



SAR EVALUATION REPORT

Applicant Name:

Samsung Electronics, Co. Ltd.
416, Maetan 3-dong, Yeongtong-gu, Suwon-si,
Gyeonggi-do, 443-742
Republic of Korea

Dates of Testing:

02/27/12, 04/30/12 - 05/04/12

Test Site/Location:

PCTEST Lab, Columbia, MD, USA

Document Serial No.:

OY1204300610.A3L

FCC ID:

A3LSGHT999

APPLICANT:

SAMSUNG ELECTRONICS, CO. LTD.

DUT Type:

Portable Handset

Application Type:

Certification

FCC Rule Part(s):

CFR §2.1093

Model(s):

SGH-T999, SGH-T999V

Band & Mode	Tx Frequency	Conducted Power [dBm]	SAR		
			1 gm Head (W/kg)	1 gm Body-Worn (W/kg)	1 gm Hotspot (W/kg)
GSM/GPRS/EDGE 850	824.20 - 848.80 MHz	32.02	0.15	0.79	0.79
WCDMA/HSPA 850	826.40 - 846.60 MHz	22.89	0.13	0.49	0.49
AWS WCDMA/HSPA	1712.40 - 1752.50 MHz	22.86	0.34	0.99	0.99
GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz	28.89	0.15	0.51	0.51
WCDMA/HSPA 1900	1852.4 - 1907.6 MHz	22.49	0.25	0.68	0.68
2.4 GHz WLAN	2412 - 2462 MHz	16.28	0.05	0.12	0.12
5.8 GHz WLAN	5745 - 5825 MHz	13.67	0.06	0.16	
5.2 GHz WLAN	5180 - 5240 MHz	13.22	0.01	0.04	
5.3 GHz WLAN	5260 - 5320 MHz	13.34	0.03	0.09	
5.5 GHz WLAN	5500 - 5700 MHz	13.54	0.13	0.27	
Bluetooth	2402 - 2480 MHz	10.22	N/A		
Simultaneous SAR per KDB 690783 D01:			0.43	1.26	1.11

Note: Powers in the above table represent output powers for the SAR test configurations and may not represent the highest output powers for all configurations for each mode.

The wireless portable device has been shown to be electrically equivalent to the device FCC ID: A3LSGHI747 with respect to IEEE 802.11a/n 5GHz WLAN mode. Previous SAR data for this mode has been incorporated in this report.

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 5 has been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001), IEEE 1528-2003 and in applicable Industry Canada Radio Standards Specifications (RSS); 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.

PCTEST certifies that no party to this application has been subject to a denial of Federal benefits that includes FCC benefits pursuant to Section 5301 of the Anti-Drug Abuse Act of 1988, 21 U.S.C. 862.


Randy Ortanez
President



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1 DEVICE UNDER TEST

1.1 Device Overview

Band & Mode	Tx Frequency
GSM/GPRS/EDGE 850	824.20 - 848.80 MHz
WCDMA/HSPA 850	826.40 - 846.60 MHz
AWS WCDMA/HSPA	1712.40 - 1752.50 MHz
GSM/GPRS/EDGE 1900	1850.20 - 1909.80 MHz
WCDMA/HSPA 1900	1852.4 - 1907.6 MHz
2.4 GHz WLAN	2412 - 2462 MHz
5.8 GHz WLAN	5745 - 5825 MHz
5.2 GHz WLAN	5180 - 5240 MHz
5.3 GHz WLAN	5260 - 5320 MHz
5.5 GHz WLAN	5500 - 5700 MHz
Bluetooth	2402 - 2480 MHz
NFC	13.56 MHz

1.2 Near Field Communications (NFC) Antenna

This DUT has NFC operations. The NFC antenna is integrated into the standard battery and will be the only battery available from the manufacturer for this model. Therefore all SAR tests were performed with the standard battery which already integrates the NFC antenna. The device restricts the battery used to battery model: EB-L1G6LLA.

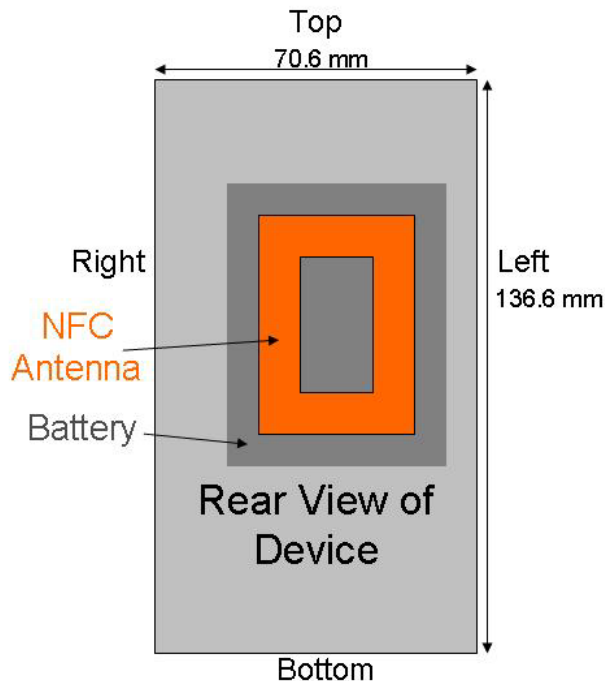


Figure 1-1
NFC Antenna Location

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1.3 DUT Antenna Locations

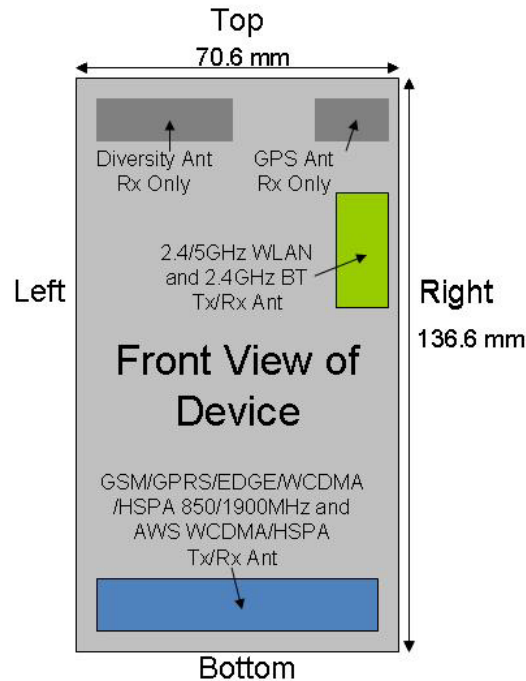


Figure 1-2
DUT Antenna Locations

Table 1-1
Mobile Hotspot Sides for SAR Testing

Mode	Back	Front	Top	Bottom	Right	Left
GPRS 850	Yes	Yes	No	Yes	Yes	Yes
WCDMA 850	Yes	Yes	No	Yes	Yes	Yes
AWS WCDMA	Yes	Yes	No	Yes	Yes	Yes
GPRS 1900	Yes	Yes	No	Yes	Yes	Yes
WCDMA 1900	Yes	Yes	No	Yes	Yes	Yes
2.4 GHz WLAN	Yes	Yes	Yes	No	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 D06 guidance, page 2. The antenna document shows the distances between the transmit antennas and the edges of the device. When the wireless router mode is enabled, all 5 GHz bands are disabled. Therefore 5 GHz WIFI is not considered in this section.

1.4 SAR Test Exclusions Applied

(A) WIFI/BT

Since Wireless Router operations are not allowed by the chipset firmware using 5 GHz WIFI, only 2.4 GHz WIFI Hotspot SAR tests and combinations are considered for SAR with respect to Wireless Router configurations in KDB 941225 D06.

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

The separation between the main antenna and the Bluetooth/WLAN antenna is 84 mm.

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RF Conducted Power of Bluetooth Tx is 10.52 mW (Please refer to the EMC DSS Report for a full set of Bluetooth conducted powers).

Per KDB Publication 648474, **Bluetooth SAR was not required** based on the maximum conducted power, the Bluetooth/WLAN to main antenna separation distance and Body-SAR of the main antenna.

This device supports 20 MHz and 40 MHz Bandwidths for IEEE 802.11n for 5 GHz WIFI only. IEEE 802.11n (20 MHz and 40 MHz Bandwidths) was not evaluated for SAR since the average output power for each bandwidth was not > 0.25 dB higher than IEEE 802.11a modes per KDB 248227.

(B) Licensed Transmitter(s)

This model does not support Simultaneous Voice and Data for the licensed transmitter in any modes except in WCDMA that allows Multi-RAB transmissions that share voice and data operations on a single physical channel.

GSM/GPRS/EDGE DTM is not supported. Therefore GSM Voice cannot transmit simultaneously with GPRS/EDGE Data.

This device is only capable of QPSK HSUPA in the uplink, but is capable of HSPA+ in the downlink. Therefore, no additional SAR tests are required beyond that described for devices with HSUPA in KDB 941225 D01.

When the user utilizes multiple services in WCDMA 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 [DPCCH]) and power control will be adjusted to meet the needs of both services. Therefore, the WCDMA+WLAN scenario also represents the WCDMA Voice/DATA + WLAN Hotspot scenario.

1.5 Power Reduction for SAR

There is no power reduction for any band/mode implemented in this device for SAR purposes.

1.6 Guidance Applied

- FCC KDB 941225 (2G/3G and Hotspot)
- FCC KDB 248227 (802.11)
- FCC KDB 648474 (Simultaneous)
- FCC KDB 865664 (5 GHz)

1.7 Samples Used for 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.

Mode/Band	Serial Number
GSM/GPRS 850/1900	310
WCDMA AWS/850/1900	310
2.4 GHz WLAN	314
5 GHz WLAN	007

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2

INTRODUCTION

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

The safety limits used for the environmental evaluation measurements are based on the criteria published by the American National Standards Institute (ANSI) for localized specific absorption rate (SAR) in IEEE/ANSI C95.1-1992 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz [3] and Health Canada RF Exposure Guidelines Safety Code 6 [24]. The measurement procedure described in IEEE/ANSI C95.3-2002 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave [4] is used for guidance in measuring the Specific Absorption Rate (SAR) due to the RF radiation exposure from the Equipment Under Test (EUT). These criteria for SAR evaluation are similar to those recommended by the International Committee for Non-Ionizing Radiation Protection (ICNIRP) in Biological Effects and Exposure Criteria for Radiofrequency Electromagnetic Fields," Report No. Vol 74. SAR is a measure of the rate of energy absorption due to exposure to an RF transmitting source. SAR values have been related to threshold levels for potential biological hazards.

