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http://www.digitalemc.com

Dates of Tests: November 06, 2008~ March 06, 2009
Test Report S/N:DR50110902D-r3
Test Site : DIGITAL EMC CO., LTD.

SAR TEST REPORT

FCC ID	**V7MSWU-3120**
APPLICANT	**SEOWON INTECH CO., LTD.**

FCC Classification:	**Licensed Non-Broadcast Station Transmitter (TNB)**
EUT Type:	**WiMAX USB Modem (Wave 1)**
Model Name:	**SWU-3120**
Modulation Technology	**OFDMA**
Duplex Method	**TDD**
Test Device Serial No.:	**Identical prototype**
TX Frequency Range:	**2506 ~ 2685 MHz (5 &10 MHz OBW)**
RX Frequency Range:	**2506 ~ 2685 MHz (5 &10 MHz OBW)**
Max. SAR Measurement:	**0.728 mW/g Body SAR**
Max. RF Output Power	**0.248 W EIRP (23.95 dBm)**
Application Type:	**FCC Certification**
Rule Part(s):	**§2.1093, FCC/OET Bulletin 65 Supplement C[July 2001]**
Data of issue:	**June 29, 2009**

This wireless portable device has been shown to be capable of compliance for localized specific absorption rate (SAR) for uncontrolled environment/general population exposure limits specified in ANSI/IEEE Std. C95.1-1992 and had been tested in accordance with the measurement procedures specified in FCC/OET Bulletin 65 Supplement C (2001) and IEEE Std. 1528-2003.

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

Tested by : Sun-Kyu Ryu (Engineer)

Reviewed by : Harvey Sung (Chief Engineering Director)

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1. INTROCUCTION/SAR DEFINITION

In 1974, the International Radiation Protection Association (IRPA) formed a working group on non-ionizing radiation (NIR), which examined the problems arising in the field of Protection against the various types of NIR. At the IRPA Congress in Paris in 1977, this working group because the International Non-Ionizing Radiation Committee (INIRC).

In cooperation with the Environmental Health Division of the World Health Organization (WHO), the IRPA/INIRC developed a number of health criteria documents on NIR as part of WHO'S Environmental Health Criteria Programme, sponsored by the United Nations Environment Programme (UNEP). Each document includes an overview of the physical characteristics, measurement and instrumentation, sources, and applications of NIR, a thorough review of the literature on biological effects, and an evaluation of the health risks of exposure to NIR. These health criteria have provided the scientific database for the subsequent development of exposure limits and codes of practice relating to NIR.

At the Eighth International Congress of the IRPA (Montreal, 18-22 May 1992), a new, independent scientific organization-the International Commission on Non-Ionizing Radiation Protection (ICNIRP)-was established as a successor to the IRPA/INIRC. The functions of the Commission are to investigate the hazards that may be association with the different forms of NIR, develop international guidelines on NIR exposure to static and extremely-low-frequency (ELF) electric and magnetic field have been reviewed by UNEP/WHO/IRPA (1984, 1987). Those publications and a number of others, including UNEP/WHO/IRPA (1993) and Allen et al. (1991), provided the scientific rationale for these guidelines.

A glossary of terms appears in the Appendix.

SAR Definition

Specific Absorption Rate (SAR) is defined as the time derivative (rate) of the incremental energy (dU) absorbed by (dissipated in) an incremental mass (dm) contained in a volume element (dV) of a given density (ρ) It is also defined as the rate of RF energy absorption per unit mass at a point in an absorbing body (see Fig. 1.1)

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

Figure 1.1
SAR Mathematical Equation

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

$$SAR = E^2 / \rho$$

Where:

σ = conductivity of the tissue-simulant material (S/m)
ρ = mass density of the tissue-simulant material (kg/m3)
E = Total RMS electric field strength (V/m)

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

2. SAR MEASUREMENT SETUP

Robotic System

Measurements are performed using the DASY4 automated dosimetric assessment system. The DASY4 is made by Schmid & Partner Engineering AG (SPEAG) in Zurich, Switzerland and consists of high precision robotics system (Staubli), robot controller, Pentium III computer, near-field probe, probe alignment sensor, and the generic twin phantom containing the brain equivalent material. The robot is a six-axis industrial robot performing precise movements to position the probe to the location (points) of maximum electromagnetic field (EMF) (see Fig. 2.1).

System Hardware

A cell controller system contains the power supply, robot controller, teach pendant (Joystick), and a remote control used to drive the robot motors. The PC consists of the Micron Pentium IV 500 MHz computer with Windows NT system and SAR Measurement Software DASY4, A/D interface card, monitor, mouse, and keyboard. The Staubli Robot is connected to the cell controller to allow software manipulation of the robot. A data acquisition electronic (DAE) circuit that performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. is connected to the Electro-optical coupler (EOC). The EOC performs the conversion from the optical into digital electric signal of the DAE and transfers data to the PC plug-in card.

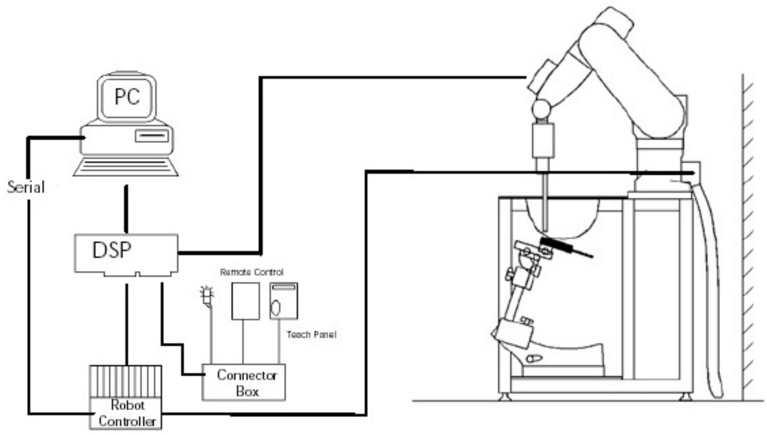


Figure 2.1 SAR Measurement System Setup

System Electronics

The DAE3 consists of a highly sensitive electrometer-grade preamplifier with auto-zeroing, a channel and gain-switching multiplexer, a fast 16 bit AD-converter and a command decoder and control logic unit. Transmission to the PC-card is accomplished through an optical downlink for data and status information and an optical uplink for commands and clock lines. The mechanical probe mounting device includes two different sensor systems for frontal and sidewise probe contacts. They are also used for mechanical surface detection and probe collision detection. The robot uses its own controller with a built in VME-bus computer. The system is described in detail in [7].

3. SAR MEASUREMENT SETUP

Probe Measurement System

Figure 3.1 DAE System

The SAR measurements were conducted with the dosimetric probe ET3DV6,designed in the classical triangular configuration [7] (see Fig. 3.2) and optimized for dosimetric evaluation. The probe is constructed using the thick film technique; with printed resistive lines on ceramic substrates. The probe is equipped with an optical multifiber line ending at the front of the probe tip (see Fig. 3.3). It is connected to the EOC box on the robot arm and provides an automatic detection of the phantom surface. Half of the fibers are connected to a pulsed infrared transmitter, the other half to a synchronized receiver. As the probe approaches the surface, the reflection from the surface produces a coupling from the transmitting to the receiving fibers. This reflection increases first during the approach, reaches maximum and then decreases. If the probe is flatly touching the surface, the coupling is zero. The distance of the coupling maximum to the surface is independent of the surface reflectivity and largely independent of the surface to probe angle. The DASY4 software reads the reflection during a software approach and looks for the maximum using a 2nd order fitting (see Fig.3.1). The approach is stopped at reaching the maximum.

Probe Specifications

Calibration : In air from 10 MHz to 6.0 GHz

In brain and muscle simulating tissue at

Frequencies of 2600 MHz, 3500 MHz

Frequency : 10 MHz to 6 GHz

Linearity : ±0.2dB (30 MHz to 6 GHz)

Dynamic : 10 mW/Kg to 100 W/Kg

Range : Linearity: ±0.2 dB

Dimensions: Overall length: 330 mm

Tip length : 20 mm

Body diameter :12 mm

Tip diameter: 2.5 mm

Distance from probe tip to sensor center: 1 mm

Application: SAR Dosimetry Testing

Compliance tests of mobile phones

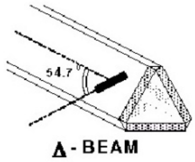


Figure 3.1 Triangular Probe Configuration

Figure 3.2 Probe Thick-Film Technique

4. Probe Calibration Process

Dosimetric Assessment Procedure

Each probe is calibrated according to a dosimetric assessment procedure described in [8] with accuracy better than +/- 10 %. The spherical isotropy was evaluated with the procedure described in [9] and found to be better than +/- 0.25 dB. The sensitivity parameters (NormX, NormY, NormZ), the diode compression parameter (DCP) and the conversion factor (ConvF) of the probe is tested.

