FCC SAR Test Report

APPLICANT	:	**HTC Corporation**
EQUIPMENT	:	**Smartphone**
MODEL NAME	:	**CDMA__HTI12**
FCC ID	:	**NM8CDMAHTI12**
STANDARD	:	**FCC 47 CFR Part 2 (2.1093)** **IEEE C95.1-1991** **IEEE 1528-2003** **FCC OET Bulletin 65 Supplement C (Edition 01-01)**

The product was received on Jun. 15, 2011 and completely tested on Jul. 04, 2011. We, SPORTON INTERNATIONAL INC., would like to declare that the tested sample has been evaluated in accordance with the procedures and shown the compliance with the applicable technical standards.

The test results in this report apply exclusively to the tested model / sample. Without written approval of SPORTON INTERNATIONAL INC., the test report shall not be reproduced except in full.

Reviewed by:

Jones Tsai / Manager

Testing Laboratory
1190

SPORTON INTERNATIONAL INC.
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Table of Contents

Revision History

REPORT NO.	VERSION	DESCRIPTION	ISSUED DATE
FA161543	Rev. 01	Initial issue of report	Jul. 21, 2011

1. Statement of Compliance

The maximum results of Specific Absorption Rate (SAR) found during testing for **HTC Corporation Smartphone CDMA__HTI12** are as follows (with expanded uncertainty 21.4 % for 300 MHz to 3 GHz,).

<Standalone SAR>

Band	Position	SAR_{1g} (W/kg)
CDMA2000 BC0	Head	0.388
	Body (1cm Gap)	0.761
	Hotspot (1cm Gap)	1.03
802.11 b/g/n	Head	0.094
	Body (1cm Gap)	0.139
	Hotspot (1cm Gap)	0.313
Bluetooth	Head	N/A
	Body	N/A
	Hotspot (1cm Gap)	N/A
WiMAX	Head	0.575
	Body(1cm Gap)	0.67
	Hotspot (1cm Gap)	0.606

This device is in compliance with Specific Absorption Rate (SAR) for general population/uncontrolled exposure limits (1.6 W/kg) specified in FCC 47 CFR part 2 (2.1093) and ANSI/IEEE C95.1-1991, and had been tested in accordance with the measurement methods and procedures specified in IEEE 1528-2003 and FCC OET Bulletin 65 Supplement C (Edition 01-01).

2. Administration Data

2.1 Testing Laboratory

Test Site	SPORTON INTERNATIONAL INC.
Test Site Location	No. 52, Hwa Ya 1st Rd., Hwa Ya Technology Park, Kwei-Shan Hsiang, Tao Yuan Hsien, Taiwan, R.O.C. TEL: +886-3-327-3456 FAX: +886-3-328-4978

2.2 Applicant

Company Name	HTC Corporation
Address	1F., No. 6-3, Baoqiang Rd., Xindian City, Taipei, Taiwan

2.3 Manufacturer

Company Name	HTC Corporation
Address	1F., No. 6-3, Baoqiang Rd., Xindian City, Taipei, Taiwan

2.4 Application Details

Date of Receipt of Application	Jun. 15, 2011
Date of Start during the Test	Jun. 26, 2011
Date of End during the Test	Jul. 04, 2011

3. General Information

3.1 Description of Device Under Test (DUT)

Product Feature & Specification	
DUT Type	Smartphone
Model Name	CDMA__HTI12
FCC ID	NM8CDMAHTI12
Tx Frequency	CDMA2000 BC0 : 824.70 MHz ~ 848.31 MHz 802.11b/g/n : 2400 MHz ~ 2483.5 MHz Bluetooth : 2400 MHz ~ 2483.5 MHz WiMAX BW 5M : 2498.5 MHz to 2687.5 MHz WiMAX BW 10M : 2501.0 MHz to 2685.0 MHz
Rx Frequency	CDMA2000 BC0 : 869.70 MHz ~ 893.31 MHz 802.11b/g/n : 2400 MHz ~ 2483.5 MHz Bluetooth : 2400 MHz ~ 2483.5 MHz WiMAX BW 5M : 2498.5 MHz to 2687.5 MHz WiMAX BW 10M : 2501.0 MHz to 2685.0 MHz
Maximum Output Power to Antenna	CDMA2000 BC0 : 24.25 dBm 802.11b : 18.89 dBm 802.11g : 11.92 dBm 802.11n (BW 20MHz) (2.4GHz) : 11.92 dBm Bluetooth : 4.82 dBm WiMAX BW 5M : 23.94 dBm WiMAX BW 10M : 23.58 dBm
Antenna Type	WWAN : PIFA Antenna WLAN : PIFA Antenna WIMAX : PIFA Antenna
Type of Modulation	CDMA2000 : QPSK 802.11b : DSSS (BPSK / QPSK / CCK) 802.11g/n : OFDM (BPSK / QPSK / 16QAM) Bluetooth (1Mbps) : GFSK Bluetooth EDR (2Mbps) : π/4-DQPSK Bluetooth EDR (3Mbps) : 8-DPSK WiMAX Up Link (QPSK / 16QAM) WiMAX Downlink : OFDMA (QPSK / 16QAM)
DUT Stage	Production Unit

Remark:

The above DUT's information was declared by manufacturer. Please refer to the specifications or user's manual for more detailed description.

3.2 Applied Standards

The Specific Absorption Rate (SAR) testing specification, method and procedure for this device is in accordance with the following standards:

- FCC 47 CFR Part 2 (2.1093)
- IEEE C95.1-1991
- IEEE 1528-2003
- FCC OET Bulletin 65 Supplement C (Edition 01-01)
- FCC KDB 615223 D01 v01
- FCC KDB 648474 D01 v01r05
- FCC KDB 941225 D01 v02
- FCC KDB 248227 D01 v01r02
- FCC KDB 941225 D06 v01
- FCC KDB 971168 D01 v01

3.3 Device Category and SAR Limits

This device belongs to portable device category because its radiating structure is allowed to be used within 20 centimeters of the body of the user. Limit for General Population/Uncontrolled exposure should be applied for this device, it is 1.6 W/kg as averaged over any 1 gram of tissue.

3.4 Test Conditions

3.4.1 Ambient Condition

Ambient Temperature	20 to 24 ℃
Humidity	< 60 %

3.4.2 Test Configuration

The device was controlled by using a base station emulator. Communication between the device and the emulator was established by air link. The distance between the DUT and the antenna of the emulator is larger than 50 cm and the output power radiated from the emulator antenna is at least 30 dB smaller than the output power of DUT. The DUT was set from the emulator to radiate maximum output power during all tests.

For WWAN SAR testing, the DUT is in CDMA2000 link mode and the crest factor is 1.

For WLAN SAR testing, WLAN engineering testing software installed on the DUT can provide continuous transmitting RF signal. This RF signal utilized in SAR measurement has almost 100% duty cycle and its crest factor is 1.

The DUT WiMax maximum output power rating is 24dBm (no greater than 24dBm), maximum DL:UL ratio =29:18, maximum SAR tested < 1.2W/kg, AMC zone is not used; therefore PBA procedure is not required according to KDB 388624 D02.

The test device is a 2.6 GHz WiMAX transceiver. It provides one completed transmitter and two receivers. This Smartphone has two built-in antennas and it supports Tx antenna diversity function. Only one transmitting antenna can be used simultaneously.

The device only transmits by PUSC zone type. The other zone types, AMC, and FUSC, are not available on this device. The maximum DL: UL (downlink-to-uplink) symbol ratio is determined according to the PUSC requirements. The system transmits an odd number of symbols using DL-PUSC, consisting of even multiples of traffic and control symbols, plus one symbol for the preamble. The device transmits in multiples of three symbols using UL-PUSC. The OFDMA symbol time allows up to 48 downlink and uplink symbols to be transmitted in each 5 ms frame. The system transmits on 5 ms frames using 5 MHz and 10 MHz channels. 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. The maximum DL:UL symbol ratio allowed for this device and determined according to these PUSC parameters is 29:18.

For PUSC zone type, the 10 MHz channel bandwidth uses 1024 sub-carriers and 35 sub-channels, with 184 spare/safeguard sub-carriers and 840 available for transmission, consisting of 560 data and 280 pilot sub-carriers. 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.

Control signals are transmitted in the first 3 symbols of each uplink burst. The rest of the uplink sub-frame contains normal traffic data bursts. The first 3 symbols are also used for ranging, which is shared with other users. During normal operation, the control symbols are transmitted at reduced power and the traffic symbols may transmit at maximum power. For SAR testing purposes, the configuration of control symbols is dependent on the test software and test equipment setup. The uplink allows a maximum of 15 traffic and 3 control symbols, 18 total, per frame. These conditions are applicable to both 5 and 10 MHz channel configurations used by this device.

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

Description	Parameter		Comment
FCC ID	NM8PG86400		Identify all related FCC ID
Radio Service	Part 27 Subpart M		Rule parts
Transmit Frequency Range (MHz)	5MHz BW : 2498.5 MHz to 2687.5 MHz 10MHz BW : 2501.0 MHz to 2685.0 MHz		System parameter
System/Channel Bandwidth (MHz)	5 MHz	10 MHz	System parameter
System Profile	Release 1.0(Revision 1.7.1 2008) Band Class 3 Radio Profile 3A		Defined by WiMAX Forum
Modulation Schemes	QPSK, 16QAM		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 ns	89 ns	($1/F_S$)
FFT Size (N_{FFT})	512	1024	(N_{FFT})
Sub-Carrier Spacing (kHz)	10.94 kHz		(Δf)
Useful Symbol Time (μs)	91.43 μs		($T_b=1/\Delta f$)
Guard Time (μs)	11.43 μs		(T_g=Tb/cp); cp = cyclic prefix
OFDMA Symbol Time (μs)	102.857 μs		($T_S=T_b+T_g$)
Frame Size (ms)	5 ms		System parameter
TTG + RTG (μs or number of symbols)	165.8 μs		Idle time, system parameter
Number of DL OFDMA Symbols per Frame	Max: 29		Identify the allowed & maximum symbols, including both traffic & control symbols
Number of UL OFDMA Symbols per Frame	Max: 18		
DL:UL Symbol Ratios	Max 29:18		For determining UL duty factor
Power Class (dBm)	Power Class 2, 23±1 dBm		Identify power class and tolerance
Wave1 / Wave2	Wave2: Two antennas for Tx/Rx diversity. ANT1 and ANT2 cannot transmit simultaneously		Describe antenna diversity info and MIMO requirements separately
UL Zone Types (FUSC, PUSC, OFUSC, OPUSC, AMC, TUSC1, TUSC2)	PUSC only. UL AMC is not used in the current profile		Describe separately the symbol and sub-carrier/sub-channel structures applicable to each zone type
Maximum Number of UL Sub-Carriers	Null Sub-Carriers=104 Pilot Sub-Carriers=136 Data Sub-Carrier=272	Null Sub-Carriers=184 Pilot Sub-Carriers=280 Data Sub-Carriers=560	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	23.94 dBm	23.58 dBm	
UL Control Symbol Configuration	3 PUSC symbols (used for ranging, CQICH and ACK/NACK)		
UL Control Symbol Maximum Conducted Average Power	73.88 mW	35.88 mW	
UL Burst Peak-to-Average (Conducted) Power Ratio (PAPR)	PAPR is between 7.68 ~ 8.36 dB An Anritsu wideband power meter was used to measure this item. Average, peak and PAPR are measured simultaneously. The test records please refer to section 12.1 of this report.		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 (%)	Duty cycle was measured by a spectrum. The measured duty cycle is 31.5 % to 32.0 %. Theoretical duty cycle is 15 x 102.857 μs / 5000 μs = 30.86 %. cf = 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

Duty Cycle = 15 data symbols UL time / Frame Length x 100 %

The plot below shows the waveform characteristics of the signal used in the SAR measurement. The pulse duration corresponds to a DL: UL symbol ratio of 29:18 and control symbols are not active.

The plots of time vector and calculation of duty cycle can be referred to Appendix G. Since there was no energy in the control symbols, the effective power is only across 15 data symbols. The calculation of duty cycle is as below:

Summary table is shown as below..

Zone Type	Modulation	Coding Rate	Duty Cycle (%)	Crest Factor
PUSC	QPSK (5M)	1/2	31.87	3.14
PUSC	QPSK (10M)	1/2	31.87	3.14
PUSC	QPSK (5M)	3/4	31.47	3.18
PUSC	QPSK (10M)	3/4	32.0	3.13
PUSC	16QAM (5M)	1/2	32.0	3.13
PUSC	16QAM (10M)	1/2	31.87	3.14
PUSC	16QAM (5M)	3/4	31.47	3.18
PUSC	16QAM (10M)	3/4	31.47	3.18

Note: Crest Factor = 1 / Duty Cycle.

The SAR probe is calibrated with a sinusoidal CW signal, not signal with certain duty factor. Per KDB 615223, since the DUT maximum DL:UL=29:18 and the DL:UL is also set to 29:18 during SAR measurement, the duty factor can be compensated by selecting the correct conversion factor for the SAR measurements.

