



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.:

OY1407221442.A3L

FCC ID:

A3LSMT537R4

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Tablet

Application Type:

Class II Permissive Change

FCC Rule Part(s):

CFR §2.1093

Model(s):

SM-T537R4

Permissive Change(s):

See FCC Change Document

Date of Original Certification:

05/23/2014

Equipment Class	Band & Mode	Tx Frequency	SAR
			1 gm Body (W/kg)
PCB	LTE Band 4 (AWS)	1712.5 - 1752.5 MHz	0.98
PCB	LTE Band 2 (PCS)	1852.5 - 1907.5 MHz	1.06
Simultaneous SAR per KDB 690783 D01v01r02:			1.44

Note: The table above shows test data evaluated for the current test report. Please refer to RF Exposure Technical Report for OY1403260617-R1.A3L original 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
PCS CDMA/EVDO	Data	1851.25 - 1908.75 MHz
LTE Band 12/17	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
ANT+	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

This device uses a proximity sensor for SAR compliance. The proximity sensor is activated when used in close proximity to the user's body. The proximity 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.

Maximum Power:

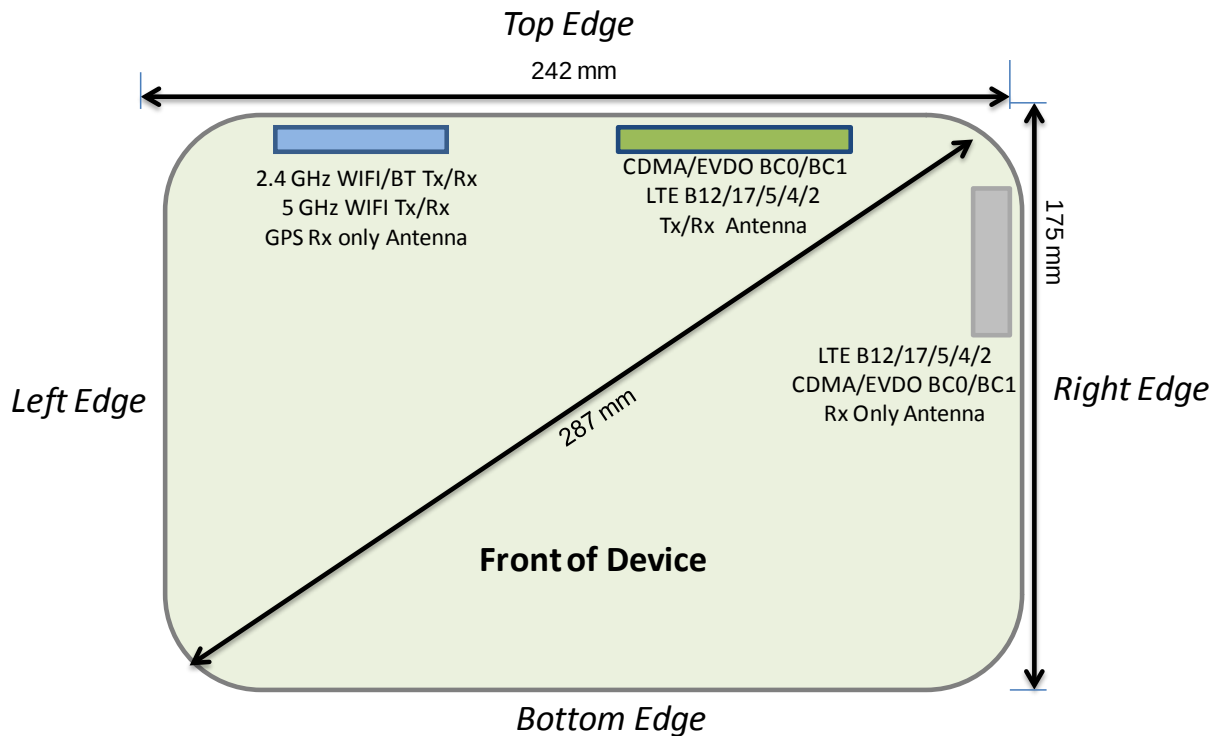
Mode / Band		Modulated Average (dBm)
LTE Band 4 (AWS)	Maximum	24.0
	Nominal	23.5
LTE Band 2 (PCS)	Maximum	23.5
	Nominal	23.0

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Reduced Power – Body at 0 mm:

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

1.4 DUT Antenna Locations



Note: Exact antenna dimensions and separation distances are shown in the Technical Descriptions.

Figure 1-1
DUT Antenna Locations

Table 1-1
Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
LTE Band 4 (AWS)	Yes	No	Yes	No	Yes	No
LTE Band 2 (PCS)	Yes	No	Yes	No	Yes	No

Note: Per FCC KDB 616217 D04, particular DUT edges were not required to be evaluated for SAR based on the SAR exclusion threshold in KDB 447498 D01.

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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.



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 1-2
Simultaneous Transmission Scenarios

No.	Capable Transmit Configuration	Body
1	LTE + 2.4 GHz WI-FI	Yes
2	LTE + 5 GHz WI-FI	Yes
3	LTE + 2.4 GHz Bluetooth	Yes
4	CDMA/EVDO data + 2.4 GHz WI-FI	Yes
5	CDMA/EVDO data + 5 GHz WI-FI	Yes
6	CDMA/EVDO data + 2.4 GHz Bluetooth	Yes

1. Bluetooth, 2.4 GHz, and 5 GHz share the same antenna path and cannot transmit simultaneously.
2. CDMA/EVDO and LTE share the same antenna path and cannot transmit simultaneously.

1.6 SAR Test Exclusions Applied

This report evaluates SAR compliance for LTE Band 2 and LTE Band 4. Please refer to RF Exposure Technical Report 0Y1403260617-R1.A3L for original compliance report containing data for other main antenna and WLAN modes. No changes were made to any other modes or bands.

(A) Licensed Transmitter(s)

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

1.7 Guidance Applied

- FCC KDB Publication 941225 D01-D06 (4G)
- 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 (Tablet SAR Consideration)

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1.8 Device Serial Numbers

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

	Maximum Power Body Serial Number	Reduced Power Serial Number
LTE Band 4 (AWS)	69	60
LTE Band 2 (PCS)	69	60

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LTE INFORMATION

LTE Information			
FCC ID	A3LSMT537R4		
Form Factor	Portable Tablet		
Frequency Range of each LTE transmission band	LTE Band 12 (701.5 - 713.5 MHz)		
	LTE Band 17 (706.5 - 713.5 MHz)		
	LTE Band 5 (Cell) (826.5 - 846.5 MHz)		
	LTE Band 4 (AWS) (1712.5 - 1752.5 MHz)		
	LTE Band 2 (PCS) (1852.5 - 1907.5 MHz)		
Channel Bandwidths	LTE Band 12: 5 MHz, 10 MHz		
	LTE Band 17: 5 MHz, 10 MHz		
	LTE Band 5 (Cell): 5 MHz, 10 MHz		
	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 12: 5 MHz	701.5 (23035)	707.5 (23095)	713.5 (23155)
LTE Band 12: 10 MHz	704 (23060)	707.5 (23095)	711 (23130)
LTE Band 17: 5 MHz	706.5 (23755)	710 (23790)	713.5 (23825)
LTE Band 17: 10 MHz	709 (23780)	710 (23790)	711 (23800)
LTE Band 5 (Cell): 5 MHz	826.5 (20425)	836.5 (20525)	846.5 (20625)
LTE Band 5 (Cell): 10 MHz	829 (20450)	836.5 (20525)	844 (20600)
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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3 INTRODUCTION

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

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

3.1 SAR Definition

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

Equation 3-1
SAR Mathematical Equation

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

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

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

where:

- σ = conductivity of the tissue-simulating material (S/m)
- ρ = mass density of the tissue-simulating material (kg/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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DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

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

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head and body interface and the horizontal grid resolution was determined per FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during the 1g/10g cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak of the region with maximum SAR was determined by spline interpolation. Around this point, a volume was assessed according to the measurement resolution and volume size requirements of FCC KDB Publication 865664 D01v01 (See Table 4-1) and IEEE 1528-2013. On the basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):
 - a. SAR values at the inner surface of the phantom are extrapolated from the measured values along the line away from the surface with spacing no greater than that in Table 4-1. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
 - b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
 - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.

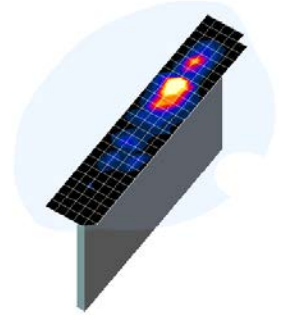


Figure 4-1
Sample SAR Area
Scan

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)			Minimum Zoom Scan Volume (mm) (x,y,z)
			Uniform Grid	Graded Grid		
				$\Delta z_{\text{zoom}}(n)$	$\Delta z_{\text{zoom}}(1)^*$	
≤ 2 GHz	≤ 15	≤ 8	≤ 5	≤ 4	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 30
2-3 GHz	≤ 12	≤ 5	≤ 5	≤ 4	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 30
3-4 GHz	≤ 12	≤ 5	≤ 4	≤ 3	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 28
4-5 GHz	≤ 10	≤ 4	≤ 3	≤ 2.5	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 25
5-6 GHz	≤ 10	≤ 4	≤ 2	≤ 2	≤ 1.5* $\Delta z_{\text{zoom}}(n-1)$	≥ 22

*Also compliant to IEEE 1528-2013 Table 6

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SAR TESTING PROCEDURES

5.1 SAR Testing for Tablet per FCC KDB Publication 616217 D04v01

Due to its size this device can be used in full sized tablet exposure conditions. 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.

5.2 Additional Test Positions due to Proximity Sensor Considerations

This device uses a proximity sensor to reduce data powers in tablet-device use conditions.

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.

FCC KDB 616217 D04 Section 6 was used as a guideline for selecting SAR test distances for this device at these additional exposure conditions. Since the sensor activation distance for the back side of the device is 23 mm, a conservative distance of 22 mm was tested for SAR on the back side at maximum power. Since the sensor activation distance for the top edge of the device is 23 mm, a conservative distance of 22 mm was tested for SAR on the top edge at maximum power. Sensor triggering distance summary data is included in Appendix G. The sensor does not trigger power reduction from the front of the device.

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.

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6 RF EXPOSURE LIMITS

6.1 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.

6.2 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 6-1
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)
Peak Spatial Average SAR Head	1.6	8.0
Whole Body SAR	0.08	0.4
Peak Spatial Average SAR Hands, Feet, Ankle, Wrists, etc.	4.0	20

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

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7 FCC MEASUREMENT PROCEDURES

7.1 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.

7.2 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.

" were applied.

7.3 SAR Measurement Conditions for LTE

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

7.3.1 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.

7.3.2 MPR

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

7.3.3 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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7.3.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r01:

- a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
 - i. The required channel and offset combination with the highest maximum output power is required for SAR.
 - ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
 - iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
- b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
- c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
- d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to $\frac{1}{2}$ 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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8 RF CONDUCTED POWERS

8.1 LTE Conducted Powers

8.1.1 LTE Band 4 Maximum Power

Table 8-1
LTE Band 4 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	23.94	0	0
	1732.5	20175	20	QPSK	1	50	23.98	0	0
	1732.5	20175	20	QPSK	1	99	24.00	0	0
	1732.5	20175	20	QPSK	50	0	22.93	0-1	1
	1732.5	20175	20	QPSK	50	25	22.97	0-1	1
	1732.5	20175	20	QPSK	50	50	23.00	0-1	1
	1732.5	20175	20	QPSK	100	0	22.99	0-1	1
	1732.5	20175	20	16QAM	1	0	22.95	0-1	1
	1732.5	20175	20	16QAM	1	50	22.98	0-1	1
	1732.5	20175	20	16QAM	1	99	23.00	0-1	1
	1732.5	20175	20	16QAM	50	0	21.99	0-2	2
	1732.5	20175	20	16QAM	50	25	22.00	0-2	2
	1732.5	20175	20	16QAM	50	50	21.98	0-2	2
	1732.5	20175	20	16QAM	100	0	21.97	0-2	2

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Table 8-2
LTE Band 4 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	23.84	0	0
	1717.5	20025	15	QPSK	1	36	23.78	0	0
	1717.5	20025	15	QPSK	1	74	23.88	0	0
	1717.5	20025	15	QPSK	36	0	22.89	0-1	1
	1717.5	20025	15	QPSK	36	18	22.75	0-1	1
	1717.5	20025	15	QPSK	36	37	22.85	0-1	1
	1717.5	20025	15	QPSK	75	0	22.88	0-1	1
	1717.5	20025	15	16QAM	1	0	22.77	0-1	1
	1717.5	20025	15	16QAM	1	36	22.81	0-1	1
	1717.5	20025	15	16QAM	1	74	22.94	0-1	1
	1717.5	20025	15	16QAM	36	0	21.79	0-2	2
	1717.5	20025	15	16QAM	36	18	21.74	0-2	2
	1717.5	20025	15	16QAM	36	37	21.84	0-2	2
	1717.5	20025	15	16QAM	75	0	21.89	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	23.89	0	0
	1732.5	20175	15	QPSK	1	36	23.91	0	0
	1732.5	20175	15	QPSK	1	74	23.97	0	0
	1732.5	20175	15	QPSK	36	0	23.00	0-1	1
	1732.5	20175	15	QPSK	36	18	22.98	0-1	1
	1732.5	20175	15	QPSK	36	37	22.96	0-1	1
	1732.5	20175	15	QPSK	75	0	22.98	0-1	1
	1732.5	20175	15	16QAM	1	0	23.00	0-1	1
	1732.5	20175	15	16QAM	1	36	22.99	0-1	1
	1732.5	20175	15	16QAM	1	74	23.00	0-1	1
	1732.5	20175	15	16QAM	36	0	21.97	0-2	2
	1732.5	20175	15	16QAM	36	18	21.99	0-2	2
	1732.5	20175	15	16QAM	36	37	21.98	0-2	2
	1732.5	20175	15	16QAM	75	0	21.99	0-2	2
High	1747.5	20325	15	QPSK	1	0	23.99	0	0
	1747.5	20325	15	QPSK	1	36	24.00	0	0
	1747.5	20325	15	QPSK	1	74	23.97	0	0
	1747.5	20325	15	QPSK	36	0	23.00	0-1	1
	1747.5	20325	15	QPSK	36	18	22.99	0-1	1
	1747.5	20325	15	QPSK	36	37	22.98	0-1	1
	1747.5	20325	15	QPSK	75	0	22.99	0-1	1
	1747.5	20325	15	16QAM	1	0	23.00	0-1	1
	1747.5	20325	15	16QAM	1	36	22.98	0-1	1
	1747.5	20325	15	16QAM	1	74	22.99	0-1	1
	1747.5	20325	15	16QAM	36	0	21.99	0-2	2
	1747.5	20325	15	16QAM	36	18	22.00	0-2	2
	1747.5	20325	15	16QAM	36	37	21.95	0-2	2
	1747.5	20325	15	16QAM	75	0	21.98	0-2	2

Table 8-3
LTE Band 4 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	23.83	0	0
	1715	20000	10	QPSK	1	25	23.63	0	0
	1715	20000	10	QPSK	1	49	23.76	0	0
	1715	20000	10	QPSK	25	0	22.71	0-1	1
	1715	20000	10	QPSK	25	12	22.64	0-1	1
	1715	20000	10	QPSK	25	25	22.75	0-1	1
	1715	20000	10	QPSK	50	0	22.74	0-1	1
	1715	20000	10	16QAM	1	0	22.59	0-1	1
	1715	20000	10	16QAM	1	25	22.70	0-1	1
	1715	20000	10	16QAM	1	49	22.83	0-1	1
	1715	20000	10	16QAM	25	0	21.76	0-2	2
	1715	20000	10	16QAM	25	12	21.75	0-2	2
Mid	1715	20000	10	16QAM	25	25	21.72	0-2	2
	1715	20000	10	16QAM	50	0	21.80	0-2	2
	1732.5	20175	10	QPSK	1	0	23.83	0	0
	1732.5	20175	10	QPSK	1	25	23.80	0	0
	1732.5	20175	10	QPSK	1	49	23.92	0	0
	1732.5	20175	10	QPSK	25	0	22.94	0-1	1
	1732.5	20175	10	QPSK	25	12	22.86	0-1	1
	1732.5	20175	10	QPSK	25	25	22.99	0-1	1
	1732.5	20175	10	QPSK	50	0	22.99	0-1	1
	1732.5	20175	10	16QAM	1	0	22.71	0-1	1
	1732.5	20175	10	16QAM	1	25	22.85	0-1	1
	1732.5	20175	10	16QAM	1	49	22.87	0-1	1
High	1732.5	20175	10	16QAM	25	0	21.94	0-2	2
	1732.5	20175	10	16QAM	25	12	22.00	0-2	2
	1732.5	20175	10	16QAM	25	25	21.98	0-2	2
	1732.5	20175	10	16QAM	50	0	21.99	0-2	2
	1750	20350	10	QPSK	1	0	24.00	0	0
	1750	20350	10	QPSK	1	25	23.99	0	0
	1750	20350	10	QPSK	1	49	23.97	0	0
	1750	20350	10	QPSK	25	0	23.00	0-1	1
	1750	20350	10	QPSK	25	12	22.93	0-1	1
	1750	20350	10	QPSK	25	25	22.98	0-1	1
	1750	20350	10	QPSK	50	0	22.99	0-1	1
	1750	20350	10	16QAM	1	0	22.88	0-1	1
	1750	20350	10	16QAM	1	25	22.58	0-1	1
	1750	20350	10	16QAM	1	49	22.83	0-1	1
	1750	20350	10	16QAM	25	0	21.91	0-2	2
	1750	20350	10	16QAM	25	12	21.99	0-2	2
	1750	20350	10	16QAM	25	25	21.97	0-2	2
	1750	20350	10	16QAM	50	0	21.94	0-2	2

Table 8-4
LTE Band 4 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	23.89	0	0
	1712.5	19975	5	QPSK	1	12	23.81	0	0
	1712.5	19975	5	QPSK	1	24	23.23	0	0
	1712.5	19975	5	QPSK	12	0	22.72	0-1	1
	1712.5	19975	5	QPSK	12	6	22.72	0-1	1
	1712.5	19975	5	QPSK	12	13	22.70	0-1	1
	1712.5	19975	5	QPSK	25	0	22.25	0-1	1
	1712.5	19975	5	16-QAM	1	0	22.45	0-1	1
	1712.5	19975	5	16-QAM	1	12	22.43	0-1	1
	1712.5	19975	5	16-QAM	1	24	22.50	0-1	1
	1712.5	19975	5	16-QAM	12	0	21.34	0-2	2
	1712.5	19975	5	16-QAM	12	6	21.48	0-2	2
Mid	1712.5	19975	5	16-QAM	12	13	21.65	0-2	2
	1712.5	19975	5	16-QAM	25	0	21.78	0-2	2
	1732.5	20175	5	QPSK	1	0	24.00	0	0
	1732.5	20175	5	QPSK	1	12	23.97	0	0
	1732.5	20175	5	QPSK	1	24	23.99	0	0
	1732.5	20175	5	QPSK	12	0	22.87	0-1	1
	1732.5	20175	5	QPSK	12	6	22.94	0-1	1
	1732.5	20175	5	QPSK	12	13	22.93	0-1	1
	1732.5	20175	5	QPSK	25	0	22.86	0-1	1
	1732.5	20175	5	16-QAM	1	0	22.87	0-1	1
	1732.5	20175	5	16-QAM	1	12	22.83	0-1	1
	1732.5	20175	5	16-QAM	1	24	23.00	0-1	1
High	1732.5	20175	5	16-QAM	12	0	21.90	0-2	2
	1732.5	20175	5	16-QAM	12	6	21.84	0-2	2
	1732.5	20175	5	16-QAM	12	13	21.92	0-2	2
	1732.5	20175	5	16-QAM	25	0	21.93	0-2	2
	1752.5	20375	5	QPSK	1	0	23.97	0	0
	1752.5	20375	5	QPSK	1	12	23.95	0	0
	1752.5	20375	5	QPSK	1	24	23.95	0	0
	1752.5	20375	5	QPSK	12	0	23.00	0-1	1
	1752.5	20375	5	QPSK	12	6	22.96	0-1	1
	1752.5	20375	5	QPSK	12	13	22.89	0-1	1
	1752.5	20375	5	QPSK	25	0	22.96	0-1	1
	1752.5	20375	5	16-QAM	1	0	22.86	0-1	1
	1752.5	20375	5	16-QAM	1	12	22.81	0-1	1
	1752.5	20375	5	16-QAM	1	24	22.89	0-1	1
	1752.5	20375	5	16-QAM	12	0	21.92	0-2	2
	1752.5	20375	5	16-QAM	12	6	21.92	0-2	2
	1752.5	20375	5	16-QAM	12	13	21.93	0-2	2
	1752.5	20375	5	16-QAM	25	0	22.00	0-2	2

8.1.2 LTE Band 4 (AWS) Reduced Power - Body at 0mm

Table 8-5
LTE Band 4 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	11.52	0	0
	1732.5	20175	20	QPSK	1	50	12.09	0	0
	1732.5	20175	20	QPSK	1	99	11.53	0	0
	1732.5	20175	20	QPSK	50	0	10.74	0-1	1
	1732.5	20175	20	QPSK	50	25	11.04	0-1	1
	1732.5	20175	20	QPSK	50	50	10.61	0-1	1
	1732.5	20175	20	QPSK	100	0	10.72	0-1	1
	1732.5	20175	20	16QAM	1	0	10.79	0-1	1
	1732.5	20175	20	16QAM	1	50	11.45	0-1	1
	1732.5	20175	20	16QAM	1	99	10.64	0-1	1
	1732.5	20175	20	16QAM	50	0	9.76	0-2	2
	1732.5	20175	20	16QAM	50	25	9.86	0-2	2
	1732.5	20175	20	16QAM	50	50	9.51	0-2	2
	1732.5	20175	20	16QAM	100	0	9.72	0-2	2

