# PCTEST ENGINEERING LABORATORY, INC.

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# SAR COMPLIANCE EVALUATION REPORT

**Applicant Name:**
Motorola Mobility, Inc.
8000 W. Sunrise Blvd.
Plantation, FL 33322 USA

**Date of Testing:**
09/15/11 - 10/06/11
**Test Site/Location:**
PCTEST Lab, Columbia, MD, USA
**Technical Report Serial No.:**
0Y1109121618-R2.IHD

**FCC ID:** **IHDP56MD1**

**APPLICANT:** **MOTOROLA MOBILITY, INC.**

**EUT Type:** Portable Handset with Lapdock
**Application Type:** Class II Permissive Change
**FCC Rule Part(s)** CFR §2.1093; FCC/OET Bulletin 65 Supplement C [June 2001]
**Test Device Serial No (Phone).:** Pre-Production [S/N: LSNW270089, LSNW230069]
**Class II Permissive Changes:** Adding Lapdock 500 (P/N: SJYN0918A)
**Date of Original Grant:** 07/07/2011

| Band & Mode | Tx Frequency | Conducted Power [dBm] | SAR<br>1 gm Body (W/kg) |
|---|---|---|---|
| Cell. CDMA/EVDO | 824.70 - 848.31 MHz | 25.19 | 0.75 |
| PCS CDMA/EVDO | 1851.25 - 1908.75 MHz | 25.36 | 0.56 |
| WIMAX | 2498.5 - 2687.5 MHz (5 MHz BW)<br>2501 - 2685 MHz (10 MHz BW) | 23.94 | 0.33<br>(scaled) |
| 2.4 GHz WLAN | 2412 - 2462 MHz | 13.97 | 0.01 |
| Bluetooth | 2402 - 2480 MHz | 9.05 | N/A |
| **Simultaneous SAR per KDB 690783 DR01:** | | | 1.08 |

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

**This revised Test Report (S/N: 0Y1109121618-R2.IHD) supersedes and replaces the previously issued test report on the same subject EUT for the same type of testing as indicated. Please discard or destroy the previously issued test report(s) and dispose of it accordingly.**

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE C95.1-1992 and has been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001), IEEE 1528-2003 and in applicable Industry Canada Radio Standards Specifications (RSS); for North American frequency bands only.

I attest to the accuracy of data. All measurements reported herein were performed by me or were made under my supervision and are correct to the best of my knowledge and belief. I assume full responsibility for the completeness of these measurements and vouch for the qualifications of all persons taking them. Test results reported herein relate only to the item(s) tested.

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

Randy Ortanez
President

ilac-MRA
ACCREDITED
TESTING LABORATORY
CERTIFICATE #2041.01

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# 1 WIMAX CHECKLIST PER KDB 615223

Based on 802.16e/WIMAX Permit-But-Ask and SAR Guidance, November 2009
FCC KDB Publication 615223 D01 802.16e WIMAX SAR Guidance v01.

| Description | Parameter | | Comment |
|---|---|---|---|
| FCC ID | IHDP56MD1 | | Identify all related FCC ID |
| Radio Service | Part 27 subpart M | | Rule parts |
| Transmit Frequency Range (MHz) | 2496MHz-2690MHz | | System parameter |
| System/Channel Bandwidth (MHz) | 5MHz | 10MHz | System parameter |
| System Profile | Revision 1.7.0 | | Defined by WiMAX Forum |
| Modulation Schemes | QPSK,16QAM | | Identify all applicable UL modulations |
| Number of DL OFDMA Symbols per Frame | 29 | | Identify the allowed & maximum symbols, including both traffic & control symbols |
| Number of UL OFDMA Symbols per Frame | 18 | | |
| DL:UL Symbol Ratio | 29:18 | | For determining UL duty factor |
| Power Class (dBm) | Power Class 2, 23±1dBm | | Identify power class and tolerance |
| UL Zone Types (FUSC, PUSC, OFUSC, OPUSC, AMC, TUSC1, TUSC2) | PUSC, Band AMC 2×3 | | Describe separately the symbol and sub-carrier/sub-channel structures applicable to each zone type |
| UL Burst Maximum Average Power | 5MHz: 24dBm<br>10MHz: 23dBm | | Identify the allowed and tested/to be tested parameters; include separate |
| Number and type of UL Control Symbols | 3 PUSC symbols (used for ranging, CQICH and ACK/NACK) | | |

# 2 INTRODUCTION

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

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

## 2.1 SAR Definition

Specific Absorption Rate is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density ($\rho$). It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1-1).

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

**Figure 2-1**
**SAR Mathematical Equation**

**SAR is expressed in units of Watts per Kilogram (W/kg).**

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

where:

$\sigma$ = conductivity of the tissue-simulating material (S/m)
$\rho$ = mass density of the tissue-simulating material (kg/m$^3$)
E = Total RMS electric field strength (V/m)

NOTE: The primary factors that control rate of energy absorption were found to be the wavelength of the incident field in relation to the dimensions and geometry of the irradiated organism, the orientation of the organism in relation to the polarity of field vectors, the presence of reflecting surfaces, and whether conductive contact is made by the organism with a ground plane.[6]

# 3 TEST SITE LOCATION

## 3.1 INTRODUCTION

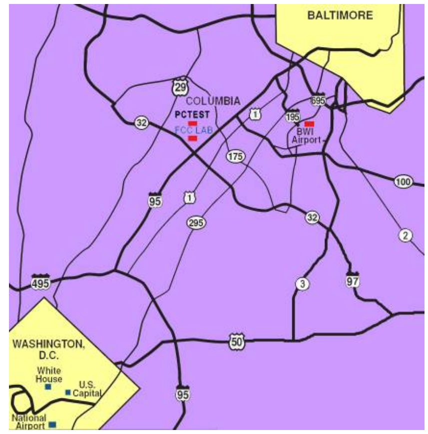


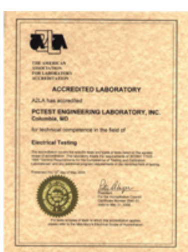

**Figure 3-1**
Map of the Greater Baltimore and Metropolitan Washington, D.C. area

The map at the right shows the location of the PCTEST LABORATORY in Columbia, Maryland. It is in proximity to the FCC Laboratory, the Baltimore-Washington International (BWI) airport, the city of Baltimore and Washington, DC.

These measurement tests were conducted at the PCTEST Engineering Laboratory, Inc. facility in New Concept Business Park, Guilford Industrial Park, Columbia, Maryland. The site address is 6660-B Dobbin Road, Columbia, MD 21045. The test site is one of the highest points in the Columbia area with an elevation of 390 feet above mean sea level. The site coordinates are 39° 11'15" N latitude and 76° 49' 38" W longitude. The facility is 1.5 miles north of the FCC laboratory, and the ambient signal and ambient signal strength are approximately equal to those of the FCC laboratory. There are no FM or TV transmitters within 15 miles of the site. The detailed description of the measurement facility was found to be in compliance with the requirements of § 2.948 according to ANSI C63.4 on January 27, 2006 and Industry Canada.

## 3.2 Test Facility / Accreditations:

Measurements were performed at an independent accredited PCTEST Engineering Lab located in Columbia, MD 21045, U.S.A.





- PCTEST Lab is accredited to ISO 17025-2005 by the American Association for Laboratory Accreditation (A2LA) in Specific Absorption Rate (SAR) testing, Hearing-Aid Compatibility (HAC), Battery Safety, CTIA Test Plans, and wireless testing for FCC and Industry Canada Rules.
- PCTEST Lab is accredited to ISO 17025 by U.S. National Institute of Standards and Technology (NIST) under the National Voluntary Laboratory Accreditation Program (NVLAP Lab code: 100431-0) in EMC, FCC and Telecommunications.
- PCTEST facility is an FCC registered (PCTEST Reg. No. 90864) test facility with the site description report on file and has met all the requirements specified in Section 2.948 of the FCC Rules and Industry Canada (IC-2451).
- PCTEST Lab is a recognized U.S. Conformity Assessment Body (CAB) in EMC and R&TTE (n.b. 0982) under the U.S.-EU Mutual Recognition Agreement (MRA).
- PCTEST TCB is a Telecommunication Certification Body (TCB) accredited to ISO/IEC Guide 65 by the American National Standards Institute (ANSI) in all scopes of FCC Rules and all Industry Canada Standards (RSS).
- PCTEST facility is an IC registered (IC-2451) test laboratory with the site description on file at Industry Canada.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for AMPS and CDMA, and EvDO mobile phones.
- PCTEST is a CTIA Authorized Test Laboratory (CATL) for Over-the-Air (OTA) Antenna Performance testing for AMPS, CDMA, GSM, GPRS, EGPRS, UMTS (W-CDMA), CDMA 1xEVDO Data, CDMA 1xRTT Data

# 4 SAR MEASUREMENT SETUP

## 4.1 Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of a high precision robotics system (Staubli), robot controller, desktop computer, near-field probe, probe alignment sensor, and the SAM phantom containing the head or body equivalent material. The robot is a six-axis industrial robot, performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Figure 3-1).

## 4.2 System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, A/D conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal from the DAE and transfers data to the PC card.

## 4.3 System Electronics

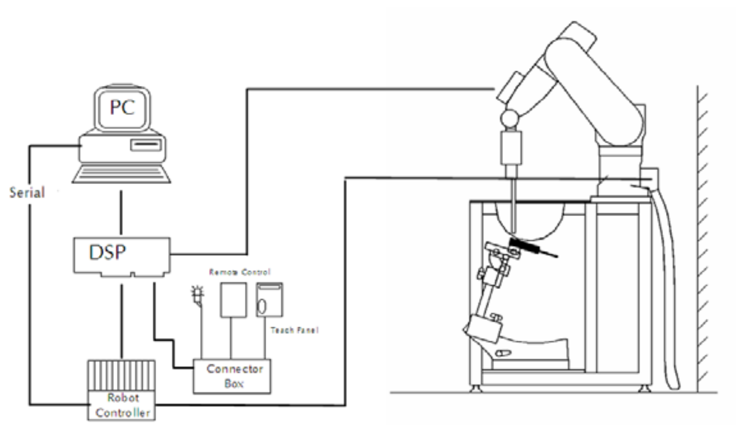



**Figure 4-1**
**SAR Measurement System Setup**

The DAE consists of a highly sensitive electrometer-grade auto-zeroing preamplifier, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer.

## 4.4 Automated Test System Specifications

| | |
|---|---|
| Test Software: | SPEAG DASY4 version 4.7 Measurement Software |
| Robot: | Stäubli Unimation Corp. Robot RX60L |
| Repeatability: | 0.02 mm |
| No. of Axes: | 6 |

Data Acquisition Electronic System (DAE)

Data Converter

| | |
|---|---|
| Features: | Signal Amplifier, multiplexer, A/D converter & control logic |
| Software: | SEMCAD software |
| Connecting Lines: | Optical Downlink for data and status info<br>Optical upload for commands and clock |

PC Interface Card

| | |
|---|---|
| Function: | Link to DAE<br>16-bit A/D converter for surface detection system<br>Two Serial & Ethernet link to robotics<br>Direct emergency stop output for robot |

Phantom

| | |
|---|---|
| Type: | SAM Twin Phantom (V4.0) |
| Shell Material: | Composite |
| Thickness: | 2.0 ± 0.2 mm |

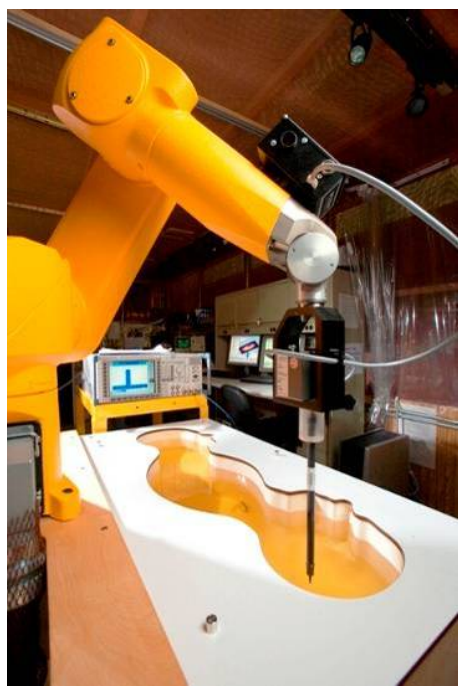


**Figure 4-2**
**SAR Measurement System**

# 5 DASY E-FIELD PROBE SYSTEM

## 5.1 Probe Measurement System

**Figure 4-1**
**SAR System**

The SAR measurements were conducted with the dosimetric probe designed in the classical triangular configuration (see Figure 5-3) and optimized for dosimetric evaluation [9]. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multi-fiber line ending at the front of the probe tip. It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order curve fitting (see Figure 5-1). The approach is stopped at reaching the maximum.

## 5.2 Probe Specifications

| | |
|---|---|
| **Model(s):** | ES3DV2, ES3DV3, EX3DV4 |
| **Frequency Range:** | 10 MHz – 6.0 GHz (EX3DV4)<br>10 MHz – 4 GHz (ES3DV3, ES3DV2) |
| **Calibration:** | In head and body simulating tissue at Frequencies from 300 up to 6000MHz |
| **Linearity:** | ± 0.2 dB (30 MHz to 6 GHz) for EX3DV4<br>± 0.2 dB (30 MHz to 4 GHz) for ES3DV3, ES3DV2 |
| **Dynamic Range:** | 10 mW/kg – 100 W/kg |
| **Probe Length:** | 330 mm |
| **Probe Tip Length:** | 20 mm |
| **Body Diameter:** | 12 mm |
| **Tip Diameter:** | 2.5 mm (3.9mm for ES3DV3) |
| **Tip-Center:** | 1 mm (2.0 mm for ES3DV3) |
| **Application:** | SAR Dosimetry Testing<br>Compliance tests of mobile phones<br>Dosimetry in strong gradient fields |

**Figure 5-2**
**Near-Field Probe**

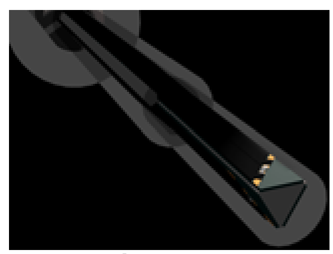


**Figure 5-3**
**Triangular Probe Configuration**

# 6 PROBE CALIBRATION PROCESS

## 6.1 Dosimetric Assessment Procedure

Each E-Probe/Probe Amplifier combination has unique calibration parameters. A TEM cell calibration procedure is conducted to determine the proper amplifier settings to enter in the probe parameters. The amplifier settings are determined for a given frequency by subjecting the probe to a known E-field density (1 mW/cm$^2$) using an RF Signal generator, TEM cell, and RF Power Meter.

## 6.2 Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This calibration can be performed in a TEM cell if the frequency is below 1 GHz and in a waveguide or other methodologies above 1 GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity and at the proper orientation with the field. The probe is rotated 360 degrees until the three channels show the maximum reading. The power density readings equates to 1 mW/cm$^2$.

