

## FCC OET BULLETIN 65 SUPPLEMENT C

### SAR EVALUATION REPORT

For

**USB MODEM** 

### (With External Antenna)

MODEL: AC250U

FCC ID: N7NAC250U

REPORT NUMBER: 10U13334-1

ISSUE DATE: June 21, 2011

Prepared for

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Prepared by

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(R)

NVLAP LAB CODE 200065-0

## **Revision History**

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

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# **1. ATTESTATION OF TEST RESULTS**

COMPANY NAME:	SIERRA WIRELESS INC.	SIERRA WIRELESS INC.					
	200 Faraday Avenue, Suite 1	200 Faraday Avenue, Suite 150					
	CARLSBAD, CA 92008	CARLSBAD, CA 92008					
EUT DESCRIPTION:	USB MODEM						
MODEL NUMBER:	AC250U						
DEVICE CATEGORY:	Portable						
EXPOSURE CATEGORY:	General Population/Uncontrolled Exposure						
DATE TESTED:	May 20, 2011						
FCC Rule Parts	Frequency Range [MHz]	Highest 1-g SAR	Limit (mW/g)				
22H	824 - 849	0.051 mW/g	1.6				
24E	1850 - 1910	0.173 mW/g	1.0				
	Applicable Standards		Test Results				
FCC OET Bulletin 65 Supp	lement C 01-01 and the follow	ing SAR test procedures:					
<ul> <li>KDB 941225 D01 SA Portable RF Exposu</li> </ul>	AR test for 3G devices v02KD	B 447498 D01 Mobile	Pass				

• KDB 447498 D02 SAR Procedures for Dongle Xmtr v02

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:

inay shih

SUNNY SHIH ENGINEERING SUPERVISOR COMPLIANCE CERTIFICATION SERVICES

Tested By:

an Char

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 SAR test procedures:

- KDB 941225 D01 SAR test for 3G devices v02
- KDB 447498 D01 Mobile Portable RF Exposure v04
- 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 <u>http://www.ccsemc.com</u>.

# 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	Manufacturor Type/Model		Carial Na	Cal. Due date		
Name of Equipment	Manufacturer	i ype/iviodei	Senai No.	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 4	1239	11	17	2011
Thermometer	ERTCO	639-1S	1718	7	7 19 2011	
System Validation Dipole	SPEAG	D835V2	4d002	4	4	2013
System Validation Dipole	SPEAG	*D1900V2	5d043	11	24	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	MSL1900	N/A	Withir	ו 24 h	rs of first test
Simulating Liquid	SPEAG	MSL835	N/A	Withir	ח 24 h	rs 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 5 $\Omega$  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 1900 MHz	-1.55	Normal	1	0.64	-0.99
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement@ Body 835 MHz	-0.90	Normal	1	0.6	-0.54
		Combined Standard	Uncertai	nty Uc(y) =	9.51
Expanded Uncertainty U, Covera	ige Factor	<sup>•</sup> = 2, > 95 % Confid	dence =	19.02	%
Expanded Uncertainty U, Covera	ige Factor	<sup>•</sup> = 2, > 95 % Confid	dence =	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					Frequen	cy (MHz)				
(% by weight)	4	50	83	835		915		00	2450	
Tissue Type	Head	Body	Head	Body	Head	Body	Head	Body	Head	Body
Water	38.56	51.16	41.45	52.4	41.05	56.0	54.9	40.4	62.7	73.2
Salt (NaCl)	3.95	1.49	1.45	1.4	1.35	0.76	0.18	0.5	0.5	0.04
Sugar	56.32	46.78	56.0	45.0	56.5	41.76	0.0	58.0	0.0	0.0
HEC	0.98	0.52	1.0	1.0	1.0	1.21	0.0	1.0	0.0	0.0
Bactericide	0.19	0.05	0.1	0.1	0.1	0.27	0.0	0.1	0.0	0.0
Triton X-100	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	36.8	0.0
DGBE	0.0	0.0	0.0	0.0	0.0	0.0	44.92	0.0	0.0	26.7
Dielectric Constant	43.42	58.0	42.54	56.1	42.0	56.8	39.9	54.0	39.8	52.5
Conductivity (S/m)	0.85	0.83	0.91	0.95	1.0	1.07	1.42	1.45	1.88	1.78

Salt: 99+% Pure Sodium Chloride

Sugar: 98+% Pure Sucrose

Water: De-ionized,  $16 \text{ M}\Omega$ + 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. LIQUID PARAMETERS CHECK

The simulating liquids should be checked at the beginning of a series of SAR measurements to determine of the dielectric parameters are within the tolerances of the specified target values. For frequencies in 300 MHz to just under 2 GHz, the measured conductivity and relative permittivity should be within  $\pm$  5% of the target values. For frequencies in the range of 2–3 GHz and above the measured conductivity should be within  $\pm$  5% of the target values. The measured relative permittivity tolerance can be relaxed to no more than  $\pm$  10%.

### Reference Values of Tissue Dielectric Parameters for Head and Body Phantom

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

Target Frequency (MHz)	He	ead	Body		
raiger Frequency (Miriz)	٤ <sub>r</sub>	σ (S/m)	ε <sub>r</sub>	σ (S/m)	
150	52.3	0.76	61.9	0.8	
300	45.3	0.87	58.2	0.92	
450	43.5	0.87	56.7	0.94	
835	41.5	0.9	55.2	0.97	
900	41.5	0.97	55	1.05	
915	41.5	0.98	55	1.06	
1450	40.5	1.2	54	1.3	
1610	40.3	1.29	53.8	1.4	
1800 – 2000	40	1.4	53.3	1.52	
2450	39.2	1.8	52.7	1.95	
3000	38.5	2.4	52	2.73	
5800	35.3	5.27	48.2	6	

( $\varepsilon_r$  = relative permittivity,  $\sigma$  = conductivity and  $\rho$  = 1000 kg/m<sup>3</sup>)

