# SAR Compliance Test Report


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**Statement of Compliance:** BlackBerry RTS declares under its sole responsibility that the product to which this declaration relates, is in conformity with the appropriate RF exposure standards, recommendations and guidelines. It also declares that the product was tested in accordance with the appropriate measurement standards, guidelines and recommended practices.

**Device Category:** This BlackBerry® Smartphone is a portable device, designed to be used in direct contact with the user's head, hand and to be carried in approved accessories when carried on the user's body.

**RF Exposure Environment:** This device has been shown to be in compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in, FCC 96-326, IEEE Std. C95.1-2005, Health Canada's Safety Code 6, as reproduced in RSS-102 issue 4-2010 and has been tested in accordance with the measurement procedures specified in latest FCC OET KDB Procedures, ANSI/IEEE Std. C95.3-2002, IEEE 1528-2003, IEC 62209-1-2005, IEC 62209 - 2-2010 and Health Canada's Safety Code 6.

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**RTS is accredited** according to EN ISO/IEC 17025 by:

SCC Accredited LAB

**592**

| Revision History | | |
|---|---|---|
| **Rev. Number** | **Date** | **Changes** |
| Initial | May 24, 2013 | ---------- |
| Rev 2 | Apr 30, 2014 | Added measured conducted power data for Wi-Fi Direct/GO mode:<br>1. Table 1.8.1-3d added on page 14<br>Updated equipment list to include those used for Wi-Fi Direct testing:<br>2. Table 2.1.1-1 changed to 2.1.1-1a on page 44<br>3. Table 2.1.1-1b added on page 45 |

# Contents

# 1.0 OPERATING CONFIGURATIONS AND TEST CONDITIONS

## 1.1 Picture of Device

Please refer to Appendix E.

**Figure 1.1-1 BlackBerry Smartphone**

## 1.2 Antenna description

| | |
|---|---|
| **Type** | Internal fixed antenna |
| **Location** | Please refer to Figure 1.9-1 |
| **Configuration** | Internal fixed antenna |

**Table 1.2-1 Antenna description**

## 1.3 Device description

| | | | | |
|---|---|---|---|---|
| **Device Model** | RFL111LW | | | |
| **FCC ID** | L6ARFL110LW | | | |
| **PIN** | Radiated: 25CF0AD9 (Rev2), 2668C71D (Rev3)<br>Conducted: 25CF0ADB (Rev2), 2668C70C (Rev3) | | | |
| **Hardware Rev** | Rev 2-905-00/01, Rev 3-906-01/03/04 | | | |
| **Software Version** | 127.0.1.2982/3123/3454/3901, MFI_4_0_11-180/181 | | | |
| **Prototype or Production Unit** | Production | | | |
| **Mode(s) of Operation** | 1-slot<br>GSM 850<br>GSM 1900 | 2-slots<br>EDGE/GPRS<br>850/1900 | 3-slots<br>EDGE/GPRS<br>850/1900 | 4-slots<br>EDGE/GPRS<br>850/1900 |
| **Nominal Maximum conducted RF Output Power (dBm)** | 33.5<br>29.0 | 30.0<br>28.5 | 29.0<br>26.0 | 27.5<br>25.0 |
| **Tolerance in Power Setting on centre channel (dB)** | ± 0.5 | ± 0.5 | ± 0.5 | ± 0.5 |
| **Duty Cycle** | 1:8 | 2:8 | 3:8 | 4:8 |
| **Transmitting Frequency Range (MHz)** | 824.2 – 848.8<br>1850.2 – 1909.8 | 824.2 – 848.8<br>1850.2 – 1909.8 | 824.2 – 848.8<br>1850.2 – 1909.8 | 824.2 – 848.8<br>1850.2 – 1909.8 |
| **Mode(s) of Operation** | 802.11a/n<br>(low band) | 802.11a/n<br>(middle band) | 802.11a/n<br>(upper band I ) | 802.11a/n<br>(upper band II ) |
| **Nominal Maximum conducted RF Output Power (dBm)** | 13.0 | 14.5 | 16.5 | 11.5 |
| **Tolerance in Power Setting on centre channel (dB)** | ± 0.5 | ± 0.5 | ± 0.5 | ± 0.5 |
| **Duty Cycle** | 1:1 | 1:1 | 1:1 | 1:1 |
| **Transmitting Frequency Range (MHz)** | 5180-5240 | 5260-5320 | 5500-5700 | 5749-5825 |
| **Mode(s) of Operation** | 802.11b | 802.11g | 802.11n | Bluetooth |
| **Nominal Maximum conducted RF Output Power (dBm)** | 19.0 | 18.5 | 16.0 | 10.0 |
| **Tolerance in Power Setting on centre channel (dB)** | ± 0.5 | ± 0.5 | ± 0.5 | N/A |
| **Duty Cycle** | 1:1 | 1:1 | 1:1 | N/A |
| **Transmitting Frequency Range (MHz)** | 2412-2462 | 2412-2462 | 2412-2462 | 2402-2483 |

| **Mode(s) of Operation** | HSPA$^{+}$/ WCDMA / UMTS FDD V (850) | HSPA$^{+}$/ WCDMA / UMTS FDD II (1900) | NFC | |
|---|---|---|---|---|
| **Nominal Maximum conducted RF Output Power (dBm)** | 24.5 | 22.5 | N/A | |
| **Tolerance in Power Setting on centre channel (dB)** | ± 0.5 | ± 0.5 | N/A | |
| **Duty Cycle** | 1:1 | 1:1 | N/A | |
| **Transmitting Frequency Range (MHz)** | 824.6 – 846.6 | 1852.4 – 1907.6 | 13.56 | |

**Table 1.3-1 Test device characterization non-LTE U.S. wireless operating modes/bands**

**Note 1:** The BlackBerry model: RFL111LW also supports GSM/GPRS/EDGE 900/1800 MHz, that are not operational in North America, therefore no data is presented in this report for those bands.

**Note 2:** SAR measurements on NFC haven't been conducted, since it is very low power and frequency magnetic field transceiver. SAR probes measure higher frequency/power electric field.

| | | | | |
|---|---|---|---|---|
| **Device Model** | RFL111LW | | | |
| **FCC ID** | L6ARFL110LW | | | |
| **PIN** | Radiated: 25CF0AD9 (Rev2), 2668C71D (Rev3)<br>Conducted: 25CF0ADB (Rev2), 2668C70C (Rev3) | | | |
| **Hardware Rev** | Rev 2-905-00/01, Rev 3-906-01/03 | | | |
| **Software Version** | 127.0.1.2982/3123/3454/3901, MFI_4_0_11-180/181 | | | |
| **Prototype or Production Unit** | Production | | | |
| **Transmission channel bandwidth** | Band 2: 1.4 MHz , 3 MHz , 5 MHz, 10 MHz, 15 MHz, 20 MHz<br>Band 4: 1.4 MHz , 3 MHz , 5 MHz, 10 MHz, 15 MHz, 20 MHz<br>Band 5: 1.4 MHz , 3 MHz , 5 MHz, 10 MHz<br>Band 17: 5 MHz, 10 MHz | | | |
| **Transmission channel number and frequencies** | | | | |
| | **LTE band 2** | | **LTE band 4** | |
| | **f (MHz)** | **Chan.** | **f (MHz)** | **Chan.** |
| **L** | 1860.0 | 18700 | 1720.0 | 20050 |
| **M** | 1880.0 | 18900 | 1732.5 | 20175 |
| **H** | 1900.0 | 19100 | 1745.0 | 20300 |
| | **LTE band 5** | | **LTE band 17** | |
| | **f (MHz)** | **Chan.** | **f (MHz)** | **Chan.** |
| **L** | 829.0 | 20450 | 709.0 | 23780 |
| **M** | 836.5 | 20525 | 710.0 | 23790 |
| **H** | 844.0 | 20600 | 711.0 | 23800 |
| | | | | |
| **UE Category** | Category 3 | | | |
| **Modulation supported in uplink** | QPSK, 16QAM | | | |
| **Description of LTE antenna** | 1 Tx/Rx Ant, Sharing with GSM/UMTS; | | | |
| **LTE voice available/supported** | third party VOIP application might be possible | | | |
| **Hotspot with LTE+WiFi** | Yes | | | |
| **Hotspot with LTE+WiFi active with GSM/UMTS voice** | No | | | |
| **LTE MPR permanently built-in by design** | Yes | | | |
| **LTE A-MPR** | Disabled during SAR testing , by setting NV value to NV_01 on the CMW500 | | | |
| **LTE maximum average power (dBm)** | Band 2: 22.34<br>Band 4: 23.83<br>Band 5: 23.78<br>Band 17: 23.70 | | | |
| **Other non-LTE U.S. wireless operating modes/bands** | GSM//WCDMA/HSPA$^{+}$ | | GSM 835 MHz<br>UMTS/WCDMA 850 MHz<br>GSM 1900 MHz<br>UMTS/WCDMA 1900 MHz | |
| | WiFi and BT | | 2.4 GHz Wi-Fi<br>5 GHz Wi-Fi<br>2.4 GHz BT | |
| **Simultaneous Tx conditions** | Please refer to section 1.9: Highlights of the FCC OET SAR Evaluation Considerations for Handsets with Multiple Transmitters/ Antennas & GSM/GPRS/EDGE Procedure. | | | |
| **Power reduction applied for SAR compliance** | Yes, please refer to sections 1.8.4 and 1.10 | | | |

**Table 1.3-2 Test device characterization all U.S. wireless operating modes/bands**

**Note 2:** As per 3GPP TS 36.521-1 V10.0.0 (2011-12):

"The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7, 15, 25, 50, 75 and 100 channel numbers at the lower operating band edge and the last 6, 14, 24, 49, 74 and 99 channel numbers at the upper operating band edge shall not be used for channel bandwidths of 1.4, 3, 5, 10, 15 and 20 MHz respectively."…5.4.4

## 1.4 Body worn accessories (holsters)

The device has been tested with the holsters listed below. The holster has been designed with the intended device orientation being with the LCD facing the belt clip only. Proper positioning is vital for protection of the LCD display, and to help maximize the battery life of the device. The device can also be placed in the holster with the backside facing the belt clip. Body SAR measurements were carried out with the worst-case configuration front LCD side and backside towards the belt clip.

| Number | Holster Type | Part Number | Separation distance (mm) |
|---|---|---|---|
| 1 | Vertical Holster, Leather | HDW-50678-001 | 20 |
| 2 | Vertical Holster, alt Leather | HDW-50677-001 | 20 |

**Table 1.4-1 Body worn holster**

**Note:** Holsters have identical design, except for different leather material being used.

Please refer to Appendix E.
**Figure 1.4-1 Body-worn holster**

## 1.5 Headset

The device was tested with and without the following headset model numbers.

1) HDW-24529-004
2) HDW-15766-005
3) HDW-44306-001

## 1.6 Battery

The device was tested with the following Lithium Ion Battery packs.

1)BAT-49702-002 (1800mA)
2)BAT-52961-002 (2100mA)

## 1.7 Procedure used to establish test signal

- The device was put into test mode for SAR measurements by placing a call from a Rohde & Schwarz CMU 200 or CMW 500 Communications Test Instrument. The power control level was set to command the device to transmit at full power at the specified frequency. Other parameters include: Channel type = full rate, discontinuous transmission off, frequency hopping off. For LTE specific bandwidths, number of resource blocks, and resource block offsets were set. In addition, LTE A-MPR was disabled.
- Software Tool was used to set WiFi to transmit at maximum power and duty cycle for each band, channel, and modulation.

## 1.8 Highlights of the FCC OET SAR Measurement Requirements

### 1.8.1 SAR Measurement Procedures for 802.11 a/b/g/n as per KDB 248227 D01 v01r02 and SAR Measurements 100 MHz to 6 GHz as per KDB 865664 D0 V01

• Repeat measurements when the measured SAR is ≥ 0.80 W/kg. If the measured SAR values are < 1.45 W/kg with ≤ 20% variation, only one repeated measurement was performed to reaffirm that the results are not expected to have substantial variations. An additional repeated measurement is required only if the measured results are within 10% of the SAR limit and vary by more than 20%, which are often related to device and measurement setup difficulties.
• Maintained dielectric parameter uncertainty to ± 5.0% of the target values, (although it is very challenging to control/maintain both permittivity and conductivity for 5-6 GHz for all test channels within ± 5.0% of the target values, some conductivity values were measured slightly higher which resulted in more conservative SAR values.
• Liquid depth from SAM ERP or flat phantom was kept at 15 cm.
• Probe Requirement: Used SPEAG probe model ET3DV6/ES3DV3 for 2.45 GHz and EX3DV4 for 5-6 GHz SAR testing specs are outlined below:

| ET3DV6/ES3DV3 | |
|---|---|
| Probe tip to sensor center | 2.7 mm / 2.0 mm |
| Probe tip diameter is | 6.8 mm / 4.0 mm |
| Probe calibration uncertainty | < 15 % for f = 2.45 GHz |
| Probe calibration range | ± 100 MHz |
| EX3DV4 | |
| Probe tip to sensor center | 1.0 mm |
| Probe tip diameter is | 2.5 mm |
| Probe calibration uncertainty | < 15 % for f = 2.45 to < 6.0 GHz |
| Probe calibration range | ± 100 MHz |

**Table 1.8.1-1 Probe specification requirements**

• Area scan resolution was maintained at 10mm (5-6 GHz)
• Area scan resolution was maintained at 12mm (2-3 GHz)
• Area scan resolution was maintained at 15mm (</= 2 GHz)

- System accuracy validation was conducted within ± 100 MHz of device mid-band frequency and results were within ± 10 % of the manufacturers target value for each band.
- Zoom Scan: The following settings were used for the validation and measurement.

| ET3DV6/ES3DV3 | |
|---|---|
| Closest Measurement Point to Phantom | 4.0 mm |
| Zoom Scan (x,y) Resolution | 7.5 mm ( ≤2 GHz) or 5 mm ( 2-3 GHz) |
| Zoom Scan (z) Resolution | 5.0 mm |
| Zoom Scan Volume | Minimum 30 x 30 x 30 mm[1] |
| EX3DV4 | |
| Closest Measurement Point to Phantom | 2.0 mm |
| Zoom Scan (x,y) Resolution | 4.0 mm (5-6 GHz) |
| Zoom Scan (z) Resolution | 2.0 mm (5-6 GHz) |
| Zoom Scan Volume | Minimum 22 x 22 x 22 mm[1] |

**Table 1.8.1-2 Zoom Scan requirement**

**Note 1: "Auto-extend zoom scan when maxima on boundary" is enabled, which can result in the zoom scan dimensions varying between 30x30x30 to 60x60x30 mm and 22x22x22 to 48x40x22 mm.**

- Frequency Channel Configuration: 802.11 b/g modes are tested on "default test channels" 1, 6 and 11.
- 802.11a is tested for UNII operations on the highest output power channel of each sub band (low, mid, upper band I, and upper band II). If the highest output power channel has a SAR level that is not 3dB lower than the limit, then the low, mid, and high channels of each sub band must also be tested.
- For each frequency band, testing at higher rates and higher modulations is not required when the maximum average output power for each of these configurations is less than ¼ dB higher than those measured at the lowest data rate.
- SAR is not required for 802.11g/n channels when the maximum average output power is less than ¼ dB higher than that measured on the corresponding 802.11b channels.
- SAR test was conducted on each "default test channel" and each band with the worst case modulation and highest duty cycle, if the SAR level was within 3dB of the limit.
- Conducted power measurements:

| **802.11b @ 1Mbps** | | **802.11g @ 6Mbps** | | **802.11n @ 6.5 Mbps** | |
|---|---|---|---|---|---|
| **Chan** | **Cond. Power (dBm)** | **Chan** | **Cond. Power (dBm)** | **Chan** | **Cond. Power (dBm)** |
| 1 | 19.61 | 1 | 18.96 | 1 | 16.47 |
| 6 | 19.71 | 6 | 19.08 | 6 | 16.52 |
| 11 | 19.63 | 11 | 18.99 | 11 | 16.40 |

| | | **802.11g** | | | **802.11b** |
|---|---|---|---|---|---|
| **Data Rate (Mbps)** | **Mod.** | **Channel 6**<br>**Cond. Power (dBm)** | **Data Rate (Mbps)** | **Mod.** | **Channel 6**<br>**Cond. Power (dBm)** |
| 6 | BPSK | 19.06 | 1 | BPSK | 19.71 |
| 9 | BPSK | 19.00 | 2 | DQPSK | 19.62 |
| 12 | QPSK | 17.73 | 5.5 | CCK | 19.59 |
| 18 | QPSK | 17.52 | 11 | CCK | 19.51 |
| 24 | 16-QAM | 16.29 | 22 | CCK | 19.52 |
| 36 | 16-QAM | 16.11 | | | |
| 48 | 64-QAM | 14.75 | | | |
| 54 | 64-QAM | 14.70 | | | |

| | | **802.11 n** |
|---|---|---|
| **Data Rate (Mbps)** | **Mod.** | **Channel 6**<br>**Cond. Power (dBm)** |
| 6.5 | MCS0 | 16.61 |
| 13 | MCS1 | 16.49 |
| 19.5 | MCS2 | 15.19 |
| 26 | MCS3 | 15.05 |
| 39 | MCS4 | 13.68 |
| 52 | MCS5 | 13.52 |
| 58.5 | MCS6 | 12.53 |
| 65 | MCS7 | 12.48 |

**Table 1.8.1-3a 802.11 b/g/n modulation type/data rate vs. conducted power with Hotspot mode enabled and disabled (Rev2-01)**

| **802.11b @ 1Mbps** | | **802.11g @ 6Mbps** | | **802.11n @ 6.5 Mbps** | |
|---|---|---|---|---|---|
| **Chan** | **Cond. Power (dBm)** | **Chan** | **Cond. Power (dBm)** | **Chan** | **Cond. Power (dBm)** |
| 1 | 17.90 | 1 | 15.18 | 1 | 15.00 |
| **6** | **17.95** | 6 | 15.37 | 6 | 15.18 |
| 11 | 17.90 | 11 | 12.14 | 11 | 11.95 |

| | | **802.11g** | | | **802.11b** |
|---|---|---|---|---|---|
| **Data Rate (Mbps)** | **Mod.** | **Channel 6<br>Cond. Power (dBm)** | **Data Rate (Mbps)** | **Mod.** | **Channel 6<br>Cond. Power (dBm)** |
| 6 | BPSK | 15.37 | 1 | BPSK | 17.95 |
| 9 | BPSK | 15.32 | 2 | DQPSK | 17.94 |
| 12 | QPSK | 15.10 | 5.5 | CCK | 17.84 |
| 18 | QPSK | 15.11 | 11 | CCK | 17.79 |
| 24 | 16-QAM | 15.00 | 22 | CCK | 17.77 |
| 36 | 16-QAM | 14.70 | | | |
| 48 | 64-QAM | 14.53 | | | |
| 54 | 64-QAM | 14.43 | | | |

| | | **802.11 n** |
|---|---|---|
| **Data Rate (Mbps)** | **Mod.** | **Channel 6<br>Cond. Power (dBm)** |
| 6.5 | MCS0 | 15.18 |
| 13 | MCS1 | 15.06 |
| 19.5 | MCS2 | 14.97 |
| 26 | MCS3 | 14.84 |
| 39 | MCS4 | 13.75 |
| 52 | MCS5 | 13.55 |
| 58.5 | MCS6 | 12.58 |
| 65 | MCS7 | 12.47 |

**Table 1.8.1-3b 802.11 b/g/n modulation type/data rate vs. conducted power with Hotspot mode enabled and disabled (Rev3-01/03)**

| 802.11b @ 1Mbps | | 802.11g @ 6Mbps | | 802.11n @ 6.5 Mbps | |
|---|---|---|---|---|---|
| **Chan** | **Cond. Power (dBm)** | **Chan** | **Cond. Power (dBm)** | **Chan** | **Cond. Power (dBm)** |
| 1 | 19.37 | 1 | 16.35 | 1 | 16.27 |
| **6** | **19.47** | 6 | 18.80 | 6 | 16.31 |
| 11 | 19.37 | 11 | 13.07 | 11 | 12.97 |
| 13 | 12.43 | 13 | 12.00 | 13 | 11.85 |

| | | 802.11g | | | 802.11b |
|---|---|---|---|---|---|
| **Data Rate (Mbps)** | **Mod.** | **Channel 6 Cond. Power (dBm)** | **Data Rate (Mbps)** | **Mod.** | **Channel 6 Cond. Power (dBm)** |
| 6 | BPSK | 18.80 | 1 | BPSK | 19.47 |
| 9 | BPSK | 18.67 | 2 | DQPSK | 19.38 |
| 12 | QPSK | 17.70 | 5.5 | CCK | 19.23 |
| 18 | QPSK | 17.54 | 11 | CCK | 19.16 |
| 24 | 16-QAM | 16.31 | 22 | CCK | 19.10 |
| 36 | 16-QAM | 16.11 | | | |
| 48 | 64-QAM | 14.80 | | | |
| 54 | 64-QAM | 14.73 | | | |

| | | 802.11 n |
|---|---|---|
| **Data Rate (Mbps)** | **Mod.** | **Channel 6 Cond. Power (dBm)** |
| 6.5 | MCS0 | 16.31 |
| 13 | MCS1 | 16.21 |
| 19.5 | MCS2 | 15.14 |
| 26 | MCS3 | 15.00 |
| 39 | MCS4 | 13.79 |
| 52 | MCS5 | 13.56 |
| 58.5 | MCS6 | 12.45 |
| 65 | MCS7 | 12.43 |

**Table 1.8.1-3c 802.11 b/g/n modulation type/data rate vs. conducted power with Hotspot mode enabled and disabled (Rev3-04)**

| **802.11b @ 1Mbps** | | | **802.11g @ 6Mbps** | | | **802.11n @ 6.5 Mbps** | | |
|---|---|---|---|---|---|---|---|---|
| **f (MHz)** | **Chan** | **Max. average conducted power (dBm)** | **f (MHz)** | **Chan** | **Max. average conducted power (dBm)** | **f (MHz)** | **Chan** | **Max. average conducted power (dBm)** |
| 2412 | 1 | 13.2 | 2412 | 1 | 13.3 | 2412 | 1 | 13.4 |
| 2437 | 6 | **13.5** | 2437 | 6 | **13.5** | 2437 | 6 | **13.5** |
| 2462 | 11 | 13.4 | 2462 | 11 | 13.4 | 2462 | 11 | 13.4 |

| **802.11g** | | | **802.11b** | | |
|---|---|---|---|---|---|
| **Data Rate (Mbps)** | **Mod.** | **Channel 6<br>Max. average conducted power (dBm)** | **Data Rate (Mbps)** | **Mod.** | **Channel 6<br>Max. average conducted power (dBm)** |
| 18 | QPSK | 13.4 | 5.5 | CCK | 13.4 |
| 54 | 64-QAM | 13.6 | 11 | CCK | 13.5 |

| **802.11 n** | | |
|---|---|---|
| **Data Rate (Mbps)** | **Mod.** | **Channel 6<br>Max. average conducted power (dBm)** |
| 26 | MCS3 | 13.5 |
| 65 | MCS7 | 13.4 |

**Table 1.8.1-3d 802.11 b/g/n modulation type/data rate vs. conducted power (Rev3-04) in Wi-Fi Direct/GO mode**

| 802.11a (low band) 6Mbps | | | 802.11a (mid band) 6Mbps | | | 802.11a (upper band I) 6Mbps | | |
|---|---|---|---|---|---|---|---|---|
| **Chan** | **f (MHz)** | **Cond. Power (dBm)** | **Chan** | **f(MHz)** | **Cond. Power (dBm)** | **Chan** | **f(MHz)** | **Cond. Power (dBm)** |
| 36 | 5180 | 19.21 | **52** | **5260** | **19.34** | **104** | **5520** | **19.65** |
| 40 | 5200 | 19.25 | 56 | 5280 | 19.30 | 116 | 5580 | 19.36 |
| 44 | 5220 | 19.28 | 60 | 5300 | 19.31 | 124 | 5620 | 19.20 |
| **48** | **5240** | **19.34** | 64 | 5320 | 19.25 | 140 | 5700 | 18.71 |

| 802.11a (upper band II) 6Mbps | | |
|---|---|---|
| **Chan** | **f(MHz)** | **Cond. Power (dBm)** |
| **149** | **5745** | **16.28** |
| 153 | 5765 | 16.00 |
| 157 | 5785 | 15.91 |
| 161 | 5805 | 15.87 |
| 165 | 5825 | 15.79 |

| | | 802.11a (lower band) | 802.11a (middle band) | 802.11a (upper band I) | 802.11a (upper band II) |
|---|---|---|---|---|---|
| **Data Rate (Mbits)** | **Mod.** | **Channel 48** | **Channel 52** | **Channel 104** | **Channel 149** |
| | | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** |
| 6 | BPSK | 19.34 | 19.34 | 19.68 | 16.28 |
| 9 | BPSK | 19.31 | 19.28 | 19.61 | 16.23 |
| 12 | QPSK | 19.29 | 19.31 | 19.59 | 16.19 |
| 18 | QPSK | 19.30 | 19.30 | 19.61 | 16.20 |
| 24 | 16-QAM | 19.31 | 19.25 | 19.59 | 16.21 |
| 36 | 16-QAM | 19.30 | 19.31 | 19.62 | 16.22 |
| 48 | 64-QAM | 19.28 | 19.29 | 19.63 | 16.20 |
| 54 | 64-QAM | 19.30 | 19.32 | 19.60 | 16.18 |

| | 802.11n (lower band) | 802.11n (middle band) | 802.11n (upper band I) | 802.11n (upper band II) |
|---|---|---|---|---|
| **Mod.** | **Channel 48** | **Channel 52** | **Channel 104** | **Channel 149** |
| | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** |
| MCS0 | 18.41 | 18.44 | 19.64 | 16.21 |
| MCS1 | 18.39 | 18.40 | 19.67 | 16.24 |
| MCS2 | 18.37 | 18.41 | 19.66 | 16.20 |
| MCS3 | 18.35 | 18.39 | 19.65 | 16.21 |
| MCS4 | 18.36 | 18.43 | 19.68 | 16.22 |
| MCS5 | 18.38 | 18.40 | 19.64 | 16.19 |
| MCS6 | 18.34 | 18.42 | 19.67 | 16.23 |
| MCS7 | 18.36 | 18.42 | 19.61 | 16.24 |