2.1 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 2-1).

Equation 2-1
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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SAR MEASUREMENT SETUP

3.1 Automated SAR Measurement System

Measurements are performed using the DASY automated dosimetric SAR assessment system. The DASY is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of a high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the SAM phantom containing the head or body equivalent material. The robot is a six-axis industrial robot, performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF). See www.speag.com for more information about the specification of the SAR assessment system.



Figure 3-1
SAR Measurement System



Figure 3-2
Near-Field Probe

Table 3-1
Composition of the Tissue Equivalent Matter

Frequency (MHz)	835	835	1750	1750	1900	1900	2450	2450	5200-5800	5200-5800
Tissue	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Ingredients (% by weight)										
Bactericide	0.1	0.1								
DGBE			47	31	44.92	29.44	7.99	26.7		
HEC	1	1								
NaCl	1.45	0.94	0.4	0.2	0.18	0.39	0.16	0.1		
Sucrose	57	44.9								
Triton X-100							19.97		17.24	
Diethyleneglycol monohexylether									17.24	
Polysorbate (Tween) 80										20
Water	40.45	53.06	52.6	68.8	54.9	70.17	71.88	73.2	65.52	80

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4 DOSIMETRIC ASSESSMENT

4.1 Measurement Procedure

The evaluation was performed using the following procedure:

1. The SAR distribution at the exposed side of the head or body was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the device-head interface and the horizontal grid resolution was 15mm and 15mm for frequencies < 3 GHz in the x and y directions respectively. When applicable, for frequencies above 3 GHz, a 10 mm by 10 mm resolution was used.
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 1 gram cube evaluation. SAR at this fixed point was measured and used as a reference value.
3. Based on the area scan data, the peak area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 32mm x 32mm x 30mm (fine resolution volume scan, zoom scan) was assessed by measuring at least 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual online for more details):
 - a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
 - b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
 - c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete to calculate the SAR drift. If the drift deviated by more than 5%, the SAR test and drift measurements were repeated.
5. For testing 5 GHz devices, finer resolution zoom scans were performed as specified by FCC SAR Measurement Requirements for 3 – 6 GHz, KDB 865664 publication. The 5 GHz zoom scan requires a minimum volume of 24mm x 24mm x 20mm and 7 x 7 x 11 points.

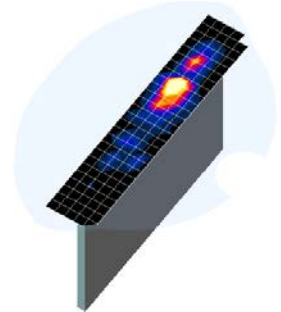


Figure 4-1
Sample SAR Area Scan

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5

DEFINITION OF REFERENCE POINTS

5.1 EAR REFERENCE POINT

Figure 5-2 shows the front, back and side views of the SAM Twin Phantom. The point “M” is the reference point for the center of the mouth, “LE” is the left ear reference point (ERP), and “RE” is the right ERP. The ERP is 15mm posterior to the entrance to the ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5-1. The plane passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck-Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 5-2). 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].

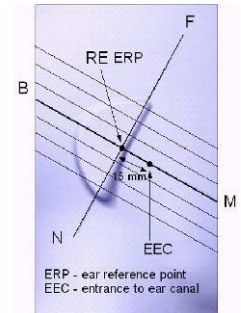


Figure 5-1
Close-Up Side view
of ERP

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 “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Figure 5-3). The “test device reference point” 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 it’s 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

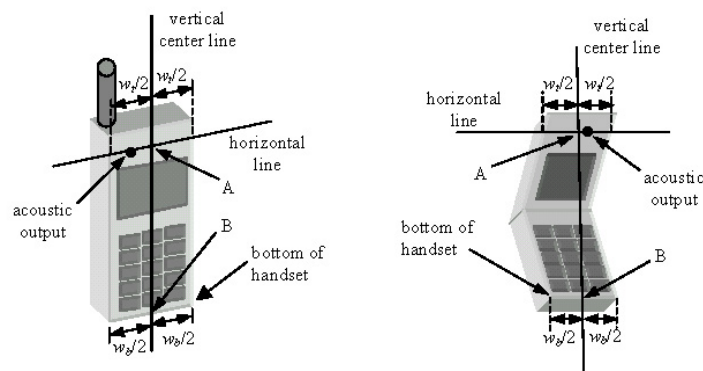


Figure 5-3
Handset Vertical Center & Horizontal Line Reference Points

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6 TEST CONFIGURATION POSITIONS FOR HANDSETS

6.1 Device Holder

The DASY device holder has been 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/Touch

1. The test device was positioned with the handset 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.

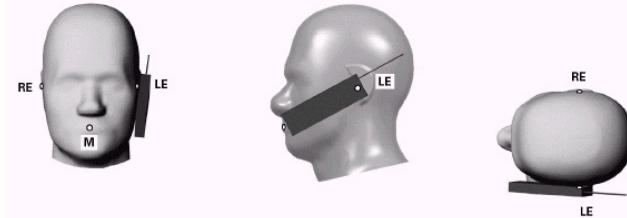


Figure 6-1 Front, Side and Top View of Cheek/Touch Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.
3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (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 phone contact with the ear, the handset was rotated about the line NF 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/Touch 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 degree.
2. The phone was then rotated around the horizontal line by 15 degree.
3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches 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. 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).

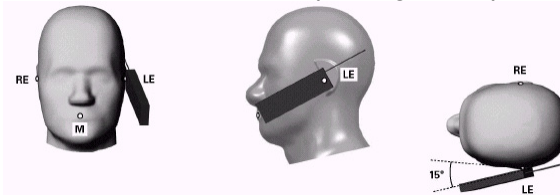


Figure 6-2 Front, Side and Top View of Ear/15° Tilt Position

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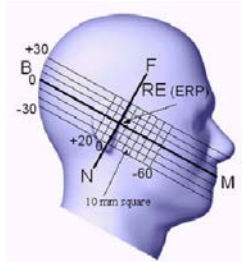


Figure 6-3
Side view w/ relevant markings



Figure 6-4 Body SAR Sample Photo
(Not Actual EUT)

6.4 Body-Worn Accessory Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attached to the device and positioned against a flat phantom in a normal use configuration (see Figure 6-4). A device with a headset output is tested with a headset connected to the device.

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.

6.5 Wireless Router Configurations

Some battery-operated handsets have the capability to transmit and receive internet connectivity through simultaneous transmission of WIFI in conjunction with a separate licensed transmitter. The FCC has provided guidance in KDB Publication 941225 D06 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 with antennas 2.5 cm or closer to the edge of the device, 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. Therefore, SAR must be evaluated for each frequency transmission and mode separately and summed with the WIFI transmitter according to KDB 648474 publication procedures. The "Portable Hotspot" feature on the handset was NOT activated, to ensure the SAR measurements were evaluated for a single transmission frequency RF signal.

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7 FCC 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)
SPATIAL PEAK SAR Brain	1.6	8.0
SPATIAL AVERAGE SAR Whole Body	0.08	0.4
SPATIAL PEAK SAR Hands, Feet, Ankles, Wrists	4.0	20

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

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

8.1 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.

8.2 SAR Measurement Conditions for WCDMA

8.2.1 Output Power Verification

Maximum output power is measured on the High, Middle and Low channels for each applicable transmission band according to the general descriptions in section 5.2 of 3GPP TS 34.121, using the appropriate RMC or AMR with TPC (transmit power control) set to all "1s".

8.2.2 Head SAR Measurements for Handsets

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all "1s". SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than 0.25 dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signaling radio bearer) using the exposure configuration that resulted in the highest SAR for that RF channel in the 12.2 kbps RMC mode.

8.2.3 Body SAR Measurements

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits all "1s".

8.2.4 SAR Measurements for Handsets with Rel 5 HSDPA

Body SAR for HSDPA is not required for handsets with HSDPA capabilities when the maximum average output power of each RF channel with HSDPA active is less than 0.25 dB higher than that measured without HSDPA using 12.2 kbps RMC and the maximum SAR for 12.2 kbps RMC is $\leq 75\%$ of the SAR limit. Otherwise, SAR is measured for HSDPA, using an FRC with H-Set 1 in Sub-test 1 and a 12.2 kbps RMC configured in Test Loop Mode 1, using the highest body SAR configuration measured in 12.2 kbps RMC without HSDPA, on the maximum output channel with the body exposure configuration that resulted in the highest SAR in 12.2 kbps RMC mode for that RF channel.

The H-set used in FRC for HSDPA should be configured according to the UE category of a test device. The number of HS-DSCH/HSPDSCHs, HARQ processes, minimum inter-TTI interval,

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transport block sizes and RV coding sequence are defined by the applicable H-set. To maintain a consistent test configuration and stable transmission conditions, QPSK is used in the FRC for SAR testing. HS-DPCCH should be configured with a CQI feedback cycle of 2 ms to maintain a constant rate of active CQI slots. DPCCH and DPDCH gain factors of $\beta_c=9$ and $\beta_d=15$, and power offset parameters of $\Delta_{ACK} = \Delta_{NACK} = 5$ and $\Delta_{CQI}=2$ is used. The CQI value is determined by the UE category, transport block size, number of HS-PDSCHs and modulation used in the FRC.

8.2.5 SAR Measurements for Handsets with Rel 6 HSUPA

Body SAR for HSUPA is not required when the maximum average output of each RF channel with HSUPA/HSDPA active is less than 0.25 dB higher than as measured without HSUPA/HSDPA using 12.2 kbps RMC and maximum SAR for 12.2 kbps RMC is $\leq 75\%$ of the SAR limit. Otherwise SAR is measured on the maximum output channel for the body exposure configuration produced highest SAR in 12.2 kbps RMC for that RF channel, using the additional procedures under "Release 6 HSPA data devices"

Head SAR for VOIP operations under HSPA is not required when maximum average output of each RF channel with HSPA is less than 0.25 dB higher than as measured using 12.2 kbps RMC. Otherwise SAR is measured using same HSPA configuration as used for body SAR.

