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SAR EVALUATION REPORT

Applicant Name:
Kyocera Communication, Inc.
8611 Balboa Ave
San Diego, CA 92123
USA

Date of Testing:
12/22/14
Test Site/Location:
PCTEST Lab, Columbia, MD, USA
Document Serial No.:
0Y1412192315.V65

FCC ID: **V65C6721A1**

APPLICANT: **KYOCERA COMMUNICATION, INC.**

DUT Type: Portable Handset
Application Type: Class II Permissive Change
FCC Rule Part(s): CFR §2.1093
Model(s): C6721
Permissive Change(s): Refer to Permissive Change Document
Date of Original Certification: 3/11/2013

Equipment Class	Band & Mode	Tx Frequency	SAR	
			1 gm Head (W/kg)	1 gm Body (W/kg)
PCE	LTE Band 4 (AWS)	1710.7 - 1754.3 MHz	0.68	0.61
PCE	LTE Band 2 (PCS)	1850.7 - 1909.3 MHz	0.64	0.63

The table above shows Test Data evaluated for the current test report. Please refer to RF Exposure Technical Report S/N 0Y1212071742-R4.V65 for compliance evaluation.

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.7 of this report; for North American frequency bands only.

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

Randy Ortanez
President

The SAR Tick is an initiative of the Mobile Manufacturers Forum (MMF). While a product may be considered eligible, use of the SAR Tick logo requires an agreement with the MMF. Further details can be obtained by emailing: sartick@mmfai.info.

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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
Cell. CDMA/EVDO	Voice/Data	824.70 - 848.31 MHz
AWS CDMA/EVDO	Voice/Data	1711.25 - 1753.75 MHz
PCS CDMA/EVDO	Voice/Data	1851.25 - 1908.75 MHz
LTE Band 12	Data	699.7 - 715.3 MHz
LTE Band 17	Data	706.5 - 713.5 MHz
LTE Band 5 (Cell)	Data	824.7 - 848.3 MHz
LTE Band 4 (AWS)	Data	1710.7 - 1754.3 MHz
LTE Band 2 (PCS)	Data	1850.7 - 1909.3 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
Bluetooth	Data	2402 - 2480 MHz

1.2 Nominal and Maximum Output Power Specifications

This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05.

Mode / Band		Modulated Average (dBm)	Modulated Average (dBm)	Modulated Average (dBm)
		Max	Step 1	Step 2
LTE Band 4 (AWS)	Maximum	**23.2**	**19.7**	**15.7**
	Nominal	**22.5**	**19.0**	**15.0**
LTE Band 2 (PCS)	Maximum	**23.7**	**19.7**	**15.7**
	Nominal	**23.0**	**19.0**	**15.0**

1.3 DUT Antenna Locations

Exact antenna dimensions and separation distances are shown in the Technical Descriptions. A diagram showing the location of the device antennas can be found in Appendix F.

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1.4 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-2 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.

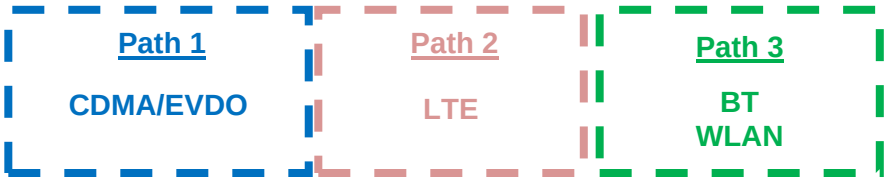

Figure 1-1
Simultaneous Transmission Paths

This device contains multiple transmitters that may operate simultaneously, and therefore requires a simultaneous transmission analysis according to FCC KDB Publication 447498 D01v05 3) procedures.

Table 1-1
Simultaneous Transmission Scenarios

No.	Capable Transmit Configurations	Head	Body-Worn Accessory	Hotspot	Note
		IEEE 1528, Supplement C	Supplement C	FCC KDB 941225 D06 Edges/Sides	
1	CDMA Voice + Wifi 2.4 GHz	Yes	Yes	N/A	
2	EVDO Data + Wifi 2.4 GHz	Yes *	Yes *	Yes	3G Hotspot, VOIP
3	LTE + Wifi 2.4 GHz	Yes *	Yes *	Yes	4G Hotspot
4	CDMA Voice + LTE Data	Yes	Yes	N/A	SVLTE
5	CDMA Voice + LTE Data + Wifi 2.4 GHz	Yes	Yes	Yes	SVLTE Hotspot
6	CDMA Voice + 2.4 GHz Bluetooth	N/A	Yes	N/A	
7	LTE + 2.4 GHz Bluetooth	N/A	Yes	N/A	
8	CDMA Voice + LTE Data + 2.4 GHz Bluetooth	N/A	Yes	N/A	SVLTE
9	EVDO Data + LTE	N/A	N/A	N/A	Not supported by S/W
10	CDMA Voice + EVDO Data	N/A	N/A	N/A	Not supported by H/W

1. (*) = for VOIP 3rd party possibly installed and used by end-user

1.5 SAR Test Exclusions Applied

(A) Licensed Transmitter(s)

LTE SAR for the higher modulations and lower bandwidths were not tested since the maximum average output power of all required channels and configurations was not more than 0.5 dB higher than the highest bandwidth; and the reported LTE SAR for the highest bandwidth was less than 1.45 W/kg for all configurations according to FCC KDB 941225 D05v02.

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1.6 Power Reduction for SAR

This device uses power reduction mechanisms for LTE during SVLTE operation (1x-RTT CDMA voice + LTE data) for SAR compliance. See Section 10 for more details.

1.7 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D05, D06 (4G and Hotspot)
- FCC KDB Publication 447498 D01v05r02 (General SAR Guidance)
- FCC KDB Publication 865664 D01v01r03, D02v01r01 (SAR Measurements up to 6 GHz)

1.8 Device Serial Numbers

Several samples were used with identical hardware to support SAR testing. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.

	Max Serial Number	Step 1 Serial Number	Step 2 Serial Number
LTE Band 4 (AWS)	LTE Band 4 - SAR		
LTE Band 2 (PCS)	LTE Band 2 - SAR		

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2 LTE INFORMATION

LTE Information			
FCC ID	**V65C6721A1**		
Form Factor	Portable Handset		
Frequency Range of each LTE transmission band	LTE Band 4 (AWS) (1710.7 - 1754.3 MHz)		
	LTE Band 2 (PCS) (1850.7 - 1909.3 MHz)		
Channel Bandwidths	LTE Band 4 (AWS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 2 (PCS): 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 4 (AWS): 1.4 MHz	1710.7 (19957)	1732.5 (20175)	1754.3 (20393)
LTE Band 4 (AWS): 3 MHz	1711.5 (19965)	1732.5 (20175)	1753.5 (20385)
LTE Band 4 (AWS): 5 MHz	1712.5 (19975)	1732.5 (20175)	1752.5 (20375)
LTE Band 4 (AWS): 10 MHz	1715 (20000)	1732.5 (20175)	1750 (20350)
LTE Band 4 (AWS): 15 MHz	1717.5 (20025)	1732.5 (20175)	1747.5 (20325)
LTE Band 4 (AWS): 20 MHz	1720 (20050)	1732.5 (20175)	1745 (20300)
LTE Band 2 (PCS): 1.4 MHz	1850.7 (18607)	1880 (18900)	1909.3 (19193)
LTE Band 2 (PCS): 3 MHz	1851.5 (18615)	1880 (18900)	1908.5 (19185)
LTE Band 2 (PCS): 5 MHz	1852.5 (18625)	1880 (18900)	1907.5 (19175)
LTE Band 2 (PCS): 10 MHz	1855 (18650)	1880 (18900)	1905 (19150)
LTE Band 2 (PCS): 15 MHz	1857.5 (18675)	1880 (18900)	1902.5 (19125)
LTE Band 2 (PCS): 20 MHz	1860 (18700)	1880 (18900)	1900 (19100)
UE Category	3		
Modulations Supported in UL	QPSK, 16QAM		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	YES		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		

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3 INTRODUCTION

The FCC and Industry Canada have adopted the guidelines for evaluating the environmental effects of radio frequency (RF) radiation in ET Docket 93-62 on Aug. 6, 1996 and Health Canada Safety Code 6 to protect the public and workers from the potential hazards of RF emissions due to FCC-regulated portable devices. [1]

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [22]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

3.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Equation 3-1).

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

σ = conductivity of the tissue-simulating material (S/m)
ρ = mass density of the tissue-simulating material (kg/m^3)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure compliant to FCC KDB Publication 865664 D01v01 and IEEE 1528-2013:

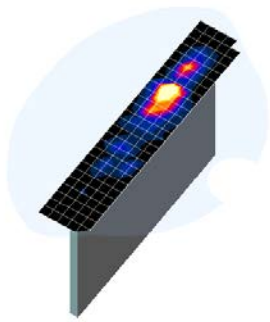

Figure 4-1
Sample SAR Area Scan

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):

    a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).

    b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.

    c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

Table 4-1
Area and Zoom Scan Resolutions per FCC KDB Publication 865664 D01v01*

Frequency	Maximum Area Scan Resolution (mm) (Δx_{area}, Δy_{area})	Maximum Zoom Scan Resolution (mm) (Δx_{zoom}, Δy_{zoom})	Maximum Zoom Scan Spatial Resolution (mm)			Minimum Zoom Scan Volume (mm) (x,y,z)
			Uniform Grid	Graded Grid		
			$\Delta z_{zoom}(n)$	$\Delta z_{zoom}(1)$*	$\Delta z_{zoom}(n>1)$*	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5*$\Delta z_{zoom}(n-1)$	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

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5 DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

Figure 5-2 shows the front, back and side views of the SAM Twin 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 ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front), also called the Reference Pivoting Line, is not perpendicular to the reference plane (see Figure 5-1). 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].

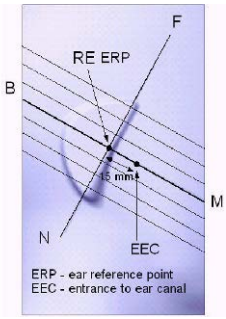

Figure 5-1
Close-Up Side view of ERP

5.2 HANDSET REFERENCE POINTS

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the acoustic output located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Figure 5-3). The acoustic output was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at its top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

Figure 5-2
Front, back and side view of SAM Twin Phantom

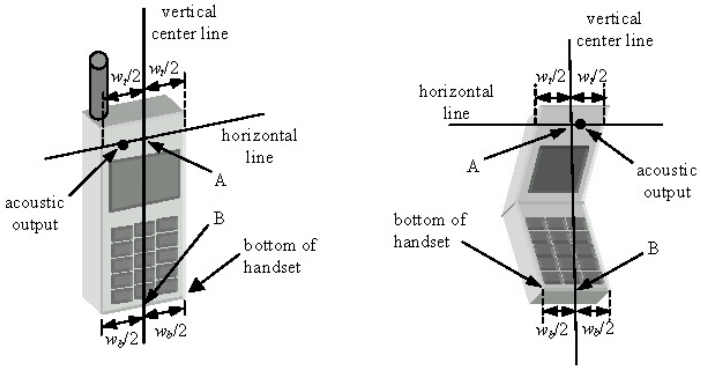

Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

The device holder is made out of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02.

6.2 Positioning for Cheek

1. The test device was positioned with 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 6-1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

Figure 6-1 Front, Side and Top View of Cheek Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the pinna.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the reference plane.
4. The phone was then rotated around the vertical centerline until the phone (horizontal line) was symmetrical was 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, the device was rotated about the NF line until any point on the handset made contact with a phantom point below the ear (cheek) (See Figure 6-2).

6.3 Positioning for Ear / 15º Tilt

With the test device aligned in the “Cheek Position”:

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15degrees.
2. The phone was then rotated around the horizontal line by 15 degrees.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the handset touched the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. In this situation, the tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 6-2).

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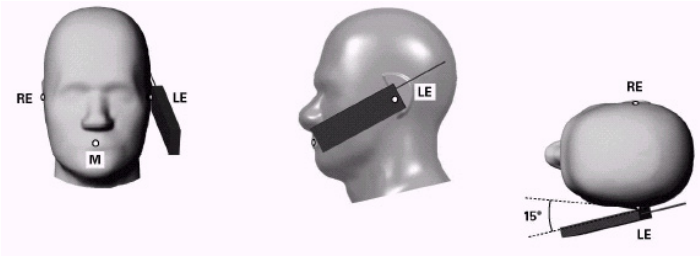

Figure 6-2 Front, Side and Top View of Ear/15º Tilt Position

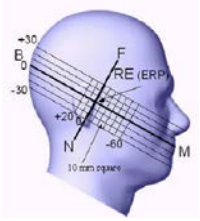

Figure 6-3
Side view w/ relevant markings

6.4 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-4). Per FCC KDB Publication 648474 D04v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. Per FCC KDB Publication 648474 D04v01, body-worn SAR was evaluated with a headset connected to the device when the standalone reported body-worn SAR was > 1.2 W/kg using the highest reported SAR configuration for that wireless mode and frequency band.

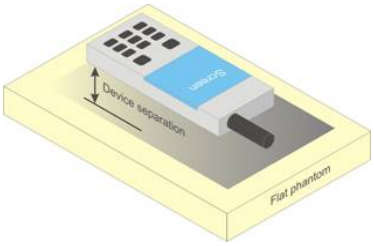

Figure 6-4
Sample Body-Worn Diagram

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 multiple accessories that contain metallic components are tested with the device with each accessory. 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 with a separation distance between the back of the device and the flat phantom is used. Test position spacing was 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 in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

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6.5 Extremity Exposure Configurations

Devices that are designed or intended for use on extremities or mainly operated in extremity only exposure conditions; i.e., hands, wrists, feet and ankles, may require extremity SAR evaluation. When the device also operates in close proximity to the user's body, SAR compliance for the body is also required. The 1-g body and 10-g extremity SAR Exclusion Thresholds found in KDB Publication 44798 D01v05 should be applied to determine SAR test requirements.

Per KDB Publication 447498 D01v05, Cell phones (handsets) are not normally designed to be used on extremities or operated in extremity only exposure conditions. The maximum output power levels of handsets generally do not require extremity SAR testing to show compliance. Therefore, extremity SAR was not evaluated for this device.