Free Space Assessment

The free space E-field from amplified probe outputs is determined in a test chamber. This is performed in a TEM cell for frequencies below 1 GHz (see Fig. 4.1), and in a waveguide above 1GHz for free space. For the free space calibration, the probe is placed in the volumetric center of the cavity at the proper orientation with the field. The probe is then rotated 360 degrees.

Temperature Assessment *

E-field temperature correlation calibration is performed in a flat phantom filled with the appropriate simulated brain tissue. The measured free space E-field in the medium correlates to temperature rise in a dielectric medium. For temperature correlation calibration a RF transparent thermistor-based temperature probe is used in conjunction with the E-field probe (see Fig. 4.2).

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

where:

Δt = exposure time (30 seconds),

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

ΔT = temperature increase due to RF exposure.

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

where:

σ = simulated tissue conductivity,

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

SAR is proportional to $\Delta T / \Delta t$, the initial rate of tissue heating, before thermal diffusion takes place. Now it's possible to quantify the electric field in the simulated tissue by equating the thermally derived SAR to the E- field;

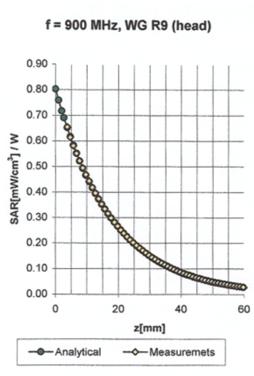


Figure 4.1 E-Field and Temperature Measurements at 900 MHz[7]

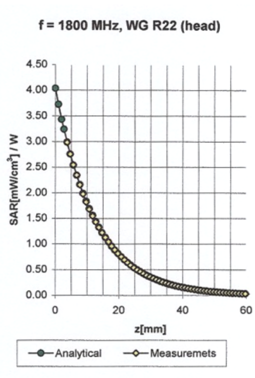


Figure 4.2 E-Field and Temperature Measurements at 1900 MHz[7]

5. PHANTOM & EQUIVALENT TISSUES

SAM Phantom

Figure 5.1 SAM Twin Phantom

The SAM Twin Phantom V4.0 is constructed of a fiberglass shell integrated in a wooden table. The shape of the shell is based on data from an anatomical study designed to determine the maximum exposure in at least 90 % of all users [11][12]. It enables the dosimetric evaluation of left and right hand phone usage as well as body mounted usage at the flat phantom region. A cover prevents the evaporation o f the liquid. Reference markings on the Phantom allow the complete setup of all predefined phantom positions and measurement grids by manually teaching three points in the robot. (see Fig. 5.1)

Brain & Muscle Simulating Mixture Characterization

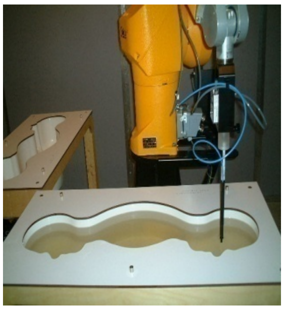


Figure 5.2 Simulated Tissue

The brain and muscle mixtures consist of a viscous gel using hydroxethyl cellullose (HEC) gelling agent and saline solution (see Table 6.1). Preservation with a bacteriacide is added and visual inspection is made to make sure air bubbles are not trapped during the mixing process. The mixture is calibrated to obtain proper dielectric constant (permittivity) and conductivity of the desired tissue. The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 have been incorporated in the following table. Other head and body tissue parameters that have not bee specified in P1528 are derived from the issue dielectric parameters computed from he 4-Cole-Cole equations The mixture characterizations used for the brain and muscle tissue simulating liquids are according to the data by C. Gabriel and G. Hartsgrove [13].(see Fig. 5.2)

Table 5.1 Composition of the Muscle Tissue Equivalent Matter

Ingredient	Brain Simulating Liquid 2600 MHz(HSL-2600)	Muscle Simulating Liquid 2600 MHz(MSL-2600)
Water	51.39 %	69.83 %
DGMBE	48.61 %	30.17 %
Salt	N/A	N/A
Dielectric Parameters at 22 ℃	F=2600 MHz ε= 39.01 %± 5 % σ= 1.96 ± 5% S/m	F=2600 MHz ε= 52.5 %± 5 % σ= 2.16 ± 5 % S/m

Device Holder for Transmitters

Figure 5.2 Mounting Device

In combination with the SAM Twin Phantom V4.0, the Mounting Device (see Fig. 5.2) enables the rotation of the mounted transmitter in spherical coordinates where by the rotation point is the ear opening. The devices can be easily, accurately, and repeatably be positioned according to the FCC specifications. The device holder can be locked at different phantom locations (left head, right head, flat phantom).

- Note: A simulating human hand is not used due to the complex anatomical and geometrical structure of the hand that may produce infinite number of configurations [12]. To produce the worst-case condition (the hand absorbs antenna output power), the hand is omitted during the tests.

6. TEST SYSTEM SPECIFICATIONS

Automated Test System Specifications

Positioner

Robot: Stäubli Unimation Corp. Robot Model: RX60L

Repeatability: 0.02 mm

No. of axis: 6

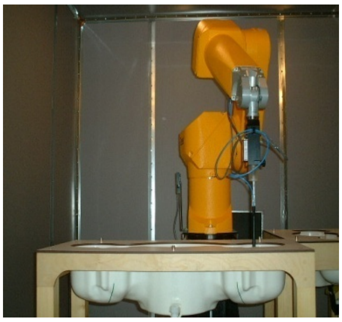


Figure 6.1 DASY4 Test System

Data Acquisition Electronic (DAE) System

Cell Controller

Processor: Pentium 4 CPU

Clock Speed: 3 GHz

Operating System: Window 2000

Data Card: DASY4 PC-Board

Data Converter

Features: Signal, multiplexer,A/D converter. & control logic

Software: DASY4

Connecting Lines : Optical downlink for data and status info

Optical uplink for commands and clock

PC Interface Card

Function: 24 bit (64 MHz) DSP for real time processing

Link to DAE 3

16 bit A/D converter for surface detection system

serial link to robot

direct emergency stop output for robot

E-Field Probes

Model: EX3DV4 S/N: 3643

Construction: Triangular core fiber optic detection system

Frequency: 10 MHz to 6 GHz

Linearity: ±0.2 dB(30 MHz to 6 GHz)

Phantom

Phantom: SAM Twin Phantom (V4.0)

Shell Material : Vivac Composite

Thickness: 2.0 ± 0.2 mm

7. DOSIMETRIC ASSESSMENT & PHANTOM SPECS

Measurement Procedure

The evaluation was performed using the following procedure:

1. The SAR measurement was taken at a selected spatial reference point to monitor power variations during testing. This fixed location point was measured and used as a reference value.
2. The SAR distribution at the exposed side of the head was measured at a distance of 3.9 mm from the Inner surface of the shell. The area covered the entire dimension o f the head and the horizontal grid spacing was 15 mm x 15 mm.
3. Based on the area scan data, the area of the maximum absorption was determined by spline interpolation. Around this point, a volume of 32 mm x 32 mm x 30 mm (fine resolution volume scan, zoom scan) was assessed by measuring 5 x 5 x 7 points. On this basis of this data set, the spatial peak SAR value was evaluated with the following procedure (see Fig. 7.1):

a. The data at the surface was extrapolated, since the center of the dipoles is 2.7 mm away from the tip of the probe and the distance between the surface and the lowest measuring point is 1.2 mm. The extrapolation was based on a least square algorithm [15]. A polynomial of the fourth order was calculated through the points in z-axes. This polynomial was then used to evaluate the points between the surface and the probe tip.

b. The maximum interpolated value was searched with a straight-for war dalgorithm. Around this maximum the SAR values averaged over the spatial volumes (1 g or 10 g) were computed using the 3D-Spline interpolation algorithm. The 3D-spline is composed of three one-dimensional splines with the "Not a knot" condition (in x, y, and z directions) [15][16]. The volume was integrated with the trapezoidal algorithm. One thousand points (10 x 10 x 10) were interpolated to calculate the average.

c. All neighboring volumes were evaluated until no neighboring volume with a higher average value was found.

4. The SAR reference value, at the same location as procedure #1, was re-measured. If the value changed by more than 5 %, the evaluation is repeated.

