



SAR EVALUATION REPORT

Applicant Name:

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Date of Testing:

07/21/2014

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

0Y1407221432.A3L

FCC ID:

A3LSCHI925U

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Tablet Computer

Application Type:

Class II Permissive Change

FCC Rule Part(s):

CFR §2.1093

Model(s):

SCH-I925U

Permissive Change(s):

Adding 15MHz & 20MHz BWs to LTE B2 & B4

Date of Original Certification:

01/24/2013

Equipment Class	Band & Mode	Tx Frequency	SAR
			1 gm Body (W/kg)
PCB	LTE Band 4 (AWS)	1712.5 - 1752.5 MHz	0.87
PCB	LTE Band 2 (PCS)	1852.5 - 1907.5 MHz	0.70
Simultaneous SAR per KDB 690783 D01v01r02:			1.59

The table above shows Test Data evaluated for the current test report. Please refer to RF Exposure Technical Report S/N 0Y1211281716-R1.A3L 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



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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Operating Modes	Tx Frequency
Cell. CDMA/EVDO	Data	824.70 - 848.31 MHz
AWS CDMA/EVDO	Data	1711.25 - 1753.75 MHz
PCS CDMA/EVDO	Data	1851.25 - 1908.75 MHz
LTE Band 12	Data	701.5 - 713.5 MHz
LTE Band 5 (Cell)	Data	826.5 - 846.5 MHz
LTE Band 4 (AWS)	Data	1712.5 - 1752.5 MHz
LTE Band 2 (PCS)	Data	1852.5 - 1907.5 MHz
2.4 GHz WLAN	Data	2412 - 2462 MHz
5.8 GHz WLAN	Data	5745 - 5825 MHz
5.2 GHz WLAN	Data	5180 - 5240 MHz
5.3 GHz WLAN	Data	5260 - 5320 MHz
5.5 GHz WLAN	Data	5500 - 5700 MHz
Bluetooth	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses a sensor for SAR compliance. The sensor is activated when used in close proximity to the user's body. The sensor triggers power reduction for all data modes and is only applicable for tablet operations. There is no power reduction mechanism for WIFI/BT modes for SAR purposes. There are no body-worn accessories for this device. Since the device is a full tablet size, the Body SAR was evaluated per FCC KDB Publication 616217 D04v01 for full sized tablets.

1.3 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.

1.3.1 Maximum Power:

Mode / Band		Modulated Average (dBm)
LTE Band 4 (AWS)	Maximum	23.7
	Nominal	23.2
LTE Band 2 (PCS)	Maximum	23.6
	Nominal	23.1

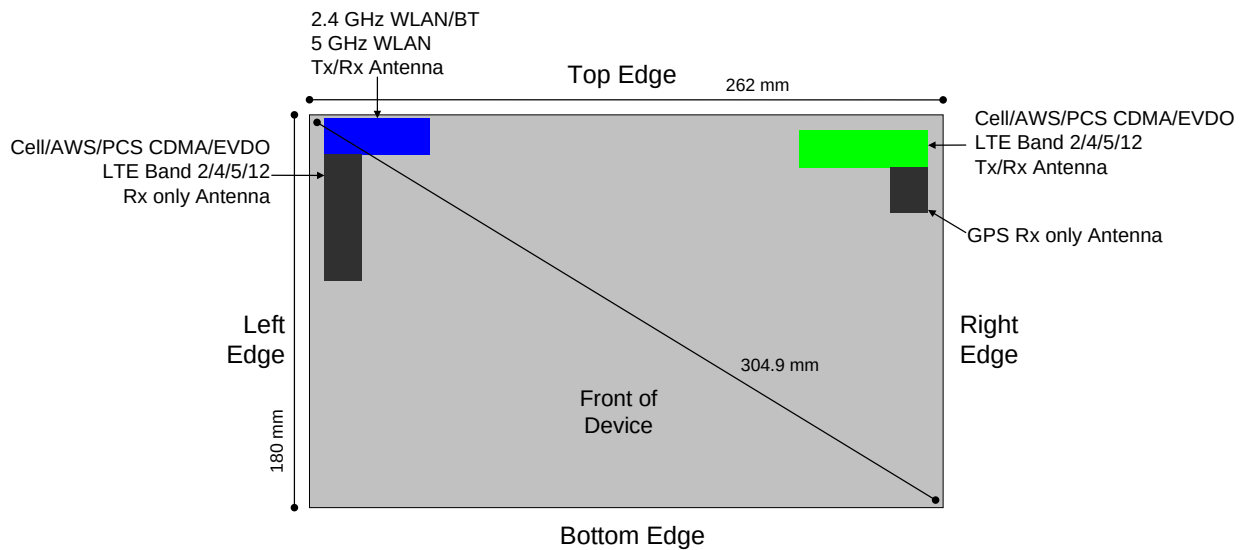
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1.3.2

Reduced Power Body at 0 mm:

Mode / Band		Modulated Average (dBm)
LTE Band 4 (AWS)	Maximum	12.6
	Nominal	12.1
LTE Band 2 (PCS)	Maximum	12.5
	Nominal	12.0

1.4 DUT Antenna Locations



Note: Specific antenna dimensions and separation distances are shown in the antenna distance document.

Figure 1-1
DUT Antenna Locations

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1.5 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.

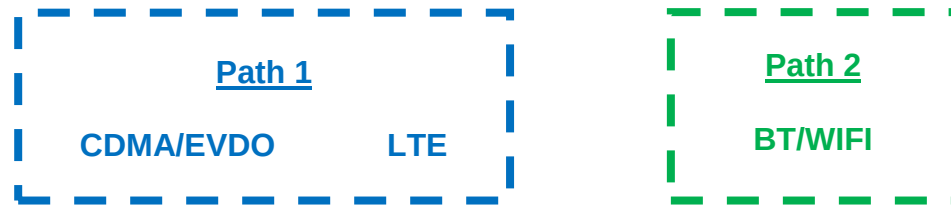


Figure 1-2
Simultaneous Transmission Paths

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	Body	Note
		FCC KDB 616217	
1	CDMA/EVDO Data + Wifi 2.4 GHz	Yes	2G/3G Hotspot or Wifi Direct
2	LTE + Wifi 2.4 GHz	Yes	4G Hotspot or Wifi Direct
3	CDMA/EVDO Data + Wifi 5 GHz	Yes	Wifi Direct
4	LTE + Wifi 5 GHz	Yes	Wifi Direct
5	CDMA/EVDO Data + Bluetooth	Yes	
6	LTE + Bluetooth	Yes	

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1.6 SAR Test Exclusions Applied

(A) WIFI/BT

2.4 GHz WLAN and 5 GHz WLAN and Bluetooth share the same antenna path and cannot transmit simultaneously.

This report evaluates SAR compliance for LTE Band 2 and LTE 4. Please refer to RF exposure Technical Report 0Y1211281716-R1.A3L for original compliance report containing data for other main antenna and WLAN modes. No changes were made to any other mode or band.

(B) 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.

1.7 Guidance Applied

- FCC KDB Publication 941225 D01-D06 (4G and Hotspot)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 616217 D04v01 (SAR for Laptops and Tablets)

1.8 Device Serial Numbers

Several samples with identical hardware were used 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 Power Serial Number	Reduced Power Number
LTE Band 4 (AWS)	4689-0543	4689-0542
LTE Band 2 (PCS)	4689-0538	4689-0542

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2 LTE INFORMATION

LTE Information			
FCC ID	A3LSCHI925U		
Form Factor	Portable Tablet Computer		
Frequency Range of each LTE transmission band	LTE Band 4 (AWS) (1712.5 - 1752.5 MHz)		
	LTE Band 2 (PCS) (1852.5 - 1907.5 MHz)		
Channel Bandwidths	LTE Band 4 (AWS): 5 MHz, 10 MHz, 15 MHz, 20 MHz		
	LTE Band 2 (PCS): 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
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): 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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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 [24]. 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/m³)
- 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:

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).
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). 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. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. 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.

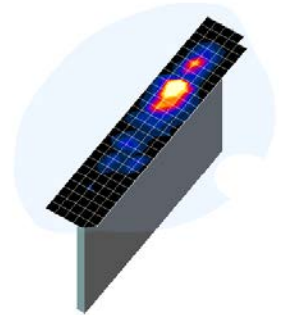


Figure 4-1
Sample SAR Area Scan

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

Frequency	Maximum Area Scan Resolution (mm) ($\Delta x_{\text{area}}, \Delta y_{\text{area}}$)	Maximum Zoom Scan Resolution (mm) ($\Delta x_{\text{zoom}}, \Delta y_{\text{zoom}}$)	Maximum Zoom Scan Spatial Resolution (mm) $\Delta z_{\text{zoom}}(n)$	Minimum Zoom Scan Volume (mm) (x,y,z)
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≥ 22

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5 RF EXPOSURE LIMITS

5.1 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.

5.2 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 5-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <i>General Population</i> (W/kg) or (mW/g)	CONTROLLED ENVIRONMENT <i>Occupational</i> (W/kg) or (mW/g)
SPATIAL PEAK SAR Brain	1.6	8.0
SPATIAL AVERAGE SAR Whole Body	0.08	0.4
SPATIAL PEAK SAR Hands, Feet, Ankles, Wrists	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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6 FCC MEASUREMENT PROCEDURES

Power measurements were performed using a base station simulator under digital average power.

6.1 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.

6.2 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" v02, October 2007.

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.

6.3 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.

6.3.1 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.

6.3.2 MPR

MPR is implemented for this device by the manufacturer when the sensor is not active (maximum power scenarios). 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. See Section 8.4 for MPR targets.

6.3.3 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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6.3.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02:

- 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 $\frac{1}{2}$ 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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7 TABLET SAR TESTING PROCEDURES

7.1 SAR Testing for Tablet per KDB Publication 616217 D04v01

Per FCC KDB 616217, the back surface and edges of the tablet should be tested for SAR compliance with the tablet touching the phantom. The SAR Exclusion Threshold in KDB 447498 D01v05 can be applied to determine SAR test exclusion for adjacent edge configurations. The closest distance from the antenna to an adjacent tablet edge is used to determine if SAR testing is required for the adjacent edges, with the adjacent edge positioned against the phantom and the edge containing the antenna positioned perpendicular to the phantom.

Based on the location and output power of the main antenna, back side and top and right edges were required to be evaluated for SAR. Back side and top and left edges were required to be evaluated for the BT/WLAN Antenna. Front side was not required to be evaluated.

7.2 Sensor Reduction Information

The technical description contains information about sensor size and locations. Power reduction levels are provided in Section 8.

FCC KDB 616217 was used as a guideline for selecting SAR test distances for this device. Since the back-off sensor activation distance for back is 13 mm, a conservative distance of 12 mm was tested for the back side at maximum power. Since the back-off sensor activation distance was 11 mm for the top edge, a conservative distance of 10 mm was tested at maximum power. Sensor triggering distance summary data is included in Appendix G.

The sensor is designed to support sufficient detection range and sensitivity to cover regions of the sensors in all applicable directions since the sensor entirely covers the antenna.

This tablet was tested in accordance with FCC KDB 616217 D04v01 for sensor power reduction.

When the sensor detects a user is touching the device on or near to the antenna the device reduces the maximum allowed output power. However, the sensor is not active when the device is moved beyond the sensor triggering distance and the maximum output power is no longer limited. Therefore, an additional exposure condition is needed in the vicinity of the triggering distance to ensure SAR is compliant when the device is allowed to operate at a non-reduced output power level.

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8 RF CONDUCTED POWERS

8.1 LTE Conducted Powers

8.1.1 LTE Band 4 (AWS)

Table 8-1
LTE Band 4 (AWS) Maximum 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	23.30	0	0
	1732.5	20175	20	QPSK	1	50	23.40	0	0
	1732.5	20175	20	QPSK	1	99	23.14	0	0
	1732.5	20175	20	QPSK	50	0	22.20	0-1	1
	1732.5	20175	20	QPSK	50	25	22.08	0-1	1
	1732.5	20175	20	QPSK	50	50	22.04	0-1	1
	1732.5	20175	20	QPSK	100	0	21.99	0-1	1
	1732.5	20175	20	16QAM	1	0	22.24	0-1	1
	1732.5	20175	20	16QAM	1	50	22.52	0-1	1
	1732.5	20175	20	16QAM	1	99	22.27	0-1	1
	1732.5	20175	20	16QAM	50	0	21.12	0-2	2
	1732.5	20175	20	16QAM	50	25	20.83	0-2	2
	1732.5	20175	20	16QAM	50	50	20.87	0-2	2
	1732.5	20175	20	16QAM	100	0	20.78	0-2	2

Note: 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 middle channel of the group of overlapping channels should be selected for testing.

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Table 8-2
LTE Band 4 (AWS) Maximum 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	23.38	0	0
	1717.5	20025	15	QPSK	1	36	23.23	0	0
	1717.5	20025	15	QPSK	1	74	23.19	0	0
	1717.5	20025	15	QPSK	36	0	22.12	0-1	1
	1717.5	20025	15	QPSK	36	18	21.97	0-1	1
	1717.5	20025	15	QPSK	36	37	21.91	0-1	1
	1717.5	20025	15	QPSK	75	0	21.85	0-1	1
	1717.5	20025	15	16QAM	1	0	22.37	0-1	1
	1717.5	20025	15	16QAM	1	36	22.40	0-1	1
	1717.5	20025	15	16QAM	1	74	22.26	0-1	1
	1717.5	20025	15	16QAM	36	0	21.03	0-2	2
	1717.5	20025	15	16QAM	36	18	20.94	0-2	2
	1717.5	20025	15	16QAM	36	37	20.86	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	23.12	0	0
	1732.5	20175	15	QPSK	1	36	23.02	0	0
	1732.5	20175	15	QPSK	1	74	22.91	0	0
	1732.5	20175	15	QPSK	36	0	22.02	0-1	1
	1732.5	20175	15	QPSK	36	18	21.90	0-1	1
	1732.5	20175	15	QPSK	36	37	21.93	0-1	1
	1732.5	20175	15	QPSK	75	0	21.79	0-1	1
	1732.5	20175	15	16QAM	1	0	22.35	0-1	1
	1732.5	20175	15	16QAM	1	36	22.24	0-1	1
	1732.5	20175	15	16QAM	1	74	22.17	0-1	1
	1732.5	20175	15	16QAM	36	0	21.17	0-2	2
	1732.5	20175	15	16QAM	36	18	20.92	0-2	2
	1732.5	20175	15	16QAM	36	37	20.94	0-2	2
	1732.5	20175	15	16QAM	75	0	20.95	0-2	2
High	1747.5	20325	15	QPSK	1	0	23.19	0	0
	1747.5	20325	15	QPSK	1	36	23.43	0	0
	1747.5	20325	15	QPSK	1	74	23.51	0	0
	1747.5	20325	15	QPSK	36	0	22.10	0-1	1
	1747.5	20325	15	QPSK	36	18	22.04	0-1	1
	1747.5	20325	15	QPSK	36	37	22.28	0-1	1
	1747.5	20325	15	QPSK	75	0	22.04	0-1	1
	1747.5	20325	15	16QAM	1	0	22.33	0-1	1
	1747.5	20325	15	16QAM	1	36	22.40	0-1	1
	1747.5	20325	15	16QAM	1	74	22.67	0-1	1
	1747.5	20325	15	16QAM	36	0	21.04	0-2	2
	1747.5	20325	15	16QAM	36	18	21.11	0-2	2
	1747.5	20325	15	16QAM	36	37	21.22	0-2	2
	1747.5	20325	15	16QAM	75	0	21.07	0-2	2

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Table 8-3
LTE Band 4 (AWS) Maximum Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1715	20000	10	QPSK	1	0	23.20	0	0
	1715	20000	10	QPSK	1	25	23.13	0	0
	1715	20000	10	QPSK	1	49	23.04	0	0
	1715	20000	10	QPSK	25	0	22.03	0-1	1
	1715	20000	10	QPSK	25	12	21.95	0-1	1
	1715	20000	10	QPSK	25	25	22.07	0-1	1
	1715	20000	10	QPSK	50	0	21.91	0-1	1
	1715	20000	10	16QAM	1	0	22.51	0-1	1
	1715	20000	10	16QAM	1	25	22.49	0-1	1
	1715	20000	10	16QAM	1	49	22.48	0-1	1
	1715	20000	10	16QAM	25	0	21.11	0-2	2
	1715	20000	10	16QAM	25	12	21.02	0-2	2
	1715	20000	10	16QAM	25	25	20.99	0-2	2
Mid	1732.5	20175	10	QPSK	1	0	23.14	0	0
	1732.5	20175	10	QPSK	1	25	23.25	0	0
	1732.5	20175	10	QPSK	1	49	23.20	0	0
	1732.5	20175	10	QPSK	25	0	22.08	0-1	1
	1732.5	20175	10	QPSK	25	12	21.98	0-1	1
	1732.5	20175	10	QPSK	25	25	21.96	0-1	1
	1732.5	20175	10	QPSK	50	0	21.89	0-1	1
	1732.5	20175	10	16QAM	1	0	21.77	0-1	1
	1732.5	20175	10	16QAM	1	25	21.81	0-1	1
	1732.5	20175	10	16QAM	1	49	21.79	0-1	1
	1732.5	20175	10	16QAM	25	0	21.14	0-2	2
	1732.5	20175	10	16QAM	25	12	21.07	0-2	2
	1732.5	20175	10	16QAM	25	25	21.05	0-2	2
	1732.5	20175	10	16QAM	50	0	20.78	0-2	2
High	1750	20350	10	QPSK	1	0	23.03	0	0
	1750	20350	10	QPSK	1	25	23.20	0	0
	1750	20350	10	QPSK	1	49	23.39	0	0
	1750	20350	10	QPSK	25	0	22.05	0-1	1
	1750	20350	10	QPSK	25	12	21.99	0-1	1
	1750	20350	10	QPSK	25	25	22.28	0-1	1
	1750	20350	10	QPSK	50	0	22.03	0-1	1
	1750	20350	10	16QAM	1	0	21.76	0-1	1
	1750	20350	10	16QAM	1	25	21.84	0-1	1
	1750	20350	10	16QAM	1	49	21.99	0-1	1
	1750	20350	10	16QAM	25	0	21.19	0-2	2
	1750	20350	10	16QAM	25	12	21.20	0-2	2
	1750	20350	10	16QAM	25	25	21.35	0-2	2
	1750	20350	10	16QAM	50	0	21.03	0-2	2

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Table 8-4
LTE Band 4 (AWS) Maximum Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1712.5	19975	5	QPSK	1	0	23.26	0	0
	1712.5	19975	5	QPSK	1	12	23.13	0	0
	1712.5	19975	5	QPSK	1	24	23.05	0	0
	1712.5	19975	5	QPSK	12	0	22.11	0-1	1
	1712.5	19975	5	QPSK	12	6	22.07	0-1	1
	1712.5	19975	5	QPSK	12	13	22.05	0-1	1
	1712.5	19975	5	QPSK	25	0	22.04	0-1	1
	1712.5	19975	5	16-QAM	1	0	22.06	0-1	1
	1712.5	19975	5	16-QAM	1	12	21.85	0-1	1
	1712.5	19975	5	16-QAM	1	24	22.05	0-1	1
	1712.5	19975	5	16-QAM	12	0	20.86	0-2	2
	1712.5	19975	5	16-QAM	12	6	21.07	0-2	2
	1712.5	19975	5	16-QAM	12	13	20.85	0-2	2
Mid	1732.5	20175	5	QPSK	1	0	23.37	0	0
	1732.5	20175	5	QPSK	1	12	23.19	0	0
	1732.5	20175	5	QPSK	1	24	23.12	0	0
	1732.5	20175	5	QPSK	12	0	22.17	0-1	1
	1732.5	20175	5	QPSK	12	6	22.07	0-1	1
	1732.5	20175	5	QPSK	12	13	22.23	0-1	1
	1732.5	20175	5	QPSK	25	0	22.08	0-1	1
	1732.5	20175	5	16-QAM	1	0	22.01	0-1	1
	1732.5	20175	5	16-QAM	1	12	22.04	0-1	1
	1732.5	20175	5	16-QAM	1	24	22.00	0-1	1
	1732.5	20175	5	16-QAM	12	0	21.06	0-2	2
	1732.5	20175	5	16-QAM	12	6	21.19	0-2	2
	1732.5	20175	5	16-QAM	12	13	21.09	0-2	2
	1732.5	20175	5	16-QAM	25	0	21.32	0-2	2
High	1752.5	20375	5	QPSK	1	0	23.13	0	0
	1752.5	20375	5	QPSK	1	12	23.35	0	0
	1752.5	20375	5	QPSK	1	24	23.19	0	0
	1752.5	20375	5	QPSK	12	0	22.11	0-1	1
	1752.5	20375	5	QPSK	12	6	22.35	0-1	1
	1752.5	20375	5	QPSK	12	13	22.34	0-1	1
	1752.5	20375	5	QPSK	25	0	22.23	0-1	1
	1752.5	20375	5	16-QAM	1	0	21.96	0-1	1
	1752.5	20375	5	16-QAM	1	12	22.07	0-1	1
	1752.5	20375	5	16-QAM	1	24	22.01	0-1	1
	1752.5	20375	5	16-QAM	12	0	21.07	0-2	2
	1752.5	20375	5	16-QAM	12	6	21.06	0-2	2
	1752.5	20375	5	16-QAM	12	13	21.07	0-2	2
	1752.5	20375	5	16-QAM	25	0	21.24	0-2	2

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Table 8-5
LTE Band 4 (AWS) Reduced 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	11.70	0	0
	1732.5	20175	20	QPSK	1	50	12.35	0	0
	1732.5	20175	20	QPSK	1	99	11.63	0	0
	1732.5	20175	20	QPSK	50	0	12.01	0-1	0
	1732.5	20175	20	QPSK	50	25	12.00	0-1	0
	1732.5	20175	20	QPSK	50	50	11.69	0-1	0
	1732.5	20175	20	QPSK	100	0	11.80	0-1	0
	1732.5	20175	20	16QAM	1	0	11.60	0-1	0
	1732.5	20175	20	16QAM	1	50	12.06	0-1	0
	1732.5	20175	20	16QAM	1	99	11.73	0-1	0
	1732.5	20175	20	16QAM	50	0	11.83	0-2	0
	1732.5	20175	20	16QAM	50	25	11.93	0-2	0
	1732.5	20175	20	16QAM	50	50	11.62	0-2	0
	1732.5	20175	20	16QAM	100	0	11.74	0-2	0

Note: 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 middle channel of the group of overlapping channels should be selected for testing.

