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Report On

Application for Grant of Equipment Authorization of the
Novatel Wireless Inc.
T1114 Wireless Router with cellular voice and data capabilities

FCC CFR 47 Part 2 and Part 27
IC RSS-Gen and RSS-139

Report No. SC1307899A

August 2013

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REPORT ON Radio Testing of the
Novatel Wireless Inc.
Wireless Router with cellular voice and data capabilities

TEST REPORT NUMBER SC1307899A

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CONTENTS

Section	Page No
1	REPORT SUMMARY5
1.1	Introduction.....6
1.2	Brief Summary Of Results 7
1.3	Product Information8
1.4	EUT Test Configuration 11
1.5	Deviations From The Standard..... 13
1.6	Modification Record 13
1.7	Test Methodology 13
1.8	Test Facility 13
1.9	Sample Calculations..... 14
2	TEST DETAILS.....15
2.1	Transmitter Conducted Power Measurements 16
2.2	Equivalent Isotropic Radiated Power 21
2.3	Effective Radiated Power Output Data 23
2.4	Occupied Bandwidth..... 25
2.5	Peak-Average Power Ratio..... 35
2.6	Band Edge..... 43
2.7	Conducted Spurious Emissions 53
2.8	Field Strength Of Spurious Radiation 65
2.9	Frequency Stability 75
2.10	Receiver Spurious Emissions 78
2.11	Power Line Conducted Emissions 81
3	TEST EQUIPMENT USED85
3.1	Test Equipment Used..... 86
3.2	Measurement Uncertainty 87
4	DIAGRAM OF TEST SETUP88
4.1	Test Setup Diagram 89
5	ACCREDITATION, DISCLAIMERS AND COPYRIGHT94
5.1	Accreditation, Disclaimers and Copyright 95



SECTION 1

REPORT SUMMARY

Radio Testing of the
Novatel Wireless Inc.
Wireless Router with cellular voice and data capabilities



1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Novatel Wireless Inc. T1114 Wireless Router with cellular voice and data capabilities to the requirements of the following:

- FCC CFR 47 Part 2 and Part 27
- IC RSS-Gen and RSS-139.

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)	T1114
FCC ID Number	PKRNVWT1114
IC Number	N/A
Serial Number(s)	SEZ100073700125
Number of Samples Tested	1
Test Specification/Issue/Date	• FCC CFR 47 Part 2 and Part 27 (October 1, 2012). • RSS-139 - Advanced Wireless Services Equipment Operating in the Bands 1710-1755 MHz and 2110-2155 MHz (Issue 2, February 2009). • RSS-Gen - General Requirements and Information for the Certification of Radio Apparatus (Issue 3, December 2010).
Start of Test	August 05, 2013
Finish of Test	August 26, 2013
Name of Engineer(s)	Juan Manuel Gonzalez Alex Chang
Related Document(s)	• ANSI/TIA-603-C-2004 – Land Mobile FM or PM – Communications Equipment – Measurement and Performance Standards. • KDB971168 (D01 Power Meas License Digital Systems v02r01) Measurement Guidance for Certification of Licensed Digital Transmitters • 412172 D01 Determining ERP and EIRP v01 (Guidelines for Determining the Effective Radiated Power (ERP) and Equivalent Isotropically Radiated Power (EIRP) of a RF Transmitting System. • 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 with cross-reference to the corresponding IC RSS standard is shown below.

Section	FCC Part Sections(s)	RSS Section(s)	Test Description	Result
2.1	2.1046		Transmitter Conducted Output Power	Compliant
2.2	2.1046 and 27.50 (d)(4)	RSS-139(6.4)	Equivalent Isotropic Radiated Power	Compliant
2.3	2.1046, 27.50 (b) (10) and (12)		Effective Radiated Power	Compliant
2.4	2.1049 and 27.53(h)(1)	RSS-Gen (4.6.1)	Occupied Bandwidth	Compliant
2.5	27.50(d)(5)	RSS-139(6.4)	Peak-Average Ratio	Compliant
2.6	27.53(c)(2)(5) and (h)	RSS-139(6.5)	Band Edge	Compliant
2.7	27.53(c)(2)(5),(f) and (h)	RSS-139(6.5)	Conducted Spurious Emissions	Compliant
2.8	2.1053, 27.53(c) and (h)	RSS-139(6.5)	Field Strength Of Spurious Radiation	Compliant
2.9	2.1055(a)(1) 2.1055(d)(1) and 27.54	RSS-139(6.3)	Frequency Stability	Compliant
2.10		RSS-139(6.6)	Receiver Spurious Emissions	Compliant
2.11		RSS-Gen 7.2.4	Powerline Conducted Emissions	Compliant



1.3 PRODUCT INFORMATION

1.3.1 EUT General Description

The Equipment Under Test (EUT) was a Novatel Wireless Inc. T1114 Wireless Router with cellular voice and data capabilities. The EUT is a wireless device that delivers Internet connectivity and telephone service, it uses LTE Bands 4 and 13 / CDMA BC0 & BC1. The EUT can make a phone call, connect up to 10 devices via Wi-Fi (b/g/n 2.4GHz and a/n 5 GHz UNII-1 and UNII-3) and connect up to 3 devices via Ethernet, simultaneously.

The EUT poses 2 optional antenna ports accessible to customers to improve the coverage range with Custom design antenna "Sold separately". (See Exhibit PKRNVWT1114_Theory of Operation page 24 - 28)



1.3.2 EUT General Description

EUT Description	Wireless Router with cellular voice and data capabilities
Model Number(s)	T1114
Rated Voltage	Ac DC Converter: 100-240VAC 50/60Hz to 5.0 VDC /3.5A Nominal voltage.
Mode Verified	4G-LTE
Capability	Band 4 (1.4, 5.0,3.0, 10, 15 and 20MHz BW) and 13 (5 and 10MHz BW) LTE
Primary Unit (EUT)	☐ Production ☐ Pre-Production ☒ Engineering

Internal Antennas Details
(Client declaration, max. antenna
gain covered under this test report)

WWAN Antenna –CDMA

Manufacturer: Pulse
Part Number: DA-01019774
Type: PIFA
Antenna Gain:

- CDMA BC0 - 850MHz : -0.59 dBi
- CDMA BC1 - 1880MHz : -0.82 dBi

WWAN Antenna – LTE Band 13/4

Manufacturer: Pulse
Part Number: DA-01019775
Type: PIFA
Antenna Gain:

- LTE B13 - 700MHz : 1.21 dBi
- LTE Band 4 – 1700MHz: 2.44 dBi

WLAN – Antenna: 802.11 a/b/g/n

Manufacturer: Murata
Part Number: 12023199
Type: CERAMIC CHIP
Antenna Gain:

- 802. 11 b/g/n 2.4MHz : 2.99 dBi
- 802.11 a/n 5GHz: 3.02 dBi

1.3.3 Transmit Frequency Table

LTE Band 4				
Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	Max.Conducted Power (W)	Max.EIRP Power (W)
1.4	1710-1755	1M10G7D	0.259	0.4549
1.4	1710-1755	1M09W7D	0.1999	0.35075
3.0	1710-1755	2M73G7D	0.2506	0.4395
3.0	1710-1755	2M72W7D	0.2051	0.35974
5.0	1710-1755	4M48G7D	0.2992	0.5248
5.0	1710-1755	4M50W7D	0.2322	0.40738
10.0	1710-1755	8M93G7D	0.2582	0.45289
10.0	1710-1755	8M95W7D	0.20183	0.35399
15.0	1710-1755	13M4G7D	0.2437	0.42756
15.0	1710-1755	13M4W7D	0.19275	0.33806
20.0	1710-1755	17M9G7D	0.2296	0.40271
20.0	1710-1755	17M9W7D	0.18197	0.31915
LTE Band 13				
Bandwidth (MHz)	Tx Frequency (MHz)	Emission Designator	Max.Conducted Power (W)	Max.ERP Power (W)
5.0	777-787	4M50G7D	0.2454	0.19769
5.0	777-787	4M53W7D	0.19054	0.15346
10.0	777-787	9M08G7D	0.2301	0.18535
10.0	777-787	9M07W7D	0.18967	0.15275



1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Conducted antenna port measurement. EUT TX a Max power and connected to supplied AC-DC adapter.
B	Radiated test setup. EUT connected wirelessly with the wideband radio communication tester (CMW500, TX a Max power and connected to supplied AC-DC adapter.
C	RX Mode. EUT in Idle mode connected to supplied AC-DC adapter.

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
Dell	Support Laptop	Novatel Wireless Test Configuration Support Laptop
LUXSHARE-ICT	USB cable	Shielded Type A to Micro USB (0.912 meter) USB Revision 2.

1.4.4 Worst Case Configuration

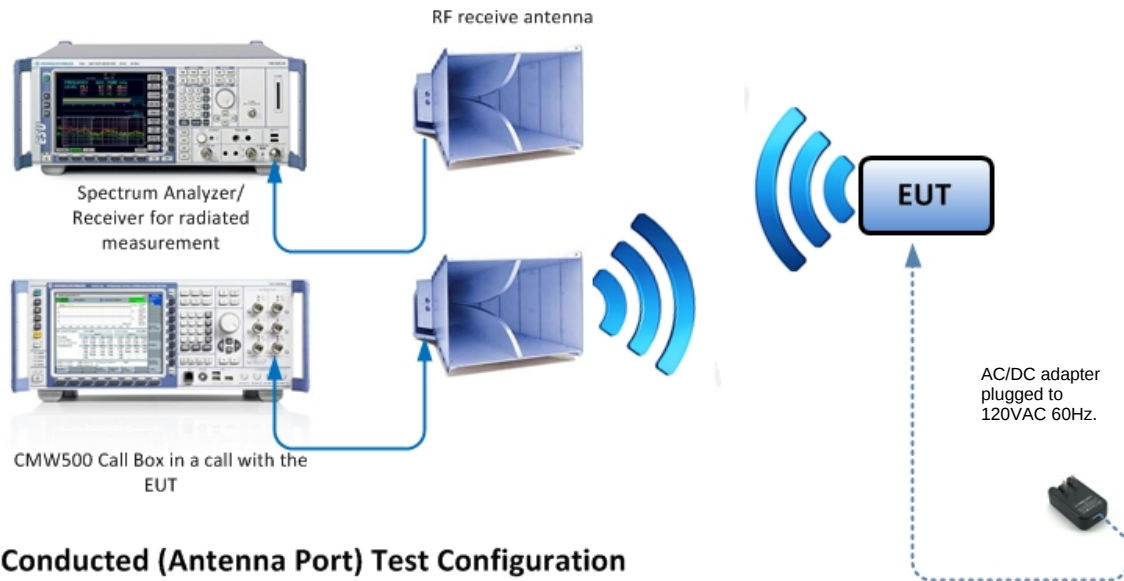
Worst-case configuration used in this test report as per output power measurements:

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

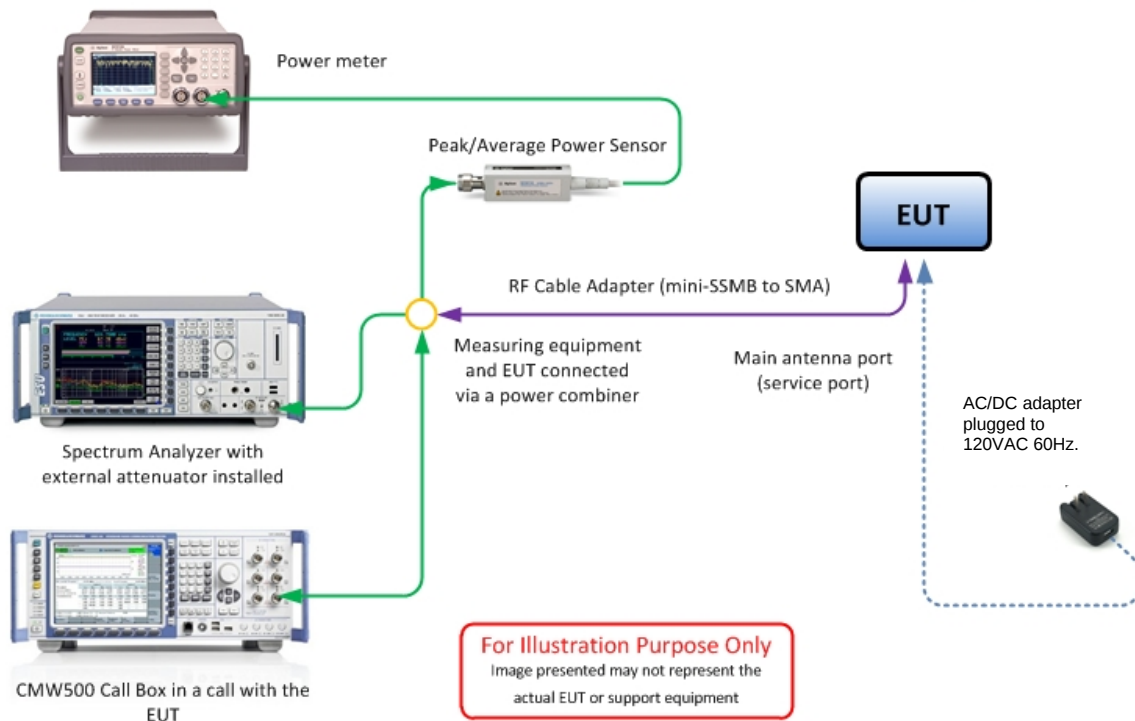
EUT is designed for indoor use an table top operation, for radiated spurious measurements only default configuration was evaluated (See Test Set up pictures Exhibit)

1.4.5 Simplified Test Configuration Diagram

Radiated Test Configuration/Conducted Emissions Test Configuration



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 SEZ100073700125		
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

1.8.1 FCC – Registration No.: US5296

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 US5296.

1.8.2 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.



1.9 SAMPLE CALCULATIONS

1.9.1 LTE Emission Designator (QPSK)

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

1.9.2 LTE Emission Designator (16QAM)

Emission Designator = 4M50W7D
 W = Frequency Modulation
 7= Quantized/Digital Info
 D = Combination (Audio/Data)

1.9.3 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

1.9.4 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:

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



SECTION 2

TEST DETAILS

Radio Testing of the
Novatel Wireless Inc.
Wireless Router with cellular voice and data capabilities



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: SEZ100073700125 / Test Configuration A

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

August 13 & 19, 2013/JMG / AC

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

Ambient Temperature	23.8°C
Relative Humidity	49.5%
ATM Pressure	99.9 kPa

2.1.7 Additional Observations

- This is a conducted test using a peak/average power meter.
- A 27.8dB power meter offset was used for the power splitter, external attenuator and cable used.
- Only representative worst case RB size and RB offset presented. Verification done using both RMC and User Defined Channels options for scheduling (CMW500).

2.1.8 Test Results

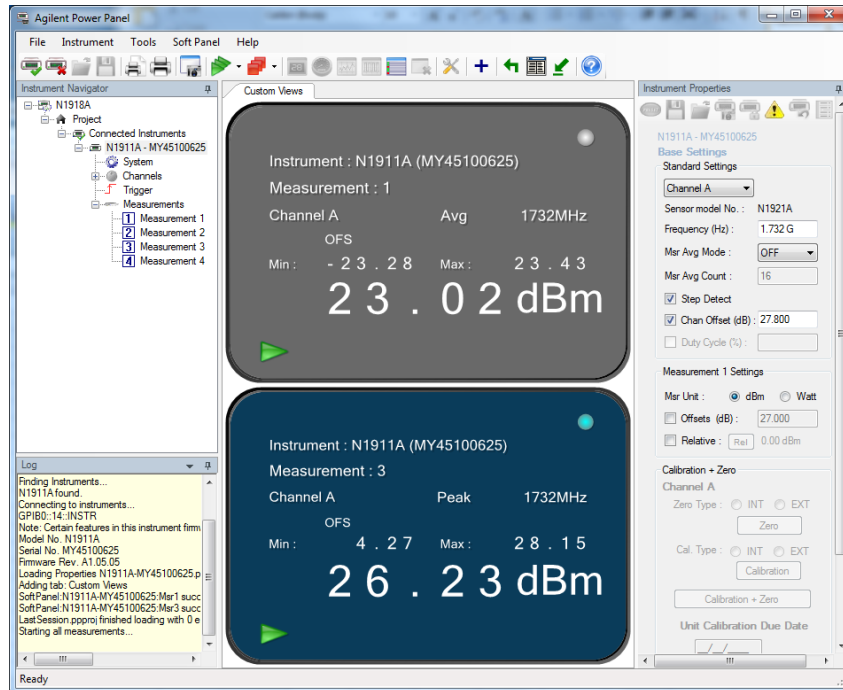
See attached table.

LTE B4						
BW	RB Size	RB Offset	Channels	Frequency	QPSK (dBm)	16QAM (dBm)
1.4MHz	1	0	19957	1710.7	24.14	23.01
	1	3			24.10	22.95
	1	5			24.04	22.96
	6	0			23.21	22.16
	1	0	20175	1732.5	23.93	22.72
	1	3			23.87	22.63
	1	5			23.87	22.63
	6	0			22.96	21.93
	1	0	20393	1754.3	24.11	22.94
	1	3			24.07	22.93
	1	5			24.08	22.92
	6	0			23.16	22.16
3MHz	1	0	19965	1711.5	23.98	23.12
	1	8			23.90	23.19
	1	14			23.75	22.97
	15	0			22.87	21.92
	1	0	20175	1732.5	23.77	22.57
	1	8			23.73	22.44
	1	14			23.73	22.50
	15	0			22.72	21.94
	1	0	20385	1753.5	23.88	22.71
	1	8			23.99	22.78
	1	14			23.90	22.74
	15	0			22.93	21.99
5MHz	1	0	19975	1712.5	24.03	22.84
	1	13			23.94	22.74
	1	24			23.90	22.74
	25	0			22.86	21.89
	1	0	20175	1732.5	23.86	22.78
	1	13			23.81	22.75
	1	24			23.84	22.80
	25	0			22.73	21.83
	1	0	20375	1752.5	24.69	23.61
	1	13			24.76	23.66
	1	24			24.74	23.67
	25	0			23.57	22.62

10MHz	1	0	20000	1715	24.12	22.86
	1	25			23.99	22.72
	1	49			23.94	22.68
	50	0			22.65	21.69
	1	0	20175	1732.5	23.76	22.49
	1	25			23.76	22.48
	1	49			23.79	22.55
	50	0			22.58	21.60
	1	0	20350	1750	23.76	22.91
	1	25			23.91	23.05
	1	49			23.91	23.10
	50	0			22.64	21.61
15MHz	1	0	20025	1717.5	23.82	22.85
	1	38			23.75	22.67
	1	74			23.68	22.69
	75	0			22.41	21.40
	1	0	20175	1732.5	23.66	22.77
	1	38			23.56	22.75
	1	74			23.67	22.77
	75	0			23.51	21.32
	1	0	20325	1747.5	23.72	22.34
	1	38			23.78	22.46
	1	74			23.87	22.64
	75	0			22.39	21.44
20MHz	1	0	20050	1720	23.56	22.59
	1	50			23.50	22.56
	1	99			23.45	22.42
	100	0			22.25	21.20
	1	0	20175	1732.5	23.35	22.40
	1	50			23.45	22.42
	1	99			23.49	22.40
	100	0			22.25	21.22
	1	0	20300	1745	23.54	22.55
	1	50			23.40	22.41
	1	99			23.61	22.60
	100	0			22.25	21.20

LTE B13						
BW	RB Size	RB Offset	Channels	Frequency	QPSK (dBm)	16QAM (dBm)
5MHz	1	0	23205	779.5	23.78	22.70
	1	13			23.67	22.61
	1	24			23.68	22.64
	25	0			22.46	21.50
	1	0	23230	23230	23.51	22.32
	1	13			23.60	22.35
	1	24			23.79	22.53
	25	0			22.50	21.42
	1	0	23255	784.5	23.62	22.49
	1	13			23.90	22.80
	1	24			23.77	22.64
	25	0			22.69	21.69
10MHz	1	0	23230	782	23.47	22.68
	1	25			23.53	22.67
	1	49			23.62	22.78
	50	0			22.13	21.16

2.1.9 Sample Test Measurement Screen





2.2 EQUIVALENT ISOTROPIC RADIATED POWER

2.2.1 Specification Reference

Part 27 Subpart C §27.50 (d) (4), Part 2.1046, RSS-139 Issue 2 (6.4)

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: SEZ100073700125, Test Configuration (N/A, calculation only)

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

August 20, 2013/JMG

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

See attached table.



LTE B4												
BW	RB Size	RB Offset	Channels	Frequency	Power QPSK (dBm)	Power 16QAM (dBm)	Antenna Gain (dBi)	EIRP QPSK (dBm)	EIRP 16 QAM (dBm)	Limit (dBm)	QPSK Margin (dBm)	16 QAM Margin (dBm)
1.4MHz	1	0	19957	1710.7	24.14	23.01	2.44	26.58	25.45	30.00	3.42	4.55
	1	0	20175	1732.5	23.93	22.72	2.44	26.37	25.16	30.00	3.63	4.84
	1	0	20393	1754.3	24.11	22.94	2.44	26.55	25.38	30.00	3.45	4.62
3MHz	1	0	19965	1711.5	23.98	23.12	2.44	26.42	25.56	30.00	3.58	4.44
	1	0	20175	1732.5	23.77	22.57	2.44	26.21	25.01	30.00	3.79	4.99
	1	8	20385	1753.5	23.99	22.78	2.44	26.43	25.22	30.00	3.57	4.78
5MHz	1	0	19975	1712.5	24.03	22.84	2.44	26.47	25.28	30.00	3.53	4.72
	1	0	20175	1732.5	23.86	22.78	2.44	26.30	25.22	30.00	3.70	4.78
	1	13	20375	1752.5	24.76	23.66	2.44	27.20	26.10	30.00	2.80	3.90
10MHz	1	0	20000	1715	24.12	22.86	2.44	26.56	25.30	30.00	3.44	4.70
	1	49	20175	1732.5	23.79	22.55	2.44	26.23	24.99	30.00	3.77	5.01
	1	25	20350	1750	23.91	23.05	2.44	26.35	25.49	30.00	3.65	4.51
15MHz	1	0	20025	1717.5	23.82	22.85	2.44	26.26	25.29	30.00	3.74	4.71
	1	74	20175	1732.5	23.67	22.77	2.44	26.11	25.21	30.00	3.89	4.79
	1	74	20325	1747.5	23.87	22.64	2.44	26.31	25.08	30.00	3.69	4.92
20MHz	1	0	20050	1720	23.56	22.59	2.44	26.00	25.03	30.00	4.00	4.97
	1	99	20175	1732.5	23.49	22.40	2.44	25.93	24.84	30.00	4.07	5.16
	1	99	20300	1745	23.61	22.60	2.44	26.05	25.04	30.00	3.95	4.96



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 746–763 MHz, 775–793 MHz and 805–806 MHz bands:

(10) Portable stations (hand-held devices) transmitting in the 746–757 MHz, 758–763 MHz, 776–793 MHz, and 805–806 MHz bands are limited to 3 watts ERP.

(12) For transmissions in the 746–757, 758–763, 776–787, and 788–793 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: SEZ100073700125, Test Configuration (N/A, calculation only)

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

August 21, 2013/JMG

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:

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

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.



LTE B13												
BW	RB Size	RB Offset	Channels	Frequency	Power QPSK (dBm)	Power 16QAM (dBm)	Antenna Gain-2.15 (1.21-2.15=-0.94) (dBi)	EIRP QPSK (dBm)	EIRP 16 QAM (dBm)	Limit (dBm)	QPSK Margin (dBm)	16 QAM Margin (dBm)
5MHz	1	0	23205	779.5	23.78	22.70	-0.94	22.84	21.76	34.77	11.93	13.01
	1	24	23230	23230	23.79	22.53	-0.94	22.85	21.59	34.77	11.92	13.18
	1	13	23255	784.5	23.90	22.80	-0.94	22.96	21.86	34.77	11.81	12.91
10MHz	1	49	23230	782	23.62	22.78	-0.94	22.68	21.84	34.77	12.09	12.93



2.4 OCCUPIED BANDWIDTH

2.4.1 Specification Reference

Part 27 Subpart C §27.53(h)(1), 2.1049, RSS-GEN Issue 3 (4.6.1)

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: SEZ100073700125 / Test Configuration A

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

August 22,26 2013/JMG

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

Ambient Temperature	24.9°C
Relative Humidity	49.2%
ATM Pressure	98.6 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 v02r01).
- Both relative OBW (-26dB BW) and 99% OBW presented.
- All channels per each channel bandwidth/band were verified. No significant difference observed. Only the worst channel presented.

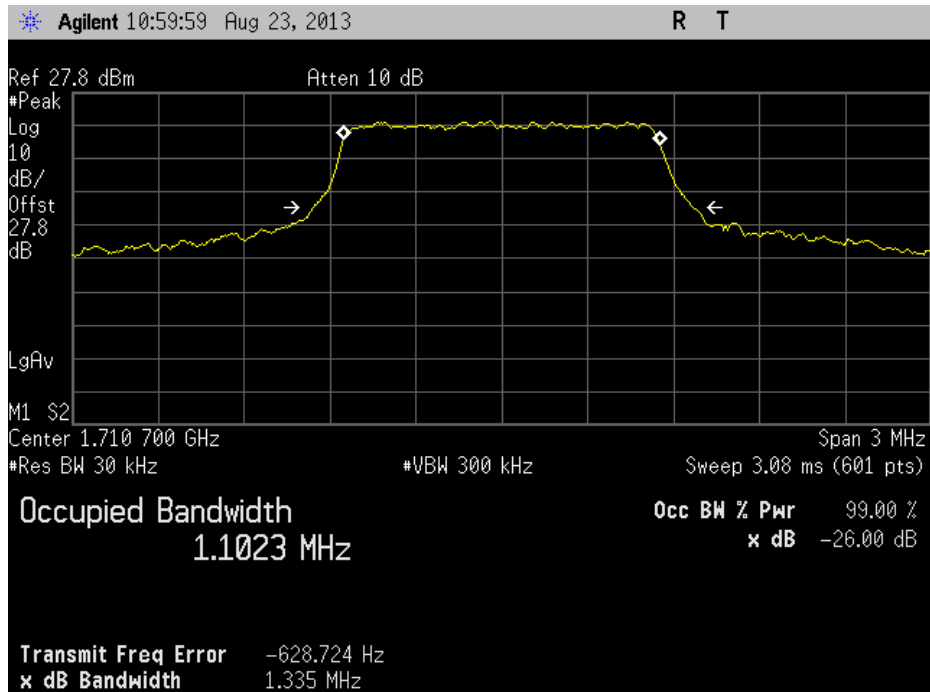
2.4.8 Test Results

See attached table and plots.