The DL:UL=29:18 with control symbol inactive, the duty factor is (15*102.857 μs) / 5000 μs = 0.30871. Therefore, the conversion factor (*cf*) = 1/ 0.30871 = **3.24** will be used for the SAR measurement system.

Test Software Details

The DUT use the HyperTerminal (AT Command) installed on a host laptop computer to configure the DUT into the engineering mode. In engineering mode, the transmitter parameters for antenna, BW, modulation, frequency and transmitting maximum power can be set, and the DUT can receive control signal from system simulator, Agilent E6651A, to keep transmitting WiMAX signal. The uplink transmission (signal characteristics such as BW, modulation, frequency and DL:UL ratio) is maintained at a stable condition by the FCH, UL-MAP and DL-MAP information transmitted over the air from the Agilent E6651A. This enables the DUT to transmit at maximum power with a constant duty factor according to the maximum DL:UL symbol ratio 29:18, using a specific modulation, zone type, sub-channel configuration and other operating requirements. The test software for this device serves only one purpose, to configure the DUT into engineering mode during the SAR measurements.

Follow these commands for Tx antenna selection
Connect DUT with laptop PC via USB cable, then execute the “adb tool” software

1. Enter android adb folder.
2. Push file [apph] into device using: adb push apph /data/local/
3. Connect device to base station
4. Enter following commands under adb folder: adb shell
5. cd /system/bin
6. apph
7. connect
8. Set WiMAX parameter:
   !clearsc
   !addch frequency=2498500 b=5 d=5
   !addch frequency=2593000 b=5 d=5
   !addch frequency=2687500 b=5 d=5
   !addch frequency=2501000 b=10 d=5
   !addch frequency=2593000 b=10 d=5
   !addch frequency=2685000 b=10 d=5
   !setndss detectBackoffLimit=3000
   !setndssconfig detectBackoffstep=3000
   !setSdcD 1 0 0 0 0 0 0 0 0
   !setSdcD 1 0 0 0 1 0 0 1 0
9. Select antenna by following commands:
   (ANT-0)
   !setmio 14 1 1 0 0
   !setmio 11 1 1 1 0
   (ANT-1)
   !setmio 14 1 1 1 0
   !setmio 11 1 1 0 0
10. run “!startss” to link DUT with BSE

Communication Test Set Details

A system simulator, Agilent E6651A, is used in conjunction with DUT engineering mode to configure the DUT for the SAR measurements. The Agilent E6651A is configured to transmit the downlink signals, containing the respective FCH, DL-MAP and UL-MAP required by the DUT to configure the DUT uplink transmissions. The waveform is configured for a DL:UL symbol ratio of 29:18. The DUT can synchronize itself to the signals received from the Agilent E6651A, both in frequency and time. It then demodulates the DL-MAP and UL-MAP transmitted in each downlink sub-frame and determines the DL:UL symbol ratio (29:18). This downlink burst is repeated in each frame, every 5 ms, to simulate the transmission from a WiMax base station. The UL-MAP received by the DUT is used to configure the uplink burst with all data (traffic) symbols and sub-channels active.

In fact, the DUT have not linked with Agilent E6651A. The DUT only receive the control signal from Agilent E6651A and then transmitting maximum power on the specific configuration. Therefore, no control channel transmissions are requested by the system simulator. SAR measurement were taken in this configuration with the DUT transmitting using the 29:18 ratio, but since there was no energy in the control symbols, the effective power is only across 15 data symbols.

The steps for system simulator setup are as below

1. Set the appropriate source amplitude and attenuation
2. Load the system profile of bandwidth 5M or 10M
3. Set the operating frequency
4. Set the UL modulation to operating mode
5. Set the test mode to UL padding test
6. Set and send the RNG-RSP message
7. Set the run test on

4. Specific Absorption Rate (SAR)

4.1 Introduction

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.

4.2 SAR Definition

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:

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

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

SAR measurement can be either related to the temperature elevation in tissue by

$$\mathbf{SAR} = \mathbf{C}\left(\frac{\boldsymbol{\delta}\mathbf{T}}{\boldsymbol{\delta}\mathbf{t}}\right)$$

Where: C is the specific heat capacity, δT is the temperature rise and δt is the exposure duration, or related to the electrical field in the tissue by

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

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

However for evaluating SAR of low power transmitter, electrical field measurement is typically applied.

5. SAR Measurement System

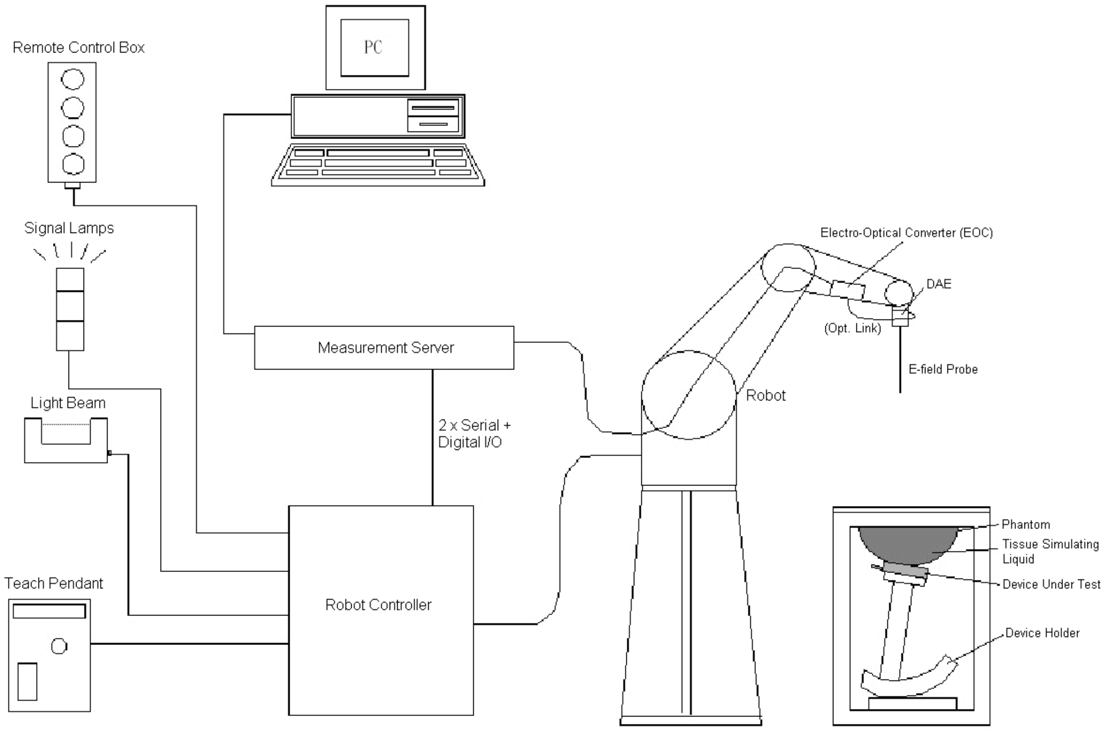


Fig 5.1 SPEAG DASY4 or DASY5 System Configurations

The DASY4 or DASY5 system for performance compliance tests is illustrated above graphically. This system consists of the following items:

- A standard high precision 6-axis robot with controller, a teach pendant and software
- A data acquisition electronic (DAE) attached to the robot arm extension
- A dosimetric probe equipped with an optical surface detector system
- The electro-optical converter (ECO) performs the conversion between optical and electrical signals
- A measurement server performs the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the accuracy of the probe positioning
- A computer operating Windows XP
- DASY4 or DASY5 software
- Remove control with teach pendant and additional circuitry for robot safety such as warming lamps, etc.
- The SAM twin phantom
- A device holder
- Tissue simulating liquid
- Dipole for evaluating the proper functioning of the system

Some of the components are described in details in the following sub-sections.

5.1 E-Field Probe

The SAR measurement is conducted with the dosimetric probe (manufactured by SPEAG).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. This probe has a built in optical surface detection system to prevent from collision with phantom.

5.1.1 E-Field Probe Specification

<ET3DV6 Probe >

Construction	Symmetrical design with triangular core Built-in optical fiber for surface detection system. Built-in shielding against static charges. PEEK enclosure material (resistant to organic solvents, e.g., DGBE)
Frequency	10 MHz to 3 GHz; Linearity: ± 0.2 dB
Directivity	± 0.2 dB in HSL (rotation around probe axis) ± 0.4 dB in HSL (rotation normal to probe axis)
Dynamic Range	5 µW/g to 100 mW/g; Linearity: ± 0.2 dB
Dimensions	Overall length: 330 mm (Tip: 16 mm) Tip diameter: 6.8 mm (Body: 12 mm) Distance from probe tip to dipole centers: 2.7 mm

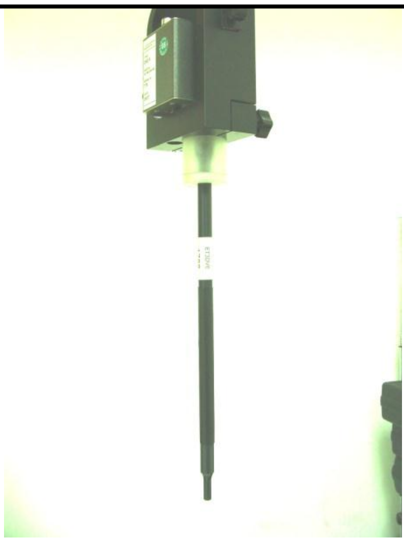


Fig 5.2 Photo of ET3DV6

<EX3DV4 Probe>

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: 330 mm (Tip: 20 mm) Tip diameter: 2.5 mm (Body: 12 mm) Typical distance from probe tip to dipole centers: 1 mm

Fig 5.3 Photo of EX3DV4

5.1.2 E-Field Probe Calibration

Each probe needs to be calibrated according to a dosimetric assessment procedure with accuracy better than ± 10%. The spherical isotropy shall be evaluated and within ± 0.25 dB. The sensitivity parameters (NormX, NormY, and NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe are tested. The calibration data can be referred to appendix C of this report.

5.2 Data Acquisition Electronics (DAE)

The data acquisition electronics (DAE) 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 measurement server is accomplished through an optical downlink for data and status information as well as an optical uplink for commands and the clock.

The input impedance of the DAE is 200 MOhm; the inputs are symmetrical and floating. Common mode rejection is above 80 dB.

Fig 5.4 Photo of DAE

5.3 Robot

The SPEAG DASY system uses the high precision robots (DASY4: RX90BL; DASY5: TX90XL) type 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)

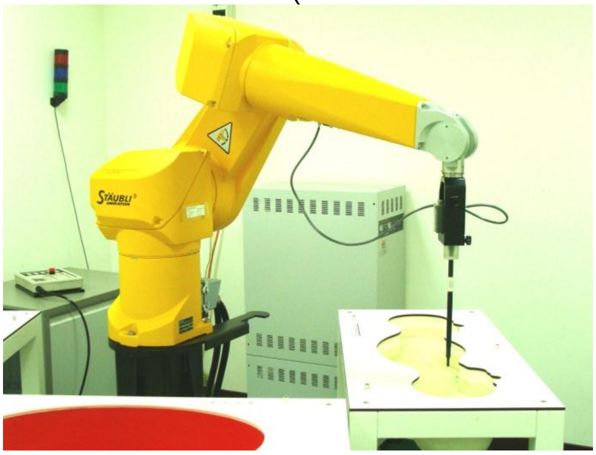


Fig 5.5 Photo of DASY4

Fig 5.6 Photo of DASY5

5.4 Measurement Server

The measurement server is based on a PC/104 CPU board with CPU (DASY4: 166 MHz, Intel Pentium; DASY5: 400 MHz, Intel Celeron), chipdisk (DASY4: 32 MB; DASY5: 128 MB), RAM (DASY4: 64 MB, DASY5: 128 MB). The necessary circuits for communication with the DAE electronic box, as well as the 16 bit AD converter system for optical detection and digital I/O interface are contained on the DASY I/O board, which is directly connected to the PC/104 bus of the CPU board.

The measurement server performs all the real-time data evaluation for field measurements and surface detection, controls robot movements and handles safety operations.

Fig 5.7 Photo of Server for DASY4

Fig 5.8 Photo of Server for DASY5

5.5 Phantom

<SAM Twin Phantom>

Shell Thickness	2 ± 0.2 mm; Center ear point: 6 ± 0.2 mm
Filling Volume	Approx. 25 liters
Dimensions	Length: 1000 mm; Width: 500 mm; Height: adjustable feet
Measurement Areas	Left Hand, Right Hand, Flat Phantom

Fig 5.9 Photo of SAM Phantom

The bottom plate contains three pair of bolts for locking the device holder. The device holder positions are adjusted to the standard measurement positions in the three sections. A white cover is provided to tap the phantom during off-periods to prevent water evaporation and changes in the liquid parameters. On the phantom top, three reference markers are provided to identify the phantom position with respect to the robot.

