SAR Test Report

FOR:

Manufacturer: Intel Corporation
Model Name: BT210/BT230/BT510

FCC ID: O2Z-BTXZ0

Test Report #: SAR_INTEL_023_12001_FCC_rev1

Date of Report: 2012-12-04

ACCREDITED
TESTING LABORATORY
Certificate #2135.01

CTIA Authorized Test Lab
LAB CODE 20020328-00

FCC Listed #:
A2LA Accredited

IC Recognized #
3462B-1

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1. Assessment

The following device was evaluated against the limits for general population uncontrolled exposure specified in FCC 2.1093 according to measurement procedures specified in FCC OET Bulletin 65, Supplement C (Edition 01-01), additional FCC regulations as listed in chapter 5, and IEEE 1528:2003, December 19, 2003 and no deviations were ascertained during the course of the tests performed.

Company	Description	Model #
Intel Corporation	Smartphone with GSM/GPRS/EDGE, UMTS/HSPA, Wi-Fi, BT, GPS and FM-Rx Radios	BT210/BT230/BT510

Responsible for Testing Laboratory:

Date	Section	Name	Signature
2012-12-04	Compliance	Sajay Jose (Test Lab Manager)	

Responsible for the Report:

Date	Section	Name	Signature
2012-12-04	Compliance	Josie Sabado (Project Engineer)	

The test results of this test report relate exclusively to the test item specified in Section3.
CETECOM Inc. USA does not assume responsibility for any conclusions and generalizations drawn from the test results with regard to other specimens or samples of the type of the equipment represented by the test item. The test report may only be reproduced or published in full. Reproduction or publication of extracts from the report requires the prior written approval of CETECOM Inc. USA.

2. Administrative Data

2.1. Identification of the Testing Laboratory Issuing the SAR Test Report

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Department:	Compliance
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Test Lab Manager:	Sajay Jose
Responsible Project Leader:	Josie Sabado

2.2. Identification of the Client

Applicant's Name:	Intel Corporation
Street Address:	2200 Mission College Blvd – MS1-20
City/Zip Code	Santa Clara, CA 95054
Country	USA
Contact Person:	Christine Ryan
Phone No.	408-300-2167
e-mail:	Christine.m.ryan@intel.com

2.3. Identification of the Manufacturer

Same as above client.

3. Equipment under Test (EUT)

3.1. Specification of the Equipment under Test

Product Type:	Portable
Prototype/Production:	Pre-Production
RF Exposure Environment:	General/Uncontrolled
Dimensions:	110.5 x 61.00 x 12.60 mm
Exposure Conditions:	Held next to the ear Body worn Wireless Router
Model No[1]:	BT210, BT230, BT510
Supported Radios:	GSM/GPRS/EGPRS, MS Class 33, Power Class 4/1, Mobile Class B WCDMA/HSDPA/HSUPA Bluetooth + 2.1 EDR 802.11 b/g/n, HT20 GPS receiver FM receiver
FCC-ID:	O2Z-BTXZ0
Transmit Frequency Range:	GSM 850: 824.2 – 848.8 MHz PCS 1900: 1850.2 – 1909.8 MHz WCDMA FDD II: 1852.4 – 1907.6 MHz WCDMA FDD V: 826.4 – 846.6 MHz Bluetooth: 2402 – 2480 MHz 802.11 b/g/n: 2412 – 2462 MHz
Type(s) of Modulation:	GSM/GPRS: GMSK EGPRS: GMSK, 8PSK WCDMA: QPSK Bluetooth: GFSK, π/4 DQPSK, 8DPSK 802.11 b/g/n: BPSK, QPSK, 16-QAM, 64-QAM
Duty Cycle:	GSM: 12.5% GPRS/EGPRS 1 uplink timeslot: 12.5% GPRS/EGPRS 2 uplink timeslots: 25% GPRS/EGPRS 3 uplink timeslots: 37.5% GPRS/EGPRS 4 uplink timeslots: 50% WCDMA: 100% Bluetooth: 46% 802.11 b/g/n:100 %
Antenna Type:	Cellular: Internal PIFA, Manufacturer stated peak gain -0.75 to 1.06 dBi Diversity Antenna, Receive only WLAN/BT combined: Internal PIFA, Manufacturer stated peak gain -0.9 dBi

Power Supply:	3.6-4.2 VDC
Operating Temperature Range:	-10° C to 55° C
Measured Maximum Conducted Output Power:	GSM 850: 32.7 dBm PCS 1900: 30.2 dBm WCDMA FDD II: 23.65dBm WCDMA FDD V: 23.88dBm Bluetooth: 9.3 dBm 802.11b: 17.4dBm 802.11g: 16.1dBm 802.11n, HT20: 15.1dBm

NOTE:

1. The given model variants are identical in all relevant parts. See manufacturer's equality declaration.

3.2. Identification of the Equipment Under Test (EUT)

During the course of testing, hardware and software changes were made to the EUT. Refer to manufacturer hardware and software change declarations for explanations of the changes.

EUT #	Serial Number	HW Version	SW Version
1	LEXP1LP1EM103466	DV1.1	7800
2	LEXP1LP1EM103632	DV1.1	7800
3	LEXP1LP1EM103521	DV1.1b	8184
4	LEXP1LP1EM104186	DV1.1b	8184

3.3. Identification of Accessory equipment

AE #	Type	Manufacturer	Model	Serial Number
1	Headset	Intel Corporation	N/A	N/A

4. Subject of Investigation

The objective of the measurements done by CETECOM Inc. was the dosimetric assessment of one device. The tests were performed in configurations for devices operated next to a person's body. The examinations were carried out with the dosimetric assessment system DASY52 described in Section 6.

4.1. The IEEE Standard C95.1 and the FCC Exposure Criteria

The limits are set by CFR 47 FCC rule parts 1.1307 and 2.1093, following the recommendations in IEEE C95.1-1999 (ANSI/IEEE C95.1-1999), "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz."

4.2. SAR Limit

In this report the comparison between the American exposure limits and the measured data is made using the spatial peak SAR.

Having in mind a worst case consideration, the SAR limit is valid for uncontrolled environment and mobile respectively portable transmitters. The SAR values have to be averaged over a mass of 1 g (SAR_{1g}) with the shape of a cube.