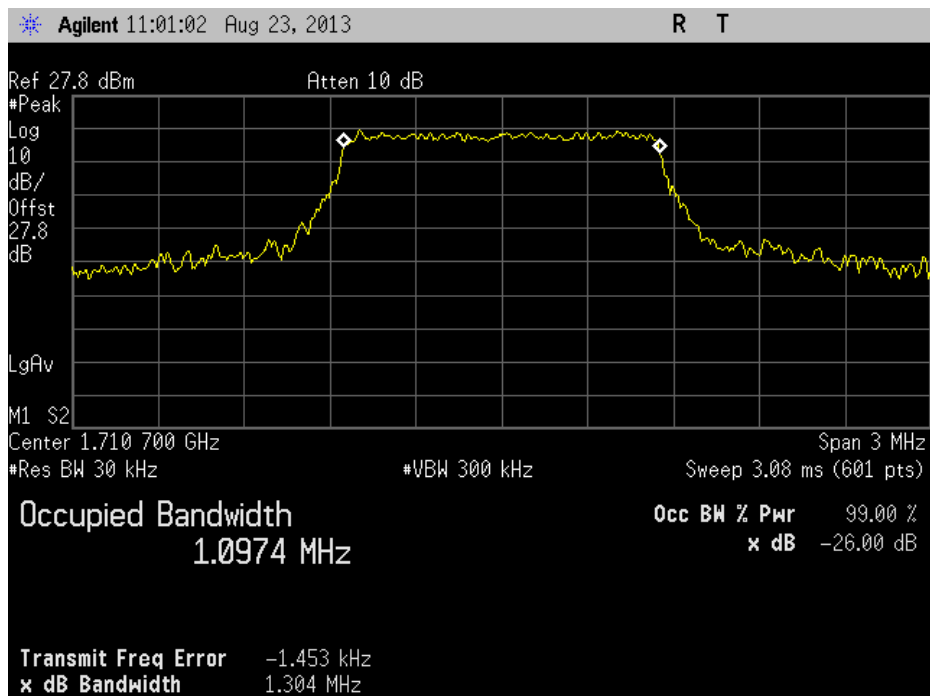
LTE B4							
BW	RB Size	RB Offset	Channels	Frequency	Modulation	99% OBW (dBm)	-26dB BW (dBm)
1.4MHz	6	0	19957	1710.7	QPSK	1.10	1.33
	6	0	19957	1710.7	16QAM	1.09	1.30
3MHz	15	0	20385	1753.5	QPSK	2.73	3.09
	15	0	20385	1753.5	16QAM	2.72	3.039
5MHz	25	0	20375	1752.5	QPSK	4.48	4.96
	25	0	20375	1752.5	16QAM	4.5	5.01
10MHz	50	0	20000	1715	QPSK	8.93	9.65
	50	0	20000	1715	16QAM	8.95	9.72
15MHz	75	0	20325	1747.5	QPSK	13.38	14.17
	75	0	20325	1747.5	16QAM	13.37	14.304
20MHz	100	0	20300	1745	QPSK	17.87	19.44
	100	0	20300	1745	16QAM	17.85	19.06

LTE B13							
BW	RB Size	RB Offset	Channels	Frequency	Modulation	99% OBW (dBm)	-26dB BW (dBm)
5MHz	25	0	23255	784.5	QPSK	4.50	5.03
	25	0	23255	784.5	16QAM	4.53	4.99
10MHz	1	49	23230	782	QPSK	9.08	10.02
	1	49	23230	782	16QAM	9.07	9.95

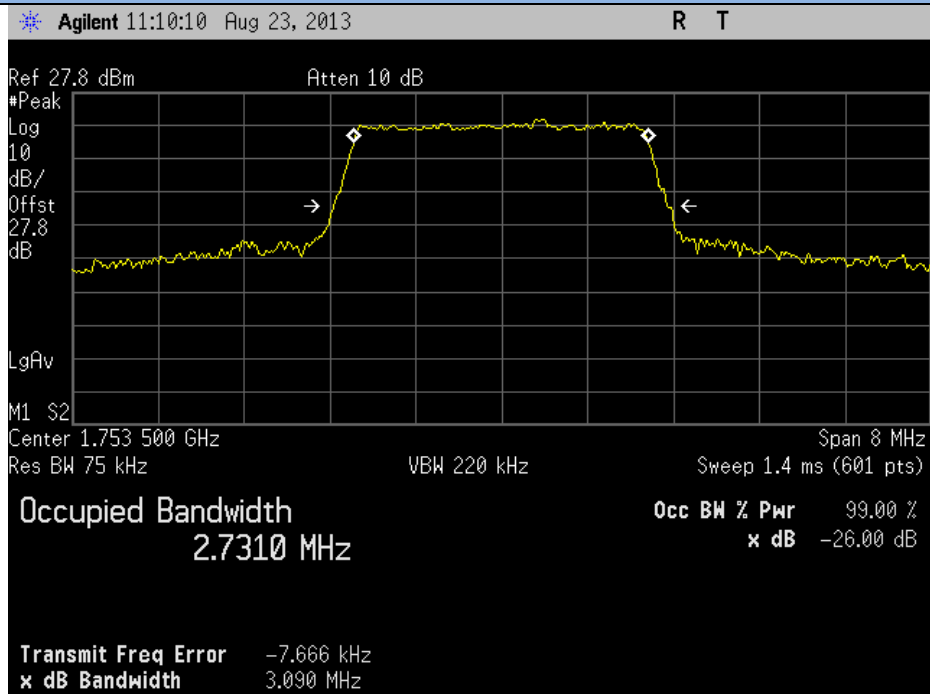
LTE Band 4 1710.7MHz (1.4 MHz BW) QPSK



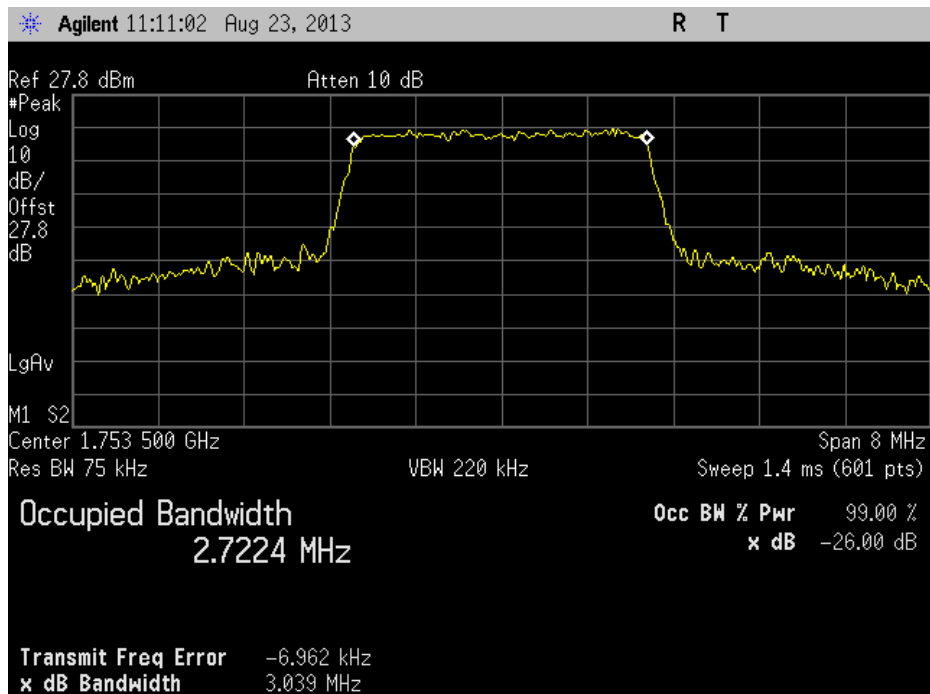
LTE Band 4 1710.7MHz (1.4 MHz BW) 16QAM



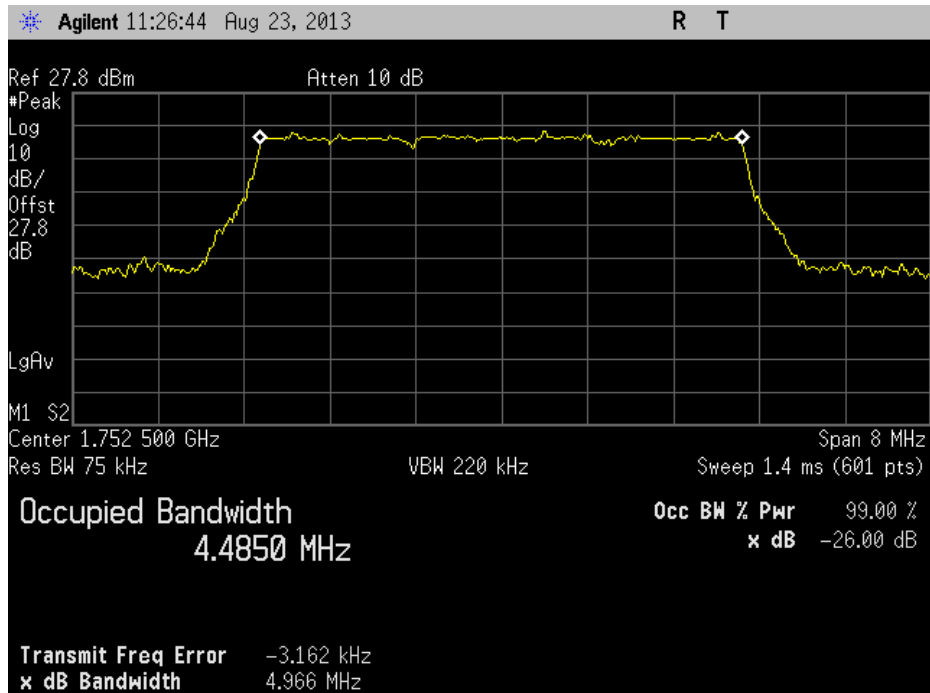
LTE Band 4 1753.5MHz (3.0 MHz BW) QPSK



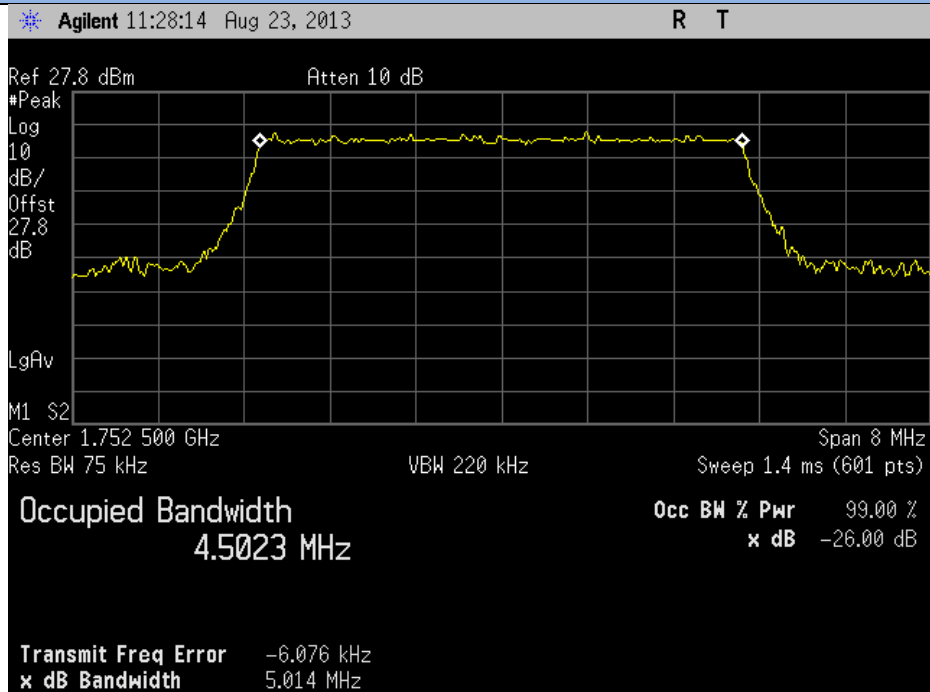
LTE Band 4 1753.5MHz MHz (3.0 MHz BW) 16QAM



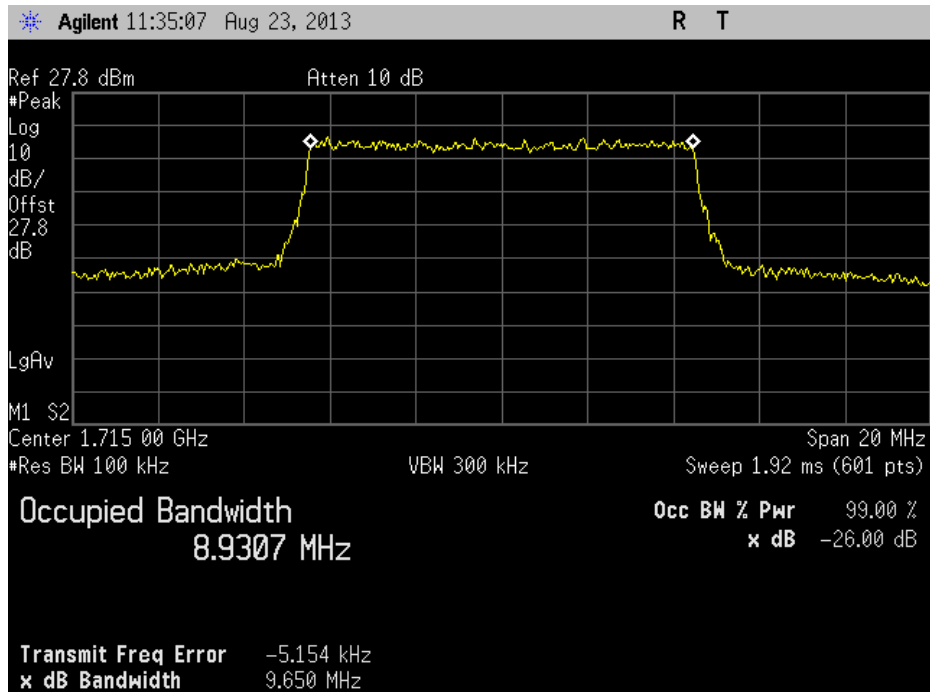
LTE Band 4 1752.5MHz (5.0 MHz BW) QPSK



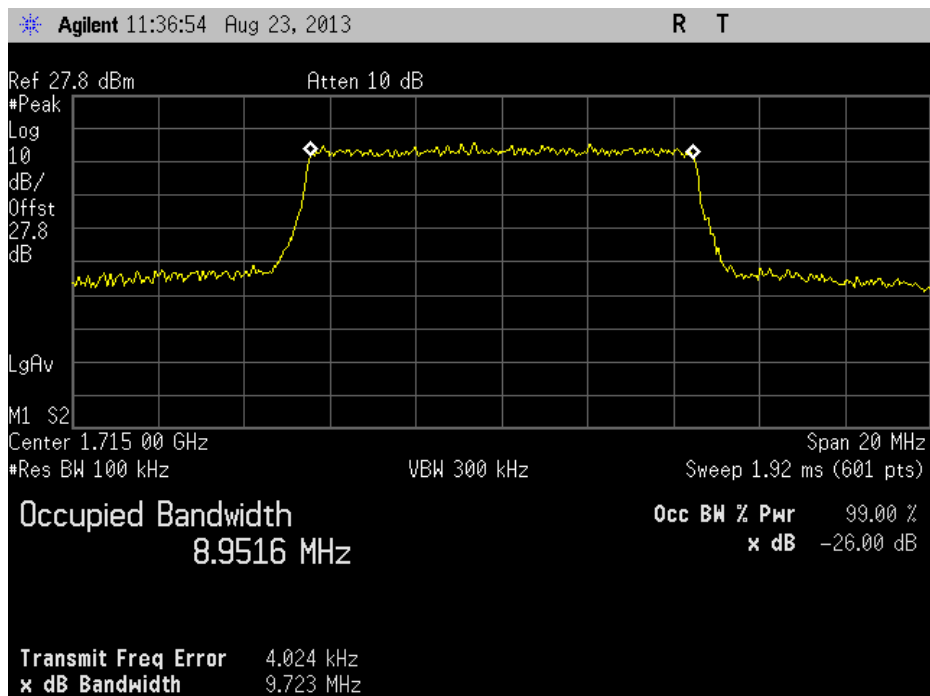
LTE Band 4 1752.5MHz (5.0 MHz BW) 16QAM



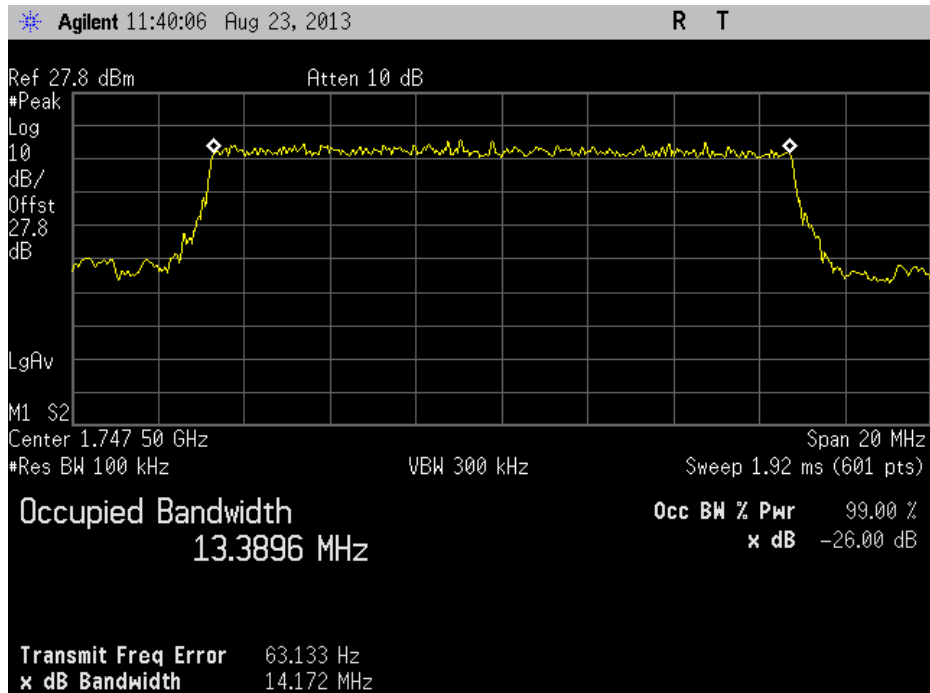
LTE Band 4 1715.0MHz (10.0 MHz BW) QPSK



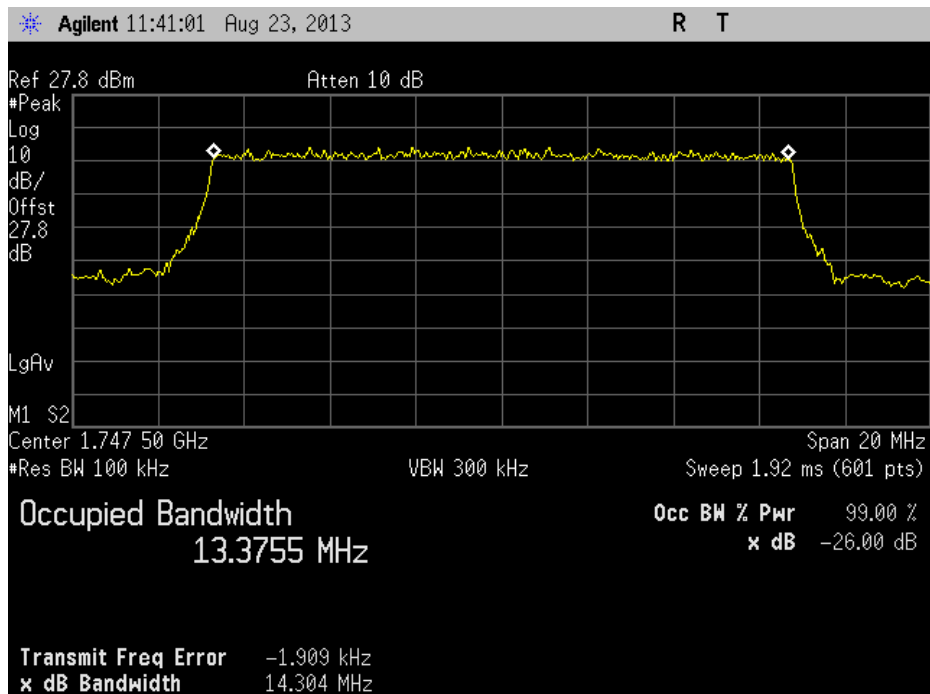
LTE Band 4 1715.0MHz (10.0 MHz BW) 16QAM



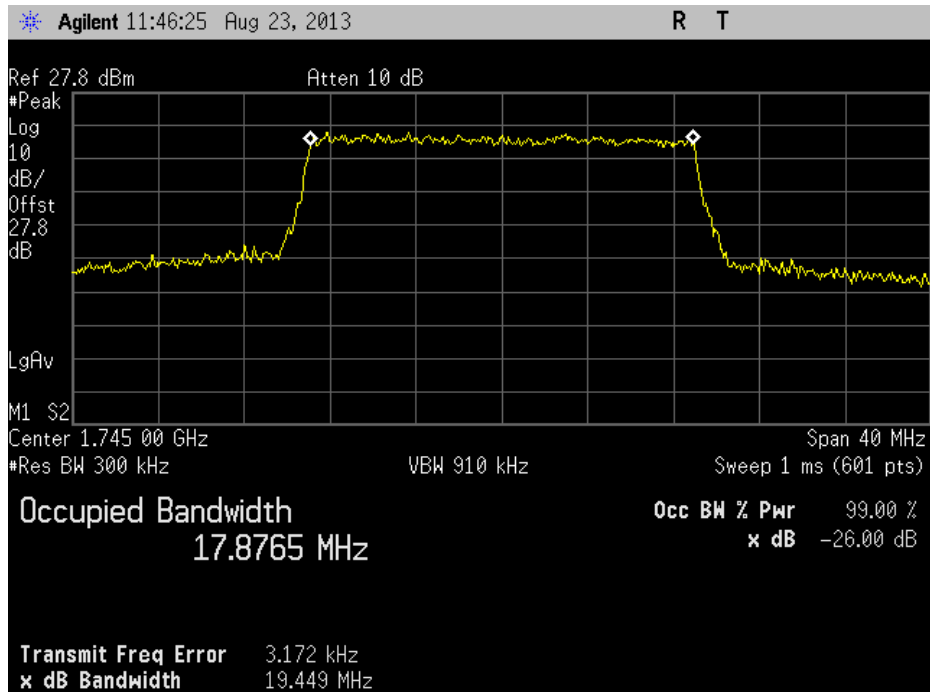
LTE Band 4 1747.5MHz (15.0 MHz BW) QPSK



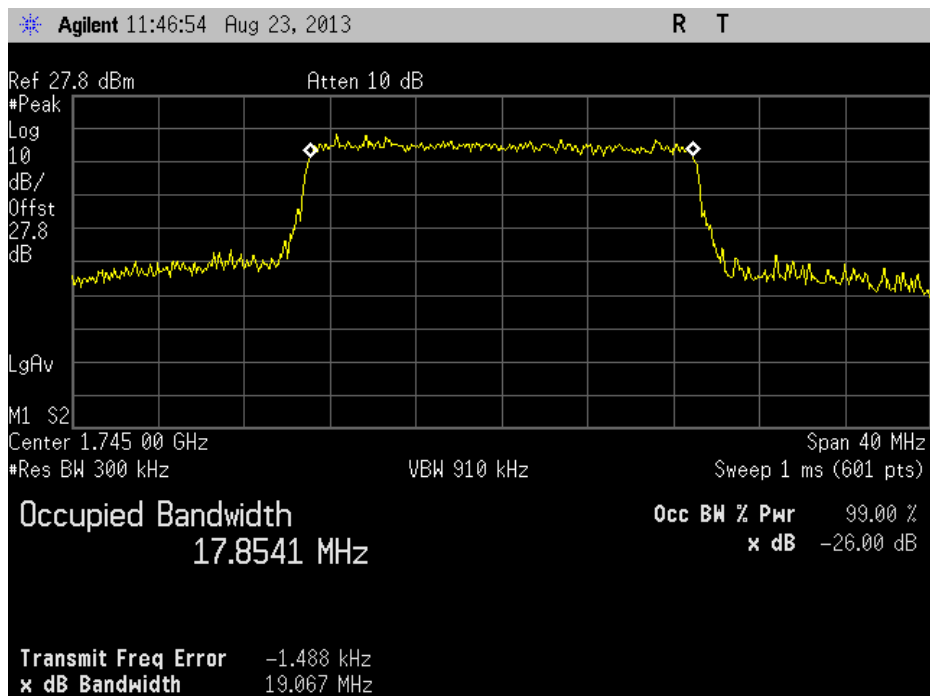
LTE Band 4 1747.5MHz (15.0 MHz BW) 16QAM



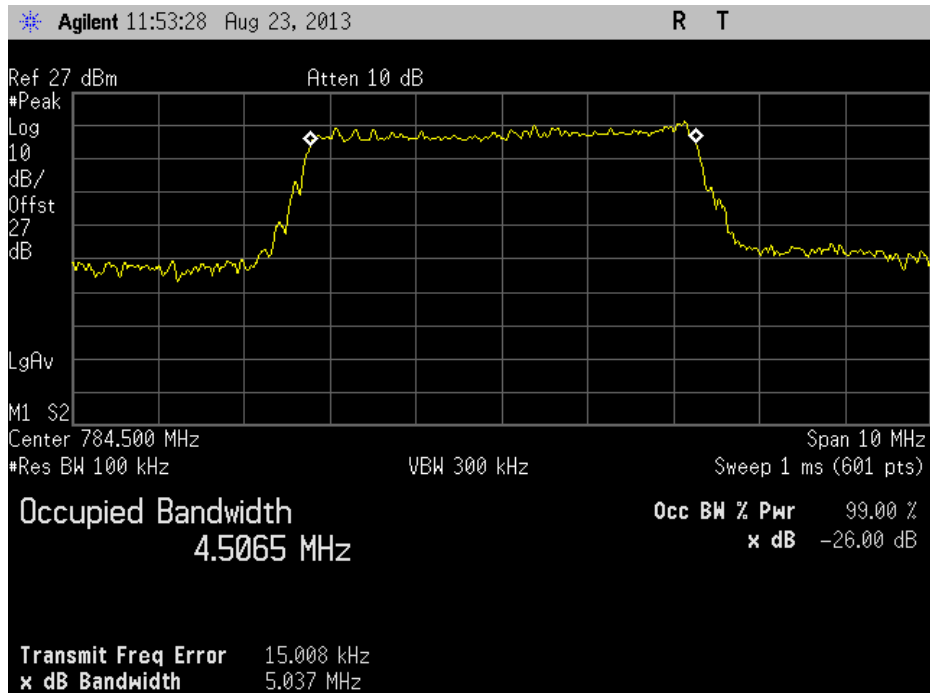
LTE Band 4 1745.0MHz (20.0 MHz BW) QPSK



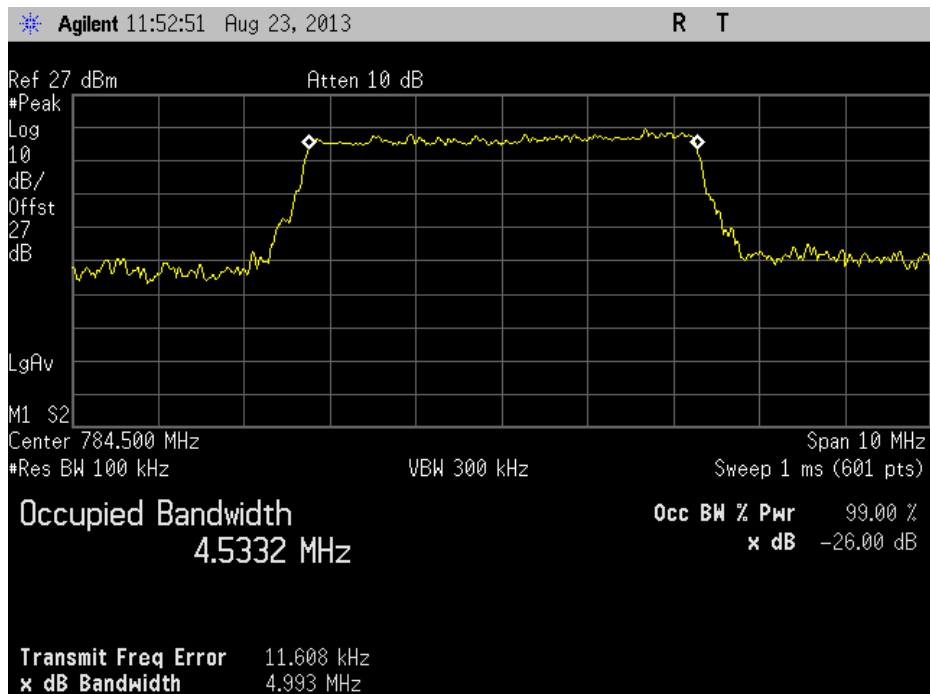
LTE Band 4 1745.0MHz (20.0 MHz BW) 16QAM



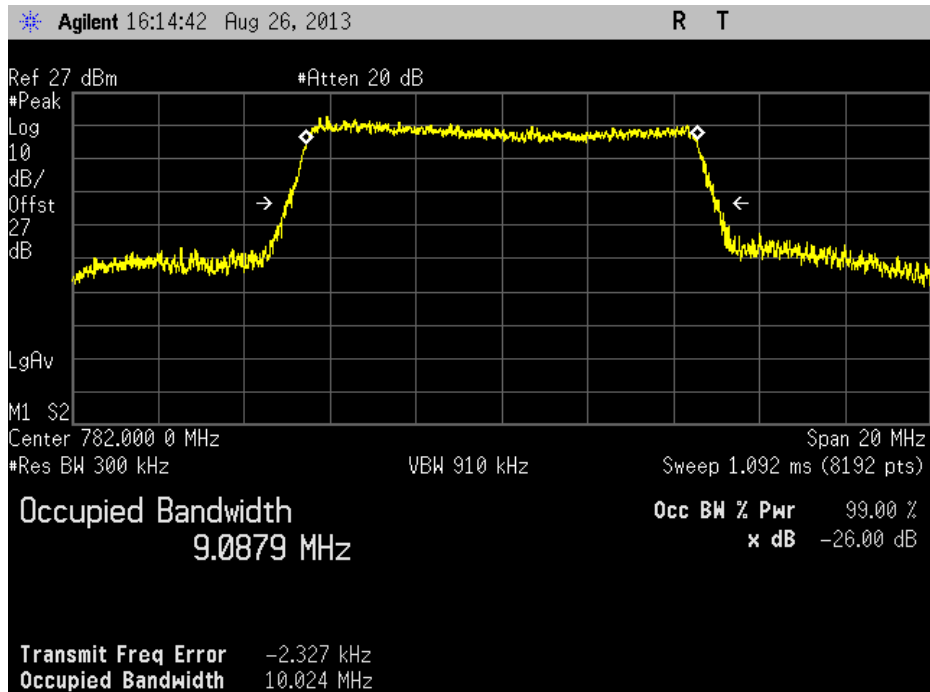
LTE Band 13 784.5MHz (5.0 MHz BW) QPSK



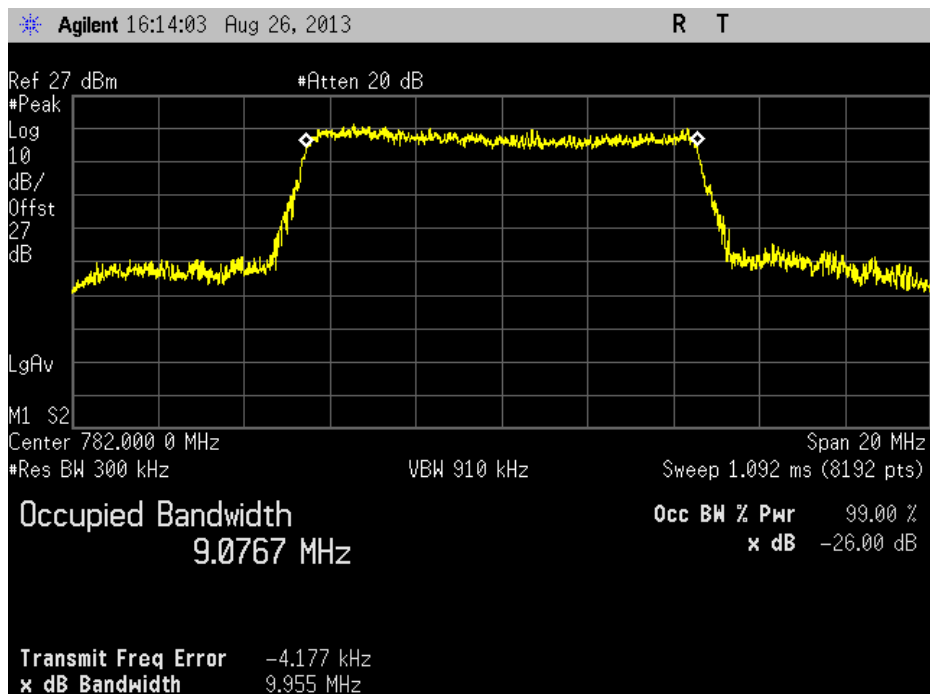
LTE Band 13 784.5MHz (5.0 MHz BW) 16QAM



LTE Band 13 782.0MHz (10.0 MHz BW) QPSK



LTE Band 13 782.0MHz (10.0 MHz BW) 16QAM





2.5 PEAK-AVERAGE POWER RATIO

2.5.1 Specification Reference

Part 27 Subpart C §27.50(d)(5), RSS-139 Issue 2 (6.4)

2.5.2 Standard Applicable

(d) The following power and antenna height requirements apply to stations transmitting in the 1710–1755 MHz and 2110–2155 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: SEZ100073700125 / Test Configuration B

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

August 23, 2013/FSC

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

Ambient Temperature	25.1°C
Relative Humidity	49.5%
ATM Pressure	100.1 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 v02r01).
- 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.



- All channels based from worst case configuration channel bandwidth were verified. Only the worst channel presented.
- For 10,15 and 20MHz BW measurements, PAR were also verified using power measurements (power meter method) under Section 2.1 of this test report using the formula:

$$\text{PAPR (dB)} = P_{\text{Pk}} \text{ (dBm)} - P_{\text{Avg}} \text{ (dBm)}$$

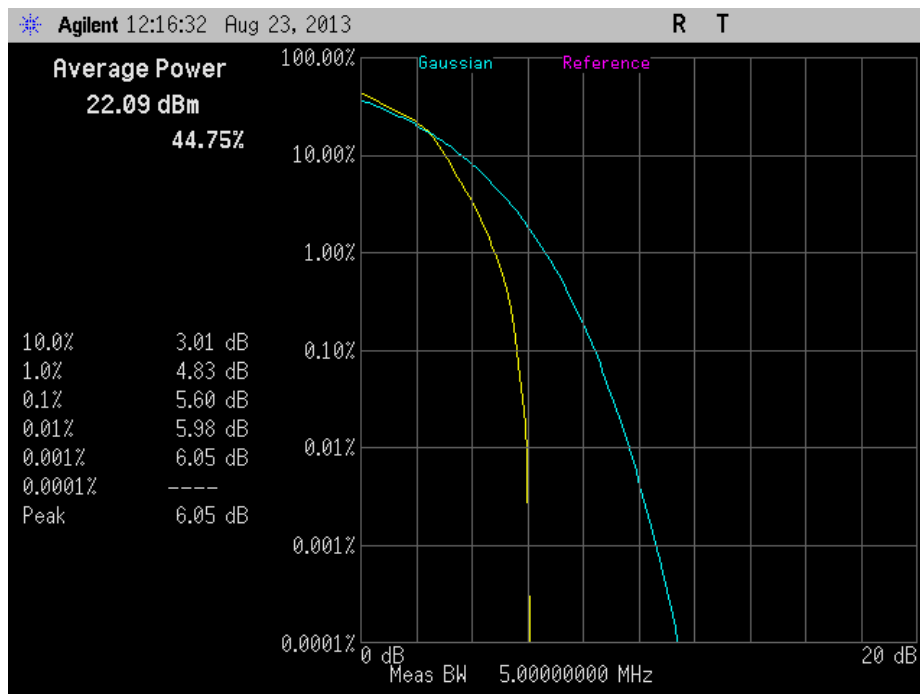
2.5.8 Test Results

See attached plots.

