FCC OET BULLETIN 65 SUPPLEMENT C

SAR EVALUATION REPORT / Part 27 WiMAX Portion

For

USB MODEM

MODEL: AC250U

FCC ID: N7NAC250U

REPORT NUMBER: 09U12929-8C3

ISSUE DATE: May 05, 2010

Prepared for

SIERRA WIRELESS INC.

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Prepared by

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NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	Feb.04, 2010	Initial Issue	--
A	Feb.23, 2010	Redo SAR Linearity Plots	Sunny Shih
A	March 12, 2010	Additional SAR test for Antenna # 2 (Secondary Tx)	Sunny Shih
B1	March 17, 2010	Update Page 8 Probe Calibration Error %	Sunny Shih
B2	March 25, 2010	Added power drift data in Section 12 Updated some typos in Section 13	Sunny Shih
B3	April 19, 2010	Added the following note on section 19. Note: This USB dongle position of orientation is limited by the hinge detent for 100 degree, 130 degree and 150 degree	Sunny Shih
B4	April 22, 2010	Additional SAR for USB connector B (Horizontal-Up) with the device parallel with the phantom at 5 mm.	Sunny Shih
C	April 25, 2010	Revised based upon FCC comments	Sunny Shih
C1	April 26, 2010	Revised based upon FCC comments	Sunny Shih
C3	May 05, 2010	Modified statement made on page 50 and 52 Photos.	Sunny Shih

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1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	SIERRA WIRELESS INC. 2200 Faraday Avenue, Suite 150 CARLSBAD, CA 92008
EUT DESCRIPTION:	USB MODEM
MODEL NUMBER:	AC250U
DEVICE CATEGORY:	Portable
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure
DATE TESTED:	December 19, 2009 – Feb.23, 2010 (Antenna # 1) March 9 - 10, 2010 (Antenna # 2) April 21, 2010 (Additional test SAR test position)

FCC rule parts	Freq. range (MHz)	Highest 1-g SAR (W/kg)	Limit (W/kg)
27	2498.5 – 2687.5	1.19 (5MHz 16QAM) USB Horizontal-down150º	1.6

Applicable Standards	Test Results
FCC OET Bulletin 65 Supplement C 01-01 and the following specific FCC test procedures: - KDB 615223 D01 802 16e WiMax SAR Guidance v01 - KDB 447498 D02 SAR Procedures for Dongle Xmtr v02	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. Measurement Uncertainties were not taken into account and are published for informational purposes only. 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. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST, any agency of the Federal Government, or any agency of any government (NIST Handbook 150, Annex A). This report is written to support regulatory compliance of the applicable standards stated above.

Approved & Released For CCS By:

SUNNY SHIH
ENGINEERING SUPERVISOR
COMPLIANCE CERTIFICATION SERVICES

Tested By:

DEVIN CHANG
EMC ENGINEER
COMPLIANCE CERTIFICATION SERVICES

2. TEST METHODOLOGY

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C 01-01 and the following specific FCC test procedures:

- o KDB 615223 D01 802 16e WiMax SAR Guidance v01
- o KDB 447498 D02 SAR Procedures for Dongle Xmtr v02

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.

Name of Equipment	Manufacturer	Type/Model	Serial No.	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	22	2010
Signal Generator	Agilent	8753ES-6	MY40001647	11	22	2010
E-Field Probe	SPEAG	EX3DV4	3686	3	23	2010
E-Field Probe	SPEAG	EX3DV3	3531	2	22	2011
Thermometer	ERTCO	639-1S	1718	9	15	2010
Data Acquisition Electronics	SPEAG	DAE3 V1	500	10	20	2010
System Validation Dipole	SPEAG	D2600V2	1006	4	22	2011
ESG Vector Signal Generator	Agilent	E4438C	US44271971	9	28	2010
Amplifier	Mini-Circuits	ZVE-8G	90606	N/A		
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	CCS	M2600	N/A	Within 24 hrs of first test		

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4.2. MEASUREMENT UNCERTAINTY

For December 19, 2009 – Feb.23, 2010 (Antenna # 1) & March 9 - 10, 2010 (Antenna # 2)
Measurement uncertainty for 300 MHz – 3000 MHz

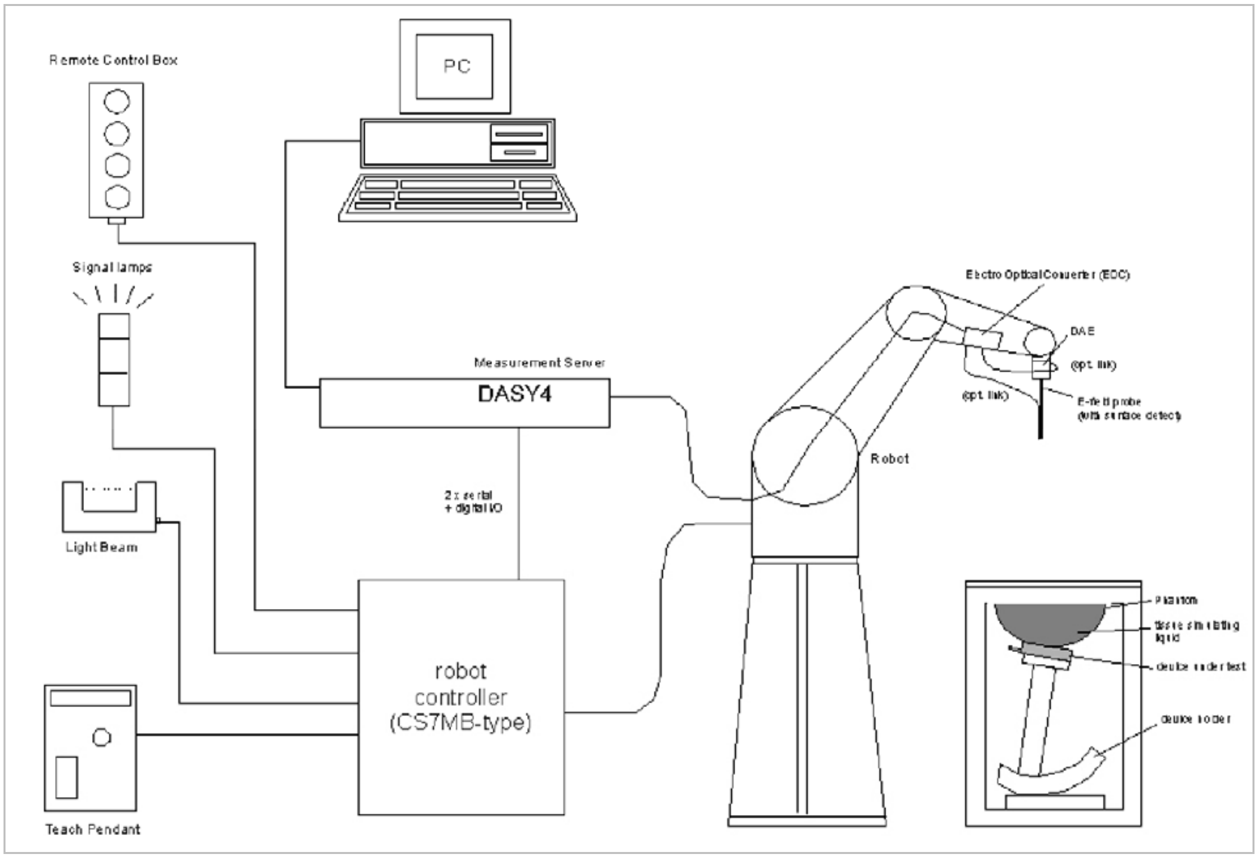
Specific Absorption Rate (SAR) uncertainty calculation					
300 MHz to 3 GHz averaged over 1 gram					
Component	**error, %**	**Distribution**	**Divisor**	**Sensitivity**	**U (Xi), %**
Measurement System					
Probe Calibration (k=1)@2600 MHz	5.5	Normal	1	1	5.5
Axial Isotropy	1.15	Rectangular	1.732	0.7071	0.47
Hemispherical Isotropy	2.30	Rectangular	1.732	0.7071	0.94
Boundary Effect	0.90	Rectangular	1.732	1	0.52
Probe Linearity	3.45	Rectangular	1.732	1	1.99
System Detection Limits	1.00	Rectangular	1.732	1	0.58
Readout Electronics	0.30	Normal	1	1	0.30
Response Time	0.80	Rectangular	1.732	1	0.46
Integration Time	2.60	Rectangular	1.732	1	1.50
RF Ambient Conditions - Noise	3.00	Rectangular	1.732	1	1.73
RF Ambient Conditions - Reflections	3.00	Rectangular	1.732	1	1.73
Probe Positioner Mechanical Tolerance	0.40	Rectangular	1.732	1	0.23
Probe Positioning with respect to Phantom	2.90	Rectangular	1.732	1	1.67
Extrapolation, Interpolation and Integration	1.00	Rectangular	1.732	1	0.58
Test Sample Related					
Test Sample Positioning	2.90	Normal	1	1	2.90
Device Holder Uncertainty	3.60	Normal	1	1	3.60
Output Power Variation - SAR Drift	5.00	Rectangular	1.732	1	2.89
Phantom and Tissue Parameters					
Phantom Uncertainty (shape and thickness)	4.00	Rectangular	1.732	1	2.31
Liquid Conductivity - deviation from target	5.00	Rectangular	1.732	0.64	1.85
Liquid Conductivity - measurement	4.24	Normal	1	0.64	2.71
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement uncertainty	2.36	Normal	1	0.6	1.42
Combined Standard Uncertainty Uc(y)					9.92
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 19.85%					
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 1.57dB					

For April 21, 2010 (Additional test SAR test position)

Measurement uncertainty for 300 MHz to 3 GHz averaged over 1 gram

Component	error, %	Probe Distribution	Divisor	Sensitivity	U (Xi), %
Measurement System					
Probe Calibration (k=1) @ 2600 MHz	5.50	Normal	1	1	5.50
Axial Isotropy	1.15	Rectangular	1.732	0.7071	0.47
Hemispherical Isotropy	9.20	Rectangular	1.732	0.7071	3.76
Boundary Effect	0.90	Rectangular	1.732	1	0.52
Probe Linearity	3.45	Rectangular	1.732	1	1.99
System Detection Limits	1.00	Rectangular	1.732	1	0.58
Readout Electronics	0.30	Normal	1	1	0.30
Response Time	0.80	Rectangular	1.732	1	0.46
Integration Time	2.60	Rectangular	1.732	1	1.50
RF Ambient Conditions - Noise	3.00	Rectangular	1.732	1	1.73
RF Ambient Conditions - Reflections	3.00	Rectangular	1.732	1	1.73
Probe Positioner Mechanical Tolerance	0.40	Rectangular	1.732	1	0.23
Probe Positioning with respect to Phantom	2.90	Rectangular	1.732	1	1.67
Extrapolation, Interpolation and Integration	1.00	Rectangular	1.732	1	0.58
Test Sample Related					
Test Sample Positioning	2.90	Normal	1	1	2.90
Device Holder Uncertainty	3.60	Normal	1	1	3.60
Output Power Variation - SAR Drift	5.00	Rectangular	1.732	1	2.89
Phantom and Tissue Parameters					
Phantom Uncertainty (shape and thickness)	4.00	Rectangular	1.732	1	2.31
Liquid Conductivity - deviation from target	5.00	Rectangular	1.732	0.64	1.85
Liquid Conductivity - measurement @ Body 2600 MHz	1.77	Normal	1	0.64	1.13
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement @ Body 2600 MHz	1.01	Normal	1	0.6	0.61
Combined Standard Uncertainty Uc(y) =					10.20
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				20.40	%
Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence =				1.61	dB

5. SYSTEM SPECIFICATIONS



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 validating the proper functioning of the system.

