FCC OET BULLETIN 65 SUPPLEMENT C 01-01
IEEE STD 1528:2003

SAR EVALUATION REPORT

For
MC7750 PCI Express Mini Card
(Tested inside of Panasonic Laptop PC CF-C1)

MODEL NUMBER: MC7750
FCC ID: N7NMC7750

REPORT NUMBER: 11J14091-1C
ISSUE DATE: 4/9/2012

Prepared for
Sierra Wireless Inc.
13811 Wireless Way
Richmond, BC, V6V 3A4
Canada

Prepared by
COMPLIANCE CERTIFICATION SERVICES (UL CCS)
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
--	10/26/2011	Initial Issue	--
A	1/4/2012	1. Sec. 2: Added KDB 616217 2. Sec. 5.1: Updated Table 3. Sec. 11: Removed 1xRTT power table as voice mode is not supported 4. Sec. 11.2: Added Measured MPR on LTE Output Power Table 5. Sec. 11.2.1: Updated Spectrum Plots 6. Sec. 12: Additional Testing for LTE Band 13. Removed unnecessary 5MHz Bandwidth SAR Test Results and Test Plots. 7. Sec. 13: Added Table 8. Sec. 16: Updated Antenna Diagram	Bobby Bayani
B	1/11/2012	1. Sec. 5: Corrected typo for item #7 2. Sec. 12.1: Added Note explain why low and high channels were not tested (CDMA modes) 3. Sec.12.2: Removed unnecessary SAR Data 4. Added missing System Validation Dipole for D750V3 – S/N 1024	Bobby Bayani
B1	2/17/2012	1. Sec. 12.2: Additional Testing for LTE Band 13 performed. Removed unnecessary SAR Data.	Bobby Bayani
C	4/9/2012	1. Sec. 5 & 5.1: Updated Table. 2. Sec. 11.2.1: Removed 5MHz Bandwidth LTE Spectrum Plots. 3. Sec. 12, 15, &16: Revised Configuration Labels. 4. Sec. 12.2: Added Measured MPR and LTE Test Reduction Note.	Bobby Bayani

This report shall not be reproduced except in full, without the written approval of UL CCS.

Table of Contents

1. Attestation of Test Results 5

2. Test Methodology 6

3. Facilities and Accreditation 6

4. Calibration and Uncertainty 7

4.1. Measuring Instrument Calibration 7

4.2. Measurement Uncertainty 8

5. Equipment Under Test 9

5.1. KDB 941225 D05 "SAR for LTE Devices v01" 10

6. System Specification 12

7. Composition of Ingredients for Tissue Simulating Liquids 13

8. Liquid Parameters 14

8.1. Simulating Liquid Check Results 15

9. System Verification 16

9.1. System Check Results 17

10. SAR Measurement Procedures 18

11. RF Output Power Verification 19

11.1. CDMA2000 Cell and PCS Band 19

11.2. LTE Band 13 21

11.2.1. Spectrum Plots for the Test RB allocations 22

12. Summary of Test Results 26

12.1. CDMA2000 Cell & PCS Band 26

12.2. LTE BAND 13 27

13. Simultaneous Transmission SAR Analysis 29

14. Appendixes 30

14.1. Appendix A: System Check Plots 30

14.2. Appendix B: SAR Test Plots for CDMA2000 Cell & PCS band 30

14.3. Appendix C: SAR Test Plots for LTE Band 13 30

14.4. Appendix D: Calibration Certificate for EX3DV4 SN 3686 30

14.5. Appendix E: Calibration Certificate for EX3DV4 SN 3772 30

14.6. Appendix F: Calibration Certificate for EX3DV4 SN 3773 30

14.7. Appendix G: Calibration Certificate for D750V3 SN1019 30

This report shall not be reproduced except in full, without the written approval of UL CCS.

14.8. Appendix H: Calibration Certificate for D750V3 SN1024 30
14.9. Appendix I: Calibration Certificate for D835V2 SN 4d117 30
14.10. Appendix J: Calibration Certificate for D1900V2 SN 5d140 30

15. Summary of Test configurations 31

16. Antenna Locations & Separation Distances 32

17. Host Device Photos 36

This report shall not be reproduced except in full, without the written approval of UL CCS.

1. Attestation of Test Results

Applicant name:	Sierra Wireless Inc.
EUT description:	The EUT is the Sierra Wireless MC7750 Cell and PCS band for CDMA/EvDO and Band 13 for LTE Module (Tested inside of Panasonic Laptop PC, Model CF-C1) (GPRS/EDGE and UMTS are disabled.)
Model number:	MC7750
Device category:	Portable
Exposure category:	General Population/Uncontrolled Exposure
Date tested:	October 17-20, 2011 February 10, 2012 (Additional Testing)

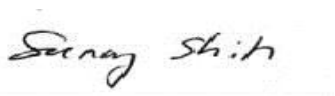
FCC Rule Parts	Freq. Range [MHz]	Highest 1g SAR (mW/g)	Limit (mW/g)
27 (LTE Band 13)	779.5 – 784.5	0.116 (Tablet mode Edge 1)	1.6
22H	824 – 849	0.135 (Tablet mode Edge 1)	
24E	1850 – 1910	0.504 (Tablet mode Edge 1)	

Applicable Standards	Test Results
OET Bulletin 65 Supplement C 01-01, IEEE STD 1528: 2003	Pass

Compliance Certification Services, Inc. (UL 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 UL 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 UL CCS and all revisions are duly noted in the revisions section. Any alteration of this document not carried out by UL 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 Team Leader
Compliance Certification Services (UL CCS)

Tested By:

Bobby Bayani
SAR Engineer
Compliance Certification Services (UL CCS)

This report shall not be reproduced except in full, without the written approval of UL CCS.

2. Test Methodology

The tests documented in this report were performed in accordance with FCC OET Bulletin 65 Supplement C Edition 01-01, IEEE STD 1528:2003 and the following KDBs Procedures.

- 447498 D01 Mobile Portable RF Exposure v04
- 616217 D03 SAR Supp Note and Netbook Laptop V01
- 941225 D01 SAR test for 3G devices v02
- 941225 D05 SAR for LTE Devices v01

3. Facilities and Accreditation

The test sites and measurement facilities used to collect data are located at 47173 Benicia Street, Fremont, California, USA.

UL CCS is accredited by NVLAP, Laboratory Code 200065-0. The full scope of accreditation can be viewed at http://www.ccsemc.com

This report shall not be reproduced except in full, without the written approval of UL CCS.