6.6 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive user data through simultaneous transmission of WIFI simultaneously with a separate licensed transmitter. The FCC has provided guidance in FCC KDB Publication 941225 D06 v01 where SAR test considerations for handsets (L x W ≥ 9 cm x 5 cm) are based on a composite test separation distance of 10 mm from the front, back and edges of the device containing transmitting antennas within 2.5 cm of their edges, determined from general mixed use conditions for this type of devices. Since the hotspot SAR results may overlap with the body-worn accessory SAR requirements, the more conservative configurations can be considered, thus excluding some body-worn accessory SAR tests.

When the user enables the personal wireless router functions for the handset, actual operations include simultaneous transmission of both the WIFI transmitter and another licensed transmitter. Both transmitters often do not transmit at the same transmitting frequency and thus cannot be evaluated for SAR under actual use conditions due to the limitations of the SAR assessment probes. Therefore, SAR must be evaluated for each frequency transmission and mode separately and spatially summed with the WIFI transmitter according to FCC KDB Publication 447498 D01v05 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated during SAR assessments, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal at a time.

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7 RF EXPOSURE LIMITS

7.1 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.

7.2 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
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT *General Population* (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT *Occupational* (W/kg) or (mW/g)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR Hands, Feet, Ankle, Wrists, etc.	4.0	20

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.

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8 FCC MEASUREMENT PROCEDURES

8.1 Measured and Reported SAR

Per FCC KDB Publication 447498 D01v05, When SAR is not measured at the maximum power level allowed for production units, the results must be scaled to the maximum tune-up tolerance limit according to the power applied to the individual channels tested to determine compliance. For simultaneous transmission, the measured aggregate SAR must be scaled according to the sum of the differences between the maximum tune-up tolerance and actual power used to test each transmitter. When SAR is measured at or scaled to the maximum tune-up tolerance limit, the results are referred to as *reported* SAR. The highest *reported* SAR results are identified on the grant of equipment authorization according to procedures in KDB 690783 D01v01r02.

8.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01 “SAR Measurement Procedures for 3G Devices”, October 2014.

The device was placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. Devices under test were evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device was tested throughout the SAR test at maximum output power, the SAR measurement system measures a “point SAR” at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. If the power drift deviated by more than 5%, the SAR test and drift measurements were repeated.

8.3 SAR Measurement Conditions for LTE

LTE modes were tested according to FCC KDB 941225 D05v02 publication. Please see notes after the tabulated SAR data for required test configurations. Establishing connections with base station simulators ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. The R&S CMW500 was used for LTE output power measurements and SAR testing. Closed loop power control was used so the UE transmits with maximum output power during SAR testing. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

8.3.1 Spectrum Plots for RB Configurations

A properly configured base station simulator was used for SAR tests and power measurements. Therefore, spectrum plots for RB configurations were not required to be included in this report.

8.3.2 MPR

MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.

8.3.3 A-MPR

A-MPR (Additional MPR) has been disabled for all SAR tests by setting NS=01 on the base station simulator.

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8.3.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r01:

a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
   i. The required channel and offset combination with the highest maximum output power is required for SAR.
   ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
   iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to ½ dB higher than the equivalent configuration using QPSK modulation and when the QPSK SAR for those configurations is <1.45 W/kg.

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9 RF CONDUCTED POWERS

9.1 LTE Conducted Powers

9.1.1 LTE Band 4 (AWS)

Table 9-1
LTE Band 4 (AWS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	1732.5	20175	20	QPSK	1	0	23.19	0	0
	1732.5	20175	20	QPSK	1	50	**23.20**	0	0
	1732.5	20175	20	QPSK	1	99	23.19	0	0
	1732.5	20175	20	QPSK	50	0	22.05	0-1	1
	1732.5	20175	20	QPSK	50	25	21.98	0-1	1
	1732.5	20175	20	QPSK	50	50	21.98	0-1	1
	1732.5	20175	20	QPSK	100	0	22.04	0-1	1
	1732.5	20175	20	16QAM	1	0	22.20	0-1	1
	1732.5	20175	20	16QAM	1	50	22.20	0-1	1
	1732.5	20175	20	16QAM	1	99	22.20	0-1	1
	1732.5	20175	20	16QAM	50	0	21.05	0-2	2
	1732.5	20175	20	16QAM	50	25	21.01	0-2	2
	1732.5	20175	20	16QAM	50	50	20.98	0-2	2
	1732.5	20175	20	16QAM	100	0	21.07	0-2	2

Note: LTE Band 4 (AWS) at 20 MHz bandwidth does not support three non-overlapping channels. Per KDB Publication 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the middle channel of the group of overlapping channels should be selected for testing.

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Table 9-2
LTE Band 4 (AWS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1717.5	20025	15	QPSK	1	0	23.20	0	0
	1717.5	20025	15	QPSK	1	36	23.20	0	0
	1717.5	20025	15	QPSK	1	74	23.17	0	0
	1717.5	20025	15	QPSK	36	0	22.20	0-1	1
	1717.5	20025	15	QPSK	36	18	22.15	0-1	1
	1717.5	20025	15	QPSK	36	37	22.09	0-1	1
	1717.5	20025	15	QPSK	75	0	22.12	0-1	1
	1717.5	20025	15	16QAM	1	0	22.20	0-1	1
	1717.5	20025	15	16QAM	1	36	22.20	0-1	1
	1717.5	20025	15	16QAM	1	74	22.19	0-1	1
	1717.5	20025	15	16QAM	36	0	21.18	0-2	2
	1717.5	20025	15	16QAM	36	18	21.14	0-2	2
	1717.5	20025	15	16QAM	36	37	21.07	0-2	2
	1717.5	20025	15	16QAM	75	0	21.12	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	23.20	0	0
	1732.5	20175	15	QPSK	1	36	23.17	0	0
	1732.5	20175	15	QPSK	1	74	23.19	0	0
	1732.5	20175	15	QPSK	36	0	22.12	0-1	1
	1732.5	20175	15	QPSK	36	18	22.05	0-1	1
	1732.5	20175	15	QPSK	36	37	22.05	0-1	1
	1732.5	20175	15	QPSK	75	0	22.01	0-1	1
	1732.5	20175	15	16QAM	1	0	22.20	0-1	1
	1732.5	20175	15	16QAM	1	36	22.19	0-1	1
	1732.5	20175	15	16QAM	1	74	22.20	0-1	1
	1732.5	20175	15	16QAM	36	0	21.12	0-2	2
	1732.5	20175	15	16QAM	36	18	21.07	0-2	2
	1732.5	20175	15	16QAM	36	37	21.10	0-2	2
	1732.5	20175	15	16QAM	75	0	21.02	0-2	2
High	1747.5	20325	15	QPSK	1	0	23.20	0	0
	1747.5	20325	15	QPSK	1	36	23.19	0	0
	1747.5	20325	15	QPSK	1	74	23.17	0	0
	1747.5	20325	15	QPSK	36	0	22.20	0-1	1
	1747.5	20325	15	QPSK	36	18	22.18	0-1	1
	1747.5	20325	15	QPSK	36	37	22.10	0-1	1
	1747.5	20325	15	QPSK	75	0	22.08	0-1	1
	1747.5	20325	15	16QAM	1	0	22.20	0-1	1
	1747.5	20325	15	16QAM	1	36	22.20	0-1	1
	1747.5	20325	15	16QAM	1	74	22.20	0-1	1
	1747.5	20325	15	16QAM	36	0	21.20	0-2	2
	1747.5	20325	15	16QAM	36	18	21.18	0-2	2
	1747.5	20325	15	16QAM	36	37	21.13	0-2	2
	1747.5	20325	15	16QAM	75	0	21.18	0-2	2

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9.1.2 LTE Band 2 (PCS)

Table 9-3
LTE Band 2 (PCS) Conducted Powers - 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1860	18700	20	QPSK	1	0	23.48	0	0
	1860	18700	20	QPSK	1	50	23.59	0	0
	1860	18700	20	QPSK	1	99	23.33	0	0
	1860	18700	20	QPSK	50	0	22.35	0-1	1
	1860	18700	20	QPSK	50	25	22.34	0-1	1
	1860	18700	20	QPSK	50	50	22.29	0-1	1
	1860	18700	20	QPSK	100	0	22.30	0-1	1
	1860	18700	20	16QAM	1	0	22.50	0-1	1
	1860	18700	20	16QAM	1	50	22.64	0-1	1
	1860	18700	20	16QAM	1	99	22.42	0-1	1
	1860	18700	20	16QAM	50	0	21.37	0-2	2
	1860	18700	20	16QAM	50	25	21.42	0-2	2
	1860	18700	20	16QAM	50	50	21.48	0-2	2
	1860	18700	20	16QAM	100	0	21.45	0-2	2
Mid	1880.0	18900	20	QPSK	1	0	23.47	0	0
	1880.0	18900	20	QPSK	1	50	23.60	0	0
	1880.0	18900	20	QPSK	1	99	**23.70**	0	0
	1880.0	18900	20	QPSK	50	0	22.27	0-1	1
	1880.0	18900	20	QPSK	50	25	22.30	0-1	1
	1880.0	18900	20	QPSK	50	50	22.46	0-1	1
	1880.0	18900	20	QPSK	100	0	22.40	0-1	1
	1880.0	18900	20	16QAM	1	0	22.47	0-1	1
	1880.0	18900	20	16QAM	1	50	22.65	0-1	1
	1880.0	18900	20	16QAM	1	99	22.70	0-1	1
	1880.0	18900	20	16QAM	50	0	21.25	0-2	2
	1880.0	18900	20	16QAM	50	25	21.33	0-2	2
	1880.0	18900	20	16QAM	50	50	21.41	0-2	2
	1880.0	18900	20	16QAM	100	0	21.39	0-2	2
High	1900	19100	20	QPSK	1	0	23.66	0	0
	1900	19100	20	QPSK	1	50	23.29	0	0
	1900	19100	20	QPSK	1	99	23.00	0	0
	1900	19100	20	QPSK	50	0	22.32	0-1	1
	1900	19100	20	QPSK	50	25	22.24	0-1	1
	1900	19100	20	QPSK	50	50	22.09	0-1	1
	1900	19100	20	QPSK	100	0	22.26	0-1	1
	1900	19100	20	16QAM	1	0	22.70	0-1	1
	1900	19100	20	16QAM	1	50	22.43	0-1	1
	1900	19100	20	16QAM	1	99	22.20	0-1	1
	1900	19100	20	16QAM	50	0	21.47	0-2	2
	1900	19100	20	16QAM	50	25	21.34	0-2	2
	1900	19100	20	16QAM	50	50	21.14	0-2	2
	1900	19100	20	16QAM	100	0	21.32	0-2	2

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Table 9-4
LTE Band 2 (PCS) Conducted Powers - 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1857.5	18675	15	QPSK	1	0	23.49	0	0
	1857.5	18675	15	QPSK	1	36	23.64	0	0
	1857.5	18675	15	QPSK	1	74	23.70	0	0
	1857.5	18675	15	QPSK	36	0	22.60	0-1	1
	1857.5	18675	15	QPSK	36	18	22.36	0-1	1
	1857.5	18675	15	QPSK	36	37	22.39	0-1	1
	1857.5	18675	15	QPSK	75	0	22.45	0-1	1
	1857.5	18675	15	16QAM	1	0	22.67	0-1	1
	1857.5	18675	15	16QAM	1	36	22.70	0-1	1
	1857.5	18675	15	16QAM	1	74	22.70	0-1	1
	1857.5	18675	15	16QAM	36	0	21.66	0-2	2
	1857.5	18675	15	16QAM	36	18	21.54	0-2	2
	1857.5	18675	15	16QAM	36	37	21.53	0-2	2
	1857.5	18675	15	16QAM	75	0	21.65	0-2	2
Mid	1880.0	18900	15	QPSK	1	0	23.65	0	0
	1880.0	18900	15	QPSK	1	36	23.64	0	0
	1880.0	18900	15	QPSK	1	74	23.70	0	0
	1880.0	18900	15	QPSK	36	0	22.29	0-1	1
	1880.0	18900	15	QPSK	36	18	22.48	0-1	1
	1880.0	18900	15	QPSK	36	37	22.51	0-1	1
	1880.0	18900	15	QPSK	75	0	22.45	0-1	1
	1880.0	18900	15	16QAM	1	0	22.67	0-1	1
	1880.0	18900	15	16QAM	1	36	22.70	0-1	1
	1880.0	18900	15	16QAM	1	74	22.70	0-1	1
	1880.0	18900	15	16QAM	36	0	21.36	0-2	2
	1880.0	18900	15	16QAM	36	18	21.49	0-2	2
	1880.0	18900	15	16QAM	36	37	21.56	0-2	2
	1880.0	18900	15	16QAM	75	0	21.50	0-2	2
High	1902.5	19125	15	QPSK	1	0	23.70	0	0
	1902.5	19125	15	QPSK	1	36	23.38	0	0
	1902.5	19125	15	QPSK	1	74	23.13	0	0
	1902.5	19125	15	QPSK	36	0	22.41	0-1	1
	1902.5	19125	15	QPSK	36	18	22.22	0-1	1
	1902.5	19125	15	QPSK	36	37	22.21	0-1	1
	1902.5	19125	15	QPSK	75	0	22.30	0-1	1
	1902.5	19125	15	16QAM	1	0	22.70	0-1	1
	1902.5	19125	15	16QAM	1	36	22.53	0-1	1
	1902.5	19125	15	16QAM	1	74	22.24	0-1	1
	1902.5	19125	15	16QAM	36	0	21.48	0-2	2
	1902.5	19125	15	16QAM	36	18	21.30	0-2	2
	1902.5	19125	15	16QAM	36	37	21.28	0-2	2
	1902.5	19125	15	16QAM	75	0	21.37	0-2	2

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10 LTE POWER REDUCTION

10.1 Introduction to LTE Power Reduction

This device is capable of Simultaneous Voice and LTE (SVLTE) calls, with the voice call supported by a CDMA 1x-RTT transmitter and the data connection supported by a separate LTE transmitter. A LTE power reduction scheme is applied during a LTE connection operating simultaneously with 1x-RTT voice calls. The maximum transmit power of LTE is limited depending on the CDMA 1x voice transmit power level. When CDMA 1x Voice is operating at a certain range of high power levels, the maximum LTE transmit power is limited. When CDMA 1x Voice transmit power is below a certain threshold transmit power level, LTE can transmit at the maximum power. Target levels of power reduction and CDMA voice threshold levels are provided in Table 10-1.