6. 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		2600
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04	0.05
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	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	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	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	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7	27.2
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5	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	2.16

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

7. TISSUE DIELECTRIC 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. For frequencies in 300 MHz to 2 GHz, the measured conductivity and relative permittivity should be within ± 5% of the target values. For frequencies in the range of 2–3 GHz and above the measured conductivity should be within ± 5% of the target values. The measured relative permittivity tolerance can be relaxed to no more than ± 10%.

Reference Values of Tissue Dielectric Parameters for Body Phantom

The 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)

7.1. LIQUID CHECK RESULTS FOR 2600 MHZ

Simulating Liquid Dielectric Parameter Check Result @ Body 2600 MHz

Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2500	e'	51.7390	Relative Permittivity (ϵ_r):	51.739	52.6	-1.64	± 5
	e"	13.9801	Conductivity (σ):	1.944	2.02	-3.75	± 5
2590	e'	51.4756	Relative Permittivity (ϵ_r):	51.476	52.5	-1.95	± 5
	e"	14.3408	Conductivity (σ):	2.066	2.15	-3.89	± 5
2600	e'	51.4547	Relative Permittivity (ϵ_r):	51.455	52.5	-2.01	± 5
	e"	14.3790	Conductivity (σ):	2.080	2.16	-3.75	± 5
2690	e'	51.1628	Relative Permittivity (ϵ_r):	51.163	52.4	-2.36	± 5
	e"	14.7379	Conductivity (σ):	2.205	2.29	-3.69	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
December 19, 2009 04:12 PM

Frequency	e'	e"
2480000000.	51.7936	13.8885
2490000000.	51.7723	13.9294
2500000000.	**51.7390**	**13.9801**
2510000000.	51.7085	14.0266
2520000000.	51.6803	14.0753
2530000000.	51.6548	14.1197
2540000000.	51.6227	14.1496
2550000000.	51.6055	14.1889
2560000000.	51.5528	14.2314
2570000000.	51.5265	14.2589
2580000000.	51.4939	14.2942
2590000000.	**51.4756**	**14.3408**
2600000000.	**51.4547**	**14.3790**
2610000000.	51.4301	14.4237
2620000000.	51.3887	14.4747
2630000000.	51.3577	14.5243
2640000000.	51.3253	14.5683
2650000000.	51.2866	14.5961
2660000000.	51.2525	14.6380
2670000000.	51.2223	14.6653
2680000000.	51.1931	14.6989
2690000000.	**51.1628**	**14.7379**
2700000000.	51.1440	14.7715
2710000000.	51.1122	14.8262
2720000000.	51.0581	14.8789

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 @ Body 2600 MHz
Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2500	e'	52.5576	Relative Permittivity (ϵ_r):	52.558	52.6	-0.08	± 5
	e"	14.5068	Conductivity (σ):	2.018	2.02	-0.12	± 5
2590	e'	52.2595	Relative Permittivity (ϵ_r):	52.260	52.5	-0.46	± 5
	e"	14.8353	Conductivity (σ):	2.138	2.15	-0.58	± 5
2600	e'	52.2093	Relative Permittivity (ϵ_r):	52.209	52.5	-0.57	± 5
	e"	14.8939	Conductivity (σ):	2.154	2.16	-0.30	± 5
2690	e'	51.9078	Relative Permittivity (ϵ_r):	51.908	52.4	-0.94	± 5
	e"	15.1893	Conductivity (σ):	2.273	2.29	-0.74	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
December 20, 2009 04:39 PM

Frequency	e'	e"
2480000000.	52.6024	14.3869
2490000000.	52.5795	14.4381
2500000000.	**52.5576**	**14.5068**
2510000000.	52.5108	14.5785
2520000000.	52.4766	14.6202
2530000000.	52.4595	14.6677
2540000000.	52.4184	14.7097
2550000000.	52.3854	14.7449
2560000000.	52.3289	14.7615
2570000000.	52.3060	14.7630
2580000000.	52.2805	14.7920
2590000000.	**52.2595**	**14.8353**
2600000000.	**52.2093**	**14.8939**
2610000000.	52.1645	14.9403
2620000000.	52.1270	14.9819
2630000000.	52.0838	15.0298
2640000000.	52.0558	15.1001
2650000000.	52.0074	15.1180
2660000000.	51.9707	15.1437
2670000000.	51.9663	15.1490
2680000000.	51.9357	15.1624
2690000000.	**51.9078**	**15.1893**
2700000000.	51.8668	15.2375
2710000000.	51.8216	15.2881
2720000000.	51.7867	15.3239

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 @ Body 2600 MHz
Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2500	e'	53.2439	Relative Permittivity (ϵ_r):	53.244	52.6	1.22	± 5
	e"	14.7737	Conductivity (σ):	2.055	2.02	1.72	± 5
2590	e'	52.9446	Relative Permittivity (ϵ_r):	52.945	52.5	0.85	± 5
	e"	14.9054	Conductivity (σ):	2.148	2.15	-0.11	± 5
2600	e'	52.9117	Relative Permittivity (ϵ_r):	52.912	52.5	0.76	± 5
	e"	15.0545	Conductivity (σ):	2.178	2.16	0.77	± 5
2690	e'	52.6156	Relative Permittivity (ϵ_r):	52.616	52.4	0.41	± 5
	e"	15.3102	Conductivity (σ):	2.291	2.29	0.05	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
December 21, 2009 03:15 PM

Frequency	e'	e"
2480000000.	53.1863	14.4811
2490000000.	53.2339	14.5737
2500000000.	**53.2439**	**14.7737**
2510000000.	53.1984	14.9495
2520000000.	53.1537	15.0426
2530000000.	53.1457	15.1028
2540000000.	53.1108	15.1407
2550000000.	53.0230	15.1400
2560000000.	52.9368	15.0395
2570000000.	52.9089	14.8993
2580000000.	52.9239	14.8534
2590000000.	**52.9446**	**14.9054**
2600000000.	**52.9117**	**15.0545**
2610000000.	52.8592	15.1915
2620000000.	52.7961	15.3307
2630000000.	52.7481	15.4430
2640000000.	52.7074	15.5256
2650000000.	52.6421	15.5267
2660000000.	52.6156	15.4709
2670000000.	52.6121	15.3689
2680000000.	52.6123	15.3170
2690000000.	**52.6156**	**15.3102**
2700000000.	52.5623	15.3755
2710000000.	52.4813	15.4666
2720000000.	52.4162	15.5668

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 @ Body 2600 MHz
Room Ambient Temperature = 23°C; Relative humidity = 40% Measured by: Devin Chang

Simulating Liquid		Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Depth (cm)							
2500	15	e'	52.1804	Relative Permittivity (ϵ_r):	52.1804	52.6	-0.80	± 5
		e"	15.1396	Conductivity (σ):	2.10559	2.02	4.24	± 5
2590	15	e'	52.0877	Relative Permittivity (ϵ_r):	52.0877	52.5	-0.79	± 5
		e"	15.4165	Conductivity (σ):	2.22129	2.15	3.32	± 5
2600	15	e'	51.9823	Relative Permittivity (ϵ_r):	51.9823	52.5	-1.01	± 5
		e"	15.4926	Conductivity (σ):	2.24087	2.16	3.71	± 5
2690	15	e'	51.7596	Relative Permittivity (ϵ_r):	51.7596	52.4	-1.22	± 5
		e"	15.8733	Conductivity (σ):	2.37541	2.29	3.73	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
March 09, 2010 02:50 PM

Frequency	e'	e"
2480000000.	52.3499	14.9354
2490000000.	52.2728	14.9895
2500000000.	**52.1804**	**15.1396**
2510000000.	52.0314	15.2681
2520000000.	51.9653	15.3929
2530000000.	51.9807	15.4724
2540000000.	52.0287	15.5595
2550000000.	52.0766	15.6041
2560000000.	52.0793	15.5566
2570000000.	52.1125	15.4495
2580000000.	52.1206	15.4026
2590000000.	**52.0877**	**15.4165**
2600000000.	**51.9823**	**15.4926**
2610000000.	51.8408	15.5768
2620000000.	51.7067	15.6743
2630000000.	51.5982	15.7788
2640000000.	51.5661	15.8754
2650000000.	51.5582	15.9354
2660000000.	51.6043	15.9626
2670000000.	51.6748	15.9256
2680000000.	51.7442	15.9052
2690000000.	**51.7596**	**15.8733**
2700000000.	51.7125	15.8925
2710000000.	51.6069	15.9396
2720000000.	51.4572	15.9750

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 @ Body 2600 MHz
Room Ambient Temperature = 23°C; Relative humidity = 40% Measured by: Devin Chang

Simulating Liquid		Parameters			Measured	Target	Deviation (%)	Limit (%)
f (MHz)	Depth (cm)							
2500	15	e'	52.5852	Relative Permittivity (ε_r):	52.5852	52.6	-0.03	± 5
		e''	14.7241	Conductivity (σ):	2.04780	2.02	1.38	± 5
2590	15	e'	52.4946	Relative Permittivity (ε_r):	52.4946	52.5	-0.01	± 5
		e''	15.0119	Conductivity (σ):	2.16299	2.15	0.60	± 5
2600	15	e'	52.3908	Relative Permittivity (ε_r):	52.3908	52.5	-0.23	± 5
		e''	15.0887	Conductivity (σ):	2.18245	2.16	1.00	± 5
2690	15	e'	52.1726	Relative Permittivity (ε_r):	52.1726	52.4	-0.43	± 5
		e''	15.4386	Conductivity (σ):	2.31036	2.29	0.89	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
March 10, 2010 11:24 AM