Standard	Status	SAR limit (W/kg)
IEEE C95.1	In force	1.6

5. The FCC Measurement Procedure

The Federal Communications Commission (FCC) requires routine dosimetric assessment of mobile telecom-communications devices, either by laboratory measurement techniques or by computational modeling, prior to equipment authorization or use. In 2001 the Commission's Office of Engineering and Technology has released Edition 01-01 of Supplement C to OET Bulletin 65. This revised edition, which replaces Edition 97-01, provides additional guidance and information for evaluating compliance of mobile and portable devices with FCC limits for human exposure to radiofrequency emissions. The following KDB Publications have also been used:

447498 D01 v04 – Mobile and portable device RF Exposure Procedures
648474 D01 v01r05 – SAR Evaluation Considerations for Handsets with Multiple Transmitters
248227 D01 v01r02 – SAR Measurement Procedures for 802.11 a/b/g Transmitters
941225 D01 v02 – SAR Measurement Procedures for 3G Devices
941225 D06 v01 – Hot Spot SAR
450824 D01 v01r01 – SAR Probe Calibration and System Verification Considerations for Measurements at 150 MHz – 3 GHz
450824 D02 v01r01 – Dipole Requirements for SAR System Validation and Verification
941225 D03 v01 – Recommended SAR Test Reduction Procedures for GSM/GPRS/EDGE

5.1. General Requirements

SAR evaluation was performed in a laboratory with an environment which avoids influence on SAR measurements by ambient EM sources and any reflection from the environment itself. The ambient temperature was in the range of 20°C to 26°C and 30-70% humidity. Simulating liquid temperature did not deviate more than +/- 2°C throughout SAR evaluation.

5.2. Body-worn and Other Configurations

Phantom Requirements
For body-worn and other configurations a flat phantom shall be used which is comprised of material with electrical properties similar to the corresponding tissues.

Test Position
The body-worn configurations shall be tested with the supplied accessories (belt-clips, holsters, etc.) attached to the device in normal use configuration. Devices with a headset output shall be tested with a connected headset.

Test to be Performed
For purpose of determining test requirements, accessories may be divided into two categories: those that do not contain metallic components and those that do. For multiple accessories that do not contain metallic components, the device may be tested only with that accessory which provides the closest spacing to the body. For multiple accessories that contain metallic

components, the device must be tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component, only the accessory that provides the closest spacing to the body must be tested. If the manufacturer provides none body-worn accessories a separation distance of 1.5 cm between the back of the device and the flat phantom is recommended. Other separation distances may be used, but they shall not exceed 2.5 cm. In these cases, the device may use body-worn accessories that provide a separation distance greater than that tested for the device provided however that the accessory contains no metallic components.

For devices with retractable antenna the SAR test shall be performed with the antenna fully extended and fully retracted. Other factors that may affect the exposure shall also be tested. For example, optional antennas or optional battery packs which may significantly change the volume, lengths, flip open/closed, etc. of the device, or any other accessories which might have the potential to considerably increase the peak spatial-average SAR value.

5.3. Procedure for assessing the peak spatial-average SAR

Step 1*:* Power reference measurement:

Prior to the SAR test, a local SAR measurement should be taken at a user-selected spatial reference point to monitor power variations during testing. For example, this power reference point can be spaced 10 mm or less in the normal direction from the liquid-shell interface and within ± 10 mm transverse to the normal line at the ear reference point.

Step 2: Area scan

The measurement procedures for evaluating SAR associated with wireless handsets typically start with a coarse measurement grid in order to determine the approximate location of the local peak SAR values. This is referred to as the "area scan" procedure. The SAR distribution is scanned along the inside surface of typically half of the head of the phantom but at least larger than the areas projected (normal to the phantom's surface) by the handset and antenna. An example grid is given in Figure 4. The distance between the measured points and phantom surface should be less than 8 mm, and should remain constant (variation less than ± 1 mm) during the entire scan in order to determine the locations of the local peak SAR with sufficient precision. The distance between the measurement points should enable the detection of the location of local maximum with an accuracy of better than half the linear dimension of the tissue cube after interpolation. The resolution can also be tested using the functions in Annex E (see E.5.2). The approximate locations of the peak SARs should be determined from area scan. Since a given amplitude local peak with steep gradients may produce lower spatial-average SAR than slightly lower amplitude peaks with less steep gradients, it is necessary to evaluate the other peaks as well. However, since the spatial gradients of local SAR peaks are a function of wavelength inside the tissue simulating liquid and incident magnetic field strength, it is not necessary to evaluate peaks that are less than –2dB of the local maximum. Two-dimensional spline algorithms [Press, et al, 1996], [Brishoual, 2001] are typically used to determine the peaks and gradients within the scanned area. If the peak is closer than one-half of the linear dimension of the 1 g or 10 g tissue cube to the scan border, the measurement area should be enlarged if possible, e.g., by tilting the probe or the phantom (see Figure 5).

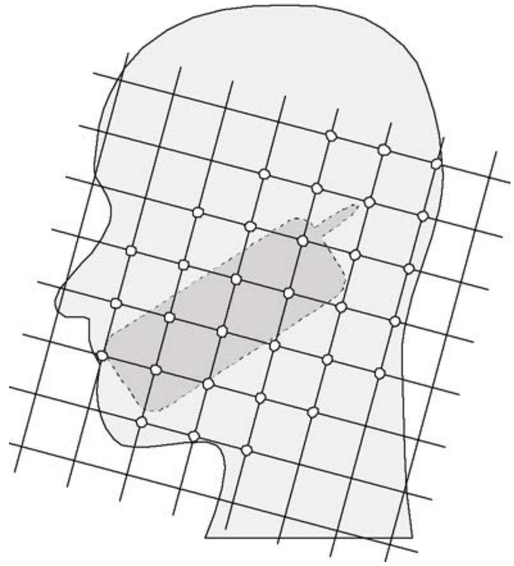

Figure 4 – Example of an area scan including the position of the handset. The scanned area (white dots) should be larger than the area projected by the handset and antenna.

Step 3: Zoom scan

In order to assess the peak spatial SAR values averaged over a 1 g and 10 g cube, fine resolution volume scans, called "zoom scans", are performed at the peak SAR locations determined during the “area scan.” The zoom scan volume should have at least 1.5 times the linear dimension of either a 1 g or a 10 g tissue cube for whichever peak spatial-average SAR is being evaluated. The peak local SAR locations that were determined in the area scan (interpolated value) should be on the centerline of the zoom scans. The centerline is the line that is normal to the surface and in the center of the volume scan. If this is not possible, the zoom scan can be shifted but not by more than half the dimension of the 1 g or a 10 g tissue cube.