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Table 8-6
LTE Band 4 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	11.99	0	0
	1717.5	20025	15	QPSK	1	36	12.43	0	0
	1717.5	20025	15	QPSK	1	74	11.77	0	0
	1717.5	20025	15	QPSK	36	0	11.10	0-1	1
	1717.5	20025	15	QPSK	36	18	11.24	0-1	1
	1717.5	20025	15	QPSK	36	37	11.13	0-1	1
	1717.5	20025	15	QPSK	75	0	11.21	0-1	1
	1717.5	20025	15	16QAM	1	0	11.26	0-1	1
	1717.5	20025	15	16QAM	1	36	11.32	0-1	1
	1717.5	20025	15	16QAM	1	74	11.05	0-1	1
	1717.5	20025	15	16QAM	36	0	10.22	0-2	2
	1717.5	20025	15	16QAM	36	18	10.29	0-2	2
	1717.5	20025	15	16QAM	36	37	10.18	0-2	2
Mid	1732.5	20175	15	QPSK	1	0	11.89	0	0
	1732.5	20175	15	QPSK	1	36	11.90	0	0
	1732.5	20175	15	QPSK	1	74	11.78	0	0
	1732.5	20175	15	QPSK	36	0	11.03	0-1	1
	1732.5	20175	15	QPSK	36	18	11.01	0-1	1
	1732.5	20175	15	QPSK	36	37	10.90	0-1	1
	1732.5	20175	15	QPSK	75	0	11.46	0-1	1
	1732.5	20175	15	16QAM	1	0	11.25	0-1	1
	1732.5	20175	15	16QAM	1	36	11.34	0-1	1
	1732.5	20175	15	16QAM	1	74	11.48	0-1	1
	1732.5	20175	15	16QAM	36	0	9.96	0-2	2
	1732.5	20175	15	16QAM	36	18	10.02	0-2	2
	1732.5	20175	15	16QAM	36	37	9.97	0-2	2
	1732.5	20175	15	16QAM	75	0	9.94	0-2	2
High	1747.5	20325	15	QPSK	1	0	11.64	0	0
	1747.5	20325	15	QPSK	1	36	11.95	0	0
	1747.5	20325	15	QPSK	1	74	11.69	0	0
	1747.5	20325	15	QPSK	36	0	10.85	0-1	1
	1747.5	20325	15	QPSK	36	18	11.12	0-1	1
	1747.5	20325	15	QPSK	36	37	11.00	0-1	1
	1747.5	20325	15	QPSK	75	0	10.91	0-1	1
	1747.5	20325	15	16QAM	1	0	10.80	0-1	1
	1747.5	20325	15	16QAM	1	36	11.09	0-1	1
	1747.5	20325	15	16QAM	1	74	10.90	0-1	1
	1747.5	20325	15	16QAM	36	0	9.87	0-2	2
	1747.5	20325	15	16QAM	36	18	10.05	0-2	2
	1747.5	20325	15	16QAM	36	37	9.94	0-2	2
	1747.5	20325	15	16QAM	75	0	9.93	0-2	2

Table 8-7
LTE Band 4 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	12.37	0	0
	1715	20000	10	QPSK	1	25	12.35	0	0
	1715	20000	10	QPSK	1	49	12.16	0	0
	1715	20000	10	QPSK	25	0	11.50	0-1	1
	1715	20000	10	QPSK	25	12	11.32	0-1	1
	1715	20000	10	QPSK	25	25	11.37	0-1	1
	1715	20000	10	QPSK	50	0	11.37	0-1	1
	1715	20000	10	16QAM	1	0	11.23	0-1	1
	1715	20000	10	16QAM	1	25	11.50	0-1	1
	1715	20000	10	16QAM	1	49	11.39	0-1	1
	1715	20000	10	16QAM	25	0	10.44	0-2	2
	1715	20000	10	16QAM	25	12	10.28	0-2	2
Mid	1715	20000	10	16QAM	25	25	10.33	0-2	2
	1715	20000	10	16QAM	50	0	10.46	0-2	2
	1732.5	20175	10	QPSK	1	0	12.03	0	0
	1732.5	20175	10	QPSK	1	25	12.00	0	0
	1732.5	20175	10	QPSK	1	49	12.00	0	0
	1732.5	20175	10	QPSK	25	0	11.30	0-1	1
	1732.5	20175	10	QPSK	25	12	11.49	0-1	1
	1732.5	20175	10	QPSK	25	25	11.48	0-1	1
	1732.5	20175	10	QPSK	50	0	11.45	0-1	1
	1732.5	20175	10	16QAM	1	0	11.43	0-1	1
	1732.5	20175	10	16QAM	1	25	11.44	0-1	1
	1732.5	20175	10	16QAM	1	49	11.48	0-1	1
High	1732.5	20175	10	16QAM	25	0	10.40	0-2	2
	1732.5	20175	10	16QAM	25	12	10.50	0-2	2
	1732.5	20175	10	16QAM	25	25	10.50	0-2	2
	1732.5	20175	10	16QAM	50	0	10.42	0-2	2
	1750	20350	10	QPSK	1	0	12.29	0	0
	1750	20350	10	QPSK	1	25	12.19	0	0
	1750	20350	10	QPSK	1	49	12.24	0	0
	1750	20350	10	QPSK	25	0	11.12	0-1	1
	1750	20350	10	QPSK	25	12	11.12	0-1	1
	1750	20350	10	QPSK	25	25	11.00	0-1	1
	1750	20350	10	QPSK	50	0	11.13	0-1	1
	1750	20350	10	16QAM	1	0	11.30	0-1	1
	1750	20350	10	16QAM	1	25	11.21	0-1	1
	1750	20350	10	16QAM	1	49	11.10	0-1	1
	1750	20350	10	16QAM	25	0	10.10	0-2	2
	1750	20350	10	16QAM	25	12	10.13	0-2	2
	1750	20350	10	16QAM	25	25	10.01	0-2	2
	1750	20350	10	16QAM	50	0	10.12	0-2	2

Table 8-8
LTE Band 4 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	11.83	0	0
	1712.5	19975	5	QPSK	1	12	11.88	0	0
	1712.5	19975	5	QPSK	1	24	11.83	0	0
	1712.5	19975	5	QPSK	12	0	10.79	0-1	1
	1712.5	19975	5	QPSK	12	6	10.74	0-1	1
	1712.5	19975	5	QPSK	12	13	10.75	0-1	1
	1712.5	19975	5	QPSK	25	0	10.74	0-1	1
	1712.5	19975	5	16-QAM	1	0	11.00	0-1	1
	1712.5	19975	5	16-QAM	1	12	11.06	0-1	1
	1712.5	19975	5	16-QAM	1	24	11.00	0-1	1
	1712.5	19975	5	16-QAM	12	0	9.80	0-2	2
	1712.5	19975	5	16-QAM	12	6	9.73	0-2	2
Mid	1712.5	19975	5	16-QAM	12	13	9.76	0-2	2
	1712.5	19975	5	16-QAM	25	0	9.68	0-2	2
	1732.5	20175	5	QPSK	1	0	12.00	0	0
	1732.5	20175	5	QPSK	1	12	12.11	0	0
	1732.5	20175	5	QPSK	1	24	12.01	0	0
	1732.5	20175	5	QPSK	12	0	10.88	0-1	1
	1732.5	20175	5	QPSK	12	6	10.68	0-1	1
	1732.5	20175	5	QPSK	12	13	10.77	0-1	1
	1732.5	20175	5	QPSK	25	0	10.80	0-1	1
	1732.5	20175	5	16-QAM	1	0	10.97	0-1	1
	1732.5	20175	5	16-QAM	1	12	10.87	0-1	1
	1732.5	20175	5	16-QAM	1	24	11.26	0-1	1
High	1732.5	20175	5	16-QAM	12	0	9.81	0-2	2
	1732.5	20175	5	16-QAM	12	6	9.70	0-2	2
	1732.5	20175	5	16-QAM	12	13	9.78	0-2	2
	1732.5	20175	5	16-QAM	25	0	9.75	0-2	2
	1752.5	20375	5	QPSK	1	0	11.70	0	0
	1752.5	20375	5	QPSK	1	12	11.64	0	0
	1752.5	20375	5	QPSK	1	24	11.53	0	0
	1752.5	20375	5	QPSK	12	0	10.63	0-1	1
	1752.5	20375	5	QPSK	12	6	10.54	0-1	1
	1752.5	20375	5	QPSK	12	13	10.56	0-1	1
	1752.5	20375	5	QPSK	25	0	10.51	0-1	1
	1752.5	20375	5	16-QAM	1	0	10.85	0-1	1
	1752.5	20375	5	16-QAM	1	12	11.00	0-1	1
	1752.5	20375	5	16-QAM	1	24	10.87	0-1	1
	1752.5	20375	5	16-QAM	12	0	9.69	0-2	2
	1752.5	20375	5	16-QAM	12	6	9.56	0-2	2
	1752.5	20375	5	16-QAM	12	13	9.50	0-2	2
	1752.5	20375	5	16-QAM	25	0	9.51	0-2	2

8.1.3 LTE Band 2 (PCS) Maximum Power

Table 8-9
LTE Band 2 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	23.40	0	0
	1860	18700	20	QPSK	1	50	23.42	0	0
	1860	18700	20	QPSK	1	99	23.37	0	0
	1860	18700	20	QPSK	50	0	22.49	0-1	1
	1860	18700	20	QPSK	50	25	22.48	0-1	1
	1860	18700	20	QPSK	50	50	22.47	0-1	1
	1860	18700	20	QPSK	100	0	22.46	0-1	1
	1860	18700	20	16QAM	1	0	22.46	0-1	1
	1860	18700	20	16QAM	1	50	22.47	0-1	1
	1860	18700	20	16QAM	1	99	22.38	0-1	1
	1860	18700	20	16QAM	50	0	21.44	0-2	2
	1860	18700	20	16QAM	50	25	21.49	0-2	2
	1860	18700	20	16QAM	50	50	21.48	0-2	2
	1860	18700	20	16QAM	100	0	21.42	0-2	2
Mid	1880.0	18900	20	QPSK	1	0	23.50	0	0
	1880.0	18900	20	QPSK	1	50	23.48	0	0
	1880.0	18900	20	QPSK	1	99	23.45	0	0
	1880.0	18900	20	QPSK	50	0	22.50	0-1	1
	1880.0	18900	20	QPSK	50	25	22.48	0-1	1
	1880.0	18900	20	QPSK	50	50	22.48	0-1	1
	1880.0	18900	20	QPSK	100	0	22.45	0-1	1
	1880.0	18900	20	16QAM	1	0	22.50	0-1	1
	1880.0	18900	20	16QAM	1	50	22.46	0-1	1
	1880.0	18900	20	16QAM	1	99	22.47	0-1	1
	1880.0	18900	20	16QAM	50	0	21.47	0-2	2
	1880.0	18900	20	16QAM	50	25	21.44	0-2	2
	1880.0	18900	20	16QAM	50	50	21.43	0-2	2
	1880.0	18900	20	16QAM	100	0	21.42	0-2	2
High	1900	19100	20	QPSK	1	0	23.28	0	0
	1900	19100	20	QPSK	1	50	23.20	0	0
	1900	19100	20	QPSK	1	99	23.14	0	0
	1900	19100	20	QPSK	50	0	22.38	0-1	1
	1900	19100	20	QPSK	50	25	22.19	0-1	1
	1900	19100	20	QPSK	50	50	22.17	0-1	1
	1900	19100	20	QPSK	100	0	22.21	0-1	1
	1900	19100	20	16QAM	1	0	22.46	0-1	1
	1900	19100	20	16QAM	1	50	22.48	0-1	1
	1900	19100	20	16QAM	1	99	22.43	0-1	1
	1900	19100	20	16QAM	50	0	21.21	0-2	2
	1900	19100	20	16QAM	50	25	21.15	0-2	2
	1900	19100	20	16QAM	50	50	21.11	0-2	2
	1900	19100	20	16QAM	100	0	21.14	0-2	2

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Table 8-10
LTE Band 2 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	23.48	0	0
	1857.5	18675	15	QPSK	1	36	23.49	0	0
	1857.5	18675	15	QPSK	1	74	23.50	0	0
	1857.5	18675	15	QPSK	36	0	22.49	0-1	1
	1857.5	18675	15	QPSK	36	18	22.48	0-1	1
	1857.5	18675	15	QPSK	36	37	22.47	0-1	1
	1857.5	18675	15	QPSK	75	0	22.48	0-1	1
	1857.5	18675	15	16QAM	1	0	22.44	0-1	1
	1857.5	18675	15	16QAM	1	36	22.49	0-1	1
	1857.5	18675	15	16QAM	1	74	22.50	0-1	1
	1857.5	18675	15	16QAM	36	0	21.48	0-2	2
	1857.5	18675	15	16QAM	36	18	21.47	0-2	2
	1857.5	18675	15	16QAM	36	37	21.45	0-2	2
Mid	1857.5	18675	15	16QAM	75	0	21.50	0-2	2
	1880.0	18900	15	QPSK	1	0	23.46	0	0
	1880.0	18900	15	QPSK	1	36	23.48	0	0
	1880.0	18900	15	QPSK	1	74	23.44	0	0
	1880.0	18900	15	QPSK	36	0	22.45	0-1	1
	1880.0	18900	15	QPSK	36	18	22.44	0-1	1
	1880.0	18900	15	QPSK	36	37	22.48	0-1	1
	1880.0	18900	15	QPSK	75	0	22.43	0-1	1
	1880.0	18900	15	16QAM	1	0	22.49	0-1	1
	1880.0	18900	15	16QAM	1	36	22.48	0-1	1
	1880.0	18900	15	16QAM	1	74	22.47	0-1	1
	1880.0	18900	15	16QAM	36	0	21.48	0-2	2
	1880.0	18900	15	16QAM	36	18	21.43	0-2	2
High	1880.0	18900	15	16QAM	36	37	21.44	0-2	2
	1880.0	18900	15	16QAM	75	0	21.43	0-2	2
	1902.5	19125	15	QPSK	1	0	23.29	0	0
	1902.5	19125	15	QPSK	1	36	23.25	0	0
	1902.5	19125	15	QPSK	1	74	23.13	0	0
	1902.5	19125	15	QPSK	36	0	22.42	0-1	1
	1902.5	19125	15	QPSK	36	18	22.23	0-1	1
	1902.5	19125	15	QPSK	36	37	22.18	0-1	1
	1902.5	19125	15	QPSK	75	0	22.24	0-1	1
	1902.5	19125	15	16QAM	1	0	22.47	0-1	1
	1902.5	19125	15	16QAM	1	36	22.35	0-1	1
	1902.5	19125	15	16QAM	1	74	22.33	0-1	1
	1902.5	19125	15	16QAM	36	0	21.38	0-2	2
	1902.5	19125	15	16QAM	36	18	21.26	0-2	2
	1902.5	19125	15	16QAM	36	37	21.13	0-2	2
	1902.5	19125	15	16QAM	75	0	21.17	0-2	2

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Table 8-11
LTE Band 2 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	23.48	0	0
	1855	18650	10	QPSK	1	25	23.27	0	0
	1855	18650	10	QPSK	1	49	23.47	0	0
	1855	18650	10	QPSK	25	0	22.48	0-1	1
	1855	18650	10	QPSK	25	12	22.26	0-1	1
	1855	18650	10	QPSK	25	25	22.40	0-1	1
	1855	18650	10	QPSK	50	0	22.46	0-1	1
	1855	18650	10	16QAM	1	0	22.37	0-1	1
	1855	18650	10	16QAM	1	25	22.39	0-1	1
	1855	18650	10	16QAM	1	49	22.38	0-1	1
	1855	18650	10	16QAM	25	0	21.50	0-2	2
	1855	18650	10	16QAM	25	12	21.49	0-2	2
Mid	1880.0	18900	10	QPSK	1	0	23.50	0	0
	1880.0	18900	10	QPSK	1	25	23.44	0	0
	1880.0	18900	10	QPSK	1	49	23.44	0	0
	1880.0	18900	10	QPSK	25	0	22.18	0-1	1
	1880.0	18900	10	QPSK	25	12	22.49	0-1	1
	1880.0	18900	10	QPSK	25	25	22.18	0-1	1
	1880.0	18900	10	QPSK	50	0	22.34	0-1	1
	1880.0	18900	10	16QAM	1	0	22.49	0-1	1
	1880.0	18900	10	16QAM	1	25	22.31	0-1	1
	1880.0	18900	10	16QAM	1	49	22.28	0-1	1
	1880.0	18900	10	16QAM	25	0	21.39	0-2	2
	1880.0	18900	10	16QAM	25	12	21.41	0-2	2
High	1905	19150	10	QPSK	1	0	23.40	0	0
	1905	19150	10	QPSK	1	25	23.23	0	0
	1905	19150	10	QPSK	1	49	23.23	0	0
	1905	19150	10	QPSK	25	0	22.13	0-1	1
	1905	19150	10	QPSK	25	12	22.15	0-1	1
	1905	19150	10	QPSK	25	25	22.20	0-1	1
	1905	19150	10	QPSK	50	0	22.27	0-1	1
	1905	19150	10	16QAM	1	0	22.16	0-1	1
	1905	19150	10	16QAM	1	25	22.00	0-1	1
	1905	19150	10	16QAM	1	49	22.05	0-1	1
	1905	19150	10	16QAM	25	0	21.14	0-2	2
	1905	19150	10	16QAM	25	12	21.17	0-2	2
	1905	19150	10	16QAM	25	25	21.28	0-2	2
	1905	19150	10	16QAM	50	0	21.12	0-2	2

Table 8-12
LTE Band 2 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	23.50	0	0
	1852.5	18625	5	QPSK	1	12	23.49	0	0
	1852.5	18625	5	QPSK	1	24	23.48	0	0
	1852.5	18625	5	QPSK	12	0	22.25	0-1	1
	1852.5	18625	5	QPSK	12	6	22.48	0-1	1
	1852.5	18625	5	QPSK	12	13	22.50	0-1	1
	1852.5	18625	5	QPSK	25	0	22.47	0-1	1
	1852.5	18625	5	16-QAM	1	0	22.24	0-1	1
	1852.5	18625	5	16-QAM	1	12	21.63	0-1	1
	1852.5	18625	5	16-QAM	1	24	21.59	0-1	1
	1852.5	18625	5	16-QAM	12	0	21.44	0-2	2
	1852.5	18625	5	16-QAM	12	6	21.33	0-2	2
Mid	1852.5	18625	5	16-QAM	12	13	21.44	0-2	2
	1852.5	18625	5	16-QAM	25	0	21.45	0-2	2
	1880.0	18900	5	QPSK	1	0	23.50	0	0
	1880.0	18900	5	QPSK	1	12	23.31	0	0
	1880.0	18900	5	QPSK	1	24	23.49	0	0
	1880.0	18900	5	QPSK	12	0	22.10	0-1	1
	1880.0	18900	5	QPSK	12	6	22.20	0-1	1
	1880.0	18900	5	QPSK	12	13	22.28	0-1	1
	1880.0	18900	5	QPSK	25	0	22.21	0-1	1
	1880.0	18900	5	16-QAM	1	0	22.25	0-1	1
	1880.0	18900	5	16-QAM	1	12	22.35	0-1	1
	1880.0	18900	5	16-QAM	1	24	22.13	0-1	1
High	1880.0	18900	5	16-QAM	12	0	21.29	0-2	2
	1880.0	18900	5	16-QAM	12	6	21.31	0-2	2
	1880.0	18900	5	16-QAM	12	13	21.27	0-2	2
	1880.0	18900	5	16-QAM	25	0	21.35	0-2	2
	1907.5	19175	5	QPSK	1	0	23.24	0	0
	1907.5	19175	5	QPSK	1	12	23.25	0	0
	1907.5	19175	5	QPSK	1	24	23.39	0	0
	1907.5	19175	5	QPSK	12	0	22.15	0-1	1
	1907.5	19175	5	QPSK	12	6	22.10	0-1	1
	1907.5	19175	5	QPSK	12	13	22.19	0-1	1
	1907.5	19175	5	QPSK	25	0	22.05	0-1	1
	1907.5	19175	5	16-QAM	1	0	22.05	0-1	1
	1907.5	19175	5	16-QAM	1	12	22.22	0-1	1
	1907.5	19175	5	16-QAM	1	24	22.22	0-1	1
	1907.5	19175	5	16-QAM	12	0	21.12	0-2	2
	1907.5	19175	5	16-QAM	12	6	21.07	0-2	2
	1907.5	19175	5	16-QAM	12	13	21.09	0-2	2
	1907.5	19175	5	16-QAM	25	0	21.19	0-2	2

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8.1.4 LTE Band 2 (PCS) Reduced Power – Body at 0mm

Table 8-13
LTE Band 2 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	11.51	0	0
	1860	18700	20	QPSK	1	50	12.35	0	0
	1860	18700	20	QPSK	1	99	11.50	0	0
	1860	18700	20	QPSK	50	0	10.90	0-1	1
	1860	18700	20	QPSK	50	25	11.14	0-1	1
	1860	18700	20	QPSK	50	50	10.89	0-1	1
	1860	18700	20	QPSK	100	0	10.90	0-1	1
	1860	18700	20	16QAM	1	0	10.71	0-1	1
	1860	18700	20	16QAM	1	50	11.49	0-1	1
	1860	18700	20	16QAM	1	99	10.59	0-1	1
	1860	18700	20	16QAM	50	0	9.87	0-2	2
	1860	18700	20	16QAM	50	25	10.11	0-2	2
	1860	18700	20	16QAM	50	50	9.87	0-2	2
	1860	18700	20	16QAM	100	0	9.87	0-2	2
Mid	1880.0	18900	20	QPSK	1	0	11.51	0	0
	1880.0	18900	20	QPSK	1	50	12.32	0	0
	1880.0	18900	20	QPSK	1	99	11.50	0	0
	1880.0	18900	20	QPSK	50	0	10.80	0-1	1
	1880.0	18900	20	QPSK	50	25	11.18	0-1	1
	1880.0	18900	20	QPSK	50	50	10.90	0-1	1
	1880.0	18900	20	QPSK	100	0	10.84	0-1	1
	1880.0	18900	20	16QAM	1	0	10.59	0-1	1
	1880.0	18900	20	16QAM	1	50	11.50	0-1	1
	1880.0	18900	20	16QAM	1	99	10.53	0-1	1
	1880.0	18900	20	16QAM	50	0	9.78	0-2	2
	1880.0	18900	20	16QAM	50	25	10.18	0-2	2
	1880.0	18900	20	16QAM	50	50	9.90	0-2	2
	1880.0	18900	20	16QAM	100	0	9.83	0-2	2
High	1900	19100	20	QPSK	1	0	11.50	0	0
	1900	19100	20	QPSK	1	50	12.37	0	0
	1900	19100	20	QPSK	1	99	11.50	0	0
	1900	19100	20	QPSK	50	0	10.75	0-1	1
	1900	19100	20	QPSK	50	25	11.19	0-1	1
	1900	19100	20	QPSK	50	50	10.87	0-1	1
	1900	19100	20	QPSK	100	0	10.89	0-1	1
	1900	19100	20	16QAM	1	0	10.52	0-1	1
	1900	19100	20	16QAM	1	50	11.50	0-1	1
	1900	19100	20	16QAM	1	99	10.53	0-1	1
	1900	19100	20	16QAM	50	0	9.72	0-2	2
	1900	19100	20	16QAM	50	25	10.17	0-2	2
	1900	19100	20	16QAM	50	50	9.87	0-2	2
	1900	19100	20	16QAM	100	0	9.87	0-2	2