Specific Anthropomorphic Mannequin (SAM) Specifications

The phantom for handset SAR assessment testing is a low-loss dielectric shell, with shape and dimensions derived from the anthropometric data of the 90th percentile adult male head dimensions as tabulated by the US Army. The SAM Twin Phantom shell is bisected along the mid-sagittal plane into right and left halves (see Fig. 7.2). The perimeter sidewalls of each phantom halves are extended to allow filling with liquid to a depth that is sufficient to minimized reflections from the upper surface. The liquid depth is maintained at a minimum depth of 15 cm to minimize reflections from the upper surface.

Figure 7.2 SAM Twin Phantom shell

8. DEFINITION OF REFERENCE POINTS

EAR Reference Point

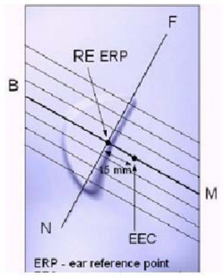


Figure 8.2 Close-up side view of ERPs

Figure 8.1 shows the front,, back and side views of the SAM Twin Phantom. The point "M" is the reference point for the center of the mouth, "LE" is the left ear reference point(ERP), and "RE" is the right ERP. The ERPs are 15 mm posterior to the entrance to the Ear canal (EEC) along the B-M line (Back-Mouth), as shown in Figure 9.2. The plane Passing through the two ear canals and M is defined as the Reference Plane. The line N-F (Neck- Front) is perpendicular to the reference plane and passing through the RE (or LE) is called the Reference Pivoting Line (see Figure 8.2). Line B-M is perpendicular to the N-F line. Both N-F and B-M lines are marked on the external phantom shell to facilitate handset positioning [5]

Figure 8.1 Front, back and side view of SAM Twin Phantom

Handset Reference Points

Two imaginary lines on the handset were established: the vertical centerline and the horizontal line. The test device was placed in a normal operating position with the "test device reference point" located along the "vertical centerline" on the front of the device aligned to the "ear reference point" (See Fig. 8.3). The "test device reference point" was than located at the same level as the center of the ear reference point. The test device was positioned so that the "vertical centerline" was bisecting the front surface of the handset at it's top and bottom edges, positioning the "ear reference point" on the outer surface of the both the left and right head phantoms on the ear reference point.

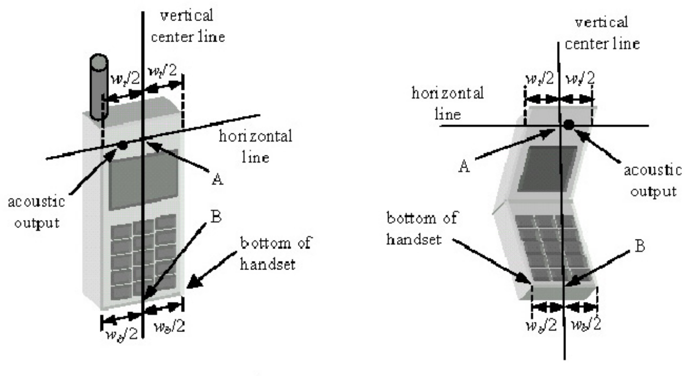


Figure 8.3 Handset Vertical Center & Horizontal Line Reference Points

9. DESCRIPTION OF SUPPORTED UNITS

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

- Supported Units

NO.	PRODUCT	BRAND	MODEL NO.	SERIAL NO.	FCC ID
1	LAPTOP	TOSHIBA	L310	48346917W	FCC DoC Approved
2	Vector Signal Generator	Rohde Schwarz	SMJ100A	100148	N/A
3	WCM TEST TOOL	GCT	N/A	V1.66	N/A
4	DM TEST TOOL	GCT	N/A	V1.95	N/A

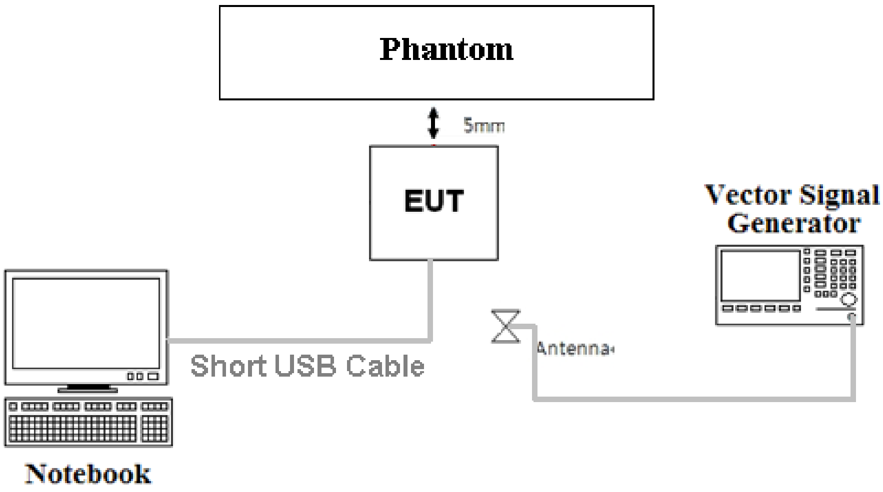
- Accessory

NO.	USB Cable (Length)
1	USB Extension Cable (12 cm)

10. TEST SETUP AND TEST SINGAL DETAIL (Continued)

The test set-up is shown in the below picture. The WiMAX USB Modem(EUT) is plugged to the USB port of the notebook computer using the short USB extension cable. The WCM v1.66 and the DM test tool v1.95 on the notebook computer are used for this SAR testing. The WCM test tool is just for display connection status between notebook computer and EUT. The DM test tool is used to control maximum transmitting power, frequency selection and TX/RX status.

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



The EUT is 2.5 GHz WiMAX transceiver using GCT chipset which supports antenna structure for 1 TX and 2 RX. Only one antenna is used for both transmitting and receiving while the other antenna is strictly used for RX diversity. The EUT has capable of both 10 MHz and 5 MHz uplink bandwidths. For the 10 MHz bandwidth of AMC zone format, it has 48 sub-channels structured from 1024 subcarriers; 160 are used as spare/safeguard subcarriers, leaving 864 available for transmission. From this, 768 subcarriers for data transmission with 96 subcarriers intended for pilot use.

For the 5 MHz bandwidth of AMC zone, it contains 24 sub-channels using 512 subcarriers; 80 subcarriers as spare/safeguard subcarriers, 384 for data transmission, and 48 for pilot.

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

10. TEST SETUP AND TEST SINGAL DETAIL(Continued)

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

The VSG produces a downlink burst every 5 milliseconds which simulates the transmission of a BS operating under normal mode. This downlink burst instructs the MS to transmit for 15 symbols in the UL data zone. This UL transmission is repeated every 5 milliseconds. The transmitting power of the MS is set to maximum power.

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

The VSG is loaded with a BS (Base Station) downlink signal which contains the 29:18 information. The mobile station synchronizes to the signal from the VSG in frequency and time and then demodulates two maps contained in the VSG DL frame. The first map, called the DL map, specifies the number of DL symbols(29). The second map, called the UL map, specifies the number of UL symbols(18). The UL map also tells the MS to transmit a burst which occupies all data symbols and all sub-channels. No control channel transmissions are requested by the VSG. Measurements were taken in this configuration with the MS transmitting using the 29:18 ratio, but since there was no energy in the control symbols, the effective power is only across 15 symbols.

As mentioned above the DL:UL frame is specified in the DL and UL maps respectively. There is no ranging present when there is data traffic. The other types of control traffic are HARQ ACK/NACK, CQICH(CINR reporting) and bandwidth(BW) requests. BW requests are piggy-backed onto the data symbols when traffic is present. Since the BW requests are shared across the Control Symbols (traffic versus non-traffic modes) and control symbols can be supported only in PUSC zone, the control traffic that is relevant to the SAR calculation is CQICH and HARQ ACK/NACK. So the conducted maximum power for this control traffic is 5/35 of 240.4 mW(23.81 dBm) for 10 MHz and 5/17 of 233.3 mW(23.68 dBm) for 5 MHz.

10. TEST SETUP AND TEST SINGAL DETAIL(Continued)

In the test mode in AMC zone format, the UL operates with all data sub-channels(48 sub-channels for 10MHz) occupied with data. During normal operation the MS will transmit on all sub-channels when maximum UL throughput is required. It is possible for the MS to will transmit fewer sub-channels

For the signal from the VSG, it looks identical to the signal that would come from a BS in the field. The intent is to make the think it is in EUT a real network. The transmission from the EUT under test conditions is exactly the same as in the field in normal operation. The only difference is that normally in the field there will be information in some of the control symbols, whereas SAR tests were performed with not having the information in the some control symbols. So it is necessary to calculate a scaling factor that takes into consideration this fact.
You will see a calculation, scaling factor from the measurements (the measurements were taken under a channel configuration of 29:18, without control symbols) to a network configuration using 29:18. This is also calculated for 10MHz and 5MHz bandwidth channels.