<ELI4 Phantom>

Shell Thickness	2 ± 0.2 mm (sagging: <1%)
Filling Volume	Approx. 30 liters
Dimensions	Major ellipse axis: 600 mm Minor axis: 400 mm

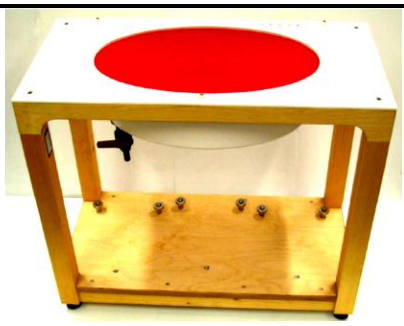


Fig 5.10 Photo of ELI4 Phantom

The ELI4 phantom is intended for compliance testing of handheld and body-mounted wireless devices in the frequency range of 30 MHz to 6 GHz. ELI4 is fully compatible with standard and all known tissue simulating liquids.

5.6 Device Holder

<Device Holder for SAM Twin Phantom>

The SAR in the phantom is approximately inversely proportional to the square of the distance between the source and the liquid surface. For a source at 5 mm distance, a positioning uncertainty of ± 0.5 mm would produce a SAR uncertainty of ± 20 %. Accurate device positioning is therefore crucial for accurate and repeatable measurements. The positions in which the devices must be measured are defined by the standards.

The DASY device holder is designed to cope with different positions given in the standard. It has two scales for the device rotation (with respect to the body axis) and the device inclination (with respect to the line between the ear reference points). The rotation center for both scales is the ear reference point (EPR). Thus the device needs no repositioning when changing the angles.

The DASY device holder is constructed of low-loss POM material having the following dielectric parameters: relative permittivity ε = 3 and loss tangent δ = 0.02. The amount of dielectric material has been reduced in the closest vicinity of the device, since measurements have suggested that the influence of the clamp on the test results could thus be lowered.

Fig 5.11 Device Holder

<Laptop Extension Kit>

The extension is lightweight and made of POM, acrylic glass and foam. It fits easily on the upper part of the mounting device in place of the phone positioned. The extension is fully compatible with the SAM Twin and ELI phantoms.

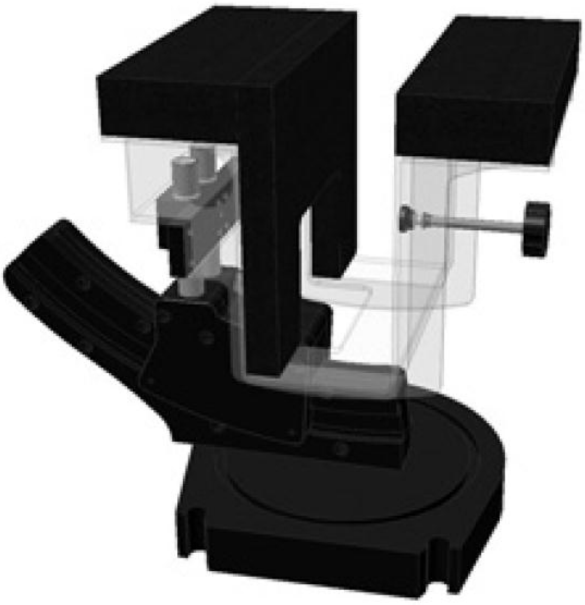


Fig 5.12 Laptop Extension Kit

5.7 Data Storage and Evaluation

5.7.1 Data Storage

The DASY software stores the assessed data from the data acquisition electronics as raw data (in microvolt readings from the probe sensors), together with all the necessary software parameters for the data evaluation (probe calibration data, liquid parameters and device frequency and modulation data) in measurement files. The post-processing software evaluates the desired unit and format for output each time the data is visualized or exported. This allows verification of the complete software setup even after the measurement and allows correction of erroneous parameter settings. For example, if a measurement has been performed with an incorrect crest factor parameter in the device setup, the parameter can be corrected afterwards and the data can be reevaluated.

The measured data can be visualized or exported in different units or formats, depending on the selected probe type (e.g., [V/m], [A/m], [mW/g]). Some of these units are not available in certain situations or give meaningless results, e.g., a SAR-output in a non-lose media, will always be zero. Raw data can also be exported to perform the evaluation with other software packages.

5.7.2 Data Evaluation

The DASY post-processing software (SEMCAD) automatically executes the following procedures to calculate the field units from the microvolt readings at the probe connector. The parameters used in the evaluation are stored in the configuration modules of the software：

Probe parameters：	- Sensitivity	$Norm_i$, a_{i0}, a_{i1}, a_{i2}
	- Conversion factor	$ConvF_i$
	- Diode compression point	dcp_i
Device parameters：	- Frequency	f
	- Crest factor	cf
Media parameters：	- Conductivity	σ
	- Density	ρ

These parameters must be set correctly in the software. They can be found in the component documents or they can be imported into the software from the configuration files issued for the DASY components. In the direct measuring mode of the multi-meter option, the parameters of the actual system setup are used. In the scan visualization and export modes, the parameters stored in the corresponding document files are used.

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 as：

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

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

H-field Probes： $\mathbf{H_i} = \sqrt{\mathbf{V_i}} \cdot \frac{\mathbf{a_{i0} + a_{i1} f + a_{i2} f^2}}{\mathbf{f}}$

with V_i = compensated signal of channel i, (i = x, y, z)
$Norm_i$ = sensor sensitivity of channel i, (i = x, y, z), μV/(V/m)^2 for E-field Probes
ConvF = sensitivity enhancement in solution
a_{ij} = sensor sensitivity factors for H-field probes
f = carrier frequency [GHz]
E_i = electric field strength of channel i in V/m
H_i = magnetic field strength of channel i in A/m

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

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

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

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

with SAR = local specific absorption rate in mW/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

Note that the density is set to 1, to account for actual head tissue density rather than the density of the tissue simulating liquid.

5.8 Test Equipment List

Manufacturer	Name of Equipment	Type/Model	Serial Number	Calibration	
				Last Cal.	Due Date
SPEAG	Dosimetric E-Field Probe	ET3DV6	1787	May. 20, 2011	May. 19, 2012
SPEAG	Dosimetric E-Filed Probe	EX3DV4	3792	Jun. 20, 2011	Jun. 19, 2012
SPEAG	Dosimetric E-Field Probe	EX3DV4	3731	Sep. 20, 2010	Sep. 19, 2011
SPEAG	Dosimetric E-Field Probe	EX3DV4	3697	Nov. 23, 2010	Nov. 22, 2011
SPEAG	835MHz System Validation Kit	D835V2	4d082	Jul. 20, 2010	Jul. 19, 2012
SPEAG	2450MHz System Validation Kit	D2450V2	735	Jun. 17, 2010	Jun. 16, 2012
SPEAG	2600MHz System Validation Kit	D2600V2	1003	Jan. 27, 2011	Jan. 26, 2012
SPEAG	Data Acquisition Electronics	DAE3	577	Jan. 13, 2011	Jan. 12, 2012
SPEAG	Data Acquisition Electronics	DAE4	778	Oct. 22, 2010	Oct. 21, 2011
SPEAG	Data Acquisition Electronics	DAE4	1244	Jan. 07, 2011	Jan. 06, 2012
SPEAG	Data Acquisition Electronics	DAE3	495	Apr. 28, 2011	Apr. 27, 2012
SPEAG	SAM Phantom	QD 000 P40 C	TP-1383	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1446	NCR	NCR
SPEAG	SAM Phantom	QD 000 P40 C	TP-1478	NCR	NCR
SPEAG	ELI4 Phantom	QD 0VA 001 BB	1026	NCR	NCR
SPEAG	ELI4 Phantom	QD 0VA 001 BA	1029	NCR	NCR
Agilent	ENA Series Network Analyzer	E5071C	MY46106933	Jul. 06, 2010	Jul. 05, 2011
Agilent	Wireless Communication Test Set	E5515C	MY48360820	Jan. 12, 2010	Jan. 11, 2012
Agilent	Wireless Communication Test Set	E5515C	GB46311322	Mar. 23, 2011	Mar. 22, 2013
Agilent	Wireless Communication Test Set	E5515C	MY50264370	Apr. 19, 2011	Apr. 18, 2013
R&S	Universal Radio Communication Tester	CMU200	114256	Feb. 08, 2010	Feb. 07, 2012
Agilent	Dielectric Probe Kit	85070D	US01440205	NCR	NCR
Agilent	Dual Directional Coupler	778D	50422	NCR	NCR
AR	Power Amplifier	5S1G4M2	0328767	NCR	NCR
R&S	Spectrum Analyzer	FSP30	101329	May. 03, 2011	May. 02, 2012

Table 5.1 Test Equipment List

Note:
1. The calibration certificate of DASY can be referred to appendix C of this report.
2. Referring to KDB 450824, the justification of dipole extended calibration would be performed, once dipoles are beyond one year period

6. Tissue Simulating Liquids

For the measurement of the field distribution inside the SAM phantom with DASY, the phantom must be filled with around 25 liters of homogeneous body tissue simulating liquid. 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, which is shown in Fig. 6.1. For body SAR testing, the liquid height from the center of the flat phantom to the liquid top surface is larger than 15 cm, which is shown in Fig. 6.2.

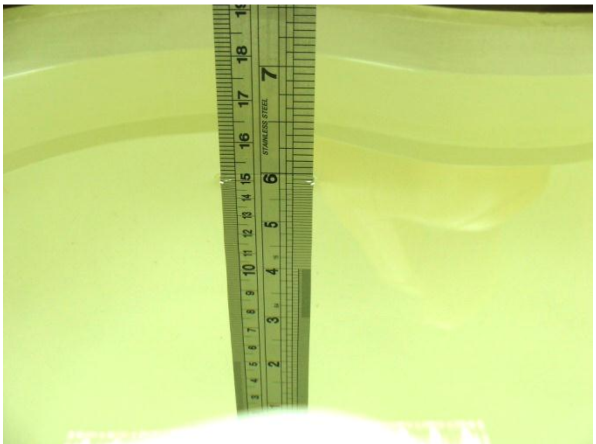


Fig 6.1 Photo of Liquid Height for Head SAR

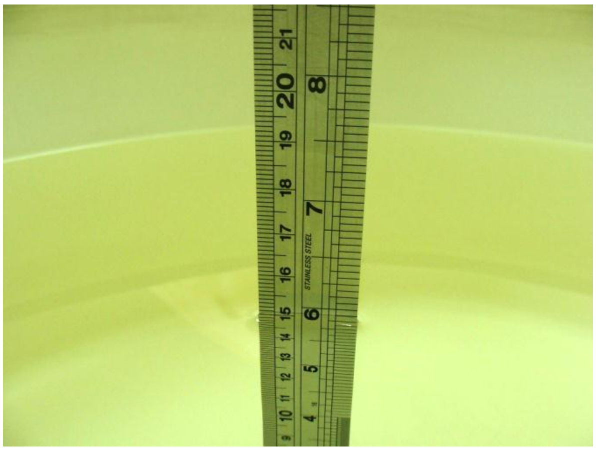


Fig 6.2 Photo of Liquid Height for Body SAR

The following table gives the recipes for tissue simulating liquid.

Frequency (MHz)	Water (%)	Sugar (%)	Cellulose (%)	Salt (%)	Preventol (%)	DGBE (%)	Conductivity (σ)	Permittivity (ε_r)
For Head								
835	40.3	57.9	0.2	1.4	0.2	0	0.90	41.5
2450	55.0	0	0	0	0	45.0	1.80	39.2
2600	54.7	0	0	0	0	45.3	1.96	39.0
For Body								
835	50.8	48.2	0	0.9	0.1	0	0.97	55.2
2450	68.6	0	0	0	0	31.4	1.95	52.7
2600	67.6	0	0	0	0	32.4	2.16	52.5

Table 6.1 Recipes of Tissue Simulating Liquid

The following table gives the targets for tissue simulating liquid.

Frequency (MHz)	Liquid Type	Conductivity (σ)	±5% Range	Permittivity (ε_r)	±5% Range
835	Head	0.90	0.86 ~ 0.95	41.5	39.4 ~ 43.6
2450	Head	1.80	1.71 ~ 1.89	39.2	37.2 ~ 41.2
2496	Head	1.85	1.76 ~ 1.94	39.14	37.18 ~ 41.10
2593	Head	1.96	1.86 ~ 2.06	39.02	37.07 ~ 40.97

2600	Head	1.96	1.86 ~ 2.06	39.01	37.06 ~ 40.96
2690	Head	2.06	1.96 ~ 2.16	38.89	36.95 ~ 40.83
835	Body	0.97	0.92 ~ 1.02	55.2	52.4 ~ 58.0
2450	Body	1.95	1.85 ~ 2.05	52.7	50.1 ~ 55.3
2496	Body	2.02	1.92 ~ 2.12	52.64	50.01 ~ 55.27
2593	Body	2.15	2.04 ~ 2.26	52.52	49.89 ~ 55.15
2600	Body	2.16	2.05 ~ 2.27	52.51	49.88 ~ 55.14
2690	Body	2.29	2.18 ~ 2.40	52.39	49.77 ~ 55.01

Table 6.2 Targets of Tissue Simulating Liquid

The dielectric parameters of the liquids were verified prior to the SAR evaluation using an Agilent 85070D Dielectric Probe Kit and an Agilent Network Analyzer.

The following table shows the measuring results for simulating liquid.