Frequency	e'	e''
2480000000.	52.7680	14.5281
2490000000.	52.6925	14.5873
2500000000.	**52.5852**	**14.7241**
2510000000.	52.4409	14.8478
2520000000.	52.3594	14.9477
2530000000.	52.3757	15.0330
2540000000.	52.4269	15.1197
2550000000.	52.4631	15.1541
2560000000.	52.4710	15.1220
2570000000.	52.5148	15.0258
2580000000.	52.5204	14.9846
2590000000.	**52.4946**	**15.0119**
2600000000.	**52.3908**	**15.0887**
2610000000.	52.2616	15.1577
2620000000.	52.1300	15.2430
2630000000.	52.0235	15.3300
2640000000.	51.9887	15.4202
2650000000.	51.9627	15.4772
2660000000.	52.0007	15.5025
2670000000.	52.0719	15.4804
2680000000.	52.1400	15.4561
2690000000.	**52.1726**	**15.4386**
2700000000.	52.1290	15.4699
2710000000.	52.0269	15.4919
2720000000.	51.8887	15.5321

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 @ Body 2600 MHz
Room Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Devin Chang

f (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit (%)
2500	e'	52.2449	Relative Permittivity (ϵ_r):	52.245	52.6	-0.68	± 5
	e"	14.7806	Conductivity (σ):	2.056	2.02	1.77	± 5
2590	e'	52.2246	Relative Permittivity (ϵ_r):	52.225	52.5	-0.52	± 5
	e"	14.9768	Conductivity (σ):	2.158	2.15	0.37	± 5
2600	e'	52.1098	Relative Permittivity (ϵ_r):	52.110	52.5	-0.76	± 5
	e"	15.0900	Conductivity (σ):	2.183	2.16	1.01	± 5
2690	e'	51.9277	Relative Permittivity (ϵ_r):	51.928	52.4	-0.90	± 5
	e"	15.4627	Conductivity (σ):	2.314	2.29	1.05	± 5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C
April 21, 2010 03:43 PM

Frequency	e'	e"
2450000000.	52.7296	14.8226
2460000000.	52.6125	14.7299
2470000000.	52.4742	14.5919
2480000000.	52.3922	14.5087
2490000000.	52.3416	14.5805
2500000000.	**52.2449**	**14.7806**
2510000000.	52.1076	14.9820
2520000000.	52.0332	15.1260
2530000000.	52.0605	15.2305
2540000000.	52.1307	15.3169
2550000000.	52.1830	15.3358
2560000000.	52.1816	15.2372
2570000000.	52.2144	15.0677
2580000000.	52.2397	14.9650
2590000000.	**52.2246**	**14.9768**
2600000000.	**52.1098**	**15.0900**
2610000000.	51.9463	15.2157
2620000000.	51.7896	15.3497
2630000000.	51.6919	15.4850
2640000000.	51.6383	15.6138
2650000000.	51.6272	15.6680
2660000000.	51.6928	15.6573
2670000000.	51.7936	15.5755
2680000000.	51.8864	15.5030
2690000000.	**51.9277**	**15.4627**
2700000000.	51.8930	15.4820
2710000000.	51.7538	15.5357
2720000000.	51.5836	15.6046
2730000000.	51.4262	15.7038
2740000000.	51.2919	15.8417
2750000000.	51.2022	15.9369

The conductivity (σ) can be given as:

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

where f = target f * 10^6

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

8. SYSTEM VERIFICATION

The system performance check is performed prior to any usage of the system in order to verify SAR measurement accuracy. 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 Head or Body simulating liquid of the following parameters.
- The DASY4 system with an Isotropic E-Field Probe EX3DV4 and EX3DV3 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 10 mm (above 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 fine cube was chosen for cube
- Distance between probe sensors and phantom surface was set to 3 mm.
  For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm
- The dipole input power (forward power) was 100 mW
- The results are normalized to 1 W input power.

Reference SAR Values for BODY-tissue from calibration certificate of SPEAG.

System validation dipole	Cal. certificate #	Cal. due date	SAR Avg (mW/g)		
			Tissue:	Head	Body
D2600V2	D2600V2-1006_Apr09	4/22/10	SAR_{1g}:		57.6
			SAR_{10g}:		25.8

8.1. SYSTEM CHECK RESULTS FOR D2600V2

System Validation Dipole: D2600V2 SN: 1006
Date: December 19, 2009
Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Devin Chang

Medium	CW Signal (MHz)	Forward Pwr (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Body	2600	250	1g SAR:	54.2	57.6	-5.90	±10
			10g SAR:	23.7	25.8	-8.14	

Date: March 9, 2009
Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Devin Chang

Medium	CW Signal (MHz)	Forward Pwr (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Body	2600	250	1g SAR:	58.9	57.6	2.26	±10
			10g SAR:	25.8	25.8	0.00	

Date: April 21, 2009
Ambient Temperature = 24°C; Relative humidity = 40% Measured by: Devin Chang

Medium	CW Signal (MHz)	Forward Pwr (mW)	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
Body	2600	250	1g SAR:	55.6	57.6	-3.47	±10
			10g SAR:	24.4	25.8	-5.43	

COMPLIANCE CERTIFICATION SERVICES FORM NO: CCSUP4031B
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888

9. WiMax DEVICE & SYSTEM OPERATING PARAMETERS

Description	Parameter	Comment
FCC ID	N7NAC250U	CDMA/WiMAX Combo USB Adapter
Radio Service	FCC Part 27	Rule parts
Transmit Frequency Range (MHz)	5 MHz BW: 2498.5 – 2687.5 10MHz BW:2501 - 2685	System parameter
System/Channel Bandwidth (MHz)	5MHz / 10MHz	System parameter
System Profile	Release 1.0 (Revision 1.7.1 2008)Band Class 3 Radio Profile 3A	Defined by WiMAX Forum
Modulation Schemes	QPSK, 16QAM	Identify all applicable UL modulations
Sampling Factor	28/25	System parameter
Sampling Frequency (MHz)	5 MHZ BW:5.6MHz 10MHz BW:11.2MHz	(Fs)
Sample Time (ns)	5MHz BW:178usec 10MHz BW:89.3usec	(1/Fs)
FFT Size (NFFT)	5MHz BW:512 10MHz BW:1024	(NFFT)
Sub-Carrier Spacing (kHz)	5MHz BW:10.9KHz 10MHz BW:10.9KHz	(If)
Useful Symbol time (as)	Symbol timing (NOT including guard time): 91.43us	(Tb=1/Δf)
Guard Time (as)	1/8 symbol:11.43us	(Tag=Tb/cp); cp = cyclic prefix
OFDMA Symbol Time (as)	102.86usec	(Ts=Tibet)
Frame Size (ms)	5	System parameter
TTG + RTG (as or number of symbols)	165.7usec	Idle time, system parameter
Number of DL OFDMA Symbols per Frame	29	Identify the allowed & maximum symbols, including both traffic & control symbols
Number of UL OFDMA Symbols per Frame	18	
DL:UL Symbol Ratio	29/18	For determining UL duty factor
Power Class (dBm)	Power Class 2 16QAM: 21 <= PTx,max < 25 QPSK: 23 <= PTx,max < 27	
Wave1 / Wave2	Wave 2: two antennas. Antenna1 (main) is TX/RX diversity antenna, Antenna 2(aux) is TX/RX diversity antenna. Antenna 1 and Antenna 2 cannot transmit simultaneously.	
UL Zone Types (FUSC, PUSC, OFUSC, OPUSC, AMC, TUSC1, TUSC2)	PUSC only	

Maximum Number of UL Sub-Carriers	**10 MHz BW**	**5 MHz BW**
	Null Sub-Carriers=184 Pilot Sub-Carriers=280 Data Sub-Carriers=560	Null Sub-Carriers=104 Pilot Sub-Carriers=136 Data Sub-Carrier=272
UL Burst Maximum Average Power	**ANT 1 (Main)**	**ANT 2 (AUX)**
	10 MHz/16QAM: 23.24 dBm	10 MHz/16QAM:22.96 dBm
	10 MHz / QPSK: 23.29 dBm	10 MHz /QPSK:22.9 dBm
	5 MHz / 16QAM:23.4 dBm	5 MHz/16QAM: 23.17 dBm
	5 MHz:/QPSK: 23.43 dBm	5 MHz/QPSK:23.25 dBm
Number and type of UL Control Symbols	3 (Ranging, CQICH, HARQ ACK/NACK) HARQ ACKCH is used for transmission of ACK/NACK for downlink HARQ burst. HARQ allows BS to employ aggressive link adaptation to improve system throughput. CQICH is used for transmission of CQI information from MS to BS. BS may utilize this information for link adaptation and handover decision. MS is configured by BS to transmit CQI every Nth frame, which implies that CQI feedback delay is determined by BS configuration. BS determines CQI period N as a result of trade-off between CQI overhead and CQI accuracy.	
UL Control Symbol Maximum Average Power	**ANT 1(Main)**	**Calculation**
	64.79mW for 5 MHz / QPSK	220.29mW x 5/17
	64.35mW for 5 MHZ / 16QAM	218.78mW x 5/17
	30.47mW for 10MHz / QPSK	213.30mW x 5/35
	30.12mW for 10MHz / 16QAM	210.86mW x 5/35
	ANT 2 (AUX)	**Calculation**
	62.16mW for 5 MHz / QPSK	211.35 mWx5/17
	61.03mW for 5 MHz / 16QAM	207.49 mWx5/17
	27.85mW for 10 MHz / QPSK	194.98 mWx5/35
	28.24mW for 10 MHz / 16QAM	197.70 mWx5/35

10. EUT DESCRIPTION

a. The Sierra Wireless CDMA/WiMAX Combo USB modem, model no: AC250U is equipped with cellular / PCS CDMA 2000 1xEVDO Rev. A and 2.6 GHz WiMAX radio capabilities.
b. AC250U 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.
c. The 802.16e WiMAX and CDMA radio will not transmit simultaneously. Once the network is chosen by the end user during WiMAX/CDMA network, only the WiMAX radio or CDMA radio will transmit.

10.1. 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 AC250U 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.

WiMAX chipset is capable of supporting the following Downlink / Uplink based upon 802.16e.

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

10.2. Duty Factor and Crest Factor Considerations

Vector Waveform File	Channel BW	Modulation	DL:UL Ratio	Measured Duty Factor (%) (1Δ-3Δ)/2Δ	Calculated Duty Factor	Calculated Crest Factor
T5D29U184Q34S85	5 MHz	QPSK	29:18	31.2%	30.86%	3.24
T5D29U1816Q34S85	5 MHz	16QAM	29:18	31.1%	30.86%	3.24
T10D29U184Q34S175	10 MHz	QPSK	29:18	31.2%	30.86%	3.24
T10D29U1816Q12S175	10 MHz	16QAM	29:18	31.2%	30.86%	3.24

Crest Factor: The SAR of this device is measured using a DL:UL symbol ratio of 29:18, consisting of 15 traffic symbols and 3 control symbols are not activated.. A duty factor of (15 x 102.857µs)/5000µs = 30.86% is applied by the SAR system to calculate the measured SAR. The cf factor, a conversion factor related to 1/(duty factor), used by SAR measurement systems for periodic pulse signal compensation is set to 1/0.3086 = 3.24.