**Table 1.8.1-4a 802.11 a/n modulation type/data rate vs. conducted power (Rev2-01)**

| 802.11a (low band) 6Mbps | | | 802.11a (mid band) 6Mbps | | | 802.11a (upper band I) 6Mbps | | |
|---|---|---|---|---|---|---|---|---|
| **Chan** | **f (MHz)** | **Cond. Power (dBm)** | **Chan** | **f(MHz)** | **Cond. Power (dBm)** | **Chan** | **f(MHz)** | **Cond. Power (dBm)** |
| **36** | **5180** | **13.21** | 52 | 5260 | 12.90 | **104** | **5520** | **11.90** |
| 40 | 5200 | 13.10 | 56 | 5280 | 12.87 | 116 | 5580 | 11.70 |
| 44 | 5220 | 13.07 | 60 | 5300 | 12.80 | 124 | 5620 | 11.50 |
| 48 | 5240 | 13.00 | **64** | **5320** | **13.65** | 140 | 5700 | 11.25 |

| | | | | | | 802.11a (upper band II) 6Mbps | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | **Chan** | **f(MHz)** | **Cond. Power (dBm)** |
| | | | | | | **149** | **5745** | **10.92** |
| | | | | | | 153 | 5765 | 10.89 |
| | | | | | | 157 | 5785 | 10.88 |
| | | | | | | 161 | 5805 | 10.90 |
| | | | | | | 165 | 5825 | 10.85 |

| | | 802.11a (lower band) | 802.11a (middle band) | 802.11a (upper band I) | 802.11a (upper band II) |
|---|---|---|---|---|---|
| **Data Rate (Mbits)** | **Mod.** | **Channel 36** | **Channel 64** | **Channel 104** | **Channel 149** |
| | | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** |
| 6 | BPSK | 12.21 | 13.65 | 11.90 | 10.90 |
| 9 | BPSK | 13.17 | 13.62 | 11.78 | 10.82 |
| 12 | QPSK | 13.13 | 13.55 | 11.72 | 10.78 |
| 18 | QPSK | 13.00 | 13.46 | 11.62 | 10.66 |
| 24 | 16-QAM | 12.63 | 13.35 | 11.40 | 10.45 |
| 36 | 16-QAM | 12.45 | 13.04 | 11.20 | 10.29 |
| 48 | 64-QAM | 12.42 | 12.88 | 10.94 | 10.10 |
| 54 | 64-QAM | 12.35 | 12.85 | 10.92 | 9.91 |

| | 802.11n (lower band) | 802.11n (middle band) | 802.11n (upper band I) | 802.11n (upper band II) |
|---|---|---|---|---|
| **Mod.** | **Channel 36** | **Channel 64** | **Channel 104** | **Channel 149** |
| | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** |
| MCS0 | 13.05 | 13.52 | 11.70 | 10.81 |
| MCS1 | 13.04 | 13.45 | 11.51 | 10.64 |
| MCS2 | 12.83 | 13.31 | 11.42 | 10.52 |
| MCS3 | 12.75 | 13.20 | 11.34 | 10.35 |
| MCS4 | 12.50 | 13.00 | 11.05 | 10.20 |
| MCS5 | 12.35 | 12.74 | 10.91 | 9.90 |
| MCS6 | 12.27 | 12.72 | 10.81 | 9.85 |
| MCS7 | 12.24 | 12.64 | 10.75 | 9.77 |

**Table 1.8.1-4b 802.11 a/n modulation type/data rate vs. conducted power (Rev3-01/03)**

| 802.11a (low band) 6Mbps | | | 802.11a (mid band) 6Mbps | | | 802.11a (upper band I) 6Mbps | | |
|---|---|---|---|---|---|---|---|---|
| **Chan** | **f (MHz)** | **Cond. Power (dBm)** | **Chan** | **f(MHz)** | **Cond. Power (dBm)** | **Chan** | **f(MHz)** | **Cond. Power (dBm)** |
| **36** | **5180** | 13.35 | **52** | **5260** | 14.96 | **104** | **5520** | 16.78 |
| 40 | 5200 | 13.18 | 56 | 5280 | 14.93 | 116 | 5580 | 16.45 |
| 44 | 5220 | 13.19 | 60 | 5300 | 14.86 | 124 | 5620 | 16.36 |
| 48 | 5240 | 13.10 | 64 | 5320 | 12.82 | 140 | 5700 | 14.21 |

| | | | | | | 802.11a (upper band II) 6Mbps | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | **Chan** | **f(MHz)** | **Cond. Power (dBm)** |
| | | | | | | 149 | 5745 | 11.95 |
| | | | | | | 153 | 5765 | 11.96 |
| | | | | | | 157 | 5785 | 11.96 |
| | | | | | | 161 | 5805 | 11.97 |
| | | | | | | **165** | **5825** | 11.99 |

| | | 802.11a (lower band) | 802.11a (middle band) | 802.11a (upper band I) | 802.11a (upper band II) |
|---|---|---|---|---|---|
| **Data Rate (Mbits)** | **Mod.** | **Channel 36** | **Channel 52** | **Channel 104** | **Channel 165** |
| | | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** |
| 6 | BPSK | 13.35 | 14.96 | 16.78 | 11.95 |
| 9 | BPSK | 13.30 | 15.00 | 16.63 | 11.93 |
| 12 | QPSK | 13.16 | 14.97 | 16.57 | 11.83 |
| 18 | QPSK | 13.10 | 14.85 | 16.47 | 11.66 |
| 24 | 16-QAM | 13.00 | 14.65 | 16.39 | 11.52 |
| 36 | 16-QAM | 12.63 | 14.43 | 16.16 | 11.32 |
| 48 | 64-QAM | 12.37 | 14.28 | 14.85 | 11.07 |
| 54 | 64-QAM | 12.44 | 14.10 | 14.82 | 11.00 |

| | 802.11n (lower band) | 802.11n (middle band) | 802.11n (upper band I) | 802.11n (upper band II) |
|---|---|---|---|---|
| **Mod.** | **Channel 36** | **Channel 52** | **Channel 104** | **Channel 165** |
| | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** | **Cond. Power (dBm)** |
| MCS0 | 13.15 | 14.96 | 16.77 | 11.85 |
| MCS1 | 13.12 | 14.83 | 16.58 | 11.72 |
| MCS2 | 12.96 | 14.56 | 16.47 | 11.53 |
| MCS3 | 12.86 | 14.55 | 16.21 | 11.44 |
| MCS4 | 12.64 | 14.30 | 14.99 | 11.20 |
| MCS5 | 12.43 | 14.15 | 14.84 | 11.06 |
| MCS6 | 12.21 | 14.12 | 13.63 | 10.92 |
| MCS7 | 12.19 | 14.00 | 13.61 | 10.82 |

**Table 1.8.1-4c 802.11 a/n modulation type/data rate vs. conducted power (Rev3-04)**

### 1.8.2 SAR Measurement Requirements for Bluetooth

| Channel | Freq (MHz) | Mode | Conducted Transmit Power (dBm) |
|---|---|---|---|
| 0 | 2402 | DH5 | 9.8 |
| 39 | 2441 | DH5 | 10.2 |
| 78 | 2480 | DH5 | 9.9 |

**Table 1.8.2-1 Bluetooth peak conducted power measurements**

### 1.8.3 SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities as per KDB 941225 D06 v01

Standalone personal wireless routers and handsets with hotspot mode capabilities must address hand-held and other near-body exposure conditions to show SAR compliance. The following procedures are applicable when the overall device length and width are ≥ 9 cm x 5 cm respectively. A test separation of 10 mm is required. SAR must be measured for all sides and surfaces with a transmitting antenna located within 25 mm from that surface or edge, for the data modes, wireless technologies and frequency bands supporting hotspot mode. The standalone SAR results in each device test orientation must be analyzed for the applicable hotspot mode simultaneous transmission configurations to determine SAR test exclusion and volume scan requirements.

Static/fixed power reduction scheme on the following modes/bands have been implemented when Hotspot Mode is enabled or active to comply with body SAR with 10 mm test separation from flat phantom on standalone transmitter and multi-band simultaneous transmission conditions:

- EDGE/GPRS 850: back off 3 dB
- LTE B4: back off 1 dB
- LTE B5: back off 2 dB

When Hotspot mode is enabled or active, all 5 GHz WiFi operations are disabled or not supported.

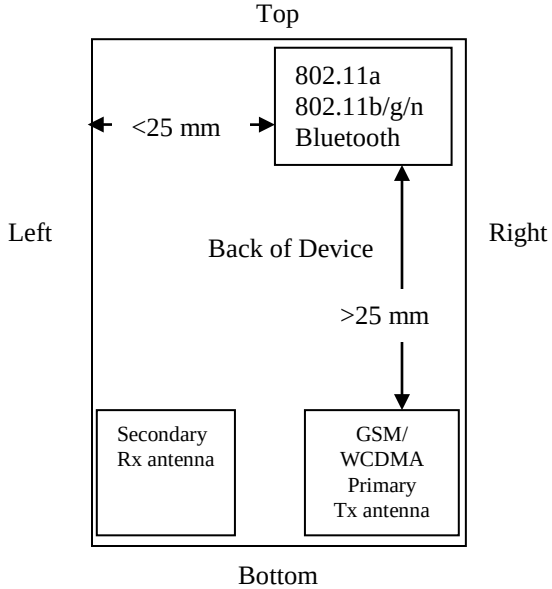


**Figure 1.8.3-1 Identification of all sides for SAR Testing**

**Note:** According to FCC guidance, Hotspot SAR testing is not required on any edge that is more than 2.5cm from the transmitting antenna.

| Hotspot Sides for SAR Testing | | | | | | |
|---|---|---|---|---|---|---|
| **Mode** | **Front** | **Back** | **Top** | **Bottom** | **Left** | **Right** |
| GPRS 850 | Yes | Yes | No | Yes | Yes | Yes |
| GPRS 1900 | Yes | Yes | No | Yes | Yes | Yes |
| WCDMA/HSPA 850 | Yes | Yes | No | Yes | Yes | Yes |
| WCDMA/HSPA 1900 | Yes | Yes | No | Yes | Yes | Yes |
| LTE band 2 | Yes | Yes | No | Yes | Yes | Yes |
| LTE band 4 | Yes | Yes | No | Yes | Yes | Yes |
| LTE band 5 | Yes | Yes | No | Yes | Yes | Yes |
| LTE band 17 | Yes | Yes | No | Yes | Yes | Yes |
| Bluetooth 2.4GHz | Yes | Yes | Yes | No | Yes | Yes |
| 802.11b 2.4GHz | Yes | Yes | Yes | No | Yes | Yes |

**Table 1.8.3-1 Identification of all sides for SAR Testing**

### 1.8.4 SAR Evaluation Procedures for LTE as per KDB 941225 D05 v02

**"1. QPSK with 1 RB allocation**
Start with the largest channel bandwidth and measure SAR for QPSK with 1 RB allocation, using the RB offset and *required test channel* combination with the highest maximum output power for RB offsets at the upper edge, middle and lower edge of each *required test channel*. When the *reported* SAR is ≤ 0.8 W/kg, testing of the remaining RB offset configurations and *required test channels* is not required for 1 RB allocation; otherwise, SAR is required for the remaining r*equired test channels* and only for the RB offset configuration with the highest output power for that channel.6 When the *reported* SAR of a *required test channel* is > 1.45 W/kg, SAR is required for all three RB offset configurations for that *required test channel*.

**2. QPSK with 50% RB allocation**
The procedures required for 1 RB allocation in 1. are applied to measure the SAR for QPSK with 50% RB allocation.

**3. QPSK with 100% RB allocation**
For QPSK with 100% RB allocation, SAR is not required when the highest maximum output power for 100 % RB allocation is less than the highest maximum output power in 50% and 1 RB allocations and the highest *reported* SAR for 1 RB and 50% RB allocation in 1. and 2. are ≤ 0.8 W/kg. Otherwise, SAR is measured for the highest output power channel and if the *reported* SAR is > 1.45 W/kg, the remaining *required test channels* must also be tested.

Higher order modulations
For each modulation besides QPSK; e.g., 16-QAM, 64-QAM, apply the QPSK procedures in sections 1. and 2.and 3. to determine the QAM configurations that may need SAR measurement.

For each configuration
identified as required for testing, SAR is required only when the highest maximum output power

for the configuration in the higher order modulation is > ½ dB higher than the same configuration in QPSK or when the *reported* SAR for the QPSK configuration is > 1.45 W/kg.

**4. Other channel bandwidth standalone SAR test requirements**

For the other channel bandwidths used by the device in a frequency band, apply all the procedures required for the largest channel bandwidth in section 5.2 to determine the channels and RB configurations that need SAR testing and only measure SAR when the highest maximum output power of a configuration requiring testing in the smaller channel bandwidth is > ½ dB higher than the equivalent channel configurations in the largest channel bandwidth configuration or the *reported* SAR of a configuration for the largest channel bandwidth is > 1.45 W/kg.

The equivalent channel configuration for the RB allocation, RB offset and modulation etc. Is determined for the smaller channel bandwidth according to the same number of RB allocated in the largest channel bandwidth. For example, 50 RB in 10 MHz channel bandwidth does not apply to 5 MHz channel bandwidth; therefore, this cannot be tested in the smaller channel bandwidth. However, 50% RB allocation in 10 MHz channel bandwidth

is equivalent to 100% RB allocation in 5 MHz channel bandwidth; therefore, these are the equivalent configurations to be compared to determine the specific channel and configuration in the smaller channel bandwidth that need SAR testing."

• MPR has been implemented permanently by the manufacturer as per 3GPP TS36.101
• A-MPR was disabled for all SAR measurements.
•LTE Head SAR was evaluated to cover third-party VoIP applications at full power.
•LTE Head SAR was evaluated in SVLTE mode at lowered LTE power.

• According to "3GPP TS 36.521-1 V10.0.0 (2011-12)":
  •"The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7, 15, 25, 50, 75 and 100 channel numbers at the lower operating band edge and the last 6, 14, 24, 49, 74 and 99 channel numbers at the upper operating band edge shall not be used for channel bandwidths of 1.4, 3, 5, 10, 15 and 20 MHz respectively."…

| Band | LTE Band 2 | | | | | |
|---|---|---|---|---|---|---|
| Frequency (MHz) | Channel | BW | Modulation | RB Size | RB Offset | Maximum Avg. Power (dBm) |
| 1860 | 18700 | 20 MHz | QPSK | 1 | 0 | 22.33 |
| | | | QPSK | 1 | 50 | 22.22 |
| | | | QPSK | 1 | 99 | 22.22 |
| | | | QPSK | 50 | 0 | 20.90 |
| | | | QPSK | 50 | 50 | 20.88 |
| | | | QPSK | 100 | 0 | 20.99 |
| | | | 16QAM | 1 | 0 | 21.15 |
| | | | 16QAM | 1 | 50 | 20.78 |
| | | | 16QAM | 1 | 99 | 20.86 |
| | | | 16QAM | 75 | 0 | 19.97 |
| | | | 16QAM | 75 | 25 | 19.89 |
| | | | 16QAM | 100 | 0 | 20.05 |
| 1880 | 18900 | 20 MHz | QPSK | 1 | 0 | 22.34 |
| | | | QPSK | 1 | 50 | 22.24 |
| | | | QPSK | 1 | 99 | 22.23 |
| | | | QPSK | 50 | 0 | 21.00 |
| | | | QPSK | 50 | 50 | 20.95 |
| | | | QPSK | 100 | 0 | 20.98 |
| | | | 16QAM | 1 | 0 | 21.05 |
| | | | 16QAM | 1 | 50 | 21.00 |
| | | | 16QAM | 1 | 99 | 21.05 |
| | | | 16QAM | 75 | 0 | 19.94 |
| | | | 16QAM | 75 | 25 | 19.88 |
| | | | 16QAM | 100 | 0 | 19.89 |
| 1900 | 19100 | 20 MHz | QPSK | 1 | 0 | 22.18 |
| | | | QPSK | 1 | 50 | 22.08 |
| | | | QPSK | 1 | 99 | 22.12 |
| | | | QPSK | 50 | 0 | 20.90 |
| | | | QPSK | 50 | 50 | 20.94 |
| | | | QPSK | 100 | 0 | 20.99 |
| | | | 16QAM | 1 | 0 | 21.16 |
| | | | 16QAM | 1 | 50 | 21.19 |
| | | | 16QAM | 1 | 99 | 21.10 |
| | | | 16QAM | 75 | 0 | 19.86 |
| | | | 16QAM | 75 | 25 | 19.89 |
| | | | 16QAM | 100 | 0 | 20.03 |
| 1860 | 18700 | 15 MHz | QPSK | 1 | 0 | 22.35 |
| | | | QPSK | 1 | 74 | 22.20 |
| | | | QPSK | 36 | 39 | 20.94 |
| | | | QPSK | 75 | 0 | 20.90 |
| | | | 16QAM | 1 | 0 | 21.15 |
| | | | 16QAM | 1 | 74 | 21.07 |
| | | | 16QAM | 16 | 59 | 21.10 |
| | | | 16QAM | 75 | 0 | 19.94 |
| 1860 | 18700 | 10 MHz | QPSK | 1 | 0 | 22.32 |
| | | | QPSK | 1 | 49 | 22.24 |
| | | | QPSK | 25 | 0 | 21.00 |
| | | | QPSK | 50 | 0 | 20.94 |
| | | | 16QAM | 1 | 0 | 21.06 |
| | | | 16QAM | 1 | 49 | 20.97 |
| | | | 16QAM | 16 | 0 | 20.18 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | 16QAM | 50 | 0 | 19.91 |
| 1860 | 18700 | 5 MHz | QPSK | 1 | 0 | 22.32 |
| | | | QPSK | 1 | 24 | 22.32 |
| | | | QPSK | 25 | 0 | 21.02 |
| | | | 16QAM | 1 | 0 | 21.50 |
| | | | 16QAM | 1 | 24 | 21.52 |
| | | | 16QAM | 25 | 0 | 19.95 |
| 1860 | 18700 | 3 MHz | QPSK | 1 | 0 | 22.41 |
| | | | QPSK | 1 | 14 | 22.31 |
| | | | QPSK | 15 | 0 | 21.14 |
| | | | 16QAM | 1 | 0 | 21.21 |
| | | | 16QAM | 1 | 14 | 21.08 |
| | | | 16QAM | 15 | 0 | 20.04 |
| 1860 | 18700 | 1.4 MHz | QPSK | 1 | 0 | 22.17 |
| | | | QPSK | 1 | 5 | 22.14 |
| | | | QPSK | 6 | 0 | 21.13 |
| | | | 16QAM | 1 | 0 | 20.81 |
| | | | 16QAM | 1 | 5 | 20.82 |
| | | | 16QAM | 6 | 0 | 20.15 |

**Table 1.8.4-1 LTE band 2 conducted power measurements**

| **Band** | **LTE Band 4** | | | | | |
|---|---|---|---|---|---|---|
| **Frequency (MHz)** | **Channel** | **BW** | **Modulation** | **RB Size** | **RB Offset** | **Maximum Avg. Power (dBm)** |
| 1720 | 20050 | 20 MHz | QPSK | 1 | 0 | **23.60** |
| | | | QPSK | 1 | 50 | 23.47 |
| | | | QPSK | 1 | 99 | 23.46 |
| | | | QPSK | 50 | 0 | 22.27 |
| | | | QPSK | 50 | 50 | 22.20 |
| | | | QPSK | 100 | 0 | 22.12 |
| | | | 16QAM | 1 | 0 | 22.20 |
| | | | 16QAM | 1 | 50 | 22.17 |
| | | | 16QAM | 1 | 99 | 22.05 |
| | | | 16QAM | 75 | 0 | 21.15 |
| | | | 16QAM | 75 | 25 | 21.24 |
| | | | 16QAM | 100 | 0 | 21.13 |
| 1732.5 | 20175 | 20 MHz | QPSK | 1 | 0 | 23.47 |
| | | | QPSK | 1 | 50 | 23.44 |
| | | | QPSK | 1 | 99 | **23.61** |
| | | | QPSK | 50 | 0 | 22.15 |
| | | | QPSK | 50 | 50 | 22.22 |
| | | | QPSK | 100 | 0 | 22.20 |
| | | | 16QAM | 1 | 0 | 22.27 |
| | | | 16QAM | 1 | 50 | 22.35 |
| | | | 16QAM | 1 | 99 | 22.43 |
| | | | 16QAM | 75 | 0 | 21.15 |
| | | | 16QAM | 75 | 25 | 21.08 |
| | | | 16QAM | 100 | 0 | 21.21 |
| 1745.0 | 20300 | 20 MHz | QPSK | 1 | 0 | 23.49 |
| | | | QPSK | 1 | 50 | 23.52 |
| | | | QPSK | 1 | 99 | **23.83** |
| | | | QPSK | 50 | 0 | **22.35** |
| | | | QPSK | 50 | 50 | 22.22 |
| | | | QPSK | 100 | 0 | **22.30** |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | 16QAM | 1 | 0 | 22.58 |
| | | | 16QAM | 1 | 50 | 22.61 |
| | | | 16QAM | 1 | 99 | 22.87 |
| | | | 16QAM | 75 | 0 | 21.28 |
| | | | 16QAM | 75 | 25 | 21.22 |
| | | | 16QAM | 100 | 0 | 21.31 |
| 1745.0 | 20300 | 15 MHz | QPSK | 1 | 0 | 23.60 |
| | | | QPSK | 1 | 74 | 23.67 |
| | | | QPSK | 36 | 39 | 22.45 |
| | | | QPSK | 75 | 0 | 22.23 |
| | | | 16QAM | 1 | 0 | 22.43 |
| | | | 16QAM | 1 | 74 | 22.49 |
| | | | 16QAM | 16 | 59 | 22.63 |
| | | | 16QAM | 75 | 0 | 21.21 |
| 1745.0 | 20300 | 10 MHz | QPSK | 1 | 0 | 23.71 |
| | | | QPSK | 1 | 49 | 23.71 |
| | | | QPSK | 25 | 0 | 22.44 |
| | | | QPSK | 50 | 0 | 22.36 |
| | | | 16QAM | 1 | 0 | 22.49 |
| | | | 16QAM | 1 | 49 | 22.47 |
| | | | 16QAM | 16 | 0 | 21.67 |
| | | | 16QAM | 50 | 0 | 21.39 |
| 1745.0 | 20300 | 5 MHz | QPSK | 1 | 0 | 23.85 |
| | | | QPSK | 1 | 24 | 23.79 |
| | | | QPSK | 25 | 0 | 22.45 |
| | | | 16QAM | 1 | 0 | 22.97 |
| | | | 16QAM | 1 | 24 | 23.05 |
| | | | 16QAM | 25 | 0 | 21.47 |
| 1745.0 | 20300 | 3 MHz | QPSK | 1 | 0 | 23.75 |
| | | | QPSK | 1 | 14 | 23.80 |
| | | | QPSK | 15 | 0 | 22.62 |
| | | | 16QAM | 1 | 0 | 22.50 |
| | | | 16QAM | 1 | 14 | 22.55 |
| | | | 16QAM | 15 | 0 | 21.62 |
| 1745.0 | 20300 | 1.4 MHz | QPSK | 1 | 0 | 23.72 |
| | | | QPSK | 1 | 5 | 23.75 |
| | | | QPSK | 6 | 0 | 22.65 |
| | | | 16QAM | 1 | 0 | 22.50 |
| | | | 16QAM | 1 | 5 | 22.55 |
| | | | 16QAM | 6 | 0 | 21.61 |

**Table 1.8.4-2 LTE band 4 conducted power measurements with Hotspot mode disabled**

| Band | LTE Band 4 | | | | | |
|---|---|---|---|---|---|---|
| Frequency (MHz) | Channel | BW | Modulation | RB Size | RB Offset | Maximum Avg. Power (dBm) |
| 1720 | 20050 | 20 MHz | QPSK | 1 | 0 | 22.63 |
| | | | QPSK | 1 | 50 | 22.60 |
| | | | QPSK | 1 | 99 | 22.68 |
| | | | QPSK | 50 | 0 | 22.18 |
| | | | QPSK | 50 | 50 | 22.13 |
| | | | QPSK | 100 | 0 | 22.17 |
| | | | 16QAM | 1 | 0 | 22.07 |
| | | | 16QAM | 1 | 50 | 22.05 |
| | | | 16QAM | 1 | 99 | 22.11 |
| | | | 16QAM | 75 | 0 | 21.12 |
| | | | 16QAM | 75 | 25 | 21.12 |
| | | | 16QAM | 100 | 0 | 21.18 |
| 1732.5 | 20175 | 20 MHz | QPSK | 1 | 0 | 22.71 |
| | | | QPSK | 1 | 50 | 22.70 |
| | | | QPSK | 1 | 99 | 22.69 |
| | | | QPSK | 50 | 0 | 22.06 |
| | | | QPSK | 50 | 50 | 22.05 |
| | | | QPSK | 100 | 0 | 22.02 |
| | | | 16QAM | 1 | 0 | 22.30 |
| | | | 16QAM | 1 | 50 | 22.22 |
| | | | 16QAM | 1 | 99 | 22.15 |
| | | | 16QAM | 75 | 0 | 21.12 |
| | | | 16QAM | 75 | 25 | 21.03 |
| | | | 16QAM | 100 | 0 | 21.00 |
| 1745.0 | 20300 | 20 MHz | QPSK | 1 | 0 | 22.60 |
| | | | QPSK | 1 | 50 | 22.60 |
| | | | QPSK | 1 | 99 | 22.87 |
| | | | QPSK | 50 | 0 | 22.00 |
| | | | QPSK | 50 | 50 | 22.11 |
| | | | QPSK | 100 | 0 | 22.08 |
| | | | 16QAM | 1 | 0 | 21.82 |
| | | | 16QAM | 1 | 50 | 21.91 |
| | | | 16QAM | 1 | 99 | 22.20 |
| | | | 16QAM | 75 | 0 | 20.90 |
| | | | 16QAM | 75 | 25 | 21.02 |
| | | | 16QAM | 100 | 0 | 21.09 |