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Table 8-14
LTE Band 2 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	12.21	0	0
	1857.5	18675	15	QPSK	1	36	12.28	0	0
	1857.5	18675	15	QPSK	1	74	12.02	0	0
	1857.5	18675	15	QPSK	36	0	11.22	0-1	1
	1857.5	18675	15	QPSK	36	18	11.31	0-1	1
	1857.5	18675	15	QPSK	36	37	11.13	0-1	1
	1857.5	18675	15	QPSK	75	0	11.22	0-1	1
	1857.5	18675	15	16QAM	1	0	11.48	0-1	1
	1857.5	18675	15	16QAM	1	36	11.50	0-1	1
	1857.5	18675	15	16QAM	1	74	11.31	0-1	1
	1857.5	18675	15	16QAM	36	0	10.19	0-2	2
	1857.5	18675	15	16QAM	36	18	10.28	0-2	2
	1857.5	18675	15	16QAM	36	37	10.10	0-2	2
Mid	1857.5	18675	15	16QAM	75	0	10.19	0-2	2
	1880.0	18900	15	QPSK	1	0	12.14	0	0
	1880.0	18900	15	QPSK	1	36	12.35	0	0
	1880.0	18900	15	QPSK	1	74	12.06	0	0
	1880.0	18900	15	QPSK	36	0	11.22	0-1	1
	1880.0	18900	15	QPSK	36	18	11.31	0-1	1
	1880.0	18900	15	QPSK	36	37	11.21	0-1	1
	1880.0	18900	15	QPSK	75	0	11.14	0-1	1
	1880.0	18900	15	16QAM	1	0	11.39	0-1	1
	1880.0	18900	15	16QAM	1	36	11.50	0-1	1
	1880.0	18900	15	16QAM	1	74	11.35	0-1	1
	1880.0	18900	15	16QAM	36	0	10.19	0-2	2
	1880.0	18900	15	16QAM	36	18	10.29	0-2	2
High	1880.0	18900	15	16QAM	36	37	10.19	0-2	2
	1880.0	18900	15	16QAM	75	0	10.12	0-2	2
	1902.5	19125	15	QPSK	1	0	11.96	0	0
	1902.5	19125	15	QPSK	1	36	12.30	0	0
	1902.5	19125	15	QPSK	1	74	11.86	0	0
	1902.5	19125	15	QPSK	36	0	11.16	0-1	1
	1902.5	19125	15	QPSK	36	18	11.34	0-1	1
	1902.5	19125	15	QPSK	36	37	11.17	0-1	1
	1902.5	19125	15	QPSK	75	0	11.10	0-1	1
	1902.5	19125	15	16QAM	1	0	11.26	0-1	1
	1902.5	19125	15	16QAM	1	36	11.50	0-1	1
	1902.5	19125	15	16QAM	1	74	11.19	0-1	1
	1902.5	19125	15	16QAM	36	0	10.15	0-2	2
	1902.5	19125	15	16QAM	36	18	10.34	0-2	2
	1902.5	19125	15	16QAM	36	37	10.17	0-2	2
	1902.5	19125	15	16QAM	75	0	10.08	0-2	2

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Table 8-15
LTE Band 2 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	12.15	0	0
	1855	18650	10	QPSK	1	25	12.00	0	0
	1855	18650	10	QPSK	1	49	11.86	0	0
	1855	18650	10	QPSK	25	0	10.82	0-1	1
	1855	18650	10	QPSK	25	12	10.79	0-1	1
	1855	18650	10	QPSK	25	25	10.75	0-1	1
	1855	18650	10	QPSK	50	0	10.76	0-1	1
	1855	18650	10	16QAM	1	0	11.21	0-1	1
	1855	18650	10	16QAM	1	25	11.07	0-1	1
	1855	18650	10	16QAM	1	49	10.98	0-1	1
	1855	18650	10	16QAM	25	0	9.75	0-2	2
	1855	18650	10	16QAM	25	12	9.72	0-2	2
Mid	1880.0	18900	10	QPSK	1	0	12.38	0	0
	1880.0	18900	10	QPSK	1	25	12.35	0	0
	1880.0	18900	10	QPSK	1	49	12.34	0	0
	1880.0	18900	10	QPSK	25	0	11.47	0-1	1
	1880.0	18900	10	QPSK	25	12	11.48	0-1	1
	1880.0	18900	10	QPSK	25	25	11.46	0-1	1
	1880.0	18900	10	QPSK	50	0	11.43	0-1	1
	1880.0	18900	10	16QAM	1	0	11.48	0-1	1
	1880.0	18900	10	16QAM	1	25	11.45	0-1	1
	1880.0	18900	10	16QAM	1	49	11.49	0-1	1
	1880.0	18900	10	16QAM	25	0	10.26	0-2	2
	1880.0	18900	10	16QAM	25	12	10.33	0-2	2
High	1905	19150	10	QPSK	1	0	11.69	0	0
	1905	19150	10	QPSK	1	25	11.57	0	0
	1905	19150	10	QPSK	1	49	11.67	0	0
	1905	19150	10	QPSK	25	0	10.77	0-1	1
	1905	19150	10	QPSK	25	12	10.81	0-1	1
	1905	19150	10	QPSK	25	25	10.79	0-1	1
	1905	19150	10	QPSK	50	0	10.76	0-1	1
	1905	19150	10	16QAM	1	0	10.83	0-1	1
	1905	19150	10	16QAM	1	25	10.70	0-1	1
	1905	19150	10	16QAM	1	49	10.91	0-1	1
	1905	19150	10	16QAM	25	0	9.69	0-2	2
	1905	19150	10	16QAM	25	12	9.80	0-2	2
	1905	19150	10	16QAM	25	25	9.73	0-2	2
	1905	19150	10	16QAM	50	0	9.72	0-2	2

Table 8-16
LTE Band 2 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	11.89	0	0
	1852.5	18625	5	QPSK	1	12	11.74	0	0
	1852.5	18625	5	QPSK	1	24	11.80	0	0
	1852.5	18625	5	QPSK	12	0	10.80	0-1	1
	1852.5	18625	5	QPSK	12	6	10.80	0-1	1
	1852.5	18625	5	QPSK	12	13	10.70	0-1	1
	1852.5	18625	5	QPSK	25	0	10.77	0-1	1
	1852.5	18625	5	16-QAM	1	0	11.03	0-1	1
	1852.5	18625	5	16-QAM	1	12	10.98	0-1	1
	1852.5	18625	5	16-QAM	1	24	11.04	0-1	1
	1852.5	18625	5	16-QAM	12	0	9.85	0-2	2
	1852.5	18625	5	16-QAM	12	6	9.81	0-2	2
Mid	1880.0	18900	5	QPSK	1	0	11.74	0	0
	1880.0	18900	5	QPSK	1	12	11.73	0	0
	1880.0	18900	5	QPSK	1	24	11.69	0	0
	1880.0	18900	5	QPSK	12	0	10.70	0-1	1
	1880.0	18900	5	QPSK	12	6	10.73	0-1	1
	1880.0	18900	5	QPSK	12	13	10.68	0-1	1
	1880.0	18900	5	QPSK	25	0	10.64	0-1	1
	1880.0	18900	5	16-QAM	1	0	10.51	0-1	1
	1880.0	18900	5	16-QAM	1	12	10.71	0-1	1
	1880.0	18900	5	16-QAM	1	24	11.05	0-1	1
	1880.0	18900	5	16-QAM	12	0	9.74	0-2	2
	1880.0	18900	5	16-QAM	12	6	9.78	0-2	2
High	1907.5	19175	5	QPSK	1	0	11.60	0	0
	1907.5	19175	5	QPSK	1	12	11.68	0	0
	1907.5	19175	5	QPSK	1	24	11.57	0	0
	1907.5	19175	5	QPSK	12	0	10.76	0-1	1
	1907.5	19175	5	QPSK	12	6	10.80	0-1	1
	1907.5	19175	5	QPSK	12	13	10.75	0-1	1
	1907.5	19175	5	QPSK	25	0	10.76	0-1	1
	1907.5	19175	5	16-QAM	1	0	10.74	0-1	1
	1907.5	19175	5	16-QAM	1	12	11.04	0-1	1
	1907.5	19175	5	16-QAM	1	24	10.55	0-1	1
	1907.5	19175	5	16-QAM	12	0	9.74	0-2	2
	1907.5	19175	5	16-QAM	12	6	9.83	0-2	2
	1907.5	19175	5	16-QAM	12	13	9.76	0-2	2
	1907.5	19175	5	16-QAM	25	0	9.77	0-2	2

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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
7/21/2014	1750B	21.0	1710	1.496	52.641	1.463	53.537	2.26%	-1.67%
			1750	1.539	52.495	1.488	53.432	3.43%	-1.75%
			1790	1.584	52.349	1.514	53.326	4.62%	-1.83%
7/21/2014	1900B	23.7	1850	1.469	52.184	1.520	53.300	-3.36%	-2.09%
			1880	1.500	52.073	1.520	53.300	-1.32%	-2.30%
			1910	1.535	51.978	1.520	53.300	0.99%	-2.48%

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

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. Full system validation status and result summary can be found in Appendix E.

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} (%)
C	1750	BODY	07/21/2014	23.3	21.0	0.100	1051	3213	3.670	37.400	36.700	-1.87%
B	1900	BODY	07/21/2014	23.8	23.7	0.100	5d148	3288	4.170	39.300	41.700	6.11%

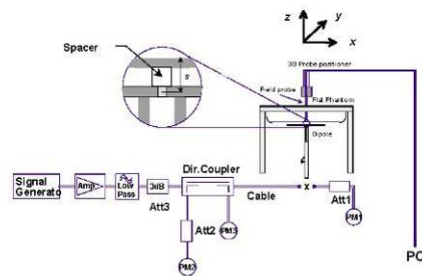


Figure 9-1
System Verification Setup Diagram



Figure 9-2
System Verification Setup Photo

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10 SAR DATA SUMMARY

10.1 Standalone Body SAR Data

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

MEASUREMENT RESULTS																			
FREQUENCY			Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #
																(W/kg)		(W/kg)	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	24.00	0.07	0	69	QPSK	1	99	22 mm	back	1:1	0.706	1.000	0.706	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	23.00	0.06	1	69	QPSK	50	50	22 mm	back	1:1	0.552	1.000	0.552	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	24.00	-0.01	0	69	QPSK	1	99	22 mm	top	1:1	0.789	1.000	0.789	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	23.00	0.01	1	69	QPSK	50	50	22 mm	top	1:1	0.589	1.000	0.589	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.5	12.09	0.06	0	60	QPSK	1	50	0 mm	back	1:1	0.887	1.099	0.975	A1
1732.50	20175	Mid	LTE Band 4 (AWS)	20	11.5	11.04	0.09	1	60	QPSK	50	25	0 mm	back	1:1	0.686	1.112	0.763	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	11.5	10.72	0.08	1	60	QPSK	100	0	0 mm	back	1:1	0.644	1.197	0.771	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.5	12.09	0.00	0	60	QPSK	1	50	0 mm	top	1:1	0.414	1.099	0.455	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	11.5	11.04	0.03	1	60	QPSK	50	25	0 mm	top	1:1	0.301	1.112	0.335	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	24.0	24.00	0.00	0	69	QPSK	1	99	0 mm	right	1:1	0.490	1.000	0.490	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	23.0	23.00	-0.01	1	69	QPSK	50	50	0 mm	right	1:1	0.373	1.000	0.373	
1732.50	20175	Mid	LTE Band 4 (AWS)	20	12.5	12.09	0.01	0	60	QPSK	1	50	0 mm	back	1:1	0.863	1.099	0.948	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population								Body 1.6 W/kg (mW/g) averaged over 1 gram											

Note: Variability data is highlighted blue in the table above.

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

MEASUREMENT RESULTS																			
FREQUENCY		Mode	Bandwidth [MHz]	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Device Serial Number	Modulation	RB Size	RB Offset	Spacing	Side	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.														(W/kg)		(W/kg)		
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.5	23.42	0.04	0	69	QPSK	1	50	22 mm	back	1:1	0.877	1.019	0.894	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.5	23.50	0.02	0	69	QPSK	1	0	22 mm	back	1:1	0.895	1.000	0.895	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.5	23.28	0.03	0	69	QPSK	1	0	22 mm	back	1:1	0.923	1.052	0.971	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.5	22.50	0.03	1	69	QPSK	50	0	22 mm	back	1:1	0.746	1.000	0.746	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.46	0.19	1	69	QPSK	100	0	22 mm	back	1:1	0.725	1.009	0.732	
1860.00	18700	Low	LTE Band 2 (PCS)	20	23.5	23.42	0.04	0	69	QPSK	1	50	22 mm	top	1:1	1.020	1.019	1.039	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.5	23.50	0.10	0	69	QPSK	1	0	22 mm	top	1:1	1.000	1.000	1.000	
1900.00	19100	High	LTE Band 2 (PCS)	20	23.5	23.28	0.03	0	69	QPSK	1	0	22 mm	top	1:1	0.969	1.052	1.019	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.49	0.00	1	69	QPSK	50	0	22 mm	top	1:1	0.809	1.002	0.811	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.5	22.50	0.02	1	69	QPSK	50	0	22 mm	top	1:1	0.822	1.000	0.822	
1900.00	19100	High	LTE Band 2 (PCS)	20	22.5	22.38	0.02	1	69	QPSK	50	0	22 mm	top	1:1	0.840	1.028	0.864	
1860.00	18700	Low	LTE Band 2 (PCS)	20	22.5	22.46	0.01	1	69	QPSK	100	0	22 mm	top	1:1	0.792	1.009	0.799	
1860.00	18700	Low	LTE Band 2 (PCS)	20	12.5	12.35	0.19	0	60	QPSK	1	50	0 mm	back	1:1	0.967	1.035	1.001	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	12.5	12.32	0.16	0	60	QPSK	1	50	0 mm	back	1:1	1.020	1.042	1.063	A2
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.37	0.03	0	60	QPSK	1	50	0 mm	back	1:1	0.886	1.030	0.913	
1900.00	19100	High	LTE Band 2 (PCS)	20	11.5	11.19	0.12	1	60	QPSK	50	25	0 mm	back	1:1	0.744	1.074	0.799	
1860.00	18700	Low	LTE Band 2 (PCS)	20	11.5	10.90	0.12	1	60	QPSK	100	0	0 mm	back	1:1	0.706	1.148	0.810	
1900.00	19100	High	LTE Band 2 (PCS)	20	12.5	12.37	-0.02	0	60	QPSK	1	50	0 mm	top	1:1	0.366	1.030	0.377	
1900.00	19100	High	LTE Band 2 (PCS)	20	11.5	11.19	0.04	1	60	QPSK	50	25	0 mm	top	1:1	0.280	1.074	0.301	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	23.5	23.50	0.11	0	69	QPSK	1	0	0 mm	right	1:1	0.390	1.000	0.390	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	22.5	22.50	-0.06	1	69	QPSK	50	0	0 mm	right	1:1	0.332	1.000	0.332	
1880.00	18900	Mid	LTE Band 2 (PCS)	20	12.5	12.32	0.13	0	60	QPSK	1	50	0 mm	back	1:1	1.010	1.042	1.052	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak								Body 1.6 W/kg (mW/g) averaged over 1 gram											
Uncontrolled Exposure/General Population																			

Note: Variability data is highlighted blue in the table above.

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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 KDB 616217 D04v01r01, and FCC KDB Publication 447498 D01v05.
2. Batteries are fully charged at the beginning of the SAR measurements.
3. Liquid tissue depth was at least 15.0 cm for all frequencies.
4. The manufacturer has confirmed that the device(s) tested have the same physical, mechanical and thermal characteristics and are within operational tolerances expected for production units.
5. SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
6. Per FCC 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.
7. 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. Top edge and right edge SAR tests were required for the main antenna.

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 7.3.4.
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 data devices 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 and IEEE 1528-2013 Section 6.3.4.1.2, 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.

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

Table 11-1
Estimated SAR

Mode	Frequency	Maximum Allowed Power	Separation Distance (Body)	Estimated SAR (Body)
	[MHz]	[dBm]	[mm]	[W/kg]
Bluetooth	2441	9.50	5	0.375
Bluetooth	2441	9.50	20	0.094
Bluetooth	2441	9.50	22	0.085

Note:

1. Per KDB Publication 447498 D01v05, the maximum power of the channel was rounded to the nearest mW before calculation.
2. Per FCC KDB Publication 447498, when the test separation distance is < 5 mm, a distance of 5 mm is applied to determine estimated SAR.
3. 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.
4. Please refer to RF Exposure Technical Report 0Y1403260617-R1.A3L for original compliance report containing SAR data WLAN modes. The highest reported SAR from the previous filing was used in the simultaneous transmission analysis below.

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11.3 Body SAR Simultaneous Transmission Analysis

Table 11-2
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	0.975	1.016	See Note 1	0.02
	Top	0.455	0.632	1.087	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.490	0.400	0.890	N/A
	Left	0.400	0.022	0.422	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	1.063	1.016	See Note 1	0.02
	Top	0.377	0.632	1.009	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.390	0.400	0.790	N/A
	Left	0.400	0.022	0.422	N/A

Table 11-3
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	0.975	1.070	See Note 1	0.02
	Top	0.455	0.177	0.632	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.490	0.400	0.890	N/A
	Left	0.400	0.067	0.467	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	1.063	1.070	See Note 1	0.02
	Top	0.377	0.177	0.554	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.390	0.400	0.790	N/A
	Left	0.400	0.067	0.467	N/A

Table 11-4
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	0.975	0.375	1.350	N/A
	Top	0.455	0.375	0.830	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.490	0.400	0.890	N/A
	Left	0.400	0.094	0.494	N/A
Simult Tx	Configuration	LTE Band 2 (PCS) SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Body SAR	Back	1.063	0.375	1.438	N/A
	Top	0.377	0.375	0.752	N/A
	Bottom	0.400	0.400	0.800	N/A
	Right	0.390	0.400	0.790	N/A
	Left	0.400	0.094	0.494	N/A

Note: Bluetooth SAR was not required to be measured per FCC KDB 447498. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

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Table 11-5
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Back at 22 mm)

Configuration	Mode	4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	LTE Band 4 (AWS)	0.706	<1.016	See Note 1	<0.02
Back Side	LTE Band 2 (PCS)	0.971	<1.016	See Note 1	<0.02

Table 11-6
Simultaneous Transmission Scenario with 5 GHz WLAN (Back at 22 mm)

Configuration	Mode	4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	LTE Band 4 (AWS)	0.706	<1.07	See Note 1	<0.02
Back Side	LTE Band 2 (PCS)	0.971	<1.07	See Note 1	<0.03

Table 11-7
Simultaneous Transmission Scenario with Bluetooth (Back at 22 mm)

Configuration	Mode	4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Back Side	LTE Band 4 (AWS)	0.706	0.085	0.791	N/A
Back Side	LTE Band 2 (PCS)	0.971	0.085	1.056	N/A

Note: Bluetooth SAR was not required to be measured per FCC KDB 447498. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

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Table 11-8
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Top at 22 mm)

Configuration	Mode	4G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	LTE Band 4 (AWS)	0.789	<0.632	<1.421	N/A
Top Edge	LTE Band 2 (PCS)	1.039	<0.632	See Note 1	<0.02

Table 11-9
Simultaneous Transmission Scenario with 5 GHz WLAN (Top at 22 mm)

Configuration	Mode	4G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	LTE Band 4 (AWS)	0.789	<0.177	<0.966	N/A
Top Edge	LTE Band 2 (PCS)	1.039	<0.177	<1.216	N/A

Table 11-10
Simultaneous Transmission Scenario with Bluetooth (Top at 22 mm)

Configuration	Mode	4G SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	SPLSR
Top Edge	LTE Band 4 (AWS)	0.789	0.085	0.874	N/A
Top Edge	LTE Band 2 (PCS)	1.039	0.085	1.124	N/A

Note: Bluetooth SAR was not required to be measured per FCC KDB 447498. Estimated SAR results were used in the above table to determine simultaneous transmission SAR test exclusion.

General Notes:

1. No evaluation was performed to determine the aggregate 1g SAR for these configurations as the SPLS ratio between the antenna pairs was not higher than 0.04 per FCC KDB 447498 D01v05. See Section 11.4 for detailed SPLS ratio analysis.
2. For SAR summations for body back at 22 mm, WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for WLAN was more conservative. "<" denotes that the 0.0 cm WLAN SAR values were used for summation purposes.
3. For SAR summations for body top edge at 22 mm, WLAN SAR values for 0.0 cm were used since the 0.0 cm test distance for WLAN was more conservative. "<" denotes that the 0.0 cm WLAN SAR values were used for summation purposes.
4. For SAR summations for body left edge at 0 mm, estimated Bluetooth SAR values for 2.0 cm were used since Bluetooth SAR was not required to be measured per FCC KDB 447498 and the Bluetooth antenna to user separation distance is > 5 mm and < 50 mm.
5. For configurations excluded per 447498 D01v05, an estimated SAR of 0.4 W/kg was used to determine simultaneous transmission SAR exclusion when the test separation distance was >50 mm.
6. The worst case 5 GHz WLAN reported SAR for each configuration was used for SAR summation, regardless of whether the WLAN channel has WIFI Direct capability. Therefore, the summations above represent the absolute worst cases for simultaneous transmission with 5 GHz WLAN.

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11.4 SPLSR Evaluation and 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.

$$\text{Distance}_{\text{Tx1} - \text{Tx2}} = R_i = \sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$$

$$\text{SPLS Ratio} = \frac{(SAR_1 + SAR_2)^{1.5}}{R_i}$$

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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 0 mm with LTE B4 antenna operating at reduced output power with 2.4 GHz WLAN.

Table 11-11
Peak SAR Locations for Body Back Side at 0 mm LTE B4 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B4	34.00	85.50
IEEE 802.11b	68.20	-75.60

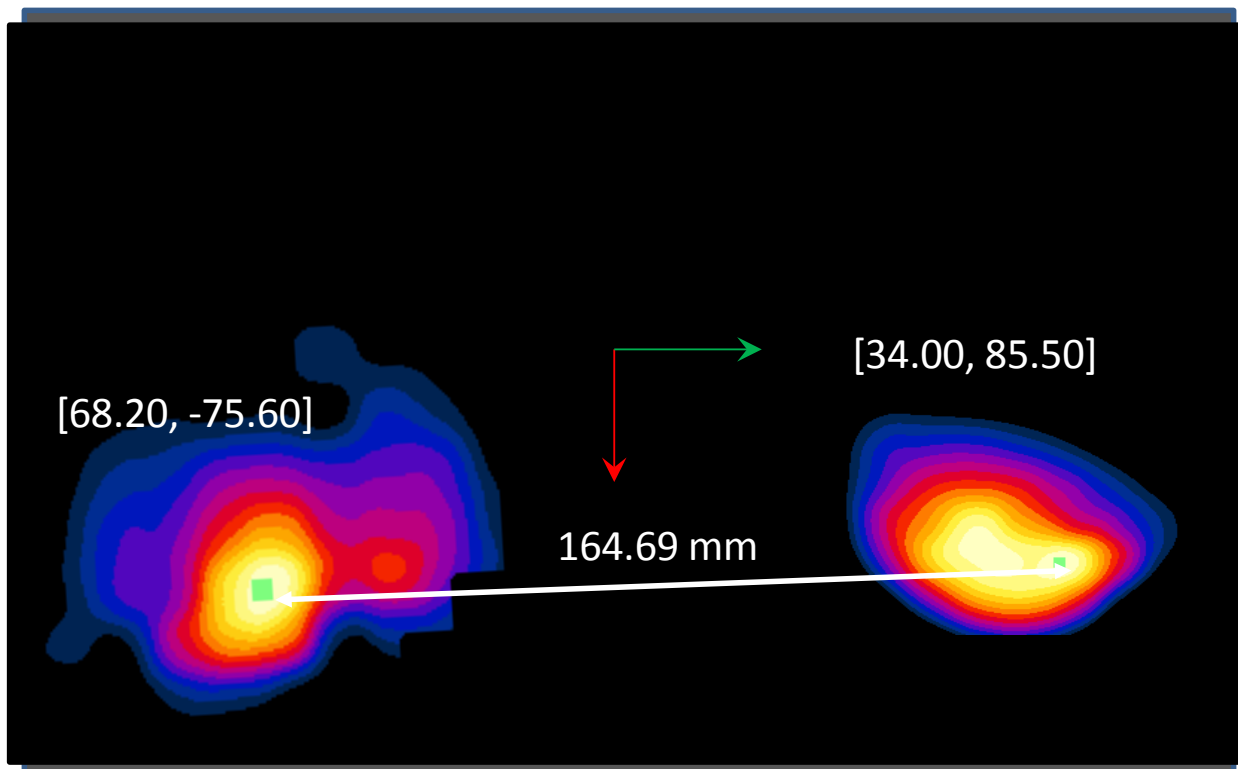


Figure 11-5
Peak SAR Locations for Body Back Side at 0 mm LTE B4 and 2.4 GHz WLAN Antenna

Table 11-12
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	IEEE 802.11b	0.975	1.016	1.991	164.69	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with LTE B2 antenna operating at reduced output power with 2.4 GHz WLAN.

