FCC OET BULLETIN 65 SUPPLEMENT C

SAR EVALUATION REPORT

FOR

INTEL WIMAX/WIFI LINK 5350 SERIES
(WiMAX)

MODEL: 533ANXMMW

FCC ID: PD9533ANXMU

REPORT NUMBER: 08U12161-5 REV. A

ISSUE DATE: JANUARY 31, 2009

Prepared for

INTEL CORPORATION
2111 N.E. 25TH AVENUE
HILLSBORO, OR 97124, USA

Prepared by

COMPLIANCE CERTIFICATION SERVICES
47173 BENICIA STREET
FREMONT, CA 94538, USA

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	November 25, 2008	Initial issue	--
Rev. A	January 31, 2009	Incorporated WiMAX SAR measurement Guideline	Mike Kuo

TABLE OF CONTENTS

1 ATTESTATION OF TEST RESULTS

COMPANY NAME:	INTEL CORPORATION 2111 N.E. 25TH AVENUE HILLSBORO, OR 97124, USA
EUT DESCRIPTION:	INTEL WIMAX/WIFI LINK 5350 SERIES
FCC ID: **MODEL:**	PD9533ANXMU 533ANXMMW
DEVICE CATEGORY:	Portable
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure
DATE TESTED:	November 21 - 22, 2008
THE HIGHEST SAR VALUES:	See Table below

FCC Rule Parts	Frequency Range [MHz]	The Highest SAR Values (1g_mW/g)	Limit (mW/g)
27	2500 - 2690	0.222 (Secondary Landscape)	1.6

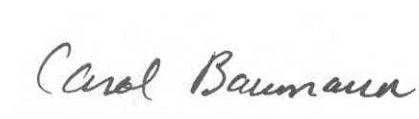
APPLICABLE STANDARDS	
STANDARD	**TEST RESULTS**
FCC OET BULLETIN 65 SUPPLEMENT C	Pass

Compliance Certification Services, Inc. (CCS) tested the above equipment in accordance with the requirements set forth in the above standards. All indications of Pass/Fail in this report are opinions expressed by CCS based on interpretations and/or observations of test results. The test results show that the equipment tested is capable of demonstrating compliance with the requirements as documented in this report.
Note: The results documented in this report apply only to the tested sample, under the conditions and modes of operation as described herein. This document may not be altered or revised in any way unless done so by CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by CCS will constitute fraud and shall nullify the document. No part of this report may be used to claim product certification, approval, or endorsement by NVLAP, NIST, or any government agency.

Approved & Released For CCS By:

SUNNY SHIH
EMC SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:



CAROL BAUMANN
SAR ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2 TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C, Specific FCC Procedure KDB 248227 SAR Measurement Procedure for 820.11abg Transmitters May 2007 and KDB 447498_RF Exposure Requirements and Procedures for mobile and portable devices and 802.16e/WiMAX Permit-But-Ask and SAR Guidance.

3 FACILITIES AND ACCREDITATION

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.
CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com.

4 CALIBRATION AND UNCERTAINTY

4.1 MEASURING INSTRUMENT CALIBRATION

The measuring equipment utilized to perform the tests documented in this report has been calibrated in accordance with the manufacturer's recommendations, and is traceable to recognized national standards.

5 MEASUREMENT UNCERTAINTY

Measurement uncertainty for 300 MHz – 3000 MHz

Uncertainty component	Tol. (±%)	Probe Dist.	Div.	Ci (1g)	Ci (10g)	Std. Unc.(±%)	
						Ui (1g)	Ui(10g)
Measurement System							
Probe Calibration	4.80	N	1	1	1	4.80	4.80
Axial Isotropy	4.70	R	1.732	0.707	0.707	1.92	1.92
Hemispherical Isotropy	9.60	R	1.732	0.707	0.707	3.92	3.92
Boundary Effects	1.00	R	1.732	1	1	0.58	0.58
Linearity	4.70	R	1.732	1	1	2.71	2.71
System Detection Limits	1.00	R	1.732	1	1	0.58	0.58
Readout Electronics	1.00	N	1	1	1	1.00	1.00
Response Time	0.80	R	1.732	1	1	0.46	0.46
Integration Time	2.60	R	1.732	1	1	1.50	1.50
RF Ambient Conditions - Noise	1.59	R	1.732	1	1	0.92	0.92
RF Ambient Conditions - Reflections	0.00	R	1.732	1	1	0.00	0.00
Probe Positioner Mechnical Tolerance	0.40	R	1.732	1	1	0.23	0.23
Probe Positioning With Respect to Phantom Shell	2.90	R	1.732	1	1	1.67	1.67
Extrapolation, interpolation, and integration algorithms for max. SAR evaluation	3.90	R	1.732	1	1	2.25	2.25
Test sample Related							
Test Sample Positioning	1.10	N	1	1	1	1.10	1.10
Device Holder Uncertainty	3.60	N	1	1	1	3.60	3.60
Power and SAR Drift Measurement	5.00	R	1.732	1	1	2.89	2.89
Phantom and Tissue Parameters							
Phantom Uncertainty	4.00	R	1.732	1	1	2.31	2.31
Liquid Conductivity - Target	5.00	R	1.732	0.64	0.43	1.85	1.24
Liquid Conductivity - Meas.	8.60	N	1	0.64	0.43	5.50	3.70
Liquid Permittivity - Target	5.00	R	1.732	0.6	0.49	1.73	1.41
Liquid Permittivity - Meas.	3.30	N	1	0.6	0.49	1.98	1.62
Combined Standard Uncertainty			RSS			11.44	10.49
Expanded Uncertainty (95% Confidence Interval)			K=2			22.87	20.98

Notesfor table
1. Tol. - tolerance in influence quaitity
2. N - Nomal
3. R - Rectangular
4. Div. - Divisor used to obtain standard uncertainty
5. Ci - is te sensitivity coefficient

6 TEST EQUIPMENT LIST

Name of Equipment	Manufacturer	Type/Model	Serial Number	Cal. Due date		
				MM	DD	Year
Robot - Six Axes	Stäubli	RX90BL	N/A	N/A		
Robot Remote Control	Stäubli	CS7MB	3403-91535	N/A		
DASY4 Measurement Server	SPEAG	SEUMS001BA	1041	N/A		
Probe Alignment Unit	SPEAG	LB (V2)	261	N/A		
SAM Phantom (SAM1)	SPEAG	QD000P40CA	1185	N/A		
SAM Phantom (SAM2)	SPEAG	QD000P40CA	1050	N/A		
Oval Flat Phantom (ELI 4.0)	SPEAG	QD OVA001 B	1003	N/A		
Electronic Probe kit	HP	85070C	N/A	N/A		
S-Parameter Network Analyzer	Agilent	8753ES-6	MY40001647	11	14	2009
E-Field Probe	SPEAG	EX3DV3	3531	4	23	2009
Thermometer	ERTCO	639-1S	1718	5	28	2009
Data Acquisition Electronics	SPEAG	DAE3 V1	427	10	20	2009
System Validation Dipole	SPEAG	D2450V2	748	4	14	2009
System Validation Dipole	SPEAG	D5GHzV2	1003	11	21	2009
Signal Generator	R&S	SMP 04	DE34210	2	16	2009
MXA Signal Analyzer	Agilent	N9020A	US48350984	10	23	2009
ESG Vector Signal Generator	Agilent	E4438C	US44271090	9	17	2010
Power Meter	Giga-tronics	8651A	8651404	1	11	2010
Power Sensor	Giga-tronics	80701A	1834588	1	11	2010
Amplifier	Mini-Circuits	ZVE-8G	90606	N/A		

7 DEVICE UNDER TEST (DUT) DESCRIPTION

INTEL WIMAX/WIFI LINK 5350 SERIES (Tested inside of LENOVO THINKPAD X200 TABLET SERIES)	
Normal operation:	• Laptop Mode • Tablet Mode – in the following configurations. o Bottom Face o Edge - Primary/Secondary landscape and Primary/Secondary portrait orientations.
Antenna tested:	Vendor / Antenna / Part Number ACON / Main / 25.90675.001 WNC / Main / 25.90669.001
Power supply:	Power supplied through laptop computer (host device)

The Intel WiFi/WiMAX Link 5350 is an embedded IEEE 802.16e and 802.11a/b/g/n wireless network adapter that operates in the 2.4 GHz and 5 GHz spectra for WiFi and 2.6 GHz for WiMAX. The adapter is capable of delivering up to 450 Mbps Tx/Rx over WiFi and up to 4 Mbps UL/10 Mbps DL over WiMAX.