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Table 8-6
LTE Band 4 (AWS) Reduced 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	11.71	0	0
	1717.5	20025	15	QPSK	1	36	12.17	0	0
	1717.5	20025	15	QPSK	1	74	11.64	0	0
	1717.5	20025	15	QPSK	36	0	12.10	0-1	0
	1717.5	20025	15	QPSK	36	18	12.00	0-1	0
	1717.5	20025	15	QPSK	36	37	11.64	0-1	0
	1717.5	20025	15	QPSK	75	0	11.92	0-1	0
	1717.5	20025	15	16QAM	1	0	11.77	0-1	0
	1717.5	20025	15	16QAM	1	36	11.93	0-1	0
	1717.5	20025	15	16QAM	1	74	11.87	0-1	0
	1717.5	20025	15	16QAM	36	0	11.87	0-2	0
	1717.5	20025	15	16QAM	36	18	11.98	0-2	0
	1717.5	20025	15	16QAM	36	37	11.68	0-2	0
Mid	1732.5	20175	15	QPSK	1	0	11.72	0	0
	1732.5	20175	15	QPSK	1	36	12.06	0	0
	1732.5	20175	15	QPSK	1	74	11.65	0	0
	1732.5	20175	15	QPSK	36	0	12.11	0-1	0
	1732.5	20175	15	QPSK	36	18	12.03	0-1	0
	1732.5	20175	15	QPSK	36	37	11.65	0-1	0
	1732.5	20175	15	QPSK	75	0	11.76	0-1	0
	1732.5	20175	15	16QAM	1	0	11.69	0-1	0
	1732.5	20175	15	16QAM	1	36	12.00	0-1	0
	1732.5	20175	15	16QAM	1	74	11.83	0-1	0
	1732.5	20175	15	16QAM	36	0	11.87	0-2	0
	1732.5	20175	15	16QAM	36	18	11.90	0-2	0
	1732.5	20175	15	16QAM	36	37	11.62	0-2	0
	1732.5	20175	15	16QAM	75	0	11.83	0-2	0
High	1747.5	20325	15	QPSK	1	0	11.94	0	0
	1747.5	20325	15	QPSK	1	36	12.15	0	0
	1747.5	20325	15	QPSK	1	74	11.64	0	0
	1747.5	20325	15	QPSK	36	0	12.30	0-1	0
	1747.5	20325	15	QPSK	36	18	12.04	0-1	0
	1747.5	20325	15	QPSK	36	37	11.76	0-1	0
	1747.5	20325	15	QPSK	75	0	11.88	0-1	0
	1747.5	20325	15	16QAM	1	0	11.66	0-1	0
	1747.5	20325	15	16QAM	1	36	11.96	0-1	0
	1747.5	20325	15	16QAM	1	74	11.77	0-1	0
	1747.5	20325	15	16QAM	36	0	11.79	0-2	0
	1747.5	20325	15	16QAM	36	18	12.09	0-2	0
	1747.5	20325	15	16QAM	36	37	11.72	0-2	0
	1747.5	20325	15	16QAM	75	0	11.86	0-2	0

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Table 8-7
LTE Band 4 (AWS) Reduced Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1715	20000	10	QPSK	1	0	12.24	0	0
	1715	20000	10	QPSK	1	25	12.47	0	0
	1715	20000	10	QPSK	1	49	12.06	0	0
	1715	20000	10	QPSK	25	0	12.04	0-1	0
	1715	20000	10	QPSK	25	12	12.08	0-1	0
	1715	20000	10	QPSK	25	25	11.99	0-1	0
	1715	20000	10	QPSK	50	0	11.98	0-1	0
	1715	20000	10	16QAM	1	0	12.00	0-1	0
	1715	20000	10	16QAM	1	25	12.16	0-1	0
	1715	20000	10	16QAM	1	49	11.89	0-1	0
	1715	20000	10	16QAM	25	0	11.97	0-2	0
	1715	20000	10	16QAM	25	12	12.04	0-2	0
	1715	20000	10	16QAM	25	25	12.00	0-2	0
	1715	20000	10	16QAM	50	0	11.96	0-2	0
Mid	1732.5	20175	10	QPSK	1	0	12.02	0	0
	1732.5	20175	10	QPSK	1	25	12.29	0	0
	1732.5	20175	10	QPSK	1	49	12.03	0	0
	1732.5	20175	10	QPSK	25	0	12.17	0-1	0
	1732.5	20175	10	QPSK	25	12	12.22	0-1	0
	1732.5	20175	10	QPSK	25	25	12.06	0-1	0
	1732.5	20175	10	QPSK	50	0	12.19	0-1	0
	1732.5	20175	10	16QAM	1	0	11.88	0-1	0
	1732.5	20175	10	16QAM	1	25	12.10	0-1	0
	1732.5	20175	10	16QAM	1	49	11.79	0-1	0
	1732.5	20175	10	16QAM	25	0	12.10	0-2	0
	1732.5	20175	10	16QAM	25	12	12.17	0-2	0
	1732.5	20175	10	16QAM	25	25	12.04	0-2	0
	1732.5	20175	10	16QAM	50	0	12.07	0-2	0
High	1750	20350	10	QPSK	1	0	11.89	0	0
	1750	20350	10	QPSK	1	25	12.32	0	0
	1750	20350	10	QPSK	1	49	11.91	0	0
	1750	20350	10	QPSK	25	0	12.00	0-1	0
	1750	20350	10	QPSK	25	12	12.13	0-1	0
	1750	20350	10	QPSK	25	25	12.04	0-1	0
	1750	20350	10	QPSK	50	0	12.08	0-1	0
	1750	20350	10	16QAM	1	0	11.75	0-1	0
	1750	20350	10	16QAM	1	25	12.04	0-1	0
	1750	20350	10	16QAM	1	49	11.87	0-1	0
	1750	20350	10	16QAM	25	0	11.83	0-2	0
	1750	20350	10	16QAM	25	12	11.93	0-2	0
	1750	20350	10	16QAM	25	25	11.87	0-2	0
	1750	20350	10	16QAM	50	0	11.97	0-2	0

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Table 8-8
LTE Band 4 (AWS) Reduced Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1712.5	19975	5	QPSK	1	0	12.46	0	0
	1712.5	19975	5	QPSK	1	12	12.54	0	0
	1712.5	19975	5	QPSK	1	24	12.37	0	0
	1712.5	19975	5	QPSK	12	0	11.97	0-1	0
	1712.5	19975	5	QPSK	12	6	12.18	0-1	0
	1712.5	19975	5	QPSK	12	13	11.98	0-1	0
	1712.5	19975	5	QPSK	25	0	12.06	0-1	0
	1712.5	19975	5	16-QAM	1	0	11.93	0-1	0
	1712.5	19975	5	16-QAM	1	12	12.31	0-1	0
	1712.5	19975	5	16-QAM	1	24	11.82	0-1	0
	1712.5	19975	5	16-QAM	12	0	11.99	0-2	0
	1712.5	19975	5	16-QAM	12	6	12.14	0-2	0
	1712.5	19975	5	16-QAM	12	13	11.96	0-2	0
Mid	1732.5	20175	5	QPSK	1	0	12.01	0	0
	1732.5	20175	5	QPSK	1	12	12.43	0	0
	1732.5	20175	5	QPSK	1	24	11.98	0	0
	1732.5	20175	5	QPSK	12	0	12.15	0-1	0
	1732.5	20175	5	QPSK	12	6	12.30	0-1	0
	1732.5	20175	5	QPSK	12	13	12.11	0-1	0
	1732.5	20175	5	QPSK	25	0	12.17	0-1	0
	1732.5	20175	5	16-QAM	1	0	11.86	0-1	0
	1732.5	20175	5	16-QAM	1	12	12.15	0-1	0
	1732.5	20175	5	16-QAM	1	24	11.77	0-1	0
	1732.5	20175	5	16-QAM	12	0	12.06	0-2	0
	1732.5	20175	5	16-QAM	12	6	12.20	0-2	0
	1732.5	20175	5	16-QAM	12	13	12.02	0-2	0
	1732.5	20175	5	16-QAM	25	0	12.00	0-2	0
High	1752.5	20375	5	QPSK	1	0	11.80	0	0
	1752.5	20375	5	QPSK	1	12	12.21	0	0
	1752.5	20375	5	QPSK	1	24	11.82	0	0
	1752.5	20375	5	QPSK	12	0	11.96	0-1	0
	1752.5	20375	5	QPSK	12	6	12.11	0-1	0
	1752.5	20375	5	QPSK	12	13	12.02	0-1	0
	1752.5	20375	5	QPSK	25	0	12.01	0-1	0
	1752.5	20375	5	16-QAM	1	0	11.88	0-1	0
	1752.5	20375	5	16-QAM	1	12	12.31	0-1	0
	1752.5	20375	5	16-QAM	1	24	12.00	0-1	0
	1752.5	20375	5	16-QAM	12	0	12.10	0-2	0
	1752.5	20375	5	16-QAM	12	6	12.11	0-2	0
	1752.5	20375	5	16-QAM	12	13	12.02	0-2	0
	1752.5	20375	5	16-QAM	25	0	11.94	0-2	0

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LTE Band 2 (PCS)

Table 8-9
LTE Band 2 (PCS) Maximum 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	23.06	0	0
	1860	18700	20	QPSK	1	50	23.40	0	0
	1860	18700	20	QPSK	1	99	23.25	0	0
	1860	18700	20	QPSK	50	0	22.15	0-1	1
	1860	18700	20	QPSK	50	25	22.04	0-1	1
	1860	18700	20	QPSK	50	50	22.04	0-1	1
	1860	18700	20	QPSK	100	0	22.14	0-1	1
	1860	18700	20	16QAM	1	0	22.18	0-1	1
	1860	18700	20	16QAM	1	50	22.35	0-1	1
	1860	18700	20	16QAM	1	99	22.23	0-1	1
	1860	18700	20	16QAM	50	0	21.20	0-2	2
	1860	18700	20	16QAM	50	25	21.42	0-2	2
	1860	18700	20	16QAM	50	50	21.00	0-2	2
	1860	18700	20	16QAM	100	0	21.25	0-2	2
Mid	1880.0	18900	20	QPSK	1	0	23.60	0	0
	1880.0	18900	20	QPSK	1	50	23.14	0	0
	1880.0	18900	20	QPSK	1	99	23.29	0	0
	1880.0	18900	20	QPSK	50	0	22.30	0-1	1
	1880.0	18900	20	QPSK	50	25	22.13	0-1	1
	1880.0	18900	20	QPSK	50	50	22.09	0-1	1
	1880.0	18900	20	QPSK	100	0	22.21	0-1	1
	1880.0	18900	20	16QAM	1	0	22.56	0-1	1
	1880.0	18900	20	16QAM	1	50	22.04	0-1	1
	1880.0	18900	20	16QAM	1	99	21.85	0-1	1
	1880.0	18900	20	16QAM	50	0	20.89	0-2	2
	1880.0	18900	20	16QAM	50	25	20.59	0-2	2
	1880.0	18900	20	16QAM	50	50	20.49	0-2	2
	1880.0	18900	20	16QAM	100	0	20.76	0-2	2
High	1900	19100	20	QPSK	1	0	23.31	0	0
	1900	19100	20	QPSK	1	50	23.00	0	0
	1900	19100	20	QPSK	1	99	23.04	0	0
	1900	19100	20	QPSK	50	0	21.86	0-1	1
	1900	19100	20	QPSK	50	25	21.63	0-1	1
	1900	19100	20	QPSK	50	50	21.76	0-1	1
	1900	19100	20	QPSK	100	0	21.77	0-1	1
	1900	19100	20	16QAM	1	0	21.64	0-1	1
	1900	19100	20	16QAM	1	50	21.93	0-1	1
	1900	19100	20	16QAM	1	99	21.32	0-1	1
	1900	19100	20	16QAM	50	0	20.29	0-2	2
	1900	19100	20	16QAM	50	25	20.35	0-2	2
	1900	19100	20	16QAM	50	50	20.23	0-2	2
	1900	19100	20	16QAM	100	0	20.57	0-2	2

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Table 8-10
LTE Band 2 (PCS) Maximum 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	23.44	0	0
	1857.5	18675	15	QPSK	1	36	23.60	0	0
	1857.5	18675	15	QPSK	1	74	23.43	0	0
	1857.5	18675	15	QPSK	36	0	22.41	0-1	1
	1857.5	18675	15	QPSK	36	18	22.05	0-1	1
	1857.5	18675	15	QPSK	36	37	22.21	0-1	1
	1857.5	18675	15	QPSK	75	0	22.29	0-1	1
	1857.5	18675	15	16QAM	1	0	22.30	0-1	1
	1857.5	18675	15	16QAM	1	36	22.60	0-1	1
	1857.5	18675	15	16QAM	1	74	22.58	0-1	1
	1857.5	18675	15	16QAM	36	0	21.20	0-2	2
	1857.5	18675	15	16QAM	36	18	21.11	0-2	2
	1857.5	18675	15	16QAM	36	37	21.30	0-2	2
Mid	1857.5	18675	15	16QAM	75	0	21.35	0-2	2
	1880.0	18900	15	QPSK	1	0	22.75	0	0
	1880.0	18900	15	QPSK	1	36	22.45	0	0
	1880.0	18900	15	QPSK	1	74	22.63	0	0
	1880.0	18900	15	QPSK	36	0	21.38	0-1	1
	1880.0	18900	15	QPSK	36	18	21.69	0-1	1
	1880.0	18900	15	QPSK	36	37	21.78	0-1	1
	1880.0	18900	15	QPSK	75	0	21.69	0-1	1
	1880.0	18900	15	16QAM	1	0	22.21	0-1	1
	1880.0	18900	15	16QAM	1	36	21.90	0-1	1
	1880.0	18900	15	16QAM	1	74	22.06	0-1	1
	1880.0	18900	15	16QAM	36	0	20.70	0-2	2
	1880.0	18900	15	16QAM	36	18	20.65	0-2	2
	1880.0	18900	15	16QAM	36	37	20.75	0-2	2
High	1880.0	18900	15	16QAM	75	0	20.75	0-2	2
	1902.5	19125	15	QPSK	1	0	22.76	0	0
	1902.5	19125	15	QPSK	1	36	22.27	0	0
	1902.5	19125	15	QPSK	1	74	22.03	0	0
	1902.5	19125	15	QPSK	36	0	21.73	0-1	1
	1902.5	19125	15	QPSK	36	18	20.90	0-1	1
	1902.5	19125	15	QPSK	36	37	21.00	0-1	1
	1902.5	19125	15	QPSK	75	0	21.11	0-1	1
	1902.5	19125	15	16QAM	1	0	21.77	0-1	1
	1902.5	19125	15	16QAM	1	36	21.82	0-1	1
	1902.5	19125	15	16QAM	1	74	21.32	0-1	1
	1902.5	19125	15	16QAM	36	0	20.62	0-2	2
	1902.5	19125	15	16QAM	36	18	19.98	0-2	2
	1902.5	19125	15	16QAM	36	37	20.43	0-2	2
	1902.5	19125	15	16QAM	75	0	20.56	0-2	2

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Table 8-11
LTE Band 2 (PCS) Maximum Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1855	18650	10	QPSK	1	0	23.02	0	0
	1855	18650	10	QPSK	1	25	23.24	0	0
	1855	18650	10	QPSK	1	49	23.34	0	0
	1855	18650	10	QPSK	25	0	22.12	0-1	1
	1855	18650	10	QPSK	25	12	22.07	0-1	1
	1855	18650	10	QPSK	25	25	22.15	0-1	1
	1855	18650	10	QPSK	50	0	22.09	0-1	1
	1855	18650	10	16QAM	1	0	21.88	0-1	1
	1855	18650	10	16QAM	1	25	22.13	0-1	1
	1855	18650	10	16QAM	1	49	22.16	0-1	1
	1855	18650	10	16QAM	25	0	21.31	0-2	2
	1855	18650	10	16QAM	25	12	21.30	0-2	2
	1855	18650	10	16QAM	25	25	21.27	0-2	2
	1855	18650	10	16QAM	50	0	21.26	0-2	2
Mid	1880.0	18900	10	QPSK	1	0	23.24	0	0
	1880.0	18900	10	QPSK	1	25	23.16	0	0
	1880.0	18900	10	QPSK	1	49	23.26	0	0
	1880.0	18900	10	QPSK	25	0	22.11	0-1	1
	1880.0	18900	10	QPSK	25	12	22.22	0-1	1
	1880.0	18900	10	QPSK	25	25	22.12	0-1	1
	1880.0	18900	10	QPSK	50	0	22.15	0-1	1
	1880.0	18900	10	16QAM	1	0	21.79	0-1	1
	1880.0	18900	10	16QAM	1	25	21.63	0-1	1
	1880.0	18900	10	16QAM	1	49	21.84	0-1	1
	1880.0	18900	10	16QAM	25	0	21.16	0-2	2
	1880.0	18900	10	16QAM	25	12	21.08	0-2	2
	1880.0	18900	10	16QAM	25	25	21.17	0-2	2
	1880.0	18900	10	16QAM	50	0	21.00	0-2	2
High	1905	19150	10	QPSK	1	0	22.88	0	0
	1905	19150	10	QPSK	1	25	23.11	0	0
	1905	19150	10	QPSK	1	49	22.87	0	0
	1905	19150	10	QPSK	25	0	21.75	0-1	1
	1905	19150	10	QPSK	25	12	22.03	0-1	1
	1905	19150	10	QPSK	25	25	22.44	0-1	1
	1905	19150	10	QPSK	50	0	22.28	0-1	1
	1905	19150	10	16QAM	1	0	21.96	0-1	1
	1905	19150	10	16QAM	1	25	22.23	0-1	1
	1905	19150	10	16QAM	1	49	22.04	0-1	1
	1905	19150	10	16QAM	25	0	20.87	0-2	2
	1905	19150	10	16QAM	25	12	21.09	0-2	2
	1905	19150	10	16QAM	25	25	21.43	0-2	2
	1905	19150	10	16QAM	50	0	21.19	0-2	2

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Table 8-12
LTE Band 2 (PCS) Maximum Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1852.5	18625	5	QPSK	1	0	23.01	0	0
	1852.5	18625	5	QPSK	1	12	23.30	0	0
	1852.5	18625	5	QPSK	1	24	23.37	0	0
	1852.5	18625	5	QPSK	12	0	22.08	0-1	1
	1852.5	18625	5	QPSK	12	6	22.07	0-1	1
	1852.5	18625	5	QPSK	12	13	22.16	0-1	1
	1852.5	18625	5	QPSK	25	0	22.15	0-1	1
	1852.5	18625	5	16-QAM	1	0	21.96	0-1	1
	1852.5	18625	5	16-QAM	1	12	22.28	0-1	1
	1852.5	18625	5	16-QAM	1	24	22.26	0-1	1
	1852.5	18625	5	16-QAM	12	0	21.08	0-2	2
	1852.5	18625	5	16-QAM	12	6	21.23	0-2	2
	1852.5	18625	5	16-QAM	12	13	21.21	0-2	2
	1852.5	18625	5	16-QAM	25	0	21.12	0-2	2
Mid	1880.0	18900	5	QPSK	1	0	23.16	0	0
	1880.0	18900	5	QPSK	1	12	23.15	0	0
	1880.0	18900	5	QPSK	1	24	23.20	0	0
	1880.0	18900	5	QPSK	12	0	22.06	0-1	1
	1880.0	18900	5	QPSK	12	6	22.11	0-1	1
	1880.0	18900	5	QPSK	12	13	22.20	0-1	1
	1880.0	18900	5	QPSK	25	0	22.06	0-1	1
	1880.0	18900	5	16-QAM	1	0	21.91	0-1	1
	1880.0	18900	5	16-QAM	1	12	21.89	0-1	1
	1880.0	18900	5	16-QAM	1	24	21.96	0-1	1
	1880.0	18900	5	16-QAM	12	0	21.02	0-2	2
	1880.0	18900	5	16-QAM	12	6	21.08	0-2	2
	1880.0	18900	5	16-QAM	12	13	21.13	0-2	2
	1880.0	18900	5	16-QAM	25	0	21.02	0-2	2
High	1907.5	19175	5	QPSK	1	0	23.11	0	0
	1907.5	19175	5	QPSK	1	12	23.54	0	0
	1907.5	19175	5	QPSK	1	24	22.77	0	0
	1907.5	19175	5	QPSK	12	0	22.35	0-1	1
	1907.5	19175	5	QPSK	12	6	22.57	0-1	1
	1907.5	19175	5	QPSK	12	13	22.15	0-1	1
	1907.5	19175	5	QPSK	25	0	22.44	0-1	1
	1907.5	19175	5	16-QAM	1	0	22.09	0-1	1
	1907.5	19175	5	16-QAM	1	12	22.27	0-1	1
	1907.5	19175	5	16-QAM	1	24	21.72	0-1	1
	1907.5	19175	5	16-QAM	12	0	21.33	0-2	2
	1907.5	19175	5	16-QAM	12	6	21.58	0-2	2
	1907.5	19175	5	16-QAM	12	13	21.40	0-2	2
	1907.5	19175	5	16-QAM	25	0	21.45	0-2	2

