FCC SAR Test Report

Report No.	:	**SA120816C10**
Applicant	:	**INFOMARK**
Address	:	**#801, KINS Tower, #25-1, Jeongja-dong, Bundang-gu, Seongnam-si, Gyonggi-do, 463-847, Korea**
Product	:	**WiMAX Jacket for IPod**
FCC ID	:	**YCO-IMW-C870W**
Brand	:	**Jacket Router**
Model No.	:	**IMW-C870W**
Standards	:	**FCC 47 CFR Part 2 (2.1093) / IEEE C95.1:1991 / IEEE 1528:2003** **FCC OET Bulletin 65 Supplement C (Edition 01-01)** **KDB 248227 D01 v01r02 / KDB 615223 D01 v01 / KDB 941225 D06 v01**
Date of Testing	:	**Aug. 16, 2012 ~ Sep. 19, 2012**

The product was attached to iPod Touch 4 (Brand Name: Apple, Model Name: A1367, FCC ID: BCG-E2407) during SAR test because it can only be fitted with iPod Touch 4 version.

CERTIFICATION: The above equipment has been tested by **Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch - Taiwan HwaYa Lab**, and found compliance with the requirement of the above standards. The test record, data evaluation & Equipment Under Test (EUT) configurations represented herein are true and accurate accounts of the measurements of the sample's SAR characteristics under the conditions specified in this report. It should not be reproduced except in full, without the written approval of our laboratory. The client should not use it to claim product certification, approval, or endorsement by TAF or any government agencies.

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Approved By : Roy Wu / Manager

Testing Laboratory
2021

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Release Control Record

Issue No.	Reason for Change	Date Issued
R01	Original release	Oct. 08, 2012

1. Summary of Maximum SAR Value

<Jacket Only>

Mode / Band	Test Position	Scaled SAR-1g (W/kg)
WiMAX	Body (1.0 cm Gap)	0.735
WLAN	Body (1.0 cm Gap)	N/A

<Jacket with Apple iPod Touch 4>

Mode / Band	Test Position	Scaled SAR-1g (W/kg)
WiMAX	Body (1.0 cm Gap)	1.134
WLAN	Body (1.0 cm Gap)	N/A

Note:

1. The SAR limit **(1.6 W/kg)** for general population/uncontrolled exposure is specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1991.
2. WLAN Power is below 60/f and can be waived for SAR testing.

< iPod Touch 4 with Jacket>

Mode / Band	Test Position	Scaled SAR-1g (W/kg)
WLAN	Body (touching position)	0.58

Simultaneous Transmission SAR Evaluation

<Jacket + iPod Touch 4>

Test Position	Jacket WiMAX	Jacket 802.11b/g/n	iPod Touch 4 802.11b/g/n	Max. SAR Summation
Front Face	0.059	0	0.09	0.149
Rear Face	1.134	0	0.03	1.164
Left Side	0.674	0	0.15	0.824
Right Side	0	0	0.05	0.05
Top Side	0	0	0.58	0.58
Bottom Side	0.194	0	0.02	0.214

2. Description of Equipment Under Test

EUT Type	WiMAX Jacket for IPod
FCC ID	YCO-IMW-C870W
Brand Name	Jacket Router
Model Name	IMW-C870W
Tx Frequency Bands (Unit: MHz)	WiMAX : 2499 ~ 2686.75 (for BW 5M), 2508.5 ~ 2683.5 (for BW 10M) WLAN : 2412 ~ 2462
Uplink Modulations	WiMAX : QPSK, 16QAM, 64QAM 802.11b : DSSS 802.11g/n : OFDM
Maximum AVG Conducted Power (Unit: dBm)	WiMAX : 23.00 802.11b : 7.12 802.11g : 6.71 802.11n HT20 : 7.31
Antenna Type	Fixed Internal Antenna (Peak Antenna Gain : -2.24 dBi for 2.4GHz Band)
EUT Stage	Identical Prototype

Note:

1. The above EUT information is declared by manufacturer and for more detailed features description please refers to the manufacturer's specifications or User's Manual.

The 802.16e/WiMAX device and system operating parameters is as below.

Description	Parameter		Comment
FCC ID	YCO-IMW-C870W		Identify all related FCC ID
Radio Service	Part 27 Subpart M		Rule parts
Transmit Frequency Range (MHz)	5MHz BW : 2499 MHz to 2686.75 MHz 10MHz BW : 2508.5 MHz to 2683.5 MHz		System parameter
System/Channel Bandwidth (MHz)	5 MHz	10 MHz	System parameter
System Profile	Mobile WiMAX (802.16e-2005)		Defined by WiMAX Forum
Modulation Schemes	QPSK, 16QAM, 64QAM		Identify all applicable UL modulations
Sampling Factor	28/25		System parameter
Sampling Frequency (MHz)	5.6 MHz	11.2 MHz	(F_S)
Sample Time (ns)	178.57 ns	89.29 ns	($1/F_S$)
FFT Size (N_{FFT})	512	1024	(N_{FFT})
Sub-Carrier Spacing (kHz)	10.9375 kHz		(Δf)
Useful Symbol Time (μs)	91.4286 μs		($T_b=1/\Delta f$)
Guard Time (μs)	11.43 μs		(T_g=Tb/cp); cp = cyclic prefix
OFDMA Symbol Time (μs)	102.8586 μs		($T_S=T_b+T_g$)
Frame Size (ms)	5 ms		System parameter
TTG + RTG (μs or number of symbols)	165.72 μs		Idle time, 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 Ratios	29:18		For determining UL duty factor
Power Class (dBm)	Power Class 2, 23.0 dBm		Identify power class and tolerance
Wave1 / Wave2	Wave2: Two antennas for Tx/Rx diversity. ANT0 and ANT1 cannot transmit simultaneously.		Describe antenna diversity info and MIMO requirements separately
UL Zone Types (FUSC, PUSC, OFUSC, OPUSC, AMC, TUSC1, TUSC2)	PUSC mode only for current FW.		Describe separately the symbol and sub-carrier/sub-channel structures applicable to each zone type
Maximum Number of UL Sub-Carriers	420	840	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
Measured UL Burst Maximum Average Conducted Power	23.00 dBm		
UL Control Symbol Configuration	3 PUSC symbols (used for ranging, CQICH and ACK/NACK)		
UL Control Symbol Maximum Conducted Average Power	58.68 mW	28.50 mW	
UL Burst Peak-to-Average (Conducted) Power Ratio (PAPR)	PAPR is between 6.63 ~ 6.95 dB		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 (%)	UL Data Symbols x Symbol Time / Frame Size = 15 x 102.857 us / 5000 us = 30.8 % Crest Factor = 1 / Duty Cycle = 3.24 This CF was used for SAR evaluation.		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

3. SAR Measurement System

3.1 Definition of Specific Absorption Rate (SAR)

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

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

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

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

SAR measurement can be related to the electrical field in the tissue by

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

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

3.2 SPEAG DASY System

DASY system consists of high precision robot, probe alignment sensor, phantom, robot controller, controlled measurement server and near-field probe. The robot includes six axes that can move to the precision position of the DASY4/5 software defined. The DASY software can define the area that is detected by the probe. The robot is connected to controlled box. Controlled measurement server is connected to the controlled robot box. The DAE includes amplifier, signal multiplexing, AD converter, offset measurement and surface detection. It is connected to the Electro-optical coupler (ECO). The ECO performs the conversion form the optical into digital electric signal of the DAE and transfers data to the PC.

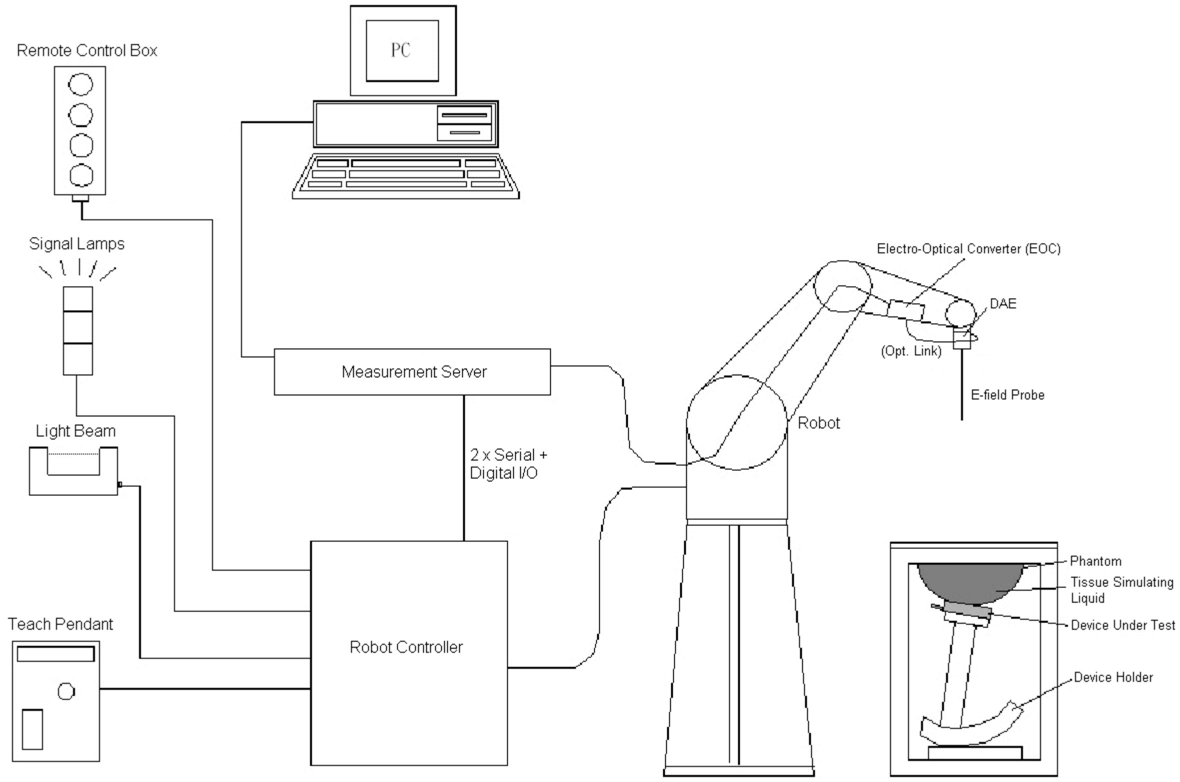


Fig-3.1 DASY System Setup

3.2.1 Robot

The DASY system uses the high precision robots from Stäubli SA (France). For the 6-axis controller system, the robot controller version (DASY4: CS7MB; DASY5: CS8c) from Stäubli is used. The Stäubli robot series have many features that are important for our application:

