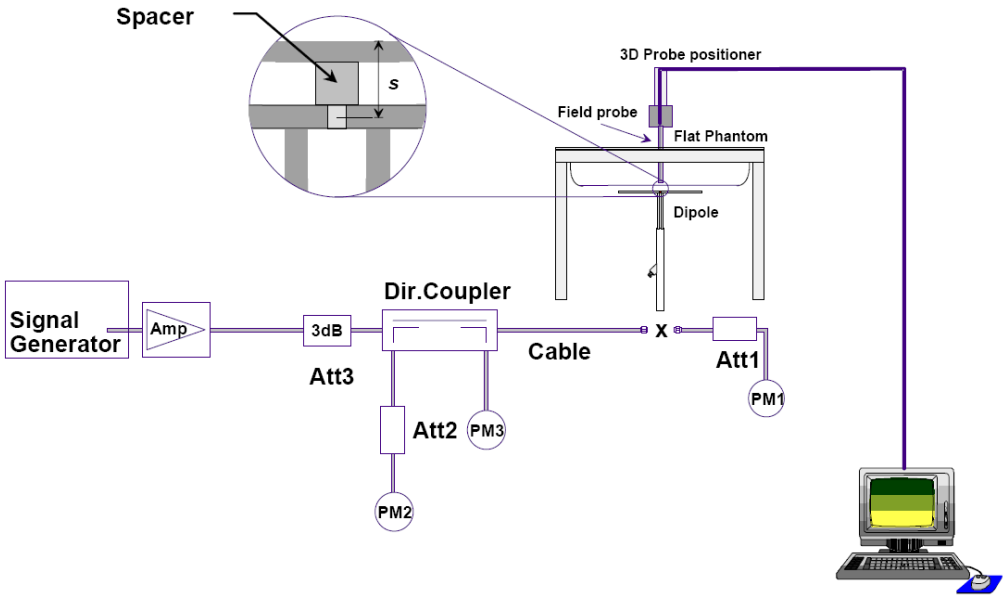
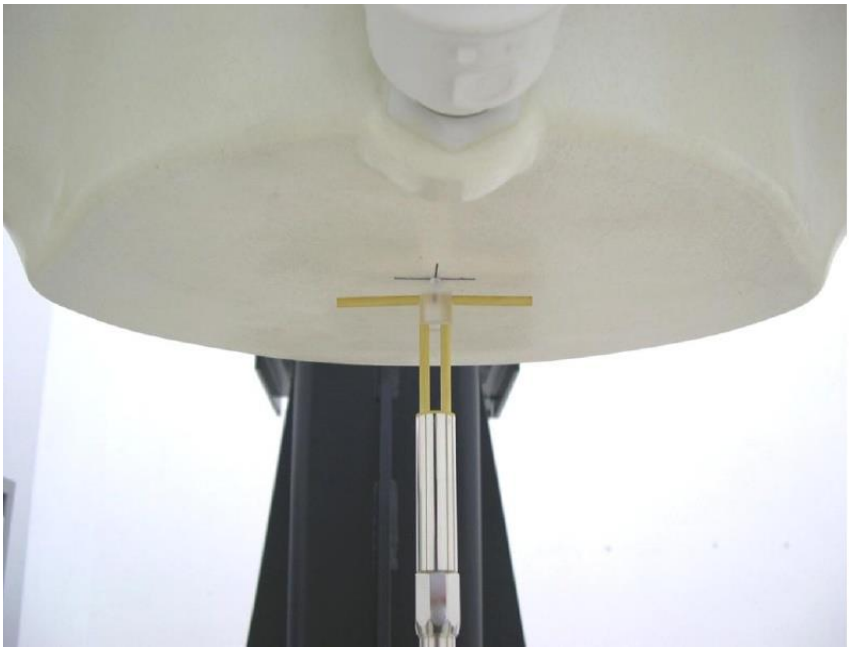
# 8 System verification

## 8.1 System Setup

In the simplified setup for system evaluation, the DUT is replaced by a calibrated dipole and the power source is replaced by a continuous wave that comes from a signal generator. The calibrated dipole must be placed beneath the flat phantom section of the SAM twin phantom with the correct distance holder. The distance holder should touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The equipment setup is shown below:




**Picture 8.1 System Setup for System Evaluation**



**Picture 8.2 Photo of Dipole Setup**

## 8.2 System Verification

SAR system verification is required to confirm measurement accuracy, according to the tissue dielectric media, probe calibration points and other system operating parameters required for measuring the SAR of a test device. The system verification must be performed for each frequency band and within the valid range of each probe calibration point required for testing the device.

The system verification results are required that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR. The details are presented in annex B.

**Table 8.1: System Verification of Head**

| Measurement Date (yyyy-mm-dd) | Frequency | Target value (W/kg) | | Measured value (W/kg) | | Deviation | |
|---|---|---|---|---|---|---|---|
| | | 10 g Average | 1 g Average | 10 g Average | 1 g Average | 10 g Average | 1 g Average |
| 2018/6/1 | 835 MHz | 6.06 | 9.37 | 6.16 | 9.36 | 1.65% | -0.11% |
| 2018/6/2 | 1900 MHz | 21.0 | 40.0 | 21.24 | 39.32 | 1.14% | -1.70% |
| 2018/6/3 | 2450 MHz | 24.7 | 52.2 | 24.6 | 51.2 | -0.40% | -1.92% |

**Table 8.2: System Verification of Body**

| Measurement Date (yyyy-mm-dd) | Frequency | Target value (W/kg) | | Measured value (W/kg) | | Deviation | |
|---|---|---|---|---|---|---|---|
| | | 10 g Average | 1 g Average | 10 g Average | 1 g Average | 10 g Average | 1 g Average |
| 2018/6/1 | 835 MHz | 6.12 | 9.41 | 6.08 | 9.48 | -0.65% | 0.74% |
| 2018/6/2 | 1900 MHz | 21.5 | 40.5 | 21.4 | 39.8 | -0.47% | -1.73% |
| 2018/6/3 | 2450 MHz | 23.8 | 50.4 | 23.6 | 50.28 | -0.84% | -0.24% |

# 9 Measurement Procedures

## 9.1 Tests to be performed

In order to determine the highest value of the peak spatial-average SAR of a handset, all device positions, configurations and operational modes shall be tested for each frequency band according to steps 1 to 3 below. A flowchart of the test process is shown in picture 9.1.