## 6.3 Temperature Assessment

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated head tissue. The E-field in the medium correlates with the temperature rise in the dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe.

SAR = $C\dfrac{\Delta T}{\Delta t}$

where:

$\Delta t$ = exposure time (30 seconds),
C = heat capacity of tissue (brain or muscle),
$\Delta T$ = temperature increase due to RF exposure.

SAR = $\dfrac{|E|^2 \cdot \sigma}{\rho}$

where:

$\sigma$ = simulated tissue conductivity,
$\rho$ = Tissue density (1.25 g/cm$^3$ for brain tissue)

SAR is proportional to $\Delta T/\Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. The electric field in the simulated tissue can be used to estimate SAR by equating the thermally derived SAR to that with the E- field component.

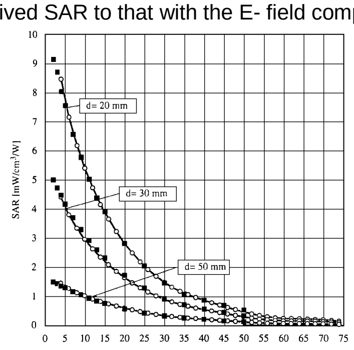



**Figure 6-1 E-Field and Temperature measurements at 900MHz [9]**

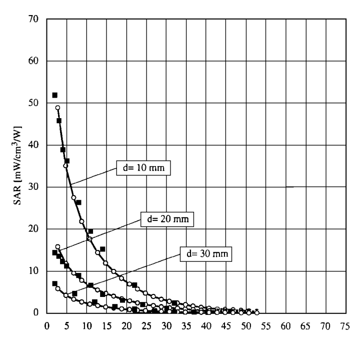



**Figure 6-2 E-Field and temperature measurements at 1.9GHz [9]**

# 7 PHANTOM AND EQUIVALENT TISSUES

## 7.1 SAM Phantoms

**Figure 7-1**
**SAM Phantoms**

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a table. The shape of the shell is based on data from an anatomical study designed to represent the 90th percentile of the population [12][13]. The phantom enables the dosimetric evaluation of SAR for both left and right handed handset usage, as well as body-worn usage using the flat phantom region. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. The shell phantom has a 2mm shell thickness (except the ear region where shell thickness increases to 6 mm).

## 7.2 Tissue Simulating Mixture Characterization

**Figure 7-2**
**SAM Phantom with Simulating Tissue**

The mixture is characterized to obtain proper dielectric constant (permittivity) and conductivity of the tissue of interest. The tissue dielectric parameters recommended in IEEE 1528 and IEC 62209 have been used as targets for the compositions, and are to match within 5%, per the FCC recommendations.

**Table 7-1**
**Composition of the Tissue Equivalent Matter**

| Frequency (MHz) | 835 | 1900 | 2450-2600 |
|---|---|---|---|
| Tissue | Body | Body | Body |
| Ingredients (% by weight) | | | |
| Bactericide | 0.1 | | |
| DGBE | | 29.44 | 26.7 |
| HEC | 1 | | |
| NaCl | 0.94 | 0.39 | 0.1 |
| Sucrose | 44.9 | | |
| Water | 53.06 | 70.17 | 73.2 |

## 8 DOSIMETRIC ASSESSMENT & PHANTOM SPECS

### 8.1 Measurement Procedure

The evaluation was performed using the following procedure:

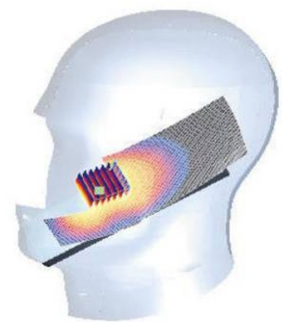


**Figure 7-1**
**Sample SAR Area Scan**

1. The SAR distribution at the exposed side of the head was measured at a distance no greater than 5.0 mm from the inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15mm x 15mm.
2. The point SAR measurement was taken at the maximum SAR region determined from Step 1 to enable the monitoring of SAR fluctuations/drifts during testing the 1 gram cube. This fixed point was measured and used as a reference value.
3. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 32mm x 32mm x 30mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see references or the DASY manual for more details):
    a. The data was extrapolated to the surface of the outer-shell of the phantom. The combined distance extrapolated was the combined distance from the center of the dipoles 2.7mm away from the tip of the probe housing plus the 1.2 mm distance between the surface and the lowest measuring point. The extrapolation was based on a least-squares algorithm. A polynomial of the fourth order was calculated through the points in the z-axis (normal to the phantom shell).
    b. After the maximum interpolated values were calculated between the points in the cube, the SAR was averaged over the spatial volume (1g or 10g) using a 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions). The volume was then integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were obtained through interpolation, in order to calculate the averaged SAR.
    c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.
4. The SAR reference value, at the same location as step 2, was re-measured after the zoom scan was complete. If the value deviated by more than 5%, the evaluation was repeated.

### 8.2 Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Figure 8-2). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimize reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15 cm.

**Figure 8-2**
**SAM Twin Phantom Shell**

# 9 FCC RF EXPOSURE LIMITS

## 9.1 Uncontrolled Environment

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

## 9.2 Controlled Environment

CONTROLLED ENVIRONMENTS are defined as locations where there is exposure that may be incurred by persons who are aware of the potential for exposure, (i.e. as a result of employment or occupation). In general, occupational/controlled exposure limits are applicable to situations in which persons are exposed as a consequence of their employment, who have been made fully aware of the potential for exposure and can exercise control over their exposure. This exposure category is also applicable when the exposure is of a transient nature due to incidental passage through a location where the exposure levels may be higher than the general population/uncontrolled limits, but the exposed person is fully aware of the potential for exposure and can exercise control over his or her exposure by leaving the area or by some other appropriate means.

**Table 9-1**
**SAR Human Exposure Specified in ANSI/IEEE C95.1-1992**

| HUMAN EXPOSURE LIMITS | | |
|---|---|---|
| | UNCONTROLLED ENVIRONMENT<br>*General Population*<br>(W/kg) or (mW/g) | CONTROLLED ENVIRONMENT<br>*Occupational*<br>(W/kg) or (mW/g) |
| SPATIAL PEAK SAR<br>Brain | 1.6 | 8.0 |
| SPATIAL AVERAGE SAR<br>Whole Body | 0.08 | 0.4 |
| SPATIAL PEAK SAR<br>Hands, Feet, Ankles, Wrists | 4.0 | 20 |

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

# 10 FCC 3G MEASUREMENT PROCEDURES

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

## 10.1 Procedures Used to Establish RF Signal for SAR

The following procedures are according to FCC KDB Publication 941225 D01 “SAR Measurement Procedures for 3G Devices” v02, October 2007.

The device was placed into a simulated call using a base station simulator in a RF shielded chamber. Establishing connections in this manner ensure a consistent means for testing SAR and are recommended for evaluating SAR [4]. Devices under test were evaluated prior to testing, with a fully charged battery and were configured to operate at maximum output power. In order to verify that the device was tested throughout the SAR test at maximum output power, the SAR measurement system measures a “point SAR” at an arbitrary reference point at the start and end of the 1 gram SAR evaluation, to assess for any power drifts during the evaluation. Any SAR measurements with power drifts of greater than 5% were repeated.

## 10.2 SAR Measurement Conditions for CDMA2000

The following procedures were performed according to FCC KDB Publication 941225 D01 “SAR Measurement Procedures for 3G Devices” v02, October 2007.

### 10.2.1 Output Power Verification

See 3GPP2 C.S0011/TIA-98-E as recommended by “SAR Measurement Procedures for 3G Devices” v02, October 2007. Maximum output power is verified on the High, Middle and Low channels according to procedures in section 4.4.5.2 of 3GPP2 C.S0011/TIA-98-E. SO55 tests were measured with power control bits in the “All Up” condition.

1. If the mobile station (MS) supports Reverse TCH RC 1 and Forward TCH RC 1, set up a call using Fundamental Channel Test Mode 1 (RC=1/1) with 9600 bps data rate only.
2. Under RC1, C.S0011 Table 4.4.5.2-1, Table 10-1 parameters were applied.
3. If the MS supports the RC 3 Reverse FCH, RC3 Reverse $SCH_0$ and demodulation of RC 3,4, or 5, set up a call using Supplemental Channel Test Mode 3 (RC 3/3) with 9600 bps Fundamental Channel and 9600 bps SCH0 data rate.
4. Under RC3, C.S0011 Table 4.4.5.2-2, Table 13-2 was applied.
5. FCHs were configured at full rate for maximum SAR with “All Up” power control bits.

**Table 10-1**
**Parameters for Max. Power for RC1**

| Parameter | Units | Value |
|---|---|---|
| $\hat{I}_{or}$ | dBm/1.23 MHz | -104 |
| $\frac{\text{Pilot } E_c}{I_{or}}$ | dB | -7 |
| $\frac{\text{Traffic } E_c}{I_{or}}$ | dB | -7.4 |

**Table 10-2**
**Parameters for Max. Power for RC3**

| Parameter | Units | Value |
|---|---|---|
| $\hat{I}_{or}$ | dBm/1.23 MHz | -86 |
| $\frac{\text{Pilot } E_c}{I_{or}}$ | dB | -7 |
| $\frac{\text{Traffic } E_c}{I_{or}}$ | dB | -7.4 |

### 10.2.2 Body SAR Measurements

SAR for body exposure configurations is measured in RC3 with the DUT configured to transmit at full rate on FCH with all other code channels disabled using TDSO / SO32. SAR for multiple code channels (FCH + $SCH_n$) is not required when the maximum average output of each RF channel is less than ¼ dB higher than that measured with FCH only. Otherwise, SAR is measured on the maximum output channel (FCH + $SCH_n$) with FCH at full rate and $SCH_0$ enabled at 9600 bps using the exposure configuration that results in the highest SAR for that channel with FCH only.   When multiple code channels are enabled, the DUT output may shift by more than 0.5 dB and lead to higher SAR drifts and SCH dropouts. Body SAR was measured using TDSO / SO32 with power control bits in the “All Up”

Body SAR in RC1 is not required when the maximum average output of each channel is less than ¼ dB higher than that measured in RC3.   Otherwise, SAR is measured on the maximum output channel in RC1; with Loopback Service Option SO55, at full rate, using the body exposure configuration that results in the highest SAR for that channel in RC3.

### 10.2.3 Body SAR Measurements for EVDO Data Devices

Hotspot Body SAR is measured using Subtype 0/1 Physical Layer configurations for Rev. 0. SAR for Subtype 2 Physical layer configurations is not required for Rev. A when the maximum average output of each RF channels is less than that measured in Subtype 0/1 Physical layer configurations. Otherwise, SAR is measured on the maximum output channel for Rev. A using the exposure configuration that results in the highest SAR for the RF channels in Rev. 0. The AT is tested with a Reverse Data Channel rate of 153.6 kbps in Subtype 0/1 Physical Layer configurations; and a Reverse Data Channel payload size of 4096 bits and Termination Target of 16 slots in Subtype 2 Physical Layer configurations. Both FTAP and FETAP are configured with a Forward Traffic Channel data rate corresponding to the 2-slot version of 307.2 kbps with the ACK Channel transmitting in all slots. AT power control should be in “All Bits Up” conditions for TAP/ETAP.

## 10.3 RF Conducted Powers

### 10.3.1 CDMA Conducted Powers

| Band | Channel | SO55 [dBm] | SO55 [dBm] | TDSO SO32 [dBm] | TDSO SO32 [dBm] | 1x EvDO Rev. 0 [dBm] | 1x EvDO Rev. A [dBm] |
|---|---|---|---|---|---|---|---|
| | F-RC | RC1 | RC3 | FCH+SCH | FCH | (RTAP) | (RETAP) |
| Cellular | 1013 | 25.18 | 25.17 | 25.19 | 25.18 | 25.15 | 25.18 |
| | 384 | 25.15 | 25.19 | 25.20 | 25.16 | 25.12 | 25.19 |
| | 777 | 25.08 | 24.96 | 25.05 | 25.14 | 25.19 | 25.18 |
| PCS | 25 | 25.32 | 25.30 | 25.32 | 25.29 | 25.33 | 25.37 |
| | 600 | 25.27 | 25.30 | 25.33 | 25.33 | 25.36 | 25.35 |
| | 1175 | 25.22 | 25.22 | 25.24 | 25.25 | 25.20 | 25.25 |

Note: RC1 is only applicable for IS-95 compatibility. Output powers are identical to the original filing since this permissive change is to add an external accessory.

Per KDB Publication 941225 D01:

1. CDMA Body SAR was tested under EVDO Rev. 0 per FCC 3G Guidance (See Section 10.2.3) per FCC KDB Publication 941225 D01. Rev. A and TDSO32 RC3 tests were not required since the maximum average output of each channel in Rev. A and RC3 (1x RTT) was not more than ¼ dB higher than that measured Rev 0.

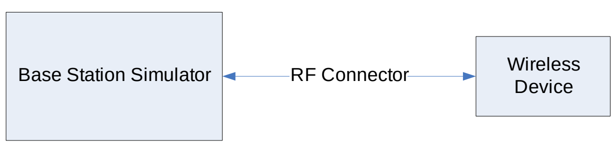



**Figure 10-1**
**Power Measurement Setup**

## 11 SAR TESTING WITH IEEE 802.11 TRANSMITTERS

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

### 11.1 General Device Setup

Chipset based test mode software is hardware dependent and generally varies among manufacturers. The device operating parameters established in test mode for SAR measurements must be identical to those programmed in production units, including output power levels, amplifier gain settings and other RF performance tuning parameters. The test frequencies should correspond to actual channel frequencies defined for domestic use. SAR for devices with switched diversity should be measured with only one antenna transmitting at a time during each SAR measurement, according to a fixed modulation and data rate. The same data pattern should be used for all measurements.

### 11.2 Frequency Channel Configurations [27]

802.11 b/g/n operating modes are tested independently according to the service requirements in each frequency band. 802.11 b/g/n modes are tested on channels 1, 6 and 11. These are referred to as the "default test channels". 802.11g/n modes were evaluated only if the output power was 0.25 dB higher than the 802.11b mode.

