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Report On

Application for Grant of Equipment Authorization of the
Novatel Wireless Inc.
USB620L MC620 USB Modem

FCC CFR 47 Part 2 and Part 27: 2014
RSS-139: 2009 and RSS-130: 2013

Report No. SD72104197-0315A

April 2015



REPORT ON Radio Testing of the
Novatel Wireless Inc.
MC620 USB Modem

TEST REPORT NUMBER SD72104197-0315A

PREPARED FOR Novatel Wireless Inc.
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Revision History

SD72104197-0315A Novatel Wireless Inc. USB620L MC620 USB Modem					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
04/30/2015	Initial Release				Ferdinand Custodio



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SECTION 1

REPORT SUMMARY

Radio Testing of the
Novatel Wireless Inc.
USB Modem



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Novatel Wireless Inc. MC620 USB Modem to the requirements of the following:

FCC CFR 47 Part 2 and Part 27: 2014
RSS-139: 2009 and RSS-130: 2013

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 Name	USB620L
Model Number(s)	MC620
FCC ID Number	PKRNVWMC620
IC Number	3229A-MC620
Serial Number(s)	SP070315900027
Number of Samples Tested	1
Test Specification/Issue/Date	<ul style="list-style-type: none">• FCC CFR 47 Part 2 and Part 27: 2014• RSS-139 issue 2: 2009 (Advanced Wireless Services Equipment Operating in the Bands 1710-1755 MHz and 2110-2155 MHz)• RSS-130 issue 1: 2013 (Mobile Broadband Services (MBS) Equipment Operating in the Frequency Bands 698-756 MHz and 777-787 MHz)• RSS-GEN issue 4 November 2014; (General Requirements for Compliance of Radio Apparatus)
Start of Test	April 13, 2015
Finish of Test	April 28, 2015
Name of Engineer(s)	Xiaoying Zhang
Related Document(s)	<ul style="list-style-type: none">• 971168 D01 Power Meas License Digital Systems v02r02: October 17 2014; (Measurement guidance for certification of licensed digital transmitters)• Supporting documents for EUT certification are separate exhibits.



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: 2014 and RSS-139: 2009 and RSS-130: 2013 standard is shown below.

Section	FCC Part Sections(s)	Industry Canada Sections	Test Description	Result
2.1	2.1046	RSS-139: 6.4 RSS-130: 4.4	Transmitter Conducted Output Power	Compliant
2.2	Part 2.1046, 27.50 (d)(4), 27.50 (b)(10)	RSS-139: 6.4 RSS-130: 4.4	Equivalent Isotropic Radiated Power	Compliant
2.3	27.50(d)(5)	RSS-139: 6.4 RSS-130: 4.4	Peak-Average Ratio	Compliant
2.4	2.1049, 27.53(h)(3),	RSS-GEN 4.6.	Occupied Bandwidth	Compliant
2.5	2.1051, 27.53(h)(1) 27.53(c)(2)	RSS-139: 6.5 RSS-130: 4.6	Band Edge	Compliant
2.6	2.1051, 27.53(h)(1) 27.53 (c)(2)	RSS-139: 6.5 RSS-130: 4.6	Conducted Spurious Emissions	Compliant
2.7	2.1053, 27.53(h)(1) 27.53(c)(2),	RSS-139: 6.5 RSS-130: 4.6	Field Strength Of Spurious Radiation	Compliant
2.8	2.1055, 27.54,	RSS-139: 6.3 RSS-130: 4.3	Frequency Stability	Compliant



1.3 PRODUCT INFORMATION

1.3.1 EUT General Description

The Equipment Under Test (EUT) was a Novatel Wireless Inc. USB620L USB Modem. The EUT is a Wireless USB Broadband Modem supporting 2G/3G/4G Technologies. The EUT comes with a USB Port.

1.3.2 EUT General Description

EUT Description	USB Modem
Model Name	USB620L
Model Number(s)	MC620
FCC Classification	Portable Transmitter
Rated Voltage	Nominal 5.0VDC USB
Mode Verified	LTE Band 4 and Band 13
Capability	GSM850/1900, Cell band and PCS Band CDMA2000 1xRTT, 1xEvDO Release 0 and A, WCDMA Band 2 and Band 5, LTE Band 2, 4, 5, 13
Primary Unit (EUT)	<input checked="" type="checkbox"/> Production <input type="checkbox"/> Pre-Production <input type="checkbox"/> Engineering
Frequency Tolerance	±0.00025% (2.5ppm)
Internal Antennas Details (Client declaration, max. antenna gain covered under this test report)	<p><u>Antenna – CDMA/GPRS/EDGE/WCDMA/LTE</u> Manufacturer: NVTL Part Number: 12023208 Type: Monopole Antenna Gain:</p> <ul style="list-style-type: none"> • CDMA BC0 – 850MHz: 1.36 dBi • CDMA BC1 – 1900MHz: 1.15 dBi • GSM850 – 850MHz: 1.36 dBi • GSM1900 – 1900MHz: 1.04 dBi • WCDMA Band 5 – 850MHz: 1.36 dBi • WCDMA Band 2 – 1900MHz: 1.23 dBi • LTE Band 5 – 800MHz: 1.07 dBi • LTE Band 2 – 1900MHz: 1.23 dBi • LTE Band 4 – 1700MHz: 1.21 dBi • LTE Band 13 – 700MHz: 1.14 dBi



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	23.36	0.22
	3	1710-1755	2M69G7D	24.20	0.26
	5	1710-1755	4M49G7D	24.18	0.26
	10	1710-1755	8M96G7D	24.09	0.26
	15	1710-1755	13M4G7D	24.17	0.26
	20	1710-1755	17M8G7D	24.21	0.26
16QAM	1.4	1710-1755	1M09G7D	22.32	0.17
	3	1710-1755	2M68G7D	23.45	0.22
	5	1710-1755	4M48G7D	23.28	0.21
	10	1710-1755	8M94G7D	23.43	0.22
	15	1710-1755	13M4G7D	23.34	0.22
	20	1710-1755	17M9G7D	23.45	0.22

LTE Band 13					
Modulation	Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	EIRP	
				Max Power (dBm)	Max Power (Watts)
QPSK	5.0	777-787	4M49G7D	25.14	0.33
	10.0	777-787	8M94G7D	23.87	0.24
16QAM	5.0	777-787	4M47W7D	24.26	0.27
	10.0	777-787	8M92W7D	24.11	0.26



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 USB port
B	Raidated test setup. EUT Tx through integral antenna and connected to a USB port

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

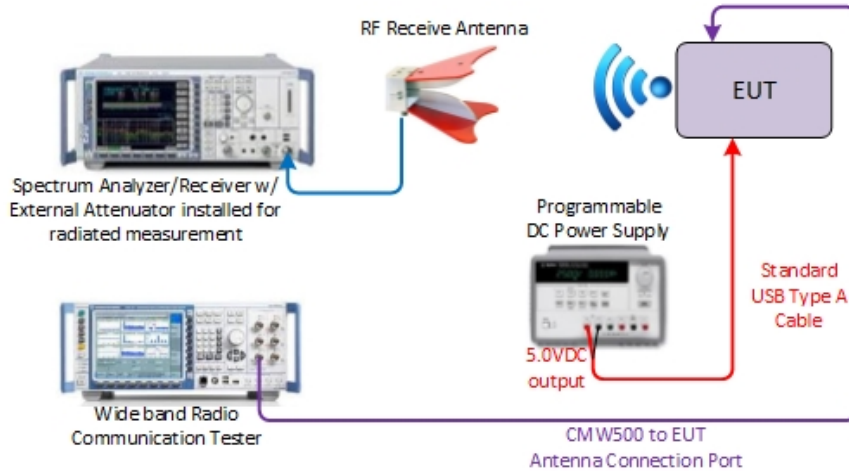
Worst-case configuration used in this test report:

Band	Modulation
LTE Band 4	QPSK
LTE Band 13	QPSK

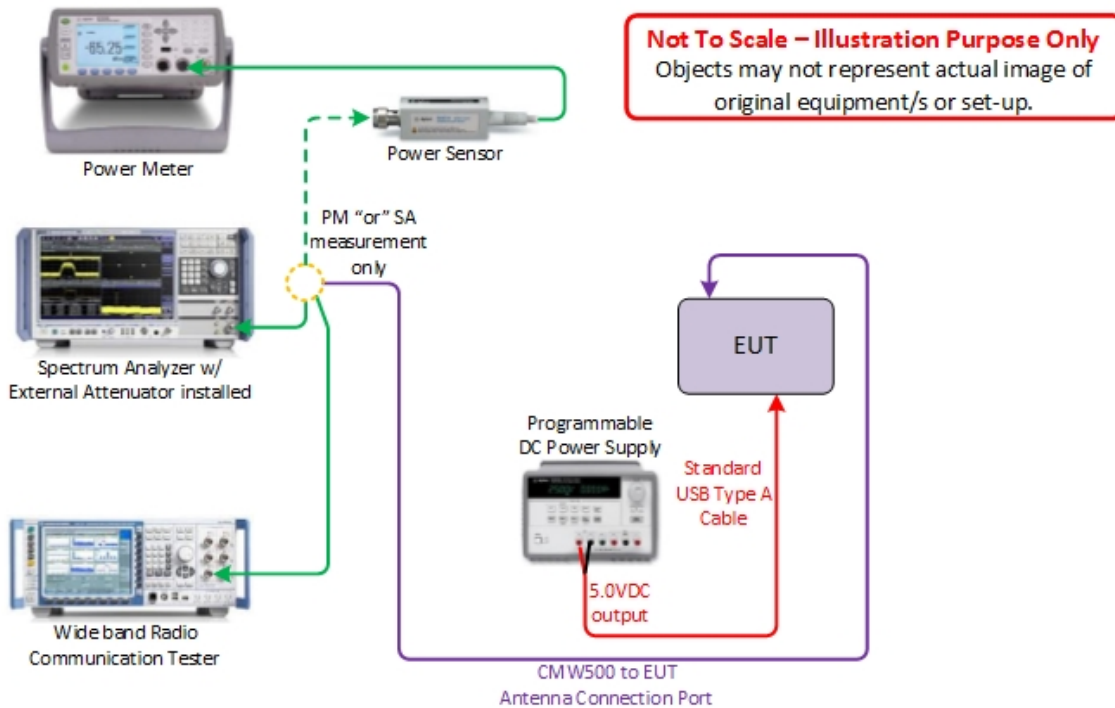
For radiated measurements X, Y, and Z orientations were verified. The verification was determined "Y" as worst case configuration.

1.4.5 Simplified Test Configuration Diagram

Radiated/Conducted Emission Test Configuration via Conducted Port



Conducted (Antenna Port) Test Configuration





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 SP070315900027		
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. Effective Radiated Power (ERP) and Equivalent Isotropic Radiated Power (EIRP) measurements by Substitution method were conducted according to ANSI/TIA/EIA-603-C-2004, August 17,2004. Land Mobile FM or PM -Communications Equipment -Measurement and Performance Standards. For conducted 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 §2.498 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.



1.10 SAMPLE CALCULATIONS

1.10.1 LTE Emission Designator (QPSK)

Emission Designator = 4M51G7D
 G = Phase Modulation
 7= Quantized/Digital Info
 D = Combination (Audio/Data)

1.10.2 LTE Emission Designator (16QAM)

Emission Designator = 4M50W7D
 W = Amplitude/Angle Modulated
 7= Quantized/Digital Info
 D = Combination (Audio/Data)

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:

$$\begin{aligned}
 P_{EIRP} &= -18 \text{ dBm} + 7.8 \text{ dBi} - 1 \text{ dB} \\
 &= 11.2 \text{ dBm} \\
 P_{ERP} &= P_{EIRP} - 2.15 \text{ dB} \\
 &= 11.2 \text{ dBm} - 2.15 \text{ dB} \\
 &= 9.05 \text{ dBm}
 \end{aligned}$$



SECTION 2

TEST DETAILS

Radio Testing of the
Novatel Wireless Inc.
USB Modem



2.1 TRANSMITTER CONDUCTED POWER MEASUREMENTS

2.1.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1046
RSS-139, Clause 6.4
RSS-130: Clause 4.4

2.1.2 RSS-133, Clause 6.4 Standard Applicable

The conducted power measurements were made in accordance to FCC Part 2 Clause 2.1046 and RSS-139 Clause 5.4 and RSS-130 Clause 4.4.