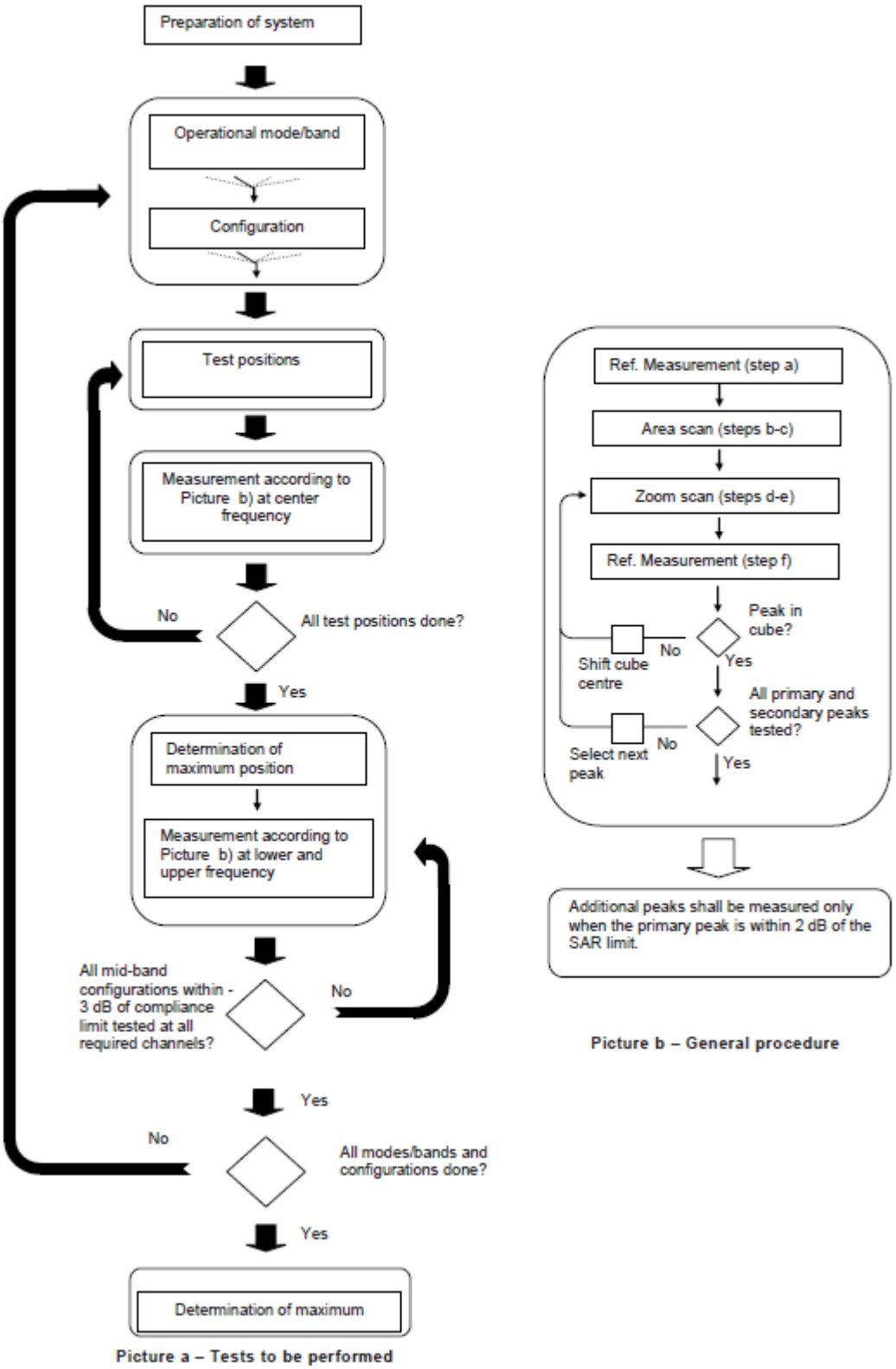
**Step 1**: The tests described in 9.2 shall be performed at the channel that is closest to the center of the transmit frequency band ( $f_c$ ) for:

a) all device positions (cheek and tilt, for both left and right sides of the SAM phantom, as described in annex D),
b) all configurations for each device position in a), e.g., antenna extended and retracted, and
c) all operational modes, e.g., analogue and digital, for each device position in a) and configuration in b) in each frequency band.

If more than three frequencies need to be tested according to 11.1 (i.e., $N_c$ > 3), then all frequencies, configurations and modes shall be tested for all of the above test conditions.

**Step 2**: For the condition providing highest peak spatial-average SAR determined in Step 1, perform all tests described in 9.2 at all other test frequencies, i.e., lowest and highest frequencies. In addition, for all other conditions (device position, configuration and operational mode) where the peak spatial-average SAR value determined in Step 1 is within 3 dB of the applicable SAR limit, it is recommended that all other test frequencies shall be tested as well.