**Table 11-1**
**802.11 Test Channels per FCC Requirements**

| Mode | | GHz | Channel | Turbo Channel | "Default Test Channels" §15.247 802.11b | §15.247 802.11g | UNII | |
|---|---|---|---|---|---|---|---|---|
| 802.11 b/g | | 2.412 | 1 | | √ | ∇ | | |
| | | 2.437 | 6 | 6 | √ | ∇ | | |
| | | 2.462 | 11 | | √ | ∇ | | |
| 802.11a | UNII | 5.18 | 36 | | | | √ | |
| | | 5.20 | 40 | 42 (5.21 GHz) | | | | * |
| | | 5.22 | 44 | | | | | * |
| | | 5.24 | 48 | 50 (5.25 GHz) | | | √ | |
| | | 5.26 | 52 | | | | √ | |
| | | 5.28 | 56 | 58 (5.29 GHz) | | | | * |
| | | 5.30 | 60 | | | | | * |
| | | 5.32 | 64 | | | | √ | |
| | | 5.500 | 100 | Unknown | | | | * |
| | | 5.520 | 104 | | | | √ | |
| | | 5.540 | 108 | | | | | * |
| | | 5.560 | 112 | | | | | * |
| | | 5.580 | 116 | | | | √ | |
| | | 5.600 | 120 | | | | | * |
| | | 5.620 | 124 | | | | √ | |
| | | 5.640 | 128 | | | | | * |
| | | 5.660 | 132 | | | | | * |
| | | 5.680 | 136 | | | | √ | |
| | | 5.700 | 140 | | | | | * |
| | UNII or §15.247 | 5.745 | 149 | | √ | | √ | |
| | | 5.765 | 153 | 152 (5.76 GHz) | | * | | * |
| | | 5.785 | 157 | | √ | | | * |
| | | 5.805 | 161 | 160 (5.80 GHz) | | * | √ | |
| | §15.247 | 5.825 | 165 | | √ | | | |

**Table 11-2**
**IEEE 802.11b Average RF Power**

| Freq [MHz] | Channel | Data Rate [Mbps] | Average Power (dBm) |
|---|---|---|---|
| 2412 | 1 | 1 | 13.6 |
| | | 2 | 13.7 |
| | | 5.5 | 13.6 |
| | | 11 | 13.75 |
| 2437 | 6 | 1 | **13.97** |
| | | 2 | 13.91 |
| | | 5.5 | 13.97 |
| | | 11 | 13.82 |
| 2462 | 11 | 1 | 13.82 |
| | | 2 | 13.97 |
| | | 5.5 | 13.92 |
| | | 11 | 13.96 |

**Table 11-3**
**IEEE 802.11g Average RF Power**

| Freq [MHz] | Channel | Data Rate [Mbps] | Average Power (dBm) |
|---|---|---|---|
| 2412 | 1 | 6 | 10.73 |
| | | 9 | 10.76 |
| | | 12 | 10.72 |
| | | 18 | 10.75 |
| | | 24 | 10.70 |
| | | 36 | 10.70 |
| | | 48 | 10.67 |
| | | 54 | 10.66 |
| 2437 | 6 | 6 | 10.92 |
| | | 9 | 11.02 |
| | | 12 | 10.73 |
| | | 18 | 10.77 |
| | | 24 | 10.90 |
| | | 36 | 10.82 |
| | | 48 | 10.91 |
| | | 54 | 10.90 |
| 2462 | 11 | 6 | 10.84 |
| | | 9 | 10.85 |
| | | 12 | 10.87 |
| | | 18 | 10.90 |
| | | 24 | 10.81 |
| | | 36 | 10.95 |
| | | 48 | 10.75 |
| | | 54 | 10.80 |

**Table 11-4**
**IEEE 802.11n (800ns) Average RF Power**

| Freq [MHz] | Channel | Data Rate [Mbps] | Average Power (dBm) |
|---|---|---|---|
| 2412 | 1 | 6.5 | 9.50 |
| | | 13 | 9.20 |
| | | 19.5 | 9.20 |
| | | 26 | 9.16 |
| | | 29 | 9.20 |
| | | 52 | 9.22 |
| | | 58.5 | 9.15 |
| | | 65 | 9.20 |
| 2437 | 6 | 6.5 | 9.50 |
| | | 13 | 9.50 |
| | | 19.5 | 9.50 |
| | | 26 | 9.25 |
| | | 29 | 9.45 |
| | | 52 | 9.40 |
| | | 58.5 | 9.45 |
| | | 65 | 9.50 |
| 2462 | 11 | 6.5 | 9.70 |
| | | 13 | 9.50 |
| | | 19.5 | 9.40 |
| | | 26 | 9.40 |
| | | 29 | 9.45 |
| | | 52 | 9.50 |
| | | 58.5 | 9.40 |
| | | 65 | 9.33 |

**Table 11-5**
**IEEE 802.11n (400ns) Average RF Power**

| Freq [MHz] | Channel | Data Rate [Mbps] | Average Power (dBm) |
|---|---|---|---|
| 2412 | 1 | 7.2 | 9.40 |
| | | 14.4 | 9.30 |
| | | 21.7 | 9.20 |
| | | 28.9 | 9.30 |
| | | 43.3 | 9.25 |
| | | 57.8 | 9.20 |
| | | 65 | 9.20 |
| | | 72.2 | 9.25 |
| 2437 | 6 | 7.2 | 9.45 |
| | | 14.4 | 9.30 |
| | | 21.7 | 9.30 |
| | | 28.9 | 9.50 |
| | | 43.3 | 9.50 |
| | | 57.8 | 9.56 |
| | | 65 | 9.30 |
| | | 72.2 | 9.40 |
| 2462 | 11 | 7.2 | 9.50 |
| | | 14.4 | 9.61 |
| | | 21.7 | 9.50 |
| | | 28.9 | 9.60 |
| | | 43.3 | 9.52 |
| | | 57.8 | 9.50 |
| | | 65 | 9.60 |
| | | 72.2 | 9.52 |

Justification for reduced test configurations for WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes: Highest average RF output power channel for the lowest data rate were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers were not greater than 0.25 dB than that of the tested channel in the lowest data rate IEEE 802.11b mode. The bolded powers in the above tables were tested for SAR.

Note: Output powers are identical to the original filing since this permissive change is to add an external accessory.

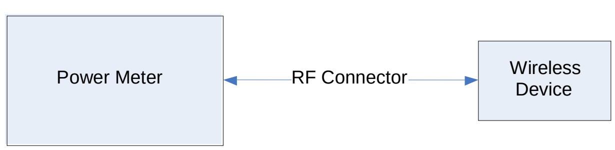



**Figure 11-1**
**Power Measurement Setup**

# 12 4G WIMAX LINEARITY & SAR CONSIDERATIONS

## 12.1 WIMAX Measured Maximum RF Output Conducted Powers

A. This device is capable of two different Channel Bandwidths (5MHz, 10 MHz), two zone types (PUSC and Band AMC) and two antennas.

B. Specific WIMAX configurations were selected for SAR testing according to WIMAX procedures in FCC KDB 615223 publication D01, and April & October 2010 FCC/TCB Workshop slides. Please see the notes following the SAR data in Section 15 for the determination of the required test configurations.

C. The devices were configured with proprietary test software. This software allows the user to fix the test frequency power. An external downlink signal was provided from a vector signal generator that contained a DL:UL ratio of 29:18 consisting of 15 traffic symbols and 3 inactive control symbols. All samples used for SAR tests were confirmed to be electrically identical with the manufacturer.

**Table 12-1**
**Measured WIMAX RF Output Powers**

| | Bandwidth | Frequency [MHz] | QPSK (CTC) 1/2 | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Ant 1 Average [dBm] | Ant 1 Peak [dBm] | PAR [dB] | Ant 2 Average [dBm] | Ant 2 Peak [dBm] | PAR [dB] |
| PUSC | 5MHz | 2498.50 | 23.87 | 32.91 | 9.04 | 23.82 | 32.70 | 8.88 |
| | | 2600.00 | **23.94** | **32.43** | 8.49 | 23.86 | 32.35 | 8.49 |
| | | 2687.50 | 24.00 | 32.23 | 8.23 | 23.66 | 32.49 | 8.83 |
| | 10MHz | 2501.00 | 23.27 | 32.04 | 8.77 | 22.99 | 31.84 | 8.85 |
| | | 2600.00 | **23.22** | **31.70** | 8.48 | 22.96 | 31.55 | 8.59 |
| | | 2685.00 | 23.10 | 31.66 | 8.56 | 23.02 | 31.51 | 8.49 |
| BAMC | 5MHz | 2498.50 | 23.46 | 32.92 | 9.46 | 23.45 | 32.56 | 9.11 |
| | | 2600.00 | **23.57** | **32.46** | 8.89 | 23.51 | 32.41 | 8.90 |
| | | 2687.50 | 23.37 | 32.47 | 9.10 | 23.31 | 32.41 | 9.10 |
| | 10MHz | 2501.00 | 22.95 | 32.68 | 9.73 | 22.91 | 32.39 | 9.48 |
| | | 2600.00 | **22.93** | **32.13** | 9.20 | 22.61 | 32.10 | 9.49 |
| | | 2685.00 | 22.81 | 32.24 | 9.43 | 22.82 | 32.27 | 9.45 |

| | Bandwidth | Frequency [MHz] | QPSK (CTC) 3/4 | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Ant 1 Average | Ant 1 Peak | PAR | Ant 2 Average | Ant 2 Peak | PAR |
| | | | [dBm] | [dBm] | [dB] | [dBm] | [dBm] | [dB] |
| PUSC | 5MHz | 2498.50 | 23.60 | 32.64 | 9.04 | 23.58 | 32.42 | 8.84 |
| | | 2600.00 | 23.45 | 31.95 | 8.50 | 23.61 | 32.05 | 8.44 |
| | | 2687.50 | 23.46 | 32.22 | 8.76 | 23.43 | 32.27 | 8.84 |
| | 10MHz | 2501.00 | 23.02 | 32.12 | 9.10 | 22.98 | 31.64 | 8.66 |
| | | 2600.00 | 22.99 | 31.68 | 8.69 | 22.95 | 31.50 | 8.55 |
| | | 2685.00 | 22.91 | 31.57 | 8.66 | 22.85 | 31.63 | 8.78 |
| BAMC | 5MHz | 2498.50 | 23.39 | 32.85 | 9.46 | 23.38 | 32.65 | 9.27 |
| | | 2600.00 | 23.49 | 32.40 | 8.91 | 23.61 | 32.33 | 8.72 |
| | | 2687.50 | 23.51 | 32.37 | 8.86 | 23.48 | 32.42 | 8.94 |
| | 10MHz | 2501.00 | 22.96 | 32.28 | 9.32 | 22.91 | 32.16 | 9.25 |
| | | 2600.00 | 22.91 | 31.98 | 9.07 | 22.63 | 31.94 | 9.31 |
| | | 2685.00 | 22.83 | 31.92 | 9.09 | 22.78 | 32.00 | 9.22 |

| | Bandwidth | Frequency [MHz] | 16QAM (CTC) 1/2 | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Ant 1 Average | Ant 1 Peak | PAR | Ant 2 Average | Ant 2 Peak | PAR |
| | | | [dBm] | [dBm] | [dB] | [dBm] | [dBm] | [dB] |
| PUSC | 5MHz | 2498.50 | 23.62 | 32.64 | 9.02 | 23.33 | 32.49 | 9.16 |
| | | 2600.00 | 23.45 | 32.11 | 8.66 | 23.56 | 32.10 | 8.54 |
| | | 2687.50 | 23.56 | 32.14 | 8.58 | 23.35 | 32.23 | 8.88 |
| | 10MHz | 2501.00 | 23.01 | 32.22 | 9.21 | 22.98 | 32.06 | 9.08 |
| | | 2600.00 | 23.01 | 31.83 | 8.82 | 22.94 | 31.64 | 8.70 |
| | | 2685.00 | 23.04 | 31.38 | 8.34 | 22.86 | 31.82 | 8.96 |
| BAMC | 5MHz | 2498.50 | 23.43 | 32.92 | 9.49 | 23.58 | 32.71 | 9.13 |
| | | 2600.00 | 23.45 | 32.47 | 9.02 | 23.46 | 32.40 | 8.94 |
| | | 2687.50 | 23.56 | 32.44 | 8.88 | 23.49 | 32.50 | 9.01 |
| | 10MHz | 2501.00 | 22.87 | 32.65 | 9.78 | 22.84 | 32.35 | 9.51 |
| | | 2600.00 | 22.85 | 32.03 | 9.18 | 22.57 | 32.04 | 9.47 |
| | | 2685.00 | 22.80 | 32.19 | 9.39 | 22.77 | 32.19 | 9.42 |

| | Bandwidth | Frequency [MHz] | 16QAM (CTC) 3/4 | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Ant 1 Average | Ant 1 Peak | PAR | Ant 2 Average | Ant 2 Peak | PAR |
| | | | [dBm] | [dBm] | [dB] | [dBm] | [dBm] | [dB] |
| PUSC | 5MHz | 2498.50 | 23.47 | 32.63 | 9.16 | 23.41 | 32.42 | 9.01 |
| | | 2600.00 | 23.34 | 32.16 | 8.82 | 23.45 | 32.09 | 8.64 |
| | | 2687.50 | 23.57 | 32.25 | 8.68 | 23.54 | 32.27 | 8.73 |
| | 10MHz | 2501.00 | 22.95 | 32.08 | 9.13 | 22.93 | 31.82 | 8.89 |
| | | 2600.00 | 22.99 | 31.54 | 8.55 | 22.88 | 31.44 | 8.56 |
| | | 2685.00 | 23.02 | 31.60 | 8.58 | 22.99 | 31.63 | 8.64 |
| BAMC | 5MHz | 2498.50 | 23.42 | 32.83 | 9.41 | 23.55 | 32.62 | 9.07 |
| | | 2600.00 | 23.47 | 32.32 | 8.85 | 23.40 | 32.28 | 8.88 |
| | | 2687.50 | 23.51 | 32.33 | 8.82 | 23.48 | 32.29 | 8.81 |
| | 10MHz | 2501.00 | 22.85 | 32.38 | 9.53 | 22.81 | 32.06 | 9.25 |
| | | 2600.00 | 23.02 | 32.04 | 9.02 | 22.51 | 31.93 | 9.42 |
| | | 2685.00 | 22.92 | 32.00 | 9.08 | 22.92 | 31.91 | 8.99 |

Note: The conducted powers for WIMAX with a 5 MHz bandwidth differ from the conducted powers for WIMAX with 10 MHz bandwidth according to the tune-up procedure.

The WIMAX powers measured represent the traffic symbol burst average power. The bolded powers above were tested for SAR.

There is no power reduction for WIMAX.

Output powers are identical to the original filing since this permissive change is to add an external accessory.

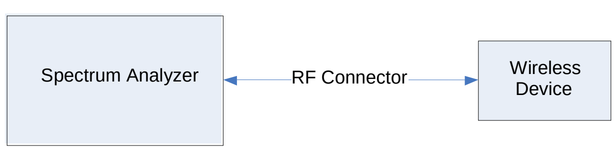



**Figure 12-1**
**Power Measurement Setup**

## 12.2 SAR Probe Linearity Considerations for WIMAX Signals

Testing was performed using test software in order to simulate WIMAX transmission for the purpose of SAR testing; specifically with control symbols deactivated for proper SAR measurements according to the FCC WIMAX KDB Publication 615223 Procedures. The operational description includes details regarding the operation of the software with WIMAX transmission characteristics.

## 12.3 Variation from Expected SAR to do WIMAX PAR

The error due to the PAR of WIMAX was between 7-10%.

