



# FCC SAR Test Report

APPLICANT : Honeywell International Inc.  
EQUIPMENT : 99EX mobile computer  
BRAND NAME : Honeywell  
MODEL NAME : 99EXBF; 99GXBF  
MARKETING NAME : Dolphin 99EX  
FCC ID : HD5-99EXBF  
STANDARD : FCC 47 CFR Part 2 (2.1093)  
ANSI/IEEE C95.1-1992  
IEEE 1528-2013

We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and had been in compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by: Eric Huang / Deputy Manager

Approved by: Jones Tsai / Manager



## **SPORTON INTERNATIONAL INC.**

No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.)



## Table of Contents

1. Statement of Compliance .....	4
2. Administration Data .....	5
3. Guidance Standard .....	5
4. Equipment Under Test (EUT) Information.....	6
4.1 General Information .....	6
5. RF Exposure Limits.....	7
5.1 Uncontrolled Environment.....	7
5.2 Controlled Environment.....	7
6. Specific Absorption Rate (SAR).....	8
6.1 Introduction .....	8
6.2 SAR Definition.....	8
7. System Description and Setup .....	9
8. Measurement Procedures .....	10
8.1 Spatial Peak SAR Evaluation.....	10
8.2 Power Reference Measurement.....	11
8.3 Area Scan .....	11
8.4 Zoom Scan.....	12
8.5 Volume Scan Procedures.....	12
8.6 Power Drift Monitoring.....	12
9. Test Equipment List.....	13
10. System Verification .....	14
10.1 Tissue Verification .....	14
10.2 System Performance Check Results.....	15
11. RF Exposure Positions .....	16
11.1 Body Worn Accessory .....	16
12. Conducted RF Output Power (Unit: dBm).....	17
13. Bluetooth Exclusions Applied .....	25
14. Antenna Location .....	26
15. SAR Test Results .....	27
15.1 Body SAR .....	28
15.2 Repeated SAR Measurement .....	32
16. Simultaneous Transmission Analysis.....	32
16.1 Body-worn Accessory Exposure Conditions.....	33
17. Uncertainty Assessment .....	34
18. References.....	37
Appendix A. Plots of System Performance Check	
Appendix B. Plots of High SAR Measurement	
Appendix C. DASY Calibration Certificate	
Appendix D. Test Setup Photos	



## Revision History



## 1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **Honeywell International Inc., 99EX mobile computer, 99EXBF; 99GXBF**, are as follows.

Equipment Class	Frequency Band	Highest SAR Summary	
		Body-worn 1g SAR (W/kg)	Simultaneous Transmission 1g SAR (W/kg)
PCB	GSM850	0.90	1.20
	GSM1900	0.61	
	WCDMA Band II	0.50	
	WCDMA Band V	0.47	
	CDMA 2000 BC0	0.70	
	CDMA 2000 BC1	0.73	
DTS	2.4GHz WLAN	0.15	1.05
NII	5.2GHz WLAN		1.20
	5.3GHz WLAN	0.30	
	5.5GHz WLAN	0.21	
	5.8GHz WLAN	0.36	
Date of Testing:		2015/9/2~2015/9/23	

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1992, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2013 and FCC KDB publications



## 2. Administration Data

Testing Laboratory	
Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No.52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan District, Taoyuan City, Taiwan (R.O.C.) TEL: +886-3-327-3456 FAX: +886-3-328-4978

Applicant	
Company Name	Honeywell International Inc.
Address	9680 Old Bailes Road, Fort Mill, SC 29707 USA

Manufacturer	
Company Name	Honeywell International Inc.
Address	9680 Old Bailes Road, Fort Mill, SC 29707 USA

## 3. Guidance Standard

The Specific Absorption Rate (SAR) testing specification, method, and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- ANSI/IEEE C95.1-1992
- IEEE 1528-2013
- FCC KDB 865664 D01 SAR Measurement 100 MHz to 6 GHz v01r04
- FCC KDB 865664 D02 SAR Reporting v01r01
- FCC KDB 447498 D01 General RF Exposure Guidance v05r02
- FCC KDB 648474 D04 SAR Evaluation Considerations for Wireless Handsets v01r02
- FCC KDB 248227 D01 802.11 Wi-Fi SAR v02r01
- FCC KDB 941225 D01 3G SAR Procedures v03



## 4. Equipment Under Test (EUT) Information

### 4.1 General Information

Product Feature & Specification	
Equipment Name	99EX mobile computer
Brand Name	Honeywell
Model Name	99EXBF; 99GXBF
Marketing Name	Dolphin 99EX
FCC ID	HD5-99EXBF
Wireless Technology and Frequency Range	GSM850: 824.2 MHz ~ 848.8 MHz GSM1900: 1850.2 MHz ~ 1909.8 MHz WCDMA Band V: 826.4 MHz ~ 846.6 MHz WCDMA Band II: 1852.4 MHz ~ 1907.6 MHz CDMA2000 BC0: 824.7 MHz ~ 848.31 MHz CDMA 2000 BC1: 1851.25 MHz ~ 1908.75 MHz WLAN 2.4GHz Band: 2412 MHz ~ 2462 MHz WLAN 5.2GHz Band: 5180 MHz ~ 5240 MHz WLAN 5.3GHz Band: 5260 MHz ~ 5320 MHz WLAN 5.5GHz Band: 5500 MHz ~ 5700 MHz WLAN 5.8GHz Band: 5745 MHz ~ 5825 MHz Bluetooth: 2402 MHz ~ 2480 MHz
Mode	<ul style="list-style-type: none"> <li>· GPRS/EGPRS</li> <li>· RMC 12.2Kbps</li> <li>· HSDPA</li> <li>· HSUPA</li> <li>· CDMA2000 : 1xRTT/1xEv-Do(Rev.0)/1xEv-Do(Rev.A)</li> <li>· 802.11a/b/g/n HT20</li> <li>· Bluetooth v3.0+EDR , Bluetooth v4.0-LE</li> </ul>
HW Version	8
SW Version	26.07
EUT Stage	Identical Prototype
Remark:	<ol style="list-style-type: none"> <li>1. The difference between the samples 1-5 is the keypad and handle, RF exposure assessment is used sample1 and sample4 as the main testing, sample 2/3/5 is selected worst case perform.</li> <li>2. The holster 1 is spot check sample1 and 3 worst cases, holster 2 is for sample2 used, holster 3 is spot check sample 4 and 5 worst case.</li> <li>3. In this case, the minimum thickness of holster is 8.6 mm (reference to appendix D), and the 8.6 mm distance is used for Bluetooth exclusion.</li> </ol>

Sample List	
IMEI Code	Sample1: 013484000248824 Sample2: 013484000249889 Sample3: 013484000248329 Sample4: 013484000248360 Sample5: 013484000249707
Sample 1	Straight type + 55Keypad + Housing Standard + Holster1
Sample 2	Straight type + 52Keypad + Housing UPS + Holster2
Sample 3	Straight type + 34Keypad + Housing Standard + Holster1
Sample 4	Handle type + 55Keypad + Holster3
Sample 5	Handle type + 34Keypad + Holster3



## 5. RF Exposure Limits

### 5.1 Uncontrolled Environment

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

### 5.2 Controlled Environment

Controlled Environments are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. The 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.

**Limits for Occupational/Controlled Exposure (W/kg)**

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.4	8.0	20.0

**Limits for General Population/Uncontrolled Exposure (W/kg)**

Whole-Body	Partial-Body	Hands, Wrists, Feet and Ankles
0.08	1.6	4.0

1. Whole-Body SAR is averaged over the entire body, partial-body SAR is averaged over any 1gram of tissue defined as a tissue volume in the shape of a cube. SAR for hands, wrists, feet and ankles is averaged over any 10 grams of tissue defined as a tissue volume in the shape of a cube.



## 6. Specific Absorption Rate (SAR)

### 6.1 Introduction

SAR is related to the rate at which energy is absorbed per unit mass in an object exposed to a radio field. The SAR distribution in a biological body is complicated and is usually carried out by experimental techniques or numerical modeling. The standard recommends limits for two tiers of groups, occupational/controlled and general population/uncontrolled, based on a person's awareness and ability to exercise control over his or her exposure. In general, occupational/controlled exposure limits are higher than the limits for general population/uncontrolled.

### 6.2 SAR Definition

The SAR definition is the time derivative (rate) of the incremental energy (dW) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dv) of a given density (ρ). The equation description is as below:

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

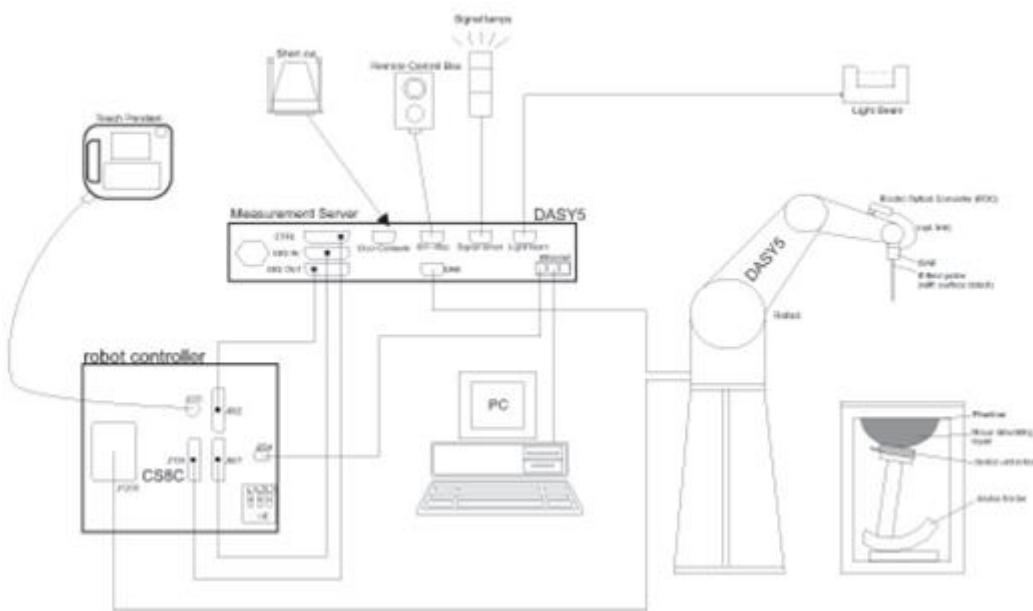
SAR is expressed in units of Watts per kilogram (W/kg)

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

Where: σ is the conductivity of the tissue, ρ is the mass density of the tissue and E is the RMS electrical field strength.

## 7. System Description and Setup

The DASY system used for performing compliance tests consists of the following items:



- A standard high precision 6-axis robot with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- An isotropic Field probe optimized and calibrated for the targeted measurement.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The Electro-optical converter (EOC) performs the conversion from optical to electrical signals for the digital communication to the DAE. To use optical surface detection, a special version of the EOC is required. The EOC signal is transmitted to the measurement server.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- The Light Beam used is for probe alignment. This improves the (absolute) accuracy of the probe positioning.
- A computer running WinXP or Win7 and the DASY5 software.
- Remote control and teach pendant as well as additional circuitry for robot safety such as warning lamps, etc.
- The phantom, the device holder and other accessories according to the targeted measurement.