# 7.1. LIQUID CHECK RESULTS

5/202011         Body 835         e'         54.7057         Relative Permittivity (e;.):         54.71         55.20         -0.90         5           Liquid Check         Ambient temperature: 23 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 40%         May 20, 2011 03:27 PM         Frequency         e'         e''         6''         80000000.         55.0163         21.2691         80500000.         55.0160         21.2478         81000000.         54.9669         21.2322         815000000.         54.9669         21.2322         815000000.         54.9669         21.2322         815000000.         54.9669         21.2322         815000000.         54.8061         21.1635         83000000.         54.8061         21.1635         83000000.         54.7573         21.1432         835000000.         54.615         21.1432         835000000.         54.615         21.0733         85000000.         54.4105         21.0733         85000000.         54.4172         21.0315         86000000.         54.4372         21.0315         86000000.         54.4372         20.9171         285000000.         54.3377         20.9204         89000000.         54.3377         20.9204         89000000.         54.3377         20.9204         89000000.         54.3377         20.9204         89000000.         53.981	Date	Freq. (MHz)		Liqu	id Parameters	Measured	Target	Delta (%)	Limit ±(%)
Subscription         Edity Gives         e'         21.1200         Conductivity ( $\sigma$ ):         0.98         0.97         1.09         5           Liquid Check         Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 40%         May 20, 2011 03:27 PM         Frequency         e'         e''         6''         80000000.         55.0635         21.2691         80000000.         55.0635         21.2478         810000000.         54.9669         21.2322         815000000.         54.9071         21.2106         82000000.         54.8615         21.1848         825000000.         54.4661         21.635         83000000.         54.7757         21.1200         840000000.         54.6652         21.0948         845000000.         54.6657         21.0538         85000000.         54.4723         21.0127         85000000.         54.3316         20.9871         80000000.         54.3347         20.9531         88000000.         54.3347         20.9531         88000000.         54.43347         20.9204         89000000.         54.9931         20.8826         90000000.         54.9931         20.8826         90000000.         53.9814         20.8826         90000000.         53.959         20.8117         92000000.         53.8580         20.7722         93000000.         53.8580	5/20/2011	Pody 925	e'	54.7057	Relative Permittivity ( $\varepsilon_r$ ):	54.71	55.20	-0.90	5
Liquid Check Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 40% May 20, 2011 03:27 PM Frequency e' e" 80000000. 55.0635 21.2691 80000000. 54.0669 21.2322 815000000. 54.9071 21.2106 820000000. 54.8015 21.1848 825000000. 54.8081 21.1635 830000000. 54.7573 21.1200 840000000. 54.6652 21.0948 845000000. 54.657 21.0538 855000000. 54.47123 21.0127 855000000. 54.4316 20.9890 87500000. 54.3347 20.9531 880000000. 54.2860 20.9330 880000000. 54.2897 20.9204 89000000. 54.1913 20.9056 885000000. 54.1913 20.9056 89500000. 54.1913 20.826 90000000. 54.4049 20.8481 91000000. 53.9981 20.8282 91500000. 53.8580 20.7722 93000000. 53.810 20.7751 92000000. 53.8580 20.7722 93000000. 53.810 20.7551 93000000. 53.810 20.7551 93000000. 53.810 20.7551 93000000. 53.810 20.7551 93000000. 53.840 20.6977 9500000. 53.840 20.6977 9500000. 53.8410 20.6829 The conductivity (0) can be given as: $C = \omega_c e' = 2 \pi f \epsilon_0 e''$ where $f = target f^{-10}^{\beta}$	5/20/2011	DUUY 030	e"	21.1200	Conductivity (o):	0.98	0.97	1.09	5
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 40% May 20, 2011 03:27 PM Frequency e' e' e' 80000000. 55.0160 21.2478 81000000. 54.9669 21.2322 815000000. 54.9669 21.2322 815000000. 54.8081 21.1635 83000000. 54.7677 21.1200 83000000. 54.6622 21.0948 845000000. 54.6622 21.0948 845000000. 54.6105 21.0733 850000000. 54.5657 21.0538 855000000. 54.4316 20.9890 87000000. 54.4316 20.9890 87000000. 54.43791 20.9719 875000000. 54.2860 20.9380 885000000. 54.2860 20.9380 885000000. 54.2397 20.9204 89000000. 54.1913 20.9651 895000000. 54.1913 20.8649 905000000. 54.3191 20.8826 90000000. 54.3981 20.8828 90000000. 54.3981 20.8828 90000000. 54.3981 20.8828 90000000. 53.9864 20.7722 93000000. 53.8580 20.7722 93000000. 53.8580 20.7722 93000000. 53.8110 20.7551 9500000. 53.8640 20.6977 9500000. 53.6410 20.6829 The conductivity (o) can be given as: $\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$ where $f = target f^* 10^d$	Liquid Check	<							
May 20, 2011 03:27 PM Frequency e' e" 800000000. 55.0635 21.2691 805000000. 55.0635 21.2478 810000000. 54.9669 21.2322 815000000. 54.9071 21.2106 820000000. 54.8081 21.1635 830000000. 54.7573 21.1432 <b>835000000. 54.7657 21.1200</b> 840000000. 54.6622 21.0948 845000000. 54.6657 21.0538 855000000. 54.5657 21.0538 855000000. 54.4723 21.01127 865000000. 54.4316 20.9890 870000000. 54.4316 20.9890 870000000. 54.4316 20.9890 870000000. 54.4316 20.9890 870000000. 54.4316 20.9890 870000000. 54.4317 20.9531 880000000. 54.4318 20.9268 880000000. 54.4319 20.9214 885000000. 54.4319 20.9204 890000000. 54.4397 20.9204 890000000. 54.049 20.8481 91000000. 54.049 20.8481 91000000. 53.9981 20.8282 90000000. 54.0449 20.8481 91000000. 53.9981 20.8282 91500000. 53.9064 20.7722 93000000. 53.8580 20.7722 93000000. 53.6410 20.6829 The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \varepsilon_{\sigma} e'' = 2 \pi f \varepsilon_{\sigma} e''$ $\omega e'' = 2 \pi f \varepsilon_{\sigma} e''$	Ambient tem	perature: 24	deg	. C; Liquid te	emperature: 23 deg. C; I	Relative hum	nidity = 40%		
Frequency $e^i$ $e^n$ 800000000. 55.0635 21.2691 80500000. 55.0160 21.2478 810000000. 54.9071 21.2106 82000000. 54.9071 21.2106 82000000. 54.8615 21.1848 825000000. 54.8615 21.1848 835000000. 54.7573 21.1432 835000000. 54.6105 21.0733 840000000. 54.6105 21.0733 85000000. 54.5657 21.0538 855000000. 54.4723 21.0127 865000000. 54.4732 21.0315 860000000. 54.4732 21.0127 865000000. 54.3347 20.9531 88000000. 54.2860 20.9380 885000000. 54.2860 20.9380 885000000. 54.1913 20.9056 89500000. 54.41391 20.8826 90000000. 54.0449 20.8481 91000000. 54.0449 20.8481 91000000. 53.9981 20.8282 91500000. 53.9981 20.8282 91500000. 53.9981 20.8282 91500000. 53.9981 20.8282 91500000. 53.9981 20.8282 91500000. 53.9981 20.8282 91500000. 53.9064 20.7722 93000000. 53.8580 20.7722 93000000. 53.8580 20.7722 93000000. 53.8580 20.7722 93000000. 53.8710 20.6751 94000000. 53.7769 20.7217 94500000. 53.6410 20.6829 The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \varepsilon_0 e^m = 2 \pi \pi \delta_0 e^m$ where $f = target f^* 10^{\sigma}$ $\varepsilon_0 = \omega \varepsilon_0 e^m = 2 \pi \pi \delta_0 e^m$	May 20, 201	1 03:27 PM							
80000000.       55.0160       21.2478         81000000.       54.9669       21.2322         81500000.       54.9071       21.2106         82000000.       54.8615       21.1848         82500000.       54.7573       21.1432         83000000.       54.7057       21.1200         84000000.       54.6622       21.0948         84500000.       54.6657       21.0538         85500000.       54.4723       21.0127         86000000.       54.3347       20.9890         87000000.       54.3347       20.9531         88000000.       54.3347       20.9531         88000000.       54.391       20.8826         9000000.       54.3931       20.8649         9000000.       54.992       20.315         9000000.       54.991       20.8282         90000000.       54.991       20.8649         90000000.       53.981       20.8282         915000000.       53.8580       20.7722         93000000.       53.86410       20.6977         935000000.       53.8640       20.6977         935000000.       53.8640       20.6977         935000000.       53.6840	Frequency	e	<del>)</del> '		e"				