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




**Picture 9.1 Block diagram of the tests to be performed**

## 9.2 General Measurement Procedure

The area and zoom scan resolutions specified in the table below must be applied to the SAR measurements and fully documented in SAR reports to qualify for TCB approval. Probe boundary effect error compensation is required for measurements with the probe tip closer than half a probe tip diameter to the phantom surface. Both the probe tip diameter and sensor offset distance must satisfy measurement protocols; to ensure probe boundary effect errors are minimized and the higher fields closest to the phantom surface can be correctly measured and extrapolated to the phantom surface for computing 1-g SAR. Tolerances of the post-processing algorithms must be verified by the test laboratory for the scan resolutions used in the SAR measurements, according to the reference distribution functions specified in IEEE Std 1528-2013. The results should be documented as part of the system validation records and may be requested to support test results when all the measurement parameters in the following table are not satisfied.

<table>
<tr><td colspan="3"></td><td>≤ 3 GHz</td><td>> 3 GHz</td></tr>
<tr><td colspan="3">Maximum distance from closest measurement point (geometric center of probe sensors) to phantom surface</td><td>5 ± 1 mm</td><td>½·δ·ln(2) ± 0.5 mm</td></tr>
<tr><td colspan="3">Maximum probe angle from probe axis to phantom surface normal at the measurement location</td><td>30° ± 1°</td><td>20° ± 1°</td></tr>
<tr><td colspan="3" rowspan="2">Maximum area scan spatial resolution: $\Delta x_{Area}$, $\Delta y_{Area}$</td><td>≤ 2 GHz: ≤ 15 mm<br>2 – 3 GHz: ≤ 12 mm</td><td>3 – 4 GHz: ≤ 12 mm<br>4 – 6 GHz: ≤ 10 mm</td></tr>
<tr><td colspan="2">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 ≤ the corresponding x or y dimension of the test device with at least one measurement point on the test device.</td></tr>
<tr><td colspan="3">Maximum zoom scan spatial resolution: $\Delta x_{Zoom}$, $\Delta y_{Zoom}$</td><td>≤ 2 GHz: ≤ 8 mm<br>2 – 3 GHz: ≤ 5 mm*</td><td>3 – 4 GHz: ≤ 5 mm*<br>4 – 6 GHz: ≤ 4 mm*</td></tr>
<tr><td rowspan="3">Maximum zoom scan spatial resolution, normal to phantom surface</td><td colspan="2">uniform grid: $\Delta z_{Zoom}(n)$</td><td>≤ 5 mm</td><td>3 – 4 GHz: ≤ 4 mm<br>4 – 5 GHz: ≤ 3 mm<br>5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td rowspan="2">graded grid</td><td>$\Delta z_{Zoom}(1)$: between 1st two points closest to phantom surface</td><td>≤ 4 mm</td><td>3 – 4 GHz: ≤ 3 mm<br>4 – 5 GHz: ≤ 2.5 mm<br>5 – 6 GHz: ≤ 2 mm</td></tr>
<tr><td>$\Delta z_{Zoom}(n>1)$: between subsequent points</td><td colspan="2">≤ 1.5·$\Delta z_{Zoom}(n-1)$</td></tr>
<tr><td>Minimum zoom scan volume</td><td colspan="2">x, y, z</td><td>≥ 30 mm</td><td>3 – 4 GHz: ≥ 28 mm<br>4 – 5 GHz: ≥ 25 mm<br>5 – 6 GHz: ≥ 22 mm</td></tr>
<tr><td colspan="5">Note: δ is the penetration depth of a plane-wave at normal incidence to the tissue medium; see draft standard IEEE P1528-2011 for details.<br>* When zoom scan is required and the <u>reported</u> SAR from the area scan based 1-g SAR estimation procedures of KDB 447498 is ≤ 1.4 W/kg, ≤ 8 mm, ≤ 7 mm and ≤ 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.</td></tr>
</table>

## 9.3 WCDMA Measurement Procedures for SAR

The following procedures are applicable to WCDMA handsets operating under 3GPP Release99, Release 5 and Release 6. The default test configuration is to measure SAR with an established radio link between the DUT and a communication test set using a 12.2kbps RMC (reference measurement channel) configured in Test Loop Mode 1. SAR is selectively confirmed for other physical channel configurations (DPCCH & $DPDCH_n$), HSDPA and HSPA (HSUPA/HSDPA) modes according to output power, exposure conditions and device operating capabilities. Both uplink and downlink should be configured with the same RMC or AMR, when required. SAR for Release 5 HSDPA and Release 6 HSPA are measured using the applicable FRC (fixed reference channel) and E-DCH reference channel configurations. Maximum output power is verified according to applicable versions of 3GPP TS 34.121 and SAR must be measured according to these maximum output conditions. When Maximum Power Reduction (MPR) is not implemented according to Cubic Metric (CM) requirements for Release 6 HSPA, the following procedures do not apply.

**For Release 5 HSDPA Data Devices:**

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ （SF） | $\beta_c/\beta_d$ | $\beta_{hs}$ | CM/dB |
|---|---|---|---|---|---|---|
| 1 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 0.0 |
| 2 | 12/15 | 15/15 | 64 | 12/15 | 24/25 | 1.0 |
| 3 | 15/15 | 8/15 | 64 | 15/8 | 30/15 | 1.5 |
| 4 | 15/15 | 4/15 | 64 | 15/4 | 30/15 | 1.5 |

**For Release 6 HSPA Data Devices**

| Sub-test | $\beta_c$ | $\beta_d$ | $\beta_d$ （SF） | $\beta_c/\beta_d$ | $\beta_{hs}$ | $\beta_{ec}$ | $\beta_{ed}$ | $\beta_{ed}$ （SF） | $\beta_{ed}$ （codes） | CM (dB) | MPR (dB) | AG Index | E-TFCI |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 11/15 | 15/15 | 64 | 11/15 | 22/15 | 209/225 | 1039/225 | 4 | 1 | 1.5 | 1.5 | 20 | 75 |
| 2 | 6/15 | 15/15 | 64 | 6/15 | 12/15 | 12/15 | 12/15 | 4 | 1 | 1.5 | 1.5 | 12 | 67 |
| 3 | 15/15 | 9/15 | 64 | 15/9 | 30/15 | 30/15 | $\beta_{ed1}$:47/15<br>$\beta_{ed2}$:47/15 | 4 | 2 | 1.5 | 1.5 | 15 | 92 |
| 4 | 2/15 | 15/15 | 64 | 2/15 | 4/15 | 4/15 | 56/75 | 4 | 1 | 1.5 | 1.5 | 17 | 71 |
| 5 | 15/15 | 15/15 | 64 | 15/15 | 24/15 | 30/15 | 134/15 | 4 | 1 | 1.5 | 1.5 | 21 | 81 |