Note: On the spectrum analyzer plots, very small power level corresponding to the noise floor of the TX in these first three control symbols. The remaining 15 symbols are fully occupied with a TX burst which uses all slots and therefore all sub channels.

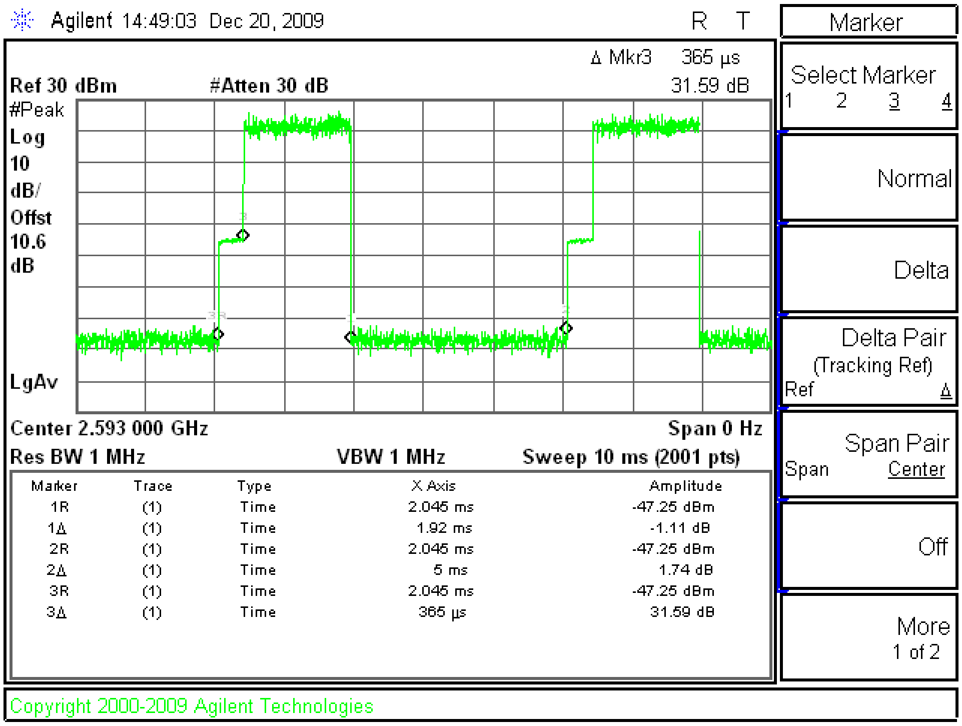


Figure 1 5 MHZ BW / 16QAM

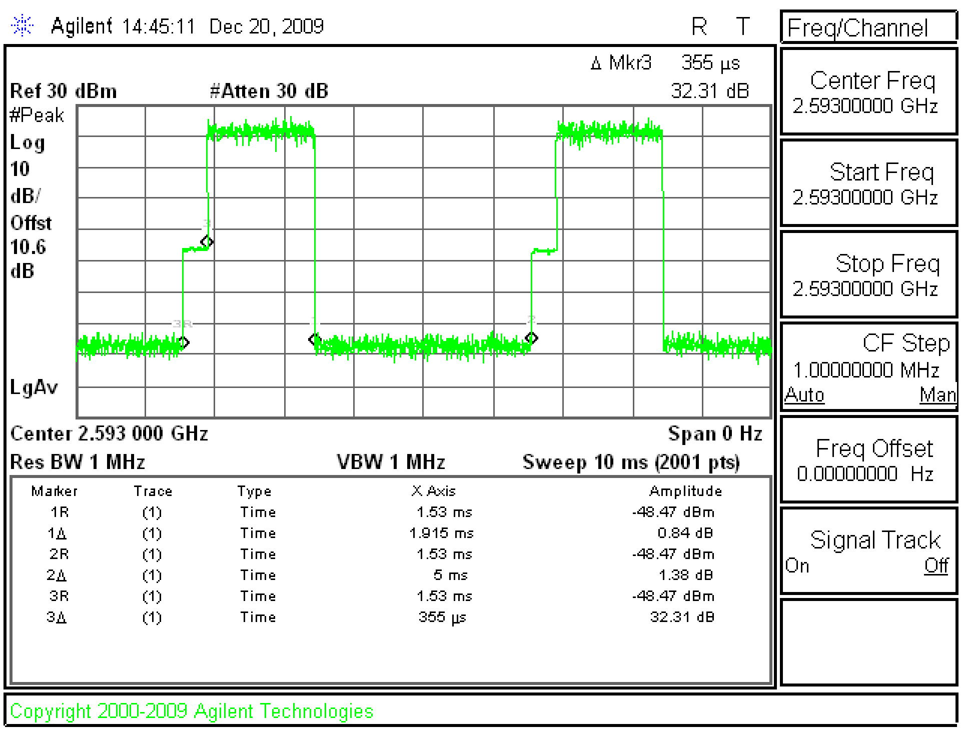


Figure 2 5 MHz BW / QPSK

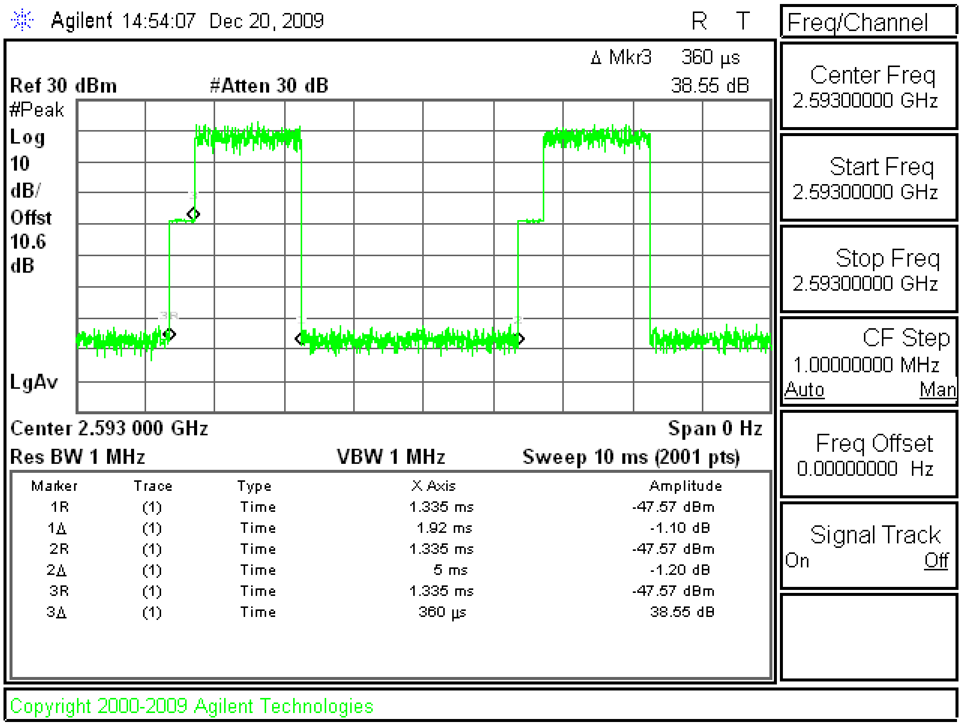


Figure 3 10 MHz BW / 16QAM

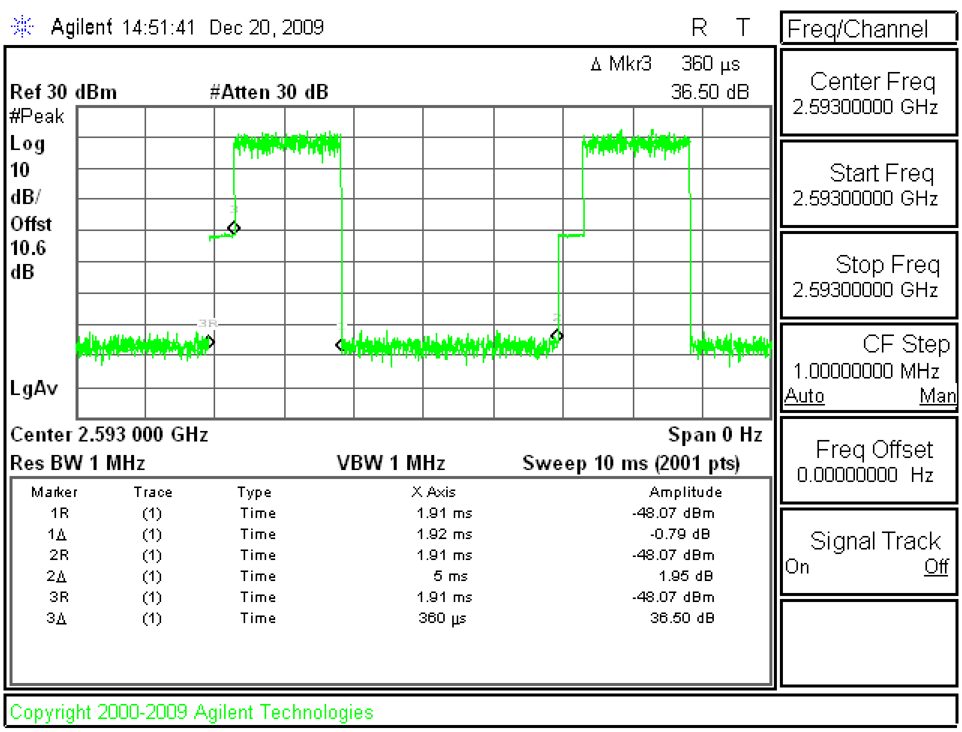


Figure 4 10 MHz BW / QPSK

10.3. SAR Scaling Consideration

d. All Test Vectors are performing with all UL symbols at maximum power

e. Although the chipset can supply higher downlink-to-uplink (DL/UL) symbol ratios, AC250U SAR values are scaled up or down based upon BRS/EBS WiMAX operators with agreements to transmit at a maximum DL/UL symbol ratio of 29:18 Vs actual UL traffic symbols were used during SAR measurement. 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.

f. UL Burst Max. Average Power: was measured using spectrum analyzer gated to measure the power only during TX “ON” stage.

