FCC OET BULLETIN 65 SUPPLEMENT C

SAR EVALUATION REPORT

For

USB MODEM

(With External Antenna)

MODEL: AC250U

FCC ID: N7NAC250U

REPORT NUMBER: 10U13334-2

ISSUE DATE: June 21, 2011

Prepared for

SIERRA WIRELESS INC.

200 FARADAY AVENUE, SUITE 150

CARLSBAD, CA 92008

Prepared by

COMPLIANCE CERTIFICATION SERVICES
47173 BENICIA STREET
FREMONT, CA 94538, U.S.A.
TEL: (510) 771-1000
FAX: (510) 661-0888

NVLAP LAB CODE 200065-0

Revision History

Rev.	Issue Date	Revisions	Revised By
--	June 21, 2011	Initial Issue	--

TABLE OF CONTENTS

1. ATTESTATION OF TEST RESULTS 4

2. TEST METHODOLOGY 5

3. FACILITIES AND ACCREDITATION 5

4. CALIBRATION AND UNCERTAINTY 6

4.1. MEASURING INSTRUMENT CALIBRATION 6

4.2. MEASUREMENT UNCERTAINTY 7

5. SYSTEM SPECIFICATIONS 8

6. COMPOSITION OF INGREDIENTS FOR TISSUE SIMULATING LIQUIDS 9

7. TISSUE DIELECTRIC PARAMETERS CHECK 10

7.1. LIQUID CHECK RESULT 11

8. SYSTEM VERIFICATION 12

8.1. SYSTEM CHECK RESULT 12

9. WiMax DEVICE & SYSTEM OPERATING PARAMETERS 13

10. EUT DESCRIPTION 15

10.1. WiMAX Zone Types 15

10.2. Duty Factor and Crest Factor Considerations 16

10.3. SAR Scaling Consideration 19

10.4. Duty-Factor Scaling to DL:UL Ratio of 29:18 21

11. SIGNAL GENERATOR DETAILS 22

12. OUTPUT POWER VERIFICATION 26

13. PEAK TO AVERAGE RATIO 28

14. SUMMARY OF SAR TEST RESULTS 31

15. ATTACHMENTS 35

16. TEST SETUP PHOTO 36

17. EXTERNAL ANTENNA PHOTO 37

1. ATTESTATION OF TEST RESULTS

COMPANY NAME:	SIERRA WIRELESS INC. 200 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:	June 5, 2011		
FCC rule parts	Freq. range (MHz)	Highest 1-g SAR (W/kg)	Limit (W/kg)
27	2498.5 – 2687.5	0.156	1.6
Applicable Standards			Test Results
FCC OET Bulletin 65 Supplement C 01-01 and the following specific FCC test procedures: - KDB 447498 D01 Mobile Portable RF Exposure v04 - 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:	Tested By:
SUNNY SHIH ENGINEERING SUPERVISOR COMPLIANCE CERTIFICATION SERVICES	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:

- KDB 447498 D01 Mobile Portable RF Exposure v04
- KDB 615223 D01 802 16e WiMax SAR Guidance v01
- 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
SAM Phantom	SPEAG	QP 000 P40 CC	1602	N/A		
Oval Flat Phantom (ELI 4.0)	SPEAG	QD OVA001 B	1099	N/A		
Dielectronic Probe kit	HP	85070C	N/A	N/A		
ESA Series Network Analyzer	Agilent	E5071B	MY42100131	8	2	2011
Synthesized Signal Generator	HP	83732B	US34490599	7	14	2012
Wireless comunication test set	Agilent	E5515C (8960)	GB46160222	6	17	2012
E-Field Probe	SPEAG	EX3DV3	3749	12	13	2012
Data Acquisition Electronics	SPEAG	DAE 3	427	7	21	2011
Thermometer	ERTCO	639-1S	1718	7	19	2011
System Validation Dipole	SPEAG	D2600V2	1006	4	7	2012
Power Meter	Giga-tronics	8651A	8651404	3	13	2012
Power Sensor	Giga-tronics	80701A	1834588	3	13	2012
Power Meter	Boonton	4541	12405	4	5	2012
Power Sensor	Boonton	57006	6940	3	31	2012
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	SPEAG	MSL2600	N/A	Within 24 hrs of first test		

***Note:**

Per KDB 450824 D02 requirements for dipole calibration, UL CCS has adopted two years calibration intervals. On annual basis, each measurement dipole has been evaluated and is in compliance with the following criteria:

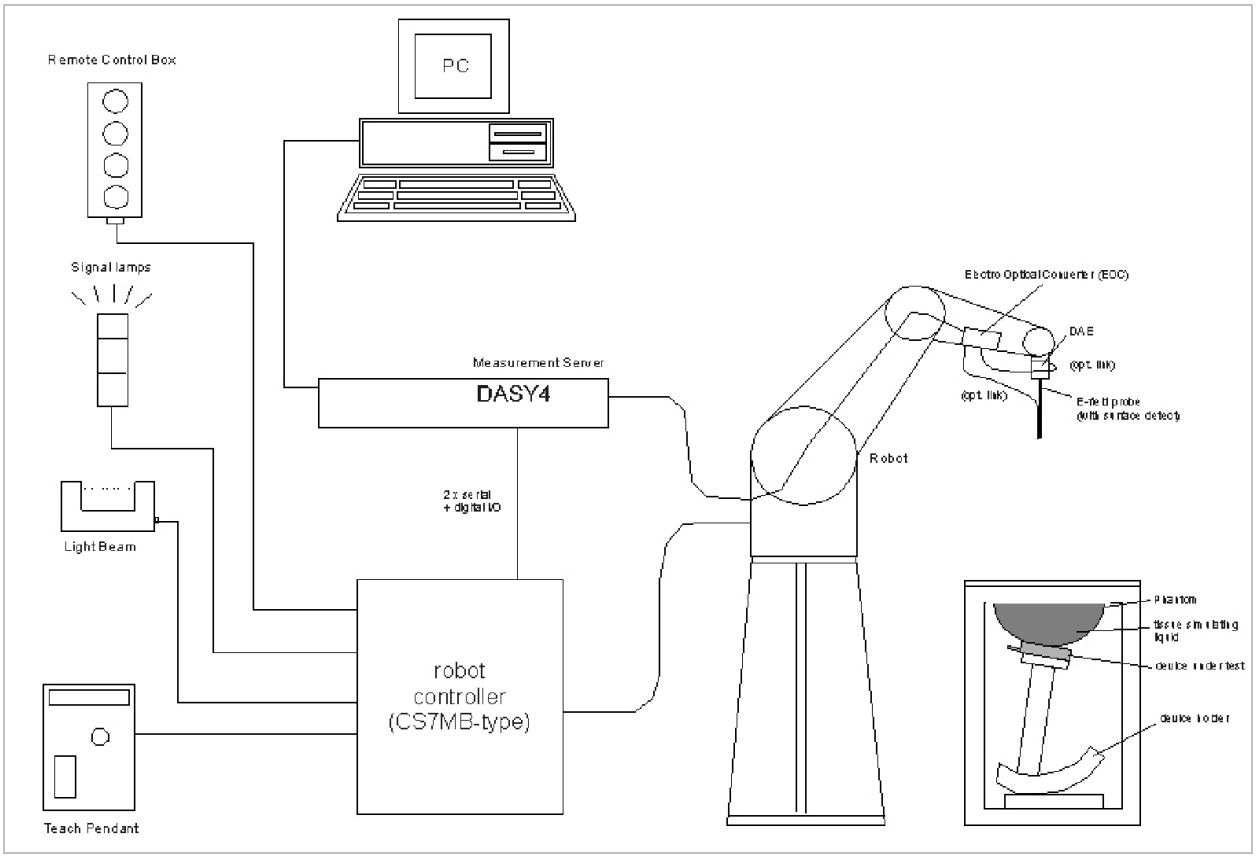
1. There is no physical damage on the dipole
2. System validation with specific dipole is within 10% of calibrated value.
3. Return-loss is within 20% of calibrated measurement (test data on file in UL CCS)
4. Impedance is within 5Ω of calibrated measurement (test data on file in UL CCS)

4.2. MEASUREMENT UNCERTAINTY

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)	5.50	Normal	1	1	5.50
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 @ Body 2600 MHz	0.50	Normal	1	0.64	0.32
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement@ Body 2600 MHz	-1.59	Normal	1	0.6	-0.95
				Combined Standard Uncertainty Uc(y) =	9.49
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 18.99	%
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 1.51	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 RESULT

Measured by: Art Tham

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
5/20/2011	Body 2500	e'	52.2236	Relative Permittivity (ε_r):	52.22	52.64	-0.79	5
		e''	14.5871	Conductivity (σ):	2.03	2.02	0.37	5
5/20/2011	Body 2590	e'	51.9119	Relative Permittivity (ε_r):	51.91	52.52	-1.16	5
		e''	14.9356	Conductivity (σ):	2.15	2.15	0.19	5
5/20/2011	Body 2600	e'	51.8798	Relative Permittivity (ε_r):	51.88	52.51	-1.20	5
		e''	14.9745	Conductivity (σ):	2.16	2.16	0.19	5
5/20/2011	Body 2690	e'	51.5670	Relative Permittivity (ε_r):	51.57	52.40	-1.58	5
		e''	15.3681	Conductivity (σ):	2.30	2.29	0.50	5

Liquid Check
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 39%
May 20, 2011 05:56 PM

Frequency	e'	e''
2490000000.	52.2555	14.5445
2500000000.	**52.2236**	**14.5871**
2510000000.	52.1900	14.6273
2520000000.	52.1580	14.6691
2530000000.	52.1224	14.7072
2540000000.	52.0913	14.7487
2550000000.	52.0525	14.7865
2560000000.	52.0176	14.8232
2570000000.	51.9835	14.8588
2580000000.	51.9473	14.8988
2590000000.	**51.9119**	**14.9356**
2600000000.	**51.8798**	**14.9745**
2610000000.	51.8439	15.0147
2620000000.	51.8120	15.0499
2630000000.	51.7798	15.0900
2640000000.	51.7424	15.1313
2650000000.	51.7063	15.1650
2660000000.	51.6729	15.2051
2670000000.	51.6369	15.2427
2680000000.	51.6020	15.2831
2690000000.	**51.5670**	**15.3205**
2700000000.	51.5319	15.3681

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 SN3749 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 HEAD & BODY-tissue from calibration certificate of SPEAG.

System validation dipole	Cal. certificate #	Cal. date	SAR Avg (mW/g)		
			Tissue:	Head	Body
D2600V2	D2600V2-1006_Apr11	4/7/2011	SAR_{1g}:	59.2	58.0
			SAR_{10g}:	26.2	25.4

8.1. SYSTEM CHECK RESULT

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D2600V2	06/05/11	SAR_{1g}:	54.7	58	-5.69	±10
		SAR_{10g}:	24.0	25.4	-5.51	

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
	60.35mW 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.