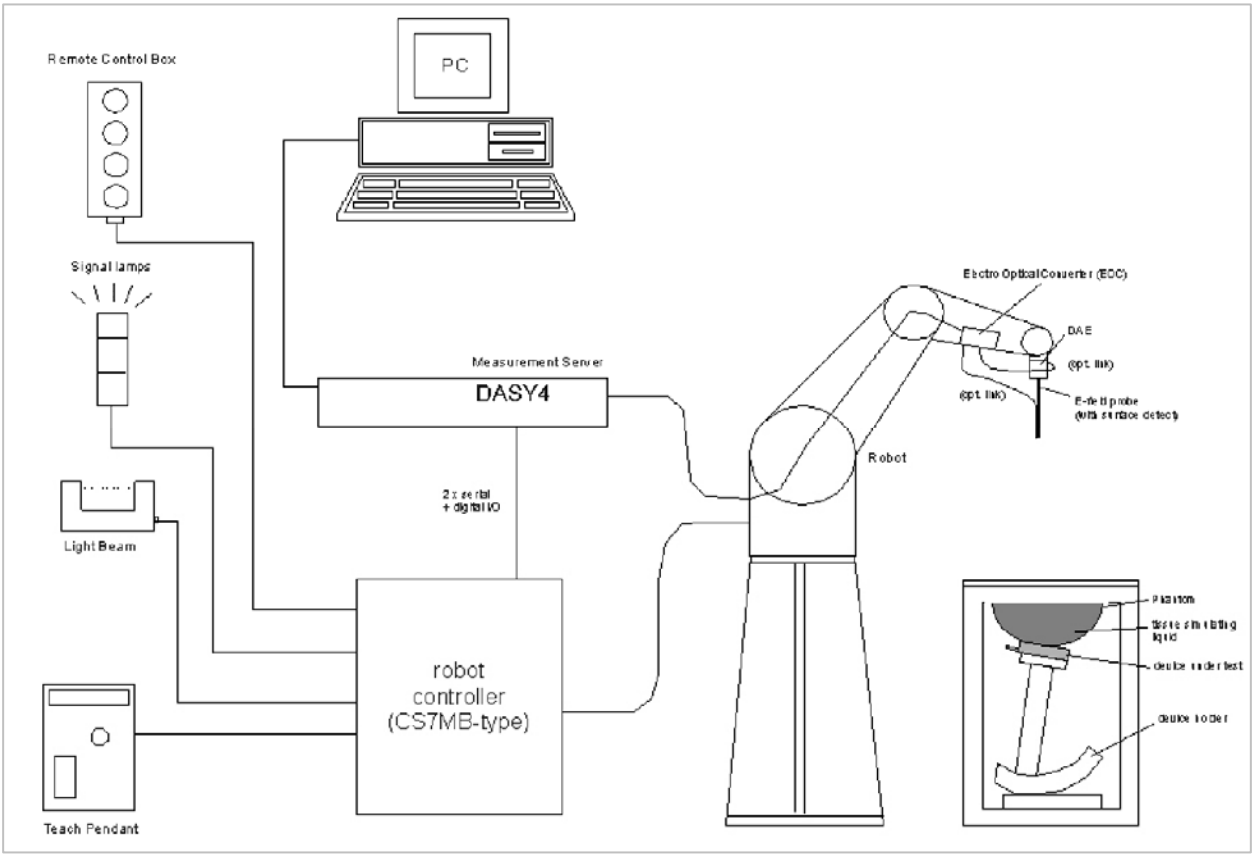
Link 5350 transmits on 5 ms frames using 5 MHz and 10 MHz channels. The 10 MHz channel bandwidth uses 1024 sub-carriers and 35 sub-channels, with 184 null sub-carriers and 840 available for transmission, consisting of 560 data sub-carriers and 280 pilot sub-carriers. The 5 MHz channel bandwidth uses 512 sub-carriers and 17 sub-channels, with 104 null sub-carriers and 408 available for transmission, consisting 272 data sub-carriers and 136 pilot sub-carriers.

Intel WiFi/WiMAX Link 5350 received single module approval on 07/18/2008.

WiMAX and 802.11 a/b/g/n co-location conditions:

The 802.16e WiMAX and 802.11 a/b/g/n WiFi radio will not transmit simultaneously. When the 533ANXMMW is installed in the typical laptop computer, once the network is chosen by the end user during WiMAX/WiFi network, only the WiMAX radio or WiFi radio will transmit.

8 SYSTEM DESCRIPTION



The DASY4 system for performing compliance tests consists of the following items:

- A standard high precision 6-axis robot (Stäubli RX family) with controller, teach pendant and software. An arm extension for accommodating the data acquisition electronics (DAE).
- A dosimetric probe, i.e., an isotropic E-field probe optimized and calibrated for usage in tissue simulating liquid. The probe is equipped with an optical surface detector system.
- A data acquisition electronics (DAE) which performs the signal amplification, signal multiplexing, AD-conversion, offset measurements, mechanical surface detection, collision detection, etc. The unit is battery powered with standard or rechargeable batteries. The signal is optically transmitted to the EOC.
- The function of the measurement server is to perform the time critical tasks such as signal filtering, control of the robot operation and fast movement interrupts.
- A probe alignment unit which improves the (absolute) accuracy of the probe positioning.
- A computer operating Windows 2000 or Windows XP.
- DASY4 software.
- Remote controls with teach pendant and additional circuitry for robot safety such as warning lamps, etc.
- The SAM twin phantom enabling testing left-hand and right-hand usage.
- The device holder for handheld mobile phones.
- Tissue simulating liquid mixed according to the given recipes.
- Validation dipole kits allowing to validate the proper functioning of the system.

8.1 COMPOSITION OF INGREDIENTS FOR TISSUE SIMULATING LIQUIDS

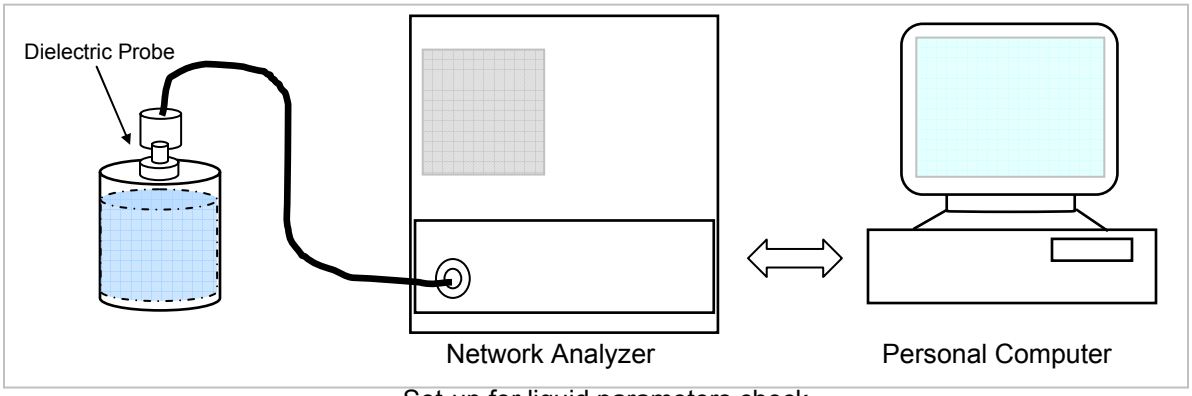
The following tissue formulations are provided for reference only as some of the parameters have not been thoroughly verified. The composition of ingredients may be modified accordingly to achieve the desired target tissue parameters required for routine SAR evaluation.

Ingredients (% by weight)	Frequency (MHz)									
	450		835		915		1900		2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99+% Pure Sodium Chloride Sugar: 98+% Pure Sucrose
Water: De-ionized, 16 MΩ+ resistivity HEC: Hydroxyethyl Cellulose
DGBE: 99+% Di(ethylene glycol) butyl ether, [2-(2-butoxyethoxy)ethanol]
Triton X-100 (ultra pure): Polyethylene glycol mono [4-(1,1, 3, 3-tetramethylbutyl)phenyl]ether

9 SIMULATING LIQUID PARAMETERS CHECK

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values. The relative permittivity and conductivity of the tissue material should be within ± 5% of the values given in the table below.



Set-up for liquid parameters check

Reference Values of Tissue Dielectric Parameters for Body Phantom

The head tissue dielectric parameters recommended by the IEEE SCC-34/SC-2 in IEEE Standard 1528 have been incorporated in the following table. These head parameters are derived from planar layer models simulating the highest expected SAR for the dielectric properties and tissue thickness variations in a human head. Other head and body tissue parameters that have not been specified in P1528 are derived from the tissue dielectric parameters computed from the 4-Cole-Cole equations and extrapolated according to the head parameters specified in IEEE Standard 1528.