ANT 1 (Main)			ANT 2 (AUX)		
10 MHz/16QAM	23.24 dBm	210.86mW	10 MHz/16QAM	22.96 dBm	197.70mW
10 MHz / QPSK	23.29 dBm	213.30mW	10 MHz /QPSK	22.9 dBm	194.98mW
5 MHz / 16QAM	23.4 dBm	218.78mW	5 MHz/16QAM	23.17 dBm	207.49mW
5 MHz:/QPSK	23.43 dBm	220.29mW	` 5 MHz/QPSK	23.25 dBm	211.35mW

g. 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.

h. 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 17 slots in the 5 MHz channel configuration.

i. When the device is transmitting at max. rated power, the output power for the control symbol is:

ANT 1 (Main)			ANT 2 (AUX)		
10 MHz/16QAM	210.86mWx5/35	30.12mW	10 MHz/16QAM	197.70mWx5/35	28.24mW
10 MHz / QPSK	213.30mWx5/35	30.47mW	10 MHz /QPSK	194.98mWx5/35	27.85mW
5 MHz / 16QAM	218.78mWx5/17	64.35mW	5 MHz/16QAM	207.49mWx5/17	61.03mW
5 MHz:/QPSK	220.29mWx5/17	64.79mW	` 5 MHz/QPSK	211.35mWx5/17	62.16mW

j. The target output power for DL:UL ratio of 29:18 is calculated as the following:

Modulation	Channel Bandwidth	ANT1/Main 29:18 DL:UL Ratio Power /mW	ANT2/Main 29:18 DL:UL Ratio Power /mW
16QAM	10 MHz	(30.12 x 3)+(210.86x15)=3253.26	(28.24x3)+(197.70x15)=3050.22
QPSK	10 MHz	(30.47x3)+(213.3X15)=3290.91	(27.85x3)+(194.98x15)=3008.25
16QAM	5 MHz	(64.35 X 3) +(218.78x15)=3474.75	(61.03x3)+(207.49x15)=3295.44
QPSK	5 MHz	(64.79X3) +(220.29X15)=3498.72	(62.16x3)+(211.35x15)=3356.73

k. Test Vector waveform power

T10D29U1816Q12S175 (29:18 DL:UL Ratio) 10 MHz BW/ 16 QAM						
Channe No	Frequency /MHz	ANT1 (Main) Measured Power/mW	ANT2(AUX) Measured Power/mW	Number of Traffic Symbols	ANT1(Main) Traffic Symbols Power/mW	ANT2(Aux) Traffic Symbols Power/mW
0	2501	210.86	176.20	15	3162.9	2643
368	2593	195.43	162.55	15	2931.45	2438.25
736	2685	204.17	197.7	15	3062.55	2965.5
T10D29U184Q34S175 (29:18 DL:UL Ratio) 10 MHz BW / QPSK						
0	2501	213.30	178.65	15	3199.5	2679.75
368	2593	196.34	164.06	15	2945.1	2460.9
736	2685	208.93	194.98	15	3133.95	2924.7
T5D29U1816Q34S85 (29:18 DL:UL Ratio) 5 MHz BW / 16QAM						
0	2498.5	218.78	190.99	15	3281.7	2864.85
378	2593	209.41	177.42	15	3141.15	2661.3
756	2687.5	217.27	207.49	15	3259.05	3112.35
T5D29U184Q34S85 (29:18 DL:UL Ratio) 5 MHz BW/ QPSK						
0	2498.5	220.29	192.31	15	3304.35	2884.65
378	2593	217.77	180.72	15	3266.55	2710.8
756	2687.5	218.78	211.35	15	3281.7	3170.25

10.4. Duty-Factor Scaling to DL:UL Ratio of 29:18

T10D29U1816Q12S175 (29:18 DL:UL Ratio) 10 MHz BW/ 16 QAM							
Channel No	Frequency/MHz	29:18 Target Power		29:18 Traffic Symbol Power		Scaling Factor (rated power/traffic power)	
		ANT1	ANT2	ANT1	ANT2	ANT1	ANT2
0	2501	3253.26	3050.22	3162.9	2643	1.03	1.15
368	2593	3253.26	3050.22	2931.45	2438.25	1.11	1.25
736	2685	3253.26	3050.22	3062.55	2965.5	1.07	1.03
T10D29U184Q34S175 (29:18 DL:UL Ratio) 10 MHz BW / QPSK							
0	2501	3290.91	3008.25	3199.5	2679.75	1.03	1.12
368	2593	3290.91	3008.25	2945.1	2460.9	1.12	1.22
736	2685	3290.91	3008.25	3133.95	2924.7	1.05	1.03
T5D29U1816Q34S85 (29:18 DL:UL Ratio) 5 MHz BW / 16QAM							
0	2498.5	3474.75	3295.44	3281.7	2864.85	1.06	1.15
378	2593	3474.75	3295.44	3141.15	2661.3	1.11	1.24
756	2687.5	3474.75	3295.44	3259.05	3112.35	1.07	1.06
T5D29U184Q34S85 (29:18 DL:UL Ratio) 5 MHz BW/ QPSK							
0	2498.5	3498.72	3356.73	3304.35	2884.65	1.06	1.16
378	2593	3498.72	3356.73	3266.55	2710.8	1.07	1.24
756	2687.5	3498.72	3356.73	3281.7	3170.25	1.07	1.06

11. SIGNAL GENERATOR DETAILS

Frame Profile loaded in Vector Signal Generator:

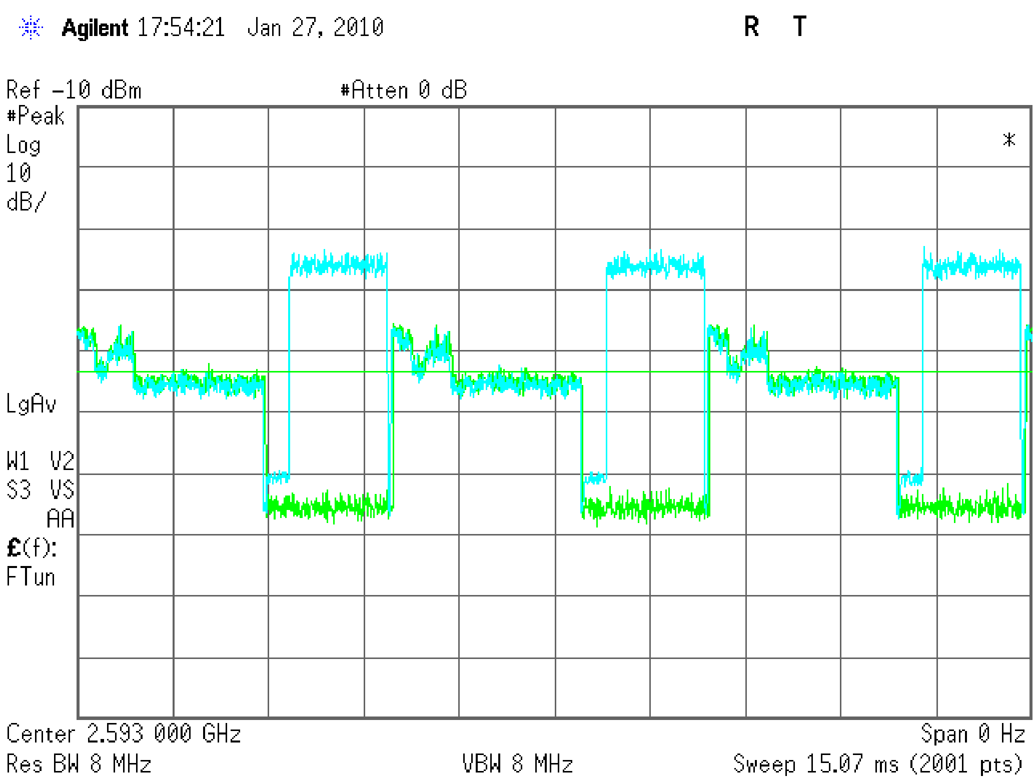
Vector Waveform File	Channel BW	Modulation	DL:UL Ratio	No of Traffic Symbol at Max. Power	No of Control Symbol with reduced power
T5D29U184Q34S85	5 MHz	QPSK	29:18	15	0
T5D29U1816Q34S85	5 MHz	16QAM	29:18	15	0
T10D29U184Q34S175	10 MHz	QPSK	29:18	15	0
T10D29U1816Q12S175	10 MHz	16QAM	29:18	15	0

Vector wave form Time Domain Plots Vs Modulated Plots

T10D29U1816Q12S175 / 10MHz BW / 16QAM

Green Trace= Vector Wave Form Generated by Vector Signal Generator before establishing the link to the EUT, ***the green trace is not needed for analysis and should be ignored.***

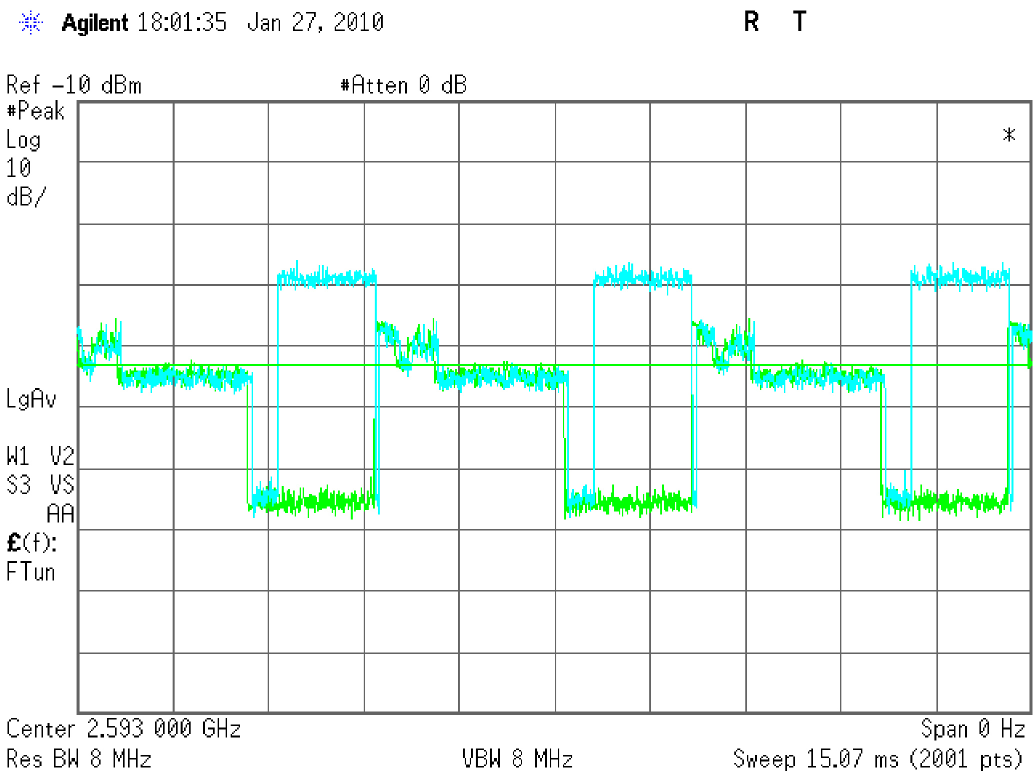
Blue Trace = Modulated Link



T10D29U184Q34S175 / 10 MHz BW / QPSK

Green Trace= Vector Wave Form Generated by Vector Signal Generator before establishing the link to the EUT, ***the green trace is not needed for analysis and should be ignored.***