The maximum spatial-average SAR is determined by a numerical analysis of the SAR values obtained in the volume of the zoom scan, whereby interpolation (between measured points) and extrapolation (between surface and closest measured points) routines should be applied. A 3-D-spline algorithm [Press, et al, 1996], [Kreyszig, 1983], [Brishoual, 2001] can be used for interpolation and a trapezoidal algorithm for the integration (averaging). Scan resolutions of larger than 2 mm can be used provided the uncertainty is evaluated according to E (see E.5).

In some areas of the phantom, such as the jaw and upper head region, the angle of the probe with respect to the line normal to the surface might become large, e.g., at angles larger than ± 30º (see Figure 5), which may increase the boundary effect to an unacceptable level. In these cases, a change in the orientation of the probe and/or the phantom is recommended during the zoom scan so that the angle between the probe housing tube and the line normal to the surface is significantly reduced (<30º).

Step 4: Power reference measurement

The local SAR should be measured at exactly the same location as in Step 1. The absolute value of the measurement drift (the difference between the SAR measured in Step 4 and Step 1) should be recorded in the uncertainty budget. It is recommended that the drift be kept within ± 5%. If this is not possible, even with repeat testing, additional information may be used to demonstrate the power stability during the test. Power reference measurements can be taken after each zoom scan, if more than one zoom scan is needed. However, the drift should always be referred to the initial state with fully charged battery.

5.4. Determination of the largest peak spatial-average SAR

In order to determine the largest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes should be tested for each frequency band according to steps 1 to 3 below.

Step 1: The tests of 6.4 should be conducted at the channel that is closest to the center of the transmit frequency band (*fc*) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom,

b) all configurations for each device position in (a), e.g. antenna extended and retracted, and

c) all operational modes for each device position in (a) and configuration in (b) in each frequency band, e.g. analog and digital.

If more than three frequencies need to be tested, (i.e., Nc > 3), then all frequencies, configurations and modes must be tested for all of the above positions.

Step 2: For the condition providing highest spatial peak SAR determined in Step 1 conduct all tests of 6.4 at all other test frequencies, e.g. lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the spatial peak SAR value determined in Step 1 is within 3dB of the applicable SAR limit, it is recommended that all other test frequencies should be tested as well[1].

Step 3: Examine all data to determine the largest value of the peak spatial-average SAR found in Steps 1 to 2.

6. The Measurement System

6.1. Robot system specification

The SAR measurement system being used is the SPEAG DASY52 system, which consists of a Stäubli TX90XL 6-axis robot arm and CS8c controller, SPEAG SAR Probe, Data Acquisition Electronics, and SAM Twin Phantom. The robot is used to articulate the probe to programmed positions inside the phantom to obtain the SAR readings from the EUT.

The system is controlled remotely from a PC, which contains the software to control the robot and data acquisition equipment. The software also displays the data obtained from test scans.

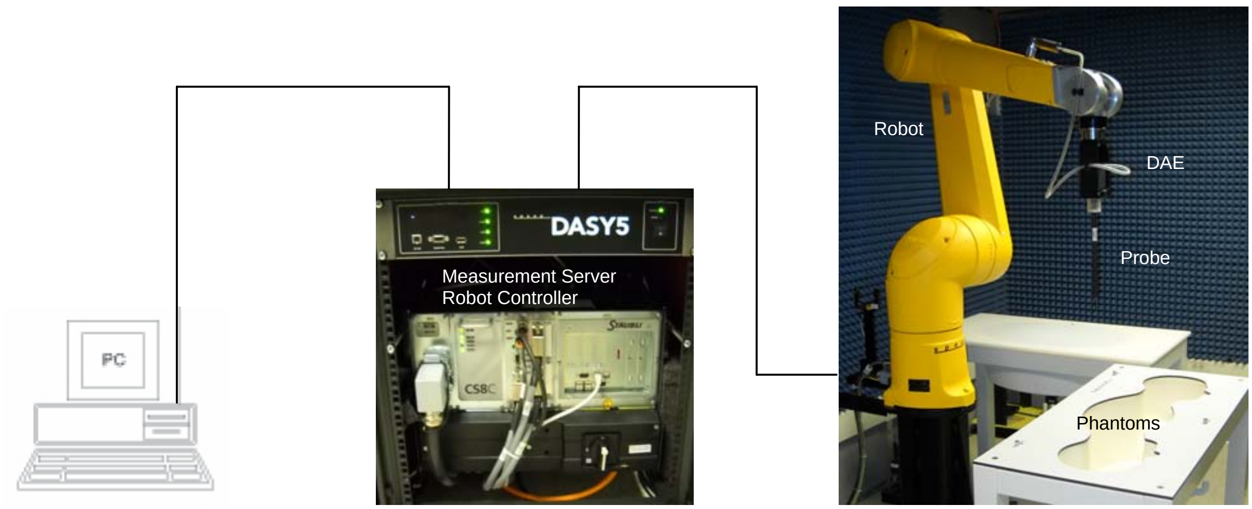

Figure 5: Schematic diagram of the SAR measurement system

In operation, the system first does an area (2D) scan at a fixed depth within the liquid from the inside wall of the phantom. When the maximum SAR point has been found, the system will then carry out a 3D scan centered at that point to determine volume averaged SAR level.

6.2. Isotropic E-Field Probe for Dosimetric Measurements

The probes are constructed using three orthogonal dipole sensors arranged on an interlocking, triangular prism core. The probes have built-in shielding against static charges and are contained within a PEEK cylindrical enclosure material at the tip. Probe calibration is described in the probe's calibration certificate.

6.3. Data Acquisition Electronics

The DAE contains a signal amplifier, multiplexer, 16bit A/D converter and control logic. It uses an optical link for communication with the DASY5 system. The DAE has a dynamic range of -100 to 300 mV. It also contains a two step probe touch detector for mechanical surface detection and emergency robot stop.

6.4. Phantoms

The Twin SAM V4.0 Phantom is designed to specifications defined in IEEE 1528 and IEC 62209-1. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region.