**Table 1.8.4-3 LTE band 4 conducted power measurements with Hot Spot mode enabled**

| Band | LTE Band 5 | | | | | |
|---|---|---|---|---|---|---|
| Frequency (MHz) | Channel | BW | Modulation | RB Size | RB Offset | Maximum Avg. Power (dBm) |
| 829 | 20450 | 10 MHz | QPSK | 1 | 0 | 23.74 |
| | | | QPSK | 1 | 25 | 23.72 |
| | | | QPSK | 1 | 49 | 23.65 |
| | | | QPSK | 25 | 0 | 23.67 |
| | | | QPSK | 25 | 25 | 22.69 |
| | | | QPSK | 50 | 0 | 22.52 |
| | | | 16QAM | 1 | 0 | 22.44 |
| | | | 16QAM | 1 | 25 | 22.42 |
| | | | 16QAM | 1 | 49 | 22.36 |
| | | | 16QAM | 30 | 0 | 21.74 |
| | | | 16QAM | 30 | 20 | 21.63 |
| | | | 16QAM | 50 | 0 | 21.67 |
| 836.5 | 20525 | 10 MHz | QPSK | 1 | 0 | 23.78 |
| | | | QPSK | 1 | 25 | 23.75 |
| | | | QPSK | 1 | 49 | 23.65 |
| | | | QPSK | 25 | 0 | 22.59 |
| | | | QPSK | 25 | 25 | 22.58 |
| | | | QPSK | 50 | 0 | 22.51 |
| | | | 16QAM | 1 | 0 | 22.61 |
| | | | 16QAM | 1 | 25 | 22.65 |
| | | | 16QAM | 1 | 49 | 22.46 |
| | | | 16QAM | 30 | 0 | 21.75 |
| | | | 16QAM | 30 | 20 | 21.53 |
| | | | 16QAM | 50 | 0 | 21.52 |
| 844.0 | 20600 | 10 MHz | QPSK | 1 | 0 | 23.64 |
| | | | QPSK | 1 | 25 | 23.61 |
| | | | QPSK | 1 | 49 | 23.63 |
| | | | QPSK | 25 | 0 | 22.57 |
| | | | QPSK | 25 | 25 | 22.44 |
| | | | QPSK | 50 | 0 | 22.40 |
| | | | 16QAM | 1 | 0 | 22.35 |
| | | | 16QAM | 1 | 25 | 22.23 |
| | | | 16QAM | 1 | 49 | 22.30 |
| | | | 16QAM | 30 | 0 | 21.51 |
| | | | 16QAM | 30 | 20 | 21.48 |
| | | | 16QAM | 50 | 0 | 21.42 |
| 836.5 | 20525 | 5 MHz | QPSK | 1 | 0 | 23.77 |
| | | | QPSK | 1 | 24 | 23.74 |
| | | | QPSK | 15 | 0 | 22.71 |
| | | | QPSK | 25 | 0 | 22.57 |
| | | | 16QAM | 1 | 0 | 23.08 |
| | | | 16QAM | 1 | 24 | 23.00 |
| | | | 16QAM | 15 | 10 | 22.62 |
| | | | 16QAM | 25 | 0 | 22.59 |
| 836.5 | 20525 | 3 MHz | QPSK | 1 | 0 | 23.80 |
| | | | QPSK | 1 | 14 | 23.74 |
| | | | QPSK | 6 | 9 | 22.70 |
| | | | QPSK | 15 | 0 | 22.62 |
| | | | 16QAM | 1 | 0 | 22.62 |
| | | | 16QAM | 1 | 8 | 22.66 |
| | | | 16QAM | 4 | 0 | 22.76 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | 16QAM | 4 | 11 | 22.85 |
| 836.5 | 20525 | 1.4 MHz | QPSK | 1 | 0 | 23.68 |
| | | | QPSK | 1 | 5 | 23.70 |
| | | | QPSK | 6 | 0 | 22.73 |
| | | | 16QAM | 1 | 0 | 22.50 |
| | | | 16QAM | 1 | 5 | 22.40 |
| | | | 16QAM | 6 | 0 | 21.70 |

**Table 1.8.4-4 LTE band 5 conducted power measurements with Hot Spot mode disabled**

| Band | LTE Band 5 | | | | | |
|---|---|---|---|---|---|---|
| Frequency (MHz) | Channel | BW | Modulation | RB Size | RB Offset | Maximum Avg. Power (dBm) |
| 829 | 20450 | 10 MHz | QPSK | 1 | 0 | 21.83 |
| | | | QPSK | 1 | 25 | 21.65 |
| | | | QPSK | 1 | 49 | 21.70 |
| | | | QPSK | 25 | 0 | 21.68 |
| | | | QPSK | 25 | 25 | 21.59 |
| | | | QPSK | 50 | 0 | 21.62 |
| | | | 16QAM | 1 | 0 | 21.60 |
| | | | 16QAM | 1 | 25 | 21.41 |
| | | | 16QAM | 1 | 49 | 21.45 |
| | | | 16QAM | 30 | 0 | 21.68 |
| | | | 16QAM | 30 | 20 | 21.72 |
| | | | 16QAM | 50 | 0 | 21.42 |
| 836.5 | 20525 | 10 MHz | QPSK | 1 | 0 | 21.85 |
| | | | QPSK | 1 | 25 | 21.60 |
| | | | QPSK | 1 | 49 | 21.65 |
| | | | QPSK | 25 | 0 | 21.57 |
| | | | QPSK | 25 | 25 | 21.58 |
| | | | QPSK | 50 | 0 | 21.45 |
| | | | 16QAM | 1 | 0 | 21.57 |
| | | | 16QAM | 1 | 25 | 21.41 |
| | | | 16QAM | 1 | 49 | 21.50 |
| | | | 16QAM | 30 | 0 | 21.60 |
| | | | 16QAM | 30 | 20 | 21.47 |
| | | | 16QAM | 50 | 0 | 21.42 |
| 844.0 | 20600 | 10 MHz | QPSK | 1 | 0 | 21.97 |
| | | | QPSK | 1 | 25 | 21.78 |
| | | | QPSK | 1 | 49 | 21.74 |
| | | | QPSK | 25 | 0 | 21.65 |
| | | | QPSK | 25 | 25 | 21.61 |
| | | | QPSK | 50 | 0 | 21.55 |
| | | | 16QAM | 1 | 0 | 21.55 |
| | | | 16QAM | 1 | 25 | 21.30 |
| | | | 16QAM | 1 | 49 | 21.43 |
| | | | 16QAM | 30 | 0 | 21.67 |
| | | | 16QAM | 30 | 20 | 21.69 |
| | | | 16QAM | 50 | 0 | 21.45 |

**Table 1.8.4-5 LTE band 5 conducted power measurements with Hot Spot mode enabled**

| Band | LTE Band 17 | | | | | |
|---|---|---|---|---|---|---|
| Frequency (MHz) | Channel | BW | Modulation | RB Size | RB Offset | Maximum Avg. Power (dBm) |
| 709.0 | 23780 | 10 MHz | QPSK | 1 | 0 | 23.63 |
| | | | QPSK | 1 | 25 | 23.55 |
| | | | QPSK | 1 | 49 | 23.60 |
| | | | QPSK | 25 | 0 | 22.50 |
| | | | QPSK | 25 | 25 | 22.53 |
| | | | QPSK | 50 | 0 | 22.41 |
| | | | 16QAM | 1 | 0 | 22.30 |
| | | | 16QAM | 1 | 25 | 22.21 |
| | | | 16QAM | 1 | 49 | 22.30 |
| | | | 16QAM | 16 | 0 | 21.73 |
| | | | 16QAM | 16 | 34 | 21.80 |
| | | | 16QAM | 50 | 0 | 21.50 |
| 710 | 23790 | 10 MHz | QPSK | 1 | 0 | 23.66 |
| | | | QPSK | 1 | 25 | 23.61 |
| | | | QPSK | 1 | 49 | 23.70 |
| | | | QPSK | 25 | 0 | 22.46 |
| | | | QPSK | 25 | 25 | 22.51 |
| | | | QPSK | 50 | 0 | 22.41 |
| | | | 16QAM | 1 | 0 | 22.55 |
| | | | 16QAM | 1 | 25 | 22.43 |
| | | | 16QAM | 1 | 49 | 22.42 |
| | | | 16QAM | 16 | 0 | 21.71 |
| | | | 16QAM | 16 | 34 | 21.70 |
| | | | 16QAM | 50 | 0 | 21.47 |
| 711 | 23800 | 10 MHz | QPSK | 1 | 0 | 23.58 |
| | | | QPSK | 1 | 25 | 23.61 |
| | | | QPSK | 1 | 49 | 23.66 |
| | | | QPSK | 25 | 0 | 22.52 |
| | | | QPSK | 25 | 25 | 22.51 |
| | | | QPSK | 50 | 0 | 22.40 |
| | | | 16QAM | 1 | 0 | 22.28 |
| | | | 16QAM | 1 | 25 | 22.31 |
| | | | 16QAM | 1 | 49 | 22.34 |
| | | | 16QAM | 16 | 0 | 21.66 |
| | | | 16QAM | 16 | 34 | 21.75 |
| | | | 16QAM | 50 | 0 | 21.54 |
| 710 | 23790 | 5 MHz | QPSK | 1 | 0 | 23.70 |
| | | | QPSK | 1 | 24 | 23.60 |
| | | | QPSK | 10 | 15 | 22.64 |
| | | | QPSK | 25 | 0 | 22.20 |
| | | | 16QAM | 1 | 0 | 22.70 |
| | | | 16QAM | 1 | 13 | 22.64 |
| | | | 16QAM | 8 | 17 | 22.66 |
| | | | 16QAM | 25 | 0 | 21.45 |

**Table 1.8.4-6 LTE band 17 conducted power measurements**

### 1.8.5 SAR Evaluation Procedures for GSM/(E)GPRS Dual Transfer Mode as per KDB 941225 D04 v01 and SAR Test Reduction Procedures GSM GPRS EDGE as per DDB 941225 D03 vo1

- The device supports EGPRS/GPRS Multi-slot Class 12, DTM/GPRS Multi-slot Class11 and DTM/EGPRS Multi-slot Class10.
- CMU200 base station simulator with DTM software option CMU-K44 was used to set device in DTM (CS+PD) mode for testing. However, device could not be connected in DTM 4-slots uplink.
- For each slot addition in multi-slot modes (DTM, GPRS, EDGE), there is software power reduction of ~ 2 dB per slot.
- For head configurations, 1 slot CS, 2/3/4-slots (PD) and DTM (CS+PD) were evaluated.
- For body SAR configurations, 2/3/4-slots GPRS (PD) mode were tested.
- In EDGE/GPRS mode, GMSK Modulation was used using CS1-CS4 or MCSI-MCS4.
- 8-PSK modulation or MCS5-MCS9 code scheme were avoided since maximum burst avg . power was measured lower on those modulation schemes.
- Please refer to the conducted power measurements table below:

| Mode | Freq. (MHz) | Max burst averaged conducted power (dBm) CS1 | Max burst averaged conducted power (dBm) MCS1 | Max burst averaged conducted power (dBm) MCS5 |
|---|---|---|---|---|
| 2-slots GPRS 850 MHz | 824.2 | 30.4 | N/A | N/A |
| | 836.8 | 30.3 | N/A | N/A |
| | 848.8 | 30.1 | N/A | N/A |
| 3-slots GPRS 850 MHz | 824.2 | 29.2 | N/A | N/A |
| | 836.8 | 29.2 | N/A | N/A |
| | 848.8 | 29.1 | N/A | N/A |
| 4-slots GPRS 850 MHz | 824.2 | 27.8 | N/A | N/A |
| | 836.8 | 27.5 | N/A | N/A |
| | 848.8 | 27.5 | N/A | N/A |
| 2-slots EDGE 850 MHz | 824.2 | 30.5 | 30.5 | 27.5 |
| | 836.8 | 30.4 | 30.4 | 27.4 |
| | 848.8 | 30.2 | 30.2 | 27.3 |
| 2-slots DTM 850 MHz | 824.2 | 30.2 | 30.2 | 30.2 |
| | 836.8 | 30.1 | 30.1 | 30.1 |
| | 848.8 | 29.9 | 29.9 | 29.9 |
| 3-slots EDGE 850 MHz | 824.2 | 29.1 | 29.0 | 25.8 |
| | 836.8 | 29.1 | 29.0 | 25.8 |
| | 848.8 | 28.9 | 28.8 | 25.7 |
| 3-slots DTM 850 MHz | 824.2 | 28.8 | 28.8 | 28.8 |
| | 836.8 | 28.7 | 28.7 | 28.7 |
| | 848.8 | 28.6 | 28.6 | 28.6 |
| 4-slots EDGE 850 MHz | 824.2 | 27.6 | 27.7 | 24.7 |
| | 836.8 | 27.4 | 27.5 | 24.6 |
| | 848.8 | 27.4 | 27.5 | 24.5 |

| | | | | |
|---|---|---|---|---|
| 2-slots GPRS 1900 MHz | 1850.2 | 28.6 | N/A | N/A |
| | 1880.0 | 28.4 | N/A | N/A |
| | 1909.8 | 28.5 | N/A | N/A |
| 3-slots GPRS 1900 MHz | 1850.2 | 26.0 | N/A | N/A |
| | 1880.0 | 25.8 | N/A | N/A |
| | 1909.8 | 25.8 | N/A | N/A |
| 4-slots GPRS 1900 MHz | 1850.2 | 25.3 | N/A | N/A |
| | 1880.0 | 25.2 | N/A | N/A |
| | 1909.8 | 25.1 | N/A | N/A |
| 2-slots EDGE 1900MHz | 1850.2 | 28.6 | 28.5 | 25.5 |
| | 1880.0 | 28.6 | 28.6 | 25.5 |
| | 1909.8 | 28.6 | 28.5 | 25.5 |
| 2-slots DTM 1900MHz | 1850.2 | 28.6 | 28.5 | 28.5 |
| | 1880.0 | 28.3 | 28.3 | 28.3 |
| | 1909.8 | 28.4 | 28.3 | 28.3 |
| 3-slots EDGE 1900MHz | 1850.2 | 26.0 | 25.9 | 24.4 |
| | 1880.0 | 26.1 | 26.1 | 24.4 |
| | 1909.8 | 25.9 | 25.9 | 24.3 |
| 3-slots DTM 1900MHz | 1850.2 | 25.9 | 25.9 | 25.9 |
| | 1880.0 | 25.8 | 25.8 | 25.8 |
| | 1909.8 | 25.7 | 25.7 | 25.8 |
| 4-slots EDGE 1900MHz | 1850.2 | 25.4 | 25.4 | 23.3 |
| | 1880.0 | 25.2 | 25.2 | 23.2 |
| | 1909.8 | 25.1 | 25.1 | 23.1 |

| Mode | Freq. (MHz) | Max burst averaged conducted power (dBm) |
|---|---|---|
| 1-slot GSM (CS) 850 MHz | 824.2 | 33.9 |
| | 836.8 | 33.9 |
| | 848.8 | 33.6 |
| 1-slot GSM (CS) 1900 MHz | 1850.2 | 30.1 |
| | 1880.0 | 30.0 |
| | 1909.8 | 30.1 |

**1.8.5-1 Rev 2 GSM/EDGE/GPRS channel vs. conducted power with Hotspot mode enabled and disabled (Rev2-00)**

| Mode | Freq. (MHz) | Max burst averaged conducted power (dBm) CS1 | Max burst averaged conducted power (dBm) MCS1 | Max burst averaged conducted power (dBm) MCS5 |
|---|---|---|---|---|
| 2-slots GPRS 1900 MHz | 1850.2 | 28.4 | N/A | N/A |
| | 1880.0 | 28.5 | N/A | N/A |
| | 1909.8 | 28.4 | N/A | N/A |

| Mode | Freq. (MHz) | Max burst averaged conducted power (dBm) |
|---|---|---|
| 1-slot GSM (CS) 1900 MHz | 1850.2 | 28.9 |
| | 1880.0 | 29.1 |
| | 1909.8 | 28.8 |

**1.8.5-2 GSM/EDGE/GPRS channel vs. conducted power with Hotspot mode enabled and disabled (Rev3-01)**

| Mode | Freq. (MHz) | Max burst averaged conducted power (dBm) CS1 | Max burst averaged conducted power (dBm) MCS1 | Max burst averaged conducted power (dBm) MCS5 |
|---|---|---|---|---|
| 2-slots GPRS 850 MHz | 824.2 | 27.1 | N/A | N/A |
| | 836.8 | 27.2 | N/A | N/A |
| | 848.8 | 26.7 | N/A | N/A |
| 3-slots GPRS 850 MHz | 824.2 | 25.5 | N/A | N/A |
| | 836.8 | 25.2 | N/A | N/A |
| | 848.8 | 25.1 | N/A | N/A |
| 4-slots GPRS 850 MHz | 824.2 | 24.1 | N/A | N/A |
| | 836.8 | 24.1 | N/A | N/A |
| | 848.8 | 23.9 | N/A | N/A |
| 2-slots EDGE 850 MHz | 128 | 27.1 | | |
| | 190 | 27.2 | | |
| | 251 | 26.7 | | |

| Mode | Freq. (MHz) | Max burst averaged conducted power (dBm) |
|---|---|---|
| 1-slot GSM (CS) 850 MHz | 824.2 | 30.1 |
| | 836.8 | 30.0 |
| | 848.8 | 29.9 |

**1.8.5-3 GSM/EDGE/GPRS channel vs. conducted power with Hotspot mode enabled (Rev3-01)**

### 1.8.6 SAR Measurement Procedure for Fast SAR Scan as per KDB 447498

- Area scan based 1-g SAR estimation.
  - Very specific implementation of fast SAR methods.
    - Reported in the 29th BEMS meeting in 2009.
    - Using the specific polynomial fit algorithm.
  - Other implementations are not considered.

- When estimated 1-g SAR is ≤ 1.2 W/kg, zoom scan is not required according to the following:
  - Zoom scan is not required for any other purposes.
  - Peaks are distinctively identified in the area scan.
  - No sharp gradients: SAR at 1 cm from peak ≥ 40% of peak value.
  - No measurement warnings or alerts for other measurement issues.

- 1-g SAR for estimated & zoom scan in the system verification (dipole) must be within 3% of each other to utilize Fast SAR.
- 1g Fast SAR values for dipole validation scans are generally more conservative than the standard SAR scans.
- Regardless of the SAR value, a zoom scan is required for the highest SAR configuration in each frequency band and wireless mode.
- Fast SAR Algorithm: The approach is based on the area scan using DASY5 system.

### 1.8.7 SAR Measurement Procedures for 3G Devices

**WCDMA Handsets**

**Output Power Verification**

- Maximum output power is verified on the High, Middle and Low channels using 12.2 kbps RMC, 12.2 kbps AMR with a 3.4 kbps SRB (signal radio bearer) with TPC (transmit power control) set to all "1's" for WCDMA/HSPA or applying the required inner loop.
- For Release 6 HSPA/Release 7 HSDPA$^+$, output power is measured according to requirements for HS-DPCCH Sub-test 1-4/1-5 and 3GPP TS 34.121.

**Head SAR Measurements**

SAR for head exposure configurations is measured using the 12.2 kbps RMC with TPC bits configured to all "1s". SAR in AMR configurations is not required when the maximum average output of each RF channel for 12.2 kbps AMR is less than ¼ dB higher than that measured in 12.2 kbps RMC. Otherwise, SAR is measured on the maximum output channel in 12.2 AMR with a 3.4 kbps SRB (signalling radio bearer) using the exposure configuration that results in the highest SAR for that RF channel in 12.2 RMC.

**Body SAR Measurements**

SAR for body exposure configurations is measured using the 12.2 kbps RMC with the TPC bits configured to all "1s". SAR for other spreading codes and multiple $DPDCH_n$, when supported by the DUT, are not required when the maximum average outputs of each RF channel, for each spreading code and $DPDCH_n$ configuration, are less than ¼ dB higher than those measured in 12.2 RMC. Otherwise, SAR is measured on the maximum output channel with an applicable RMC configuration for the corresponding spreading code or $DPDCH_n$ using the exposure configuration that results in the highest SAR with 12.2 RMC.

**Handsets with HSPA**

Body SAR is not required for handsets with HSPA/HSPA+ capabilities, when the maximum average output of each RF channel with HSPA active is less than ¼ dB higher than that measured in 12.2 kbps RMC without HSPA/HSPA+. Otherwise, SAR for HSPA is measured using FRC (fixed reference channel) in the body exposure configuration that results in the highest SAR for that RF channel in 12.2kbps RMC.

| | **Band** | **FDD V (850)** | | |
|---|---|---|---|---|
| | **Channel** | 4132 | 4182 | 4233 |
| | **Freq (MHz)** | 826.4 | 836.4 | 846.6 |
| **Mode** | **Subtest** | **Max burst averaged conducted power (dBm)** | | |
| Rel99 | 12.2 kbps RMC | 24.71 | 24.44 | 24.35 |
| Rel99 | 12.2 kbps, Voice, AMR, SRB 3.4 kbps | 24.68 | 24.46 | 24.37 |
| Rel6 HSUPA | 1 | 23.66 | 23.33 | 23.26 |
| Rel6 HSUPA | 2 | 23.35 | 23.11 | 23.16 |
| Rel6 HSUPA | 3 | 23.15 | 22.93 | 22.97 |
| Rel6 HSUPA | 4 | 23.51 | 23.11 | 23.18 |
| Rel6 HSUPA | 5 | 21.43 | 21.10 | 21.13 |
| Rel7 HSDPA+ | 1 | 23.26 | 23.11 | 22.80 |
| Rel7 HSDPA+ | 2 | 22.20 | 22.03 | 22.13 |
| Rel7 HSDPA+ | 3 | 22.92 | 22.83 | 22.77 |
| Rel7 HSDPA+ | 4 | 21.40 | 21.10 | 21.30 |
| | **Band** | **FDD II (1900)** | | |
| | **Channel** | 9262 | 9400 | 9538 |
| | **Freq (MHz)** | 1852.4 | 1880.0 | 1907.6 |
| **Mode** | **Subtest** | **Max burst averaged conducted power (dBm)** | | |
| Rel99 | 12.2 kbps RMC | 22.83 | 22.82 | 22.76 |
| Rel99 | 12.2 kbps, Voice, AMR, SRB 3.4 kbps | 22.92 | 22.80 | 22.80 |
| Rel6 HSUPA | 1 | 22.84 | 22.92 | 22.87 |
| Rel6 HSUPA | 2 | 22.85 | 22.80 | 22.85 |
| Rel6 HSUPA | 3 | 22.44 | 22.41 | 22.36 |
| Rel6 HSUPA | 4 | 22.94 | 22.67 | 22.72 |
| Rel6 HSUPA | 5 | 20.51 | 20.52 | 20.44 |
| Rel7 HSDPA+ | 1 | 22.70 | 22.77 | 22.85 |
| Rel7 HSDPA+ | 2 | 22.04 | 22.14 | 22.10 |
| Rel7 HSDPA+ | 3 | 22.04 | 22.03 | 21.95 |
| Rel7 HSDPA+ | 4 | 21.55 | 21.33 | 21.41 |

**Table 1.8.7-1 WCDMA (Rel99) / HSPA/HSPA+ conducted power measurements with Mobile Hot Spot mode disabled**

| | Band | FDD V (850) | | |
|---|---|---|---|---|
| | Channel | 4132 | 4182 | 4233 |
| | Freq (MHz) | 826.4 | 836.4 | 846.6 |
| Mode | Subtest | Max burst averaged conducted power (dBm) | | |
| Rel99 | 12.2 kbps RMC | 22.81 | 22.60 | 22.50 |
| Rel99 | 12.2 kbps, Voice, AMR, SRB 3.4 kbps | 22.78 | 22.65 | 22.65 |
| Rel6 HSUPA | 1 | 21.70 | 21.64 | 21.51 |
| Rel6 HSUPA | 2 | | | |
| Rel6 HSUPA | 3 | | | |
| Rel6 HSUPA | 4 | | | |
| Rel6 HSUPA | 5 | | | |
| Rel7 HSDPA+ | 1 | | | |
| Rel7 HSDPA+ | 2 | | | |
| Rel7 HSDPA+ | 3 | | | |
| Rel7 HSDPA+ | 4 | | | |

**Table 1.8.7-2 WCDMA (Rel99) / HSPA/HSPA+ conducted power measurements with Mobile Hot Spot mode enabled**

### 1.9 General SAR Test Reduction and Exclusion procedure as per KDB 447498 D01 V05 and SAR Handsets Multi Xmiter and Ant procedure as per 648474 D04 v01

**Standalone SAR test exclusion guidance:**

The 1-g and 10-g SAR test exclusion thresholds for 100 MHz to 6 GHz at *test separation distances*

$$\left(\frac{max.power\ of\ channel, including\ tune-up\ tolerance\ (mW)}{min.test\ separation\ distance\ (mm)} \times \sqrt{\frac{f}{(GHz)}}\right) \leq 3.0$$ , For 1g 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[17]
- If *distance* is < 5 mm, a distance of 5 mm is applied to determine SAR test exclusion
- The result is rounded to one decimal place for comparison

.

**Simultaneous Transmission SAR Test exclusion considerations:**

When the sum of 1-g of all simultaneously transmitting antennas in an operating mode and exposure condition combination is within the SAR limit, SAR test exclusion applies to that simultaneous transmission configuration. When the sum is greater than the SAR limit, the SAR to peak location separation ratio procedures described below may be applied to determine if simultaneous transmission SAR test exclusion applies.

The ratio is determined by:

$$\left([SAR1 + SAR2]^{\frac{1.5}{R_i}}\right) \leq 0.04$$

Where:

- $R_i$ = the separation distance between the peak SAR locations for the antenna pair (mm)

**Simultaneous Transmission SAR required:**

• antenna pairs with SAR to antenna separation ratio > 0.04; test is only required for the configuration that results in the highest SAR in standalone configuration for each wireless mode and exposure condition.