Sub-test	β_c	β_d	β_d (SF)	β_c/β_d	$\beta_{hs}^{(1)}$	β_{ec}	β_{ed}	β_{ed} (SF)	β_{ed} (codes)	CM ⁽²⁾ (dB)	MPR (dB)	AG ⁽⁴⁾ Index	E-TFCI
1	11/15 ⁽³⁾	15/15 ⁽³⁾	64	11/15 ⁽³⁾	22/15	209/225	1039/225	4	1	1.0	0.0	20	75
2	6/15	15/15	64	6/15	12/15	12/15	94/75	4	1	3.0	2.0	12	67
3	15/15	9/15	64	15/9	30/15	30/15	$\beta_{d1}: 47/15$ $\beta_{d2}: 47/15$	4	2	2.0	1.0	15	92
4	2/15	15/15	64	2/15	4/15	2/15	56/75	4	1	3.0	2.0	17	71
5	15/15 ⁽⁴⁾	15/15 ⁽⁴⁾	64	15/15 ⁽⁴⁾	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1: Δ_{ACK} , Δ_{NACK} and $\Delta_{CQI} = 8 \Leftrightarrow A_{hs} = \beta_{hs}/\beta_c = 30/15 \Leftrightarrow \beta_{hs} = 30/15 * \beta_c$.

Note 2: CM = 1 for $\beta_c/\beta_d = 12/15$, $\beta_{hs}/\beta_c = 24/15$. For all other combinations of DPDCH, DPCCH, HS-DPCCH, E-DPDCH and E-DPCCH the MPR is based on the relative CM difference.

Note 3: For subtest 1 the β_c/β_d ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 10/15$ and $\beta_d = 15/15$.

Note 4: For subtest 5 the β_c/β_d ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signaled gain factors for the reference TFC (TF1, TF1) to $\beta_c = 14/15$ and $\beta_d = 15/15$.

Note 5: Testing UE using E-DPDCH Physical Layer category 1 Sub-test 3 is not required according to TS 25.306 Table 5.1g.

Note 6: β_{ed} can not be set directly; it is set by Absolute Grant Value.

8.3 SAR Testing with 802.11 Transmitters

Normal network operating configurations are not suitable for measuring the SAR of 802.11 a/b/g/n transmitters. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure the results are consistent and reliable. See KDB Publication 248227 for more details.

8.3.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity

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should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

8.3.2 Frequency Channel Configurations [27]

For 2.4 GHz, the highest average RF output power channel between the low, mid and high channel at the lowest data rate was selected for SAR evaluation in 802.11b mode. 802.11g/n modes and higher data rates for 802.11b were additionally evaluated for SAR if the output power of the respective mode was 0.25 dB or higher than the powers of the SAR configurations tested in the 802.11b mode.

For 5 GHz, the highest average RF output power channel across the default test channels at the lowest data rate was selected for SAR evaluation in 802.11a. When the adjacent channels are higher in power than the default channels, these "required channels" were considered instead of the default channels for SAR testing. 802.11n modes and higher data rates for 802.11a/n were evaluated only if the respective mode was 0.25 dB or higher than the 802.11a mode.

If the maximum extrapolated peak SAR of the zoom scan for the highest output channel was less than 1.6 W/kg or if the 1g averaged SAR was less than 0.8 W/kg, SAR testing was not required for the other test channels in the band.

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9 RF CONDUCTED POWERS

9.1 GSM Conducted Powers

		Maximum Burst-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
Cellular	128	32.08	31.99	29.62	28.45	27.53	26.44	24.87	23.14	21.34
	190	32.02	32.04	29.67	28.79	27.69	26.67	25.10	23.48	21.56
	251	32.19	32.21	29.85	28.90	27.61	26.88	25.22	23.66	21.77
PCS	512	28.79	28.82	26.94	25.79	24.42	25.58	23.37	21.76	20.66
	661	28.89	28.98	26.92	25.72	24.23	25.45	23.21	21.53	20.36
	810	29.03	29.13	27.11	25.62	24.22	25.71	23.47	21.79	20.67

		Calculated Maximum Frame-Averaged Output Power								
		Voice	GPRS/EDGE Data (GMSK)				EDGE Data (8-PSK)			
Band	Channel	GSM [dBm] CS (1 Slot)	GPRS [dBm] 1 Tx Slot	GPRS [dBm] 2 Tx Slot	GPRS [dBm] 3 Tx Slot	GPRS [dBm] 4 Tx Slot	EDGE [dBm] 1 Tx Slot	EDGE [dBm] 2 Tx Slot	EDGE [dBm] 3 Tx Slot	EDGE [dBm] 4 Tx Slot
Cellular	128	23.05	22.96	23.60	24.19	24.52	17.41	18.85	18.88	18.33
	190	22.99	23.01	23.65	24.53	24.68	17.64	19.08	19.22	18.55
	251	23.16	23.18	23.83	24.64	24.60	17.85	19.20	19.40	18.76
PCS	512	19.76	19.79	20.92	21.53	21.41	16.55	17.35	17.50	17.65
	661	19.86	19.95	20.90	21.46	21.22	16.42	17.19	17.27	17.35
	810	20.00	20.10	21.09	21.36	21.21	16.68	17.45	17.53	17.66

Note: Both burst-averaged and calculated frame-averaged powers are included. Frame-averaged power was calculated from the measured burst-averaged power by converting the slot powers into linear units and calculating the energy over 8 timeslots.

The bolded GPRS modes were selected according to the highest frame-averaged output power table according to KDB 941225 D03.

CS1 coding scheme was used in GPRS output power measurements and SAR Testing, as a condition where GMSK modulation was ensured. Investigation has shown that CS1 - CS4 settings do not have any impact on the output levels in the GPRS modes.

MCS7 coding scheme was used to measure the output powers for EDGE since investigation has shown that choosing MCS7 coding scheme will ensure 8-PSK modulation and that MCS settings that produce 8-PSK modulation do not have any impact on the output power levels.

GSM Class: B
GPRS Multislot class: 12 (max 4 Tx Uplink slots)
EDGE Multislot class: 12 (max 4Tx Uplink slots)
DTM Multislot Class: N/A

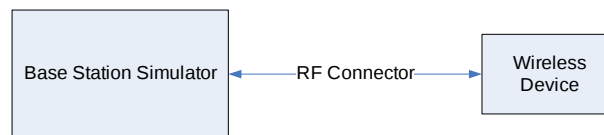


Figure 9-1
Power Measurement Setup

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9.2 HSPA Conducted Powers

3GPP Release Version	Mode	3GPP 34.121 Subtest	Cellular Band [dBm]			AWS Band [dBm]			PCS Band [dBm]			MPR [dB]
			4132	4183	4233	1312	1412	1862	9262	9400	9538	
99	WCDMA	12.2 kbps RMC	22.82	22.89	22.71	22.77	22.86	22.64	22.49	22.15	21.85	-
99		12.2 kbps AMR	22.80	22.89	22.65	22.73	22.87	22.71	22.47	22.12	21.85	-
6	HSDPA	Subtest 1	21.95	22.08	21.89	21.87	21.94	21.98	21.52	21.34	21.12	0
6		Subtest 2	22.23	22.12	22.13	21.82	22.16	22.07	21.85	21.72	21.65	0
6		Subtest 3	21.81	21.67	21.65	21.46	21.46	21.71	21.22	21.10	21.24	0.5
6		Subtest 4	21.56	21.71	21.76	21.14	21.14	21.49	21.03	21.16	20.58	0.5
6	HSUPA	Subtest 1	21.47	21.82	21.84	21.87	21.88	21.28	21.06	21.20	20.90	0
6		Subtest 2	19.34	19.27	18.73	19.04	18.86	18.93	18.95	18.77	18.25	2
6		Subtest 3	21.22	20.89	21.32	20.93	20.96	20.84	20.79	20.79	20.13	1
6		Subtest 4	20.18	20.65	20.99	20.89	20.81	20.25	20.26	20.28	20.25	2
6		Subtest 5	21.47	21.68	21.16	21.39	20.70	21.66	20.80	21.06	21.09	0

WCDMA SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.

It is expected by the manufacturer that MPR for some HSUPA subtests may be up to 2 dB more than specified by 3GPP, but also as low as 0 dB according to the chipset implementation in this model. Detailed information is included in the operational description explaining how the MPR is applied for this model.



Figure 9-2
Power Measurement Setup

9.3 WLAN Conducted Powers

Table 9-1
IEEE 802.11b Average RF Power

Mode	Freq [MHz]	Channel	802.11b Conducted Power [dBm]			
			Data Rate [Mbps]			
			1	2	5.5	11
802.11b	2412	1	15.66	15.44	15.76	15.66
802.11b	2437	6	15.67	15.74	15.86	15.83
802.11b	2462	11	16.28	16.22	15.79	16.15

Table 9-2
IEEE 802.11g Average RF Power

Mode	Freq [MHz]	Channel	Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11g	2412	1	13.79	14.01	14.10	13.79	13.85	13.72	13.93	13.84
802.11g	2437	6	14.19	14.29	13.99	13.71	13.86	13.71	14.33	14.31
802.11g	2462	11	14.35	14.55	14.72	14.47	14.68	14.36	14.53	14.49

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Table 9-3
IEEE 802.11n Average RF Power

Mode	Freq [MHz]	Channel	Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	20	26	39	52	58	65
802.11n	2412	1	12.41	12.56	12.46	12.46	12.59	12.34	12.34	12.61
802.11n	2437	6	12.71	12.79	13.00	13.02	13.18	12.91	13.13	13.09
802.11n	2462	11	13.18	13.27	13.27	13.30	13.43	13.23	13.37	13.32