- High precision (repeatability ±0.035 mm)
- High reliability (industrial design)
- Jerk-free straight movements
- Low ELF interference (the closed metallic construction shields against motor control fields)

Fig-3.2 DASY4

Fig-3.3 DASY5

3.2.2 Probes

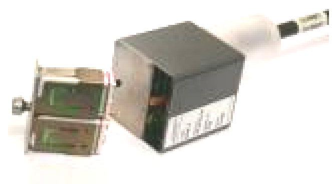
The SAR measurement is conducted with the dosimetric probe. The probe is specially designed and calibrated for use in liquid with high permittivity. The dosimetric probe has special calibration in liquid at different frequency.

Model	EX3DV4
Construction	Symmetrical design with triangular core. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
Frequency	10 MHz to 6 GHz Linearity: ± 0.2 dB
Directivity	± 0.3 dB in HSL (rotation around probe axis) ± 0.5 dB in tissue material (rotation normal to probe axis)
Dynamic Range	10 µW/g to 100 mW/g Linearity: ± 0.2 dB (noise: typically < 1 µW/g)
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

Model	ES3DV3
Construction	Symmetrical design with triangular core. Interleaved sensors. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE).
Frequency	10 MHz to 4 GHz Linearity: ± 0.2 dB
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.3 dB in tissue material (rotation normal to probe axis)
Dynamic Range	5 µW/g to 100 mW/g Linearity: ± 0.2 dB
Dimensions	Overall length: 337 mm (Tip: 20 mm) Tip diameter: 3.9 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.0 mm

3.2.3 Data Acquisition Electronics (DAE)

Model	DAE3, DAE4
Construction	Signal amplifier, multiplexer, A/D converter and control logic. Serial optical link for communication with DASY4/5 embedded system (fully remote controlled). Two step probe touch detector for mechanical surface detection and emergency robot stop.
Measurement Range	-100 to +300 mV (16 bit resolution and two range settings: 4mV, 400mV)
Input Offset Voltage	< 5µV (with auto zero)
Input Bias Current	< 50 fA
Dimensions	60 x 60 x 68 mm



3.2.4 Phantoms

Model	Twin SAM
Construction	The shell corresponds to the specifications of the Specific Anthropomorphic Mannequin (SAM) phantom defined in IEEE 1528 and IEC 62209-1. 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 evaporation of the liquid. Reference markings on the phantom allow the complete setup of all predefined phantom positions and measurement grids by teaching three points with the robot.
Material	Vinylester, glass fiber reinforced (VE-GF)
Shell Thickness	2 ± 0.2 mm (6 ± 0.2 mm at ear point)
Dimensions	Length: 1000 mm Width: 500 mm Height: adjustable feet
Filling Volume	approx. 25 liters

Model	ELI
Construction	Phantom for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI is fully compatible with the IEC 62209-2 standard and all known tissue simulating liquids. ELI has been optimized regarding its performance and can be integrated into our standard phantom tables. A cover prevents evaporation of the liquid. Reference markings on the phantom allow installation of the complete setup, including all predefined phantom positions and measurement grids, by teaching three points. The phantom is compatible with all SPEAG dosimetric probes and dipoles.
Material	Vinylester, glass fiber reinforced (VE-GF)
Shell Thickness	2.0 ± 0.2 mm (bottom plate)
Dimensions	Major axis: 600 mm Minor axis: 400 mm
Filling Volume	approx. 30 liters

3.2.5 Device Holder

Model	Mounting Device
Construction	In combination with the Twin SAM Phantom or ELI4, the Mounting Device enables the rotation of the mounted transmitter device in spherical coordinates. Rotation point is the ear opening point. Transmitter devices can be easily and accurately positioned according to IEC, IEEE, FCC or other specifications. The device holder can be locked for positioning at different phantom sections (left head, right head, flat).
Material	POM

Model	Laptop Extensions Kit
Construction	Simple but effective and easy-to-use extension for Mounting Device that facilitates the testing of larger devices according to IEC 62209-2 (e.g., laptops, cameras, etc.). It is lightweight and fits easily on the upper part of the Mounting Device in place of the phone positioner.
Material	POM, Acrylic glass, Foam

3.2.6 System Validation Dipoles

Model	D-Serial
Construction	Symmetrical dipole with l/4 balun. Enables measurement of feed point impedance with NWA. Matched for use near flat phantoms filled with tissue simulating solutions.
Frequency	750 MHz to 5800 MHz
Return Loss	> 20 dB
Power Capability	> 100 W (f < 1GHz), > 40 W (f > 1GHz)

3.2.7 Tissue Simulating Liquids

For SAR measurement of the field distribution inside the phantom, the phantom must be filled with homogeneous tissue simulating liquid to a depth of at least 15 cm. For head SAR testing, the liquid height from the ear reference point (ERP) of the phantom to the liquid top surface is larger than 15 cm. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm. The nominal dielectric values of the tissue simulating liquids in the phantom and the tolerance of 5% are listed in Table-3.1.

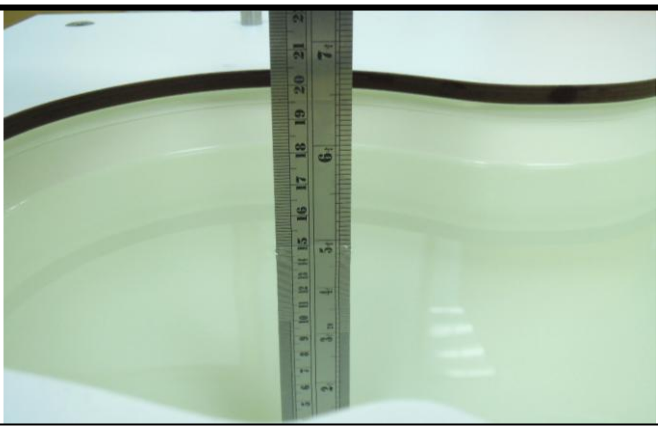
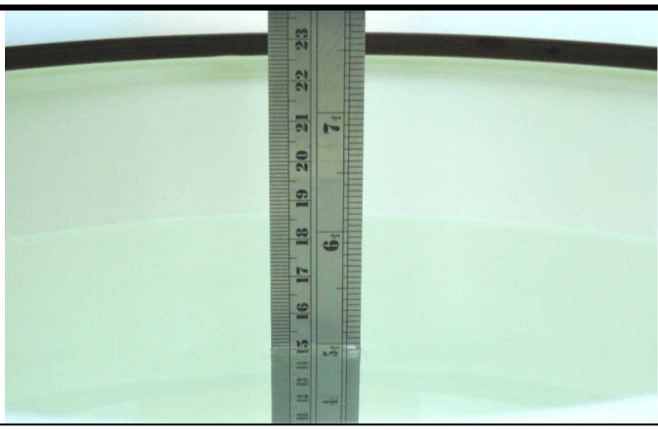
	

Photo of Liquid Height for Head Position	**Photo of Liquid Height for Body Position**

The dielectric properties of the head tissue simulating liquids are defined in IEEE 1528 and FCC OET 65 Supplement C Appendix C. For the body tissue simulating liquids, the dielectric properties are defined in FCC OET 65 Supplement C Appendix C. The dielectric properties of the tissue simulating liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.

Table-3.1 Targets of Tissue Simulating Liquid

Frequency (MHz)	Target Permittivity	Range of ±5%	Target Conductivity	Range of ±5%
For Body				
2450	52.7	50.1 ~ 55.3	1.95	1.85 ~ 2.05
2600	52.5	49.9 ~ 55.1	2.16	2.05 ~ 2.27

The following table gives the recipes for tissue simulating liquids.

Table-3.2 Recipes of Tissue Simulating Liquid

Tissue Type	Bactericide	DGBE	HEC	NaCl	Sucrose	Triton X-100	Water	Diethylene Glycol Mono-hexylether
B2450	-	31.4	-	0.1	-	-	68.5	-
B2600	-	31.8	-	0.1	-	-	68.1	-

3.3 SAR System Verification

The system check verifies that the system operates within its specifications. It is performed daily or before every SAR measurement. The system check uses normal SAR measurements in the flat section of the phantom with a matched dipole at a specified distance. The system verification setup is shown as below.