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Table 8-13
LTE Band 2 (PCS) Reduced 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	11.66	0	0
	1860	18700	20	QPSK	1	50	12.49	0	0
	1860	18700	20	QPSK	1	99	11.59	0	0
	1860	18700	20	QPSK	50	0	11.96	0-1	0
	1860	18700	20	QPSK	50	25	11.79	0-1	0
	1860	18700	20	QPSK	50	50	11.51	0-1	0
	1860	18700	20	QPSK	100	0	11.58	0-1	0
	1860	18700	20	16QAM	1	0	11.62	0-1	0
	1860	18700	20	16QAM	1	50	11.96	0-1	0
	1860	18700	20	16QAM	1	99	11.50	0-1	0
	1860	18700	20	16QAM	50	0	11.83	0-2	0
	1860	18700	20	16QAM	50	25	11.76	0-2	0
	1860	18700	20	16QAM	50	50	11.54	0-2	0
	1860	18700	20	16QAM	100	0	11.57	0-2	0
Mid	1880.0	18900	20	QPSK	1	0	11.61	0	0
	1880.0	18900	20	QPSK	1	50	12.32	0	0
	1880.0	18900	20	QPSK	1	99	11.58	0	0
	1880.0	18900	20	QPSK	50	0	12.19	0-1	0
	1880.0	18900	20	QPSK	50	25	12.33	0-1	0
	1880.0	18900	20	QPSK	50	50	12.16	0-1	0
	1880.0	18900	20	QPSK	100	0	11.96	0-1	0
	1880.0	18900	20	16QAM	1	0	11.50	0-1	0
	1880.0	18900	20	16QAM	1	50	12.28	0-1	0
	1880.0	18900	20	16QAM	1	99	11.61	0-1	0
	1880.0	18900	20	16QAM	50	0	11.79	0-2	0
	1880.0	18900	20	16QAM	50	25	12.11	0-2	0
	1880.0	18900	20	16QAM	50	50	11.92	0-2	0
	1880.0	18900	20	16QAM	100	0	11.91	0-2	0
High	1900	19100	20	QPSK	1	0	11.65	0	0
	1900	19100	20	QPSK	1	50	12.14	0	0
	1900	19100	20	QPSK	1	99	11.50	0	0
	1900	19100	20	QPSK	50	0	11.77	0-1	0
	1900	19100	20	QPSK	50	25	11.78	0-1	0
	1900	19100	20	QPSK	50	50	11.79	0-1	0
	1900	19100	20	QPSK	100	0	11.80	0-1	0
	1900	19100	20	16QAM	1	0	11.57	0-1	0
	1900	19100	20	16QAM	1	50	11.97	0-1	0
	1900	19100	20	16QAM	1	99	11.53	0-1	0
	1900	19100	20	16QAM	50	0	11.77	0-2	0
	1900	19100	20	16QAM	50	25	11.81	0-2	0
	1900	19100	20	16QAM	50	50	11.74	0-2	0
	1900	19100	20	16QAM	100	0	11.75	0-2	0

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Table 8-14
LTE Band 2 (PCS) Reduced 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	11.84	0	0
	1857.5	18675	15	QPSK	1	36	11.78	0	0
	1857.5	18675	15	QPSK	1	74	12.34	0	0
	1857.5	18675	15	QPSK	36	0	11.55	0-1	0
	1857.5	18675	15	QPSK	36	18	11.74	0-1	0
	1857.5	18675	15	QPSK	36	37	12.26	0-1	0
	1857.5	18675	15	QPSK	75	0	11.89	0-1	0
	1857.5	18675	15	16QAM	1	0	11.84	0-1	0
	1857.5	18675	15	16QAM	1	36	11.53	0-1	0
	1857.5	18675	15	16QAM	1	74	11.72	0-1	0
	1857.5	18675	15	16QAM	36	0	12.09	0-2	0
	1857.5	18675	15	16QAM	36	18	11.53	0-2	0
Mid	1857.5	18675	15	16QAM	36	37	12.46	0-2	0
	1857.5	18675	15	16QAM	75	0	12.30	0-2	0
	1880.0	18900	15	QPSK	1	0	11.93	0	0
	1880.0	18900	15	QPSK	1	36	11.55	0	0
	1880.0	18900	15	QPSK	1	74	11.60	0	0
	1880.0	18900	15	QPSK	36	0	12.26	0-1	0
	1880.0	18900	15	QPSK	36	18	12.12	0-1	0
	1880.0	18900	15	QPSK	36	37	12.08	0-1	0
	1880.0	18900	15	QPSK	75	0	12.38	0-1	0
	1880.0	18900	15	16QAM	1	0	12.23	0-1	0
	1880.0	18900	15	16QAM	1	36	11.54	0-1	0
	1880.0	18900	15	16QAM	1	74	11.51	0-1	0
High	1880.0	18900	15	16QAM	36	0	12.12	0-2	0
	1880.0	18900	15	16QAM	36	18	12.13	0-2	0
	1880.0	18900	15	16QAM	36	37	11.67	0-2	0
	1880.0	18900	15	16QAM	75	0	11.77	0-2	0
	1902.5	19125	15	QPSK	1	0	11.73	0	0
	1902.5	19125	15	QPSK	1	36	11.69	0	0
	1902.5	19125	15	QPSK	1	74	11.83	0	0
	1902.5	19125	15	QPSK	36	0	12.00	0-1	0
	1902.5	19125	15	QPSK	36	18	11.84	0-1	0
	1902.5	19125	15	QPSK	36	37	12.12	0-1	0
	1902.5	19125	15	QPSK	75	0	12.43	0-1	0
	1902.5	19125	15	16QAM	1	0	11.74	0-1	0
	1902.5	19125	15	16QAM	1	36	12.02	0-1	0
	1902.5	19125	15	16QAM	1	74	11.53	0-1	0
	1902.5	19125	15	16QAM	36	0	11.51	0-2	0
	1902.5	19125	15	16QAM	36	18	11.64	0-2	0
	1902.5	19125	15	16QAM	36	37	11.52	0-2	0
	1902.5	19125	15	16QAM	75	0	11.54	0-2	0

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Table 8-15
LTE Band 2 (PCS) Reduced Conducted Powers – 10 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1855	18650	10	QPSK	1	0	11.86	0	0
	1855	18650	10	QPSK	1	25	12.50	0	0
	1855	18650	10	QPSK	1	49	12.22	0	0
	1855	18650	10	QPSK	25	0	12.06	0-1	0
	1855	18650	10	QPSK	25	12	12.15	0-1	0
	1855	18650	10	QPSK	25	25	12.02	0-1	0
	1855	18650	10	QPSK	50	0	12.09	0-1	0
	1855	18650	10	16QAM	1	0	11.86	0-1	0
	1855	18650	10	16QAM	1	25	12.29	0-1	0
	1855	18650	10	16QAM	1	49	11.84	0-1	0
	1855	18650	10	16QAM	25	0	12.03	0-2	0
	1855	18650	10	16QAM	25	12	12.17	0-2	0
	1855	18650	10	16QAM	25	25	12.08	0-2	0
	1855	18650	10	16QAM	50	0	12.17	0-2	0
Mid	1880.0	18900	10	QPSK	1	0	11.96	0	0
	1880.0	18900	10	QPSK	1	25	12.30	0	0
	1880.0	18900	10	QPSK	1	49	12.02	0	0
	1880.0	18900	10	QPSK	25	0	12.36	0-1	0
	1880.0	18900	10	QPSK	25	12	12.48	0-1	0
	1880.0	18900	10	QPSK	25	25	12.43	0-1	0
	1880.0	18900	10	QPSK	50	0	12.38	0-1	0
	1880.0	18900	10	16QAM	1	0	11.92	0-1	0
	1880.0	18900	10	16QAM	1	25	12.42	0-1	0
	1880.0	18900	10	16QAM	1	49	12.22	0-1	0
	1880.0	18900	10	16QAM	25	0	12.18	0-2	0
	1880.0	18900	10	16QAM	25	12	12.40	0-2	0
	1880.0	18900	10	16QAM	25	25	12.37	0-2	0
	1880.0	18900	10	16QAM	50	0	12.24	0-2	0
High	1905	19150	10	QPSK	1	0	11.81	0	0
	1905	19150	10	QPSK	1	25	12.10	0	0
	1905	19150	10	QPSK	1	49	11.65	0	0
	1905	19150	10	QPSK	25	0	11.69	0-1	0
	1905	19150	10	QPSK	25	12	11.80	0-1	0
	1905	19150	10	QPSK	25	25	11.98	0-1	0
	1905	19150	10	QPSK	50	0	11.87	0-1	0
	1905	19150	10	16QAM	1	0	11.64	0-1	0
	1905	19150	10	16QAM	1	25	11.66	0-1	0
	1905	19150	10	16QAM	1	49	11.65	0-1	0
	1905	19150	10	16QAM	25	0	11.60	0-2	0
	1905	19150	10	16QAM	25	12	11.66	0-2	0
	1905	19150	10	16QAM	25	25	11.90	0-2	0
	1905	19150	10	16QAM	50	0	11.78	0-2	0

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Table 8-16
LTE Band 2 (PCS) Reduced Conducted Powers – 5 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1852.5	18625	5	QPSK	1	0	11.78	0	0
	1852.5	18625	5	QPSK	1	12	12.45	0	0
	1852.5	18625	5	QPSK	1	24	12.10	0	0
	1852.5	18625	5	QPSK	12	0	11.92	0-1	0
	1852.5	18625	5	QPSK	12	6	12.16	0-1	0
	1852.5	18625	5	QPSK	12	13	11.95	0-1	0
	1852.5	18625	5	QPSK	25	0	12.03	0-1	0
	1852.5	18625	5	16-QAM	1	0	11.60	0-1	0
	1852.5	18625	5	16-QAM	1	12	12.23	0-1	0
	1852.5	18625	5	16-QAM	1	24	11.69	0-1	0
	1852.5	18625	5	16-QAM	12	0	11.85	0-2	0
	1852.5	18625	5	16-QAM	12	6	12.04	0-2	0
	1852.5	18625	5	16-QAM	12	13	11.90	0-2	0
	1852.5	18625	5	16-QAM	25	0	11.94	0-2	0
Mid	1880.0	18900	5	QPSK	1	0	11.88	0	0
	1880.0	18900	5	QPSK	1	12	12.39	0	0
	1880.0	18900	5	QPSK	1	24	12.00	0	0
	1880.0	18900	5	QPSK	12	0	12.16	0-1	0
	1880.0	18900	5	QPSK	12	6	12.47	0-1	0
	1880.0	18900	5	QPSK	12	13	12.28	0-1	0
	1880.0	18900	5	QPSK	25	0	12.31	0-1	0
	1880.0	18900	5	16-QAM	1	0	11.72	0-1	0
	1880.0	18900	5	16-QAM	1	12	12.26	0-1	0
	1880.0	18900	5	16-QAM	1	24	11.92	0-1	0
	1880.0	18900	5	16-QAM	12	0	12.04	0-2	0
	1880.0	18900	5	16-QAM	12	6	12.26	0-2	0
	1880.0	18900	5	16-QAM	12	13	12.12	0-2	0
	1880.0	18900	5	16-QAM	25	0	12.09	0-2	0
High	1907.5	19175	5	QPSK	1	0	11.54	0	0
	1907.5	19175	5	QPSK	1	12	12.09	0	0
	1907.5	19175	5	QPSK	1	24	11.50	0	0
	1907.5	19175	5	QPSK	12	0	11.73	0-1	0
	1907.5	19175	5	QPSK	12	6	12.14	0-1	0
	1907.5	19175	5	QPSK	12	13	11.86	0-1	0
	1907.5	19175	5	QPSK	25	0	11.99	0-1	0
	1907.5	19175	5	16-QAM	1	0	11.65	0-1	0
	1907.5	19175	5	16-QAM	1	12	12.39	0-1	0
	1907.5	19175	5	16-QAM	1	24	11.86	0-1	0
	1907.5	19175	5	16-QAM	12	0	11.65	0-2	0
	1907.5	19175	5	16-QAM	12	6	12.11	0-2	0
	1907.5	19175	5	16-QAM	12	13	11.88	0-2	0
	1907.5	19175	5	16-QAM	25	0	11.94	0-2	0

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9 SYSTEM VERIFICATION

9.1 Tissue Verification

Table 9-1
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
07/21/2014	1750B	22.4	1710	1.400	52.108	1.463	53.537	-4.31%	-2.67%
			1750	1.441	51.958	1.488	53.432	-3.16%	-2.76%
			1790	1.481	51.839	1.514	53.326	-2.18%	-2.79%
07/21/2014	1900B	23.2	1850	1.455	52.660	1.520	53.300	-4.28%	-1.20%
			1880	1.489	52.551	1.520	53.300	-2.04%	-1.41%
			1910	1.521	52.442	1.520	53.300	0.07%	-1.61%

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 IEEE 1528 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.

9.2 Test System Verification

Prior to SAR assessment, the system is verified to $\pm 10\%$ of the SAR measurement on the reference dipole at the time of calibration by the calibration facility.

Table 9-2
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} (%)
H	1750	BODY	07/21/2014	23.4	22.4	0.100	1051	3319	3.680	37.400	36.800	-1.60%
K	1900	BODY	07/21/2014	24.5	23.2	0.100	5d141	3287	4.070	40.600	40.700	0.25%

Note: Full system validation status and results can be found in Appendix E.

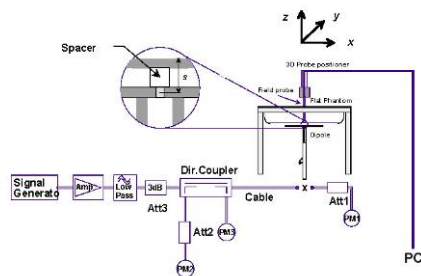


Figure 9-1
System Verification Setup Diagram



Figure 9-2
System Verification Setup Photo

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10 SAR DATA SUMMARY

10.1 Standalone Body SAR Data

Table 10-1
PCB Body SAR: LTE Band 4 (AWS)

MEASUREMENT RESULTS																			
FREQUENCY		Ch.	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																(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.70	23.40	-0.01	0	4689-0543	QPSK	1	50	12 mm	back	1:1	0.812	1.072	0.870	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.70	22.20	0.04	1	4689-0543	QPSK	50	0	12 mm	back	1:1	0.651	1.122	0.730	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.70	21.99	0.00	1	4689-0543	QPSK	100	0	12 mm	back	1:1	0.607	1.178	0.715	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.70	23.40	-0.01	0	4689-0543	QPSK	1	50	10 mm	top	1:1	0.738	1.072	0.791	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.70	22.20	0.15	1	4689-0543	QPSK	50	0	10 mm	top	1:1	0.582	1.122	0.653	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.70	23.40	0.08	0	4689-0543	QPSK	1	50	0 mm	right	1:1	0.208	1.072	0.223	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	22.70	22.20	0.04	1	4689-0543	QPSK	50	0	0 mm	right	1:1	0.148	1.122	0.166	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.60	12.35	-0.01	0	4689-0542	QPSK	1	50	0 mm	back	1:1	0.606	1.059	0.642	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.60	12.01	-0.10	0	4689-0542	QPSK	50	0	0 mm	back	1:1	0.497	1.146	0.570	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.60	12.35	-0.01	0	4689-0542	QPSK	1	50	0 mm	top	1:1	0.314	1.059	0.333	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.60	12.01	-0.10	0	4689-0542	QPSK	50	0	0 mm	top	1:1	0.271	1.146	0.311	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.70	23.40	-0.04	0	4689-0543	QPSK	1	50	12 mm	back	1:1	0.813	1.072	0.872	A1
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

Blue entries represent variability

Table 10-2
PCB Body SAR: LTE Band 2 (PCS)

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 #
																(W/kg)		(W/kg)	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.60	23.60	-0.01	0	4689-0538	QPSK	1	0	12 mm	back	1:1	0.703	1.000	0.703	A2
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.60	22.30	0.06	1	4689-0538	QPSK	50	0	12 mm	back	1:1	0.478	1.072	0.512	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.60	23.60	-0.20	0	4689-0538	QPSK	1	0	10 mm	top	1:1	0.651	1.000	0.651	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.60	22.30	-0.06	1	4689-0538	QPSK	50	0	10 mm	top	1:1	0.425	1.072	0.456	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.60	23.60	0.14	0	4689-0538	QPSK	1	0	0 mm	right	1:1	0.599	1.000	0.599	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.60	22.30	0.16	1	4689-0538	QPSK	50	0	0 mm	right	1:1	0.414	1.072	0.444	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.50	12.49	0.06	0	4689-0542	QPSK	1	50	0 mm	back	1:1	0.432	1.002	0.433	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	12.50	12.33	0.17	0	4689-0542	QPSK	50	25	0 mm	back	1:1	0.539	1.040	0.561	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.50	12.49	-0.02	0	4689-0542	QPSK	1	50	0 mm	top	1:1	0.247	1.002	0.247	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	12.50	12.33	-0.11	0	4689-0542	QPSK	50	25	0 mm	top	1:1	0.280	1.040	0.291	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population									Body 1.6 W/kg (mW/g) averaged over 1 gram										

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10.2 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR values according to test procedures specified in FCC KDB Publication 616217 D04.
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 KDB 616217 D04 Section 4.3, SAR tests are required for the back surface and edges of the tablet with the tablet touching the phantom. The SAR Exclusion Threshold in FCC KDB 447498 D01v05 was applied to determine SAR test exclusion for adjacent edge configurations. SAR tests were required for top and right edge for the main antenna.
7. Per FCC KDB 865664 D01 v01, variability SAR tests were performed when the measured SAR results for a frequency band were greater than 0.8 W/kg. Repeated SAR measurements are highlighted in the tables above for clarity. Please see Section 12 for variability analysis.

LTE Notes:

1. 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 6.3.4.
2. 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.
3. 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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11 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

11.1 Introduction

The following procedures adopted from FCC KDB Publication 447498 D01v05 are applicable to handsets with built-in unlicensed transmitters such as 802.11a/b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

11.2 Simultaneous Transmission Procedures

This device contains transmitters that may operate simultaneously. Therefore simultaneous transmission analysis is required. Per FCC KDB 447498 D01v05 IV.C.1.iii, simultaneous transmission SAR test exclusion may be applied when the sum of the 1-g SAR for all the simultaneous transmitting antennas in a specific physical test configuration is ≤ 1.6 W/kg. When standalone SAR is not required to be measured, per FCC KDB 447498 D01v05 4.3.2 2), the following equation must be used to estimate the standalone 1g SAR for simultaneous transmission assessment involving that transmitter when the test separation distance is less than 50mm; otherwise 0.4 W/kg should be used for 1g SAR.

$$\text{Estimated SAR} = \frac{\sqrt{f(\text{GHz})}}{7.5} * \frac{(\text{Max Power of channel, mW})}{\text{Min. Separation Distance, mm}}$$

Note: Please see RF Exposure Technical Report S/N: 0Y1211281716-R1.A3L with simultaneous SAR assessments for the other combinations not referred to in these tables. This report only contains the combinations applicable to the permissive change.

11.3 Body Simultaneous Transmission Analysis

Table 11-1
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 0 mm)

Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.642	1.027	See Note 1	0.01
	Top	0.333	0.337	0.670	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.223	0.400	0.623	N/A
	Left	0.400	0.136	0.536	N/A
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.561	1.027	1.588	N/A
	Top	0.291	0.337	0.628	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.599	0.400	0.999	N/A
	Left	0.400	0.136	0.536	N/A

Note 1: No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was below 0.04 per FCC KDB 447498 D01v05. See Section 11.4 for detailed SPLS ratio analysis.

Note 2: For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion since the test separation distance was >50 mm.

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Table 11-2
Simultaneous Transmission Scenario with 5 GHz WLAN (Body at 0 mm)

Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.642	0.565	1.207	N/A
	Top	0.333	0.880	1.213	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.223	0.400	0.623	N/A
	Left	0.400	0.358	0.758	N/A
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.561	0.565	1.126	N/A
	Top	0.291	0.880	1.171	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.599	0.400	0.999	N/A
	Left	0.400	0.358	0.758	N/A

Note 1: The worst case 5 GHz WIFI reported SAR for each configuration was considered for simultaneous SAR exclusion via summation of standalone SAR, regardless of whether the WIFI channel has WIFI Direct capability, for simplicity to determine compliance. Please note that the actual simultaneous transmission SAR will not exceed the summed levels indicated.

Note 2: For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion since the test separation distance was >50 mm.

Table 11-3
Simultaneous Transmission Scenario with Bluetooth (Body at 0 mm)

Simult Tx	Configuration	LTE Band 4 (AWS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.642	0.301	0.943	N/A
	Top	0.333	0.094	0.427	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.223	0.400	0.623	N/A
	Left	0.400	0.037	0.437	N/A
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	0.561	0.301	0.862	N/A
	Top	0.291	0.094	0.385	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.599	0.400	0.999	N/A
	Left	0.400	0.037	0.437	N/A

Note 1: For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion since the test separation distance was >50 mm.

Table 11-4
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 12mm)

Configuration	Mode	4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	LTE Band 4 (AWS)	0.872	< 1.027	See Note 1	<0.02
Back Side	LTE Band 2 (PCS)	0.703	< 1.027	See Note 1	<0.02

Note 1: No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was below 0.04 per FCC KDB 447498 D01v05. See Section 11.4 for detailed SPLS ratio analysis.

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Table 11-5
Simultaneous Transmission Scenario with 5 GHz WLAN (Body at 12mm)

Configuration	Mode	4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	LTE Band 4 (AWS)	0.872	< 0.565	< 1.437	N/A
Back Side	LTE Band 2 (PCS)	0.703	< 0.565	< 1.268	N/A

Note 1: The worst case 5 GHz WIFI reported SAR for each configuration was considered for simultaneous SAR exclusion via summation of standalone SAR, regardless of whether the WIFI channel has WIFI Direct capability, for simplicity to determine compliance. Please note that the actual simultaneous transmission SAR will not exceed the summed levels indicated.

