



SAR EVALUATION REPORT

Applicant Name:

Samsung Electronics, Co. Ltd.
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Yeongtong-gu, Suwon-si
Gyeonggi-do 443-742, Korea

Date of Testing:

05/26/14 - 05/27/14

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

0Y1405211052.A3L

FCC ID:

A3LSPHL720

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Handset

Application Type:

Class II Permissive Change

FCC Rule Part(s):

CFR §2.1093

Model(s):

SPH-L720

Permissive Change(s):

Adding 1.4MHz, 3MHz, 10MHz, 15MHz & 20MHz BWs to LTE B25.

Date of Original Certification:

03/27/2013

Equipment Class	Band & Mode	Tx Frequency	SAR		
			1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)
PCE	LTE Band 25	1850.7 - 1914.3 MHz	0.59	0.53	0.53
Simultaneous SAR per KDB 690783 D01v01r02:			0.96	1.59	1.59

The table above shows Test Data evaluated for the current test report. Please refer to RF Exposure Technical Reports 0Y1303040414-R2.A3L and 0Y1308281697.A3L for compliance evaluation.

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in Section 1.8 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
GSM/GPRS/EDGE 850	Voice/Data	824.20 - 848.80 MHz
GSM/GPRS/EDGE 1900	Voice/Data	1850.20 - 1909.80 MHz
UMTS 850	Voice/Data	826.40 - 846.60 MHz
UMTS 1900	Voice/Data	1852.4 - 1907.6 MHz
Cell. CDMA - FCC Rule Part 22H	Voice/Data	824.70 - 848.31 MHz
Cell. CDMA - FCC Rule Part 90S	Voice/Data	817.90 - 823.10 MHz
PCS CDMA - FCC Rule Part 24E	Voice/Data	1851.25 - 1908.75 MHz
LTE Band 25	Data	1850.7 - 1914.3 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
NFC	Data	13.56 MHz
ANT+	Data	2402 - 2480 MHz

1.2 Power Reduction for SAR

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

1.3 Nominal and Maximum Output Power Specifications

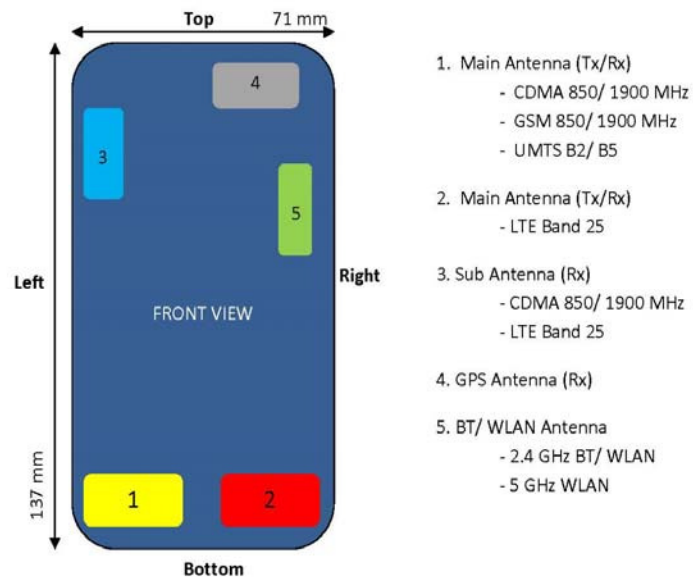
This device operates using the following maximum and nominal output power specifications. SAR values were scaled to the maximum allowed power to determine compliance per KDB Publication 447498 D01v05.

Mode / Band	Power Reduction	Modulated Average (dBm)	
LTE Band 25	Inactive	Maximum	24.5
		Nominal	24.0
	Active (*)	Maximum	19.5
		Nominal	19.0

(*) Only applies in SVLTE conditions where the 1x-RTT CDMA voice power is 18 dBm or greater.

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1.4 DUT Antenna Locations



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

Figure 1-1
DUT Antenna Locations

Table 1-1
Mobile Hotspot Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
LTE Band 25	Yes	Yes	No	Yes	Yes	No

Note: Particular DUT edges were not required to be evaluated for Wireless Router SAR if the edges were greater than 2.5 cm from the transmitting antenna according to FCC KDB Publication 941225 D06v01 guidance, page 2.

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1.5 NFC Antenna Locations

This DUT has NFC operations. The NFC antenna is integrated into the device and will be the only battery available from the manufacturer for this model (Model: B600BU). Therefore, all SAR tests were performed with the device which already integrates the NFC antenna.

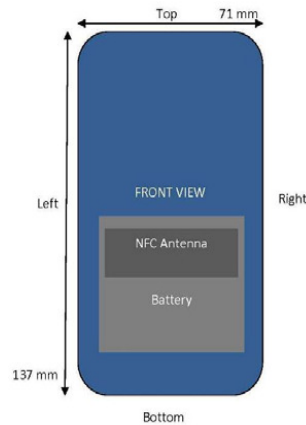


Figure 1-2
DUT Antenna Locations

1.6 Simultaneous Transmission Capabilities

According to FCC KDB Publication 447498 D05v01, transmitters are considered to be transmitting simultaneously when there is overlapping transmission, with the exception of transmissions during network hand-offs with maximum hand-off duration less than 30 seconds. Possible transmission paths for the DUT are shown in Figure 1-3 and are color-coded to indicate communication modes which share the same path. Modes which share the same transmission path cannot transmit simultaneously with one another.



Figure 1-3
Simultaneous Transmission Paths

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

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**Table 1-2
Simultaneous Transmission Scenarios**

Ref.	Simultaneous Transmit Configurations	Power Reduction	Head	Body-Worn Accessory	Hot Spot	Note
			IEEE 1528, Supp. C	Supplement C	FCC KDB 941225 OBC edges/sides	
1	1X CDMA BC0/ BC1/ BC10 Voice + LTE B25 Data	SVLTE	Yes	Yes	N/A	SVLTE
2	1X CDMA BC0/ BC1/ BC10 Voice + 2.4 GHz WIFI	N/A	Yes	Yes	N/A	1x Voice + WIFI Data
3	1X CDMA BC0/ BC1/ BC10 Voice + 5 GHz WIFI	N/A	Yes	Yes	N/A	1x Voice + WIFI Data
4	GSM850/ 1900 Voice + 2.4 GHz WIFI	N/A	Yes	Yes	N/A	Voice + WIFI Data
5	GSM850/ 1900 Voice + 5 GHz WIFI	N/A	Yes	Yes	N/A	Voice + WIFI Data
6	WCDMA 850/ 1900 Voice + 2.4 GHz WIFI	N/A	Yes	Yes	N/A	Voice + WIFI Data
7	WCDMA 850/ 1900 Voice + 5 GHz WIFI	N/A	Yes	Yes	N/A	Voice + WIFI Data
8	1X CDMA BC0/ BC1/ BC10 Voice + LTE B25 Data + 2.4 GHz WIFI	SVLTE	Yes	Yes	Yes	Voice + LTE + WIFI Hotspot
9	1X CDMA BC0/ BC1/ BC10 Voice + LTE B25 Data + 5 GHz WIFI	SVLTE	Yes	Yes	Yes	Voice + LTE + WIFI Hotspot
10	1X CDMA BC0 Data / EVDO BC0 Data + 2.4 GHz WIFI	N/A	Yes*	Yes*	Yes	1X CDMA Data / EVDO +WIFI Hotspot
11	1X CDMA BC1 Data / EVDO BC1 Data + 2.4 GHz WIFI	N/A	Yes*	Yes*	Yes	1X CDMA Data / EVDO +WIFI Hotspot
12	1X CDMA BC10 Data / EVDO BC10 Data + 2.4 GHz WIFI	N/A	Yes*	Yes*	Yes	1X CDMA Data / EVDO +WIFI Hotspot
13	1X CDMA BC0 Data / EVDO BC0 Data + 5 GHz WIFI	N/A	Yes*	Yes*	Yes	1X CDMA Data / EVDO +WIFI Hotspot
14	1X CDMA BC1 Data / EVDO BC1 Data + 5 GHz WIFI	N/A	Yes*	Yes*	Yes	1X CDMA Data / EVDO +WIFI Hotspot
15	1X CDMA BC10 Data / EVDO BC10 Data + 5 GHz WIFI	N/A	Yes*	Yes*	Yes	1X CDMA Data / EVDO +WIFI Hotspot
16	WCDMA 850/ 1900 Data + 2.4 GHz WIFI	N/A	Yes	Yes	Yes	WCDMA + WIFI Hotspot
17	WCDMA 850/ 1900 Data + 5 GHz WIFI	N/A	Yes	Yes	Yes	WCDMA + WIFI Hotspot
18	LTE B25 Data + 2.4 GHz WIFI	N/A	Yes*	Yes*	Yes	LTE+WIFI Hotspot
19	LTE B25 Data + 5 GHz WIFI	N/A	Yes*	Yes*	Yes	LTE+WIFI Hotspot
20	GPRS/EDGE 850/ 1900 Data + 2.4 GHz WIFI	N/A	N/A	N/A	Yes	GPRS/EDGE + WIFI Hotspot
21	GPRS/EDGE 850/ 1900 Data + 5 GHz WIFI	N/A	N/A	N/A	Yes	GPRS/EDGE + WIFI Hotspot
22	1X CDMA BC0 Voice + EVDO BC0 Data	N/A	N/A	N/A	N/A	Not Supported by HW (Non-SVDO)
23	1X CDMA BC0 Voice + EVDO BC1 Data	N/A	N/A	N/A	N/A	Not Supported by HW (Non-SVDO)
24	1X CDMA BC0 Voice + EVDO BC10 Data	N/A	N/A	N/A	N/A	Not Supported by HW (Non-SVDO)
25	1X CDMA BC1 Voice + EVDO BC0 Data	N/A	N/A	N/A	N/A	Not Supported by HW (Non-SVDO)
26	1X CDMA BC1 Voice + EVDO BC1 Data	N/A	N/A	N/A	N/A	Not Supported by HW (Non-SVDO)
27	1X CDMA BC1 Voice + EVDO BC10 Data	N/A	N/A	N/A	N/A	Not Supported by HW (Non-SVDO)
28	1X CDMA BC10 Voice + EVDO BC0 Data	N/A	N/A	N/A	N/A	Not Supported by HW (Non-SVDO)
29	1X CDMA BC10 Voice + EVDO BC1 Data	N/A	N/A	N/A	N/A	Not Supported by HW (Non-SVDO)
30	1X CDMA BC10 Voice + EVDO BC10 Data	N/A	N/A	N/A	N/A	Not Supported by HW (Non-SVDO)
31	1X CDMA BC0 Voice + EVDO BC0 Data + 2.4 GHz WIFI	N/A	N/A	N/A	N/A	Not Supported by HW (Voice + EVDO + WIFI Hotspot)
32	1X CDMA BC0 Voice + EVDO BC1 Data + 2.4 GHz WIFI	N/A	N/A	N/A	N/A	Not Supported by HW (Voice + EVDO + WIFI Hotspot)
33	1X CDMA BC0 Voice + EVDO BC10 Data + 2.4 GHz WIFI	N/A	N/A	N/A	N/A	Not Supported by HW (Voice + EVDO + WIFI Hotspot)
34	1X CDMA BC1 Voice + EVDO BC0 Data + 2.4 GHz WIFI	N/A	N/A	N/A	N/A	Not Supported by HW (Voice + EVDO + WIFI Hotspot)
35	1X CDMA BC1 Voice + EVDO BC1 Data + 2.4 GHz WIFI	N/A	N/A	N/A	N/A	Not Supported by HW (Voice + EVDO + WIFI Hotspot)
36	1X CDMA BC1 Voice + EVDO BC10 Data + 2.4 GHz WIFI	N/A	N/A	N/A	N/A	Not Supported by HW (Voice + EVDO + WIFI Hotspot)
37	1X CDMA BC10 Voice + EVDO BC0 Data + 2.4 GHz WIFI	N/A	N/A	N/A	N/A	Not Supported by HW (Voice + EVDO + WIFI Hotspot)
38	1X CDMA BC10 Voice + EVDO BC1 Data + 2.4 GHz WIFI	N/A	N/A	N/A	N/A	Not Supported by HW (Voice + EVDO + WIFI Hotspot)
39	1X CDMA BC10 Voice + EVDO BC10 Data + 2.4 GHz WIFI	N/A	N/A	N/A	N/A	Not Supported by HW (Voice + EVDO + WIFI Hotspot)
40	GSM 850/1900 Voice + 850/1900 1X-RTT/ EVDO CDMA Data	N/A	N/A	N/A	N/A	Not Supported by SW
41	GSM 850/1900 Voice + GPRS/EDGE Data	N/A	N/A	N/A	N/A	Not Supported by HW
42	GSM 850/1900 Voice + LTE	N/A	N/A	N/A	N/A	Not Supported by HW
43	GSM 850/1900 Voice + 850/1900 1X-RTT/ EVDO CDMA + 2.4/5 GHz WIFI	N/A	N/A	N/A	N/A	Not Supported by SW
44	GSM 850/1900 Voice + GPRS/EDGE + 2.4/5 GHz WIFI	N/A	N/A	N/A	N/A	Not supported by HW
45	GSM 850/1900 Voice + LTE + 2.4/5 GHz WIFI	N/A	N/A	N/A	N/A	Not supported by HW
46	850/1900 GPRS/EDGE Data + LTE B25 MHz Data	N/A	N/A	N/A	N/A	Not supported by the HW
47	BC0/BC1/BC10 EVDO Data + 850/1900 GPRS/EDGE Data	N/A	N/A	N/A	N/A	Not supported by the SW
48	BC0/BC1/BC10 EVDO data + LTE B25 MHz Data	N/A	N/A	N/A	N/A	Not supported by the SW
49	WCDMA 850/1900 Voice + BC0/BC1/BC10 1X-RTT/ EVDO CDMA Data	N/A	N/A	N/A	N/A	Not supported by the SW
50	WCDMA 850/1900 Voice + GPRS/EDGE Data	N/A	N/A	N/A	N/A	Not Supported by HW
51	WCDMA 850/1900 Voice + LTE	N/A	N/A	N/A	N/A	Not Supported by HW
52	WCDMA 850/1900 Voice + BC0/BC1/BC10 1X-RTT/ EVDO CDMA + 2.4/5 GHz WIFI	N/A	N/A	N/A	N/A	Not supported by SW
53	WCDMA 850/1900 Voice + GPRS/EDGE + 2.4/5 GHz WIFI	N/A	N/A	N/A	N/A	Not supported by HW
54	WCDMA 850/1900 Voice + LTE + 2.4/5 GHz WIFI	N/A	N/A	N/A	N/A	Not supported by HW

Notes:

1. CDMA and EVDO share the same antenna path and cannot transmit simultaneously. (Non-SVDO)
2. Bluetooth and 2.4 GHz WLAN and 5 GHz WLAN share the same antenna path and cannot transmit simultaneously.
3. GSM/WCDMA/LTE use one modem and transceiver IC. The signals can not be transmitted simultaneously.
4. For 5 GHz Hotspot, S/W only supports the 5.8 GHz Band, therefore all other bands were not evaluated for hotspot conditions.

This cannot be changed by any S/W modification by any party after it is manufactured.

Notes:

1. (*) = for VOIP 3rd party applications possibly installed and used by the end-user
2. When the user utilizes multiple services in UMTS 3G mode it uses multi-Radio Access Bearer or multi-RAB. The power control is based on a physical control channel (Dedicated Physical Control Channel [DPCH]) and power control will be adjusted to meet the needs of both services. Therefore, the UMTS+WLAN scenario also represents the UMTS Voice/DATA + WLAN Hotspot scenario.
3. Per the manufacturer, WIFI Direct is not expected to be used in conjunction with a held-to-ear or body-worn accessory voice call. Therefore, there are no new simultaneous transmission scenarios involving WIFI direct.

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1.7 Wireless Charging Cover

This DUT may be used with a standard battery cover or with an optional wireless charging battery cover. Per FCC KDB Publication 648474 D04, SAR was measured using the standard battery cover and then repeated with the wireless charging battery cover for the highest reported SAR for each wireless technology, frequency band, operating mode, and exposure condition. No additional testing with wireless charging cover was required since all the reported SAR was less than 1.2 W/kg.

1.8 Guidance Applied

- IEEE 1528-2003
- FCC KDB Publication 941225 D01-D06 (4G and Hotspot)
- FCC KDB Publication 447498 D01v05 (General SAR Guidance)
- FCC KDB Publication 865664 D01-D02 (SAR Measurements up to 6 GHz)
- FCC KDB Publication 648474 D04 (Wireless Charging Battery Cover)

1.9 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.

	Head Serial Number	Body-Worn Serial Number	Hotspot Serial Number
LTE Band 25 - Max Power	3272A	3272A	3272A
LTE Band 25 - Reduced Power	32745	32745	32745

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LTE INFORMATION

LTE Information			
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Form Factor	Portable Handset		
Frequency Range of each LTE transmission band	LTE Band 25 (1850.7 - 1914.3 MHz)		
Channel Bandwidths	LTE Band 25: 1.4 MHz, 3 MHz, 5 MHz, 10 MHz, 15 MHz, 20 MHz		
Channel Numbers and Frequencies (MHz)	Low	Mid	High
LTE Band 25: 1.4 MHz	1850.7 (26047)	1882.5 (26365)	1914.3 (26683)
LTE Band 25: 3 MHz	1851.5 (26055)	1882.5 (26365)	1913.5 (26675)
LTE Band 25: 5 MHz	1852.5 (26065)	1882.5 (26365)	1912.5 (26665)
LTE Band 25: 10 MHz	1855 (26090)	1882.5 (26365)	1910 (26640)
LTE Band 25: 15 MHz	1857.5 (26115)	1882.5 (26365)	1907.5 (26615)
LTE Band 25: 20 MHz	1860 (26140)	1882.5 (26365)	1905 (26590)
UE Category	3		
Modulations Supported in UL	QPSK, 16QAM		
LTE Transmitter and Antenna Implementation	This device uses 1 Tx/Rx antenna for LTE , 1 Tx/Rx Antenna for CDMA/GSM/UMTS, and 1 Rx Only Antenna for CDMA/LTE		
Description of LTE Tx and Ant. Implementation	CDMA and LTE operate on separate transmission paths		
Hotspot with LTE+WIFI	YES		
Hotspot with LTE+WIFI active with 1XVoice sessions?	YES		
LTE MPR Permanently implemented per 3GPP TS 36.101 section 6.2.3~6.2.5? (manufacturer attestation to be provided)	See Section 9.4 and 10.3		
A-MPR (Additional MPR) disabled for SAR Testing?	YES		
Conducted power Table provided for 1RB (low, mid and high offset), 50% RB (low, mid, and high offset), and 100% RB	YES		

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

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [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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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

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

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.

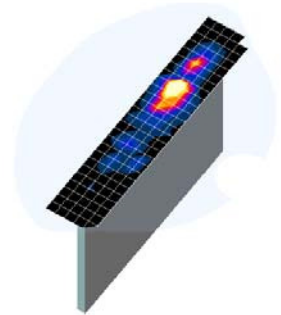


Figure 4-1
Sample SAR Area
Scan

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

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

*Also compliant to IEEE 1528-2013 Table 6

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DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

Figure 5-2 shows the front, back and side views of the SAM Twin Phantom. The point “M” is the reference point for the center of the mouth, “LE” is the left ear reference point (ERP), and “RE” is the right ERP. The ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front), also called the Reference Pivoting Line, is not perpendicular to the reference plane (see Figure 5-1). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5].

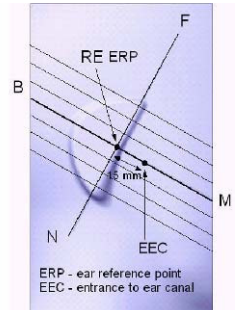


Figure 5-1
Close-Up Side view
of ERP

5.2 HANDSET REFERENCE POINTS

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



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

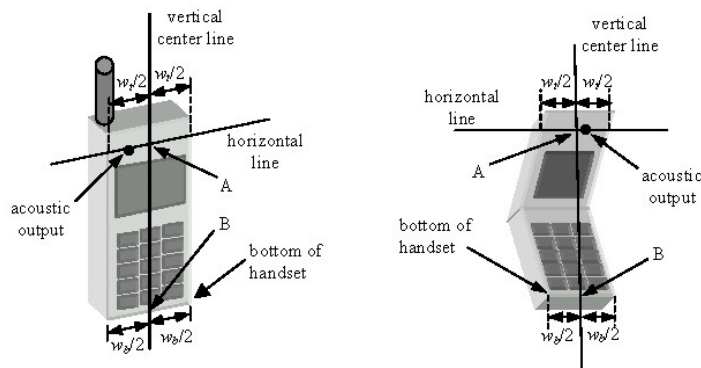


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

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

6.2 Positioning for Cheek

1. The test device was positioned with the device close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 6-1), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

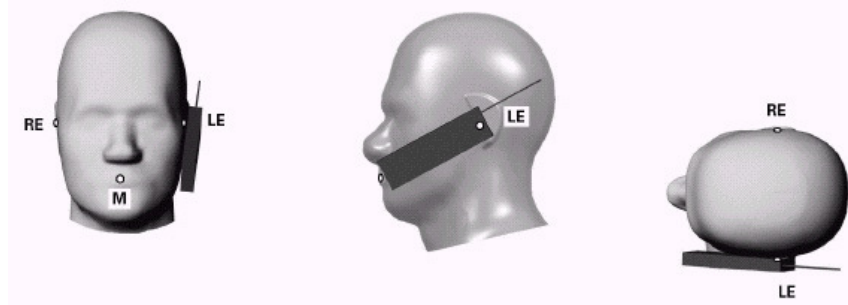


Figure 6-1 Front, Side and Top View of Cheek Position

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

6.3 Positioning for Ear / 15° Tilt

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

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

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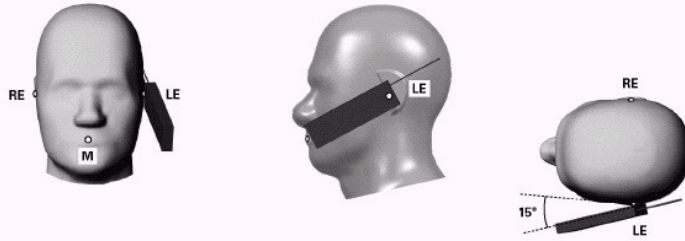


Figure 6-2 Front, Side and Top View of Ear/15° Tilt Position

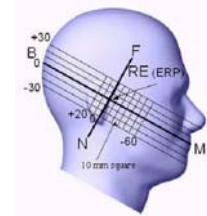


Figure 6-3 Side view w/ relevant markings

6.4 SAR Evaluations near the Mouth/Jaw Regions of the SAM Phantom

Antennas located near the bottom of a phone may require SAR measurements around the mouth and jaw regions of the SAM head phantom. This typically applies to clam-shell style phones that are generally longer in the unfolded normal use positions or to certain older style long rectangular phones. Per IEEE 1528-2013, a rotated SAM phantom is necessary to allow probe access to such regions. Both SAM heads of the TwinSAM-Chin20 are rotated 20 degrees around the NF line. Each head can be removed from the table for emptying and cleaning.