## 8. Measurement Procedures

The measurement procedures are as follows:

### <Conducted power measurement>

- (a) For WWAN power measurement, use base station simulator to configure EUT WWAN transmission in conducted connection with RF cable, at maximum power in each supported wireless interface and frequency band.
- (b) Read the WWAN RF power level from the base station simulator.
- (c) For WLAN/BT power measurement, use engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power in each supported wireless interface and frequency band
- (d) Connect EUT RF port through RF cable to the power meter, and measure WLAN/BT output power

### <SAR measurement>

- (a) Use base station simulator to configure EUT WWAN transmission in radiated connection, and engineering software to configure EUT WLAN/BT continuously transmission, at maximum RF power, in the highest power channel.
- (b) Place the EUT in the positions as Appendix D demonstrates.
- (c) Set scan area, grid size and other setting on the DASY software.
- (d) Measure SAR results for the highest power channel on each testing position.
- (e) Find out the largest SAR result on these testing positions of each band
- (f) Measure SAR results for other channels in worst SAR testing position if the reported SAR of highest power channel is larger than 0.8 W/kg

According to the test standard, the recommended procedure for assessing the peak spatial-average SAR value consists of the following steps:

- (a) Power reference measurement
- (b) Area scan
- (c) Zoom scan
- (d) Power drift measurement

### 8.1 Spatial Peak SAR Evaluation

The procedure for spatial peak SAR evaluation has been implemented according to the test standard. It can be conducted for 1g and 10g, as well as for user-specific masses. The DASY software includes all numerical procedures necessary to evaluate the spatial peak SAR value.

The base for the evaluation is a "cube" measurement. The measured volume must include the 1g and 10g cubes with the highest averaged SAR values. For that purpose, the center of the measured volume is aligned to the interpolated peak SAR value of a previously performed area scan.

The entire evaluation of the spatial peak values is performed within the post-processing engine (SEMCAD). The system always gives the maximum values for the 1g and 10g cubes. The algorithm to find the cube with highest averaged SAR is divided into the following stages:

- (a) Extraction of the measured data (grid and values) from the Zoom Scan
- (b) Calculation of the SAR value at every measurement point based on all stored data (A/D values and measurement parameters)
- (c) Generation of a high-resolution mesh within the measured volume
- (d) Interpolation of all measured values from the measurement grid to the high-resolution grid
- (e) Extrapolation of the entire 3-D field distribution to the phantom surface over the distance from sensor to surface
- (f) Calculation of the averaged SAR within masses of 1g and 10g



## **8.2 Power Reference Measurement**

The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. This distance cannot be smaller than the distance of sensor calibration points to probe tip as defined in the probe properties.

## **8.3 Area Scan**

The area scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY software can find the maximum found in the scanned area, within a range of the global maximum. The range (in dB0) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan), if only one zoom scan follows the area scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of zoom scans has to be increased accordingly.

Area scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

	$\leq 3$ GHz	$> 3$ GHz
Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface	$5 \pm 1$ mm	$\frac{1}{2} \cdot \delta \cdot \ln(2) \pm 0.5$ mm
Maximum probe angle from probe axis to phantom surface normal at the measurement location	$30^\circ \pm 1^\circ$	$20^\circ \pm 1^\circ$
	$\leq 2$ GHz: $\leq 15$ mm $2 - 3$ GHz: $\leq 12$ mm	$3 - 4$ GHz: $\leq 12$ mm $4 - 6$ GHz: $\leq 10$ mm
Maximum area scan spatial resolution: $\Delta x_{\text{Area}}, \Delta y_{\text{Area}}$	When the x or y dimension of the test device, in the measurement plane orientation, is smaller than the above, the measurement resolution must be $\leq$ the corresponding x or y dimension of the test device with at least one measurement point on the test device.	



## 8.4 Zoom Scan

Zoom scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 gram and 10 gram of simulated tissue. The zoom scan measures points (refer to table below) within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the zoom scan evaluates the averaged SAR for 1 gram and 10 gram and displays these values next to the job's label.

Zoom scan parameters extracted from FCC KDB 865664 D01v01r04 SAR measurement 100 MHz to 6 GHz.

		$\leq 3$ GHz	$> 3$ GHz
Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$ , $\Delta y_{Zoom}$		$\leq 2$ GHz: $\leq 8$ mm $2 - 3$ GHz: $\leq 5$ mm*	$3 - 4$ GHz: $\leq 5$ mm* $4 - 6$ GHz: $\leq 4$ mm*
Maximum zoom scan spatial resolution, normal to phantom surface	uniform grid: $\Delta z_{Zoom}(n)$  graded grid	$\leq 5$ mm	$3 - 4$ GHz: $\leq 4$ mm $4 - 5$ GHz: $\leq 3$ mm $5 - 6$ GHz: $\leq 2$ mm
		$\Delta z_{Zoom}(1)$ : between 1 <sup>st</sup> two points closest to phantom surface	$\leq 4$ mm
Minimum zoom scan volume	$x, y, z$	$\geq 30$ mm	$3 - 4$ GHz: $\geq 28$ mm $4 - 5$ GHz: $\geq 25$ mm $5 - 6$ GHz: $\geq 22$ mm

Note:  $\delta$  is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.

\* When zoom scan is required and the *reported* SAR from the *area scan based 1-g SAR estimation* procedures of KDB 447498 is  $\leq 1.4$  W/kg,  $\leq 8$  mm,  $\leq 7$  mm and  $\leq 5$  mm zoom scan resolution may be applied, respectively, for 2 GHz to 3 GHz, 3 GHz to 4 GHz and 4 GHz to 6 GHz.

## 8.5 Volume Scan Procedures

The volume scan is used to assess overlapping SAR distributions for antennas transmitting in different frequency bands. It is equivalent to an oversized zoom scan used in standalone measurements. The measurement volume will be used to enclose all the simultaneous transmitting antennas. For antennas transmitting simultaneously in different frequency bands, the volume scan is measured separately in each frequency band. In order to sum correctly to compute the 1g aggregate SAR, the EUT remains in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing. When all volume scan are completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

## 8.6 Power Drift Monitoring

All SAR testing is under the EUT installed full charged battery and transmit maximum output power. In DASY measurement software, the power reference measurement and power drift measurement procedures are used for monitoring the power drift of EUT during SAR test. Both these procedures measure the field at a specified reference position before and after the SAR testing. The software will calculate the field difference in dB. If the power drifts more than 5%, the SAR will be retested.



## 9. Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	835MHz System Validation Kit	D835V2	499	Mar. 20, 2015	Mar. 19, 2016
SPEAG	1900MHz System Validation Kit	D1900V2	5d041	Mar. 24, 2015	Mar. 23, 2016
SPEAG	2450MHz System Validation Kit	D2450V2	735	Dec. 08, 2014	Dec. 07, 2015
SPEAG	5GHz System Validation Kit	D5GHzV2	1006	Sep. 25, 2014	Sep. 24, 2015
SPEAG	Data Acquisition Electronics	DAE4	1388	Sep. 24, 2014	Sep. 23, 2015
SPEAG	Data Acquisition Electronics	DAE3	577	Oct. 06, 2014	Oct. 05, 2015
SPEAG	Data Acquisition Electronics	DAE4	915	Jun. 11, 2015	Jun. 10, 2016
SPEAG	Dosimetric E-Field Probe	ES3DV3	3270	Sep. 26, 2014	Sep. 25, 2015
SPEAG	Dosimetric E-Field Probe	EX3DV4	3697	Sep. 29, 2014	Sep. 28, 2015
SPEAG	Dosimetric E-Field Probe	EX3DV4	3931	Sep. 25, 2014	Sep. 24, 2015
SPEAG	Dosimetric E-Field Probe	EX3DV4	3955	Nov. 21, 2014	Nov. 20, 2015
WonDer	Thermometer	WD-5015	TM685	Oct. 21, 2014	Oct. 20, 2015
Wisewind	Thermometer	HTC-1	TM642	Oct. 21, 2014	Oct. 20, 2015
Wisewind	Thermometer	HTC-1	TM281	Oct. 21, 2014	Oct. 20, 2015
Anritsu	Radio Communication Analyzer	MT8820C	6201074414	Feb. 06, 2015	Feb. 05, 2016
Agilent	Wireless Communication Test Set	E5515C	MY50266977	May. 14, 2015	May. 13, 2016
Anritsu	Spectrum Analyzer	MS2830A	6201396378	Jun. 17, 2015	Jun. 16, 2016
Agilent	Dual Directional Coupler	778D	50422	Note 1	
Woken	Attenuator 1	WK0602-XX	N/A	Note 1	
PE	Attenuator 2	PE7005-10	N/A	Note 1	
PE	Attenuator 3	PE7005- 3	N/A	Note 1	
AR	Power Amplifier	5S1G4M2	0328767	Note 1	
Mini-Circuits	Power Amplifier	ZVE-3W	162601250	Note 1	

**General Note:**

1. Prior to system verification and validation, the path loss from the signal generator to the system check source and the power meter, which includes the amplifier, cable, attenuator and directional coupler, was measured by the network analyzer. The reading of the power meter was offset by the path loss difference between the path to the power meter and the path to the system check source to monitor the actual power level fed to the system check source.