Table 11-6
Simultaneous Transmission Scenario with Bluetooth (Body at 12mm)

Configuration	Mode	4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	LTE Band 4 (AWS)	0.872	< 0.301	< 1.173	N/A
Back Side	LTE Band 2 (PCS)	0.703	< 0.301	< 1.004	N/A

Table 11-7
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body at 10mm)

Configuration	Mode	4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	LTE Band 4 (AWS)	0.791	< 0.337	< 1.128	N/A
Top Edge	LTE Band 2 (PCS)	0.651	< 0.337	< 0.988	N/A

Table 11-8
Simultaneous Transmission Scenario with 5 GHz WLAN (Body at 10mm)

Configuration	Mode	4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	LTE Band 4 (AWS)	0.791	< 0.880	See Note 1	<0.01
Top Edge	LTE Band 2 (PCS)	0.651	< 0.880	< 1.531	N/A

Note 1: No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was below 0.04 per FCC KDB 447498 D01v05. See Section 11.4 for detailed SPLS ratio analysis.

Note 2: The worst case 5 GHz WIFI reported SAR for each configuration was considered for simultaneous SAR exclusion via summation of standalone SAR, regardless of whether the WIFI channel has WIFI Direct capability, for simplicity to determine compliance. Please note that the actual simultaneous transmission SAR will not exceed the summed levels indicated.

Table 11-9
Simultaneous Transmission Scenario with Bluetooth (Body at 10mm)

Configuration	Mode	4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	LTE Band 4 (AWS)	0.791	< 0.094	< 0.885	N/A
Top Edge	LTE Band 2 (PCS)	0.651	< 0.094	< 0.745	N/A

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11.4 SPLSR Evaluation Analysis

Per FCC KDB Publication 447498 D01v05, when the sum of the standalone transmitters is more than 1.6 W/kg, the SAR sum to peak locations can be analyzed to determine SAR distribution overlaps. When the SAR peak to location ratio (shown below) for each pair of antennas is ≤ 0.04 , simultaneous SAR evaluation is not required. The distance between the transmitters was calculated using the following formula.

$$\text{Distance}_{T_{X1}-T_{X2}} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

$$\text{SPLS Ratio} = (\text{SAR}_1 + \text{SAR}_2)^{1.5} / R_i$$

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 0cm with LTE Band 4 potentially operating at limited output power with 2.4 GHz WIFI.

Figure 11-4
Peak SAR Location Plot of LTE Band 4 and 2.4 GHz WLAN

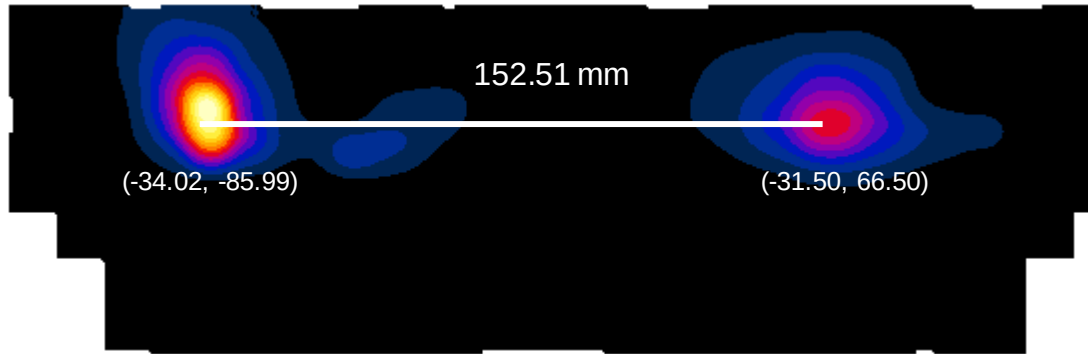


Table 11-16
Peak SAR Locations for Body Back Side LTE Band 4 and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
LTE B4	-31.50	66.50
802.11b	-34.02	-85.99

Table 11-17
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5} / D_{a-b}$
LTE B4	802.11b	0.642	1.027	1.669	152.51	0.01

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 1.2cm with LTE Band 4 potentially operating at maximum output power with 2.4 GHz WIFI.

Figure 11-5
Peak SAR Location Plot of LTE Band 4 and 2.4 GHz WLAN

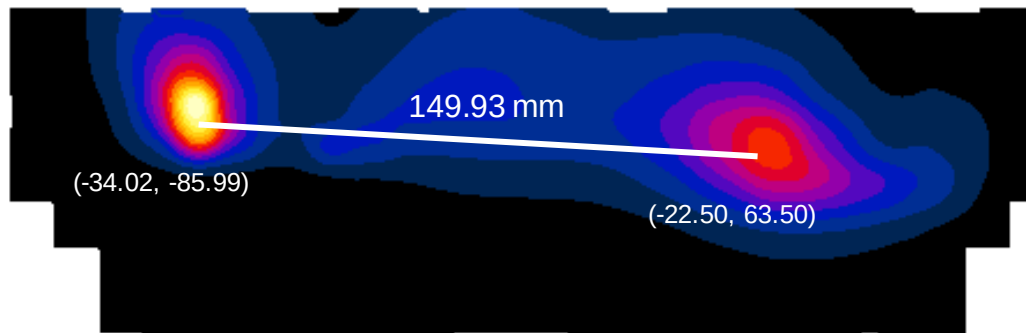


Table 11-18
Peak SAR Locations for Body Back Side LTE Band 4 and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
LTE B4	-22.50	63.50
802.11b	-34.02	-85.99

Table 11-19
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B4	802.11b	0.872	<1.027	<1.899	149.93	<0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Back side configuration at a separation distance of 1.2cm with LTE B2 potentially operating at maximum output power with 2.4 GHz WIFI.

Figure 11-6
Peak SAR Location Plot of LTE B2 and 2.4 GHz WLAN

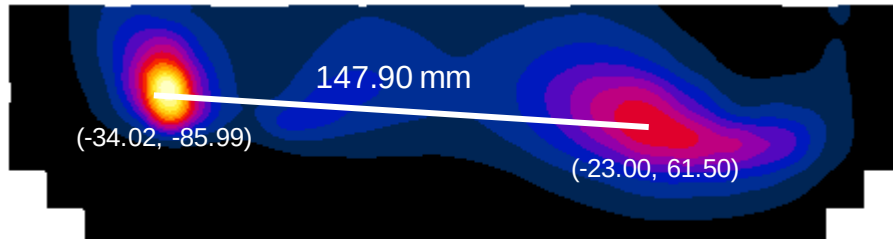


Table 11-20
Peak SAR Locations for Body Back Side LTE B2 and 2.4 GHz WLAN

Mode/Band	x (mm)	y (mm)
LTE B2	-23.00	61.50
802.11b	-34.02	-85.99

Table 11-21
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B2	802.11b	0.703	<1.027	<1.730	147.90	<0.02

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The sum of the standalone SAR values was above 1.6 W/kg for the Body Top Edge configuration at a separation distance of 1.0cm with LTE B4 potentially operating at maximum output power with 5 GHz WIFI.

Figure 11-7
Peak SAR Location Plot of LTE B4 and 5 GHz WLAN



Table 11-22
Peak SAR Locations for Body Top Side LTE B4 and 5 GHz WLAN

Mode/Band	x (mm)	y (mm)
LTE B4	-15.50	57.50
802.11a	-12.13	-104.97

Table 11-23
SAR Sum to Peak Location Separation Ratio Calculation

Antenna Pair		Standalone 1g SAR (W/kg)		Standalone SAR Sum (W/kg)	Peak SAR Separation Distance (mm)	SPLS Ratio
Ant "a"	Ant "b"	a	b	a+b	D_{a-b}	$(a+b)^{1.5}/D_{a-b}$
LTE B4	802.11a	0.791	<0.880	<1.671	162.50	<0.01

11.5 Simultaneous Transmission Conclusion

The above numerical summed SAR results and SPLSR analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05.

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12 SAR MEASUREMENT VARIABILITY

12.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, SAR measurement variability was assessed for each frequency band, which was determined by the SAR probe calibration point and tissue-equivalent medium used for the device measurements. When both head and body tissue-equivalent media were required for SAR measurements in a frequency band, the variability measurement procedures were applied to the tissue medium with the highest measured SAR, using the highest measured SAR configuration for that tissue-equivalent medium. These additional measurements were repeated after the completion of all measurements requiring the same head or body tissue-equivalent medium in a frequency band. The test device was returned to ambient conditions (normal room temperature) with the battery fully charged before it was re-mounted on the device holder for the repeated measurement(s) to minimize any unexpected variations in the repeated results.

SAR Measurement Variability was assessed using the following procedures for each frequency band:

- 1) When the original highest measured SAR is ≥ 0.80 W/kg, the measurement was repeated once.
- 2) A second repeated measurement was performed only if the ratio of largest to smallest SAR for the original and first repeated measurements was > 1.20 or when the original or repeated measurement was ≥ 1.45 W/kg (~ 10% from the 1-g SAR limit).
- 3) A third repeated measurement was performed only if the original, first or second repeated measurement was ≥ 1.5 W/kg and the ratio of largest to smallest SAR for the original, first and second repeated measurements is > 1.20 .
- 4) Repeated measurements are not required when the original highest measured SAR is < 0.80 W/kg

Table 12-1
Body SAR Measurement Variability Results

BODY VARIABILITY RESULTS													
Band	FREQUENCY		Mode	Service	Side	Spacing	Measured SAR (1g)	1st Repeated SAR (1g)	Ratio	2nd Repeated SAR (1g)	Ratio	3rd Repeated SAR (1g)	Ratio
	MHz	Ch.					(W/kg)	(W/kg)		(W/kg)		(W/kg)	
1750	1732.50	20175	LTE Band 4 (AWS)	QPSK, 1 RB, 50 RB Offset	back	12 mm	0.812	0.813	1.00	N/A	N/A	N/A	N/A
ANSI / IEEE C95.1 1992 - SAFETY LIMIT						Body							
Spatial Peak						1.6 W/kg (mW/g)							
Uncontrolled Exposure/General Population						averaged over 1 gram							

12.2 Measurement Uncertainty

The measured SAR was < 1.5 W/kg for all frequency bands. Therefore, per KDB Publication 865664 D01v01, the extensive SAR measurement uncertainty analysis described in IEEE 1528-2003 was not required

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13 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	E5515C	Wireless Communications Test Set	9/24/2012	Biennial	9/24/2014	GB43163447
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
Agilent	E4438C	ESG Vector Signal Generator	4/25/2014	Annual	4/25/2015	MY42082385
Agilent	8753ES	S-Parameter Network Analyzer	5/22/2014	Annual	5/22/2015	US39170118
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Amplifier Research	1551G6	Amplifier	CBT	NA	CBT	433978
Anritsu	ML2495A	Power Meter	10/31/2013	Annual	10/31/2014	1039008
Anritsu	MA2411B	Pulse Power Sensor	11/14/2013	Annual	11/14/2014	1126066
Anritsu	MA2411B	Pulse Power Sensor	2/3/2014	Annual	2/3/2015	1339018
Anritsu	ML2469A	Power Meter	3/14/2014	Annual	3/14/2015	1306009
Anritsu	MA24106A	USB Power Sensor	5/15/2014	Annual	5/15/2015	1244524
Anritsu	MA24106A	USB Power Sensor	5/15/2014	Annual	5/15/2015	1244512
Anritsu	MT8820C	Radio Communication Analyzer	CBT	NA	CBT	6201144418
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	NA	CBT	M3W1A00-1002
Control Company	61220-416	Long-Stem Thermometer	4/29/2014	Biennial	4/29/2016	111331323
Control Company	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	122014488
Fisher Scientific	S97611	Thermometer	4/12/2013	Biennial	4/12/2015	130219304
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764558
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/30/2013	Annual	10/30/2014	1833460
Gigatronics	8651A	Universal Power Meter	10/30/2013	Annual	10/30/2014	8650319
MCL	BW-N6W5+	6dB Attenuator	CBT	NA	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	NA	CBT	R8979500903
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	NA	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	NA	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	NA	CBT	N/A
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	NA	CBT	1226
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264165
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	NA	CBT	N/A
Narda	BW-S3W2	Attenuator (3dB)	CBT	NA	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	NA	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	NA	CBT	N/A
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Rohde & Schwarz	NRV-Z32	Peak Power Sensor	10/12/2012	Biennial	10/12/2014	836019/013
Rohde & Schwarz	CMW500	Radio Communication Tester	10/4/2013	Biennial	10/4/2015	103962
Rohde & Schwarz	SME06	Signal Generator	10/30/2013	Annual	10/30/2014	832026
Rohde & Schwarz	NRVS	Single Channel Power Meter	10/31/2013	Annual	10/31/2014	835360/0079
Rohde & Schwarz	CMU200	Base Station Simulator	6/6/2014	Annual	6/6/2015	109892
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	22313
Seekonk	NC-100	Torque Wrench 5/16", 8" lbs	3/18/2014	Biennial	3/18/2016	N/A
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/18/2013	Annual	8/18/2014	1009
SPEAG	DAE4	Dasy Data Acquisition Electronics	11/19/2013	Annual	11/19/2014	1408
SPEAG	ES3DV3	SAR Probe	11/20/2013	Annual	11/20/2014	3287
SPEAG	D1900V2	1900 MHz SAR Dipole	4/9/2014	Annual	4/9/2015	5d141
SPEAG	D1750V2	1750 MHz SAR Dipole	4/10/2014	Annual	4/10/2015	1051
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/11/2014	Annual	4/11/2015	1368
SPEAG	ES3DV3	SAR Probe	4/17/2014	Annual	4/17/2015	3319
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/6/2014	Annual	5/6/2015	1070
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/16/2014	Annual	4/16/2015	8010177

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
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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FCC ID: A3LSCHI925U	 SAR EVALUATION REPORT 		Reviewed by: Quality Manager
Document S/N: OY1407221432.A3L	Test Dates: 07/21/2014	DUT Type: Portable Tablet Computer	Page 44 of 45

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FCC ID: A3LSCHI925U	 SAR EVALUATION REPORT 		Reviewed by: Quality Manager
Document S/N: OY1407221432.A3L	Test Dates: 07/21/2014	DUT Type: Portable Tablet Computer	Page 45 of 45

APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHI925U; Type: Portable Tablet Computer; Serial: 4689-0543

Communication System: UID 0, LTE Band 4 (AWS); Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium: 1750 Body Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.423 \text{ S/m}$; $\epsilon_r = 52.024$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.2 cm

Test Date: 07-21-2014; Ambient Temp: 23.4°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3319; ConvF(4.85, 4.85, 4.85); Calibrated: 4/17/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202

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**

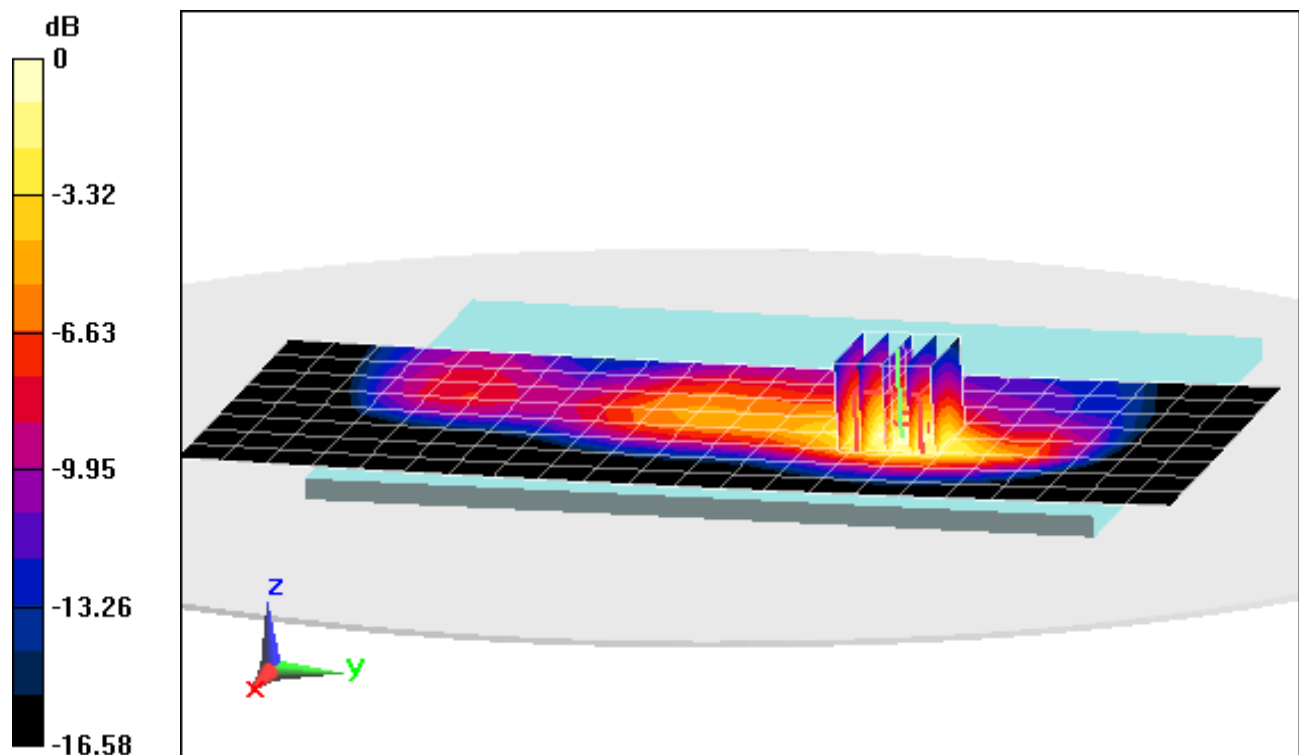
Area Scan (9x23x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 25.61 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 1.34 W/kg

SAR(1 g) = 0.813 W/kg



0 dB = 0.981 W/kg = -0.08 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSCHI925U; Type: Portable Tablet Computer; Serial: 4689-0538

Communication System: UID 0, LTE Band 2 (PCS); Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.489 \text{ S/m}$; $\epsilon_r = 52.551$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.2 cm

Test Date: 07-21-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.2°C

Probe: ES3DV3 - SN3287; ConvF(4.67, 4.67, 4.67); Calibrated: 11/20/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229

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, 0 RB Offset**

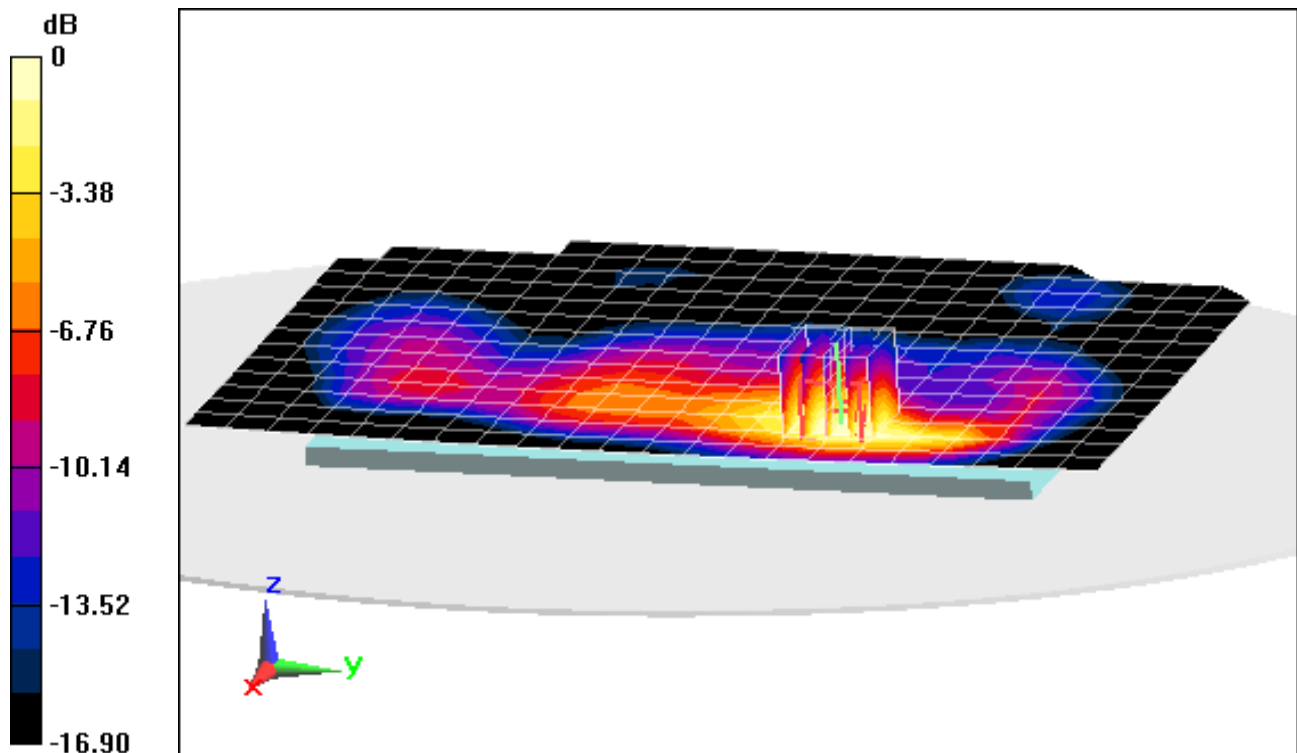
Area Scan (16x23x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 22.70 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 1.21 W/kg

SAR(1 g) = 0.703 W/kg



0 dB = 0.860 W/kg = -0.66 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 1750 MHz; Type: D1750V2; Serial: 1051

Communication System: UID 0, CW; Frequency: 1750 MHz; Duty Cycle: 1:1

Medium: 1750 Body Medium parameters used:

$f = 1750 \text{ MHz}$; $\sigma = 1.441 \text{ S/m}$; $\epsilon_r = 51.958$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 07-21-2014; Ambient Temp: 23.4°C; Tissue Temp: 22.4°C

Probe: ES3DV3 - SN3319; ConvF(4.85, 4.85, 4.85); Calibrated: 4/17/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1368; Calibrated: 4/11/2014