2.1.3 Equipment Under Test and Modification State

Serial No: SP070315900027 / Test Configuration A

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

April 13 and 14, 2015 / XYZ

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 TÜV SUD America Inc. Rancho Bernardo facility

Ambient Temperature	22.7 - 25.1°C
Relative Humidity	25.7 - 28.0%
ATM Pressure	99.2 - 99.7 kPa

2.1.7 Additional Observations

- This is a conducted test using a peak/average power meter.
- The path loss for LTE Band 4 and B13 was measured and entered as a level offset.
- Only representative worst case RB size and RB offset presented.



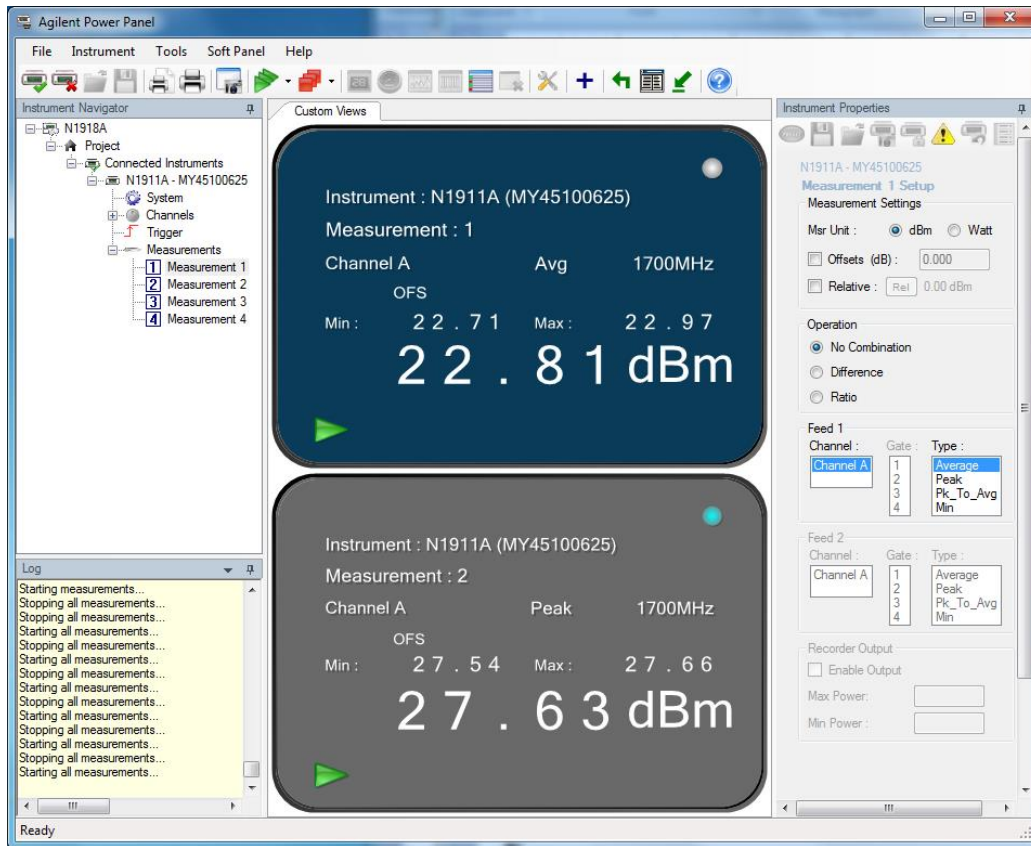
2.1.8 Test Results

LTE Band 4							
Modulation	Bandwidth	RB Size	RB Offset	Channels	Frequency	Tx Average (dBm)	Tx Peak (dBm)
QPSK	1.4 MHz	1	0	19957	1710.7	21.79	27.47
		1	0	20175	1732.5	21.99	27.86
		1	0	20393	1754.3	22.15	27.23
	3 MHz	1	0	19965	1711.5	22.99	27.12
		1	0	20175	1732.5	22.82	27.74
		1	0	20385	1753.5	22.95	27.07
	5 MHz	1	0	19975	1712.5	22.90	27.12
		1	0	20175	1732.5	22.97	27.66
		1	0	20375	1752.5	22.85	27.20
	10 MHz	1	0	20000	1715.0	22.83	27.13
		1	0	20175	1732.5	22.88	27.58
		1	0	20350	1750.0	22.83	27.33
	15 MHz	1	0	20025	1717.5	22.79	27.16
		1	0	20175	1732.5	22.96	27.61
		1	0	20325	1747.5	22.89	27.62
	20 MHz	1	0	20050	1720.0	22.89	27.20
		1	0	20175	1732.5	22.99	27.63
		1	0	20300	1745.0	23.00	27.77
16QAM	1.4 MHz	1	0	19957	1710.7	20.83	27.43
		1	0	20175	1732.5	21.08	27.68
		1	0	20393	1754.3	21.11	27.32
	3 MHz	1	0	19965	1711.5	22.24	27.22
		1	0	20175	1732.5	21.94	27.63
		1	0	20385	1753.5	22.05	27.04
	5 MHz	1	0	19975	1712.5	22.01	27.04
		1	0	20175	1732.5	21.88	27.69
		1	0	20375	1752.5	22.07	27.10
	10 MHz	1	0	20000	1715.0	22.22	27.22
		1	0	20175	1732.5	22.01	27.63
		1	0	20350	1750.0	22.13	27.32
	15 MHz	1	0	20025	1717.5	22.13	27.25
		1	0	20175	1732.5	21.96	27.61
		1	0	20325	1747.5	21.91	27.56
	20 MHz	1	0	20050	1720.0	21.91	27.10
		1	0	20175	1732.5	22.00	27.43
		1	0	20300	1745.0	22.24	27.86



LTE Band 13							
Modulation	Bandwidth	RB Size	RB Offset	Channels	Frequency	Tx Average (dBm)	Tx Peak (dBm)
QPSK	5 MHz	1	0	23205	779.5	24.00	28.11
		1	0	23230	782.0	23.65	27.74
		1	0	23255	784.5	23.81	28.37
	10 MHz	1	0	-	-	-	-
		1	0	23230	782.0	23.87	28.13
		1	0	-	-	-	-
16QAM	5 MHz	1	0	23205	779.5	23.12	27.98
		1	0	23230	782.0	22.66	27.65
		1	0	23255	784.5	23.00	28.18
	10 MHz	1	0	-	-	-	-
		1	0	23230	782.0	22.97	28.10
		1	0	-	-	-	-

2.1.9 Sample Test Measurement Screen





2.2 EQUIVALENT ISOTROPIC RADIATED POWER AND EQUIVALENT RADIATED POWER

2.2.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1046
RSS-139, Clause 6.4
RSS-130: Clause 4.4

2.2.2 Standard Applicable

FCC Part 27:

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

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

IC RSS-139:

The average equivalent isotropically radiated power (e.i.r.p.) for fixed, mobile and portable transmitters in the 1710-1755 MHz shall not exceed 1 watt.

IC RSS-130:

The e.i.r.p. shall not exceed 50 watts for mobile equipment or for outdoor fixed subscriber equipment, nor shall it exceed 5 watts for portable equipment or for indoor fixed subscriber equipment.

2.2.3 Equipment Under Test

Serial No: SP070315900027, Test Configuration (N/A, calculation only)

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

April 13 and 14, 2015 / XYZ

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:

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

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);

L_C = signal attenuation in the connecting cable between the transmitter and antenna, in dB (EUT poses an internal Antenna. The loss between the EUT and the antenna port is considered negligible).



2.2.6 Test Results

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	1/0	19957	1710.7	21.79	1.21	23.00	30.00	7.00
		1/0	20175	1732.5	21.99	1.21	23.20	30.00	6.80
		1/0	20393	1754.3	22.15	1.21	23.36	30.00	6.64
	3	1/0	19965	1711.5	22.99	1.21	24.20	30.00	5.80
		1/0	20175	1732.5	22.82	1.21	24.03	30.00	5.97
		1/0	20385	1753.5	22.95	1.21	24.16	30.00	5.84
	5	1/0	19975	1712.5	22.90	1.21	24.11	30.00	5.89
		1/0	20175	1732.5	22.97	1.21	24.18	30.00	5.82
		1/0	20375	1752.5	22.85	1.21	24.06	30.00	5.94
	10	1/0	20000	1715.0	22.83	1.21	24.04	30.00	5.96
		1/0	20175	1732.5	22.88	1.21	24.09	30.00	5.91
		1/0	20350	1750.0	22.83	1.21	24.04	30.00	5.96
	15	1/0	20025	1717.5	22.79	1.21	24.00	30.00	6.00
		1/0	20175	1732.5	22.96	1.21	24.17	30.00	5.83
		1/0	20325	1747.5	22.89	1.21	24.10	30.00	5.90
20	1/0	20050	1720.0	22.89	1.21	24.10	30.00	5.90	
	1/0	20175	1732.5	22.99	1.21	24.20	30.00	5.80	
	1/0	20300	1745.0	23.00	1.21	24.21	30.00	5.79	
16QAM	1.4	1/0	19957	1710.7	20.83	1.21	22.04	30.00	7.96
		1/0	20175	1732.5	21.08	1.21	22.29	30.00	7.71
		1/0	20393	1754.3	21.11	1.21	22.32	30.00	7.68
	3	1/0	19965	1711.5	22.24	1.21	23.45	30.00	6.55
		1/0	20175	1732.5	21.94	1.21	23.15	30.00	6.85
		1/0	20385	1753.5	22.05	1.21	23.26	30.00	6.74
	5	1/0	19975	1712.5	22.01	1.21	23.22	30.00	6.78
		1/0	20175	1732.5	21.88	1.21	23.09	30.00	6.91
		1/0	20375	1752.5	22.07	1.21	23.28	30.00	6.72
	10	1/0	20000	1715.0	22.22	1.21	23.43	30.00	6.57
		1/0	20175	1732.5	22.01	1.21	23.22	30.00	6.78
		1/0	20350	1750.0	22.13	1.21	23.34	30.00	6.66
	15	1/0	20025	1717.5	22.13	1.21	23.34	30.00	6.66
		1/0	20175	1732.5	21.96	1.21	23.17	30.00	6.83
		1/0	20325	1747.5	21.91	1.21	23.12	30.00	6.88
20	1/0	20050	1720.0	21.91	1.21	23.12	30.00	6.88	
	1/0	20175	1732.5	22.00	1.21	23.21	30.00	6.79	
	1/0	20300	1745.0	22.24	1.21	23.45	30.00	6.55	



LTE Band 13									
Modulation	Bandwidth (MHz)	RB Size/Offset	Channels	Frequency (MHz)	Tx Average Power (dBm)	Antenna Gain (dBi)	ERP / EIRP (dBm)	ERP / EIRP Limit (dBm)	Margin (dBm)
QPSK	5	1/0	23205	779.5	24.00	1.14	22.99 / 25.14	34.8 / 37.0	11.81 / 11.86
		1/0	23255	782.0	23.65	1.14	22.64 / 24.79	34.8 / 37.0	12.16 / 12.21
		1/0	23255	784.5	23.81	1.14	22.80 / 24.95	34.8 / 37.0	12.00 / 12.05
	10	-	-	-	-	-	-	-	-
		1/0	23230	782.0	23.87	1.14	22.86 / 23.87	34.8 / 37.0	11.94 / 11.99
		-	-	-	-	-	-	-	-
16QAM	5	1/0	23205	779.5	23.12	1.14	22.11 / 24.26	34.8 / 37.0	12.69 / 12.74
		1/0	23255	782.0	22.66	1.14	22.66 / 23.8	34.8 / 37.0	13.15 / 13.20
		1/0	23255	784.5	23.00	1.14	23.00 / 24.14	34.8 / 37.0	12.81 / 12.86
	10	-	-	-	-	-	-	-	-
		1/0	23230	782.0	22.97	1.14	22.97 / 24.11	34.8 / 37.0	12.84 / 12.89
		-	-	-	-	-	-	-	-

EPR = EIRP - 2.15



2.3 PEAK-AVERAGE POWER RATIO

2.3.1 Specification Reference

FCC 47 CFR Part 27, Clause 27.50(d)(5)
RSS-139, Clause 6.4
RSS-130: Clause 4.4

2.3.2 Standard Applicable

FCC Part 27:

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.

RSS-139:

The peak-to-average ratio of the power shall not exceed 13 dB.

RSS-130:

The peak-to-average power ratio (PAPR) of the transmitter shall not exceed 13 dB for more than 0.1% of the time and shall use a signal corresponding to the highest PAPR during periods of continuous transmission.

