

ELECTROMAGNETIC EMISSION COMPLIANCE REPORT FOR LICENSED TRANSMITTER

Test Report No. : E124R-061
AGR No. : A122A-154
Applicant : SOLiD, Inc.
Address : 10,9th Floor, SOLiD Space, Pangyoeyeok-ro 220, Bundang-gu, Seongnam-si,
Gyeonggi-do, 463-400, Korea
Manufacturer : SOLiD, Inc.
Address : 10,9th Floor, SOLiD Space, Pangyoeyeok-ro 220, Bundang-gu, Seongnam-si,
Gyeonggi-do, 463-400, Korea
Type of Equipment : RDU MODULE (850CEL)
FCC ID. : W6UH850C
Model Name : 850CEL RDU44.5
Serial number : N/A
Total page of Report : 83 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 22 Subpart H.**

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.

CONTENTS

	PAGE
1. VERIFICATION OF COMPLIANCE	5
2. TEST SUMMARY	6
2.1 TEST ITEMS AND RESULTS	6
2.2 ADDITIONS, DEVIATIONS, EXCLUSIONS FROM STANDARDS	6
2.3 RELATED SUBMITTAL(S) / GRANT(S)	6
2.4 PURPOSE OF THE TEST	6
2.5 TEST METHODOLOGY	6
2.6 TEST FACILITY	6
3. GENERAL INFORMATION	7
3.1 PRODUCT DESCRIPTION	7
3.2 ALTERNATIVE TYPE(S)/MODEL(S); ALSO COVERED BY THIS TEST REPORT.	7
3.3 PERIPHERAL EQUIPMENT	8
3.4 MODE OF OPERATION DURING THE TEST	8
4. EUT MODIFICATIONS	8
5. RF POWER OUTPUT AT ANTENNA TERMINAL	9
5.1 OPERATING ENVIRONMENT	9
5.2 TEST SET-UP	9
5.3 TEST EQUIPMENT USED	9
5.4 TEST DATA	10
6. OCCUPIED BANDWIDTH	11
6.1 OPERATING ENVIRONMENT	11
6.2 TEST SET-UP	11
6.3 TEST EQUIPMENT USED	11
6.4 TEST DATA	12
7. SPURIOUS EMISSION AT ANTENNA TERMINAL	43
7.1 OPERATING ENVIRONMENT	43
7.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	43
7.3 TEST EQUIPMENT USED	43
7.4 TEST DATA	44

8. BAND EDGE MEASUREMENT	61
8.1 OPERATING ENVIRONMENT	61
8.2 TEST SET-UP FOR CONDUCTED MEASUREMENT	61
8.3 TEST EQUIPMENT USED	61
8.4 TEST DATA	62
9. INTERMODULATION TEST	68
9.1 OPERATING ENVIRONMENT	68
9.2 TEST SET-UP	68
9.3 TEST EQUIPMENT USED	68
9.4 TEST DATA	69
<i>9.4.1 Test Result for peak power</i>	69
<i>9.4.2 Test Result for Spurious emission</i>	73
10. FIELD STRENGTH OF SPURIOUS RADIATION	77
10.1 OPERATING ENVIRONMENT	77
10.2 TEST SET-UP	77
10.3 TEST EQUIPMENT USED	77
10.4 TEST DATA	78
11. FREQUENCY STABILITY WITH TEMPERATURE VARIATION	79
11.1 OPERATING ENVIRONMENT	79
11.2 TEST SET-UP	79
11.3 TEST EQUIPMENT USED	79
11.4 TEST DATA	80
12. FREQUENCY STABILITY WITH VOLTAGE VARIATION	81
12.1 OPERATING ENVIRONMENT	81
12.2 TEST SET-UP	81
12.3 TEST EQUIPMENT USED	81
12.4 TEST DATA	82
13. MAXIMUM PERMISSIBLE EXPOSURE	83
13.1 RF EXPOSURE CALCULATION	83
13.2 CALCULATED MPE SAFE DISTANCE	83

Revision History

Issued Report No.	Issued Date	Revisions	Effect Section
E124R-061	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 : W6UH850C
MODEL NAME : 850CEL RDU44.5
SERIAL NUMBER : N/A
DATE : April 24, 2012

EQUIPMENT CLASS	PCB - PCS Licensed Transmitter
EQUIPMENT DESCRIPTION	RDU MODULE (850CEL)
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 22 Subpart H
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), 22.913(a)	RF Power Output at Antenna Terminals	Met the Limit / PASS
2.1047	Modulation Characteristics	PASS (See Note 1)
2.1049	Occupied Bandwidth, Bandwidth Limitation	Met the Limit / PASS
2.1049, 22.917	Band Edge	Met the Limit / PASS
2.1051, 22.917	Spurious Emissions at Antenna Terminals	Met the Limit / PASS
2.1053, 22.917	Field strength of Spurious Radiation	Met the Limit / PASS
2.1055, 22.355	Frequency Stability with Temperature variation	Met the requirement / PASS
2.1055, 22.355	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 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	800/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 (850CEL)
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)
OPERATING FREQUENCY	869 MHz ~ 894 MHz
CHANNEL SEPARATION	GSM(200 kHz), EDGE(200 kHz), CDMA(1.25 MHz), EVDO(1.25 MHz), WCDMA(5 MHz)
RF OUTPUT POWER	44.5 dBm
DC VOLTAGE & CURRENT INTO FINAL AMPLIFIER	28 V, 10 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

It should not be reproduced except in full, without the written approval of ONETECH.

EMC-003 (Rev.2)

HEAD OFFICE : 301-14 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-799-9500, FAX: 82-31-799-9599)

EMC Testing Dept : 307-51 Daessangnyeong-ri, Chowol-eup, Gwangju-si, Gyeonggi-do 464-862 Korea (TEL: 82-31-765-8289, FAX: 82-31-766-2904)

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
850CEL RDU44.5	SOLiD Technologies	W6UH850C	RDU MODULE (850CEL) (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/ EDGD	Low	869.20	CDMA/ 1xEVDO	Low	870.25
	Middle	881.60		Middle	881.50
	High	893.80		High	892.75
WCDMA	Low	871.40			
	Middle	881.00			
	High	891.60			

4. EUT MODIFICATIONS

-. None

5. RF POWER OUTPUT at ANTENNA TERMINAL

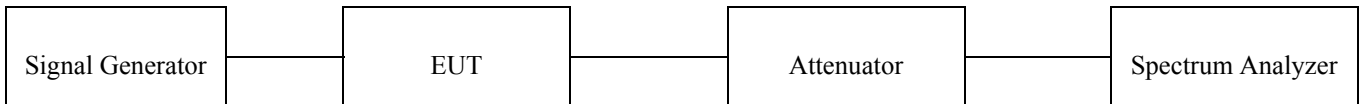
5.1 Operating environment

Temperature : 21 °C
 Relative humidity : 52 %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

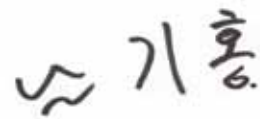
	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	E4432B	HP	Signal Generator	US38440950	June 10, 2011 (1Y)
■ -	SMJ100A	R/S	Signal Generator	101038	Feb. 02, 2012 (1Y)
■ -	FSP	R/S	Spectrum Analyzer	100017	Mar. 15, 2011 (1Y)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	Jun. 10, 2011 (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 20, 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	869.20	-9.90	44.50	28.183 829	100.00
	Middle	881.60	-9.90	44.50		
	High	893.80	-9.80	44.50		
EDGE	Low	869.20	-9.80	44.50	28.183 829	
	Middle	881.60	-9.70	44.50		
	High	893.80	-9.80	44.50		
CDMA	Low	870.25	-9.90	44.50	28.183 829	
	Middle	881.50	-9.90	44.50		
	High	892.75	-9.80	44.50		
1xEVDO	Low	870.25	-9.80	44.50	28.183 829	
	Middle	881.50	-9.90	44.50		
	High	892.75	-9.80	44.50		
WCDMA	Low	871.40	-9.70	44.50	28.183 829	
	Middle	881.00	-9.80	44.50		
	High	891.60	-9.80	44.50		



Tested by: Ki-Hong, Nam / Senior Engineer

6. OCCUPIED BANDWIDTH

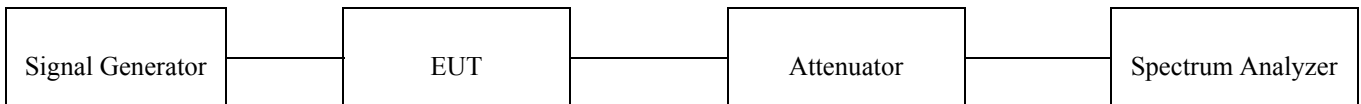
6.1 Operating environment

Temperature : 21 °C
 Relative humidity : 52 %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)

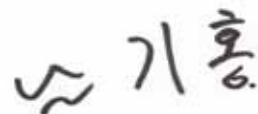
All test equipment used is calibrated on a regular basis.

6.4 Test data

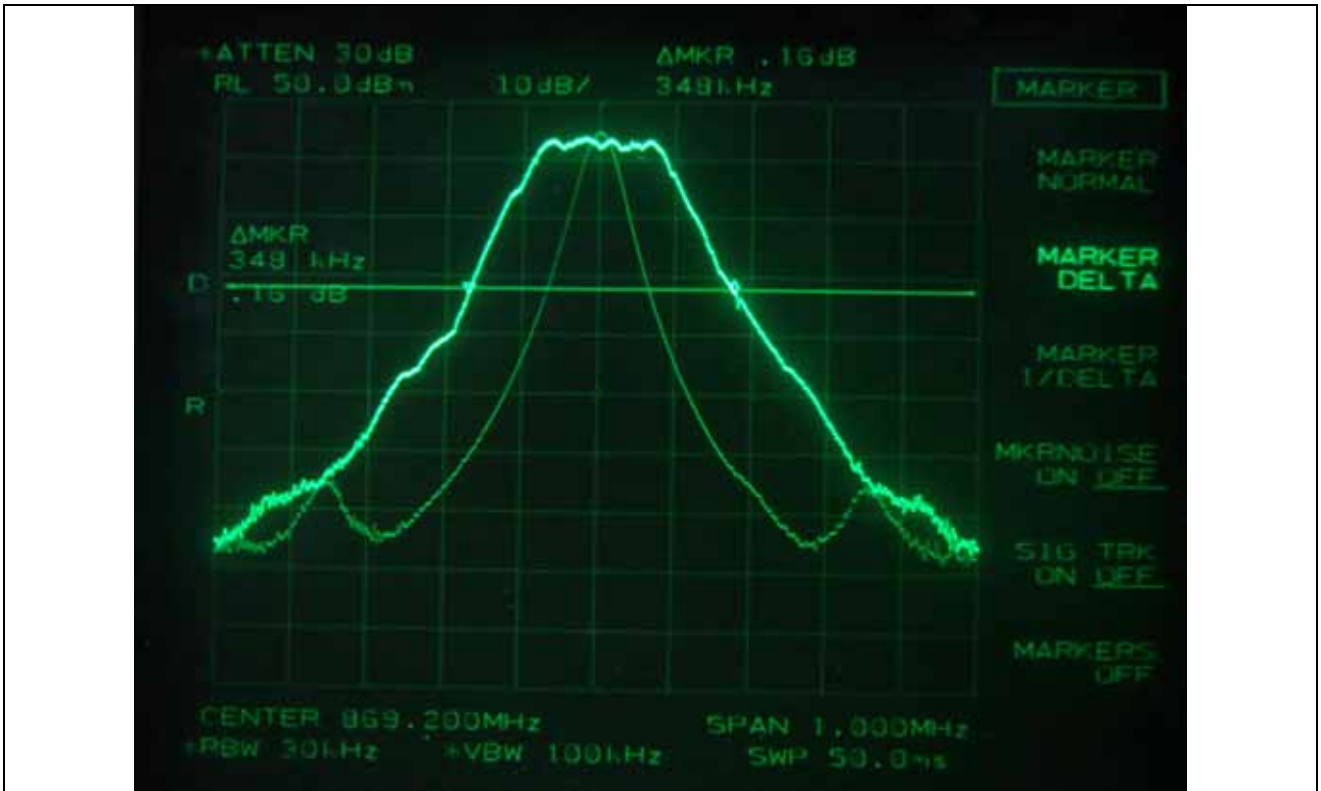
- Test Date : February 20, 2012
- Test Result : Pass

Modulation	Channel	26 dB Bandwidth (kHz)	99 % Occupied Bandwidth (kHz)
GSM	Low	348.0	253.3
	Middle	348.0	253.3
	High	348.0	253.3
EDGE	Low	335.0	253.3
	Middle	335.0	253.3
	High	335.0	255.0
CDMA	Low	1 583	1 342
	Middle	1 592	1 333
	High	1 583	1 325
1xEVDO	Low	1 583	1 342
	Middle	1 583	1 333
	High	1 583	1 333
WCDMA	Low	4 700	4 167
	Middle	4 680	4 183
	High	4 670	4 167

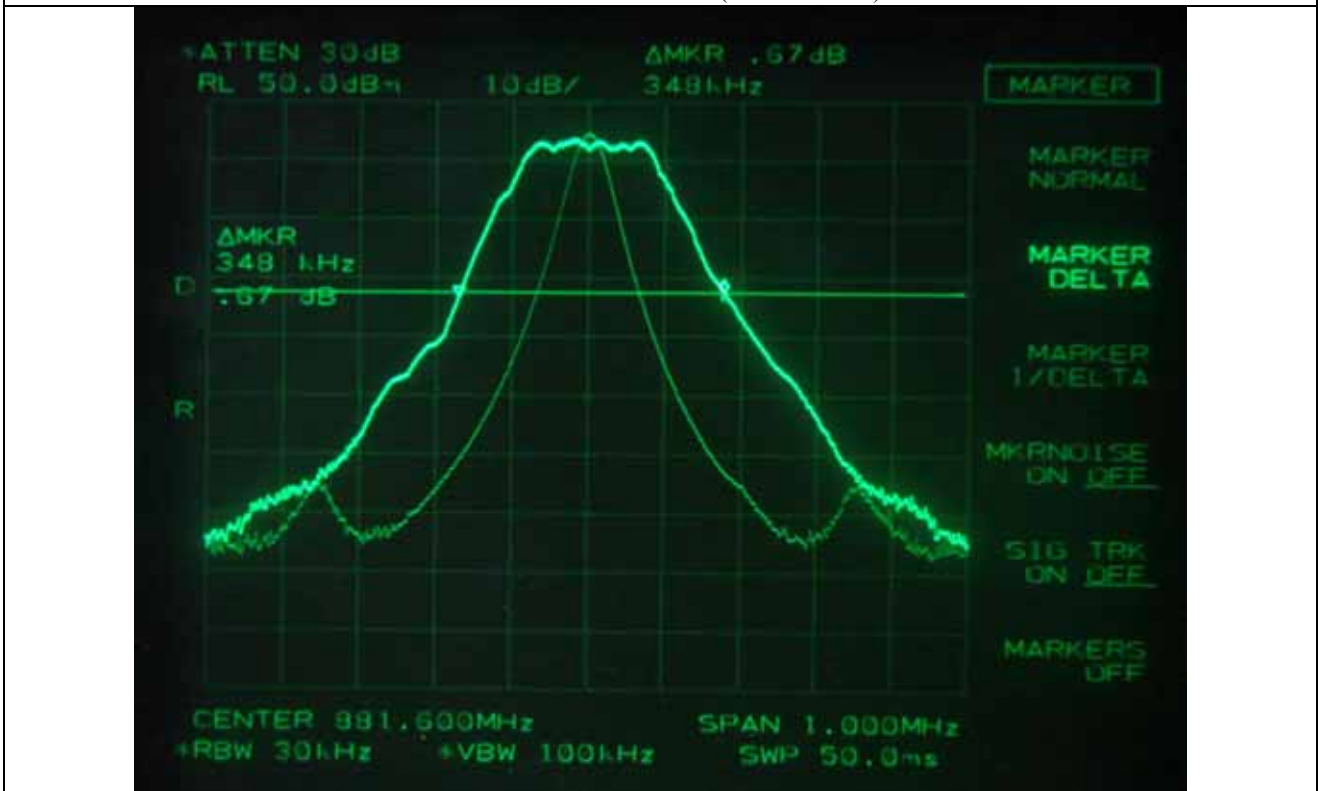
Remark: According to above result, the carrier frequency shall be within the frequency block edges.



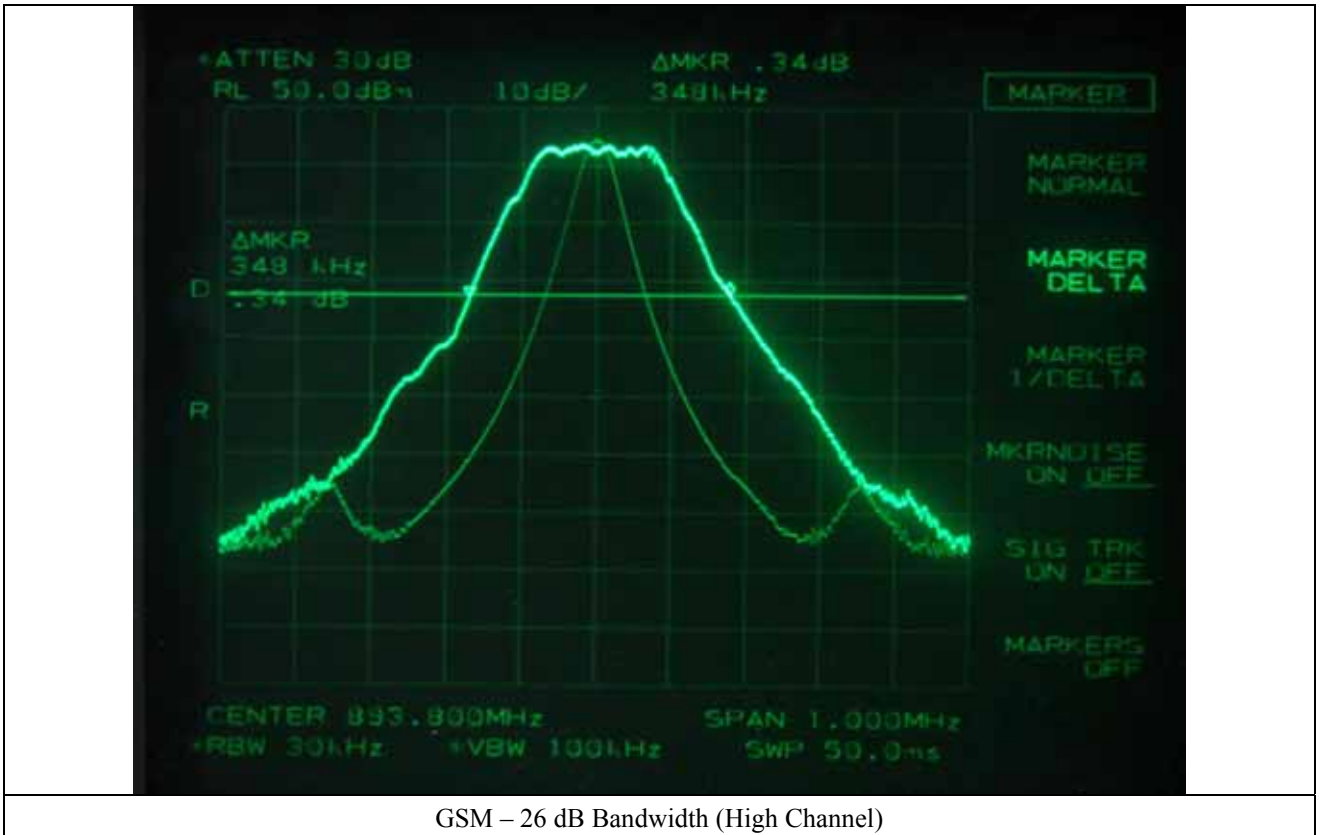
Tested by: Ki-Hong, Nam / Senior Engineer



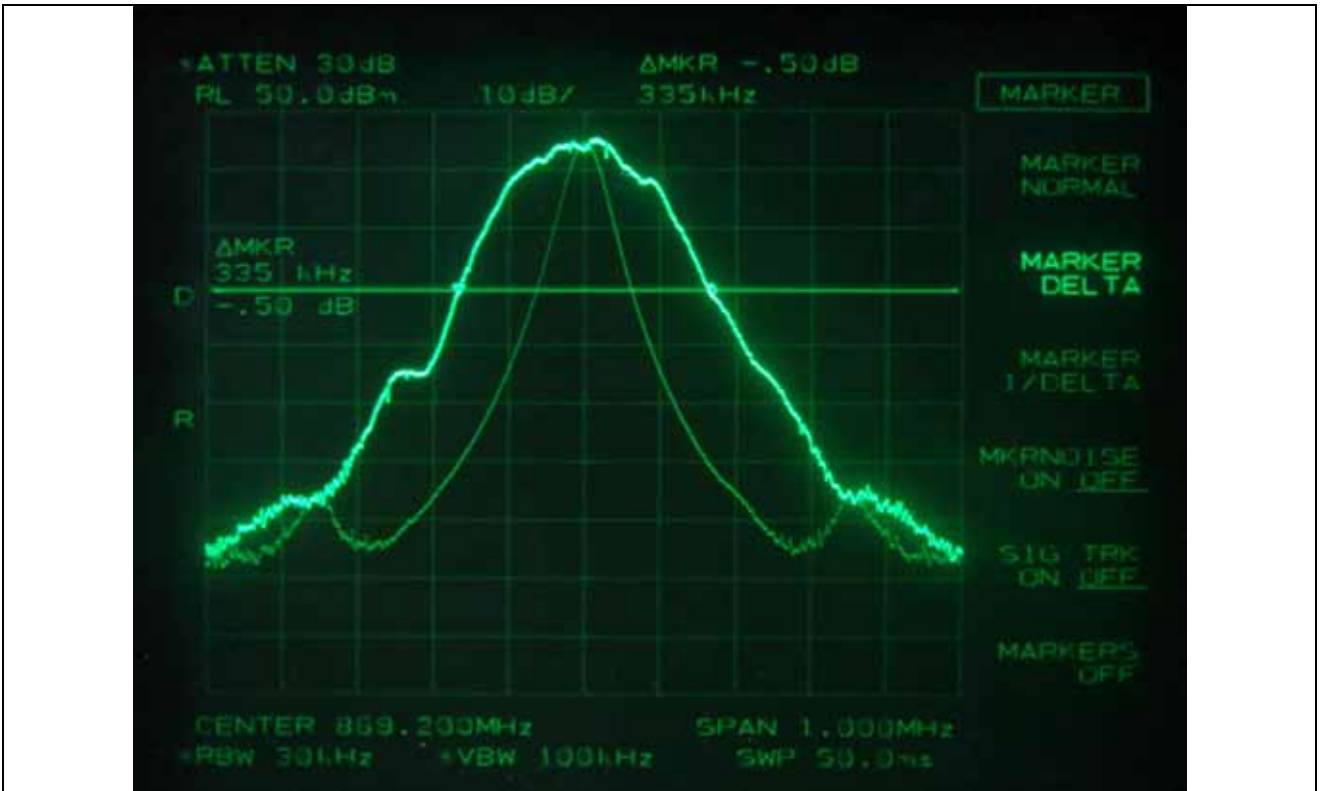
GSM – 26 dB Bandwidth (Low Channel)



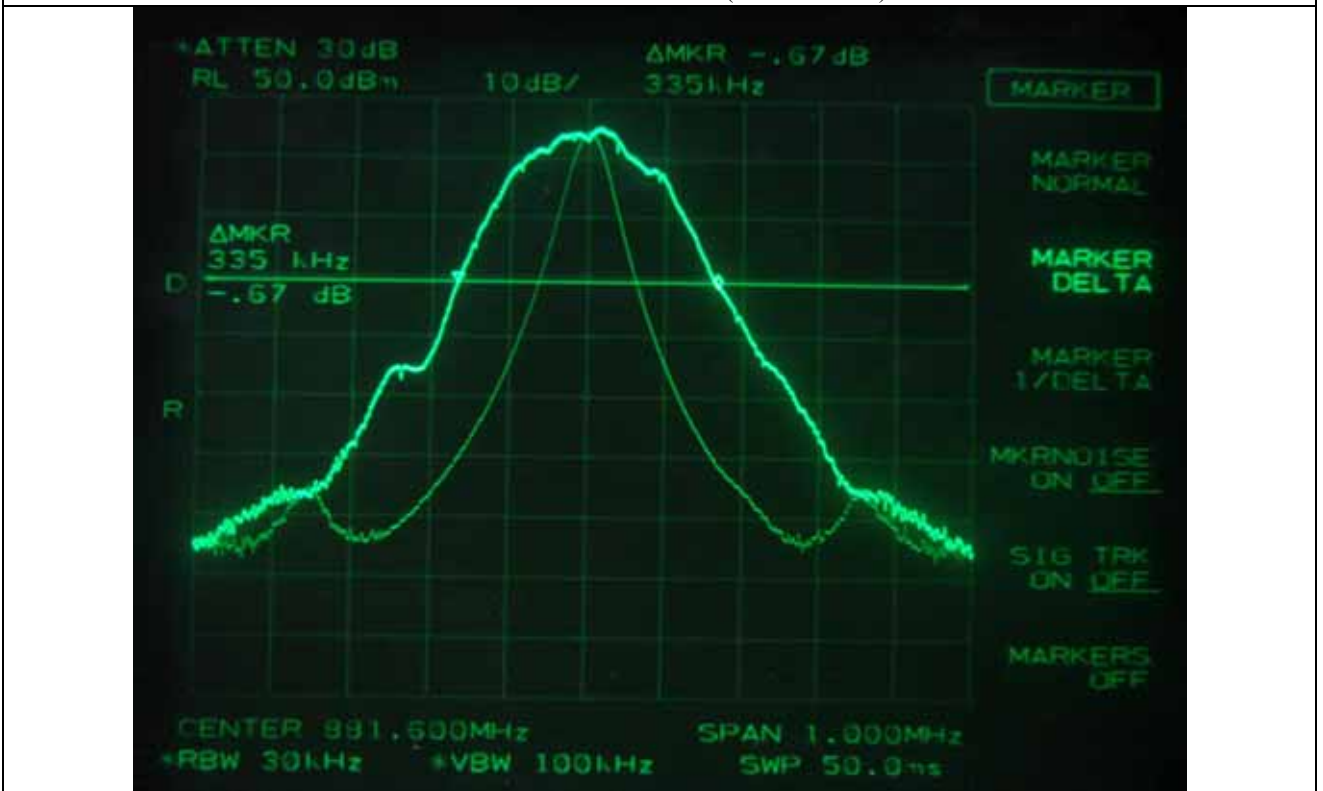
GSM – 26 dB Bandwidth (Middle Channel)



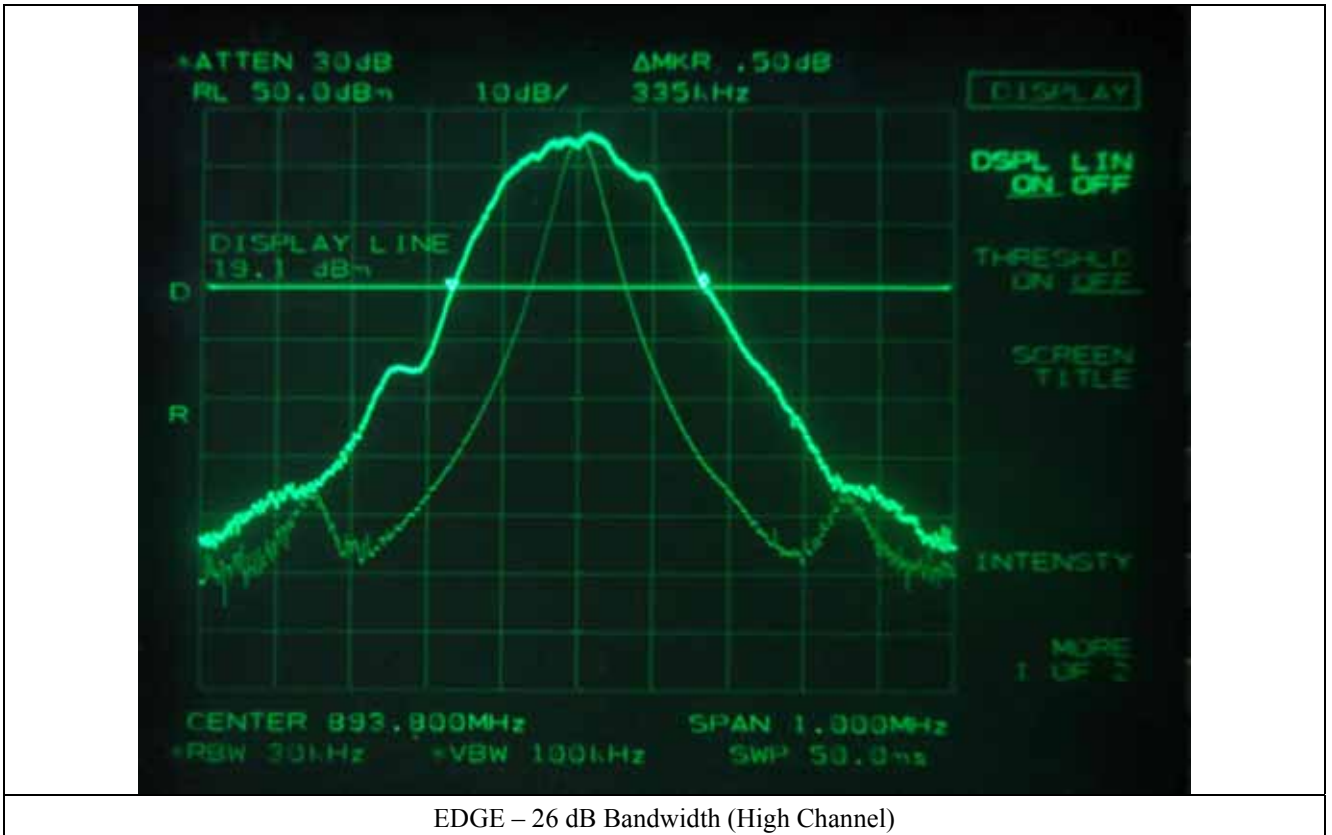
GSM – 26 dB Bandwidth (High Channel)