## 12.4 Probe Linearity Data and Linearity Graphs

SAR linearity was measured for the zone type, bandwidth, channel and mode that was tested for SAR per April 2010 FCC/TCB Workshop guidance. Please note that, according to October 2010 FCC/TCB Workshop notes, 16-QAM test reduction was not required for SAR given the conducted power measurements and SAR measurements. Therefore 16-QAM linearity plots were not required. See the notes following the SAR data in Section 15 for the description of test configurations used for the SAR assessment.

In order to achieve the appropriate SAR levels for linearity for this handset since the measured SAR was low, the EUT was positioned at 0.0 cm from the flat phantom. For each modulation, BW, and zone type tested for SAR, the probe was moved to the peak SAR location. Then the point SAR readings from the DASY software were measured using the multi-meter function and recorded while decreasing the RF powers starting from the highest maximum output power to a power level closest to 10 mW according to the FCC KDB 615223 publication guidance for testing WIMAX for SAR.

**Table 12-2**
**WIMAX PUSC QPSK Linearity for 5 MHz Bandwidth, Tx 1 Antenna**

| SAR (W/kg) | Zone | PUSC | | | | | |
|---|---|---|---|---|---|---|---|
| | Modulation | QPSK | | | | | |
| | Power (mW) | 9.616 | 19.543 | 39.084 | 77.625 | 123.31 | 244.34 |
| 5 MHz | point SAR | 0.0890 | 0.1845 | 0.3734 | 0.7585 | 1.21 | 2.470 |
| | linear line | 0.0890 | 0.1810 | 0.3619 | 0.7188 | 1.1418 | 2.263 |
| | ε | 0.0% | 2.0% | 3.2% | 5.5% | 6.1% | 9.2% |

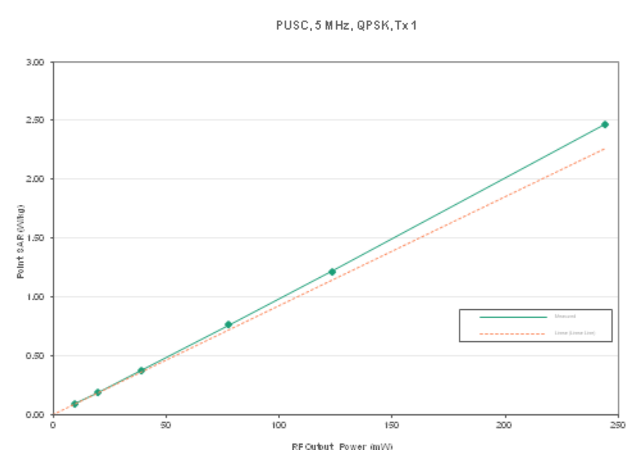


**Table 12-3**
**WIMAX PUSC QPSK Linearity for 10 MHz Bandwidth, Tx 1 Antenna**

| SAR (W/kg) | Zone | PUSC | | | | | |
|---|---|---|---|---|---|---|---|
| | Modulation | QPSK | | | | | |
| | Power (mW) | 10.257 | 20.606 | 41.21 | 82.414 | 130.92 | 207.01 |
| 10 MHz | point SAR | 0.0682 | 0.1424 | 0.2855 | 0.5881 | 0.943 | 1.506 |
| | linear line | 0.0682 | 0.1370 | 0.2740 | 0.5480 | 0.8705 | 1.3765 |
| | ε | 0.0% | 3.9% | 4.2% | 7.3% | 8.4% | 9.4% |

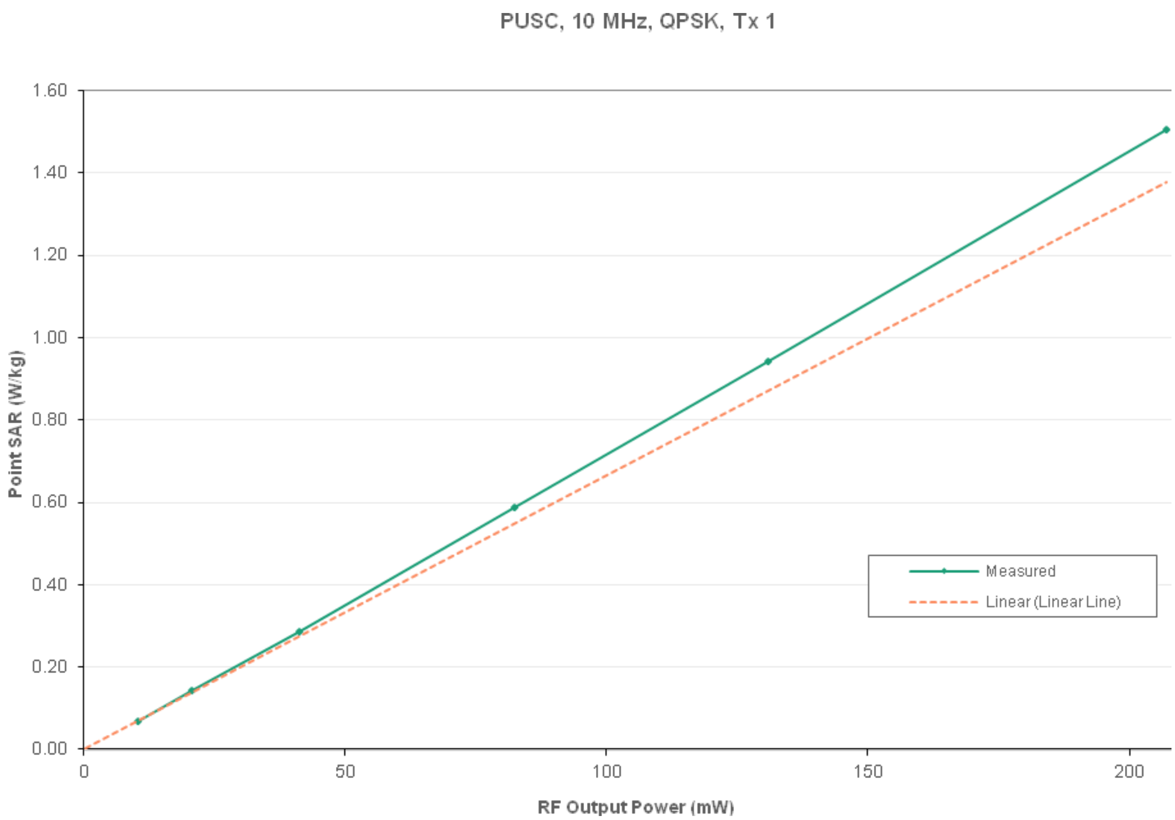


**Table 12-4**
**WIMAX BAMC QPSK Linearity for 5 MHz Bandwidth, Tx 1 Antenna**

| SAR (W/kg) | Zone | AMC | | | | | |
|---|---|---|---|---|---|---|---|
| | Modulation | QPSK | | | | | |
| | Power (mW) | 10.495 | 21.135 | 41.976 | 84.333 | 134.28 | 234.963 |
| 5 MHz | point SAR | 0.0969 | 0.197 | 0.401 | 0.820 | 1.322 | 2.3750 |
| | linear line | 0.0969 | 0.1950 | 0.3874 | 0.7782 | 1.2391 | 2.1683 |
| | ε | 0.0% | 1.2% | 3.5% | 5.4% | 6.7% | 9.5% |

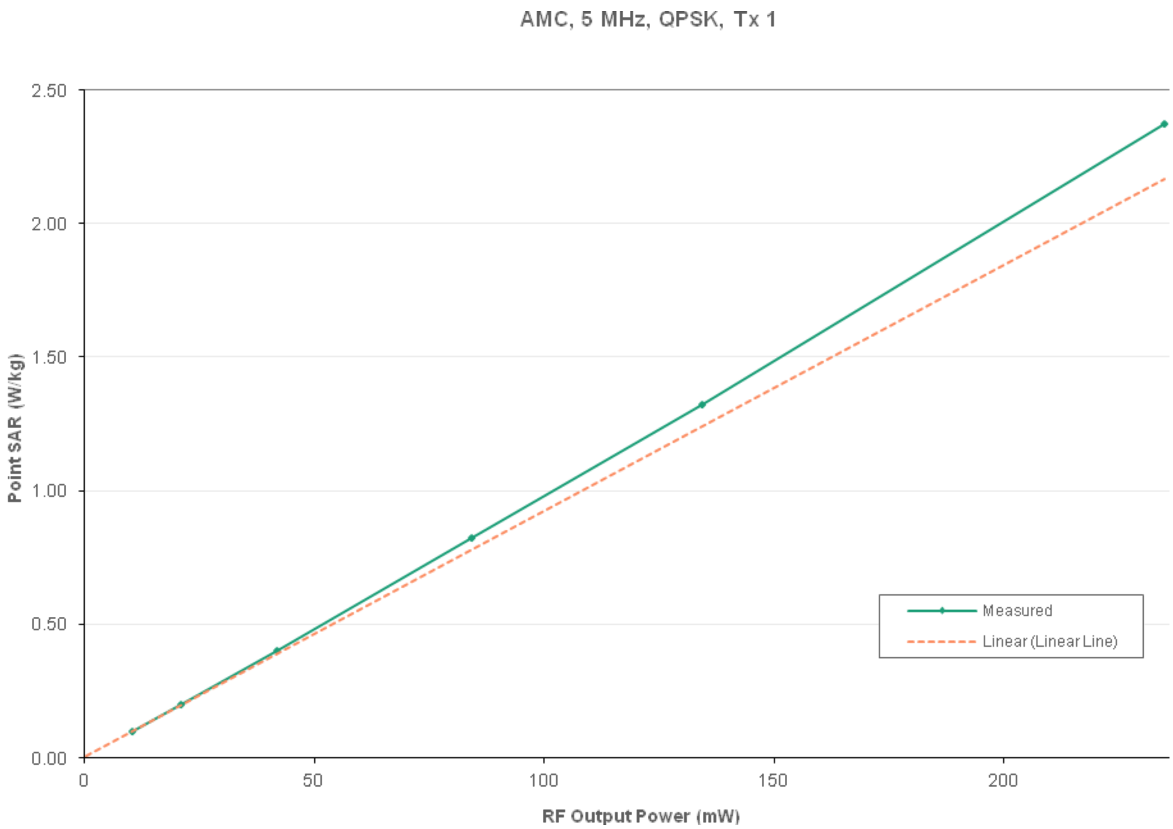


**Table 12-5**
**WIMAX BAMC QPSK Linearity for 10 MHz Bandwidth, Tx 1 Antenna**

| SAR (W/kg) | Zone | AMC | | | | | |
|---|---|---|---|---|---|---|---|
| | Modulation | QPSK | | | | | |
| | Power (mW) | 11.298 | 22.646 | 45.29 | 89.536 | 142.23 | 222.331 |
| 10 MHz | point SAR | 0.1056 | 0.2178 | 0.4402 | 0.8931 | 1.4420 | 2.2810 |
| | linear line | 0.1056 | 0.2117 | 0.4233 | 0.8369 | 1.3294 | 2.0781 |
| | ε | 0.0% | 2.9% | 4.0% | 6.7% | 8.5% | 9.8% |

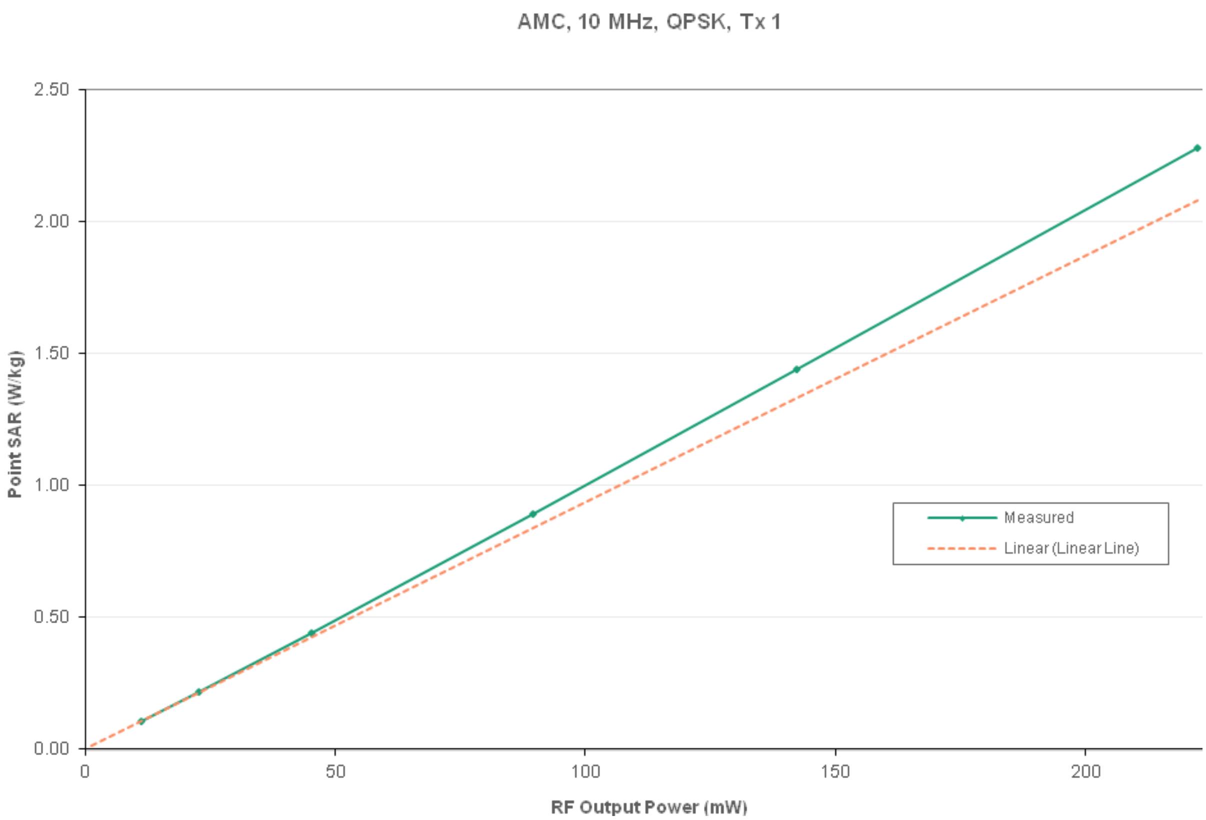


**Table 12-6**
**WIMAX PUSC QPSK Linearity for 5 MHz Bandwidth, Tx 2 Antenna**

| SAR (W/kg) | Zone | PUSC | | | | | |
|---|---|---|---|---|---|---|---|
| | Modulation | QPSK | | | | | |
| | Power (mW) | 9.183 | 18.113 | 36.392 | 72.778 | 115.61 | 225.94 |
| 5 MHz | point SAR | 0.1334 | 0.2724 | 0.5504 | 1.1230 | 1.80 | 3.607 |
| | linear line | 0.1334 | 0.2631 | 0.5287 | 1.0572 | 1.6795 | 3.282 |
| | ε | 0.0% | 3.5% | 4.1% | 6.2% | 7.4% | 9.9% |