Frequency	Liquid	Temperature	Conductivity	Permittivity	Measurement
835	Head	21.6	0.929	43.1	Jun. 26, 2011
835	Head	21.6	0.895	41.1	Jul. 01, 2011
835	Body	21.7	0.963	54.5	Jun. 26, 2011
835	Body	21.6	0.961	54.1	Jul. 01, 2011
2450	Head	21.5	1.84	39.3	Jun. 28, 2011
2450	Head	21.5	1.8	38.4	Jun. 30, 2011
2450	Head	21.6	1.84	38.7	Jul. 02, 2011
2450	Body	21.5	2.02	53.9	Jun. 27, 2011
2450	Body	21.5	1.98	51.3	Jul. 01, 2011
2450	Body	21.6	1.98	51.3	Jul. 01, 2011
2450	Body	21.6	2.02	53.9	Jul. 04, 2011
2498.5	Head	21.5	1.86	38.2	Jun. 30, 2011
2501	Head	21.5	1.89	38.7	Jun. 30, 2011
2501	Body	21.4	2.06	54	Jun. 30, 2011
2498.5	Body	21.5	2.06	50.9	Jul. 01, 2011
2498.5	Body	21.6	2.08	53.8	Jul. 04, 2011
2501	Body	21.4	2.1	54	Jul. 04, 2011
2600	Head	21.5	1.98	38.3	Jun. 30, 2011
2600	Body	21.4	2.17	53.8	Jun. 30, 2011
2600	Body	21.4	2.23	53.8	Jul. 04, 2011

Table 6.3 Measuring Results for Simulating Liquid

7. Uncertainty Assessment

The component of uncertainly may generally be categorized according to the methods used to evaluate them. The evaluation of uncertainly by the statistical analysis of a series of observations is termed a Type An evaluation of uncertainty. The evaluation of uncertainty by means other than the statistical analysis of a series of observation is termed a Type B evaluation of uncertainty. Each component of uncertainty, however evaluated, is represented by an estimated standard deviation, termed standard uncertainty, which is determined by the positive square root of the estimated variance.

A Type A evaluation of standard uncertainty may be based on any valid statistical method for treating data. This includes calculating the standard deviation of the mean of a series of independent observations; using the method of least squares to fit a curve to the data in order to estimate the parameter of the curve and their standard deviations; or carrying out an analysis of variance in order to identify and quantify random effects in certain kinds of measurement.

A type B evaluation of standard uncertainty is typically based on scientific judgment using all of the relevant information available. These may include previous measurement data, experience and knowledge of the behavior and properties of relevant materials and instruments, manufacture's specification, data provided in calibration reports and uncertainties assigned to reference data taken from handbooks. Broadly speaking, the uncertainty is either obtained from an outdoor source or obtained from an assumed distribution, such as the normal distribution, rectangular or triangular distributions indicated in Table 7.1

Uncertainty Distributions	Normal	Rectangular	Triangular	U-Shape
Multi-plying Factor[(a)]	$1/k^{(b)}$	$1/\sqrt{3}$	$1/\sqrt{6}$	$1/\sqrt{2}$

(a) standard uncertainty is determined as the product of the multiplying factor and the estimated range of variations in the measured quantity

(b) κ is the coverage factor

Table 7.1 Standard Uncertainty for Assumed Distribution

The combined standard uncertainty of the measurement result represents the estimated standard deviation of the result. It is obtained by combining the individual standard uncertainties of both Type A and Type B evaluation using the usual "root-sum-squares" (RSS) methods of combining standard deviations by taking the positive square root of the estimated variances.

Expanded uncertainty is a measure of uncertainty that defines an interval about the measurement result within which the measured value is confidently believed to lie. It is obtained by multiplying the combined standard uncertainty by a coverage factor. Typically, the coverage factor ranges from 2 to 3. Using a coverage factor allows the true value of a measured quantity to be specified with a defined probability within the specified uncertainty range. For purpose of this document, a coverage factor two is used, which corresponds to confidence interval of about 95 %. The DASY uncertainty Budget is showed in Table 7.2.

Error Description	Uncertainty Value (±%)	Probability Distribution	Divisor	Ci (1g)	Standard Uncertainty (1g)
Measurement System					
Probe Calibration	5.5	Normal	1	1	± 5.5 %
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	0.3	Normal	1	1	± 0.3 %
Response Time	0.8	Rectangular	√3	1	± 0.5 %
Integration Time	2.6	Rectangular	√3	1	± 1.5 %
RF Ambient Noise	3.0	Rectangular	√3	1	± 1.7 %
RF Ambient Reflections	3.0	Rectangular	√3	1	± 1.7 %
Probe Positioner	0.4	Rectangular	√3	1	± 0.2 %
Probe Positioning	2.9	Rectangular	√3	1	± 1.7 %
Max. SAR Eval.	1.0	Rectangular	√3	1	± 0.6 %
Test Sample Related					
Device Positioning	2.9	Normal	1	1	± 2.9 %
Device Holder	3.6	Normal	1	1	± 3.6 %
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.)	2.5	Normal	1	0.64	± 1.6 %
Liquid Permittivity (Target)	5.0	Rectangular	√3	0.6	± 1.7 %
Liquid Permittivity (Meas.)	2.5	Normal	1	0.6	± 1.5 %
Combined Standard Uncertainty					± 10.7 %
Coverage Factor for 95 %					K = 2
Expanded Uncertainty					**± 21.4 %**

Table 7.2 Uncertainty Budget of DASY for frequency range 300 MHz to 3 GHz

8. SAR Measurement Evaluation

Each DASY system is equipped with one or more system validation kits. These units, together with the predefined measurement procedures within the DASY software, enable the user to conduct the system performance check and system validation. System validation kit includes a dipole, tripod holder to fix it underneath the flat phantom and a corresponding distance holder.

8.1 Purpose of System Performance check

The system performance check verifies that the system operates within its specifications. System and operator errors can be detected and corrected. It is recommended that the system performance check be performed prior to any usage of the system in order to guarantee reproducible results. The system performance check uses normal SAR measurements in a simplified setup with a well characterized source. This setup was selected to give a high sensitivity to all parameters that might fail or vary over time. The system check does not intend to replace the calibration of the components, but indicates situations where the system uncertainty is exceeded due to drift or failure.

8.2 System Setup

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

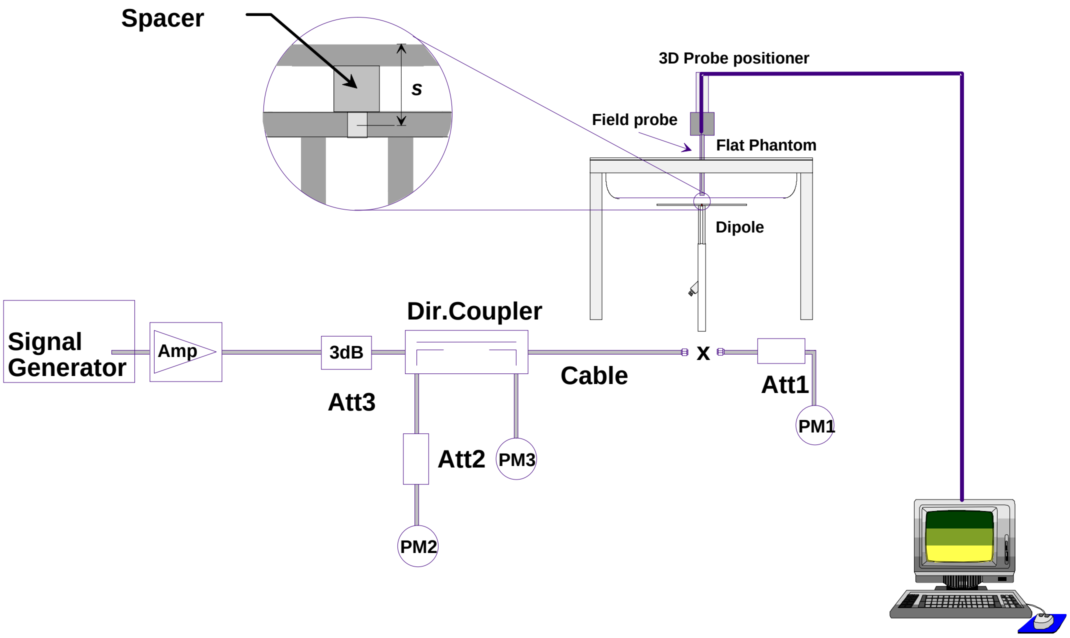


Fig 8.1 System Setup for System Evaluation

1. Signal Generator
2. Amplifier
3. Directional Coupler
4. Power Meter
5. Calibrated Dipole

The output power on dipole port must be calibrated to 24 dBm (250 mW) before dipole is connected.

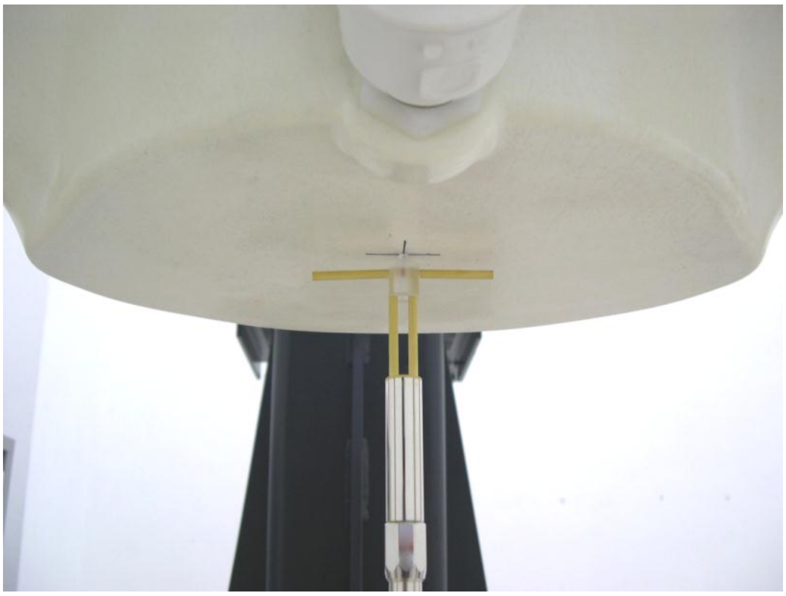


Fig 8.2 Photo of Dipole Setup

8.3 Validation Results

Comparing to the original SAR value provided by SPEAG, the validation data should be within its specification of 10 %. Table 8.1 shows the target SAR and measured SAR after normalized to 1W input power. The table below indicates the system performance check can meet the variation criterion and the plots can be referred to Appendix A of this report.

Measurement Date	Frequency (MHz)	Targeted SAR_{1g} (W/kg)	Measured SAR_{1g} (W/kg)	Deviation (%)
Jun. 26, 2011	835	9.650	2.480	2.80
Jul. 01, 2011	835	9.650	2.240	-7.15
Jun. 26, 2011	835	10.000	2.570	2.80
Jul. 01, 2011	835	10.000	2.440	-2.40
Jun. 28, 2011	2450	52.200	13.600	4.21
Jun. 30, 2011	2450	52.200	13.700	4.98
Jul. 02, 2011	2450	52.200	13.500	3.45
Jun. 27, 2011	2450	53.500	14.400	7.66
Jul. 01, 2011	2450	53.500	12.800	-4.30
Jul. 01, 2011	2450	53.500	13.800	3.18
Jul. 04, 2011	2450	53.500	14.000	4.67
Jun. 30, 2011	2600	58.500	13.500	-7.69
Jun. 30, 2011	2600	57.900	14.400	-0.52
Jul. 04, 2011	2600	57.900	14.800	2.25

Table 8.1 Target and Measurement SAR after Normalized

9. DUT Testing Position

This DUT was tested in ten different positions. They are right cheek, right tilted, left cheek, left tilted, Front Face of the DUT with phantom 1 cm gap, Rear Face of the DUT with phantom 1 cm gap, Top Side of the DUT with phantom 1 cm gap, Bottom Side of the DUT with phantom 1 cm gap, Right Side of the DUT with phantom 1 cm gap, and Left Side of the DUT with phantom 1 cm gap. as illustrated below:

1. Define two imaginary lines on the handset

(a) The vertical centerline passes through two points on the front side of the handset - the midpoint of the width w_t of the handset at the level of the acoustic output, and the midpoint of the width w_b of the bottom of the handset.

(b) The horizontal line is perpendicular to the vertical centerline and passes through the center of the acoustic output. The horizontal line is also tangential to the face of the handset at point A.

(c) The two lines intersect at point A. Note that for many handsets, point A coincides with the center of the acoustic output; however, the acoustic output may be located elsewhere on the horizontal line. Also note that the vertical centerline is not necessarily parallel to the front face of the handset, especially for clamshell handsets, handsets with flip covers, and other irregularly shaped handsets.