## 10. System Verification

### 10.1 Tissue Verification

The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )
For Head								
750	41.1	57.0	0.2	1.4	0.2	0	0.89	41.9
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
900	40.3	57.9	0.2	1.4	0.2	0	0.97	41.5
1800, 1900, 2000	55.2	0	0	0.3	0	44.5	1.40	40.0
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.8	0	0	0.1	0	45.1	1.96	39.0
For Body								
750	51.7	47.2	0	0.9	0.1	0	0.96	55.5
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
900	50.8	48.2	0	0.9	0.1	0	1.05	55.0
1800, 1900, 2000	70.2	0	0	0.4	0	29.4	1.52	53.3
2450	68.6	0	0	0	0	31.4	1.95	52.7
2600	68.1	0	0	0.1	0	31.8	2.16	52.5

Simulating Liquid for 5GHz, Manufactured by SPEAG

Ingredients	(% by weight)
Water	64~78%
Mineral oil	11~18%
Emulsifiers	9~15%
Additives and Salt	2~3%

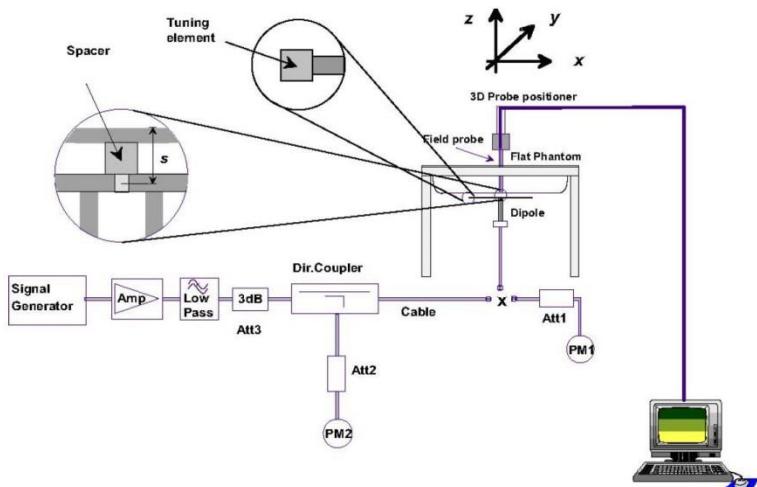
### < Tissue Dielectric Parameter Check Results >

Frequency (MHz)	Tissue Type	Liquid Temp. (°C)	Conductivity ( $\sigma$ )	Permittivity ( $\epsilon_r$ )	Conductivity Target ( $\sigma$ )	Permittivity Target ( $\epsilon_r$ )	Delta ( $\sigma$ ) (%)	Delta ( $\epsilon_r$ ) (%)	Limit (%)	Date
835	MSL	22.4	0.977	53.183	0.97	55.20	0.72	-3.65	$\pm 5$	2015/9/9
835	MSL	22.3	0.976	53.012	0.97	55.20	0.62	-3.96	$\pm 5$	2015/9/16
835	MSL	22.5	0.987	57.308	0.97	55.20	1.75	3.82	$\pm 5$	2015/9/21
1900	MSL	22.6	1.566	55.409	1.52	53.30	3.03	3.96	$\pm 5$	2015/9/2
1900	MSL	22.2	1.571	50.832	1.52	53.30	3.36	-4.63	$\pm 5$	2015/9/16
1900	MSL	22.5	1.527	54.259	1.52	53.30	0.46	1.80	$\pm 5$	2015/9/21
2450	MSL	22.5	2.000	53.914	1.95	52.70	2.56	2.30	$\pm 5$	2015/9/9
2450	MSL	22.2	2.040	51.400	1.95	52.70	4.62	-2.47	$\pm 5$	2015/9/16
5300	MSL	22.5	5.563	47.029	5.42	48.90	2.64	-3.83	$\pm 5$	2015/9/12
5600	MSL	22.5	5.640	46.800	5.77	48.50	-2.25	-3.51	$\pm 5$	2015/9/15
5800	MSL	22.5	5.980	46.500	6.00	48.20	-0.33	-3.53	$\pm 5$	2015/9/15

## 10.2 System Performance Check Results

Comparing to the original SAR value provided by SPEAG, the verification data should be within its specification of 10 %. Below table shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Date	Frequency (MHz)	Tissue Type	Input Power (mW)	Dipole S/N	Probe S/N	DAE S/N	Measured 1g SAR (W/kg)	Targeted 1g SAR (W/kg)	Normalized 1g SAR (W/kg)	Deviation (%)
2015/9/9	835	MSL	250	D835V2-499	EX3DV4 - SN3931	DAE3 Sn577	2.42	9.30	9.68	4.09
2015/9/16	835	MSL	250	D835V2-499	ES3DV3 - SN3270	DAE4 Sn1388	2.42	9.30	9.68	4.09
2015/9/21	835	MSL	250	D835V2-499	EX3DV4 - SN3955	DAE4 Sn915	2.35	9.30	9.40	1.08
2015/9/2	1900	MSL	250	D1900V2-5d041	EX3DV4 - SN3931	DAE3 Sn577	9.64	39.80	38.56	-3.12
2015/9/16	1900	MSL	250	D1900V2-5d041	ES3DV3 - SN3270	DAE4 Sn1388	10.00	39.80	40.00	0.50
2015/9/21	1900	MSL	250	D1900V2-5d041	EX3DV4 - SN3955	DAE4 Sn915	9.94	39.80	39.76	-0.10
2015/9/9	2450	MSL	250	D2450V2-735	EX3DV4 - SN3931	DAE3 Sn577	13.50	51.10	54.00	5.68
2015/9/16	2450	MSL	250	D2450V2-735	EX3DV4 - SN3955	DAE4 Sn915	13.60	51.10	54.40	6.46
2015/9/12	5300	MSL	100	D5GHzV2-1006-5300	EX3DV4 - SN3697	DAE4 Sn1388	8.25	80.00	82.50	3.13
2015/9/15	5600	MSL	100	D5GHzV2-1006-5600	EX3DV4 - SN3697	DAE3 Sn577	8.15	85.20	81.50	-4.34
2015/9/15	5800	MSL	100	D5GHzV2-1006-5800	EX3DV4 - SN3697	DAE3 Sn577	8.11	78.40	81.10	3.44



**Fig 8.3.1 System Performance Check Setup**



**Fig 8.3.2 Setup Photo**

## 11. RF Exposure Positions

### 11.1 Body Worn Accessory

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 9.4). Per KDB 648474 D04v01r02, body-worn accessory exposure is typically related to voice mode operations when handsets are carried in body-worn accessories. The body-worn accessory procedures in FCC KDB 447498 D01v05r02 should be used to test for body-worn accessory SAR compliance, without a headset connected to it. This enables the test results for such configuration to be compatible with that required for hotspot mode when the body-worn accessory test separation distance is greater than or equal to that required for hotspot mode, when applicable. When the reported SAR for body-worn accessory, measured without a headset connected to the handset is < 1.2 W/kg, the highest reported SAR configuration for that wireless mode and frequency band should be repeated for that body-worn accessory with a handset attached to the handset.

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 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 test with the device with each accessory. If multiple accessories share an identical metallic component (i.e. the same metallic belt-chip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

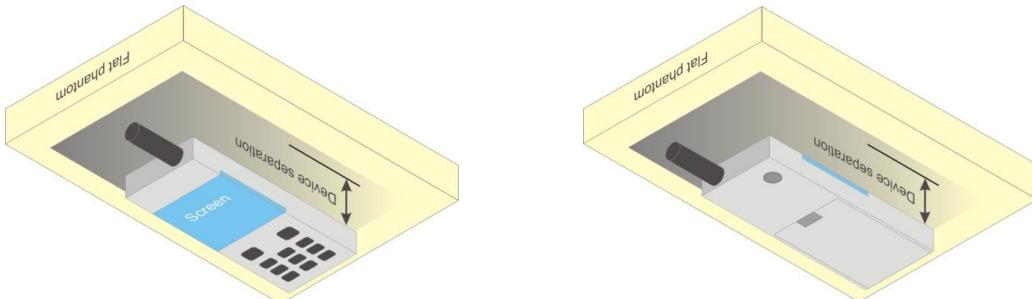


Fig 9.4 Body Worn Position



## 12. Conducted RF Output Power (Unit: dBm)

### <GSM Conducted Power>

**General Note:**

1. Per KDB 447498 D01v05r02, the maximum output power channel is used for SAR testing and for further SAR test reduction.
2. Per KDB 941225 D01v03, for Body-worn SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power including tune-up tolerance, for modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested, therefore, the EUT was set in GPRS (2Tx slots) for GSM850/GSM1900.

Band GSM850	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	TX Channel	128	189		128	189	251	
Frequency (MHz)	824.2	836.4	848.8	824.2	836.4	848.8	824.2	824.2
GPRS (GMSK, 1 Tx slot)	33.39	33.30	33.19	33.50	24.39	24.30	24.19	24.50
GPRS (GMSK, 2 Tx slots)	33.22	33.12	33.06	33.50	27.22	27.12	27.06	27.50
EDGE (8PSK, 1 Tx slot)	26.94	26.92	26.98	27.50	17.94	17.92	17.98	18.50
EDGE (8PSK, 2 Tx slots)	26.34	26.33	26.73	27.00	20.34	20.33	20.73	21.00
EDGE (8PSK, 3 Tx slots)	26.16	26.07	26.20	26.50	21.90	21.81	21.94	22.24
EDGE (8PSK, 4 Tx slots)	26.15	25.99	26.14	26.50	23.15	22.99	23.14	23.50

Band GSM1900	Burst Average Power (dBm)			Tune-up Limit (dBm)	Frame-Average Power (dBm)			Tune-up Limit (dBm)
	TX Channel	512	661	810	512	661	810	
Frequency (MHz)	1850.2	1880	1909.8	1850.2	1880	1909.8	1850.2	1850.2
GPRS (GMSK, 1 Tx slot)	30.31	30.69	30.66	31.00	21.31	21.69	21.66	22.00
GPRS (GMSK, 2 Tx slots)	30.17	30.59	30.58	31.00	24.17	24.59	24.58	25.00
EDGE (8PSK, 1 Tx slot)	26.27	26.34	26.34	26.50	17.27	17.34	17.34	17.50
EDGE (8PSK, 2 Tx slots)	26.17	26.19	26.24	26.50	20.17	20.19	20.24	20.50
EDGE (8PSK, 3 Tx slots)	26.06	26.08	26.06	26.50	21.80	21.82	21.80	22.24
EDGE (8PSK, 4 Tx slots)	25.88	25.90	25.92	26.50	22.88	22.90	22.92	23.50

**<WCDMA Conducted Power>**

1. The following tests were conducted according to the test requirements outlined in 3GPP TS 34.121 specification.
2. The procedures in KDB 941225 D01 are applied for 3GPP Rel. 6 HSPA to configure the device in the required sub-test mode(s) to determine SAR test exclusion.

A summary of these settings are illustrated below:

**HSDPA Setup Configuration:**

- a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting:
  - i. Set Gain Factors ( $\beta_c$  and  $\beta_d$ ) and parameters were set according to each
  - ii. Specific sub-test in the following table, C10.1.4, quoted from the TS 34.121
  - iii. Set RMC 12.2Kbps + HSDPA mode.
  - iv. Set Cell Power = -86 dBm
  - v. Set HS-DSCH Configuration Type to FRC (H-set 1, QPSK)
  - vi. Select HSDPA Uplink Parameters
  - vii. Set Delta ACK, Delta NACK and Delta CQI = 8
  - viii. Set Ack-Nack Repetition Factor to 3
  - ix. Set CQI Feedback Cycle (k) to 4 ms
  - x. Set CQI Repetition Factor to 2
  - xi. Power Ctrl Mode = All Up bits
- d. The transmitted maximum output power was recorded.