Phantom: ELI left; Type: QDOVA002AA; Serial: TP:1202

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification

Area Scan (7x9x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

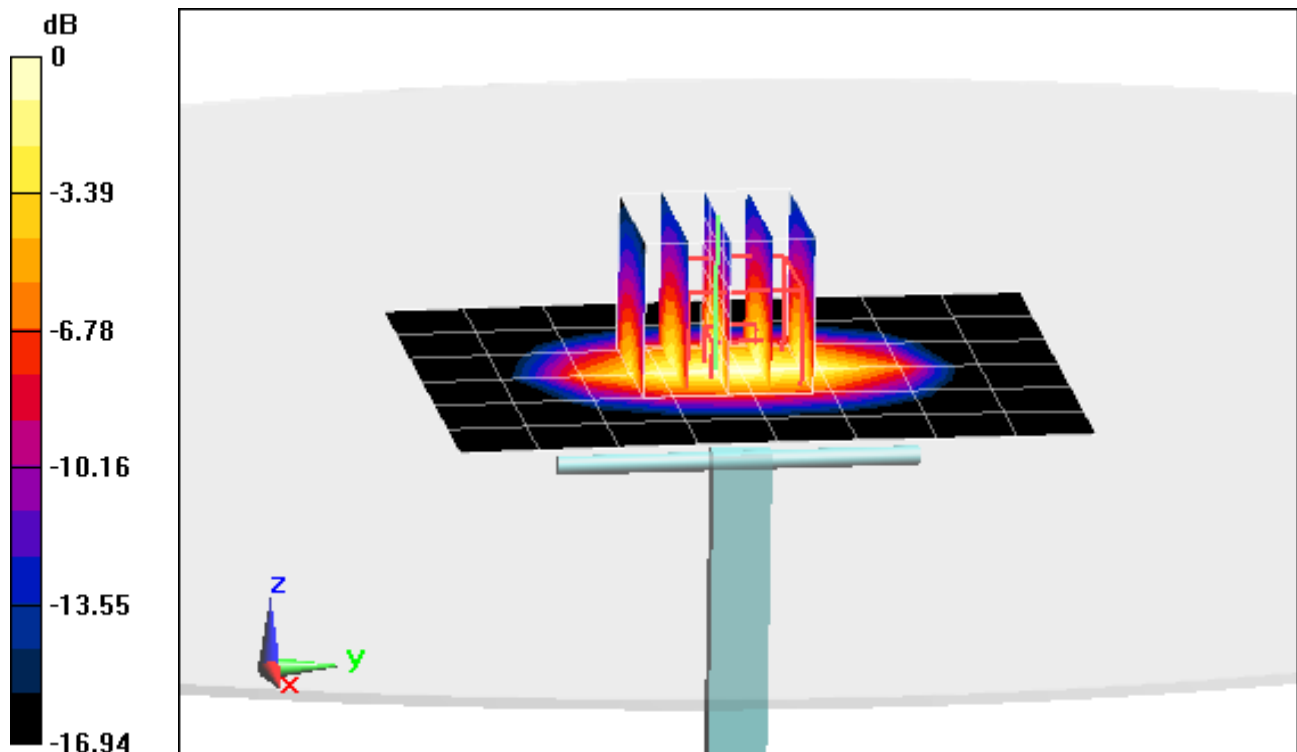
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 6.35 W/kg

SAR(1 g) = 3.68 W/kg

Deviation: -1.60%



0 dB = 4.53 W/kg = 6.56 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

Communication System: UID 0, CW; Frequency: 1900 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.510 \text{ S/m}$; $\epsilon_r = 52.478$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section ; Space: 1.0 cm

Test Date: 07-21-2014; Ambient Temp: 24.5°C; Tissue Temp: 23.2°C

Probe: ES3DV3 - SN3287; ConvF(4.67, 4.67, 4.67); Calibrated: 11/20/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1408; Calibrated: 11/19/2013

Phantom: ELI v5.0; Type: QDOVA001BB; Serial: 1229

Measurement SW: DASY52, Version 52.8 (8); SEMCAD X Version 14.6.10 (7331)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

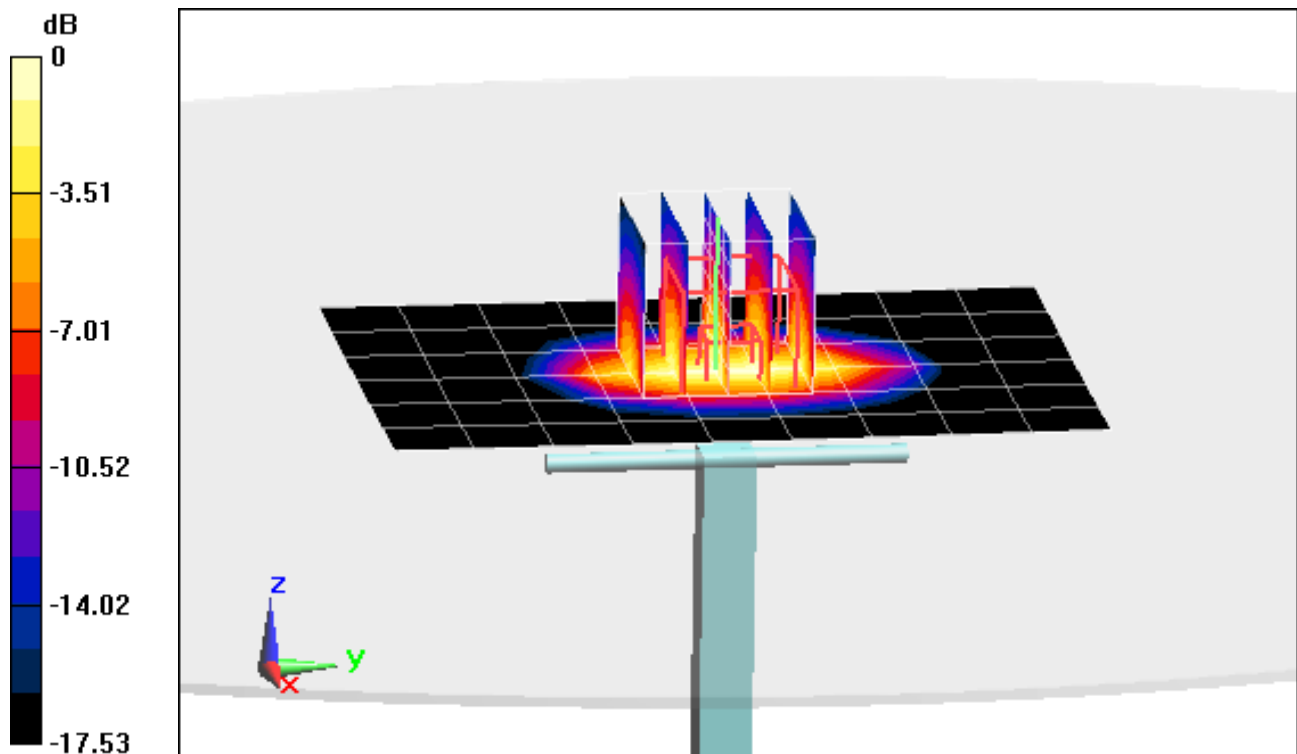
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power: 20 dBm (100 mW)

Peak SAR (extrapolated) = 7.19 W/kg

SAR(1 g) = 4.07 W/kg

Deviation 0.25%



0 dB = 5.11 W/kg = 7.08 dBW/kg

APPENDIX C: PROBE CALIBRATION



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: **D1750V2-1051_Apr14**

CALIBRATION CERTIFICATE

Object **D1750V2 - SN: 1051**

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

Calibration date: **April 10, 2014**

✓
KOK
5/7/14

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 EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Israe El-Naouq** Function: **Laboratory Technician**

Approved by: **Katja Pokovic** Technical Manager

Signature

Israe El-Naouq
Katja Pokovic

Issued: April 10, 2014

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



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**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- d) DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1750 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.1	1.37 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.1 $\pm$ 6 %	1.35 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.02 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	36.2 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	4.79 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	19.2 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.4	1.49 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.0 $\pm$ 6 %	1.48 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	9.37 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	37.4 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.04 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.1 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	50.7 Ω + 0.4 j Ω
Return Loss	- 41.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	46.8 Ω + 0.8 j Ω
Return Loss	- 29.3 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.222 ns
----------------------------------	----------

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

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	February 19, 2010

DASY5 Validation Report for Head TSL

Date: 10.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1051

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

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.35$ S/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.23, 5.23, 5.23); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

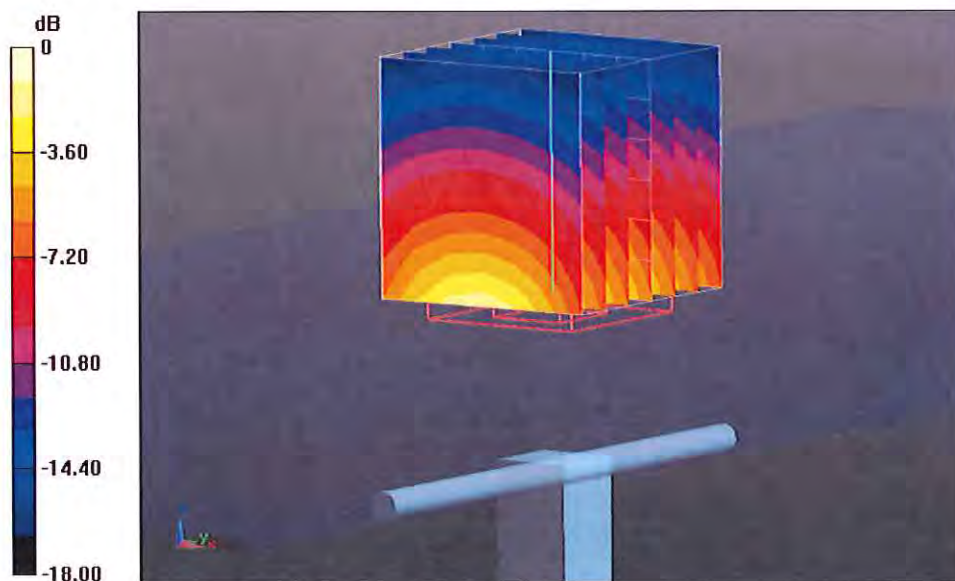
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.631 V/m; Power Drift = 0.00 dB

Peak SAR (extrapolated) = 16.2 W/kg

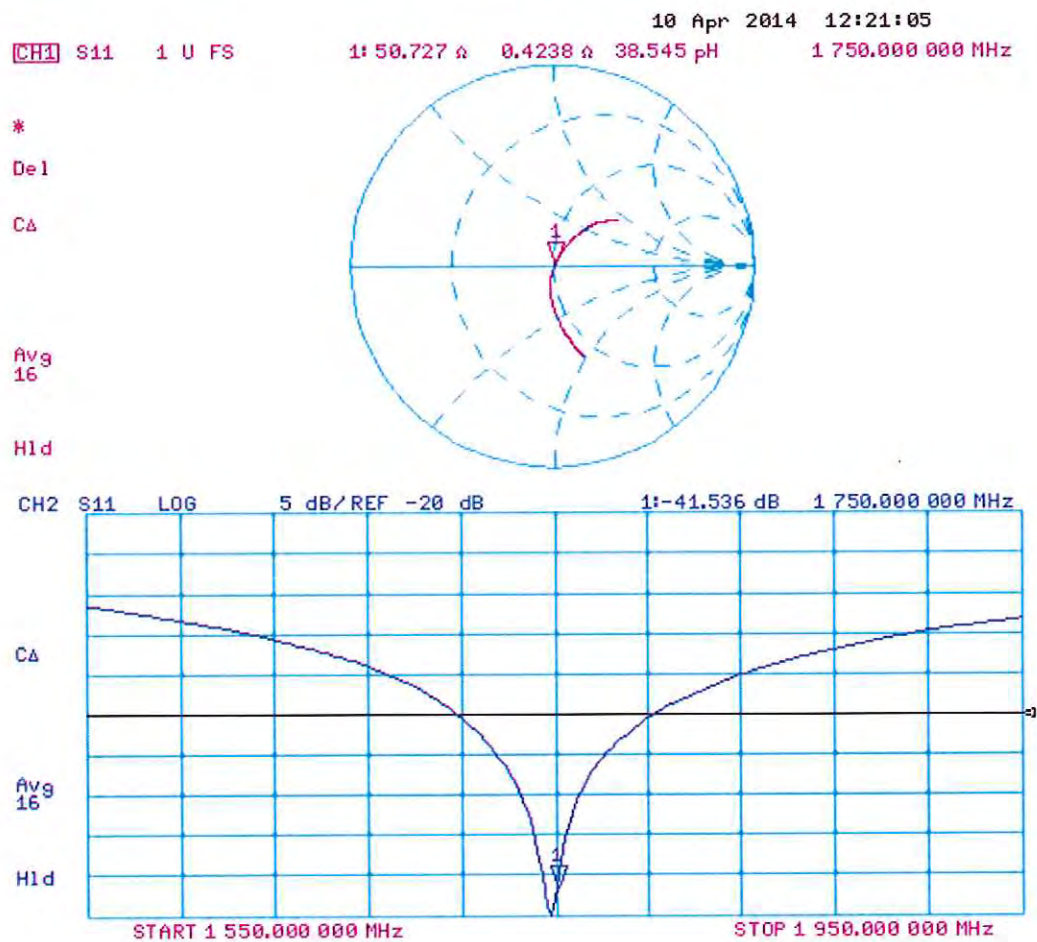
SAR(1 g) = 9.02 W/kg; SAR(10 g) = 4.79 W/kg

Maximum value of SAR (measured) = 11.3 W/kg



0 dB = 11.3 W/kg = 10.53 dBW/kg

Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 10.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1750 MHz; Type: D1750V2; Serial: D1750V2 - SN: 1051

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

Medium parameters used: $f = 1750$ MHz; $\sigma = 1.48$ S/m; $\epsilon_r = 52$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.89, 4.89, 4.89); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

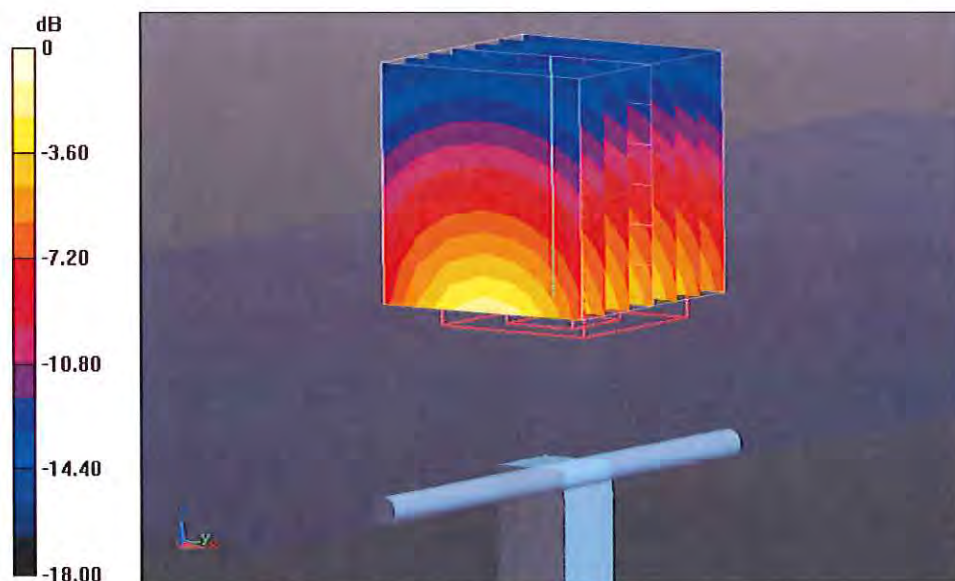
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 93.321 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 16.1 W/kg

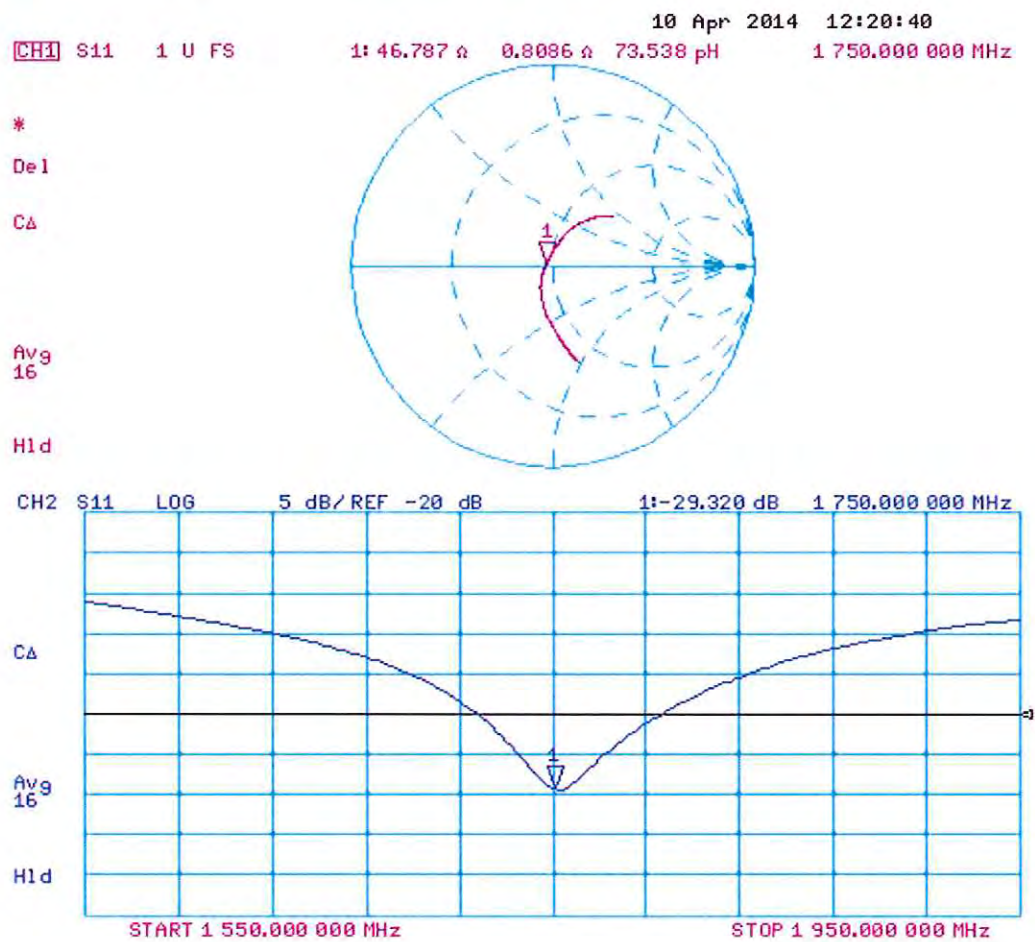
SAR(1 g) = 9.37 W/kg; SAR(10 g) = 5.04 W/kg

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



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

Impedance Measurement Plot for Body TSL





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 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d141_Apr14**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d141**

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

Calibration date: **April 09, 2014**

✓
KOK
5/7/14

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 $(22 \pm 3)^{\circ}\text{C}$ and humidity $< 70\%$.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID #	Cal Date (Certificate No.)	Scheduled Calibration
Power meter EPM-442A	GB37480704	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	US37292783	09-Oct-13 (No. 217-01827)	Oct-14
Power sensor HP 8481A	MY41092317	09-Oct-13 (No. 217-01828)	Oct-14
Reference 20 dB Attenuator	SN: 5058 (20k)	03-Apr-14 (No. 217-01918)	Apr-15
Type-N mismatch combination	SN: 5047.2 / 06327	03-Apr-14 (No. 217-01921)	Apr-15
Reference Probe ES3DV3	SN: 3205	30-Dec-13 (No. ES3-3205_Dec13)	Dec-14
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-13)	In house check: Oct-16
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

Calibrated by: **Claudio Leubler** Name: **Claudio Leubler** Function: **Laboratory Technician**

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

Signature

[Handwritten signatures]

Issued: April 9, 2014

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Accreditation No.: **SCS 108**

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Multilateral Agreement for the recognition of calibration certificates

Glossary:

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

Calibration is Performed According to the Following Standards:

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

Additional Documentation:

- DASY4/5 System Handbook

Methods Applied and Interpretation of Parameters:

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

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

Measurement Conditions

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

DASY Version	DASY5	V52.8.7
Extrapolation	Advanced Extrapolation	
Phantom	Modular Flat Phantom	
Distance Dipole Center - TSL	10 mm	with Spacer
Zoom Scan Resolution	dx, dy, dz = 5 mm	
Frequency	1900 MHz $\pm$ 1 MHz	

Head TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Head TSL parameters	22.0 °C	40.0	1.40 mho/m
Measured Head TSL parameters	(22.0 $\pm$ 0.2) °C	39.1 $\pm$ 6 %	1.36 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.91 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.1 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Head TSL	condition	
SAR measured	250 mW input power	5.17 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	20.8 W/kg $\pm$ 16.5 % (k=2)

Body TSL parameters

The following parameters and calculations were applied.

	Temperature	Permittivity	Conductivity
Nominal Body TSL parameters	22.0 °C	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.4 $\pm$ 6 %	1.52 mho/m $\pm$ 6 %
Body TSL temperature change during test	< 0.5 °C	----	----

SAR result with Body TSL

SAR averaged over 1 cm ³ (1 g) of Body TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.6 W/kg $\pm$ 17.0 % (k=2)

SAR averaged over 10 cm ³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	5.41 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.8 \Omega + 5.5 j\Omega$
Return Loss	- 24.5 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.8 \Omega + 6.3 j\Omega$
Return Loss	- 23.7 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.199 ns
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After long term use with 100W radiated power, only a slight warming of the dipole near the feedpoint can be measured.

The dipole is made of standard semirigid coaxial cable. The center conductor of the feeding line is directly connected to the second arm of the dipole. The antenna is therefore short-circuited for DC-signals. On some of the dipoles, small end caps are added to the dipole arms in order to improve matching when loaded according to the position as explained in the "Measurement Conditions" paragraph. The SAR data are not affected by this change. The overall dipole length is still according to the Standard.