$\begin{aligned} 80500000. & 55.0160 & 21.2478 \\ 81000000. & 54.9669 & 21.2322 \\ 815000000. & 54.8017 & 21.2106 \\ 82000000. & 54.8018 & 21.1848 \\ 82500000. & 54.8018 & 21.1635 \\ 83000000. & 54.7057 & 21.1200 \\ 84000000. & 54.6622 & 21.0948 \\ 845000000. & 54.6105 & 21.0733 \\ 85500000. & 54.6105 & 21.0733 \\ 85500000. & 54.5192 & 21.0318 \\ 865000000. & 54.4723 & 21.0127 \\ 865000000. & 54.4712 & 21.0127 \\ 865000000. & 54.4316 & 20.9890 \\ 87000000. & 54.3791 & 20.9719 \\ 87500000. & 54.3347 & 20.9531 \\ 88000000. & 54.2860 & 20.9380 \\ 88500000. & 54.3347 & 20.9531 \\ 88000000. & 54.3347 & 20.9531 \\ 88000000. & 54.391 & 20.8826 \\ 9000000. & 54.391 & 20.8826 \\ 9000000. & 54.0931 & 20.8649 \\ 90500000. & 54.0931 & 20.8649 \\ 90500000. & 53.9981 & 20.8822 \\ 91500000. & 53.9981 & 20.8282 \\ 91500000. & 53.9964 & 20.712 \\ 92000000. & 53.8580 & 20.7722 \\ 93000000. & 53.8700 & 20.7375 \\ 94000000. & 53.7700 & 20.7375 \\ 94000000. & 53.7410 & 20.6829 \\ The conductivity (o) can be given as:  \textbf{ σ = \omega \textbf{ E}_0 \textbf{ e}^{-2} \textbf{ T f } \textbf{ E}_0 \textbf{ e}^{-1} \\ \textbf{ where } \textbf{ f = target f^{*} 10^6 \\ \textbf{ k} = 8.864^{*1} 10^{-2} \end{aligned}$	800000000.		55.0	0635	21.2691				
81000000. 54.9669 21.2322 81500000. 54.9071 21.2106 82000000. 54.8081 21.1848 825000000. 54.7573 21.1432 835000000. 54.7573 21.1432 835000000. 54.6622 21.0948 845000000. 54.6657 21.0538 855000000. 54.5192 21.0315 86000000. 54.4733 21.0127 86000000. 54.473 21.0127 86000000. 54.3347 20.9531 88000000. 54.2860 20.9380 885000000. 54.2397 20.9204 89000000. 54.1913 20.9056 89500000. 54.1931 20.8826 90000000. 54.0449 20.8481 91000000. 53.9981 20.8826 90000000. 54.0449 20.8481 91000000. 53.9981 20.8282 91500000. 53.9981 20.8282 91500000. 53.9981 20.8282 91500000. 53.9984 20.7712 93000000. 53.9964 20.7712 93000000. 53.8580 20.7722 93000000. 53.8580 20.7722 93000000. 53.8640 20.6829 The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e^{\sigma} = 2 \pi f \epsilon_0 e^{\sigma}$ where $f = target f^* 10^{\sigma}$ $\epsilon_{n} = 8.854^+ 10^{12}$	805000000.		55.0	0160	21.2478				
81500000.54.801121.210682000000.54.801521.184882500000.54.808121.16358300000.54.757321.143283500000.54.705721.120084000000.54.610521.073385000000.54.565721.0538855000000.54.519221.031586000000.54.431620.989087000000.54.373120.9719875000000.54.334720.953188000000.54.239720.920489000000.54.191320.862690000000.54.093120.862690000000.54.093120.862990000000.53.952920.811792000000.53.858020.7551935000000.53.770020.737594000000.53.641020.6829The conductivity (\sigma) can be given as: $\sigma = \omega \varepsilon_0 e^{\sigma} = 2 \pi f \varepsilon_0 e^{\sigma}$ where $f = target f^* 10^6$ $\xi_0 = 0.00000$ $\kappa_0 = 8.854^* 10^{12}$	810000000.		54.9	9669	21.2322				
82000000.54.861521.184882500000.54.808121.163583000000.54.757321.143283500000.54.705721.02084000000.54.662221.073385000000.54.510521.0733855000000.54.519221.031586000000.54.472321.0127865000000.54.31620.989087000000.54.334720.971987500000.54.334720.953188000000.54.239720.920489000000.54.139120.864990000000.54.093120.848191000000.53.998120.828291500000.53.952920.811792000000.53.858020.772293000000.53.770020.737594000000.53.76920.721794500000.53.641020.6829The conductivity (σ) can be given as: $\sigma = \omega \epsilon_0 e^{\mu} = 2 \pi f \epsilon_0 e^{\mu}$ $\sigma = \omega \epsilon_0 e^{\mu} = 2 \pi f \epsilon_0 e^{\mu}$ where $f = target f^* 10^{0}$	815000000.		54.9	9071	21.2106				
82500000.54.808121.163583000000.54.757321.143283500000.54.705721.120084000000.54.662221.094884500000.54.665721.053885000000.54.565721.053885000000.54.472321.01127865000000.54.379120.9719875000000.54.334720.953188000000.54.286020.9380885000000.54.39720.905689500000.54.19120.864990000000.54.043120.864990000000.54.044920.848191000000.53.952920.811792000000.53.850020.772293000000.53.811020.7551935000000.53.770020.737594000000.53.644020.6829The conductivity (a) can be given as: $\mathcal{D} = \omega \varepsilon_0 e^{\omega} = 2 \pi f \varepsilon_0 e^{\omega}$ where $f = target f^* 10^6$ $\mathcal{L} = 5.854^* 10^{12}$	820000000.		54.8	8615	21.1848				
83000000.54.757321.143283500000.54.705721.120084000000.54.662221.094884500000.54.610521.073385000000.54.565721.0538855000000.54.519221.031586000000.54.472321.0127865000000.54.379120.971987500000.54.334720.953188000000.54.239720.920489000000.54.191320.864990000000.54.093120.864990000000.53.988120.828291500000.53.858020.772293000000.53.811020.755193500000.53.841020.755193500000.53.641020.6829The conductivity (a) can be given as: $\sigma = \omega \varepsilon_0 e^{\mu} = 2 \pi f \varepsilon_0 e^{\mu}$ $\sigma = \omega \varepsilon_0 e^{\mu} = 2 \pi f \varepsilon_0 e^{\mu}$ where $f = target f^* 10^6$ $\varepsilon_0 = 8.854^* 10^{12}$ $\sigma^2$	825000000.		54.8	8081	21.1635				
<b>83500000.</b> 54,7057 21,1200 84000000. 54,6622 21.0948 845000000. 54,6105 21.0733 85000000. 54,557 21.0538 855000000. 54,5192 21.0315 860000000. 54,4723 21.0127 865000000. 54,4316 20.9890 87000000. 54,3347 20.9531 88000000. 54,2860 20.9380 885000000. 54,2860 20.9380 885000000. 54,2397 20.9204 89000000. 54,1913 20.9056 895000000. 54,1391 20.8826 90000000. 54,0931 20.8649 90000000. 54,0931 20.8649 905000000. 54,0449 20.8481 91000000. 53.9981 20.8282 91500000. 53.9981 20.8282 91500000. 53.9064 20.7712 93000000. 53.8110 20.7551 93500000. 53.8110 20.7551 93500000. 53.7700 20.7375 94000000. 53.7269 20.7217 945000000. 53.6440 20.6977 95000000. 53.6440 20.697 95000000. 53.640 20.697 950000000. 53.640 20.697 95000000000000	830000000.		54.	7573	21.1432				
84000000. 54.6622 21.0948 845000000. 54.6657 21.0538 855000000. 54.5657 21.0538 855000000. 54.5192 21.0315 86000000. 54.4723 21.0127 865000000. 54.3791 20.9719 87000000. 54.3347 20.9531 88000000. 54.2860 20.9380 885000000. 54.2867 20.9204 89000000. 54.1913 20.9056 895000000. 54.1913 20.8826 90000000. 54.0449 20.8481 90000000. 54.0449 20.8481 91000000. 53.9529 20.8117 92000000. 53.9064 20.7910 92500000. 53.8580 20.7722 93000000. 53.8110 20.7551 93500000. 53.8110 20.7551 93500000. 53.8110 20.7551 93500000. 53.8110 20.7551 93500000. 53.8410 20.6829 The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e^n = 2 \pi f \epsilon_0 e^n$ where $f = target f^* 10^6$ $\epsilon_0 = 8854^* 10^{12}$	835000000.		54.7	7057	21.1200				
845000000.54.610521.073385000000.54.565721.0538855000000.54.519221.031586000000.54.472321.0127865000000.54.431620.9890870000000.54.334720.9531880000000.54.286020.9380885000000.54.239720.920489000000.54.191320.864990000000.54.093120.864990000000.54.044920.848191000000.53.998120.828291500000.53.952920.811792000000.53.858020.772293000000.53.811020.7551935000000.53.770020.737594000000.53.684020.697795000000.53.684020.697795000000.53.684020.697795000000.53.684020.697795000000.53.684020.697795000000.53.684020.697795000000.53.684020.697795000000.53.684020.697795000000.53.684020.697795000000.53.641020.6829The conductivity (\sigma) can be given as: $\sigma = \omega \epsilon_o e'' = 2 \pi f \epsilon_o e'''$ where $f = target f * 10^6$ $\kappa = 8.854 * 10^{12}$	840000000.		54.6	6622	21.0948				
85000000.54.565721.053885500000.54.519221.031586000000.54.472321.012786500000.54.379120.9719875000000.54.334720.953188000000.54.286020.9380885000000.54.239720.920489000000.54.139120.882690000000.54.093120.848190500000.54.044920.848191000000.53.998120.828291500000.53.952920.811792000000.53.858020.772293000000.53.858020.772594000000.53.770020.737594000000.53.684020.697795000000.53.684020.697795000000.53.641020.6829The conductivity (σ) can be given as: $\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$ where $f = target f * 10^6$ $\varepsilon_0 = 8.854 * 10^{12}$	845000000.		54.6	6105	21.0733				
855000000.       54.5192       21.0315         86000000.       54.4723       21.0127         865000000.       54.3316       20.9890         87000000.       54.3791       20.9719         875000000.       54.3347       20.9531         88000000.       54.2860       20.9380         885000000.       54.2397       20.9024         89000000.       54.1913       20.9056         895000000.       54.1391       20.8826         90000000.       54.0931       20.8649         905000000.       53.9981       20.8282         915000000.       53.999       20.8117         920000000.       53.8580       20.7712         930000000.       53.8580       20.7722         930000000.       53.7700       20.7375         940000000.       53.6410       20.6829         The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_{n=8.854 * 10^{12}$	850000000.		54.	5657	21.0538				