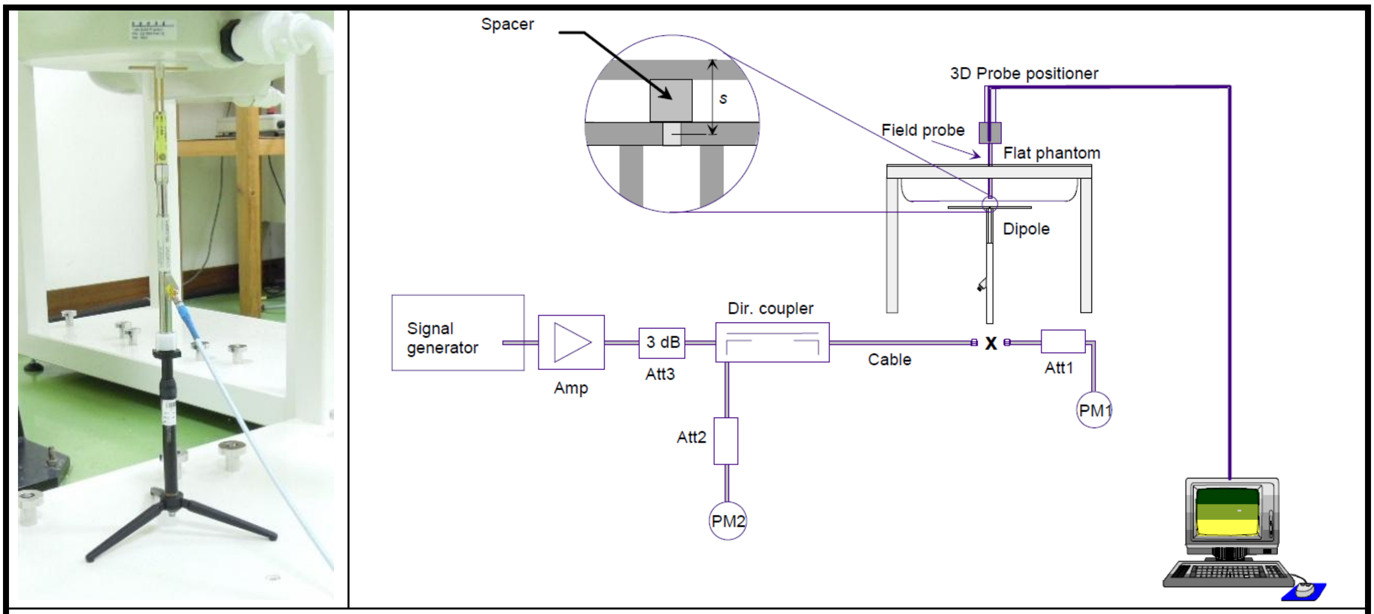


Fig-3.4 System Verification Setup

The validation dipole is placed beneath the flat phantom with the specific spacer in place. The distance spacer is touch the phantom surface with a light pressure at the reference marking and be oriented parallel to the long side of the phantom. The power meter PM1 measures the forward power at the location of the system check dipole connector. The signal generator is adjusted for the desired forward power (250 mW is used for 700 MHz to 3 GHz, 100 mW is used for 3.5 GHz to 6 GHz) at the dipole connector and the power meter PM2 is read at that level. After connecting the cable to the dipole, the signal generator is readjusted for the same reading at power meter PM2.

After system check testing, the SAR result will be normalized to 1W forward input power and compared with the reference SAR value derived from validation dipole certificate report. The deviation of system check should be within 10 %.

3.4 SAR Measurement Procedure

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

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

The SAR measurement procedures for each of test conditions are as follows:

(a) Make EUT to transmit maximum output power
(b) Measure conducted output power through RF cable
(c) Place the EUT in the specific position of phantom
(d) Perform SAR testing steps on the DASY system
(e) Record the SAR value

3.4.1 Area & Zoom Scan Procedure

First Area Scan is used to locate the approximate location(s) of the local peak SAR value(s). The measurement grid within an Area Scan is defined by the grid extent, grid step size and grid offset. Next, in order to determine the EM field distribution in a three-dimensional spatial extension, Zoom Scan is required. The Zoom Scan measures 5x5x7 points with step size 8, 8 and 5 mm for below 3 GHz, and 7x7x9 points with step size 4, 4 and 2.5 mm for above 5 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

3.4.2 Volume Scan Procedure

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

3.4.3 Power Drift Monitoring

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

3.4.4 Spatial Peak SAR Evaluation

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

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

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

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

3.4.5 SAR Averaged Methods

In DASY, the interpolation and extrapolation are both based on the modified Quadratic Shepard's method. The interpolation scheme combines a least-square fitted function method and a weighted average method which are the two basic types of computational interpolation and approximation.

Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty within 1% for the 1 g and 10 g cubes, the extrapolation distance should not be larger than 5 mm.

4. SAR Measurement Evaluation

4.1 EUT Configuration and Setting

For WiMAX SAR testing, the EUT has installed WiMAX engineering software which can control EUT to transmit at specific channel bandwidth, modulation type, coding rate, power level and frequency without signal generator. The test mode instructs the EUT to transmit for 15 symbols in the UL data zone. This UL transmission is repeated every 5 milliseconds. The TX power of the EUT is set to maximum power. As mentioned above that all 15 symbols (no control symbols plus and 15 data symbols) were all transmitted at full power.

The device and its system are both transmitting using only PUSC zone type. This enables multiple users to transmit simultaneously within the system. FUSC, AMC and other zone types are not used by the test device for uplink transmission. The maximum DL:UL symbol ratio can be determined according to the PUSC requirements. The system transmit an odd number of symbols using DL-PUSC consisting of even multiples of traffics and control symbols plus one symbol for the preamble. Multiples of three symbols are transmitted by the device using UL-PUSC. The OFDMA symbol time allows up to 48 downlink and uplink symbols in each 5 ms frame. TTG and RTG are also included in each frame as DL/UL transmission gaps; therefore, the system can only allow 47 or less symbols per frame.

PUSC zone type

For the 10 MHz bandwidth, it has 35 sub-channels structured from 1024 subcarriers per OFDMA symbol and each sub-channel is spanned over 3 OFDMA symbols and consists of 72 subcarriers including 48 data and 24 pilot subcarriers. For each symbol, there are 184 guard subcarriers, leaving 840 available subcarriers for transmission. For the 5 MHz bandwidth, it contains 17 sub-channels using 512 subcarriers including 104 guard subcarriers per symbol and leaving 408 available subcarriers for transmission.

The control channels may occupy up to 5 slots during normal operation. A slot is a sub-channel with the duration of 3 symbols. There are a total of 35 (17) slots in the 10 MHz (5 MHz) channel configuration. The maximum power for each control symbol has been determined to be 28.50 (5/35 of 199.53 mW) for 10MHz and 58.68 (5/17 of 199.53 mW) for 5MHz. A maximum of two simultaneous CQICH reports are possible, which can occupy up to 2 slots. A maximum of three slots can be used for HARQ ACK/NAK by the five possible DL HARQ bursts in the previous DL frame. The 5 ACK/NAK bits each occupies ½ a slot. These 5 slots correspond to 5/35 (5/17) of the total number of uplink slots. When the device is transmitting at its maximum rated power of 23.0 dBm (199.53 mW), the output power for these control channels is 28.50 (5/35 of 199.53 mW) for 10MHz and 58.68 (5/17 of 199.53 mW) for 5MHz. Due to the limitation of the test mode software which cannot control the device to output typical control symbols (3 symbols with 5 slots occupied). The EUT was programmed to output full power at 23.0 dBm per symbol and this represents the max worst case power which a transmitted symbol can get (no mater it is data symbol or control symbol, the 23.0 dBm is the max output power that this device can output).

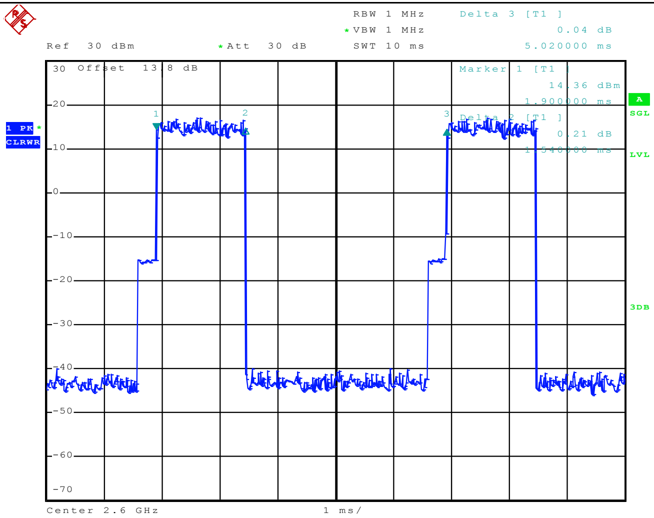
The up-link sub-frame is triggered by an Allocation Start Time contained in the information of UL-MAP. This information specifies the starting times of the Uplink and Downlink frames. In any UL sub-frame, the duty factor and bandwidth information is used to ensure optimal system operation. In the real usage, the data burst power will be adjusted according to the signal strength of the communication.
Theoretical duty cycle is

UL Data Symbols x Symbol Time / Frame Size
= 15 x 102.857 us / 5000 us
= 30.8 %

Crest Factor = 1 / Duty Cycle = 3.24
This CF was used for SAR evaluation.

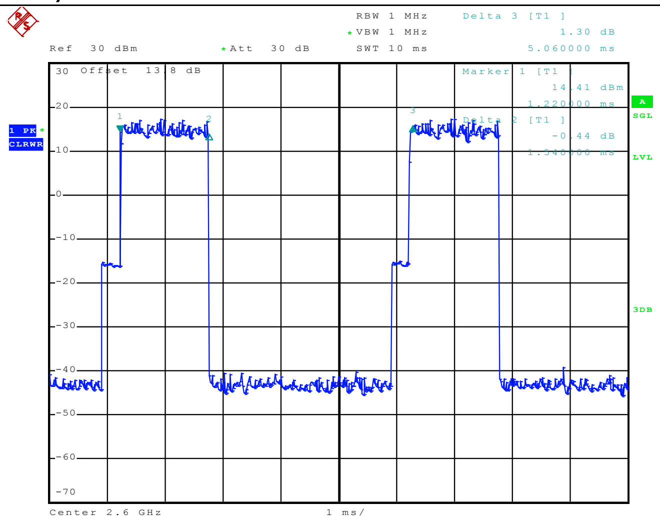
The WiMAX time domain waveform used for SAR testing is shown as below.