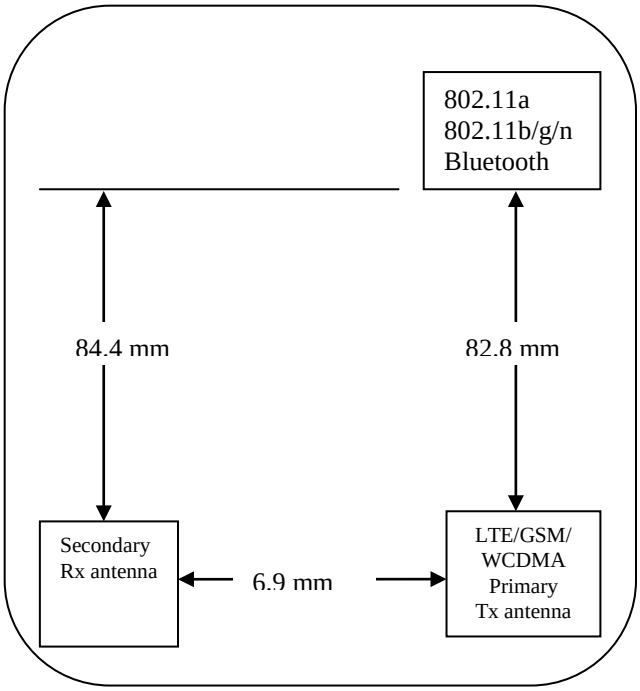


**Figure 1.9-1 Back view of device showing closest distance between antenna pairs**

### 1.9.1 Simultaneous Transmission Analysis

| Simultaneous Transmission Combination | Head | Body-Worn Accessory | Mobile Hotspot |
|---|---|---|---|
| WCDMA/GSM voice + WiFi 2.4 GHz | Yes | Yes | No |
| WCDMA/GSM voice + WiFi 5.0 GHz | Yes | Yes | No |
| WCDMA/GSM voice + BT | Yes | Yes | No |
| LTE/HSPA/EDGE/GPRS data + WiFi 2.4 GHz | Yes | Yes | Yes |
| LTE/HSPA/EDGE/GPRS data + WiFi 5.0 GHz | Yes | Yes | No |
| LTE/HSPA/EDGE/GPRS data + BT | Yes | Yes | No |

**Table 1.9.1-1 Simultaneous Transmission Scenarios**

**Note 1:** BT and WiFi cannot transmit simultaneously since the design doesn't allow it and they use the same antenna.
**Note 2:** GSM/UMTS and LTE cannot transmit simultaneously since they share the same antenna.

| Test | Configuration | Licensed Transmitters | | WiFi 2.4/5.0G 1 g avg. SAR (W/kg) | Maximum Summation 1 g avg. SAR (W/kg) |
|---|---|---|---|---|---|
| | | Band | 1 g avg. SAR (W/kg) | | |
| Head SAR | Right Cheek | LTE Band 17 | 0.45 | 0.33 | 0.78 |
| | Right Cheek | LTE Band 5 | 0.54 | | 0.87 |
| | Right Cheek | GSM/GPRS/EDGE 850 | 0.66 | | 0.99 |
| | Right Cheek | UMTS Band V | 0.63 | | 0.96 |
| | Right Cheek | LTE Band 4 | 0.75 | | 1.08 |
| | Right Cheek | LTE Band 2 | 0.47 | | 0.80 |
| | Right Cheek | GSM/GPRS/EDGE 1900 | 0.48 | | 0.81 |
| | Right Cheek | UMTS Band II | 0.54 | | 0.87 |
| | Right Tilt | LTE Band 17 | 0.26 | 0.39 | 0.65 |
| | Right Tilt | LTE Band 5 | 0.33 | | 0.72 |
| | Right Tilt | GSM/GPRS/EDGE 850 | 0.37 | | 0.76 |
| | Right Tilt | UMTS Band V | 0.39 | | 0.78 |
| | Right Tilt | LTE Band 4 | 0.65 | | 1.04 |
| | Right Tilt | LTE Band 2 | 0.43 | | 0.82 |
| | Right Tilt | GSM/GPRS/EDGE 1900 | 0.42 | | 0.81 |
| | Right Tilt | UMTS Band II | 0.50 | | 0.89 |
| | Left Cheek | LTE Band 17 | 0.59 | 0.22 | 0.81 |
| | Left Cheek | LTE Band 5 | 0.75 | | 0.97 |
| | Left Cheek | GSM/GPRS/EDGE 850 | 0.94 | | 1.16 |
| | Left Cheek | UMTS Band V | 1.03 | | 1.25 |
| | Left Cheek | LTE Band 4 | 1.16 | | 1.38 |
| | Left Cheek | LTE Band 2 | 0.92 | | 1.14 |
| | Left Cheek | GSM/GPRS/EDGE 1900 | 1.01 | | 1.23 |
| | Left Cheek | UMTS Band II | 1.07 | | 1.29 |
| | Left Tilt | LTE Band 17 | 0.27 | 0.29 | 0.56 |
| | Left Tilt | LTE Band 5 | 0.33 | | 0.62 |
| | Left Tilt | GSM/GPRS/EDGE 850 | 0.40 | | 0.69 |
| | Left Tilt | UMTS Band V | 0.39 | | 0.68 |
| | Left Tilt | LTE Band 4 | 0.58 | | 0.87 |
| | Left Tilt | LTE Band 2 | 0.42 | | 0.71 |
| | Left Tilt | GSM/GPRS/EDGE 1900 | 0.41 | | 0.70 |
| | Left Tilt | UMTS Band II | 0.50 | | 0.79 |

**Table 1.9.1-2 Highest Head SAR values and summation**

**Note 1:** If sum of 1 g SAR < 1.6 W/kg, Simultaneous SAR measurement is not required.
**Note 2:** If sum of 1 g SAR > 1.6 W/kg, ratio of SAR to peak separation distance for pair of transmitters calculated.

| Test | Configuration | Licensed Transmitters | | WiFi 2.4/5.0G 1 g avg. SAR (W/kg) | Maximum Summation 1 g avg. SAR (W/kg) |
|---|---|---|---|---|---|
| | | Band | 1 g avg. SAR (W/kg) | | |
| Body Worn SAR | 15 mm separation, device back | LTE Band 17 | 0.46 | 0.31 | 0.77 |
| | | LTE Band 5 | 0.58 | | 0.89 |
| | | GSM/GPRS/EDGE 850 | 0.58 | | 0.89 |
| | | UMTS Band V | 0.75 | | 1.06 |
| | | LTE Band 4 | 0.69 | | 1.00 |
| | | LTE Band 2 | 0.56 | | 0.87 |
| | | GSM/GPRS/EDGE 1900 | 0.62 | | 0.93 |
| | | UMTS Band II | 0.65 | | 0.96 |
| | Holster device back | LTE Band 17 | 0.33 | 0.25 | 0.58 |
| | | LTE Band 5 | 0.52 | | 0.77 |
| | | GSM/GPRS/EDGE 850 | 0.51 | | 0.76 |
| | | UMTS Band V | 0.62 | | 0.87 |
| | | LTE Band 4 | 0.32 | | 0.57 |
| | | LTE Band 2 | 0.38 | | 0.63 |
| | | GSM/GPRS/EDGE 1900 | 0.37 | | 0.62 |
| | | UMTS Band II | 0.44 | | 0.69 |
| | Holster device front | LTE Band 17 | 0.27 | 0.05 | 0.32 |
| | | LTE Band 5 | 0.48 | | 0.53 |
| | | GSM/GPRS/EDGE 850 | 0.49 | | 0.54 |
| | | UMTS Band V | 0.58 | | 0.63 |
| | | LTE Band 4 | 0.24 | | 0.29 |
| | | LTE Band 2 | 0.23 | | 0.28 |
| | | GSM/GPRS/EDGE 1900 | 0.23 | | 0.28 |
| | | UMTS Band II | 0.28 | | 0.33 |

**Table 1.9.1-3 Highest Body-worn SAR values for the same configuration**

**Note 1:** If sum of 1 g SAR < 1.6 W/kg, Simultaneous SAR measurement is not required.
**Note 2:** If sum of 1 g SAR > 1.6 W/kg, ratio of SAR to peak separation distance for pair of transmitters is required.

| Test | Configuration | Licensed Transmitters | | WiFi 2.4 G 1 g avg. SAR (W/kg) | Maximum Summation 1 g avg. SAR (W/kg) |
|---|---|---|---|---|---|
| | | Band | 1 g avg. SAR (W/kg) | | |
| Mobile Hotspot SAR | 10 mm separation, device back | LTE Band 17 | 0.77 | 0.68 | 1.45 |
| | | LTE Band 5 | 0.50 | | 1.18 |
| | | GSM/GPRS/EDGE 850 | 0.45 | | 1.13 |
| | | UMTS Band V | 0.62 | | 1.10 |
| | | LTE Band 4 | 1.04 | | 1.72 |
| | | LTE Band 2 | 1.15 | | 1.83 |
| | | GSM/GPRS/EDGE 1900 | 1.21 | | 1.89 |
| | | UMTS Band II | 1.36 | | 2.04 |
| | 10 mm separation, device front | LTE Band 17 | 0.51 | 0.11 | 0.62 |
| | | LTE Band 5 | 0.40 | | 0.51 |
| | | GSM/GPRS/EDGE 850 | 0.37 | | 0.48 |
| | | UMTS Band V | 0.52 | | 0.63 |
| | | LTE Band 4 | 0.57 | | 0.68 |
| | | LTE Band 2 | 0.61 | | 0.72 |
| | | GSM/GPRS/EDGE 1900 | 0.64 | | 0.75 |
| | | UMTS Band II | 0.70 | | 0.81 |
| | 10 mm separation, device left | LTE Band 17 | 0.34 | 0.20 | 0.54 |
| | | LTE Band 5 | 0.43 | | 0.63 |
| | | GSM/GPRS/EDGE 850 | 0.41 | | 0.61 |
| | | UMTS Band V | 0.55 | | 0.75 |
| | | LTE Band 4 | 0.31 | | 0.51 |
| | | LTE Band 2 | 0.34 | | 0.54 |
| | | GSM/GPRS/EDGE 1900 | 0.32 | | 0.52 |
| | | UMTS Band II | 0.34 | | 0.54 |
| | 10 mm separation, device right | LTE Band 17 | 0.15 | 0.08 | 0.23 |
| | | LTE Band 5 | 0.19 | | 0.27 |
| | | GSM/GPRS/EDGE 850 | 0.21 | | 0.29 |
| | | UMTS Band V | 0.25 | | 0.33 |
| | | LTE Band 4 | 0.16 | | 0.24 |
| | | LTE Band 2 | 0.15 | | 0.23 |
| | | GSM/GPRS/EDGE 1900 | 0.13 | | 0.21 |
| | | UMTS Band II | 0.15 | | 0.23 |
| | 10 mm separation, device bottom | LTE Band 17 | 0.11 | 0.00 | 0.11 |
| | | LTE Band 5 | 0.04 | | 0.04 |
| | | GSM/GPRS/EDGE 850 | 0.06 | | 0.06 |
| | | UMTS Band V | 0.05 | | 0.05 |
| | | LTE Band 4 | 0.52 | | 0.52 |
| | | LTE Band 2 | 0.79 | | 0.79 |
| | | GSM/GPRS/EDGE 1900 | 0.75 | | 0.75 |
| | | UMTS Band II | 0.74 | | 0.74 |

| | | | | | |
|---|---|---|---|---|---|
| | 10 mm separation, device top | LTE Band 17 | 0.00 | 0.22 | 0.22 |
| | | LTE Band 5 | 0.00 | | 0.22 |
| | | GSM/GPRS/EDGE 850 | 0.00 | | 0.22 |
| | | UMTS Band V | 0.00 | | 0.22 |
| | | LTE Band 4 | 0.00 | | 0.22 |
| | | LTE Band 2 | 0.00 | | 0.22 |
| | | GSM/GPRS/EDGE 1900 | 0.00 | | 0.22 |
| | | UMTS Band II | 0.00 | | 0.22 |

**Table 1.9.1-4 Highest Mobile Hotspot SAR values for the same configuration**

**Note 1:** If sum of 1 g SAR < 1.6 W/kg, Simultaneous SAR measurement is not required.
**Note 2:** If sum of 1 g SAR > 1.6 W/kg, ratio of SAR to peak separation distance for pair of transmitters calculated.

| Antenna | Position | SAR Zoom 1g | X [mm] | Y [mm] | Z [mm] | |
|---|---|---|---|---|---|---|
| Antenna 1 (802.11 b) | MHS 10mm, device back | 0.68 | -33.2 | -45.6 | -208.0 | |
| Antenna 2 (LTE Band 4) | MHS 10mm, device back | 1.04 | -41.0 | 44.0 | -207.6 | |
| | | | | | | |
| | SAR Sum | 1.72 | | | | |
| | SAR Sum to the power of 1.5 | 2.26 | | | | |
| | Delta [mm] | | 7.8 | -89.6 | -0.4 | |
| | closest Distance [mm] | | | | | 89.95 |
| | | | | | | |
| | Ratio | 0.03 | | | | |

| Antenna | Position | SAR Zoom 1g | X [mm] | Y [mm] | Z [mm] | |
|---|---|---|---|---|---|---|
| Antenna 1 (802.11 b) | MHS 10mm, device back | 0.68 | -33.2 | -45.6 | -208.0 | |
| Antenna 2 (GPRS 1900 2slots) | MHS 10mm, device back | 1.21 | -29.0 | 52.0 | -208.2 | |
| | | | | | | |
| | SAR Sum | 1.89 | | | | |
| | SAR Sum to the power of 1.5 | 2.60 | | | | |
| | Delta [mm] | | -4.2 | -97.6 | 0.2 | |
| | closest Distance [mm] | | | | | 97.70 |
| | | | | | | |
| | Ratio | 0.03 | | | | |

| Antenna | Position | SAR Zoom 1g | X [mm] | Y [mm] | Z [mm] | |
|---|---|---|---|---|---|---|
| Antenna 1 (802.11 b) | MHS 10mm, device back | 0.68 | -33.2 | -45.6 | -208.0 | |
| Antenna 2 (LTE Band 2) | MHS 10mm, device back | 1.15 | -30.5 | 52.0 | -208.0 | |
| | | | | | | |
| | SAR Sum | 1.83 | | | | |
| | SAR Sum to the power of 1.5 | 2.48 | | | | |
| | Delta [mm] | | -2.7 | -97.6 | 0.0 | |
| | closest Distance [mm] | | | | | 97.65 |
| | | | | | | |
| | Ratio | 0.03 | | | | |

| Antenna | Position | SAR Zoom 1g | X [mm] | Y [mm] | Z [mm] | |
|---|---|---|---|---|---|---|
| Antenna 1 (802.11 b) | MHS 10mm, device back | 0.68 | -33.2 | -45.6 | -208.0 | |
| Antenna 2 (UMTS Band II) | MHS 10mm, device back | 1.36 | -29.0 | 45.5 | -207.6 | |
| | | | | | | |
| | SAR Sum | 2.04 | | | | |
| | SAR Sum to the power of 1.5 | 2.91 | | | | |
| | Delta [mm] | | -4.2 | -91.1 | -0.4 | |
| | closest Distance [mm] | | | | | 91.21 |
| | | | | | | |
| | Ratio | 0.03 | | | | |

| Antenna | Position | SAR Zoom 1g | X [mm] | Y [mm] | Z [mm] | |
|---|---|---|---|---|---|---|
| Antenna 1 (802.11 b) | MHS 10mm, back, 2100mA | 0.68 | -39.17 | -50.01 | -208 | |
| Antenna 2 (LTE Band 4) | MHS 10mm, device back | 1.04 | -41.0 | 44.0 | -207.6 | |
| | | | | | | |
| | SAR Sum | 1.72 | | | | |
| | SAR Sum to the power of 1.5 | 2.26 | | | | |
| | Delta [mm] | | 1.8 | -94.0 | -0.4 | |
| | closest Distance [mm] | | | | | 94.03 |
| | | | | | | |
| | Ratio | 0.02 | | | | |

| Antenna | Position | SAR Zoom 1g | X [mm] | Y [mm] | Z [mm] | |
|---|---|---|---|---|---|---|
| Antenna 1 (802.11 b) | MHS 10mm, back, 2100mA | 0.68 | -39.17 | -50.01 | -208 | |
| Antenna 2 (GPRS 1900 2slots) | MHS 10mm, device back | 1.21 | -29.0 | 52.0 | -208.2 | |
| | | | | | | |
| | SAR Sum | 1.89 | | | | |
| | SAR Sum to the power of 1.5 | 2.60 | | | | |
| | Delta [mm] | | -10.2 | -102.0 | 0.2 | |
| | closest Distance [mm] | | | | | 102.52 |
| | | | | | | |
| | Ratio | 0.03 | | | | |

| Antenna | Position | SAR Zoom 1g | X [mm] | Y [mm] | Z [mm] | |
|---|---|---|---|---|---|---|
| Antenna 1 (802.11 b) | MHS 10mm, back, 2100mA | 0.68 | -39.17 | -50.01 | -208 | |
| Antenna 2 (LTE Band 2) | MHS 10mm, device back | 1.15 | -30.5 | 52.0 | -208.0 | |
| | | | | | | |
| | SAR Sum | 1.83 | | | | |
| | SAR Sum to the power of 1.5 | 2.48 | | | | |
| | Delta [mm] | | -8.7 | -102.0 | 0.0 | |
| | closest Distance [mm] | | | | | 102.38 |
| | | | | | | |
| | Ratio | 0.02 | | | | |

| Antenna | Position | SAR Zoom 1g | X [mm] | Y [mm] | Z [mm] | |
|---|---|---|---|---|---|---|
| Antenna 1 (802.11 b) | MHS 10mm, back, 2100mA | 0.68 | -39.17 | -50.01 | -208 | |
| Antenna 2 (UMTS Band II) | MHS 10mm, device back | 1.36 | -29.0 | 45.5 | -207.6 | |
| | | | | | | |
| | SAR Sum | 2.04 | | | | |
| | SAR Sum to the power of 1.5 | 2.91 | | | | |
| | Delta [mm] | | -10.2 | -95.5 | -0.4 | |
| | closest Distance [mm] | | | | | 96.05 |
| | | | | | | |
| | Ratio | 0.03 | | | | |

**Table 1.9.1-5 Mobile Hotspot configuration ratio of SAR to peak separation distance for pair of transmitters**

**Note 3:** If the ratio of SAR to peak separation distance is $\leq 0.04$, Simultaneous SAR measurement is not required.

## 2.0 DESCRIPTION OF THE TEST EQUIPMENT

### 2.1 SAR measurement system

SAR measurements were performed using a Dosimetric Assessment System (DASY52), an automated SAR measurement system manufactured by Schmid & Partner Engineering AG (SPEAG), of Zurich, Switzerland.

The DASY 52 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller and software.
- An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A DAE module that performs the signal amplification, signal multiplexing, A/D 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 Electro-optical coupler (EOC).
- A unit to operate the optical surface detector that is connected to the EOC.
- The EOC performs the conversion from an optical signal into the digital electric signal of the DAE. The EOC is connected to the PC plug-in card.
- The functions of the PC plug-in card based on a DSP are to perform the time critical tasks such as signal filtering, surveillance of the robot operation fast movement interrupts.
- A computer operating Windows.
- DASY52 software version 52.8.
- Remote control with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM Twin Phantom enabling testing left-hand and right-hand usage.
- The device holder for mobile phones.
- Tissue simulating liquid mixed according to the given recipes (see section 6.1).
- System validation dipoles allowing for the validation of proper functioning of the system.

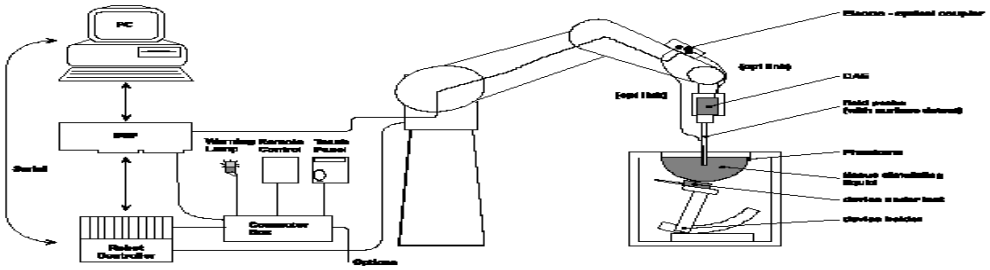


**Figure 2.1-1 System Description**

### 2.1.1 Equipment List

| Manufacturer | Test Equipment | Model Number | Serial Number | Cal. Due Date (MM/DD/YY) |
|---|---|---|---|---|
| SCHMID & Partner Engineering AG | E-field probe | ES3DV3 | 3225 | 01/10/2014 |
| SCHMID & Partner Engineering AG | E-field probe | EX3DV4 | 3592 | 11/14/2013 |
| SCHMID & Partner Engineering AG | E-field probe | ET3DV6 | 1644 | 11/13/2013 |
| SCHMID & Partner Engineering AG | Data Acquisition Electronics (DAE3) | DAE3 V1 | 473 | 01/15/2014 |
| SCHMID & Partner Engineering AG | Data Acquisition Electronics (DAE3) | DAE3 V1 | 472 | 03/07/2013 |
| SCHMID & Partner Engineering AG | Dipole Validation Kit | D750V3 | 1021 | 01/07/2015 |
| SCHMID & Partner Engineering AG | Dipole Validation Kit | D835V2 | 446 | 01/07/2015 |
| SCHMID & Partner Engineering AG | Dipole Validation Kit | D835V2 | 4d043 | 04/07/2013 |
| SCHMID & Partner Engineering AG | Dipole Validation Kit | D1800V2 | 2d020 | 01/09/2015 |
| SCHMID & Partner Engineering AG | Dipole Validation Kit | D1900V2 | 545 | 01/09/2015 |
| SCHMID & Partner Engineering AG | Dipole Validation Kit | D1900V2 | 5d075 | 04/05/2013 |
| SCHMID & Partner Engineering AG | Dipole Validation Kit | D2450V2 | 747 | 11/09/2013 |
| SCHMID & Partner Engineering AG | Dipole Validation Kit | D5000V2 | 1033 | 11/15/2013 |
| Agilent Technologies | Signal generator | 8648C | 4037U03155 | 09/23/2013 |
| Agilent Technologies | Power meter | E4419B | GB40202821 | 09/23/2013 |
| Agilent Technologies | Power sensor | 8481A | MY41095417 | 09/26/2013 |
| Amplifier Research | Amplifier | 5S1G4M3 | 300986 | CNR |
| Agilent Technologies | Power meter | N1911A | MY45100905 | 05/17/2013 |
| Agilent Technologies | Power sensor | N1921A | SG45240281 | 06/12/2013 |
| Agilent Technologies | Power sensor | N1921A | MY45241383 | 09/11/2013 |
| Weinschel Corp | 20dB Attenuator | 33-20-34 | BMO697 | CNR |
| Agilent Technologies | Network analyzer | 8753ES | US39174857 | 09/20/2013 |
| Rohde & Schwarz | Base Station Simulator | CMU 200 | 109747 | 11/19/2013 |
| CPI Wireless Solutions | Amplifier | VZC-6961K4 | SK4310E5 | CNR |
| Rohde & Schwarz | Signal generator | SMA 100A | 102106 | 12/02/2013 |
| Rohde & Schwarz | Wideband Base Station Simulator | CMW 500 | 109949 | 12/10/2014 |
| Rohde & Schwarz | Wideband Base Station Simulator | CMW 500 | 101169 | 12/10/2014 |

**Table 2.1.1-1a Equipment list**

| Manufacturer | Test Equipment | Model Number | Serial Number | Cal. Due Date (MM/DD/YY) |
|---|---|---|---|---|
| Agilent Technologies | Power meter | N1911A | MY45100905 | 05/29/2015 |
| Agilent Technologies | Power sensor | N1921A | SG45240281 | 12/04/2014 |

**Table 2.1.1-1b Equipment list for Wi-Fi Direct/GO additional testing**

## 2.2 Description of the test setup

Before SAR measurements are conducted, the device and the DASY equipment are setup as follows:

### 2.2.1 Device and base station simulator setup

- Power up the device.
- Turn on the base station simulator and set the radio channel and power to the appropriate values.
- Connect an antenna to the RF IN/OUT of the communication test set and place it close to the device.

### 2.2.2 DASY setup

- Turn the computer on and log on to Windows.
- Start the DASY software by clicking on the icon located on the Windows desktop.
- Mount the DAE unit and the probe. Turn on the DAE unit.
- Turn the Robot Controller on by turning the main power switch to the horizontal position
- Align the probe by clicking the 'Align probe in light beam' button.
- Open a file and configure the proper parameters - probe, medium, communications system etc.
- Establish a connection between the Device and the communications test instrument. Place the Device on the stand and adjust it under the phantom.
- Start SAR measurements.

# 3.0 ELECTRIC FIELD PROBE CALIBRATION

## 3.1 Probe Specifications

SAR measurements were conducted using the dosimetric probes ES3DV3/ET3DV6 and EX3DV4, designed by Schmid & Partner Engineering AG for the measurement of SAR. The probe is constructed using the thin film technique, with printed resistive lines on ceramic substrates. It has a symmetrical design with triangular core, built-in optical fibre for the surface detection system and built-in shielding against static discharge. The probe is sensitive to E-fields and thus incorporates three small dipoles arranged so that the overall response is close to isotropic. The table below summarizes the technical data for the probe.

| Property | Data |
|---|---|
| Frequency range | 30 MHz – 3 GHz |
| Linearity | ±0.1 dB |
| Directivity (rotation around probe axis) | ≤ ±0.2 dB |
| Directivity (rotation normal to probe axis) | ±0.4 dB |
| Dynamic Range | 5 mW/kg – 100 W/kg |

| | |
|---|---|
| Probe positioning repeatability | ±0.2 mm |
| Spatial resolution | < 0.125 mm [3] |
| **Probe model EX3DV4 for 2.4 – 6 GHz** | |
| Probe tip to sensor center | 1.0 mm |
| Probe tip diameter is | 2.5 mm |
| Probe calibration uncertainty | < 15 % for f = 2.45 to < 6.0 GHz |
| Probe calibration range | ± 100 MHz |

**Table 3.1-1 Probe specifications**

## 3.2 Probe calibration and measurement uncertainty

The probe had been calibrated with accuracy better than ±12% . The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe were tested. The probe calibration parameters are shown on Appendix D and below:

**Calibration Parameter Determined in Head Tissue Simulating Media**

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 41.9 | 0.89 | 6.42 | 6.42 | 6.42 | 0.27 | 2.04 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 6.06 | 6.06 | 6.06 | 0.35 | 1.74 | ± 12.0 % |
| 1810 | 40.0 | 1.40 | 5.23 | 5.23 | 5.23 | 0.73 | 1.21 | ± 12.0 % |
| 1950 | 40.0 | 1.40 | 4.98 | 4.98 | 4.98 | 0.58 | 1.41 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 4.50 | 4.50 | 4.50 | 0.79 | 1.26 | ± 12.0 % |
| 2600 | 39.0 | 1.96 | 4.32 | 4.32 | 4.32 | 0.77 | 1.32 | ± 12.0 % |

**Calibration Parameter Determined in Body Tissue Simulating Media**

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 55.5 | 0.96 | 6.27 | 6.27 | 6.27 | 0.36 | 1.74 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 6.07 | 6.07 | 6.07 | 0.29 | 2.02 | ± 12.0 % |
| 1810 | 53.3 | 1.52 | 4.92 | 4.92 | 4.92 | 0.50 | 1.57 | ± 12.0 % |
| 1950 | 53.3 | 1.52 | 4.87 | 4.87 | 4.87 | 0.59 | 1.49 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 4.30 | 4.30 | 4.30 | 0.68 | 1.16 | ± 12.0 % |
| 2600 | 52.5 | 2.16 | 4.12 | 4.12 | 4.12 | 0.80 | 0.99 | ± 12.0 % |

**Table 3.2-1 Probe ES3DV3 SN: 3225**

**Calibration Parameter Determined in Head Tissue Simulating Media**

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 41.9 | 0.89 | 6.57 | 6.57 | 6.57 | 0.44 | 2.25 | ± 12.0 % |
| 900 | 41.5 | 0.97 | 6.24 | 6.24 | 6.24 | 0.38 | 2.52 | ± 12.0 % |
| 1810 | 40.0 | 1.40 | 5.21 | 5.21 | 5.21 | 0.80 | 2.10 | ± 12.0 % |
| 1950 | 40.0 | 1.40 | 5.16 | 5.16 | 5.16 | 0.80 | 2.09 | ± 12.0 % |
| 2450 | 39.2 | 1.80 | 4.60 | 4.60 | 4.60 | 0.65 | 2.00 | ± 12.0 % |