Target Frequency (MHz)	Body	
	ε_r	σ (S/m)
2450	52.7	1.95
2500	52.6	2.02
2600	52.5	2.16
2690	52.4	2.29

(ε_r = relative permittivity, σ = conductivity and ρ = 1000 kg/m^3)

9.1 SIMULATING LIQUID PARAMETER CHECK RESULT

Simulating Liquid Dielectric Parameter Check Result @ Muscle 2600 MHz

Room Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Carol Baumann

Simulating Liquid		Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Depth (cm)							
2500	15	e'	51.2719	Relative Permittivity (ε_r):	51.2719	52.6	-2.52	± 5
		e"	15.0582	Conductivity (σ):	2.09427	2.02	3.68	± 5
2590	15	e'	50.9287	Relative Permittivity (ε_r):	50.9287	52.5	-2.99	± 5
		e"	15.2627	Conductivity (σ):	2.19913	2.15	2.28	± 5
2600	15	e'	50.8962	Relative Permittivity (ε_r):	50.8962	52.5	-3.07	± 5
		e"	15.3419	Conductivity (σ):	2.21907	2.16	2.70	± 5
2690	15	e'	50.7095	Relative Permittivity (ε_r):	50.7095	52.4	-3.23	± 5
		e"	15.5350	Conductivity (σ):	2.32478	2.29	1.52	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid temperature: 24 deg. C
November 21, 2008 08:38 AM

Frequency	e'	e"
2480000000.	51.2669	14.9864
2490000000.	51.2849	14.9627
2500000000.	**51.2719**	**15.0582**
2510000000.	51.2942	15.0181
2520000000.	51.2256	14.8808
2530000000.	51.1673	14.9575
2540000000.	51.0485	15.0304
2550000000.	50.9791	15.1458
2560000000.	50.9128	15.1638
2570000000.	50.9548	15.3325
2580000000.	51.0082	15.2548
2590000000.	**50.9287**	**15.2627**
2600000000.	**50.8962**	**15.3419**
2610000000.	50.7393	15.3670
2620000000.	50.6909	15.3893
2630000000.	50.7059	15.4608
2640000000.	50.5492	15.4212
2650000000.	50.5709	15.5770
2660000000.	50.5674	15.7105
2670000000.	50.6359	15.6307
2680000000.	50.6458	15.6475
2690000000.	**50.7095**	**15.5350**
2700000000.	50.6122	15.5429
2710000000.	50.3644	15.6999
2720000000.	50.2529	15.7369

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target $f * 10^6$

$\varepsilon_0 = 8.854 * 10^{-12}$

Simulating Liquid Dielectric Parameter Check Result @ Muscle 2600 MHz

Room Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Carol Baumann

Simulating Liquid		Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Depth (cm)							
2500	15	e'	51.6102	Relative Permittivity (ϵ_r):	51.6102	52.6	-1.88	± 5
		e"	14.5706	Conductivity (σ):	2.02645	2.02	0.32	± 5
2590	15	e'	51.3809	Relative Permittivity (ϵ_r):	51.3809	52.5	-2.13	± 5
		e"	14.9554	Conductivity (σ):	2.15485	2.15	0.23	± 5
2600	15	e'	51.2924	Relative Permittivity (ϵ_r):	51.2924	52.5	-2.32	± 5
		e"	15.0246	Conductivity (σ):	2.17318	2.16	0.57	± 5
2690	15	e'	51.0575	Relative Permittivity (ϵ_r):	51.0575	52.4	-2.56	± 5
		e"	15.3945	Conductivity (σ):	2.30376	2.29	0.60	± 5

Liquid Check
Ambient temperature: 25 deg. C; Liquid Temperature: 24 deg. C
November 22, 2008 10:15 AM

Frequency	e'	e"
2480000000.	51.7496	14.6590
2490000000.	51.6309	14.7061
2500000000.	**51.6102**	**14.5706**
2510000000.	51.6944	14.7243
2520000000.	51.7179	14.8130
2530000000.	51.6745	14.8493
2540000000.	51.5176	14.9256
2550000000.	51.5109	14.8574
2560000000.	51.4847	14.8544
2570000000.	51.4975	15.0339
2580000000.	51.3833	15.0464
2590000000.	**51.3809**	**14.9554**
2600000000.	**51.2924**	**15.0246**
2610000000.	51.3383	14.9764
2620000000.	51.2431	15.1148
2630000000.	51.0568	15.0507
2640000000.	51.1060	15.1312
2650000000.	51.0991	15.2011
2660000000.	51.0852	15.3205
2670000000.	51.0388	15.3262
2680000000.	51.0786	15.4032
2690000000.	**51.0575**	**15.3945**
2700000000.	50.9908	15.4355
2710000000.	50.9034	15.4363
2720000000.	50.7986	15.5064

The conductivity (σ) can be given as:

$$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$$

where f = target f * 10^6

$\varepsilon_0 = 8.854 * 10^{-12}$

10 SYSTEM PERFORMANCE CHECK

The system performance check is performed prior to any usage of the system in order to guarantee reproducible results. The system performance check verifies that the system operates within its specifications of ±10%.

System Performance Check Measurement Conditions

- The measurements were performed in the flat section of the SAM twin phantom filled with Body simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV3-SN: 3531 was used for the measurements.
- The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
  For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 (2.4 GHz) fine cube was chosen for cube integration.
- Distance between probe sensors and phantom surface was set to 3 mm.
- The dipole input power (forward power) was 250 mW±3%.
- The results are normalized to 1 W input power.

Reference SAR Values for body-tissue

The reference SAR values based on SPEAG's Calibration Certificate, Certificate No: D2600V2-1006_Jun07.

SAR result with Body TSL

SAR averaged over 1 cm³ (1 g) of Body TSL	condition	
SAR measured	250 mW input power	14.4 mW / g
SAR normalized	normalized to 1W	57.6 mW / g
SAR for nominal Body TSL parameters [1]	normalized to 1W	**58.5 mW / g ± 17.0 % (k=2)**

SAR averaged over 10 cm³ (10 g) of Body TSL	condition	
SAR measured	250 mW input power	6.46 mW / g
SAR normalized	normalized to 1W	25.8 mW / g
SAR for nominal Body TSL parameters [1]	normalized to 1W	**26.2 mW / g ± 16.5 % (k=2)**

Please see Attachment named "4_Certificate of System Validation Dipole - D2600V2 SN 1006" for details.

10.1 SYSTEM PERFORMANCE CHECK RESULTS

System Validation Dipole: D2600V2 SN 1006

The dipole input power (forward power): 250 mW

Results

Date: November 21, 2008

Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Carol Baumann

Body Simulating Liquid			Normalized to 1 W		Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)					
2600	24	15	1g	53.9	57.6	-6.42	± 10
			10g	23.6	25.8	-8.53	± 10

Date: November 22, 2008

Ambient Temperature = 25°C; Relative humidity = 40% Measured by: Carol Baumann

Body Simulating Liquid			Normalized to 1 W		Target	Deviation (%)	Limit (%)
f (MHz)	Temp. (°C)	Depth (cm)					
2600	24	15	1g	53.6	57.6	-6.94	± 10
			10g	23.6	25.8	-8.53	± 10

11 WiMAX / 802.16e Device Specification

11.1 WiMAX Zone Types

The device and its system are both transmitting using only PUSC zone type. This enables multiple users to transmit simultaneously within the system. FUSC, AMC and other zone types are not used by Link 5350 for uplink transmission. The maximum DL:UL symbol ratio can be determined according to the PUSC requirements. The system transmit an odd number of symbols using DL-PUSL consisting of even multiples of traffics and control symbols plus one symbol for the preamble. Multiples of three symbols are transmitted by the device using UL-PUSC. The OFDMA symbol time allows up to 48 downlink and uplink symbols in each 5 ms frame. TTG and RTG are also included in each frame as DL/UL transmission gaps; therefore, the system can only allow 47 or less symbols per frame. The maximum DL:UL symbol ratio is determined according to these PUSC parameters for evaluating SAR compliance.

Description	Down Link	Up Link
Number of OFDM Symbols in Down Link and Up Link for 5 MHz and 10 MHz Bandwidth	35	12
	34	13
	32	15
	31	16
	30	17
	29	18
	28	19
	27	20
	26	21

11.2 Duty Factor Considerations

a. Although the chipset can supply higher downlink-to-uplink (DL/UL) symbol ratios, Link 5350 is only supplied to BRS/EBS WiMAX operators with agreements to transmit at a maximum DL/UL symbol ratio of 29:18. Link 5350 is limited by firmware and the corresponding WiMAX system to operate at or below this maximum duty factor. Therefore, the maximum transmission duty factor supported by the chipset is not applicable for this device. The system can transmit up to 48 OFDMA symbols in each 5 ms frame, including 1.6 symbols for TTG and RTG. With a maximum of 18 uplink symbols transmitting at the maximum power, the duty factor is estimated to be 18/48 or 37.5%. Since the first three uplink symbols are reserved for control signals/channels, which are transmitted at reduced power; additional considerations are required to determine the duty factor applicable to the SAR measurements, with respect to the actual power of the control and traffic symbols transmitted during the measurement. In addition, due to test software and signal generator constraints, both the control symbols and maximum DL:UL symbol ratio cannot be configured for the SAR measurements. The measured SAR must be scaled to the maximum control and traffic symbol power levels according to the DL:UL symbol ratio used for the test to determine compliance.

b. Duty Factor and Crest Factor: Since control symbols were used in the SAR measurement, traffic symbols and control symbols are used. All UL symbols are counted. A duty factor = (number of uplink symbols x 102.857us)/5000us. Crest Factor = 1/(duty factor) for this periodic pulse signal device.