PUSC, QPSK, BW 5MHz, 2600 MHz



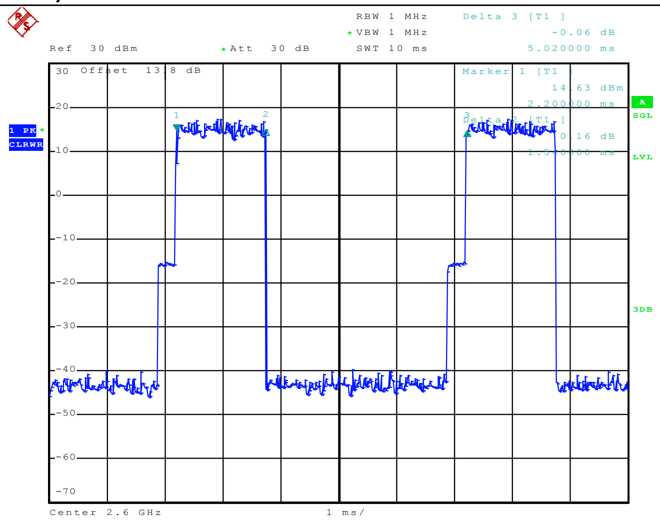
Frame Length = Mark 3 – Mark 1 = 5 ms	**UL Data Symbols (15 symbols)** = Mark 2 – Mark 1 = 1.54 ms **Duty Cycle** = 15 symbols UL time / Frame Length x 100% = 1.54 / 5 x 100% = 30.8 %

PUSC, 16QAM, BW 5MHz, 2600 MHz



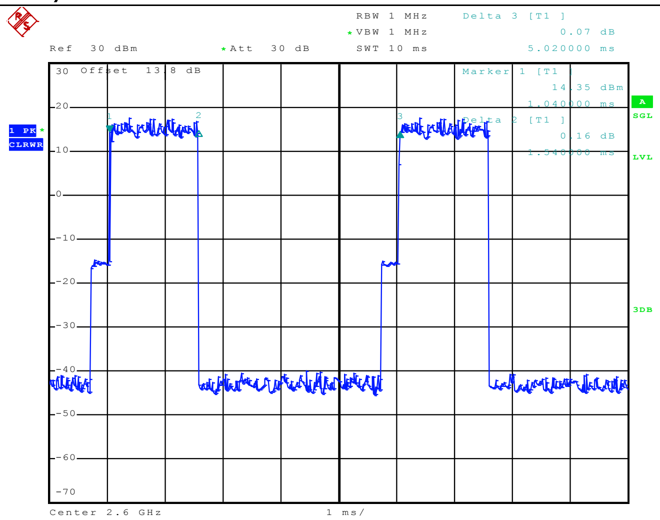
Frame Length = Mark 3 – Mark 1 = 5 ms	**UL Data Symbols (15 symbols)** = Mark 2 – Mark 1 = 1.54 ms **Duty Cycle** = 15 symbols UL time / Frame Length x 100% = 1.54 / 5 x 100% = 30.8 %

PUSC, 64QAM, BW 5MHz, 2600 MHz



Frame Length	UL Data Symbols (15 symbols)
= Mark 3 – Mark 1 = 5 ms	= Mark 2 – Mark 1 = 1.54 ms **Duty Cycle** = 15 symbols UL time / Frame Length x 100% = 1.54 / 5 x 100% = 30.8 %

PUSC, QPSK, BW 10MHz, 2600 MHz



Frame Length	UL Data Symbols (15 symbols)
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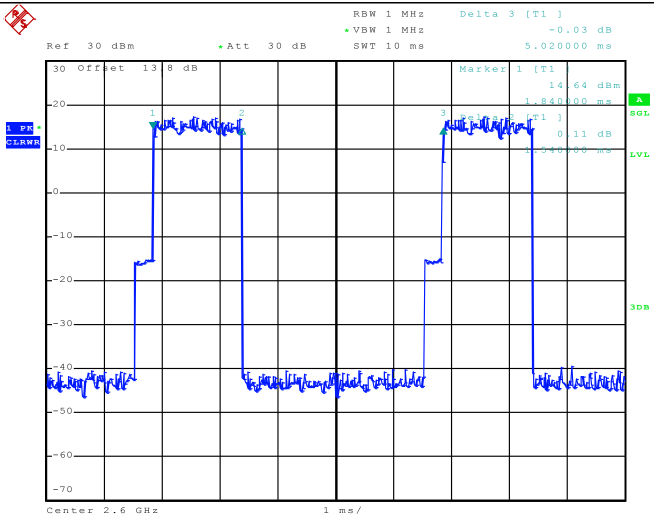
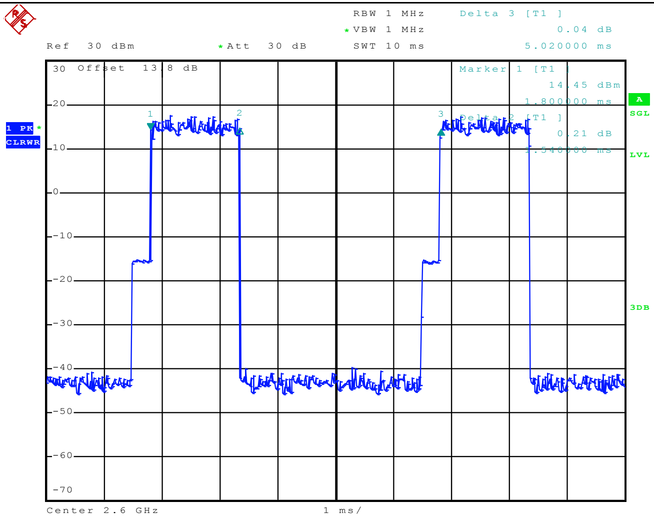
PUSC, 16QAM, BW 10MHz, 2600 MHz



Frame Length	UL Data Symbols (15 symbols)
= Mark 3 – Mark 1 = 5 ms	= Mark 2 – Mark 1 = 1.54 ms **Duty Cycle** = 15 symbols UL time / Frame Length x 100% = 1.54 / 5 x 100% = 30.8 %

PUSC, 64QAM, BW 10MHz, 2600 MHz



Frame Length	UL Data Symbols (15 symbols)
= Mark 3 – Mark 1 = 5 ms	= Mark 2 – Mark 1 = 1.54 ms **Duty Cycle** = 15 symbols UL time / Frame Length x 100% = 1.54 / 5 x 100% = 30.8 %

Scaling Factor

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. Inside the uplink, 15 of the symbols are used for data, and 3 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. To compensate for the maximum energy which may presented in the 3 control symbols, following scheme is used for the up scaling.

<Scaling Factor for 5MHz BW>

This device is power class 2 device and the maximum power tolerance is 23.0 dBm.
The maximum rated output power of 5M BW is 23.0 dBm (199.53 mW).
Maximum power in 5M control traffic is 58.68 mW (5/17 of 199.53 mW).
Scaling Factor = (3 * 58.68 + 15 * 199.53) / (15 * max. measured power of the channel tested)
= 3168.99 / (15 * max. measured power of the channel tested)

For WiMAX Antenna 0

Zone Type	Modulation	Coding Rate	Frequency (MHz)	Average Power (dBm)	Average Power (mW)	Scaling Factor
PUSC	QPSK (BW 5MHz)	1/2	2499.00	22.87	193.64	1.09
			2600.00	23.00	199.53	1.06
			2686.75	22.84	192.31	1.10
		3/4	2499.00	22.96	197.70	1.07
			2600.00	22.97	198.15	1.07
			2686.75	22.94	196.79	1.07
	16QAM (BW 5MHz)	1/2	2499.00	22.87	193.64	1.09
			2600.00	22.95	197.24	1.07
			2686.75	22.77	189.23	1.12
		3/4	2499.00	22.87	193.64	1.09
			2600.00	22.92	195.88	1.08
			2686.75	22.91	195.43	1.08
	64QAM (BW 5MHz)	1/2	2499.00	22.86	193.20	1.09
			2600.00	22.87	193.64	1.09
			2686.75	22.80	190.55	1.11
		2/3	2499.00	22.72	187.07	1.13
			2600.00	22.85	192.75	1.10
			2686.75	22.63	183.23	1.15
		3/4	2499.00	22.77	189.23	1.12
			2600.00	22.81	190.99	1.11
			2686.75	22.70	186.21	1.13
		5/6	2499.00	22.66	184.50	1.15
			2600.00	22.78	189.67	1.11
			2686.75	22.74	187.93	1.12

For WiMAX Antenna 1

Zone Type	Modulation	Coding Rate	Frequency (MHz)	Average Power (dBm)	Average Power (mW)	Scaling Factor
PUSC	QPSK (BW 5MHz)	1/2	2499.00	22.87	193.64	1.09
			2600.00	22.98	198.61	1.06
			2686.75	22.84	192.31	1.10
		3/4	2499.00	22.93	196.34	1.08
			2600.00	22.96	197.70	1.07
			2686.75	22.94	196.79	1.07
	16QAM (BW 5MHz)	1/2	2499.00	22.79	190.11	1.11
			2600.00	22.95	197.24	1.07
			2686.75	22.72	187.07	1.13
		3/4	2499.00	22.79	190.11	1.11
			2600.00	22.92	195.88	1.08
			2686.75	22.91	195.43	1.08
	64QAM (BW 5MHz)	1/2	2499.00	22.87	193.64	1.09
			2600.00	22.89	194.54	1.09
			2686.75	22.81	190.99	1.11
		2/3	2499.00	22.81	190.99	1.11
			2600.00	22.87	193.64	1.09
			2686.75	22.63	183.23	1.15
		3/4	2499.00	22.71	186.64	1.13
			2600.00	22.79	190.11	1.11
			2686.75	22.63	183.23	1.15
		5/6	2499.00	22.73	187.50	1.13
			2600.00	22.75	188.36	1.12
			2686.75	22.63	183.23	1.15

<Scaling Factor for 10MHz BW>

This device is power class 2 device and the maximum power tolerance is 23.0 dBm.