Table 11-13
Peak SAR Locations for Body Back Side at 0 mm LTE B2 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B2	43.00	75.00
IEEE 802.11b	68.20	-75.60

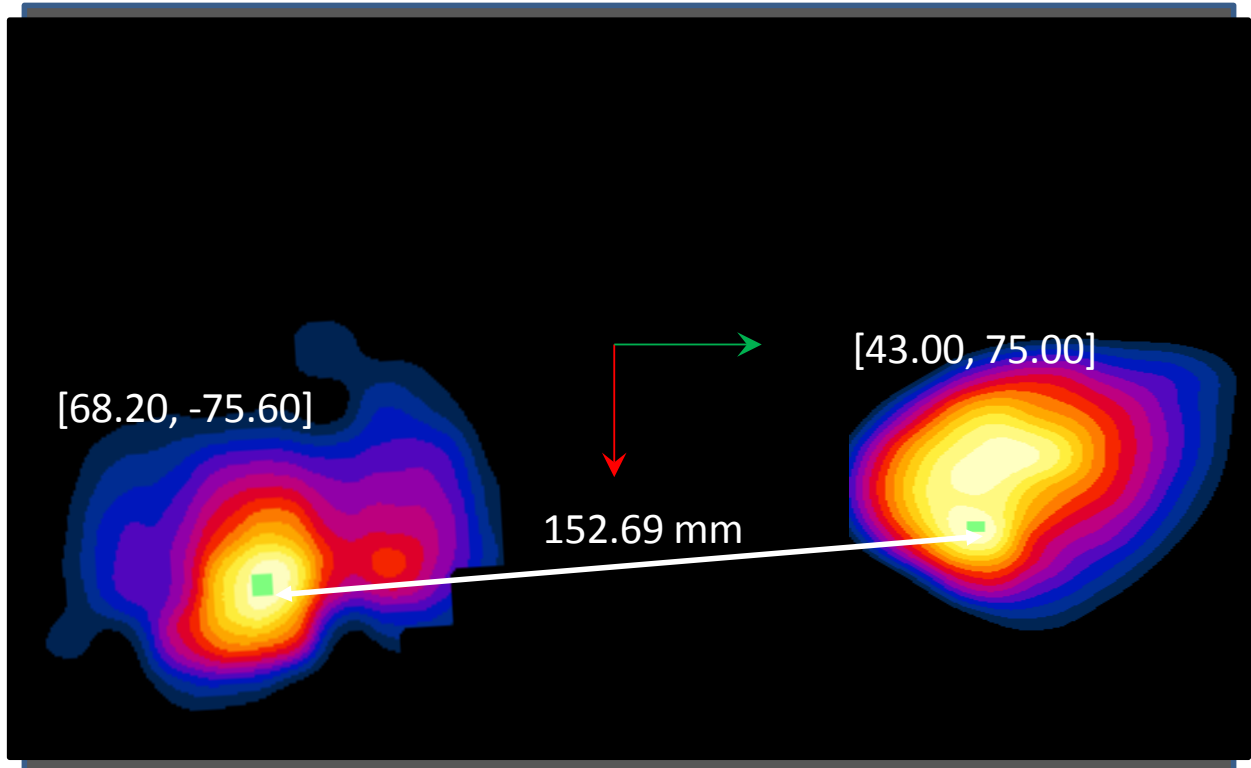


Figure 11-6
Peak SAR Locations for Body Back Side at 0 mm LTE B2 and 2.4 GHz WLAN Antenna

Table 11-14
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	IEEE 802.11b	1.063	1.016	2.079	152.69	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 0 mm with LTE B4 antenna operating at reduced output power with 5 GHz WLAN.

Table 11-15
Peak SAR Locations for Body Back Side at 0 mm LTE B4 and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B4	34.00	85.50
IEEE 802.11a	39.00	-58.00

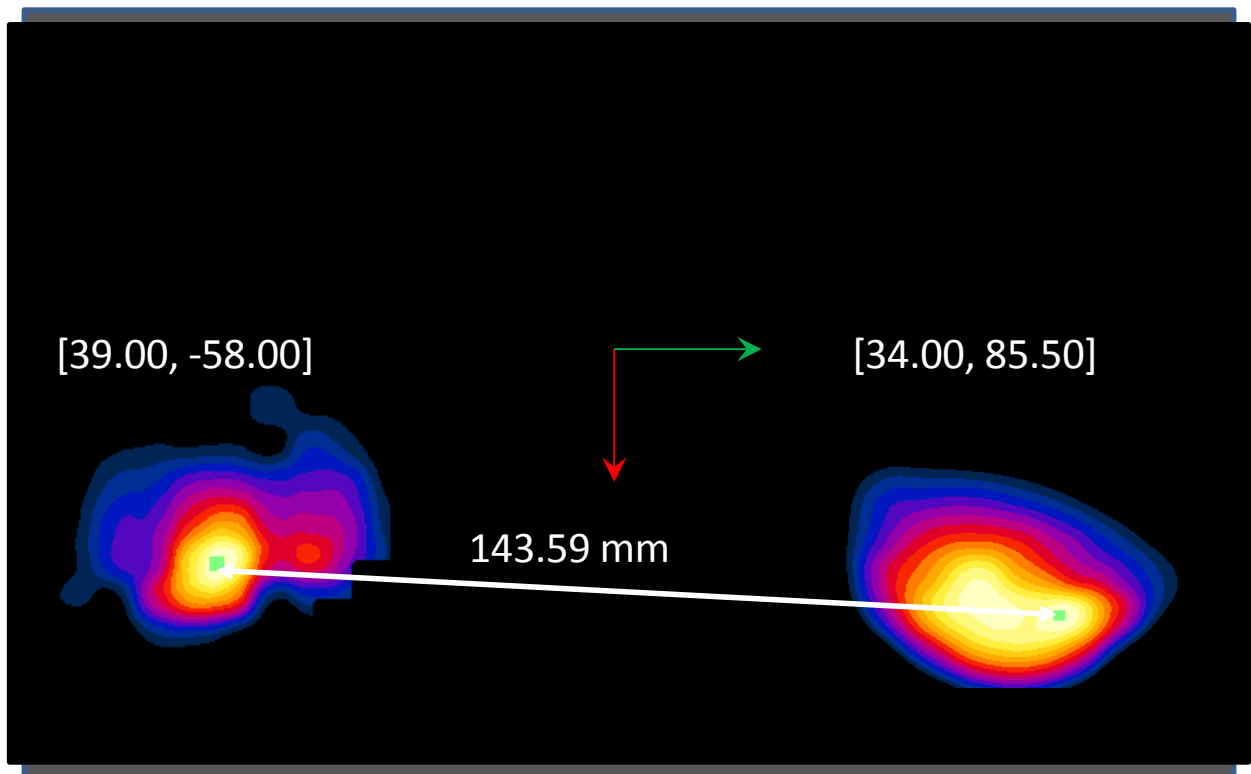


Figure 11-11
Peak SAR Locations for Body Back Side at 0 mm LTE B4 and 5 GHz WLAN Antenna

Table 11-16
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	IEEE 802.11a	0.975	1.07	2.045	143.59	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 0 mm with LTE B2 antenna operating at reduced output power with 5 GHz WLAN.

Table 11-17
Peak SAR Locations for Body Back Side at 0 mm LTE B2 and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B2	43.00	75.00
IEEE 802.11a	39.00	-58.00

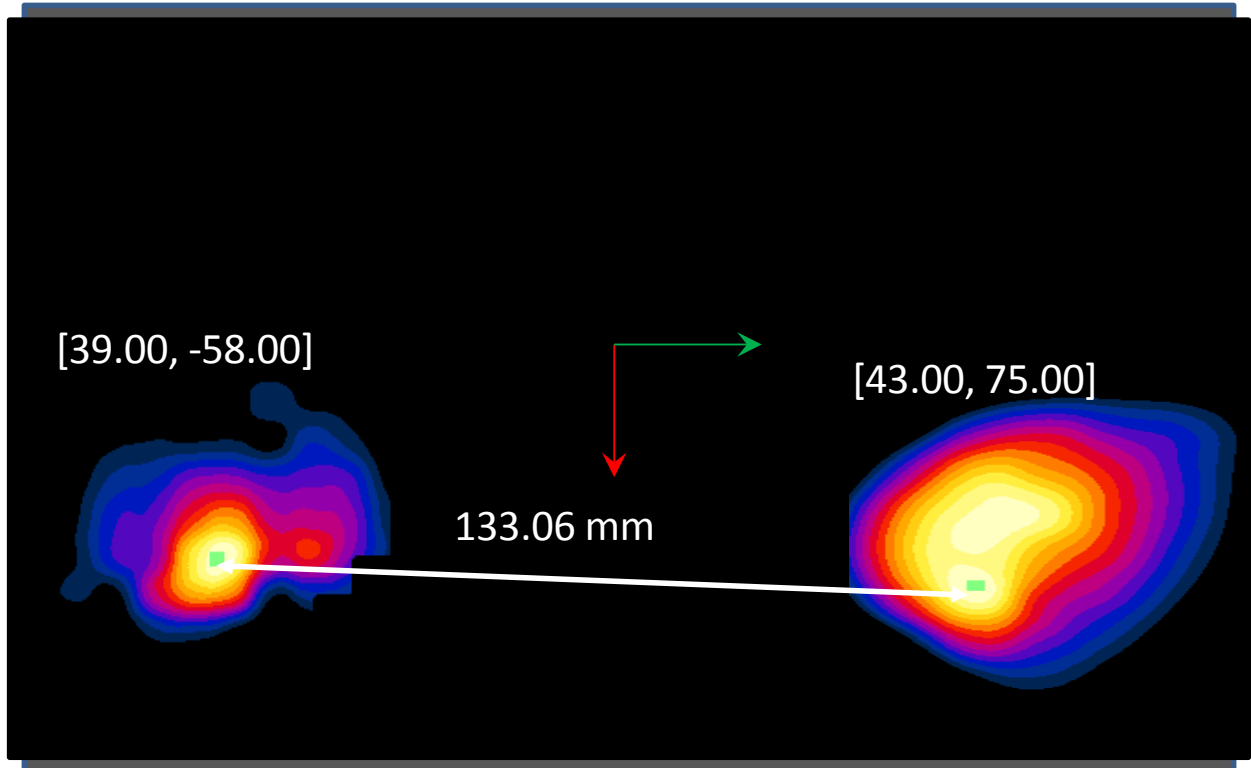


Figure 11-12
Peak SAR Locations for Body Back Side at 0 mm LTE B2 and 5 GHz WLAN Antenna

Table 11-18
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	IEEE 802.11a	1.063	1.07	2.133	133.06	0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 22 mm with LTE B4 antenna operating at maximum output power with 2.4 GHz WLAN.

Table 11-19
Peak SAR Locations for Body Back Side at 22 mm LTE B4 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B4	44.51	67.52
IEEE 802.11b	68.20	-75.60

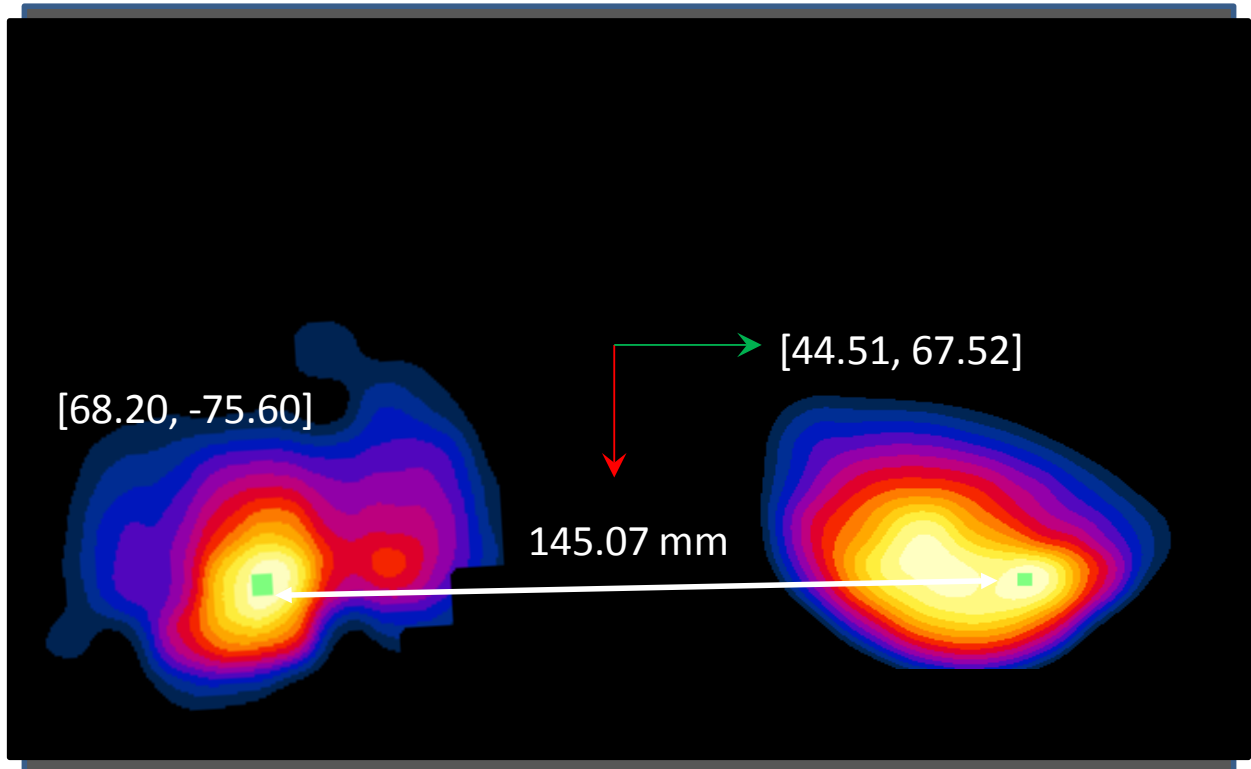


Figure 11-14
Peak SAR Locations for Body Back Side at 22 mm LTE B4 and 2.4 GHz WLAN Antenna

Table 11-20
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	IEEE 802.11b	0.706	< 1.016	< 1.722	145.07	< 0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 22 mm with LTE B2 antenna operating at maximum output power with 2.4 GHz WLAN.

Table 11-21
Peak SAR Locations for Body Back Side at 22 mm LTE B2 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B2	34.98	52.00
IEEE 802.11b	68.20	-75.60

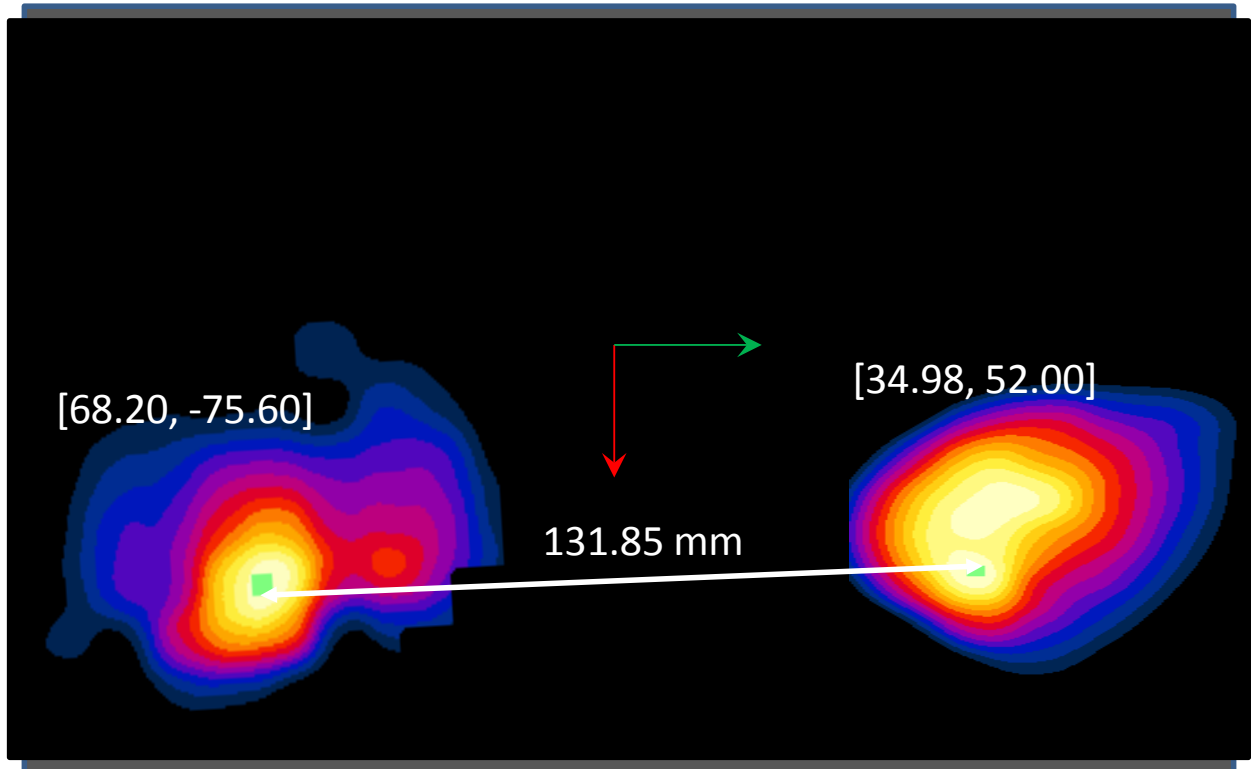


Figure 11-15
Peak SAR Locations for Body Back Side at 22 mm LTE B2 and 2.4 GHz WLAN Antenna

Table 11-22
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	IEEE 802.11b	0.971	< 1.016	< 1.987	131.85	< 0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 22 mm with LTE B4 antenna operating at maximum output power with 5 GHz WLAN.

Table 11-23
Peak SAR Locations for Body Back Side at 22 mm LTE B4 and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B4	44.51	67.52
IEEE 802.11a	39.00	-58.00

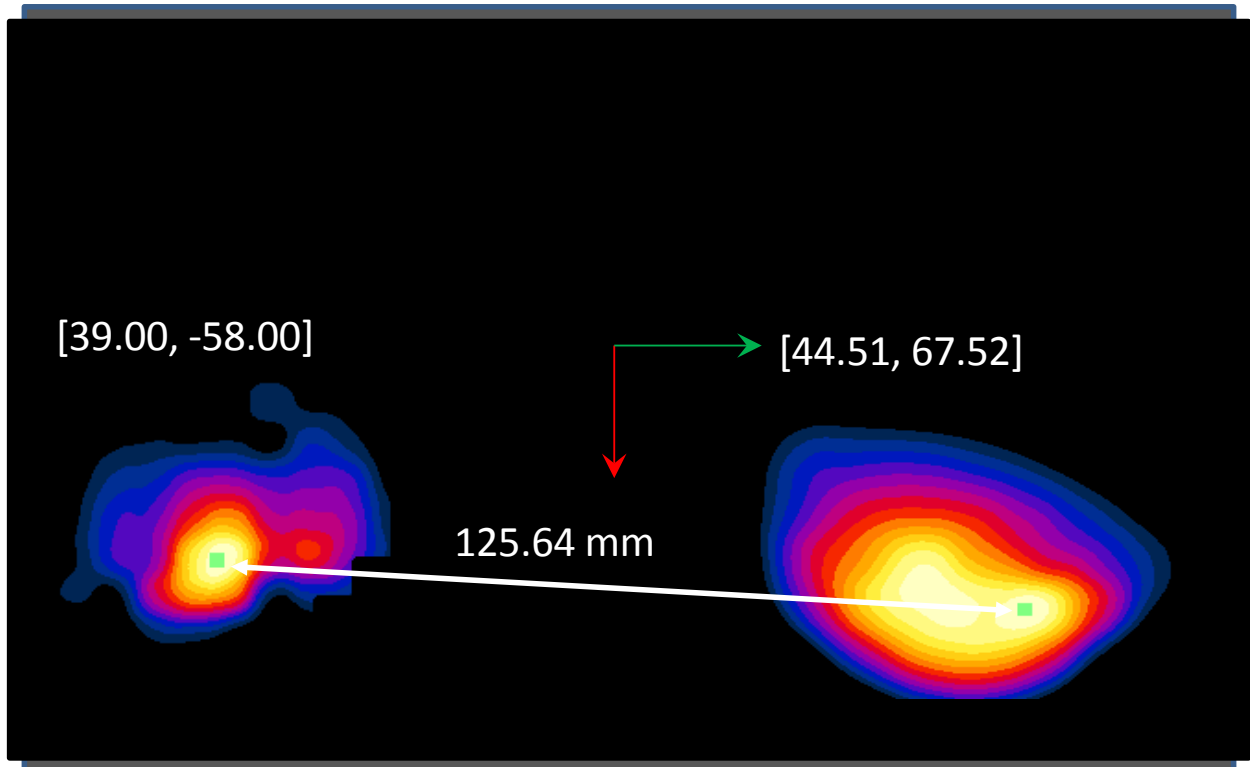


Figure 11-17
Peak SAR Locations for Body Back Side at 22 mm LTE B4 and 5 GHz WLAN Antenna

Table 11-24
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	IEEE 802.11a	0.706	< 1.070	< 1.776	125.64	< 0.02

The sum of the standalone SAR values was above 1.6 W/kg for the Body Back Side configuration at a separation distance of 22 mm with LTE B2 antenna operating at maximum output power with 5 GHz WLAN.