Table 9-4
IEEE 802.11a Average RF Power

Mode	Freq [MHz]	Channel	Conducted Power [dBm]							
			Data Rate [Mbps]							
			6	9	12	18	24	36	48	54
802.11a	5180	36*	13.01	13.24	13.37	13.12	13.25	13.15	13.27	13.11
802.11a	5200	40	13.11	13.34	13.35	13.18	13.37	13.10	13.26	13.24
802.11a	5220	44	13.11	13.40	13.36	13.27	13.33	13.11	13.31	13.23
802.11a	5240	48*	13.22	13.41	13.46	13.17	13.37	13.08	13.34	13.40
802.11a	5260	52*	13.22	13.44	13.56	13.24	13.40	13.23	13.40	13.44
802.11a	5280	56	13.30	13.40	13.47	13.31	13.51	13.32	13.40	13.51
802.11a	5300	60	13.31	13.42	13.50	13.30	13.41	13.33	13.46	13.52
802.11a	5320	64*	13.34	13.52	13.55	13.31	13.50	13.34	13.51	13.45
802.11a	5500	100	13.13	13.45	13.51	13.31	13.21	13.37	13.29	13.26
802.11a	5520	104*	13.29	13.43	13.46	13.25	13.52	13.27	13.37	13.41
802.11a	5540	108	13.14	13.34	13.52	13.33	13.36	13.40	13.33	13.39
802.11a	5560	112	13.41	13.51	13.55	13.32	13.37	13.49	13.41	13.33
802.11a	5580	116*	13.42	13.58	13.63	13.35	13.49	13.54	13.47	13.54
802.11a	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11a	5660	132	13.54	13.62	13.58	13.11	13.04	13.09	13.11	13.12
802.11a	5680	136*	12.94	13.25	13.21	13.02	13.20	13.22	13.31	13.31
802.11a	5700	140	13.23	13.24	13.40	12.94	13.26	13.20	13.33	13.14
802.11a	5745	149*	13.50	13.60	13.77	13.57	13.84	13.51	13.74	13.67
802.11a	5765	153	13.67	13.75	13.72	13.59	13.64	13.52	13.80	13.78
802.11a	5785	157*	13.49	13.71	13.58	13.45	13.58	13.50	13.53	13.60
802.11a	5805	161*	13.27	13.69	13.64	13.36	13.52	13.37	13.43	13.43
802.11a	5825	165	13.38	13.40	13.74	13.14	13.44	13.33	13.40	13.41

Per FCC KDB Publication 443999 and RSS-210 A9.2(3), transmission on channels which overlap the 5600-5650 MHz is prohibited as a client. This device does not transmit any beacons or initiate any transmissions in 5.3 and 5.5 GHz Band. (*) – indicates default channels per KDB Publication 248227. When the adjacent channels are higher in power then the default channels, these “required channels” are considered instead of the default channels for SAR testing.

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Table 9-5
IEEE 802.11n (20 MHz) Average RF Power

Mode	Freq [MHz]	Channel	Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5	13	20	26	39	52	58	65
802.11n	5180	36*	12.95	12.92	12.83	12.86	13.05	12.82	13.15	13.00
802.11n	5200	40	12.82	12.94	12.79	12.91	13.00	12.75	12.91	12.94
802.11n	5220	44	12.87	12.83	12.77	12.81	13.01	12.82	13.00	12.97
802.11n	5240	48*	12.92	13.17	13.01	13.04	13.41	13.17	13.33	13.32
802.11n	5260	52*	13.22	13.20	13.04	13.27	13.34	13.22	13.41	13.33
802.11n	5280	56	13.30	13.29	13.27	13.24	13.42	13.22	13.40	13.38
802.11n	5300	60	13.21	13.31	13.29	13.34	13.35	13.11	13.36	13.44
802.11n	5320	64*	13.25	13.44	13.34	13.34	13.52	13.30	13.44	13.51
802.11n	5500	100	13.04	13.10	13.12	13.14	13.29	13.14	13.24	13.24
802.11n	5520	104*	13.01	13.12	13.06	13.11	13.37	13.01	13.14	13.22
802.11n	5540	108	13.18	13.14	13.18	13.17	13.44	13.21	13.34	13.36
802.11n	5560	112	13.21	13.24	13.22	13.14	13.37	13.20	13.31	13.31
802.11n	5580	116*	13.21	13.24	13.41	13.34	13.43	13.41	13.40	13.41
802.11n	5600	120	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5620	124	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5640	128	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5660	132	13.37	13.42	13.40	13.35	13.45	13.27	13.47	13.45
802.11n	5680	136*	13.42	13.34	13.32	13.41	13.46	13.38	13.44	13.41
802.11n	5700	140	13.41	13.32	13.37	13.44	13.55	13.42	13.44	13.41
802.11n	5745	149*	13.51	13.59	13.51	13.44	13.71	13.52	13.73	13.69
802.11n	5765	153	13.15	13.05	13.20	13.26	13.37	13.21	13.17	13.00
802.11n	5785	157*	13.42	13.35	13.31	13.36	13.55	13.25	13.45	13.40
802.11n	5805	161*	13.02	13.34	13.33	13.34	13.50	13.32	13.42	13.19
802.11n	5825	165	13.25	13.28	13.31	13.25	13.28	13.26	13.40	13.30

Table 9-6
IEEE 802.11n (40 MHz) Average RF Power

Mode	Freq [MHz]	Channel	802.11n (5GHz) Conducted Power [dBm]							
			Data Rate [Mbps]							
			6.5/7.2	13/14.4	19.5/21.7	26/28.9	39/43.4	52/57.8	58.5/65	65/72.2
802.11n	5190	38*	12.66	12.38	12.61	12.66	12.67	12.77	12.56	12.82
802.11n	5230	46	12.52	12.88	12.47	12.49	12.67	12.79	12.43	12.56
802.11n	5270	54	12.63	12.84	12.42	12.46	12.72	12.72	12.44	12.53
802.11n	5310	62*	12.51	12.59	12.80	12.33	12.50	12.71	12.73	12.80
802.11n	5510	102*	12.48	12.28	12.31	12.50	12.39	12.54	12.53	12.40
802.11n	5550	110	12.30	12.56	12.48	12.45	12.43	12.65	12.44	12.74
802.11n	5590	118	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5630	126	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
802.11n	5670	134	12.69	12.75	12.77	12.89	12.85	12.92	12.89	12.93
802.11n	5755	151*	12.79	12.75	12.92	12.82	13.02	13.01	12.99	13.05
802.11n	5795	159	12.80	12.79	12.89	12.83	13.05	12.93	12.92	12.92

Per FCC KDB Publication 443999 and RSS-210 A9.2(3), transmission on channels which overlap the 5600-5650 MHz is prohibited as a client. This device does not transmit any beacons or initiate any transmissions in 5.3 and 5.5 GHz Bands. (*) – indicates default channels per KDB Publication 248227. When the adjacent channels are higher in power then the default channels, these “required channels” are considered instead of the default channels for SAR testing.

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Justification for reduced test configurations for WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes:

- For 2.4 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11b were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
- For 5 GHz, highest average RF output power channel for the lowest data rate for IEEE 802.11a were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11n 20 MHz Bandwidth and 802.11n 40 MHz Bandwidth) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
- When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6 W/kg and the 1g averaged SAR is <0.8 W/kg, SAR testing on other channels is not required. Otherwise, the other default (or corresponding required) test channels were additionally tested using the lowest data rate.
- The bolded data rate and channel above were tested for SAR.

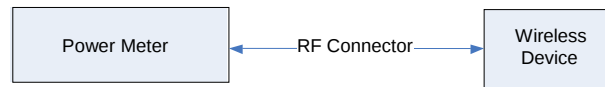


Figure 9-3
Power Measurement Setup

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10 SYSTEM VERIFICATION

10.1 Tissue Verification

Table 10-1
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
5/3/2012	835H	22.8	820	0.901	40.98	0.898	41.571	0.33%	-1.42%
			835	0.914	40.78	0.900	41.500	1.56%	-1.73%
			850	0.928	40.63	0.916	41.500	1.31%	-2.10%
5/3/2012	1750H	22.6	1710	1.384	38.97	1.348	40.136	2.67%	-2.91%
			1750	1.423	38.78	1.370	40.100	3.87%	-3.29%
			1790	1.460	38.58	1.394	40.020	4.73%	-3.60%
5/2/2012	1900H	22.0	1850	1.411	39.16	1.400	40.000	0.79%	-2.10%
			1880	1.442	39.03	1.400	40.000	3.00%	-2.43%
			1910	1.469	38.92	1.400	40.000	4.93%	-2.70%
5/2/2012	2450H	22.9	2401	1.827	37.92	1.758	39.298	3.92%	-3.51%
			2450	1.883	37.70	1.800	39.200	4.61%	-3.83%
			2499	1.940	37.47	1.852	39.135	4.75%	-4.25%
02/27/2012	5200H-5800H	22.3	5200	4.553	35.71	4.660	36.000	-2.30%	-0.81%
			5240	4.598	35.70	4.700	35.960	-2.17%	-0.72%
			5320	4.671	35.60	4.780	35.880	-2.28%	-0.78%
			5500	4.847	35.27	4.965	35.650	-2.38%	-1.07%
			5660	5.014	35.16	5.130	35.440	-2.26%	-0.79%
			5765	5.129	34.96	5.235	35.335	-2.02%	-1.06%
			5800	5.159	34.94	5.270	35.300	-2.11%	-1.02%
5/2/2012	835B	23.0	820	0.981	53.33	0.969	55.284	1.24%	-3.53%
			835	0.994	53.21	0.970	55.200	2.47%	-3.61%
			850	1.010	53.11	0.988	55.154	2.23%	-3.71%
5/4/2012	1750B	21.6	1710	1.493	51.23	1.460	53.540	2.26%	-4.31%
			1750	1.537	51.05	1.490	53.430	3.15%	-4.45%
			1790	1.580	50.88	1.510	53.330	4.64%	-4.59%
5/2/2012	1900B	22.1	1850	1.477	51.66	1.520	53.300	-2.83%	-3.08%
			1880	1.514	51.56	1.520	53.300	-0.39%	-3.26%
			1910	1.544	51.49	1.520	53.300	1.58%	-3.40%
4/30/2012	2450B	22.8	2401	1.937	51.01	1.903	52.765	1.79%	-3.33%
			2450	1.893	50.32	1.950	52.700	-2.92%	-4.52%
			2499	2.072	50.33	2.019	52.638	2.63%	-4.38%
02/27/2012	5200B-5800B	22.3	5200	5.210	47.52	5.299	49.014	-1.68%	-3.05%
			5240	5.285	47.49	5.346	48.933	-1.14%	-2.95%
			5320	5.394	47.31	5.439	48.607	-0.83%	-2.67%
			5500	5.656	46.78	5.650	48.580	0.11%	-3.71%
			5660	5.903	46.51	5.837	48.363	1.13%	-3.83%
			5765	6.069	46.15	5.959	48.220	1.85%	-4.29%
			5800	6.116	46.12	6.000	48.200	1.93%	-4.32%

Note: KDB Publication 450824 was ensured to be applied for probe calibration frequencies greater than or equal to 50 MHz of the DUT frequencies.