**Rel.8 DC-HSDPA (Cat 24)**

SAR test exclusion for Rel.8 DC-HSDPA must satisfy the SAR test exclusion requirements of Rel.5 HSDPA. SAR test exclusion for DC-HSDPA devices is determined by power measurements according to the H-Set 12, Fixed Reference Channel (FRC) configuration in Table C.8.1.12 of 3GPP TS 34.121-1. A primary and a secondary serving HS-DSCH Cell are required to perform the power measurement and for the results to qualify for SAR test exclusion.

## 9.4 Bluetooth & Wi-Fi Measurement Procedures for SAR

Normal network operating configurations are not suitable for measuring the SAR of 802.11 transmitters in general. Unpredictable fluctuations in network traffic and antenna diversity conditions can introduce undesirable variations in SAR results. The SAR for these devices should be measured using chipset based test mode software to ensure that the results are consistent and reliable.
Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in a test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

## 9.5 Power Drift

To control the output power stability during the SAR test, DASY4 system calculates the power drift by measuring the E-field at the same location at the beginning and at the end of the measurement for each test position. These drift values can be found in section 14 labeled as: (Power Drift [dB]). This ensures that the power drift during one measurement is within 5%.

# 10 Area Scan Based 1-g SAR

## 10.1 Requirement of KDB

According to the KDB447498 D01 v05, when the implementation is based the specific polynomial fit
algorithm as presented at the 29th Bioelectromagnetics Society meeting (2007) and the estimated 1-g SAR is ≤ 1.2 W/kg, a zoom scan measurement is not required provided it is also not needed for any other purpose; for example, if the peak SAR location required for simultaneous transmission SAR test exclusion can be determined accurately by the SAR system or manually to discriminate between distinctive peaks and scattered noisy SAR distributions from area scans.

There must not be any warning or alert messages due to various measurement concerns identified by the SAR system; for example, noise in measurements, peaks too close to scan boundary, peaks are too sharp, spatial resolution and uncertainty issues etc. The SAR system verification must also demonstrate that the area scan estimated 1-g SAR is within 3% of the zoom scan 1-g SAR (See Annex B). When all the SAR results for each exposure condition in a frequency band and wireless mode are based on estimated 1-g SAR, the 1-g SAR for the highest SAR configuration must be determined by a zoom scan.

## 10.2 Fast SAR Algorithms

The approach is based on the area scan measurement applying a frequency dependent attenuation parameter. This attenuation parameter was empirically determined by analyzing a large number of phones. The MOTOROLA FAST SAR was developed and validated by the MOTOROLA Research Group in Ft. Lauderdale.

In the initial study, an approximation algorithm based on Linear fit was developed. The accuracy of the algorithm has been demonstrated across a broad frequency range (136-2450 MHz) and for both 1- and 10-g averaged SAR using a sample of 264 SAR measurements from 55 wireless handsets. For the sample size studied, the root-mean-squared errors of the algorithm are 1.2% and 5.8% for 1- and 10-g averaged SAR, respectively. The paper describing the algorithm in detail is expected to be published in August 2004 within the Special Issue of Transactions on MTT.

In the second step, the same research group optimized the fitting algorithm to an Polynomial fit whereby the frequency validity was extended to cover the range 30-6000MHz. Details of this study can be found in the BEMS 2007 Proceedings.
Both algorithms are implemented in DASY software.

# 11 Conducted Output Power

There are two sets of tune-up power, Normal power and Low power, for all bands by proximity sensor. The detail of proximity sensor is presented in annex I.
The #1 is normal power, the #2 is low power.

## 11.1 GSM Measurement result

During the process of testing, the EUT was controlled via Agilent Digital Radio Communication tester (E5515C) to ensure the maximum power transmission and proper modulation. This result contains conducted output power for the EUT. In all cases, the measured peak output power should be greater and within 5% than EMI measurement.

**Table 11-1 GSM850 #1**

| GSM850 #1 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Measured Power (dBm) | | | Caculation | Frame Burst Power （dBm） | | |
| Config | Tune-up | CH251 848.8 MHz | CH190 836.6 MHz | CH128 824.2 MHz | | CH251 848.8 MHz | CH190 836.6 MHz | CH128 824.2 MHz |
| GSM Speech | 34.00 | 33.10 | 33.08 | 33.12 | | | | |
| GPRS 1 Txslot | 34.00 | 33.01 | 33.00 | 33.03 | -9.03 | 23.98 | 23.97 | 24.00 |
| GPRS 2 Txslots | 33.00 | 32.31 | 32.28 | 32.33 | -6.02 | 26.29 | 26.26 | 26.31 |
| GPRS 3 Txslots | 31.00 | 30.57 | 30.55 | 30.57 | -4.26 | 26.31 | 26.29 | 26.31 |
| GPRS 4 Txslots | 30.00 | 29.50 | 29.48 | 29.49 | -3.01 | 26.49 | 26.47 | 26.48 |
| EGPRS GMSK 1 Txslot | 34.00 | 32.98 | 32.97 | 33.01 | -9.03 | 23.95 | 23.94 | 23.98 |
| EGPRS GMSK 2 Txslots | 33.00 | 32.28 | 32.26 | 32.30 | -6.02 | 26.26 | 26.24 | 26.28 |
| EGPRS GMSK 3 Txslots | 31.00 | 30.55 | 30.52 | 30.55 | -4.26 | 26.29 | 26.26 | 26.29 |
| EGPRS GMSK 4 Txslots | 30.00 | 29.48 | 29.45 | 29.47 | -3.01 | 26.47 | 26.44 | 26.46 |
| EGPRS 8PSK 1 Txslot | 28.00 | 26.45 | 26.34 | 26.49 | -9.03 | 17.42 | 17.31 | 17.46 |
| EGPRS 8PSK 2 Txslots | 26.50 | 25.44 | 25.35 | 25.43 | -6.02 | 19.42 | 19.33 | 19.41 |
| EGPRS 8PSK 3 Txslots | 24.50 | 23.20 | 23.11 | 23.17 | -4.26 | 18.94 | 18.85 | 18.91 |
| EGPRS 8PSK 4 Txslots | 23.00 | 21.95 | 21.82 | 21.88 | -3.01 | 18.94 | 18.81 | 18.87 |