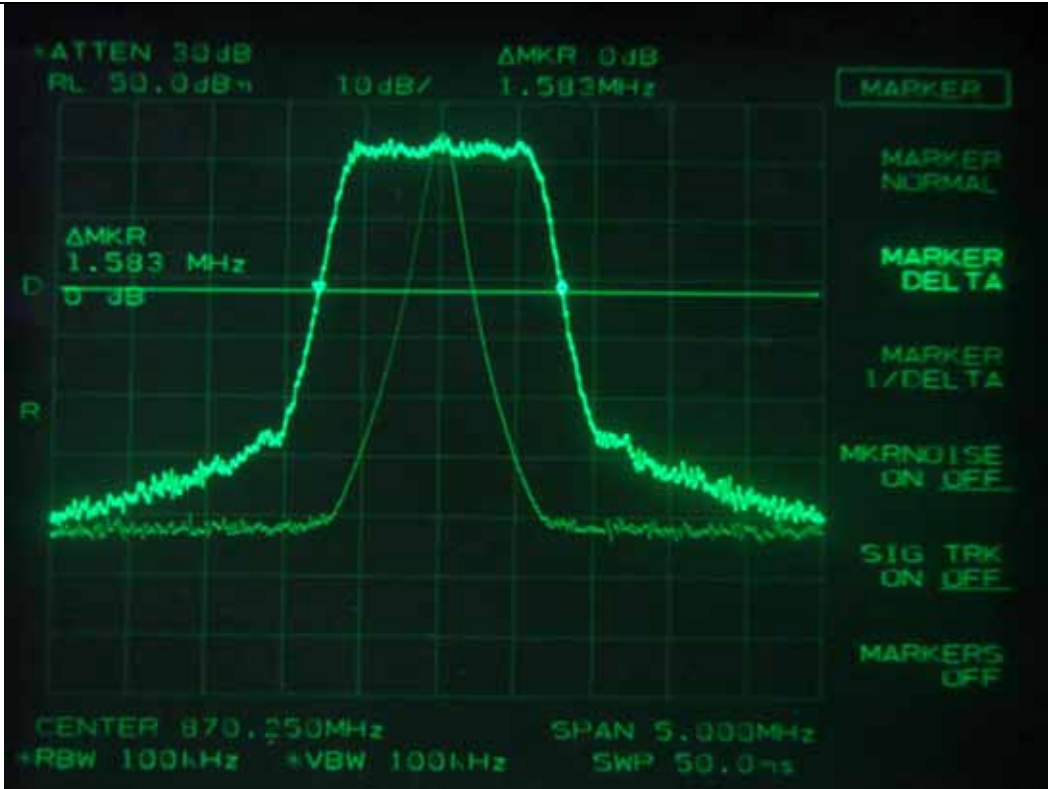


EDGE - 26 dB Bandwidth (Low Channel)

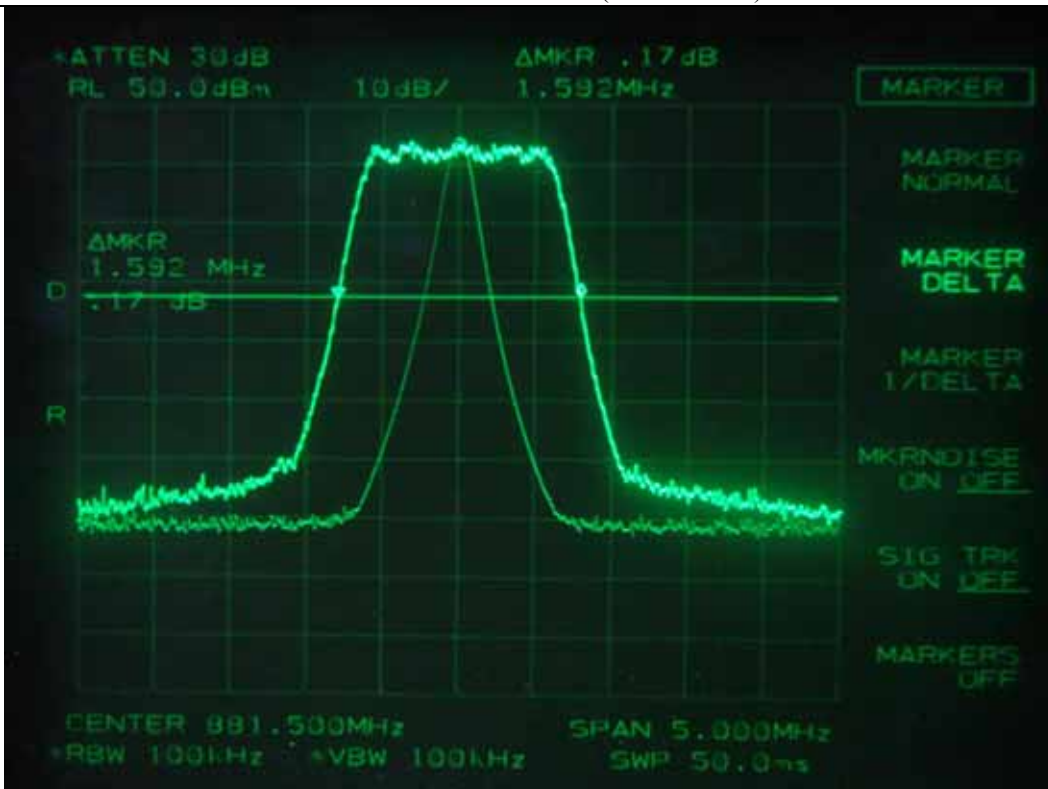


EDGE - 26 dB Bandwidth (Middle Channel)

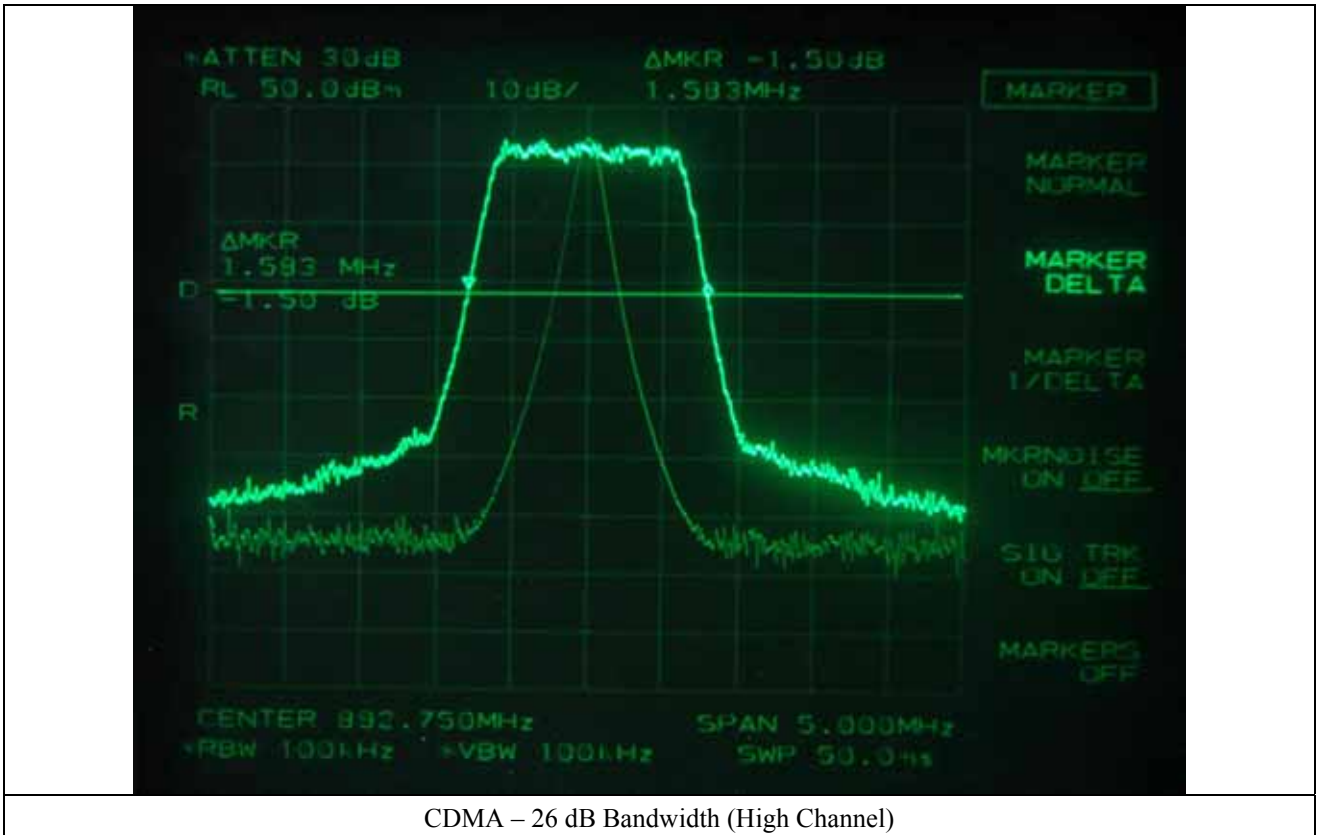


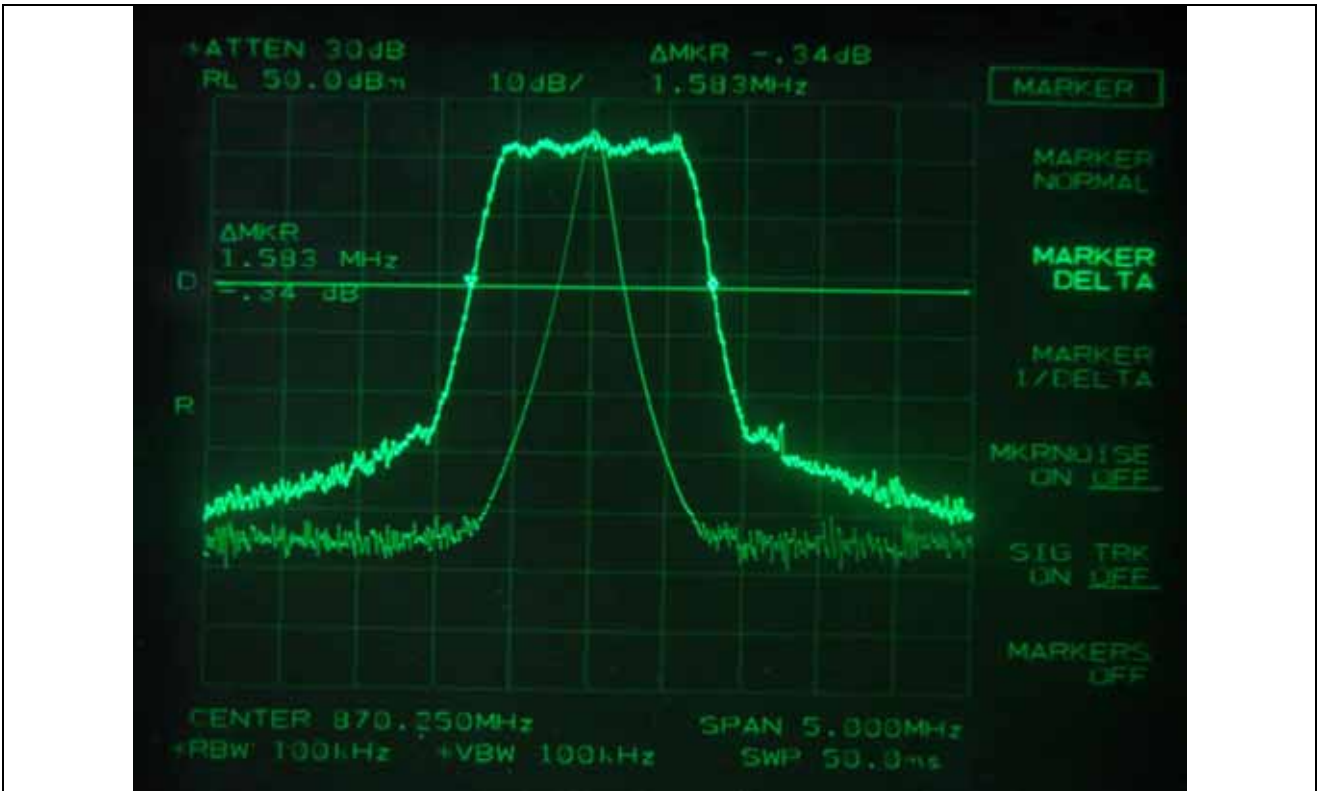


CDMA – 26 dB Bandwidth (Low Channel)

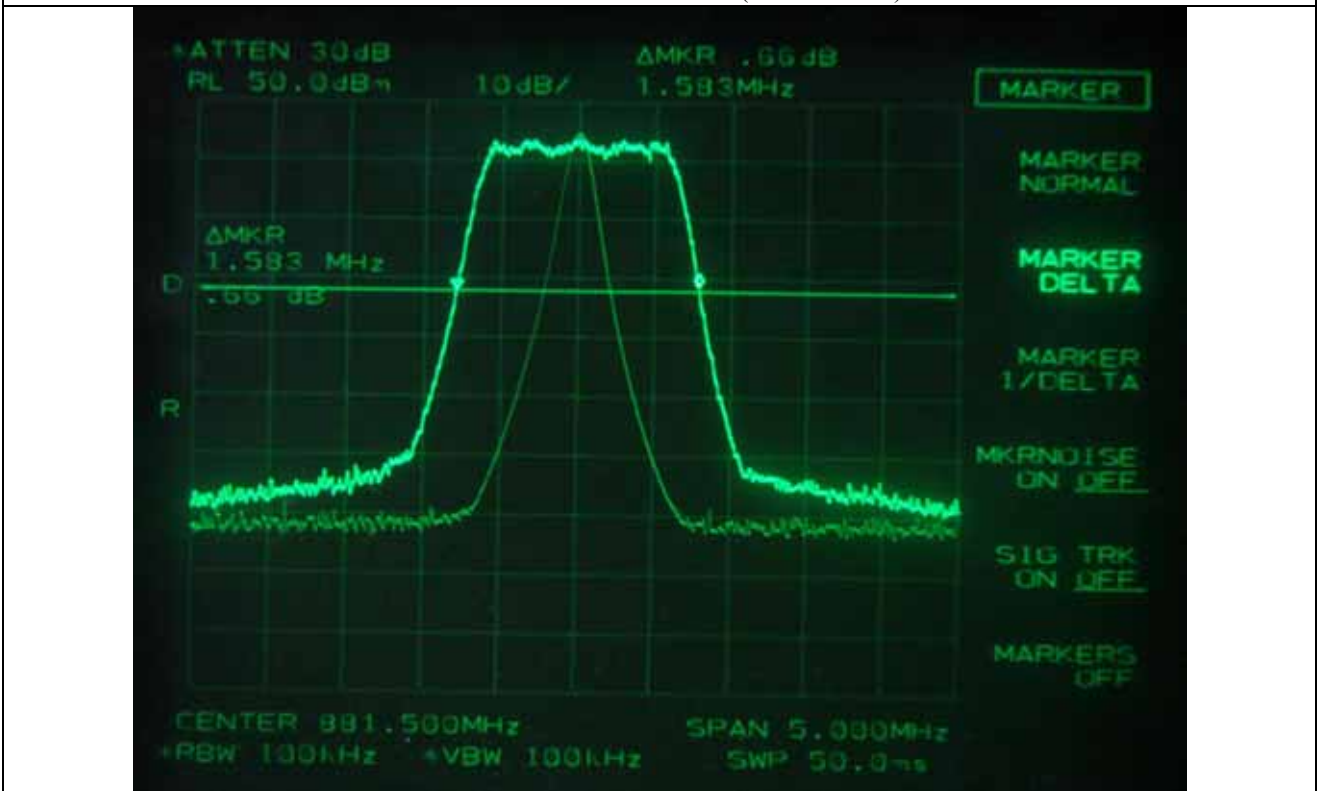


CDMA – 26 dB Bandwidth (Middle Channel)

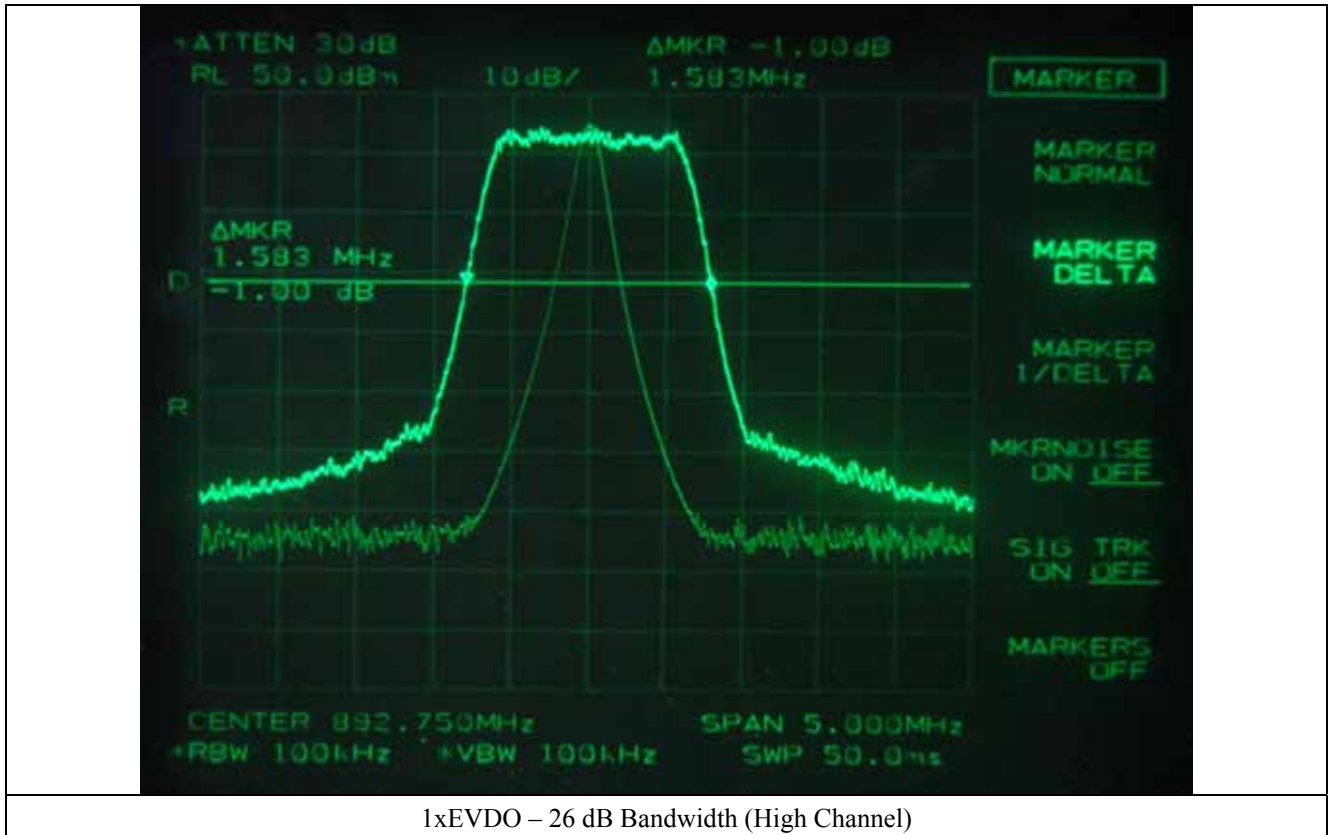


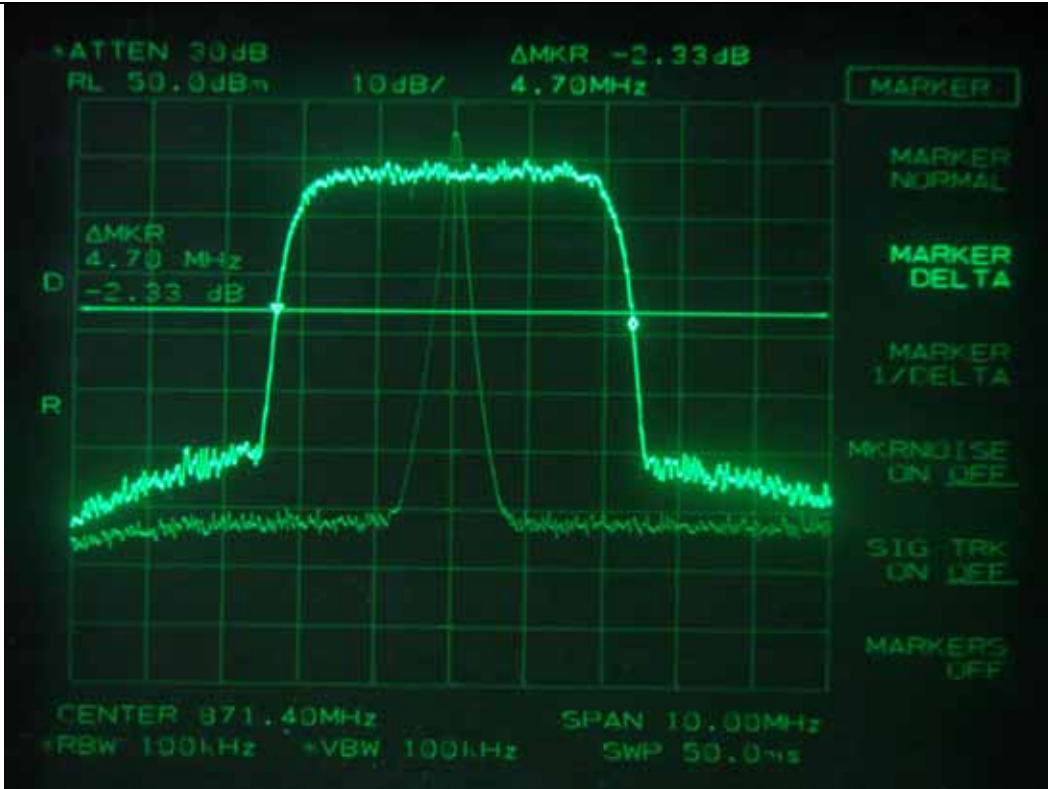


1xEVDO – 26 dB Bandwidth (Low Channel)

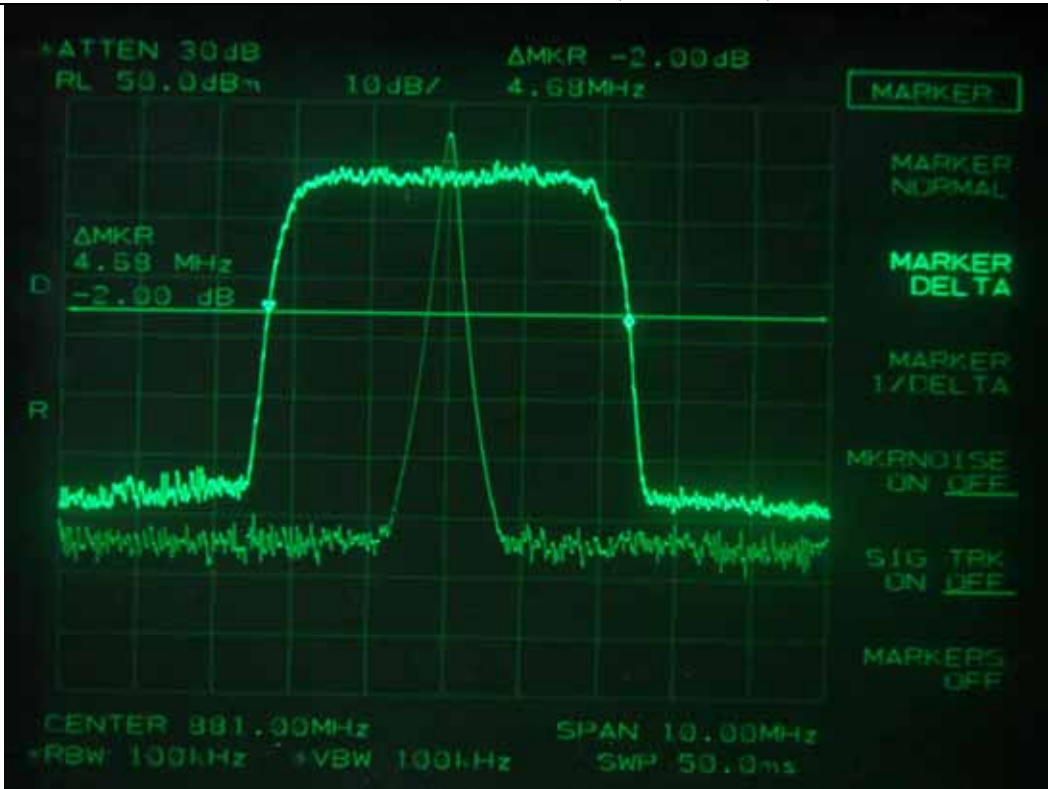


1xEVDO – 26 dB Bandwidth (Middle Channel)

