SAR TEST REPORT

Test item	:	Portable WiMax CPE
Model No.	:	WXR-PG
Order No.	:	1110-01451
Date of receipt	:	2011-10-27
Test duration	:	2012-02-20 ~ 2012-03-24
Date of issue	:	2012-03-26
Use of report	:	FCC Original Grant

Applicant : Virtualtek Corp.
12F Younpoong Bldg, 33, Seorin-dong, Chongro-gu, Seoul, Korea 110-752

Test laboratory : Digital EMC Co., Ltd.
683-3, Yubang-Dong, Cheoin-Gu, Yongin-Si, Kyunggi-Do, 449-080, Korea

Test specification	:	§2.1093, FCC/OET Bulletin 65 Supplement C[July 2001]
Test environment	:	See appended test report
Test result	:	☒ Pass ☐ Fail

- The test results presented in this test report are limited only to the sample supplied by applicant and the use of this test report is inhibited other than its purpose. This test report shall not be reproduced except in full, without the written approval of DIGITAL EMC CO., LTD.

Tested by:	Witnessed by:	Reviewed by:
Engineer N.K.Lim	Engineer S.K.Ryu	Technical Director Harvey sung

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1. DESCRIPTION OF DEVICE

Environmental evaluation measurements of specific absorption rate (SAR) distributions in emulated human head and body tissues exposed to radio frequency (RF) radiation from wireless portable devices for compliance with the rules and regulations of the U.S. Federal Communications Commission (FCC).

General Information

Equipment type	Portable WiMax CPE
FCC ID:	B9I-WXR-PG
Equipment model name	WXR-PG
Equipment add model name	N/A
Equipment serial no.	Identical prototype
Mode(s) of Operation	QPSK, 16QAM
TX Frequency Range	2499.00 ~2686.75 MHz (5MHz OBW) 2508.50 ~2683.50 MHz (10MHz OBW)
RX Frequency Range	2499.00 ~2686.75 MHz (5MHz OBW) 2508.50 ~2683.50 MHz (10MHz OBW)
Max. SAR Measurement	**0.878 (Scaled) / 0.715 (Non-Scaled)** mW/g Body SAR
FCC Equipment Class	Licensed Non-Broadcast Station Transmitter(TNB)
Date(s) of Tests	2012-02-20 ~ 2012-03-24
Antenna Type	Internal antenna

1.1 WiMAX Device and System Operating Parameters

Description	Parameter	Comment
FCC ID	B9I-WXR-PG	Identify all related FCC ID
Radio Service	PART 27	Rule parts
Transmit Frequency Range (MHz)	2499.00 ~ 2686.75MHz (5MHz OBW) 2508.50 ~ 2683.50MHz (10MHz OBW)	System parameter
System/Channel Bandwidth (MHz)	5 MHz or 10 MHz	System parameter
System Profile	Mobile WiMAX (802.16e-2005)	Defined by WiMAX Forum
Modulation Schemes	QPSK, 16QAM	Identify all applicable UL modulations
FFT Size (NFFT)	512 (5MHz), 1024 (10MHz)	(NFFT)
Sub-Carrier Spacing (kHz)	10.9375 (fixed)	(Δf)
Useful Symbol time (μs)	91.4286	(Tb=1/Δf)
Guard Time (μs)	11.43	(Tg=Tb/cp); cp = cyclic prefix
OFDMA Symbol Time (μs)	102.8586	(Ts=Tb+Tg)
Frame Size (ms)	5	System parameter
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
Wave1 / Wave2	Wave 2 (2 Antennas for TX/RX diversity. Ant0,Ant1 can not transmit simultaneously)	Describe antenna diversity info and MIMO requirements separately
UL Zone Types (FUSC, PUSC, OFUSC, OPUSC, AMC, TUSC1, TUSC2)	PUSC	Describe separately the symbol and sub-carrier/sub-channel structures applicable to each zone type
Maximum Number of UL Sub-Carriers	1024 (UL data Bursts of PUSC)	Identify the allowed and tested / to be tested parameters; include separate explanations on the types of control symbols and how the power levels are determined.
UL Burst Maximum Average Power	23.36 dBm	
Number and type of UL Control Symbols	3 Symbols of PUSC zone format only (CQICH, HARQ ACK/NACK)	
UL Control Symbol Maximum Average Power	18.05 dBm (5MHz/PUSC) 14.42 dBm (10MHz/PUSC)	
UL Burst Peak-to-Average Power Ratio (PAR)	~ 5.5 dB (10% CCDF)	Identify the expected range and measured/tested PAR; explain separately the methods used / to be used to address SAR probe calibration and measurement error issues.
Frame Averaged UL Transmission Duty Factor (%)	30.86%	Show calculations separately and explain how the applicable CF (crest factor) used / to be use in the SAR measurements is derived and how the control symbols are accounted for

Table 1.1: 802.16e/WiMAX Device and System Operating Parameters

Equipment / Results	Description
Test Software Signal Generator Communication Test Set	Describe the configuration details and test methodology, including test signal characteristics, similar to examples in the Annex. This is described in the 19, 20 pages.
SAR Test Signal Characteristics and Structure	Describe the test signal and data/burst structure used / to be used in the SAR tests. Explain why the system operating parameters, test software, signal generator, communication test set and other test configurations are chosen for evaluating the maximum exposure conditions. This is described in the 19 ~21 page.
Output Power Measurement	Include average conducted power measurement results for the UL burst, at maximum duty factor, on high, middle & low channels for each modulation. Identify the control symbol configurations tested for SAR; include the measurement setup, any test software and signal generator setup details This is described in the 36 page.
SAR Measurement Results	SAR results are not necessary for KDB/PBA inquiries on how a device should be tested. However, tabulated SAR results are necessary for PBA requests submitted by a TCB; a representative SAR plot should also be included to identify the measurement parameters such as the crest factor used for SAR conversion and other relevant information – probe, tissues. This is described in the 32 ~ 35 page.
Other Relevant Parameters and Issues	Explain any other concerns specific to the test device should be addressed; for example, MIMO or non-standard WiMAX systems. N/A

Table 1.2: Information on Test Equipment and Measurement Results

2. INTROCUCTION

The FCC has adopted the guidelines for evaluating the environmental effects of radio frequency 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. 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 C95.1-2005 Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz. 1992 by the Institute of Electrical and Electronics Engineers, Inc., New York, New York 10017. The measurement procedure described in IEEE/ANSI C95.3-1992 Recommended Practice for the Measurement of Potentially Hazardous Electromagnetic Fields - RF and Microwave is used for guidance in measuring 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 National Council on Radiation Protection and Measurements (NCRP) in Biological Effects and Exposure Criteria for Radio frequency Electromagnetic Fields," NCRP Report No. 86 NCRP, 1986, Bethesda, MD 20814. 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.

SAR Definition

Specific Absorption Rate (SAR) 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 (ρ) It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 2.1)

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

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:

σ = conductivity of the tissue - simulating material (S/m)

ρ = mass density of the tissue-simulating material (kg/m3)

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 relations 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.

Automated TEST SYSTEM SPECIFICATIONS

Positioner

Robot: Stäubli Unimation Corp. Robot Model: RX60L
Repeatability: 0.02 mm
No. of axis: 6

Data Acquisition Electronic (DAE) System

Cell Controller

Processor: Intel Core i5-2500
Clock Speed: 3.31 GHz
Operating System: Windows XP Professional
Data Card: DASY4 PC-Board

Data Converter

Features: Signal, multiplexer, A/D converter. & control logic
Software: DASY4
Connecting Lines: Optical downlink for data and status info
Optical uplink for commands and clock

PC Interface Card

Function: 24 bit (64 MHz) DSP for real time processing
Link to DAE 3
16 bit A/D converter for surface detection system
serial link to robot
direct emergency stop output for robot

E-Field Probes

Model: EX3DV4 S/N: 3643
Construction: Triangular core fiber optic detection system
Frequency: 10 MHz to 6 GHz
Linearity: ±0.2dB (30MHz to 6GHz)

Phantom

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

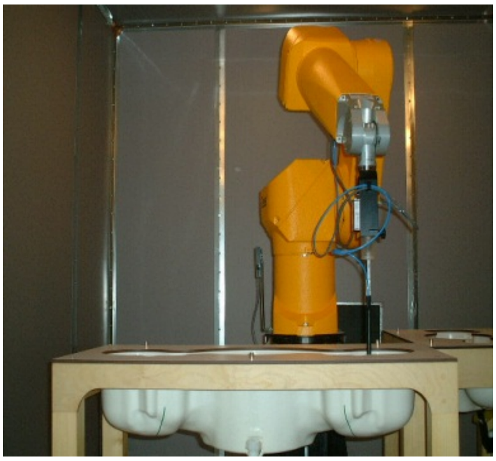


Figure 2.2 DASY4 Test System

3. DESCRIPTION OF TEST EQUIPMENT

3.1 SAR MEASUREMENT SETUP

Robotic System

These measurements are performed using the DASY4 automated dos imetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain 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 Fig. 3.1).

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 Micron Pentium IV 500 MHz computer with Windows NT system and 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, AD-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 of the DAE and transfers data to the PC plug-in card.

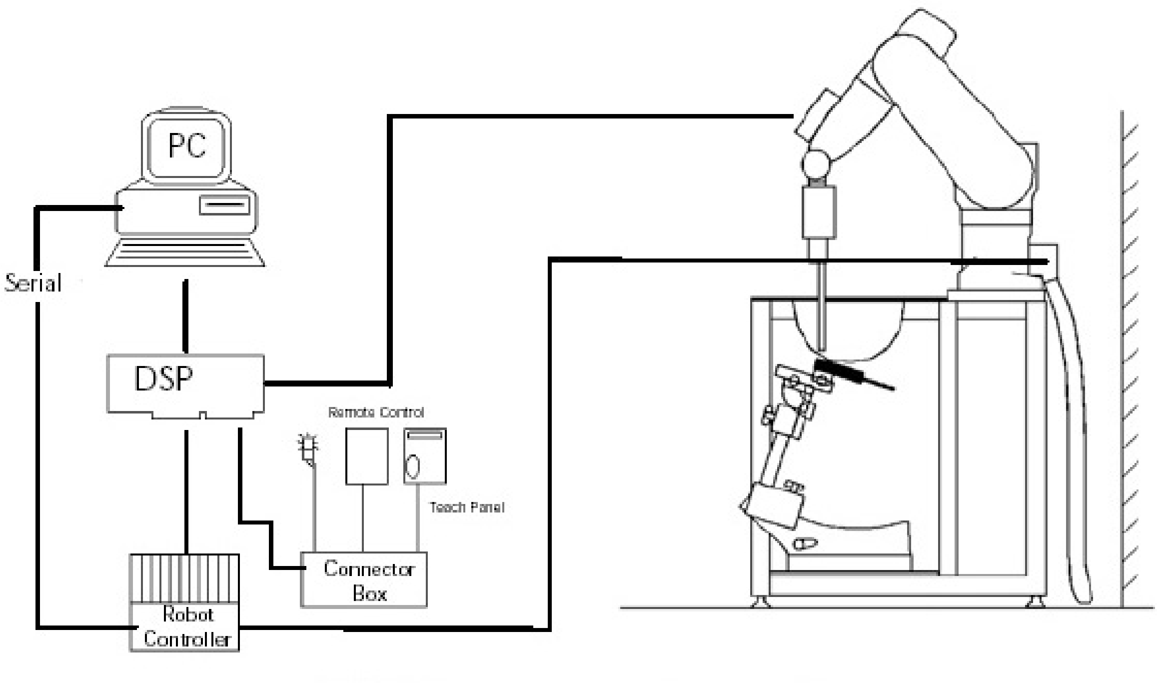


Figure 3.1 SAR Measurement System Setup

System Electronics

The DAE3 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, 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. The system is described in detail in.

3.2 Probe Measurement System

The SAR measurements were conducted with the dosimetric probe EX3DV4, designed in the classical triangular configuration (see Fig. 3.2) and optimized for dosimetric evaluation. 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. (see Fig. 3.3) 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 fitting. The approach is stopped at reaching the maximum.

DAE System

Probe Specifications

Calibration: In air from 10 MHz to 6.0 GHz
In brain and muscle simulating tissue at Frequencies of
450 MHz, 750 MHz, 835 MHz, 1750 MHz, 1900 MHz, 2300 MHz, 2450 MHz, 2600 MHz, 3500 MHz, 5200 MHz, 5300 MHz, 5600 MHz, 5800 MHz

Frequency: 10 MHz to 6 GHz

Linearity: ±0.2dB (30 MHz to 6 GHz)

Dynamic: 10 mW/kg to 100 W/kg

Range: Linearity: ±0.2dB

Dimensions: Overall length: 330 mm

Tip length: 20 mm

Body diameter: 12 mm

Tip diameter: 2.5 mm

Distance from probe tip to sensor center: 1 mm

Application: SAR Dosimetry Testing
Compliance tests of mobile phones

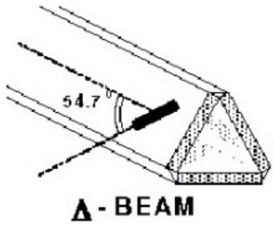


Figure 3.2 Triangular Probe Configurations

Figure 3.3 Probe Thick-Film Technique

3.3 Probe Calibration Process

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in with accuracy better than +/-10%. The spherical isotropy was evaluated with the procedure described in and found to be better than +/-0.25dB. The sensitivity parameters (Norm X, Norm Y, Norm Z), the diode compression parameter (DCP) and the conversion factor (Conv F) of the probe is tested.