860000000. 54.4723 21.0127 865000000. 54.4316 20.9890 87000000. 54.3347 20.9531 880000000. 54.2860 20.9380 885000000. 54.2897 20.9204 890000000. 54.1913 20.9056 895000000. 54.1391 20.8826 90000000. 54.0931 20.8649 905000000. 54.0449 20.8481 910000000. 53.9881 20.8282 915000000. 53.9529 20.8117 92000000. 53.9529 20.8117 92000000. 53.964 20.7910 925000000. 53.8580 20.7722 930000000. 53.8110 20.7551 935000000. 53.7700 20.7375 94000000. 53.769 20.7217 945000000. 53.6840 20.6977 95000000. 53.6840 20.6977 95000000. 53.6410 20.6829 The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f^* 10^6$ $\epsilon_0 = 8.854^* 10^{12}$	855000000.		54.	5192	21.0315				
865000000. 54.4316 20.9890 87000000. 54.3791 20.9719 875000000. 54.2860 20.9380 880000000. 54.297 20.9204 89000000. 54.2397 20.9204 89000000. 54.1913 20.8626 90000000. 54.0931 20.8649 90500000. 54.0449 20.8481 91000000. 53.981 20.8282 915000000. 53.9529 20.8117 92000000. 53.964 20.7910 925000000. 53.8580 20.7722 93000000. 53.8110 20.7551 935000000. 53.87269 20.7217 94000000. 53.7269 20.7217 94000000. 53.6440 20.6977 95000000. 53.6410 20.6829 The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f^* 10^6$ $\epsilon_0 = 8.854^* 10^{12}$	860000000.		54.4	4723	21.0127				
870000000.54.379120.9719875000000.54.334720.953188000000.54.286020.9380885000000.54.239720.920489000000.54.191320.882690000000.54.093120.882690000000.54.044920.8481910000000.53.998120.8282915000000.53.998120.8282915000000.53.906420.7910925000000.53.858020.772293000000.53.870020.737594000000.53.684020.697795000000.53.684020.697795000000.53.641020.6829The conductivity (σ) can be given as: $\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$ where $f = target f^* 10^6$ $\varepsilon_0 = 8.854^* 10^{-12}$	865000000.		54.4	4316	20.9890				
$875000000.$ $54.3347$ $20.9531$ $88000000.$ $54.2397$ $20.9204$ $89000000.$ $54.1913$ $20.9056$ $89500000.$ $54.1913$ $20.8826$ $90000000.$ $54.0931$ $20.8649$ $90500000.$ $54.0449$ $20.8481$ $91000000.$ $53.9981$ $20.8282$ $915000000.$ $53.9529$ $20.8117$ $92000000.$ $53.9064$ $20.7910$ $92500000.$ $53.810$ $20.7551$ $93000000.$ $53.7700$ $20.7375$ $94000000.$ $53.7269$ $20.7217$ $94500000.$ $53.6840$ $20.6977$ $95000000.$ $53.6410$ $20.6829$ The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$ where $f = target f * 10^6$ $\varepsilon_0 = 8.854 * 10^{-12}$	870000000.		54.3	3791	20.9719				
88000000.       54.2860       20.9380         88500000.       54.2397       20.9204         89000000.       54.1913       20.9056         895000000.       54.0931       20.8826         90000000.       54.0449       20.8481         91000000.       53.9981       20.8282         915000000.       53.9981       20.8117         920000000.       53.9064       20.7910         925000000.       53.8580       20.7722         930000000.       53.8110       20.7375         940000000.       53.7269       20.7217         945000000.       53.6840       20.6977         95000000.       53.6410       20.6829         The conductivity (\sigma) can be given as: $\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$ where $f = target f * 10^6$ $\varepsilon_0 = 8.854 * 10^{-12}$	875000000.		54.3	3347	20.9531				
885000000. $54.2397$ $20.9204$ 890000000. $54.1913$ $20.9056$ 990000000. $54.0931$ $20.8826$ 90000000. $54.0449$ $20.8481$ 91000000. $53.9981$ $20.8282$ 915000000. $53.9981$ $20.8282$ 915000000. $53.9981$ $20.8282$ 915000000. $53.9964$ $20.7122$ 920000000. $53.8580$ $20.7722$ 930000000. $53.87700$ $20.7375$ 940000000. $53.7769$ $20.7217$ 945000000. $53.6440$ $20.6977$ 950000000. $53.6410$ $20.6829$ The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$ where $f = target f^* 10^6$ $\varepsilon_0 = 8.854^* 10^{-12}$	880000000.		54.2	2860	20.9380				
890000000.54.191320.9056895000000.54.139120.8826900000000.54.043920.8649905000000.54.044920.8481910000000.53.998120.8282915000000.53.952920.8117920000000.53.906420.7910925000000.53.858020.7722930000000.53.811020.7375935000000.53.770020.7375940000000.53.684020.697795000000.53.641020.6829The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	885000000.		54.2	2397	20.9204				
895000000.       54.1391       20.8826         900000000.       54.0931       20.8649         905000000.       54.0449       20.8481         910000000.       53.9981       20.8282         915000000.       53.9529       20.8117         920000000.       53.9064       20.7910         925000000.       53.8580       20.7722         930000000.       53.8110       20.7375         940000000.       53.7700       20.7375         940000000.       53.6840       20.6977         95000000.       53.6410       20.6829         The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	890000000.		54.	1913	20.9056				
900000000.54.093120.8649905000000.54.044920.8481910000000.53.998120.8282915000000.53.952920.8117920000000.53.906420.7910925000000.53.858020.7722930000000.53.811020.7551935000000.53.770020.7375940000000.53.684020.697795000000.53.641020.6829The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	895000000.		54.	1391	20.8826				
90500000.54.044920.848191000000.53.998120.828291500000.53.952920.811792000000.53.906420.791092500000.53.858020.772293000000.53.811020.7551935000000.53.770020.737594000000.53.684020.697795000000.53.641020.6829The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	900000000.		54.0	0931	20.8649				
91000000. 53.9981 20.8282 91500000. 53.9529 20.8117 92000000. 53.9064 20.7910 925000000. 53.8580 20.7722 93000000. 53.8110 20.7551 935000000. 53.7700 20.7375 940000000. 53.7269 20.7217 945000000. 53.6840 20.6977 95000000. 53.6410 20.6829 The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f^* 10^6$ $\epsilon_0 = 8.854^* 10^{-12}$	905000000.		54.0	0449	20.8481				
91500000. $53.9529$ $20.8117$ 92000000. $53.9064$ $20.7910$ 92500000. $53.8580$ $20.7722$ 93000000. $53.8110$ $20.7551$ 935000000. $53.7700$ $20.7375$ 94000000. $53.7269$ $20.7217$ 94500000. $53.6840$ $20.6977$ 95000000. $53.6410$ $20.6829$ The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	910000000.		53.9	9981	20.8282				
92000000.       53.9064       20.7910         925000000.       53.8580       20.7722         93000000.       53.8110       20.7551         935000000.       53.7700       20.7375         940000000.       53.7269       20.7217         945000000.       53.6840       20.6977         95000000.       53.6410       20.6829         The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$ where $f = target f * 10^6$ $\varepsilon_0 = 8.854 * 10^{-12}$	915000000.		53.9	9529	20.8117				
925000000.       53.8580       20.7722         930000000.       53.8110       20.7551         935000000.       53.7700       20.7375         940000000.       53.7269       20.7217         945000000.       53.6840       20.6977         950000000.       53.6410       20.6829         The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	920000000.		53.9	9064	20.7910				
93000000.       53.8110       20.7551         935000000.       53.7700       20.7375         94000000.       53.7269       20.7217         945000000.       53.6840       20.6977         950000000.       53.6410       20.6829         The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	925000000.		53.8	8580	20.7722				
935000000.       53.7700       20.7375         940000000.       53.7269       20.7217         945000000.       53.6840       20.6977         950000000.       53.6410       20.6829         The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	930000000.		53.8	8110	20.7551				
94000000.       53.7269       20.7217         945000000.       53.6840       20.6977         950000000.       53.6410       20.6829         The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	935000000.		53.7	7700	20.7375				
945000000.       53.6840       20.6977         950000000.       53.6410       20.6829         The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	94000000.		53.7	7269	20.7217				
95000000. 53.6410 20.6829 The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$ where $f = target f * 10^6$ $\varepsilon_0 = 8.854 * 10^{-12}$	945000000.		53.6	6840	20.6977				
The conductivity ( $\sigma$ ) can be given as: $\sigma = \omega \epsilon_0 e'' = 2 \pi f \epsilon_0 e''$ where $f = target f * 10^6$ $\epsilon_0 = 8.854 * 10^{-12}$	95000000.		53.6	6410	20.6829				
$\sigma = \omega \varepsilon_0 e'' = 2 \pi f \varepsilon_0 e''$ where $f = target f * 10^6$ $\varepsilon_0 = 8.854 * 10^{-12}$	The Conduct	tivity (σ) can	be g	iven as:					
where $f = target f * 10^{6}$ $s_{2} = 8.854 * 10^{-12}$	$\sigma = \omega \varepsilon_0 e^{\prime\prime}$	$= 2 \pi f \varepsilon_0 \epsilon$	"						
$s_0 - 8.854 * 10^{-12}$	where $f = t$	arget f * 10 <sup>6</sup>							
	$\boldsymbol{\varepsilon}_0 = \boldsymbol{\varepsilon}$	3.854 * 10 <sup>-12</sup>							