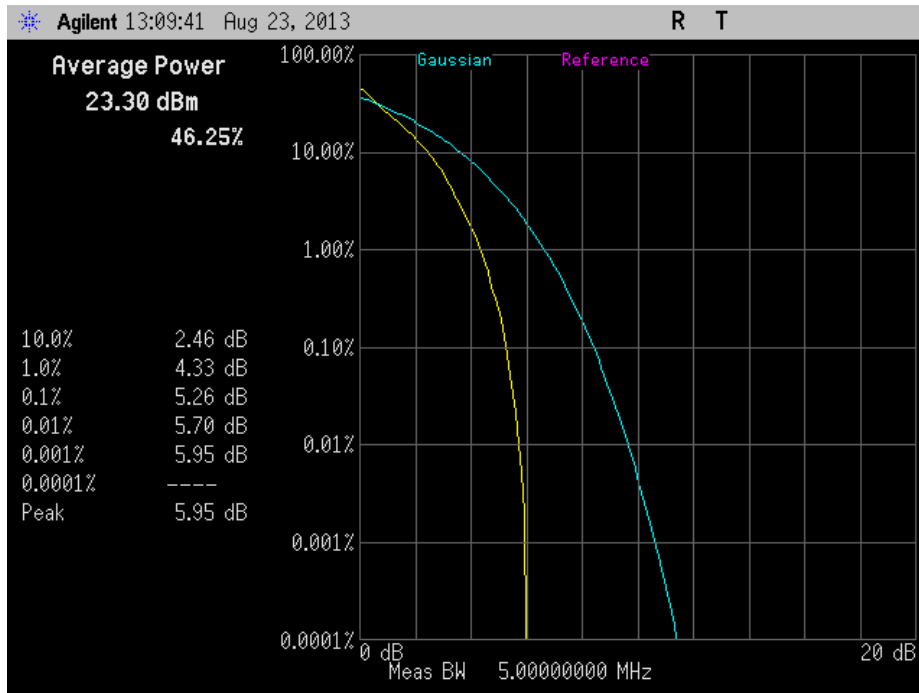
LTE Band 4 1710.7MHz (1.4 MHz BW) QPSK



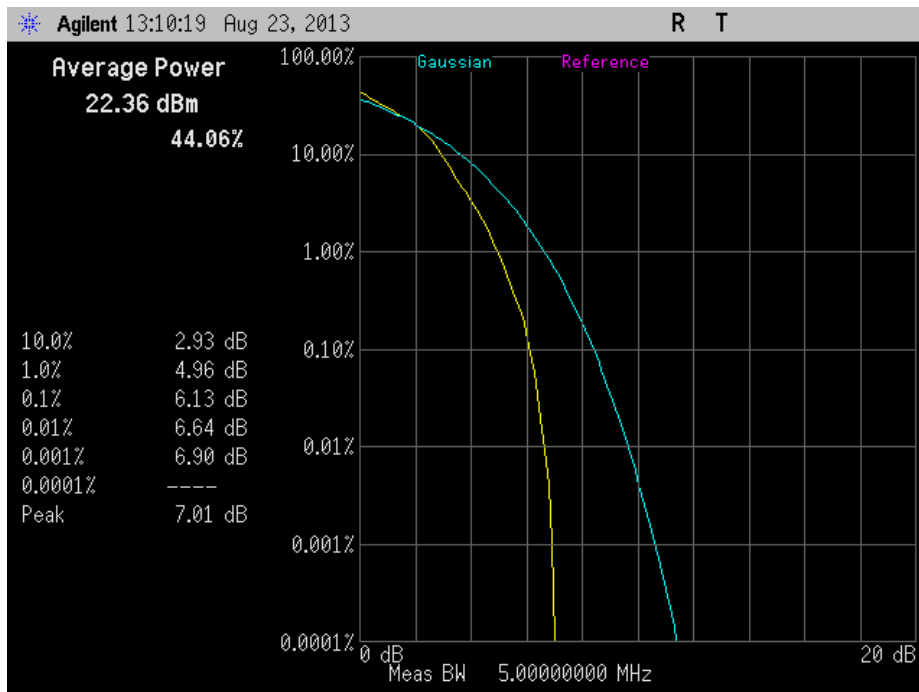
LTE Band 4 1710.7MHz (1.4 MHz BW) 16QAM



LTE Band 4 1753.5MHz (3.0 MHz BW) QPSK



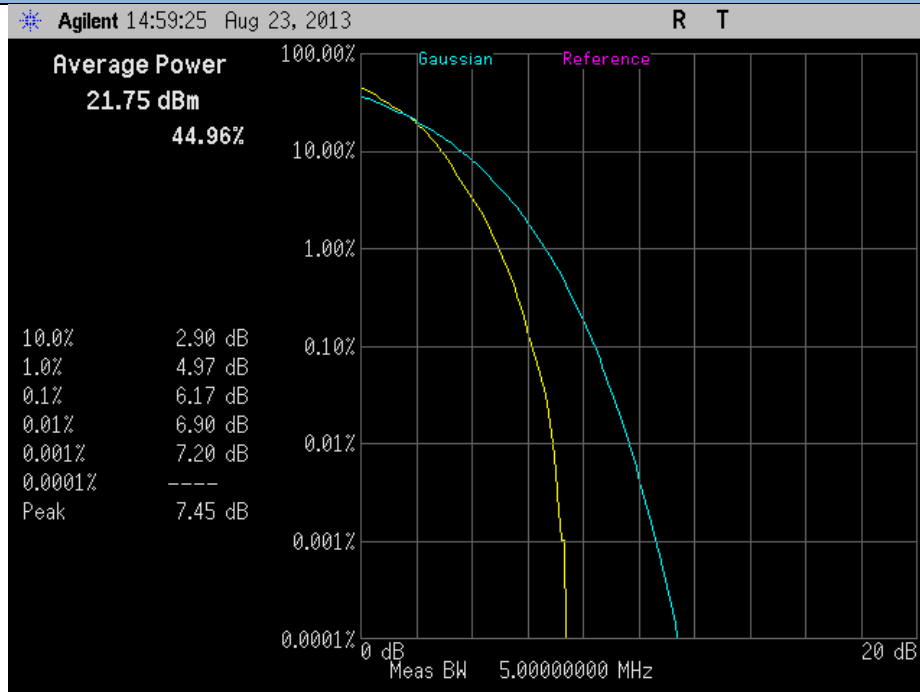
LTE Band 4 1753.5MHz (3.0 MHz BW) 16QAM



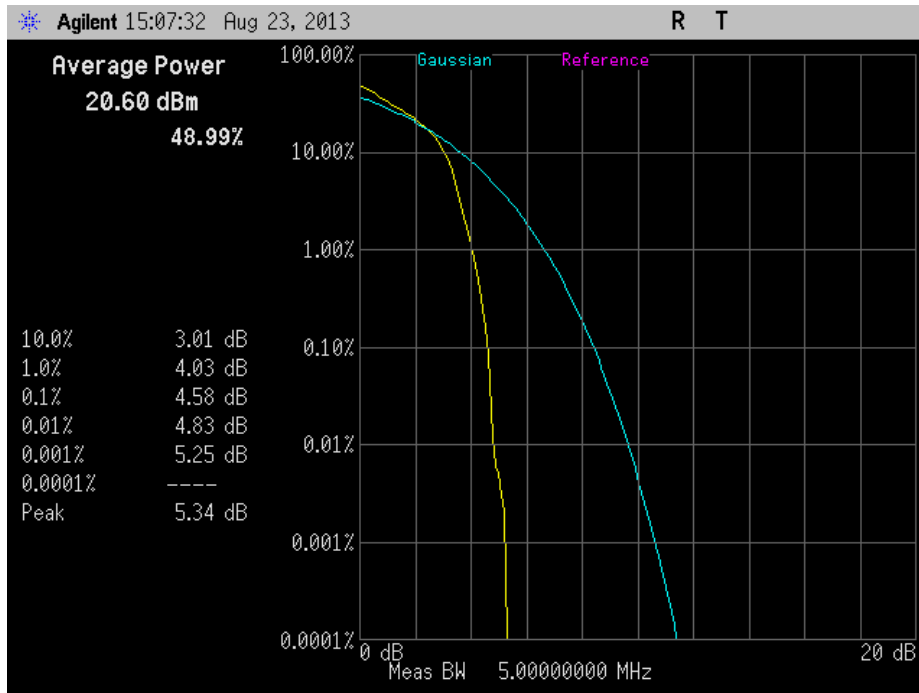
LTE Band 4 1752.5MHz (5.0 MHz BW) QPSK



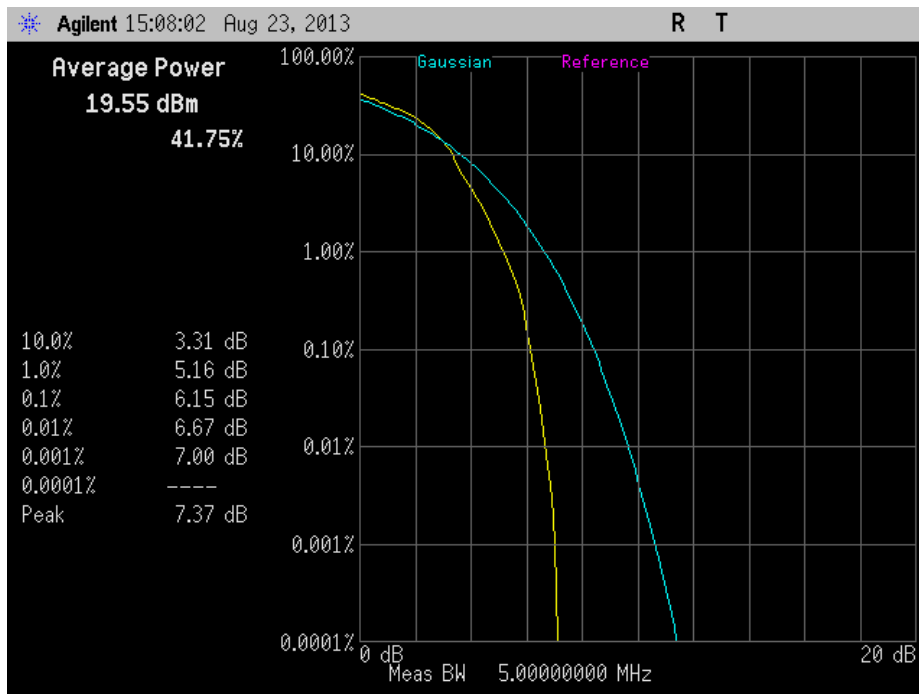
LTE Band 4 1752.5MHz (5.0 MHz BW) 16QAM



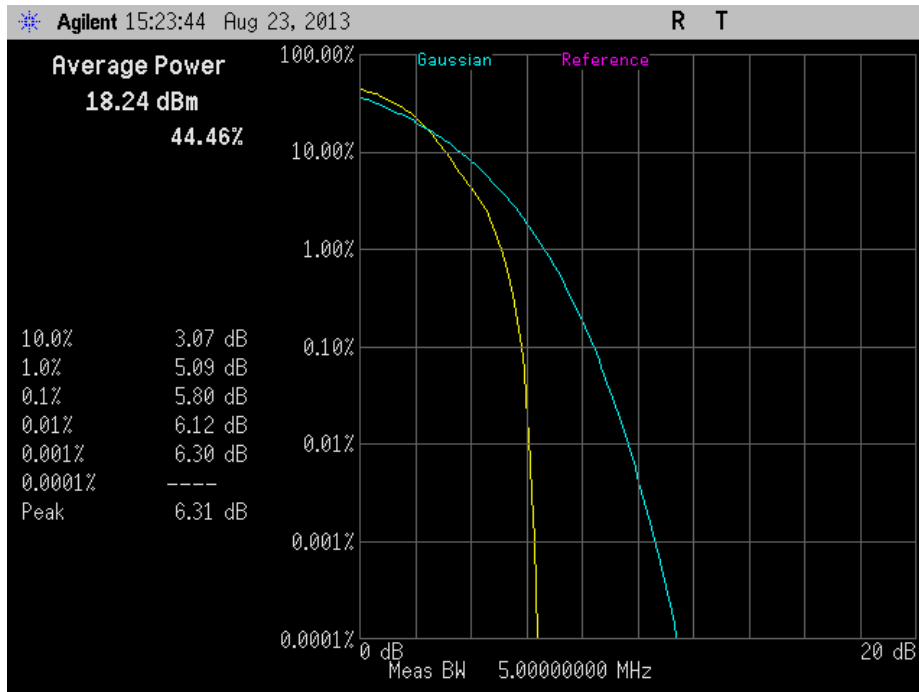
LTE Band 4 1715.0MHz (10.0 MHz BW) QPSK



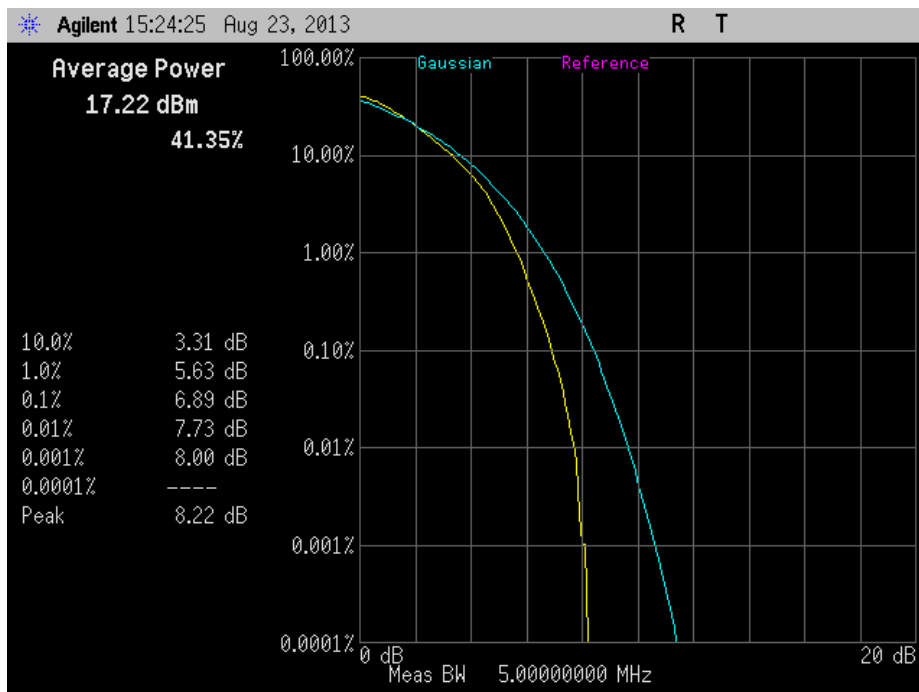
LTE Band 4 1715.0MHz (10.0 MHz BW) 16QAM



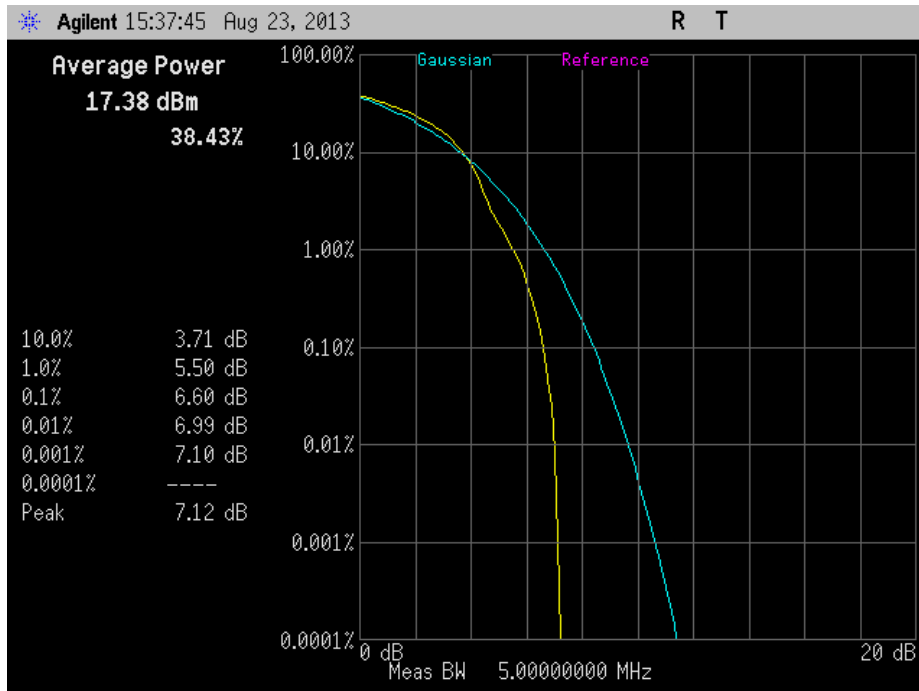
LTE Band 4 1747.5MHz (15.0 MHz BW) QPSK



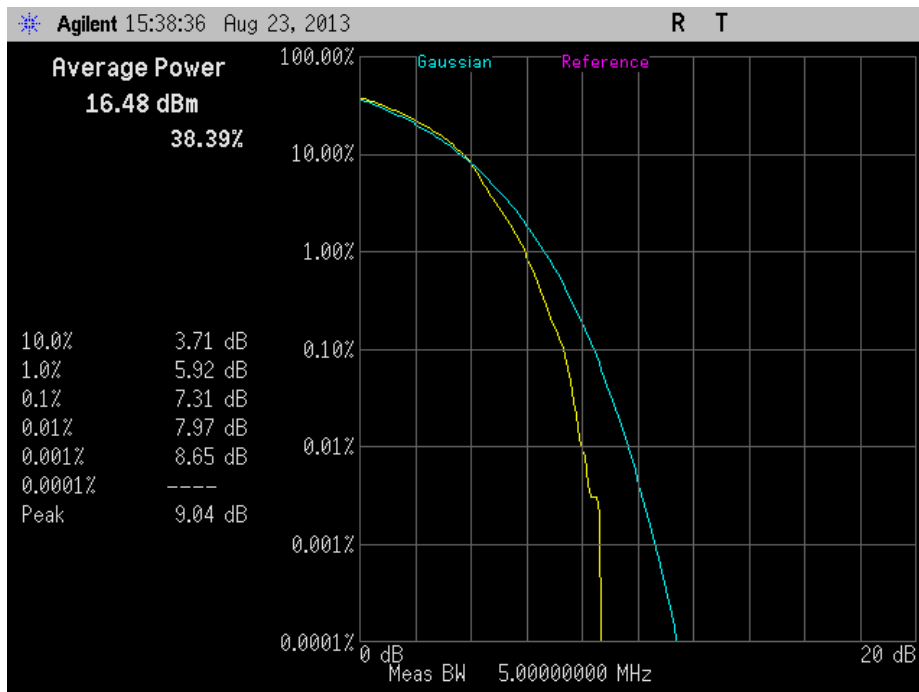
LTE Band 4 1747.5MHz (15.0 MHz BW) 16QAM



LTE Band 4 1745.0MHz (20.0 MHz BW) QPSK



LTE Band 4 1720.0MHz (20.0 MHz BW) 16QAM





2.6 BAND EDGE

2.6.1 Specification Reference

Part 27 Subpart C §27.53(c)(2)(5) and (h), RSS-139 Issue 2 (6.5)

2.6.2 Standard Applicable

(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;

(c)(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;

(h) For operations in the 1710–1755 MHz and 2110–2155 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

2.6.3 Equipment Under Test and Modification State

Serial No: SEZ100073700125 / Test Configuration B

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

August 26, 2013/JMG

2.6.5 Test Equipment Used

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

2.6.6 Environmental Conditions

Ambient Temperature	24.9°C
Relative Humidity	49.2%
ATM Pressure	98.6 kPa

2.6.7 Additional Observations

- This is a conducted test. Test guidance is per Section 6.0 of KDB971168 (D01 Power Meas License Digital Systems v02r01).

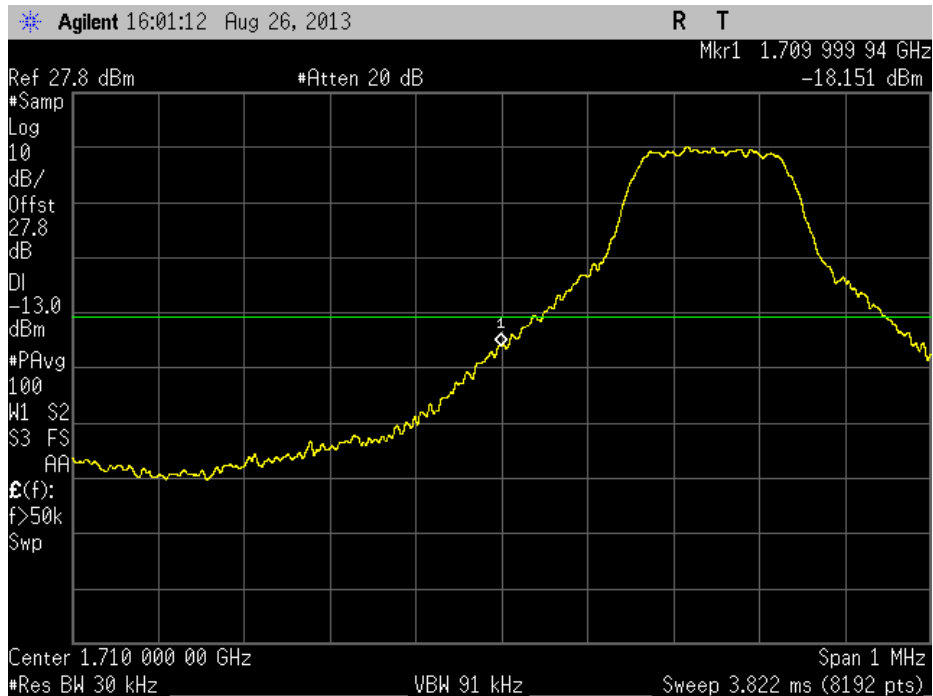


- The 27.8dB (Band 4) / 27.0(Band 13) offset is from the power splitter, external attenuator and cable used.
- The center frequency of the spectrum is the band edge frequency.
- Using a span of 1MHz for Band 13, RBW is set to 100 kHz (minimum of 30kHz limited to 1% of EBW) and VBW is set to 3X RBW.
- In the band 1710-1755MHz (Band 4), RBW setting used is 1% of the -26dB bandwidth (EBW).
- For lower band edge, 1 offset is utilized while the maximum allowable offset per channel bandwidth for upper band edge is used.
- All RB size available verified and the worst case size for band edge verification presented in this test report.

2.6.8 Test Results

See attached plots.

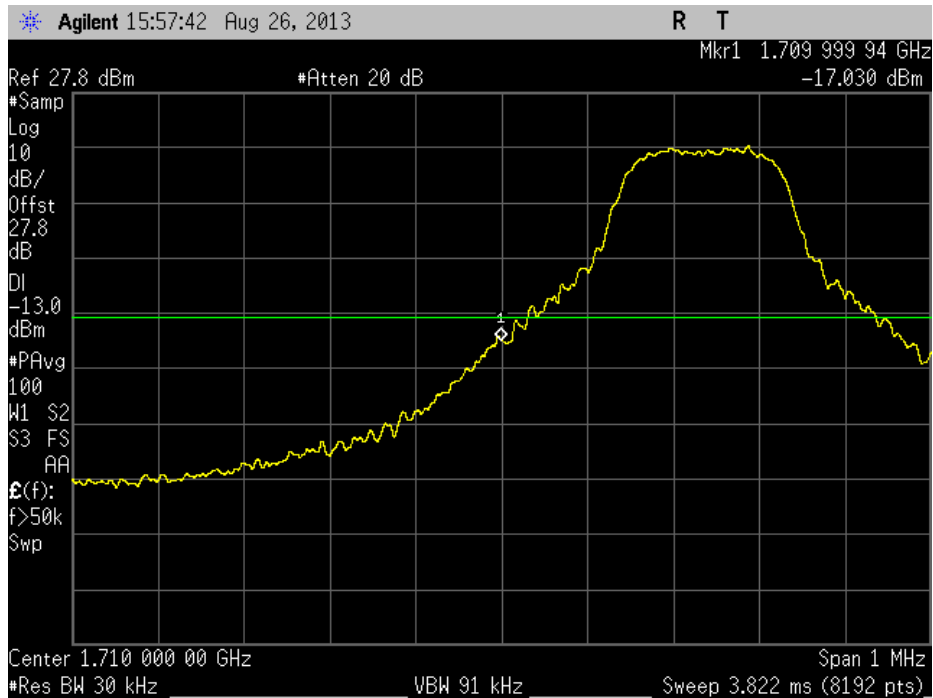
LTE Band 4 1.4MHz BW Low Channel (19957) Band Edge @ 1710MHz



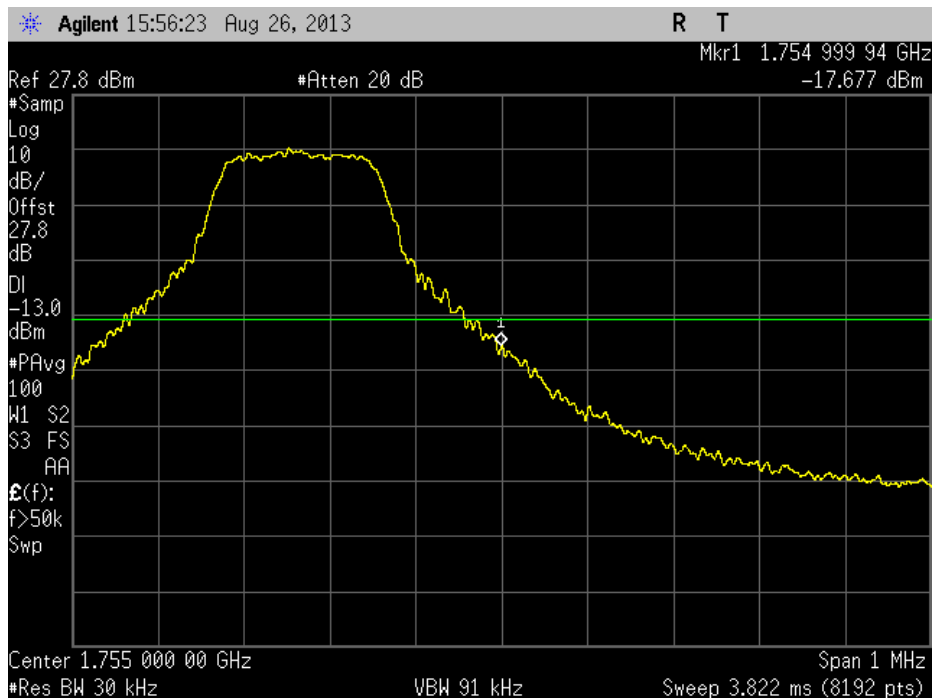
LTE Band 4 1.4MHz BW High Channel (20393) Band Edge @ 1755MHz



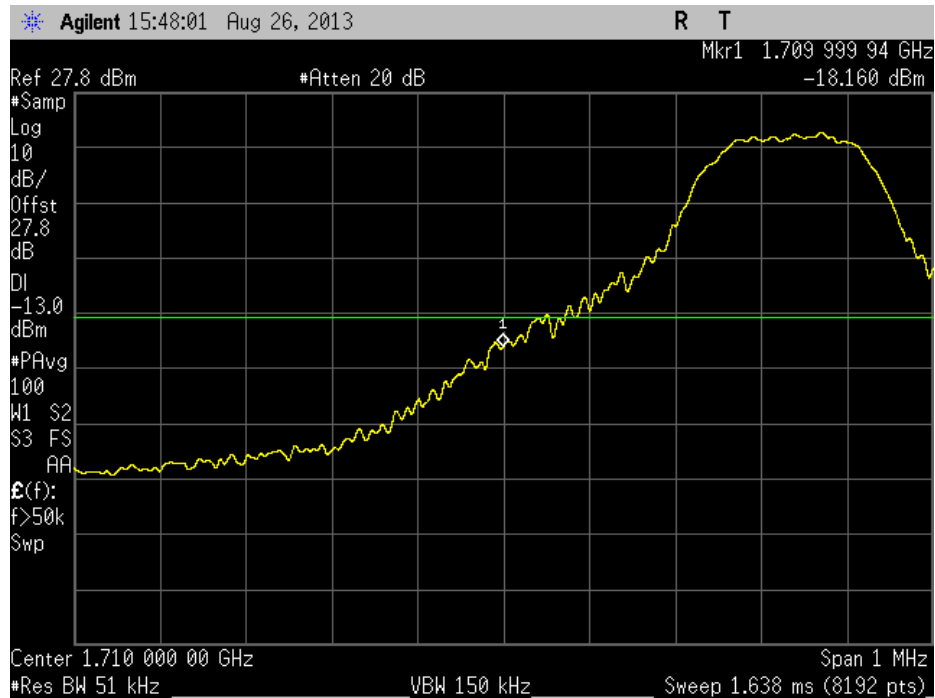
LTE Band 4 3.0MHz BW Low Channel (19975) Band Edge @ 1710MHz