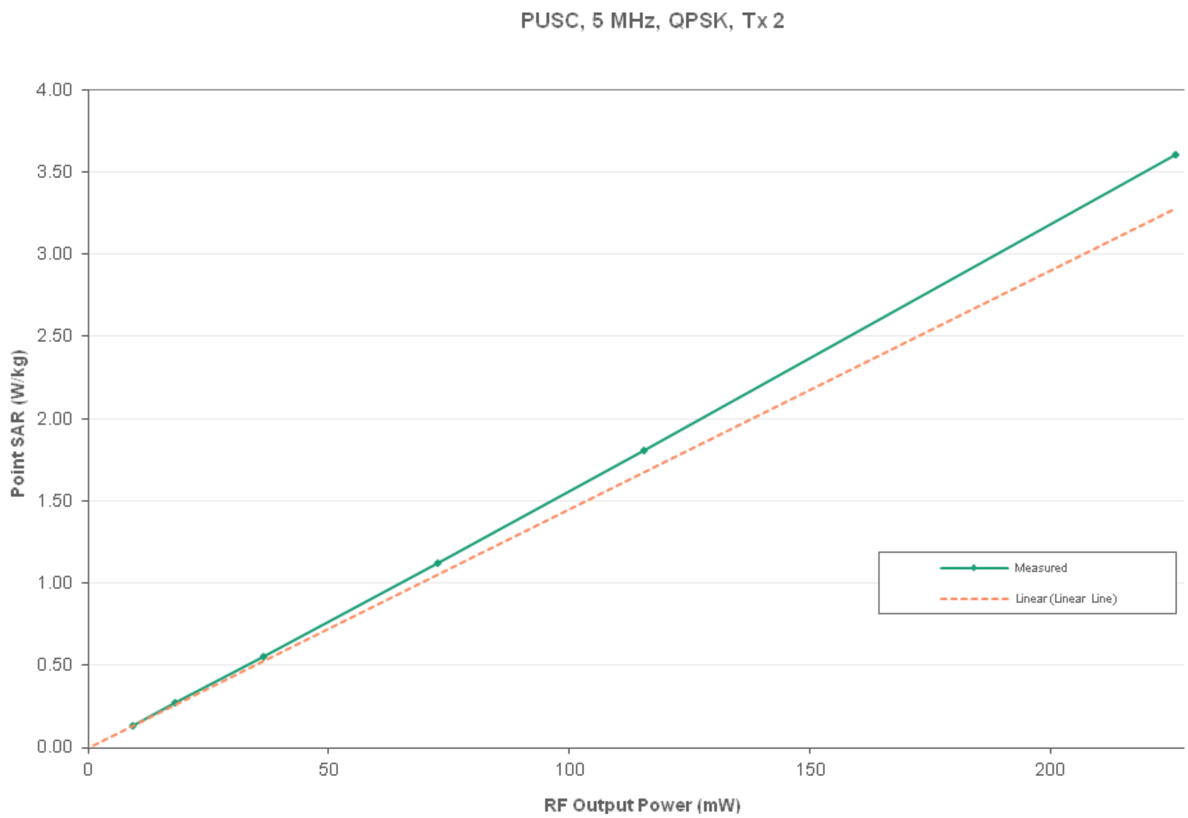


**Table 12-7**
**WIMAX PUSC QPSK Linearity for 10 MHz Bandwidth, Tx 2 Antenna**

| SAR (W/kg) | Zone | PUSC | | | | | |
|---|---|---|---|---|---|---|---|
| | Modulation | QPSK | | | | | |
| | Power (mW) | 9.863 | 19.543 | 38.994 | 77.625 | 122.46 | 193.2 |
| 10 MHz | point SAR | 0.1792 | 0.3643 | 0.7341 | 1.5020 | 2.414 | 3.855 |
| | linear line | 0.1792 | 0.3551 | 0.7085 | 1.4104 | 2.2250 | 3.5102 |
| | ε | 0.0% | 2.6% | 3.6% | 6.5% | 8.5% | 9.8% |

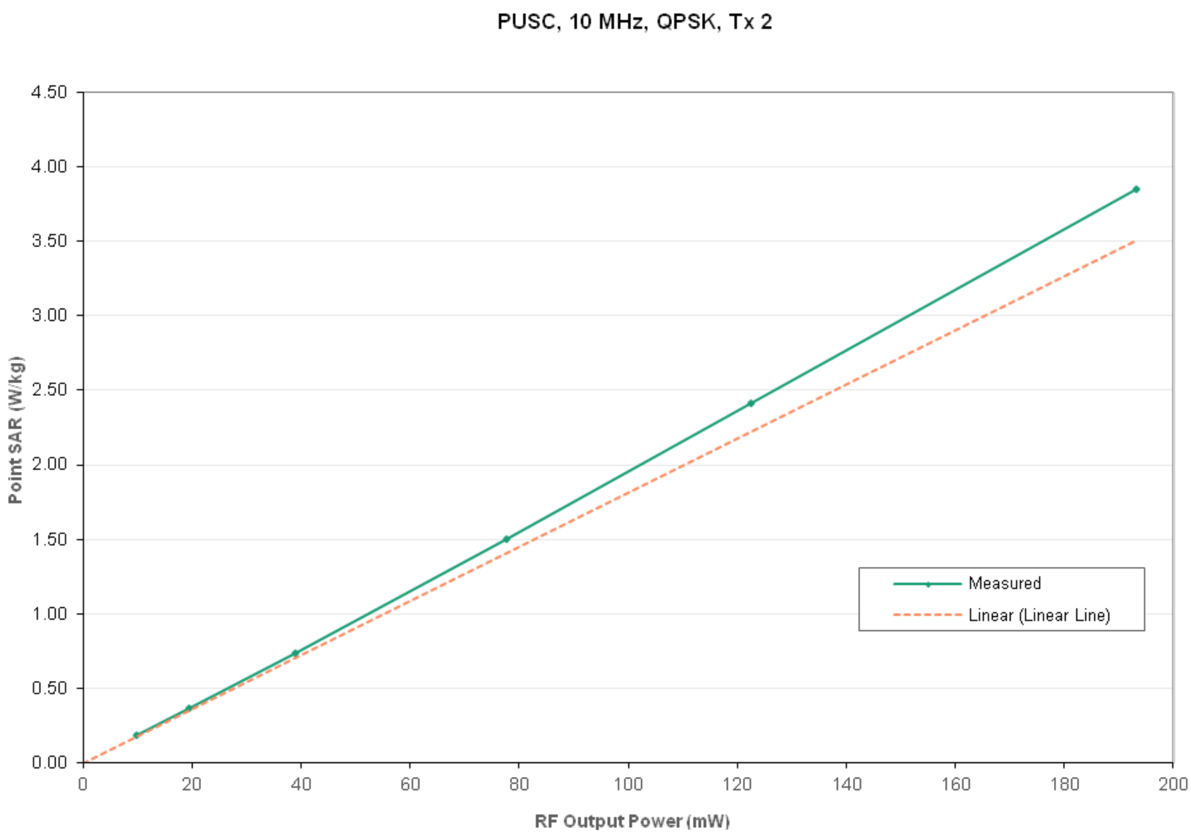


**Table 12-8**
**WIMAX BAMC QPSK Linearity for 5 MHz Bandwidth, Tx 2 Antenna**

| SAR (W/kg) | Zone | AMC | | | | | |
|---|---|---|---|---|---|---|---|
| | Modulation | QPSK | | | | | |
| | Power (mW) | 9.817 | 19.543 | 39.355 | 78.343 | 123.88 | 243.22 |
| 5 MHz | point SAR | 0.1448 | 0.295 | 0.602 | 1.211 | 1.951 | 3.9140 |
| | linear line | 0.1448 | 0.2883 | 0.5805 | 1.1556 | 1.8272 | 3.5875 |
| | ε | 0.0% | 2.4% | 3.8% | 4.8% | 6.8% | 9.1% |

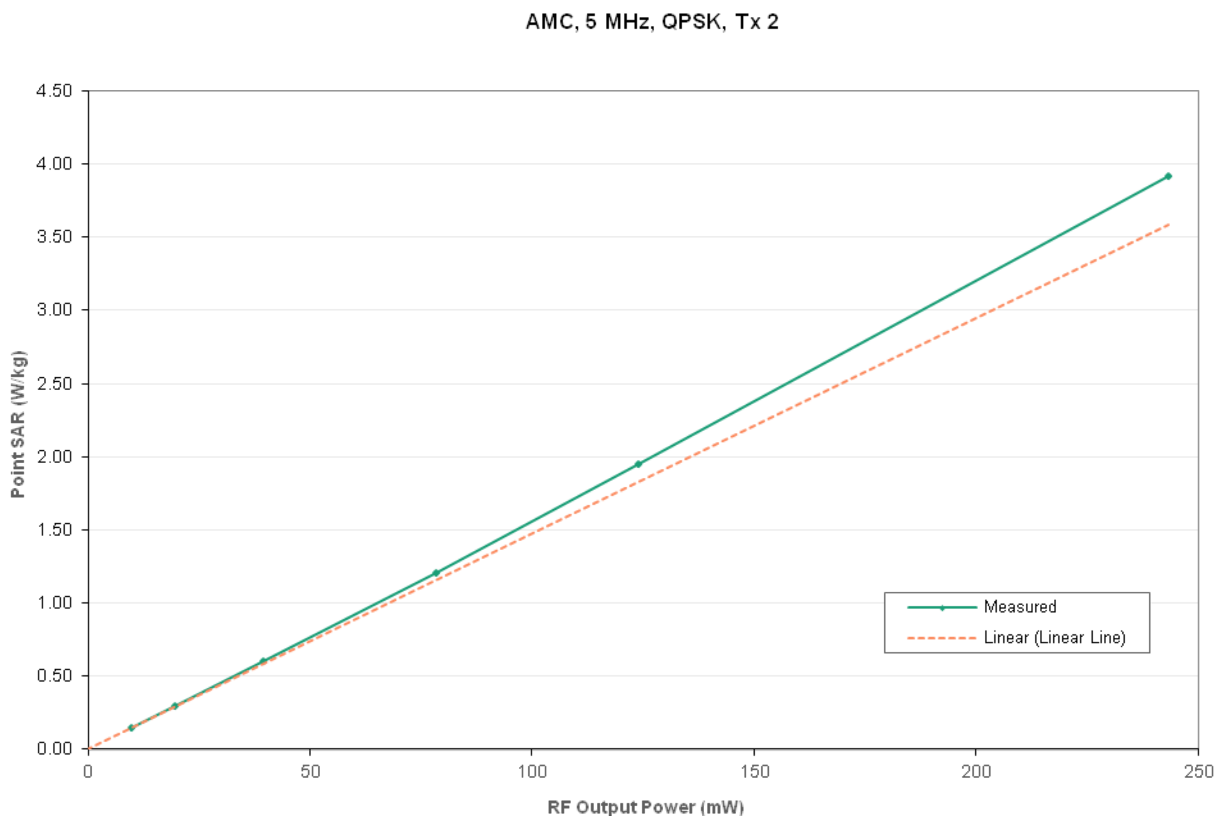
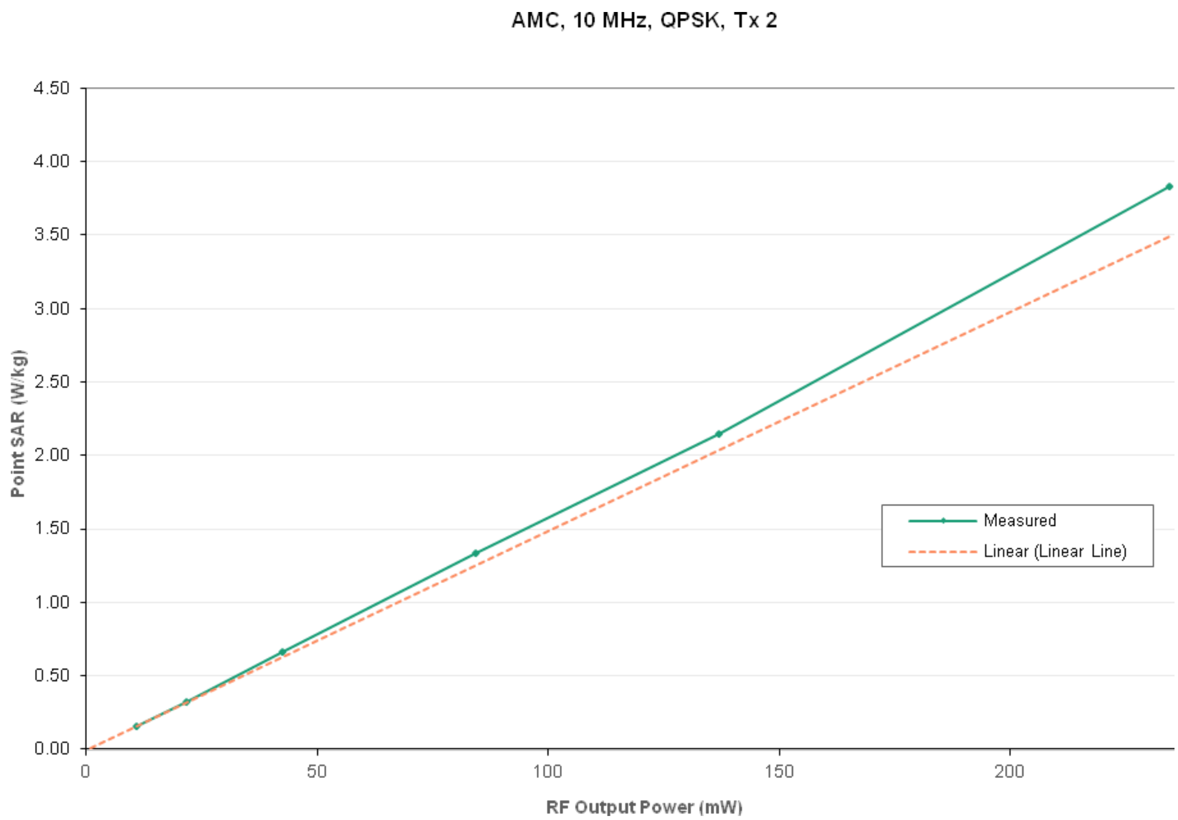


**Table 12-9**
**WIMAX BAMC QPSK Linearity for 10 MHz Bandwidth, Tx 2 Antenna**

| SAR (W/kg) | Zone | AMC | | | | | |
|---|---|---|---|---|---|---|---|
| | Modulation | QPSK | | | | | |
| | Power (mW) | 10.74 | 21.528 | 42.462 | 84.14 | 136.77 | 234.423 |
| 10 MHz | point SAR | 0.1600 | 0.3269 | 0.6604 | 1.3390 | 2.1490 | 3.8280 |
| | linear line | 0.1600 | 0.3207 | 0.6326 | 1.2535 | 2.0376 | 3.4923 |
| | ε | 0.0% | 1.9% | 4.4% | 6.8% | 5.5% | 9.6% |



## 12.5 Spectrum Analyzer Plots for WIMAX

Timing plots for the signal were analyzed to confirm control and traffic symbol duration.