Table 11-25
Peak SAR Locations for Body Back Side at 22 mm LTE B2 and 5 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B2	34.98	52.00
IEEE 802.11a	39.00	-58.00

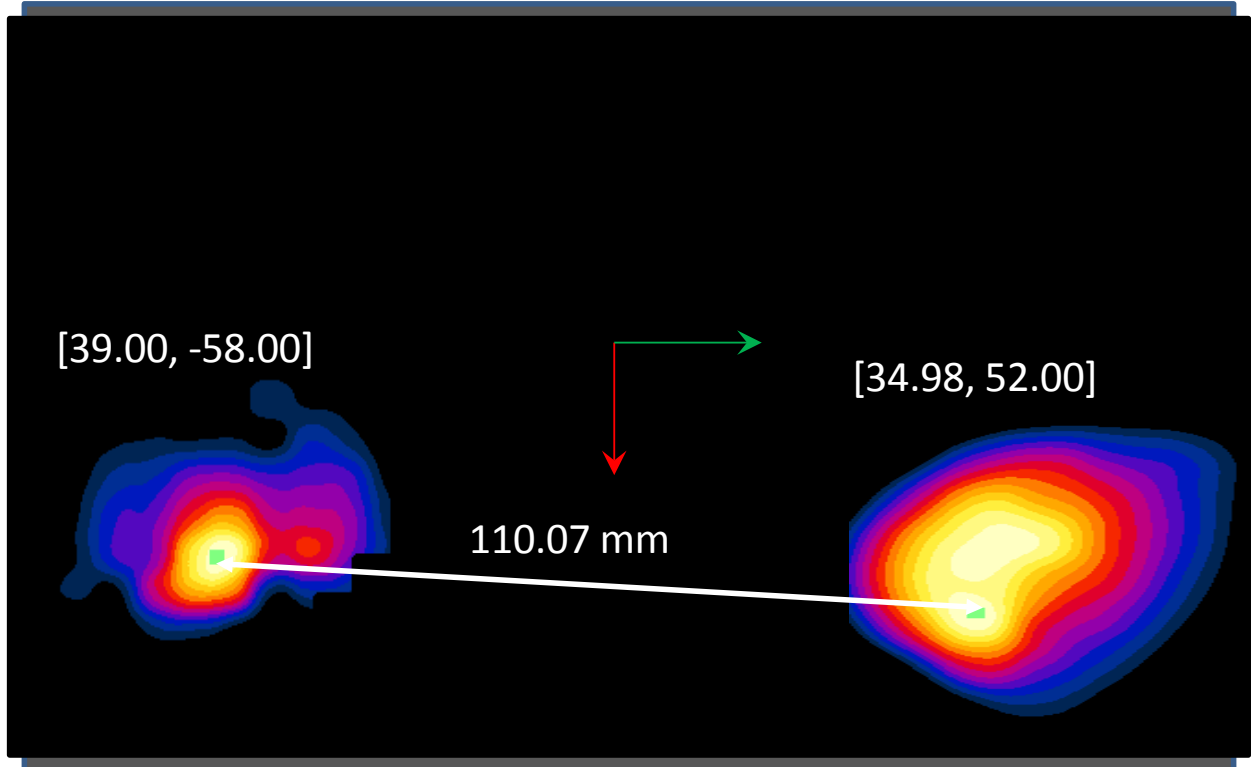


Figure 11-18
Peak SAR Locations for Body Back Side at 22 mm LTE B2 and 5 GHz WLAN Antenna

Table 11-26
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	IEEE 802.11a	0.971	< 1.070	< 2.041	110.07	< 0.03

The sum of the standalone SAR values was above 1.6 W/kg for the Body Top Edge configuration at a separation distance of 22 mm with LTE B2 antenna operating at maximum output power with 2.4 GHz WLAN.

Table 11-27
Peak SAR Locations for Body Top Edge at 22 mm LTE B2 and 2.4 GHz WLAN Antenna

Mode/Band	x (mm)	y (mm)
LTE B2	-17.04	59.99
IEEE 802.11b	-22.50	-79.20



Figure 11-19
Peak SAR Locations for Body Top Edge at 22 mm LTE B2 and 2.4 GHz WLAN Antenna

Table 11-28
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	IEEE 802.11b	1.039	< 0.632	< 1.671	139.3	< 0.02

11.5 Simultaneous Transmission Conclusion

The above numerical summed SAR and SPLSR analysis results for all the worst-case simultaneous transmission conditions were below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit and therefore no measured volumetric simultaneous SAR summation is required per FCC KDB Publication 447498 D01v05 and IEEE 1528-2013 Section 6.3.4.1.2.

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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	0 mm	0.887	0.863	1.03	N/A	N/A	N/A	N/A
1900	1880.00	18900	LTE Band 2 (PCS)	QPSK, 1 RB, 50 RB Offset	back	0 mm	1.020	1.010	1.01	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 extended measurement uncertainty analysis per 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	8648D	(9kHz-4GHz) Signal Generator	4/15/2014	Annual	4/15/2015	3629J00687
Agilent	8753E	(30kHz-6GHz) Network Analyzer	7/23/2013	Annual	7/23/2014	US37390350
Agilent	8753ES	S-Parameter Network Analyzer	5/22/2014	Annual	5/22/2015	US39170118
Agilent	8753ES	S-Parameter Network Analyzer	10/29/2013	Annual	10/29/2014	US39170122
Agilent	E4438C	ESG Vector Signal Generator	4/25/2014	Annual	4/25/2015	MY42082385
Agilent	E4438C	ESG Vector Signal Generator	3/31/2014	Annual	3/31/2015	MY42082659
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/15/2014	Annual	4/15/2015	MY45470194
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420651
Agilent	N5182A	MXG Vector Signal Generator	4/15/2014	Annual	4/15/2015	MY47420800
Agilent	N9020A	MXA Signal Analyzer	10/29/2013	Annual	10/29/2014	US46470561
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433971
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433972
Anritsu	MA24106A	USB Power Sensor	5/14/2014	Annual	5/14/2015	1231535
Anritsu	MA24106A	USB Power Sensor	5/14/2014	Annual	5/14/2015	1231538
Anritsu	MA24106A	USB Power Sensor	5/15/2014	Annual	5/15/2015	1244512
Anritsu	MA24106A	USB Power Sensor	5/14/2014	Annual	5/14/2015	1244515
Anritsu	MA2411B	Pulse Power Sensor	11/14/2013	Annual	11/14/2014	1126066
Anritsu	MA2411B	Pulse Power Sensor	3/25/2014	Annual	3/25/2015	1207470
Anritsu	ML2469A	Power Meter	3/14/2014	Annual	3/14/2015	1306009
COMTECH	AR85729-5	Solid State Amplifier	CBT	N/A	CBT	M155A00-009
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Control Company	4052	Long Stem Thermometer	9/27/2013	Biennial	9/27/2015	130567447
Control Company	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	122014488
Fisher Scientific	15-077-960	Digital Thermometer	11/6/2012	Biennial	11/6/2014	122640025
Fisher Scientific	15-078J	Long Stem Thermometer	10/30/2012	Biennial	10/30/2014	122626059
Fisher Scientific	S97611	Thermometer	4/12/2013	Biennial	4/12/2015	130219303
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	N/A	CBT	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	CBT	R8979500903
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	CBT	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
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	N/A	CBT	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Narda	BW-33W2	Attenuator (3dB)	CBT	N/A	CBT	120
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMW500	Radio Communication Tester	2/20/2014	Annual	2/20/2015	128633
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
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
SPEAG	D1750V2	1750 MHz SAR Dipole	4/10/2014	Annual	4/10/2015	1051
SPEAG	D1900V2	1900 MHz SAR Dipole	2/27/2014	Annual	2/27/2015	5d148
SPEAG	DAE4	Dasy Data Acquisition Electronics	9/17/2013	Annual	9/17/2014	1323
SPEAG	DAE4	Dasy Data Acquisition Electronics	3/17/2014	Annual	3/17/2015	1364
SPEAG	DAK-3.5	Dielectric Assessment Kit	5/6/2014	Annual	5/6/2015	1070
SPEAG	DAK-3.5	Dielectric Assessment Kit	11/13/2013	Annual	11/13/2014	1091
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/18/2013	Annual	8/18/2014	1008
SPEAG	DAKS-3.5	Portable Dielectric Assessment Kit	8/18/2013	Annual	8/18/2014	1009
SPEAG	ES3DV3	SAR Probe	4/11/2014	Annual	4/11/2015	3213
SPEAG	ES3DV3	SAR Probe	9/23/2013	Annual	9/23/2014	3288
Tektronix	RSA6114A	Real Time Spectrum Analyzer	4/16/2014	Annual	4/16/2015	B010177
VWR	36934-158	Wall-Mounted Thermometer	4/29/2014	Biennial	4/29/2016	111859323

Note:

1. 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.
2. Each equipment item was used solely within its respective calibration period.

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14 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz:

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
									299

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: A3LSMT537R4		SAR EVALUATION REPORT		Reviewed by: Quality Manager
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APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 60

Communication System: UID 0, LTE RF; Frequency: 1732.5 MHz; Duty Cycle: 1:1

Medium: 1750 Body, Medium parameters used (interpolated):

$f = 1732.5 \text{ MHz}$; $\sigma = 1.52 \text{ S/m}$; $\epsilon_r = 52.559$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0 cm

Test Date: 07-21-2014; Ambient Temp: 23.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3213; ConvF(4.89, 4.89, 4.89); Calibrated: 4/11/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 3/17/2014

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); 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**

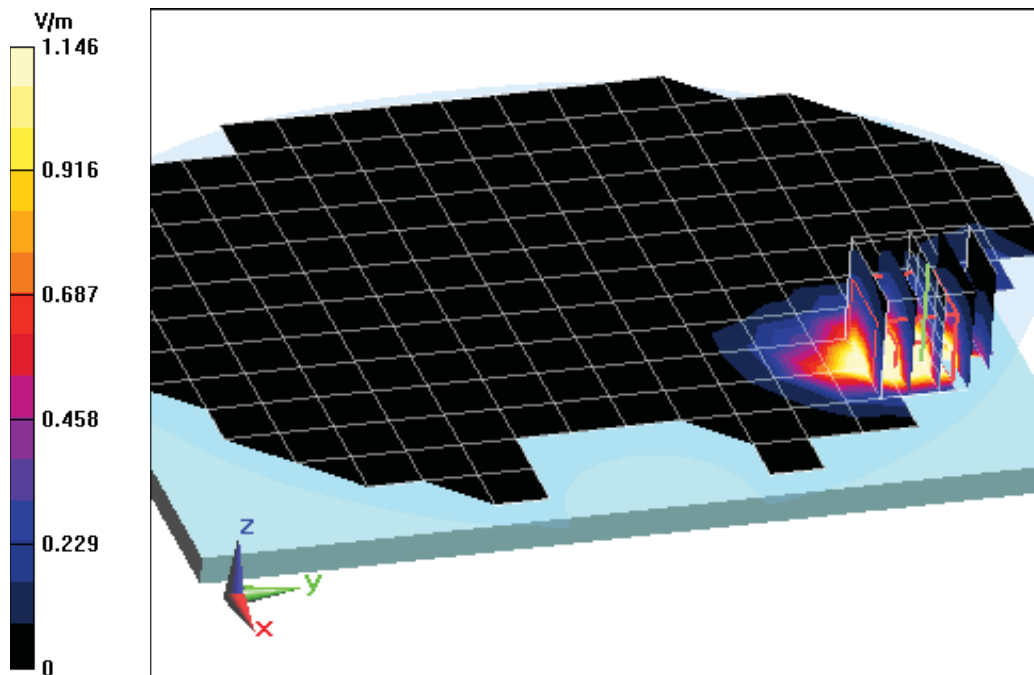
Area Scan (14x19x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 22.73 V/m; Power Drift = 0.06 dB

Peak SAR (extrapolated) = 1.99 W/kg

SAR(1 g) = 0.887 W/kg



PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSMT537R4; Type: Portable Tablet; Serial: 60

Communication System: UID 0, LTE PCS 20 Mhz; Frequency: 1880 MHz; Duty Cycle: 1:1

Medium: 1900 Body, Medium parameters used:

$f = 1880 \text{ MHz}$; $\sigma = 1.5 \text{ S/m}$; $\epsilon_r = 52.073$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 0 cm

Test Date: 07-21-2014; Ambient Temp: 23.8°C; Tissue Temp: 23.7°C

Probe: ES3DV3 - SN3288; ConvF(4.82, 4.82, 4.82); Calibrated: 9/23/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/17/2013

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

**Mode: LTE Band 2 (PCS), Body SAR, Back side, Mid.ch, 20 MHz Bandwidth,
QPSK, 1 RB, 50 RB Offset**

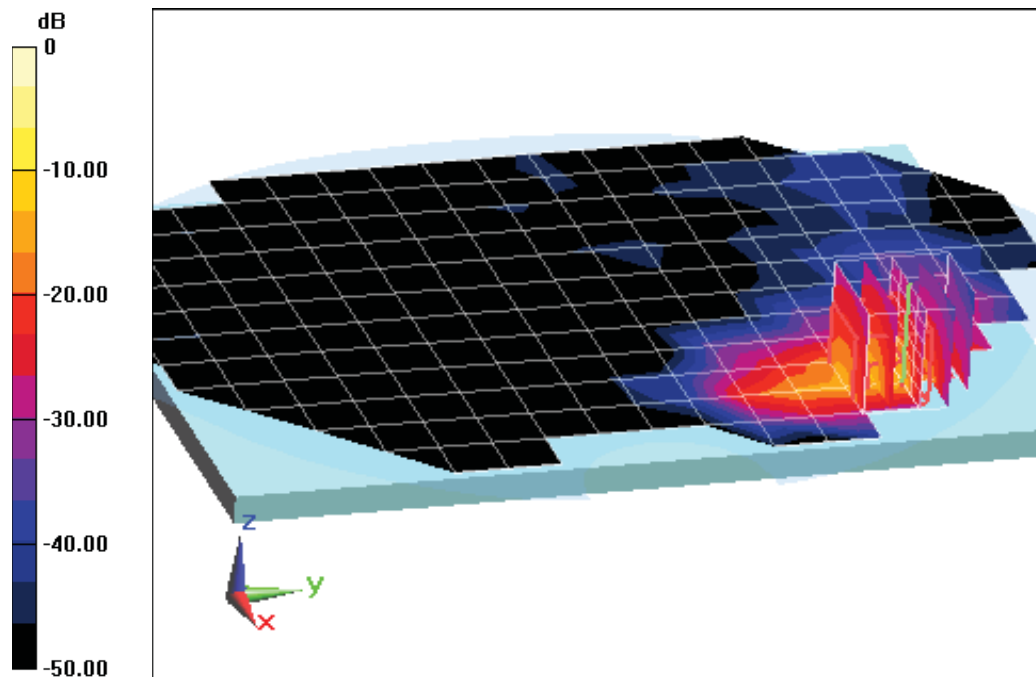
Area Scan (13x21x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 25.57 V/m; Power Drift = 0.16 dB

Peak SAR (extrapolated) = 2.40 W/kg

SAR(1 g) = 1.02 W/kg



0 dB = 20.0 W/kg = 13.01 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

DUT: 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:

$f = 1750 \text{ MHz}$; $\sigma = 1.539 \text{ S/m}$; $\epsilon_r = 52.495$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-21-2014; Ambient Temp: 23.3°C; Tissue Temp: 21.0°C

Probe: ES3DV3 - SN3213; ConvF(4.89, 4.89, 4.89); Calibrated: 4/11/2014;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1364; Calibrated: 3/17/2014

Phantom: SAM Sub; Type: SAM 4.0; Serial: TP-1357

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

1750 MHz System Verification

Area Scan (6x8x1): Measurement grid: dx=15mm, dy=15mm

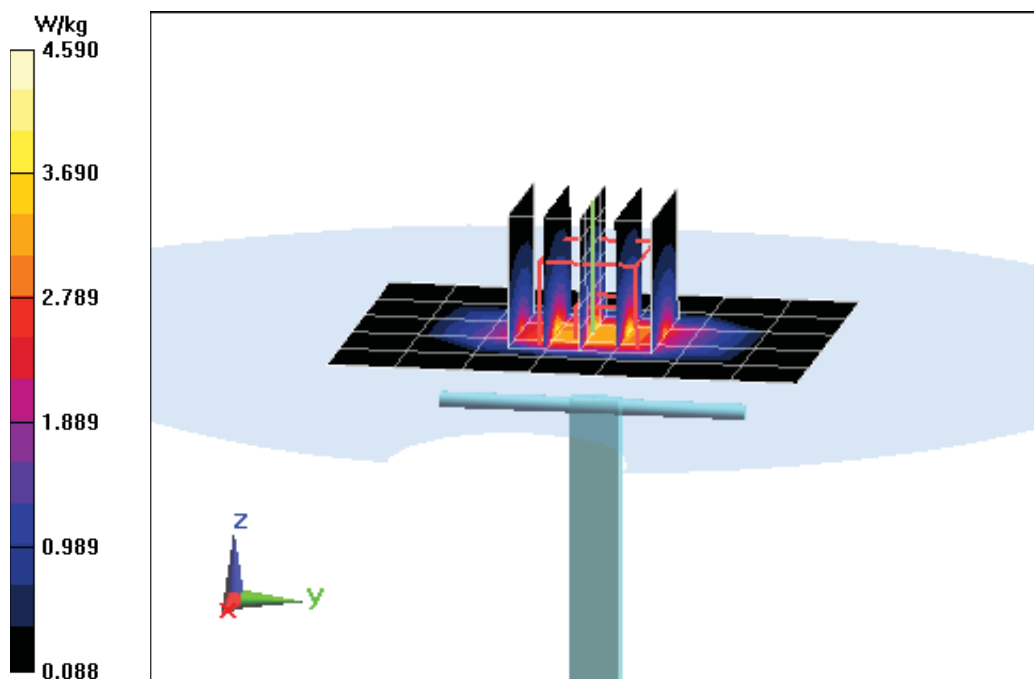
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 6.57 W/kg

SAR(1 g) = 3.67 W/kg

Deviation = -1.87%



PCTEST ENGINEERING LABORATORY, INC.

DUT: SAR Dipole 1900 MHz; Type: D1900V2; Serial: 5d148

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

Medium: 1900 Body, Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.523 \text{ S/m}$; $\epsilon_r = 52.01$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 07-21-2014; Ambient Temp: 23.8°C; Tissue Temp: 23.7°C

Probe: ES3DV3 - SN3288; ConvF(4.82, 4.82, 4.82); Calibrated: 9/23/2013;

Sensor-Surface: 3mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1323; Calibrated: 9/17/2013

Phantom: SAM with CRP; Type: SAM; Serial: TP1375

Measurement SW: DASY4, Version 4.7 (80); SEMCAD X Version 14.6.10 (7331)

1900MHz System Verification

Area Scan (5x7x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

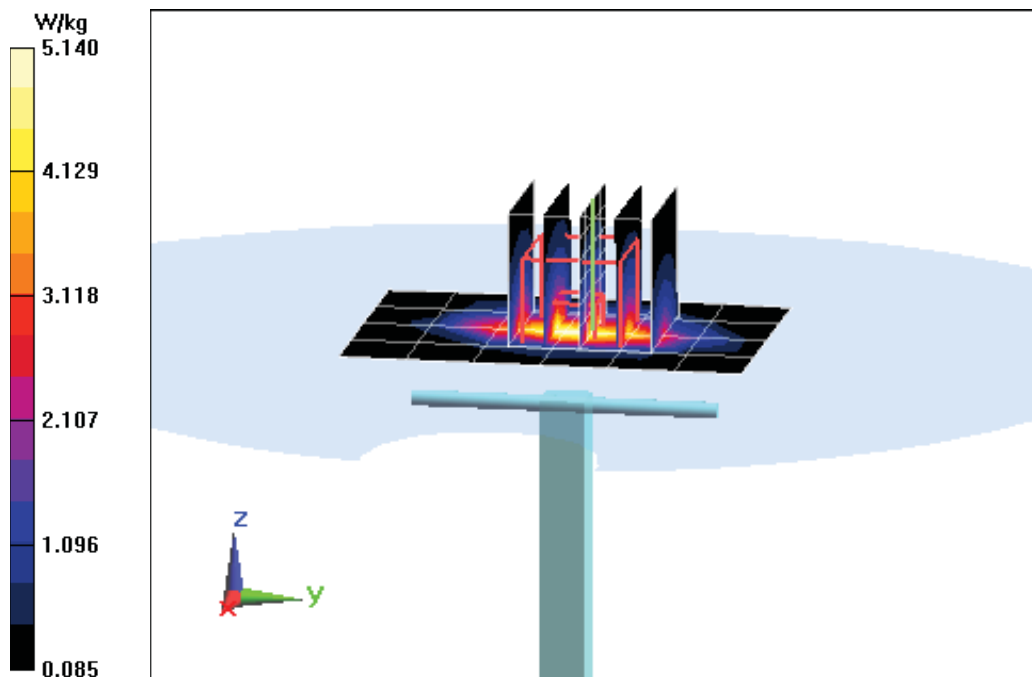
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.25 W/kg

SAR(1 g) = 4.17 W/kg

Deviation = 6.11%



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

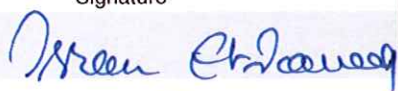
This calibration certificate documents the traceability to national standards, which realize the physical units of measurements (SI).
The measurements and the uncertainties with confidence probability are given on the following pages and are part of the certificate.