Free Space Assessment

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

Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium, correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent the rmistor based temperature probe is used in conjunction with the E-field probe

$$\text{SAR} = C\frac{\Delta T}{\Delta t}$$

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

where:

Δt = exposure time (30 seconds),

C = heat capacity of tissue (brain or muscle),

ΔT = temperature increase due to RF exposure.

where:

σ = simulated tissue conductivity,

ρ = Tissue density (1.25 g/cm^3 for brain tissue)

SAR is proportional to ΔT / Δt , the initial rate of tissue heating, before thermal diffusion takes place.
Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

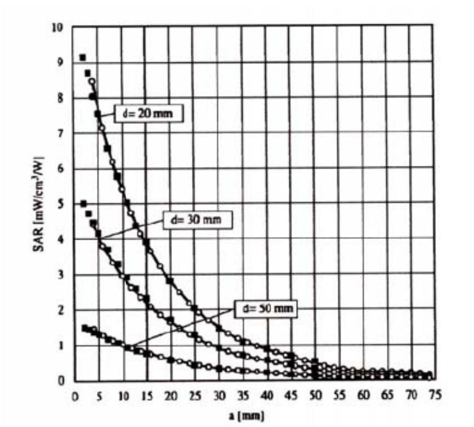


Figure 3.4 E-Field and Temperature Measurements at 900MHz

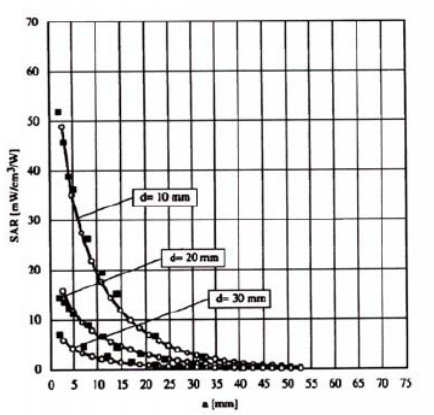


Figure 3.5 E-Field and Temperature Measurements at 1800MHz

Data Extrapolation

The DASY4 software automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The first step of the evaluation is a linearization of the filtered input signal to account for the compression characteristics of the detector diode. The compensation depends on the input signal, the diode type and the DC-transmission factor from the diode to the evaluation electronics. If the exciting field is pulsed, the crest factor of the signal must be known to correctly compensate for peak power. The formula for each channel can be given like below;

$$V_i = U_i + U_i^2 \cdot \frac{cf}{dcp_i}$$

with V_i = compensated signal of channel i (i=x,y,z)
U_i = input signal of channel i (i=x,y,z)
cf = crest factor of exciting field (DASY parameter)
dcp_i = diode compression point (DASY parameter)

From the compensated input signals the primary field data for each channel can be evaluated:

E-field probes:

$$E_i = \sqrt{\frac{V_i}{Norm_i \cdot ConvF}}$$

with V_i = compensated signal of channel i (i = x,y,z)
$Norm_i$ = sensor sensitivity of channel i (i = x,y,z) $\mu V/(V/m)^2$ for E-field probes
ConvF = sensitivity of enhancement in solution
E_i = electric field strength of channel i in V/m

The RSS value of the field components gives the total field strength (Hermetian magnitude):

$$E_{tot} = \sqrt{E_x^2 + E_y^2 + E_z^2}$$

The primary field data are used to calculate the derived field units.

$$SAR = E_{tot}^2 \cdot \frac{\sigma}{\rho \cdot 1000}$$

with SAR = local specific absorption rate in W/g
E_{tot} = total field strength in V/m
σ = conductivity in [mho/m] or [Siemens/m]
ρ = equivalent tissue density in g/cm^3

The power flow density is calculated assuming the excitation field to be a free space field.

$$P_{pwe} = \frac{E_{tot}^2}{3770}$$

with P_{pwe} = equivalent power density of a plane wave in W/cm^2
E_{tot} = total electric field strength in V/m

3.4 SAM PHANTOM

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90% of all users. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation of the liquid. 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. (see Fig. 3.6)

Phantom Specification

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

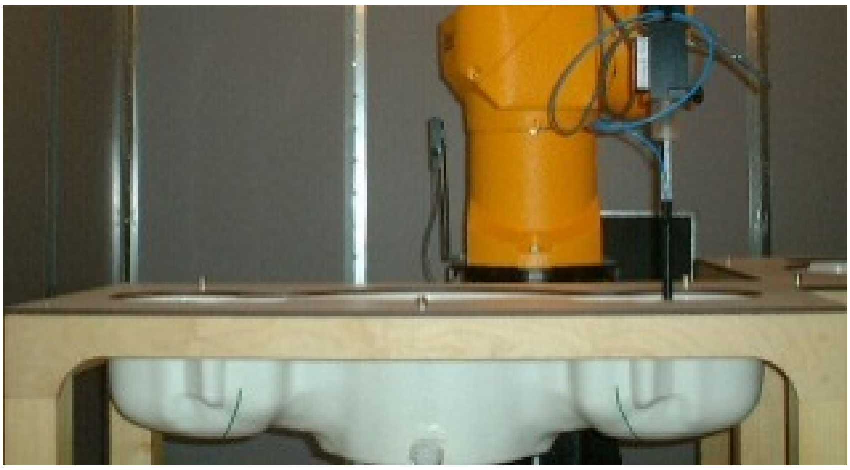


Figure 3.6 SAM Twin Phantom

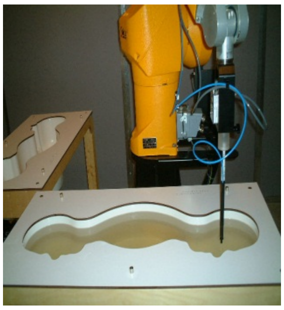
3.5 Device Holder for Transmitters

In combination with the SAM Twin Phantom V4.0 the Mounting Device (see Fig. 3.7), enables the rotation of the mounted transmitter in spherical coordinates whereby the rotation point is the ear opening. The devices can be easily, accurately, and repeat ably be positioned according to the FCC, CENELEC, IEC and IEEE specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

Figure 3.7 Mounting Device

Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

3.6 Brain & Muscle Simulating Mixture Characterization



Simulated Tissue

The brain and muscle mixtures consist of a viscous gel using hydrox-ethyl cellulose (HEC) gelling agent and saline solution (see Table 3.1). Preservation with a bacteriacide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Harts grove.

Table 3.1 Composition of the Tissue Equivalent Matter

Ingredient	Muscle Simulating Liquid 2600 MHz(MSL-2600)
Water	69.83 %
DGMBE	30.17 %
Salt	N/A
Dielectric Parameters at 22 ℃	F=2600 MHz ε= 52.5 %± 5 % σ= 2.16 ± 5 % S/m

Salt: 99 % Pure Sodium Chloride Sugar: 98 % Pure Sucrose

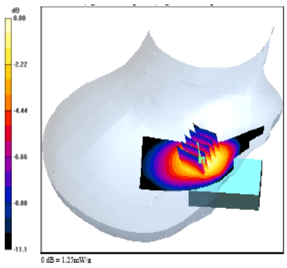
Water: De-ionized, 16M resistivity HEC: Hydroxyethyl Cellulose

DGBE: 99 % Di(ethylene glycol) butyl ether,[2-(2-butoxyethoxy) ethanol]

Triton X-100(ultra pure): Polyethylene glycol mono [4-(1,1,3,3-tetramethylbutyl)phenyl]

4. SAR MEASUREMENT PROCEDURE

The evaluation was performed using the following procedure:



Sample SAR Area Scan

1. The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed location point was measured and used as a reference value.

2. The SAR distribution at the exposed side of the head was measured at a distance of 3.9mm from the Inner surface of the shell. The area covered the entire dimension of the head and the horizontal grid spacing was 15 mm x 15 mm.

3. Based on the area scan data, the area of the maximum absorption was determined by sp line interpolation. Around this point, a volume of 32 mm x32 mm x 30 mm (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 Sample SAR Area Scan):

   a. The data at the surface was extrapolated, since the center of the dipoles is 2.5 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2mm. The extrapolation was based on a least square algorithm. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

   b. The maximum interpolated value was searched with a straight-forward algorithm. Around this maximum the SAR values averaged over the spatial volumes (1g or 10g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional sp lines with the "Not a knot" condition (in x, y, and z directions). The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10x 10) were interpolated to calculate the average.

   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 1, was re-measured. If the value changed by more than 5%, the evaluation is repeated.

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 Fig. 4.1). The perimeter side walls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15cm to minimize reflections from the upper surface.

Figure 4.1 Sam Twin Phantom shell

5. DEFINITION OF REFERENCE POINTS

EAR Reference Point

Figure 5.1 shows the front, back and side views of the SAM Twin Phantom. The point“M” is the reference point for the center of the mouth, “LE” is the left ear reference point(ERP), and “RE” is the right ERP. The ERPs are 15mm posterior to the entrance to the Ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 5.5. The plane Passing, through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck- Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 5.2). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning.

Figure 5.1 Front, back and side view of SAM Twin Phantom

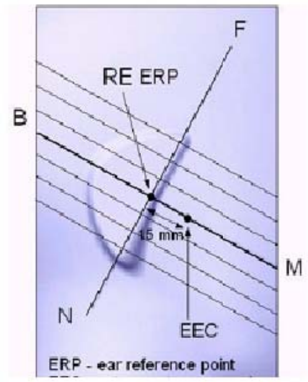


Figure 5.2 Close-up side view of ERPs

Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the “test device reference point” located along the “vertical centerline” on the front of the device aligned to the “ear reference point” (See Fig. 5.3). The “test device reference point” was than located at the same level as the center of the ear reference point. The test device was positioned so that the “vertical centerline” was bisecting the front surface of the handset at it’s top and bottom edges, positioning the “ear reference point” on the outer surface of the both the left and right head phantoms on the ear reference point.

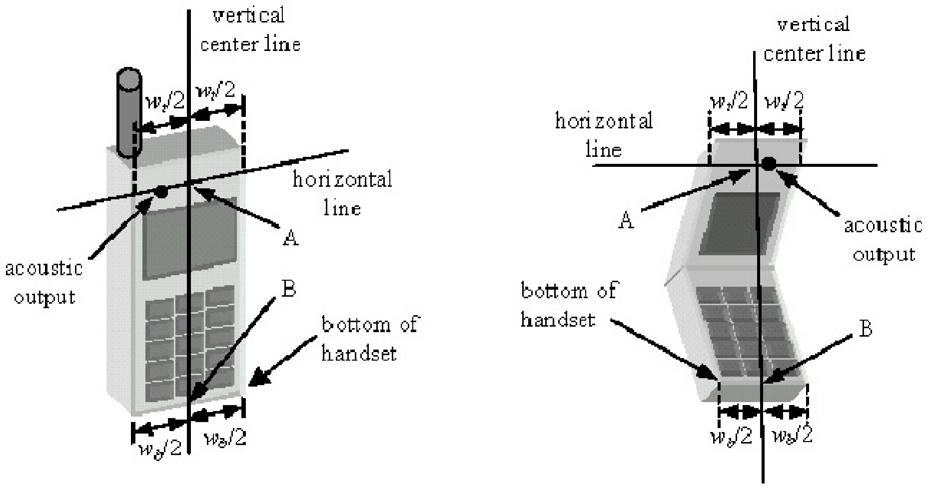


Figure 5.3 Handset Vertical Center & Horizontal Line Reference Points

5.1 TEST CONFIGURATION POSITIONS

Positioning for Cheek/Touch

1. The test device was positioned with 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 5.4), such that the plane defined by the vertical center line and the horizontal line of the phone is approximately parallel to the sagittal plane of the phantom.

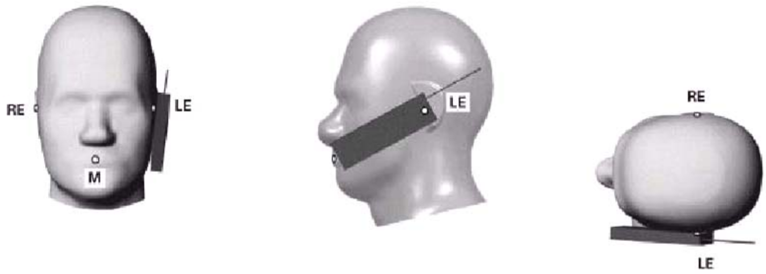


Figure 5.4 Front, Side and Top View of Cheek/Touch Position

2. The handset was translated towards the phantom along the line passing through RE & LE until the handset touches the ear.

3. While maintaining the handset in this plane, the handset was rotated around the LE-RE line until the vertical centerline was in the plane normal to MB-NF including the line MB (reference plane).

4. The phone was hen rotated around the vertical centerline until the phone (horizontal line) was symmetrical was respect to the line NF.

5. 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, the handset was rotated about the line NF until any point on the handset made contact with a phantom point below the ear (cheek). (See Figure 5.5)

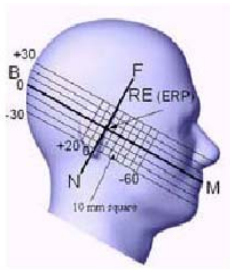


Figure 5.5 Side view w/ relevant markings

Positioning for Ear / 15 ° Tilt

With the test device aligned in the "Cheek/Touch Position":

1. While maintaining the orientation of the phone, the phone was retracted parallel to the reference plane far enough to enable a rotation of the phone by 15degree.

2. The phone was then rotated around the horizontal line by 15 degree.

3. While maintaining the orientation of the phone, the phone was moved parallel to the reference plane until any part of the phone touches the head. (In this position, point A was located on the line RE-LE). The tilted position is obtained when the contact is on the pinna. If the contact was at any location other than the pinna, the angle of the phone would then be reduced. The tilted position was obtained when any part of the phone was in contact of the ear as well as a second part of the phone was in contact with the head (see Figure 5.6).

Figure 5.6 Front, Side and Top View of Ear/15^{o} Tilt Position

Body Holster /Belt Clip Configurations

Body-worn operating configurations are tested with the belt-clips and holsters attacked to 3the device and positioned against a flat phantom in a normal use configuration (see Figure 5.7). A device with a headset output is tested with a headset connected to the device. Body dielectric parameters are used.

Figure 5.7 Body Belt Clip & Holster Configurations

Accessories for Body-worn operation configurations are divided into two categories: those that do not contain metallic components and those that contain metallic components. When multiple accessories that do not contain metallic components are supplied with the device, the device is tested with only the accessory that dictates the closest spacing to the body. Then multiple accessories that contain metallic components are supplied with the device, the device is tested with each accessory that contains a unique metallic component. If multiple accessories share an identical metallic component (i.e. the same metallic belt-clip used with different holsters with no other metallic components) only the accessory that dictates the closest spacing to the body is tested.

Body-worn accessories may not always be supplied or available as options for some Devices intended to be authorized for body-worn use. In this case, a test configuration where a separation distances between the back of the device and the flat phantom is used. All test position spacing is documented.

Transmitters that are designed to operate in front of a person's face, as in push-to-talk configurations, are tested for SAR compliance with the front of the device positioned to face the flat phantom. For devices that are carried next to the body such as a shoulder, waist or chest-worn transmitters, SAR compliance is tested with the accessories, including headsets and microphones, attached to the device and positioned against a flat phantom in a normal use configuration.

In all cases SAR measurements are performed to investigate the worst-case positioning. Worst-case positioning is then documented and used to perform Body SAR testing.

In order for users to be aware of the body-worn operating requirements for meeting RF exposure compliance, operating instructions and cautions statements are included in the user's manual.

6. DESCRIPTION OF SUPPORTED UNITS

The EUT has been tested with other necessary accessories or supported units. The following supported units or accessories were used to perform SAR tests for this device.

- Supported Units

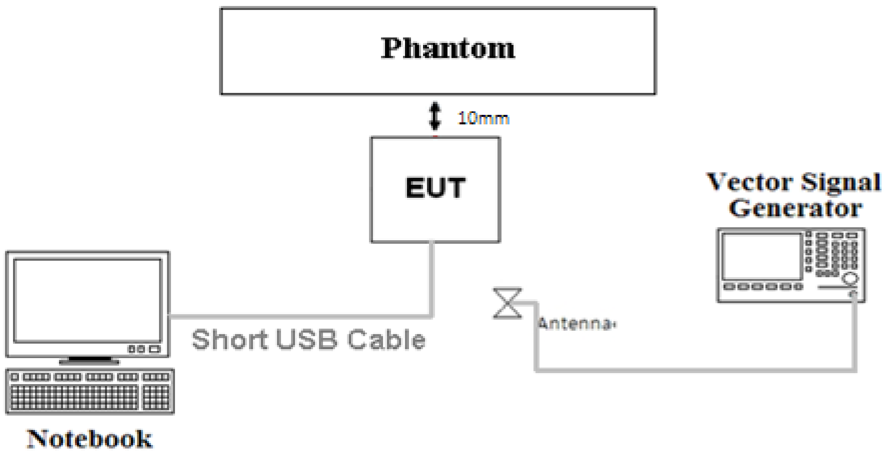
NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	LAPTOP	ACER	P5LJ0	LXRMY0C0091252F8711601	FCC DOC
2	Vector Signal Generator	Rohde Schwarz	SMJ100A	100148	N/A

7. TEST SETUP AND TEST SINGAL DETAIL

The test set-up is shown in the below picture. The WiMAX CPE (EUT) to transmit rated output power under appropriate transmission mode and specific frequency.

The telnet program is used for verifying a connection status between notebook computer and EUT and to control maximum transmitting power, channel selection, BW (5MHz & 10MHz) and TX/RX status of the DUT.