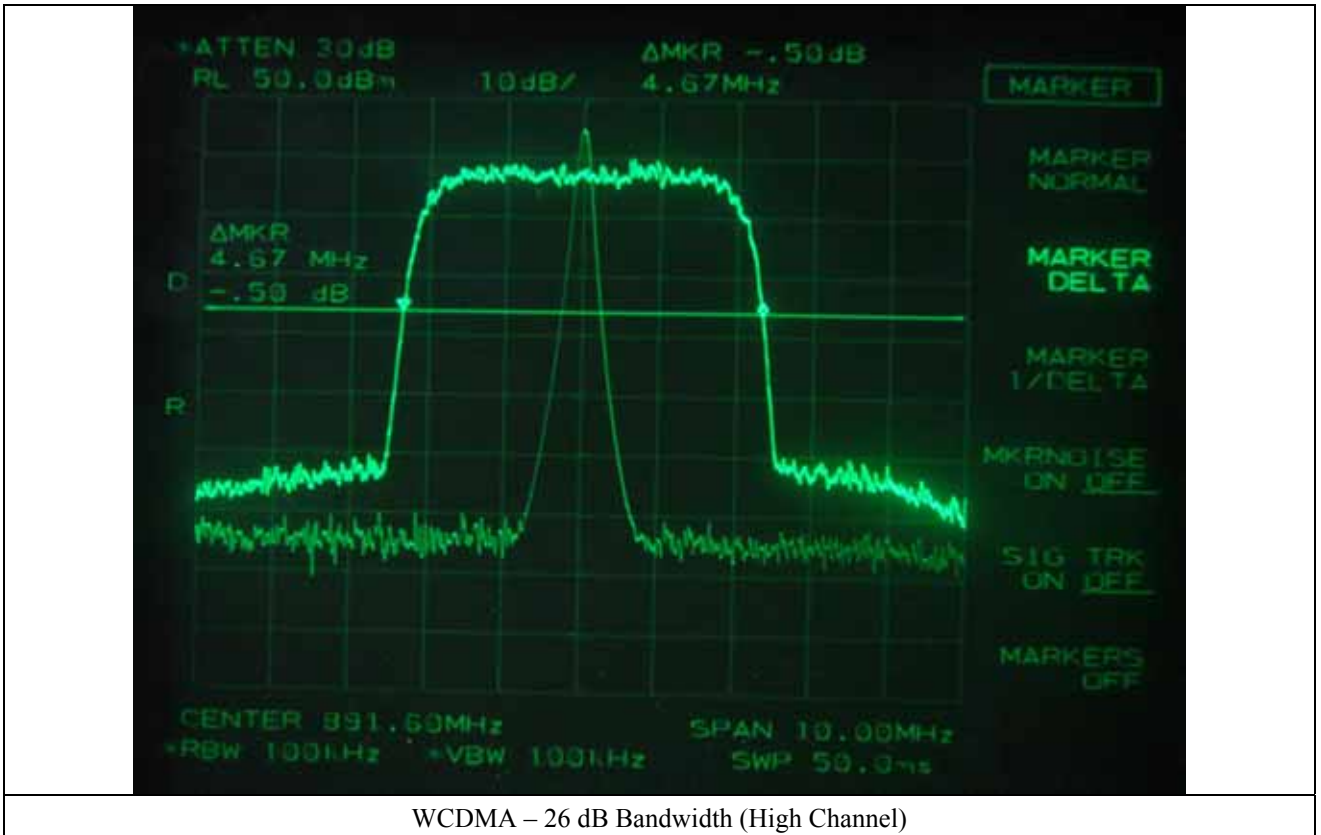


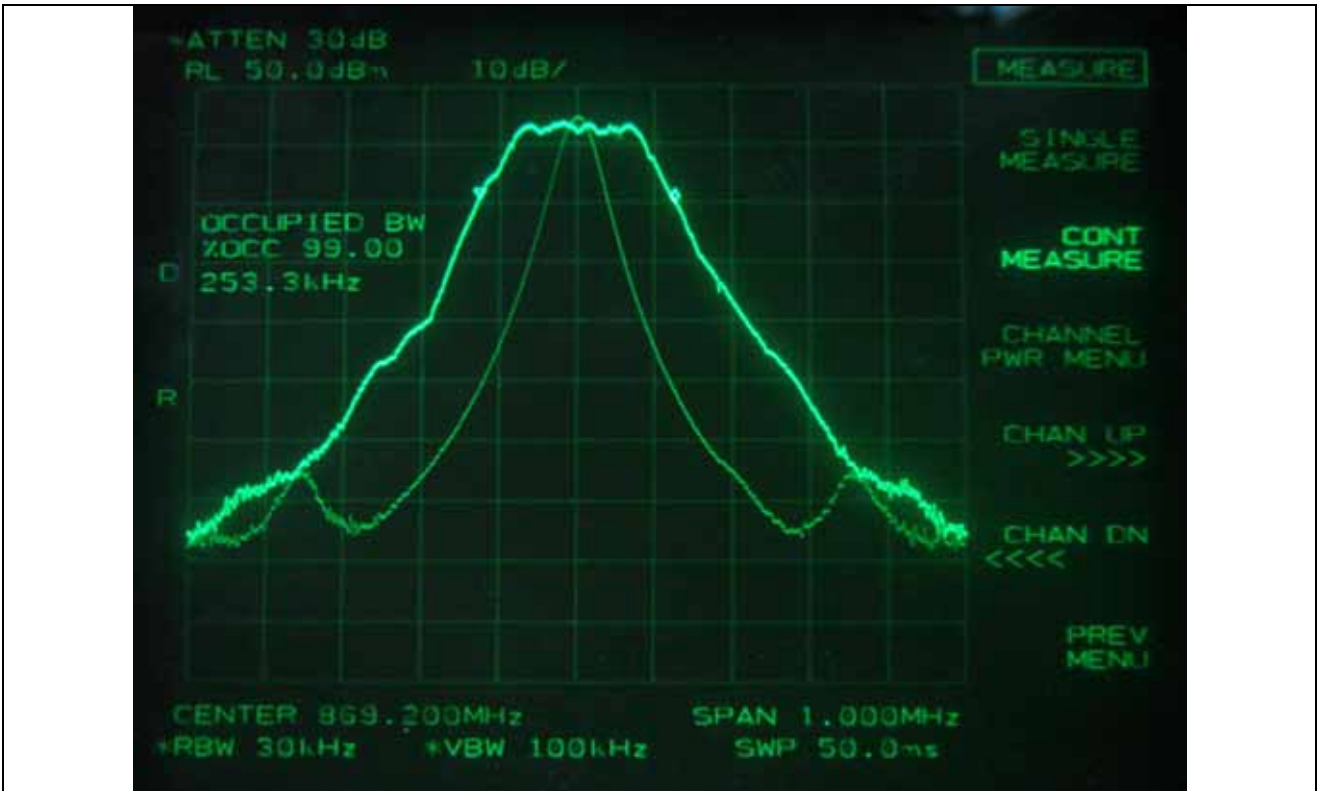


WCDMA – 26 dB Bandwidth (Low Channel)

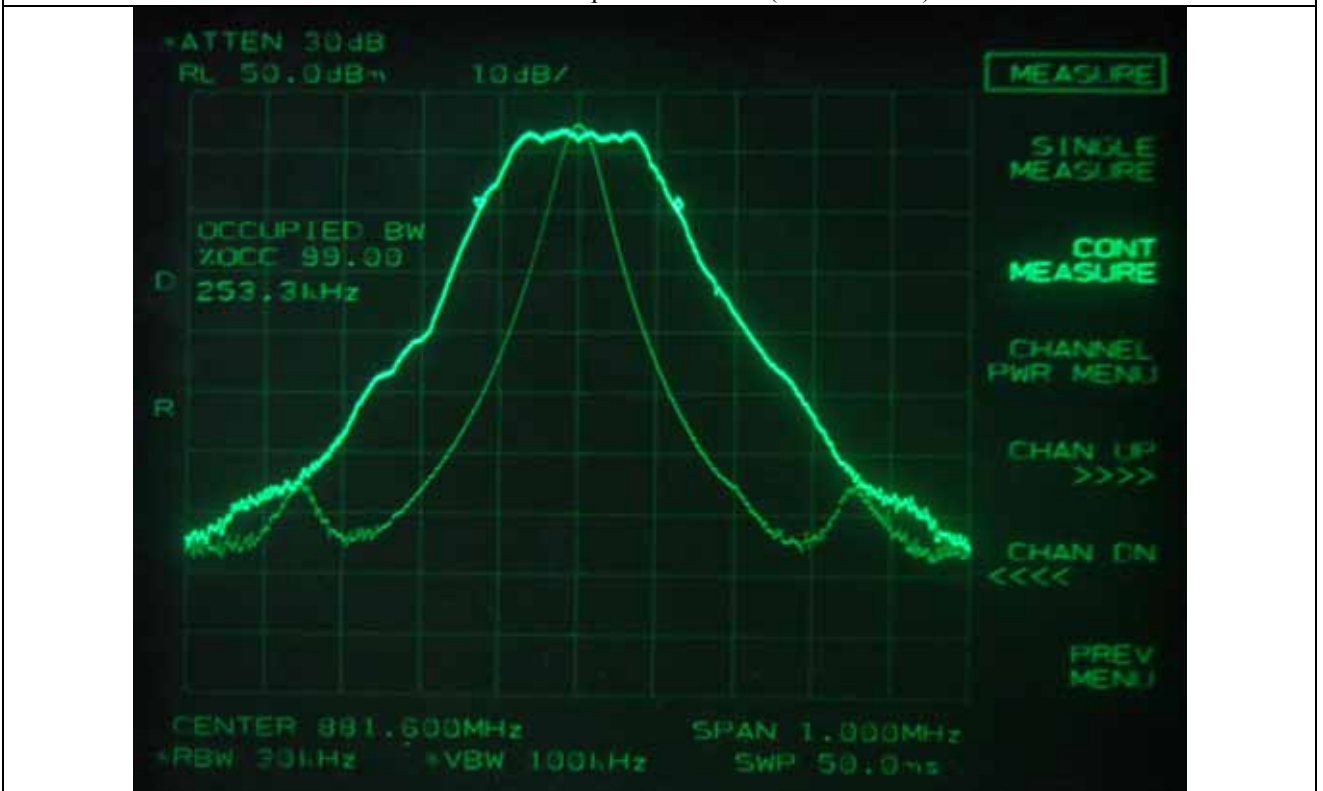


WCDMA – 26 dB Bandwidth (Middle Channel)

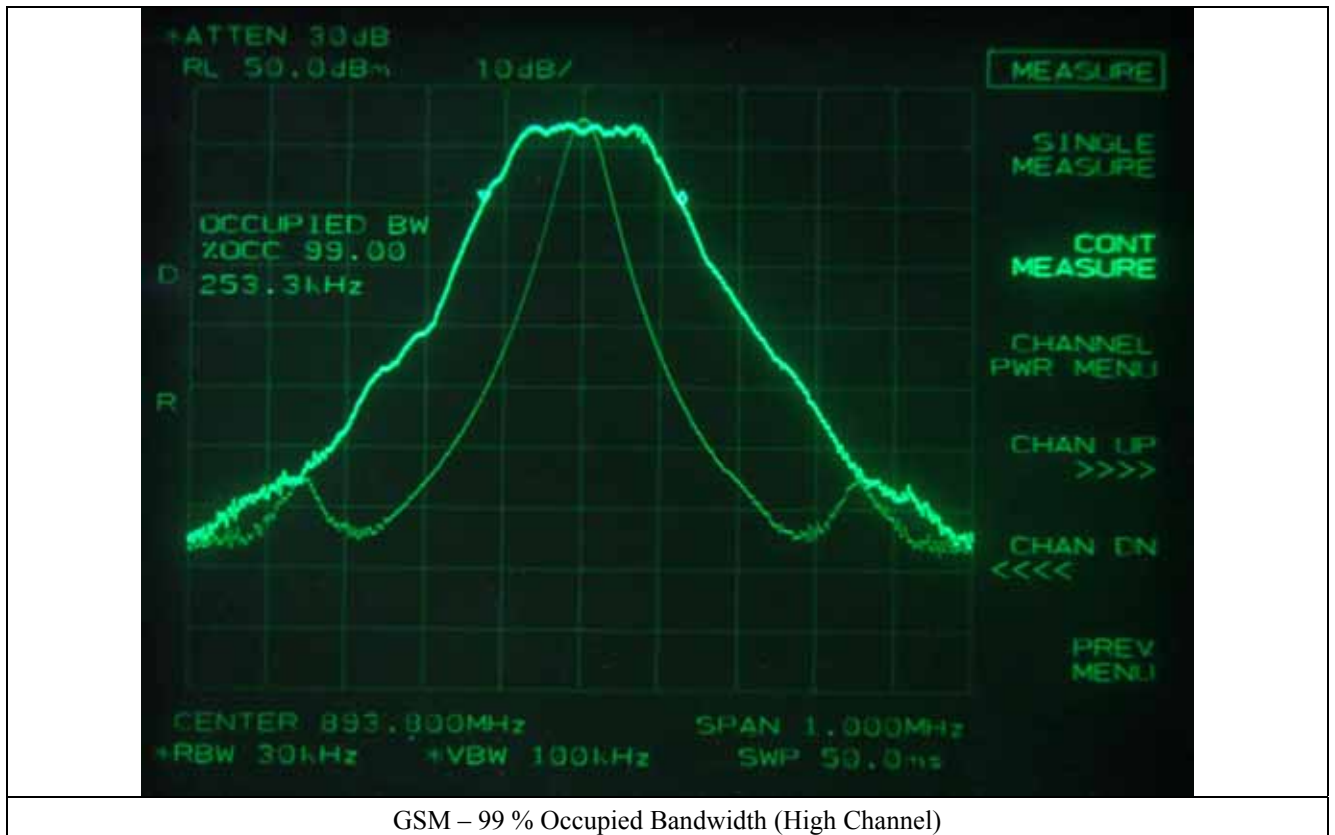




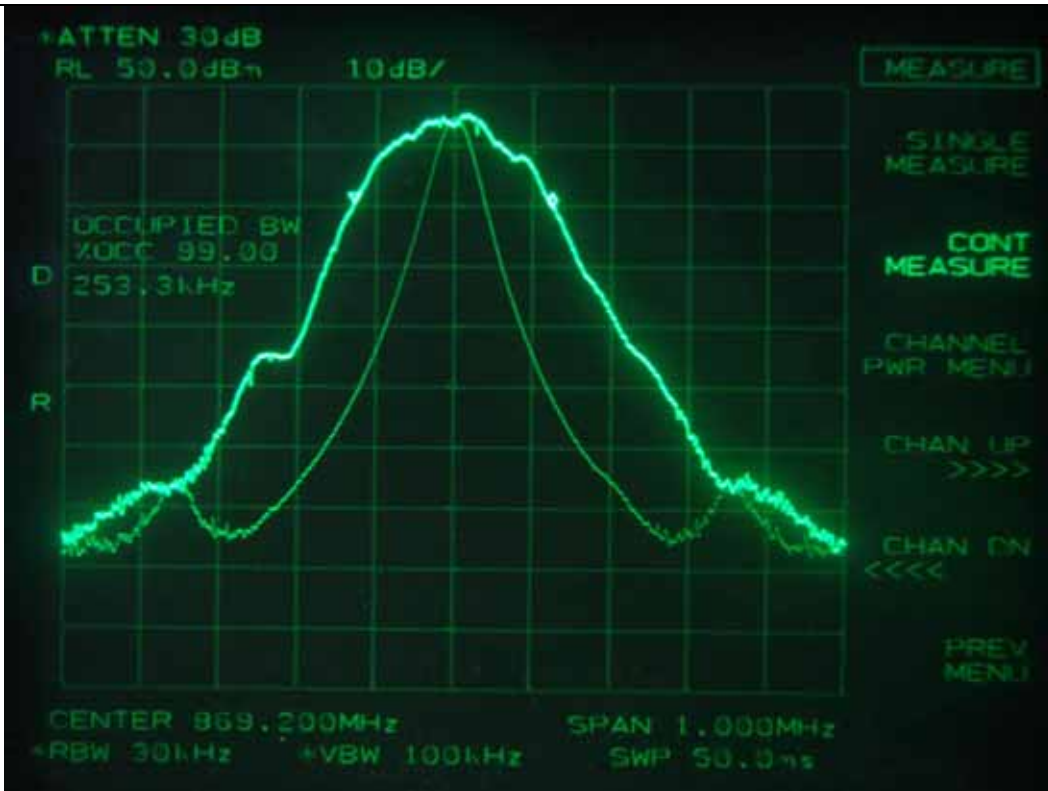
GSM – 99 % Occupied Bandwidth (Low Channel)



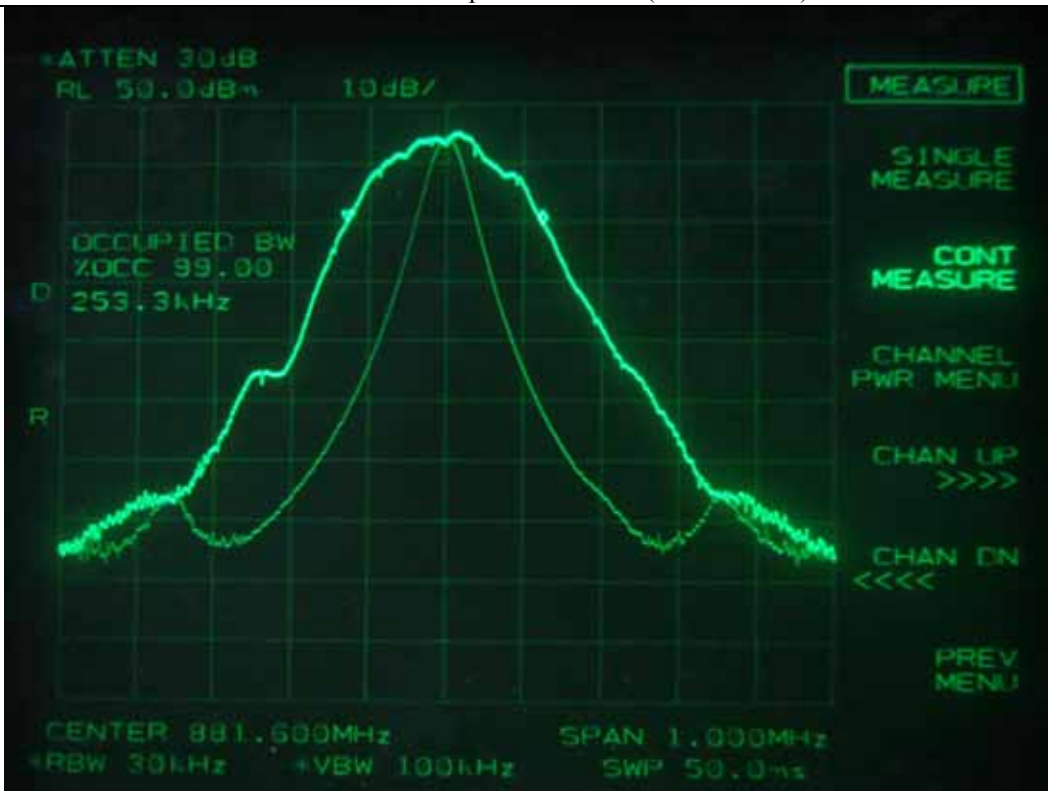
GSM – 99 % Occupied Bandwidth (Middle Channel)



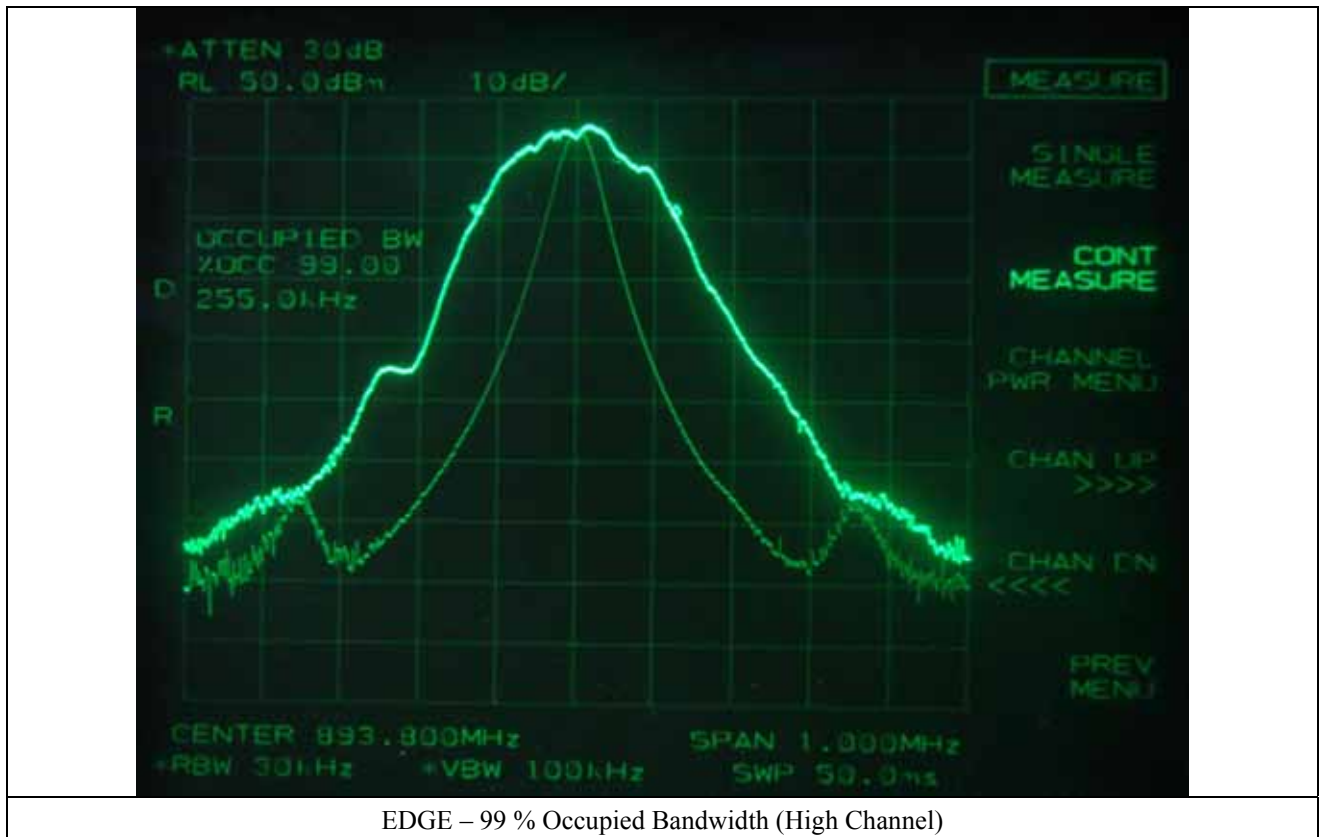
GSM – 99 % Occupied Bandwidth (High Channel)

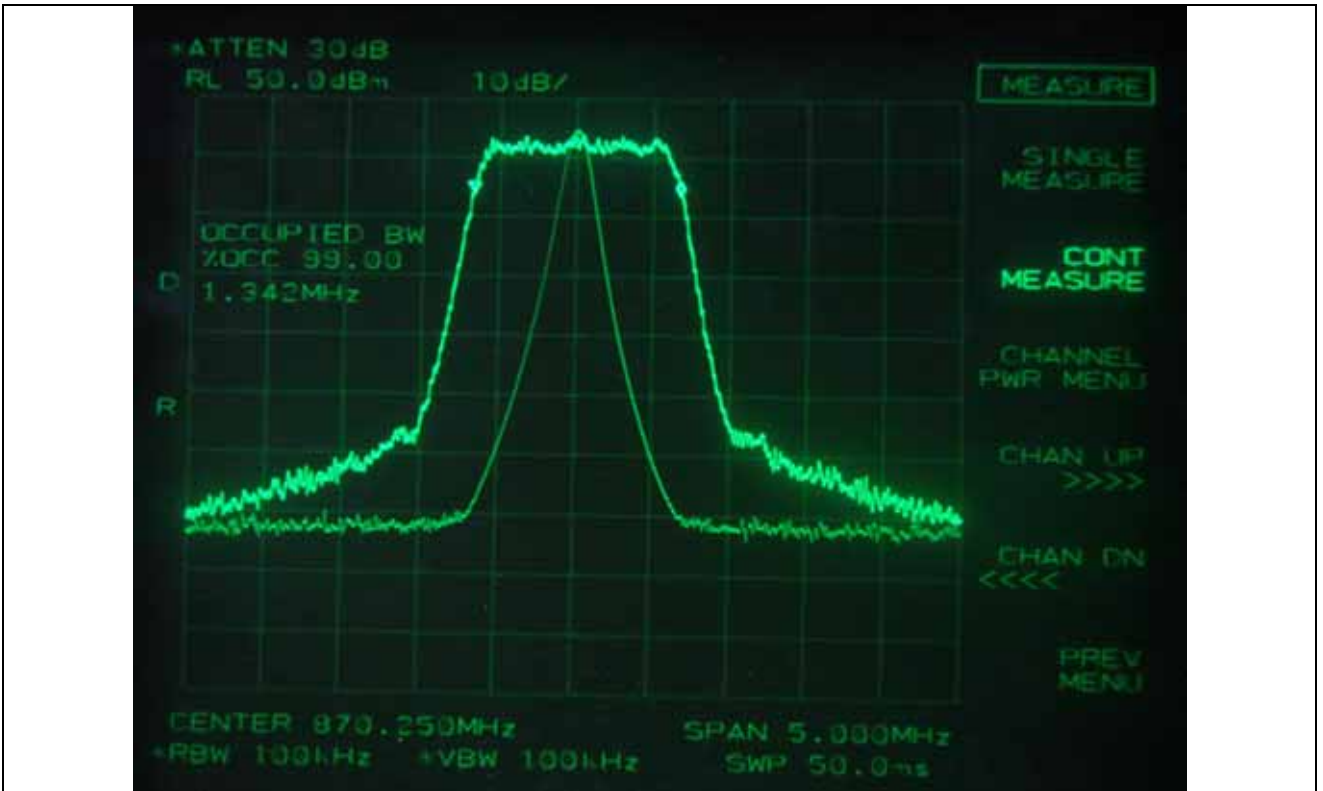


EDGE – 99 % Occupied Bandwidth (Low Channel)

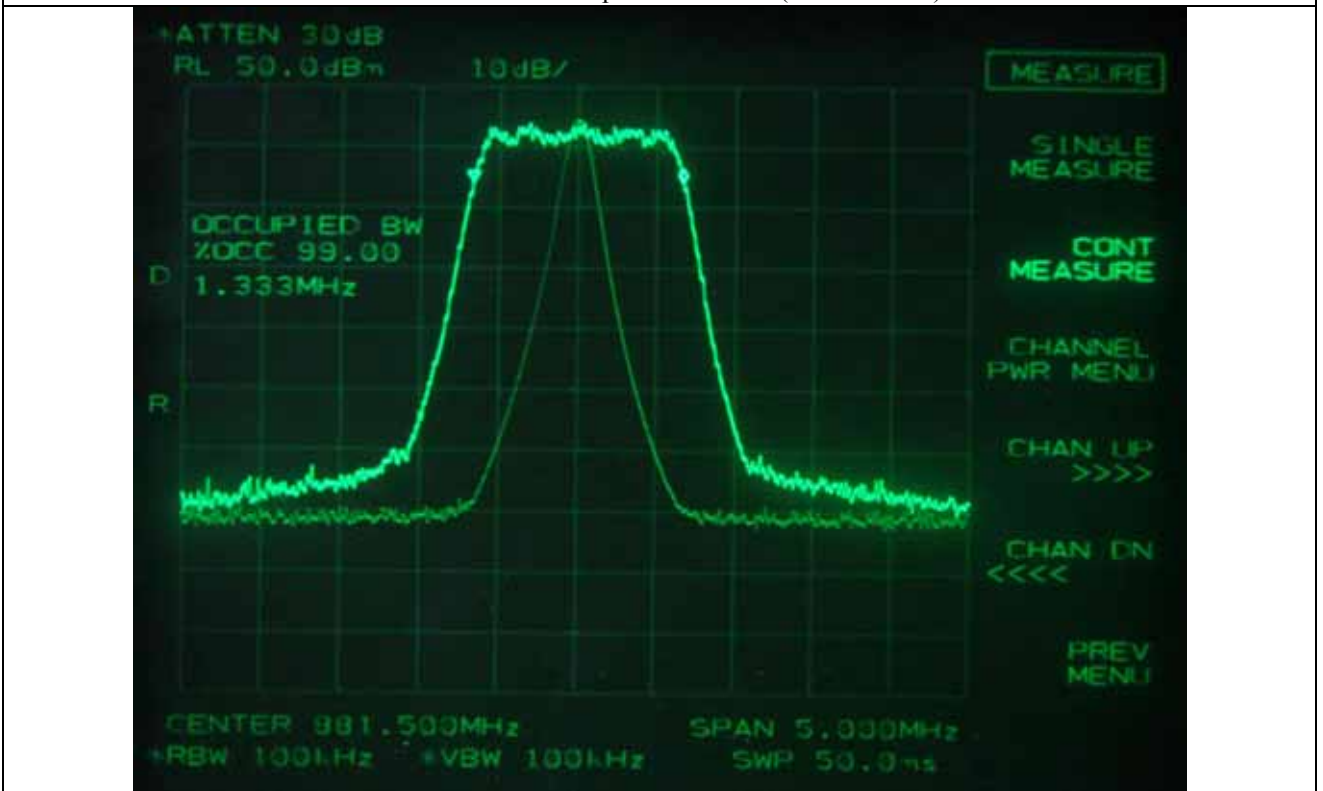


EDGE – 99 % Occupied Bandwidth (Middle Channel)