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

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)

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
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:

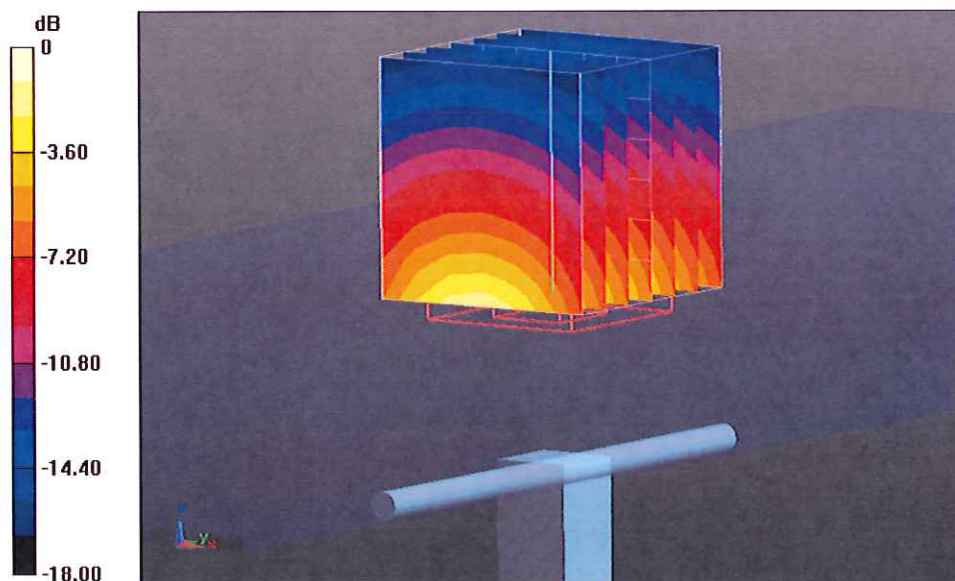
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 16.2 W/kg

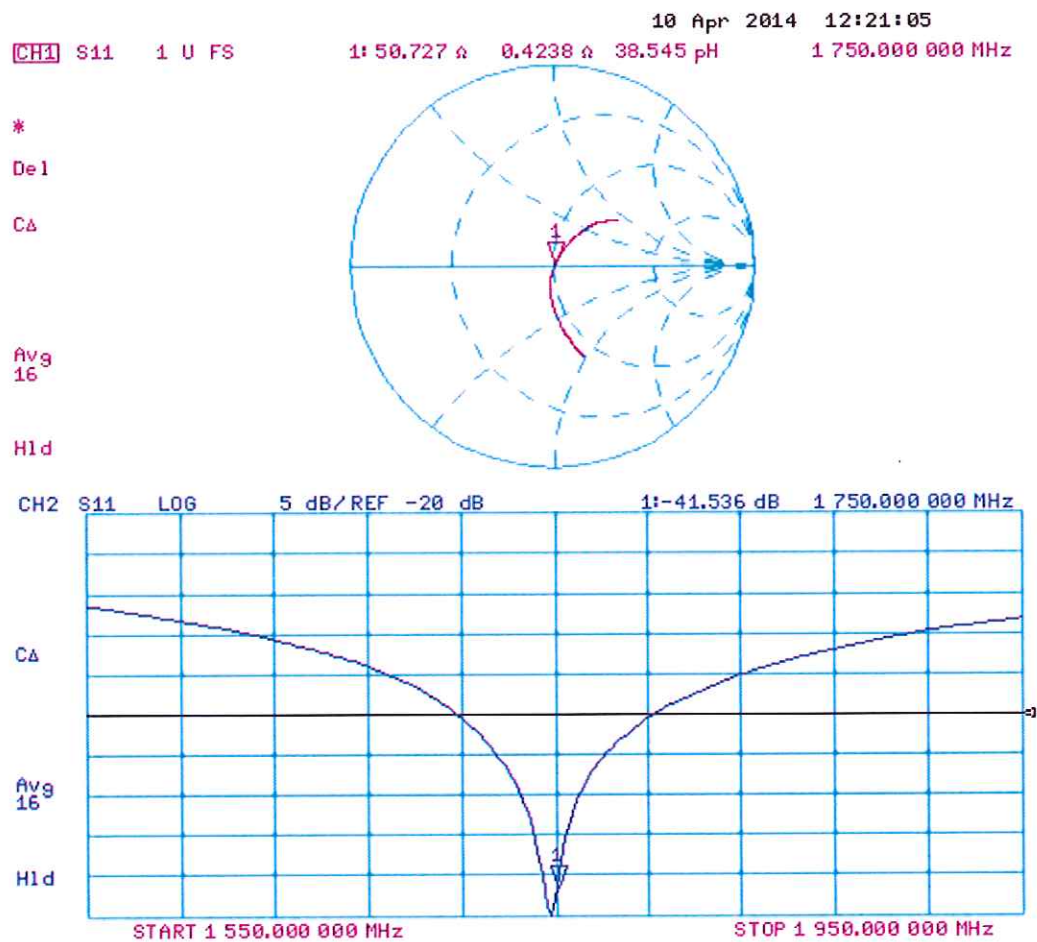
SAR(1 g) = 9.02 W/kg; SAR(10 g) = 4.79 W/kg

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:

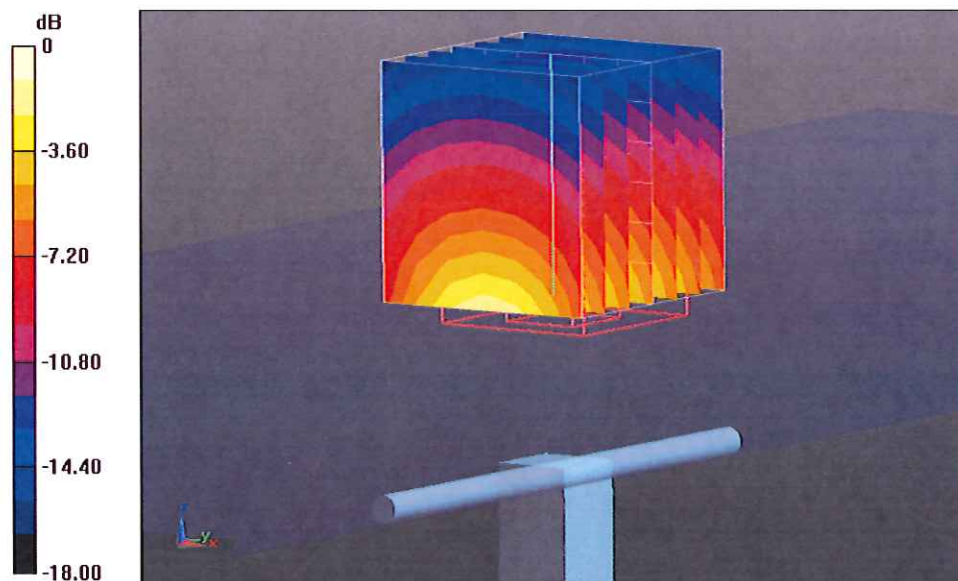
Measurement grid: dx=5mm, dy=5mm, dz=5mm

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

Peak SAR (extrapolated) = 16.1 W/kg

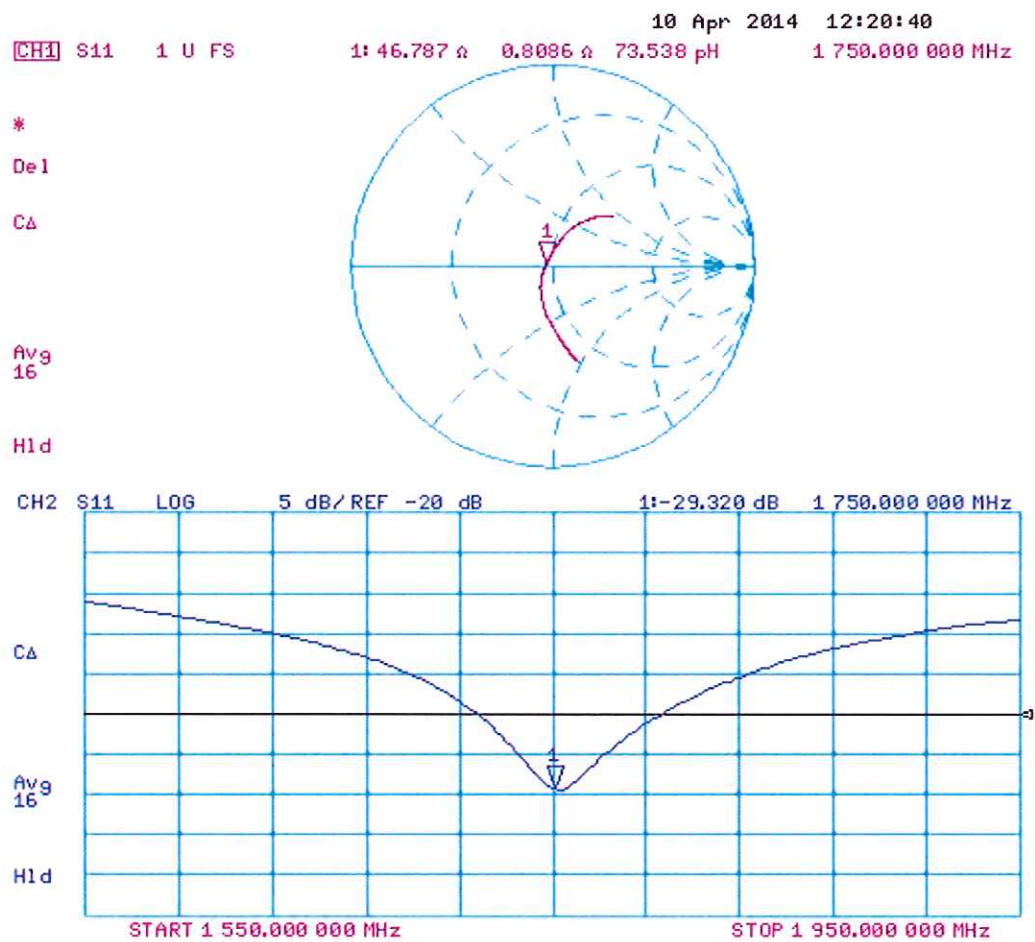
SAR(1 g) = 9.37 W/kg; SAR(10 g) = 5.04 W/kg

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: **D1900V2-5d148_Feb14**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d148**

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

Calibration date: **February 27, 2014**

QC✓
3/4/2014

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 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)	04-Apr-13 (No. 217-01736)	Apr-14
Type-N mismatch combination	SN: 5047.3 / 06327	04-Apr-13 (No. 217-01739)	Apr-14
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: **Jeton Kastrati** Name **Jeton Kastrati** Function **Laboratory Technician** Signature *[Signature]*

Approved by: **Katja Pokovic** Name **Katja Pokovic** Function **Technical Manager** Signature *[Signature]*

Issued: February 27, 2014

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



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Accreditation No.: **SCS 108**

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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	38.9 $\pm$ 6 %	1.39 mho/m $\pm$ 6 %
Head TSL temperature change during test	< 0.5 °C	----	----

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	10.2 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.7 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	5.31 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.2 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	53.3	1.52 mho/m
Measured Body TSL parameters	(22.0 $\pm$ 0.2) °C	52.8 $\pm$ 6 %	1.49 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	9.73 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	39.3 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	5.15 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	20.7 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.5 \Omega + 5.5 j\Omega$
Return Loss	- 24.6 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.0 \Omega + 6.7 j\Omega$
Return Loss	- 23.0 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.197 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: 27.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d148

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

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

Phantom section: Flat Section

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

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:

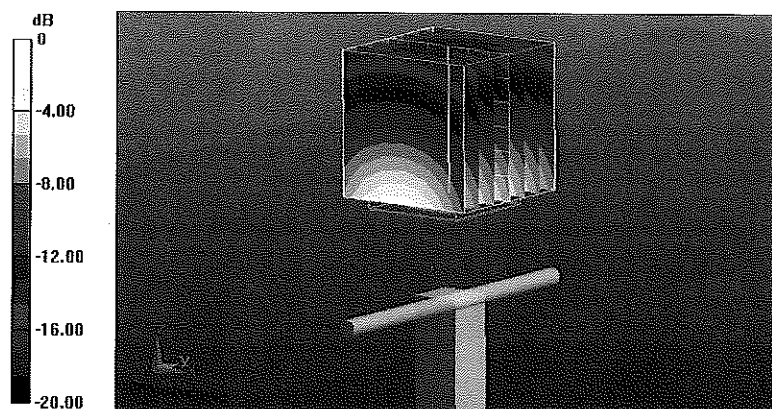
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 98.796 V/m; Power Drift = 0.02 dB

Peak SAR (extrapolated) = 18.9 W/kg

SAR(1 g) = 10.2 W/kg; SAR(10 g) = 5.31 W/kg

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

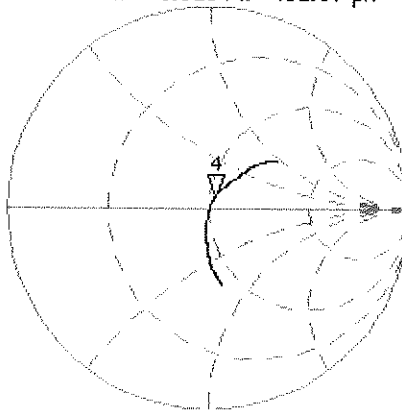


0 dB = 12.8 W/kg = 11.07 dBW/kg

Impedance Measurement Plot for Head TSL

27 Feb 2014 09:42:31
 CH1 S11 1 U FS 4: 52.533 Δ 5.5234 Δ 462.67 pH 1 900.000 000 MHz

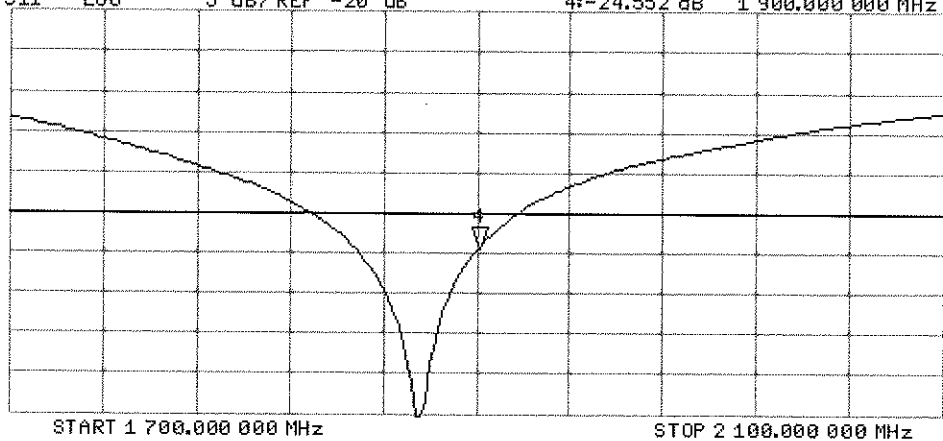
*
 De1
 CA



Avg
 16
 H1d

CH2 S11 LOG 5 dB/REF -20 dB 4:-24.552 dB 1 900.000 000 MHz

CA
 Avg
 16
 H1d



DASY5 Validation Report for Body TSL

Date: 27.02.2014

Test Laboratory: SPEAG, Zurich, Switzerland

DUT: Dipole 1900 MHz; Type: D1900V2; Serial: D1900V2 - SN: 5d148

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.49$ S/m; $\epsilon_r = 52.8$; $\rho = 1000$ 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:

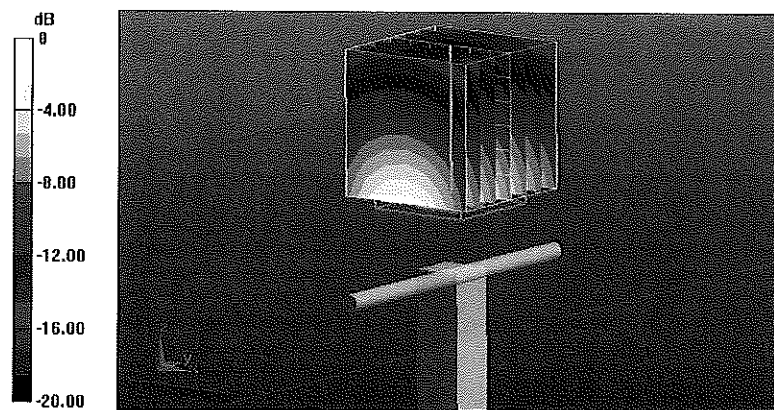
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 94.520 V/m; Power Drift = -0.02 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 9.73 W/kg; SAR(10 g) = 5.15 W/kg

Maximum value of SAR (measured) = 12.2 W/kg

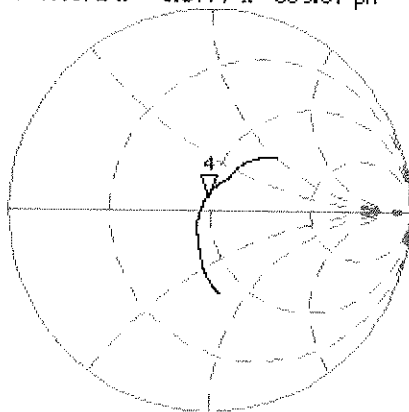


0 dB = 12.2 W/kg = 10.86 dBW/kg

Impedance Measurement Plot for Body TSL

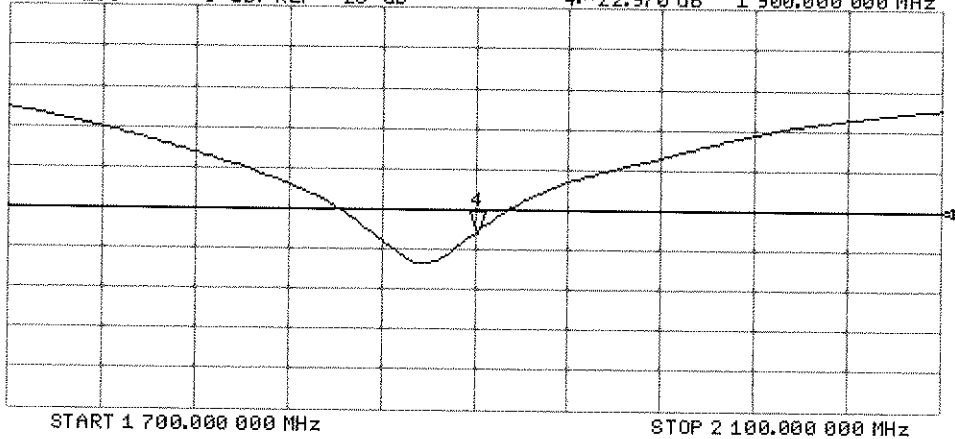
CH1 S11 1 U FS 4: 47.971 Ω 6.6777 Ω 559.37 pF 1 900.000 000 MHz 27 Feb 2014 09:42:04

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 4:-22.970 dB 1 900.000 000 MHz

CA
Avg
16
H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3213_Apr14**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3213**

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

CCV
5/7/14

Calibration date: **April 11, 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 ± 3)°C and humidity < 70%.

Calibration Equipment used (M&TE critical for calibration)

Primary Standards	ID	Cal Date (Certificate No.)	Scheduled Calibration
Power meter E4419B	GB41293874	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 Leif Klysner	Function Laboratory Technician	Signature 
Approved by:	Katja Pokovic	Technical Manager	
This calibration certificate shall not be reproduced except in full without written approval of the laboratory.			Issued: April 14, 2014



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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 E²-field uncertainty inside TSL (see below *ConvF*).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of *ConvF*.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3213

Manufactured: October 14, 2008
Calibrated: April 11, 2014

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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3213

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.47	1.36	1.32	$\pm 10.1 \%$
DCP (mV) ^B	102.9	101.6	102.7	

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	197.4	$\pm 3.8 \%$
		Y	0.0	0.0	1.0		219.1	
		Z	0.0	0.0	1.0		195.3	
10010- CAA	SAR Validation (Square, 100ms, 10ms)	X	5.05	68.5	14.4	10.00	41.4	$\pm 0.9 \%$
		Y	9.83	75.4	16.6		39.8	
		Z	10.63	76.7	17.0		40.3	
10011- CAB	UMTS-FDD (WCDMA)	X	3.25	67.1	18.8	2.91	135.4	$\pm 0.5 \%$
		Y	3.21	66.6	18.4		131.4	
		Z	3.43	68.3	19.4		133.5	
10012- CAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps)	X	3.39	71.8	20.4	1.87	137.8	$\pm 0.7 \%$
		Y	2.98	69.1	19.1		133.1	
		Z	3.26	71.3	20.3		133.8	
10021- DAB	GSM-FDD (TDMA, GMSK)	X	22.08	99.1	27.6	9.39	143.1	$\pm 2.2 \%$
		Y	21.57	99.6	28.2		141.4	
		Z	13.61	90.9	24.9		137.1	
10023- DAB	GPRS-FDD (TDMA, GMSK, TN 0)	X	16.13	94.0	26.2	9.57	133.8	$\pm 1.9 \%$
		Y	22.39	99.7	28.1		137.8	
		Z	18.99	97.5	27.4		129.2	
10024- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1)	X	21.23	93.4	23.4	6.56	148.9	$\pm 1.9 \%$
		Y	33.62	99.9	25.4		148.5	
		Z	32.72	99.7	25.1		141.6	
10027- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2)	X	49.20	99.7	23.0	4.80	138.6	$\pm 2.5 \%$
		Y	40.22	99.8	23.9		134.7	
		Z	43.82	99.8	23.4		131.9	
10028- DAB	GPRS-FDD (TDMA, GMSK, TN 0-1-2-3)	X	50.05	99.8	22.4	3.55	146.5	$\pm 2.2 \%$
		Y	51.41	99.6	22.3		144.4	
		Z	46.36	99.5	22.4		140.0	
10032- CAA	IEEE 802.15.1 Bluetooth (GFSK, DH5)	X	40.43	99.5	20.4	1.16	135.1	$\pm 1.7 \%$
		Y	24.55	99.5	21.7		133.5	
		Z	32.87	99.9	21.0		131.0	
10039- CAB	CDMA2000 (1xRTT, RC1)	X	4.69	66.6	19.0	4.57	133.4	$\pm 0.9 \%$
		Y	4.76	66.9	19.3		133.2	
		Z	4.71	66.8	19.2		130.1	

10081-CAB	CDMA2000 (1xRTT, RC3)	X	3.87	66.1	18.6	3.97	129.0	±0.7 %
		Y	3.89	66.1	18.7		129.6	
		Z	3.97	66.6	19.0		146.7	
10098-CAB	UMTS-FDD (HSUPA, Subtest 2)	X	4.59	66.8	18.8	3.98	141.1	±0.7 %
		Y	4.64	67.0	19.0		140.0	
		Z	4.67	67.2	19.1		138.5	
10100-CAB	LTE-FDD (SC-FDMA, 100% RB, 20 MHz, QPSK)	X	6.52	68.0	20.1	5.67	147.5	±1.4 %
		Y	6.61	68.3	20.4		148.5	
		Z	6.51	68.0	20.1		145.4	
10108-CAB	LTE-FDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	6.39	67.5	19.9	5.80	145.2	±1.4 %
		Y	6.44	67.8	20.2		145.8	
		Z	6.41	67.7	20.1		145.5	
10110-CAB	LTE-FDD (SC-FDMA, 100% RB, 5 MHz, QPSK)	X	6.02	66.7	19.5	5.75	141.3	±1.4 %
		Y	6.10	67.2	20.0		141.0	
		Z	6.05	67.0	19.8		141.2	
10114-CAA	IEEE 802.11n (HT Greenfield, 13.5 Mbps, BPSK)	X	10.19	68.9	21.4	8.10	135.6	±2.2 %
		Y	10.43	69.6	21.9		135.7	
		Z	10.21	69.0	21.5		134.5	
10117-CAA	IEEE 802.11n (HT Mixed, 13.5 Mbps, BPSK)	X	10.17	68.9	21.3	8.07	137.7	±2.5 %
		Y	10.45	69.6	21.9		137.2	
		Z	10.22	69.1	21.5		136.9	
10151-CAB	LTE-TDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	9.70	74.8	25.8	9.28	133.6	±3.0 %
		Y	9.81	75.7	26.7		130.1	
		Z	9.49	74.4	25.7		131.6	
10154-CAB	LTE-FDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	6.07	67.0	19.7	5.75	142.9	±1.4 %
		Y	6.19	67.6	20.2		145.4	
		Z	6.06	67.0	19.8		141.7	
10160-CAB	LTE-FDD (SC-FDMA, 50% RB, 15 MHz, QPSK)	X	6.50	67.5	19.9	5.82	148.5	±1.4 %
		Y	6.35	67.0	19.7		127.0	
		Z	6.52	67.6	20.0		147.9	
10169-CAB	LTE-FDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	5.00	66.8	19.8	5.73	145.4	±1.4 %
		Y	5.13	67.5	20.4		148.9	
		Z	5.06	67.3	20.2		144.8	
10172-CAB	LTE-TDD (SC-FDMA, 1 RB, 20 MHz, QPSK)	X	9.02	79.7	28.5	9.21	148.9	±3.0 %
		Y	8.14	77.1	27.6		125.0	
		Z	8.82	79.5	28.6		147.1	
10175-CAB	LTE-FDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	5.05	67.2	20.0	5.72	146.2	±1.4 %
		Y	5.14	67.6	20.4		145.9	
		Z	5.00	67.1	20.1		140.8	
10181-CAB	LTE-FDD (SC-FDMA, 1 RB, 15 MHz, QPSK)	X	5.07	67.2	20.0	5.72	149.7	±1.4 %
		Y	5.15	67.6	20.4		146.0	
		Z	5.00	67.0	20.0		141.0	