The EUT uses 29:18 WiMAX frame (Downlink: Uplink Symbols). Currently this is the maximum duty for WiMAX device. This WiMAX frame is selected using the specific wave form in the VSG (Vector Signal Generator).



The EUT is 2.5 GHz WiMAX transceiver using GCT chipset which supports antenna structure for 1TX and 2RX. Only one antenna is used for both transmitting and receiving while the other antenna is strictly used for RX diversity. The EUT has capable of both 10 MHz and 5 MHz uplink bandwidths. For the 10 MHz bandwidth of PUSC zone format, it has 35 sub-channels structured from1024 subcarriers; 184 are used as spare/safeguard subcarriers, leaving 840 available for transmission. From this, 560 subcarriers for data transmission with 280 subcarriers intended for pilot use. The 5 MHz channel bandwidth uses 512 sub-carriers and 17 sub-channels, with 104 spare/safeguard sub-carriers and 408 available for transmission, consisting 272 data and 136 pilot sub-carriers.

The up-link sub-frame is triggered by an Allocation Start Time contained in the information of UL-MAP. This information specifies the starting times of the Uplink and Downlink frames. In any UL sub-frame, the duty factor ranging and bandwidth information is used to ensure optimal system operation. In normal transmission, the device will transmit control signaling at the first 3 uplink symbols and then use the rest of the uplink symbols for data traffic bursts in the uplink sub-frame.

Since the first 3 symbols are also used for ranging detection purposes and are shared among other devices , its transmitting power is much smaller than the data burst symbol power. During the SAR testing, the first 3 symbols are also kept in reduced power level and the data traffic bursts are always running at the maximum output power level. In the real usage, the data burst power will be adjusted according to the signal strength of the communication.

The VSG produces a downlink burst every 5 milliseconds which simulates the transmission of a BS operating under normal mode. This downlink burst instructs the MS to transmit for 12 symbols in the UL data zone. This UL transmission is repeated every 5 milliseconds. The transmitting power of the MS is set to maximum power.

The VSG and MS use same frequency. The VSG level is much less than the MS Tx power (Approximately 80dB less than the MS power) and so does not affect the SAR readings. Since both the VSG (Base station simulator) and MS are working in TDD mode, co-operation under same frequency is not an issue.

The VSG and MS use same frequency. The VSG level is much less than the MS Tx power(Approximately 80dB less than the MS power) and so does not affect the SAR readings. Since both the VSG (Base station simulator) and MS are working in TDD mode, co-operation under same frequency is not an issue.

The VSG is loaded with a BS (Base Station) downlink signal which contains the 29:18 information. The mobile station synchronizes to the signal from the VSG in frequency and time and then demodulates two maps contained in the VSG DL frame. The first map, called the DL map, specifies the number of DL symbols (29). The second map, called the UL map, specifies the number of UL symbols (18). The UL map also tells the MS to transmit a burst which occupies all data symbols and all sub-channels. No control channel transmissions are requested by the VSG. Measurements were taken in this configuration with the MS transmitting using the 29:18 ratio, but since there was no energy in the control symbols, the effective power is only across 12 symbols.

As mentioned above the DL:UL frame is specified in the DL and UL maps respectively. There is no ranging present when there is data traffic. The other types of control traffic are HARQ ACK/NACK, CQICH(CINR reporting)and bandwidth(BW) requests. BW requests are piggy-backed onto the data symbols when traffic is present. Since the BW requests are shared across the Control symbols (traffic versus non-traffic modes) and control symbols can be supported only in PUSC zone, the control traffic that is relevant to the SAR calculation is CQICH and HARQ ACK/NACK. So the conducted maximum power for this control traffic is 5/35 of 193.642 mW (22.87 dBm) for 10 MHz and 5/17 of 216.770 mW (23.36 dBm) for 5 MHz.

In the test mode in PUSC zone format, the UL operates with all data sub-channels(35 sub-channels for 10MHz) occupied with data. During normal operation the MS will transmit on al sub-channels when maximum UL throughput is required. It is possible for the MS to will transmit fewer sub-channels

For the signal from the VSG, it looks identical to the signal that would come from a BS in the field. The intent is to make the think it is in EUT a real network. The transmission from the EUT under test conditions is exactly the same as in the field in normal operation. The only difference is that normally in the field there will be information in some of the control symbols, whereas SAR tests were performed with not having the information in the some control symbols. So it is necessary to calculate a scaling factor that takes into consideration this fact.
You will see a calculation, scaling factor from the measurements (the measurements were taken under a channel configuration of 29:18, without control symbols)to a network configuration using 29:18. This is also calculated for 10MHz bandwidth channels.

The testing was done using a common 29:18 ratio as specified in the WiMAX specifications. The 29 indicates the number of downlink (from the base station)symbols, and the 18 indicates the number of uplink (transmitted from the MS)symbols. Inside the uplink, 15 of the symbols are used for data, and three of the symbols are used for sending control information to the network. During the testing, the control symbols contained no information, so did not contribute to the total energy transmitted. The correct duty factor should be(15*102.8571uS)/5000uS=30.86 %. Using this calculation method eliminates all the other transmit time, guard time, etc, and only uses the transmit time.

Regarding to why these numbers don't total to 48: Since PUSC is dominant, this determines the allowed DL:UL ratios. In DL PUSC, bursts require two symbols so DL symbol count must be an even number+1 symbol for the preamble. Hence the number of DL symbols must bean odd number. In the UL, PUSC bursts require 3 symbols so UL must be a multiple of three symbols. In addition, the total number of symbols(DL+UL)is chosen to be 47 or less to allow for sufficient time to switch between DL and UL and vice versa.

There is a quiet time between the DL and UL transmission and a quiet time between the UL and DL transmission. During these quiet intervals the Base Station is neither transmitting nor receiving. The unoccupied symbols become part of this quiet time.

Ranging is performed to make sure the MS transmits in the correct time window. Data transmission is disabled when the MS is ranging. This is done to prevent the MS from transmitting at the wrong time and interfering with other users. Hence the MS is not allowed to range and transmit data at the same time. So ranging was not considered in the scaling factor.

Actual Duty Cycle VS Theoretically Calculated Duty Cycle

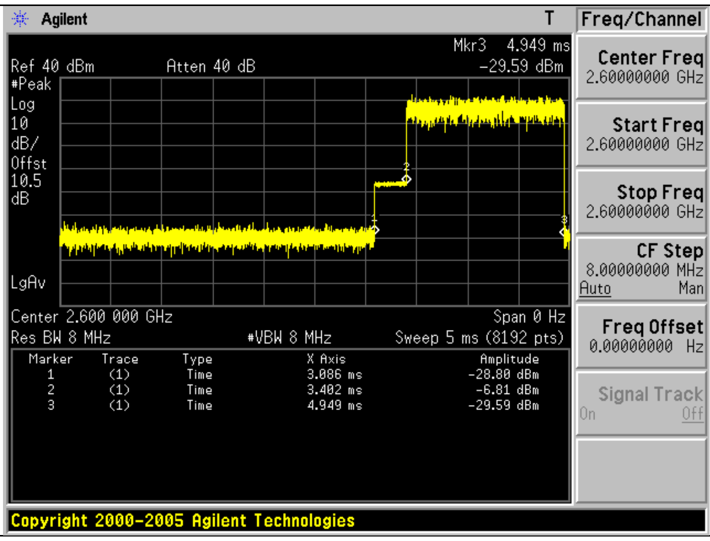
The testing was done using a common 29:18 ratio as described in this report. The 29 indicates the number of downlink (from the base station) symbols and the 18 indicates the number of uplink (transmitted from the MS) symbols. Inside the uplink, 15 of the symbols are used for data, and three of the symbols are used for sending control information to the network. During the testing, the control symbols contained no information, so did not contribute to the total energy transmitted. The theoretical duty factor should be (15*102.8586 uS)/5000 uS=30.86 %. According to below actual plots of this device,

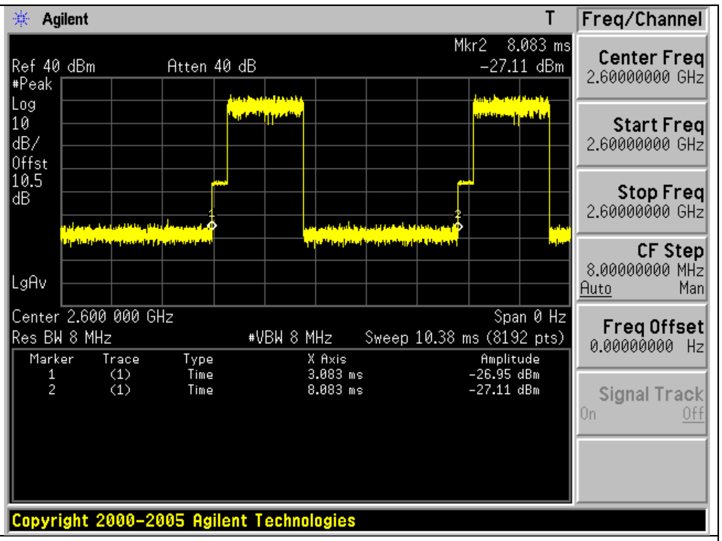
Frame length (Right Plot 1) = Mark 2 – Mark 1 = 8.083 ms – 3.083 ms = 5.00 ms
15 uplink data symbol length (Left Plot 1) = Mark 3 – Mark 2= 4.949 ms-3.402 ms = 1.547 ms
So Duty cycle = 1.547 / 5 * 100 % = 30.94 %

This agrees with the above calculated theoretical duty cycle (30.86%) of this device.
Using this calculation method eliminates all the other transmit time, guard time, etc, and only uses the transmit time. Regarding to why these numbers don't total to 48: Since PUSC is dominant, this determines the allowed DL:UL ratios. In DL PUSC, bursts require two symbols so DL symbol count must be an even number+1 symbol for the preamble. Hence the number of DL symbols must be an odd number. In the UL, PUSC bursts require 3 symbols so UL must be a multiple of three symbols. In addition, the total number of symbols (DL+UL) is chosen to be 47 or less to allow for sufficient time to switch between DL and UL and vice versa.

There is a quiet time between the DL and UL transmission and a quiet time between the UL and DL transmission. During these quiet intervals the Base Station is neither transmitting nor receiving. The unoccupied symbols become part of this quiet time.

Ranging is performed to make sure the MS transmits in the correct time window. Data transmission is disabled when the MS is ranging. This is done to prevent the MS from transmitting at the wrong time and interfering with other users. Hence the MS is not allowed to range and transmit data at the same time. So ranging was not considered in the scaling factor.





Sample Time Vector Plot 1 for 5MHz & PUSC Zone

Uplink burst for 29:18 symbol ratio with control symbol inactive

The theoretically Duty Cycle = (15*102.8571 uS)/5000 uS=30.86 %.

This agrees with the actual duty cycles of this device and the theoretical DF is used for SAR Crest Factor.

So SAR Crest Factor (CF) = 1/0.3086 = 3.2

8. SUMMARY OF TEST RESULTS

According to the supplied product information, basically the SAR test was performed at 29:18 (18 uplink symbols per frame with 15 data symbols) as the worst case. When performing the SAR tests using the VSG, it looks identical to the signal that would come from a BS in the field. The intent is to make the think it is in EUT a real network. The transmission from the EUT under test conditions is exactly the same as in the field in normal operation. The only difference is that normally in the field there will be information in some of the control symbols, whereas SAR tests were performed with not having in the some control symbols. Therefore it is necessary to calculate a scaling factor that takes into consideration this fact. The calculation of this scaling factor is described in the followings.

Scaling Factor for a 5MHz channel bandwidth

The testing was done at DL:UL symbol ratio, 29:18 as this is the maximum achievable ratio for the product. The 18 indicates the number of uplink symbols.

The 3 symbols are control channels (BS signaling) and the remaining 15 symbols are for data.
Since PUSC zone only support control signal, the first 3 symbols have a total of 17 slots in a 5 MHz channel bandwidth. The maximum number of control slots that an active can occupy in any frame is:

(A) 2 slots for CQICH report-maximum of 2 simultaneous CQICH reports are allowed by the Standard from any MS
(B) 3 slots for HARQ ACK/NAK (5 ACK/NAK bits corresponding to maximum of 5 DL HARQ bursts in previous DL frame allowed by the standard - each HARQ ACK/NAK bit is transmitted using 1/2 slot)

During the testing, the control symbols contained no information, so did not contribute to the total energy transmitted. To compensate for the maximum energy which may presented in the 3 control symbols, following scheme is used for the up scaling.

- The maximum rated output power = 23.36dBm = 216.770 mW
- The maximum power in control traffic = 63.756 mW (5 / 17 × 216.770 mW)
- Scaling Factor = (3 × 63.756 + 15 × 216.770) / (15 × Measured power of the tested channel)

Example:

Scaling Factor = (3 × 63.756 + 15 × 216.770) / (15 × 180.717) = **1.2701**

- Measured power of the high channel: 22.57 dBm = 180.717 mW

Scaled SAR Value = Measured SAR Value × Scaling Factor = 0.691 W/kg × 1.2701 = **0.878 W/kg**

- Measured SAR Value of the High channel with PUSC & 16QAM 1/2 and Rear position = 0.691 W/kg

Scaling Factor for a 10 MHz channel bandwidth

The testing was done at DL:UL symbol ratio, 29:18 as this is the maximum achievable ratio for the product. The 18 indicates the number of uplink symbols.

The 3 symbols are control channels (BS signaling) and the remaining 15 symbols are for data.
Since PUSC zone only support control signal, the first 3 symbols have a total of 35 slots in a 10 MHz channel bandwidth. The maximum number of control slots that an active can occupy in any frame is:

(A) 2 slots for CQICH report - maximum of 2 simultaneous CQICH reports are allowed by the Standard from any MS
(B) 3 slots for HARQ ACK/NAK (5 ACK/NAK bits corresponding to maximum of 5 DL HARQ bursts in previous DL frame allowed by the standard - each HARQ ACK/NAK bit is transmitted using 1/2 slot)

During the testing, the control symbols contained no information, so did not contribute to the total energy transmitted. To compensate for the maximum energy which may presented in the 3 control symbols, following scheme is used for the up scaling.