**Table C.10.1.4:  $\beta$  values for transmitter characteristics tests with HS-DPCCH**

Sub-test	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{HS}$ (Note 1, Note 2)	CM (dB) (Note 3)	MPR (dB) (Note 3)
1	2/15	15/15	64	2/15	4/15	0.0	0.0
2	12/15 (Note 4)	15/15 (Note 4)	64	12/15 (Note 4)	24/15	1.0	0.0
3	15/15	8/15	64	15/8	30/15	1.5	0.5
4	15/15	4/15	64	15/4	30/15	1.5	0.5

Note 1:  $\Delta_{ACK}, \Delta_{NACK}$  and  $\Delta_{CQI} = 30/15$  with  $\beta_{hs} = 30/15 * \beta_c$ .  
 Note 2: For the HS-DPCCH power mask requirement test in clause 5.2C, 5.7A, and the Error Vector Magnitude (EVM) with HS-DPCCH test in clause 5.13.1A, and HSDPA EVM with phase discontinuity in clause 5.13.1AA,  $\Delta_{ACK}$  and  $\Delta_{NACK} = 30/15$  with  $\beta_{hs} = 30/15 * \beta_c$ , and  $\Delta_{CQI} = 24/15$  with  $\beta_{hs} = 24/15 * \beta_c$ .  
 Note 3: CM = 1 for  $\beta_c/\beta_d = 12/15$ ,  $\beta_{hs}/\beta_c = 24/15$ . For all other combinations of DPDCH, DPCCH and HS-DPCCH the MPR is based on the relative CM difference. This is applicable for only UEs that support HSDPA in release 6 and later releases.  
 Note 4: For subtest 2 the  $\beta_c/\beta_d$  ratio of 12/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 11/15$  and  $\beta_d = 15/15$ .

**Setup Configuration**

**HSUPA Setup Configuration:**

- a. The EUT was connected to Base Station Agilent E5515C referred to the Setup Configuration.
- b. The RF path losses were compensated into the measurements.
- c. A call was established between EUT and Base Station with following setting \* :
  - i. Call Configs = 5.2B, 5.9B, 5.10B, and 5.13.2B with QPSK
  - ii. Set the Gain Factors ( $\beta_c$  and  $\beta_d$ ) and parameters (AG Index) were set according to each specific sub-test in the following table, C11.1.3, quoted from the TS 34.121
  - iii. Set Cell Power = -86 dBm
  - iv. Set Channel Type = 12.2k + HSPA
  - v. Set UE Target Power
  - vi. Power Ctrl Mode= Alternating bits
  - vii. Set and observe the E-TFCI
  - viii. Confirm that E-TFCI is equal to the target E-TFCI of 75 for sub-test 1, and other subtest's E-TFCI
- d. The transmitted maximum output power was recorded.

**Table C.11.1.3:  $\beta$  values for transmitter characteristics tests with HS-DPCCH and E-DCH**

Sub-test	$\beta_c$	$\beta_d$	$\beta_d$ (SF)	$\beta_c/\beta_d$	$\beta_{hs}$ (Note 1)	$\beta_{ec}$	$\beta_{ed}$ (Note 5) (Note 6)	$\beta_{ed}$ (SF)	$\beta_{ed}$ (Codes)	CM (dB) (Note 2)	MPR (dB) (Note 2)	AG Index (Note 6)	E-TFCI
1	11/15 (Note 3)	15/15 (Note 3)	64	11/15 (Note 3)	22/15	209/25	1309/225	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	$\beta_{ed1}: 47/15$ $\beta_{ed2}: 47/15$	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 (Note 4)	15/15 (Note 4)	64	15/15 (Note 4)	30/15	24/15	134/15	4	1	1.0	0.0	21	81

Note 1:  $\Delta_{ACK}, \Delta_{NACK}$  and  $\Delta_{CQI} = 30/15$  with  $\beta_{hs} = 30/15 * \beta_c$ .  
 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  $\beta_c/\beta_d$  ratio of 11/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 10/15$  and  $\beta_d = 15/15$ .  
 Note 4: For subtest 5 the  $\beta_c/\beta_d$  ratio of 15/15 for the TFC during the measurement period (TF1, TF0) is achieved by setting the signalled gain factors for the reference TFC (TF1, TF1) to  $\beta_c = 14/15$  and  $\beta_d = 15/15$ .  
 Note 5: In case of testing by UE using E-DPDCH Physical Layer category 1, Sub-test 3 is omitted according to TS25.306 Table 5.1g.  
 Note 6:  $\beta_{ed}$  can not be set directly, it is set by Absolute Grant Value.

**Setup Configuration**

**<WCDMA Conducted Power>****General Note:**

1. Per KDB 941225 D01v03, SAR for Head / Hotspot / Body-worn exposure is measured using a 12.2 kbps RMC with TPC bits configured to all "1's".
2. Per KDB 941225 D01v03, RMC 12.2kbps setting is used to evaluate SAR. If the maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA is  $\leq \frac{1}{4}$  dB higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA / HSUPA to RMC12.2Kbps and the adjusted SAR is  $\leq 1.2$  W/kg, SAR measurement is not required for HSDPA / HSUPA .

Band			WCDMA V			Tune-up Limit (dBm)	WCDMA II			Tune-up Limit (dBm)
TX Channel		4132	4182	4233	9262	9400	9538			
Rx Channel		4357	4407	4458	9662	9800	9938			
Frequency (MHz)			826.4	836.4	846.6	1852.4	1880	1907.6		
MPR (dB)	3GPP Rel 99	RMC 12.2Kbps	23.64	23.56	23.67	24.00	24.20	24.00	23.91	24.50
0	3GPP Rel 6	HSDPA Subtest-1	23.11	23.12	23.52	24.00	23.92	23.93	23.85	24.50
0	3GPP Rel 6	HSDPA Subtest-2	23.26	23.13	23.23	24.00	23.99	23.85	23.81	24.50
0.5	3GPP Rel 6	HSDPA Subtest-3	22.74	22.75	22.83	23.50	23.57	23.60	23.44	24.00
0.5	3GPP Rel 6	HSDPA Subtest-4	22.70	22.71	22.75	23.50	23.48	23.51	23.35	24.00
0	3GPP Rel 6	HSUPA Subtest-1	22.75	22.65	22.83	24.00	23.68	23.61	23.55	24.50
2	3GPP Rel 6	HSUPA Subtest-2	20.79	20.73	20.94	22.00	21.74	21.69	21.64	22.50
1	3GPP Rel 6	HSUPA Subtest-3	21.83	21.78	21.86	23.00	22.80	22.75	22.70	23.50
2	3GPP Rel 6	HSUPA Subtest-4	21.13	21.00	21.19	22.00	21.94	21.85	21.75	22.50
0	3GPP Rel 6	HSUPA Subtest-5	22.84	22.81	23.00	24.00	23.83	23.72	23.50	24.50



## &lt;CDMA2000 Conducted Power&gt;

**General Note:**

1. Per KDB 941225 D01v03, for Body-worn accessory SAR is measured in RC3 with the handset configured in TDSO/SO32 to transmit at full rate on FCH only with all other code channels disabled. The body-worn accessory procedures in KDB Publication 447498 are applied. The 3G SAR test reduction procedure is applied to the multiple code channel configuration (FCH+SCH), with FCH only as the primary mode.

Band	CDMA2000 BC0			Tune-up Limit (dBm)	CDMA2000 BC1			Tune-up Limit (dBm)
	1013	384	777		25	600	1175	
TX Channel	1013	384	777	1851.25	1880	1908.75		
Frequency (MHz)	824.7	836.52	848.31					
1xRTT RC1 SO55	24.57	24.52	24.56	25.00	24.39	24.41	24.43	25.00
1xRTT RC3 SO55	24.56	24.50	24.55	25.00	24.37	24.40	24.41	25.00
1xRTT RC3 SO32(+ F-SCH)	24.54	24.49	24.54	25.00	24.38	24.42	24.39	25.00
1xRTT RC3 SO32(+SCH)	24.54	24.51	24.56	25.00	24.39	24.39	24.42	25.00
1xEVDO RTAP 153.6Kbps	24.53	24.50	24.56	25.00	24.39	24.36	24.41	25.00
1xEVDO RETAP 4096Bits	24.52	24.49	24.54	25.00	24.36	24.37	24.39	25.00

**<WLAN Conducted Power>****General Note:**

1. Per KDB 248227 D01v02r01, SAR test reduction is determined according to 802.11 transmission mode configurations and certain exposure conditions with multiple test positions. In the 2.4 GHz band, separate SAR procedures are applied to DSSS and OFDM configurations to simplify DSSS test requirements. For OFDM, in both 2.4 and 5 GHz bands, an initial test configuration must be determined for each standalone and aggregated frequency band, according to the transmission mode configuration with the highest maximum output power specified for production units to perform SAR measurements. If the same highest maximum output power applies to different combinations of channel bandwidths, modulations and data rates, additional procedures are applied to determine which test configurations require SAR measurement. When applicable, an initial test position may be applied to reduce the number of SAR measurements required for next to the ear, UMPC mini-tablet or hotspot mode configurations with multiple test positions.
2. For 2.4 GHz 802.11b DSSS, either the initial test position procedure for multiple exposure test positions or the DSSS procedure for fixed exposure position is applied; these are mutually exclusive. For 2.4 GHz and 5 GHz OFDM configurations, the initial test configuration is applied to measure SAR using either the initial test position procedure for multiple exposure test position configurations or the initial test configuration procedures for fixed exposure test conditions. Based on the reported SAR of the measured configurations and maximum output power of the transmission mode configurations that are not included in the initial test configuration, the subsequent test configuration and initial test position procedures are applied to determine if SAR measurements are required for the remaining OFDM transmission configurations. In general, the number of test channels that require SAR measurement is minimized based on maximum output power measured for the test sample(s).
3. For OFDM transmission configurations in the 2.4 GHz and 5 GHz bands, When the same maximum power is specified for multiple transmission modes in a frequency band, the largest channel bandwidth, lowest order modulation, lowest data rate and lowest order 802.11a/g/n/ac mode is used for SAR measurement, on the highest measured output power channel for each frequency band.
4. DSSS and OFDM configurations are considered separately according to the required SAR procedures. SAR is measured in the initial test position using the 802.11 transmission mode configuration required by the DSSS procedure or initial test configuration and subsequent test configuration(s) according to the OFDM procedures.<sup>18</sup> The initial test position procedure is described in the following:
  - a. When the reported SAR of the initial test position is  $\leq 0.4$  W/kg, further SAR measurement is not required for the other test positions in that exposure configuration and 802.11 transmission mode combinations within the frequency band or aggregated band.
  - b. When the reported SAR of the test position is  $> 0.4$  W/kg, SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closest/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the reported SAR is  $\leq 0.8$  W/kg or all required test position are tested.
  - c. For all positions/configurations, when the reported SAR is  $> 0.8$  W/kg, SAR is measured for these test positions/configurations on the subsequent next highest measured output power channel(s) until the reported SAR is  $\leq 1.2$  W/kg or all required channels are tested.