**Table 11-2 GSM850 #2**

| GSM850 #2 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Measured Power (dBm) | | | Caculation | Frame Burst Power （dBm） | | |
| Config | Tune-up | CH251 848.8 MHz | CH190 836.6 MHz | CH128 824.2 MHz | | CH251 848.8 MHz | CH190 836.6 MHz | CH128 824.2 MHz |
| GSM Speech | 30.00 | 28.68 | 28.76 | 28.83 | | | | |
| GPRS 1 Txslot | 30.00 | 28.72 | 28.78 | 28.86 | -9.03 | 19.69 | 19.75 | 19.83 |
| GPRS 2 Txslots | 27.00 | 25.76 | 25.87 | 25.94 | -6.02 | 19.74 | 19.85 | 19.92 |
| GPRS 3 Txslots | 25.00 | 24.03 | 24.11 | 24.18 | -4.26 | 19.77 | 19.85 | 19.92 |
| GPRS 4 Txslots | 24.00 | 22.73 | 22.80 | 22.91 | -3.01 | 19.72 | 19.79 | 19.90 |
| EGPRS GMSK 1 Txslot | 30.00 | 28.69 | 28.77 | 28.85 | -9.03 | 19.66 | 19.74 | 19.82 |
| EGPRS GMSK 2 Txslots | 27.00 | 25.73 | 25.86 | 25.93 | -6.02 | 19.71 | 19.84 | 19.91 |
| EGPRS GMSK 3 Txslots | 25.00 | 24.01 | 24.10 | 24.17 | -4.26 | 19.75 | 19.84 | 19.91 |
| EGPRS GMSK 4 Txslots | 24.00 | 22.91 | 22.80 | 22.91 | -3.01 | 19.90 | 19.79 | 19.90 |
| EGPRS 8PSK 1 Txslot | 23.00 | 22.03 | 21.81 | 21.87 | -9.03 | 13.00 | 12.78 | 12.84 |
| EGPRS 8PSK 2 Txslots | 20.00 | 18.76 | 18.63 | 18.57 | -6.02 | 12.74 | 12.61 | 12.55 |
| EGPRS 8PSK 3 Txslots | 18.00 | 16.83 | 16.68 | 16.64 | -4.26 | 12.57 | 12.42 | 12.38 |
| EGPRS 8PSK 4 Txslots | 16.00 | 15.35 | 15.21 | 15.17 | -3.01 | 12.34 | 12.20 | 12.16 |

**Table 11-3 PCS1900 #1**

| PCS1900 #1 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Measured Power (dBm) | | | Caculation | Frame Burst Power （dBm） | | |
| Config | Tune-up | CH810 1909.8 MHz | CH661 1880 MHz | CH512 1850.2 MHz | | CH810 1909.8 MHz | CH661 1880 MHz | CH512 1850.2 MHz |
| GSM Speech | 30.50 | 30.26 | 30.23 | 30.24 | | | | |
| GPRS 1 Txslot | 30.50 | 30.30 | 30.24 | 30.24 | -9.03 | 21.27 | 21.21 | 21.21 |
| GPRS 2 Txslots | 29.50 | 29.50 | 29.48 | 29.49 | -6.02 | 23.48 | 23.46 | 23.47 |
| GPRS 3 Txslots | 28.00 | 27.89 | 27.80 | 27.81 | -4.26 | 23.63 | 23.54 | 23.55 |
| GPRS 4 Txslots | 27.00 | 26.79 | 26.71 | 26.70 | -3.01 | 23.78 | 23.70 | 23.69 |
| EGPRS GMSK 1 Txslot | 30.50 | 30.24 | 30.20 | 30.21 | -9.03 | 21.21 | 21.17 | 21.18 |
| EGPRS GMSK 2 Txslots | 29.50 | 29.50 | 29.49 | 29.49 | -6.02 | 23.48 | 23.47 | 23.47 |
| EGPRS GMSK 3 Txslots | 28.00 | 27.84 | 27.77 | 27.79 | -4.26 | 23.58 | 23.51 | 23.53 |
| EGPRS GMSK 4 Txslots | 27.00 | 26.75 | 26.68 | 26.68 | -3.01 | 23.74 | 23.67 | 23.67 |
| EGPRS 8PSK 1 Txslot | 27.00 | 25.48 | 25.49 | 25.54 | -9.03 | 16.45 | 16.46 | 16.51 |
| EGPRS 8PSK 2 Txslots | 25.50 | 24.25 | 24.54 | 24.58 | -6.02 | 18.23 | 18.52 | 18.56 |
| EGPRS 8PSK 3 Txslots | 23.50 | 22.27 | 22.47 | 22.44 | -4.26 | 18.01 | 18.21 | 18.18 |
| EGPRS 8PSK 4 Txslots | 22.50 | 20.80 | 21.13 | 21.14 | -3.01 | 17.79 | 18.12 | 18.13 |