- The maximum rated output power = 22.87 dBm = 193.642 mW
- The maximum power in control traffic = 27.663 mW (5 / 35 × 193.642 mW)
- Scaling Factor = (3 × 27.663 + 15 × 193.642) / (15 × Measured power of the tested channel)

Example:

Scaling Factor = (3 × 27.663 + 15 × 193.642) / (15 × 174.181) = **1.1435**

- Measured power of the low channel: 22.41dBm = 174.181 mW

Scaled SAR Value = Measured SAR Value × Scaling Factor = 0.680 W/kg × 1.1435 = **0.778 W/kg**

- Measured SAR Value of the high channel with PUSC & 16QAM 1/2 and Rear position = 0.680 W/kg

9. TEST CONFIGURATION POSITIONS

9.1 The exterior of the device

· **Position: Front of EUT**

· **Position: Rear of EUT**

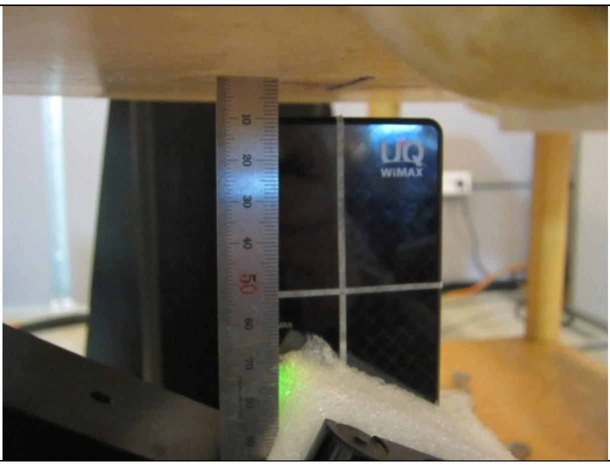
· **Position: Top of EUT**

· **Position: Bottom of EUT**

· **Position: Right of EUT**

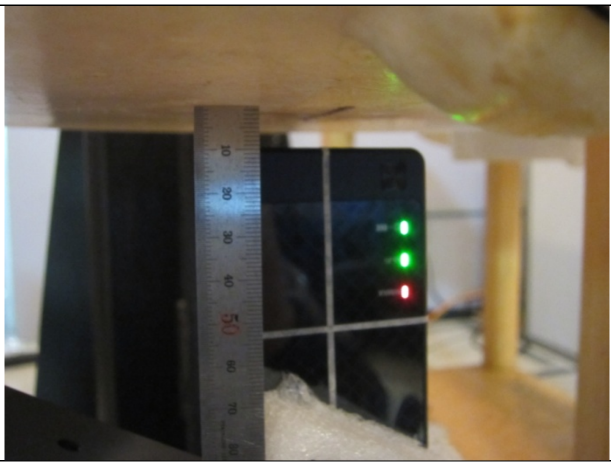
· **Position: Left of EUT**

9.2 The following test configurations have been applied in this test report:



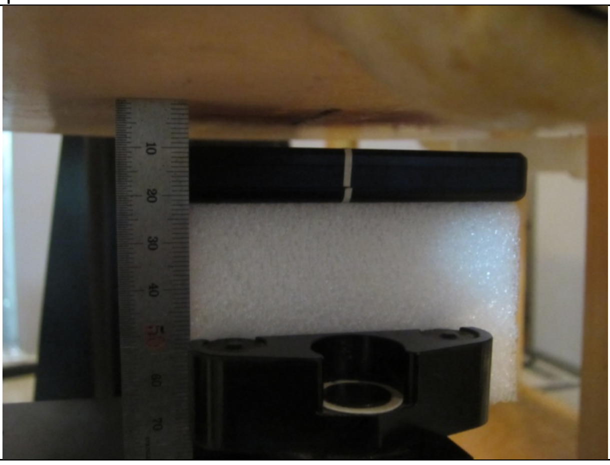
A: Top

The top of the EUT face to the phantom with 10 mm separation distance.



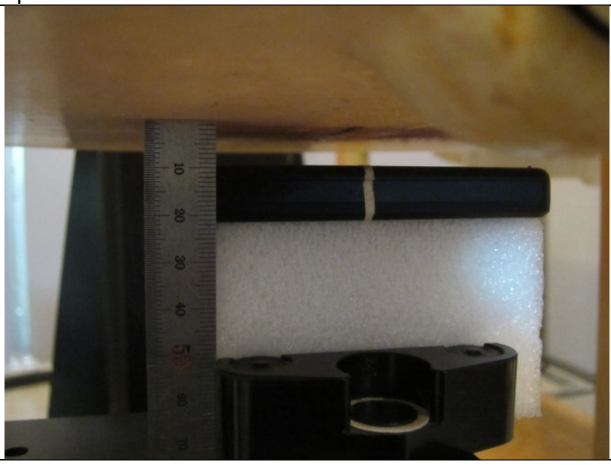
B: Bottom

The bottom of the EUT face to the phantom with 10 mm separation distance.



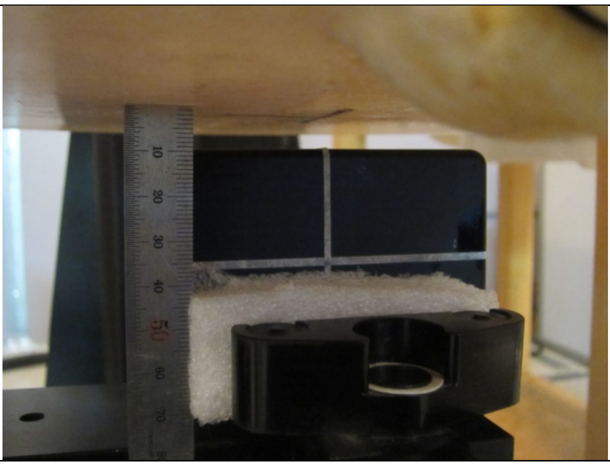
C: Front

The front of the EUT face to the phantom with 10 mm separation distance.



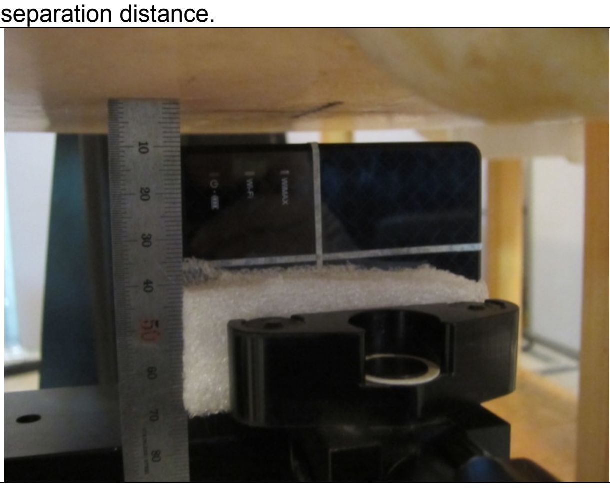
D: Rear

The rear of the EUT face to the phantom with 10 mm separation distance.



E: Right

The right of the EUT face to the phantom with 10 mm separation distance.



F: Left

The left of the EUT face to the phantom with 10 mm separation distance.

10. ANSI / IEEE C95.1-2005 RF EXPOSURE LIMITS

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.

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 employment, which 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 6.1.SAR Human Exposure Specified in ANSI / IEEE C95.1-2005

	HUMAN EXPOSURE LIMITS	
	General Public Exposure (W/kg) or (mW/g)	Occupational Exposure (W/kg) or (mW/g)
Whole-Body average SAR (W/kg)	0.08	0.40
Localized SAR (head and trunk) (W/kg)	1.60	8.00
Localized SAR (limbs) (W/kg)	4.00	20.0

NOTES:

* The Spatial Peak value of the SAR averaged over any 1 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

** The Spatial Average value of the SAR averaged over the whole-body.

*** The Spatial Peak value of the SAR averaged over any 10 g of tissue (defined as a tissue volume in the shape of a cube) and over the appropriate averaging time.

Uncontrolled Environments are defined as locations where there is the 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).

11. IEEE P1528 –MEASUREMENT UNCERTAINTIES

Error Description	Uncertaint value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 5.5	Normal	1	1	± 5.5 %	∞
Axial isotropy	± 4.7	Rectangular	√3	1	± 2.714 %	∞
Hemispherical isotropy	± 9.6	Rectangular	√3	1	± 5.543 %	∞
Boundary Effects	± 0.8	Rectangular	√3	1	± 0.462 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.714 %	∞
Detection limits	± 0.25	Rectangular	√3	1	± 0.144 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.462 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.501 %	∞
RF Ambient Conditions	± 3.0	Rectangular	√3	1	± 1.732 %	∞
Probe Positioner	± 0.4	Rectangular	√3	1	± 0.231 %	∞
Probe Positioning	± 2.9	Rectangular	√3	1	± 1.674 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.577 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.887 %	∞
Physical Parameters						
Phantom Shell	± 4.0	Rectangular	√3	1	± 2.309 %	∞
Liquid conductivity (Target)	± 5.0	Rectangular	√3	0.64	± 2.887 %	∞
Liquid conductivity (Meas.)	± 5.0	Normal	1	0.64	± 5.0 %	∞
Liquid permittivity (Target)	± 5.0	Rectangular	√3	0.6	± 2.887 %	∞
Liquid permittivity (Meas.)	± 5.0	Normal	1	0.6	± 5.0 %	∞
CombinedStandard Uncertainty					**± 12.1 %**	330
Expanded Uncertainty (k=2)					**± 24.2 %**	

The above measurement uncertainties are according to IEEE P1528 (2003)

12. SYSTEM VERIFICATION

Tissue Verification

Table 12.1 Simulated Tissue Verification

MEASURED TISSUE PARAMETERS							
Date(s)	Target Frequency	Dielectric constant: ε			Conductivity: σ		
		Target	Measured	Deviation (%)	Target	Measured	Deviation (%)
Feb. 20, 2012	2499.00 MHz Body	52.6	51.9	-1.33	2.020	2.070	2.48
	2508.50 MHz Body	52.6	51.9	-1.33	2.020	2.079	2.92
	2600.00 MHz Body	52.5	51.6	-1.71	2.160	2.200	1.85
	2683.50 MHz Body	52.4	51.3	-2.10	2.280	2.319	1.71
	2686.75 MHz Body	52.4	51.3	-2.10	2.290	2.320	1.31
Feb. 21, 2012	2499.00 MHz Body	52.6	51.5	-2.09	2.020	2.070	2.48
	2508.50 MHz Body	52.6	51.5	-2.09	2.020	2.080	2.97
	2600.00 MHz Body	52.5	51.1	-2.67	2.160	2.200	1.85
	2683.50 MHz Body	52.4	50.8	-3.05	2.280	2.310	1.32
	2686.75 MHz Body	52.4	50.8	-3.05	2.290	2.318	1.22
Mar. 22, 2012	2499.00 MHz Body	52.6	51.5	-2.09	2.020	2.090	3.47
	2508.50 MHz Body	52.6	51.5	-2.09	2.020	2.086	3.27
	2600.00 MHz Body	52.5	51.1	-2.67	2.160	2.220	2.78
	2683.50 MHz Body	52.4	50.8	-3.05	2.280	2.332	2.28
	2686.75 MHz Body	52.4	50.8	-3.05	2.290	2.340	2.18
Mar. 23, 2012	2499.00 MHz Body	52.6	52.0	-1.14	2.020	2.056	1.78
	2508.50 MHz Body	52.6	52.0	-1.14	2.020	2.070	2.48
	2600.00 MHz Body	52.5	51.6	-1.71	2.160	2.190	1.39
	2683.50 MHz Body	52.4	51.3	-2.10	2.280	2.300	0.88
	2686.75 MHz Body	52.4	51.3	-2.10	2.290	2.305	0.66
Mar. 24, 2012	2499.00 MHz Body	52.6	51.9	-1.33	2.020	2.069	2.43
	2508.50 MHz Body	52.6	52.0	-1.14	2.020	2.070	2.48
	2600.00 MHz Body	52.5	52.2	-0.57	2.160	2.200	1.85
	2683.50 MHz Body	52.4	52.3	-0.19	2.280	2.309	1.27
	2686.75 MHz Body	52.4	52.3	-0.19	2.290	2.310	0.87

Test System Validation

Prior to assessment, the system is verified to the ±10% of the specifications at 2600 MHz by using the system validation kit(s). (Graphic Plots Attached)

Table 12.2 System Validation

SYSTEM DIPOLE VALIDATION TARGET & MEASURED										
Freq. [MHz]	System Validation Kit:	Date(s)	Liquid	Ambient Temp.[°C]	Liquid Temp.[°C]	Input Power (mW)	1 W Target SAR1g (W/kg)	Measured SAR1g (mW/g)	1 W Normalized SAR$_{1g}$ (W/kg)	Deviation (%)
2600	D-2600V2, S/N: 1016	Feb. 20, 2012	Body	21.8	22.0	250	58.9	14.20	56.80	-3.57
2600	D-2600V2, S/N: 1016	Feb. 21, 2012	Body	22.0	22.5	250	58.9	14.30	57.20	-2.89
2600	D-2600V2, S/N: 1016	Mar. 22, 2012	Body	22.2	22.5	250	58.9	14.70	58.80	-0.17
2600	D-2600V2, S/N: 1016	Mar. 23, 2012	Body	21.9	22.1	250	58.9	14.60	58.40	-0.85
2600	D-2600V2, S/N: 1016	Mar. 24, 2012	Body	22.3	22.4	250	58.9	15.10	60.40	2.55

Note: Validation was measured with input power 250 mW and normalized to 1 W.

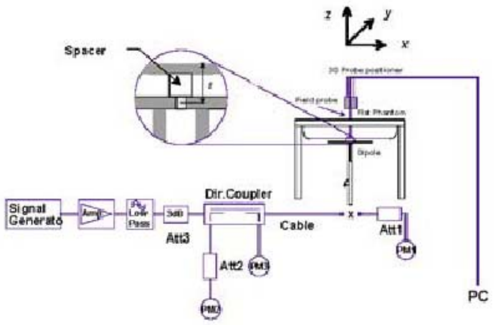


Figure 12.1 Dipole Validation Test Setup

Justification for Extended SAR Dipole Calibrations

About KDB Publication 450824-2

The following are the recommended FCC procedures for SAR dipole calibration.

1) The phantom configuration, tissue dielectric parameters, dipole positioning requirements, dielectric spacer and other electrical and mechanical details should be clearly specified in the dipole calibration report. Dipoles must be recalibrated at least once every three years; however, immediate re-calibration is required for the following conditions. The test laboratory must ensure that the required supporting information and documentation have been included in the SAR report to qualify for the extended 3-year calibration interval; otherwise, the IEEE Standard 1528-2003 recommended annual calibration is expected.

When the most recent return-loss, measured at least annually, deviates by more than 20% from the previous measurement (i.e. 0.2 of the dB value) or not meeting the required -20 dB return-loss specification

Antenna Parameters

Date(s)	Frequency	Return loss (Head)	Impedance (Ω)	Return loss (Body)	Impedance (Ω)
May 26.2011	2600 MHz	-25.6 dB	50.1	-26.8 dB	47.2

13. SAR exclusion for W-LAN stand alone & Simultaneous transmission

According to the below FCC KDB#447498 D01 Section 3), W-LAN stand alone SAR and Simultaneous SAR for this device is excluded.

FCC KDB#447498 D01 Section 3)

3) Transmitters and modules for use in portable exposure conditions that allow simultaneous transmission

b) SAR is not required for the following simultaneous transmission conditions

i) When excluded by the procedures in KDB 616217 or KDB 648474.

ii) When specific requirements for simultaneous transmission SAR evaluation have not been established for the host platform or device configuration:

(1) for the antennas that are located < 5 cm from persons, where

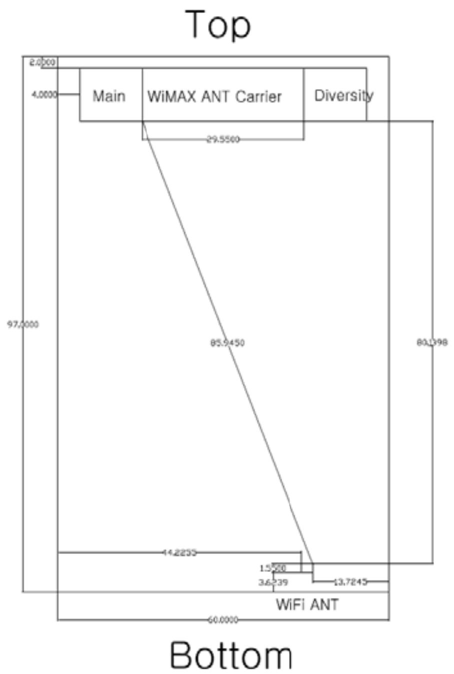
(a) The closest antenna separation distance is ≥ 5 cm for all simultaneous transmitting antennas within the host or device; and

(b) The sum of the 1-g SAR is < 1.6 W/kg for all simultaneous transmitting antennas that require stand-alone SAR evaluation or the SAR to peak location separation ratios are < 0.3 for all simultaneous transmitting antenna pairs and

(c) The output power is ≤ $60/f_{(GHz)}$ mW for any simultaneous transmitting antenna(s) for which stand-alone SAR evaluation is not required.