Under these circumstances, the following procedures apply, adopted from the FCC guidance on SAR handsets document FCC KDB Publication 648474 D04_v01. The SAR required in these regions of SAM should be measured using a flat phantom. The phone should be positioned with a separation distance of 4 mm between the ear reference point (ERP) and the outer surface of the flat phantom shell. While maintaining this distance at the ERP location, the low (bottom) edge of the phone should be lowered from the phantom to establish the same separation distance between the peak SAR location identified by the truncated partial SAR distribution measured with the SAM phantom. The distance from the peak SAR location to the phone is determined by the straight line passing perpendicularly through the phantom surface. When it is not feasible to maintain 4 mm separation at the ERP while also establishing the required separation at the peak SAR location, the top edge of the phone will be allowed to touch the phantom with a separation < 4 mm at the ERP. The phone should not be tilted to the left or right while placed in this inclined position to the flat phantom.

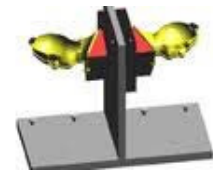


Figure 6-4 Twin SAM Chin20

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6.5 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-5). Per FCC KDB Publication 648474 D04v01, Body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB Publication 447498 D01v05 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for a body-worn accessory, measured without a headset connected to the handset, is $> 1.2 \text{ W/kg}$, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a headset attached to the handset.

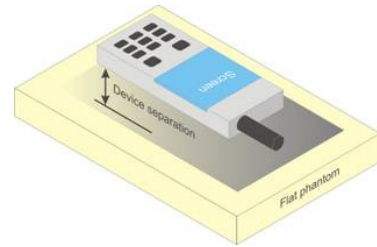


Figure 6-5
Sample Body-Worn Diagram

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

Body-worn accessories may not always be supplied or available as options for some devices intended to be authorized for body-worn use. In this case, a test configuration with a separation distance between the back of the device and the flat phantom is used. Test position spacing was documented. Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom in head fluid. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

6.6 Extremity Exposure Configurations

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

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

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6.7 Wireless Router Configurations

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

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

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7 RF EXPOSURE LIMITS

7.1 Uncontrolled Environment

UNCONTROLLED ENVIRONMENTS are defined as locations where there is the exposure of individuals who have no knowledge or control of their exposure. The general population/uncontrolled exposure limits are applicable to situations in which the general public may be exposed or in which persons who are exposed as a consequence of their employment may not be made fully aware of the potential for exposure or cannot exercise control over their exposure. Members of the general public would come under this category when exposure is not employment-related; for example, in the case of a wireless transmitter that exposes persons in its vicinity.

7.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

Table 7-1
SAR Human Exposure Specified in ANSI/IEEE C95.1-1992 and Health Canada Safety Code 6

HUMAN EXPOSURE LIMITS		
	UNCONTROLLED ENVIRONMENT <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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Power measurements were performed using a base station simulator under digital average power.

8.1 Measured and Reported SAR

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

8.2 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01 "SAR Measurement Procedures for 3G Devices" 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.

8.3 SAR Measurement Conditions for LTE

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

8.3.1 Spectrum Plots for RB Configurations

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

8.3.2 MPR

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

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8.3.3 A-MPR

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

8.3.4 Required RB Size and RB Offsets for SAR Testing

According to FCC KDB 941225 D05v02r01:

- a. Per Section 5.2.1, SAR is required for QPSK 1 RB Allocation for the largest bandwidth
 - i. The required channel and offset combination with the highest maximum output power is required for SAR.
 - ii. When the reported SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and required test channels is not required. Otherwise, SAR is required for the remaining required test channels using the RB offset configuration with highest output power for that channel.
 - iii. When the reported SAR for a required test channel is > 1.45 W/kg, SAR is required for all RB offset configurations for that channel.
- b. Per Section 5.2.2, SAR is required for 50% RB allocation using the largest bandwidth following the same procedures outlined in Section 5.2.1.
- c. Per Section 5.2.3, QPSK SAR is not required for the 100% allocation when the highest maximum output power for the 100% allocation is less than the highest maximum output power of the 1 RB and 50% RB allocations and the reported SAR for the 1 RB and 50% RB allocations is < 0.8 W/kg.
- d. Per Section 5.2.4 and 5.3, SAR tests for higher order modulations and lower bandwidths configurations are not required when the conducted power of the required test configurations determined by Sections 5.2.1 through 5.2.3 is less than or equal to $\frac{1}{2}$ 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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9 RF CONDUCTED POWERS

9.1 LTE Conducted Powers

Table 9-1
LTE Band 25 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	26140	20	QPSK	1	0	23.78	0	0
	1860	26140	20	QPSK	1	50	23.66	0	0
	1860	26140	20	QPSK	1	99	23.98	0	0
	1860	26140	20	QPSK	50	0	22.71	0-1	1
	1860	26140	20	QPSK	50	25	22.65	0-1	1
	1860	26140	20	QPSK	50	50	22.77	0-1	1
	1860	26140	20	QPSK	100	0	22.75	0-1	1
	1860	26140	20	16QAM	1	0	22.80	0-1	1
	1860	26140	20	16QAM	1	50	22.73	0-1	1
	1860	26140	20	16QAM	1	99	23.05	0-1	1
	1860	26140	20	16QAM	50	0	21.70	0-2	2
	1860	26140	20	16QAM	50	25	21.62	0-2	2
	1860	26140	20	16QAM	50	50	21.69	0-2	2
	1860	26140	20	16QAM	100	0	21.64	0-2	2
Mid	1882.5	26365	20	QPSK	1	0	24.26	0	0
	1882.5	26365	20	QPSK	1	50	24.02	0	0
	1882.5	26365	20	QPSK	1	99	23.77	0	0
	1882.5	26365	20	QPSK	50	0	22.89	0-1	1
	1882.5	26365	20	QPSK	50	25	22.62	0-1	1
	1882.5	26365	20	QPSK	50	50	22.56	0-1	1
	1882.5	26365	20	QPSK	100	0	22.67	0-1	1
	1882.5	26365	20	16QAM	1	0	23.29	0-1	1
	1882.5	26365	20	16QAM	1	50	23.09	0-1	1
	1882.5	26365	20	16QAM	1	99	22.91	0-1	1
	1882.5	26365	20	16QAM	50	0	21.86	0-2	2
	1882.5	26365	20	16QAM	50	25	21.65	0-2	2
	1882.5	26365	20	16QAM	50	50	21.57	0-2	2
	1882.5	26365	20	16QAM	100	0	21.76	0-2	2
High	1905	26590	20	QPSK	1	0	23.95	0	0
	1905	26590	20	QPSK	1	50	24.28	0	0
	1905	26590	20	QPSK	1	99	24.04	0	0
	1905	26590	20	QPSK	50	0	23.03	0-1	1
	1905	26590	20	QPSK	50	25	22.99	0-1	1
	1905	26590	20	QPSK	50	50	22.88	0-1	1
	1905	26590	20	QPSK	100	0	22.89	0-1	1
	1905	26590	20	16QAM	1	0	23.15	0-1	1
	1905	26590	20	16QAM	1	50	23.49	0-1	1
	1905	26590	20	16QAM	1	99	23.33	0-1	1
	1905	26590	20	16QAM	50	0	21.96	0-2	2
	1905	26590	20	16QAM	50	25	21.94	0-2	2
	1905	26590	20	16QAM	50	50	21.86	0-2	2
	1905	26590	20	16QAM	100	0	21.85	0-2	2

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Table 9-2
LTE Band 25 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	26115	15	QPSK	1	0	24.40	0	0
	1857.5	26115	15	QPSK	1	36	24.30	0	0
	1857.5	26115	15	QPSK	1	74	24.36	0	0
	1857.5	26115	15	QPSK	36	0	23.02	0-1	1
	1857.5	26115	15	QPSK	36	18	22.97	0-1	1
	1857.5	26115	15	QPSK	36	37	23.01	0-1	1
	1857.5	26115	15	QPSK	75	0	22.99	0-1	1
	1857.5	26115	15	16QAM	1	0	23.44	0-1	1
	1857.5	26115	15	16QAM	1	36	23.26	0-1	1
	1857.5	26115	15	16QAM	1	74	23.36	0-1	1
	1857.5	26115	15	16QAM	36	0	21.94	0-2	2
	1857.5	26115	15	16QAM	36	18	21.94	0-2	2
	1857.5	26115	15	16QAM	36	37	21.95	0-2	2
Mid	1882.5	26365	15	QPSK	1	0	24.50	0	0
	1882.5	26365	15	QPSK	1	36	24.48	0	0
	1882.5	26365	15	QPSK	1	74	24.05	0	0
	1882.5	26365	15	QPSK	36	0	23.20	0-1	1
	1882.5	26365	15	QPSK	36	18	23.05	0-1	1
	1882.5	26365	15	QPSK	36	37	23.02	0-1	1
	1882.5	26365	15	QPSK	75	0	23.03	0-1	1
	1882.5	26365	15	16QAM	1	0	23.50	0-1	1
	1882.5	26365	15	16QAM	1	36	23.42	0-1	1
	1882.5	26365	15	16QAM	1	74	23.11	0-1	1
	1882.5	26365	15	16QAM	36	0	22.22	0-2	2
	1882.5	26365	15	16QAM	36	18	22.09	0-2	2
	1882.5	26365	15	16QAM	36	37	21.95	0-2	2
	1882.5	26365	15	16QAM	75	0	22.01	0-2	2
High	1907.5	26615	15	QPSK	1	0	24.44	0	0
	1907.5	26615	15	QPSK	1	36	24.50	0	0
	1907.5	26615	15	QPSK	1	74	24.30	0	0
	1907.5	26615	15	QPSK	36	0	23.30	0-1	1
	1907.5	26615	15	QPSK	36	18	23.19	0-1	1
	1907.5	26615	15	QPSK	36	37	23.09	0-1	1
	1907.5	26615	15	QPSK	75	0	23.08	0-1	1
	1907.5	26615	15	16QAM	1	0	23.26	0-1	1
	1907.5	26615	15	16QAM	1	36	23.44	0-1	1
	1907.5	26615	15	16QAM	1	74	23.13	0-1	1
	1907.5	26615	15	16QAM	36	0	22.14	0-2	2
	1907.5	26615	15	16QAM	36	18	22.03	0-2	2
	1907.5	26615	15	16QAM	36	37	21.89	0-2	2
	1907.5	26615	15	16QAM	75	0	21.87	0-2	2

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Table 9-3
LTE Band 25 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	26090	10	QPSK	1	0	23.99	0	0
	1855	26090	10	QPSK	1	25	23.92	0	0
	1855	26090	10	QPSK	1	49	23.97	0	0
	1855	26090	10	QPSK	25	0	22.78	0-1	1
	1855	26090	10	QPSK	25	12	22.75	0-1	1
	1855	26090	10	QPSK	25	25	22.73	0-1	1
	1855	26090	10	QPSK	50	0	22.65	0-1	1
	1855	26090	10	16QAM	1	0	23.05	0-1	1
	1855	26090	10	16QAM	1	25	23.01	0-1	1
	1855	26090	10	16QAM	1	49	23.09	0-1	1
	1855	26090	10	16QAM	25	0	21.78	0-2	2
	1855	26090	10	16QAM	25	12	21.71	0-2	2
	1855	26090	10	16QAM	25	25	21.73	0-2	2
Mid	1882.5	26365	10	QPSK	1	0	24.24	0	0
	1882.5	26365	10	QPSK	1	25	24.04	0	0
	1882.5	26365	10	QPSK	1	49	23.81	0	0
	1882.5	26365	10	QPSK	25	0	22.78	0-1	1
	1882.5	26365	10	QPSK	25	12	22.72	0-1	1
	1882.5	26365	10	QPSK	25	25	22.72	0-1	1
	1882.5	26365	10	QPSK	50	0	22.55	0-1	1
	1882.5	26365	10	16QAM	1	0	23.33	0-1	1
	1882.5	26365	10	16QAM	1	25	23.14	0-1	1
	1882.5	26365	10	16QAM	1	49	22.79	0-1	1
	1882.5	26365	10	16QAM	25	0	21.78	0-2	2
	1882.5	26365	10	16QAM	25	12	21.81	0-2	2
	1882.5	26365	10	16QAM	25	25	21.67	0-2	2
	1882.5	26365	10	16QAM	50	0	21.62	0-2	2
High	1910	26640	10	QPSK	1	0	24.41	0	0
	1910	26640	10	QPSK	1	25	24.07	0	0
	1910	26640	10	QPSK	1	49	24.09	0	0
	1910	26640	10	QPSK	25	0	22.98	0-1	1
	1910	26640	10	QPSK	25	12	22.92	0-1	1
	1910	26640	10	QPSK	25	25	22.76	0-1	1
	1910	26640	10	QPSK	50	0	22.85	0-1	1
	1910	26640	10	16QAM	1	0	23.48	0-1	1
	1910	26640	10	16QAM	1	25	23.10	0-1	1
	1910	26640	10	16QAM	1	49	23.21	0-1	1
	1910	26640	10	16QAM	25	0	21.95	0-2	2
	1910	26640	10	16QAM	25	12	21.93	0-2	2
	1910	26640	10	16QAM	25	25	21.78	0-2	2
	1910	26640	10	16QAM	50	0	21.85	0-2	2

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Table 9-4
LTE Band 25 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	26065	5	QPSK	1	0	24.45	0	0
	1852.5	26065	5	QPSK	1	12	24.42	0	0
	1852.5	26065	5	QPSK	1	24	24.33	0	0
	1852.5	26065	5	QPSK	12	0	23.43	0-1	1
	1852.5	26065	5	QPSK	12	6	23.40	0-1	1
	1852.5	26065	5	QPSK	12	13	23.45	0-1	1
	1852.5	26065	5	QPSK	25	0	23.30	0-1	1
	1852.5	26065	5	16-QAM	1	0	23.38	0-1	1
	1852.5	26065	5	16-QAM	1	12	23.14	0-1	1
	1852.5	26065	5	16-QAM	1	24	23.31	0-1	1
	1852.5	26065	5	16-QAM	12	0	22.48	0-2	2
	1852.5	26065	5	16-QAM	12	6	22.45	0-2	2
	1852.5	26065	5	16-QAM	12	13	22.40	0-2	2
Mid	1882.5	26365	5	QPSK	1	0	24.38	0	0
	1882.5	26365	5	QPSK	1	12	24.32	0	0
	1882.5	26365	5	QPSK	1	24	24.28	0	0
	1882.5	26365	5	QPSK	12	0	23.35	0-1	1
	1882.5	26365	5	QPSK	12	6	23.20	0-1	1
	1882.5	26365	5	QPSK	12	13	23.12	0-1	1
	1882.5	26365	5	QPSK	25	0	23.19	0-1	1
	1882.5	26365	5	16-QAM	1	0	23.16	0-1	1
	1882.5	26365	5	16-QAM	1	12	23.09	0-1	1
	1882.5	26365	5	16-QAM	1	24	23.07	0-1	1
	1882.5	26365	5	16-QAM	12	0	22.27	0-2	2
	1882.5	26365	5	16-QAM	12	6	22.28	0-2	2
	1882.5	26365	5	16-QAM	12	13	22.09	0-2	2
High	1912.5	26665	5	QPSK	1	0	23.63	0	0
	1912.5	26665	5	QPSK	1	12	23.54	0	0
	1912.5	26665	5	QPSK	1	24	23.55	0	0
	1912.5	26665	5	QPSK	12	0	22.61	0-1	1
	1912.5	26665	5	QPSK	12	6	22.56	0-1	1
	1912.5	26665	5	QPSK	12	13	22.55	0-1	1
	1912.5	26665	5	QPSK	25	0	22.52	0-1	1
	1912.5	26665	5	16-QAM	1	0	22.85	0-1	1
	1912.5	26665	5	16-QAM	1	12	22.79	0-1	1
	1912.5	26665	5	16-QAM	1	24	22.56	0-1	1
	1912.5	26665	5	16-QAM	12	0	21.65	0-2	2
	1912.5	26665	5	16-QAM	12	6	21.58	0-2	2
	1912.5	26665	5	16-QAM	12	13	21.64	0-2	2
	1912.5	26665	5	16-QAM	25	0	21.57	0-2	2

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Table 9-5
LTE Band 25 Conducted Powers – 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1851.5	26055	3	QPSK	1	0	23.96	0	0
	1851.5	26055	3	QPSK	1	7	23.98	0	0
	1851.5	26055	3	QPSK	1	14	23.95	0	0
	1851.5	26055	3	QPSK	8	0	22.91	0-1	1
	1851.5	26055	3	QPSK	8	4	22.99	0-1	1
	1851.5	26055	3	QPSK	8	7	23.00	0-1	1
	1851.5	26055	3	QPSK	15	0	22.91	0-1	1
	1851.5	26055	3	16-QAM	1	0	23.01	0-1	1
	1851.5	26055	3	16-QAM	1	7	23.17	0-1	1
	1851.5	26055	3	16-QAM	1	14	22.96	0-1	1
	1851.5	26055	3	16-QAM	8	0	21.92	0-2	2
	1851.5	26055	3	16-QAM	8	4	21.94	0-2	2
	1851.5	26055	3	16-QAM	8	7	21.94	0-2	2
	1851.5	26055	3	16-QAM	15	0	21.86	0-2	2
Mid	1882.5	26365	3	QPSK	1	0	23.98	0	0
	1882.5	26365	3	QPSK	1	7	23.96	0	0
	1882.5	26365	3	QPSK	1	14	23.91	0	0
	1882.5	26365	3	QPSK	8	0	22.86	0-1	1
	1882.5	26365	3	QPSK	8	4	22.78	0-1	1
	1882.5	26365	3	QPSK	8	7	22.86	0-1	1
	1882.5	26365	3	QPSK	15	0	22.70	0-1	1
	1882.5	26365	3	16-QAM	1	0	22.99	0-1	1
	1882.5	26365	3	16-QAM	1	7	23.03	0-1	1
	1882.5	26365	3	16-QAM	1	14	22.94	0-1	1
	1882.5	26365	3	16-QAM	8	0	21.83	0-2	2
	1882.5	26365	3	16-QAM	8	4	21.81	0-2	2
	1882.5	26365	3	16-QAM	8	7	21.83	0-2	2
	1882.5	26365	3	16-QAM	15	0	21.80	0-2	2
High	1913.5	26675	3	QPSK	1	0	23.86	0	0
	1913.5	26675	3	QPSK	1	7	23.98	0	0
	1913.5	26675	3	QPSK	1	14	24.05	0	0
	1913.5	26675	3	QPSK	8	0	22.96	0-1	1
	1913.5	26675	3	QPSK	8	4	22.97	0-1	1
	1913.5	26675	3	QPSK	8	7	22.92	0-1	1
	1913.5	26675	3	QPSK	15	0	22.92	0-1	1
	1913.5	26675	3	16-QAM	1	0	22.85	0-1	1
	1913.5	26675	3	16-QAM	1	7	23.00	0-1	1
	1913.5	26675	3	16-QAM	1	14	23.03	0-1	1
	1913.5	26675	3	16-QAM	8	0	21.89	0-2	2
	1913.5	26675	3	16-QAM	8	4	21.93	0-2	2
	1913.5	26675	3	16-QAM	8	7	21.90	0-2	2
	1913.5	26675	3	16-QAM	15	0	21.90	0-2	2

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Table 9-6
LTE Band 25 Conducted Powers – 1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1850.7	26047	1.4	QPSK	1	0	23.92	0	0
	1850.7	26047	1.4	QPSK	1	2	23.87	0	0
	1850.7	26047	1.4	QPSK	1	5	23.89	0	0
	1850.7	26047	1.4	QPSK	3	0	23.87	0	0
	1850.7	26047	1.4	QPSK	3	2	23.90	0	0
	1850.7	26047	1.4	QPSK	3	3	23.83	0	0
	1850.7	26047	1.4	QPSK	6	0	22.92	0-1	1
	1850.7	26047	1.4	16-QAM	1	0	22.99	0-1	1
	1850.7	26047	1.4	16-QAM	1	2	22.93	0-1	1
	1850.7	26047	1.4	16-QAM	1	5	22.84	0-1	1
	1850.7	26047	1.4	16-QAM	3	0	22.93	0-1	1
	1850.7	26047	1.4	16-QAM	3	2	22.94	0-1	1
	1850.7	26047	1.4	16-QAM	3	3	22.91	0-1	1
Mid	1850.7	26047	1.4	16-QAM	6	0	21.80	0-2	2
	1882.5	26365	1.4	QPSK	1	0	23.95	0	0
	1882.5	26365	1.4	QPSK	1	2	23.87	0	0
	1882.5	26365	1.4	QPSK	1	5	23.95	0	0
	1882.5	26365	1.4	QPSK	3	0	23.91	0	0
	1882.5	26365	1.4	QPSK	3	2	23.85	0	0
	1882.5	26365	1.4	QPSK	3	3	23.96	0	0
	1882.5	26365	1.4	QPSK	6	0	22.77	0-1	1
	1882.5	26365	1.4	16-QAM	1	0	22.96	0-1	1
	1882.5	26365	1.4	16-QAM	1	2	22.90	0-1	1
	1882.5	26365	1.4	16-QAM	1	5	22.99	0-1	1
	1882.5	26365	1.4	16-QAM	3	0	22.88	0-1	1
	1882.5	26365	1.4	16-QAM	3	2	22.86	0-1	1
	1882.5	26365	1.4	16-QAM	3	3	22.91	0-1	1
High	1882.5	26365	1.4	16-QAM	6	0	21.80	0-2	2
	1914.3	26683	1.4	QPSK	1	0	23.98	0	0
	1914.3	26683	1.4	QPSK	1	2	23.98	0	0
	1914.3	26683	1.4	QPSK	1	5	23.94	0	0
	1914.3	26683	1.4	QPSK	3	0	23.90	0	0
	1914.3	26683	1.4	QPSK	3	2	23.90	0	0
	1914.3	26683	1.4	QPSK	3	3	23.95	0	0
	1914.3	26683	1.4	QPSK	6	0	22.98	0-1	1
	1914.3	26683	1.4	16-QAM	1	0	23.07	0-1	1
	1914.3	26683	1.4	16-QAM	1	2	22.99	0-1	1
	1914.3	26683	1.4	16-QAM	1	5	23.01	0-1	1
	1914.3	26683	1.4	16-QAM	3	0	23.03	0-1	1
	1914.3	26683	1.4	16-QAM	3	2	22.97	0-1	1
	1914.3	26683	1.4	16-QAM	3	3	23.02	0-1	1
	1914.3	26683	1.4	16-QAM	6	0	21.91	0-2	2

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10 LTE POWER REDUCTION

10.1 Introduction to LTE Power Reduction

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

Table 10-1
SVLTE Power Reduction Scheme

Mode	Voice Avg Power(P) 1x 850/1900 MHz (dBm)	Max. B25 LTE Data Avg Power (dBm)
SVLTE	$P \geq 18$	19
	$P < 18$	24

10.2 Output Power Verification

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

The power reduction targets and threshold level described in **Table 10-1** were confirmed. Please see results in **Table 10-2**.