10193-CAA	IEEE 802.11n (HT Greenfield, 6.5 Mbps, BPSK)	X	9.92	68.8	21.4	8.09	135.2	±2.2 %
		Y	10.06	69.3	21.8		130.6	
		Z	9.78	68.4	21.2		126.9	
10196-CAA	IEEE 802.11n (HT Mixed, 6.5 Mbps, BPSK)	X	9.93	68.9	21.4	8.10	136.4	±2.2 %
		Y	10.06	69.3	21.9		131.1	
		Z	9.84	68.7	21.4		128.8	
10219-CAA	IEEE 802.11n (HT Mixed, 7.2 Mbps, BPSK)	X	9.81	68.8	21.4	8.03	135.3	±2.2 %
		Y	9.95	69.3	21.8		130.1	
		Z	9.71	68.5	21.2		127.4	
10222-CAA	IEEE 802.11n (HT Mixed, 15 Mbps, BPSK)	X	10.24	69.1	21.5	8.06	141.2	±2.2 %
		Y	10.45	69.7	22.0		136.8	
		Z	10.13	68.9	21.4		133.6	
10225-CAB	UMTS-FDD (HSPA+)	X	6.95	66.9	19.5	5.97	137.9	±1.4 %
		Y	7.03	67.2	19.8		133.2	
		Z	6.92	66.9	19.5		130.6	
10237-CAB	LTE-TDD (SC-FDMA, 1 RB, 10 MHz, QPSK)	X	8.08	76.6	27.0	9.21	127.8	±3.0 %
		Y	10.15	84.0	31.2		149.6	
		Z	8.67	79.0	28.3		145.4	
10252-CAB	LTE-TDD (SC-FDMA, 50% RB, 10 MHz, QPSK)	X	8.92	73.6	25.3	9.24	126.0	±3.5 %
		Y	9.19	75.1	26.5		124.0	
		Z	9.66	76.2	26.8		149.1	
10267-CAB	LTE-TDD (SC-FDMA, 100% RB, 10 MHz, QPSK)	X	9.59	74.5	25.7	9.30	131.9	±3.0 %
		Y	9.87	75.8	26.8		130.6	
		Z	9.36	73.9	25.5		127.8	
10274-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.10)	X	5.84	66.6	18.8	4.87	128.6	±0.9 %
		Y	5.87	66.7	19.0		128.8	
		Z	6.08	67.6	19.4		149.9	
10275-CAB	UMTS-FDD (HSUPA, Subtest 5, 3GPP Rel8.4)	X	4.35	66.6	18.8	3.96	134.0	±0.9 %
		Y	4.46	67.0	19.1		138.5	
		Z	4.39	66.8	19.0		129.4	
10291-AAB	CDMA2000, RC3, SO55, Full Rate	X	3.72	67.5	19.2	3.46	149.2	±0.7 %
		Y	3.66	67.1	19.1		129.6	
		Z	3.72	67.6	19.3		143.2	
10292-AAB	CDMA2000, RC3, SO32, Full Rate	X	3.54	66.9	18.8	3.39	128.3	±0.5 %
		Y	3.61	67.2	19.1		130.4	
		Z	3.69	67.8	19.4		146.2	
10297-AAA	LTE-FDD (SC-FDMA, 50% RB, 20 MHz, QPSK)	X	6.38	67.4	19.9	5.81	145.8	±1.4 %
		Y	6.50	68.0	20.4		148.6	
		Z	6.35	67.4	19.9		140.8	
10311-AAA	LTE-FDD (SC-FDMA, 100% RB, 15 MHz, QPSK)	X	6.70	67.2	19.7	6.06	127.8	±1.4 %
		Y	6.85	67.7	20.3		130.2	
		Z	6.98	68.2	20.4		147.9	

10315-AAA	IEEE 802.11b WiFi 2.4 GHz (DSSS, 1 Mbps, 96pc duty cycle)	X	2.82	69.1	19.2	1.71	135.1	±0.7 %
		Y	2.92	69.5	19.6		136.9	
		Z	3.22	71.8	20.6		130.9	
10403-AAB	CDMA2000 (1xEV-DO, Rev. 0)	X	4.77	68.3	18.9	3.76	140.0	±0.5 %
		Y	4.80	68.4	19.1		141.4	
		Z	4.86	68.9	19.3		134.8	
10404-AAB	CDMA2000 (1xEV-DO, Rev. A)	X	4.61	68.0	18.8	3.77	138.2	±0.7 %
		Y	4.67	68.2	19.0		139.3	
		Z	4.69	68.5	19.1		133.9	

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:3213

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	6.58	6.58	6.58	0.34	1.79	± 12.0 %
835	41.5	0.90	6.37	6.37	6.37	0.29	1.94	± 12.0 %
1750	40.1	1.37	5.18	5.18	5.18	0.79	1.17	± 12.0 %
1900	40.0	1.40	4.99	4.99	4.99	0.57	1.36	± 12.0 %
2450	39.2	1.80	4.40	4.40	4.40	0.78	1.28	± 12.0 %
2600	39.0	1.96	4.25	4.25	4.25	0.77	1.23	± 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:3213

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	6.21	6.21	6.21	0.77	1.19	± 12.0 %
835	55.2	0.97	6.18	6.18	6.18	0.54	1.37	± 12.0 %
1750	53.4	1.49	4.89	4.89	4.89	0.73	1.27	± 12.0 %
1900	53.3	1.52	4.68	4.68	4.68	0.47	1.70	± 12.0 %
2450	52.7	1.95	4.26	4.26	4.26	0.70	1.16	± 12.0 %
2600	52.5	2.16	4.05	4.05	4.05	0.67	1.00	± 12.0 %

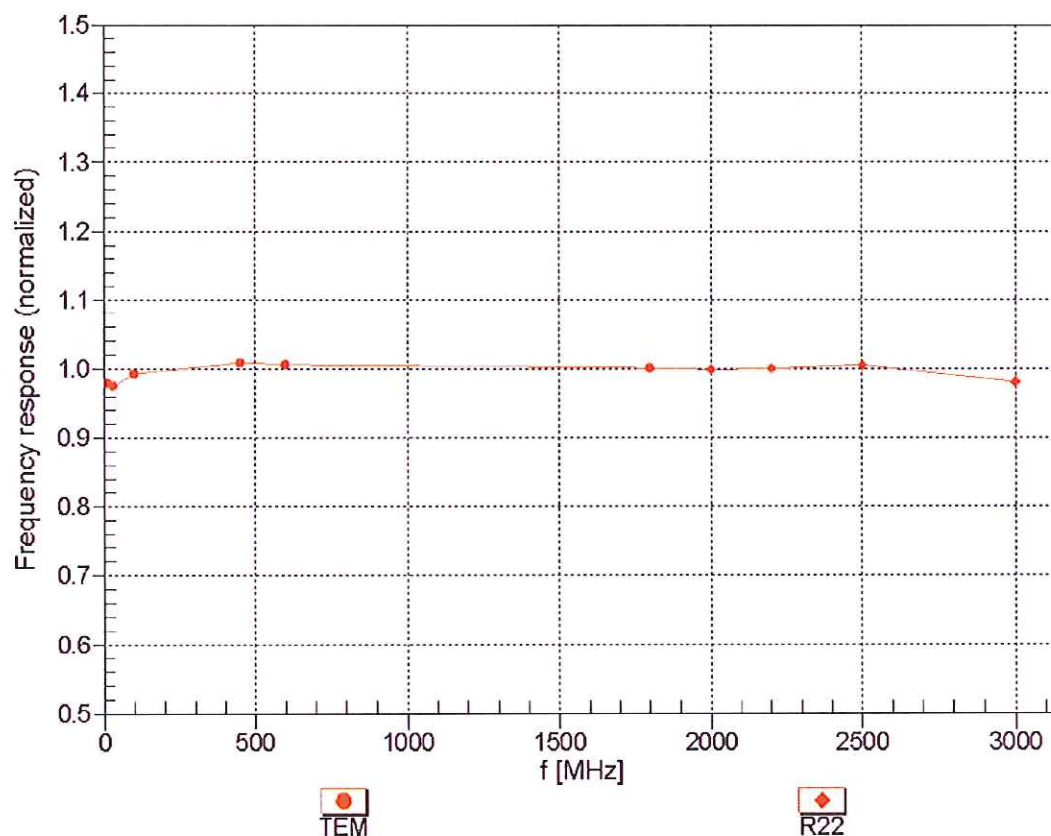
^C Frequency validity of ± 100 MHz only applies for DASY v4.4 and higher (see Page 2), else it is restricted to ± 50 MHz. The uncertainty is the RSS of the ConvF uncertainty at calibration frequency and the uncertainty for the indicated frequency band.

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

^G Alpha/Depth are determined during calibration. SPEAG warrants that the remaining deviation due to the boundary effect after compensation is always less than ± 1% for frequencies below 3 GHz and below ± 2% for frequencies between 3-6 GHz at any distance larger than half the probe tip diameter from the boundary.

Frequency Response of E-Field

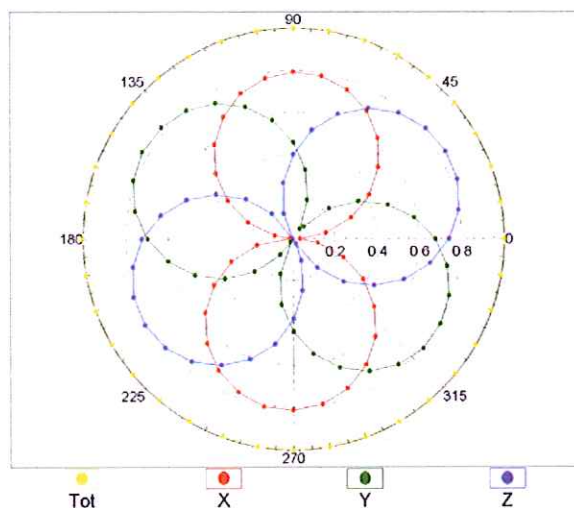
(TEM-Cell:ifi110 EXX, Waveguide: R22)



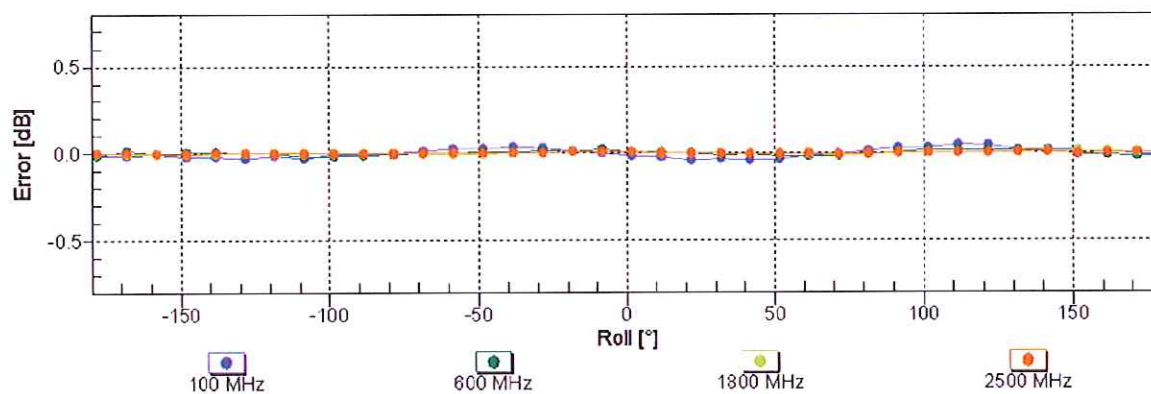
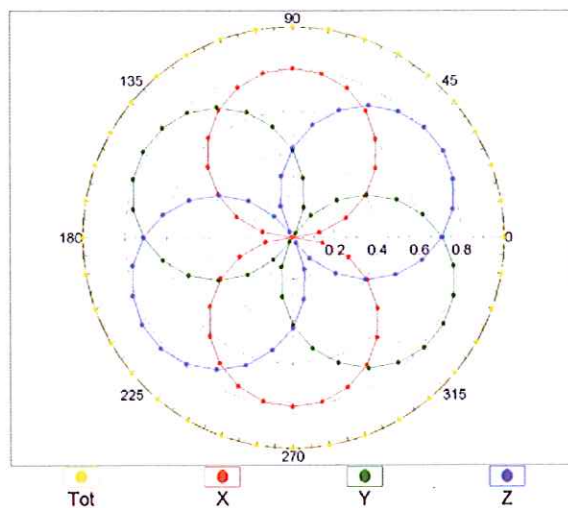
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz, TEM

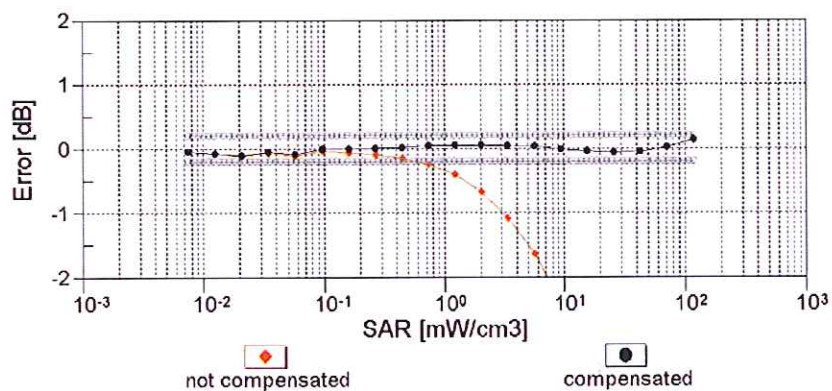
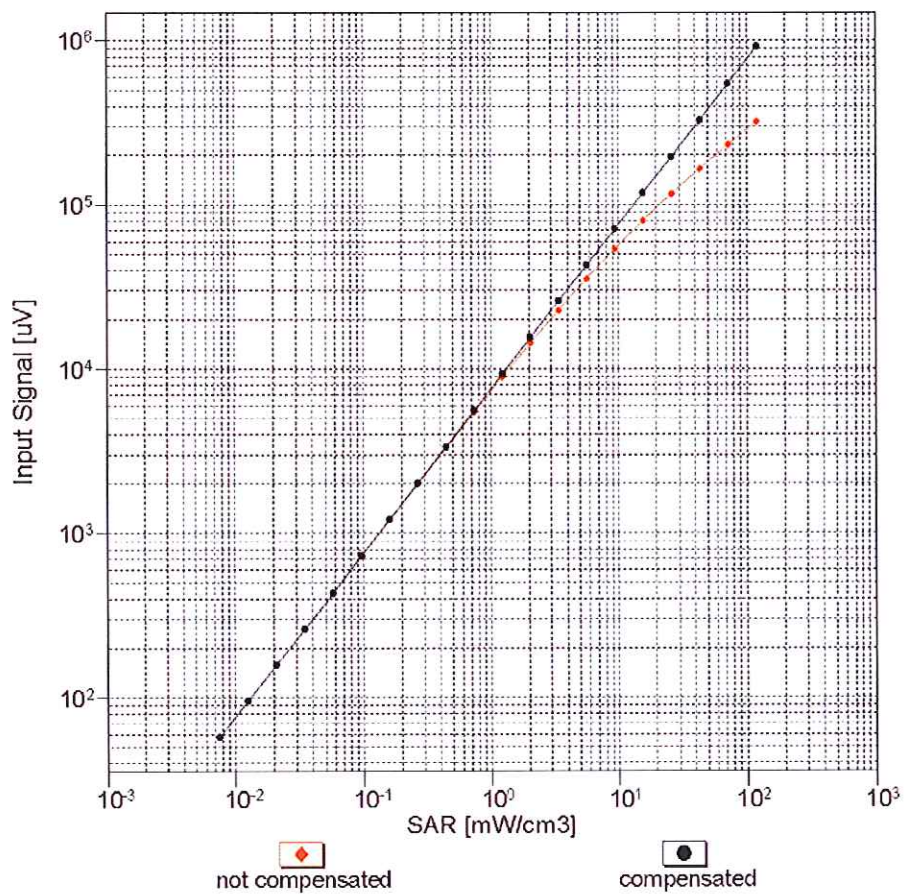


f=1800 MHz, R22



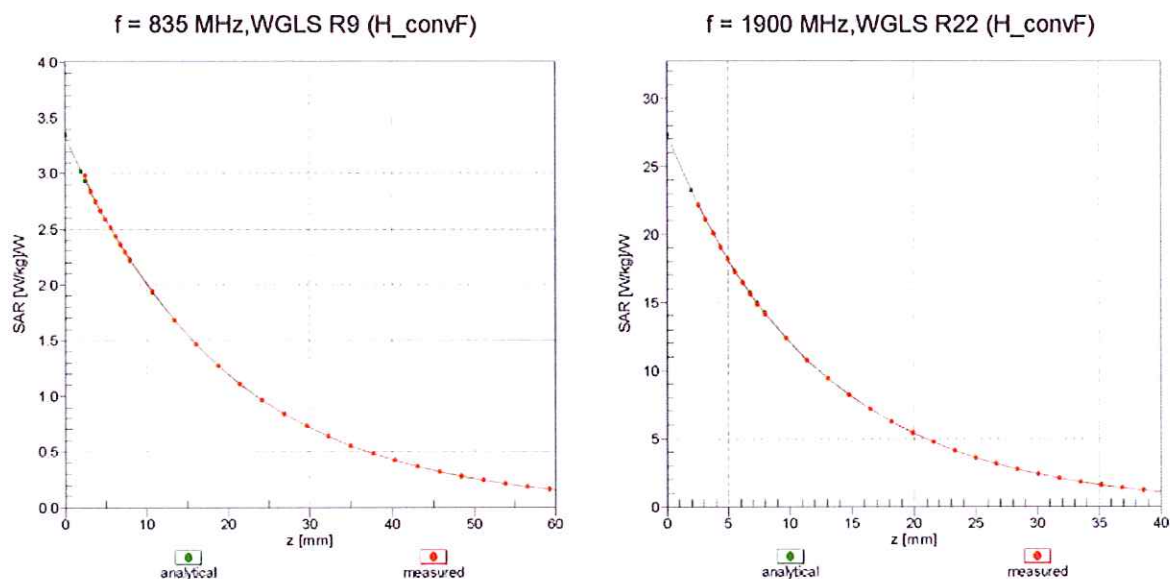
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



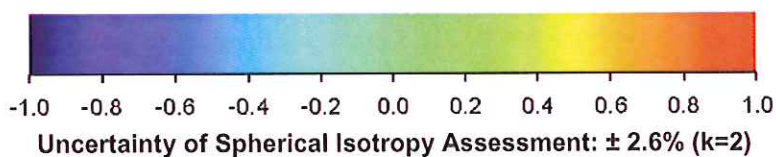
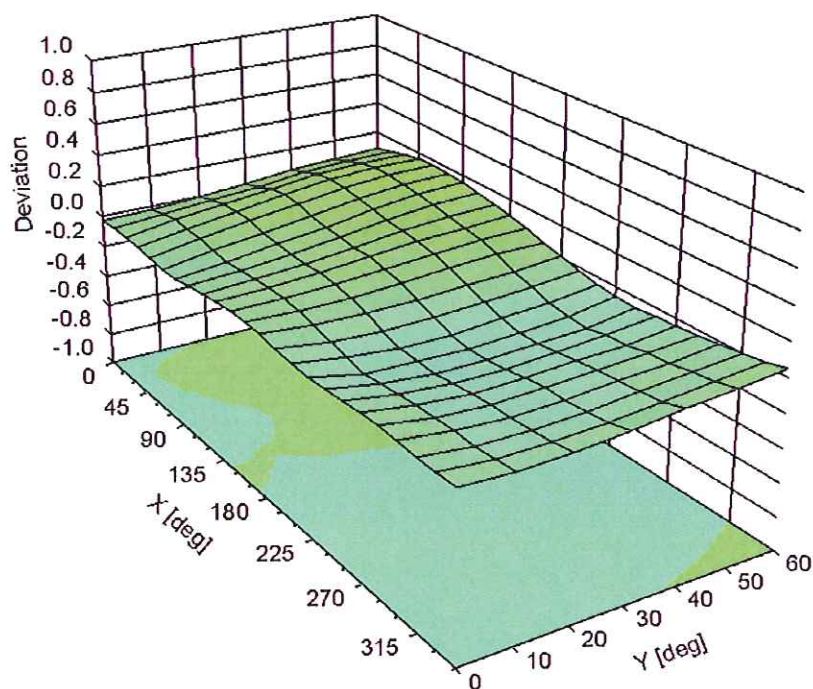
Uncertainty of Linearity Assessment: $\pm 0.6\%$ ($k=2$)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV3 - SN:3213

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-68.3
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: **ES3-3288_Sep13/2**

CALIBRATION CERTIFICATE (Replacement of No: ES3-3288_Sep13)

Object **ES3DV3 - SN:3288**

CCV
 10/4/13

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

Calibration date: **September 23, 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)	Apr-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-12)	In house check: Oct-13

Calibrated by:	Name Jeton Kastrati	Function Laboratory Technician	Signature
Approved by:	Name Katja Pokovic	Function Technical Manager	Signature
			Issued: October 4, 2013

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

Probe ES3DV3

SN:3288

Manufactured: July 6, 2010
Calibrated: September 23, 2013

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



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

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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	0.87	0.97	0.75	± 10.1 %
DCP (mV) ^B	103.3	103.2	100.2	

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	171.1	±3.5 %
		Y	0.0	0.0	1.0		135.0	
		Z	0.0	0.0	1.0		154.3	

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 E²-field uncertainty inside TSL (see Pages 5 and 6).

^B Numerical linearization parameter: uncertainty not required.