The above measured tissue parameters were used in the DASY software to perform interpolation via the DASY software to determine actual dielectric parameters at the test frequencies (per IEEE 1528 6.6.1.2). The SAR test plots may slightly differ from the table above since the DASY software rounds to three significant digits.

Probe calibration used within ± 100 MHz of the test frequency in either 5.725 - 5.85 or 5.47-5.725 GHz is acceptable per KDB Publication 865664 since the design of the SAR probe supports the extended frequency, provided the DASY software version recommended is used for the tests, and the expanded calibration uncertainty ($k=2$) is less than or equal to 15% (See SAR probe calibration certificate for this information). The dielectric and conductivities measured are within 10% and 5% respectively of the target parameters specified in Supplement C 01-01.

10.2 Measurement Procedure for Tissue verification

- 1) The network analyzer and probe system was configured and calibrated.

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- 2) The probe was immersed in the sample which 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 $j = \sqrt{-1}$.

10.3 Test System Verification

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

Table 10-2
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 (%)
835	Head	05/03/2012	24.3	23.6	0.100	4d026	3258	1.01	9.460	10.100	6.77%
1750	Head	05/03/2012	22.5	21.8	0.100	1051	3022	3.79	36.600	37.900	3.55%
1900	Head	05/02/2012	23.6	22.3	0.100	5d080	3209	4.03	39.900	40.300	1.00%
2450	Head	05/02/2012	22.4	21.1	0.100	719	3022	5.57	53.800	55.700	3.53%
5200	Head	02/27/2012	23.8	22.7	0.100	1007	3589	7.27	79.800	72.700	-8.90%
5500	Head	02/27/2012	24.1	22.8	0.100	1007	3589	7.90	86.300	79.000	-8.46%
5800	Head	02/27/2012	24.0	22.9	0.100	1007	3589	7.58	79.400	75.800	-4.53%
835	Body	05/02/2012	23.9	22.7	0.100	4d026	3258	0.995	9.660	9.950	3.00%
1750	Body	05/04/2012	23.7	22.6	0.100	1051	3209	3.88	37.600	38.800	3.19%
1900	Body	05/02/2012	24.3	22.9	0.100	5d080	3209	3.86	40.900	38.600	-5.62%
2450	Body	04/30/2012	23.1	21.3	0.100	719	3022	4.88	51.300	48.800	-4.87%
5200	Body	02/27/2012	23.8	22.6	0.100	1007	3589	7.79	75.500	77.900	3.18%
5500	Body	02/27/2012	24.1	22.6	0.100	1007	3589	8.74	81.300	87.400	7.50%
5800	Body	02/27/2012	24.0	22.8	0.100	1007	3589	7.96	75.300	79.600	5.71%

Note: Per KDB Publication 865664, when a reference dipole is not defined within ± 100 MHz of the test frequency, the system verification may be conducted within ± 200 MHz of the center frequency of the measurement frequencies if the SAR probe calibration is valid and the same tissue-equivalent matter is used for verification and test measurements.

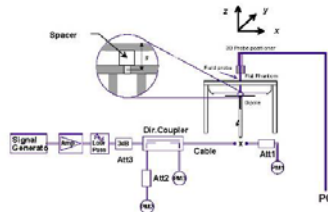


Figure 10-1
System Verification Setup Diagram



Figure 10-2
System Verification Setup Photo

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11 SAR DATA SUMMARY

11.1 Standalone Head SAR Data

Table 11-1
GSM 850 Head SAR Results

MEASUREMENT RESULTS								
FREQUENCY		Mode/Band	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	SAR (1g)
MHz	Ch.							(W/kg)
836.60	190	GSM 850	32.02	-0.06	Right	Touch	310	0.152
836.60	190	GSM 850	32.02	0.00	Right	Tilt	310	0.101
836.60	190	GSM 850	32.02	0.00	Left	Touch	310	0.131
836.60	190	GSM 850	32.02	0.01	Left	Tilt	310	0.090
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					Head 1.6 W/kg (mW/g) averaged over 1 gram			

Table 11-2
WCDMA 850 Head SAR Results

MEASUREMENT RESULTS								
FREQUENCY		Mode/Band	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	SAR (1g)
MHz	Ch.							(W/kg)
836.60	4183	WCDMA 850	22.89	0.04	Right	Touch	310	0.133
836.60	4183	WCDMA 850	22.89	0.17	Right	Tilt	310	0.077
836.60	4183	WCDMA 850	22.89	0.02	Left	Touch	310	0.110
836.60	4183	WCDMA 850	22.89	0.00	Left	Tilt	310	0.074
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					Head 1.6 W/kg (mW/g) averaged over 1 gram			

Table 11-3
AWS WCDMA Head SAR Results

MEASUREMENT RESULTS								
FREQUENCY		Mode/Band	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	SAR (1g)
MHz	Ch.							(W/kg)
1730.40	1412	AWS WCDMA	22.86	0.17	Right	Touch	310	0.343
1730.40	1412	AWS WCDMA	22.86	0.11	Right	Tilt	310	0.180
1730.40	1412	AWS WCDMA	22.86	0.05	Left	Touch	310	0.270
1730.40	1412	AWS WCDMA	22.86	0.18	Left	Tilt	310	0.132
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					Head 1.6 W/kg (mW/g) averaged over 1 gram			

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Table 11-4
GSM 1900 Head SAR Results

MEASUREMENT RESULTS								
FREQUENCY		Mode	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	SAR (1g)
MHz	Ch.							(W/kg)
1880.00	661	GSM 1900	28.89	-0.06	Right	Touch	310	0.113
1880.00	661	GSM 1900	28.89	0.11	Right	Tilt	310	0.078
1880.00	661	GSM 1900	28.89	-0.11	Left	Touch	310	0.145
1880.00	661	GSM 1900	28.89	-0.06	Left	Tilt	310	0.063
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					Head 1.6 W/kg (mW/g) averaged over 1 gram			

Table 11-5
WCDMA 1900 Head SAR Results

MEASUREMENT RESULTS								
FREQUENCY		Mode	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	SAR (1g)
MHz	Ch.							(W/kg)
1852.40	9262	WCDMA 1900	22.49	0.01	Right	Touch	310	0.182
1852.40	9262	WCDMA 1900	22.49	-0.06	Right	Tilt	310	0.133
1852.40	9262	WCDMA 1900	22.49	-0.11	Left	Touch	310	0.247
1852.40	9262	WCDMA 1900	22.49	-0.08	Left	Tilt	310	0.136
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population					Head 1.6 W/kg (mW/g) averaged over 1 gram			

For WCDMA 1900 mode, output powers across low, mid, and high channels deviated by > 0.5dB, therefore low channel was evaluated for SAR.

Table 11-6
2.4 GHz WLAN Head SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	SAR (1g)
MHz	Ch.									(W/kg)
2462	11	IEEE 802.11b	DSSS	16.28	0.06	Right	Touch	314	1	0.032
2462	11	IEEE 802.11b	DSSS	16.28	0.00	Right	Tilt	314	1	0.026
2462	11	IEEE 802.11b	DSSS	16.28	0.20	Left	Touch	314	1	0.051
2462	11	IEEE 802.11b	DSSS	16.28	0.18	Left	Tilt	314	1	0.029
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Head 1.6 W/kg (mW/g) averaged over 1 gram				

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Table 11-7
5.8 GHz WLAN Head SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	SAR (1g)
MHz	Ch.									(W/kg)
5765	153	IEEE 802.11a	OFDM	13.67	0.19	Right	Touch	007	6	0.048
5765	153	IEEE 802.11a	OFDM	13.67	0.05	Right	Tilt	007	6	0.057
5765	153	IEEE 802.11a	OFDM	13.67	-0.05	Left	Touch	007	6	0.059
5765	153	IEEE 802.11a	OFDM	13.67	0.03	Left	Tilt	007	6	0.055
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Head 1.6 W/kg (mW/g) averaged over 1 gram				

Table 11-8
5.2 GHz WLAN Head SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	SAR (1g)
MHz	Ch.									(W/kg)
5240	48	IEEE 802.11a	OFDM	13.22	-0.07	Right	Touch	007	6	0.001
5240	48	IEEE 802.11a	OFDM	13.22	0.03	Right	Tilt	007	6	0.003
5240	48	IEEE 802.11a	OFDM	13.22	0.02	Left	Touch	007	6	0.010
5240	48	IEEE 802.11a	OFDM	13.22	-0.02	Left	Tilt	007	6	0.003
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Head 1.6 W/kg (mW/g) averaged over 1 gram				

Table 11-9
5.3 GHz WLAN Head SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	SAR (1g)
MHz	Ch.									(W/kg)
5320	64	IEEE 802.11a	OFDM	13.34	-0.06	Right	Touch	007	6	0.001
5320	64	IEEE 802.11a	OFDM	13.34	-0.06	Right	Tilt	007	6	0.022
5320	64	IEEE 802.11a	OFDM	13.34	-0.02	Left	Touch	007	6	0.025
5320	64	IEEE 802.11a	OFDM	13.34	0.07	Left	Tilt	007	6	0.011
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Head 1.6 W/kg (mW/g) averaged over 1 gram				

Table 11-10
5.5 - 5.7 GHz WLAN Head SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Side	Test Position	Device Serial Number	Data Rate (Mbps)	SAR (1g)
MHz	Ch.									(W/kg)
5660	132	IEEE 802.11a	OFDM	13.54	0.02	Right	Touch	007	6	0.091
5660	132	IEEE 802.11a	OFDM	13.54	-0.08	Right	Tilt	007	6	0.095
5660	132	IEEE 802.11a	OFDM	13.54	0.21	Left	Touch	007	6	0.126
5660	132	IEEE 802.11a	OFDM	13.54	0.10	Left	Tilt	007	6	0.125
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Head 1.6 W/kg (mW/g) averaged over 1 gram				

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11.2 Standalone Body-Worn SAR Data

Table 11-11
Licensed Transmitter Body-Worn SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of Time Slots	Side	SAR (1g)
MHz	Ch.									(W/kg)
836.60	190	GSM 850	GSM	32.02	0.04	1.0 cm	310	1	back	0.617
836.60	190	GSM 850	GPRS	27.69	0.03	1.0 cm	310	4	back	0.786
836.60	4183	WCDMA 850	RMC	22.89	-0.03	1.0 cm	310	N/A	back	0.486
1712.40	1312	AWS WCDMA	RMC	22.77	-0.01	1.0 cm	310	N/A	back	0.983
1730.40	1412	AWS WCDMA	RMC	22.86	-0.04	1.0 cm	310	N/A	back	0.810
1752.50	1862	AWS WCDMA	RMC	22.64	0.08	1.0 cm	310	N/A	back	0.986
1880.00	661	GSM 1900	GSM	28.89	-0.07	1.0 cm	310	1	back	0.304
1880.00	661	GSM 1900	GPRS	25.72	-0.05	1.0 cm	310	3	back	0.513
1852.40	9262	WCDMA 1900	RMC	22.49	-0.02	1.0 cm	310	N/A	back	0.680
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram				

Note:

1. For GPRS and WCDMA modes, Hotspot SAR Data was considered to determine body-worn SAR compliance per FCC KDB Publication 941225 D06.
2. For WCDMA 1900 mode, output powers across low, mid, and high channels deviated by > 0.5dB, therefore low channel was evaluated for SAR.