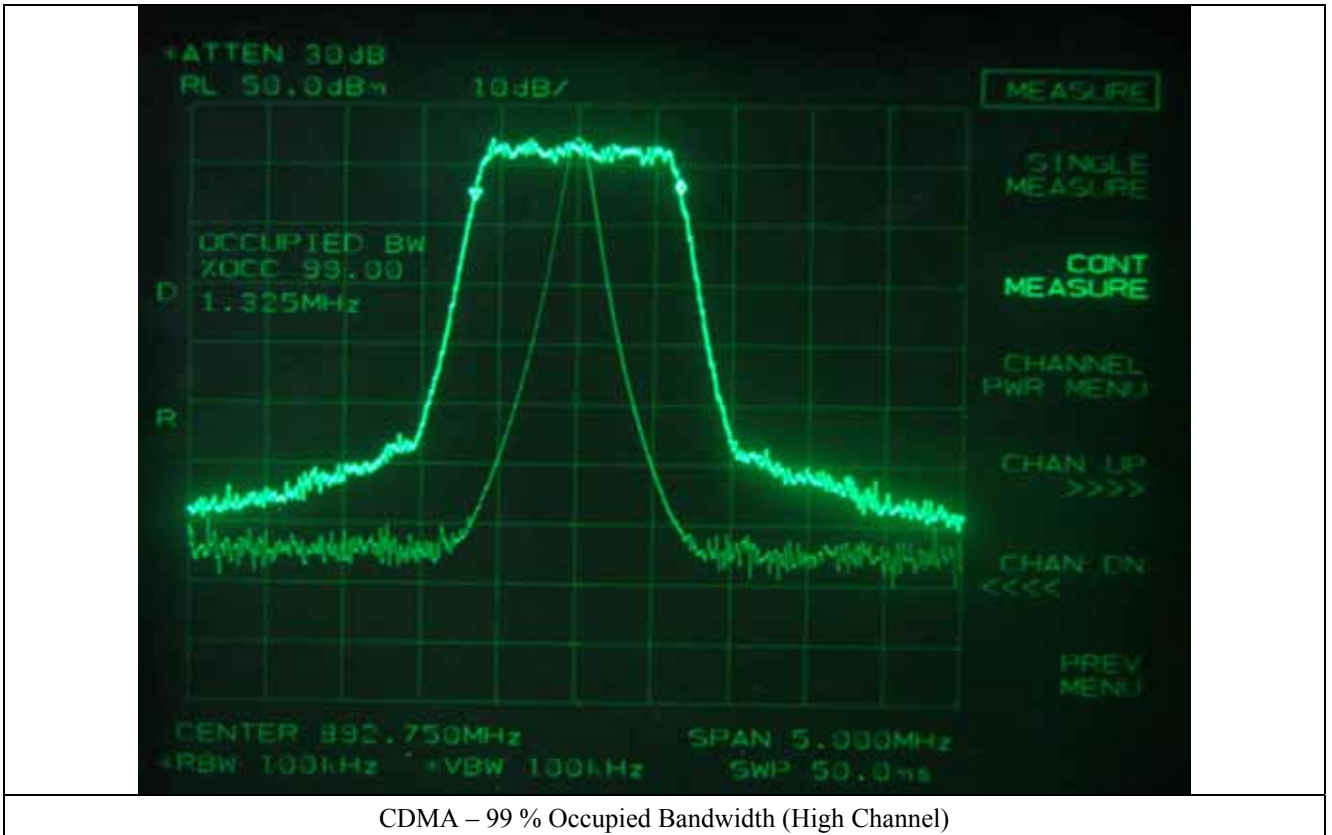


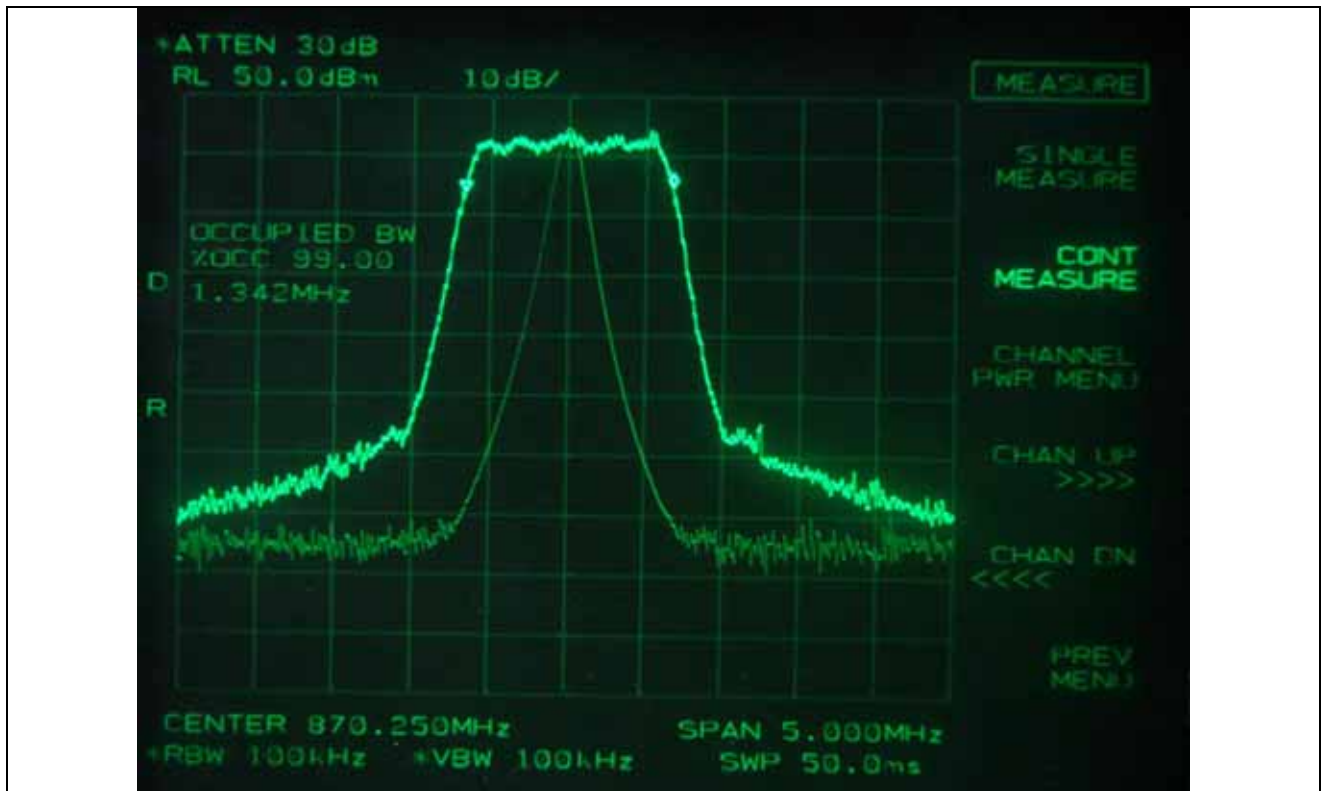


CDMA – 99 % Occupied Bandwidth (Low Channel)

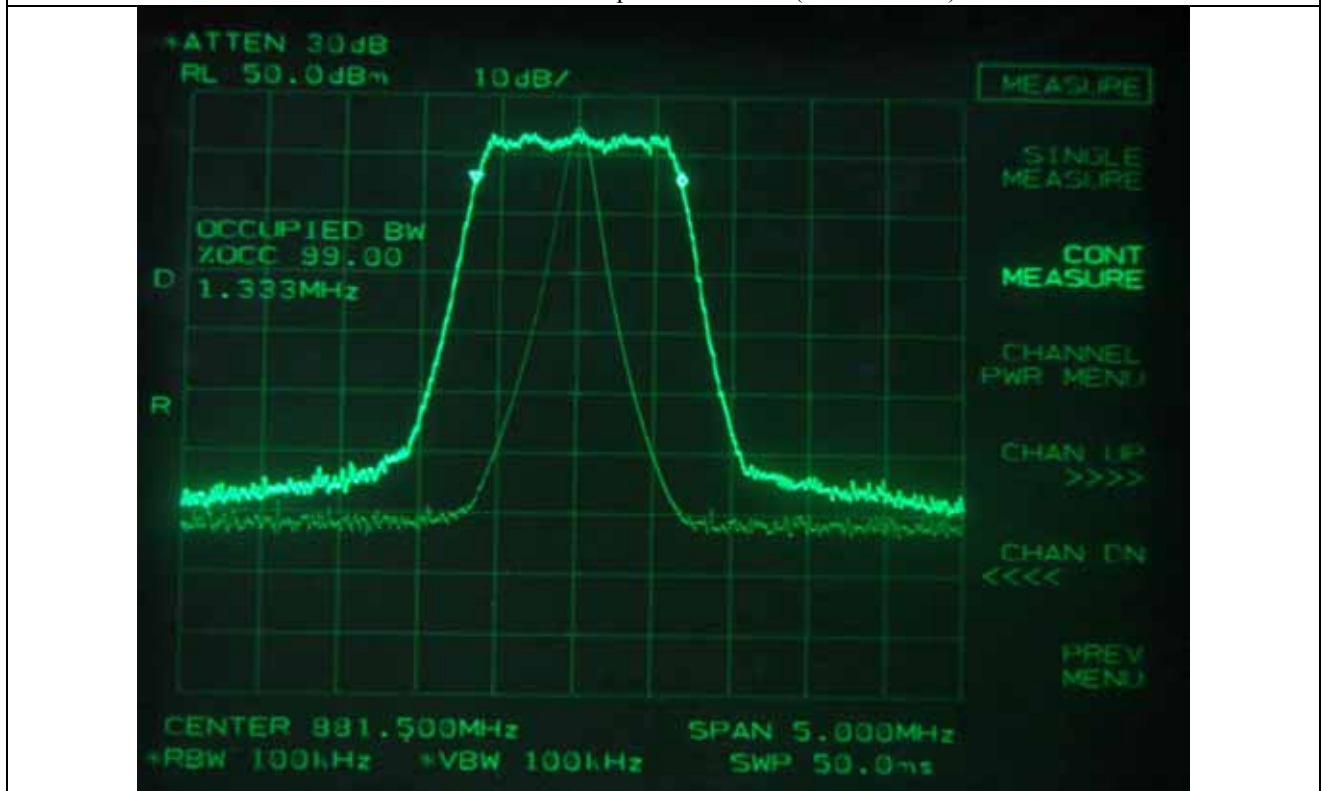


CDMA – 99 % Occupied Bandwidth (Middle Channel)

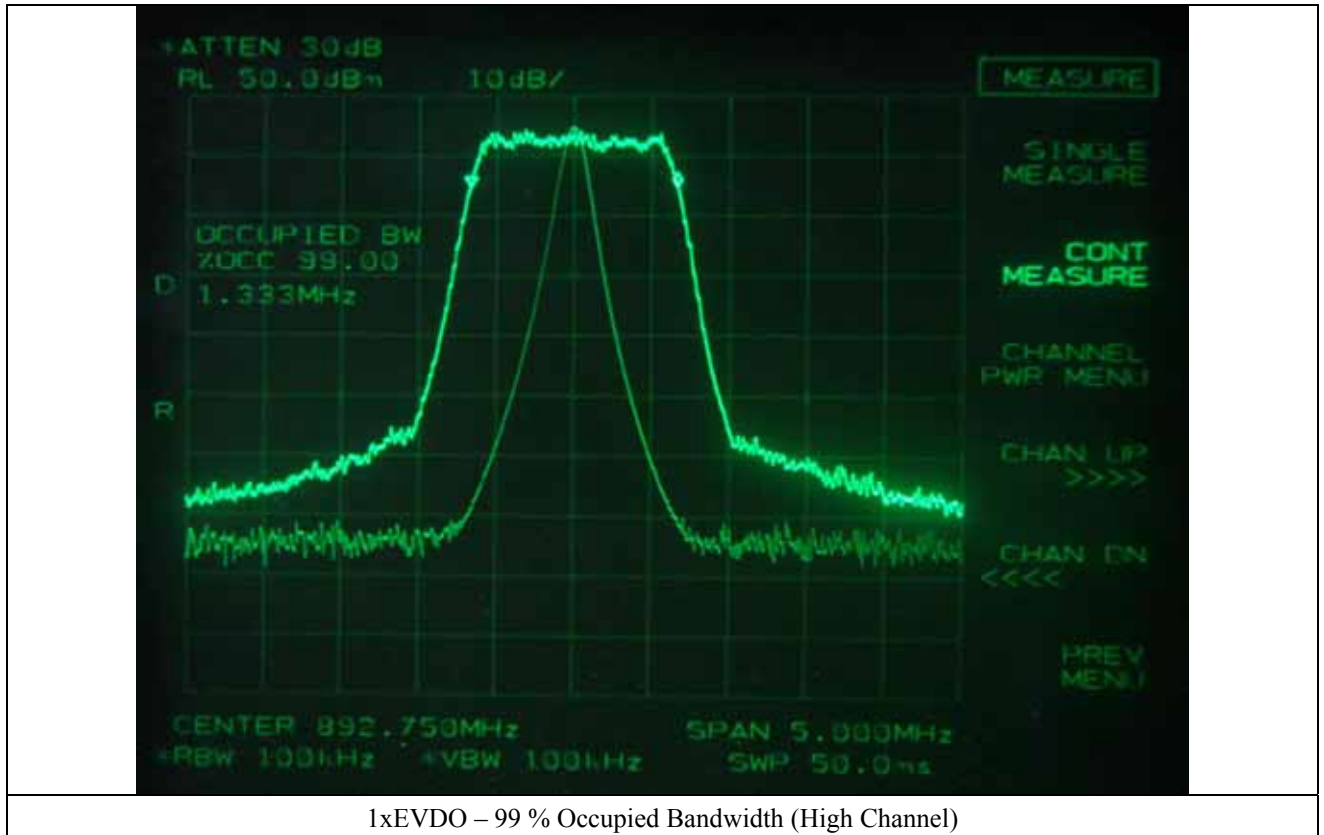


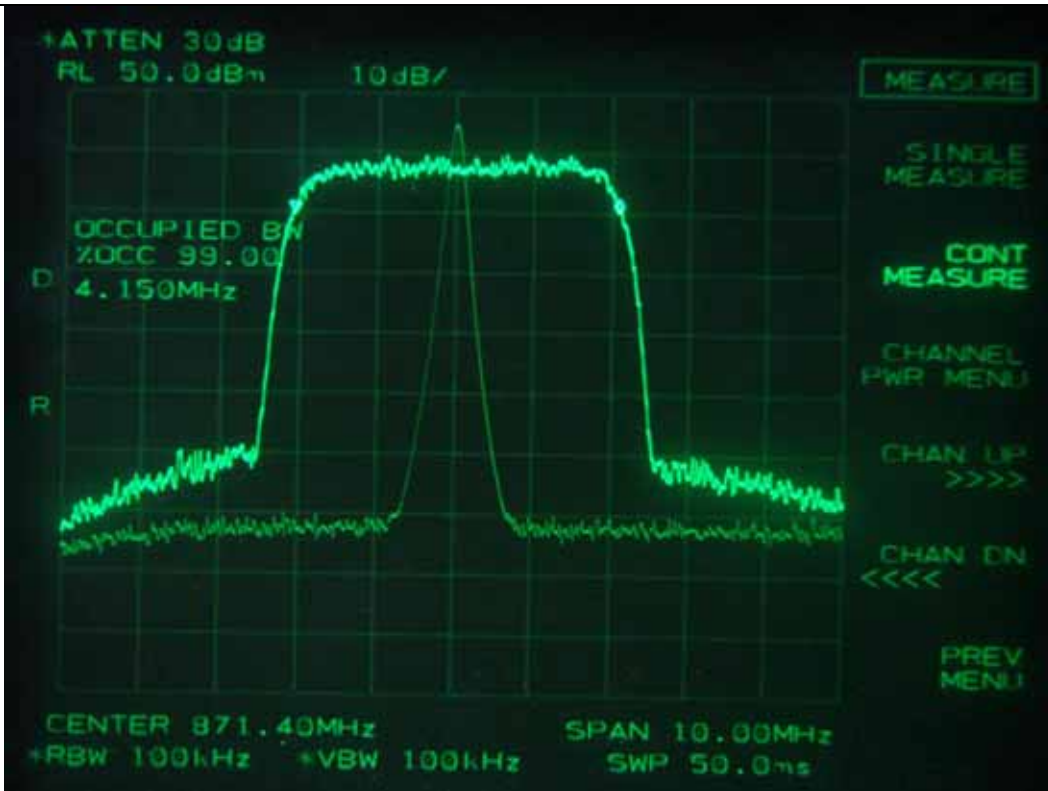


1xEVDO – 99 % Occupied Bandwidth (Low Channel)

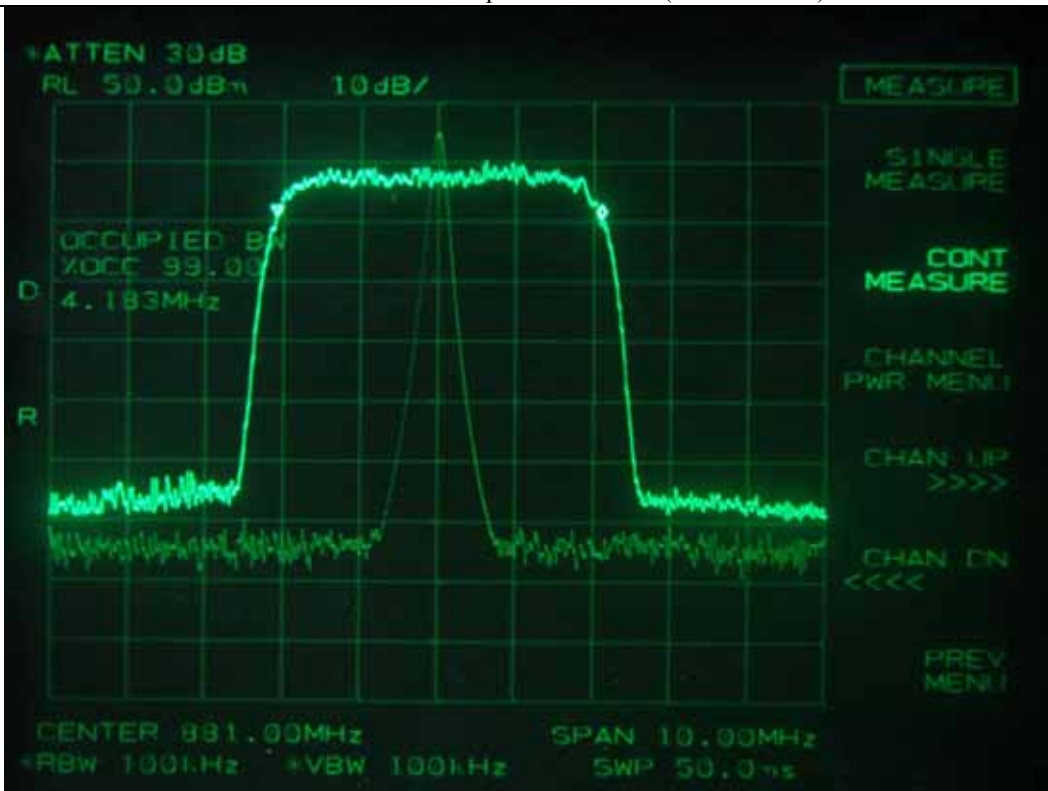


1xEVDO – 99 % Occupied Bandwidth (Middle Channel)

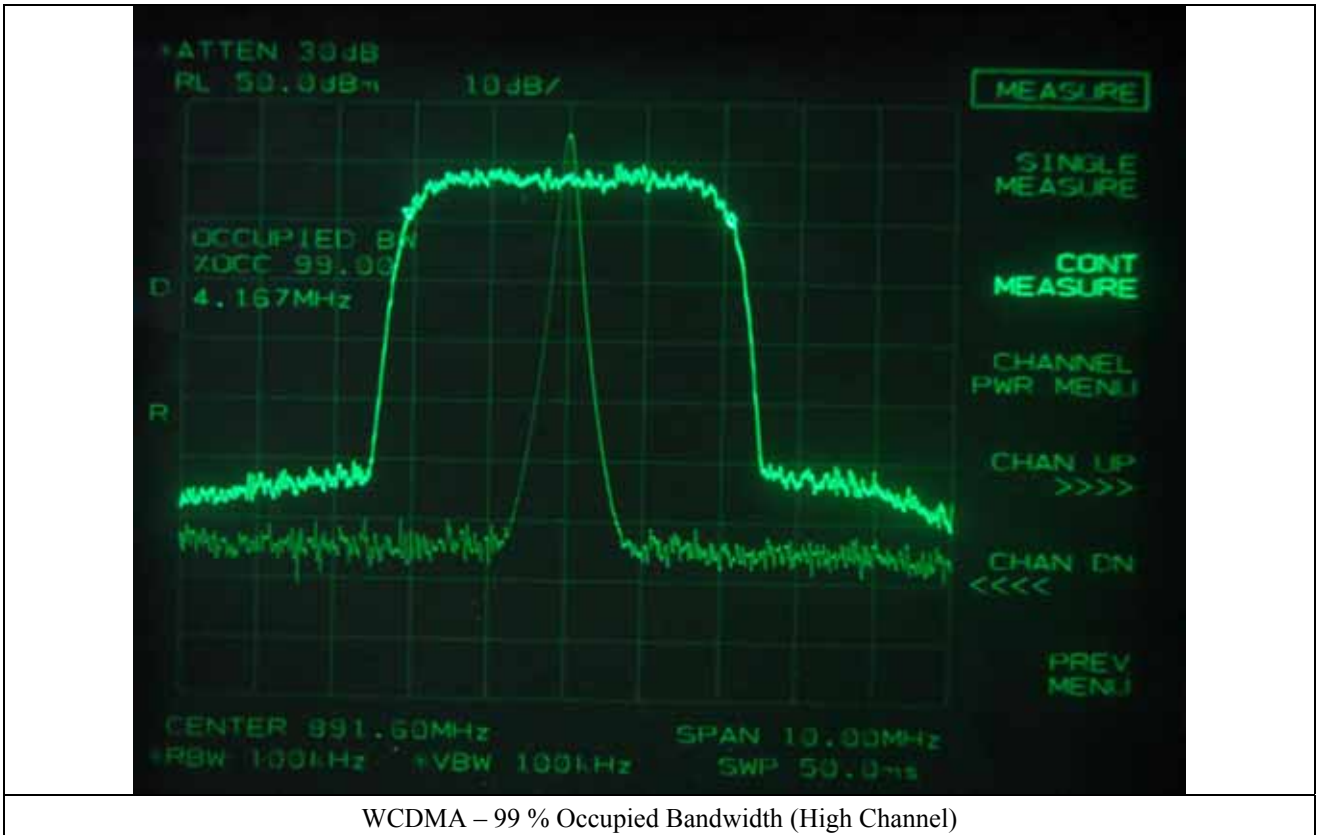




WCDMA – 99 % Occupied Bandwidth (Low Channel)



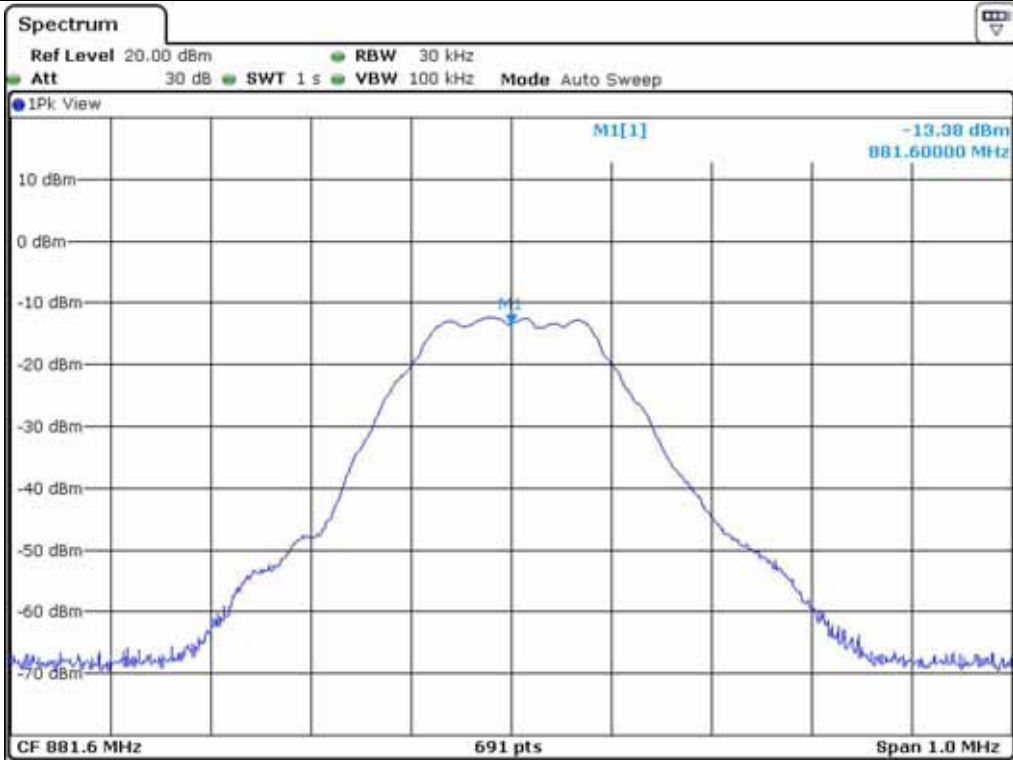
WCDMA – 99 % Occupied Bandwidth (Middle Channel)



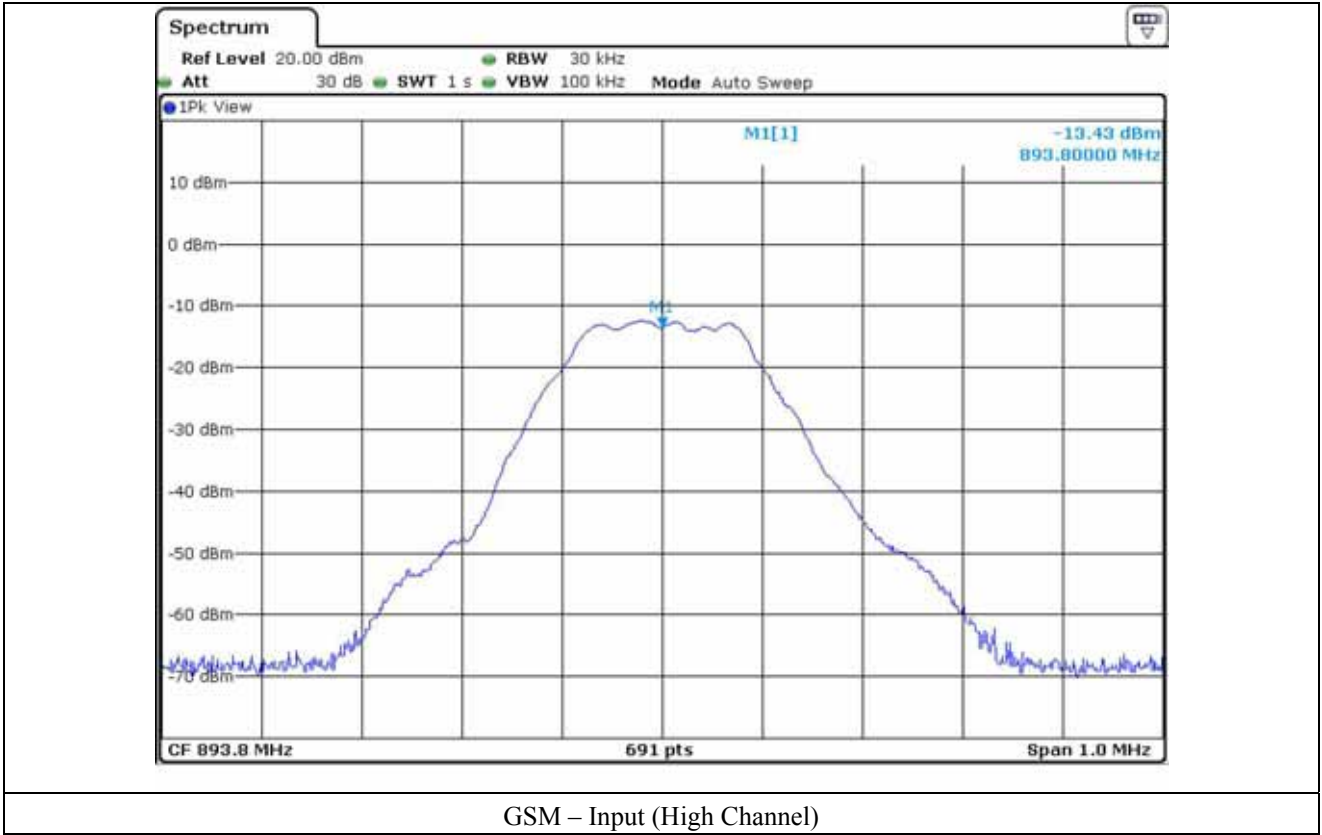
WCDMA – 99 % Occupied Bandwidth (High Channel)

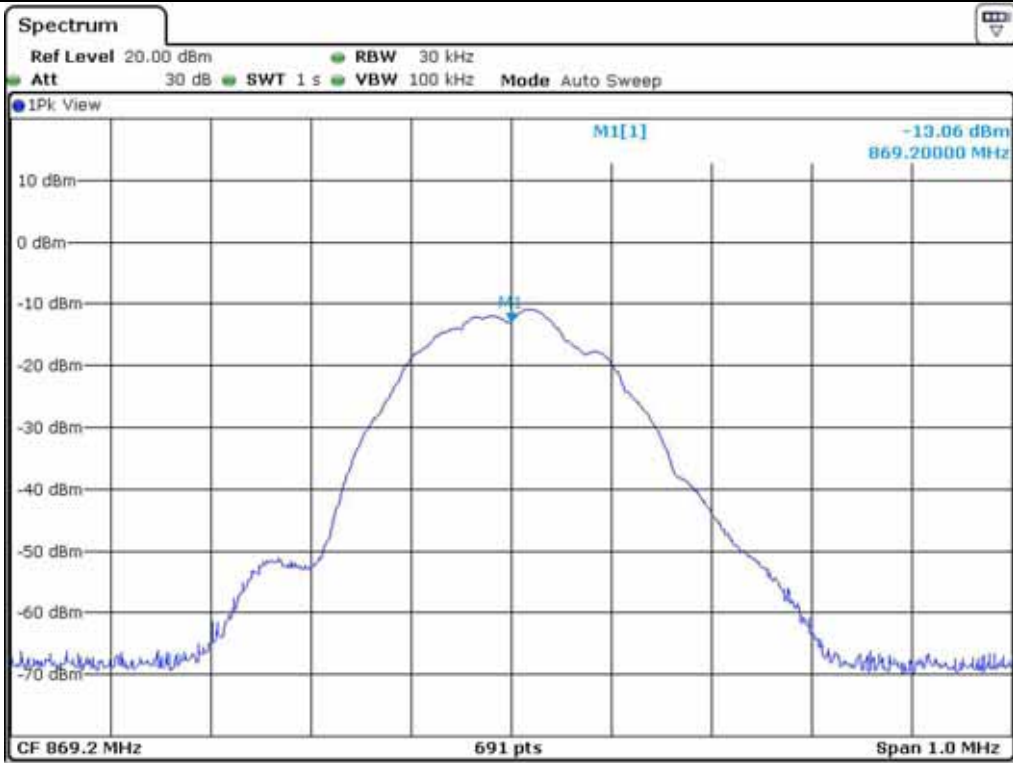


GSM – Input (Low Channel)