2.3.3 Equipment Under Test and Modification State

Serial No: SP070315900027 / Test Configuration A

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

April 15 to 23, 2015 / XYZ

2.3.5 Test Equipment Used

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

2.3.6 Environmental Conditions/ Test Location

Test performed at TÜV SÜD America Inc. Rancho Bernardo facility

Ambient Temperature	24.2 - 25.6°C
Relative Humidity	38.6 - 42.4%
ATM Pressure	99.2 -99.7 kPa

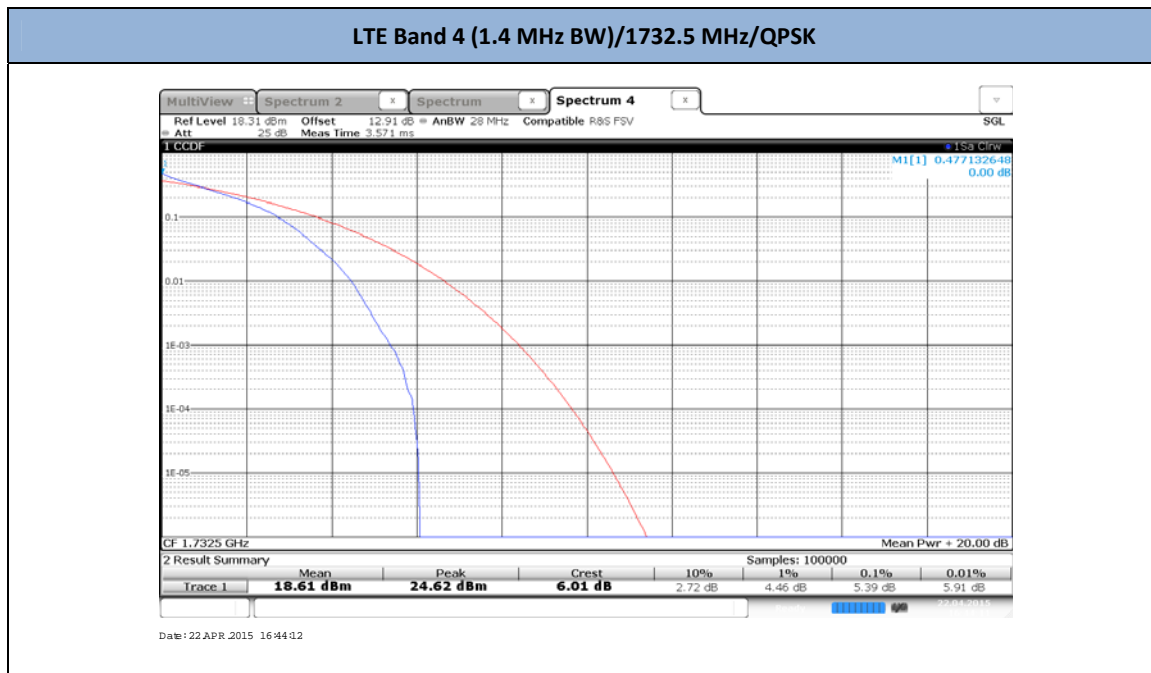
2.3.7



2.3.8 Additional Observations

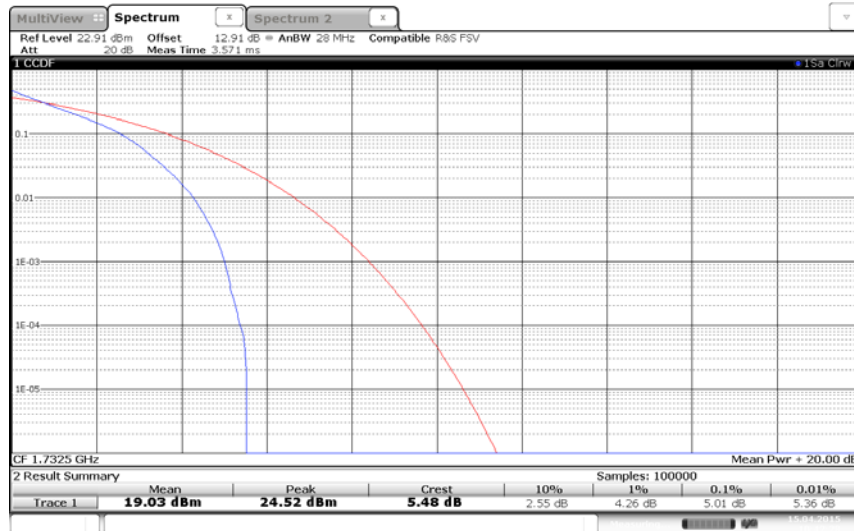
- This is a conducted test. Test procedure is per Section 5.7.1 of KDB971168 (D01 Power Meas License Digital Systems v02 DR02-41372).
- Measurement was done using the Spectrum Analyzer's Complementary Cumulative Distribution Function (CCDF) measurement profile. The built-in function is used to determine 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 the instrument's resolution bandwidth can be set wide enough to accommodate the entire input signal bandwidth.
- The path loss for Cell LTE Band 4 and 13 was measured and entered as a level offset.
- Low, Mid and High channels for all bandwidths and modulations were verified. Test results of Mid channel for QPSK were presented as representative.
- There are no measured PAPR levels greater than 13dB. EUT complies.

2.3.9 Test Results





LTE Band 4 (3 MHz BW)/1732.5 MHz/QPSK



Date: 15 APR. 2015 10:42:28

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



Date: 22 APR. 2015 16:48:48

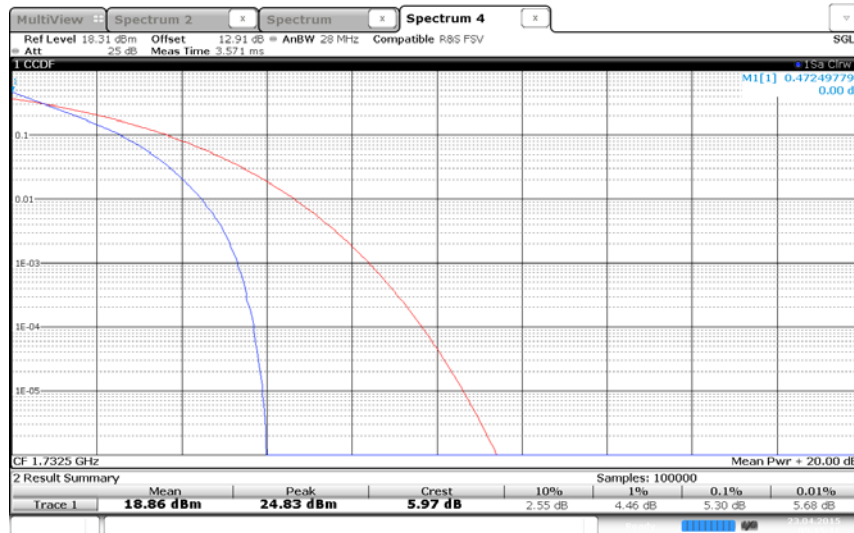


LTE Band 4 (10 MHz BW)/1732.5 MHz/QPSK



Date: 22 APR 2015 16:50:55

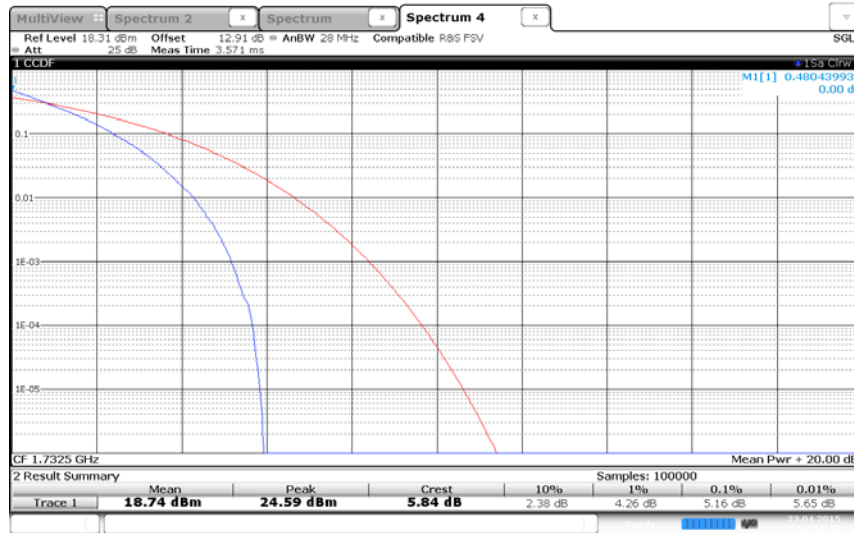
LTE Band 4 (15 MHz BW)/1732.5 MHz/QPSK



Date: 23 APR 2015 09:45:16

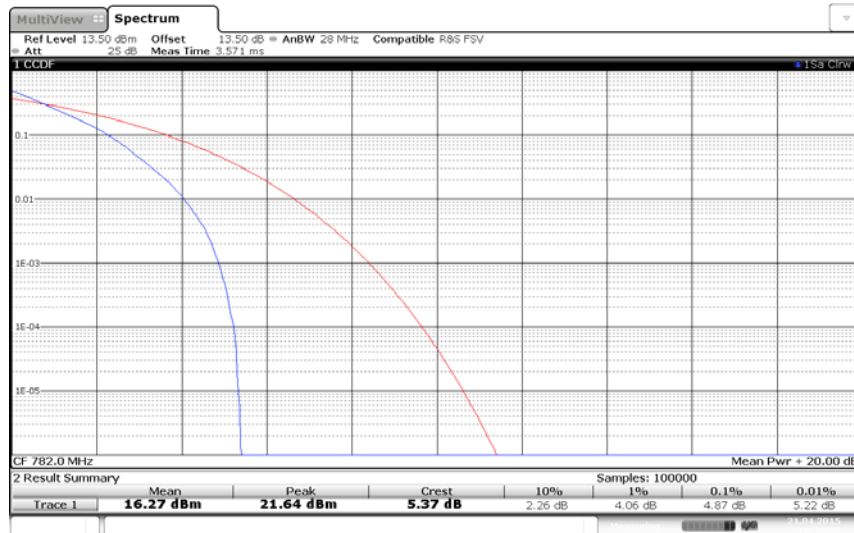


LTE Band 4 (20 MHz BW)/1732.5 MHz/QPSK



Date: 23 APR.2015 09:18:00

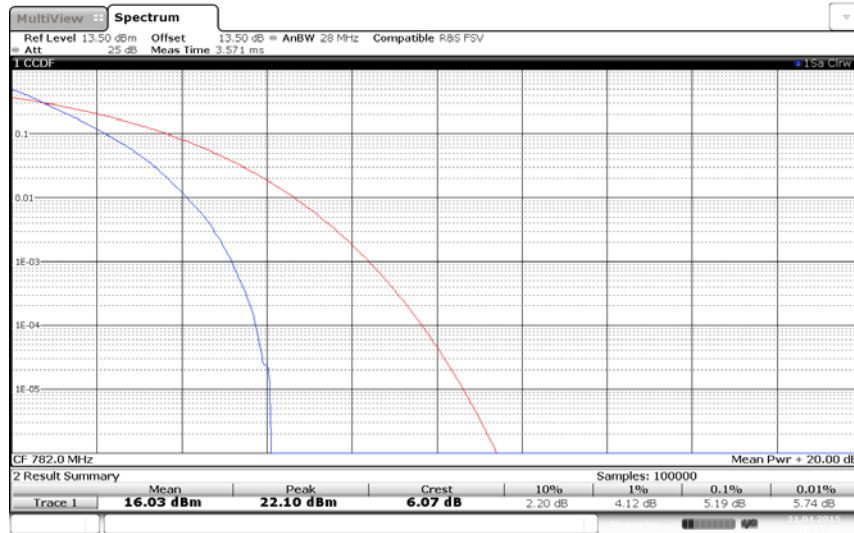
LTE Band 13 (5 MHz BW)/782 MHz/QPSK



Date: 21 APR.2015 10:21:08



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



Date: 21 APR 2015 10:21:46



2.4 OCCUPIED BANDWIDTH

2.4.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1049
FCC 47 CFR Part 27, Clause 27.53(h)(3)
RSS-GEN, Clause 4.6

2.4.2 Standard Applicable

The transmitted signal bandwidth shall be reported as the 99% emission bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission.

26dB 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 by at least 26 dB below the transmitter power.