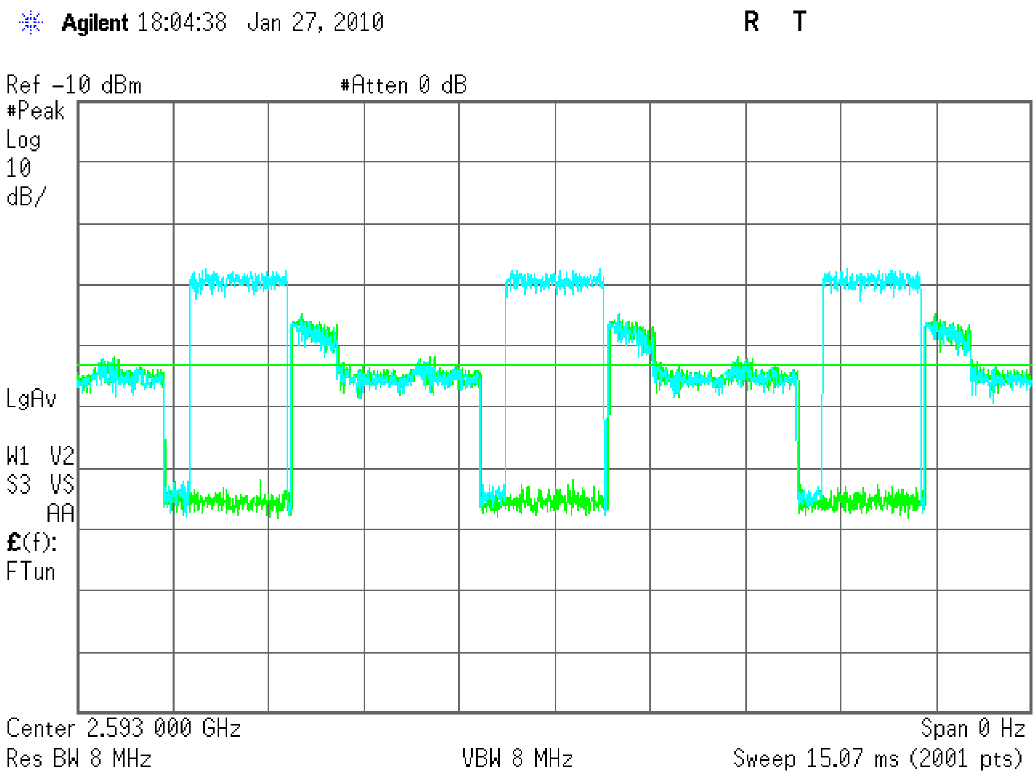
Blue Trace = Modulated Link



T5D29U1816Q34S85 / 5 MHz / 16QAM

Green Trace= Vector Wave Form Generated by Vector Signal Generator before establishing the link to the EUT. ***the green trace is not needed for analysis and should be ignored.***

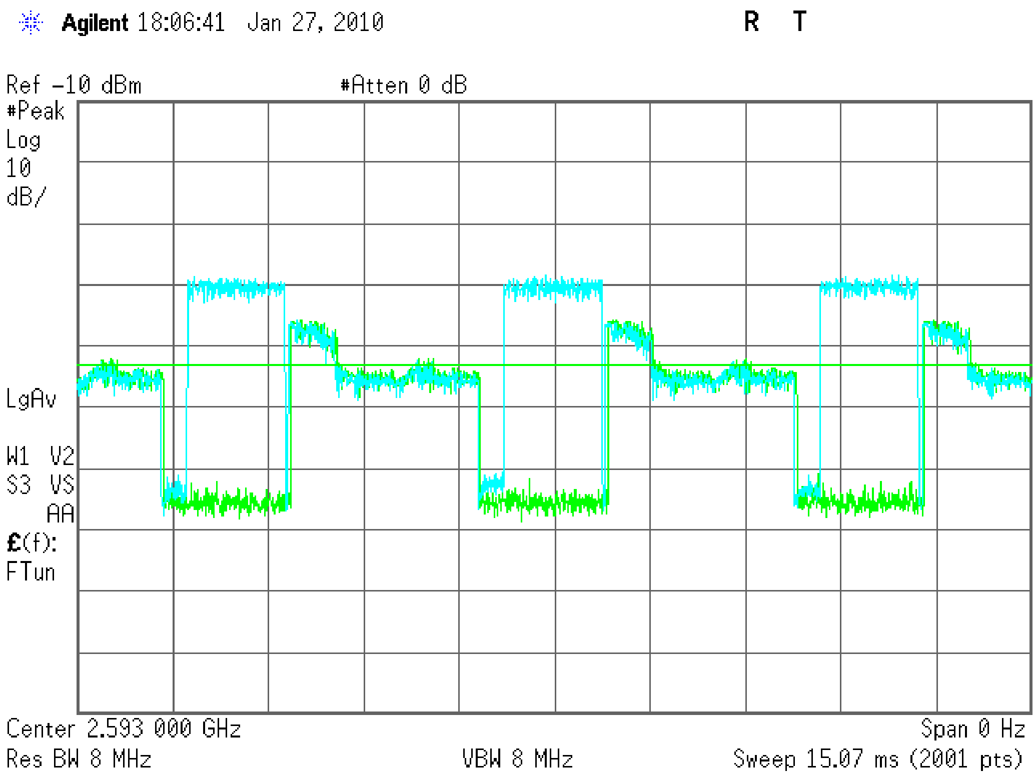
Blue Trace = Modulated Link



T5D29U184Q34S85 / 5 MHz / QPSK

Green Trace= Vector Wave Form Generated by Vector Signal Generator before establishing the link to the EUT, ***the green trace is not needed for analysis and should be ignored.***

Blue Trace = Modulated Link



12. OUTPUT POWER VERIFICATION

The max. conducted output power is measured for the uplink durst in the difference modulation and channel bandwidth. Conducted output powers were measured with the module connected to the test jig with over-to-air communication link to Vector Signal generator. During SAR evaluation, the AC250U is connected to notebook PC and the over-the-air communication link is established between AC250U data modem and Vector signal generator. The output power is measured for the uplink bursts through triggering and gating.

With Spectrum Analyzer with Gate-On, Channel Power

Vector Waveform File	Frequency (MHz)	Channel BW	Modulation	DL:UL Ratio	No of Traffic Symbol at Max. Power	No of Control Symbol with reduced power
T5D29U184Q34S85	2498.5	5 MHz	QPSK	29:18	15	0
	2593					
	2687.5					
T5D29U1816Q34S85	2498.5	5 MHz	16QAM	29:18	15	0
	2593					
	2687.5					
T10D29U184Q34S175	2501	10 MHz	QPSK	29:18	15	0
	2596					
	2685					
T10D29U1816Q12S175	2501	10 MHz	16QAM	29:18	15	0
	2596					
	2685					

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Power Drift: Per the requirement stated in IEEE1528 section 6.3.3., power drift shall be recorded the absolute value between step 1 and step 4. However, with repeat testing, it is not possible to obtain meaningful absolute value. In order to determine if device output has been stable during a SAR measurement, conducted power were measured before and after based upon the length of time of each SAR test to verify if the output changes are within the 5% drift (< 0.25 dB).

Antenna 1 (Main) Port

Mode	Test Vector file name	Freq.	Output Pwr				Delta
			Before		After SAR test		
		(MHz)	(dBm)	(mW)	(dBm)	(mW)	(%)
5MHz QPSK	T5D29U184Q12S85	2498.5	23.43	220.29	23.40	218.78	-0.13
		2593	23.38	217.77	23.38	217.77	0.00
		2687.5	23.40	218.78	23.35	216.27	-0.21
5MHz 16QAM	T5D29U1816Q34S85	2498.5	23.40	218.78	23.40	218.78	0.00
		2593	23.21	209.41	23.20	208.93	-0.04
		2687.5	23.37	217.27	23.35	216.27	-0.09
10MHz QPSK	T10D29U184Q12S175	2501	23.29	213.30	23.28	212.81	-0.04
		2593	22.93	196.34	22.90	194.98	-0.13
		2685	23.20	208.93	23.20	208.93	0.00
10MHz 16QAM	T10D29U1816Q12S175	2501	23.24	210.86	23.20	208.93	-0.17
		2593	22.91	195.43	22.90	194.98	-0.04
		2685	23.10	204.17	23.10	204.17	0.00

Antenna 2(Aux) Port

Mode	Test Vector file name	Freq.	Output Pwr				Delta
			Before		After SAR test		
		(MHz)	(dBm)	(mW)	(dBm)	(mW)	(%)
5MHz QPSK	T5D29U184Q12S85	2498.5	22.84	192.31	22.80	190.55	-0.18
		2593	22.57	180.72	22.55	179.89	-0.09
		2687.5	23.25	211.35	23.20	208.93	-0.22
5MHz 16QAM	T5D29U1816Q34S85	2498.5	22.81	190.99	22.80	190.55	-0.04
		2593	22.49	177.42	22.45	175.79	-0.18
		2687.5	23.17	207.49	23.15	206.54	-0.09
10MHz QPSK	T10D29U184Q12S175	2501	22.52	178.65	22.50	177.83	-0.09
		2593	22.15	164.06	22.11	162.55	-0.18
		2685	22.90	194.98	22.80	190.55	-0.44
10MHz 16QAM	T10D29U1816Q12S175	2501	22.46	176.20	22.46	176.20	0.00
		2593	22.11	162.55	22.05	160.32	-0.27
		2685	22.96	197.70	22.90	194.98	-0.26

13. PEAK TO AVERAGE RATIO

Peak and Average Output power measurements were made with Power Meter.