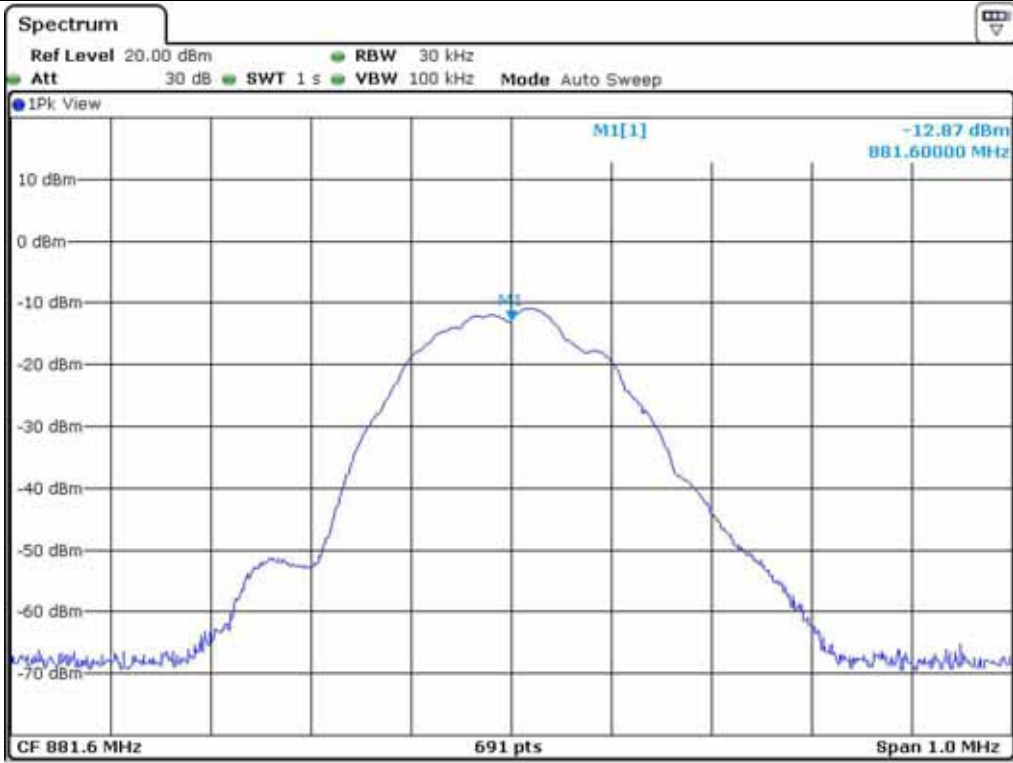


GSM – Input (Middle Channel)

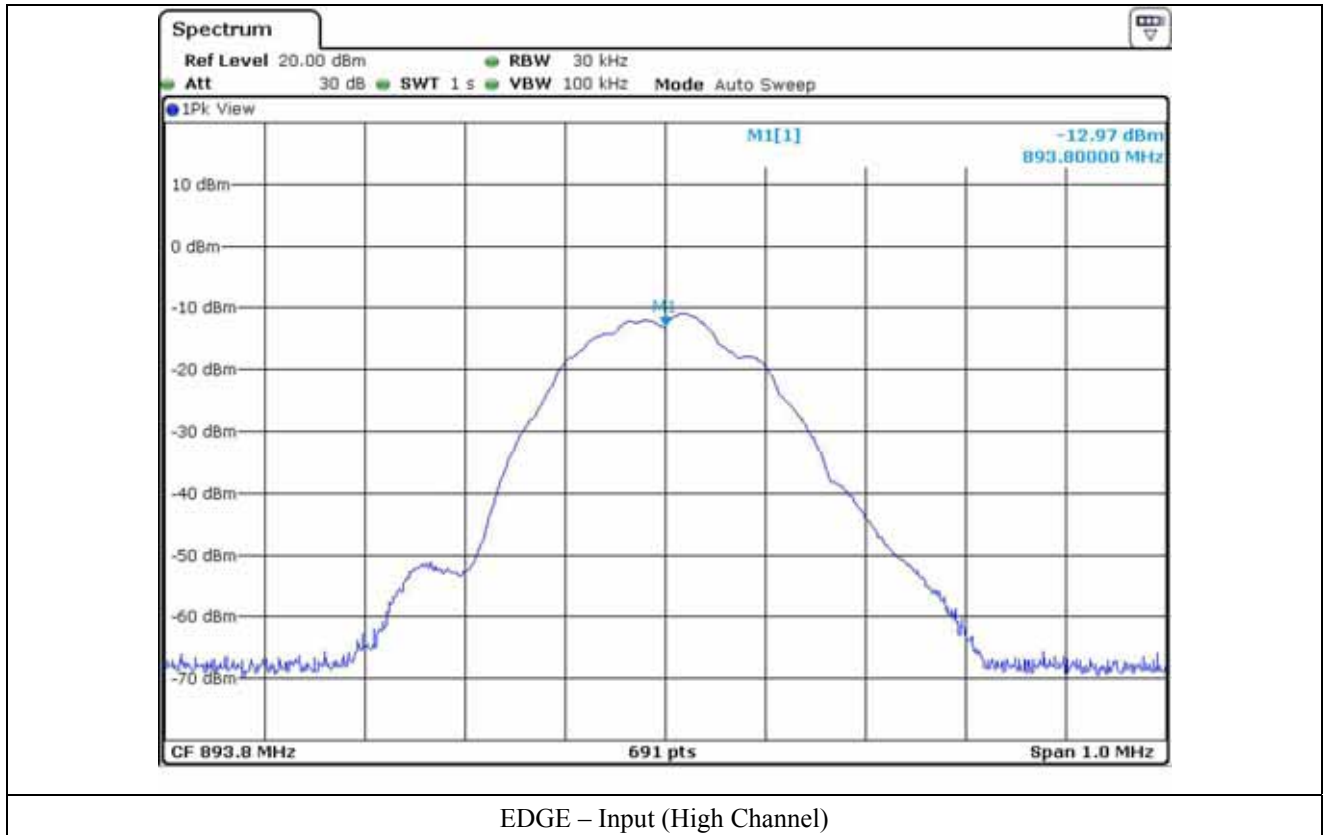


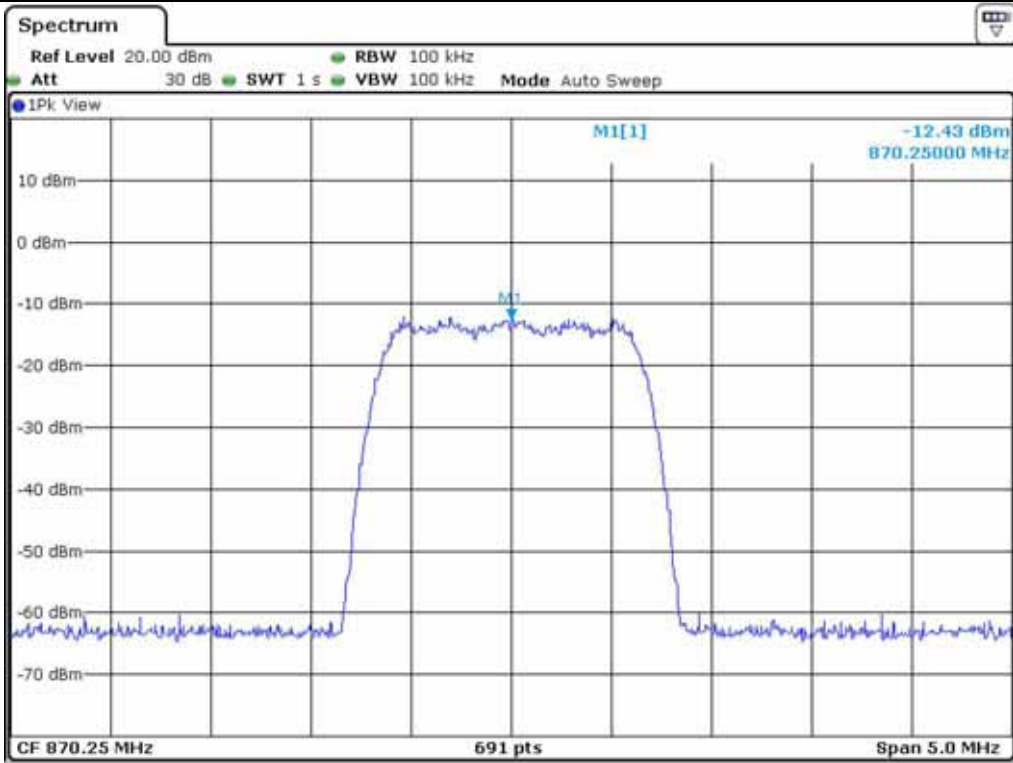


EDGE – Input (Low Channel)

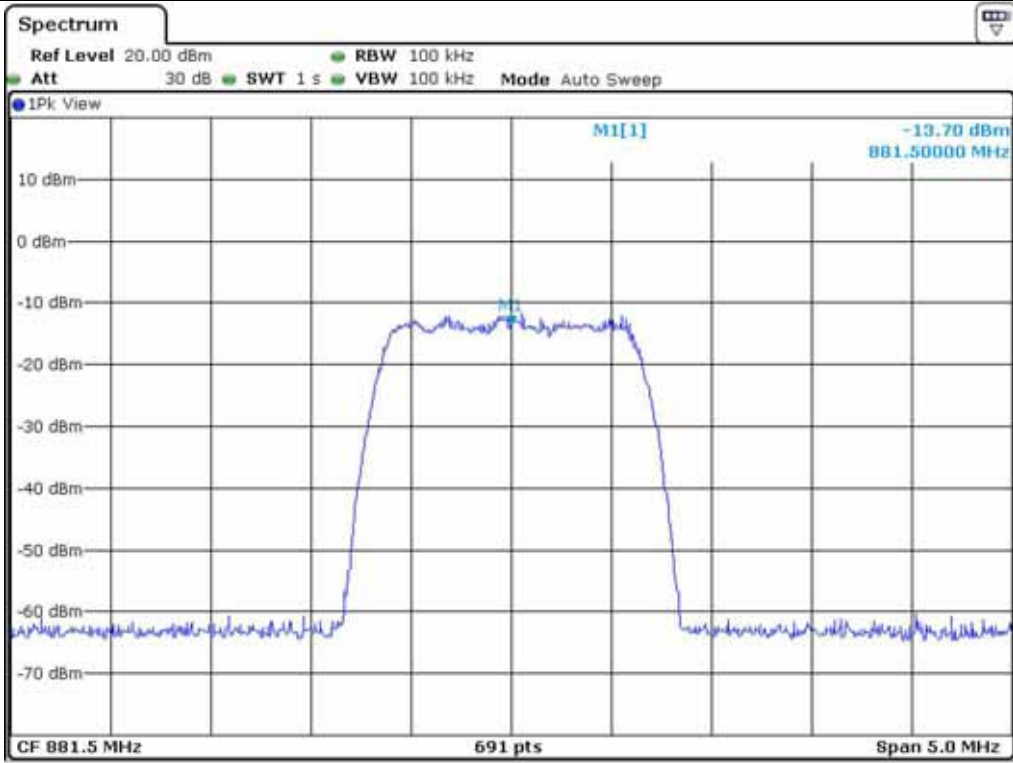


EDGE – Input (Middle Channel)

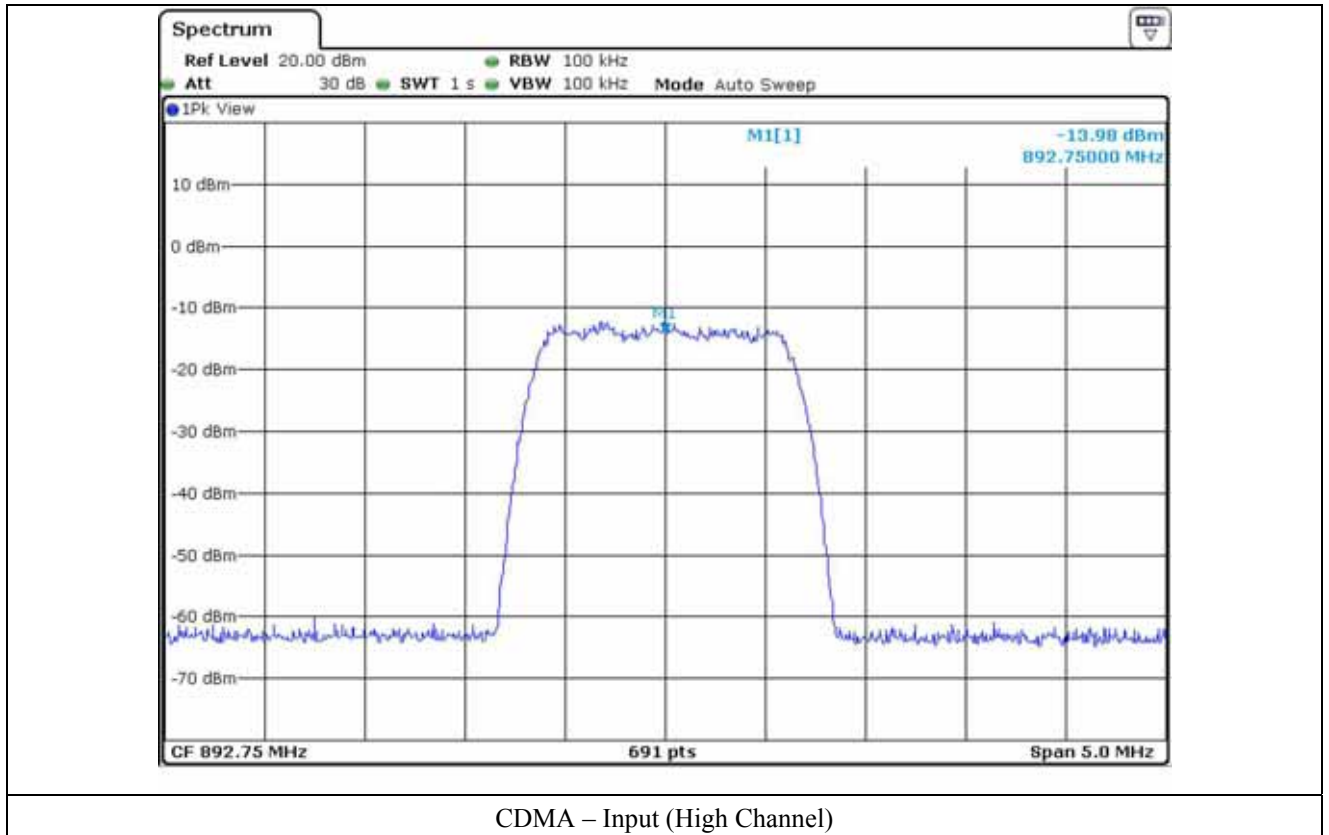


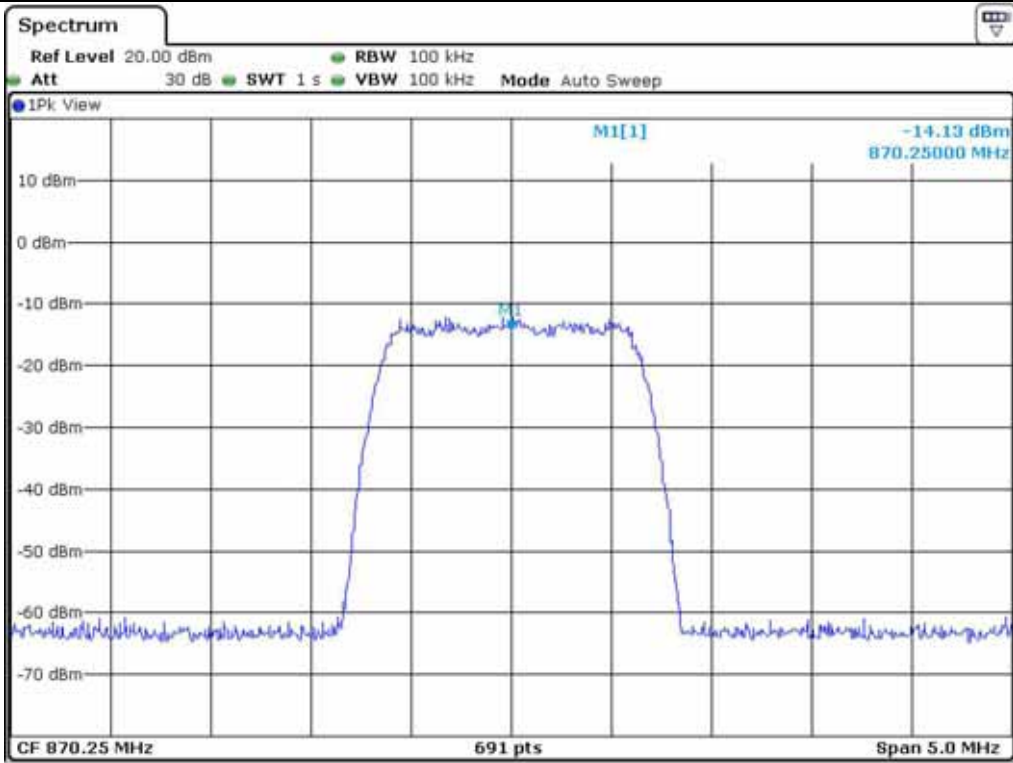


CDMA – Input (Low Channel)

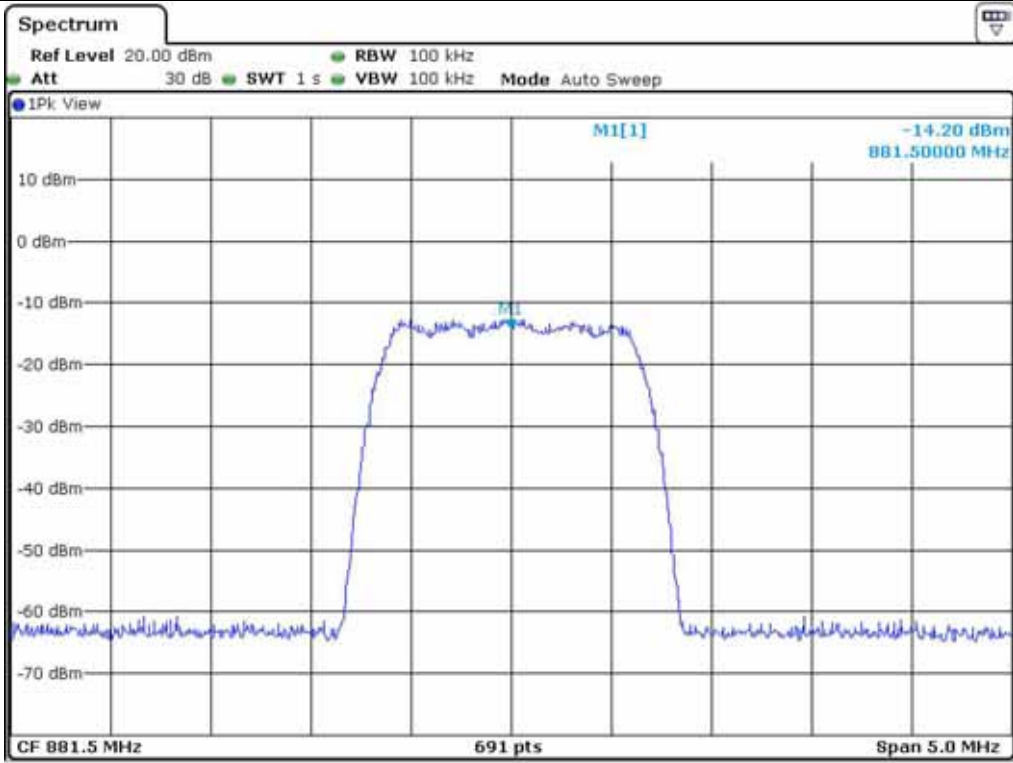


CDMA – Input (Middle Channel)

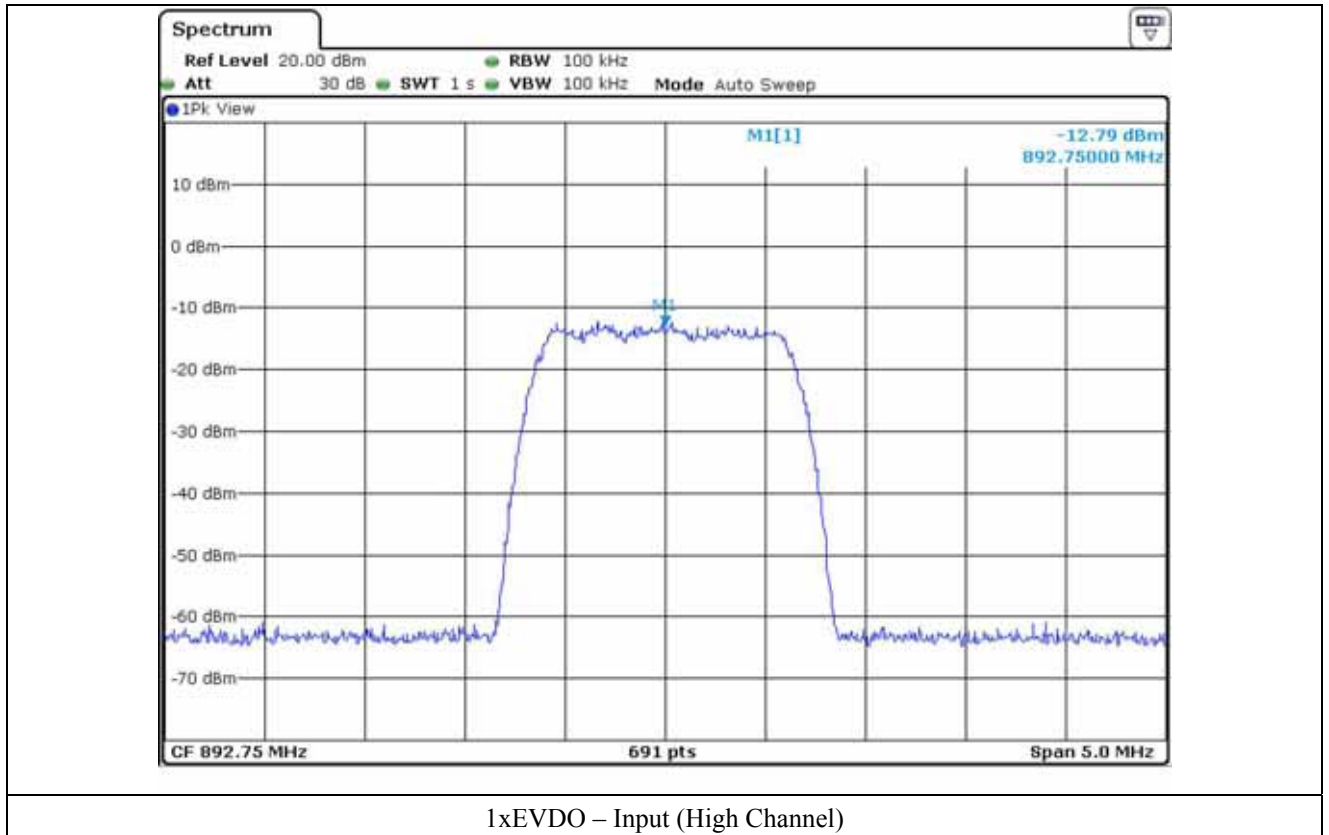




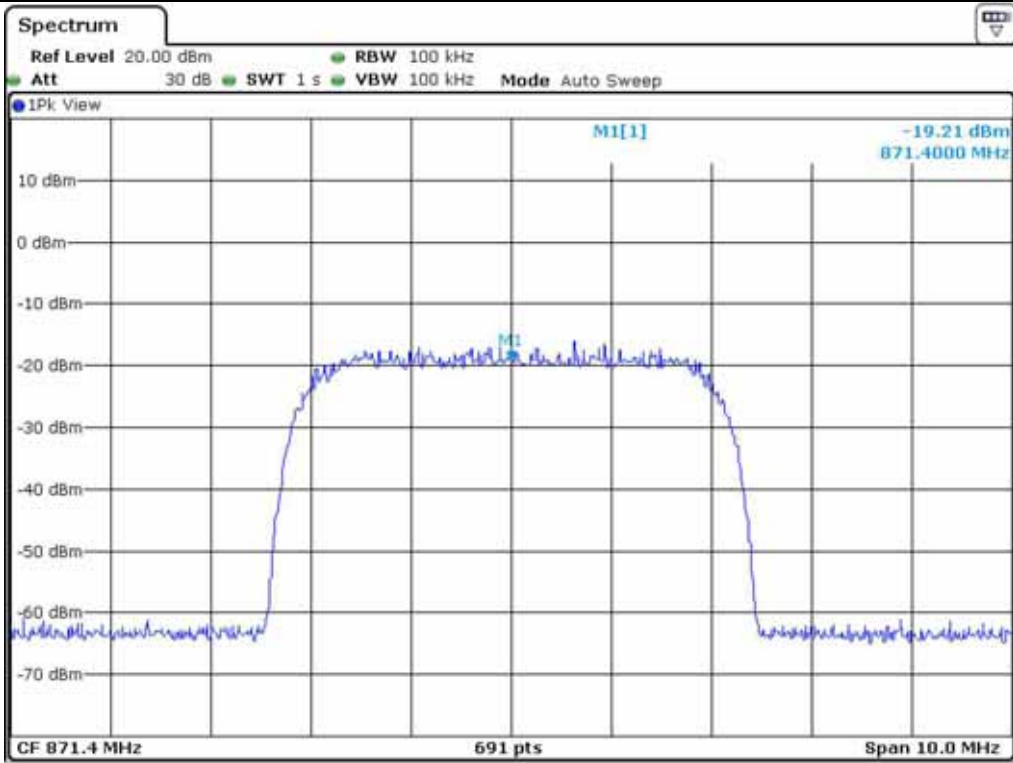
1xEVDO – Input (Low Channel)



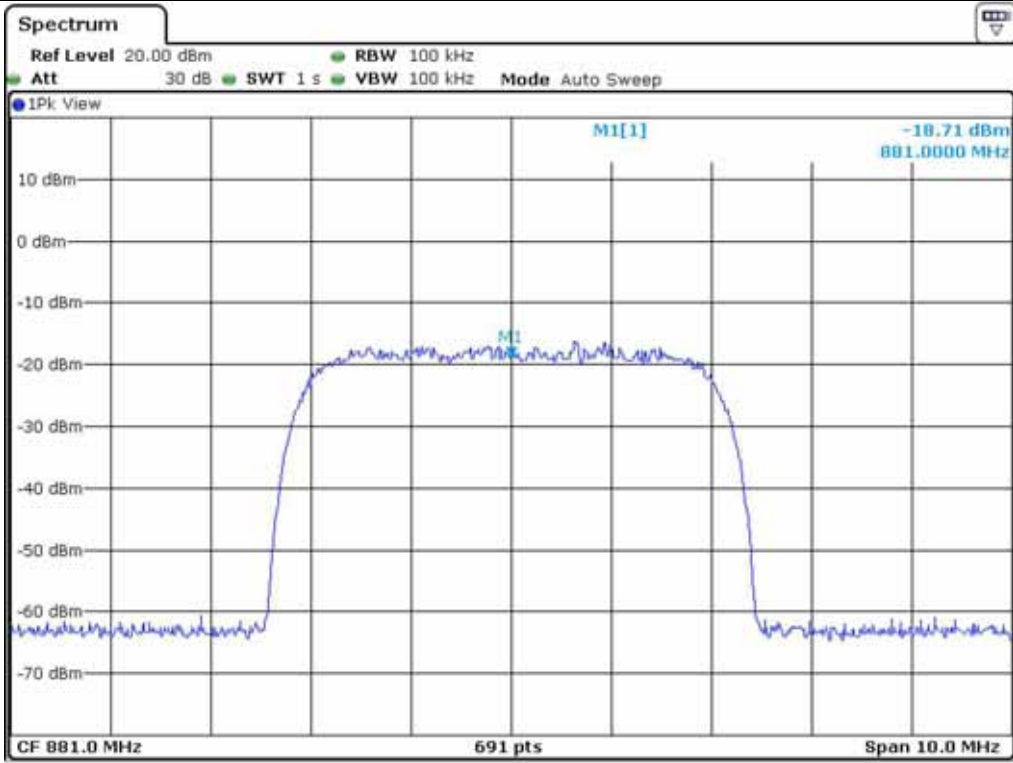
1xEVDO – Input (Middle Channel)