2.4.3 Equipment Under Test and Modification State

Serial No: SP070315900027 / Test Configuration A

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

April 20 and 21, 2015 / XYZ

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	24.3 - 25.1°C
Relative Humidity	37.8 - 41.5%
ATM Pressure	99.2 - 99.7 kPa

2.4.7 Additional Observations

- This is a conducted test. Both 26dB bandwidth and 99% bandwidth presented.
- Using the occupied bandwidth measurement function in the spectrum analyzer, the 99% occupied bandwidth was measured.
- The 26dB bandwidth was measured in accordance with FCC KDB 971168 D01 V0202 Clause 4.1 using the ndB measurement function in the spectrum analyzer.
- The transmitter shall be operated at its maximum carrier power measured under normal test conditions.
- The span of the analyzer shall be set to capture all products of the modulation process, including the emission skirts.



- The resolution bandwidth (RBW) shall be in the range of 1% of the occupied bandwidth (OBW) and video bandwidth (VBW) shall be at least 3x RBW.
- Low, Mid and High channels for all bandwidths and modulations were verified. Test results of Mid channel for QPSK were presented as representative.

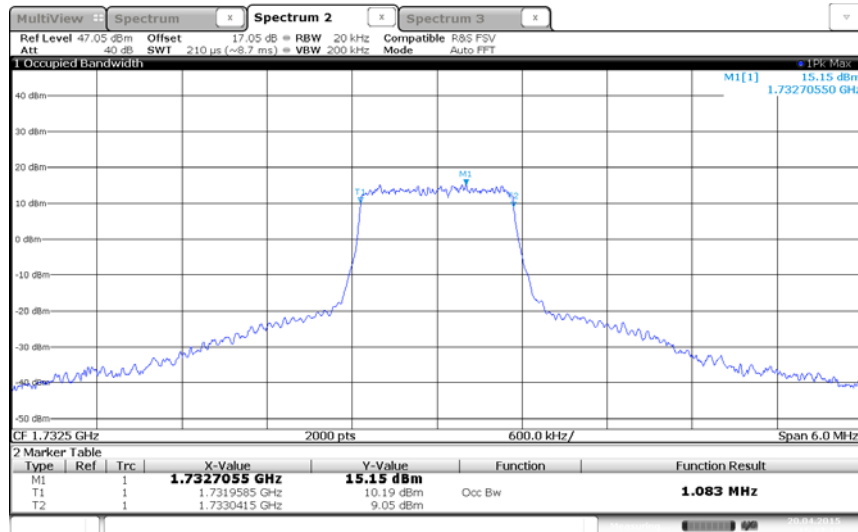
2.4.8 Test Results

LTE (QPSK)					
Band	Bandwidth (MHz)	Channel	Frequency	99% OBW (kHz)	26dB BW (kHz)
4	1.4	20175	1732.5	1.08	1.28
	3			2.69	2.96
	5			4.49	4.92
	10			8.96	9.79
	15			13.41	14.67
	20			17.80	18.96
13	5	23230	782.0	4.49	4.98
	10			8.94	9.78

LTE (16QAM)					
Band	Bandwidth (MHz)	Channel	Frequency	99% OBW (kHz)	26dB BW (kHz)
4	1.4	20175	1732.5	1.09	1.29
	3			2.68	2.94
	5			4.48	4.90
	10			8.94	9.65
	15			13.41	14.57
	20			17.88	19.08
13	5	23230	782.0	4.47	4.92
	10			8.92	9.64

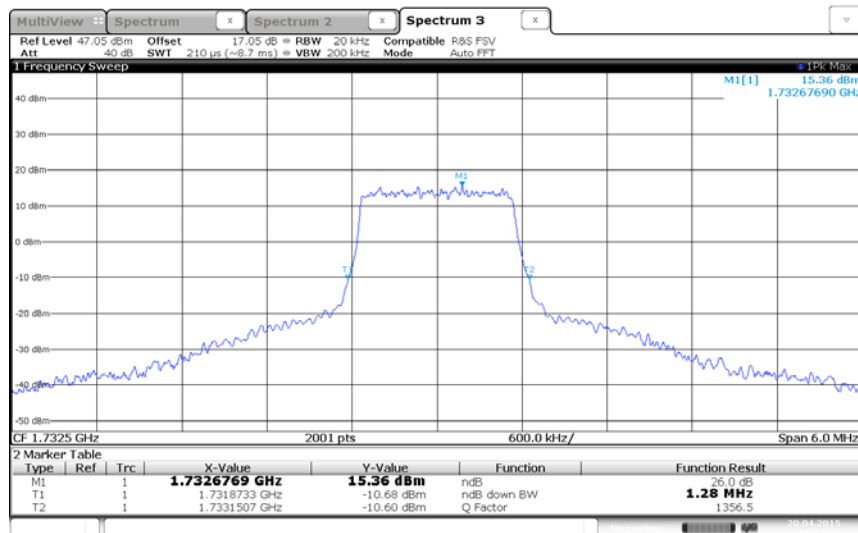


LTE Band 4 (1.4 MHz BW)/1732.5 MHz/QPSK/99%OBW



Date: 20 APR.2015 15:27:19

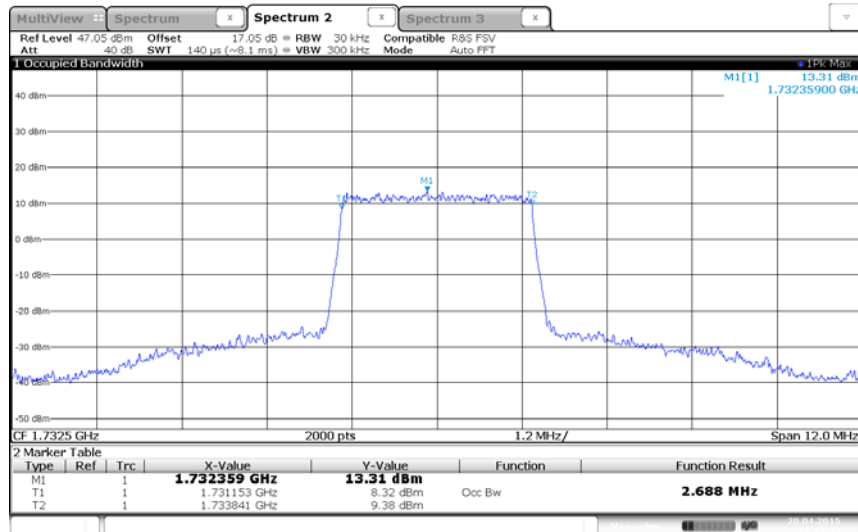
LTE Band 4 (1.4 MHz BW)/1732.5 MHz/QPSK/26dB BW



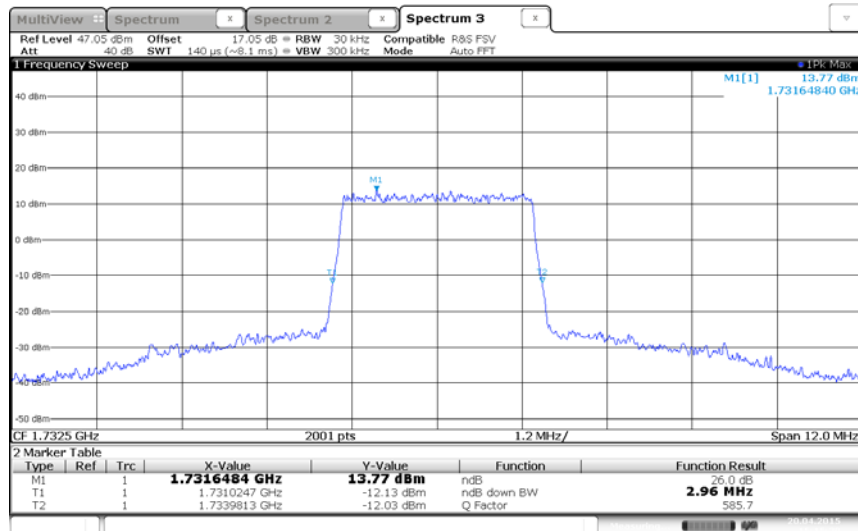
Date: 20 APR.2015 15:27:43



LTE Band 4 (3 MHz BW)/1732.5 MHz/QPSK/99%OBW

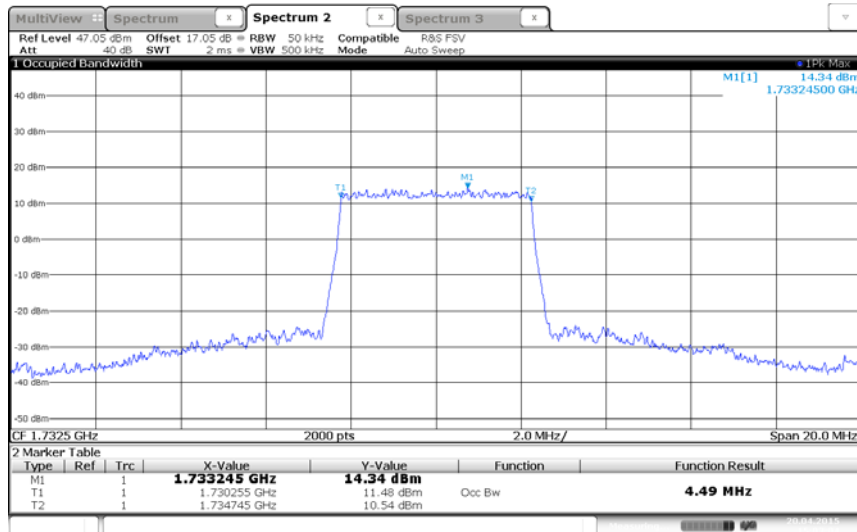


LTE Band 4 (3 MHz BW)/1732.5 MHz/QPSK/26dB BW



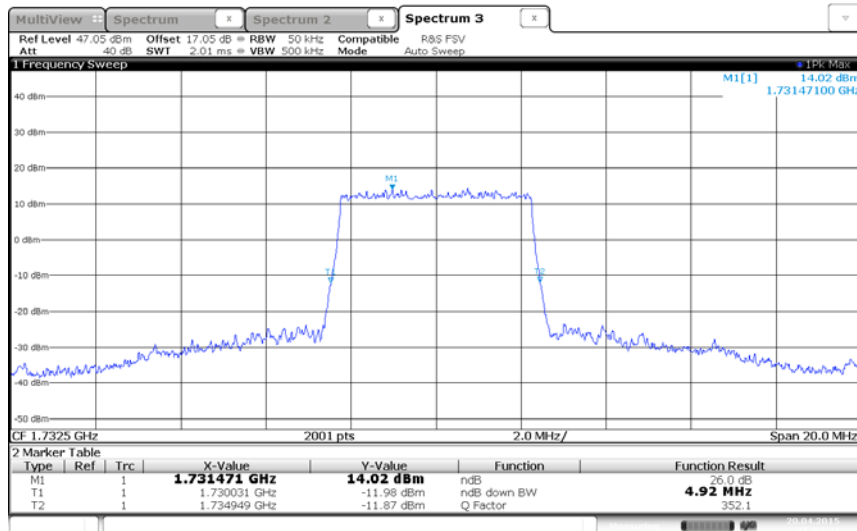


LTE Band 4 (5 MHz BW)/1732.5 MHz/QPSK/99%OBW



Date: 20 APR.2015 15:03:04

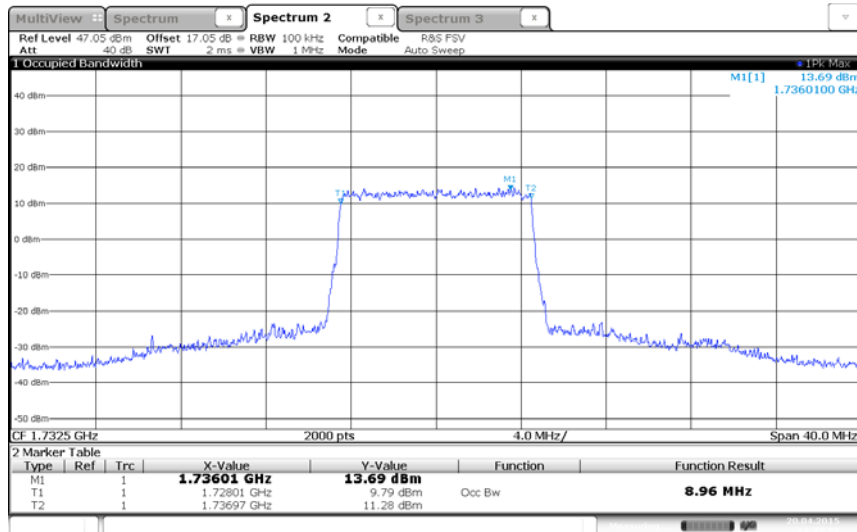
LTE Band 4 (5 MHz BW)/1732.5MHz/QPSK/26dB BW