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

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

10. TEST SETUP AND TEST SINGAL DETAIL(Continued)

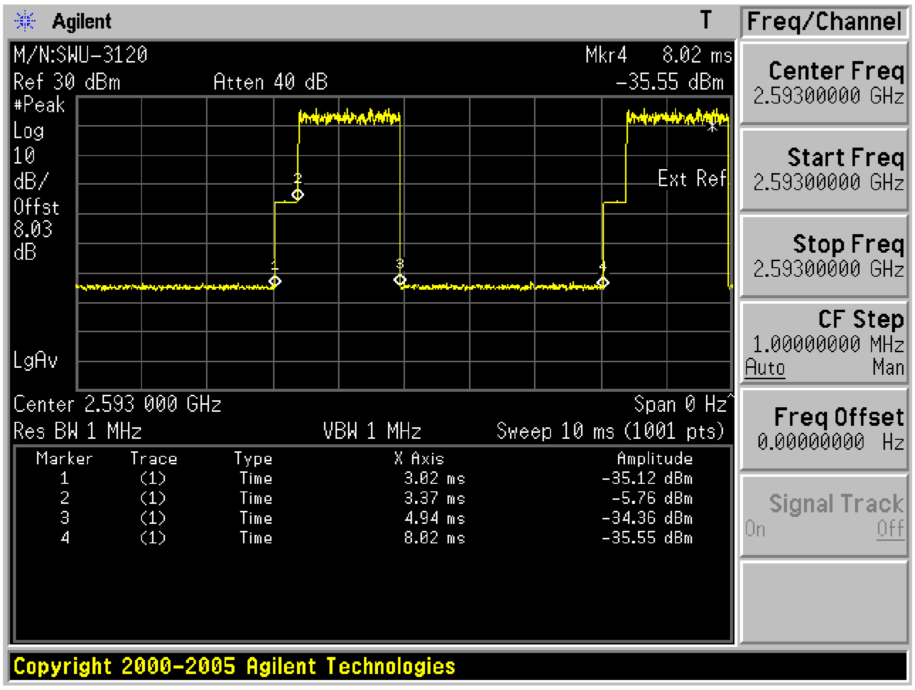
There is a quiet time between the DL and UL transmission and a quiet time between the UL and DL transmission. During these quiet intervals the Base Station is neither transmitting nor receiving. The unoccupied symbols become part of this quiet time.

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

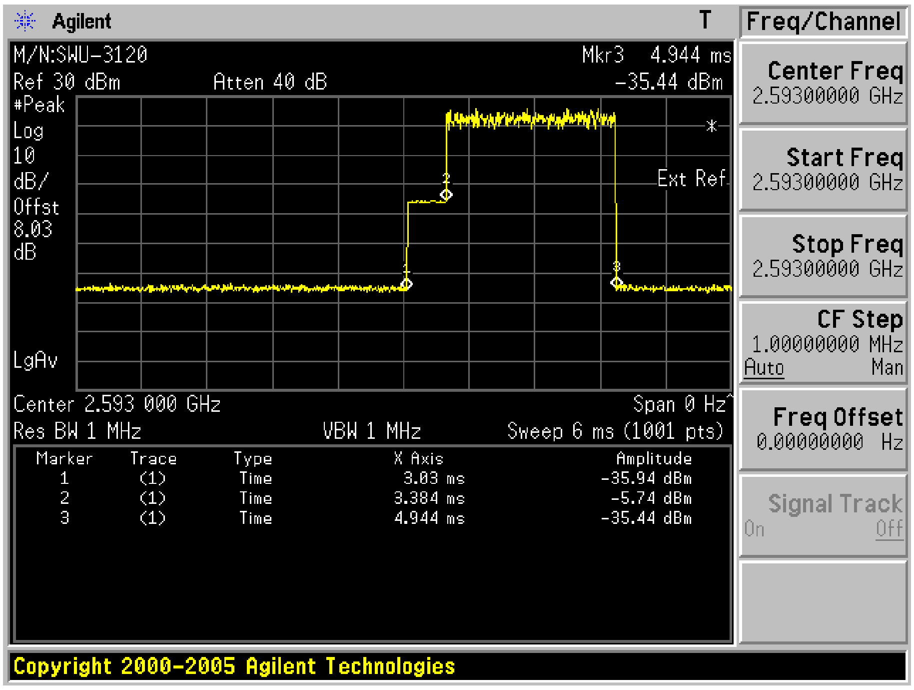
10. TEST SETUP AND TEST SINGAL DETAIL (Continued)

Actual Duty Cycle VS Theoretically Calculated Duty Cycle

AMC_QPSK 1/2(Plot 1)



AMC_QPSK 1/2(Plot 2)



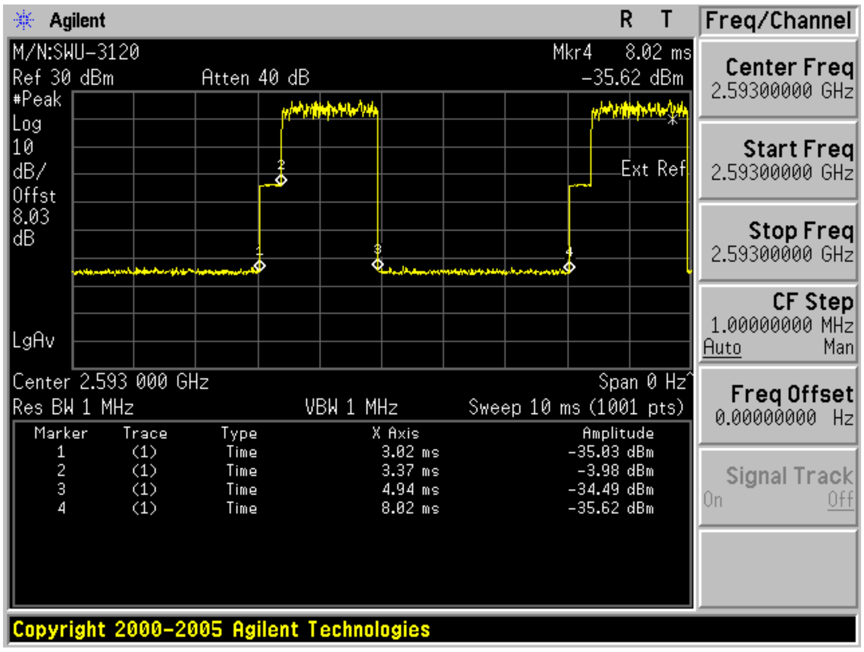
Burst length (Plot 1) = Mark 4 – Mark 1 = 8.02 ms – 3.02 ms = 5 ms

15 uplink symbol length (Plot 2) = Mark 3 – Mark 2= 4.944 ms – 3.384 ms = 1.56 ms

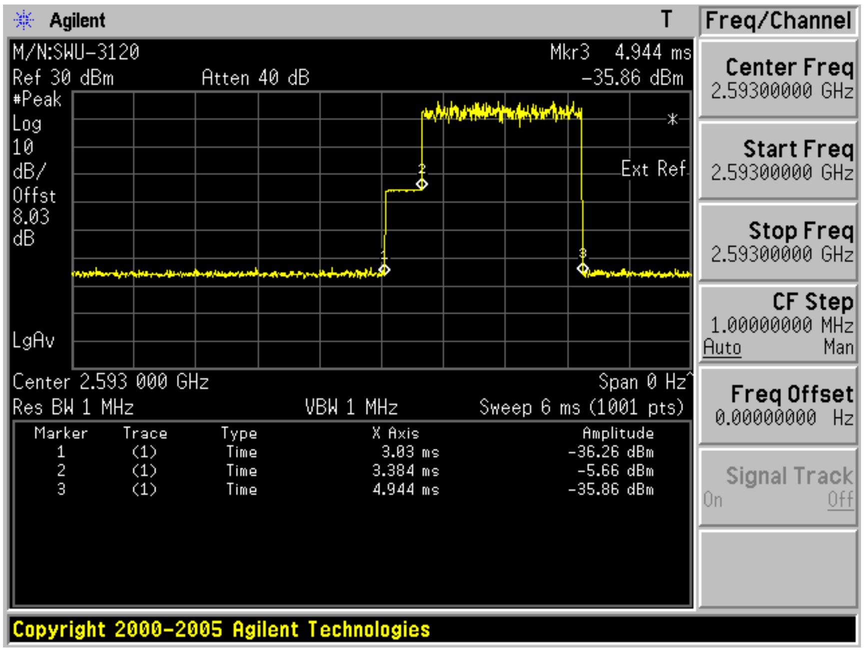
Duty cycle = 1.56 / 5 * 100 % = 31.2 %

10. TEST SETUP AND TEST SINGAL DETAIL

AMC_16QAM 1/2(Plot 1)