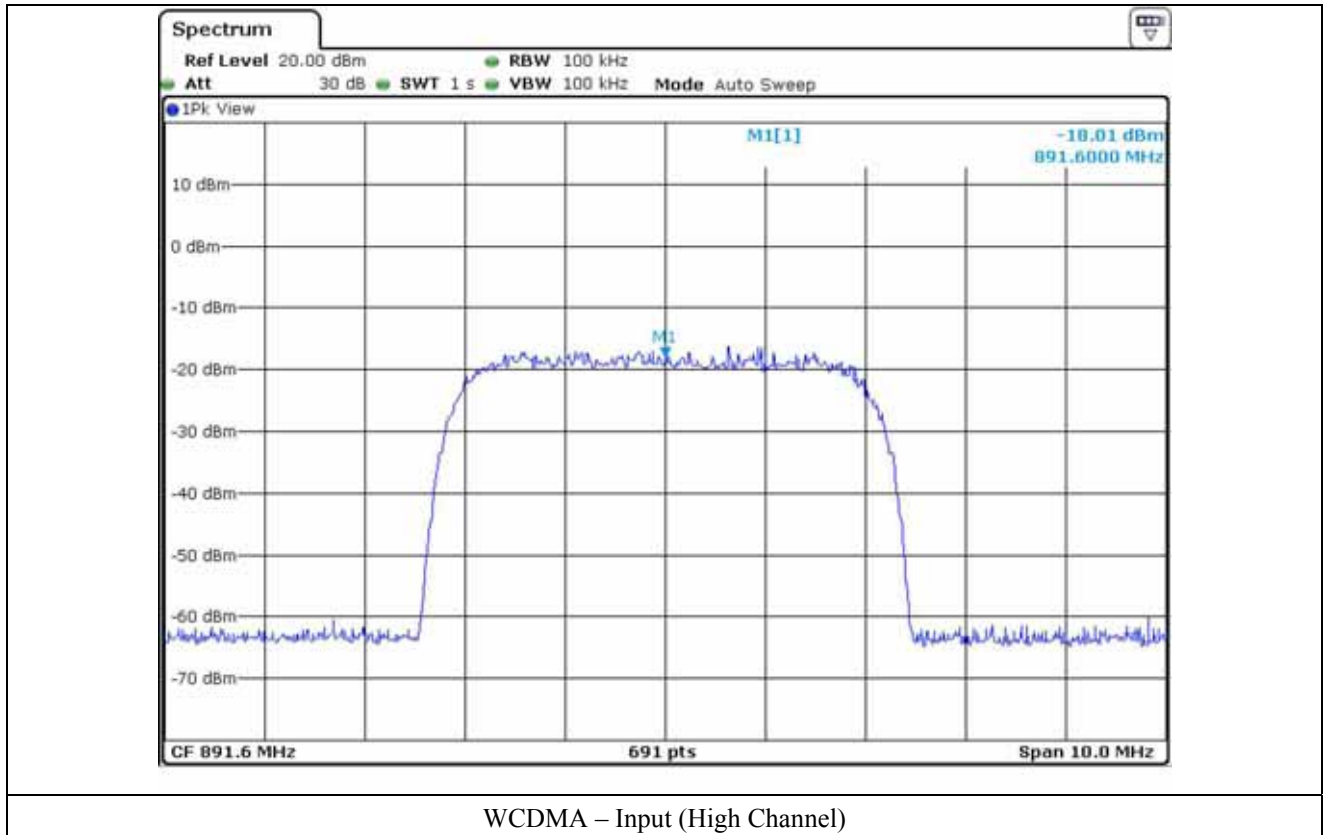
1xEVDO – Input (High Channel)



WCDMA – Input (Low Channel)



WCDMA – Input (Middle Channel)



WCDMA – Input (High Channel)

7. SPURIOUS EMISSION AT ANTENNA TERMINAL

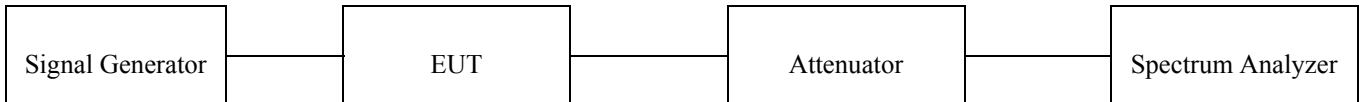
7.1 Operating environment

Temperature : 20 °C
 Relative humidity : 51 % 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 10 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 824/ 894-5/40-8SSK	Wainwright Instruments GmbH	Tunable Band Reject Filter	18	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 21, 2012
- Frequency range : 30 MHz ~ 10 GHz
- Result : PASSED BY -24.38 dB at GSM Mode

Modulation	Harmonic Frequency (MHz)	Measured Value (dBm)	Cable Loss (dB)	Total (dBm)	Limit (dBm)	Margin (dB)	
GSM	Low	623.10	-61.51	0.65	-60.86	-13.00	-47.86
		7 831.00	-41.15	3.50	-37.65		-24.65
	Middle	618.90	-61.93	0.65	-61.28		-48.28
		7 831.00	-41.01	3.50	-37.51		-24.51
	High	652.60	-61.61	0.65	-60.96		-47.96
		7 831.00	-40.88	3.50	-37.38		-24.38
EDGE	Low	715.70	-61.64	0.70	-60.94	-13.00	-47.94
		7 831.00	-41.59	3.50	-38.09		-25.09
	Middle	663.80	-60.88	0.65	-60.23		-47.23
		7 831.00	-41.58	3.50	-38.08		-25.08
	High	738.20	-61.53	0.70	-60.83		-47.83
		7 831.00	-41.30	3.50	-37.80		-24.80
CDMA	Low	704.50	-61.81	0.70	-61.11	-13.00	-48.11
		7 831.00	-42.38	3.50	-38.88		-25.88
	Middle	686.30	-61.05	0.65	-60.40		-47.40
		7 831.00	-42.27	3.50	-38.77		-25.77
	High	800.00	-61.73	0.70	-61.03		-48.03
		7 831.00	-41.96	3.50	-38.46		-25.46
1xEVDO	Low	731.20	-62.01	0.70	-61.31	-13.00	-48.31
		7 831.00	-42.05	3.50	-38.55		-25.55
	Middle	718.50	-61.58	0.70	-60.88		-47.88
		7 831.00	-41.52	3.50	-38.02		-25.02
	High	710.10	-61.80	0.70	-61.10		-48.10
		7 831.00	-41.92	3.50	-38.42		-25.42

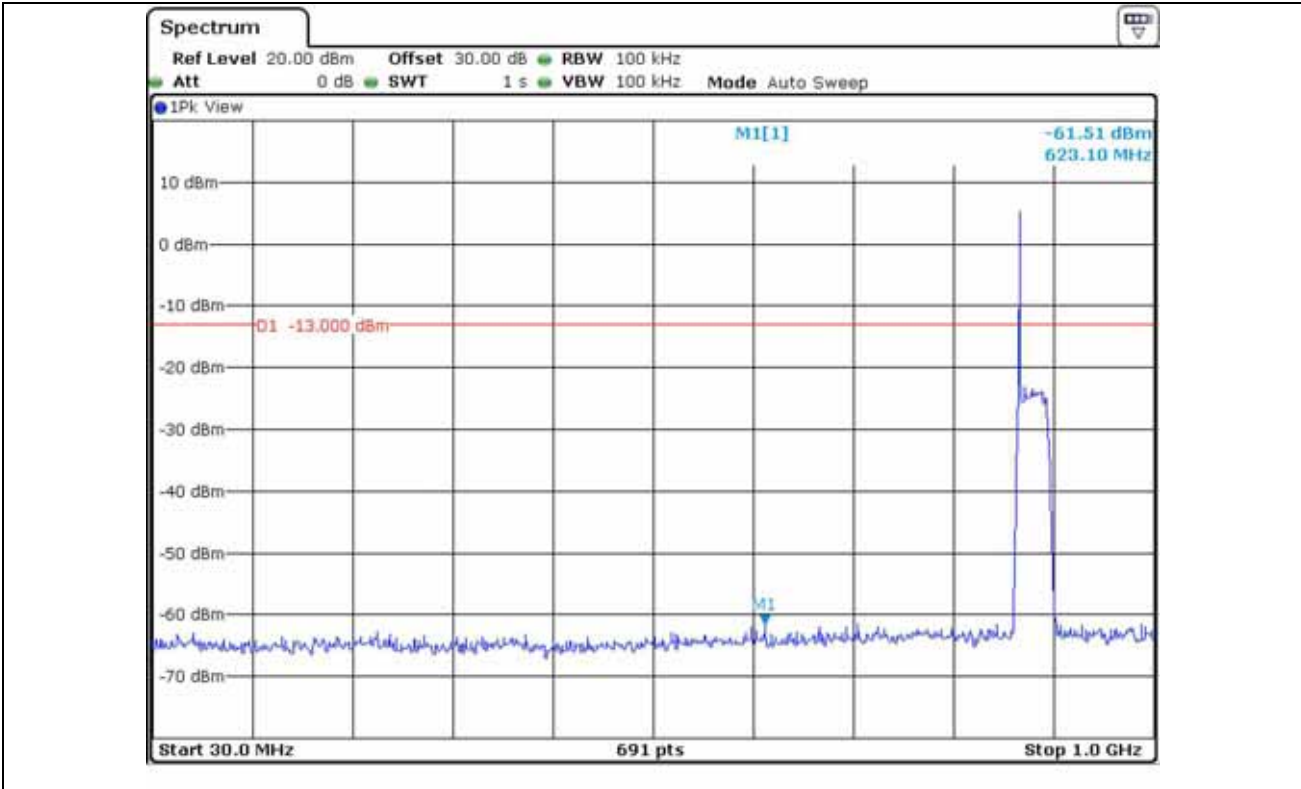
According to Part 22H, out of band emission shall be attenuated by $43 + 10 \log (P)$ dBc, equates to -13.0 dBm.

Modulation	Harmonic Frequency (MHz)	Measured Value (dBm)	Cable Loss (dB)	Total (dBm)	Limit (dBm)	Margin (dB)
WCDMA	Low	818.20	703.10	-62.40	0.70	-48.70
		7 825.00	7 831.00	-41.36	3.50	-24.86
	Middle	999.30	669.40	-62.48	0.65	-48.83
		7 825.00	7 831.00	-41.97	3.50	-25.47
	High	867.30	712.90	-61.10	0.70	-47.40
		7 825.00	7 831.00	-41.38	3.50	-24.88

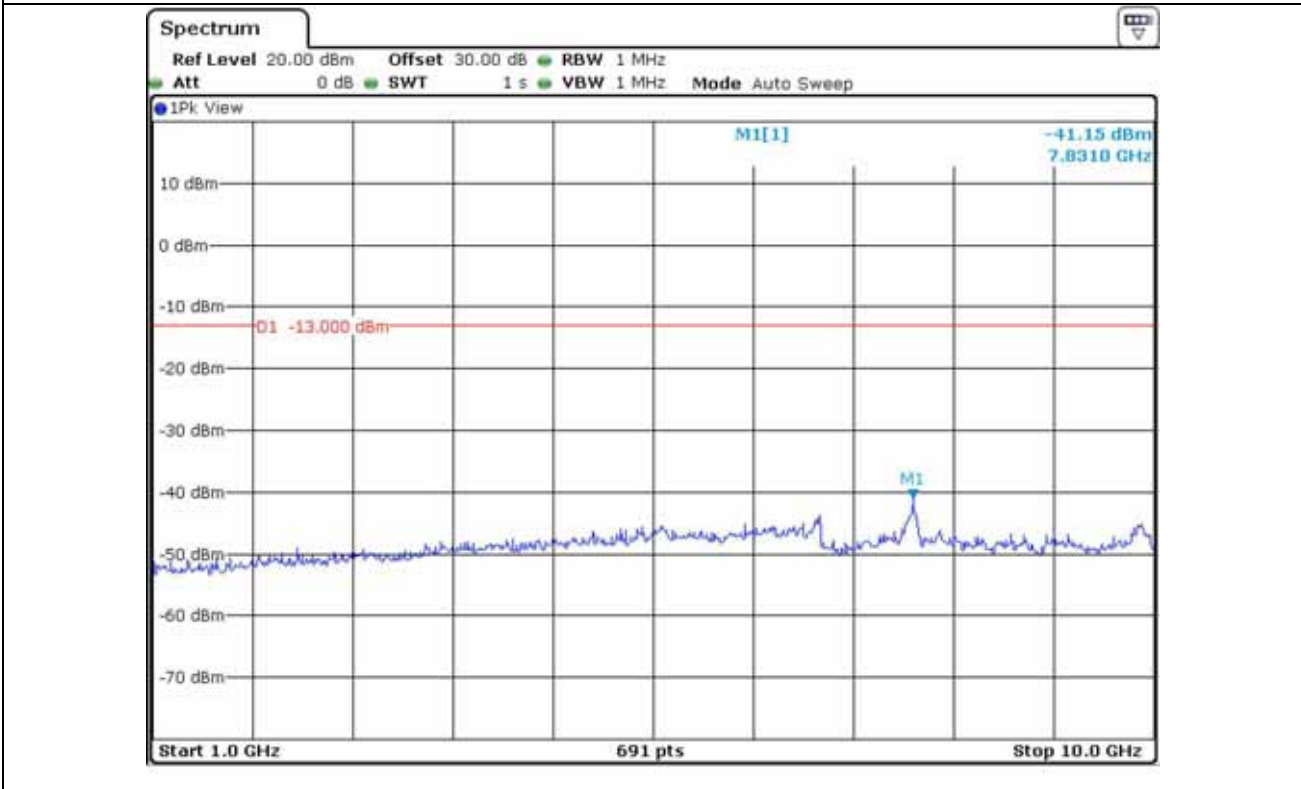
According to Part 22H, out of band emission shall be attenuated by $43 + 10 \log (P)$ dBc, equates to -13.0 dBm.

~ 기홍

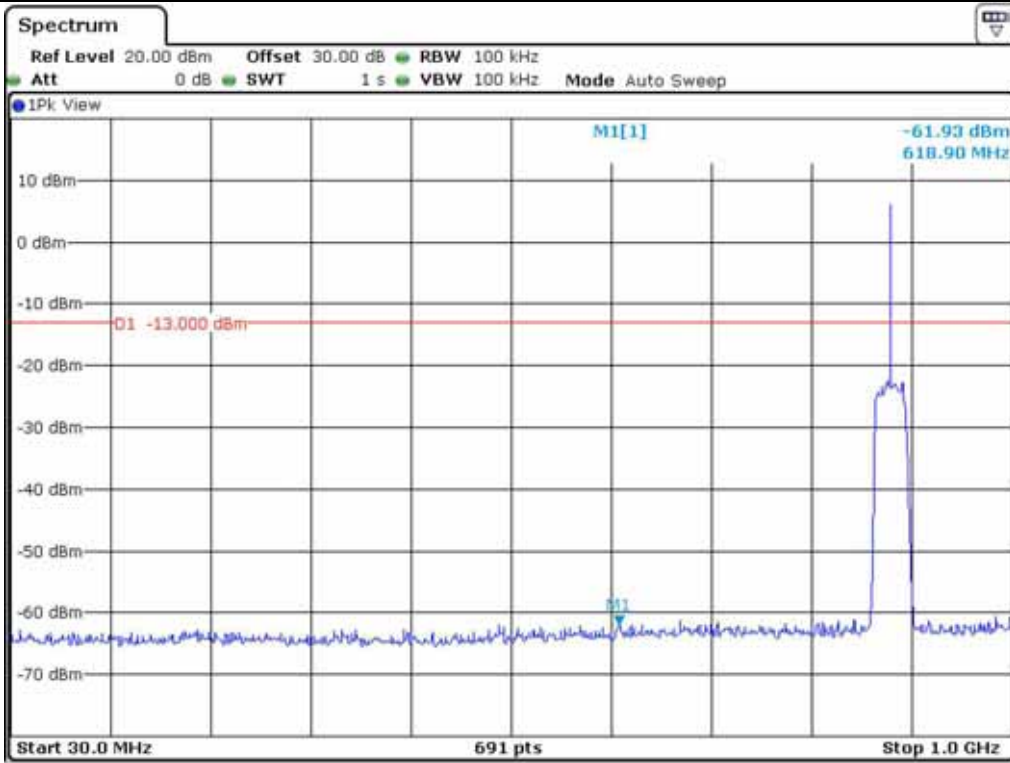
Tested by: Ki-Hong, Nam / Project Engineer