Mode	Test Vector file name	f (MHz)	Conducted Power (dBm)		Peak-to-average ratio (PAR)
			Peak	Average	
5MHz QPSK	T5D29U184Q12S85	2593	31.872	23.971	7.901
5MHz 16QAM	T5D29U1816Q34S85	2593	31.872	23.93	7.942
10MHz QPSK	T10D29U184Q12S175	2593	31.872	23.529	8.343
10MHz 16QAM	T10D29U1816Q12S175	2593	31.872	23.541	8.331

5MHz_QPSK

5MHz_16QAM

10MHz_QPSK

10MHz_16QAM

14. SUMMARY OF SAR TEST RESULTS

1 HORIZONTAL-UP/Connector A/Side B faced phantom/150 degree/ Setup Picture #1

(A)
Horizontal-Up Inserted into laptop

Antenna # 1 (Primary Tx)

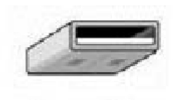
BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	QPSK	T5D29U184Q34S85	Horizontal-up 150º Degrees	Low	2498.5			
				Middle	2593.0	0.136	1.070	0.15
				High	2687.5			
5MHz	16QAM	T5D29U1816Q34S85	Horizontal-up 150º Degrees	Low	2498.5			
				Middle	2593.0	0.156	1.110	0.17
				High	2687.5			
10MHz	QPSK	T10D29U184Q34S175	Horizontal-up 150º Degrees	Low	2501.0			
				Middle	2593.0	0.144	1.120	0.16
				High	2685.0			
10MHz	16QAM	T10D29U1816Q34S175	Horizontal-up 150º Degrees	Low	2501.0			
				Middle	2593.0	0.140	1.110	0.16
				High	2685.0			

Antenna # 2 (Secondary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	16QAM	T5D29U1816Q34S85	Horizontal-up 150º Degrees	Low	2498.5			
				Middle	2593.0	0.305	1.240	0.38
				High	2687.5			

Note: Based upon the power measurement, ANT2 has lower output power by comparing to ANT1. Based upon section 19 antenna location, the antenna-to-user separation distance of ANT1 is closer than ANT2. At ANT2 position, SAR is performed on the highest SAR value at ANT1 position.

2-1_ HORIZONTAL-DOWN/Connector B/Side A faced phantom/150 degree/Setup Picture #2



(B)

Horizontal-Down With USB cable .Due to the 150 degree operation, this test position to evaluate the 5 mm distance to the closest point of EUT dongle.

Antenna # 1 (Primary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	QPSK	T5D29U184Q34S85	Horizontal-down 150º Degrees	Low	2498.5			
				Middle	2593.0	0.749	1.070	0.80
				High	2687.5			
5MHz	16QAM	T5D29U1816Q34S85	Horizontal-down 150º Degrees	Low	2498.5			
				Middle	2593.0	0.757	1.110	0.84
				High	2687.5			
10MHz	QPSK	T10D29U184Q34S175	Horizontal-down 150º Degrees	Low	2501.0			
				Middle	2593.0	0.676	1.120	0.76
				High	2685.0			
10MHz	16QAM	T10D29U1816Q34S175	Horizontal-down 150º Degrees	Low	2501.0			
				Middle	2593.0	0.655	1.110	0.73
				High	2685.0			

Antenna # 2 (Secondary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	16QAM	T5D29U1816Q34S85	Horizontal-up 150º Degrees	Low	2498.5			
				Middle	2593.0	0.405	1.240	0.50
				High	2687.5			

Note: Based upon the power measurement, ANT2 has lower output power by comparing to ANT1. Based upon section 19 antenna location, the antenna-to-user separation distance of ANT1 is closer than ANT2. At ANT2 position, SAR is performed on the highest SAR value at ANT1 position.

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2-2_ HORIZONTAL-DOWN/Connector B/ Side A parallel with phantom/Setup Picture#3

(B)
Horizontal-Down With USB cable

Antenna # 1 (Primary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	16QAM	T5D29U1816Q34S85	Horizontal-down 150º Degrees	Low	2498.5	1.120	1.060	**1.19**
				Middle	2593.0	0.991	1.110	1.10
				High	2687.5	0.956	1.070	1.02
10MHz	QPSK	T10D29U184Q34S175	Horizontal-down 150º Degrees	Low	2501.0	0.990	1.030	1.02
				Middle	2593.0	0.850	1.120	0.95
				High	2685.0	0.895	1.050	0.94

Antenna # 2 (Secondary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	16QAM	T5D29U1816Q34S85	Horizontal-up 150º Degrees	Low	2498.5			
				Middle	2593.0	0.436	1.240	**0.54**
				High	2687.5			

3-1_ VERTICAL-FRONT/Connector C/Side A faced phantom (Worst-Case)/150 degree/ Setup Picture#4

(C)
Vertical-Front

With USB cable. Due to the 150 degree operation, this test position to evaluate the 5 mm distance to the closest point of EUT dongle. ***This test position was chosen voluntarily and was not required by KDB 447498 D02.***

Antenna # 1 (Primary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	QPSK	T5D29U184Q34S85	Vertical-front (Face UP)	Low	2498.5	1.020	1.060	1.08
				Middle	2593.0	0.892	1.070	0.95
				High	2687.5	0.649	1.070	0.69
5MHz	16QAM	T5D29U1816Q34S85	Vertical-front (Face UP)	Low	2498.5	1.030	1.060	1.09
				Middle	2593.0	0.859	1.110	0.95
				High	2687.5	0.644	1.070	0.69
10MHz	QPSK	T10D29U184Q34S175	Vertical-front (Face UP)	Low	2501.0	0.898	1.030	0.92
				Middle	2593.0	0.817	1.120	0.92
				High	2685.0	0.592	1.050	0.62
10MHz	16QAM	T10D29U1816Q34S175	Vertical-front (Face UP)	Low	2501.0			
				Middle	2593.0	0.789	1.110	0.88
				High	2685.0			

Antenna # 2 (Secondary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	QPSK	T5D29U184Q34S85	Vertical-front (Face UP)	Middle	2593.0	0.408	1.240	0.51
5MHz	16QAM	T5D29U1816Q34S85	Vertical-front (Face UP)	Middle	2593.0	0.405	1.240	0.50
10MHz	QPSK	T10D29U184Q34S175	Vertical-front (Face UP)	Middle	2593.0	0.375	1.220	0.46
10MHz	16QAM	T10D29U1816Q34S175	Vertical-front (Face UP)	Middle	2593.0	0.368	1.250	0.46

Note: Based upon the power measurement, ANT2 has lower output power by comparing to ANT1. Based upon section 19 antenna location, at this position, ANT2 has closer antenna-to-user separation distance by comparing to ANT1. Thus all BW and Modulations are investigated on ANT1 and ANT2 position.

3-2_VERTICAL-FRONT/Connector B/ Edge B faced phantom/Setup Picture#5

Antenna # 1 (Primary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	QPSK	T5D29U184Q34S85	Vertical-front (Face Left)	Low	2498.5			
				Middle	2593.0	0.365	1.070	0.39
				High	2687.5			
5MHz	16QAM	T5D29U1816Q34S85	Vertical-front (Face Left)	Low	2498.5			
				Middle	2593.0	0.347	1.110	0.39
				High	2687.5			
10MHz	QPSK	T10D29U184Q34S175	Vertical-front (Face Left)	Low	2501.0			
				Middle	2593.0	0.321	1.120	0.36
				High	2685.0			
10MHz	16QAM	T10D29U1816Q34S175	Vertical-front (Face Left)	Low	2501.0			
				Middle	2593.0	0.303	1.110	0.34
				High	2685.0			

Antenna # 2 (Secondary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	16QAM	T5D29U1816Q34S85	Horizontal-up 150º Degrees	Low	2498.5			
				Middle	2593.0	0.223	1.240	0.28
				High	2687.5			

Note: Based upon the power measurement, ANT2 has lower output power by comparing to ANT1. Based upon section 19 antenna location, the antenna-to-user separation distance of ANT1 is closer than ANT2. At ANT2 position, SAR is performed on the highest SAR value at ANT1 position.

4-1 VERTICAL-BACK/Connector D/ Side B faced phantom/Setup Picture#6

(D)

Vertical-Back Inserted into laptop. Due to the 150 degree operation, this test position to evaluate the 5 mm distance to the closest point of EUT dongle. ***This test position was chosen voluntarily and was not required by KDB 447498 D02.***

Antenna # 1 (Primary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	QPSK	T5D29U184Q34S85	Vertical-back 150º Degrees	Low	2498.5			
				Middle	2593.0	0.130	1.070	0.14
				High	2687.5			
5MHz	16QAM	T5D29U1816Q34S85	Vertical-back 150º Degrees	Low	2498.5			
				Middle	2593.0	0.126	1.110	0.14
				High	2687.5			
10MHz	QPSK	T10D29U184Q34S175	Vertical-back 150º Degrees	Low	2501.0			
				Middle	2593.0	0.120	1.120	0.13
				High	2685.0			
10MHz	16QAM	T10D29U1816Q34S175	Vertical-back 150º Degrees	Low	2501.0			
				Middle	2593.0	0.117	1.110	0.13
				High	2685.0			

Antenna # 2 (Secondary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	16QAM	T5D29U1816Q34S85	Horizontal-up 150º Degrees	Low	2498.5			
				Middle	2593.0	0.226	1.240	0.28
				High	2687.5			

Note: Based upon the power measurement, ANT2 has lower output power by comparing to ANT1. Based upon section 19 antenna location, the antenna-to-user separation distance of ANT1 is closer than ANT2. At ANT2 position, SAR is performed on the highest SAR value at ANT1 position.

4-2 VERTICAL-BACK/ Connector D/ Edge A faced phantom/Setup Picture#7

Antenna # 1 (Primary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	QPSK	T5D29U184Q34S85	Vertical-back (Face Right)	Low	2498.5			
				Middle	2593.0	0.109	1.070	0.12
				High	2687.5			
5MHz	16QAM	T5D29U1816Q34S85	Vertical-back (Face Right)	Low	2498.5			
				Middle	2593.0	0.115	1.110	0.13
				High	2687.5			
10MHz	QPSK	T10D29U184Q34S175	Vertical-back (Face Right)	Low	2501.0			
				Middle	2593.0	0.104	1.120	0.12
				High	2685.0			
10MHz	16QAM	T10D29U1816Q34S175	Vertical-back (Face Right)	Low	2501.0			
				Middle	2593.0	0.102	1.110	0.11
				High	2685.0			

Antenna # 2 (Secondary Tx)

BW	Mode	Test vector file name	Test position	Ch No.	f (MHz)	SAR (mW/g)		
						1-g	Scaling Factor	Adjusted 1-g
5MHz	16QAM	T5D29U1816Q34S85	Horizontal-up 150° Degrees	Low	2498.5			
				Middle	2593.0	0.050	1.240	0.06
				High	2687.5			

Note: Based upon the power measurement, ANT2 has lower output power by comparing to ANT1. Based upon section 19 antenna location, the antenna-to-user separation distance of ANT1 is closer than ANT2. At ANT2 position, SAR is performed on the highest SAR value at ANT1 position.