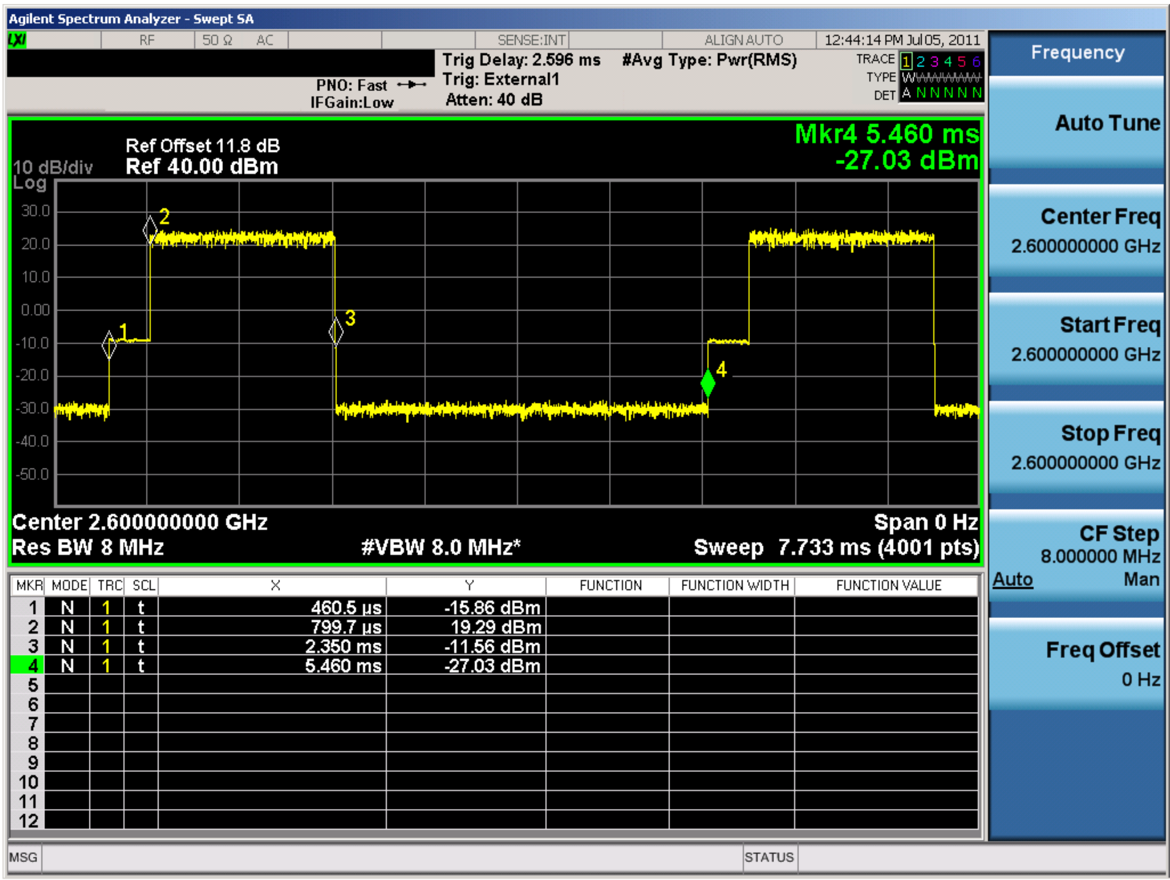



**Figure 12-2**
**Timing Plot for WIMAX Signal – PUSC**

Note: Both 5 MHz and 10 MHz Bandwidths and QPSK and 16-QAM Modulations have identical timing plots.

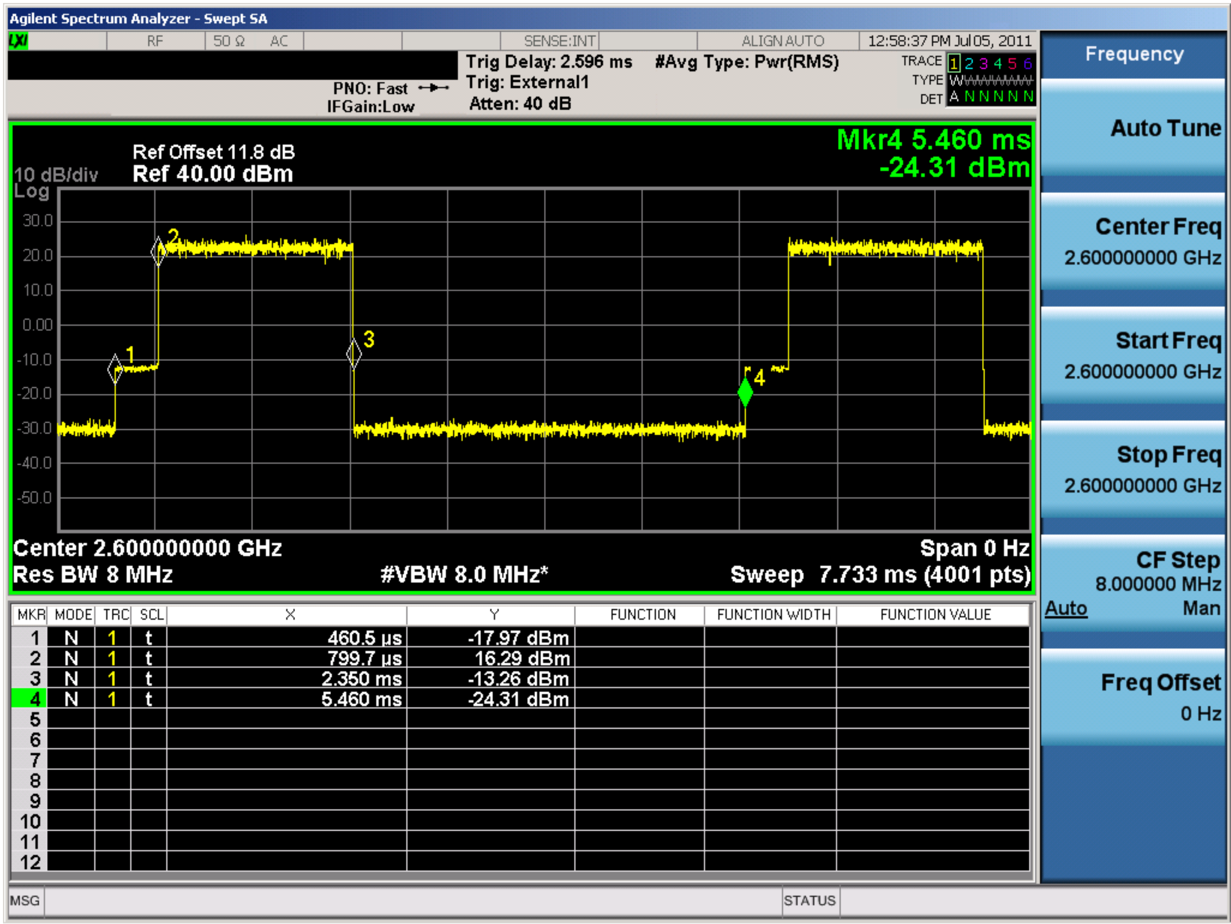



**Figure 12-3**
**Timing Plot for WIMAX Signal – BAMC**

Note: Both 5 MHz and 10 MHz Bandwidths and QPSK and 16-QAM Modulations have identical timing plots.

## 12.6 DASY Crest Factor Calculations

For 5 MHz and 10 MHz:

**Frame Averaged Duty Cycle:** 15/48 = 0.3125
**Duty Factor (DF):** 1/0.3125 = **3.2**

The duty factor is the same for all bandwidths, channels, modulations and zone-types.

## 12.7 WIMAX Error Correction Scaling Factors

The WIMAX error correction scaling factors below in Table 12-10 were applied to the measured SAR results per April 2010 FCC/TCB Workshop Guidance.

Control channels for PUSC occupy 5 slots for operations in the 5MHz and 10MHz bandwidths. For the 10 MHz bandwidth, there are 35 total slots. For the 5 MHz bandwidth, there are 17 total slots. This device transmits 15 traffic symbols and 3 control symbols for all modulations and bandwidths.

The maximum rated power for WIMAX 10 MHz is 199.53 mW. The control symbol power is calculated from this level, to be 28.50 mW.

The maximum rated power for WIMAX 5 MHz is 251.19 mW. The control symbol power is calculated from this level, to be 73.88 mW.

Error Correction Scaling Factors were calculated based on the following equation:

$$SAR\ Scaling\ Factor = \frac{\left(P_{Max} * \frac{\#\ of\ Control\ Slots\ Occupied}{\#\ of\ Slots\ (total)}\right) * \#\ of Control\ Symbols + P_{Max} * \#\ of\ Traffic\ Symbols}{P * \#\ of\ Traffic\ Symbols}$$

Given:
$P_{Max}$ = Maximum Rated Power (mW)
P = Measured Maximum Output Power (mW)

The following is a sample calculation of the SAR Scaling factors:

$$SAR\ Scaling\ Factor(Mid\ Ch, 10MHz\ BW, PUSC, QPSK, Tx\ 1) = \frac{\left(199.53\ mW * \frac{5}{35}\right) * 3 + 199.53\ mW * 15}{209.89\ mW * 15} = 0.98$$

$$SAR\ Scaling\ Factor(Mid\ Ch, 5MHz\ BW, BAMC, QPSK, Tx\ 2) = \frac{\left(251.19\ mW * \frac{5}{17}\right) * 3 + 251.19\ mW * 15}{247.74\ mW * 15} = 1.07$$

## Table 12-10
## WIMAX Scaling Factors

| Frequency [MHz] | Zone Type | Modulation | BW | Tune Up Max in mW | CS+TS Slots | CS Slots | 1 Control Symbol Power [a*c/b] (mW) | Combined power of CS [d*3] (mW) | Measured Average RF Output Power | | | SAR Error Correction Scaling Factor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Tx Antenna | dBm | mW | |
| Low | PUSC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 23.27 | 212.32 | 0.97 |
| | PUSC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 23.01 | 199.99 | 1.03 |
| | Band AMC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 22.95 | 197.24 | 1.04 |
| | Band AMC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 22.87 | 193.64 | 1.06 |
| Mid | PUSC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 23.22 | 209.89 | 0.98 |
| | PUSC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 23.01 | 199.99 | 1.03 |
| | Band AMC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 22.93 | 196.34 | 1.05 |
| | Band AMC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 22.85 | 192.75 | 1.06 |
| High | PUSC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 23.10 | 204.17 | 1.01 |
| | PUSC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 23.04 | 201.37 | 1.02 |
| | Band AMC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 22.81 | 190.99 | 1.07 |
| | Band AMC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 1 | 22.80 | 190.55 | 1.08 |
| Low | PUSC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.87 | 243.78 | 1.09 |
| | PUSC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.62 | 230.14 | 1.16 |
| | Band AMC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.46 | 221.82 | 1.20 |
| | Band AMC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.43 | 220.29 | 1.21 |
| Mid | PUSC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.94 | 247.74 | 1.07 |
| | PUSC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.45 | 221.31 | 1.20 |
| | Band AMC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.57 | 227.51 | 1.17 |
| | Band AMC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.45 | 221.31 | 1.20 |
| High | PUSC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 24.00 | 251.19 | 1.06 |
| | PUSC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.56 | 226.99 | 1.17 |
| | Band AMC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.37 | 217.27 | 1.22 |
| | Band AMC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 1 | 23.56 | 226.99 | 1.17 |
| Low | PUSC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.99 | 199.07 | 1.03 |
| | PUSC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.98 | 198.61 | 1.03 |
| | Band AMC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.91 | 195.43 | 1.05 |
| | Band AMC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.84 | 192.31 | 1.07 |
| Mid | PUSC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.96 | 197.70 | 1.04 |
| | PUSC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.94 | 196.79 | 1.04 |
| | Band AMC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.61 | 182.39 | 1.13 |
| | Band AMC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.57 | 180.72 | 1.14 |
| High | PUSC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 23.02 | 200.45 | 1.02 |
| | PUSC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.86 | 193.20 | 1.06 |
| | Band AMC | QPSK | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.82 | 191.43 | 1.07 |
| | Band AMC | 16QAM | 10 MHz | 199.53 | 35 | 5 | 28.50 | 85.51 | 2 | 22.77 | 189.23 | 1.08 |
| Low | PUSC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.82 | 240.99 | 1.10 |
| | PUSC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.33 | 215.28 | 1.24 |
| | Band AMC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.45 | 221.31 | 1.20 |
| | Band AMC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.58 | 228.03 | 1.17 |
| Mid | PUSC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.86 | 243.22 | 1.09 |
| | PUSC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.56 | 226.99 | 1.17 |
| | Band AMC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.51 | 224.39 | 1.19 |
| | Band AMC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.46 | 221.82 | 1.20 |
| High | PUSC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.66 | 232.27 | 1.15 |
| | PUSC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.35 | 216.27 | 1.23 |
| | Band AMC | QPSK | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.31 | 214.29 | 1.24 |
| | Band AMC | 16QAM | 5 MHz | 251.19 | 17 | 5 | 73.88 | 221.64 | 2 | 23.49 | 223.36 | 1.19 |

The rated power for each zone is within the tune-up maximum of 24.0 dBm for 5 MHz BW and 23.0 dBm for 10 MHz BW. The rated maximum power is the same for all higher coding rates.