Calibration Parameter Determined in Body Tissue Simulating Media

| f (MHz) [C] | Relative Permittivity [F] | Conductivity (S/m) [F] | ConvF X | ConvF Y | ConvF Z | Alpha | Depth (mm) | Unct. (k=2) |
|---|---|---|---|---|---|---|---|---|
| 750 | 55.5 | 0.96 | 6.30 | 6.30 | 6.30 | 0.33 | 2.61 | ± 12.0 % |
| 900 | 55.0 | 1.05 | 6.06 | 6.06 | 6.06 | 0.31 | 2.99 | ± 12.0 % |
| 1810 | 53.3 | 1.52 | 4.75 | 4.75 | 4.75 | 0.80 | 2.40 | ± 12.0 % |
| 1950 | 53.3 | 1.52 | 4.75 | 4.75 | 4.75 | 0.80 | 2.28 | ± 12.0 % |
| 2450 | 52.7 | 1.95 | 4.11 | 4.11 | 4.11 | 0.50 | 2.15 | ± 12.0 % |

**Table 3.2-2 Probe ET3DV6 SN: 1644**

Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz] | Validity [MHz][C] | Permittivity | Conductivity | ConvF X | ConvF Y | ConvF Z | Alpha | Depth Unc (k=2) |
|---|---|---|---|---|---|---|---|---|
| 5200 | ± 50 / ± 100 | 36.0 ± 5% | 4.66 ± 5% | 4.50 | 4.50 | 4.50 | 0.45 | 1.90 ± 13.1% |
| 5500 | ± 50 / ± 100 | 35.6 ± 5% | 4.96 ± 5% | 4.25 | 4.25 | 4.25 | 0.50 | 1.90 ± 13.1% |
| 5800 | ± 50 / ± 100 | 35.3 ± 5% | 5.27 ± 5% | 3.98 | 3.98 | 3.98 | 0.52 | 1.90 ± 13.1% |

Calibration Parameter Determined in Body Tissue Simulating Media

| f [MHz] | Validity [MHz][C] | Permittivity | Conductivity | ConvF X | ConvF Y | ConvF Z | Alpha | Depth Unc (k=2) |
|---|---|---|---|---|---|---|---|---|
| 5200 | ± 50 / ± 100 | 49.0 ± 5% | 5.30 ± 5% | 3.95 | 3.95 | 3.95 | 0.52 | 1.95 ± 13.1% |
| 5500 | ± 50 / ± 100 | 48.6 ± 5% | 5.65 ± 5% | 3.73 | 3.73 | 3.73 | 0.55 | 1.95 ± 13.1% |
| 5800 | ± 50 / ± 100 | 48.2 ± 5% | 6.00 ± 5% | 3.40 | 3.40 | 3.40 | 0.63 | 1.95 ± 13.1% |

**Table 3.2-3 Probe EX3DV4 SN: 3592**

Calibration Parameter Determined in Head Tissue Simulating Media

| f [MHz] | Validity [MHz][C] | Permittivity | Conductivity | ConvF X | ConvF Y | ConvF Z | Alpha | Depth Unc (k=2) |
|---|---|---|---|---|---|---|---|---|
| 2600 | ± 50 / ± 100 | 39.0 ± 5% | 1.96 ± 5% | 7.08 | 7.08 | 7.08 | 0.23 | 1.34 ± 11.0% |
| 5200 | ± 50 / ± 100 | 36.0 ± 5% | 4.66 ± 5% | 5.01 | 5.01 | 5.01 | 0.40 | 1.80 ± 13.1% |
| 5500 | ± 50 / ± 100 | 35.6 ± 5% | 4.96 ± 5% | 4.63 | 4.63 | 4.63 | 0.50 | 1.80 ± 13.1% |
| 5800 | ± 50 / ± 100 | 35.3 ± 5% | 5.27 ± 5% | 4.42 | 4.42 | 4.42 | 0.50 | 1.80 ± 13.1% |

Calibration Parameter Determined in Body Tissue Simulating Media

| f [MHz] | Validity [MHz][C] | Permittivity | Conductivity | ConvF X | ConvF Y | ConvF Z | Alpha | Depth Unc (k=2) |
|---|---|---|---|---|---|---|---|---|
| 2600 | ± 50 / ± 100 | 52.5 ± 5% | 2.16 ± 5% | 7.12 | 7.12 | 7.12 | 0.67 | 0.71 ± 11.0% |
| 5200 | ± 50 / ± 100 | 49.0 ± 5% | 5.30 ± 5% | 4.79 | 4.79 | 4.79 | 0.45 | 1.90 ± 13.1% |
| 5500 | ± 50 / ± 100 | 48.6 ± 5% | 5.65 ± 5% | 4.29 | 4.29 | 4.29 | 0.50 | 1.90 ± 13.1% |
| 5800 | ± 50 / ± 100 | 48.2 ± 5% | 6.00 ± 5% | 4.08 | 4.08 | 4.08 | 0.60 | 1.90 ± 13.1% |

**Table 3.2-4 Probe EX3DV4 SN: 3548**

C The validity of ± 100 MHz only applies for DASY v4.4 and higher.
DASY 52 has been used for measurements, therefore ± 100 MHz tolerance is valid.
Measured dielectric parameters are within +/- 5% of the probe calibration values and target values.
Expanded probe calibration uncertainty (k=2) is < 15 %

## 4.0 SAR MEASUREMENT SYSTEM VERIFICATION

Prior to conducting SAR measurements, the system was validated using the dipole validation kit and the flat section of the SAM phantom. A power level of 1.0W was applied to the dipole antenna. The verification results are in the table below with a comparison to reference values. Printouts are shown in Appendix A. All the measured parameters are within the allowed tolerances.

At above 1.5 – 2 GHz, dipoles maintain good return loss of -15 dB to -20 dB, therefore SAR measurements are limited to approximately +/- 100 MHz of the probe/dipole calibration frequency.

### 4.1 System accuracy verification for head adjacent use

| f (MHz) | Limits / Measured (MM/DD/YYYY) | Scan Type | SAR 1 g/10 g (W/kg) | Dielectric Parameters | | Liquid Temp. (°C) |
|---|---|---|---|---|---|---|
| | | | | $\varepsilon_r$ | σ [S/m] | |
| 750 | Measured (12/14/2012) | Area/Fast Scan | 7.97/5.47 | 42.2 | 0.92 | 22.5 |
| | Measured (12/14/2012) | Zoom Scan | 7.98/5.20 | 42.2 | 0.92 | 22.5 |
| | Measured (12/17/2012) | Area/Fast Scan | 7.98/5.47 | 42.1 | 0.91 | 22.0 |
| | Measured (12/17/2012) | Zoom Scan | 7.87/5.14 | 42.1 | 0.91 | 22.0 |
| | Recommended Limits | | 8.36/5.45 | 41.9 | 0.89 | N/A |
| 835 | Measured (12/09/2012) | Area/Fast Scan | 9.44/6.40 | 40.1 | 0.89 | 22.5 |
| | Measured (12/09/2012) | Zoom Scan | 9.37/6.15 | 40.1 | 0.89 | 22.5 |
| | Measured (02/04/2013) | Area/Fast Scan | 9.15/6.24 | 40.0 | 0.90 | 22.6 |
| | Measured (02/04/2013) | Zoom Scan | 9.20/6.05 | 40.0 | 0.90 | 22.6 |
| | Recommended Limits (Dipole: 446) | | 9.63/6.27 | 41.5 | 0.90 | N/A |
| | Recommended Limits (Dipole: 4d043) | | 9.43/6.14 | 41.5 | 0.90 | N/A |
| 1800 | Measured (12/04/2012) | Area/Fast Scan | 37.2/20.2 | 38.7 | 1.43 | 22.8 |
| | Measured (12/04/2012) | Zoom Scan | 36.6/19.0 | 38.7 | 1.43 | 22.8 |
| | Measured (12/06/2012) | Area/Fast Scan | 38.1/20.7 | 40.4 | 1.44 | 22.4 |
| | Measured (12/06/2012) | Zoom Scan | 37.4/19.5 | 40.4 | 1.44 | 22.4 |
| | Measured (01/31/2013) | Area/Fast Scan | 36.8/20.1 | 38.2 | 1.47 | 22.3 |
| | Measured (01/31/2013) | Zoom Scan | 35.9/19.1 | 38.2 | 1.47 | 22.3 |
| | Recommended Limits(2012) | | 39.2/20.5 | 40.0 | 1.40 | N/A |
| | Recommended Limits (2013) | | 38.5/20.3 | 40.0 | 1.40 | N/A |
| 1900 | Measured (11/22/2012) | Area/Fast Scan | 38.9/20.6 | 38.4 | 1.38 | 22.8 |
| | Measured (11/22/2012) | Zoom Scan | 38.5/20.1 | 38.4 | 1.38 | 22.8 |
| | Measured (11/26/2012) | Area/Fast Scan | 38.8/20.5 | 38.9 | 1.36 | 22.6 |
| | Measured (11/26/2012) | Zoom Scan | 38.3/20.0 | 38.9 | 1.36 | 22.6 |
| | Measured (01/24/2013) | Area/Fast Scan | 38.3/20.3 | 38.2 | 1.44 | 22.7 |
| | Measured (01/24/2013) | Zoom Scan | 36.9/19.6 | 38.2 | 1.44 | 22.7 |
| | Measured (01/28/2013) | Area/Fast Scan | 38.2/20.4 | 38.3 | 1.38 | 22.9 |
| | Measured (01/28/2013) | Zoom Scan | 36.9/19.9 | 38.3 | 1.38 | 22.9 |
| | Recommended Limits (Dipole: 545) | | 40.0/20.8 | 40.0 | 1.40 | N/A |
| | Recommended Limits (Dipole: 5d075) | | 40.4/21.0 | 40.0 | 1.40 | N/A |
| 2450 | Measured (01/04/2012) | Area/Fast Scan | 54.3/24.5 | 38.4 | 1.86 | 23.1 |
| | Measured (01/04/2012) | Zoom Scan | 55.5/25.9 | 38.4 | 1.86 | 23.1 |
| | Measured (01/07/2012) | Area/Fast Scan | 56.5/25.5 | 37.8 | 1.76 | 21.5 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Measured (01/07/2012) | Zoom Scan | 54.9/25.9 | 37.8 | 1.76 | 21.5 |
| | Measured (01/21/2013) | Area/Fast Scan | 52.1/24.7 | 37.4 | 1.76 | 22.5 |
| | Measured (01/21/2013) | Zoom Scan | 50.9/24.1 | 37.4 | 1.76 | 22.5 |
| | Measured (02/27/2013) | Area/Fast Scan | 50.4/22.4 | 37.7 | 1.78 | 20.5 |
| | Measured (02/27/2013) | Zoom Scan | 49.6/23.2 | 37.7 | 1.78 | 20.5 |
| | Recommended Limits | | 54.1/25.3 | 39.2 | 1.80 | N/A |
| 5200 | Measured (01/14/2013) | Zoom Scan | 83.5/24.2 | 34.4 | 4.66 | 21.5 |
| | Measured (02/25/2013) | Zoom Scan | 77.5/22.4 | 34.7 | 4.75 | 21.7 |
| | Recommended Limits | | 80.8/23.0 | 36.0 | 4.66 | N/A |
| 5500 | Measured (01/14/2013) | Zoom Scan | 93.9/26.7 | 34.2 | 5.10 | 21.5 |
| | Measured (02/25/2013) | Zoom Scan | 85.8/24.5 | 34.6 | 5.13 | 21.7 |
| | Recommended Limits | | 87.3/24.7 | 35.6 | 4.96 | N/A |
| 5800 | Measured (01/10/2013) | Zoom Scan | 86.1/24.4 | 34.7 | 5.52 | 21.1 |
| | Measured (02/25/2013) | Zoom Scan | 85.8/24.4 | 34.0 | 5.45 | 21.7 |
| | Recommended Limits | | 79.4/22.5 | 35.3 | 5.27 | N/A |

**Table 4.1-1 System accuracy (validation for head adjacent use**)

## 5.0 PHANTOM DESCRIPTION

The SAM Twin Phantom, manufactured by SPEAG, was used during the SAR measurements. The phantom is made of a fibreglass shell integrated with a wooden table.

The SAM Twin Phantom is a fibreglass shell phantom with 2 mm shell thickness. It has three measurement areas:

Left side head
Right side head
Flat phantom

The phantom table dimensions are: 100x50x85 cm (LxWxH). The table is intended for use with freestanding robots.

The bottom shelf contains three pair of bolts for locking the device holder in place. The device holder positions are adjusted to the standard measurement positions in the three sections. Only one device holder is necessary if two phantoms are used (e.g., for different solutions).

A white cover is provided to top the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. Free space scans of devices on the cover are possible; however the optical surface detector does not work properly at the cover surface. Place a sheet of white paper on the cover when using optical surface detection.

Liquid depth of ≥ 15 cm is maintained in the phantom for all the measurements.

**Figure 5.0-1 SAM Twin Phantom**

# 6.0 TISSUE DIELECTRIC PROPERTIES

## 6.1 Composition of tissue simulant

The composition of the brain and muscle simulating liquids are shown in the table below.

| INGREDIENT | MIXTURE 800–900MHz | | MIXTURE 1800–1900MHz | | MIXTURE 2450 MHz | | MIXTURE 5 – 6 GHz | |
|---|---|---|---|---|---|---|---|---|
| | Brain % | Muscle % | Brain % | Muscle % | Brain % | Muscle % | Brain % | Muscle % |
| Water | 40.29 | 65.45 | 55.24 | 69.91 | 55.0 | 68.75 | 64 | 64-78 |
| Sugar | 57.90 | 34.31 | 0 | 0 | 0 | 0 | 0 | 0 |
| Salt | 1.38 | 0.62 | 0.31 | 0.13 | 0 | 0 | 0 | 0 |
| HEC | 0.24 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Bactericide | 0.18 | 0.10 | 0 | 0 | 0 | 0 | 0 | 0 |
| DGBE | 0 | 0 | 44.45 | 29.96 | 40.0 | 31.25 | 0 | 0 |
| Triton X-100 | 0 | 0 | 0 | 0 | 5.0 | 0 | 0 | 0 |
| Additives and Salt | 0 | 0 | 0 | 0 | 0 | 0 | 3 | 2-3 |
| Emulsifiers | 0 | 0 | 0 | 0 | 0 | 0 | 15 | 9-15 |
| Mineral Oil | 0 | 0 | 0 | 0 | 0 | 0 | 18 | 11-18 |

**Table 6.1-1 Tissue simulant recipe**

### 6.1.1 Equipment

| Manufacturer | Test Equipment | Model Number | Serial Number | Cal. Due Date (MM/DD/YY) |
|---|---|---|---|---|
| Pyrex, England | Graduated Cylinder | N/A | N/A | N/A |
| Pyrex, USA | Beaker | N/A | N/A | N/A |
| Acculab | Weight Scale | V1-1200 | 018WB2003 | N/A |
| IKA Works Inc. | Hot Plate | RC Basic | 3.107433 | N/A |
| Dell | PC using GPIB card | GX110 | 347 | N/A |
| Agilent Technologies | Dielectric probe kit | HP 85070C | US9936135 | CNR |
| Agilent Technologies | Network Analyzer | 8753ES | US39174857 | 09/20/2013 |
| Control Company | Digital Thermometer | 23609-234 | 21352860 | 09/26/2013 |

**Table 6.1.1-1 Tissue simulant preparation equipment**

### 6.1.2 Preparation procedure

**800-900 MHz liquids**

- Fill the container with **water**. Begin heating and stirring.
- Add the **Cellulose,** the **preservative substance** and the **salt**. After several hours, the liquid will become more transparent again. The container must be covered to prevent evaporation.
- Add **Sugar**. Stir it well until the sugar is sufficiently dissolved.
- Keep the liquid hot but below the boiling point for at least an hour. The container must be covered to prevent evaporation.
- Remove the container from, and turn the hotplate off and allow the liquid to cool off to room temperature prior to performing dielectric measurements.

**1800-2450 MHz liquid**

- Fill the container with water and place it on hotplate. Begin heating and stirring.
- Add the salt, Glycol/Triton X-100. The container must be covered to prevent evaporation.
- Keep the liquid hot enough to dissolve sugar for at least an hour. The container must be covered to prevent evaporation.
- Remove the container from, and turn the hotplate off and allow the liquid to cool off to room temperature prior to performing dielectric measurements.

## 6.2 Electrical parameters of the tissue simulating liquid

The tissue dielectric parameters shall be measured before a batch can be used for SAR measurements to ensure that the simulated tissue was properly made and will simulate the desired human characteristic. Limits and measured electrical parameters are shown in the table below.
Recommended limits are adopted from IEEE P1528-2003:
" Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques", DASY manual and from FCC Tissue Dielectric Properties web page at http://www.fcc.gov/fcc-bin/dielec.sh

| Band (MHz) | Tissue Type | Limits / Measured (MM/DD/YYYY) | f (MHz) | Dielectric Parameters | | Liquid Temp (°C) |
|---|---|---|---|---|---|---|
| | | | | $\varepsilon_r$ | σ[S/m] | |
| 750 | Head | Measured (12/14/2012) | 705 | 42.8 | 0.88 | 22.5 |
| | | | 715 | 42.7 | 0.89 | |
| | | | 750 | 42.2 | 0.92 | |
| | | Measured (12/17/2012) | 705 | 42.7 | 0.87 | 22.0 |
| | | | 715 | 42.6 | 0.88 | |
| | | | 750 | 42.1 | 0.91 | |
| | | Recommended Limits | 750 | 41.9 | 0.89 | N/A |
| | Muscle | Measured (12/14/2012) | 705 | 54.4 | 0.92 | 22.5 |
| | | | 715 | 54.3 | 0.93 | |
| | | | 750 | 53.9 | 0.96 | |
| | | Measured (12/17/2012) | 705 | 54.2 | 0.91 | 22.0 |
| | | | 715 | 54.2 | 0.92 | |
| | | | 750 | 53.7 | 0.96 | |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Recommended Limits | 750 | 55.5 | 0.96 | N/A |
| 835 | Head | Measured (12/09/2012) | 815 | 40.4 | 0.87 | 22.5 |
| | | | 825 | 40.3 | 0.88 | |
| | | | 835 | 40.1 | 0.89 | |
| | | | 850 | 40.0 | 0.90 | |
| | | | 865 | 39.7 | 0.92 | |
| | | Measured (02/04/2013) | 815 | 40.3 | 0.88 | 22.6 |
| | | | 825 | 40.2 | 0.89 | |
| | | | 835 | 40.0 | 0.90 | |
| | | | 850 | 39.8 | 0.91 | |
| | | | 865 | 39.6 | 0.93 | |
| | | Recommended Limits | 835 | 41.5 | 0.90 | N/A |
| | Muscle | Measured (12/09/2012) | 815 | 54.6 | 0.95 | 22.5 |
| | | | 825 | 54.5 | 0.96 | |
| | | | 835 | 54.4 | 0.97 | |
| | | | 850 | 54.2 | 0.98 | |
| | | Measured (02/04/2013) | 815 | 53.3 | 0.96 | 22.6 |
| | | | 825 | 53.2 | 0.97 | |
| | | | 835 | 53.0 | 0.98 | |
| | | | 850 | 52.8 | 1.00 | |
| | | Recommended Limits | 835 | 55.2 | 0.97 | N/A |
| 1800 | Head | Measured (12/04/2012) | 1710 | 39.0 | 1.34 | 22.8 |
| | | | 1750 | 39.9 | 1.38 | |
| | | | 1800 | 38.7 | 1.43 | |
| | | Measured (12/06/2012) | 1710 | 40.6 | 1.36 | 22.4 |
| | | | 1750 | 40.5 | 1.40 | |
| | | | 1800 | 40.4 | 1.44 | |
| | | Measured (01/31/2013) | 1710 | 38.7 | 1.38 | 22.3 |
| | | | 1750 | 38.5 | 1.42 | |
| | | | 1800 | 38.2 | 1.47 | |
| | | Recommended Limits | 1800 | 40.0 | 1.40 | N/A |
| | Muscle | Measured (12/04/2012) | 1710 | 51.7 | 1.50 | 22.8 |
| | | | 1750 | 51.6 | 1.55 | |
| | | | 1800 | 51.4 | 1.60 | |
| | | Measured (01/31/2013) | 1710 | 51.5 | 1.49 | 22.1 |
| | | | 1750 | 51.4 | 1.54 | |
| | | | 1800 | 51.2 | 1.59 | |
| | | Recommended Limits | 1800 | 53.3 | 1.52 | N/A |
| 1900 | Head | Measured (11/22/2012) | 1850 | 38.8 | 1.33 | 22.8 |
| | | | 1900 | 38.4 | 1.38 | |
| | | | 1910 | 38.4 | 1.39 | |
| | | | 1980 | 38.2 | 1.46 | |
| | | Measured (11/26/2012) | 1850 | 39.1 | 1.33 | 22.6 |
| | | | 1900 | 38.9 | 1.36 | |
| | | | 1910 | 38.8 | 1.37 | |
| | | | 1980 | 38.8 | 1.46 | |
| | | Measured (01/24/2013) | 1850 | 38.3 | 1.40 | 22.7 |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | 1900 | 38.2 | 1.44 | |
| | | | 1910 | 38.1 | 1.45 | |
| | | Measured (01/28/2013) | 1850 | 38.5 | 1.33 | 22.5 |
| | | | 1900 | 38.3 | 1.38 | |
| | | | 1910 | 38.3 | 1.39 | |
| | | | 1980 | 38.0 | 1.47 | |
| | | Recommended Limits | 1900 | 40.0 | 1.40 | N/A |
| | Muscle | Measured (11/22/2012) | 1850 | 51.1 | 1.52 | 22.8 |
| | | | 1900 | 50.9 | 1.57 | |
| | | | 1910 | 50.8 | 1.58 | |
| | | Measured (11/26/2012) | 1850 | 50.9 | 1.47 | 22.6 |
| | | | 1900 | 50.7 | 1.51 | |
| | | | 1910 | 50.6 | 1.53 | |
| | | Measured (01/24/2013) | 1850 | 51.0 | 1.53 | 22.7 |
| | | | 1900 | 50.9 | 1.58 | |
| | | | 1910 | 50.9 | 1.59 | |
| | | Recommended Limits | 1900 | 53.3 | 1.52 | N/A |
| 2450 | Head | Measured (01/04/2013) | 2410 | 38.5 | 1.82 | 21.5 |
| | | | 2450 | 38.4 | 1.86 | |
| | | | 2480 | 38.2 | 1.88 | |
| | | Measured (01/07/2013) | 2410 | 37.9 | 1.72 | 22.3 |
| | | | 2450 | 37.8 | 1.76 | |
| | | | 2480 | 37.6 | 1.79 | |
| | | Measured (01/21/2013) | 2410 | 37.5 | 1.72 | 22.5 |
| | | | 2450 | 37.4 | 1.76 | |
| | | | 2480 | 37.2 | 1.79 | |
| | | Measured (02/27/2013) | 2410 | 37.8 | 1.74 | 20.5 |
| | | | 2450 | 37.7 | 1.78 | |
| | | | 2480 | 37.6 | 1.82 | |
| | | Recommended Limits | 2450 | 39.2 | 1.80 | N/A |
| | Muscle | Measured (01/07/2013) | 2410 | 51.7 | 1.86 | 22.3 |
| | | | 2450 | 51.6 | 1.90 | |
| | | | 2480 | 51.5 | 1.94 | |
| | | Measured (01/21/2013) | 2410 | 51.2 | 1.85 | 22.5 |
| | | | 2450 | 51.1 | 1.91 | |
| | | | 2480 | 51.0 | 1.95 | |
| | | Measured (02/27/2013) | 2410 | 50.3 | 1.89 | 20.5 |
| | | | 2450 | 50.2 | 1.94 | |
| | | | 2480 | 50.1 | 1.98 | |
| | | Recommended Limits | 2450 | 52.7 | 1.95 | N/A |
| 5200 | Head | Measured (01/14/2013) | 5180 | 34.4 | 4.65 | 21.5 |
| | | | 5200 | 34.4 | 4.66 | |
| | | | 5280 | 34.2 | 4.77 | |
| | | Measured (02/25/2013) | 5180 | 34.7 | 4.72 | 21.7 |
| | | | 5200 | 34.7 | 4.75 | |
| | | | 5280 | 34.4 | 4.83 | |
| | | Recommended Limits | 5200 | 36.0 | 4.66 | N/A |

| | | | | | | |
|---|---|---|---|---|---|---|
| | Muscle | Measured (01/14/2013) | 5180 | 46.8 | 5.06 | 21.5 |
| | | | 5200 | 46.7 | 5.09 | |
| | | | 5280 | 46.6 | 5.19 | |
| | | Measured (02/25/2013) | 5180 | 47.0 | 5.12 | 22.1 |
| | | | 5200 | 47.0 | 5.14 | |
| | | | 5320 | 46.7 | 5.32 | |
| | | Recommended Limits | 5200 | 49.0 | 5.30 | N/A |
| 5500 | Head | Measured (01/14/2013) | 5500 | 34.2 | 5.10 | 21.5 |
| | | | 5620 | 33.9 | 5.27 | |
| | | Measured (02/25/2013) | 5500 | 34.6 | 5.13 | 21.7 |
| | | | 5620 | 34.3 | 5.27 | |
| | | Recommended Limits | 5500 | 35.6 | 4.96 | N/A |
| | Muscle | Measured (01/14/2013) | 5500 | 46.4 | 5.54 | 21.5 |
| | | | 5620 | 46.2 | 5.72 | |
| | | Measured (02/25/2013) | 5500 | 47.9 | 5.64 | 22.1 |
| | | | 5620 | 47.7 | 5.81 | |
| | | Recommended Limits | 5500 | 48.6 | 5.65 | N/A |
| 5800 | Head | Measured (01/10/2013) | 5745 | 34.9 | 5.43 | 21.1 |
| | | | 5800 | 34.7 | 5.52 | |
| | | Measured (02/25/2013) | 5745 | 34.0 | 5.33 | 21.7 |
| | | | 5800 | 34.0 | 5.45 | |
| | | Recommended Limits | 5800 | 35.3 | 5.27 | N/A |
| | Muscle | Measured (01/10/13) | 5745 | 46.0 | 5.98 | 21.0 |
| | | | 5800 | 45.9 | 6.06 | |
| | | Measured (02/25/2013) | 5745 | 45.8 | 5.72 | 22.1 |
| | | | 5800 | 45.8 | 5.85 | |
| | | Recommended Limits | 5800 | 48.2 | 6.00 | N/A |

**Table 6.2-1 Electrical parameters of tissue simulating liquid**

### 6.2.2 Test Configuration

Dielectric
Probe
Kit

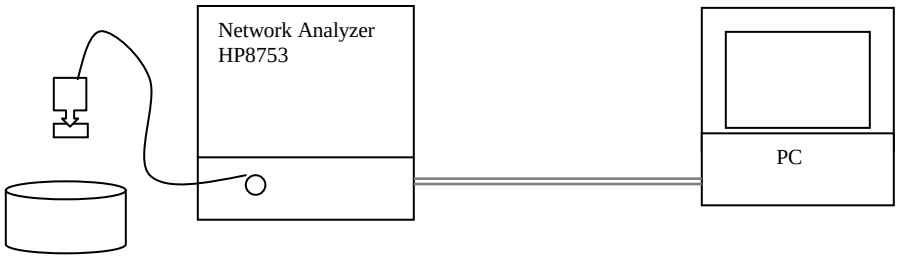


**Figure 6.2.2-1 Test configuration**

### 6.2.3 Procedure

1. Turn NWA on and allow at least 30 minutes for warm up.
2. Mount dielectric probe kit so that interconnecting cable to NWA will not be moved during measurements or calibration.
3. Pour de-ionized water and measure water temperature (±1°).
4. Set water temperature in HP-Software (Calibration Setup).
5. Perform calibration.
6. Relative permittivity $\varepsilon r = \varepsilon'$ and conductivity can be calculated from $\varepsilon''$ ($\sigma = \omega \varepsilon_0 \varepsilon''$)
7. Measure liquid shortly after calibration.
8. Stir the liquid to be measured. Take a sample (~50ml) with a syringe from the center of the liquid container.
9. Pour the liquid into a small glass flask. Hold the syringe at the bottom of the flask to avoid air bubbles.
10. Put the dielectric probe in the glass flask. Check that there are no air bubbles in front of the opening in the dielectric probe kit.
11. Perform measurements.
12. Adjust medium parameters in DASY software for the frequencies necessary for the measurements ('Setup Config', select medium (e.g. Head 835 MHz) and press 'Option'-button.
13. Select the current medium for the frequency of the validation (e.g. Setup Medium Brain 835 MHz).