15. WORST-CASE SAR TEST PLOTS

WORST-CASE SAR PLOT

Date/Time: 4/21/2010 5:06:20 PM

Test Laboratory: Compliance Certification Services

Horizon Down Antenna 1_5M_16QAM

DUT: Sierra Wireless; Type: AC250; Serial: Unit # 1

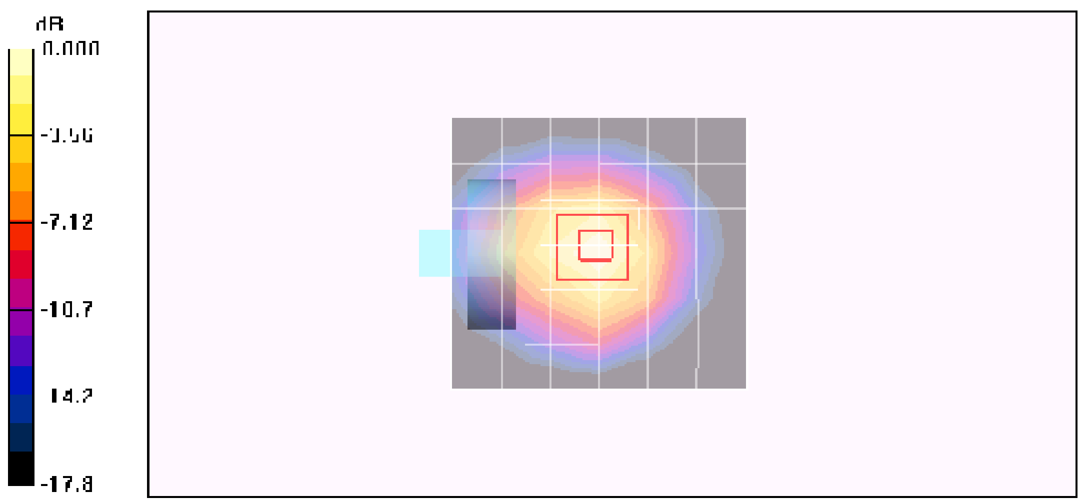
Communication System: WIMAX 2.6G 5M; Frequency: 2498.5 MHz;Duty Cycle: 1:3.24
Medium parameters used (interpolated): f = 2498.5 MHz; σ = 2.05 mho/m; ε_r = 52.3; ρ = 1000 kg/m^3
Phantom section: Flat Section

Room Ambient Temperature: 24.0 deg. C; Liquid Temperature: 23.0 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: 2/23/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn500; Calibrated: 9/15/2009
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:XXXX
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

Low-ch/Area Scan (7x7x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.41 mW/g

Low-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 12.8 V/m; Power Drift = -0.10 dB
Peak SAR (extrapolated) = 2.11 W/kg
SAR(1 g) = 1.12 mW/g; SAR(10 g) = 0.576 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 1.39 mW/g



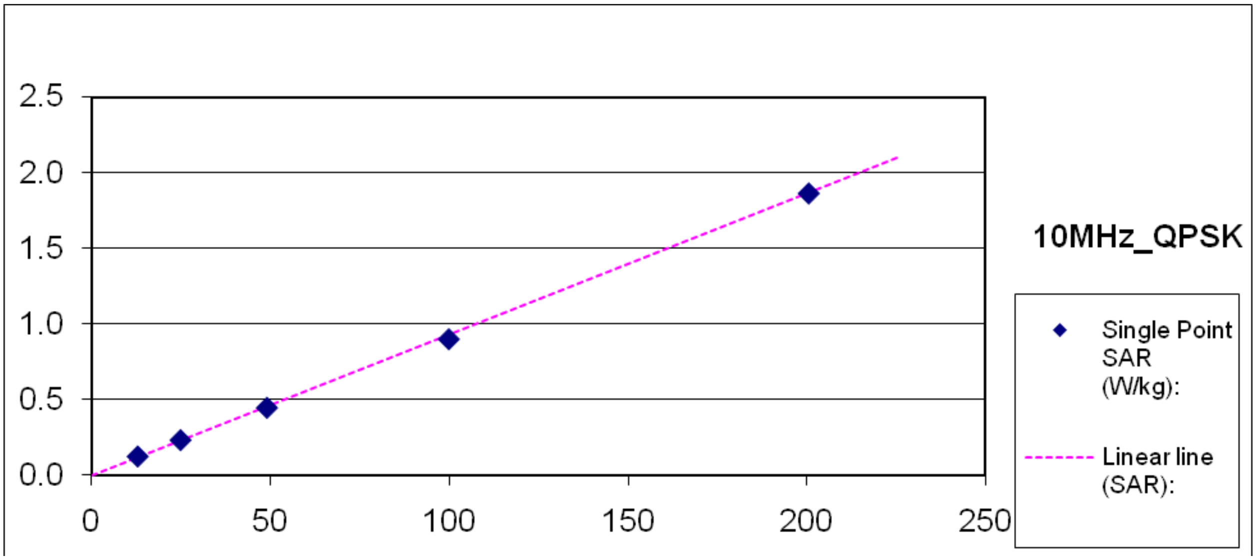
0 dB = 1.39mW/g

16. PAR AND SAR ERROR CONSIDERATIONPAR

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 12.5 mW, at approx. 3 dB steps, until 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.

10MHz_QPSK

Average Power (mW):	12.96	24.92	49.06	99.87	200.40
Single Point SAR (W/kg):	0.121	0.229	0.443	0.896	1.860
Linear line (SAR):	0.121	0.233	0.458	0.932	1.871
Estimation (%):	0.000	-1.575	-3.285	-3.907	-0.589

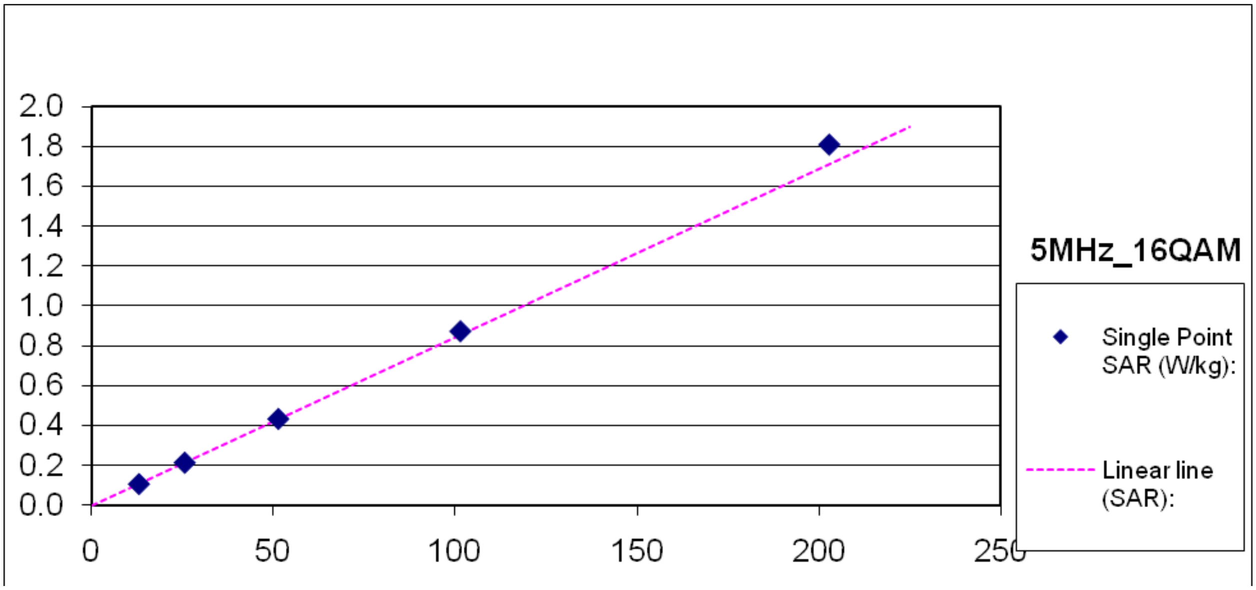


Procedure:

1. Position the EUT at flat phantom with 0 cm separation distance
2. Perform single point SAR evaluation with EUT power to be tuned at 12.96mW
3. Record the highest single point SAR value 0.121W/kg @ 12.96mW.
4. Without changing probe position but tune the EUT power to 24.92mW (3dB step).
5. Record the highest single point SAR value 0.229 W/kg @ 24.92mW- second single peak SAR
6. Repeat the step 4 and 5 to measure single peak SAR for third, fourth and fifth single peak SAR
7. Procedure in establishing reference line
    a. First Reference Point= 0.121 W/kg @ 12.96mW
    b. 0.121 / 12.96 = 0.0093 W/kg per mW
    c. Second reference point=0.0093 x 24.92=0.233W/kg
    d. Third reference point = 0,0093 x 49.06=0.458W/kg
    e. Fourth reference point= 0,0093 x 99.87=0.932W/kg
    f. Fifth reference point= 0.0093 x 200.4=1.871W/kg
    g. Sixth reference point = 0,0093 x 225 = 2.101W/kg
    h. Draw a reference line from first reference point to sixth reference point.

5MHz_16QAM

Average Power (mW):	13.05	25.62	51.34	101.40	202.80
Single Point SAR (W/kg):	0.110	0.217	0.436	0.875	1.810
Linear line (SAR):	0.110	0.216	0.433	0.855	1.709
Estimation (%):	0.110	0.484	0.751	2.374	5.884



Procedure:

8. Position the EUT at flat phantom with 0 cm separation distance
9. Perform single point SAR evaluation with EUT power to be tuned at 13.05mW
10. Record the highest single point SAR value 0.110W/kg @ 13.05mW.
11. Without changing probe position but tune the EUT power to 25.62mW (3dB step).
12. Record the highest single point SAR value 0.217 W/kg @ 25.62mW- second single peak SAR
13. Repeat the step 4 and 5 to measure single peak SAR for third, fourth and fifth single peak SAR
14. Procedure in establishing reference line
    a. First Reference Point= 0.110 W/kg @ 13.05mW
    b. 0.110 / 13.05 = 0.0084 W/kg per mW
    c. Second reference point=0.0084 x 25.62=0.216W/kg
    d. Third reference point = 0,0084 x 51.34=0.433W/kg
    e. Fourth reference point= 0,0084 x 101.4=0.855W/kg
    f. Fifth reference point= 0.0084 x 202.8=1.709W/kg
    g. Sixth reference point = 0,0084 x 225 = 1.897W/kg
    h. Draw a reference line from first reference point to sixth reference point.

17. ATTACHMENTS

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