**Table 11-4 PCS1900 #2**

| PCS1900 #2 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Measured Power (dBm) | | | Caculation | Frame Burst Power （dBm） | | |
| Config | Tune-up | CH810 1909.8 MHz | CH661 1880 MHz | CH512 1850.2 MHz | | CH810 1909.8 MHz | CH661 1880 MHz | CH512 1850.2 MHz |
| GSM Speech | 24.50 | 23.75 | 23.73 | 23.71 | | | | |
| GPRS 1 Txslot | 24.50 | 23.82 | 23.82 | 23.78 | -9.03 | 14.79 | 14.79 | 14.75 |
| GPRS 2 Txslots | 21.50 | 20.90 | 20.83 | 20.79 | -6.02 | 14.88 | 14.81 | 14.77 |
| GPRS 3 Txslots | 20.00 | 19.17 | 19.08 | 19.02 | -4.26 | 14.91 | 14.82 | 14.76 |
| GPRS 4 Txslots | 19.00 | 17.79 | 17.66 | 17.59 | -3.01 | 14.78 | 14.65 | 14.58 |
| EGPRS GMSK 1 Txslot | 24.50 | 23.80 | 23.80 | 23.78 | -9.03 | 14.77 | 14.77 | 14.75 |
| EGPRS GMSK 2 Txslots | 21.50 | 20.88 | 20.83 | 20.79 | -6.02 | 14.86 | 14.81 | 14.77 |
| EGPRS GMSK 3 Txslots | 20.00 | 19.17 | 19.07 | 19.03 | -4.26 | 14.91 | 14.81 | 14.77 |
| EGPRS GMSK 4 Txslots | 19.00 | 17.78 | 17.66 | 17.59 | -3.01 | 14.77 | 14.65 | 14.58 |
| EGPRS 8PSK 1 Txslot | 19.50 | 18.54 | 18.48 | 17.95 | -9.03 | 9.51 | 9.45 | 8.92 |
| EGPRS 8PSK 2 Txslots | 16.50 | 15.41 | 15.38 | 14.84 | -6.02 | 9.39 | 9.36 | 8.82 |
| EGPRS 8PSK 3 Txslots | 14.50 | 13.41 | 13.34 | 12.84 | -4.26 | 9.15 | 9.08 | 8.58 |
| EGPRS 8PSK 4 Txslots | 13.00 | 11.89 | 11.72 | 11.35 | -3.01 | 8.88 | 8.71 | 8.34 |

NOTES:

Division Factors

To average the power, the division factor is as follows:

1TX-slot = 1 transmit time slot out of 8 time slots=> conducted power divided by (8/1) => -9.03dB

2TX-slots = 2 transmit time slots out of 8 time slots=> conducted power divided by (8/2) => -6.02dB

3TX-slots = 3 transmit time slots out of 8 time slots=> conducted power divided by (8/3) => -4.26dB

4TX-slots = 4 transmit time slots out of 8 time slots=> conducted power divided by (8/4) => -3.01dB

**According to the conducted power as above, the body measurements are performed with 4Txslots for 850MHz #1 and 1900MHz #1, 3Txslots for 850MHz #2 and 1900MHz #2.**

## 11.2 WCDMA Measurement result

**Table 11-5 WCDMA1900-BII #1**

| WCDMA1900-BII #1 | | | | | |
|---|---|---|---|---|---|
| | | | Measured Power (dBm) | | |
| Item | | Tune-up | CH9538 1907.6 MHz | CH9400 1880 MHz | CH9262 1852.4 MHz |
| WCDMA | RMC | 24.50 | 24.04 | 24.27 | 24.07 |
| HSUPA | subtest1 | 23.00 | 22.71 | 22.80 | 22.72 |
| | subtest2 | 23.00 | 22.76 | 22.86 | 22.75 |
| | subtest3 | 23.00 | 22.31 | 22.39 | 22.32 |
| | subtest4 | 23.00 | 22.78 | 22.86 | 22.72 |
| | subtest5 | 23.00 | 22.73 | 22.85 | 22.71 |

**Table 11-6 WCDMA1900-BII #2**

| WCDMA1900-BII #2 | | | | | |
|---|---|---|---|---|---|
| | | | Measured Power (dBm) | | |
| Item | | Tune-up | CH9538 1907.6 MHz | CH9400 1880 MHz | CH9262 1852.4 MHz |
| WCDMA | RMC | 17.50 | 16.09 | 15.94 | 15.82 |
| HSUPA | subtest1 | 17.00 | 16.02 | 15.92 | 15.93 |
| | subtest2 | 17.00 | 16.04 | 15.94 | 16.00 |
| | subtest3 | 16.50 | 15.55 | 15.46 | 15.49 |
| | subtest4 | 17.00 | 16.08 | 16.00 | 15.96 |
| | subtest5 | 17.00 | 16.09 | 15.97 | 15.94 |

**Table 11-7 WCDMA850-BV #1**

| WCDMA850-BV #1 | | | | | |
|---|---|---|---|---|---|
| | | | Measured Power (dBm) | | |
| Item | | Tune-up | CH4233 846.6 MHz | CH4182 835.4 MHz | CH4132 826.4 MHz |
| WCDMA | RMC | 24.50 | 24.12 | 24.11 | 24.09 |
| HSUPA | subtest1 | 23.00 | 22.61 | 22.72 | 22.67 |
| | subtest2 | 23.00 | 22.67 | 22.75 | 22.71 |
| | subtest3 | 23.00 | 22.15 | 22.28 | 22.22 |
| | subtest4 | 23.00 | 22.62 | 22.77 | 22.67 |
| | subtest5 | 23.00 | 22.59 | 22.76 | 22.68 |