## 7.0 SAR SAFETY LIMITS

| Standards/Guideline | Localized SAR Limit (W/kg) General public (uncontrolled) | Localized SAR Limits (W/kg) Workers (controlled) |
|---|---|---|
| ICNIRP Standard | 2.0 (10g) | 10.0 (10g) |
| IEEE C95.1 Standard | 1.6 (1g) | 8.0 (1g) |

**Table 7.0-1 SAR safety limits for Controlled / Uncontrolled environment**

| Human Exposure | Localized SAR Limits (W/kg) 10g, ICNIRP Standard | Localized SAR Limits (W/kg) 1g, IEEE C95.1 Standard |
|---|---|---|
| Spatial Average (averaged over the whole body) | 0.08 | 0.08 |
| Spatial Peak (averaged over any X g of tissue) | 2.00 | 1.60 |
| Spatial Peak (hands/wrists/feet/ankles averaged over 10 g) | 4.00 | 4.00 (10g) |

**Table 7.0-2 SAR safety limits**

**Uncontrolled Environments** are defined as locations where there is exposure of individuals who have no knowledge or control of their exposure.

**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).

# 8.0 DEVICE POSITIONING

## 8.1 Device holder for SAM Twin Phantom

The Device was positioned for all test configurations using the DASY5 holder. The device holder facilitates the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately and with repeatability positioned according to FCC and CENELEC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

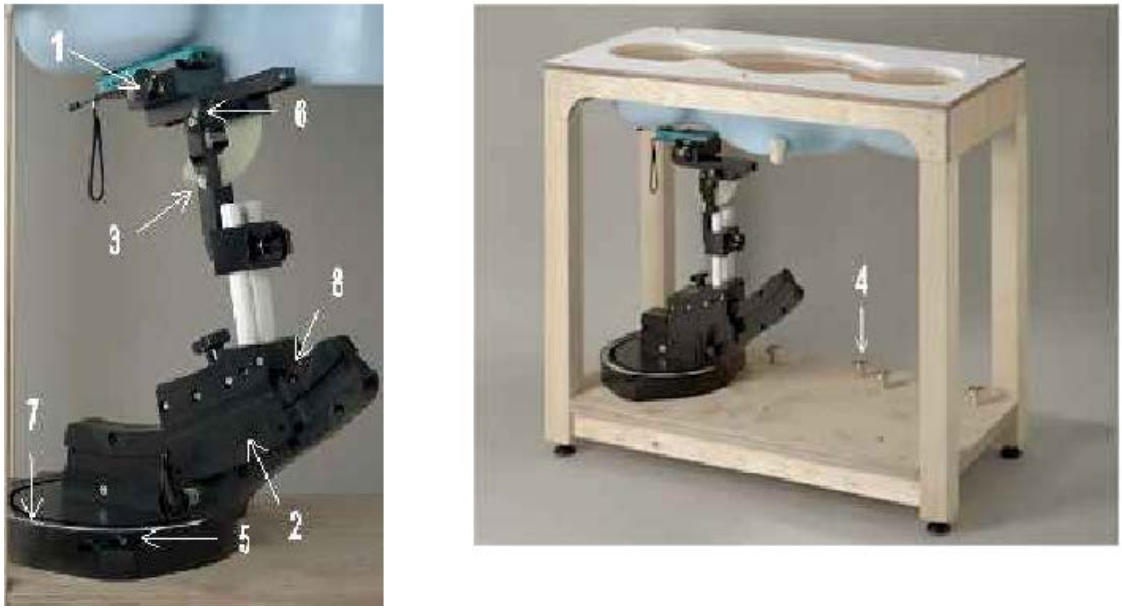


**Figure 8.1-1 Device Holder**

1. Put the phone in the clamp mechanism (1) and hold it straight while tightening. (Curved phones or phones with asymmetrical ear pieces should be positioned so that the earpiece is in the symmetry plane of the clamp).
2. Adjust the sliding carriage (2) to 90°. Then adjust the phone holder angle (3) until the reference line of the phone is horizontal (parallel to the flat phantom bottom). The phone reference line is defined as the front tangential line between the earpiece and the center of the device bottom (or the center of the flip hinge). For devices with parallel front and backsides, the phone holder angle (3) is 0°.
3. Place the device holder at the desired phantom section and move it securely against the positioning pins (4). The screw in front of the turning plate can be applied for correct positioning (5). (Do not tighten it too strongly).
4. Shift the phone clamp (6) so that the earpiece is exactly below the ear marking of the phantom. The phone is now correctly positioned in the holder for all standard phantom measurements, even after changing the phantom or phantom section.
5. Adjust the device position angles to the desired measurement position.
6. After fixing the device angles, move the phone fixture up until the phone touches the ear marking. (The point of contact depends on the design of the device and the positioning angle).

## 8.2 Description of the test positioning

### 8.2.1 Test Positions of Device Relative to Head

The handset was tested in two test positions against the head phantom, the "cheek" position and the "tilted" position, on both left and right sides of the phantom.

The handset was tested in the above positions according to IEEE 1528- 2003 "Recommended Practice for Determining the Spatial-Peak Specific Absorption Rate (SAR) in the Human Body Due to Wireless Communications Devices: Experimental Techniques".

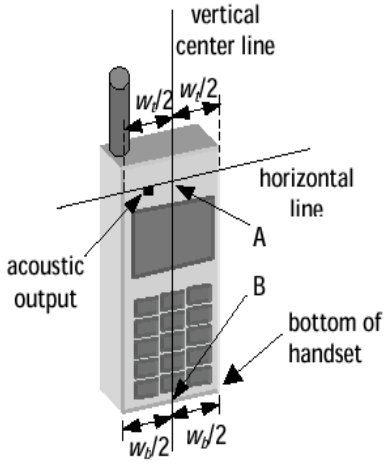


**Figure 8.2.1-1 Handset vertical and horizontal reference lines – fixed case**

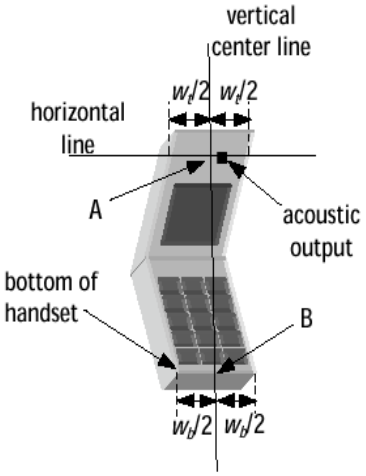


**Figure 8.2.1-2 Handset vertical and horizontal reference lines – "clam-shell"**

**Definition of the "cheek" position**

**1)** Ready the handset for talk operation, if necessary. For example, for handsets with a cover piece, open the cover.
**2)** Define two imaginary lines on the handset: the vertical centerline and the horizontal line. The vertical centerline passes through two points on the front side of the handset: the midpoint of the width *wt* of the handset at the level of the acoustic output (point A on Figures 8.2.1-1 and 8.2.1-2), and the midpoint of the width *wb* of the bottom of the handset (point B). The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output (see Figure 8.2.1-1). The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output. However, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset (see Figure 8.2.1-2), especially for clamshell handsets, handsets with flip pieces, and other irregularly shaped handsets.
**3)** Position the handset close to the surface of the phantom such that point A is on the (virtual) extension of the line passing through points RE and LE on the phantom (see Figure 8.2.1-3), such that the plane defined by the vertical center line and the horizontal center line is in a plane approximately parallel to the sagittal plane of the phantom.
**4)** Translate the handset towards the phantom along the line passing through RE and LE until the handset touches the ear.
**5)** While maintaining the handset in this plane, rotate it around the LE-RE line until the vertical centerline is the plane normal to MB ("*mouth-bac*k") - NF ("*neck-fron*t") including the line MB (reference plane).
**6)** Rotate the phone around the vertical centerline until the phone (horizontal line) is symmetrical with respect to the line NF.
**7)** While maintaining the vertical centerline in the reference plane, keeping point A on the line passing through RE and LE, and maintaining the phone contact with the ear, rotate the handset about the line NF until any point on the handset is in contact with a phantom point below the ear (cheek).

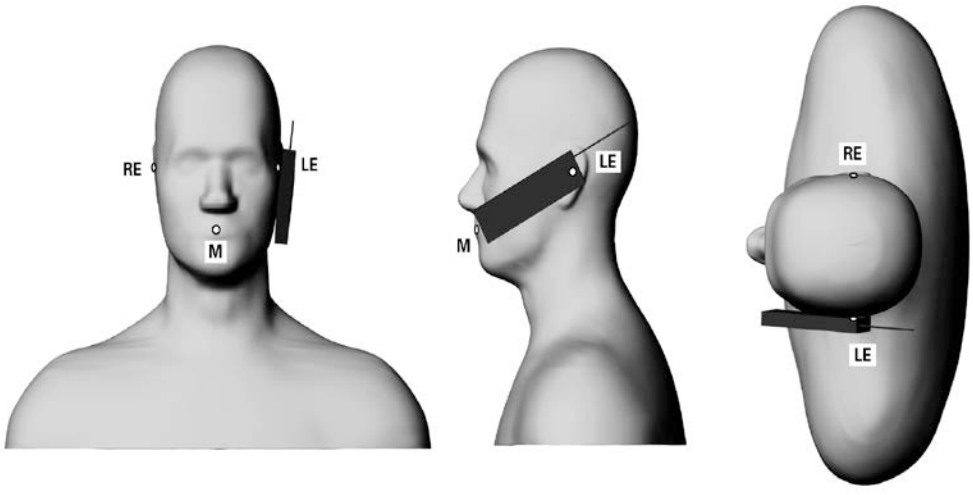


**Figure 8.2.1-3 Phone position 1, "cheek" or "touch" position. The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.**

**Definition of the "Tilted" Position**

**1)** Repeat steps 1 to 7 from above.
**2)** While maintaining the device in the reference plane (described above) and pivoting against the ear, move the device outward away from the mouth by an angle of 15 degrees, or until the antenna touches the phantom**.**

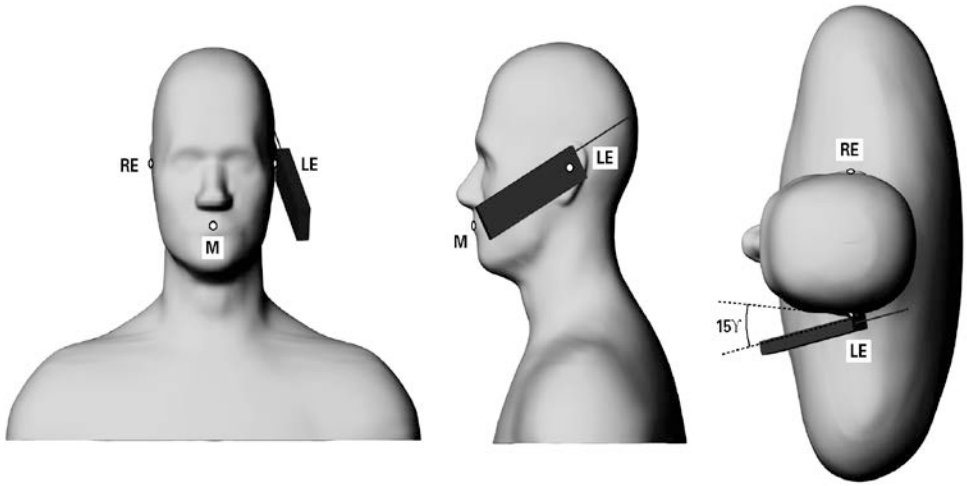


**Figure 8.2.1-4 Phone position 2, "tilted position." The reference points for the right ear (RE), left ear (LE) and mouth (M), which define the reference plane for phone positioning, are indicated. The shoulders are shown for illustration purposes only.**

### 8.2.2 Body-worn Configuration

Body-worn holsters, as shown on Figure 1.4-1, have been test with the device for RF exposure compliance. The device was positioned in each holster case and the belt clip was placed against the flat section of the phantom. A headset was then connected to the device to simulate hands-free operation in a body worn holster configuration.

In addition, device was tested with 15 mm BB recommended separation distance to allow typical after-market holster to be used. BB body-worn holsters with belt-clip have been designed to maintain ~ 19-20 mm separation distance from body.

### 8.2.3 Limb/Hand Configuration

BlackBerry device is not a limb-worn device and hasn't been tested for such a configuration.

As per Clause 6.1.4.9 in the IEC/EN 62209-2 standard:

"Additional studies remain needed for devising a representative method for evaluating SAR in the hand of hand-held devices. Future versions of this standard are intended to contain a test method based on scientific data and rationale. Annex J presents the currently available test procedure."

Clause J.2 of the IEC/EN 62209-2 states that testing for compliance for the exposure of the hand is not applicable for devices that are intended to being hand-held to enable use at the ear (see EN 62209-1) or worn on the body when transmitting.

In addition, BlackBerry device is not intended to be held in hand at a distance of larger than 200 mm from the head and body during normal use.

# 9.0 HIGH LEVEL EVALUATION

## 9.1 Maximum search

The maximum search is automatically performed after each coarse scan measurement. It is based on splines in two or three dimensions. The procedure can find the maximum for most SAR distributions even with relatively large grid spacing. After the coarse scan measurement, the probe is automatically moved to a position at the interpolated maximum. The following scan can directly use this position for reference, e.g., for a finer resolution grid or the cube evaluations.

## 9.2 Extrapolation

The extrapolation can be used in z-axis scans with automatic surface detection. The SAR values can be extrapolated to the inner phantom surface. The extrapolation distance is the sum of the probe sensor offset, the surface detection distance and the grid offset. The extrapolation is based on fourth order polynomial functions. The extrapolation is only available for SAR values.

## 9.3 Boundary correction

The correction of the probe boundary effect in the vicinity of the phantom surface is done in the standard (worst case) evaluation; the boundary effect is reduced by different weights for the lowest measured points in the extrapolation routine. The result is a slight overestimation of the extrapolated SAR values (2% to 8%) depending on the SAR distribution and gradient. The advanced evaluation makes a full compensation of the boundary effect before doing the extrapolation. This is only possible for probes with specifications on the boundary effect.

## 9.4 Peak search for 1g and 10g cube averaged SAR

The 1g and 10g peak evaluations are only available for the predefined cube 5x5x7 / 7x7x9 scan. The routines are verified and optimized for the grid dimensions used in these cube measurements.
The measured volume of 30x30x30mm / 22x22x22 with 7.5 / 5 / 4.0 mm resolution in (x,y) and 5mm / 2.mm resolution in z axis amounts to 175 / 693 measurement points. The first procedure is an extrapolation (incl. Boundary correction) to get the points between the lowest measured plane and the surface. The next step uses 3D interpolation to get all points within the measured volume in a 1mm grid. In the last step, a 1g cube is placed numerically into the volume and its averaged SAR is calculated. This cube is then moved around until the highest averaged SAR is found. This last procedure is repeated for a 10 g cube. If the highest SAR is found at the edge of the measured volume, the system will issue a warning: higher SAR values might be found outside of the measured volume. In that case the cube measurement can be repeated, using the new interpolated maximum as the center.

## 10.0 MEASUREMENT UNCERTAINTY

**DASY5 Uncertainty Budget**
**According to IEEE 1528/2003 [1]**

| Error Description | Uncert. value | Prob. Dist. | Div. | ($c_i$) 1g | ($c_i$) 10g | Std. Unc. (1g) | Std. Unc. (10g) | ($v_i$) $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | ±5.5 % | N | 1 | 1 | 1 | ±5.5 % | ±5.5 % | ∞ |
| Axial Isotropy | ±4.7 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ±1.9 % | ±1.9 % | ∞ |
| Hemispherical Isotropy | ±9.6 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ±3.9 % | ±3.9 % | ∞ |
| Boundary Effects | ±1.0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| Linearity | ±4.7 % | R | $\sqrt{3}$ | 1 | 1 | ±2.7 % | ±2.7 % | ∞ |
| System Detection Limits | ±1.0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| Readout Electronics | ±0.3 % | N | 1 | 1 | 1 | ±0.3 % | ±0.3 % | ∞ |
| Response Time | ±0.8 % | R | $\sqrt{3}$ | 1 | 1 | ±0.5 % | ±0.5 % | ∞ |
| Integration Time | ±2.6 % | R | $\sqrt{3}$ | 1 | 1 | ±1.5 % | ±1.5 % | ∞ |
| RF Ambient Noise | ±3.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| RF Ambient Reflections | ±3.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| Probe Positioner | ±0.4 % | R | $\sqrt{3}$ | 1 | 1 | ±0.2 % | ±0.2 % | ∞ |
| Probe Positioning | ±2.9 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| Max. SAR Eval. | ±1.0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device Positioning | ±2.9 % | N | 1 | 1 | 1 | ±2.9 % | ±2.9 % | 145 |
| Device Holder | ±3.6 % | N | 1 | 1 | 1 | ±3.6 % | ±3.6 % | 5 |
| Power Drift | ±5.0 % | R | $\sqrt{3}$ | 1 | 1 | ±2.9 % | ±2.9 % | ∞ |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | ±4.0 % | R | $\sqrt{3}$ | 1 | 1 | ±2.3 % | ±2.3 % | ∞ |
| Liquid Conductivity (target) | ±5.0 % | R | $\sqrt{3}$ | 0.64 | 0.43 | ±1.8 % | ±1.2 % | ∞ |
| Liquid Conductivity (meas.) | ±2.5 % | N | 1 | 0.64 | 0.43 | ±1.6 % | ±1.1 % | ∞ |
| Liquid Permittivity (target) | ±5.0 % | R | $\sqrt{3}$ | 0.6 | 0.49 | ±1.7 % | ±1.4 % | ∞ |
| Liquid Permittivity (meas.) | ±2.5 % | N | 1 | 0.6 | 0.49 | ±1.5 % | ±1.2 % | ∞ |
| Combined Std. Uncertainty | | | | | | ±10.7 % | ±10.5 % | 387 |
| **Expanded STD Uncertainty** | | | | | | **±21.4 %** | **±21.0 %** | |

**Table 10.0-1 Worst-Case uncertainty budget for DASY5 assessed according to IEEE P1528. Source: Schmid & Partner Engineering AG.**

[1] The budget is valid for the frequency range 300MHz - 3 GHz and represents a worst-case analysis. For specific tests and configurations, the uncertainty could be considerably smaller.

## Relative DASY5 Uncertainty Budget for Fast SAR Tests
**According to IEEE 1528/2011 and IEC 62209-1/2011**
**(0.3 - 3 GHz range)**

| Error Description | Uncert. value | Prob. Dist. | Div. | ($c_i$) 1g | ($c_i$) 10g | Std. Unc. (1g) | Std. Unc. (10g) | ($v_i$) $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | ±6.0% | N | 1 | 0 | 0 | | | |
| Axial Isotropy | ±4.7% | R | $\sqrt{3}$ | 0.7 | 0.7 | ±1.9% | ±1.9% | ∞ |
| Hemispherical Isotropy | ±9.6% | R | $\sqrt{3}$ | 0.7 | 0.7 | ±3.9% | ±3.9% | ∞ |
| Boundary Effects | ±1.0% | R | $\sqrt{3}$ | 1 | 1 | ±0.6% | ±0.6% | ∞ |
| Linearity | ±4.7% | R | $\sqrt{3}$ | 1 | 1 | ±2.7% | ±2.7% | ∞ |
| System Detection Limits | ±1.0% | R | $\sqrt{3}$ | 1 | 1 | ±0.6% | ±0.6% | ∞ |
| Modulation Response | ±2.4% | R | $\sqrt{3}$ | 1 | 1 | ±1.4% | ±1.4% | ∞ |
| Readout Electronics | ±0.3% | N | 1 | 0 | 0 | | | |
| Response Time | ±0.8% | R | $\sqrt{3}$ | 0 | 0 | | | |
| Integration Time | ±2.6% | R | $\sqrt{3}$ | 1 | 1 | ±1.5% | ±1.5% | ∞ |
| RF Ambient Noise | ±3.0% | R | $\sqrt{3}$ | 1 | 1 | ±1.7% | ±1.7% | ∞ |
| RF Ambient Reflections | ±3.0% | R | $\sqrt{3}$ | 0 | 0 | | | |
| Probe Positioner | ±0.4% | R | $\sqrt{3}$ | 1 | 1 | ±0.2% | ±0.2% | ∞ |
| Probe Positioning | ±2.9% | R | $\sqrt{3}$ | 1 | 1 | ±1.7% | ±1.7% | ∞ |
| Spatial x-y-Resolution | ±10.0% | R | $\sqrt{3}$ | 1 | 1 | ±5.8% | ±5.8% | ∞ |
| Fast SAR z-Approximation | ±7.0% | R | $\sqrt{3}$ | 1 | 1 | ±4.0% | ±4.0% | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device Positioning | ±2.9% | N | 1 | 1 | 1 | ±2.9% | ±2.9% | 145 |
| Device Holder | ±3.6% | N | 1 | 1 | 1 | ±3.6% | ±3.6% | 5 |
| Power Drift | ±5.0% | R | $\sqrt{3}$ | 1 | 1 | ±2.9% | ±2.9% | ∞ |
| Power Scaling | ±0% | R | $\sqrt{3}$ | 0 | 0 | | | |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | ±6.1% | R | $\sqrt{3}$ | 1 | 1 | ±3.5% | ±3.5% | ∞ |
| SAR correction | ±1.9% | R | $\sqrt{3}$ | 0 | 0 | | | |
| Liquid Conductivity (mea.) | ±2.5% | R | $\sqrt{3}$ | 0 | 0 | | | |
| Liquid Permittivity (mea.) | ±2.5% | R | $\sqrt{3}$ | 0 | 0 | | | |
| Temp. unc. - Conductivity | ±3.4% | R | $\sqrt{3}$ | 0 | 0 | | | |
| Temp. unc. - Permittivity | ±0.4% | R | $\sqrt{3}$ | 0 | 0 | | | |
| Combined Std. Uncertainty | | | | | | ±11.4% | ±11.4% | 748 |
| **Expanded STD Uncertainty** | | | | | | **±22.7%** | **±22.7%** | |

**Table 10.0-2 Worst-Case uncertainty budget for DASY5 assessed according to IEEE P1528/2011 and IEC 62209-1/2011**
**Source: Schmid & Partner Engineering AG.**

**DASY5 Uncertainty Budget**
**for the 3 - 6 GHz range**

| Error Description | Uncert. value | Prob. Dist. | Div. | ($c_i$) 1g | ($c_i$) 10g | Std. Unc. (1g) | Std. Unc. (10g) | ($v_i$) $v_{eff}$ |
|---|---|---|---|---|---|---|---|---|
| **Measurement System** | | | | | | | | |
| Probe Calibration | ±6.55 % | N | 1 | 1 | 1 | ±6.55 % | ±6.55 % | ∞ |
| Axial Isotropy | ±4.7 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ±1.9 % | ±1.9 % | ∞ |
| Hemispherical Isotropy | ±9.6 % | R | $\sqrt{3}$ | 0.7 | 0.7 | ±3.9 % | ±3.9 % | ∞ |
| Boundary Effects | ±2.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.2 % | ±1.2 % | ∞ |
| Linearity | ±4.7 % | R | $\sqrt{3}$ | 1 | 1 | ±2.7 % | ±2.7 % | ∞ |
| System Detection Limits | ±1.0 % | R | $\sqrt{3}$ | 1 | 1 | ±0.6 % | ±0.6 % | ∞ |
| Readout Electronics | ±0.3 % | N | 1 | 1 | 1 | ±0.3 % | ±0.3 % | ∞ |
| Response Time | ±0.8 % | R | $\sqrt{3}$ | 1 | 1 | ±0.5 % | ±0.5 % | ∞ |
| Integration Time | ±2.6 % | R | $\sqrt{3}$ | 1 | 1 | ±1.5 % | ±1.5 % | ∞ |
| RF Ambient Noise | ±3.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| RF Ambient Reflections | ±3.0 % | R | $\sqrt{3}$ | 1 | 1 | ±1.7 % | ±1.7 % | ∞ |
| Probe Positioner | ±0.8 % | R | $\sqrt{3}$ | 1 | 1 | ±0.5 % | ±0.5 % | ∞ |
| Probe Positioning | ±9.9 % | R | $\sqrt{3}$ | 1 | 1 | ±5.7 % | ±5.7 % | ∞ |
| Max. SAR Eval. | ±4.0 % | R | $\sqrt{3}$ | 1 | 1 | ±2.3 % | ±2.3 % | ∞ |
| **Test Sample Related** | | | | | | | | |
| Device Positioning | ±2.9 % | N | 1 | 1 | 1 | ±2.9 % | ±2.9 % | 145 |
| Device Holder | ±3.6 % | N | 1 | 1 | 1 | ±3.6 % | ±3.6 % | 5 |
| Power Drift | ±5.0 % | R | $\sqrt{3}$ | 1 | 1 | ±2.9 % | ±2.9 % | ∞ |
| **Phantom and Setup** | | | | | | | | |
| Phantom Uncertainty | ±4.0 % | R | $\sqrt{3}$ | 1 | 1 | ±2.3 % | ±2.3 % | ∞ |
| Liquid Conductivity (target) | ±5.0 % | R | $\sqrt{3}$ | 0.64 | 0.43 | ±1.8 % | ±1.2 % | ∞ |
| Liquid Conductivity (meas.) | ±2.5 % | N | 1 | 0.64 | 0.43 | ±1.6 % | ±1.1 % | ∞ |
| Liquid Permittivity (target) | ±5.0 % | R | $\sqrt{3}$ | 0.6 | 0.49 | ±1.7 % | ±1.4 % | ∞ |
| Liquid Permittivity (meas.) | ±2.5 % | N | 1 | 0.6 | 0.49 | ±1.5 % | ±1.2 % | ∞ |
| Combined Std. Uncertainty | | | | | | ±12.8 % | ±12.6 % | 330 |
| **Expanded STD Uncertainty** | | | | | | **±25.6 %** | **±25.2 %** | |