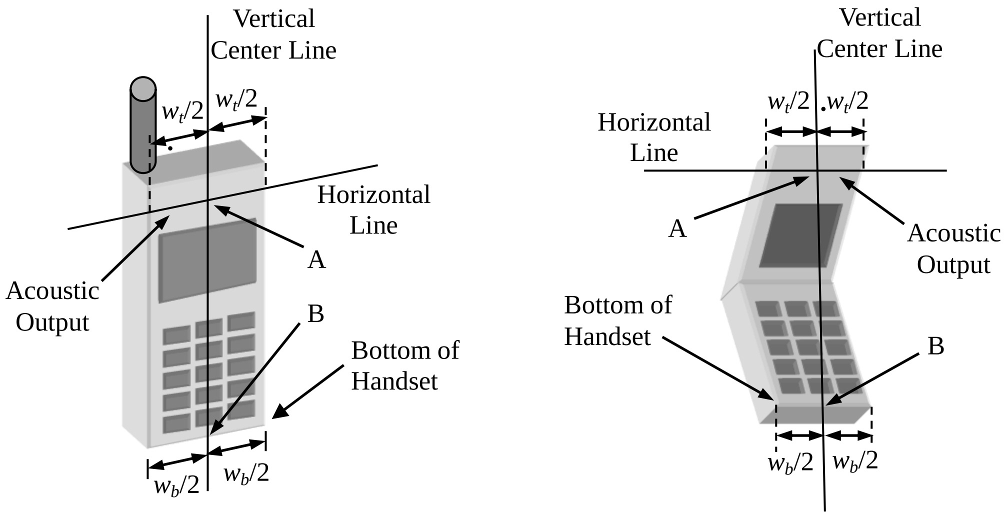


Fig 9.1 Illustration for Handset Vertical and Horizontal Reference Lines

2. **Cheek Position**

(a) To position the device with the vertical center line of the body of the device and the horizontal line crossing the center piece in a plane parallel to the sagittal plane of the phantom. While maintaining the device in this plane, align the vertical center line with the reference plane containing the three ear and mouth reference point (M: Mouth, RE: Right Ear, and LE: Left Ear) and align the center of the ear piece with the line RE-LE.

(b) To move the device towards the phantom with the ear piece aligned with the line LE-RE until the phone touched the ear. While maintaining the device in the reference plane and maintaining the phone contact with the ear, move the bottom of the phone until any point on the front side is in contact with the cheek of the phantom or until contact with the ear is lost (see Fig. 9.2).

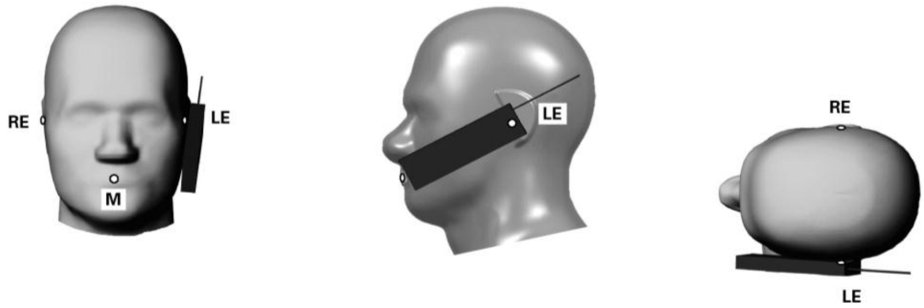


Fig 9.2 Illustration for Cheek Position

3. **Tilted Position**

(a) To position the device in the “cheek” position described above.

(b) While maintaining the device the reference plane described above and pivoting against the ear, moves it outward away from the mouth by an angle of 15 degrees or until contact with the ear is lost (see Fig. 9.3).

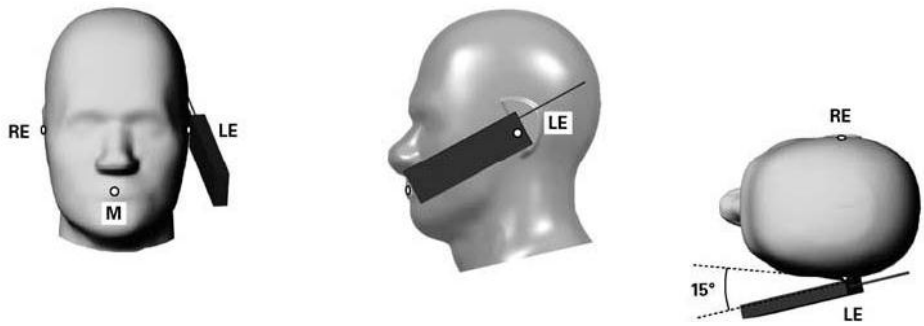


Fig 9.3 Illustration for Tilted Position

4. Body Worn Position

(a) To position the device parallel to the phantom surface.

(b) To adjust the device parallel to the flat phantom.

(c) To adjust the distance between the device surface and the flat phantom to 1.0 cm.

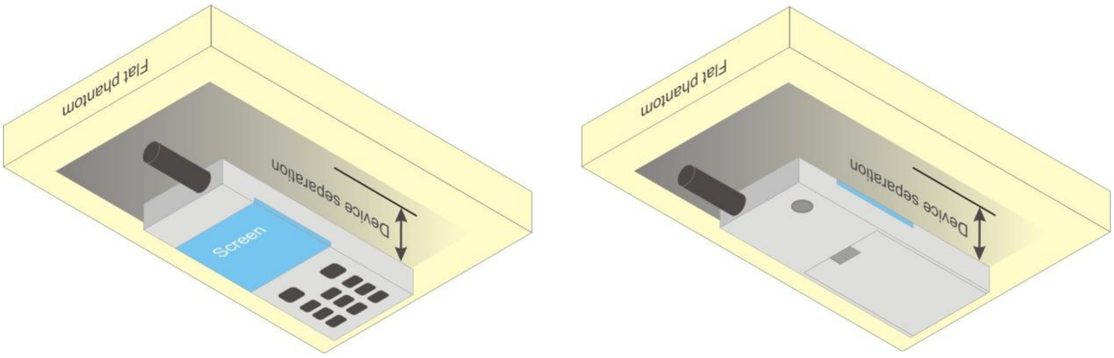


Fig 9.4 Illustration for Body Worn Position

5. DUT Setup Photos

Please refer to Appendix E for the test setup photos.

10. Measurement Procedures

The measurement procedures are as follows:

(a) For WWAN function, link DUT with base station emulator in highest power channel
(b) Set base station emulator to allow DUT to radiate maximum output power
(c) For WLAN function, using engineering software to transmit RF power continuously (continuous Tx) in the middle channel
(d) Measure output power through RF cable and power meter
(e) Place the DUT in the positions described in the last section
(f) Set scan area, grid size and other setting on the DASY software
(g) Taking data for the middle channel on each testing position
(h) Find out the largest SAR result on these testing positions of each band
(i) Measure SAR results for other channels in worst SAR testing position if the SAR of highest power channel is larger than 0.8 W/kg

According to the 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

10.1 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

10.2 Area & Zoom Scan Procedures

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 300 MHz to 3 GHz, and 8x8x8 points with step size 4, 4 and 2.5 mm for 3 GHz to 6 GHz. The Zoom Scan is performed around the highest E-field value to determine the averaged SAR-distribution over 10 g.

10.3 Volume Scan Procedures

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 DUT remain in the same test position for all measurements and all volume scan use the same spatial resolution and grid spacing (step-size is 4, 4 and 2.5 mm). When all volume scan were completed, the software, SEMCAD postprocessor can combine and subsequently superpose these measurement data to calculating the multiband SAR.

10.4 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.

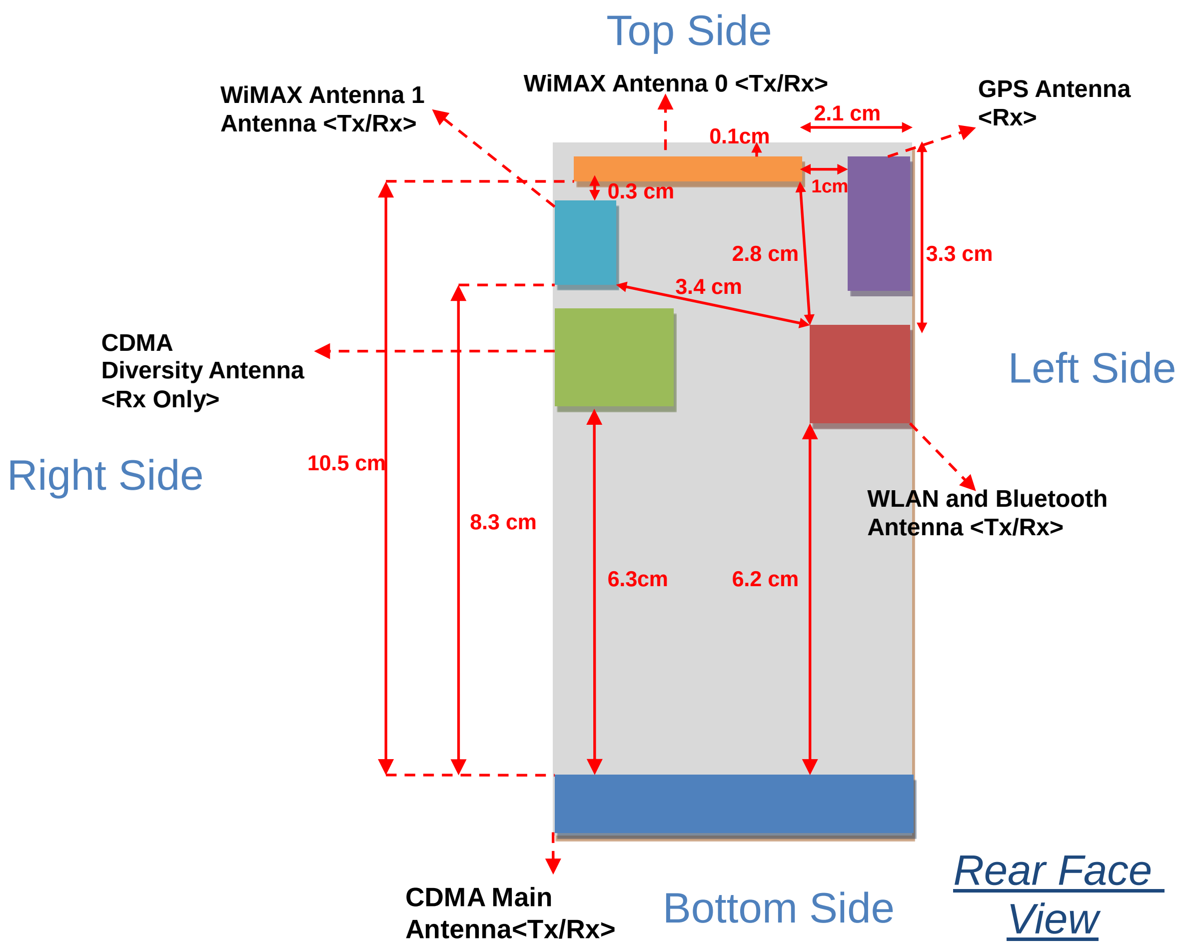
Extrapolation routines are used to obtain SAR values between the lowest measurement points and the inner phantom surface. The extrapolation distance is determined by the surface detection distance and the probe sensor offset. The uncertainty increases with the extrapolation distance. To keep the uncertainty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

10.5 Power Drift Monitoring

All SAR testing is under the DUT 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 DUT 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.