Date	Freq.	(MHz)		Liqu	iid Parameters	Measured	Target	Delta (%)	Limit ±(%)	
E/20/2011	Dedu	1000	e'	53.2378	Relative Permittivity ( $\varepsilon_r$ ):	53.24	53.30	-0.12	5	
5/20/2011	Боау	1900	e"	14.1641	Conductivity (σ):	1.50	1.52	-1.55	5	
Liquid Checl	Liquid Check									
Ambient temperature: 24 deg. C; Liquid temperature: 23 deg. C; Relative humidity = 42%										
May 20, 201	1 08:58	3 AM								
Frequency		e			e"					
171000000	).	4	53.8	3757	13.4730					
172000000	).	4	53.8	3537	13.5071					
173000000	).	:	53.8	3279	13.5402					
174000000	).	:	53.7	7983	13.5786					
1750000000	).	:	53.7	7764	13.6154					
176000000	).	:	53.7	7485	13.6589					
1770000000	).	:	53.7	7169	13.7029					
178000000	).	:	53.6	6853	13.7482					
179000000	).	:	53.6	6517	13.7905					
180000000	).	:	53.6	6143	13.8304					
181000000	).	:	53.5	5749	13.8720					
182000000	).	4	53.5	5372	13.9108					
183000000	).	:	53.4	1964	13.9458					
184000000	).	:	53.4	1554	13.9818					
185000000	).	:	53.4	1225	14.0143					
186000000	).	:	53.3	3799	14.0393					
187000000	).	4	53.3	3412	14.0737					
188000000	).	:	53.3	3062	14.1020					
189000000	).	:	53.2	2711	14.1320					
190000000	).	:	53.2	2378	14.1641					
191000000	).	4	53.2	2080	14.1982					
The Conduct	tivity (σ	) can b	e g	iven as:						
$\sigma = \omega \varepsilon_0 e''$	=2π	fε <sub>0</sub> e'	,							
where $f = t$	arget f	* 10 <sup>6</sup>								
$\boldsymbol{\varepsilon}_0 = \delta$	8.854 *	10 <sup>-12</sup>								