AMC_16QAM 1/2(Plot 2)



Burst length (Plot 1) = Mark 4 – Mark 1 = 8.02 ms – 3.02 ms = 5 ms

15 uplink symbol length (Plot 2) = Mark 3 – Mark 2= 4.944 ms-3.384 ms = 1.56 ms

Duty cycle = 1.56 / 5 * 100 % = 31.2 %

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

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

11. CHECK FOR PROBE LINEARITY

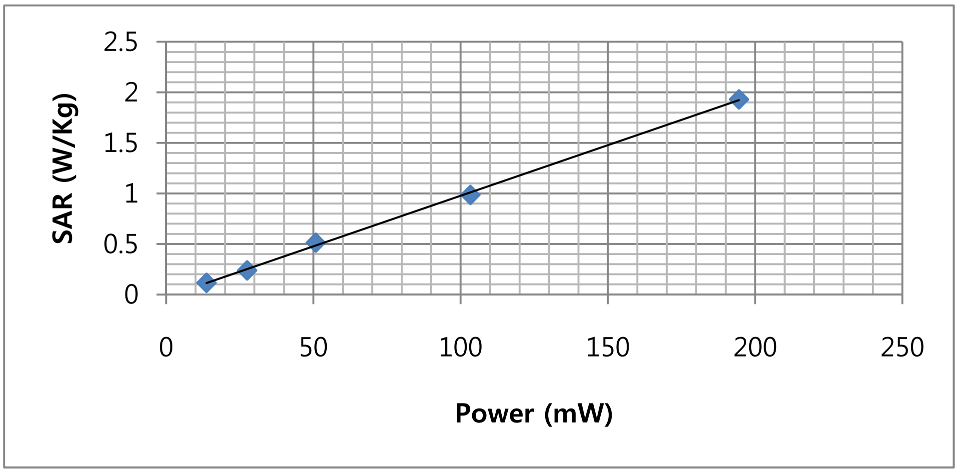
The same waveform (29:18) was use for this test; the output power was adjusted to the target value with a spectrum analyzer which is capable of channel power measurement (integration of the output power over specified -26 dB bandwidth). The average detector was selected and gating was on for measuring only in Tx burst on period.

The SAR probe used for the measurements is calibrated with a sinusoidal CW signal. Since the DL:UL symbol ratio configuration allows a periodic uplink burst, the duty factor can be compensated by selecting the correct crest factor (CF) for the SAR measurement. If the duty factor were non-periodic, compensation is typically not possible and substantial SAR measurement error could be expected. The high peak-to-average power ratio (PAR) of OFDM/OFDMA is expected to introduce additional SAR measurement errors because the SAR probe is not calibrated for this type of random noise-like signals with large amplitude variations within the burst. This SAR error is also expected to vary with both the average power and average PAR at each measurement point, temporally and spatially. In order to estimate the measurement error due to PAR issues, the configuration with the highest SAR in each channel bandwidth and frequency band is measured at various power levels, from approximately 10 mW, at 3 dB steps, until close on the maximum power level is reached. As shown by the results and plot below, SAR is linear to power only when the probe sensors are operating within the square-law region. As power continues to increase, the measured SAR error becomes increasingly larger. Since these are single point peak SAR values measured with the probe positioned at the peak SAR location, at 2 mm from the phantom surface; therefore, the values are substantially higher than the 1-g SAR required to determine compliance. The results indicate that at approximately 200 mW SAR could be overestimated by 0.5 %. Since this type of measurement error is dependent on the signal characteristics, the results demonstrate that there is no SAR underestimation.

Average Power(mW)	13.7	27.5	50.8	103.3	194.5
Single Point SAR(W/Kg)	0.115	0.238	0.512	0.985	1.930

Note: The measurement plots for this linearity check are attached within the SAR test plots (Page 34~38 of SAR_VAL_Plots.pdf)

Regression analysis for SAR Probe Linearity Check



12. SUMMARY OF TEST RESULTS (Continued)

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

Scaling Factor for a 5MHz channel bandwidth

For the 29:18 frame the UL consists of 18 symbols.

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

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

These 5 slots occupy 5/17 of the total number of available UL slots.
If the UL data burst is transmitted at full power (23.68 dBm in PUSC zone), then the control channels using 5/17th the total number of slots transmitting at the maximum power should use :

23.68 dBm – 10 log(17/5) =(23.68- 5.32) dBm=18.37 dBm= 68.71 mW.

BW requests from the MS to the BS are piggy-backed on the data symbols if the MS is transmitting in the frame.
For using a 5 MHz channel using the maximum 68.71 mw for each control symbol, and 233.35 mW on the data symbols, the math is as follow:

On the 29:18(15 data symbols are used)
Scaling Factor = (3*68.71+15*233.35)/(15*233.35)=1.06
So the worst case SAR value can be compensated as below.
0.640*1.06=0.6784 mW/g

12. SUMMARY OF TEST RESULTS

Scaling Factor for a 10 MHz channel bandwidth

For the 29:18 frame the UL consists of 18 symbols.

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

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

These 5 slots occupy 5/35 of the total number of available UL slots.

If the UL data burst is transmitted at full power (23.81 dBm in PUSC), then the control channels using 5/35th the total number of slots transmitting at the maximum power should use 23.81 dBm-10log(35/5)=(23.81-8.45) dBm=15.36 dBm=34.36 mW.

BW requests from the MS to the BS are piggy-backed on the data symbols if the MS is transmitting in the frame.
For a 10 MHz channel using the maximum 34.36 mW for each control symbol, and 240.43 mW on the data symbols, the math is as follow:

On the 29:18 (15 data symbols are used)
Scaling Factor = (3*34.36+15*240.43)/(15*240.43)=1.03

So the worst case SAR data can be compensated as below
0.707*1.03=0.728 mW/g

Currently 29:18 (Downlink / Uplink Ratio) is the maximum duty for WIMAX device. Since US WiMAX operators in the BRS/EBS band have agreed to operate with 29 OFDMA symbols downstream and 18 symbols upstream. US operators are working through the Wireless Communications Association International (WCA) to finalize a US best practices document including this ratio. The proposal has been approval at the WCA working group level and is awaiting final approval by the Board of Directors.
Therefore other duty (downlink : uplink symbol ratio) is not considered for SAR test of this device.