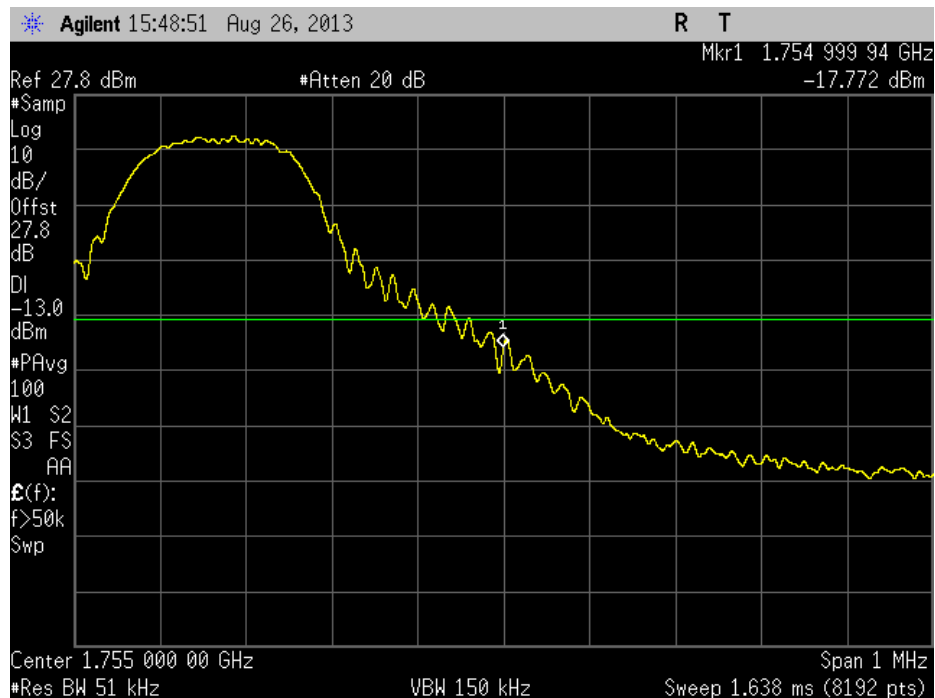
LTE Band 4 3.0MHz BW High Channel (20375) Band Edge @ 1755MHz



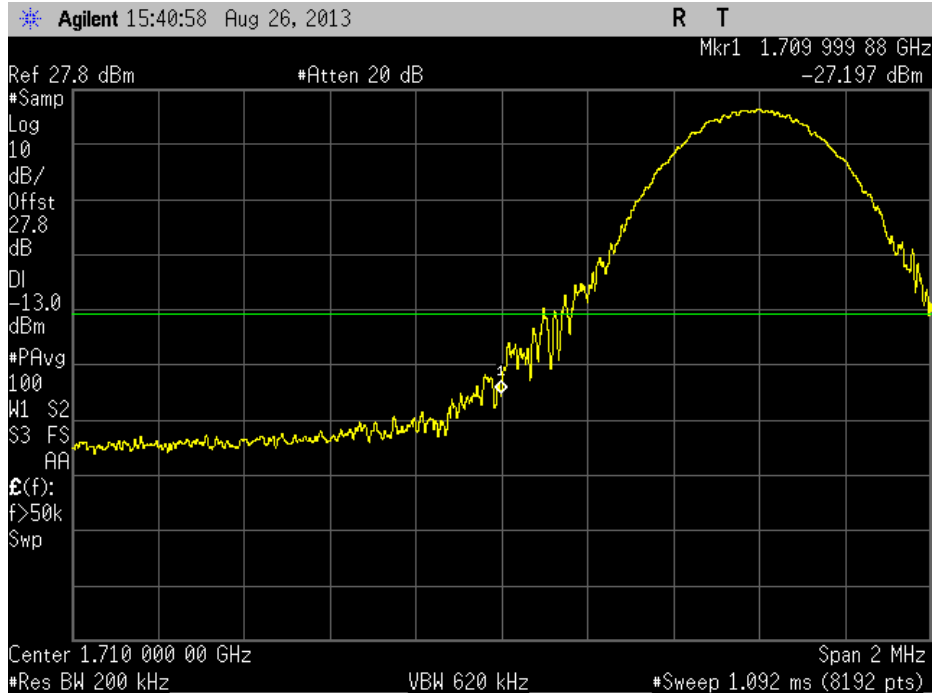
LTE Band 4 5.0MHz BW Low Channel (19975) Band Edge @ 1710MHz



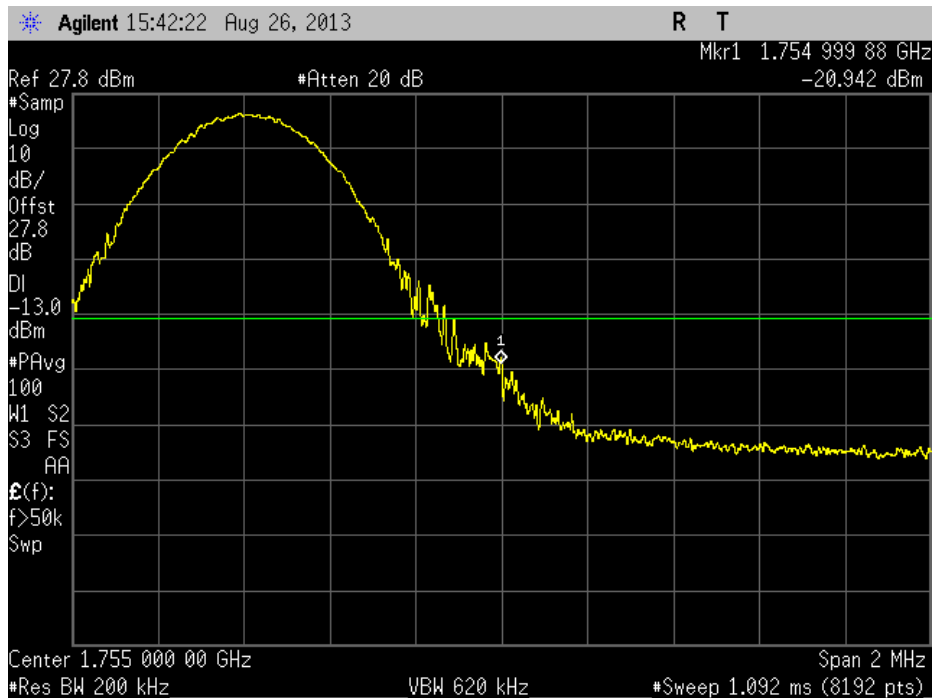
LTE Band 4 5.0MHz BW High Channel (20375) Band Edge @ 1755MHz



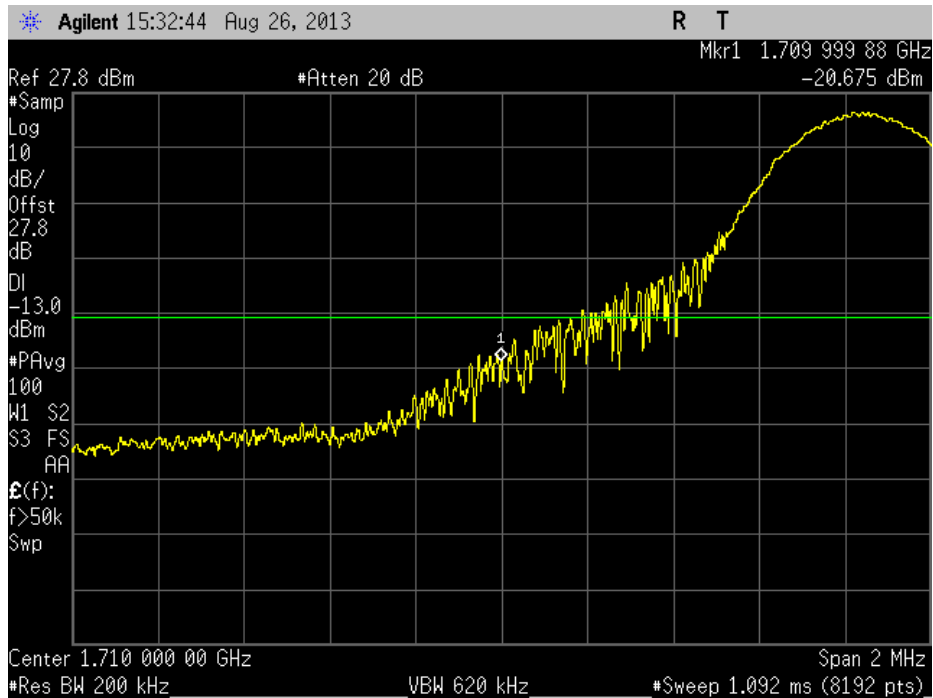
LTE Band 4 10.0MHz BW Low Channel (20000) Band Edge @ 1710MHz



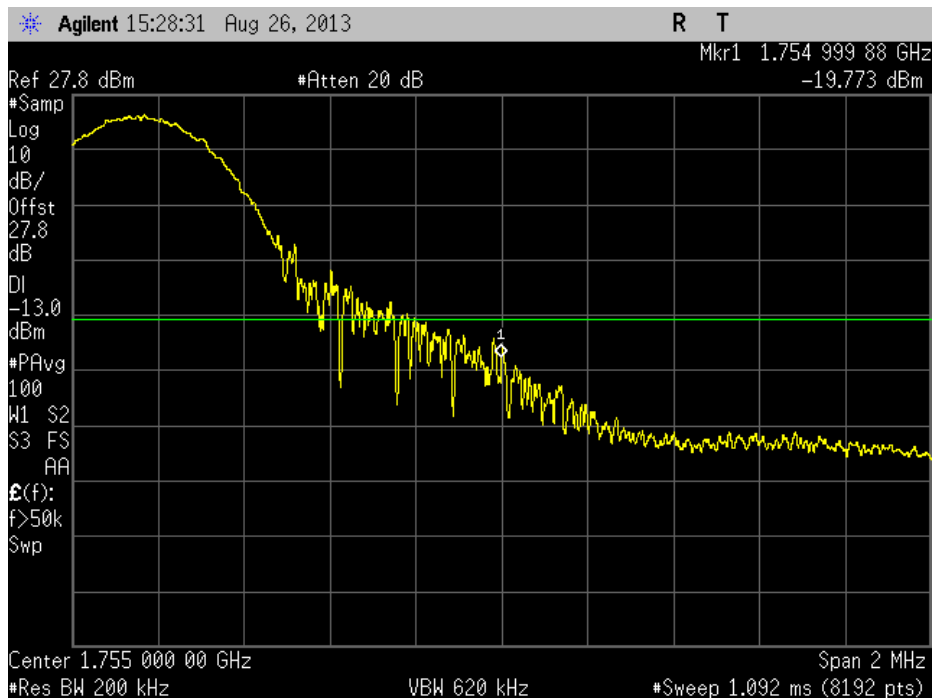
LTE Band 4 10.0MHz BW High Channel (20350) Band Edge @ 1755MHz



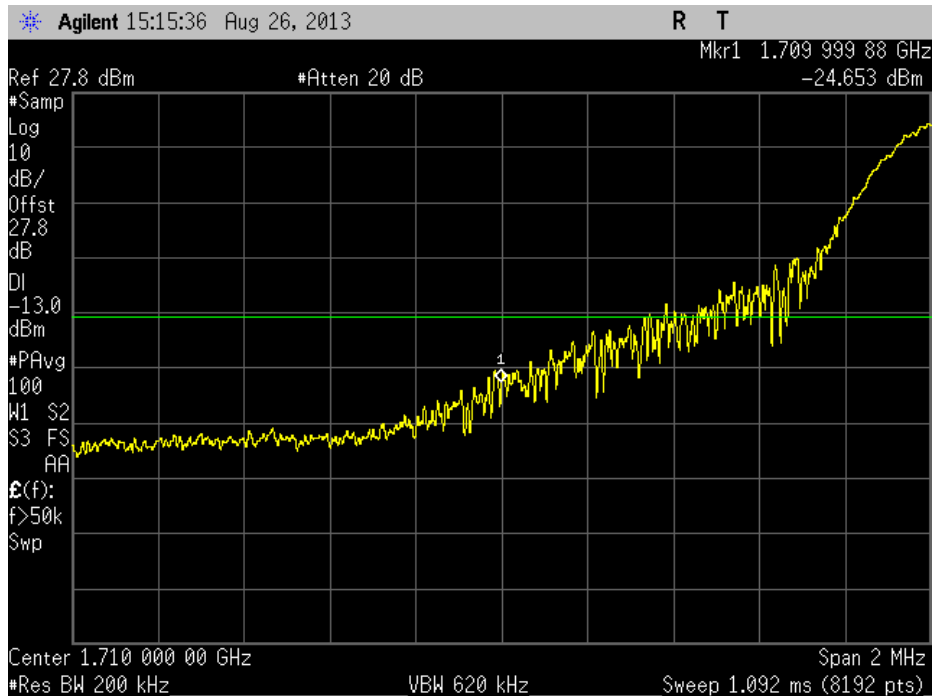
LTE Band 4 15.0MHz BW Low Channel (20025) Band Edge @ 1710MHz



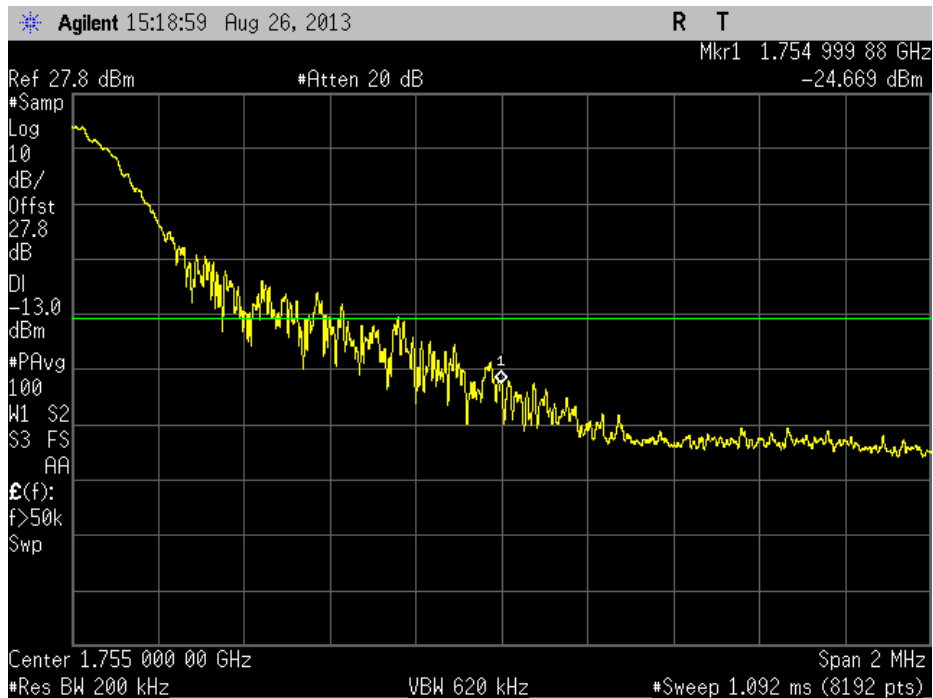
LTE Band 4 15.0MHz BW High Channel (20325) Band Edge @ 1755MHz



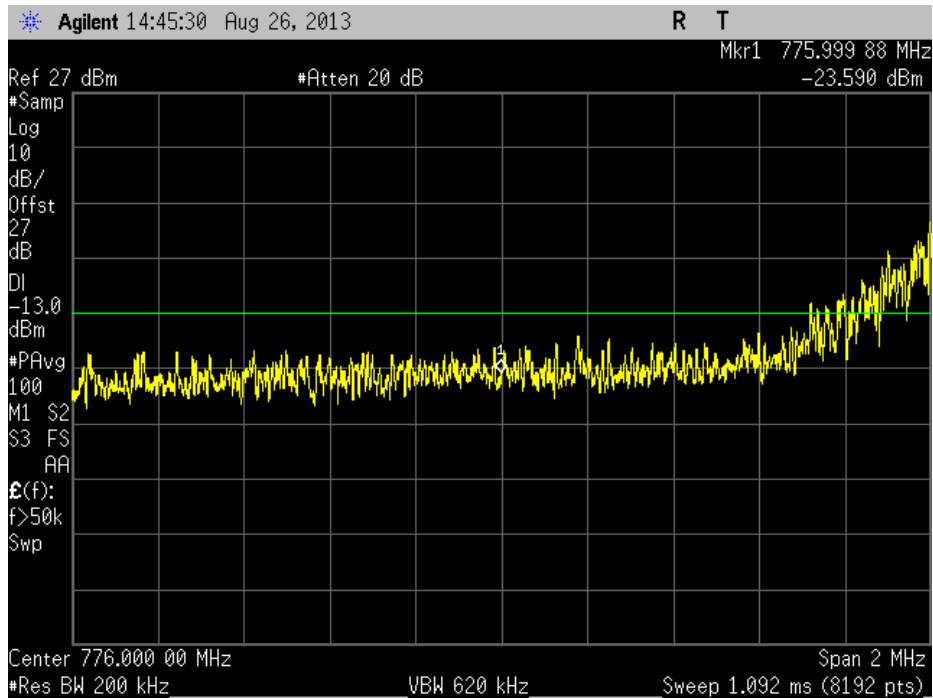
LTE Band 4 20.0MHz BW Low Channel (20050) Band Edge @ 1710MHz



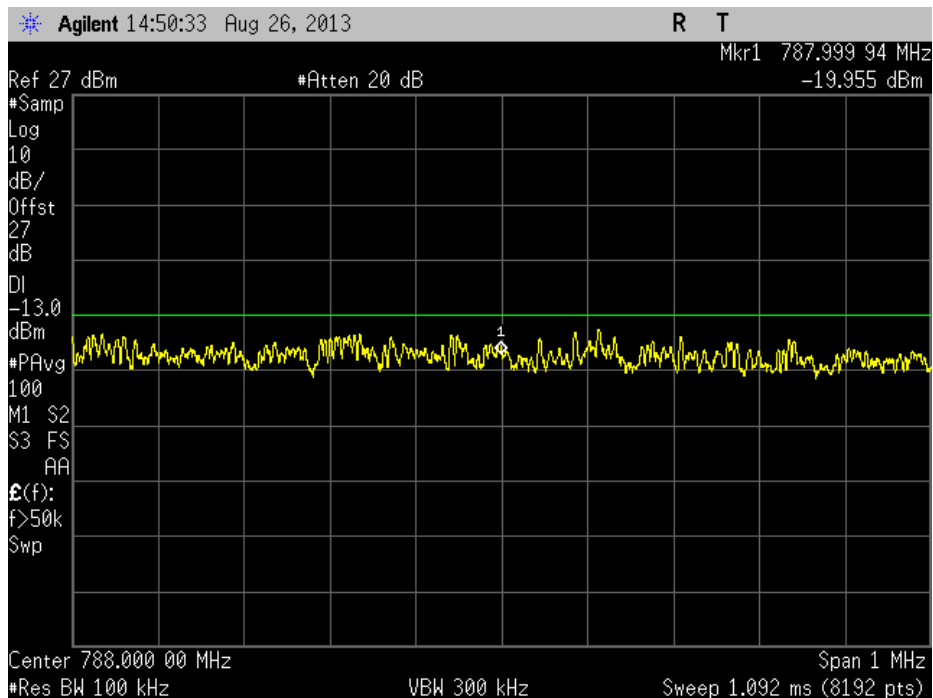
LTE Band 4 20.0MHz BW High Channel (20300) Band Edge @ 1755MHz



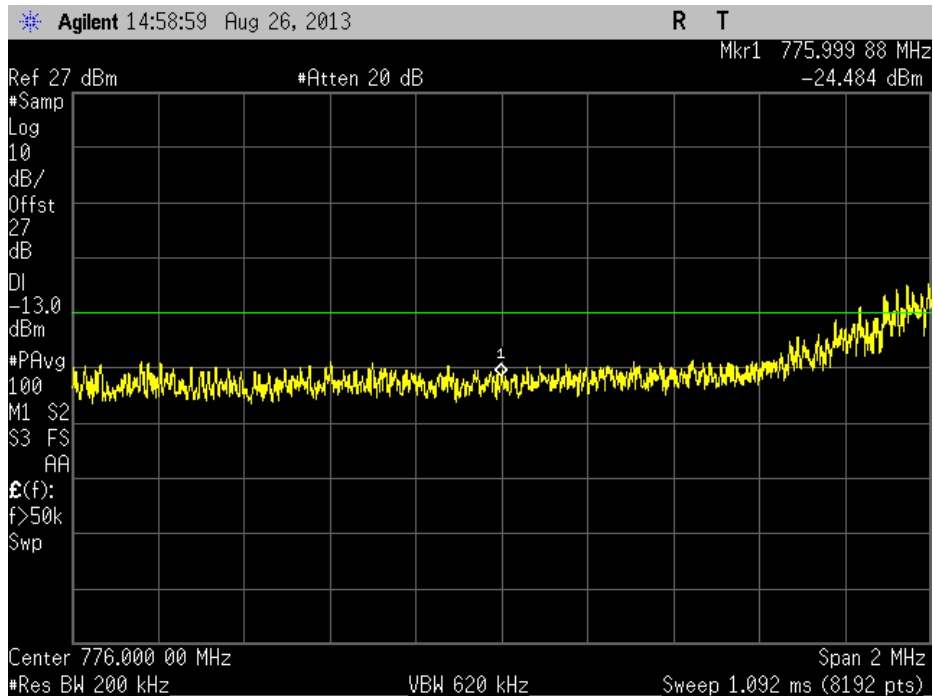
LTE Band 13 5.0MHz BW Low Channel (23205) Band Edge @ 776MHz



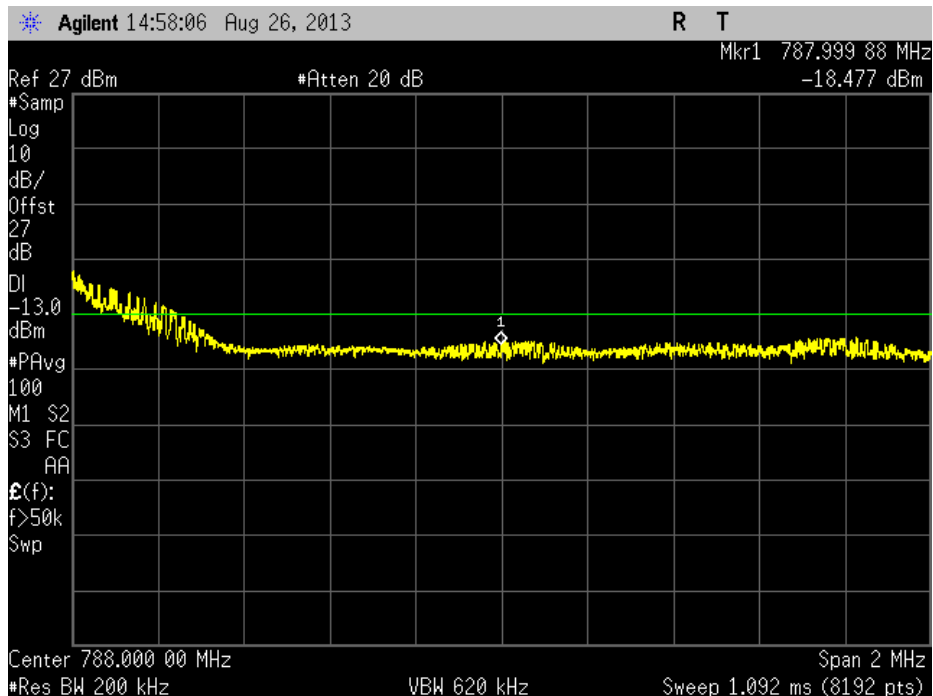
LTE Band 13 5.0MHz BW High Channel (23255) Band Edge @ 788MHz



LTE Band 13 10.0MHz BW Channel 23230 Band Edge @ 776MHz



LTE Band 13 10.0MHz BW Channel 23230 Band Edge @ 788MHz





2.7 CONDUCTED SPURIOUS EMISSIONS

2.7.1 Specification Reference

Part 27 Subpart C §27.53 (c)(2)(5),(f),(h) and Part 2.1051, RSS-139 Issue 2(6.5)

2.7.2 Standard Applicable

(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;

(c)(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;

(f) For operations in the 746–763 MHz, 775–793 MHz, and 805–806 MHz bands, emissions in the band 1559–1610 MHz shall be limited to –70 dBW/MHz equivalent isotropically radiated power (EIRP) for wideband signals, and –80 dBW EIRP for discrete emissions of less than 700 Hz bandwidth. For the purpose of equipment authorization, a transmitter shall be tested with an antenna that is representative of the type that will be used with the equipment in normal operation.

(h) For operations in the 1710–1755 MHz and 2110–2155 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.

2.7.3 Equipment Under Test and Modification State

Serial No: SEZ100073700125 / Test Configuration A

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

August 23, 2013/JMG

2.7.5 Test Equipment Used

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

2.7.6 Environmental Conditions

Ambient Temperature	25.1°C
Relative Humidity	50.0%
ATM Pressure	99.5 kPa

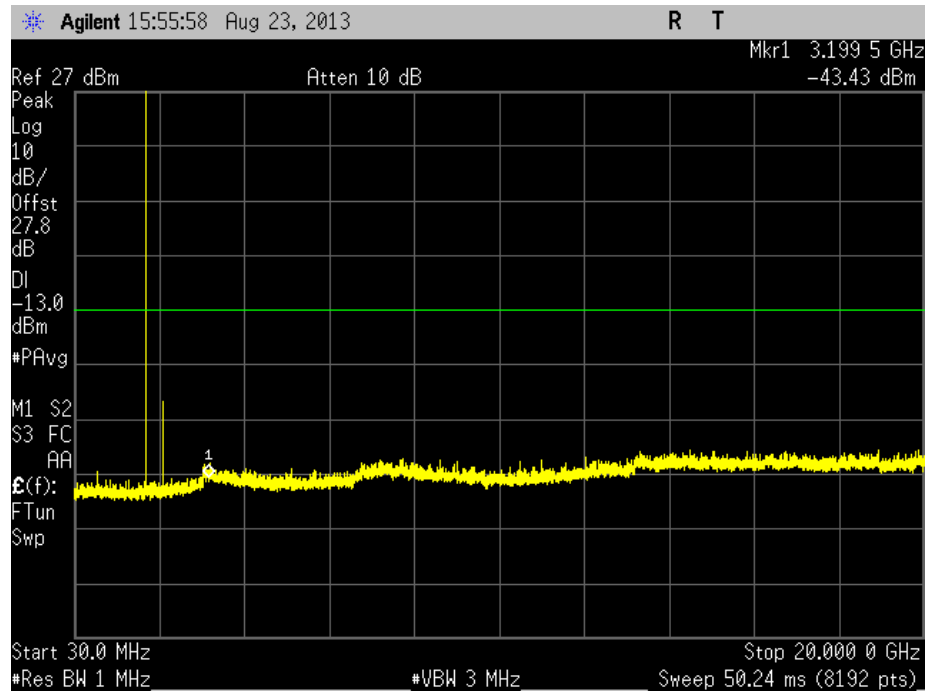
2.7.7 Additional Observations

- This is a conducted test. The 27.8dB (band 4) /27.0(Band 13) offset is from the power splitter, external attenuator and cable used.
- The spectrum was searched from 30MHz to the 10th harmonic (20GHz) for Band 4. Band 13 was verified up to 20GHz.
- Low, Mid and High channels on all channel bandwidth verified. Only the worst RB size/offset presented (See Section 1.4.4 for worst case modulation).

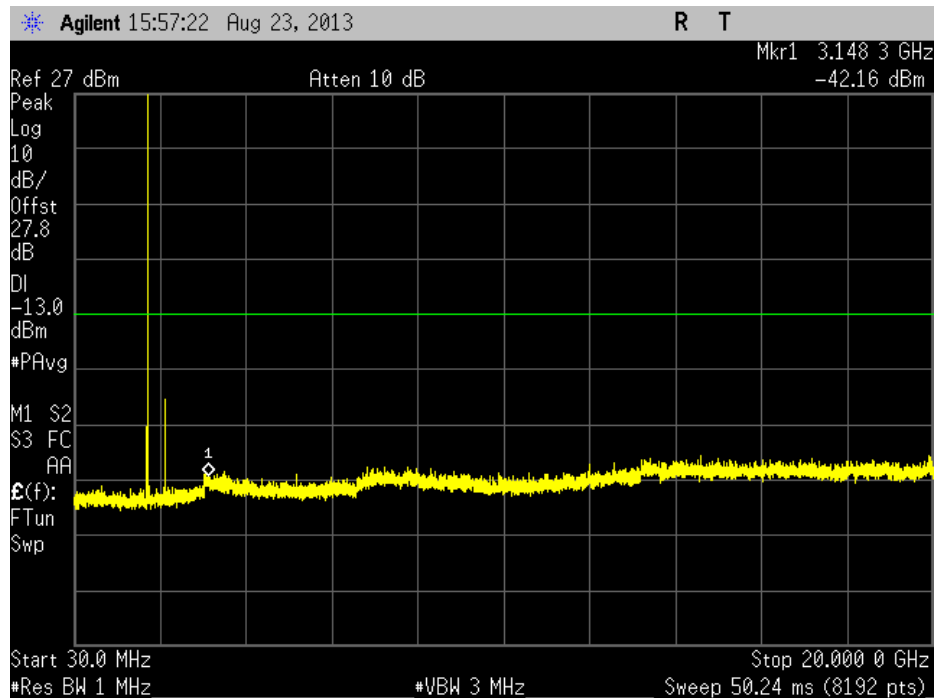
2.7.8 Test Results

Compliant. See attached plots.