**<2.4GHz WLAN>**

2.4GHz WLAN	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11b	CH 1	2412	1Mbps	17.48	17.50	94.25
		CH 6	2437		17.43	17.50	
		CH 11	2462		17.35	17.50	
	802.11g	CH 1	2412	6Mbps	11.95	12.00	85.02
		CH 6	2437		16.31	16.50	
		CH 11	2462		12.48	12.50	
	802.11n-HT20	CH 1	2412	MCS0	11.88	12.00	85.83
		CH 6	2437		16.38	16.50	
		CH 11	2462		12.46	12.50	

**<5GHz WLAN>**

5.2GHz WLAN	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a	CH 36	5180	6Mbps	15.48	15.50	85.00
		CH 40	5200		15.32	15.50	
		CH 44	5220		15.47	15.50	
		CH 48	5240		15.41	15.50	
	802.11n-HT20	CH 36	5180	MCS0	15.49	15.50	85.99
		CH 40	5200		15.28	15.50	
		CH 44	5220		15.37	15.50	
		CH 48	5240		15.33	15.50	

5.3GHz WLAN	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a	CH 52	5260	6Mbps	15.45	15.50	85.00
		CH 56	5280		15.39	15.50	
		CH 60	5300		15.40	15.50	
		CH 64	5320		15.33	15.50	
	802.11n-HT20	CH 52	5260	MCS0	15.19	15.50	85.99
		CH 56	5280		15.47	15.50	
		CH 60	5300		15.13	15.50	
		CH 64	5320		15.18	15.50	



5.5GHz WLAN	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a	CH 100	5500	6Mbps	15.39	15.50	85.00
		CH 116	5580		15.49	15.50	
		CH 124	5620		15.43	15.50	
		CH 132	5660		15.42	15.50	
		CH 140	5700		15.29	15.50	
	802.11n-HT20	CH 100	5500	MCS0	15.40	15.50	85.99
		CH 116	5580		15.18	15.50	
		CH 124	5620		15.28	15.50	
		CH 132	5660		15.26	15.50	
		CH 140	5700		15.22	15.50	

5.8GHz WLAN	Mode	Channel	Frequency (MHz)	Data Rate	Average power (dBm)	Tune-Up Limit	Duty Cycle %
	802.11a	CH 149	5745	MCS0	15.48	15.50	85.00
		CH 157	5785		15.47	15.50	
		CH 165	5825		15.42	15.50	
	802.11n-HT20	CH 149	5745	MCS0	15.49	15.50	85.99
		CH 157	5785		15.30	15.50	
		CH 165	5825		15.27	15.50	



### 13. Bluetooth Exclusions Applied

Mode Band	Average power(dBm)	
	Bluetooth v3.0+EDR	Bluetooth v4.0+LE
2.4GHz Bluetooth	5.0	4.0

**Note:**

1. Per KDB 447498 D01v05r02, the 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances*  $\leq$  50 mm are determined by:

$[(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm})] \cdot [\sqrt{f(\text{GHz})}] \leq 3.0$  for 1-g SAR and  $\leq 7.5$  for 10-g extremity SAR

- $f(\text{GHz})$  is the RF channel transmit frequency in GHz
- Power and distance are rounded to the nearest mW and mm before calculation
- The result is rounded to one decimal place for comparison

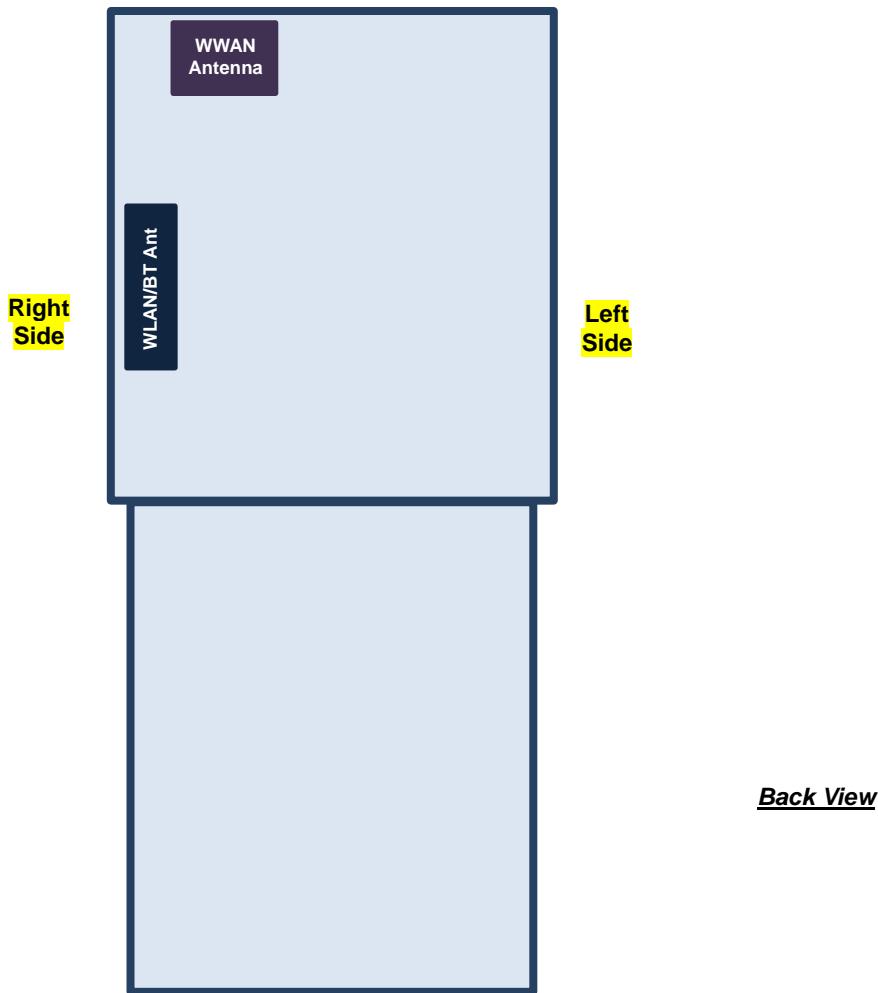
Bluetooth Max Power (dBm)	Separation Distance (mm)	Frequency (GHz)	exclusion thresholds
5	8.6	2.48	0.55

**Note:**

Per KDB 447498 D01v05r02, when the minimum test separation distance is  $<$  5 mm, a distance of 5 mm is applied to determine SAR test exclusion. The test exclusion threshold is 0.31 which is  $\leq 3$ , SAR testing is not required.



#### **14. Antenna Location**





## **15. SAR Test Results**

**General Note:**

1. Per KDB 447498 D01v05r02, the reported SAR is the measured SAR value adjusted for maximum tune-up tolerance.
  - a. Tune-up scaling Factor = tune-up limit power (mW) / EUT RF power (mW), where tune-up limit is the maximum rated power among all production units.
  - b. For SAR testing of WLAN signal with non-100% duty cycle, the measured SAR is scaled-up by the duty cycle scaling factor which is equal to "1/(duty cycle)"
  - c. For WWAN: Reported SAR(W/kg)= Measured SAR(W/kg)\*Tune-up Scaling Factor
  - d. For WLAN: Reported SAR(W/kg)= Measured SAR(W/kg)\* Duty Cycle scaling factor \* Tune-up scaling factor
2. Per KDB 447498 D01v05r02, for each exposure position, testing of other required channels within the operating mode of a frequency band is not required when the *reported* 1-g or 10-g SAR for the mid-band or highest output power channel is:
  - $\leq 0.8 \text{ W/kg}$  or  $2.0 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is  $\leq 100 \text{ MHz}$
  - $\leq 0.6 \text{ W/kg}$  or  $1.5 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is between  $100 \text{ MHz}$  and  $200 \text{ MHz}$
  - $\leq 0.4 \text{ W/kg}$  or  $1.0 \text{ W/kg}$ , for 1-g or 10-g respectively, when the transmission band is  $\geq 200 \text{ MHz}$

**GSM Note:**

1. Per KDB 941225 D01v03, for Body-worn SAR test reduction for GPRS and EDGE modes is determined by the source-based time-averaged output power including tune-up tolerance, for modes with the same specified maximum output power and tolerance, the higher number time-slot configuration should be tested, therefore, the EUT was set in GPRS (2Tx slots) for GSM850/GSM1900.

**UMTS Note:**

1. Per KDB 941225 D01v03, SAR for Body-worn exposure is measured using a 12.2 kbps RMC with TPC bits configured to all "1's".
2. Per KDB 941225 D01v03, RMC 12.2kbps setting is used to evaluate SAR. If the maximum output power and tune-up tolerance specified for production units in HSDPA / HSUPA is  $\leq \frac{1}{4} \text{ dB}$  higher than RMC 12.2Kbps or when the highest reported SAR of the RMC12.2Kbps is scaled by the ratio of specified maximum output power and tune-up tolerance of HSDPA / HSUPA to RMC12.2Kbps and the adjusted SAR is  $\leq 1.2 \text{ W/kg}$ , SAR measurement is not required for HSDPA / HSUPA.

**CMDA Note:**

1. Per KDB 941225 D01v03, for Body-worn accessory SAR is measured in RC3 with the handset configured in TDSO/SO32 to transmit at full rate on FCH only with all other code channels disabled. The body-worn accessory procedures in KDB Publication 447498 are applied. The 3G SAR test reduction procedure is applied to the multiple code channel configuration (FCH+SCH), with FCH only as the primary mode.

**WLAN Note:**

1. Per KDB 248227 D01v02r01, for 2.4GHz 802.11g/n SAR testing is not required when the highest reported SAR for DSSS is adjusted by the ratio of OFDM to DSSS specified maximum output power and the adjusted SAR is  $\leq 1.2 \text{ W/kg}$ .
2. Per KDB 248227 D01v02r01, for U-NII-1 SAR testing is not required when the U-NII-2A band highest reported SAR for a test configuration is  $\leq 1.2 \text{ W/kg}$ , SAR is not required for U-NII-1 band.
3. When the reported SAR of the test position is  $> 0.4 \text{ W/kg}$ , SAR is repeated for the 802.11 transmission mode configuration tested in the initial test position to measure the subsequent next closet/smallest test separation distance and maximum coupling test position on the highest maximum output power channel, until the report SAR is  $\leq 0.8 \text{ W/kg}$  or all required test position are tested.
4. For all positions / configurations, when the reported SAR is  $> 0.8 \text{ W/kg}$ , SAR is measured for these test positions / configurations on the subsequent next highest measured output power channel(s) until the reported SAR is  $\leq 1.2 \text{ W/kg}$  or all required channels are tested.
5. During SAR testing the WLAN transmission was verified using a spectrum analyzer.