Additionally, the Oval Flat ELI V4.0 Phantom is designed to specification defined in IEEE 1528 and IEC 62209-2. It enables the dosimetric evaluation of body mounted usage.

6.5. Interpolation and Extrapolation schemes

The interpolation, extrapolation and maximum search routines are all based on the modifed Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation. The routines construct a once-continuously differentiable function that interpolates the measurement values.

7. Uncertainty Assessment

Measurement uncertainty values were evaluated for SAR measurements performed by Cetecom Inc. The uncertainty values for components specified in *FCC Supplement C (01-01) to OET Bulletin 65 (97-01)* were evaluated according to the procedures of *IEEE 1528-200X December 29, 2002, NIST 1297 1994 edition and ISO Guide to the Expression of Uncertainty in Measurements (GUM)*.

7.1. Measurement Uncertainty Budget

a	***b***	***c***	***d***	***e = f(d,k)***	***f***	***g = c x f / e***	***k***
Uncertainty Component	**Sec.**	**Tol. (± %)**	**Prob. Dist.**	**Div.**	**c_i (1-g)**	**1-g u_i (±%)**	**v_i**
Measurement System							
Probe Calibration	E2.1	5.5	N	1	1	5.5	∞
Axial Isotropy	E2.2	4.7	R	√3	0.7	1.9	∞
Hemispherical Isotropy	E2.2	9.6	R	√3	0.7	3.9	∞
Boundary Effect	E2.3	1.0	R	√3	1	0.6	∞
Linearity	E2.4	4.7	R	√3	1	2.7	∞
System Detection Limits	E2.5	1.0	R	√3	1	0.6	∞
Readout Electronics	E2.6	0.3	N	1	1	0.3	∞
Response Time	E2.7	0.8	R	√3	1	0.5	∞
Integration Time	E2.8	2.6	R	√3	1	1.5	∞
RF Ambient Noise	E6.1	3.0	R	√3	1	1.7	∞
RF Ambient Reflections	E6.1	3.0	R	√3	1	1.7	∞
Probe Positioner Mechanical Tolerance	E6.2	0.4	R	√3	1	0.2	∞
Probe Positioning with respect to Phantom Shell	E6.3	2.9	R	√3	1	1.7	∞
Extrapolation, interpolation and Integration Algorithms for Max. SAR Evaluation	E5.2	1.0	R	√3	1	0.6	∞
Test sample Related							
Test Sample Positioning	E4.2	2.9	N	1	1	2.9	*145*
Device Holder Uncertainty	E4.1	3.6	N	1	1	3.6	*5*
Output Power Variation - SAR drift measurement	6.6.2	5.0	R	√3	1	2.9	∞
Phantom and Tissue Parameters							
Phantom Uncertainty (shape and thickness tolerances)	E3.1	4.0	R	√3	1	2.3	∞
Liquid Conductivity Target - tolerance	E3.2	5.0	R	√3	0.7	1.8	∞
Liquid Conductivity - measurement uncertainty	E3.3	2.5	N	1	0.7	1.6	∞
Liquid Permittivity Target tolerance	E3.2	5.0	R	√3	0.6	1.7	∞
Liquid Permittivity - measurement uncertainty	E3.3	2.5	N	1	0.6	1.5	∞
Combined Standard Uncertainty			RSS			**± 10.7%**	
Expanded Uncertainty (95% CONFIDENCE INTERVAL)			*k*= 2.00705			**± 21.4%**	

8. Test results summary

8.1. Conducted Average Output Power

Measurement uncertainty for conducted measurements is ±0.5dB

Bluetooth

Average power measured using an average power meter.

Channel	Frequency [MHz]	HW: DV1.1 / DV 1.1b SW: 7800 / 8184		
		Average Power [dBm]		
		GFSK	π/4 DQPSK	8-DPSK
0	2402	9.3	6.8	6.8
39	2441	9.1	6.9	6.9
78	2480	9.2	7	7

WLAN

Average power measured using an average power meter.

Channel	Frequency [MHz]	HW: DV1.1 / DV 1.1b SW: 7800 / 8184		
		Average Power [dBm]		
		802.11b	802.11g	802.11n
1	2412	17.2	16	14.8
6	2437	17.2	16	14.8
11	2462	17.4	15.9	14.8

GSM

Average power measured using a Rhode and Schwarz CMU 200.

Band	Channel	Frequency [MHz]	HW: DV1.1 SW: 7800	HW: DV1.1b SW: 8184
			Average Power [dBm]	Average Power [dBm]
GSM850	128	824.2	32.7	31.8
	190	836.6	32.7	31.8
	251	848.8	32.7	31.8
PCS1900	512	1850.2	30.2	30.2
	661	1880	30.1	30.1
	810	1909.8	30.1	30.1

GSM 850 Band – (E)GPRS

Average power measured using a Rhode and Schwarz CMU 200.

Mode of Operation	Modulation	Channel	Frequency [MHz]	HW: DV1.1 SW: 7800		HW: DV1.1b SW: 8184	
				Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]
GPRS 1 uplink timeslot	GMSK	128	824.2	32.6	23.6	31.9	22.9
		190	836.6	32.6	23.6	31.8	22.8
		251	848.8	32.7	23.7	31.8	22.8
GPRS 2 uplink timeslots	GMSK	128	824.2	29.6	23.6	28.7	22.7
		190	836.6	29.6	23.6	28.7	22.7
		251	848.8	29.6	23.6	28.7	22.7
GPRS 3 uplink timeslots	GMSK	128	824.2	27.7	23.45	26.8	22.55
		190	836.6	27.7	23.45	26.9	22.65
		251	848.8	27.7	23.45	26.8	22.55
GPRS 4 uplink timeslots	GMSK	128	824.2	26.5	23.5	25.6	22.6
		190	836.6	26.5	23.5	25.6	22.6
		251	848.8	26.5	23.5	25.7	22.7
EGPRS 1 uplink timeslot	GMSK	128	824.2	32.65	23.65	31.8	22.8
		190	836.6	32.65	23.65	31.8	22.8
		251	848.8	32.7	23.7	31.8	22.8
EGPRS 2 uplink timeslots	GMSK	128	824.2	29.6	23.6	28.7	22.7
		190	836.6	29.6	23.6	28.7	22.7
		251	848.8	29.6	23.6	28.7	22.7
EGPRS 3 uplink timeslots	GMSK	128	824.2	27.7	23.45	26.8	22.55
		190	836.6	27.7	23.45	26.8	22.55
		251	848.8	27.7	23.45	26.8	22.55
EGPRS 4 uplink timeslots	GMSK	128	824.2	26.5	23.5	25.6	22.6
		190	836.6	26.5	23.5	25.7	22.7
		251	848.8	26.55	23.55	25.7	22.7
EGPRS 1 uplink timeslot	8PSK	128	824.2	26.9	17.9	26	17
		190	836.6	26.9	17.9	26.1	17.1
		251	848.8	27	18	26.1	17.1
EGPRS 2 uplink timeslots	8PSK	128	824.2	26.9	20.9	26	20
		190	836.6	26.9	20.9	26	20
		251	848.8	27	21	26.1	20.1
EGPRS 3 uplink timeslots	8PSK	128	824.2	26.05	21.8	25.2	20.95
		190	836.6	26.05	21.8	25.2	20.95
		251	848.8	26.15	21.9	25.2	20.95
EGPRS 4 uplink timeslots	8PSK	128	824.2	24.8	21.8	24	21
		190	836.6	24.85	21.85	24	21
		251	848.8	24.9	21.9	24	21