Table 11-12
WLAN Body-Worn SAR Results

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	SAR (1g)
MHz	Ch.									(W/kg)
2462	11	IEEE 802.11b	DSSS	16.28	0.03	1.0 cm	314	1	back	0.119
5765	153	IEEE 802.11a	OFDM	13.67	-0.15	1.0 cm	007	6	back	0.158
5240	48	IEEE 802.11a	OFDM	13.22	0.16	1.0 cm	007	6	back	0.043
5320	64	IEEE 802.11a	OFDM	13.34	-0.09	1.0 cm	007	6	back	0.086
5660	132	IEEE 802.11a	OFDM	13.54	-0.10	1.0 cm	007	6	back	0.272
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram				

Note: For IEEE 802.11b mode, Hotspot SAR Data was considered to determine body-worn SAR compliance per FCC KDB Publication 941225 D06.

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11.3 Standalone Wireless Router SAR Data

Table 11-13
Licensed Transmitter Hotspot SAR Data

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	# of GPRS Slots	Side	SAR (1g)
MHz	Ch.									(W/kg)
836.60	190	GSM 850	GPRS	27.69	0.03	1.0 cm	310	4	back	0.786
836.60	190	GSM 850	GPRS	27.69	-0.03	1.0 cm	310	4	front	0.291
836.60	190	GSM 850	GPRS	27.69	-0.13	1.0 cm	310	4	bottom	0.090
836.60	190	GSM 850	GPRS	27.69	0.06	1.0 cm	310	4	right	0.404
836.60	190	GSM 850	GPRS	27.69	0.05	1.0 cm	310	4	left	0.270
836.60	4183	WCDMA 850	RMC	22.89	-0.03	1.0 cm	310	N/A	back	0.486
836.60	4183	WCDMA 850	RMC	22.89	-0.01	1.0 cm	310	N/A	front	0.178
836.60	4183	WCDMA 850	RMC	22.89	-0.07	1.0 cm	310	N/A	bottom	0.063
836.60	4183	WCDMA 850	RMC	22.89	-0.02	1.0 cm	310	N/A	right	0.270
836.60	4183	WCDMA 850	RMC	22.89	0.00	1.0 cm	310	N/A	left	0.176
1712.40	1312	AWS WCDMA	RMC	22.77	-0.01	1.0 cm	310	N/A	back	0.983
1730.40	1412	AWS WCDMA	RMC	22.86	-0.04	1.0 cm	310	N/A	back	0.810
1752.50	1862	AWS WCDMA	RMC	22.64	0.08	1.0 cm	310	N/A	back	0.986
1730.40	1412	AWS WCDMA	RMC	22.86	0.05	1.0 cm	310	N/A	front	0.469
1730.40	1412	AWS WCDMA	RMC	22.86	0.16	1.0 cm	310	N/A	bottom	0.490
1730.40	1412	AWS WCDMA	RMC	22.86	0.11	1.0 cm	310	N/A	right	0.096
1730.40	1412	AWS WCDMA	RMC	22.86	0.06	1.0 cm	310	N/A	left	0.190
1880.00	661	GSM 1900	GPRS	25.72	-0.05	1.0 cm	310	3	back	0.513
1880.00	661	GSM 1900	GPRS	25.72	0.08	1.0 cm	310	3	front	0.289
1880.00	661	GSM 1900	GPRS	25.72	-0.21	1.0 cm	310	3	bottom	0.366
1880.00	661	GSM 1900	GPRS	25.72	-0.02	1.0 cm	310	3	right	0.066
1880.00	661	GSM 1900	GPRS	25.72	-0.02	1.0 cm	310	3	left	0.150
1852.40	9262	WCDMA 1900	RMC	22.49	-0.02	1.0 cm	310	N/A	back	0.680
1852.40	9262	WCDMA 1900	RMC	22.49	-0.04	1.0 cm	310	N/A	front	0.405
1852.40	9262	WCDMA 1900	RMC	22.49	0.17	1.0 cm	310	N/A	bottom	0.609
1852.40	9262	WCDMA 1900	RMC	22.49	0.00	1.0 cm	310	N/A	right	0.090
1852.40	9262	WCDMA 1900	RMC	22.49	0.03	1.0 cm	310	N/A	left	0.177
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram				

For WCDMA 1900 mode, output powers across all channels deviated by > 0.5dB, therefore low channel was evaluated for SAR.

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Table 11-14
WLAN Hotspot SAR Data

MEASUREMENT RESULTS										
FREQUENCY		Mode	Service	Conducted Power [dBm]	Power Drift [dB]	Spacing	Device Serial Number	Data Rate (Mbps)	Side	SAR (1g)
MHz	Ch.									(W/kg)
2462	11	IEEE 802.11b	DSSS	16.28	0.03	1.0 cm	314	1	back	0.119
2462	11	IEEE 802.11b	DSSS	16.28	-0.01	1.0 cm	314	1	front	0.016
2462	11	IEEE 802.11b	DSSS	16.28	0.19	1.0 cm	314	1	top	0.013
2462	11	IEEE 802.11b	DSSS	16.28	-0.12	1.0 cm	314	1	right	0.058
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						Body 1.6 W/kg (mW/g) averaged over 1 gram				

11.4 SAR Test Notes

General Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration.
2. Batteries are fully charged for all readings. The standard battery was used.
3. This DUT has NFC operations. The NFC antenna is integrated into the standard battery and will be the only battery available from the manufacturer for this model. Therefore all SAR tests were performed with the standard battery which already integrates the NFC antenna. The device restricts the battery used to battery model: EB-L1G6LLA.
4. Tissue parameters and temperatures are listed on the SAR plots.
5. Liquid tissue depth was at least 15.0 cm. To confirm the proper SAR liquid depth, the z-axis plots from the system verifications were included since the system verifications were performed using the same liquid, probe and DAE as the SAR tests in the same time period.
6. 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.
7. Per October 2010 TCB Workshop, the mid. channel may be used as a default test channel when the output power deviation across low, mid, and high channels is <0.5 dB, otherwise the maximum output power must be used. If the SAR measured at for each test configuration for the default channel is at least 3.0 dB lower than the SAR limit, testing at the other channels is optional for such test configuration(s).
8. 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.

GSM Test Notes:

1. Body-Worn accessory testing is typically associated with voice operations. Therefore, GSM voice was evaluated for body-worn SAR using headphones.
2. Per FCC guidance, GPRS Data Mode is additionally required for body-worn configuration. Per KDB 941225 D06, when the same wireless modes and device transmission configurations are required for body-worn accessories and hotspot mode, it is not necessary to additionally test body-worn accessory SAR for the same device orientation. Therefore, the hotspot data for the back side configurations additionally shows body-worn compliance at the same distance.

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3. Justification for reduced test configurations per KDB Publication 941225 D03: The source-based time-averaged output power was evaluated for all multi-slot operations. The worst-case source-based time-averaged power was evaluated for data modes.

WCDMA Notes:

1. WCDMA mode in Body SAR was tested under RMC 12.2 kbps with HSPA Inactive per KDB Publication 941225 D01. HSPA SAR was not required since the average output power of the HSPA subtests was not more than 0.25 dB higher than the RMC level and SAR was less than 1.2 W/kg.
2. Per FCC KDB Publication 941225 D06, when the same wireless modes and device transmission configurations are required for body-worn accessories and hotspot mode, it is not necessary to additionally test body-worn accessory SAR for the same device orientation. Therefore, the hotspot data for the back side configuration additionally shows body-worn compliance at the same distance.
3. AWS WCDMA SAR was measured with a probe calibrated at 1750 MHz and is valid for measuring SAR from ± 50 MHz. The 1750MHz specific liquid was verified with specific probe calibration factors as required per FCC KDB Publication 450824 D01.

WLAN Notes:

1. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes for 2.4 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11b. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11b mode.
2. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes for 5 GHz WIFI: Highest average RF output power channel for the lowest data rate was selected for SAR evaluation in 802.11a. Other IEEE 802.11 modes (including 802.11n 20 MHz Bandwidth and 802.11n 40 MHz Bandwidth) were not investigated since the average output powers over all channels and data rates were not more than 0.25 dB higher than the tested channel in the lowest data rate of IEEE 802.11a mode.
3. When Hotspot is enabled, all 5 GHz bands are disabled.
4. WLAN transmission was verified using an uncalibrated spectrum analyzer.
5. When the maximum extrapolated peak SAR of the zoom scan for the maximum output channel is <1.6 W/kg and the 1g averaged SAR is <0.8 W/kg, SAR testing on other channels is not required. Otherwise, the other default (or corresponding required) test channels were additionally tested using the lowest data rate.
6. Per FCC KDB Publication 941225 D06, when the same wireless modes and device transmission configurations are required for body-worn accessories and hotspot mode, it is not necessary to additionally test body-worn accessory SAR for the same device orientation. Therefore, the hotspot data for the back side configuration additionally shows body-worn compliance at the same distance.