13. TEST CONFIGURATION POSITIONS(Continued)

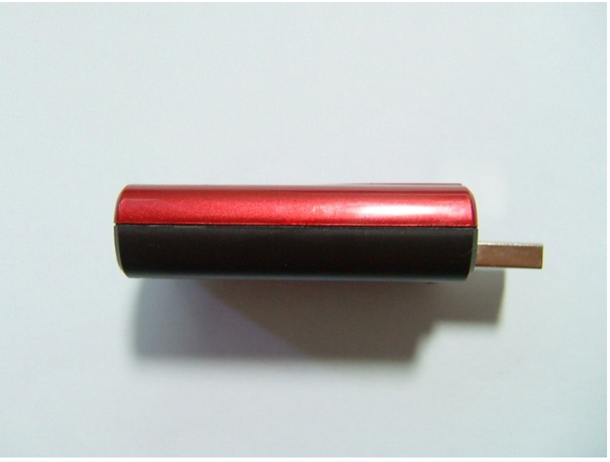
13.1 The exterior of the device

· **Position: Front of EUT**

· **Position: Rear of EUT**

· **Position: Bottom of EUT**

· **Position: Top of EUT**

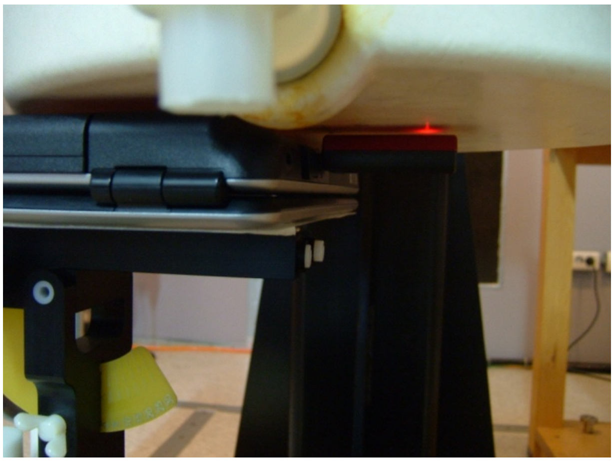
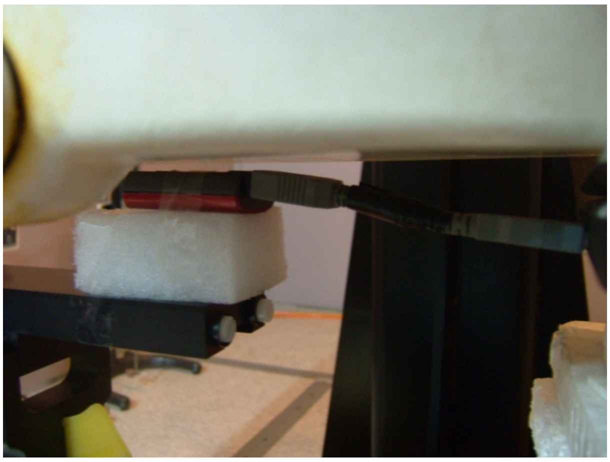
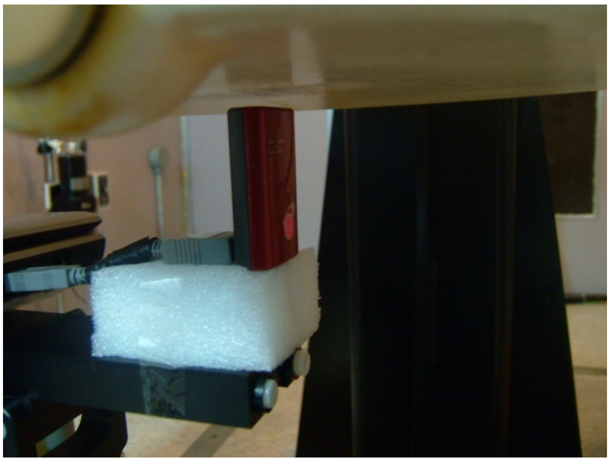


· **Position: Right of EUT**

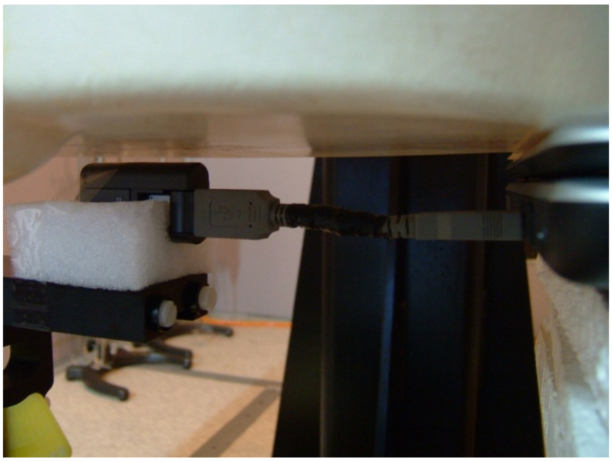
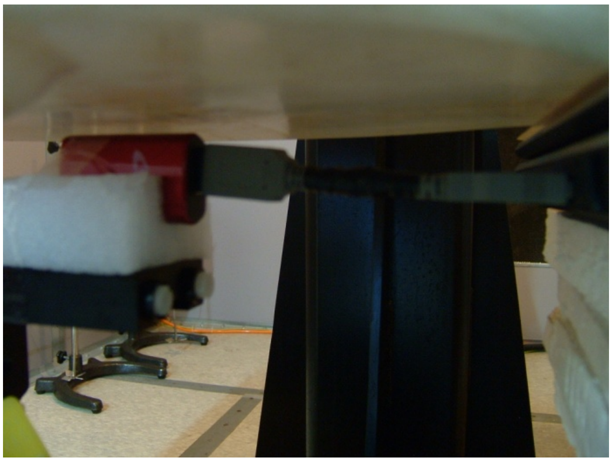
· **Position: Left of EUT**

13. TEST CONFIGURATION POSITIONS(Continued)

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

	
A: Laptop Model : L310 (Horizontal Up) The front of the EUT face to the phantom with 4 mm separation distance.	**B: Laptop Model : L310 with USB Cable (Horizontal Down)** The rear of the EUT face to the phantom with 5 mm separation distance.
	
C: Laptop Model : L310 (Horizontal Up 90°) The bottom of the EUT face to the phantom with 5 mm separation distance.	**D: Laptop Model : L310 with USB Cable (Horizontal Down 90°)** The top of the EUT face to the phantom with 5 mm separation distance.

13. TEST CONFIGURATION POSITIONS

	
E: Laptop Model : L310 with USB Cable (Vertical Right) The right of the EUT face to the phantom with 5 mm separation distance.	**F: Laptop Model : L310 with USB Cable (Vertical Left)** The left of the EUT face to the phantom with 5 mm separation distance.

Note : This USB Dongle was tested with the Styrofoam.

13.3 Enhanced energy coupling at increased separation distances.

(1) The probe tip is positioned at the worst case peak SAR location and at a distance of one half the probe tip diameter from the phantom surface. With the probe fixed at this location, the device is moved away from the phantom in 5 mm increments from the initial touching or minimum separation position. A single point SAR is measured for each of these device positions until the SAR is less than 50 % of that measured at the initial position.

Test Position	Single Point SAR (mW/g)	Deviation (%)
Initial Position	2.21	-
5 mm Increments from initial Position	0.951	-56.97

14. ANSI / IEEE C95.1-1992 RF EXPOSURE LIMITS

Uncontrolled Environment

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

Controlled Environment

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

Table 14.1.

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

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

15.IEEE P1528 – MEASUREMENT UNCERTAINTIES

Error Description	Uncertaint value ±%	Probability Distribution	Divisor	(Ci) 1g	Standard (1g)	vi 2 or Veff
Measurement System						
Probe calibration	± 4.8	Normal	1	1	± 4.8 %	∞
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 %	∞
Probe Linearity	± 4.7	Rectangular	√3	1	± 2.7 %	∞
Detection limits	± 1.0	Rectangular	√3	1	± 0.6 %	∞
Readout Electronics	± 1.0	Normal	1	1	± 1.0 %	∞
Response time	± 0.8	Rectangular	√3	1	± 0.5 %	∞
Integration time	± 2.6	Rectangular	√3	1	± 1.5 %	∞
RF Ambient Conditions	± 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 %	∞
Algorithms for Max. SAR Eval.	± 1.0	Rectangular	√3	1	± 0.6 %	∞
Test Sample Related						
Device Positioning	± 2.9	Normal	1	1	± 2.9 %	145
Device Holder	± 3.6	Normal	1	1	± 3.6 %	5
Power Drift	± 5.0	Rectangular	√3	1	± 2.9 %	∞
Physical Parameters						
Phantom Shell	± 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					**± 10.3 %**	330
Expanded Uncertainty (k=2)					**± 20.6 %**	

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

16. SYSTEM VERIFICATION

Tissue Verification

Table 16.1 Simulated Tissue Verification [5]

MEASURED TISSUE PARAMETERS					
Date(s)	**Target Frequency**	**Dielectric constant: ε**		**Conductivity: σ**	
		Target	**Measured**	**Target**	**Measured**
Nov.06, 2008	**2600 MHz Brain**	39.01	38.9	1.96	2.04
	2506 MHz Muscle	52.6	52.2	2.03	2.07
	2593 MHz Muscle	52.5	51.7	2.16	2.17
	2600 MHz Muscle	52.5	51.7	2.16	2.18
	2685 MHz Muscle	52.4	51.3	2.28	2.27
Nov.07, 2008	**2600 MHz Brain**	39.01	39.1	1.96	1.99
	2593 MHz Muscle	52.5	51.2	2.16	2.14
	2506 MHz Muscle	52.6	51.5	2.03	2.05
	2600 MHz Muscle	52.5	51.2	2.16	2.15
	2685 MHz Muscle	52.4	50.9	2.28	2.26
Nov.08, 2008	**2600 MHz Brain**	39.01	40.0	1.96	2.02
	2685 MHz Muscle	52.4	51.3	2.28	2.26
Mar.06,2009	**2600 MHz Brain**	39.01	38.9	1.96	2.03
	2506 MHz Muscle	52.6	52.0	2.03	2.07
	2593 MHz Muscle	52.5	51.7	2.16	2.16

Test System Validation

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

Table 16.2 System Validation [5]

SYSTEM DIPOLE VALIDATION TARGET & MEASURED (2600 MHz values are normalized to a forward power of 1/8 W)					
Date(s)	System Validation Kit:	Target Frequency	Targeted SAR_{1g} (mW/g)	Measured SAR_{1g} (mW/g)	Deviation (%)
Nov.06, 2008	D-2600V2, S/N: 1016	2600 MHz Brain	7.25	7.82	7.86
Nov.07, 2008	D-2600V2, S/N: 1016	2600 MHz Brain	7.25	7.86	8.41
Nov.08, 2008	D-2600V2, S/N: 1016	2600 MHz Brain	7.25	7.68	5.93
Mar.06, 2009	D-2600V2, S/N: 1016	2600 MHz Brain	7.25	7.70	6.21