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PCS 1900 Band - (E)GPRS

Average power measured using a Rhode and Schwarz CMU 200.

Mode of Operation	Modulation	Channel	Frequency [MHz]	HW: DV1.1 SW: 7800		HW: DV1.1b SW: 8184	
				Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]	Measured Burst Average Power [dBm]	Calculated Time Average Power [dBm]
GPRS 1 uplink timeslot	GMSK	512	1850.2	30.2	21.2	30.2	21.2
		661	1880	30.1	21.1	30.1	21.1
		810	1909.8	30.1	21.1	30.1	21.1
GPRS 2 uplink timeslots	GMSK	512	1850.2	27.2	21.2	27.2	21.2
		661	1880	27.1	21.1	27.1	21.1
		810	1909.8	27.2	21.2	27.1	21.1
GPRS 3 uplink timeslots	GMSK	512	1850.2	25.3	21.05	25.3	21.05
		661	1880	25.3	21.05	25.3	21.05
		810	1909.8	25.4	21.15	25.3	21.05
GPRS 4 uplink timeslots	GMSK	512	1850.2	24.2	21.2	24.2	21.2
		661	1880	24.1	21.1	24.2	21.2
		810	1909.8	24.2	21.2	24.2	21.2
EGPRS 1 uplink timeslot	GMSK	512	1850.2	30.2	21.2	30.2	21.2
		661	1880	30.2	21.2	30.1	21.1
		810	1909.8	30.1	21.1	30.1	21.1
EGPRS 2 uplink timeslots	GMSK	512	1850.2	27.2	21.2	27.1	21.1
		661	1880	27.1	21.1	27.1	21.1
		810	1909.8	27.2	21.2	27.1	21.1
EGPRS 3 uplink timeslots	GMSK	512	1850.2	25.3	21.05	25.3	21.05
		661	1880	25.3	21.05	25.3	21.05
		810	1909.8	25.4	21.15	25.3	21.05
EGPRS 4 uplink timeslots	GMSK	512	1850.2	24.1	21.1	24.1	21.1
		661	1880	24.1	21.1	24.1	21.1
		810	1909.8	24.2	21.2	24.2	21.2
EGPRS 1 uplink timeslot	8PSK	512	1850.2	25.4	16.4	25.5	16.5
		661	1880	25.4	16.4	25.4	16.4
		810	1909.8	25.4	16.4	25.4	16.4
EGPRS 2 uplink timeslots	8PSK	512	1850.2	25.4	19.4	25.5	19.5
		661	1880	25.4	19.4	25.5	19.5
		810	1909.8	25.4	19.4	25.5	19.5
EGPRS 3 uplink timeslots	8PSK	512	1850.2	24.6	20.35	24.5	20.25
		661	1880	24.5	20.25	24.5	20.25
		810	1909.8	24.5	20.25	24.5	20.25
EGPRS 4 uplink timeslots	8PSK	512	1850.2	23.3	20.3	23.3	20.3
		661	1880	23.3	20.3	23.3	20.3
		810	1909.8	23.3	20.3	23.4	20.4

WCDMA

Average power measured using a Rhode and Schwarz CMU 200.

Band	Channel	Frequency [MHz]	HW: DV1.1 SW: 7800		HW: DV1.1b SW: 8184	
			Average Power [dBm]		Average Power [dBm]	
			12.2kbps AMR, 3.4kb SRB	12.2kbps RMC	12.2kbps AMR, 3.4kb SRB	12.2kbps RMC
WCDMA FDD V	4132	826.42	23.88	23.88	23.3	23.27
	4175	836.6	23.75	23.73	23.12	23.15
	4233	846.6	23.76	23.68	23.11	23.13
WCDMA FDD II	9262	1852.4	23.39	23.35	23.06	23.05
	9400	1880	23.41	23.38	23.06	23.01
	9538	1907.6	23.61	23.65	23.13	23.12

HSDPA

Settings are according to FCC KDB 941225 D01, "SAR Measurement Procedures for 3G Devices" section "Release 5 HSDPA Data Devices"

Average power measured using a Rhode and Schwarz CMU 200. Reference Rhode and Schwarz application note 1CM72: Operation Guide for HSDPA Test Setup according to 3GPP TS 34.121, section 2.2.

Band	Channel	Frequency [MHz]	HW: DV1.1b SW: 8184			
			Average Power [dBm]			
			Sub-test 1	Sub-test 2	Sub-test 3	Sub-test 4
WCDMA FDD V	4132	826.42	23.36	22.87	22.36	22.08
	4175	836.6	23.25	22.75	22.27	21.99
	4233	846.6	23.27	22.8	22.3	22.01
WCDMA FDD II	9262	1852.4	23.36	22.86	22.39	22.18
	9400	1880	23.2	22.73	22.23	22.03
	9538	1907.6	23.3	22.82	22.4	22.12

HSUPA

Settings are according to FCC KDB 941225 D01, "SAR Measurement Procedures for 3G Devices" section "Release 6 HSPA Data Devices"
Average power measured using a Rhode and Schwarz CMU 200. Reference Rhode and Schwarz application note 1CM73: Operation Guide for HSUPA Test Setup according to 3GPP TS 34.121, section 2.1 and 2.2.