**15.1 Body SAR****<GSM SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Sample	Holster	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
01	GSM850	GPRS (2 Tx slots)	Front	15mm	Sample 1		128	824.2	33.22	33.50	1.067	-0.06	0.441	0.470
	GSM850	GPRS (2 Tx slots)	Back	15mm	Sample 1		128	824.2	33.22	33.50	1.067	-0.04	0.717	0.765
	GSM850	GPRS (2 Tx slots)	Back	15mm	Sample 2		128	824.2	33.22	33.50	1.067	-0.07	0.844	0.900
	GSM850	GPRS (2 Tx slots)	Back	15mm	Sample 2		189	836.4	33.12	33.50	1.091	0	0.668	0.729
	GSM850	GPRS (2 Tx slots)	Back	15mm	Sample 2		251	848.8	33.06	33.50	1.107	-0.07	0.466	0.516
	GSM850	GPRS (2 Tx slots)	Back	15mm	Sample 3		128	824.2	33.22	33.50	1.067	-0.05	0.811	0.865
	GSM850	GPRS (2 Tx slots)	Back	15mm	Sample 3		189	836.4	33.12	33.50	1.091	-0.08	0.636	0.694
	GSM850	GPRS (2 Tx slots)	Back	15mm	Sample 3		251	848.8	33.06	33.50	1.107	-0.13	0.465	0.515
	GSM850	GPRS (2 Tx slots)	Left Side	15mm	Sample 4		128	824.2	33.22	33.50	1.067	-0.07	0.222	0.237
	GSM850	GPRS (2 Tx slots)	Right Side	15mm	Sample 4		128	824.2	33.22	33.50	1.067	-0.03	0.279	0.298
02	GSM850	GPRS (2 Tx slots)	Right Side	15mm	Sample 5		128	824.2	33.22	33.50	1.067	0.04	0.316	0.337
	GSM850	GPRS (2 Tx slots)	Back	0mm	Sample 3	Holster 1	128	824.2	33.22	33.50	1.067	-0.18	0.424	0.452
	GSM850	GPRS (2 Tx slots)	Back	0mm	Sample 2	Holster 2	128	824.2	33.22	33.50	1.067	-0.19	0.550	0.587
	GSM850	GPRS (2 Tx slots)	Right Side	0mm	Sample 5	Holster 3	128	824.2	33.22	33.50	1.067	-0.02	0.744	0.794
	GSM1900	GPRS (2 Tx slots)	Front	15mm	Sample 1		661	1880	30.59	31.00	1.099	-0.07	0.107	0.118
	GSM1900	GPRS (2 Tx slots)	Back	15mm	Sample 1		661	1880	30.59	31.00	1.099	0.02	0.157	0.173
	GSM1900	GPRS (2 Tx slots)	Back	15mm	Sample 2		661	1880	30.59	31.00	1.099	-0.01	0.168	0.185
	GSM1900	GPRS (2 Tx slots)	Back	15mm	Sample 3		661	1880	30.59	31.00	1.099	-0.01	0.159	0.175
	GSM1900	GPRS (2 Tx slots)	Left Side	15mm	Sample 4		661	1880	30.59	31.00	1.099	0.18	0.081	0.089
	GSM1900	GPRS (2 Tx slots)	Right Side	15mm	Sample 4		661	1880	30.59	31.00	1.099	0.03	0.233	0.256
	GSM1900	GPRS (2 Tx slots)	Right Side	15mm	Sample 5		661	1880	30.59	31.00	1.099	0.01	0.209	0.230
	GSM1900	GPRS (2 Tx slots)	Back	0mm	Sample 3	Holster 1	661	1880	30.59	31.00	1.099	-0.06	0.064	0.070
	GSM1900	GPRS (2 Tx slots)	Back	0mm	Sample 2	Holster 2	661	1880	30.59	31.00	1.099	-0.06	0.263	0.289
	GSM1900	GPRS (2 Tx slots)	Right Side	0mm	Sample 4	Holster 3	661	1880	30.59	31.00	1.099	-0.01	0.555	0.610
	GSM1900	GPRS (2 Tx slots)	Right Side	0mm	Sample 4	Holster 3	512	1850.2	30.17	31.00	1.211	-0.09	0.500	0.605
	GSM1900	GPRS (2 Tx slots)	Right Side	0mm	Sample 4	Holster 3	810	1909.8	30.58	31.00	1.102	0.01	0.522	0.575

**<WCDMA SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Sample	Holster	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WCDMA II	RMC 12.2Kbps	Front	15mm	Sample 1		9262	1852.4	24.20	24.50	1.072	0.02	0.094	0.101
	WCDMA II	RMC 12.2Kbps	Back	15mm	Sample 1		9262	1852.4	24.20	24.50	1.072	-0.04	0.118	0.126
	WCDMA II	RMC 12.2Kbps	Back	15mm	Sample 2		9262	1852.4	24.20	24.50	1.072	-0.07	0.168	0.180
	WCDMA II	RMC 12.2Kbps	Back	15mm	Sample 3		9262	1852.4	24.20	24.50	1.072	0.05	0.143	0.153
	WCDMA II	RMC 12.2Kbps	Left Side	15mm	Sample 4		9262	1852.4	24.20	24.50	1.072	0.06	0.079	0.085
	WCDMA II	RMC 12.2Kbps	Right Side	15mm	Sample 4		9262	1852.4	24.20	24.50	1.072	-0.04	0.226	0.242
	WCDMA II	RMC 12.2Kbps	Right Side	15mm	Sample 5		9262	1852.4	24.20	24.50	1.072	-0.02	0.218	0.234
	WCDMA II	RMC 12.2Kbps	Back	0mm	Sample 3	Holster 1	9262	1852.4	24.20	24.50	1.072	-0.01	0.072	0.077
	WCDMA II	RMC 12.2Kbps	Back	0mm	Sample 2	Holster 2	9262	1852.4	24.20	24.50	1.072	0.15	0.282	0.302
03	WCDMA II	RMC 12.2Kbps	Right Side	0mm	Sample 4	Holster 3	9262	1852.4	24.20	24.50	1.072	0.09	0.470	0.504
	WCDMA II	RMC 12.2Kbps	Right Side	0mm	Sample 4	Holster 3	9400	1880	24.00	24.50	1.122	-0.01	0.430	0.482
	WCDMA II	RMC 12.2Kbps	Right Side	0mm	Sample 4	Holster 3	9538	1907.6	23.91	24.50	1.146	0.02	0.436	0.499
	WCDMA V	RMC 12.2Kbps	Front	15mm	Sample 1		4233	846.6	23.67	24.00	1.079	-0.03	0.245	0.264
	WCDMA V	RMC 12.2Kbps	Back	15mm	Sample 1		4233	846.6	23.67	24.00	1.079	-0.04	0.334	0.360
04	WCDMA V	RMC 12.2Kbps	Back	15mm	Sample 2		4233	846.6	23.67	24.00	1.079	0.08	0.434	0.468
	WCDMA V	RMC 12.2Kbps	Back	15mm	Sample 2		4132	826.4	23.64	24.00	1.086	-0.13	0.400	0.435
	WCDMA V	RMC 12.2Kbps	Back	15mm	Sample 2		4182	836.4	23.56	24.00	1.107	0.05	0.419	0.464
	WCDMA V	RMC 12.2Kbps	Back	15mm	Sample 3		4233	846.6	23.67	24.00	1.079	-0.01	0.329	0.355
	WCDMA V	RMC 12.2Kbps	Left Side	15mm	Sample 4		4233	846.6	23.67	24.00	1.079	0.04	0.086	0.093
	WCDMA V	RMC 12.2Kbps	Right Side	15mm	Sample 4		4233	846.6	23.67	24.00	1.079	-0.05	0.155	0.167
	WCDMA V	RMC 12.2Kbps	Right Side	15mm	Sample 5		4233	846.6	23.67	24.00	1.079	-0.13	0.182	0.196
	WCDMA V	RMC 12.2Kbps	Back	0mm	Sample 1	Holster 1	4233	846.6	23.67	24.00	1.079	0.1	0.245	0.264
	WCDMA V	RMC 12.2Kbps	Back	0mm	Sample 2	Holster 2	4233	846.6	23.67	24.00	1.079	0.04	0.227	0.245
	WCDMA V	RMC 12.2Kbps	Right Side	0mm	Sample 5	Holster 3	4233	846.6	23.67	24.00	1.079	-0.09	0.414	0.447

**CDMA SAR**

Plot No.	Band	Mode	Test Position	Gap (mm)	Sample	Holster	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	CDMA2000 BC0	1xRTT RC3 SO32	Front	15mm	Sample 1		777	848.31	24.54	25.00	1.112	-0.07	0.395	0.439
	CDMA2000 BC0	1xRTT RC3 SO32	Back	15mm	Sample 1		777	848.31	24.54	25.00	1.112	0.13	0.485	0.539
	CDMA2000 BC0	1xRTT RC3 SO32	Back	15mm	Sample 1		1013	824.7	24.54	25.00	1.112	0.02	0.558	0.620
05	CDMA2000 BC0	1xRTT RC3 SO32	Back	15mm	Sample 1		384	836.52	24.49	25.00	1.125	0.04	0.621	0.698
	CDMA2000 BC0	1xRTT RC3 SO32	Back	15mm	Sample 2		777	848.31	24.54	25.00	1.112	-0.11	0.474	0.527
	CDMA2000 BC0	1xRTT RC3 SO32	Back	15mm	Sample 3		777	848.31	24.54	25.00	1.112	-0.02	0.465	0.517
	CDMA2000 BC0	1xRTT RC3 SO32	Left Side	15mm	Sample 4		777	848.31	24.54	25.00	1.112	-0.09	0.150	0.167
	CDMA2000 BC0	1xRTT RC3 SO32	Right Side	15mm	Sample 4		777	848.31	24.54	25.00	1.112	0.02	0.306	0.340
	CDMA2000 BC0	1xRTT RC3 SO32	Right Side	15mm	Sample 5		777	848.31	24.54	25.00	1.112	-0.05	0.287	0.319
	CDMA2000 BC0	1xRTT RC3 SO32	Back	0mm	Sample 1	Holster 1	777	848.31	24.54	25.00	1.112	-0.09	0.350	0.389
	CDMA2000 BC0	1xRTT RC3 SO32	Back	0mm	Sample 2	Holster 2	777	848.31	24.54	25.00	1.112	-0.06	0.423	0.470
	CDMA2000 BC0	1xRTT RC3 SO32	Right Side	0mm	Sample 4	Holster 3	777	848.31	24.54	25.00	1.112	-0.02	0.473	0.526
	CDMA2000 BC1	1xRTT RC3 SO32	Front	15mm	Sample 1		1175	1908.75	24.41	25.00	1.146	-0.08	0.166	0.190
	CDMA2000 BC1	1xRTT RC3 SO32	Back	15mm	Sample 1		1175	1908.75	24.41	25.00	1.146	-0.07	0.250	0.286
	CDMA2000 BC1	1xRTT RC3 SO32	Back	15mm	Sample 2		1175	1908.75	24.41	25.00	1.146	-0.1	0.278	0.318
	CDMA2000 BC1	1xRTT RC3 SO32	Back	15mm	Sample 3		1175	1908.75	24.41	25.00	1.146	-0.07	0.252	0.289
	CDMA2000 BC1	1xRTT RC3 SO32	Left Side	15mm	Sample 4		1175	1908.75	24.41	25.00	1.146	-0.15	0.114	0.131
	CDMA2000 BC1	1xRTT RC3 SO32	Right Side	15mm	Sample 4		1175	1908.75	24.41	25.00	1.146	-0.13	0.416	0.477
	CDMA2000 BC1	1xRTT RC3 SO32	Right Side	15mm	Sample 5		1175	1908.75	24.41	25.00	1.146	-0.09	0.368	0.422
	CDMA2000 BC1	1xRTT RC3 SO32	Back	0mm	Sample 3	Holster 1	1175	1908.75	24.41	25.00	1.146	-0.19	0.124	0.142
	CDMA2000 BC1	1xRTT RC3 SO32	Back	0mm	Sample 2	Holster 2	1175	1908.75	24.41	25.00	1.146	-0.03	0.556	0.637
06	CDMA2000 BC1	1xRTT RC3 SO32	Right Side	0mm	Sample 4	Holster 3	1175	1908.75	24.41	25.00	1.146	-0.08	0.635	0.727
	CDMA2000 BC1	1xRTT RC3 SO32	Right Side	0mm	Sample 4	Holster 3	25	1851.25	24.38	25.00	1.153	-0.04	0.620	0.715
	CDMA2000 BC1	1xRTT RC3 SO32	Right Side	0mm	Sample 4	Holster 3	600	1880	24.40	25.00	1.148	-0.09	0.614	0.705