# 8. SYSTEM VERIFICATION

The system performance check is performed prior to any usage of the system in order to verify SAR system measurement accuracy. The system performance check verifies that the system operates within its specifications of  $\pm 10\%$ .

### 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 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.
- The coarse grid with a grid spacing of 15 mm was aligned with the dipole. For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.
- Special 7x7x7 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 250 mW
- The results are normalized to 1 W input power.

System	Cal cortificato #	Cal data	SAR Avg (mW/g)				
validation dipole		Cal. Uale	Tissue:	Head	Body		
D835V2	D835V2-4d002_Apr11	4/4/2011	1g SAR:	9.36	10.2		
SN: 4d002			10g SAR:	6.12	6.68		
D1900V2	D1900V2-5d043_Nov09	11/24/2009	1g SAR:	39.8	40.4		
SN: 5d043			10g SAR:	20.7	21.4		

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

## 8.1. SYSTEM CHECK RESULTS

System	Data Taatad	Measured (N	ormalized to 1 W)	Target	Dolto (%)	Tolerance
validation dipole	Dale Tesleu	Tissue:	Body	Taiyei		(%)
D0251/2	05/20/11	SAR <sub>1g</sub> :	9.5	10.2	-6.86	.10
D033V2		SAR <sub>10g</sub> :	6.23	6.68	-6.74	±10
	05/20/11	SAR <sub>1g</sub> :	42.0	40.4	3.96	.10
D1900VZ	05/20/11	SAR <sub>10g</sub> :	21.8	21.4	1.87	