Band	Channel	Frequency [MHz]	HW: DV1.1b SW: 8184 Average Power [dBm]				
			Sub-test 1	Sub-test 2	Sub-test 3	Sub-test 4	Sub-test 5
WCDMA FDD V	4132	826.42	22.54	20.6	21.44	20.85	22.7
	4175	836.6	22.43	20.53	21.32	20.75	22.61
	4233	846.6	22.42	20.54	21.36	20.72	22.6
WCDMA FDD II	9262	1852.4	22.55	20.8	21.43	21.06	22.73
	9400	1880	22.52	20.6	21.42	20.87	22.69
	9538	1907.6	22.65	20.7	21.55	20.8	22.64

8.2. Stand-Alone SAR Evaluation Exclusion

Antenna	Operation Mode	SAR Evaluation Exclusion Reason
WLAN	802.11g 802.11n HT20	According to KDB 248227, 802.11g and/or 802.11n HT20 is not required when the maximum average output power is < ¼ dB higher than that measured on the corresponding 802.11b channels.
Bluetooth	GFSK π/4 DQPSK 8DPSK	According to KDB 648474, Bluetooth is not required when the output power is ≤ 24 mW and the antenna is ≥ 5 cm from other antennas
Cellular	GSM 850 band, 8PSK Modulation	According to KDB 941225 and IEEE 1528-2003 footnote 11, SAR evaluation for low-power modes are required for devices that produced a peak SAR larger than one half of the compliance limit. The highest SAR value for GMSK is 0.686 W/kg, less than one half of the 1.6 W/kg limit.
Cellular	PCS 1900 band, 8PSK Modulation	According to KDB 941225 and IEEE 1528-2003 footnote 11, SAR evaluation for low-power modes are required for devices that produced a peak SAR larger than one half of the compliance limit. The highest SAR value for GMSK is 0.579 W/kg, less than one half of the 1.6 W/kg limit.
Cellular	WCDMA, AMR Configurations	According to KDB 941225, SAR evaluation is not required when the maximum average output power of is < ¼ dB higher than that measured in 12.2 kbps RMC.
Cellular	HSDPA	According to KDB 941225, SAR evaluation is not required when the maximum average output power is < ¼ dB higher than that measured on the corresponding channels without HSDPA using 12.2 kbps RMC and the maximum measured SAR for 12.2 kbps RMC is less than 1.2 W/kg.
Cellular	HSPA	According to KDB 941225, SAR evaluation is not required when the maximum average output power is < ¼ dB higher than that measured on the corresponding channels without HSPA using 12.2 kbps RMC and the maximum measured SAR for 12.2 kbps RMC is less than 1.2 W/kg.

8.3. Test Positions and Configurations

Exposure Condition	Position	Positioning Photo (Appendix B)
Head SAR	Left Touch	Photo 1
	Left 15° Tilt	Photo 2
	Right Touch	Photo 3
	Right 15° Tilt	Photo 4
Body SAR	Front 10 mm with headset	Photo 5
	Back 10 mm with headset	Photo 6
Wireless Router SAR	Front 10 mm with headset	Photo 5
	Back 10 mm with headset	Photo 6
	Top Edge 10 mm with headset	Photo 7
	Left Edge 10 mm with headset	Photo 8
	Right Edge 10 mm with headset	Photo 9
	Bottom Edge 10 mm with headset	Photo 10

WLAN is tested with 100% duty cycle. According to SPEAG user manual section 27.2, CW can be assumed which results in crest factor 1.

If the SAR value on the middle channel was more than 3dB below the limit, high and low channels were not evaluated.

For GSM bands, the uplink timeslot configuration with the highest source-based time-averaged output power is used for full SAR evaluation for body exposure and wireless router mode positions. Spot check measurements for other uplink timeslot configurations are performed on the position with the highest measured SAR value to ensure compliance.

SAR evaluation for wireless router mode is performed on the faces and edges that are within 2.5 cm of the transmitting antenna as required by KDB 941225 D06 v01.

During the course of testing, the hardware and software of the EUT was changed. If the previous hardware/software was evaluated, spot checks with the new hardware/software version are performed on the position with the highest measured SAR. If spot check measurements using the new hardware/software version are higher than the previous hardware/software version, full testing is performed for the new hardware/software version for the exposure condition.

8.4. SAR Results for Head

Band	Operation Mode	Channel	Frequency (MHz)	HW/SW Version	Position	SAR 1g (W/kg)	Results (Appendix A)
GSM 850	GSM	190	836.6	DV1.1/7800	Left Touch	0.558	Plot 1
				DV1.1/7800	Left Tilt	0.313	Plot 2
				DV1.1/7800	Right Touch	0.467	Plot 3
				DV1.1/7800	Right 15° Tilt	0.286	Plot 4
				DV1.1b/8184	Left Touch	0.403	Plot 5
PCS 1900	GSM	661	1880	DV1.1/7800	Left Touch	0.982	Plot 6
				DV1.1/7800	Left Tilt	0.327	Plot 7
				DV1.1/7800	Right Touch	0.589	Plot 8
				DV1.1/7800	Right 15° Tilt	0.325	Plot 9
		512	1850.2	DV1.1/7800	Left Touch	0.862	Plot 10
		810	1909.8	DV1.1/7800	Left Touch	1.08	Plot 11
				DV1.1b/8184	Left Touch	0.982	Plot 12
WCDMA FDD II	RMC, 12.2 kbps	9400	1880	DV1.1b/8184	Left Touch	0.978	Plot 13
				DV1.1b/8184	Left Tilt	0.286	Plot 14
				DV1.1b/8184	Right Touch	0.720	Plot 15
				DV1.1b/8184	Right 15° Tilt	0.344	Plot 16
		9262	1850.4	DV1.1b/8184	Left Touch	0.936	Plot 17
		9538	1907.6	DV1.1b/8184	Left Touch	1.09	Plot 18
WCDMA FDD V	RMC, 12.2 kbps	4183	836.6	DV1.1/7800	Left Touch	0.603	Plot 19
				DV1.1/7800	Left Tilt	0.344	Plot 20
				DV1.1/7800	Right Touch	0.508	Plot 21
				DV1.1/7800	Right 15° Tilt	0.309	Plot 22
				DV1.1b/8184	Left Touch	0.459	Plot 23
802.11b	100% Duty Cycle	6	2437	DV1.1/7800	Left Touch	0.501	Plot 24
				DV1.1/7800	Left Tilt	0.568	Plot 25
				DV1.1/7800	Right Touch	0.472	Plot 26
				DV1.1/7800	Right 15° Tilt	0.459	Plot 27
				DV1.1b/8184	Left Tilt	0.483	Plot 28