Table 10-1
SVLTE Power Reduction Scheme

CDMA BC0 and LTE Band 4		CDMA BC15 and LTE Band 4		CDMA BC1 and LTE Band 4		CDMA BC0 and LTE Band 2		CDMA BC15 and LTE Band 2		CDMA BC1 and LTE Band 2	
1xPower [dBm]	LTE Limit	1xPower [dBm]	LTE Limit [dBm]	1xPower [dBm]	LTE Limit [dBm]	1xPower [dBm]	LTE Limit	1xPower [dBm]	LTE Limit [dBm]	1xPower [dBm]	LTE Limit [dBm]
≥15	19	≥10	15	≥10	15	≥15	19	≥10	15	≥10	15
<15	22.5	<10	22.5	<10	22.5	<15	23	<10	23	<10	23

10.2 Output Power Verification

Per KDB Publication 941225 D05v02 Section 4.4, output powers were measured in SVLTE mode to determine that the power reduction mechanism was operating reliably and consistently. The power reduction was investigated by simultaneously connecting the device to both LTE and CDMA base station simulators. LTE output powers were measured through conducted RF connections by first connecting the device in a LTE data call and subsequently a CDMA 1x-RTT call. CDMA powers were controlled by configuring the CDMA base station simulator to active bits. The LTE output power was monitored while changing the cell output power level.

The power reduction targets and threshold level described in Table 10-1 were confirmed. Please refer to RF Exposure Technical Report S/N 0Y1212071742-R4.V65 for original compliance evaluation.

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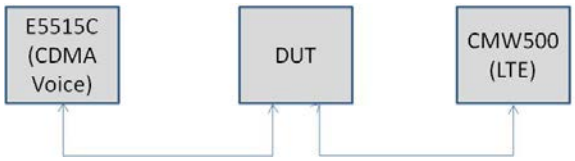

Figure 10-1
SVLTE Conducted Test Setup Diagram

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10.3 SVLTE SAR Testing Procedures

Per KDB 941225 D05v02 Section 4.4 B), SAR testing was additionally performed at the reduced CDMA and LTE power levels with respect to the simultaneous transmission scenarios. Samples were tuned to fixed reduced power levels to represent the SVLTE condition in a standalone environment. While the power reduction mechanism is activated at the specified CDMA Voice power level (see Table 10-1) simultaneous SAR summations of maximum power LTE were evaluated at this reduced fixed CDMA voice power level. SAR was additionally evaluated at reduced power LTE levels to perform simultaneous SAR analysis when CDMA voice is at maximum power.

10.3.1 Reduced LTE Band 4 Conducted Powers

Table 10-2
Reduced LTE Band 4 Conducted Powers Target 19 dBm – 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	1732.5	20175	20	QPSK	1	0	**19.68**	0	0
	1732.5	20175	20	QPSK	1	50	19.59	0	0
	1732.5	20175	20	QPSK	1	99	19.37	0	0
	1732.5	20175	20	QPSK	50	0	19.51	0-1	0
	1732.5	20175	20	QPSK	50	25	19.38	0-1	0
	1732.5	20175	20	QPSK	50	50	19.34	0-1	0
	1732.5	20175	20	QPSK	100	0	19.41	0-1	0
	1732.5	20175	20	16QAM	1	0	19.57	0-1	0
	1732.5	20175	20	16QAM	1	50	19.19	0-1	0
	1732.5	20175	20	16QAM	1	99	18.96	0-1	0
	1732.5	20175	20	16QAM	50	0	18.81	0-2	0
	1732.5	20175	20	16QAM	50	25	18.79	0-2	0
	1732.5	20175	20	16QAM	50	50	18.76	0-2	0
	1732.5	20175	20	16QAM	100	0	18.72	0-2	0

LTE Notes:
1. Please refer to Section 8.4.4 for LTE testing requirements per FCC KDB 941225 D05.
2. The bolded powers were tested for SAR.
3. LTE Band 4 at 20 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the mid channel of the group of overlapping channels should be selected for testing

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Table 10-3
Reduced LTE Band 4 Conducted Powers Target 19 dBm – 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1717.5	20025	15	QPSK	1	0	19.65	0	0
	1717.5	20025	15	QPSK	1	36	19.51	0	0
	1717.5	20025	15	QPSK	1	74	19.45	0	0
	1717.5	20025	15	QPSK	36	0	19.34	0-1	0
	1717.5	20025	15	QPSK	36	18	19.32	0-1	0
	1717.5	20025	15	QPSK	36	37	19.32	0-1	0
	1717.5	20025	15	QPSK	75	0	19.35	0-1	0
	1717.5	20025	15	16QAM	1	0	19.45	0-1	0
	1717.5	20025	15	16QAM	1	36	19.16	0-1	0
	1717.5	20025	15	16QAM	1	74	19.02	0-1	0
	1717.5	20025	15	16QAM	36	0	18.74	0-2	0
	1717.5	20025	15	16QAM	36	18	18.71	0-2	0
	1717.5	20025	15	16QAM	36	37	18.79	0-2	0
	1717.5	20025	15	16QAM	75	0	18.70	0-2	0
Mid	1732.5	20175	15	QPSK	1	0	19.64	0	0
	1732.5	20175	15	QPSK	1	36	19.52	0	0
	1732.5	20175	15	QPSK	1	74	19.55	0	0
	1732.5	20175	15	QPSK	36	0	19.41	0-1	0
	1732.5	20175	15	QPSK	36	18	19.37	0-1	0
	1732.5	20175	15	QPSK	36	37	19.37	0-1	0
	1732.5	20175	15	QPSK	75	0	19.31	0-1	0
	1732.5	20175	15	16QAM	1	0	19.53	0-1	0
	1732.5	20175	15	16QAM	1	36	19.23	0-1	0
	1732.5	20175	15	16QAM	1	74	19.00	0-1	0
	1732.5	20175	15	16QAM	36	0	18.96	0-2	0
	1732.5	20175	15	16QAM	36	18	18.79	0-2	0
	1732.5	20175	15	16QAM	36	37	18.79	0-2	0
	1732.5	20175	15	16QAM	75	0	18.80	0-2	0
High	1747.5	20325	15	QPSK	1	0	19.66	0	0
	1747.5	20325	15	QPSK	1	36	19.52	0	0
	1747.5	20325	15	QPSK	1	74	19.44	0	0
	1747.5	20325	15	QPSK	36	0	19.33	0-1	0
	1747.5	20325	15	QPSK	36	18	19.22	0-1	0
	1747.5	20325	15	QPSK	36	37	19.24	0-1	0
	1747.5	20325	15	QPSK	75	0	19.16	0-1	0
	1747.5	20325	15	16QAM	1	0	19.38	0-1	0
	1747.5	20325	15	16QAM	1	36	19.06	0-1	0
	1747.5	20325	15	16QAM	1	74	19.10	0-1	0
	1747.5	20325	15	16QAM	36	0	18.70	0-2	0
	1747.5	20325	15	16QAM	36	18	18.74	0-2	0
	1747.5	20325	15	16QAM	36	37	18.76	0-2	0
	1747.5	20325	15	16QAM	75	0	18.70	0-2	0

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Table 10-4
Reduced LTE Band 4 Conducted Powers Target 15 dBm – 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Mid	1732.5	20175	20	QPSK	1	0	**15.25**	0	0
	1732.5	20175	20	QPSK	1	50	15.01	0	0
	1732.5	20175	20	QPSK	1	99	14.92	0	0
	1732.5	20175	20	QPSK	50	0	15.06	0-1	0
	1732.5	20175	20	QPSK	50	25	14.94	0-1	0
	1732.5	20175	20	QPSK	50	50	14.91	0-1	0
	1732.5	20175	20	QPSK	100	0	14.84	0-1	0
	1732.5	20175	20	16QAM	1	0	15.02	0-1	0
	1732.5	20175	20	16QAM	1	50	14.95	0-1	0
	1732.5	20175	20	16QAM	1	99	14.79	0-1	0
	1732.5	20175	20	16QAM	50	0	14.66	0-2	0
	1732.5	20175	20	16QAM	50	25	14.60	0-2	0
	1732.5	20175	20	16QAM	50	50	14.62	0-2	0
	1732.5	20175	20	16QAM	100	0	14.63	0-2	0

LTE Notes:

1. Please refer to Section 8.4.4 for LTE testing requirements per FCC KDB 941225 D05.
2. The bolded powers were tested for SAR.
3. LTE Band 4 at 20 MHz Bandwidth does not support three non-overlapping channels. Per KDB 941225 D05v02, when a device supports overlapping channel assignment in a channel bandwidth configuration, the mid channel of the group of overlapping channels should be selected for testing

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Table 10-4
Reduced LTE Band 4 Conducted Powers Target 15 dBm – 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1717.5	20025	15	QPSK	1	0	15.24	0	0
	1717.5	20025	15	QPSK	1	36	15.09	0	0
	1717.5	20025	15	QPSK	1	74	14.79	0	0
	1717.5	20025	15	QPSK	36	0	14.95	0-1	0
	1717.5	20025	15	QPSK	36	18	14.92	0-1	0
	1717.5	20025	15	QPSK	36	37	14.64	0-1	0
	1717.5	20025	15	QPSK	75	0	14.93	0-1	0
	1717.5	20025	15	16QAM	1	0	15.03	0-1	0
	1717.5	20025	15	16QAM	1	36	15.04	0-1	0
	1717.5	20025	15	16QAM	1	74	15.04	0-1	0
	1717.5	20025	15	16QAM	36	0	14.83	0-2	0
	1717.5	20025	15	16QAM	36	18	14.58	0-2	0
	1717.5	20025	15	16QAM	36	37	14.69	0-2	0
	1717.5	20025	15	16QAM	75	0	14.81	0-2	0
Mid	1732.5	20175	15	QPSK	1	0	15.19	0	0
	1732.5	20175	15	QPSK	1	36	15.19	0	0
	1732.5	20175	15	QPSK	1	74	14.92	0	0
	1732.5	20175	15	QPSK	36	0	15.02	0-1	0
	1732.5	20175	15	QPSK	36	18	14.77	0-1	0
	1732.5	20175	15	QPSK	36	37	14.84	0-1	0
	1732.5	20175	15	QPSK	75	0	15.04	0-1	0
	1732.5	20175	15	16QAM	1	0	15.19	0-1	0
	1732.5	20175	15	16QAM	1	36	15.02	0-1	0
	1732.5	20175	15	16QAM	1	74	14.98	0-1	0
	1732.5	20175	15	16QAM	36	0	14.76	0-2	0
	1732.5	20175	15	16QAM	36	18	14.66	0-2	0
	1732.5	20175	15	16QAM	36	37	14.63	0-2	0
	1732.5	20175	15	16QAM	75	0	14.64	0-2	0
High	1747.5	20325	15	QPSK	1	0	15.10	0	0
	1747.5	20325	15	QPSK	1	36	15.07	0	0
	1747.5	20325	15	QPSK	1	74	14.77	0	0
	1747.5	20325	15	QPSK	36	0	15.16	0-1	0
	1747.5	20325	15	QPSK	36	18	14.95	0-1	0
	1747.5	20325	15	QPSK	36	37	14.73	0-1	0
	1747.5	20325	15	QPSK	75	0	15.19	0-1	0
	1747.5	20325	15	16QAM	1	0	15.24	0-1	0
	1747.5	20325	15	16QAM	1	36	15.12	0-1	0
	1747.5	20325	15	16QAM	1	74	15.02	0-1	0
	1747.5	20325	15	16QAM	36	0	14.81	0-2	0
	1747.5	20325	15	16QAM	36	18	14.52	0-2	0
	1747.5	20325	15	16QAM	36	37	14.62	0-2	0
	1747.5	20325	15	16QAM	75	0	14.51	0-2	0

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10.3.2 Reduced LTE Band 2 Conducted Powers

Table 10-5
Reduced LTE Band 2 Conducted Powers Target 19 dBm – 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1860	18700	20	QPSK	1	0	19.54	0	0
	1860	18700	20	QPSK	1	50	19.55	0	0
	1860	18700	20	QPSK	1	99	19.61	0	0
	1860	18700	20	QPSK	50	0	19.57	0-1	0
	1860	18700	20	QPSK	50	25	19.14	0-1	0
	1860	18700	20	QPSK	50	50	19.23	0-1	0
	1860	18700	20	QPSK	100	0	19.20	0-1	0
	1860	18700	20	16QAM	1	0	19.29	0-1	0
	1860	18700	20	16QAM	1	50	19.46	0-1	0
	1860	18700	20	16QAM	1	99	18.71	0-1	0
	1860	18700	20	16QAM	50	0	18.76	0-2	0
	1860	18700	20	16QAM	50	25	18.75	0-2	0
	1860	18700	20	16QAM	50	50	18.95	0-2	0
	1860	18700	20	16QAM	100	0	18.87	0-2	0
Mid	1880.0	18900	20	QPSK	1	0	19.40	0	0
	1880.0	18900	20	QPSK	1	50	19.42	0	0
	1880.0	18900	20	QPSK	1	99	19.69	0	0
	1880.0	18900	20	QPSK	50	0	19.43	0-1	0
	1880.0	18900	20	QPSK	50	25	19.33	0-1	0
	1880.0	18900	20	QPSK	50	50	19.36	0-1	0
	1880.0	18900	20	QPSK	100	0	19.37	0-1	0
	1880.0	18900	20	16QAM	1	0	19.38	0-1	0
	1880.0	18900	20	16QAM	1	50	19.39	0-1	0
	1880.0	18900	20	16QAM	1	99	18.70	0-1	0
	1880.0	18900	20	16QAM	50	0	18.73	0-2	0
	1880.0	18900	20	16QAM	50	25	18.79	0-2	0
	1880.0	18900	20	16QAM	50	50	18.80	0-2	0
	1880.0	18900	20	16QAM	100	0	18.77	0-2	0
High	1900	19100	20	QPSK	1	0	**19.70**	0	0
	1900	19100	20	QPSK	1	50	19.69	0	0
	1900	19100	20	QPSK	1	99	19.07	0	0
	1900	19100	20	QPSK	50	0	19.68	0-1	0
	1900	19100	20	QPSK	50	25	19.64	0-1	0
	1900	19100	20	QPSK	50	50	19.46	0-1	0
	1900	19100	20	QPSK	100	0	19.60	0-1	0
	1900	19100	20	16QAM	1	0	18.70	0-1	0
	1900	19100	20	16QAM	1	50	18.72	0-1	0
	1900	19100	20	16QAM	1	99	19.15	0-1	0
	1900	19100	20	16QAM	50	0	18.91	0-2	0
	1900	19100	20	16QAM	50	25	18.89	0-2	0
	1900	19100	20	16QAM	50	50	18.77	0-2	0
	1900	19100	20	16QAM	100	0	18.96	0-2	0

LTE Notes:
1. Please refer to Section 8.4.4 for LTE testing requirements per FCC KDB 941225 D05.
2. The bolded powers were tested for SAR.