**Table 11-8 WCDMA850-BV #2**

| WCDMA850-BV #2 | | | | | |
|---|---|---|---|---|---|
| | | | Measured Power (dBm) | | |
| Item | | Tune-up | CH4233 846.6 MHz | CH4182 835.4 MHz | CH4132 826.4 MHz |
| WCDMA | RMC | 17.50 | 17.22 | 17.22 | 17.01 |
| HSUPA | subtest1 | 17.50 | 17.05 | 16.96 | 16.81 |
| | subtest2 | 17.50 | 17.03 | 16.99 | 16.80 |
| | subtest3 | 17.00 | 16.60 | 16.50 | 16.37 |
| | subtest4 | 17.50 | 17.09 | 17.05 | 16.92 |
| | subtest5 | 17.50 | 17.06 | 17.03 | 16.00 |

## 11.3 Wi-Fi and BT Measurement result

**Table 11-9 Bluetooth Power**

| Bluetooth Power | | | | |
|---|---|---|---|---|
| Mode | Channel | Frequence | Tune-up | Measured |
| GFSK | 78 | 2480 MHz | 5.5 | 4.82 |
| | 39 | 2441 MHz | 5.5 | 4.99 |
| | 0 | 2402 MHz | 5.5 | 4.58 |
| EDR2M-4_DQPSK | 78 | 2480 MHz | 5.5 | 3.74 |
| | 39 | 2441 MHz | 5.5 | 4.22 |
| | 0 | 2402 MHz | 5.5 | 3.9 |
| EDR3M-8DPSK | 78 | 2480 MHz | 5.5 | 3.9 |
| | 39 | 2441 MHz | 5.5 | 4.13 |
| | 0 | 2402 MHz | 5.5 | 3.84 |

**Table 11-10 WLAN2450 #1**

| Mode | Channel | Frequence | Data Rate | Tune-up | Measured |
|---|---|---|---|---|---|
| 802.11b | 11 | 2462 MHz | 5.5Mbps | 17.00 | 16.19 |
| | 6 | 2437 MHz | | 17.00 | 16.24 |
| | 1 | 2412 MHz | | 17.00 | 16.31 |
| | 11 | 2462 MHz | 1Mbps | 17.00 | 16.08 |
| | 6 | 2437 MHz | | 17.00 | 16.21 |
| | 1 | 2412 MHz | | 17.00 | 16.06 |
| | 11 | 2462 MHz | 2Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 17.00 | 16.08 |
| | 11 | 2462 MHz | 11Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 17.00 | 16.12 |
| 802.11g | 11 | 2462 MHz | 6Mbps | 17.00 | 15.97 |
| | 6 | 2437 MHz | | 17.00 | 15.83 |
| | 1 | 2412 MHz | | 17.00 | 16.21 |
| | 11 | 2462 MHz | 9Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 17.00 | 16.24 |
| | 11 | 2462 MHz | 12Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 17.00 | 16.28 |
| | 11 | 2462 MHz | 18Mbps | 17.00 | 15.93 |
| | 6 | 2437 MHz | | 17.00 | 16.27 |
| | 1 | 2412 MHz | | 17.00 | 16.30 |
| | 11 | 2462 MHz | 24Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 17.00 | 15.79 |
| | 11 | 2462 MHz | 36Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 17.00 | 16.23 |
| | 11 | 2462 MHz | 48Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 16.00 | 14.36 |
| | 11 | 2462 MHz | 54Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 16.00 | 14.35 |
| 802.11n 20M | 11 | 2462 MHz | MCS0 | 16.00 | 15.54 |
| | 6 | 2437 MHz | | 16.00 | 16.00 |
| | 1 | 2412 MHz | | 16.00 | 15.98 |
| | 11 | 2462 MHz | MCS1 | / | / |
| | 6 | 2437 MHz | | 16.00 | 15.77 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS2 | / | / |
| | 6 | 2437 MHz | | 16.00 | 15.88 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS3 | / | / |
| | 6 | 2437 MHz | | 16.00 | 15.85 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS4 | / | / |
| | 6 | 2437 MHz | | 16.00 | 15.64 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS5 | / | / |
| | 6 | 2437 MHz | | 16.00 | 14.66 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS6 | / | / |
| | 6 | 2437 MHz | | 16.00 | 15.15 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS7 | / | / |
| | 6 | 2437 MHz | | 16.00 | 14.85 |
| | 1 | 2412 MHz | | / | / |