Date: 20 APR.2015 15:03:34

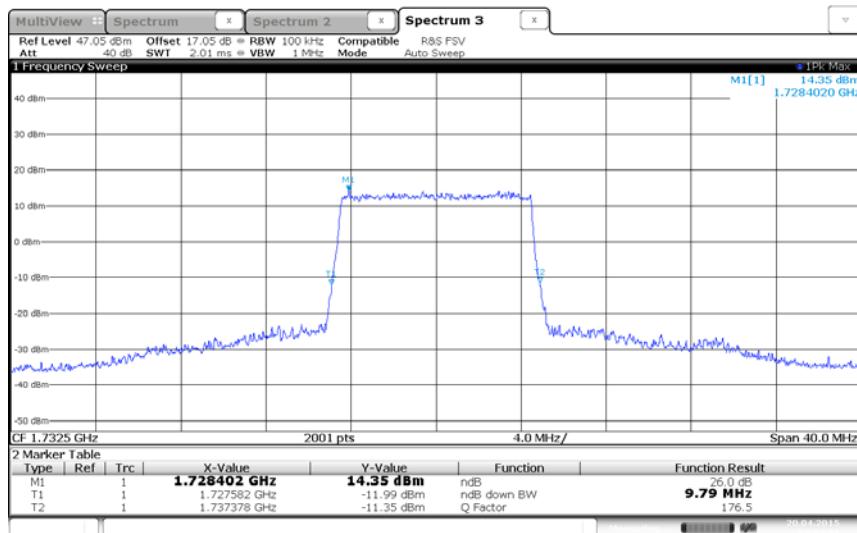


LTE Band 4 (10 MHz BW)/1732.5 MHz/QPSK/99%OBW



Date: 20 APR.2015 14:42:58

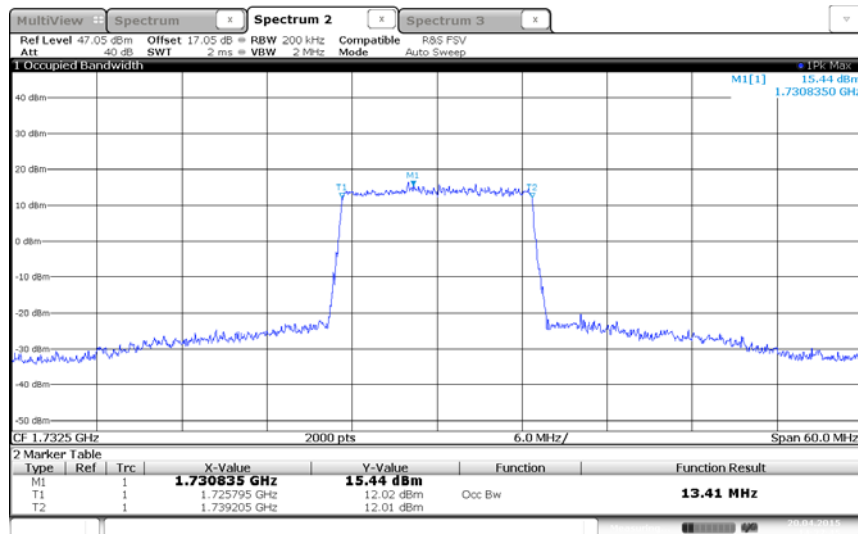
LTE Band 4 (10 MHz BW)/1732.5 MHz/QPSK/26dB BW