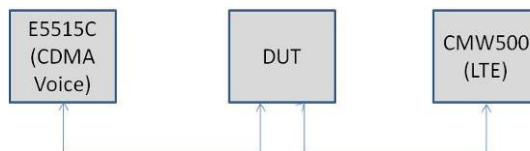


Figure 10-1
SVLTE Conducted Test Setup Diagram

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Table 10-2
SVLTE Power Reduction Verification Results

1xRTT CDMA Voice Band	BC10 1xRTT CDMA Voice Channel	BC10 1xRTT CDMA Voice Tx [dBm]	LTE Band 25 Conducted Power (dBm)													
			Mid													
			QPSK 1 RB, Low Edge	QPSK 1 RB, Mid Edge	QPSK 1 RB, Upper Edge	QPSK 50% RB, Low Edge	QPSK 50% RB, Mid Edge	QPSK 50% RB, Upper Edge	QPSK 100% RB ORB offset	16 QAM 1 RB, Low Edge	16 QAM 1 RB, Mid Edge	16 QAM 1 RB, Upper Edge	16 QAM 50% RB, Low Edge	16 QAM 50% RB, Mid Edge	16 QAM 50% RB, Upper Edge	16 QAM 100% RB ORB offset
800 MHz	564	25	19.1	19.14	19.08	19.15	19.22	19.08	19.12	19.02	19.03	18.97	19.11	19.08	19.06	19.06
		24	19.21	19.02	19.07	19.16	19.22	19.09	19.11	19.03	19.11	18.97	19.13	19.09	19.07	19.08
		23	19.19	19.15	19.07	19.16	19.18	19.09	19.12	19.1	19.04	18.98	19.14	19.08	19.06	19.07
		22	19.2	19.03	19.06	19.15	19.19	19.08	19.2	19.08	19.05	18.97	19.27	19.09	18.97	19.09
		21	19.2	19.14	19.13	19.22	19.17	19.09	19.1	19.04	19.06	18.99	19.14	19.08	19.05	19.08
		20	19.19	19.02	19.01	19.11	19.18	19.08	19.12	19.04	19.06	18.99	19.16	19.09	19.1	19.09
		19	19.18	19.03	19.02	19.19	19.18	19.1	19.13	19.05	19.07	19.98	19.03	19.09	19.07	19.1
		18	19.18	19.16	19.14	19.18	19.19	19.09	19.14	19.11	19.06	18.98	19.15	19.09	19.07	19.02
		17	24.05	24.02	23.9	22.9	22.89	22.79	22.81	23.22	23.17	23.1	22.02	22.05	21.94	21.9
		16	23.94	23.92	24.02	22.89	22.88	22.85	22.79	23.21	23.18	23.08	21.98	21.92	21.85	21.87
		15	24.05	24.01	24.02	22.88	22.87	22.83	22.88	23.21	23.17	23.07	22.13	22.01	21.9	21.88
		14	24.06	24	23.91	22.89	22.88	22.82	22.83	23.21	23.18	23.17	21.99	22.11	21.94	21.91
		13	24.05	23.99	24.02	22.88	22.89	22.85	22.85	23.2	23.17	23.16	22.02	22.01	21.86	21.86
		12	23.94	23.98	23.92	22.87	22.9	22.81	22.82	23.2	23.17	23.16	22.02	22.11	21.93	21.85
		11	24.06	23.97	23.04	22.89	22.88	22.83	22.84	23.19	23.17	23.15	22.02	22.01	21.93	21.88

1xRTT CDMA Voice Band	BC0 1xRTT CDMA Voice Channel	BC0 1xRTT CDMA Voice Tx [dBm]	LTE Band 25 Conducted Power (dBm)													
			Mid													
			QPSK 1 RB, Low Edge	QPSK 1 RB, Mid Edge	QPSK 1 RB, Upper Edge	QPSK 50% RB, Low Edge	QPSK 50% RB, Mid Edge	QPSK 50% RB, Upper Edge	QPSK 100% RB ORB offset	16 QAM 1 RB, Low Edge	16 QAM 1 RB, Mid Edge	16 QAM 1 RB, Upper Edge	16 QAM 50% RB, Low Edge	16 QAM 50% RB, Mid Edge	16 QAM 50% RB, Upper Edge	16 QAM 100% RB ORB offset
800 MHz	384	25	19.11	19.11	19.09	19.05	19.14	19.12	19.13	19.07	19.07	18.97	19.05	19.07	19.06	19.04
		24	19.23	19.12	19.08	19.15	19.21	19.1	19.14	19.01	19.07	18.96	19.16	19.09	18.97	19.01
		23	19.13	19.23	19.11	19.16	19.21	19.11	19.17	19.1	18.96	18.98	19.17	19.15	19.06	19.02
		22	19.13	19.11	19.08	19.15	19.22	19.11	19.16	19.03	19.07	18.97	19.06	19.07	19.06	19.07
		21	19.12	19.11	19.07	19.16	19.2	19.12	19.09	19.02	18.97	18.98	19.17	19.17	18.98	19.05
		20	19.21	18.99	19.12	19.17	19.19	19.13	19.1	19.03	19.08	18.98	19.16	19.19	18.97	19.03
		19	19.1	19.13	19.16	19.16	19.19	19	19.09	19.11	19.07	18.98	19.06	19.09	19.08	19.02
		18	19.08	19.12	19.08	19.17	19.18	19.11	19.11	19.1	19.08	18.98	19.06	19.07	19.09	19
		17	24.1	24	24.01	22.97	22.89	22.81	22.83	23.21	23.15	23.08	22.05	22.09	21.97	21.85
		16	23.99	23.99	23.92	22.96	22.88	22.79	22.84	23.2	23.14	23.18	22.02	21.98	21.97	21.85
		15	24.1	23.98	24.04	22.95	22.87	22.84	22.83	23.21	23.13	23.18	22.01	22.09	21.98	21.83
		14	23.99	23.84	23.93	22.94	22.86	22.81	22.84	23.2	23.13	23.08	22.02	22.09	21.96	21.85
		13	24.11	23.99	24.05	22.95	22.89	22.85	22.83	23.2	23.12	23.08	22.01	21.98	21.95	21.86
		12	24.1	23.97	24.04	22.96	22.88	22.86	22.84	23.2	23.13	23.09	21.9	21.99	21.87	21.85
		11	24.1	23.84	24.05	22.94	22.88	22.84	22.82	23.21	23.12	23.09	21.9	22.1	21.96	21.86

1xRTT CDMA Voice Band	BC1 1xRTT CDMA Voice Channel	BC1 1xRTT CDMA Voice Tx [dBm]	LTE Band 25 Conducted Power (dBm)													
			Mid													
			QPSK 1 RB, Low Edge	QPSK 1 RB, Mid Edge	QPSK 1 RB, Upper Edge	QPSK 50% RB, Low Edge	QPSK 50% RB, Mid Edge	QPSK 50% RB, Upper Edge	QPSK 100% RB ORB offset	16 QAM 1 RB, Low Edge	16 QAM 1 RB, Mid Edge	16 QAM 1 RB, Upper Edge	16 QAM 50% RB, Low Edge	16 QAM 50% RB, Mid Edge	16 QAM 50% RB, Upper Edge	16 QAM 100% RB ORB offset
1900 MHz	600	25	19.11	19.11	19.14	19.16	19.14	19.06	19.1	19.02	18.92	19.03	19.12	19.07	19.09	19.06
		24	19.22	19.05	19.01	19.17	19.15	19.07	19.11	19.03	18.93	19.11	19.22	19.18	19.1	19.08
		23	19.14	18.95	19.11	19.14	19.16	19.12	19.1	19.03	18.96	19.04	19.13	19.07	19.01	19.05
		22	19.15	19.09	19.13	19.18	19.17	19.13	19.11	19.03	18.97	19.03	19.14	19.08	19.11	18.99
		21	19.17	19.11	19.01	19.16	19.14	19.01	19.12	19.02	19.04	19.03	19.16	19.17	19.02	19.08
		20	15.13	18.96	19.11	19.14	19.15	19	19.1	19.03	19.03	19.04	19.03	19.18	19.11	19.06
		19	19.26	19.08	18.99	19.13	19.16	19.02	19.12	19.02	19.04	19.11	19.14	19.08	19.02	18.98
		18	19.17	19.11	19.12	19.22	19.14	19.05	19.08	19.03	19.04	19.07	19.15	19.09	19.03	19.06
		17	24.06	23.97	23.92	22.95	22.88	22.8	22.82	23.18	23.17	23.08	22.12	22.01	21.95	21.83
		16	23.97	23.85	24.06	22.96	22.86	22.79	22.81	23.18	22.78	23.07	22.02	22.1	21.86	21.84
		15	24.03	23.97	24.06	22.96	22.94	22.78	22.8	23.25	23.17	23.09	21.97	21.99	21.95	21.82
		14	23.96	23.98	24.04	22.95	22.96	22.8	22.81	23.17	23.17	23.16	22.03	22	21.94	21.84
		13	23.86	23.98	24.14	22.94	22.94	22.81	22.81	23.18	23.14	22.8	21.98	22.03	21.95	21.85
		12	23.97	23.98	23.86	22.95	22.92	22.82	22.82	23.23	23.16	23.14	22.02	21.98	21.86	21.86
		11	24.13	23.84	24.05	22.94	22.93	22.79	22.83	23.17	23.16	23.14	21.98	22.09	21.94	21.88

Note:

The low and high channels were additionally confirmed to operate according to the SVLTE Power Reduction scheme.

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10.3 SVLTE SAR Testing Procedures

Per KDB 941225 D05v02 Section 4.4 B), SAR testing was additionally performed at the reduced LTE power levels with respect to the simultaneous transmission scenarios. Additional samples were tuned to fixed reduced power levels to represent the SVLTE condition in a standalone environment. While the power reduction mechanism is activated at the CDMA Voice power level of 18 dBm, simultaneous SAR summations of maximum power LTE were evaluated at this reduced fixed CDMA voice power level. SAR was additionally evaluated at reduced power LTE levels to perform simultaneous SAR analysis when CDMA voice is at maximum power.

10.3.1 Reduced LTE Band 25 Conducted Powers

Table 10-3
Reduced LTE Band 25 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	26140	20	QPSK	1	0	18.89	0	0
	1860	26140	20	QPSK	1	50	19.11	0	0
	1860	26140	20	QPSK	1	99	19.45	0	0
	1860	26140	20	QPSK	50	0	18.90	0-1	0
	1860	26140	20	QPSK	50	25	19.05	0-1	0
	1860	26140	20	QPSK	50	50	19.04	0-1	0
	1860	26140	20	QPSK	100	0	19.21	0-1	0
	1860	26140	20	16QAM	1	0	18.76	0-1	0
	1860	26140	20	16QAM	1	50	19.05	0-1	0
	1860	26140	20	16QAM	1	99	19.36	0-1	0
	1860	26140	20	16QAM	50	0	18.85	0-2	0
	1860	26140	20	16QAM	50	25	19.04	0-2	0
Mid	1860	26140	20	16QAM	50	50	19.28	0-2	0
	1860	26140	20	16QAM	100	0	19.12	0-2	0
	1882.5	26365	20	QPSK	1	0	19.49	0	0
	1882.5	26365	20	QPSK	1	50	18.82	0	0
	1882.5	26365	20	QPSK	1	99	19.10	0	0
	1882.5	26365	20	QPSK	50	0	19.21	0-1	0
	1882.5	26365	20	QPSK	50	25	18.81	0-1	0
	1882.5	26365	20	QPSK	50	50	18.92	0-1	0
	1882.5	26365	20	QPSK	100	0	19.01	0-1	0
	1882.5	26365	20	16QAM	1	0	19.49	0-1	0
	1882.5	26365	20	16QAM	1	50	18.89	0-1	0
	1882.5	26365	20	16QAM	1	99	19.13	0-1	0
High	1882.5	26365	20	16QAM	50	0	19.17	0-2	0
	1882.5	26365	20	16QAM	50	25	18.74	0-2	0
	1882.5	26365	20	16QAM	50	50	18.94	0-2	0
	1882.5	26365	20	16QAM	100	0	18.98	0-2	0
	1905	26590	20	QPSK	1	0	19.18	0	0
	1905	26590	20	QPSK	1	50	19.50	0	0
	1905	26590	20	QPSK	1	99	18.98	0	0
	1905	26590	20	QPSK	50	0	19.29	0-1	0
	1905	26590	20	QPSK	50	25	19.24	0-1	0
	1905	26590	20	QPSK	50	50	19.12	0-1	0
	1905	26590	20	QPSK	100	0	19.16	0-1	0
	1905	26590	20	16QAM	1	0	19.34	0-1	0
	1905	26590	20	16QAM	1	50	19.50	0-1	0
	1905	26590	20	16QAM	1	99	19.15	0-1	0
	1905	26590	20	16QAM	50	0	19.14	0-2	0
	1905	26590	20	16QAM	50	25	19.22	0-2	0
	1905	26590	20	16QAM	50	50	19.04	0-2	0
	1905	26590	20	16QAM	100	0	19.09	0-2	0

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Table 10-4
Reduced LTE Band 25 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	26115	15	QPSK	1	0	19.04	0	0
	1857.5	26115	15	QPSK	1	36	19.13	0	0
	1857.5	26115	15	QPSK	1	74	19.41	0	0
	1857.5	26115	15	QPSK	36	0	18.86	0-1	0
	1857.5	26115	15	QPSK	36	18	19.01	0-1	0
	1857.5	26115	15	QPSK	36	37	19.07	0-1	0
	1857.5	26115	15	QPSK	75	0	18.99	0-1	0
	1857.5	26115	15	16QAM	1	0	19.08	0-1	0
	1857.5	26115	15	16QAM	1	36	19.16	0-1	0
	1857.5	26115	15	16QAM	1	74	19.49	0-1	0
	1857.5	26115	15	16QAM	36	0	18.82	0-2	0
	1857.5	26115	15	16QAM	36	18	18.95	0-2	0
	1857.5	26115	15	16QAM	36	37	19.08	0-2	0
Mid	1857.5	26115	15	16QAM	75	0	18.90	0-2	0
	1882.5	26365	15	QPSK	1	0	19.50	0	0
	1882.5	26365	15	QPSK	1	36	19.10	0	0
	1882.5	26365	15	QPSK	1	74	19.30	0	0
	1882.5	26365	15	QPSK	36	0	19.17	0-1	0
	1882.5	26365	15	QPSK	36	18	18.88	0-1	0
	1882.5	26365	15	QPSK	36	37	18.90	0-1	0
	1882.5	26365	15	QPSK	75	0	19.08	0-1	0
	1882.5	26365	15	16QAM	1	0	19.49	0-1	0
	1882.5	26365	15	16QAM	1	36	19.14	0-1	0
	1882.5	26365	15	16QAM	1	74	19.35	0-1	0
	1882.5	26365	15	16QAM	36	0	19.10	0-2	0
	1882.5	26365	15	16QAM	36	18	18.76	0-2	0
	1882.5	26365	15	16QAM	36	37	18.85	0-2	0
High	1882.5	26365	15	16QAM	75	0	19.00	0-2	0
	1907.5	26615	15	QPSK	1	0	19.29	0	0
	1907.5	26615	15	QPSK	1	36	19.27	0	0
	1907.5	26615	15	QPSK	1	74	18.83	0	0
	1907.5	26615	15	QPSK	36	0	19.27	0-1	0
	1907.5	26615	15	QPSK	36	18	19.17	0-1	0
	1907.5	26615	15	QPSK	36	37	18.80	0-1	0
	1907.5	26615	15	QPSK	75	0	19.07	0-1	0
	1907.5	26615	15	16QAM	1	0	19.35	0-1	0
	1907.5	26615	15	16QAM	1	36	19.33	0-1	0
	1907.5	26615	15	16QAM	1	74	18.89	0-1	0
	1907.5	26615	15	16QAM	36	0	19.23	0-2	0
	1907.5	26615	15	16QAM	36	18	19.09	0-2	0
	1907.5	26615	15	16QAM	36	37	18.77	0-2	0
	1907.5	26615	15	16QAM	75	0	19.03	0-2	0

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Table 10-5
Reduced LTE Band 25 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	26090	10	QPSK	1	0	18.95	0	0
	1855	26090	10	QPSK	1	25	18.97	0	0
	1855	26090	10	QPSK	1	49	19.16	0	0
	1855	26090	10	QPSK	25	0	18.71	0-1	0
	1855	26090	10	QPSK	25	12	18.77	0-1	0
	1855	26090	10	QPSK	25	25	18.93	0-1	0
	1855	26090	10	QPSK	50	0	18.78	0-1	0
	1855	26090	10	16QAM	1	0	18.98	0-1	0
	1855	26090	10	16QAM	1	25	19.02	0-1	0
	1855	26090	10	16QAM	1	49	19.10	0-1	0
	1855	26090	10	16QAM	25	0	18.70	0-2	0
	1855	26090	10	16QAM	25	12	18.76	0-2	0
	1855	26090	10	16QAM	25	25	18.88	0-2	0
Mid	1855	26090	10	16QAM	50	0	18.78	0-2	0
	1882.5	26365	10	QPSK	1	0	19.32	0	0
	1882.5	26365	10	QPSK	1	25	18.82	0	0
	1882.5	26365	10	QPSK	1	49	18.97	0	0
	1882.5	26365	10	QPSK	25	0	18.82	0-1	0
	1882.5	26365	10	QPSK	25	12	18.74	0-1	0
	1882.5	26365	10	QPSK	25	25	18.64	0-1	0
	1882.5	26365	10	QPSK	50	0	18.61	0-1	0
	1882.5	26365	10	16QAM	1	0	19.33	0-1	0
	1882.5	26365	10	16QAM	1	25	18.89	0-1	0
	1882.5	26365	10	16QAM	1	49	19.02	0-1	0
	1882.5	26365	10	16QAM	25	0	18.82	0-2	0
	1882.5	26365	10	16QAM	25	12	18.73	0-2	0
	1882.5	26365	10	16QAM	25	25	18.66	0-2	0
High	1882.5	26365	10	16QAM	50	0	18.61	0-2	0
	1910	26640	10	QPSK	1	0	19.46	0	0
	1910	26640	10	QPSK	1	25	18.95	0	0
	1910	26640	10	QPSK	1	49	18.97	0	0
	1910	26640	10	QPSK	25	0	19.15	0-1	0
	1910	26640	10	QPSK	25	12	18.82	0-1	0
	1910	26640	10	QPSK	25	25	18.78	0-1	0
	1910	26640	10	QPSK	50	0	18.88	0-1	0
	1910	26640	10	16QAM	1	0	19.45	0-1	0
	1910	26640	10	16QAM	1	25	18.95	0-1	0
	1910	26640	10	16QAM	1	49	18.92	0-1	0
	1910	26640	10	16QAM	25	0	19.08	0-2	0
	1910	26640	10	16QAM	25	12	18.80	0-2	0
	1910	26640	10	16QAM	25	25	18.72	0-2	0
	1910	26640	10	16QAM	50	0	18.85	0-2	0