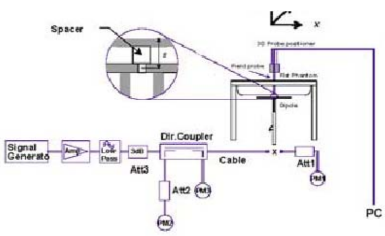


Figure 16.1 Dipole Validation Test Setup

17. DESCRIPTION OF TEST MODE AND SUMMARY OF RESULTS

17.1 DESCRIPTION OF TEST MODE

TEST MODE	COMMUNICATION	MODULATION TYPE & CODING RATE NOTE 1	Zone Format	ASSESSEMENT POSITION	TESTED CHANNEL
1	WiMAX-5 M,10 M	16QAM 1/2, QPSK 1/2	AMC	A	M
2	WiMAX-5 M,10 M	16QAM 1/2, QPSK 1/2	AMC	B	M
3	WiMAX-5 M,10 M	16QAM 1/2, QPSK 1/2	AMC	C	M
4	WiMAX-5 M,10 M	16QAM 1/2, QPSK 1/2	AMC	D	M
5	WiMAX-5 M,10 M	16QAM 1/2, QPSK 1/2	AMC	E	L,M,H
6	WiMAX-5 M,10 M	16QAM 1/2, QPSK 1/2	AMC	F	M

Note 1 : According to the conducted power table on clause 19.1, above modulation types, coding rates and AMC zone format are selected for the worst case SAR test. Also 29 :18 frame structure is used for the SAR tests.

17.2 SUMMARY OF TEST RESULTS (Actual measured SAR)

- BANDWIDTH: 5 MHz

	MEASURED VALUE OF 1 g SAR (W/kg)											
TEST MODE	1		2		3		4		5		6	
MODULATION TYPE	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK
LOW CHANNEL	-	-	-	-	-	-	-	-	-	0.623	-	-
Middle CHANNEL	0.292	0.294	0.239	0.242	0.039	0.039	0.166	0.166	0.374	0.382	0.026	0.026
High CHANNEL	-	-	-	-	-	-	-	-	-	**0.640**	-	-

- BANDWIDTH: 10 MHz

	MEASURED VALUE OF 1 g SAR (W/kg)											
TEST MODE	1		2		3		4		5		6	
MODULATION TYPE	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK
LOW CHANNEL	-	-	-	-	-	-	-	-	-	**0.707**	-	-
Middle CHANNEL	0.318	0.319	0.226	0.224	0.034	0.036	0.173	0.170	0.400	0.411	0.039	0.038
HIGH CHANNEL	-	-	-	-	-	-	-	-	-	0.699	-	-

18. SCALING VALUE OF SAR

18.1 SUMMARY OF TEST RESULTS (Scaling SAR)

- BANDWIDTH: 5 MHz

	SCALED VALUE OF 1 g SAR (W/kg)											
TEST MODE	1		2		3		4		5		6	
MODULATION TYPE	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK
SCALING FACTOR	**1.06**	**1.06**	**1.06**	**1.06**	**1.06**	**1.06**	**1.06**	**1.06**	**1.06**	**1.06**	**1.06**	**1.06**
LOW CHANNEL	-	-	-	-	-	-	-	-	-	0.660	-	-
Middle CHANNEL	0.310	0.312	0.253	0.257	0.041	0.041	0.176	0.176	0.396	0.405	0.028	0.028
High CHANNEL	-	-	-	-	-	-	-	-	-	**0.678**	-	-

- BANDWIDTH: 10 MHz

	MEASURED VALUE OF 1 g SAR (W/kg)											
TEST MODE	1		2		3		4		5		6	
MODULATION TYPE	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK	16QAM	QPSK
SCALING FACTOR	**1.03**	**1.03**	**1.03**	**1.03**	**1.03**	**1.03**	**1.03**	**1.03**	**1.03**	**1.03**	**1.03**	**1.03**
LOW CHANNEL	-	-	-	-	-	-	-	-	-	**0.728**	-	-
Middle CHANNEL	0.328	0.329	0.233	0.231	0.035	0.037	0.178	0.175	0.412	0.423	0.040	0.039
HIGH CHANNEL	-	-	-	-	-	-	-	-	-	0.720	-	-

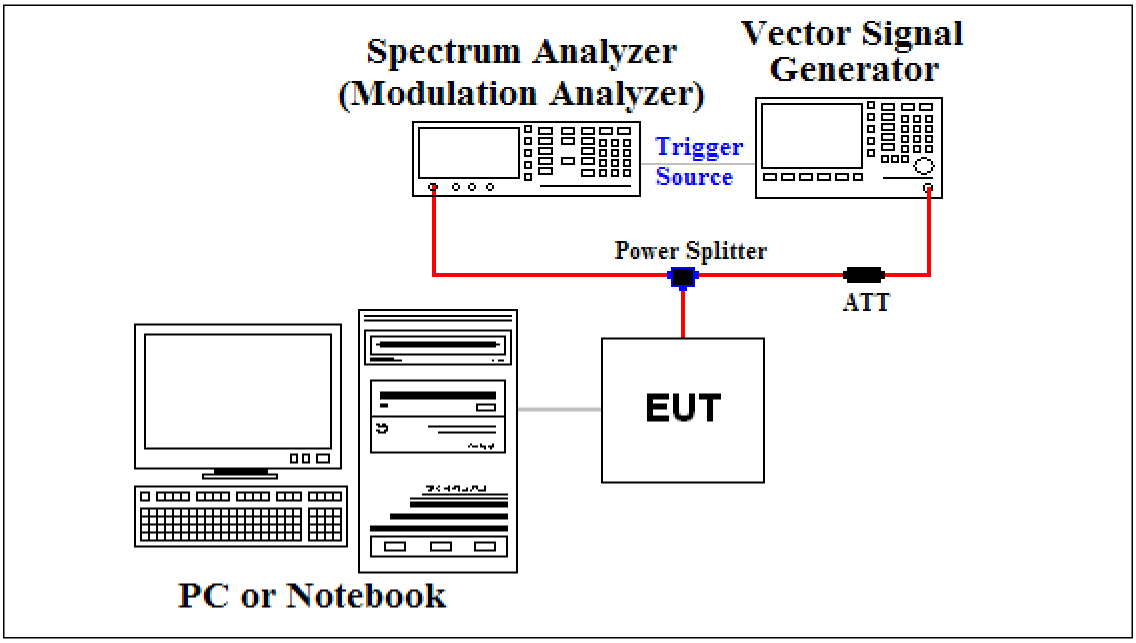
19. POWER TABLE

19.1 Max. Power Output Table for SWU-3120 (W/ Short USB Cable)

Bandwidth	Zone Format	Frequency (MHz)	QPSK 1/2 (dBm)	QPSK 3/4 (dBm)	16QAM 1/2 (dBm)	16QAM 3/4 (dBm)
5MHz	PUSC	2506	23.50	23.34	23.68	23.46
		2593	23.60	23.50	23.51	23.35
		2685	22.60	22.57	22.43	22.23
	AMC	2506	**24.14**	24.13	**24.11**	24.07
		2593	**24.10**	24.06	**23.99**	23.88
		2685	**23.41**	23.26	**23.42**	23.15
10MHz	PUSC	2506	23.81	23.75	23.73	23.62
		2593	23.58	23.42	23.45	23.42
		2685	22.75	22.66	22.65	22.45
	AMC	2506	**24.33**[NOTE1]	24.27	**24.25**	24.15
		2593	**23.89**	23.80	**23.71**	23.68
		2685	**23.32**	23.25	**23.27**	23.19

NOTE1: There was no power deviation between the power when using the short USB cable and the power when direct plug into USB port of the Laptop PC.