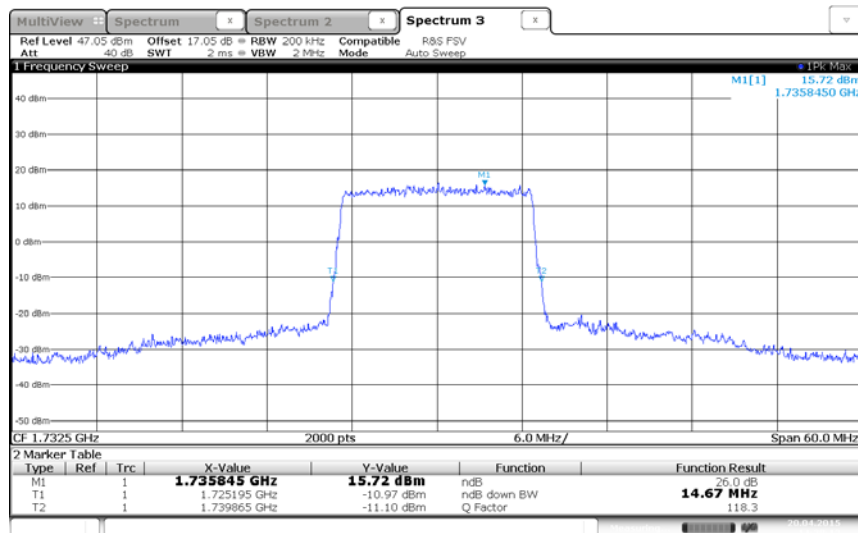
Date: 20 APR.2015 14:42:31



LTE Band 4 (15 MHz BW)/1732.5 MHz/QPSK/99%OBW

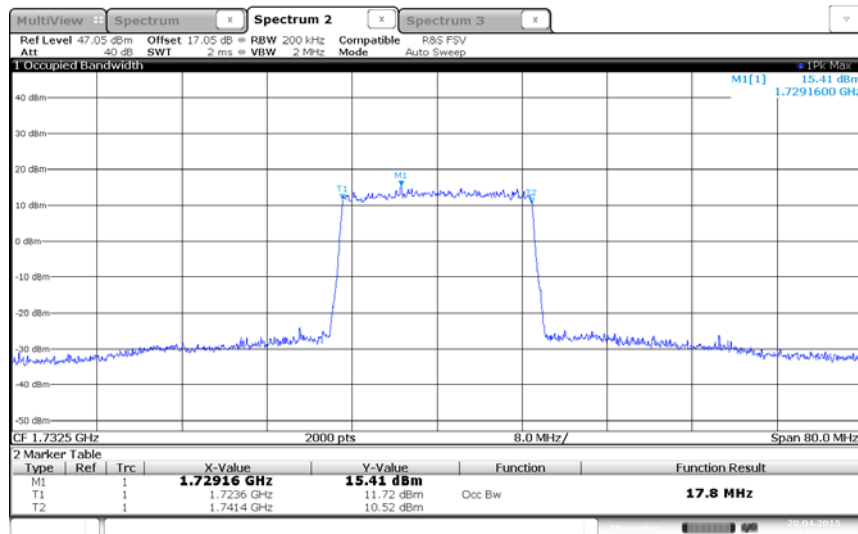


LTE Band 4 (15 MHz BW)/1732.5 MHz/QPSK/26dB BW

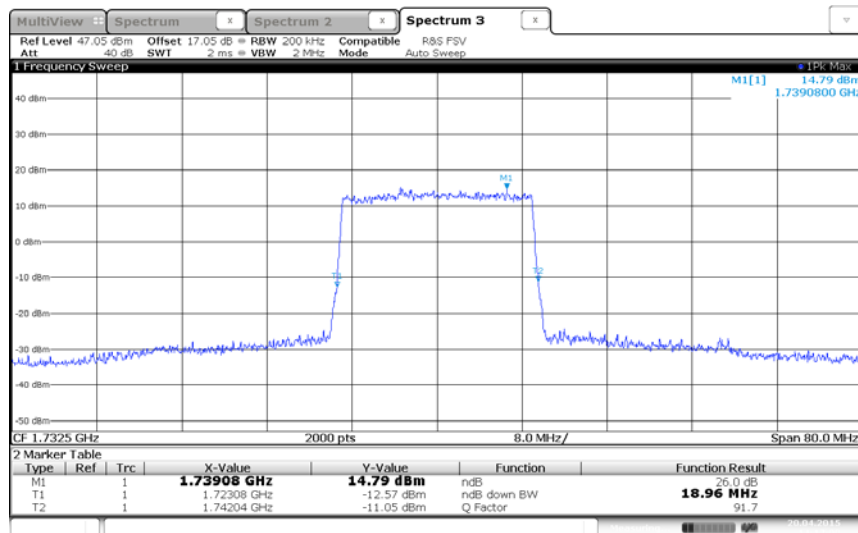




LTE Band 4 (20 MHz BW)/1732.5 MHz/QPSK/99%OBW

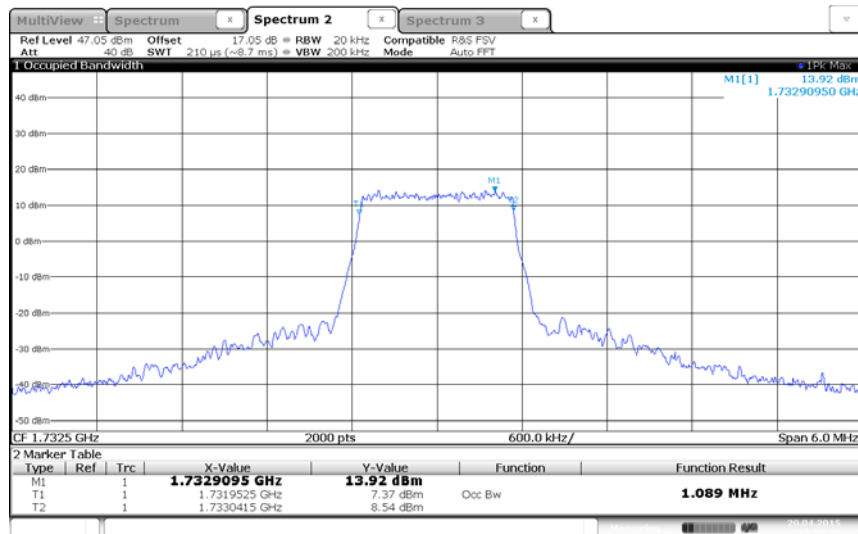


LTE Band 4 (20 MHz BW)/1732.5 MHz/QPSK/26dB BW

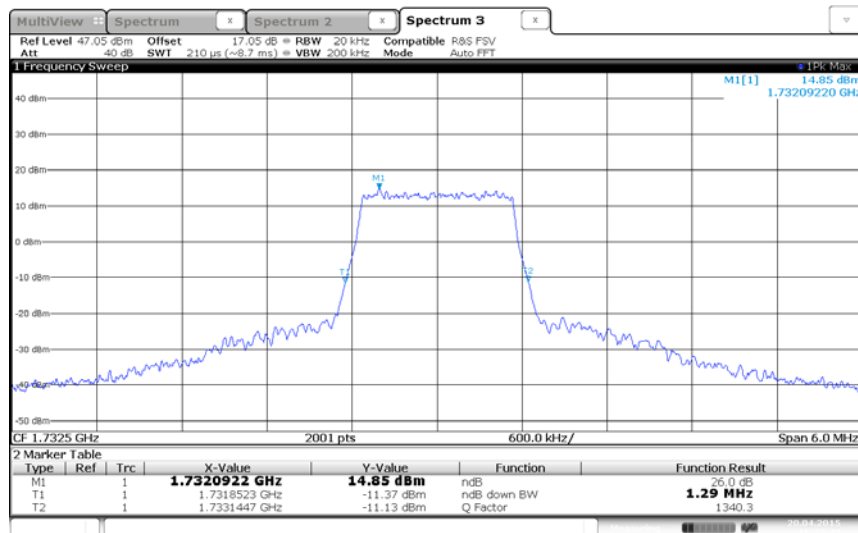




LTE Band 4 (1.4 MHz BW)/1732.5MHz/16QAM/99%OBW

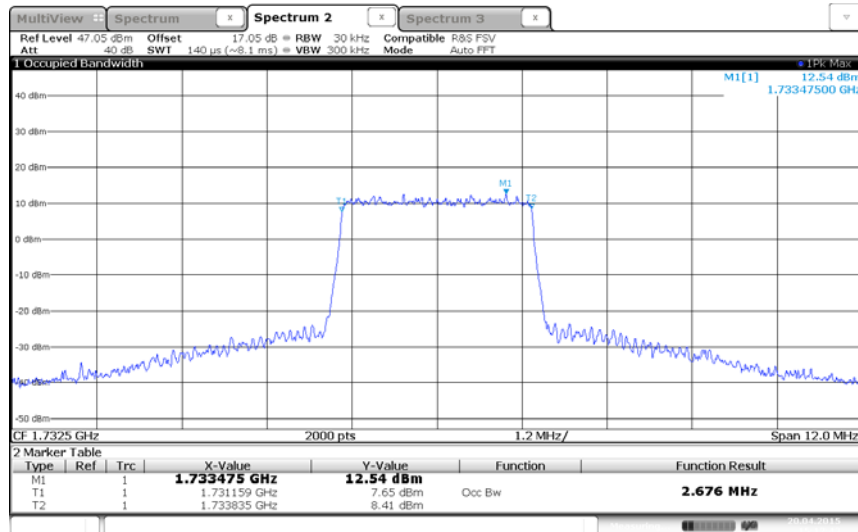


LTE Band 4 (1.4 MHz BW)/1732.5 MHz/16QAM/26dB BW

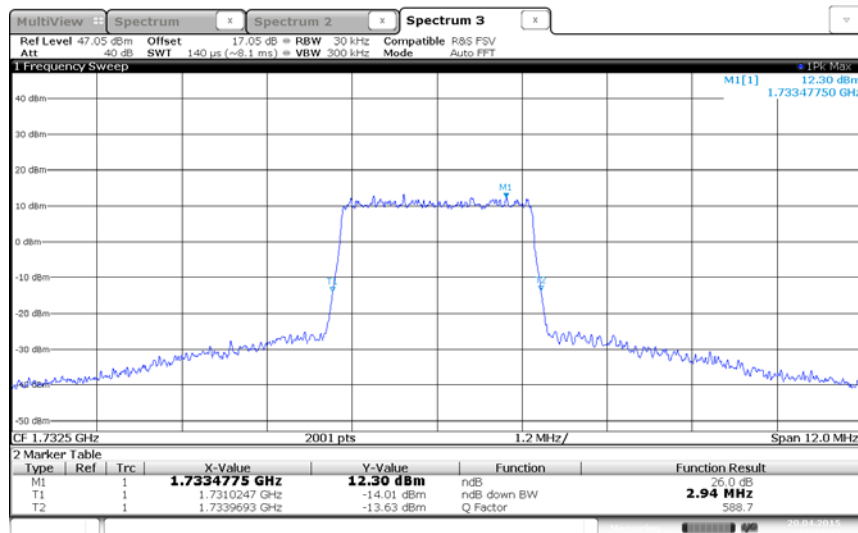




LTE Band 4 (3 MHz BW)/1732.5 MHz/16QAM/99%OBW

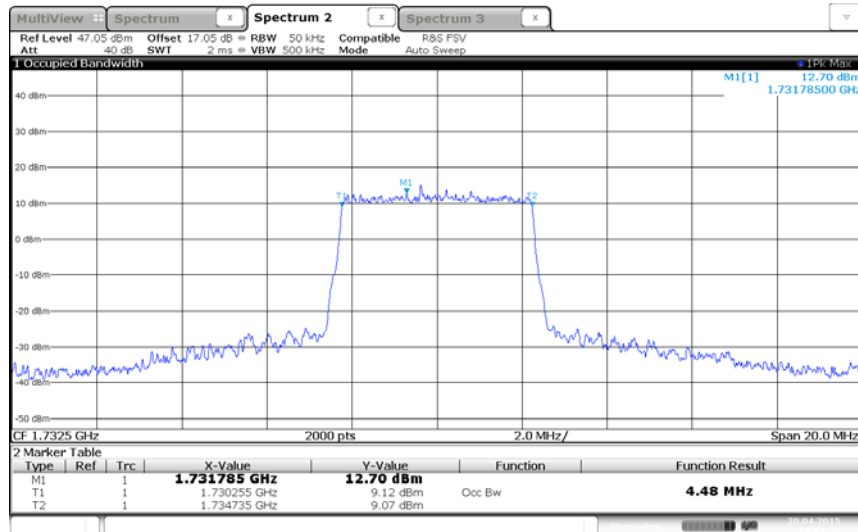


LTE Band 4 (3 MHz BW)/1732.5 MHz/16QAM/26dB BW



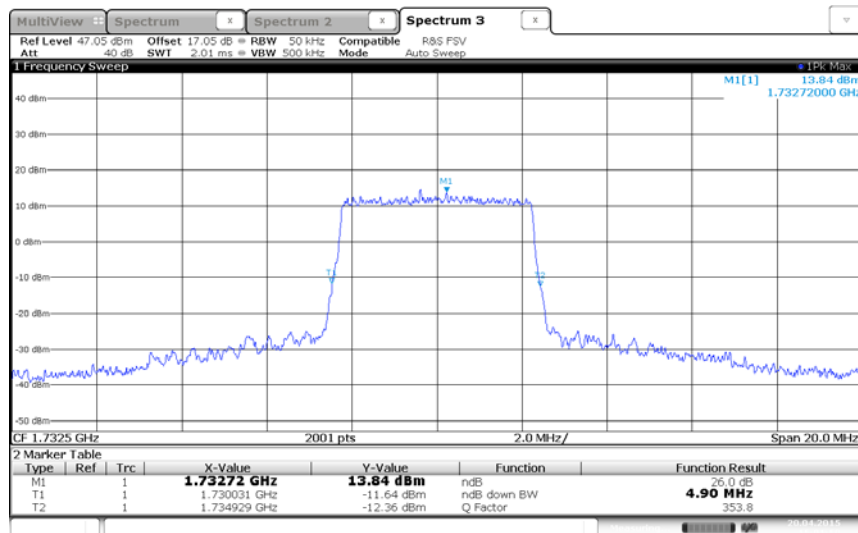


LTE Band 4 (5 MHz BW)/1732.5 MHz/16QAM/99%OBW



Date: 20 APR.2015 15:01:25

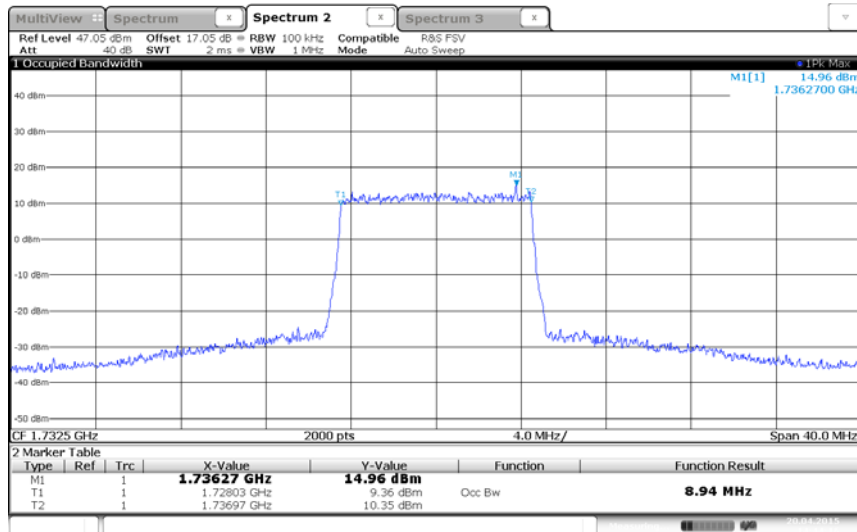
LTE Band 4 (5 MHz BW)/1732.5 MHz/16QAM/26dB BW



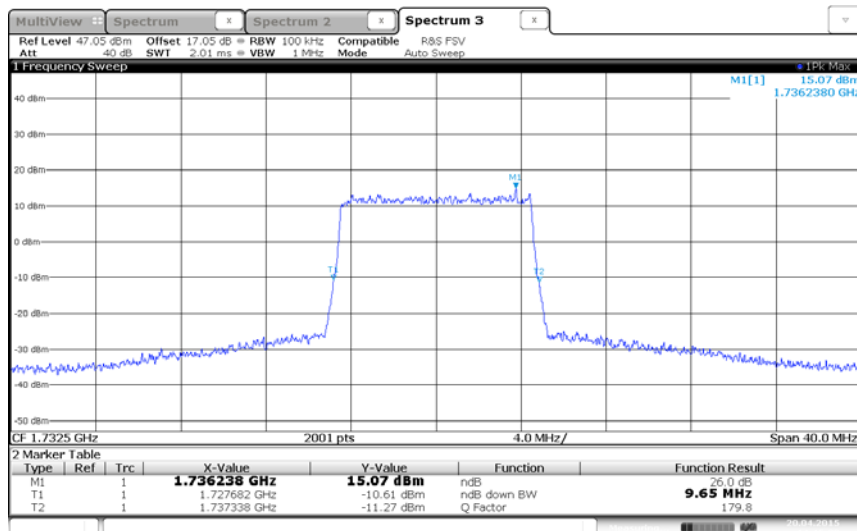
Date: 20 APR.2015 15:01:59



LTE Band 4 (10 MHz BW)/1732.5 MHz/16QAM/99%OBW



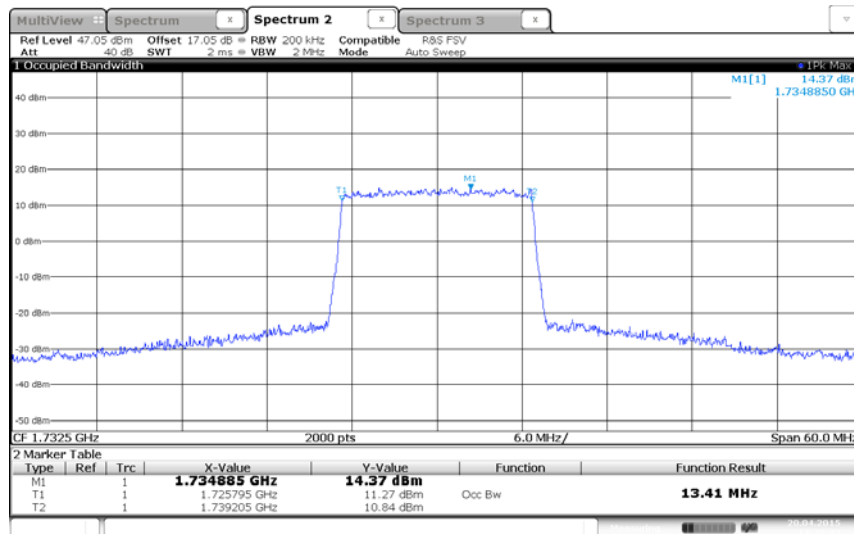
LTE Band 4 (10 MHz BW)/1732.5 MHz/16QAM/26dB BW