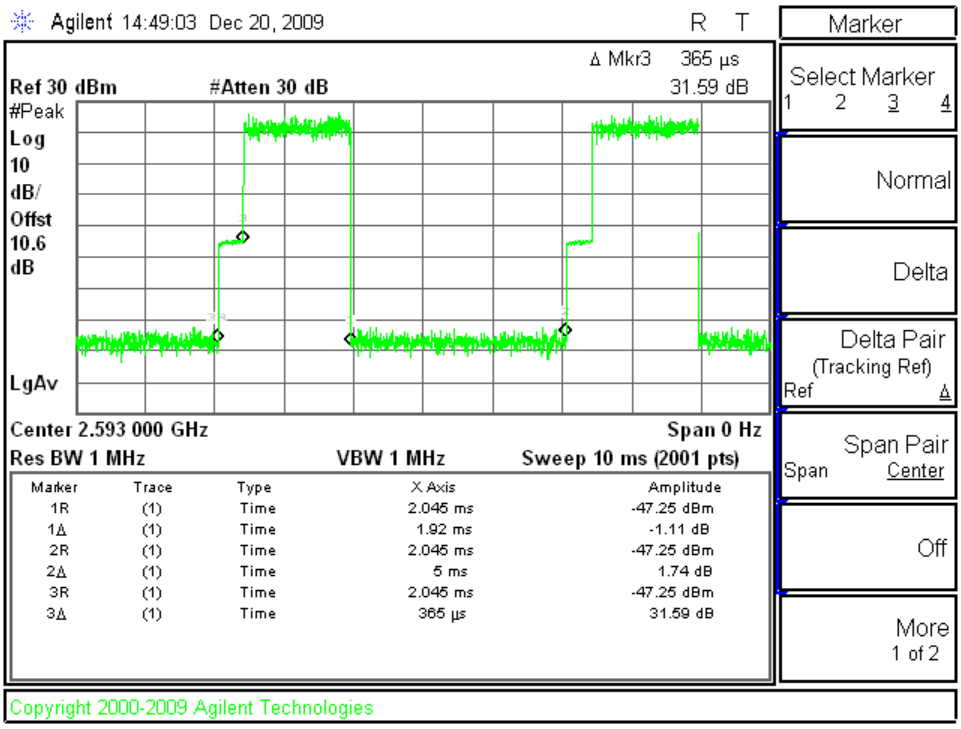


Figure 1 5 MHZ BW / 16QAM

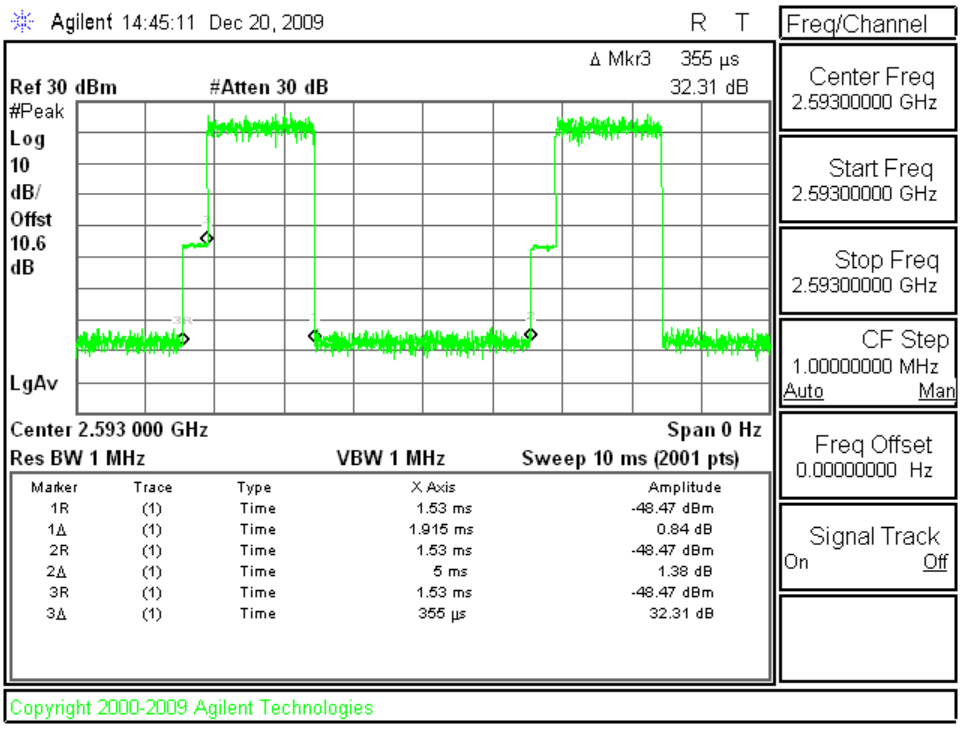


Figure 2 5 MHz BW / QPSK

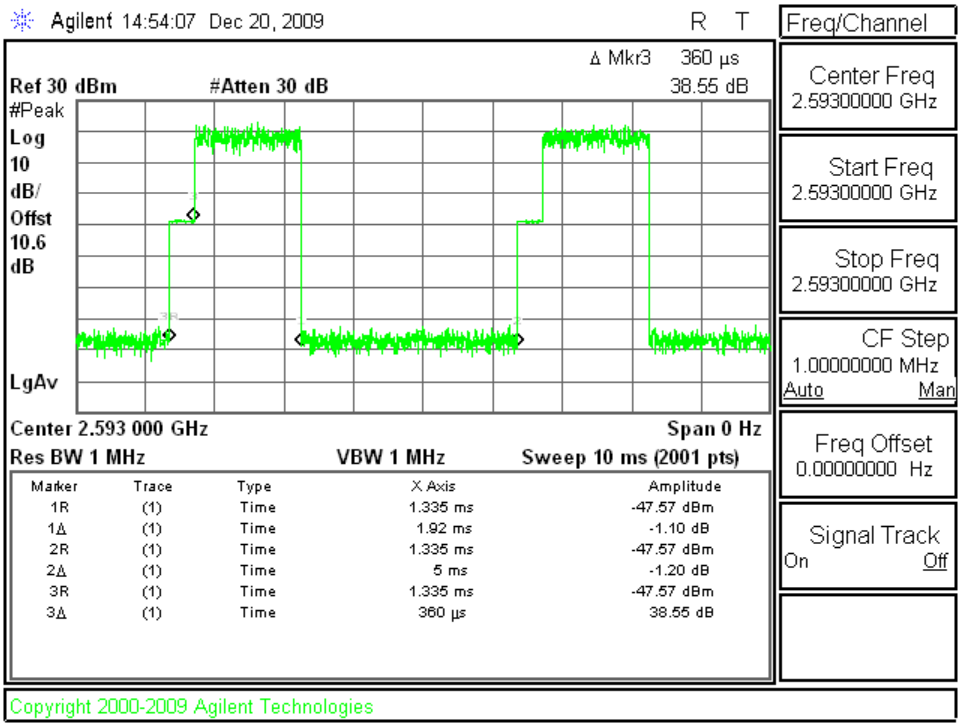


Figure 3 10 MHz BW / 16QAM

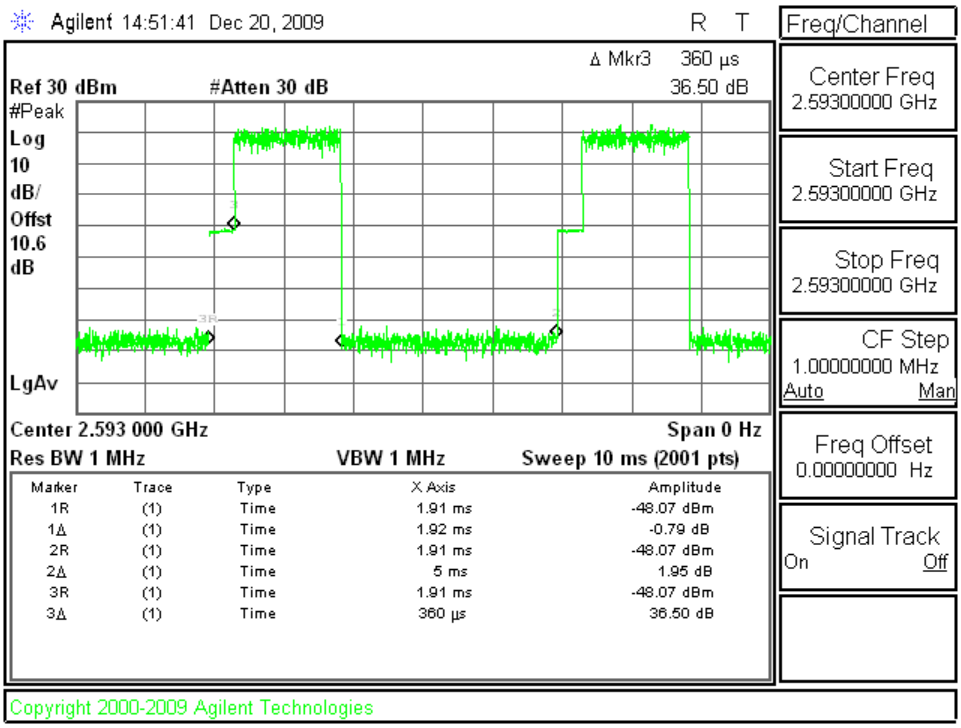


Figure 4 10 MHz BW / QPSK

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:

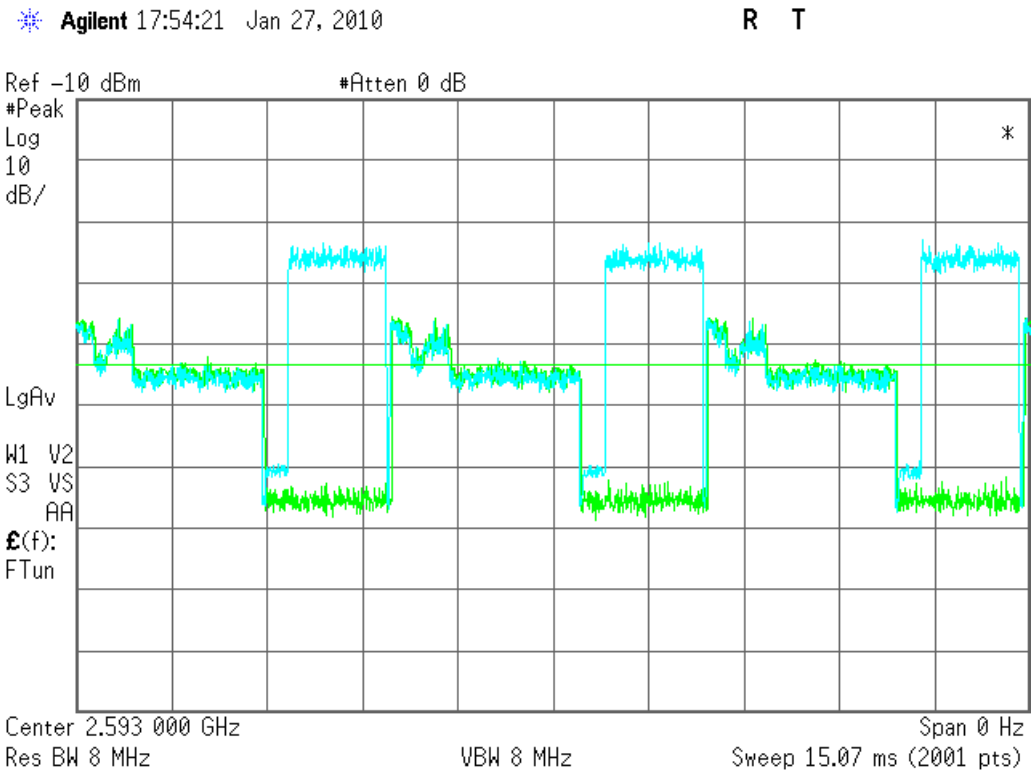
Vector Waveform File	Channel BW	Modulation	DL:UL Ratio	No of Traffic Symbol at Max. Power	No of Control Symbol with reduced power
T5D29U184Q34S85	5 MHz	QPSK	29:18	15	0
T5D29U1816Q34S85	5 MHz	16QAM	29:18	15	0
T10D29U184Q34S175	10 MHz	QPSK	29:18	15	0
T10D29U1816Q12S175	10 MHz	16QAM	29:18	15	0