**Table 11-11 WLAN2450 #2**

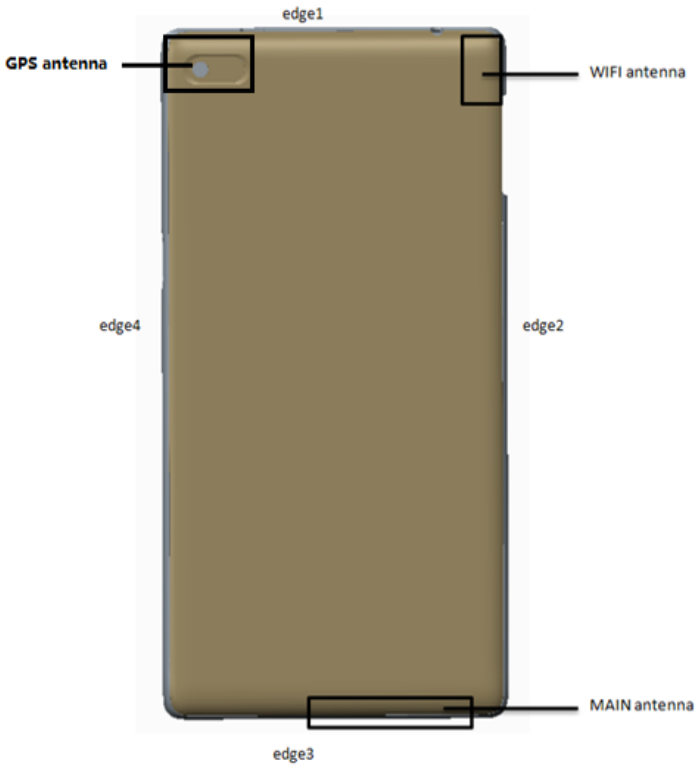
| Mode | Channel | Frequence | Data Rate | Tune-up | Measured |
|---|---|---|---|---|---|
| 802.11b | 11 | 2462 MHz | 1Mbps | 11.00 | 10.33 |
| | 6 | 2437 MHz | | 11.00 | 10.50 |
| | 1 | 2412 MHz | | 11.00 | 10.64 |
| | 11 | 2462 MHz | 2Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 11.00 | 10.59 |
| | 11 | 2462 MHz | 5.5Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 11.00 | 10.57 |
| | 11 | 2462 MHz | 11Mbps | / | / |
| | 6 | 2437 MHz | | / | / |
| | 1 | 2412 MHz | | 11.00 | 10.55 |
| 802.11g | 11 | 2462 MHz | 6Mbps | 11.00 | 9.67 |
| | 6 | 2437 MHz | | 11.00 | 10.29 |
| | 1 | 2412 MHz | | 11.00 | 10.15 |
| | 11 | 2462 MHz | 9Mbps | / | / |
| | 6 | 2437 MHz | | 11.00 | 10.07 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | 12Mbps | / | / |
| | 6 | 2437 MHz | | 11.00 | 10.09 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | 18Mbps | 11.00 | 10.15 |
| | 6 | 2437 MHz | | 11.00 | 10.36 |
| | 1 | 2412 MHz | | 11.00 | 10.29 |
| | 11 | 2462 MHz | 24Mbps | / | / |
| | 6 | 2437 MHz | | 11.00 | 10.26 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | 36Mbps | / | / |
| | 6 | 2437 MHz | | 11.00 | 10.02 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | 48Mbps | / | / |
| | 6 | 2437 MHz | | 11.00 | 9.44 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | 54Mbps | / | / |
| | 6 | 2437 MHz | | 11.00 | 9.00 |
| | 1 | 2412 MHz | | / | / |
| 802.11n 20M | 11 | 2462 MHz | MCS0 | 11.00 | 9.68 |
| | 6 | 2437 MHz | | 11.00 | 10.29 |
| | 1 | 2412 MHz | | 11.00 | 10.25 |
| | 11 | 2462 MHz | MCS1 | / | / |
| | 6 | 2437 MHz | | 11.00 | 10.01 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS2 | / | / |
| | 6 | 2437 MHz | | 11.00 | 10.14 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS3 | / | / |
| | 6 | 2437 MHz | | 11.00 | 10.11 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS4 | / | / |
| | 6 | 2437 MHz | | 11.00 | 10.08 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS5 | / | / |
| | 6 | 2437 MHz | | 11.00 | 9.62 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS6 | / | / |
| | 6 | 2437 MHz | | 11.00 | 9.27 |
| | 1 | 2412 MHz | | / | / |
| | 11 | 2462 MHz | MCS7 | / | / |
| | 6 | 2437 MHz | | 11.00 | 9.21 |
| | 1 | 2412 MHz | | / | / |

# 12 Simultaneous TX SAR Considerations

## 12.1 Introduction

The following procedures adopted from “FCC SAR Considerations for Cell Phones with Multiple Transmitters” are applicable to handsets with built-in unlicensed transmitters such as 802.11 a/b/g and Bluetooth devices which may simultaneously transmit with the licensed transmitter.
For this device, the BT and Wi-Fi can transmit simultaneous with other transmitters.

## 12.2 Transmit Antenna Separation Distances




| | | distance |
|---|---|---|
| WIFI ANTENNA | edge 1 | 5.34mm |
| WIFI ANTENNA | edge 2 | 4.75mm |

| | | distance |
|---|---|---|
| GPS ANTENNA | edge 1 | 1.95mm |
| GPS ANTENNA | edge 4 | 3.13mm |

| | | distance |
|---|---|---|
| Main ANTENNA | edge 2 | 1.83mm |
| Main ANTENNA | edge 3 | 1.96mm |
| Main ANTENNA | edge 4 | 38.54mm |

**Picture 12.1 Antenna Locations**

## 12.3 SAR Measurement Positions

According to the KDB941225 D06 Hot Spot SAR v01, the edges with less than 2.5 cm distance to the antennas need to be tested for SAR.

| SAR measurement positions | | | | | | |
|---|---|---|---|---|---|---|
| Mode | Front | Rear | Left edge | Right edge | Top edge | Bottom edge |
| Main antenna | No | Yes | Yes | No | No | Yes |
| WLAN | No | Yes | Yes | No | Yes | No |

## 12.4 Standalone SAR Test Exclusion Considerations

Standalone 1-g head or body SAR evaluation by measurement or numerical simulation is not required when the corresponding SAR Exclusion Threshold condition, listed below, is satisfied.
The 1-g SAR test exclusion threshold for 100 MHz to 6 GHz at test separation distances ≤ 50 mm are determined by:
[(max. power of channel, including tune-up tolerance, mW) / (min. test separation distance, mm)] · [√f(GHz)] ≤ 3.0 for 1-g SAR, where

- f(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

**Table 12.1: Standalone SAR test exclusion considerations**

| Band/Mode | F(GHz) | Position | SAR test exclusion threshold (mW) | RF output power | | SAR test exclusion |
|---|---|---|---|---|---|---|
| | | | | dBm | mW | |
| Bluetooth | 2.441 | Head | 9.6 | 5.5 | 3.55 | Yes |
| | | Body | 9.6 | 5.5 | 3.55 | Yes |
| 2.4GHz WLAN 802.11 b | 2.45 | Head | 9.58 | 17 | 50.12 | No |
| | | Body | 9.58 | 17 | 50.12 | No |