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Table 10-6
Reduced LTE Band 25 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	26065	5	QPSK	1	0	19.23	0	0
	1852.5	26065	5	QPSK	1	12	19.26	0	0
	1852.5	26065	5	QPSK	1	24	19.24	0	0
	1852.5	26065	5	QPSK	12	0	19.16	0-1	0
	1852.5	26065	5	QPSK	12	6	19.27	0-1	0
	1852.5	26065	5	QPSK	12	13	19.18	0-1	0
	1852.5	26065	5	QPSK	25	0	19.00	0-1	0
	1852.5	26065	5	16-QAM	1	0	19.22	0-1	0
	1852.5	26065	5	16-QAM	1	12	19.29	0-1	0
	1852.5	26065	5	16-QAM	1	24	19.21	0-1	0
	1852.5	26065	5	16-QAM	12	0	19.17	0-2	0
	1852.5	26065	5	16-QAM	12	6	19.24	0-2	0
	1852.5	26065	5	16-QAM	12	13	19.14	0-2	0
	1852.5	26065	5	16-QAM	25	0	19.03	0-2	0
Mid	1882.5	26365	5	QPSK	1	0	19.34	0	0
	1882.5	26365	5	QPSK	1	12	19.31	0	0
	1882.5	26365	5	QPSK	1	24	19.21	0	0
	1882.5	26365	5	QPSK	12	0	19.39	0-1	0
	1882.5	26365	5	QPSK	12	6	19.35	0-1	0
	1882.5	26365	5	QPSK	12	13	19.20	0-1	0
	1882.5	26365	5	QPSK	25	0	19.24	0-1	0
	1882.5	26365	5	16-QAM	1	0	19.27	0-1	0
	1882.5	26365	5	16-QAM	1	12	19.34	0-1	0
	1882.5	26365	5	16-QAM	1	24	19.24	0-1	0
	1882.5	26365	5	16-QAM	12	0	19.40	0-2	0
	1882.5	26365	5	16-QAM	12	6	19.32	0-2	0
	1882.5	26365	5	16-QAM	12	13	19.21	0-2	0
	1882.5	26365	5	16-QAM	25	0	19.19	0-2	0
High	1912.5	26665	5	QPSK	1	0	18.64	0	0
	1912.5	26665	5	QPSK	1	12	18.51	0	0
	1912.5	26665	5	QPSK	1	24	18.62	0	0
	1912.5	26665	5	QPSK	12	0	18.59	0-1	0
	1912.5	26665	5	QPSK	12	6	18.50	0-1	0
	1912.5	26665	5	QPSK	12	13	18.57	0-1	0
	1912.5	26665	5	QPSK	25	0	18.54	0-1	0
	1912.5	26665	5	16-QAM	1	0	18.60	0-1	0
	1912.5	26665	5	16-QAM	1	12	18.54	0-1	0
	1912.5	26665	5	16-QAM	1	24	18.61	0-1	0
	1912.5	26665	5	16-QAM	12	0	18.55	0-2	0
	1912.5	26665	5	16-QAM	12	6	18.52	0-2	0
	1912.5	26665	5	16-QAM	12	13	18.54	0-2	0
	1912.5	26665	5	16-QAM	25	0	18.64	0-2	0

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Table 10-7
Reduced LTE Band 25 Conducted Powers – 3 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1851.5	26055	3	QPSK	1	0	18.94	0	0
	1851.5	26055	3	QPSK	1	7	18.89	0	0
	1851.5	26055	3	QPSK	1	14	18.97	0	0
	1851.5	26055	3	QPSK	8	0	18.88	0-1	0
	1851.5	26055	3	QPSK	8	4	18.88	0-1	0
	1851.5	26055	3	QPSK	8	7	18.85	0-1	0
	1851.5	26055	3	QPSK	15	0	18.78	0-1	0
	1851.5	26055	3	16-QAM	1	0	18.93	0-1	0
	1851.5	26055	3	16-QAM	1	7	18.95	0-1	0
	1851.5	26055	3	16-QAM	1	14	18.93	0-1	0
	1851.5	26055	3	16-QAM	8	0	18.85	0-2	0
	1851.5	26055	3	16-QAM	8	4	18.82	0-2	0
	1851.5	26055	3	16-QAM	8	7	18.77	0-2	0
	1851.5	26055	3	16-QAM	15	0	18.79	0-2	0
Mid	1882.5	26365	3	QPSK	1	0	18.87	0	0
	1882.5	26365	3	QPSK	1	7	18.84	0	0
	1882.5	26365	3	QPSK	1	14	18.77	0	0
	1882.5	26365	3	QPSK	8	0	18.86	0-1	0
	1882.5	26365	3	QPSK	8	4	18.73	0-1	0
	1882.5	26365	3	QPSK	8	7	18.69	0-1	0
	1882.5	26365	3	QPSK	15	0	18.72	0-1	0
	1882.5	26365	3	16-QAM	1	0	18.93	0-1	0
	1882.5	26365	3	16-QAM	1	7	18.85	0-1	0
	1882.5	26365	3	16-QAM	1	14	18.69	0-1	0
	1882.5	26365	3	16-QAM	8	0	18.85	0-2	0
	1882.5	26365	3	16-QAM	8	4	18.72	0-2	0
	1882.5	26365	3	16-QAM	8	7	18.68	0-2	0
	1882.5	26365	3	16-QAM	15	0	18.71	0-2	0
High	1913.5	26675	3	QPSK	1	0	18.88	0	0
	1913.5	26675	3	QPSK	1	7	18.84	0	0
	1913.5	26675	3	QPSK	1	14	18.88	0	0
	1913.5	26675	3	QPSK	8	0	18.80	0-1	0
	1913.5	26675	3	QPSK	8	4	18.85	0-1	0
	1913.5	26675	3	QPSK	8	7	18.78	0-1	0
	1913.5	26675	3	QPSK	15	0	18.79	0-1	0
	1913.5	26675	3	16-QAM	1	0	18.84	0-1	0
	1913.5	26675	3	16-QAM	1	7	18.94	0-1	0
	1913.5	26675	3	16-QAM	1	14	18.88	0-1	0
	1913.5	26675	3	16-QAM	8	0	18.72	0-2	0
	1913.5	26675	3	16-QAM	8	4	18.76	0-2	0
	1913.5	26675	3	16-QAM	8	7	18.72	0-2	0
	1913.5	26675	3	16-QAM	15	0	18.76	0-2	0

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Table 10-8
Reduced LTE Band 25 Conducted Powers – 1.4 MHz Bandwidth

	Frequency [MHz]	Channel	Bandwidth [MHz]	Modulation	RB Size	RB Offset	Conducted Power [dBm]	MPR Allowed per 3GPP [dB]	MPR [dB]
Low	1850.7	26047	1.4	QPSK	1	0	18.89	0	0
	1850.7	26047	1.4	QPSK	1	2	18.93	0	0
	1850.7	26047	1.4	QPSK	1	5	18.85	0	0
	1850.7	26047	1.4	QPSK	3	0	18.91	0	0
	1850.7	26047	1.4	QPSK	3	2	18.96	0	0
	1850.7	26047	1.4	QPSK	3	3	18.92	0	0
	1850.7	26047	1.4	QPSK	6	0	18.89	0-1	0
	1850.7	26047	1.4	16-QAM	1	0	18.96	0-1	0
	1850.7	26047	1.4	16-QAM	1	2	18.94	0-1	0
	1850.7	26047	1.4	16-QAM	1	5	18.90	0-1	0
	1850.7	26047	1.4	16-QAM	3	0	18.86	0-1	0
	1850.7	26047	1.4	16-QAM	3	2	18.92	0-1	0
	1850.7	26047	1.4	16-QAM	3	3	18.93	0-1	0
	1850.7	26047	1.4	16-QAM	6	0	18.83	0-2	0
Mid	1882.5	26365	1.4	QPSK	1	0	18.92	0	0
	1882.5	26365	1.4	QPSK	1	2	18.94	0	0
	1882.5	26365	1.4	QPSK	1	5	18.78	0	0
	1882.5	26365	1.4	QPSK	3	0	18.92	0	0
	1882.5	26365	1.4	QPSK	3	2	18.86	0	0
	1882.5	26365	1.4	QPSK	3	3	18.85	0	0
	1882.5	26365	1.4	QPSK	6	0	18.76	0-1	0
	1882.5	26365	1.4	16-QAM	1	0	18.94	0-1	0
	1882.5	26365	1.4	16-QAM	1	2	19.01	0-1	0
	1882.5	26365	1.4	16-QAM	1	5	18.84	0-1	0
	1882.5	26365	1.4	16-QAM	3	0	18.89	0-1	0
	1882.5	26365	1.4	16-QAM	3	2	18.83	0-1	0
	1882.5	26365	1.4	16-QAM	3	3	18.80	0-1	0
	1882.5	26365	1.4	16-QAM	6	0	18.71	0-2	0
High	1914.3	26683	1.4	QPSK	1	0	18.84	0	0
	1914.3	26683	1.4	QPSK	1	2	18.94	0	0
	1914.3	26683	1.4	QPSK	1	5	18.90	0	0
	1914.3	26683	1.4	QPSK	3	0	18.90	0	0
	1914.3	26683	1.4	QPSK	3	2	18.93	0	0
	1914.3	26683	1.4	QPSK	3	3	18.89	0	0
	1914.3	26683	1.4	QPSK	6	0	18.87	0-1	0
	1914.3	26683	1.4	16-QAM	1	0	18.86	0-1	0
	1914.3	26683	1.4	16-QAM	1	2	18.89	0-1	0
	1914.3	26683	1.4	16-QAM	1	5	18.85	0-1	0
	1914.3	26683	1.4	16-QAM	3	0	18.82	0-1	0
	1914.3	26683	1.4	16-QAM	3	2	18.89	0-1	0
	1914.3	26683	1.4	16-QAM	3	3	18.87	0-1	0
	1914.3	26683	1.4	16-QAM	6	0	18.80	0-2	0

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11 SYSTEM VERIFICATION

11.1 Tissue Verification

Table 11-1
Measured Tissue Properties

Calibrated for Tests Performed on:	Tissue Type	Tissue Temp During Calibration (C°)	Measured Frequency (MHz)	Measured Conductivity, σ (S/m)	Measured Dielectric Constant, ϵ	TARGET Conductivity, σ (S/m)	TARGET Dielectric Constant, ϵ	% dev σ	% dev ϵ
05/27/2014	1900H	23.4	1850	1.368	39.876	1.400	40.000	-2.29%	-0.31%
			1880	1.400	39.752	1.400	40.000	0.00%	-0.62%
			1910	1.429	39.628	1.400	40.000	2.07%	-0.93%
05/26/2014	1900B	22.0	1850	1.494	52.007	1.520	53.300	-1.71%	-2.43%
			1880	1.529	51.874	1.520	53.300	0.59%	-2.68%
			1910	1.565	51.760	1.520	53.300	2.96%	-2.89%

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

11.2 Test System Verification

Prior to SAR assessment, the system is verified to $\pm 10\%$ 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 11-2
System Verification Results

System Verification TARGET & MEASURED											
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 (%)
1900	HEAD	05/27/2014	24.1	23.4	0.100	5d149	3022	3.870	40.400	38.700	-4.21%
1900	BODY	05/26/2014	24.0	22.2	0.100	5d149	3258	4.040	40.500	40.400	-0.25%

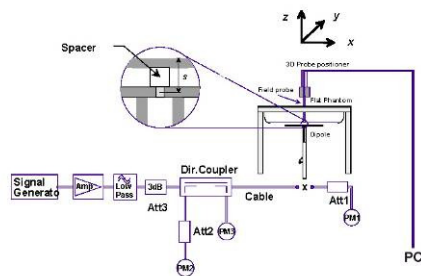


Figure 11-1
System Verification Setup Diagram



Figure 11-2
System Verification Setup Photo

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12 SAR DATA SUMMARY

12.1 Standalone Head SAR Data

Table 12-1
LTE Band 25 Head SAR Data

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Bandwidth [MHz]	Battery Cover	Maximum Allowed Power [dBm]	Conducted Power [dBm]	Power Drift [dB]	MPR [dB]	Side	Test Position	Modulation	RB Size	RB Offset	Device Serial Number	Duty Cycle	SAR (1g)	Scaling Factor	Scaled SAR (1g)	Plot #	
MHz	Ch.															(W/kg)		(W/kg)		
1905.00	26590	High	LTE Band 25	20	Standard	24.5	24.28	-0.04	0	Right	Cheek	QPSK	1	50	3272A	1:1	0.562	1.052	0.591	A1
1905.00	26590	High	LTE Band 25	20	Wireless Charging	24.5	24.28	0.03	0	Right	Cheek	QPSK	1	50	3272A	1:1	0.445	1.052	0.468	
1905.00	26590	High	LTE Band 25	20	Standard	23.5	23.03	-0.03	1	Right	Cheek	QPSK	50	0	3272A	1:1	0.378	1.114	0.421	
1905.00	26590	High	LTE Band 25	20	Standard	24.5	24.28	0.10	0	Right	Tilt	QPSK	1	50	3272A	1:1	0.252	1.052	0.265	
1905.00	26590	High	LTE Band 25	20	Standard	23.5	23.03	0.00	1	Right	Tilt	QPSK	50	0	3272A	1:1	0.177	1.114	0.197	
1905.00	26590	High	LTE Band 25	20	Standard	24.5	24.28	0.12	0	Left	Cheek	QPSK	1	50	3272A	1:1	0.291	1.052	0.306	
1905.00	26590	High	LTE Band 25	20	Standard	23.5	23.03	-0.04	1	Left	Cheek	QPSK	50	0	3272A	1:1	0.190	1.114	0.212	
1905.00	26590	High	LTE Band 25	20	Standard	24.5	24.28	0.03	0	Left	Tilt	QPSK	1	50	3272A	1:1	0.280	1.052	0.295	
1905.00	26590	High	LTE Band 25	20	Standard	23.5	23.03	-0.04	1	Left	Tilt	QPSK	50	0	3272A	1:1	0.193	1.114	0.215	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.50	0.05	0	Right	Cheek	QPSK	1	50	32745	1:1	0.151	1.000	0.151	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.29	0.00	0	Right	Cheek	QPSK	50	0	32745	1:1	0.139	1.050	0.146	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.50	0.04	0	Right	Tilt	QPSK	1	50	32745	1:1	0.070	1.000	0.070	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.29	-0.02	0	Right	Tilt	QPSK	50	0	32745	1:1	0.063	1.050	0.066	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.50	0.04	0	Left	Cheek	QPSK	1	50	32745	1:1	0.080	1.000	0.080	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.29	0.04	0	Left	Cheek	QPSK	50	0	32745	1:1	0.065	1.050	0.069	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.50	0.02	0	Left	Tilt	QPSK	1	50	32745	1:1	0.086	1.000	0.086	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.29	0.11	0	Left	Tilt	QPSK	50	0	32745	1:1	0.075	1.050	0.078	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT										Head										
Spatial Peak										1.6 W/kg (mW/g)										
Uncontrolled Exposure/General Population										averaged over 1 grams										

12.2 Standalone Body-Worn SAR Data

Table 12-2
LTE Band 25 Body-Worn SAR Data

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Bandwidth [MHz]	Battery Cover	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)		
1905.00	26590	High	LTE Band 25	20	Standard	24.5	24.28	-0.06	0	3272A	QPSK	1	50	10 mm	back	1:1	0.503	1.052	0.529	A2
1905.00	26590	High	LTE Band 25	20	Wireless Charging	24.5	24.28	-0.02	0	3272A	QPSK	1	50	10 mm	back	1:1	0.417	1.052	0.439	
1905.00	26590	High	LTE Band 25	20	Standard	23.5	23.03	0.04	1	3272A	QPSK	50	0	10 mm	back	1:1	0.374	1.114	0.417	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.50	-0.08	0	32745	QPSK	1	50	10 mm	back	1:1	0.173	1.000	0.173	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.29	0.05	0	32745	QPSK	50	0	10 mm	back	1:1	0.168	1.050	0.176	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population										Body 1.6 W/kg (mW/g) averaged over 1 grams										

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12.3 Standalone Wireless Router SAR Data

Table 12-3
LTE Band 25 Hotspot SAR Data

MEASUREMENT RESULTS																				
FREQUENCY		Mode	Bandwidth [MHz]	Battery Cover	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)		
1905.00	26590	High	LTE Band 25	20	Standard	24.5	24.28	-0.06	0	3272A	QPSK	1	50	10 mm	back	1:1	0.503	1.052	0.529	A2
1905.00	26590	High	LTE Band 25	20	Wireless Charging	24.5	24.28	-0.02	0	3272A	QPSK	1	50	10 mm	back	1:1	0.417	1.052	0.439	
1905.00	26590	High	LTE Band 25	20	Standard	23.5	23.03	0.04	1	3272A	QPSK	50	0	10 mm	back	1:1	0.374	1.114	0.417	
1905.00	26590	High	LTE Band 25	20	Standard	24.5	24.28	0.02	0	3272A	QPSK	1	50	10 mm	front	1:1	0.484	1.052	0.509	
1905.00	26590	High	LTE Band 25	20	Standard	23.5	23.03	0.05	1	3272A	QPSK	50	0	10 mm	front	1:1	0.385	1.114	0.429	
1905.00	26590	High	LTE Band 25	20	Standard	24.5	24.28	0.00	0	3272A	QPSK	1	50	10 mm	bottom	1:1	0.300	1.052	0.316	
1905.00	26590	High	LTE Band 25	20	Standard	23.5	23.03	-0.03	1	3272A	QPSK	50	0	10 mm	bottom	1:1	0.266	1.114	0.296	
1905.00	26590	High	LTE Band 25	20	Standard	24.5	24.28	-0.02	0	3272A	QPSK	1	50	10 mm	right	1:1	0.366	1.052	0.385	
1905.00	26590	High	LTE Band 25	20	Standard	23.5	23.03	0.11	1	3272A	QPSK	50	0	10 mm	right	1:1	0.288	1.114	0.321	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.50	-0.08	0	32745	QPSK	1	50	10 mm	back	1:1	0.173	1.000	0.173	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.29	0.05	0	32745	QPSK	50	0	10 mm	back	1:1	0.168	1.050	0.176	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.50	-0.06	0	32745	QPSK	1	50	10 mm	front	1:1	0.152	1.000	0.152	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.29	0.02	0	32745	QPSK	50	0	10 mm	front	1:1	0.143	1.050	0.150	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.50	-0.05	0	32745	QPSK	1	50	10 mm	bottom	1:1	0.132	1.000	0.132	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.29	0.03	0	32745	QPSK	50	0	10 mm	bottom	1:1	0.127	1.050	0.133	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.50	-0.15	0	32745	QPSK	1	50	10 mm	right	1:1	0.115	1.000	0.115	
1905.00	26590	High	LTE Band 25	20	Standard	19.5	19.29	0.01	0	32745	QPSK	50	0	10 mm	right	1:1	0.107	1.050	0.112	
ANSI / IEEE C95.1 1992 - SAFETY LIMIT									Body											
Spatial Peak									1.6 W/kg (mW/g)											
Uncontrolled Exposure/General Population									averaged over 1 gram											

12.4 SAR Test Notes

General Notes:

- The test data reported are the worst-case SAR values according to test procedures specified in IEEE 1528-2003, and FCC KDB Publication 447498 D01v05.
- Batteries are fully charged at the beginning of the SAR measurements. A specialized battery with NFC operations was used for all SAR measurements.
- Liquid tissue depth was at least 15.0 cm for all frequencies.
- 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.
- SAR results were scaled to the maximum allowed power to demonstrate compliance per FCC KDB Publication 447498 D01v05.
- Device was tested using a fixed spacing for body-worn accessory testing. A separation distance of 10 mm was considered because the manufacturer has determined that there will be body-worn accessories available in the marketplace for users to support this separation distance.
- Per FCC KDB Publication 648474 D04v01, body-worn SAR was evaluated without a headset connected to the device. Since the standalone reported SAR was ≤ 1.2 W/kg, no additional SAR evaluations using a headset cable were required.
- Per FCC KDB 865664 D01 v01, variability SAR test was not performed since the measured SAR results for all frequency bands were less than 0.8 W/kg. Please see Section 14 for more information.
- During SAR Testing for the Wireless Router conditions per FCC KDB Publication 941225 D06v01, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.7 for more details).
- This DUT may be used with a wireless charging cover. Per FCC KDB Publication 648474 D04, SAR was measured using the standard battery cover and then repeated with the wireless charging cover for the highest reported SAR for each wireless technology, frequency band, operating mode, and exposure condition. No other additional testing with the wireless charging battery cover was required since all reported SAR was less than 1.2 W/kg.

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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 8.4.4.
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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13 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

13.1 Introduction

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

13.2 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 a physical test configuration is ≤ 1.6 W/kg.

Note: Please see RF Exposure Technical Reports S/N: 0Y1303040414-R2.A3L and 0Y1308281697.A3L with simultaneous SAR assessments for the other combinations not referred to in these tables. This report only contains the combinations applicable to the permissive change.

13.3 Head SAR Simultaneous Transmission Analysis

Table 13-1
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)

Simult Tx	Configuration	LTE Band 25 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.591	0.172	0.763
	Right Tilt	0.265	0.142	0.407
	Left Cheek	0.306	0.479	0.785
	Left Tilt	0.295	0.196	0.491

Table 13-2
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)

Simult Tx	Configuration	LTE Band 25 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.591	0.049	0.640
	Right Tilt	0.265	0.048	0.313
	Left Cheek	0.306	0.247	0.553
	Left Tilt	0.295	0.111	0.406

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

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13.4 Body-Worn Simultaneous Transmission Analysis

Table 13-3
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 1.0 cm)

Configuration	LTE B25 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	0.529	0.372	0.901

Table 13-4
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 1.0 cm)

Configuration	LTE B25 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	0.529	0.311	0.840

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

Table 13-5
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 1.0 cm)

Configuration	LTE B25 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)
Back Side	0.529	0.167	0.696

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.