11. SAR Test Configurations

11.1 Exposure Positions Consideration



Antenna	Length	Width
WIMAX Antenna 0 (TX/RX)	2.9cm	0.6cm
WIMAX Antenna 1 (TX/RX)	2.0cm	1.0cm
CDMA Diversity (Rx Only)	2.2cm	1.9cm
CDMA MAIN (TX/RX)	6.3cm	1.1cm
WLAN&BT (TX/RX)	2.0cm	2.0cm
GPS (Rx Only)	2.8cm	1.3cm

WiMAX Antenna 0	WiMax 5M,10M (TX/RX), Ant 0
WiMAX Antenna 1	WiMax 5M,10M (TX/RX), Ant 1
CDMA Diversity	Diversity receiving only
CDMA Main	CDMA BC0 (Tx/Rx)
WLAN & BT antenna	WLAN and Bluetooth TX/RX
GPS antenna	GPS receiving only

Sides for SAR tests; Body-worn mode Test distance: 10 mm						
	Rear Face	Front Face	Top Side	Bottom Side	Right Side	Left Side
WiMax Ant 0	✓	✓	x	x	x	x
WiMax Ant 1	✓	✓	x	x	x	x
CDMA BC0	✓	✓	x	x	x	x
WLAN 11b/g/n 2.4GHz	✓	✓	x	x	x	x

Sides for SAR tests; Hotspot mode Test distance: 10 mm						
	Rear Face	Front Face	Top Side	Bottom Side	Right Side	Left Side
WiMax Ant 0	✓	✓	✓	X	✓	✓
WiMax Ant 1	✓	✓	✓	X	✓	X
CDMA BC0	✓	✓	X	✓	✓	✓
WLAN 11b/g/n 2.4GHz	✓	✓	X	X	X	✓

11.2 Simultaneous Transmitting Configurations

	Combinations	Head	Body-worn	Hotspot	Remark
1	CDMA BC 0 WLAN 2.4GHz	✓	✓	✓	1. In Head/Body-worn position, 1xRTT is mainly used for SAR tests. 2. In Hotspot mode, Ev-Do is mainly used for SAR tests.
2	WiMax 0 WLAN 2.4GHz	✓	✓	✓	1. For Head SAR, user may install some 3rd party software enabling WiMax in VOIP, and WLAN acts as router for other user's data connection at the same time.
3	CDMA BC 0, 1xRTT WiMax 0	✓	✓	✓	WiMax 0 and CDMA BC0 Ev-Do cannot transmit simultaneously.
4	CDMA BC 0, 1xRTT WiMax 1	✓	✓	✓	CDMA BC0 Ev-Do and WiMax 1 cannot transmit simultaneously.
5	WiMax 1 WLAN 2.4GHz	✓	✓	✓	1. For Head SAR, user may install some 3rd party software enabling WiMax in VOIP, and WLAN acts as router for other user's data connection at the same time.
6	WiMax 0 WiMax 1	x	x	x	WiMax 0 and WiMax 1 cannot transmit simultaneously.
7	CDMA BC 0, 1xRTT WiMax 0 WLAN 2.4GHz	✓	✓	x	In Hotspot mode, Ev-Do cannot transmit simultaneously with WiMax
8	CDMA BC 0, 1xRTT WiMax 1 WLAN 2.4GHz	✓	✓	x	In Hotspot mode, Ev-Do cannot transmit simultaneously with WiMax

12. SAR Test Results

12.1 Conducted Power (Unit: dBm)

<CDMA2000>

Band	BC0 (850)		
Channel	1013	384	777
Frequency (MHz)	824.70	836.52	848.31
1xRTT RC1+SO55	24.20	24.19	24.25
1xRTT RC3+SO55	24.14	24.10	24.12
1xRTT RC3+SO32 (FCH)	24.11	24.13	24.09
1xRTT RC3+SO32 (SCH)	24.01	23.98	23.99
1xEVDO RTAP 153.6	24.19	24.20	24.18
1xEVDO RETAP 4096	24.22	24.24	24.23

Note:

1. According to KDB 941225 D01, Head SAR for RC1-SO55 is not required because the maximum average output power of RC1 is less than 1/4 dB higher than RC3-SO55.
2. Referring to KDB 941225 D01, the CDMA Handset Body SAR tests based on RC3+SO32. RC1, RTAP (REV 0), and RETAP (Rev A) power are all less than 1/4 dB higher than RC3, thus SAR tests in these mode are not necessary.
3. Referring to KDB 941225 D01, in hotspot mode DUT is treated as data device and SAR is tested with RTAP 153.6kbps (Ev-Do). If RC3+SO32 power is less than 1/4dB higher than Ev-Do, SAR tests with RC3+SO32 setting are not necessary.

<WLAN>

Band	802.11b			802.11g		
Channel	1	6	11	1	6	11
Frequency (MHz)	2412	2437	2462	2412	2437	2462
Power	18.89	18.52	17.96	11.85	11.92	11.48

Band	802.11n (BW 20MHz)		
Channel	1	6	11
Frequency (MHz)	2412	2437	2462
Power	11.87	11.92	11.25

Note:

1. Per KDB 248227, choose 11b mode to test SAR; 11g and 11n output power is less than 11b mode, and SAR can be excluded.
2. Per 2010/4 TCB workshop, choose the highest output power channel to test SAR and determine further SAR exclusion, and 11b CH1 is chosen here.

Channel	Frequency	Bluetooth RF Peak Output Power		
		Data Rate / Modulation		
		GFSK	π/4-DQPSK	8-DPSK
		1Mbps	2Mbps	3Mbps
Ch00	2402MHz	0.21	3.00	0.81
Ch39	2441MHz	1.99	4.82	2.49
Ch78	2480MHz	0.97	3.78	1.37

Note:

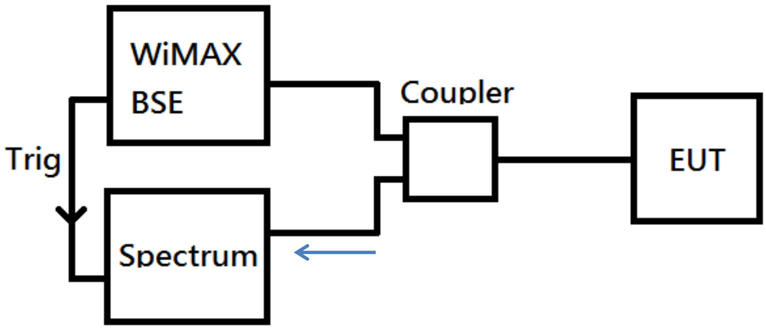
The data rate was set in 2Mbps for all the test items due to the highest RF output power.

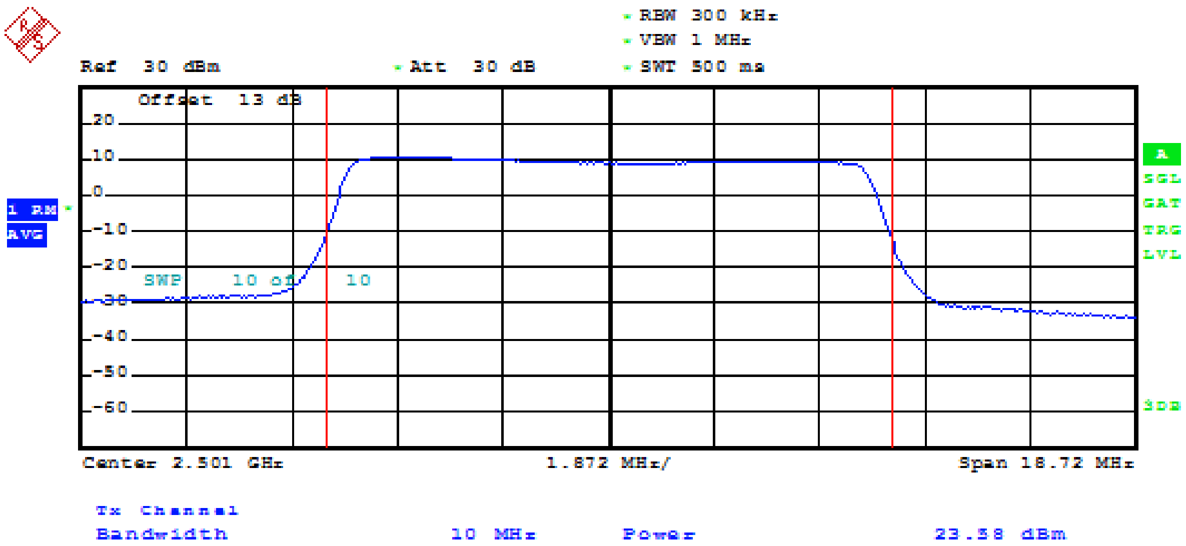
<WIMAX>

The WiMax signal bandwidth is 5MHz and 10MHz, therefore we follow “KDB971168 power measurement with bandwidths greater than 1 MHz” to measure average power.

The WiMax connection between DUT and WiMax communication tester E6651A is setup, and we use the directional coupler to split the DUT output signal to spectrum analyzer.

1. Set frequency = nominal signal center frequency.
2. Connect E6651A “Trigger Out” to Spectrum analyzer “Trigger In”, set Gated-Trigger function in Spectrum analyzer
3. Set span = 2 X occupied bandwidth.
4. Set resolution bandwidth ≈ 1~ 5% of the span, we set 300 kHz here.
5. VBW ≥ 3 X RBW, we set 1MHz here
6. Select RMS detector
7. Sweep time= 500ms with 501 points, averaging over 10 sweeps
8. Compensate the cable loss and read the average power in 5MHz/10MHz





Zone Type	Modulation	Coding Rate	Frequency	Ant-0 (Main Antenna)			Ant-1 (Aux. Antenna)		
				Peak Power	Average Power	PAPR	Peak Power	Average Power	PAPR
PUSC	QPSK (BW 5MHz)	1/2	2498.5	31.78	23.90	7.88	31.90	23.94	7.96
			2593.0	31.58	23.34	8.24	31.38	23.34	8.04
			2687.5	30.97	23.29	7.68	30.97	23.29	7.68
		3/4	2498.5	31.85	23.89	7.96	31.83	23.87	7.96
			2593.0	31.41	23.21	8.20	31.29	23.25	8.04
			2687.5	30.93	23.25	7.68	30.96	23.28	7.68
	16QAM (BW 5MHz)	1/2	2498.5	31.87	23.83	8.04	31.86	23.82	8.04
			2593.0	31.31	23.11	8.20	31.14	23.18	7.96
			2687.5	30.85	23.05	7.80	30.92	23.20	7.72
		3/4	2498.5	31.92	23.76	8.16	31.97	23.81	8.16
			2593.0	31.24	23.00	8.24	31.11	23.07	8.04
			2687.5	30.80	22.92	7.88	30.92	23.08	7.84
	QPSK (BW 10MHz)	1/2	2501.0	31.74	23.42	8.32	31.90	23.58	8.32
			2593.0	31.26	22.94	8.32	31.33	23.09	8.24
			2685.0	31.28	23.16	8.12	31.14	23.22	7.92
		3/4	2501.0	31.67	23.35	8.32	31.83	23.47	8.36
			2593.0	31.22	22.86	8.36	31.40	23.08	8.32
			2685.0	31.08	23.00	8.08	31.17	23.21	7.96
	16QAM (BW 10MHz)	1/2	2501.0	31.64	23.36	8.28	31.81	23.53	8.28
			2593.0	31.24	22.92	8.32	31.35	23.07	8.28
			2685.0	31.08	23.00	8.08	31.16	23.16	8.00
		3/4	2501.0	31.57	23.25	8.32	31.77	23.45	8.32
			2593.0	31.09	22.77	8.32	31.28	22.96	8.32
			2685.0	30.93	22.85	8.08	31.06	23.06	8.00

Note: An Anritsu wideband power meter was used for measuring the conducted power.

Scaling Factor Deriving

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±1 dBm.
The maximum rated output power of 5M BW is 24 dBm (251.19 mW).
Maximum power in 5M control traffic is 73.88 mW (5/17 of 251.19 mW).
Scaling Factor = (3 * 73.88+ 15 * 251.19) / (15 * 245.47)
= 3989.49 / 3682.05 = 1.08

For Ant-0 (Main Antenna)

Zone Type	Modulation	Coding Rate	Frequency (MHz)	Average Power for Ant-0 (Main Antenna) (dBm)	Average Power for Ant-0 (Main Antenna) (mW)	Scaling Factor
PUSC	QPSK (BW 5MHz)	1/2	2498.5	23.90	245.47	1.08
			2593.0	23.34	215.77	1.23
			2687.5	23.29	213.30	1.25
		3/4	2498.5	23.89	244.91	1.09
			2593.0	23.21	209.41	1.27
			2687.5	23.25	211.35	1.26
	16QAM (BW 5MHz)	1/2	2498.5	23.83	241.55	1.10
			2593.0	23.11	204.64	1.30
			2687.5	23.05	201.84	1.32
		3/4	2498.5	23.76	237.68	1.12
			2593.0	23.00	199.53	1.33
			2687.5	22.92	195.88	1.36

For Ant-1 (Aux. Antenna)

Zone Type	Modulation	Coding Rate	Frequency (MHz)	Average Power for Ant-1 (Aux. Antenna) (dBm)	Average Power for Ant-1 (Aux. Antenna) (mW)	Scaling Factor
PUSC	QPSK (BW 5MHz)	1/2	2498.5	23.94	247.74	1.07
			2593.0	23.34	215.77	1.23
			2687.5	23.29	213.30	1.25
		3/4	2498.5	23.87	243.78	1.09
			2593.0	23.25	211.35	1.26
			2687.5	23.28	212.81	1.25
	16QAM (BW 5MHz)	1/2	2498.5	23.82	240.99	1.10
			2593.0	23.18	207.97	1.28
			2687.5	23.20	208.93	1.27
		3/4	2498.5	23.81	240.44	1.11
			2593.0	23.07	202.77	1.31
			2687.5	23.08	203.24	1.31

<Scaling Factor for 10MHz BW>

This device is power class 2 device and the maximum power tolerance is 23±1 dBm.
The maximum rated output power of 10M BW is 24 dBm (251.19 mW).
Maximum power in 10M control traffic is 35.88 mW (5/35 of 251.19 mW).
Scaling Factor = (3 * 35.88 + 15 * 251.19) / (15 * 219.79)
= 3875.49 / 3296.85 = 1.18

For Ant-0 (Main Antenna)

Zone Type	Modulation	Coding Rate	Frequency (MHz)	Average Power for Ant-0 (Main Antenna)		Scaling Factor
				(dBm)	(mW)	
PUSC	QPSK (BW 10MHz)	1/2	2501.0	23.42	219.79	1.18
			2593.0	22.94	196.79	1.31
			2685.0	23.16	207.01	1.25
		3/4	2501.0	23.35	216.27	1.19
			2593.0	22.86	193.20	1.34
			2685.0	23.00	199.53	1.29
	16QAM (BW 10MHz)	1/2	2501.0	23.36	216.77	1.19
			2593.0	22.92	195.88	1.32
			2685.0	23.00	199.53	1.29
		3/4	2501.0	23.25	211.35	1.22
			2593.0	22.77	189.23	1.37
			2685.0	22.85	192.75	1.34