^E Uncertainty is determined using the max. deviation from linear response applying rectangular distribution and is expressed for the square of the field value.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

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	Depth (mm)	Unct. (k=2)
750	41.9	0.89	6.56	6.56	6.56	0.32	1.89	± 12.0 %
835	41.5	0.90	6.37	6.37	6.37	0.34	1.82	± 12.0 %
1750	40.1	1.37	5.67	5.67	5.67	0.56	1.51	± 12.0 %
1900	40.0	1.40	5.47	5.47	5.47	0.80	1.29	± 12.0 %
2450	39.2	1.80	4.63	4.63	4.63	0.80	1.34	± 12.0 %
2600	39.0	1.96	4.55	4.55	4.55	0.80	1.41	± 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.

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

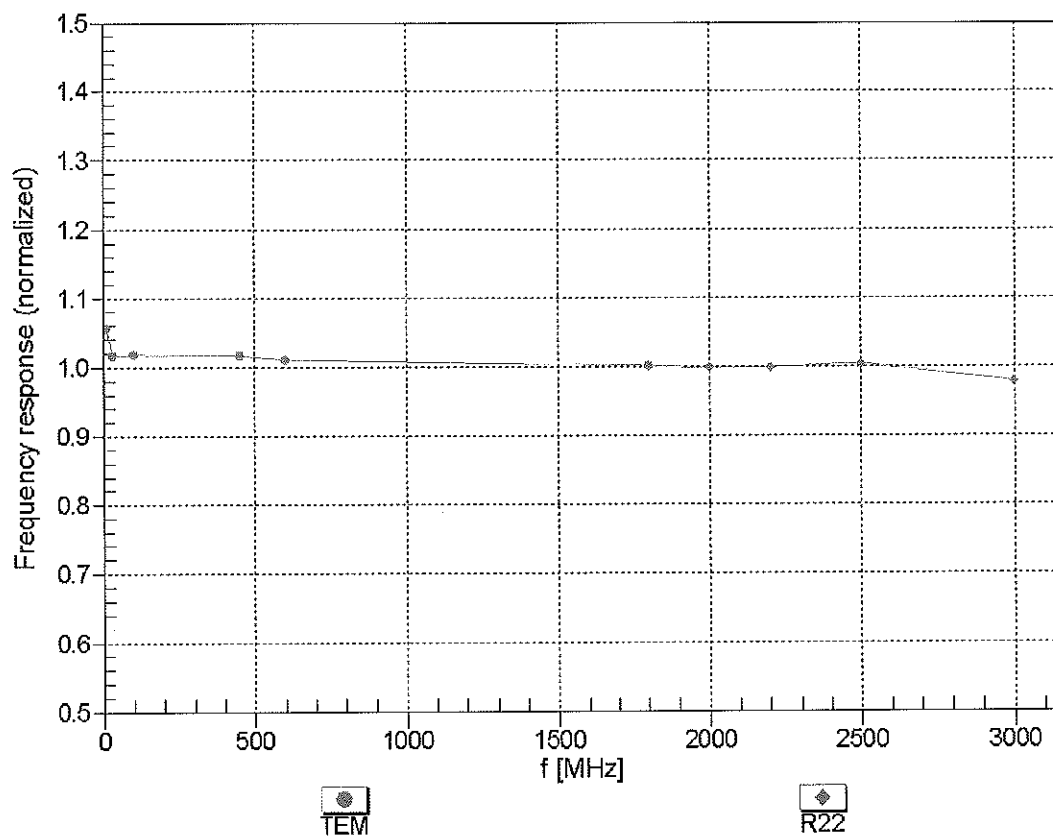
Calibration Parameter Determined in Body Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	6.25	6.25	6.25	0.70	1.27	± 12.0 %
835	55.2	0.97	6.27	6.27	6.27	0.75	1.22	± 12.0 %
1750	53.4	1.49	5.10	5.10	5.10	0.59	1.46	± 12.0 %
1900	53.3	1.52	4.82	4.82	4.82	0.53	1.54	± 12.0 %
2450	52.7	1.95	4.37	4.37	4.37	0.80	1.02	± 12.0 %
2600	52.5	2.16	4.14	4.14	4.14	0.64	0.94	± 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.

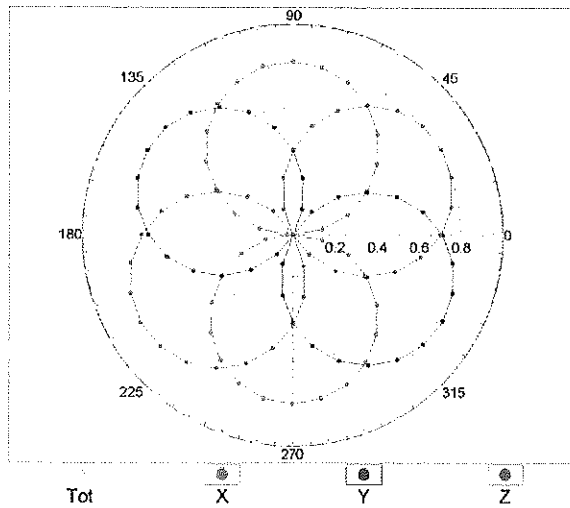
Frequency Response of E-Field (TEM-Cell:ifi110 EXX, Waveguide: R22)



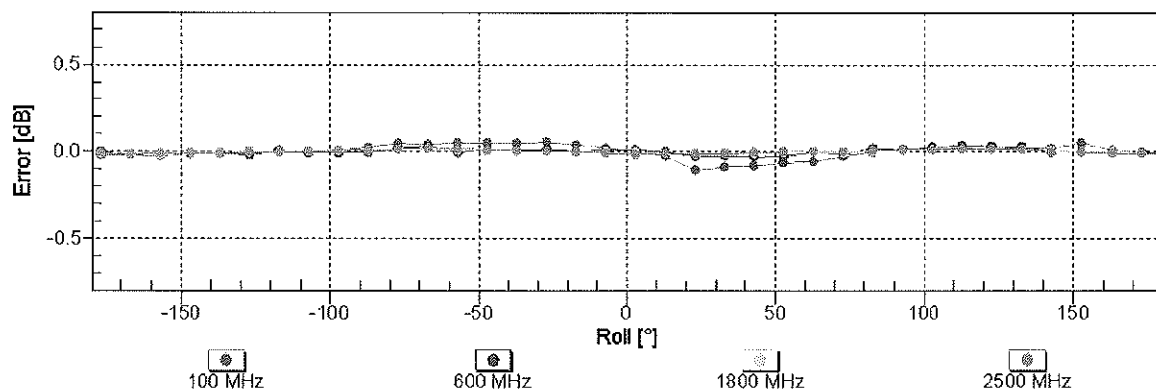
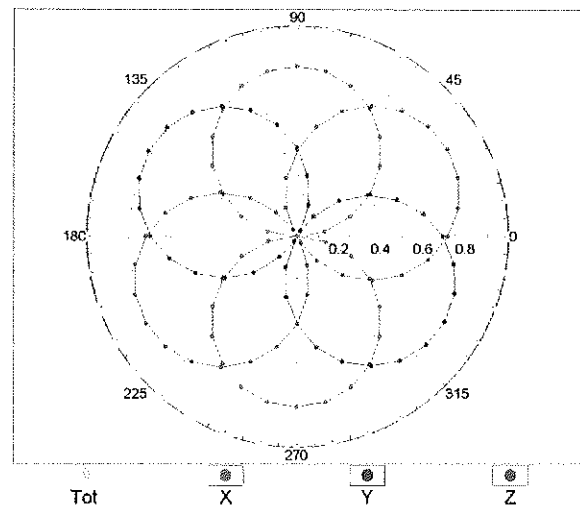
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

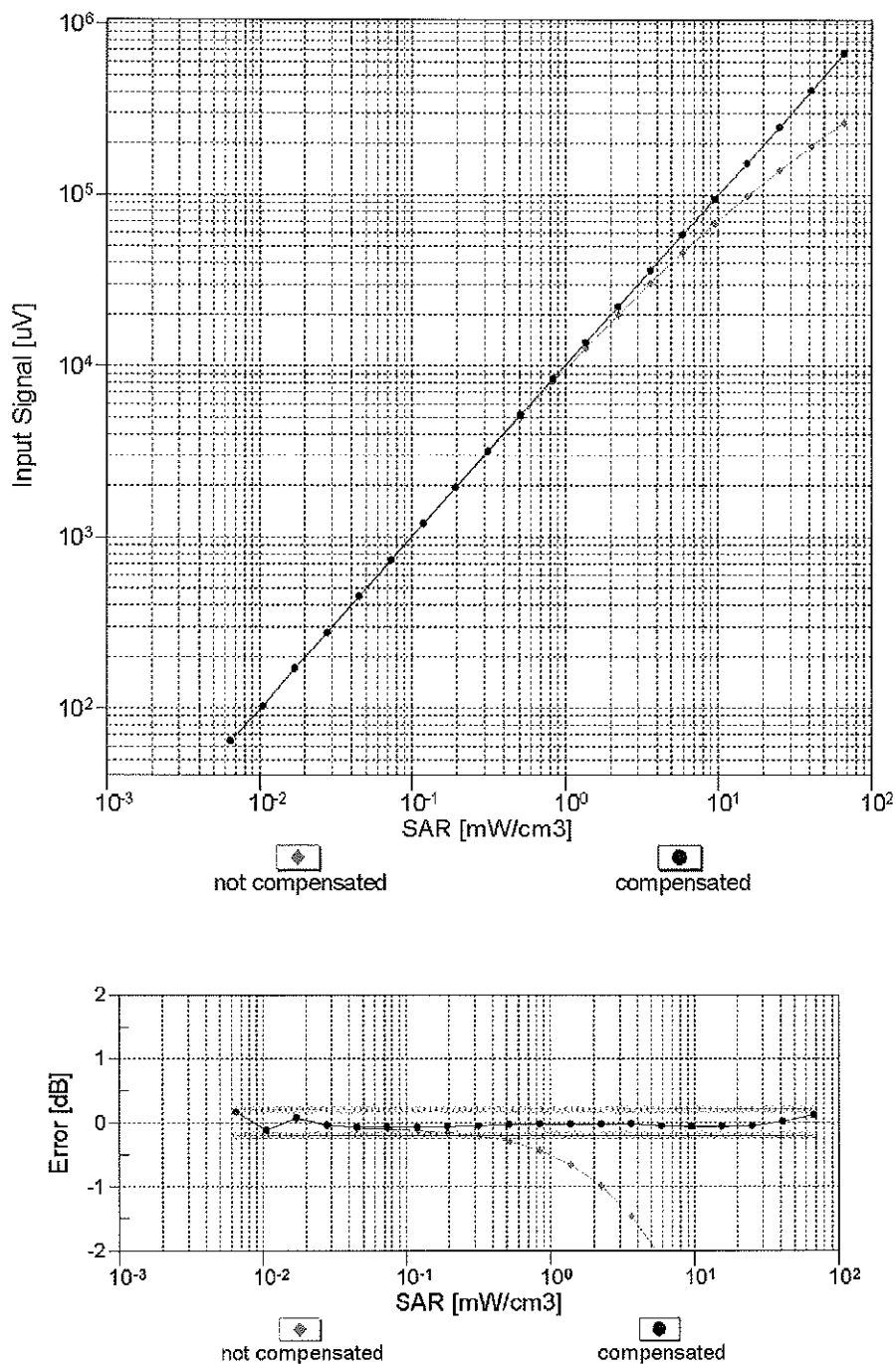


f=1800 MHz,R22



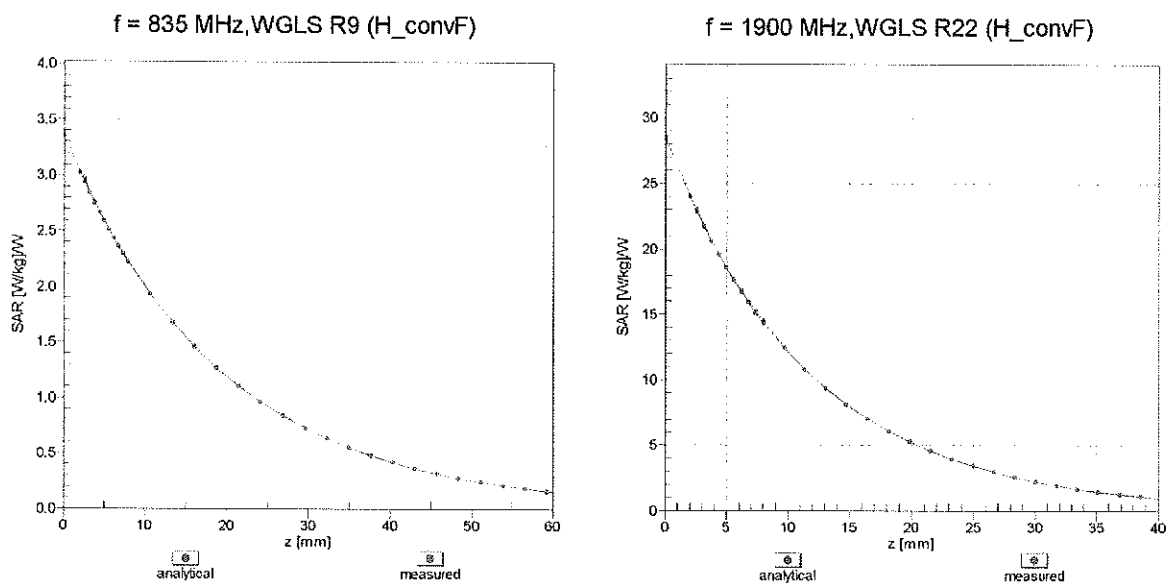
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

Dynamic Range f(SAR_{head}) (TEM cell , f = 900 MHz)



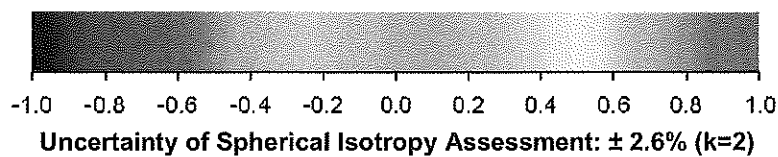
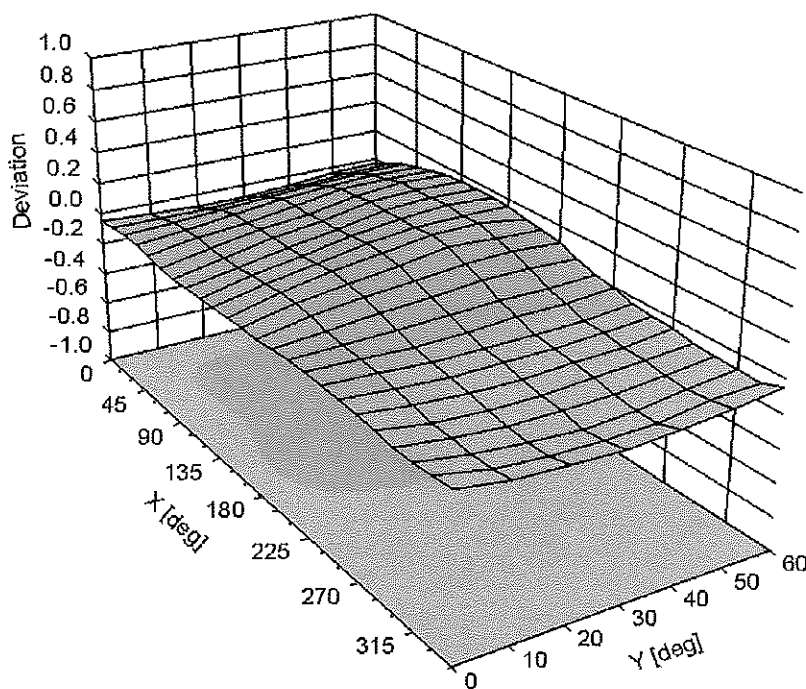
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, θ), $f = 900 \text{ MHz}$



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

DASY/EASY - Parameters of Probe: ES3DV3 - SN:3288

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-127.1
Mechanical Surface Detection Mode	enabled
Optical Surface Detection Mode	disabled
Probe Overall Length	337 mm
Probe Body Diameter	10 mm
Tip Length	10 mm
Tip Diameter	4 mm
Probe Tip to Sensor X Calibration Point	2 mm
Probe Tip to Sensor Y Calibration Point	2 mm
Probe Tip to Sensor Z Calibration Point	2 mm
Recommended Measurement Distance from Surface	3 mm

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 FCC KDB 865664 D01 v01 and IEEE 1528-2013. Since SAR probe calibrations are frequency dependent, each probe calibration point was validated at a frequency within the valid frequency range of the probe calibration point, using the system that normally operates with the probe for routine SAR measurements and according to the required tissue-equivalent media.

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

Table 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
B	1900	6/28/2014	3288	ES3DV3	1900	Body	1.565	52.71	PASS	PASS	PASS	GMSK	PASS	N/A
C	1750	6/18/2014	3213	ES3DV3	1750	Body	1.531	51.36	PASS	PASS	PASS	N/A	N/A	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 and TDD, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664

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APPENDIX G: SENSOR TRIGGERING DATA SUMMARY

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A3LSMT537R4 Sensor Triggering Data Summary

Per FCC KDB Publication 616217 D04v01, 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 1 mm less than the smallest distance from the device and SAR phantom (determined from these triggering tests according to the KDB 616217 D04v01) with the device at maximum output power without power reduction. These SAR Tests are included in addition to the SAR tests for the device touching the SAR phantom, with reduced power.

The operational description contains information explaining how this device remains compliant in the event of a sensor malfunction.

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Back Side

Moving device toward the phantom:

KDB616217 6.2.6 Measured Power [dBm]											
Distance	28	27	26	25	24	23	22	21	20	19	18
CDMA 850	24.58	24.64	24.46	24.45	24.40	20.08	20.06	20.13	19.99	19.92	20.12
CDMA 1900	23.98	24.24	24.07	24.21	23.96	12.69	12.46	12.60	12.61	12.45	12.78
LTE B2	23.18	23.15	23.30	23.26	23.24	12.30	12.24	11.93	12.00	12.08	12.05
LTE B4	23.78	23.50	23.58	23.74	23.73	12.07	12.30	12.26	12.02	11.90	12.02
LTE B5	24.59	24.40	24.70	24.74	24.76	20.05	20.12	20.10	20.17	20.26	19.96
LTE B12	24.07	23.96	23.91	24.14	23.95	20.30	19.91	20.04	19.97	20.02	19.99
LTE B17	24.10	24.27	24.17	24.21	24.24	19.99	19.90	20.20	20.26	20.09	20.30

Moving device away from the phantom:

KDB616217 6.2.8 Measured Power [dBm]																			
Distance	34	31	28	27	26	25	24	23	22	21	20	19	18	15	12	9	6	3	0
CDMA 850	24.78	24.49	24.56	24.53	24.47	24.58	24.67	20.15	19.92	20.11	19.93	20.12	20.00	20.07	19.95	19.98	20.24	19.97	20.15
CDMA 1900	24.21	23.97	24.10	23.96	23.93	24.30	24.11	12.45	12.71	12.56	12.60	12.80	12.54	12.47	12.74	12.73	12.79	12.65	12.77
LTE B2	23.13	23.21	23.04	23.05	23.02	23.15	22.91	11.98	12.08	12.19	12.18	11.94	12.01	12.30	12.01	12.16	12.03	11.90	11.94
LTE B4	23.46	23.40	23.77	23.71	23.62	23.56	23.44	11.97	11.91	12.11	12.16	11.98	12.22	12.17	12.12	12.21	11.90	12.29	12.16
LTE B5	24.42	24.53	24.62	24.77	24.51	24.43	24.42	20.18	20.13	19.91	20.09	20.03	20.25	20.09	20.24	20.20	20.30	20.18	20.11
LTE B12	24.21	24.27	24.11	23.90	24.30	24.03	24.14	20.16	20.10	20.16	19.91	19.91	19.94	20.21	20.06	20.09	20.29	20.04	19.94
LTE B17	24.22	24.07	24.03	24.23	24.02	24.23	24.19	19.96	20.30	20.30	20.01	20.06	20.29	20.11	19.93	20.23	20.16	20.22	20.09

Based on the most conservative measured triggering distance of 23 mm, additional SAR measurements were required at 22 mm from the back side.

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Top Edge

Moving device toward the phantom:

KDB616217 6.2.6 Measured Power [dBm]											
Distance	28	27	26	25	24	23	22	21	20	19	18
CDMA 850	24.41	24.72	24.42	24.61	24.61	20.25	19.99	20.28	19.90	20.23	19.96
CDMA 1900	24.08	24.00	23.99	23.93	24.04	12.60	12.52	12.64	12.61	12.67	12.66
LTE B2	23.25	22.96	23.19	23.05	22.93	12.11	12.02	12.06	12.21	11.90	12.06
LTE B4	23.77	23.54	23.51	23.58	23.48	12.02	12.27	11.95	11.96	11.90	12.04
LTE B5	24.75	24.56	24.62	24.53	24.42	20.02	20.05	19.97	19.91	20.11	19.97
LTE B12	24.29	24.18	23.94	24.02	24.05	19.93	20.09	19.99	19.96	20.03	20.08
LTE B17	23.91	24.16	24.20	24.04	24.05	20.23	20.14	20.29	19.90	20.21	20.30

Moving device away from the phantom:

KDB616217 6.2.8 Measured Power [dBm]																			
Distance	34	31	28	27	26	25	24	23	22	21	20	19	18	15	12	9	6	3	0
CDMA 850	24.52	24.73	24.78	24.60	24.72	24.41	24.61	20.03	19.92	19.91	20.07	20.00	19.92	20.06	19.96	19.90	20.09	20.25	20.29
CDMA 1900	24.29	24.19	24.00	23.91	23.90	24.21	24.03	12.53	12.49	12.60	12.46	12.48	12.68	12.80	12.41	12.64	12.56	12.63	12.68
LTE B2	22.97	22.94	23.13	23.08	23.04	22.96	23.25	12.21	12.00	12.30	12.21	12.01	12.00	12.30	12.23	11.97	12.08	12.22	12.22
LTE B4	23.68	23.79	23.50	23.66	23.59	23.41	23.50	12.10	12.19	12.08	12.21	12.02	12.30	12.21	12.18	11.92	12.22	12.04	11.94
LTE B5	24.59	24.74	24.63	24.64	24.80	24.40	24.57	20.01	19.99	20.04	20.30	20.19	20.15	20.09	20.02	20.01	19.93	20.18	20.17
LTE B12	24.00	23.90	24.23	24.13	24.11	23.94	24.23	19.95	19.90	20.23	20.17	20.19	19.94	20.11	20.23	20.27	19.94	20.29	20.01
LTE B17	24.28	24.08	24.09	24.21	24.25	24.05	23.93	20.26	20.11	20.04	20.17	20.26	19.90	20.23	19.97	19.92	20.22	19.96	20.29

Based on the most conservative measured triggering distance of 23 mm, additional SAR measurements were required at 22 mm from the top edge.

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