**Table 10.0-3 Worst-Case uncertainty budget for DASY52 assessed according to IEEE P1528. Source: Schmid & Partner Engineering AG.**

# 11.0 TEST RESULTS

## 11.1 SAR Measurement results at highest power measured against the head

| Test Position | Mode | f (MHz) | Ch. | Mod. | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Right Head Cheek | LTE Band 17 | 710 | 23790 | QPSK | 1 | 49 | 23.7 | 0.45 | 0.13 | 0.45 |
| | | 710 | 23790 | QPSK | 25 | 25 | 22.5 | 0.33 | 0.11 | 0.33 |
| Right Head 15° Tilt | LTE Band 17 | 710 | 23790 | QPSK | 1 | 49 | 23.7 | 0.26 | 0.11 | 0.26 |
| Left Head Cheek | LTE Band 17 | 710 | 23790 | QPSK | 1 | 49 | 23.7 | 0.59 | -0.02 | 0.59 |
| | | 710 | 23790 | QPSK | 25 | 25 | 22.5 | 0.47 | 0.17 | 0.47 |
| Left Head 15° Tilt | LTE Band 17 | 710 | 23790 | QPSK | 1 | 49 | 23.7 | 0.27 | -0.02 | 0.27 |

**Table 11.1-1a SAR results for LTE Band 17 (10MHz BW) head configuration**

**Note 1:** If the power drift is ≤ – 0.200 dB, the extrapolated SAR is calculated using the formula:
**Extrapolated SAR = (Measured SAR) * 10^( |Power Drift (dB)| / 10)**
**Note 2:** Only required to test the configuration (channel and offset) yielding the highest conducted power for RB 1 and RB 50% when combined 1g avg. SAR <0.8 W/Kg or 3dB lower than the limit for both cases.
**Note 3:** If 1g avg. SAR >0.8 W/Kg or not at least 3dB lower than the limit, than the remaining channels for that RB number must be tested and one additional scan must be done with RB 100%. For all additional scans the highest conducted power configuration (channel and offset) must be used.
**Note 4:** Tested only the highest bandwidth since conducted power on other bandwidths is about the same.
**Note 5:** Did not test 16 QAM as conducted power was lower than QPSK.

| Test Position | Mode | f (MHz) | Channel | Modulation | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Left Head Cheek | LTE Band 17 | 710 | 23790 | QPSK | 1 | 49 | 23.7 | 0.56 | 0.00 | 0.56 |

**Table 11.1-1b SAR results for LTE Band 17 (10MHz BW) head configuration**
**2100mA Battery**

| Test Position | Mode | f (MHz) | Ch. | Mod. | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Right Head Cheek | LTE Band 5 | 836.5 | 20525 | QPSK | 1 | 0 | 23.8 | 0.54 | -0.18 | 0.54 |
| | | 836.5 | 20525 | QPSK | 25 | 0 | 22.6 | 0.41 | 0.43 | 0.41 |
| Right Head 15° Tilt | LTE Band 5 | 836.5 | 20525 | QPSK | 1 | 0 | 23.8 | 0.33 | -0.08 | 0.33 |
| Left Head Cheek | LTE Band 5 | 836.5 | 20525 | QPSK | 1 | 0 | 23.8 | 0.75 | 0.00 | 0.75 |
| | | 836.5 | 20525 | QPSK | 25 | 0 | 22.6 | 0.56 | -0.13 | 0.56 |
| Left Head 15° Tilt | LTE Band 5 | 836.5 | 20525 | QPSK | 1 | 0 | 23.8 | 0.33 | -0.07 | 0.33 |

**Table 11.1-2a SAR results for LTE Band 5 (10MHz BW) head configuration**

| Test Position | Mode | f (MHz) | Channel | Modulation | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Left Head Cheek | LTE Band 5 | 836.5 | 20525 | QPSK | 1 | 0 | 23.8 | 0.74 | 0.03 | 0.74 |

**Table 11.1-2b SAR results for LTE Band 5 (10MHz BW) head configuration**
**2100mA Battery**

| Test Position | Mode | f (MHz) | Ch. | Cond. Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Right Head Cheek | 2-slots DTM 850 MHz | 824.2 | 128 | | | | | |
| | | 836.8 | 190 | 30.4 | | 0.54 | -0.05 | 0.54 |
| | | 848.8 | 251 | | | | | |
| Right Head 15° Tilt | 2-slots DTM 850 MHz | 824.2 | 128 | | | | | |
| | | 836.8 | 190 | 30.4 | | 0.37 | 0.05 | 0.37 |
| | | 848.8 | 251 | | | | | |
| Right Head Cheek | 1-slot GSM 850 MHz | 824.2 | 128 | | | | | |
| | | 836.8 | 190 | 33.9 | | 0.66 | -0.09 | 0.66 |
| | | 848.8 | 251 | | | | | |
| Left Head Cheek | 2-slots DTM 850 MHz | 824.2 | 128 | | | | | |
| | | 836.8 | 190 | 30.4 | | 0.68 | -0.22 | 0.72 |
| | | 848.8 | 251 | | | | | |
| Left Head Cheek | 3-slots DTM 850 MHz | 824.2 | 128 | | | | | |
| | | 836.8 | 190 | 29.1 | | 0.71 | -0.16 | 0.71 |
| | | 848.8 | 251 | | | | | |
| Left Head Cheek | 4-slots GSM/EDGE 850 MHz | 824.2 | 128 | 27.6 | | 0.70 | 0.30 | 0.70 |
| | | 836.8 | 190 | 27.4 | | 0.83 | -0.14 | 0.83 |
| | | 848.8 | 251 | 27.4 | | 0.89 | 0.20 | 0.89 |
| | | 848.8 | 251 | 27.4 | 2nd scan | 0.94 | -0.14 | 0.94 |
| Left Head 15° Tilt | 2-slots DTM 850 MHz | 824.2 | 128 | | | | | |
| | | 836.8 | 190 | 30.4 | | 0.40 | -0.16 | 0.40 |
| | | 848.8 | 251 | | | | | |
| Left Head Cheek | 1-slot GSM 850 MHz | 824.2 | 128 | | | | | |
| | | 836.8 | 190 | 33.9 | | 0.83 | -0.02 | 0.83 |
| | | 848.8 | 251 | | | | | |

**Table 11.1-3a SAR results for GSM/DTM 850 head configuration**

**Note 1:** If the power drift is ≤ – 0.200 dB, the extrapolated SAR is calculated using the formula:
**Extrapolated SAR = (Measured SAR) * 10^( |Power Drift (dB)| / 10)**
**Note 2:** Only Middle channel was tested when 1g Average SAR <0.8 W/Kg or 3dB lower than the limit.

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|
| | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Left Head Cheek | 4-slots GSM/EDGE 850 MHz | 824.2 | 128 | | | | |
| | | 836.8 | 190 | | | | |
| | | 848.8 | 254 | 27.4 | 0.94 | -0.18 | 0.94 |

**Table 11.1-3b SAR results for GSM/DTM 850 head configuration**
**2100mA Battery**

| Test Position | Mode | f (MHz) | Ch. | Cond. Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Right Head Cheek | WCDMA FDD V 850 MHz | 826.4 | 4132 | | | | | |
| | | 836.4 | 4182 | 22.6 | | 0.63 | 0.22 | 0.63 |
| | | 846.6 | 4233 | | | | | |
| Right Head 15° Tilt | WCDMA FDD V 850 MHz | 826.4 | 4132 | | | | | |
| | | 836.4 | 4182 | 22.6 | | 0.39 | 0.17 | 0.39 |
| | | 846.6 | 4233 | | | | | |
| Left Head Cheek | WCDMA FDD V 850 MHz | 826.4 | 4132 | 22.8 | | 0.90 | 0.03 | 0.90 |
| | | 836.4 | 4182 | 22.6 | | 0.89 | -0.11 | 0.89 |
| | | 846.6 | 4233 | 22.5 | | 1.00 | -0.08 | 1.00 |
| | | 846.6 | 4233 | 22.5 | 2nd scan | 0.98 | -0.05 | 0.98 |
| Left Head 15° Tilt | WCDMA FDD V 850 MHz | 826.4 | 4233 | | | | | |
| | | 836.4 | 4132 | 22.6 | | 0.39 | 0.12 | 0.39 |
| | | 846.6 | 4182 | | | | | |

**Table 11.1-4a SAR results for WCDMA FDD V head configuration**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|
| | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Left Head Cheek | WCDMA FDD V 850 MHz | 826.4 | 4132 | | | | |
| | | 836.4 | 4182 | | | | |
| | | 846.6 | 4233 | 22.5 | 1.03 | -0.15 | 1.03 |

**Table 11.1-4b SAR results for WCDMA FDD V head configuration 2100mA Battery**

| Test Position | Mode | f (MHz) | Ch. | Mod. | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Right Head Cheek | LTE Band 4 | 1720.0 | 20050 | QPSK | | | | | | | |
| | | 1732.5 | 20175 | QPSK | | | | | | | |
| | | 1745.0 | 20300 | QPSK | 1 | 99 | 23.8 | | 0.75 | 0.09 | 0.75 |
| | | 1745.0 | 20300 | QPSK | 50 | 0 | 22.4 | | 0.55 | 0.11 | 0.55 |
| Right Head 15° Tilt | LTE Band 4 | 1720.0 | 20050 | QPSK | | | | | | | |
| | | 1732.5 | 20175 | QPSK | | | | | | | |
| | | 1745.0 | 20300 | QPSK | 1 | 99 | 23.8 | | 0.65 | -0.13 | 0.65 |
| Left Head Cheek | LTE Band 4 | 1720.0 | 20050 | QPSK | 1 | 0 | 23.6 | | 1.12 | 0.29 | 1.12 |
| | | 1732.5 | 20175 | QPSK | 1 | 99 | 23.6 | | 1.16 | -0.01 | 1.16 |
| | | 1745.0 | 20300 | QPSK | 1 | 99 | 23.8 | | **1.16** | -0.19 | **1.16** |
| | | 1745.0 | 20300 | QPSK | 1 | 99 | 23.8 | 2nd scan | 1.04 | -0.10 | 1.04 |
| | | 1720.0 | 20050 | QPSK | 50 | 0 | 22.3 | | 0.98 | 0.01 | 0.98 |
| | | 1732.5 | 20175 | QPSK | 50 | 50 | 22.2 | | 1.01 | 0.07 | 1.01 |
| | | 1745.0 | 20300 | QPSK | 50 | 0 | 22.4 | | 1.04 | -0.07 | 1.04 |
| | | 1745.0 | 20300 | QPSK | 100 | 0 | 22.3 | | 0.88 | 0.05 | 0.88 |
| Left Head 15° Tilt | LTE Band 4 | 1720.0 | 20050 | QPSK | | | | | | | |
| | | 1732.5 | 20175 | QPSK | | | | | | | |
| | | 1745.0 | 20300 | QPSK | 1 | 99 | 23.8 | | 0.58 | 0.00 | 0.58 |

**Table 11.1-5a SAR results for LTE Band 4 (20MHz BW) head configuration**

| Test Position | Mode | f (MHz) | Channel | Modulation | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Left Head Cheek | LTE Band 4 | 1720.0 | 20050 | QPSK | | | | | | |
| | | 1732.5 | 20175 | QPSK | | | | | | |
| | | 1745.0 | 20300 | QPSK | 1 | 99 | 23.8 | 1.14 | -0.06 | 1.14 |

**Table 11.1-5b SAR results for LTE Band 4 (20MHz BW) head configuration**
**2100mA Battery**

| Test Position | Mode | f (MHz) | Ch. | Mod. | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Right Head Cheek | LTE Band 2 | 1880 | 18900 | QPSK | 1 | 0 | 22.3 | 0.47 | 0.36 | 0.47 |
| | | 1880 | 18900 | QPSK | 1 | 99 | 22.2 | 0.46 | 0.01 | 0.46 |
| | | 1880 | 18900 | QPSK | 50 | 0 | 21.0 | 0.36 | 0.01 | 0.36 |
| Right Head 15° Tilt | LTE Band 2 | 1880 | 18900 | QPSK | 1 | 0 | 22.3 | 0.43 | 0.12 | 0.43 |
| Left Head Cheek | LTE Band 2 | 1880 | 18900 | QPSK | 1 | 0 | 22.3 | 0.74 | -0.14 | 0.74 |
| | | 1880 | 18900 | QPSK | 1 | 99 | 22.2 | 0.73 | 0.03 | 0.73 |
| | | 1880 | 18900 | QPSK | 50 | 0 | 21.0 | 0.59 | 0.00 | 0.59 |
| Left Head 15° Tilt | LTE Band 2 | 1880 | 18900 | QPSK | 1 | 0 | 22.3 | 0.42 | 0.17 | 0.42 |

**Table 11.1-6a SAR results for LTE Band 2 (20MHz BW) head configuration**

| Test Position | Mode | f (MHz) | Ch. | Mod. | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Right Head Cheek | LTE Band 2 | 1860 | 18700 | QPSK | 1 | 0 | 22.3 | | 0.88 | -0.06 | 0.88 |
| | | 1880 | 18900 | QPSK | 1 | 0 | 22.3 | | 0.86 | -0.15 | 0.86 |
| | | 1900 | 19100 | QPSK | 1 | 0 | 22.2 | | 0.90 | 0.08 | 0.90 |
| | | 1900 | 19100 | QPSK | 1 | 0 | 22.2 | 2nd Scan | 0.92 | 0.00 | 0.92 |
| | | 1880 | 18900 | QPSK | 50 | 0 | 21.0 | | 0.64 | -0.04 | 0.64 |
| | | 1860 | 18700 | QPSK | 100 | 0 | 21.0 | | 0.63 | -0.12 | 0.63 |

**Table 11.1-6b SAR results for LTE Band 2 (20MHz BW) head configuration**
**2100mA Battery**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Right Head Cheek | 2-slots DTM 1900 MHz | 1850.2 | 512 | | | | | |
| | | 1880.0 | 661 | 28.6 | | 0.48 | -0.04 | 0.48 |
| | | 1909.8 | 810 | | | | | |
| Right Head 15° Tilt | 2-slots DTM 1900 MHz | 1850.2 | 512 | | | | | |
| | | 1880.0 | 661 | 28.6 | | 0.42 | 0.04 | 0.42 |
| | | 1909.8 | 810 | | | | | |
| Right Head Cheek | 1-slot GSM 1900 MHz | 1850.2 | 512 | | | | | |
| | | 1880.0 | 661 | 29.1 | | 0.40 | 0.16 | 0.40 |
| | | 1909.8 | 810 | | | | | |
| Left Head Cheek | 2-slots DTM 1900 MHz | 1850.2 | 512 | 28.6 | | 0.90 | -0.06 | 0.90 |
| | | 1850.2 | 512 | 28.6 | 2nd scan | 0.95 | 0.02 | 0.95 |
| | | 1880.0 | 661 | 28.6 | | 0.85 | 0.07 | 0.85 |
| | | 1909.8 | 810 | 28.6 | | 0.81 | -0.11 | 0.81 |
| Left Head Cheek | 3-slots DTM 1900 MHz | 1850.2 | 512 | 26.0 | | 0.73 | 0.02 | 0.73 |
| | | 1880.0 | 661 | | | | | |
| | | 1909.8 | 810 | | | | | |
| Left Head Cheek | 4-slots GSM/EDGE 1900 MHz | 1850.2 | 512 | 25.4 | | 0.82 | 0.00 | 0.82 |
| | | 1880.0 | 661 | | | | | |
| | | 1909.8 | 810 | | | | | |
| Left Head 15° Tilt | 2-slots DTM 1900 MHz | 1850.2 | 512 | | | | | |
| | | 1880.0 | 661 | 28.6 | | 0.41 | -0.07 | 0.41 |
| | | 1909.8 | 810 | | | | | |
| Left Head Cheek | 1-slot GSM 1900 MHz | 1850.2 | 512 | 28.9 | | 0.70 | 0.08 | 0.70 |
| | | 1880.0 | 661 | | | | | |
| | | 1909.8 | 810 | | | | | |

**Table 11.1-7a SAR results for GSM/DTM 1900 head configuration**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Left Head Cheek | 2-slots DTM 1900 MHz | 1850.2 | 512 | 28.6 | | 1.01 | -0.07 | 1.01 |
| | | 1850.2 | 512 | 28.6 | 2nd scan | 0.91 | 0.02 | 0.91 |
| | | 1880.0 | 661 | | | | | |
| | | 1909.8 | 810 | | | | | |

**Table 11.1-7b SAR results for GSM/DTM 1900 head configuration**
**2100mA Battery**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Right Head Cheek | WCDMA FDD II 1900 MHz | 1852.4 | 9262 | | | | | |
| | | 1880.0 | 9400 | 22.8 | | 0.54 | 0.27 | 0.54 |
| | | 1907.6 | 9538 | | | | | |
| Right Head 15° Tilt | WCDMA FDD II 1900 MHz | 1852.4 | 9262 | | | | | |
| | | 1880.0 | 9400 | 22.8 | | 0.50 | 0.12 | 0.50 |
| | | 1907.6 | 9538 | | | | | |
| Left Head Cheek | WCDMA FDD II 1900 MHz | 1852.4 | 9262 | 22.8 | | 0.93 | -0.04 | 0.93 |
| | | 1880.0 | 9400 | 22.8 | | 0.98 | 0.14 | 0.98 |
| | | 1907.6 | 9538 | 22.8 | | 1.03 | 0.09 | 1.03 |
| | | 1907.6 | 9538 | 22.8 | 2nd Scan | 1.07 | -0.03 | 1.07 |
| Left Head 15° Tilt | WCDMA FDD II 1900 MHz | 1852.4 | 9262 | | | | | |
| | | 1880.0 | 9400 | 22.8 | | 0.50 | 0.03 | 0.50 |
| | | 1907.6 | 9538 | | | | | |

**Table 11.1-8a SAR results for WCDMA FDD II head configuration**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| Left Head Cheek | WCDMA FDD II 1900 MHz | 1852.4 | 9262 | | | | | |
| | | 1880.0 | 9400 | | | | | |
| | | 1907.6 | 9538 | 22.8 | | 1.07 | -0.08 | 1.07 |
| | | 1907.6 | 9538 | 22.8 | 2nd Scan | 1.03 | -0.00 | 1.03 |

**Table 11.1-8b SAR results for WCDMA FDD II head configuration**
**2100mA Battery**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| Right | 802.11 b | 2412 | 1 | | | | |
| Head | 2450 | 2437 | 6 | 19.9 | -0.08 | 0.32 | 0.15 |
| Cheek | MHz | 2462 | 11 | | | | |
| Right | 802.11 b | 2412 | 1 | | | | |
| Head | 2450 | 2437 | 6 | 19.9 | -0.18 | 0.32 | 0.16 |
| 15° Tilt | MHz | 2462 | 11 | | | | |
| Left | 802.11 b | 2412 | 1 | | | | |
| Head | 2450 | 2437 | 6 | 19.9 | -0.04 | 0.21 | 0.11 |
| Cheek | MHz | 2462 | 11 | | | | |
| Left | 802.11 b | 2412 | 1 | | | | |
| Head | 2450 | 2437 | 6 | 19.9 | -0.19 | 0.29 | 0.15 |
| 15° Tilt | MHz | 2462 | 11 | | | | |

**Table 11.1-9a SAR results for WiFi/WLAN/802.11b head configuration (Rev2-01/Rev3-04)**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| Right | 802.11 b | 2412 | 1 | | | | |
| Head | 2450 | 2437 | 6 | 19.9 | 0.22 | 0.30 | 0.15 |
| Cheek | MHz | 2462 | 11 | | | | |

**Table 11.1-9b SAR results for WiFi/WLAN/802.11b head configuration 2100mA Battery (Rev2-01/Rev3-04)**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| Right | 802.11 b | 2412 | 1 | | | | |
| Head | 2450 | 2437 | 6 | 18.0 | 0.45 | 0.23 | 0.11 |
| Cheek | MHz | 2462 | 11 | | | | |

**Table 11.1-9c SAR results for WiFi/WLAN/802.11b head configuration (Rev3-03)**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| Right Head Cheek | Bluetooth 2450 MHz | 2402 | 0 | | | | |
| | | 2441 | 39 | 10.2 | -0.34 | 0.00 | 0.00 |
| | | 2480 | 78 | | | | |
| Right Head 15° Tilt | Bluetooth 2450 MHz | 2402 | 0 | | | | |
| | | 2441 | 39 | 10.2 | 0.35 | 0.00 | 0.00 |
| | | 2480 | 78 | | | | |
| Left Head Cheek | Bluetooth 2450 MHz | 2402 | 0 | | | | |
| | | 2441 | 39 | 10.2 | 2.44 | 0.00 | 0.00 |
| | | 2480 | 78 | | | | |
| Left Head 15° Tilt | Bluetooth 2450 MHz | 2402 | 0 | | | | |
| | | 2441 | 39 | 10.2 | -0.48 | 0.00 | 0.00 |
| | | 2480 | 78 | | | | |

**Table 11.1-10 SAR results for Bluetooth head configuration**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| Right Head Cheek | 802.11 a 5180-5825 MHz | 5240 | 48 | 19.3 | 0.65 | 0.33 | 0.12 |
| | | 5260 | 52 | 19.3 | 0.23 | 0.33 | 0.12 |
| | | 5520 | 104 | 19.6 | -0.13 | 0.21 | 0.07 |
| | | 5745 | 149 | 16.3 | 0.21 | 0.21 | 0.07 |
| Right Head 15° Tilt | 802.11 a 5180-5825 MHz | 5300 | 52 | 19.3 | 0.65 | 0.39 | 0.14 |
| Left Head Cheek | 802.11 a 5180-5825 MHz | 5240 | 48 | 19.3 | 0.27 | 0.19 | 0.07 |
| | | 5260 | 52 | 19.3 | -0.06 | 0.22 | 0.08 |
| | | 5520 | 104 | 19.6 | 0.49 | 0.16 | 0.06 |
| | | 5745 | 149 | 16.3 | 0.75 | 0.08 | 0.03 |
| Left Head 15° Tilt | 802.11 a 5180-5825 MHz | 5260 | 52 | 19.3 | 0.38 | 0.26 | 0.10 |

**Table 11.1-11a SAR results for 802.11a head configuration (Rev2-01/Rev3-04)**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| Right Head 15° Tilt | 802.11 a 5180-5825 MHz | 5240 | 48 | | | | |
| | | 5260 | 52 | 19.3 | 0.09 | 0.37 | 0.14 |
| | | 5520 | 104 | | | | |
| | | 5745 | 149 | | | | |

**Table 11.1-11b SAR results for 802.11a head configuration 2100mA Battery (Rev2-01/Rev3-04)**

| Test Position | Mode | f (MHz) | Channel | Cond. Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| Right Head 15° Tilt | 802.11 a 5180-5825 MHz | 5260 | 52 | 12.9 | 0.78 | 0.10 | 0.04 |

**Table 11.1-11c SAR results for 802.11a head configuration (Rev 3-03)**

## 11.2 SAR measurement results at highest power measured against the body using accessories

| Mode | f (MHz) | Ch. | Test Position | Spacing (cm)/ Holster | Side | Mod. | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| LTE Band 17 | 710 | 23790 | Body Hotspot Mode | 1.0 | Back | QPSK | 1 | 49 | 23.7 | 0.75 | -0.09 | 0.75 |
| | 710 | 23790 | | 1.0 | Back | QPSK | 25 | 25 | 22.5 | 0.59 | 0.06 | 0.59 |
| | 710 | 23790 | | 1.0 | Front | QPSK | 1 | 49 | 23.7 | 0.51 | -0.01 | 0.51 |
| | 710 | 23790 | | 1.0 | Left | QPSK | 1 | 49 | 23.7 | 0.34 | -0.01 | 0.34 |
| | 710 | 23790 | | 1.0 | Right | QPSK | 1 | 49 | 23.7 | 0.15 | -0.03 | 0.15 |
| | 710 | 23790 | | 1.0 | Bottom | QPSK | 1 | 49 | 23.7 | 0.11 | -0.14 | 0.11 |
| | 710 | 23790 | | 1.0 | Back+HS | QPSK | 1 | 49 | 23.7 | 0.68 | 0.02 | 0.68 |
| LTE Band 17 | 710 | 23790 | Body-worn | 1.5 | Back | QPSK | 1 | 49 | 23.7 | 0.46 | -0.02 | 0.46 |
| | 710 | 23790 | | Holster | Back | QPSK | 1 | 49 | 23.7 | 0.33 | 0.04 | 0.33 |
| | 710 | 23790 | | Holster | Front | QPSK | 1 | 49 | 23.7 | 0.27 | -0.03 | 0.27 |

**Table 11.2-1a LTE Band 17 (10MHz BW) body-worn and Hotspot configurations**

**Note 1:** If the power drift is ≤ – 0.200 dB, the extrapolated SAR is calculated using the formula:
**Extrapolated SAR = (Measured SAR) * 10^( |Power Drift (dB)| / 10)**
**Note 2:** Only required to test the configuration (channel and offset) yielding the highest conducted power for RB 1 and RB 50% when combined 1g avg. SAR <0.8 W/Kg or 3dB lower than the limit for both cases.
**Note 3:** If 1g avg. SAR >0.8 W/Kg or not at least 3dB lower than the limit, than the remaining channels for that RB number must be tested and one additional scan must be done with RB 100%. For all additional scans the highest conducted power configuration (channel and offset) must be used.
**Note 4:** Tested only the highest bandwidth since conducted power on other bandwidths is about the same.
**Note 5:** Did not test 16 QAM as conducted power was lower than QPSK.
**Note 6:** Device was tested with 15 mm BB recommended separation distance to allow typical after-market holster to be used. BB body-worn holsters with belt-clip have been designed to maintain ~ 19-20 mm separation distance from body.
**Note 7:** For Hot Spot mode any side of the phone that is further than 2.5 cm away from the transmitting antenna can be exempted from testing.

| Mode | f (MHz) | Channel | Test Position | Spacing (cm)/ Holster | Side | Mod. | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| LTE Band 17 | 710 | 23790 | Body Hotspot Mode | 1.0 | Back | QPSK | 1 | 49 | 23.7 | 0.75 | 0.00 | 0.75 |