# 9. OUTPUT POWER VERIFICATION

Maximum output power is verified on the Low, Middle and High channels according to procedures in section 4.4.5.2 of 3GPP2 C.S0011/TIA-98-E for 1xRTT, section 3.1.2.3.4 of 3GPP2 C.S0033-0/TIA-866 for Rel. 0 and section 4.3.4 of 3GPP2 C.S0033-A for Rev. A

## 9.1. CDMA2000 1xRTT

This procedure assumes the Agilent 8960 Test Set has the following applications installed and with valid license.ApplicationRev, License

CDMA2000 Mobile Test B.13.08, L

- Protocol Rev > 6 (IS-2000-0)
- Radio Config (RC) > Please see following table or details
- FCH Service Option (SO) Setup > Please see following table or details
- Traffic Data Rate > Full
- TDSO SCH Info > F-SCH Parameters > F-SCH Data Rate > 153.6 kbps
  - > R-SCH Parameters > R-SCH Data Rate > 153.6 kbps
- Rvs Power Ctrl > Active bits
   o Rvs Power Ctrl > All Up bits (Maximum TxPout)

#### RF Output Power for Cellular Band

Radio		Conducted Output Power (dBm)						
Configuration	Service Option	Ch. 1013 / 824.7 MHz		Ch. 384 / 8	36.52 MHz	Ch. 777 / 848.31 MHz		
(RC)	(SO)	Average	Peak	Average	Peak	Average	Peak	
RC1	2 (Loopback)	23.74		23.80		23.72		
	55 (Loopback)	24.16		24.15		23.75		
RC2	9 (Loopback)	23.57		23.77		23.71		
	55 (Loopback)	23.65		23.80		23.74		
RC3	2 (Loopback)	23.50		23.83		23.67		
	55 (Loopback)	23.56		23.80		23.70		
	32 (Test Data)	23.50		23.85		23.67		
RC4	2 (Loopback)	23.47		23.87		23.70		
	55 (Loopback)	23.56		23.89		23.69		
	32 (Test Data)	23.65		23.82		23.70		
RC5	9 (Loopback)	23.56		23.85		23.69		
	55 (Loopback)	23.58		23.79		23.70		

#### RF Output Power for PCS Band

Radio		Conducted Output Power (dBm)						
Configuration	Service Option	Ch. 25 / 18	351.25 MHz	Ch. 600 /	Ch. 600 / 1880 MHz		Ch. 1175 / 1908.75 MHz	
(RC)	(SO)	Average	Peak	Average	Peak	Average	Peak	
RC1	2 (Loopback)	24.08		24.00		24.00		
	55 (Loopback)	24.32		24.34		24.32		
RC2	9 (Loopback)	24.05		24.20		24.30		
	55 (Loopback)	24.03		24.15		24.30		
RC3	2 (Loopback)	24.18		24.20		24.25		
	55 (Loopback)	24.20		24.12		24.30		
	32 (Test Data)	24.00		24.10		24.25		
RC4	2 (Loopback)	24.20		24.10		24.30		
	55 (Loopback)	24.03		24.08		24.30		
	32 (Test Data)	24.19		24.15		24.26		
RC5	9 (Loopback)	24.15		24.20		24.30		
	55 (Loopback)	24.13		24.10		24.30		

## 9.2. CDMA2000 1xEv-Do

### 9.2.1. Release 0

This procedure assumes the Agilent 8960 Test Set has the following applications installed and with valid license.

#### EVDO Release 0 - RTAP

- Call Setup > Shift & Preset
- Call Control:
  - Access Network Info > Cell Parameters > Sector ID > 00000000 > Subnet Mask > 0
  - Generator Info > Termination Parameters > Max Forward Packet Duration > 16 Slots
- Call Parms:
  - Cell Power > -105.5 dBm/1.23 MHz
  - Cell Band > (Select US Cellular or US PCS)
  - Channel > (Enter channel number)
  - Application Config > Enhanced Test Application Protocol > RTAP
  - RTAP Rate > 153.6 kbps
  - Rvs Power Ctrl > Active bits
  - Protocol Rel > 0 (1xEV-DO)
- Press "Start Data Connection" when "Session Open" appear in "Active Cell"
- Rvs Power Ctrl > All Up bits (Maximum TxPout)

#### EVDO Release 0 - FTAP

- Call Setup > Shift & Preset
- Call Control:
  - Access Network Info > Cell Parameters > Sector ID > 00000000 > Subnet Mask > 0
  - o Generator Info > Termination Parameters > Max Forward Packet Duration > 16 Slots
- Call Parms:
  - Cell Power > -105.5 dBm/1.23 MHz
  - Cell Band > (Select US Cellular or US PCS)
  - Channel > (Enter channel number)
  - Application Config > Enhanced Test Application Protocol > FTAP (default)
  - FTAP Rate > 307.2 kbps (2 Slot, QPSK)
  - Rvs Power Ctrl > Active bits
  - Protocol Rel > 0 (1xEV-DO)
- Press "Start Data Connection" when "Session Open" appear in "Active Cell"
- Rvs Power Ctrl > All Up bits (Maximum TxPout)

#### RF Power Output for EV-DO Rel 0

Band			Channel	f (M⊔⇒)	Conducted power (dBm)	
Danu	FTAF Nale	RTAF Rale			Average	Peak
	307.2 kbps (2 slot, QPSK)	153.6 kbps	1013	824.70	23.60	
Cellular			384	836.52	23.78	
			777	848.31	23.85	
PCS	307.2 kbps (2 slot, QPSK)	153.6 kbps	25	1851.25	24.15	
			600	1880.00	24.18	
			1175	1908.75	24.25	

### 9.2.2. Revision A

This procedure assumes the Agilent 8960 Test Set has the following applications installed and with valid license.ApplicationRev, License1xEV-DO Terminal TestA.09.13

	<b>-</b> .			
EVDO	Release	A –	RETAP	

- Call Setup > Shift & Preset
- Cell Power > -60 dBm/1.23 MHz
- Protocol Rev > A (1xEV-DO-A)
- Application Config > Enhanced Test Application Protocol > RETAP
- R-Data Pkt Size > 4096
- Protocol Subtype Config > Release A Physical Layer Subtype > Subtype 2
- > PL Subtype 2 Access Channel MAC Subtype > Default (Subtype 0)
- Access Network Info > Cell Parameters > Sector ID > 00000000 > Subnet Mask > 0
- Generator Info > Termination Parameters > Max Forward Packet Duration >16 Slots > ACK R-Data After > Subpacket 0 (All ACK)
- Rvs Power Ctrl > All Up bits (to get the maximum power)