13.5 Hotspot SAR Simultaneous Transmission Analysis

Per FCC KDB Publication 941225 D06v01, the devices edges with antennas more than 2.5 cm from edge are not required to be evaluated for SAR ("–").

Table 13-6
Simultaneous Transmission Scenario (2.4 GHz Hotspot at 1.0 cm)

Simult Tx	Configuration	LTE Band 25 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.529	0.372	0.901
	Front	0.509	0.095	0.604
	Top	–	0.073	0.073
	Bottom	0.316	–	0.316
	Right	0.385	0.210	0.595
	Left	–	–	0.000

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Table 13-7
Simultaneous Transmission Scenario (5 GHz Hotspot at 1.0 cm)

Simult Tx	Configuration	LTE Band 25 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.529	0.134	0.663
	Front	0.509	0.038	0.547
	Top	-	0.043	0.043
	Bottom	0.316	-	0.316
	Right	0.385	0.222	0.607
	Left	-	-	0.000

13.6 SVLTE Simultaneous Transmission Analysis

Table 13-8
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Held to Ear)

Simult Tx	CDMA Power Level (dBm)	Configuration	Cell. CDMA - FCC Rule Part 22H SAR (W/kg)	LTE Band 25 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
			1	2	3	1+2	1+2+3
			Target Power (dBm)	19	15.5		
Head SAR	P ≥ 18	Right Cheek	0.255	0.151	0.172	0.406	0.578
		Right Tilt	0.134	0.070	0.142	0.204	0.346
		Left Cheek	0.249	0.080	0.479	0.329	0.808
		Left Tilt	0.150	0.086	0.196	0.236	0.432
		Target Power (dBm)	18	24	15.5		
	P < 18	Right Cheek	0.032	0.591	0.172	0.623	0.795
		Right Tilt	0.017	0.265	0.142	0.282	0.424
		Left Cheek	0.032	0.306	0.479	0.338	0.817
		Left Tilt	0.018	0.295	0.196	0.313	0.509
		Target Power (dBm)	18	24	15.5		
Simult Tx	CDMA Power Level (dBm)	Configuration	Cell. CDMA - FCC Rule Part 90S SAR (W/kg)	LTE Band 25 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
			1	2	3	1+2	1+2+3
			Target Power (dBm)	19	15.5		
Head SAR	P ≥ 18	Right Cheek	0.185	0.151	0.172	0.336	0.508
		Right Tilt	0.139	0.070	0.142	0.209	0.351
		Left Cheek	0.215	0.080	0.479	0.295	0.774
		Left Tilt	0.150	0.086	0.196	0.236	0.432
		Target Power (dBm)	18	24	15.5		
	P < 18	Right Cheek	0.024	0.591	0.172	0.615	0.787
		Right Tilt	0.015	0.265	0.142	0.280	0.422
		Left Cheek	0.026	0.306	0.479	0.332	0.811
		Left Tilt	0.017	0.295	0.196	0.312	0.508
		Target Power (dBm)	18	24	15.5		
Simult Tx	CDMA Power Level (dBm)	Configuration	PCS CDMA - FCC Rule Part 24E SAR (W/kg)	LTE Band 25 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
			1	2	3	1+2	1+2+3
			Target Power (dBm)	19	15.5		
Head SAR	P ≥ 18	Right Cheek	0.155	0.151	0.172	0.306	0.478
		Right Tilt	0.115	0.070	0.142	0.185	0.327
		Left Cheek	0.401	0.080	0.479	0.481	0.960
		Left Tilt	0.099	0.086	0.196	0.185	0.381
		Target Power (dBm)	18	24	15.5		
	P < 18	Right Cheek	0.026	0.591	0.172	0.617	0.789
		Right Tilt	0.020	0.265	0.142	0.285	0.427
		Left Cheek	0.052	0.306	0.479	0.358	0.837
		Left Tilt	0.010	0.295	0.196	0.305	0.501
		Target Power (dBm)	18	24	15.5		

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Table 13-9
Simultaneous Transmission Scenario with 5 GHz WLAN (Held to Ear)

Simult Tx	CDMA Power Level (dBm)	Configuration	Cell. CDMA - FCC Rule Part 22H SAR (W/kg)	LTE Band 25 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3	1+2	1+2+3
		Target Power (dBm)	24.5	19	13		
Head SAR	P $\geq$ 18	Right Cheek	0.255	0.151	0.049	0.406	0.455
		Right Tilt	0.134	0.070	0.048	0.204	0.252
		Left Cheek	0.249	0.080	0.247	0.329	0.576
		Left Tilt	0.150	0.086	0.111	0.236	0.347
		Target Power (dBm)	18	24	13		
	P < 18	Right Cheek	0.032	0.591	0.049	0.623	0.672
		Right Tilt	0.017	0.265	0.048	0.282	0.330
		Left Cheek	0.032	0.306	0.247	0.338	0.585
		Left Tilt	0.018	0.295	0.111	0.313	0.424
		Target Power (dBm)	18	24	13		
Head SAR	P $\geq$ 18	Right Cheek	0.185	0.151	0.049	0.336	0.385
		Right Tilt	0.139	0.070	0.048	0.209	0.257
		Left Cheek	0.215	0.080	0.247	0.295	0.542
		Left Tilt	0.150	0.086	0.111	0.236	0.347
		Target Power (dBm)	18	24	13		
	P < 18	Right Cheek	0.024	0.591	0.049	0.615	0.664
		Right Tilt	0.015	0.265	0.048	0.280	0.328
		Left Cheek	0.026	0.306	0.247	0.332	0.579
		Left Tilt	0.017	0.295	0.111	0.312	0.423
		Target Power (dBm)	18	24	13		
Head SAR	P $\geq$ 18	Right Cheek	0.155	0.151	0.049	0.306	0.355
		Right Tilt	0.115	0.070	0.048	0.185	0.233
		Left Cheek	0.401	0.080	0.247	0.481	0.728
		Left Tilt	0.099	0.086	0.111	0.185	0.296
		Target Power (dBm)	18	24	13		
	P < 18	Right Cheek	0.026	0.591	0.049	0.617	0.666
		Right Tilt	0.020	0.265	0.048	0.285	0.333
		Left Cheek	0.052	0.306	0.247	0.358	0.605
		Left Tilt	0.010	0.295	0.111	0.305	0.416
		Target Power (dBm)	18	24	13		

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

Table 13-10
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Body-Worn at 1.0 cm)

Configuration	CDMA Power Level (dBm)	Mode	CDMA SAR (W/kg)	LTE Band 25 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)		SPLSR		
		Tx Antenna	1	2	3	1+2	1+2+3	1+2	1+3	2+3
		Target Power (dBm)	24.5	19	15.5					
Back Side	P $\geq$ 18	Cell. CDMA - FCC Rule Part 22H	1.037	0.176	0.372	1.213	1.585	N/A	N/A	N/A
		Cell. CDMA - FCC Rule Part 90S	0.597	0.176	0.372	0.773	1.145	N/A	N/A	N/A
		PCS CDMA - FCC Rule Part 24E	1.095	0.176	0.372	1.271	See Note 1	0.03	0.01	0.00
		Target Power (dBm)	18	24	15.5					
	P < 18	Cell. CDMA - FCC Rule Part 22H	0.178	0.529	0.372	0.707	1.079	N/A	N/A	N/A
		Cell. CDMA - FCC Rule Part 90S	0.172	0.529	0.372	0.701	1.073	N/A	N/A	N/A
		PCS CDMA - FCC Rule Part 24E	0.285	0.529	0.372	0.814	1.186	N/A	N/A	N/A
		Target Power (dBm)	18	24	15.5					

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Table 13-11
Simultaneous Transmission Scenario with 5 GHz WLAN (Body-Worn at 1.0 cm)

Configuration	CDMA Power Level (dBm)	Mode	CDMA SAR (W/kg)	LTE Band 25 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3		
		Target Power (dBm)	24.5	19	13	1+2	1+2+3
Back Side	P ≥ 18	Cell. CDMA - FCC Rule Part 22H	1.037	0.176	0.311	1.213	1.524
		Cell. CDMA - FCC Rule Part 90S	0.597	0.176	0.311	0.773	1.084
		PCS CDMA - FCC Rule Part 24E	1.095	0.176	0.311	1.271	1.582
		Target Power (dBm)	18	24	13		
	P < 18	Cell. CDMA - FCC Rule Part 22H	0.178	0.529	0.311	0.707	1.018
		Cell. CDMA - FCC Rule Part 90S	0.172	0.529	0.311	0.701	1.012
		PCS CDMA - FCC Rule Part 24E	0.285	0.529	0.311	0.814	1.125

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

Table 13-12
Simultaneous Transmission Scenario with Bluetooth (Body-Worn at 1.0 cm)

Configuration	CDMA Power Level (dBm)	Mode	CDMA SAR (W/kg)	LTE Band 25 SAR (W/kg)	Bluetooth SAR (W/kg)	Σ SAR (W/kg)	
		Tx Antenna	1	2	3		
		Target Power (dBm)	24.5	19	8.5	1+2	1+2+3
Back Side	P ≥ 18	Cell. CDMA - FCC Rule Part 22H	1.037	0.176	0.167	1.213	1.380
		Cell. CDMA - FCC Rule Part 90S	0.597	0.176	0.167	0.773	0.940
		PCS CDMA - FCC Rule Part 24E	1.095	0.176	0.167	1.271	1.438
		Target Power (dBm)	18	24	8.5		
	P < 18	Cell. CDMA - FCC Rule Part 22H	0.178	0.529	0.167	0.707	0.874
		Cell. CDMA - FCC Rule Part 90S	0.172	0.529	0.167	0.701	0.868
		PCS CDMA - FCC Rule Part 24E	0.285	0.529	0.167	0.814	0.981

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.

Table 13-13
Simultaneous Transmission Scenario with 2.4 GHz WLAN (Hotspot at 1.0 cm)

Simult Tx	CDMA Power Level (dBm)	Configuration	Cell. CDMA - FCC Rule Part 22H SAR (W/kg)	LTE Band 25 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	P $\geq$ 18	Tx Antenna	1	2	3	1+2+3
		Target Power (dBm)	24.5	19	15.5	
		Back	1.037	0.176	0.372	1.585
		Front	0.352	0.152	0.095	0.599
		Top	-	-	0.073	0.073
		Bottom	0.240	0.133	-	0.373
		Right	-	0.115	0.210	0.325
		Left	0.467	-	-	0.467
	P < 18	Target Power (dBm)	18	24	15.5	
		Back	0.178	0.529	0.372	1.079
		Front	0.087	0.509	0.095	0.691
		Top	-	-	0.073	0.073
		Bottom	0.030	0.316	-	0.346
		Right	-	0.385	0.210	0.595
		Left	0.055	-	-	0.055

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Simult Tx	CDMA Power Level (dBm)	Configuration	Cell. CDMA - FCC Rule Part 90S SAR (W/kg)	LTE Band 25 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)			
		Tx Antenna	1	2	3	1+2+3			
		Target Power (dBm)	24.5	19	15.5				
Body SAR	P ≥ 18	Back	0.597	0.176	0.372	1.145			
		Front	0.238	0.152	0.095	0.485			
		Top	-	-	0.073	0.073			
		Bottom	0.137	0.133	-	0.270			
		Right	-	0.115	0.210	0.325			
		Left	0.387	-	-	0.387			
		Target Power (dBm)	18	24	15.5				
	P < 18	Back	0.172	0.529	0.372	1.073			
		Front	0.076	0.509	0.095	0.680			
		Top	-	-	0.073	0.073			
		Bottom	0.020	0.316	-	0.336			
		Right	-	0.385	0.210	0.595			
		Left	0.056	-	-	0.056			
Simult Tx	CDMA Power Level (dBm)	Configuration	PCS CDMA - FCC Rule Part 24E SAR (W/kg)	LTE Band 25 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	SPLS Ratio		
		Tx Antenna	1	2	3	1+2+3	1+2	1+3	2+3
		Target Power (dBm)	24.5	19	15.5				
Body SAR	P ≥ 18	Back	1.095	0.176	0.372	See Note 1	0.03	0.01	0.00
		Front	0.480	0.152	0.095	0.727	N/A	N/A	N/A
		Top	-	-	0.073	0.073	N/A	N/A	N/A
		Bottom	0.479	0.133	-	0.612	N/A	N/A	N/A
		Right	-	0.115	0.210	0.325	N/A	N/A	N/A
		Left	0.217	-	-	0.217	N/A	N/A	N/A
		Target Power (dBm)	18	24	15.5				
	P < 18	Back	0.285	0.529	0.372	1.186	N/A	N/A	N/A
		Front	0.122	0.509	0.095	0.726	N/A	N/A	N/A
		Top	-	-	0.073	0.073	N/A	N/A	N/A
		Bottom	0.119	0.316	-	0.435	N/A	N/A	N/A
		Right	-	0.385	0.210	0.595	N/A	N/A	N/A
		Left	0.059	-	-	0.059	N/A	N/A	N/A

Table 13-14
Simultaneous Transmission Scenario with 5 GHz WLAN (Hotspot at 1.0 cm)

Simult Tx	CDMA Power Level (dBm)	Configuration	Cell. CDMA - FCC Rule Part 22H SAR (W/kg)	LTE Band 25 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)		
		Tx Antenna	1	2	3	1+2+3		
		Target Power (dBm)	24.5	19	13			
Body SAR	P ≥ 18	Back	1.037	0.176	0.134	1.347		
		Front	0.352	0.152	0.038	0.542		
		Top	-	-	0.043	0.043		
		Bottom	0.240	0.133	-	0.373		
		Right	-	0.115	0.222	0.337		
		Left	0.467	-	-	0.467		
		Target Power (dBm)	18	24	13			
	P < 18	Back	0.178	0.529	0.134	0.841		
		Front	0.087	0.509	0.038	0.634		
		Top	-	-	0.043	0.043		
		Bottom	0.030	0.316	-	0.346		
		Right	-	0.385	0.222	0.607		
		Left	0.055	-	-	0.055		
		Target Power (dBm)	18	24	13			

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Simult Tx	CDMA Power Level (dBm)	Configuration	Cell. CDMA - FCC Rule Part 90S SAR (W/kg)	LTE Band 25 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		Tx Antenna	1	2	3	1+2+3
		Target Power (dBm)	24.5	19	13	
Body SAR	P ≥ 18	Back	0.597	0.176	0.134	0.907
		Front	0.238	0.152	0.038	0.428
		Top	-	-	0.043	0.043
		Bottom	0.137	0.133	-	0.270
		Right	-	0.115	0.222	0.337
		Left	0.387	-	-	0.387
		Target Power (dBm)	18	24	13	
	P < 18	Back	0.172	0.529	0.134	0.835
		Front	0.076	0.509	0.038	0.623
		Top	-	-	0.043	0.043
		Bottom	0.020	0.316	-	0.336
		Right	-	0.385	0.222	0.607
		Left	0.056	-	-	0.056
		Target Power (dBm)	18	24	13	
Simult Tx	CDMA Power Level (dBm)	Configuration	PCS CDMA - FCC Rule Part 24E SAR (W/kg)	LTE Band 25 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
		Tx Antenna	1	2	3	1+2+3
		Target Power (dBm)	24.5	19	13	
Body SAR	P ≥ 18	Back	1.095	0.176	0.134	1.405
		Front	0.480	0.152	0.038	0.670
		Top	-	-	0.043	0.043
		Bottom	0.479	0.133	-	0.612
		Right	-	0.115	0.222	0.337
		Left	0.217	-	-	0.217
		Target Power (dBm)	18	24	13	
	P < 18	Back	0.285	0.529	0.134	0.948
		Front	0.122	0.509	0.038	0.669
		Top	-	-	0.043	0.043
		Bottom	0.119	0.316	-	0.435
		Right	-	0.385	0.222	0.607
		Left	0.059	-	-	0.059
		Target Power (dBm)	18	24	13	

Note:

- 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 13.7 for detailed SPLS ratio analysis.

13.7 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 10 mm with PCS CDMA - FCC Rule Part 24E antenna operating at maximum output power with LTE Band 25 operating at reduced output power with 2.4 GHz WLAN.

Table 13-15
Peak SAR Locations for Body Back Side at 10 mm

Mode/Band	x (mm)	y (mm)
PCS CDMA - FCC Rule Part 24E	-6.50	-64.50
LTE Band 25	-36.50	-36.00
802.11b	-49.90	58.81

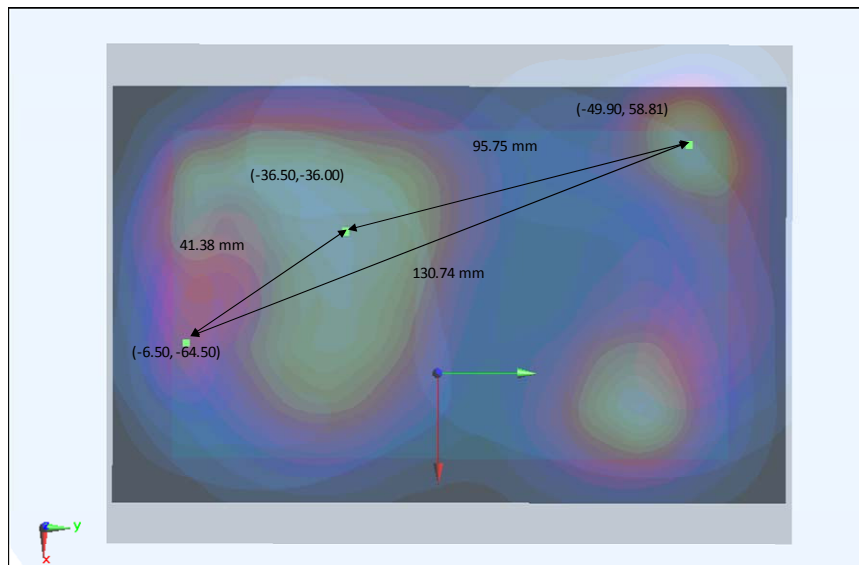


Figure 13-1
Peak SAR Location of 2.4 GHz WLAN and PCS CDMA at 10 mm

Table 13-16
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}	$(a+b)^{1.5}/D_{a-b}$
PCS CDMA - FCC Rule Part 24E	LTE Band 25	1.095	0.176	1.271	41.38	0.03
PCS CDMA - FCC Rule Part 24E	802.11b	1.095	0.372	1.467	130.74	0.01
LTE Band 25	802.11b	0.176	0.372	0.548	95.75	0.00

13.8 Simultaneous Transmission Conclusion

The above numerical summed SAR 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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14 SAR MEASUREMENT VARIABILITY

14.1 Measurement Variability

Per FCC KDB Publication 865664 D01v01, SAR measurement variability is assessed when the highest measured SAR is ≥ 0.80 W/kg. Since all measured SAR values are < 0.80 W/kg for this device, SAR measurement variability was not assessed.