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Table 10-6
Reduced LTE Band 2 Conducted Powers Target 19 dBm – 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1857.5	18675	15	QPSK	1	0	19.68	0	0
	1857.5	18675	15	QPSK	1	36	19.57	0	0
	1857.5	18675	15	QPSK	1	74	19.63	0	0
	1857.5	18675	15	QPSK	36	0	19.46	0-1	0
	1857.5	18675	15	QPSK	36	18	18.96	0-1	0
	1857.5	18675	15	QPSK	36	37	19.33	0-1	0
	1857.5	18675	15	QPSK	75	0	19.01	0-1	0
	1857.5	18675	15	16QAM	1	0	19.35	0-1	0
	1857.5	18675	15	16QAM	1	36	19.34	0-1	0
	1857.5	18675	15	16QAM	1	74	18.72	0-1	0
	1857.5	18675	15	16QAM	36	0	18.70	0-2	0
	1857.5	18675	15	16QAM	36	18	18.75	0-2	0
	1857.5	18675	15	16QAM	36	37	19.09	0-2	0
	1857.5	18675	15	16QAM	75	0	18.78	0-2	0
Mid	1880.0	18900	15	QPSK	1	0	19.24	0	0
	1880.0	18900	15	QPSK	1	36	19.58	0	0
	1880.0	18900	15	QPSK	1	74	19.50	0	0
	1880.0	18900	15	QPSK	36	0	19.57	0-1	0
	1880.0	18900	15	QPSK	36	18	19.18	0-1	0
	1880.0	18900	15	QPSK	36	37	19.32	0-1	0
	1880.0	18900	15	QPSK	75	0	19.35	0-1	0
	1880.0	18900	15	16QAM	1	0	19.19	0-1	0
	1880.0	18900	15	16QAM	1	36	19.27	0-1	0
	1880.0	18900	15	16QAM	1	74	18.74	0-1	0
	1880.0	18900	15	16QAM	36	0	18.71	0-2	0
	1880.0	18900	15	16QAM	36	18	18.74	0-2	0
	1880.0	18900	15	16QAM	36	37	18.70	0-2	0
	1880.0	18900	15	16QAM	75	0	18.79	0-2	0
High	1902.5	19125	15	QPSK	1	0	19.60	0	0
	1902.5	19125	15	QPSK	1	36	19.66	0	0
	1902.5	19125	15	QPSK	1	74	19.13	0	0
	1902.5	19125	15	QPSK	36	0	19.51	0-1	0
	1902.5	19125	15	QPSK	36	18	19.59	0-1	0
	1902.5	19125	15	QPSK	36	37	19.58	0-1	0
	1902.5	19125	15	QPSK	75	0	19.61	0-1	0
	1902.5	19125	15	16QAM	1	0	18.84	0-1	0
	1902.5	19125	15	16QAM	1	36	18.81	0-1	0
	1902.5	19125	15	16QAM	1	74	19.00	0-1	0
	1902.5	19125	15	16QAM	36	0	19.06	0-2	0
	1902.5	19125	15	16QAM	36	18	18.78	0-2	0
	1902.5	19125	15	16QAM	36	37	18.91	0-2	0
	1902.5	19125	15	16QAM	75	0	18.76	0-2	0

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Table 10-7
Reduced LTE Band 2 Conducted Powers Target 15 dBm – 20 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1860	18700	20	QPSK	1	0	15.29	0	0
	1860	18700	20	QPSK	1	50	14.78	0	0
	1860	18700	20	QPSK	1	99	15.14	0	0
	1860	18700	20	QPSK	50	0	14.96	0-1	0
	1860	18700	20	QPSK	50	25	15.09	0-1	0
	1860	18700	20	QPSK	50	50	15.00	0-1	0
	1860	18700	20	QPSK	100	0	15.01	0-1	0
	1860	18700	20	16QAM	1	0	15.12	0-1	0
	1860	18700	20	16QAM	1	50	15.38	0-1	0
	1860	18700	20	16QAM	1	99	15.23	0-1	0
	1860	18700	20	16QAM	50	0	15.10	0-2	0
	1860	18700	20	16QAM	50	25	15.22	0-2	0
	1860	18700	20	16QAM	50	50	15.01	0-2	0
	1860	18700	20	16QAM	100	0	15.10	0-2	0
Mid	1880.0	18900	20	QPSK	1	0	15.29	0	0
	1880.0	18900	20	QPSK	1	50	14.97	0	0
	1880.0	18900	20	QPSK	1	99	15.19	0	0
	1880.0	18900	20	QPSK	50	0	15.08	0-1	0
	1880.0	18900	20	QPSK	50	25	15.18	0-1	0
	1880.0	18900	20	QPSK	50	50	15.17	0-1	0
	1880.0	18900	20	QPSK	100	0	15.11	0-1	0
	1880.0	18900	20	16QAM	1	0	15.11	0-1	0
	1880.0	18900	20	16QAM	1	50	15.31	0-1	0
	1880.0	18900	20	16QAM	1	99	15.24	0-1	0
	1880.0	18900	20	16QAM	50	0	15.07	0-2	0
	1880.0	18900	20	16QAM	50	25	15.16	0-2	0
	1880.0	18900	20	16QAM	50	50	15.20	0-2	0
	1880.0	18900	20	16QAM	100	0	15.11	0-2	0
High	1900	19100	20	QPSK	1	0	**15.30**	0	0
	1900	19100	20	QPSK	1	50	15.01	0	0
	1900	19100	20	QPSK	1	99	15.22	0	0
	1900	19100	20	QPSK	50	0	14.93	0-1	0
	1900	19100	20	QPSK	50	25	15.06	0-1	0
	1900	19100	20	QPSK	50	50	15.08	0-1	0
	1900	19100	20	QPSK	100	0	15.11	0-1	0
	1900	19100	20	16QAM	1	0	15.03	0-1	0
	1900	19100	20	16QAM	1	50	15.11	0-1	0
	1900	19100	20	16QAM	1	99	15.23	0-1	0
	1900	19100	20	16QAM	50	0	14.96	0-2	0
	1900	19100	20	16QAM	50	25	15.14	0-2	0
	1900	19100	20	16QAM	50	50	15.20	0-2	0
	1900	19100	20	16QAM	100	0	14.91	0-2	0

LTE Notes:
1. Please refer to Section 8.4.4 for LTE testing requirements per FCC KDB 941225 D05.
2. The bolded powers were tested for SAR.

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Table 10-8
Reduced LTE Band 2 Conducted Powers Target 15 dBm – 15 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1857.5	18675	15	QPSK	1	0	15.20	0	0
	1857.5	18675	15	QPSK	1	36	14.69	0	0
	1857.5	18675	15	QPSK	1	74	15.05	0	0
	1857.5	18675	15	QPSK	36	0	14.85	0-1	0
	1857.5	18675	15	QPSK	36	18	15.15	0-1	0
	1857.5	18675	15	QPSK	36	37	14.84	0-1	0
	1857.5	18675	15	QPSK	75	0	14.82	0-1	0
	1857.5	18675	15	16QAM	1	0	15.13	0-1	0
	1857.5	18675	15	16QAM	1	36	15.18	0-1	0
	1857.5	18675	15	16QAM	1	74	15.15	0-1	0
	1857.5	18675	15	16QAM	36	0	15.08	0-2	0
	1857.5	18675	15	16QAM	36	18	15.32	0-2	0
	1857.5	18675	15	16QAM	36	37	14.92	0-2	0
	1857.5	18675	15	16QAM	75	0	15.03	0-2	0
Mid	1880.0	18900	15	QPSK	1	0	15.21	0	0
	1880.0	18900	15	QPSK	1	36	14.89	0	0
	1880.0	18900	15	QPSK	1	74	15.29	0	0
	1880.0	18900	15	QPSK	36	0	14.88	0-1	0
	1880.0	18900	15	QPSK	36	18	15.20	0-1	0
	1880.0	18900	15	QPSK	36	37	14.97	0-1	0
	1880.0	18900	15	QPSK	75	0	15.19	0-1	0
	1880.0	18900	15	16QAM	1	0	14.96	0-1	0
	1880.0	18900	15	16QAM	1	36	15.20	0-1	0
	1880.0	18900	15	16QAM	1	74	15.05	0-1	0
	1880.0	18900	15	16QAM	36	0	15.01	0-2	0
	1880.0	18900	15	16QAM	36	18	15.14	0-2	0
	1880.0	18900	15	16QAM	36	37	15.29	0-2	0
	1880.0	18900	15	16QAM	75	0	14.91	0-2	0
High	1902.5	19125	15	QPSK	1	0	15.16	0	0
	1902.5	19125	15	QPSK	1	36	14.95	0	0
	1902.5	19125	15	QPSK	1	74	15.05	0	0
	1902.5	19125	15	QPSK	36	0	14.78	0-1	0
	1902.5	19125	15	QPSK	36	18	14.96	0-1	0
	1902.5	19125	15	QPSK	36	37	15.08	0-1	0
	1902.5	19125	15	QPSK	75	0	15.15	0-1	0
	1902.5	19125	15	16QAM	1	0	15.01	0-1	0
	1902.5	19125	15	16QAM	1	36	15.02	0-1	0
	1902.5	19125	15	16QAM	1	74	15.16	0-1	0
	1902.5	19125	15	16QAM	36	0	14.95	0-2	0
	1902.5	19125	15	16QAM	36	18	15.02	0-2	0
	1902.5	19125	15	16QAM	36	37	15.27	0-2	0
	1902.5	19125	15	16QAM	75	0	14.77	0-2	0

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11 SYSTEM VERIFICATION

11.1 Tissue Verification

Table 11-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C˚)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ε	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ε	% dev σ	% dev ε
12/22/2014	**1750H**	22.4	1710	1.365	38.974	1.348	40.142	*1.26%*	*-2.91%*
			1750	1.406	38.702	1.371	40.079	*2.55%*	*-3.44%*
			1790	1.447	38.552	1.394	40.016	*3.80%*	*-3.66%*
12/22/2014	**1900H**	22.0	1850	1.404	39.113	1.400	40.000	*0.29%*	*-2.22%*
			1880	1.434	38.996	1.400	40.000	*2.43%*	*-2.51%*
			1910	1.464	38.840	1.400	40.000	*4.57%*	*-2.90%*
12/22/2014	**1750B**	21.6	1710	1.497	52.186	1.463	53.537	*2.32%*	*-2.52%*
			1750	1.543	52.013	1.488	53.432	*3.70%*	*-2.66%*
			1790	1.587	51.837	1.514	53.326	*4.82%*	*-2.79%*
12/22/2014	**1900B**	21.5	1850	1.513	52.099	1.520	53.300	*-0.46%*	*-2.25%*
			1880	1.546	51.994	1.520	53.300	*1.71%*	*-2.45%*
			1910	1.581	51.853	1.520	53.300	*4.01%*	*-2.71%*

The above measured tissue parameters were used in the DASY software. The DASY software was used to perform interpolation to determine the dielectric parameters at the SAR test device frequencies (per KDB Publication 865664 and IEEE 1528-2013 6.6.1.2). The tissue parameters listed in the SAR test plots may slightly differ from the table above due to significant digit rounding in the software.

11.2 Test System Verification

Prior to SAR assessment, the system is verified to ±10% of the SAR measurement on the reference dipole at the time of calibration by the calibration facility. Full system validation status and result summary can be found in Appendix E.

Table 11-2
System Verification Results

System Verification TARGET & MEASURED												
SAR System #	**Tissue Frequency (MHz)**	**Tissue Type**	**Date:**	**Amb. Temp (°C)**	**Liquid Temp (°C)**	**Input Power (W)**	**Dipole SN**	**Probe SN**	**Measured SAR_{1g} (W/kg)**	**1 W Target SAR_{1g} (W/kg)**	**1 W Normalized SAR_{1g} (W/kg)**	**$Deviation_{1g}$ (%)**
G	1750	HEAD	12/22/2014	23.3	22.0	0.100	1008	3258	3.400	36.900	34.000	-7.86%
D	1900	HEAD	12/22/2014	22.9	22.0	0.100	5d141	3263	4.020	40.100	40.200	0.25%
G	1750	BODY	12/22/2014	23.1	21.8	0.100	1008	3258	3.690	37.600	36.900	-1.86%
D	1900	BODY	12/22/2014	23.1	22.3	0.100	5d149	3263	4.210	40.400	42.100	4.21%

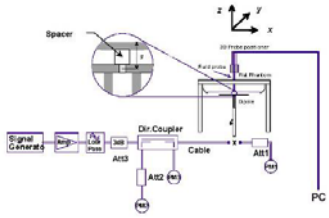

Figure 11-1
System Verification Setup Diagram

Figure 11-2
System Verification Setup Photo

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12 SAR DATA SUMMARY

12.1 Standalone SAR Data

Table 12-1
LTE Head SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	23.20	0.04	0	Left	Cheek	QPSK	1	50	LTE Band 4 - SAR	1:1	0.682	1.000	0.682	A1
1732.50	20175	Mid	LTE Band 4 (AWS)	20	19.7	19.68	0.12	0	Left	Cheek	QPSK	1	0	LTE Band 4 - SAR	1:1	0.251	1.005	0.252	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	15.7	15.25	0.06	0	Left	Cheek	QPSK	1	0	LTE Band 4 - SAR	1:1	0.120	1.109	0.133	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.70	0.03	0	Left	Cheek	QPSK	1	99	LTE Band 2 - SAR	1:1	0.641	1.000	0.641	A2
1900.00	19100	High	LTE Band 2 (PCS)	20	19.7	19.70	0.05	0	Left	Cheek	QPSK	1	0	LTE Band 2 - SAR	1:1	0.266	1.000	0.266	
1900.00	19100	High	LTE Band 2 (PCS)	20	15.7	15.30	-0.07	0	Left	Cheek	QPSK	1	0	LTE Band 2 - SAR	1:1	0.157	1.096	0.172	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Head 1.6 W/kg (mW/g) averaged over 1 gram										

Table 12-2
LTE Body SAR

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
MHz	Ch.															(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	23.20	-0.07	0	LTE Band 4 - SAR	QPSK	1	50	10mm	back	1:1	0.613	1.000	0.613	A3
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.2	23.20	-0.04	0	LTE Band 4 - SAR	QPSK	1	50	10 mm	front	1:1	0.553	1.000	0.553	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.70	-0.03	0	LTE Band 2 - SAR	QPSK	1	99	10mm	back	1:1	0.629	1.000	0.629	A4
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.7	23.70	-0.03	0	LTE Band 2 - SAR	QPSK	1	99	10mm	front	1:1	0.577	1.000	0.577	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

12.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Per FCC Guidance, only specific head and body tests were required to determine compliance.
7. LTE Considerations: LTE test configurations are determined according to SAR Evaluation Considerations for LTE Devices in FCC KDB Publication 941225 D05v02r01. The general test procedures used for testing can be found in Section 8.4.4.
8. MPR is permanently implemented for this device by the manufacturer. The specific manufacturer target MPR is indicated alongside the SAR results. MPR is enabled for this device, according to 3GPP TS36.101 Section 6.2.3 – 6.2.5 under Table 6.2.3-1.
9. A-MPR was disabled for all SAR tests by setting NS=01 on the base station simulator. SAR tests were performed with the same number of RB and RB offsets transmitting on all TTI frames (maximum TTI).