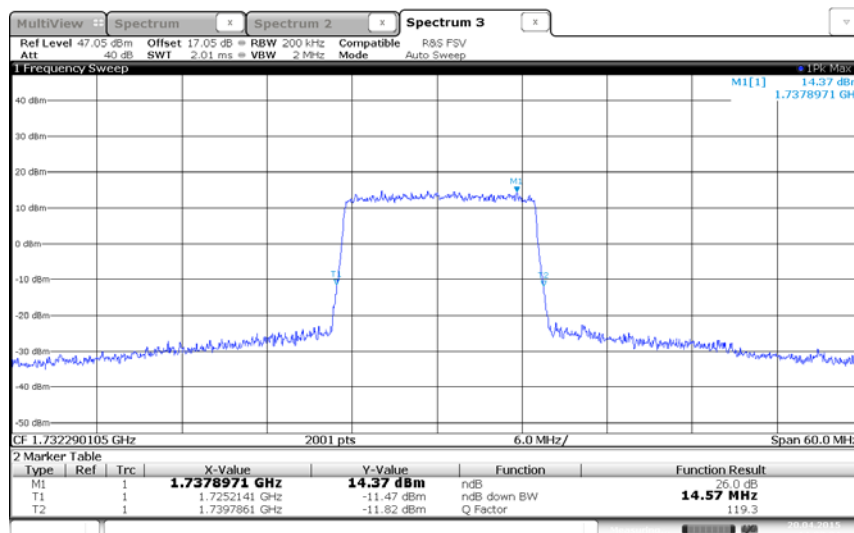


America

LTE Band 4 (15 MHz BW)/1732.5 MHz/16QAM/99%OBW

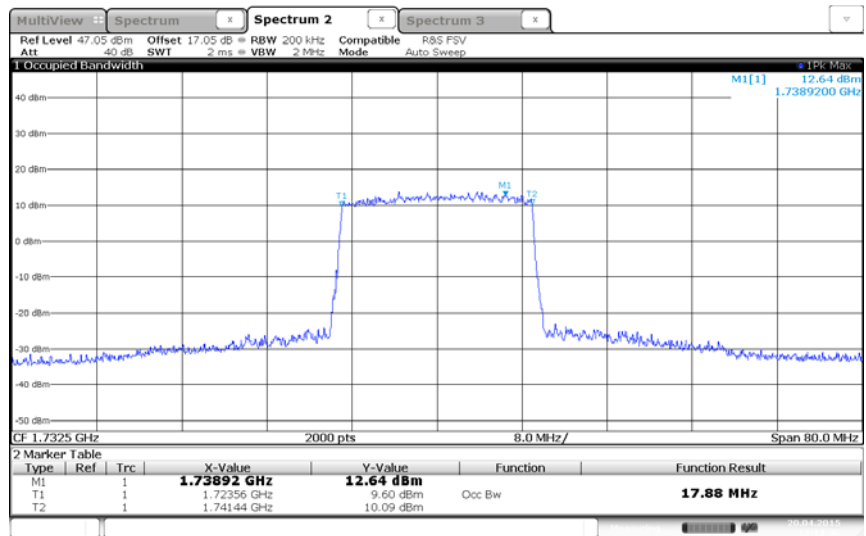


LTE Band 4 (15 MHz BW)/1732.5 MHz/16QAM/26dB BW

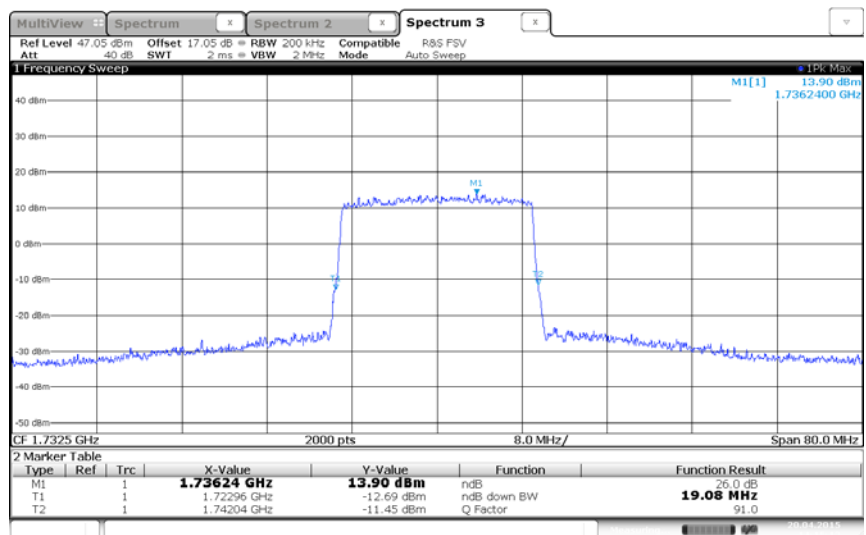




LTE Band 4 (20 MHz BW)/1732.5 MHz/16QAM/99%OBW

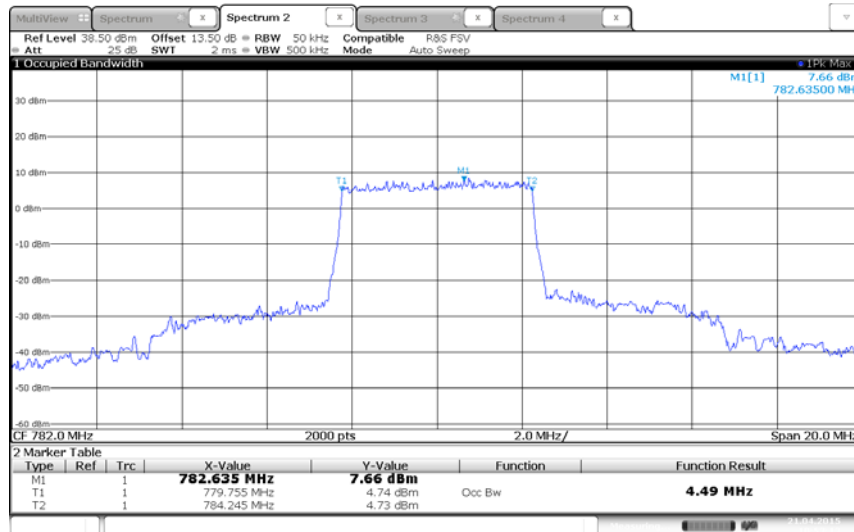


LTE Band 4 (20 MHz BW)/1732.5 MHz/16QAM/26dB BW



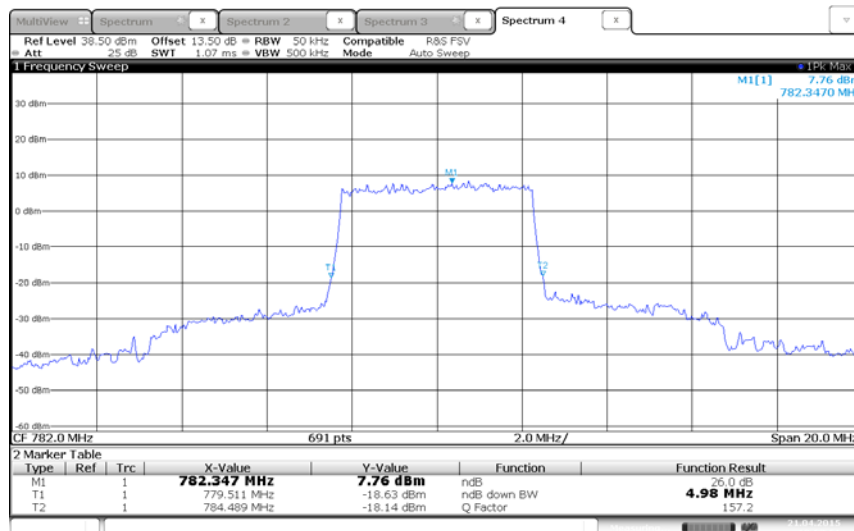


LTE Band 13 (5 MHz BW)/782.0 MHz/QPSK/99%OBW



Date: 21 APR 2015 10:53:13

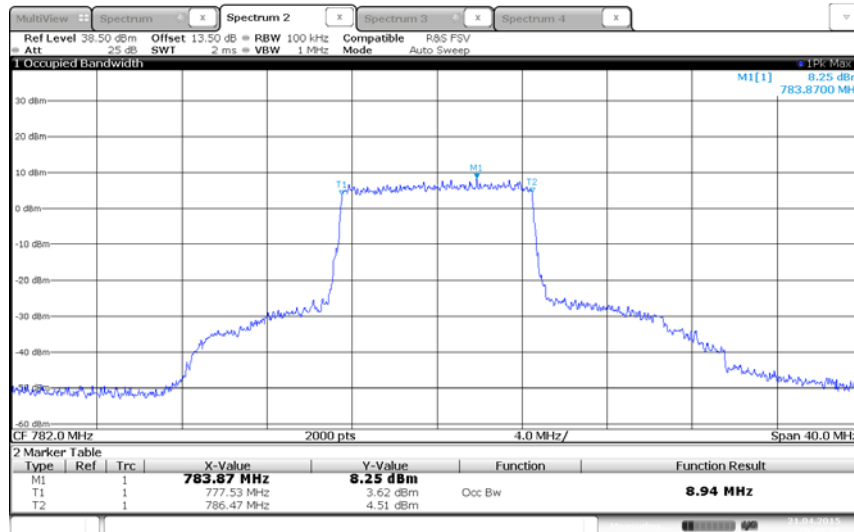
LTE Band 13 (5 MHz BW)/782.0 MHz/QPSK/26dB BW



Date: 21 APR 2015 10:53:50

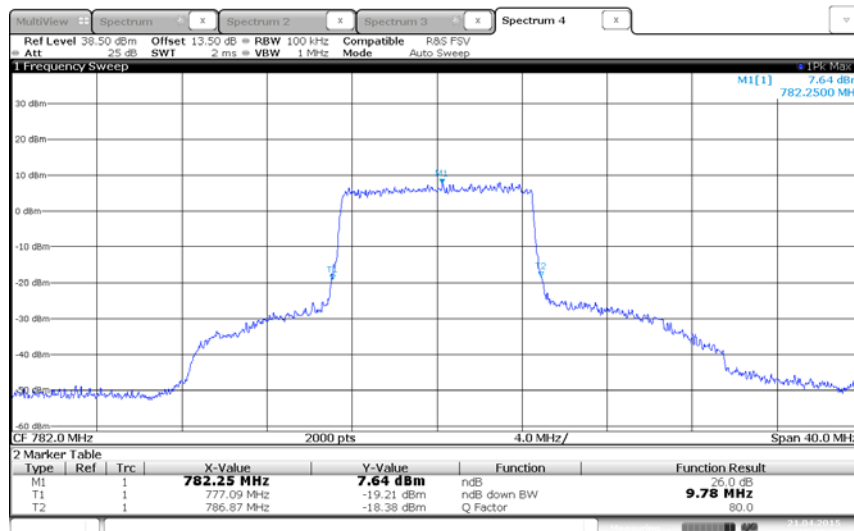


LTE Band 13 (10 MHz BW)/782.0 MHz/QPSK/99%OBW



Date: 21 APR 2015 10:48:55

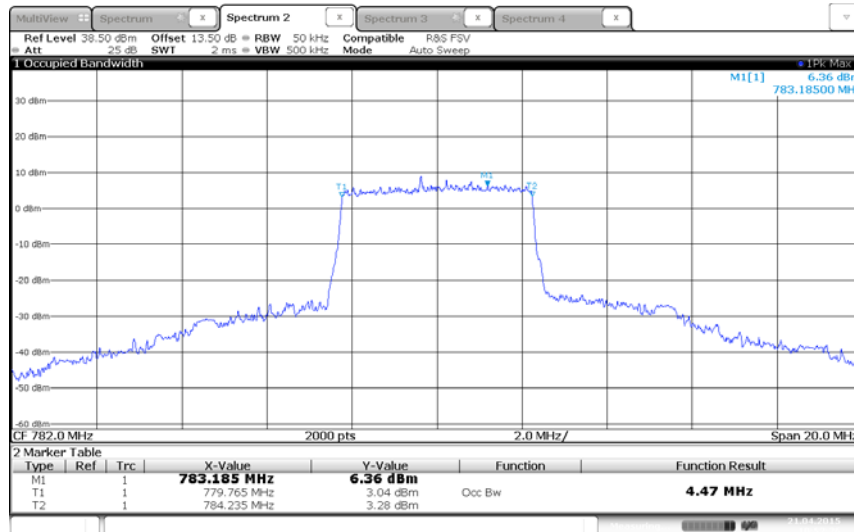
LTE Band 13 (10 MHz BW)/782.0 MHz/QPSK/26dB BW



Date: 21 APR 2015 10:49:28

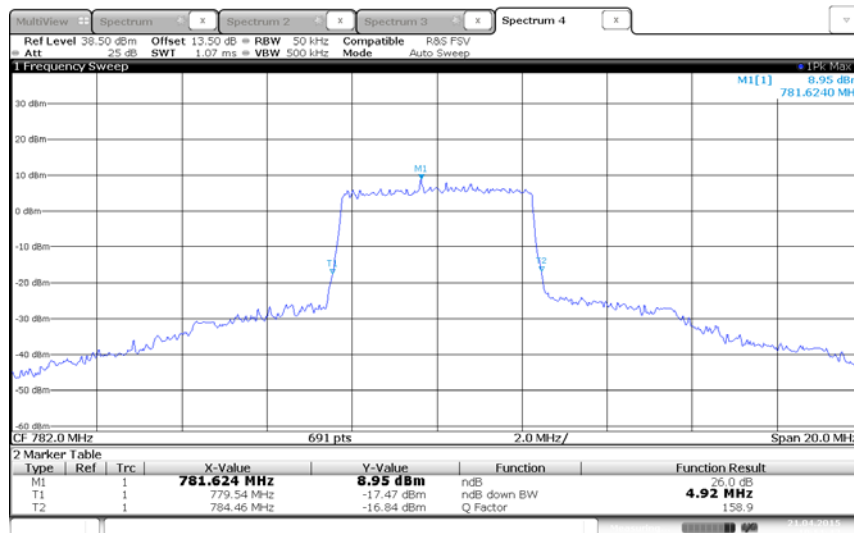


LTE Band 13 (5 MHz BW)/782.0 MHz/16QAM/99%OBW



Date: 21 APR 2015 10:52:27

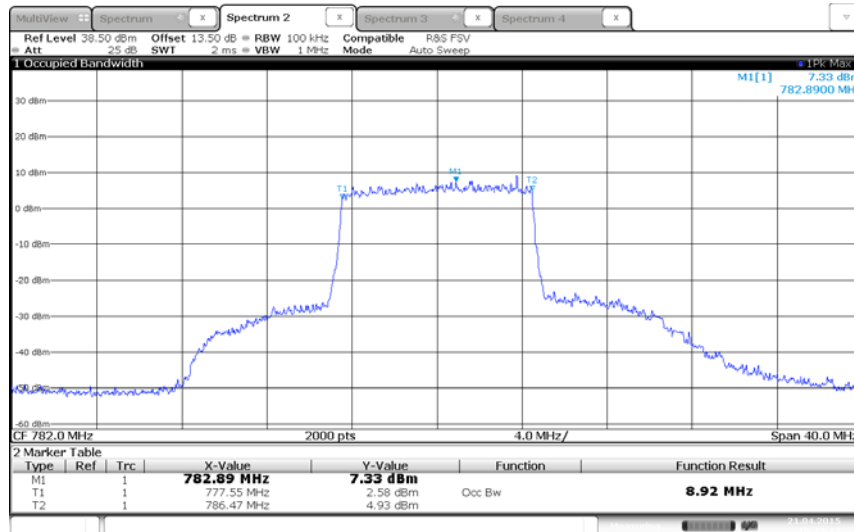
LTE Band 13 (5 MHz BW)/782.0 MHz/16QAM/26dB BW