Hotspot Notes:

1. Top Edge for the licensed transmitter was not tested since the antenna distance from the edge was greater than 2.5 cm per FCC KDB Publication 941225 D06 guidance (see Section 1.3).
2. Bottom and Left Edges for the WLAN transmitter was not tested since the antenna distance from the edge was greater than 2.5 cm per FCC KDB Publication 941225 D06 (see Section 1.3).
3. During SAR Testing for the Wireless Router conditions per KDB 941225 D06, the actual Portable Hotspot operation (with actual simultaneous transmission of a transmitter with WIFI) was not activated (See Section 6.5.)

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12 FCC MULTI-TX AND ANTENNA SAR CONSIDERATIONS

12.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” FCC KDB Publication 648474 are applicable to handsets with built-in unlicensed transmitters such as 802.11a/b/g/n and Bluetooth devices which may simultaneously transmit with the licensed transmitter.

12.2 FCC Power Tables & Conditions

	2.45	5.15 - 5.35	5.47 - 5.85	GHz
P_{Ref}	12	6	5	mW

Device output power should be rounded to the nearest mW to compare with values specified in this table.

Figure 12-1
Output Power Thresholds for Unlicensed Transmitters

	Individual Transmitter	Simultaneous Transmission
Licensed Transmitters	<u>Routine evaluation required</u>	<u>SAR not required:</u> <u>Unlicensed only</u> - when stand-alone 1-g SAR is not required and antenna is ≥ 5 cm from other antennas <u>Licensed & Unlicensed</u> - when the sum of the 1-g SAR is < 1.6 W/kg for all simultaneous transmitting antennas - when SAR to peak location separation ratio of simultaneous transmitting antenna pair is < 0.3
Unlicensed Transmitters	<u>When there is no simultaneous transmission –</u> - output ≤ 60/f: SAR not required - output > 60/f: stand-alone SAR required <u>When there is simultaneous transmission –</u> <u>Stand-alone SAR not required when</u> - output $\leq 2 \cdot P_{Ref}$ and antenna is ≥ 5.0 cm from other antennas - output $\leq P_{Ref}$ and antenna is ≥ 2.5 cm from other antennas - output $\leq P_{Ref}$ and antenna is < 2.5 cm from other antennas, each with either output power $\leq P_{Ref}$ or 1-g SAR < 1.2 W/kg <u>Otherwise stand-alone SAR is required</u> <u>When stand-alone SAR is required</u> - test SAR on highest output channel for each wireless mode and exposure condition - if SAR for highest output channel is $> 50\%$ of SAR limit, evaluate all channels according to normal procedures	<u>SAR required:</u> <u>Licensed & Unlicensed</u> antenna pairs with SAR to peak location separation ratio ≥ 0.3 ; test is only required for the configuration that results in the highest SAR in stand-alone configuration for each wireless mode and exposure condition <u>Note: simultaneous transmission exposure conditions for head and body can be different for different style phones; therefore, different test requirements may apply</u>

Figure 12-2
SAR Evaluation Requirements for Multiple Transmitter Handsets

According to Figure 12-1 and Figure 12-2, simultaneous transmission analysis of SAR may be required for this device for the licensed and unlicensed transmitters. Possible simultaneous transmissions for this device were numerically summed using stand-alone SAR data and are shown in the following tables.

Per KDB Publication 648474, standalone Bluetooth SAR tests were not required. Standalone SAR tests for WLAN were required. See Section 1.4(A) for more information.

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12.3 Head SAR Simultaneous Transmission Analysis

Table 12-1
Simultaneous Transmission Scenario (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	WCDMA 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.152	0.032	0.184	Head SAR	Right Cheek	0.133	0.032	0.165
	Right Tilt	0.101	0.026	0.127		Right Tilt	0.077	0.026	0.103
	Left Cheek	0.131	0.051	0.182		Left Cheek	0.110	0.051	0.161
	Left Tilt	0.090	0.029	0.119		Left Tilt	0.074	0.029	0.103
Simult Tx	Configuration	AWS WCDMA SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	GSM 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.343	0.032	0.375	Head SAR	Right Cheek	0.113	0.032	0.145
	Right Tilt	0.180	0.026	0.206		Right Tilt	0.078	0.026	0.104
	Left Cheek	0.270	0.051	0.321		Left Cheek	0.145	0.051	0.196
	Left Tilt	0.132	0.029	0.161		Left Tilt	0.063	0.029	0.092
		Simult Tx	Configuration	WCDMA 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)			
		Head SAR	Right Cheek	0.182	0.032	0.214			
			Right Tilt	0.133	0.026	0.159			
			Left Cheek	0.247	0.051	0.298			
			Left Tilt	0.136	0.029	0.165			

The above tables represent a held to ear voice call potentially simultaneously operating with 2.4 GHz WLAN.

Table 12-2
Simultaneous Transmission Scenario (Held to Ear)

Simult Tx	Configuration	GSM 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	WCDMA 850 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.152	0.091	0.243	Head SAR	Right Cheek	0.133	0.091	0.224
	Right Tilt	0.101	0.095	0.196		Right Tilt	0.077	0.095	0.172
	Left Cheek	0.131	0.126	0.257		Left Cheek	0.110	0.126	0.236
	Left Tilt	0.090	0.125	0.215		Left Tilt	0.074	0.125	0.199
Simult Tx	Configuration	AWS WCDMA SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	GSM 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Head SAR	Right Cheek	0.343	0.091	0.434	Head SAR	Right Cheek	0.113	0.091	0.204
	Right Tilt	0.180	0.095	0.275		Right Tilt	0.078	0.095	0.173
	Left Cheek	0.270	0.126	0.396		Left Cheek	0.145	0.126	0.271
	Left Tilt	0.132	0.125	0.257		Left Tilt	0.063	0.125	0.188
		Simult Tx	Configuration	WCDMA 1900 SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)			
		Head SAR	Right Cheek	0.182	0.091	0.273			
			Right Tilt	0.133	0.095	0.228			
			Left Cheek	0.247	0.126	0.373			
			Left Tilt	0.136	0.125	0.261			

The above tables represent a held to ear voice call potentially simultaneously operating with 5 GHz WLAN.

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12.4 Body-Worn Simultaneous Transmission Analysis

Table 12-3
Simultaneous Transmission Scenario (Body-Worn at 1.0 cm)

Configuration	Mode	2G/3G SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.617	0.119	0.736
Back Side	WCDMA 850	0.486	0.119	0.605
Back Side	AWS WCDMA	0.986	0.119	1.105
Back Side	GSM 1900	0.304	0.119	0.423
Back Side	WCDMA 1900	0.680	0.119	0.799

The above tables represent a body-worn voice call potentially simultaneously operating with 2.4 GHz WLAN.

Table 12-4
Simultaneous Transmission Scenario (Body-Worn at 1.0 cm)

Configuration	Mode	2G/3G SAR (W/kg)	5 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Back Side	GSM 850	0.617	0.272	0.889
Back Side	WCDMA 850	0.486	0.272	0.758
Back Side	AWS WCDMA	0.986	0.272	1.258
Back Side	GSM 1900	0.304	0.272	0.576
Back Side	WCDMA 1900	0.680	0.272	0.952

The above tables represent a body-worn voice call potentially simultaneously operating with 5 GHz WLAN.

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12.5 Hotspot SAR Simultaneous Transmission Analysis

Table 12-5
Simultaneous Transmission Scenario (Hotspot at 1.0 cm)

Simult Tx	Configuration	GPRS 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	WCDMA 850 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.786	0.119	0.905	Body SAR	Back	0.486	0.119	0.605
	Front	0.291	0.016	0.307		Front	0.178	0.016	0.194
	Top	-	0.013	0.013		Top	-	0.013	0.013
	Bottom	0.090	-	0.090		Bottom	0.063	-	0.063
	Right	0.404	0.058	0.462		Right	0.270	0.058	0.328
	Left	0.270	-	0.270		Left	0.176	-	0.176
Simult Tx	Configuration	AWS WCDMA SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)	Simult Tx	Configuration	GPRS 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)
Body SAR	Back	0.986	0.119	1.105	Body SAR	Back	0.513	0.119	0.632
	Front	0.469	0.016	0.485		Front	0.289	0.016	0.305
	Top	-	0.013	0.013		Top	-	0.013	0.013
	Bottom	0.490	-	0.490		Bottom	0.366	-	0.366
	Right	0.096	0.058	0.154		Right	0.066	0.058	0.124
	Left	0.190	-	0.190		Left	0.150	-	0.150
		Simult Tx	Configuration	WCDMA 1900 SAR (W/kg)	2.4 GHz WLAN SAR (W/kg)	Σ SAR (W/kg)			
Body SAR		Back	0.680	0.119	0.799				
		Front	0.405	0.016	0.421				
		Top	-	0.013	0.013				
		Bottom	0.609	-	0.609				
		Right	0.090	0.058	0.148				
		Left	0.177	-	0.177				

Note: Per FCC KDB Publication 941225 D06, the edges with antennas more than 2.5 cm are not required to be evaluated for SAR (""). The above tables represent a portable hotspot condition.

12.6 Simultaneous Transmission Conclusion

The above numerical summed SAR was below the SAR limit. Therefore, the above analysis is sufficient to determine that simultaneous transmission cases will not exceed the SAR limit. No volumetric SAR summation is required per FCC KDB Publication 648474.