Test Vector File Name	BW	DL/UL Symbols	UL duty Cycle	Crest Factor	DL Modulation	UL Modulation
RDQ64_56_UQ4_12_10M	10 MHz	35/12	24.69%	4.05	QAM64 R5/6	QPSK R1/2
RDQ4_12_UQ16_34_10M	10 MHz	35/12	24.69%	4.05	QPSK R1/2	QAM16 R3/4
RDQ64_56_UQ4_12_5M	5 MHz	29/18	37%	2.7	QAM64 R5/6	QPSK R1/2
RDQ4_12_UQ16_34_5M	5 MHz	29/18	37%	2.7	QPSK R1/2	QAM16 R3/4

c. Duty Cycle power Compensation: The max. rated power is 23 dBm (200mW). The control symbols were included in the SAR measurement. The control channels may occupy up to 5 slots during normal operation. A slot is a sub-channel with the duration of 3 symbols. There are a total of 35 slots in the 10 MHZ channel configuration, 17 slots in 5 MHz channel configuration. The max. power for each control symbol is 28.57mW / 10 MHz and 58.82mW / 5 MHz . For a DL:UL symbol ratio of 35:12 with 10MHZ BW, the measured SAR is scaled up by the factor (28.57x3+200x9)/(actual-output x 9). The actual-power is the average conducted power of the traffic burst measured for the corresponding high, middle or low channel.

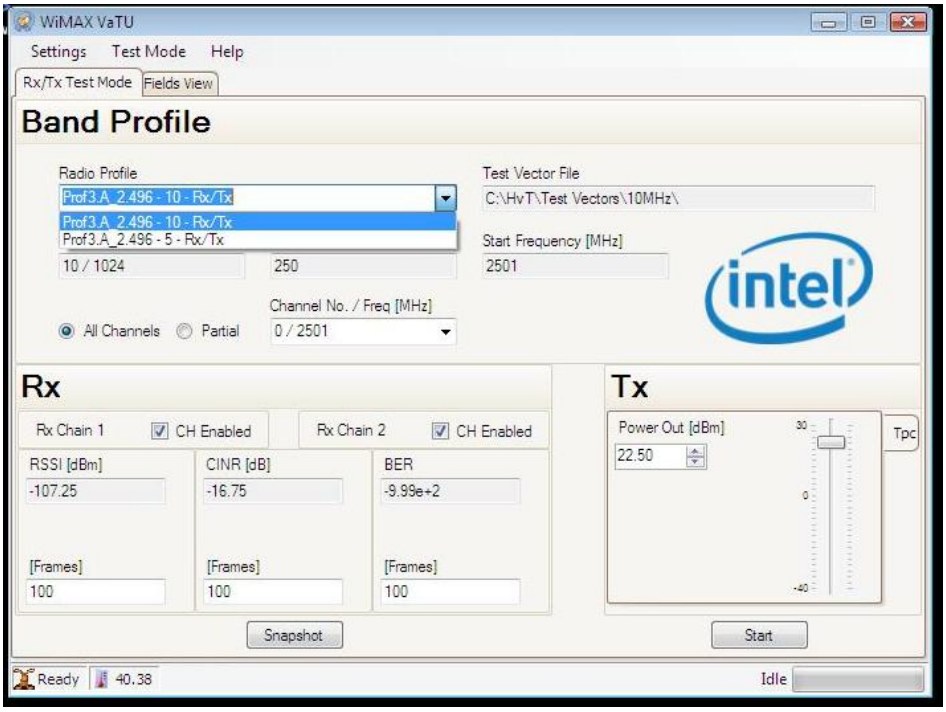
Test Vector File Name	BW	DL/UL Symbols	UL duty Cycle	Actual Power (mW)-Lowest power is used among L/M/H	Duty Cycle Compensation Factor
RDQ64_56_UQ4_12_10M	10 MHz	35/12	24.69%	166.34mW	1.26
RDQ4_12_UQ16_34_10M	10 MHz	35/12	24.69%	166.34mW	1.26
RDQ64_56_UQ4_12_5M	5 MHz	29/18	37%	181.55mW	1.17
RDQ4_12_UQ16_34_5M	5 MHz	29/18	37%	181.555mW	1.17

12 Test Software

The Test tool is a diagnostic software tool that works in conjunction with the WiMAX simulated base station waveforms loaded in the ESG (Vector Signal Generator) to operate the client card at full power (originally tested and approved) in the various modes:

10MHz Channel BW 16QAM
10MHz Channel BW QPSK
5MHz Channel BW 16QAM
5MHz Channel BW QPSK

The test software tool (WiMAX VaTU SW application) is installed on the tablet computer to configure the test device, Intel WiFi/WiMAX Link 5350, to transmit at max. output power. During normal operation, the output power of WiFi/WiMAX client module is controlled by a WiMAX basestation, which also determines the characteristics of the transmission. For testing purposes, the device output power is kept at this max. using WiMAX VATU SW application loaded in the tablet. The uplink transmission is maintained at a stable condition by the radio profile loaded in Vector signal generator. This enables the WiFi/WiMAX module to transmit at max. power with a constant duty factor according to the specific radio profile as documented in the section 3. The test software serves only one purpose, to configure the WiFi/WiMAX module to transmit at the max. power during SAR measurement.

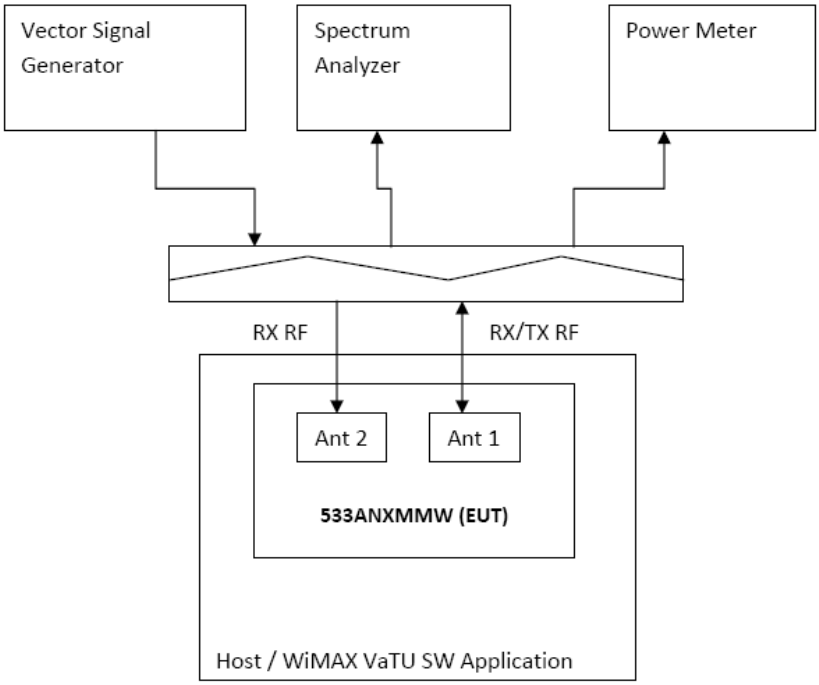


13 Signal Generator Details

a. Frame Profile loaded in Vector Signal Generator:

Test Vector File Name	BW	DL/UL Symbols	UL duty Cycle	DL Modulation	UL Modulation
RDQ64_56_UQ4_12_10M	10 MHz	35/12	24.69%	QAM64 R5/6	QPSK R1/2
RDQ4_12_UQ16_34_10M	10 MHz	35/12	24.69%	QPSK R1/2	QAM16 R3/4
RDQ64_56_UQ4_12_5M	5 MHz	29/18	37%	QAM64 R5/6	QPSK R1/2
RDQ4_12_UQ16_34_5M	5 MHz	29/18	37%	QPSK R1/2	QAM16 R3/4

b. Connection Diagram



Agilent ESG Vector Signal Generator / Model :E4438C is used in conjunction with Intel supplied radio profile to configure the WiFi/WiMAX module for the SAR evaluation. ESG Vector Signal Generator is loaded with the downlink signal, containing the respective FCH, DL-MAP and UL-MAP required by the test device to configure the uplink transmission. The waveform is configured for a DL:UL symbol ratio of 35:12 for 10 MHz and 29:19 for 5 MHz using Intel Signal Waveform Software for 802.16 WiMAX, on the PC and downloaded to the VSG. The test device can synchronize itself to the signal received from VSG, both in frequency and time. It then modulates the DL-MAP and UL-MAP transmitted in the downlink sub-frame and determine the DL:UL symbol ratio. The downlink burst is repeated in each frame, every 5 ms, to simulate the normal transmission from a WiMAX basestation. The UL-MAP received by the device is used to configure the uplink burst with all data symbols and sub-channels active. Since this is a one-way communication configuration, control channel transmission is neither requested nor transmitted.
For TDD systems, both uplink and downlink transmissions are at the same frequency. The output power of the VSG is kept at least 80 dB lower than the test device to avoid interfering with the SAR measurements. In addition, a horn antenna is used for the VSG and it is kept more than 1 meter away from the test device to further minimize unnecessary pickup by the SAR probe.