**Table 11.2-1b SAR results for LTE Band 17 (10MHz BW) body-worn and Hotspot configurations 2100 mA battery**

| Mode | f (MHz) | Channel | Test Position | Spacing (cm)/ Holster | Side | Modulation | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| LTE Band 5 | 844 | 20600 | Body Hotspot Mode | 1.0 | Back | QPSK | 1 | 0 | 22.0 | 0.48 | -0.02 | 0.48 |
| | 844 | 20600 | | 1.0 | Back | QPSK | 1 | 25 | | | | |
| | 844 | 20600 | | 1.0 | Back | QPSK | 1 | 49 | | | | |
| | 829 | 20450 | | 1.0 | Back | QPSK | 25 | 0 | 21.6 | 0.45 | -0.11 | 0.45 |
| | 829 | 20450 | | 1.0 | Back | QPSK | 25 | 25 | | | | |
| | 829 | 20450 | | 1.0 | Back | QPSK | 50 | 0 | | | | |
| | 844 | 20600 | | 1.0 | Front | QPSK | 1 | 0 | 22.0 | 0.40 | 0.00 | 0.40 |
| | 844 | 20600 | | 1.0 | Right | QPSK | 1 | 0 | 22.0 | 0.19 | 0.01 | 0.19 |
| | 844 | 20600 | | 1.0 | Left | QPSK | 1 | 0 | 22.0 | 0.43 | -0.01 | 0.43 |
| | 844 | 20600 | | 1.0 | Bottom | QPSK | 1 | 0 | 22.0 | 0.04 | -0.06 | 0.04 |
| | 844 | 20600 | | 1.0 | Back+HS | QPSK | 1 | 0 | 22.0 | 0.43 | 0.15 | 0.43 |
| | 844 | 20600 | | 1.0 | Back 2100mA | QPSK | 1 | 0 | 22.0 | 0.50 | -0.08 | 0.50 |
| LTE Band 5 | 836.5 | 20525 | Body-worn | 1.5 | Back | QPSK | 1 | 0 | 23.8 | 0.58 | -0.11 | 0.58 |
| | 836.5 | 20525 | | Holster | Back | QPSK | 1 | 0 | 23.8 | 0.52 | 0.03 | 0.52 |
| | 836.5 | 20525 | | Holster | Front | QPSK | 1 | 0 | 23.8 | 0.48 | 0.06 | 0.48 |

**Table 11.2-2 SAR results for LTE Band 5 (10MHz BW) body-worn and Hotspot configurations**

| Mode | f (MHz) | Ch. | Test Position | Spacing (cm)/ Holster | Side | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| 2-slots GPRS/ EDGE 850 MHz | 824.2 | 128 | Body Hotspot Mode | 1.0 | Back | | | | |
| | 836.8 | 190 | | 1.0 | Back | 27.2 | 0.43 | -0.10 | 0.43 |
| | 848.8 | 251 | | 1.0 | Back | | | | |
| | 836.8 | 190 | | 1.0 | Front | 27.2 | 0.37 | -0.06 | 0.37 |
| | 836.8 | 190 | | 1.0 | Right | 27.2 | 0.21 | -0.01 | 0.21 |
| | 836.8 | 190 | | 1.0 | Left | 27.2 | 0.41 | 0.01 | 0.41 |
| | 836.8 | 190 | | 1.0 | Bottom | 27.2 | 0.06 | -0.07 | 0.06 |
| | 836.8 | 190 | | 1.0 | Back+HS | 27.2 | 0.36 | -0.08 | 0.36 |
| | 836.8 | 190 | | 1.0 | Back 2100mA | 27.2 | 0.45 | -0.09 | 0.45 |
| 3-slots GPRS/ EDGE 850 MHz | 836.8 | 190 | | 1.0 | Back | 25.2 | 0.41 | -0.12 | 0.41 |
| 4-slots GPRS/ EDGE 850 MHz | 836.8 | 190 | | 1.0 | Back | 24.1 | 0.43 | 0.01 | 0.43 |
| 2-slots GPRS 850 MHz | 836.8 | 190 | Body-worn | 1.5 | Back | 30.3 | 0.58 | -0.11 | 0.58 |
| | 836.8 | 190 | | Holster | Back | 30.3 | 0.51 | 0.10 | 0.51 |
| | 836.8 | 190 | | Holster | Front | 30.3 | 0.49 | 0.04 | 0.49 |

**Table 11.2-3 SAR results for EDGE/EGPRS 850 body-worn and Hotspot configurations**

| Mode | f (MHz) | Channel | Test Position | Spacing (cm)/ Holster | Side | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| WCDMA FDD V 850 MHz | 826.4 | 4132 | Body<br><br>Hotspot Mode | 1.0 | Back | | | | |
| | 836.4 | 4182 | | 1.0 | Back | 22.6 | 0.62 | -0.09 | 0.62 |
| | 846.6 | 4233 | | 1.0 | Back | | | | |
| | 826.4 | 4132 | | 1.0 | Front | | | | |
| | 836.4 | 4182 | | 1.0 | Front | 22.6 | 0.52 | 0.08 | 0.52 |
| | 846.6 | 4233 | | 1.0 | Front | | | | |
| | 836.4 | 4182 | | 1.0 | Right | 22.6 | 0.25 | 0.10 | 0.25 |
| | 836.4 | 4182 | | 1.0 | Left | 22.6 | 0.55 | 0.00 | 0.55 |
| | 836.4 | 4182 | | 1.0 | Bottom | 22.6 | 0.05 | -0.09 | 0.05 |
| | 836.4 | 4182 | | 1.0 | Back+HS | 22.6 | 0.55 | 0.08 | 0.55 |
| | 836.4 | 4182 | | 1.0 | Back + 2100mA | 24.4 | 0.62 | -0.03 | 0.62 |
| WCDMA FDD V 850 MHz | 836.4 | 4182 | Body-worn | 1.5 | Back | 24.4 | 0.75 | -0.11 | 0.75 |
| | 836.4 | 4182 | | Holster | Back | 24.4 | 0.62 | -0.10 | 0.62 |
| | 836.4 | 4182 | | Holster | Front | 24.4 | 0.58 | -0.17 | 0.58 |

**Table 11.2-4 SAR results for WCDMA FDD V body-worn and Hotspot configurations**

**Note 1:** If the power drift is ≤ – 0.200 dB, the extrapolated SAR is calculated using the formula:

**Extrapolated SAR = (Measured SAR) * 10^( |Power Drift (dB)| / 10)**

**Note 2:** Only Middle channel was tested when 1g Average SAR <0.8 W/Kg or 3dB lower than the limit.

**Note 3:** Device was tested with 15 mm BB recommended separation distance to allow typical after-market holster to be used. BB body-worn holsters with belt-clip have been designed to maintain ~ 19 mm separation distance from body.

**Note 4:** For Hot Spot mode any side of the phone that is further than 2.5 cm away from the transmitting antenna can be exempted from testing.

| Mode | f (MHz) | Ch. | Test Position | Spacing (cm)/ Holster | Side | Mod. | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| LTE Band 4 | 1745.0 | 20300 | Body Hotspot Mode | 1.0 | Back | QPSK | 1 | 99 | 22.9 | | 1.02 | 0.12 | 1.02 |
| | 1732.5 | 20175 | | 1.0 | Back | QPSK | 1 | 0 | 22.7 | | 1.04 | -0.03 | 1.04 |
| | 1732.5 | 20175 | | 1.0 | Back | QPSK | 1 | 0 | 22.7 | 2nd Scan | 1.01 | -0.02 | 1.01 |
| | 1720.0 | 20050 | | 1.0 | Back | QPSK | 1 | 99 | 22.7 | | 1.03 | -0.11 | 1.03 |
| | 1720.0 | 20050 | | 1.0 | Back | QPSK | 50 | 0 | 22.2 | | 0.86 | 0.05 | 0.86 |
| | 1732.5 | 20175 | | 1.0 | Back | QPSK | 50 | 0 | 22.1 | | 0.90 | -0.04 | 0.90 |
| | 1745.0 | 20300 | | 1.0 | Back | QPSK | 50 | 50 | 22.1 | | 0.91 | -0.01 | 0.91 |
| | 1720.0 | 20050 | | 1.0 | Back | QPSK | 100 | 0 | 22.2 | | 0.89 | 0.02 | 0.89 |
| | 1732.5 | 20175 | | 1.0 | Front | QPSK | 1 | 0 | 22.7 | | 0.57 | 0.07 | 0.57 |
| | 1732.5 | 20175 | | 1.0 | Left | QPSK | 1 | 0 | 22.7 | | 0.31 | -0.05 | 0.31 |
| | 1732.5 | 20175 | | 1.0 | Right | QPSK | 1 | 0 | 22.7 | | 0.16 | 0.09 | 0.16 |
| | 1732.5 | 20175 | | 1.0 | Bottom | QPSK | 1 | 0 | 22.7 | | 0.52 | 0.00 | 0.52 |
| | 1732.5 | 20175 | | 1.0 | Back+HS | QPSK | 1 | 0 | 22.7 | | 0.97 | 0.11 | 0.97 |
| | 1732.5 | 20175 | | 1.0 | Back+ 2100mA | QPSK | 1 | 0 | 22.7 | | 0.91 | 0.17 | 0.91 |
| LTE Band 4 | 1745.0 | 20300 | Body-worn | 1.5 | Back | QPSK | 1 | 99 | 23.8 | | 0.69 | -0.05 | 0.69 |
| | 1745.0 | 20300 | | Holster | Back | QPSK | 1 | 99 | 23.8 | | 0.32 | 0.01 | 0.32 |
| | 1745.0 | 20300 | | Holster | Front | QPSK | 1 | 99 | 23.8 | | 0.24 | -0.04 | 0.24 |

**Table 11.2-5 SAR results for LTE Band 4 (20MHz BW) body-worn and Hotspot configurations**

| Mode | f (MHz) | Ch. | Test Position | Spacing (cm)/ Holster | Side | Mod. | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| LTE Band 2 | 1880 | 18900 | Body Hotspot Mode | 1.0 | Back | QPSK | 1 | 0 | 22.3 | | 0.94 | 0.34 | 0.94 |
| | 1860 | 18700 | | 1.0 | Back | QPSK | 1 | 0 | 22.3 | | 0.97 | 0.07 | 0.97 |
| | 1900 | 19100 | | 1.0 | Back | QPSK | 1 | 0 | 22.2 | | 0.93 | -0.05 | 0.93 |
| | 1880 | 18900 | | 1.0 | Back | QPSK | 1 | 99 | 22.2 | | 1.03 | 0.20 | 1.03 |
| | 1860 | 18700 | | 1.0 | Back | QPSK | 1 | 99 | 22.2 | | 0.88 | -0.09 | 0.88 |
| | 1900 | 19100 | | 1.0 | Back | QPSK | 1 | 99 | 22.1 | | 1.15 | -0.08 | 1.15 |
| | 1900 | 19100 | | 1.0 | Back | QPSK | 1 | 99 | 22.1 | 2nd Scan | 1.10 | 0.08 | 1.10 |
| | 1880 | 18900 | | 1.0 | Back | QPSK | 50 | 0 | 21.0 | | 0.76 | -0.20 | 0.76 |
| | 1860 | 18700 | | 1.0 | Back | QPSK | 100 | 0 | 21.0 | | 0.68 | 0.29 | 0.68 |
| | 1880 | 18900 | | 1.0 | Front | QPSK | 1 | 99 | 22.2 | | 0.61 | 0.22 | 0.61 |
| | 1880 | 18900 | | 1.0 | Left | QPSK | 1 | 99 | 22.2 | | 0.34 | 0.01 | 0.34 |
| | 1880 | 18900 | | 1.0 | Right | QPSK | 1 | 99 | 22.2 | | 0.15 | -0.05 | 0.15 |
| | 1880 | 18900 | | 1.0 | Bottom | QPSK | 1 | 99 | 22.2 | | 0.79 | 0.02 | 0.79 |
| | 1880 | 18900 | | 1.0 | Back+HS | QPSK | 1 | 99 | 22.2 | | 0.94 | -0.02 | 0.94 |
| LTE Band 2 | 1880 | 18900 | Body-worn | 1.5 | Back | QPSK | 1 | 99 | 22.2 | | 0.56 | -0.08 | 0.56 |
| | 1880 | 18900 | | Holster | Back | QPSK | 1 | 99 | 22.2 | | 0.38 | -0.12 | 0.38 |
| | 1880 | 18900 | | Holster | Front | QPSK | 1 | 99 | 22.2 | | 0.23 | 0.29 | 0.23 |

**Table 11.2-6a SAR results for LTE Band 2 (20MHz BW) body-worn and Hotspot configurations**

| Mode | f (MHz) | Channel | Test Position | Spacing (cm)/ Holster | Side | Modulation | # of Resource Blocks | RB Offset | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| LTE Band 2 | 1860 | 18700 | Body Hotspot Mode | 1.0 | Back | QPSK | 1 | 99 | | | | |
| | 1880 | 18900 | | 1.0 | Back | QPSK | 1 | 99 | | | | |
| | 1900 | 19100 | | 1.0 | Back | QPSK | 1 | 99 | 22.1 | 1.09 | -0.11 | 1.09 |
| LTE Band 2 | 1860 | 18700 | Body-worn | 1.0 | Back | QPSK | 1 | 99 | | | | |
| | 1880 | 18900 | | 1.0 | Back | QPSK | 1 | 99 | 22.2 | 0.54 | -0.07 | 0.54 |
| | 1900 | 19100 | | 1.0 | Back | QPSK | 1 | 99 | | | | |

**Table 11.2-6b SAR results for LTE Band 2 (20MHz BW) body-worn and Hotspot configurations 2100mA Battery**

| Mode | f (MHz) | Ch. | Test Position | Spacing (cm)/ Holster | Side | Conducted Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| 2-slots GPRS/ EDGE 1900MHz | 1850.2 | 512 | Body Hotspot Mode | 1.0 | Back | 28.4 | | 1.04 | -0.06 | 1.04 |
| | 1880.0 | 661 | | 1.0 | Back | 28.5 | | 1.03 | -0.04 | 1.03 |
| | 1909.8 | 810 | | 1.0 | Back | 28.4 | | 1.08 | -0.11 | 1.08 |
| | 1909.8 | 810 | | 1.0 | Back | 28.4 | 2nd Scan | 1.01 | -0.04 | 1.01 |
| | 1880.0 | 661 | | 1.0 | Front | 28.5 | | 0.64 | 0.16 | 0.64 |
| | 1880.0 | 661 | | 1.0 | Left | 28.5 | | 0.32 | -0.07 | 0.32 |
| | 1880.0 | 661 | | 1.0 | Right | 28.5 | | 0.13 | 0.00 | 0.13 |
| | 1880.0 | 661 | | 1.0 | Bottom | 28.5 | | 0.75 | -0.11 | 0.75 |
| | 1909.8 | 810 | | 1.0 | Back+HS | 28.4 | | 1.00 | 0.08 | 1.00 |
| 3-slots GPRS/ EDGE 1900MHz | 1909.8 | 810 | | 1.0 | Back | 25.8 | | 0.82 | -0.09 | 0.82 |
| 4-slots GPRS/ EDGE 1900MHz | 1909.8 | 810 | | 1.0 | Back | 25.1 | | 0.93 | -0.17 | 0.93 |
| 2-slots GPRS/ EDGE 1900MHz | 1880.0 | 661 | Body-worn | 1.5 | Back | 28.5 | | 0.52 | -0.04 | 0.52 |
| | 1880.0 | 661 | | Holster | Back | 28.5 | | 0.37 | 0.05 | 0.37 |
| | 1880.0 | 661 | | Holster | Front | 28.5 | | 0.23 | -0.06 | 0.23 |

**Table 11.2-7a SAR results for GPRS/EDGE 1900 body-worn and Hotspot configurations**

| Mode | f (MHz) | Ch. | Test Position | Spacing (cm)/ Holster | Side | Conducted Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| 2-slots GPRS/ EDGE 1900MHz | 1850.2 | 512 | Body Hotspot Mode | 1.0 | Back | | | | | |
| | 1880.0 | 661 | | 1.0 | Back | | | | | |
| | 1909.8 | 810 | | 1.0 | Back | 28.4 | | 1.21 | -0.16 | 1.21 |
| | 1909.8 | 810 | | 1.0 | Back | 28.4 | 2nd scan | 1.12 | -0.17 | 1.12 |
| 2-slots GPRS/ EDGE 1900MHz | 1850.2 | 512 | Body-worn | 1.5 | Back | | | | | |
| | 1880.0 | 661 | | 1.5 | Back | 28.5 | | 0.62 | 0.10 | 0.62 |
| | 1909.8 | 810 | | 1.5 | Back | | | | | |

**Table 11.2-7b SAR results for GPRS/EDGE 1900 body-worn and Hotspot configurations 2100mA Battery**

| Mode | f (MHz) | Channel | Test Position | Spacing (cm)/ Holster | Side | Conducted Output Power (dBm) | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| WCDMA FDD II 1900 MHz | 1852.4 | 9262 | Body Hotspot Mode | 1.0 | Back | 22.8 | 1.12 | 0.13 | 1.12 |
| | 1880.0 | 9400 | | 1.0 | Back | 22.8 | 1.17 | -0.07 | 1.17 |
| | 1907.6 | 9538 | | 1.0 | Back | 22.8 | 1.28 | 0.02 | 1.28 |
| | 1880.0 | 9400 | | 1.0 | Front | 22.8 | 0.70 | 0.06 | 0.70 |
| | 1880.0 | 9400 | | 1.0 | Left | 22.8 | 0.34 | 0.02 | 0.34 |
| | 1880.0 | 9400 | | 1.0 | Right | 22.8 | 0.15 | 0.08 | 0.15 |
| | 1880.0 | 9400 | | 1.0 | Bottom | 22.8 | 0.74 | 0.04 | 0.74 |
| | 1907.6 | 9400 | | 1.0 | Back+HS | 22.8 | 1.19 | 0.14 | 1.19 |
| WCDMA FDD II 1900 MHz | 1880.0 | 9400 | Body-worn | 1.5 | Back | 22.8 | 0.64 | -0.12 | 0.64 |
| | 1880.0 | 9400 | | Holster | Back | 22.8 | 0.44 | 0.25 | 0.44 |
| | 1880.0 | 9400 | | Holster | Front | 22.8 | 0.28 | -0.04 | 0.28 |

**Table 11.2-8a SAR results for WCDMA FDD II body-worn and Hotspot configurations**

| Mode | f (MHz) | Ch. | Test Position | Spacing (cm)/ Holster | Side | Conducted Output Power (dBm) | Scan Type | SAR, averaged over 1 g | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | Measured (W/kg) | Power Drift (dB) | *Extrapolated (W/kg) |
| WCDMA FDD II 1900 MHz | 1852.4 | 9262 | Body Hotspot Mode | 1.0 | Back | 22.8 | | | | |
| | 1880.0 | 9400 | | 1.0 | Back | 22.8 | | | | |
| | 1907.6 | 9538 | | 1.0 | Back | 22.8 | | 1.35 | -0.12 | 1.35 |
| | 1907.6 | 9538 | | 1.0 | Back | 22.8 | 2nd scan | **1.36** | 0.07 | **1.36** |
| WCDMA FDD II 1900 MHz | 1852.4 | 9262 | Body-worn | 1.5 | Back | 22.8 | | | | |
| | 1880.0 | 9400 | | 1.5 | Back | 22.8 | | 0.65 | 0.16 | 0.65 |
| | 1907.6 | 9538 | | 1.5 | Back | 22.8 | | | | |

**Table 11.2-8b SAR results for WCDMA FDD II body-worn and Hotspot configurations 2100mA Battery**

| Mode | f (MHz) | Ch. | Test Position | Spacing (cm)/ Holster | Side | Conducted Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| 802.11b/ WLAN 2450 MHz | 2437 | 6 | Body Hotspot Mode | 1.0 | Front | 19.9 | 0.11 | 0.11 | 0.06 |
| | 2437 | 6 | | 1.0 | Left | 19.9 | 0.05 | 0.20 | 0.11 |
| | 2437 | 6 | | 1.0 | Right | 19.9 | 0.30 | 0.08 | 0.04 |
| | 2437 | 6 | | 1.0 | Top | 19.9 | -0.10 | 0.22 | 0.12 |
| 802.11b/ WLAN 2450 MHz | 2437 | 6 | Body-worn | 1.5 | Back | 19.9 | 0.23 | 0.31 | 0.16 |
| | 2437 | 6 | | Holster | Back | 19.9 | 0.12 | 0.25 | 0.14 |
| | 2437 | 6 | | Holster | Front | 19.9 | 0.06 | 0.05 | 0.03 |

**Table 11.2-9a SAR results for WiFi/WLAN/802.11b body-worn and Hotspot configurations (Rev2-01)**

| Mode | f (MHz) | Ch. | Test Position | Spacing (cm)/ Holster | Side | Conducted Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| 802.11b/ WLAN 2450 MHz | 2437 | 6 | Body Hotspot Mode | 1.0 | Back | 18.0 | 0.03 | 0.48 | 0.22 |
| | 2437 | 6 | | 1.0 | Back+HS | 18.0 | 0.07 | 0.34 | 0.15 |
| | 2437 | 6 | | 1.0 | Back+ 2100mA Batt | 18.0 | 0.00 | 0.48 | 0.22 |

**Table 11.2-9b SAR results for WiFi/WLAN/802.11b body-worn and Hotspot configurations (Rev3-03)**

| Mode | f (MHz) | Ch. | Test Position | Spacing (cm)/ Holster | Side | Conducted Output Power (dBm) | Extrapolated SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| 802.11b/ WLAN 2450 MHz | 2437 | 6 | Body Hotspot Mode | 1.0 | Back | 19.5 | 0.03 | 0.68 | 0.31 |
| | 2437 | 6 | | 1.0 | Back+HS | 19.5 | 0.07 | 0.48 | 0.21 |
| | 2437 | 6 | | 1.0 | Back+ 2100mA Batt | 19.5 | 0.00 | 0.68 | 0.31 |

**Table 11.2-9c SAR results for WiFi/WLAN/802.11b body-worn and Hotspot configurations (Rev3-04)**

| Mode | f (MHz) | Ch | Test Position | Spacing (cm)/ Holster | Side | Conducted Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| Bluetooth 2450 MHz | 2441 | 39 | Body Hotspot Mode | 1.0 | Back | 10.2 | 0.03 | 0.00 | 0.00 |
| | 2441 | 39 | | 1.0 | Front | | | | |
| | 2441 | 39 | | 1.0 | Left | | | | |
| | 2441 | 39 | | 1.0 | Right | | | | |
| | 2441 | 39 | | 1.0 | Top | 10.2 | -0.10 | 0.00 | 0.00 |
| Bluetooth 2450 MHz | 2441 | 39 | Body-worn | 1.5 | Back | 10.2 | -0.23 | 0.00 | 0.00 |
| | 2441 | 39 | | Holster | Back | | | | |
| | 2441 | 39 | | Holster | Front | | | | |

**Table 11.2-10 SAR results for Bluetooth body-worn and Hotspot configurations**

| Mode | Freq. (MHz) | Channel | Holster type / device configuration | Conducted Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| 802.11a 5000 MHz | 5180 | 36 | No Holster, back side 15 mm away | 13.2 | 0.43 | 0.24 | 0.09 |
| | 5320 | 64 | No Holster, back side 15 mm away | 13.6 | 0.61 | 0.19 | 0.07 |
| | 5520 | 104 | No Holster, back side 15 mm away | 11.9 | 0.00 | 0.08 | 0.03 |
| | 5745 | 149 | No Holster, back side 15 mm away | 10.9 | 0.49 | 0.18 | 0.07 |
| | 5180 | 36 | Vertical Holster, back side facing | 13.2 | 0.17 | 0.06 | 0.02 |
| | 5180 | 36 | Vertical Holster, front side facing | 13.2 | 0.62 | 0.01 | 0.00 |
| | 5180 | 36 | No Holster, HS, back side 15mm away | 13.2 | 0.28 | 0.18 | 0.07 |

**Table 11.2-11a SAR results for 802.11a body-worn configurations (Rev3-03)**

| Mode | Freq. (MHz) | Channel | Holster type / device configuration | Conducted Output Power (dBm) | Measured SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| 802.11a 5000 MHz | 5180 | 36 | No Holster, back side 15 mm away | 13.2 | 0.07 | 0.24 | 0.09 |

**Table 11.2-11b SAR results for 802.11a body-worn configurations 2100mA Battery (Rev3-03)**

| Mode | Freq. (MHz) | Channel | Holster type / device configuration | Conducted Output Power (dBm) | Extrapolated SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| 802.11a 5000 MHz | 5180 | 36 | No Holster, back side 15 mm away | 13.4 | 0.43 | 0.25 | 0.09 |
| | 5300 | 60 | No Holster, back side 15 mm away | 14.9 | 0.61 | 0.30 | 0.11 |
| | 5520 | 104 | No Holster, back side 15 mm away | 16.8 | 0.00 | 0.25 | 0.09 |
| | 5745 | 149 | No Holster, back side 15 mm away | 12.0 | 0.49 | 0.23 | 0.09 |
| | 5180 | 36 | Vertical Holster, back side facing | 13.4 | 0.17 | 0.06 | 0.02 |
| | 5180 | 36 | Vertical Holster, front side facing | 13.4 | 0.62 | 0.01 | 0.00 |
| | 5180 | 36 | No Holster, HS, back side 15mm away | 13.4 | 0.28 | 0.18 | 0.07 |

**Table 11.2-11c SAR results for 802.11a body-worn configurations (Rev3-04)**

| Mode | Freq. (MHz) | Channel | Holster type / device configuration | Conducted Output Power (dBm) | Extrapolated SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|
| | | | | | Power Drift (dB) | Extrapolated SAR Averaged over 1 g | Extrapolated SAR Averaged over 10 g |
| 802.11a 5000 MHz | 5180 | 36 | No Holster, back side 15 mm away | 13.4 | 0.07 | 0.25 | 0.09 |

**Table 11.2-11d SAR results for 802.11a body-worn configurations 2100mA Battery (Rev3-04)**

## 12.0 REFERENCES

[1] IEEE 1528-2003: Recommended Practice for Determining the Peak Spatial-Average Specific Absorption Rate (SAR) in the Human Head from Wireless Communications Devices: Measurement Techniques.

[2] EN 50360: 2001, Product standard to demonstrate the compliance of mobile phones with the basic restrictions related to human exposure to electromagnetic fields (300 MHz – 3 GHz)

[3] ICNIRP, International Commission on Non-Ionizing Radiation Protection (2009), Guidelines for limiting exposure in time-varying electric, magnetic, and electromagnetic fields (up to 300 GHz).

[4] Council Recommendation 1999/519/EC of July 1999 on the limitation of exposure of the general public to electromagnetic fields (0 Hz to 300 GHz)

[5] IEEE C95.3-2002, IEEE Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields – RF and Microwave.

[6] IEEE C95.1-2005, IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz.

[7] FCC 96-326, Guidelines for Evaluating the Environmental Effects of Radio-Frequency Radiation.

[8] DASY 5 DOSIMETRIC ASSESSMENT SYSTEM SOFTWARE MANUAL, Schmid & Partner Engineering AG.

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