The maximum rated output power of 10M BW is 23.0 dBm (199.53 mW).

Maximum power in 10M control traffic is 28.50 mW (5/35 of 199.53 mW).

Scaling Factor = (3 * 28.50 + 15 * 199.53) / (15 * max. measured power of the channel tested)

= 3078.45 / (15 * max. measured power of the channel tested)

For WiMAX Antenna 0

Zone Type	Modulation	Coding Rate	Frequency (MHz)	Average Power		Scaling Factor
				(dBm)	(mW)	
PUSC	QPSK (BW 10MHz)	1/2	2508.50	22.74	187.93	1.09
			2600.00	22.76	188.80	1.09
			2683.50	22.72	187.07	1.10
		3/4	2508.50	22.71	186.64	1.10
			2600.00	22.74	187.93	1.09
			2683.50	22.64	183.65	1.12
	16QAM (BW 10MHz)	1/2	2508.50	22.67	184.93	1.11
			2600.00	22.73	187.50	1.09
			2683.50	22.61	182.39	1.13
		3/4	2508.50	22.66	184.50	1.11
			2600.00	22.71	186.64	1.10
			2683.50	22.67	184.93	1.11
	64QAM (BW 10MHz)	1/2	2508.50	22.68	185.35	1.11
			2600.00	22.69	185.78	1.10
			2683.50	22.66	184.50	1.11
		2/3	2508.50	22.60	181.97	1.13
			2600.00	22.65	184.08	1.11
			2683.50	22.36	172.19	1.19
		3/4	2508.50	22.57	180.72	1.14
			2600.00	22.62	182.81	1.12
			2683.50	22.45	175.79	1.17
		5/6	2508.50	22.51	178.24	1.15
			2600.00	22.60	181.97	1.13
			2683.50	22.54	179.47	1.14

For WiMAX Antenna 1

Zone Type	Modulation	Coding Rate	Frequency (MHz)	Average Power		Scaling Factor
				(dBm)	(mW)	
PUSC	QPSK (BW 10MHz)	1/2	2508.50	22.71	186.64	1.10
			2600.00	22.73	187.50	1.09
			2683.50	22.70	186.21	1.10
		3/4	2508.50	22.69	185.78	1.10
			2600.00	22.72	187.07	1.10
			2683.50	22.58	181.13	1.13
	16QAM (BW 10MHz)	1/2	2508.50	22.68	185.35	1.11
			2600.00	22.70	186.21	1.10
			2683.50	22.59	181.55	1.13
		3/4	2508.50	22.66	184.50	1.11
			2600.00	22.68	185.35	1.11
			2683.50	22.67	184.93	1.11
	64QAM (BW 10MHz)	1/2	2508.50	22.62	182.81	1.12
			2600.00	22.64	183.65	1.12
			2683.50	22.55	179.89	1.14
		2/3	2508.50	22.61	182.39	1.13
			2600.00	22.63	183.23	1.12
			2683.50	22.33	171.00	1.20
		3/4	2508.50	22.49	177.42	1.16
			2600.00	22.59	181.55	1.13
			2683.50	22.42	174.58	1.18
		5/6	2508.50	22.48	177.01	1.16
			2600.00	22.56	180.30	1.14
			2683.50	22.50	177.83	1.15

<Scaling Up SAR>

Calculating used follow scheme for scale up SAR.

Scaled SAR = Measured SAR * Scaling Factor

4.2 EUT Testing Position

This WiMAX Jacket device supports WiFi hotspot function, so WiMAX Jacket standalone body SAR was tested under 1 cm for the surfaces / slide edges where a transmitting antenna is within 2.5 cm from the edge. Since the SAR is required for antenna located within 2.5 cm from edge and considering the antenna location shown in appendix D, SAR testing for each antenna is listed as below.

We also test WiMAX Jacket body SAR at 1 cm attached with Apple iPod Touch 4 to verify the iPod Touch 4 effect on WiMAX Jacket SAR.

In addition, the WiFi SAR of Apple iPod Touch 4 attached on WiMAX Jacket is also tested at touching position (0cm) to verify Jacket effect on iPod Touch 4.

WiMAX Antenna 0 : Front Face, Rear Face, Left Side

WiMAX Antenna 1 : Front Face, Rear Face, Left Side, Bottom Side

4.3 Tissue Verification

The measuring results for tissue simulating liquid are shown as below.

Frequency (MHz)	Liquid Temp. (℃)	Measured Conductivity (σ)	Measured Permittivity (ε_r)	Target Conductivity (σ)	Target Permittivity (ε_r)	Conductivity Deviation (%)	Permittivity Deviation (%)	Test Date
2450	22.3	1.94	52.9	1.95	52.7	-0.51	0.38	Aug. 31, 2012
2600	22.6	2.12	53.0	2.16	52.5	-1.85	0.95	Aug. 16, 2012
2600	22.6	2.15	51.9	2.16	52.5	-0.46	-1.14	Aug. 17, 2012
2600	22.7	2.19	52.1	2.16	52.5	1.39	-0.76	Aug. 20, 2012
2600	22.6	2.12	51.8	2.16	52.5	-1.85	-1.33	Sep. 19, 2012

Note:

The dielectric properties of the tissue simulating liquid must be measured within 24 hours before the SAR testing and within ±5% of the target values. Liquid temperature during the SAR testing must be within ±2 ℃.

4.4 System Verification

The measuring results for system check are shown as below.

Test Date	Frequency (MHz)	1W Target SAR-1g (W/kg)	Measured SAR-1g (W/kg)	Normalized to 1W SAR-1g (W/kg)	Deviation (%)	Dipole S/N	Probe S/N	DAE S/N
Aug. 31, 2012	2450	50.20	13.0	52.00	3.59	726	3643	519
Aug. 16, 2012	2600	54.10	13.9	55.60	2.77	1016	3173	519
Aug. 17, 2012	2600	54.10	14.1	56.40	4.25	1016	3173	519
Aug. 20, 2012	2600	54.10	14.3	57.20	5.73	1016	3173	519
Sep. 19, 2012	2600	54.10	13.6	54.40	0.55	1016	3643	519

Note:

Comparing to the reference SAR value provided by SPEAG, the validation data should be within its specification of 10 %. The result indicates the system check can meet the variation criterion and the plots can be referred to Appendix A of this report.

4.5 Conducted Power Results

The measuring conducted power (Unit: dBm) are shown as below.

Band	802.11b			802.11g		
Channel	1	6	11	1	6	11
Frequency (MHz)	2412	2437	2462	2412	2437	2462
Average Power	6.76	7.12	5.01	6.52	6.71	4.69

Band	802.11n (HT20)		
Channel	1	6	11
Frequency (MHz)	2412	2437	2462
Average Power	7.31	7.29	4.61

Modulation	Coding Rate	Frequency (MHz)	WiMAX Antenna-0			WiMAX Antenna-1		
			Peak Power	Average Power	PAPR	Peak Power	Average Power	PAPR
QPSK (BW 5MHz)	1/2	2499.00	29.61	22.87	6.74	29.67	22.87	6.80
		2600.00	29.76	23.00	6.76	29.79	22.98	6.81
		2686.75	29.66	22.84	6.82	29.71	22.84	6.87
	3/4	2499.00	29.71	22.96	6.75	29.73	22.93	6.80
		2600.00	29.72	22.97	6.75	29.75	22.96	6.79
		2686.75	29.69	22.94	6.75	29.69	22.94	6.75
16QAM (BW 5MHz)	1/2	2499.00	29.63	22.87	6.76	29.66	22.79	6.87
		2600.00	29.74	22.95	6.79	29.73	22.95	6.78
		2686.75	29.62	22.77	6.85	29.57	22.72	6.85
	3/4	2499.00	29.72	22.87	6.85	29.60	22.79	6.81
		2600.00	29.79	22.92	6.87	29.81	22.92	6.89
		2686.75	29.75	22.91	6.84	29.77	22.91	6.86
64QAM (BW 5MHz)	1/2	2499.00	29.63	22.86	6.77	29.67	22.87	6.80
		2600.00	29.65	22.87	6.78	29.65	22.89	6.76
		2686.75	29.57	22.80	6.77	29.69	22.81	6.88
	2/3	2499.00	29.48	22.72	6.76	29.71	22.81	6.90
		2600.00	29.61	22.85	6.76	29.73	22.87	6.86
		2686.75	29.49	22.63	6.86	29.44	22.63	6.81
	3/4	2499.00	29.59	22.77	6.82	29.61	22.71	6.90
		2600.00	29.69	22.81	6.88	29.62	22.79	6.83
		2686.75	29.61	22.70	6.91	29.55	22.63	6.92
	5/6	2499.00	29.58	22.66	6.92	29.57	22.73	6.84
		2600.00	29.69	22.78	6.91	29.58	22.75	6.83
		2686.75	29.59	22.74	6.85	29.43	22.63	6.80