13.1 Communication Test Set Details

Modulation and channel bandwidth selection is loaded to Vector Signal Generator. For example, when evaluating 16QAM with 10 MHz channel Bandwidth, radio profile name "RDQ4_12_UQ16_34_10M " is active on the Vector Signal Generator.

Parameter /Value	Frame definition for 10 MHz RCT		
	Test vector name		
	RDQ4_12_UQ16_34_10M	RDQ64_56_UQ4_12_10M	Remark
Band Width	10MHz	10MHz	
FFT size	1024	1024	
DL/UL ratio	35/12	35/12	
Down link			
Zone profiles	Zone 1 – PUSC	Zone 1 – PUSC	single zone
Burst profile / MCS	MCS : QPSK R1/2	MCS : QAM64 R5/6	Single DIUC
Up link			
Duty Cycle power compensation factor	6.1dB	6.1dB	
Zone profiles	Zone 1 – PUSC	Zone 1 – PUSC	single zone
Burst profile / MCS	MCS : QAM16 R3/4	MCS : QPSK R1/2	Single DIUC

Parameter /Value	Frame definition for 5MHz RCT		
	Test vector name		Remarks
	RDQ64_56_UQ4_12_5M	RDQ4_12_UQ16_34_5M	
Band Width	5MHz	5MHz	
FFT size	512	512	
DL/UL ratio	29/18	29/18	
Down link			
Zone profiles	Zone 1 – PUSC	Zone 1 – PUSC	single zone
Burst profile / MCS	MCS : QAM64 R5/6	MCS : QPSK R1/2	Single DIUC
Up link			
Duty Cycle power compensation factor	4.3dB	4.3dB	
Zone profiles	Zone 1 – PUSC	Zone 1 – PUSC	single zone
Burst profile / MCS	MCS : QPSK R1/2	MCS : QAM16 R3/4	Single DIUC

14 OUTPUT POWER VERIFICATION

The max. average conducted output power is measured for the uplink durst in the difference modulation and channel bandwidth. Conducted average output power were measured with the module connected to the test jig with over-to-air communication link to Vector Signal generator. During SAR evaluation, the module is installed in the tablet computer and the over-the-air communication link is established between tablet and Vector signal generator. The average output power is measured for the uplink bursts through triggering and gating.

The following procedures have been used to prepare the EUT for the SAR test.

The EUT driver software installed in the host support equipment during testing was WiMAX VaTU, version: 3.0.0.0

The modes with highest output power channel were chosen for the conducted output power measurement.

Offset: 1.1 (cable) + 20 (pad) = 21.1 dB

Peak and Average Output power measurements were made with Spectrum Analyzer with various settings

With Spectrum Analyzer with Gate-On, Channel Power. Measured with peak and average detector

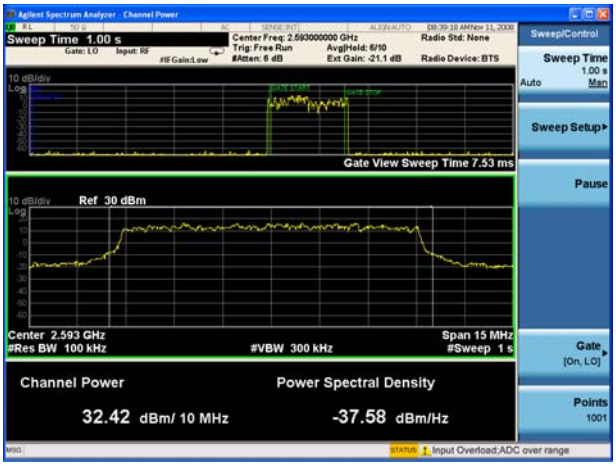
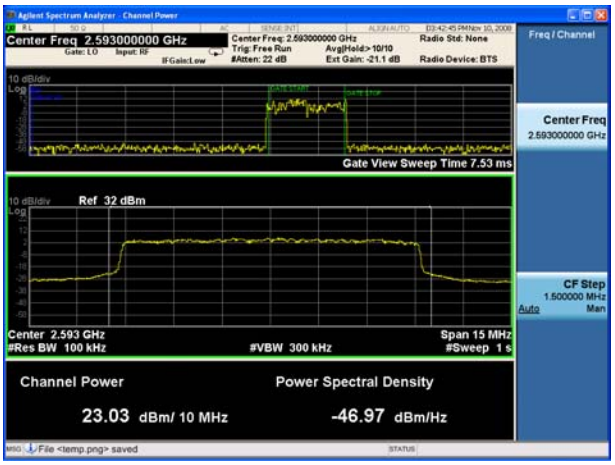
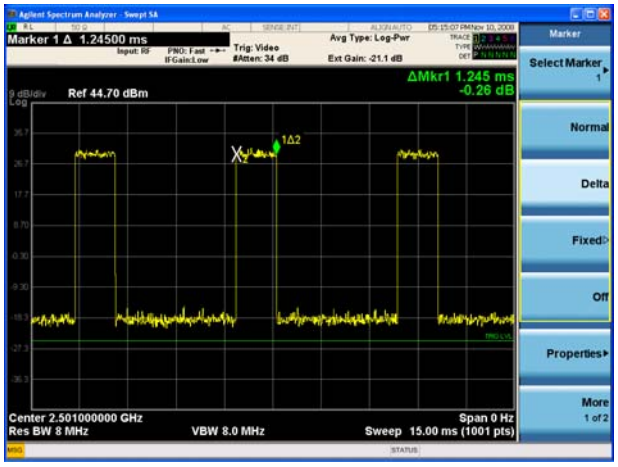
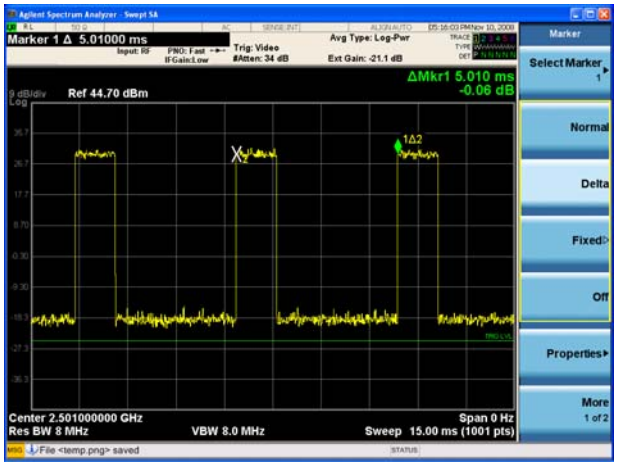
Mode	Channel Band-width (MHZ)	Ch. No.	f (MHz)	Couducted Power (dBm)		Peak-to-Average Ratio	Duty Cycle (%)	Power Setting form SW
				Peak	Average			
16QAM	10	0	2501	32.31	23.09	9.22	24.85	23.5
		368	2593	32.42	23.03	9.39		23.5
		736	2685	31.84	22.21	9.63		23.5

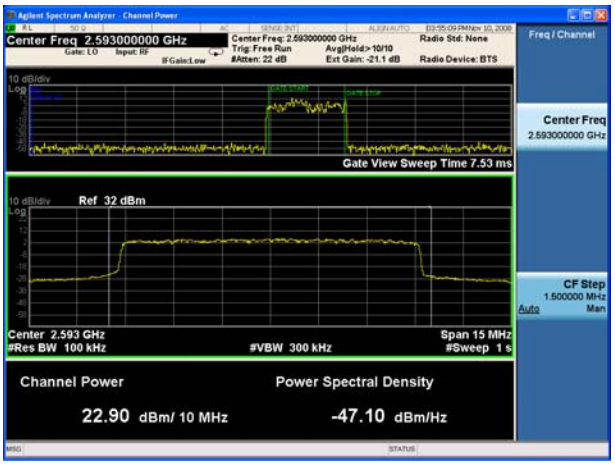
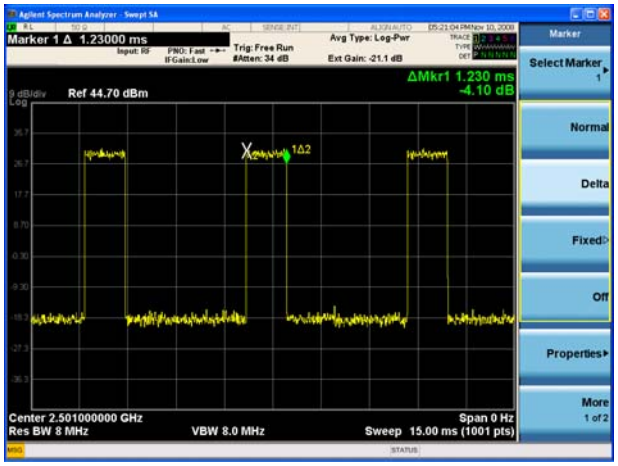
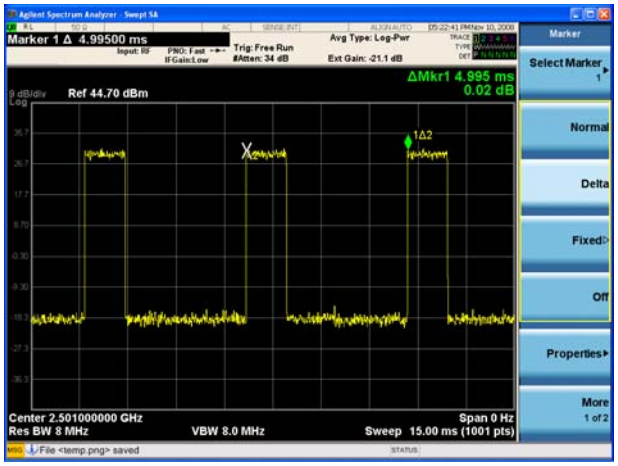
Mode	Channel Band-width	Ch. No.	f (MHz)	Couducted Power (dBm)		Peak-to-Average	Duty Cycle (%)	Power Setting
				Peak	Average			
QPSK (4QAM)	10	0	2501	32.40	23.02	9.38	24.62	23.5
		368	2593	32.57	22.90	9.67		23.5
		736	2685	31.98	22.40	9.58		23.5