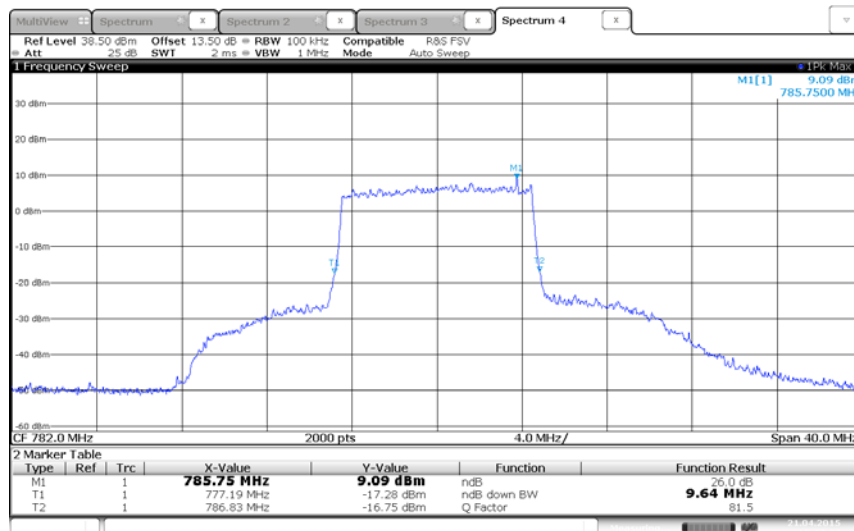
Date: 21 APR 2015 10:51:46



LTE Band 13 (10 MHz BW)/782.0 MHz/16QAM/99%OBW



LTE Band 13 (10 MHz BW)/782.0 MHz/16QAM/26dB BW





2.5 BAND EDGE

2.5.1 Specification Reference

FCC 47 CFR Part 2, Clause 2.1051
FCC 47 CFR Part 27, Clause 27.53(h)(1)
FCC 47 CFR Part 27, Clause 27.53(c)(2)
RSS-139, Clause 6.5
RSS-130, Clause 4.6

2.5.2 Standard Applicable

FCC Part 27:

Clause 27.53 (c)(2) On any frequency outside the 776–788 MHz band, the power of any emission shall be attenuated outside the band below the transmitter power (P) by at least $43 + 10 \log(P)$ dB;

(5) Compliance with the provisions of paragraphs (c)(1) and (c)(2) of this section is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater. However, in the 100 kHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 30 kHz may be employed;

Clause 27.53 (h) AWS emission limits—(1) General protection levels. Except as otherwise specified below, for operations in the 1710-1755 MHz, 2110-2155 MHz, 2000-2020 MHz, 2180-2200 MHz, 1915-1920 MHz, and 1995-2000 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}(P)$ dB.

(3) Measurement procedure. (i) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. 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.

RSS-139:

In the first 1.0 MHz bands immediately outside and adjacent to the equipment's operating frequency block, the emission power per any 1% of the emission bandwidth shall be attenuated below the transmitter output power P (in watts) by at least $43 + 10 \log_{10}(P)$, dB.

RSS-130:

The power of any unwanted emissions in any 100 kHz bandwidth on any frequency outside the frequency range(s) within which the equipment is designed to operate shall be attenuated below the transmitter power, P (dBW), by at least $43 + 10 \log_{10} p$ (watts), dB. However, in the 100 kHz band immediately outside the equipment's operating frequency range, a resolution bandwidth of 30 kHz may be employed.

In addition to the limit outlined in Section 4.6.1 above, equipment operating in the frequency bands 746-756 MHz and 777-787 MHz shall also comply with the following restrictions:

- (i) $76 + 10 \log_{10} p$ (watts), dB, for base and fixed equipment, and
- (ii) $65 + 10 \log_{10} p$ (watts), dB, for mobile and portable equipment.



2.5.3 Equipment Under Test and Modification State

Serial No: SP070315900027 / Test Configuration A

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

April 21, 2015 / XYZ

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

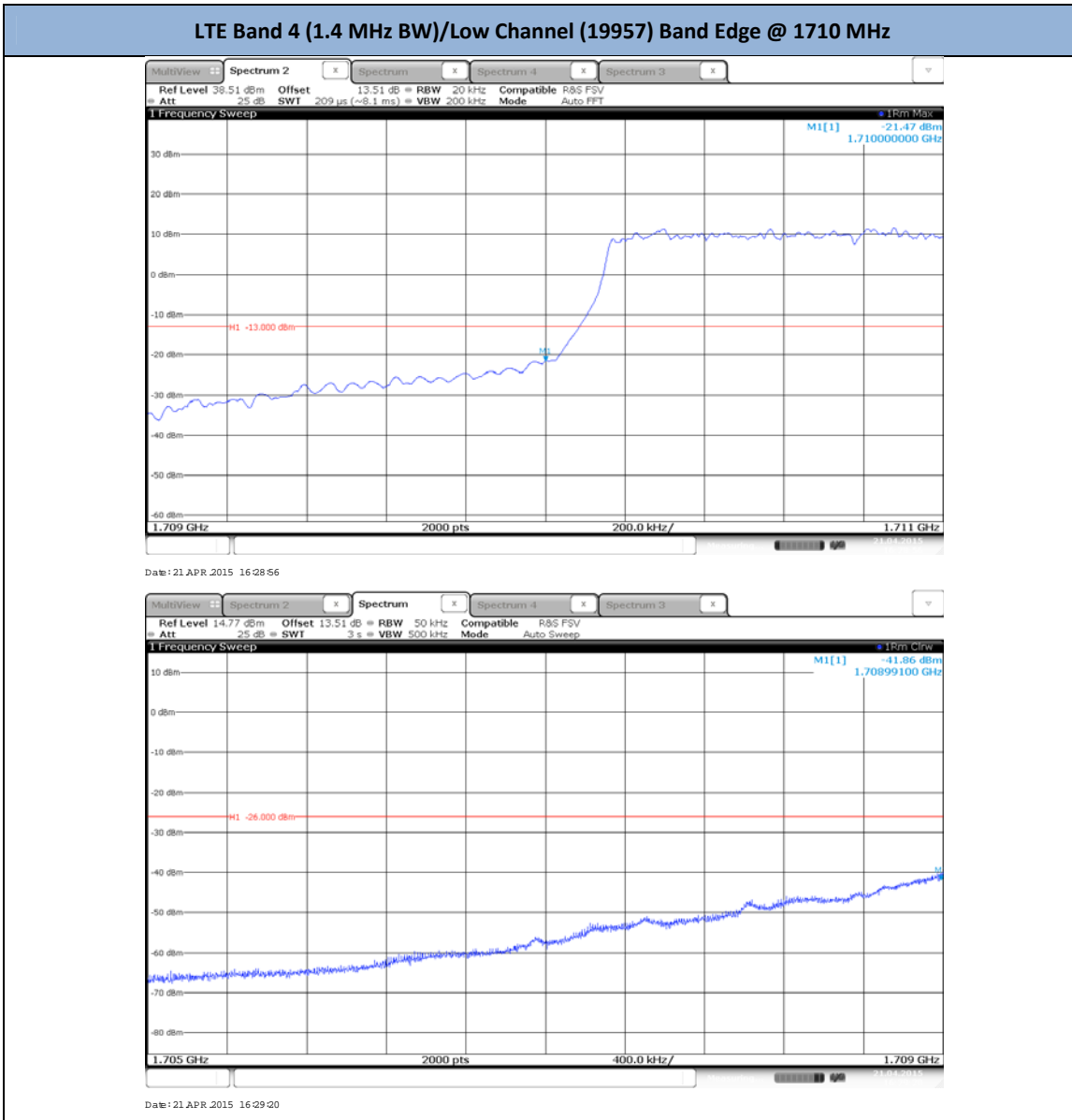
Ambient Temperature	24.7°C
Relative Humidity	38.7%
ATM Pressure	99.5 kPa

2.5.7 Additional Observations

- This is a conducted test.
- The path loss for LTE Band 4 and 13 was measured and entered as a level offset.
- For Band 4, RBW is set to minimum 1% of EBW and VBW is set to >3 x RBW in the 1 MHz band immediately outside and adjacent to the channel edge. RBW should be 1MHz from the channel edges to 5 MHz away, a narrower RBW was used and the Limit line was adjusted accordingly.
- For Band 13, the 100 kHz bands immediately outside and adjacent to the frequency block RBW is set to 30 kHz and VBW is set to >3x RBW.
- Both QPSK and 16QAM were verified, and only QPSK test results presented in this test report.

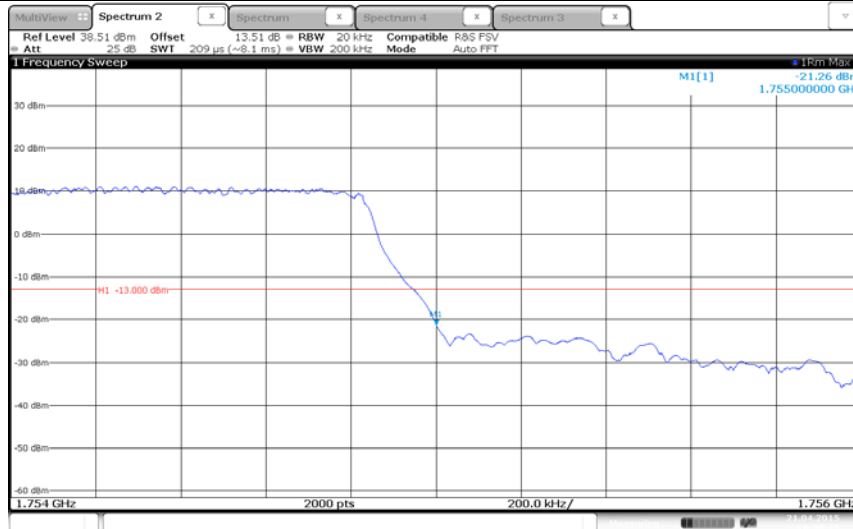


2.5.8 Test Results

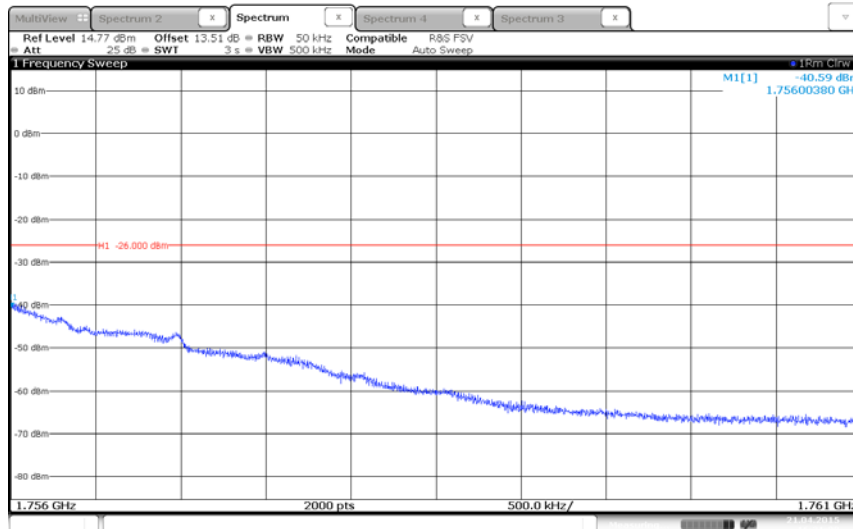




LTE Band 4 (1.4 MHz BW)/High Channel (20393) Band Edge @ 1755 MHz



Date: 21 APR 2015 16:30:25



Date: 21 APR 2015 16:31:09