No excessive force must be applied to the dipole arms, because they might bend or the soldered connections near the feedpoint may be damaged.

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 09.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.36$ S/m; $\epsilon_r = 39.1$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(5.06, 5.06, 5.06); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (front); Type: QD000P50AA; Serial: 1001
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

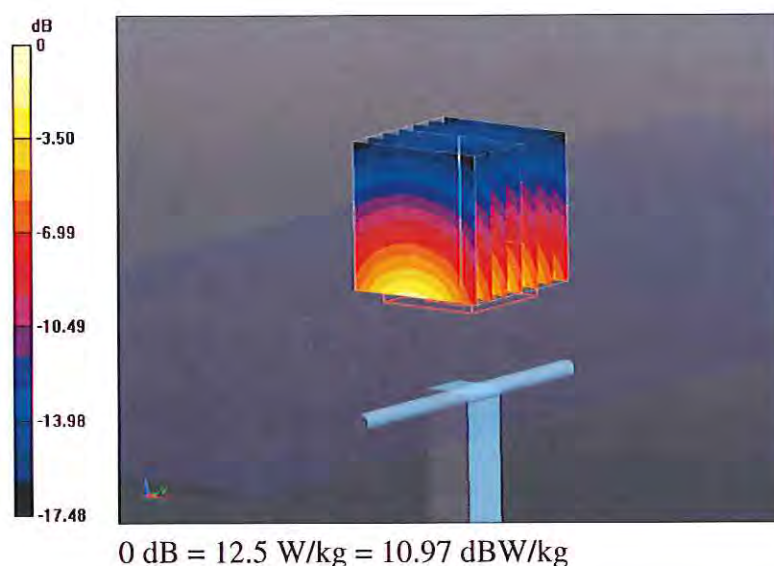
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 99.080 V/m; Power Drift = 0.01 dB

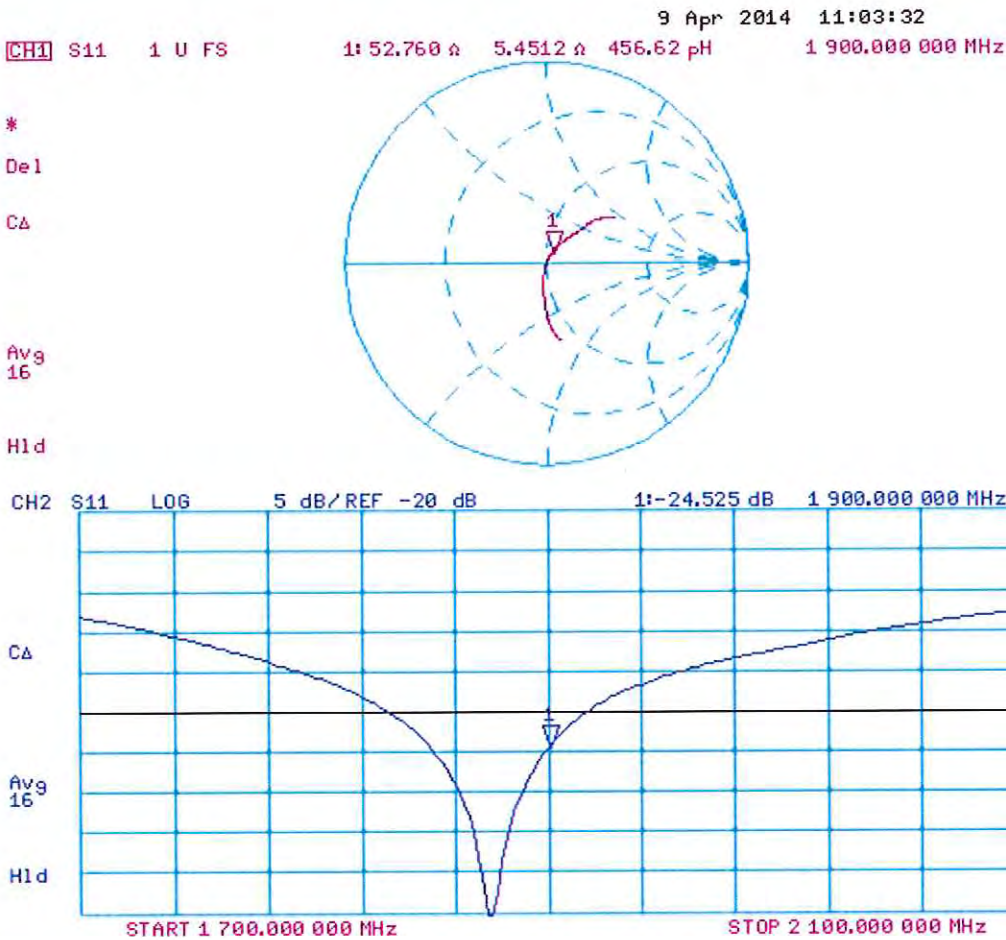
Peak SAR (extrapolated) = 18.2 W/kg

SAR(1 g) = 9.91 W/kg; SAR(10 g) = 5.17 W/kg

Maximum value of SAR (measured) = 12.5 W/kg



Impedance Measurement Plot for Head TSL



DASY5 Validation Report for Body TSL

Date: 09.04.2014

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.52$ S/m; $\epsilon_r = 52.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

Measurement Standard: DASY5 (IEEE/IEC/ANSI C63.19-2007)

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.76, 4.76, 4.76); Calibrated: 30.12.2013;
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE4 Sn601; Calibrated: 25.04.2013
- Phantom: Flat Phantom 5.0 (back); Type: QD000P50AA; Serial: 1002
- DASY52 52.8.7(1137); SEMCAD X 14.6.10(7164)

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

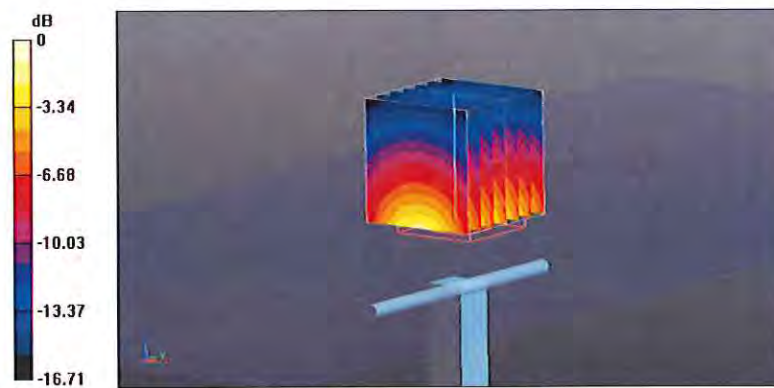
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 95.820 V/m; Power Drift = -0.01 dB

Peak SAR (extrapolated) = 17.9 W/kg

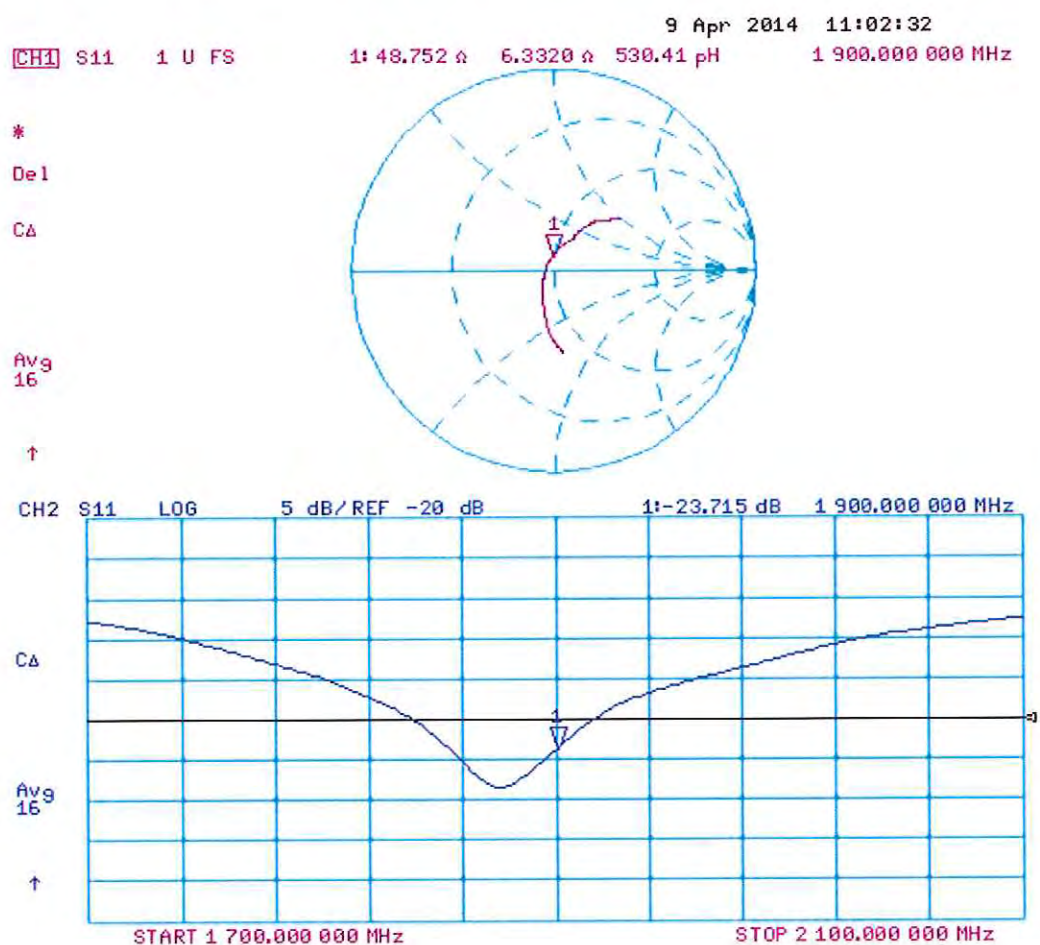
SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.41 W/kg

Maximum value of SAR (measured) = 12.9 W/kg



0 dB = 12.9 W/kg = 11.11 dBW/kg

Impedance Measurement Plot for Body TSL





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: **ES3-3319_Apr14**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3319**

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

Calibration date: **April 17, 2014**

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	03-Apr-14 (No. 217-01911)	Apr-15
Power sensor E4412A	MY41498087	03-Apr-14 (No. 217-01911)	Apr-15
Reference 3 dB Attenuator	SN: S5054 (3c)	03-Apr-14 (No. 217-01915)	Apr-15
Reference 20 dB Attenuator	SN: S5277 (20x)	03-Apr-14 (No. 217-01919)	Apr-15
Reference 30 dB Attenuator	SN: S5129 (30b)	03-Apr-14 (No. 217-01920)	Apr-15
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

Calibrated by:	Name Claudio Leubler	Function Laboratory Technician	Signature
Approved by:	Katja Pokovic	Technical Manager	
Issued: April 21, 2014			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



Accredited by the Swiss Accreditation Service (SAS)

Accreditation No.: **SCS 108**

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

Glossary:

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

Calibration is Performed According to the Following Standards:

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

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

Probe ES3DV3

SN:3319

Manufactured:	January 10, 2012
Repaired:	April 11, 2014
Calibrated:	April 17, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3319

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.11	1.08	1.15	$\pm 10.1 \%$
DCP (mV) ^B	102.6	104.2	103.7	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	199.6	$\pm 3.5 \%$
		Y	0.0	0.0	1.0		188.8	
		Z	0.0	0.0	1.0		178.5	
10010-CAA	SAR Validation (Square, 100ms, 10ms)	X	3.31	63.3	12.9	10.00	42.6	$\pm 2.2 \%$
		Y	5.10	68.0	14.1		38.8	
		Z	2.84	61.7	12.1		44.3	
10011-CAB	UMTS-FDD (WCDMA)	X	3.30	66.9	18.4	2.91	136.7	$\pm 0.5 \%$
		Y	3.32	67.1	18.4		127.0	
		Z	3.45	68.0	19.1		145.1	
10012-CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.12	69.3	19.0	1.87	138.7	$\pm 0.7 \%$
		Y	3.22	70.2	19.3		127.0	
		Z	3.40	71.3	19.9		146.4	
10021-DAB	GSM-FDD (TDMA, GMSK)	X	25.66	99.7	28.3	9.39	139.0	$\pm 1.4 \%$
		Y	16.30	92.5	25.7		141.7	
		Z	25.20	99.5	28.1		144.9	
10023-DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	25.81	100.0	28.5	9.57	128.3	$\pm 2.2 \%$
		Y	13.99	89.5	24.6		129.0	
		Z	25.39	99.7	28.3		141.2	
10024-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	37.04	99.8	25.7	6.56	131.4	$\pm 2.2 \%$
		Y	37.62	99.7	25.0		139.6	
		Z	38.36	99.8	25.3		145.5	
10027-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	48.04	99.6	23.8	4.80	144.6	$\pm 1.9 \%$
		Y	29.62	94.2	22.1		129.3	
		Z	43.87	99.7	24.0		129.9	
10028-DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	54.95	99.9	22.9	3.55	149.6	$\pm 1.7 \%$
		Y	57.76	99.6	22.2		138.2	
		Z	54.27	99.8	22.7		137.3	
10032-CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	44.58	99.9	21.1	1.16	134.6	$\pm 1.7 \%$
		Y	96.74	98.9	18.8		149.0	
		Z	59.46	99.9	20.4		149.1	
10039-CAB	CDMA2000 (1xRTT, RC1)	X	4.70	66.3	18.7	4.57	130.9	$\pm 0.9 \%$
		Y	4.85	67.1	19.0		147.5	
		Z	4.88	67.3	19.3		147.2	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.90	65.8	18.4	3.97	130.0	±0.7 %
		Y	4.00	66.5	18.6		140.8	
		Z	3.99	66.5	18.7		142.5	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.64	66.7	18.6	3.98	143.1	±0.9 %
		Y	4.58	66.5	18.4		132.8	
		Z	4.60	66.7	18.6		131.9	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.32	67.1	19.5	5.67	125.8	±1.4 %
		Y	6.41	67.4	19.5		138.4	
		Z	6.51	67.9	19.9		143.6	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.48	67.7	20.0	5.80	148.0	±1.4 %
		Y	6.28	66.9	19.4		135.8	
		Z	6.39	67.4	19.8		141.0	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.17	67.2	19.8	5.75	141.0	±1.4 %
		Y	5.94	66.3	19.1		132.2	
		Z	6.08	67.0	19.6		137.9	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.35	69.2	21.5	8.10	133.6	±2.2 %
		Y	9.93	68.1	20.7		124.5	
		Z	10.29	69.2	21.5		131.9	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.42	69.4	21.6	8.07	140.6	±2.2 %
		Y	9.93	68.1	20.7		125.5	
		Z	10.28	69.1	21.5		132.6	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	11.18	78.2	27.5	9.28	143.6	±3.3 %
		Y	9.33	73.0	24.5		124.3	
		Z	10.45	76.4	26.6		132.7	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.16	67.2	19.8	5.75	145.7	±1.4 %
		Y	5.96	66.4	19.1		133.0	
		Z	6.08	66.9	19.6		138.6	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.32	66.6	19.4	5.82	126.2	±1.4 %
		Y	6.40	66.9	19.4		137.3	
		Z	6.51	67.4	19.8		143.8	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.12	67.3	20.0	5.73	147.9	±1.2 %
		Y	4.90	66.4	19.4		134.4	
		Z	5.07	67.2	20.0		141.5	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	9.44	80.0	28.6	9.21	128.7	±3.3 %
		Y	8.63	77.8	27.1		143.9	
		Z	10.62	83.7	30.3		148.2	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.04	66.9	19.8	5.72	140.4	±1.4 %
		Y	4.92	66.6	19.5		133.7	
		Z	5.01	66.9	19.8		134.9	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.05	67.0	19.9	5.72	140.6	±1.4 %
		Y	4.90	66.5	19.4		132.4	
		Z	4.97	66.7	19.7		134.1	

10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.98	68.8	21.4	8.09	131.1	±2.5 %
		Y	10.00	68.8	21.2		145.5	
		Z	10.14	69.4	21.7		144.7	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.99	68.9	21.5	8.10	132.0	±2.7 %
		Y	10.05	69.0	21.3		148.1	
		Z	10.16	69.5	21.8		145.8	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.88	68.8	21.4	8.03	131.3	±2.5 %
		Y	9.96	69.0	21.3		147.8	
		Z	10.03	69.3	21.6		144.7	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.34	69.3	21.6	8.06	137.1	±2.2 %
		Y	9.93	68.2	20.8		127.8	
		Z	10.07	68.6	21.2		125.1	
10225-CAB	UMTS-FDD (HSPA+)	X	6.97	66.8	19.4	5.97	133.6	±1.4 %
		Y	6.90	66.7	19.2		129.7	
		Z	7.14	67.5	19.8		147.4	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	9.18	79.3	28.2	9.21	128.1	±3.5 %
		Y	8.54	77.6	27.0		144.1	
		Z	9.99	81.9	29.4		141.7	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	9.65	75.1	26.1	9.24	126.1	±3.5 %
		Y	9.34	74.2	25.3		141.3	
		Z	10.46	77.6	27.3		144.1	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	10.46	76.2	26.5	9.30	133.6	±3.5 %
		Y	9.23	72.7	24.4		122.8	
		Z	9.90	74.8	25.7		123.8	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.04	67.1	19.0	4.87	149.9	±1.2 %
		Y	6.02	67.1	18.9		142.8	
		Z	6.00	67.1	19.0		141.0	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.22	65.6	18.1	3.96	131.0	±0.9 %
		Y	4.49	66.9	18.6		144.3	
		Z	4.55	67.3	19.1		147.0	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.74	67.2	18.9	3.46	145.6	±0.5 %
		Y	3.66	66.8	18.5		136.7	
		Z	3.71	67.2	18.9		136.5	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.65	67.0	18.7	3.39	147.2	±0.7 %
		Y	3.61	66.8	18.4		139.6	
		Z	3.64	67.1	18.8		139.6	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.37	67.3	19.8	5.81	140.5	±1.4 %
		Y	6.24	66.8	19.3		134.0	
		Z	6.33	67.2	19.8		134.8	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.00	68.0	20.2	6.06	146.8	±1.7 %
		Y	6.82	67.4	19.7		140.3	
		Z	6.90	67.8	20.1		141.4	

10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.85	68.5	18.8	1.71	129.5	±0.5 %
		Y	3.09	70.0	19.2		146.1	
		Z	3.15	70.6	19.8		146.8	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.73	67.9	18.7	3.76	137.5	±0.5 %
		Y	4.77	68.3	18.7		126.5	
		Z	4.77	68.1	18.8		128.1	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.55	67.6	18.6	3.77	132.0	±0.7 %
		Y	4.89	69.1	19.1		148.8	
		Z	4.90	69.1	19.3		148.0	

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:3319

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	6.48	6.48	6.48	0.28	2.09	± 12.0 %
835	41.5	0.90	6.27	6.27	6.27	0.34	1.72	± 12.0 %
1750	40.1	1.37	5.24	5.24	5.24	0.80	1.14	± 12.0 %
1900	40.0	1.40	5.05	5.05	5.05	0.72	1.24	± 12.0 %
2450	39.2	1.80	4.45	4.45	4.45	0.77	1.23	± 12.0 %
2600	39.0	1.96	4.29	4.29	4.29	0.80	1.27	± 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:3319

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	6.25	6.25	6.25	0.39	1.65	± 12.0 %
835	55.2	0.97	6.18	6.18	6.18	0.56	1.37	± 12.0 %
1750	53.4	1.49	4.85	4.85	4.85	0.57	1.46	± 12.0 %
1900	53.3	1.52	4.67	4.67	4.67	0.53	1.58	± 12.0 %
2450	52.7	1.95	4.24	4.24	4.24	0.74	1.10	± 12.0 %
2600	52.5	2.16	4.05	4.05	4.05	0.80	1.02	± 12.0 %

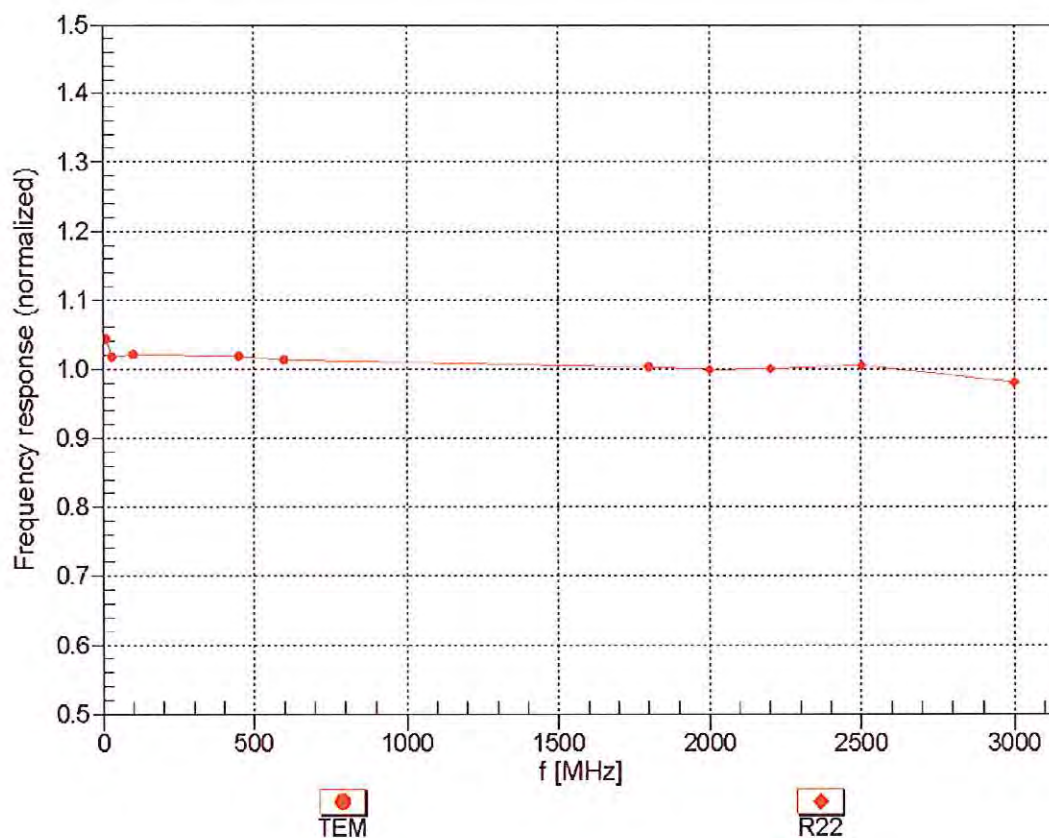
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^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.