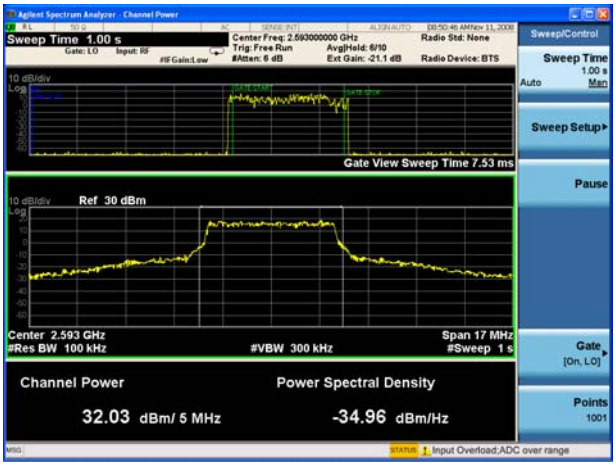
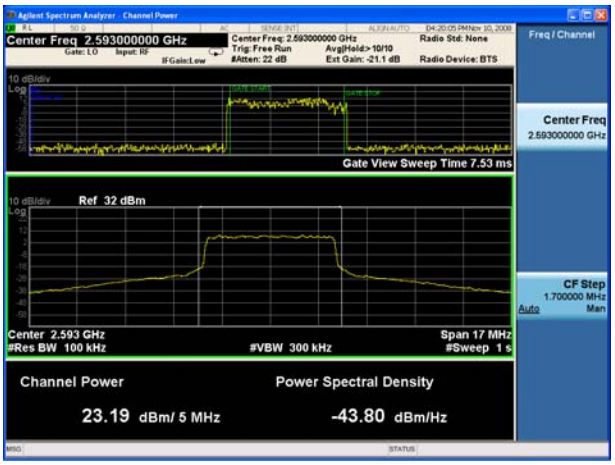
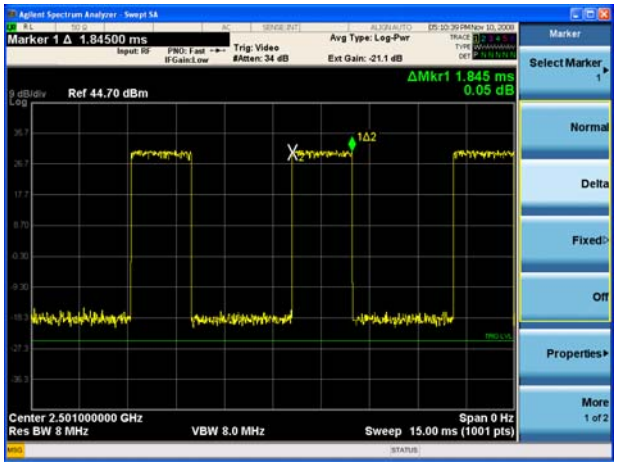
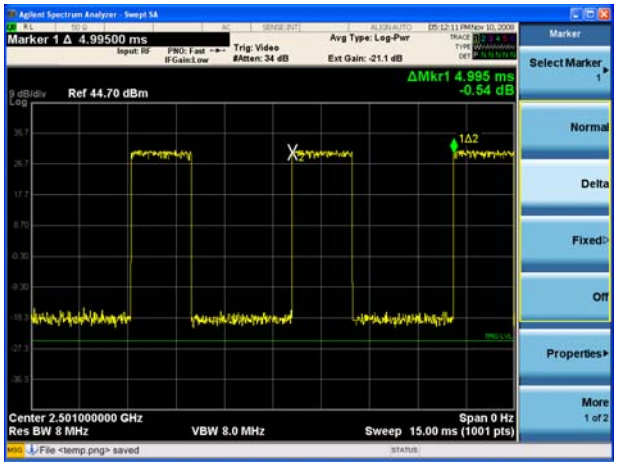
Mode	Channel Band-width	Ch. No.	f (MHz)	Couducted Power (dBm)		Peak-to-Average	Duty Cycle (%)	Power Setting
				Peak	Average			
16QAM	5	0	2498.5	31.94	23.37	8.57	36.9	23.5
		378	2593	32.03	23.19	8.84		23.5
		756	2687.5	31.46	22.79	8.67		23.5

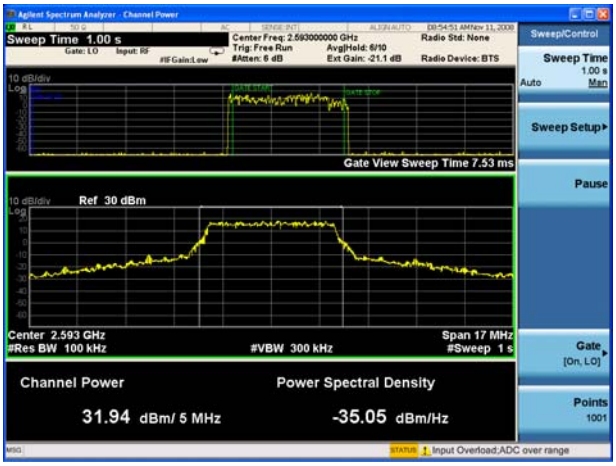
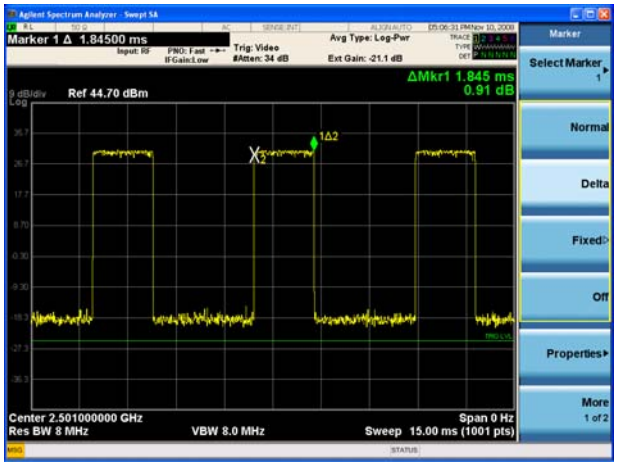
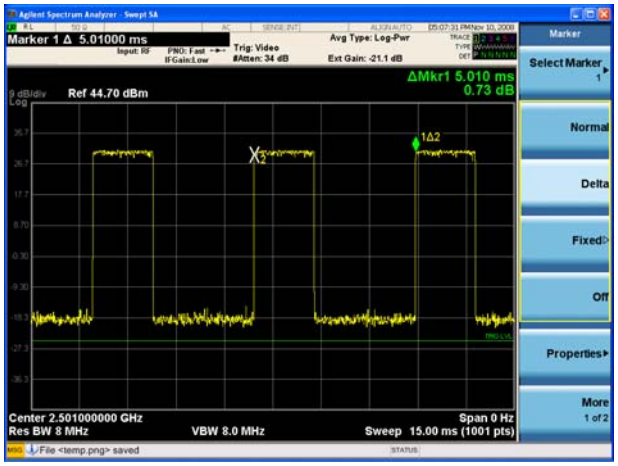
Mode	Channel Band-width	Ch. No.	f (MHz)	Couducted Power (dBm)		Peak-to-Average	Duty Cycle (%)	Power Setting
				Peak	Average			
QPSK (4QAM)	5	0	2498.5	31.7	23.45	8.25	36.8	23.5
		378	2593	31.94	23.46	8.48		23.5
		756	2687.5	31.33	22.59	8.74		23.5

Note:
PSA with Channel Power function and Gate On
Peak power: RBW=100 kHz; VBW = 300 kHz with Peak detection, sweep time = 1 s
Average power: RBW=100 kHz; VBW = 300 kHz with Avearge detection, sweep time = 1 s

Spectrum Plot for 16QAM/ 10 MHz @ center channel	
Peak	**Average**
	
Duty Cycle / 24.85%	
Tone 1.245 ms	**Tone-On + Tone off (5.01 ms)**
	

Spectrum Plot for QPSK/ 10 MHz @ center channel	
Peak	**Average**
	
Duty Cycle / 24.62%	
Tone 1.230 ms	**Tone-On + Tone off (4.995 ms)**
	

Spectrum Plot for 16QAM/ 5 MHz @ center channel	
Peak	**Average**
	
Duty Cycle / 36.9%	
Tone 1.845 ms	**Tone-On + Tone off (4.995 ms)**
	

Spectrum Plot for QPSK/ 10 MHz @ center channel	
Peak	**Average**
	
Duty Cycle / 36.8%	
Tone 1.845 ms	**Tone-On + Tone off (5.01 ms)**
	

15 FINAL SAR TEST RESULTS

Due to the host is tablet computer, KDB 447498 procedures is used while performing SAR evaluation.

