

# ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LICENSED TRANSMITTER

**Test Report No.** : E124R-057

**AGR No.** : A122A-154

**Applicant** : SOLiD, Inc.  
**Address** : 10,9th Floor, SOLiD Space, Pangyoyeok-ro 220, Bundang-gu, Seongnam-si,  
Gyeonggi-do, 463-400, Korea

**Manufacturer** : SOLiD, Inc.  
**Address** : 10,9th Floor, SOLiD Space, Pangyoyeok-ro 220, Bundang-gu, Seongnam-si,  
Gyeonggi-do, 463-400, Korea

**Type of Equipment** : RDU MODULE (1900PCS)

**FCC ID.** : W6UH1900P

**Model Name** : 1900PCS RDU44.5

**Serial number** : N/A

**Total page of Report** : 93 pages (including this page)

**Date of Incoming** : February 06, 2012

**Date of issue** : April 24, 2012

## SUMMARY

The equipment complies with the regulation; **FCC Part 24 Subpart E.**


This test report only contains the result of a single test of the sample supplied for the examination.

It is not a generally valid assessment of the features of the respective products of the mass-production.

Prepared by:

  
Ki-Hong, Nam / Senior Engineer  
ONETECH Corp.

Reviewed by:

  
Y. K. Kwon / Exe. Managing Director  
ONETECH Corp.

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### Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
E124R-057	April 24, 2012	Initial Issue	All

## 1. VERIFICATION OF COMPLIANCE

**APPLICANT** : SOLiD, Inc.  
**ADDRESS** : 10,9th Floor, SOLiD Space, Pangyoyeok-ro 220, Bundang-gu, Seongnam-si, Gyeonggi-do,  
 463-400, Korea  
**CONTACT PERSON** : Mr. Kangyeob, Bae / Director  
**TELEPHONE NO** : +82-31-627-6292  
**FCC ID** : W6UH1900P  
**MODEL NAME** : 1900PCS RDU44.5  
**SERIAL NUMBER** : N/A  
**DATE** : April 24, 2012

EQUIPMENT CLASS	PCB - PCS Licensed Transmitter
EQUIPMENT DESCRIPTION	RDU MODULE (1900PCS)
THIS REPORT CONCERNS	Original Grant
MEASUREMENT PROCEDURES	ANSI C63.4: 2009, EIA/TIA-603-C
TYPE OF EQUIPMENT TESTED	Pre-Production
KIND OF EQUIPMENT AUTHORIZATION REQUESTED	Certification
EQUIPMENT WILL BE OPERATED UNDER FCC RULES PART(S)	FCC Part 24 Subpart E
MODIFICATIONS ON THE EQUIPMENT TO ACHIEVE COMPLIANCE	No
FINAL TEST WAS CONDUCTED ON	3 m open area test site

-. The above equipment was tested by ONETECH Corp. for compliance with the requirement set forth in the FCC Rules and Regulations. This said equipment in the configuration described in this report, shows the maximum emission levels emanating from equipment are within the compliance requirements.

## 2. TEST SUMMARY

### 2.1 Test items and results

SECTION	TEST ITEMS	RESULTS
2.1046(a), 24.232	RF Power Output at Antenna Terminals	Met the Limit / PASS
2.1047	Modulation Characteristics	PASS (See Note 1)
2.1049, 24.238	Occupied Bandwidth, Bandwidth Limitation	Met the Limit / PASS
2.1049	Band Edge	Met the Limit / PASS
2.1051, 24.238(a)	Spurious Emissions at Antenna Terminals	Met the Limit / PASS
2.1053, 24.238(a)	Field strength of Spurious Radiation	Met the Limit / PASS
2.1055, 24.235	Frequency Stability with Temperature variation	Met the requirement / PASS
2.1055, 24.235	Frequency stability with primary voltage variation	Met the requirement / PASS
1.1307(b)	RF Safety	PASS (See Note 2)

Note 1: The Equipment under Test (EUT) is a repeater which reproduces the modulated input signal, so the EUT meets the requirement

Note2: End users and/or installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance, because the applicant does not provide an antenna for sale with the EUT.

### 2.2 Additions, deviations, exclusions from standards

No additions, deviations or exclusions have been made from standard.

### 2.3 Related Submittal(s) / Grant(s)

Original Grant

### 2.4 Purpose of the test

To determine whether the equipment under test fulfills the requirements of the regulation stated in section 2.1.

### 2.5 Test Methodology

Radiated testing was performed according to the procedures in ANSI C63.4: 2009 & EIA/TIA-603-C: 2004 and was performed at a distance of 3 m from EUT to the antenna.

### 2.6 Test Facility

The open area test site and conducted measurement facilities are located on at 301-14, Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do, 464-862, Korea. The Onetech Corp. has been accredited as a Conformity Assessment Body (CAB) with designation number KR0013.

### 3. GENERAL INFORMATION

#### 3.1 Product Description

The SOLiD, Inc., Models 1900PCS RDU44.5 (referred to as the EUT in this report) is RDU MODULE (1900PCS) has function for transmitting of GSM and EDGE, CDMA, 1xEVDO, WCDMA, LTE signal. And the device shall be plugged in HROU (High power Remote Optic Unit) or HMRU (High power Main Remote Unit).

ROU or HMRU devices are varied for each frequency band, including the following:

No	Unit naming	Description	Frequency	
			TX	RX
1	1900PCS RDU44.5	Single band	1 930-1995 MHz	1 850-1 915 MHz
2	850CEL RDU44.5	Single band	869-894 MHz	824-849 MHz
3	700LTE RDU44.5	Single band	728-756 MHz	698-716 MHz 777-787 MHz
4	AWS-1 RDU44.5	Single band	2 110-2155 MHz	1 710-1 755 MHz
5	700PS RDU44.5	Single band	758-775 MHz	788-805 MHz
6	800I/PS RDU44.5	Single band	851-869 MHz	806-824 MHz
7	900I RDU44.5	Single band	929-941 MHz	896-902 MHz

When receiving TX signals from each band through Remote Optic, RDU filters the signals and amplifies them with High Power Amplifier. The unit also filters RX signals given through cavity filter and amplifies them to send the signals to Remote Optic. In the unit, there is ATT to adjust gain. RDU consist of RFU, PAU and cavity duplexer and all modules are merged with one package. The product specification described herein was obtained from product data sheet or user's manual.

DEVICE TYPE	RDU MODULE (1900PCS)
LIST OF EACH OSC. or CRY. FREQ.(FREQ. >= 1 MHz)	14.745 6 MHz, 8 MHz
EMISSION DESIGNATOR	F9W(CDMA, EVDO, WCDMA), G7W(GSM, EDGE), D7W(LTE)
OPERATING FREQUENCY	1 930 MHz ~ 1 995 MHz
CHANNEL SEPARATION	GSM(200 kHz), EDGE(200 kHz), CDMA(1.25 MHz), EVDO(1.25 MHz), WCDMA(5 MHz), LTE(5 MHz)
RF OUTPUT POWER	44.5 dBm
DC VOLTAGE & CURRENT INTO FINAL AMPLIFIER	28 V, 12 A
ELECTRICAL RATING	AC 120 V
OPERATING TEMPERATURE	-10 °C ~ 50 °C

#### 3.2 Alternative type(s)/model(s); also covered by this test report.

-. None

### 3.3 Peripheral equipment

Defined as equipment needed for correct operation of the EUT, but not considered as tested:

Model	Manufacturer	FCC ID	Description	Connected to
1900PCS RDU44.5	SOLiD Technologies	W6UH1900P	RDU MODULE (1900PCS) (EUT)	Signal Generator
SMJ100A	Rohde & Schwarz	N/A	Vector Signal Generator	EUT

### 3.4 Mode of operation during the test

The EUT was received signal form signal generator and then each modulation was configured for maximum signal gain and bandwidth. The EUT was operated in a manner representative of the typical usage of the equipment. During all testing, system components were manipulated within the confines of typical usage to maximize each emission. The applicant does not supply antenna(s) with the system, so the dummy loads were connected to the RF output ports on the EUT for radiated spurious emission testing.

For the above testing, following frequencies per channel were selected for each modulation.

Modulation	Channel	Frequency	Modulation	Channel	Frequency
GSM/ EDGE	Low	1 930.20	CDMA/ 1xEVDO	Low	1 931.25
	Middle	1 962.60		Middle	1 967.50
	High	1 994.80		High	1 993.75
WCDMA	Low	1 932.40	LTE	Low	1 932.50
	Middle	1 962.40		Middle	1 962.50
	High	1 992.60		High	1 992.50

## 4. EUT MODIFICATIONS

-. None



## 5. RF POWER OUTPUT at ANTENNA TERMINAL

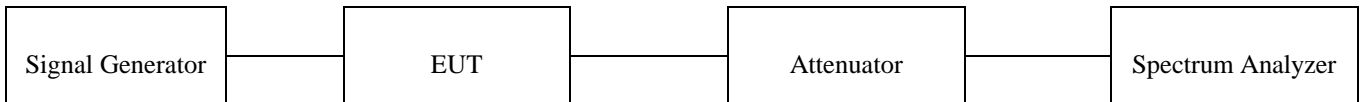
### 5.1 Operating environment

Temperature : 24 °C  
 Relative humidity : 48 %R.H.

### 5.2 Test set-up

The RF signal from the signal generator(s) was injected to the EUT and the amplified RF signal at the output of the EUT was connected to the spectrum analyzer. The test was performed at three frequencies (low, middle, and high channels) at each band using all applicable modulation.

RF output power was measured by channel power measurement function of the spectrum analyzer with rms detector mode.



### 5.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	E4432B	HP	Signal Generator	US38440950	June 10, 2011 (1Y)
■ -	SMJ100A	R/S	Signal Generator	101038	Feb. 02, 2012 (1Y)
■ -	FSP	R/S	Spectrum Analyzer	100017	Mar. 15, 2011 (1Y)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	Jun. 10, 2011 (1Y)
■ -	FSV30	R/S	Spectrum Analyzer	101372	Aug. 29, 2011 (1Y)
■ -	67-30-43	Aeroflex Weinschel	Power Attenuator	CA5760	Nov. 30, 2011 (1Y)

All test equipment used is calibrated on a regular basis.

**5.4 Test data**

- Test Date : February 23, 2012
- Measurement Function : Channel Power
- Detector Mode : RMS detector
- Test Result : Pass

Modulation	Channel	Frequency (MHz)	Input Power (dBm)	Output Power (dBm)	Output Power (W)	Limit (W)
GSM	Low	1 930.20	-9.80	44.50	28.183 829	100.00
	Middle	1 962.60	-9.80	44.50		
	High	1 994.80	-9.90	44.50		
EDGE	Low	1 930.20	-9.90	44.50	28.183 829	
	Middle	1 962.60	-9.90	44.50		
	High	1 994.80	-9.90	44.50		
CDMA	Low	1 931.25	-9.80	44.50	28.183 829	
	Middle	1 967.50	-9.90	44.50		
	High	1 993.75	-9.70	44.50		
1xEVDO	Low	1 931.25	-9.80	44.50	28.183 829	
	Middle	1 967.50	-9.70	44.50		
	High	1 993.75	-9.80	44.50		
WCDMA	Low	1 932.40	-9.90	44.50	28.183 829	
	Middle	1 962.40	-9.80	44.50		
	High	1 992.60	-9.80	44.50		
LTE	Low	1 932.50	-9.70	44.50	28.183 829	
	Middle	1 962.50	-9.80	44.50		
	High	1 992.50	-9.70	44.50		

Ki-Hong

**Tested by: Ki-Hong, Nam / Senior Engineer**

## 6. OCCUPIED BANDWIDTH

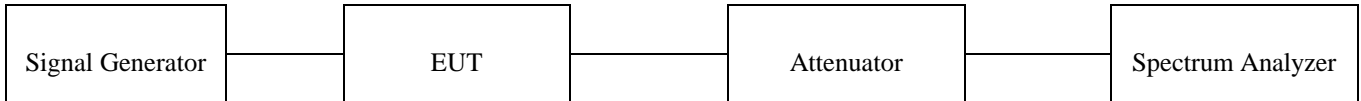
### 6.1 Operating environment

Temperature : 24 °C  
 Relative humidity : 48 %R.H.

### 6.2 Test set-up

The RF signal from the signal generator(s) was injected to the EUT and the amplified RF signal at the output of the EUT was connected to the spectrum analyzer. The test was performed at three frequencies (low, middle, and high channels) at each band using all applicable modulation.

For the testing, the RBW was set to 1 % to 3 % of the - 26 dB bandwidth. The VBW is set to 3 times the RBW and sweep time is coupled.



### 6.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	E4432B	HP	Signal Generator	US38440950	June 10, 2011 (1Y)
■ -	SMJ100A	R/S	Signal Generator	101038	Feb. 02, 2012 (1Y)
■ -	FSP	R/S	Spectrum Analyzer	100017	Mar. 15, 2011 (1Y)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	Jun. 10, 2011 (1Y)
■ -	FSV30	R/S	Spectrum Analyzer	101372	Aug. 29, 2011 (1Y)
■ -	67-30-43	Aeroflex Weinschel	Power Attenuator	CA5760	Nov. 30, 2011 (1Y)

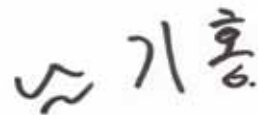
All test equipment used is calibrated on a regular basis.

**6.4 Test data**

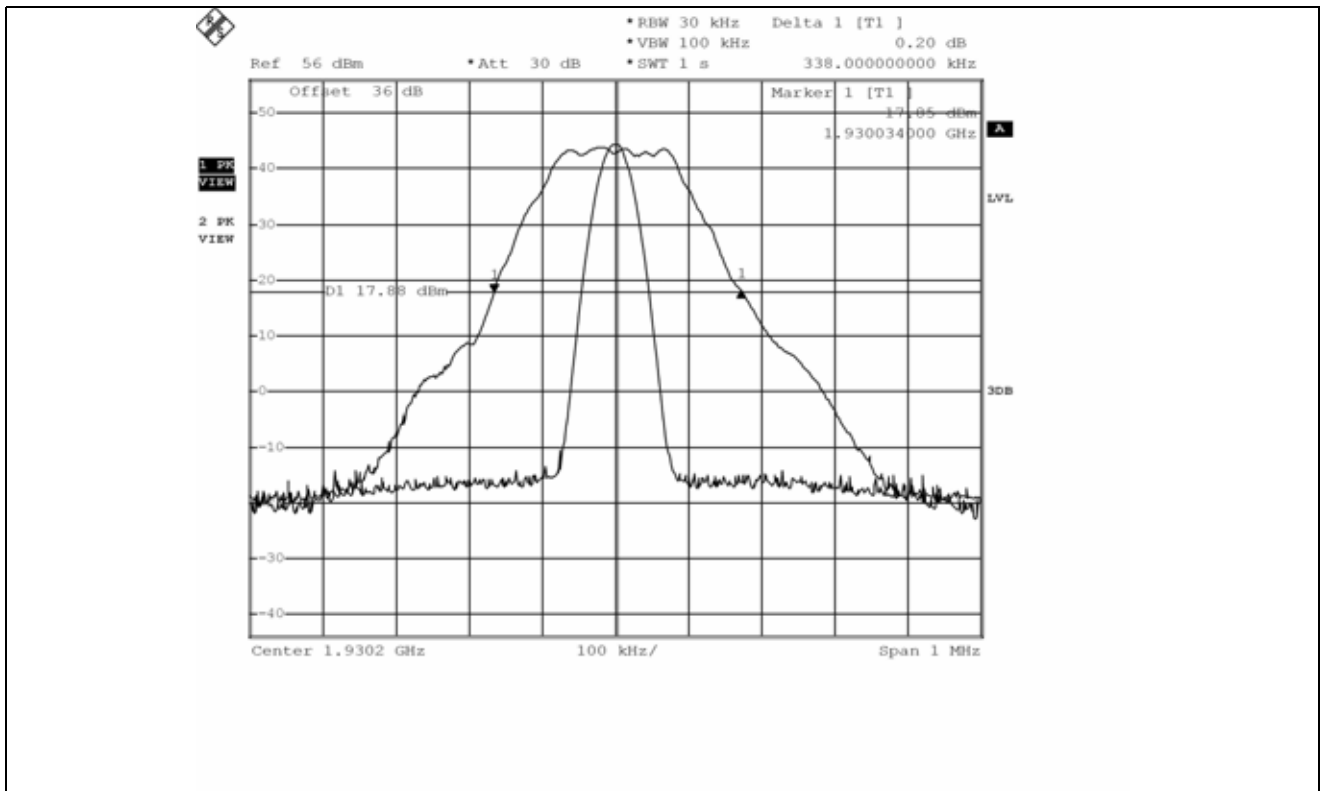
- Test Date : February 23, 2012
- Test Result : Pass

Modulation	Channel	26 dB Bandwidth (kHz)	99 % Occupied Bandwidth (kHz)
GSM	Low	338	248
	Middle	338	248
	High	338	248
EDGE	Low	324	252
	Middle	324	252
	High	324	252
CDMA	Low	1 520	1 320
	Middle	1 530	1 320
	High	1 520	1 320
1xEVDO	Low	1 520	1 320
	Middle	1 520	1 320
	High	1 530	1 330
WCDMA	Low	4 680	4 180
	Middle	4 680	4 180
	High	4 680	4 180
LTE	Low	5 000	4 520
	Middle	5 000	4 520
	High	5 000	4 520

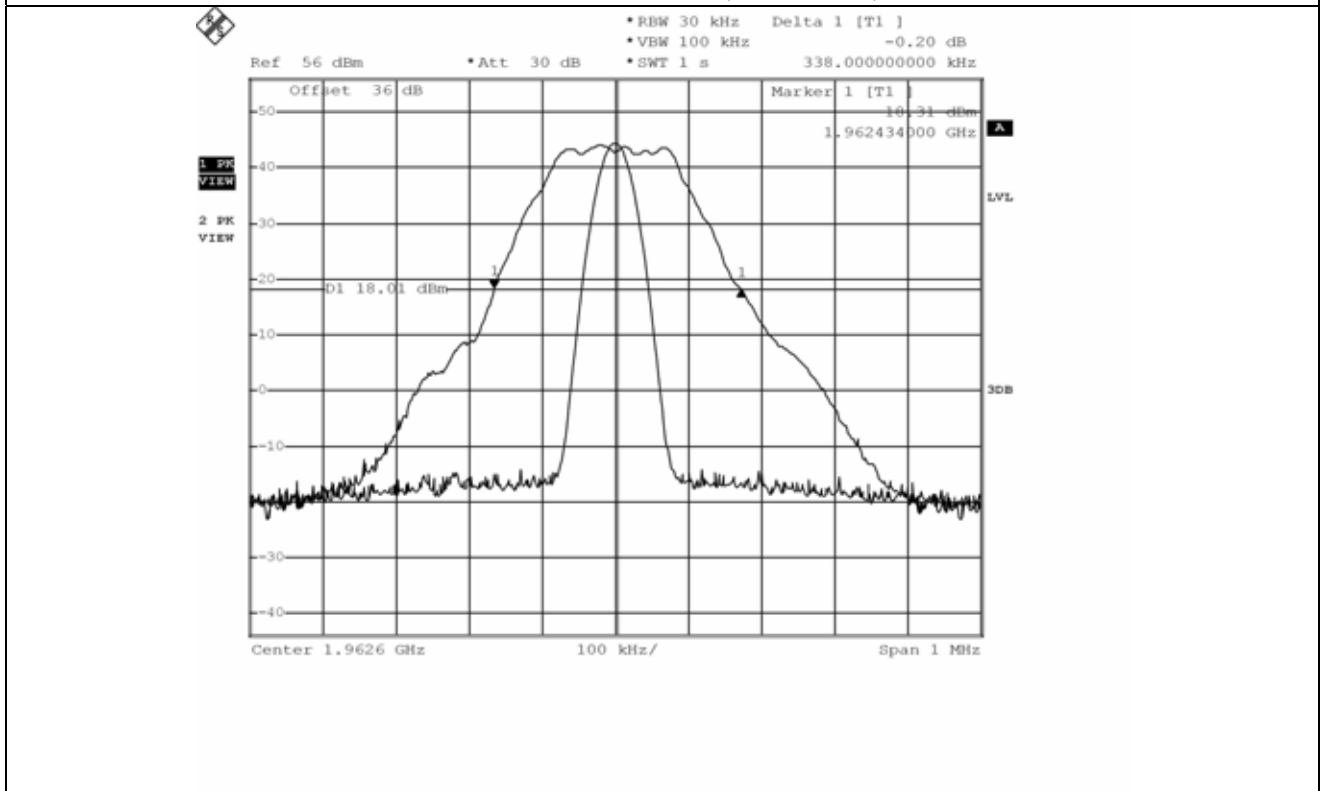
Remark: According to above result, the carrier frequency shall be within the frequency block edges.



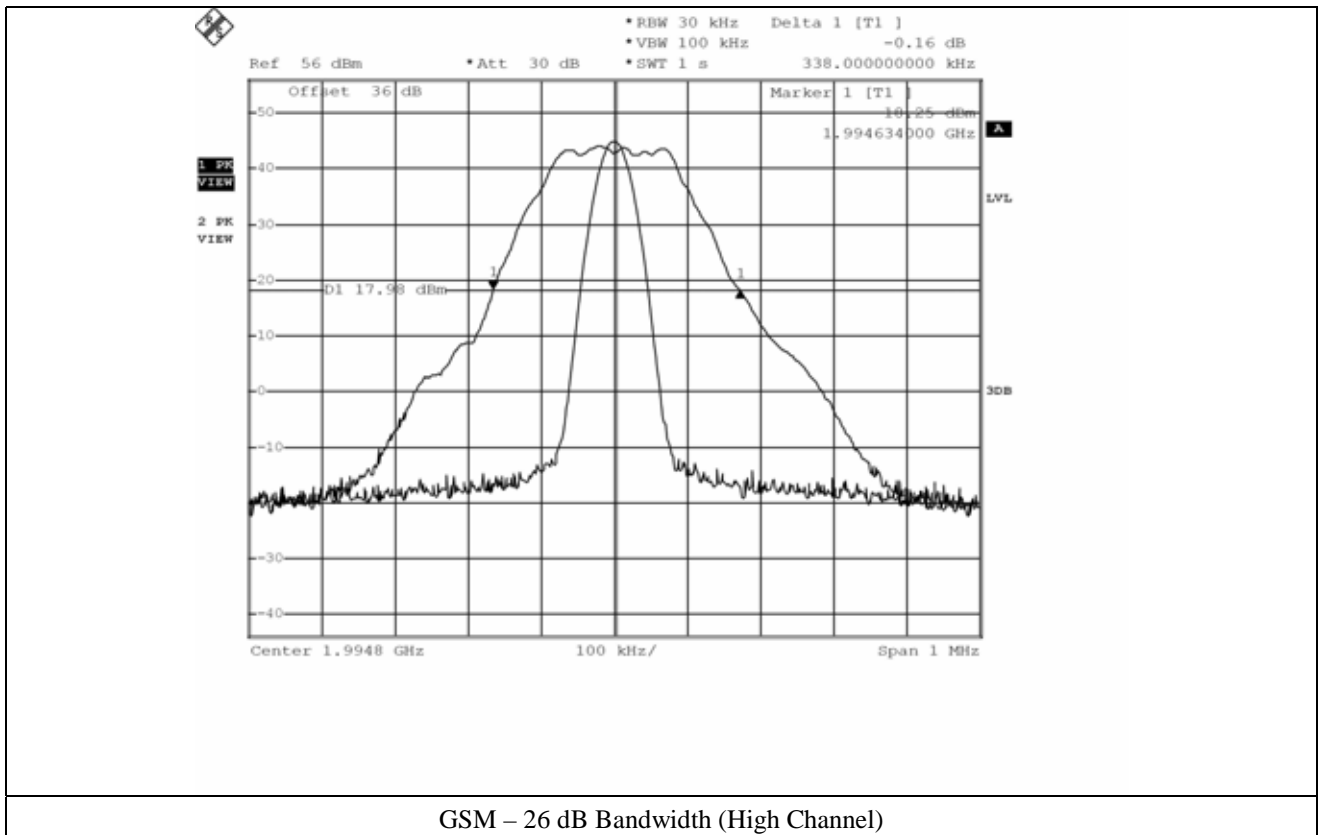
**Tested by: Ki-Hong, Nam / Senior Engineer**

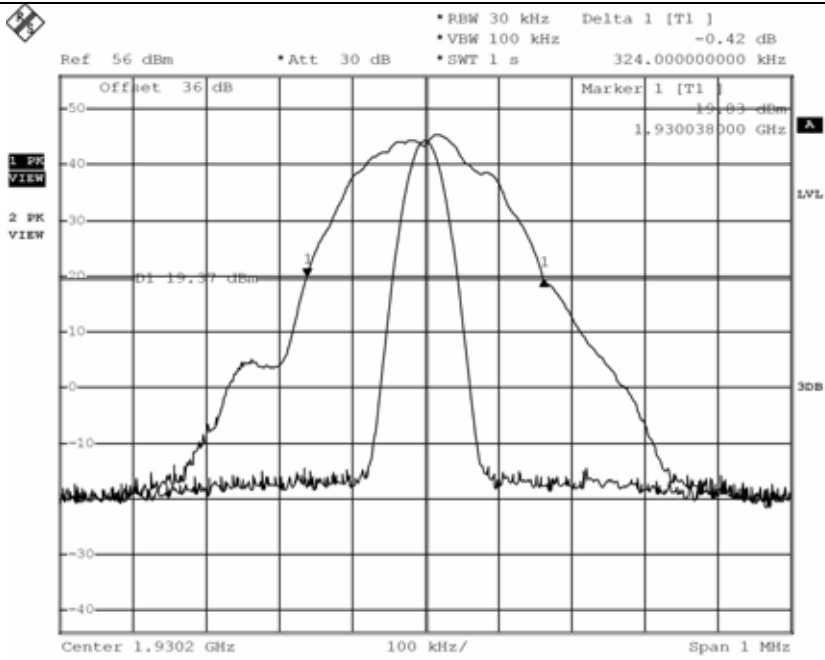


GSM – 26 dB Bandwidth (Low Channel)

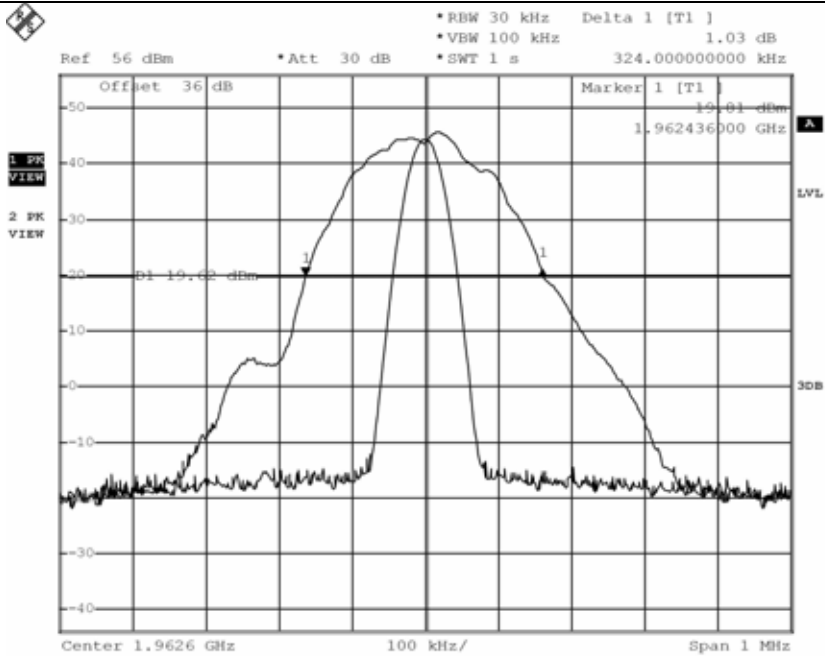


GSM – 26 dB Bandwidth (Middle Channel)

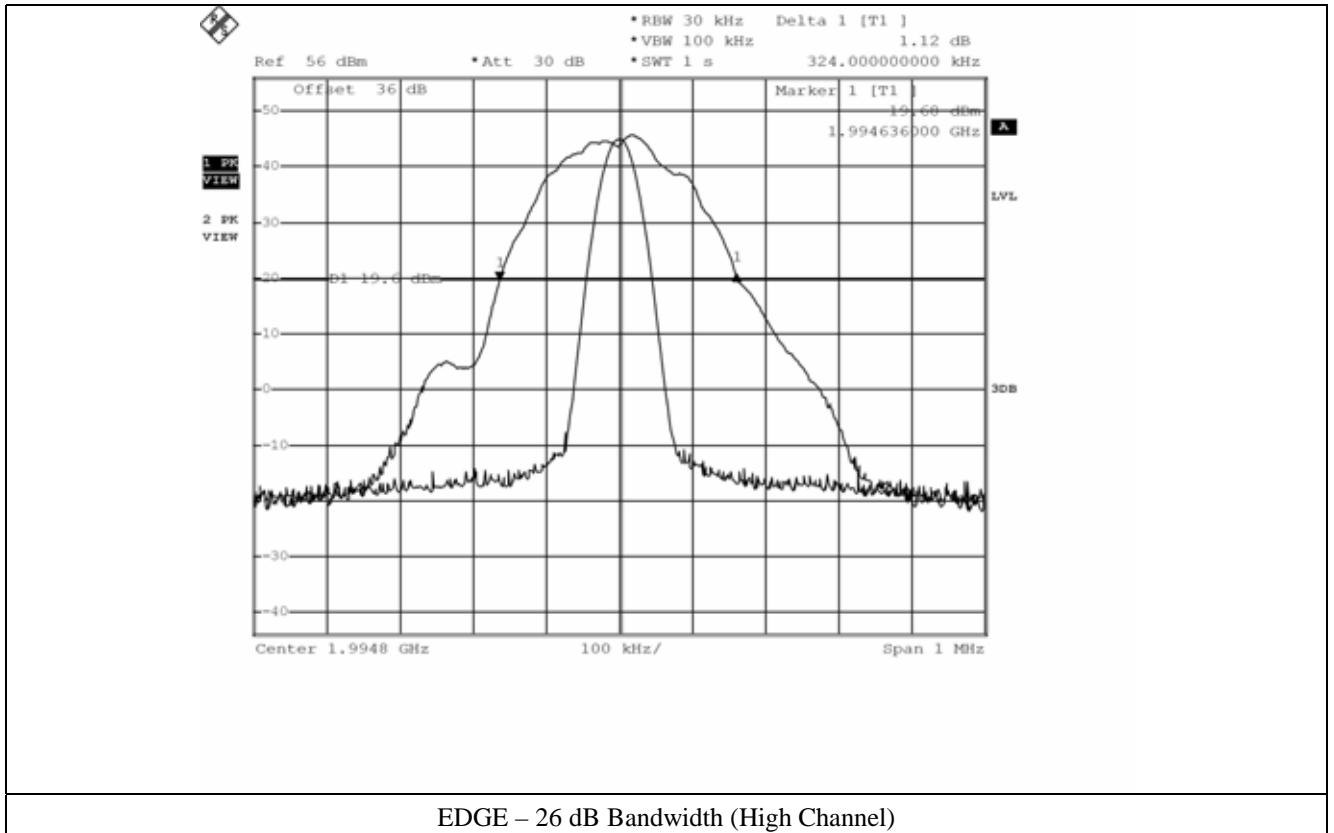




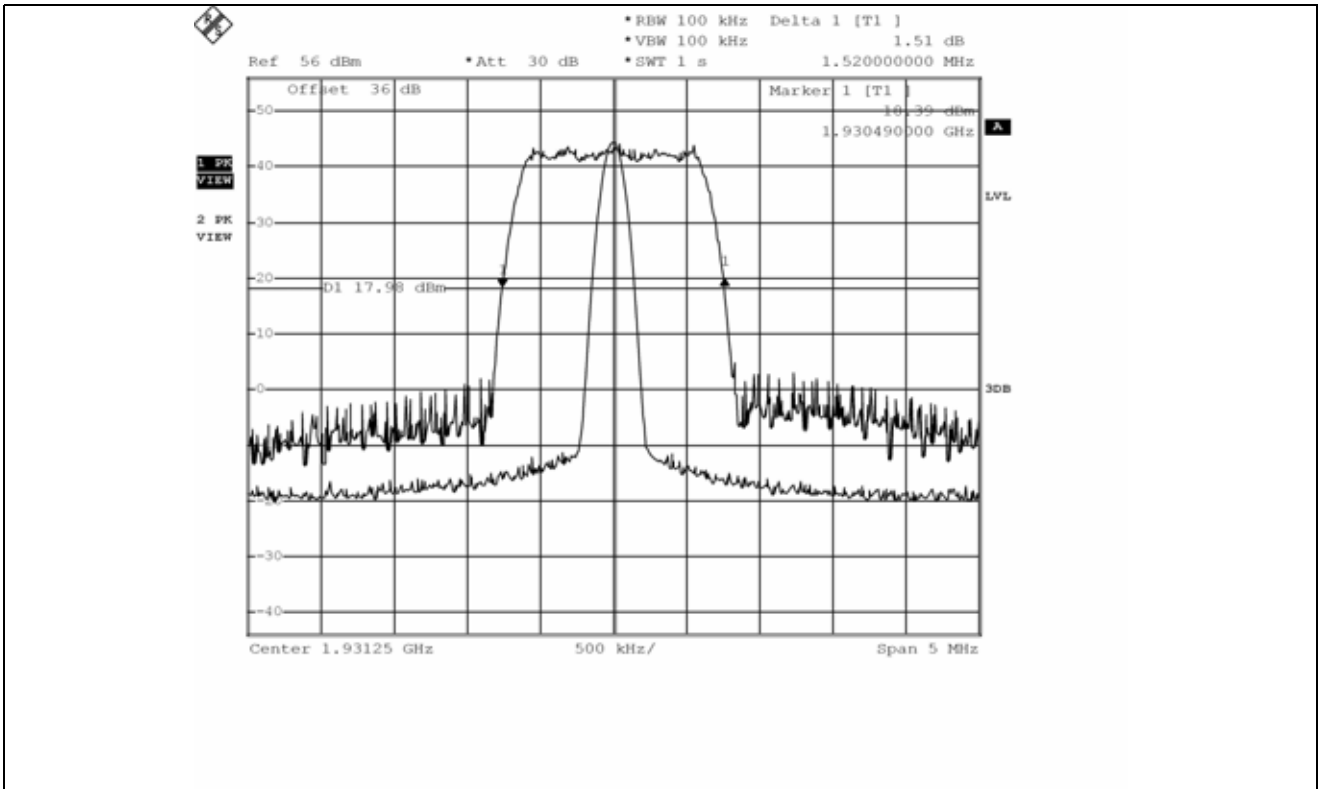
EDGE – 26 dB Bandwidth (Low Channel)



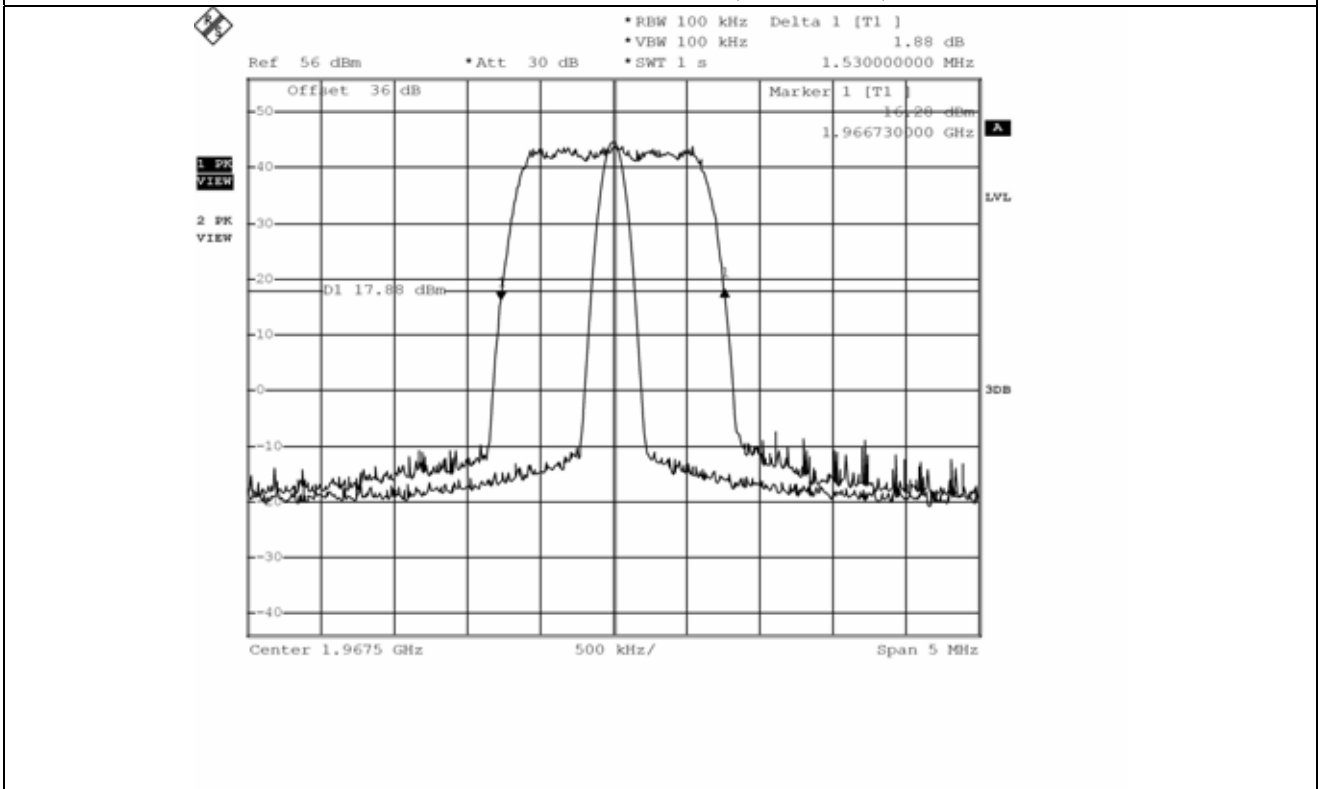
EDGE – 26 dB Bandwidth (Middle Channel)



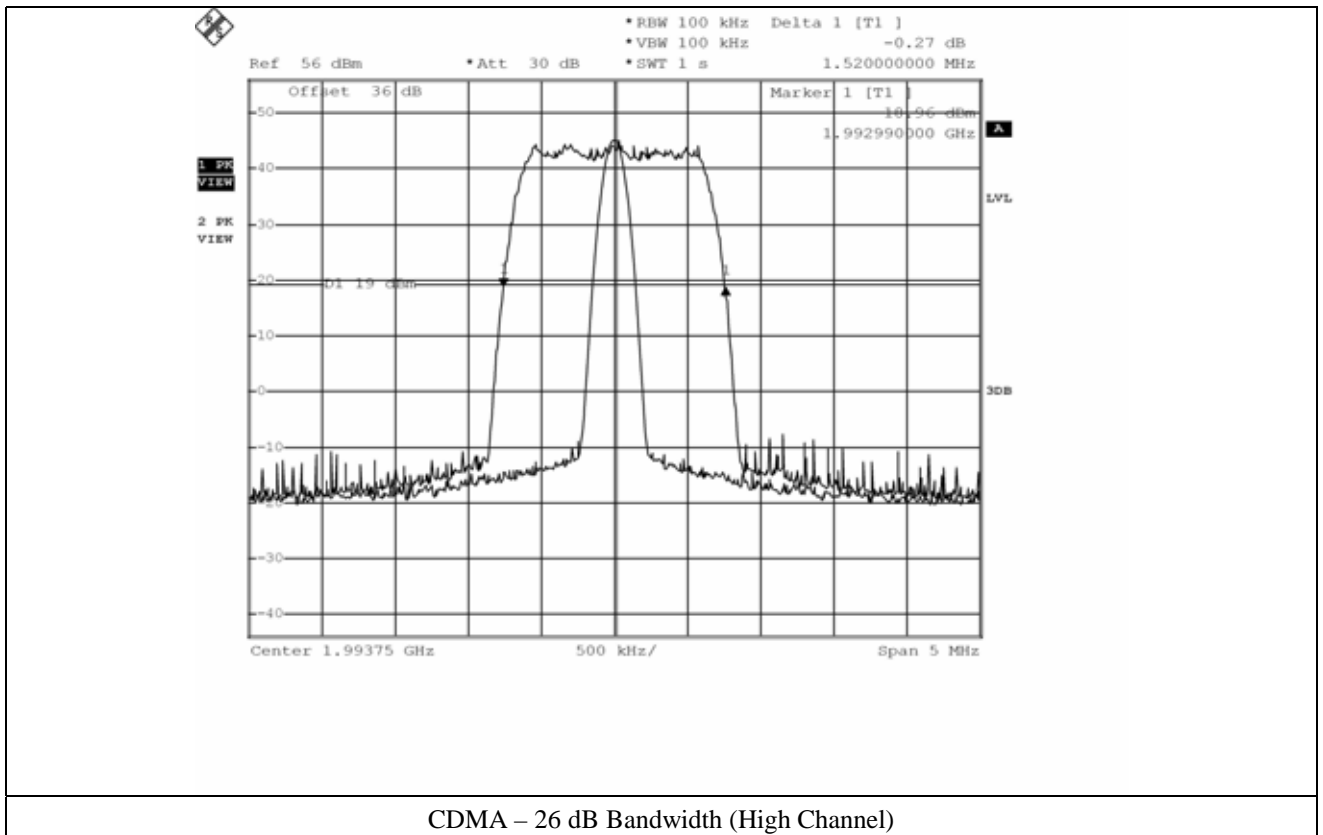


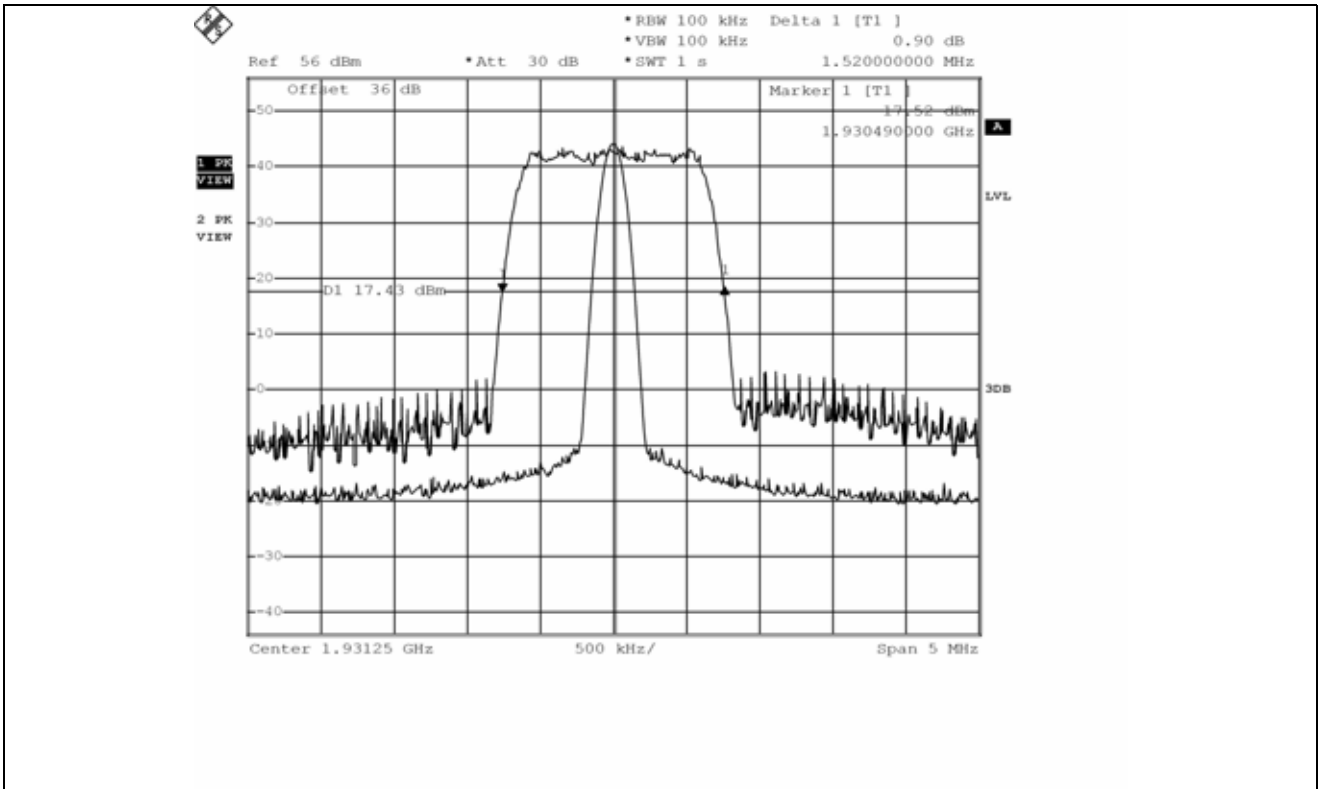


CDMA – 26 dB Bandwidth (Low Channel)

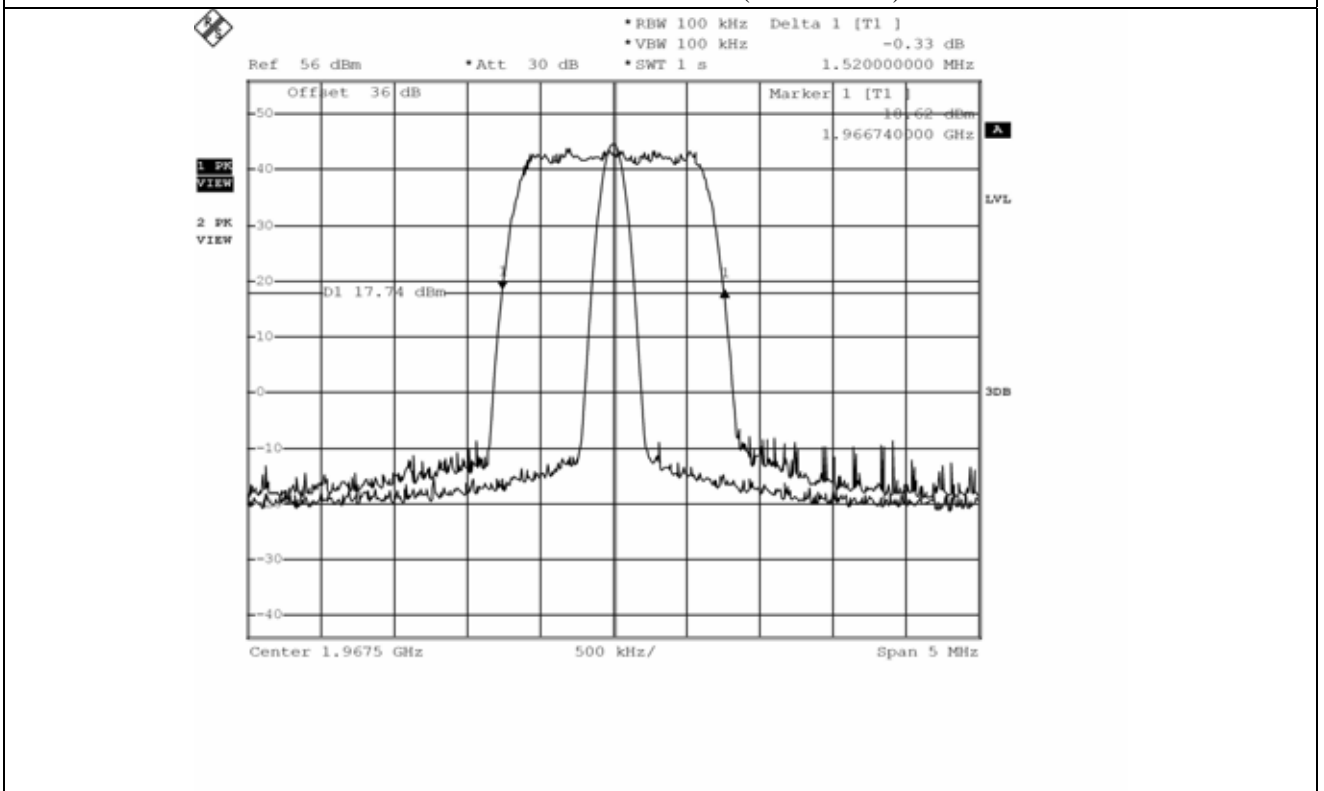


CDMA – 26 dB Bandwidth (Middle Channel)

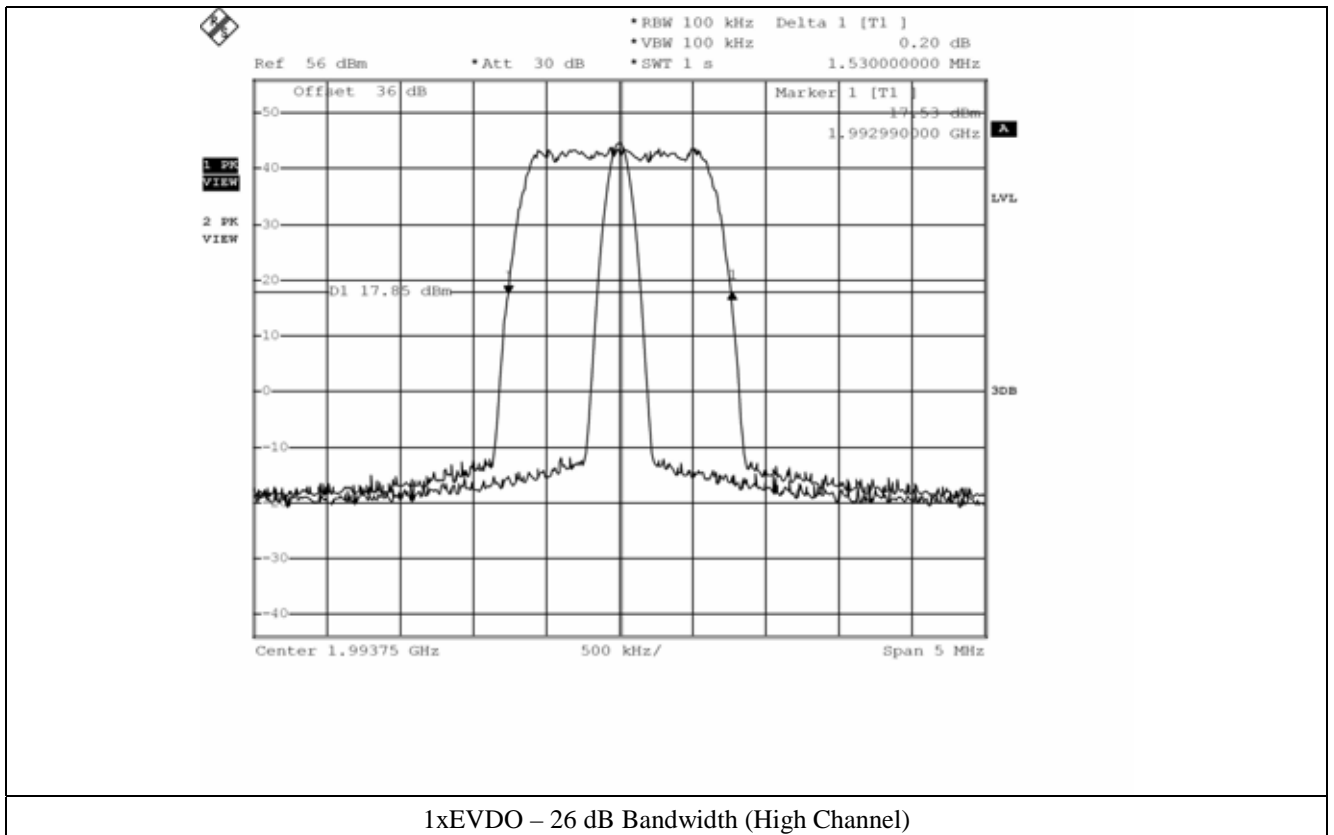


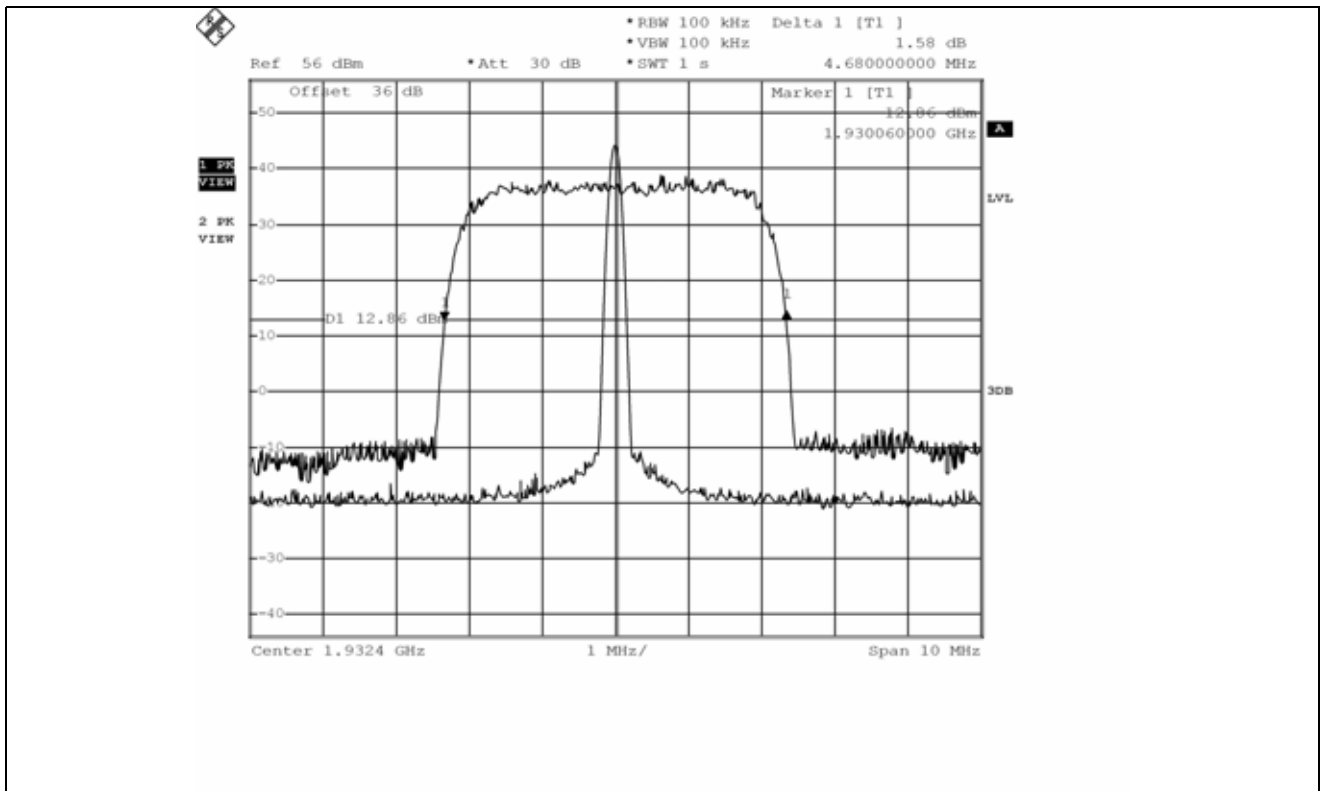


1xEVDO – 26 dB Bandwidth (Low Channel)

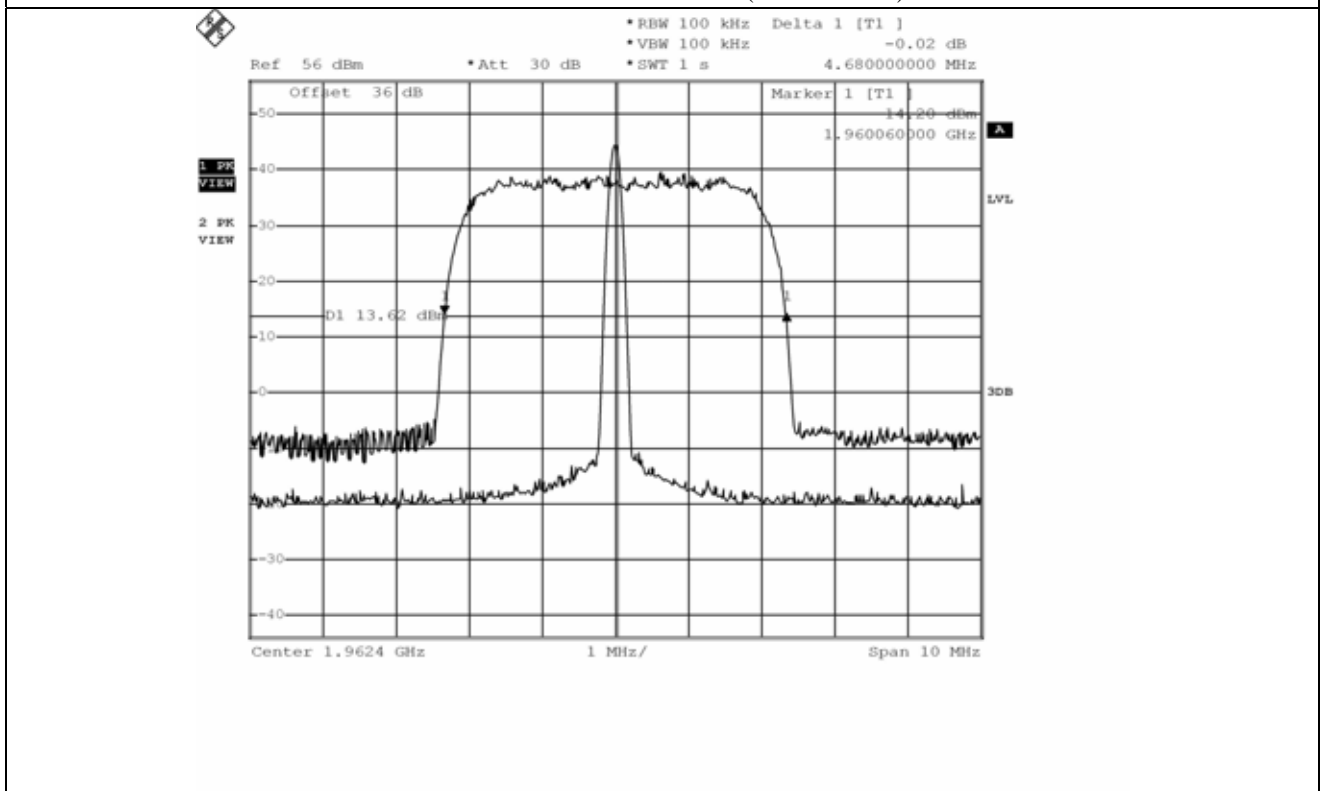


1xEVDO – 26 dB Bandwidth (Middle Channel)

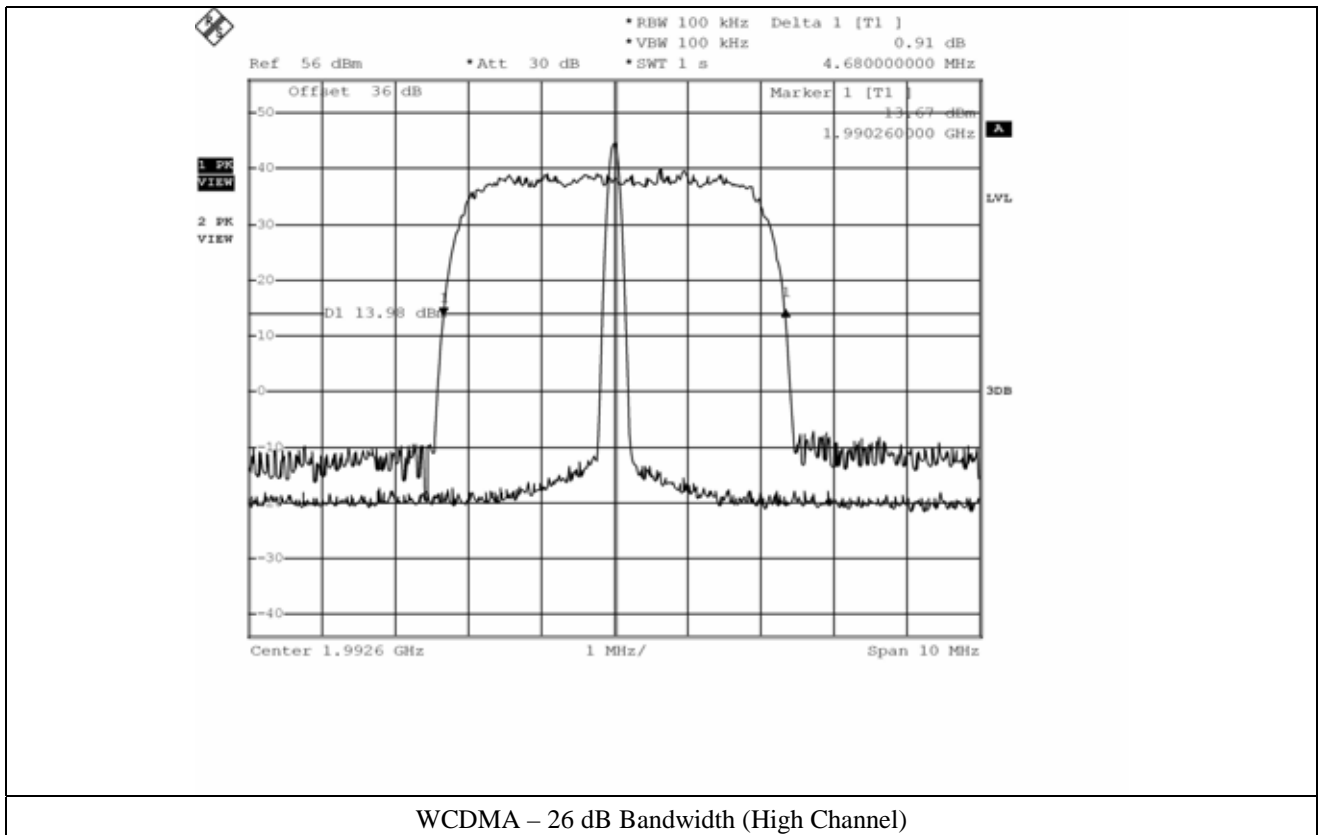


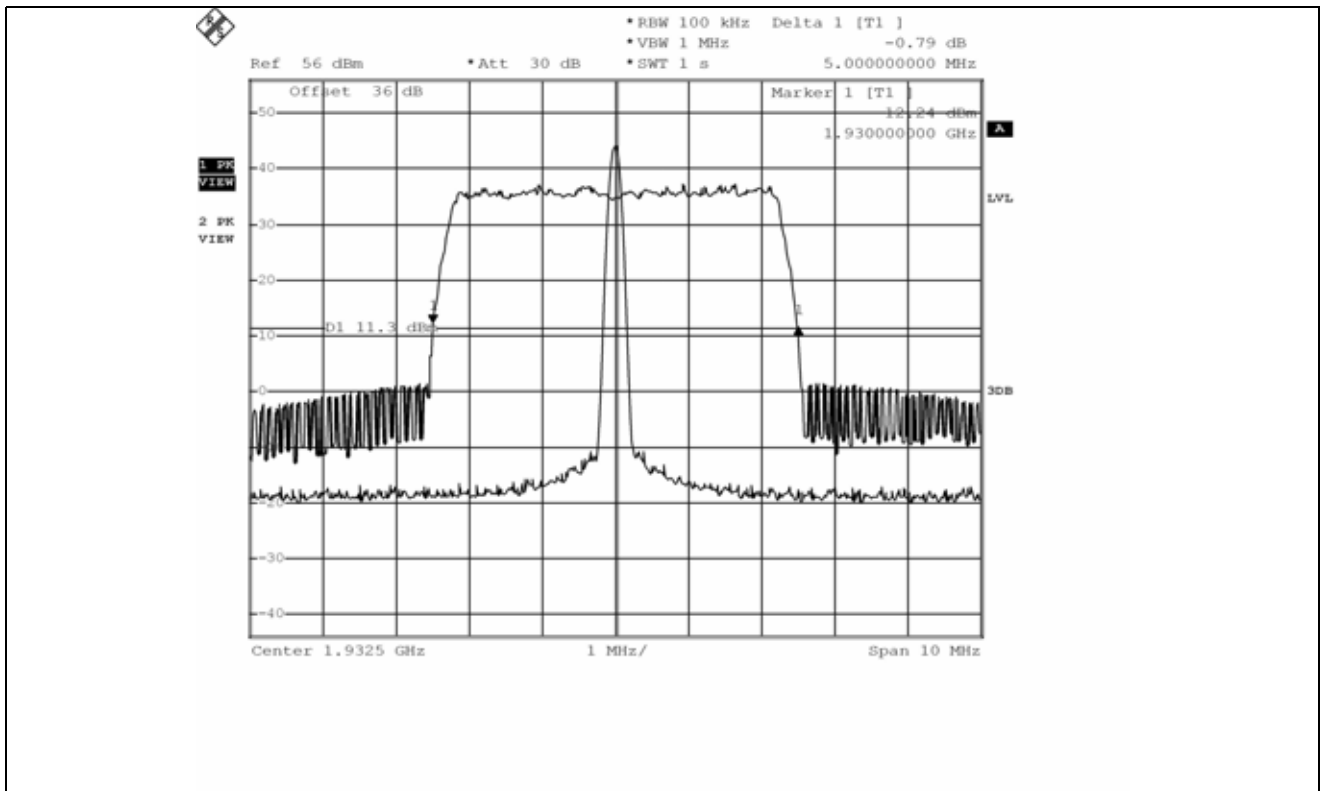


WCDMA – 26 dB Bandwidth (Low Channel)

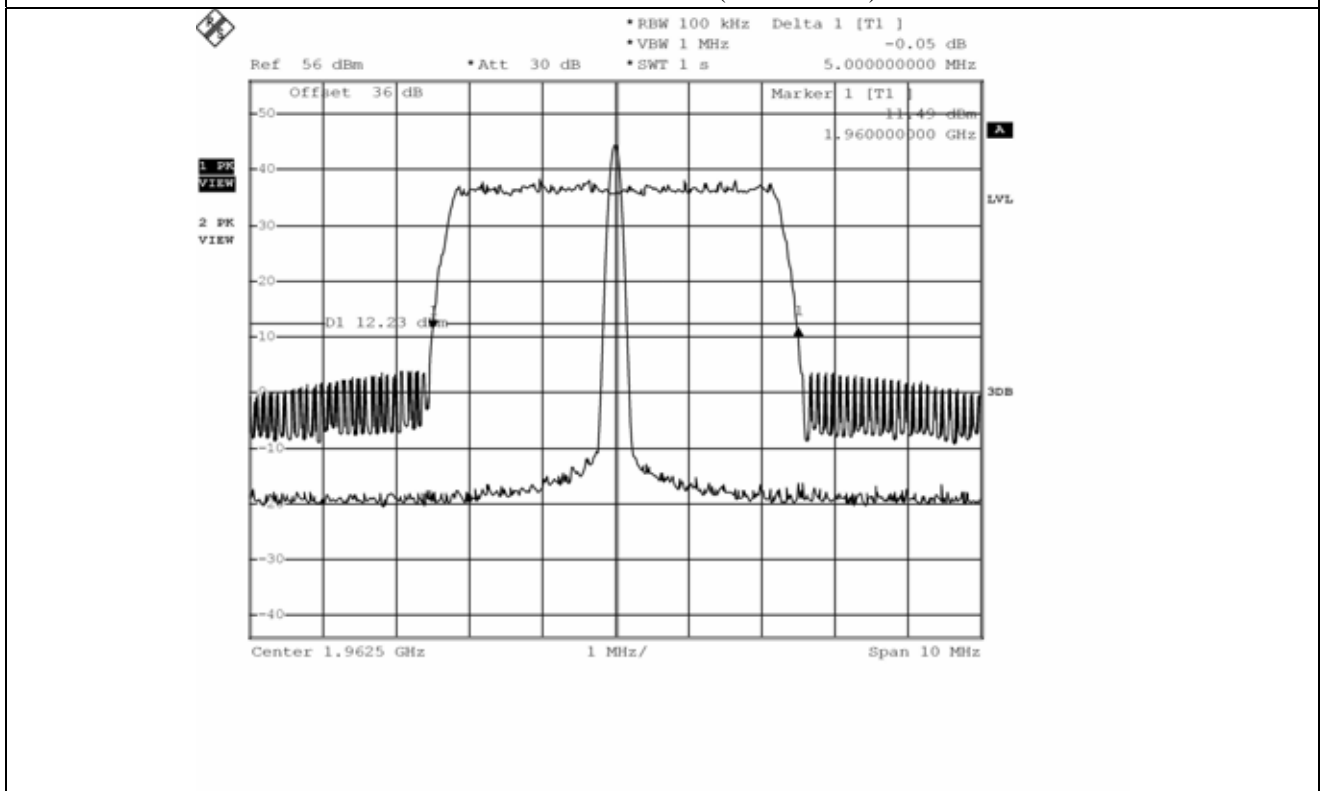


WCDMA – 26 dB Bandwidth (Middle Channel)

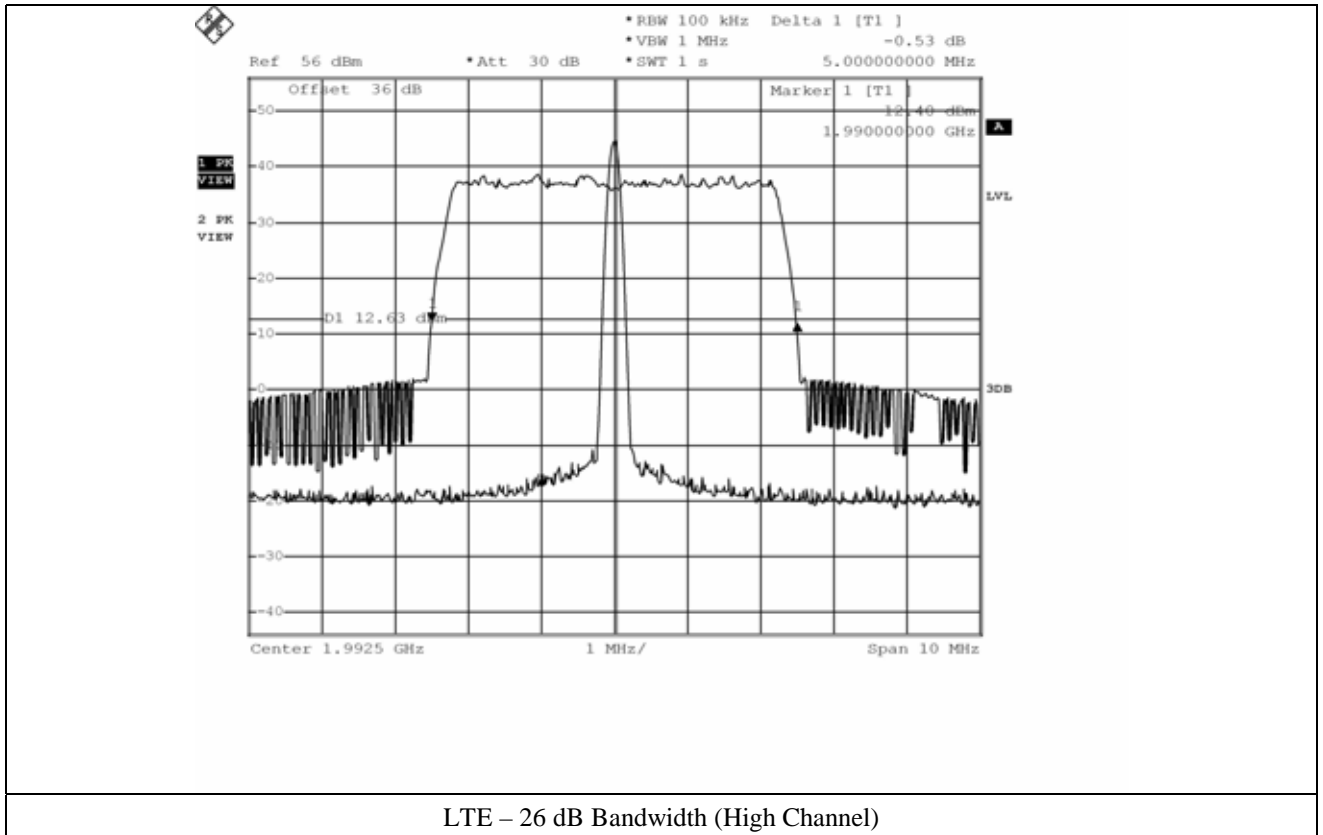




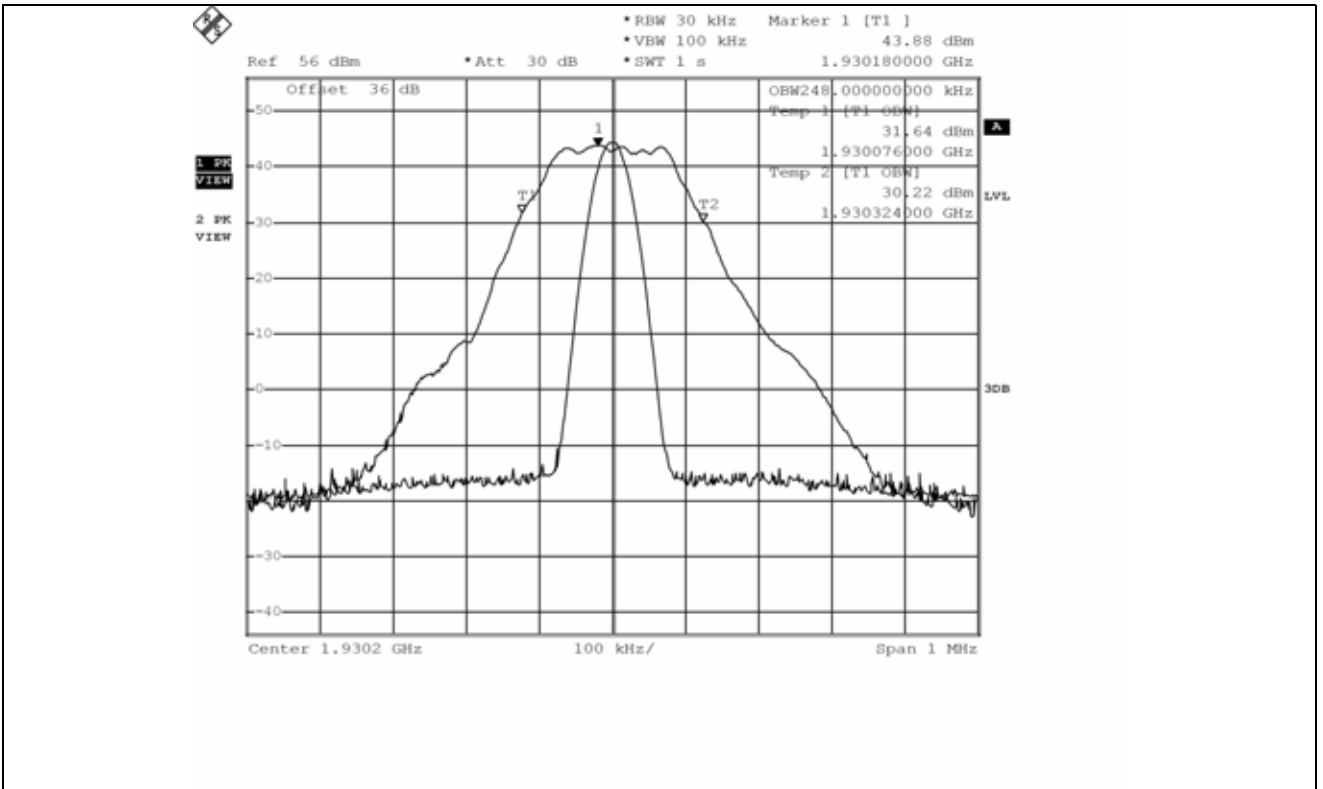
LTE – 26 dB Bandwidth (Low Channel)



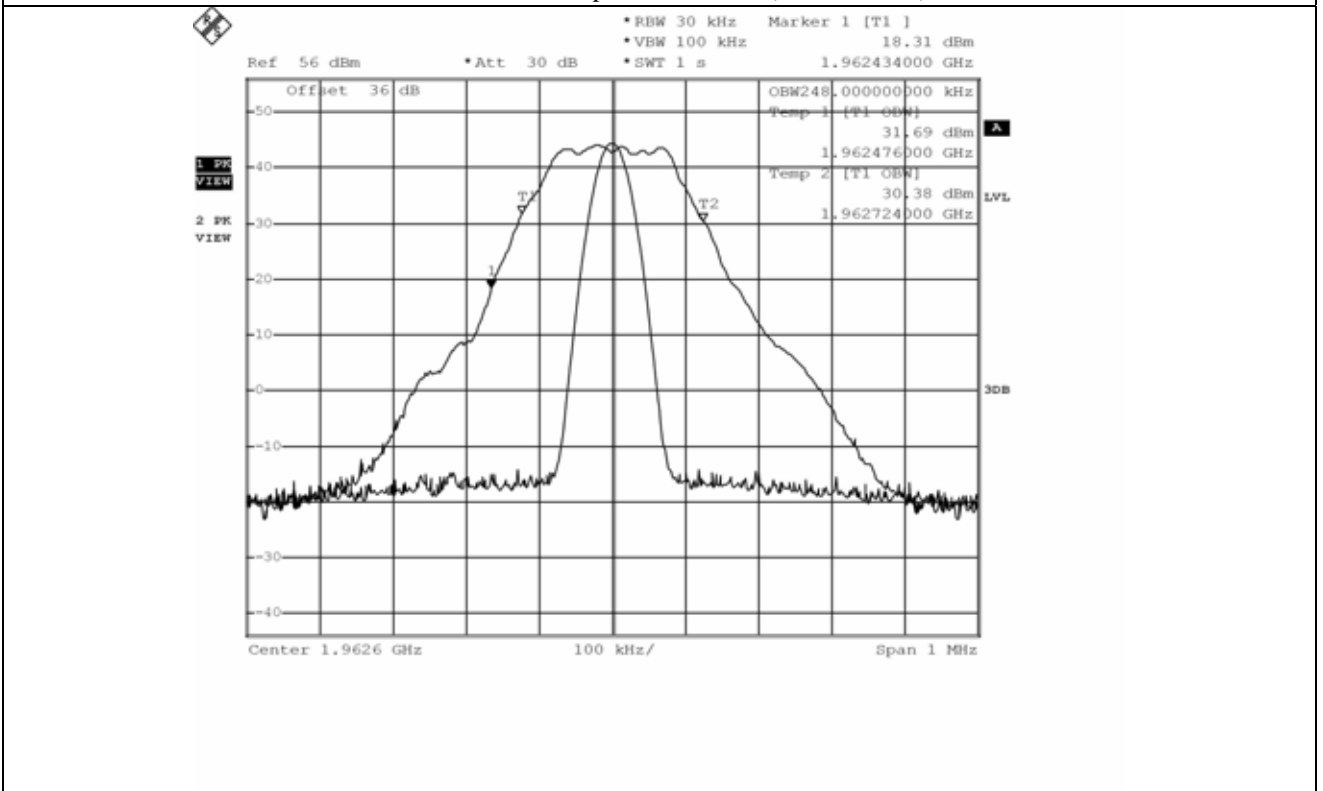
LTE – 26 dB Bandwidth (Middle Channel)



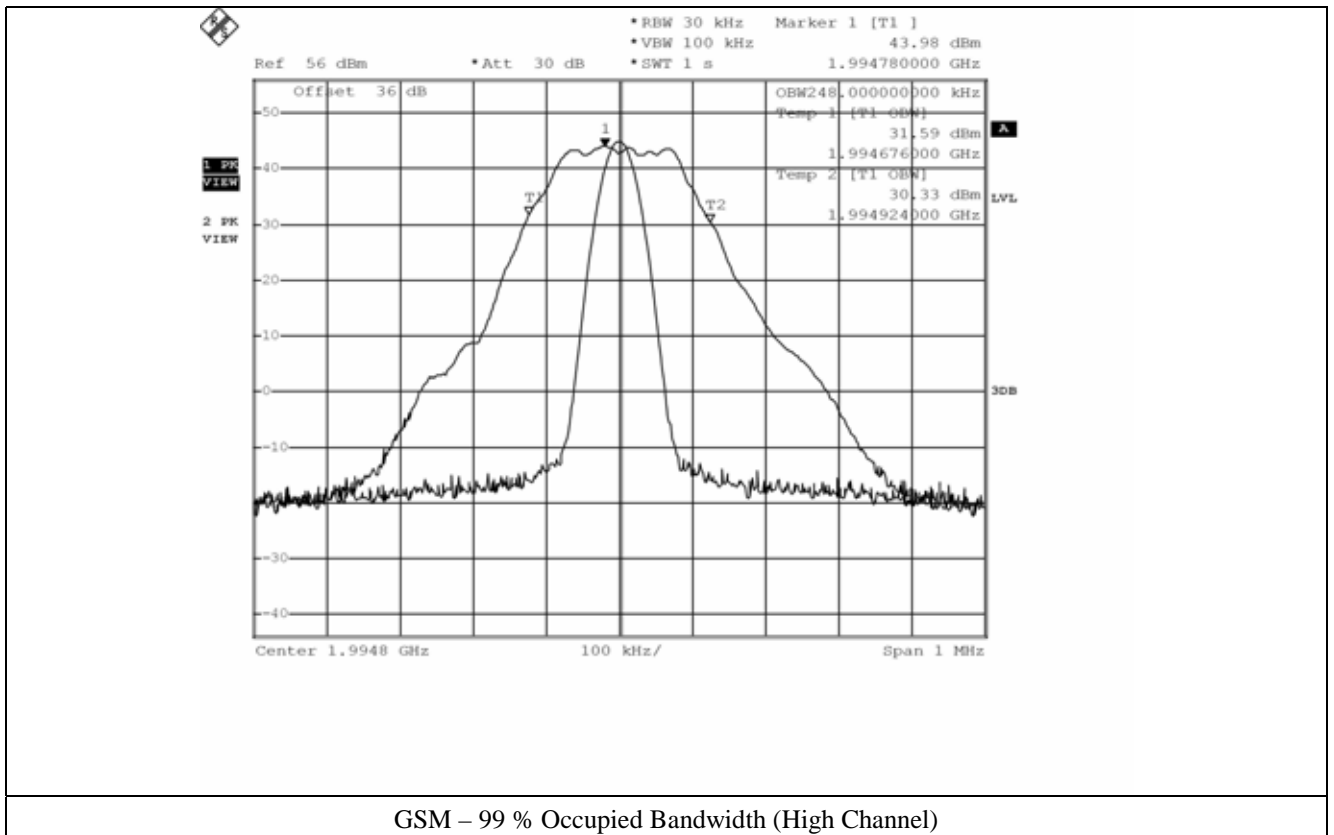




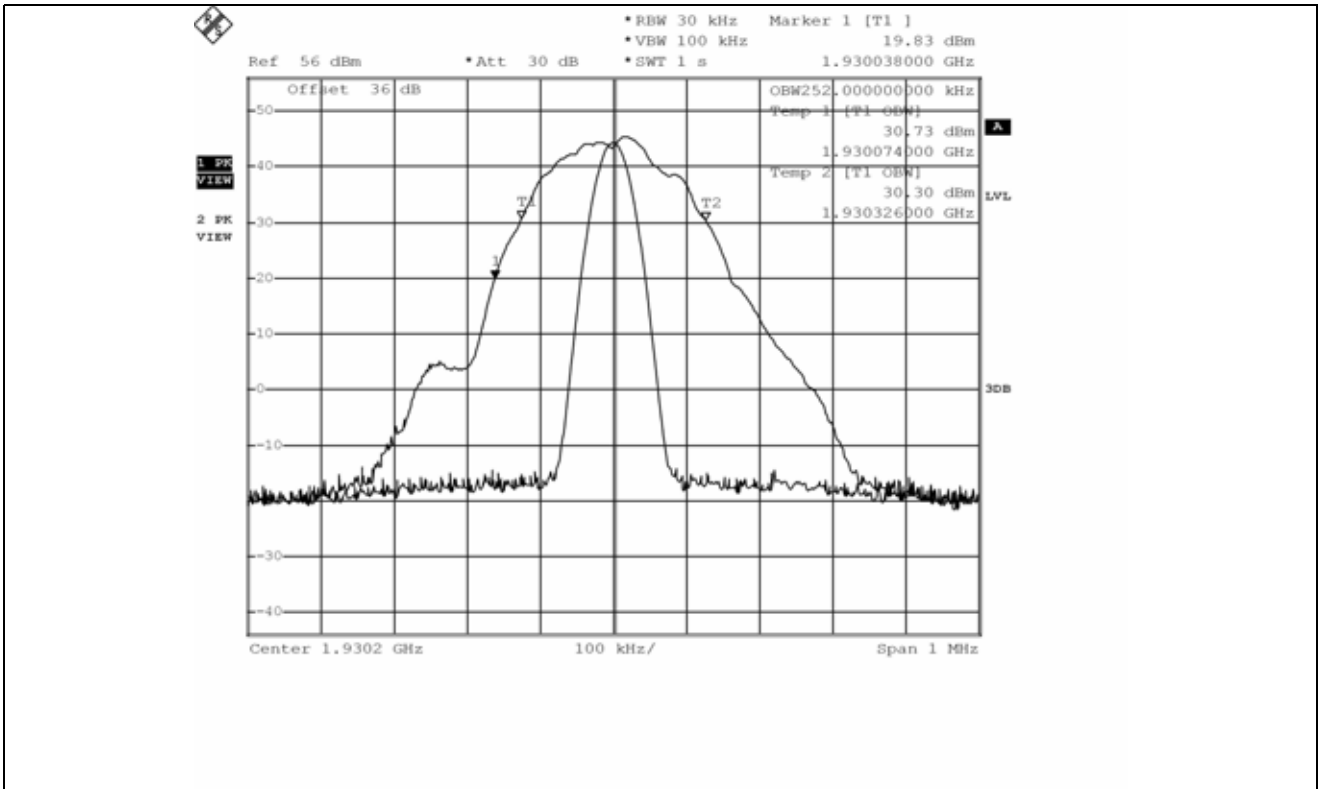
GSM – 99 % Occupied Bandwidth (Low Channel)



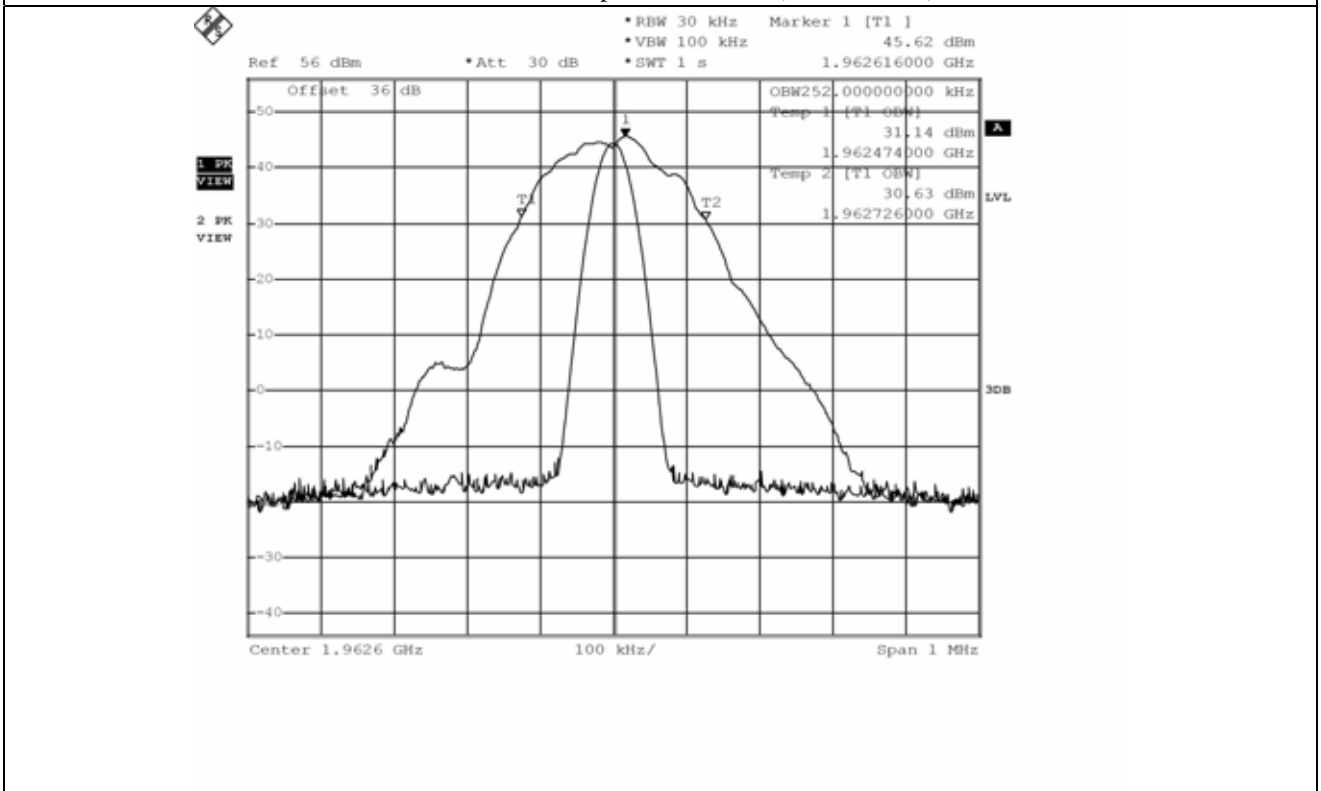
GSM – 99 % Occupied Bandwidth (Middle Channel)



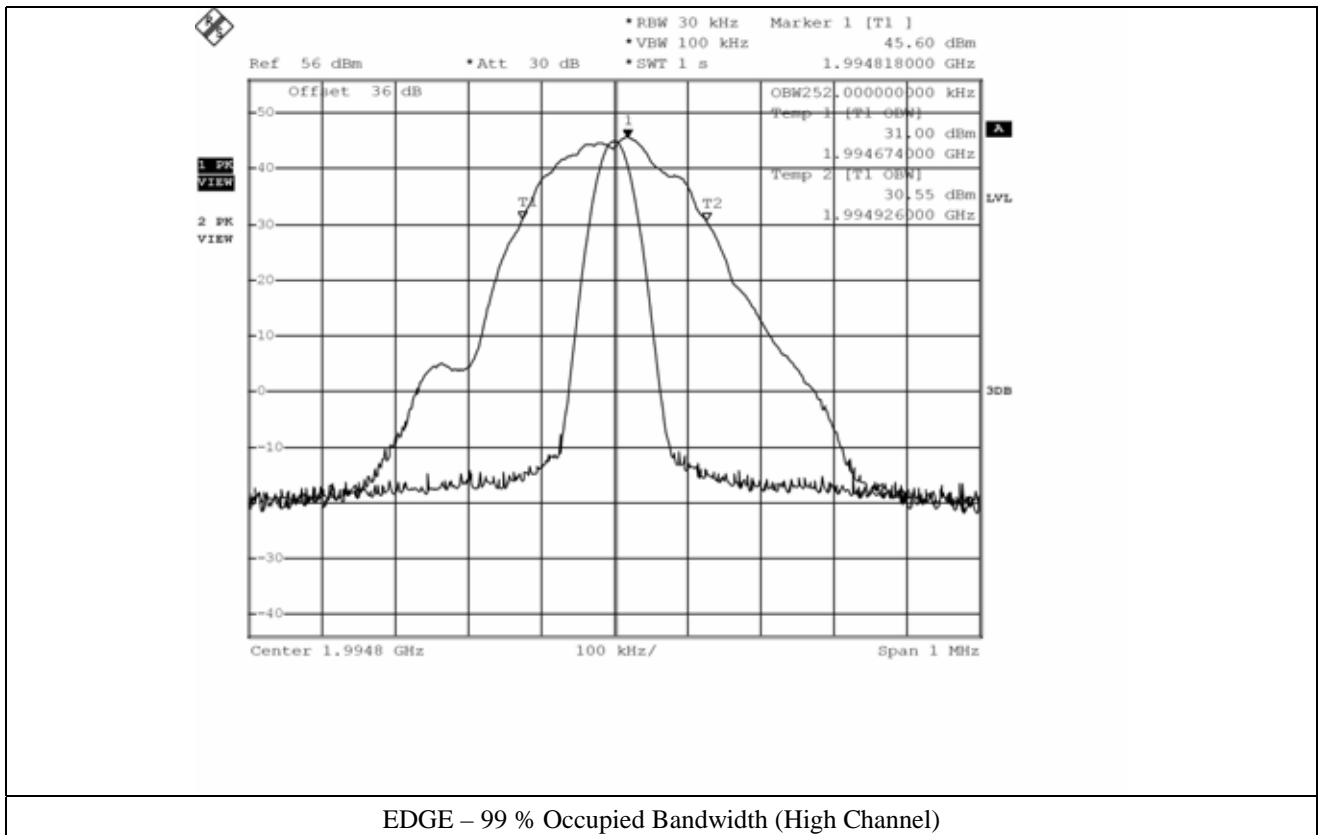
GSM – 99 % Occupied Bandwidth (High Channel)

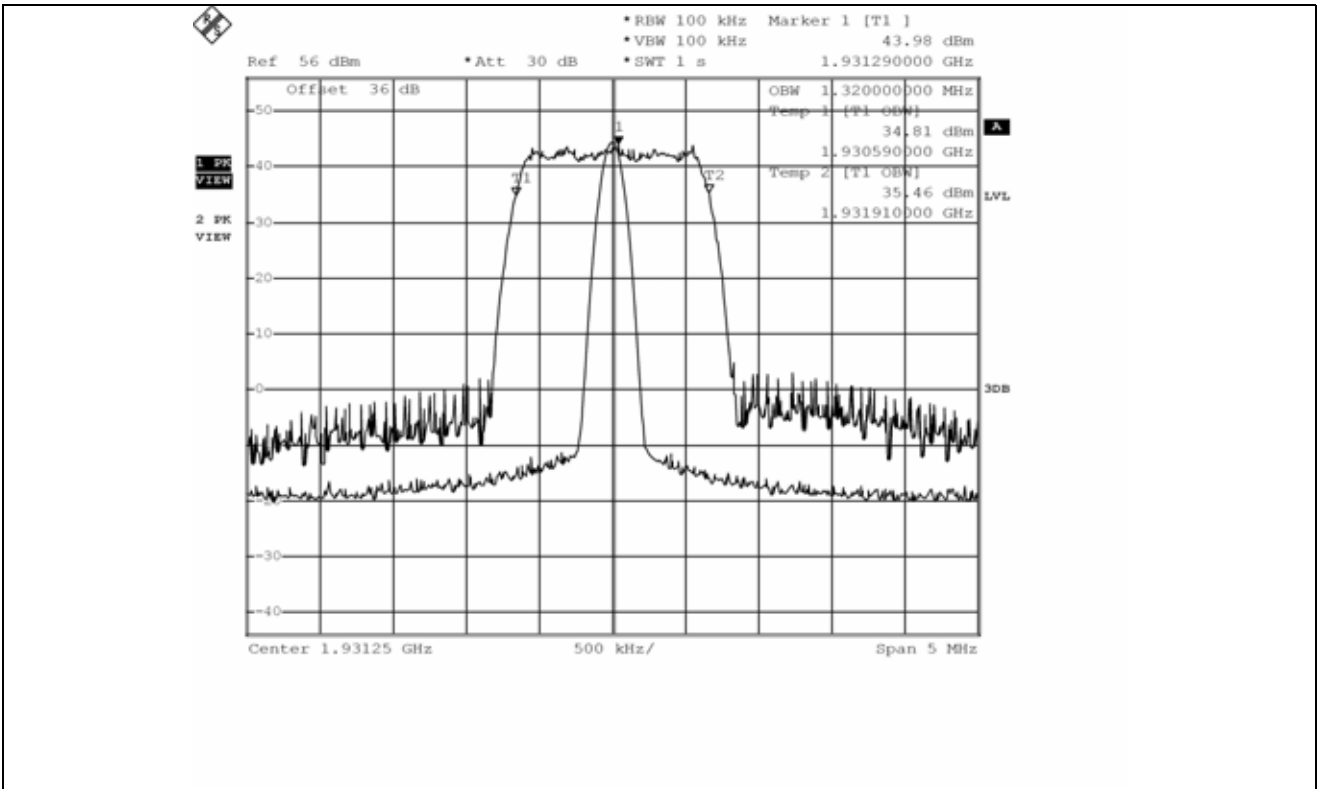


EDGE – 99 % Occupied Bandwidth (Low Channel)

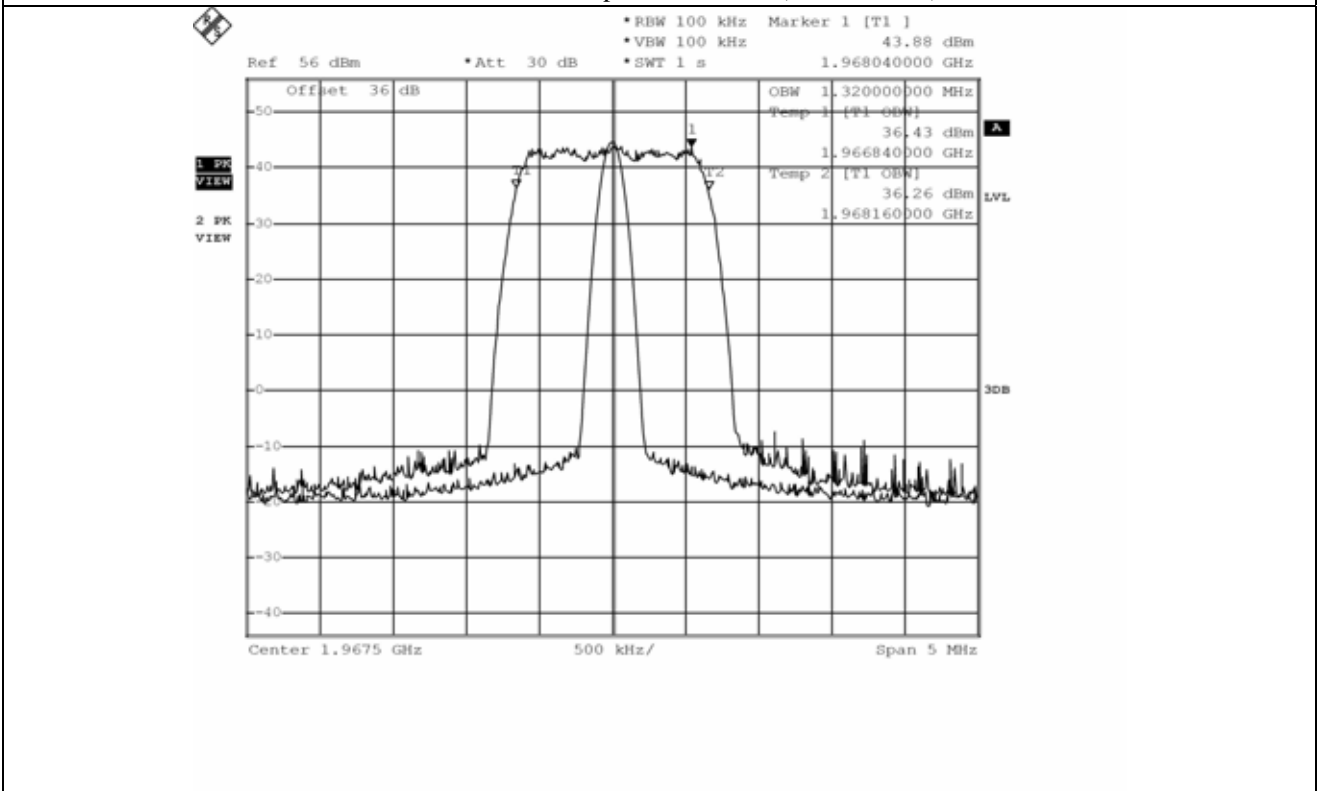


EDGE – 99 % Occupied Bandwidth (Middle Channel)

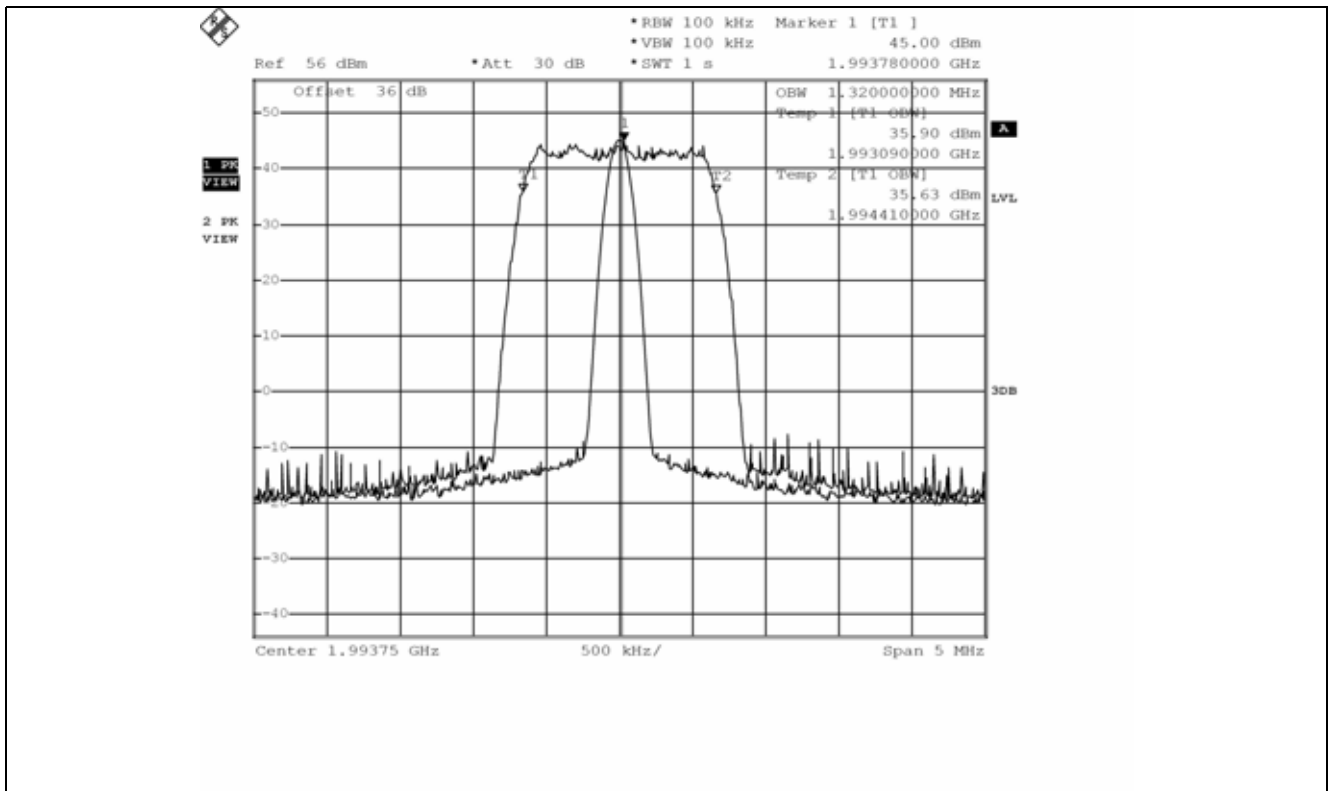




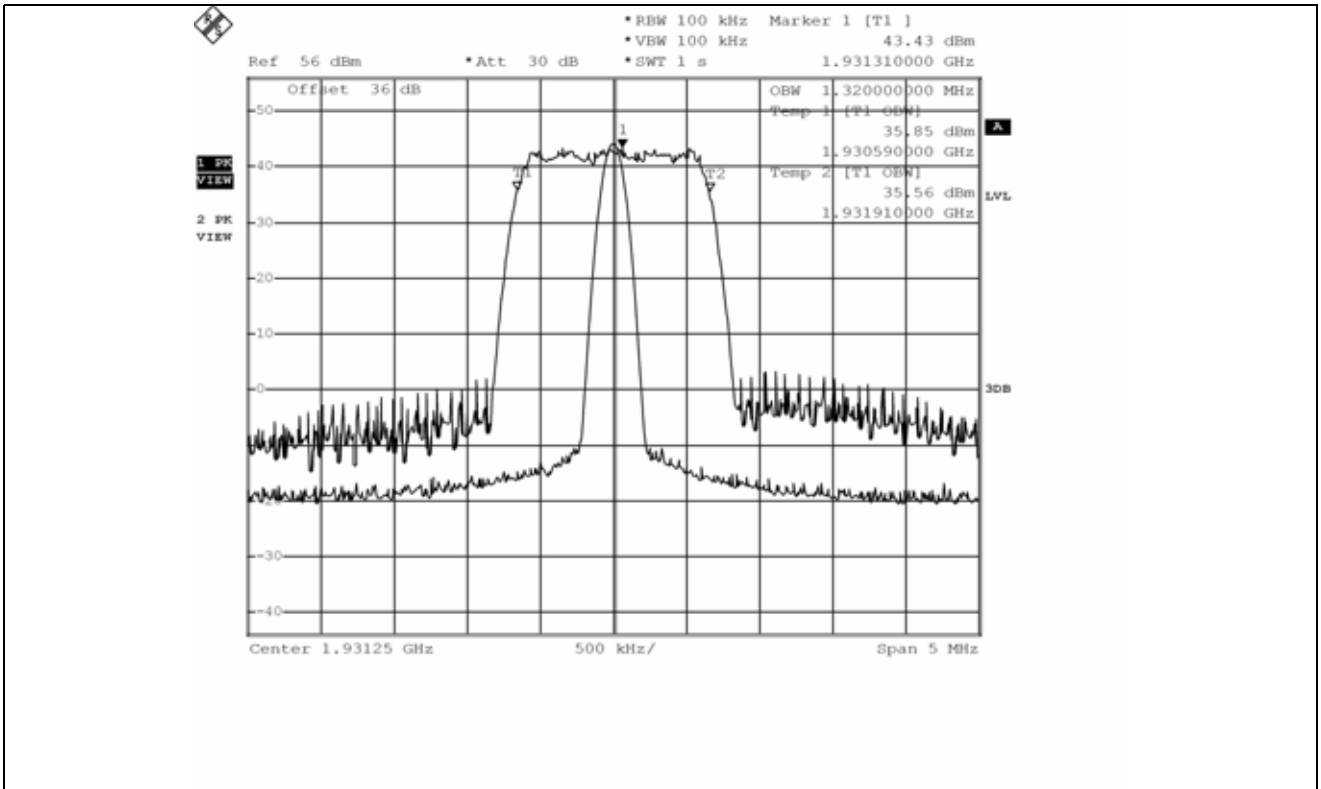
CDMA – 99 % Occupied Bandwidth (Low Channel)



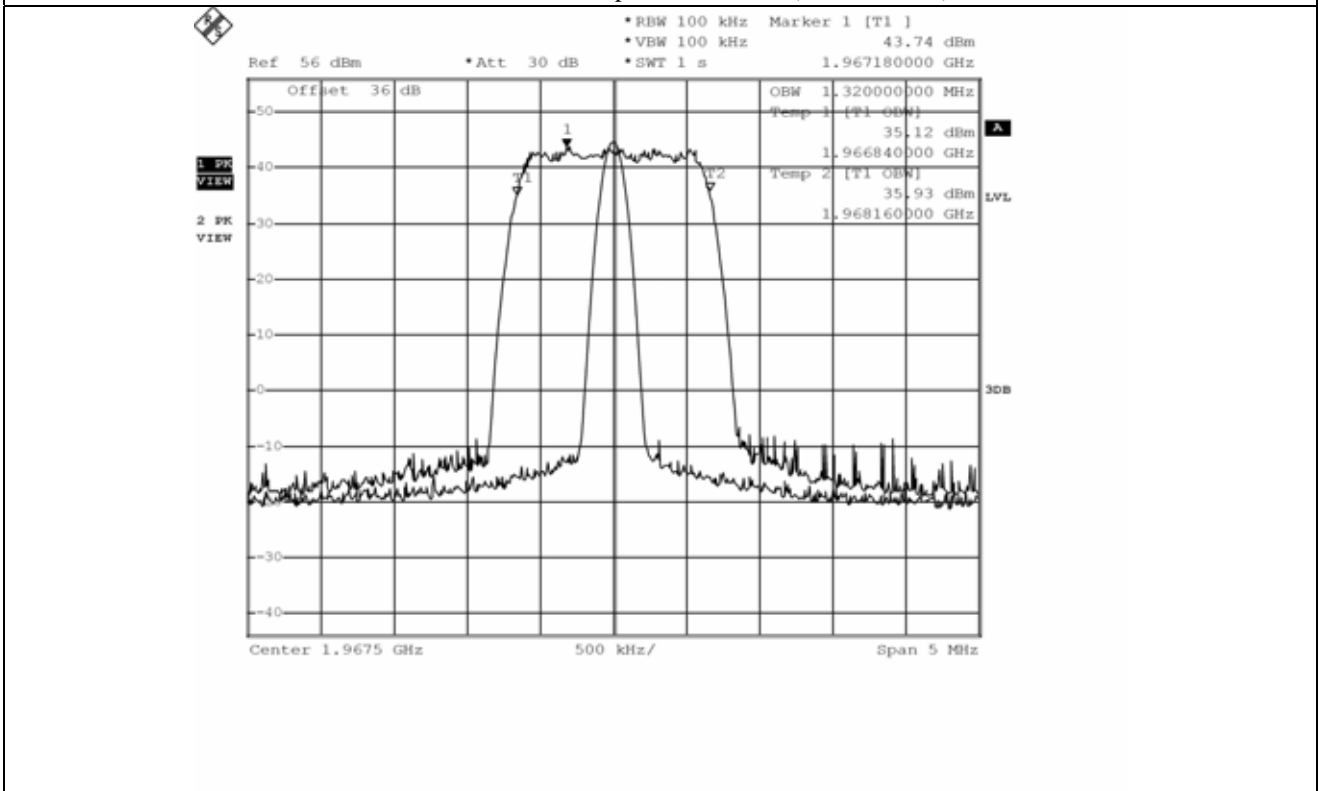
CDMA – 99 % Occupied Bandwidth (Middle Channel)



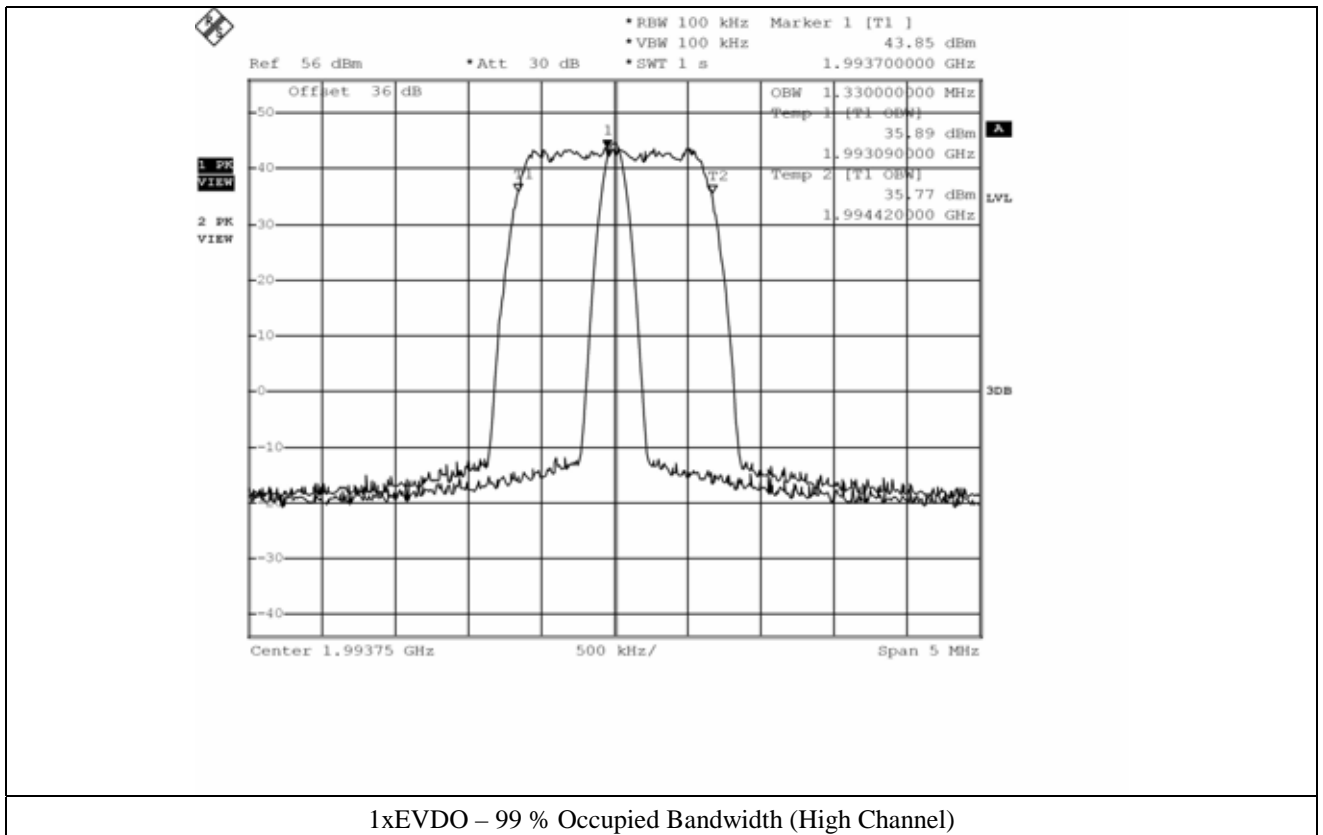
CDMA – 99 % Occupied Bandwidth (High Channel)



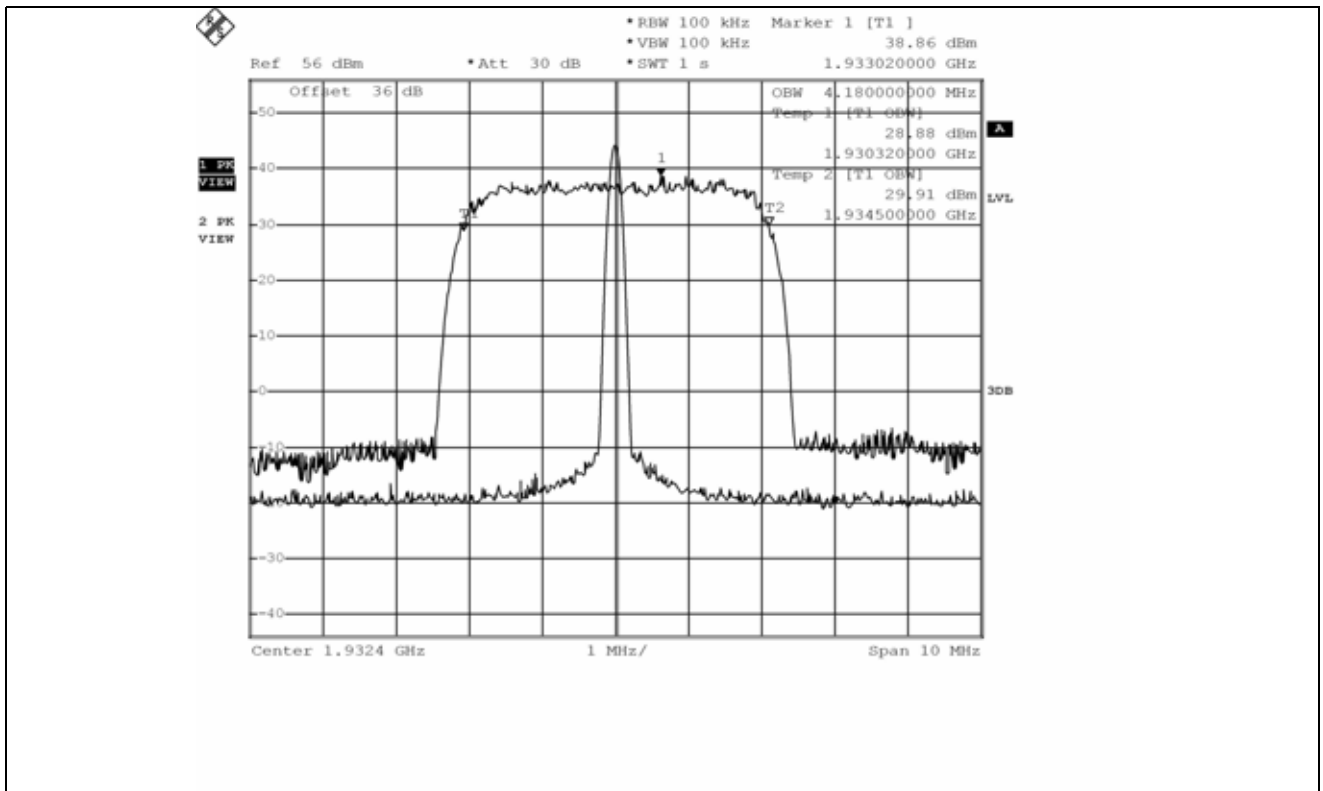
1xEVDO – 99 % Occupied Bandwidth (Low Channel)



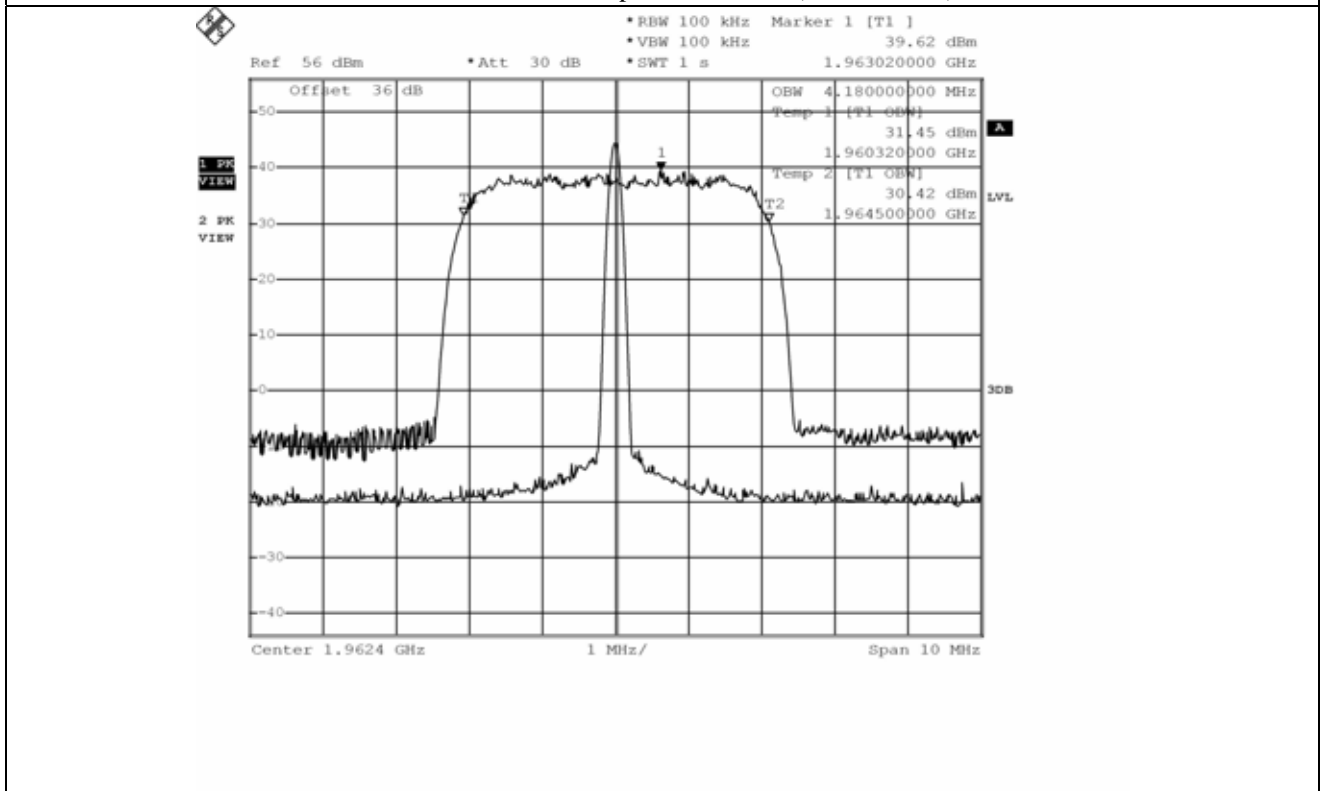
1xEVDO – 99 % Occupied Bandwidth (Middle Channel)



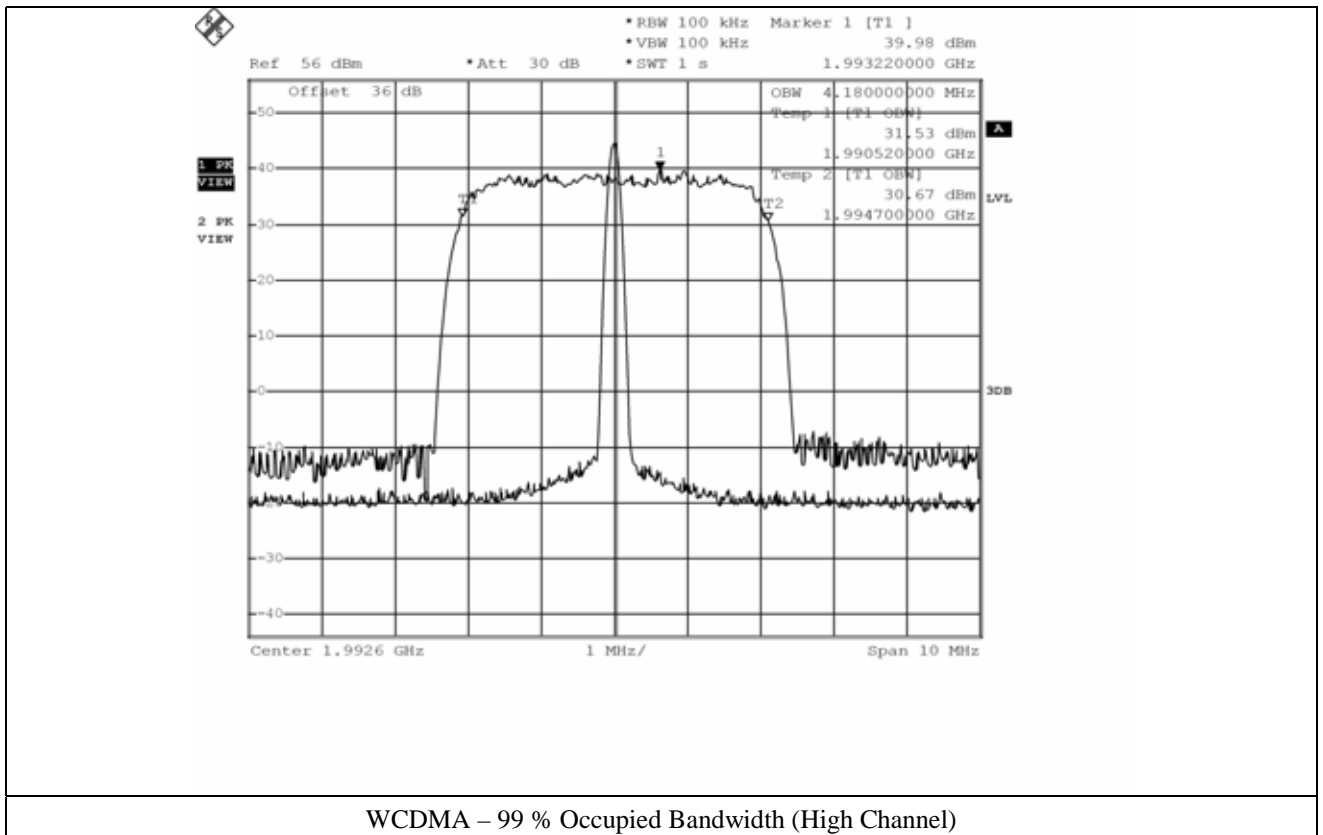


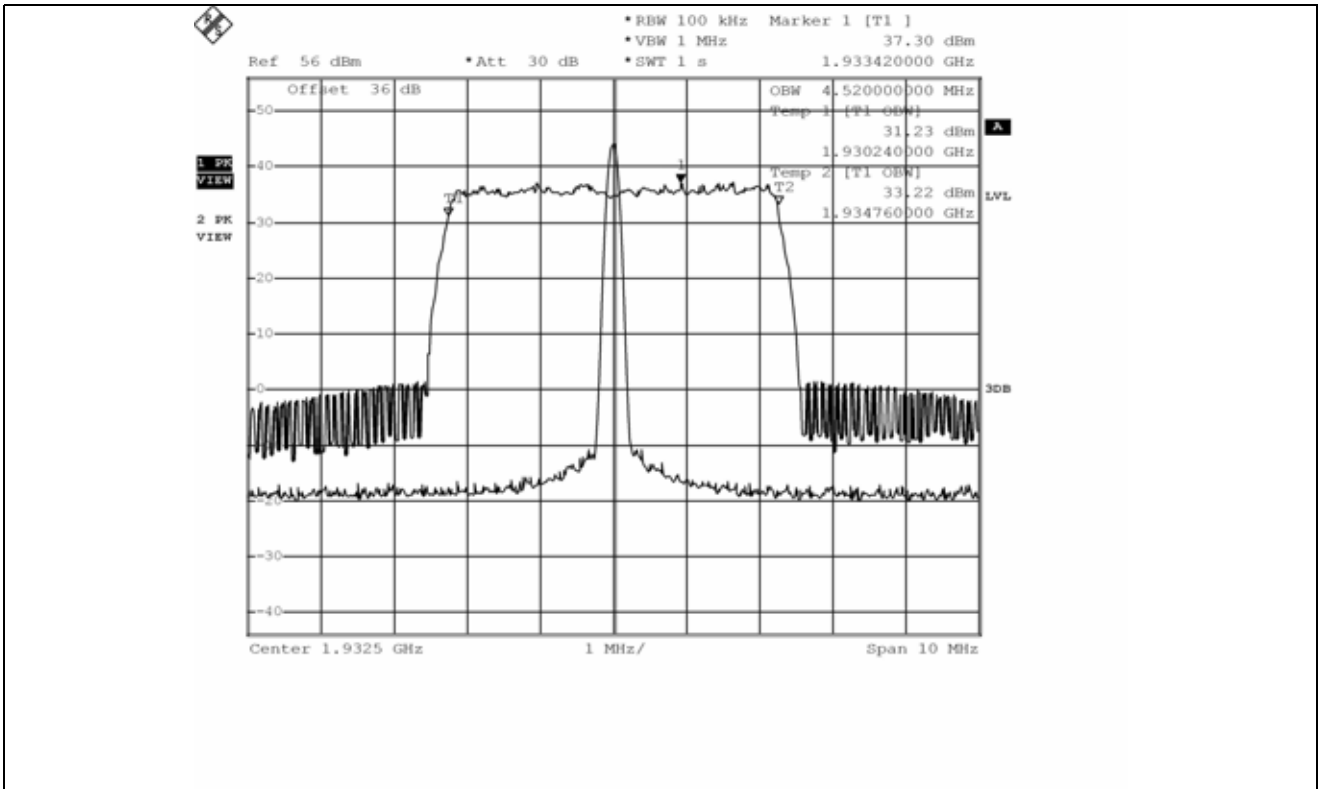


WCDMA – 99 % Occupied Bandwidth (Low Channel)

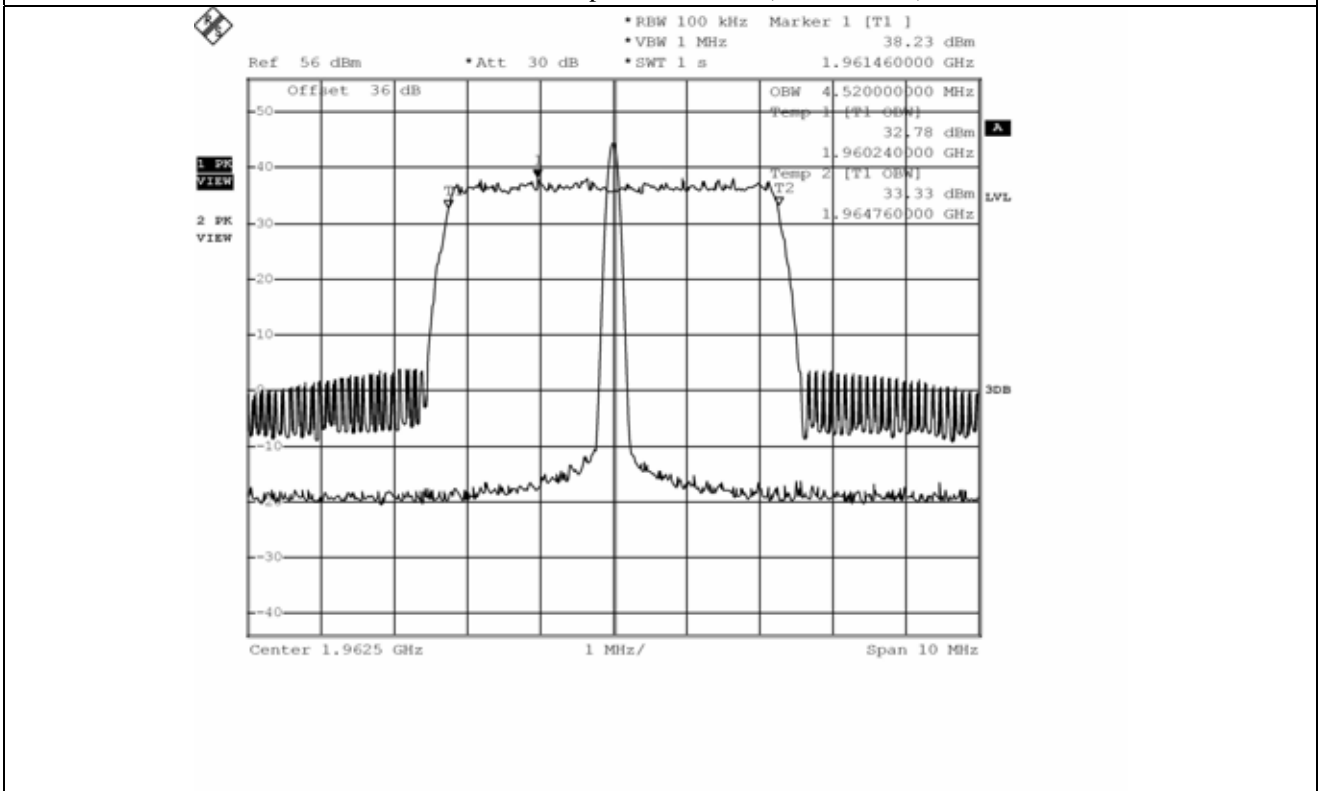


WCDMA – 99 % Occupied Bandwidth (Middle Channel)

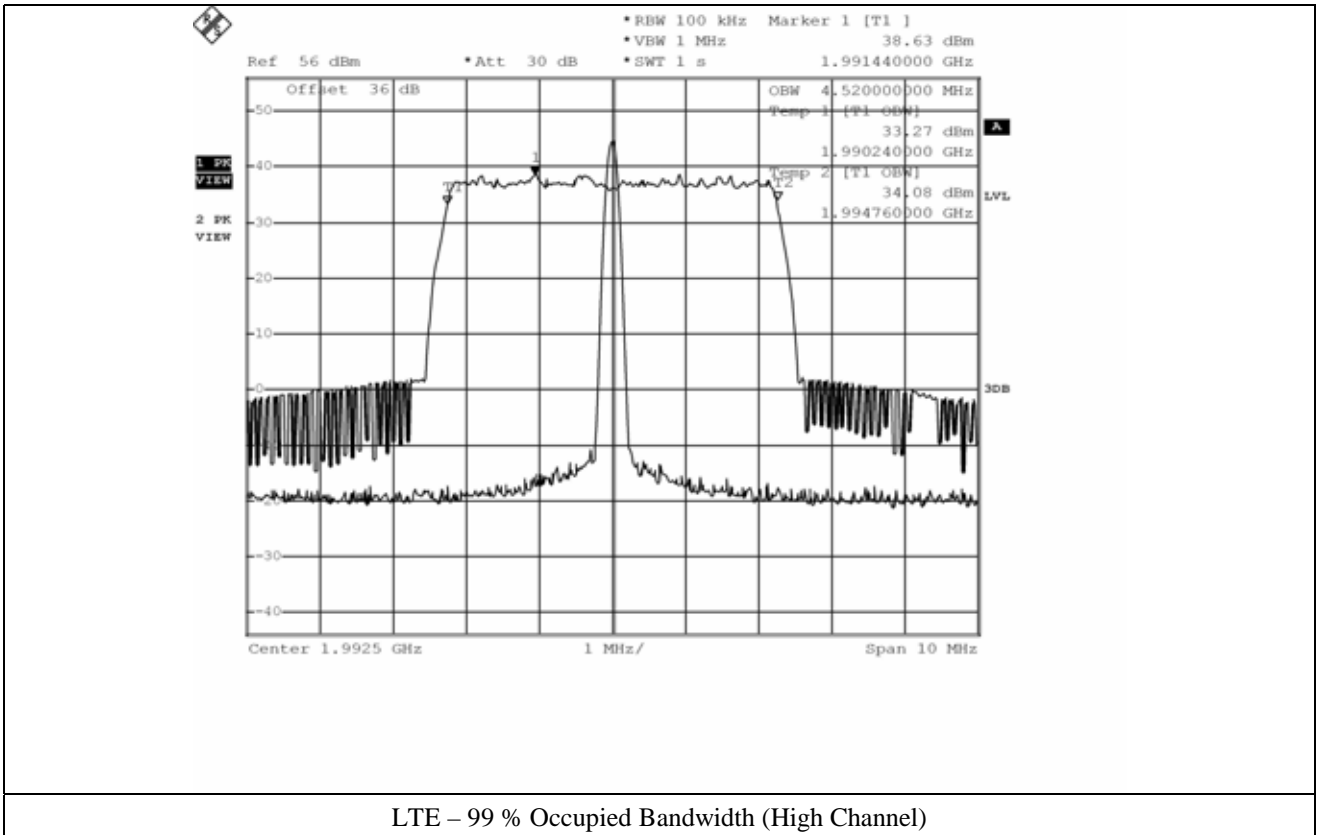


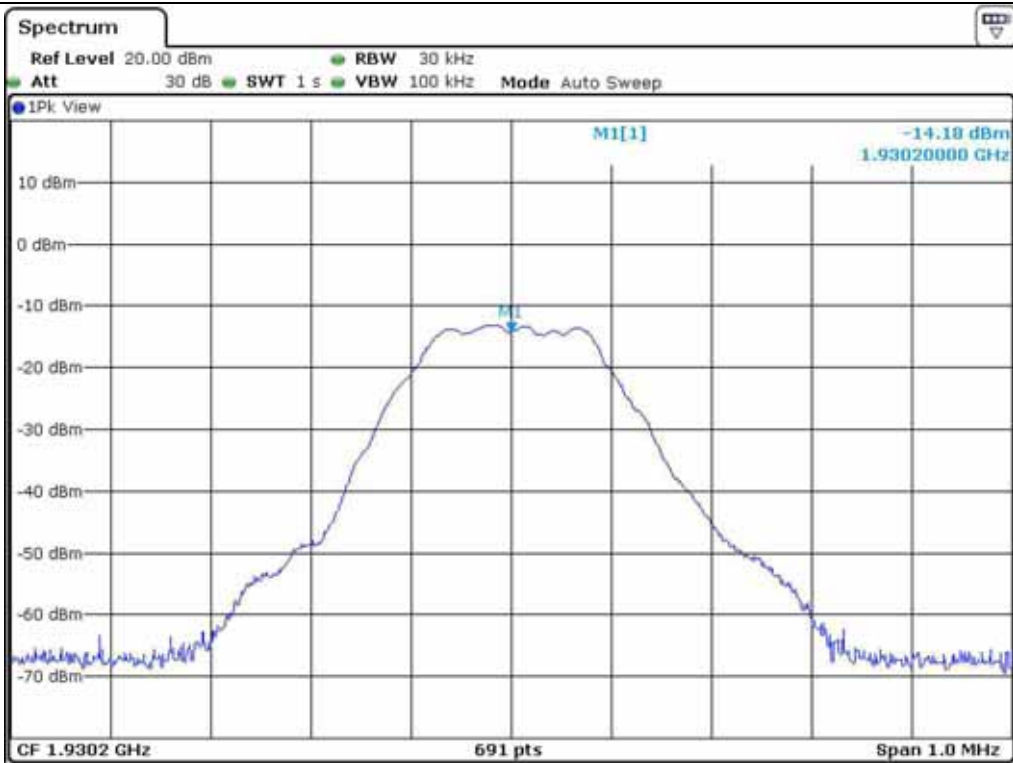


LTE – 99 % Occupied Bandwidth (Low Channel)

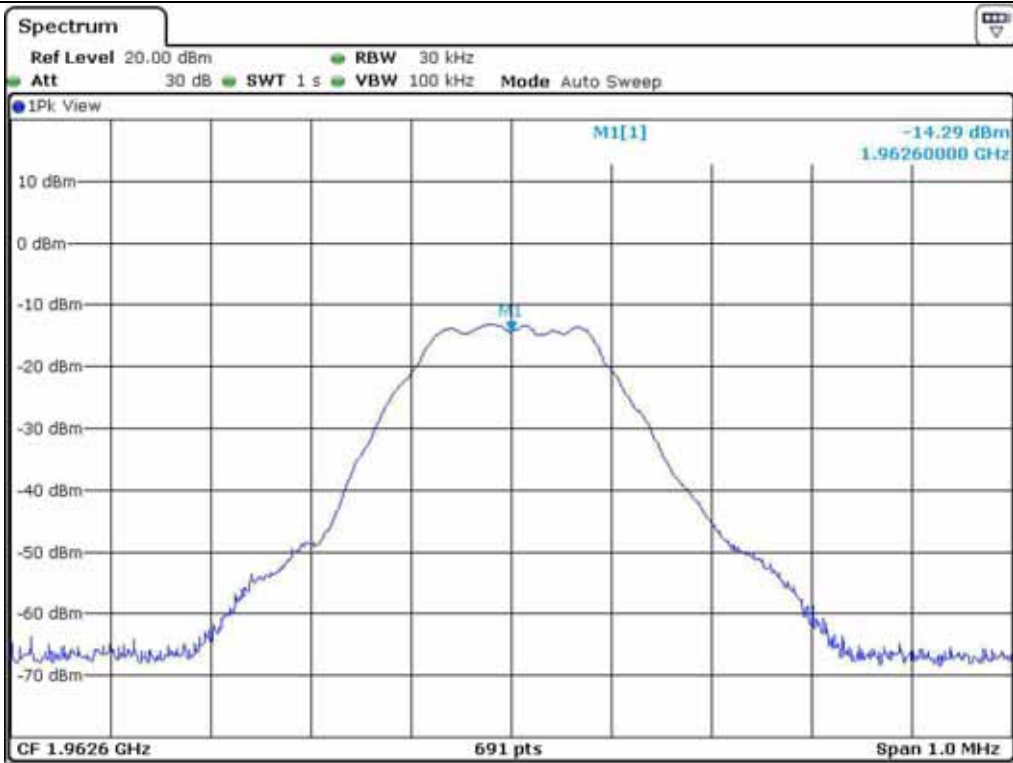


LTE – 99 % Occupied Bandwidth (Middle Channel)

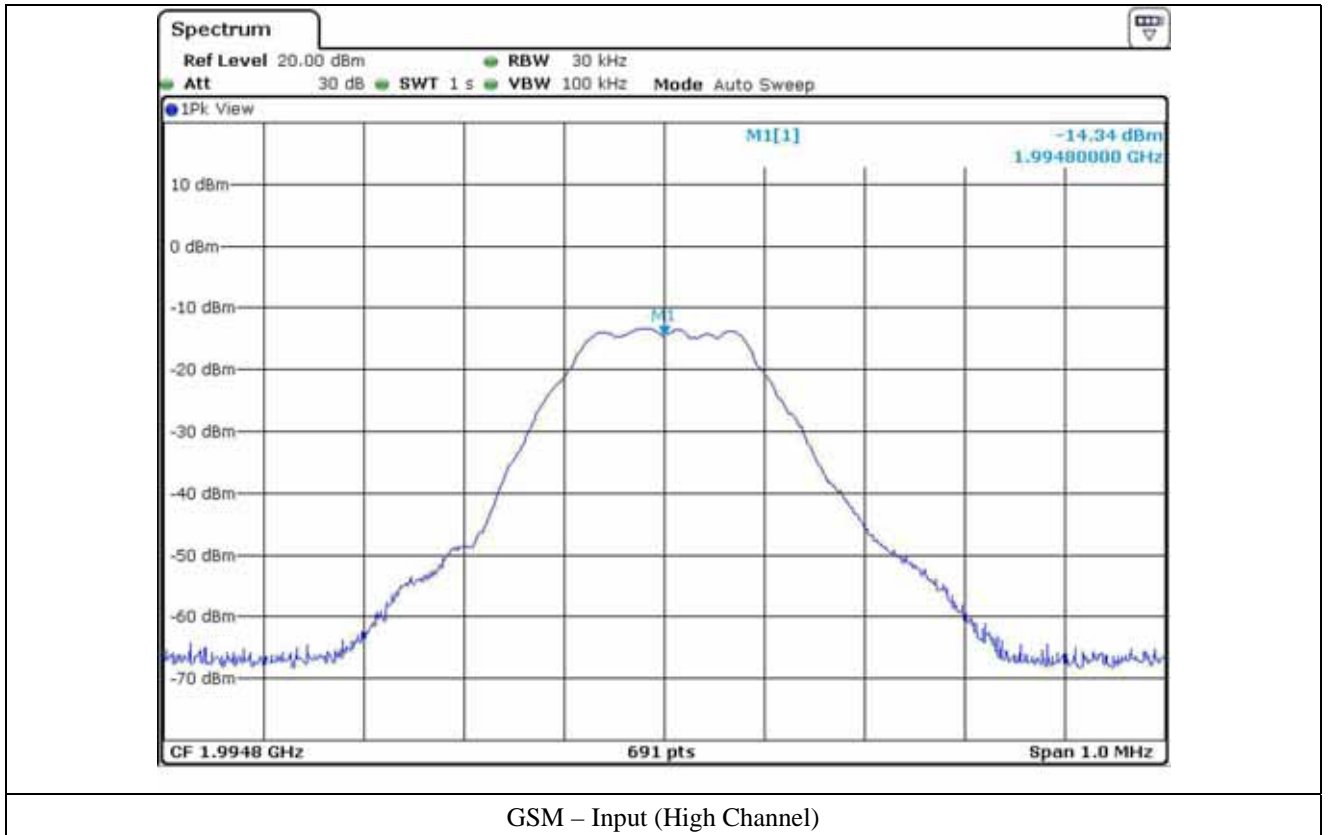


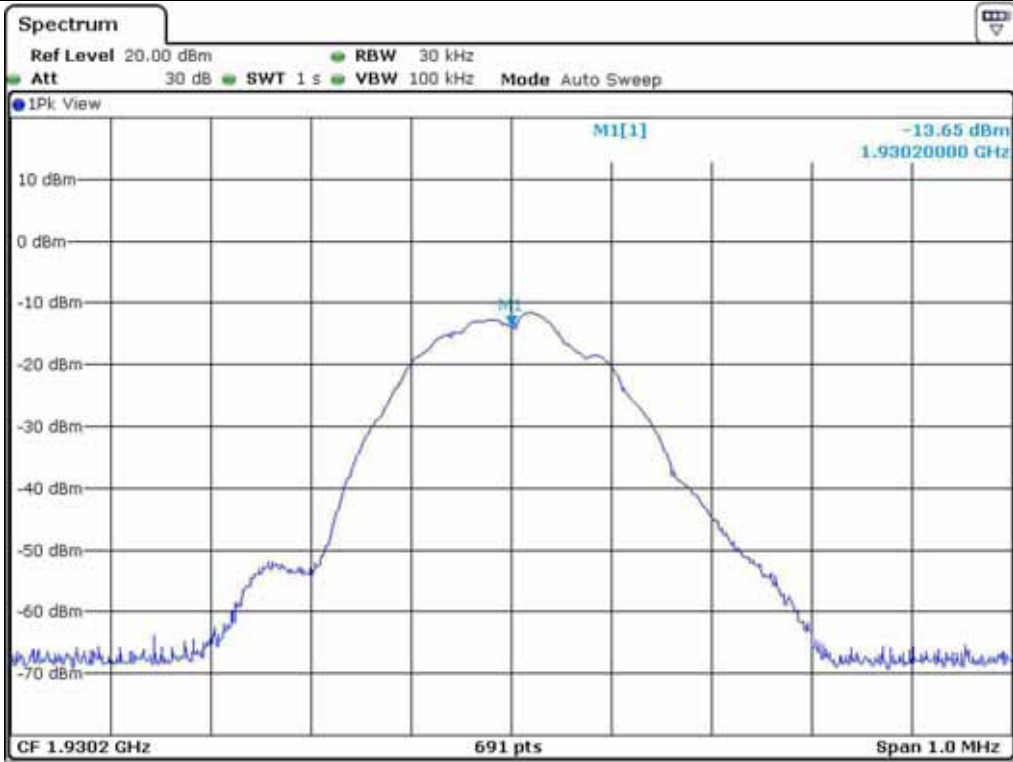


GSM – Input (Low Channel)

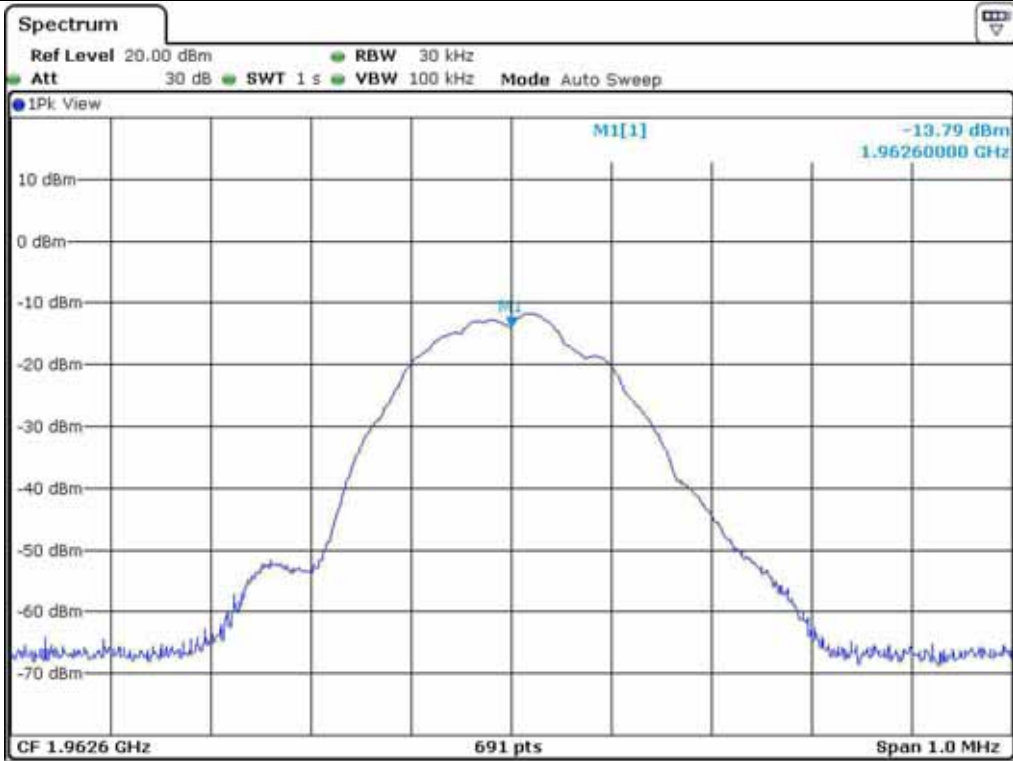


GSM – Input (Middle Channel)

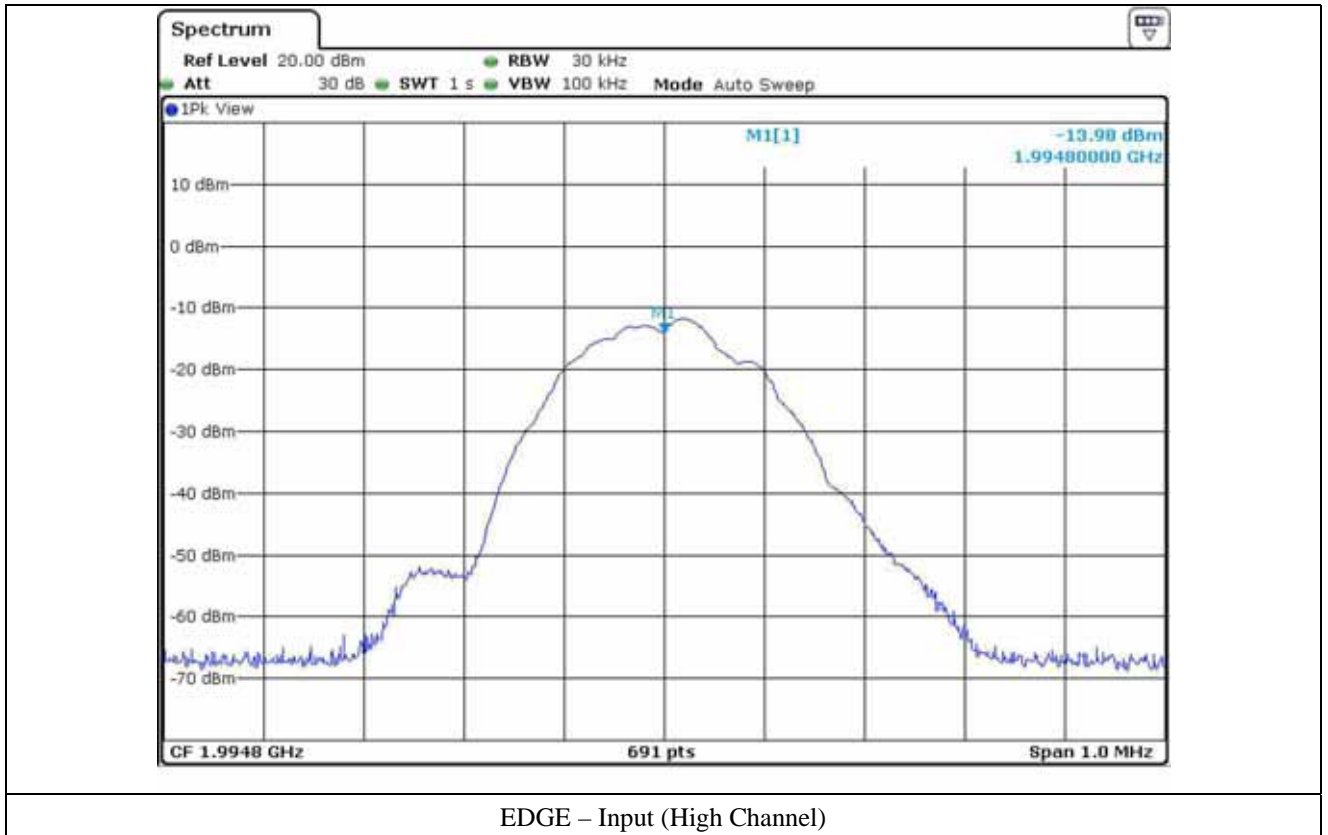




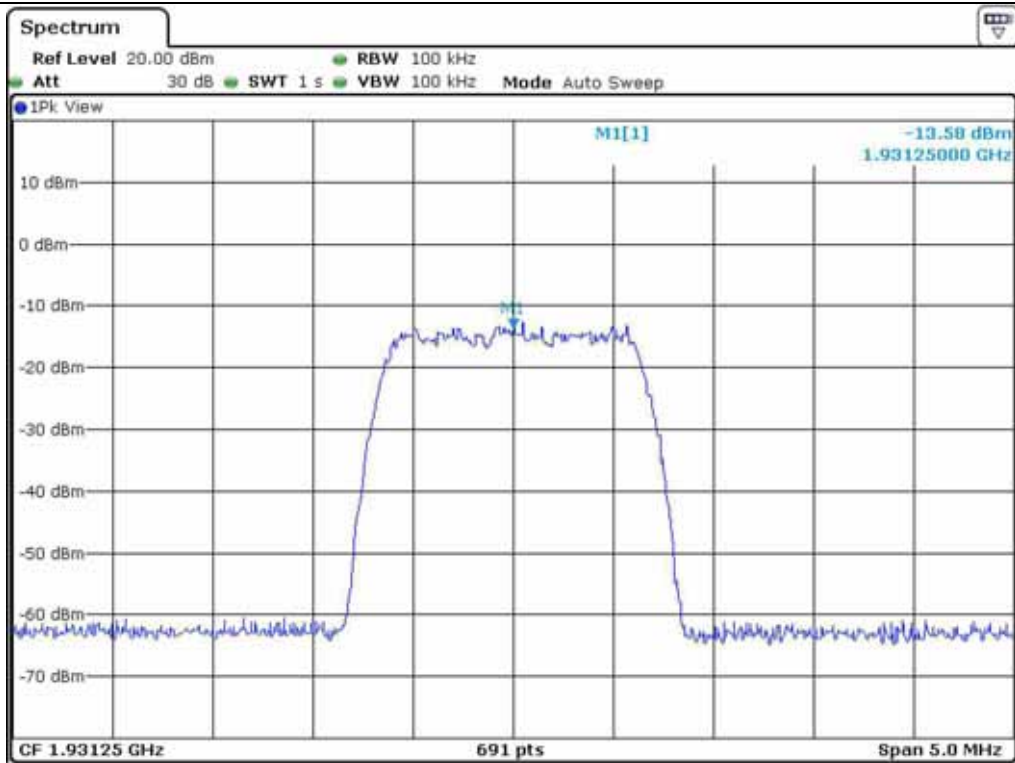
EDGE – Input (Low Channel)



EDGE – Input (Middle Channel)



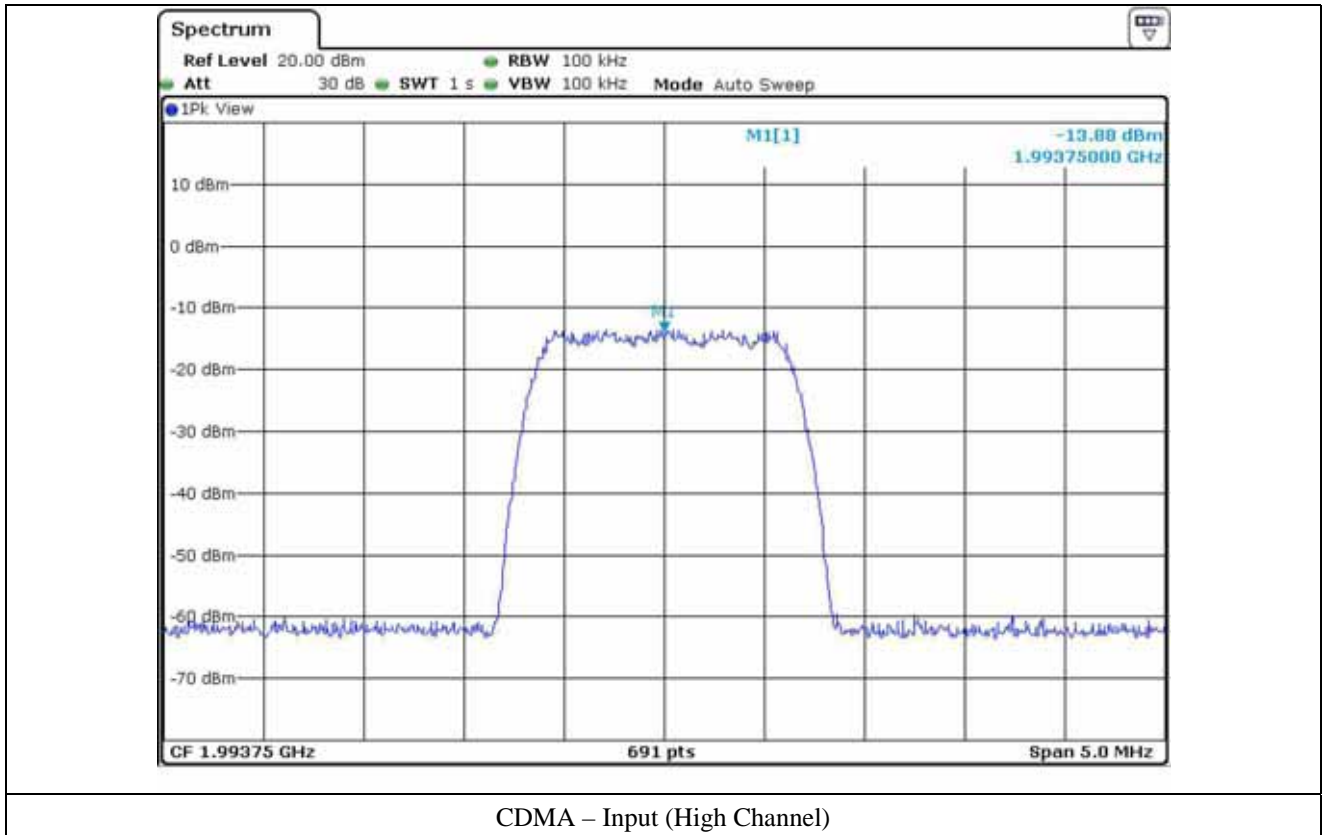


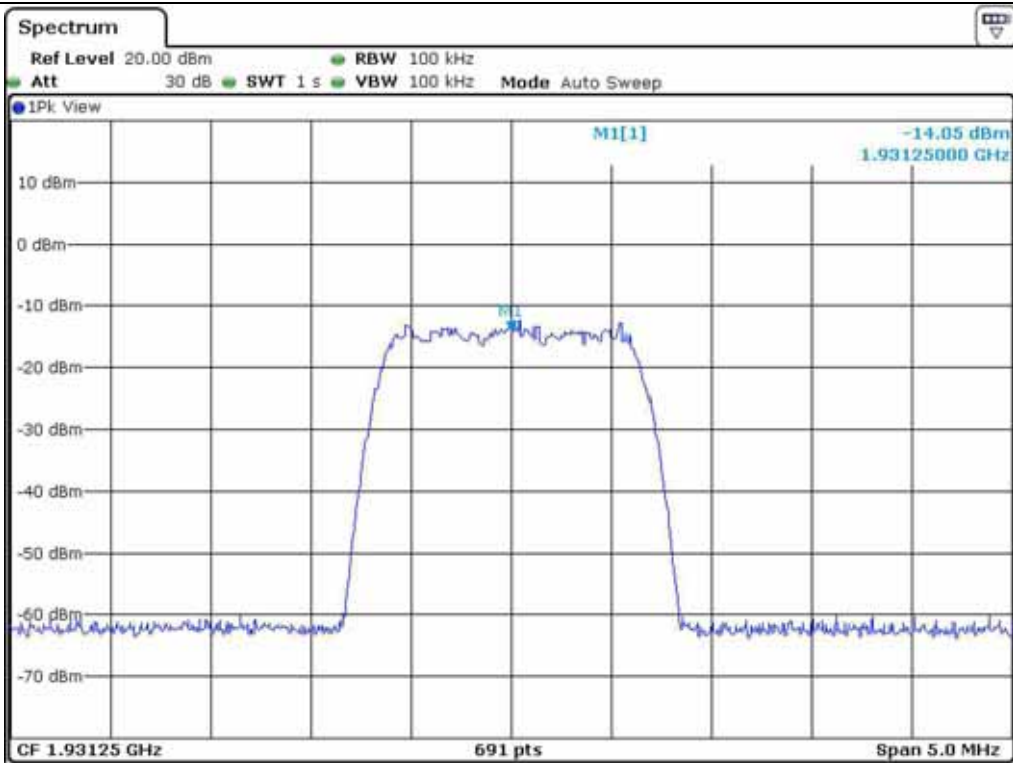


CDMA – Input (Low Channel)

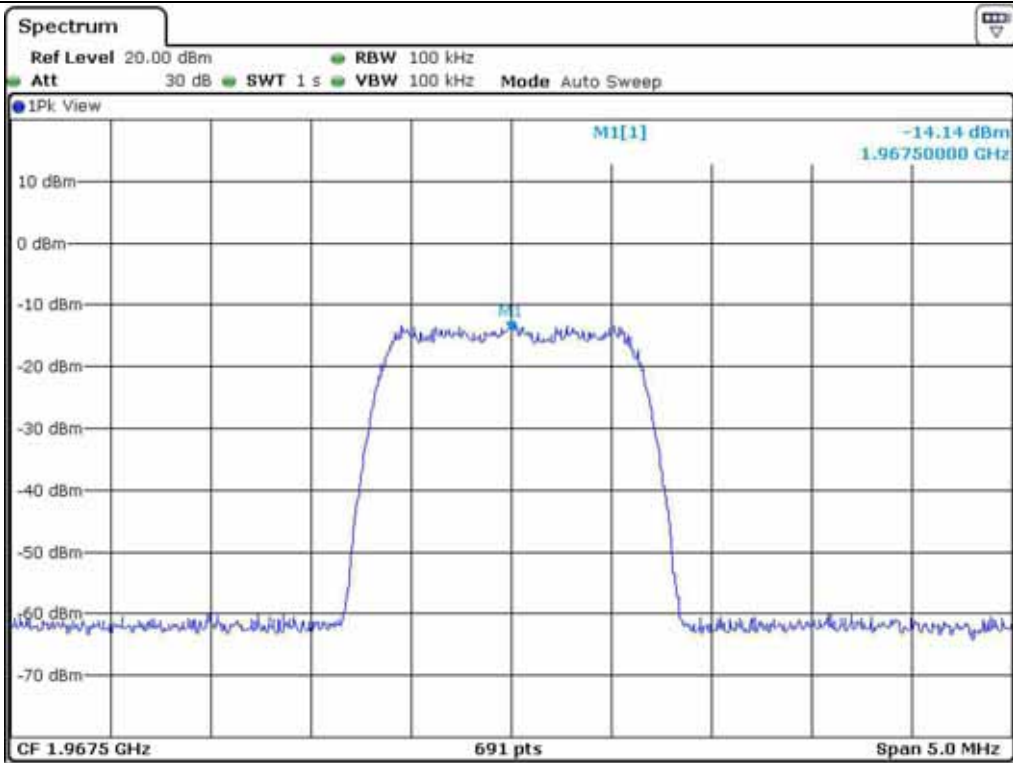


CDMA – Input (Middle Channel)

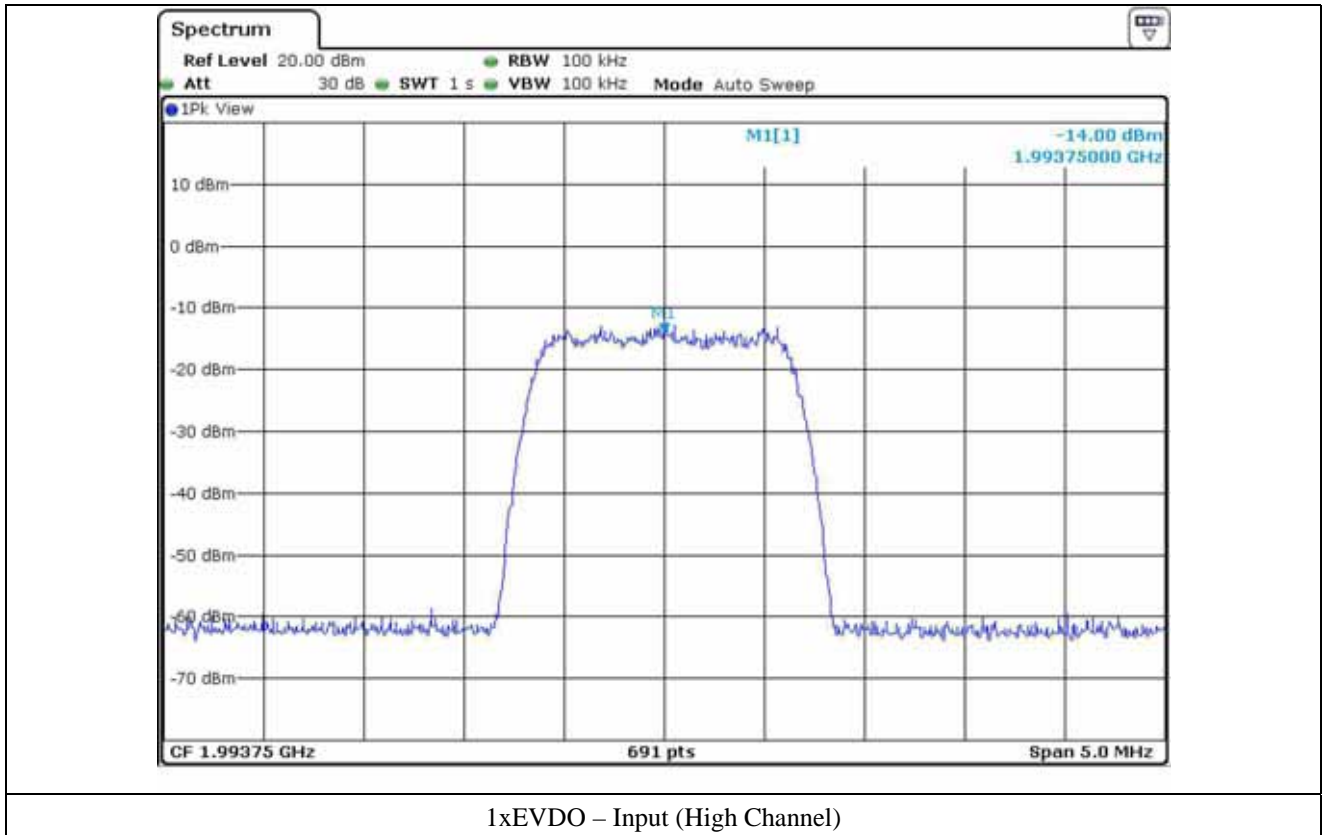


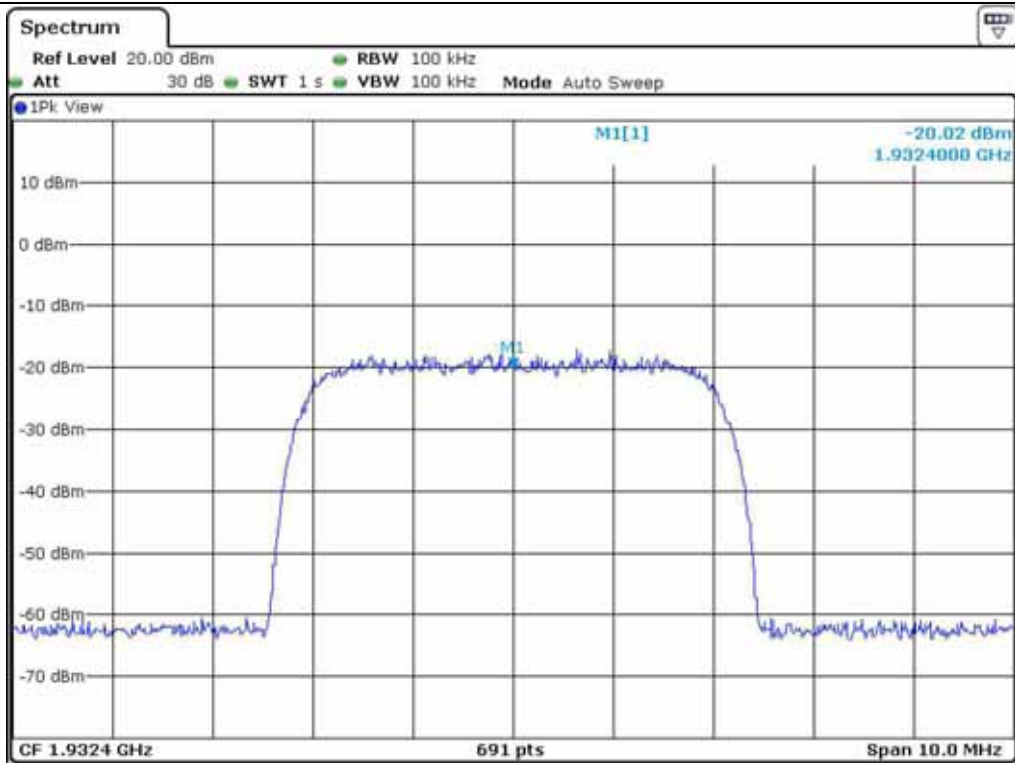


1xEVDO – Input (Low Channel)

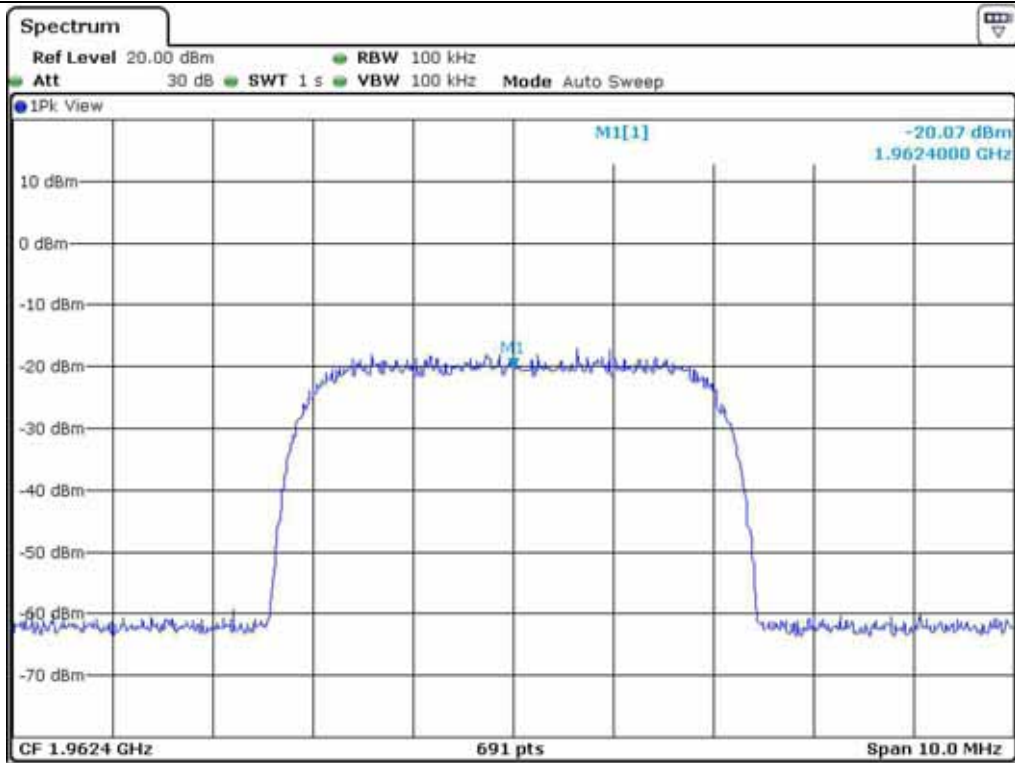


1xEVDO – Input (Middle Channel)

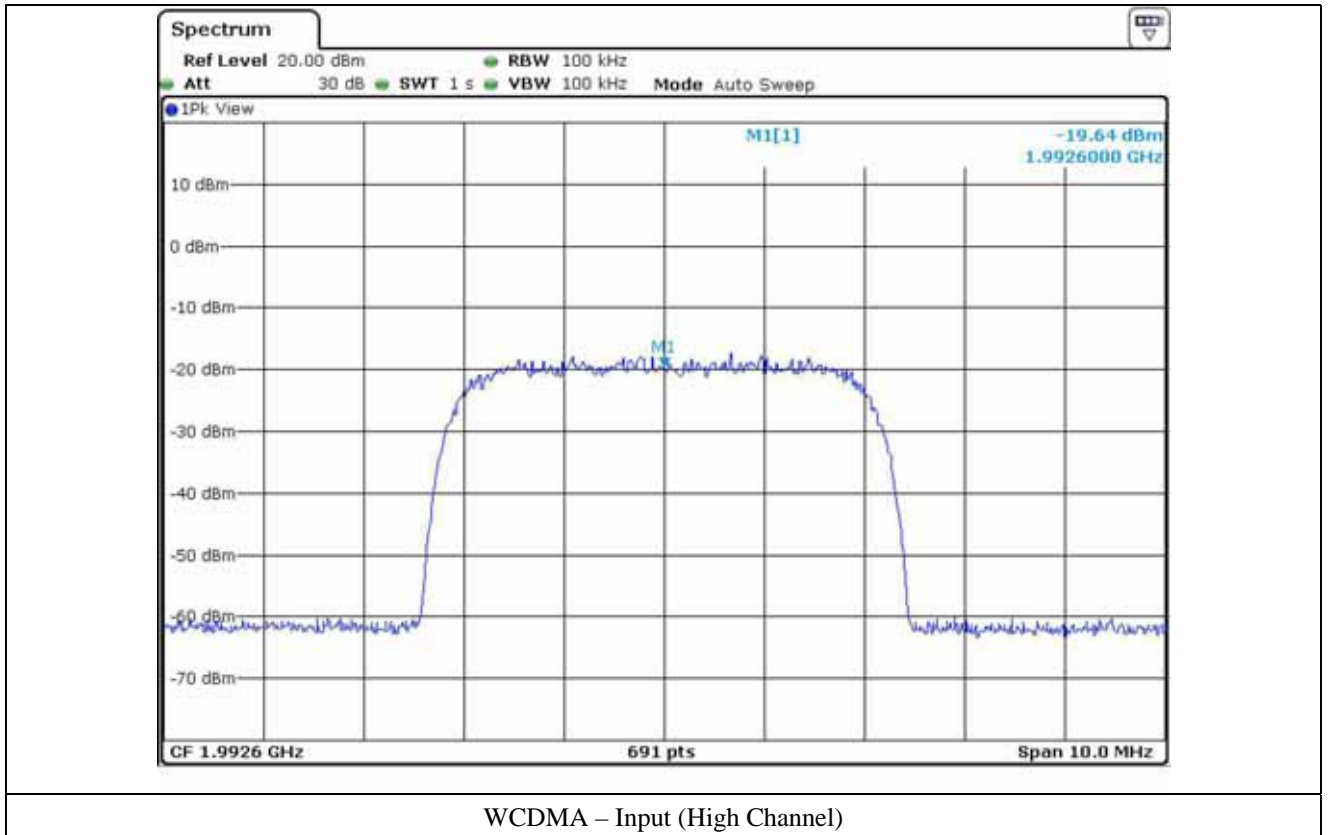


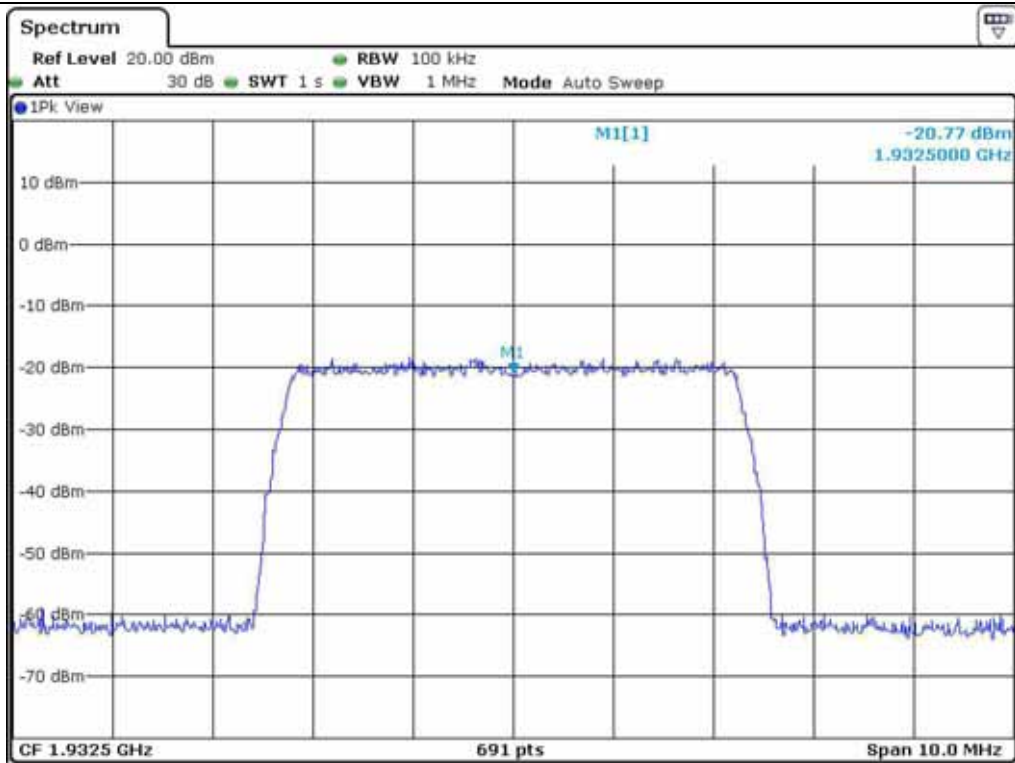


WCDMA – Input (Low Channel)

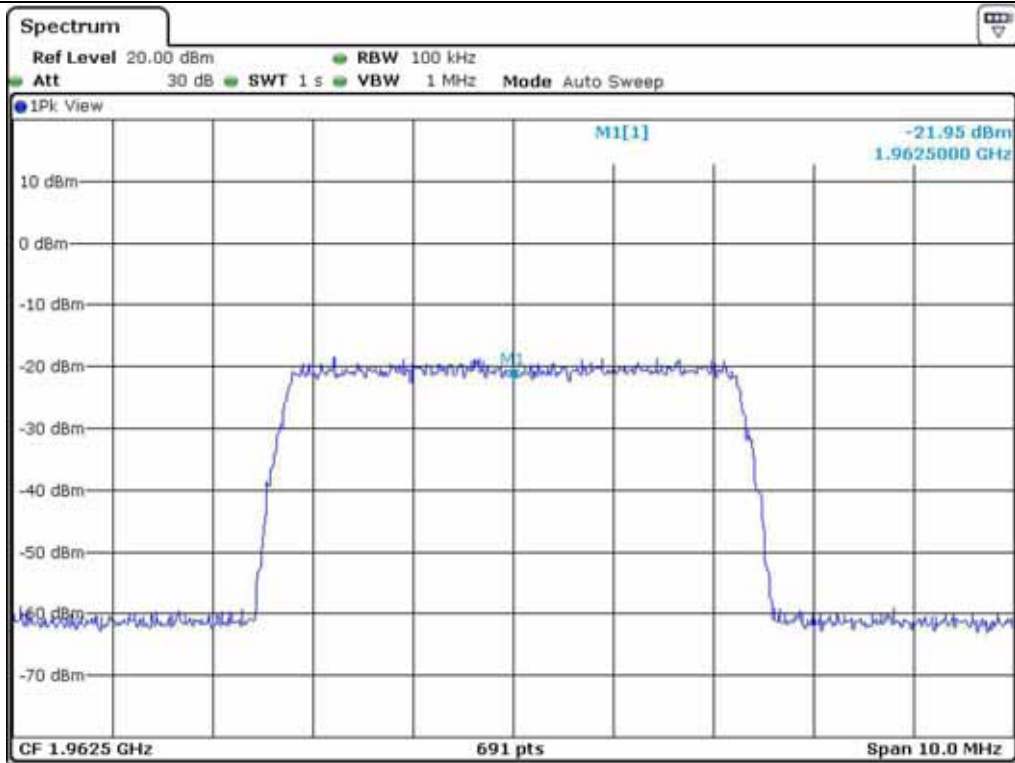


WCDMA – Input (Middle Channel)

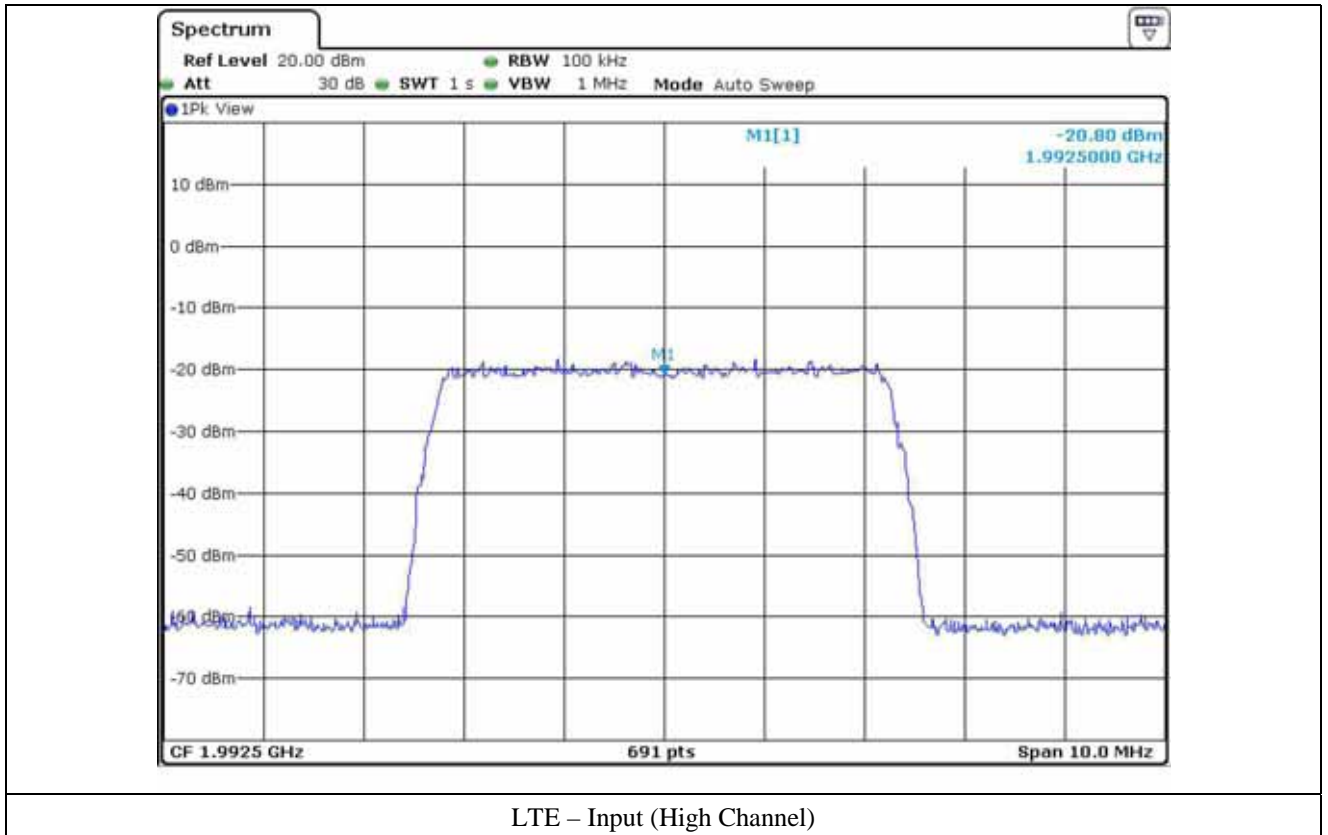




LTE – Input (Low Channel)



LTE – Input (Middle Channel)





## 7. SPURIOUS EMISSION AT ANTENNA TERMINAL

### 7.1 Operating environment

Temperature : 24 °C  
 Relative humidity : 48 % R.H.

### 7.2 Test set-up for conducted measurement

The RF signal from the signal generator(s) was injected to the EUT and the amplified RF signal at the output of the EUT was connected to the spectrum analyzer. The test was performed at three frequencies (low, middle, and high channels) at each band using all applicable modulation.

The resolution bandwidth and video bandwidth of the spectrum analyzer was set at 1 MHz and sufficient scans were taken to show any out of band emissions up to 25 GHz.



### 7.3 Test equipment used

Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
<input type="checkbox"/> - E4432B	HP	Signal Generator	US38440950	June 10, 2011 (1Y)
<input checked="" type="checkbox"/> - SMJ100A	R/S	Signal Generator	101038	Feb. 01, 2012 (1Y)
<input type="checkbox"/> - FSP	R/S	Spectrum Analyzer	100017	Mar. 15, 2011 (1Y)
<input type="checkbox"/> - 8564E	HP	Spectrum Analyzer	3650A00756	Jun. 10, 2011 (1Y)
<input checked="" type="checkbox"/> - FSV30	R/S	Spectrum Analyzer	101372	Aug. 29, 2011 (1Y)
<input checked="" type="checkbox"/> - WRCT 1900/ 2200-5/40-10SSK	Wainwright Instruments GmbH	Tunable Band Reject Filter	33	Oct. 21, 2011(2Y)
<input checked="" type="checkbox"/> - 67-30-43	Aeroflex Weinschel	Power Attenuator	CA5760	Nov. 30, 2011 (1Y)

All test equipment used is calibrated on a regular basis.

### 7.4 Test data

- Test Date : February 23, 2012
- Frequency range : 30 MHz ~ 25 GHz
- Result : PASSED BY -23.99 dB at LTE Mode

Modulation	Harmonic Frequency (MHz)		Measured Value (dBm)	Cable Loss (dB)	Total (dBm)	Limit (dBm)	Margin (dB)
GSM	Low	944.60	-61.03	0.90	-60.13	-13.00	-47.13
		7 825.00	-42.13	3.50	-38.63		-25.63
	Middle	822.40	-60.95	0.75	-60.20		-47.20
		7 825.00	-41.82	3.50	-38.32		-25.32
	High	936.10	-61.06	0.90	-60.16		-47.16
		7 825.00	-41.35	3.50	-37.85		-24.85
EDGE	Low	717.10	-61.23	0.70	-60.53	-13.00	-47.53
		7 825.00	-42.08	3.50	-38.58		-25.58
	Middle	936.10	-61.02	0.90	-60.12		-47.12
		7 825.00	-41.84	3.50	-38.34		-25.34
	High	948.80	-60.25	0.90	-59.35		-46.35
		7 825.00	-41.42	3.50	-37.92		-24.92
CDMA	Low	868.70	-60.81	0.75	-60.06	-13.00	-47.06
		7 825.00	-42.06	3.50	-38.56		-25.56
	Middle	666.60	-61.57	0.60	-60.97		-47.97
		7 825.00	-42.22	3.50	-38.72		-25.72
	High	870.20	-61.28	0.75	-60.53		-47.53
		7 825.00	-41.79	3.50	-38.29		-25.29
1xEVDO	Low	774.70	-61.00	0.65	-60.35	-13.00	-47.35
		7 825.00	-42.17	3.50	-38.67		-25.67
	Middle	837.90	-61.03	0.75	-60.28		-47.28
		7 825.00	-42.24	3.50	-38.74		-25.74
	High	965.60	-60.56	0.90	-59.66		-46.66
		7 825.00	-42.43	3.50	-38.93		-25.93

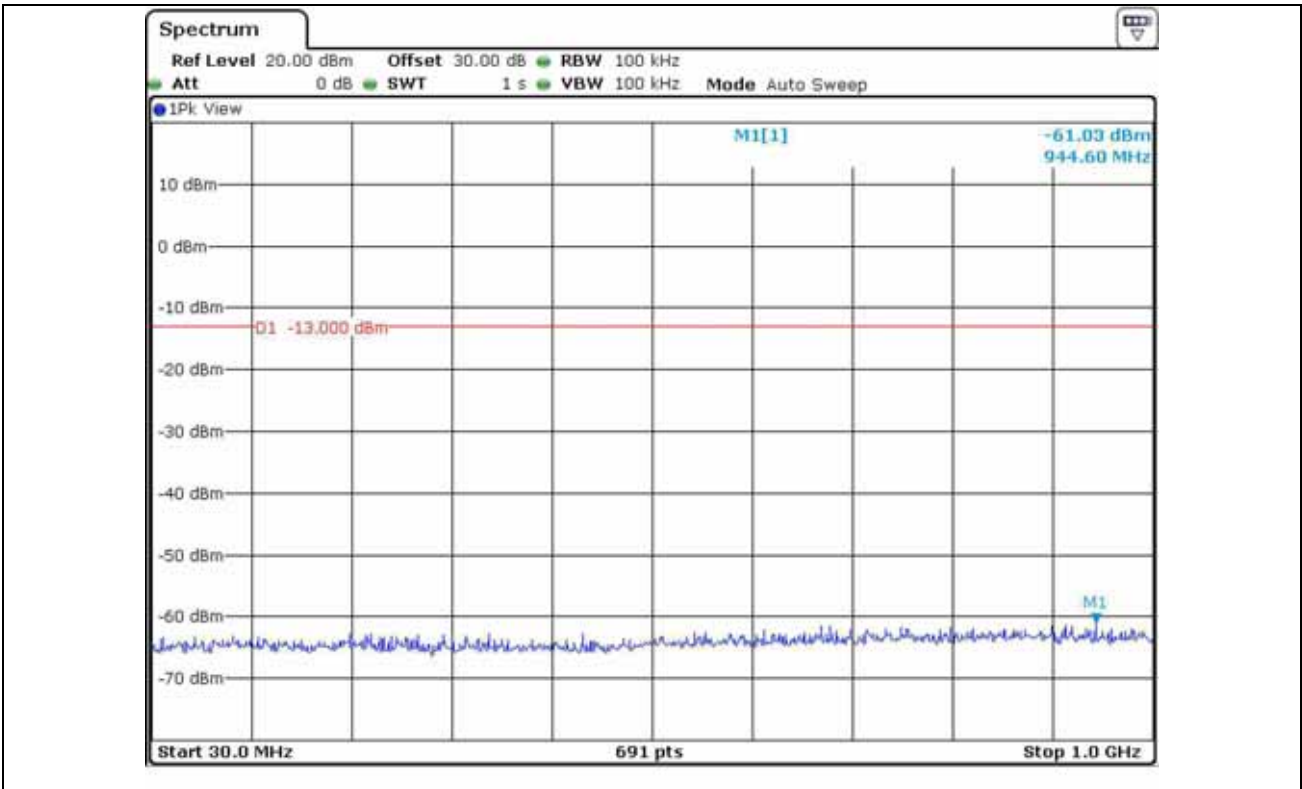
According to Part 24E, out of band emission shall be attenuated by  $43 + 10 \log (P)$  dBc, equates to -13.0 dBm.

Modulation	Harmonic Frequency (MHz)		Measured Value (dBm)	Cable Loss (dB)	Total (dBm)	Limit (dBm)	Margin (dB)
WCDMA	Low	818.20	-61.05	0.75	-60.30	-13.00	-47.30
		7 825.00	-42.90	3.50	-39.40		-26.40
	Middle	999.30	-60.60	0.90	-59.70		-46.70
		7 825.00	-42.39	3.50	-38.89		-25.89
	High	867.30	-61.12	0.75	-60.37		-47.37
		7 825.00	-40.84	3.50	-37.34		-24.34
LTE	Low	707.30	-60.98	0.70	-60.28	-13.00	-47.28
		7 825.00	-42.18	3.50	-38.68		-25.68
	Middle	808.40	-61.23	0.75	-60.48		-47.48
		7 825.00	-40.49	3.50	-36.99		-23.99
	High	829.40	-60.94	0.75	-60.19		-47.19
		7 825.00	-41.98	3.50	-38.48		-25.48

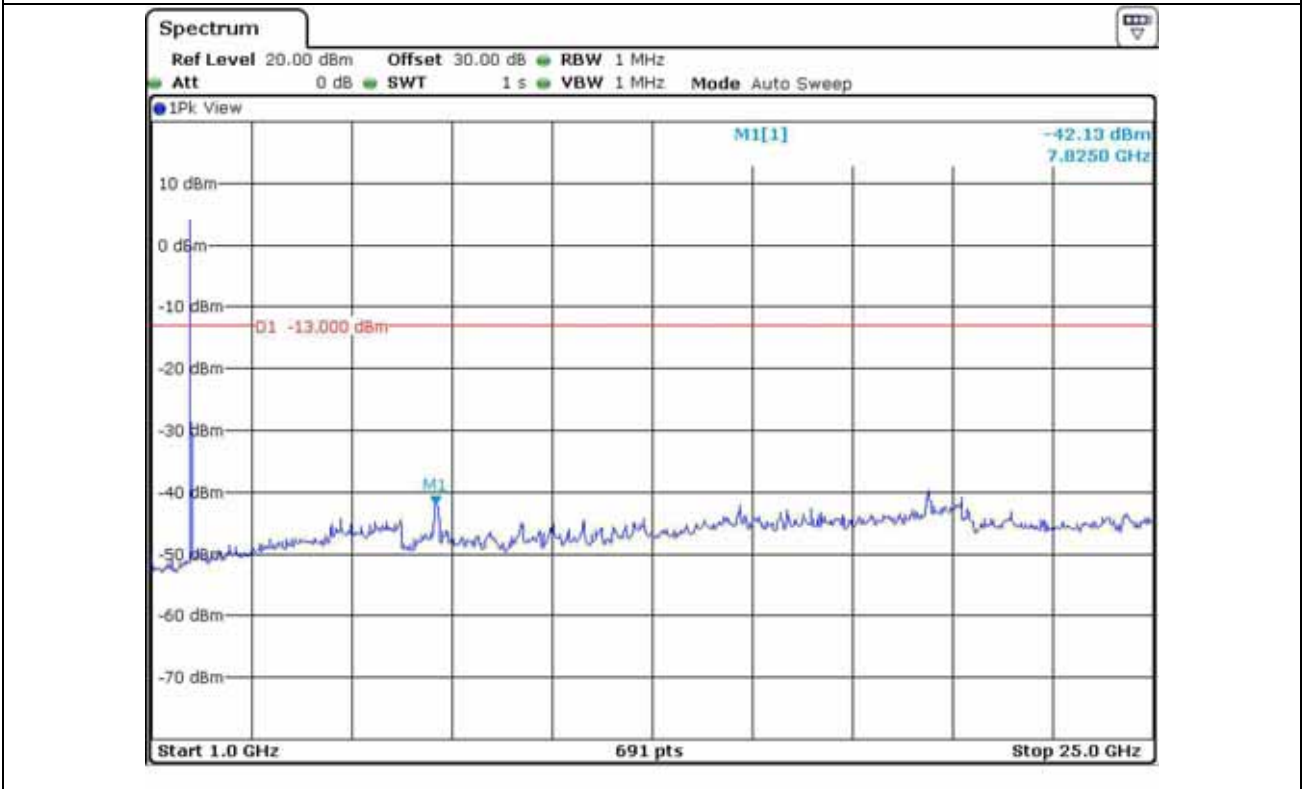
According to Part 24E, out of band emission shall be attenuated by  $43 + 10 \log (P)$  dBc, equates to -13.0 dBm.

Ki-Hong

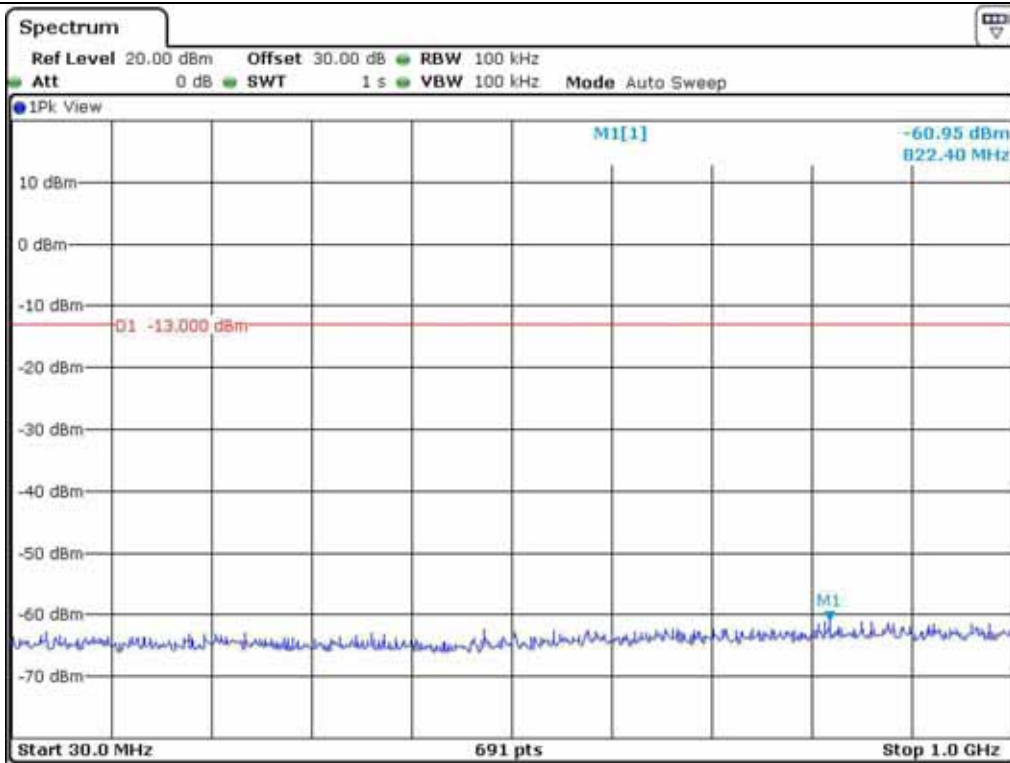
**Tested by: Ki-Hong, Nam / Project Engineer**



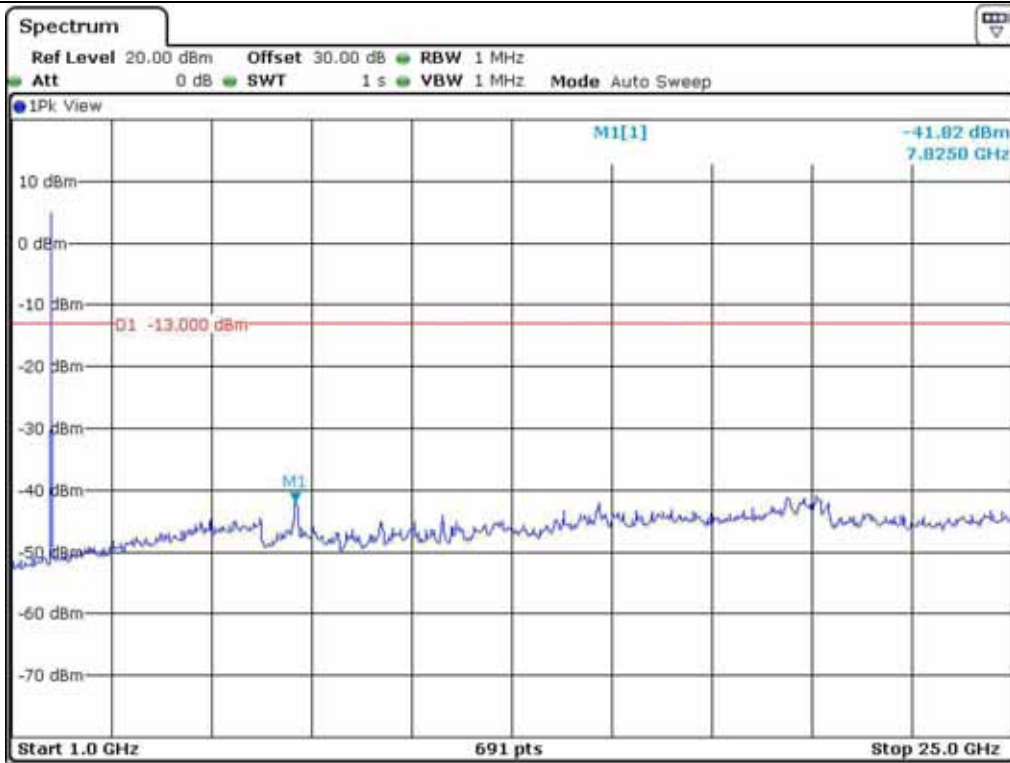
GSM – Low Channel



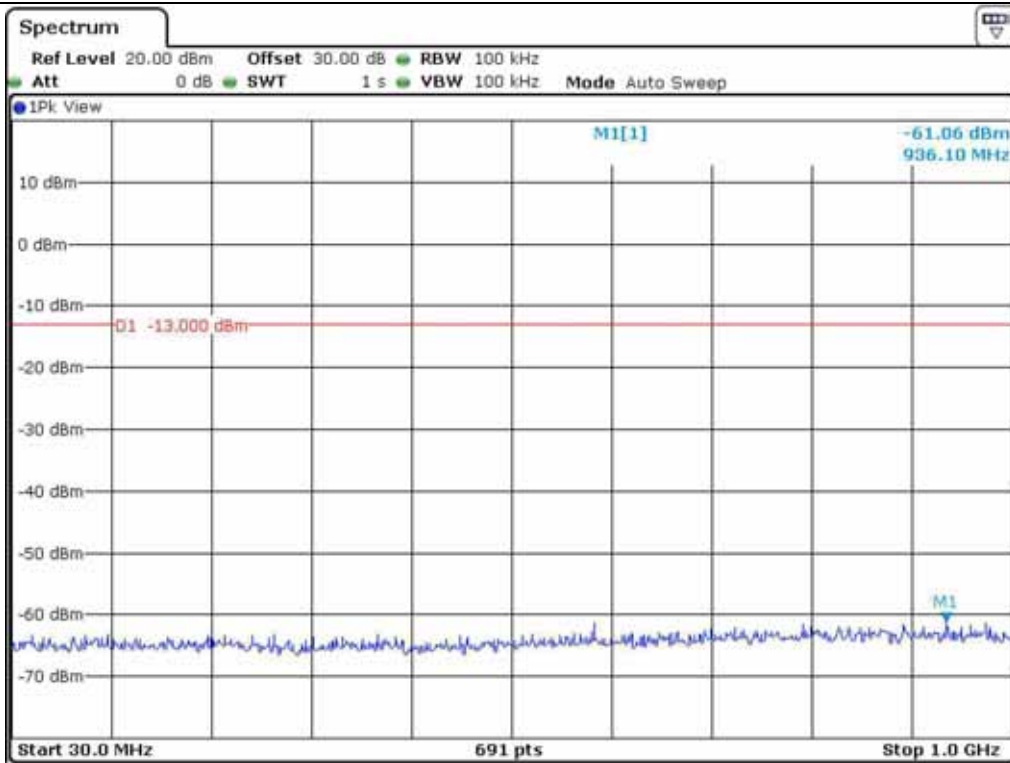
GSM – Low Channel



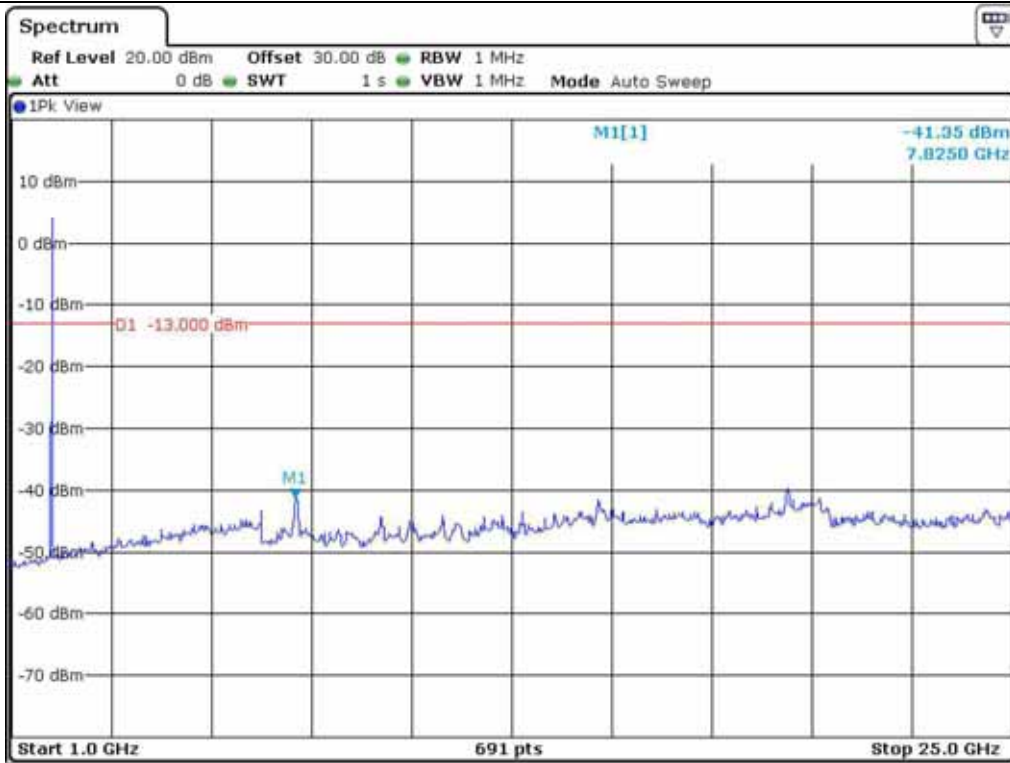
GSM – Middle Channel



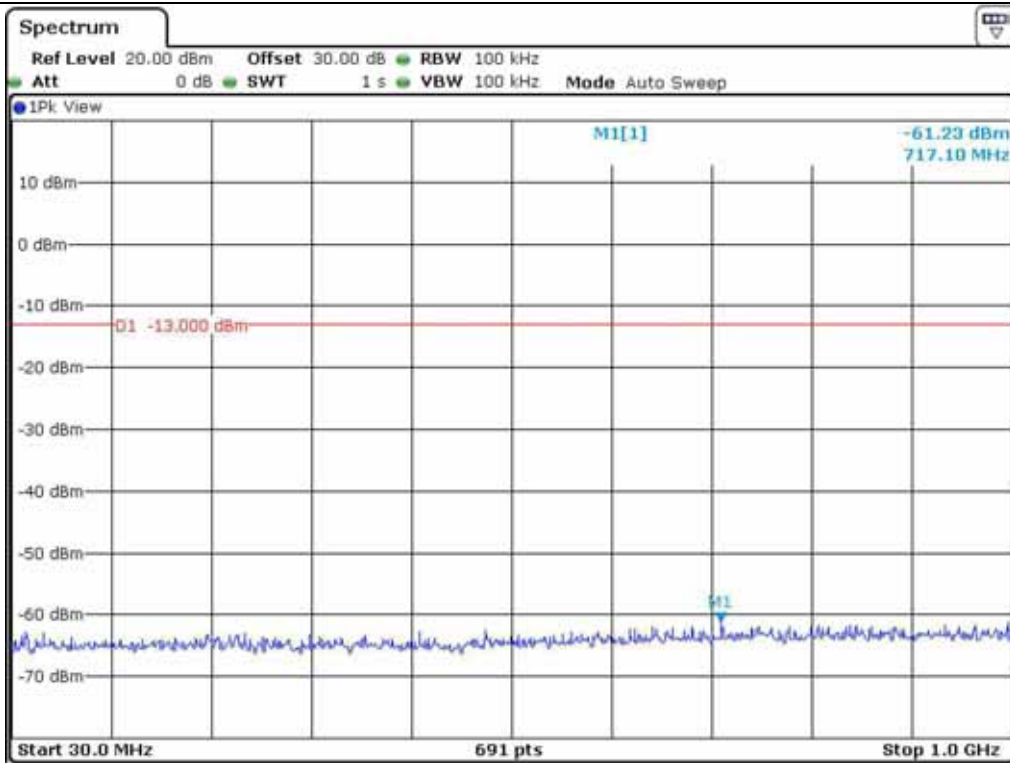
GSM – Middle Channel



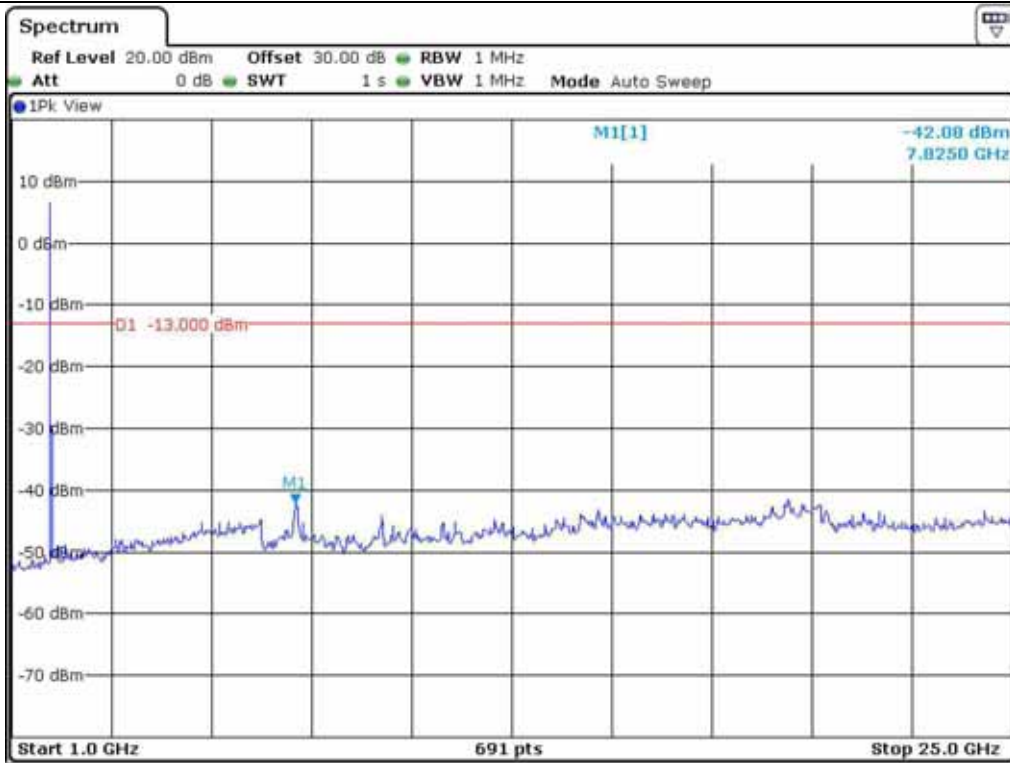
GSM – High Channel



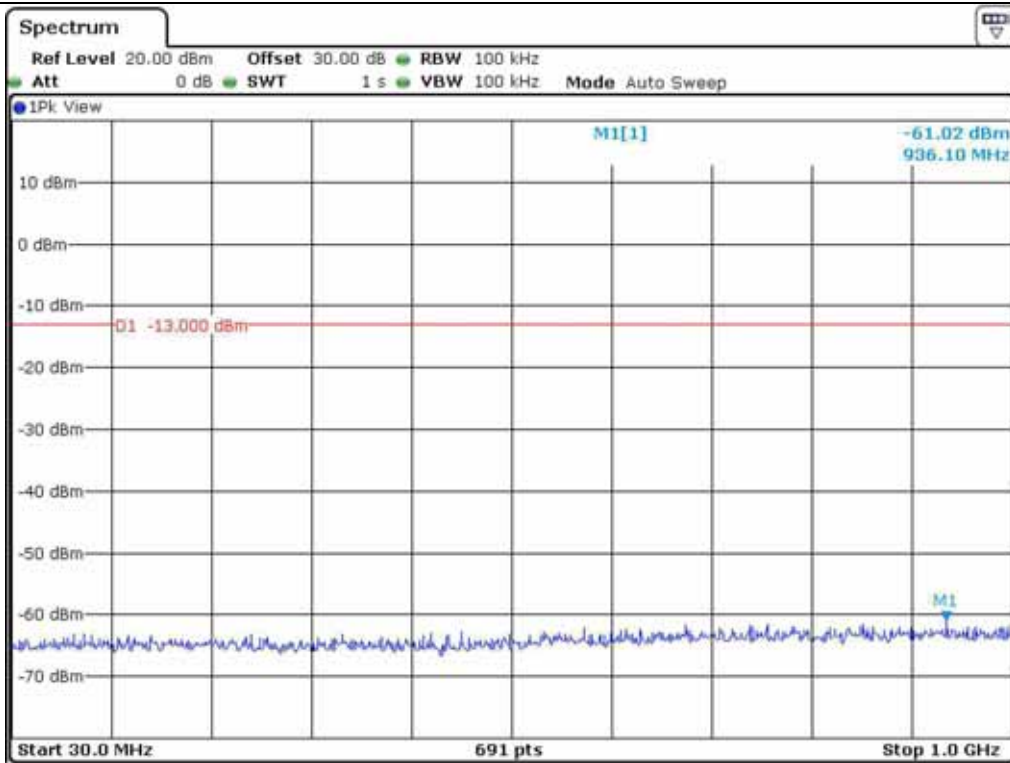
GSM – High Channel



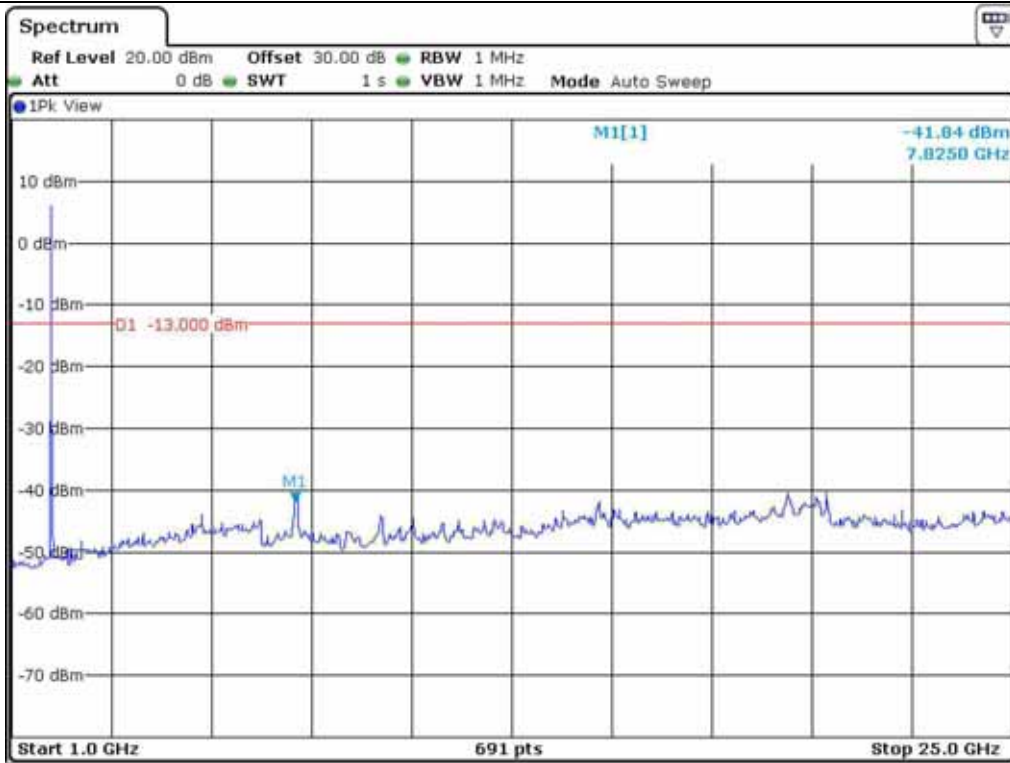
EDGE – Low Channel



EDGE – Low Channel

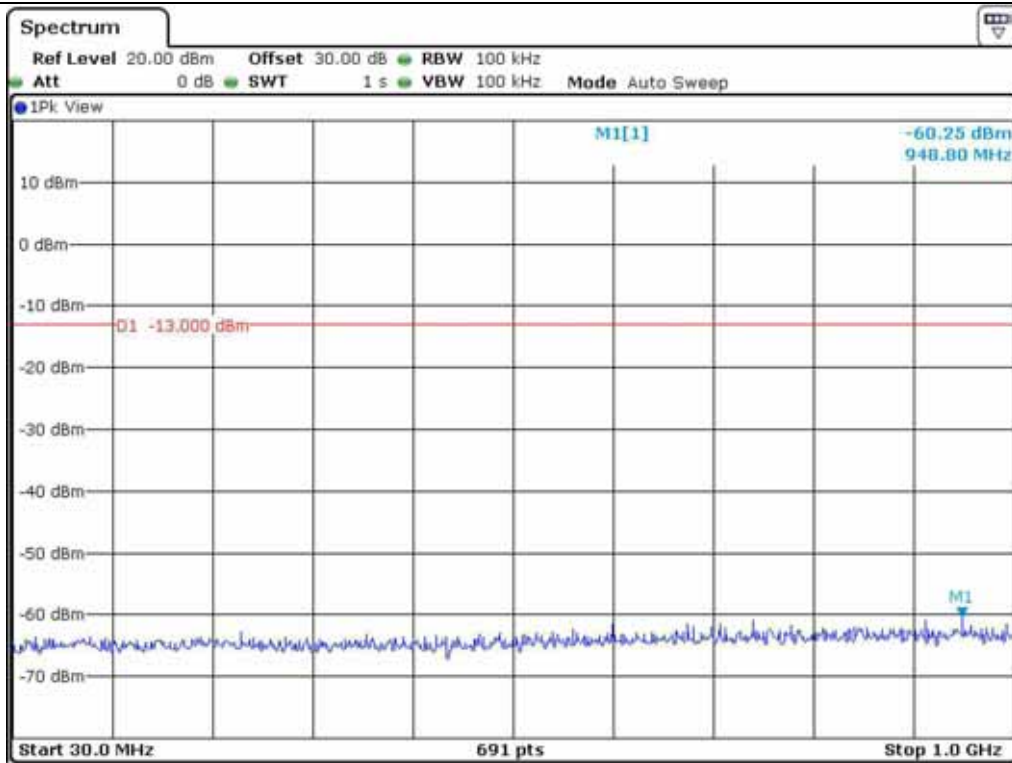


EDGE – Middle Channel

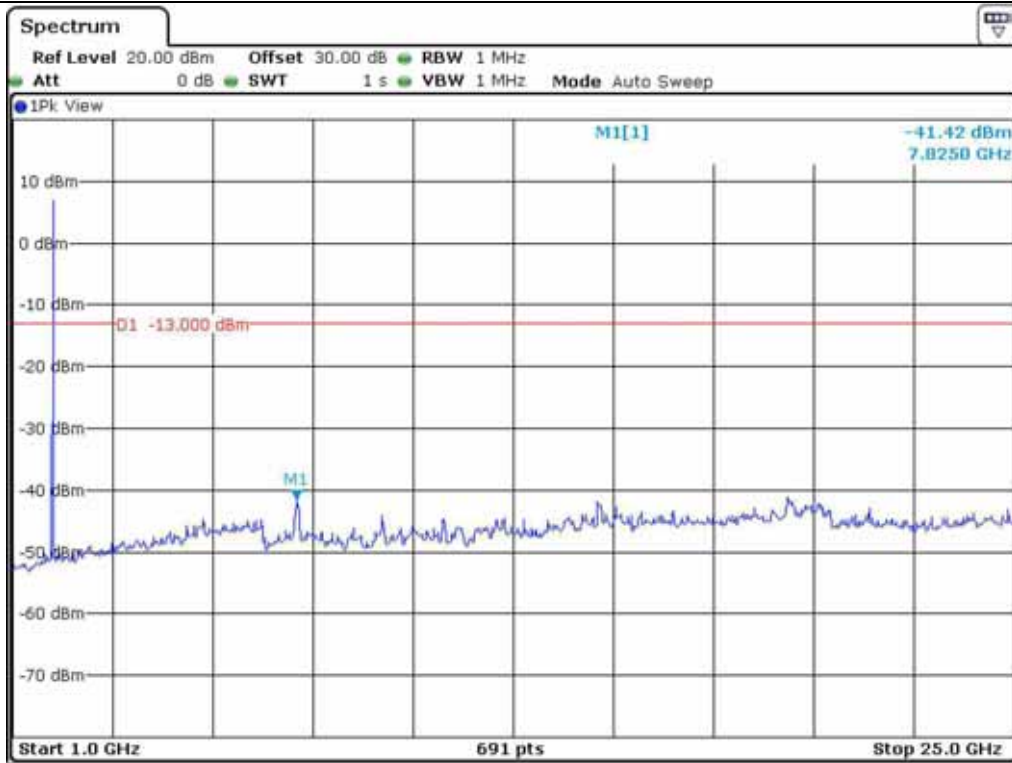


EDGE – Middle Channel

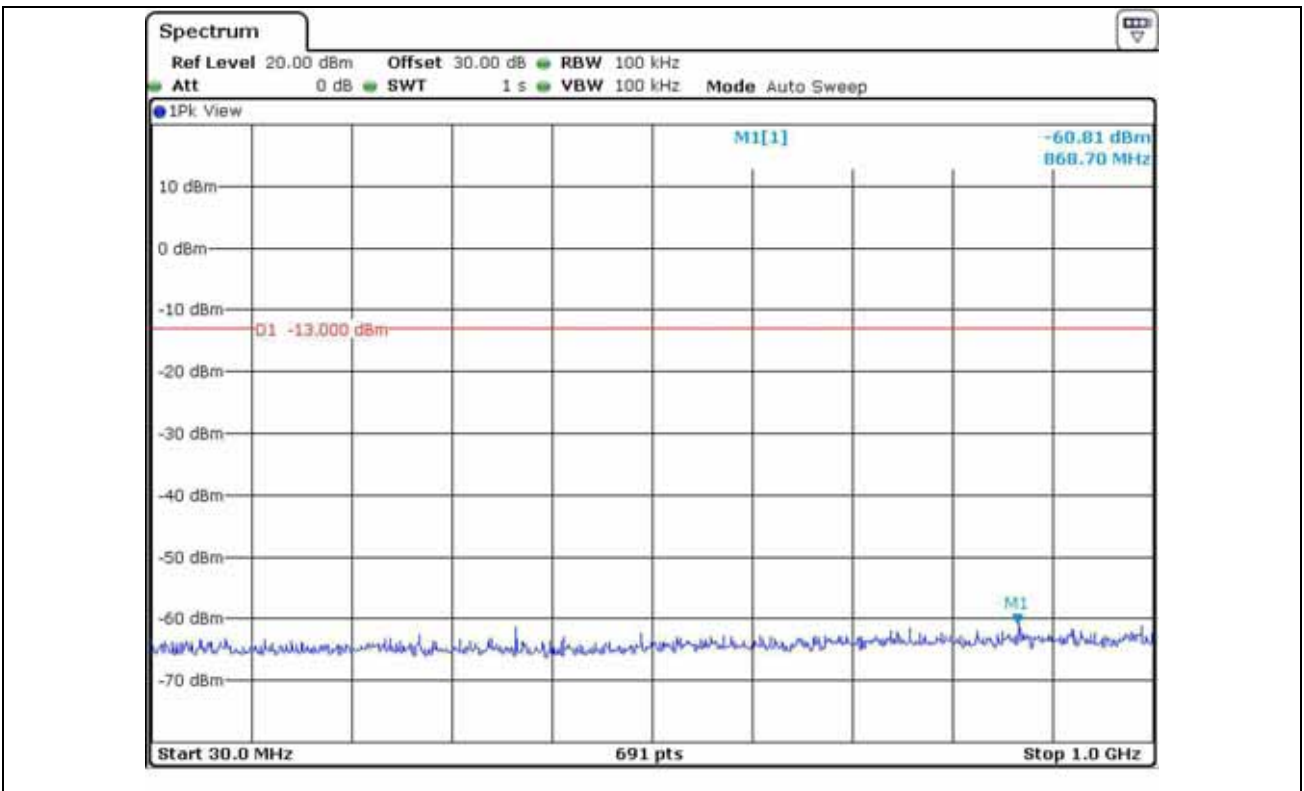




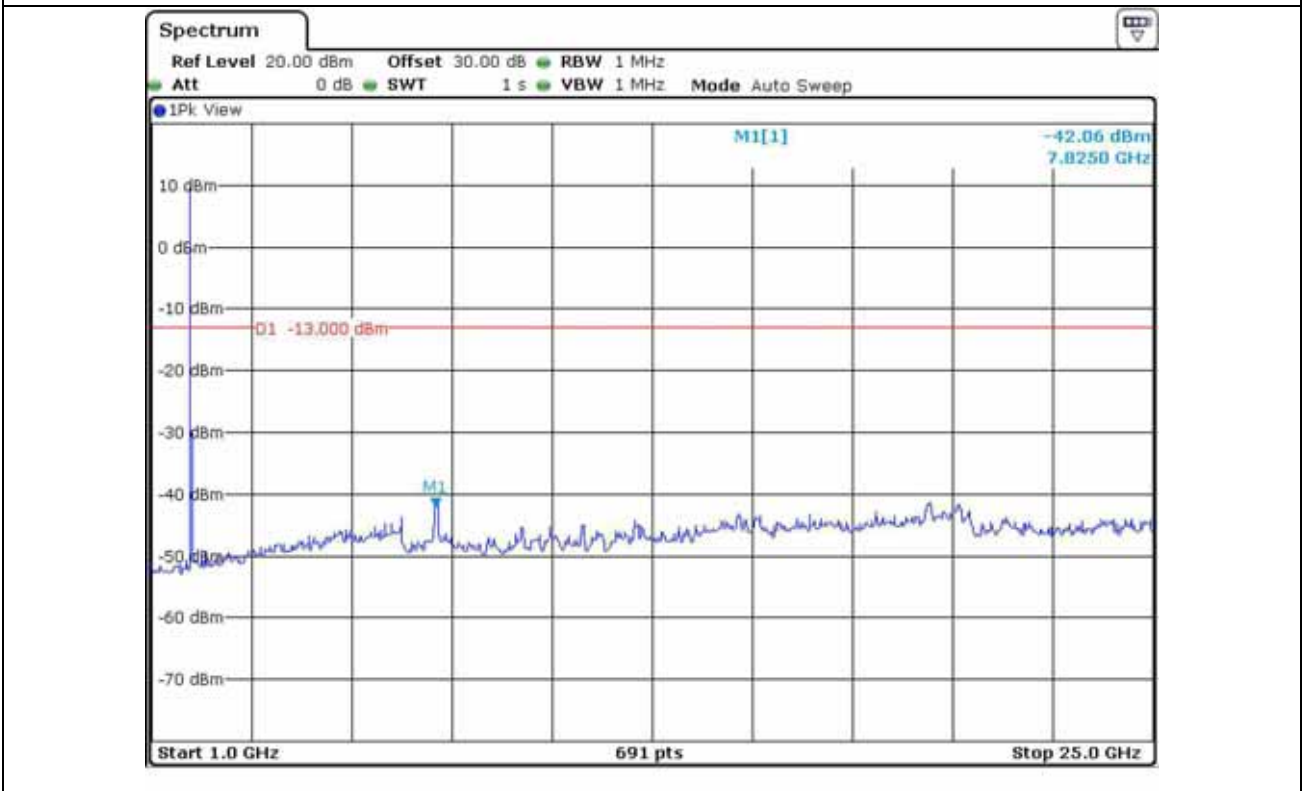
EDGE – High Channel



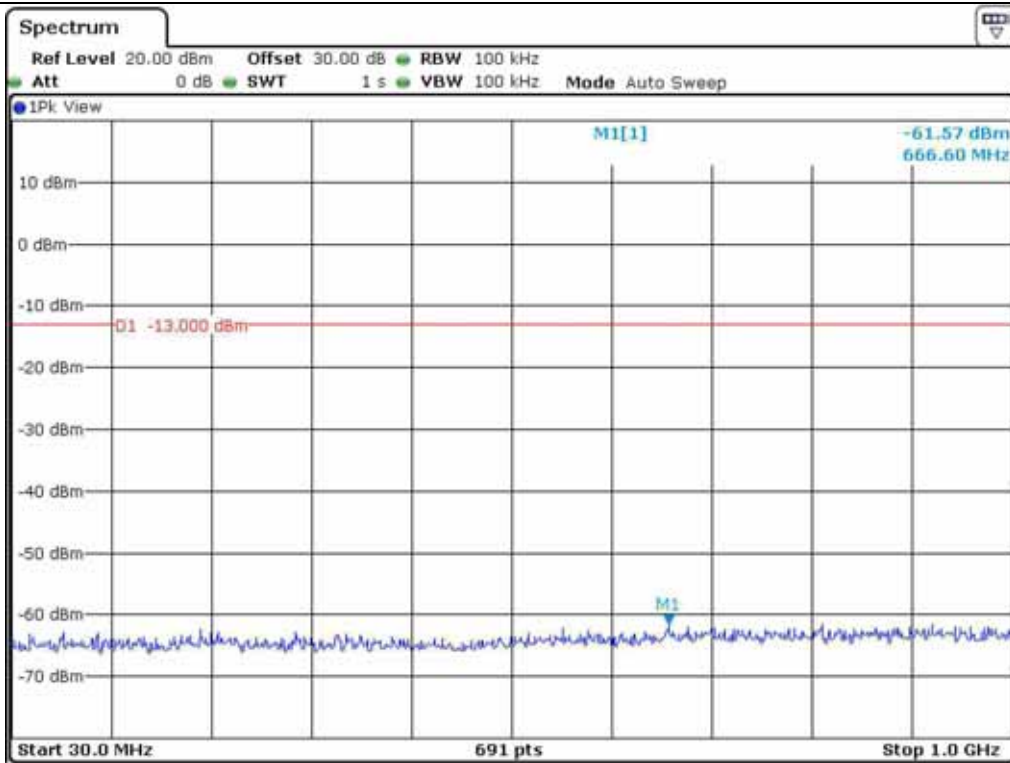
EDGE – High Channel



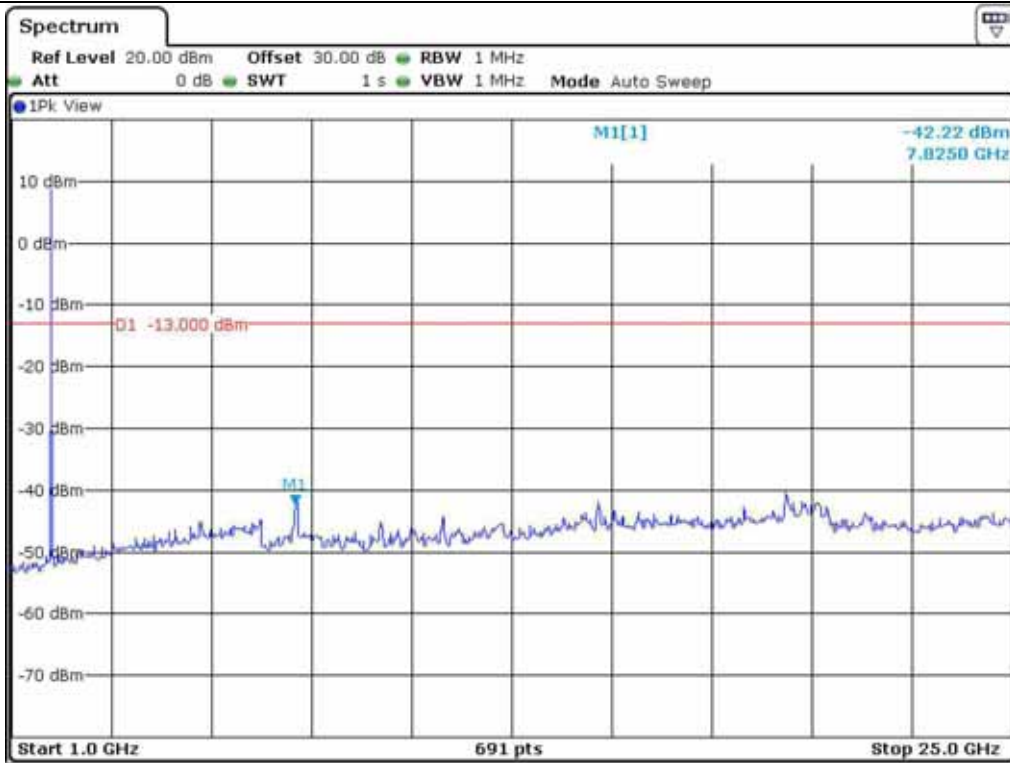
CDMA – Low Channel



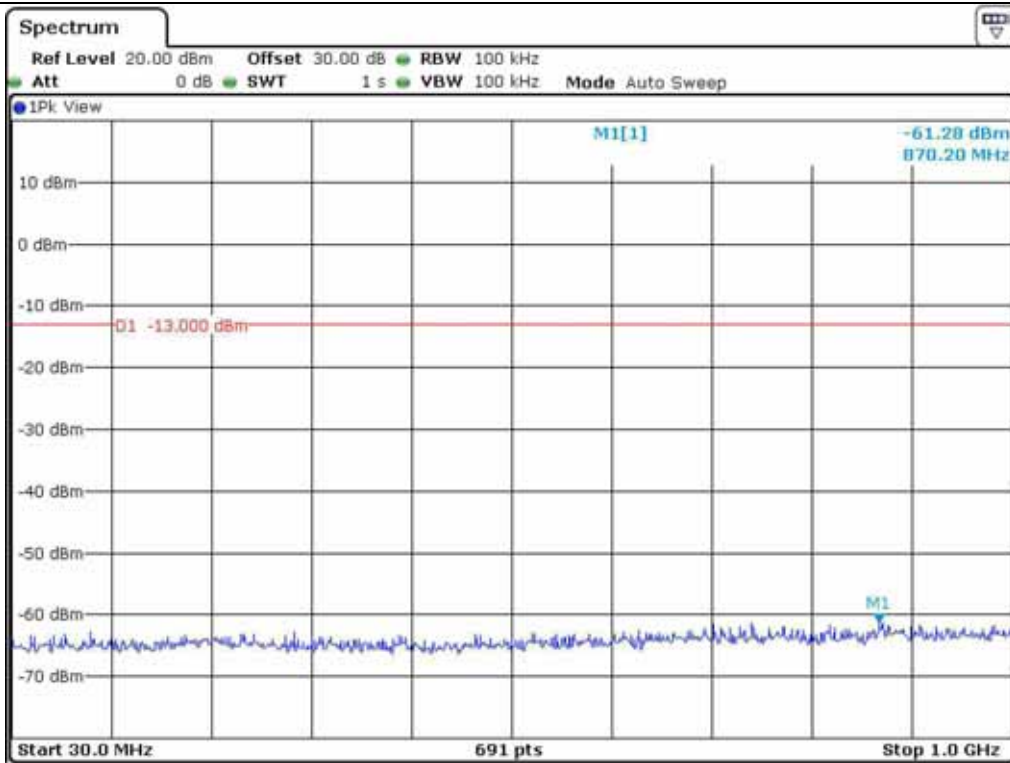
CDMA – Low Channel



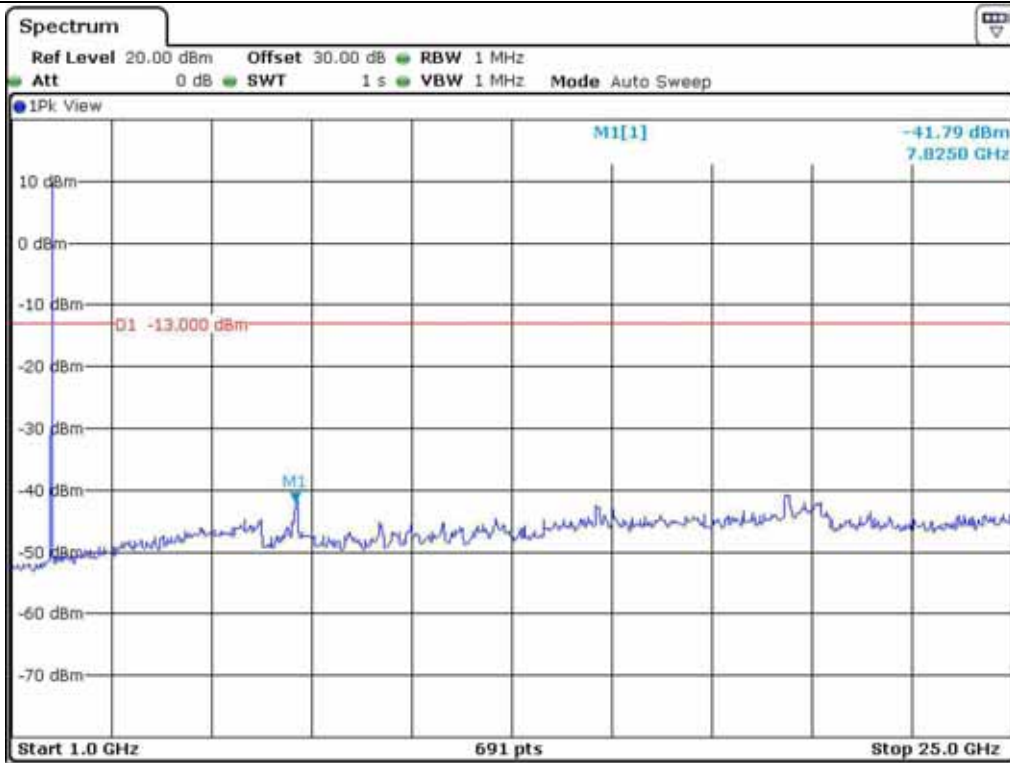
CDMA – Middle Channel



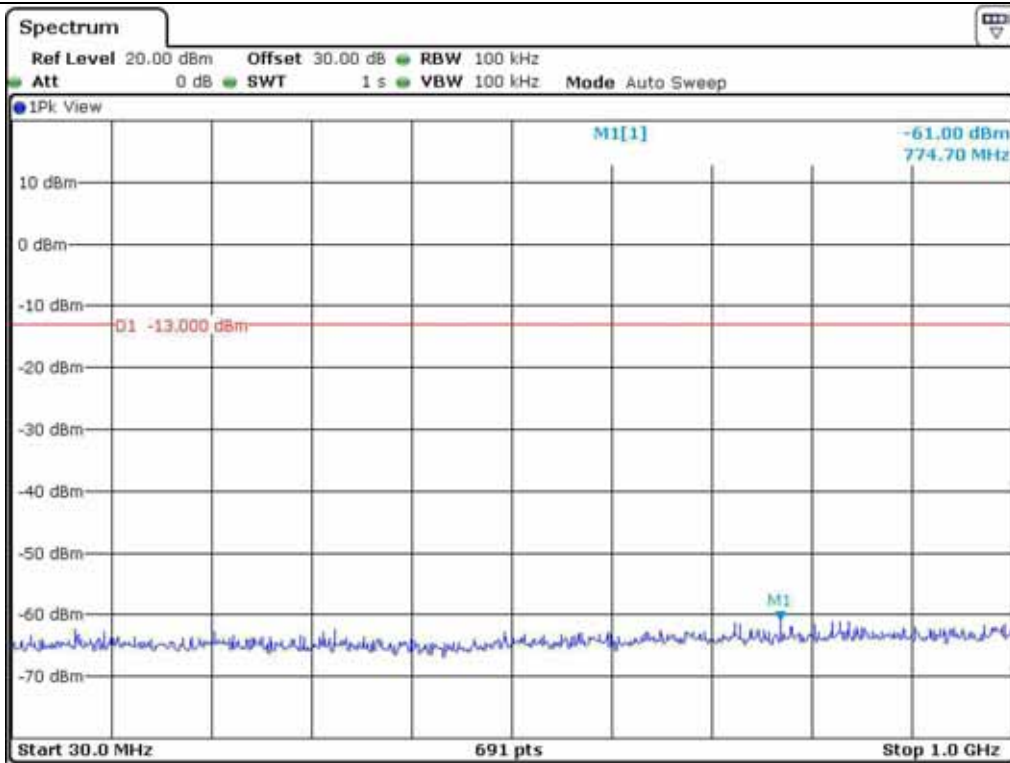
CDMA – Middle Channel



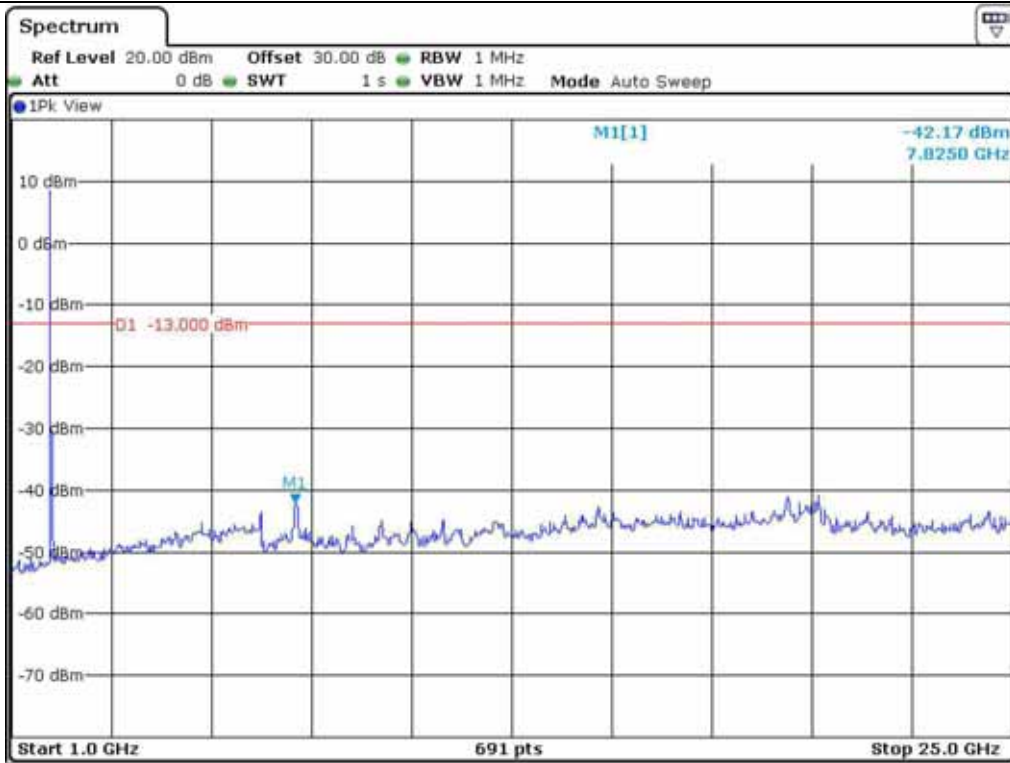
CDMA – High Channel



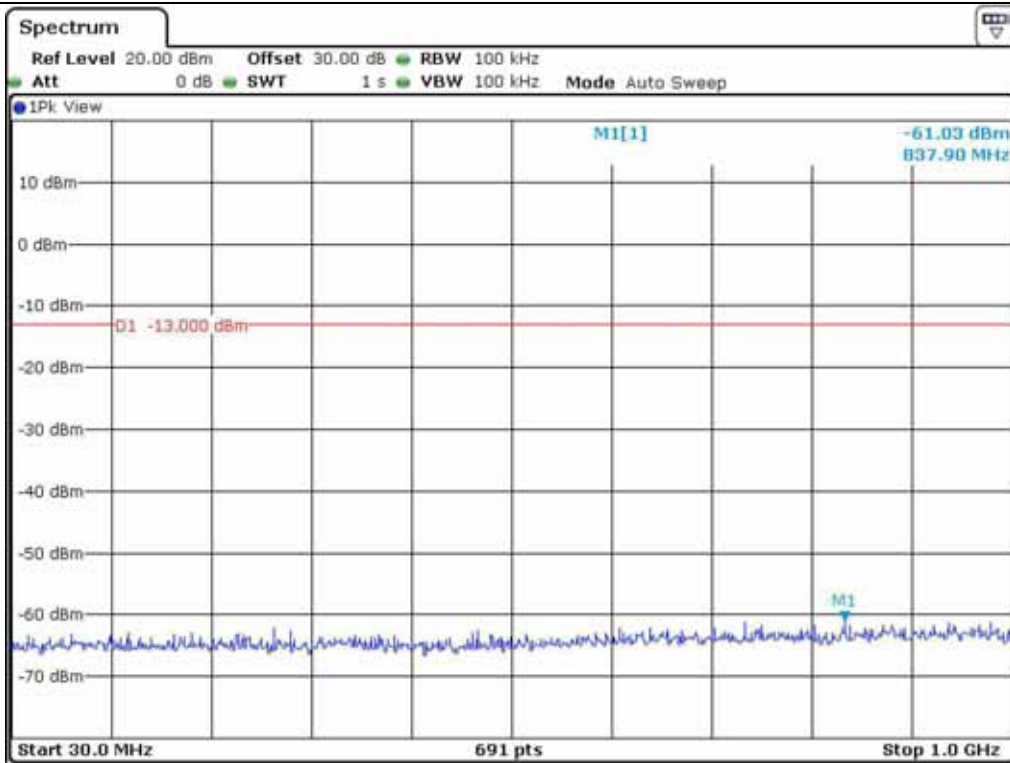
CDMA – High Channel



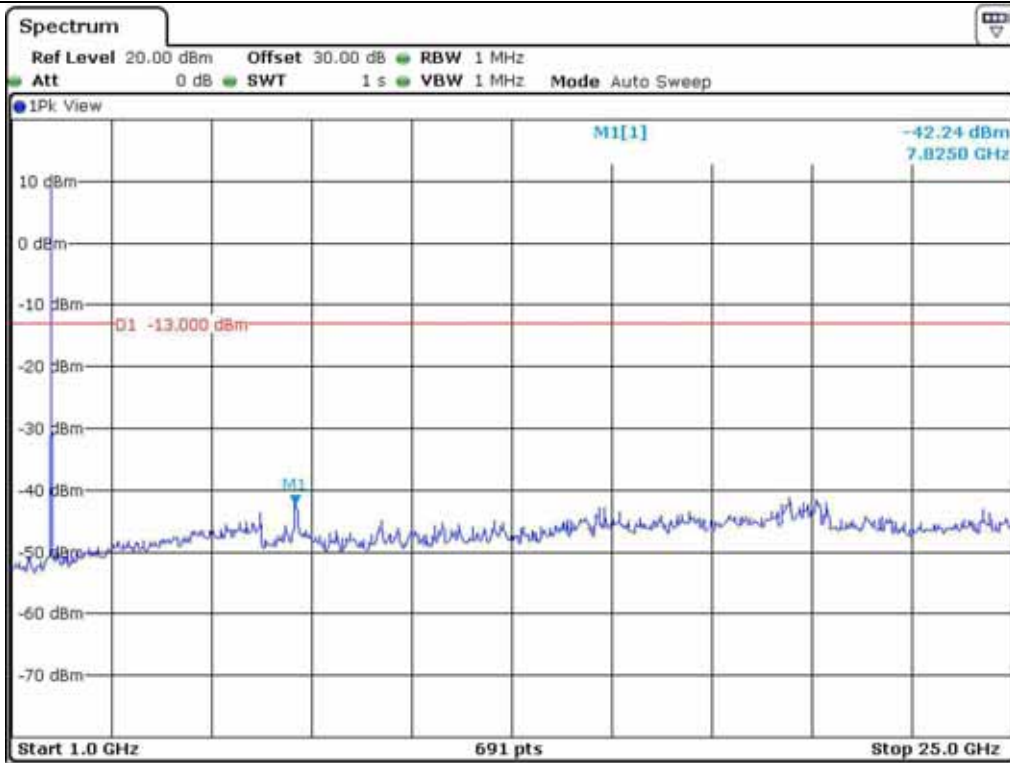
1xEVDO – Low Channel



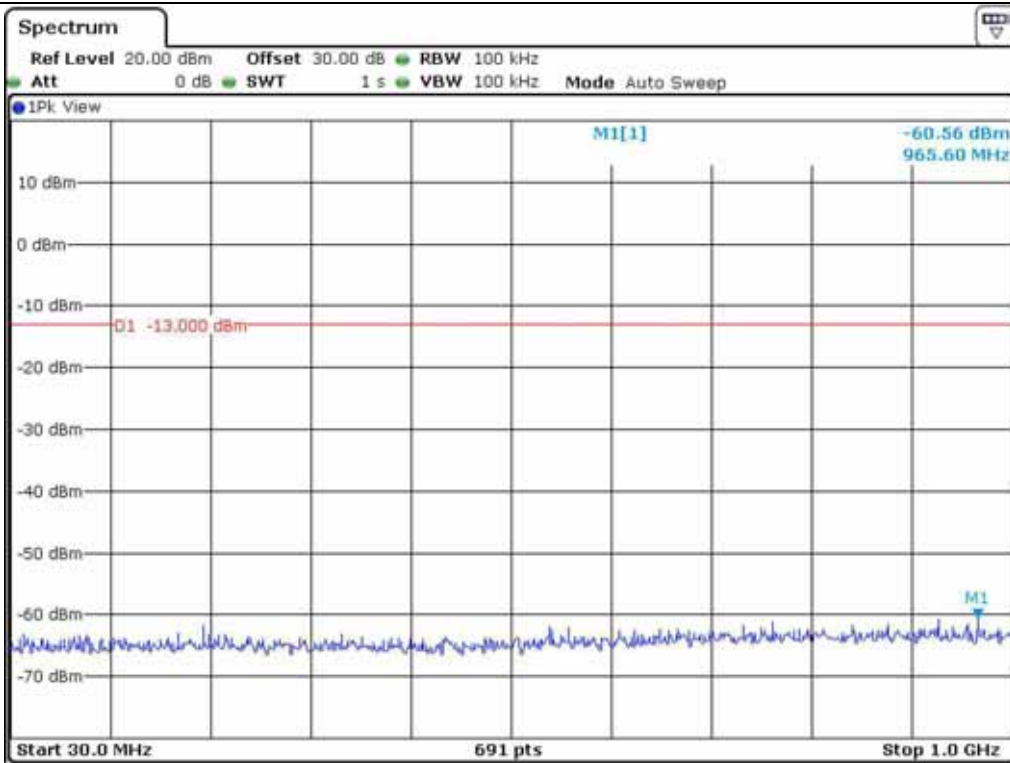
1xEVDO – Low Channel



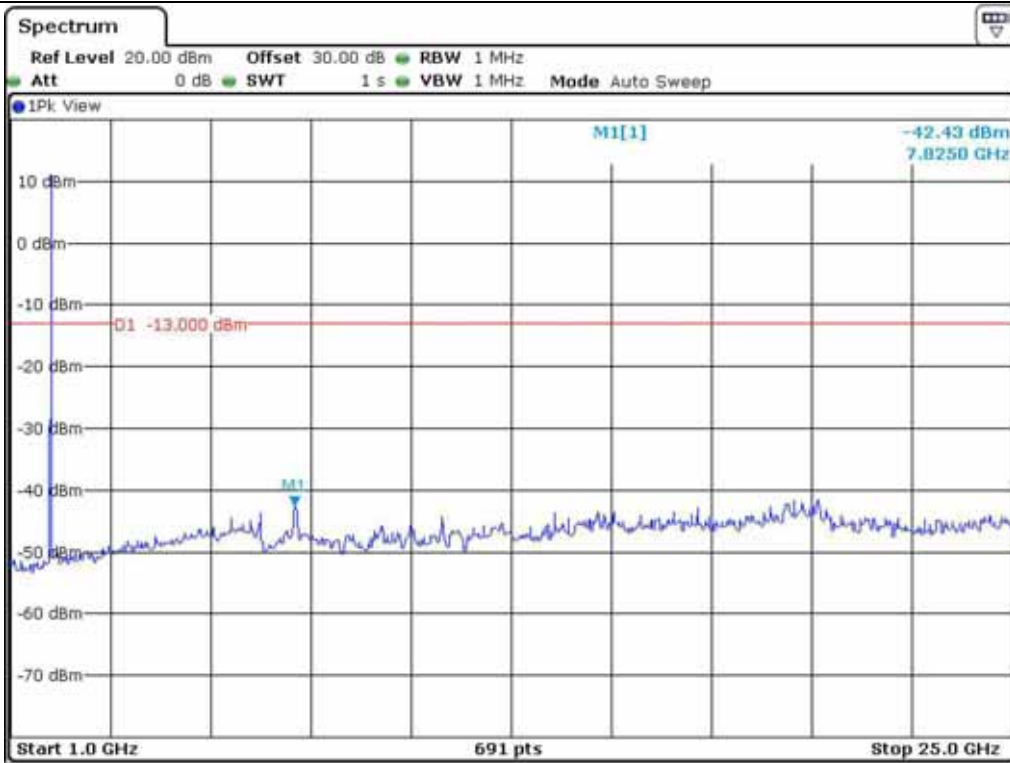
1xEVDO – Middle Channel



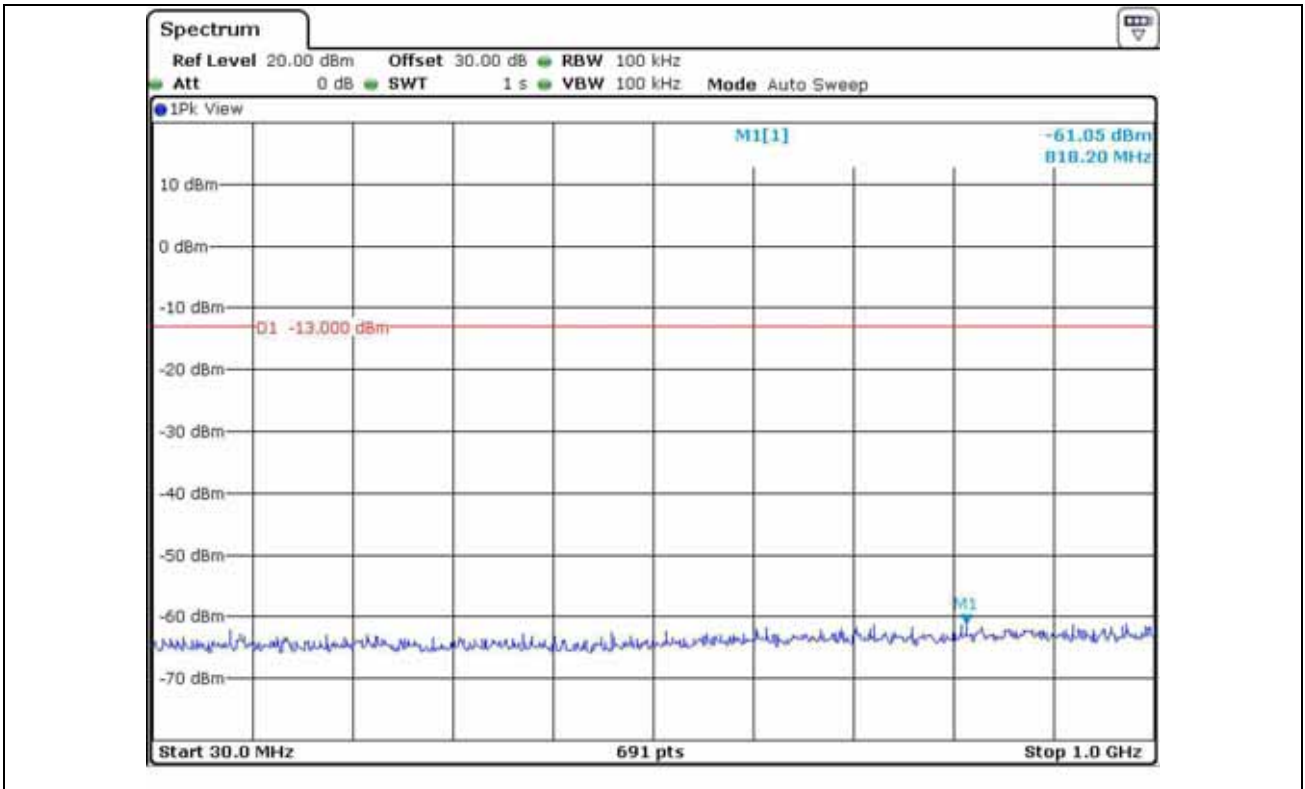
1xEVDO – Middle Channel



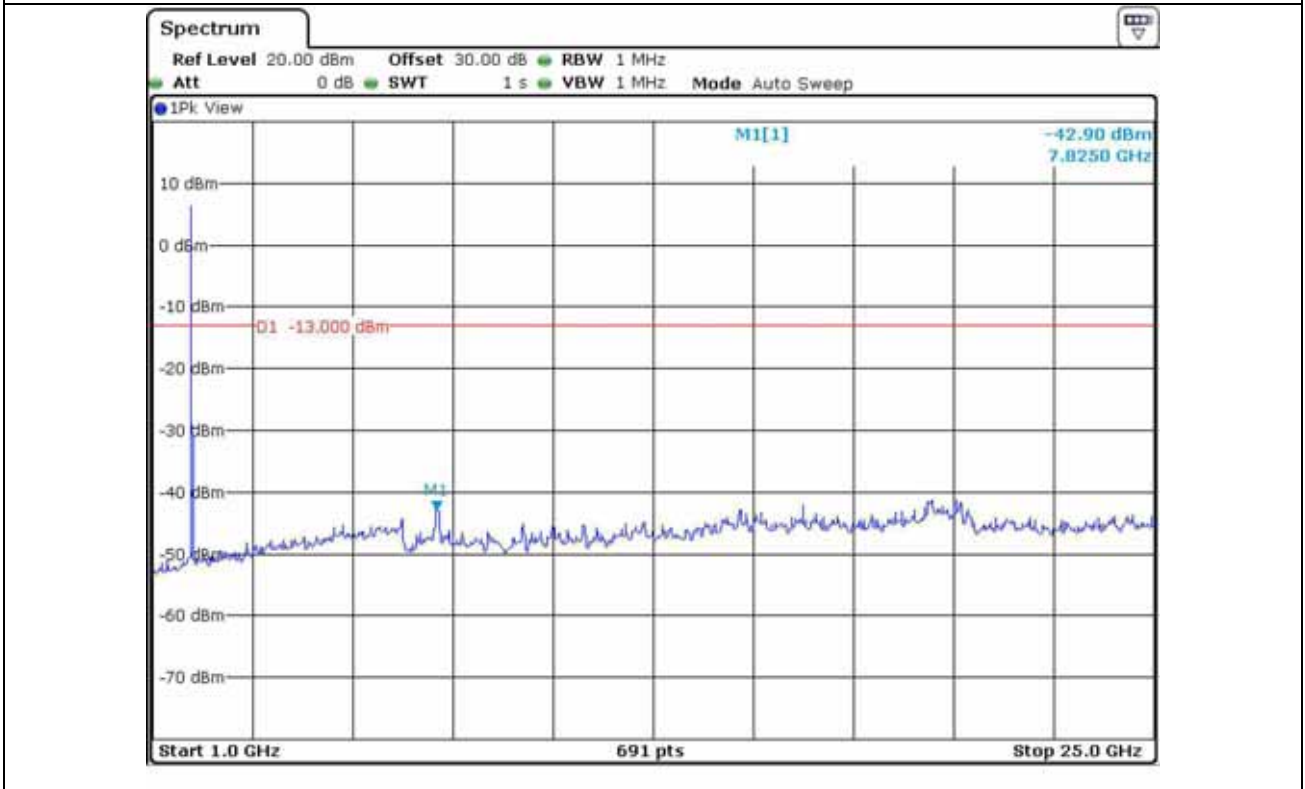
1xEVDO – High Channel



1xEVDO – High Channel

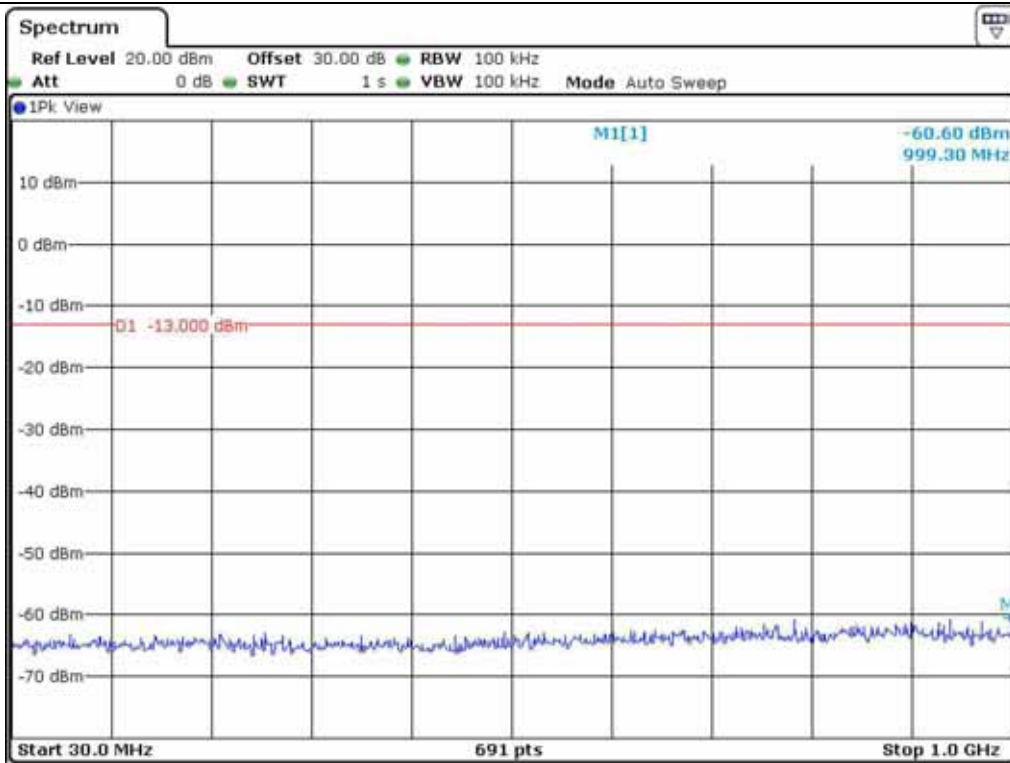


WCDMA – Low Channel

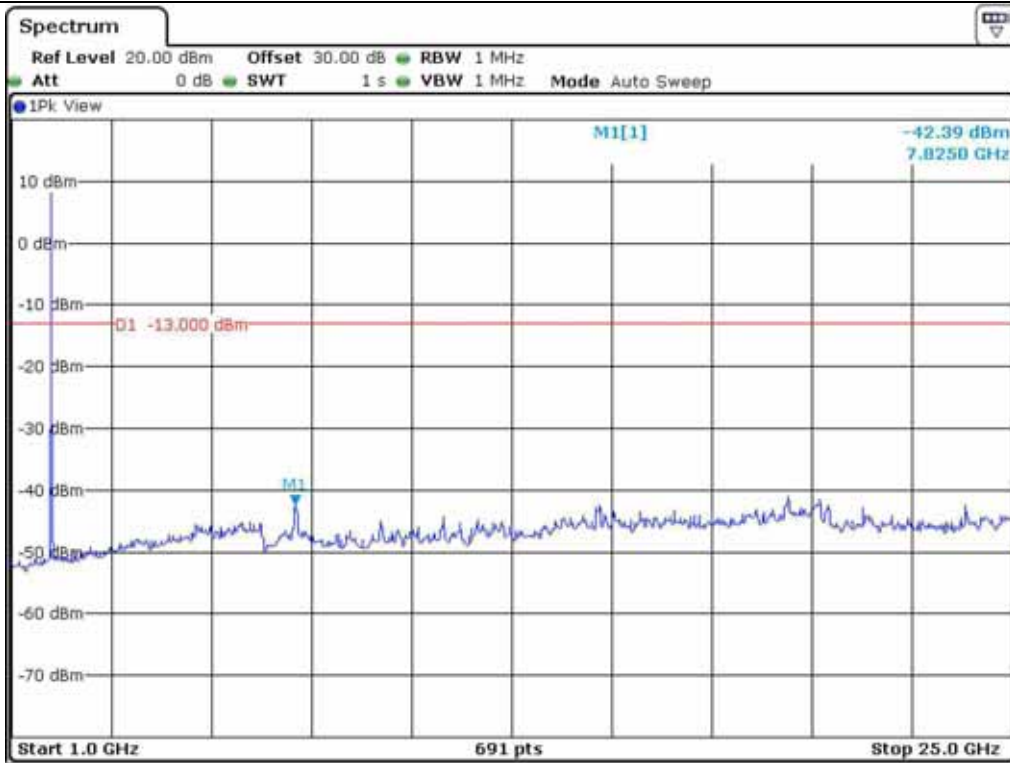


WCDMA – Low Channel

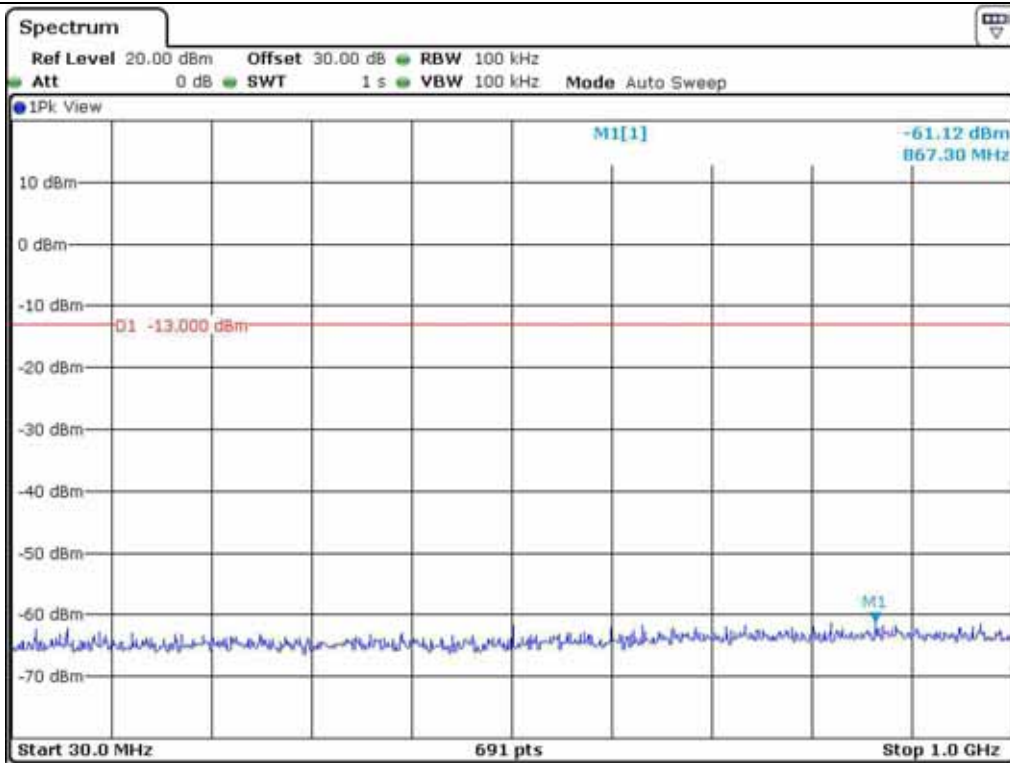




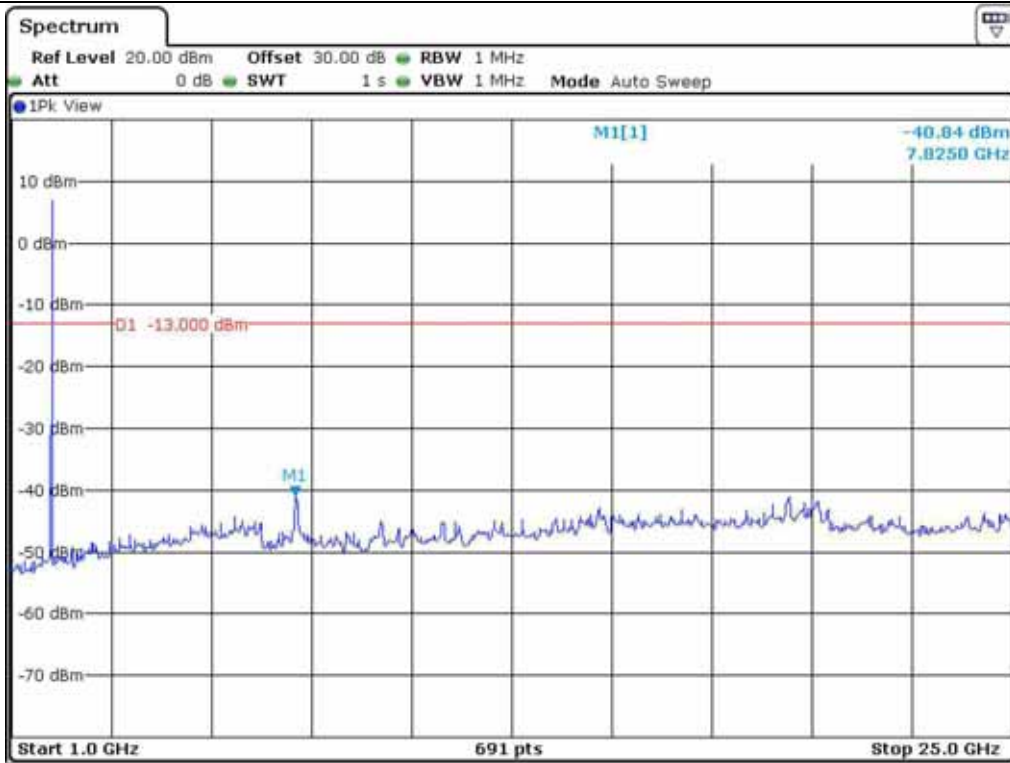
WCDMA – Middle Channel



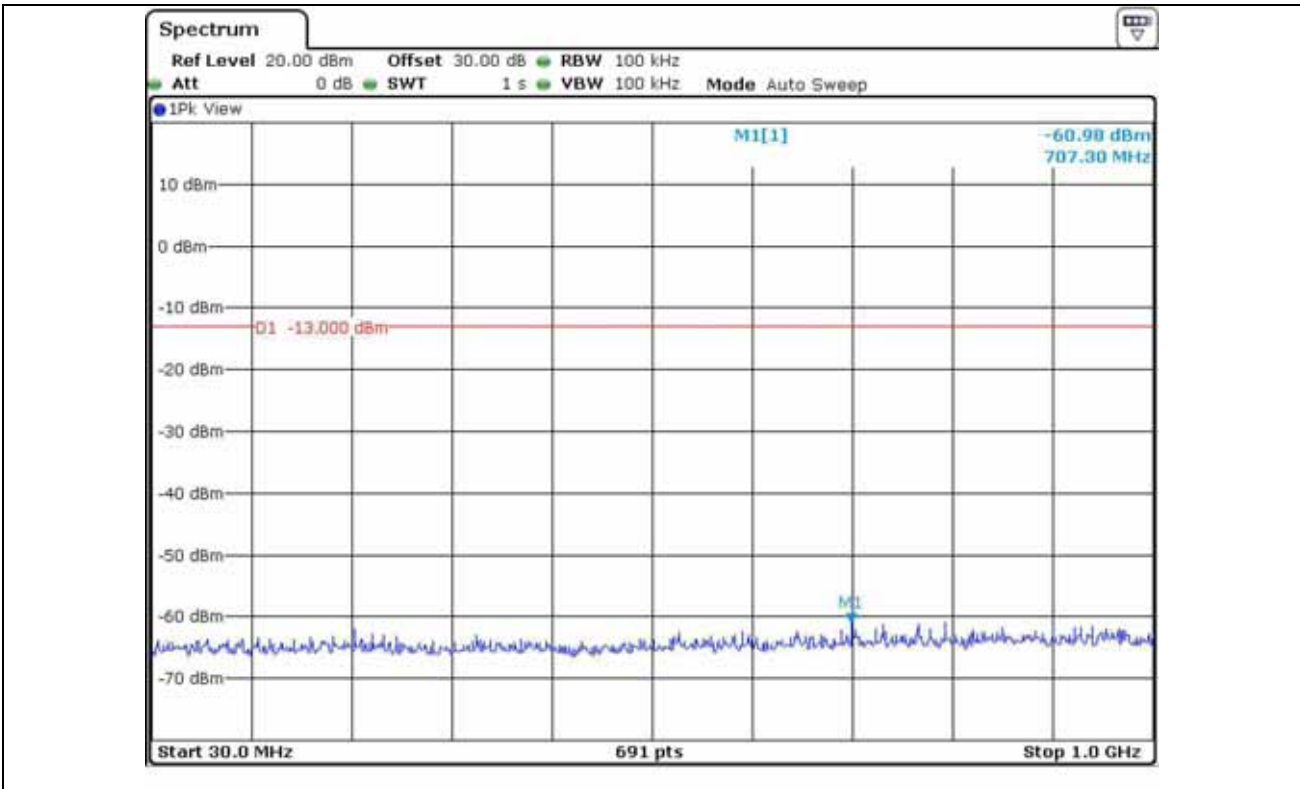
WCDMA – Middle Channel



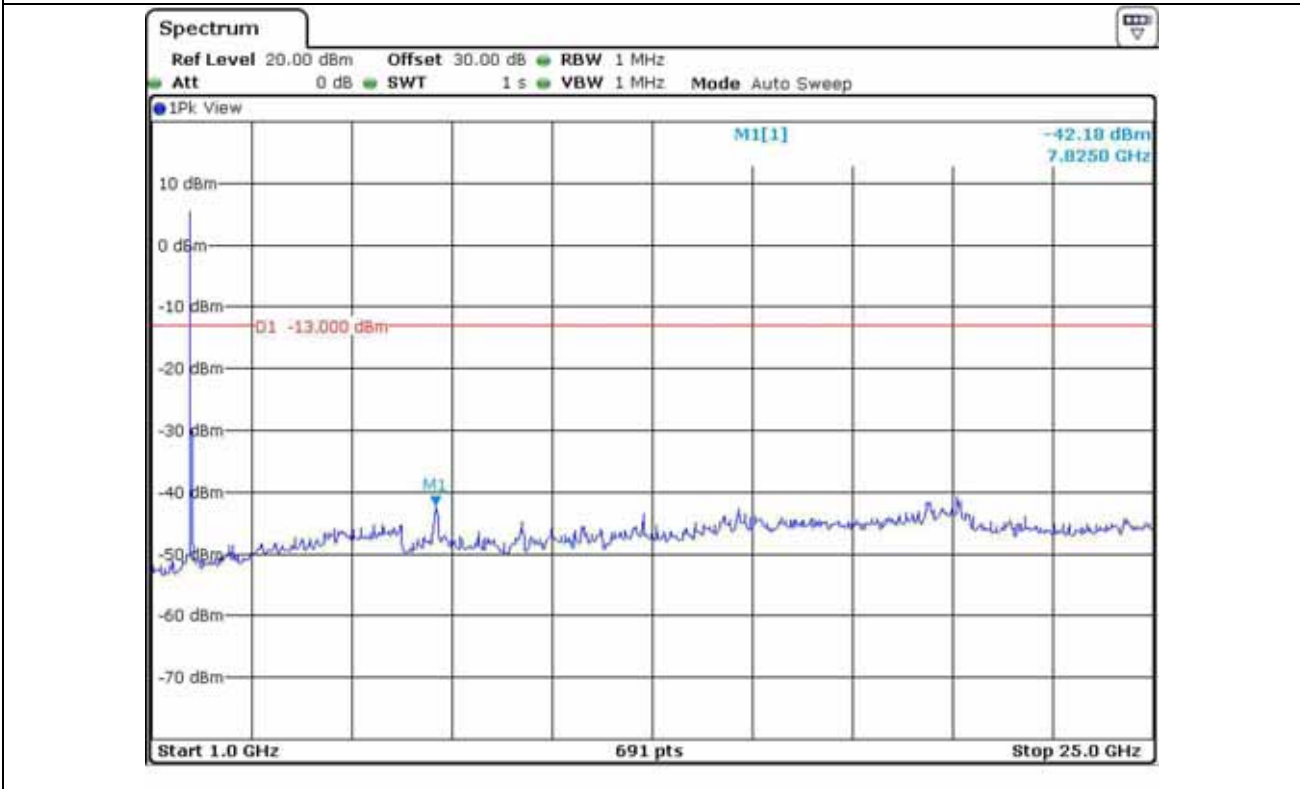
WCDMA – High Channel



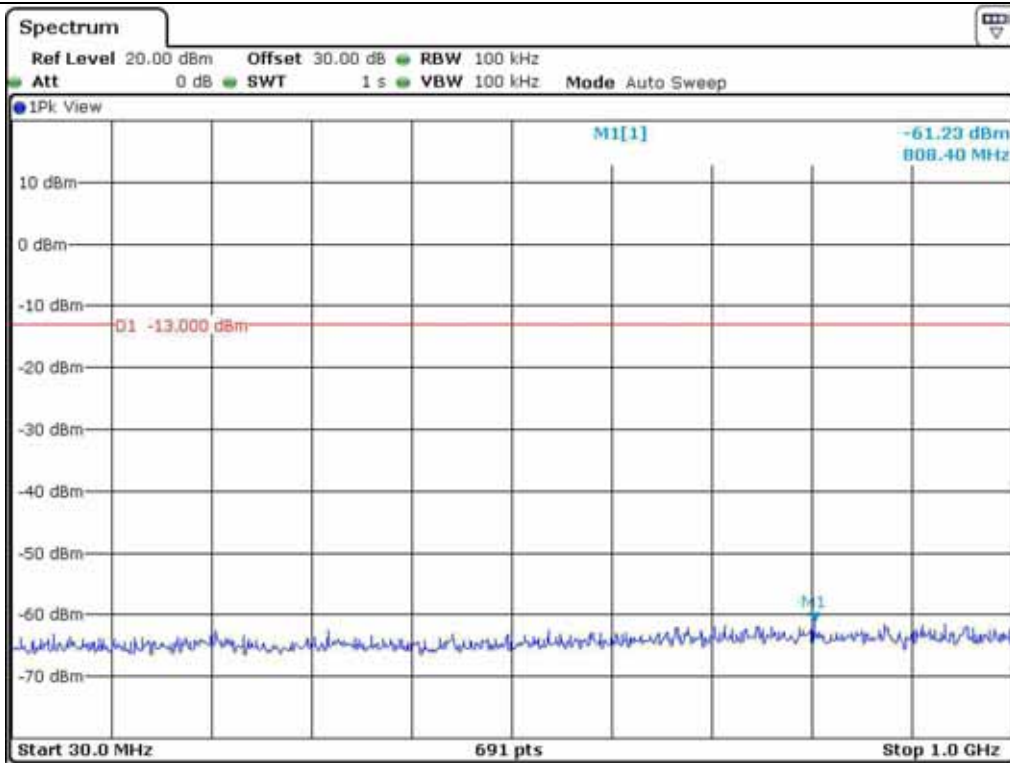
WCDMA – High Channel



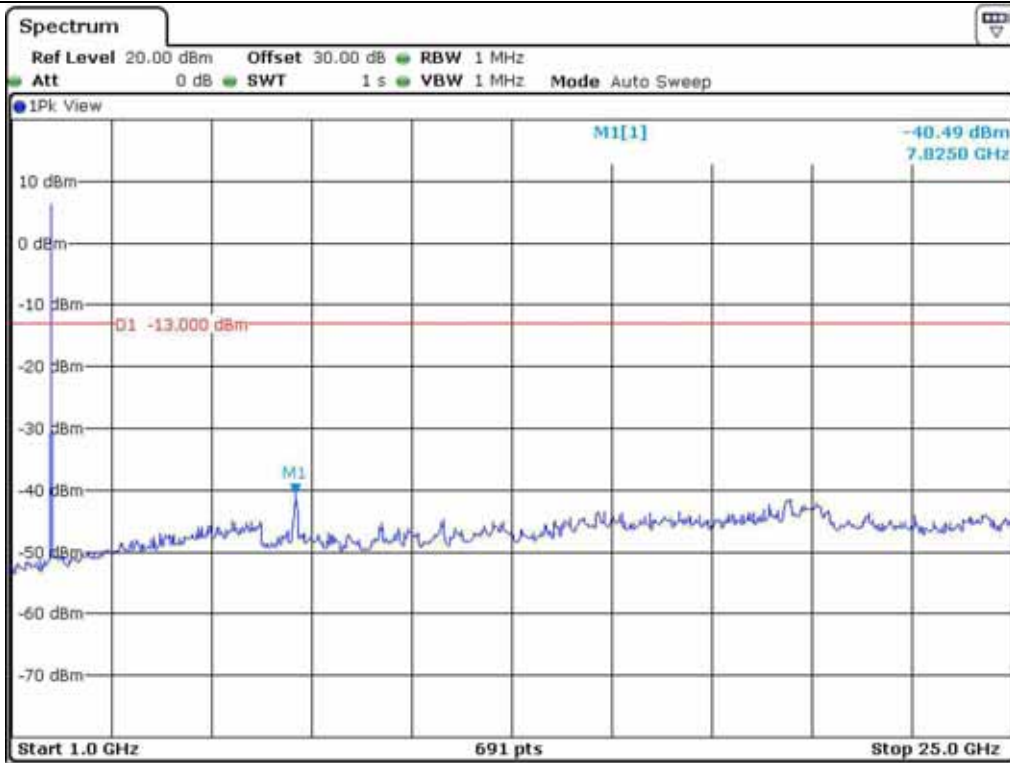
LTE – Low Channel



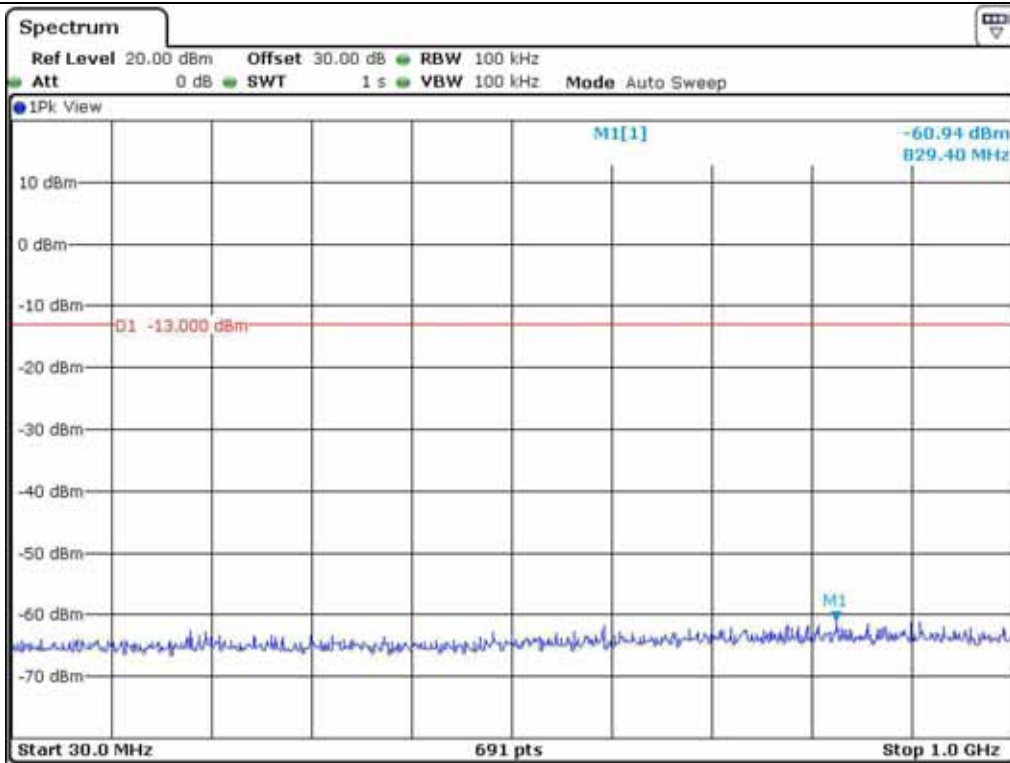
LTE – Low Channel



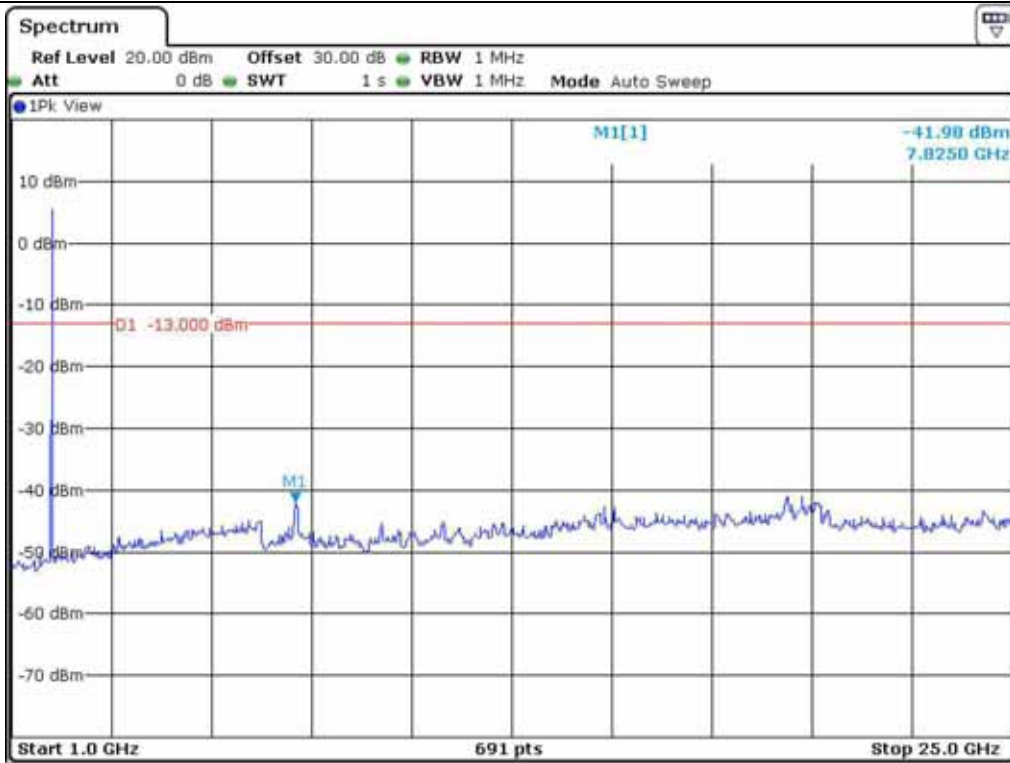
LTE – Middle Channel



LTE – Middle Channel



LTE – High Channel



LTE – High Channel

## 8. BAND EDGE MEASUREMENT

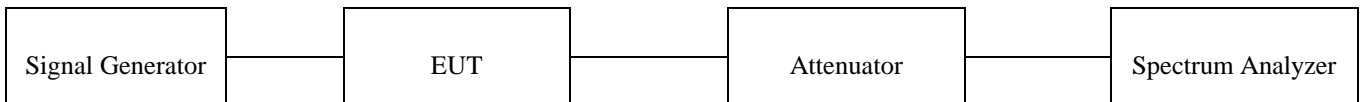
### 8.1 Operating environment

Temperature : 24 °C  
 Relative humidity : 48 % R.H.

### 8.2 Test set-up for conducted measurement

The RF signal from the signal generator(s) was injected to the EUT and the amplified RF signal at the output of the EUT was connected to the spectrum analyzer. The test was performed at three frequencies (low, middle, and high channels) at each band using all applicable modulation.

The resolution bandwidth and video bandwidth of the spectrum analyzer was set according to the regulation and sufficient scans were taken to show any out of band emissions.



### 8.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
<input type="checkbox"/>	E4432B	HP	Signal Generator	US38440950	June 10, 2011 (1Y)
<input checked="" type="checkbox"/>	SMJ100A	R/S	Signal Generator	101038	Feb. 01, 2012 (1Y)
<input checked="" type="checkbox"/>	FSP	R/S	Spectrum Analyzer	100017	Mar. 15, 2011 (1Y)
<input type="checkbox"/>	8564E	HP	Spectrum Analyzer	3650A00756	Jun. 10, 2011 (1Y)
<input type="checkbox"/>	FSV30	R/S	Spectrum Analyzer	101372	Aug. 29, 2011 (1Y)
<input checked="" type="checkbox"/>	67-30-43	Aeroflex Weinschel	Power Attenuator	CA5760	Nov. 30, 2011 (1Y)

All test equipment used is calibrated on a regular basis.

**8.4 Test data**

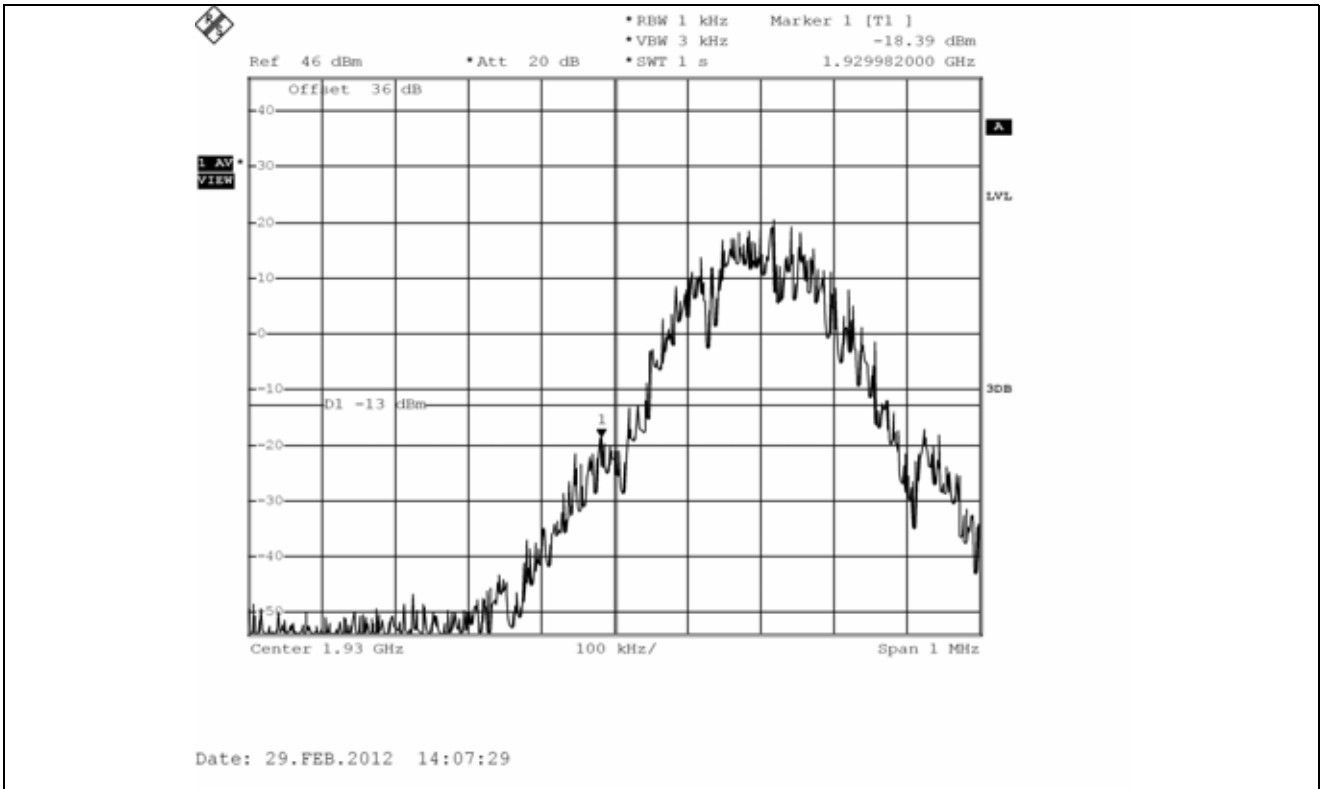
-. Test Date : February 23, 2012  
 -. Result : PASSED BY -4.03 dB at EDGE Mode

Modulation	Channel	Measured Frequency (MHz)	Max. Measured Value (dBm)	Limit (dBm)	Margin (dB)
GSM	Low	1 929.982	-18.39	-13.00	-5.39
	High	1 995.028	-18.35		-5.35
EDGE	Low	1 929.966	-20.55		-7.55
	High	1 995.004	-17.03		-4.03
CDMA	Low	1 930.000	-26.88		-13.88
	High	1 995.000	-26.30		-13.30
1xEVDO	Low	1 930.000	-25.86		-12.86
	High	1 995.000	-26.70		-13.70
WCDMA	Low	1 930.000	-22.22		-9.22
	High	1 995.000	-21.14		-8.14
LTE	Low	1 930.000	-20.26		-7.26
	High	1 995.000	-18.46		-5.46

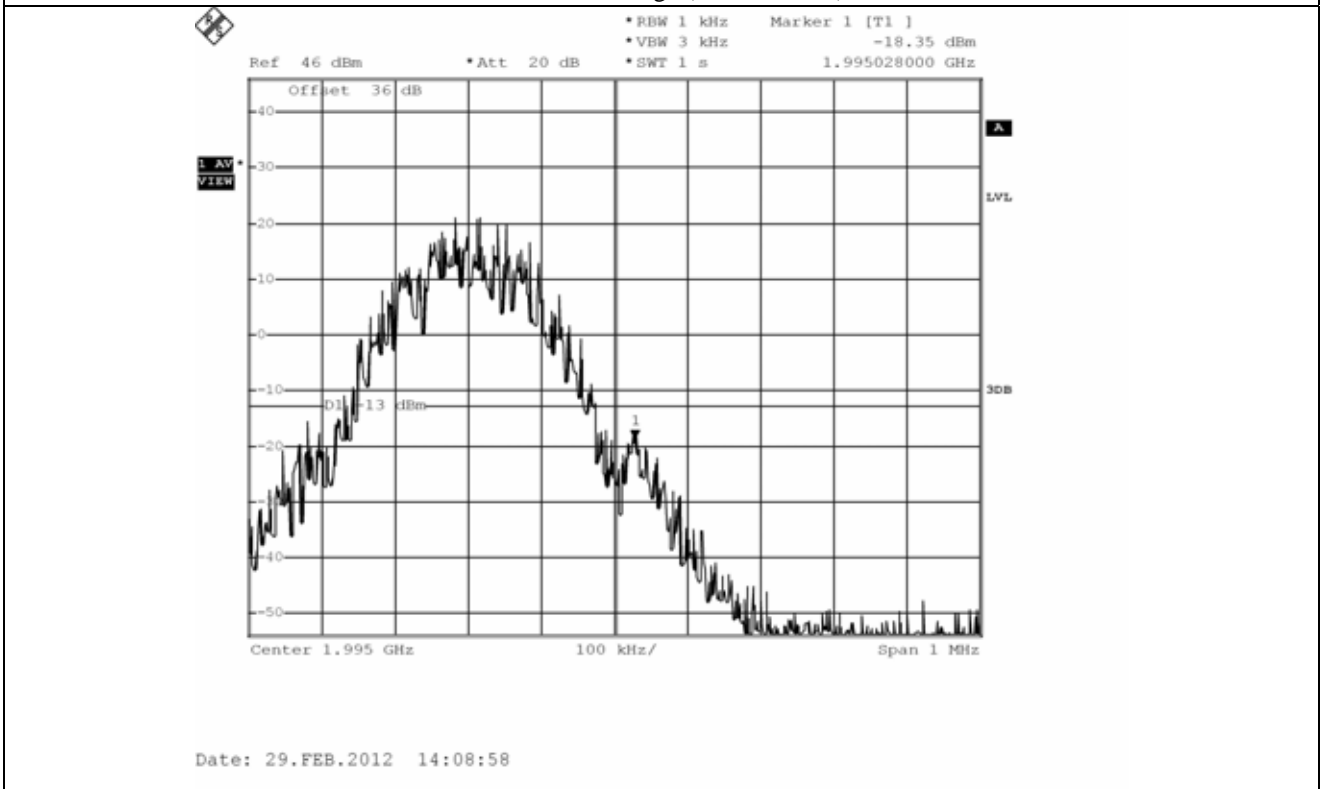
According to Part 24E, out of band emission shall be attenuated by  $43 + 10 \log (P)$  dBc, equates to -13.0dBm.

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**Tested by: Ki-Hong, Nam / Senior Engineer**

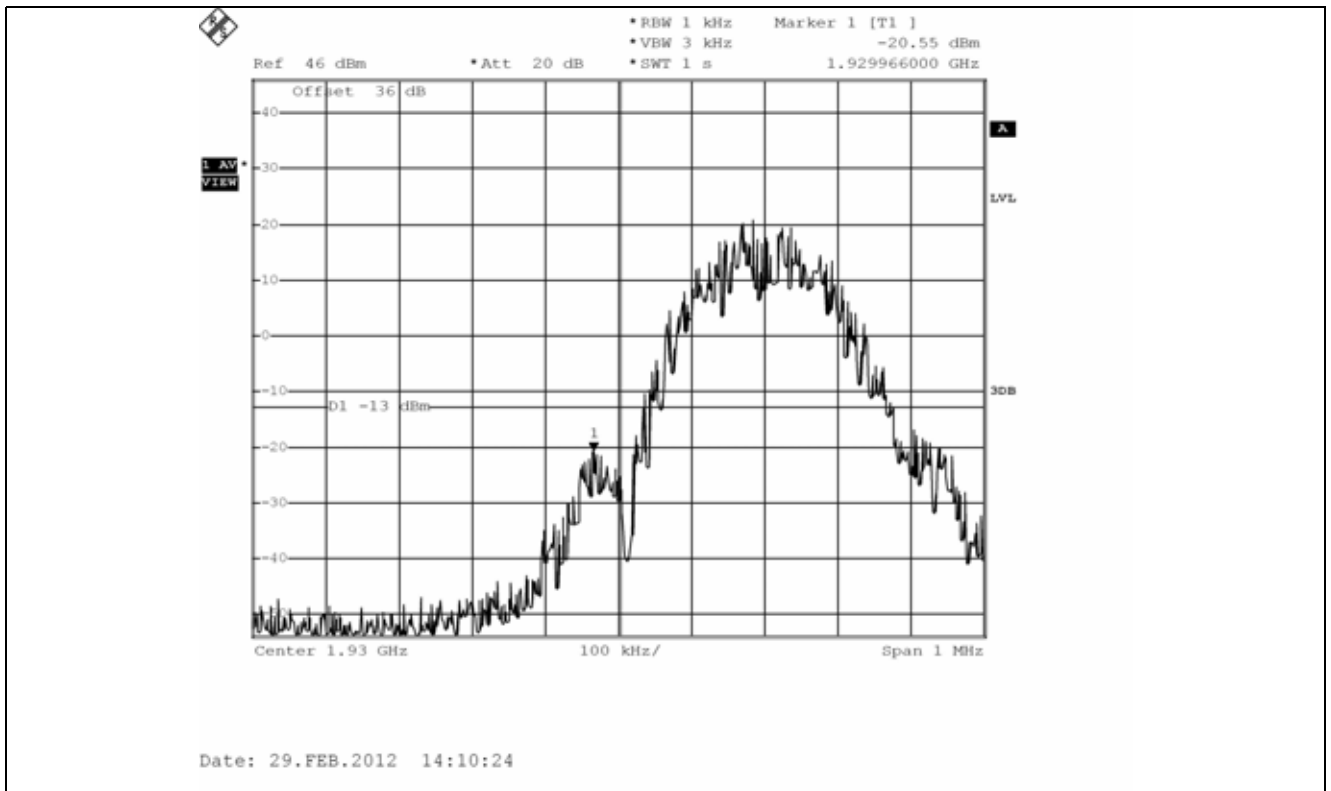


GSM – Band Edge (Low Channel)

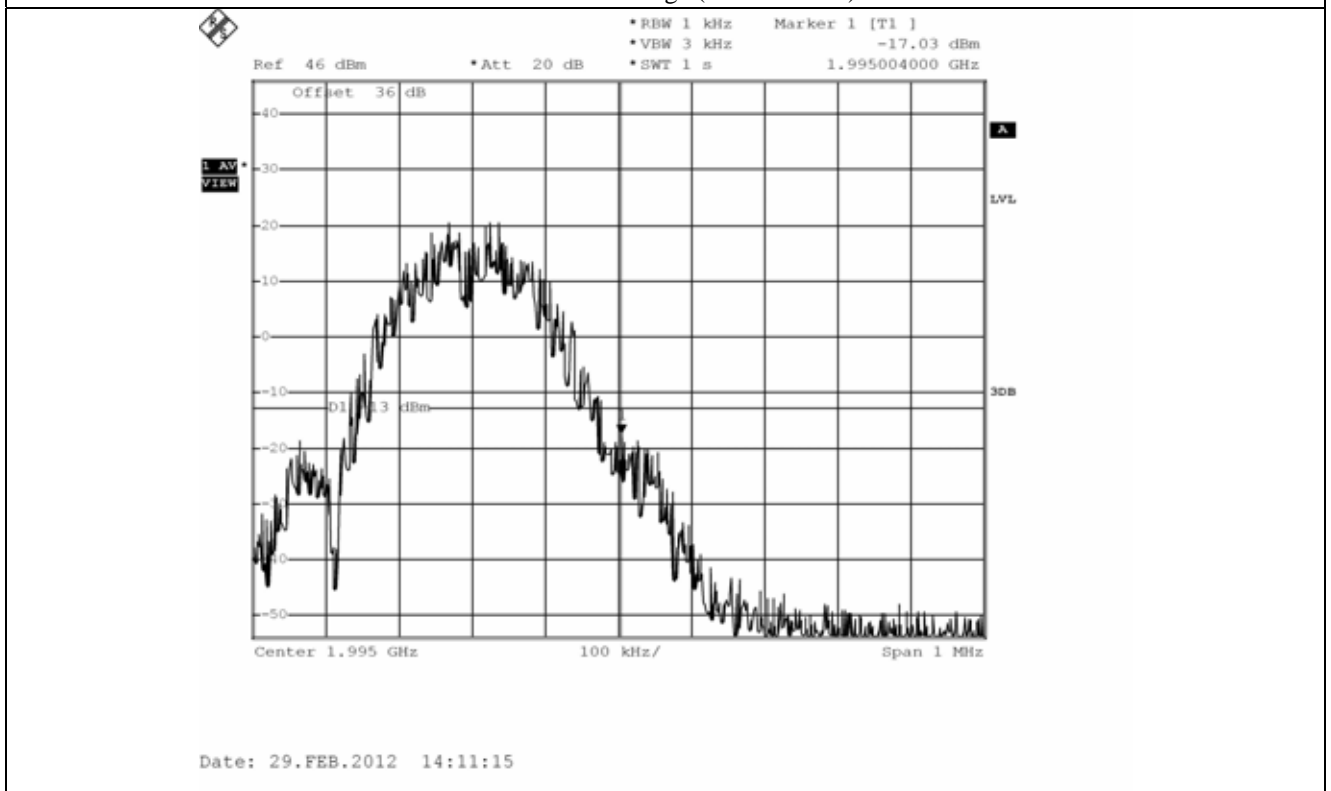


GSM – Band Edge (High Channel)

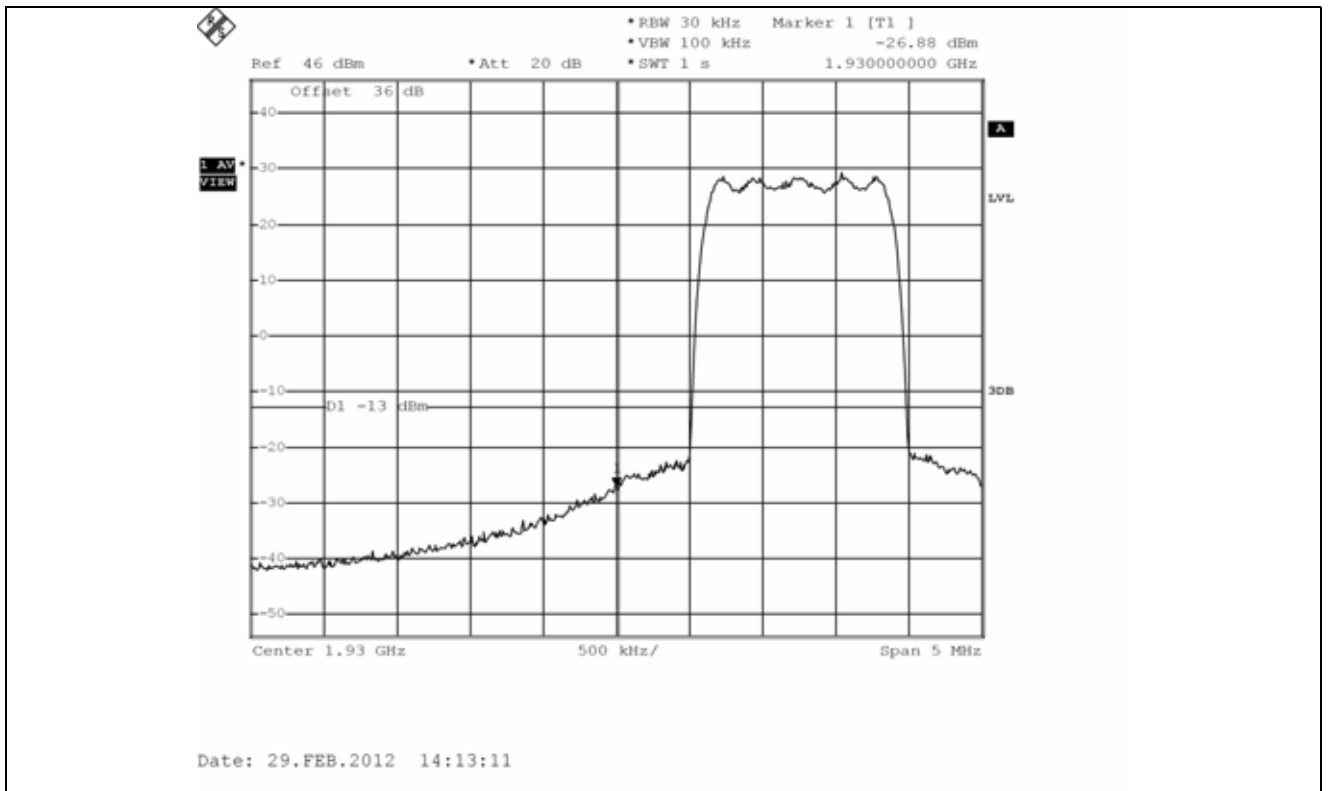




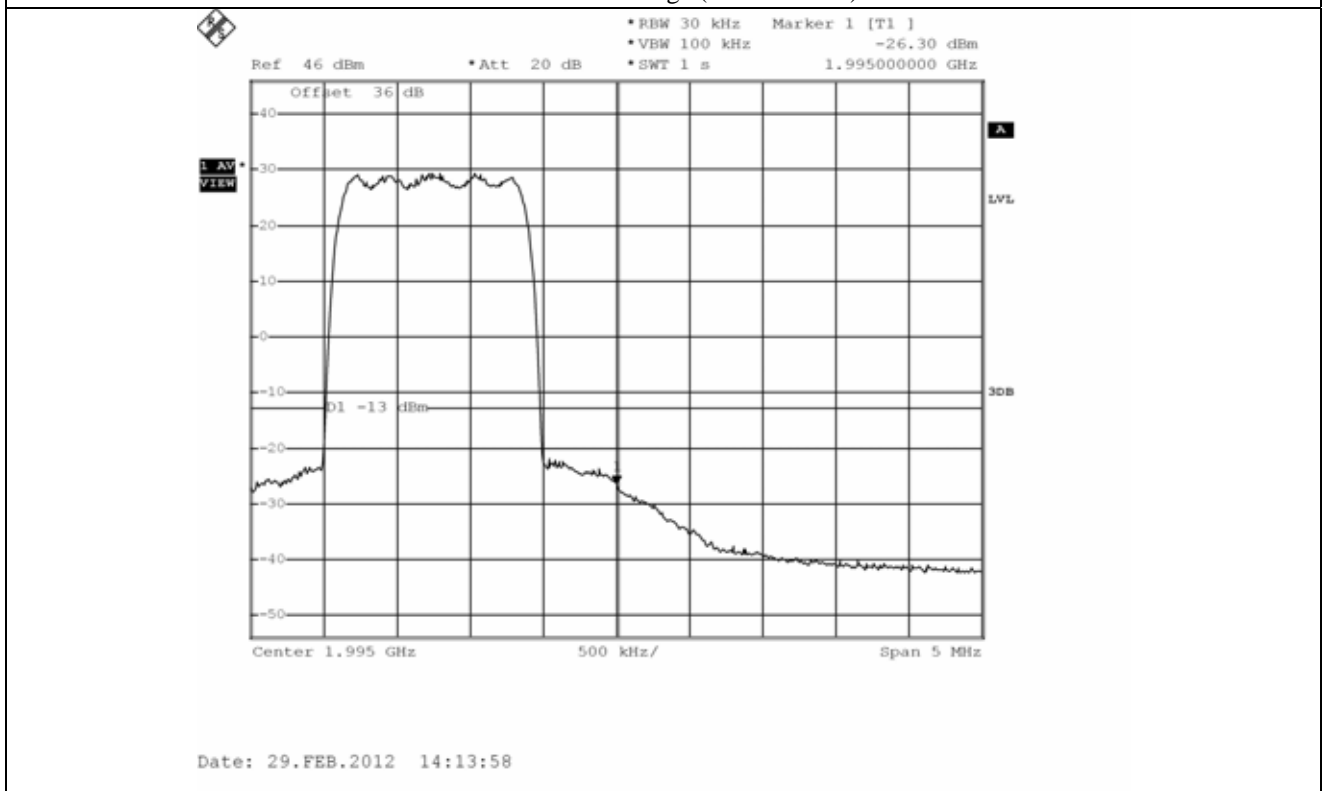
EDGE – Band Edge (Low Channel)



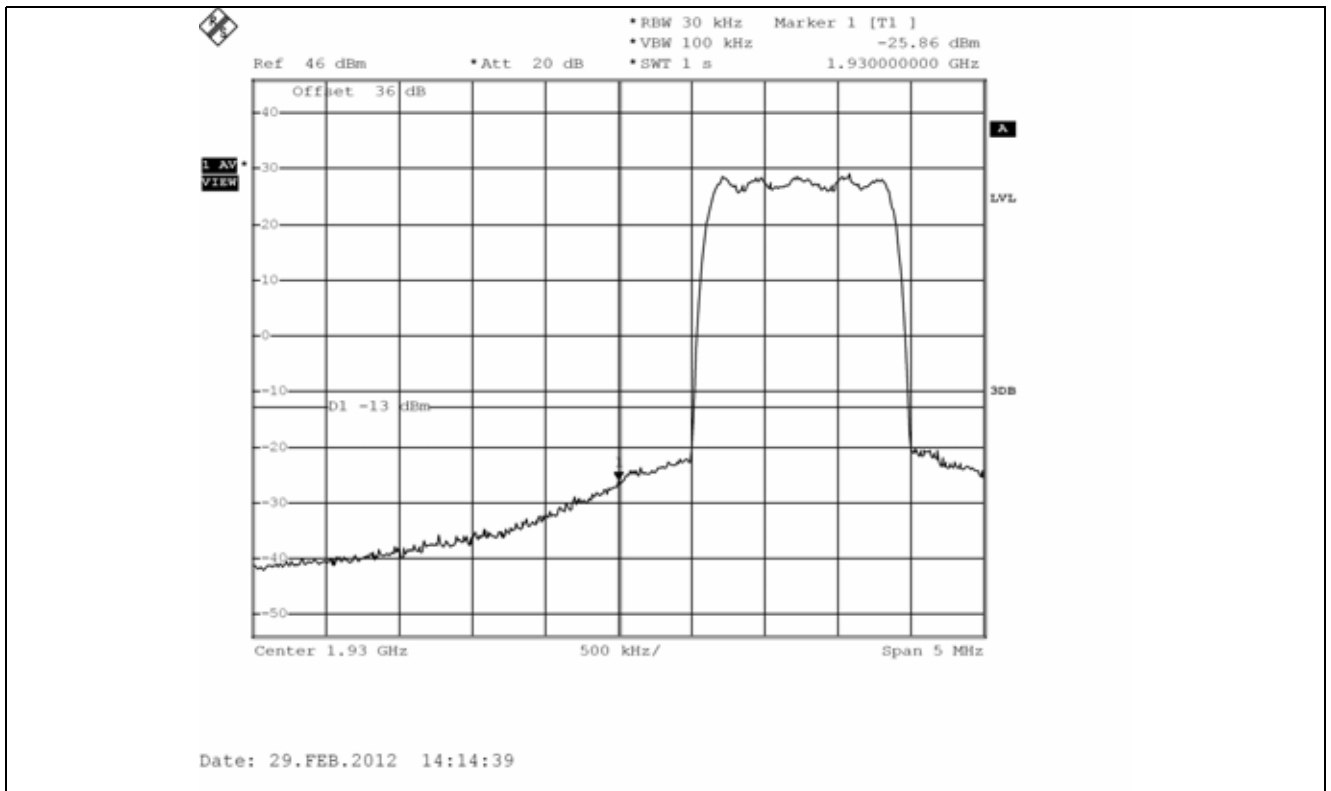
1xEVDO – Band Edge (High Channel)



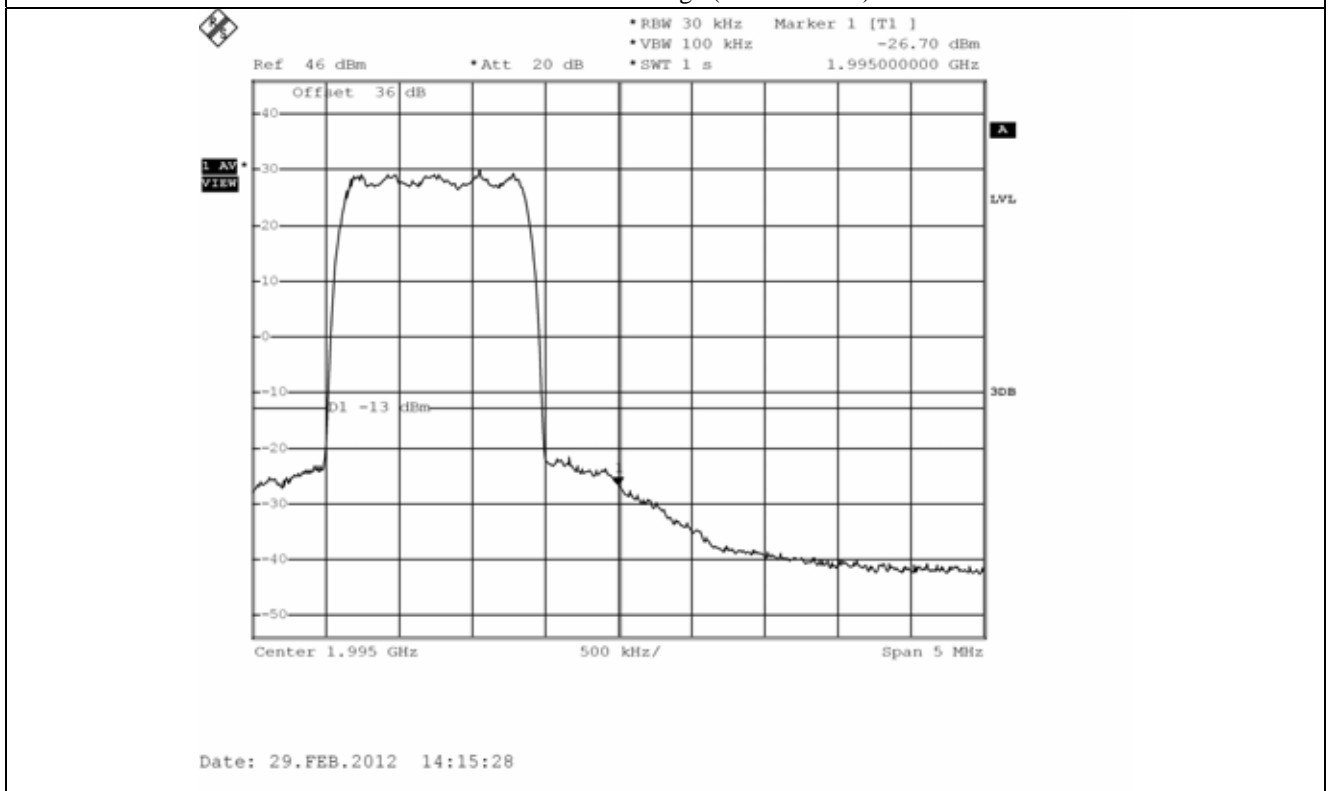
CDMA – Band Edge (Low Channel)



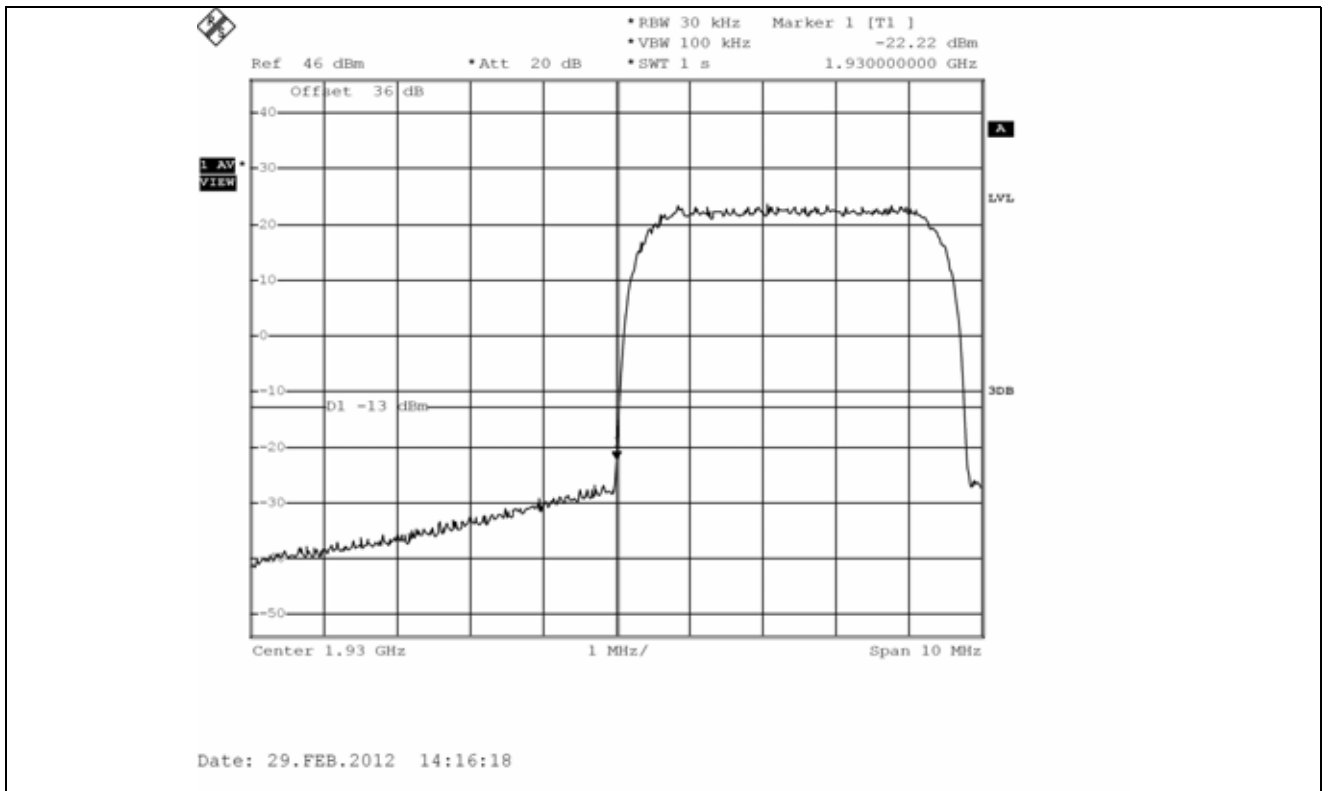
CDMA – Band Edge (High Channel)



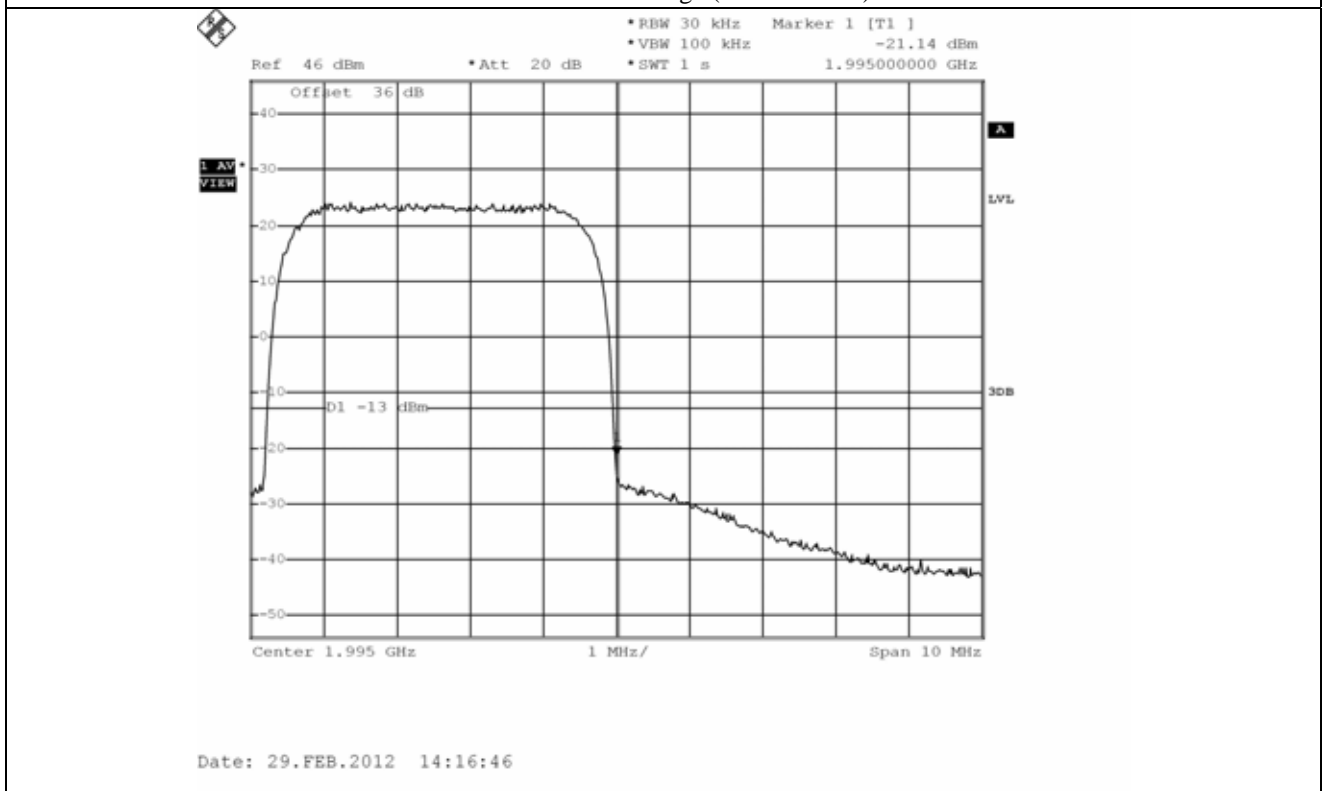
1xEVDO – Band Edge (Low Channel)



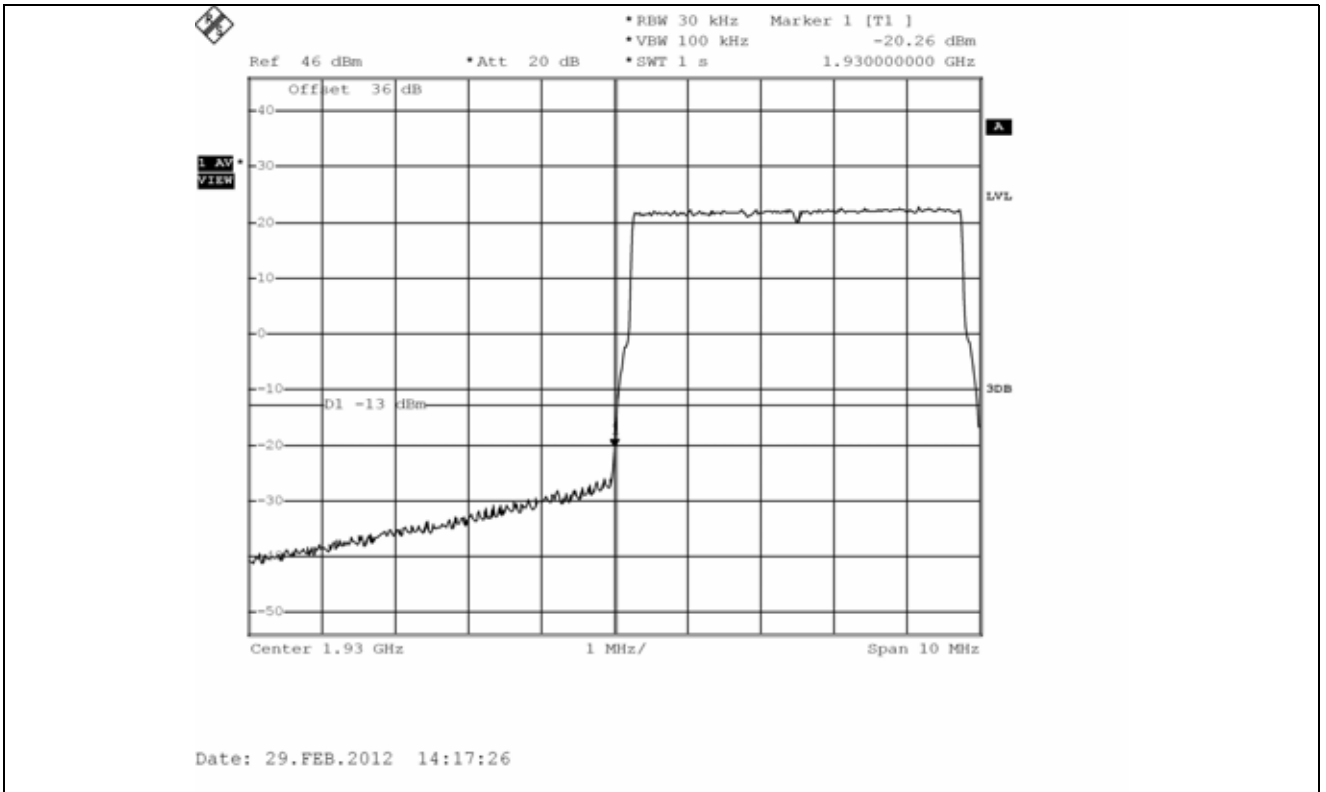
1xEVDO – Band Edge (High Channel)



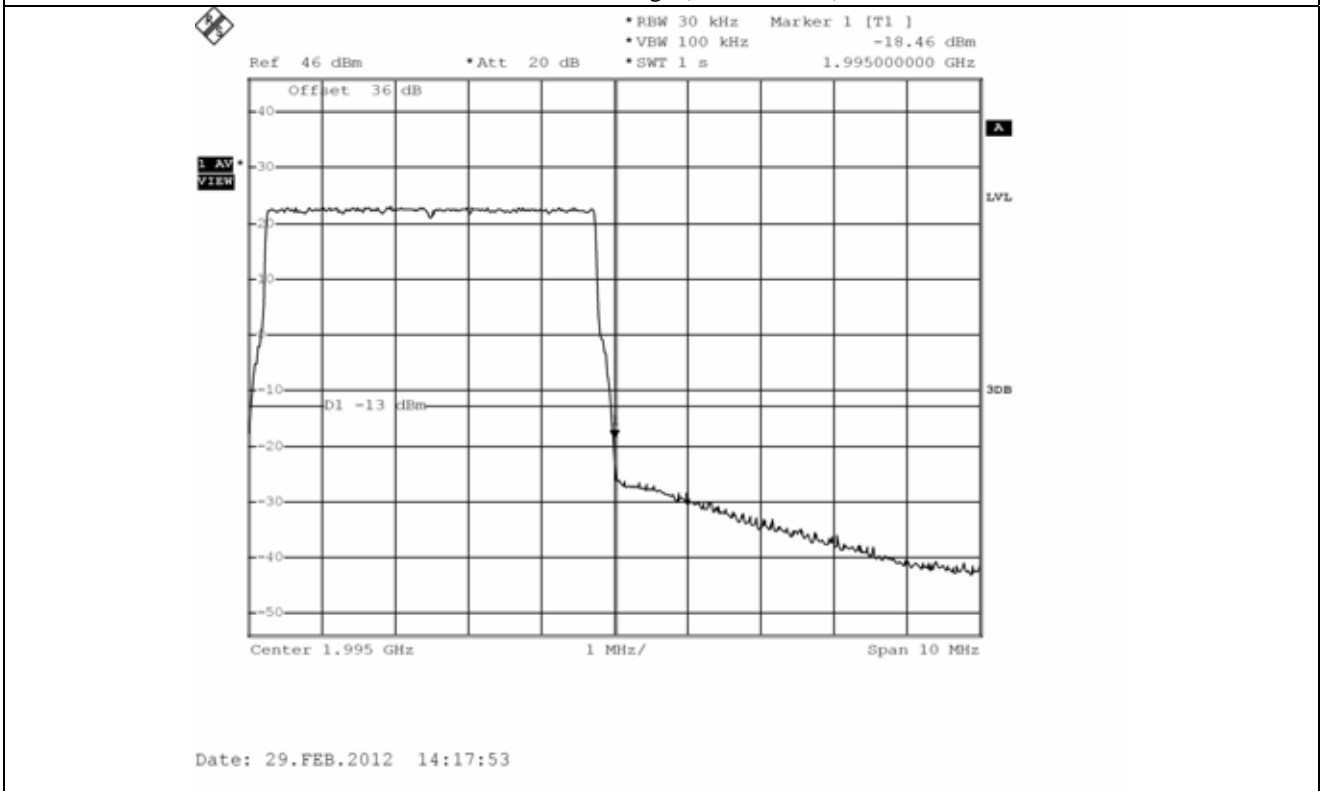
WCDMA – Band Edge (Low Channel)



WCDMA – Band Edge (High Channel)



LTE – Band Edge (Low Channel)



LTE – Band Edge (High Channel)

## 9. INTERMODULATION TEST

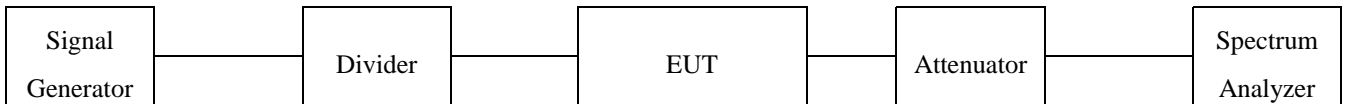
### 9.1 Operating environment

Temperature : 24 °C  
 Relative humidity : 48 %R.H.

### 9.2 Test set-up

The RF signal from the signal generator(s) was injected to the EUT and the amplified RF signal at the output of the EUT was connected to the spectrum analyzer. The test was performed at three frequencies (low, middle, and high channels) at each band using all applicable modulation.

Three input signals are equal in level and were sent to the input of the EUT.



### 9.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
■ -	E4432B	HP	Signal Generator	US38440950	June 10, 2011 (1Y)
■ -	SMJ100A	R/S	Signal Generator	101038	Feb. 01, 2012 (1Y)
■ -	83650L	HP	Swept CW Generator	3844A00415	Jun. 10, 2012 (1Y)
□ -	FSP	R/S	Spectrum Analyzer	100017	Mar. 15, 2011 (1Y)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	Jun. 10, 2011 (1Y)
■ -	FSV30	R/S	Spectrum Analyzer	101372	Aug. 29, 2011 (1Y)
■ -	67-30-43	Aeroflex Weinschel	Power Attenuator	CA5760	Nov. 30, 2011 (1Y)

All test equipment used is calibrated on a regular basis.

**9.4 Test data**

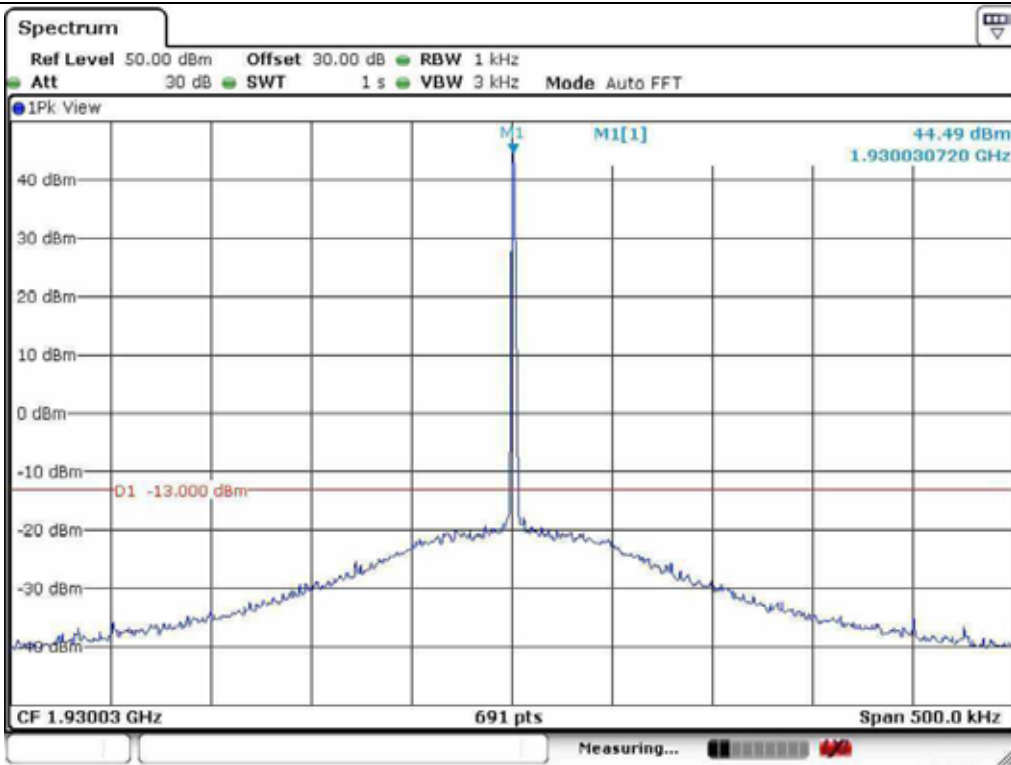
**9.4.1 Test Result for peak power**

- Test Date : February 23, 2012
- Test Result : Pass
- Modulation : No-Modulation

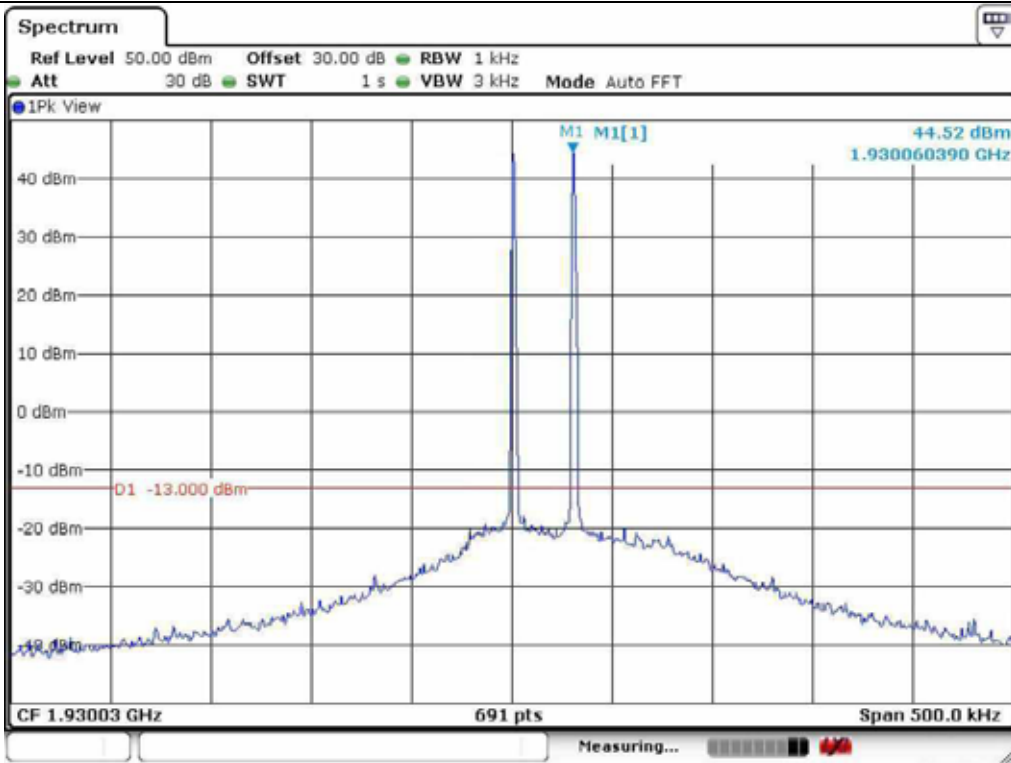
Frequency (MHz)	Number of Input Channel	Input Power (dBm)	Output Power (dBm)
1 930.030	1	-9.90	44.49
1 930.030 & 1 930.06	2	-9.80	44.51
1 930.030 & 1 930.06 & 1 930.09	3	-9.90	44.50
1 994.970	1	-9.90	44.49
1 994.970 & 1 994.940	2	-9.80	44.49
1 994.970 & 1 994.940 & 1 994.910	3	-9.80	44.50

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**Tested by: Ki-Hong, Nam / Senior Engineer**

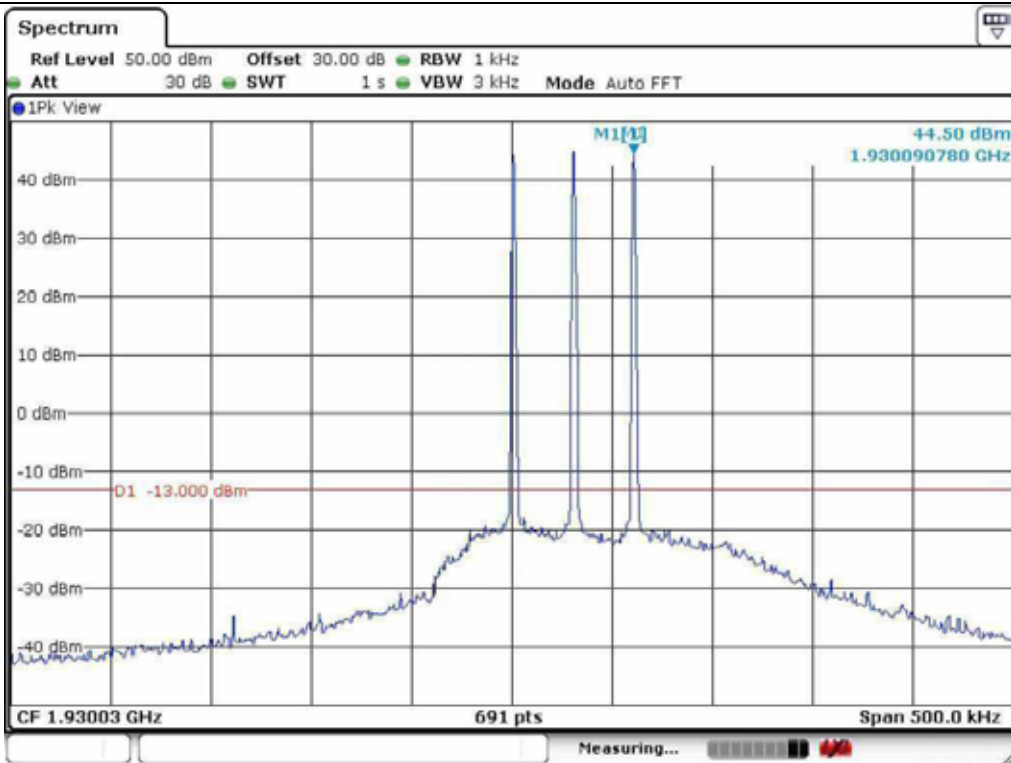


Low Channel – 1 input signal

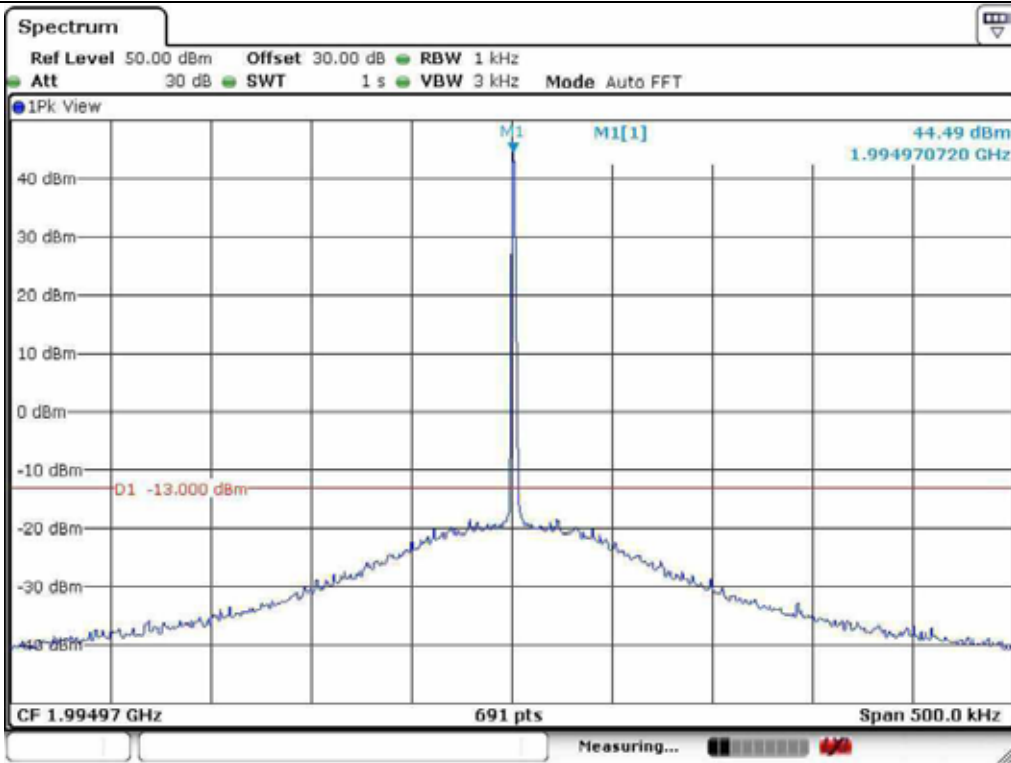


Low Channel – 2 input signals

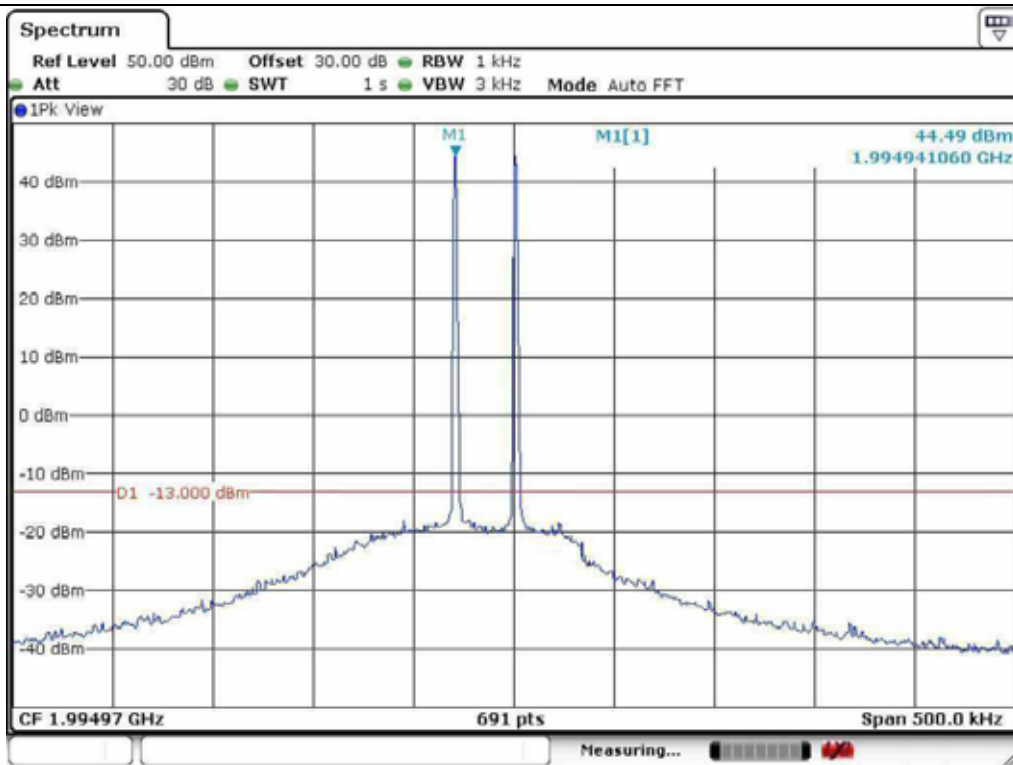




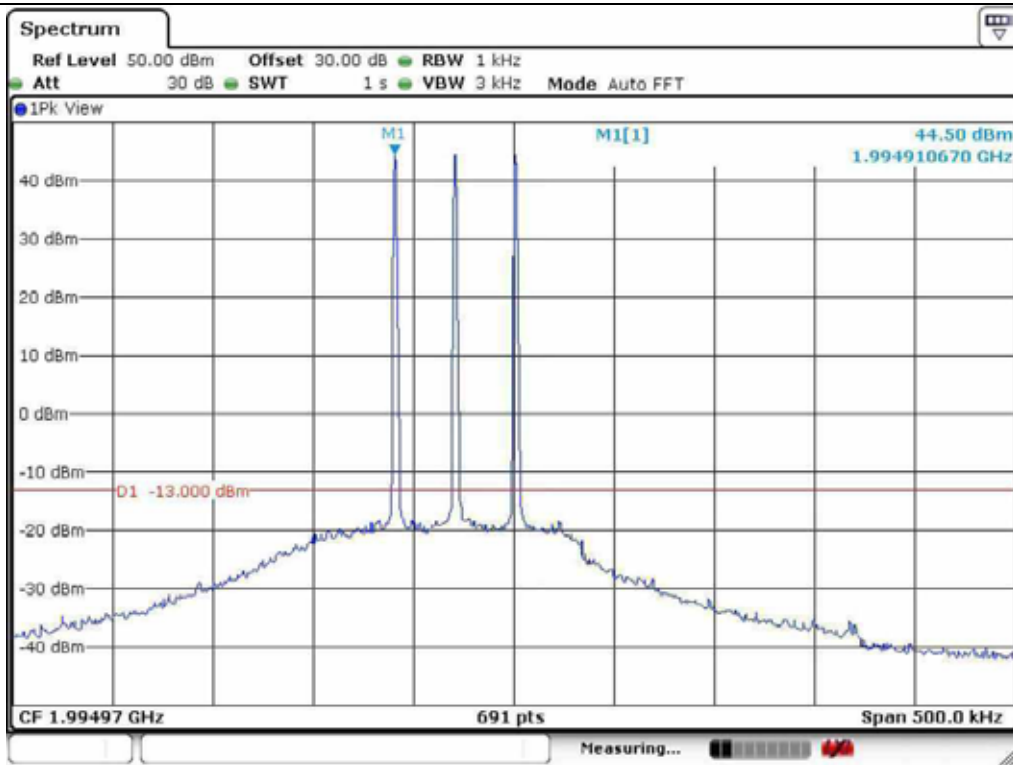
Low Channel – 3 input signals



High Channel – 1 input signal



High Channel – 2 input signals



High Channel – 3 input signals

**9.4.2 Test Result for Spurious emission**

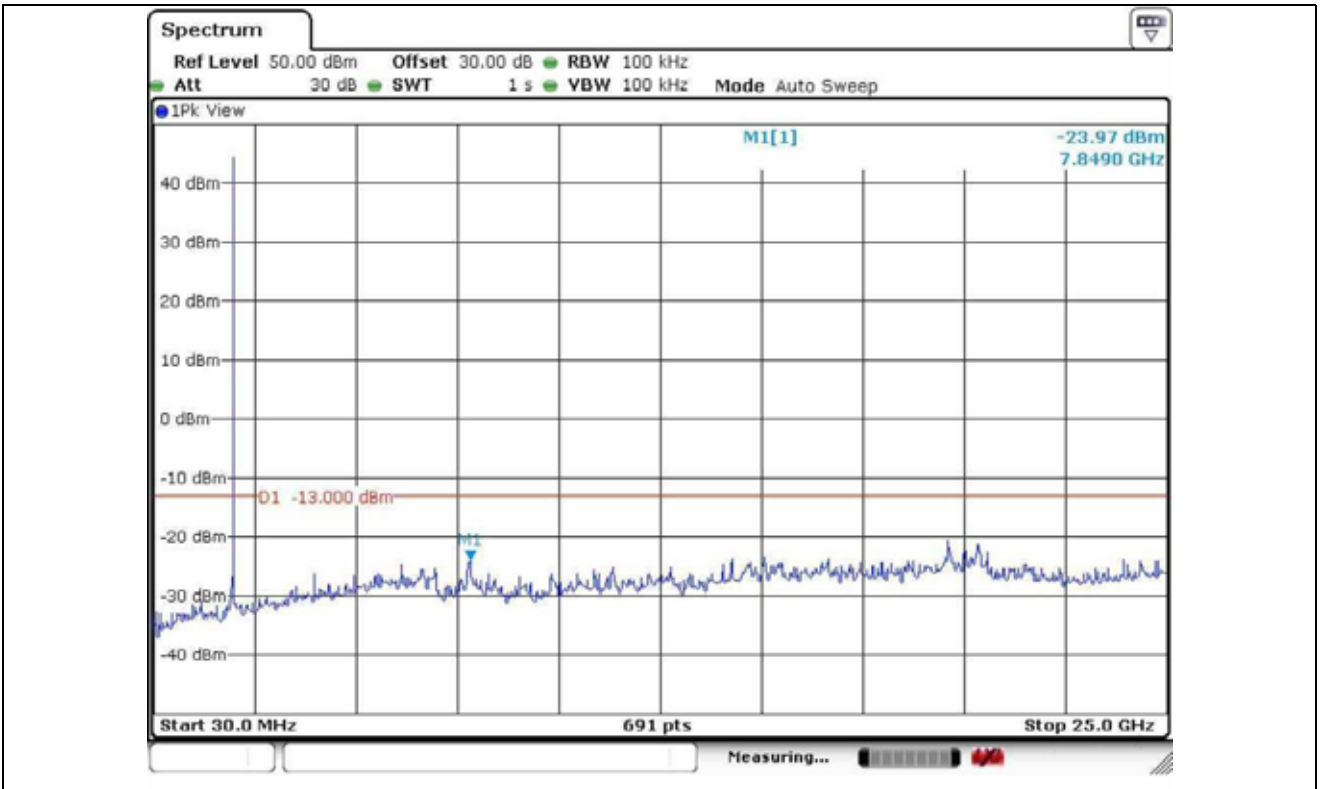
- Test Date : February 23, 2012
- Test Result : Pass
- Modulation : No-Modulation

Frequency (MHz)	Number of Input Channel	Measured Value	Result
1 930.030	1	< -13 dBm	Pass
1 930.030 & 1 930.06	2		
1 930.030 & 1 930.06 & 1 930.09	3		
1 994.970	1	< -13 dBm	Pass
1 994.970 & 1 994.940	2		
1 994.970 & 1 994.940 & 1 994.9210	3		

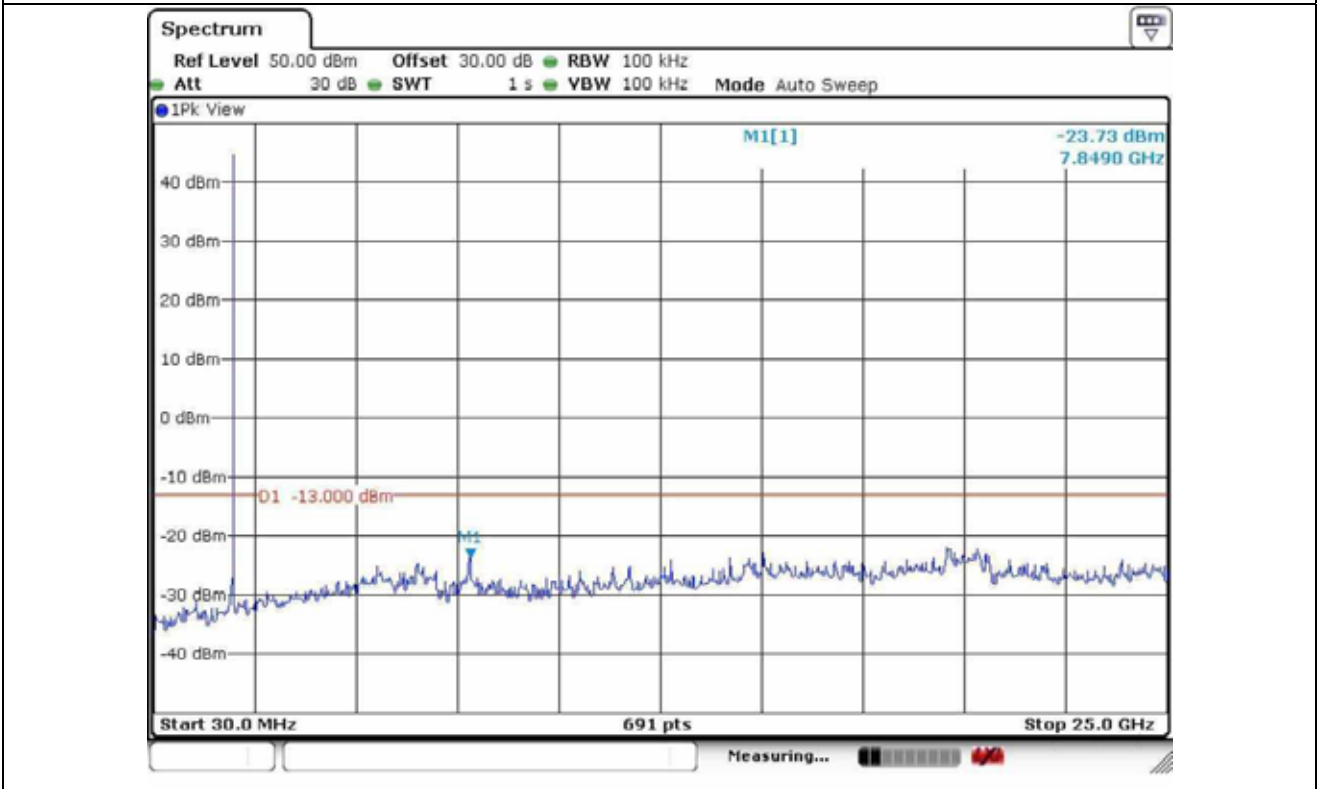
Remark: Intermodulation products must be attenuated below the rated power of the EUT at least  $43 + 10\log (P_w)$ , equivalent to -13 dBm. Please refer to test data hereinafter.

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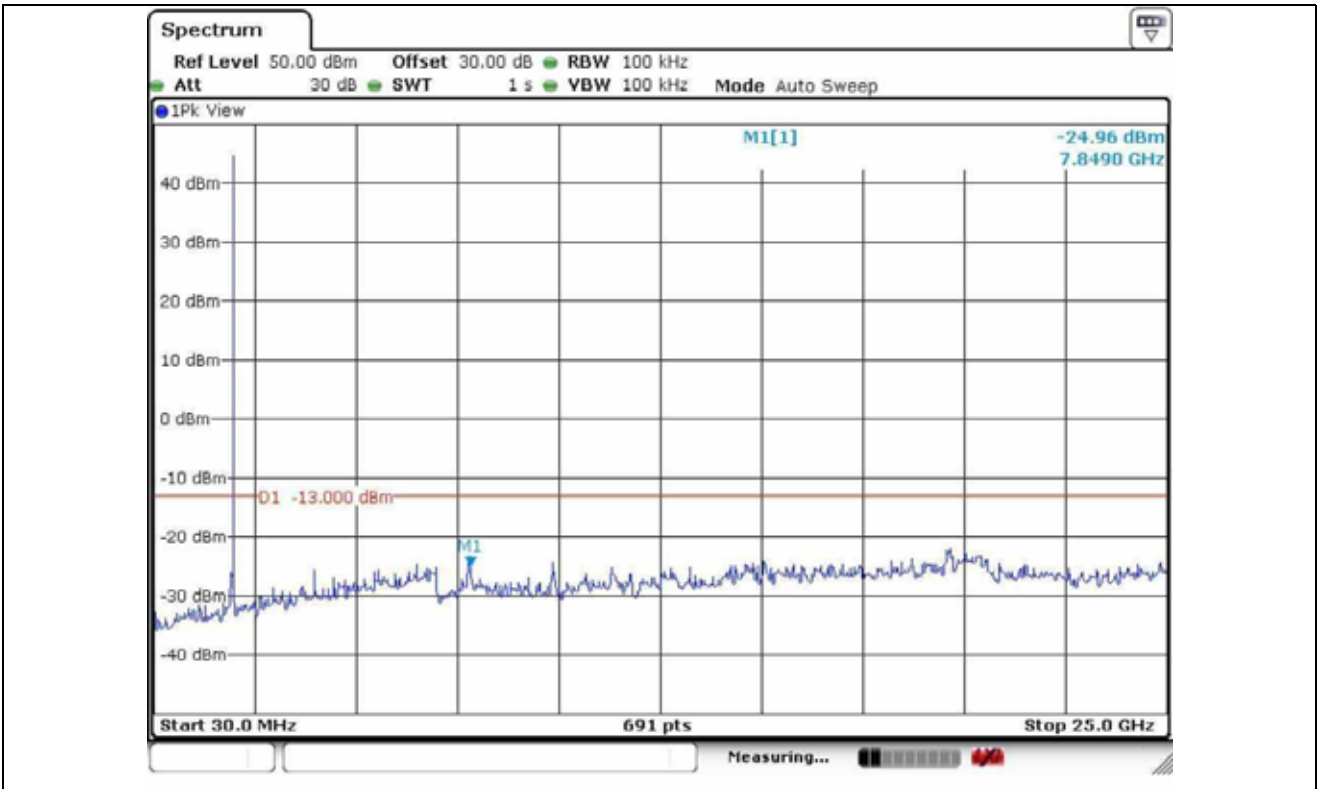
**Tested by: Ki-Hong, Nam / Senior Engineer**



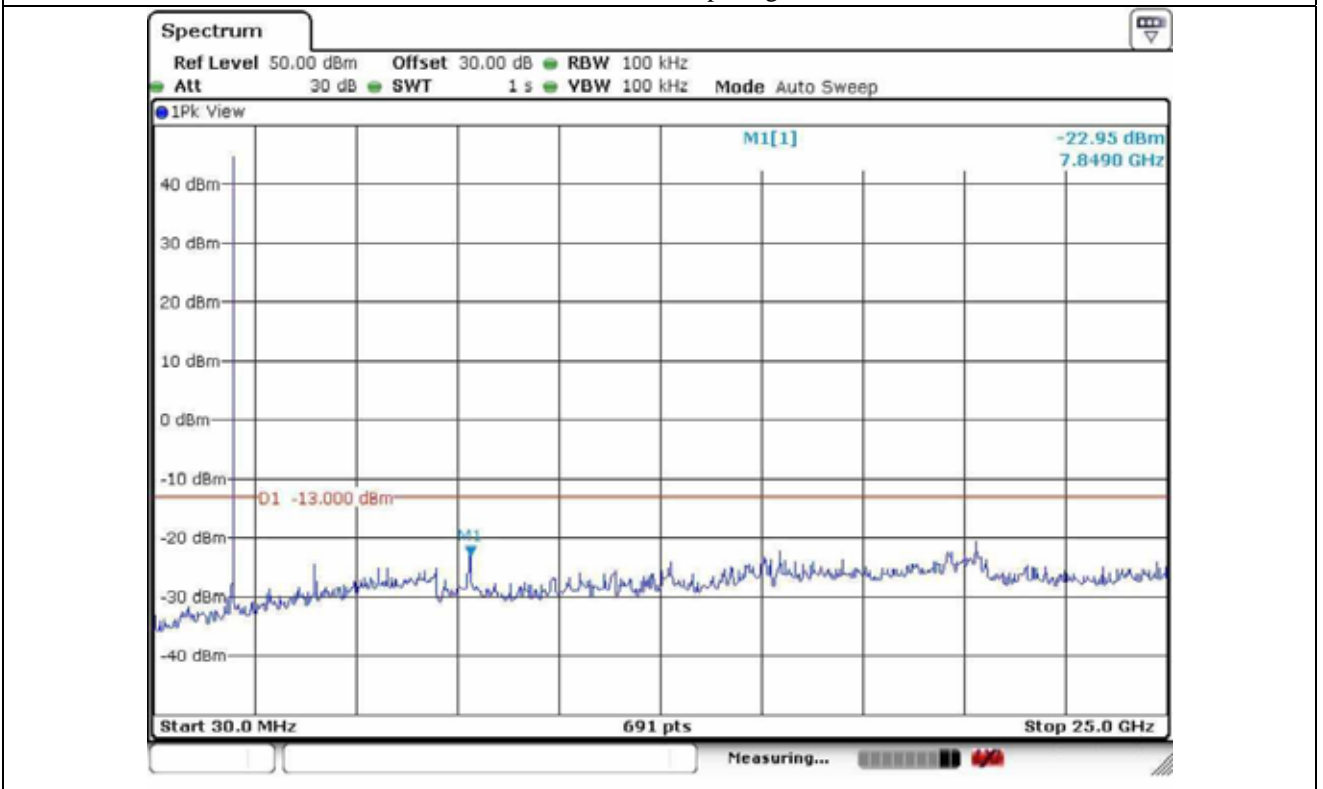
Low Channel – 1 input signal



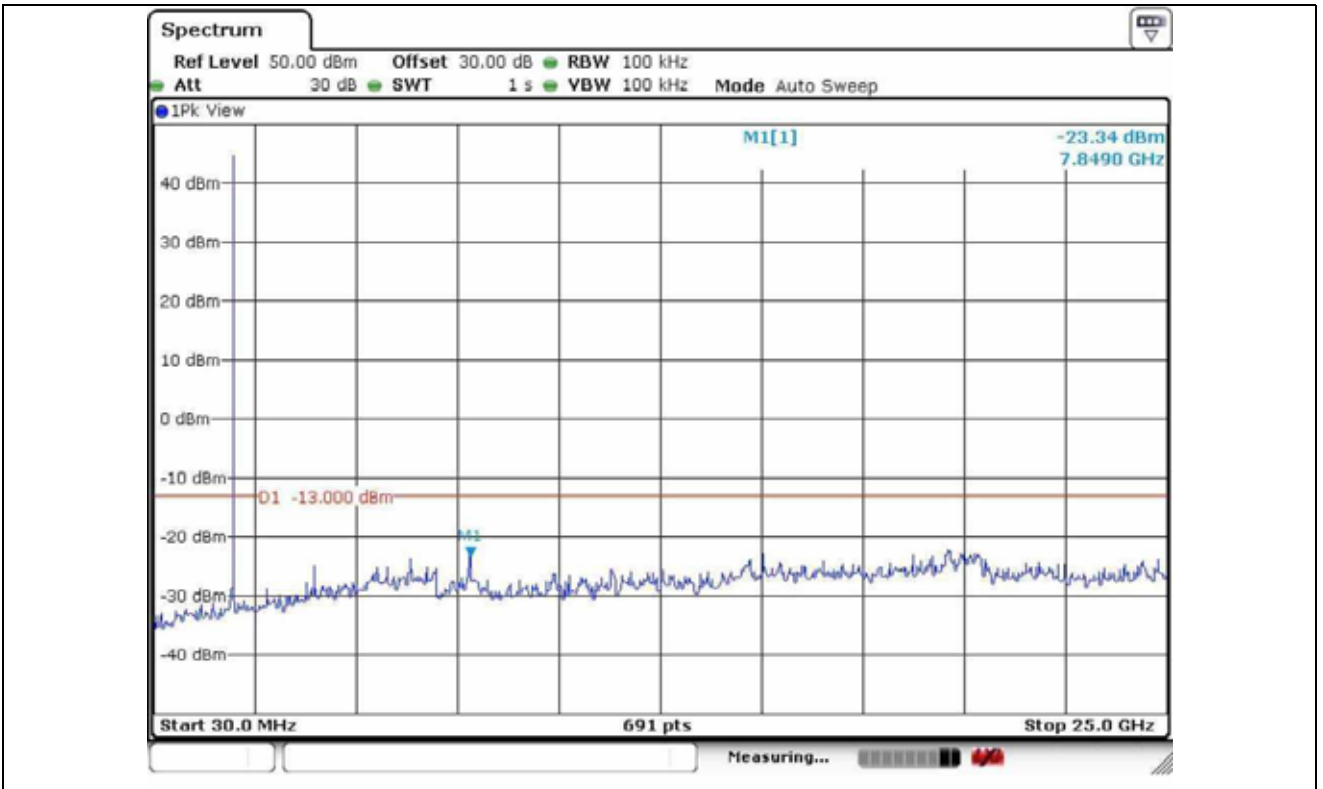
Low Channel – 2 input signals



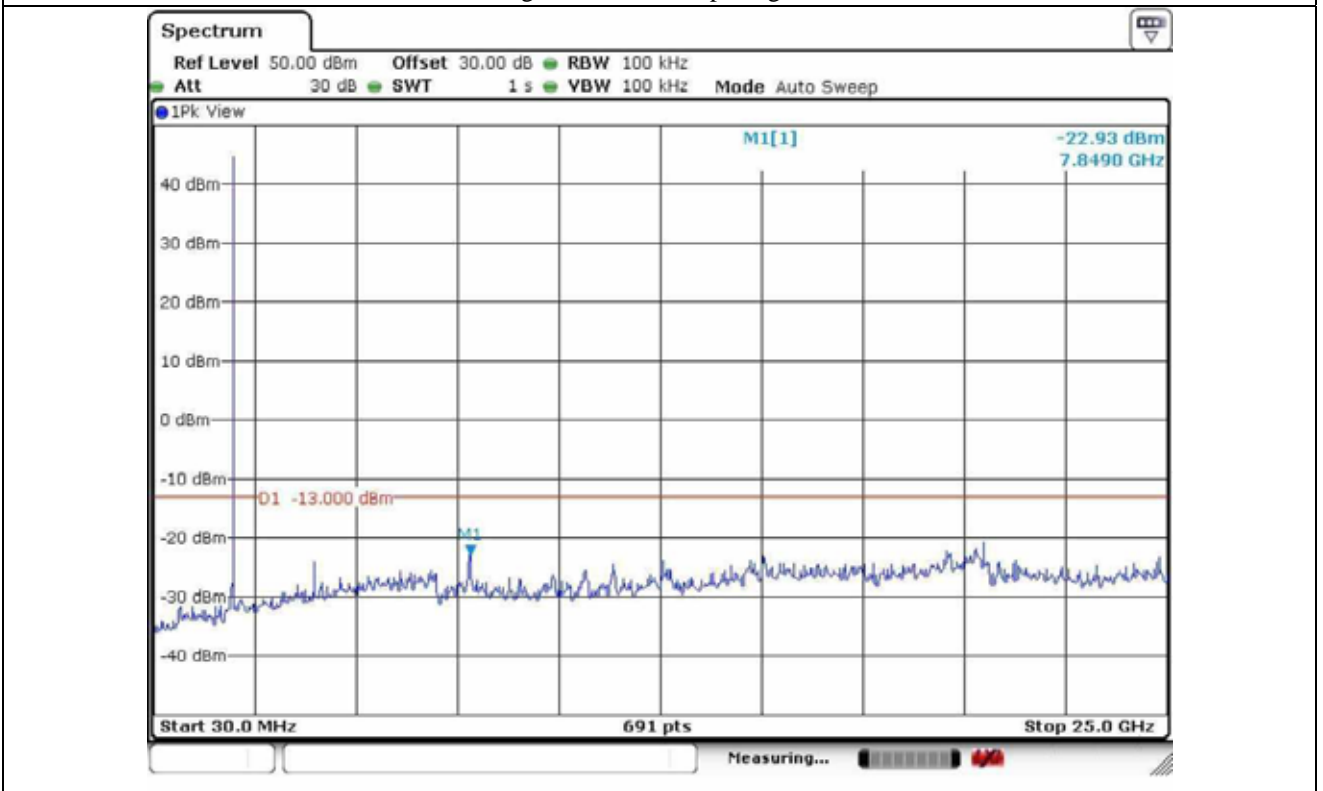
Low Channel – 3 input signals



High Channel – 1 input signal



High Channel – 2 input signals



High Channel – 3 input signals

## 10. FIELD STRENGTH OF SPURIOUS RADIATION

### 10.1 Operating environment

Temperature : 8 °C  
 Relative humidity : 42 % R.H.

### 10.2 Test set-up

The radiated emissions measurements were on the 3 m, open-field test site. The EUT and other support equipment were placed on a non-conductive turntable above the ground plane. The interconnecting cables from outside test site were inserted into ferrite clamps at the point where the cables reach the turntable.

The frequency spectrum from 30 MHz to up to 10<sup>th</sup> harmonic of the fundamental frequency was scanned and emission levels maximized at each frequency recorded. The system was rotated 360°, and the antenna was varied in height between 1.0 m and 4.0 m in order to determine the maximum emission levels. The test was performed by placing the EUT on 3-orthogonal axis. This procedure was performed for both horizontal and vertical polarization of the receiving antenna.

The maximum radiated emission was recorded and used as reference for the effective radiated power measurement. The EUT was then replaced by a tuned dipole antenna or Horn antenna and was oriented for vertical polarization and then the length was adjusted to correspond to the frequency of the transmitter. The substitution antenna was connected to a signal generator with a coaxial cable. The receiving antenna height was raised and lowered again through the specified range of height until maximum signal level is detected by the measuring receiver. The signal to the substitution antenna was adjusted to the level that produces a level detected by the measuring receiver, that is equal to the level noted while the EUT radiated power measured, corrected for the change of input attenuation setting of the measuring receiver. The signal generator level was recorded and corrected by the power loss in the cable between the signal generator and substitution antenna and further corrected for the gain of the dipole antenna or horn antenna used relative to an ideal tuned dipole antenna. The measurement was repeated with the test antenna and the substitution antenna oriented for horizontal polarization. The measure of the effective radiated power is the larger of the two levels recorded.

### 10.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□	ESVD	Rohde & Schwarz	EMI Test Receiver	838453/018	Oct. 20, 2011 (1Y)
□	8564E	Hewlett-Packard	Spectrum Analyzer	3650A00756	Jun. 10, 2011 (1Y)
■	83051A	Agilent	Preamplifier	3950M00201	Jun. 11, 2011 (1Y)
□	E4432B	Hewlett-Packard	Signal Generator	US38440950	Jun. 10, 2011 (1Y)
□	83650L	Hewlett-Packard	Signal Generator	3844A00415	Jun. 10, 2011 (1Y)
■	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D294	Aug. 23, 2011 (2Y)
■	BBHA9120D	Schwarzbeck	Horn Antenna	BBHA9120D295	Aug. 23, 2011 (2Y)
■	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170178	Aug. 23, 2011 (2Y)
■	BBHA9170	Schwarzbeck	Horn Antenna	BBHA9170179	Aug. 23, 2011 (2Y)
■	SMJ100A	R/S	Signal Generator	101038	Feb. 01, 2012 (1Y)
□	FSP	R/S	Spectrum Analyzer	100017	Mar. 16, 2011 (1Y)
■	FSV30	R/S	Spectrum Analyzer	101372	Aug. 29, 2011 (1Y)

All test equipment used is calibrated on a regular basis.

**10.4 Test data**

- Test Date : February 17, 2012
- Resolution bandwidth : 120 kHz (below 1 GHz), 1 MHz (above 1 GHz)
- Video bandwidth : 300 kHz (below 1 GHz), 3 MHz (above 1 GHz)
- Frequency range : 1 GHz ~ 25 GHz
- Measurement distance : 3 m
- Result : PASSED BY -47.77 dB at 136.80 MHz

Frequency (MHz)	Spectrum Reading (dBμV)	Generator Reading (dBm)	Ant. Gain (dBi)	Ant. Pol. (H/V)	Cable Loss (dB)	Total (dBm)	Limit (dBm)	Margin (dB)
<b>Test Data for Low Channel</b>								
1 930.03	67.50	-1.80	10.02	H	4.12	4.10	-	-
	70.13	0.83		V		6.73	-	-
<b>Test Data for Middle Channel</b>								
1 962.50	67.83	-1.67	10.16	H	4.06	4.43	-	-
	70.50	1.00		V		7.10	-	-
<b>Test Data for High Channel</b>								
1 994.97	67.33	-1.83	10.30	H	4.01	4.46	-	-
	70.00	0.80		V		7.09	-	-
38.00	29.50	-64.50	1.22	V	0.50	-63.78	-13.00	-50.78
42.83	28.00	-65.00	1.53	H	1.50	-61.97	-13.00	-48.97
136.80	35.17	-65.17	2.57	H	1.83	-60.77	-13.00	-47.77
163.86	32.33	-66.17	2.92	V	2.17	-61.08	-13.00	-48.08
Other frequencies have margin more than 20 dB.								

Tabulated test data for Restricted Band

Remark: "H": Horizontal, "V": Vertical

**Tested by: Ki-Hong, Nam / Senior Engineer**



## 11. FREQUENCY STABILITY WITH TEMPERATURE VARIATION

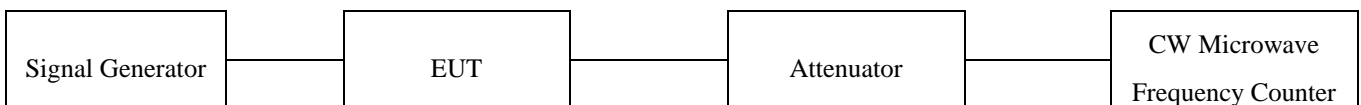
### 11.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 50 % R.H.

### 11.2 Test set-up

The RF signal from the signal generator(s) was injected to the EUT and the amplified RF signal at the output of the EUT was connected to the CW Microwave Frequency Counter. The test was performed at Middle channel at each band using all applicable unmodulation.

Turn EUT off and set chamber temperature to -30 °C and then allow sufficient time (approximately 20 min to 30 min after chamber reach the assigned temperature) for EUT to stabilize. Turn on the EUT and measure the EUT operating frequency and then turn off the EUT after the measurement. The temperature in the chamber was raised 10 °C step from -30 °C to +50 °C. Repeat above method for frequency measurements every 10 °C step and then record all measured frequencies on each temperature step.



### 11.3 Test equipment used

	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
<input type="checkbox"/>	E4432B	HP	Signal Generator	US38440950	June 10, 2011 (1Y)
<input checked="" type="checkbox"/>	SMJ100A	R/S	Signal Generator	101038	Feb. 01, 2012 (1Y)
<input type="checkbox"/>	FSP	R/S	Spectrum Analyzer	100017	Mar. 15, 2011 (1Y)
<input type="checkbox"/>	8564E	HP	Spectrum Analyzer	3650A00756	Jun. 10, 2011 (1Y)
<input type="checkbox"/>	FSV30	R/S	Spectrum Analyzer	101372	Aug. 29, 2011 (1Y)
<input checked="" type="checkbox"/>	53152A	R/S	CW Microwave Frequency Counter	US39270295	Dec. 30, 2011 (1Y)
<input checked="" type="checkbox"/>	67-30-43	Aeroflex Weinschel	Power Attenuator	CA5760	Nov. 30, 2011 (1Y)
<input checked="" type="checkbox"/>	SSE-43CI-A	Samkun Tech	Chamber	060712	Jun. 11, 2011(1Y)

All test equipment used is calibrated on a regular basis.

**11.4 Test data**

-. Test Date : February 24, 2012  
 -. Result : PASSED

Temperature (°C)	Input Freq. (Hz)	Measured Freq. (Hz)	Result (PPM)	Limit
-30	196 250 000 0	196 250 000 1	0.000 5	Within the Authorized Frequency block
-20		196 250 000 0	0.000 0	
-10		196 250 000 1	0.000 5	
0		196 250 000 1	0.000 5	
10		196 250 000 1	0.000 5	
20		196 250 000 0	0.000 0	
30		196 250 000 0	0.000 0	
40		196 250 000 0	0.000 0	
50		196 250 000 1	0.000 5	

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**Tested by: Ki-Hong, Nam / Senior Engineer**

## 12. FREQUENCY STABILITY WITH VOLTAGE VARIATION

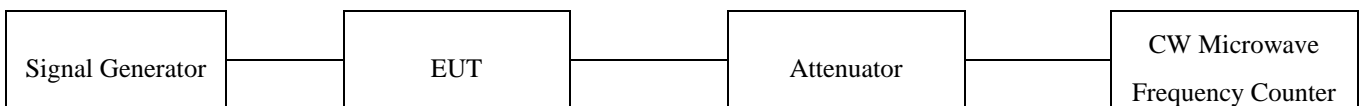
### 12.1 Operating environment

Temperature : 23 °C  
 Relative humidity : 50 % R.H.

### 12.2 Test set-up

The RF signal from the signal generator(s) was injected to the EUT and the amplified RF signal at the output of the EUT was connected to the CW Microwave Frequency Counter. The test was performed at Middle channel at each band using all applicable unmodulation.

The RF output port of the EUT was connected to the input of the spectrum analyzer. The signal generator was set to center frequency for each band with an un-modulated signal. The voltage of EUT set to 115 % of the nominal value and then was reduced to 85 % of nominal voltage. The output frequency was recorded at each step.



### 12.3 Test equipment used

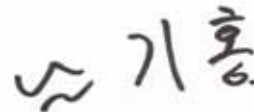
	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	E4432B	HP	Signal Generator	US38440950	June 10, 2011 (1Y)
■ -	SMJ100A	R/S	Signal Generator	101038	Feb. 01, 2012 (1Y)
□ -	FSP	R/S	Spectrum Analyzer	100017	Mar. 15, 2011 (1Y)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	Jun. 10, 2011 (1Y)
□ -	FSV30	R/S	Spectrum Analyzer	101372	Aug. 29, 2011 (1Y)
■ -	53152A	R/S	CW Microwave Frequency Counter	US39270295	Dec. 30, 2011 (1Y)
■ -	DH-60	Dea Kwang Elec.	Slidacs	N/A	Sep 03, 2011 (1Y)
■ -	67-30-43	Aeroflex Weinschel	Power Attenuator	CA5760	Nov. 30, 2011 (1Y)

All test equipment used is calibrated on a regular basis.

**12.4 Test data**

- Test Date : February 24, 2012  
 - Result : PASSED

Voltage (Vac)	Input Freq. (Hz)	Measured Freq. (Hz)	Result (PPM)	Limit
138 (115 %)	196 250 000 0	196 250 000 0	0.000 0	Within the Authorized Frequency block
120 (100 %)		196 250 000 0	0.000 0	
102 (85 %)		196 250 000 1	0.000 5	



**Tested by: Ki-Hong, Nam / Senior Engineer**

### 13. MAXIMUM PERMISSIBLE EXPOSURE

#### 13.1 RF Exposure Calculation

According to the FCC rule 1.1310 table 1B, the limit for the maximum permissible RF exposure for an uncontrolled environment is 1.0 mW/cm<sup>2</sup> the frequency range between 1 500 MHz and 100 000 MHz.

The electric field generated for a 1 mW/cm<sup>2</sup> exposure is calculated as follows:

$$E = \sqrt{(30 * P * G) / d}, \text{ and } S = E^2 / Z = E^2 / 377, \text{ because } 1 \text{ mW/cm}^2 = 10 \text{ W/m}^2$$

Where

S = Power density in mW/cm<sup>2</sup>, Z = Impedance of free space, 377 Ω

E = Electric field strength in V/m, G = Numeric antenna gain, and d = distance in meter

Combining equations and rearranging the terms to express the distance as a function of the remaining variable

$$d = \sqrt{(30 * P * G) / (377 * S)}$$

Changing to units of mW and cm, using P (mW) = P (W) / 1 000, d (cm) = 100 \* d (m)

$$d = 0.282 * \sqrt{(P * G) / S}$$

Where

d = distance in cm, P = Power in mW, G = Numeric antenna gain, and S = Power density in mW/cm<sup>2</sup>

#### 13.2 Calculated MPE Safe Distance

According to above equation, the following result was obtained.

Peak Output Power		Antenna Gain		Safe Distance	Power Density (mW/cm <sup>2</sup> )	FCC Limit
(dBm)	(mW)	Log	Linear	(cm)	@ 70 cm Separation	(mW/cm <sup>2</sup> )
44.50	28 183.8	2.0	1.58	59.51	0.72	1.0

According to above table, safe distance,  $D = 0.282 * \sqrt{28\ 183.8 * 1.58} = 59.51 \text{ cm}$ .

For getting power density at 80 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 28\ 183.8 * 1.58 / (4 * 3.14 * 70^2) = 0.72$$

Where:

S = Power Density,

P = Power input to the external antenna (Output power from the EUT antenna port (dBm) – cable loss (dB)),

G = Gain of Transmit Antenna (linear gain), R = Distance from Transmitting Antenna

Note: End users and installers must be provided with antenna installation instructions and transmitter operating conditions for satisfying RF exposure compliance, because the applicant does not provide an antenna for sale with the EUT.