14.2 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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15 EQUIPMENT LIST

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/30/2013	Annual	10/30/2014	1833460
Agilent	E8257D	(250kHz-20GHz) Signal Generator	4/15/2014	Annual	4/15/2015	MY45470194
Agilent	8753E	(30kHz-6GHz) Network Analyzer	7/23/2013	Annual	7/23/2014	US37390350
Agilent	8648D	(9kHz-4GHz) Signal Generator	4/15/2014	Annual	4/15/2015	3629U00687
SPEAG	D1900V2	1900 MHz SAR Dipole	7/22/2013	Annual	7/22/2014	5d149
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	CBT	1139
Amplifier Research	15S1G6	Amplifier	CBT	N/A	CBT	433972
Narda	4772-3	Attenuator (3dB)	CBT	N/A	CBT	9406
Pasternack	PE2208-6	Bidirectional Coupler	CBT	N/A	CBT	N/A
Pasternack	PE2209-10	Bidirectional Coupler	CBT	N/A	CBT	N/A
SPEAG	DAE4	Dasy Data Acquisition Electronics	8/21/2013	Annual	8/21/2014	1322
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/26/2014	Annual	2/26/2015	665
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	CBT	N/A
SPEAG	DAK-3.5	Dielectric Assessment Kit	11/13/2013	Annual	11/13/2014	1091
Mitutoyo	CD-6"CSX	Digital Caliper	5/8/2014	Biennial	5/8/2016	13264162
Fisher Scientific	15-077-960	Digital Thermometer	12/4/2013	Biennial	12/4/2015	130764558
Rohde & Schwarz	NRVD	Dual Channel Power Meter	10/12/2012	Biennial	10/12/2014	101695
Control Company	4353	Long Stem Thermometer	9/25/2012	Biennial	9/25/2014	122541143
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	CBT	N/A
Rohde & Schwarz	CMW500	LTE Radio Communication Tester	6/6/2013	Annual	6/6/2014	111427
Mini-Circuits	BW-N20W5	Power Attenuator	CBT	N/A	CBT	1226
Anritsu	ML2495A	Power Meter	10/31/2013	Annual	10/31/2014	1039008
Anritsu	MA2481A	Power Sensor	10/30/2013	Annual	10/30/2014	5605
Anritsu	MT8820C	Radio Communication Analyzer	6/28/2013	Annual	6/28/2014	6201240328
SPEAG	ES3DV2	SAR Probe	8/22/2013	Annual	8/22/2014	3022
SPEAG	ES3DV3	SAR Probe	2/25/2014	Annual	2/25/2015	3258
Rohde & Schwarz	SME06	Signal Generator	10/30/2013	Annual	10/30/2014	832026
Rohde & Schwarz	NRVS	Single Channel Power Meter	10/31/2013	Annual	10/31/2014	835360/0079
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	CBT	M3W1A00-1002
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
Seekonk	NC-100	Torque Wrench	3/18/2014	Biennial	3/18/2016	N/A
Anritsu	MA24106A	USB Power Sensor	1/3/2014	Annual	1/3/2015	1344554
Anritsu	MA24106A	USB Power Sensor	1/3/2014	Annual	1/3/2015	1344557
VWR	36934-158	Wall-Mounted Thermometer	8/8/2013	Biennial	8/8/2015	130477877

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

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16 MEASUREMENT UNCERTAINTIES

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

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

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17 CONCLUSION

17.1 Measurement Conclusion

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

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease). Because various factors may interact with one another to vary the specific biological outcome of an exposure to electromagnetic fields, any protection guide should consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables. [3]

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APPENDIX A: SAR TEST DATA

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSPHL720; Type: Portable Handset; Serial: 3272A

Communication System: UID 0, LTE Band 25 (PCS) (0); Frequency: 1905 MHz; Duty Cycle: 1:1

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1905 \text{ MHz}$; $\sigma = 1.424 \text{ S/m}$; $\epsilon_r = 39.649$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Right Section

Test Date: 05-27-2014; Ambient Temp: 24.1°C; Tissue Temp: 23.4°C

Probe: ES3DV2 - SN3022; ConvF(5.03, 5.03, 5.03); Calibrated: 8/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/21/2013

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

Mode: LTE Band 25 (PCS), Right Head, Cheek, High.ch
20 MHz Bandwidth, QPSK, 1 RB, 50 RB Offset
Standard Battery Cover

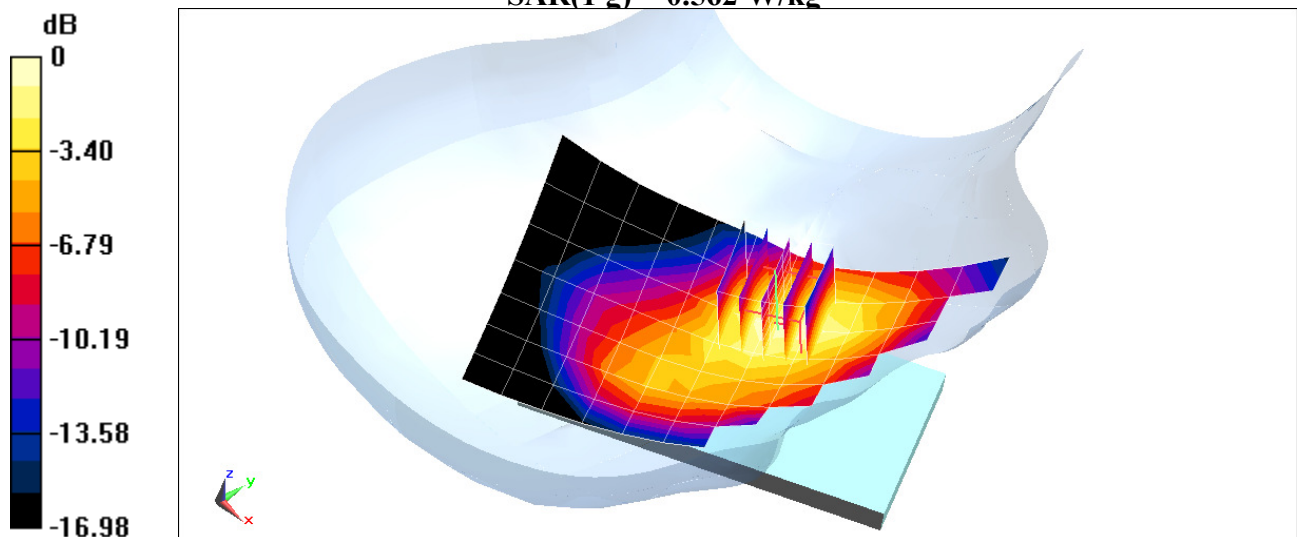
Area Scan (8x13x1): Measurement grid: $dx=15\text{mm}$, $dy=15\text{mm}$

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

Reference Value = 22.011 V/m; Power Drift = -0.04 dB

Peak SAR (extrapolated) = 0.884 W/kg

SAR(1 g) = 0.562 W/kg



0 dB = 0.602 W/kg = -2.20 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

DUT: A3LSPHL720; Type: Portable Handset; Serial: 3272A

Communication System: UID 0, LTE Band 25 (PCS) (0); Frequency: 1905 MHz; Duty Cycle: 1:1

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1905 \text{ MHz}$; $\sigma = 1.559 \text{ S/m}$; $\epsilon_r = 51.779$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 05-26-2014; Ambient Temp: 24.0°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

Mode: LTE Band 25 (PCS), Body SAR, Back side, High.ch
20 MHz Bandwidth, QPSK, 1 RB, 50 RB Offset
Standard Battery Cover

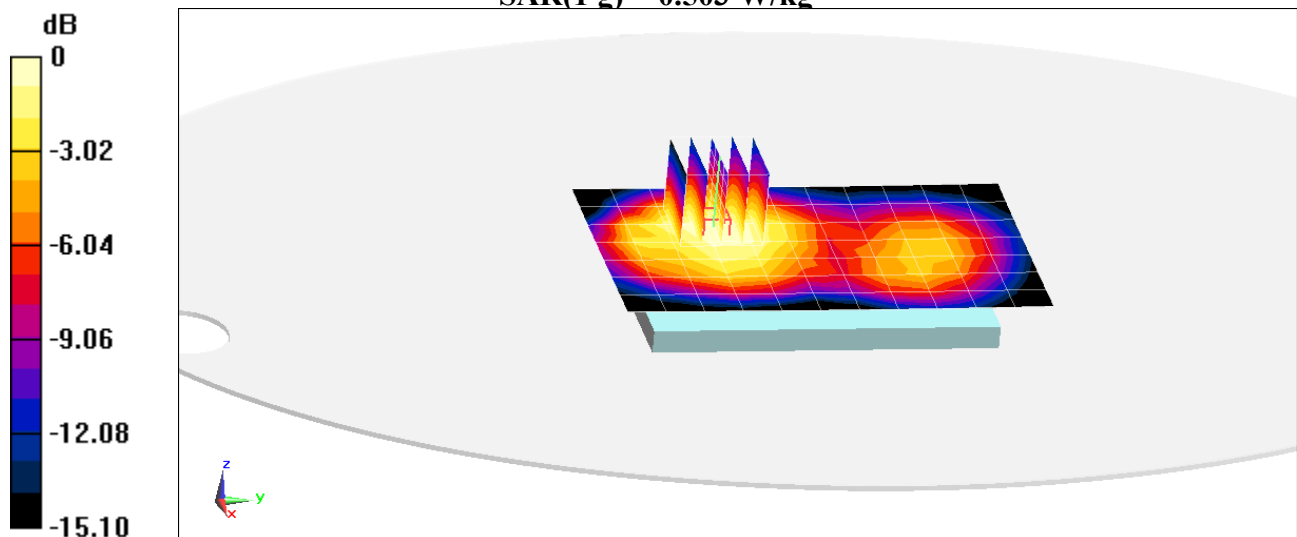
Area Scan (8x12x1): Measurement grid: dx=15mm, dy=15mm

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

Reference Value = 18.883 V/m; Power Drift = -0.06 dB

Peak SAR (extrapolated) = 0.749 W/kg

SAR(1 g) = 0.503 W/kg



0 dB = 0.543 W/kg = -2.65 dBW/kg

APPENDIX B: SYSTEM VERIFICATION

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1900 Head Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.419 \text{ S/m}$; $\epsilon_r = 39.669$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 05-27-2014; Ambient Temp: 24.1°C; Tissue Temp: 23.4°C

Probe: ES3DV2 - SN3022; ConvF(5.03, 5.03, 5.03); Calibrated: 8/22/2013;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn1322; Calibrated: 8/21/2013

Phantom: SAM v5.0 front; Type: QD000P40CD; Serial: TP-1646

Measurement SW: DASY52, Version 52.8 (7); SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

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

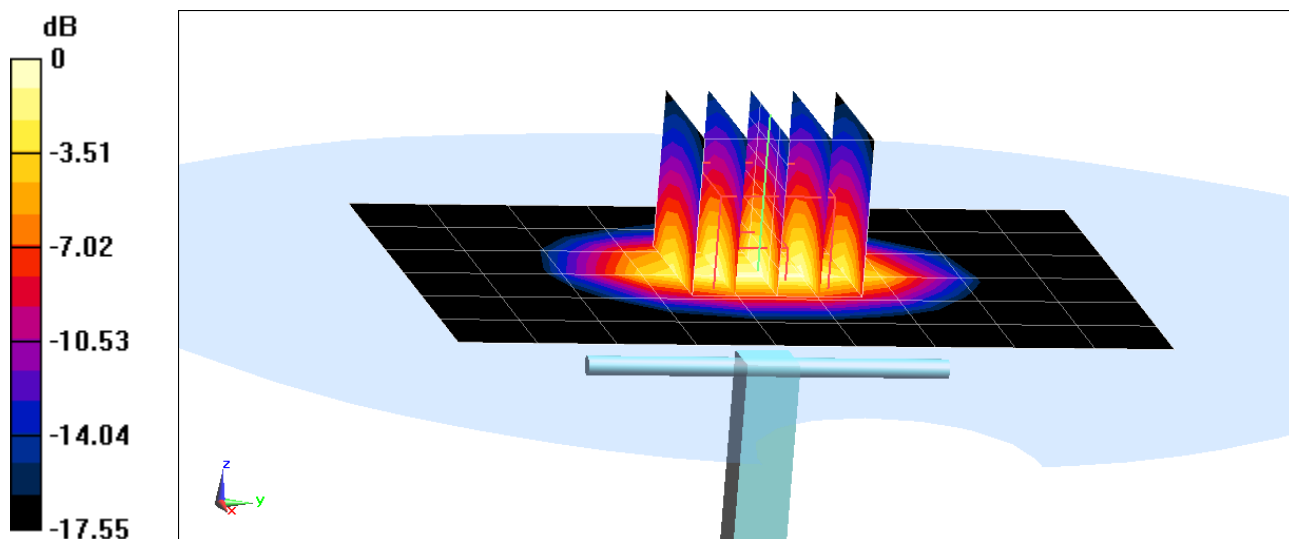
Zoom Scan (5x5x7)/Cube 0: Measurement grid: $dx=8\text{mm}$, $dy=8\text{mm}$, $dz=5\text{mm}$

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.14 W/kg

SAR(1 g) = 3.87 W/kg

Deviation = -4.21%



0 dB = 4.35 W/kg = 6.38 dBW/kg

PCTEST ENGINEERING LABORATORY, INC.

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

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

Medium: 1900 Body Medium parameters used (interpolated):

$f = 1900 \text{ MHz}$; $\sigma = 1.553 \text{ S/m}$; $\epsilon_r = 51.798$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section; Space: 1.0 cm

Test Date: 05-26-2014; Ambient Temp: 24.0°C; Tissue Temp: 22.2°C

Probe: ES3DV3 - SN3258; ConvF(4.61, 4.61, 4.61); Calibrated: 2/25/2014;

Sensor-Surface: 4mm (Mechanical Surface Detection)

Electronics: DAE4 Sn665; Calibrated: 2/26/2014

Phantom: ELI v5.0; Type: QDOVA002AA; Serial: TP-1158

Measurement SW: DASY52, Version 52.8 (7);SEMCAD X Version 14.6.10 (7164)

1900 MHz System Verification

Area Scan (7x10x1): Measurement grid: dx=15mm, dy=15mm

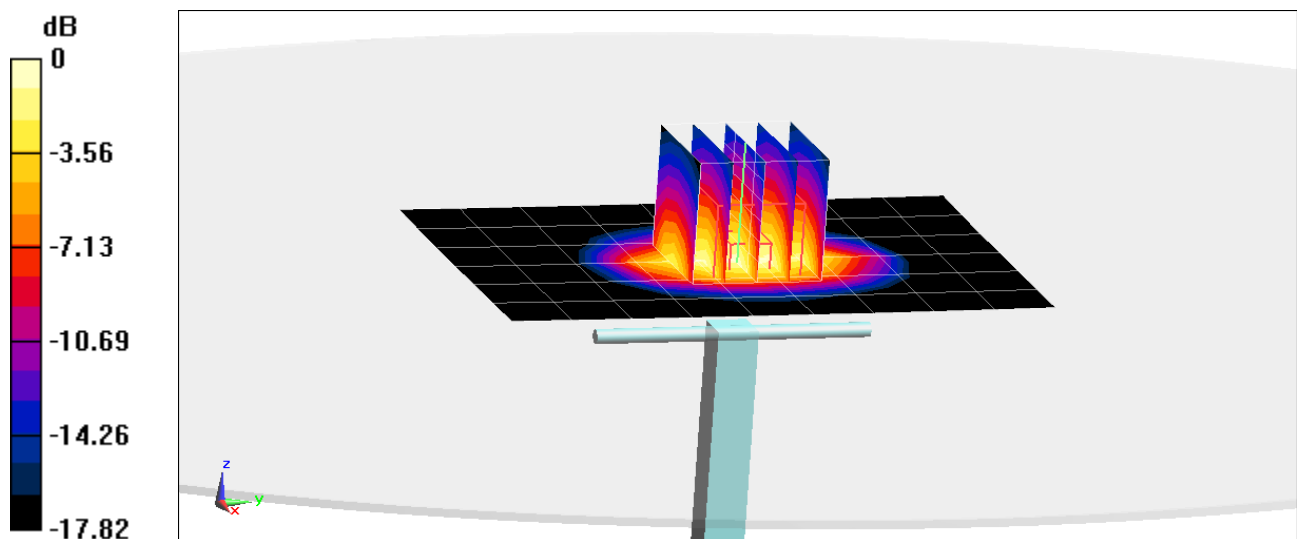
Zoom Scan (5x5x7)/Cube 0: Measurement grid: dx=8mm, dy=8mm, dz=5mm

Input Power = 20.0 dBm (100 mW)

Peak SAR (extrapolated) = 7.21 W/kg

SAR(1 g) = 4.04 W/kg

Deviation = -0.25%



0 dB = 4.52 W/kg = 6.55 dBW/kg

APPENDIX C: PROBE CALIBRATION



Accredited by the Swiss Accreditation Service (SAS)
 The Swiss Accreditation Service is one of the signatories to the EA
 Multilateral Agreement for the recognition of calibration certificates

Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **D1900V2-5d149_Jul13**

CALIBRATION CERTIFICATE

Object **D1900V2 - SN: 5d149**

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

Calibration date: **July 22, 2013**

✓
 KOK
 8/19/13

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	01-Nov-12 (No. 217-01640)	Oct-13
Power sensor HP 8481A	US37292783	01-Nov-12 (No. 217-01640)	Oct-13
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	28-Dec-12 (No. ES3-3205_Dec12)	Dec-13
DAE4	SN: 601	25-Apr-13 (No. DAE4-601_Apr13)	Apr-14
Secondary Standards	ID #	Check Date (in house)	Scheduled Check
Power sensor HP 8481A	MY41092317	18-Oct-02 (in house check Oct-11)	In house check: Oct-13
RF generator R&S SMT-06	100005	04-Aug-99 (in house check Oct-11)	In house check: Oct-13
Network Analyzer HP 8753E	US37390585 S4206	18-Oct-01 (in house check Oct-12)	In house check: Oct-13

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

Issued: July 22, 2013

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



Accredited by the Swiss Accreditation Service (SAS)

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

Accreditation No.: **SCS 108**

Glossary:

TSL	tissue simulating liquid
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 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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
- Federal Communications Commission Office of Engineering & Technology (FCC OET), "Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields; Additional Information for Evaluating Compliance of Mobile and Portable Devices with FCC Limits for Human Exposure to Radiofrequency Emissions", Supplement C (Edition 01-01) to Bulletin 65

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

SAR result with Head TSL

SAR averaged over 1 cm ³ (1 g) of Head TSL	Condition	
SAR measured	250 mW input power	9.99 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	40.4 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	5.28 W/kg
SAR for nominal Head TSL parameters	normalized to 1W	21.3 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	53.4 $\pm$ 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	10.0 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	40.5 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	5.36 W/kg
SAR for nominal Body TSL parameters	normalized to 1W	21.6 W/kg $\pm$ 16.5 % (k=2)

Appendix

Antenna Parameters with Head TSL

Impedance, transformed to feed point	$52.9\ \Omega + 6.0\ j\Omega$
Return Loss	- 23.8 dB

Antenna Parameters with Body TSL

Impedance, transformed to feed point	$48.5\ \Omega + 6.4\ j\Omega$
Return Loss	- 23.5 dB

General Antenna Parameters and Design

Electrical Delay (one direction)	1.196 ns
----------------------------------	----------

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

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

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

Additional EUT Data

Manufactured by	SPEAG
Manufactured on	March 11, 2011

DASY5 Validation Report for Head TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1900 \text{ MHz}$; $\sigma = 1.36 \text{ S/m}$; $\epsilon_r = 38.9$; $\rho = 1000 \text{ kg/m}^3$

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.98, 4.98, 4.98); Calibrated: 28.12.2012;
- 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:

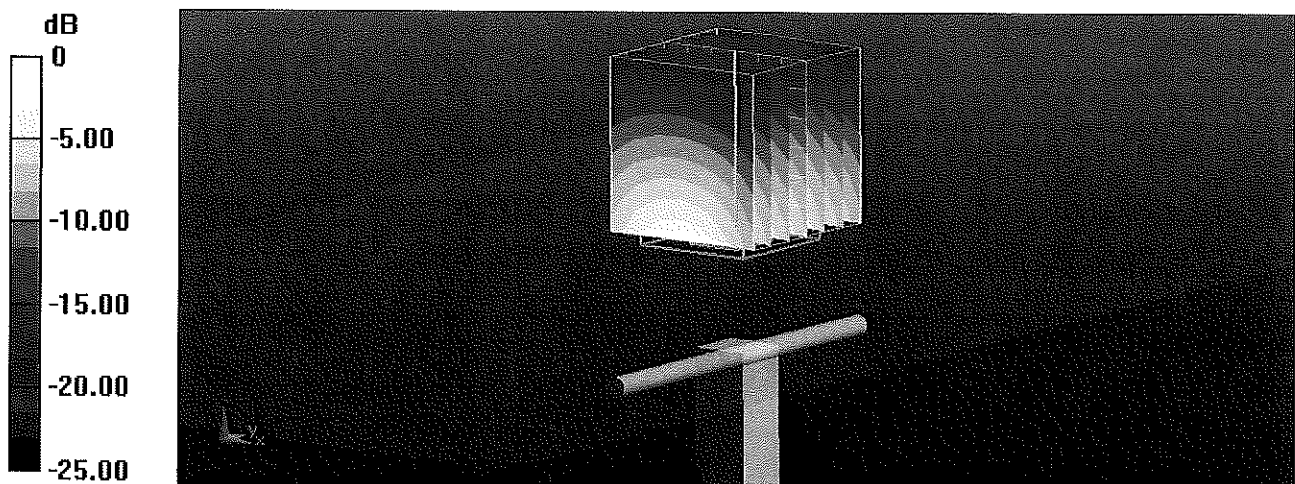
Measurement grid: $dx=5\text{mm}$, $dy=5\text{mm}$, $dz=5\text{mm}$

Reference Value = 96.173 V/m; Power Drift = 0.04 dB

Peak SAR (extrapolated) = 18.0 W/kg

SAR(1 g) = 9.99 W/kg; SAR(10 g) = 5.28 W/kg

Maximum value of SAR (measured) = 12.4 W/kg



0 dB = 12.4 W/kg = 10.93 dBW/kg

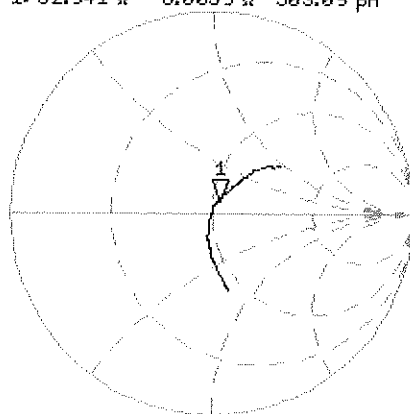
Impedance Measurement Plot for Head TSL

22 Jul 2013 11:59:34
 CH1 S11 1 U FS 1: 52.941 Ω 6.0059 Ω 503.09 μH 1 900.000 000 MHz

*
 De1
 CA

Avg
 16

H1d

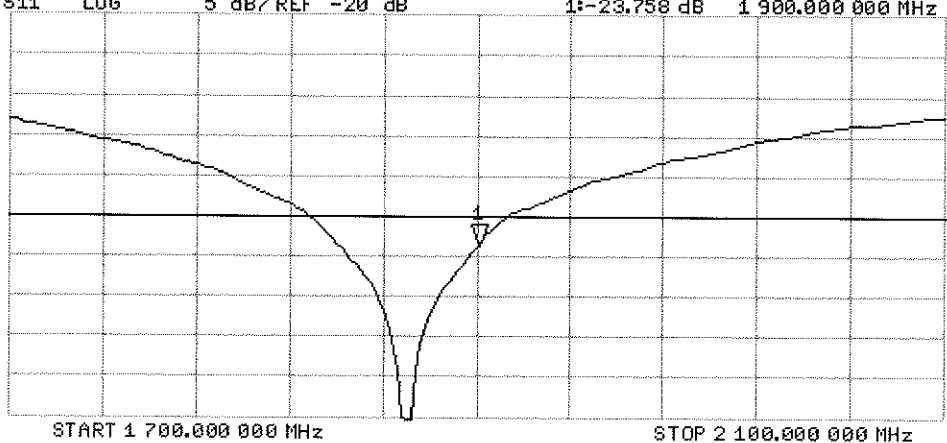


CH2 S11 LOG 5 dB/REF -20 dB 1:-23.758 dB 1 900.000 000 MHz

CA

Avg
 16

H1d



DASY5 Validation Report for Body TSL

Date: 22.07.2013

Test Laboratory: SPEAG, Zurich, Switzerland

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

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

Medium parameters used: $f = 1900$ MHz; $\sigma = 1.49$ S/m; $\epsilon_r = 53.4$; $\rho = 1000$ kg/m³