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
Dielectric Probe Kit	HP	85070C	N/A	N/A		
Network Analyzer	Agilent	E5071B	MY42100131	2	11	2013
Synthesized Signal Generator	HP	83732B	US34490599	7	14	2012
E-Field Probe	SPEAG	EX3DV4	3686	1	24	2012
E-Field Probe	SPEAG	EX3DV4	3772	5	3	2012
E-Field Probe	SPEAG	EX3DV4	3773	5	3	2012
Thermometer	EXTECH	Thermometer	SCL29766	5	17	2012
Data Acquisition Electronics	SPEAG	DAE3	500	7	14	2012
System Validation Dipole	SPEAG	D750V3	1019	12	10	2011
System Validation Dipole	SPEAG	D750V3	1024	4	20	2012
System Validation Dipole	SPEAG	D835V2	4d117	4	15	2012
System Validation Dipole	SPEAG	D1900V2	5d140	4	18	2012
Power Meter	HP	437B	3125U16345	5	13	2012
Power Sensor	HP	8481A	1834588	5	13	2012
Directional Coupler	Warlatone	C8060-102	2141	N/A		
Radio Communication Analyzer	R&S	CMU200	838114/032	3	1	2012
Radio Communication Analyzer	Anritsu	MT8820C	6200985430	6	17	2012
Amplifier	Mini-Circuits	ZVE-8G	90606	N/A		
Amplifier	Mini-Circuits	ZHL-42W	D072701-5	N/A		
Simulating Liquid	SPEAG	MSL750	N/A	Within 24 hrs of first test		
Simulating Liquid	SPEAG	MSL900	N/A	Within 24 hrs of first test		
Simulating Liquid	SPEAG	MSL1900	N/A	Within 24 hrs of first test		

This report shall not be reproduced except in full, without the written approval of UL CCS.

4.2. Measurement Uncertainty

Specific Absorption Rate (SAR) uncertainty calculation

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	3.10	Normal	1	0.64	1.98
Liquid Permittivity - deviation from target	5.00	Rectangular	1.732	0.6	1.73
Liquid Permittivity - measurement	-2.59	Normal	1	0.6	-1.55
				Combined Standard Uncertainty Uc(y) =	9.77
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 19.54	%
				Expanded Uncertainty U, Coverage Factor = 2, > 95 % Confidence = 1.55	dB

This report shall not be reproduced except in full, without the written approval of UL CCS.

5. Equipment Under Test

The EUT is the Sierra Wireless MC7750 Cell and PCS band for CDMA/EvDO and Band 13 for LTE Module. Tested inside Panasonic Laptop PC, CF-C1 (GPRS/EDGE and UMTS are disabled.)	
Normal operation:	• Laptop mode (notebook) • Tablet with Multiple display orientations supporting all Edge configurations.
Antenna tested:	Manufactured: Panasonic Part Number: Main: DFUP1887ZA(1) Aux: Rx only
Antenna-to-antenna/user separation distances:	See Section 16 for details of antenna locations and separation distances.
Simultaneous transmission:	• WWAN can transmit simultaneously with WiFi • WWAN can transmit simultaneously with Bluetooth • WiFi can transmit simultaneously with Bluetooth
Assessment for SAR evaluation for Simultaneous transmission:	**WiFi and BT** Due to Bluetooth's maximum output is < 60/f(GHz) mW and standalone SAR is not required, that WiFi and Bluetooth are not considered as co-located transmitters each other. (Bluetooth – FCC ID: ACJ9TGBT11B, IC: 216A-CFBT11B) **WWAN and BT** Same as WiFi and BT **WWAN and WiFi** SAR is not required due to $\sum (SAR_{1g})$ < SAR limit. (Refer to Sec. 13 Simultaneous Transmission SAR Analyses.)

This report shall not be reproduced except in full, without the written approval of UL CCS.

5.1. KDB 941225 D05 "SAR for LTE Devices v01"

#	Description	Parameter
1	Identify the operating frequency range of each LTE transmission band used by the device	Band 13: 779.5 - 784.5 MHz (5 MHz BW) 782 MHz (10MHz BW)
2	Identify the channel bandwidths used in each frequency band; 1.4, 3, 5, 10, 15, 20 MHz etc	5MHz, 10MHz
3	Identify the high, middle and low (H, M, L) channel numbers and frequencies in each LTE frequency band	Please refer to section 11.2
4	Specify the UE category and uplink modulations used	The UE Category is 3 Uplink modulations: QPSK, 16QAM
5	Descriptions of the LTE transmitter and antenna implementation & identify whether it is a standalone transmitter operating independently of other wireless transmitters in the device or sharing hardware components and/or antenna(s) with other transmitters etc.	Please refer Sec. 16 Antenna locations and distance
6	Identify the LTE voice/data requirements in each operating mode and exposure condition with respect to head and body test configurations, antenna locations, handset flip-cover or slide positions, antenna diversity conditions, etc.	Please refer to Tables in section 12
7	Identify if Maximum Power Reduction (MPR) is optional or mandatory, i.e. built-in by design: a) only mandatory MPR may be considered during SAR testing, when the maximum output power is permanently limited by the MPR implemented within the UE; and only for the applicable RB (resource block) configurations specified in LTE standards b) A-MPR (additional MPR) must be disabled.	• Built-in by design • A-MPR was disabled. Please refer to Tables in section 12
8	Include the maximum average conducted output power measured on the required test channels for each channel bandwidth and UL modulation used in each frequency band: a) with 1 RB allocated at the upper edge of a channel b) with 1 RB allocated at the lower edge of a channel c) using 50% RB allocation centered within a channel d) using 100% RB allocation	Refer to section 11.2 RF output power table
9	Identify all other U.S. wireless operating modes (3G, Wi-Fi, WiMax, Bluetooth etc), device/exposure configurations (head and body, antenna and handset flip-cover or slide positions, antenna diversity conditions etc.) and frequency bands used for these modes	CDMA2000 (Cell and PCS) and LTE functions are contained within the module. Only one band/mode can be operational at a time
10	Include the maximum average conducted output power measured for the other wireless mode and frequency bands	See section 11 RF output power measurements in SAR report.
11	Identify the simultaneous transmission conditions for the voice and data configurations supported by all wireless modes, device configurations and frequency bands, for the head and body exposure conditions and device operating configurations (handset flip or cover positions, antenna diversity conditions etc.)	Please refer to the table in section 5