#### EVDO Release A - FETAP

- Call Setup > Shift & Preset
- Cell Power > -60 dBm/1.23 MHz
- Protocol Rev > A (1xEV-DO-A)
- Application Config > Enhanced Test Application Protocol > FETAP
- F-Traffic Format > 4 (1024, 2,128) Canonical (307.2k, QPSK)
- Protocol Subtype Config > Release A Physical Layer Subtype > Subtype 2

> PL Subtype 2 Access Channel MAC Subtype > Default (Subtype 0)

- Access Network Info > Cell Parameters > Sector ID > 00000000 > Subnet Mask > 0
- Generator Info > Termination Parameters > Max Forward Packet Duration >16 Slots
- > ACK R-Data After > Subpacket 0 (All ACK)
- Rvs Power Ctrl > All Up bits (to get the maximum power)

	FFTΔP	RETAP		f (MHz)	Conducted power (dBm)	
Band	Traffic Format	Data Payload Size	Channel		Average	Peak
	307.2k, QPSK/ ACK		1013	824.70	23.70	
Cellular	channel is transmitted at all the slots	4096	384	836.52	24.00	
			777	848.31	23.98	
PCS	307.2k, QPSK/ ACK channel is transmitted at all the slots		25	1851.25	24.40	
		4096	600	1880.00	24.30	
			1175	1908.75	24.45	

# 10. SUMMARY OF TEST RESULTS

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

Bond	Mode	Test position	Ch No.	f (MHz)	SAR (mW/g)	
Бапо					1-g	10-g
Cellular	EV-DO Rev A	Front Side	1013	824.70		
			384	836.52	0.051	0.033
			777	848.31		
PCS	EV-DO Rev A	Front Side	25	1851.25		
			600	1880.00	0.173	0.107
			1175	1908.75		

# 11. SAR TEST PLOTS

### SAR PLOT

Date/Time: 5/20/2011 4:57:11 PM

Test Laboratory: UL CCS

### Nearby Person\_CDMA2000 Cell band

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

Communication System: CDMA Cell Band; Frequency: 836.52 MHz;Duty Cycle: 1:1 Medium parameters used (interpolated): f = 836.52 MHz;  $\sigma$  = 0.982 mho/m;  $\epsilon_r$  = 54.7;  $\rho$  = 1000 kg/m<sup>3</sup> 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(8.79, 8.79, 8.79); Calibrated: 12/13/2010

- Sensor-Surface: 3mm (Mechanical Surface Detection)
- Electronics: DAE3 Sn427; Calibrated: 7/21/2010
- Phantom: Flat Phantom ELI4.0; Type: QDOVA001BB; Serial: SN:1017
- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

#### 1xEv-Do-A\_M-ch/Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm

Info: Interpolated medium parameters used for SAR evaluation. Maximum value of SAR (measured) = 0.063 mW/g

#### 1xEv-Do-A\_M-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 6.63 V/m; Power Drift = 0.187 dB Peak SAR (extrapolated) = 0.117 W/kg SAR(1 g) = 0.051 mW/g; SAR(10 g) = 0.033 mW/g Info: Interpolated medium parameters used for SAR evaluation. Maximum value of SAR (measured) = 0.065 mW/g



Date/Time: 5/20/2011 5:22:20 PM

Test Laboratory: UL CCS

### Nearby Person\_CDMA2000 Cell band

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

Communication System: CDMA Cell Band; Frequency: 836.52 MHz;Duty Cycle: 1:1

### 1xEv-Do-A\_M-ch/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) = 0.049 mW/g



### SAR PLOT

Date/Time: 5/20/2011 2:15:16 PM

Test Laboratory: UL CCS

#### Nearby Person\_CDMA2000 PCS band

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

Communication System: CDMA PCS Band; Frequency: 1880 MHz;Duty Cycle: 1:1 Medium parameters used: f = 1880 MHz;  $\sigma$  = 1.47 mho/m;  $\epsilon_r$  = 53.3;  $\rho$  = 1000 kg/m<sup>3</sup> 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(7.33, 7.33, 7.33); Calibrated: 12/13/2010

- Sensor-Surface: 3mm (Mechanical Surface Detection)

- Electronics: DAE3 Sn427; Calibrated: 7/21/2010

- Phantom: SAM 2 (Twin); Type: SAM 2; Serial: 1050

- Measurement SW: DASY4, V4.7 Build 80; Postprocessing SW: SEMCAD, V1.8 Build 186

#### 1xEv-Do-A\_M-ch/Area Scan (8x13x1): Measurement grid: dx=15mm, dy=15mm

Maximum value of SAR (measured) = 0.206 mW/g

#### 1xEv-Do-A\_M-ch/Zoom Scan (7x7x9)/Cube 0: Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 11.9 V/m; Power Drift = -0.113 dB Peak SAR (extrapolated) = 0.281 W/kg SAR(1 g) = 0.182 mW/g; SAR(10 g) = 0.116 mW/g Maximum value of SAR (measured) = 0.213 mW/g

### 1xEv-Do-A\_M-ch/Zoom Scan (7x7x9)/Cube 1: Measurement grid: dx=5mm, dy=5mm, dz=3mm

Reference Value = 11.9 V/m; Power Drift = -0.113 dB Peak SAR (extrapolated) = 0.271 W/kg SAR(1 g) = 0.173 mW/g; SAR(10 g) = 0.107 mW/g Maximum value of SAR (measured) = 0.205 mW/g



Date/Time: 5/20/2011 2:57:41 PM

Test Laboratory: UL CCS

### Nearby Person\_CDMA2000 PCS band

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

Communication System: CDMA PCS Band; Frequency: 1880 MHz;Duty Cycle: 1:1

## 1xEv-Do-A\_M-ch/Z Scan (1x1x29): Measurement grid: dx=20mm, dy=20mm, dz=3.5mm

Maximum value of SAR (measured) = 0.215 mW/g



# 12. ATTACHMENTS

<u>No.</u>	Contents	<u>No. of page (s)</u>
1	System Check Plots	4
2	Certificate of E-Field Probe EX3DV4 SN3749	11
3	Certificate of System Validation Dipole D835V2 SN:4d002	9
4	Certificate of System Validation Dipole D1900V2 SN:5d043	9

# 13. TEST SETUP PHOTO

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



# 14. EXTERNAL ANTENNA PHOTO

Front Side





### **END OF REPORT**

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