Phantom section: Flat Section

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

DASY52 Configuration:

- Probe: ES3DV3 - SN3205; ConvF(4.6, 4.6, 4.6); Calibrated: 28.12.2012;
- 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:

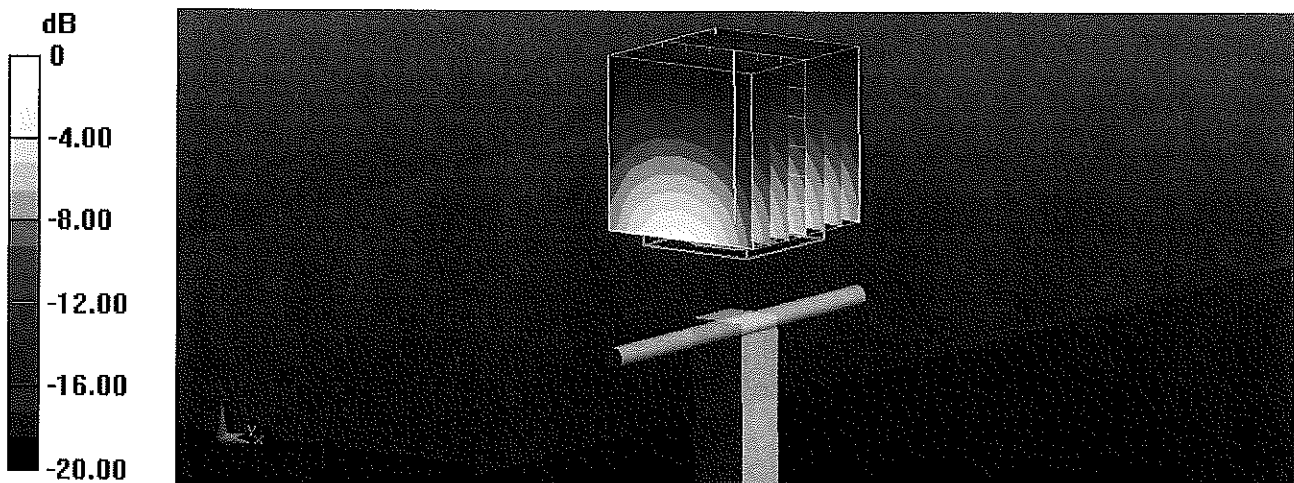
Measurement grid: dx=5mm, dy=5mm, dz=5mm

Reference Value = 96.173 V/m; Power Drift = 0.01 dB

Peak SAR (extrapolated) = 17.0 W/kg

SAR(1 g) = 10 W/kg; SAR(10 g) = 5.36 W/kg

Maximum value of SAR (measured) = 12.6 W/kg

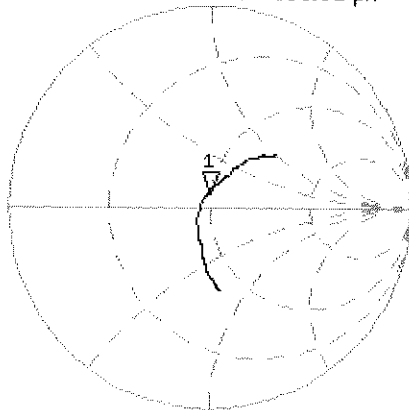


0 dB = 12.6 W/kg = 11.00 dBW/kg

Impedance Measurement Plot for Body TSL

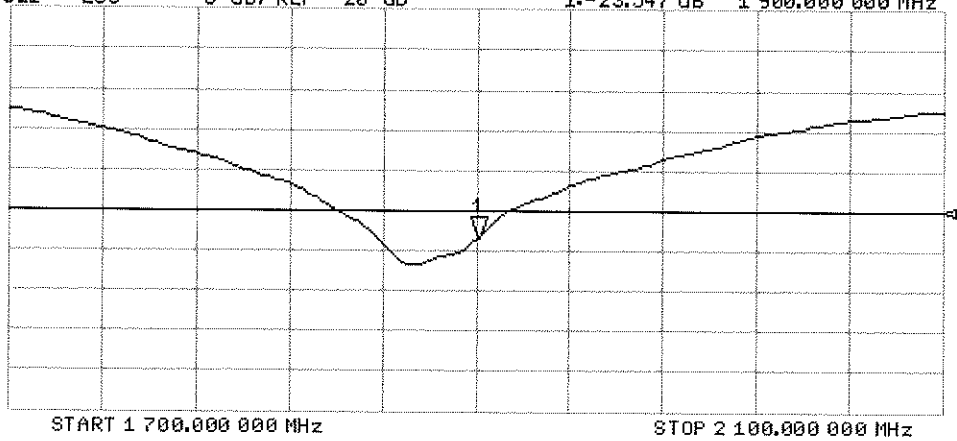
22 Jul 2013 11:32:14
CH1 S11 1 U FS 1: 48.525 Ω 6.3906 Ω 535.32 pF 1 900.000 000 MHz

*
De1
CA
Avg
16
H1d



CH2 S11 LOG 5 dB/REF -20 dB 1:-23.547 dB 1 900.000 000 MHz

CA
Avg
16
H1d





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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3022_Aug13**

CALIBRATION CERTIFICATE

Object **ES3DV2 - SN:3022**

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

Calibration date: **August 22, 2013**

UTC
9/13/13

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	31-Jan-13 (No. DAE4-660_Jan13)	Jan-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

	Name	Function	Signature
Calibrated by:	Jeton Kastrati	Laboratory Technician	
Approved by:	Katja Pokovic	Technical Manager	
Issued: August 23, 2013			
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
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 1528-2003, "IEEE Recommended Practice for Determining the Peak Spatial-Averaged Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", December 2003
- 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.

Probe ES3DV2

SN:3022

Manufactured: April 15, 2003
Calibrated: August 22, 2013

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

DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Basic Calibration Parameters

	Sensor X	Sensor Y	Sensor Z	Unc (k=2)
Norm ($\mu\text{V}/(\text{V}/\text{m})^2$) ^A	1.00	1.04	0.99	± 10.1 %
DCP (mV) ^B	100.7	97.4	99.7	

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	178.6	±3.0 %
		Y	0.0	0.0	1.0		141.9	
		Z	0.0	0.0	1.0		134.7	

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

^A The uncertainties of NormX,Y,Z do not affect the 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: ES3DV2 - SN:3022

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	6.21	6.21	6.21	0.19	2.37	± 12.0 %
835	41.5	0.90	6.09	6.09	6.09	0.30	1.70	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.65	1.23	± 12.0 %
1900	40.0	1.40	5.03	5.03	5.03	0.51	1.43	± 12.0 %
2450	39.2	1.80	4.36	4.36	4.36	0.51	1.51	± 12.0 %
2600	39.0	1.96	4.16	4.16	4.16	0.74	1.29	± 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: ES3DV2 - SN:3022

Calibration Parameter Determined in Body Tissue Simulating Media

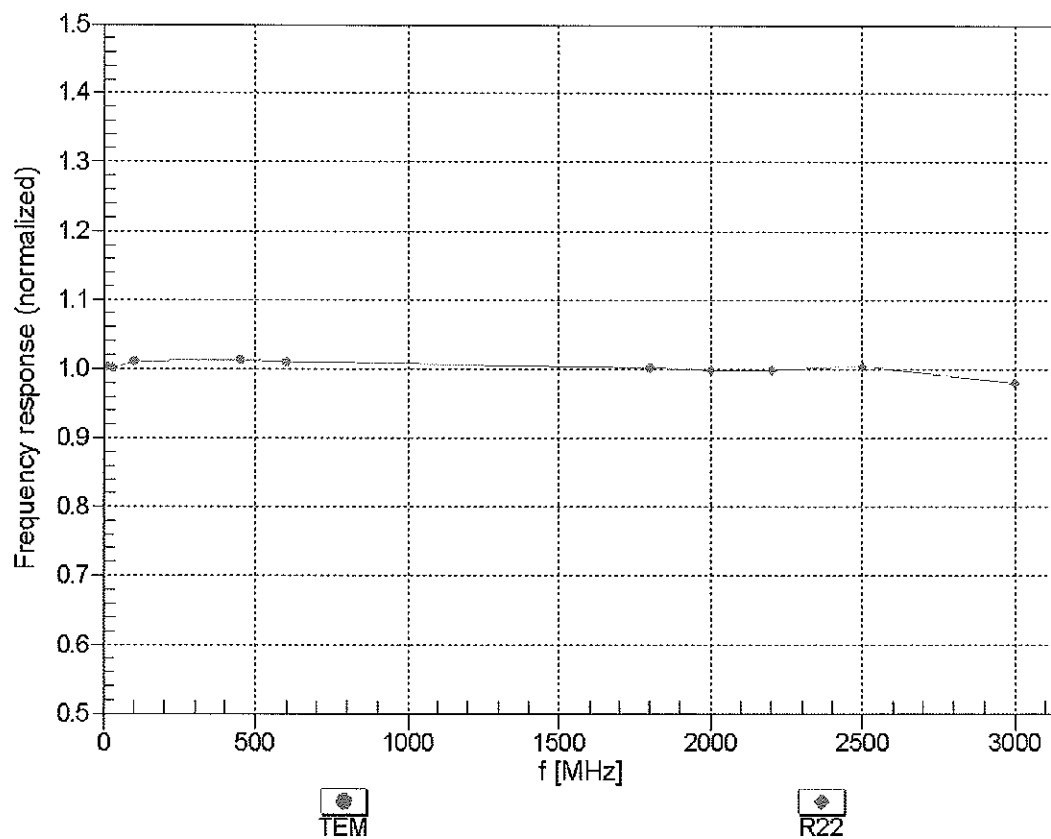
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha	Depth (mm)	Unct. (k=2)
750	55.5	0.96	5.92	5.92	5.92	0.24	1.99	± 12.0 %
835	55.2	0.97	5.91	5.91	5.91	0.29	1.85	± 12.0 %
1750	53.4	1.49	4.75	4.75	4.75	0.52	1.52	± 12.0 %
1900	53.3	1.52	4.49	4.49	4.49	0.49	1.56	± 12.0 %
2450	52.7	1.95	4.01	4.01	4.01	0.70	1.02	± 12.0 %
2600	52.5	2.16	3.85	3.85	3.85	0.58	0.90	± 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

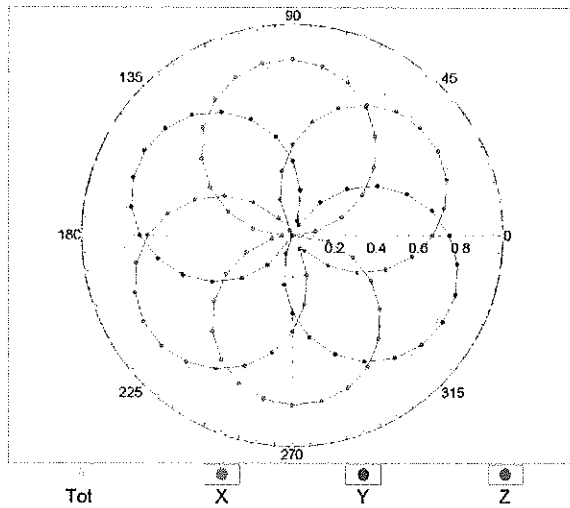
(TEM-Cell:ifi110 EXX, Waveguide: R22)



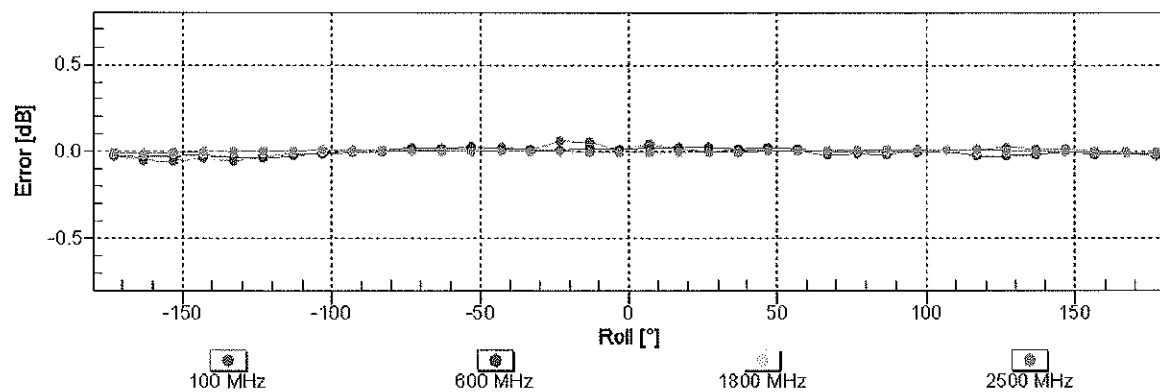
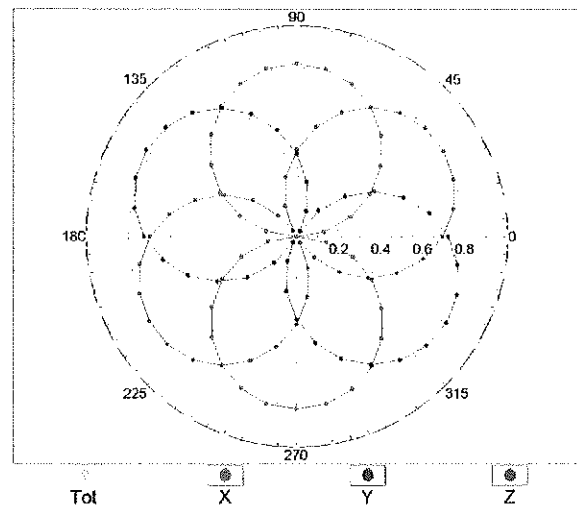
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ ($k=2$)

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

f=600 MHz,TEM

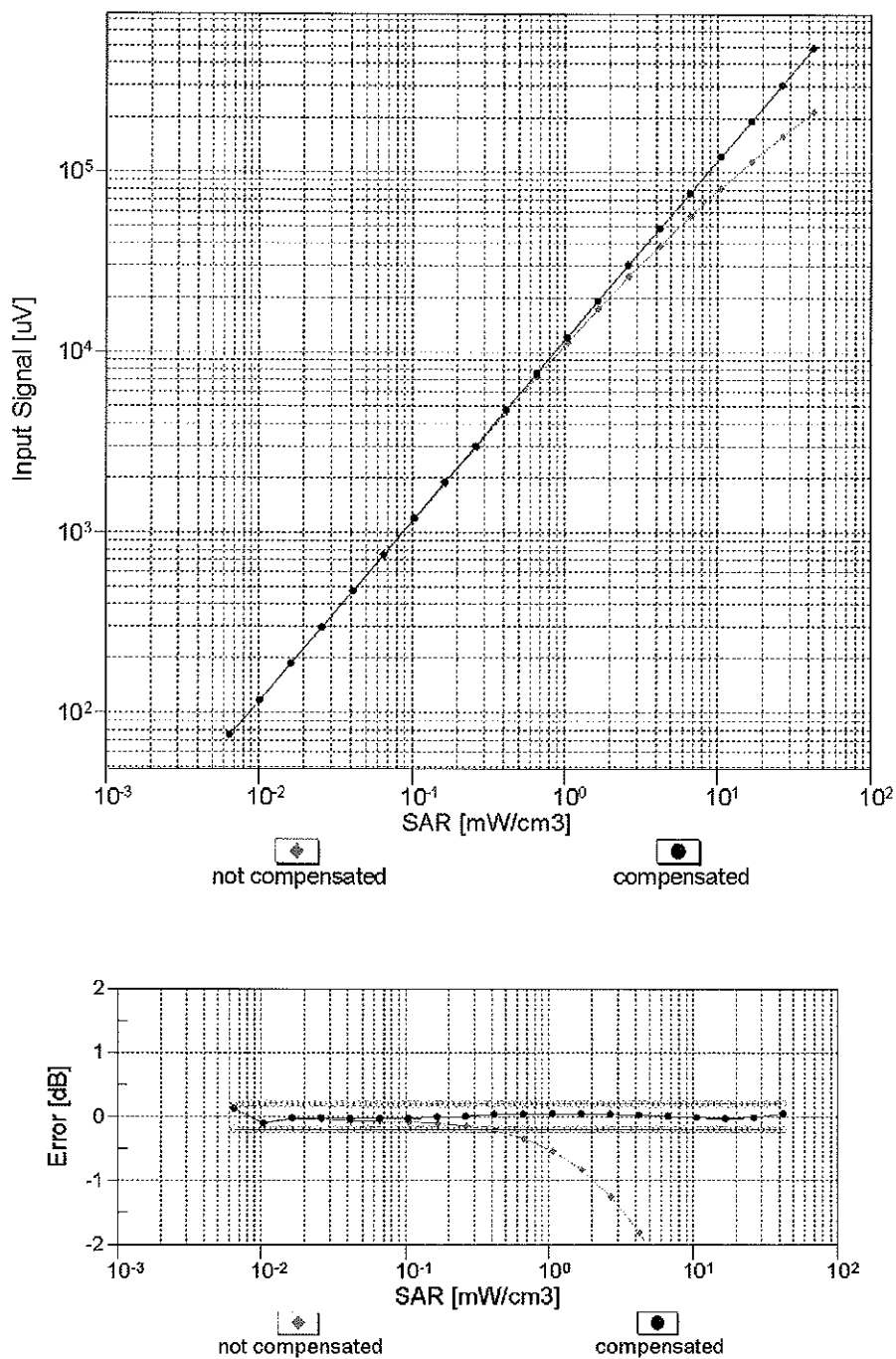


f=1800 MHz,R22



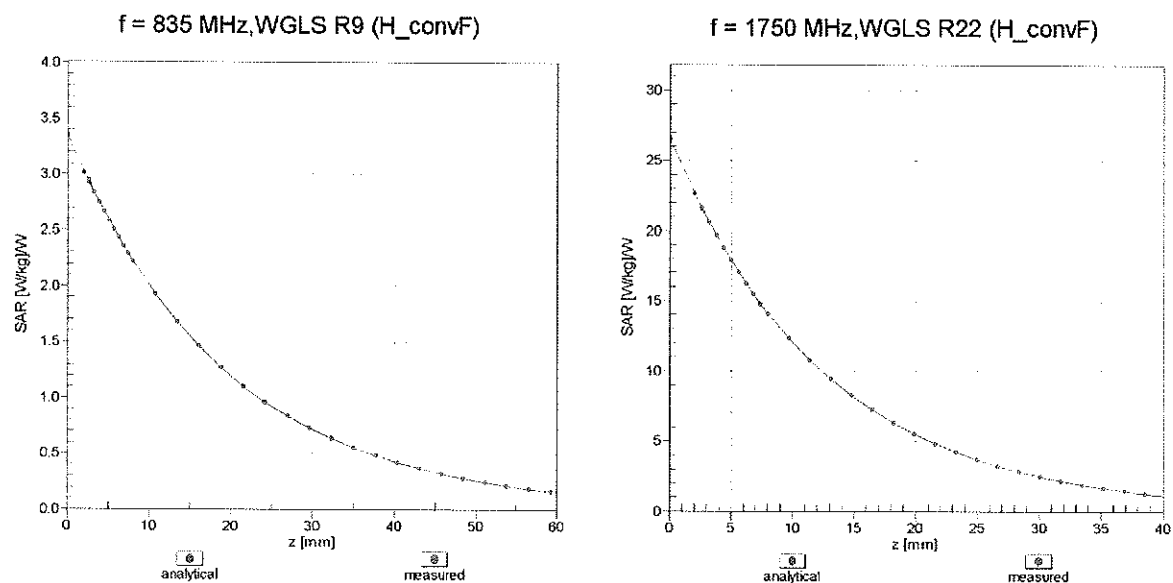
Uncertainty of Axial Isotropy Assessment: $\pm 0.5\%$ ($k=2$)

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



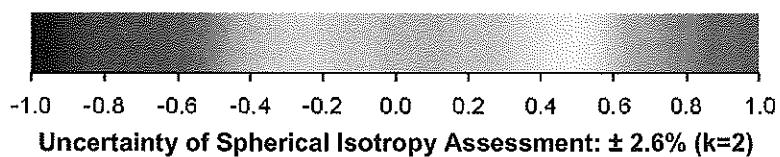
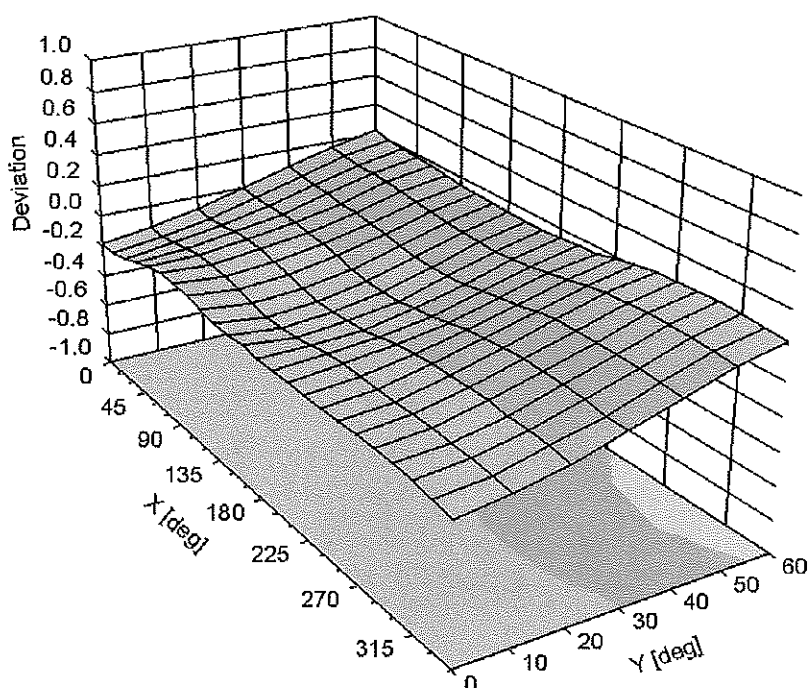
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ , θ), $f = 900 \text{ MHz}$