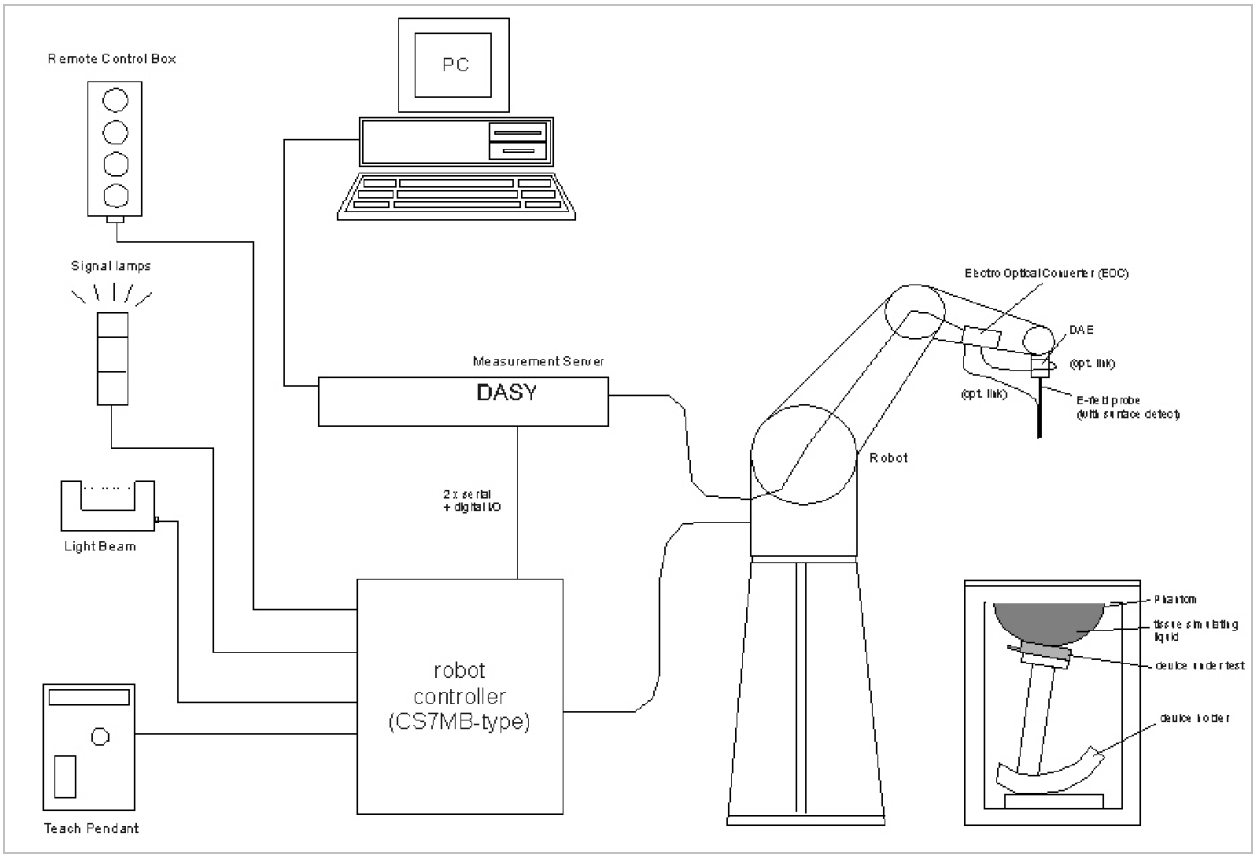
This report shall not be reproduced except in full, without the written approval of UL CCS.

KDB 941225 D05 "SAR for LTE Devices v01" (continued)

12	When power reduction is applied to certain wireless modes to satisfy SAR compliance for simultaneous transmission conditions, other equipment certification or operating requirements, include the maximum average conducted output power measured in each power reduction mode applicable to the simultaneous voice/data transmission configurations for such wireless configurations and frequency bands; and also include details of the power reduction implementation and measurement setup	Not Applicable
13	Include descriptions of the test equipment, test software, built-in test firmware etc. required to support testing the device when power reduction is applied to one or more transmitters/antennas for simultaneous voice/data transmission	Not Applicable
14	When appropriate, include a SAR test plan proposal with respect to the above	Not Applicable
15	If applicable, include preliminary SAR test data and/or supporting information in laboratory testing inquiries to address specific issues and concerns or for requesting further test reduction considerations appropriate for the device; for example, simultaneous transmission configurations	Not applicable

This report shall not be reproduced except in full, without the written approval of UL CCS.

6. System Specification



The DASY 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.
- DASY 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.

This report shall not be reproduced except in full, without the written approval of UL CCS.

7. Composition of Ingredients for Tissue Simulating Liquids

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

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

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

MSL/HSL750 (Body and Head liquids for 700 – 800 MHz)

Item	Head Tissue Simulation Liquids HSL750 Muscle (body) Tissue Simulation Liquids MSL750
Type No	SL AAH 075
Manufacturer	SPEAG
The item is composed of the following ingredients:	
H^2O	Water, 35 – 58%
Sucrese	Sugar, white, refined, 40-60%
NaCl	Sodium Chloride, 0-6%
Hydroxyethel-cellulsoe	Medium Viscosity (CAS# 9004-62-0), <0.3%
Preventol-D7	Preservative: aqueous preparation, (CAS# 55965-84-9), containing 5-chloro-2-methyl-3(2H)-isothiazolone and 2-methyyl-3(2H)-isothiazolone, 0.1-0.7%

MSL/HSL1750 (Body and Head liquids for 1700 – 1800 MHz)

Item	Head Tissue Simulation Liquids HSL1750 Muscle (body) Tissue Simulation Liquids MSL1750
Type No	SL AAM 175
Manufacturer	SPEAG
The item is composed of the following ingredients:	
H^2O	Water, 52 – 75%
C8H18O3	Diethylene glycol monobutyl ether (DGBE), 25-48%
NaCl	Sodium Chloride, <1.0%

This report shall not be reproduced except in full, without the written approval of UL CCS.

8. Liquid Parameters

The simulating liquids are checked at the beginning of a series of SAR measurements to determine if 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 were within ± 5% of the target values. For frequencies above 2 GHz the measured conductivity was within ± 5% of the target values. The measured relative permittivity tolerance was within ± 10% of the target value.

Reference Values of Tissue Dielectric Parameters for Head & 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)	Head		Body	
	ε_r	σ (S/m)	ε_r	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
750	41.96	0.89	55.6	0.96
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
1750	40.08	1.37	53.44	1.49
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

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

This report shall not be reproduced except in full, without the written approval of UL CCS.

8.1. Simulating Liquid Check Results

Date	Freq. (MHz)	Liquid Parameters			Measured	Target	Delta (%)	Limit ±(%)
10/17/2011	Body 835	e'	53.8385	Relative Permittivity (ϵ_r):	53.84	55.20	-2.47	5
		e"	21.2134	Conductivity (σ):	0.98	0.97	1.54	5
10/18/2011	Body 1900	e'	51.9189	Relative Permittivity (ϵ_r):	51.92	53.30	-2.59	5
		e"	14.0796	Conductivity (σ):	1.49	1.52	-2.14	5
10/18/2011	Body 750	e'	54.5980	Relative Permittivity (ϵ_r):	54.60	55.55	-1.71	5
		e"	23.5839	Conductivity (σ):	0.98	0.96	2.12	5
10/19/2011	Body 750	e'	54.8742	Relative Permittivity (ϵ_r):	54.87	55.55	-1.21	5
		e"	23.6116	Conductivity (σ):	0.98	0.96	2.24	5
10/20/2011	Body 750	e'	54.5819	Relative Permittivity (ϵ_r):	54.58	55.55	-1.74	5
		e"	23.5233	Conductivity (σ):	0.98	0.96	1.86	5
12/30/2011	Body 750	e'	55.6750	Relative Permittivity (ϵ_r):	55.68	55.55	0.23	5
		e"	22.8304	Conductivity (σ):	0.95	0.96	-1.14	5
	Body 775	e'	55.4296	Relative Permittivity (ϵ_r):	55.43	55.45	-0.04	5
		e"	22.6199	Conductivity (σ):	0.97	0.97	1.01	5
	Body 790	e'	55.2885	Relative Permittivity (ϵ_r):	55.29	55.39	-0.19	5
		e"	22.5508	Conductivity (σ):	0.99	0.97	2.53	5
02/10/2012	Body 750	e'	55.0280	Relative Permittivity (ϵ_r):	55.03	55.55	-0.93	5
		e"	23.0432	Conductivity (σ):	0.96	0.96	-0.22	5
	Body 775	e'	54.6960	Relative Permittivity (ϵ_r):	54.70	55.45	-1.36	5
		e"	22.9016	Conductivity (σ):	0.99	0.97	2.27	5
	Body 790	e'	54.3517	Relative Permittivity (ϵ_r):	54.35	55.39	-1.88	5
		e"	22.6759	Conductivity (σ):	1.00	0.97	3.10	5

COMPLIANCE CERTIFICATION SERVICES (UL CCS) FORM NO: CCSUP4031B
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
This report shall not be reproduced except in full, without the written approval of UL CCS.

9. System Verification

The system performance check is performed prior to any usage of the system in order to verify SAR system 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 TWIN SAM or ELI phantom, shell thickness: 2.0 ±0.2 mm (bottom plate) filled with Body or Head simulating liquid of the following parameters.

The DASY5 system with an Isotropic E-Field Probe EX3DV4 was used for the measurements.

The dipole was mounted on the small tripod so that the dipole feed point was positioned below the center marking of the flat phantom section and the dipole was oriented parallel to the body axis (the long side of the phantom). The standard measuring distance was 10 mm (above 1 GHz) and 15 mm (below 1 GHz) from dipole center to the simulating liquid surface.

The coarse grid with a grid spacing of 15 mm was aligned with the dipole.
For 5 GHz band - The coarse grid with a grid spacing of 10 mm was aligned with the dipole.

Special 7x7x7 (2.4 GHz) fine cube was chosen for cube integration and Special 8x8x10 (5 GHz) fine cube was chosen for cube integration

Distance between probe sensors and phantom surface was set to 2.5 mm.
For 5 GHz band - Distance between probe sensors and phantom surface was set to 2.5 mm

The dipole input powers (forward power) were 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:	Freq.	Head	Body
D750V3 SN: 1019	D750V3-1019_Dec10	12/10/10	1g SAR:	750 MHz	8.16	8.64
			10g SAR:		5.32	5.72
D835V2 SN: 4d117	D835V2-4d117_Apr11	4/15/11	1g SAR:	835 MHz	9.64	10.1
			10g SAR:		6.28	6.6
D1900V2 SN: 5d140	D1900V2-5d140_Apr11	4/18/11	1g SAR:	1.9 GHz	41.6	41.2
			10g SAR:		21.5	21.6
D750V3 SN: 1024	D750V3-1024_Apr11	4/20/11	1g SAR:	750 MHz	8.52	8.8
			10g SAR:		5.56	5.84

This report shall not be reproduced except in full, without the written approval of UL CCS.

9.1. System Check Results

System validation dipole	Date Tested	Measured (Normalized to 1 W)		Target	Delta (%)	Tolerance (%)
		Tissue:	Body			
D835V2 SN: 4d117	10/17/11	1g SAR:	10.40	10.1	2.97	±10
		10g SAR:	6.82	6.6	3.33	
D1900V2 SN: 5d140	10/18/11	1g SAR:	42.0	41.2	1.94	±10
		10g SAR:	22.1	21.6	2.31	
D750V3 SN: 1019	10/18/11	1g SAR:	9.35	8.64	8.22	±10
		10g SAR:	6.18	5.72	8.04	
D750V3 SN: 1019	10/19/11	1g SAR:	9.25	8.64	7.06	±10
		10g SAR:	6.16	5.72	7.69	
D750V3 SN: 1019	10/20/11	1g SAR:	9.30	8.64	7.64	±10
		10g SAR:	6.18	5.72	8.04	
D750V3 SN: 1024	01/03/12	1g SAR:	8.61	8.80	-2.16	±10
		10g SAR:	5.71	5.84	-2.23	
D750V3 SN: 1024	02/10/12	1g SAR:	8.81	8.80	0.11	±10
		10g SAR:	5.84	5.84	0.00	

This report shall not be reproduced except in full, without the written approval of UL CCS.

10. SAR Measurement Procedures

Step 1: Power Reference Measurement
The Power Reference Measurement and Power Drift Measurements are for monitoring the power drift of the device under test in the batch process. The Minimum distance of probe sensors to surface determines the closest measurement point to phantom surface. The minimum distance of probe sensors to surface is 2.1 mm. This distance cannot be smaller than the Distance of sensor calibration points to probe tip as defined in the probe properties.

Step 2: Area Scan
The Area Scan is used as a fast scan in two dimensions to find the area of high field values, before doing a fine measurement around the hot spot. The sophisticated interpolation routines implemented in DASY5 software can find the maximum locations even in relatively coarse grids. When an Area Scan has measured all reachable points, it computes the field maximal found in the scanned area, within a range of the global maximum. The range (in dB) is specified in the standards for compliance testing. For example, a 2 dB range is required in IEEE Standard 1528 and IEC 62209 standards, whereby 3 dB is a requirement when compliance is assessed in accordance with the ARIB standard (Japan). If only one Zoom Scan follows the Area Scan, then only the absolute maximum will be taken as reference. For cases where multiple maximums are detected, the number of Zoom Scans has to be increased accordingly.

Step 3: Zoom Scan
Zoom Scans are used to assess the peak spatial SAR values within a cubic averaging volume containing 1 g and 10 g of simulated tissue. The Zoom Scan measures ≥ 7x7x9 (above 4.5 GHz) or 5x5x7 (below 3 GHz) points within a cube whose base faces are centered on the maxima found in a preceding area scan job within the same procedure. When the measurement is done, the Zoom Scan evaluates the averaged SAR for 1 g and 10 g and displays these values next to the job's label.

Step 4: Power drift measurement
The Power Drift Measurement measures the field at the same location as the most recent power reference measurement within the same procedure, and with the same settings. The Power Drift Measurement gives the field difference in dB from the reading conducted within the last Power Reference Measurement. This allows a user to monitor the power drift of the device under test within a batch process. The measurement procedure is the same as Step 1.

Step 5: Z-Scan
The Z Scan measures points along a vertical straight line. The line runs along the Z-axis of a one-dimensional grid. In order to get a reasonable extrapolation, the extrapolated distance should not be larger than the step size in Z-direction.

This report shall not be reproduced except in full, without the written approval of UL CCS.

11. RF Output Power Verification

11.1. CDMA2000 Cell and PCS Band

1xEv-Do - Release 0 (Rel. 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 : 00000000 : 00000000 : 00000000 > Subnet Mask > 0
- Generator Info > Termination Parameters > Max Forward Packet Duration > 16 Slots
- Call Parms:
- Cell Power > -105.5 dBm/1.23 MHz
- System ID: 2004; NID: 65535, Reg. Ch. #.: 610 for Cell and 600 for 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 : 00000000 : 00000000 : 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 > 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)

Band	FTAP Rate	RTAP Rate	Channel	f (MHz)	Conducted power (dBm)	
					Average	Peak
Cell	307.2 kbps (2 slot, QPSK)	153.6 kbps	1013	824.70	25.32	
			384	836.52	25.30	
			777	848.31	25.30	
PCS	307.2 kbps (2 slot, QPSK)	153.6 kbps	25	1851.25	25.30	
			600	1880.00	24.74	
			1175	1908.75	25.29	

This report shall not be reproduced except in full, without the written approval of UL CCS.

1xEv-Do - Revision A (Rev. A)

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

Application	Rev, License
1xEV-DO Terminal Test	A.09.13

EVDO Rev. 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: 00000000: 00000000: 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 Rev. 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: 00000000: 00000000: 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)

Band	FETAP Traffic Format	RETAP Data Payload Size	Channel	f (MHz)	Conducted power (dBm)	
					Average	Peak
Cell	307.2k, QPSK/ ACK channel is transmitted at all the slots	4096	1013	824.70	25.31	
			384	836.52	25.28	
			777	848.31	25.25	
PCS	307.2k, QPSK/ ACK channel is transmitted at all the slots	4096	25	1851.25	25.29	
			600	1880.00	24.63	
			1175	1908.75	25.27	

COMPLIANCE CERTIFICATION SERVICES (UL CCS) FORM NO: CCSUP4031B
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
This report shall not be reproduced except in full, without the written approval of UL CCS.

11.2. LTE Band 13

Output power for LTE Band 13

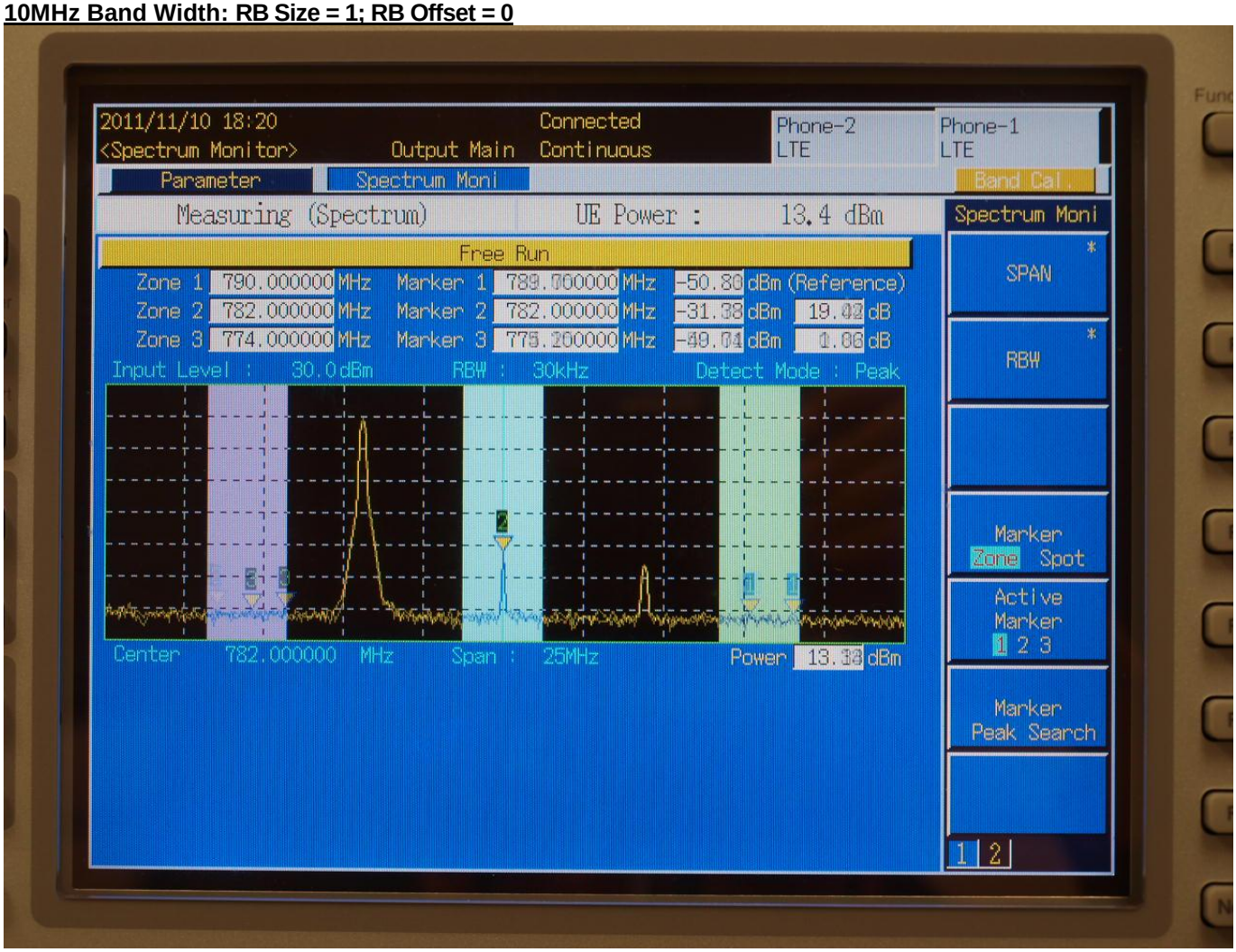
BW	Ch	Freq. (MHz)	Mode	UL RB Allocation	UL RB Start	Target MPR	Measured MPR	Max. Avg. Power (dBm)
5	23205	779.5	QPSK	1	0	0	0	23.4
				1	24	0	0	23.8
				12	6	1	1	22.8
				25	0	1	1	22.6
			16QAM	1	0	1	1	22.6
				1	24	1	1	22.8
				12	6	2	2	21.9
				25	0	2	2	21.9
10	23230	782.0	QPSK	1	0	0	0	23.5
				1	49	0	0	23.4
				25	12	1	1	22.6
				50	0	1	1	22.6
			16QAM	1	0	1	1	22.6
				1	49	1	1	22.8
				25	12	2	2	21.7
				50	0	2	2	21.8
5	23255	784.5	QPSK	1	0	0	0	23.4
				1	24	0	0	23.5
				12	6	1	1	22.7
				25	0	1	1	22.7
			16QAM	1	0	1	1	22.7
				1	24	1	1	22.7
				12	6	2	2	21.9
				25	0	2	2	22.0

This report shall not be reproduced except in full, without the written approval of UL CCS.

11.2.1. Spectrum Plots for the Test RB allocations

The following plots are to demonstrate the tested RB allocations have been established correctly at the maximum output power conditions.

10MHz Band Width: RB Size = 1; RB Offset = 0

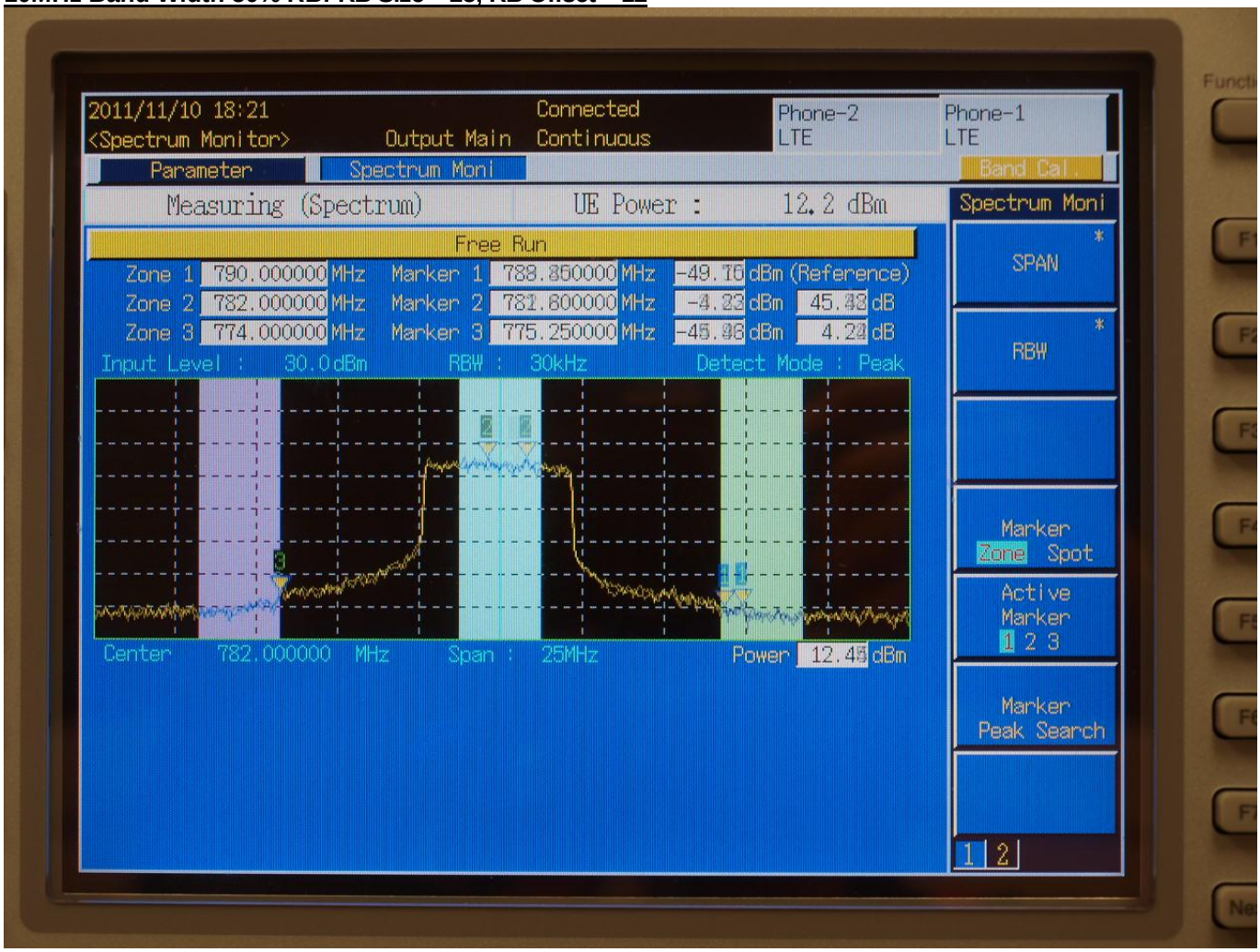


This report shall not be reproduced except in full, without the written approval of UL CCS.

10MHz Band Width: RB Size = 1; RB Offset = 49

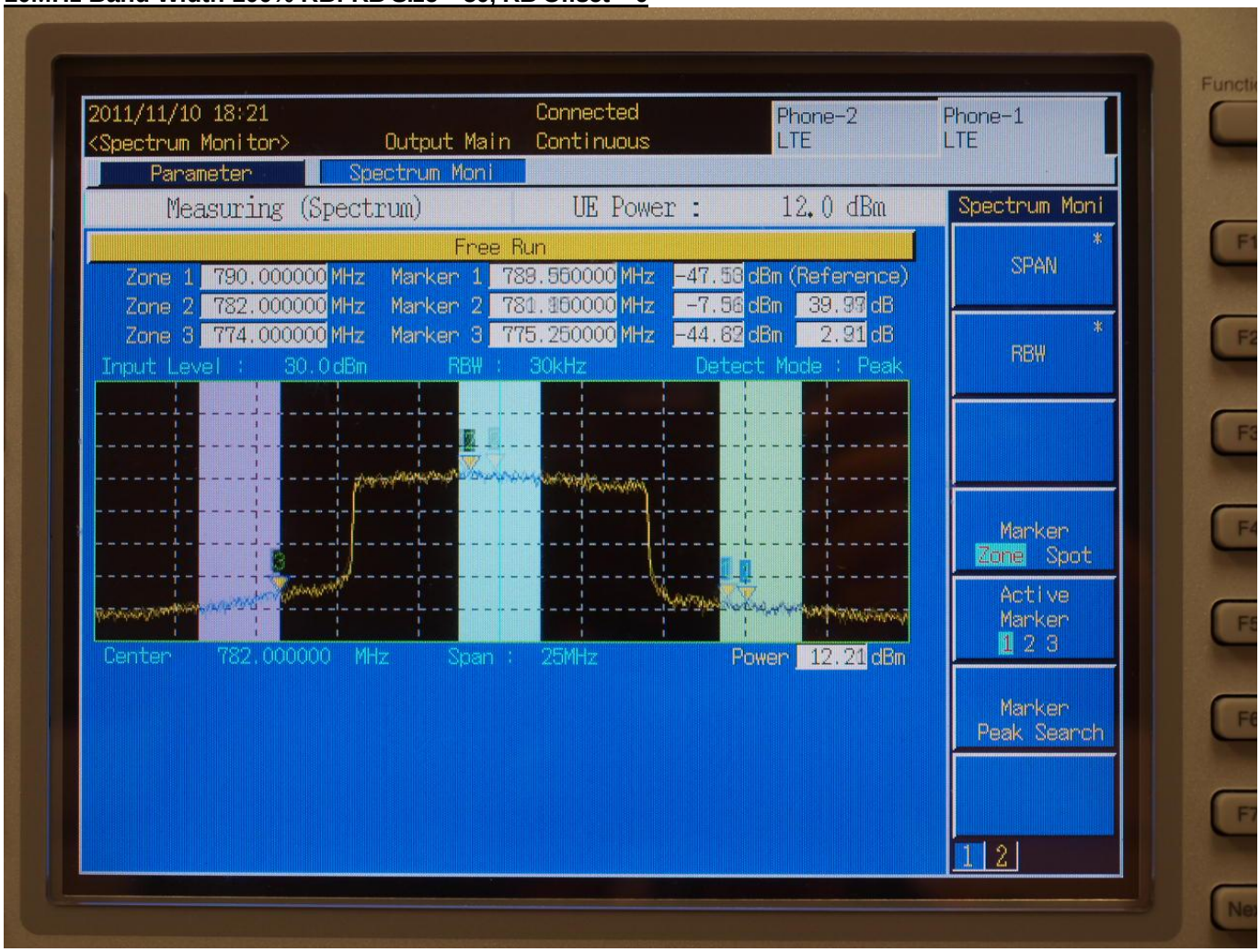
This report shall not be reproduced except in full, without the written approval of UL CCS.

10MHz Band Width 50% RB: RB Size = 25; RB Offset = 12



This report shall not be reproduced except in full, without the written approval of UL CCS.

10MHz Band Width 100% RB: RB Size = 50; RB Offset = 0



This report shall not be reproduced except in full, without the written approval of UL CCS.

12. Summary of Test Results

12.1. CDMA2000 Cell & PCS Band

The following SAR is measured using Subtype 0/1 Physical Layer configurations for Rel. 0.

SAR for Subtype 2 Physical layer configurations in not required for Rev. A since the maximum average output of each RF channel is less than that measured in Subtype 0/1 Physical layer configurations as per KDB 941225 D01 SAR test for 3G devices v02.

Laptop Mode - LapHeld

Band	Mode	Ch No.	f (MHz)	Average Power	SAR (mW/g)	
					1-g	10-g
Cellular	1xEVDO (Rel. 0)	1013	824.70	25.32		
		384	836.52	25.30	0.011	0.009
		777	848.31	25.30		
PCS	1xEVDO (Rel. 0)	25	1851.25	25.30		
		600	1880.00	24.74	0.014	0.011
		1175	1908.75	25.29		

Tablet Mode – Bottom Face

Band	Mode	Ch No.	f (MHz)	Average Power	SAR (mW/g)	
					1-g	10-g
Cellular	1xEVDO (Rel. 0)	1013	824.70	25.32		
		384	836.52	25.30	0.100	0.070
		777	848.31	25.30		
PCS	1xEVDO (Rel. 0)	25	1851.25	25.30		
		600	1880.00	24.74	0.062	0.039
		1175	1908.75	25.29		

Tablet Mode – Edge 1

Band	Mode	Ch No.	f (MHz)	Average Power	SAR (mW/g)	
					1-g	10-g
Cellular	1xEVDO (Rel. 0)	1013	824.70	25.32		
		384	836.52	25.30	**0.135**	**0.086**
		777	848.31	25.30		
PCS	1xEVDO (Rel. 0)	25	1851.25	25.30		
		600	1880.00	24.74	**0.504**	**0.245**
		1175	1908.75	25.29		

Note(s):

1. SAR test was performed in the middle channel only as the measured level was < 50% of the SAR limit as stated in FCC “Public Notice DA 02-1438” by the SCC-34/SC-2. Testing in the low and high channel is optional.

This report shall not be reproduced except in full, without the written approval of UL CCS.

12.2. LTE BAND 13

The test reduction for LTE SAR is based on KDB 941225 D05 SAR for LTE Devices v01.

Tablet Mode – Edge 1

BAND 13, 10 MHz BW - Middle Channel

Mode	UL Ch #.	Freq. (MHz)	RB SIze	RB Offset	Avg Pwr (dBm)	MPR	Measured MPR	Separation Distance (mm)	SAR (mW/g)	
									1-g	10-g
QPSK	23230	782	1	0	23.5	0	0	0	**0.116**	**0.072**
	23230	782	1	49	23.4	0	0	0	0.113	0.070
	23230	782	25	12	22.6	1	1	0	0.100	0.062
	23230	782	50	0	22.6	1	1	0		
16QAM	23230	782	1	0	22.6	1	1	0	0.058	0.036
	23230	782	1	49	22.8	1	1	0	0.080	0.050
	23230	782	25	12	21.7	2	2	0	0.081	0.051
	23230	782	50	0	21.8	2	2	0		

Note(s):
Testing for 100% RB allocation is not required because the SAR value for 50% RB allocation is ≤ 1.45W/Kg.
Testing was only performed on the middle channel because the output power variance over low/middle/high channels is ≤ ½ dB and the measured SAR for the middle channel is ≤ 0.8W/Kg.
Testing for 5MHz Bandwidth is not required as the SAR for the Largest Channel Bandwidth (10MHz) measured is < 1.45 W/kg and the output power for the 5MHz channel bandwidth is within +/- ½dB of the output power for the widest (10MHz) bandwidth.

Tablet Mode – Bottom Face

BAND 13, 10 MHz BW - Middle Channel

Mode	UL Ch #.	Freq. (MHz)	RB SIze	RB Offset	Avg Pwr (dBm)	MPR	Measured MPR	Separation Distance (mm)	SAR (mW/g)	
									1-g	10-g
QPSK	23230	782	1	0	23.5	0	0	0	0.087	0.060
QPSK	23230	782	1	49	23.4	0	0	0	0.098	0.065
QPSK	23230	782	25	12	22.6	1	1	0	0.076	0.050
QPSK	23230	782	50	0	22.6	1	1	0		
16QAM	23230	782	1	0	22.6	1	1	0	0.073	0.049
16QAM	23230	782	1	49	22.8	1	1	0	0.060	0.041
16QAM	23230	782	25	12	21.7	2	2	0	0.056	0.039
16QAM	23230	782	50	0	21.8	2	2	0		

Note(s):
Testing for 100% RB allocation is not required because the SAR value for 50% RB allocation is ≤ 1.45W/Kg.
Testing was only performed on the middle channel because the output power variance over low/middle/high channels is ≤ ½ dB and the measured SAR for the middle channel is ≤ 0.8W/Kg.
Testing for 5MHz Bandwidth is not required as the SAR for the Largest Channel Bandwidth (10MHz) measured is < 1.45 W/kg and the output power for the 5MHz channel bandwidth is within +/- ½dB of the output power for the widest (10MHz) bandwidth.

COMPLIANCE CERTIFICATION SERVICES (UL CCS) FORM NO: CCSUP4031B
47173 BENICIA STREET, FREMONT, CA 94538, USA TEL: (510) 771-1000 FAX: (510) 661-0888
This report shall not be reproduced except in full, without the written approval of UL CCS.

Laptop Mode – LapHeld

BAND 13, 10 MHz BW - Middle Channel

Mode	UL Ch #.	Freq. (MHz)	RB SIze	RB Offset	Avg Pwr (dBm)	MPR	Measured MPR	Separation Distance (mm)	SAR (mW/g)	
									1-g	10-g
QPSK	23230	782	1	0	23.5	0	0	0	0.015	0.012
QPSK	23230	782	1	49	23.4	0	0	0	0.00940	0.00679
QPSK	23230	782	25	12	22.6	1	1	0	0.0086	0.00424
QPSK	23230	782	50	0	22.6	1	1	0		
16QAM	23230	782	1	0	22.6	1	1	0	0.015	0.011
16QAM	23230	782	1	49	22.8	1	1	0	0.013	0.00937
16QAM	23230	782	25	12	21.7	2	2	0	0.011	0.00911
16QAM	23230	782	50	0	21.8	2	2	0		

Note(s):

Testing for 100% RB allocation is not required because the SAR value for 50% RB allocation is ≤ 1.45W/Kg.
Testing was only performed on the middle channel because the output power variance over low/middle/high channels is ≤ ½ dB and the measured SAR for the middle channel is ≤ 0.8W/Kg.
Testing for 5MHz Bandwidth is not required as the SAR for the Largest Channel Bandwidth (10MHz) measured is < 1.45 W/kg and the output power for the 5MHz channel bandwidth is within +/- ½dB of the output power for the widest (10MHz) bandwidth.

This report shall not be reproduced except in full, without the written approval of UL CCS.

13. Simultaneous Transmission SAR Analysis

WWAN + WiFi 2.4 GHz

Test configuration	(1) CDMA Cell	(2) CDMA PCS	(3) LTE Band 13	(4)* WiFi Main	(5)* WiFi Aux	Sum of 1g SAR (mW/g)
Laptop Mode Lapheld	0.011				0.02	0.03
		0.014			0.02	0.03
			0.015		0.02	0.04
Tablet Mode Bottom Face	0.100			0.024	0.031	0.16
		0.062		0.024	0.031	0.12
			0.098	0.024	0.031	0.15

WWAN + WiFi 5.2 GHz

Test configuration	(1) CDMA Cell	(2) CDMA PCS	(3) LTE Band 13	(4)* WiFi Main	(5)* WiFi Aux	Sum of 1g SAR (mW/g)
Laptop Mode Lapheld	0.011				0.052	0.06
		0.014			0.052	0.07
			0.015		0.052	0.07
Tablet Mode Bottom Face	0.100			0.024	0.024	0.15
		0.062		0.024	0.024	0.11
			0.098	0.024	0.024	0.15

WWAN + WiFi 5.3 GHz

Test configuration	(1) CDMA Cell	(2) CDMA PCS	(3) LTE Band 13	(4)* WiFi Main	(5)* WiFi Aux	Sum of 1g SAR (mW/g)
Laptop Mode Lapheld	0.011				0.017	0.03
		0.014			0.017	0.03
			0.015		0.017	0.03
Tablet Mode Bottom Face	0.100			0.033	0.043	0.18
		0.062		0.033	0.043	0.14
			0.098	0.033	0.043	0.17

WWAN + WiFi 5.5 GHz

Test configuration	(1) CDMA Cell	(2) CDMA PCS	(3) LTE Band 13	(4)* WiFi Main	(5)* WiFi Aux	Sum of 1g SAR (mW/g)
Laptop Mode Lapheld	0.011				0.011	0.02
		0.014			0.011	0.03
			0.015		0.011	0.03
Tablet Mode Bottom Face	0.100			0.038	0.037	0.18
		0.062		0.038	0.037	0.14
			0.098	0.038	0.037	0.17

WWAN + WiFi 5.8 GHz

Test configuration	(1) CDMA Cell	(2) CDMA PCS	(3) LTE Band 13	(4)* WiFi Main	(5)* WiFi Aux	Sum of 1g SAR (mW/g)
Laptop Mode Lapheld	0.011				0.029	0.04
		0.014			0.029	0.04
			0.015		0.029	0.04
Tablet Mode Bottom Face	0.100			0.00112	0.029	0.13
		0.062		0.00112	0.029	0.09
			0.098	0.00112	0.029	0.13

Note(s)

1. *: WiFi max. 1g SAR from SAR report "11J13739-3 SAR report" submitted under FCC ID: ACJ9TGWL11A (Panasonic Corporation of North America)

This WiFi module supports MIMO operation in all bands in 802.11n modes and the simultaneous evaluation has included an evaluation with both WLAN antennas operational with the WWAN antenna based on the worst case SAR in each band for each individual WLAN antenna.

Conclusions:

☒ Simultaneous transmission SAR is not required because the sum of the 1-g SAR is < 1.6 W/kg

This report shall not be reproduced except in full, without the written approval of UL CCS.

14. Appendixes

Refer to separated files for the following appendixes

14.1. Appendix A: System Check Plots

14.2. Appendix B: SAR Test Plots for CDMA2000 Cell & PCS band

14.3. Appendix C: SAR Test Plots for LTE Band 13

14.4. Appendix D: Calibration Certificate for EX3DV4 SN 3686

14.5. Appendix E: Calibration Certificate for EX3DV4 SN 3772

14.6. Appendix F: Calibration Certificate for EX3DV4 SN 3773

14.7. Appendix G: Calibration Certificate for D750V3 SN1019

14.8. Appendix H: Calibration Certificate for D750V3 SN1024

14.9. Appendix I: Calibration Certificate for D835V2 SN 4d117

14.10. Appendix J: Calibration Certificate for D1900V2 SN 5d140

This report shall not be reproduced except in full, without the written approval of UL CCS.

15. Summary of Test configurations

Configuration	Antenna-to-User distance	SAR Require	Comments
(1) Bottom/Base (Tablet mode)	28 mm from WWAN Main to user.	Yes	
	28 mm from WWAN Aux to user.	No	WWAN Aux is Rx only.
(2)Bottom/Base (Laptop held)	155 mm from WWAN Main to user.	Yes	
	155 mm from WWAN Aux to user.	No	WWAN Aux is Rx only.
Edge 3	135 mm from WWAN Main to user.	No	
	135 mm from WWAN Aux to user.	No	
(3) Edge 1	20 mm from WWAN Main to user.	Yes	
	20 mm from WWAN Aux to user.	No	WWAN Aux is Rx only.
Edge 2	1 mm from WWAN Main to user.	No	Tx is disabled by software when screen turn to this orientation.
	296 mm from WWAN Aux to user.	No	
Edge 4	296 mm from WWAN Main to user.	No	
	1 mm from WWAN Aux to user.	No	WWAN Aux is Rx only.

This report shall not be reproduced except in full, without the written approval of UL CCS.