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13 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/30/2014	Annual	10/30/2015	1833460
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/15/2014	Annual	4/15/2015	MY45470194
Agilent	8648D	(9kHz-4GHz) Signal Generator	4/15/2014	Annual	4/15/2015	3629U00687
SPEAG	D1765V2	1765 MHz SAR Dipole	5/7/2014	Annual	5/7/2015	1008
SPEAG	D1900V2	1900 MHz SAR Dipole	4/9/2014	Annual	4/9/2015	5d141
SPEAG	D1900V2	1900 MHz SAR Dipole	7/23/2014	Annual	7/23/2015	5d149
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	CBT	N/A
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/26/2014	Annual	2/26/2015	665
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/14/2014	Annual	5/14/2015	859
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/6/2014	Annual	5/6/2015	1070
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764558
Agilent	E4438C	ESG Vector Signal Generator	3/31/2014	Annual	3/31/2015	MY42082659
Control Company	61220-416	Long-Stem Thermometer	4/29/2014	Biennial	4/29/2016	111331323
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Agilent	N9020A	MXA Signal Analyzer	10/27/2014	Annual	10/27/2015	US46470561
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420800
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Anritsu	ML2469A	Power Meter	3/14/2014	Annual	3/14/2015	1306009
Anritsu	MA2411B	Pulse Power Sensor	3/25/2014	Annual	3/25/2015	1207470
Anritsu	MT8820C	Radio Communication Analyzer	5/6/2014	Annual	5/6/2015	6201144419
Rohde & Schwarz	CMW500	Radio Communication Tester	4/17/2014	Annual	4/17/2015	101699
Rohde & Schwarz	CMW500	Radio Communication Tester	4/17/2014	Annual	4/17/2015	102060
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/16/2014	Annual	4/16/2015	B010177
SPEAG	ES3DV3	SAR Probe	2/25/2014	Annual	2/25/2015	3258
SPEAG	ES3DV3	SAR Probe	5/15/2014	Annual	5/15/2015	3263
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
COMTech	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M1S5A00-009
Agilent	8753ES	S-Parameter Network Analyzer	5/22/2014	Annual	5/22/2015	US39170118
Fisher Scientific	S97611	Thermometer	4/12/2013	Biennial	4/12/2015	130219303
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
Gigatronics	8651A	Universal Power Meter	10/30/2014	Annual	10/30/2015	8650319
Anritsu	MA24106A	USB Power Sensor	5/14/2014	Annual	5/14/2015	1231538
Anritsu	MA24106A	USB Power Sensor	5/14/2014	Annual	5/14/2015	1231535
VWR	36934-158	Wall-Mounted Thermometer	8/8/2013	Biennial	8/8/2015	130477877

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, amplifier, attenuator, coupler or filter were connected to a calibrated source (i.e. a signal generator) to determine the losses of the measurement path. The power meter offset was then adjusted to compensate for the measurement system losses. This level offset is stored within the power meter before measurements are made. This calibration verification procedure applies to the system verification and output power measurements. The calibrated reading is then taken directly from the power meter after compensation of the losses for all final power measurements.

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14 MEASUREMENT UNCERTAINTIES

a	b	c	d	e= f(d,k)	f	g	h = c x f/e	i = c x g/e	k
Uncertainty Component	**IEEE 1528 Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i 1gm**	**c_i 10 gms**	**1gm u_i (± %)**	**10gms u_i (± %)**	**v_i**
Measurement System									
Probe Calibration	E.2.1	6.0	N	1	1.0	1.0	6.0	6.0	∞
Axial Isotropy	E.2.2	0.25	N	1	0.7	0.7	0.2	0.2	∞
Hemishperical Isotropy	E.2.2	1.3	N	1	1.0	1.0	1.3	1.3	∞
Boundary Effect	E.2.3	0.4	N	1	1.0	1.0	0.4	0.4	∞
Linearity	E.2.4	0.3	N	1	1.0	1.0	0.3	0.3	∞
System Detection Limits	E.2.5	5.1	N	1	1.0	1.0	5.1	5.1	∞
Readout Electronics	E.2.6	1.0	N	1	1.0	1.0	1.0	1.0	∞
Response Time	E.2.7	0.8	R	1.73	1.0	1.0	0.5	0.5	∞
Integration Time	E.2.8	2.6	R	1.73	1.0	1.0	1.5	1.5	∞
RF Ambient Conditions	E.6.1	3.0	R	1.73	1.0	1.0	1.7	1.7	∞
Probe Positioner Mechanical Tolerance	E.6.2	0.4	R	1.73	1.0	1.0	0.2	0.2	∞
Probe Positioning w/ respect to Phantom	E.6.3	2.9	R	1.73	1.0	1.0	1.7	1.7	∞
Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation	E.5	1.0	R	1.73	1.0	1.0	0.6	0.6	∞
Test Sample Related									
Test Sample Positioning	E.4.2	6.0	N	1	1.0	1.0	6.0	6.0	287
Device Holder Uncertainty	E.4.1	3.32	R	1.73	1.0	1.0	1.9	1.9	∞
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	1.73	1.0	1.0	2.9	2.9	∞
Phantom & Tissue Parameters									
Phantom Uncertainty (Shape & Thickness tolerances)	E.3.1	4.0	R	1.73	1.0	1.0	2.3	2.3	∞
Liquid Conductivity - deviation from target values	E.3.2	5.0	R	1.73	0.64	0.43	1.8	1.2	∞
Liquid Conductivity - measurement uncertainty	E.3.3	3.8	N	1	0.64	0.43	2.4	1.6	6
Liquid Permittivity - deviation from target values	E.3.2	5.0	R	1.73	0.60	0.49	1.7	1.4	∞
Liquid Permittivity - measurement uncertainty	E.3.3	4.5	N	1	0.60	0.49	2.7	2.2	6
Combined Standard Uncertainty (k=1)			RSS				12.1	11.7	299
Expanded Uncertainty (95% CONFIDENCE LEVEL)			k=2				24.2	23.5	

The above measurement uncertainties are according to IEEE Std. 1528-2003

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15 CONCLUSION

15.1 Measurement Conclusion

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

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend 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 various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

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APPENDIX A: SAR TEST DATA

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PCTEST ENGINEERING LABORATORY, INC.

DUT: V65C6721A1; Type: Portable Handset; Serial: LTE Band 4 - SAR

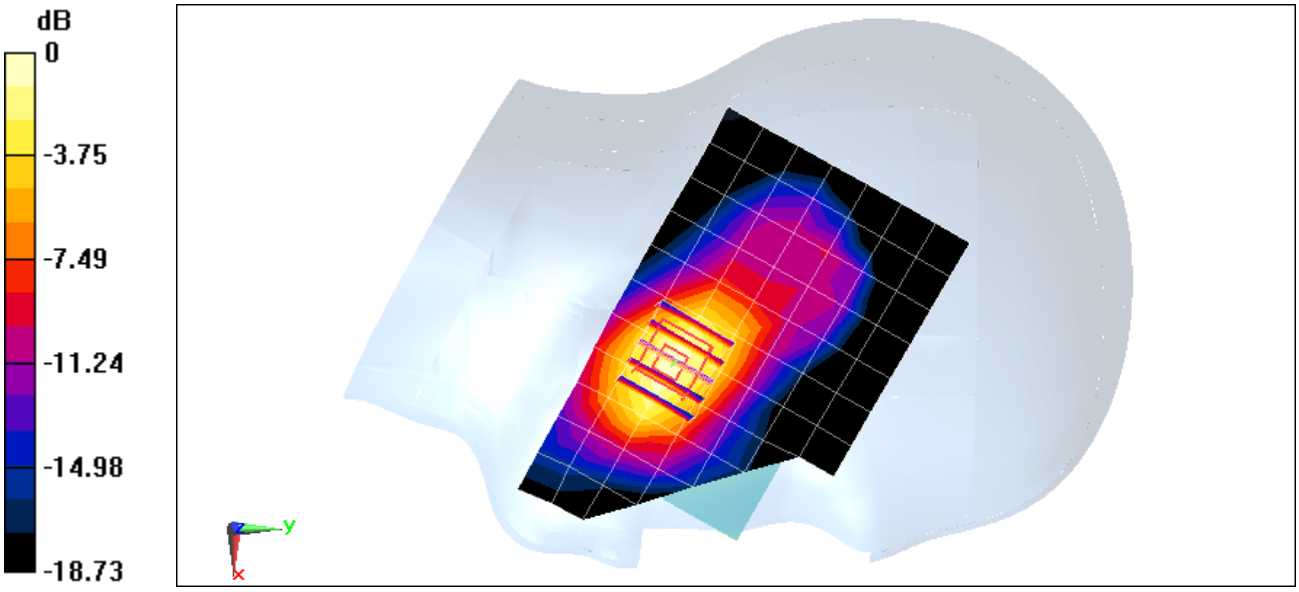
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Head, Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.388 S/m; ε_r = 38.821; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 12-22-2014; Ambient Temp: 23.3°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3258; ConvF(5.19, 5.19, 5.19); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 4 (AWS), Left Head, Cheek, Mid.ch, QPSK,
20 MHz Bandwidth, 1 RB, 50 RB Offset

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.01 V/m; Power Drift = 0.04 dB
Peak SAR (extrapolated) = 1.07 W/kg
SAR(1 g) = 0.682 W/kg



0 dB = 0.809 W/kg = -0.92 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: V65C6721A1; Type: Portable Handset; Serial: LTE Band 2 - SAR

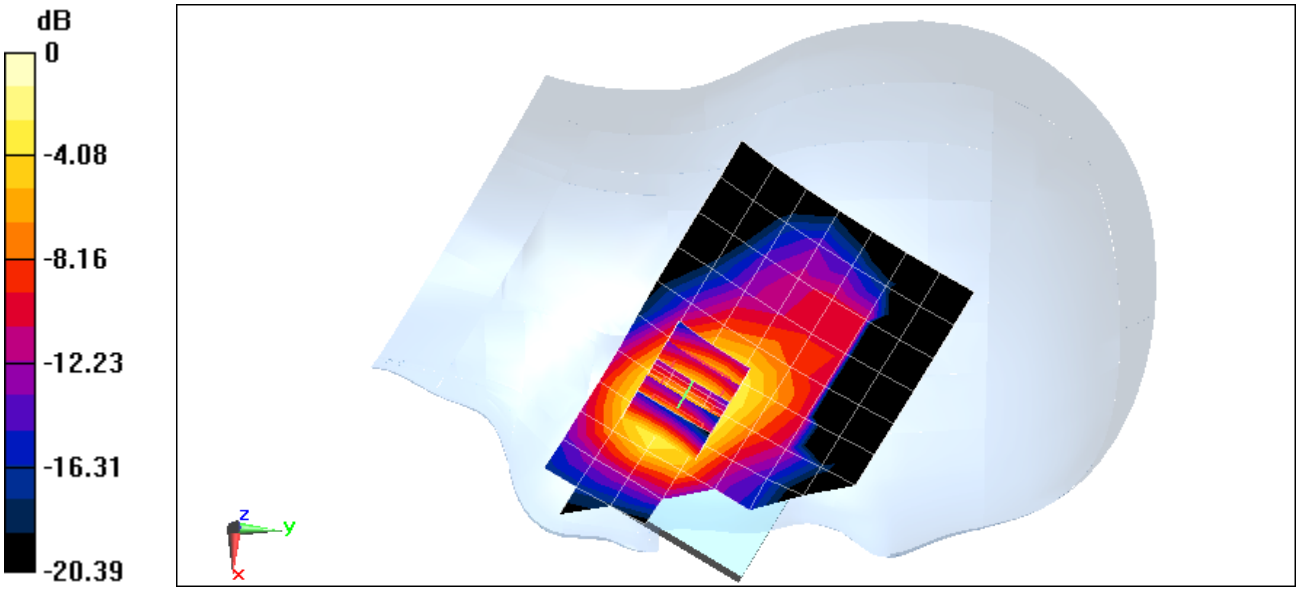
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used:
f = 1880 MHz; σ = 1.434 S/m; ε_r = 38.996; ρ = 1000 kg/m^3
Phantom section: Left Section

Test Date: 12-22-2014; Ambient Temp: 22.9°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3263; ConvF(5.08, 5.08, 5.08); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 2 (PCS), Left Head, Cheek, Mid.ch, QPSK,
20 MHz Bandwidth, 1 RB, 99 RB Offset

Area Scan (8x12x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 23.97 V/m; Power Drift = 0.03 dB
Peak SAR (extrapolated) = 1.01 W/kg
SAR(1 g) = 0.641 W/kg



0 dB = 0.774 W/kg = -1.11 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: V65C6721A1; Type: Portable Handset; Serial: LTE Band 4 - SAR