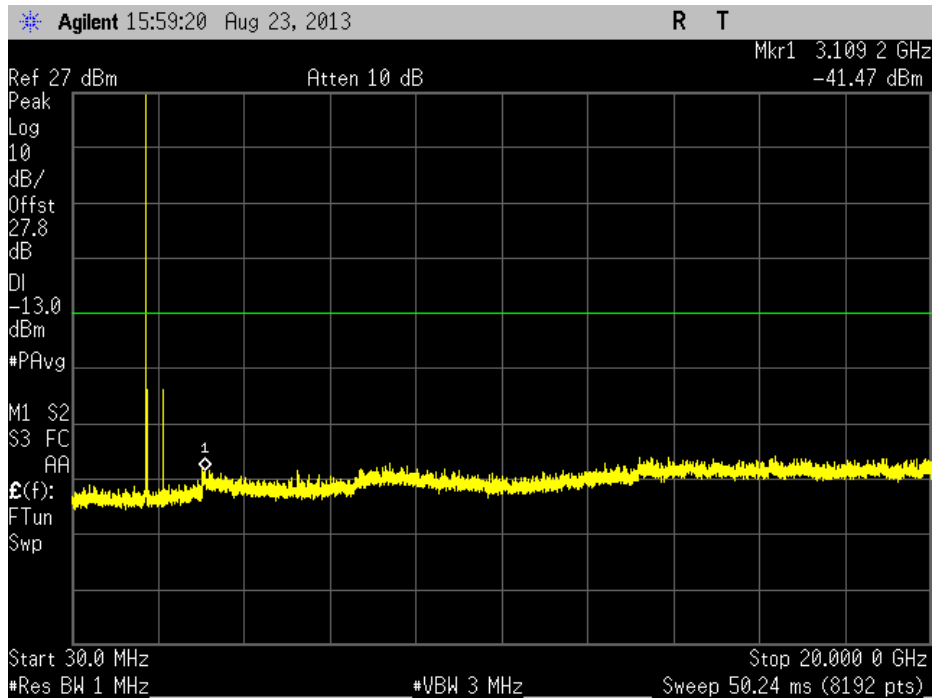
LTE Band 4 1.4MHz BW Low Channel



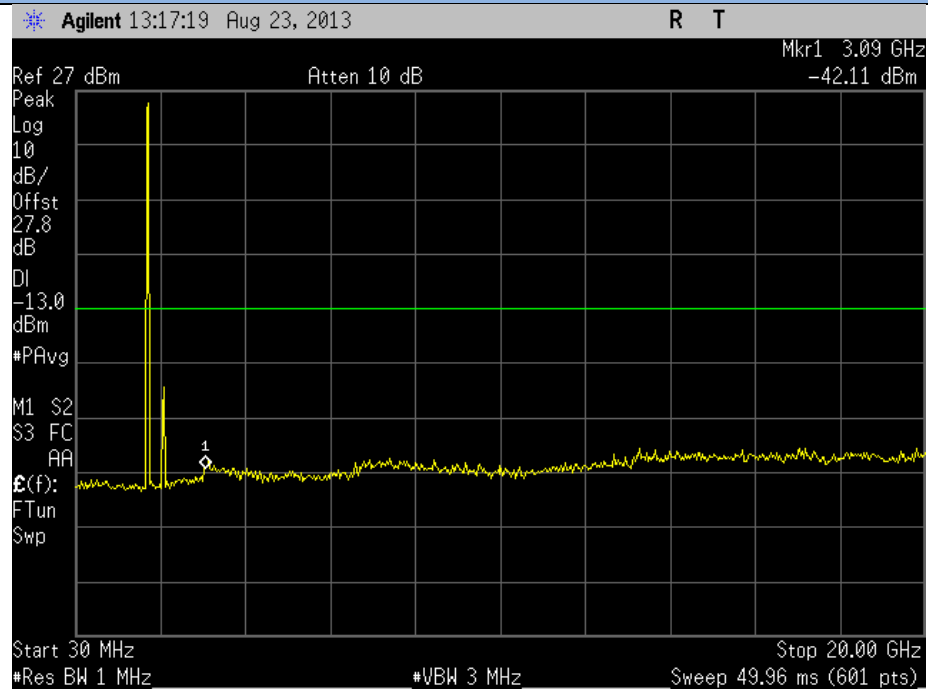
LTE Band 4 1.4MHz BW Mid Channel



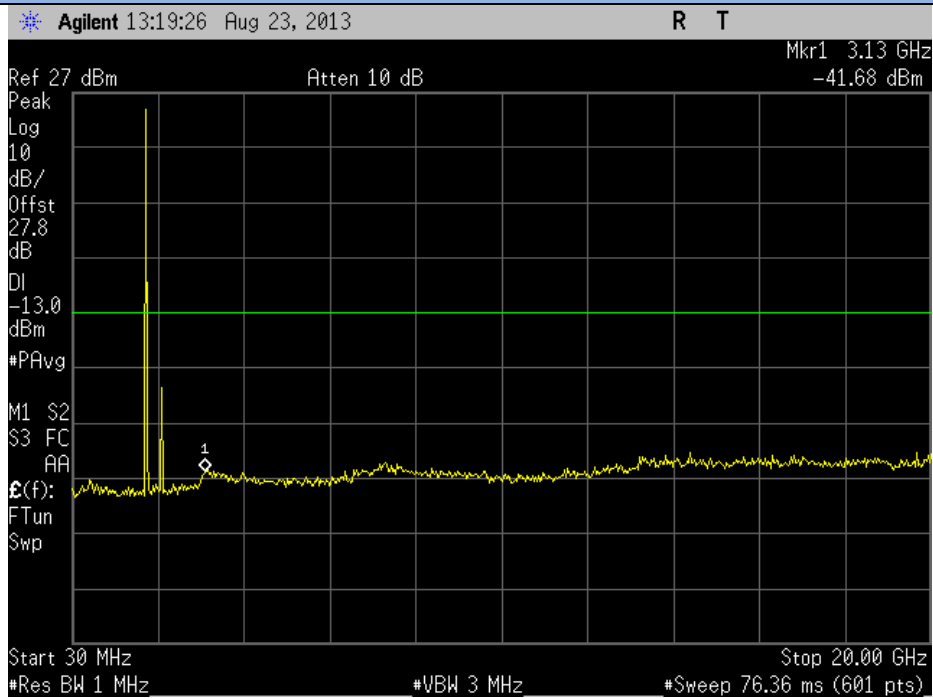
LTE Band 4 1.4MHz BW High Channel



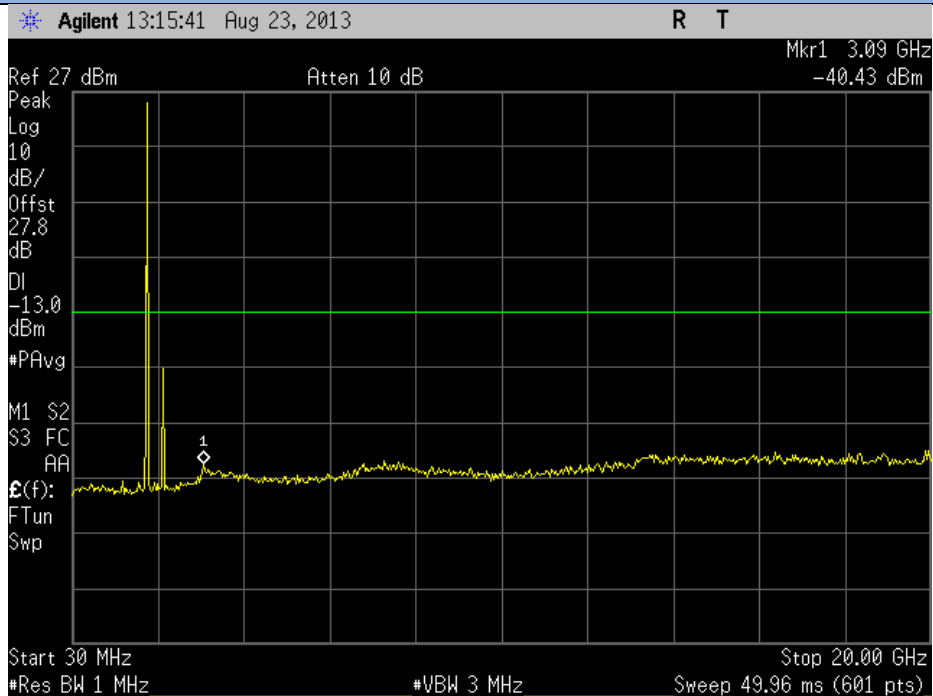
LTE Band 4 3.0MHz BW Low Channel



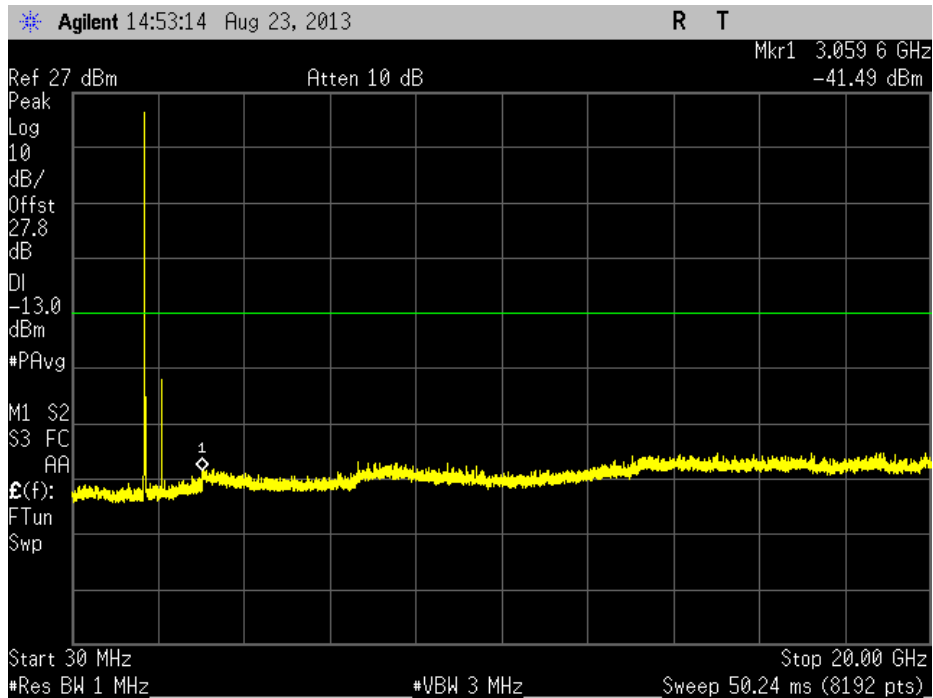
LTE Band 4 3.0MHz BW Mid Channel



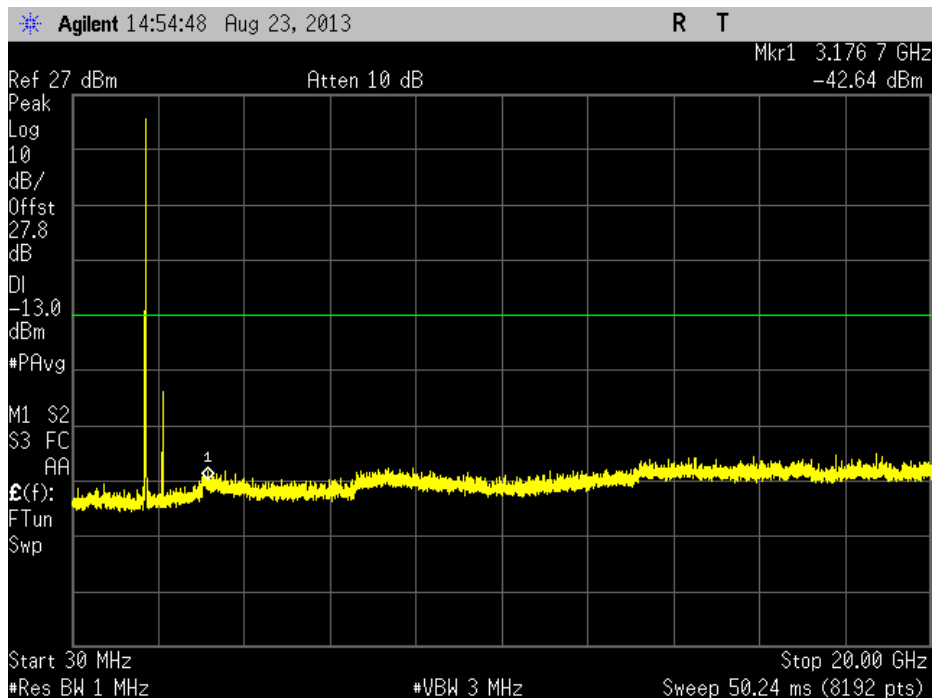
LTE Band 4 3.0MHz BW High Channel



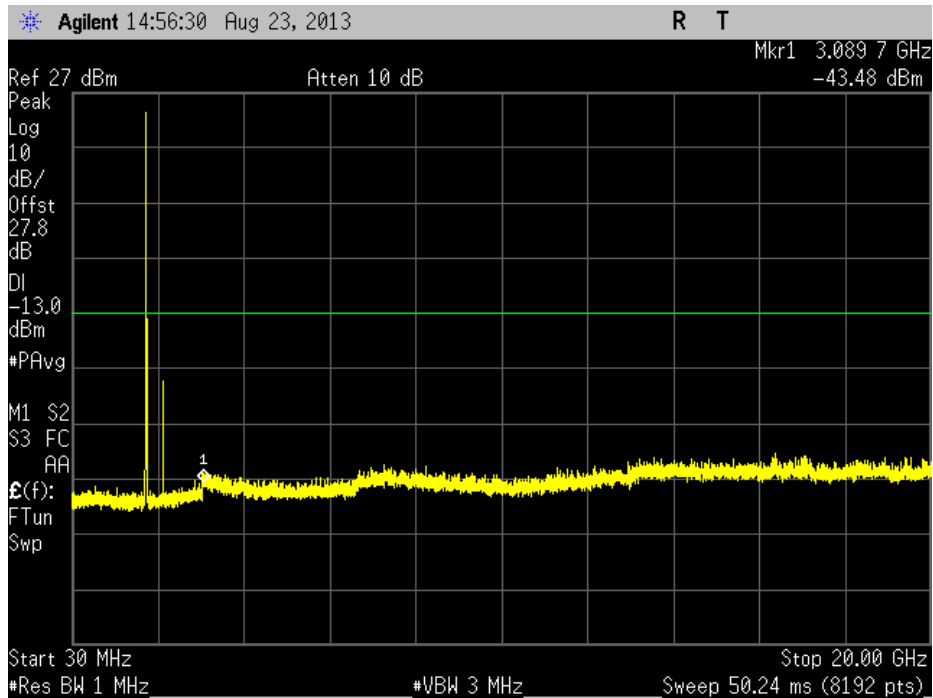
LTE Band 4 5MHz BW Low Channel



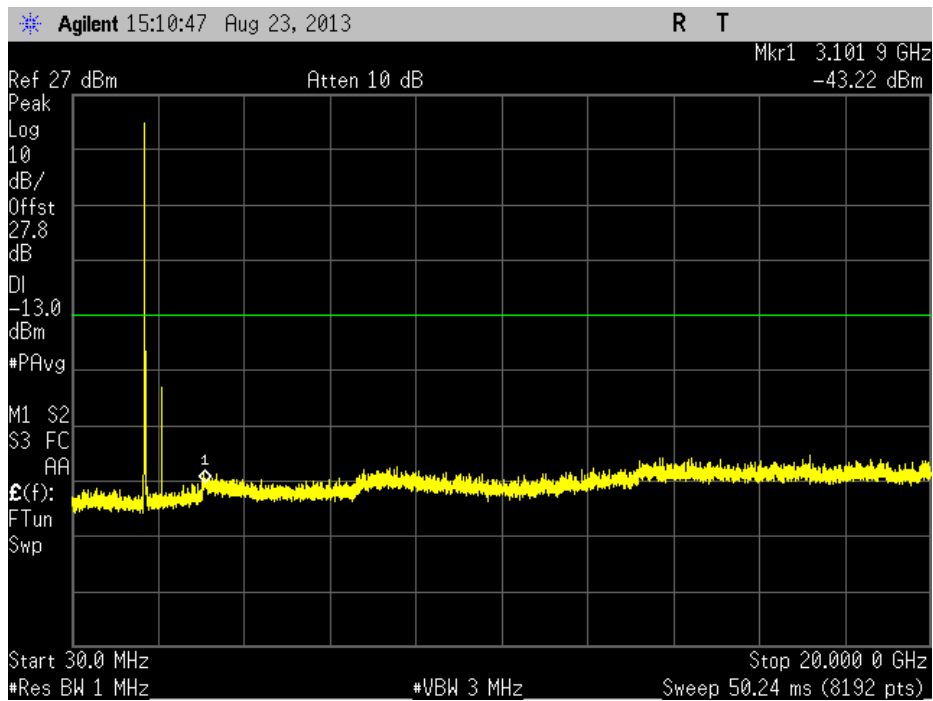
LTE Band 4 5MHz BW Mid Channel



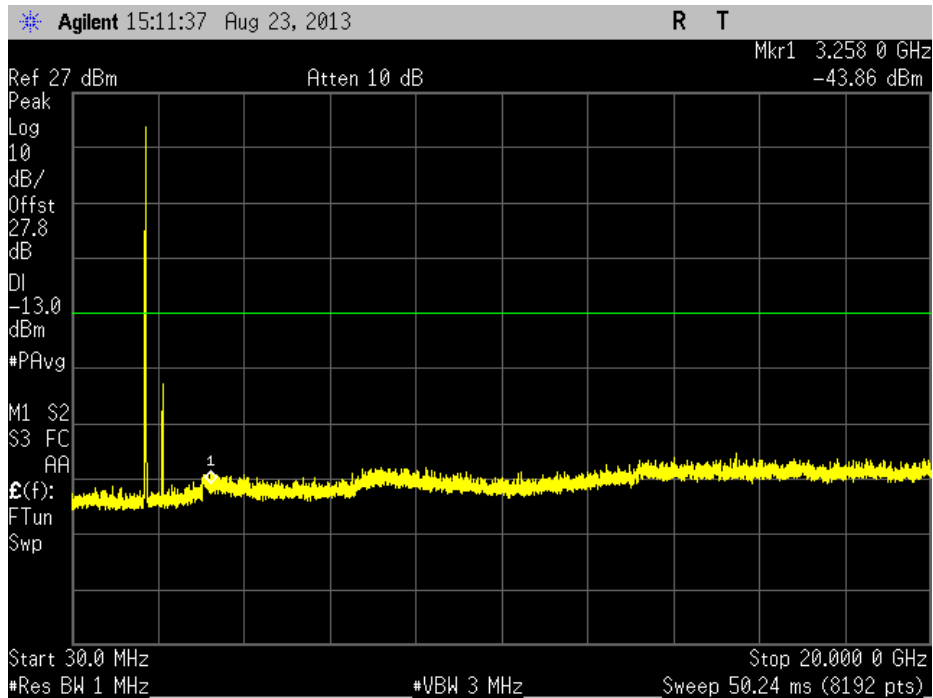
LTE Band 4 5MHz BW High Channel



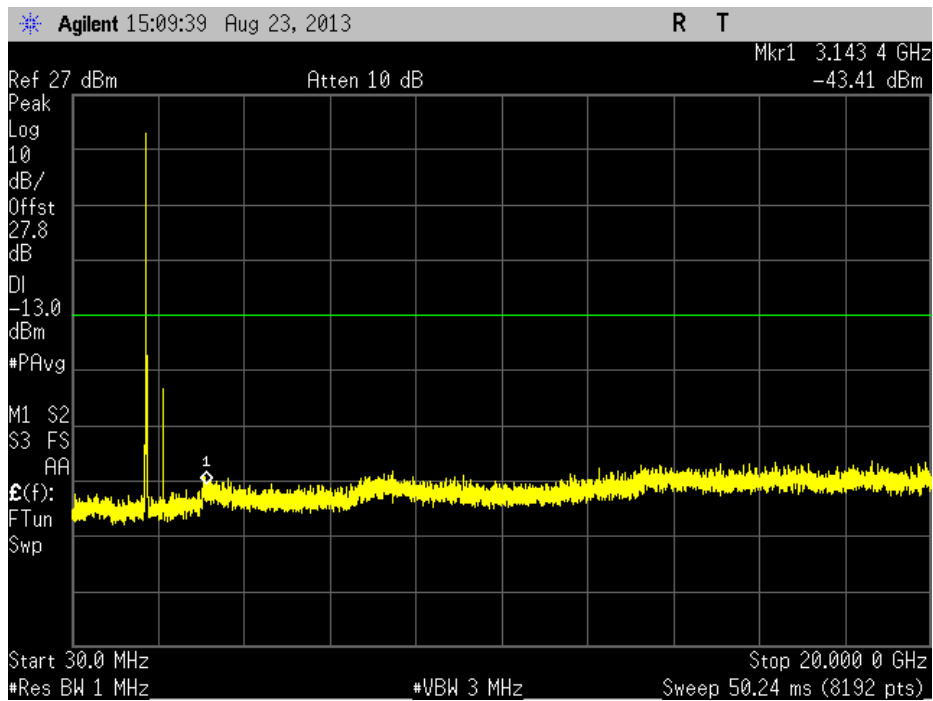
LTE Band 4 10MHz BW Low Channel



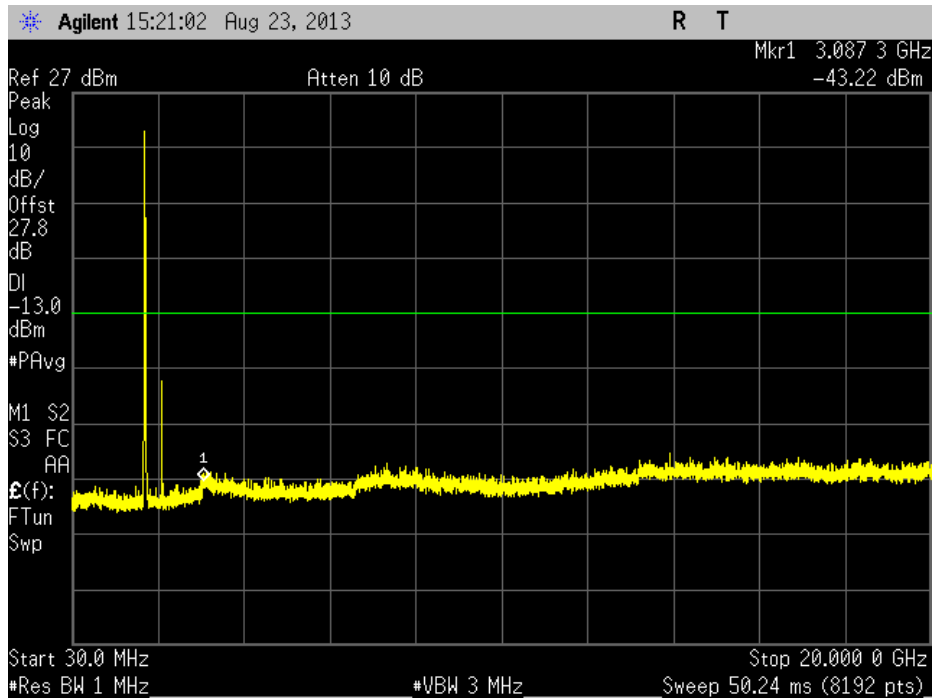
LTE Band 4 10MHz BW Mid Channel



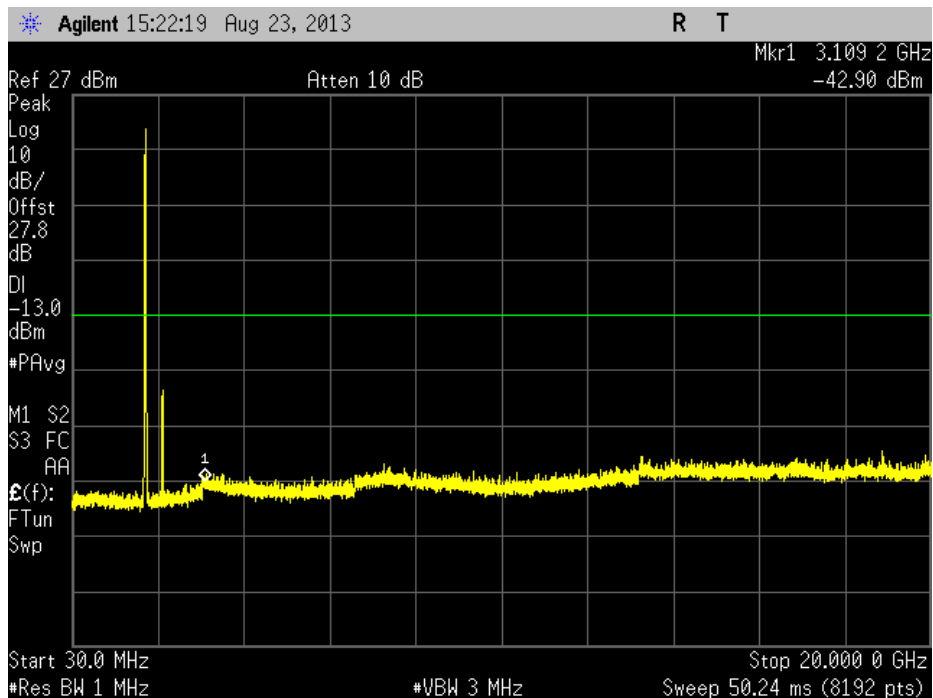
LTE Band 4 10MHz BW High Channel



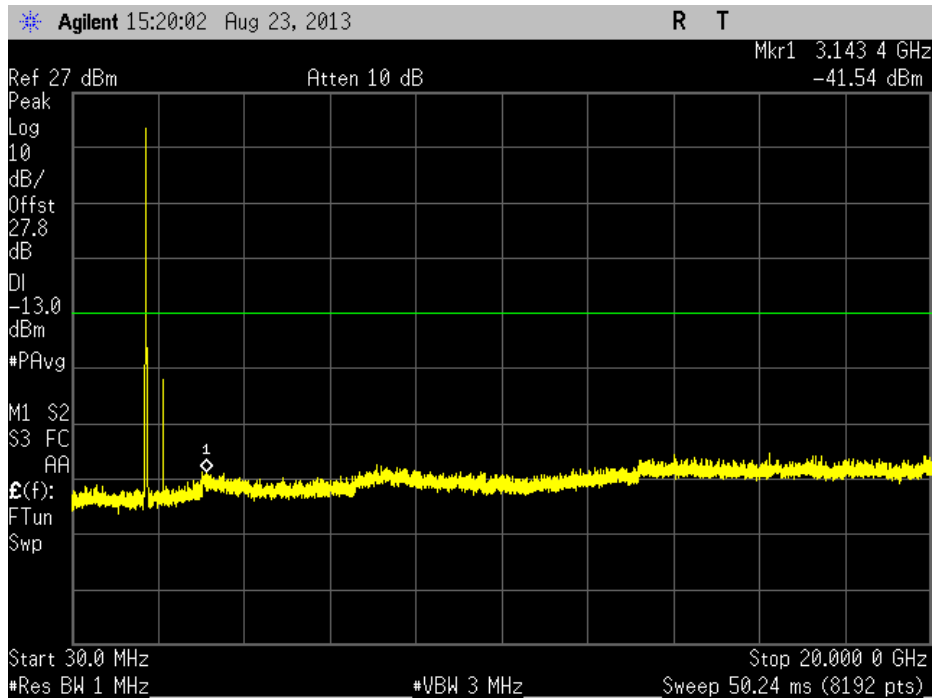
LTE Band 4 15MHz BW Low Channel



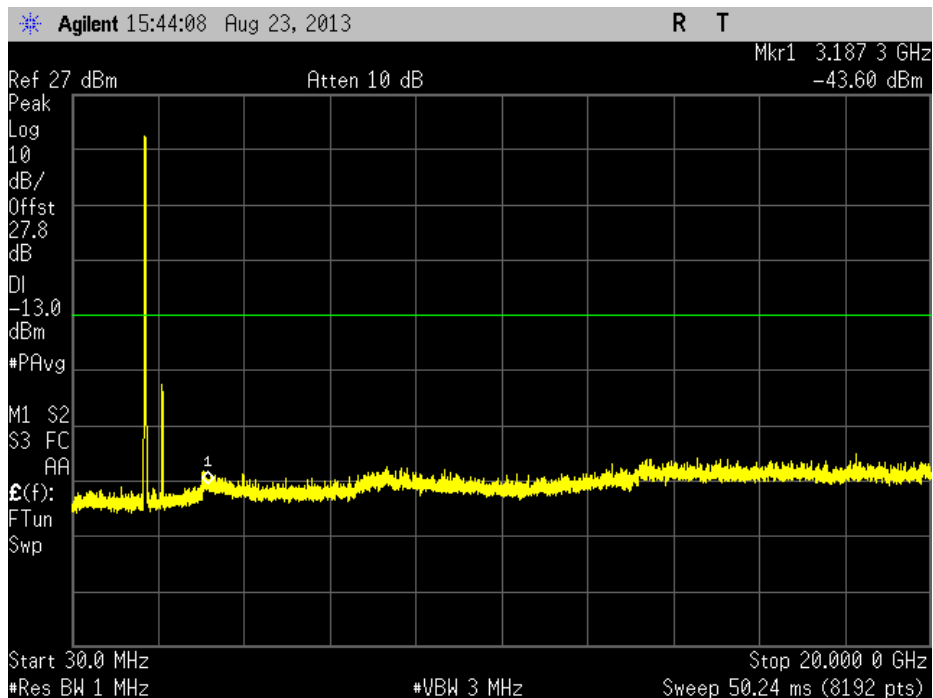
LTE Band 4 15MHz BW Mid Channel



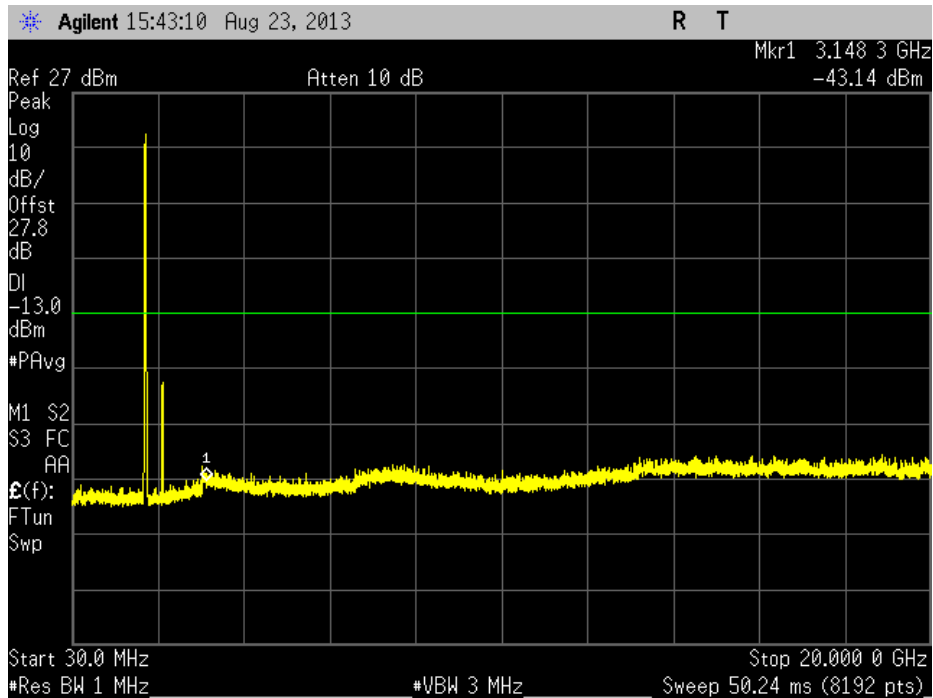
LTE Band 4 15MHz BW High Channel



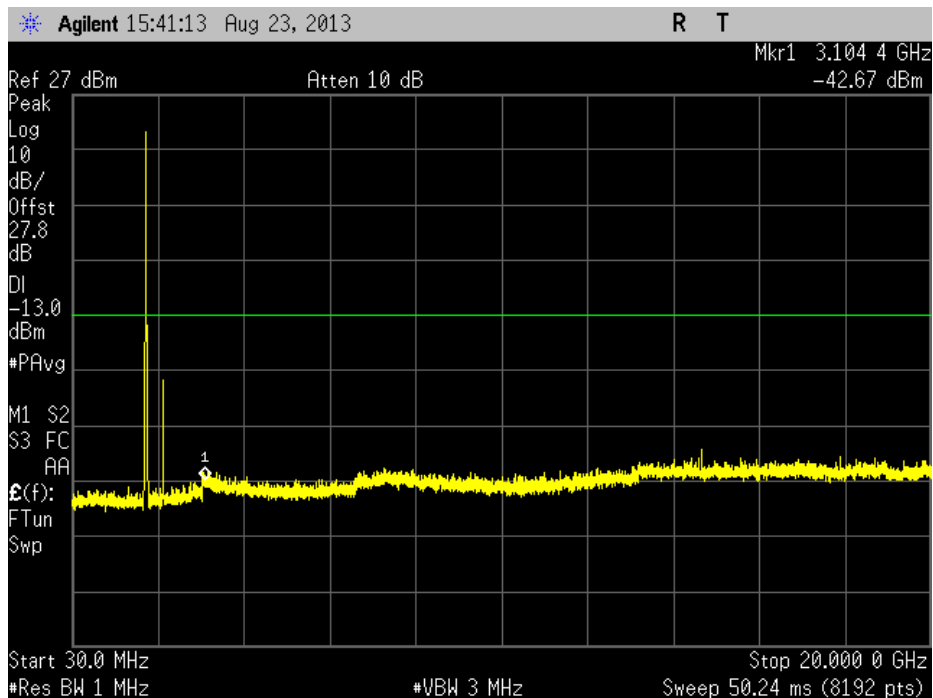
LTE Band 4 20MHz BW Low Channel



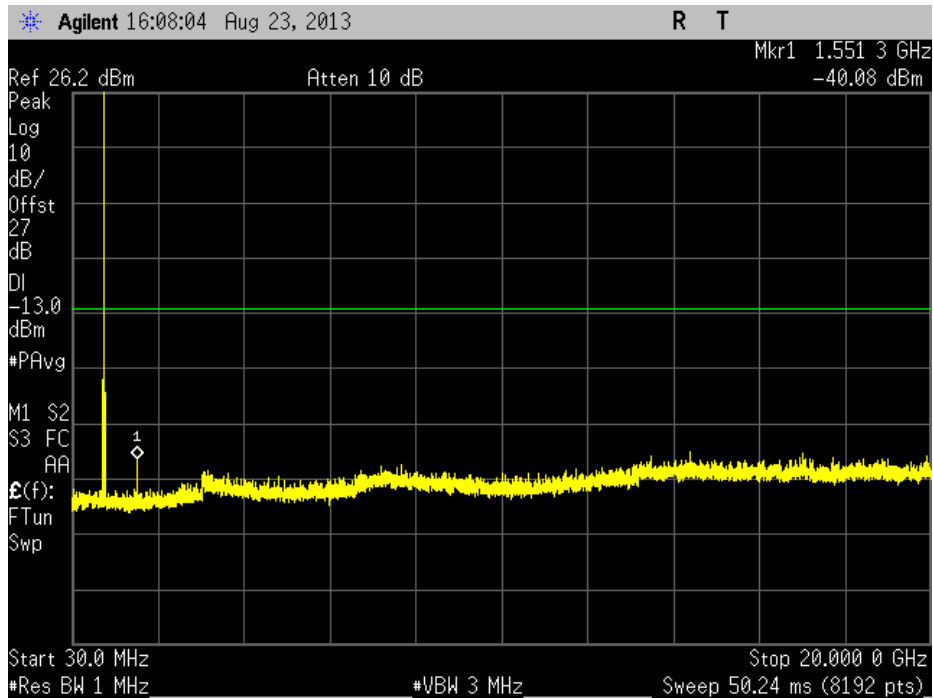
LTE Band 4 20MHz BW Mid Channel



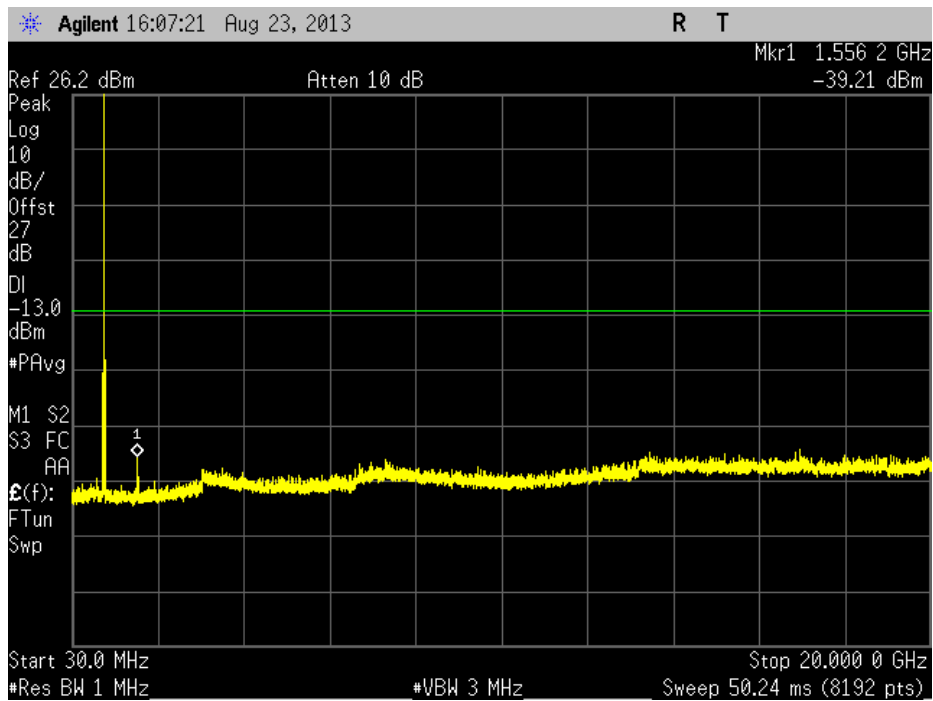
LTE Band 4 20MHz BW High Channel

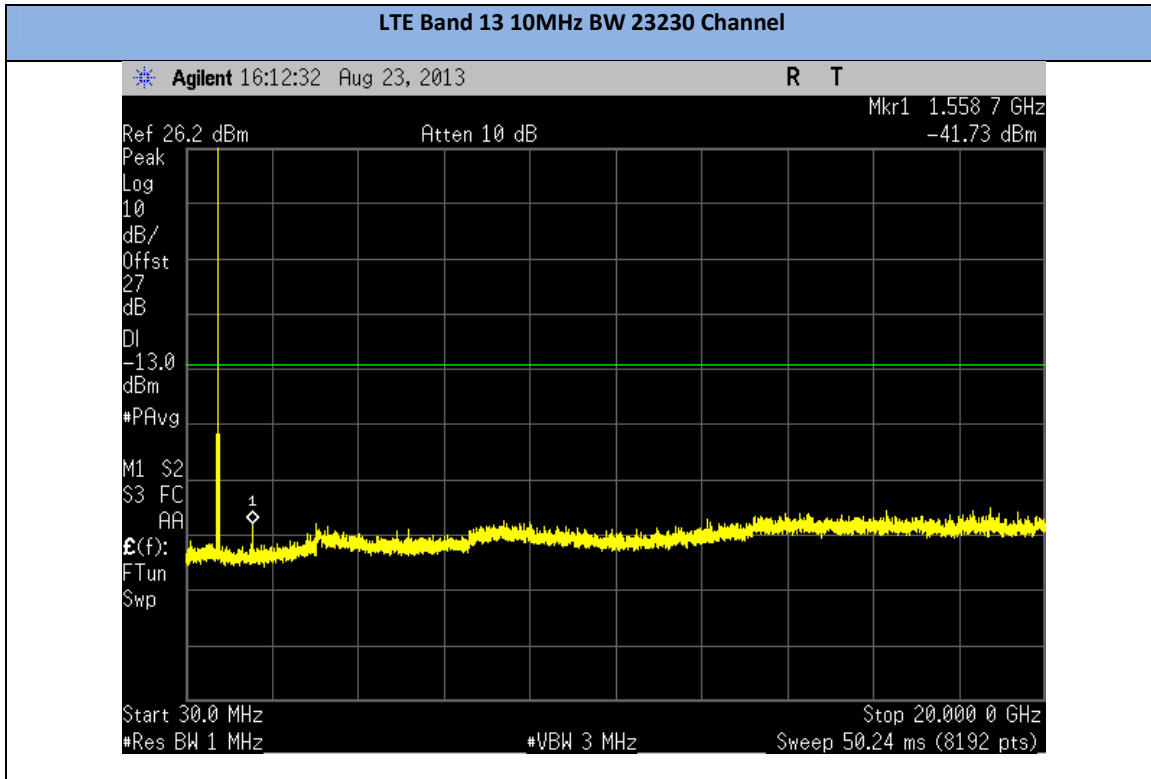
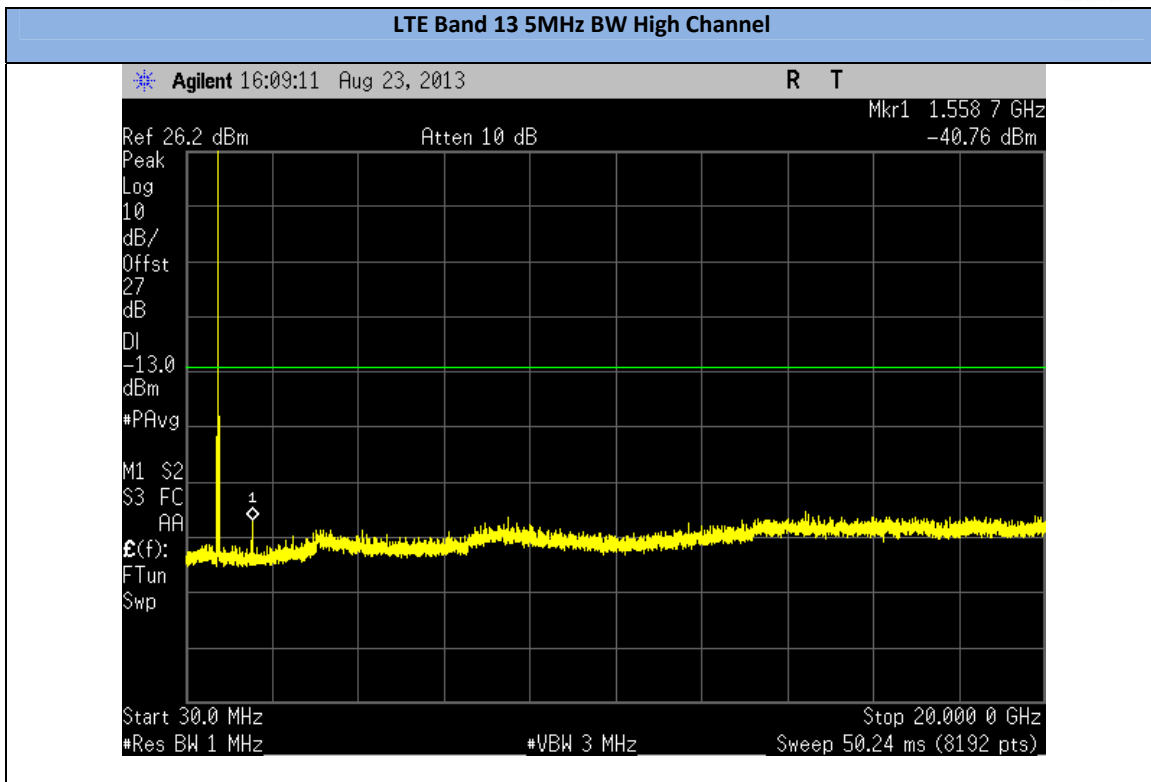


LTE Band 13 5MHz BW Low Channel



LTE Band 13 5MHz BW Mid Channel







2.8 FIELD STRENGTH OF SPURIOUS RADIATION

2.8.1 Specification Reference

Part 27 Subpart C §27.53(c) and (h) and Part 2.1053, RSS-139 Issue 2(6.5)

2.8.2 Standard Applicable

c) For operations in the 746-758 MHz band and the 776-788 MHz band, the power of any emission outside the licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, in accordance with the following: (1) On any frequency outside the 746-758 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) 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;

(h) For operations in the 1710–1755 MHz and 2110–2155 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.

2.8.3 Equipment Under Test and Modification State

Serial No: SEZ100073700125 / Test Configuration B

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

August 13 and 14, 2013/JMG/AC

2.8.5 Test Equipment Used

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

2.8.6 Environmental Conditions

Ambient Temperature	23.9 °C
Relative Humidity	51.2 %
ATM Pressure	99.2 kPa

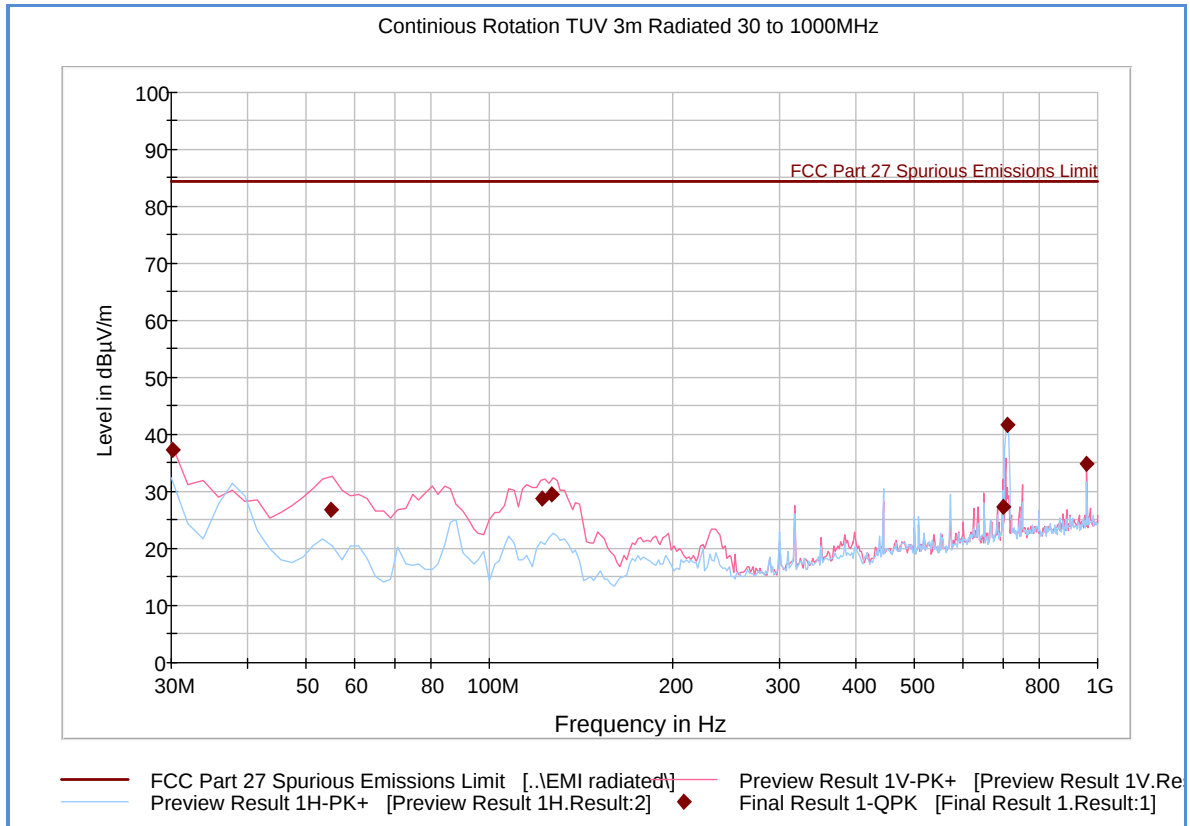
2.8.7 Additional Observations

- This is a radiated test using substitution method as per Unwanted Emissions: Radiated Spurious method of measurement of ANSI/TIA/EIA-603-C 2004, August 17, 2004.
- Only the worst case configuration presented in this test report.
- Measurement was done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only.

2.8.8 Test Results

See attached plots.

2.8.9 Test Results Below 1GHz-(Band 4 High CH 20375_QPSK 1_13)

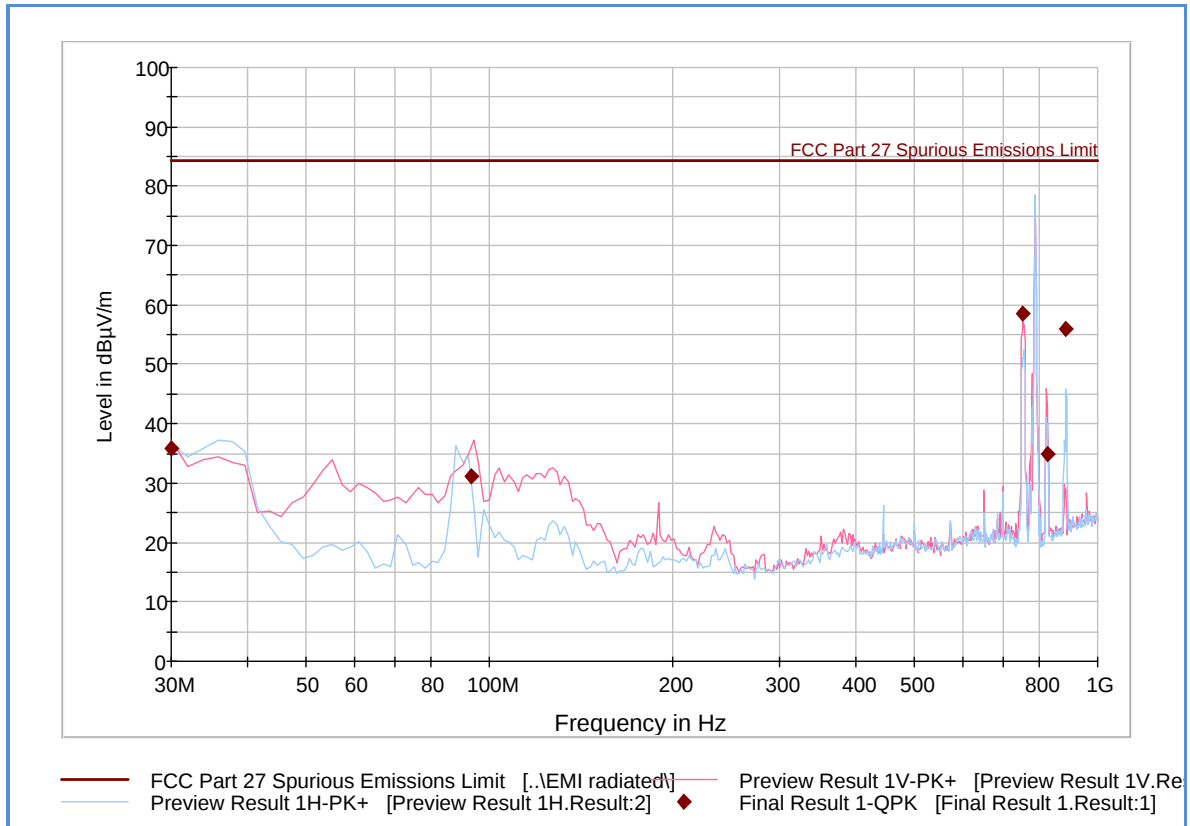


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
30.080000	37.3	1000.0	120.000	100.0	V	294.0	-10.8	47.1	84.4