Vector wave form Time Domain Plots Vs Modulated Plots

T10D29U1816Q12S175 / 10MHz BW / 16QAM

Green Trace= Vector Wave Form

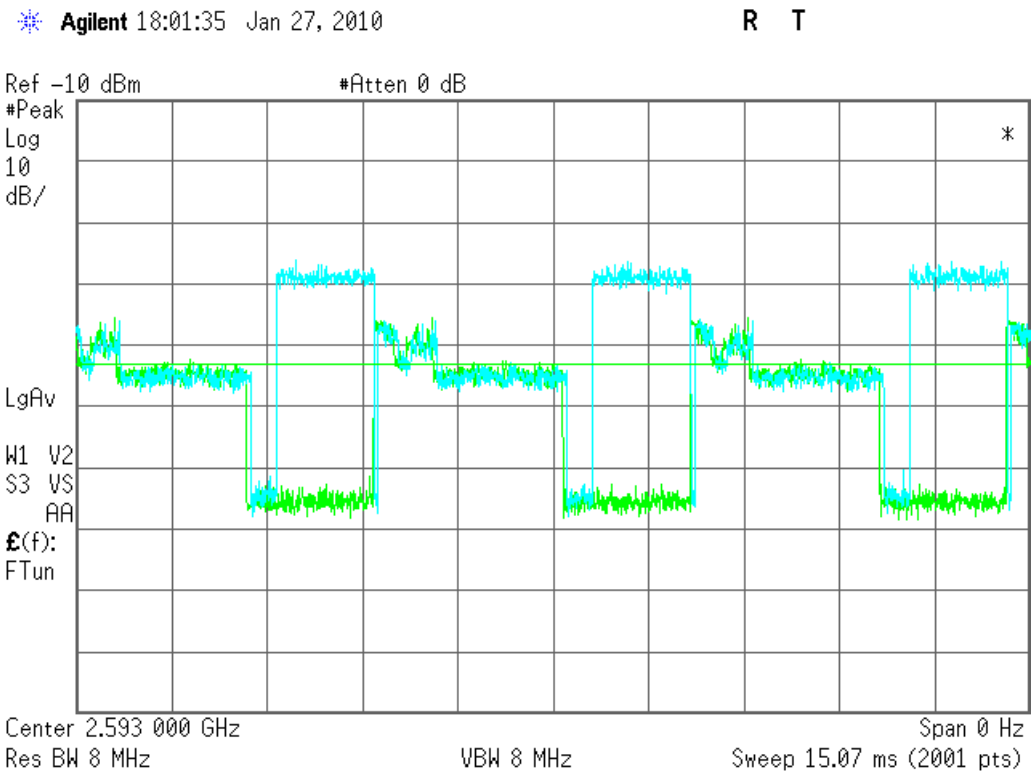
Blue Trace = Modulated Link



T10D29U184Q34S175 / 10 MHz BW / QPSK

Green Trace= Vector Wave Form

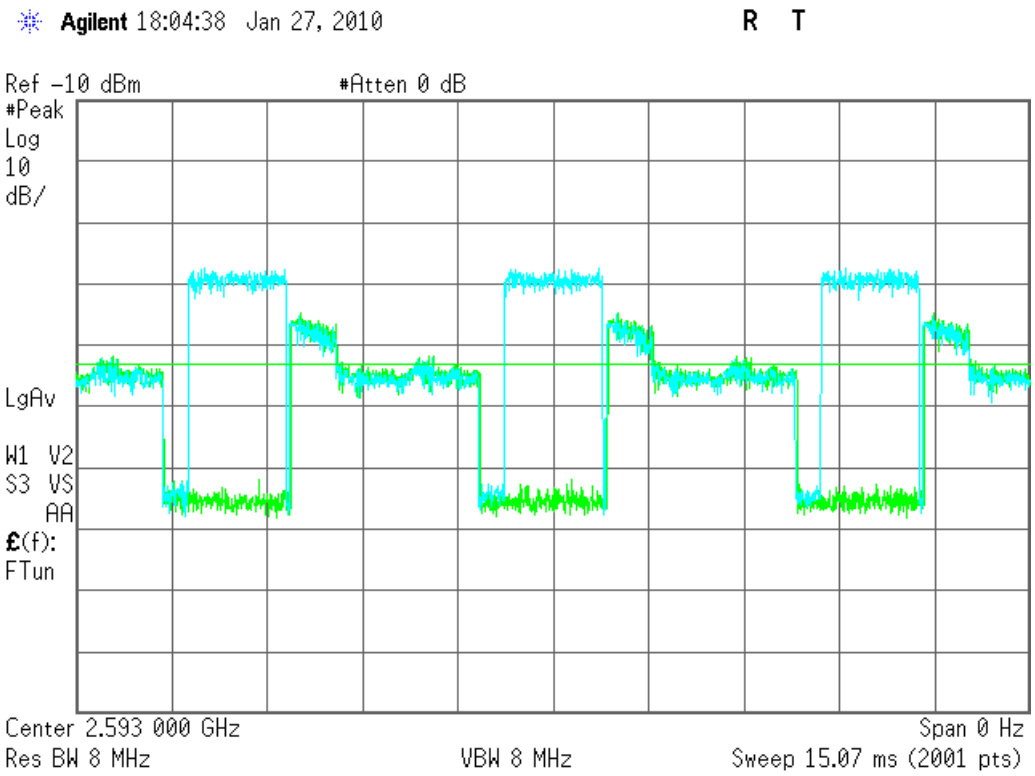
Blue Trace = Modulated Link



T5D29U1816Q34S85 / 5 MHz / 16QAM

Green Trace= Vector Wave Form

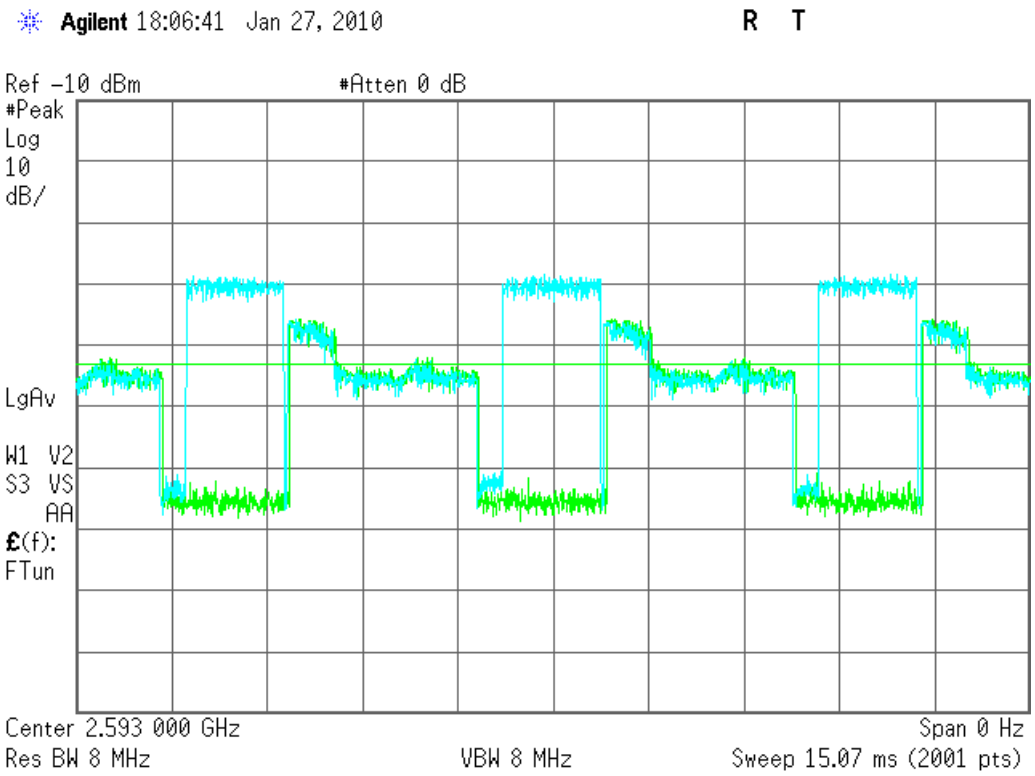
Blue Trace = Modulated Link



T5D29U184Q34S85 / 5 MHz / QPSK

Green Trace= Vector Wave Form

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 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 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					

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

Front side with 2.5 cm separation distance from EUT-to-flat phantom

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	Front Side	Low	2498.5			
				Middle	2593.0	0.146	1.070	0.156
				High	2687.5			

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	Front Side	Low	2498.5			
				Middle	2593.0	0.080	1.070	0.086
				High	2687.5			

SAR TEST PLOT

Date/Time: 6/5/2011 1:08:48 PM

Test Laboratory: UL CCS

Nearby Person_WiMAX (5MHz)

