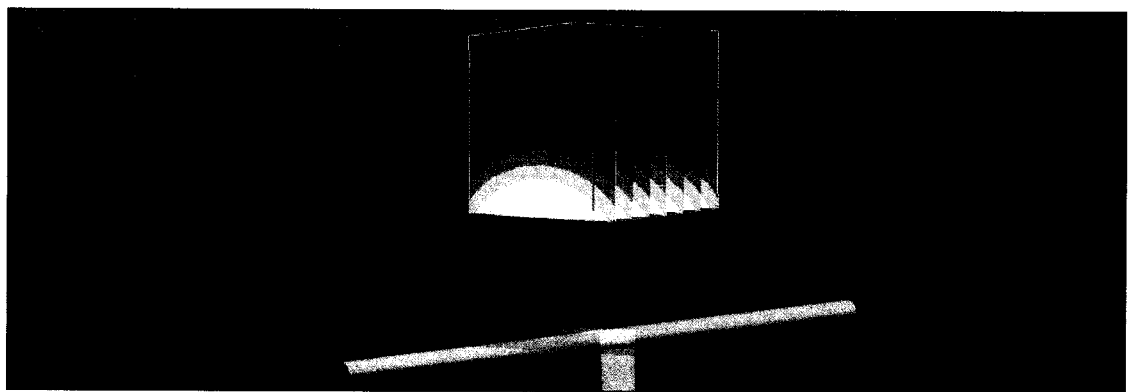
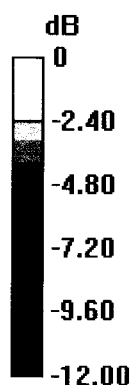
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 52.22 V/m; Power Drift = -0.00 dB

Peak SAR (extrapolated) = 3.19 W/kg

SAR(1 g) = 2.18 W/kg; SAR(10 g) = 1.43 W/kg

Maximum value of SAR (measured) = 2.55 W/kg



0 dB = 2.55 W/kg = 4.07 dBW/kg

Impedance Measurement Plot for Body TSL

10 Aug 2015 10:58:10
 CH1 S11 1 U FS 1: 49.469 Ω -2.4551 Ω 86.436 pF 750.000 000 MHz

*

De1

CA

Avg
16

H1d

CH2 S11 LOG 5 dB/REF -20 dB 1: -31.950 dB 750.000 000 MHz

De1

CA

Avg
16

H1d

START 550.000 000 MHz

STOP 950.000 000 MHz



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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 Multilateral Agreement for the recognition of calibration certificates

Client **RF Exposure Lab**

Certificate No: **D1750V2-1061_Aug15**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN:1061**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 13, 2015**

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

All calibrations have been conducted in the closed laboratory facility: environment temperature $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

Calibrated by: **Jeton Kastrati** **Laboratory Technician** 

Approved by: **Katja Pokovic** **Technical Manager** 

Issued: August 13, 2015

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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:

- 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
- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- 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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.8 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.18 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.8 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.90 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.6 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.1 $\pm$ 6 %	1.48 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.43 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.7 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.09 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.3 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.5 Ω + 1.2 j Ω
Return Loss	- 37.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	47.3 Ω + 0.8 j Ω
Return Loss	- 30.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.220 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
Manufactured on	June 15, 2010

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.

D1750V2 SN: 1061 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real (Ω)	$\Delta\Omega$	Impedance Imaginary (j Ω)	$\Delta\Omega$
8/13/2015	-37.8		50.5		1.2	
8/12/2016	-39.4	4.2	49.2	-1.3	0.7	-0.5
8/13/2017	-38.2	1.1	48.2	-2.3	1.1	-0.1

D1750V2 SN: 1061 - Body						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real (Ω)	$\Delta\Omega$	Impedance Imaginary (j Ω)	$\Delta\Omega$
8/13/2015	-30.7		47.3		0.8	
8/12/2016	-29.4	-4.2	46.1	-1.2	0.6	-0.2
8/13/2017	-30.1	-2.0	45.8	-1.5	0.7	-0.1

DASY5 Validation Report for Head TSL

Date: 13.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1061

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.36$ S/m; $\epsilon_r = 39.8$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.2, 5.2, 5.2); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