55.030541	26.9	1000.0	120.000	100.0	V	253.0	-20.1	57.5	84.4
122.122725	28.7	1000.0	120.000	100.0	V	318.0	-19.5	55.7	84.4
126.794389	29.6	1000.0	120.000	100.0	V	324.0	-19.8	54.8	84.4
698.297395	27.3	1000.0	120.000	109.0	V	185.0	-2.1	57.1	84.4
710.320721	41.7	1000.0	120.000	158.0	H	132.0	-1.5	42.7	84.4
960.082244	35.0	1000.0	120.000	100.0	V	156.0	0.9	49.4	84.4

Test Notes: Only worst case channel presented for spurious emissions below 1GHz band 4. Emissions within 20dB of the Part 27 Subpart C §27.53 limit are proven by substitution method. However no such emission observed.

2.8.10 Test Results Below 1GHz-(Band 13 CH.23230 QPSK 1_49)

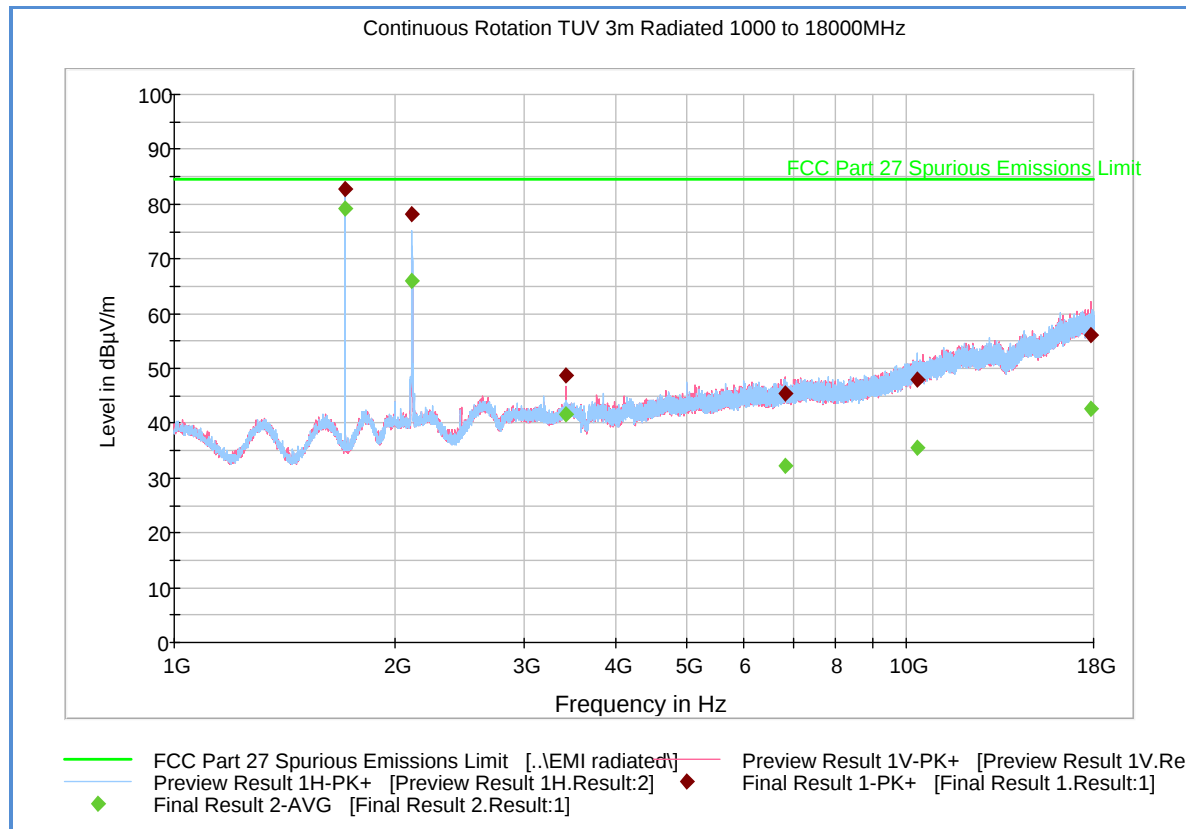


Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
30.000000	35.8	1000.0	120.000	100.0	V	164.0	-10.7	48.6	84.4
93.228297	31.1	1000.0	120.000	116.0	V	236.0	-19.4	53.3	84.4
751.366253	58.4	1000.0	120.000	250.0	V	198.0	-1.5	26.0	84.4
788.900120	115.1	1000.0	120.000	259.0	V	18.0	Fundamental		
826.050100	34.9	1000.0	120.000	140.0	V	8.0	-0.9	49.5	84.4
885.174509	56.0	1000.0	120.000	100.0	H	244.0	-0.4	28.4	84.4

Test Notes: Only worst case channel presented for spurious emissions below 1GHz band 13. Emissions within 20dB of the Part 27 Subpart C §27.53 limit are proven by substitution method. However no such emission observed. 788.90 MHz is part of the fundamental frequency and out of the scope of this test.

2.8.11 Test Results Above 1GHz (Low Channel - Worst Case Configuration Band 4)



Peak Data

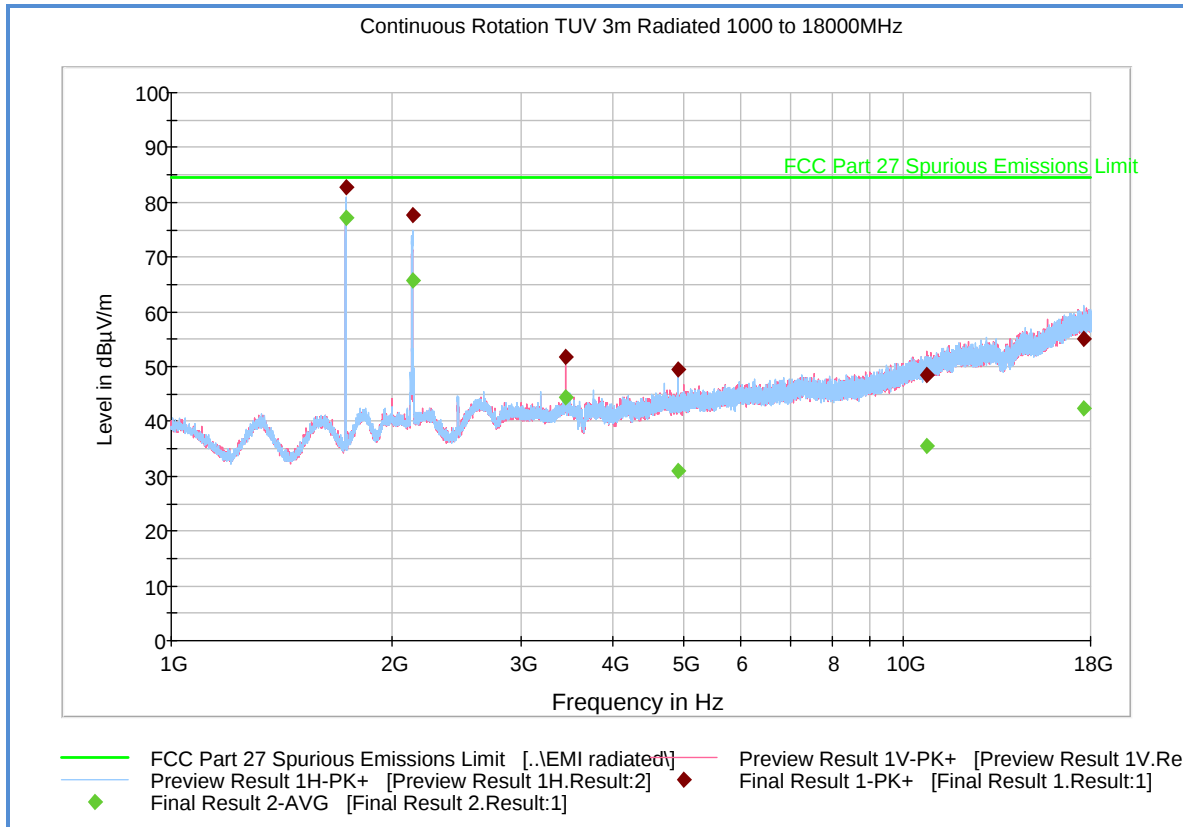
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1710.233333	82.6	1000.	1000.000	198.4	H	132.0		Fundamental	
2113.133333	78.2	1000.	1000.000	337.1	H	95.0		Downlink	
3420.600000	48.7	1000.	1000.000	123.6	V	313.0	1.9	35.7	84.4
6813.800000	45.5	1000.	1000.000	400.0	V	85.0	8.8	38.9	84.4
10342.03333	48.0	1000.	1000.000	134.6	H	322.0	13.3	36.4	84.4
17853.06666	56.1	1000.	1000.000	385.0	V	224.0	22.3	28.3	84.4

Substitution Data

Frequency (MHz)	Field Strength @ 3 meters (dBμV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance

Test Notes: Only worst case bandwidth/modulation presented for spurious emissions above 1GHz. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters). 2113.13 MHz is the downlink frequency from the CMW500.

2.8.12 Test Results Above 1GHz (Mid Channel - Worst Case Configuration Band 4)



Peak Data

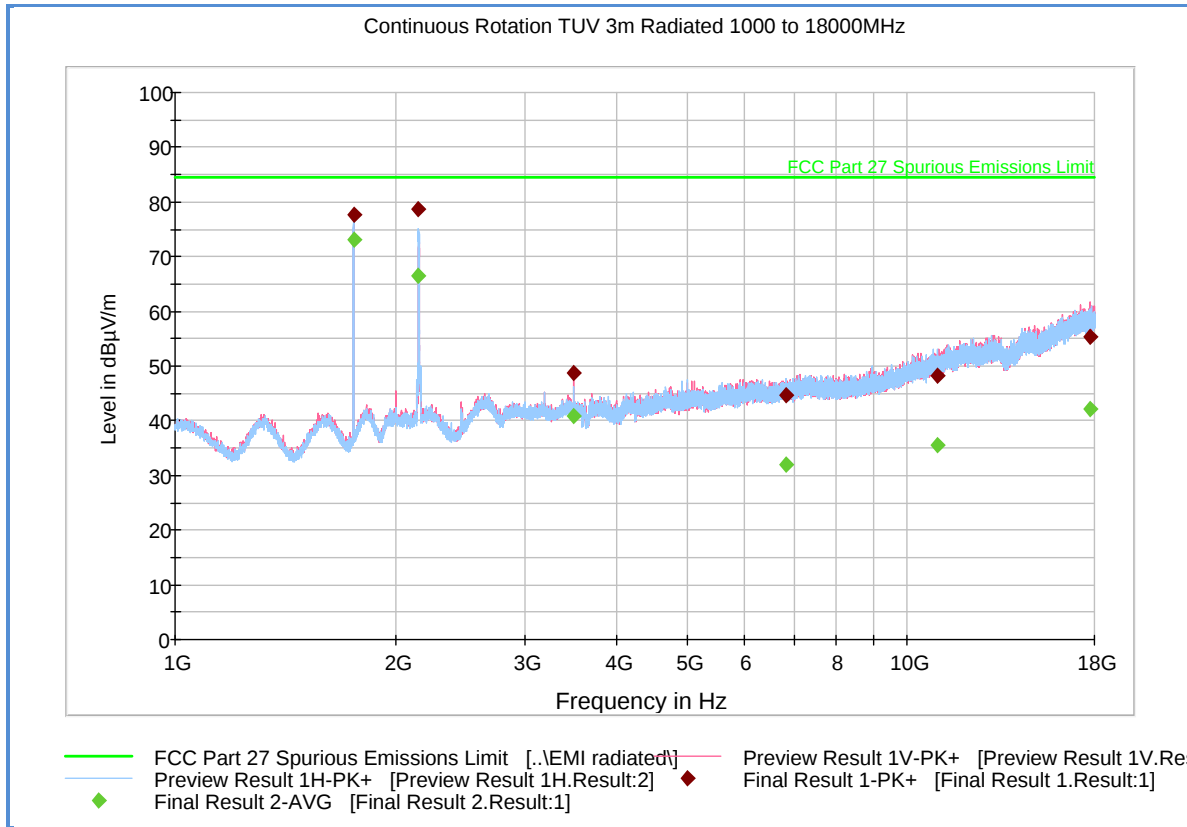
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1730.266667	82.7	1000.	1000.000	196.4	H	132.0		Fundamental	
2133.466667	77.6	1000.	1000.000	335.1	H	98.0		Downlink	
3460.666667	51.8	1000.	1000.000	149.5	V	293.0	2.0	32.6	84.4
4923.800000	49.6	1000.	1000.000	123.6	H	205.0	5.2	34.8	84.4
10758.23333	48.4	1000.	1000.000	203.4	V	128.0	13.8	36.0	84.4
17649.63333	55.1	1000.	1000.000	385.0	H	229.0	22.1	29.3	84.4

Substitution Data

Frequency (MHz)	Field Strength @ 3 meters (dBμV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance (Margin in dB)

Test Notes: Only worst case bandwidth/modulation presented for spurious emissions above 1GHz. 2133.46 MHz is the downlink frequency from the CMW500. Substitution data not required since margin is >20dB.