**<WLAN SAR>**

Plot No.	Band	Mode	Test Position	Gap (mm)	Sample	Holster	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-Up Limit (dBm)	Tune-up Scaling Factor	Duty Cycle %	Duty Cycle Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Reported 1g SAR (W/kg)
	WLAN2.4GHz	802.11b 1Mbps	Front	15mm	Sample 1		1	2412	17.48	17.50	1.005	94.25	1.061	0.03	0.006	0.006
	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Sample 1		1	2412	17.48	17.50	1.005	94.25	1.061	-0.01	0.042	0.045
	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Sample 2		1	2412	17.48	17.50	1.005	94.25	1.061	-0.06	0.051	0.054
	WLAN2.4GHz	802.11b 1Mbps	Back	15mm	Sample 3		1	2412	17.48	17.50	1.005	94.25	1.061	-0.03	0.040	0.043
	WLAN2.4GHz	802.11b 1Mbps	Left Side	15mm	Sample 4		1	2412	17.48	17.50	1.005	94.25	1.061	0	0.001	0.001
	WLAN2.4GHz	802.11b 1Mbps	Right Side	15mm	Sample 4		1	2412	17.48	17.50	1.005	94.25	1.061	-0.07	0.056	0.060
	WLAN2.4GHz	802.11b 1Mbps	Right Side	15mm	Sample 5		1	2412	17.48	17.50	1.005	94.25	1.061	-0.06	0.048	0.051
07	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Sample 1	Holster 1	1	2412	17.48	17.50	1.005	94.25	1.061	-0.087	0.141	0.150
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Sample 1	Holster 1	6	2437	17.43	17.50	1.016	94.25	1.061	-0.06	0.137	0.148
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Sample 1	Holster 1	11	2462	17.35	17.50	1.035	94.25	1.061	-0.09	0.135	0.148
	WLAN2.4GHz	802.11b 1Mbps	Back	0mm	Sample 2	Holster 2	1	2412	17.48	17.50	1.005	94.25	1.061	-0.142	0.061	0.065
	WLAN2.4GHz	802.11b 1Mbps	Right Side	0mm	Sample 4	Holster 3	1	2412	17.48	17.50	1.005	94.25	1.061	-0.111	0.139	0.148
	WLAN5GHz	802.11a 6Mbps	Front	15mm	Sample 1		52	5260	15.45	15.50	1.012	85.00	1.176	0	0.001	0.001
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Sample 1		52	5260	15.45	15.50	1.012	85.00	1.176	-0.16	0.095	0.113
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Sample 2		52	5260	15.45	15.50	1.012	85.00	1.176	-0.14	0.104	0.124
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Sample 3		52	5260	15.45	15.50	1.012	85.00	1.176	-0.11	0.066	0.079
	WLAN5GHz	802.11a 6Mbps	Left Side	15mm	Sample 4		52	5260	15.45	15.50	1.012	85.00	1.176	0	0.001	0.001
	WLAN5GHz	802.11a 6Mbps	Right Side	15mm	Sample 4		52	5260	15.45	15.50	1.012	85.00	1.176	-0.15	0.083	0.099
	WLAN5GHz	802.11a 6Mbps	Right Side	15mm	Sample 5		52	5260	15.45	15.50	1.012	85.00	1.176	-0.1	0.083	0.099
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Sample 1	Holster 1	52	5260	15.45	15.50	1.012	85.00	1.176	-0.18	0.136	0.162
08	WLAN5GHz	802.11a 6Mbps	Back	0mm	Sample 2	Holster 2	52	5260	15.45	15.50	1.012	85.00	1.176	0.11	0.253	0.301
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Sample 2	Holster 2	60	5300	15.40	15.50	1.023	85.00	1.176	-0.12	0.248	0.298
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Sample 5	Holster 3	52	5260	15.45	15.50	1.012	85.00	1.176	-0.12	0.178	0.212
	WLAN5GHz	802.11a 6Mbps	Front	15mm	Sample 1		116	5580	15.49	15.50	1.002	85.00	1.176	0	0.001	0.001
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Sample 1		116	5580	15.49	15.50	1.002	85.00	1.176	-0.137	0.051	0.060
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Sample 2		116	5580	15.49	15.50	1.002	85.00	1.176	-0.192	0.060	0.071
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Sample 3		116	5580	15.49	15.50	1.002	85.00	1.176	-0.16	0.051	0.060
	WLAN5GHz	802.11a 6Mbps	Left Side	15mm	Sample 4		116	5580	15.49	15.50	1.002	85.00	1.176	-0.13	0.001	0.001
	WLAN5GHz	802.11a 6Mbps	Right Side	15mm	Sample 4		116	5580	15.49	15.50	1.002	85.00	1.176	-0.079	0.052	0.061
	WLAN5GHz	802.11a 6Mbps	Right Side	15mm	Sample 5		116	5580	15.49	15.50	1.002	85.00	1.176	-0.13	0.065	0.077
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Sample 1	Holster 1	116	5580	15.49	15.50	1.002	85.00	1.176	-0.134	0.051	0.060
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Sample 2	Holster 2	116	5580	15.49	15.50	1.002	85.00	1.176	0.003	0.076	0.090
09	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Sample 5	Holster 3	116	5580	15.49	15.50	1.002	85.00	1.176	-0.118	0.179	0.211
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Sample 5	Holster 3	100	5500	15.39	15.50	1.026	85.00	1.176	-0.093	0.152	0.183
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Sample 5	Holster 3	124	5620	15.43	15.50	1.016	85.00	1.176	-0.12	0.161	0.192
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Sample 5	Holster 3	132	5660	15.42	15.50	1.019	85.00	1.176	-0.104	0.159	0.190
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Sample 5	Holster 3	140	5700	15.29	15.50	1.050	85.00	1.176	-0.14	0.161	0.199
	WLAN5GHz	802.11a 6Mbps	Front	15mm	Sample 1		149	5745	15.48	15.50	1.005	85.00	1.176	0	0.001	0.001
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Sample 1		149	5745	15.48	15.50	1.005	85.00	1.176	-0.154	0.098	0.116
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Sample 2		149	5745	15.48	15.50	1.005	85.00	1.176	-0.023	0.107	0.126
	WLAN5GHz	802.11a 6Mbps	Back	15mm	Sample 3		149	5745	15.48	15.50	1.005	85.00	1.176	-0.167	0.087	0.103
	WLAN5GHz	802.11a 6Mbps	Left Side	15mm	Sample 4		149	5745	15.48	15.50	1.005	85.00	1.176	0	0.001	0.001
	WLAN5GHz	802.11a 6Mbps	Right Side	15mm	Sample 4		149	5745	15.48	15.50	1.005	85.00	1.176	0.006	0.107	0.126
	WLAN5GHz	802.11a 6Mbps	Right Side	15mm	Sample 5		149	5745	15.48	15.50	1.005	85.00	1.176	0.123	0.101	0.119
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Sample 1	Holster 1	149	5745	15.48	15.50	1.005	85.00	1.176	-0.076	0.084	0.099
	WLAN5GHz	802.11a 6Mbps	Back	0mm	Sample 2	Holster 2	149	5745	15.48	15.50	1.005	85.00	1.176	0.142	0.125	0.148
10	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Sample 4	Holster 3	149	5745	15.48	15.50	1.005	85.00	1.176	-0.077	0.302	0.357
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Sample 4	Holster 3	157	5785	15.47	15.50	1.008	85.00	1.176	0.093	0.286	0.339
	WLAN5GHz	802.11a 6Mbps	Right Side	0mm	Sample 4	Holster 3	165	5825	15.42	15.50	1.019	85.00	1.176	-0.139	0.297	0.356



## 15.2 Repeated SAR Measurement

No.	Band	Mode	Test Position	Gap (mm)	Sample	Ch.	Freq. (MHz)	Average Power (dBm)	Tune-up Limit (dBm)	Tune-up Scaling Factor	Power Drift (dB)	Measured 1g SAR (W/kg)	Ratio	Reported 1g SAR (W/kg)
1st	GSM850	GPRS (2 Tx slots)	Back	15mm	Sample 2	128	824.2	33.22	33.50	1.067	-0.07	0.844	-	0.900
2nd	GSM850	GPRS (2 Tx slots)	Back	15mm	Sample 2	128	824.2	33.22	33.50	1.067	-0.06	0.819	1.03	0.874

**General Note:**

1. Per KDB 865664 D01v01r04, for each frequency band, repeated SAR measurement is required only when the measured SAR is  $\geq 0.8\text{W/kg}$ .
2. Per KDB 865664 D01v01r04, if the ratio among the repeated measurement is  $\leq 1.2$  and the measured SAR  $< 1.45\text{W/kg}$ , only one repeated measurement is required.
3. The ratio is the difference in percentage between original and repeated *measured SAR*.
4. All measurement SAR result is scaled-up to account for tune-up tolerance and is compliant.