# 13 SYSTEM VERIFICATION

## 13.1 Tissue Verification

**Table 13-1**
**Measured Tissue Properties**

| Calibrated for Tests Performed on: | Tissue Type | Tissue Temp During Calibration (C°) | Measured Frequency (MHz) | Measured Conductivity, σ (S/m) | Measured Dielectric Constant, ε | TARGET Conductivity, σ (S/m) | TARGET Dielectric Constant, ε | % dev σ | % dev ε |
|---|---|---|---|---|---|---|---|---|---|
| 09/15/2011 | 835B | 22.9 | 820 | 0.967 | 54.60 | 0.969 | 55.284 | -0.21% | -1.24% |
| | | | 835 | 0.975 | 54.52 | 0.970 | 55.200 | 0.52% | -1.23% |
| | | | 850 | 0.985 | 54.37 | 0.988 | 55.154 | -0.30% | -1.42% |
| 10/06/2011 | 835B | 22.0 | 820 | 0.961 | 54.51 | 0.969 | 55.284 | -0.83% | -1.40% |
| | | | 835 | 0.985 | 54.51 | 0.970 | 55.200 | 1.55% | -1.25% |
| | | | 850 | 0.994 | 54.24 | 0.988 | 55.154 | 0.61% | -1.66% |
| 09/18/2011 | 1900B | 23.0 | 1850 | 1.493 | 52.07 | 1.520 | 53.300 | -1.78% | -2.31% |
| | | | 1880 | 1.508 | 51.97 | 1.520 | 53.300 | -0.79% | -2.50% |
| | | | 1910 | 1.549 | 51.83 | 1.520 | 53.300 | 1.91% | -2.76% |
| 10/05/2011 | 1900B | 23.8 | 1850 | 1.455 | 52.11 | 1.520 | 53.300 | -4.28% | -2.23% |
| | | | 1880 | 1.487 | 52.06 | 1.520 | 53.300 | -2.17% | -2.33% |
| | | | 1910 | 1.523 | 51.90 | 1.520 | 53.300 | 0.20% | -2.63% |
| 09/19/2011 | 2450B | 23.4 | 2401 | 1.867 | 50.81 | 1.903 | 52.765 | -1.89% | -3.71% |
| | | | 2450 | 1.932 | 50.67 | 1.950 | 52.700 | -0.92% | -3.85% |
| | | | 2499 | 2.003 | 50.48 | 2.019 | 52.638 | -0.79% | -4.10% |
| 09/19/2011 | 2600B | 22.9 | 2600 | 2.059 | 50.97 | 2.163 | 52.509 | -4.81% | -2.93% |

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

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

## 13.2 Measurement Procedure for Tissue verification

1) The network analyzer and probe system was configured and calibrated.
2) The probe was immersed in the sample which was placed in a nonmetallic container. Trapped air bubbles beneath the flange were minimized by placing the probe at a slight angle.
3) The complex admittance with respect to the probe aperture was measured
4) The complex relative permittivity , for example from the below equation (Pournaropoulos and Misra):

$$Y = \frac{j2\omega\varepsilon_r\varepsilon_0}{[\ln(b/a)]^2}\int_a^b\int_a^b\int_0^\pi \cos\phi' \frac{\exp\left[-j\omega r(\mu_0\varepsilon_r'\varepsilon_0)^{1/2}\right]}{r} d\phi' d\rho' d\rho$$

where $Y$ is the admittance of the probe in contact with the sample, the primed and unprimed coordinates refer to source and observation points, respectively, $r^2 = \rho^2 + \rho'^2 - 2\rho\rho'\cos\phi'$, $\omega$ is the angular frequency, and $j = \sqrt{-1}$.

## 13.3 Test System Verification

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

**Table 13-2**
**System Verification Results**

| System Verification TARGET & MEASURED | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Date: | Amb. Temp (°C) | Liquid Temp (°C) | Input Power (W) | Tissue Frequency (MHz) | Dipole SN | Probe SN | Tissue Type | Measured $SAR_{1g}$ (W/kg) | 1 W Target $SAR_{1g}$ (W/kg) | 1 W Normalized $SAR_{1g}$ (W/kg) | Deviation (%) |
| 09/15/2011 | 23.5 | 21.8 | 0.100 | 835 | 4d047 | 3258 | Body | 0.955 | 9.850 | 9.550 | -3.05% |
| 10/06/2011 | 22.1 | 21.8 | 0.100 | 835 | 4d047 | 3258 | Body | 0.983 | 9.850 | 9.830 | -0.20% |
| 09/18/2011 | 24.2 | 22.8 | 0.100 | 1900 | 5d080 | 3209 | Body | 4.12 | 40.900 | 41.200 | 0.73% |
| 10/05/2011 | 23.1 | 22.5 | 0.100 | 1900 | 502 | 3209 | Body | 4.33 | 41.100 | 43.300 | 5.35% |
| 09/19/2011 | 24.7 | 23.1 | 0.0158 | 2450 | 719 | 3209 | Body | 0.872 | 51.300 | 55.190 | 7.58% |
| 09/19/2011 | 24.2 | 22.9 | 0.0158 | 2600 | 1004 | 3209 | Body | 0.87 | 58.900 | 55.063 | -6.51% |

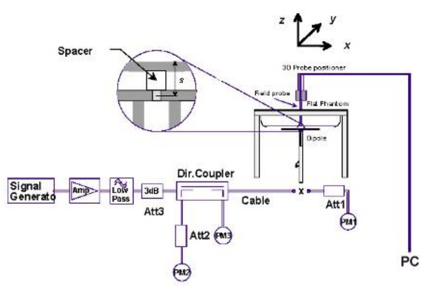



**Figure 13-1**
**System Verification Setup Diagram**

**Figure 13-2**
**System Verification Setup Photo**

# 14 SAR TEST SETUP PER KDB INQUIRY DISCUSSIONS

## 14.1 SAR Test Setup

The lapdock was placed below a SAM phantom with the base of the laptop in contact with the flat portion of the phantom and the screen opened 90 degrees. A cable connects the lapdock to the phone and the phone is positioned in a slot behind the screen. There is only one orientation for the phone with respect to the lapdock. The SAR test setup photographs show device positioning and setup.

## 14.2 Simultaneous Transmission

When in the lapdock configuration, this device supports simultaneous transmission scenarios, including CDMA/EVDO Hotspot, WIMAX Hotspot and CDMA Voice + WIMAX Hotspot. See Section 16 for simultaneous transmission analysis.

## 14.3 Power Reduction

There is no power reduction in portable hotspot mode for this device when being used with the lapdock due to the manufacturer's algorithm for power reduction. The operational description contains details of the power reduction algorithm. Therefore mobile hotspot scenarios with Lapdock accessory were assessed in Section 16 without power reduction applied (i.e. maximum output power).

# 15 SAR DATA SUMMARY

**Table 15-1**
**CDMA Body SAR Results**

| MEASUREMENT RESULTS | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Conducted Power [dBm] | Power Drift [dB] | Spacing | Phone Serial Number | Position | SAR (1g) |
| MHz | Ch. | | | | | | | | (W/kg) |
| 836.52 | 384 | Cell. CDMA | EVDO | 25.12 | 0.02 | 0.0 cm | LSNW230069 | Lapdock | 0.743 |
| 836.52 | 384 | Cell. CDMA | SO55 | 25.19 | 0.00 | 0.0 cm | LSNW230069 | Lapdock | 0.749 |
| 1880.00 | 600 | PCS CDMA | EVDO | 25.36 | 0.02 | 0.0 cm | LSNW230069 | Lapdock | 0.434 |
| 1880.00 | 600 | PCS CDMA | SO55 | 25.30 | -0.01 | 0.0 cm | LSNW230069 | Lapdock | 0.556 |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | |

Notes:
1. The test data reported are the worst-case SAR value with the position set in a typical configuration (See Section 14.1). Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001].
2. Batteries are fully charged for all readings. Standard battery was used.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Liquid tissue depth was at least 15.0 cm.
5. Justification for reduced test configurations: Per FCC/OET Bulletin 65 Supplement C (June 2001) and Public Notice DA-02-1438, if the SAR measured at the middle channel for each test configuration is at least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).
6. CDMA Body SAR was tested under EVDO Rev. 0 per FCC 3G Guidance (See Section 10.2.3) per FCC KDB Publication 941225 D01. Rev. A and TDSO32 RC3 tests were not required since the maximum average output of each channel in Rev. A and RC3 (1x RTT) was not more than ¼ dB higher than that measured Rev 0.
7. CDMA Body SAR was additionally tested with RC3/SO55 to cover the simultaneous transmission scenario of CDMA Voice + WLAN data and CDMA Voice+WIMAX Hotspot.
8. To confirm the proper SAR liquid depth, the z-axis plots are included from the system verification using with the same liquid as the SAR tests.

**Table 15-2**
**WIMAX Body SAR Results**

| MEASUREMENT RESULTS | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY MHz | Mode | Zone Type | Modulation | Bandwidth [MHz] | Tx Antenna | Conducted Power [dBm] | Power Drift [dB] | Spacing | Phone Serial Number | Position | Measured SAR (1g) (W/kg) | Scaling Factor | Scaled SAR (1g) (W/kg) |
| 2600 | WIMAX | PUSC | QPSK | 5 | 1 | 23.94 | 0.00 | 0.0 cm | LSNW270089 | Lapdock | 0.172 | 1.074 | 0.185 |
| 2600 | WIMAX | PUSC | QPSK | 10 | 1 | 23.22 | 0.06 | 0.0 cm | LSNW270089 | Lapdock | 0.115 | 0.978 | 0.112 |
| 2600 | WIMAX | BAMC | QPSK | 5 | 1 | 23.57 | 0.06 | 0.0 cm | LSNW270089 | Lapdock | 0.137 | 1.169 | 0.160 |
| 2600 | WIMAX | BAMC | QPSK | 10 | 1 | 22.93 | 0.04 | 0.0 cm | LSNW270089 | Lapdock | 0.137 | 1.045 | 0.143 |
| 2600 | WIMAX | PUSC | QPSK | 5 | 2 | 23.86 | 0.07 | 0.0 cm | LSNW270089 | Lapdock | 0.258 | 1.094 | 0.282 |
| 2600 | WIMAX | PUSC | QPSK | 10 | 2 | 22.96 | -0.06 | 0.0 cm | LSNW270089 | Lapdock | 0.217 | 1.038 | 0.225 |
| 2600 | WIMAX | BAMC | QPSK | 5 | 2 | 23.51 | -0.06 | 0.0 cm | LSNW270089 | Lapdock | 0.274 | 1.185 | 0.325 |
| 2600 | WIMAX | BAMC | QPSK | 10 | 2 | 22.61 | -0.08 | 0.0 cm | LSNW270089 | Lapdock | 0.195 | 1.125 | 0.219 |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | | |

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration (See Section 14.1). Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001].
2. Batteries are fully charged for all readings. Standard battery was used.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Liquid tissue depth was at least 15.0 cm.
5. Per KDB Publication 447498 D01 v04 1)e)ii), for operating bands where the transmission band corresponding to all channels is ≤ 200 MHz, if the SAR measured at the middle channel for each test configuration is less than 0.4 W/kg, testing for other channels is not required.
6. SAR Test configurations per FCC KDB Publication 615223 and April/Oct. 2010 FCC/TCB Workshop Notes :
    a. This device supports two coding rates (1/2 and 3/4) that are rated to the same maximum output power. Since the higher rates were not more than 0.25 dB from the lowest coding rate, only the lowest coding rate (1/2) was tested.
    b. 16 QAM was not required to be tested since the output power for 16-QAM was not more than 0.25 higher than QPSK and the QPSK SAR was less than 0.8 W/kg.
    c. This device supports BAMC and PUSC Zone types.
    d. The average output power of BAMC zone type is lower than PUSC zone type for all configurations measured. Therefore, WIMAX SAR for BAMC Zone type was tested in the highest SAR configuration determined in each PUSC configuration.
    e. WIMAX SAR was scaled according to FCC WIMAX requirements (See Section 14.7). The device was configured to operate with 15 traffic symbols active and the 3 control symbols inactive for SAR testing purposes. The SAR result was then scaled up to the maximum tune up power for both the maximum output power for 15 traffic symbols and 3 control symbols. The SAR plots reflect measured SAR values.
    f. Crest Factor used for the SAR system for the WIMAX signal for 5 MHz and 10 MHz BW was 1/(15/48) = 3.2.
    g. The scaled SAR was used to determine test reduction scenarios.
7. To confirm the proper SAR liquid depth, the z-axis plots are included from the system verification using with the same liquid as the SAR tests.

**Table 15-3**
**WLAN Body SAR Results**

| MEASUREMENT RESULTS | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| FREQUENCY | | Mode | Service | Conducted Power [dBm] | Power Drift [dB] | Spacing | Phone Serial Number | Data Rate (Mbps) | Position | SAR (1g) |
| MHz | Ch. | | | | | | | | | (W/kg) |
| 2437 | 6 | IEEE 802.11b | DSSS | 13.97 | 0.06 | 0.0 cm | LSNW230069 | 1 | Lapdock | 0.008 |
| ANSI / IEEE C95.1 1992 - SAFETY LIMIT<br>Spatial Peak<br>Uncontrolled Exposure/General Population | | | | | | Body<br>1.6 W/kg (mW/g)<br>averaged over 1 gram | | | | |

Notes:

1. The test data reported are the worst-case SAR value with the position set in a typical configuration (See Section 14.1). Test procedures used were according to FCC/OET Bulletin 65, Supplement C [June 2001].
2. Batteries are fully charged for all readings. Standard battery was used.
3. Tissue parameters and temperatures are listed on the SAR plots.
4. Liquid tissue depth was at least 15.0 cm.
5. Justification for reduced test configurations for WIFI channels per KDB Publication 248227 and April 2010 FCC/TCB Meeting Notes: Highest average RF output power channel for the lowest data rate were selected for SAR evaluation. Other IEEE 802.11 modes (including 802.11g/n) were not investigated since the average output powers were not greater than 0.25 dB than that of the corresponding channel in the lowest data rate IEEE 802.11b mode.
6. WLAN transmission was verified with a spectrum analyzer.
7. To confirm the proper SAR liquid depth, the z-axis plots are included from the system verification using with the same liquid as the SAR tests.

# 16 SIMULTANEOUS TRANSMISSION

## 16.1 Multiple Antenna/Transmission Information

The separation distance between the main antenna and the Bluetooth/WLAN antenna is 28.9 mm.

Peak RF Conducted Power of Bluetooth Tx is 16.943 mW. Peak RF Conducted Power of WLAN 802.11b mode is 44.57 mW. Peak RF Conducted Power of WLAN 802.11g mode is 69.98 mW. Peak RF Conducted Power of WLAN 802.11n mode is 60.26 mW.

Maximum average RF Conducted Power of Bluetooth Tx is 9.05 dBm. Maximum average RF Conducted Power of WLAN 802.11b mode is 24.95 mW. Maximum average RF Conducted Power of WLAN 802.11g mode is 12.65 mW. Maximum average RF Conducted Power of WLAN 802.11n mode is 9.33 mW.

Per April 2011 FCC/TCB Workshop Guidance, p.20, Bluetooth SAR was not required since

1. Bluetooth and 2.4GHz Wi-Fi are implemented in the same chipset, using the same antenna and RF components
2. Bluetooth time-averaged power is < 60/2.4 mW (or 25 mW)
3. The maximum peak and average Bluetooth power is less than the respective peak and average output powers in all Wi-Fi modes.
4. The measured Wi-Fi SAR is < 0.4 W/kg for all applicable Bluetooth configurations (Body-Worn).
5. Simultaneous transmission SAR exclusion applies to all applicable configurations involving Wi-Fi or Bluetooth.

## 16.2 Simultaneous Transmission Scenarios

Bluetooth cannot transmit with WIFI (same RF path) but can additionally transmit with CDMA/EVDO and WIMAX for Body SAR conditions only. Bluetooth was not required to be required to be measured and is 0 W/kg for all summation analysis. WIMAX and WLAN can transmit simultaneously as a hotspot condition. CDMA voice can transmit simultaneously with WIMAX and WLAN acting as a hotspot. WIMAX Tx Ant 1 and WIMAX Tx Ant 2 cannot transmit simultaneously. CDMA and EVDO cannot transmit simultaneously (same RF path).