For Ant-1 (Aux. Antenna)

Zone Type	Modulation	Coding Rate	Frequency (MHz)	Average Power for Ant-1 (Aux. Antenna)		Scaling Factor
				(dBm)	(mW)	
PUSC	QPSK (BW 10MHz)	1/2	2501.0	23.58	228.03	1.13
			2593.0	23.09	203.70	1.27
			2685.0	23.22	209.89	1.23
		3/4	2501.0	23.47	222.33	1.16
			2593.0	23.08	203.24	1.27
			2685.0	23.21	209.41	1.23
	16QAM (BW 10MHz)	1/2	2501.0	23.53	225.42	1.15
			2593.0	23.07	202.77	1.27
			2685.0	23.16	207.01	1.25
		3/4	2501.0	23.45	221.31	1.17
			2593.0	22.96	197.70	1.31
			2685.0	23.06	202.30	1.28

<Scaling Up SAR>

Calculating used follow scheme for scale up SAR.
Scaled SAR = Measured SAR * Scaling Factor

12.2 Test Records for Head SAR Test

<CDMA2000>

Plot No.	Band	Mode	Test Position	Ch.	SAR_{1g} (W/kg)	SAR_{10g} (W/kg)
53	CDMA2000 BC0	RC3+SO55	Right Cheek	1013	0.337	**0.256**
54	CDMA2000 BC0	RC3+SO55	Right Tilted	1013	0.199	**0.157**
55	**CDMA2000 BC0**	**RC3+SO55**	**Left Cheek**	**1013**	**0.388**	**0.285**
56	CDMA2000 BC0	RC3+SO55	Left Tilted	1013	0.187	**0.147**
57	CDMA2000 BC0	RC3+SO55	Left Cheek	1013	0.293	**0.211**

Note:

1. According to KDB 941225 D01, Head SAR for RC1-SO55 is not required because the maximum average output power of RC1 is less than 1/4 dB higher than RC3-SO55.
2. If the highest output channel SAR for each exposure position is < 0.8 W/kg, other channels SAR tests are not necessary.

<WLAN>

Plot No.	Band	Test Position	Ch.	Battery	SAR_{1g} (W/kg)	SAR_{10g} (W/kg)
76	**802.11b**	**Right Cheek**	**1**	**1**	**0.094**	**0.045**
77	802.11b	Right Tilted	1	1	0.057	0.03
78	802.11b	Left Cheek	1	1	0.087	0.041
79	802.11b	Left Tilted	1	1	0.058	0.027
80	802.11b	Right Cheek	1	2	0.092	0.043

Note:

Per KDB 447498 and KDB 248227, if the 1st measured SAR < 0.8W/kg and remaining channels SAR tests can be excluded.

<WIMAX>

Plot No.	Modulation	Coding Rate	BW (MHz)	Frequency (MHz)	Test Position	WiMAX Ant.	Battery	SAR_{1g} (W/kg)	Scaling Factor	Scaling SAR
11	QPSK	1/2	5	2498.5	Right Cheek	0	1	0.311	1.08	0.336
12	QPSK	1/2	5	2498.5	Right Tilted	0	1	0.346	1.08	0.374
13	QPSK	1/2	5	2498.5	Left Cheek	0	1	0.474	1.08	0.512
14	**QPSK**	**1/2**	**5**	**2498.5**	**Left Tilted**	**0**	**1**	**0.532**	**1.08**	**0.575**
15	QPSK	1/2	5	2498.5	Left Tilted	0	2	0.437	1.08	0.472
1	QPSK	1/2	10	2501.0	Right Cheek	0	1	0.3	1.18	0.354
2	QPSK	1/2	10	2501.0	Right Tilted	0	1	0.332	1.18	0.392
3	QPSK	1/2	10	2501.0	Left Cheek	0	1	0.393	1.18	0.464
4	QPSK	1/2	10	2501.0	Left Tilted	0	1	0.446	1.18	0.526
5	QPSK	1/2	10	2501.0	Left Tilted	0	2	0.439	1.18	0.518
16	QPSK	1/2	5	2498.5	Right Cheek	1	1	0.124	1.07	0.133
17	QPSK	1/2	5	2498.5	Right Tilted	1	1	0.1	1.07	0.107
18	QPSK	1/2	5	2498.5	Left Cheek	1	1	0.27	1.07	0.289
19	QPSK	1/2	5	2498.5	Left Tilted	1	1	0.186	1.07	0.199
20	QPSK	1/2	5	2498.5	Left Cheek	1	2	0.268	1.07	0.287
6	QPSK	1/2	10	2501.0	Right Cheek	1	1	0.116	1.13	0.131
7	QPSK	1/2	10	2501.0	Right Tilted	1	1	0.087	1.13	0.098
8	**QPSK**	**1/2**	**10**	**2501.0**	**Left Cheek**	**1**	**1**	**0.305**	**1.13**	**0.345**
9	QPSK	1/2	10	2501.0	Left Tilted	1	1	0.197	1.13	0.223
10	QPSK	1/2	10	2501.0	Left Cheek	1	2	0.302	1.13	0.341

Remark:

1 The WiMAX SAR test reduction is referred Oct 2010 TCB Workshop RF Exposure Procedures Update.

a. Use the lowest coding rate for each modulation when the same rated maximum output applies to all coding rates in a modulation
b. Test higher coding rates only if the rated maximum output is higher
c. Use the scaled SAR to determine test reduction (< 0.8 W/kg etc.). The remaining 2 channels SAR are not necessary due to 1st tested channel SAR < 0.8W/kg.
d. For each channel bandwidth, if 16QAM maximum output power is <= 1/4 dB higher than QPSK and QPSK SAR is < 0.8 W/kg, 16QAM SAR is not needed

12.3 Test Records for Body-worn SAR Test

<CDMA2000>

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Ch.	Battery	Ear-phone	SAR_{1g} (W/kg)
70	CDMA2000 BC0	RC3+SO32	Front Face	1	384	1	v	0.266
74	**CDMA2000 BC0**	**RC3+SO32**	**Rear Face**	**1**	**384**	**1**	**v**	**0.761**
66	CDMA2000 BC0	RC3+SO32	Rear Face	1	384	2	v	0.759

Note:
1. For Body-worn configuration, SAR evaluated for Front Face and Rear Face.
2. Referring to KDB 941225 D01, the CDMA Handset Body SAR tests based on RC3+SO32. RC1, RTAP (REV 0), and RETAP (Rev A) power are all less than 1/4 dB higher than RC3, thus SAR tests in these mode are not necessary.

<WLAN>

Plot No.	Band	Test Position	Separation Distance (cm)	Ch.	Battery	Ear-phone	SAR_{1g} (W/kg)
93	802.11b	Front Face	1	1	1	v	0.038
87	**802.11b**	**Rear Face**	**1**	**1**	**1**	**v**	**0.139**

<WIMAX>

Plot No.	Modulation	Coding Rate	BW (MHz)	Frequency (MHz)	Test Position	Separation Distance(cm)	WiMAX Ant	Battery	Ear-phone	SAR1g (W/kg)	Scaling Factor	Scaling SAR
89	QPSK	1/2	5	2498.5	Front Face	1	0	1	v	0.125	1.08	0.135
43	**QPSK**	**1/2**	**5**	**2498.5**	**Rear Face**	**1**	**0**	**1**	**v**	**0.62**	**1.08**	**0.670**
44	QPSK	1/2	5	2498.5	Rear Face	1	0	2	v	0.578	1.08	0.624
90	QPSK	1/2	10	2501.0	Front Face	1	0	1	v	0.111	1.18	0.131
27	QPSK	1/2	10	2501.0	Rear Face	1	0	1	v	0.543	1.18	0.641
28	QPSK	1/2	10	2501.0	Rear Face	1	0	2	v	0.486	1.18	0.573
92	QPSK	1/2	5	2498.5	Front Face	1	1	1	v	0.052	1.07	0.056
51	**QPSK**	**1/2**	**5**	**2498.5**	**Rear Face**	**1**	**1**	**1**	**v**	**0.443**	**1.07**	**0.474**
91	QPSK	1/2	10	2501.0	Front Face	1	1	1	v	0.045	1.13	0.051
35	QPSK	1/2	10	2501.0	Rear Face	1	1	1	v	0.314	1.13	0.355

Remark:
1. For Body-worn, SAR tests performed for Front Face and Rear Face, with test distance 1cm to the phantom.
2. The WiMax SAR test reduction is referred Oct 2010 TCB Workshop RF Exposure Procedures Update.
   a. Use the lowest coding rate for each modulation when the same rated maximum output applies to all coding rates in a modulation
   b. Test higher coding rates only if the rated maximum output is higher
   c. Use the scaled SAR to determine test reduction (< 0.8 W/kg etc.). The remaining 2 channels SAR are not necessary due to 1st tested channel SAR < 0.8W/kg.
   d. For each channel bandwidth, if 16QAM maximum output power is <= 1/4 dB higher than QPSK and QPSK SAR is < 0.8 W/kg, 16QAM SAR is not needed

12.4 Test Records for Hotspot SAR Test

<CDMA2000>

Plot No.	Band	Mode	Test Position	Separation Distance (cm)	Ch.	Battery	SAR_{1g} (W/kg)
58	CDMA2000 BC0	RTAP 153.6	Front Face	1	384	1	0.525
59	CDMA2000 BC0	RTAP 153.6	Rear Face	1	384	1	0.949
60	CDMA2000 BC0	RTAP 153.6	Left Side	1	384	1	0.567
61	CDMA2000 BC0	RTAP 153.6	Right Side	1	384	1	0.377
62	CDMA2000 BC0	RTAP 153.6	Top Side	1	384	1	0.023
63	CDMA2000 BC0	RTAP 153.6	Bottom Side	1	384	1	0.213
64	CDMA2000 BC0	RTAP 153.6	Rear Face	1	1013	1	0.763
65	**CDMA2000 BC0**	**RTAP 153.6**	**Rear Face**	**1**	**777**	**1**	**1.03**
67	CDMA2000 BC0	RTAP 153.6	Rear Face	1	777	2	0.993
68	CDMA2000 BC0	RTAP 153.6	Rear Face	1	1013	2	0.745
69	CDMA2000 BC0	RTAP 153.6	Rear Face	1	384	2	0.953

Note:

1. Referring to KDB 941225 D06, the WWAN Antenna SAR for hotspot mode of Front Face / Rear Face / Right Side / Left Side / Bottom Side are needed due to the antenna location is within 2.5 cm from the edge.

2. SAR data of Top side is submitted voluntarily.

3. Referring to KDB 941225 D01, in hotspot mode DUT is treated as data device and SAR is tested with RTAP 153.6kbps (Ev-Do). If RC3+SO32 power is less than 1/4dB higher than Ev-Do, SAR tests with RC3+SO32 setting are not necessary.

<WLAN>

Plot No.	Band	Test Position	Separation Distance (cm)	Ch.	Battery	SAR_{1g} (W/kg)
81	802.11b	Front Face	1	1	1	0.014
82	802.11b	Rear Face	1	1	1	0.18
83	802.11b	Top Side	1	1	1	0.034
84	802.11b	Bottom Side	1	1	1	0.022
85	**802.11b**	**Left Side**	**1**	**1**	**1**	**0.313**
86	802.11b	Right Side	1	1	1	0.0032
88	802.11b	Left Side	1	1	2	0.223

Note:

1. Referring to KDB 941225 D06, the WLAN Antenna SAR for hotspot mode of Front Face / Rear Face / Left Side are needed, due to the antenna location is within 2.5 cm from the edge.