The power threshold of 60/f(GHz) (Source-Based Time Average of Conducted power) for W-LAN of this device is 24.37mW.
The minimum antenna separation distance is 80.1398 mm and the sum of the WiMAX (0.878 W/Kg) and WLAN (0 W/Kg since WLAN stand alone SAR is exempted) is 0.878 W/Kg and the maximum W-LAN average output power of this device is 19.32 mW.
(Please refer to AVG power table for this device on page 37 of this test report)

Therefore SAR for W-LAN stand alone and simultaneous transmission for this device are excluded.



FCC ID: B9I-WXR-PG

Antenna separation distance: 80.1398 mm
The sum of the WiMAX and WLAN : 0.878 W/Kg
W-LAN Max. RF average output power: 12.86 dBm (19.32 mW)

14. DESCRIPTION OF TEST MODE AND SUMMARY OF RESULTS

14.1 DESCRIPTION OF TEST MODES AND JUSTIFICATION FOR SAR REDUCTION

TEST MODE	COMMUNICATION	MODULATION TYPE & CODING RATE	Zone Format	ASSESSEMENT POSITION	TESTED CHANNEL
1	WiMAX-5,10 M	QPSK 1/2, 16QAM 1/2	PUSC	A(Top)	M
2	WiMAX-5,10 M	QPSK 1/2, 16QAM 1/2	PUSC	B(Bottom)	M
3	WiMAX-5,10 M	QPSK 1/2, 16QAM 1/2	PUSC	C(Front)	M
4	WiMAX-5,10 M	QPSK 1/2, 16QAM 1/2	PUSC	D(Rear)	L,M,H
5	WiMAX-5,10 M	QPSK 1/2, 16QAM 1/2	PUSC	E(Right)	M
6	WiMAX-5,10 M	QPSK 1/2, 16QAM 1/2	PUSC	F(Left)	M

Note : The SAR measurements were performed at the above worst case modes and middle channel.
If the measured SAR value at the worst case mode and middle channel is less than 0.8 W/kg, the SAR for low and high channels were omitted.

15. SUMMARY OF TEST RESULTS

15.1 SAR Value for 5 MHz (Antenna Position: Ant. 0)

Assessment Position	Zone Format & Modulation Type	Scaling Factor(dB)			SAR Value(W/kg)					
					Measured Value			Scaled Value		
		Low CH.	Middle CH.	High CH.	Low CH.	Middle CH.	High CH.	Low CH.	Middle CH.	High CH.
Top	PUSC & QPSK 1/2	-	1.2383	-	-	0.065	-	-	0.080	-
	PUSC & 16QAM 1/2	-	1.2354	-	-	0.068	-	-	0.084	-
Bottom	PUSC & QPSK 1/2	-	1.2383	-	-	0.129	-	-	0.160	-
	PUSC & 16QAM 1/2	-	1.2354	-	-	0.070	-	-	0.086	-
Front	PUSC & QPSK 1/2	-	1.2383	-	-	0.424	-	-	0.525	-
	PUSC & 16QAM 1/2	-	1.2354	-	-	0.410	-	-	0.507	-
Rear	PUSC & QPSK 1/2	1.1880	1.2383	1.0588	0.474	0.440	0.683	0.563	0.545	0.723
	PUSC & 16QAM 1/2	1.1771	1.2354	1.2701	0.423	0.438	0.691	0.498	0.541	**0.878**
Right	PUSC & QPSK 1/2	-	1.2383	-	-	0.057	-	-	0.071	-
	PUSC & 16QAM 1/2	-	1.2354	-	-	0.123	-	-	0.152	-
Left	PUSC & QPSK 1/2	-	1.2383	-	-	0.402	-	-	0.498	-
	PUSC & 16QAM 1/2	-	1.2354	-	-	0.374	-	-	0.462	-

15.2 SAR Value for 10 MHz (Antenna Position: Ant. 0)

Assessment Position	Zone Format & Modulation Type	Scaling Factor(dB)			SAR Value(W/kg)					
					Measured Value			Scaled Value		
		Low CH.	Middle CH.	High CH.	Low CH.	Middle CH.	High CH.	Low CH.	Middle CH.	High CH.
Top	PUSC & QPSK 1/2	-	1.1098	-	-	0.065	-	-	0.072	-
	PUSC & 16QAM 1/2	-	1.0920	-	-	0.072	-	-	0.079	-
Bottom	PUSC & QPSK 1/2	-	1.1098	-	-	0.119	-	-	0.132	-
	PUSC & 16QAM 1/2	-	1.0920	-	-	0.126	-	-	0.138	-
Front	PUSC & QPSK 1/2	-	1.1098	-	-	0.475	-	-	0.527	-
	PUSC & 16QAM 1/2	-	1.0920	-	-	0.448	-	-	0.489	-
Rear	PUSC & QPSK 1/2	1.0286	1.1098	1.1149	0.389	0.494	0.697	0.400	0.548	0.777
	PUSC & 16QAM 1/2	1.0309	1.0920	1.1435	0.459	0.479	0.680	0.473	0.523	**0.778**
Right	PUSC & QPSK 1/2	-	1.1098	-	-	0.054	-	-	0.060	-
	PUSC & 16QAM 1/2	-	1.0920	-	-	0.059	-	-	0.064	-
Left	PUSC & QPSK 1/2	-	1.1098	-	-	0.418	-	-	0.464	-
	PUSC & 16QAM 1/2	-	1.0920	-	-	0.406	-	-	0.443	-

15.3 SAR Value for 5 MHz (Antenna Position: Ant. 1)

Assessment Position	Zone Format & Modulation Type	Scaling Factor(dB)			SAR Value(W/kg)					
					Measured Value			Scaled Value		
		Low CH.	Middle CH.	High CH.	Low CH.	Middle CH.	High CH.	Low CH.	Middle CH.	High CH.
Top	PUSC & QPSK 1/2	-	1.2967	-	-	0.071	-	-	0.092	-
	PUSC & 16QAM 1/2	-	1.2701	-	-	0.066	-	-	0.084	-
Bottom	PUSC & QPSK 1/2	-	1.2967	-	-	0.081	-	-	0.105	-
	PUSC & 16QAM 1/2	-	1.2701	-	-	0.087	-	-	0.110	-
Front	PUSC & QPSK 1/2	-	1.2967	-	-	0.352	-	-	0.456	-
	PUSC & 16QAM 1/2	-	1.2701	-	-	0.356	-	-	0.452	-
Rear	PUSC & QPSK 1/2	1.1826	1.2967	1.0588	0.611	0.463	0.715	0.723	0.600	0.757
	PUSC & 16QAM 1/2	1.1530	1.2701	1.2613	0.579	0.476	0.674	0.668	0.605	0.850
Right	PUSC & QPSK 1/2	-	1.2967	-	-	0.398	-	-	0.516	-
	PUSC & 16QAM 1/2	-	1.2701	-	-	0.405	-	-	0.514	-
Left	PUSC & QPSK 1/2	-	1.2967	-	-	0.029	-	-	0.038	-
	PUSC & 16QAM 1/2	-	1.2701	-	-	0.023	-	-	0.029	-

15.4 SAR Value for 10 MHz (Antenna Position: Ant. 1)

Assessment Position	Zone Format & Modulation Type	Scaling Factor(dB)			SAR Value(W/kg)					
					Measured Value			Scaled Value		
		Low CH.	Middle CH.	High CH.	Low CH.	Middle CH.	High CH.	Low CH.	Middle CH.	High CH.
Top	PUSC & QPSK 1/2	-	1.1278	-	-	0.058	-	-	0.065	-
	PUSC & 16QAM 1/2	-	1.1149	-	-	0.068	-	-	0.076	-
Bottom	PUSC & QPSK 1/2	-	1.1278	-	-	0.071	-	-	0.080	-
	PUSC & 16QAM 1/2	-	1.1149	-	-	0.074	-	-	0.083	-
Front	PUSC & QPSK 1/2	-	1.1278	-	-	0.344	-	-	0.388	-
	PUSC & 16QAM 1/2	-	1.1149	-	-	0.360	-	-	0.401	-
Rear	PUSC & QPSK 1/2	1.0286	1.1278	1.1226	0.380	0.466	0.547	0.391	0.526	0.614
	PUSC & 16QAM 1/2	1.0381	1.1149	1.1541	0.445	0.469	0.553	0.462	0.523	0.638
Right	PUSC & QPSK 1/2	-	1.1278	-	-	0.390	-	-	0.440	-
	PUSC & 16QAM 1/2	-	1.1149	-	-	0.395	-	-	0.440	-
Left	PUSC & QPSK 1/2	-	1.1278	-	-	0.029	-	-	0.033	-
	PUSC & 16QAM 1/2	-	1.1149	-	-	0.026	-	-	0.029	-

16. POWER TABLE

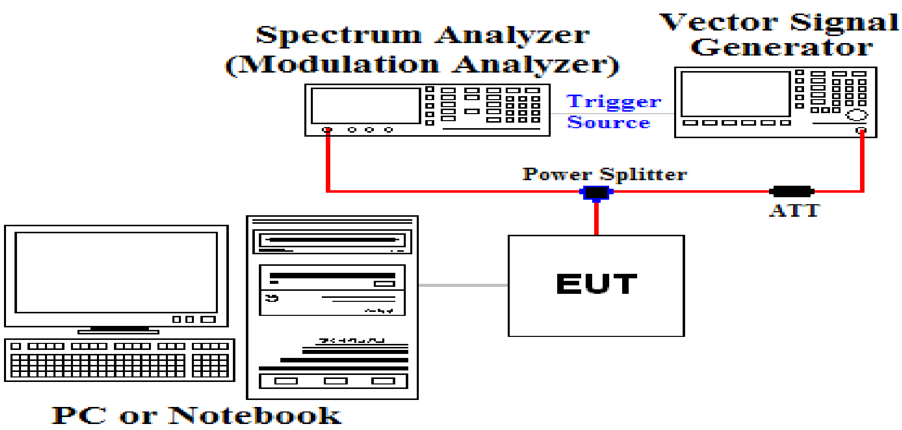
Max. Power Output Table for WXR-PG (WiMAX) Antenna 0

Zone Format	Modulation Type	OBW: 5MHz			OBW: 10MHz		
		Low CH	Mid. CH	High CH	Low CH	Mid. CH	High CH
		2499.00	2600.00	2686.75	2508.50	2600.00	2683.50
PUSC	QPSK1/2	22.86	22.68	23.36	22.87	22.54	22.52
	QPSK3/4	22.81	22.50	23.19	22.78	22.33	22.40
	16QAM1/2	22.90	22.69	22.57	22.86	22.61	22.41
	16QAM3/4	22.58	22.42	22.50	22.73	22.35	22.17

Max. Power Output Table for WXR-PG (WiMAX) Antenna 1

Zone Format	Modulation Type	OBW: 5MHz			OBW: 10MHz		
		Low CH	Mid. CH	High CH	Low CH	Mid. CH	High CH
		2499.00	2600.00	2686.75	2508.50	2600.00	2683.50
PUSC	QPSK1/2	22.75	22.35	23.23	22.78	22.38	22.40
	QPSK3/4	22.64	22.21	23.08	22.77	22.22	22.29
	16QAM1/2	22.86	22.44	22.47	22.74	22.43	22.28
	16QAM3/4	22.41	22.32	22.43	22.44	22.31	22.10

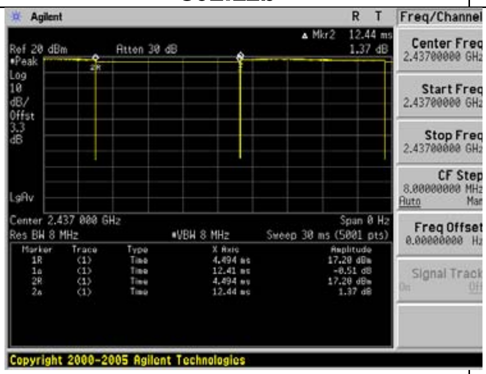
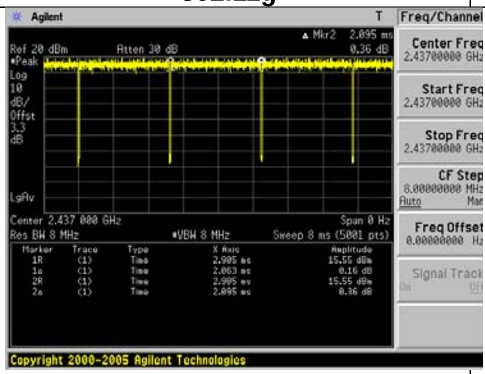
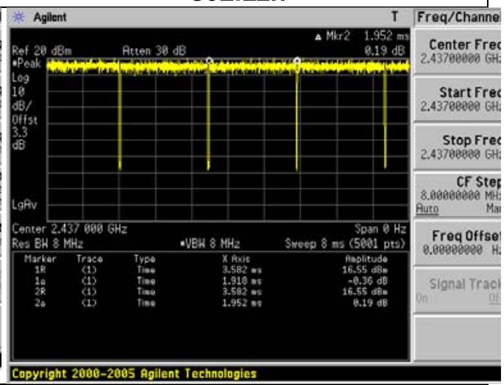
WiMAX Conducted Power Test Setup Diagram



Max. Power Output Table for WXR-PG (W-LAN)

Mode	Frequency (MHz)	Channel No.	Power Meter Reading(dBm)	DCF (dB)	Corrected AVG Output Power (dBm)
802.11b	2412	1	12.21	0.01	12.22
	2437	6	12.49	0.01	12.50
	2462	**11**	**12.85**	**0.01**	**12.86**
802.11g	2412	1	11.34	0.07	11.41
	2437	6	11.84	0.07	11.91
	2462	11	12.29	0.07	12.36
802.11n	2412	1	11.72	0.08	11.80
	2437	6	12.25	0.08	12.33
	2462	11	12.11	0.08	12.19

Duty Factors for W-LAN

802.11b	802.11g	802.11n
		
$T_{on} + T_{off}$ = 12.44 ms T_{on} = 12.41 ms Duty = 12.41/ 12.44 = 0.998 Duty Cycle Correction Factor = 10log(1/Duty) = 0.01	$T_{on} + T_{off}$ = 2.095 us T_{on} = 2.063 us Duty = 2.063/ 2.095 = 0.985 Duty Cycle Correction Factor = 10log(1/Duty) = 0.07	$T_{on} + T_{off}$ = 1.952 us T_{on} = 1.918 us Duty = 1.918/ 1.952 = 0.983 Duty Cycle Correction Factor = 10log(1/Duty) = 0.08

17. SAR TEST DATA RESULTS

17.1 Measurement Results (Bandwidth: 5 MHz, QPSK12) – Antenna Position: Ant. 0

FREQUENCY MHz	Begin Power (dBm)	Drift Power (dB)	Mode	Spacing	Antenna Position	Device Test Position	SAR (W/kg)
2600.00	22.68	0.114	PUSC/QPSK	10 mm [Phantom]	Internal	1	0.065
2600.00	22.68	0.148	PUSC/QPSK	10 mm [Phantom]	Internal	2	0.129
2600.00	22.68	-0.053	PUSC/QPSK	10 mm [Phantom]	Internal	3	0.424
2499.00	22.86	-0.055	PUSC/QPSK	10 mm [Phantom]	Internal	4	0.474
2600.00	22.68	-0.066	PUSC/QPSK	10 mm [Phantom]	Internal	4	0.440
2686.75	**23.36**	**-0.069**	**PUSC/QPSK**	**10 mm [Phantom]**	**Internal**	**4**	**0.683**
2600.00	22.68	-0.129	PUSC/QPSK	10 mm [Phantom]	Internal	5	0.057
2600.00	22.68	0.012	PUSC/QPSK	10 mm [Phantom]	Internal	6	0.402
ANSI / IEEE C95.1 2005 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population Exposure					**Body 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Battery is fully charged for all readings.
6. Test Signal Call Mode □Continuous Tx On □Manu.Test Codes ▣Vector Signal Generator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.0cm.±0.1
9. Test configuration of each mode is described in section 9.2