DUT: Sierra Wireless; Type: N/A; Serial: N/A

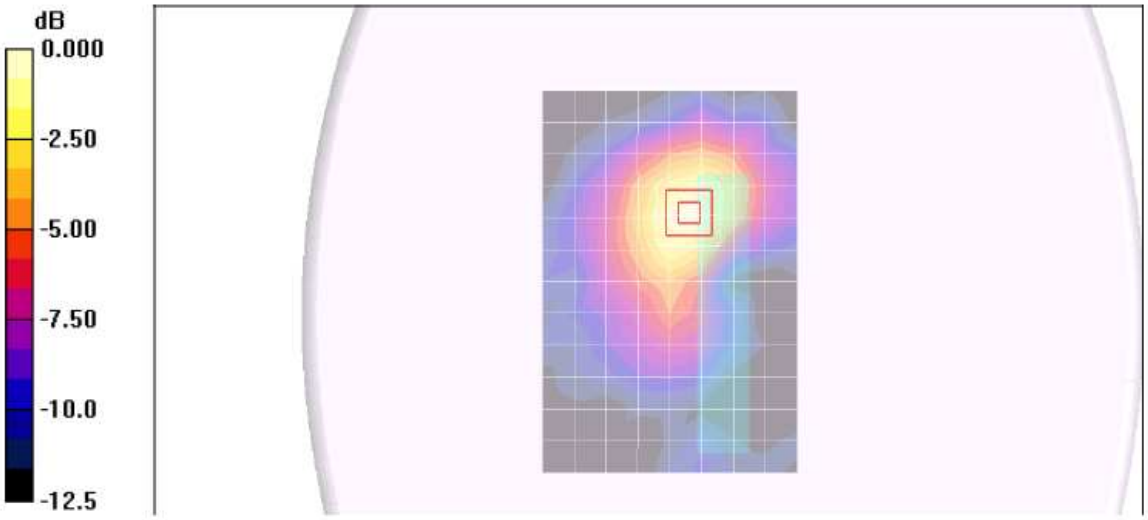
Communication System: WiMAX 2.6GHz; Frequency: 2593 MHz;Duty Cycle: 1:3.24
Medium parameters used (interpolated): f = 2593 MHz; σ = 2.16 mho/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

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: EX3DV4 - SN3749; ConvF(6.82, 6.82, 6.82); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:XXXX
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

5MHz_QPSK_M-ch_TX1/Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.163 mW/g

5MHz_QPSK_M-ch_TX1/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 8.77 V/m; Power Drift = 0.223 dB
Peak SAR (extrapolated) = 0.272 W/kg
SAR(1 g) = 0.146 mW/g; SAR(10 g) = 0.085 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.179 mW/g



0 dB = 0.179mW/g

Date/Time: 6/5/2011 1:33:52 PM

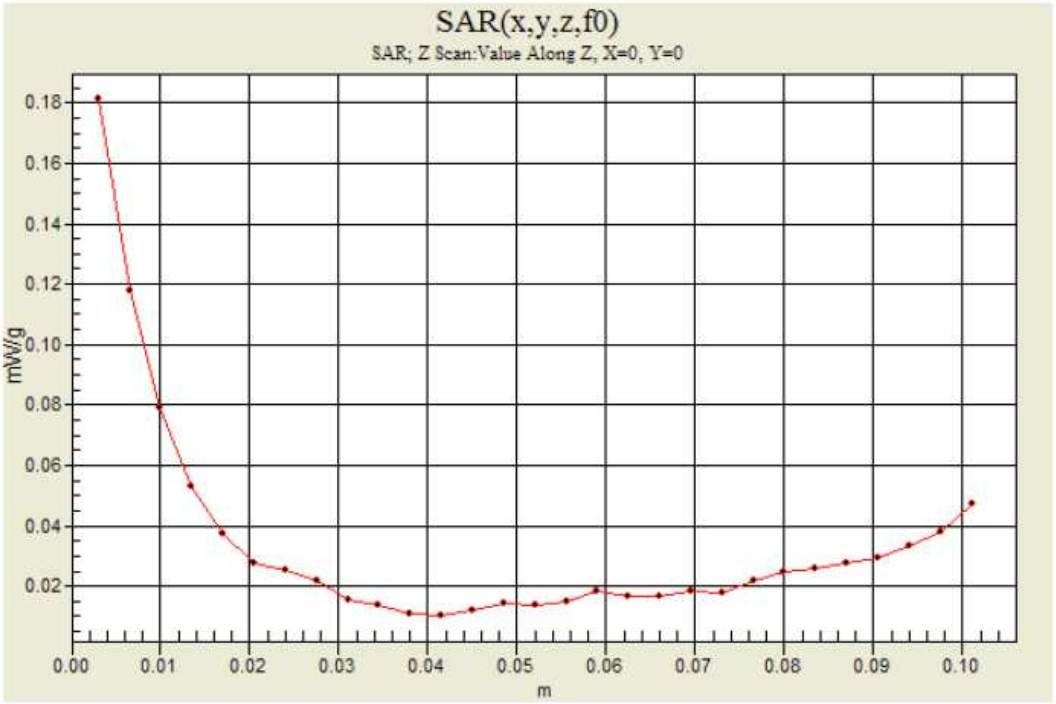
Test Laboratory: UL CCS

Nearby Person_WiMAX (5MHz)

DUT: Sierra Wireless; Type: N/A; Serial: N/A

Communication System: WiMAX 2.6GHz; Frequency: 2593 MHz;Duty Cycle: 1:3.24

5MHz_QPSK_M-ch_TX1/Z Scan (1x1x29): Measurement grid: dx=20mm, dy=20mm, dz=3.5mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.181 mW/g



Date/Time: 6/5/2011 1:38:18 PM

Test Laboratory: UL CCS

Nearby Person_WiMAX (5MHz)