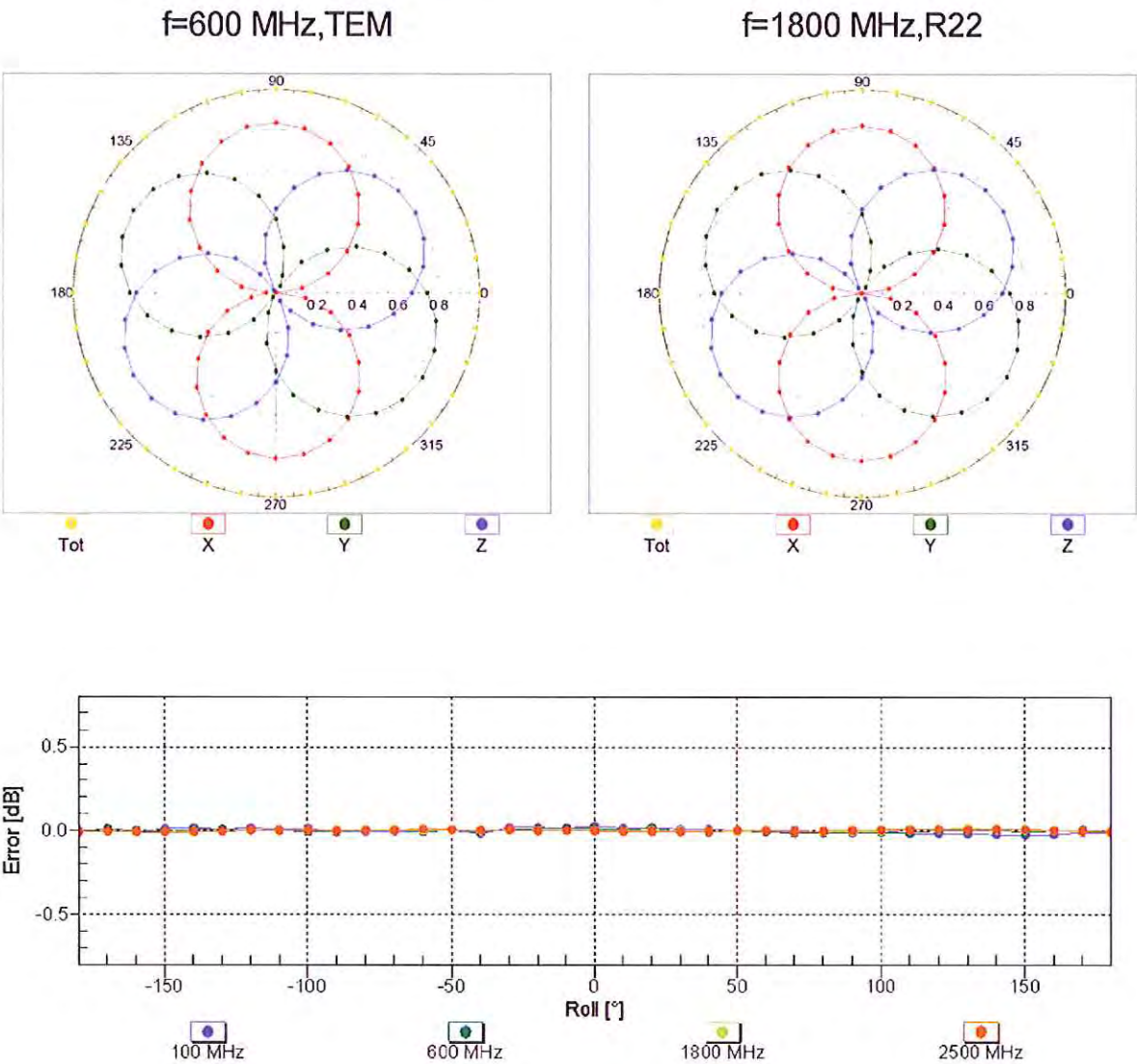
Frequency Response of E-Field

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



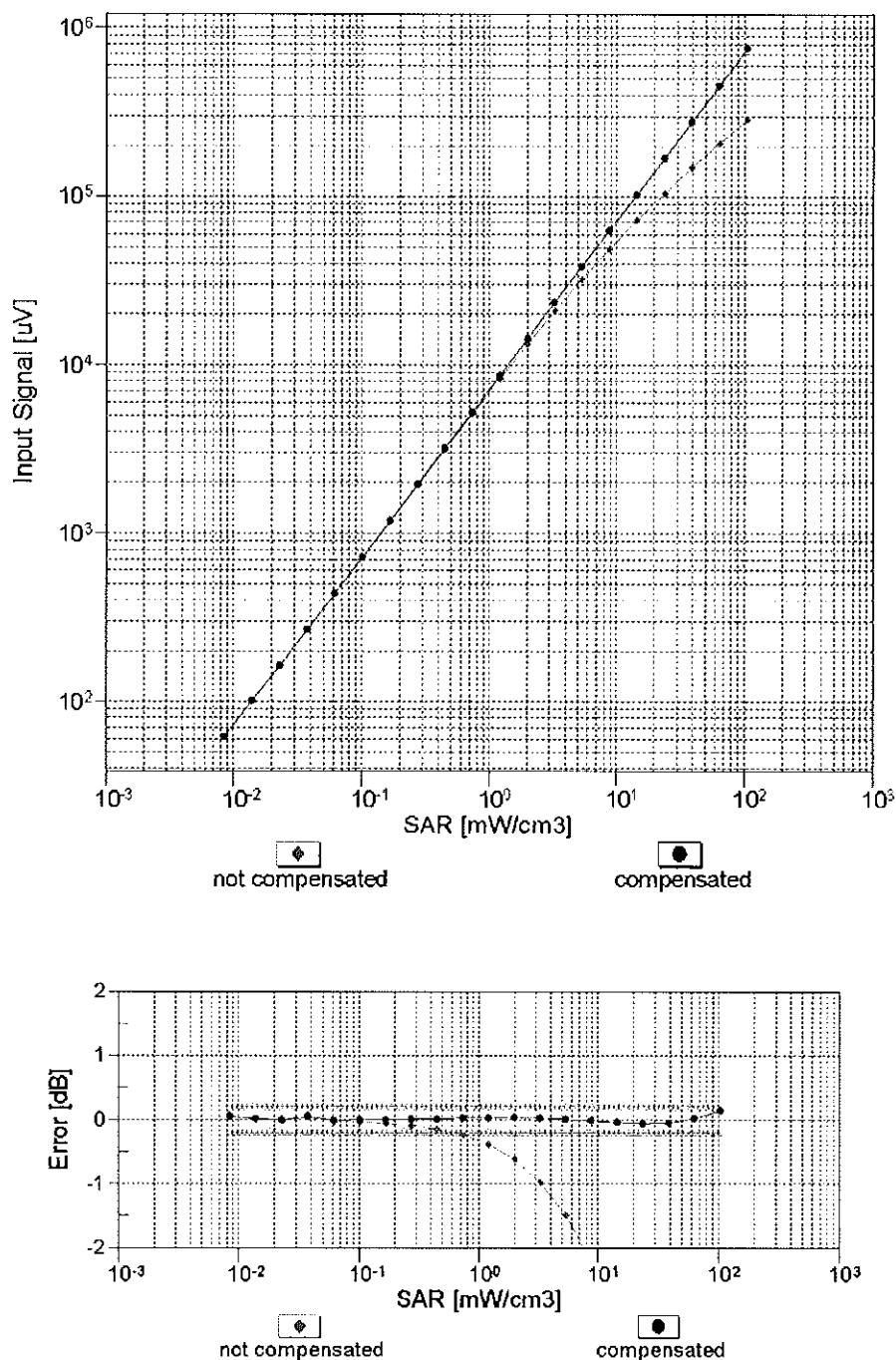
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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



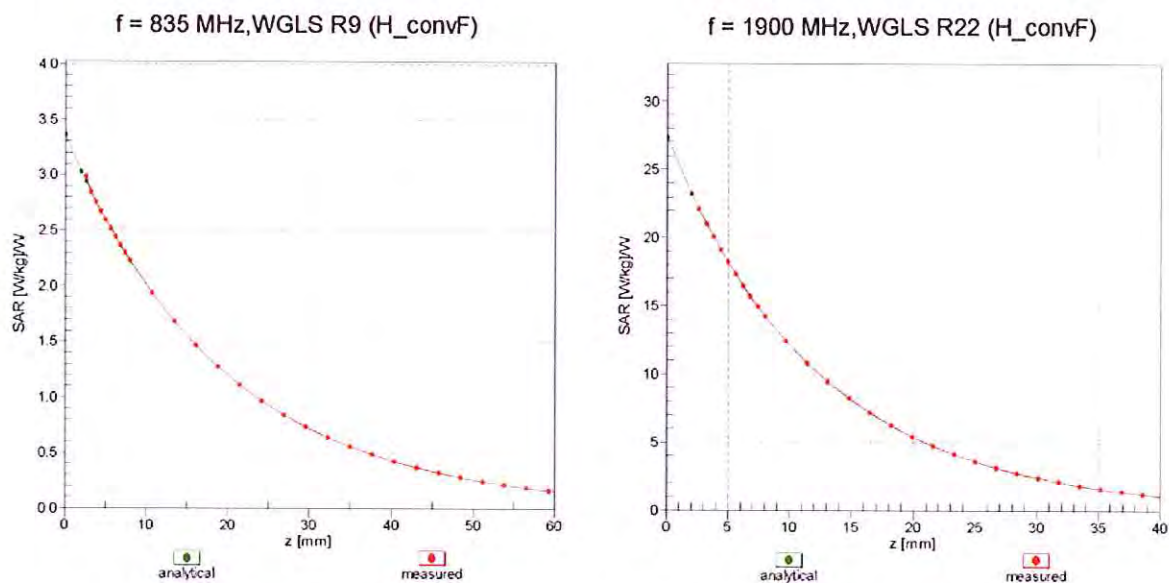
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



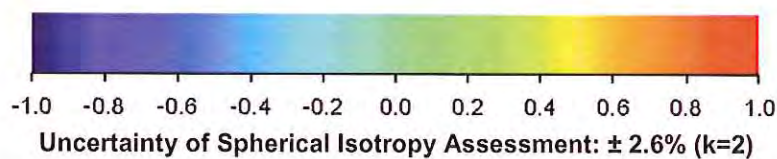
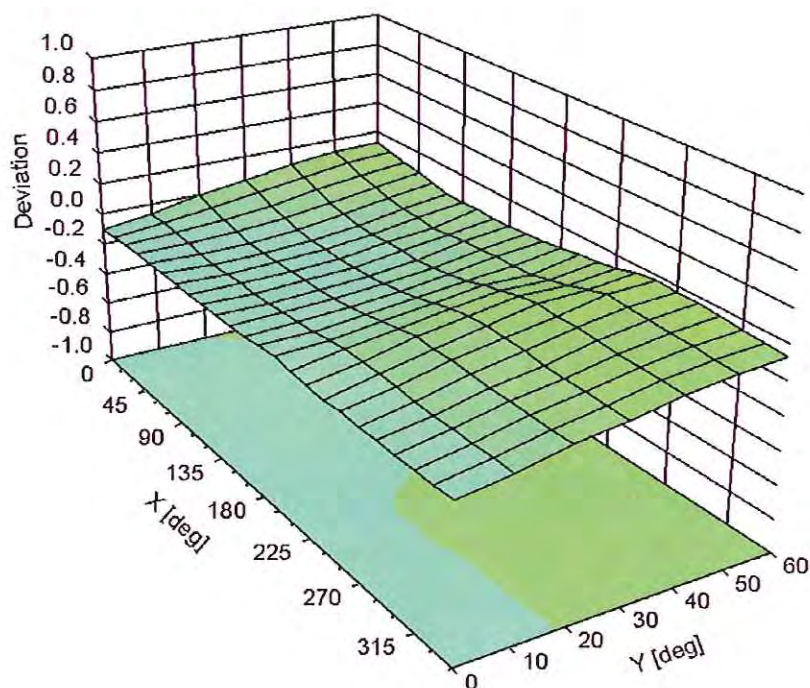
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3319

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-119.8
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



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: **ES3-3287_Nov13**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3287**

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

Calibration date: **November 20, 2013**

CC
11/20/2013

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

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

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter 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	28-Dec-12 (No. ES3-3013_Dec12)	Dec-13
DAE4	SN: 660	4-Sep-13 (No. DAE4-660_Sep13)	Sep-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-15
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

	Name	Function	Signature
Calibrated by:	Leif Klysner	Laboratory Technician	
Approved by:	Kalja Pokovic	Technical Manager	
Issued: November 20, 2013			
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			



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**

Glossary:

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

Calibration is Performed According to the Following Standards:

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

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

Probe ES3DV3

SN:3287

Manufactured: June 7, 2010
Calibrated: November 20, 2013

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.31	1.25	1.25	$\pm 10.1 \%$
DCP (mV) ^B	102.6	102.5	100.4	

Modulation Calibration Parameters

UID	Communication System Name		A dB	B dB $\sqrt{\mu\text{V}}$	C	D dB	VR mV	Unc ^E (k=2)
0	CW	X	0.0	0.0	1.0	0.00	157.3	$\pm 2.7 \%$
		Y	0.0	0.0	1.0		159.9	
		Z	0.0	0.0	1.0		152.5	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	2.23	57.9	9.9	10.00	45.7	$\pm 1.4 \%$
		Y	2.13	57.6	9.8		46.6	
		Z	3.31	61.1	11.8		47.6	
10011- CAA	UMTS-FDD (WCDMA)	X	3.25	66.3	17.9	2.91	124.8	$\pm 0.5 \%$
		Y	3.16	65.7	17.4		127.4	
		Z	3.15	65.5	17.4		122.8	
10012- CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.08	68.7	18.3	1.87	127.2	$\pm 0.7 \%$
		Y	3.03	68.2	17.9		129.4	
		Z	2.87	67.0	17.3		126.5	
10021- DAA	GSM-FDD (TDMA, GMSK)	X	15.99	90.6	25.0	9.39	99.9	$\pm 1.2 \%$
		Y	12.41	86.6	23.6		101.5	
		Z	29.18	99.9	28.5		109.2	
10023- DAA	GPRS-FDD (TDMA, GMSK, TN 0)	X	25.67	98.9	27.8	9.57	97.9	$\pm 1.7 \%$
		Y	14.20	88.5	24.3		100.6	
		Z	27.68	99.8	28.8		107.7	
10024- DAA	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	42.95	99.6	24.9	6.56	124.4	$\pm 1.4 \%$
		Y	45.27	99.9	24.8		128.8	
		Z	42.64	99.6	25.5		135.7	
10027- DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	27.78	91.3	21.1	4.80	136.0	$\pm 1.4 \%$
		Y	32.74	93.9	21.9		146.6	
		Z	23.93	89.5	21.1		144.8	
10028- DAA	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	59.17	99.6	22.4	3.55	142.5	$\pm 1.2 \%$
		Y	78.76	99.7	21.7		104.9	
		Z	38.06	94.2	21.4		148.8	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	93.35	99.7	19.5	1.16	108.1	$\pm 0.9 \%$
		Y	96.67	94.0	16.9		114.7	
		Z	98.17	96.2	18.2		108.9	
10039- CAA	CDMA2000 (1xRTT, RC1)	X	4.84	66.7	18.8	4.57	126.5	$\pm 0.9 \%$
		Y	4.83	66.6	18.6		134.4	
		Z	4.76	66.0	18.3		125.9	
10081- CAA	CDMA2000 (1xRTT, RC3)	X	4.00	66.2	18.5	3.97	121.9	$\pm 0.7 \%$
		Y	3.91	65.5	17.9		128.9	
		Z	3.88	65.2	17.8		120.7	

10098-CAA	UMTS-FDD (HSUPA, Subtest 2)	X	4.66	66.6	18.4	3.98	132.5	±0.7 %
		Y	4.66	66.5	18.2		141.3	
		Z	4.54	65.9	17.9		130.7	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.65	68.3	20.1	5.67	139.5	±1.4 %
		Y	6.69	68.3	19.9		148.9	
		Z	6.60	67.9	19.8		137.5	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.52	67.8	20.0	5.80	137.3	±1.4 %
		Y	6.53	67.6	19.7		147.5	
		Z	6.51	67.6	19.8		135.3	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.19	67.2	19.7	5.75	134.3	±1.2 %
		Y	6.24	67.3	19.6		142.9	
		Z	6.23	67.1	19.6		132.3	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	11.56	79.1	27.9	9.28	130.1	±3.0 %
		Y	11.01	76.8	26.2		141.9	
		Z	12.98	81.2	28.7		135.7	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.25	67.4	19.8	5.75	135.1	±1.2 %
		Y	6.17	66.9	19.3		143.6	
		Z	6.16	66.8	19.4		132.8	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.66	67.8	20.0	5.82	140.3	±1.4 %
		Y	6.72	67.9	19.9		148.8	
		Z	6.66	67.6	19.8		137.4	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.05	66.7	19.5	5.73	117.8	±0.9 %
		Y	4.93	66.0	18.9		125.0	
		Z	5.08	66.3	19.3		116.3	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	8.47	76.8	26.9	9.21	100.3	±2.2 %
		Y	8.06	74.6	25.3		107.5	
		Z	9.43	78.2	27.4		102.5	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	4.98	66.3	19.3	5.72	118.2	±0.9 %
		Y	4.96	66.1	19.0		119.9	
		Z	5.03	66.1	19.1		116.1	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.06	66.7	19.6	5.72	118.7	±0.9 %
		Y	4.97	66.2	19.1		120.0	
		Z	5.03	66.1	19.1		116.3	
10225-CAA	UMTS-FDD (HSPA+)	X	6.78	66.1	18.9	5.97	105.3	±1.2 %
		Y	6.68	65.7	18.6		106.8	
		Z	7.32	67.6	19.7		148.0	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	8.56	77.1	27.1	9.21	100.8	±1.9 %
		Y	8.33	75.8	26.1		103.8	
		Z	9.39	78.0	27.3		101.9	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	10.58	77.8	27.4	9.24	123.3	±2.5 %
		Y	10.48	76.9	26.5		128.1	
		Z	11.79	79.6	28.0		127.0	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	11.52	79.1	27.9	9.30	130.1	±2.7 %
		Y	11.24	77.7	26.9		136.0	
		Z	12.96	81.2	28.8		134.8	

10274-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	6.14	67.4	19.0	4.87	145.5	±1.2 %
		Y	6.19	67.4	19.0		149.2	
		Z	6.10	66.9	18.8		142.3	
10275-CAA	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.41	66.4	18.3	3.96	126.4	±0.7 %
		Y	4.43	66.3	18.2		130.4	
		Z	4.36	65.9	18.0		123.8	
10291-AAA	CDMA2000, RC3, SO55, Full Rate	X	3.57	65.9	17.9	3.46	120.0	±0.5 %
		Y	3.55	65.6	17.6		121.7	
		Z	3.50	65.1	17.5		117.2	
10292-AAA	CDMA2000, RC3, SO32, Full Rate	X	3.55	66.1	18.0	3.39	121.3	±0.5 %
		Y	3.54	66.0	17.8		123.6	
		Z	3.45	65.2	17.4		118.9	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.53	67.8	20.0	5.81	136.2	±1.2 %
		Y	6.48	67.5	19.6		139.3	
		Z	6.52	67.6	19.8		134.1	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	7.12	68.4	20.4	6.06	141.7	±1.4 %
		Y	7.11	68.3	20.1		145.3	
		Z	7.14	68.4	20.3		139.8	
10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.79	67.6	18.0	1.71	125.5	±0.5 %
		Y	2.71	66.9	17.3		128.2	
		Z	2.64	66.2	17.0		123.5	
10403-AAA	CDMA2000 (1xEV-DO, Rev. 0)	X	4.78	67.5	18.3	3.76	130.6	±0.5 %
		Y	4.77	67.5	18.2		133.8	
		Z	4.65	66.5	17.8		130.0	
10404-AAA	CDMA2000 (1xEV-DO, Rev. A)	X	4.83	68.2	18.6	3.77	129.2	±0.7 %
		Y	4.68	67.4	18.0		131.9	
		Z	4.52	66.3	17.7		128.7	

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 7 and 8).