Duty Factor Correction: Max. Duty Cycle for 10/5 MHz channel BW: 21/48=43.75%

DL: UL Ratio used during SAR measurement:

5 MHz Channel BW=29:18. 10 MHz Channel BW=35:12

Duty Cycle Scale Up Factor: Max. Duty Cycle/ measured Duty Cycle

Corrected 1-g SAR Value= Measured 1g SAR x Scale up factor

16QAM / 10 MHz scale up factor=1.76 (43.75/24.69)

QPSK / 10 MHz scale up factor=1.76 (43.75/24.69)

16QAM / 5 MHz scale up factor=1.18 (43.75/37)

QPSK / 5 MHz scale up factor= 1.18 (43.75/37)

1) Laptop Mode: Lap-held with the display open at 90° to the keyboard.

Mode	Ch. BW (MHz)	Ch. No.	Freq. (MHz)	1g_SAR (mW/g)	Duty Cycle Power Factor	Duty Cycle Factor Scale Up to Maximum of 43.75%	Corrected 1g-SAR(mW/g)	Limit
16QAM	5	378	2593	0.019	1.17	1.18	0.026	1.6

2) Tablet Mode 1: Edge - Primary Landscape

Mode	Ch. BW (MHz)	Ch. No.	Freq. (MHz)	1g_SAR (mW/g)	Duty Cycle Power Factor	Duty Cycle Factor Scale Up to Maximum of 43.75%	Corrected 1g-SAR(mW/g)	Limit
16QAM	5	378	2593	0.050	1.17	1.18	0.069	1.6

3) Tablet Mode 2: Edge - Secondary Landscape (Worst-case position)

Mode	Ch. BW (MHz)	Ch. No.	Freq. (MHz)	1g_SAR (mW/g)	Duty Cycle Power Factor	Duty Cycle Factor Scale Up to Maximum of 43.75%	Corrected 1g-SAR(mW/g)	Limit
QPSK (4QAM)	10	368	2593	0.097	1.26	1.76	0.215	1.6
16QAM	10	368	2593	0.093	1.26	1.76	0.206	
QPSK (4QAM)	5	378	2593	0.160	1.17	1.18	0.22	
16QAM	5	0	2498.5	0.122	1.17	1.18	0.168	
		378	**2593**	**0.161**	**1.17**	**1.18**	**0.222**	
		756	2687.5	0.071	1.17	1.18	0.098	

4) Tablet Mode 3: Edge - Primary Portrait
SAR testing is not required due to the large distance (> 20 cm) between main antenna and person's body.

5) Tablet Mode 4: Edge - Secondary Portrait
SAR testing is not required since the system disables the WiMAX device in Secondary Portrait (SP) mode.

6) Tablet Mode 5: Bottom Face - Lap-held

Mode	Ch. BW (MHz)	Ch. No.	Freq. (MHz)	1g_SAR (mW/g)	Duty Cycle Power Factor	Duty Cycle Factor Scale Up to Maximum of 43.75%	Corrected 1g-SAR(mW/g)	Limit
16QAM	5	378	2593	0.016	1.17	1.18	0.022	1.6

7) SAR Error Consideration

As documented in the section 15 of SAR measurement section, the highest measured SAR value at secondary landscape mode is 0.161 W/kg. Due to the larger separation distance from WiMAX main antenna (TX) to the body of user, estimation of PAR measurement cannot be done with meaningful SAR values with 3 dB power step.

16QAM 5 MHz Ch. BW SAR Plot & Data (Laptop Mode)

Date/Time: 11/22/2008 3:01:54 PM

Test Laboratory: Compliance Certification Services

Laptop mode

DUT: Lenovo X200 Tablet; Type: N/A; Serial: N/A

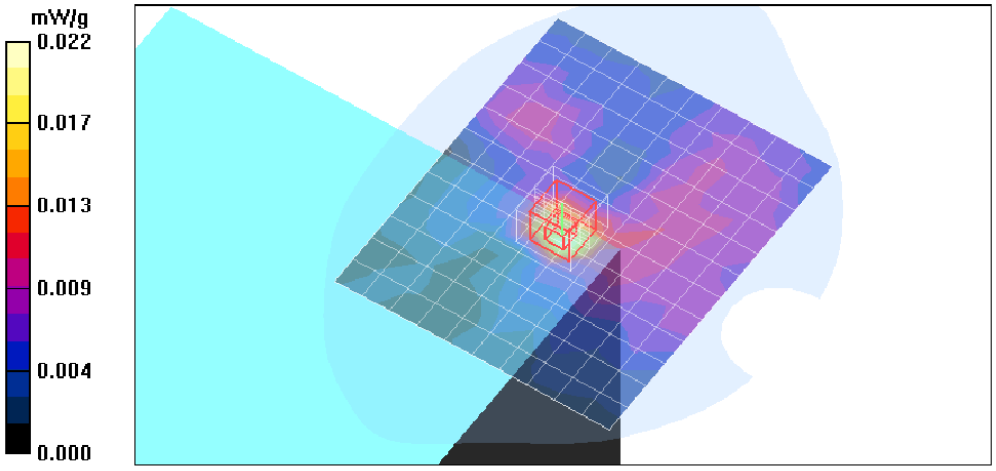
Communication System: WiMAX; Frequency: 2593 MHz;Duty Cycle: 1:2.71
Medium parameters used (interpolated): f = 2593 MHz; σ = 2.21 mho/m; ε_r = 50.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(7.58, 7.58, 7.58); Calibrated: 4/23/2008
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

16QAM 5 MHz_M-Ch WiMAX Main Ant/Area Scan (11x13x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.022 mW/g

16QAM 5 MHz_M-Ch WiMAX Main Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 2.40 V/m; Power Drift = -0.072 dB
Peak SAR (extrapolated) = 0.038 W/kg
SAR(1 g) = 0.019 mW/g; SAR(10 g) = 0.00889 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.025 mW/g



16QAM 5 MHz Ch. BW SAR Plot & Data (Primary Landscape Mode)

Date/Time: 11/22/2008 3:49:49 PM

Test Laboratory: Compliance Certification Services

Tablet mode - Primary Landscape

DUT: Lenovo X200 Tablet; Type: N/A; Serial: N/A

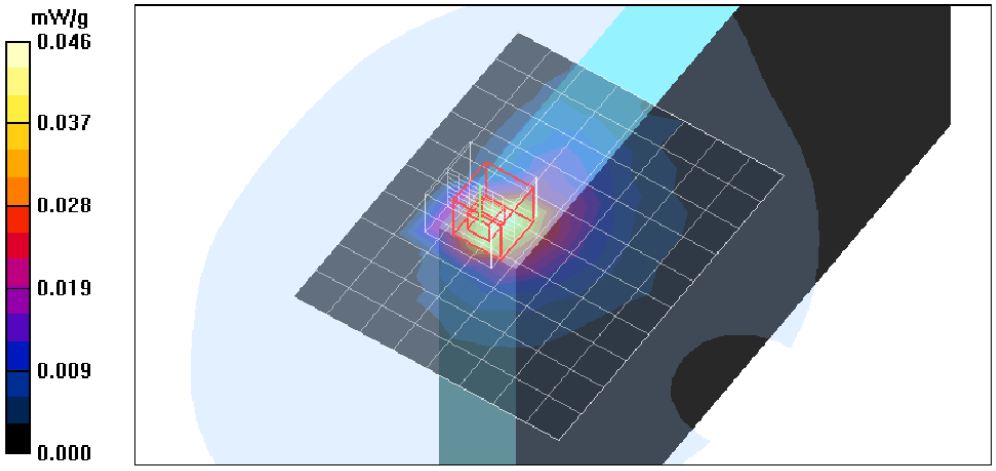
Communication System: WiMAX; Frequency: 2593 MHz;Duty Cycle: 1:2.71
Medium parameters used (interpolated): f = 2593 MHz; σ = 2.21 mho/m; ε_r = 50.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(7.58, 7.58, 7.58); Calibrated: 4/23/2008
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