17.2 Measurement Results (Bandwidth: 5 MHz, 16QAM12) – Antenna Position: Ant. 0

FREQUENCY MHz	Begin Power (dBm)	Drift Power (dB)	Mode	Spacing	Antenna Position	Device Test Position	SAR (W/kg)
2600.00	22.69	0.074	PUSC /16QAM	10 mm [Phantom]	Internal	1	0.068
2600.00	22.69	0.176	PUSC /16QAM	10 mm [Phantom]	Internal	2	0.070
2600.00	22.69	0.169	PUSC /16QAM	10 mm [Phantom]	Internal	3	0.410
2499.00	22.90	0.052	PUSC /16QAM	10 mm [Phantom]	Internal	4	0.423
2600.00	22.69	0.179	PUSC /16QAM	10 mm [Phantom]	Internal	4	0.438
2686.75	**22.57**	**-0.055**	**PUSC /16QAM**	**10 mm [Phantom]**	**Internal**	**4**	**0.691**
2600.00	22.69	-0.162	PUSC /16QAM	10 mm [Phantom]	Internal	5	0.123
2600.00	22.69	0.111	PUSC /16QAM	10 mm [Phantom]	Internal	6	0.374
ANSI / IEEE C95.1 2005 – SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/ General Population Exposure**					**Body** **1.6 W/kg (mW/g)** averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Battery is fully charged for all readings.
6. Test Signal Call Mode □Continuous Tx On □Manu.Test Codes ▣Vector Signal Generator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.0cm.±0.1
9. Test configuration of each mode is described in section 9.2

17.3 Measurement Results (Bandwidth: 10 MHz, QPSK12) – Antenna Position: Ant. 0

FREQUENCY MHz	Begin Power (dBm)	Drift Power (dB)	Mode	Spacing	Antenna Position	Device Test Position	SAR (W/kg)
2600.00	22.54	0.147	PUSC/QPSK	10 mm [Phantom]	Internal	1	0.065
2600.00	22.54	0.189	PUSC/QPSK	10 mm [Phantom]	Internal	2	0.119
2600.00	22.54	-0.023	PUSC/QPSK	10 mm [Phantom]	Internal	3	0.475
2508.50	22.87	0.198	PUSC/QPSK	10 mm [Phantom]	Internal	4	0.389
2600.00	22.54	0.002	PUSC/QPSK	10 mm [Phantom]	Internal	4	0.494
2683.50	**22.52**	**-0.048**	**PUSC/QPSK**	**10 mm [Phantom]**	**Internal**	**4**	**0.697**
2600.00	22.54	-0.026	PUSC/QPSK	10 mm [Phantom]	Internal	5	0.054
2600.00	22.54	0.086	PUSC/QPSK	10 mm [Phantom]	Internal	6	0.418
ANSI / IEEE C95.1 2005 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population Exposure					**Body 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Battery is fully charged for all readings.
6. Test Signal Call Mode □Continuous Tx On □Manu.Test Codes ▣Vector Signal Generator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.0cm.±0.1
9. Test configuration of each mode is described in section 9.2

17.4 Measurement Results (Bandwidth: 10 MHz, 16QAM12) – Antenna Position: Ant. 0

FREQUENCY MHz	Begin Power (dBm)	Drift Power (dB)	Mode	Spacing	Antenna Position	Device Test Position	SAR (W/kg)
2600.00	22.61	0.199	PUSC /16QAM	10 mm [Phantom]	Internal	1	0.072
2600.00	22.61	0.077	PUSC /16QAM	10 mm [Phantom]	Internal	2	0.126
2600.00	22.61	0.206	PUSC /16QAM	10 mm [Phantom]	Internal	3	0.448
2508.50	22.86	-0.036	PUSC /16QAM	10 mm [Phantom]	Internal	4	0.459
2600.00	22.61	-0.184	PUSC /16QAM	10 mm [Phantom]	Internal	4	0.479
2683.50	**22.41**	**0.001**	**PUSC /16QAM**	**10 mm [Phantom]**	**Internal**	**4**	**0.680**
2600.00	22.61	0.063	PUSC /16QAM	10 mm [Phantom]	Internal	5	0.059
2600.00	22.61	0.096	PUSC /16QAM	10 mm [Phantom]	Internal	6	0.406
ANSI / IEEE C95.1 2005 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population Exposure					**Body 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Battery is fully charged for all readings.
6. Test Signal Call Mode □Continuous Tx On □Manu.Test Codes ▣Vector Signal Generator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.0cm.±0.1
9. Test configuration of each mode is described in section 9.2

17.5 Measurement Results (Bandwidth: 5 MHz, QPSK12) – Antenna Position: Ant. 1

FREQUENCY MHz	Begin Power (dBm)	Drift Power (dB)	Mode	Spacing	Antenna Position	Device Test Position	SAR (W/kg)
2600.00	22.35	-0.061	PUSC/QPSK	10 mm [Phantom]	Internal	1	0.071
2600.00	22.35	0.029	PUSC/QPSK	10 mm [Phantom]	Internal	2	0.081
2600.00	22.35	-0.097	PUSC/QPSK	10 mm [Phantom]	Internal	3	0.352
2499.00	22.75	0.078	PUSC/QPSK	10 mm [Phantom]	Internal	4	0.611
2600.00	22.35	0.054	PUSC/QPSK	10 mm [Phantom]	Internal	4	0.463
2686.75	**23.23**	**-0.016**	**PUSC/QPSK**	**10 mm [Phantom]**	**Internal**	**4**	**0.715**
2600.00	22.35	0.103	PUSC/QPSK	10 mm [Phantom]	Internal	5	0.398
2600.00	22.35	0.076	PUSC/QPSK	10 mm [Phantom]	Internal	6	0.029
ANSI / IEEE C95.1 2005 – SAFETY LIMIT **Spatial Peak** **Uncontrolled Exposure/ General Population Exposure**					**Body** **1.6 W/kg (mW/g)** averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Battery is fully charged for all readings.
6. Test Signal Call Mode □Continuous Tx On □Manu.Test Codes ▣Vector Signal Generator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.0cm.±0.1
9. Test configuration of each mode is described in section 9.2

17.6 Measurement Results (Bandwidth: 5 MHz, 16QAM12) – Antenna Position: Ant. 1

FREQUENCY MHz	Begin Power (dBm)	Drift Power (dB)	Mode	Spacing	Antenna Position	Device Test Position	SAR (W/kg)
2600.00	22.44	0.137	PUSC /16QAM	10 mm [Phantom]	Internal	1	0.066
2600.00	22.44	-0.188	PUSC /16QAM	10 mm [Phantom]	Internal	2	0.087
2600.00	22.44	0.074	PUSC /16QAM	10 mm [Phantom]	Internal	3	0.356
2499.00	22.86	0.110	PUSC /16QAM	10 mm [Phantom]	Internal	4	0.579
2600.00	22.44	0.129	PUSC /16QAM	10 mm [Phantom]	Internal	4	0.476
2686.75	**22.47**	**0.084**	**PUSC /16QAM**	**10 mm [Phantom]**	**Internal**	**4**	**0.674**
2600.00	22.44	0.111	PUSC /16QAM	10 mm [Phantom]	Internal	5	0.405
2600.00	22.44	0.127	PUSC /16QAM	10 mm [Phantom]	Internal	6	0.023
ANSI / IEEE C95.1 2005 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population Exposure					**Body 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Battery is fully charged for all readings.
6. Test Signal Call Mode □Continuous Tx On □Manu.Test Codes ▣Vector Signal Generator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.0cm.±0.1
9. Test configuration of each mode is described in section 9.2

17.7 Measurement Results (Bandwidth: 10 MHz, QPSK12) – Antenna Position: Ant. 1

FREQUENCY MHz	Begin Power (dBm)	Drift Power (dB)	Mode	Spacing	Antenna Position	Device Test Position	SAR (W/kg)
2600.00	22.38	-0.141	PUSC/QPSK	10 mm [Phantom]	Internal	1	0.058
2600.00	22.38	0.203	PUSC/QPSK	10 mm [Phantom]	Internal	2	0.071
2600.00	22.38	-0.063	PUSC/QPSK	10 mm [Phantom]	Internal	3	0.344
2508.50	22.78	0.148	PUSC/QPSK	10 mm [Phantom]	Internal	4	0.380
2600.00	22.38	0.139	PUSC/QPSK	10 mm [Phantom]	Internal	4	0.466
2683.50	**22.40**	**0.086**	**PUSC/QPSK**	**10 mm [Phantom]**	**Internal**	**4**	**0.547**
2600.00	22.38	0.188	PUSC/QPSK	10 mm [Phantom]	Internal	5	0.390
2600.00	22.38	-0.056	PUSC/QPSK	10 mm [Phantom]	Internal	6	0.029
ANSI / IEEE C95.1 2005 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population Exposure					**Body 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Battery is fully charged for all readings.
6. Test Signal Call Mode □Continuous Tx On □Manu.Test Codes ▣Vector Signal Generator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.0cm.±0.1
9. Test configuration of each mode is described in section 9.2

17.8 Measurement Results (Bandwidth: 10 MHz, 16QAM) – Antenna Position: Ant. 1

FREQUENCY MHz	Begin Power (dBm)	Drift Power (dB)	Mode	Spacing	Antenna Position	Device Test Position	SAR (W/kg)
2600.00	22.43	0.120	PUSC /16QAM	10 mm [Phantom]	Internal	1	0.068
2600.00	22.43	-0.189	PUSC /16QAM	10 mm [Phantom]	Internal	2	0.074
2600.00	22.43	0.005	PUSC /16QAM	10 mm [Phantom]	Internal	3	0.360
2508.50	22.74	0.130	PUSC /16QAM	10 mm [Phantom]	Internal	4	0.445
2600.00	22.43	0.135	PUSC /16QAM	10 mm [Phantom]	Internal	4	0.469
2683.50	**22.28**	**0.030**	**PUSC /16QAM**	**10 mm [Phantom]**	**Internal**	**4**	**0.553**
2600.00	22.43	0.148	PUSC /16QAM	10 mm [Phantom]	Internal	5	0.395
2600.00	22.43	0.088	PUSC /16QAM	10 mm [Phantom]	Internal	6	0.026
ANSI / IEEE C95.1 2005 – SAFETY LIMIT Spatial Peak Uncontrolled Exposure/ General Population Exposure					**Body 1.6 W/kg (mW/g)** averaged over 1 gram		

NOTE:

1. The test data reported are the worst-case SAR value with the antenna-body position set in a typical configuration. Test procedures used are according to FCC/OET Bulletin 65, Supp.C [July 2001].
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2dB below the highest peak.
5. Battery is fully charged for all readings.
6. Test Signal Call Mode □Continuous Tx On □Manu.Test Codes ▣Vector Signal Generator
7. Tissue parameters and temperatures are listed on the SAR plots.
8. Liquid tissue depth is 15.0cm.±0.1
9. Test configuration of each mode is described in section 9.2

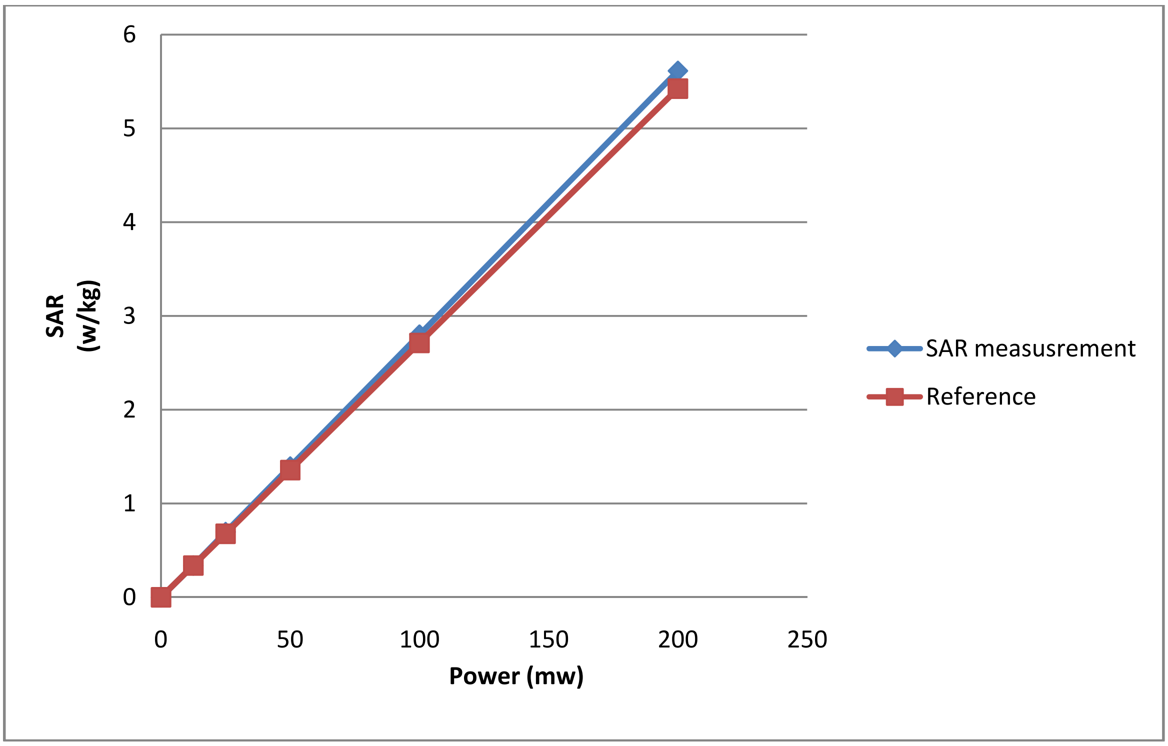
18. Linearity response & Scan resolution check & SAR probe calibration for WiMAX

18.1 Linearity response check:

The single point SAR measurement were measured with the configuration with the highest SAR in each channel bandwidth and frequency band is measured at various power levels, from approximately 10 mW or less, in 3 dB steps, until the maximum power level is reached. As shown by the results and plots, SAR is linear to power only when the probe sensors are operating within the square-law region. As power continues to increase, the measured SAR error becomes increasingly larger. Since these are single point peak SAR values measured with the probe positioned at the peak SAR location, at 2 mm from the phantom surface, the values are substantially higher than the 1-g SAR required to determine compliance. For changing the transmit power of the DUT, a power control command is used in DM test tool.