19.2. WiMAX Conducted Power Test Setup Diagram



20. SAR TEST DATA SUMMARY(Continued)

Mixture Type : 2600 MHz Body

BANDWIDTH: 5 MHz (16QAM)

20.1 MEASUREMENT RESULTS

FREQUENCY MHz	Begin Power (dBm)	End Power (dBm)	Mode	Spacing	Device Test Position	SAR (W/kg)
2593	23.99	23.76	16QAM	4 mm [Phantom]	1	0.292
2593	23.99	23.83	16QAM	5 mm [Phantom]	3	0.039
2593	23.99	23.82	16QAM	5 mm [Phantom]	5	0.374
2593	23.99	23.89	16QAM	5 mm [Phantom]	2	0.239
2593	23.99	23.98	16QAM	5 mm [Phantom]	4	0.166
2593	23.99	23.81	16QAM	5 mm [Phantom]	6	0.026
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						**Body 1.6 W/kg (mW/g)** averaged over 1 gram

NOTE:

1. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001] and KDB 447498 Mobile and Portable Device.
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2 dB below the highest peak.
5. Tissue parameters and temperatures are listed on the SAR plots.
6. Liquid tissue depth is 15.0 cm ± 0.1
7. Test configuration of each mode is described in section 13.2
8. Justification for reduced test configurations for device position of 1,2,3,4,5,6: Per FCC/OET Bulletin 65 Supplement C (July,2001), if the SAR measured at the middle channel for each test configuration is least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).

20. SAR TEST DATA SUMMARY(Continued)

Mixture Type : 2600 MHz Body

BANDWIDTH: 5 MHz(QPSK)

20.2 MEASUREMENT RESULTS						
FREQUENCY MHz	**Begin Power (dBm)**	**End Power (dBm)**	**Mode**	**Spacing**	**Device Test Position**	**SAR (W/kg)**
2593	24.10	23.94	QPSK	4 mm [Phantom]	1	0.294
2593	24.10	24.01	QPSK	5 mm [Phantom]	3	0.039
2506	24.14	23.96	QPSK	5 mm [Phantom]	5	0.623
2593	24.10	23.90	QPSK	5 mm [Phantom]	5	0.382
2685	23.41	23.16	QPSK	5 mm [Phantom]	5	0.640
2593	24.10	24.01	QPSK	5 mm [Phantom]	2	0.242
2593	24.10	23.95	QPSK	5 mm [Phantom]	4	0.166
2593	24.10	24.09	QPSK	5 mm [Phantom]	6	0.026
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						**Body 1.6 W/kg (mW/g)** averaged over 1 gram

NOTE:

1. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001] and KDB 447498 Mobile and Portable Device.
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2 dB below the highest peak.
5. Tissue parameters and temperatures are listed on the SAR plots.
6. Liquid tissue depth is 15.0 cm ±0.1
7. Test configuration of each mode is described in section 13.2
8. Justification for reduced test configurations for device position of 1,2,3,4,6: Per FCC/OET Bulletin 65 Supplement C (July,2001), if the SAR measured at the middle channel for each test configuration is least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).

20. SAR TEST DATA SUMMARY(Continued)

Mixture Type : 2600 MHz Body

BANDWIDTH: 10 MHz (16QAM)

20.3 MEASUREMENT RESULTS						
FREQUENCY MHz	**Begin Power (dBm)**	**End Power (dBm)**	**Mode**	**Spacing**	**Device Test Position**	**SAR (W/kg)**
2593	23.71	23.70	16QAM	4 mm [Phantom]	1	0.318
2593	23.71	23.48	16QAM	5 mm [Phantom]	3	0.034
2593	23.71	23.50	16QAM	5 mm [Phantom]	5	0.400
2593	23.71	23.69	16QAM	5 mm [Phantom]	2	0.226
2593	23.71	23.71	16QAM	5 mm [Phantom]	4	0.173
2593	23.71	23.35	16QAM	5 mm [Phantom]	6	0.039
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						**Body 1.6 W/kg (mW/g)** averaged over 1 gram

NOTE:

1. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001] and KDB 447498 Mobile and Portable Device.
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2 dB below the highest peak.
5. Tissue parameters and temperatures are listed on the SAR plots.
6. Liquid tissue depth is 15.0 cm ± 0.1
7. Test configuration of each mode is described in section 13.2
8. Justification for reduced test configurations for device position of 1,2,3,4,5,6: Per FCC/OET Bulletin 65 Supplement C (July,2001), if the SAR measured at the middle channel for each test configuration is least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).

20. SAR TEST DATA SUMMARY

Mixture Type : 2600 MHz Body

BANDWIDTH: 10 MHz (QPSK)

20.4 MEASUREMENT RESULTS						
FREQUENCY MHz	**Begin Power (dBm)**	**End Power (dBm)**	**Mode**	**Spacing**	**Device Test Position**	**SAR (W/kg)**
2593	23.89	23.85	QPSK	4 mm [Phantom]	1	0.319
2593	23.89	23.61	QPSK	5 mm [Phantom]	3	0.036
2506	**24.33**	**24.28**	**QPSK**	**5 mm [Phantom]**	**5**	**0.707**
2593	23.89	23.79	QPSK	5 mm [Phantom]	5	0.411
2685	23.32	23.07	QPSK	5 mm [Phantom]	5	0.699
2593	23.89	23.88	QPSK	5 mm [Phantom]	2	0.224
2593	23.89	23.84	QPSK	5 mm [Phantom]	4	0.170
2593	23.89	23.57	QPSK	5 mm [Phantom]	6	0.038
ANSI / IEEE C95.1 1992 - SAFETY LIMIT Spatial Peak Uncontrolled Exposure/General Population						**Body 1.6 W/kg (mW/g)** averaged over 1 gram

NOTE:

1. Test procedures used are according to FCC/OET Bulletin 65, Supplement C [July 2001] and KDB 447498 Mobile and Portable Device.
2. All modes of operation were investigated, and worst-case results are reported.
3. Prior to testing the conducted output power was measured.
4. The EUT is tested 2nd hot-spot peak, if it is less than 2 dB below the highest peak.
5. Tissue parameters and temperatures are listed on the SAR plots.
6. Liquid tissue depth is 15.0 cm ± 0.1
7. Test configuration of each mode is described in section 13.2
8. Justification for reduced test configurations for device position of 1,2,3,4,6: Per FCC/OET Bulletin 65 Supplement C (July,2001), if the SAR measured at the middle channel for each test configuration is least 3.0 dB lower than the SAR limit, testing at the high and low channels is optional for such test configuration(s).

21. SAR TEST EQUIPMENT

Table 21.1 Test Equipment Calibration

EQUIPMENT SPECIFICATIONS			
Type	**Calibration Date**	**Next Calibration Date**	**Serial Number**
Robot	N/A	N/A	F02/5Q85A1/A/01
Robot Controller	N/A	N/A	F02/5Q85A1/C/01
Joystick	N/A	N/A	D221340031
Hicron Computer 1.1GHz Pentium Celeron ,Window 2000	N/A	N/A	N/A
Data Acquisition Electronics	November 20, 2007	November 20, 2008	520
Data Acquisition Electronics	November 12, 2008	November 12, 2009	519
Dosimetric E-Field Probe	June 23, 2008	June 23, 2009	3643
Dummy Probe	N/A	N/A	N/A
Sam Phantom	N/A	N/A	N/A
Probe Alignment Unit LB	N/A	N/A	321
SPEAG Validation Dipole D2600 MHz	June 23, 2008	June 23, 2010	1016
Head Equivalent Matter(2600 MHz)	November 2008	November 2009	N/A
Body Equivalent Matter(2600 MHz)	August 2008	August 2009	N/A
HP EPM-442A Power Meter	March 11, 2008	March 11, 2010	GB37170267
HP E4421A Signal Generator	July 09, 2008	July 09, 2009	US37230529
Attenuator (10dB)	January 19, 2009	January 19, 2010	BP4387
Attenuator (3dB)	July 15, 2008	July 15,2009	MY39260699
Low pass filter (1.5GHz)	February 03, 2009	February 03, 2010	N/A
Low pass filter (3.0GHz)	October 01, 2008	October 01, 2009	N/A
Dual Directional Coupler	February 03, 2009	February 03, 2010	50228
Amplifier	February 02, 2009	February 02, 2010	1020 D/C 0221
Network Analyzer	March 21, 2008	March 21, 2009	8753D
HP85070D Dielectric Probe Kit	N/A	N/A	LISO1440118
SEMITEC Engineering	N/A	N/A	Shield Room

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

22. CONCLUSION

Measurement Conclusion

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

Please note that the absorption and distribution of electromagnetic energy in the body are very complex phenomena that depend on the mass, shape, and size of the body, the orientation of the body with respect to the field vectors, and the electrical properties of both the body and the environment. Other variables that may play a substantial role in possible biological effects are those that characterize the environment (e.g. ambient temperature, air velocity, relative humidity, and body insulation) and those that characterize the individual (e.g. age, gender, activity level, debilitation, or disease).

Because innumerable factors may interact to determine the specific biological outcome of an exposure to electromagnetic fields, any protection guide shall consider maximal amplification of biological effects as a result of field-body interactions, environmental conditions, and physiological variables.

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