16QAM 5 MHz_M-Ch WiMAX Main Ant/Area Scan (9x11x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.046 mW/g

16QAM 5 MHz_M-Ch WiMAX Main Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 3.24 V/m; Power Drift = 0.261 dB
Peak SAR (extrapolated) = 0.104 W/kg
SAR(1 g) = 0.050 mW/g; SAR(10 g) = 0.023 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.065 mW/g



16QAM 5 MHz Ch. BW SAR Plot & Data (Secondary Landscape Mode)

Date/Time: 11/21/2008 3:20:25 PM

Test Laboratory: Compliance Certification Services

Tablet Mode 2 Edge - Secondary Landscape

DUT: Lenovo X200 Tablet; Type: N/A; Serial: N/A

Communication System: WiMAX; Frequency: 2593 MHz;Duty Cycle: 1:2.71
Medium parameters used (interpolated): f = 2593 MHz; σ = 2.21 mho/m; ε_r = 50.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

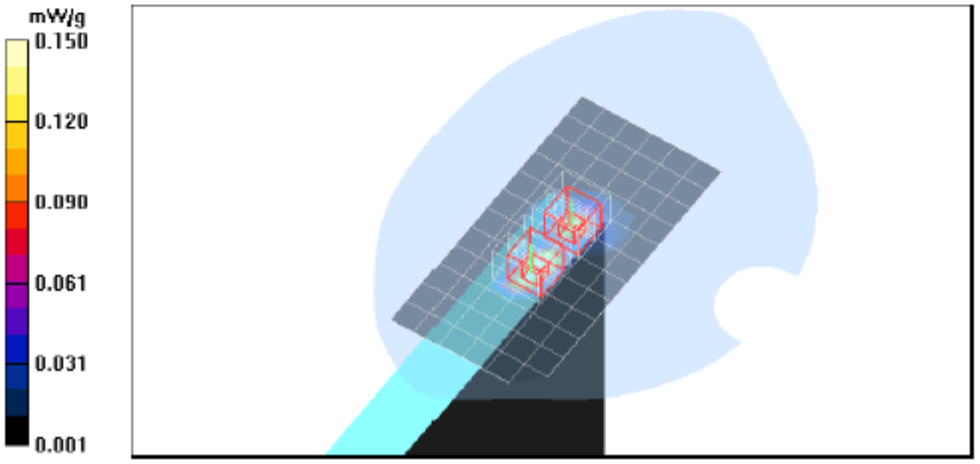
Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(7.58, 7.58, 7.58); Calibrated: 4/23/2008
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

16QAM 5 MHz_M-Ch WiMAX Main Ant/Area Scan (7x13x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.186 mW/g

16QAM 5 MHz_M-Ch WiMAX Main Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 3.51 V/m; Power Drift = 0.824 dB
Peak SAR (extrapolated) = 0.434 W/kg
SAR(1 g) = 0.161 mW/g; SAR(10 g) = 0.056 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.221 mW/g

16QAM 5 MHz_M-Ch WiMAX Main Ant/Zoom Scan 2 (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 3.51 V/m; Power Drift = 0.824 dB
Peak SAR (extrapolated) = 0.255 W/kg
SAR(1 g) = 0.108 mW/g; SAR(10 g) = 0.046 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.150 mW/g



16QAM 5 MHz Ch. BW SAR Plot & Data (Secondary Landscape Mode)

Date/Time: 11/21/2008 4:03:27 PM

Test Laboratory: Compliance Certification Services

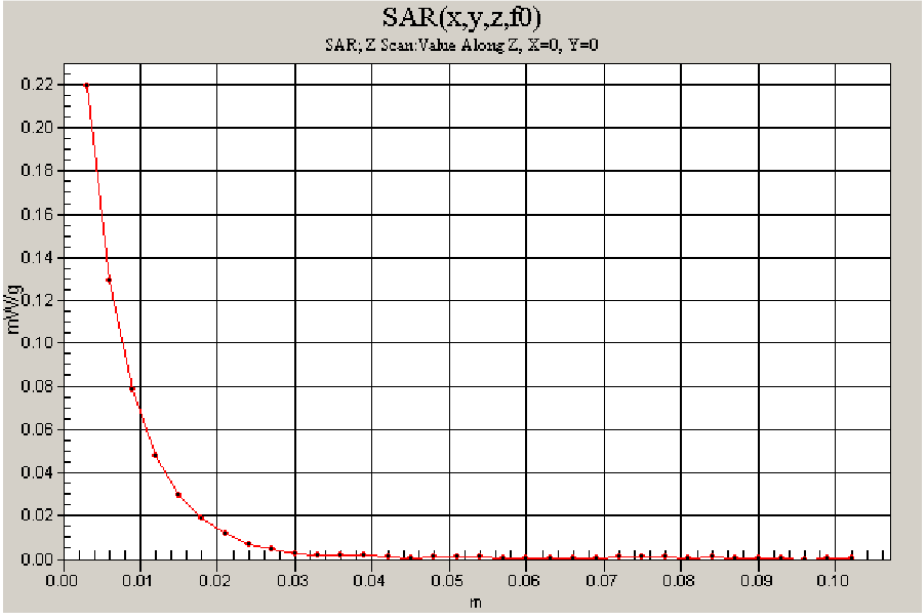
Tablet Mode 2 Edge - Secondary Landscape

DUT: Lenovo X200 Tablet; Type: N/A; Serial: N/A

Communication System: WiMAX; Frequency: 2593 MHz;Duty Cycle: 1:2.71

16QAM 5 MHz_M-Ch WiMAX Main Ant/Z Scan (1x1x34): Measurement grid: dx=20mm, dy=20mm, dz=3mm

Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.219 mW/g



16QAM 5 MHz Ch. BW SAR Plot & Data (Bottom Face - Lapheld Mode)

Date/Time: 11/22/2008 4:44:50 PM

Test Laboratory: Compliance Certification Services

Tablet mode - Lap-held

DUT: Lenovo X200 Tablet; Type: N/A; Serial: N/A

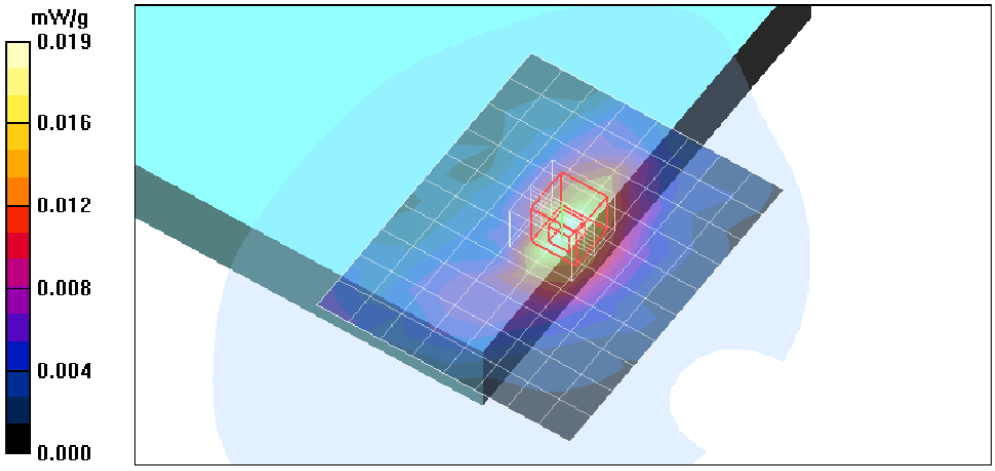
Communication System: WiMAX; Frequency: 2593 MHz;Duty Cycle: 1:2.71
Medium parameters used (interpolated): f = 2593 MHz; σ = 2.21 mho/m; ε_r = 50.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 25.0 deg. C; Liquid Temperature: 24.0 deg. C

DASY4 Configuration:
- Area Scan setting - Find Secondary Maximum Within: 2.0 dB and with a peak SAR value greater than 0.0012W/kg
- Probe: EX3DV3 - SN3531; ConvF(7.58, 7.58, 7.58); Calibrated: 4/23/2008
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 10/20/2008
- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050
- Measurement SW: DASY4, V4.7 Build 71; Postprocessing SW: SEMCAD, V1.8 Build 184

16QAM 5 MHz_M-Ch WiMAX Main Ant/Area Scan (9x11x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.019 mW/g

16QAM 5 MHz_M-Ch WiMAX Main Ant/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 2.10 V/m; Power Drift = -0.877 dB
Peak SAR (extrapolated) = 0.034 W/kg
SAR(1 g) = 0.016 mW/g; SAR(10 g) = 0.00848 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.021 mW/g



16 ATTACHMENTS

No.	Contents	No. Of Pages
1	System Performance Check Plots	4
2	SAR Test Plots	10
3	Certificate of E-Field Probe - EX3DV3SN3531	10
4	Certificate of System Validation Dipole - D2600V2 - SN:1006	6