Wimax Peak RMS output power (mW)	12.5	25	50	100	200
Measured SAR (mW / g)	0.339	0.697	1.395	2.801	5.614
Value from 12.5-25mw reference line	0.339	0.678	1.356	2.712	5.424
Difference	0	0.019	0.039	0.089	0.190
Percentage of Difference %	0	2.80	2.88	3.28	3.50

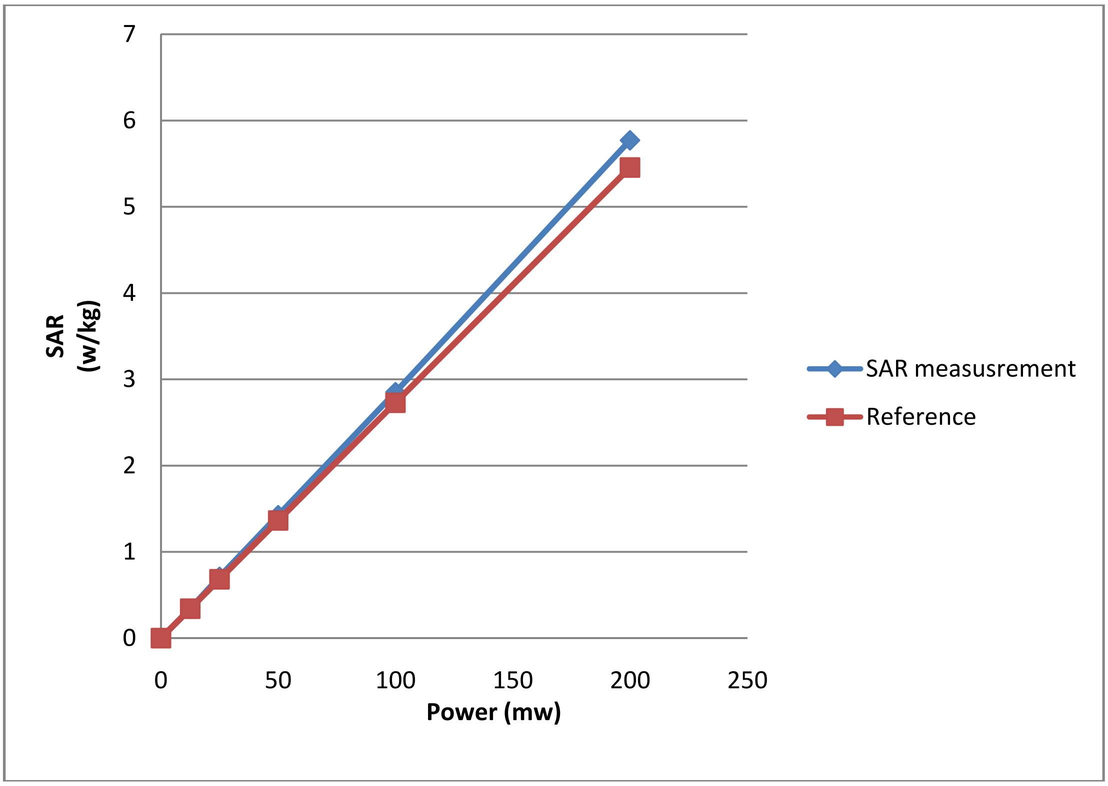
Table 18.1 Linearity response check PUSC, QPSK1/2, 5 MHz, High Channel, Ant. 0



18.1 Linearity response check (Continued)

Wimax Peak RMS output power (mW)	12.5	25	50	100	200
Measured SAR (mW / g)	0.341	0.711	1.425	2.851	5.771
Value from 12.5-25mw reference line	0.341	0.682	1.364	2.728	5.456
Difference	0	0.029	0.061	0.123	0.315
Percentage of Difference %	0	4.25	4.47	4.51	5.77

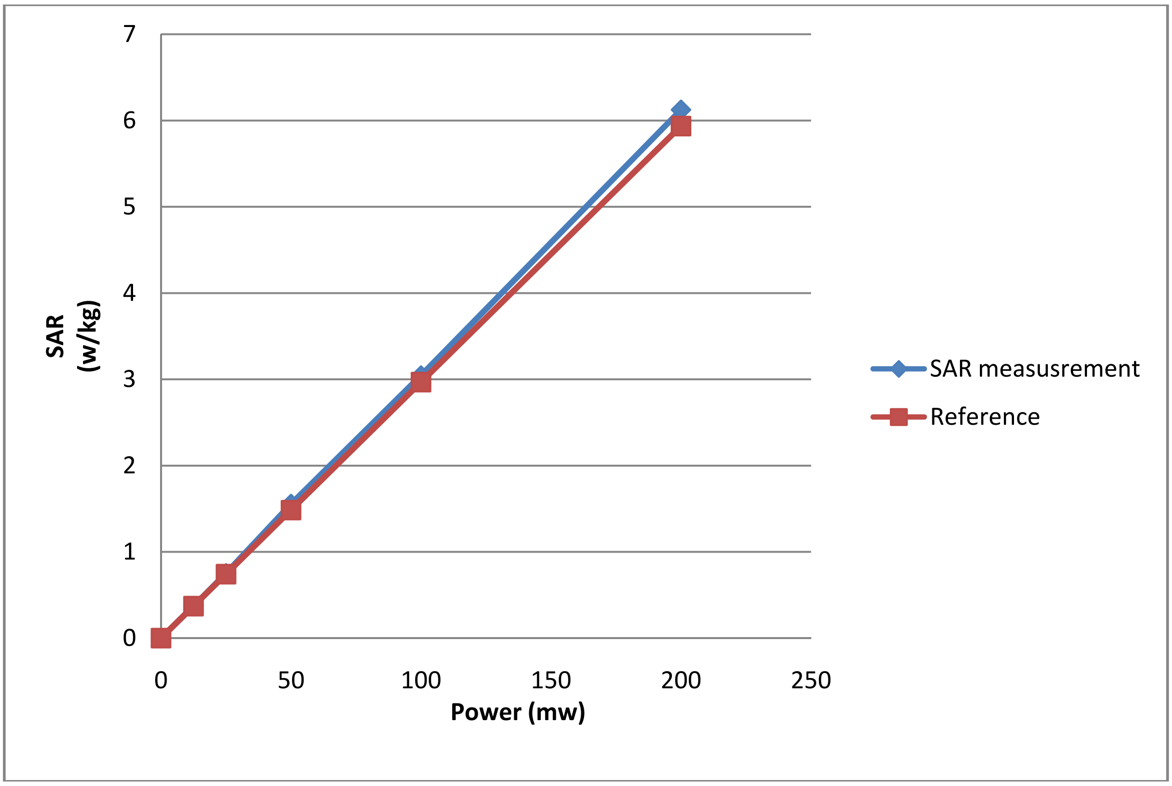
Table 18.2 Linearity response check PUSC, 16QAM1/2, 5 MHz, High Channel, Ant. 0



18.1 Linearity response check (Continued)

Wimax Peak RMS output power (mW)	12.5	25	50	100	200
Measured SAR (mW / g)	0.371	0.751	1.556	3.044	6.124
Value from 12.5-25mw reference line	0.371	0.742	1.484	2.968	5.936
Difference	0	0.009	0.072	0.076	0.188
Percentage of Difference %	0	1.21	4.85	2.56	3.17

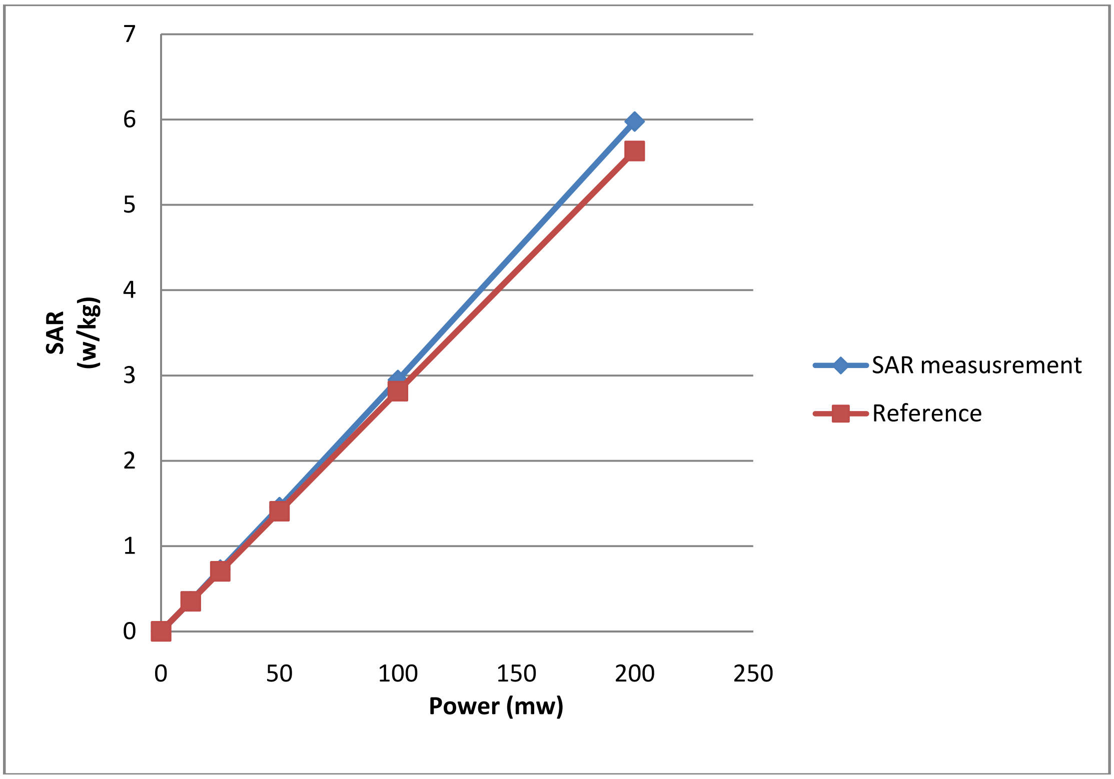
Table 18.3 Linearity response check PUSC, QPSK1/2, 10 MHz, High Channel, Ant. 0



18.1 Linearity response check (Continued)

Wimax Peak RMS output power (mW)	12.5	25	50	100	200
Measured SAR (mW / g)	0.352	0.725	1.457	2.948	5.978
Value from 12.5-25mw reference line	0.352	0.704	1.408	2.816	5.632
Difference	0	0.021	0.049	0.132	0.346
Percentage of Difference %	0	2.98	3.48	4.69	6.14

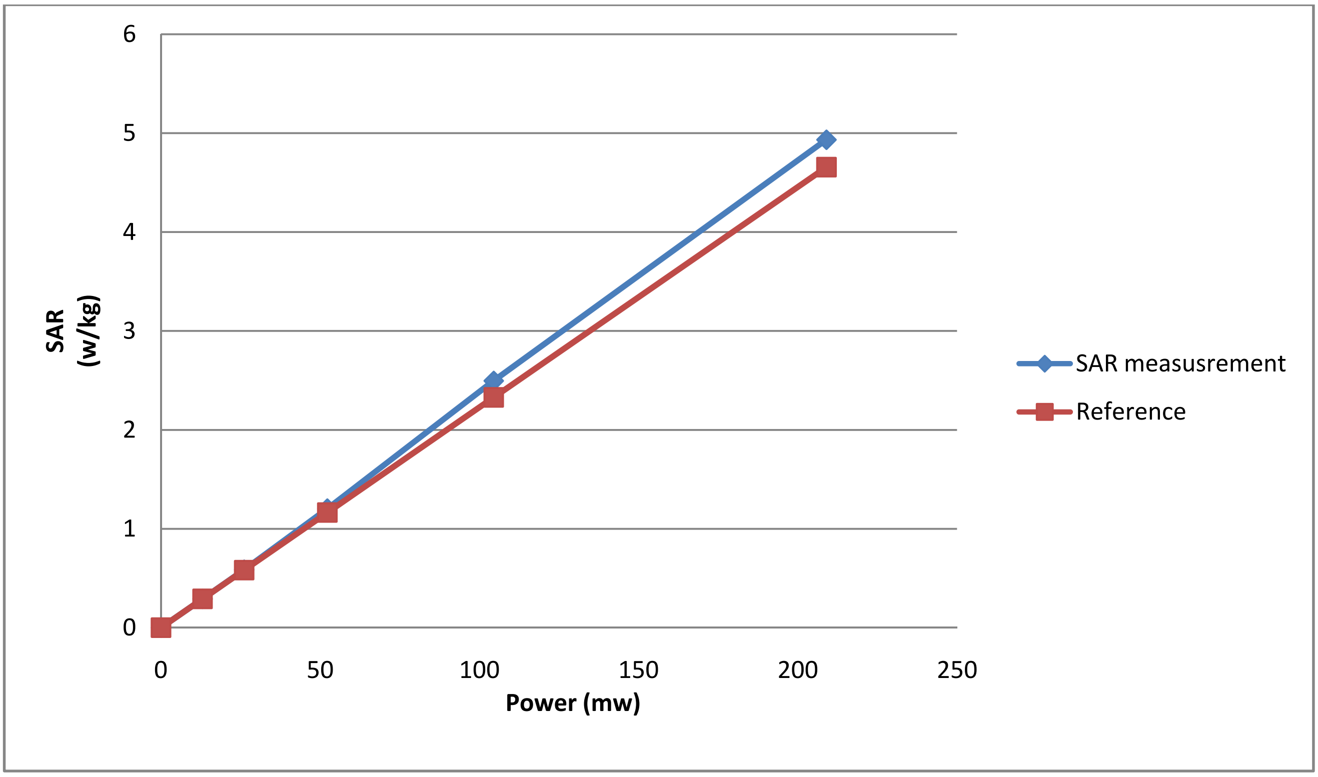
Table 18.4 Linearity response check PUSC, 16QAM1/2, 10 MHz, High Channel, Ant. 0



18.1 Linearity response check (Continued)

Wimax Peak RMS output power (mW)	12.5	25	50	100	200
Measured SAR (mW / g)	0.369	0.751	1.511	3.057	6.179
Value from 12.5-25mw reference line	0.369	0.738	1.476	2.952	5.904
Difference	0	0.013	0.035	0.105	0.275
Percentage of Difference %	0	1.76	2.37	3.56	4.66

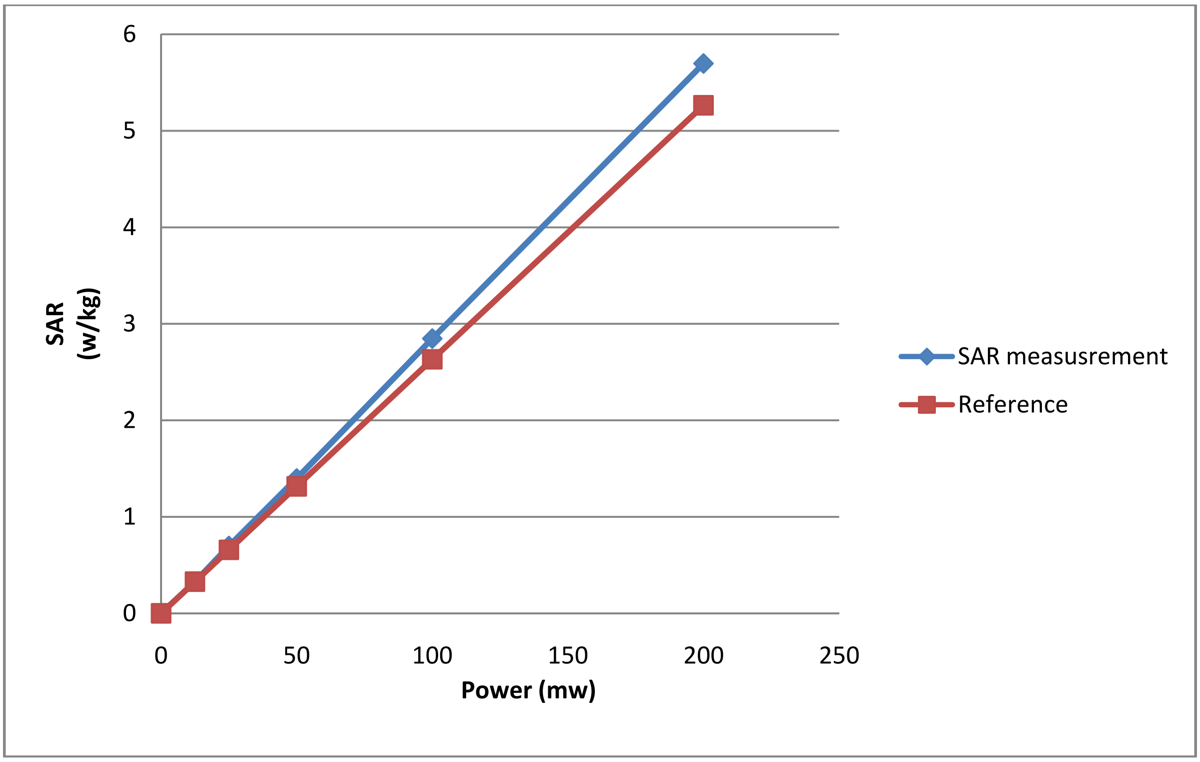
Table 18.5 Linearity response check PUSC, QPSK1/2, 5 MHz, High Channel, Ant. 1