8.5. SAR Results for Body and Wireless Router Mode

Band	Operation Mode	Channel	Frequency (MHz)	HW/SW Version	Position	SAR 1g (W/kg)	Results (Appendix A)
GSM 850	GPRS, 4 Uplink Timeslots	190	836.6	DV1.1/7800	Back 10mm	0.675	Plot 29
	GPRS, 3 Uplink Timeslots	190	836.6	DV1.1/7800	Back 10mm	0.672	Plot 30
	GPRS, 2 Uplink Timeslots	190	836.6	DV1.1/7800	Front 10mm	0.444	Plot 31
				DV1.1/7800	Back 10mm	0.686	Plot 32
				DV1.1b/8184	Left Edge 10mm	0.493	Plot 33
				DV1.1b/8184	Right Edge 10mm	0.330	Plot 34
				DV1.1b/8184	Bottom Edge 10mm	0.044	Plot 35
				DV1.1b/8184	Back 10mm	0.495	Plot 36
	GPRS, 1 Uplink Timeslots	190	836.6	DV1.1/7800	Back 10mm	0.671	Plot 37
PCS 1900	GPRS, 4 Uplink Timeslots	661	1880	DV1.1/7800	Front 10mm	0.579	Plot 38
				DV1.1/7800	Back 10mm	0.538	Plot 39
				DV1.1b/8184	Left Edge 10mm	0.215	Plot 40
				DV1.1b/8184	Right Edge 10mm[1]	0.048	Plot 41
						0.047	
				DV1.1b/8184	Bottom Edge 10mm	0.408	Plot 42
				DV1.1b/8184	Front 10mm	0.552	Plot 43
	GPRS, 3 Uplink Timeslots	661	1880	DV1.1/7800	Front 10mm	0.523	Plot 44
	GPRS, 2 Uplink Timeslots	661	1880	DV1.1/7800	Front 10mm	0.527	Plot 45
	GPRS, 1 Uplink Timeslots	661	1880	DV1.1/7800	Front 10mm	0.504	Plot 46
WCDMA FDD II	RMC, 12.2 kbps	9400	1880	DV1.1b/8184	Front 10mm	0.618	Plot 47
					Back 10mm	0.797	Plot 48
					Left Edge 10mm	0.293	Plot 49
					Right Edge 10mm[1]	0.057	Plot 50
						0.049	
					Bottom Edge 10mm	0.513	Plot 51
WCDMA FDD V	RMC, 12.2 kbps	4183	836.6	DV1.1/7800	Front 10mm	0.557	Plot 52
				DV1.1/7800	Back 10mm	0.922	Plot 53
				DV1.1b/8184	Left Edge 10mm	0.441	Plot 54
				DV1.1b/8184	Right Edge 10mm	0.378	Plot 55
				DV1.1b/8184	Bottom Edge 10mm	0.060	Plot 56
		4132	826.4	DV1.1/7800	Back 10mm	0.970	Plot 57
		4233	846.6	DV1.1/7800	Back 10mm	0.974	Plot 58
				DV1.1b/8184	Back 10mm	0.838	Plot 59

802.11b	**100% Duty Cycle**	**6**	**2437**	DV1.1/7800	Front 10mm[1]	0.157 0.112	Plot 60
				DV1.1/7800	Back 10mm	0.179	Plot 61
				DV1.1b/8184	Left Edge 10mm[1]	0.040 0.032	Plot 62
				DV1.1b/8184	Right Edge 10mm[1]	0.141 0.101	Plot 63
				DV1.1b/8184	Top Edge 10mm	0.167	Plot 64
				DV1.1b/8184	Back 10mm	0.127	Plot 65

NOTES:
1. Configurations with multiple SAR values have at least one hotspot within 2 dB of the primary hotspot.

8.6. SAR Results Extrapolated to Upper Tolerance Limit

TCB Workshop presentation "RF Exposure Procedure Review" April 2010, slide 43, states test results must demonstrate compliance when results are extrapolated to the upper tune-up tolerance limit, with respect to the maximum measured output power of the test sample, to ensure all production units are compliant. The upper tune-up tolerance is declared by the manufacturer. The table below extrapolates the measured SAR results to the upper tune-up tolerance limit of licensed bands. Only the highest SAR results of each band are shown.

HW/SW Version	Band	Operation Mode	Channel	Frequency (MHz)	Measured Avg Output Power (dBm)	Upper Tolerance Limit (dBm)	Measured SAR 1g (W/kg)	Extrapolated SAR 1g (W/kg)
DV1.1/7800	**GSM 850**	**GPRS, 2 Uplink Timeslots**	**190**	**836.6**	29.6	30.5	0.686	0.84
DV1.1/7800	**PCS 1900**	**GSM**	**810**	**1909.8**	30.1	31.5	1.08	1.49
DV1.1b/8184	**WCDMA FDD II**	**RMC, 12.2 kbps**	**9538**	**1907.6**	23.12	24.5	1.09	1.50
DV1.1/7800	**WCDMA FDD V**	**RMC, 12.2 kbps**	**4233**	**846.6**	23.68	24.5	0.974	1.18

8.7. Simultaneous Transmission SAR Evaluation Consideration

According to KDB 648474 D01 V01R05, SAR evaluation for simultaneous transmission can be excluded when specific requirements are satisfied.