## 16. Simultaneous Transmission Analysis

NO.	Simultaneous Transmission Configurations	mobile computer
		Body-worn
1.	GSM + WLAN2.4GHz	Yes
2.	WCDMA + WLAN2.4GHz	Yes
3.	GSM + Bluetooth	Yes
4.	WCDMA+ Bluetooth	Yes
5.	GSM + WLAN5GHz	Yes
6.	WCDMA + WLAN5GHz	Yes

**General Note:**

1. WLAN and Bluetooth share the same antenna, and cannot transmit simultaneously.
2. EUT will choose either WLAN 2.4GHz or WLAN 5GHz according to the network signal condition; therefore, 2.4GHz WLAN and 5GHz WLAN will not operate simultaneously at any moment.
3. The Scaled SAR summation is calculated based on the same configuration and test position.
4. Per KDB 447498 D01v05r02, simultaneous transmission SAR is compliant if,
  - i) Scalar SAR summation  $< 1.6\text{W/kg}$ .
  - ii) SPLSR =  $(\text{SAR1} + \text{SAR2})^{1.5} / (\text{min. separation distance, mm})$ , and the peak separation distance is determined from the square root of  $[(x_1-x_2)^2 + (y_1-y_2)^2 + (z_1-z_2)^2]$ , where  $(x_1, y_1, z_1)$  and  $(x_2, y_2, z_2)$  are the coordinates of the extrapolated peak SAR locations in the zoom scan.
  - iii) If SPLSR  $\leq 0.04$ , simultaneously transmission SAR measurement is not necessary.
  - iv) Simultaneously transmission SAR measurement, and the reported multi-band SAR  $< 1.6\text{W/kg}$ .
5. For simultaneous transmission analysis, Bluetooth SAR is estimated per KDB 447498 D01v05r02 based on the formula below.
  - i)  $(\text{max. power of channel, including tune-up tolerance, mW}) / (\text{min. test separation distance, mm}) \cdot [\sqrt{f(\text{GHz})/x}] \text{ W/kg}$  for test separation distances  $\leq 50\text{ mm}$ ; where  $x = 7.5$  for 1-g SAR, and  $x = 18.75$  for 10-g SAR.
  - ii) When the minimum separation distance is  $< 5\text{mm}$ , the distance is used 5mm to determine SAR test exclusion.
  - iii) 0.4 W/kg for 1-g SAR and 1.0 W/kg for 10-g SAR, when the test separation distances is  $> 50\text{ mm}$ .

Bluetooth Max Power	Exposure Position	Body-worn
	Test separation	8.6 mm
5.0 dBm	Estimated SAR (W/kg)	0.073 W/kg

**16.1 Body-worn Accessory Exposure Conditions**

WWAN Band		Exposure Position	1	2	3	4	1+2 Summed 1g SAR (W/kg)	1+3 Summed 1g SAR (W/kg)	1+4 Summed 1g SAR (W/kg)
			WWAN	2.4GHz WLAN	2.4GHz Bluetooth	5GHz WLAN			
			1g SAR (W/kg)	1g SAR (W/kg)	Estimated 1g SAR (W/kg)	1g SAR (W/kg)			
GSM	GSM850	Front	0.470	0.006	0.073	0.001	<b>0.48</b>	<b>0.54</b>	<b>0.47</b>
		Back	0.900	0.150	0.073	0.301	<b>1.05</b>	<b>0.97</b>	<b>1.20</b>
		Left side	0.237	0.001	0.073	0.001	<b>0.24</b>	<b>0.31</b>	<b>0.24</b>
		Right side	0.794	0.148	0.073	0.357	<b>0.94</b>	<b>0.87</b>	<b>1.15</b>
	GSM1900	Front	0.118	0.006	0.073	0.001	<b>0.12</b>	<b>0.19</b>	<b>0.12</b>
		Back	0.289	0.150	0.073	0.301	<b>0.44</b>	<b>0.36</b>	<b>0.59</b>
		Left side	0.089	0.001	0.073	0.001	<b>0.09</b>	<b>0.16</b>	<b>0.09</b>
		Right side	0.610	0.148	0.073	0.357	<b>0.76</b>	<b>0.68</b>	<b>0.97</b>
WCDMA	WCDMA II	Front	0.101	0.006	0.073	0.001	<b>0.11</b>	<b>0.17</b>	<b>0.10</b>
		Back	0.302	0.150	0.073	0.301	<b>0.45</b>	<b>0.38</b>	<b>0.60</b>
		Left side	0.085	0.001	0.073	0.001	<b>0.09</b>	<b>0.16</b>	<b>0.09</b>
		Right side	0.504	0.148	0.073	0.357	<b>0.65</b>	<b>0.58</b>	<b>0.86</b>
	WCDMA V	Front	0.264	0.006	0.073	0.001	<b>0.27</b>	<b>0.34</b>	<b>0.27</b>
		Back	0.468	0.150	0.073	0.301	<b>0.62</b>	<b>0.54</b>	<b>0.77</b>
		Left side	0.093	0.001	0.073	0.001	<b>0.09</b>	<b>0.17</b>	<b>0.09</b>
		Right side	0.447	0.148	0.073	0.357	<b>0.60</b>	<b>0.52</b>	<b>0.80</b>
CDMA	CDMA2000 BC0	Front	0.439	0.006	0.073	0.001	<b>0.45</b>	<b>0.51</b>	<b>0.44</b>
		Back	0.698	0.150	0.073	0.301	<b>0.85</b>	<b>0.77</b>	<b>1.00</b>
		Left side	0.167	0.001	0.073	0.001	<b>0.17</b>	<b>0.24</b>	<b>0.17</b>
		Right side	0.526	0.148	0.073	0.357	<b>0.67</b>	<b>0.60</b>	<b>0.88</b>
	CDMA2000 BC1	Front	0.190	0.006	0.073	0.001	<b>0.20</b>	<b>0.26</b>	<b>0.19</b>
		Back	0.289	0.150	0.073	0.301	<b>0.44</b>	<b>0.36</b>	<b>0.59</b>
		Left side	0.131	0.001	0.073	0.001	<b>0.13</b>	<b>0.20</b>	<b>0.13</b>
		Right side	0.727	0.148	0.073	0.357	<b>0.88</b>	<b>0.80</b>	<b>1.08</b>

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## 17. Uncertainty Assessment

The component of uncertainty may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainty by the statistical analysis of a series of observations is termed a Type A evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observations is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience, and knowledge of the behavior and properties of relevant materials and instruments, manufacturer's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in table below.

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor <sup>(a)</sup>	$1/k^{(b)}$	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

- (a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity
- (b)  $k$  is the coverage factor

**Table 17.1. Standard Uncertainty for Assumed Distribution**

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is shown in the following tables.



Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
<b>Measurement System</b>							
Probe Calibration	6.0	N	1	1	1	6.0	6.0
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	1.0	R	1.732	1	1	0.6	0.6
Linearity	4.7	R	1.732	1	1	2.7	2.7
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	2.9	R	1.732	1	1	1.7	1.7
Max. SAR Eval.	2.0	R	1.732	1	1	1.2	1.2
<b>Test Sample Related</b>							
Device Positioning	3.0	N	1	1	1	3.0	3.0
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
<b>Phantom and Setup</b>							
Phantom Uncertainty	6.1	R	1.732	1	1	3.5	3.5
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
<b>Combined Std. Uncertainty</b>						11.4%	11.4%
<b>Coverage Factor for 95 %</b>						K=2	K=2
<b>Expanded STD Uncertainty</b>						22.9%	22.7%

Table 17.2. Uncertainty Budget for frequency range 300 MHz to 3 GHz



Error Description	Uncertainty Value (±%)	Probability	Divisor	(Ci) 1g	(Ci) 10g	Standard Uncertainty (1g) (±%)	Standard Uncertainty (10g) (±%)
<b>Measurement System</b>							
Probe Calibration	6.55	N	1	1	1	6.6	6.6
Axial Isotropy	4.7	R	1.732	0.7	0.7	1.9	1.9
Hemispherical Isotropy	9.6	R	1.732	0.7	0.7	3.9	3.9
Boundary Effects	2.0	R	1.732	1	1	1.2	1.2
Linearity	4.7	R	1.732	1	1	2.7	2.7
System Detection Limits	1.0	R	1.732	1	1	0.6	0.6
Modulation Response	3.2	R	1.732	1	1	1.8	1.8
Readout Electronics	0.3	N	1	1	1	0.3	0.3
Response Time	0.0	R	1.732	1	1	0.0	0.0
Integration Time	2.6	R	1.732	1	1	1.5	1.5
RF Ambient Noise	3.0	R	1.732	1	1	1.7	1.7
RF Ambient Reflections	3.0	R	1.732	1	1	1.7	1.7
Probe Positioner	0.4	R	1.732	1	1	0.2	0.2
Probe Positioning	6.7	R	1.732	1	1	3.9	3.9
Max. SAR Eval.	4.0	R	1.732	1	1	2.3	2.3
<b>Test Sample Related</b>							
Device Positioning	3.0	N	1	1	1	3.0	3.0
Device Holder	3.6	N	1	1	1	3.6	3.6
Power Drift	5.0	R	1.732	1	1	2.9	2.9
Power Scaling	0.0	R	1.732	1	1	0.0	0.0
<b>Phantom and Setup</b>							
Phantom Uncertainty	6.6	R	1.732	1	1	3.8	3.8
SAR correction	0.0	R	1.732	1	0.84	0.0	0.0
Liquid Conductivity Repeatability	0.2	N	1	0.78	0.71	0.1	0.1
Liquid Conductivity (target)	5.0	R	1.732	0.78	0.71	2.3	2.0
Liquid Conductivity (mea.)	2.5	R	1.732	0.78	0.71	1.1	1.0
Temp. unc. - Conductivity	3.4	R	1.732	0.78	0.71	1.5	1.4
Liquid Permittivity Repeatability	0.15	N	1	0.23	0.26	0.0	0.0
Liquid Permittivity (target)	5.0	R	1.732	0.23	0.26	0.7	0.8
Liquid Permittivity (mea.)	2.5	R	1.732	0.23	0.26	0.3	0.4
Temp. unc. - Permittivity	0.83	R	1.732	0.23	0.26	0.1	0.1
<b>Combined Std. Uncertainty</b>						12.5%	12.5%
<b>Coverage Factor for 95 %</b>						K=2	K=2
<b>Expanded STD Uncertainty</b>						25.0%	24.9%

Table 17.3. Uncertainty Budget for frequency range 3 GHz to 6 GHz



## **18. References**

- [1] FCC 47 CFR Part 2 "Frequency Allocations and Radio Treaty Matters; General Rules and Regulations"
- [2] ANSI/IEEE Std. C95.1-1992, "IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz", September 1992
- [3] IEEE Std. 1528-2013, "IEEE Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", Sep 2013
- [4] SPEAG DASY System Handbook
- [5] FCC KDB 248227 D01 v02r01, "SAR Guidance for IEEE 802.11 (WiFi) Transmitters", Jun 2015.
- [6] FCC KDB 447498 D01 v05r02, "Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies", Feb 2014
- [7] FCC KDB 648474 D04 v01r02, "SAR Evaluation Considerations for Wireless Handsets", Dec 2013.
- [8] FCC KDB 941225 D01 v03, "3G SAR MEAUREMENT PROCEDURES", Oct 2014
- [9] FCC KDB 865664 D01 v01r04, "SAR Measurement Requirements for 100 MHz to 6 GHz", Aug 2015.
- [10] FCC KDB 865664 D02 v01r01, "RF Exposure Compliance Reporting and Documentation Considerations" May 2013.