DUT: Sierra Wireless; Type: N/A; Serial: N/A

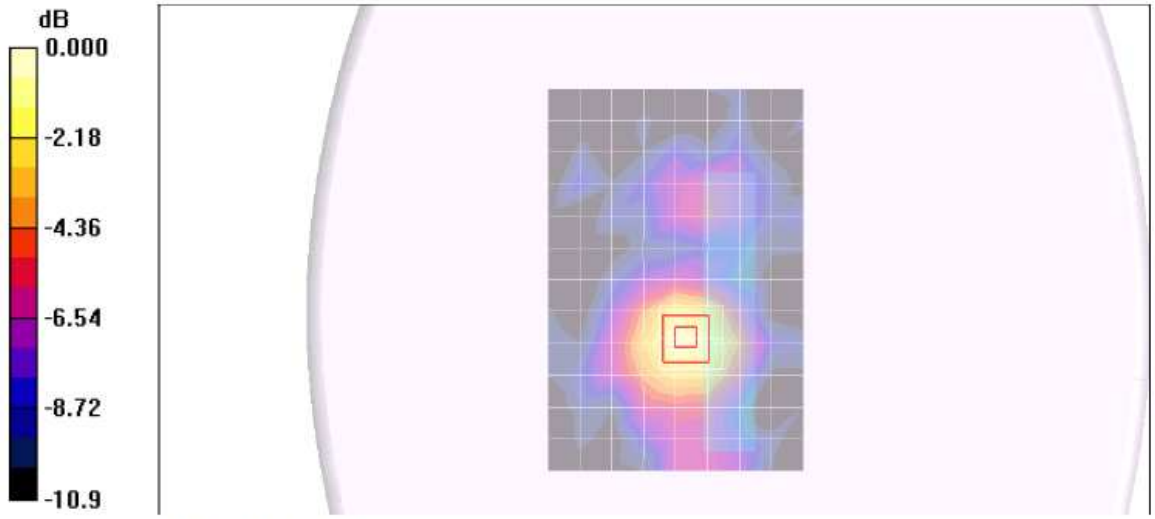
Communication System: WiMAX 2.6GHz; Frequency: 2593 MHz;Duty Cycle: 1:3.24
Medium parameters used (interpolated): f = 2593 MHz; σ = 2.16 mho/m; ε_r = 51.9; ρ = 1000 kg/m^3
Phantom section: Flat Section

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: EX3DV4 - SN3749; ConvF(6.82, 6.82, 6.82); Calibrated: 12/13/2010
- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BA; Serial: SN:XXXX
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

5MHz_QPSK_M-ch_TX2/Area Scan (9x13x1): Measurement grid: dx=15mm, dy=15mm
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.088 mW/g

5MHz_QPSK_M-ch_TX2/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm
Reference Value = 6.66 V/m; Power Drift = -0.206 dB
Peak SAR (extrapolated) = 0.159 W/kg
SAR(1 g) = 0.080 mW/g; SAR(10 g) = 0.047 mW/g
Info: Interpolated medium parameters used for SAR evaluation.
Maximum value of SAR (measured) = 0.099 mW/g



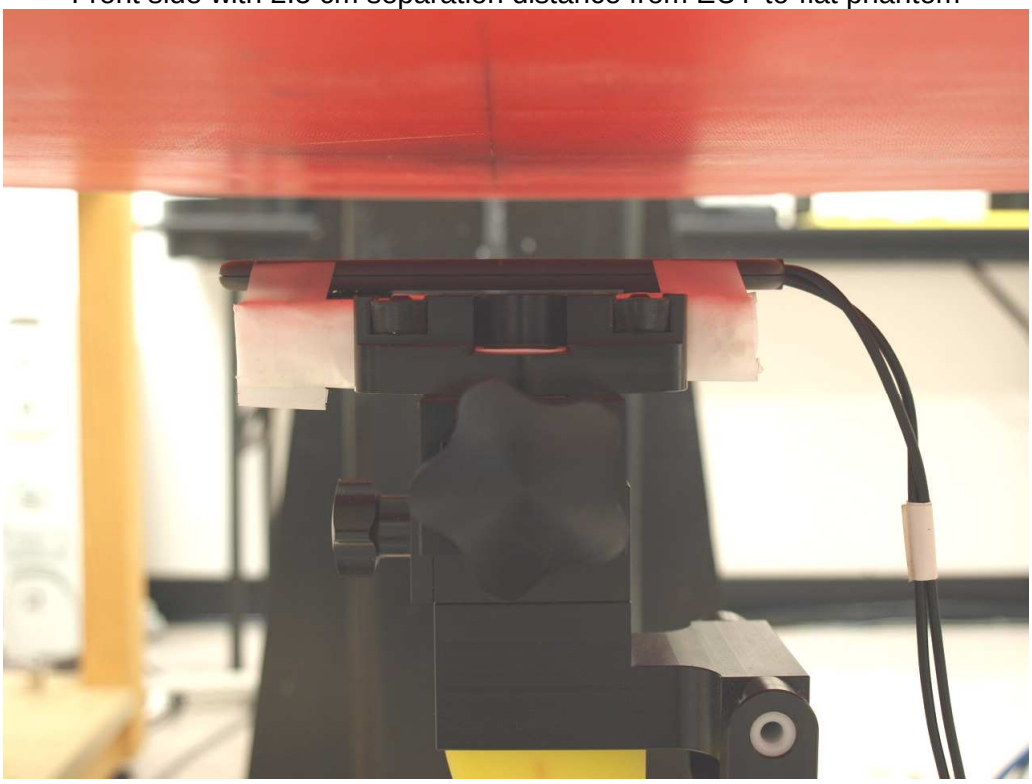
0 dB = 0.099mW/g

15. ATTACHMENTS

No.	Contents	No. of page (s)
1	System Check Plots	2
2	Certificate of E-Field Probe EX3DV4 SN3749	11
3	Certificate of System Validation Dipole D2600V2 SN:1006	9

16. TEST SETUP PHOTO

Front side with 2.5 cm separation distance from EUT-to-flat phantom



17. EXTERNAL ANTENNA PHOTO

Front Side

Back Side

END OF REPORT