



# RF TEST REPORT

Test item : LTE/CDMA(EVDO) Wireless Modem Module  
Model No. : LTD-VL1000  
Order No. : DEMC1406-02530  
Date of receipt : 2014-06-24  
Test duration : 2014-06-27 ~ 2014-08-14  
Date of issue : 2014-08-14  
Use of report : FCC Original Grant

Applicant : LG Innotek Co.,Ltd.  
978-1, Jangduk-dong, Gwangsan-gu, Gwangju-City, South Korea

Test laboratory : DT&C Co., Ltd.  
42, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935

Test specification : FCC Part 27  
Test environment : See appended test report  
Test result :  Pass       Fail

The test results presented in this test report are limited only to the sample supplied by applicant and  
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without the written approval of DT&C Co., Ltd.

Tested by:

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General Manager  
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## Test Report Version

<b>Test Report No.</b>	<b>Date</b>	<b>Description</b>
DRTFCC1408-1021	Aug. 11, 2014	Initial issue
DRTFCC1408-1021(1)	Aug. 14, 2014	Re-test of BE extended LTE Band 4 OBW 3MHz High Ch (1753.5MHz) Revised the Effective Radiated Power

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## 1. GENERAL INFORMATION

**Applicant Name:** LG Innotek Co.,Ltd.

**Address:** 978-1, Jangduk-dong, Gwangsan-gu, Gwangju-City, South Korea

**FCC ID** : YZP-VL1000  
**FCC Classification** : PCS Licensed Transmitter (PCB)  
**EUT Type** : LTE/CDMA(EVDO) Wireless Modem Module  
**Model Name** : LTD-VL1000  
**Add Model Name** : N/A  
**Supplying power** : DC 3.8V  
**Antenna Type** : Cellular & PCS band for CDMA 1x EVDO(Rev. A) : External type  
 LTE for Band 13 and Band 4 : External type

Mode	Tx Frequency (MHz)	Rx Frequency (MHz)	Emission Designator	Modulation	Conducted Power	
					Max power (dBm)	Max power (W)
LTE Band 13	779.5 ~ 784.5	748.5 ~ 753.5	4M49G7D	QPSK	23.28	0.213
LTE Band 13	779.5 ~ 784.5	748.5 ~ 753.5	4M49W7D	16QAM	22.23	0.167
LTE Band 13	782	751	8M94G7D	QPSK	23.26	0.212
LTE Band 13	782	751	8M92W7D	16QAM	22.22	0.167
LTE Band 4	1710.7 ~ 1754.3	2110.7 ~ 2154.3	1M09G7D	QPSK	23.50	0.224
LTE Band 4	1710.7 ~ 1754.3	2110.7 ~ 2154.3	1M09W7D	16QAM	22.57	0.181
LTE Band 4	1711.5 ~ 1753.5	2111.5 ~ 2153.5	2M68G7D	QPSK	23.62	0.230
LTE Band 4	1711.5 ~ 1753.5	2111.5 ~ 2153.5	2M69W7D	16QAM	22.62	0.183
LTE Band 4	1712.5 ~ 1752.5	2112.5 ~ 2152.5	4M48G7D	QPSK	23.90	0.245
LTE Band 4	1712.5 ~ 1752.5	2112.5 ~ 2152.5	4M48W7D	16QAM	22.91	0.195
LTE Band 4	1715 ~ 1750	2115 ~ 2150	8M95G7D	QPSK	23.68	0.233
LTE Band 4	1715 ~ 1750	2115 ~ 2150	8M92W7D	16QAM	22.88	0.194
LTE Band 4	1717.5 ~ 1747.5	2117.5 ~ 2147.5	13M4G7D	QPSK	23.67	0.233
LTE Band 4	1717.5 ~ 1747.5	2117.5 ~ 2147.5	13M4W7D	16QAM	22.92	0.196
LTE Band 4	1720 ~ 1745	2120 ~ 2145	17M9G7D	QPSK	23.60	0.229
LTE Band 4	1720 ~ 1745	2120 ~ 2145	17M9W7D	16QAM	22.83	0.195

## 2. INTRODUCTION

### 2.1. EUT DESCRIPTION

The Equipment Under Test(EUT) supports CDMA and EVDO(Rev. A) of Cellular/PCS bands and LTE(Band 4, 13). The EUT has below 2 transceivers.

1. CDMA 1x/ EVDO(Rev. A)
2. LTE

### 2.2. MEASURING INSTRUMENT CALIBRATION

The measuring equipment, which was utilized in performing the tests documented herein, has been calibrated in accordance with the manufacturer's recommendations for utilizing calibration equipment, which is traceable to recognized national standards.

### 2.3. TEST FACILITY

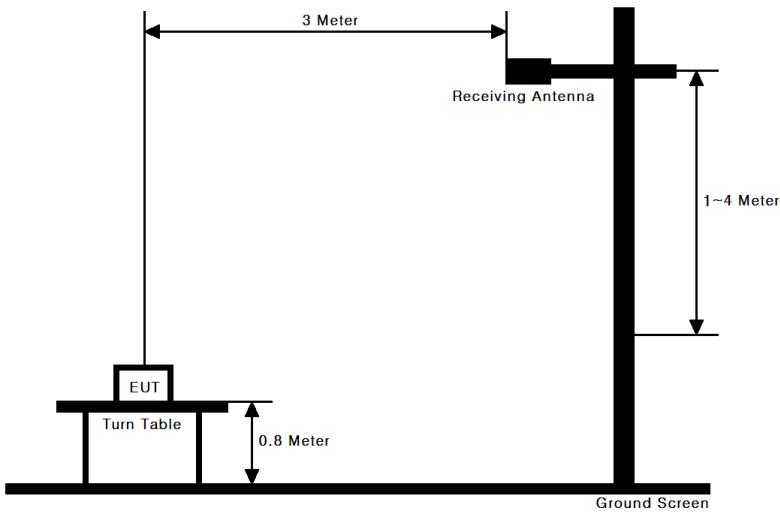
The 3 & 10M test site and conducted measurement facility used to collect the radiated data are located at the 38, Yurim-ro, 154beon-gil, Cheoin-gu, Yongin-si, Gyeonggi-do, Korea 449-935. The site is constructed in conformance with the requirements.

- 3 & 10M test site registration Number: 678747

### 3. DESCRIPTION OF TESTS

#### 3.1 ERP & EIRP (Effective Radiated Power & Equivalent Isotropic Radiated Power)

##### *Test Set-up*



##### *Test Procedure*

These measurements were performed at 3 & 10m test site. The equipment under test is placed on a wooden turntable 0.8-meters above the ground plane and 3meters from the receive antenna.

##### Test setting

The spectrum Analyzer's channel power function is enabled.

1. RBW = 1 ~ 5% of the expected OBW, not to exceed 1MHz & VBW  $\geq$  3 X RBW
2. Span = 1.5 times the OBW & Number of sweep point  $\geq$  2 X span / RBW
3. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation. For signals with burst transmission, the gating function was enabled to ensure that measurements are performed during times in which the transmitter is operating at its maximum power.
4. Detector = RMS & RMS trace averaging over 100 sweeps for stabilizing

The receive antenna height and turntable rotations were adjusted for the highest reading on the receive spectrum analyzer.

A half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same receive spectrum analyzer reading. The conducted power at the terminal of the substitute antenna is measured.

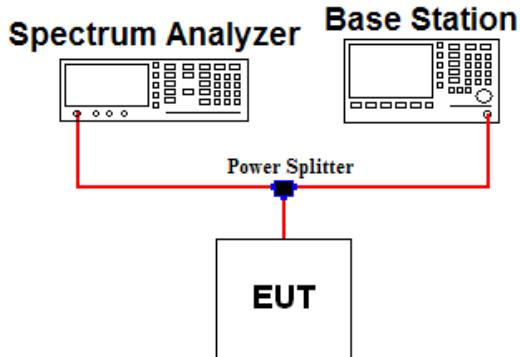
The ERP/EIRP is calculated using the following formula:

ERP/EIRP = The conducted power at the substitute antenna's terminal + Substitute Antenna gain

For readings above 1GHz, the above procedure is repeated using horn antennas and the difference between the gain of the horn antenna and an isotropic antenna are taken into consideration.

### 3.2 PEAK TO AVERAGE RATIO

#### **Test set-up**



#### **Test Procedure**

A peak to average ratio measurement is performed at the conducted port of the EUT. The spectrum analyzers Complementary Cumulative Distribution Function(CCDF) measurement profile is used to determine the largest deviation between the average and the peak power of the EUT in a given bandwidth. The CCDF curve shows how much time the peak waveform spends at or above a given average power level. The present of time the signal spends at or above the level defines the probability for that particular power level.

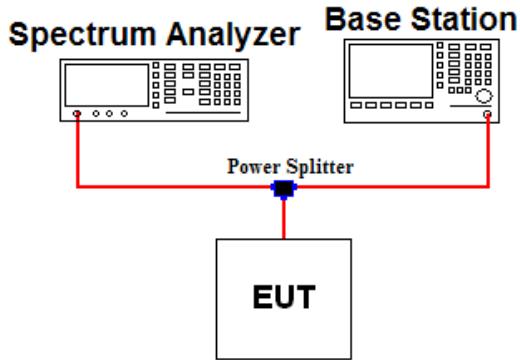
#### Test setting

The spectrum Analyzer's channel power function is enabled.

1. Set resolution/measurement bandwidth  $\geq$  signal's occupied bandwidth
2. Set the number of counts to a value that stabilizes the measured CCDF curve
3. Set the measurement interval as follows:
  - 1) For continuous transmissions, set to 1 ms
  - 2) For burst transmissions, employ an external trigger that is synchronized with the EUT burst timing sequence, or use the internal burst trigger with a trigger level that allows the burst to stabilize and set the measurement interval to a time that is less than or equal to the burst duration.
4. Record the maximum PAPR level associated with a probability of 0.1%

### 3.3 OCCUPIED BANDWIDTH.

#### **Test set-up**



#### **Test Procedure**

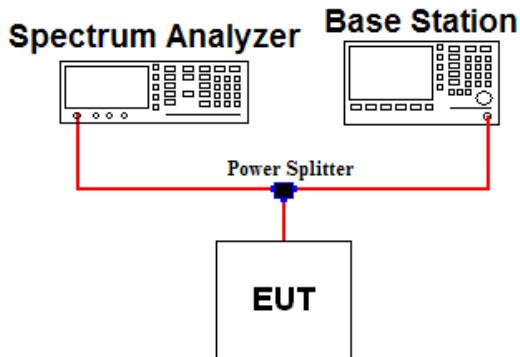
The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power of a given emission.

#### Test setting

1. The signal analyzer's automatic bandwidth measurement capability was used to perform the 99% occupied bandwidth and the 26dB bandwidth. The bandwidth measurement was not influenced by any intermediate power nulls in the fundamental emission.
2. RBW = 1 ~ 5% of the expected OBW & VBW  $\geq 3 \times$  RBW
3. Detector = Peak
4. Trace mode = Max hold
5. Sweep = Auto couple
6. The trace was allowed to stabilize
7. If necessary, step 2 ~ 7 were repeated after changing the RBW such that it would be within 1 ~ 5% of the 99% occupied bandwidth observed in step 7.

### 3.4 UNDESIRABLE EMISSIONS (CONDUCTED)

#### **Test set-up**



#### **Test Procedure**

The level of the carrier and the various conducted spurious and harmonic frequencies is measured by means of a calibrated spectrum analyzer. The EUT was setup to maximum output power at its lowest channel with all modulations RB size and RB offsets. The spectrum is scanned from the lowest frequency generated in the equipment up to a frequency including its 10th harmonic.

On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log(P)$  dB.

#### Test setting

1. RBW = 100kHz or 1MHz & VBW  $\geq$  3MHz
2. Detector = RMS & Trace mode = Max hold
3. Sweep time = Auto & 1s for band edge
4. Number of sweep point  $\geq$  2 X span / RBW
5. The trace was allowed to stabilize

The highest, lowest and a middle channel were tested for out of band measurements. the worst case data are reported in clause 8.3.

Note 1: In the 1MHz bands immediately outside and adjacent to the frequency block, a resolution bandwidth of at least 1 percent of the emission bandwidth of the fundamental emission of the transmitter as employed to measure the out of band Emissions.

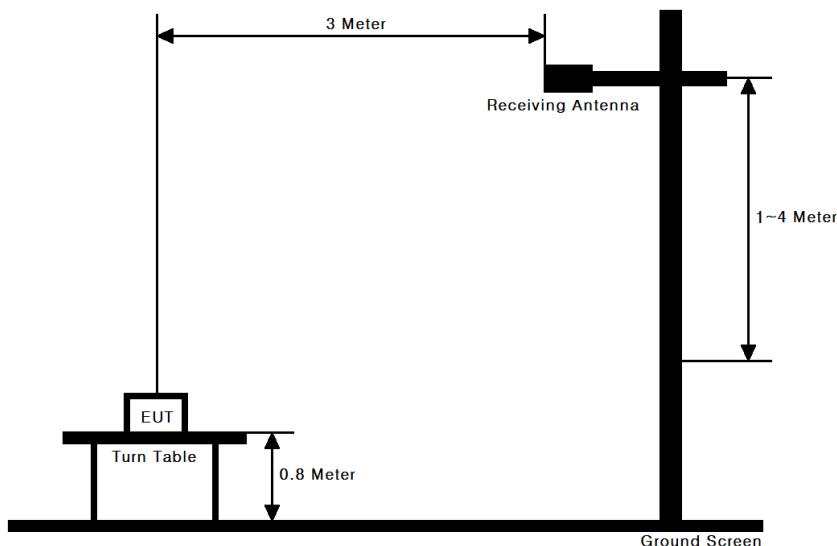
Note 2: Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 100 kHz or greater for 776-788 MHz band, or 1 MHz or greater for AWS band. However, in the 100 kHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least 30kHz may be employed for 776-788MHz band. In the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed for AWS band.

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 emission are attenuated at least 26 dB below the transmitter power.

Note 3: For part 27.53(c)(4) measurement, the FCC limit is  $65 + 10\log_{10}(P_{\text{Watts}}) = -35\text{dBm}$  in a 6.25kHz bandwidth. Since it was not possible to set the resolution bandwidth to 6.25kHz with the available equipment, a bandwidth of 10kHz was used instead to show compliance. By using a 10kHz bandwidth, the limit was adjusted by  $10\log_{10}(10\text{kHz}/6.25\text{kHz}) = 2.04\text{dB}$ . Thus, the limit shown in all plots in the test bands was  $-35\text{dBm} + 2.04\text{dB} = -32.96\text{dBm}$ .

### 3.5 UNDESIRABLE EMISSIONS (RADIATED)

#### **Test Set-up**



#### **Test Procedure**

This measurement was performed at 3meter test range. The equipment under test is placed on a wooden turntable 0.8meters above the ground plane and 3meters from the receive antenna.

#### Test setting

The spectrum Analyzer's channel power function is enabled.

1. RBW = 1 ~ 5% of the expected OBW, not to exceed 1MHz & VBW  $\geq$  3 X RBW
2. Span = 1.5 times the OBW & Number of sweep point  $\geq$  2 X span / RBW
3. The integration bandwidth was roughly set equal to the measured OBW of the signal for signals with continuous operation. For signals with burst transmission, the gating function was enabled to ensure that measurements are performed during times in which the transmitter is operating at its maximum power.
4. Detector = RMS & RMS trace averaging over 100 sweeps for stabilizing

The receive antenna height and turntable rotations were adjusted for the highest reading on the receive spectrum analyzer.

For radiated power measurements below 1GHz, a half-wave dipole was substituted in place of the EUT. This dipole antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same spectrum analyzer reading.

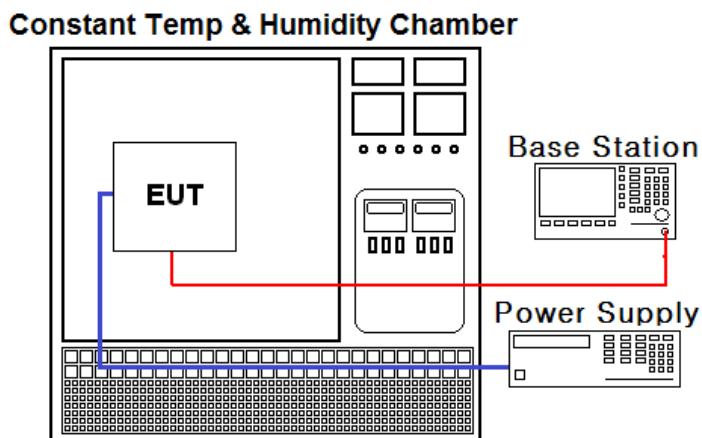
For radiated power measurements above 1GHz, a Horn antenna was substituted in place of the EUT. This Horn antenna was driven by a signal generator and the level of the signal generator was adjusted to obtain the same spectrum analyzer reading. The difference between the gain of the horn and an isotropic antenna are taken into consideration.

This measurement was performed with the EUT oriented in 3 orthogonal axis.

NOTE : For operations in the 746-758 MHz, 775-788 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.

### 3.6 FREQUENCY STABILITY

#### Test Set-up



#### Test Procedure

The frequency stability of the transmitter is measured by:

- Temperature:** The temperature is varied from -30 °C to +50 °C using an environmental chamber.
- Primary Supply Voltage:** The primary supply voltage is varied from battery end point to 115 % of the voltage normally at the input to the device or at the power supply terminals if cables are not normally supplied.

Specification - the frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block. The frequency stability of the transmitter shall be maintained within ± 0.000 25 %(± 2.5 ppm) of the center frequency.

#### Time Period and Procedure:

1. The carrier frequency of the transmitter is measured at room temperature. (25°C to provide a reference).
2. The equipment is turned on in a “standby” condition for one minute before applying power to the transmitter. Measurement of the carrier frequency of the transmitter is made within one minute after applying power to the transmitter.
3. Frequency measurements are made at 10°C intervals ranging from -30°C to +50°C. A period of at least one half-hour is provided to allow stabilization of the equipment at each temperature level.

**4. LIST OF TEST EQUIPMENT**

Type	Manufacturer	Model	Cal.Date (yy/mm/dd)	Next.Cal. Date (yy/mm/dd)	S/N
Multimeter	Fluke	17B	14/05/12	15/05/12	26030065WS
DC Power Supply	H.P	66332A	14/02/04	15/02/04	GB37470200
Power Splitter	Anritsu	K241B	14/02/28	15/02/28	1301181
Thermohygrometer	BODYCOM	BJ5478	14/03/03	15/03/03	1209
Temp & Humi Test Chamber	SJ Science	SJ-TH-S50	13/10/22	14/10/22	SJ-TH-S50-130930
MXA Signal Analyzer	Agilent	N9020A	13/09/24	14/09/24	MY50200867
PXA Signal Analyzer	Agilent	N9030A	13/10/29	14/10/29	MY53310140
Signal Generator	Rohde Schwarz	SMF100A	14/07/01	15/07/01	102341
Vector Signal Generator	Rohde Schwarz	SMBV100A	14/01/08	15/01/08	255571
Dipole Antenna	Schwarzbeck	VHA9103	13/10/24	15/10/24	2116
Dipole Antenna	Schwarzbeck	VHA9103	14/04/01	16/04/01	2117
Dipole Antenna	Schwarzbeck	UHA9105	13/10/24	15/10/24	2261
Dipole Antenna	Schwarzbeck	UHA9105	14/04/01	16/04/01	2262
Bilog Antenna	SCHAFFNER	CBL6112B	12/11/06	14/11/06	2737
HORN ANT	ETS	3115	14/02/26	16/02/26	6419
HORN ANT	ETS	3115	13/02/28	15/02/28	00021097
Amplifier (22dB)	H.P	8447E	14/01/07	15/01/07	2945A02865
Amplifier (30dB)	Agilent	8449B	14/02/27	15/02/27	3008A00370
High-pass filter	Wainwright	WHKX1.0	13/09/12	14/09/12	9
High-Pass Filter	Wainwright	WHNX2.1	13/09/12	14/09/12	1
Radio Communication Analyzer	Anritsu	MT8820C	14/01/10	15/01/10	6201274516

## 5. SUMMARY OF TEST RESULTS

FCC Part Section(s)	Test Description	Test Limit	Test Condition	Status Note 1	Reference
2.1046	Conducted Output Power	N/A	Conducted	C	Section 7.1
2.1049	Occupied Bandwidth	N/A		C	Section 7.2, 8.1, 8.2
24.232(d)	Peak to Average Ratio	< 13dB		C	Section 7.3, 8.3, 8.4
2.1051 27.53(c.2) 27.53(h)	Undesirable Emissions at band edge and for all out-of-band emissions	< 43+10log <sub>10</sub> (P) dB		C	Section 7.4, 8.5, 8.6
27.53(c.4)	Undesirable Emissions in 763 ~ 775MHz & 793 ~ 805MHz	< 65+10log <sub>10</sub> (P) dB		C	Section 7.4, 8.5
2.1055 27.54	Frequency Stability	Fundamental emissions must stay within authorized frequency block		C	Section 7.8
27.50(b.10)	Effective Radiated Power	< 3W ERP		C	Section 7.5
27.50(d.4)	Equivalent Isotropic Radiated Power	< 1W EIRP	Radiated	C	Section 7.6
2.1051 27.53(c.2) 27.53(h)	Undesirable Emissions at band edge and for all out-of-band emissions	< 43+10log <sub>10</sub> (P) dB		C	Section 7.7
27.53(f)	Undesirable Emissions in 1559 ~ 1610MHz	< -70dBW/MHz (-40dBm/MHz)		C	Section 7.7
27.53(c.4)	Undesirable Emissions in 763 ~ 775MHz & 793 ~ 805MHz	< 65+10log <sub>10</sub> (P) dB		C	Section 7.7
Note1: C=Comply NC=Not Comply NT=Not Tested NA=Not Applicable					

The sample was tested according to the following specification:

**ANSI/TIA/EIA-603-C-2004 and KDB 971168 D01 v02r01**

## 6. SAMPLE CALCULATION

### A. Emission Designator

#### LTE Band 13(QPSK)

Emission Designator = **8M94G7D**

LTE OBW = 8.944 MHz

G = Phase Modulation

7 = Quantized/Digital Info

D = Data Transmission

#### LTE Band 13(16QAM)

Emission Designator = **8M92W7D**

LTE OBW = 8.921 MHz

W = Amplitude/Angle Modulated

7 = Quantized/Digital Info

D = Data Transmission

#### LTE Band 4(QPSK)

Emission Designator = **17M88G7D**

LTE OBW = 17.880 MHz

G = Phase Modulation

7 = Quantized/Digital Info

D = Data Transmission

#### LTE Band 4(16QAM)

Emission Designator = **17M87W7D**

LTE OBW = 17.872 MHz

W = Amplitude/Angle Modulated

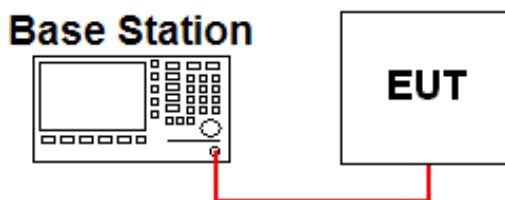
7 = Quantized/Digital Info

D = Data Transmission

## 7. TEST DATA

### 7.1 CONDUCTED OUTPUT POWER

A base station simulator was used to establish communication with the EUT. The base station simulator parameters were set to produce the maximum power from the EUT. This device was tested under all configurations and the highest power is reported. Conducted Output Powers of EUT are reported below.



- Band 13

Conducted Power [dBm]									
RB Alloc			1 RB			MID RB			FULL RB
B.W(MHz)	Freq.(MHz)	Modulation	LOW	MID	HIGH	LOW	MID	HIGH	
10	782	QPSK	23.26	23.08	22.83	21.82	21.89	21.81	21.63
		16QAM	22.22	22.18	22.06	20.85	20.95	20.84	20.67
5	779.5	QPSK	23.28	23.04	23.04	21.89	21.86	21.90	21.85
		16QAM	22.19	22.16	22.17	20.99	21.03	21.11	20.99
	784.5	QPSK	23.07	22.86	22.77	21.87	21.78	21.76	21.80
		16QAM	22.23	22.08	21.99	21.03	20.92	20.95	20.94

Note 1 : The conducted output power was measured using the Anritsu MT8820C

Note 2 : The number of Mid RB are used 25,12 for 10,5MHz B.W

## ▪ Band 4

Conducted Power [dBm]									
RB Alloc			1 RB			MID RB			FULL RB
B.W(MHz)	Freq.(MHz)	Modulation	LOW	MID	HIGH	LOW	MID	HIGH	
20	1720	QPSK	23.21	23.57	23.60	22.28	22.35	22.28	22.25
		16QAM	22.15	22.78	22.77	21.26	21.45	21.37	21.24
	1745	QPSK	23.23	23.60	23.25	22.10	22.18	22.24	22.10
		16QAM	22.26	22.83	22.48	21.03	21.18	21.22	21.16
15	1717.5	QPSK	23.29	23.67	23.59	22.10	22.37	22.28	22.26
		16QAM	22.20	22.88	22.61	21.18	21.42	21.35	21.20
	1732.5	QPSK	23.49	23.62	23.15	22.32	22.12	21.91	22.07
		16QAM	22.60	22.53	22.31	21.42	21.24	21.06	21.12
10	1747.5	QPSK	23.30	23.62	23.33	22.27	22.33	22.26	22.15
		16QAM	22.36	22.92	22.52	21.30	21.43	21.28	21.19
	1715	QPSK	22.94	23.57	23.54	22.04	22.45	22.49	22.15
		16QAM	22.06	22.72	22.85	20.96	21.39	21.52	21.16
5	1732.5	QPSK	23.66	23.68	23.25	22.38	22.24	22.13	22.18
		16QAM	22.88	22.54	22.18	21.44	21.41	21.20	21.23
	1750	QPSK	23.61	23.63	23.20	22.50	22.38	22.28	22.23
		16QAM	22.71	22.69	22.63	21.62	21.48	21.27	21.21
3	1712.5	QPSK	23.12	23.10	23.66	21.96	22.03	22.13	22.00
		16QAM	21.97	22.38	22.89	21.05	21.18	21.31	21.05
	1732.5	QPSK	23.55	23.48	23.56	22.45	22.27	22.32	22.44
		16QAM	22.63	22.60	22.29	21.48	21.43	21.38	21.40
1.4	1752.5	QPSK	23.90	23.32	23.27	22.37	22.27	22.40	22.33
		16QAM	22.91	22.55	22.42	21.39	21.33	21.33	21.25
	1711.5	QPSK	23.16	22.94	23.08	21.98	21.90	21.87	21.88
		16QAM	22.06	22.19	22.22	20.98	20.89	20.92	20.87
1.4	1732.5	QPSK	23.62	23.44	23.60	22.33	22.36	22.34	22.41
		16QAM	22.62	22.61	22.39	21.45	21.42	21.39	21.54
	1753.5	QPSK	23.31	23.28	23.24	22.21	22.33	22.32	22.32
		16QAM	22.48	22.55	22.42	21.31	21.28	21.28	21.27
1.4	1710.7	QPSK	22.93	22.88	22.92	22.80	22.85	22.85	21.94
		16QAM	22.13	22.21	22.20	22.17	22.23	22.23	21.10
	1732.5	QPSK	23.36	23.43	23.50	23.25	23.33	23.39	22.32
		16QAM	22.51	22.57	22.57	22.36	22.45	22.47	21.60
1.4	1754.3	QPSK	23.35	23.29	23.27	23.22	23.18	23.17	22.30
		16QAM	22.56	22.45	22.48	22.43	22.26	22.33	21.35

Note 1 : The conducted output power was measured using the Anritsu MT8820C

Note 2 : The number of Mid RB are used 50,36,25,12,8,3 for 20,15,10,5,3,1.4MHz B.W

## 7.2 OCCUPIED BANDWIDTH

Band	B.W (MHz)	Frequency (MHz)	Modulation	Test Result (MHz)
LTE Band 13	10	782	QPSK	8.944
			16QAM	8.921
	5	779.5	QPSK	4.486
			16QAM	4.475
	784.5		QPSK	4.474
			16QAM	4.493

Band	B.W (MHz)	Frequency (MHz)	Modulation	Test Result (MHz)
LTE Band 4	20	1720	QPSK	17.860
			16QAM	17.839
		1745	QPSK	17.880
			16QAM	17.872
	15	1717.5	QPSK	13.395
			16QAM	13.387
		1732.5	QPSK	13.398
			16QAM	13.411
	10	1747.5	QPSK	13.412
			16QAM	13.412
		1715	QPSK	8.943
			16QAM	8.922
	5	1732.5	QPSK	8.927
			16QAM	8.914
		1750	QPSK	8.951
			16QAM	8.912
	3	1712.5	QPSK	4.474
			16QAM	4.478
		1732.5	QPSK	4.480
			16QAM	4.469
	1.4	1752.5	QPSK	4.467
			16QAM	4.474
		1711.5	QPSK	2.683
			16QAM	2.689
		1732.5	QPSK	2.684
			16QAM	2.678
		1753.5	QPSK	2.683
			16QAM	2.692
		1710.7	QPSK	1.086
			16QAM	1.089
		1732.5	QPSK	1.087
			16QAM	1.088
		1754.3	16QAM	1.090
			QPSK	1.085

- Plots of the EUT's Occupied Bandwidth are shown in Clause 8.1

**7.3 PEAK TO AVERAGE RATIO**

- Plots of the EUT's Peak- to- Average Ratio are shown in Clause 8.3

**7.4 UNDESIRABLE EMISSIONS (CONDUCTED)**

- Plots of the EUT's Conducted Spurious Emissions are shown in Clause 8.5

## 7.5 EFFECTIVE RADIATED POWER (LTE Band 13)

Band	Mode	Maximum Output Power(dBm)	Antenna Gain (dBd)	ERP (dBm)	LIMIT (dBm)
13	QPSK	25.70	3.16	28.86	34.77
13	16QAM	25.70	3.16	28.86	34.77

Note 1 : The maximum output power used max tune-up power.

Note 2 : Available max Antenna gain is 5.31dBi in Band13 of LTE, and compliant with MPE requirement.

## 7.6 EQUIVALENT ISOTROPIC RADIATED POWER (LTE Band 4)

Band	Mode	Maximum Output Power(dBm)	Antenna Gain (dBi)	EIRP (dBm)	LIMIT (dBm)
4	QPSK	25.70	4.29	29.99	30.00
4	16QAM	25.70	4.29	29.99	30.00

Note 1 : The maximum output power used max tune-up power.

Note 2 : Available max Antenna gain is 4.29dBi in Band4 of LTE, and compliant with MPE requirement.

## 7.7 UNDESIRABLE EMISSIONS (RADIATED)

### 7.7.1 UNDESIRABLE EMISSIONS (LTE Band 13)

B.W (MHz)	Test Freq. (MHz)	RB Offset/Size	Test Mode	Freq.(MHz)	EUT Axis	Ant Pol (H/V)	Level(dBm) @ Ant Terminal	TX Ant Gain(dBd)	Result (dBm)	Margin (dB)	Limit (dBm)
10	782	0/1	QPSK	1555.18	X	H	-65.44	6.39	-59.05	46.05	-13
				3110.63	Y	H	-61.62	7.76	-53.86	40.86	
5	779.5	0/1	QPSK	1554.78	X	H	-68.55	6.39	-62.16	49.16	-13
				3109.41	Y	H	-63.59	7.76	-55.83	42.83	
	784.5	0/1	QPSK	3129.51	Y	H	-63.44	7.76	-55.68	42.68	
				-	-	-	-	-	-	-	

Note 1: Limit Calculation=  $43 + 10\log_{10}(P_{[\text{Watts}]})$

Note 2: This device was tested under all modulations, RB size and RB offsets and the worst case data are reported in the table above. (The worst case mode is the QPSK modulation type with RB Size 1)

Note 3: No other spurious and harmonic emissions were reported greater than listed emissions above table.

**7.7.2 UNDESIRABLE EMISSIONS IN 763 ~ 775 MHz & 793 ~ 805 MHz(LTE Band 13)**

B.W (MHz)	Test Freq. (MHz)	RB Offset/Size	Test Mode	Freq.(MHz)	EUT Axis	Ant Pol (H/V)	Level(dBm) @ Ant Terminal	TX Ant Gain(dBd)	Result (dBm)	Margin (dB)	Limit (dBm)
10	782	0/1	QPSK	773.30	Y	V	-40.61	1.20	-39.41	4.41	-35
				804.25	Y	V	-52.13	1.17	-50.96	15.96	
5	779.5	0/1	QPSK	774.50	Y	V	-47.33	1.20	-46.13	11.13	-35
				796.35	Y	V	-51.86	1.17	-50.69	15.69	
	784.5	0/1	QPSK	772.52	Y	V	-51.21	1.20	-50.01	15.01	
				793.63	Y	V	-52.19	1.18	-51.01	16.01	

Note 1 : This device was tested under all modulations, RB size and RB offsets and the worst case data are reported in the table above. (The worst case mode is the QPSK modulation type with RB Size 1)

Note 2 : For part 27.53(c)(4) measurement, the FCC limit is  $65 + 10\log_{10}(P_{[Watts]}) = -35\text{dBm}$  in a 6.25kHz bandwidth. Since it was not possible to set the resolution bandwidth to 6.25kHz with the available equipment, a bandwidth of 10kHz was used instead to show compliance. By using a 10kHz bandwidth, the result was adjusted by  $10\log_{10} (10\text{kHz}/6.25\text{kHz}) = 2.04\text{dB}$ .

Note 3 : No other spurious and harmonic emissions were reported greater than listed emissions above table.

**7.7.3 UNDESIRABLE EMISSIONS IN 1559 ~ 1610 MHz(LTE Band 13)**

B.W (MHz)	Test Freq. (MHz)	RB Offset/ Size	Test Mode	Freq.(MHz)	EUT (Axis)	Ant Pol (H/V)	Level(dBm) @ Ant Terminal	TX Ant Gain(dBi)	Result (dBm)	Margin (dB)	Limit (dBm/MHz)
10	782	0/49	QPSK	1573.46	X	H	-65.57	8.57	-57.00	17.00	-40.00
5	779.5	0/24	QPSK	1564.02	X	H	-67.76	8.55	-59.21	19.21	-40.00
	784.5	0/1	QPSK	1564.83	X	H	-66.83	8.56	-58.27	18.27	

Note 1 : This device was tested under all modulations, RB size and RB offsets and the worst case data are reported in the table above. (The worst case mode is the QPSK modulation type with RB Size 1 and Full RB)

Note 2 : No other spurious and harmonic emissions were reported greater than listed emissions above table.

## 7.7.4 UNDESIRABLE EMISSIONS (LTE Band 4)

B.W (MHz)	Test Freq. (MHz)	RB Offset/Size	Test Mode	Freq.(MHz)	EUT Axis	Ant Pol (H/V)	Level(dBm) @ Ant Terminal	TX Ant Gain(dBi)	Result (dBm)	Margin (dB)	Limit (dBm)
20	1720	99/1	QPSK	3457.77	X	V	-51.05	9.97	-41.08	28.08	-13
				5186.81	Z	H	-52.26	10.86	-41.40	28.40	
	1745	50/1	QPSK	3440.28	X	V	-51.74	9.97	-41.77	28.77	
				5234.71	Z	H	-55.36	10.88	-44.48	31.48	
15	1717.5	37/1	QPSK	3435.04	X	V	-53.72	9.97	-43.75	30.75	-13
				5152.48	Y	V	-55.96	10.85	-45.11	32.11	
	1732.5	37/1	QPSK	3464.97	Z	V	-52.98	9.97	-43.01	30.01	
				5197.45	Y	H	-57.70	10.87	-46.83	33.83	
	1747.5	37/1	QPSK	3495.03	X	V	-53.00	9.98	-43.02	30.02	
				5242.36	Z	H	-53.13	10.89	-42.24	29.24	
10	1715	25/1	QPSK	3430.22	X	V	-52.66	9.97	-42.69	29.69	-13
				5137.87	Y	V	-58.27	10.85	-47.42	34.42	
	1732.5	25/1	QPSK	3465.25	Z	V	-51.05	9.97	-41.08	28.08	
				5197.91	Y	H	-54.30	10.87	-43.43	30.43	
	1750	25/1	QPSK	3500.22	X	V	-52.01	9.98	-42.03	29.03	
				5250.34	Z	H	-55.29	10.89	-44.40	31.40	
5	1712.5	24/1	QPSK	3429.29	X	H	-51.77	9.97	-41.80	28.80	-13
				5143.90	Y	V	-56.49	10.85	-45.64	32.64	
	1732.5	24/1	QPSK	3469.39	Z	V	-50.88	9.97	-40.91	27.91	
				5204.05	Y	H	-54.52	10.87	-43.65	30.65	
	1752.5	0/1	QPSK	3500.74	X	V	-52.47	9.98	-42.49	29.49	
				5251.15	Z	H	-56.59	10.89	-45.70	32.70	
3	1711.5	0/1	QPSK	3420.49	X	H	-53.38	9.97	-43.41	30.41	-13
				5130.75	Y	V	-56.22	10.84	-45.38	32.38	
	1732.5	0/1	QPSK	3462.45	Z	V	-52.12	9.97	-42.15	29.15	
				3504.49	Y	H	-51.81	9.98	-41.83	28.83	
	1753.5	0/1	QPSK	3504.49	X	V	-53.66	9.98	-43.68	30.68	
				5256.71	Z	H	-55.05	10.89	-44.16	31.16	
1.4	1710.7	0/1	QPSK	3420.48	X	H	-52.16	9.97	-42.19	29.19	-13
				5130.70	Y	V	-56.47	10.84	-45.63	32.63	
	1732.5	5/1	QPSK	3465.85	Z	V	-50.24	9.97	-40.27	27.27	
				5198.85	Y	H	-52.41	10.87	-41.54	28.54	
	1754.3	0/1	QPSK	3507.62	X	V	-50.41	9.97	-40.44	27.44	
				5261.50	Z	H	-51.49	10.89	-40.60	27.60	

Note 1 : Limit Calculation=  $43 + 10\log_{10}(P_{[\text{Watts}]})$

Note 2 : This device was tested under all modulations, RB size and RB offsets and the worst case data are reported in the table above. (The worst case mode is the QPSK modulation type with RB Size 1)

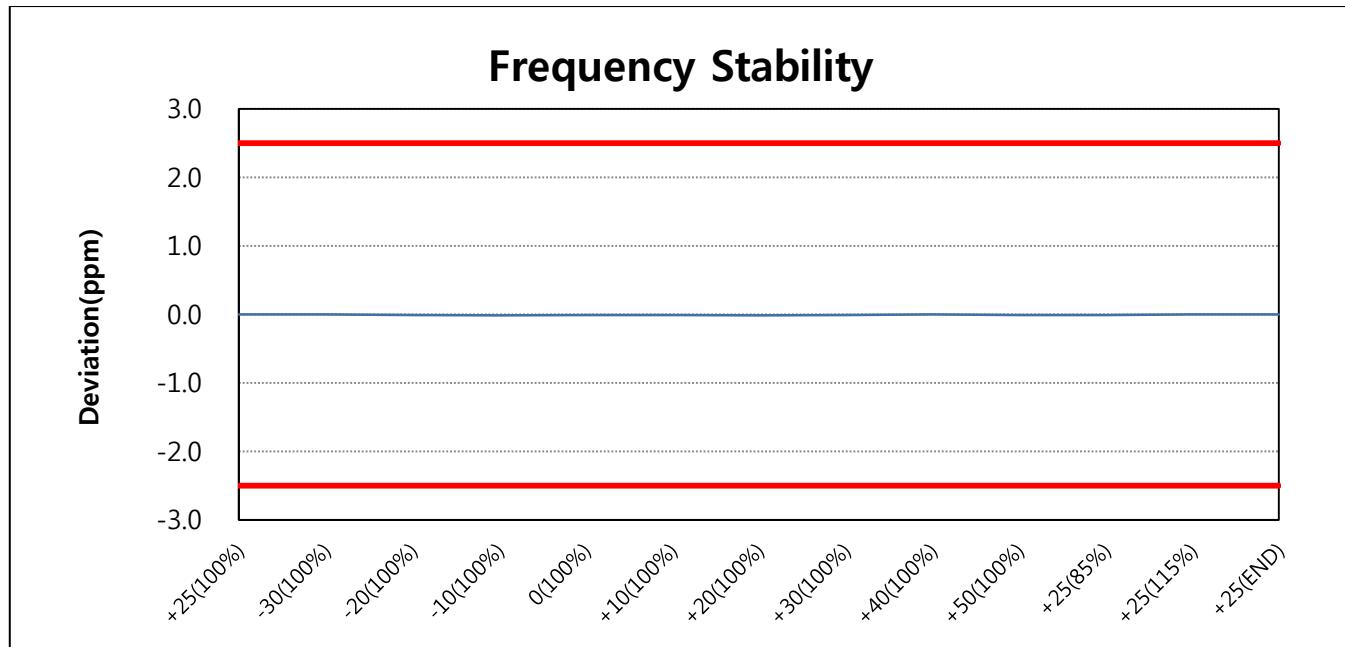
Note 3 : No other spurious and harmonic emissions were reported greater than listed emissions above table.

## 7.8 FREQUENCY STABILITY

### 7.8.1 FREQUENCY STABILITY (LTE Band 13)

OPERATING FREQUENCY : 782,000,000 Hz  
 CHANNEL : 23230  
 REFERENCE VOLTAGE : 3.8 V DC  
 DEVIATION LIMIT : ± 0.00025 % or 2.5 ppm

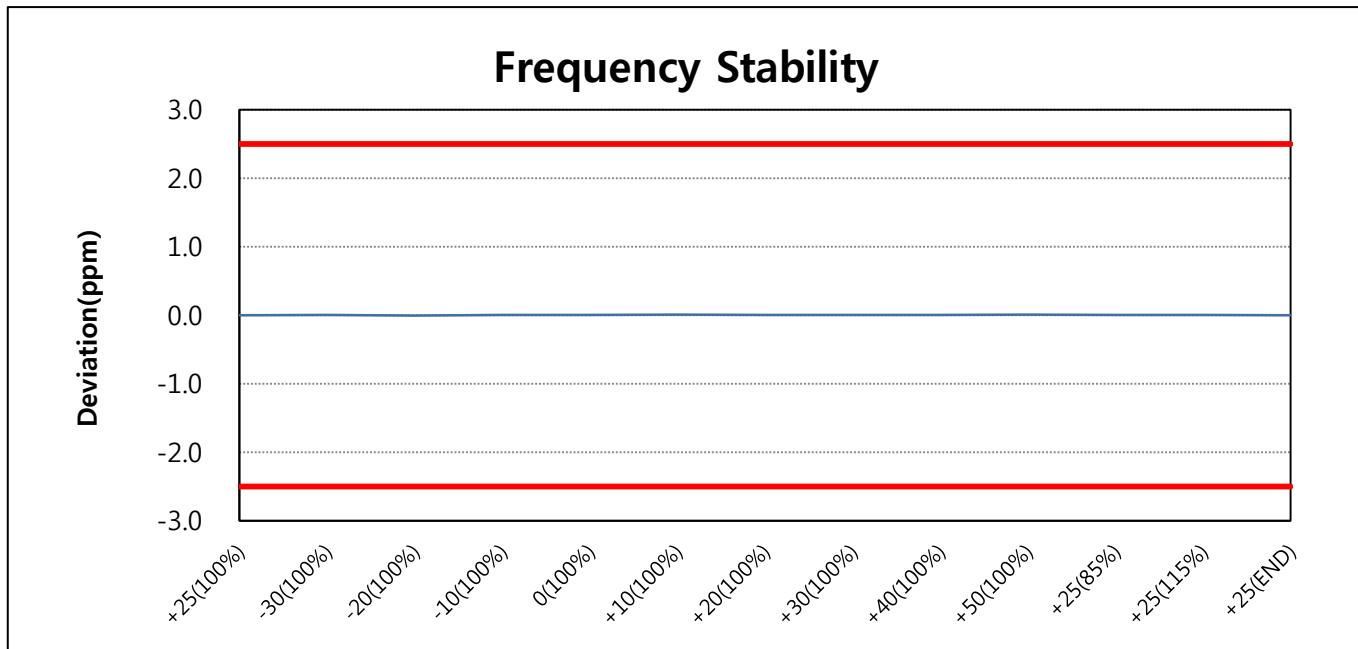
VOLTAGE (%)	POWER (V DC)	TEMP (°C)	FREQuency (Hz)	FREQ.Dev (Hz)	Deviation	
					(ppm)	(%)
100%	3.8	+25(Ref)	782,000,005	5	0.0	0
100%		-30	782,000,003	3	-0.0017	-0.00000017
100%		-20	781,999,997	-3	-0.0098	-0.00000098
100%		-10	781,999,996	-4	-0.0113	-0.00000113
100%		0	781,999,996	-4	-0.0107	-0.00000107
100%		10	781,999,996	-4	-0.0105	-0.00000105
100%		20	781,999,995	-5	-0.0123	-0.00000123
100%		30	781,999,998	-2	-0.0088	-0.00000088
100%		40	782,000,003	3	-0.0015	-0.00000015
100%		50	781,999,998	-2	-0.0087	-0.00000087
85%	3.23	25	781,999,997	-3	-0.0101	-0.00000101
115%	4.37	25	782,000,004	4	-0.0012	-0.00000012
BATT.ENDPOINT	-	-	-	-	-	-



**7.8.2 FREQUENCY STABILITY (LTE Band 4)**

OPERATING FREQUENCY : 1,732,500,000 Hz  
 CHANNEL : 20175  
 REFERENCE VOLTAGE : 3.8 V DC  
 DEVIATION LIMIT : ± 0.00025 % or 2.5 ppm

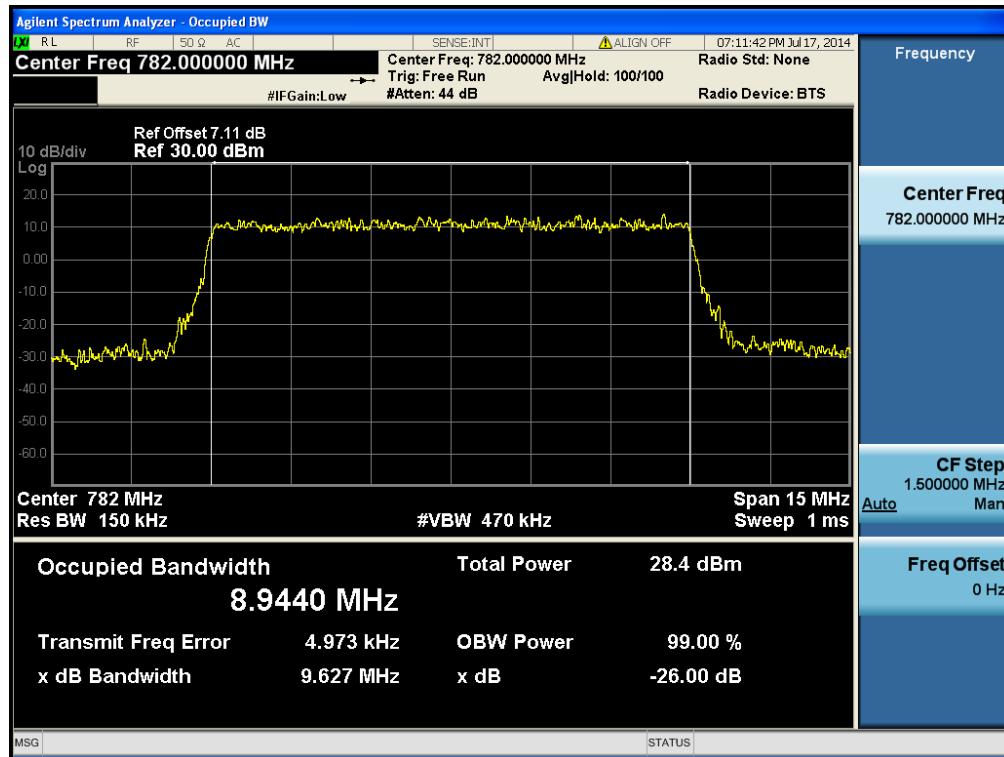
VOLTAGE (%)	POWER (V DC)	TEMP (°C)	FREQuency (Hz)	FREQ.Dev (Hz)	Deviation	
					(ppm)	(%)
100%	3.8	+25(Ref)	1,732,499,995	-5	0.0	0
100%		-30	1,732,500,003	3	0.0048	0.00000048
100%		-20	1,732,499,990	-10	-0.0028	-0.00000028
100%		-10	1,732,500,006	6	0.0064	0.00000064
100%		0	1,732,500,006	6	0.0066	0.00000066
100%		10	1,732,500,012	12	0.0097	0.00000097
100%		20	1,732,500,007	7	0.0071	0.00000071
100%		30	1,732,500,005	5	0.0057	0.00000057
100%		40	1,732,500,005	5	0.0057	0.00000057
100%		50	1,732,500,009	9	0.0083	0.00000083
85%	3.23	25	1,732,500,004	4	0.0052	0.00000052
115%	4.37	25	1,732,500,007	7	0.0072	0.00000072
BATT.ENDPOINT	-	-	-	-	-	-



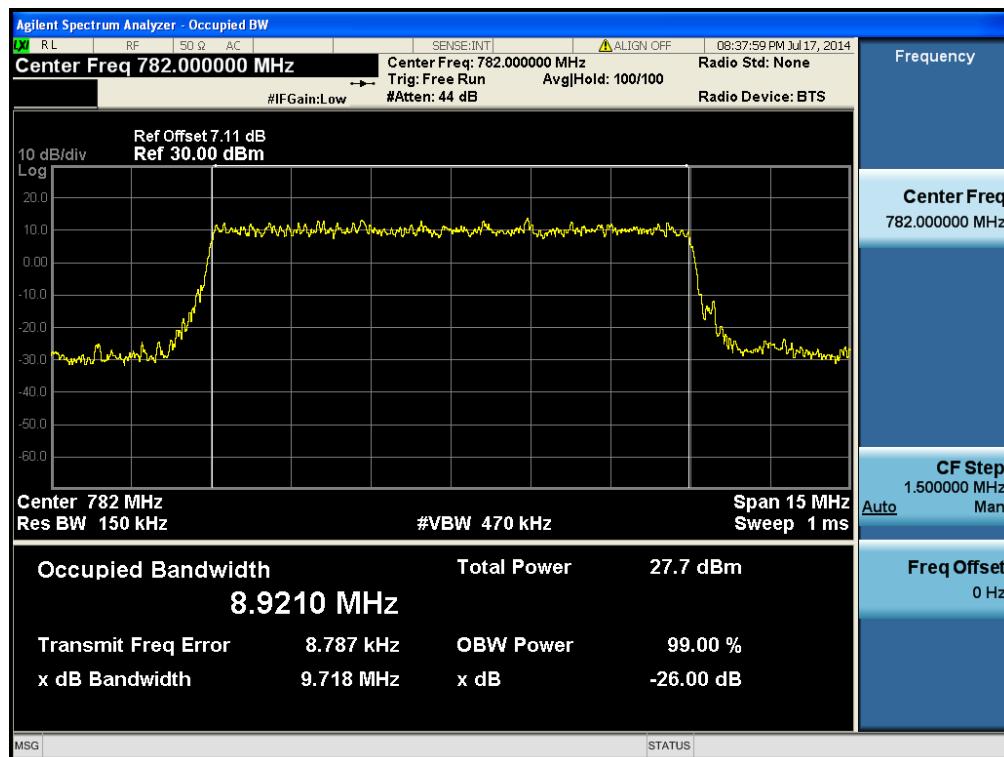
## 8. TEST PLOTS

**Note:** All bandwidths, RB configurations, and modulations were investigated. The worst case test results are reported below.

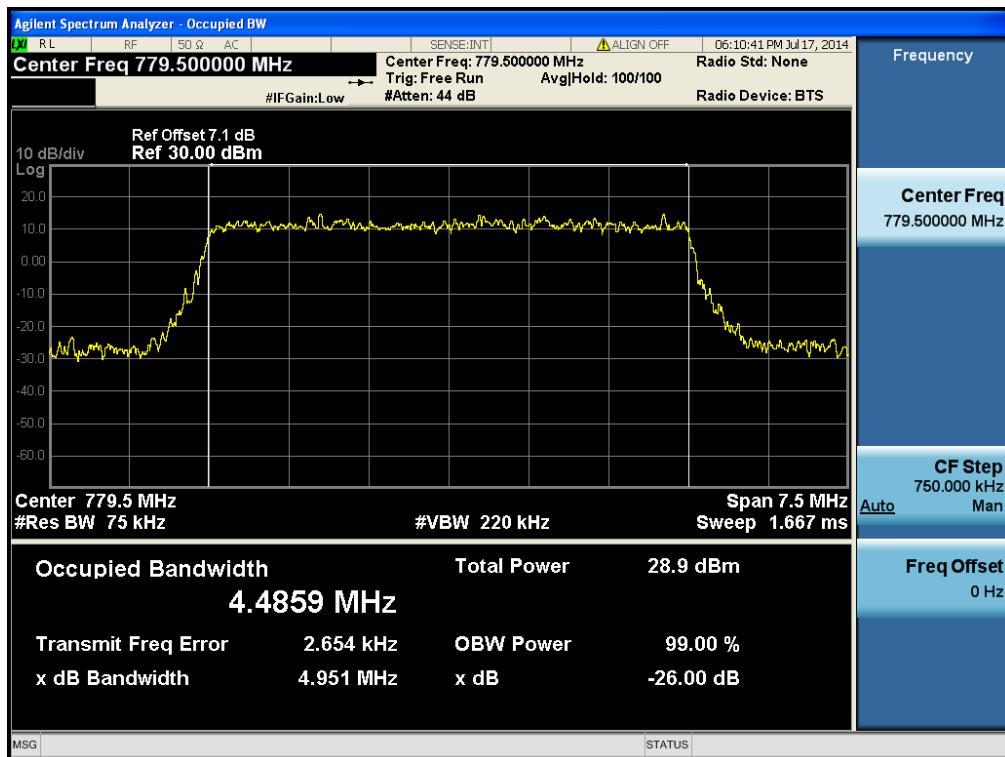
### 8.1 OCCUPIED BANDWIDTH (LTE Band 13)



LTE Band 13 / 10MHz / QPSK - RB Size 50



LTE Band 13 / 10MHz / 16QAM - RB Size 50

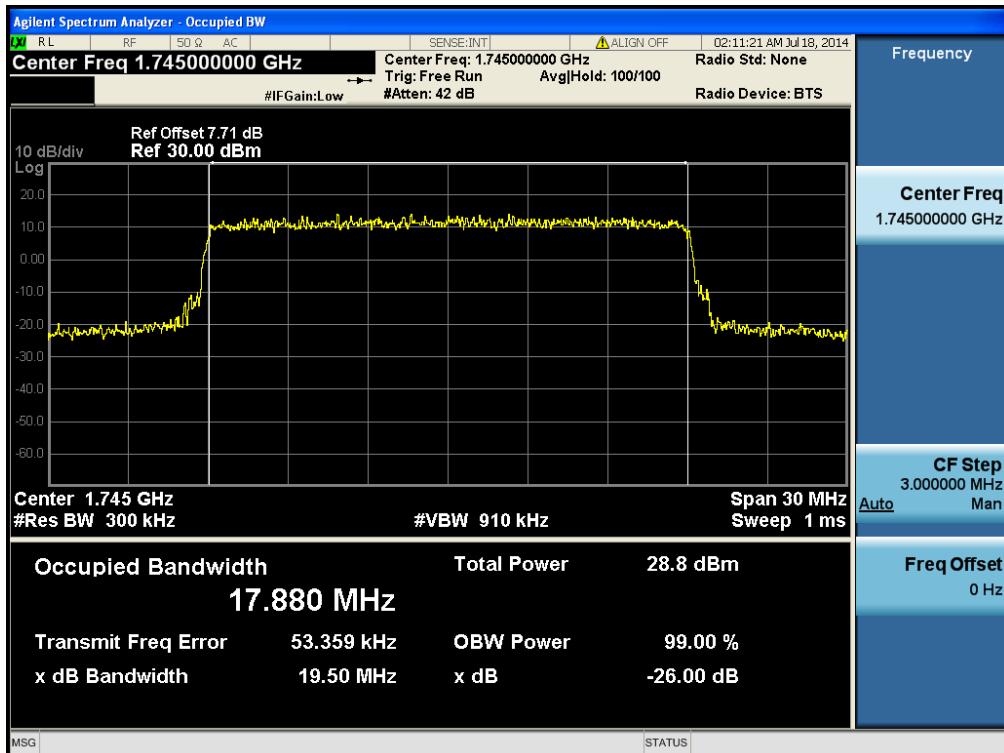


LTE Band 13 / 5MHz / QPSK - RB Size 25

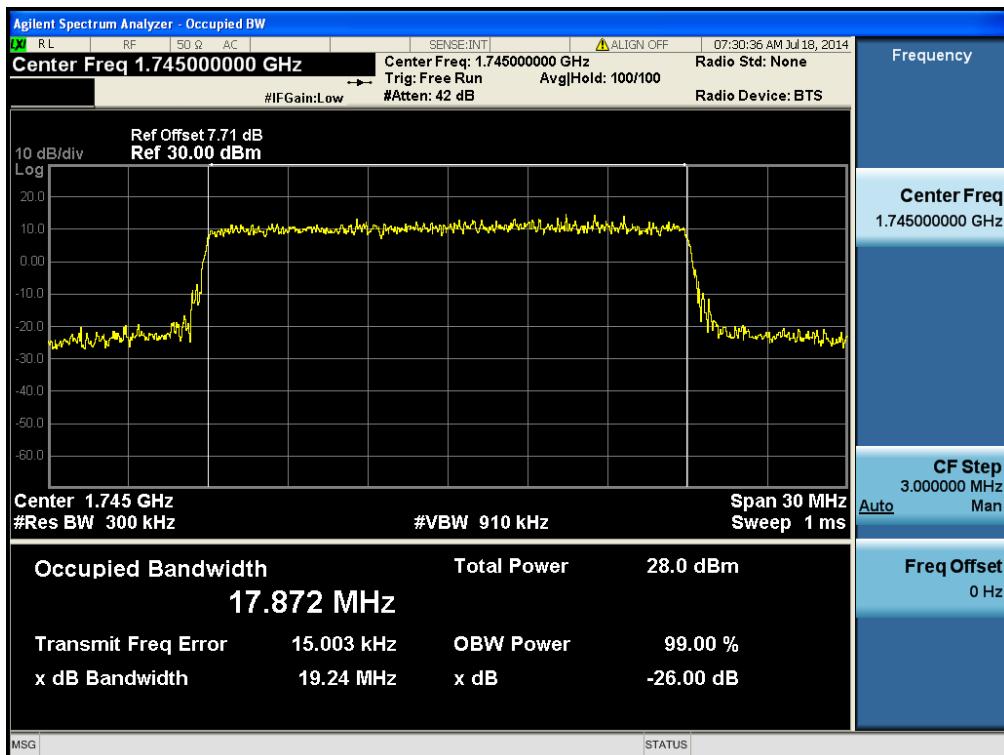


LTE Band 13 / 5MHz / 16QAM - RB Size 25

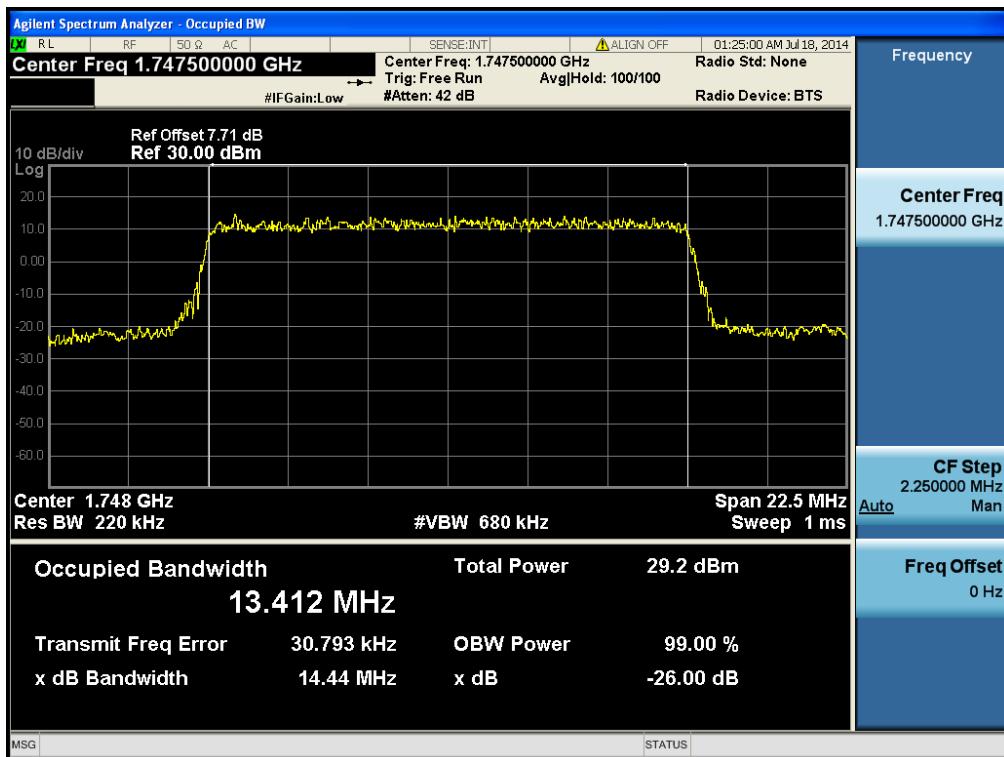
## 8.2 OCCUPIED BANDWIDTH (LTE Band 4)



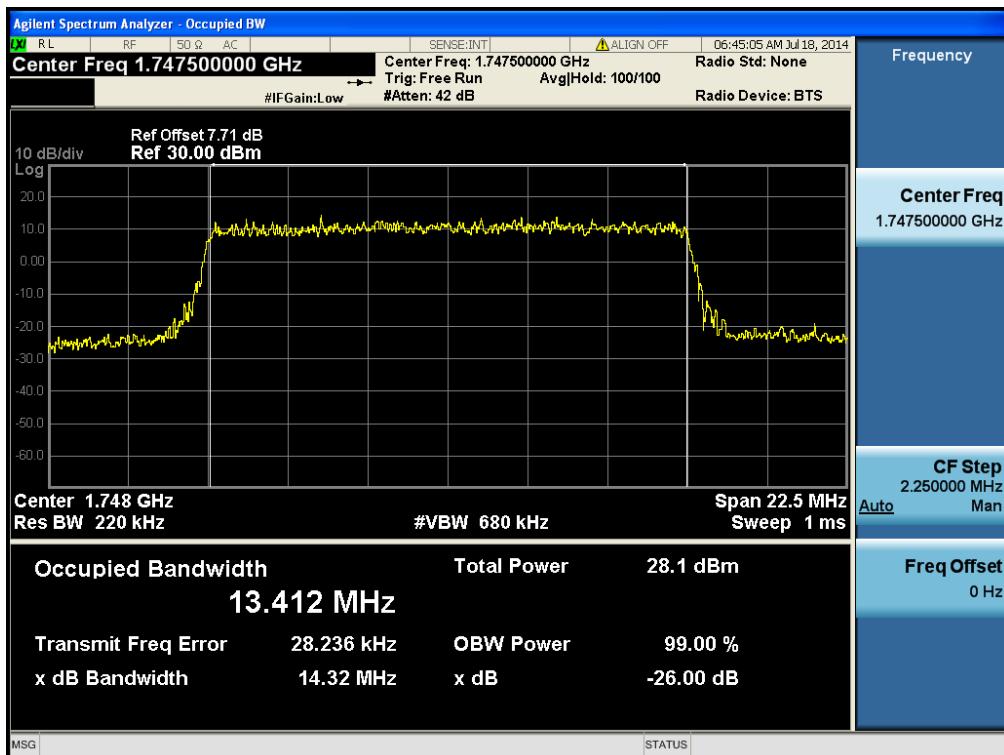
LTE Band 4 / 20MHz / QPSK - RB Size 100



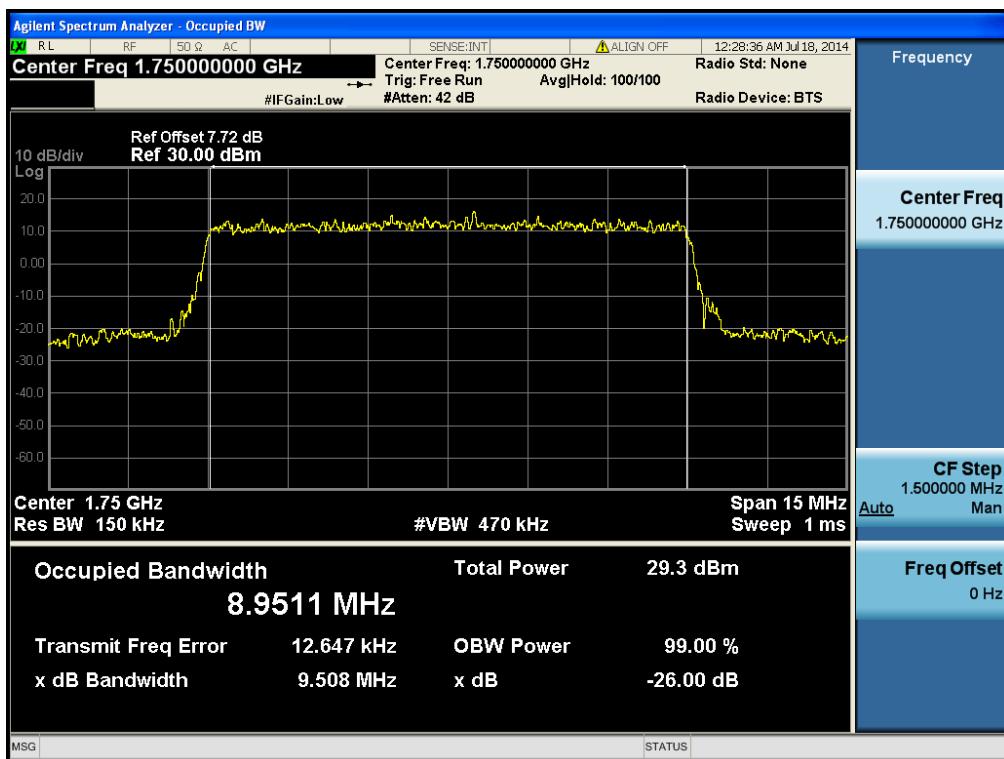
LTE Band 4 / 20MHz / 16QAM - RB Size 100



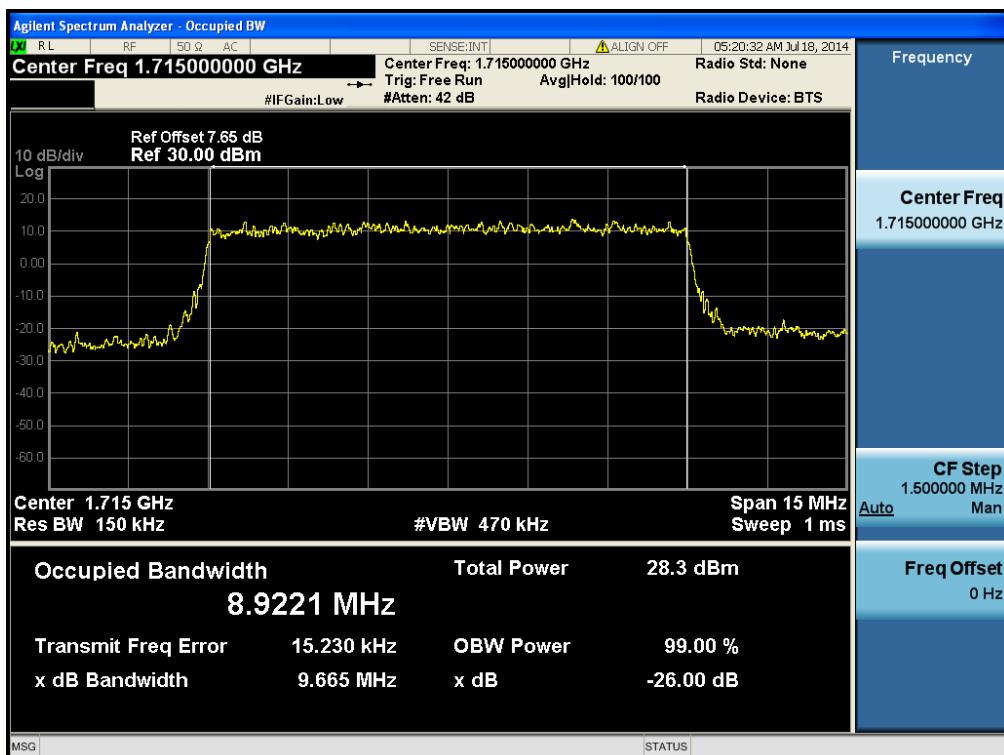
LTE Band 4 / 15MHz / QPSK - RB Size 75



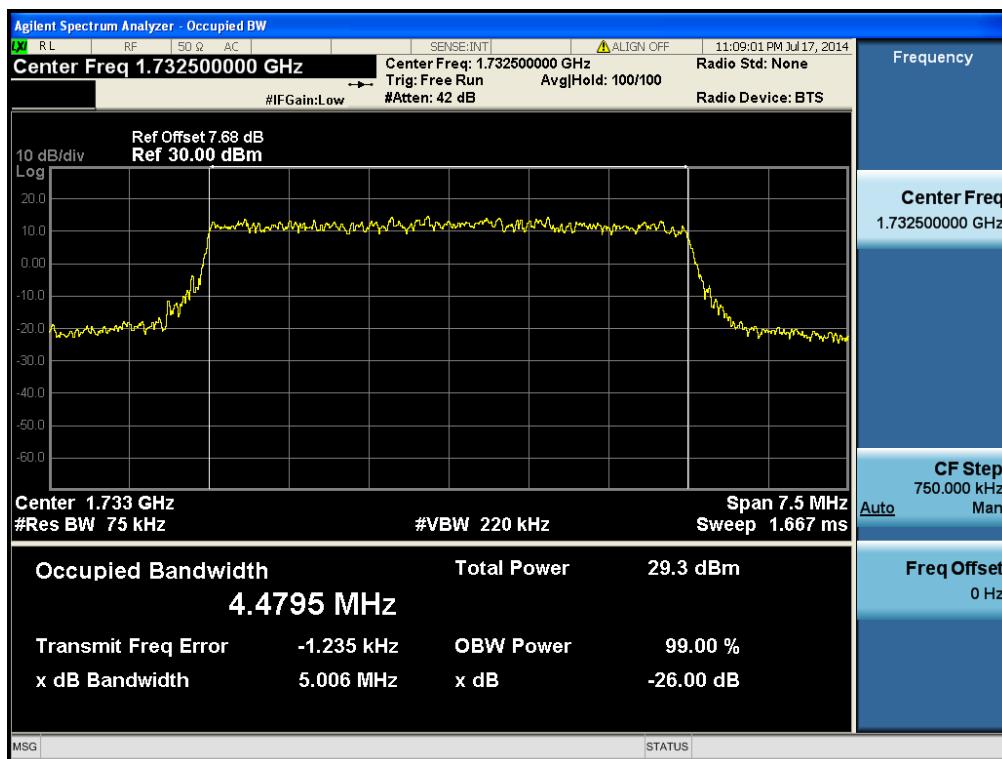
LTE Band 4 / 15MHz / 16QAM - RB Size 75



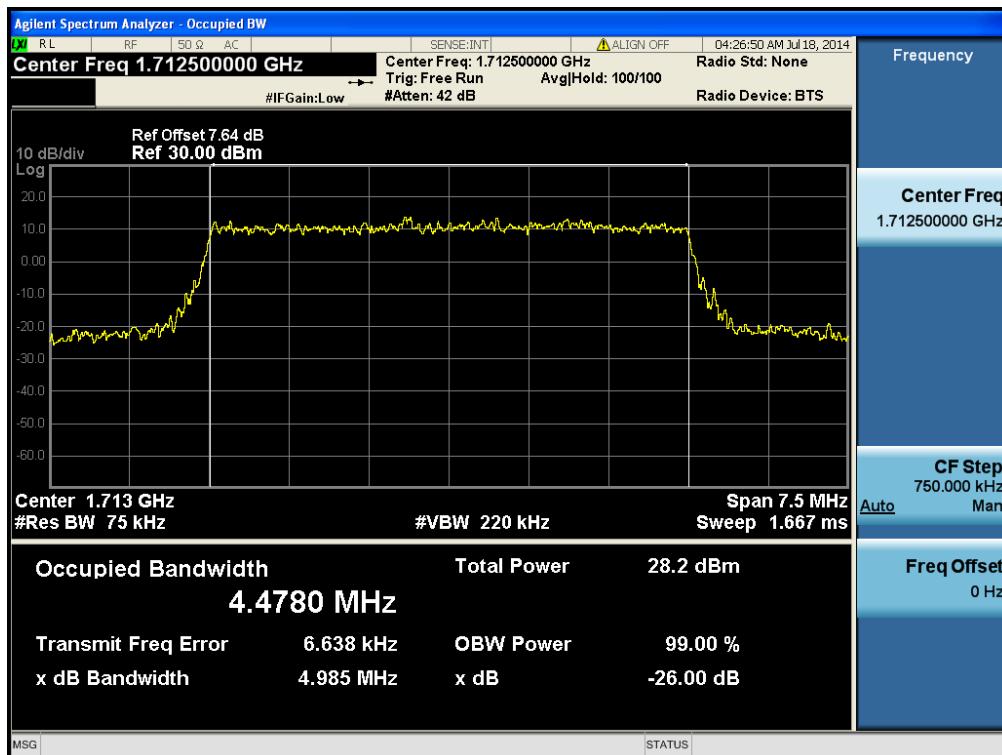
LTE Band 4 / 10MHz / QPSK - RB Size 50



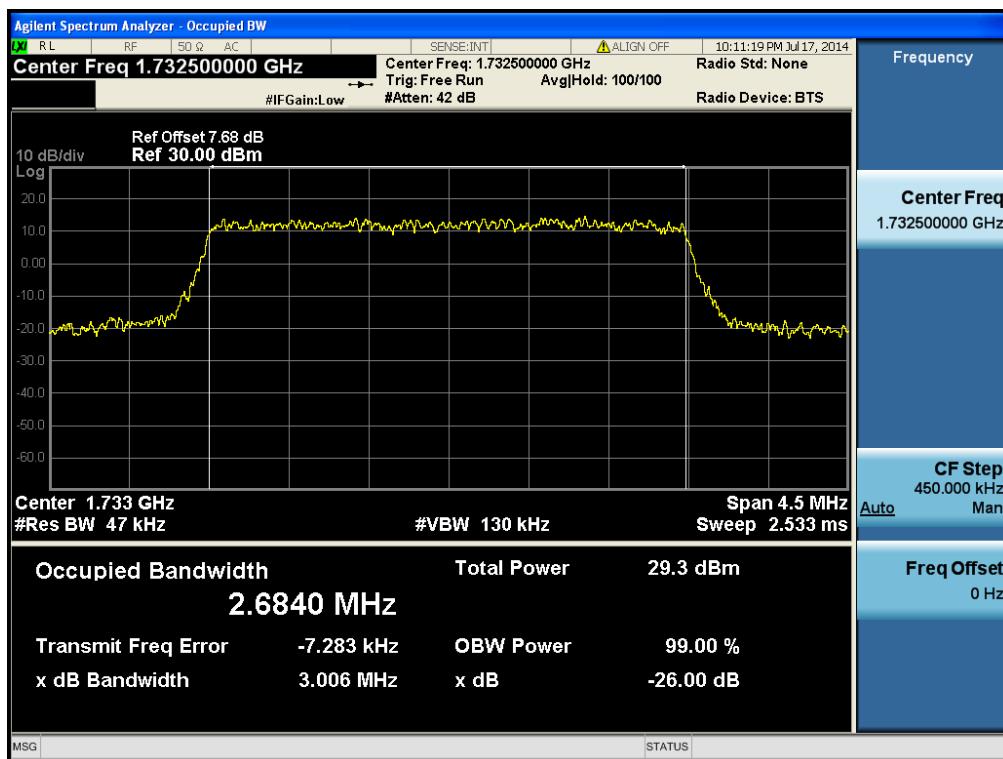
LTE Band 4 / 10MHz / 16QAM - RB Size 50



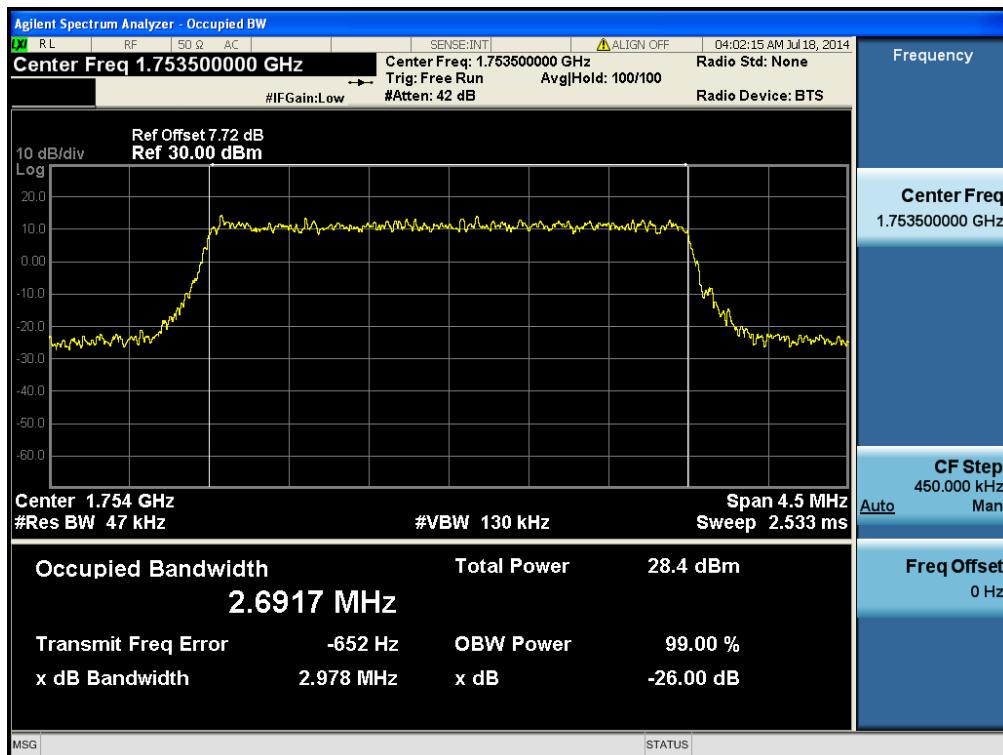
LTE Band 4 / 5MHz / QPSK - RB Size 25



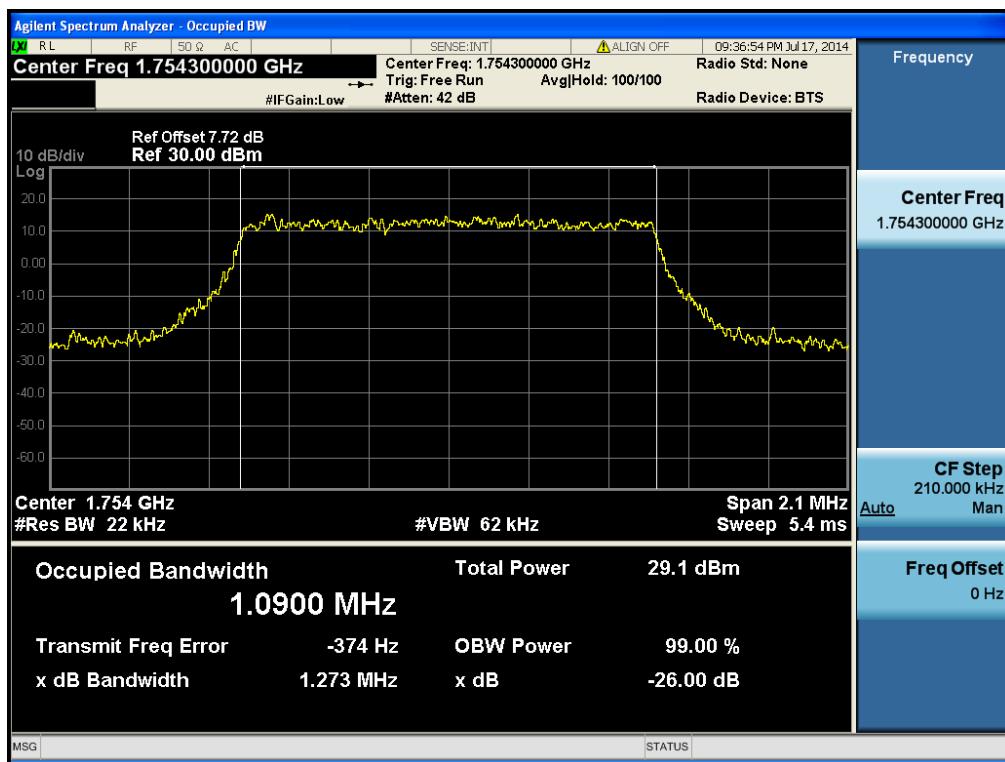
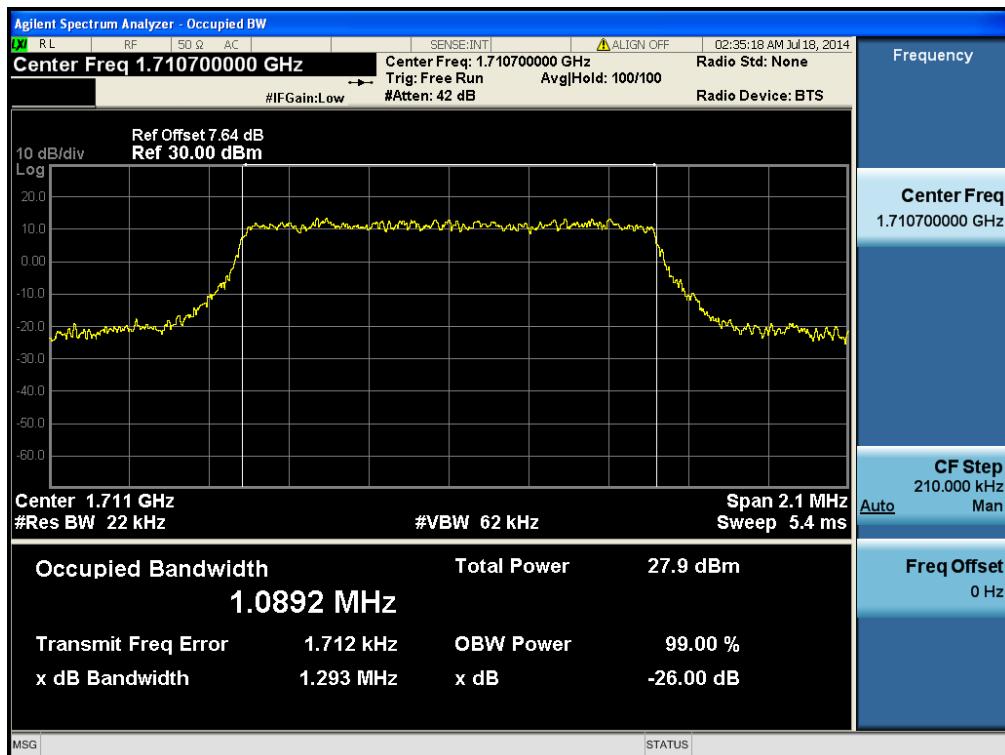
LTE Band 4 / 5MHz / 16QAM - RB Size 25



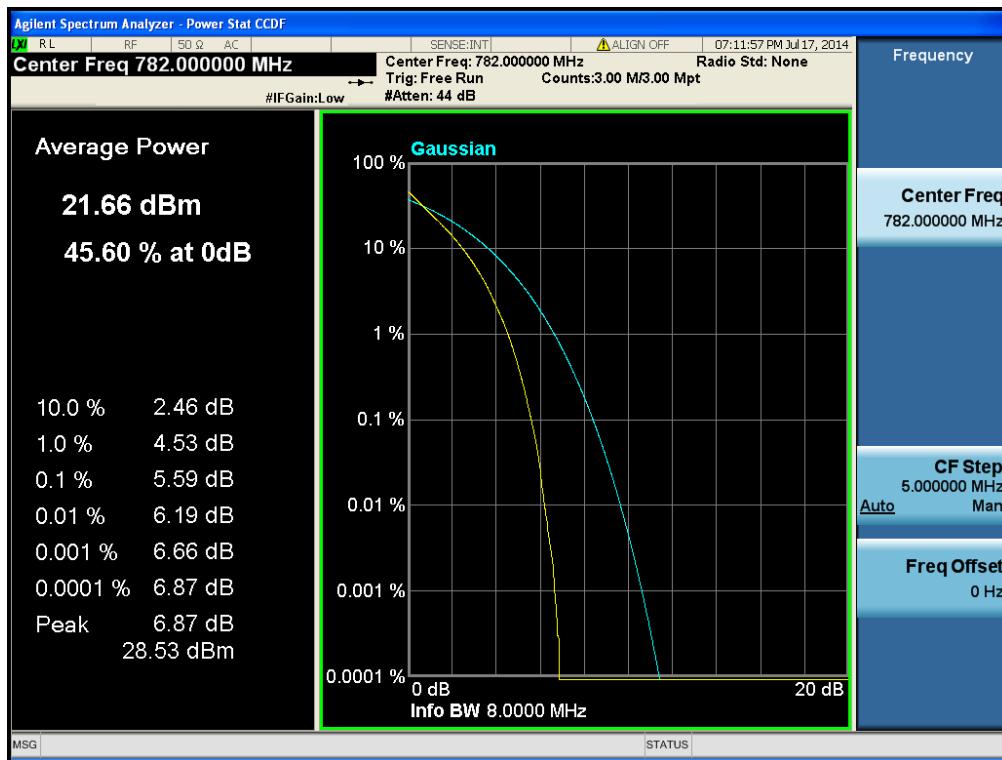
LTE Band 4 / 3MHz / QPSK - RB Size 15



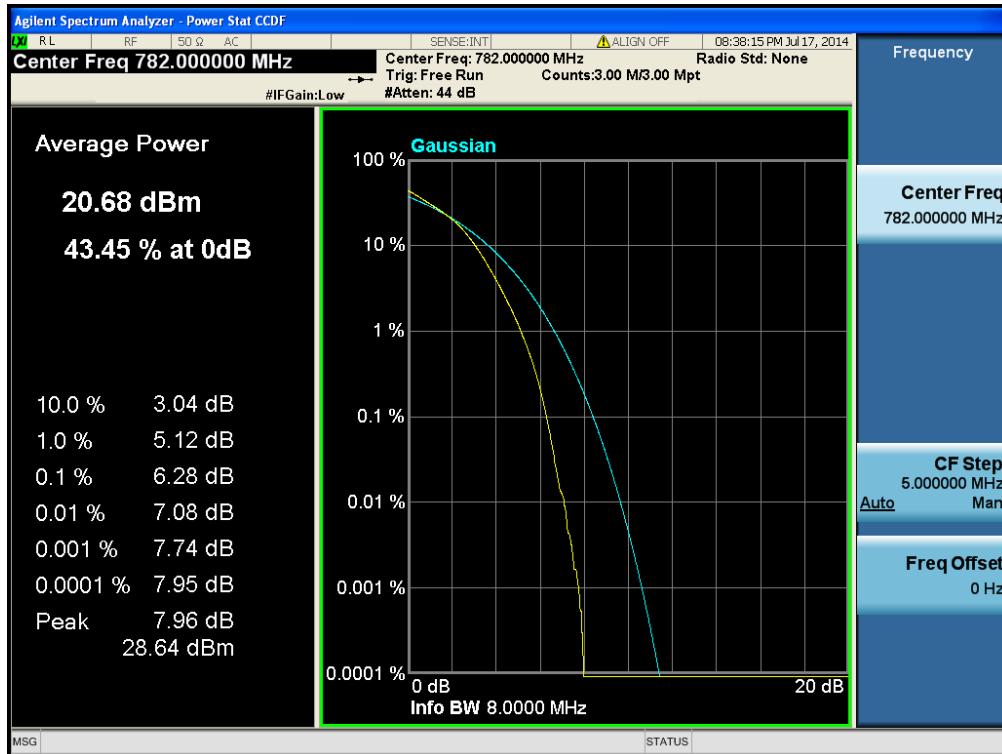
LTE Band 4 / 3MHz / 16QAM - RB Size 15


**LTE Band 4 / 1.4MHz / QPSK - RB Size 6**

**LTE Band 4 / 1.4MHz / 16QAM - RB Size 6**

### 8.3 PEAK TO AVERAGE RATIO (LTE Band 13)



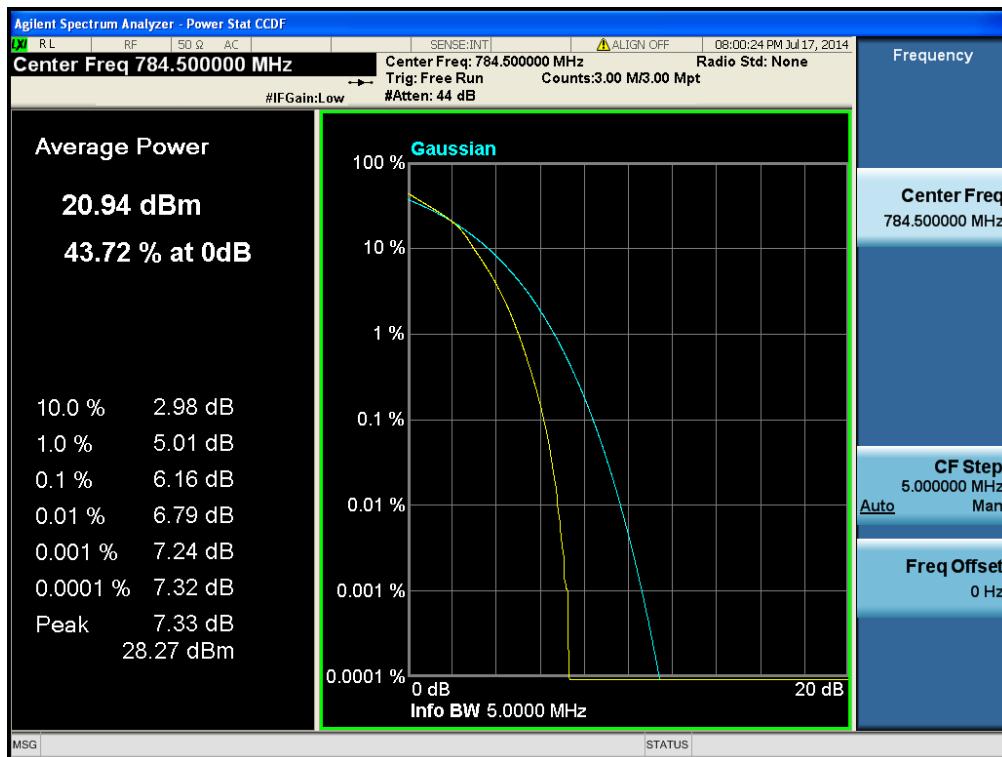
LTE Band 13 / 10MHz / QPSK - RB Size 50



LTE Band 13 / 10MHz / 16QAM - RB Size 50

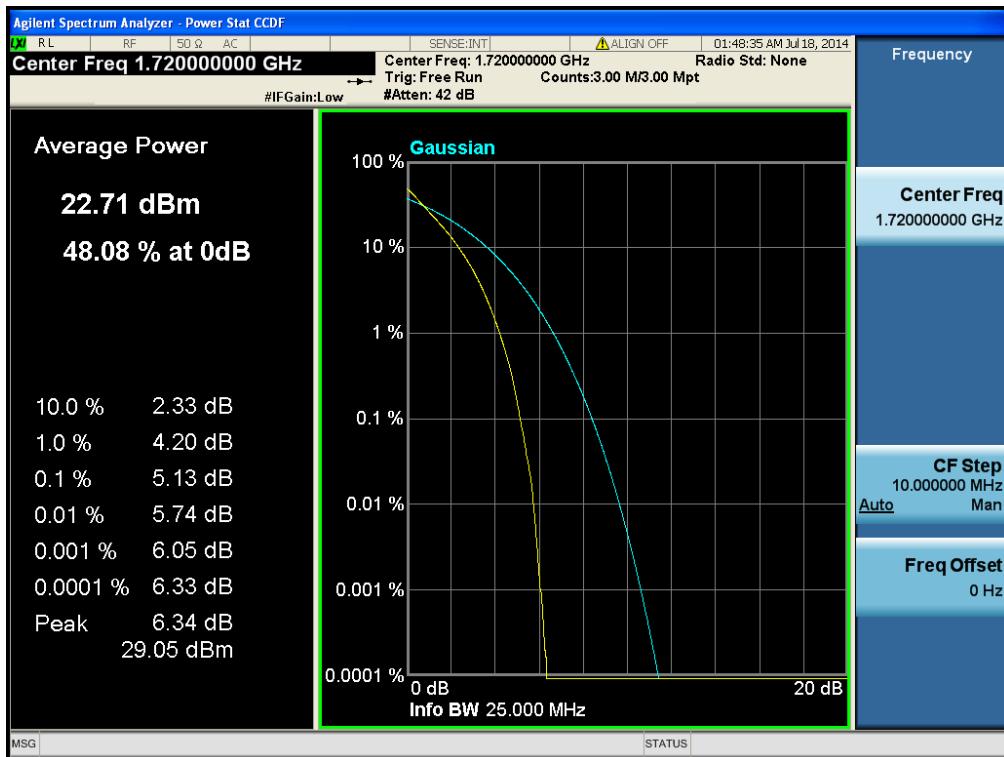


LTE Band 13 / 5MHz / QPSK - RB Size 25

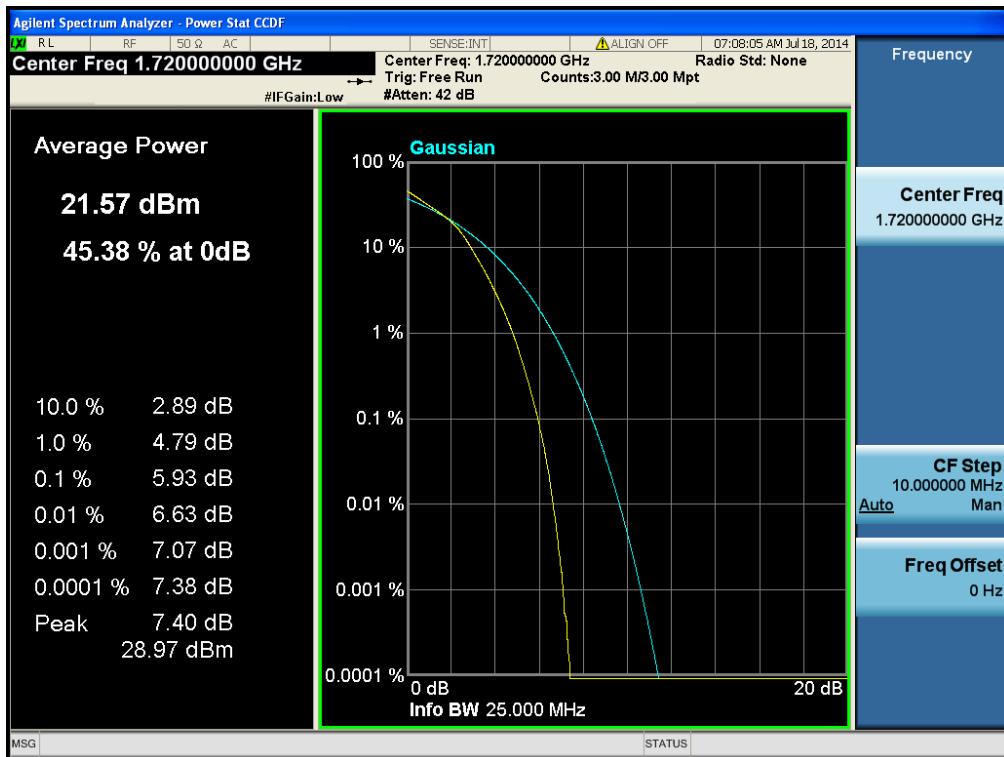


LTE Band 13 / 5MHz / 16QAM - RB Size 25

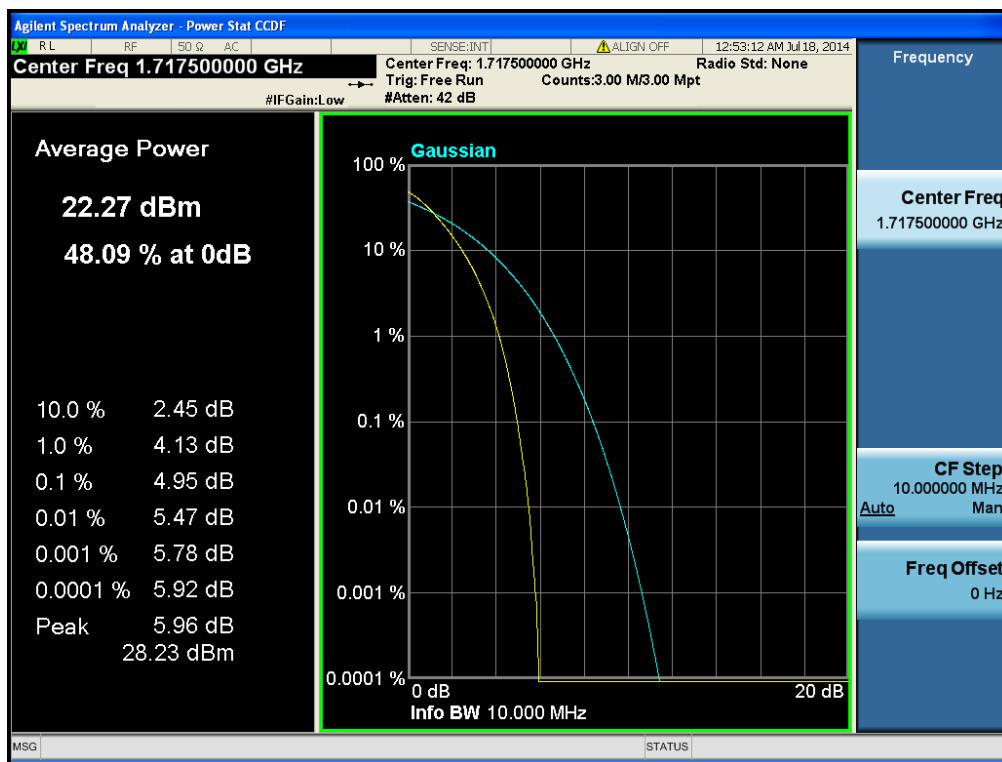
## 8.4 PEAK TO AVERAGE RATIO (LTE Band 4)



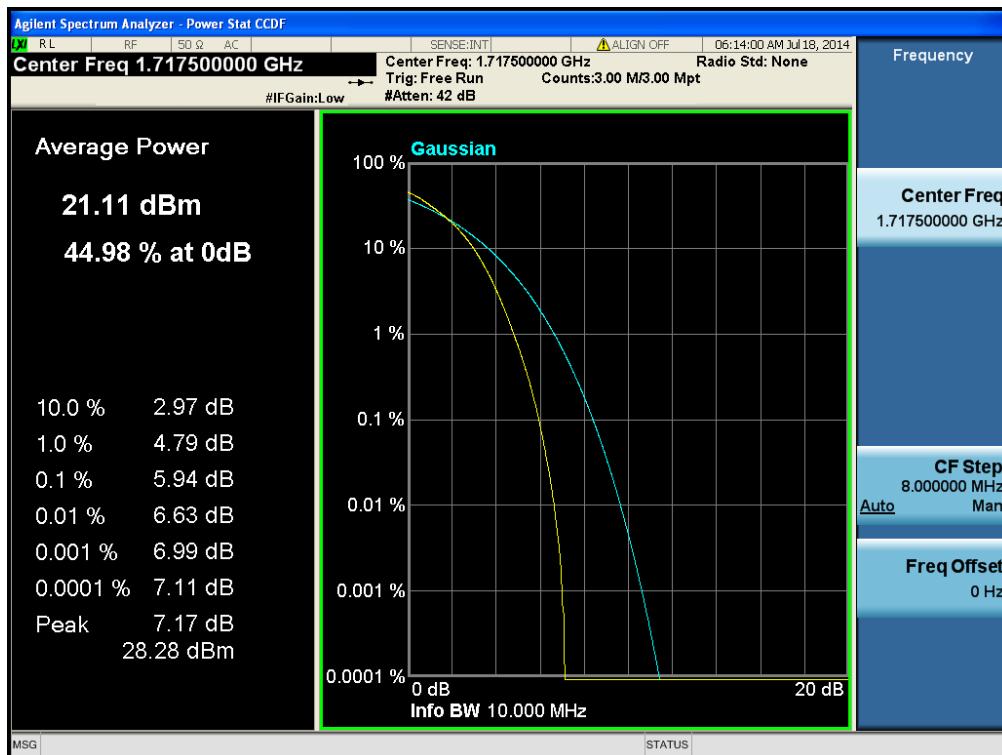
LTE Band 4 / 20MHz / QPSK - RB Size 100



LTE Band 4 / 20MHz / 16QAM - RB Size 100



LTE Band 4 / 15MHz / QPSK - RB Size 75



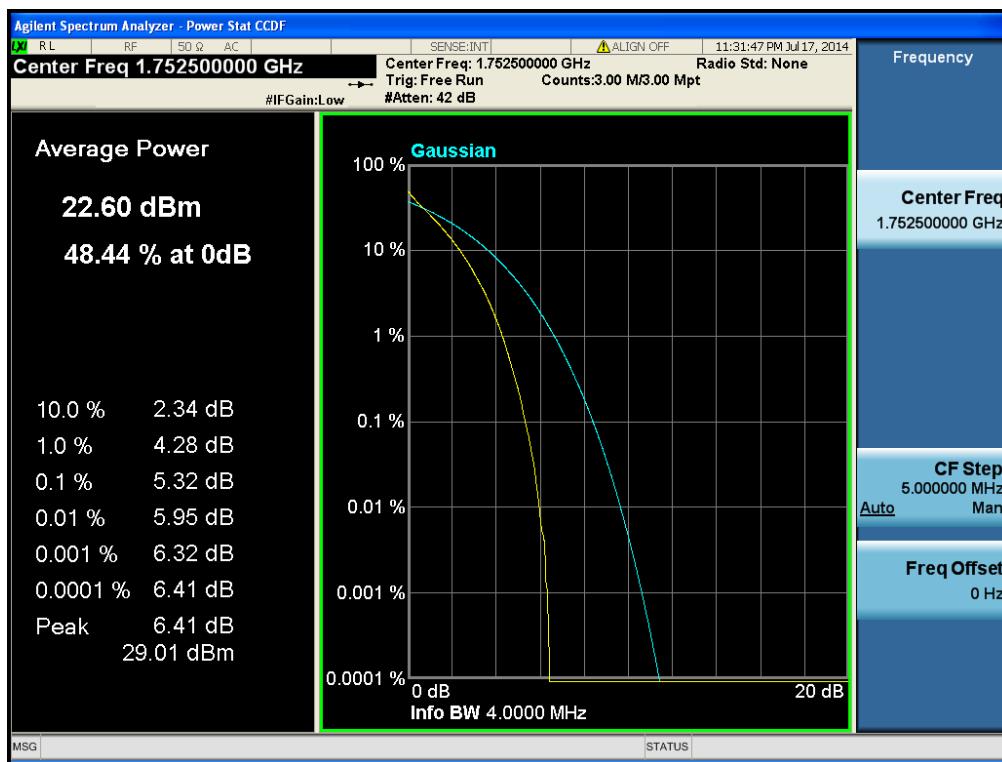
LTE Band 4 / 15MHz / 16QAM - RB Size 75



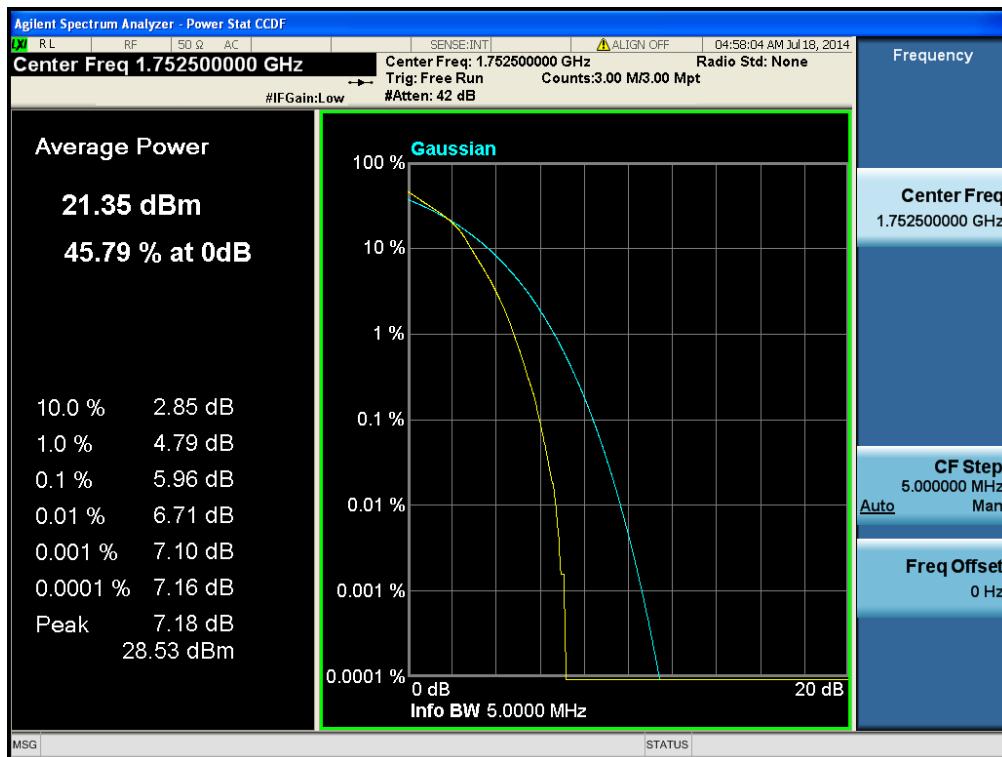
LTE Band 4 / 10MHz / QPSK - RB Size 50



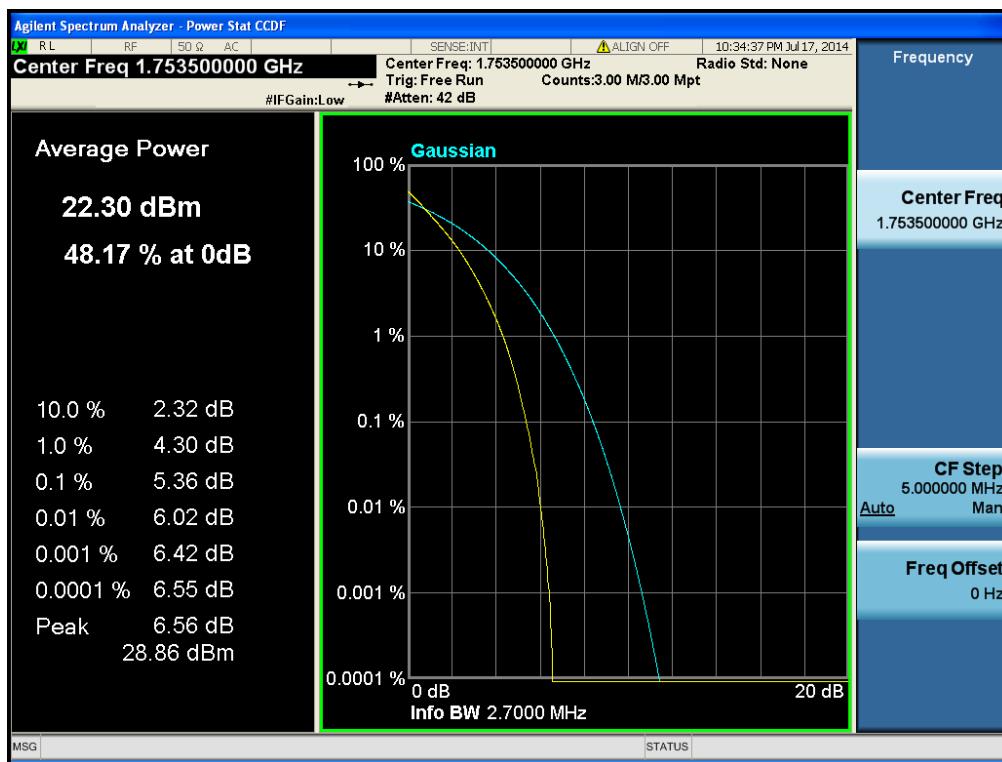
LTE Band 4 / 10MHz / 16QAM - RB Size 50



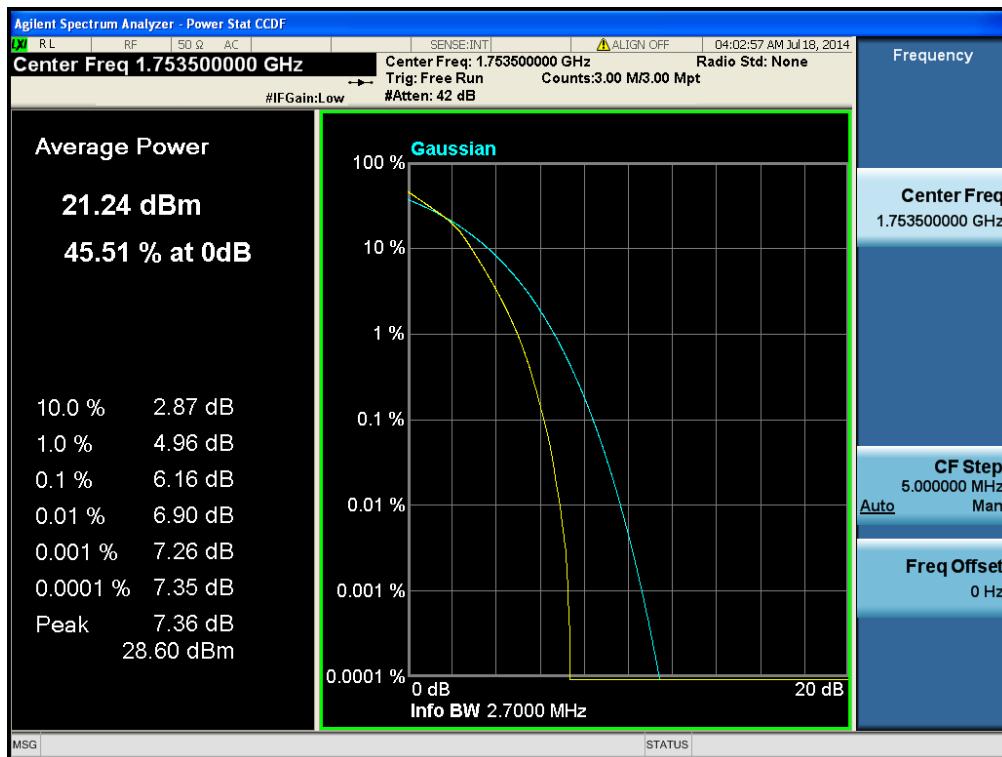
LTE Band 4 / 5MHz / QPSK - RB Size 25



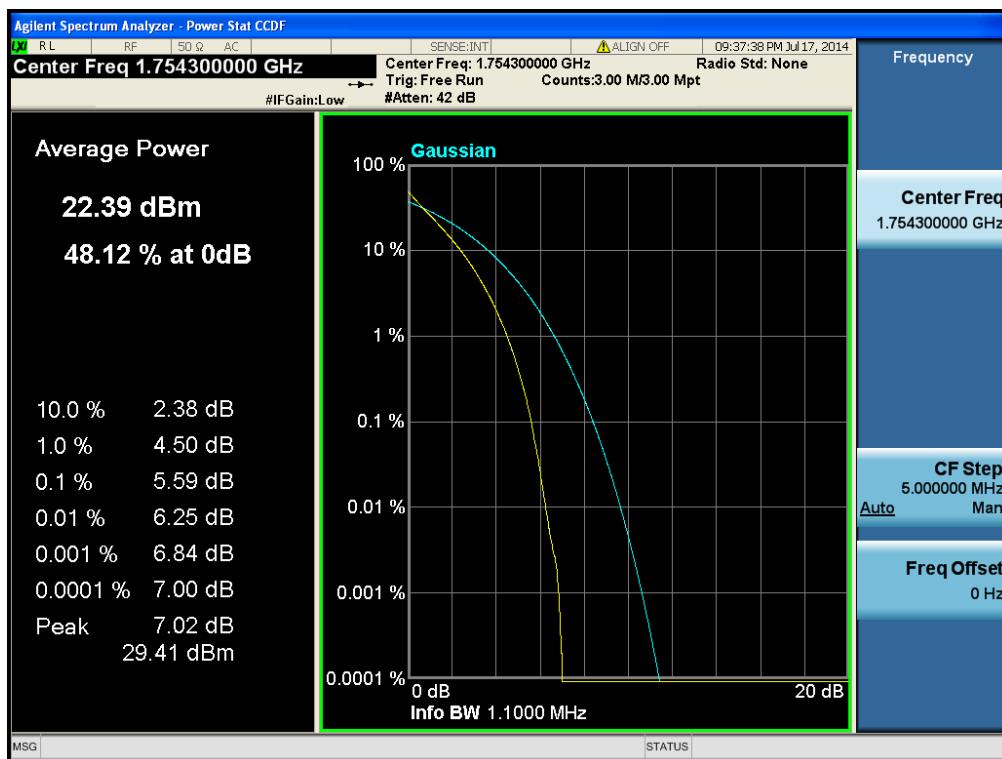
LTE Band 4 / 5MHz / 16QAM - RB Size 25



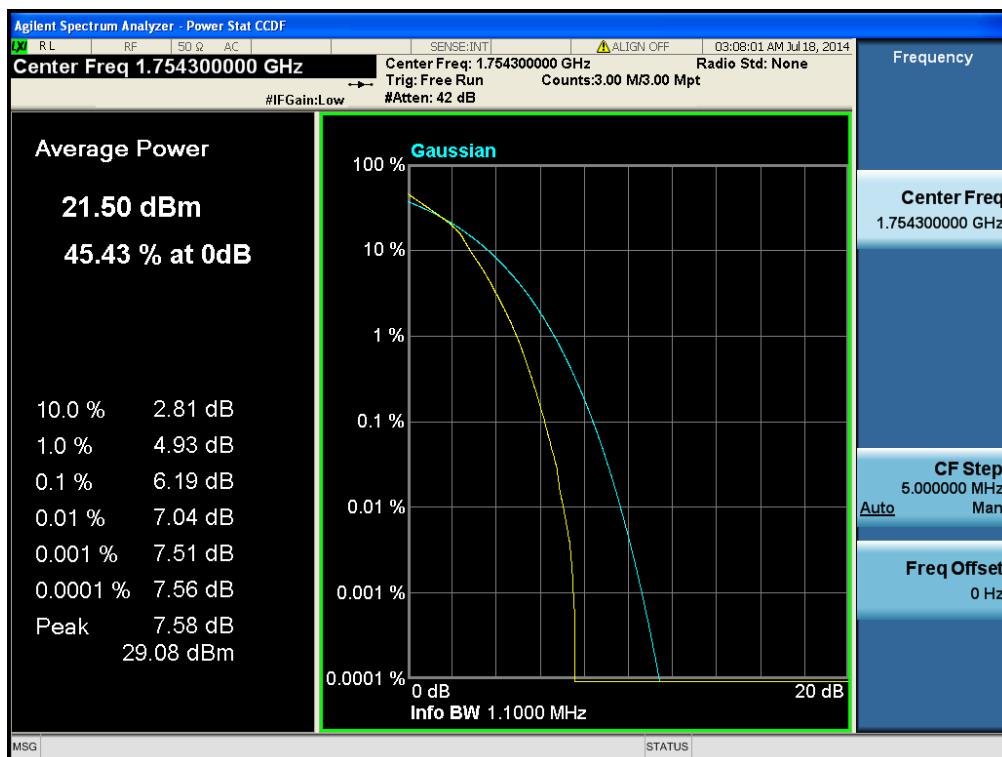
LTE Band 4 / 3MHz / QPSK - RB Size 15



LTE Band 4 / 3MHz / 16QAM - RB Size 15



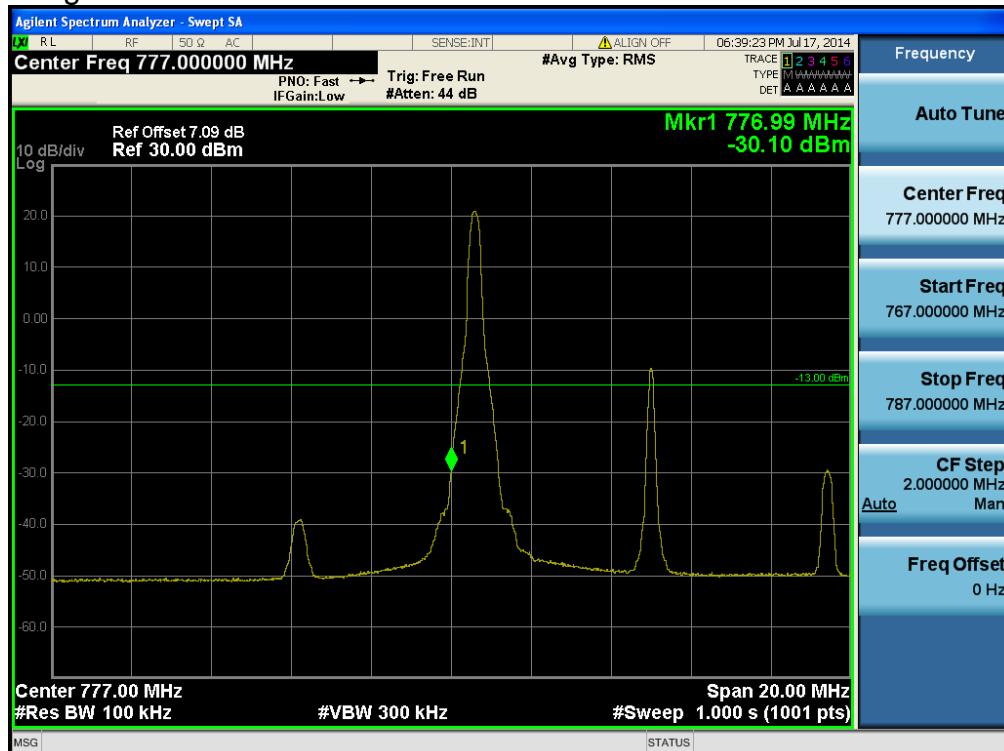
LTE Band 4 / 1.4MHz / QPSK - RB Size 6



LTE Band 4 / 1.4MHz / 16QAM - RB Size 6

## 8.5 UNDESIRABLE EMISSIONS (CONDUCTED- LTE Band 13)

- Lower Band Edge



LTE Band 13 / 10MHz / QPSK - RB Offset/Size (0/1)

- Lower Extended Band Edge



LTE Band 13 / 10MHz / QPSK - RB Offset/Size (0/25)

- Lower (763 ~ 775 MHz)



LTE Band 13 / 10MHz / QPSK - RB Offset/Size (0/25)

- Upper Band Edge



LTE Band 13 / 10MHz / QPSK - RB Offset/Size (12/25)

- Upper Extended Band Edge



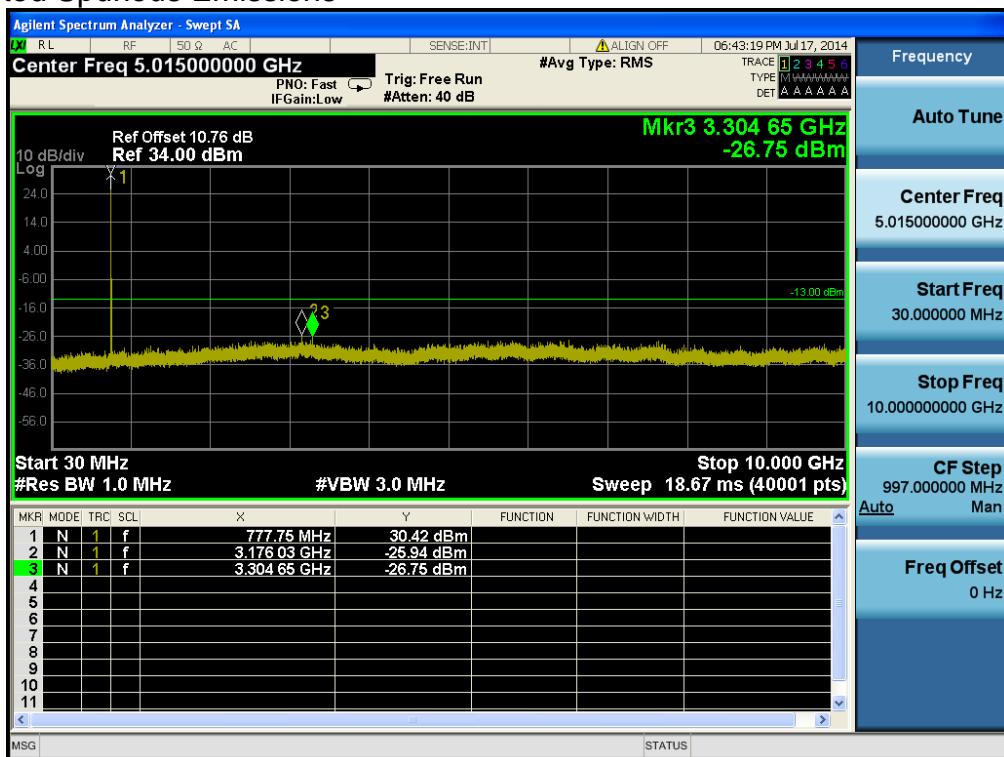
LTE Band 13 / 10MHz / QPSK - RB Offset/Size (12/25)

- Upper (793 ~ 805 MHz)



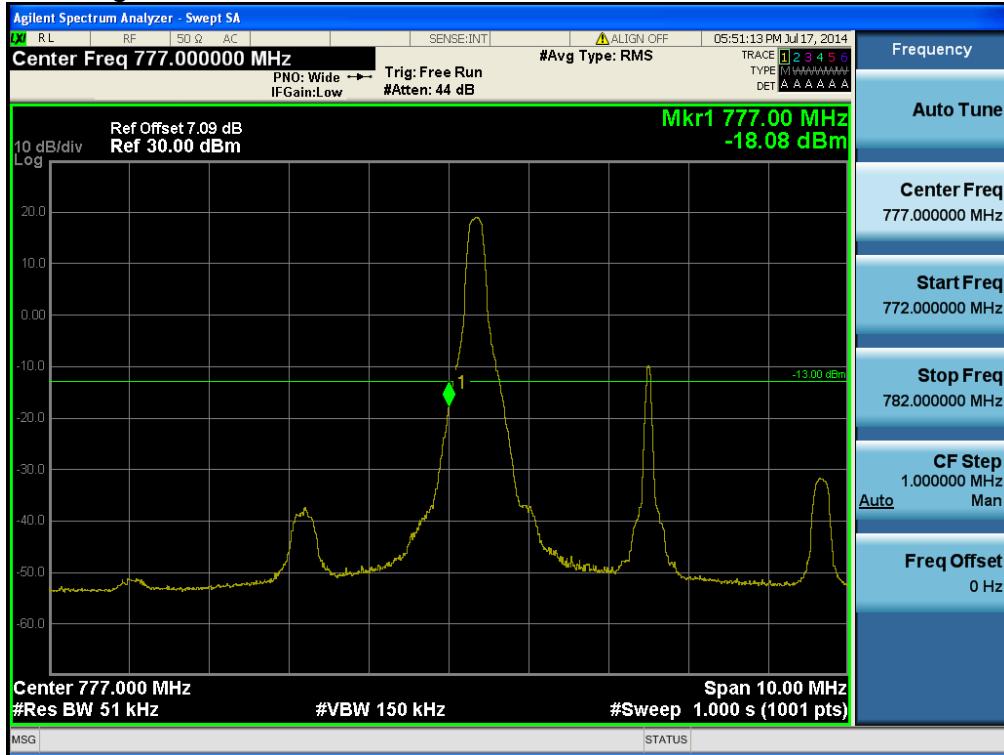
LTE Band 13 / 10MHz / QPSK – Offset/Size (0/50)

- Conducted Spurious Emissions



LTE Band 13 / 10MHz / QPSK - RB Offset/Size (0/1)

- Lower Band Edge



LTE Band 13 / 5MHz / QPSK - RB Offset/Size (0/1)

- Lower Extended Band Edge



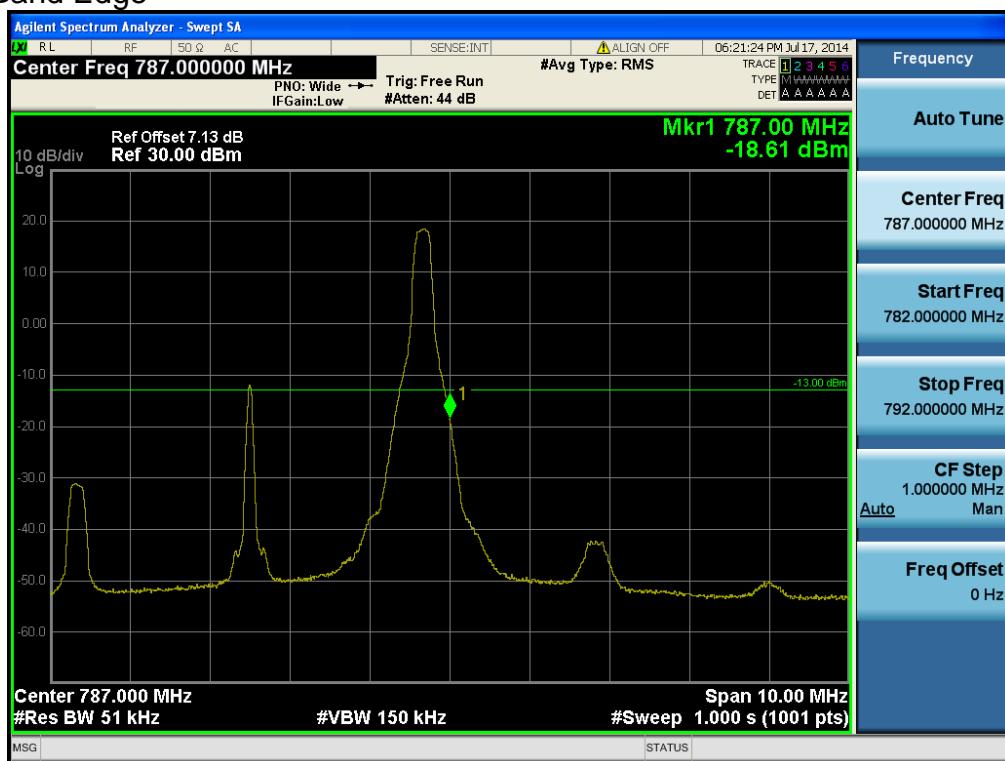
LTE Band 13 / 5MHz / 16QAM - RB Offset/Size (0/1)

- Lower (763 ~ 775 MHz)



LTE Band 13 / 5MHz / QPSK - RB Offset/Size (0/25)

- Upper Band Edge



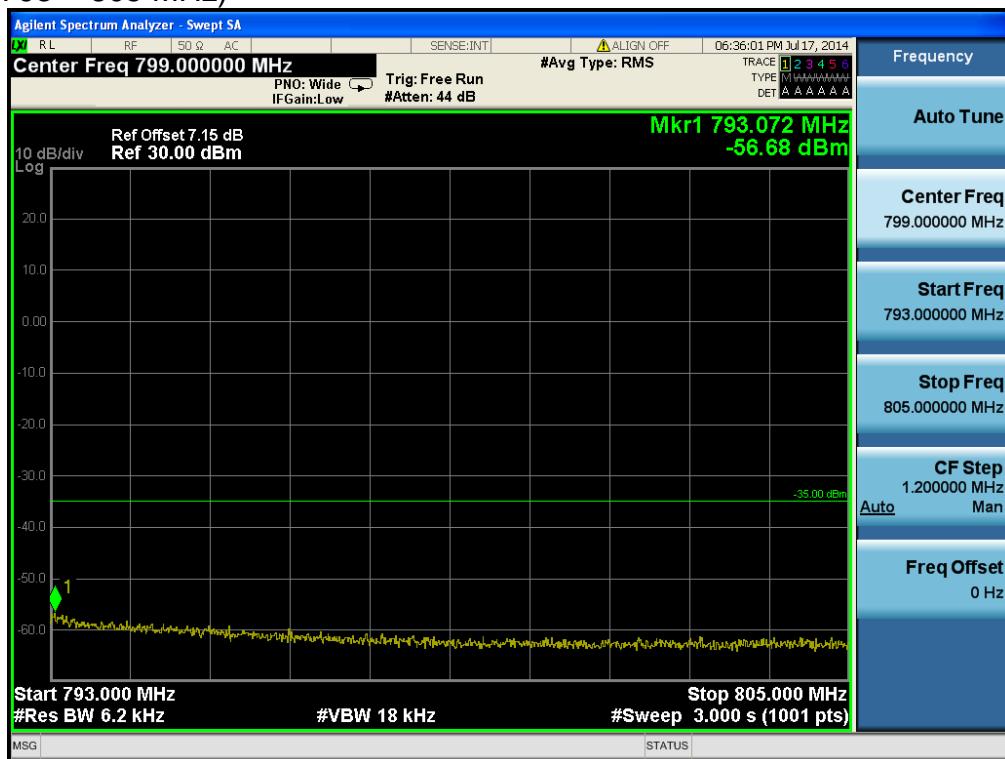
LTE Band 13 / 5MHz / QPSK - RB Offset/Size (24/1)

- Upper Extended Band Edge



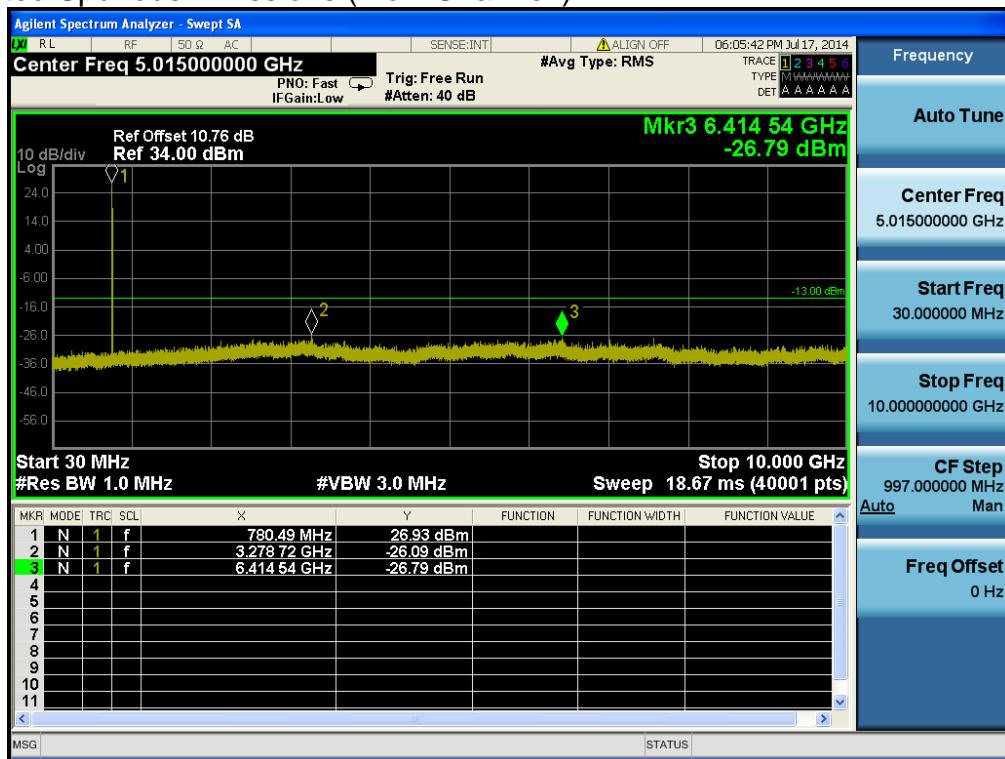
LTE Band 13 / 5MHz / QPSK - RB Offset/Size (24/1)

- Upper (793 ~ 805 MHz)



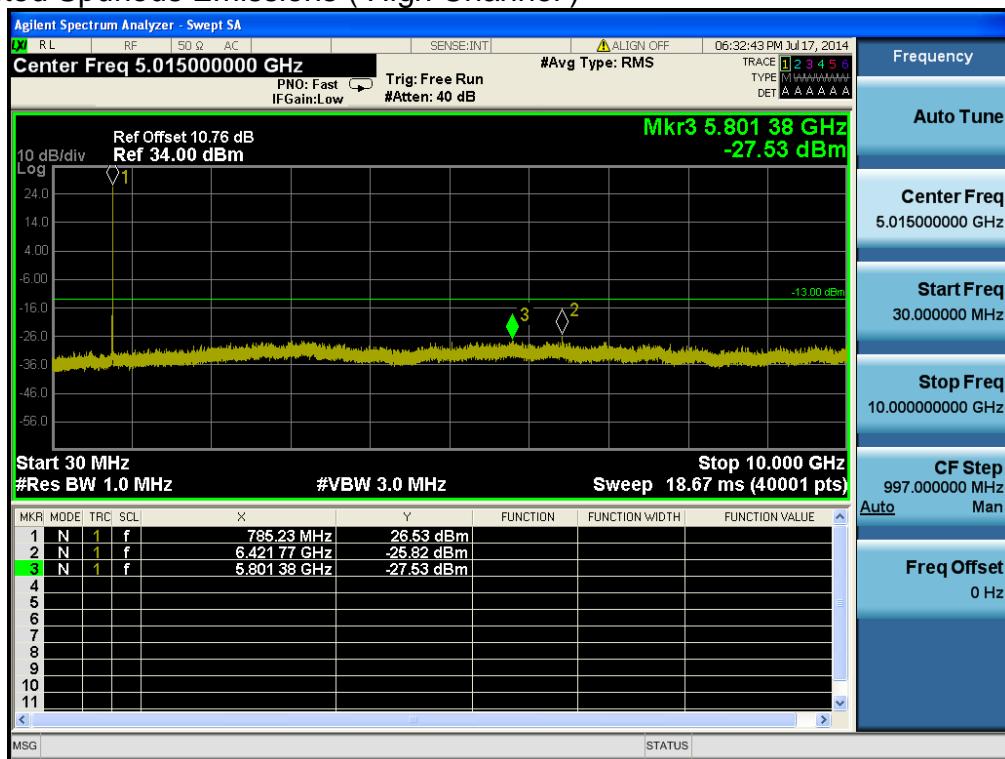
LTE Band 13 / 5MHz / QPSK - RB Offset/Size (0/25)

- Conducted Spurious Emissions ( Low Channel )



LTE Band 13 / 5MHz / QPSK - RB Offset/Size (6/12)

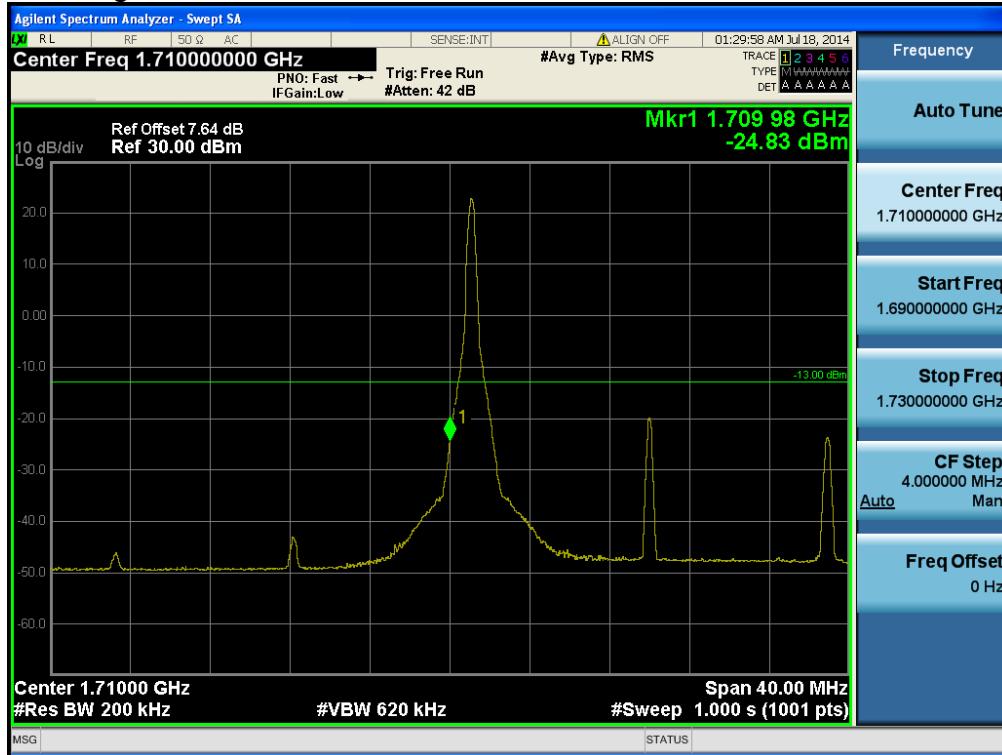
- Conducted Spurious Emissions ( High Channel )



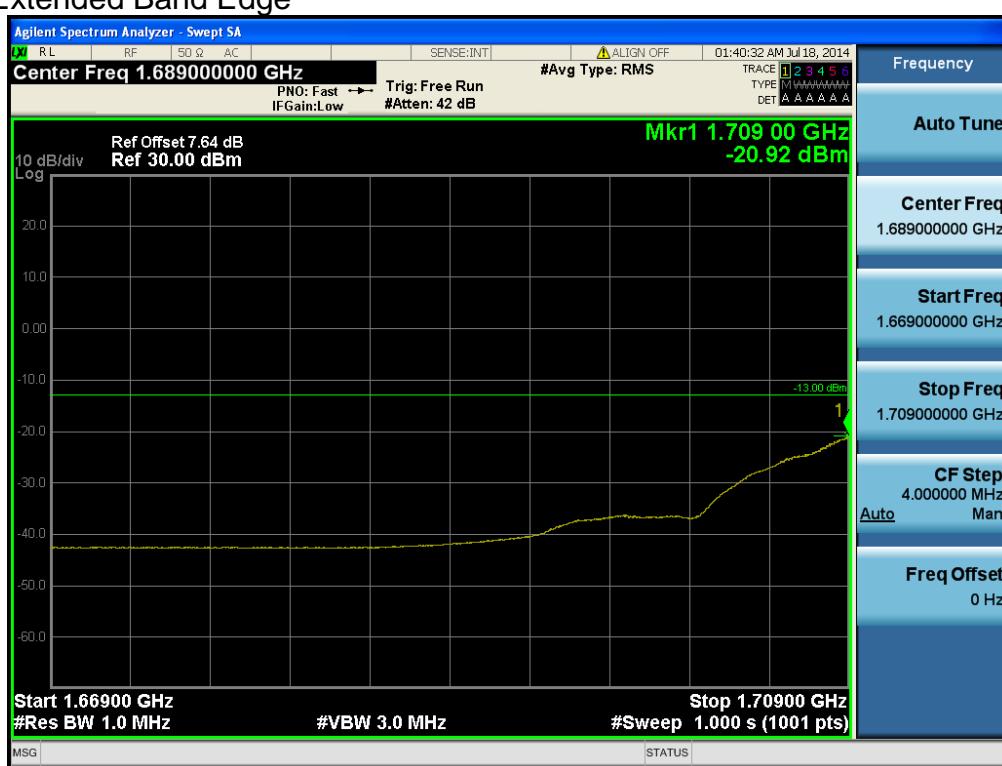
LTE Band 13 / 5MHz / QPSK - RB Offset/Size (13/12)

## 8.6 UNDESIRABLE EMISSIONS (CONDUCTED- LTE Band 4)

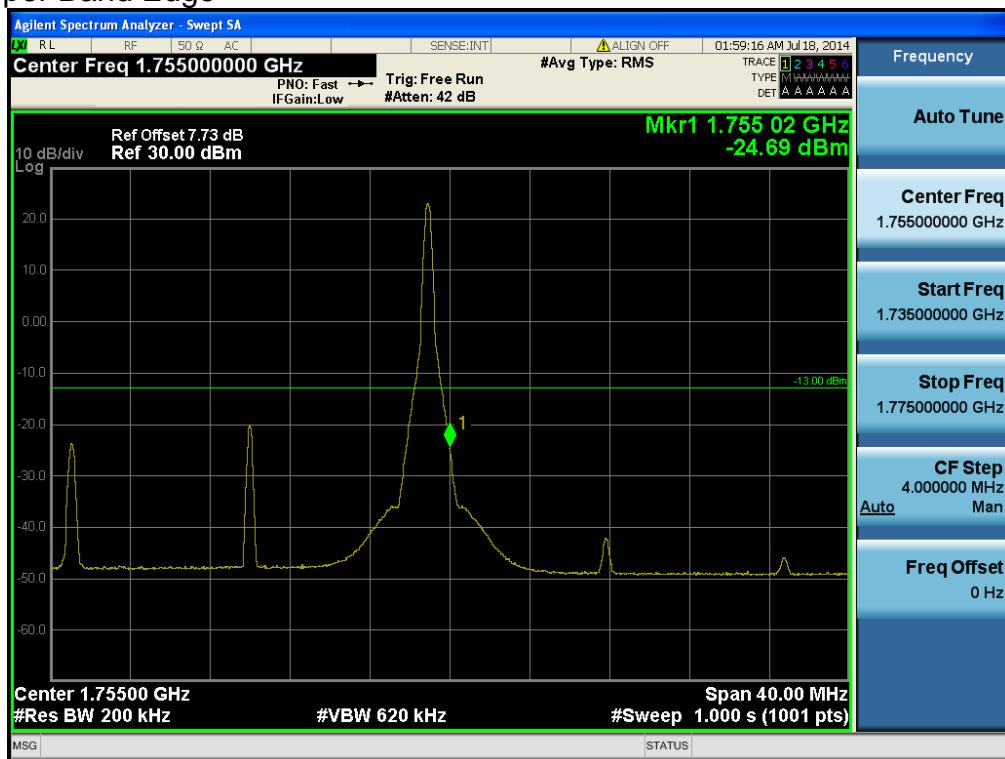
- Lower Band Edge



- Lower Extended Band Edge



- Upper Band Edge



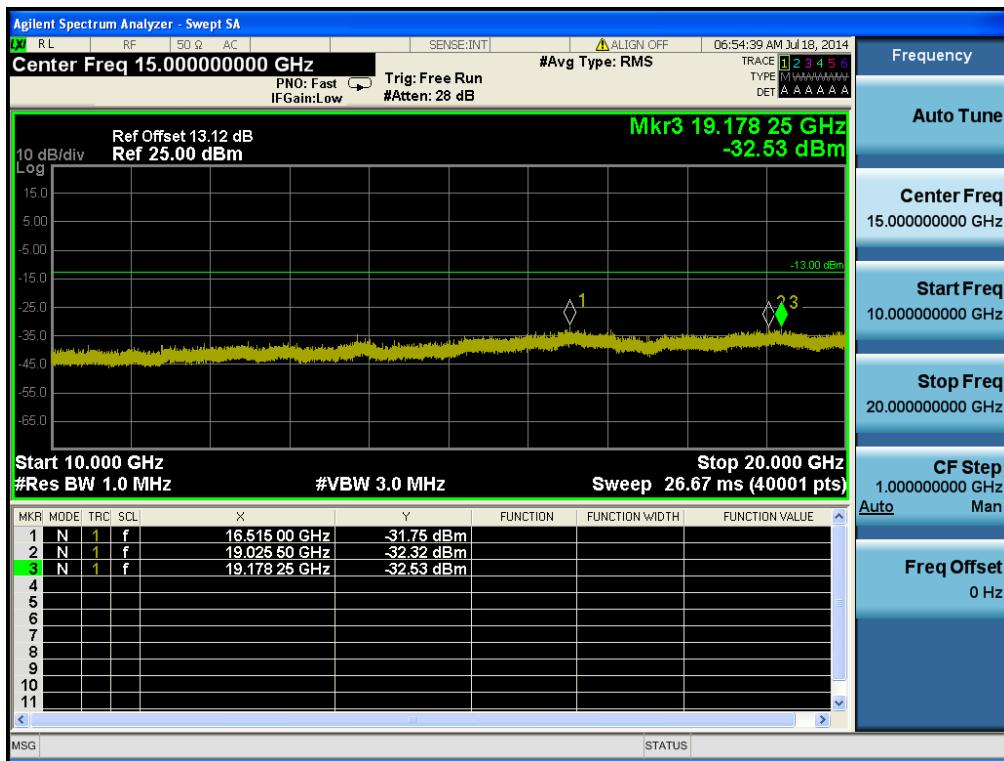
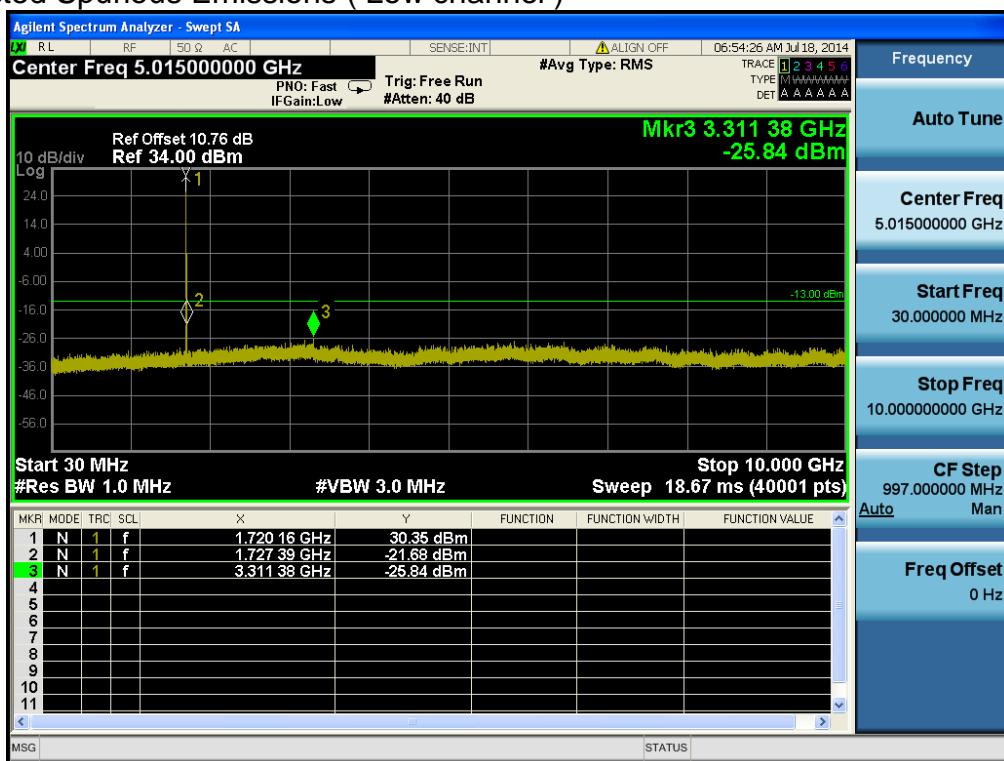
LTE Band 4 / 20MHz / QPSK - RB Offset/Size (99/1)

- Upper Extended Band Edge



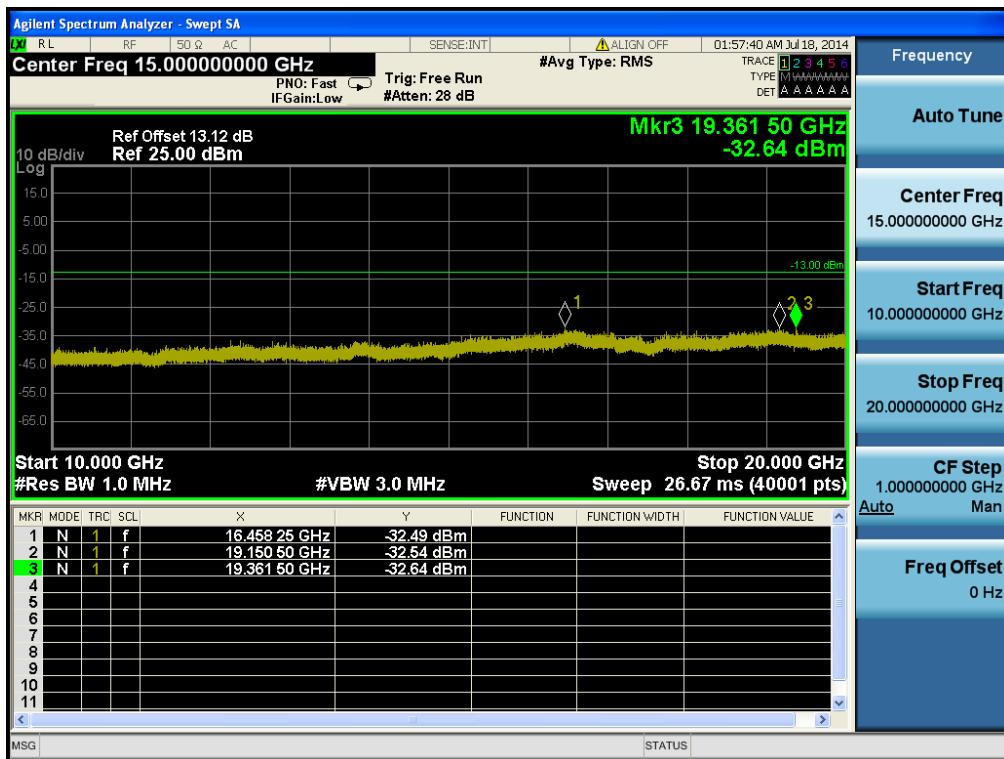
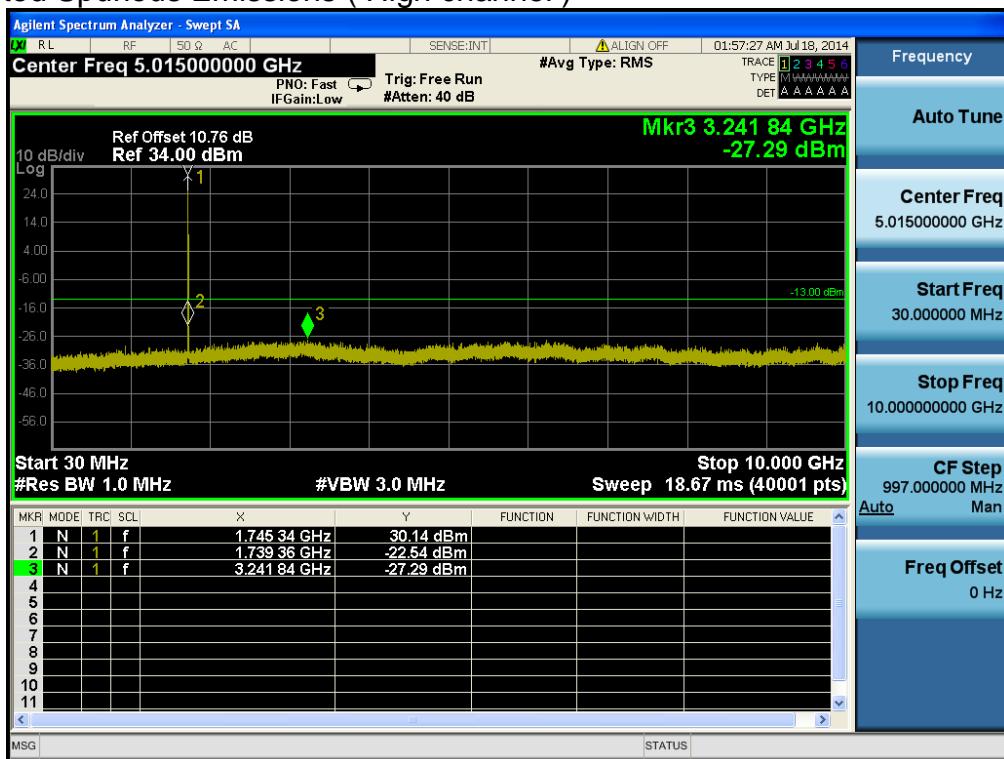
LTE Band 4 / 20MHz / QPSK - RB Offset/Size (50/50)

- Conducted Spurious Emissions ( Low channel )



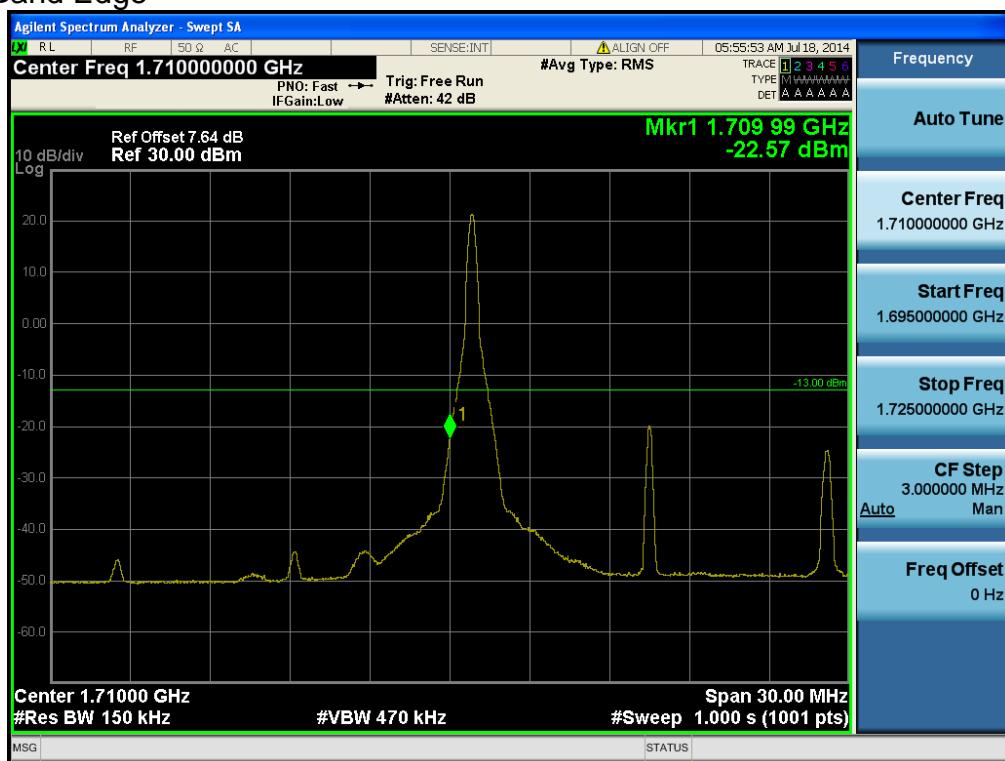
LTE Band 4 / 20MHz / 16QAM - RB Offset/Size (50/1)

- Conducted Spurious Emissions ( High channel )



LTE Band 4 / 20MHz / QPSK - RB Offset/Size (50/1)

## Lower Band Edge



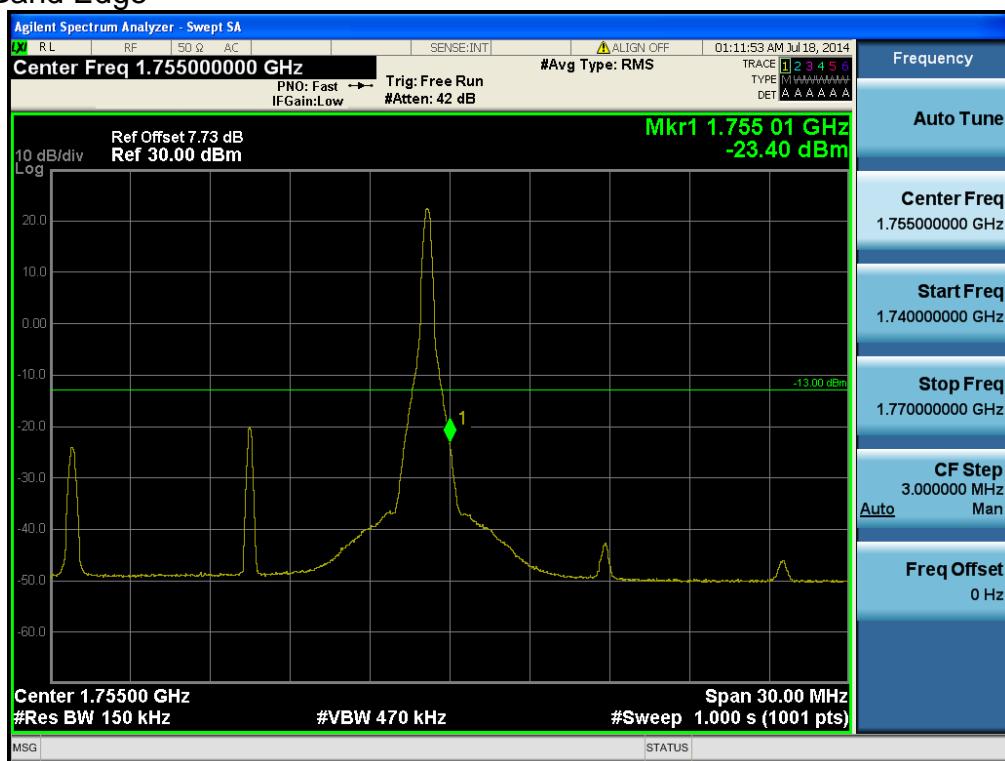
LTE Band 4 / 15MHz / 16QAM - RB Offset/Size (0/1)

## - Lower Extended Band Edge



LTE Band 4 / 15MHz / QPSK - RB Offset/Size (0/36)

- Upper Band Edge



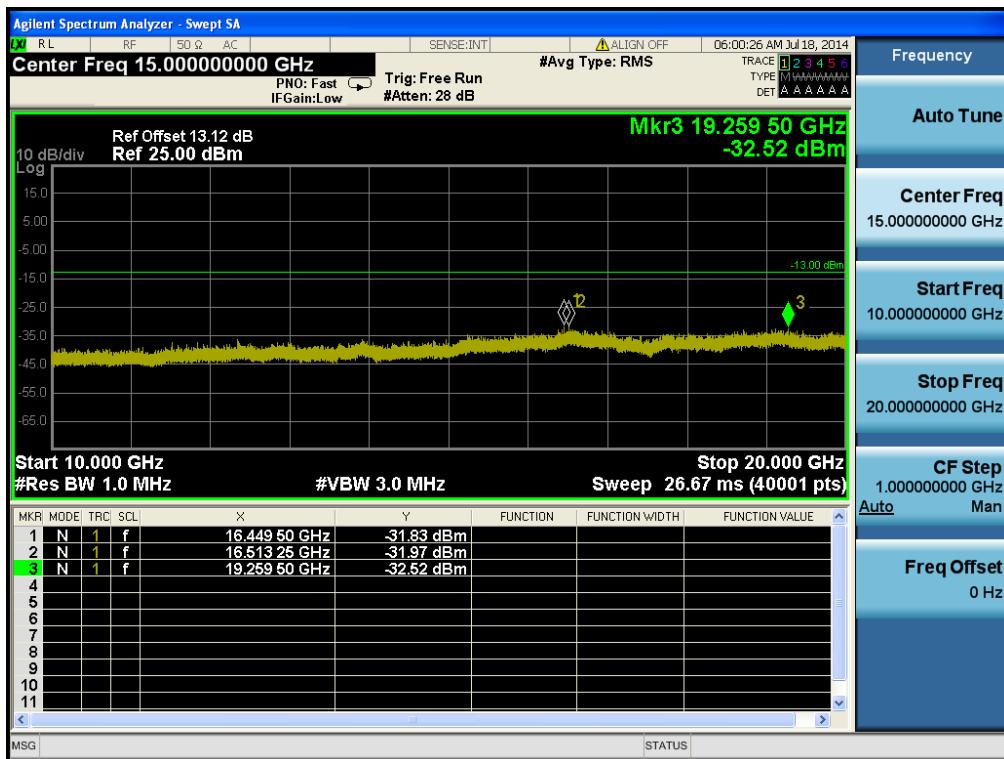
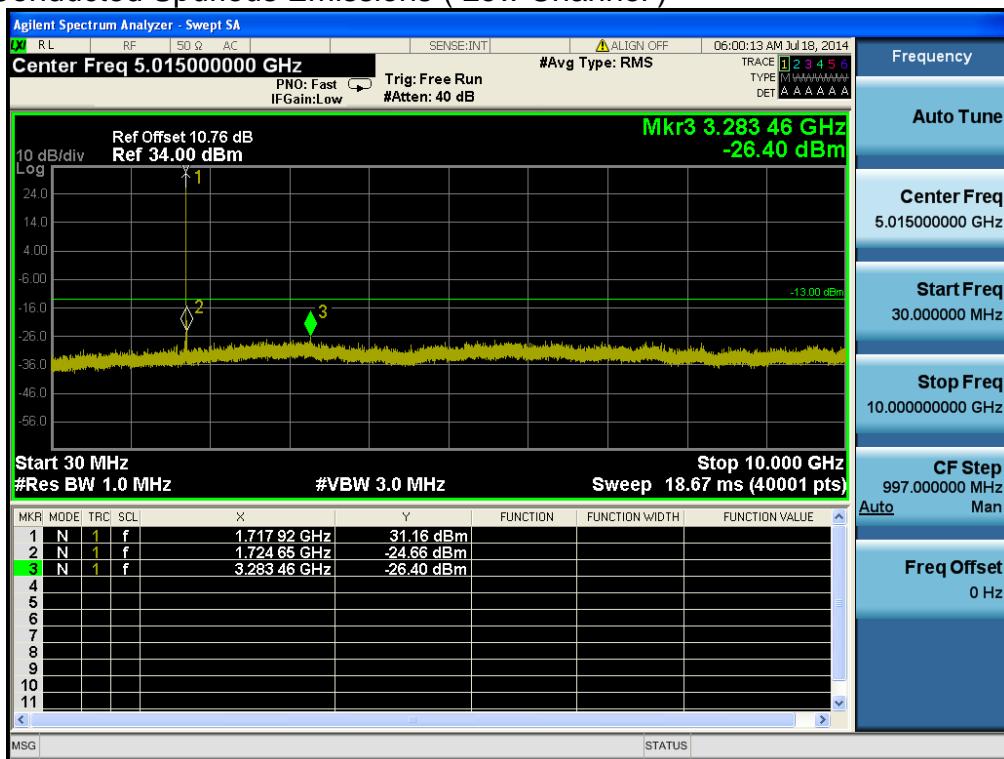
LTE Band 4 / 15MHz / QPSK - RB Offset/Size (74/1)

- Upper Extended Band Edge



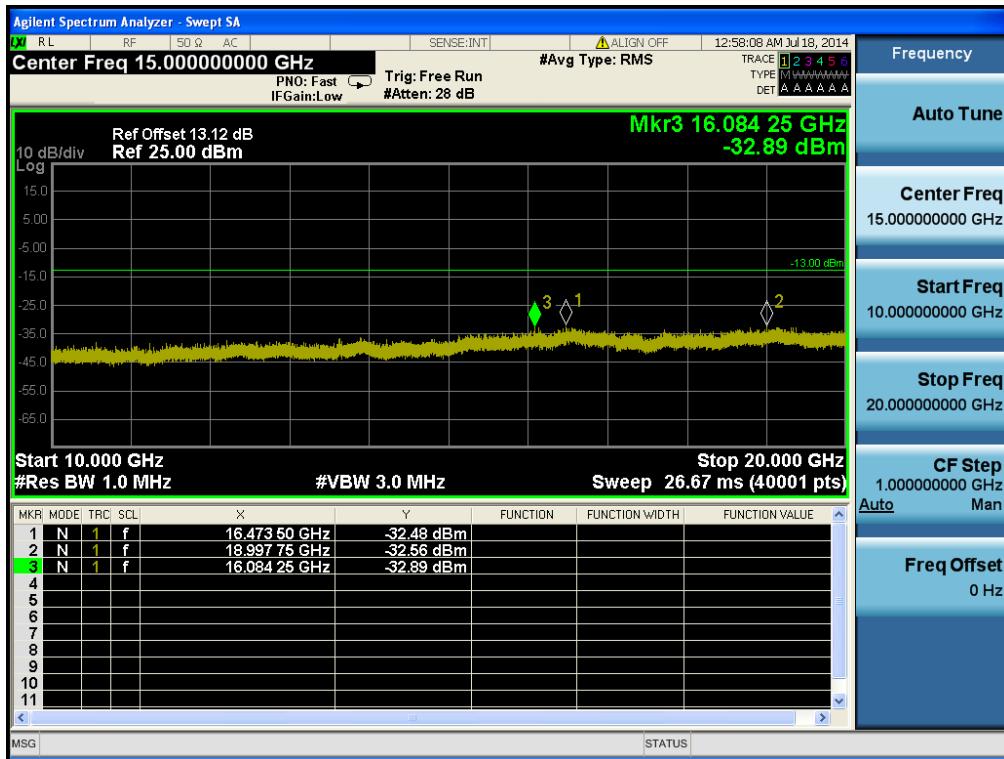
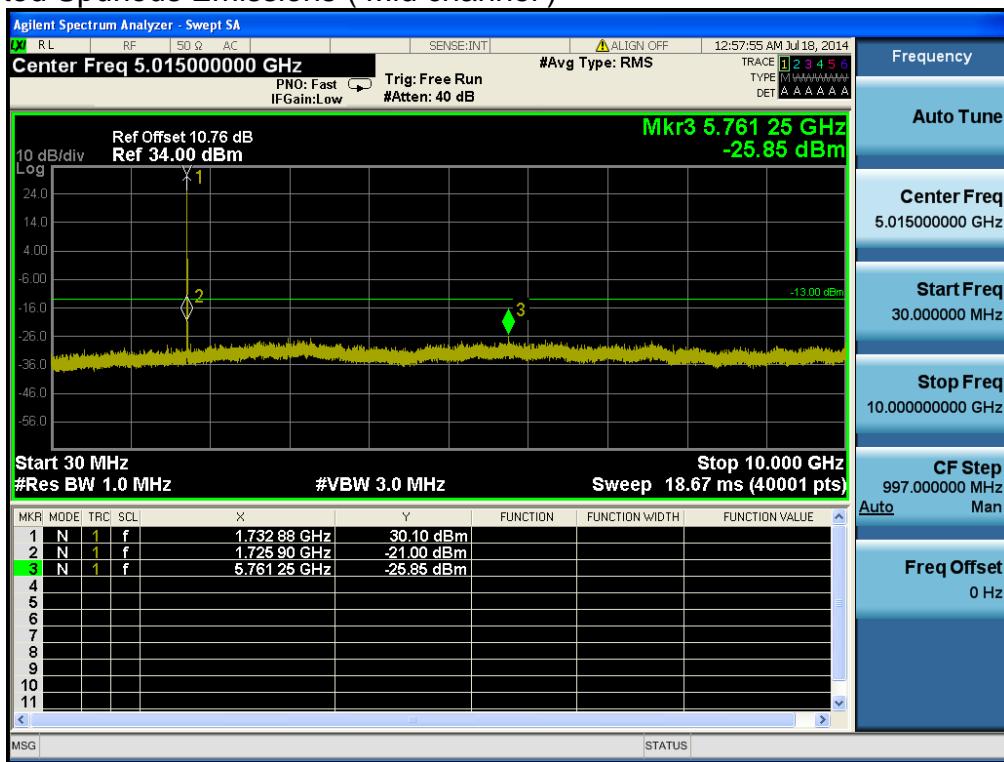
LTE Band 4 / 15MHz / QPSK - RB Offset/Size (39/36)

- Lower Conducted Spurious Emissions ( Low Channel )



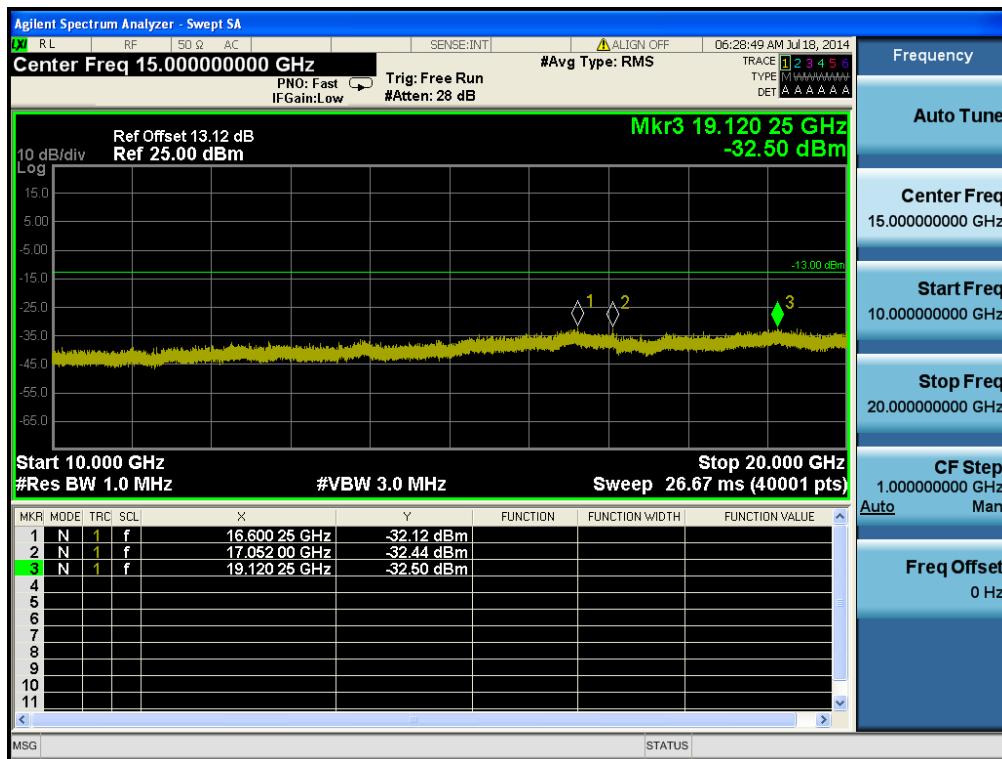
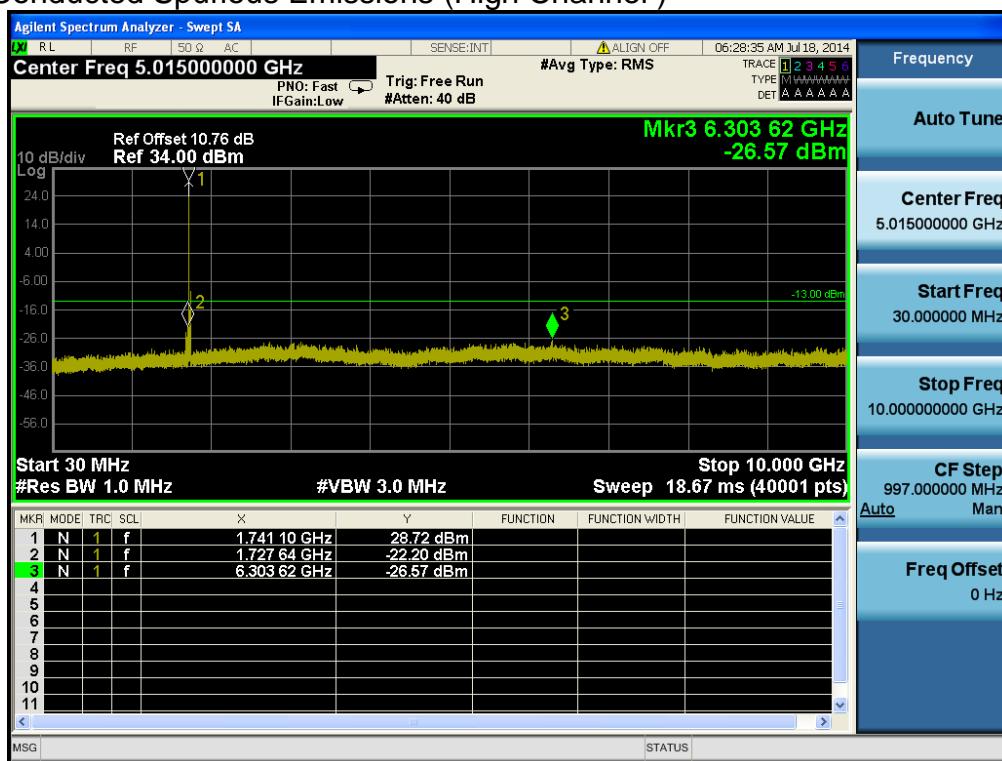
LTE Band 4 / 15MHz / 16QAM - RB Offset/Size (37/1)

- Conducted Spurious Emissions ( Mid channel )



LTE Band 4 / 15MHz / QPSK - RB Offset/Size (37/1)

- Upper Conducted Spurious Emissions (High Channel )



LTE Band 4 / 15MHz / 16QAM - RB Offset/Size (0/1)

- Lower Band Edge



LTE Band 4 / 10MHz / QPSK - RB Offset/Size (0/25)

- Lower Extended Band Edge



LTE Band 4 / 10MHz / QPSK - RB Offset/Size (0/25)

- Upper Band Edge



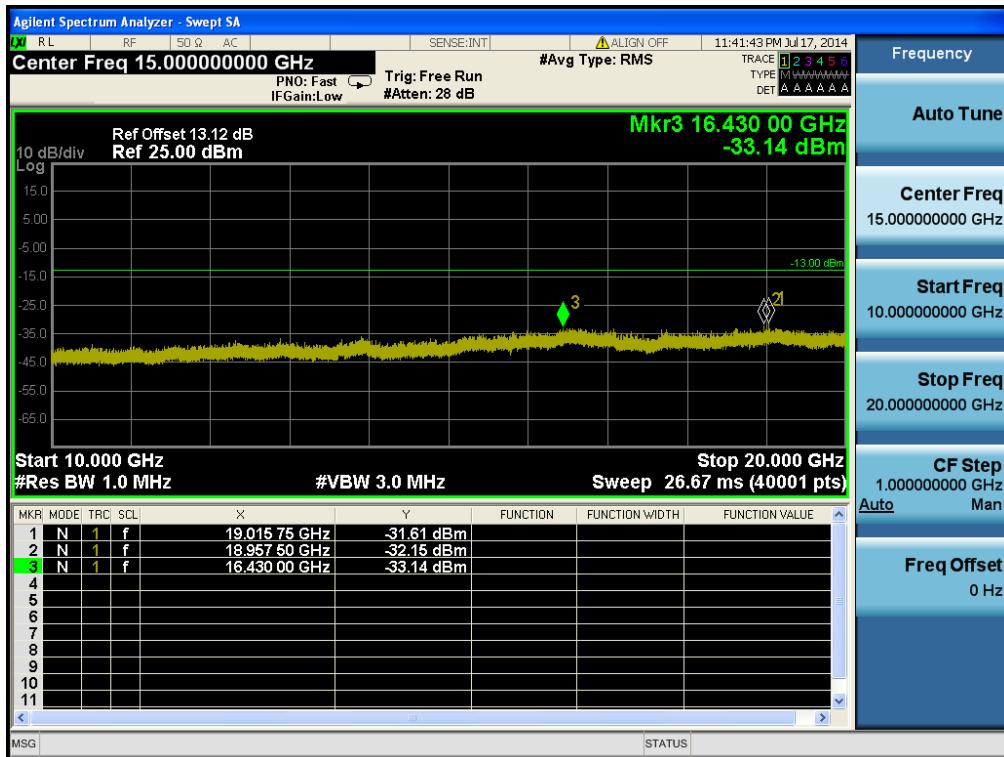
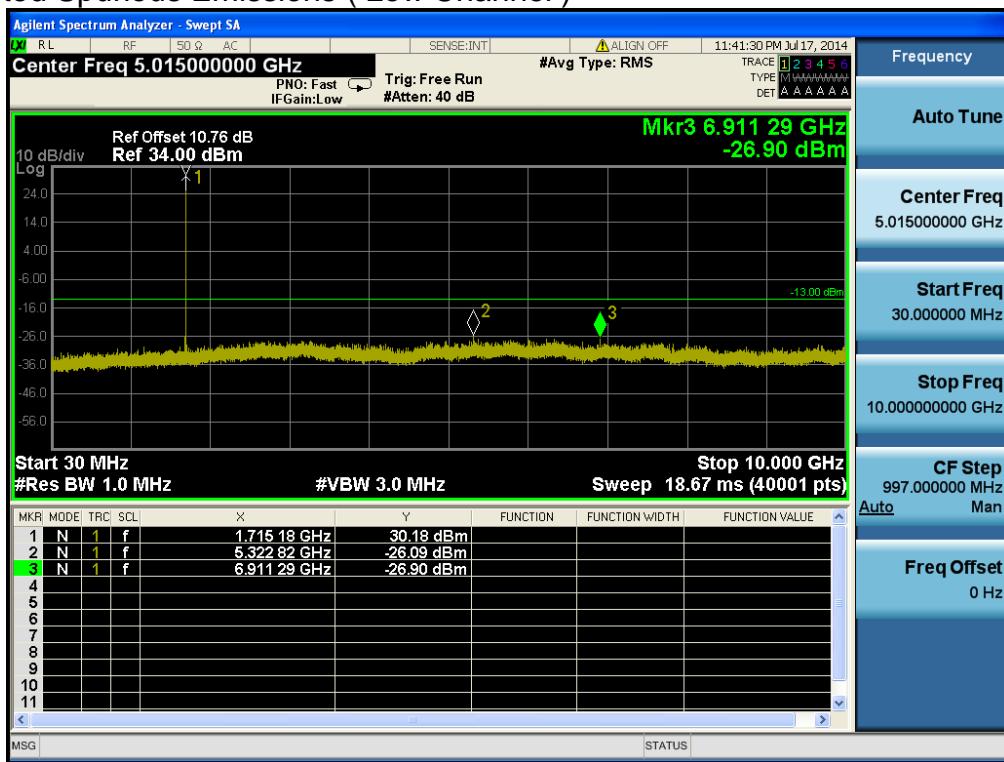
LTE Band 4 / 10MHz / QPSK - RB Offset/Size (25/25)

- Upper Extended Band Edge



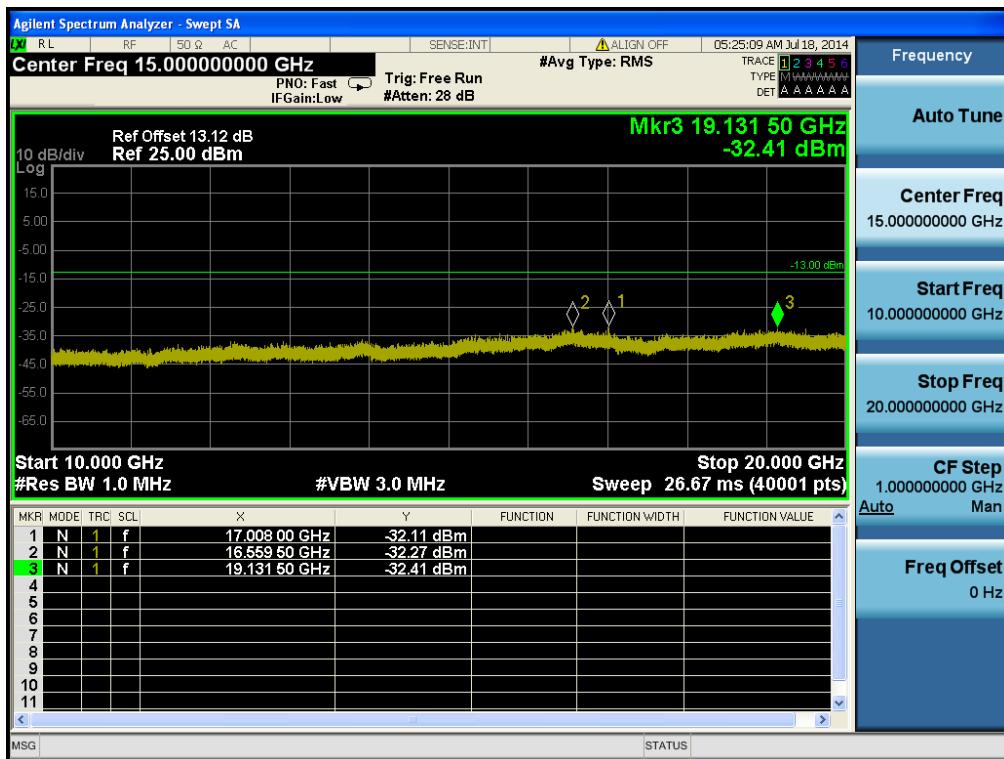
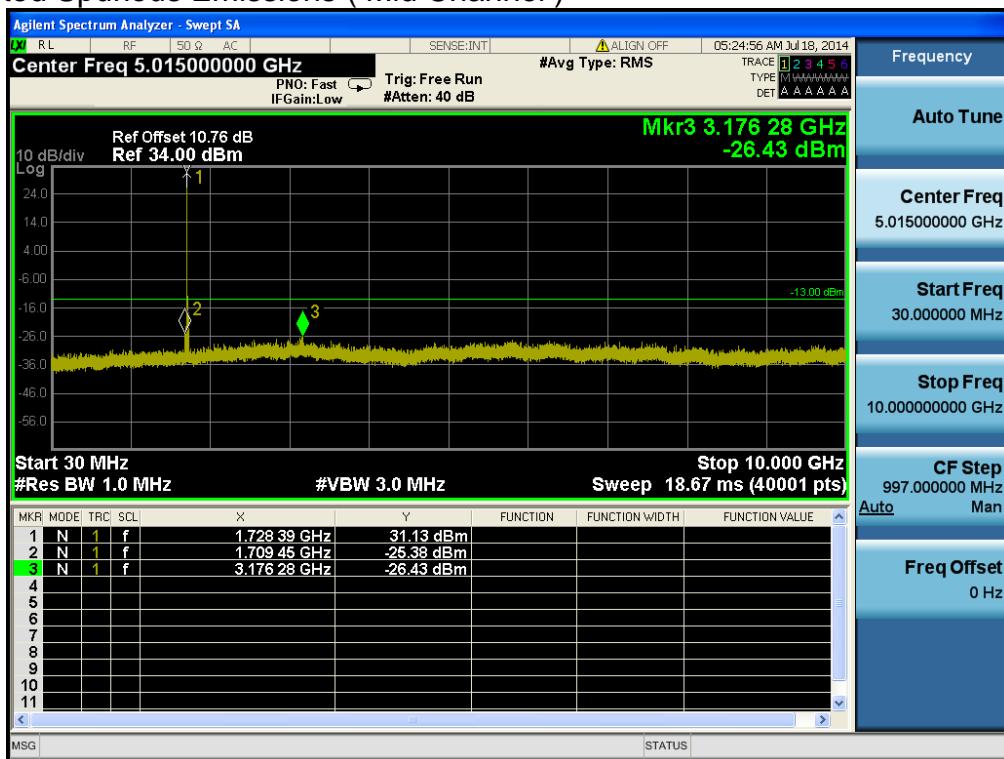
LTE Band 4 / 10MHz / QPSK - RB Offset/Size (25/25)

- Conducted Spurious Emissions ( Low Channel )



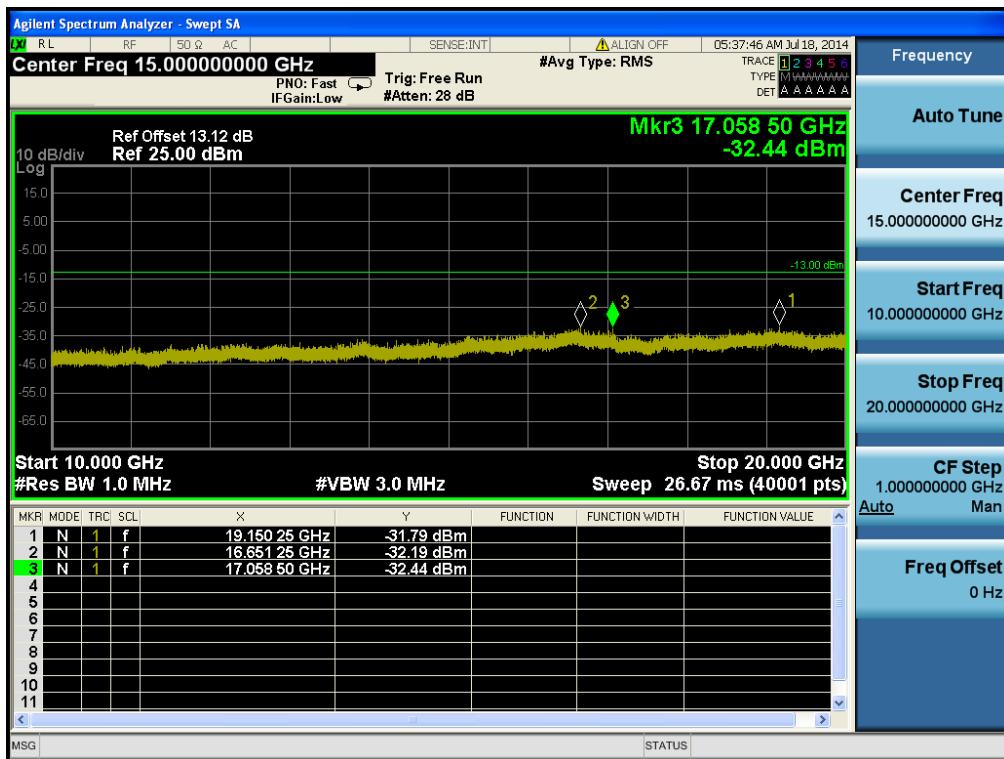
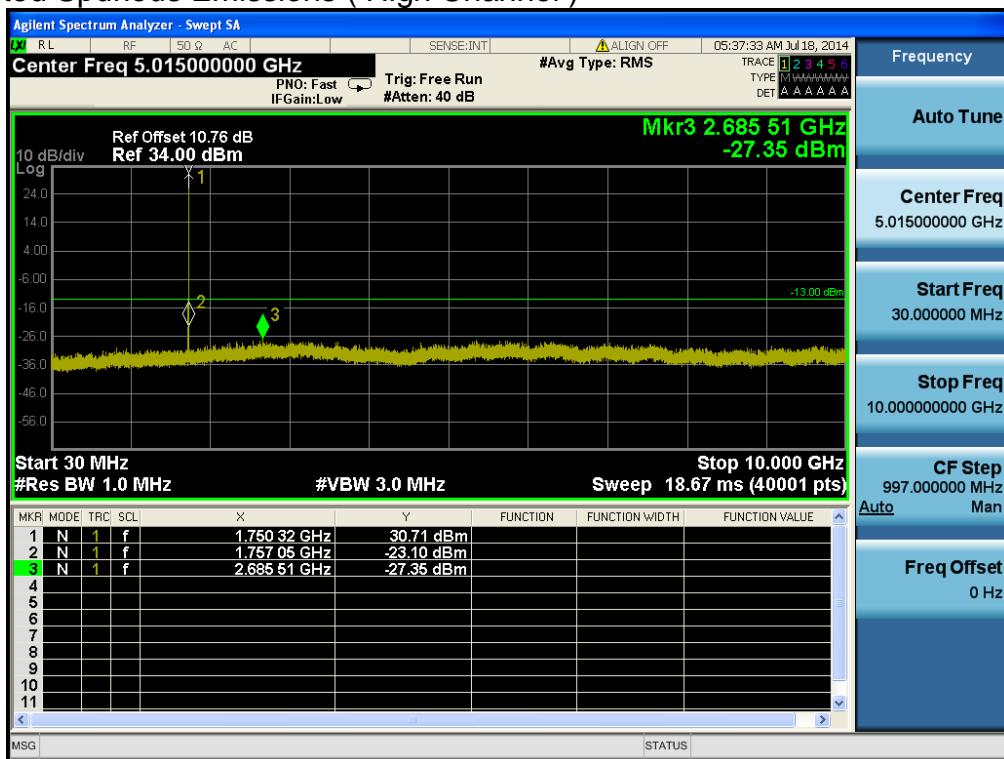
LTE Band 4 / 10MHz / QPSK - RB Offset/Size (25/1)

- Conducted Spurious Emissions ( Mid Channel )



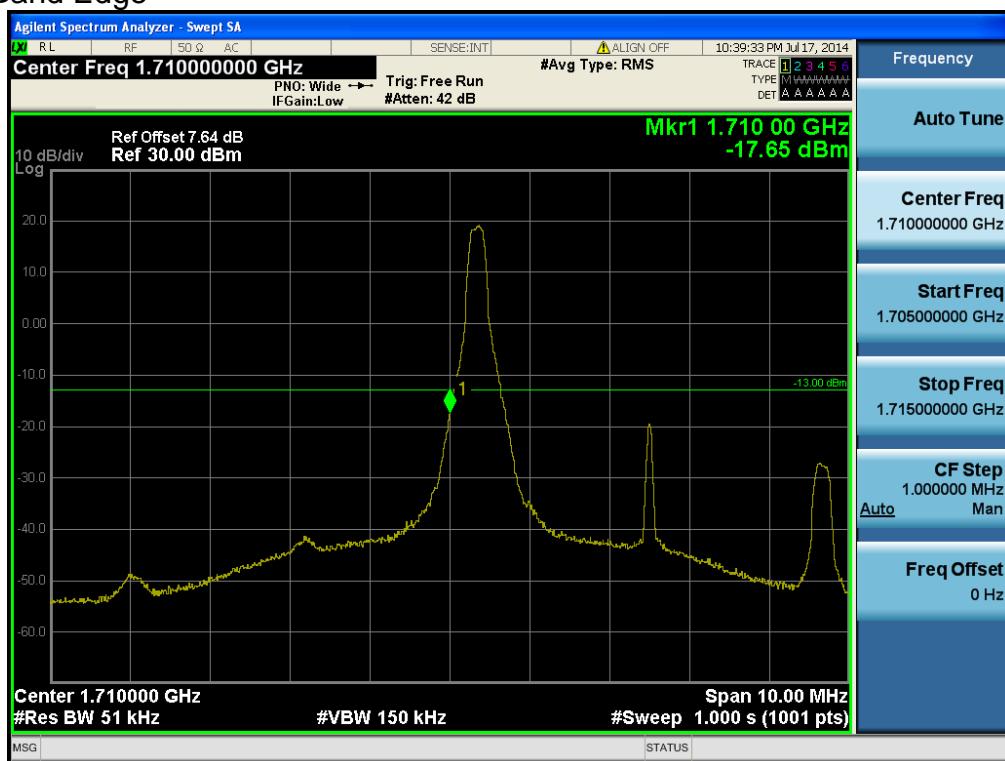
LTE Band 4 / 10MHz / 16QAM - RB Offset/Size (0/1)

- Conducted Spurious Emissions ( High Channel )



LTE Band 4 / 10MHz / 16QAM - RB Offset/Size (25/1)

- Lower Band Edge



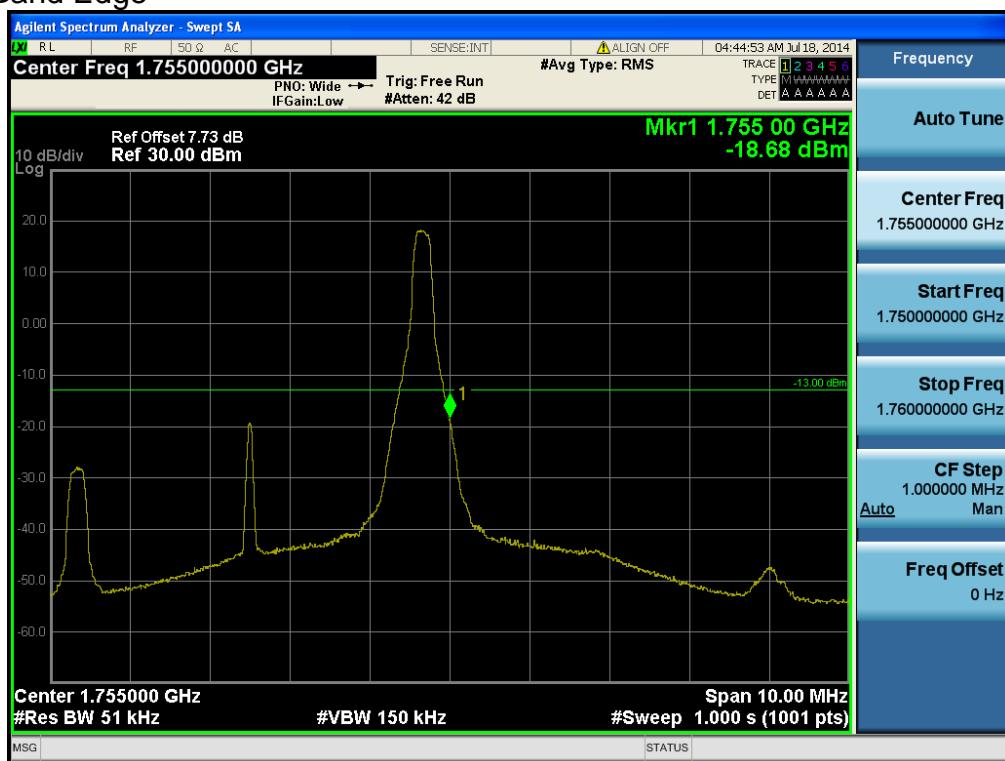
LTE Band 4 / 5MHz / QPSK - RB Offset/Size (0/1)

- Lower Extended Band Edge



LTE Band 4 / 5MHz / 16QAM - RB Offset/Size (0/25)

- Upper Band Edge



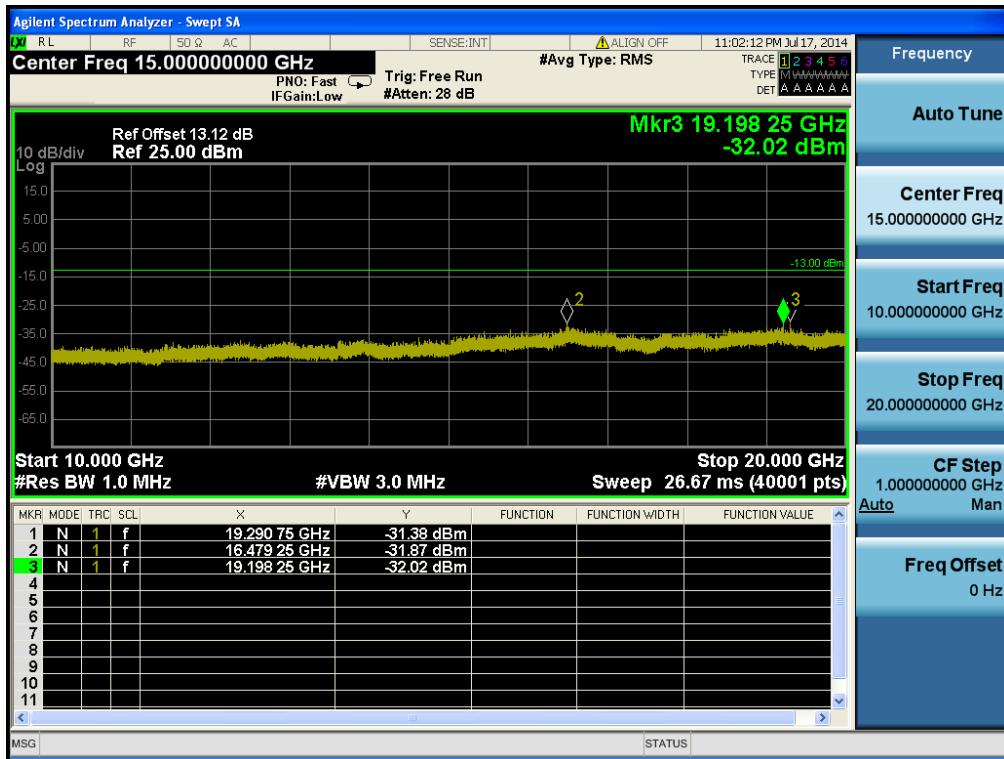
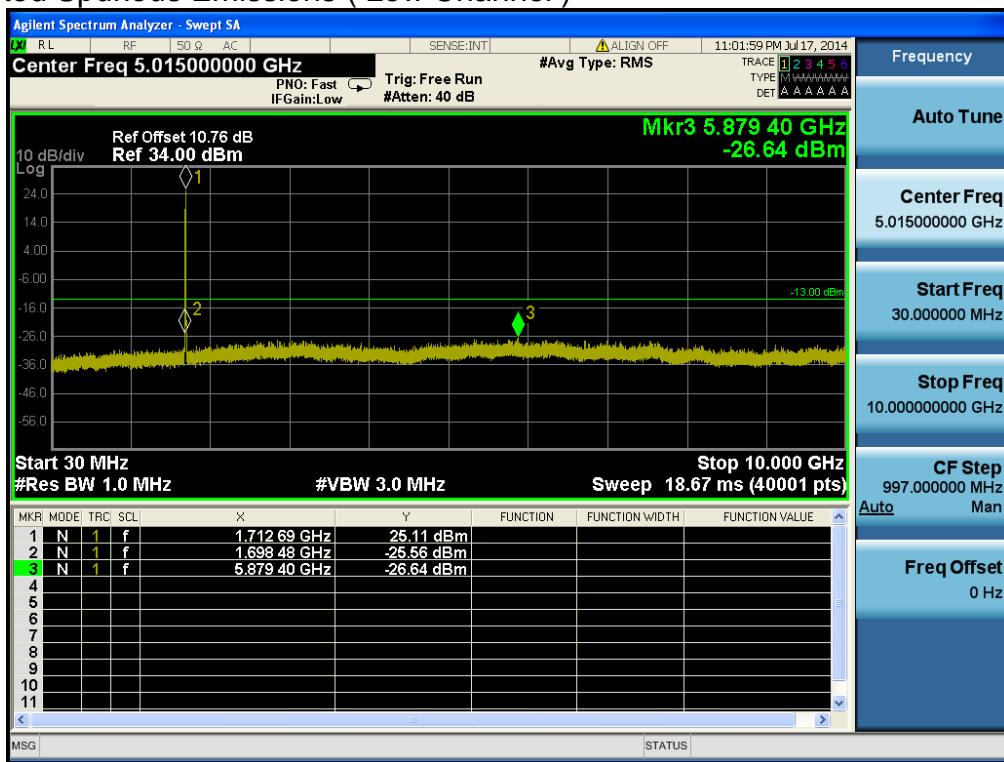
LTE Band 4 / 5MHz / 16QAM - RB Offset/Size (24/1)

- Upper Extended Band Edge



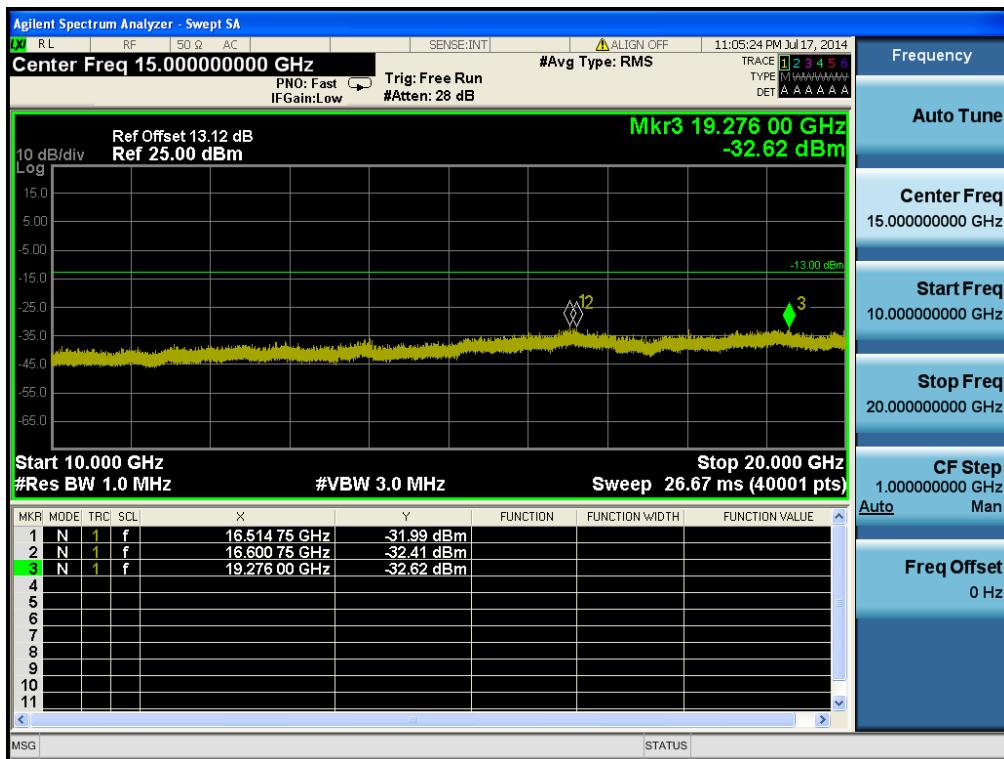
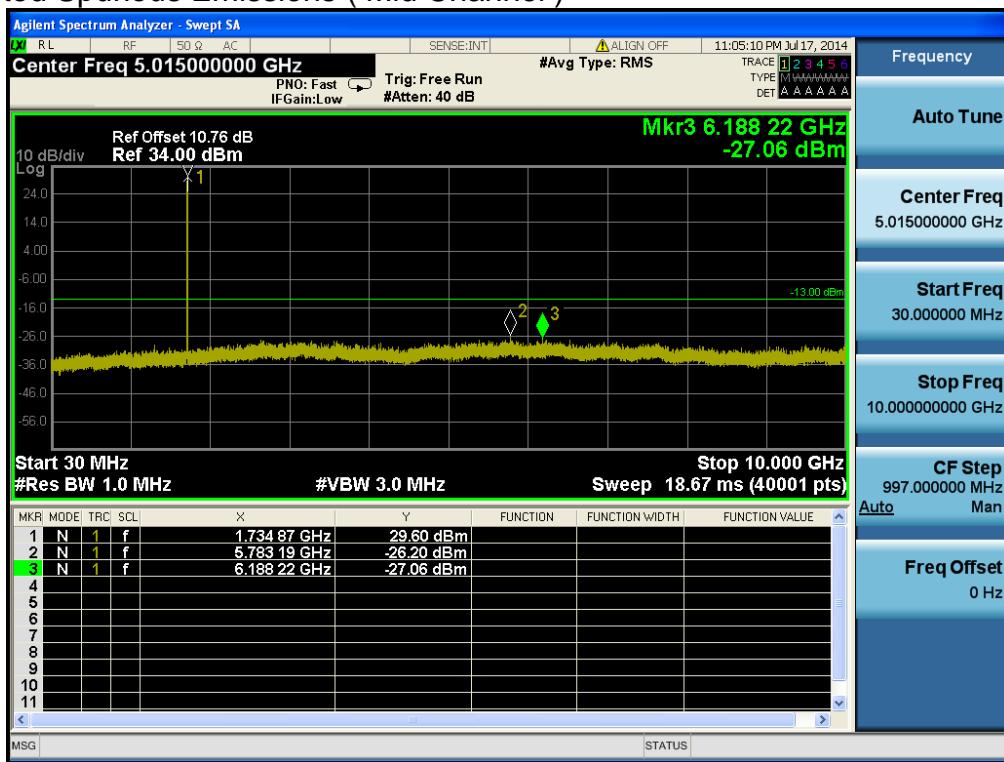
LTE Band 4 / 5MHz / QPSK - RB Offset/Size (6/12)

- Conducted Spurious Emissions ( Low Channel )



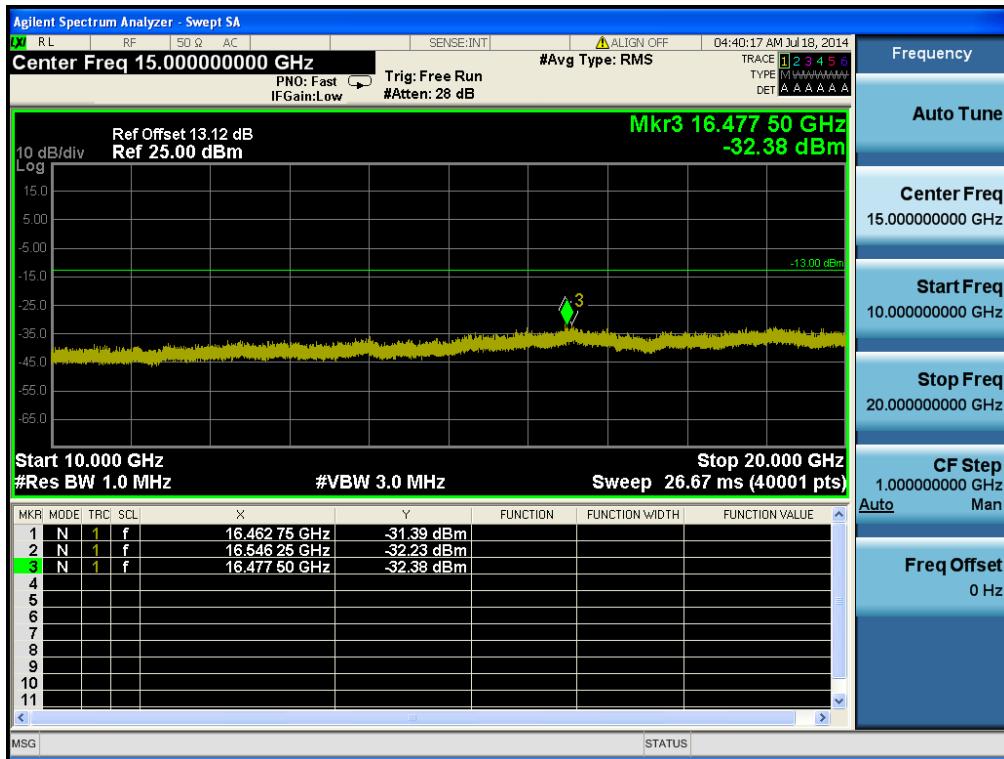
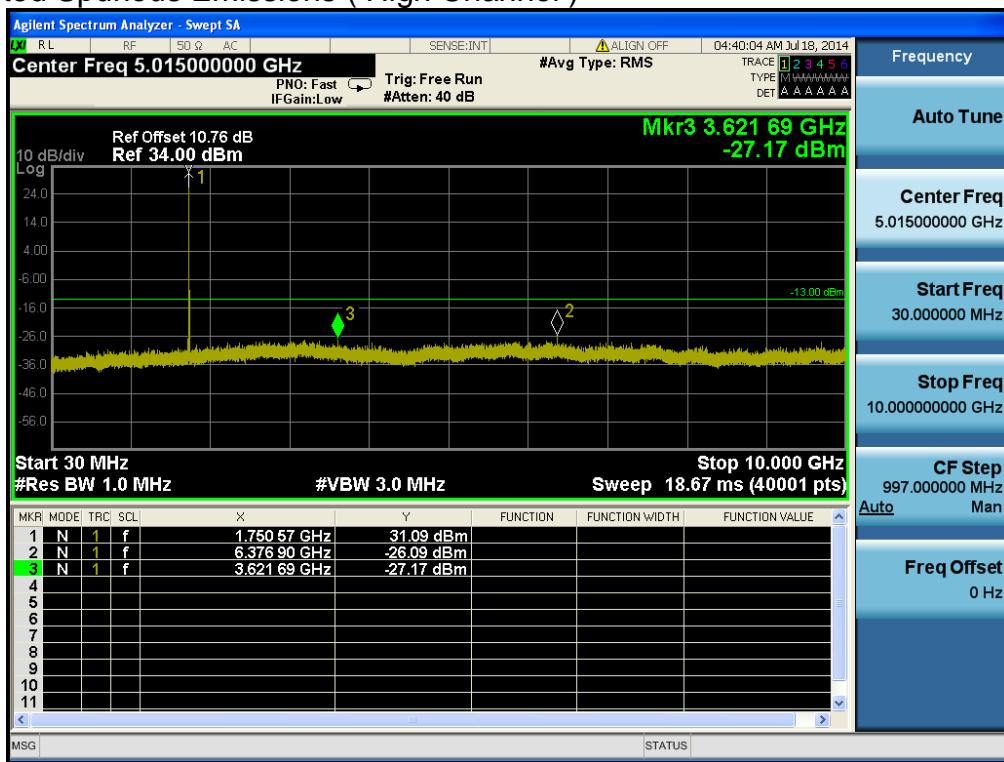
LTE Band 4 / 5MHz / QPSK - RB Offset/Size (0/25)

- Conducted Spurious Emissions ( Mid Channel )



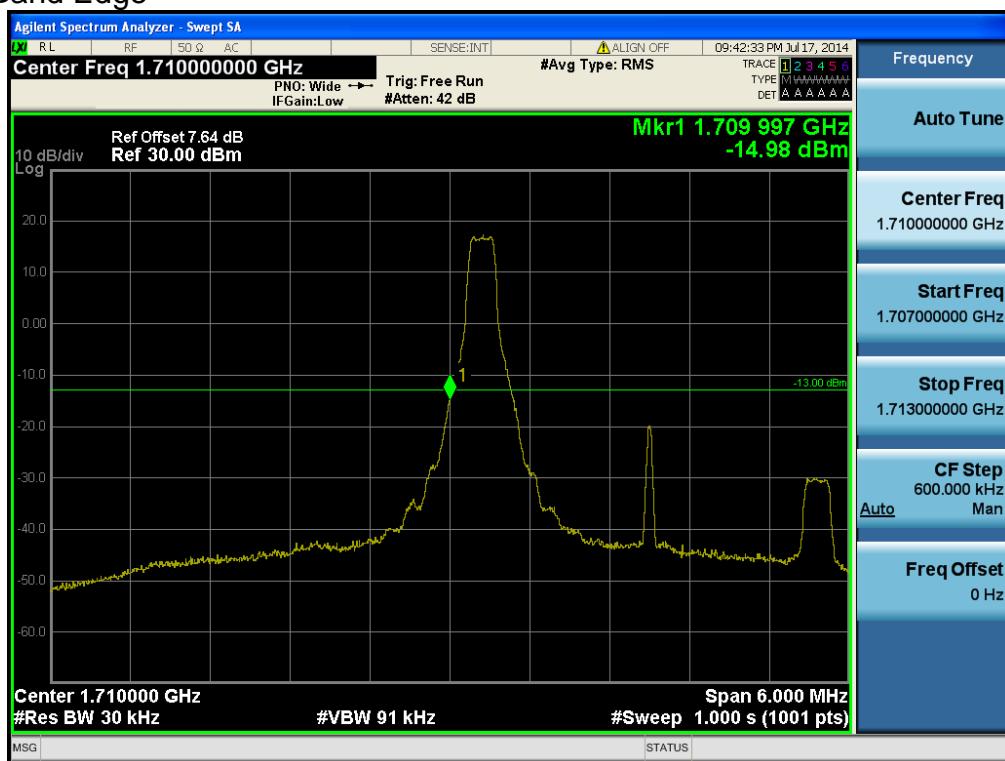
LTE Band 4 / 5MHz / QPSK - RB Offset/Size (24/1)

- Conducted Spurious Emissions ( High Channel )



LTE Band 4 / 5MHz / 16QAM - RB Offset/Size (0/1)

- Lower Band Edge



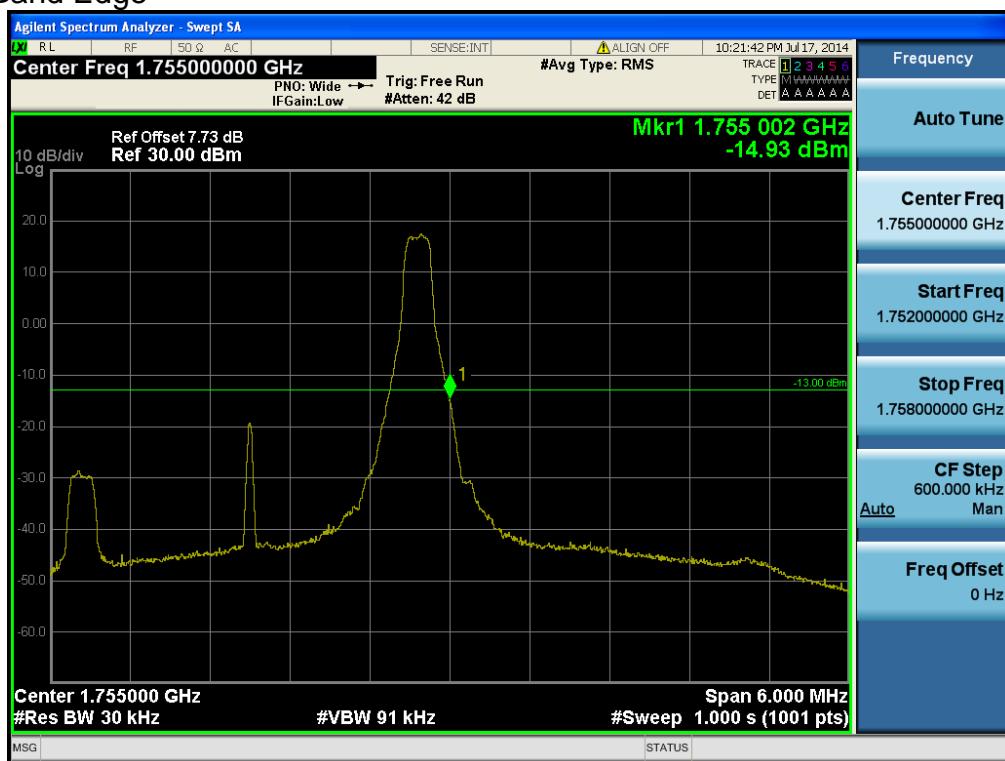
LTE Band 4 / 3MHz / QPSK - RB Offset/Size (0/1)

- Lower Extended Band Edge



LTE Band 4 / 3MHz / QPSK - RB Offset/Size (0/15)

- Upper Band Edge



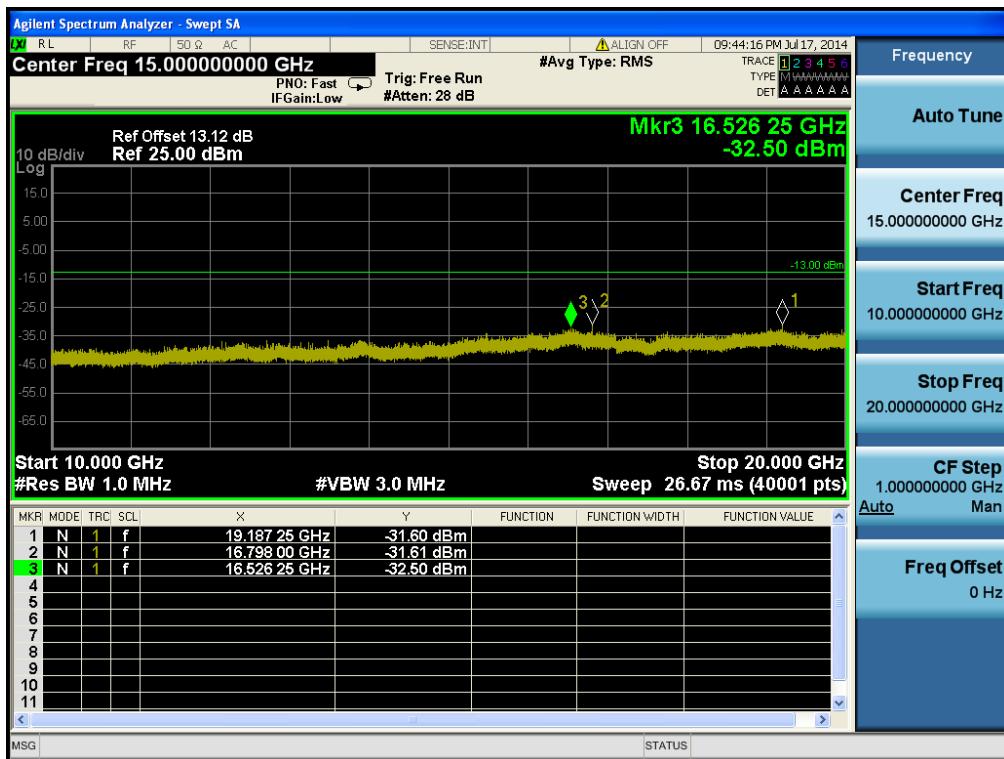
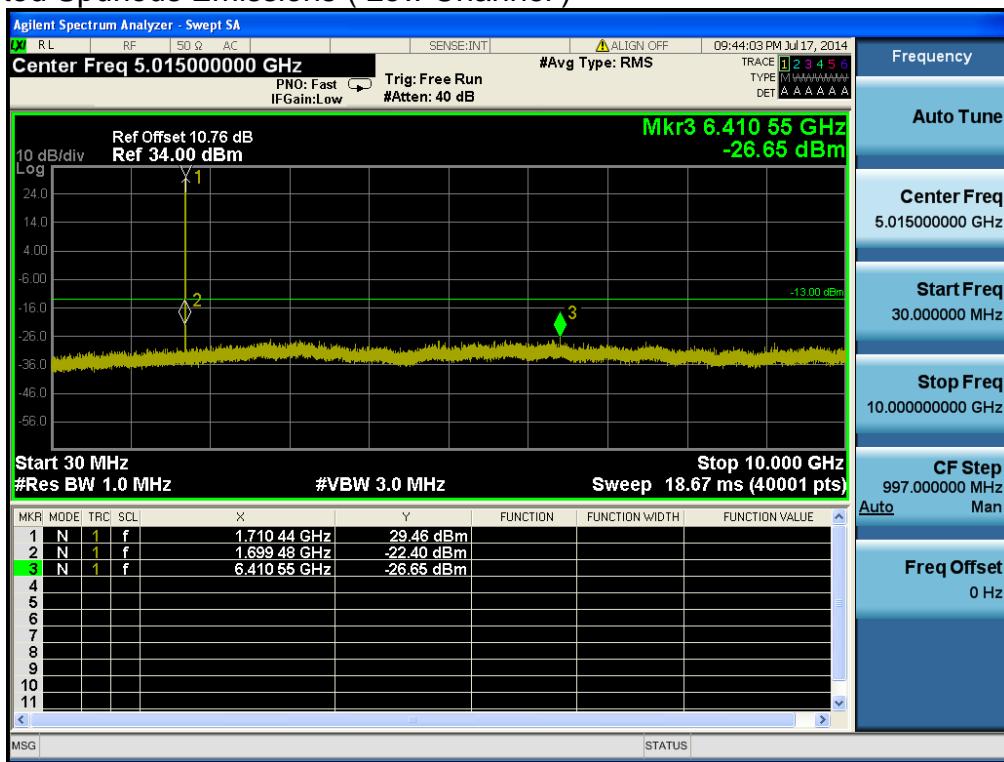
LTE Band 4 / 3MHz / QPSK - RB Offset/Size (14/1)

- Upper Extended Band Edge



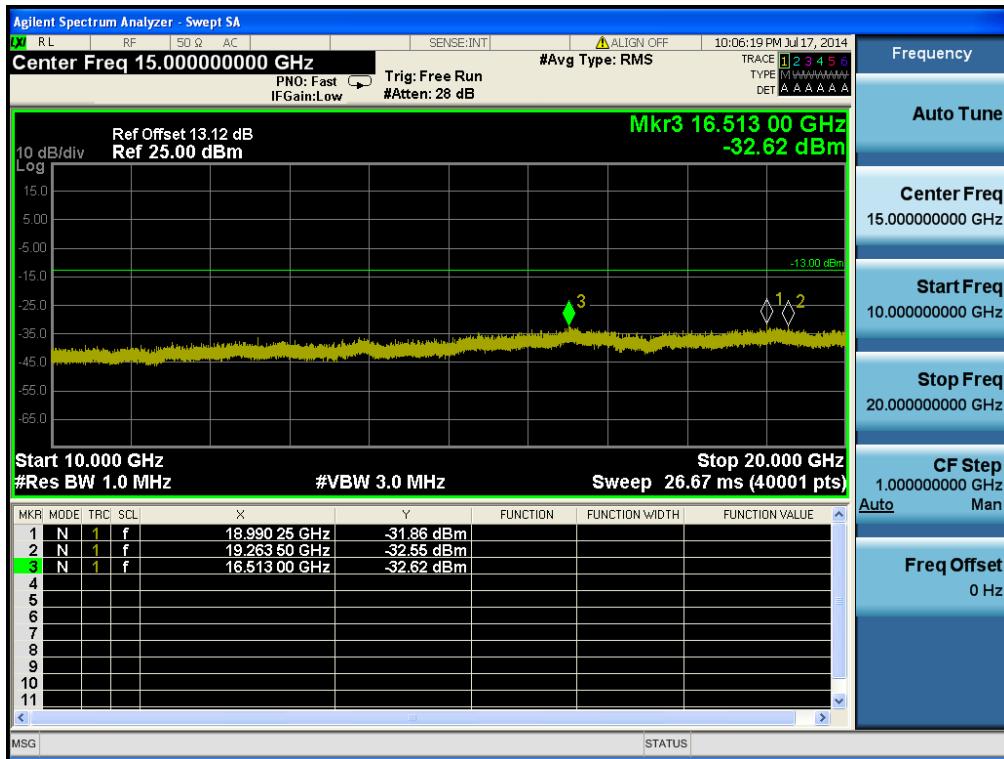
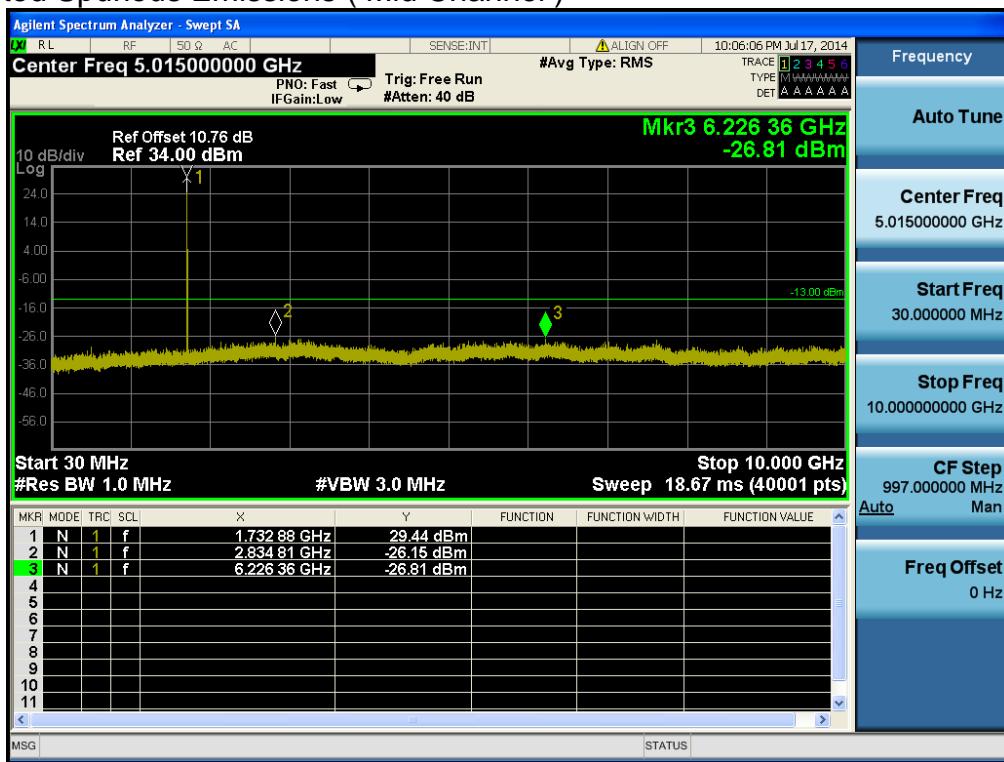
LTE Band 4 / 3MHz / QPSK - RB Offset/Size (0/15)

- Conducted Spurious Emissions ( Low Channel )



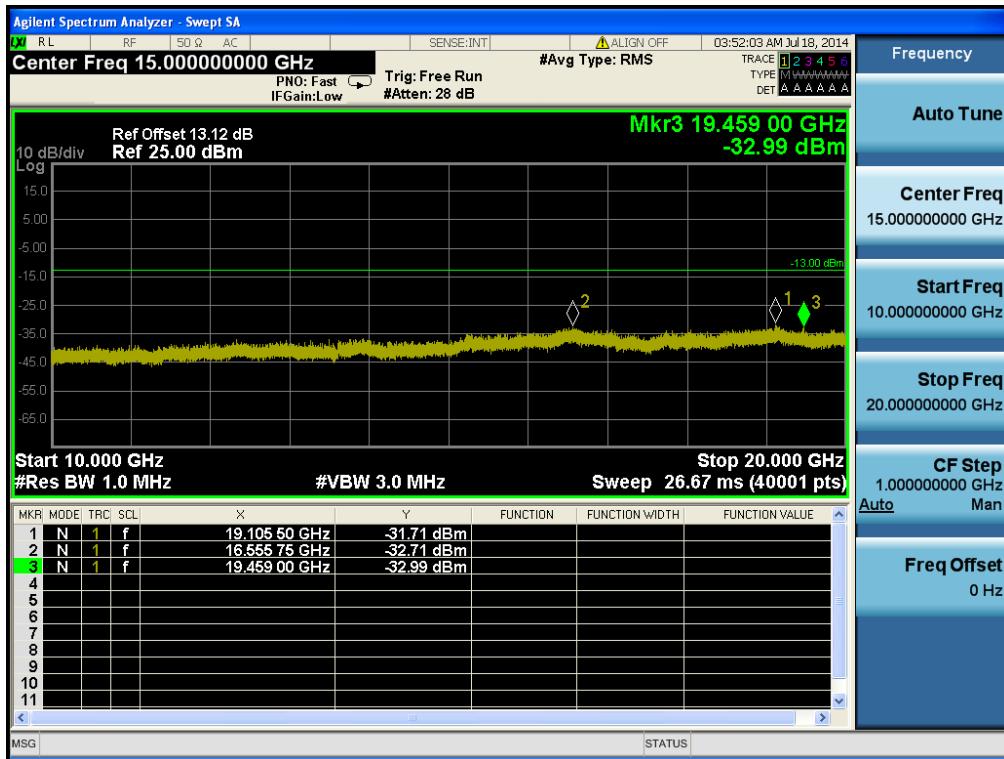
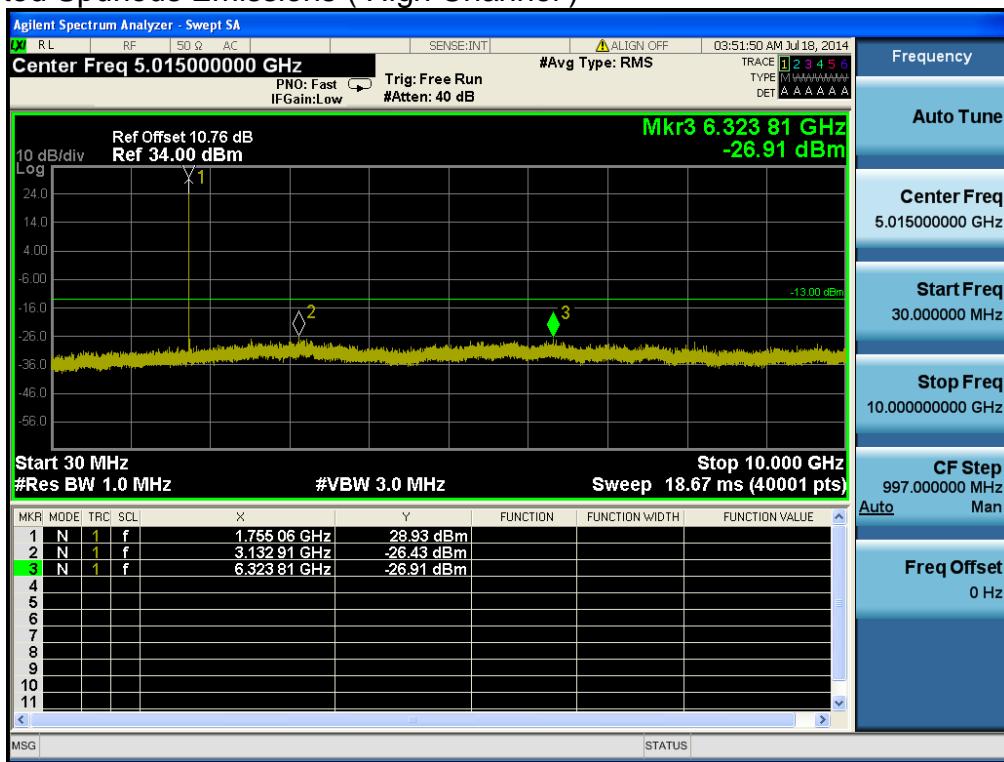
LTE Band 4 / 3MHz / QPSK - RB Offset/Size (0/1)

- Conducted Spurious Emissions ( Mid Channel )



LTE Band 4 / 3MHz / QPSK - RB Offset/Size (7/1)

- Conducted Spurious Emissions ( High Channel )



LTE Band 4 / 3MHz / QPSK - RB Offset/Size (14/1)

- Lower Band Edge



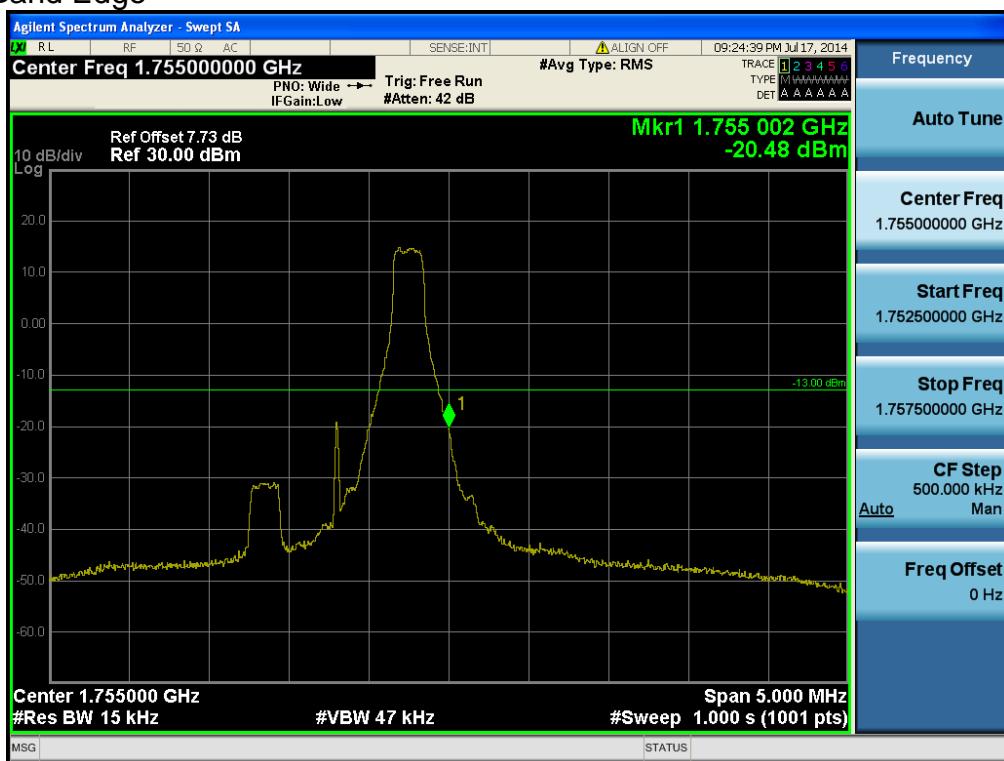
LTE Band 4 / 1.4MHz / QPSK - RB Offset/Size (0/3)

- Lower Extended Band Edge



LTE Band 4 / 1.4MHz / QPSK - RB Offset/Size (1/3)

- Upper Band Edge



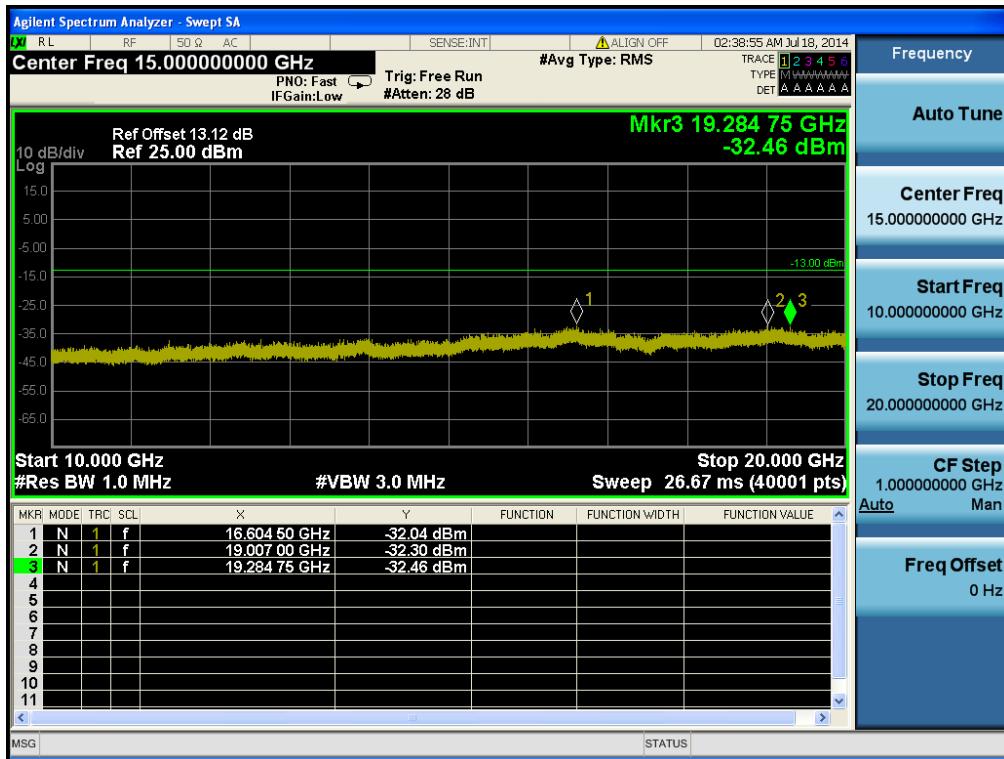
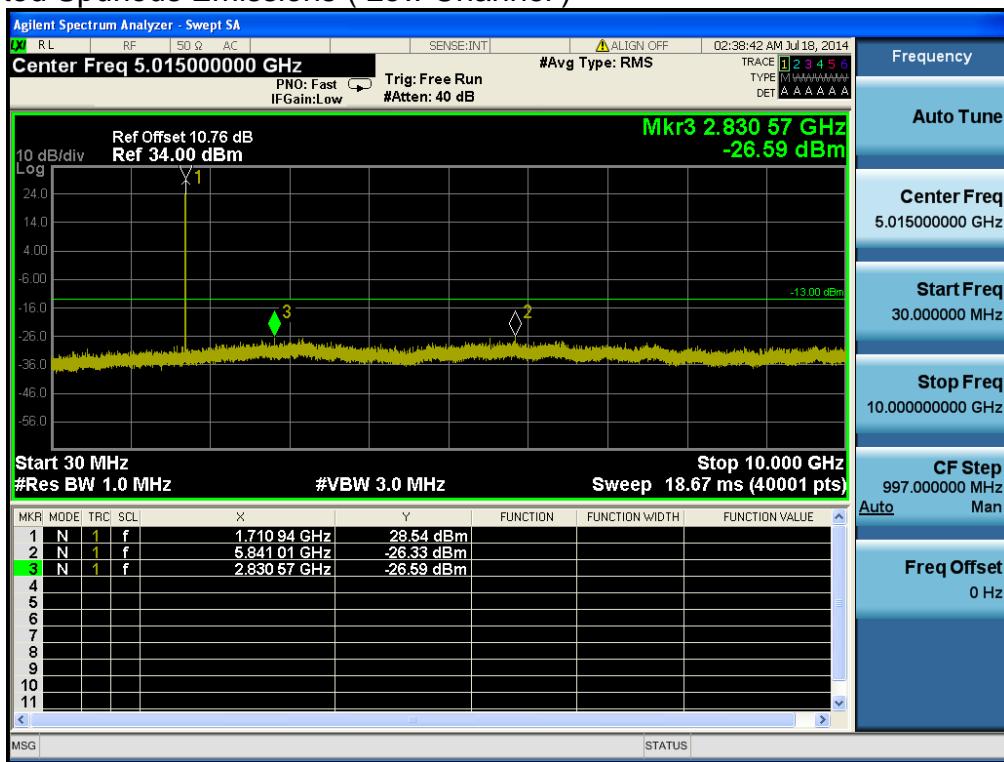
LTE Band 4 / 1.4MHz / QPSK - RB Offset/Size (5/1)

- Upper Extended Band Edge



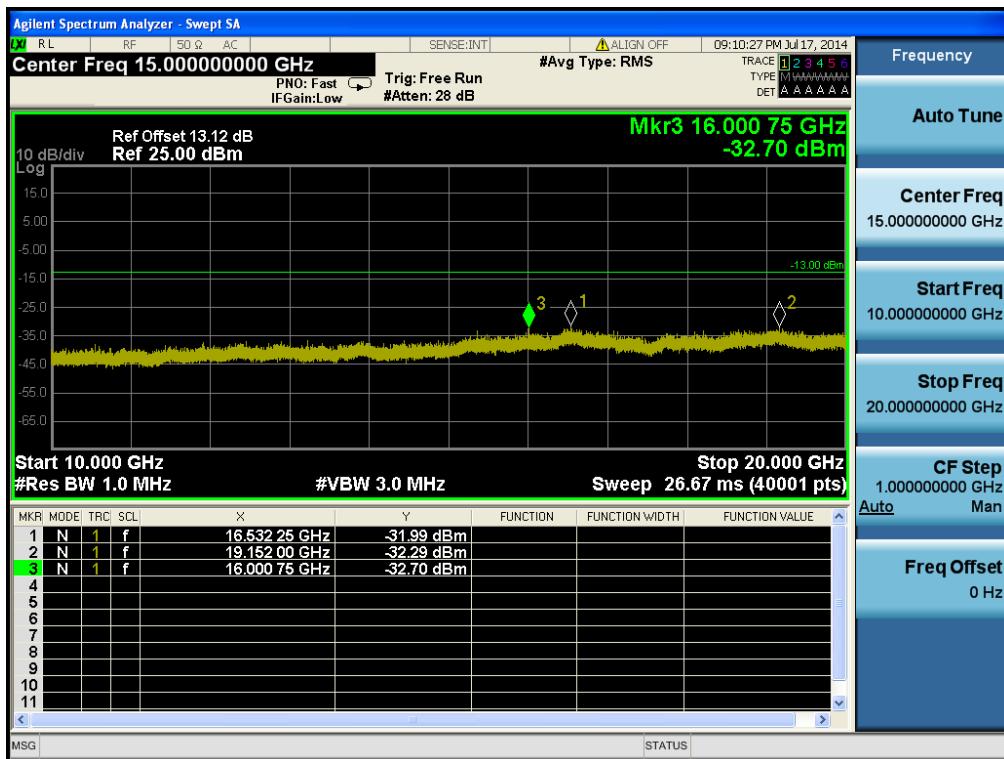
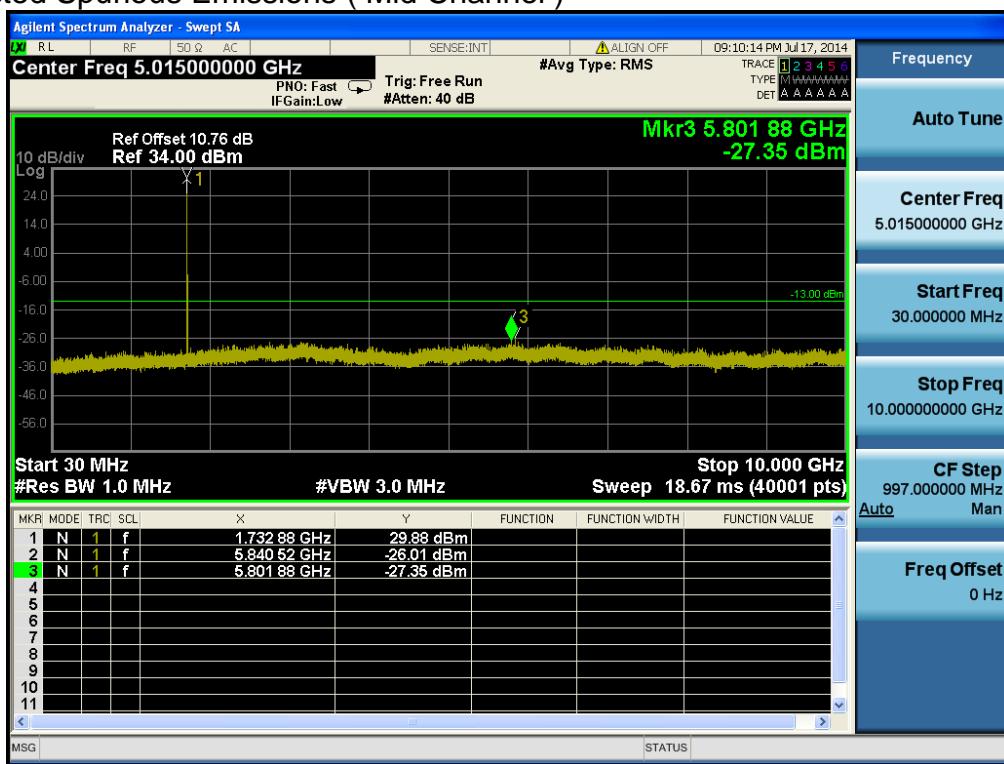
LTE Band 4 / 1.4MHz / QPSK - RB Offset/Size (0/3)

- Conducted Spurious Emissions ( Low Channel )



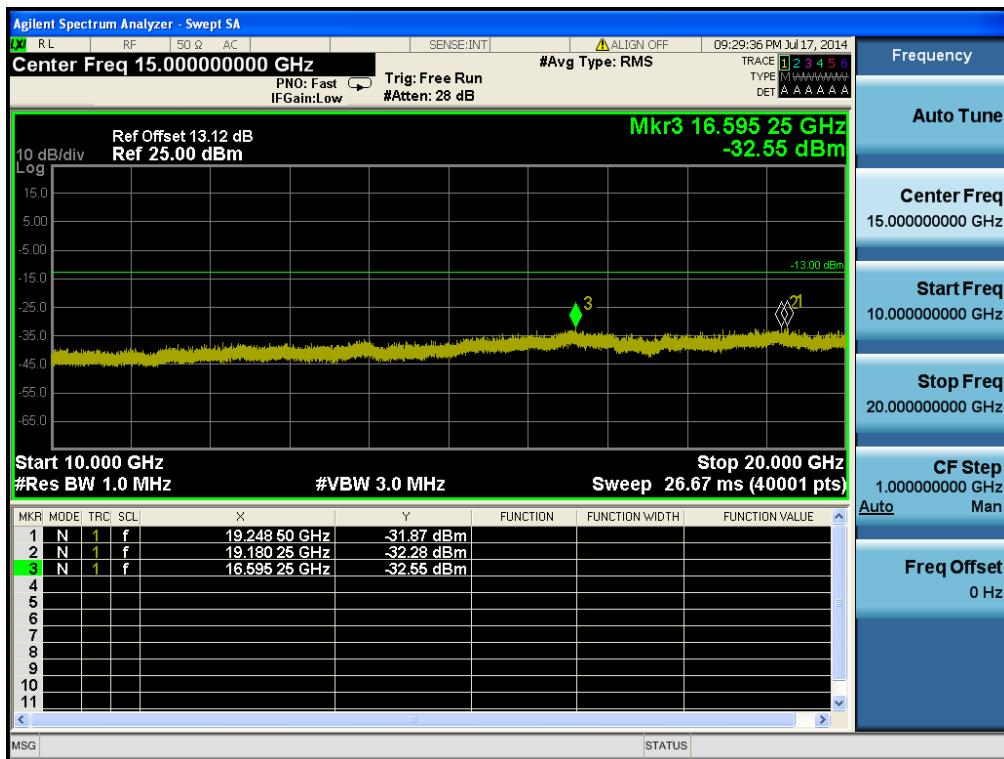
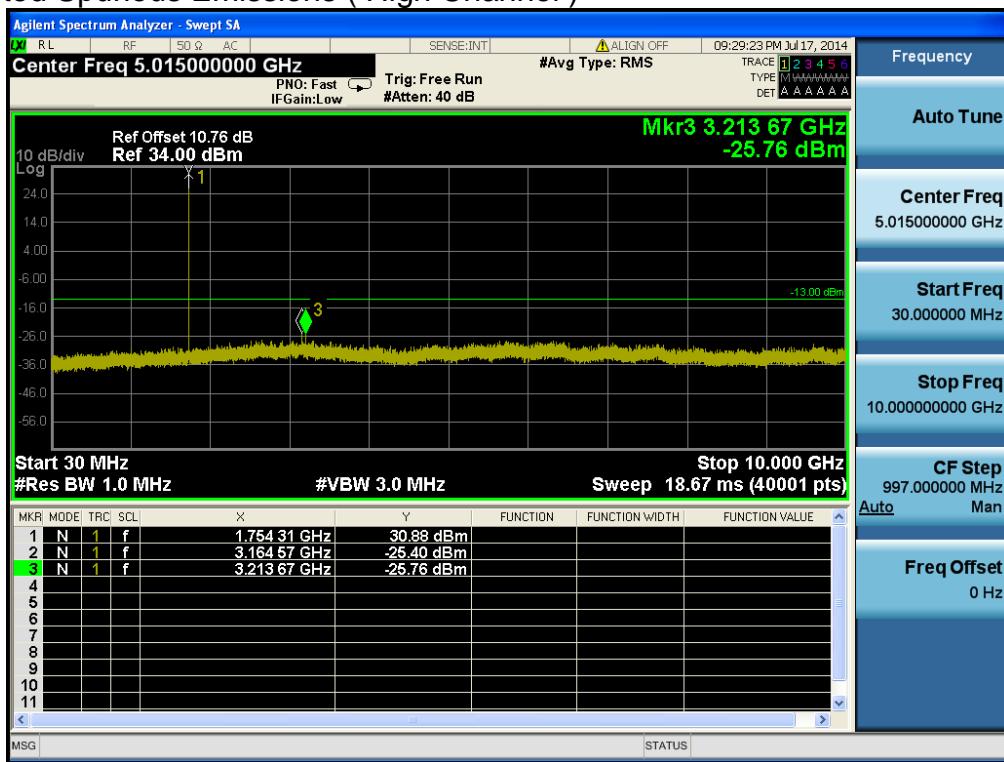
LTE Band 4 / 1.4MHz / 16QAM - RB Offset/Size (0/6)

- Conducted Spurious Emissions ( Mid Channel )



LTE Band 4 / 1.4MHz / QPSK - RB Offset/Size (3/1)

- Conducted Spurious Emissions ( High Channel )



LTE Band 4 / 1.4MHz / QPSK - RB Offset/Size (0/3)