Modulation	Coding Rate	Frequency (MHz)	WiMAX Antenna-0			WiMAX Antenna-1		
			Peak Power	Average Power	PAPR	Peak Power	Average Power	PAPR
QPSK (BW 10MHz)	1/2	**2508.50**	29.57	22.74	6.83	29.58	22.71	6.87
		2600.00	29.61	**22.76**	6.85	29.61	**22.73**	6.88
		2683.50	29.51	22.72	6.79	29.57	22.70	6.87
	3/4	**2508.50**	29.57	22.71	6.86	29.52	22.69	6.83
		2600.00	29.58	22.74	6.84	29.59	22.72	6.87
		2683.50	29.49	22.64	6.85	29.37	22.58	6.79
16QAM (BW 10MHz)	1/2	**2508.50**	29.42	22.67	6.75	29.49	22.68	6.81
		2600.00	29.51	**22.73**	6.78	29.54	**22.70**	6.84
		2683.50	29.52	22.61	6.91	29.43	22.59	6.84
	3/4	**2508.50**	29.49	22.66	6.83	29.49	22.66	6.83
		2600.00	29.59	22.71	6.88	29.51	22.68	6.83
		2683.50	29.48	22.67	6.81	29.48	22.67	6.81
64QAM (BW 10MHz)	1/2	**2508.50**	29.49	22.68	6.81	29.52	22.62	6.90
		2600.00	29.51	**22.69**	6.82	29.53	**22.64**	6.89
		2683.50	29.52	22.66	6.86	29.39	22.55	6.84
	2/3	**2508.50**	29.41	22.60	6.81	29.43	22.61	6.82
		2600.00	29.51	22.65	6.86	29.51	22.63	6.88
		2683.50	29.25	22.36	6.89	29.07	22.33	6.74
	3/4	**2508.50**	29.41	22.57	6.84	29.22	22.49	6.73
		2600.00	29.47	22.62	6.85	29.37	22.59	6.78
		2683.50	29.29	22.45	6.84	29.21	22.42	6.79
	5/6	**2508.50**	29.34	22.51	6.83	29.11	22.48	6.63
		2600.00	29.48	22.60	6.88	29.51	22.56	6.95
		2683.50	29.46	22.54	6.92	29.39	22.50	6.89

4.6 SAR Testing Results

4.6.1 SAR Results for Body

<Jacket Only>

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Frequency (MHz)	Tx Antenna	Measured SAR-1g (W/kg)	Scaling Factor	Scaled SAR-1g (W/kg)
1	WiMAX	QPSK 5M_1/2	Front Face	1	2600	Ant. 0	0.153	1.06	0.162
2	WiMAX	QPSK 5M_1/2	Rear Face	1	2600	Ant. 0	0.693	1.06	**0.735**
3	WiMAX	QPSK 5M_1/2	Left Side	1	2600	Ant. 0	0.519	1.06	0.550
4	WiMAX	QPSK 5M_1/2	Front Face	1	2600	Ant. 1	0.12	1.06	0.127
5	WiMAX	QPSK 5M_1/2	Rear Face	1	2600	Ant. 1	0.555	1.06	0.588
6	WiMAX	QPSK 5M_1/2	Left Side	1	2600	Ant. 1	0.262	1.06	0.278
7	WiMAX	QPSK 5M_1/2	Bottom Side	1	2600	Ant. 1	0.187	1.06	0.198
8	WiMAX	QPSK 10M_1/2	Front Face	1	2600	Ant. 0	0.141	1.09	0.154
9	WiMAX	QPSK 10M_1/2	Rear Face	1	2600	Ant. 0	0.61	1.09	0.665
10	WiMAX	QPSK 10M_1/2	Left Side	1	2600	Ant. 0	0.465	1.09	0.507
11	WiMAX	QPSK 10M_1/2	Front Face	1	2600	Ant. 1	0.106	1.09	0.116
12	WiMAX	QPSK 10M_1/2	Rear Face	1	2600	Ant. 1	0.47	1.09	0.512
13	WiMAX	QPSK 10M_1/2	Left Side	1	2600	Ant. 1	0.283	1.09	0.308
14	WiMAX	QPSK 10M_1/2	Bottom Side	1	2600	Ant. 1	0.188	1.09	0.205

<Jacket attached with Apple iPod Touch 4>

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Frequency (MHz)	Tx Antenna	Measured SAR-1g (W/kg)	Scaling Factor	Scaled SAR-1g (W/kg)
31	WiMAX	QPSK 5M_1/2	Front Face	1	2600	Ant. 0	0.053	1.06	0.056
32	WiMAX	QPSK 5M_1/2	Rear Face	1	2600	Ant. 0	1.07	1.06	**1.134**
33	WiMAX	QPSK 5M_1/2	Left Side	1	2600	Ant. 0	0.636	1.06	0.674
34	WiMAX	QPSK 5M_1/2	Rear Face	1	2499	Ant. 0	0.232	1.09	0.253
35	WiMAX	QPSK 5M_1/2	Rear Face	1	2686.75	Ant. 0	1	1.10	1.100
36	WiMAX	16QAM_5M_1/2	Rear Face	1	2600	Ant. 0	0.884	1.07	0.946
37	WiMAX	64QAM_5M_1/2	Rear Face	1	2600	Ant. 0	0.695	1.09	0.758
38	WiMAX	QPSK 5M_1/2	Front Face	1	2600	Ant. 1	0.039	1.06	0.041
39	WiMAX	QPSK 5M_1/2	Rear Face	1	2600	Ant. 1	0.838	1.06	0.888
40	WiMAX	QPSK 5M_1/2	Left Side	1	2600	Ant. 1	0.142	1.06	0.151
41	WiMAX	QPSK 5M_1/2	Bottom Side	1	2600	Ant. 1	0.177	1.06	0.188
42	WiMAX	QPSK 5M_1/2	Rear Face	1	2499	Ant. 1	0.908	1.09	0.990
43	WiMAX	QPSK 5M_1/2	Rear Face	1	2686.75	Ant. 1	0.459	1.10	0.505
44	WiMAX	16QAM 5M_1/2	Rear Face	1	2499	Ant. 1	0.582	1.11	0.646
45	WiMAX	64QAM 5M_1/2	Rear Face	1	2499	Ant. 1	0.655	1.09	0.714
46	WiMAX	QPSK 10M_1/2	Front Face	1	2600	Ant. 0	0.054	1.09	0.059
47	WiMAX	QPSK 10M_1/2	Rear Face	1	2600	Ant. 0	0.988	1.09	1.077
48	WiMAX	QPSK 10M_1/2	Left Side	1	2600	Ant. 0	0.471	1.09	0.513
49	WiMAX	QPSK 10M_1/2	Rear Face	1	2508.50	Ant. 0	0.235	1.09	0.256
50	WiMAX	QPSK 10M_1/2	Rear Face	1	2683.50	Ant. 0	0.98	1.10	1.078
51	WiMAX	16QAM 10M_1/2	Rear Face	1	2600	Ant. 0	0.848	1.09	0.924
52	WiMAX	64QAM 10M_1/2	Rear Face	1	2600	Ant. 0	0.708	1.10	0.779
53	WiMAX	QPSK 10M_1/2	Front Face	1	2600	Ant. 1	0.037	1.09	0.040
54	WiMAX	QPSK 10M_1/2	Rear Face	1	2600	Ant. 1	0.589	1.09	0.642
55	WiMAX	QPSK 10M_1/2	Left Side	1	2600	Ant. 1	0.136	1.09	0.148
56	WiMAX	QPSK 10M_1/2	Bottom Side	1	2600	Ant. 1	0.178	1.09	0.194

Note:

1. SAR is performed on the highest power channel. When the SAR value of highest power channel is less than 0.8 W/kg, SAR testing for optional channel is not required.
2. According to KDB 615223, the SAR testing for 16QAM and 64QAM is not required when the maximum SAR value of QPSK is less than 0.8 W/kg.

Test Engineer： Eli Hsu, and Jerome Chang

<WiMAX Linearity Response Check>

Setup and Calculation Procedure

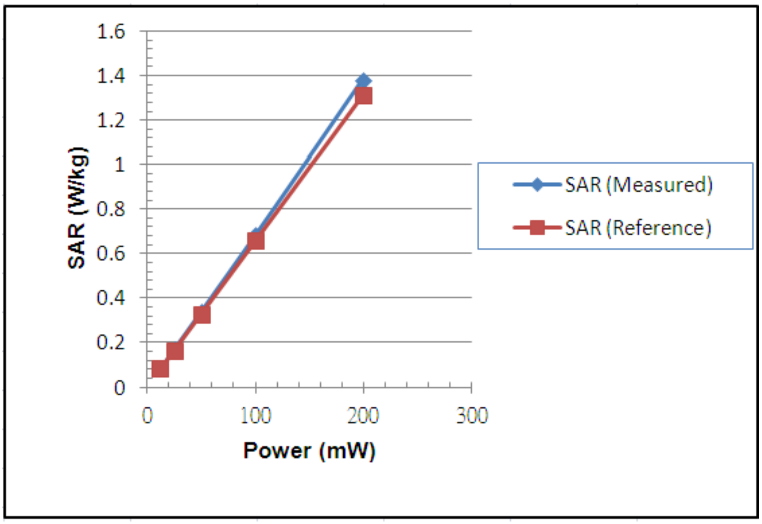
Set up the EUT in the position of the worst SAR, i.e. Vertical Back of EUT, and keep the separation distance as 0.5 cm. The channel of maximum SAR for each Modulation/Bandwidth is chosen for single point peak SAR testing. Using the same setup as complete 1g SAR and set the device to transmit at specified power and check by Anritus wideband power meter.

The reference line is based on the SAR at the power of 12.5 mW, and the proportional SARs of its multiples of 12.5 mW. The measured SAR at different multiple power of 12.5 mW is also plotted. The deviation is the difference between the reference line and the measured SAR.