2.8.13 Test Results Above 1GHz (High Channel - Worst Case Configuration Band 4)



Peak Data

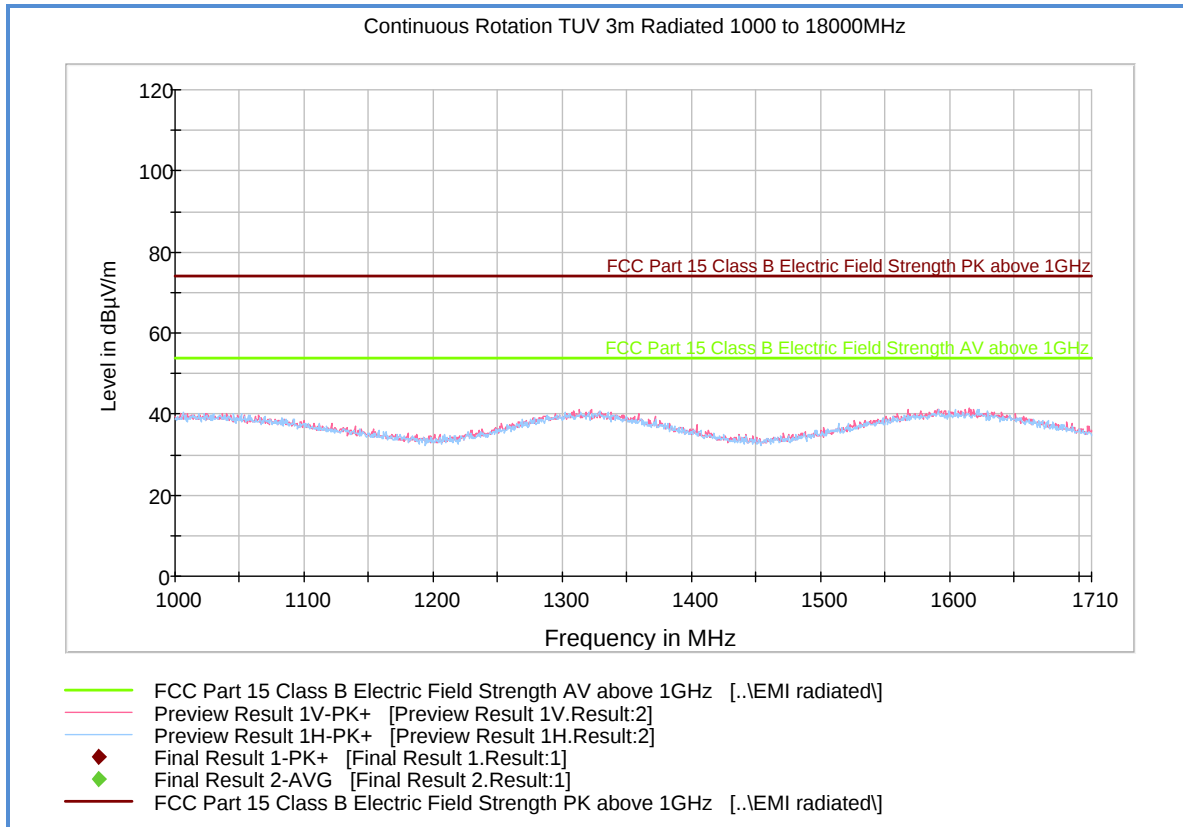
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1752.733333	77.7	1000.	1000.000	188.4	H	152.0		Fundamental	
2151.466667	78.6	1000.	1000.000	334.2	H	87.0		Downlink	
3505.433333	48.6	1000.	1000.000	249.3	V	254.0	2.2	35.8	84.4
6837.433333	44.7	1000.	1000.000	400.1	H	40.0	8.8	39.7	84.4
10997.666666	48.2	1000.	1000.000	388.1	H	126.0	14.5	36.2	84.4
17777.433333	55.3	1000.	1000.000	342.1	V	138.0	22.2	29.1	84.4

Substitution Data

Frequency (MHz)	Field Strength @ 3 meters (dBμV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance (Margin in dB)

Test Notes: Only worst case bandwidth/modulation presented for spurious emissions above 1GHz. 2151.46 MHz is the downlink frequency from the CMW500. Substitution data not required since margin is >20dB.

2.8.14 Test Results Between 1GHz and 1.71GHz-(Worst Case Channel/Configuration Band 4)



Peak Data

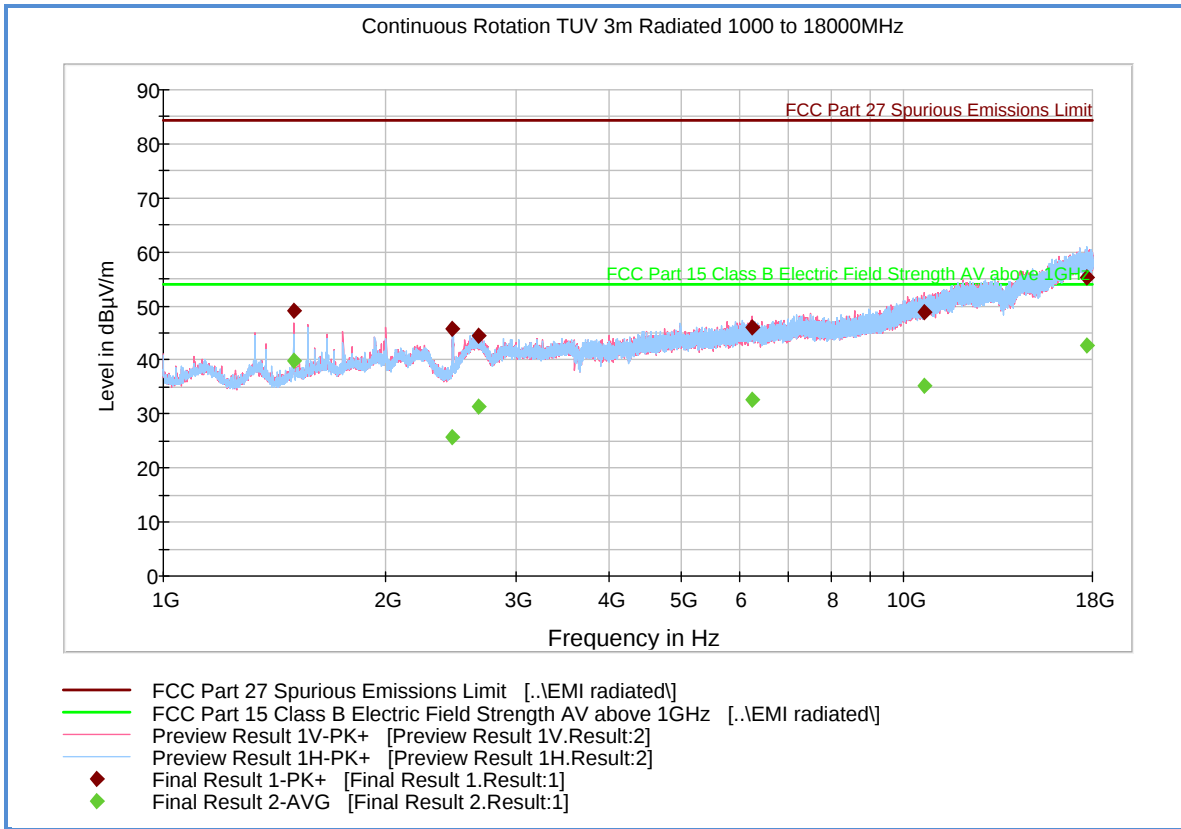
Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)

Average Data

Frequency (MHz)	QuasiPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)

Test Notes: No Emissions Observed in the 1000MHz to 1710MHz Band (No peaks calculated, Margin > 30 dB compared to Peak limit)

2.8.15 Test Results Above 1GHz (Low Channel-Worst Case Configuration Band 13)



Note.- FCC part 15 Class B (AV) Limit can be ignored for this test.

Peak Data

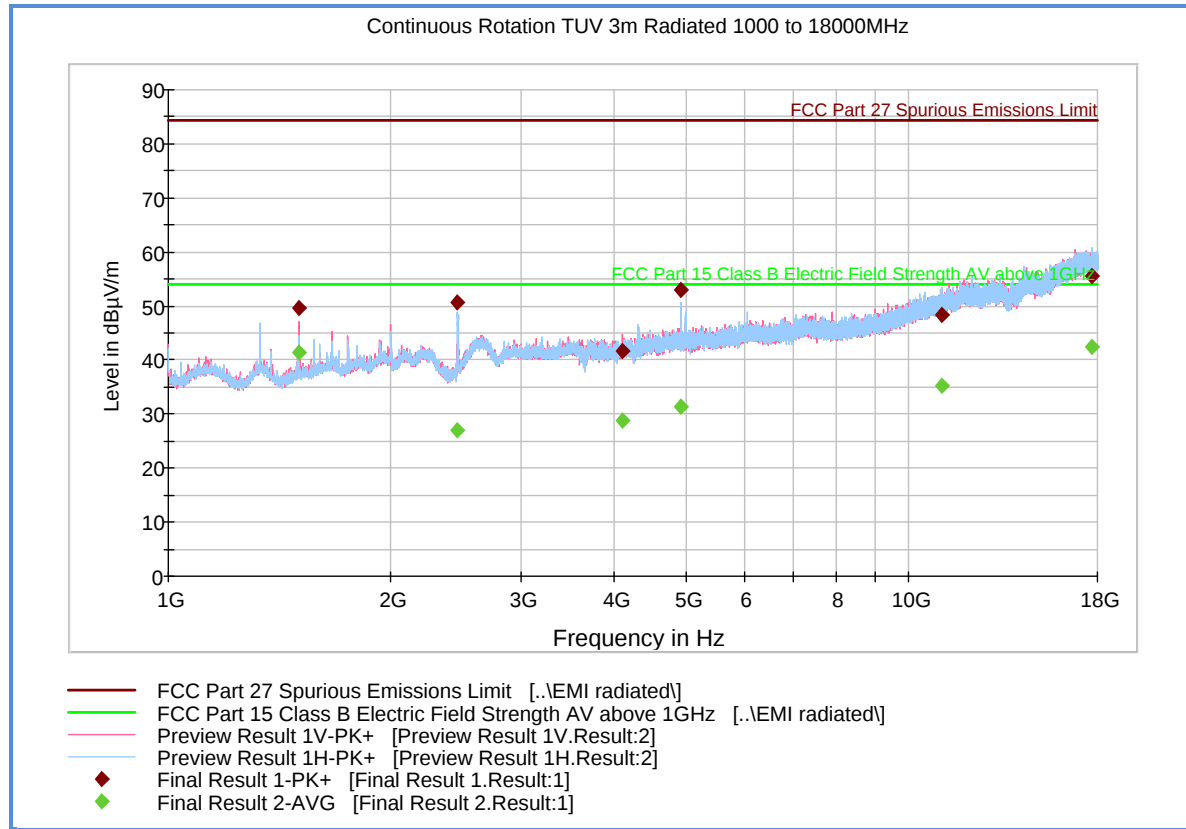
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1500.000000	49.1	1000.0	1000.000	301.1	V	22.0	-5.1	35.3	84.4
2460.266667	45.7	1000.0	1000.000	383.0	H	171.0	-0.2	38.7	84.4
2660.933333	44.5	1000.0	1000.000	400.2	V	-3.0	0.6	39.9	84.4
6256.766667	46.1	1000.0	1000.000	400.2	V	164.0	8.5	38.3	84.4
10651.466667	48.8	1000.0	1000.000	177.5	V	77.0	13.8	35.6	84.4
17664.533333	55.2	1000.0	1000.000	160.5	H	20.0	22.1	29.2	84.4

Substitution Data

Frequency (MHz)	Field Strength @ 3 meters (dBμV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance

Test Notes: Only worst case presented for spurious emissions above 1GHz, low Channel band 13. A 900MHz high pass filter was used. Substitution data not required since margin is >20dB.

2.8.16 Test Results Above 1GHz (Mid Channel-Worst Case Configuration Band 13)



Note.- FCC part 15 Class B (AV) Limit can be ignored for this test.

Peak Data

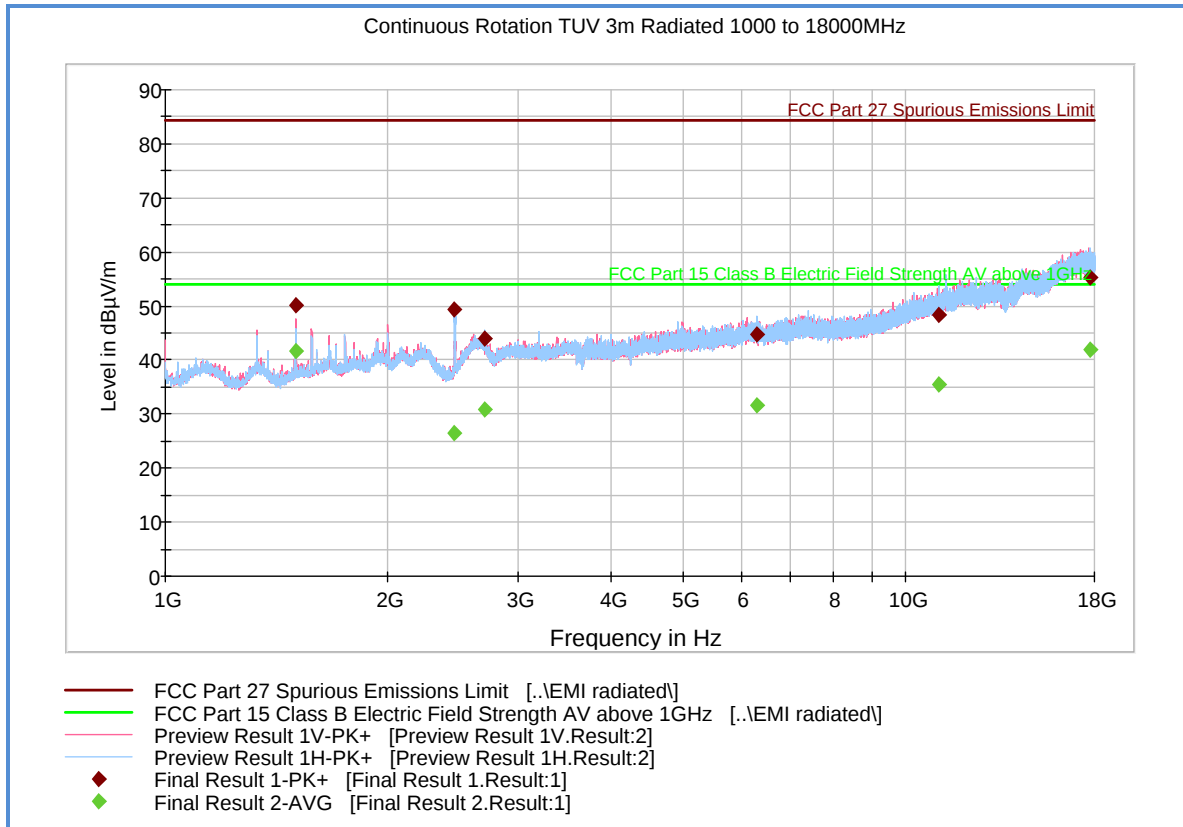
Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1500.000000	49.6	1000.0	1000.000	303.2	V	65.0	-5.1	34.8	84.4
2460.666667	50.7	1000.0	1000.000	99.6	H	171.0	-0.2	33.7	84.4
4103.266667	41.6	1000.0	1000.000	400.2	V	276.0	3.7	42.8	84.4
4923.800000	53.0	1000.0	1000.000	229.3	H	337.0	5.2	31.4	84.4
11107.100000	48.3	1000.0	1000.000	365.1	H	16.0	14.6	36.1	84.4
17678.666667	55.5	1000.0	1000.000	201.4	V	22.0	22.1	28.9	84.4

Substitution Data

Frequency (MHz)	Field Strength @ 3 meters (dBμV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance

Test Notes: Only worst case presented for spurious emissions above 1GHz, Mid Channel band 13. A 900MHz high pass filter was used. Substitution data not required since margin is >20dB.

2.8.17 Test Results Above 1GHz (High Channel-Worst Case Configuration Band 13)



Note.- FCC part 15 Class B (AV) Limit can be ignored for this test.

Peak Data

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1500.000000	50.1	1000.0	1000.000	301.2	V	65.0	-5.1	34.3	84.4
2460.700000	49.4	1000.0	1000.000	101.6	H	188.0	-0.2	35.0	84.4
2697.366667	43.9	1000.0	1000.000	400.1	H	-11.0	0.7	40.5	84.4
6294.766667	44.8	1000.0	1000.000	268.3	H	27.0	8.4	39.6	84.4
11095.366667	48.2	1000.0	1000.000	300.6	H	354.0	14.6	36.2	84.4
17744.266667	55.2	1000.0	1000.000	400.1	H	20.0	22.1	29.2	84.4

Substitution Data

Frequency (MHz)	Field Strength @ 3 meters (dBμV/m)	Cable Loss (dB)	Substitution Antenna Gain (dBi)	Signal Generator Level (dBm)	Substitution Data SGL+AG-CL (dBm)	Limit (dBm)	Compliance

Test Notes: Only worst case presented for spurious emissions above 1GHz, High Channel band 13. A 900MHz high pass filter was used. Substitution data not required since margin is >20dB.



2.9 FREQUENCY STABILITY

2.9.1 Specification Reference

Part 27 Subpart C §27.54 and Part 2.1055(a)(1) and (d)(1), RSS-139(6.3)

2.9.2 Standard Applicable

The frequency stability shall be sufficient to ensure that the fundamental emissions stay within the authorized bands of operation.

2.9.3 Equipment Under Test and Modification State

Serial No: SEZ100073700125 / Test Configuration A

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

August 16, 2013/AC

2.9.5 Test Equipment Used

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

2.9.6 Environmental Conditions

Ambient Temperature	24.9°C
Relative Humidity	50.6%
ATM Pressure	99.7 kPa

2.9.7 Additional Observations

- This is a conducted test. The EUT was operated at 5.0 VDC nominal voltage and was placed in the temperature chamber for this evaluation. The EUT was controlled by a CMW500 and the maximum frequency error was monitored through the Wideband Radio Communication Tester Frequency Error measurement function under LTE Tx Measurement. These results are then verified against Transmit Frequency Error function of the Spectrum Analyzer used.
- The Temperature was reduced to -30°C and allowed to sit for 1 hour to allow the equipment and chamber temperature to stabilize. The measurements on both Band 4 and Band 13 were then performed. The temperature was then increased by 10°C steps and allowed to settle before taking the next set of measurements.
- Voltage variation was also performed at 85% and 115% of the nominal voltage.
- Only worst case configuration presented. See Section 1.4.4 of this test report for details.
- The maximum frequency deviation was verified against the frequency band edges using the EBW data. Sample calculation:

<i>LTE Band 4 worst case frequency error:</i>	<i>-18.32 Hz</i>
<i>Worst case 99% OBW of LTE Band 4 5.0MHz BW:</i>	<i>4.502 MHz</i>



Low Channel Sample Calculation:

Edge of fundamental emission $(1712.5 - (4.502/2))$: 1710.249 MHz
 Max. fundamental frequency error $(1710.249 - 0.00001832)$: 1710.24898168MHz
 EUT complies. 1710.24898168MHz > 1710 MHz (edge of authorized band)

High Channel Sample Calculation:

Edge of fundamental emission $(1752.5 + (4.502/2))$: 1754.751MHz
 Max. fundamental frequency error $(1755.007 - 0.00001832)$: 1754.75098168MHz
 EUT complies. 1754.75098168MHz < 1755 MHz (edge of authorized band)

2.9.8 Test Results Summary

LTE Band 4 – QPSK 5MHz - Channel 20375– Frequency 1752.5MHz – RB 1/13				
Voltage (%)	Power (VDC)	Temp (°C)	Frequency Deviation (Hz)	Complies (Y or N)
100	5.0	-30	-16.75	EUT complies. See Section 2.9.7 for sample calculation
100		-20	-15.51	
100		-10	-18.32	
100		0	-14.91	
100		+10	-16.52	
100		+20	-17.01	
100		+30	-14.51	
100		+40	-14.93	
100		+50	-15.01	
115	5.75	+20	-13.49	
85	4.25	+20	-14.18	



LTE Band 13 – QPSK 10MHz - Channel 23230– Frequency 782.0MHz – RB 1/49				
<i>Voltage (%)</i>	<i>Power (VDC)</i>	<i>Temp (°C)</i>	<i>Frequency Deviation (Hz)</i>	<i>Complies (Y or N)</i>
100	5.0	-30	-6.24	EUT complies. See Section 2.9.7 for sample calculation
100		-20	9.83	
100		-10	8.80	
100		0	10.13	
100		+10	8.77	
100		+20	15.58	
100		+30	15.68	
100		+40	-6.25	
100		+50	-8.44	
115	5.75	+20	9.76	
85	4.25	+20	14.92	



2.10 RECEIVER SPURIOUS EMISSIONS

2.10.1 Specification Reference

RSS-139(6.6) and RSS-GEN Issue 3

2.10.2 Standard Applicable

Receiver spurious emissions shall comply with the limits specified in RSS-Gen.

2.10.3 Equipment Under Test and Modification State

Serial No: SEZ100073700125 / Test Configuration B

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

August 07, 2013/AC

2.10.5 Test Equipment Used

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

2.10.6 Environmental Conditions

Ambient Temperature	25.1°C
Relative Humidity	51.8%
ATM Pressure	100.1 kPa

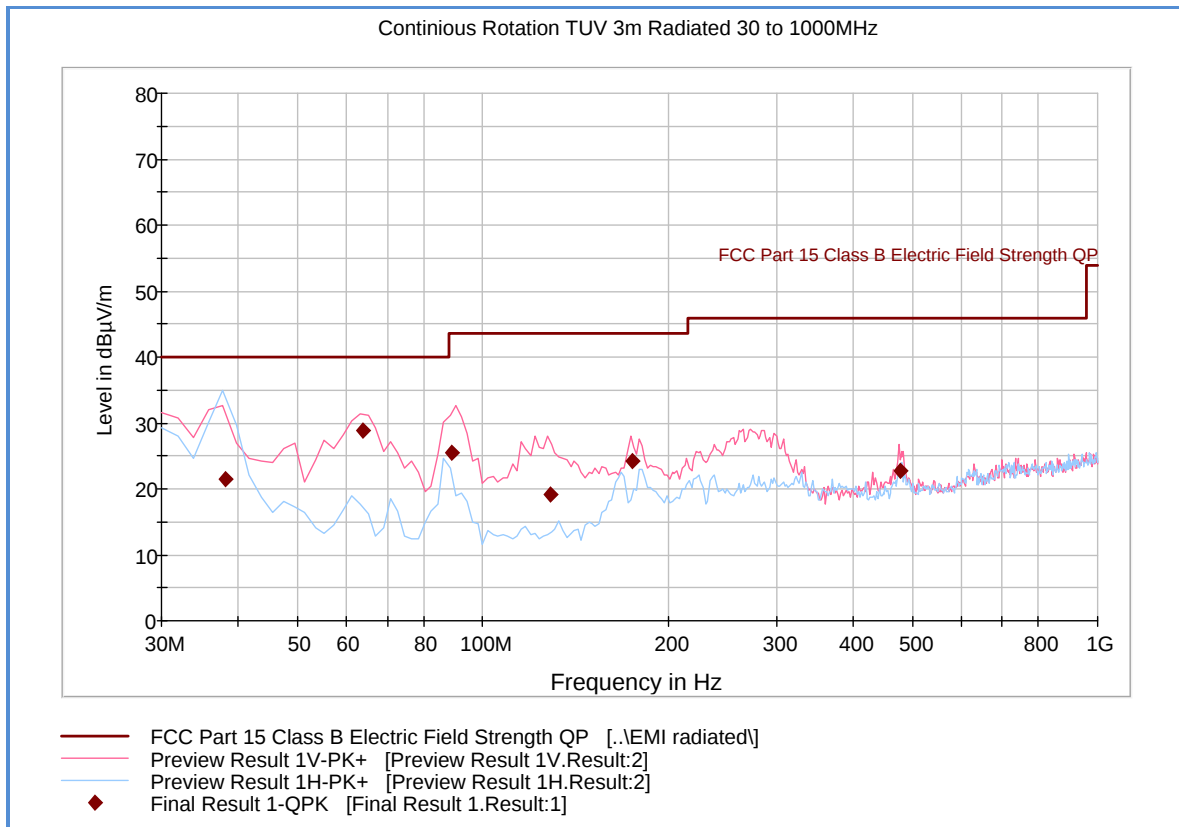
2.10.7 Additional Observations

- This is a radiated test. The spectrum was searched from 30MHz to the 18GHz
- Limit used is from FCC §15.209 which is identical to RSS-Gen limits.
- There are no separate receive mode configurable during verification, the EUT was verified in stand-by mode.
- Measurement was done using EMC32 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only.

2.10.8 Test Results

See attached plots.

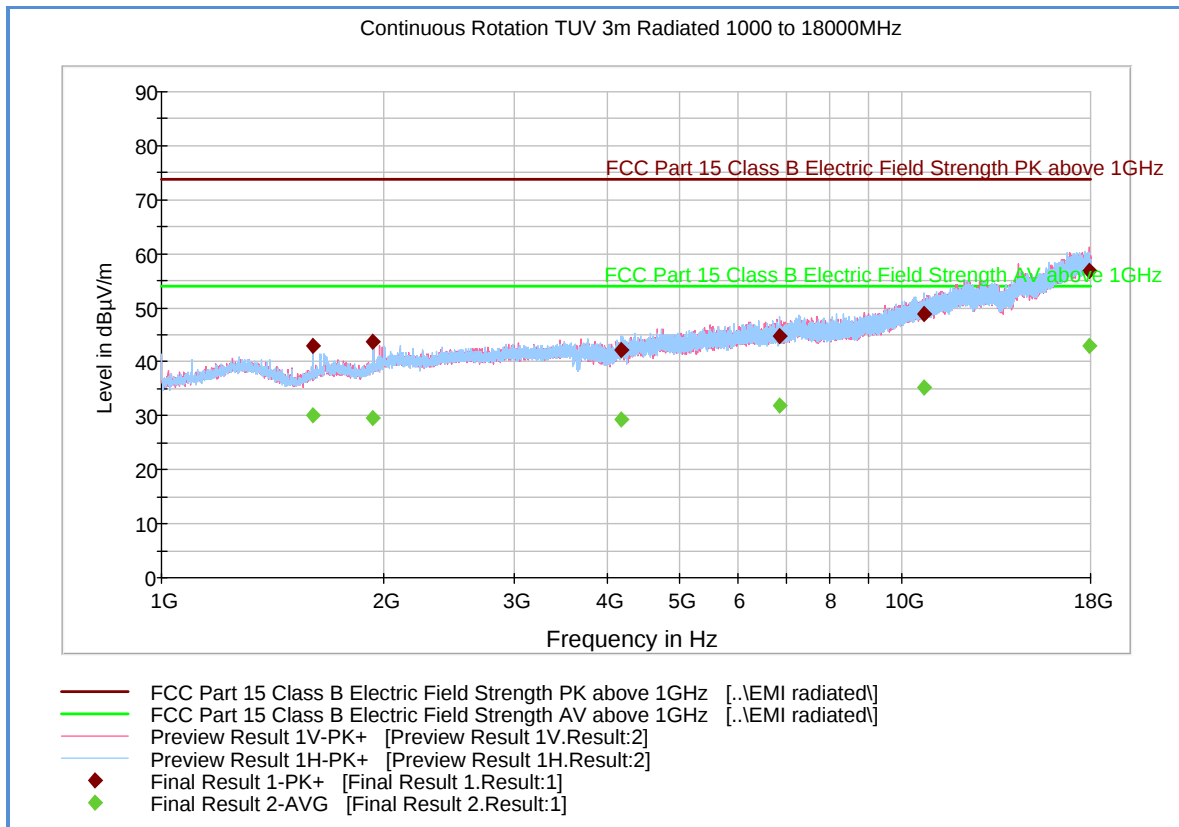
2.10.9 Test Results Below 1GHz (Receive Mode)



Quasi Peak Data

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
38.175551	21.5	1000.0	120.000	365.0	H	15.0	-15.3	18.5	40.0
63.726092	28.7	1000.0	120.000	110.0	V	173.0	-21.4	11.3	40.0
89.212745	25.4	1000.0	120.000	150.0	V	15.0	-20.1	18.1	43.5
128.754389	19.1	1000.0	120.000	106.0	V	15.0	-19.9	24.4	43.5
175.247695	24.2	1000.0	120.000	100.0	V	325.0	-17.0	19.3	43.5
477.958076	22.7	1000.0	120.000	120.0	V	316.0	-5.8	23.3	46.0

2.10.10 Test Results Above 1GHz (Receive Mode)



Peak Data

Frequency (MHz)	MaxPeak (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1599.900000	43.0	1000.0	1000.000	400.5	H	46.0	-4.3	30.9	73.9
1931.966667	43.8	1000.0	1000.000	355.1	V	39.0	-2.0	30.1	73.9
4174.866667	42.1	1000.0	1000.000	131.6	H	270.0	3.7	31.8	73.9
6830.666667	44.6	1000.0	1000.000	158.5	H	283.0	8.8	29.3	73.9
10721.700000	49.0	1000.0	1000.000	300.2	H	194.0	13.8	24.9	73.9
17896.733333	56.8	1000.0	1000.000	203.4	V	278.0	22.4	17.1	73.9

Average Data

Frequency (MHz)	Average (dBμV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBμV/m)
1599.900000	30.1	1000.0	1000.000	400.5	H	46.0	-4.3	23.8	53.9
1931.966667	29.5	1000.0	1000.000	355.1	V	39.0	-2.0	24.4	53.9
4174.866667	29.4	1000.0	1000.000	131.6	H	270.0	3.7	24.5	53.9
6830.666667	31.9	1000.0	1000.000	158.5	H	283.0	8.8	22.0	53.9
10721.700000	35.3	1000.0	1000.000	300.2	H	194.0	13.8	18.6	53.9
17896.733333	42.9	1000.0	1000.000	203.4	V	278.0	22.4	11.0	53.9

Test Notes: No significant emissions observed.

2.11 POWER LINE CONDUCTED EMISSIONS

2.11.1 Specification Reference

RSS-Gen 7.2.4

2.11.2 Standard Applicable

Except when the requirements applicable to a given device state otherwise, for any radio apparatus equipped to operate from the public utility AC power supply, either directly or indirectly (such as with a battery charger), the radio frequency voltage of emissions conducted back onto the AC power lines in the frequency range of 0.15 MHz to 30 MHz shall not exceed the limits shown in the table below. The more stringent limit applies at the frequency range boundaries.