DASY/EASY - Parameters of Probe: ES3DV2 - SN:3022

Other Probe Parameters

Sensor Arrangement	Triangular
Connector Angle (°)	-83.1
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



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Accreditation No.: **SCS 108**

Client **PC Test**

Certificate No: **ES3-3258_Feb14**

CALIBRATION CERTIFICATE

Object **ES3DV3 - SN:3258**

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

CCV
 3/6/14

Calibration date: **February 25, 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	04-Apr-13 (No. 217-01733)	Apr-14
Power sensor E4412A	MY41498087	04-Apr-13 (No. 217-01733)	Apr-14
Reference 3 dB Attenuator	SN: S5054 (3c)	04-Apr-13 (No. 217-01737)	Apr-14
Reference 20 dB Attenuator	SN: S5277 (20x)	04-Apr-13 (No. 217-01735)	Apr-14
Reference 30 dB Attenuator	SN: S5129 (30b)	04-Apr-13 (No. 217-01738)	Apr-14
Reference Probe ES3DV2	SN: 3013	30-Dec-13 (No. ES3-3013_Dec13)	Dec-14
DAE4	SN: 660	13-Dec-13 (No. DAE4-660_Dec13)	Dec-14
Secondary Standards	ID	Check Date (in house)	Scheduled Check
RF generator HP 8648C	US3642U01700	4-Aug-99 (in house check Apr-13)	In house check: Apr-16
Network Analyzer HP 8753E	US37390585	18-Oct-01 (in house check Oct-13)	In house check: Oct-14

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

Issued: February 27, 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 E^2 -field uncertainty inside TSL (see below ConvF).
- NORM(f)_{x,y,z}** = NORM_{x,y,z} * frequency_response (see Frequency Response Chart). This linearization is implemented in DASY4 software versions later than 4.2. The uncertainty of the frequency response is included in the stated uncertainty of ConvF.
- DCP_{x,y,z}**: DCP are numerical linearization parameters assessed based on the data of power sweep with CW signal (no uncertainty required). DCP does not depend on frequency nor media.
- PAR**: PAR is the Peak to Average Ratio that is not calibrated but determined based on the signal characteristics
- A_{x,y,z}; B_{x,y,z}; C_{x,y,z}; D_{x,y,z}; VR_{x,y,z}**: A, B, C, D are numerical linearization parameters assessed based on the data of power sweep for specific modulation signal. The parameters do not depend on frequency nor media. VR is the maximum calibration range expressed in RMS voltage across the diode.
- ConvF and Boundary Effect Parameters**: Assessed in flat phantom using E-field (or Temperature Transfer Standard for $f \leq 800$ MHz) and inside waveguide using analytical field distributions based on power measurements for $f > 800$ MHz. The same setups are used for assessment of the parameters applied for boundary compensation (alpha, depth) of which typical uncertainty values are given. These parameters are used in DASY4 software to improve probe accuracy close to the boundary. The sensitivity in TSL corresponds to NORM_{x,y,z} * ConvF whereby the uncertainty corresponds to that given for ConvF. A frequency dependent ConvF is used in DASY version 4.4 and higher which allows extending the validity from ± 50 MHz to ± 100 MHz.
- Spherical isotropy (3D deviation from isotropy)**: in a field of low gradients realized using a flat phantom exposed by a patch antenna.
- Sensor Offset**: The sensor offset corresponds to the offset of virtual measurement center from the probe tip (on probe axis). No tolerance required.
- Connector Angle**: The angle is assessed using the information gained by determining the NORM_x (no uncertainty required).

Probe ES3DV3

SN:3258

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

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

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

Basic Calibration Parameters

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

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

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

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

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

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

^A The uncertainties of NormX,Y,Z do not affect the E^2 -field uncertainty inside TSL (see Pages 8 and 9).

^B Numerical linearization parameter: uncertainty not required.

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

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

Calibration Parameter Determined in Head Tissue Simulating Media

f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	41.9	0.89	6.53	6.53	6.53	0.40	1.60	± 12.0 %
835	41.5	0.90	6.27	6.27	6.27	0.80	1.17	± 12.0 %
1750	40.1	1.37	5.19	5.19	5.19	0.80	1.10	± 12.0 %
1900	40.0	1.40	5.04	5.04	5.04	0.68	1.27	± 12.0 %
2450	39.2	1.80	4.52	4.52	4.52	0.78	1.23	± 12.0 %
2600	39.0	1.96	4.34	4.34	4.34	0.76	1.33	± 12.0 %

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

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

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

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

Calibration Parameter Determined in Body Tissue Simulating Media

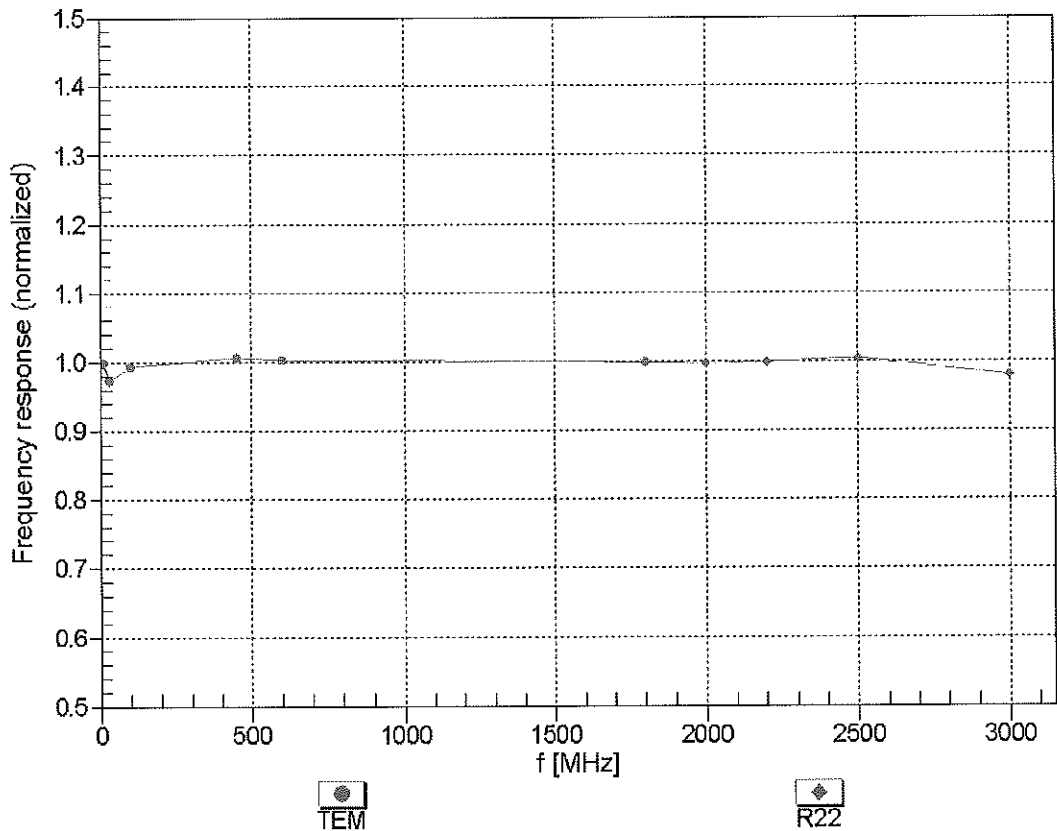
f (MHz) ^C	Relative Permittivity ^F	Conductivity (S/m) ^F	ConvF X	ConvF Y	ConvF Z	Alpha ^G	Depth ^G (mm)	Unct. (k=2)
750	55.5	0.96	6.15	6.15	6.15	0.61	1.32	± 12.0 %
835	55.2	0.97	6.11	6.11	6.11	0.80	1.15	± 12.0 %
1750	53.4	1.49	4.83	4.83	4.83	0.47	1.74	± 12.0 %
1900	53.3	1.52	4.61	4.61	4.61	0.55	1.59	± 12.0 %
2450	52.7	1.95	4.14	4.14	4.14	0.80	1.11	± 12.0 %
2600	52.5	2.16	3.91	3.91	3.91	0.80	1.00	± 12.0 %

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

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

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

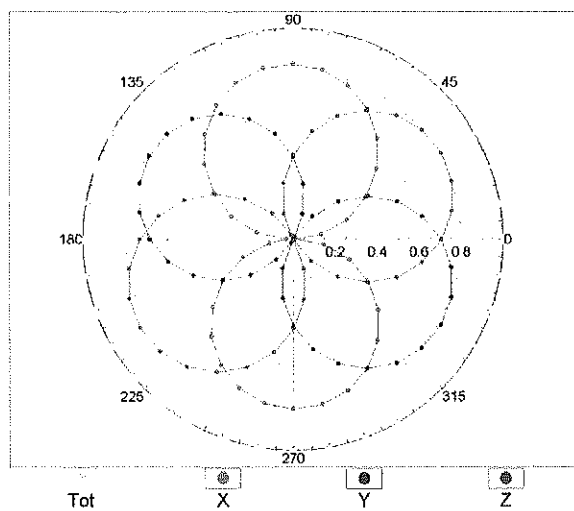
Frequency Response of E-Field
(TEM-Cell:ifi110 EXX, Waveguide: R22)



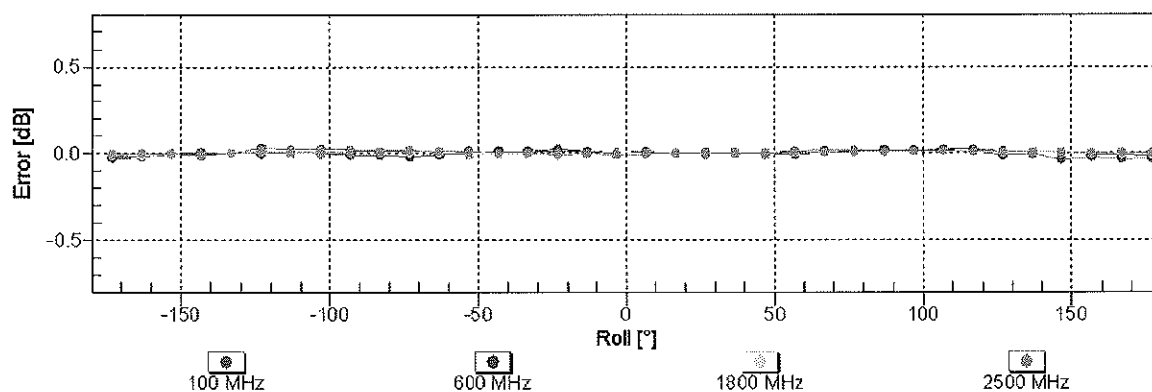
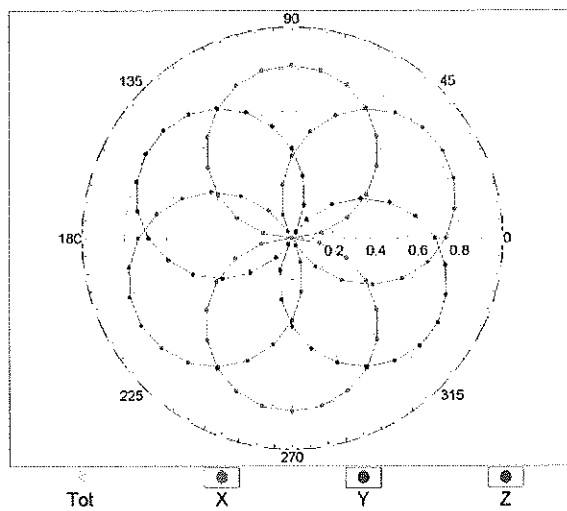
Uncertainty of Frequency Response of E-field: $\pm 6.3\%$ (k=2)

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

f=600 MHz,TEM



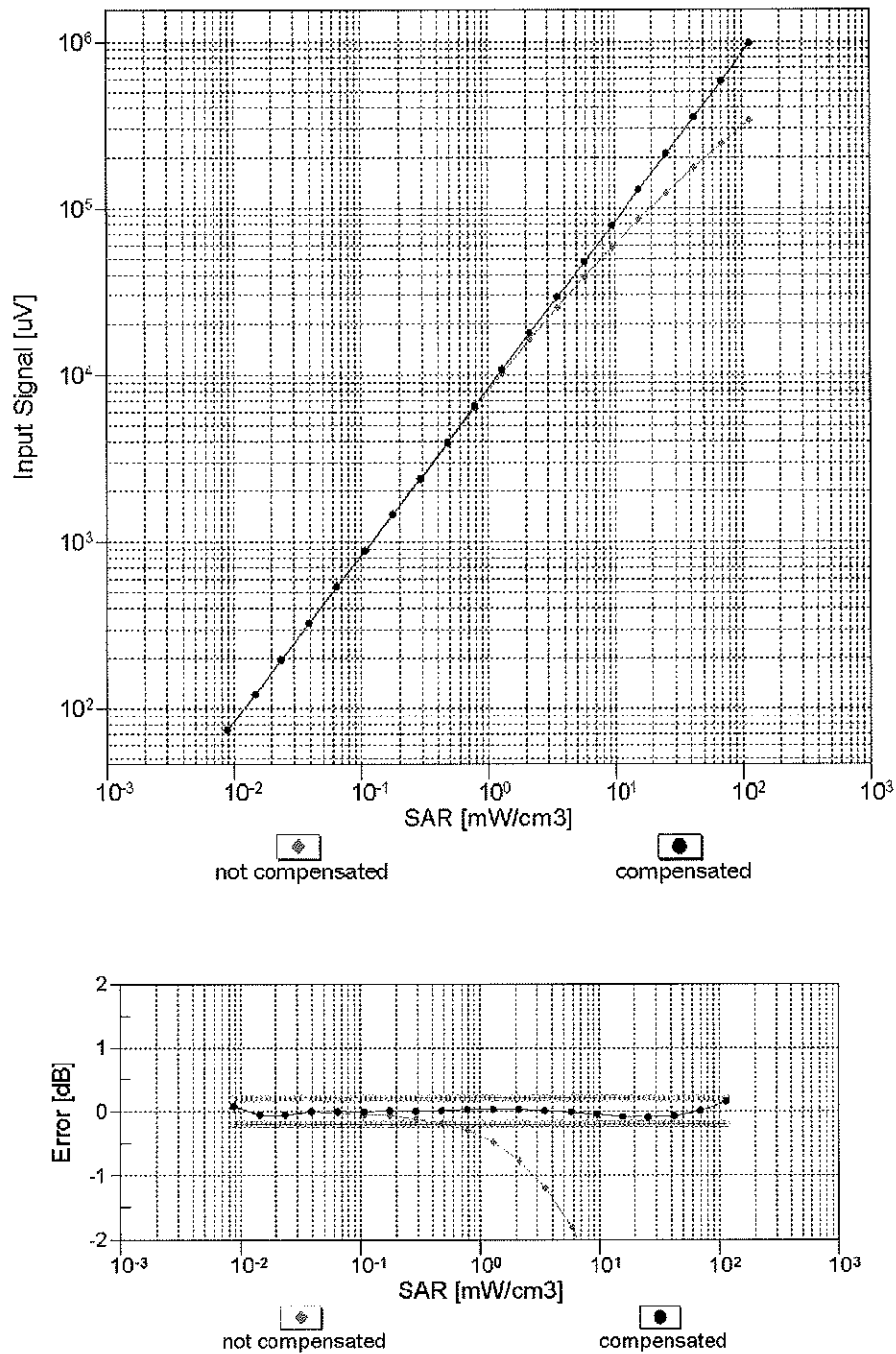
f=1800 MHz,R22



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

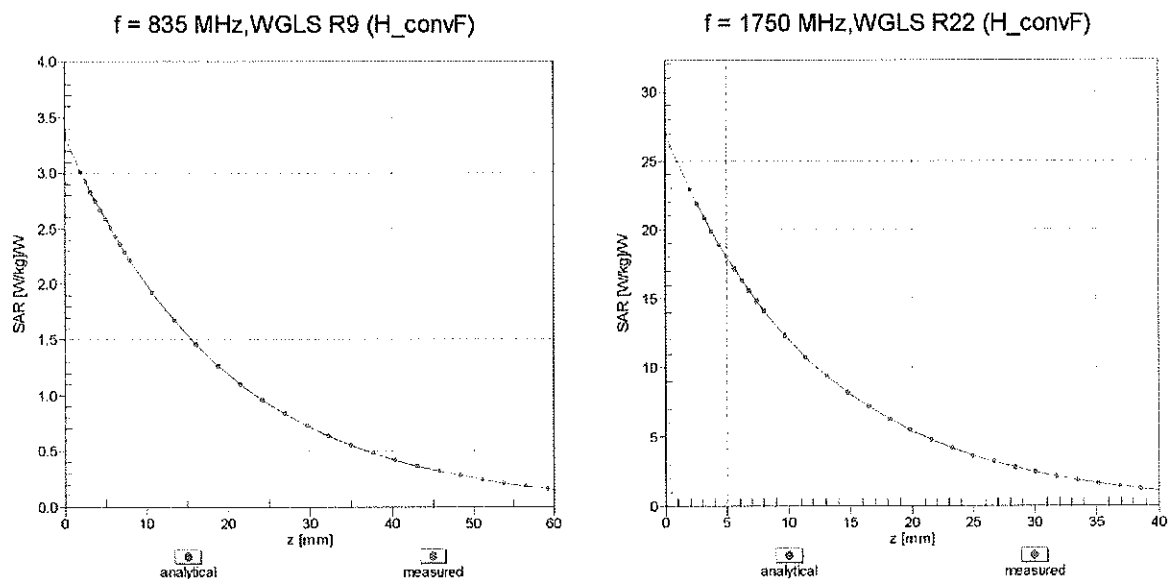
Dynamic Range f(SAR_{head})

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



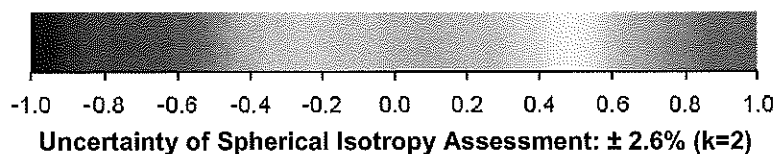
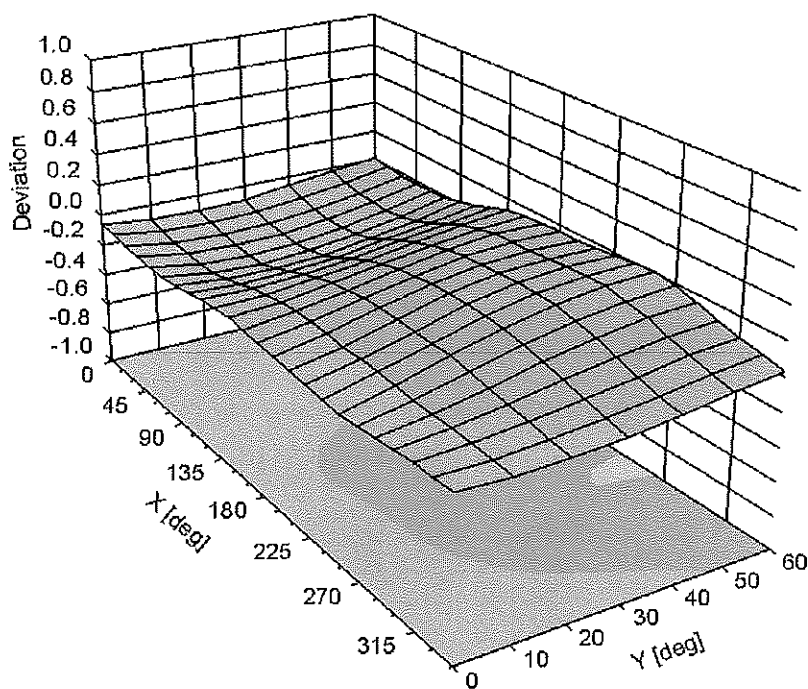
Uncertainty of Linearity Assessment: $\pm 0.6\%$ (k=2)

Conversion Factor Assessment



Deviation from Isotropy in Liquid

Error (ϕ, ϑ), $f = 900 \text{ MHz}$



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

Other Probe Parameters

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

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)	1900	1900
Tissue	Head	Body
Ingredients (% by weight)		
DGBE	44.92	29.44
NaCl	0.18	0.39
Water	54.9	70.17

FCC ID: A3LSPHL720		SAR EVALUATION REPORT		Reviewed by: Quality Manager
Test Dates: 05/26/14 - 05/27/14	DUT Type: Portable Handset			APPENDIX D: Page 1 of 1

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
D	1900	9/30/2013	3022	ES3DV2	1900	Head	1.419	39.22	PASS	PASS	PASS	GMSK	PASS	N/A
G	1900	3/7/2014	3258	ES3DV3	1900	Body	1.566	52.44	PASS	PASS	PASS	GMSK	PASS	N/A

NOTE: While the probes have been calibrated for both a CW and modulated signals, all measurements were performed using communication systems calibrated for CW signals only. Modulations in the table above represent test configurations for which the measurement system has been validated per FCC KDB Publication 865664 D01v01 for scenarios when CW probe calibrations are used with other signal types. SAR systems were validated for modulated signals with a periodic duty cycle, such as GMSK, or with a high peak to average ratio (>5 dB), such as OFDM according to KDB 865664.

FCC ID: A3LSPHL720	 SAR EVALUATION REPORT 	Reviewed by: Quality Manager
Test Dates: 05/26/14 - 05/27/14	DUT Type: Portable Handset	APPENDIX E: Page 1 of 1