The example for QPSK 1/2, BW 5M, 2600MHz is as below:
Base value = SAR measured at power of 12.5 mW = 0.082
2nd point (25 mW) = SAR value of 0.082 * (25 / 12.5) = 0.164
3rd point (50 mW) = SAR value of 0.082 * (50 / 12.5) = 0.328
4th point (100 mW) = SAR value of 0.082 * (100 / 12.5) = 0.656
5th point (199.5 mW) = SAR value of 0.082 * (199.5 / 12.5) = 1.312

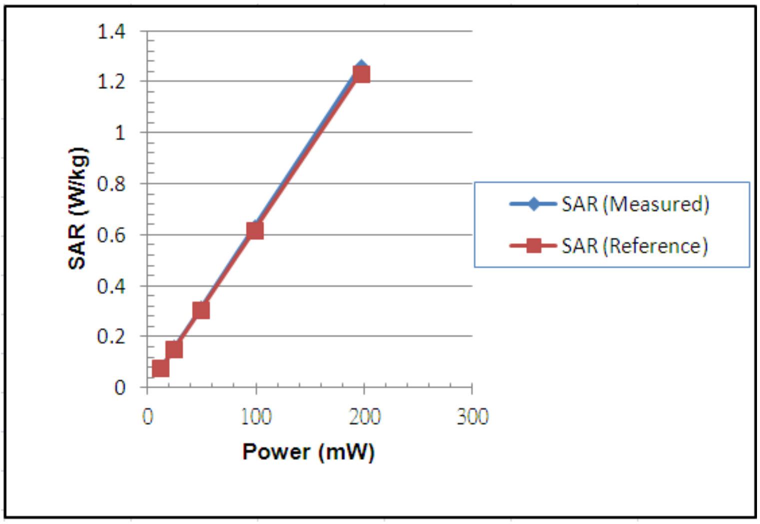
For QPSK, 1/2, BW 5M, 2600MHz, Rear Face, WiMAX Ant-0, Configuration #05

Average Power (mW)	12.5	25	50	100	199.5
Single Point SAR (W/kg)	0.082	0.168	0.339	0.682	1.38
Reference Line (W/kg)	0.082	0.164	0.328	0.656	1.312
Deviation (%)	**0.00%**	**2.44%**	**3.35%**	**3.96%**	**5.18%**



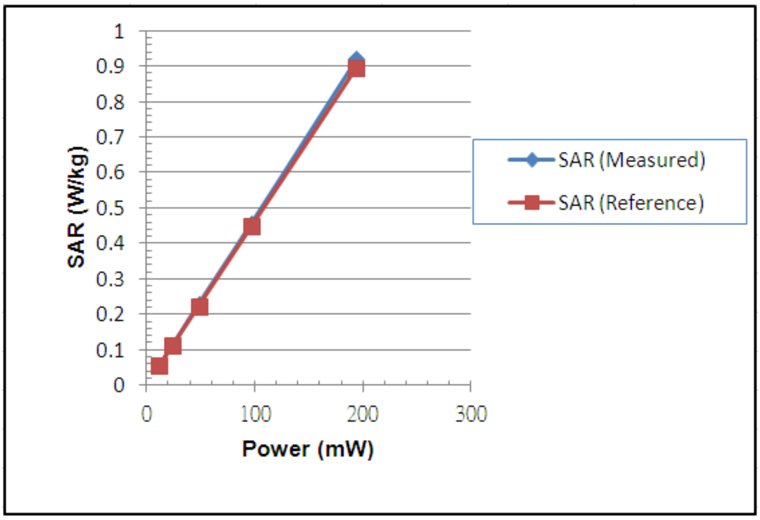
For 16QAM, 1/2, BW 5M, 2600MHz, Rear Face, WiMAX Ant-0, Configuration #35

Average Power (mW)	12.3	24.7	49.3	98.6	197.2
Single Point SAR (W/kg)	0.077	0.158	0.313	0.63	1.26
Reference Line (W/kg)	0.077	0.154	0.308	0.616	1.232
Deviation (%)	**0.00%**	**2.60%**	**1.62%**	**2.27%**	**2.27%**



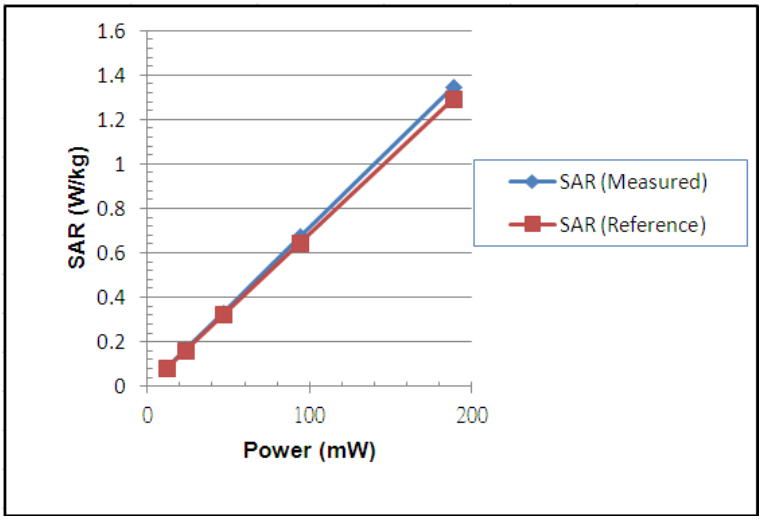
For 64QAM, 1/2, BW 5M, 2600MHz, Rear Face, WiMAX Ant-0, Configuration #62

Average Power (mW)	12.1	24.2	48.4	96.8	193.6
Single Point SAR (W/kg)	0.056	0.113	0.23	0.457	0.92
Reference Line (W/kg)	0.056	0.112	0.224	0.448	0.896
Deviation (%)	**0.00%**	**0.89%**	**2.68%**	**2.01%**	**2.68%**



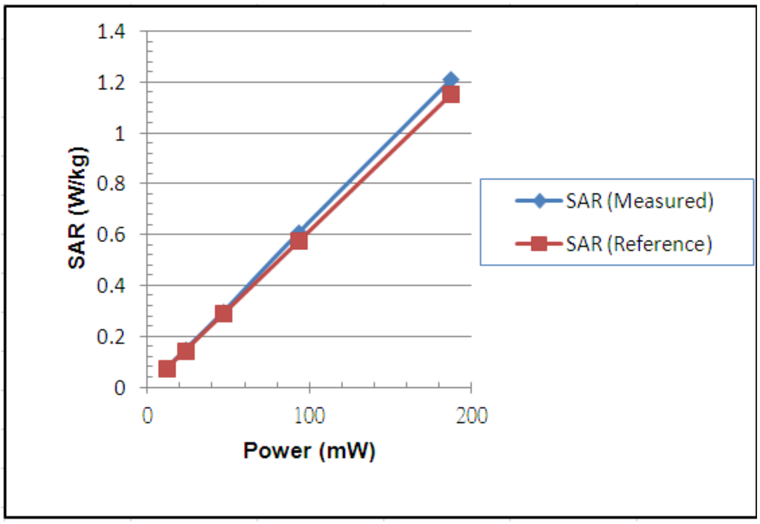
For QPSK, 1/2, BW 10M, 2600MHz, Rear Face, WiMAX Ant-0, Configuration #21

Average Power (mW)	11.8	23.6	47.2	94.4	188.8
Single Point SAR (W/kg)	0.081	0.166	0.334	0.675	1.35
Reference Line (W/kg)	0.081	0.162	0.324	0.648	1.296
Deviation (%)	**0.00%**	**2.47%**	**3.09%**	**4.17%**	**4.17%**



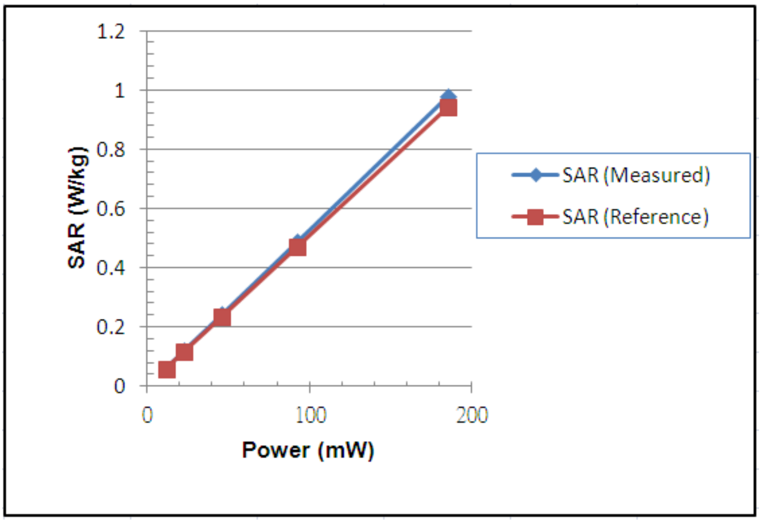
For 16QAM, 1/2, BW 10M, 2600MHz, Rear Face, WiMAX Ant-0, Configuration #49

Average Power (mW)	11.7	23.4	46.9	93.8	187.5
Single Point SAR (W/kg)	0.072	0.148	0.296	0.61	1.21
Reference Line (W/kg)	0.072	0.144	0.288	0.576	1.152
Deviation (%)	**0.00%**	**2.78%**	**2.78%**	**5.90%**	**5.03%**



For 64QAM, 1/2, BW 10M, 2600MHz, Rear Face, WiMAX Ant-0, Configuration #74

Average Power (mW)	11.6	23.2	46.5	92.9	185.8
Single Point SAR (W/kg)	0.059	0.121	0.243	0.488	0.98
Reference Line (W/kg)	0.059	0.118	0.236	0.472	0.944
Deviation (%)	**0.00%**	**2.54%**	**2.97%**	**3.39%**	**3.81%**



Conclusion

From the above test results, the SAR probe can measure SAR correctly under high PAPR of OFDM/OFDMA, and the pretest SAR is not underestimated.