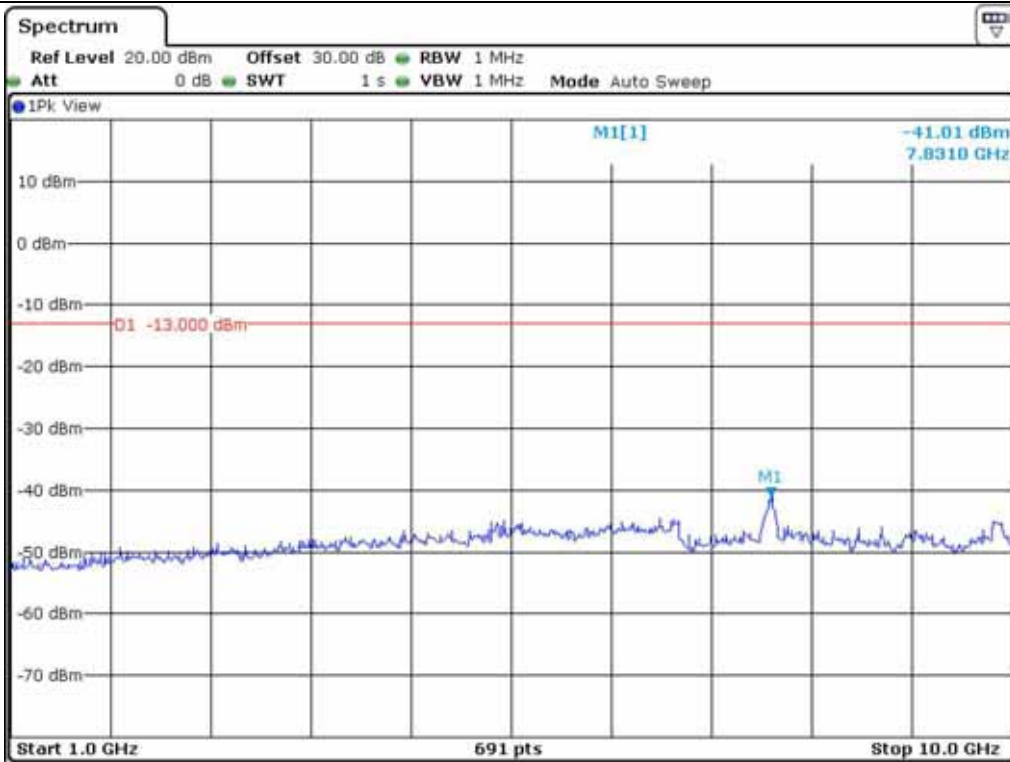
GSM – Low Channel



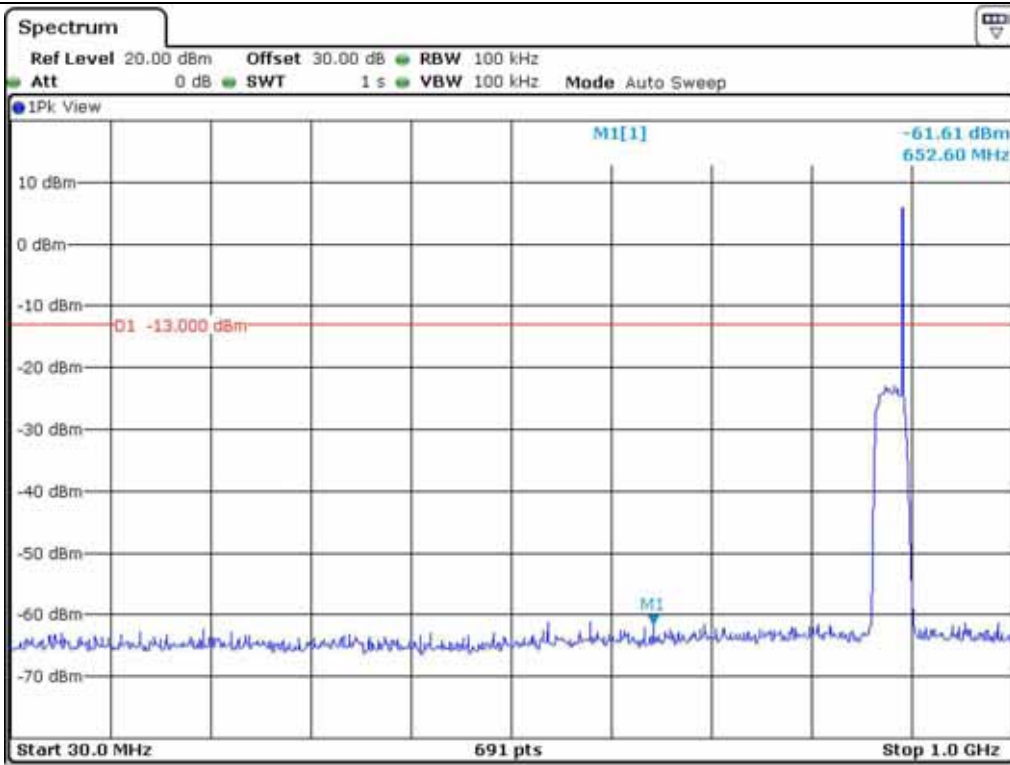
GSM – Low Channel



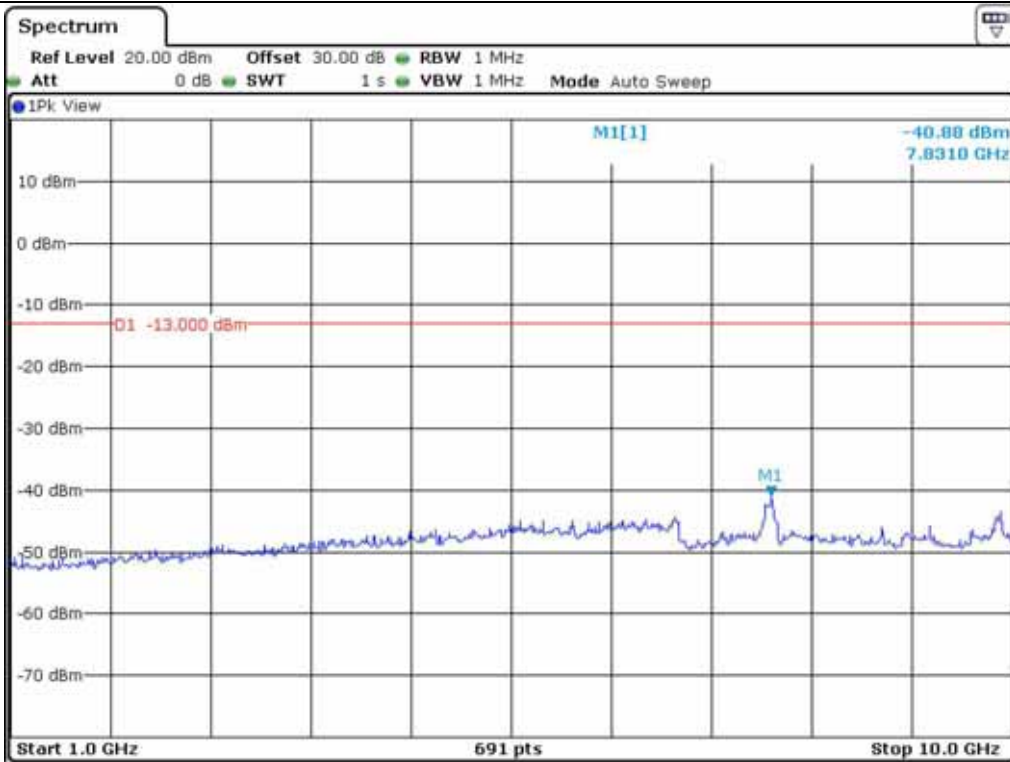
GSM – Middle Channel



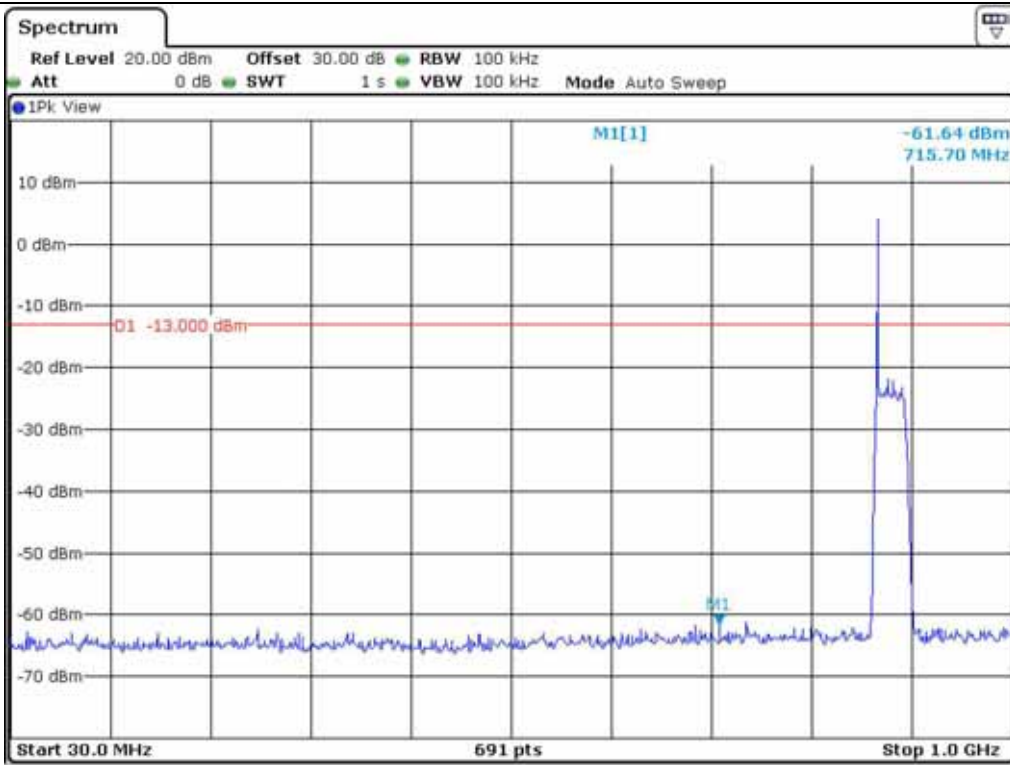
GSM – Middle Channel



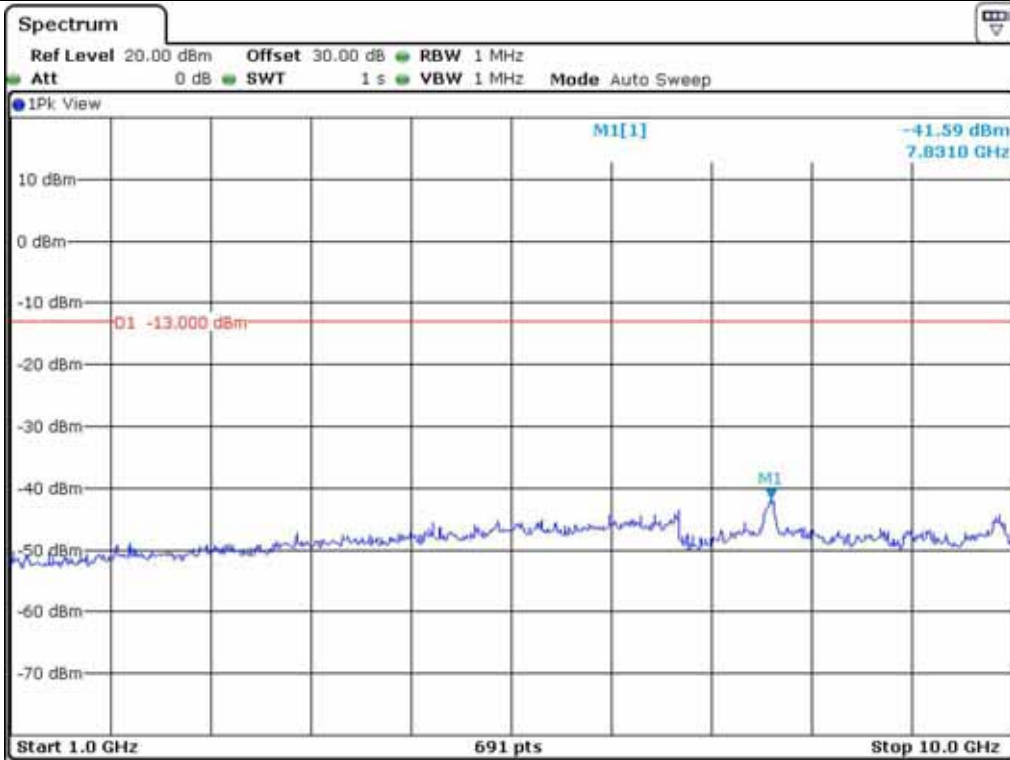
GSM – High Channel



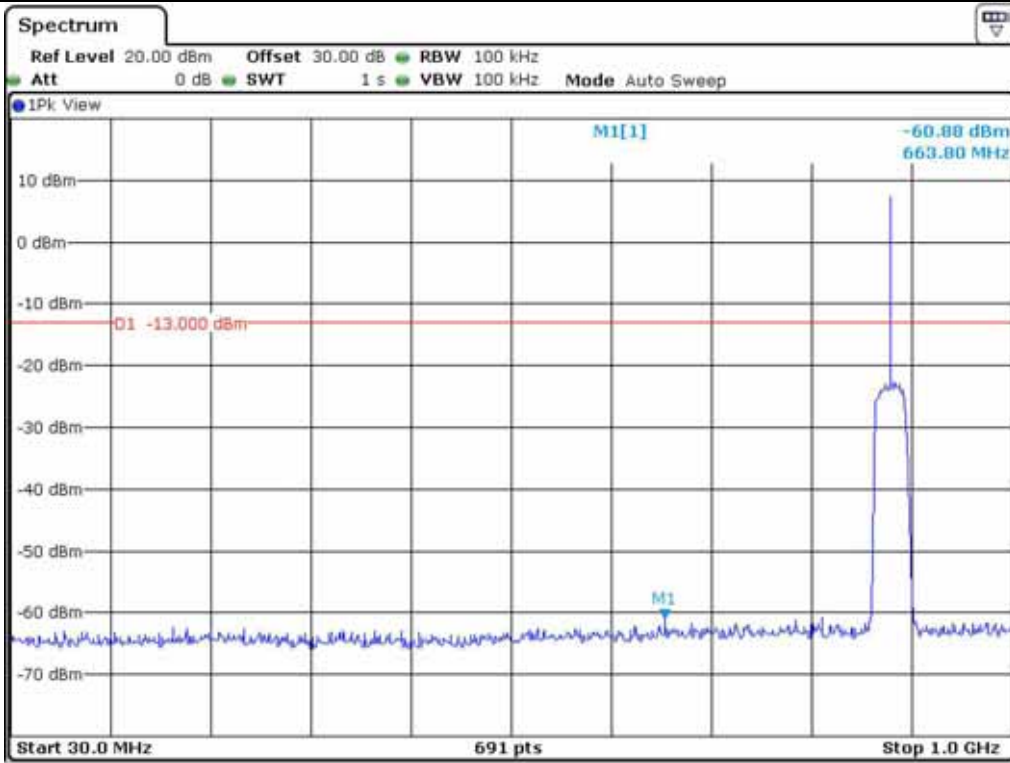
GSM – High Channel



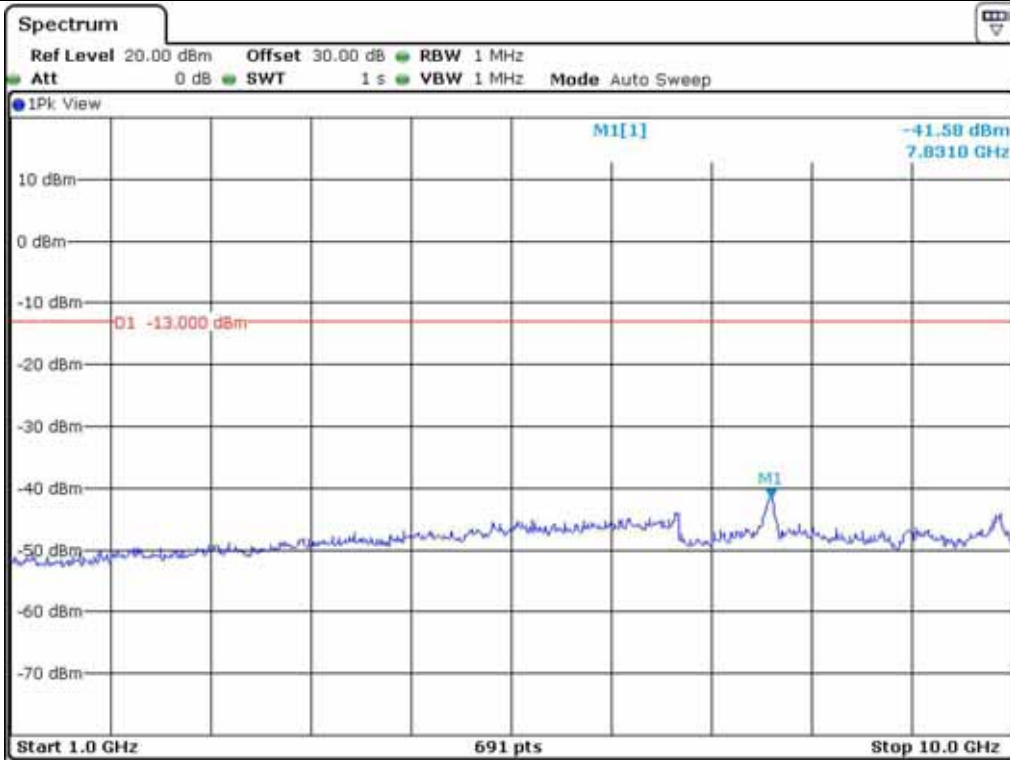
EDGE – Low Channel



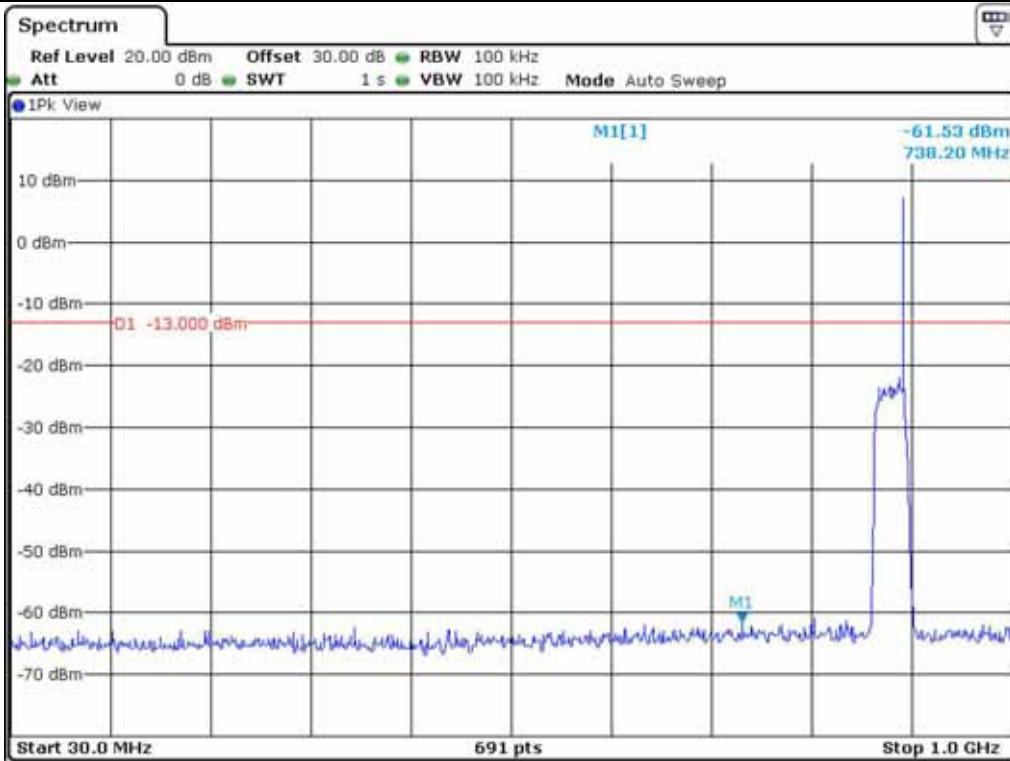
EDGE – Low Channel



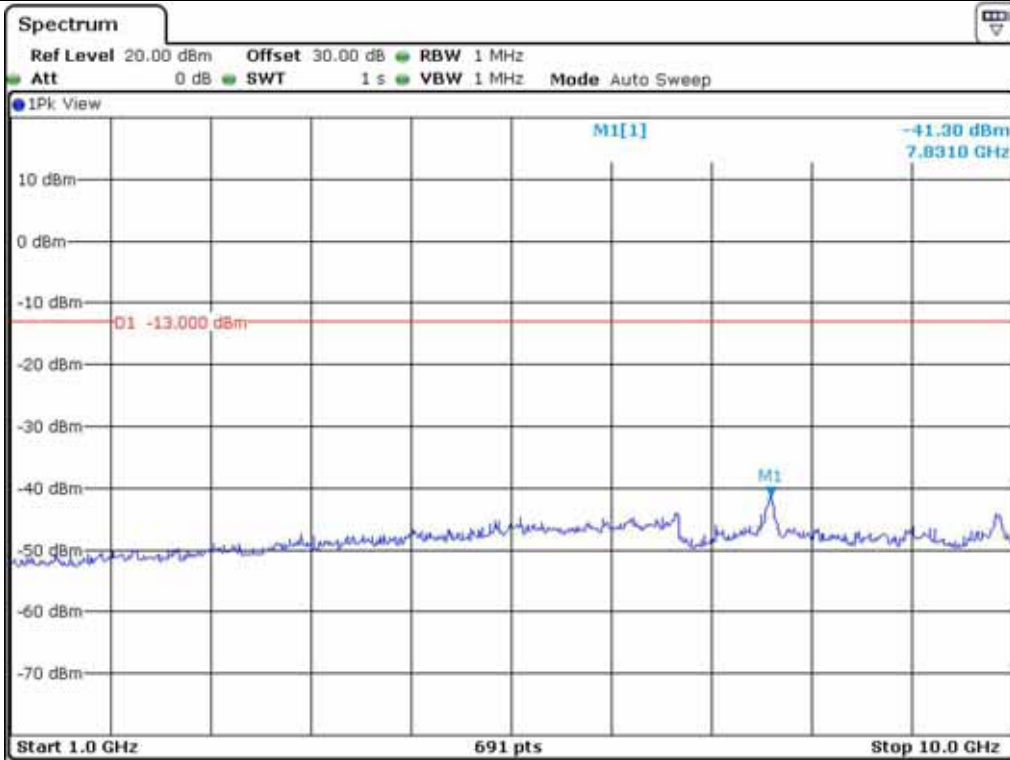
EDGE – Middle Channel



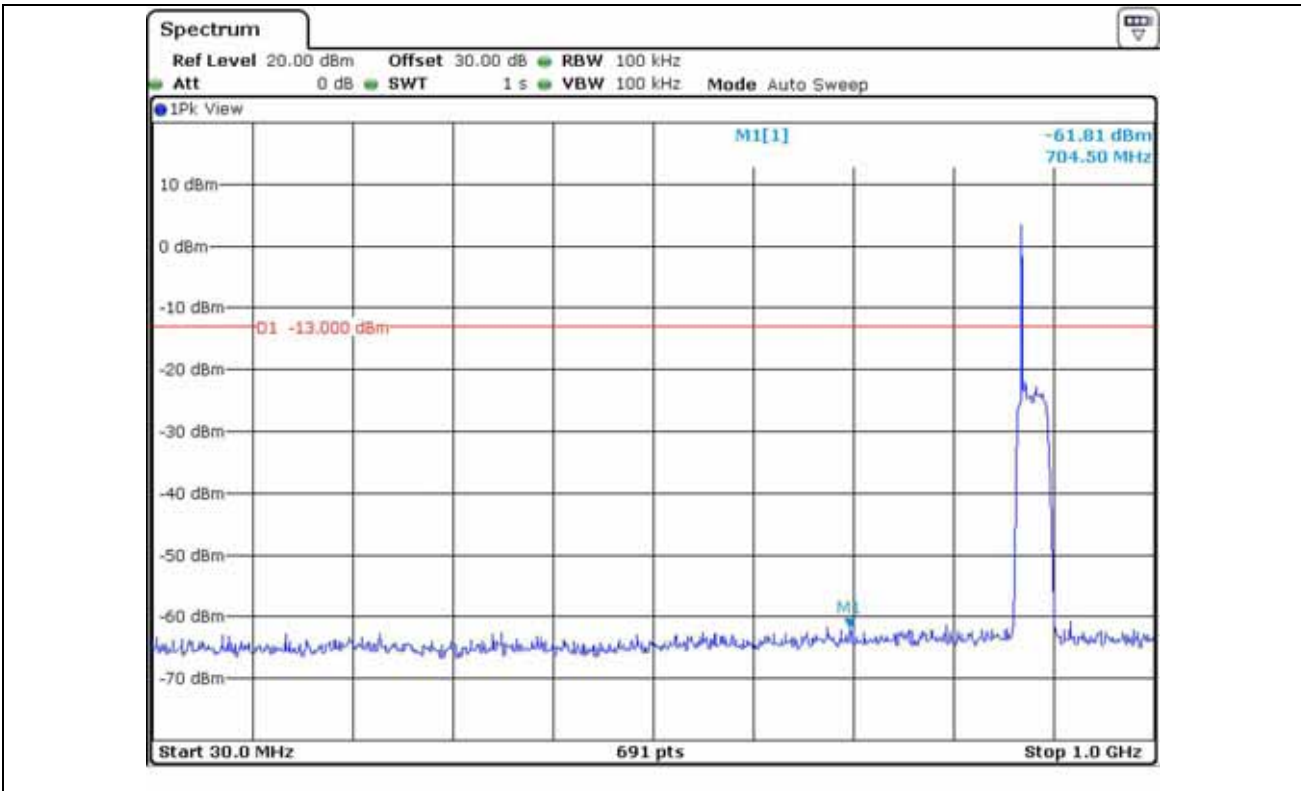
EDGE – Middle Channel



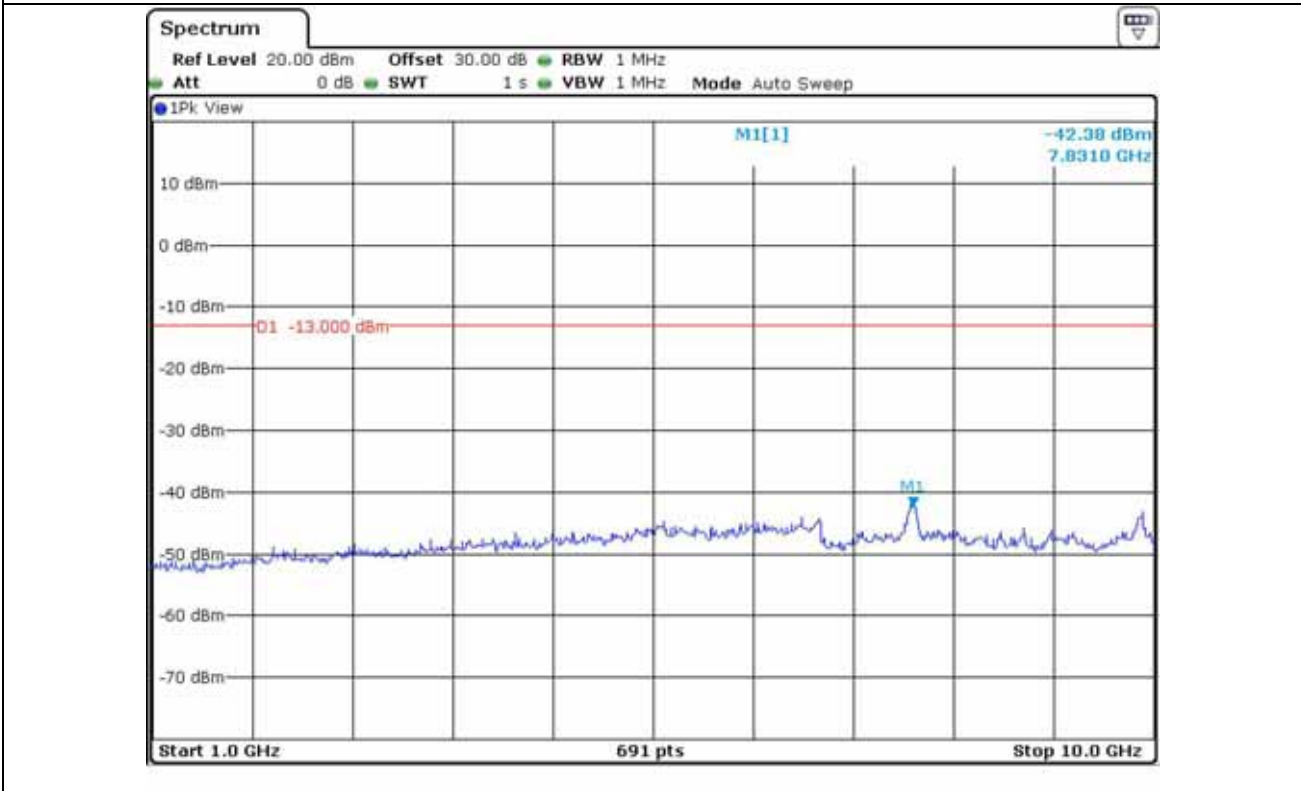
EDGE – High Channel



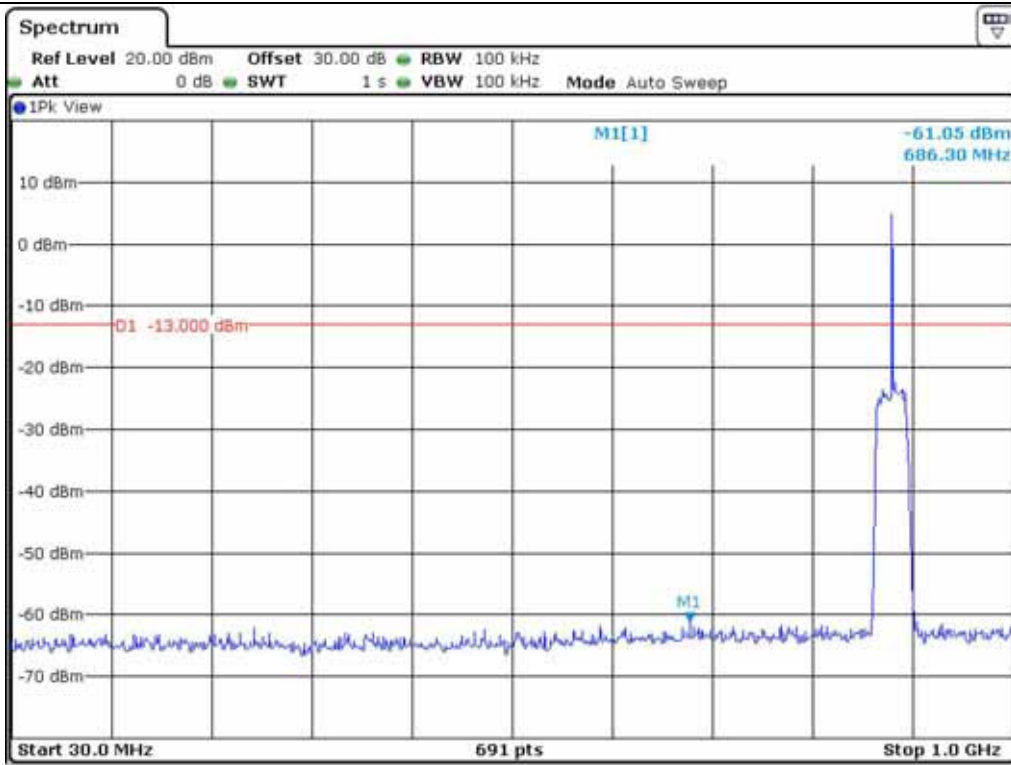
EDGE – High Channel



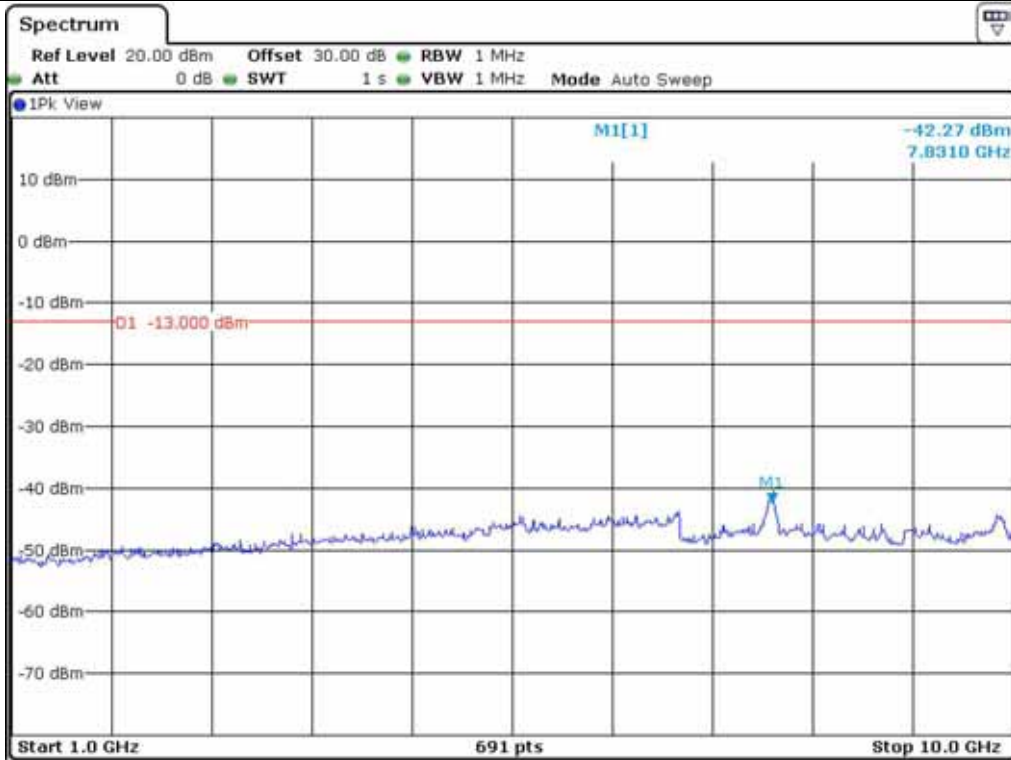
CDMA – Low Channel