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13 EQUIPMENT LIST

Valid for testing performed on 02/27/12.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	10/10/2011	Annual	10/10/2012	3613A00315
Agilent	E5515C	Wireless Communications Test Set	10/10/2011	Annual	10/10/2012	GB46110872
Agilent	E5515C	Wireless Communications Test Set	10/20/2011	Annual	10/20/2012	GB46310798
Agilent	E5515C	Wireless Communications Test Set	10/14/2011	Annual	10/14/2012	GB41450275
Agilent	E5515C	Wireless Communications Test Set	2/14/2012	Annual	2/14/2013	GB43304447
Agilent	E5515C	Wireless Communications Test Set	2/12/2012	Annual	2/12/2013	GB45360985
Agilent	E5515C	Wireless Communications Test Set	2/14/2012	Annual	2/14/2013	GB43163447
Agilent	E5515C	Wireless Communications Test Set	2/9/2012	Annual	2/9/2013	GB43460554
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
Amplifier Research	551G4	5W, 800MHz-4.2GHz	CBT	N/A	N/A	21910
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	5318
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	5442
Anritsu	ML2438A	Power Meter	2/14/2012	Annual	2/14/2013	1190013
Anritsu	ML2438A	Power Meter	2/14/2012	Annual	2/14/2013	98150041
Anritsu	ML2438A	Power Meter	10/13/2011	Annual	10/13/2012	1070030
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	5821
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	8013
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	2400
Anritsu	MA2411B	Pulse Sensor	10/13/2011	Annual	10/13/2012	1027293
Anritsu	ML2495A	Power Meter	10/13/2011	Annual	10/13/2012	1039008
Anritsu	MT8820C	Radio Communication Tester	11/11/2011	Annual	11/11/2012	6200901190
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	N/A	M3W1A00-1002
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331322
Control Company	61220-416	Long-Stem Thermometer	7/1/2011	Biennial	7/1/2013	111642834
Control Company	61220-416	Long-Stem Thermometer	10/12/2011	Biennial	10/12/2013	111860820
Control Company	61220-416	Long-Stem Thermometer	10/12/2011	Biennial	10/12/2013	111860844
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/12/2011	Annual	10/12/2012	1833460
Gigatronics	8651A	Universal Power Meter	10/12/2011	Annual	10/12/2012	8650319
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	N/A	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	N/A	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	N/A	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	N/A	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	N/A	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	N/A	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	N/A	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	N/A	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	N/A	120
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	N/A	N/A
Pasternack	PE2208-6	Bidirectional Coupler	6/3/2011	Annual	6/3/2012	N/A
Pasternack	PE2209-10	Bidirectional Coupler	6/3/2011	Annual	6/3/2012	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	11/11/2010	Annual	11/11/2011	836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	6/1/2011	Annual	6/1/2012	833855/0010
Rohde & Schwarz	CMU200	Base Station Simulator	11/4/2009	Annual	11/4/2010	109892
Rohde & Schwarz	NRVD	Dual Channel Power Meter	4/8/2011	Biennial	4/8/2013	101695
Seekonk	NC-100	Torque Wrench (8" lb)	11/29/2011	Triennial	11/29/2014	21053
SPEAG	D5GHzV2	5 GHz SAR Dipole	7/26/2011	Annual	7/26/2012	1007
SPEAG	DAE4	Dasy Data Acquisition Electronics	4/20/2011	Annual	4/20/2012	665
SPEAG	EX3DV4	SAR Probe	1/27/2012	Annual	1/27/2013	3589
VWR	36934-158	Wall-Mounted Thermometer	5/26/2010	Biennial	5/26/2012	101718589
VWR	36934-158	Wall-Mounted Thermometer	1/21/2011	Biennial	1/21/2013	111286454
VWR	36934-158	Wall-Mounted Thermometer	9/30/2011	Biennial	9/30/2013	111859332

Note: CBT (Calibrated Before Testing). Prior to testing, the measurement paths containing a cable, attenuator, amplifier, 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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Valid for testing performed on 04/30/12 – 05/04/12.

Manufacturer	Model	Description	Cal Date	Cal Interval	Cal Due	Serial Number
Agilent	8594A	(9kHz-2.9GHz) Spectrum Analyzer	N/A	N/A	N/A	3051A00187
Agilent	8648D	(9kHz-4GHz) Signal Generator	10/10/2011	Annual	10/10/2012	3613A00315
Agilent	8753E	(30kHz-6GHz) Network Analyzer	4/4/2012	Annual	4/4/2013	JP38020182
Agilent	E5515C	Wireless Communications Test Set	10/10/2011	Annual	10/10/2012	GB46110872
Agilent	E5515C	Wireless Communications Test Set	10/20/2011	Annual	10/20/2012	GB46310798
Agilent	E5515C	Wireless Communications Test Set	10/14/2011	Annual	10/14/2012	GB41450275
Agilent	E5515C	Wireless Communications Test Set	2/14/2012	Annual	2/14/2013	GB43304447
Agilent	E5515C	Wireless Communications Test Set	2/12/2012	Annual	2/12/2013	GB45360985
Agilent	E5515C	Wireless Communications Test Set	2/14/2012	Annual	2/14/2013	GB43163447
Agilent	85070E	Dielectric Probe Kit	3/8/2012	Annual	3/8/2013	MY44300633
Agilent	E5515C	Wireless Communications Test Set	2/9/2012	Annual	2/9/2013	GB43460554
Agilent	85047A	S-Parameter Test Set	N/A	N/A	N/A	2904A00579
Amplifier Research	5S1G4	5W, 800MHz-4.2GHz	CBT	N/A	N/A	21910
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	5318
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	5442
Anritsu	ML2438A	Power Meter	2/14/2012	Annual	2/14/2013	1190013
Anritsu	ML2438A	Power Meter	2/14/2012	Annual	2/14/2013	98150041
Anritsu	ML2438A	Power Meter	10/13/2011	Annual	10/13/2012	1070030
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	5821
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	8013
Anritsu	MA2481A	Power Sensor	2/14/2012	Annual	2/14/2013	2400
Anritsu	MA2411B	Pulse Sensor	10/13/2011	Annual	10/13/2012	1027293
Anritsu	ML2495A	Power Meter	10/13/2011	Annual	10/13/2012	1039008
Anritsu	MT8820C	Radio Communication Tester	11/11/2011	Annual	11/11/2012	6200901190
COMTECH	AR85729-5/5759B	Solid State Amplifier	CBT	N/A	N/A	M3W1A00-1002
Control Company	61220-416	Long-Stem Thermometer	2/15/2011	Biennial	2/15/2013	111331322
Control Company	61220-416	Long-Stem Thermometer	7/1/2011	Biennial	7/1/2013	111642834
Control Company	61220-416	Long-Stem Thermometer	10/12/2011	Biennial	10/12/2013	111860820
Control Company	61220-416	Long-Stem Thermometer	10/12/2011	Biennial	10/12/2013	111860844
Gigatronics	80701A	(0.05-18GHz) Power Sensor	10/12/2011	Annual	10/12/2012	1833460
Gigatronics	8651A	Universal Power Meter	10/12/2011	Annual	10/12/2012	8650319
Intelligent Weigh	PD-3000	Electronic Balance	3/27/2012	Annual	3/27/2013	11081534
MCL	BW-N6W5+	6dB Attenuator	CBT	N/A	N/A	1139
MiniCircuits	SLP-2400+	Low Pass Filter	CBT	N/A	N/A	R8979500903
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	N/A	N/A
MiniCircuits	VLF-6000+	Low Pass Filter	CBT	N/A	N/A	N/A
Mini-Circuits	BW-N20W5+	DC to 18 GHz Precision Fixed 20 dB Attenuator	CBT	N/A	N/A	N/A
Mini-Circuits	NLP-2950+	Low Pass Filter DC to 2700 MHz	CBT	N/A	N/A	N/A
Mini-Circuits	NLP-1200+	Low Pass Filter DC to 1000 MHz	CBT	N/A	N/A	N/A
Narda	4772-3	Attenuator (3dB)	CBT	N/A	N/A	9406
Narda	BW-S3W2	Attenuator (3dB)	CBT	N/A	N/A	120
Narda	4014C-6	4 - 8 GHz SMA 6 dB Directional Coupler	CBT	N/A	N/A	N/A
Pasternack	PE2208-6	Bidirectional Coupler	6/3/2011	Annual	6/3/2012	N/A
Pasternack	PE2209-10	Bidirectional Coupler	6/3/2011	Annual	6/3/2012	N/A
Rohde & Schwarz	CMU200	Base Station Simulator	11/11/2010	Annual	11/11/2011	836371/0079
Rohde & Schwarz	CMU200	Base Station Simulator	6/1/2011	Annual	6/1/2012	833855/0010
Rohde & Schwarz	CMU200	Base Station Simulator	11/4/2009	Annual	11/4/2010	109892
Rohde & Schwarz	NRVD	Dual Channel Power Meter	4/8/2011	Biennial	4/8/2013	101695
Seekonk	NC-100	Torque Wrench (8" lb)	11/29/2011	Triennial	11/29/2014	21053
Seekonk	NC-100	Torque Wrench (8" lb)	3/5/2012	Triennial	3/5/2015	N/A
Seekonk	NC-100	Torque Wrench (8" lb)	3/5/2012	Triennial	3/5/2015	N/A
SPEAG	D1900V2	1900 MHz SAR Dipole	7/22/2011	Annual	7/22/2012	5d080
SPEAG	D2450V2	2450 MHz SAR Dipole	8/19/2011	Annual	8/19/2012	719
SPEAG	D835V2	835 MHz SAR Dipole	8/15/2011	Annual	8/15/2012	4d026
SPEAG	ES3DV2	SAR Probe	8/25/2011	Annual	8/25/2012	3022
SPEAG	DAE4	Dasy Data Acquisition Electronics	5/19/2011	Annual	5/19/2012	859
SPEAG	ES3DV3	SAR Probe	3/16/2012	Annual	3/16/2013	3209
SPEAG	ES3DV3	SAR Probe	2/21/2012	Annual	2/21/2013	3258
SPEAG	D1750V2	1750 MHz SAR Dipole	4/24/2012	Annual	4/24/2013	1051
SPEAG	DAE4	Dasy Data Acquisition Electronics	1/18/2012	Annual	1/18/2013	1272
SPEAG	DAE4	Dasy Data Acquisition Electronics	2/15/2012	Annual	2/15/2013	1323
VWR	36934-158	Wall-Mounted Thermometer	5/26/2010	Biennial	5/26/2012	101718589
VWR	36934-158	Wall-Mounted Thermometer	1/21/2011	Biennial	1/21/2013	111286454
VWR	36934-158	Wall-Mounted Thermometer	9/30/2011	Biennial	9/30/2013	111859332

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

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14 MEASUREMENT UNCERTAINTIES

Applicable for frequencies less than 3000 MHz.

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

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

FCC ID: A3LSGHT999	 PCTEST ENGINEERING LABORATORY, INC.	SAR EVALUATION REPORT		Reviewed by: Quality Manager
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Applicable for frequencies up to 6 GHz.

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	6.55	N	1	1.0	1.0	6.6	6.6	∞
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	12.4	12.0
Expanded Uncertainty (95% CONFIDENCE LEVEL)							k=2	24.7	24.0

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

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15 CONCLUSION

15.1 Measurement Conclusion

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

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

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