Exposure Condition	Position	Antenna	Highest measured SAR 1g (W/kg)
Head SAR	Left Touch	WLAN	0.501
		Bluetooth[1]	0.00
		Cellular	1.09
	Left Tilt	WLAN	0.568
		Bluetooth[1]	0.00
		Cellular	0.344
	Right Touch	WLAN	0.472
		Bluetooth[1]	0.00
		Cellular	0.720
	Right Tilt	WLAN	0.459
		Bluetooth[1]	0.00
		Cellular	0.344
Body SAR	Front 10mm	WLAN	0.157
		Bluetooth[1]	0.00
		Cellular	0.618
	Back 10mm	WLAN	0.179
		Bluetooth[1]	0.00
		Cellular	0.974
Wireless Router SAR	Front 10mm	WLAN	0.157
		Bluetooth[1]	0.00
		Cellular	0.618
	Back 10mm	WLAN	0.179
		Bluetooth[1]	0.00
		Cellular	0.974
	Left Edge 10mm	WLAN	0.04
		Bluetooth[1]	0.00
		Cellular	0.493
	Right Edge 10mm	WLAN	0.141
		Bluetooth[1]	0.00
		Cellular	0.378
	Bottom Edge 10mm	Cellular	0.513
		Bluetooth[1]	0.00

NOTES:
1. When stand-alone SAR evaluation is not required, SAR value is assumed to be 0.0 W/kg.

Exposure Condition	Position	Simultaneous Transmission Antenna Combinations	Sum of SAR 1g (W/kg)	Peak Location Separation[1]	SAR to Peak Location Separation Ratio[2]
Head SAR	Left Touch	WLAN and Cellular[2]	1.591	N/A	N/A
		Bluetooth and Cellular	1.09	N/A	N/A
	Left Tilt	WLAN and Cellular	0.912	N/A	N/A
		Bluetooth and Cellular	0.344	N/A	N/A
	Right Touch	WLAN and Cellular	1.192	N/A	N/A
		Bluetooth and Cellular	0.720	N/A	N/A
	Right Tilt	WLAN and Cellular	0.803	N/A	N/A
		Bluetooth and Cellular	0.344	N/A	N/A
Body SAR	Front 10mm	WLAN and Cellular	0.775	N/A	N/A
		Bluetooth and Cellular	0.618	N/A	N/A
	Back 10mm	WLAN and Cellular	1.153	N/A	N/A
		Bluetooth and Cellular	0.974	N/A	N/A
Wireless Router SAR	Front 10mm	WLAN and Cellular	0.775	N/A	N/A
		Bluetooth and Cellular	0.618	N/A	N/A
	Back 10mm	WLAN and Cellular	1.153	N/A	N/A
		Bluetooth and Cellular	0.974	N/A	N/A
	Left Edge 10mm	WLAN and Cellular	0.533	N/A	N/A
		Bluetooth and Cellular	0.493	N/A	N/A
	Right Edge 10mm	WLAN and Cellular	0.519	N/A	N/A
		Bluetooth and Cellular	0.378	N/A	N/A
	Bottom Edge 10mm	Bluetooth and Cellular	0.513	N/A	N/A

NOTES:
1. Coordinates are locations (x, y, z) of peak SAR in the zoom scan. Coordinates listed only if Sum of SAR 1g (W/kg) is equal to or greater than 1.6 W/kg.
2. SAR to Peak Location Separation Ratio is only calculated if the Sum of SAR 1g (W/kg) is equal to or greater than 1.6 W/kg.

Exposure Condition	Position	Simultaneous Transmission Antenna Combinations	Simultaneous Transmission SAR Evaluation Exclusion Reason
Head SAR	All Positions[1]	WLAN and Cellular	Sum of SAR 1g is less than 1.6 W/kg
		Bluetooth and Cellular	Sum of SAR 1g is less than 1.6 W/kg
Body SAR	All Positions[1]	WLAN and Cellular	Sum of SAR 1g is less than 1.6 W/kg
		Bluetooth and Cellular	Sum of SAR 1g is less than 1.6 W/kg
Wireless Router SAR	All Positions[1]	WLAN and Cellular	Sum of SAR 1g is less than 1.6 W/kg
		Bluetooth and Cellular	Sum of SAR 1g is less than 1.6 W/kg

NOTES:
1. Refer to the table under section 8.3 for positions.

9. Dipole verification

Prior to formal testing at each frequency a system verification was performed in accordance with IEEE 1528. The 1 Watt reference SAR value is taken from the SPEAG dipole calibration report as required by FCC KDB 450824 D01. All of the testing described in this report was performed within 24 hours of the system verification. The following results were obtained:

Date	Liquid Type	Frequency (MHz)	CW input at dipole feed (Watts)	1g SAR (W/kg)	Reference SPEAG Report		Results (Appendix A)
					1 Watt reference SAR value (W/kg)	Difference reference SAR value to normalized SAR	
2012-10-09	HSL	835	1	9.91	9.69	2.27%	Plot 66
2012-11-14	HSL	900	1	11	10.5	4.76%	Plot 67
2012-10-26	HSL	1900	1	37.6	40.5	-7.16%	Plot 68
2012-11-12	HSL	1900	1	37.7	39.8	-5.28%	Plot 69
2012-10-17	HSL	2450	1	52	54.4	-4.41%	Plot 70
2012-11-16	HSL	2450	1	47.5	51.2	-7.23%	Plot 71
2012-10-10	MSL	835	1	9.98	9.96	0.20%	Plot 72
2012-10-11	MSL	835	1	10.1	9.96	1.41%	Plot 73
2012-10-25	MSL	835	1	10.4	9.96	4.42%	Plot 74
2012-11-14	MSL	900	1	10.4	10.9	-4.59%	Plot 75
2012-10-17	MSL	1900	1	37.1	40.1	-7.48%	Plot 76
2012-11-12	MSL	1900	1	40.1	40.2	-0.25%	Plot 77
2012-10-18	MSL	2450	1	49.7	50.5	-1.58%	Plot 78
2012-11-16	MSL	2450	1	49.5	49.6	-0.20%	Plot 79

10. References

1. [FCC 2001] Federal Communications Commission: Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields, Supplement C (Edition 01-01) to OET Bulletin 65 (Edition 97-01), FCC, June 2001.

2. [IEEE 2005] IEEE Std C95.1-2005: IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz, Inst. of Electrical and Electronics Engineers, Inc., October 2005.

3. [IEEE 2003] IEEE Std 1528-2003: IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head From Wireless Communications Devices: Measurement Techniques. Inst. of Electrical and Electronics Engineers, Inc., December 2003.

4. [NIST 1994] NIST: Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results, Technical Note 1297 (TN1297), United States Department of Commerce Technology Administration, National Institute of Standards and Technology, September 1994.

11. Report History

2012-12-03: Original Report
2012-12-04: Updated HSUPA conducted power. Replaces previous test report number