<WiMAX Compare with Different Scan Resolution>

Retest the maximum raw 1g SAR with the same EUT setting on the different scan resolution. The test results are shown as below.

Scan Resolution (mm)	**Measured SAR_{1g} (W/kg)**
8 x 8 x 5	1.07
4 x 4 x 2.5	1.06

Conclusion

From the above test results, the different scan resolution has no significant change.

4.6.2 Simultaneous Multi-band Transmission Evaluation

Since the Apple iPod Touch 4 can't set it up into engineer mode for continuous transmission, we follow two steps as below to transmit a large file to evaluate the worst SAR of Apple iPod Touch 4. The testing method has been discussed with FCC by KDB number 679292.

Step 1:

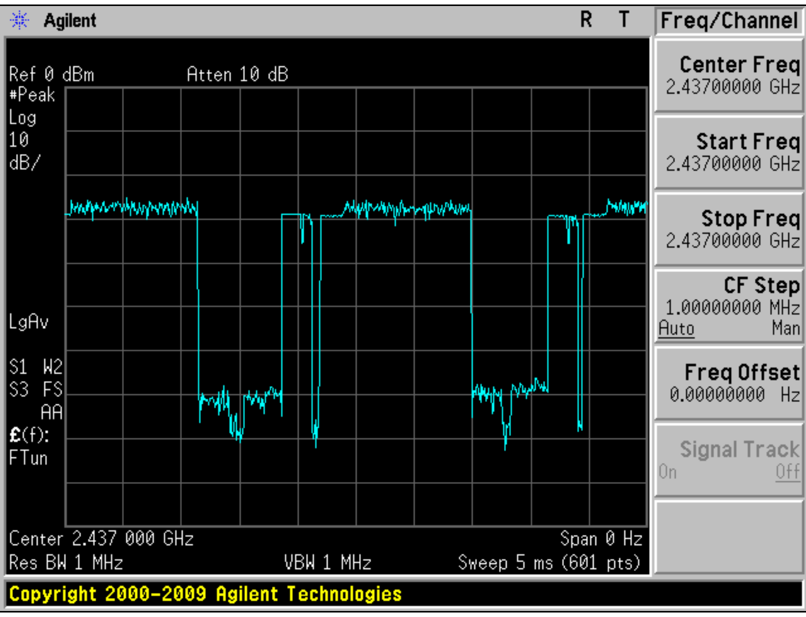
The Apple iPod Touch 4 should NOT be mounted in the iPod Jacket. Instead it should be tested by itself. It should be set to communicate with a WiFi access point at some distance away so that the Apple iPod Touch 4 will be operating at the maximum power level. The SAR readings should then be measured at 0 cm from the Apple iPod Touch 4 on the worst case frequency and in the worst case position as documented in Apple's SAR report.

Step 2:

The Apple iPod Touch 4 should be mounted in the iPod Jacket. However, the Jacket should be turned off. Again the Apple iPod Touch 4 should be set to communicate with a WiFi access point at some distance away so that the Apple iPod Touch 4 will be operating at the maximum power level. The SAR readings should then be taken at 0 cm from the Jacket/iPod Touch 4 on the same frequency as the Step 1. It should take these measurements using the same position as the Step 1.

The setup steps for large-file-transfer from Apple iPod Touch 4 to Laptop PC are as below.

1. Install FTP application software into both Apple iPod Touch 4 and laptop PC.
2. Set the Access Point to use 802.11b mode channel 6 only.
3. Make both Apple iPod Touch 4 and laptop PC linking with Access Point.
4. Execute FTP software of Apple iPod Touch 4 to transfer one large file (file name: V20120904.MOV, file size: 2GB) to laptop PC through Access Point.
5. Use a Spectrum Analyzer to monitor and make sure the WLAN continuous transmission during SAR testing.



Spectrum Analyzer Transmission Monitoring Plot

<Scaling Up Factor>

iPod Touch Version	Apple Report (0 mm Gap)	iPod Big-File-Transfer (0 mm Gap)	Scaling Up Factor
iPod Touch 4 SAR_{1g}	1.11	0.649	**1.71**

Note:

1. The test condition for Apple iPod Touch 4 WLAN SAR testing is Front Face of iPod Touch 4, and channel 6 of 802.11b mode.
2. Scaling Up Factor = SAR of Apple Report / SAR of iPod Big-File-Transfer.

<Worst SAR measurement and scaling SAR for iPod Touch 4>

Test Position	iPod Big-File-Transfer (0 cm Gap)	Scaling Up Factor	Calculated Worst SAR
Front Face	0.054	1.71	0.09
Rear Face	0.02	1.71	0.03
Left Side	0.086	1.71	0.15
Right Side	0.027	1.71	0.05
Top Side	0.342	1.71	0.58
Bottom Side	0.014	1.71	0.02

Note:

1. Calculated Worst SAR = SAR of iPod Big-File-Transfer *Scaling Up Factor.

Simultaneous Transmission SAR Evaluation

<Jacket + iPod Touch 4>

Test Position	Jacket WiMAX	Jacket 802.11b/g/n	iPod Touch 4 802.11b/g/n	Max. SAR Summation
Front Face	0.059	0	0.09	0.149
Rear Face	1.134	0	0.03	1.164
Left Side	0.674	0	0.15	0.824
Right Side	0	0	0.05	0.05
Top Side	0	0	0.58	0.58
Bottom Side	0.194	0	0.02	0.214

Note:

1. The Jacket WLAN SAR is not required because its average power is less than 60/f.

<Conclusion>

Since all the SAR summations are less than 1.6 W/kg, the simultaneous transmission SAR is not required.

5. Calibration of Test Equipment

Equipment	Manufacturer	Model	SN	Cal. Date	Cal. Interval
System Validation Kit	SPEAG	D2450V2	726	Mar. 15, 2012	Annual
System Validation Kit	SPEAG	D2600V2	1016	May 15, 2012	Annual
Dosimetric E-Field Probe	SPEAG	ES3DV3	3173	Feb. 24, 2012	Annual
Dosimetric E-Field Probe	SPEAG	EX3DV4	3643	Jan. 27, 2012	Annual
Data Acquisition Electronics	SPEAG	DAE3	519	Jan. 20, 2012	Annual
SAM Phantom	SPEAG	QD000P40CD	TP-1224	N/A	N/A
ENA Series Network Analyzer	Agilent	E5071C	MY46106970	Nov. 25, 2011	Annual
Vector Signal Generator	R&S	SMJ100A	100148	Jan. 09, 2012	Annual
Power Meter	HP	EPM-442A	GB37170267	Mar. 05, 2012	Annual
Power Sensor	HP	8481A	3318A96566	Mar. 05, 2012	Annual
EXA Spectrum Analyzer	Agilent	N9010A	MY52100136	Apr. 23, 2012	Annual
Dielectric Probe Kit	Agilent	85070D	E2-020018	May 14, 2012	Annual
Directional Coupler	Agilent	773D	2389A00640	Jul. 01, 2012	Annual
Power Amplifier	EMPOWER	BBS3Q7ELU	1020	Sep. 30, 2011	Annual
Attenuator	Agilent	8491B	MY39260700	Jul. 02, 2012	Annual

6. Measurement Uncertainty

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Standard Uncertainty (1g)	Vi
Measurement System						
Probe Calibration	6.0	Normal	1	1	± 6.0 %	∞
Axial Isotropy	4.7	Rectangular	√3	0.7	± 1.9 %	∞
Hemispherical Isotropy	9.6	Rectangular	√3	0.7	± 3.9 %	∞
Boundary Effects	1.0	Rectangular	√3	1	± 0.6 %	∞
Linearity	4.7	Rectangular	√3	1	± 2.7 %	∞
System Detection Limits	1.0	Rectangular	√3	1	± 0.6 %	∞
Readout Electronics	0.6	Normal	1	1	± 0.6 %	∞
Response Time	0.0	Rectangular	√3	1	± 0.0 %	∞
Integration Time	1.7	Rectangular	√3	1	± 1.0 %	∞
RF Ambient Noise	3.0	Rectangular	√3	1	± 1.7 %	∞
RF Ambient Reflections	3.0	Rectangular	√3	1	± 1.7 %	∞
Probe Positioner	0.5	Rectangular	√3	1	± 0.3 %	∞
Probe Positioning	2.9	Rectangular	√3	1	± 1.7 %	∞
Max. SAR Eval.	2.3	Rectangular	√3	1	± 1.3 %	∞
Test Sample Related						
Device Positioning	3.9	Normal	1	1	± 3.9 %	31
Device Holder	2.7	Normal	1	1	± 2.7 %	19
Power Drift	5.0	Rectangular	√3	1	± 2.9 %	∞
Phantom and Setup						
Phantom Uncertainty	4.0	Rectangular	√3	1	± 2.3 %	∞
Liquid Conductivity (Target)	5.0	Rectangular	√3	0.64	± 1.8 %	∞
Liquid Conductivity (Meas.)	5.0	Normal	1	0.64	± 3.2 %	29
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	± 1.7 %	∞
Liquid Permittivity (Meas.)	5.0	Normal	1	0.6	± 3.0 %	29
Combined Standard Uncertainty					± 11.7 %	
Expanded Uncertainty (K=2)					**± 23.4 %**	

Uncertainty budget for frequency range 300 MHz to 3 GHz

7. Information on the Testing Laboratories

We, Bureau Veritas Consumer Products Services (H.K.) Ltd., Taoyuan Branch, were founded in 1988 to provide our best service in EMC, Radio, Telecom and Safety consultation. Our laboratories are accredited and approved according to ISO/IEC 17025.

Copies of accreditation and authorization certificates of our laboratories obtained from approval agencies can be downloaded from our web site. If you have any comments, please feel free to contact us at the following:

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The road map of all our labs can be found in our web site also.

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