CDMA supports voice or data modes. WIFI and WIMAX support data communication only.

## 16.3 Simultaneous Transmission Analysis

**Table 16-1**
**Simultaneous Transmission Scenario (CDMA Voice Calls with WLAN or WIMAX Data)**

| Configuration | Mode | CDMA SAR (W/kg) | WIMAX SAR (W/kg) (Scaled) | | 2.4 GHz WIFI SAR (W/kg) | Σ SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | Tx1 2a | Tx2 2b | 3 | 1+2a | 1+2b | 1+3 |
| | | | | | | CDMA Voice + WIMAX Data | | CDMA Voice + WLAN Data |
| Lapdock | Cell. CDMA | 0.749 | 0.185 | 0.325 | 0.008 | 0.934 | 1.074 | 0.757 |
| Lapdock | PCS CDMA | 0.556 | 0.185 | 0.325 | 0.008 | 0.741 | 0.881 | 0.564 |

The above table represents scenarios with CDMA voice call with WLAN or WIMAX Data.

**Table 16-2**
**Simultaneous Transmission Scenario (Portable Hotspot)**

| Configuration | Mode | EVDO SAR (W/kg) | WIMAX SAR (W/kg) (Scaled) | | 2.4 GHz WIFI SAR (W/kg) | Σ SAR (W/kg) | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | Tx1 2a | Tx2 2b | 3 | 1+3 | 2a+3 | 2b+3 |
| | | | | | | EVDO Hotspot | WIMAX Hotspot | |
| Lapdock | Cell. CDMA | 0.743 | 0.185 | 0.325 | 0.008 | 0.751 | 0.193 | 0.333 |
| Lapdock | PCS CDMA | 0.434 | 0.185 | 0.325 | 0.008 | 0.442 | 0.193 | 0.333 |

The above table represents portable hotspot conditions using the lapdock.

**Table 16-3**
**Simultaneous Transmission Scenario (CDMA Voice Call with WIMAX Hotspot)**

| Configuration | Mode | CDMA SAR (W/kg) | WIMAX SAR (W/kg) (Scaled) | | 2.4 GHz WIFI SAR (W/kg) | Σ SAR (W/kg) | |
|---|---|---|---|---|---|---|---|
| | | 1 | Tx1 2a | Tx2 2b | 3 | 1+2a+3 | 1+2b+3 |
| | | | | | | CDMA Voice + WIMAX Hotspot | |
| Lapdock | Cell. CDMA | 0.749 | 0.185 | 0.325 | 0.008 | 0.942 | **1.082** |
| Lapdock | PCS CDMA | 0.556 | 0.185 | 0.325 | 0.008 | 0.749 | 0.889 |

The above table represents scenarios with CDMA voice call with WIMAX Hotspot.

## 16.4 Simultaneous Transmission Conclusion

Per FCC KDB Publication 648474 D01, no aggregate volumetric simultaneous transmission is required for the device, since the sum of the standalone SAR values is <1.6 W/kg for all configurations.

# 17 EQUIPMENT LIST

| Manufacturer | Model | Description | Cal Date | Cal Interval | Cal Due | Serial Number |
|---|---|---|---|---|---|---|
| Agilent | 8648D | (9kHz-4GHz) Signal Generator | 10/13/2010 | Annual | 10/13/2011 | 3613A00315 |
| Agilent | 8753E | (30kHz-6GHz) Network Analyzer | 4/21/2011 | Annual | 4/21/2012 | JP38020182 |
| Agilent | E5515C | Wireless Communications Test Set | 10/11/2010 | Annual | 10/11/2011 | GB46110872 |
| Agilent | E5515C | Wireless Communications Test Set | 10/8/2010 | Annual | 10/8/2011 | GB46310798 |
| Agilent | E5515C | Wireless Communications Test Set | 7/6/2011 | Annual | 7/6/2012 | GB41450275 |
| Agilent | E8257D | (250kHz-20GHz) Signal Generator | 4/8/2011 | Annual | 4/8/2012 | MY45470194 |
| Gigatronics | 80701A | (0.05-18GHz) Power Sensor | 10/11/2010 | Annual | 10/11/2011 | 1833460 |
| Gigatronics | 8651A | Universal Power Meter | 10/11/2010 | Annual | 10/11/2011 | 8650319 |
| Index SAR | IXTL-010 | Dielectric Measurement Kit | N/A | | N/A | N/A |
| Index SAR | IXTL-030 | 30MM TEM line for 6 GHz | N/A | | N/A | N/A |
| Pasternack | PE2208-6 | Bidirectional Coupler | N/A | | N/A | N/A |
| Pasternack | PE2209-10 | Bidirectional Coupler | N/A | | N/A | N/A |
| Rohde & Schwarz | CMU200 | Base Station Simulator | 11/11/2010 | Annual | 11/11/2011 | 836371/0079 |
| Rohde & Schwarz | CMU200 | Base Station Simulator | 6/1/2011 | Annual | 6/1/2012 | 833855/0010 |
| Rohde & Schwarz | CMU200 | Base Station Simulator | 4/19/2011 | Annual | 4/19/2012 | 107826 |
| Rohde & Schwarz | CMU200 | Base Station Simulator | 11/4/2009 | Annual | 11/4/2010 | 109892 |
| Rohde & Schwarz | NRVD | Dual Channel Power Meter | 4/8/2011 | Biennial | 4/8/2013 | 101695 |
| SPEAG | D1900V2 | 1900 MHz SAR Dipole | 2/17/2011 | Annual | 2/17/2012 | 502 |
| SPEAG | D1900V2 | 1900 MHz SAR Dipole | 7/22/2011 | Annual | 7/22/2012 | 5d080 |
| SPEAG | D2450V2 | 2450 MHz SAR Dipole | 8/19/2011 | Annual | 8/19/2012 | 719 |
| SPEAG | D2600V2 | 2600 MHz SAR Dipole | 4/15/2011 | Annual | 4/15/2012 | 1004 |
| SPEAG | D835V2 | 835 MHz SAR Dipole | 2/9/2011 | Annual | 2/9/2012 | 4d047 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 2/21/2011 | Annual | 2/21/2012 | 649 |
| SPEAG | DAE4 | Dasy Data Acquisition Electronics | 5/19/2011 | Annual | 5/19/2012 | 859 |
| SPEAG | ES3DV3 | SAR Probe | 4/18/2011 | Annual | 4/18/2012 | 3209 |
| Rohde & Schwarz | SMIQ03B | Signal Generator | 4/6/2011 | Annual | 4/6/2012 | DE27259 |
| Anritsu | MA2481A | Power Sensor | 2/7/2011 | Annual | 2/7/2012 | 5318 |
| Anritsu | MA2481A | Power Sensor | 2/7/2011 | Annual | 2/7/2012 | 5442 |
| Anritsu | ML2438A | Power Meter | 2/7/2011 | Annual | 2/7/2012 | 1190013 |
| Anritsu | ML2438A | Power Meter | 2/7/2011 | Annual | 2/7/2012 | 98150041 |
| Agilent | 8648D | Signal Generator | 4/5/2011 | Annual | 4/5/2012 | 3629U00687 |
| Anritsu | ML2438A | Power Meter | 2/7/2011 | Annual | 2/7/2012 | 1070030 |
| Anritsu | MA2481A | Power Sensor | 2/7/2011 | Annual | 2/7/2012 | 5821 |
| Anritsu | MA2481A | Power Sensor | 2/7/2011 | Annual | 2/7/2012 | 8013 |
| Anritsu | MA2481A | Power Sensor | 2/7/2011 | Annual | 2/7/2012 | 5605 |
| Anritsu | MA2481A | Power Sensor | 2/7/2011 | Annual | 2/7/2012 | 2400 |
| Agilent | E5515C | Wireless Communications Test Set | 7/6/2011 | Annual | 7/6/2012 | GB43304447 |
| Agilent | E5515C | Wireless Communications Tester | 4/21/2011 | Annual | 4/21/2012 | US41140256 |
| Amplifier Research | 5S1G4 | 5W, 800MHz-4.2GHz | N/A | | N/A | 21910 |
| Mini-Circuits | BW-N20W5+ | DC to 18 GHz Precision Fixed 20 dB Attenuator | N/A | | N/A | N/A |
| Agilent | E5515C | Wireless Communications Test Set | 2/8/2011 | Annual | 2/8/2012 | GB45360985 |
| Rohde & Schwarz | CMW500 | LTE Radio Communication Tester | 3/11/2011 | Annual | 3/11/2012 | 103962 |
| Control Company | 61220-416 | Long-Stem Thermometer | 2/15/2011 | Biennial | 2/15/2013 | 111331322 |
| Control Company | 61220-416 | Long-Stem Thermometer | 2/15/2011 | Biennial | 2/15/2013 | 111331323 |
| Control Company | 61220-416 | Long-Stem Thermometer | 2/15/2011 | Biennial | 2/15/2013 | 111331330 |
| Control Company | 61220-416 | Long-Stem Thermometer | 2/15/2011 | Biennial | 2/15/2013 | 111331332 |
| Control Company | 61220-416 | Long-Stem Thermometer | 3/16/2011 | Biennial | 3/16/2013 | 111391601 |
| VWR | 36934-158 | Wall-Mounted Thermometer | 1/21/2011 | Biennial | 1/21/2013 | 111286445 |
| VWR | 36934-158 | Wall-Mounted Thermometer | 1/21/2011 | Biennial | 1/21/2013 | 111286460 |
| VWR | 36934-158 | Wall-Mounted Thermometer | 5/26/2010 | Biennial | 5/26/2012 | 101718589 |
| VWR | 36934-158 | Wall-Mounted Thermometer | 1/21/2011 | Biennial | 1/21/2013 | 111286454 |
| VWR | 36934-158 | Wall-Mounted Thermometer | 2/26/2010 | Biennial | 2/26/2012 | 101536273 |
| SPEAG | ES3DV3 | SAR Probe | 4/8/2011 | Annual | 4/8/2012 | 3258 |
| MiniCircuits | SLP-2400+ | Low Pass Filter | N/A | | N/A | R8979500903 |
| Narda | 4772-3 | Attenuator (3dB) | N/A | | N/A | 9406 |
| Narda | BW-S3W2 | Attenuator (3dB) | N/A | | N/A | 120 |
| Rohde & Schwarz | CMW500 | LTE Radio Communication Tester | 8/5/2011 | Annual | 8/5/2012 | 112347 |
| Mini-Circuits | NLP-2950+ | Low Pass Filter DC to 2700 MHz | N/A | | N/A | N/A |
| Mini-Circuits | NLP-1200+ | Low Pass Filter DC to 1000 MHz | N/A | | N/A | N/A |

# 18 MEASUREMENT UNCERTAINTIES

Applicable for 750 – 3000 MHz.

| a | b | c | d | e= f(d,k) | f | g | h = c x f/e | i = c x g/e | k |
|---|---|---|---|---|---|---|---|---|---|
| **Uncertainty Component** | **IEEE 1528 Sec.** | **Tol. (± %)** | **Prob. Dist.** | **Div.** | **$c_i$ 1gm** | **$c_i$ 10 gms** | **1gm $u_i$ (± %)** | **10gms $u_i$ (± %)** | **$v_i$** |
| **Measurement System** | | | | | | | | | |
| Probe Calibration | E.2.1 | 6.0 | N | 1 | 1.0 | 1.0 | 6.0 | 6.0 | ∞ |
| Axial Isotropy | E.2.2 | 0.25 | N | 1 | 0.7 | 0.7 | 0.2 | 0.2 | ∞ |
| Hemishperical Isotropy | E.2.2 | 1.3 | N | 1 | 1.0 | 1.0 | 1.3 | 1.3 | ∞ |
| Boundary Effect | E.2.3 | 0.4 | N | 1 | 1.0 | 1.0 | 0.4 | 0.4 | ∞ |
| Linearity | E.2.4 | 0.3 | N | 1 | 1.0 | 1.0 | 0.3 | 0.3 | ∞ |
| System Detection Limits | E.2.5 | 5.1 | N | 1 | 1.0 | 1.0 | 5.1 | 5.1 | ∞ |
| Readout Electronics | E.2.6 | 1.0 | N | 1 | 1.0 | 1.0 | 1.0 | 1.0 | ∞ |
| Response Time | E.2.7 | 0.8 | R | 1.73 | 1.0 | 1.0 | 0.5 | 0.5 | ∞ |
| Integration Time | E.2.8 | 2.6 | R | 1.73 | 1.0 | 1.0 | 1.5 | 1.5 | ∞ |
| RF Ambient Conditions | E.6.1 | 3.0 | R | 1.73 | 1.0 | 1.0 | 1.7 | 1.7 | ∞ |
| Probe Positioner Mechanical Tolerance | E.6.2 | 0.4 | R | 1.73 | 1.0 | 1.0 | 0.2 | 0.2 | ∞ |
| Probe Positioning w/ respect to Phantom | E.6.3 | 2.9 | R | 1.73 | 1.0 | 1.0 | 1.7 | 1.7 | ∞ |
| Extrapolation, Interpolation & Integration algorithms for Max. SAR Evaluation | E.5 | 1.0 | R | 1.73 | 1.0 | 1.0 | 0.6 | 0.6 | ∞ |
| **Test Sample Related** | | | | | | | | | |
| Test Sample Positioning | E.4.2 | 6.0 | N | 1 | 1.0 | 1.0 | 6.0 | 6.0 | 287 |
| Device Holder Uncertainty | E.4.1 | 3.32 | R | 1.73 | 1.0 | 1.0 | 1.9 | 1.9 | ∞ |
| Output Power Variation - SAR drift measurement | 6.6.2 | 5.0 | R | 1.73 | 1.0 | 1.0 | 2.9 | 2.9 | ∞ |
| **Phantom & Tissue Parameters** | | | | | | | | | |
| Phantom Uncertainty (Shape & Thickness tolerances) | E.3.1 | 4.0 | R | 1.73 | 1.0 | 1.0 | 2.3 | 2.3 | ∞ |
| Liquid Conductivity - deviation from target values | E.3.2 | 5.0 | R | 1.73 | 0.64 | 0.43 | 1.8 | 1.2 | ∞ |
| Liquid Conductivity - measurement uncertainty | E.3.3 | 3.8 | N | 1 | 0.64 | 0.43 | 2.4 | 1.6 | 6 |
| Liquid Permittivity - deviation from target values | E.3.2 | 5.0 | R | 1.73 | 0.60 | 0.49 | 1.7 | 1.4 | ∞ |
| Liquid Permittivity - measurement uncertainty | E.3.3 | 4.5 | N | 1 | 0.60 | 0.49 | 2.7 | 2.2 | 6 |
| **Combined Standard Uncertainty (k=1)** | | | RSS | | | | 12.1 | 11.7 | 299 |
| **Expanded Uncertainty** (95% CONFIDENCE LEVEL) | | | k=2 | | | | 24.2 | 23.5 | |

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

# 19 CONCLUSION

## 19.1 Measurement Conclusion

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

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

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