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Report On

Application for Grant of Equipment Authorization of the
Novatel Wireless Inc.
MiFi5580 Personal Wireless Router

FCC CFR 47 Part 2 and 90

Report No. SC1303824E June 2013

REPORT ON	Radio Testing of the Novatel Wireless Inc. Personal Wireless Router
TEST REPORT NUMBER	SC1303824E
PREPARED FOR	Novatel Wireless Inc. 9645 Scranton Road, Suite 205 San Diego, CA 92121-3030 USA
CONTACT PERSON	Todd Gallagher Regulatory Engineering Manager (403) 295-4891 tgallagher@nvt.com
PREPARED BY	Ferdinand S. Custodio **Name** Authorized Signatory Title: EMC/Wireless Test Engineer
APPROVED BY	Chip R. Fleury **Name** Authorized Signatory
DATED	June 07, 2013

Revision History

SC1303824E Novatel Wireless Inc. MiFi5580 Personal Wireless Router					
DATE	OLD REVISION	NEW REVISION	REASON	PAGES AFFECTED	APPROVED BY
06/07/13	Initial Release				Ferdinand Custodio

CONTENTS

SECTION 1

REPORT SUMMARY

Radio Testing of the
Novatel Wireless Inc.
Personal Wireless Router

1.1 INTRODUCTION

The information contained in this report is intended to show verification of the Novatel Wireless Inc. MiFi5580 Personal Wireless Router to the requirements of FCC CFR 47 Part 2 and 90.

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)	MiFi5580
FCC ID Number	PKRNVWMIFI5580
IC Number	N/A
Serial Number(s)	Engineering Sample
Number of Samples Tested	1
Test Specification/Issue/Date	FCC CFR 47 Part 2 and 90 (October 1, 2012).
Start of Test	May 14, 2013
Finish of Test	June 6, 2013
Name of Engineer(s)	Ferdinand Custodio Juan Manuel Gonzalez
Related Document(s)	• KDB971168 (D01 Power Meas License Digital Systems v02) 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 90 is shown below.

Section	FCC Part Sections(s)	Test Description	Result
2.1	2.1046(a) and (c)	Transmitter Conducted Power Measurements	Compliant
2.2	90.635(b)	Effective Radiated Power Output Data	Compliant
2.3	2.1049 and 90.209(7)	Occupied Bandwidth	Compliant
2.4	90.691	Band Edge (Emission Mask)	Compliant
2.5	2.1051	Conducted Spurious Emissions	Compliant
2.6	2.1053	Field Strength Of Spurious Radiation	Compliant
2.7	2.1055(a)(1) and 90.213	Frequency Stability	Compliant

1.3 PRODUCT INFORMATION

1.3.1 EUT General Description

The Equipment Under Test (EUT) was a Novatel Wireless Inc. MiFi5580 Personal Wireless Router. The EUT creates a personal Wi-Fi cloud, capable of sharing high-speed 4G LTE and 3G Mobile Broadband Internet connectivity with up to 10 Wi-Fi-enabled devices simultaneously. The EUT comes with an AC adapter Novatel Wireless model: SSW-2423.

1.3.2 EUT General Description

EUT Description	MiFi5580 Personal Wireless Router
Model Number(s)	MiFi5580
Rated Voltage	3.7VDC Nominal Voltage.
Mode Verified	4G-LTE
Capability	800/1900 CDMA2000 1xRTT and 1xEV-DO Release 0 Revision A, Band 25, 26 and 41 LTE, 802.11 b/g/n WLAN
Primary Unit (EUT)	☐ Production ☒ Pre-Production ☐ Engineering
Antenna Details	WLAN – Antenna 5: 802.11 b/g/n Manufacturer: NVTL Part Number: N/A Type: Monopole (Etched onto PCB) Antenna Gain: • 802. 11 b/g/n 2450MHz : 1.03 dBi WWAN –EVDO/ LTE Band 25, 26, Manufacturer: Ethertronics Part Number: NVTL Part #: 01019835 Type: Monopole Antenna Gain: • CDMA BC0 - 850MHz : -0.21 dBi • CDMA BC1 - 1880MHz : 2.45 dBi • CDMA BC10 – 850MHz : -0.21 dBi • LTE B25 - 1880MHz : 2.45 dBi • LTE B26 - 850MHz : -0.21 dBi WWAN – LTE Band 41 Manufacturer: NVTL Part Number: N/A Type: Monopole (Etched onto PCB) Antenna Gain: LTE B41 - 2600MHz : 0.81 dBi

1.3.3 Transmit Frequency Table

LTE Band 26			
Bandwidth (MHz)	Tx Frequency (MHz)	ERP	
		Max. Power (dBm)	Max. Power (W)
1.4	814.7-823.3	21.81	0.151
3.0	815.5-822.5	21.81	0.151
5.0	816.5-821.5	21.77	0.150
10.0	819	21.86	0.153

CDMA BC10			
Mode	Tx Frequency (MHz)	ERP	
		Max. Power (dBm)	Max. Power (W)
CDMA2000-1xRTT BC 10	817.90-823.10	21.94	0.156
CDMA2000-1xEvDO BC 10	817.90-823.10	21.84	0.152

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1.4 EUT TEST CONFIGURATION

1.4.1 Test Configuration Description

Test Configuration	Description
A	Conducted antenna port measurement
B	Radiated test setup. EUT transmitting through integral antenna.

Note: Antenna port is for service function only.

1.4.2 EUT Exercise Software

None. The firmware installed in the EUT allows direct connection with the call box. All test configuration parameters are configured using the call box (CMW500).

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.

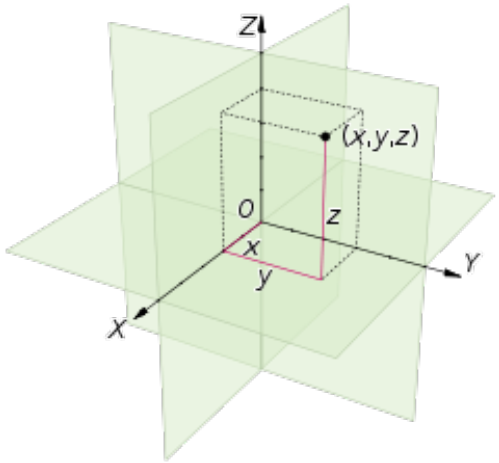
1.4.4 Worst Case Configuration

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

Band	Channel BW	Modulation	CH	RB Size/Offset
LTE Band 26	10.0MHz	QPSK	26740	1/0

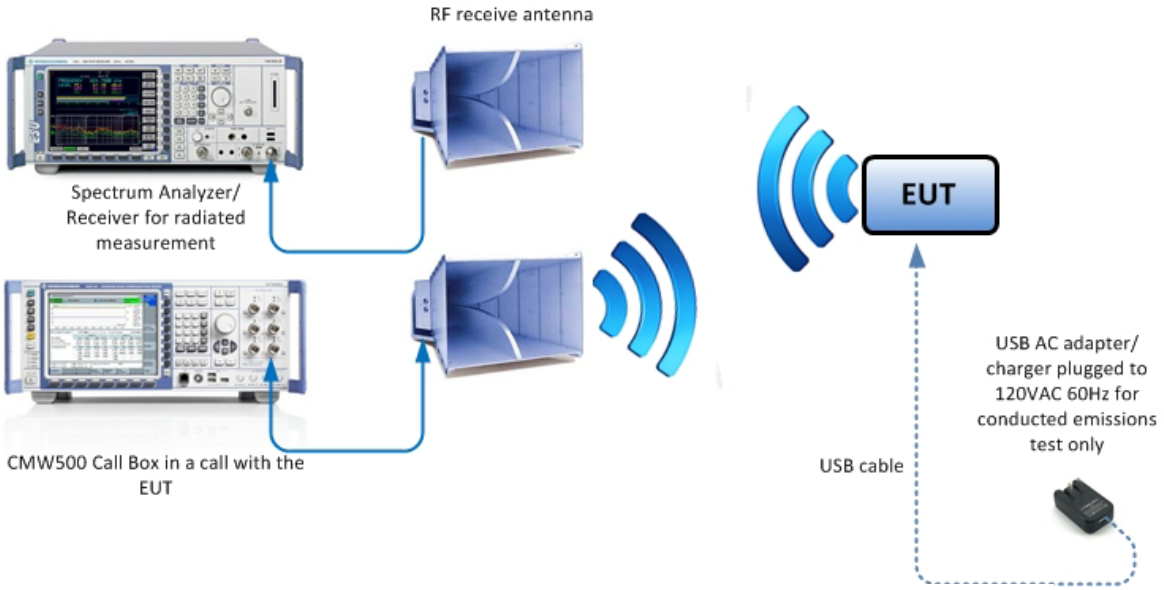
Mode	SO	RC	CH
CDMA 2000 (BC10)	55	3/3	Channel 684

EUT is a portable device. For radiated measurements X, Y and Z orientations were verified. Worst case position is “X”.

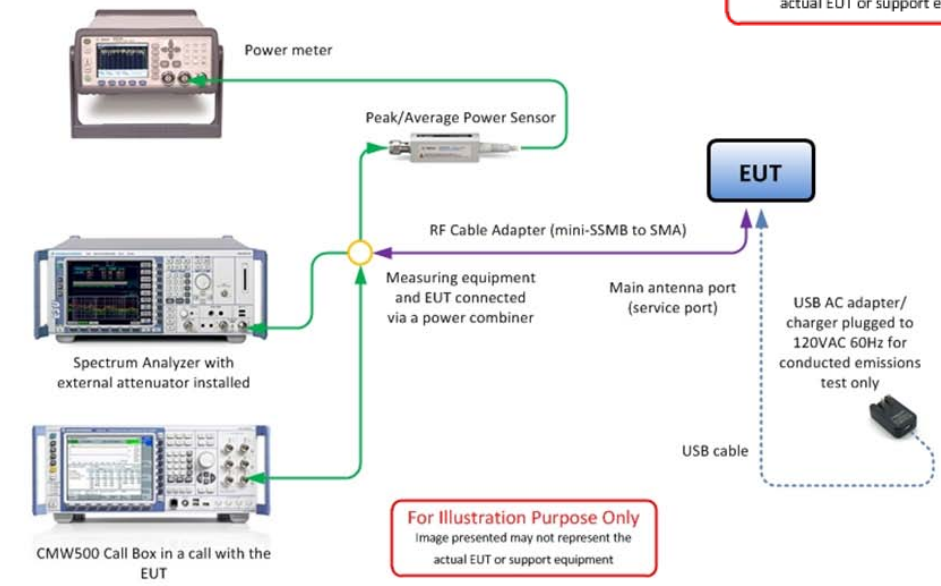


1.4.5 Simplified Test Configuration Diagram

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 Engineering Sample		
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:

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

SECTION 2

TEST DETAILS

Radio Testing of the
Novatel Wireless Inc.
Personal Wireless Router

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2.1 TRANSMITTER CONDUCTED POWER MEASUREMENTS

2.1.1 Specification Reference

Part 2.1046 (a) and (c)

2.1.2 Standard Applicable

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

2.1.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Test Configuration A

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

June 05, 2013/FSC

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	25.1°C
Relative Humidity	49.0%
ATM Pressure	99.1 kPa

2.1.7 Additional Observations

- This is a conducted test using an average power meter.
- A 27.2dB power meter offset was used for the power splitter, external attenuator and cable used.

2.1.8 Test Results

See attached table.

Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
QPSK	1.4 MHz	6	0	26697	814.7	23.09
				26740	819.0	22.73
				26783	823.3	22.72
		1	3	26697	814.7	24.15
				26740	819.0	23.88
				26783	823.3	23.8
		1	0	26697	814.7	24.17
				26740	819.0	23.97
				26783	823.3	23.84
		1	5	26697	814.7	23.16
				26740	819.0	23.82
				26783	823.3	23.82
	3.0 MHz	15	0	26705	815.5	23.01
				26740	819.0	22.63
				26775	822.5	22.88
		1	8	26705	815.5	24.11
				26740	819.0	23.96
				26775	822.5	24.11
		1	0	26705	815.5	24.17
				26740	819.0	24.12
				26775	822.5	23.91
		1	14	26705	815.5	24.08
				26740	819.0	23.85
				26775	822.5	24.07
	5.0 MHz	25	0	26715	816.5	23.04
				26740	819.0	22.53
				26740	821.5	22.45
		1	13	26715	816.5	24.02
				26740	819.0	23.91
				26740	821.5	23.74
		1	0	26715	816.5	24.03
				26740	819.0	24.13
				26740	821.5	23.82
		1	24	26715	816.5	23.91
				26740	819.0	23.7
				26740	821.5	23.86
	10.0 MHz	50	0	26740	819.0	22.58
		1	25	26740	819.0	23.93
		1	**0**	26740	819.0	**24.22**
		1	49	26740	819.0	24

Modulation	Bandwidth	RB Size	RB Offset	Channel	Frequency	Power
16-QAM	1.4 MHz	6	0	26697	814.7	22.09
				26740	819.0	21.68
				26783	823.3	21.9
		1	3	26697	814.7	23.13
				26740	819.0	22.73
				26783	823.3	22.86
		1	0	26697	814.7	23.12
				26740	819.0	22.84
				26783	823.3	23.63
		1	5	26697	814.7	23.06
				26740	819.0	23.66
				26783	823.3	22.8
	3.0 MHz	15	0	26705	815.5	23.08
				26740	819.0	22.51
				26775	822.5	21.95
		1	8	26705	815.5	23.34
				26740	819.0	22.83
				26775	822.5	23.11
		1	0	26705	815.5	23.96
				26740	819.0	22.86
				26775	822.5	22.9
		1	14	26705	815.5	23.46
				26740	819.0	22.69
				26775	822.5	23.07
	5.0 MHz	25	0	26715	816.5	21.98
				26740	819.0	22.38
				26740	821.5	21.54
		1	13	26715	816.5	22.87
				26740	819.0	22.83
				26740	821.5	22.85
		1	**0**	26715	816.5	23
				26740	**819.0**	**23.99**
				26740	821.5	22.79
		1	24	26715	816.5	22.86
				26740	819.0	22.78
				26740	821.5	22.94
	10.0 MHz	50	0	26740	819.0	21.57
		1	25	26740	819.0	22.85
		1	0	26740	819.0	23.17
		1	49	26740	819.0	22.95

BC10

		IS-2000	1Xev-Do Rev. 0	1Xev-Do Rev. A Subtype 0/1
	Channel	**TDSO SO55 RC3/3**	**FRTAP (dBm)**	**FRTAP (dBm)**
BC10	476	24.20	24.04	24.12
	580	24.21	24.00	24.08
	684	24.30	24.14	24.20

2.2 EFFECTIVE RADIATED POWER OUTPUT DATA

2.2.1 Specification Reference

Part 90.635(b)

2.2.2 Standard Applicable

(b) The maximum output power of the transmitter for mobile stations is 100 watts (20 dBw). Power is given in terms of effective radiated power (ERP)

2.2.3 Equipment Under Test

Serial No: Engineering Sample

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

June 05, 2013/FSC

2.2.5 Additional Observations

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

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

Where:

$\mathbf{P_T}$ = transmitter conducted output power dBm (Section 2.1 of this test report)
$\mathbf{G_T}$ = gain of the transmitting antenna, in dBi (EIRP - the -2.15 in the formula is to convert EIRP to ERP);
$\mathbf{L_C}$ = signal attenuation in the connecting cable between the transmitter and antenna, in dB (EUT uses integral antenna, this value is negligible).

2.2.6 Test Results

See attached table.

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Band 26 QPSK								
Bandwidth	**RB Size**	**RB Offset**	**Channel**	**Frequency (MHz)**	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**ERP (dBm)**	**Limit (dBm)**
1.4 MHz	6	0	26697	814.7	23.09	-0.21	20.73	50
			26740	819.0	22.73		20.37	
			26783	823.3	22.72		20.36	
	1	3	26697	814.7	24.15		21.79	
			26740	819.0	23.88		21.52	
			26783	823.3	23.8		21.44	
	1	0	26697	814.7	24.17		21.81	
			26740	819.0	23.97		21.61	
			26783	823.3	23.84		21.48	
	1	5	26697	814.7	23.16		20.8	
			26740	819.0	23.82		21.46	
			26783	823.3	23.82		21.46	
3.0 MHz	15	0	26705	815.5	23.01		20.65	
			26740	819.0	22.63		20.27	
			26775	822.5	22.88		20.52	
	1	8	26705	815.5	24.11		21.75	
			26740	819.0	23.96		21.6	
			26775	822.5	24.11		21.75	
	1	0	26705	815.5	24.17		21.81	
			26740	819.0	24.12		21.76	
			26775	822.5	23.91		21.55	
	1	14	26705	815.5	24.08		21.72	
			26740	819.0	23.85		21.49	
			26775	822.5	24.07		21.71	
5.0 MHz	25	0	26715	816.5	23.04		20.68	
			26740	819.0	22.53		20.17	
			26740	821.5	22.45		20.09	
	1	13	26715	816.5	24.02		21.66	
			26740	819.0	23.91		21.55	
			26740	821.5	23.74		21.38	
	1	0	26715	816.5	24.03		21.67	
			26740	819.0	24.13		21.77	
			26740	821.5	23.82		21.46	
	1	24	26715	816.5	23.91		21.55	
			26740	819.0	23.7		21.34	
			26740	821.5	23.86		21.5	
10.0 MHz	50	0	26740	819.0	22.58		20.22	
	1	25	26740	819.0	23.93		21.57	
	1	**0**	**26740**	**819.0**	**24.22**		**21.86**	
	1	49	26740	819.0	24		21.64	

Band 26 16-QAM								
Bandwidth	**RB Size**	**RB Offset**	**Channel**	**Frequency (MHz)**	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**ERP (dBm)**	**Limit (dBm)**
1.4 MHz	6	0	26697	814.7	22.09	-0.21	19.73	50
			26740	819.0	21.68		19.32	
			26783	823.3	21.9		19.54	
	1	3	26697	814.7	23.13		20.77	
			26740	819.0	22.73		20.37	
			26783	823.3	22.86		20.5	
	1	0	26697	814.7	23.12		20.76	
			26740	819.0	22.84		20.48	
			26783	823.3	23.63		21.27	
	1	5	26697	814.7	23.06		20.7	
			26740	819.0	23.66		21.3	
			26783	823.3	22.8		20.44	
3.0 MHz	15	0	26705	815.5	23.08		20.72	
			26740	819.0	22.51		20.15	
			26775	822.5	21.95		19.59	
	1	8	26705	815.5	23.34		20.98	
			26740	819.0	22.83		20.47	
			26775	822.5	23.11		20.75	
	1	0	26705	815.5	23.96		21.6	
			26740	819.0	22.86		20.5	
			26775	822.5	22.9		20.54	
	1	14	26705	815.5	23.46		21.1	
			26740	819.0	22.69		20.33	
			26775	822.5	23.07		20.71	
5.0 MHz	25	0	26715	816.5	21.98		19.62	
			26740	819.0	22.38		20.02	
			26740	821.5	21.54		19.18	
	1	13	26715	816.5	22.87		20.51	
			26740	819.0	22.83		20.47	
			26740	821.5	22.85		20.49	
	1	**0**	26715	816.5	23		20.64	
			26740	**819.0**	**23.99**		**21.63**	
			26740	821.5	22.79		20.43	
	1	24	26715	816.5	22.86		20.5	
			26740	819.0	22.78		20.42	
			26740	821.5	22.94		20.58	
10.0 MHz	50	0	26740	819.0	21.57		19.21	
	1	25	26740	819.0	22.85		20.49	
	1	0	26740	819.0	23.17		20.81	
	1	49	26740	819.0	22.95		20.59	

BC 10 CDMA2000							
SO	**RC**	**Channel**	**Frequency (MHz)**	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**ERP (dBm)**	**Limit (dBm)**
55	3/3	476	817.9	24.20	-0.21	21.84	50
		580	820.5	24.21		21.85	
		684	823.1	24.30		21.94	
BC 10 1Xev-Do Rev. 0							
Application		**Channel**	**Frequency (MHz)**	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**ERP (dBm)**	**Limit (dBm)**
FRETAP		476	817.9	24.04	-0.21	21.68	50
		580	820.5	24.00		21.64	
		684	823.1	24.14		21.78	
BC 10 1Xev-Do Rev. A							
Application		**Channel**	**Frequency (MHz)**	**Conducted Power (dBm)**	**Antenna Gain (dBi)**	**ERP (dBm)**	**Limit (dBm)**
FRETAP		476	817.9	24.12	-0.21	21.76	50
		580	820.5	24.08		21.72	
		684	823.1	24.20		21.84	

2.3 OCCUPIED BANDWIDTH

2.3.1 Specification Reference

Part 90 Subpart I §90.209(7) and Part 2.1049

2.3.2 Standard Applicable

(7) Economic Area (EA)-based licensees in frequencies 817-824/862-869 MHz (813.5-824/858.5-869 MHz in the counties listed in § 90.614(c)) may exceed the standard channel spacing and authorized bandwidth listed in paragraph (b)(5) of this section in any National Public Safety Planning Advisory Committee Region when all 800 MHz public safety licensees in the Region have completed band reconfiguration consistent with this part. In any National Public Safety Planning Advisory Committee Region where the 800 MHz band reconfiguration is incomplete, EA-based licensees in frequencies 817-821/862-866 MHz (813.5-821/858.5-866 MHz in the counties listed in § 90.614(c)) may exceed the standard channel spacing and authorized bandwidth listed in paragraph (b)(5) of this section. Upon all 800 MHz public safety licensees in a National Public Safety Planning Advisory Committee Region completing band reconfiguration, EA-based 800 MHz SMR licensees in the 821-824/866-869 MHz band may exceed the channel spacing and authorized bandwidth in paragraph (b)(5) of this section. Licensees authorized to exceed the standard channel spacing and authorized bandwidth under this paragraph must provide at least 30 days written notice prior to initiating such service in the bands listed herein to every 800 MHz public safety licensee with a base station in an affected National Public Safety Planning Advisory Committee Region, and every 800 MHz public safety licensee with a base station within 113 kilometers (70 miles) of an affected National Public Safety Planning Advisory Committee Region. Such notice shall include the estimated date upon which the EA-based 800 MHz SMR licensee intends to begin operations that exceed the channel spacing and authorized bandwidth in paragraph (b)(5) of this section.

2.3.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Test Configuration A

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

June 05, 2013/FSC

2.3.5 Test Equipment Used

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

2.3.6 Environmental Conditions

Ambient Temperature	25.1°C
Relative Humidity	49.0%
ATM Pressure	99.1 kPa

2.3.7 Additional Observations

- This is a conducted test. Test procedure is per Section 4.0 of KDB971168 (D01 Power Meas License Digital Systems v02).
- Both 99% OBW and -26dB BW presented.
- All channels and bandwidths were verified. Representative channel presented.

2.3.8 Test Results

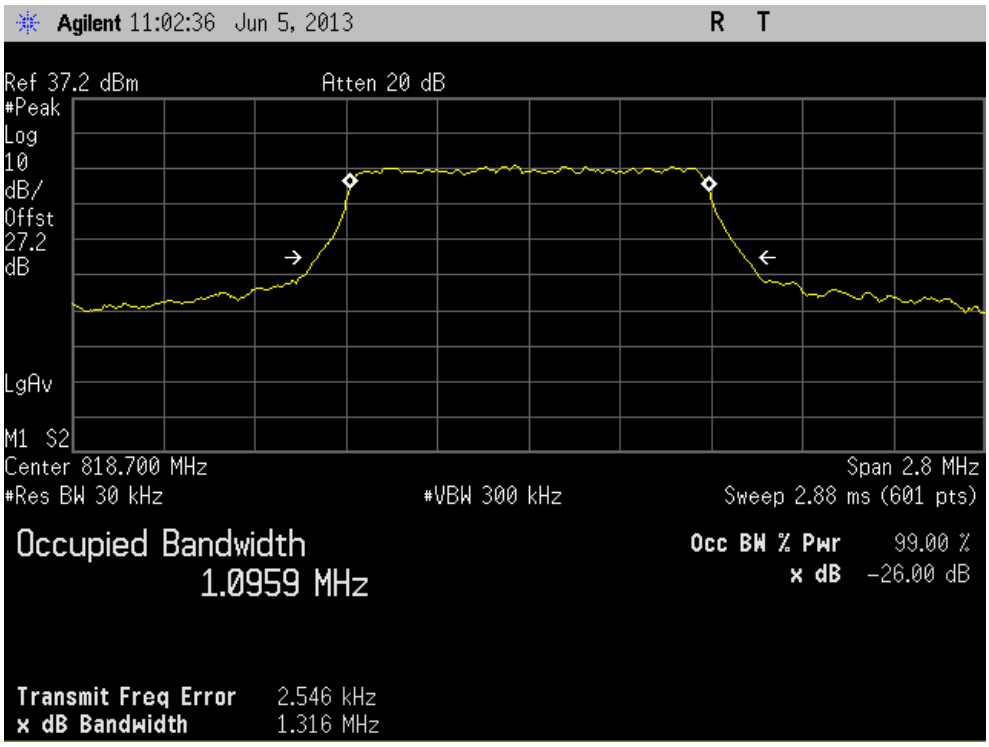
See attached table and plots. For information purposes only.

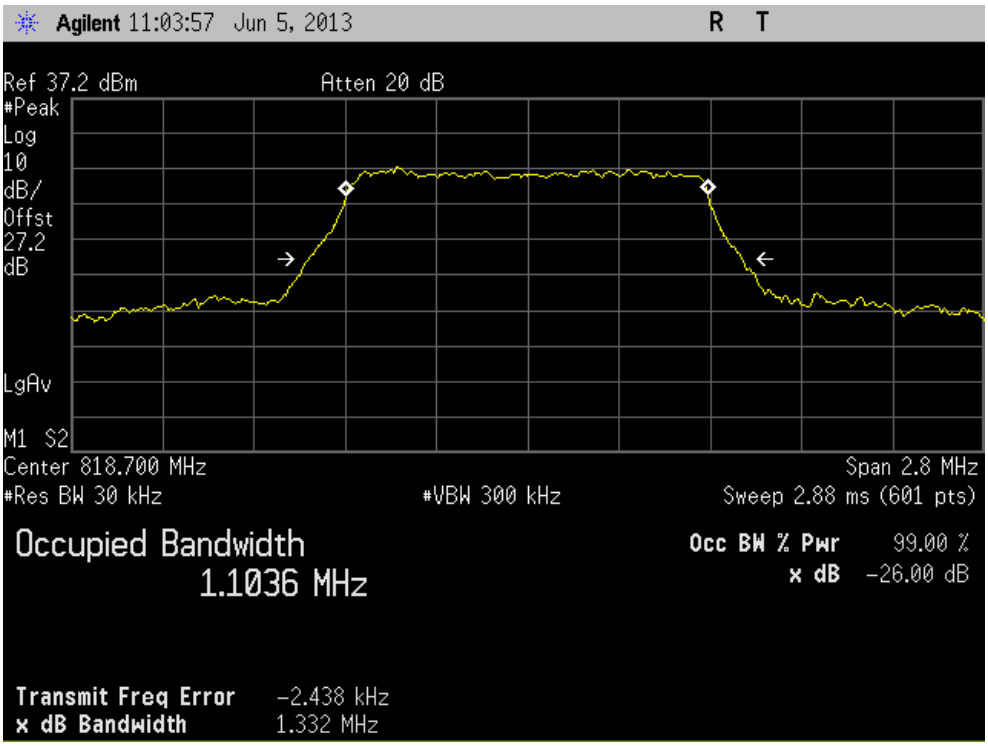
LTE Band	Channel	Frequency (MHz)	BW (MHz)	Modulation	99% OBW (MHz)	-26dB BW (MHz)
26	26737	818.7	1.4	QPSK	1.0959	1.316
	26737	818.7	1.4	16QAM	1.1036	1.332
	26737	818.7	3.0	QPSK	2.7021	3.033
	26737	818.7	3.0	16QAM	2.7134	3.086
	26737	818.7	5.0	QPSK	4.4851	4.984
	26737	818.7	5.0	16QAM	4.4794	4.965
	26737	818.7	10.0	QPSK	8.9650	9.820
	26737	818.7	10.0	16QAM	8.9589	9.639

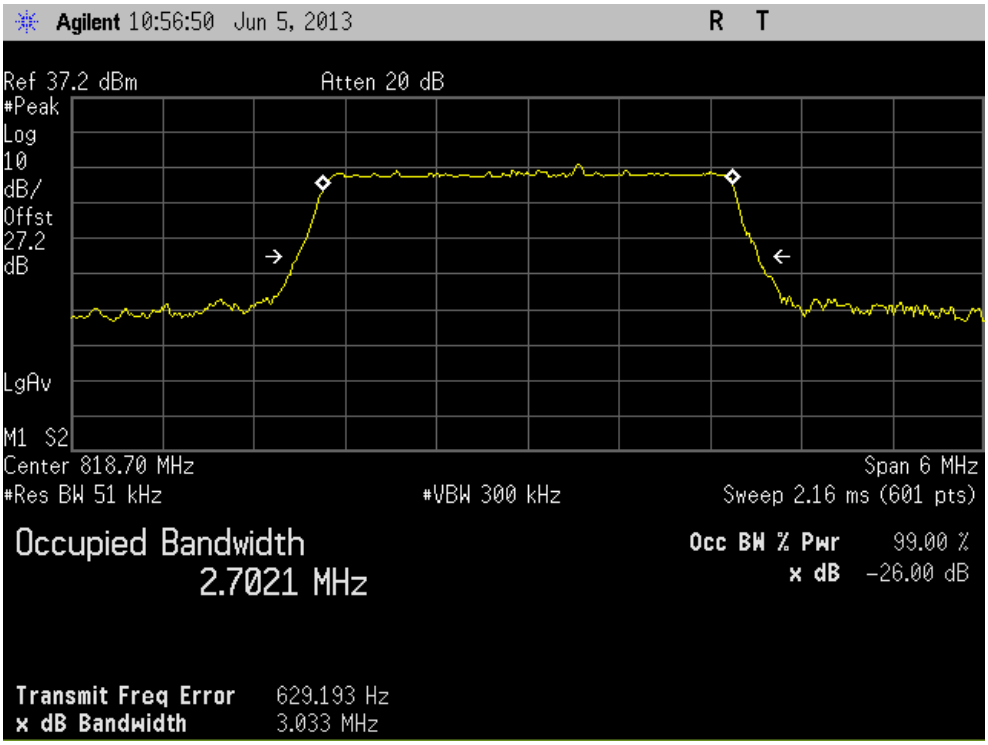
BC10 CDMA	Channel	Frequency (MHz)	SO	RC	99% OBW (MHz)	-26dB BW (MHz)
26	384	818.7	55	3/3	1.2768	1.427

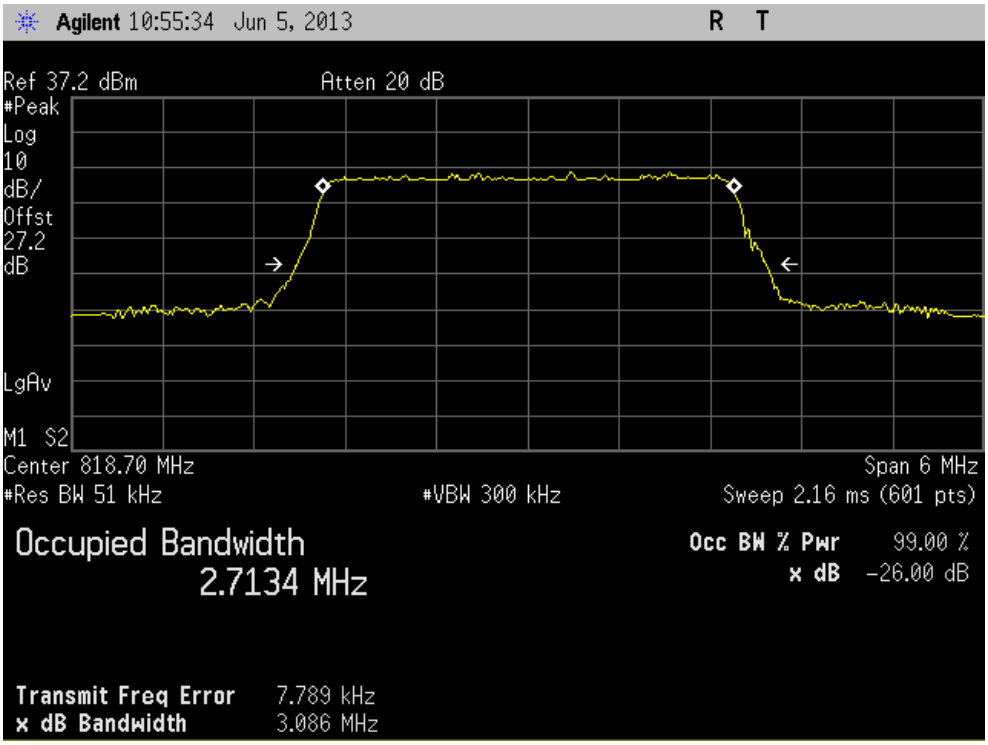
BC10 1Xev-Do Rev. 0	Channel	Frequency (MHz)	Application	99% OBW (MHz)	-26dB BW (MHz)
26	384	818.7	FRETAP	1.2734	1.431

BC10 1Xev-Do Rev. A	Channel	Frequency (MHz)	Application	99% OBW (MHz)	-26dB BW (MHz)
26	384	818.7	FRETAP	1.2862	1.9

LTE Band 26 818.7MHz (1.4 MHz BW) QPSK


LTE Band 26 818.7MHz (1.4 MHz BW) 16QAM


LTE Band 26 818.7MHz (3.0 MHz BW) QPSK


LTE Band 26 818.7MHz (3.0 MHz BW) 16QAM


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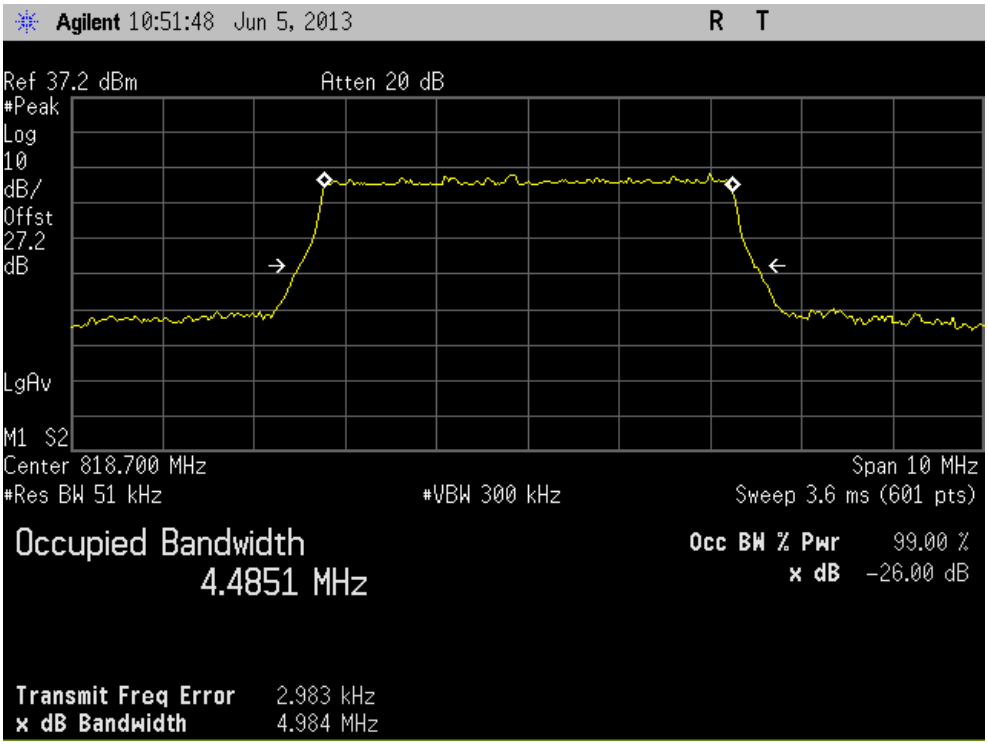
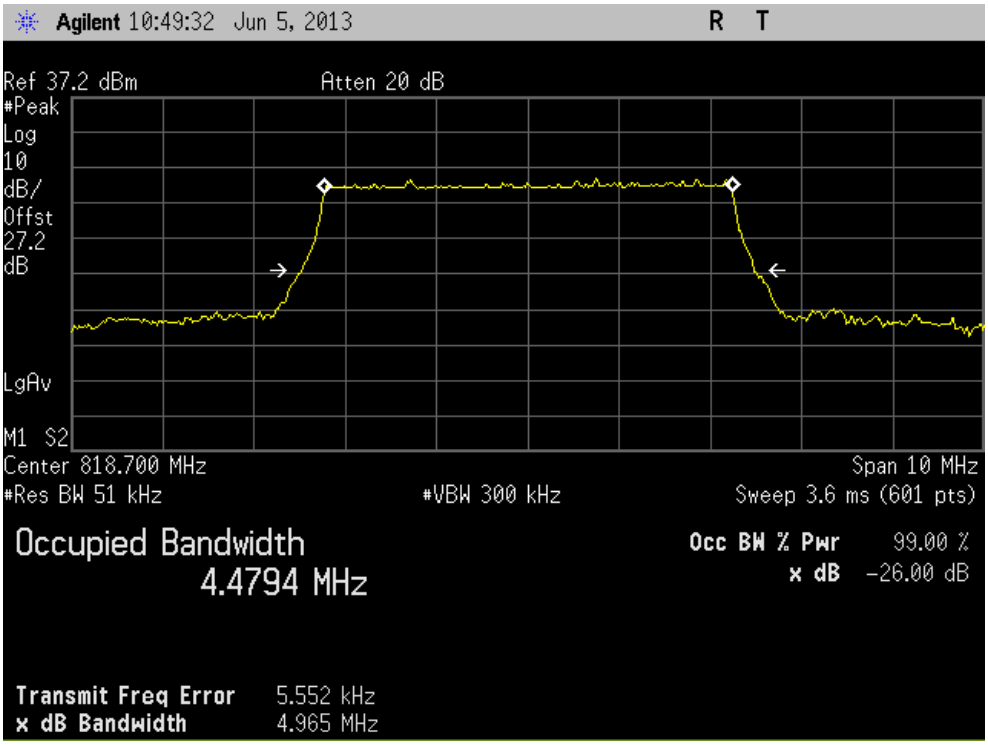
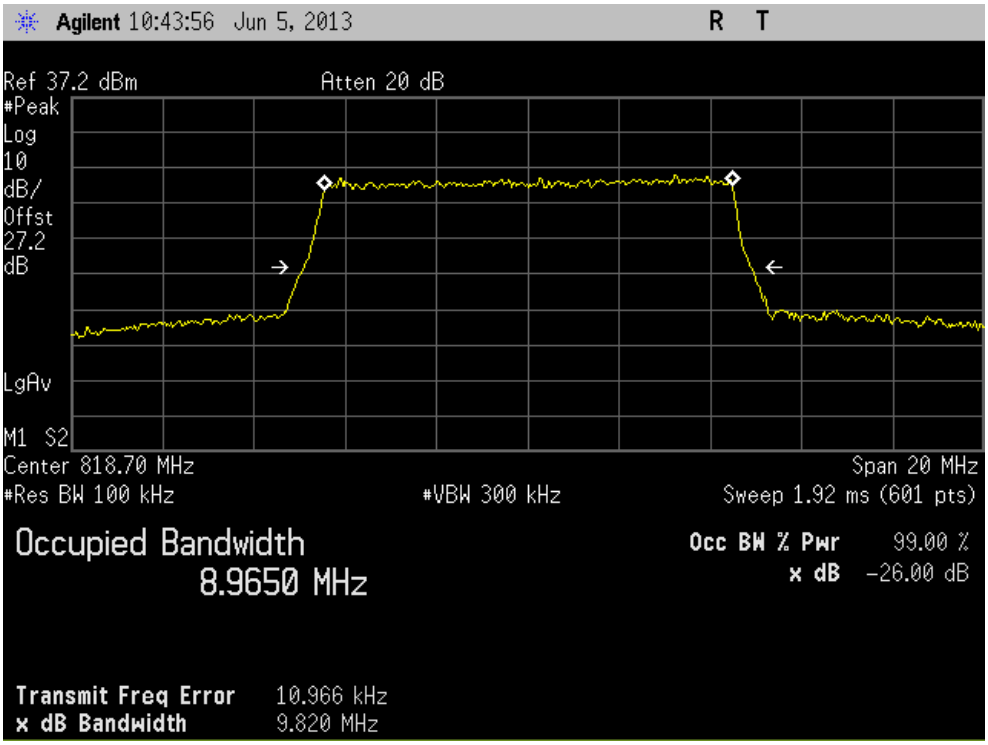
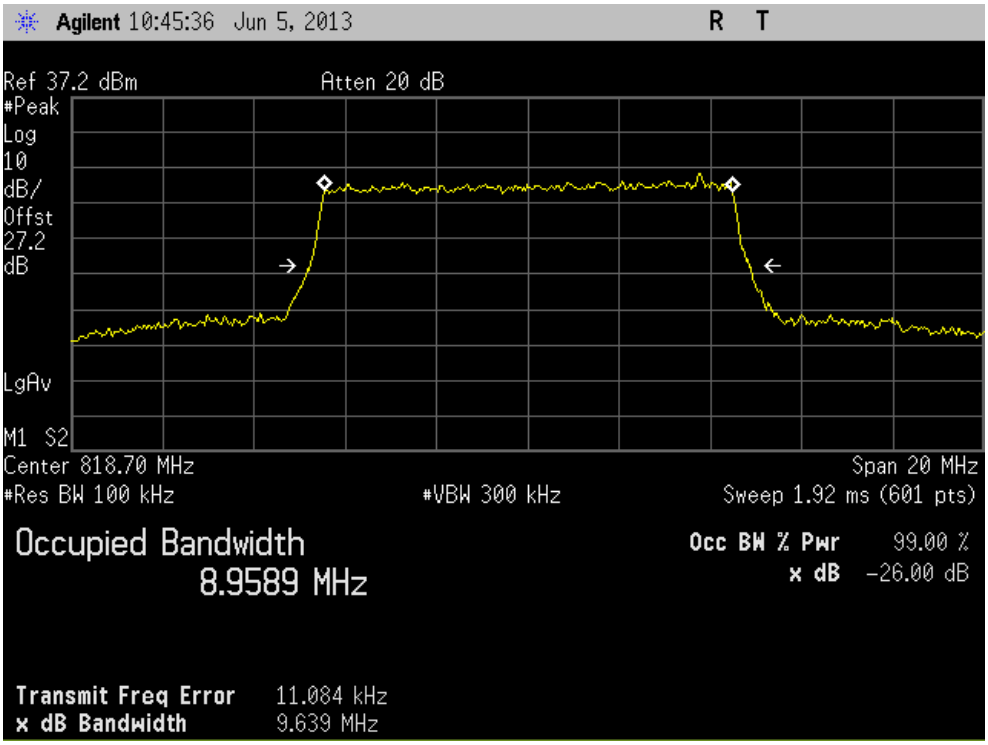
LTE Band 26 818.7MHz (5.0 MHz BW) QPSK


LTE Band 26 818.7MHz (5.0 MHz BW) 16QAM


LTE Band 26 818.7MHz (10.0 MHz BW) QPSK


LTE Band 26 818.7MHz (10.0 MHz BW) 16QAM


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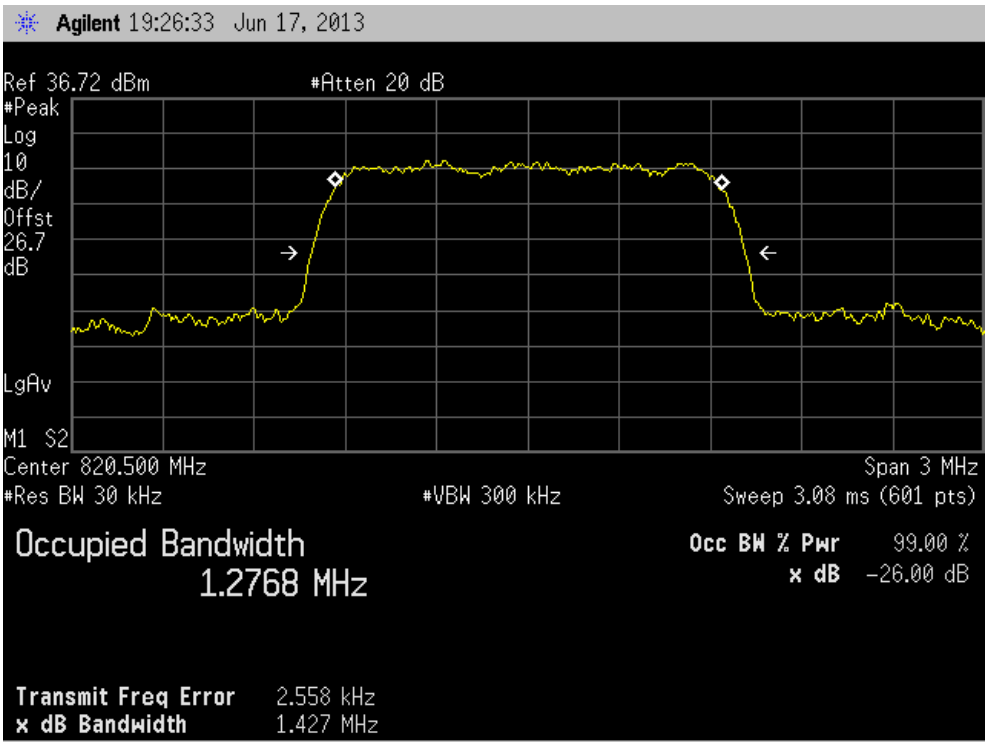
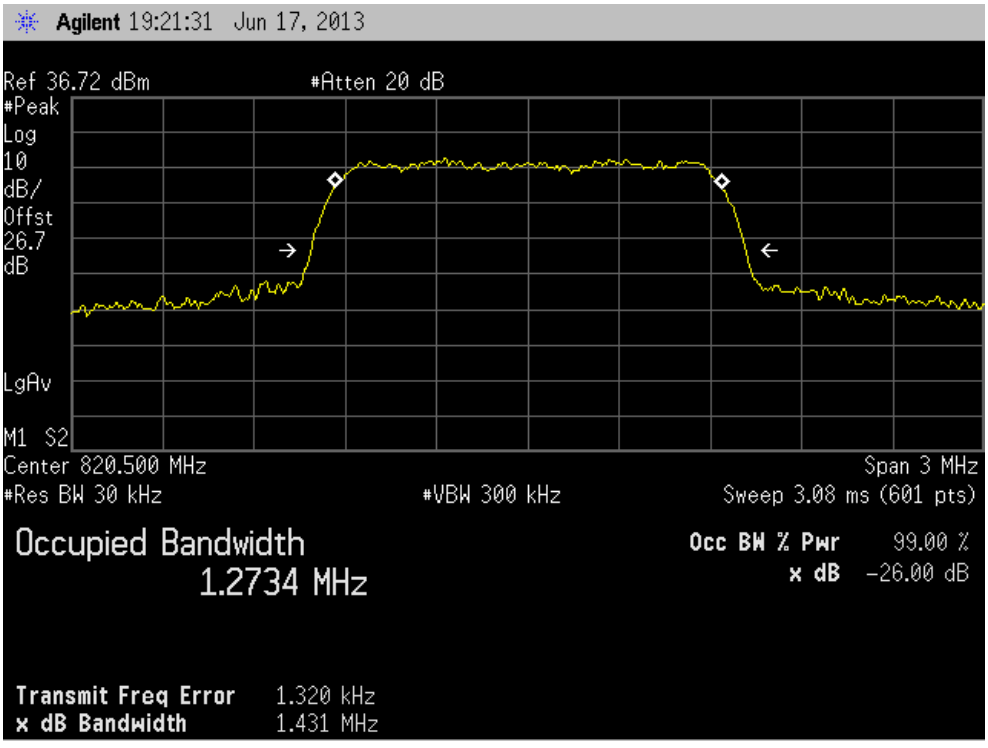
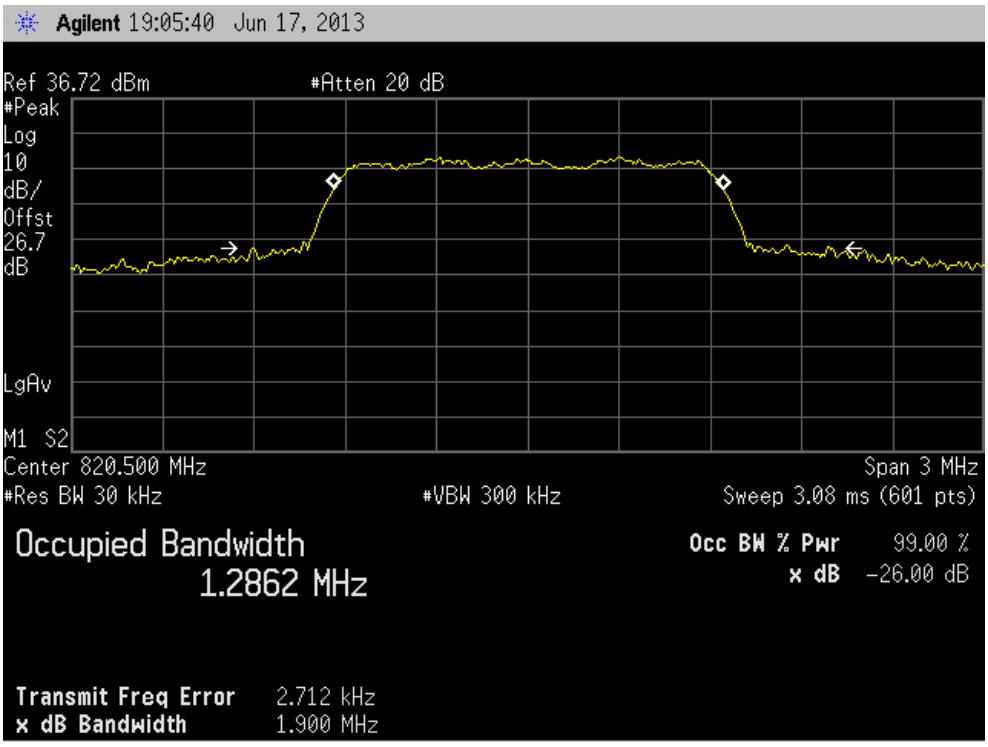
BC10 CDMA


BC10 1Xev-Do Rev. 0


BC10 1Xev-Do Rev. A


2.4 BAND EDGE (EMISSION MASK)

2.4.1 Specification Reference

Part 90 Subpart S §90.691

2.4.2 Standard Applicable

(a) Out-of-band emission requirement shall apply only to the “outer” channels included in an EA license and to spectrum adjacent to interior channels used by incumbent licensees. The emission limits are as follows:
(1) For any frequency removed from the EA licensee's frequency block by up to and including 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 116 Log10 (f/6.1) decibels or 50 + 10 Log10 (P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 12.5 kHz.
(2) For any frequency removed from the EA licensee's frequency block greater than 37.5 kHz, the power of any emission shall be attenuated below the transmitter power (P) in watts by at least 43 + 10Log10 (P) decibels or 80 decibels, whichever is the lesser attenuation, where f is the frequency removed from the center of the outer channel in the block in kilohertz and where f is greater than 37.5 kHz.
(b) When an emission outside of the authorized bandwidth causes harmful interference, the Commission may, at its discretion, require greater attenuation than specified in this section

2.4.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Test Configuration A

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

June 05, 2013/FSC

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	25.1°C
Relative Humidity	49.0%
ATM Pressure	99.1 kPa

2.4.7 Additional Observations

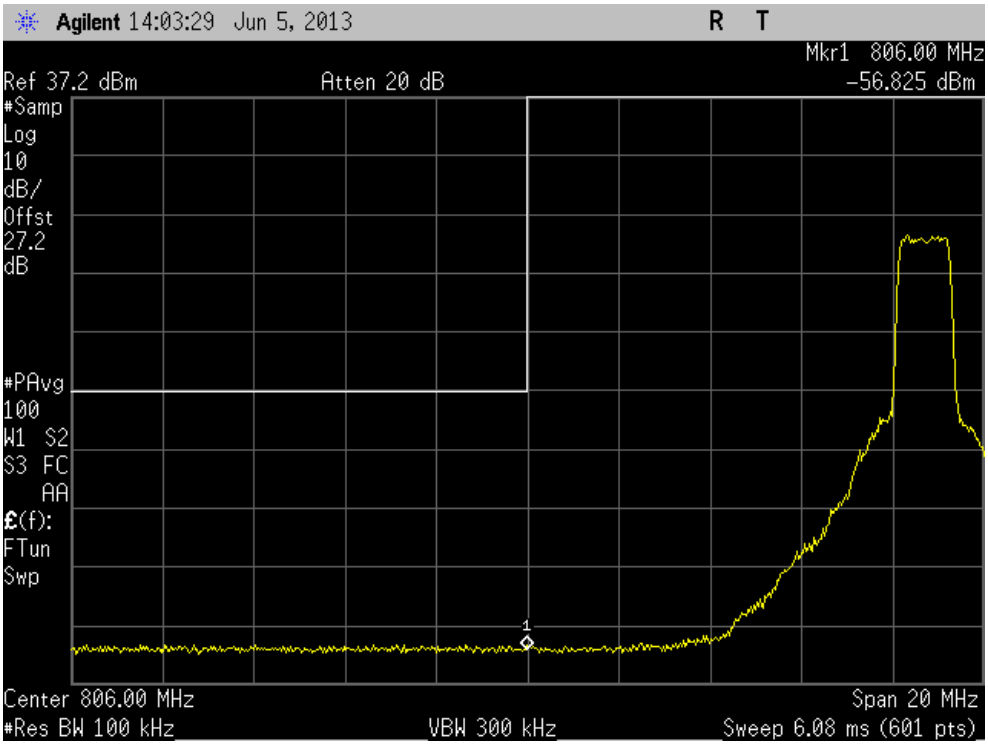
- This is a conducted test.
- The 27.2dB offset is from the power splitter, external attenuator and cable used.

- The center frequency of the spectrum is the band edge frequency.
- RBW is set to 100 kHz and VBW is set to 3X RBW. A narrower RBW was also utilized as long as it's not less than 1% of the OBW.
- The lowest RB position is always used for lower band edge while the highest RB position for upper band edge measurement.
- Both modulation and all RB size available verified and only the worst case presented in this test report.

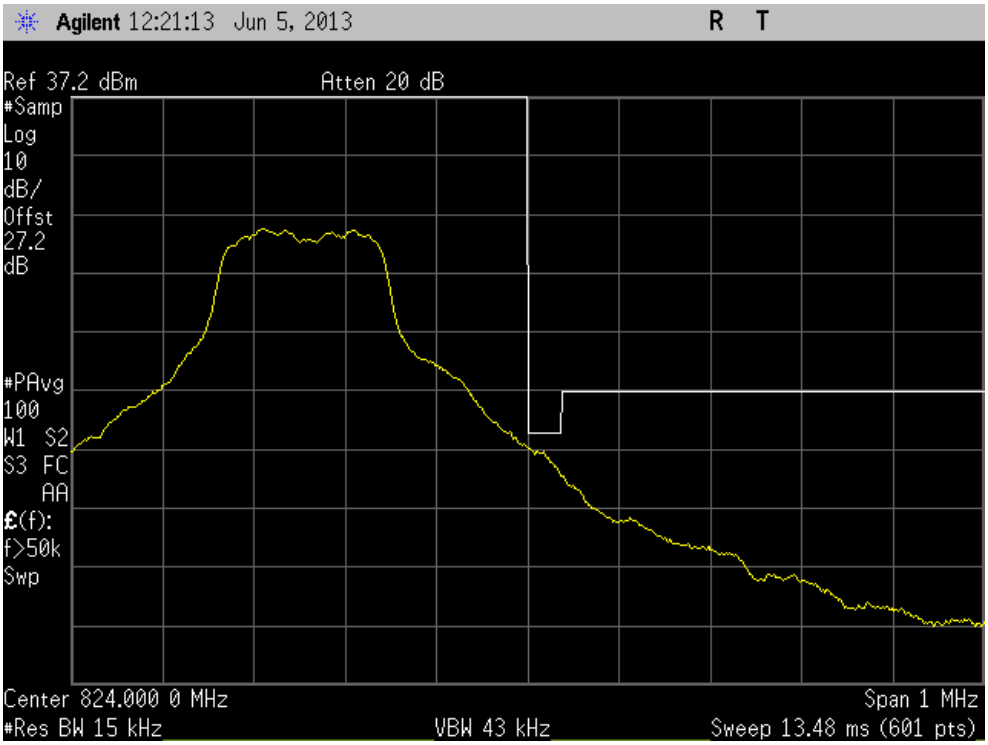
2.4.8 **Test Results**

See attached plots.

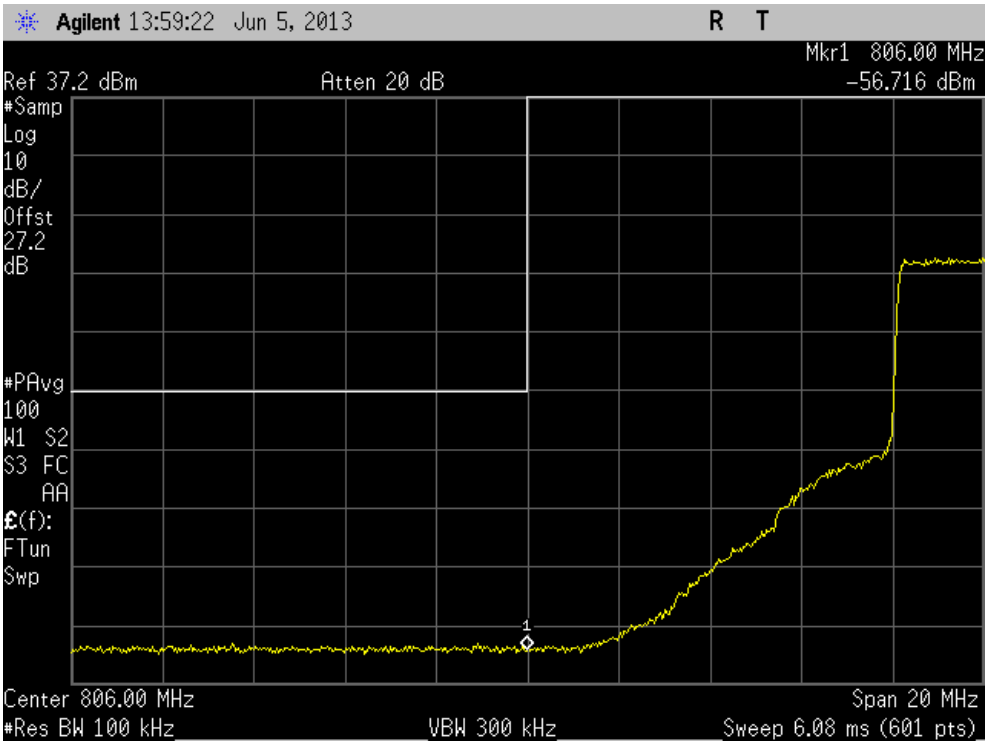
LTE Band 26 1.4MHz BW Low Channel (26697) Band Edge @ 806MHz (#RB is 6)



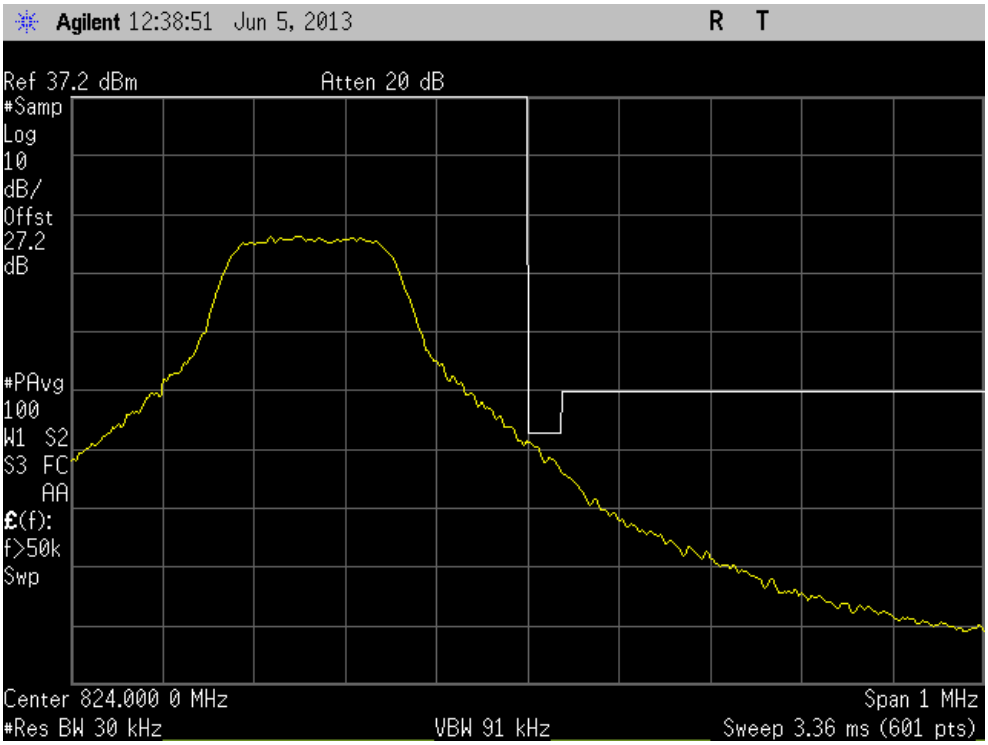
LTE Band 26 1.4MHz BW High Channel (26783) Band Edge @ 824MHz (#RB is 1)



LTE Band 26 3.0MHz BW Low Channel (26705) Band Edge @ 806MHz (#RB is 15)



LTE Band 26 3.0MHz BW High Channel (26775) Band Edge @ 824MHz (#RB is 1)



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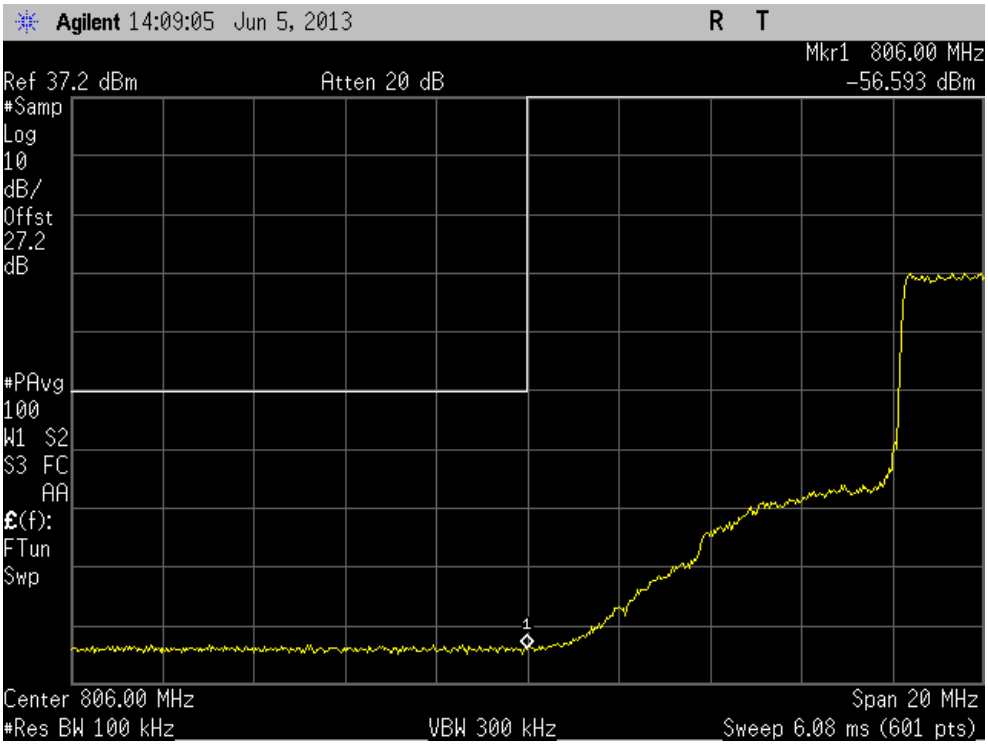
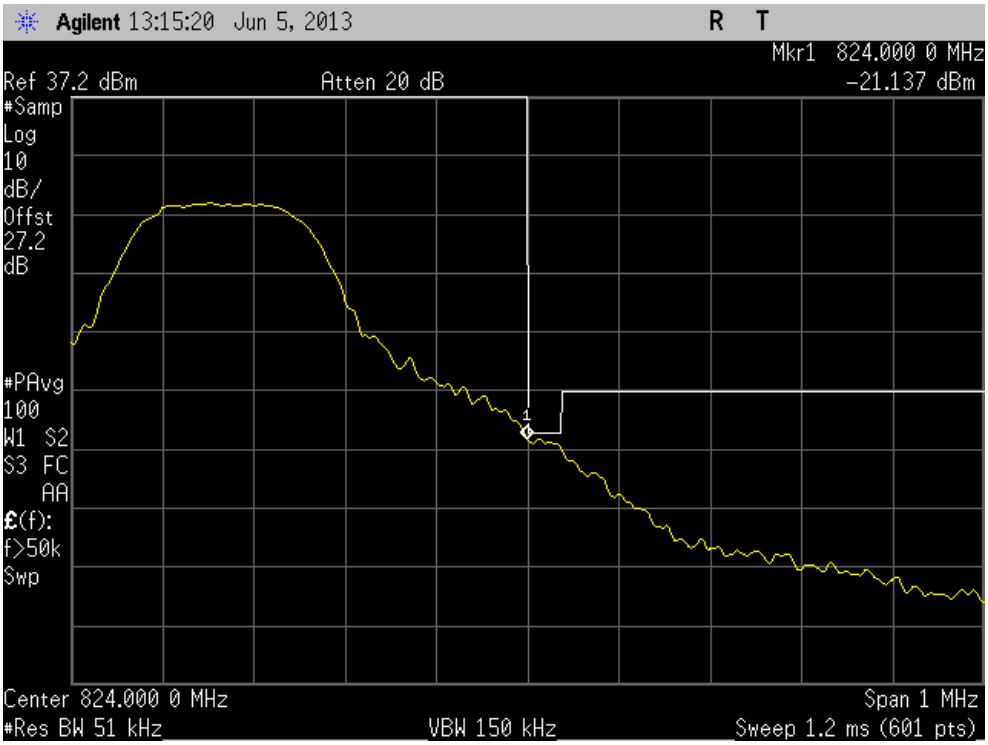
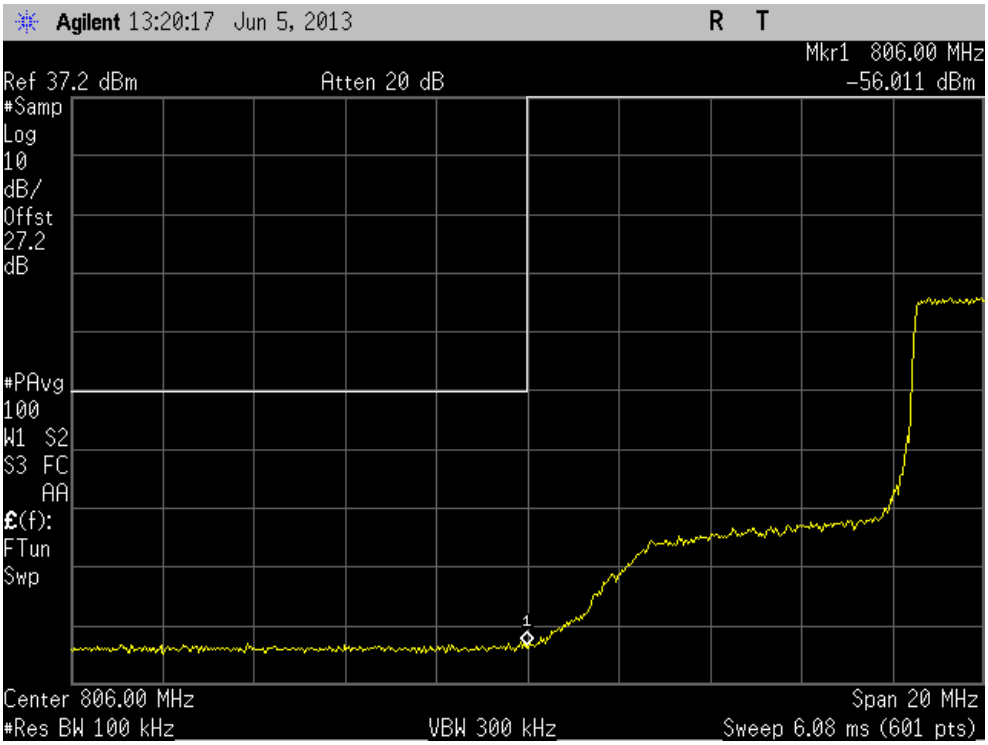
LTE Band 26 5.0MHz BW Low Channel (26715) Band Edge @ 806MHz (#RB is 25)



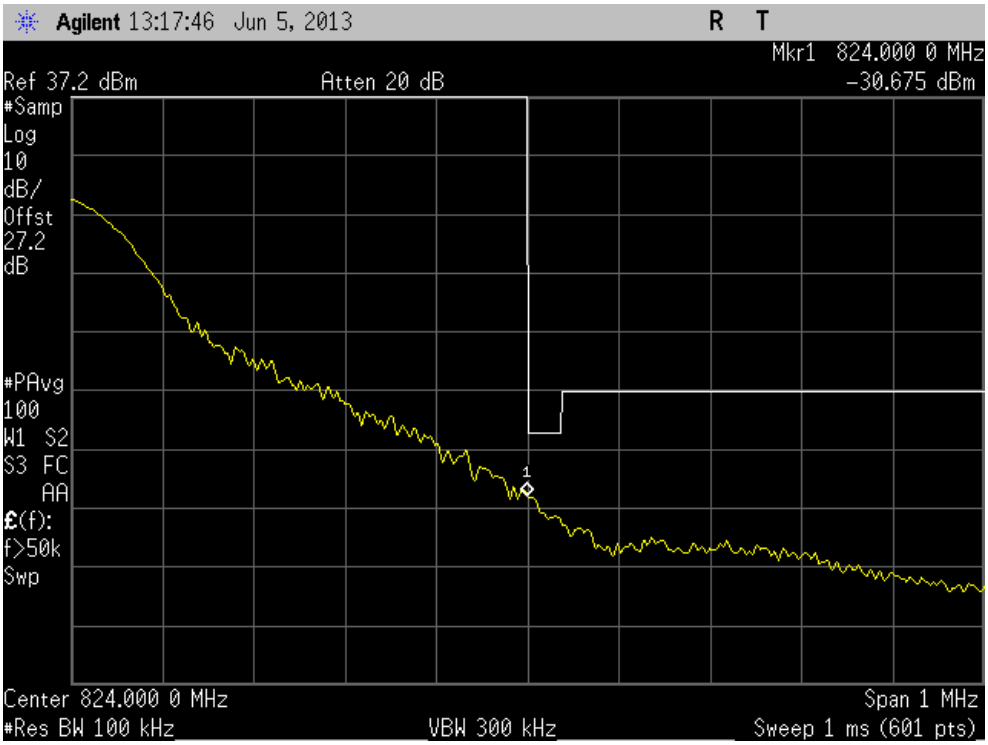
LTE Band 26 5.0MHz BW High Channel (26765) Band Edge @ 824MHz (#RB is 1)



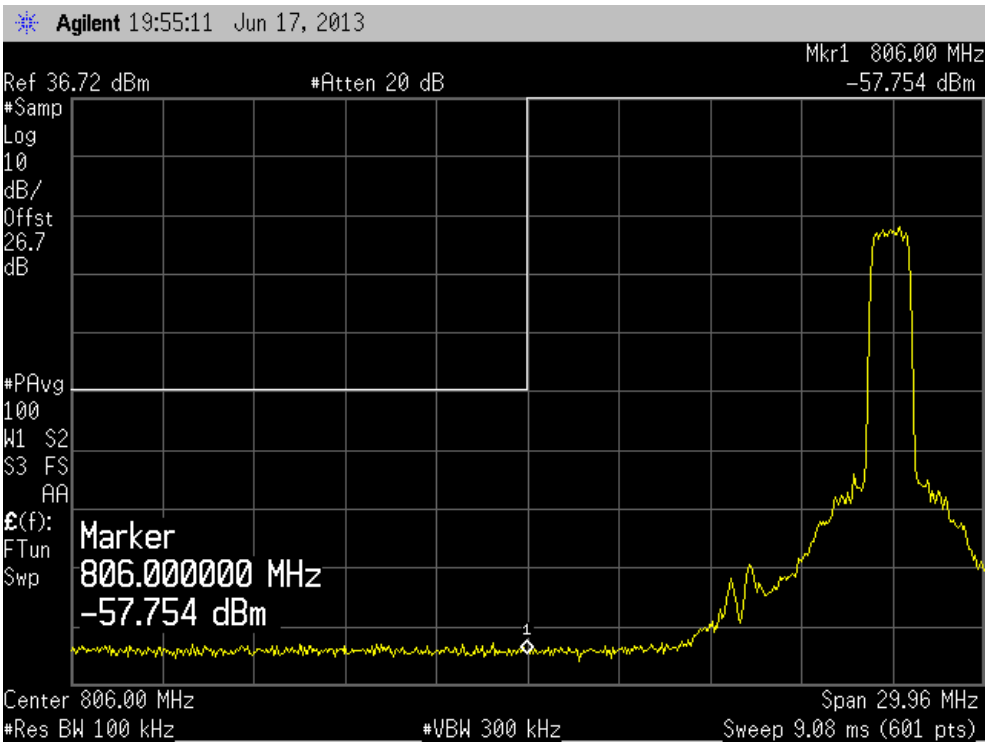
LTE Band 26 10MHz BW Low Channel (26740) Band Edge @ 806MHz (#RB is 50)



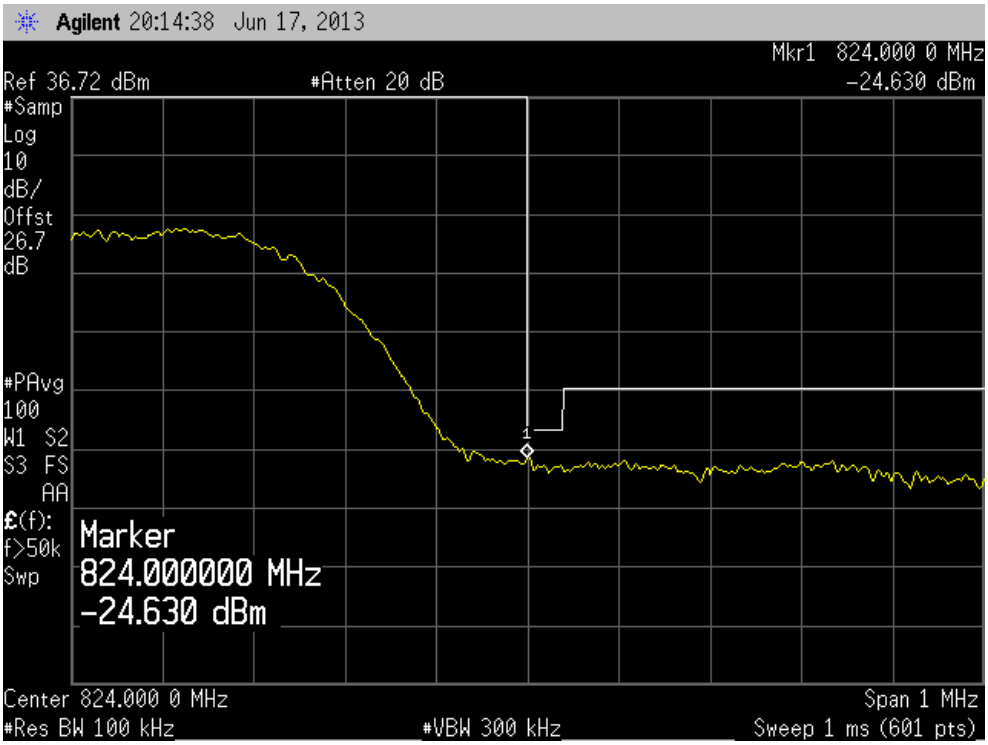
LTE Band 26 10MHz BW High Channel (26740) Band Edge @ 824MHz (#RB is 1)



BC10 CDMA Low Channel (476) Band Edge @ 806MHz



BC10 CDMA High Channel (684) Band Edge @ 824MHz



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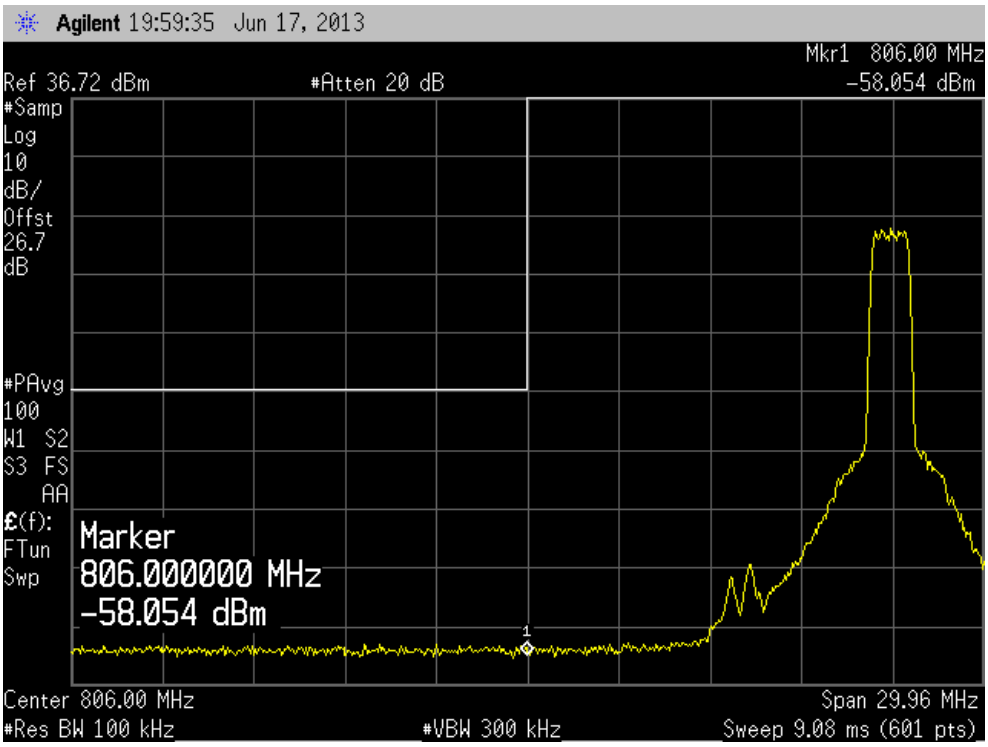
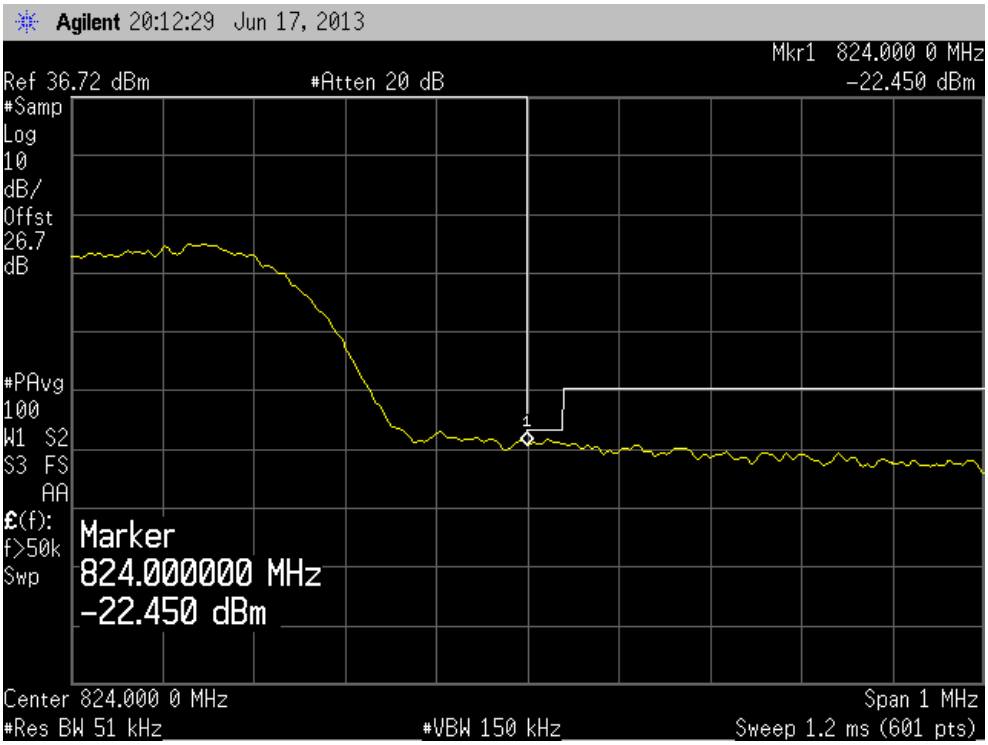
BC10 1Xev-Do Rev. 0 Low Channel (476) Band Edge @ 806MHz



BC10 1Xev-Do Rev. 0 High Channel (684) Band Edge @ 824MHz



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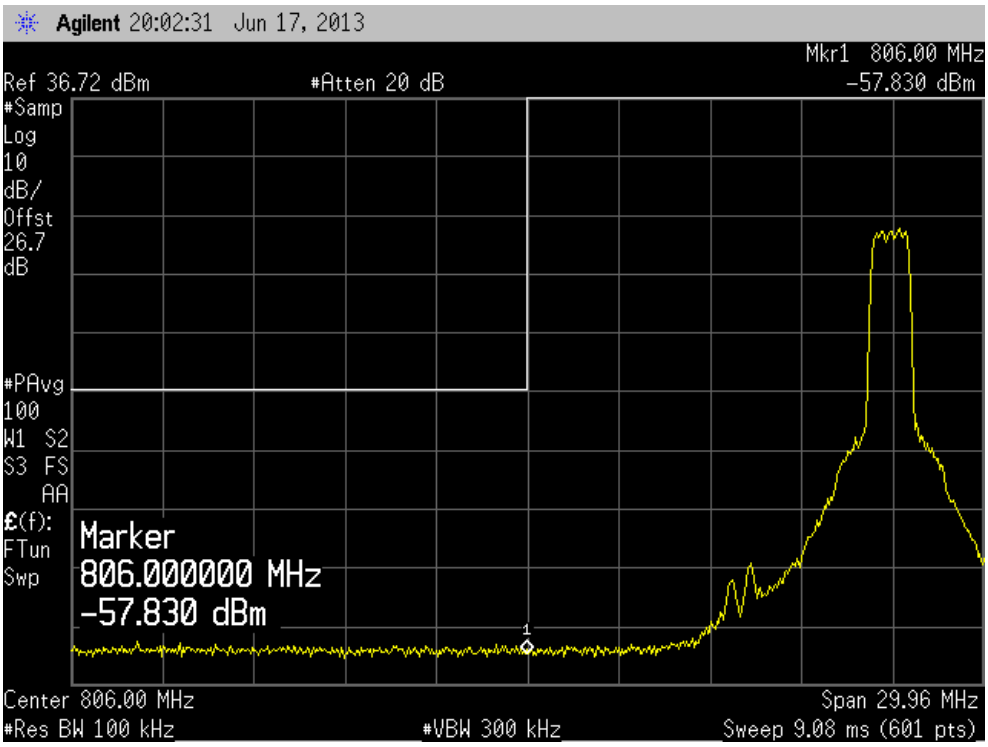
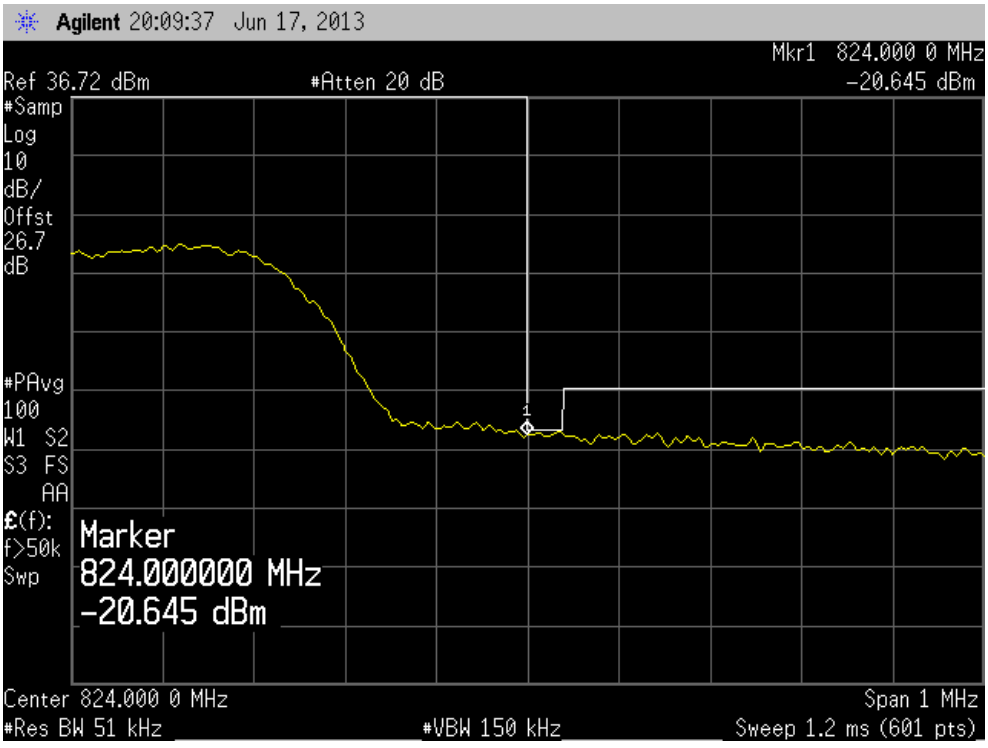
BC10 1Xev-Do Rev. A Low Channel (476) Band Edge @ 806MHz



BC10 1Xev-Do Rev. A High Channel (684) Band Edge @ 824MHz



2.5 CONDUCTED SPURIOUS EMISSIONS

2.5.1 Specification Reference

Part 2.1051

2.5.2 Standard Applicable

The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in § 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

2.5.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Test Configuration A

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

June 05, 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	49.0%
ATM Pressure	99.1 kPa

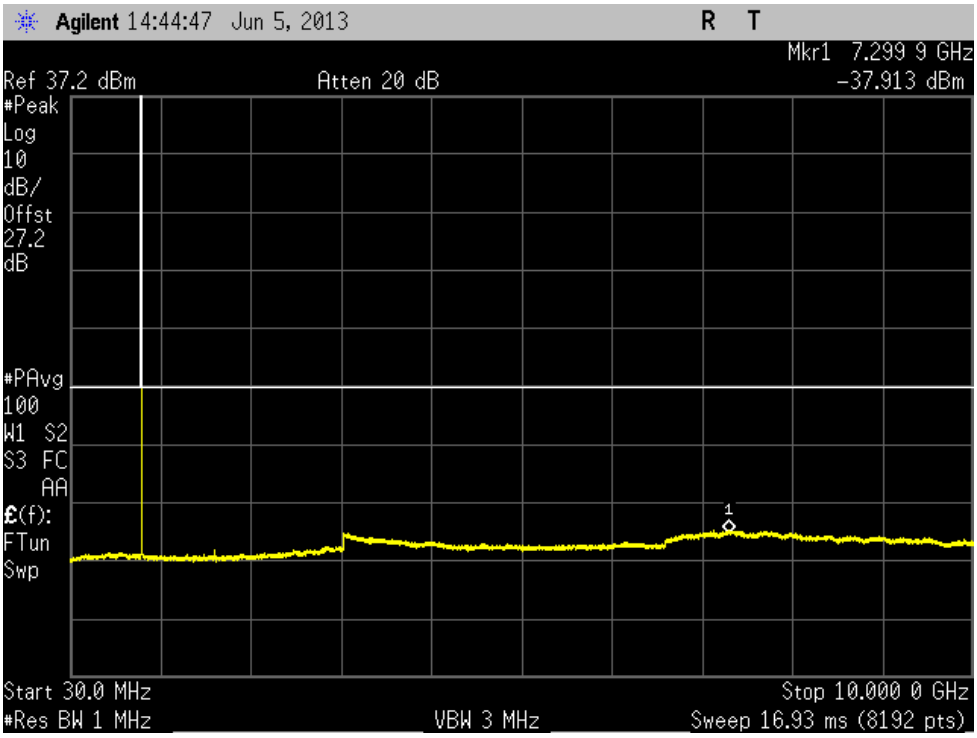
2.5.7 Additional Observations

- This is a conducted test. The 27.2dB offset is from the power splitter, external attenuator and cable used.
- The spectrum was searched from 30MHz to the 10th harmonic (up to 10GHz presented).
- Low, Mid and High channels on all channel bandwidth verified. Only the worst modulation, RB size/offset presented.

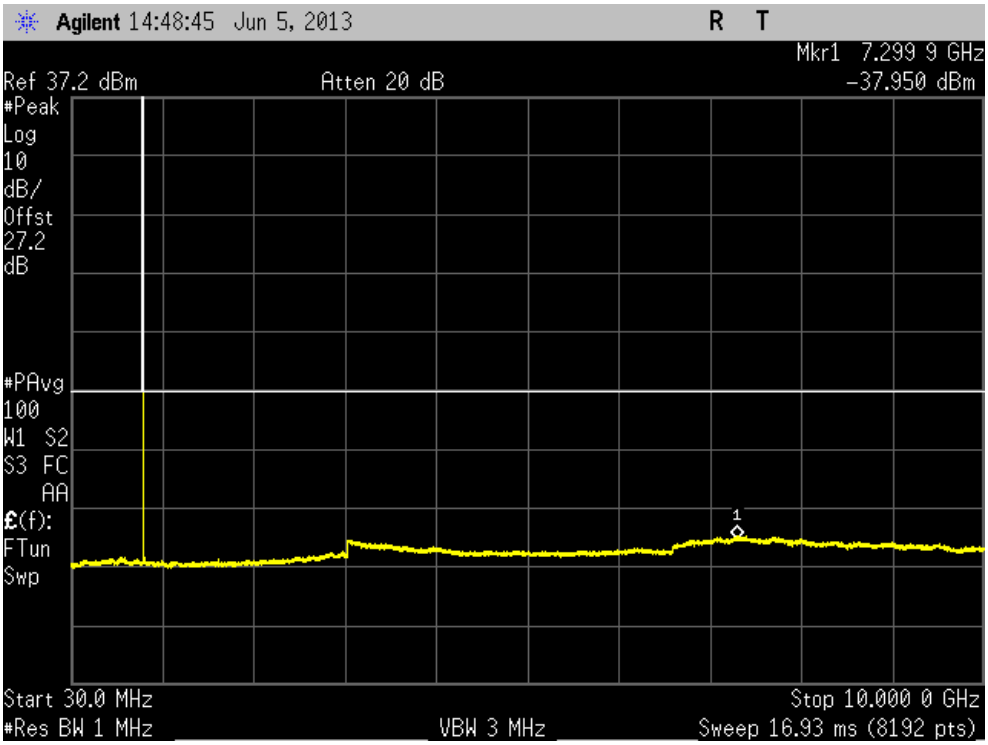
2.5.8 Test Results

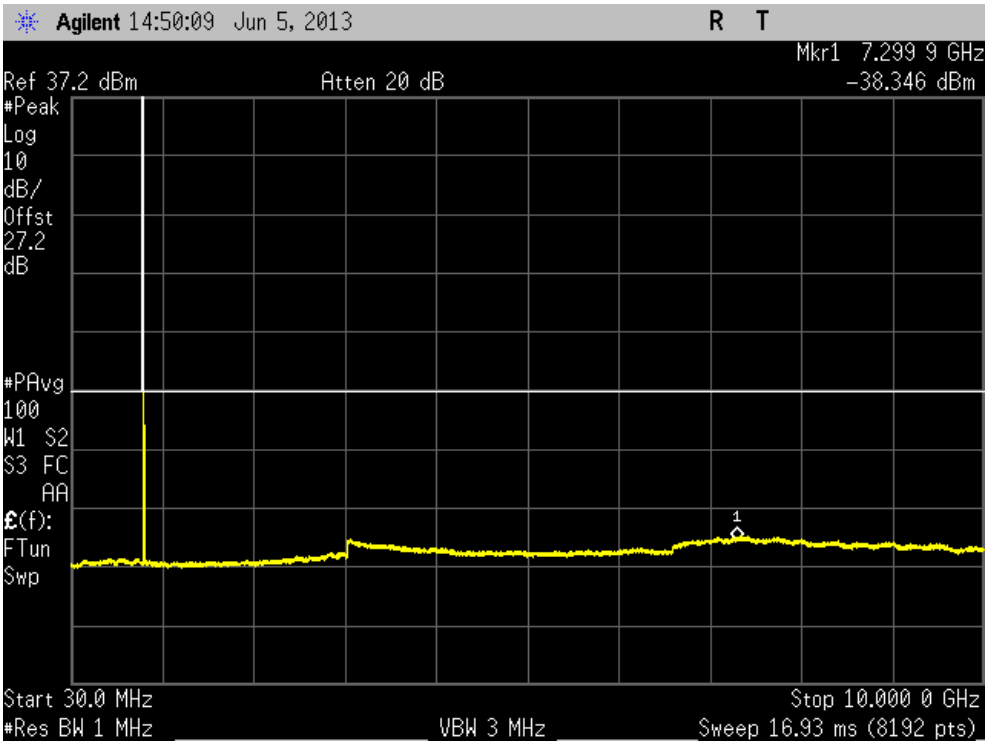
Compliant. See attached plots.

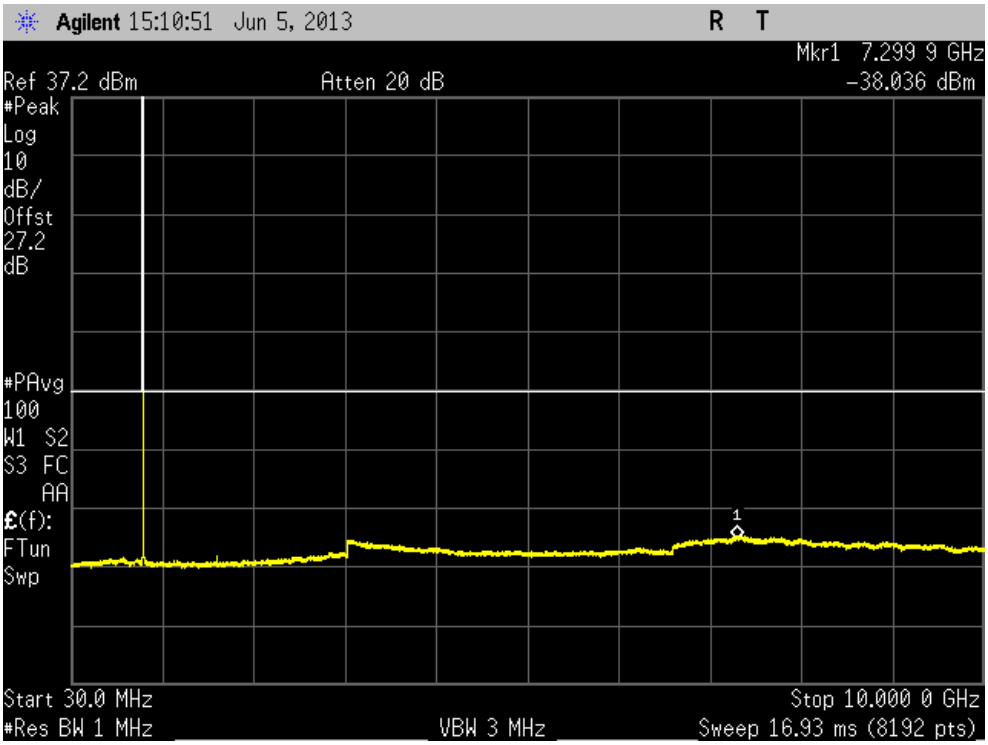
LTE Band 26 1.4MHz BW Low Channel



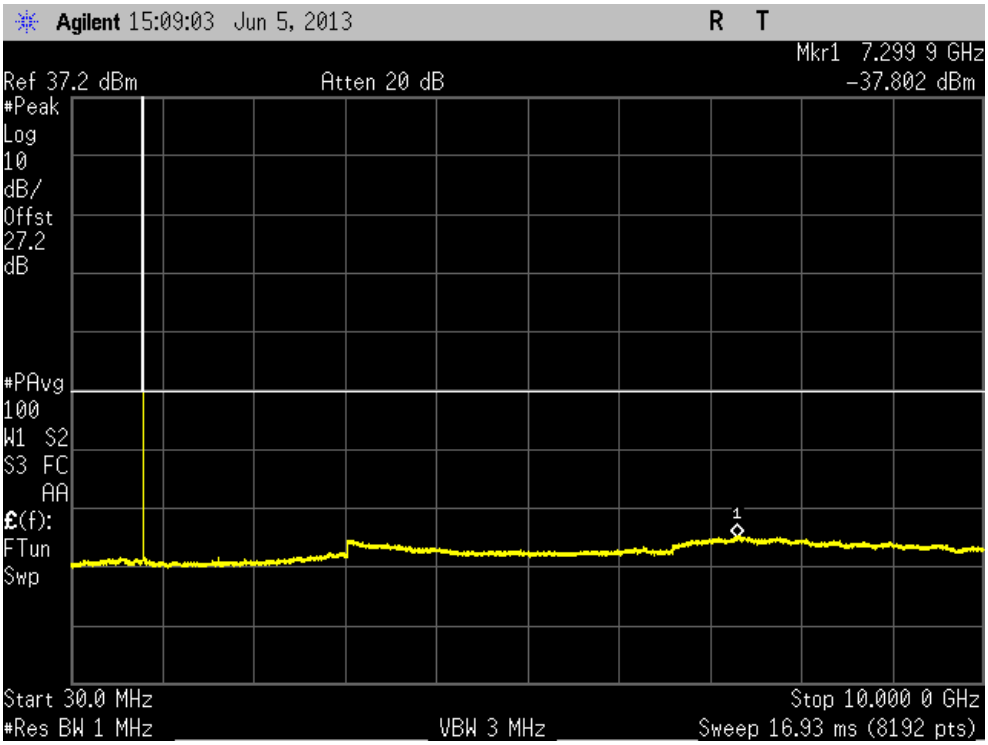
LTE Band 26 1.4MHz BW Mid Channel



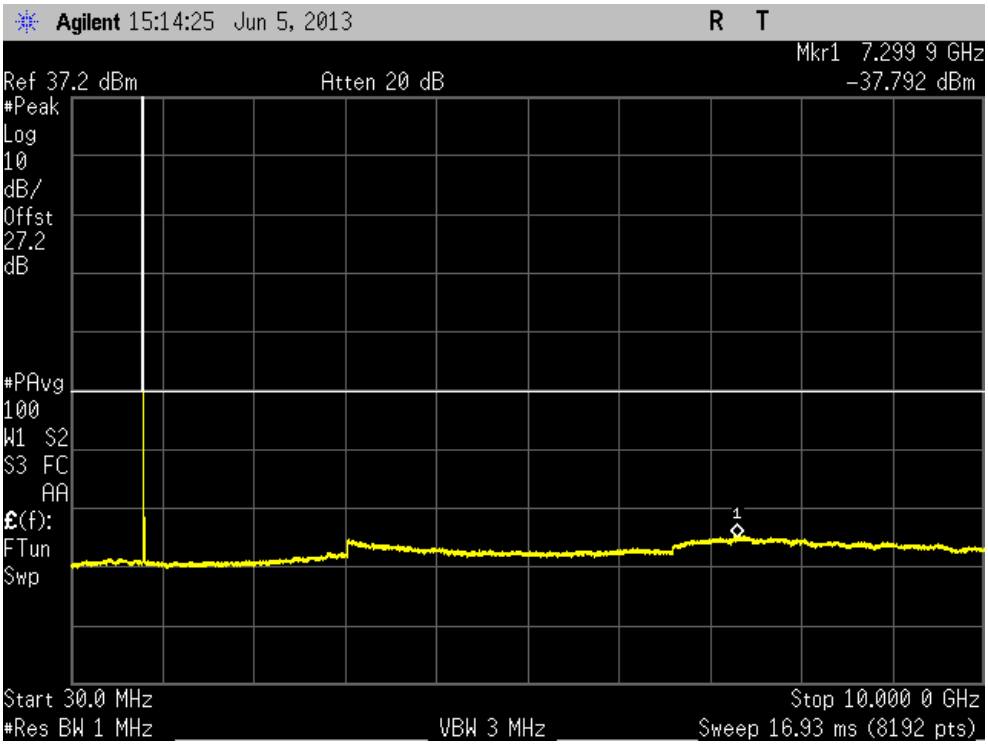
LTE Band 26 1.4MHz BW High Channel


LTE Band 26 3MHz BW Low Channel


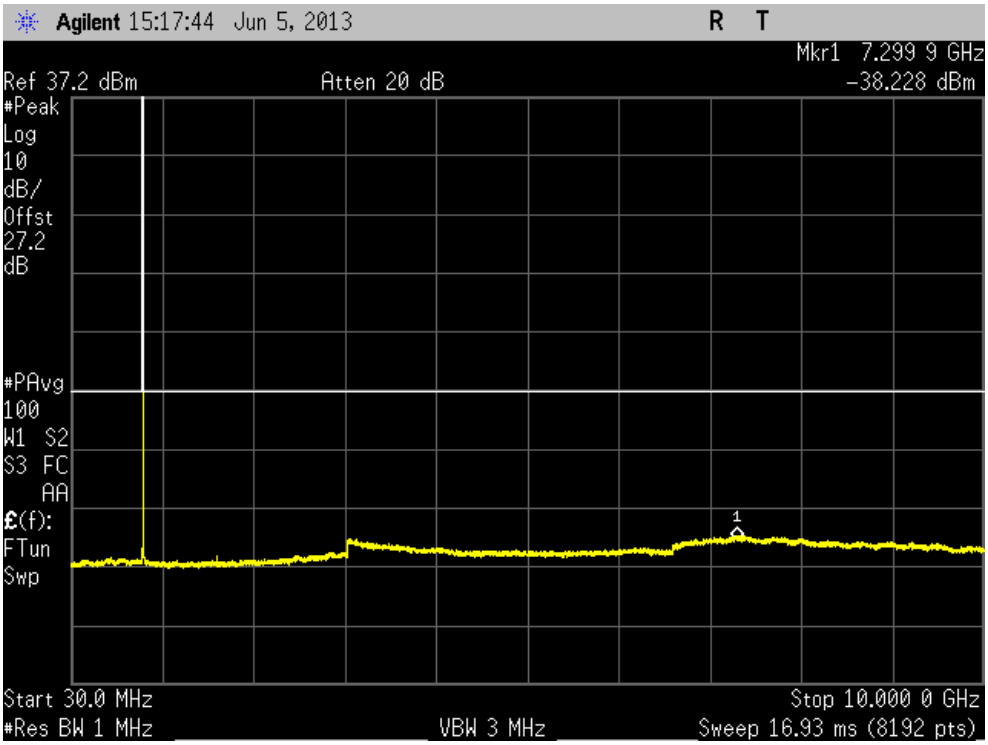
LTE Band 26 3MHz BW Mid Channel



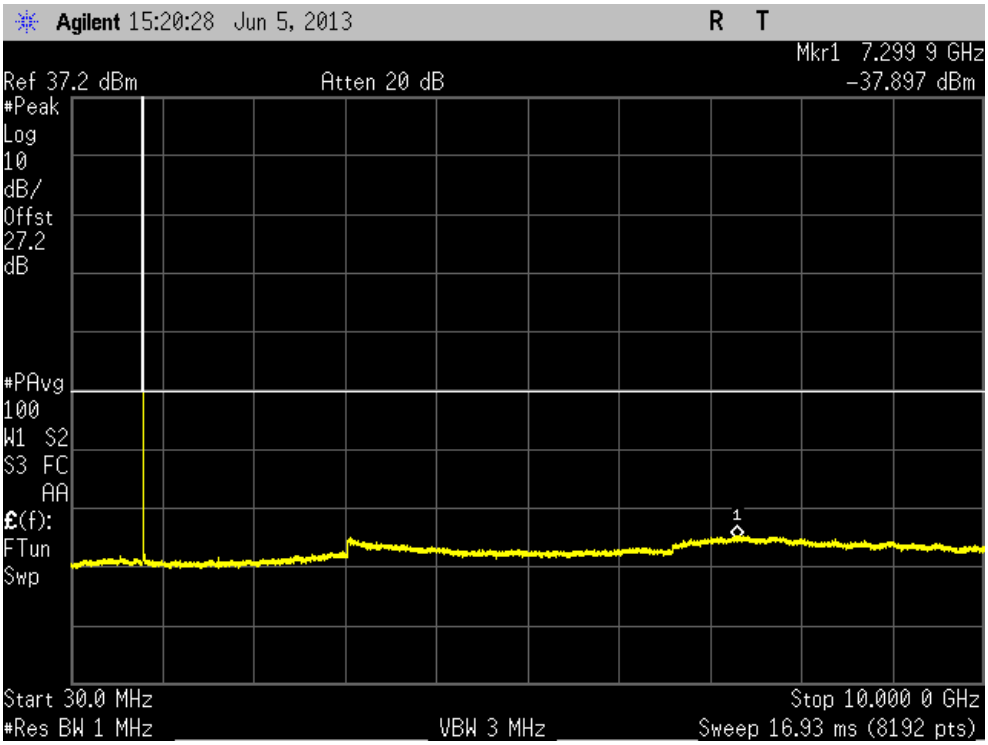
LTE Band 26 3MHz BW High Channel

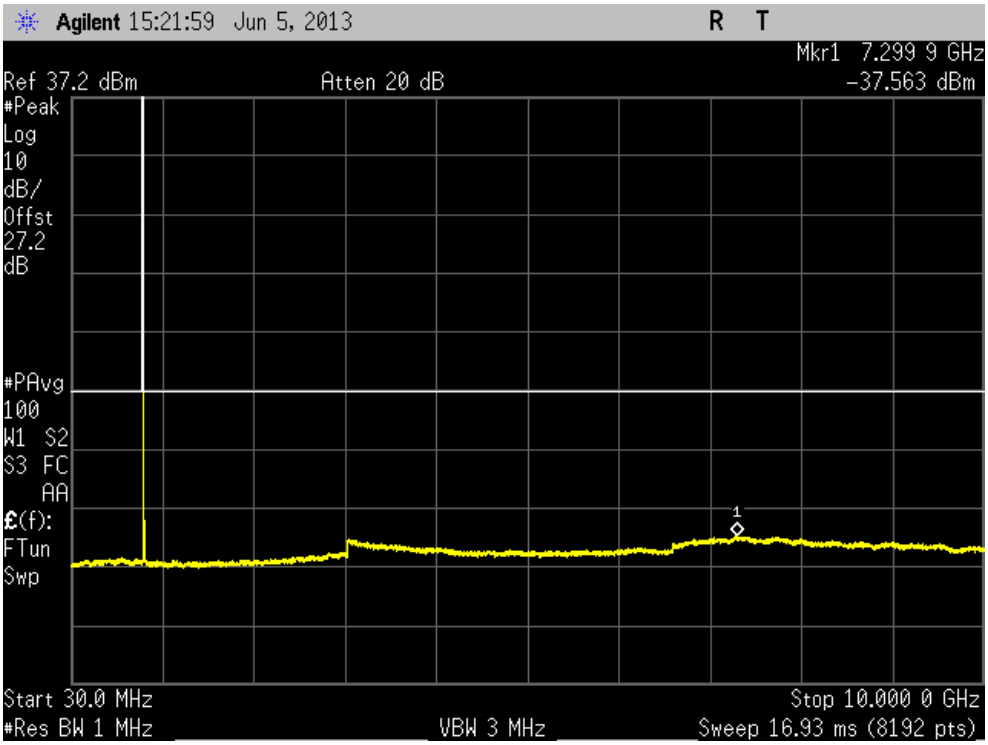


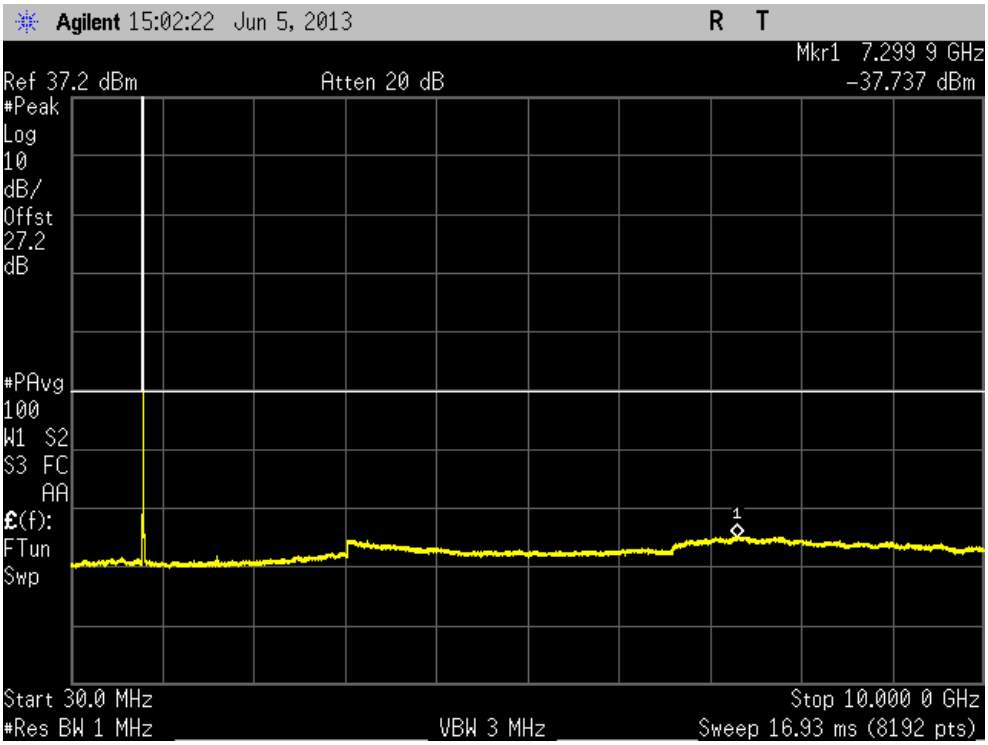
LTE Band 26 5MHz BW Low Channel

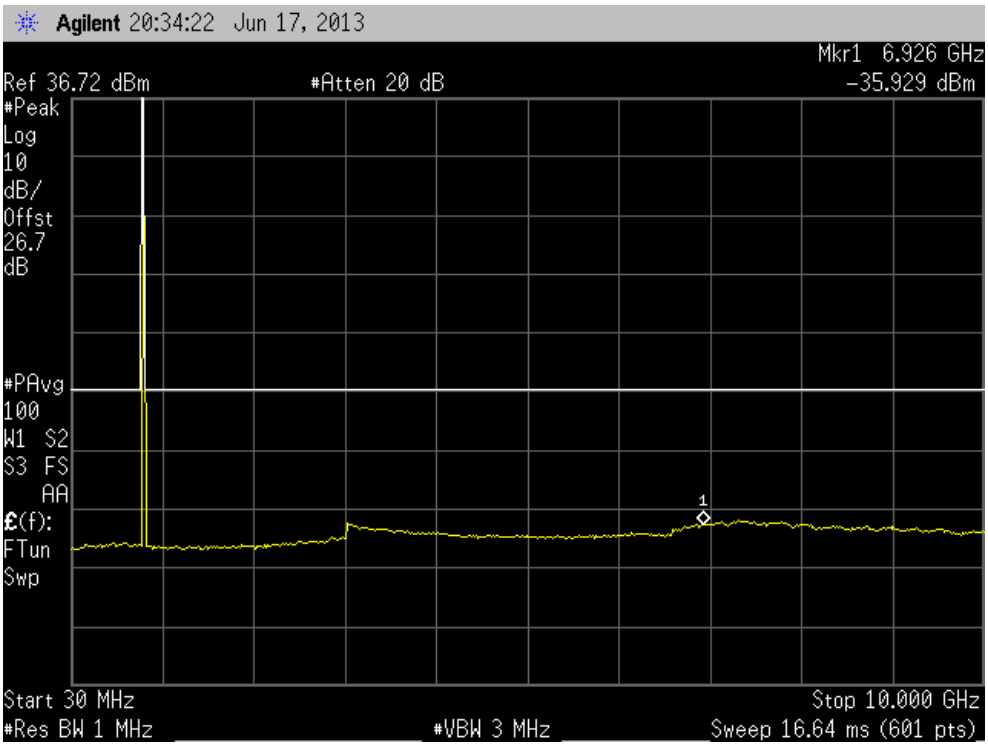


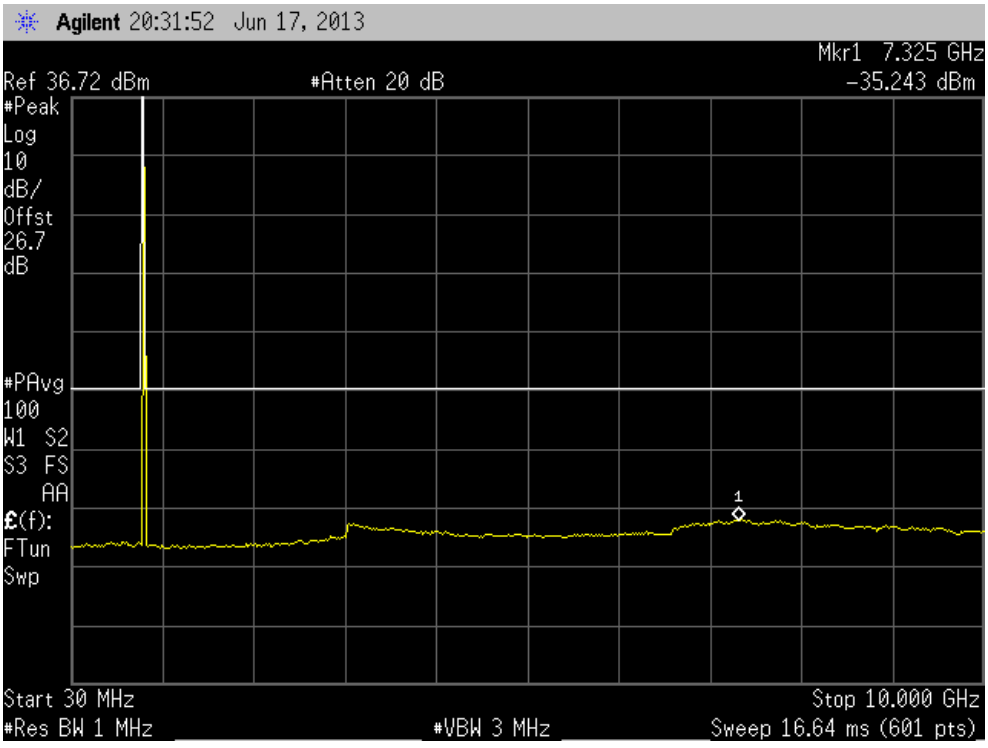
LTE Band 26 5MHz BW Mid Channel



LTE Band 26 5MHz BW High Channel


LTE Band 26 10MHz BW (Single Channel)


BC10 CDMA2000 Low Channel


BC10 CDMA2000 Mid Channel


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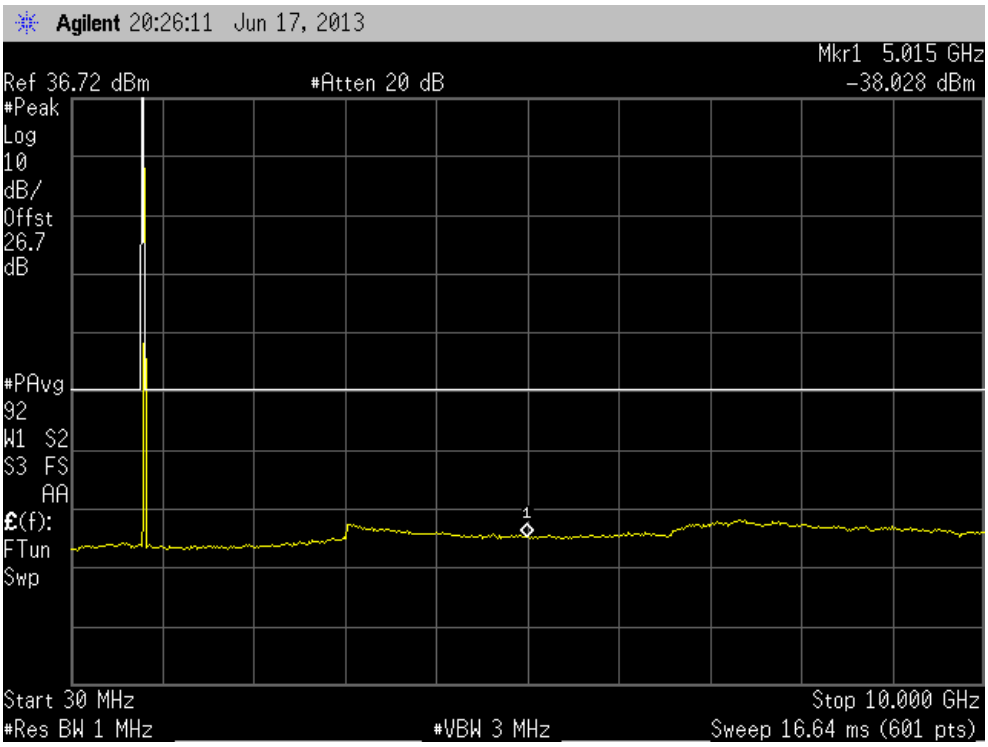
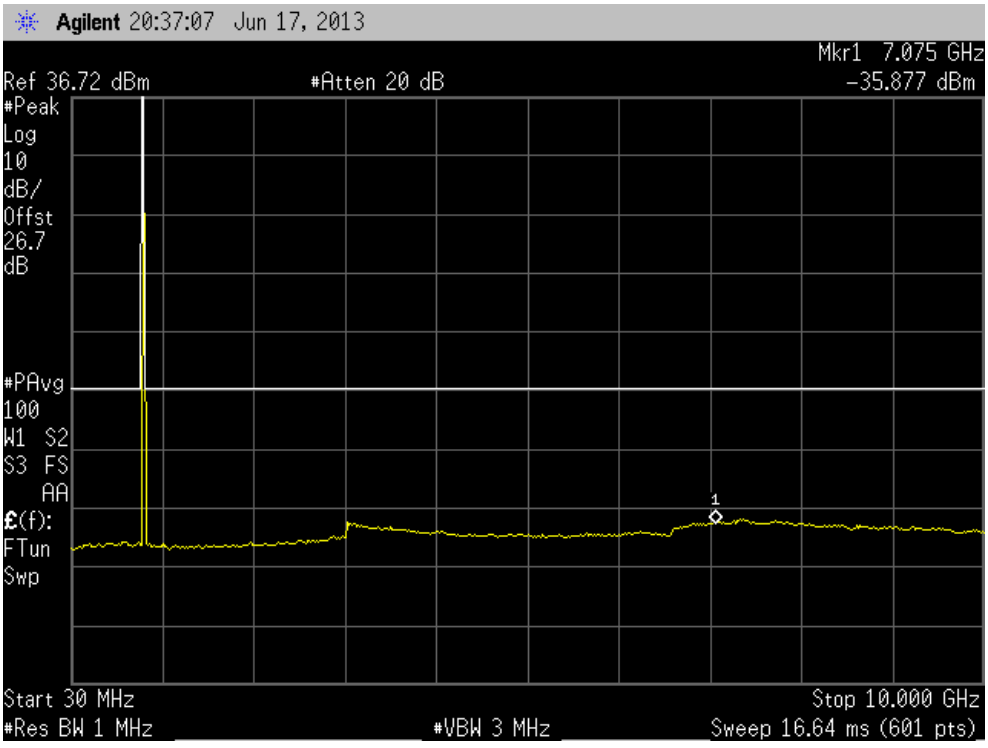
BC10 CDMA2000 High Channel


BC10 1Xev-Do Rev. 0 Low Channel


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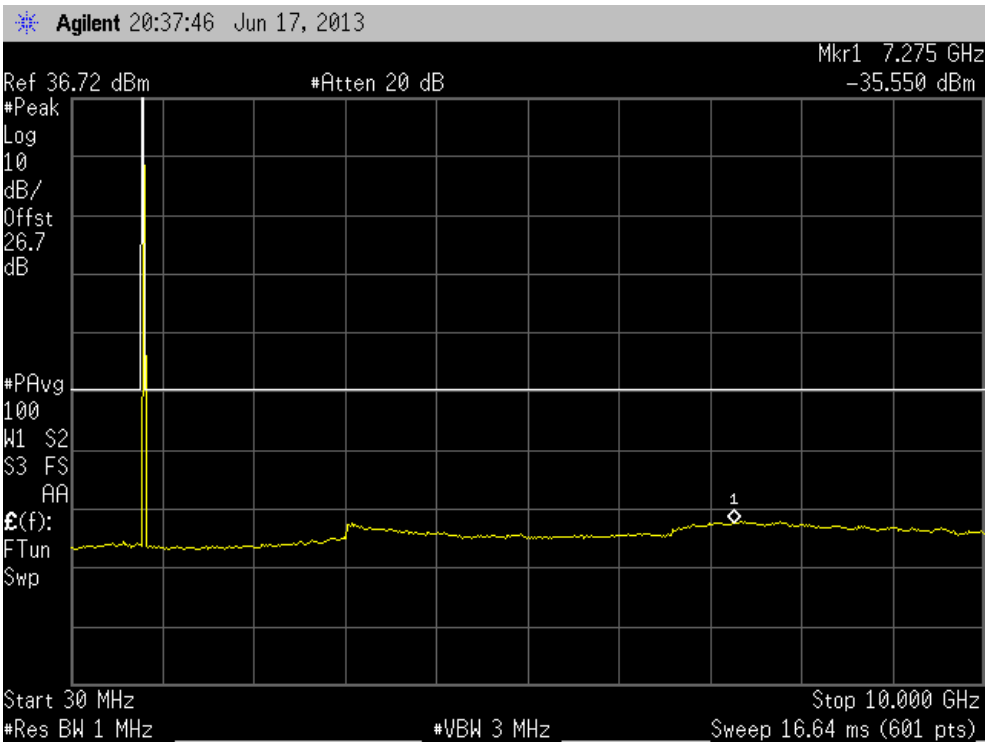
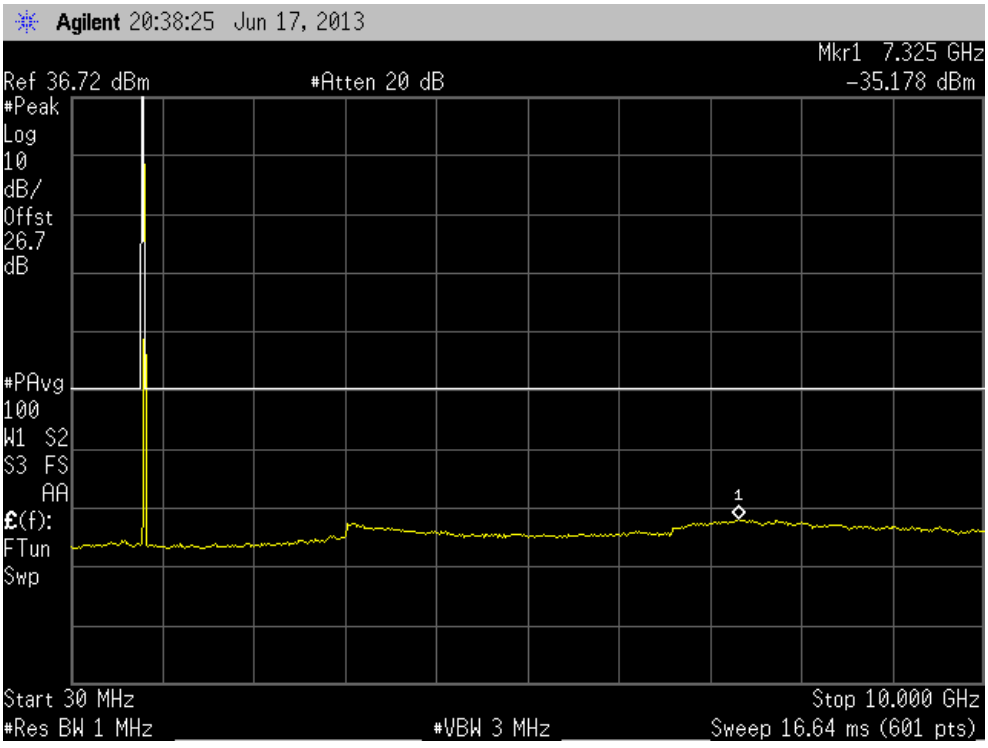
BC10 1Xev-Do Rev. 0 Mid Channel


BC10 1Xev-Do Rev. 0 High Channel


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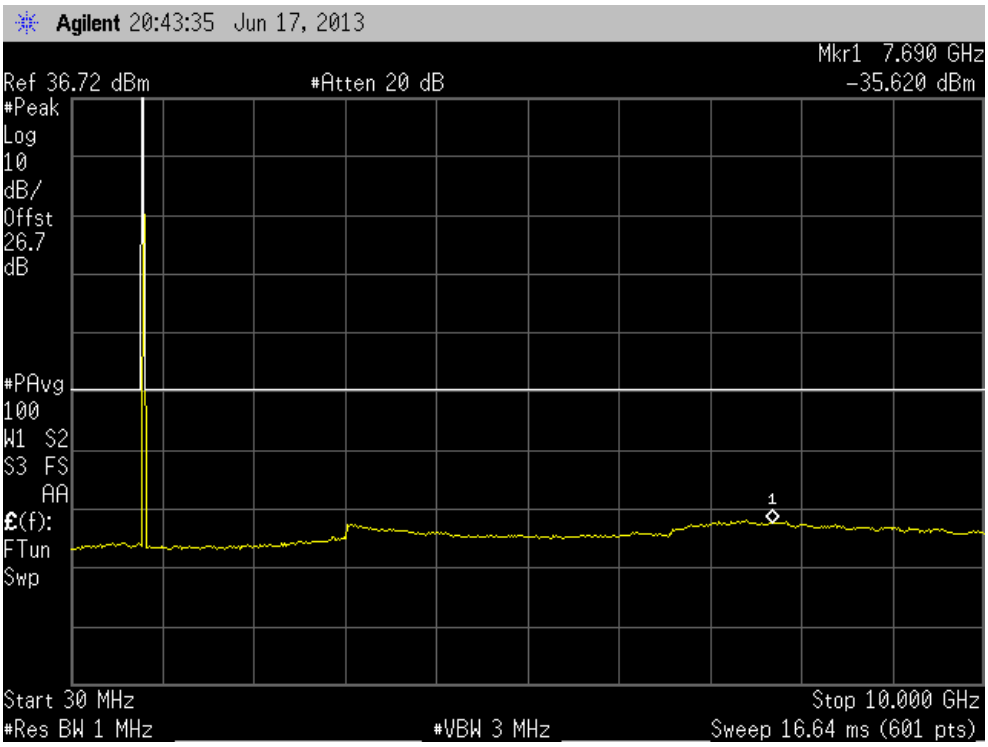
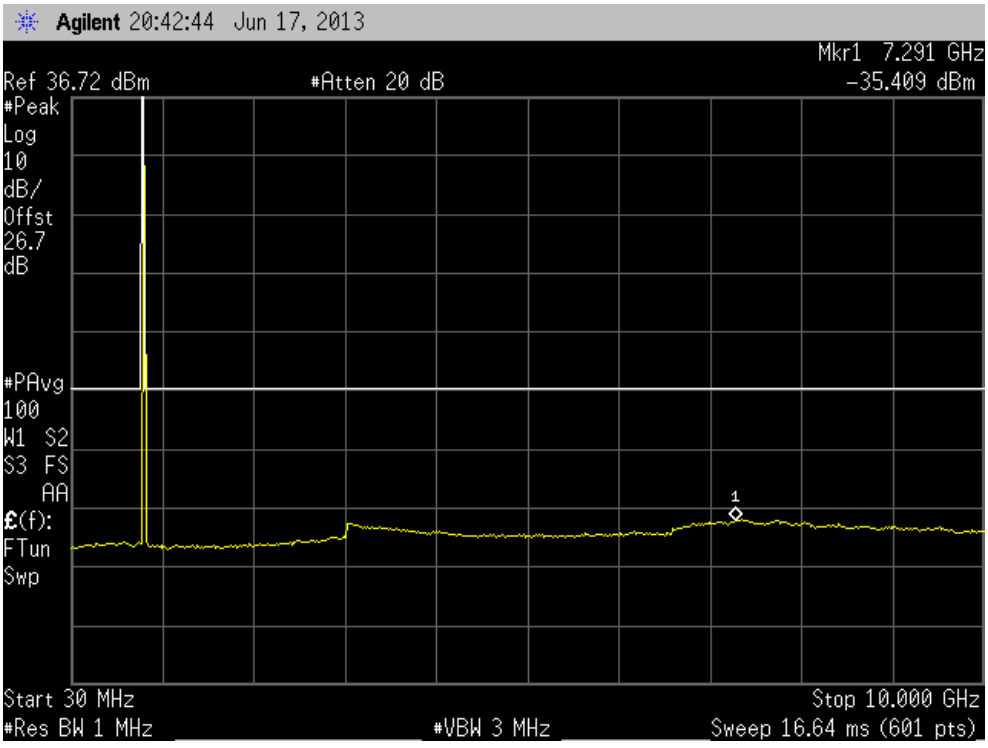
BC10 1Xev-Do Rev. A Low Channel


BC10 1Xev-Do Rev. A CDMA2000 Mid Channel


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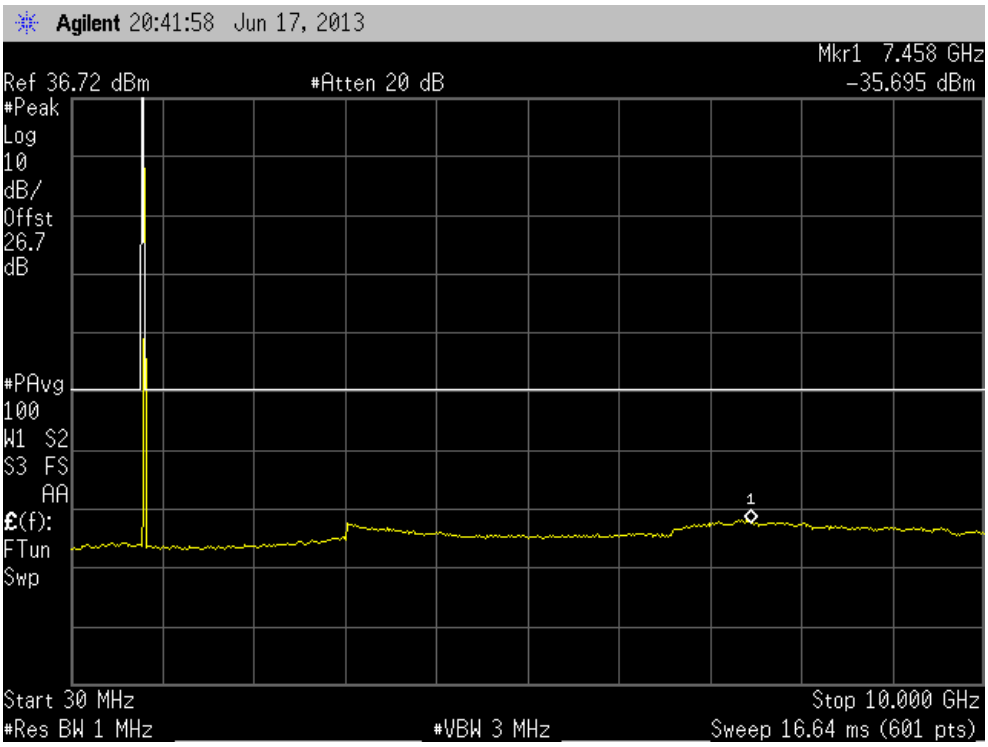
BC10 1Xev-Do Rev. A High Channel


2.6 FIELD STRENGTH OF SPURIOUS RADIATION

2.6.1 Specification Reference

Part 2.1053

2.6.2 Standard Applicable

(a) Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of § 2.1049, as appropriate. For equipment operating on frequencies below 890 MHz, an open field test is normally required, with the measuring instrument antenna located in the far-field at all test frequencies. In the event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurements will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from halfwave dipole antennas.

2.6.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Test Configuration B

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

June 06, 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	23.6 °C
Relative Humidity	45.3 %
ATM Pressure	99.5 kPa

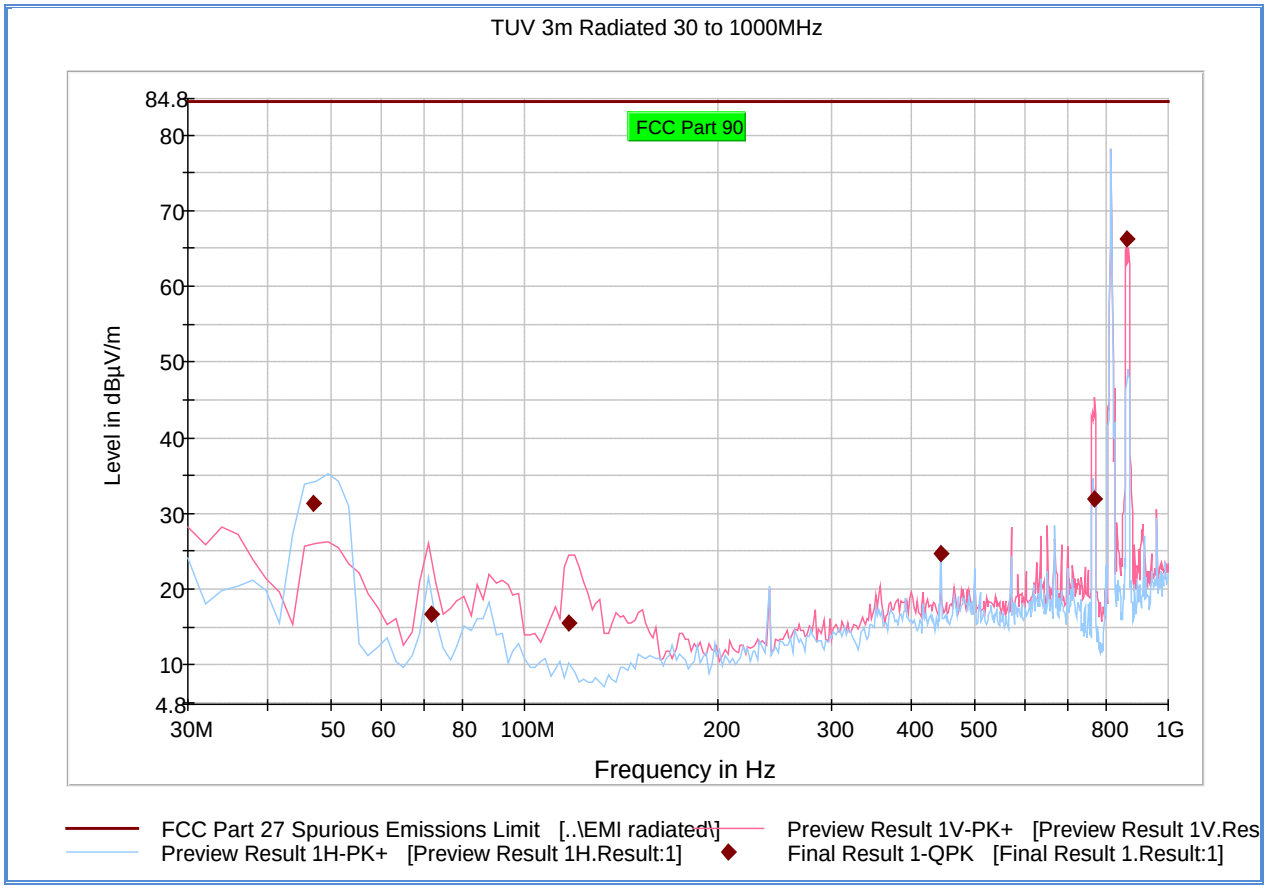
2.6.7 Additional Observations

- 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.

2.6.8 Test Results

See attached plots.

2.6.9 Test Results Below 1GHz (Band 26)



Quasi Peak Data

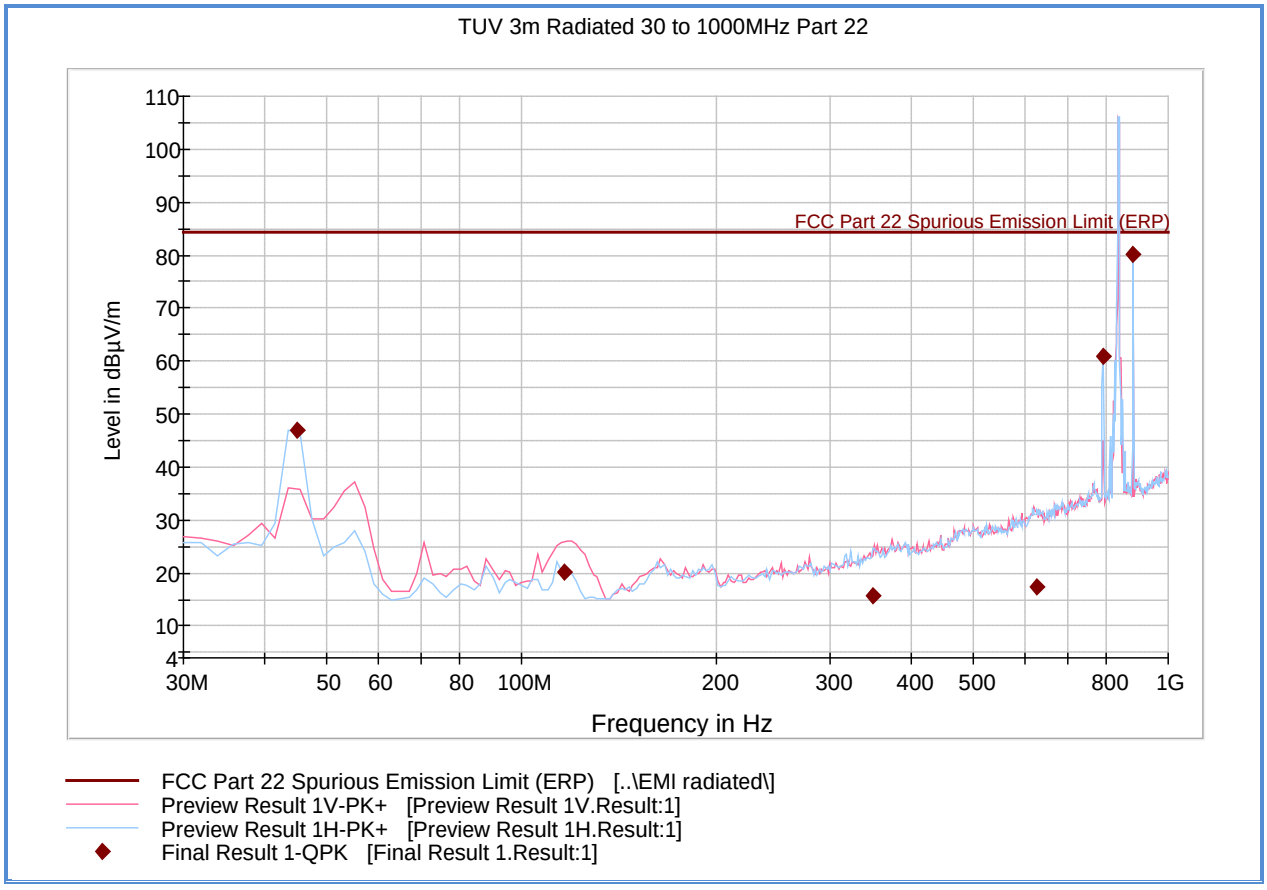
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
47.078878	31.4	1000.0	120.000	100.0	H	3.0	-19.2	53.0	84.4
71.581643	16.8	1000.0	120.000	100.0	V	220.0	-21.7	67.6	84.4
116.994950	15.5	1000.0	120.000	105.0	V	78.0	-20.2	68.9	84.4
443.728096	24.7	1000.0	120.000	100.0	H	208.0	-8.3	59.7	84.4
767.877355	32.0	1000.0	120.000	100.0	V	6.0	-0.6	52.4	84.4
860.383968	66.2	1000.0	120.000	100.0	V	128.0	-0.3	Downlink Channel	

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 channel presented for spurious emissions below 1GHz. Plot presented is Band 26, Mid channel, 10MHz channel bandwidth with RB size/offset of 1/0.
Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).

2.6.10 Test Results Below 1GHz (BC 10)



Quasi Peak Data

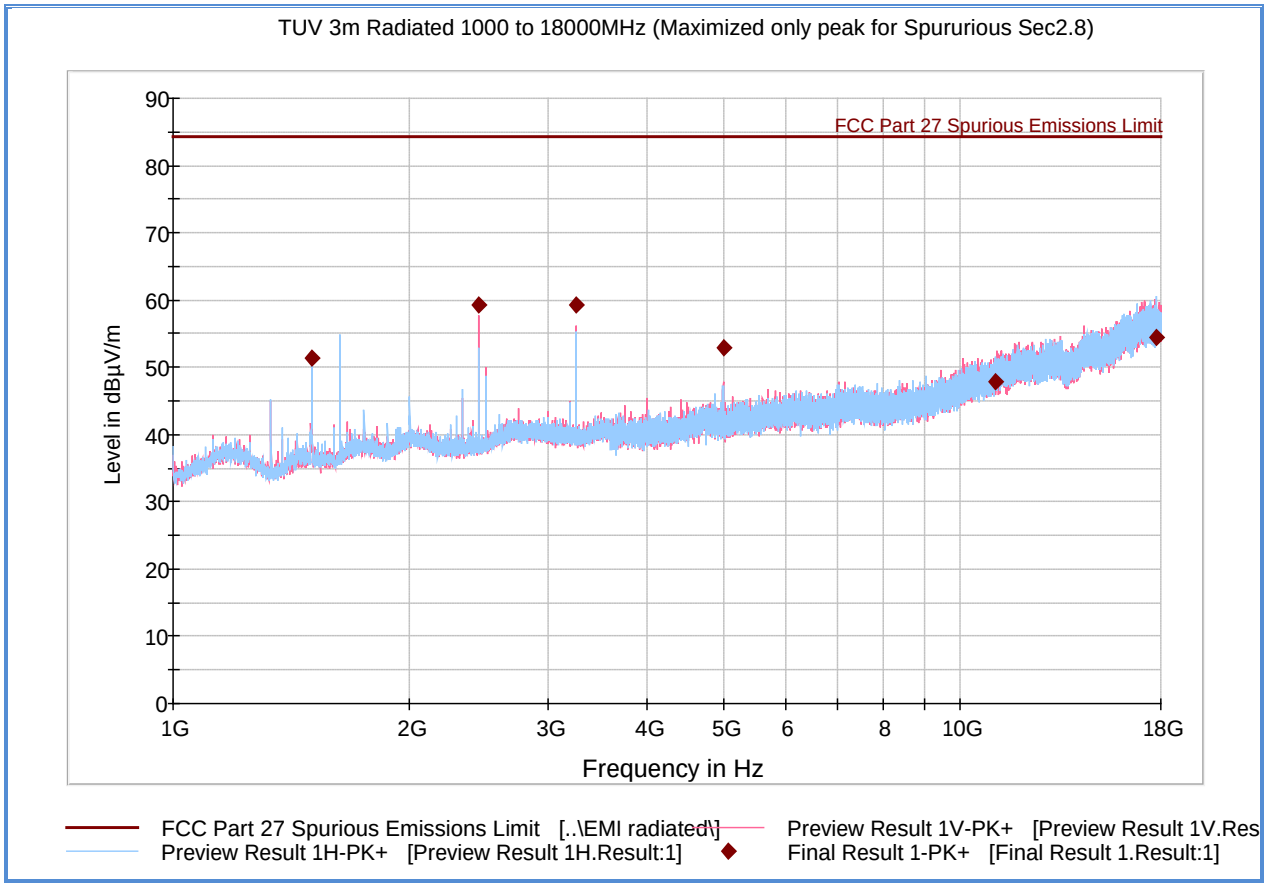
Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
45.087214	46.8	1000.0	120.000	167.0	H	134.0	-18.7	37.5	84.4
116.498838	20.3	1000.0	120.000	100.0	V	66.0	-20.2	64.1	84.4
349.957595	15.7	1000.0	120.000	370.0	H	154.0	-9.6	68.7	84.4
627.813547	17.5	1000.0	120.000	265.0	V	304.0	-2.8	66.9	84.4
792.164008	61.0	1000.0	120.000	169.0	H	44.0	-2.1	23.3	84.4
881.502846	80.2	1000.0	120.000	226.0	V	358.0	-1.4	Downlink Channel	

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 channel presented for spurious emissions below 1GHz BC 10.
Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).

2.6.11 Test Results Above 1GHz (Worst Case Configuration Band 26)



Test Note: *Part 27 limit is identical to the limit required for this test (-13dBm)*

Peak Data

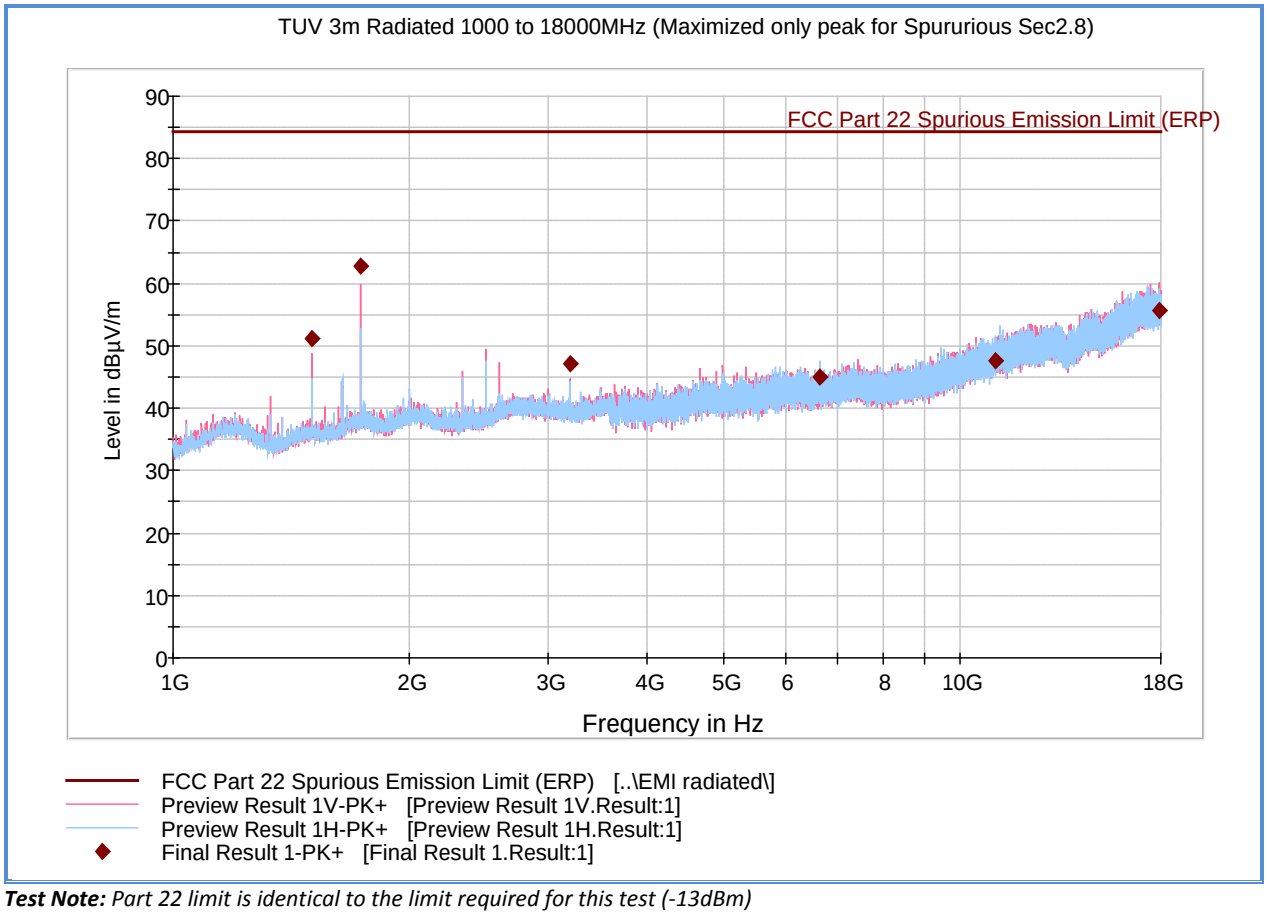
Frequency (MHz)	MaxPeak-MaxHold (dBµV/m)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin - PK+ (dB)	Limit - PK+ (dBµV/m)
1500.140000	51.3	99.8	H	359.0	-5.1	33.1	84.4
2443.800000	59.2	99.8	V	324.0	-0.3	25.2	84.4
3258.393333	59.3	144.8	V	264.0	1.4	25.1	84.4
5000.040000	52.9	159.7	V	3.0	5.4	31.5	84.4
11106.12000	47.9	99.8	H	73.0	14.6	36.5	84.4
17768.38000	54.4	123.8	H	88.0	22.2	30.0	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)	Margin

Test Notes: Worst case channel presented for spurious emissions above 1GHz in Band 26. Measurement was performed with a 900MHz High pass filter. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).

2.6.12 Test Results Above 1GHz (Worst Case Configuration BC 10)



Test Note: *Part 22 limit is identical to the limit required for this test (-13dBm)*

Peak Data

Frequency (MHz)	MaxPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Height (cm)	Polarization	Azimuth (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
1499.980000	51.2	1000.0	1000.000	111.9	V	132.0	-5.1	33.2	84.4
1731.013333	62.7	1000.0	1000.000	111.9	V	129.0	-3.1	21.7	84.4
3200.020000	47.1	1000.0	1000.000	147.8	V	72.0	1.4	37.3	84.4
6626.340000	45.1	1000.0	1000.000	101.9	H	196.0	8.1	39.3	84.4
11116.393333	47.7	1000.0	1000.000	146.8	H	248.0	14.6	36.7	84.4
17936.993333	55.7	1000.0	1000.000	151.1	V	193.0	22.5	28.6	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)	Margin

Test Notes: Worst case channel presented for spurious emissions above 1GHz in BC 10. Measurement was performed with a 900MHz High pass filter. Substitution data not required since margin is >20dB compared to the -13dBm limit (converted to field strength @ 3 meters).

2.7 FREQUENCY STABILITY

2.7.1 Specification Reference

Part 2.1055(a)(1) and Part 90.213

2.7.2 Standard Applicable

(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following table.

MINIMUM FREQUENCY STABILITY (PPM)

Frequency range (MHz)	Mobile stations	
	Over 2 watts output power	2 watts or less output power
809-824	2.5	2.5

2.7.3 Equipment Under Test and Modification State

Serial No: Engineering Sample / Test Configuration A

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

Testing taken from Part 22 and 24 report of NVTLT0047-01 the conclusion reached is that testing of BC1 and BC0 showed no variation with Frequency stability therefore neither would BC10. This also demonstrates the compliance of LTE band 26 was also confirmed in the Part 22 adn 24 report.

This represents worst case evaluation of the CDMA and LTE transmitters.

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	23.4°C
Relative Humidity	37.4%
ATM Pressure	100 kPa

2.7.7 Additional Observations

- The carrier frequency shall not depart from the reference frequency in excess of ±2.5 ppm for mobile stations.
- The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block .

- EUT was operated at +3.7VDC using the battery eliminator unit for testing and was placed in the temperature chamber for this evaluation.
- To determine worst case configuration for this test, the worst case test results of the conducted band edge were used (refer to Section 4.4).
- Communication Test Set used to collect Frequency Error results.
- Measurement Analysis (EVM) Function set

2.7.8 Test Results Summary

1xRTT CELL Band (BC0) - Ch. 777/RC3/SO32				
Voltage	Voltage	Temperature	Frequency Deviation	Limit
(%)	(Vdc)	(ºC)	(Hz)	(ppm)
100	3.7	-30	-4.3	±2.5
100		-20	-5.6	±2.5
100		-10	-6.2	±2.5
100		0	1.3	±2.5
100		10	2.3	±2.5
100		20	-4.8	±2.5
100		30	-5.3	±2.5
100		40	-6.6	±2.5
100		50	-7.5	±2.5
115	4.2	20	3.3	±2.5
85	3.1	20	3.1	±2.5

1xEvDO CELL Band (BC0) - Ch. 777/RTAP/153.6Kbps				
Voltage	Voltage	Temperature	Frequency Deviation	Limit
(%)	(Vdc)	(ºC)	(Hz)	(ppm)
100	3.7	-30	-6.5	±2.5
100		-20	-4.8	±2.5
100		-10	-5.7	±2.5
100		0	1.5	±2.5
100		10	2.0	±2.5
100		20	-4.5	±2.5
100		30	-5.8	±2.5
100		40	-6.6	±2.5
100		50	-3.3	±2.5
115	4.2	20	4.0	±2.5
85	3.1	20	2.9	±2.5

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
Radiated Test Setup						
1002	Bilog Antenna	3142C	000058717	EMCO	01/21/13	01/21/14
7575	Double-ridged waveguide horn antenna	3117	00155511	EMCO	03/25/13	03/25/14
8628	Pre-amplifier	QLJ 01182835-JO	8986002	QuinStar Technologies Inc.	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	08/10/12	08/10/13
1049	EMI Test Receiver	ESU	100133	Rhode & Schwarz	06/13/12	06/13/13
1016	Pre-amplifier	PAM-0202	187	PAM	09/24/12	09/24/13
6815	2.4GHz Band Notch Filter	BRM50702	008	Micro-Tronics	Verified by 1040	
7571	Wideband Radio Communication Tester	CMW 500	1201.0002k50/ 103829	Rhode & Schwarz	Verified 04/04/13	
Miscellaneous						
7560	Barometer/Temperature /Humidity Transmitter	iBTHX-W	1240476	Omega	08/12/12	08/12/13
6452	Multimeter	3478A	2911A52177	Hewlett Packard	07/16/12	07/16/13
	Test Software	EMC32	V8.52	Rhode & Schwarz	N/A	
1003	Signal Generator	SMR-40	1104.0002.40	Rhode & Schwarz	11/12/12	11/12/13
Conducted Port Setup						
7569	Series Power Meter	N1911A P-	MY45100625	Agilent	04/15/13	04/15/14
5217 (loaner from Techmaster)	50MHz-18GHz Wideband Power Sensor	N1921A	MY45240180	Agilent	10/18/12	02/18/14
7571	Wideband Radio Communication Tester	CMW 500	1201.0002k50/1 03829	Rhode & Schwarz	Signalling purpose only	
6814	PSA Series Spectrum Analyzer	E4440A	MY42510441	Agilent	11/07/12	11/07/13
	20dB Attenuator	34-20-34	BP4180	MCE/Weinschel	Verified by 6814 and 1003	
8686	20dB Attenuator	0846	BW-N20W5+	MCL	Verified by 6814 and 1003	

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

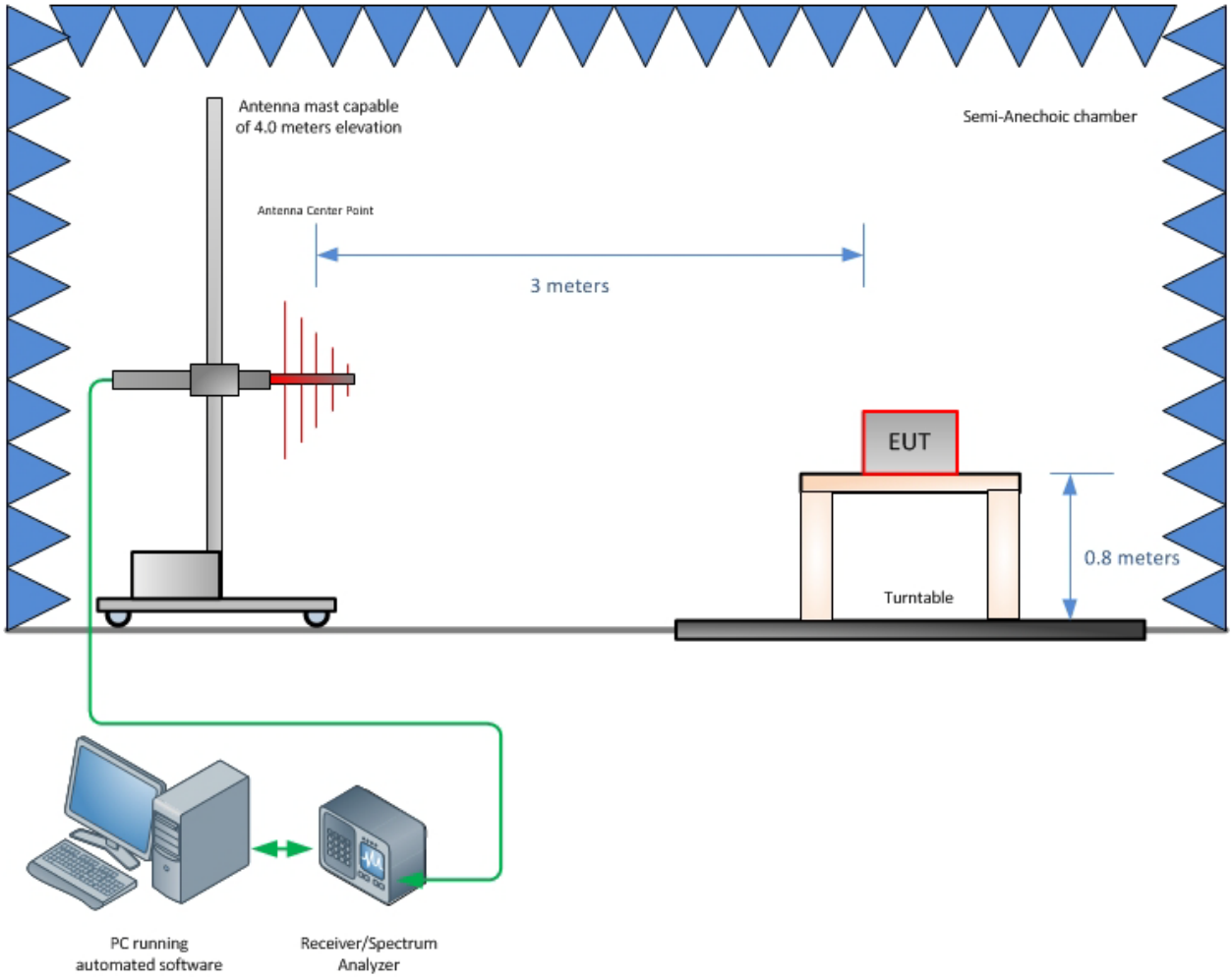
3.2.3 Conducted Antenna Port Measurement

	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)

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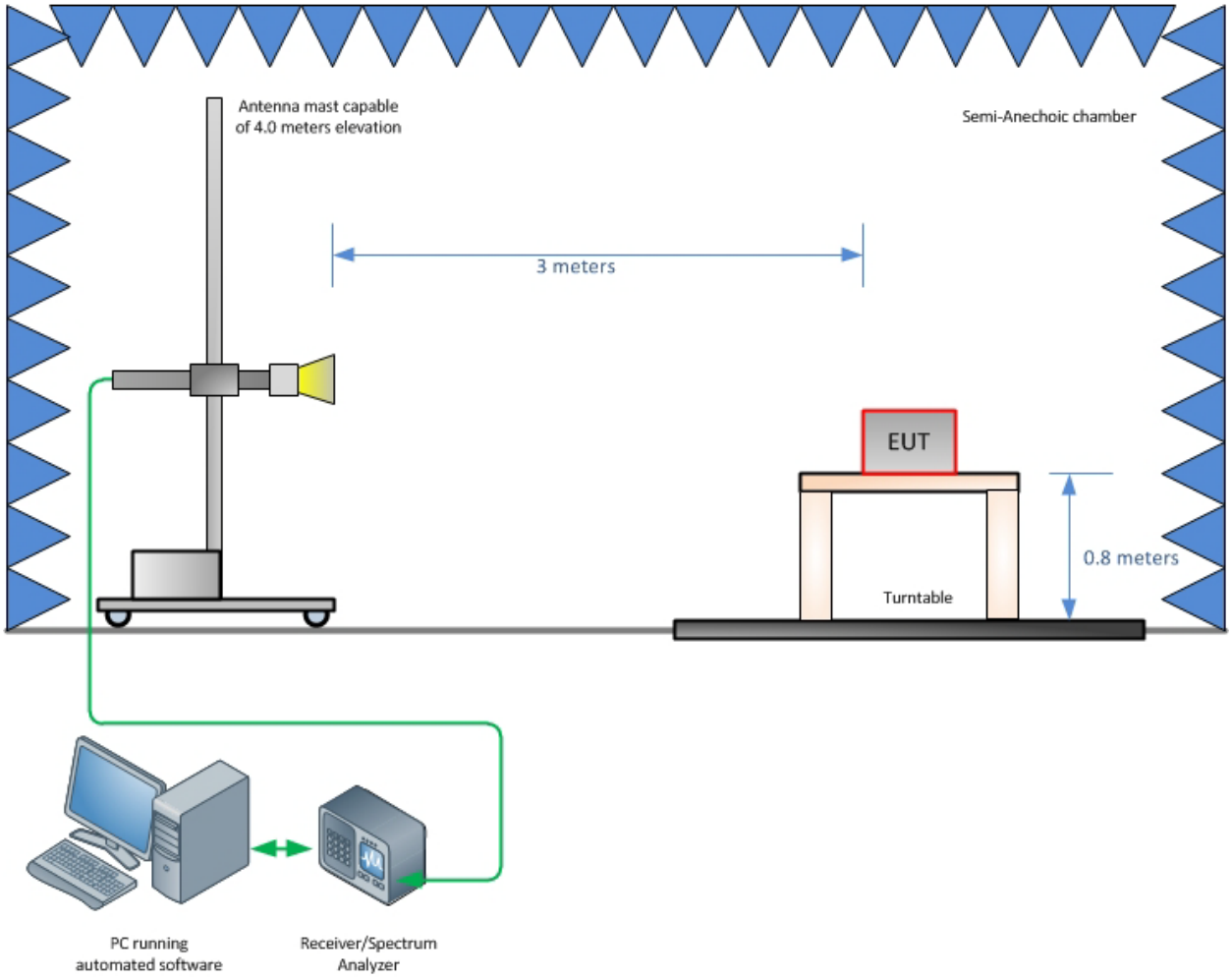
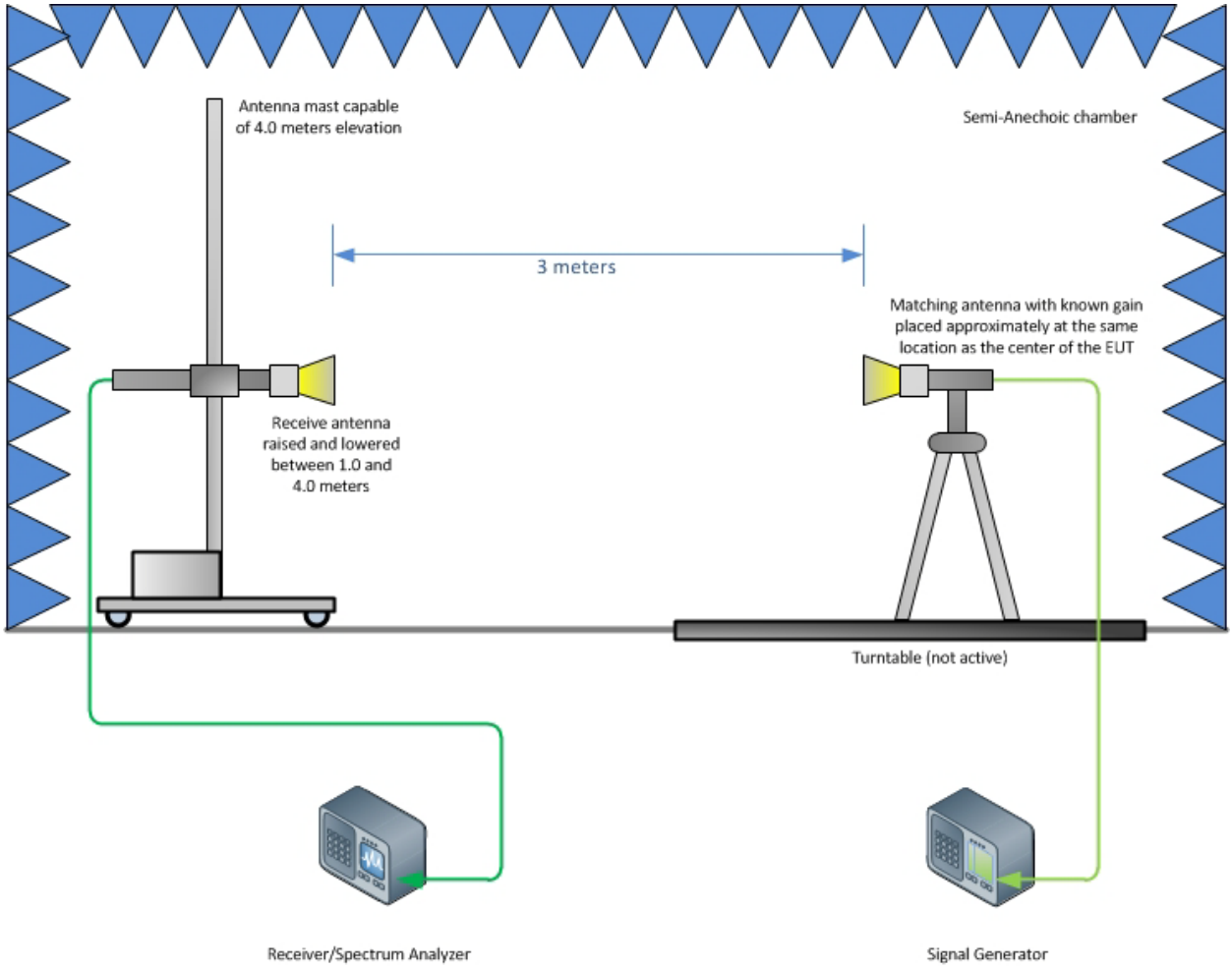
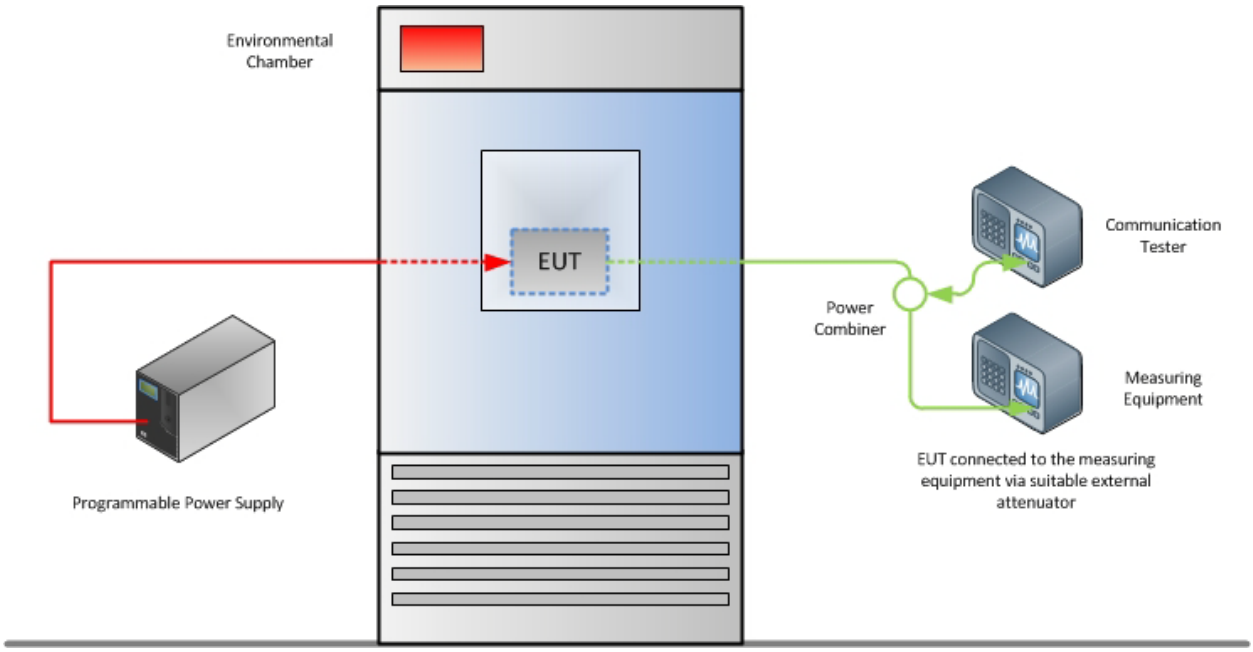


Radiated Emission Test Setup (Above 1GHz)



Substitution Test Method (Above 1GHz)



Frequency Stability Test Comfiguration

SECTION 5

ACCREDITATION, DISCLAIMERS AND COPYRIGHT

5.1 ACCREDITATION, DISCLAIMERS AND COPYRIGHT

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