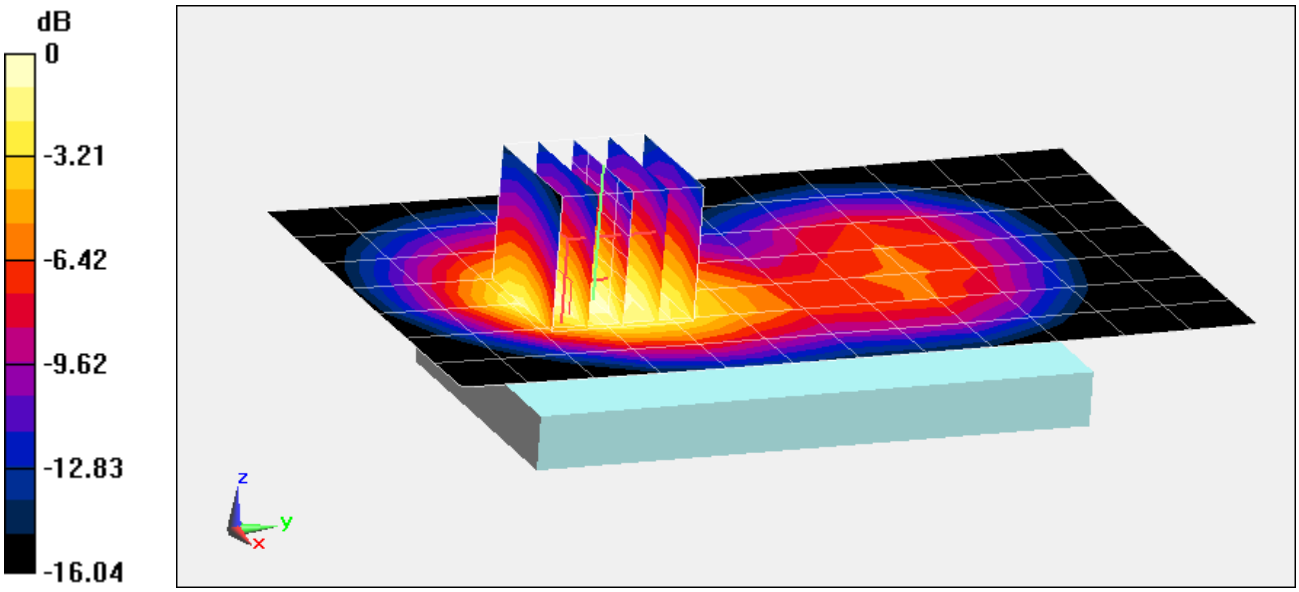
Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1
Medium: 1750 Body, Medium parameters used (interpolated):
f = 1732.5 MHz; σ = 1.523 S/m; ε_r = 52.089; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-22-2014; Ambient Temp: 23.1°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3258; ConvF(4.83, 4.83, 4.83); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 4 (AWS), Body SAR, Back side, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 50 RB Offset

Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.36 V/m; Power Drift = -0.07 dB
Peak SAR (extrapolated) = 0.968 W/kg
SAR(1 g) = 0.613 W/kg



0 dB = 0.712 W/kg = -1.48 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: V65C6721A1; Type: Portable Handset; Serial: LTE Band 2 - SAR

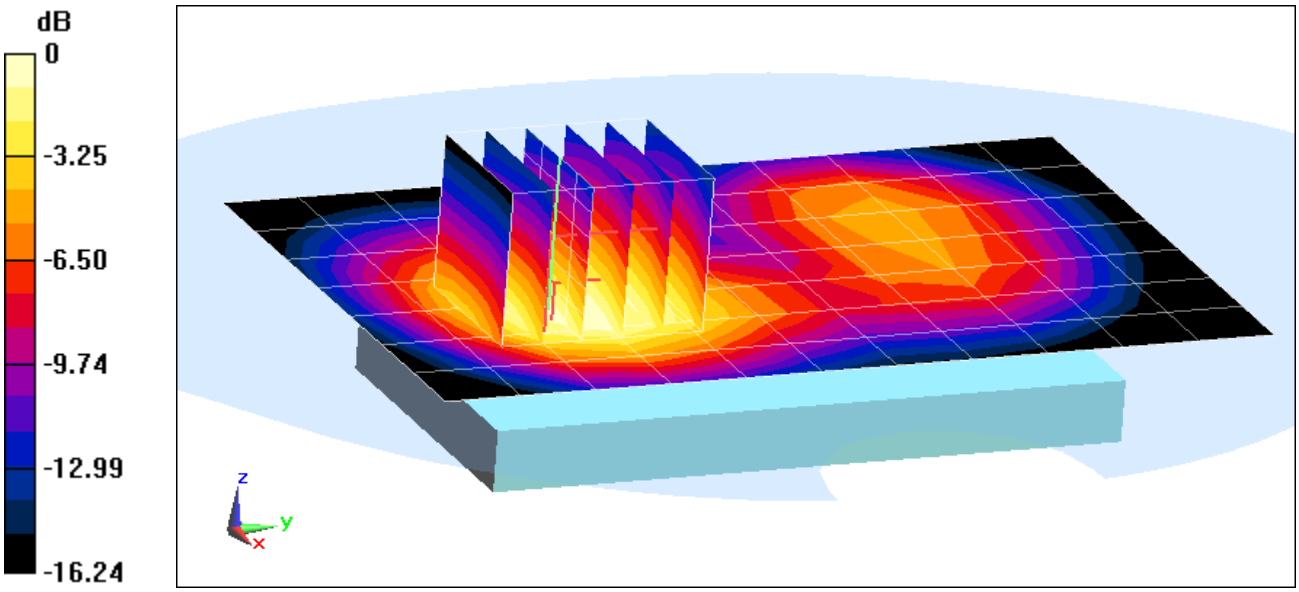
Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1880 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used:
f = 1880 MHz; σ = 1.546 S/m; ε_r = 51.994; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-22-2014; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3263; ConvF(4.78, 4.78, 4.78); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

Mode: LTE Band 2 (PCS), Body SAR, Back side, Mid.ch,
20 MHz Bandwidth, QPSK, 1 RB, 99 RB Offset

Area Scan (8x12x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x6x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Reference Value = 21.04 V/m; Power Drift = -0.03 dB
Peak SAR (extrapolated) = 1.02 W/kg
SAR(1 g) = 0.629 W/kg



0 dB = 0.737 W/kg = -1.33 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

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DUT: Dipole 1750 MHz; Type: D1765V2; Serial: 1008

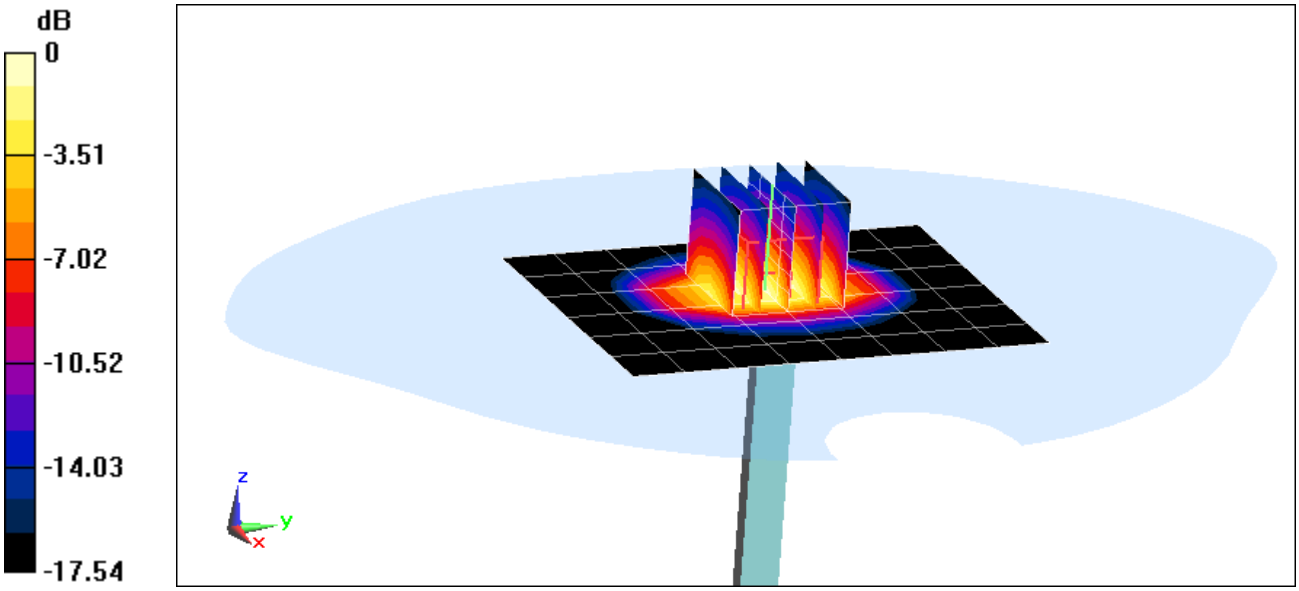
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Head, Medium parameters used:
f = 1750 MHz; σ = 1.406 S/m; ε_r = 38.702; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-22-2014; Ambient Temp: 23.3°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3258; ConvF(5.19, 5.19, 5.19); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: SAM Front; Type: SAM; Serial: 1686
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 6.33 W/kg
SAR(1 g) = 3.4 W/kg
Deviation = -7.86%



0 dB = 4.36 W/kg = 6.39 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d141

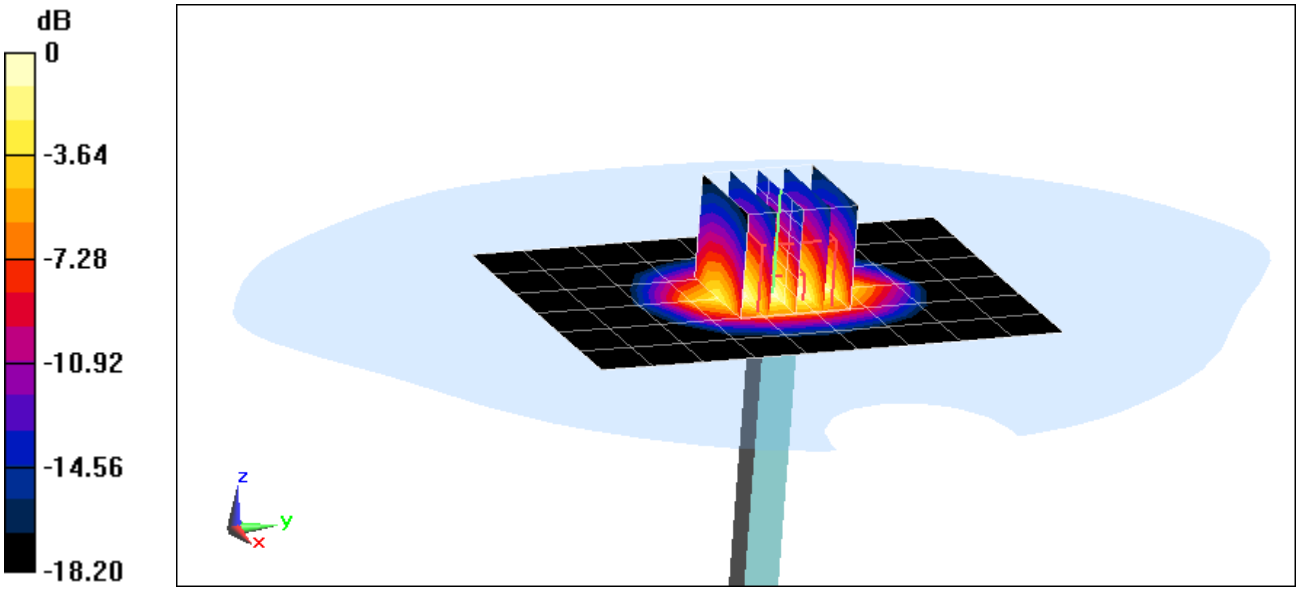
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Head, Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.454 S/m; ε_r = 38.892; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-22-2014; Ambient Temp: 22.9°C; Tissue Temp: 22.0°C

Probe: ES3DV3 - SN3263; ConvF(5.08, 5.08, 5.08); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 Left; Type: QD000P40CD; Serial: TP: 1687
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 7.47 W/kg
SAR(1 g) = 4.02 W/kg
Deviation = 0.25%



0 dB = 5.12 W/kg = 7.09 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1750 MHz; Type: D1765V2; Serial: 1008

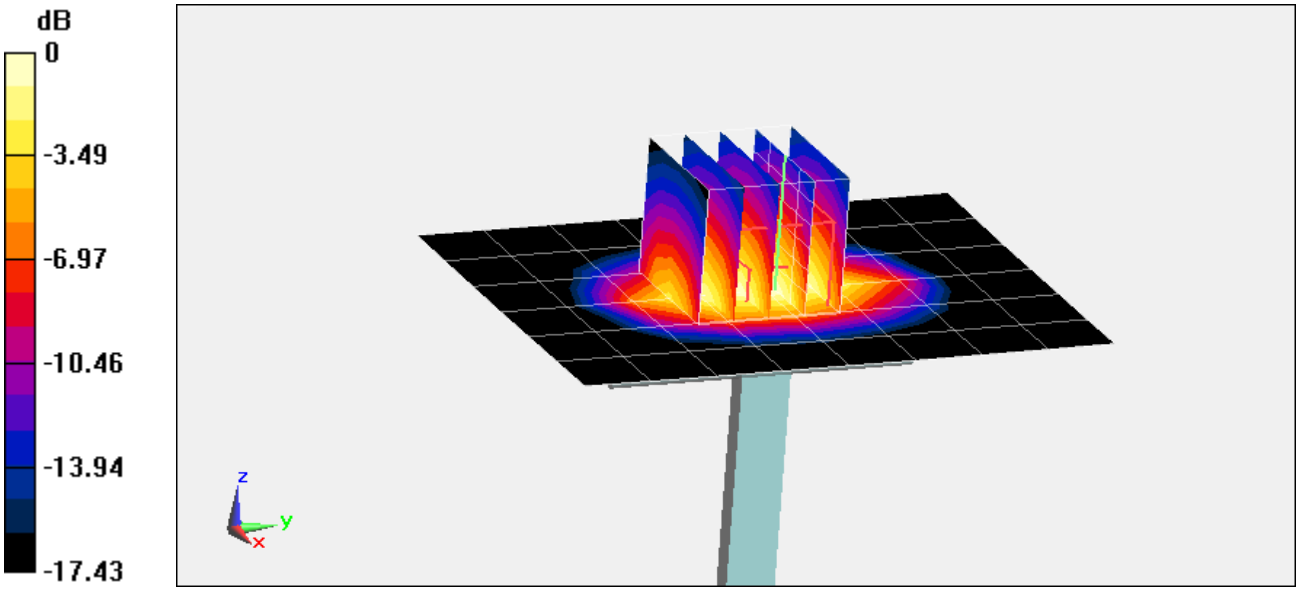
Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1
Medium: 1750 Body, Medium parameters used:
f = 1750 MHz; σ = 1.543 S/m; ε_r = 52.013; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-22-2014; Ambient Temp: 23.1°C; Tissue Temp: 21.8°C