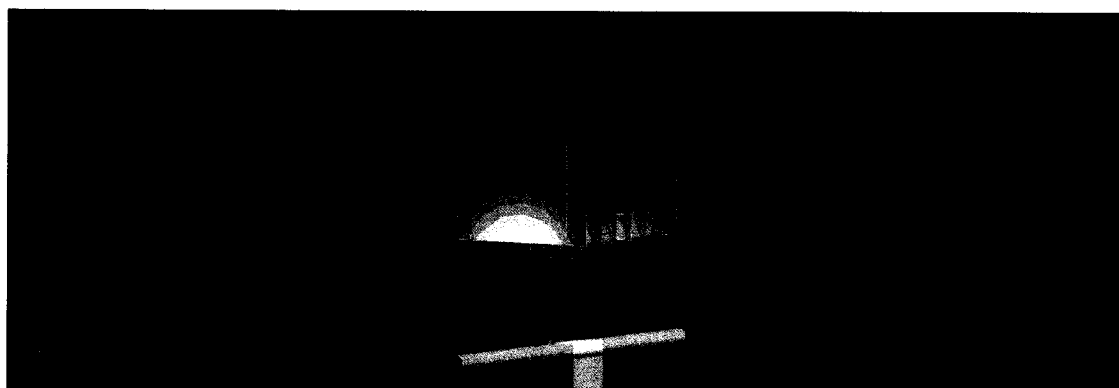
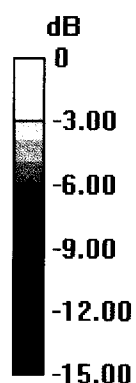
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.55 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 16.4 W/kg

SAR(1 g) = 9.18 W/kg; SAR(10 g) = 4.9 W/kg

Maximum value of SAR (measured) = 11.6 W/kg



0 dB = 11.6 W/kg = 10.64 dBW/kg

Impedance Measurement Plot for Head TSL

13 Aug 2015 13:43:33
 CH1 S11 1 U FS 1: 50.514 Ω 1.1777 Ω 107.11 μH 1 750.000 000 MHz

*

Del

CA

Avg
16

H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-37.844 dB 1 750.000 000 MHz

CA

Avg
16

H1d

START 1 550.000 000 MHz

STOP 1 950.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 13.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN:1061

Communication System: UID 0 - CW; Frequency: 1750 MHz

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.48$ S/m; $\epsilon_r = 52.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.88, 4.88, 4.88); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

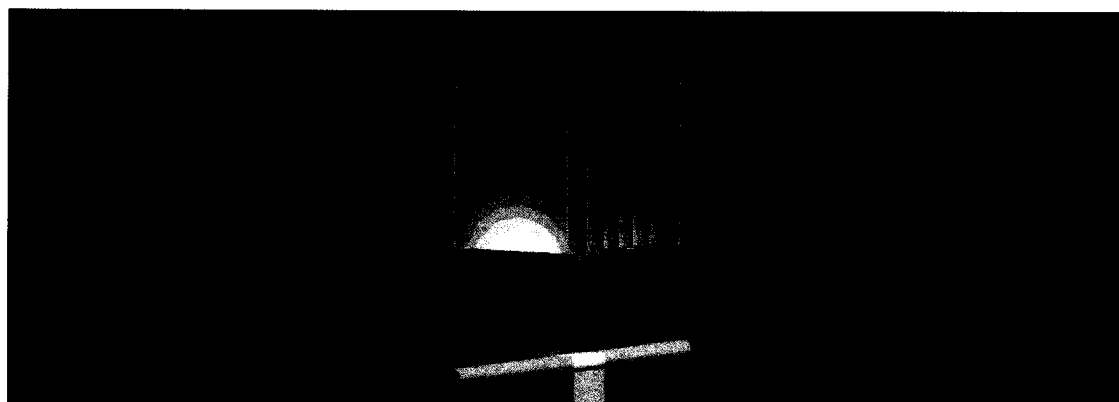
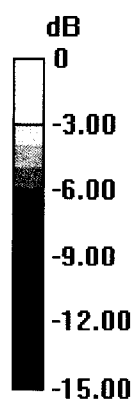
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.33 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 16.1 W/kg

SAR(1 g) = 9.43 W/kg; SAR(10 g) = 5.09 W/kg

Maximum value of SAR (measured) = 11.8 W/kg



0 dB = 11.8 W/kg = 10.72 dBW/kg

Impedance Measurement Plot for Body TSL

13 Aug 2015 13:42:55
 CH1 S11 1 U FS 1: 47.281 Ω 0.7871 Ω 71.584 μH 1 750.000 000 MHz

*

Del

CA

Avg
16

H1d

CH2 S11 LOG 5 dB/REF -20 dB 1:-30.723 dB 1 750.000 000 MHz

CA

Avg
16

H1d

START 1 550.000 000 MHz

STOP 1 950.000 000 MHz

gm

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
S 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: **D1900V2-5d147_Aug15**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN:5d147**

Calibration procedure(s) **QA CAL-05.v9**
Calibration procedure for dipole validation kits above 700 MHz

Calibration date: **August 13, 2015**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	US37292783	07-Oct-14 (No. 217-02020)	Oct-15
Power sensor HP 8481A	MY41092317	07-Oct-14 (No. 217-02021)	Oct-15
Reference 20 dB Attenuator	SN: 5058 (20k)	01-Apr-15 (No. 217-02131)	Mar-16
Type-N mismatch combination	SN: 5047.2 / 06327	01-Apr-15 (No. 217-02134)	Mar-16
Reference Probe ES3DV3	SN: 3205	30-Dec-14 (No. ES3-3205_Dec14)	Dec-15
DAE4	SN: 601	18-Aug-14 (No. DAE4-601_Aug14)	Aug-15
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-14)	In house check: Oct-15

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

Issued: August 13, 2015

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



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 0108**

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

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:

- 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
- 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
- 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
- KDB 865664, "SAR Measurement Requirements for 100 MHz to 6 GHz"

Additional Documentation:

- 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	V52.8.8
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	38.9 $\pm$ 6 %	1.39 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.4 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	41.5 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.47 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.8 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.5 $\pm$ 6 %	1.51 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.1 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.4 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.5 W/kg $\pm$ 16.5 % (k=2)

Appendix (Additional assessments outside the scope of SCS 0108)

Antenna Parameters with Head TSL

Impedance, transformed to feed point	53.1 Ω + 6.2 j Ω
Return Loss	- 23.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	48.9 Ω + 6.5 j Ω
Return Loss	- 23.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.193 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
Manufactured on	March 11, 2011

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.

D1900V2 SN: 5d147 - Head						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real (Ω)	$\Delta\Omega$	Impedance Imaginary (j Ω)	$\Delta\Omega$
8/13/2015	-23.5		53.1		6.2	
8/12/2016	-24.9	6.0	53.9	0.8	5.4	-0.8
8/13/2017	-23.8	1.3	52.7	-0.4	5.9	-0.3

D1900V2 SN: 5d147 - Body						
Date of Measurement	Return Loss (dB)	$\Delta\%$	Impedance Real (Ω)	$\Delta\Omega$	Impedance Imaginary (j Ω)	$\Delta\Omega$
8/13/2015	-23.5		48.9		6.5	
8/12/2016	-22.8	-3.0	46.3	-2.6	6.9	0.4
8/13/2017	-22.4	-4.7	47.5	-1.4	6.7	0.2

DASY5 Validation Report for Head TSL

Date: 13.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d147

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.39$ S/m; $\epsilon_r = 38.9$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5, 5, 5); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Head Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 100.3 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 19.0 W/kg

SAR(1 g) = 10.4 W/kg; SAR(10 g) = 5.47 W/kg

Maximum value of SAR (measured) = 13.2 W/kg



0 dB = 13.2 W/kg = 11.21 dBW/kg

Impedance Measurement Plot for Head TSL

13 Aug 2015 13:23:19
 CH1 S11 1 U FS 3: 53.094 Ω 6.2012 Ω 519.45 μH 1 900.000 000 MHz

*
 Del

CΔ

Avg
 16

H1d

CH2 S11 LOG 5 dB/REF -20 dB 3:-23.465 dB 1 900.000 000 MHz

CΔ

Avg
 16

H1d

START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

DASY5 Validation Report for Body TSL

Date: 13.08.2015

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN:5d147

Communication System: UID 0 - CW; Frequency: 1900 MHz

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.51$ S/m; $\epsilon_r = 52.5$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2011)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.65, 4.65, 4.65); Calibrated: 30.12.2014;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 18.08.2014
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.8(1222); SEMCAD X 14.6.10(7331)

Dipole Calibration for Body Tissue/Pin=250 mW, d=10mm/Zoom Scan (7x7x7)/Cube 0:

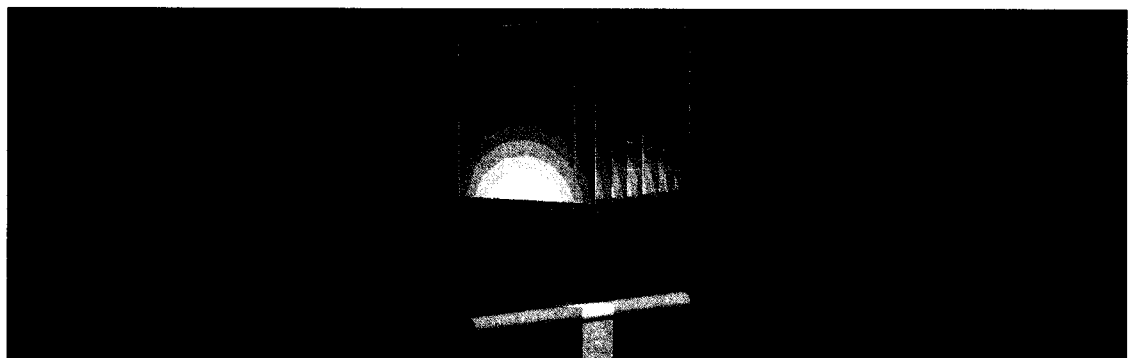
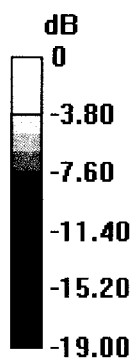
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.00 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.2 W/kg

SAR(1 g) = 10.1 W/kg; SAR(10 g) = 5.37 W/kg

Maximum value of SAR (measured) = 12.8 W/kg



0 dB = 12.8 W/kg = 11.07 dBW/kg

Impedance Measurement Plot for Body TSL

13 Aug 2015 13:22:49
 CH1 S11 1 U FS 3: 48.922 Ω 6.5039 Ω 544.80 μ H 1 900.000 000 MHz

*

Del

CA

Avg
16

H1d

CH2 S11 LOG 5 dB/REF -20 dB 3:-23.539 dB 1 900.000 000 MHz

CA

Avg
16

H1d

START 1 700.000 000 MHz

STOP 2 100.000 000 MHz

Appendix F – Phantom Calibration Data Sheets

Certificate of Conformity / First Article Inspection

Item	SAM Twin Phantom V4.0
Type No	QD 000 P40 C
Series No	TP-1150 and higher
Manufacturer	SPEAG Zeughausstrasse 43 CH-8004 Zürich Switzerland

Tests

The series production process used allows the limitation to test of first articles.

Complete tests were made on the pre-series Type No. QD 000 P40 AA, Serial No. TP-1001 and on the series first article Type No. QD 000 P40 BA, Serial No. TP-1006. Certain parameters have been retested using further series items (called samples) or are tested at each item.

Test	Requirement	Details	Units tested
Dimensions	Compliant with the geometry according to the CAD model.	IT'IS CAD File (*)	First article, Samples
Material thickness of shell	Compliant with the requirements according to the standards	2mm +/- 0.2mm in flat and specific areas of head section	First article, Samples, TP-1314 ff.
Material thickness at ERP	Compliant with the requirements according to the standards	6mm +/- 0.2mm at ERP	First article, All items
Material parameters	Dielectric parameters for required frequencies	300 MHz – 6 GHz: Relative permittivity < 5, Loss tangent < 0.05	Material samples
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions. Observe technical Note for material compatibility.	DEGMBE based simulating liquids	Pre-series, First article, Material samples
Sagging	Compliant with the requirements according to the standards. Sagging of the flat section when filled with tissue simulating liquid.	< 1% typical < 0.8% if filled with 155mm of HSL900 and without DUT below	Prototypes, Sample testing

Standards

[1] CENELEC EN 50361

[2] IEEE Std 1528-2003

[3] IEC 62209 Part I

[4] FCC OET Bulletin 65, Supplement C, Edition 01-01

(*) The IT'IS CAD file is derived from [2] and is also within the tolerance requirements of the shapes of the other documents.

Conformity

Based on the sample tests above, we certify that this item is in compliance with the uncertainty requirements of SAR measurements specified in standards [1] to [4].

Date

07.07.2005

Signature / Stamp

s p e a g

Schmid & Partner Engineering AG

Zeughausstrasse 43, 8004 Zurich, Switzerland

Phone +41 1 245 9700, Fax +41 1 245 9779

Info@speag.com, http://www.speag.com

Certificate of Conformity / First Article Inspection

Item	Oval Flat Phantom ELI 4.0
Type No	QD OVA 001 B
Series No	1003 and higher
Manufacturer	Untersee Composites Knebelstrasse 8 CH-8268 Mannenbach, Switzerland

Tests

Complete tests were made on the prototype units QD OVA 001 AA 1001, QD OVA 001 AB 1002, pre-series units QD OVA 001 BA 1003-1005 as well as on the series units QD OVA 001 BB, 1006 ff.

Test	Requirement	Details	Units tested
Material thickness	Compliant with the standard requirements	Bottom plate: 2.0mm +/- 0.2mm	all
Material parameters	Dielectric parameters for required frequencies	< 6 GHz: Rel. permittivity = 4 +/-1, Loss tangent ≤ 0.05	Material sample
Material resistivity	The material has been tested to be compatible with the liquids defined in the standards if handled and cleaned according to the instructions.	DGBE based simulating liquids. Observe Technical Note for material compatibility.	Equivalent phantoms, Material sample
Shape	Thickness of bottom material, Internal dimensions, Sagging compatible with standards from minimum frequency	Bottom elliptical 600 x 400 mm Depth 190 mm, Shape is within tolerance for filling height up to 155 mm, Eventual sagging is reduced or eliminated by support via DUT	Prototypes, Sample testing

Standards

- [1] CENELEC EN 50361-2001, « Basic standard for the measurement of the Specific Absorption Rate related to human exposure to electromagnetic fields from mobile phones (300 MHz – 3 GHz) », July 2001
- [2] IEEE 1528-2003, "Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques, December 2003
- [3] IEC 62209 – 1, "Specific Absorption Rate (SAR) in the frequency range of 300 MHz to 3 GHz – Measurement Procedure, Part 1: Hand-held mobile wireless communication devices", February 2005
- [4] IEC 62209 – 2, Draft, "Human Exposure to Radio Frequency Fields from Handheld and Body-Mounted Wireless Communication Devices – Human models, Instrumentation and Procedures – Part 2: Procedure to determine the Specific Absorption Rate (SAR) in the head and body for 30 MHz to 6 GHz Handheld and Body-Mounted Devices used in close proximity to the Body.", February 2005
- [5] OET Bulletin 65, Supplement C, "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields", Edition January 2001

Based on the tests above, we certify that this item is in compliance with the standards [1] to [5] if operated according to the specific requirements and considering the thickness. The dimensions are fully compliant with [4] from 30 MHz to 6 GHz. For the other standards, the minimum lower frequency limit is limited due to the dimensional requirements ([1]: 450 MHz, [2]: 300 MHz, [3]: 800 MHz, [5]: 375 MHz) and possibly further by the dimensions of the DUT.

s p e a g

Date 28.4.2008

Signature / Stamp

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Appendix G – Validation Summary

Per FCC KDB 865664 D02 v01r02, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue equivalent media for system validation according to the procedures outlined in FCC KDB 865664 D01 v01r04 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point using the system that normally operates with the probe for routine SAR measurements and according to the required tissue equivalent media.

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

Table G-1
SAR System Validation Summary

SAR System #	Freq. (MHz)	Date	Probe S/N	Probe Type	Probe Cal. Point		Cond. (σ)	Perm. (ϵ_r)	CW Validation			Modulation Validation		
									Sens-itivity	Probe Linearity	Probe Isotropy	Modulation Type	Duty Factor	PAR
2	750	5/10/2018	3662	EX3DV4	900	Head	0.91	41.29	Pass	Pass	Pass	QPSK	Pass	Pass
2	750	5/11/2018	3662	EX3DV4	750	Body	0.99	55.57	Pass	Pass	Pass	QPSK	Pass	Pass
2	1750	5/10/2018	3662	EX3DV4	1750	Head	1.39	39.94	Pass	Pass	Pass	QPSK	Pass	Pass
2	1750	5/11/2018	3662	EX3DV4	1750	Body	1.52	53.32	Pass	Pass	Pass	QPSK	Pass	Pass
2	1900	5/8/2018	3662	EX3DV4	1900	Head	1.41	39.87	Pass	Pass	Pass	QPSK	Pass	Pass
2	1900	5/9/2018	3662	EX3DV4	1900	Body	1.47	52.07	Pass	Pass	Pass	QPSK	Pass	Pass