2. SAR data of Top side, Right Side, and Bottom Side is submitted voluntarily.

<WIMAX>

Plot No.	Modulation	Coding Rate	BW (MHz)	Frequency (MHz)	Test Position	Separation Distance(cm)	WiMAX Ant	Battery	SAR1g (W/kg)	Scaling Factor	Scaling SAR
37	QPSK	1/2	5	2498.5	Front Face	1	0	1	0.139	1.08	0.150
38	**QPSK**	**1/2**	**5**	**2498.5**	**Rear Face**	**1**	**0**	**1**	**0.561**	**1.08**	**0.606**
39	QPSK	1/2	5	2498.5	Left Side	1	0	1	0.035	1.08	0.038
40	QPSK	1/2	5	2498.5	Right Side	1	0	1	0.129	1.08	0.139
41	QPSK	1/2	5	2498.5	Top Side	1	0	1	0.348	1.08	0.376
42	QPSK	1/2	5	2498.5	Bottom Side	1	0	1	0.024	1.08	0.026
21	QPSK	1/2	10	2501.0	Front Face	1	0	1	0.107	1.18	0.126
22	QPSK	1/2	10	2501.0	Rear Face	1	0	1	0.444	1.18	0.524
23	QPSK	1/2	10	2501.0	Left Side	1	0	1	0.027	1.18	0.032
24	QPSK	1/2	10	2501.0	Right Side	1	0	1	0.114	1.18	0.135
25	QPSK	1/2	10	2501.0	Top Side	1	0	1	0.278	1.18	0.328
26	QPSK	1/2	10	2501.0	Bottom Side	1	0	1	0.021	1.18	0.025
45	QPSK	1/2	5	2498.5	Front Face	1	1	1	0.072	1.07	0.077
46	**QPSK**	**1/2**	**5**	**2498.5**	**Rear Face**	**1**	**1**	**1**	**0.452**	**1.07**	**0.484**
47	QPSK	1/2	5	2498.5	Left Side	1	1	1	0.02	1.07	0.021
48	QPSK	1/2	5	2498.5	Right Side	1	1	1	0.276	1.07	0.295
49	QPSK	1/2	5	2498.5	Top Side	1	1	1	0.067	1.07	0.072
50	QPSK	1/2	5	2498.5	Bottom Side	1	1	1	0.02	1.07	0.021
52	QPSK	1/2	5	2498.5	Rear Face	1	1	2	0.446	1.07	0.477
29	QPSK	1/2	10	2501.0	Front Face	1	1	1	0.051	1.13	0.058
30	QPSK	1/2	10	2501.0	Rear Face	1	1	1	0.388	1.13	0.438
31	QPSK	1/2	10	2501.0	Left Side	1	1	1	0.017	1.13	0.019
32	QPSK	1/2	10	2501.0	Right Side	1	1	1	0.247	1.13	0.279
33	QPSK	1/2	10	2501.0	Top Side	1	1	1	0.053	1.13	0.060
34	QPSK	1/2	10	2501.0	Bottom Side	1	1	1	0.022	1.13	0.025
36	QPSK	1/2	10	2501.0	Rear Face	1	1	2	0.329	1.13	0.372

Remark:

1. For Hotspot mode, SAR is necessary for all surfaces/edges with antenna 2.5cm or less from that surface or edge.
2. Therefore, for WiMax Antenna 0, SAR tests were performed for Front Face, Rear Face, Top side, Left Side and Right side, with test distance 1cm to the phantom. SAR data for Bottom side is submitted voluntarily.
3. Therefore, for WiMax Antenna 1, SAR tests were performed for Front Face, Rear Face, Top side, and Right side, with test distance 1cm to the phantom. SAR data for Left side and Bottom Side is submitted voluntarily.
4. The WiMAX SAR test reduction is referred Oct 2010 TCB Workshop RF Exposure Procedures Update.
   a. Use the lowest coding rate for each modulation when the same rated maximum output applies to all coding rates in a modulation
   b. Test higher coding rates only if the rated maximum output is higher
   c. Use the scaled SAR to determine test reduction (< 0.8 W/kg etc.). The remaining 2 channels SAR are not necessary due to 1^{st} tested channel SAR < 0.8W/kg.
   d. For each channel bandwidth, if 16QAM maximum output power is <= 1/4 dB higher than QPSK and QPSK SAR is < 0.8 W/kg, 16QAM SAR is not needed

12.5 Linearity Response Check

<Setup and Calculation Procedure>

Put DUT at the worst case SAR position/channel for each bandwidth/modulation. Use the Agilent E6651A to configure the device to transmit at specified power and check by spectrum analyzer.

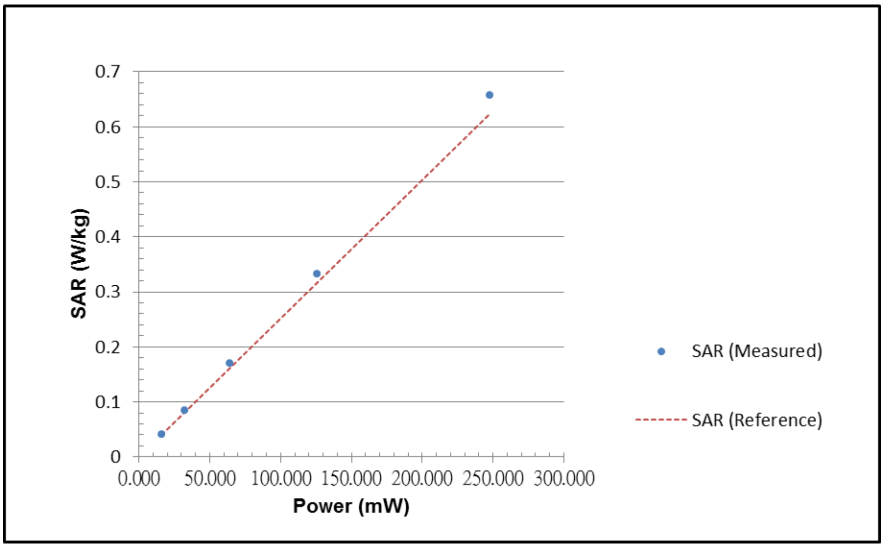
The power decreasing step is 3dB, commanded via E6615A.Checking output power on spectrum analyzer via directional coupler, the 3dB-down command was not leading exactly 3dB power drop; the actual power decrement is record to achieve correct linearity check.

The SAR data readings were measured using multimeter function of the SAR system software.

SAR linearity was measured for the zone type, bandwidth, and modulation performed in the SAR tests in this report.16QAM is excluded in this SAR report per 2010/10 TCB workshop, the 16 QAM power is less than 1/4dB higher than QPSK and QPSK SAR < 0.8W/kg; therefore linearity check for 16QAM is not required.

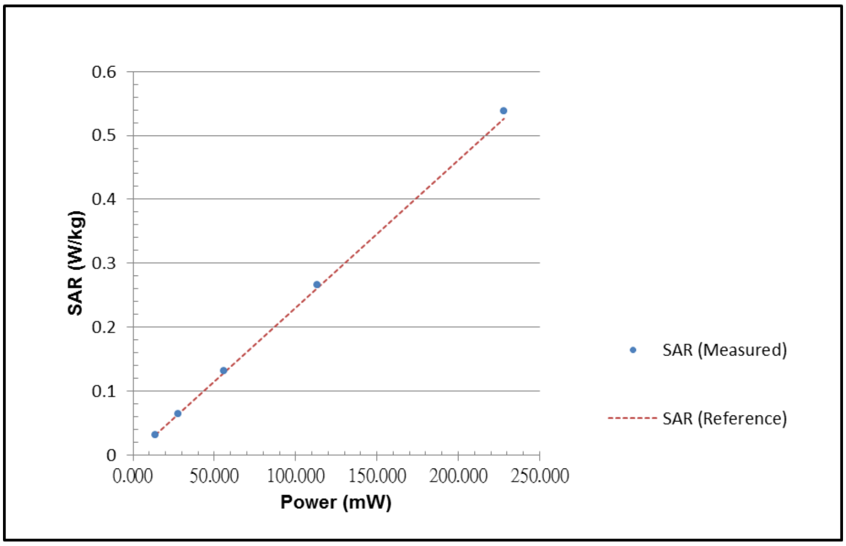
<For PUSC, QPSK, 1/2, BW 5M >

Average Power (mW)	15.885	32.137	64.565	125.603	247.742
Single Point SAR (W/kg)	0.04	0.084	0.17	0.332	0.658
Reference Line (W/kg)	0.040	0.081	0.163	0.316	0.624
Deviation (%)	0.00	3.81	4.57	4.97	5.48



<For PUSC, QPSK, 1/2, BW 10M>

Average Power (mW)	13.868	27.606	56.105	113.240	228.034
Single Point SAR (W/kg)	0.032	0.065	0.132	0.266	0.538
Reference Line (W/kg)	0.032	0.064	0.129	0.261	0.526
Deviation (%)	0.00	2.04	1.96	1.80	2.24



<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.

12.6 Compare with Different Scan Resolution

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

Scan Resolution (mm)	Measured SAR_{1g} (W/kg)
5.0	0.67
2.5	0.687

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

12.7 Simultaneous Multi-band Transmission

<Maximum SAR list for each band and position>

<Dual-antennas simultaneously transmission - Hotspot>

	CDMA BC0_EVDO	Wimax 10M_Ant0	Wimax 10M_Ant1	Wimax 5M_Ant0	Wimax 5M_Ant1	802.11b/g	Max. SAR Summation	Hot Spot Separation	SPLSR
Front Face	**0.525**	0.126	0.058	0.150	0.077	**0.014**	**0.54**	N/A	N/A
Rear Face	**1.03**	0.524	0.438	0.606	0.484	**0.18**	**1.21**	N/A	N/A
Left Side	**0.567**	0.032	0.019	0.038	0.021	**0.313**	**0.88**	N/A	N/A
Right Side	**0.377**	0.135	0.279	0.139	0.295	**0.0032**	**0.38**	N/A	N/A
Top Side	0.023	0.328	0.060	**0.376**	0.072	**0.034**	**0.41**	N/A	N/A
Bottom Side	**0.213**	0.025	0.025	0.026	0.021	**0.022**	**0.24**	N/A	N/A

<Tri-antennas simultaneously transmission - Head>

	CDMA BC0_1XRTT	Wimax 10M_Ant0	Wimax 10M_Ant1	Wimax 5M_Ant0	Wimax 5M_Ant1	802.11b/g	Max. SAR Summation	Hot Spot Separation	SPLSR
Right Cheek	**0.337**	**0.354**	0.131	0.336	0.133	**0.094**	**0.79**	N/A	N/A
Right Tilted	**0.199**	**0.392**	0.098	0.374	0.107	**0.057**	**0.65**	N/A	N/A
Left Cheek	**0.388**	0.464	0.345	**0.512**	0.289	**0.087**	**0.99**	N/A	N/A
Left Tilted	**0.187**	0.526	0.223	**0.575**	0.199	**0.058**	**0.82**	N/A	N/A

<Tri-antennas simultaneously transmission – Body-Worn>

	CDMA BC0_1XRTT	Wimax 10M_Ant0	Wimax 10M_Ant1	Wimax 5M_Ant0	Wimax 5M_Ant1	802.11b/g	Max. SAR Summation	Hot Spot Separation	SPLSR
Front Face	**0.266**	0.131	0.051	**0.135**	0.056	**0.038**	**0.44**	N/A	N/A
Rear Face	**0.761**	0.641	0.355	**0.670**	0.474	**0.139**	**1.57**	N/A	N/A

Note:

1 The maximum SAR summation is calculated based on the same configuration and test position.

2 For 1g-SAR scalar summation < 1.6W/kg, simultaneous SAR measurement is not necessary

3 According to KDB 648474, the simultaneous transmission SAR for WWAN and BT was not required, because the closest separation distance of these antennas (6.2 cm) is larger than 5 cm and the output power of Bluetooth (4.82 dBm) is less than 2PRef (13.8 dBm).

4 According to KDB 648474, the simultaneous transmission SAR for WiMax and BT was not required, because the closest separation distance of these antennas (2.8 cm) is > 2.5 cm; while and the output power of Bluetooth (4.82 dBm) is less than PRef (10.8 dBm).

5 WLAN and BT share the same antenna. Furthermore, Bluetooth standalone SAR and WLAN/ Bluetooth simultaneous transmission SAR are not required because the Bluetooth power (4.82 dBm) is less than P_{Ref} (10.8 dBm) and WLAN SAR is less than 1.2 W/kg.

6 Per Note 3/4/5 above, Bluetooth standalone and simultaneous SAR can be excluded.

13. References

[1] FCC 47 CFR Part 2 “Frequency Allocations and Radio Treaty Matters; General Rules and Regulations”

[2] IEEE Std. C95.1-1991, “IEEE Standard for Safety Levels with Respect to Human Exposure to Radio Frequency Electromagnetic Fields, 3 kHz to 300 GHz”, 1991

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

[4] FCC OET Bulletin 65 (Edition 97-01) Supplement C (Edition 01-01), “Evaluating Compliance with FCC Guidelines for Human Exposure to Radiofrequency Electromagnetic Fields”, June 2001

[5] SPEAG DASY System Handbook

[6] FCC KDB 248227 D01 v01r02, “SAR Measurement Procedures for 802.11 a/b/g Transmitters”, May 2007

[7] FCC KDB 447498 D01 v04, “Mobile and Portable Device RF Exposure Procedures and Equipment Authorization Policies”, November 2009

[8] FCC KDB 616217 D03 v01, “SAR Evaluation Considerations for Laptop/Notebook/Netbook and Tablet Computers”, November 2009

[9] FCC KDB 648474 D01 v01r05, “SAR Evaluation Considerations for Handsets with Multiple Transmitters and Antennas”, September 2008

[10] FCC KDB 941225 D01 v02, “SAR Measurement Procedures for 3G Devices – CDMA 2000 / Ev-Do / WCDMA / HSDPA / HSPA”, October 2007

[11] FCC KDB 941225 D06 v01 "SAR Evaluation Procedures for Portable Devices with Wireless Router Capabilities", April 2011.

[12] FCC KDB 615223 D01 v01 "802.16e/WiMax SAR Measurement Guidance", November 2009.

Appendix A. Plots of System Performance Check

The plots are shown as follows.

Appendix B. Plots of SAR Measurement

The plots are shown as follows.

Appendix C. DASY Calibration Certificate

The DASY calibration certificates are shown as follows.