Probe: ES3DV3 - SN3258; ConvF(4.83, 4.83, 4.83); Calibrated: 2/25/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn665; Calibrated: 2/26/2014
Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 6.30 W/kg
SAR(1 g) = 3.69 W/kg
Deviation = -1.86%



0 dB = 4.56 W/kg = 6.59 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: 5d149

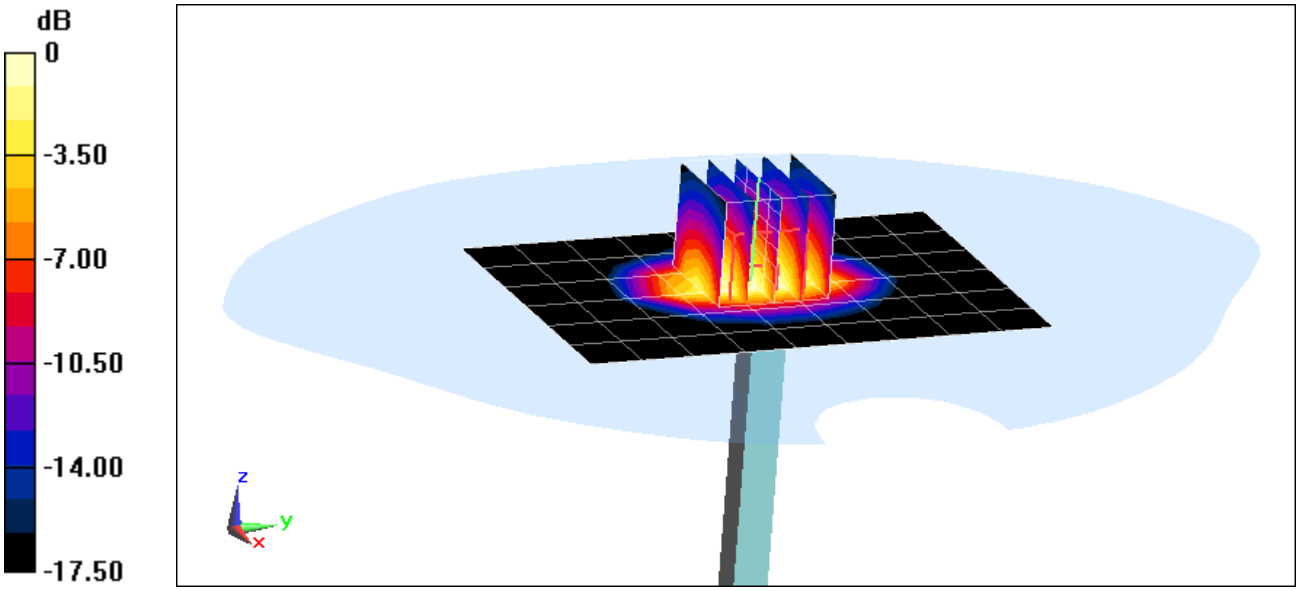
Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1
Medium: 1900 Body, Medium parameters used (interpolated):
f = 1900 MHz; σ = 1.569 S/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section; Space: 1.0 cm

Test Date: 12-22-2014; Ambient Temp: 23.1°C; Tissue Temp: 22.3°C

Probe: ES3DV3 - SN3263; ConvF(4.78, 4.78, 4.78); Calibrated: 5/15/2014;
Sensor-Surface: 3mm (Mechanical Surface Detection)
Electronics: DAE4 Sn859; Calibrated: 5/14/2014
Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646
Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm
Input Power = 20.0 dBm (100 mW)
Peak SAR (extrapolated) = 7.58 W/kg
SAR(1 g) = 4.21 W/kg
Deviation = 4.21%



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

APPENDIX C: PROBE CALIBRATION

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

S Schweizerischer Kalibrierdienst
C Service suisse d'étalonnage
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 108

Client **PC Test**

Certificate No: ES3-3258_Feb14

CALIBRATION CERTIFICATE

Object	ES3DV3 - SN:3258
Calibration procedure(s)	QA CAL-01.v9, QA CAL-23.v5, QA CAL-25.v6 Calibration procedure for dosimetric E-field probes
Calibration date:	February 25, 2014

CCV 3/6/14

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Israe El-Naouq	Laboratory Technician	Israe El-Naouq
Approved by:	Katja Pokovic	Technical Manager	

Issued: February 27, 2014

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

PCT# 80615

Glossary:

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

Calibration is Performed According to the Following Standards:

a) IEEE Std 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", June 2013
b) IEC 62209-1, "Procedure to measure the Specific Absorption Rate (SAR) for hand-held devices used in close proximity to the ear (frequency range of 300 MHz to 3 GHz)", February 2005

Methods Applied and Interpretation of Parameters:

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

Probe ES3DV3

SN:3258

Manufactured: January 25, 2010
Calibrated: February 25, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu V/(V/m)^2$)[A]	1.29	1.19	1.23	± 10.1 %
DCP (mV)[B]	104.5	107.0	103.0	

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	222.4	±3.8 %
		Y	0.0	0.0	1.0		202.2	
		Z	0.0	0.0	1.0		207.1	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	5.09	65.6	14.1	10.00	44.8	±1.9 %
		Y	1.68	57.4	9.3		40.7	
		Z	4.01	62.4	13.0		51.1	
10011-CAB	UMTS-FDD (WCDMA)	X	3.34	67.5	18.9	2.91	131.2	±0.5 %
		Y	3.43	67.9	18.7		137.1	
		Z	3.42	67.8	19.0		146.0	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.40	70.9	19.8	1.87	134.2	±0.7 %
		Y	3.19	70.2	19.2		137.9	
		Z	3.46	70.8	19.6		149.6	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	30.24	99.7	28.7	9.39	131.2	±1.4 %
		Y	12.91	88.5	23.9		147.5	
		Z	30.37	99.5	28.9		128.0	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	29.88	100.0	29.0	9.57	123.0	±1.9 %
		Y	16.02	92.5	25.4		140.7	
		Z	30.01	100.0	29.4		125.8	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	44.57	99.7	25.9	6.56	119.6	±1.7 %
		Y	28.97	95.3	23.2		127.6	
		Z	43.72	99.8	26.3		120.1	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	53.52	99.7	24.4	4.80	129.4	±2.2 %
		Y	54.55	99.9	22.9		143.3	
		Z	51.63	99.7	24.8		127.5	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	58.93	99.8	23.4	3.55	133.4	±2.2 %
		Y	77.54	99.7	21.3		125.3	
		Z	56.64	99.8	23.8		130.8	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	47.03	99.5	21.3	1.16	136.3	±1.7 %
		Y	95.86	95.2	17.1		138.2	
		Z	39.68	100.0	22.2		132.3	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.84	66.8	19.1	4.57	131.3	±0.9 %
		Y	4.75	67.0	18.9		135.2	
		Z	4.86	66.7	19.0		127.2	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	4.06	66.8	19.0	3.97	148.4	±0.7 %
		Y	3.96	66.6	18.6		134.7	
		Z	4.13	66.9	19.1		143.4	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.63	66.8	18.7	3.98	137.3	±0.7 %
		Y	4.75	67.5	18.8		148.4	
		Z	4.65	66.7	18.7		133.2	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.66	68.5	20.3	5.67	144.0	±1.2 %
		Y	6.27	67.1	19.3		130.6	
		Z	6.62	68.2	20.1		140.5	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.53	68.0	20.2	5.80	142.6	±1.4 %
		Y	6.17	66.8	19.3		129.2	
		Z	6.52	67.8	20.1		139.0	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.19	67.3	19.9	5.75	137.9	±1.4 %
		Y	6.12	67.3	19.6		149.5	
		Z	6.19	67.1	19.8		136.1	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.49	69.5	21.7	8.10	132.4	±2.5 %
		Y	10.23	69.1	21.3		144.3	
		Z	10.45	69.3	21.6		129.5	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.46	69.5	21.7	8.07	133.9	±2.5 %
		Y	10.26	69.2	21.3		147.4	
		Z	10.47	69.4	21.7		130.5	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	11.61	77.4	26.8	9.28	118.8	±3.0 %
		Y	9.89	75.2	25.7		144.9	
		Z	12.01	77.8	26.9		119.6	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.20	67.3	19.9	5.75	139.2	±1.2 %
		Y	5.86	66.2	19.0		128.5	
		Z	6.22	67.3	19.9		136.3	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.63	67.8	20.1	5.82	144.1	±1.4 %
		Y	6.31	66.8	19.3		133.1	
		Z	6.66	67.7	20.0		140.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.25	67.5	20.2	5.73	143.6	±1.2 %
		Y	4.92	66.7	19.5		131.0	
		Z	5.29	67.4	20.2		140.7	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	13.49	87.5	31.6	9.21	139.0	±2.7 %
		Y	7.83	75.5	26.0		124.9	
		Z	13.47	86.5	31.1		137.8	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.22	67.4	20.1	5.72	144.3	±1.4 %
		Y	5.08	67.5	19.9		147.9	
		Z	5.26	67.2	20.0		139.6	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.24	67.5	20.1	5.72	144.5	±1.2 %
		Y	5.06	67.4	19.8		147.0	
		Z	5.29	67.3	20.1		139.2	

10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	10.12	69.1	21.6	8.09	128.8	±2.2 %
		Y	9.76	68.4	21.0		132.8	
		Z	10.08	68.9	21.5		123.4	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	10.15	69.2	21.7	8.10	130.2	±2.2 %
		Y	9.77	68.5	21.0		134.1	
		Z	10.10	69.0	21.5		124.0	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	10.02	69.0	21.5	8.03	128.7	±2.2 %
		Y	9.67	68.5	21.0		133.3	
		Z	10.02	68.9	21.5		123.9	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.46	69.6	21.7	8.06	134.0	±2.2 %
		Y	10.09	68.8	21.1		139.7	
		Z	10.40	69.3	21.6		128.7	
10225-CAB	UMTS-FDD (HSPA+)	X	7.09	67.1	19.6	5.97	131.2	±1.4 %
		Y	6.98	67.2	19.4		138.0	
		Z	7.06	66.8	19.4		127.2	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	13.63	87.8	31.7	9.21	141.6	±3.0 %
		Y	7.85	75.5	26.0		126.5	
		Z	13.99	87.7	31.6		141.4	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	12.86	81.4	28.9	9.24	142.1	±3.0 %
		Y	8.91	73.4	24.8		129.9	
		Z	13.15	81.4	28.8		142.0	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	11.63	77.5	26.8	9.30	118.7	±3.0 %
		Y	9.62	74.3	25.2		138.4	
		Z	11.96	77.7	26.9		119.3	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.14	67.4	19.3	4.87	149.9	±0.9 %
		Y	5.90	66.9	18.7		132.8	
		Z	6.20	67.5	19.3		146.6	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.45	66.9	18.9	3.96	130.1	±0.7 %
		Y	4.50	67.2	18.8		137.9	
		Z	4.64	67.6	19.3		149.2	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.79	67.5	19.2	3.46	145.3	±0.7 %
		Y	3.74	67.5	18.9		128.2	
		Z	3.78	67.3	19.1		139.1	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.77	67.8	19.3	3.39	147.0	±0.5 %
		Y	3.69	67.7	18.9		130.1	
		Z	3.73	67.3	19.0		141.3	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.52	67.9	20.1	5.81	141.4	±1.4 %
		Y	6.41	67.6	19.7		147.4	
		Z	6.51	67.7	20.1		135.4	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.17	68.7	20.7	6.06	147.7	±1.4 %
		Y	6.69	67.2	19.6		128.6	
		Z	7.12	68.4	20.5		142.0	

10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	3.04	70.0	19.6	1.71	129.8	±0.5 %
		Y	3.25	71.3	19.7		136.9	
		Z	3.09	69.9	19.5		148.7	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.73	67.3	18.6	3.76	135.7	±0.5 %
		Y	4.93	69.1	19.0		141.5	
		Z	4.73	67.1	18.4		132.7	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.67	67.5	18.6	3.77	134.0	±0.5 %
		Y	4.92	69.4	19.1		139.8	
		Z	4.65	67.1	18.5		130.7	

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 NormX,Y,Z do not affect the E^2-field uncertainty inside TSL (see Pages 8 and 9).
[B] Numerical linearization parameter: uncertainty not required.
[E] Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

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)	Unct. (k=2)
750	41.9	0.89	6.53	6.53	6.53	0.40	1.60	± 12.0 %
835	41.5	0.90	6.27	6.27	6.27	0.80	1.17	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.80	1.10	± 12.0 %
1900	40.0	1.40	5.04	5.04	5.04	0.68	1.27	± 12.0 %
2450	39.2	1.80	4.52	4.52	4.52	0.78	1.23	± 12.0 %
2600	39.0	1.96	4.34	4.34	4.34	0.76	1.33	± 12.0 %

[C] Frequency validity 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.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