The conducted emissions shall be measured with a 50 ohm/50 microhenry line impedance stabilization network (LISN).

Frequency of emission (MHz)	Conducted limit (dBμV)	
	Quasi-peak	Average
0.15–0.5	66 to 56*	56 to 46*
0.5–5	56	46
5–30	60	50

**Decreases with the logarithm of the frequency.*

2.11.3 Equipment Under Test and Modification State

Serial No: SEZ100073700125 / Test Configuration B

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

August 14, 2013/JMG

2.11.5 Test Equipment Used

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

2.11.6 Environmental Conditions

Ambient Temperature 24.7°C
Relative Humidity 51.0%
ATM Pressure 99.1 kPa

2.11.7 Additional Observations

- Limit used is from FCC Part 15.107 Class B which is identical to RSS-Gen limits.
- Voltage confirmed was 120VAC / 50 Hz
- Only worst case condition was verified (LTE Band 4 BW 5MHz High Channel)



- Measurement was done using EMC32 V8.53 automated software. Reported level is the actual level with all the correction factors factored in. Correction Factor column is for informational purposes only. See Section 2.11.8 for sample computation.

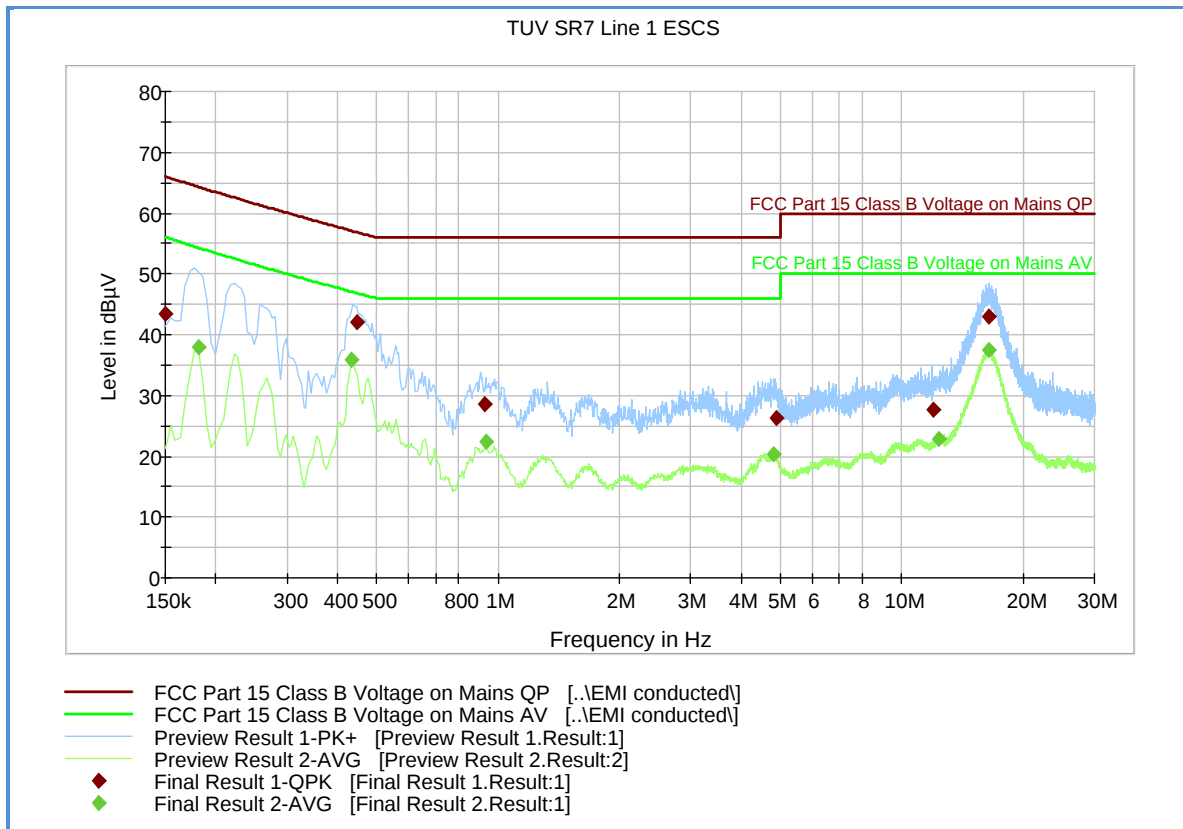
2.11.8 Sample Computation (Conducted Emission – Quasi Peak)

Measuring equipment raw measurement (dbμV) @ 150kHz			5.5
Correction Factor (dB)	Asset# 8607 (20 dB attenuator)	19.9	20.7
	Asset# 1177 (cable)	0.15	
	Asset# 1176 (cable)	0.35	
	Asset# 7568 (LISN)	0.30	
Reported QuasiPeak Final Measurement (dbμV) @ 150kHz			26.2

2.11.9 Test Results

Compliant. See attached plots and tables.

2.11.9.1 Line 1 (Worst Case Band 4)



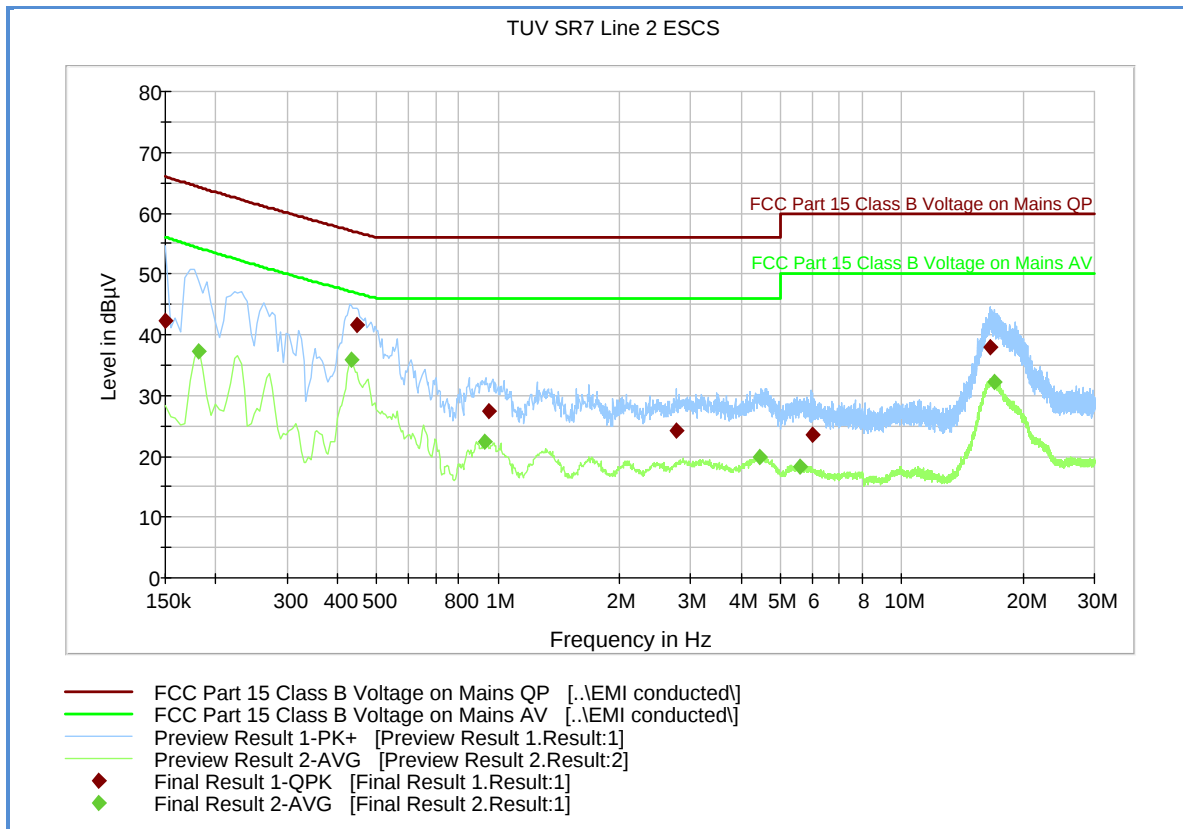
Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	43.4	1000.0	9.000	Off	L1	20.4	22.6	66.0
0.447000	42.0	1000.0	9.000	Off	L1	20.2	14.8	56.9
0.924000	28.7	1000.0	9.000	Off	L1	20.2	27.3	56.0
4.879500	26.3	1000.0	9.000	Off	L1	20.4	29.7	56.0
11.944500	27.6	1000.0	9.000	Off	L1	20.5	32.4	60.0
16.372500	43.0	1000.0	9.000	Off	L1	20.8	17.0	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.181500	38.0	1000.0	9.000	Off	L1	20.4	16.3	54.3
0.433500	35.8	1000.0	9.000	Off	L1	20.2	11.3	47.1
0.933000	22.5	1000.0	9.000	Off	L1	20.2	23.5	46.0
4.830000	20.5	1000.0	9.000	Off	L1	20.4	25.5	46.0
12.381000	22.8	1000.0	9.000	Off	L1	20.5	27.2	50.0
16.422000	37.5	1000.0	9.000	Off	L1	20.8	12.5	50.0

2.11.9.2 Line 2 (Worst Case Band 4)



Quasi Peak

Frequency (MHz)	QuasiPeak (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - QPK (dB)	Limit - QPK (dBµV)
0.150000	42.3	1000.0	9.000	Off	N	21.2	23.7	66.0
0.447000	41.5	1000.0	9.000	Off	N	21.1	15.3	56.9
0.951000	27.5	1000.0	9.000	Off	N	21.1	28.6	56.0
2.769000	24.3	1000.0	9.000	Off	N	21.1	31.7	56.0
6.022500	23.6	1000.0	9.000	Off	N	21.2	36.4	60.0
16.602000	38.0	1000.0	9.000	Off	N	21.6	22.0	60.0

Average

Frequency (MHz)	Average (dBµV)	Meas. Time (ms)	Bandwidth (kHz)	Filter	Line	Corr. (dB)	Margin - Ave (dB)	Limit - Ave (dBµV)
0.181500	37.2	1000.0	9.000	Off	N	21.2	17.0	54.3
0.433500	35.8	1000.0	9.000	Off	N	21.1	11.3	47.1
0.924000	22.3	1000.0	9.000	Off	N	21.1	23.7	46.0
4.456500	19.9	1000.0	9.000	Off	N	21.2	26.1	46.0
5.613000	18.2	1000.0	9.000	Off	N	21.2	31.8	50.0
16.935000	32.3	1000.0	9.000	Off	N	21.6	17.7	50.0



SECTION 3

TEST EQUIPMENT USED



3.1 TEST EQUIPMENT USED

List of absolute measuring and other principal items of test equipment.

ID Number (SDGE/SDRB)	Test Equipment	Type	Serial Number	Manufacturer	Cal Date	Cal Due Date
Conducted Port Setup						
7569	Series Power Meter	N1911A P-	MY45100625	Agilent	04/15/13	04/15/14
7570	50MHz-18GHz Wideband Power Sensor	N1921A	MY45240588	Agilent	05/06/13	05/06/14
7571	Wideband Radio Communication Tester	CMW 500	1201.0002k50/103829	Rhode & Schwarz	05/06/13	05/06/14
6814	PSA Series Spectrum Analyzer	E4440A	MY42510441	Agilent	11/07/12	11/07/13
7579	Temperature Chamber	Model 115	92009707	Test Equity	07/16/13	07/16/14
8686	20dB Attenuator	0846	BW-N20W5+	MCL	Verified by 6814 and 1003	
Radiated Test Setup						
1033	Bilog Antenna	3142C	00044556	EMCO	06/25/13	06/25/14
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	03/25/13	03/25/14
1051	Double-ridged waveguide horn antenna	3115	9408-4329	EMCO	06/11/13	06/11/14
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	09/21/12	09/21/13
1153	High-frequency cable	SucoFlex 100 SX	N/A	Suhner	09/21/12	09/21/13
8543	High-frequency cable	Micropore 19057793	N/A	United Microwave Products	09/21/12	09/21/13
1040	EMI Test Receiver	ESIB40	100292	Rhode & Schwarz	07/31/13	07/31/14
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	07/24/13	07/24/14
TUV777	900MHz High Pass Filter	FF6549-1	004	Sage	Verified by 1049 and 1003	
TUV783	2.0GHz High Pass Filter	FF6549-2	008	Sage	Verified by 1049 and 1003	
1016	Pre-amplifier	PAM-0202	187	PAM	09/24/12	09/24/13
Conducted Emissions						
1024	EMI Test Receiver	ESCS 30	847793/001	Rhode & Schwarz	03/11/13	03/11/14
7567	LISN	FCC-LISN-50-25-2-10	120304	Fischer Custom Comm.	06/11/13	06/11/14
7568	LISN	FCC-LISN-50-25-2-10	120305	Fischer Custom Comm.	07/10/13	07/10/14
8607	20dB Attenuator	CAT-20	N/A	MCL HAT-20	08/21/12	08/21/13
8609	20dB Attenuator	CAT-20	N/A	MCL HAT-20	08/21/12	08/21/13
Miscellaneous						
	Test Software	EMC32	V8.53	Rhode & Schwarz	N/A	
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	11/12/12	11/12/13
6452	Multimeter	3478A	2911A52177	Hewlett Packard	08/02/13	08/02/14
7560	Barometer/Temperature /Humidity Transmitter	iBTHX-W	1240476	Omega	11/19/12	11/19/13
7539	DC Power Supply	6434B	1140A01866	Hewlett Packard	Verified by 6452	

Note.- For ID #8607 and 8609 Conducted Emission Was performed on August 14, 2013. (when the the Equipment was within the calibration range.)

3.2 MEASUREMENT UNCERTAINTY

For a 95% confidence level, the measurement uncertainties for defined systems are:

3.2.1 Radiated Emission Measurements (Below 1GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.45	0.26	0.07
2	Cables	Rectangular	0.50	0.29	0.08
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.75	0.43	0.19
5	Site	Rectangular	3.89	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.41
Coverage Factor (k):					2
Expanded Uncertainty:					4.82

3.2.2 Radiated Emission Measurements (Above 1GHz)

Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.70	0.40	0.16
3	Preamp	Rectangular	0.50	0.29	0.08
4	Antenna	Rectangular	0.37	0.21	0.05
5	Site	Rectangular	3.89	2.25	5.04
6	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					2.40
Coverage Factor (k):					2
Expanded Uncertainty:					4.81

3.2.3 Conducted Antenna Port Measurement

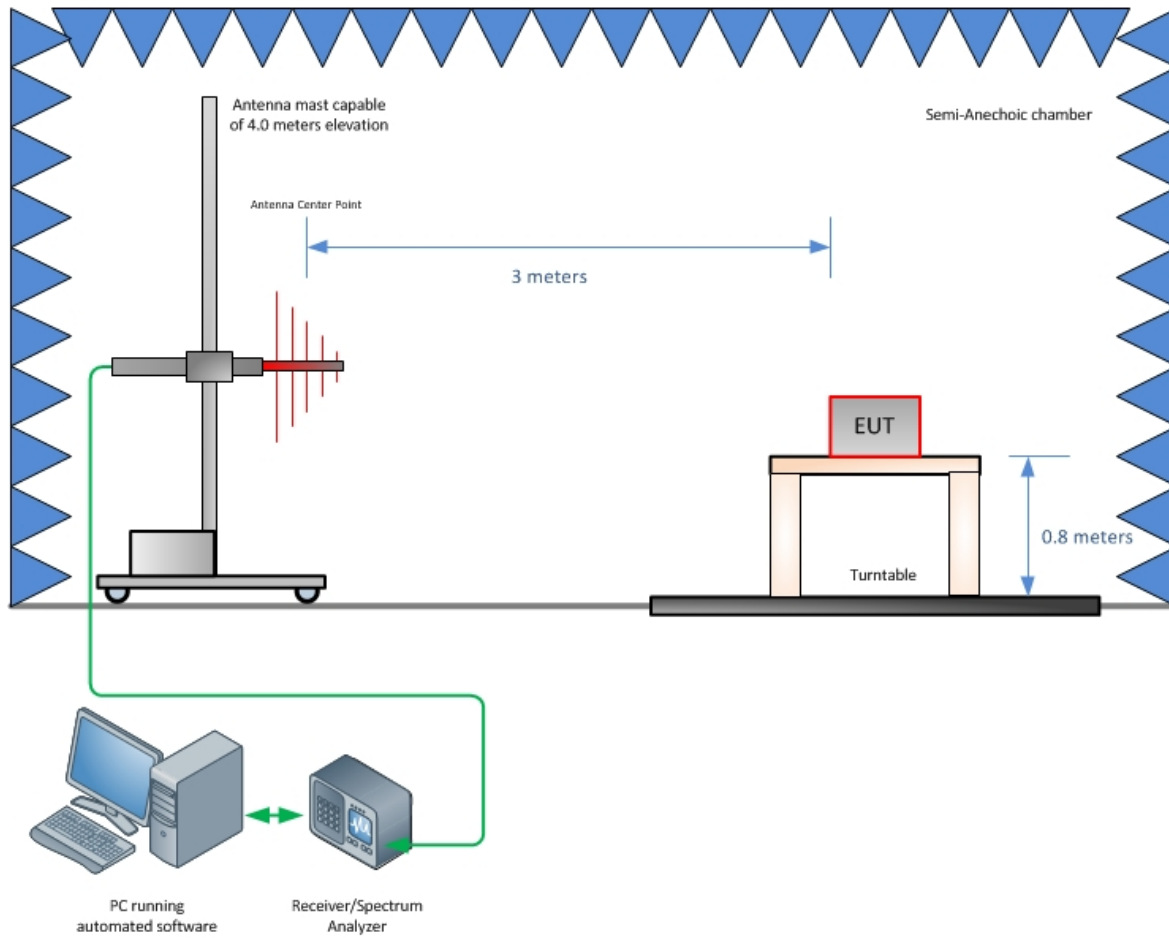
Contribution		Probability Distribution Type	Probability Distribution x_i	Standard Uncertainty $u(x_i)$	$[u(x_i)]^2$
1	Receiver/Spectrum Analyzer	Rectangular	0.57	0.33	0.11
2	Cables	Rectangular	0.50	0.29	0.08
3	EUT Setup	Rectangular	1.00	0.58	0.33
Combined Uncertainty (u_c):					0.72
Coverage Factor (k):					2
Expanded Uncertainty:					1.45



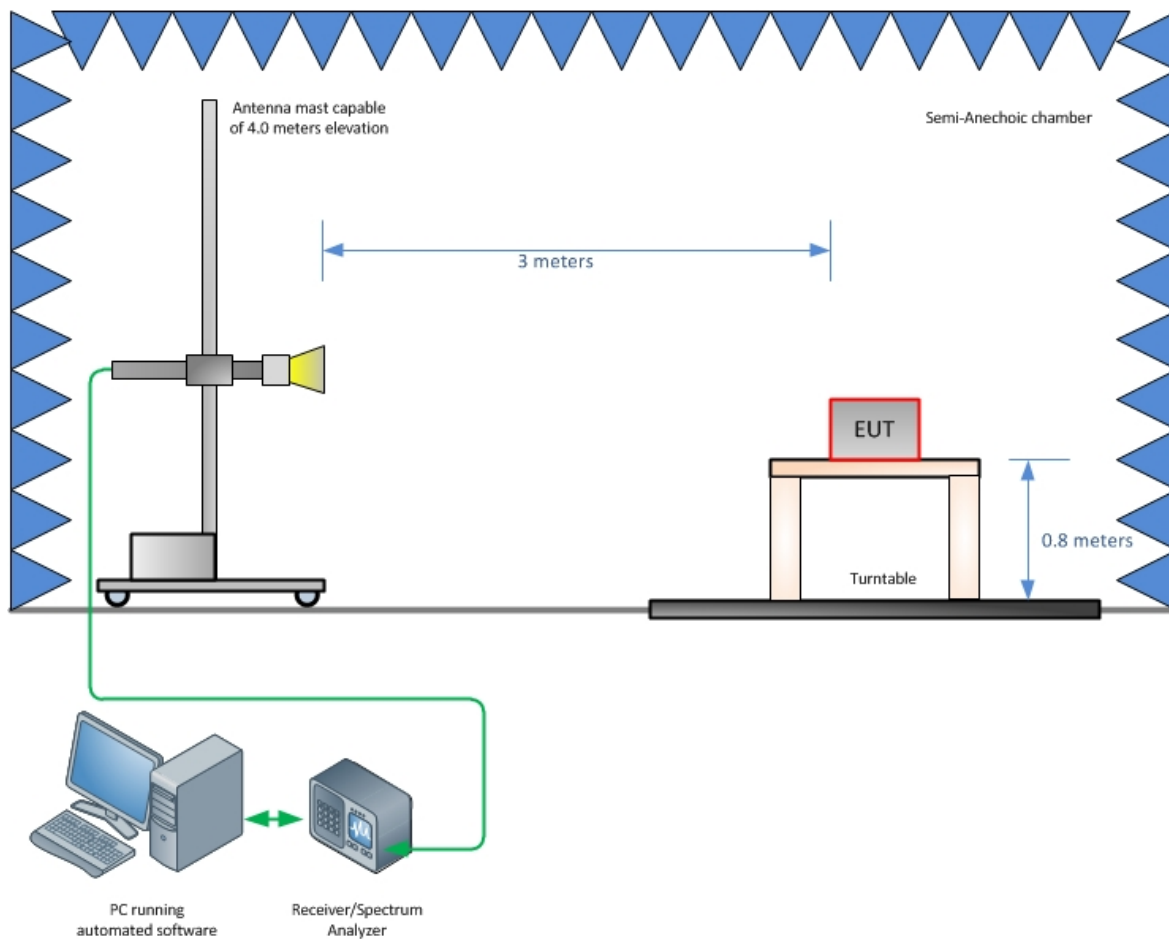
SECTION 4

DIAGRAM OF TEST SETUP

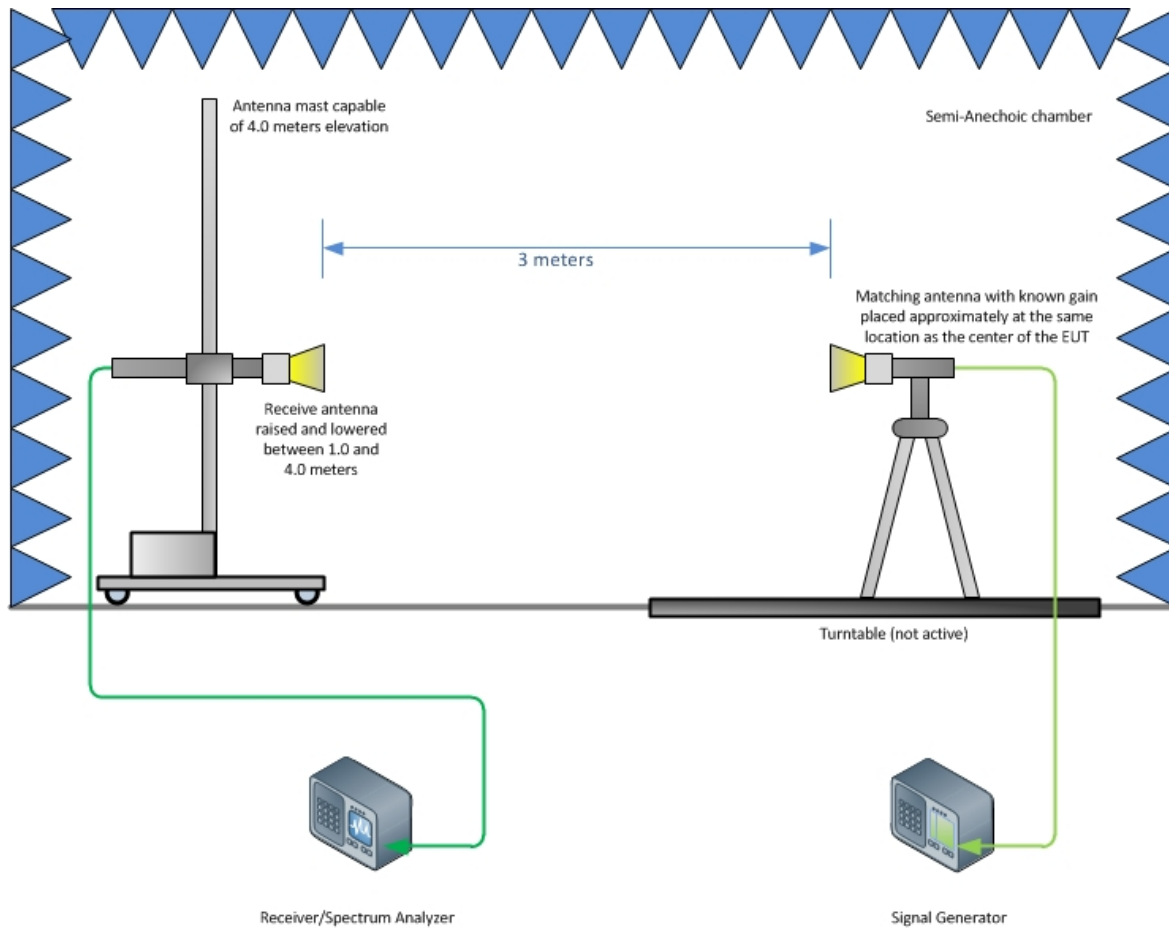
4.1 TEST SETUP DIAGRAM



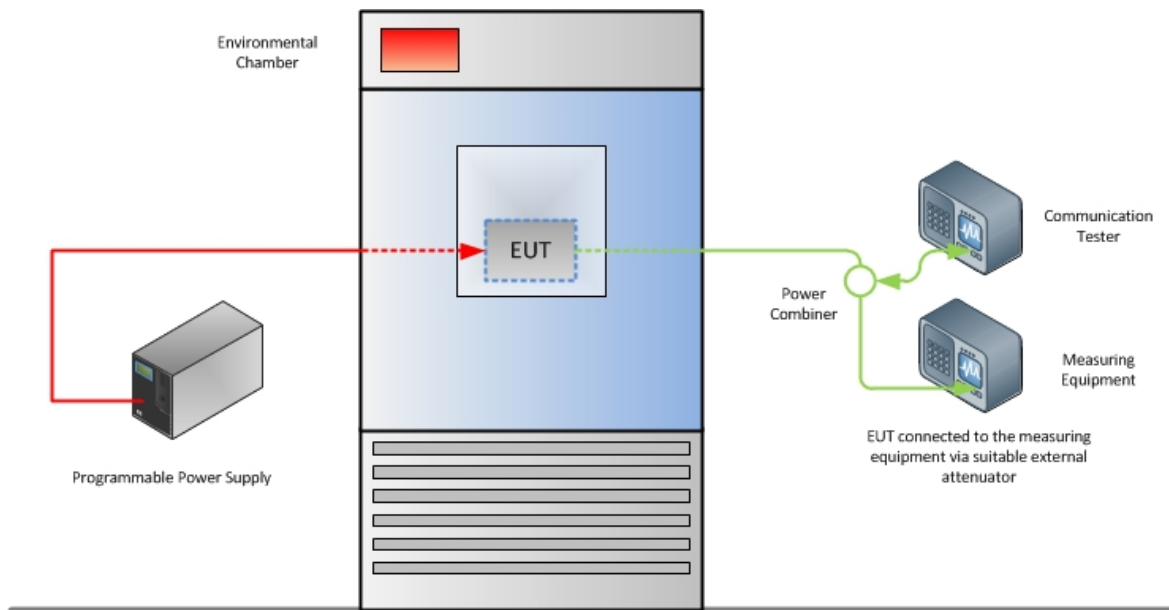
Radiated Emission Test Setup (Below 1GHz)



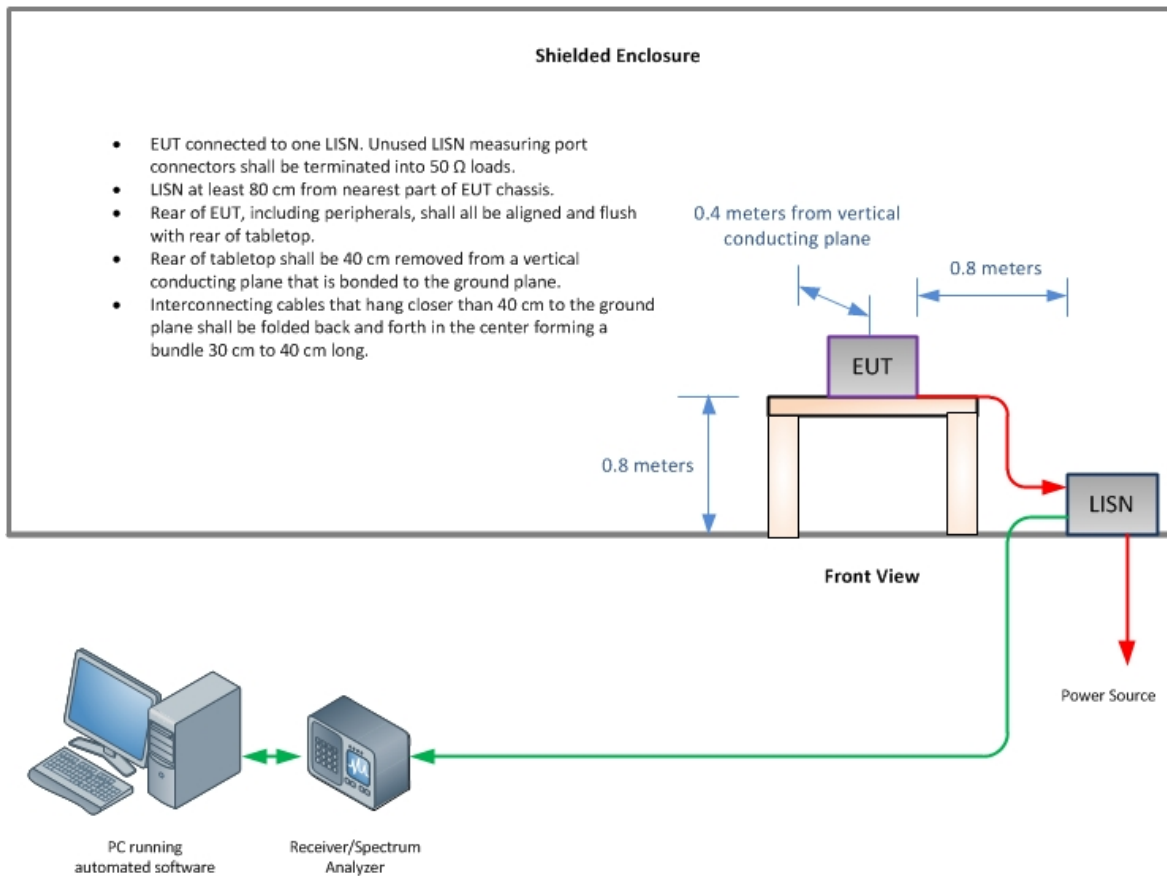
Radiated Emission Test Setup (Above 1GHz)



Substitution Test Method (Above 1GHz)



Frequency Stability Test Configuration





SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT



5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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