18.1 Linearity response check (Continued)

Wimax Peak RMS output power (mW)	12.5	25	50	100	200
Measured SAR (mW / g)	0.329	0.699	1.397	2.847	5.698
Value from 12.5-25mw reference line	0.329	0.658	1.316	2.632	5.264
Difference	0	0.041	0.081	0.215	0.434
Percentage of Difference %	0	6.23	6.16	8.17	8.24

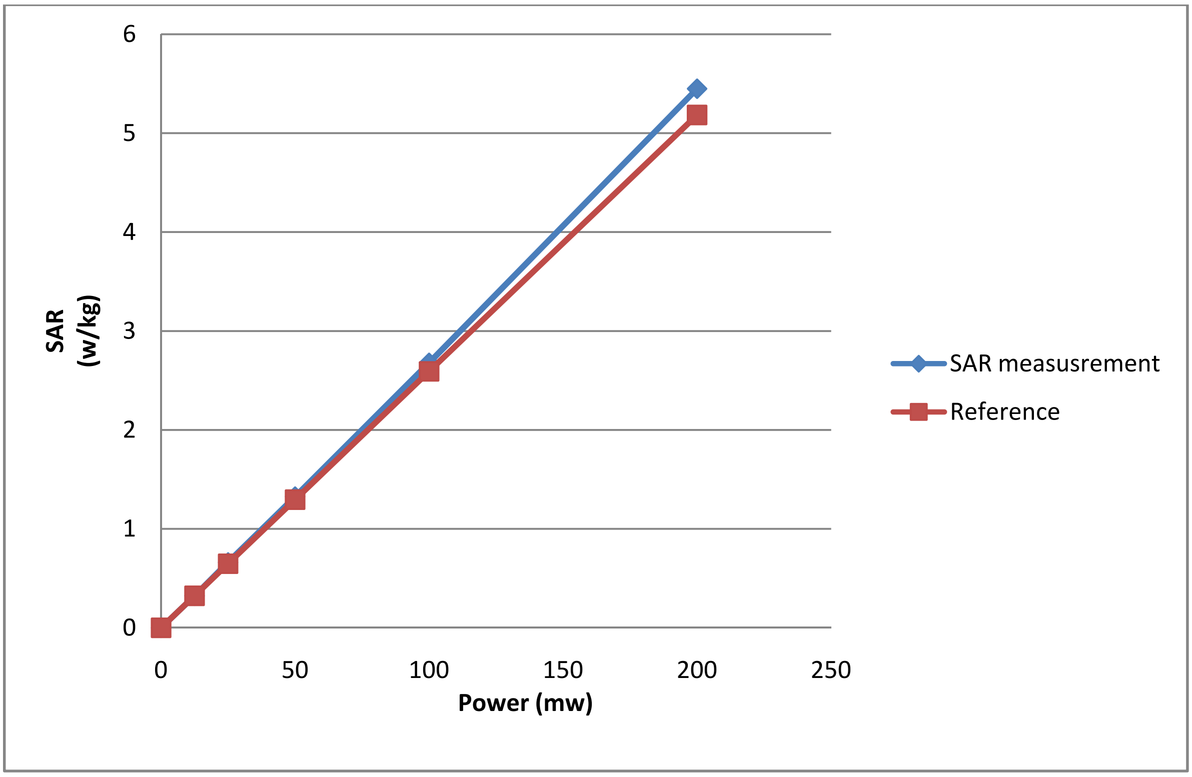
Table 18.6 Linearity response check PUSC, 16QAM1/2, 5 MHz, High Channel, Ant. 1



18.1 Linearity response check (Continued)

Wimax Peak RMS output power (mW)	12.5	25	50	100	200
Measured SAR (mW / g)	0.324	0.661	1.327	2.679	5.449
Value from 12.5-25mw reference line	0.324	0.648	1.296	2.592	5.184
Difference	0	0.013	0.031	0.087	0.265
Percentage of Difference %	0	2.01	2.39	3.36	5.11

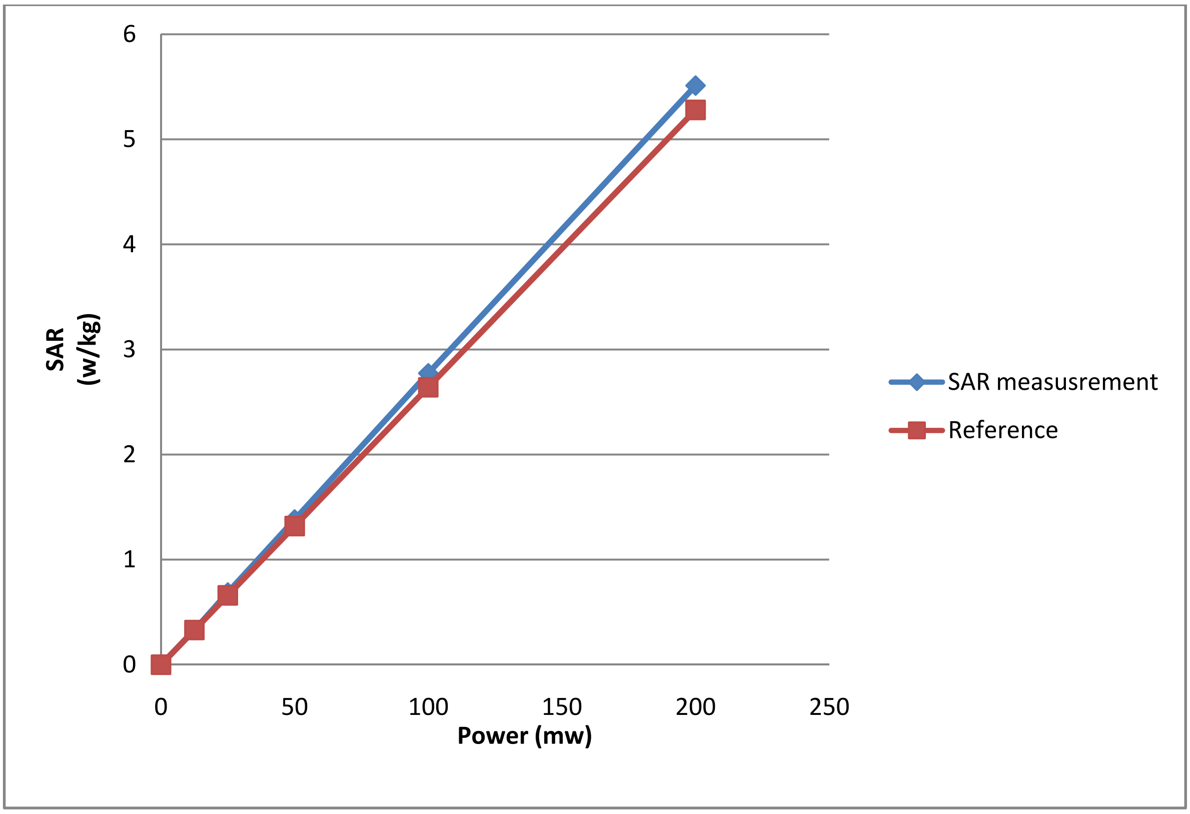
Table 18.7 Linearity response check PUSC, QPSK1/2, 10 MHz, High Channel, Ant. 1



18.1 Linearity response check (Continued)

Wimax Peak RMS output power (mW)	12.5	25	50	100	200
Measured SAR (mW / g)	0.330	0.688	1.382	2.774	5.512
Value from 12.5-25mw reference line	0.330	0.660	1.320	2.640	5.280
Difference	0	0.028	0.062	0.134	0.232
Percentage of Difference %	0	4.24	4.70	5.08	4.39

Table 18.11 Linearity response check PUSC, 16QAM1/2, 10 MHz, High Channel, Ant. 1



18.2 Compare with different scan grid size

With EUT hold on the highest raw 1g SAR configuration (5M bandwidth / High channel/ rear configuration position which has highest measured SAR number) with no any change in position or setting.
Two 1g SAR evaluations were performed with different scanning grid size as listed below for assessing the impact on SAR reading.

High channel of 5 MHz at Rear position.		
Area scan grid size(mm)	**Zoom scan grid size(mm)**	**SAR value (w/kg)**
15	**8**	**0.715**
5	**4**	**0.711**

18.3 Probe calibration for WIMAX testing.

The SAR probe used in the measurements is calibrated with a sinusoidal CW signal. The high PAPR of OFDM/OFDMA is expected to introduce additional SAR measurement errors because the SAR probe is not calibrated for this type of random noise-like signals with large amplitude and phase variations within the bursts. The SAR error is also expected to vary with the average power and average PAPR at each measurement point, both temporally and spatially. In order to estimate the measurement error due to PAPR issues, the configuration with the highest SAR in each channel bandwidth and frequency band is measured at various power levels, from approximately 10 mW or less, in 3 dB steps, until the maximum power level is reached. As shown by the results and plots of the linearity response check , SAR is linear to power only when the probe sensors are operating within the square-law region. As power continues to increase, the measured SAR error becomes increasingly larger. Since these are single point peak SAR values measured with the probe positioned at the peak SAR location, at 2 mm from the phantom surface, the values are substantially higher than the 1-g SAR required to determine compliance. The results indicate that at approximately 215 mW SAR were overestimated by 3.7 – 6%.

19. SAR TEST EQUOPMENT

Table 19.1 Test Equipment Calibration

	Type	Manufacturer	Model	Cal.Date (dd/mm/yy)	Next.Cal.Date (dd/mm/yy)	S/N
☒	SEMITEC Engineering	SEMITEC	N/A	N/A	N/A	Shield Room
☒	Robot	SCHMID	RX90BL	N/A	N/A	F02/5Q85A1/A/01
☒	Robot Controller	SCHMID	CS7MB	N/A	N/A	F02/5Q85A1/C/01
☒	Joystick	SCHMID	N/A	N/A	N/A	D221340031
☒	Intel Core i5-2500 3.31 GHz Windows XP Professional	N/A	N/A	N/A	N/A	N/A
☒	Probe Alignment Unit LB	N/A	N/A	N/A	N/A	321
☒	Mounting Device	SCHMID	Holder	N/A	N/A	N/A
☐	Sam Phantom	SCHMID	TP1223	N/A	N/A	N/A
☒	Sam Phantom	SCHMID	TP1224	N/A	N/A	N/A
☐	Head/Body Equivalent Matter(450MHz)	N/A	N/A	01/01/12	01/01/13	N/A
☐	Head/Body Equivalent Matter(835MHz)	N/A	N/A	01/01/12	01/01/13	N/A
☐	Head/Body Equivalent Matter(1800MHz)	N/A	N/A	01/01/12	01/01/13	N/A
☐	Head/Body Equivalent Matter(1900MHz)	N/A	N/A	01/01/12	01/01/13	N/A
☒	Head/Body Equivalent Matter(2600MHz)	N/A	N/A	01/01/12	01/01/13	N/A
☒	Data Acquisition Electronics	SCHMID	DAE3V1	20/01/12	20/01/13	519
☒	Dosimetric E-Field Probe	SCHMID	EX3DV4	27/01/12	27/01/13	3643
☐	Dummy Probe	N/A	N/A	N/A	N/A	N/A
☐	450MHz System Validation Dipole	SCHMID	D450V2	24/01/11	24/01/13	1011
☐	835MHz System Validation Dipole	SCHMID	D835V2	22/03/10	22/03/12	464
☐	1800MHz System Validation Dipole	SCHMID	D1800V2	16/07/10	16/07/12	2d047
☐	1900MHz System Validation Dipole	SCHMID	D1900V2	23/03/10	23/03/12	5d029
☐	2450MHz System Validation Dipole	SCHMID	D2450V2	18/03/10	18/03/12	726
☒	2600MHz System Validation Dipole	SCHMID	D2600V2	27/05/10	27/05/12	1016
☐	3500MHz System Validation Dipole	SCHMID	D3500V2	27/05/10	27/05/12	1018
☒	Network Analyzer	Agilent	E5071C	25/11/11	25/11/12	MY46106970
☒	Signal Generator	HP	ESG-3000A	01/07/11	01/07/12	US37230529
☐	Amplifier	EMPOWER	BBS3Q7ELU	30/09/11	30/09/12	1020
☒	High Power RF Amplifier	EMPOWER	BBS3Q8CCJ	07/11/11	07/11/12	1005
☒	Power Meter	HP	EPM-442A	05/03/12	05/03/13	GB37170267
☒	Power Sensor	HP	8481A	05/03/12	05/03/13	3318A96566
☒	Power Sensor	HP	8481A	27/02/12	27/02/13	3318A96030
☐	Dual Directional Coupler	Agilent	778D-012	09/01/12	09/01/13	50228
☒	Directional Coupler	HP	773D	01/07/11	01/07/12	2389A00640
☐	Low Pass Filter 1.5GHz	Micro LAB	LA-15N	09/01/12	09/01/13	N/A
☒	Low Pass Filter 3.0GHz	Micro LAB	LA-30N	30/09/11	30/09/12	N/A
☒	Attenuators(3dB)	Agilent	8491B	02/07/11	02/07/12	MY39260700
☒	Attenuators(10dB)	WEINSCHEL	23-10-34	09/01/12	09/01/13	BP4387
☐	Step Attenuator	HP	8494A	30/09/11	30/09/12	3308A33341
☒	Dielectric Probe kit	Agilent	85070D	N/A	N/A	US01440118
☐	8960 Series 10 Wireless Comms. Test Set	Agilent	E5515C	05/03/12	05/03/13	GB43461134
☐	Bluetooth Tester	TESCOM	TC-3000B	01/07/11	01/07/12	3000B640046
☒	Vector Signal Generator	Rohde Schwarz	SMJ100A	09/01/12	09/01/13	100148

NOTE: The E-field probe was calibrated by SPEAG, by temperature measurement procedure. Dipole Validation measurement is performed by Digital EMC before each test. The brain simulating material is calibrated by Digital EMC using the dielectric probe system and network analyzer to determine the conductivity and permittivity (dielectric constant) of the brain-equivalent material.

20. CONCLUSION

Measurement Conclusion

The SAR measurement indicates that the EUT complies with the RF radiation exposure limits of the FCC. These measurements are taken to simulate the RF effects exposure under the worst-case conditions. Precise laboratory measures were taken to assure repeatability of the tests. The tested device complies with the requirements in respect to all parameters subject to the test. The test 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 impossible 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 innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

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