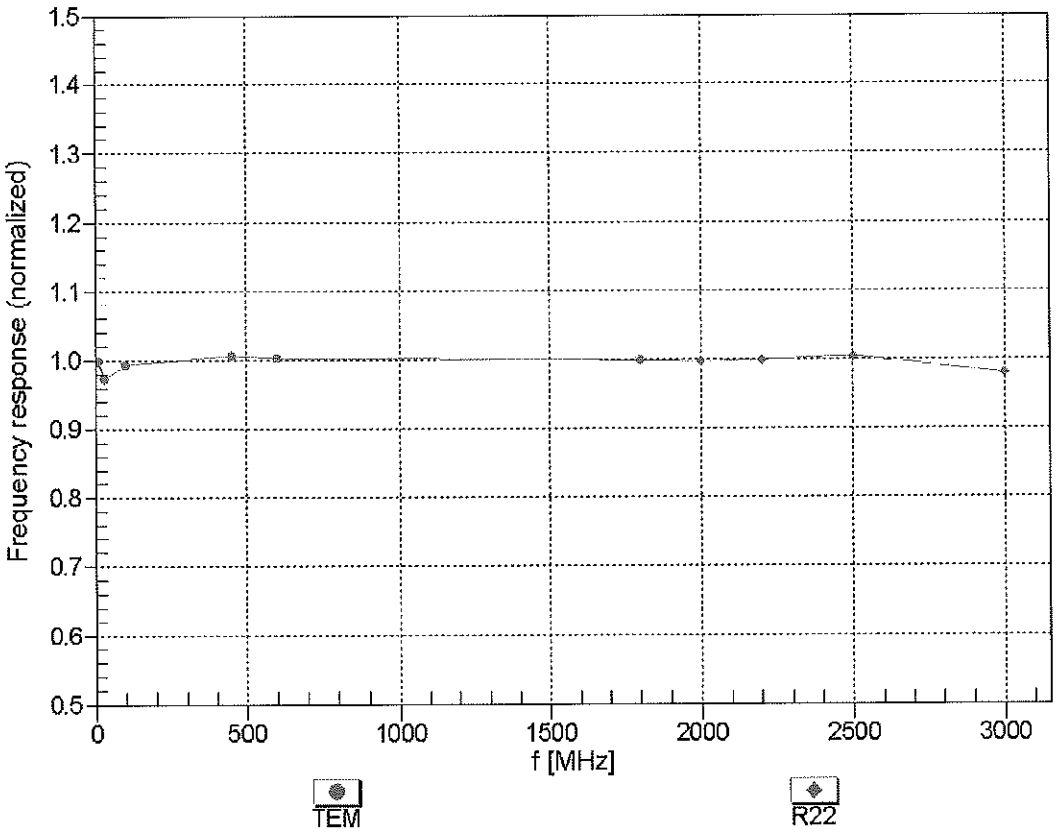
DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

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)	Unct. (k=2)
750	55.5	0.96	6.15	6.15	6.15	0.61	1.32	± 12.0 %
835	55.2	0.97	6.11	6.11	6.11	0.80	1.15	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.47	1.74	± 12.0 %
1900	53.3	1.52	4.61	4.61	4.61	0.55	1.59	± 12.0 %
2450	52.7	1.95	4.14	4.14	4.14	0.80	1.11	± 12.0 %
2600	52.5	2.16	3.91	3.91	3.91	0.80	1.00	± 12.0 %

[C] Frequency validity 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.
[F] At frequencies below 3 GHz, the validity of tissue parameters (ε and σ) can be relaxed to ± 10% if liquid compensation formula is applied to measured SAR values. At frequencies above 3 GHz, the validity of tissue parameters (ε and σ) is restricted to ± 5%. The uncertainty is the RSS of the ConvF uncertainty for indicated target tissue parameters.
[G] Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

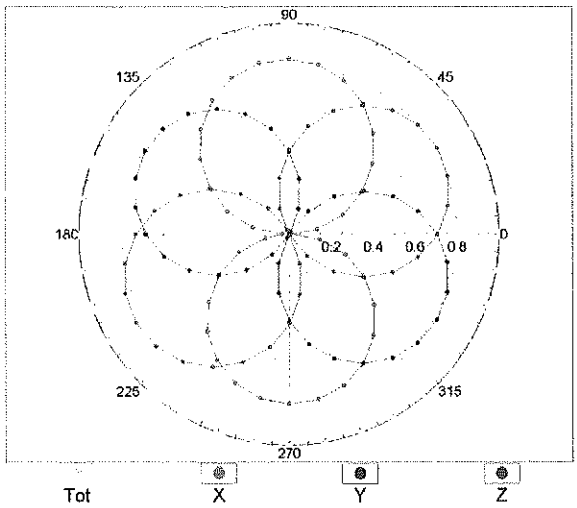
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



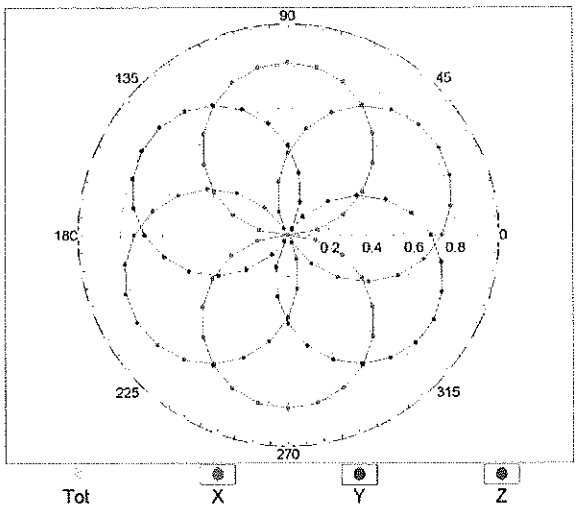
Uncertainty of Frequency Response of E-field: ± 6.3% (k=2)

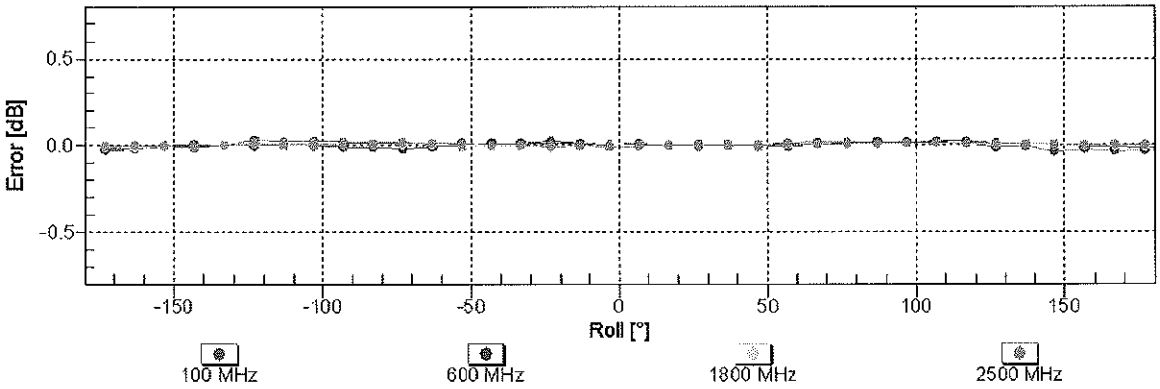
Receiving Pattern (ϕ), ϑ = 0°

f=600 MHz,TEM



f=1800 MHz,R22

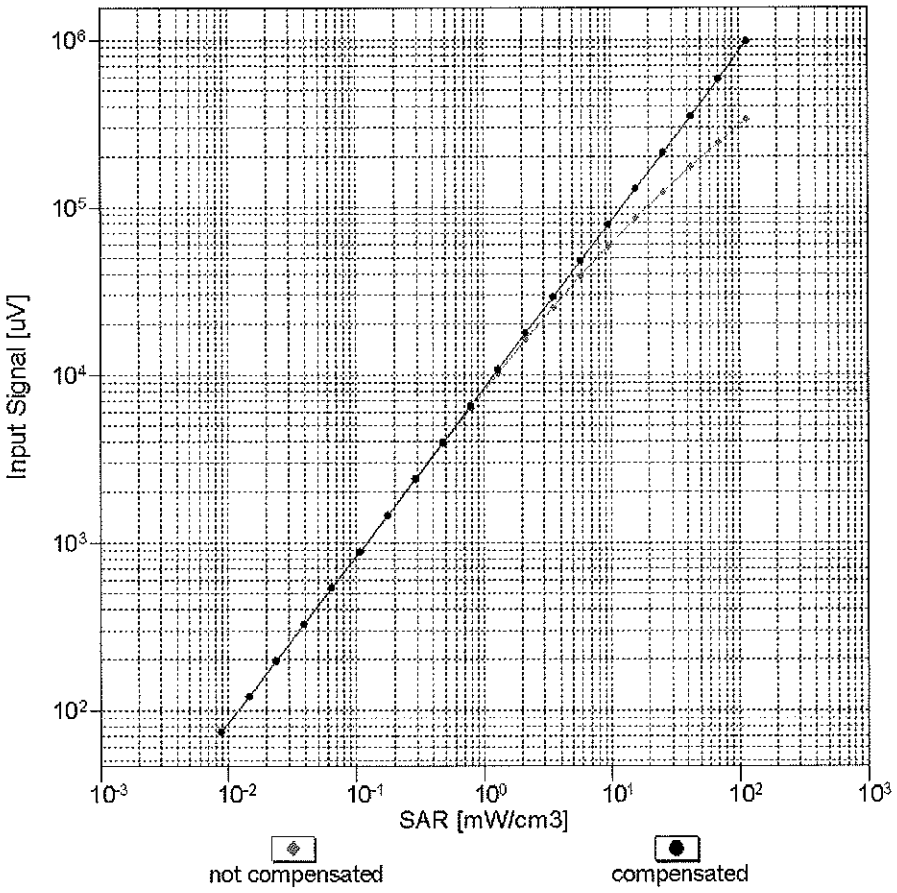


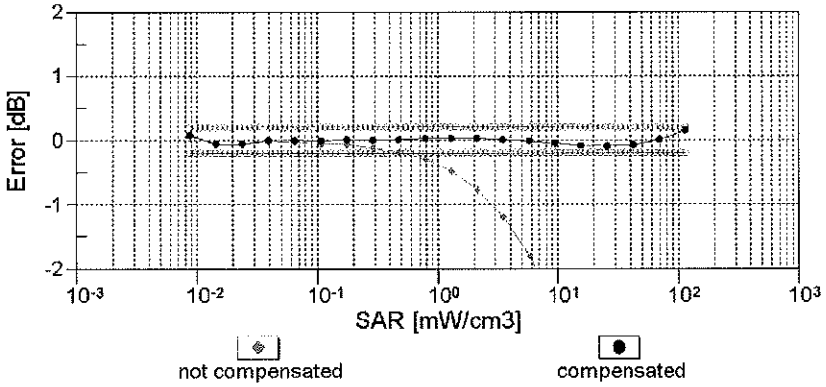


Uncertainty of Axial Isotropy Assessment: ± 0.5% (k=2)

Dynamic Range f(SAR_{head})

(TEM cell , f_{eval}= 1900 MHz)

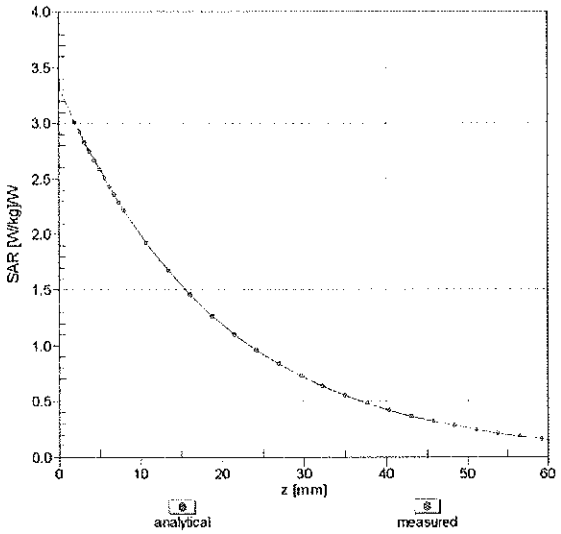




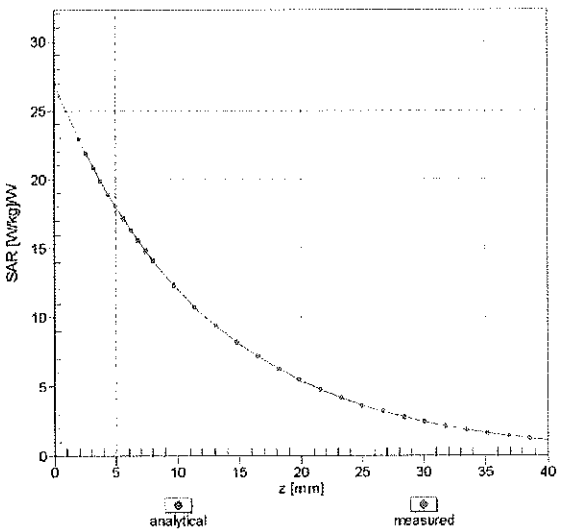
Uncertainty of Linearity Assessment: ± 0.6% (k=2)

Conversion Factor Assessment

f = 835 MHz,WGLS R9 (H_convF)

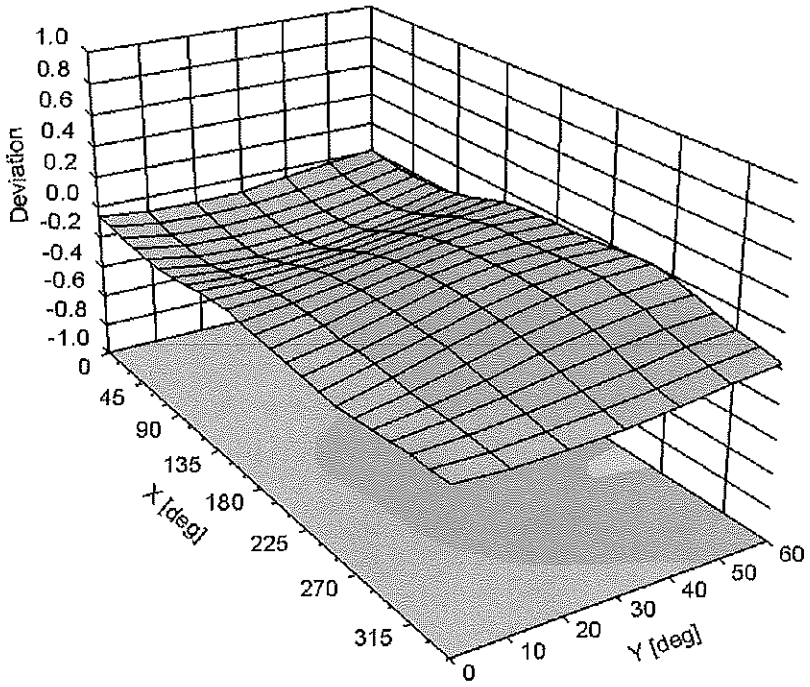


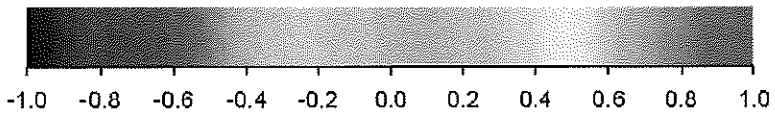
f = 1750 MHz,WGLS R22 (H_convF)



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), f = 900 MHz





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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3258

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-123.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm