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Report On

Application for Grant of Equipment Authorization of the
Novatel Wireless Inc.
MiFi 6620L Wireless Hotspot Modem

FCC CFR 47 Part 2 and Part 27

Report No. SC1403560B Rev.1 July 2014

REPORT ON	Radio Testing of the Novatel Wireless Inc. MiFi 6620L Wireless Hotspot Modem
TEST REPORT NUMBER	SC1403560B Rev.1
PREPARED FOR	Novatel Wireless Inc. 9645 Scranton Road, Suite 205 San Diego, CA 92121
CONTACT PERSON	Roman Olmos Hardware Engineer II & ISO-17025 Technical Manager (858) 812-3400 rolmos@nvtl.com
PREPARED BY	Alex Chang **Name** Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Senior Wireless Test Engineer
DATED	July 15, 2014

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

Revision History

SC1403560B Rev.1 Novatel Wireless Inc. MiFi 6620L Wireless Hotspot Modem					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
07/15/2014	Initial Release				Ferdinand Custodio
07/18/2014	Initial Release	Rev. 1	Model name change from MiFi6620L to MiFi 6620L	2, 3, 5, 6, 8 and 15	Ferdinand Custodio

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SECTION 1

REPORT SUMMARY

Radio Testing of the
Novatel Wireless Inc.
MiFi 6620L Wireless Hotspot Modem

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1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Novatel Wireless Inc. MiFi 6620L Wireless Hotspot Modem to the requirements of FCC CFR 47 Part 2 and Part 27

Objective	To perform Radio Testing to determine the Equipment Under Test's (EUT's) compliance with the Test Specification, for the series of tests carried out.
Manufacturer	Novatel Wireless Inc.
Model Number(s)	MiFi 6620L
FCC ID Number	PKRNVWMIFI6620
IC Number	N/A
Serial Number(s)	SS220414800535
Number of Samples Tested	1
Start of Test	May 30, 2014
Finish of Test	July 03, 2014
Name of Engineer(s)	Alex Chang
Related Document(s)	• RF Exposure Lab Certificate of Compliance SAR Evaluation Test Report Number: SAR.20140601 Revision D. • Supporting documents for EUT certification are separate exhibits.

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1.2 BRIEF SUMMARY OF RESULTS

A brief summary of the tests carried out in accordance with FCC CFR 47 Part 2 and Part 27 standard is shown below.

Section	FCC Part Sections(s)	Test Description	Result
2.1	2.1046 (a) and (c)	Transmitter Conducted Output Power	Compliant (RF Exposure Test Report)
2.2	27.50 (d)(4), Part 2.1046	Equivalent Isotropic Radiated Power	Compliant
2.3	27.50 (b)(10)(12) and Part 2.1046	Effective Radiated Power	Compliant
2.4	27.53(h)(1), 2.1049	Occupied Bandwidth	Compliant
2.5	27.50(d)(5)	Peak-Average Ratio	Compliant
2.6	27.53(c)(2)(5), (g) and (g)(3)	Band Edge	Compliant
2.7	27.53 (c)(2)(5), (e), (g) and Part 2.1051	Conducted Spurious Emissions	Compliant
2.8	27.53(c), (g) and Part 2.1053	Field Strength Of Spurious Radiation	Compliant
2.9	27.54, Part 2.1055(a)(1) and (d)(1)	Frequency Stability	Compliant

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1.3 PRODUCT INFORMATION

1.3.1 EUT General Description

The Equipment Under Test (EUT) was a Novatel Wireless Inc. MiFi 6620L Wireless Hotspot Modem. The EUT creates a personal Wi-Fi cloud, capable of sharing high speed 4G LTE and 3G Mobile Broadband Internet connectivity with up to 15 Wi-Fi enable devices simultaneously. The EUT comes with an AC power adaptor Novatel Wirelss, model: SSW-2597.

1.3.2 EUT General Description

EUT Description	Wireless Hotspot Modem
Model Number(s)	MiFi 6620L
Rated Voltage	Nominal 3.8VDC Li-Ion Battery AC Power Adaptor: Input: 100-240VAC/0.3A/50-60Hz Output: 5.0 VDC/2.0A
Mode Verified	LTE Band 4 and Band 13
Capability	GSM850/1900, CDMA2000 1xRTT, 1xEV-DO Release 0 and A, WCDMA850/1900, LTE Band 2, 4, and 13, WLAN 802.11 a/b/g/n
Internal Antennas Details (Client declaration, max. antenna gain covered under this test report)	**<u>WWAN Antenna – CDMA/GPRS/EDGE/WCDMA/LTE</u>** Manufacturer: NVTL Part Number: NVTL DA-01020345 Type: Monopole Antenna Gain: • CDMA BC0 – 850MHz: -3.46 dBi • CDMA BC1 – 1900MHz: -0.97 dBi • GSM850 – 850MHz: -2.0 dBi • GSM1900 – 1900MHz: -1.64 dBi • WCDMA Band 5 – 850MHz: -2.0 dBi • WCDMA Band 2 – 1900MHz: -1.64 dBi • LTE Band 2 – 1900MHz: -1.64 dBi • LTE Band 4 – 1700MHz: 0.83 dBi • LTE Band 13 – 700MHz: -1.09 dBi **<u>WLAN – Antenna: 802.11 a/b/g/n</u>** Manufacturer: NVTL Part Number: NVTL 12023203 Type: CERAMIC CHIP Antenna Tx0 Gain: • 802. 11 b/g/n 2.4MHz : -0.94 dBi • 802.11 a/n 5GHz: 1.72 dBi Antenna Tx1 Gain: • 802. 11 b/g/n 2.4MHz : -0.94 dBi • 802.11 a/n 5GHz: 1.72 dBi

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1.3.3 Transmit Frequency Table

LTE Band 4					
Modulation	Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	EIRP	
				Max Power (dBm)	Max Power (Watts)
QPSK	1.4	1710-1755	1M08G7D	24.83	0.304
16QAM	1.4	1710-1755	1M09W7D	24.27	0.267
QPSK	3.0	1710-1755	2M68G7D	24.83	0.304
16QAM	3.0	1710-1755	2M68W7D	24.33	0.271
QPSK	5.0	1710-1755	4M47G7D	24.83	0.304
16QAM	5.0	1710-1755	4M47W7D	24.23	0.264
QPSK	10.0	1710-1755	8M94G7D	24.83	0.304
16QAM	10.0	1710-1755	8M94W7D	24.18	0.261
QPSK	15.0	1710-1755	13M4G7D	24.82	0.303
16QAM	15.0	1710-1755	13M4W7D	24.21	0.263
QPSK	20.0	1710-1755	17M8G7D	24.83	0.304
16QAM	20.0	1710-1755	17M8W7D	24.07	0.255

LTE Band 13					
Modulation	Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	ERP	
				Max Power (dBm)	Max Power (Watts)
QPSK	5.0	777-788	4M49G7D	20.68	0.117
16QAM	5.0	777-788	4M49W7D	19.48	0.088
QPSK	10.0	777-788	8M97G7D	20.66	0.116
16QAM	10.0	777-788	8M94W7D	19.39	0.086

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1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Conducted antenna port measurement. EUT Tx at a max power and connected to a programmable DC power supply via dummy battery pack.
B	Raidated test setup. EUT Tx through integral antenna and connected to supplied AC-DC power adaptor.

1.4.2 EUT Exercise Software

EUT is controlled by a CMW 500 Wideband Radio Communication Tester. There are no other test software used during verification.

1.4.3 Support Equipment and I/O cables

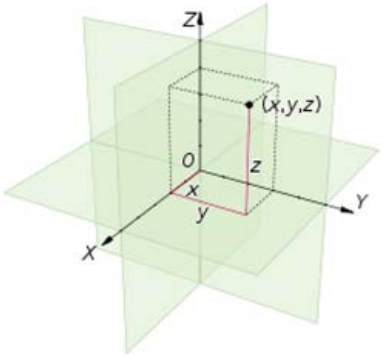
Manufacturer	Equipment/Cable	Description
Novatel Wireless	USB Cable	Micro USB Type B to Standard USB Type B

1.4.4 Worst Case Configuration

Worst-case configuration used in this test report as per output power measurements:

Band	Channel BW	Modulation	RB Size/Offset
LTE Band 4	5.0 MHz	QPSK	1/24
LTE Band 13	5.0 MHz	QPSK	1/0

For radiated measurements X, Y, and Z orientations were verified. The verification was determined “Y” as worst case configuration.



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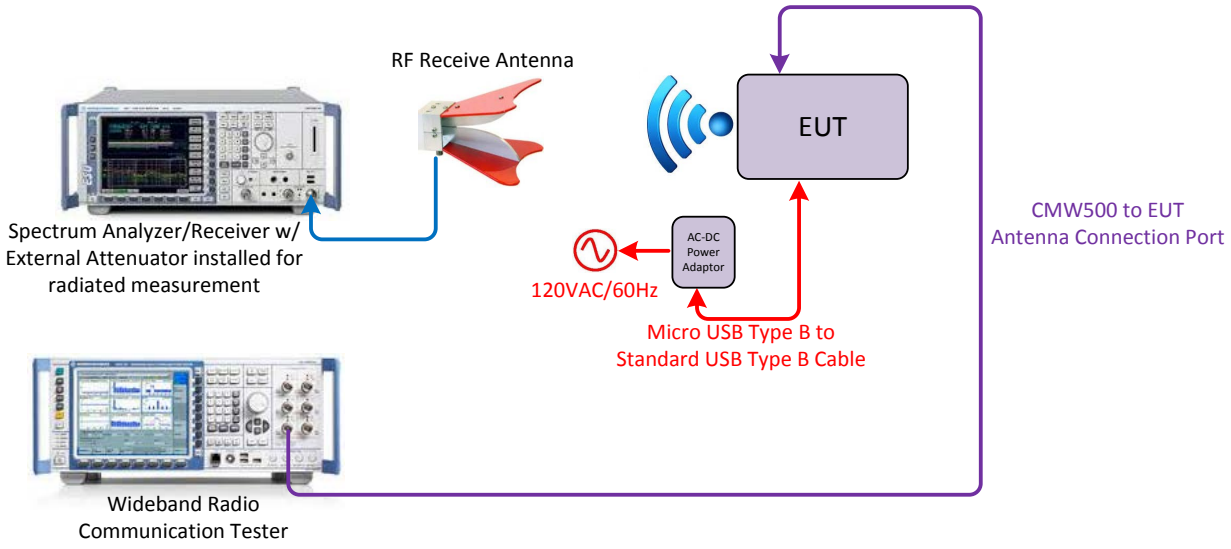
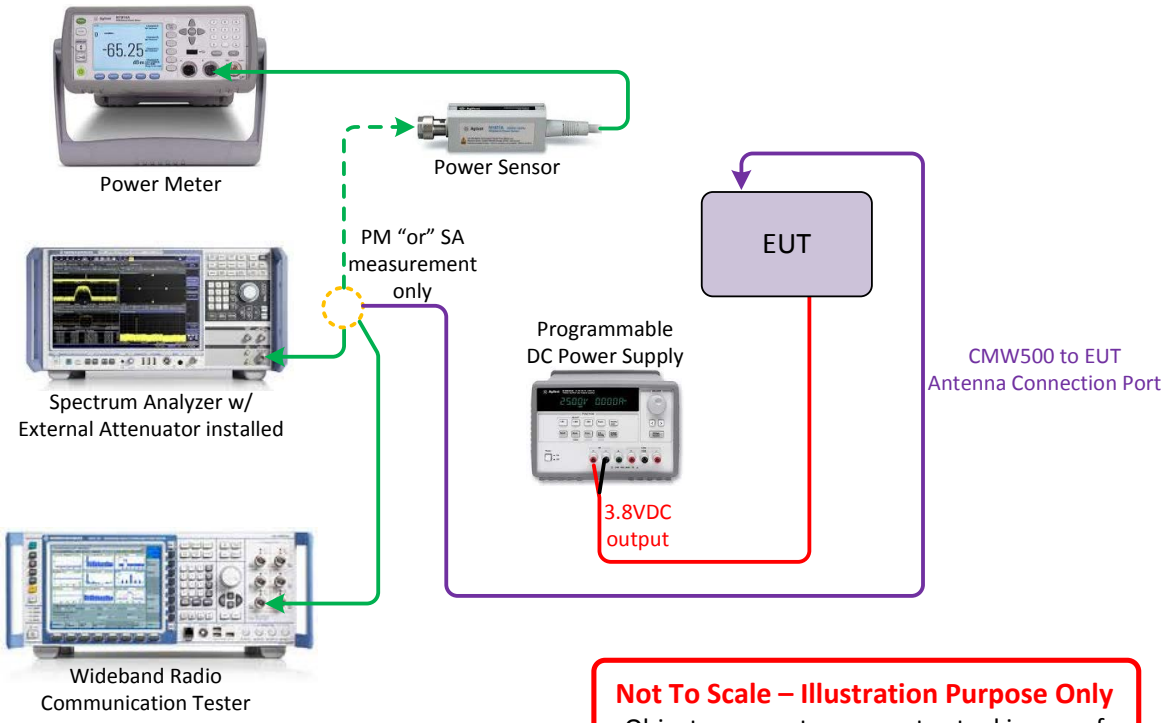
1.4.5 Simplified Test Configuration Diagram

Radiated/Conducted Emission Test Configuration via Conducted Port



Conducted (Antenna Port) Test Configuration



Not To Scale – Illustration Purpose Only
Objects may not represent actual image of original equipment/s or set-up.

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1.5 DEVIATIONS FROM THE STANDARD

No deviations from the applicable test standards or test plan were made during testing.

1.6 MODIFICATION RECORD

Description of Modification	Modification Fitted By	Date Modification Fitted
Serial Number SS220414800535		
N/A	—	—

The table above details modifications made to the EUT during the test programme. The modifications incorporated during each test (if relevant) are recorded on the appropriate test pages.

1.7 TEST METHODOLOGY

All measurements contained in this report were conducted with ANSI C63.4-2009, American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the range of 9 kHz to 40 GHz.
For conducted (if applicable) and radiated emissions the equipment under test (EUT) was configured to measure its highest possible emission level. This level was based on the maximized cable configuration from exploratory testing per ANSI C63.4-2009. The test modes were adapted according to the Operating Instructions provided by the manufacturer/client.

1.8 TEST FACILITY LOCATION

1.8.1 TÜV SÜD America Inc. (Mira Mesa)

10040 Mesa Rim Road, San Diego, CA 92121-2912 (32.901268,-117.177681). Phone: 858 678 1400 FAX: 858-546 0364

1.8.2 TÜV SÜD America Inc. (Rancho Bernardo)

Sony Electronics Inc., Building #8 16530 Via Esprillo, San Diego, CA 92127-1708 (33.018644,-117.092409). Phone: 858 942 5542 FAX: 858-546 0364

1.9 TEST FACILITY REGISTRATION

1.9.1 FCC – Registration No.: US1146

TUV SUD America Inc. (San Diego), is an accredited test facility with the site description report on file and has met all the requirements specified in §2.948 of the FCC rules. The acceptance letter from the FCC is maintained in our files and the Registration is US1146.

1.9.2 Industry Canada (IC) Registration No.: 3067A

The 10m Semi-anechoic chamber of TUV SUD America Inc. (San Diego) has been registered by Certification and Engineering Bureau of Industry Canada for radio equipment testing with Registration No. 3067A.

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1.10 SAMPLE CALCULATIONS

1.10.1 LTE Emission Designator (QPSK)

Emission Designator = 4M51G7D
G = Phase Modulation
7= Quantized/Digital Info
D = Data Transmission, telemetry, telecommand

1.10.2 LTE Emission Designator (16QAM)

Emission Designator = 4M50W7D
W = Amplitude/Angle Modulated
7= Quantized/Digital Info
D = Data Transmission, telemetry, telecommand

1.10.3 Spurious Radiated Emission (below 1GHz)

Measuring equipment raw measurement (dbµV) @ 30 MHz			24.4
Correction Factor (dB)	Asset# 1066 (cable)	0.3	-12.6
	Asset# 1172 (cable)	0.3	
	Asset# 1016 (preamplifier)	-30.7	
	Asset# 1175(cable)	0.3	
	Asset# 1002 (antenna)	17.2	
Reported QuasiPeak Final Measurement (dbµV/m) @ 30MHz			**11.8**

1.10.4 Spurious Radiated Emission – Substitution Method

Example = 84dBµV/m @ 1413 MHz (numerical sample only)

The field strength reading of 84dBµV/m @ 1413 MHz (2nd Harmonic of 706.5 MHz) is the maximized measurement when the EUT is on the turntable measured at 3 meters. The gain of the substituted antenna is 7.8dBi while the transmit cable loss is 1.0 dB (cable between signal generator and the substituted antenna). The signal generator level is adjusted until the 84dBµV/m level at the receiving end is replicated (identical test setup, i.e. same antenna, cable/s and preamp). If the adjusted signal generator level is -18dBm, then we have the following for both EIRP and ERP as required:

P_{EIRP} = -18 dBm + 7.8 dBi – 1dB
= 11.2 dBm
P_{ERP} = P_{EIRP} – 2.15 dB
= 11.2 dBm – 2.15 dB
= 9.05 dBm

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SECTION 2

TEST DETAILS

Radio Testing of the
Novatel Wireless Inc.
MiFi 6620L Wireless Hotspot Modem

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2.1 TRANSMITTER CONDUCTED POWER MEASUREMENTS

2.1.1 Specification Reference

Part 2.1046 (a) and (c)

2.1.2 Standard Applicable

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.
(c) For measurements conducted pursuant to paragraphs (a) and (b) of this section, all calculations and methods used by the applicant for determining carrier power or peak envelope power, as appropriate, on the basis of measured power in the radio frequency load attached to the transmitter output terminals shall be shown. Under the test conditions specified, no components of the emission spectrum shall exceed the limits specified in the applicable rule parts as necessary for meeting occupied bandwidth or emission limitations.

2.1.3 Equipment Under Test and Modification State

Serial No: SS220414800535 / Test Configuration A

2.1.4 Date of Test/Initial of test personnel who performed the test

*May 30, 2014 / AC
*The tables presented on this test report are from SAR Evaluation Test Report Number: SAR.20140601 Revision D ; TUV performed Verification on random channels and worst case conditions and did not find any significant differences.

2.1.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.1.6 Environmental Conditions/ Test Location

Test performed at TUV SUD America Inc. Rancho Bernardo facility

Ambient Temperature	25.4°C
Relative Humidity	51.7%
ATM Pressure	98.7 kPa

2.1.7 Additional Observations

- These are the Conducted port measurement provided by the RF exposure SAR laboratory. The data was used and help in determining worst case testing conditions for the remainder of the report.
- This is a conducted test using a peak/average power meter.
- The 27.75dB (Band 4) / 27.38dB (Band 13) offset on the power meter was used for the power splitter, external attenuator and cable used.

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- TUV performed verification checks and compared the measurments to the data provided by RF Exposure Labs (SAR.20140601 Revision D) and the results were found to be similar and are used to show compliance in this test report.
- Only representative worst case RB size and RB offset presented. Verification done using both RMC and User Defined Channels options for scheduling (CMW500).
- All available RB size and RB offset were verified. The worst case for each mode (marked bold and italic) will be verified for each test throughout this test report.

2.1.8 Test Results

See attached table.

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LTE Band 4							
Modulation	**Bandwidth**	**RB Size**	**RB Offset**	**Channels**	**Frequency**	**Tx Average (dBm)**	**Tx Peak (dBm)**
QPSK	1.4 MHz	6	0	19957	1710.7	23.67	27.83
		3	***1***			***23.99***	***27.87***
		1	0			23.98	26.86
		1	5			23.98	27.88
		6	0	20175	1732.5	23.06	28.03
		3	***1***			***24.00***	***28.14***
		1	0			23.58	27.96
		1	5			23.93	28.14
		6	0	20393	1754.3	23.61	26.80
		3	1			23.99	26.86
		1	0			23.99	26.82
		1	***5***			***24.00***	***26.85***
	3 MHz	15	0	19965	1711.5	23.11	27.86
		8	3			23.02	27.79
		1	***0***			***24.00***	***27.78***
		1	14			23.34	27.83
		15	0	20175	1732.5	23.09	28.02
		8	3			22.93	27.93
		1	0			23.40	27.75
		1	***14***			***23.99***	***28.27***
		15	0	20385	1753.5	23.15	26.77
		8	3			23.07	26.69
		1	0			23.53	26.71
		1	***14***			***23.94***	***26.77***
	5 MHz	25	0	19975	1712.5	22.49	27.81
		12	6			22.44	27.79
		1	***0***			***23.99***	***27.81***
		1	24			23.19	27.92
		25	0	20175	1732.5	23.19	27.97
		12	6			23.13	27.96
		1	0			23.31	27.66
		1	***24***			***24.00***	***28.34***
		25	0	20375	1752.5	22.87	26.70
		12	6			22.64	26.71
		1	0			23.67	27.01
		1	***24***			***23.99***	***26.87***

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LTE Band 4							
Modulation	**Bandwidth**	**RB Size**	**RB Offset**	**Channels**	**Frequency**	**Tx Average (dBm)**	**Tx Peak (dBm)**
QPSK	10 MHz	50	0	20000	1715.0	22.36	27.80
		25	12			21.92	27.75
		1	***0***			***24.00***	***27.13***
		1	24			23.14	27.89
		50	0	20175	1732.5	22.99	27.88
		25	12			23.04	27.96
		1	0			23.31	27.48
		1	***24***			***23.92***	***28.02***
		50	0	20350	1750.0	22.80	27.06
		25	12			22.57	27.01
		1	0			23.60	27.80
		1	***24***			***23.67***	***27.06***
	15 MHz	75	0	20025	1717.5	22.29	27.65
		36	19			22.01	27.72
		1	***0***			***23.99***	***27.87***
		1	74			23.18	27.38
		75	0	20175	1732.5	22.67	27.80
		36	19			23.17	27.92
		1	0			23.13	27.35
		1	***74***			***23.45***	***28.44***
		75	0	20325	1747.5	22.62	27.30
		36	19			22.64	27.43
		1	0			23.38	28.25
		1	***74***			***23.60***	***28.13***
	20 MHz	100	0	20050	1720.0	22.23	27.41
		50	25			22.21	27.58
		1	***0***			***24.00***	***27.89***
		1	99			23.28	27.51
		100	0	20175	1732.5	22.68	27.63
		50	25			23.00	27.84
		1	0			23.10	27.41
		1	***99***			***23.56***	***28.26***
		100	0	20300	1745.0	22.52	27.32
		50	25			22.61	27.72
		1	0			23.98	28.37
		1	***99***			***24.00***	***26.86***

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LTE Band 4							
Modulation	**Bandwidth**	**RB Size**	**RB Offset**	**Channels**	**Frequency**	**Tx Average (dBm)**	**Tx Peak (dBm)**
16QAM	1.4 MHz	6	0	19957	1710.7	22.51	27.79
		3	***1***			***23.44***	***27.87***
		1	0			23.39	27.82
		1	5			23.09	27.91
		6	0	20175	1732.5	22.02	28.00
		3	1			22.90	28.13
		1	0			22.52	28.02
		1	***5***			***23.05***	***28.20***
		6	0	20393	1754.3	22.52	26.76
		3	1			23.25	26.85
		1	***0***			***23.25***	***26.85***
		1	5			23.21	26.87
	3 MHz	15	0	19965	1711.5	22.12	27.86
		8	3			22.02	27.76
		1	***0***			***23.20***	***27.85***
		1	14			22.18	27.91
		15	0	20175	1732.5	22.19	28.02
		8	3			22.05	27.90
		1	0			22.22	27.78
		1	***14***			***23.32***	***28.28***
		15	0	20385	1753.5	22.22	26.77
		8	3			22.27	26.68
		1	0			22.51	26.79
		1	***14***			***23.50***	***26.85***
	5 MHz	25	0	19975	1712.5	21.53	27.75
		12	6			21.51	27.86
		1	***0***			***23.40***	***27.86***
		1	24			21.62	28.04
		25	0	20175	1732.5	22.19	27.94
		12	6			22.00	27.98
		1	0			22.03	27.78
		1	***24***			***23.26***	***28.39***
		25	0	20375	1752.5	21.94	26.68
		12	6			21.59	26.73
		1	0			22.33	27.08
		1	***24***			***23.33***	***26.88***

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LTE Band 4							
Modulation	**Bandwidth**	**RB Size**	**RB Offset**	**Channels**	**Frequency**	**Tx Average (dBm)**	**Tx Peak (dBm)**
16QAM	10 MHz	50	0	20000	1715.0	21.37	27.84
		25	12			21.11	27.71
		1	***0***			***23.35***	***27.91***
		1	24			22.00	28.10
		50	0	20175	1732.5	22.06	27.92
		25	12			21.96	27.90
		1	0			21.91	27.56
		1	***24***			***22.83***	***28.10***
		50	0	20350	1750.0	21.69	27.05
		25	12			21.44	26.96
		1	0			22.26	27.97
		1	***24***			***22.33***	***27.18***
	15 MHz	75	0	20025	1717.5	21.23	27.63
		36	19			21.13	27.82
		1	***0***			***23.38***	***27.90***
		1	74			21.96	27.50
		75	0	20175	1732.5	21.58	27.77
		36	19			22.17	28.00
		1	0			21.79	27.44
		1	***74***			***22.32***	***28.58***
		75	0	20325	1747.5	21.61	27.37
		36	19			21.55	27.51
		1	0			22.15	28.38
		1	***74***			***23.19***	***26.88***
	20 MHz	100	0	20050	1720.0	21.30	27.46
		50	25			21.21	27.52
		1	***0***			***23.20***	***27.97***
		1	99			21.94	27.63
		100	0	20175	1732.5	21.65	27.71
		50	25			22.12	27.84
		1	***0***			***23.13***	***27.96***
		1	99			22.35	28.45
		100	0	20300	1745.0	21.57	27.40
		50	25			21.58	27.73
		1	0			22.75	28.45
		1	***99***			***23.24***	***26.93***

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LTE Band 13							
Modulation	**Bandwidth**	**RB Size**	**RB Offset**	**Channels**	**Frequency**	**Tx Average (dBm)**	**Tx Peak (dBm)**
QPSK	5 MHz	25	0	23205	779.5	22.92	28.94
		12	6			22.90	28.78
		1	***0***			***23.92***	***29.21***
		1	24			23.88	29.40
		25	0	23255	784.5	23.01	29.20
		12	6			22.84	29.22
		1	***0***			***23.88***	***29.56***
		1	24			23.81	29.17
	10 MHz	50	0	23230	782	22.96	29.09
		25	12			22.89	29.00
		1	0			23.74	29.18
		1	***24***			***23.90***	***29.40***

LTE Band 13							
Modulation	**Bandwidth**	**RB Size**	**RB Offset**	**Channels**	**Frequency**	**Tx Average (dBm)**	**Tx Peak (dBm)**
16QAM	5 MHz	25	0	23205	779.5	21.74	28.83
		12	6			21.77	28.87
		1	0			22.54	29.30
		1	***24***			***22.54***	***29.33***
		25	0	23255	784.5	22.05	29.13
		12	6			22.03	29.34
		1	0			22.43	29.55
		1	***24***			***22.72***	***29.36***
	10 MHz	50	0	23230	782	21.98	29.17
		25	12			22.00	28.99
		1	***0***			***22.63***	***29.24***
		1	24			22.52	29.48

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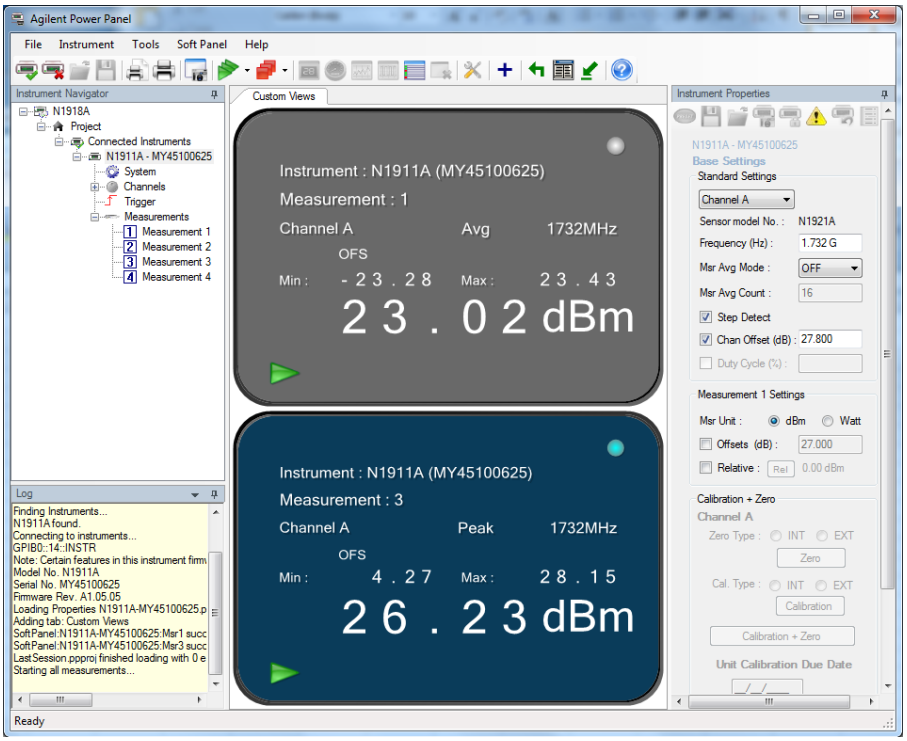
2.1.9 Sample Test Measurement Screen



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2.2 EQUIVALENT ISOTROPIC RADIATED POWER

2.2.1 Specification Reference

Part 27 Subpart C §27.50 (d)(4), Part 2.1046

2.2.2 Standard Applicable

(4) Fixed, mobile, and portable (hand-held) stations operating in the 1710–1755 MHz band are limited to 1 watt EIRP. Fixed stations operating in this band are limited to a maximum antenna height of 10 meters above ground. Mobile and portable stations operating in this band must employ a means for limiting power to the minimum necessary for successful communications.

2.2.3 Equipment Under Test

Serial No: SS220414800535, Test Configuration (N/A, calculation only)

2.2.4 Date of Verification/Initial of test personnel who performed the calculation

July 03, 2014 / AC

2.2.5 Additional Observations

- EIRP was calculated as per Section 1.3.2 of KDB412172 D01 (Determining ERP and EIRP v01).
- Calculation formula in logarithmic terms:

$$\mathbf{EIRP = P_T + G_T - L_C}$$

Where:

$\mathbf{P_T}$ = transmitter conducted output power dBm (Section 2.1 of this test report)
$\mathbf{G_T}$ = gain of the transmitting antenna, in dBi (EIRP);
$\mathbf{L_C}$ = signal attenuation in the connecting cable between the transmitter and antenna, in dB (EUT posees an internal Antenna. The loss between the EUT and the antenna port is considered negligible).

2.2.6 Test Results

See attached table.

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LTE Band 4									
Modulation	***Bandwidth (MHz)***	***RB Size/Offset***	***Channels***	***Frequency (MHz)***	***Tx Average Power (dBm)***	***Antenna Gain (dBi)***	***EIRP (dBm)***	***Limit (dBm)***	***Margin (dBm)***
QPSK	1.4	3 / 1	19957	1710.7	23.99	0.83	24.82	30.00	5.18
		3 / 1	20175	1732.5	24.00	0.83	24.83	30.00	5.17
		1 / 5	20393	1754.3	24.00	0.83	24.83	30.00	5.17
	3	1 / 0	19965	1711.5	24.00	0.83	24.83	30.00	5.17
		1 / 14	20175	1732.5	23.99	0.83	24.82	30.00	5.18
		1 / 14	20385	1753.5	23.94	0.83	24.77	30.00	5.23
	5	1 / 0	19975	1712.5	23.99	0.83	24.82	30.00	5.18
		1 / 24	20175	1732.5	24.00	0.83	24.83	30.00	5.17
		1 / 24	20375	1752.5	23.99	0.83	24.82	30.00	5.18
	10	1 / 0	20000	1715.0	24.00	0.83	24.83	30.00	5.17
		1 / 24	20175	1732.5	23.92	0.83	24.75	30.00	5.25
		1 / 24	20350	1750.0	23.67	0.83	24.50	30.00	5.50
	15	1 / 0	20025	1717.5	23.99	0.83	24.82	30.00	5.18
		1 / 74	20175	1732.5	23.45	0.83	24.28	30.00	5.72
		1 / 74	20325	1747.5	23.60	0.83	24.43	30.00	5.57
	20	1 / 0	20050	1720.0	24.00	0.83	24.83	30.00	5.17
		1 / 99	20175	1732.5	23.56	0.83	24.39	30.00	5.61
		1 / 99	20300	1745.0	24.00	0.83	24.83	30.00	5.17

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LTE Band 4									
Modulation	***Bandwidth (MHz)***	***RB Size/Offset***	***Channels***	***Frequency (MHz)***	***Tx Average Power (dBm)***	***Antenna Gain (dBi)***	***EIRP (dBm)***	***Limit (dBm)***	***Margin (dBm)***
16QAM	1.4	3 / 1	19957	1710.7	23.44	0.83	24.27	30.00	5.73
		1 / 5	20175	1732.5	23.05	0.83	23.88	30.00	6.12
		1 / 0	20393	1754.3	23.25	0.83	24.08	30.00	5.92
	3	1 / 0	19965	1711.5	23.20	0.83	24.03	30.00	5.97
		1 / 14	20175	1732.5	23.32	0.83	24.15	30.00	5.85
		1 / 14	20385	1753.5	23.50	0.83	24.33	30.00	5.67
	5	1 / 0	19975	1712.5	23.40	0.83	24.23	30.00	5.77
		1 / 24	20175	1732.5	23.26	0.83	24.09	30.00	5.91
		1 / 24	20375	1752.5	23.33	0.83	24.16	30.00	5.84
	10	1 / 0	20000	1715.0	23.35	0.83	24.18	30.00	5.82
		1 / 24	20175	1732.5	22.83	0.83	23.66	30.00	6.34
		1 / 24	20350	1750.0	22.33	0.83	23.16	30.00	6.84
	15	1 / 0	20025	1717.5	23.38	0.83	24.21	30.00	5.79
		1 / 74	20175	1732.5	22.32	0.83	23.15	30.00	6.85
		1 / 74	20325	1747.5	23.19	0.83	24.02	30.00	5.98
	20	1 / 0	20050	1720.0	23.20	0.83	24.03	30.00	5.97
		1 / 0	20175	1732.5	23.13	0.83	23.96	30.00	6.04
		1 / 99	20300	1745.0	23.24	0.83	24.07	30.00	5.93

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2.3 EFFECTIVE RADIATED POWER OUTPUT DATA

2.3.1 Specification Reference

Part 27 Subpart C §27.50 (b)(10)(12) and Part 2.1046

2.3.2 Standard Applicable

(b) The following power and antenna height limits apply to transmitters operating in the 746–758 MHz, 775–788 MHz and 805–806 MHz bands:
(10) Portable stations (hand-held devices) transmitting in the 746–757 MHz, 776-788 MHz, and 805–806 MHz bands are limited to 3 watts ERP.
(12) For transmissions in the 746–757 and 776-787 MHz bands, licensees may employ equipment operating in compliance with either the measurement techniques described in paragraph (b)(11) of this section or a Commission-approved average power technique. In both instances, equipment employed must be authorized in accordance with the provisions of §27.51.

2.3.3 Equipment Under Test

Serial No: SS220414800535, Test Configuration (N/A, calculation only)

2.3.4 Date of Verification/Initial of test personnel who performed the calculation

July 03, 2014 / AC

2.3.5 Additional Observations

- ERP was calculated as per Section 1.3.2 of KDB412172 D01 (Determining ERP and EIRP v01).
- Calculation formula in logarithmic terms:

$$\mathbf{ERP = P_T + G_T - L_C - 2.15dB}$$

Where:

P_T = transmitter conducted output power dBm (Section 2.1 of this test report)
G_T = gain of the transmitting antenna, in dBi (EIRP - the -2.15 in the formula is to convert EIRP to ERP);
L_C = signal attenuation in the connecting cable between the transmitter and antenna, in dB (EUT configuration during verification is mounted on a interface board with short direct connection to the antenna port. The loss between the EUT and the antenna port is considered negligible).

2.3.6 Test Results

See attached table.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 13									
Modulation	Bandwidth (MHz)	RB Size/Offset	Channels	Frequency (MHz)	Tx Average Power (dBm)	Antenna Gain-2.15 (-1.09-2.15= -3.24) (dBi)	ERP (dBm)	Limit (dBm)	Margin (dBm)
QPSK	5	1/0	23205	779.5	23.92	-3.24	20.68	30.00	9.32
		1/0	23255	784.5	23.88	-3.24	20.64	30.00	9.36
	10	1/24	23230	782	23.90	-3.24	20.66	30.00	9.34

LTE Band 13									
Modulation	Bandwidth (MHz)	RB Size/Offset	Channels	Frequency (MHz)	Tx Average Power (dBm)	Antenna Gain-2.15 (-1.09-2.15= -3.24) (dBi)	ERP (dBm)	Limit (dBm)	Margin (dBm)
16QAM	5	1/24	23205	779.5	22.54	-3.24	19.30	30.00	10.7
		1/24	23255	784.5	22.72	-3.24	19.48	30.00	10.52
	10	1/0	23230	782	22.63	-3.24	19.39	30.00	10.61

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2.4 OCCUPIED BANDWIDTH

2.4.1 Specification Reference

Part 27 Subpart C §27.53(h)(1), 2.1049

2.4.2 Standard Applicable

The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

2.4.3 Equipment Under Test and Modification State

Serial No: SS220414800535 / Test Configuration A

2.4.4 Date of Test/Initial of test personnel who performed the test

May 30, 2014 / AC

2.4.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.4.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.4°C
Relative Humidity	51.7%
ATM Pressure	98.7 kPa

2.4.7 Additional Observations

- This is a conducted test. Test procedure is per Section 4.0 of KDB971168 D01 (Power Meas License Digital Systems v02 DR02-41372).
- The 27.75dB (Band 4) / 27.38dB (Band 13) offset on the power meter was used for the power splitter, external attenuator and cable used.
- Both relative 26dB BW and 99% OBW presented.
- All channels per each channel bandwidth/band were verified. No significant difference observed. Only the worst channel presented.

2.4.8 Test Results

See attached table and plots.

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4							
Modulation	***BW***	***RB Size***	***RB Offset***	***Channel***	***Frequency***	***99% OBW (MHz)***	***26dB BW (MHz)***
QPSK	1.4 MHz	3	1	20175	1732.5	1.08	1.28
	3 MHz	1	0	19965	1711.5	2.68	2.94
	5 MHz	1	24	20175	1732.5	4.47	4.95
	10 MHz	1	0	20000	1715.0	8.94	9.81
	15 MHz	1	0	20025	1717.5	13.46	14.70
	20 MHz	1	0	20050	1720.0	17.80	18.97

LTE Band 4							
Modulation	***BW***	***RB Size***	***RB Offset***	***Channel***	***Frequency***	***99% OBW (MHz)***	***26dB BW (MHz)***
16QAM	1.4 MHz	3	1	19957	1710.7	1.09	1.29
	3 MHz	1	14	20385	1753.5	2.68	2.93
	5 MHz	1	0	19975	1712.5	4.47	4.96
	10 MHz	1	0	20000	1715.0	8.94	9.77
	15 MHz	1	0	20025	1717.5	13.40	14.62
	20 MHz	1	99	20300	1745.0	17.89	19.15

LTE Band 13							
Modulation	***BW***	***RB Size***	***RB Offset***	***Channel***	***Frequency***	***99% OBW (kHz)***	***26dB BW (MHz)***
QPSK	5 MHz	1	0	23205	779.5	4.49	4.91
	10 MHz	1	24	23230	782.0	8.97	9.88

LTE Band 13							
Modulation	***BW***	***RB Size***	***RB Offset***	***Channel***	***Frequency***	***99% OBW (kHz)***	***26dB BW (MHz)***
16QAM	5 MHz	1	24	23255	784.5	4.49	4.95
	10 MHz	1	0	23230	782.0	8.94	9.70

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LTE Band 4 (1.4 MHz BW)/1732.5 MHz/QPSK/99%OBW

Date: 30.MAY.2014 14:22:06

LTE Band 4 (1.4 MHz BW)/1732.5 MHz/QPSK/26dB BW

Date: 30.MAY.2014 14:22:45

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (3 MHz BW)/1711.5 MHz/QPSK/99%OBW

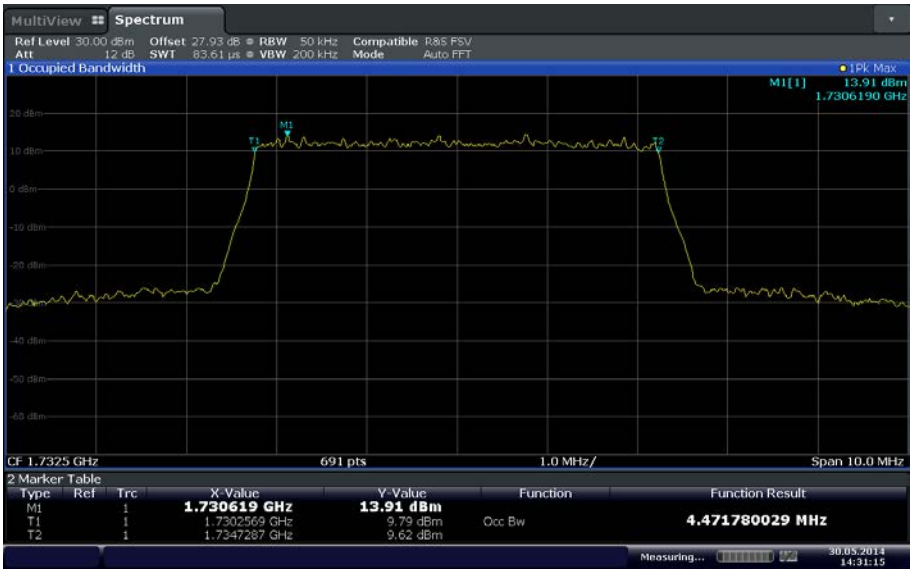
Date: 30.MAY.2014 14:28:01

LTE Band 4 (3 MHz BW)/1711.5 MHz/QPSK/26dB BW

Date: 30.MAY.2014 14:29:08

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (5 MHz BW)/1732.5 MHz/QPSK/99%OBW



Date: 30 MAY 2014 14:31:15

LTE Band 4 (5 MHz BW)/1732.5MHz/QPSK/26dB BW

Date: 30 MAY 2014 14:33:43

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (10 MHz BW)/1715 MHz/QPSK/99%OBW

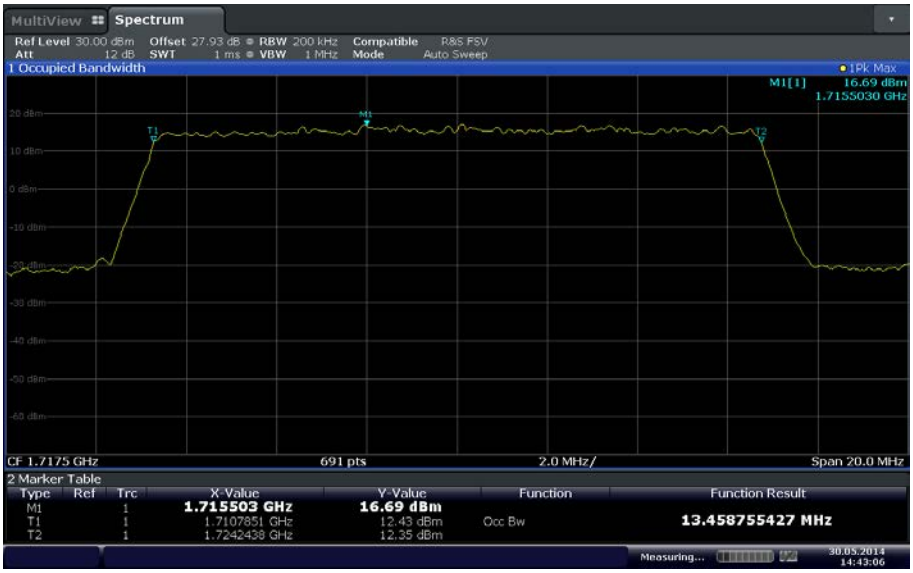
Date: 30.MAY.2014 14:36:43

LTE Band 4 (10 MHz BW)/1715 MHz/QPSK/26dB BW

Date: 30.MAY.2014 14:37:21

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (15 MHz BW)/1717.5 MHz/QPSK/99%OBW



Date: 30.MAY.2014 14:43:06

LTE Band 4 (15 MHz BW)/1717.5 MHz/QPSK/26dB BW

Date: 30.MAY.2014 14:44:03

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (20 MHz BW)/1720 MHz/QPSK/99%OBW

Date: 30.MAY.2014 14:49:06

LTE Band 4 (20 MHz BW)/1720 MHz/QPSK/26dB BW

Date: 30.MAY.2014 14:49:46

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (1.4 MHz BW)/1710.7 MHz/16QAM/99%OBW

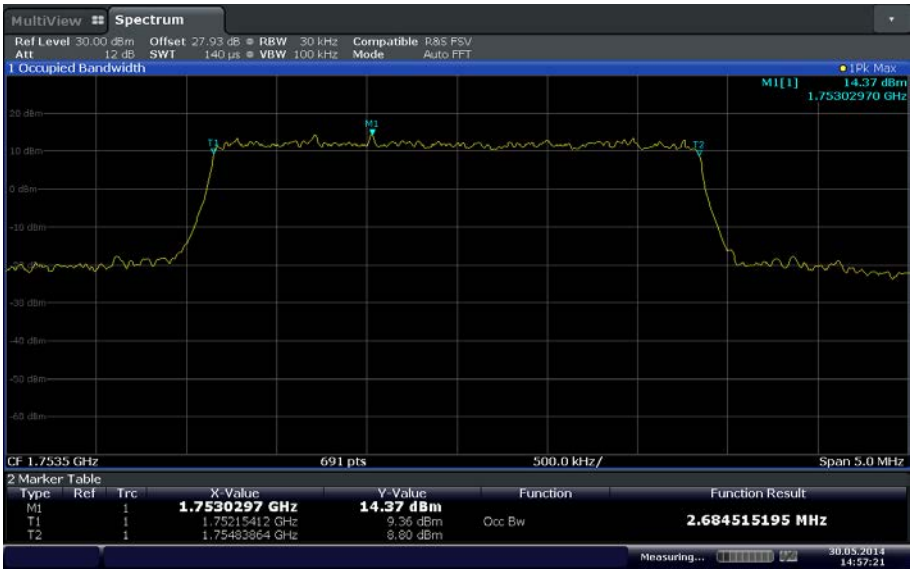
Date: 30.MAY.2014 14:53:51

LTE Band 4 (1.4 MHz BW)/1710.7 MHz/16QAM/26dB BW

Date: 30.MAY.2014 14:55:09

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (3 MHz BW)/1753.5 MHz/16QAM/99%OBW



Date: 30.MAY.2014 14:57:21

LTE Band 4 (3 MHz BW)/1753.5 MHz/16QAM/26dB BW

Date: 30.MAY.2014 14:59:50

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (5 MHz BW)/1712.5 MHz/16QAM/99%OBW

Date: 30.MAY.2014 15:01:46

LTE Band 4 (5 MHz BW)/1712.5 MHz/16QAM/26dB BW

Date: 30.MAY.2014 15:02:25

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (10 MHz BW)/1715 MHz/16QAM/99%OBW

Date: 30.MAY.2014 15:06:39

LTE Band 4 (10 MHz BW)/1715 MHz/16QAM/26dB BW

Date: 30.MAY.2014 15:06:05

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (15 MHz BW)/1717.5 MHz/16QAM/99%OBW

Date:30.MAY.2014 15:10:51

LTE Band 4 (15 MHz BW)/1717.5 MHz/16QAM/26dB BW

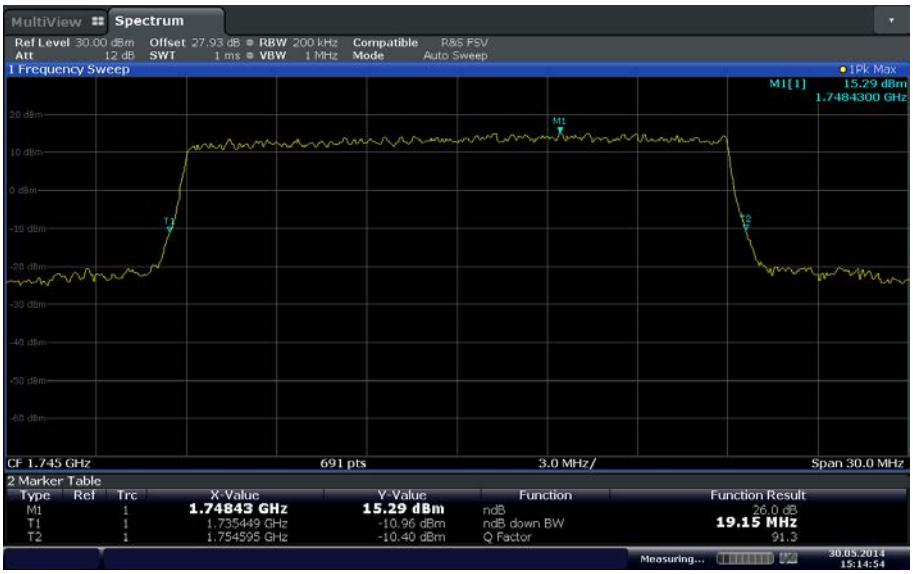
Date:30.MAY.2014 15:11:33

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 4 (20 MHz BW)/1745 MHz/16QAM/99%OBW

Date: 30 MAY 2014 15:14:19

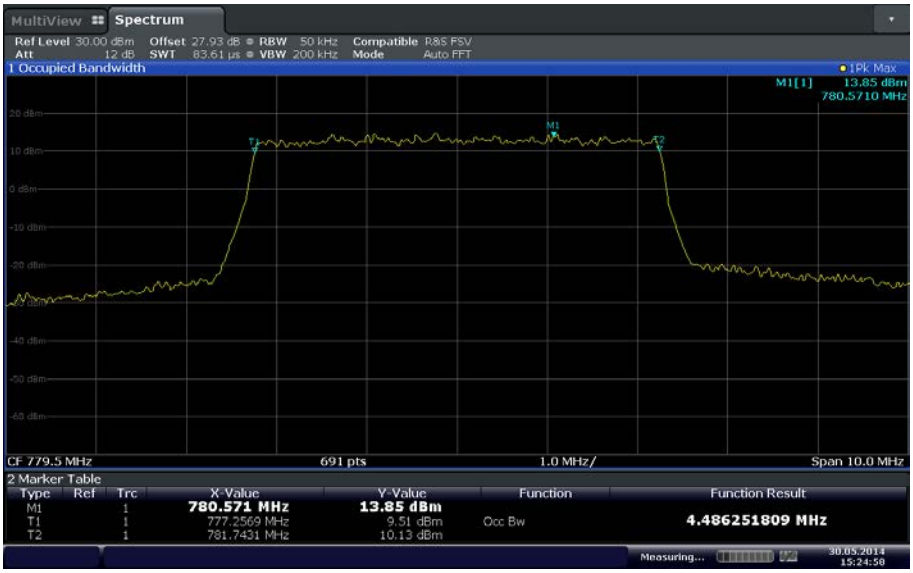
LTE Band 4 (20 MHz BW)/1745 MHz/16QAM/26dB BW



Date: 30 MAY 2014 15:14:55

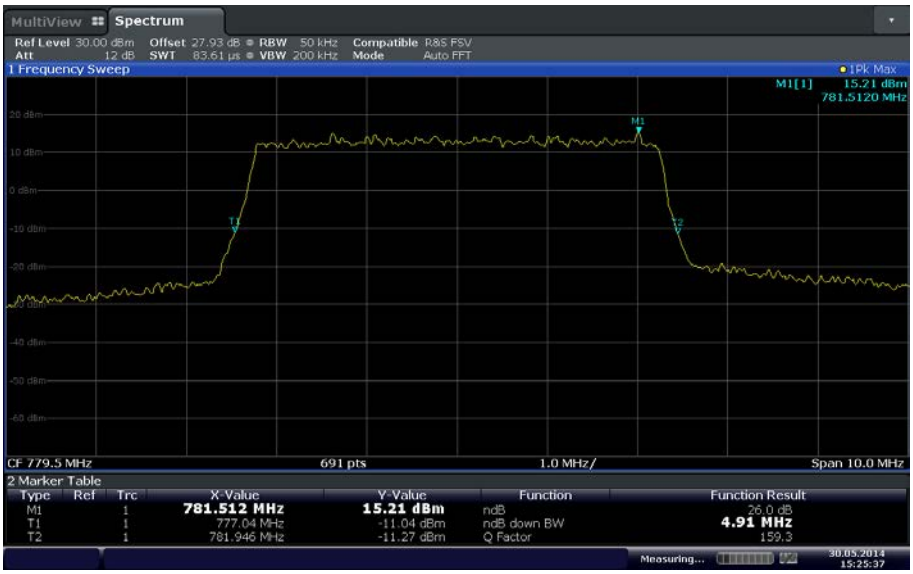
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 13 (5 MHz BW)/779.5 MHz/QPSK/99%OBW



Date: 30.MAY.2014 15:24:58

LTE Band 13 (5 MHz BW)/779.5 MHz/QPSK/26dB BW



Date: 30.MAY.2014 15:25:38

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 13 (10 MHz BW)/782 MHz/QPSK/99%OBW

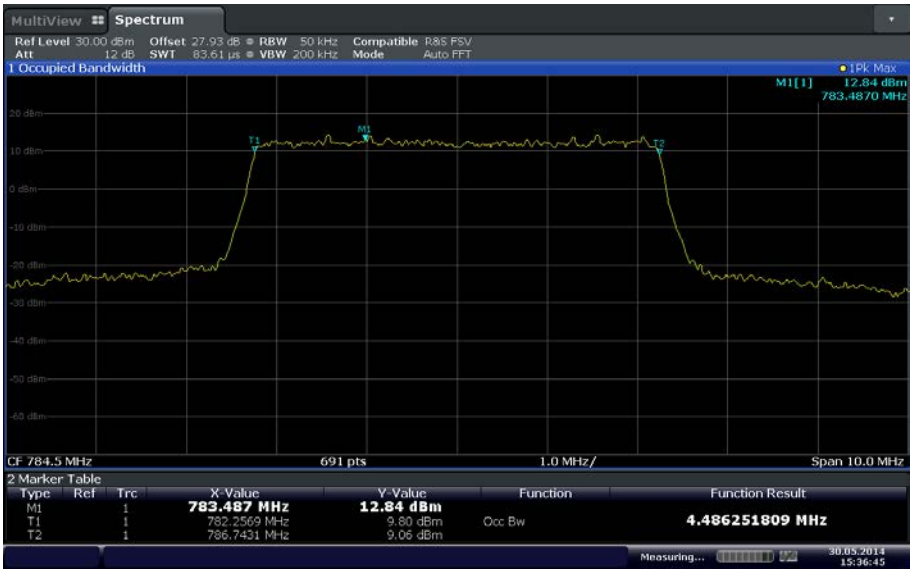
Date: 30.MAY.2014 15:27:11

LTE Band 13 (10 MHz BW)/782 MHz/QPSK/26dB BW

Date: 30.MAY.2014 15:27:51

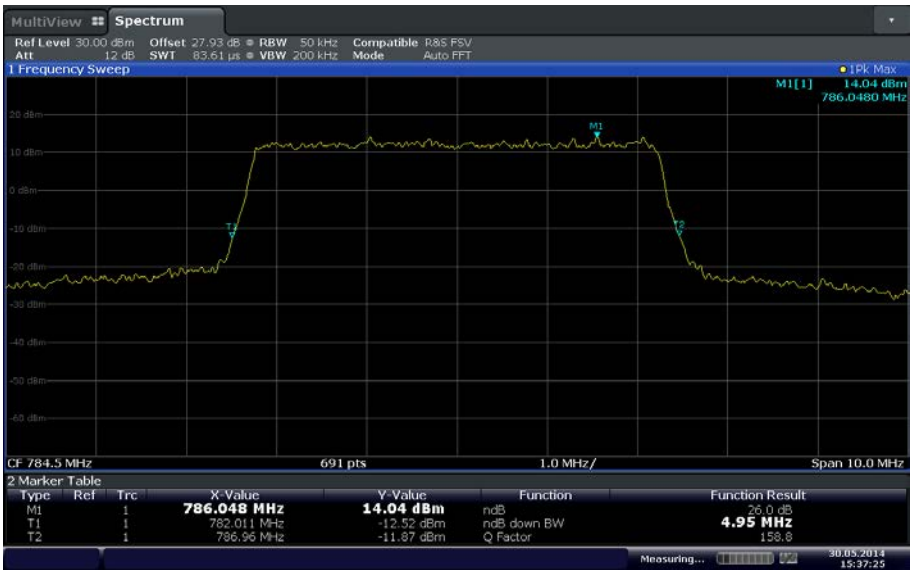
TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 13 (5 MHz BW)/784.5 MHz/16QAM/99%OBW



Date: 30.MAY.2014 15:36:45

LTE Band 13 (5 MHz BW)/784.5 MHz/16QAM/26dB BW



Date: 30.MAY.2014 15:37:26

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

LTE Band 13 (10 MHz BW)/782 MHz/16QAM/99%OBW

Date: 30 MAY 2014 15:38:48

LTE Band 13 (10 MHz BW)/782 MHz/16QAM/26dB BW

Date: 30 MAY 2014 15:39:35

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364

2.5 PEAK-AVERAGE POWER RATIO

2.5.1 Specification Reference

Part 27 Subpart C §27.50(d)(5)

2.5.2 Standard Applicable

(d) The following power and antenna height requirements apply to stations transmitting in the 1710–1755 MHz, 2110-2155 MHz, 2000-2020 MHz, 2180-2200 MHz, 1915-1920 MHz, and 1995-2000 MHz bands:
(5) Equipment employed must be authorized in accordance with the provisions of §24.51. Power measurements for transmissions by stations authorized under this section may be made either in accordance with a Commission-approved average power technique or in compliance with paragraph (d)(6) of this section. In measuring transmissions in this band using an average power technique, the peak-to-average ratio (PAR) of the transmission may not exceed 13 dB.

2.5.3 Equipment Under Test and Modification State

Serial No: SS220414800535 / Test Configuration B

2.5.4 Date of Test/Initial of test personnel who performed the test

June 02, 2014 / AC

2.5.5 Test Equipment Used

The major items of test equipment used for the above tests are identified in Section 3.1.

2.5.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	25.2°C
Relative Humidity	45.7%
ATM Pressure	98.9 kPa

2.5.7 Additional Observations

- This is a conducted test. Test procedure is per Section 5.7.1 of KDB971168 (D01 Power Meas License Digital Systems v02 DR02-41372).
- The 27.75dB (Band 4) / 27.38dB (Band 13) offset on the power meter was used for the power splitter, external attenuator and cable used.
- Measurement was done using the Spectrum Analyzer's Complementary Cumulative Distribution Function (CCDF) measurement profile. The built-in function is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth (crest factor or peak-to-average ratio) A CCDF curve depicts the probability of the peak signal amplitude exceeding the average power level. Most contemporary measurement instrumentation include the capability to produce CCDF curves for an input signal provided that

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the instrument's resolution bandwidth can be set wide enough to accommodate the entire input signal bandwidth.

- All channels based from worst case configuration channel bandwidth were verified. Only the worst channel presented.

2.5.8 Test Results

See attached plots.

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LTE Band 4 (1.4 MHz BW)/1732.5 MHz/QPSK

Date: 2.JUN.2014 12:31:26

LTE Band 4 (3 MHz BW)/1711.5 MHz/QPSK

Date: 2.JUN.2014 12:30:50

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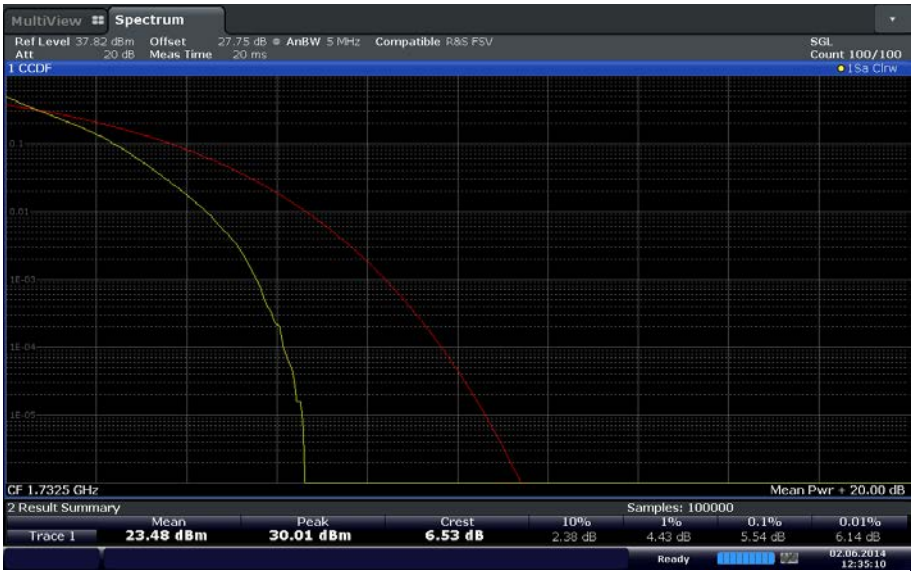
LTE Band 4 (5 MHz BW)/1732.5 MHz/QPSK



Date: 2.JUN.2014 12:35:10

LTE Band 4 (10 MHz BW)/1715 MHz/QPSK

Date: 2.JUN.2014 12:35:56

TÜV SÜD AMERICA INC 10040 Mesa Rim Road San Diego, CA 92121-2912 Phone: 858 678 1400 FAX: 858 546 0364