^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:3287

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	6.52	6.52	6.52	0.47	1.46	± 12.0 %
835	41.5	0.90	6.30	6.30	6.30	0.40	1.59	± 12.0 %
1750	40.1	1.37	5.27	5.27	5.27	0.63	1.34	± 12.0 %
1900	40.0	1.40	5.08	5.08	5.08	0.62	1.37	± 12.0 %
2450	39.2	1.80	4.43	4.43	4.43	0.79	1.28	± 12.0 %
2600	39.0	1.96	4.29	4.29	4.29	0.77	1.38	± 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:3287

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	6.09	6.09	6.09	0.55	1.37	± 12.0 %
835	55.2	0.97	6.04	6.04	6.04	0.55	1.39	± 12.0 %
1750	53.4	1.49	4.93	4.93	4.93	0.39	1.73	± 12.0 %
1900	53.3	1.52	4.67	4.67	4.67	0.38	1.75	± 12.0 %
2450	52.7	1.95	4.17	4.17	4.17	0.60	1.20	± 12.0 %
2600	52.5	2.16	4.00	4.00	4.00	0.60	1.10	± 12.0 %

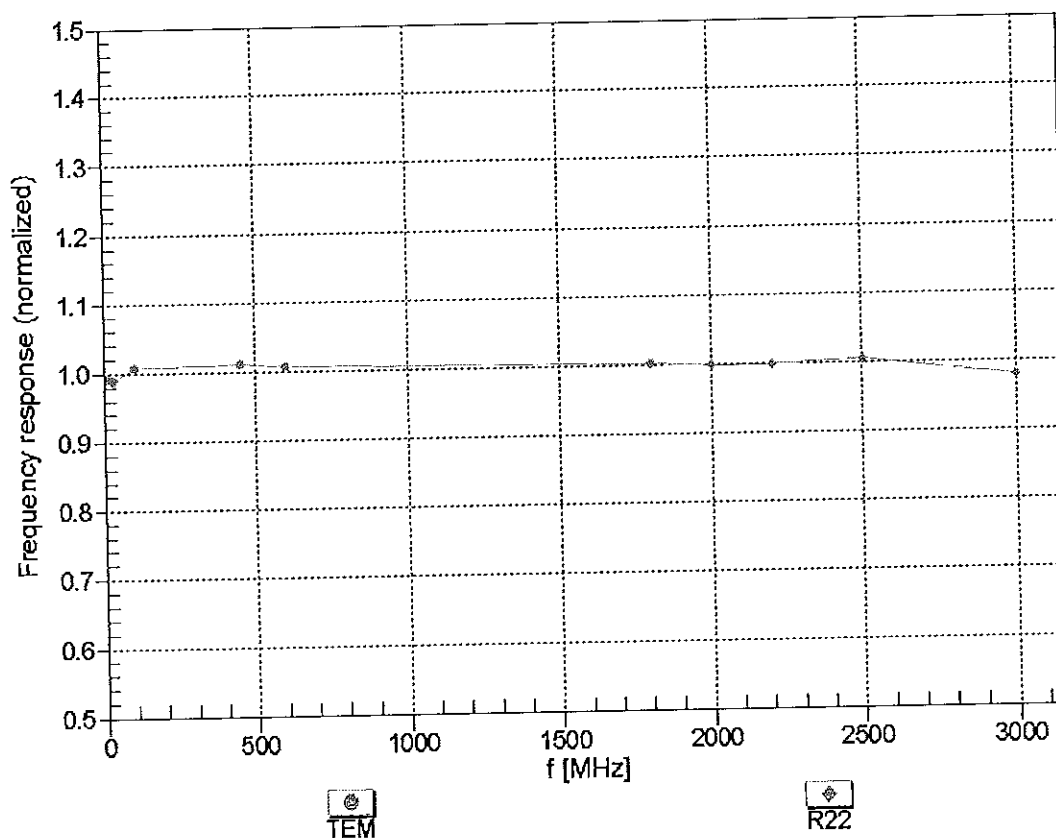
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

^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

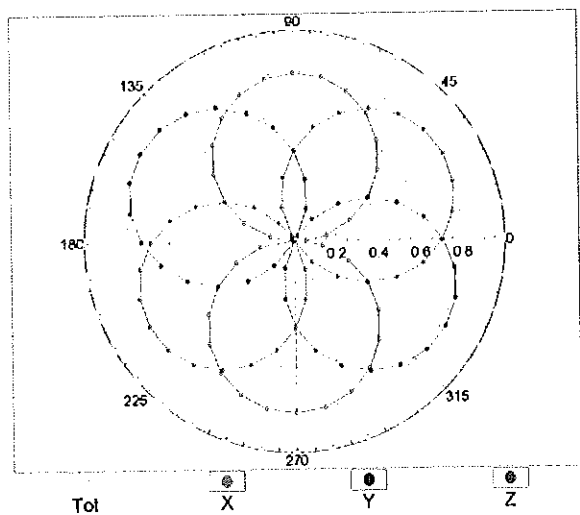
(TEM-Cell:ifi110 EXX, Waveguide: R22)



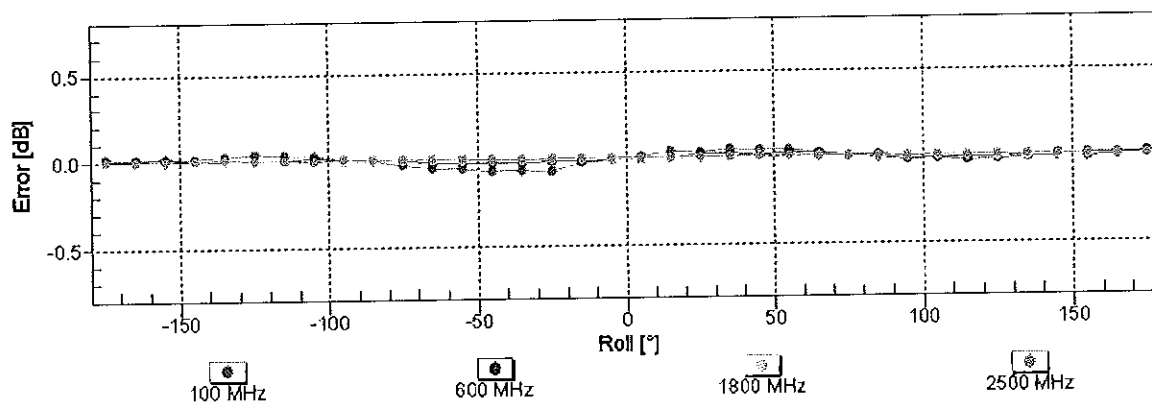
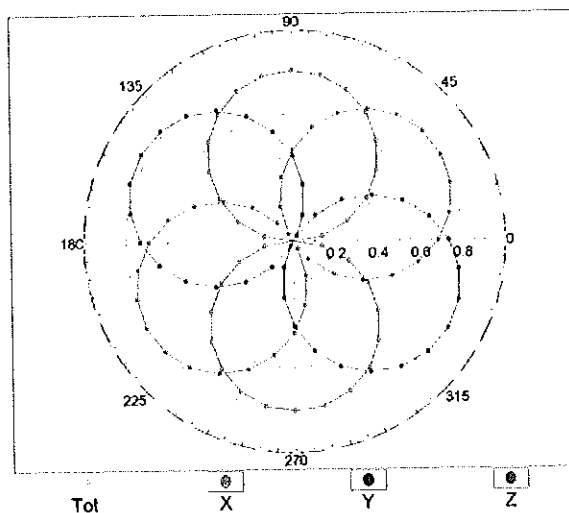
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM



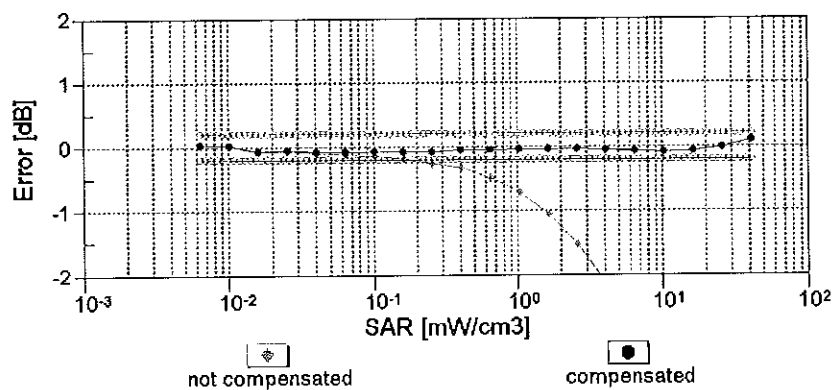
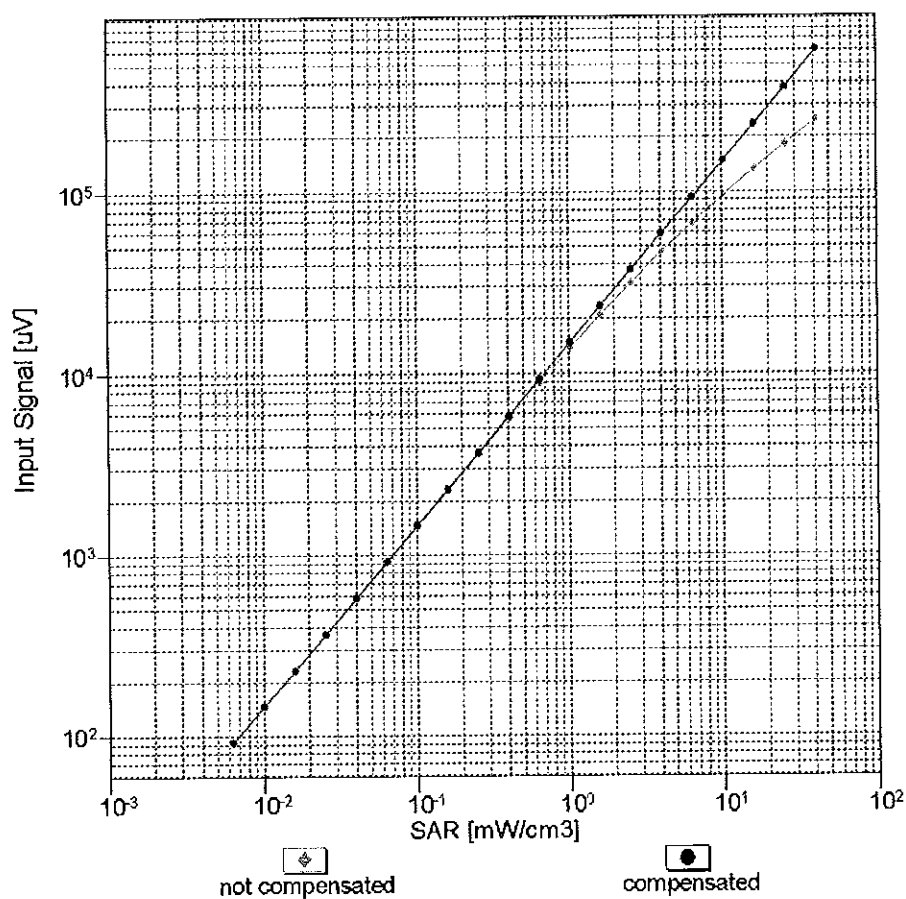
f=1800 MHz,R22



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

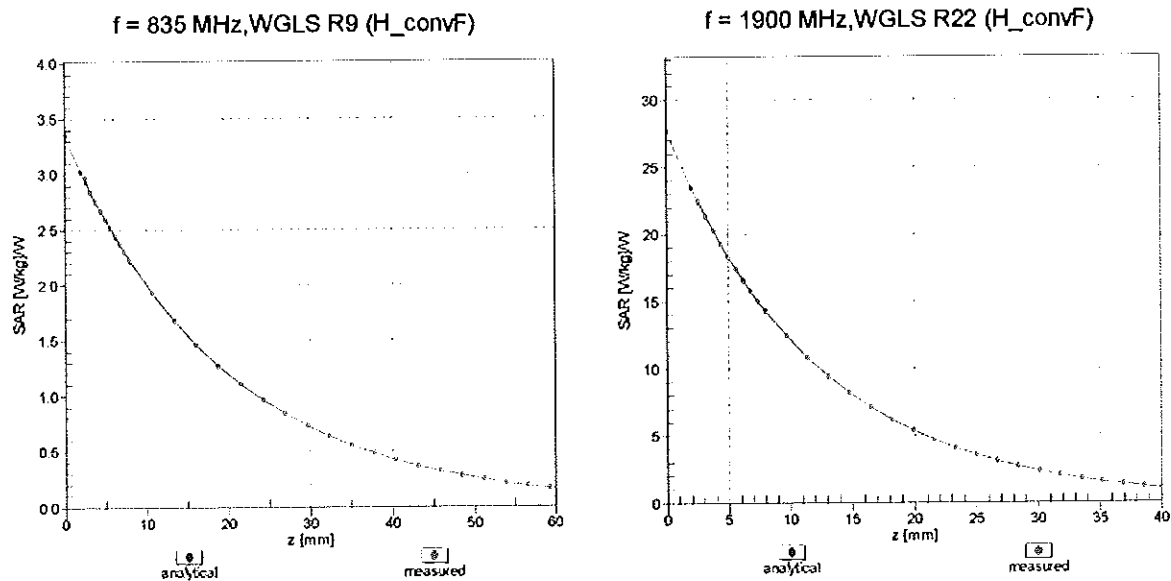
Dynamic Range f(SAR_{head})

(TEM cell , f = 900 MHz)



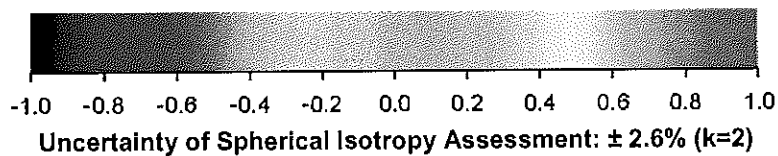
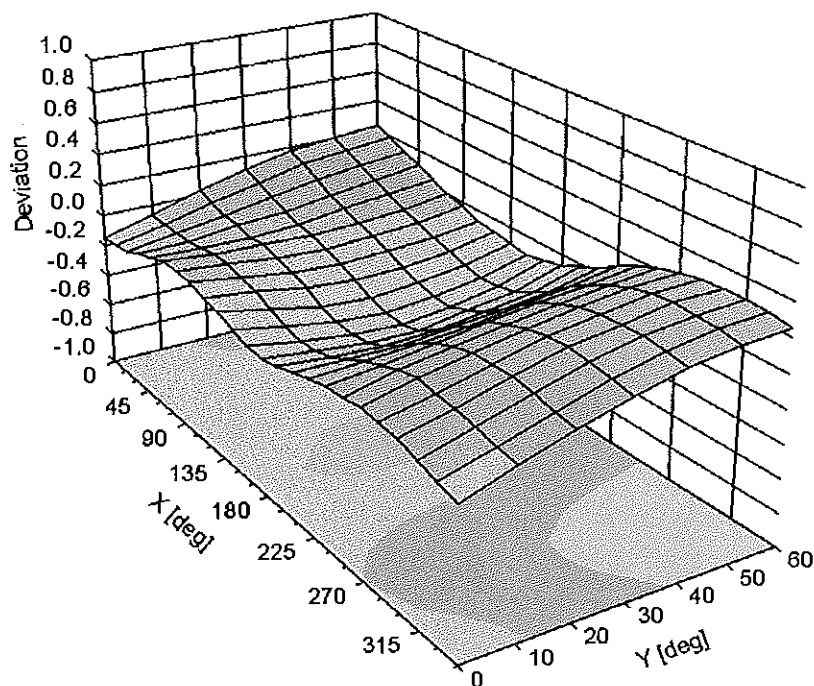
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3287**Other Probe Parameters**

Sensor Arrangement	Triangular
Connector Angle (°)	-15
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

APPENDIX D: SAR TISSUE SPECIFICATIONS

Measurement Procedure for Tissue verification:

- 1) The network analyzer and probe system was configured and calibrated.
- 2) The probe was immersed in the tissue. The tissue was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
- 3) The complex admittance with respect to the probe aperture was measured
- 4) The complex relative permittivity ϵ can be calculated from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\epsilon_r\epsilon_0}{[\ln(b/a)]^2} \int_a^b \int_a^b \int_0^\pi \cos\phi' \frac{\exp[-j\omega r(\mu_0\epsilon_r'\epsilon_0)^{1/2}]}{r} d\phi' d\rho' d\rho$$

where Y is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, ω is the angular frequency, and $j = \sqrt{-1}$.

Table D-I
Composition of the Tissue Equivalent Matter

Frequency (MHz)	1750	1900
Tissue	Body	Body
Ingredients (% by weight)		
DGBE	31	29.44
NaCl	0.2	0.39
Water	68.8	70.17

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APPENDIX E: SAR SYSTEM VALIDATION

Per FCC KDB 865664 D02v01, SAR system validation status should be documented to confirm measurement accuracy. The SAR systems (including SAR probes, system components and software versions) used for this device were validated against its performance specifications prior to the SAR measurements. Reference dipoles were used with the required tissue- equivalent media for system validation, according to the procedures outlined in IEEE 1528-2003 and FCC KDB 865664 D01 v01. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

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

Table E-I
SAR System Validation Summary

SAR SYSTEM #	FREQ. [MHz]	DATE	PROBE SN	PROBE TYPE	PROBE CAL. POINT		COND.	PERM.	CW VALIDATION			MOD. VALIDATION		
							(σ)	(ϵ_r)	SENSI-TIVITY	PROBE LINEARITY	PROBE ISOTROPY	MOD. TYPE	DUTY FACTOR	PAR
H	1750	6/27/2014	3319	ES3DV3	1750	Body	1.449	51.91	PASS	PASS	PASS	N/A	N/A	N/A
K	1900	6/25/2014	3287	ES3DV3	1900	Body	1.523	51.28	PASS	PASS	PASS	GMSK	PASS	N/A

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, according to KDB 865664.

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APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

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A3LSCHI925U Sensor Triggering Data Summary

Per FCC KDB Publication 616217 D01, this device was tested by the manufacturer to determine the proximity sensor triggering distances for the back and top edge of the device. The measured output power within ± 5 mm of the triggering points (or until touching the phantom) is included for back side and each applicable edge.

To ensure all production units are compliant it is necessary to test SAR at a distance 1mm less than the smallest distance from the device and SAR phantom (determined from these triggering tests according to the KDB 616217 D01) with the device at maximum output power without power reduction. These additional SAR Tests are included additionally to the SAR tests for the device touching the SAR phantom, with reduced power.

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Back Side

Moving Towards the Phantom

KDB 616217 6.2.9 Measured Power [dBm]											
Distance[mm]	18	17	16	15	14	13	12	11	10	9	8
Cell CDMA	24.69	24.71	24.90	24.71	24.70	19.01	18.99	18.96	19.04	19.03	19.00
PCS CDMA	24.73	24.69	24.71	24.70	24.72	14.04	13.97	14.01	14.01	14.03	14.03
AWS CDMA	24.71	24.71	24.73	24.71	24.70	14.52	14.51	14.49	14.48	14.48	14.50
LTE B2	23.11	23.10	23.10	23.13	23.12	12.11	12.01	12.14	12.08	12.08	12.02
LTE B4	23.20	23.20	23.21	23.22	23.22	12.21	21.13	21.11	12.09	12.12	12.12
LTE B5	23.21	23.20	23.20	23.22	23.20	15.00	15.00	15.01	15.01	15.02	15.00
LTE B12	23.00	23.03	23.00	23.01	23.01	14.70	14.72	14.74	14.73	14.73	14.74

Moving Away from the Phantom

KDB 616217 6.2.9 Measured Power [dBm]											
Distance[mm]	18	17	16	15	14	13	12	11	10	9	8
Cell CDMA	24.69	24.71	24.90	24.71	24.70	19.01	18.99	18.96	19.04	19.03	19.00
PCS CDMA	24.73	24.69	24.71	24.70	24.72	14.04	13.97	14.01	14.01	14.03	14.03
AWS CDMA	24.71	24.71	24.73	24.71	24.70	14.52	14.51	14.49	14.48	14.48	14.50
LTE B2	23.11	23.10	23.10	23.13	23.12	12.11	12.01	12.00	12.03	12.04	12.02
LTE B4	23.20	23.20	23.21	23.22	23.22	12.11	12.13	12.11	12.09	12.12	12.12
LTE B5	2.21	23.20	23.20	23.22	23.20	15.00	15.00	15.01	15.01	15.02	15.00
LTE B12	23.00	23.03	23.00	23.01	23.01	14.70	14.72	14.74	14.73	14.73	14.74

Based on the most conservative measured triggering distance of 13 mm, additional SAR measurements were required at 12 mm from the back side.

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Top Edge

Moving Towards the Phantom

KDB 616217 6.2.9 Measured Power [dBm]											
Distance[mm]	16	15	14	13	12	11	10	9	8	7	6
Cell CDMA	24.69	24.71	24.90	24.71	24.70	19.01	18.99	18.96	19.04	19.03	19.00
PCS CDMA	24.73	24.69	24.71	24.70	24.72	14.04	13.97	14.01	14.01	14.03	14.03
AWS CDMA	24.71	24.71	24.73	24.71	24.70	14.52	14.51	14.49	14.48	14.48	14.50
LTE B2	23.11	23.10	23.10	23.13	23.12	12.01	12.01	12.03	12.09	12.08	12.02
LTE B4	23.20	23.20	23.21	23.22	23.22	12.11	12.13	12.11	12.11	12.13	12.10
LTE B5	2.21	23.20	23.20	23.22	23.20	15.00	15.00	15.01	15.01	15.02	15.00
LTE B12	23.00	23.03	23.00	23.01	23.01	14.70	14.72	14.74	14.73	14.73	14.74

Moving Away from the Phantom

KDB 616217 6.2.9 Measured Power [dBm]											
Distance[mm]	16	15	14	13	12	11	10	9	8	7	6
Cell CDMA	24.69	24.71	24.90	24.71	24.70	19.01	18.99	18.96	19.04	19.03	19.00
PCS CDMA	24.73	24.69	24.71	24.70	24.72	14.04	13.97	14.01	14.01	14.03	14.03
AWS CDMA	24.71	24.71	24.73	24.71	24.70	14.52	14.51	14.49	14.48	14.48	14.50
LTE B2	23.11	23.10	23.10	23.13	23.12	12.01	12.01	12.03	12.09	12.08	12.02
LTE B4	23.20	23.20	23.21	23.22	23.22	12.11	12.13	12.11	12.11	12.13	12.10
LTE B5	2.21	23.20	23.20	23.22	23.20	15.00	15.00	15.01	15.01	15.02	15.00
LTE B12	23.00	23.03	23.00	23.01	23.01	14.70	14.72	14.74	14.73	14.73	14.74

Based on the most conservative measured triggering distance of 11 mm, additional SAR measurements were required at 10 mm from the top edge.

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