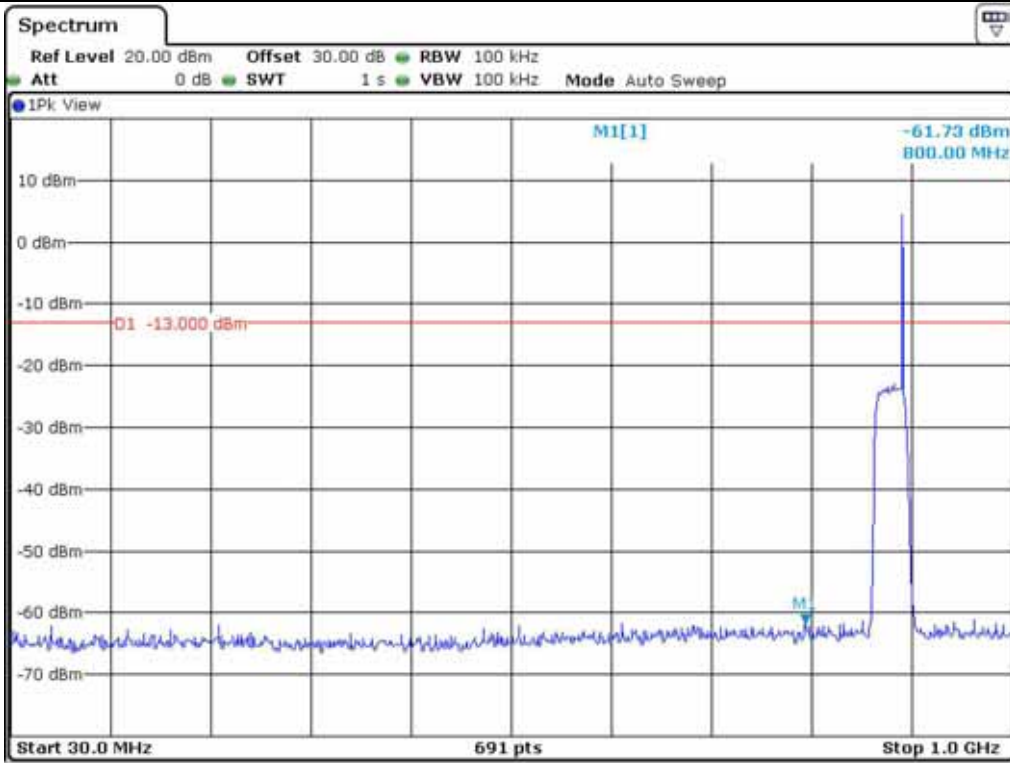
CDMA – Low Channel



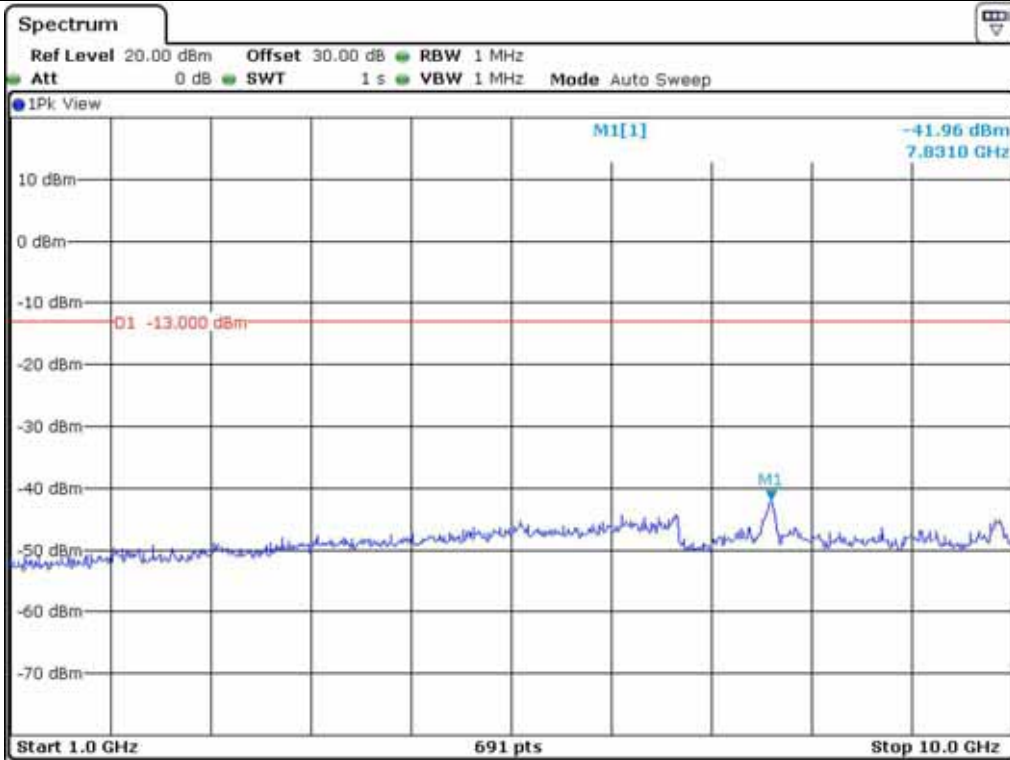
CDMA – Middle Channel



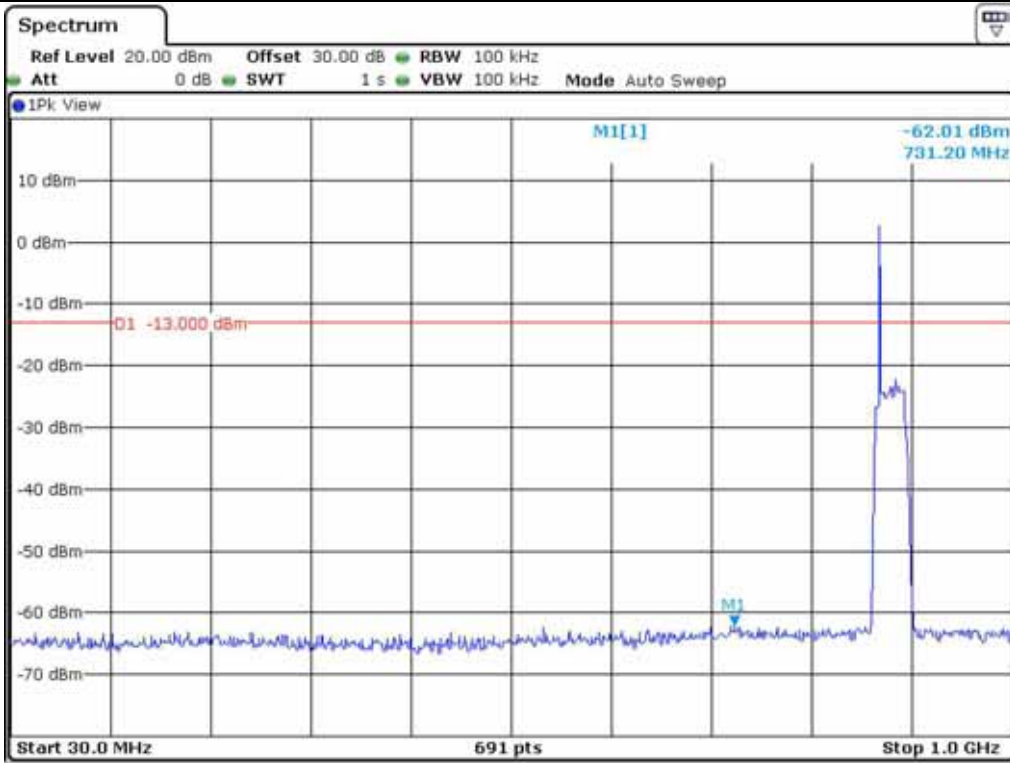
CDMA – Middle Channel



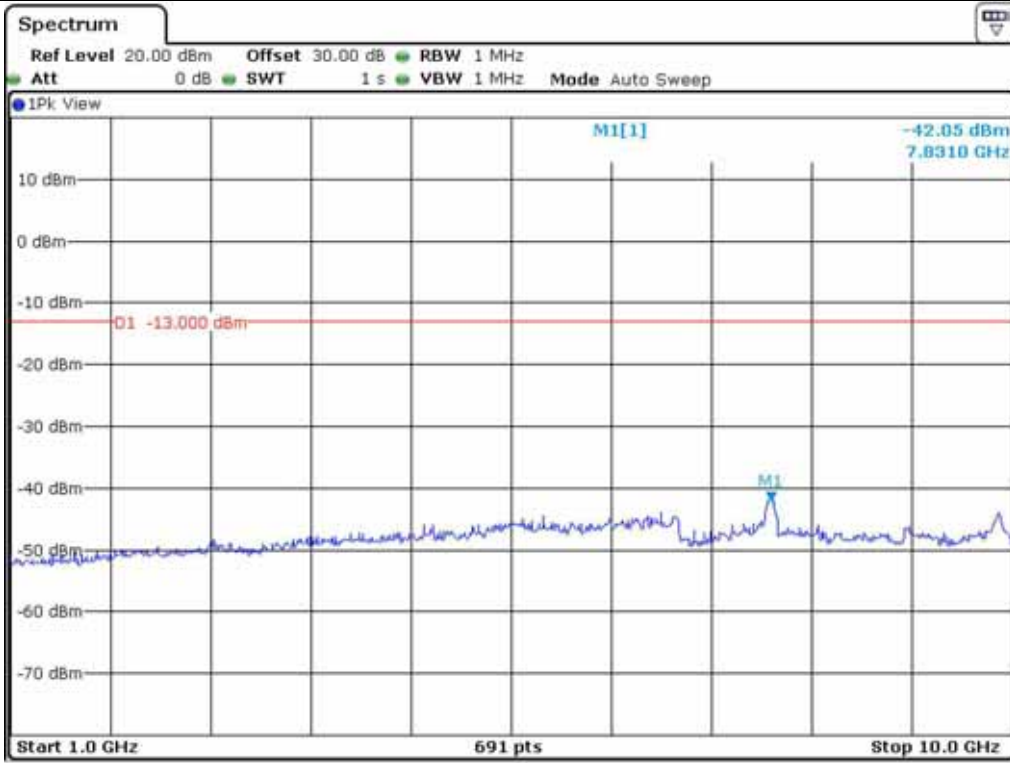
CDMA – High Channel



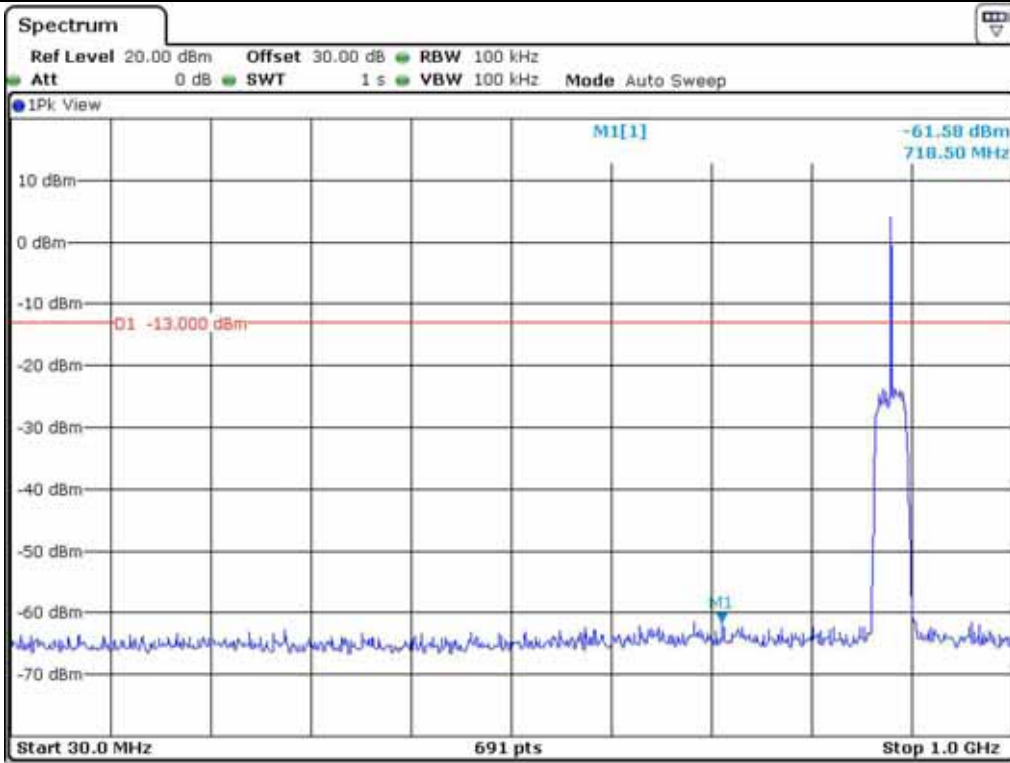
CDMA – High Channel



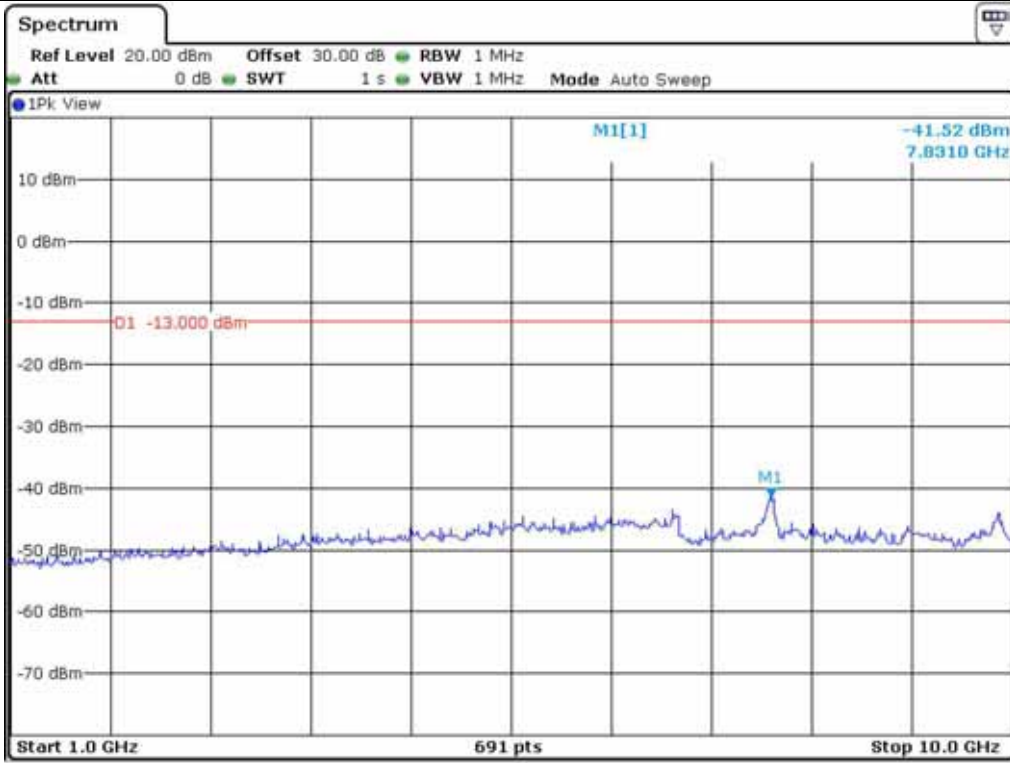
1xEVDO – Low Channel



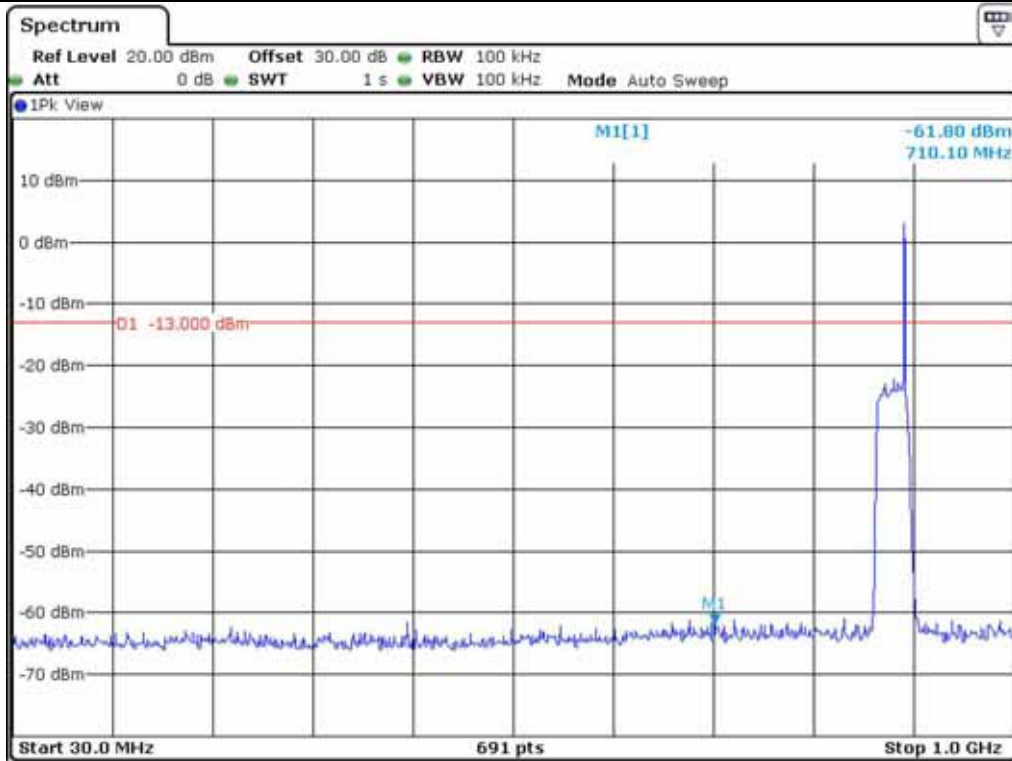
1xEVDO – Low Channel



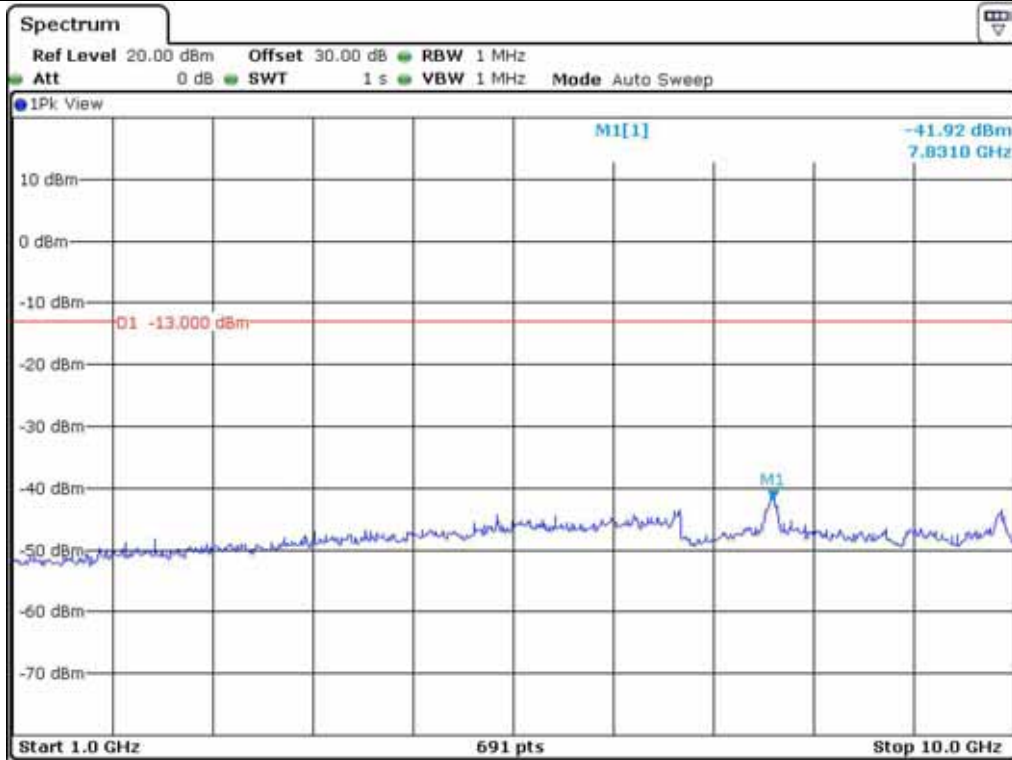
1xEVDO – Middle Channel



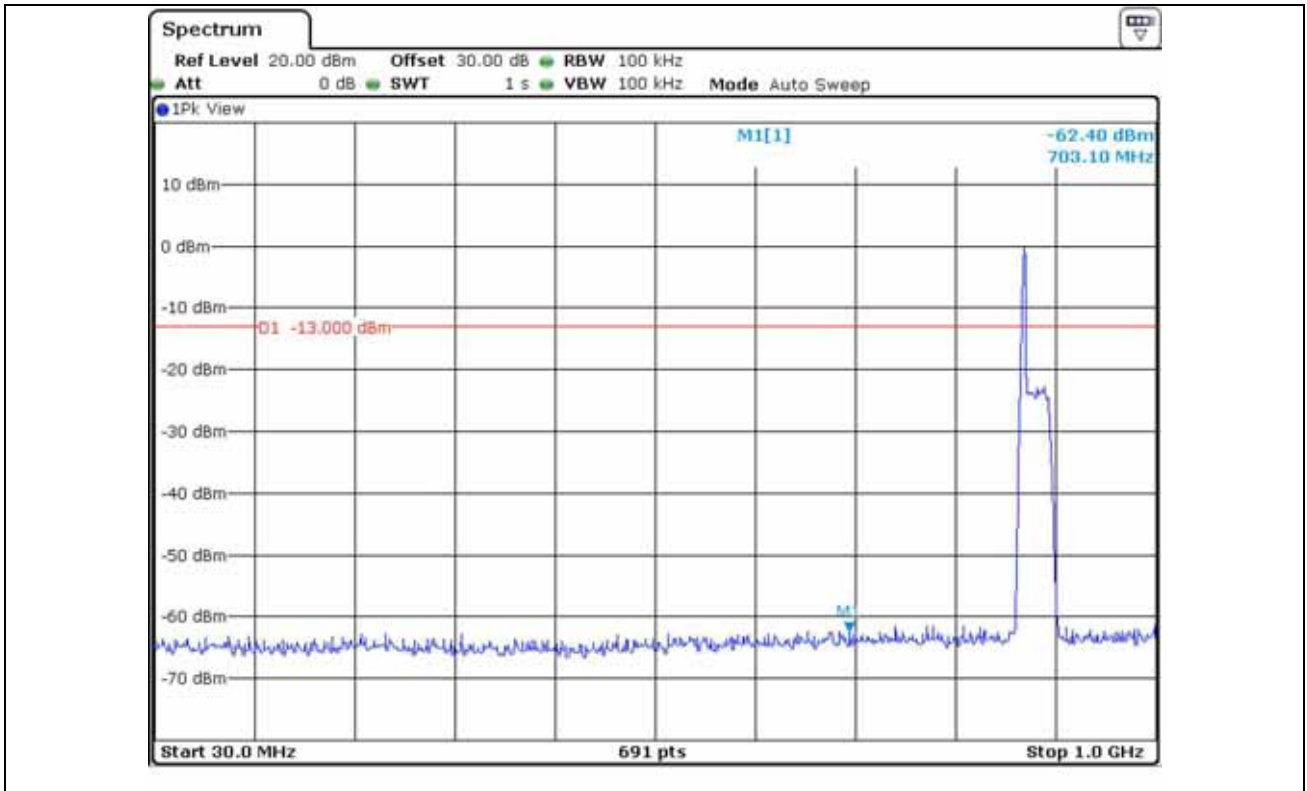
1xEVDO – Middle Channel



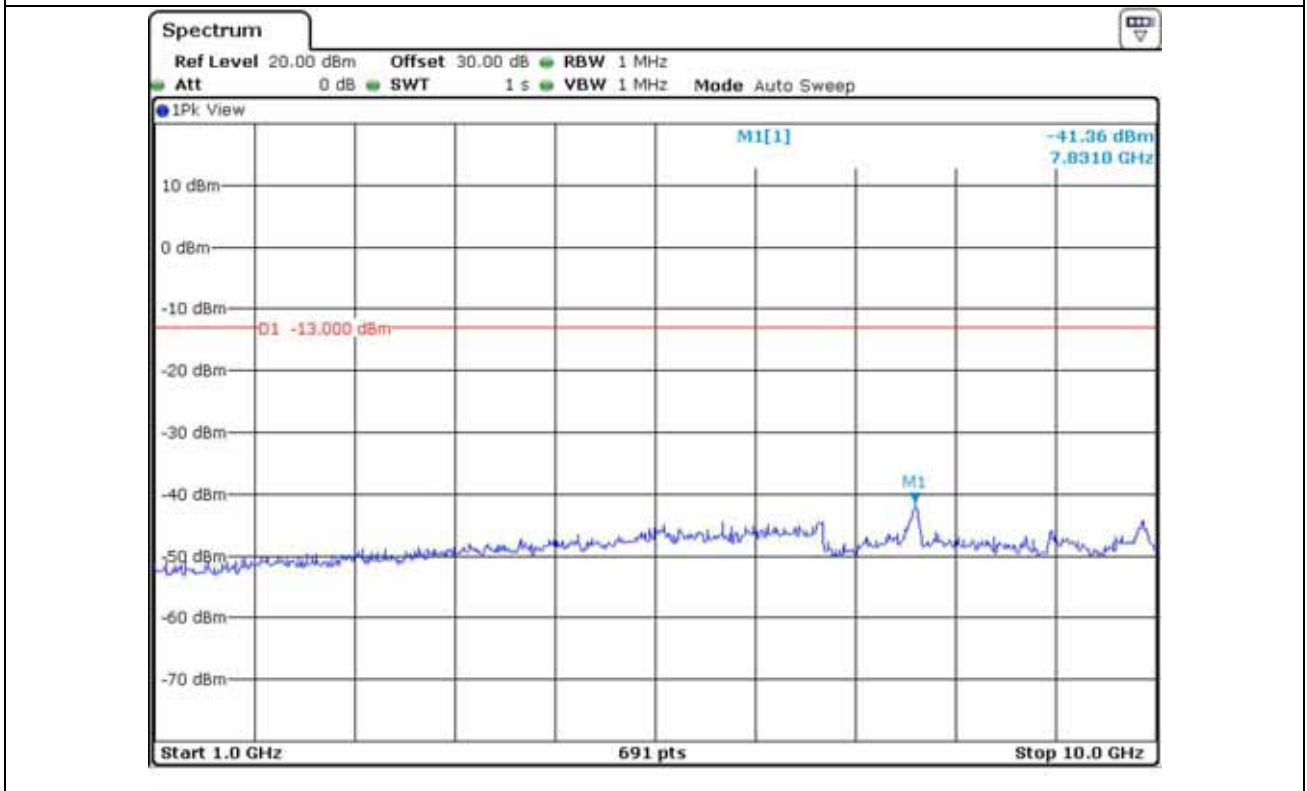
1xEVDO – High Channel



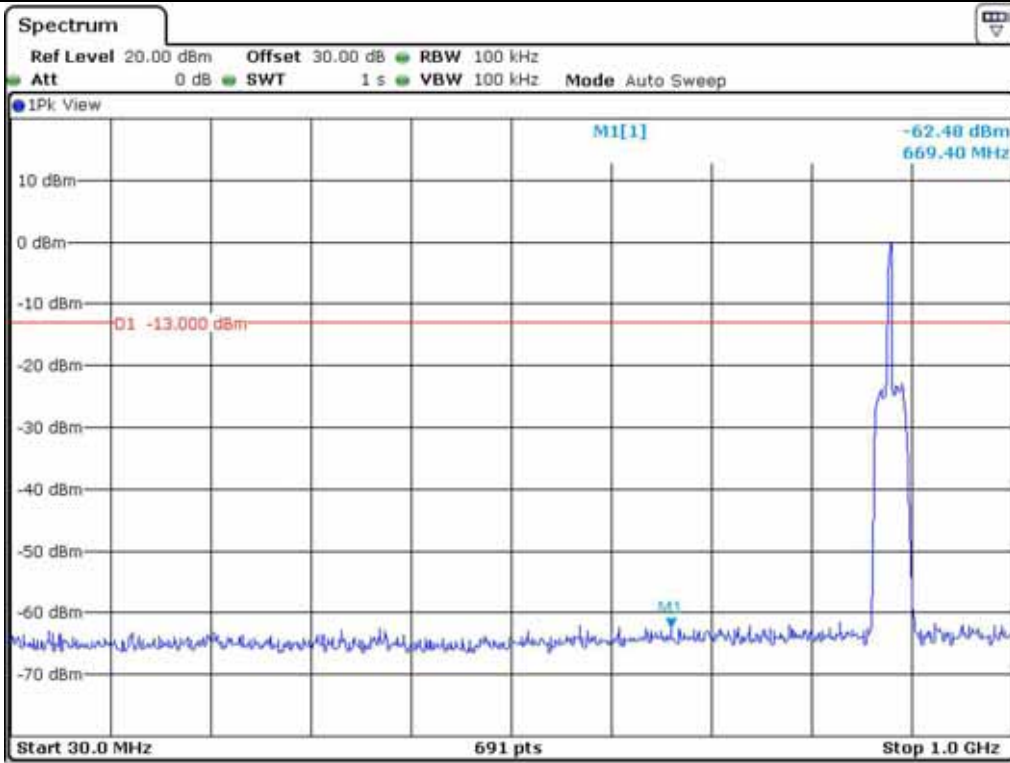
1xEVDO – High Channel



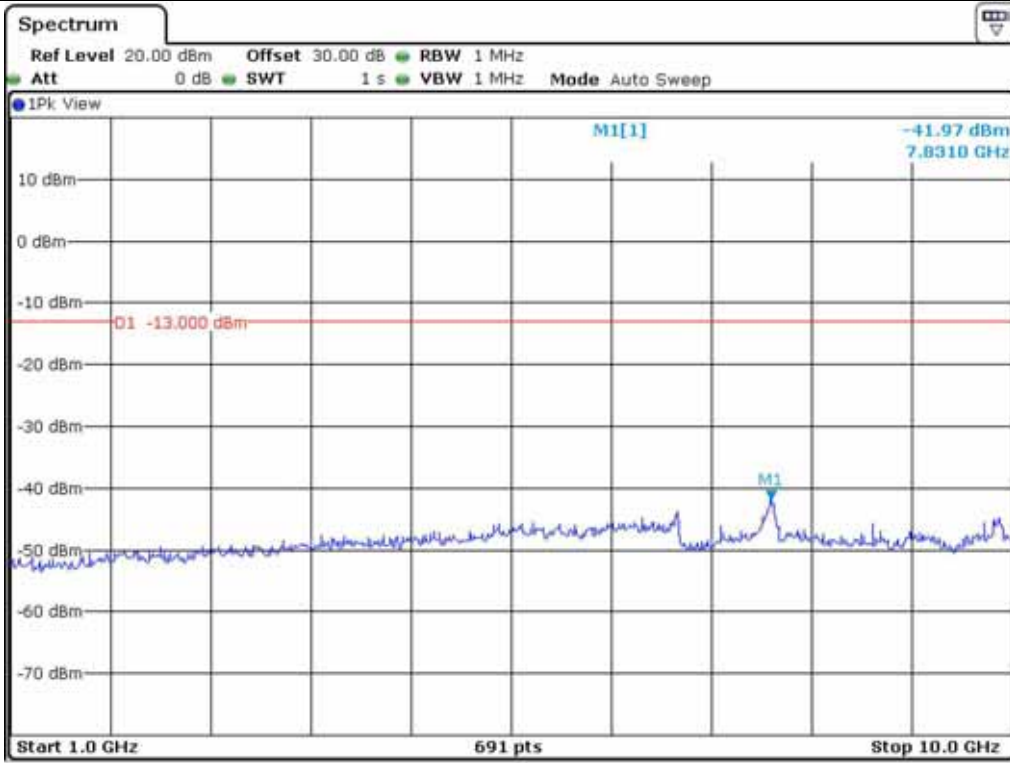
WCDMA – Low Channel



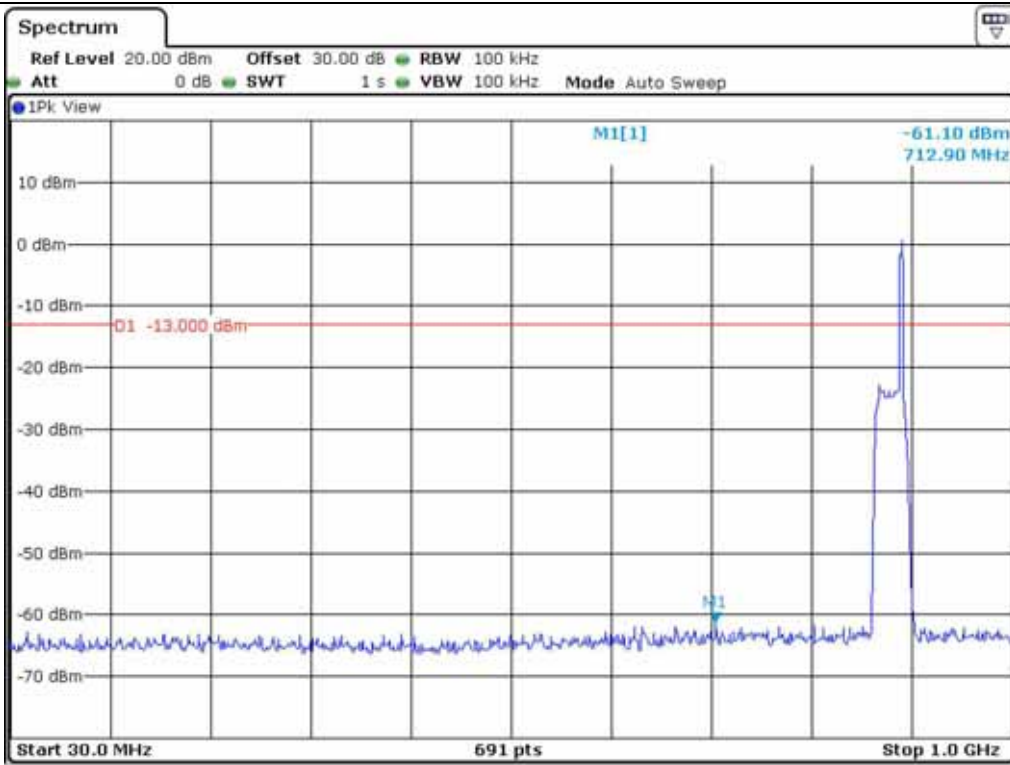
WCDMA – Low Channel



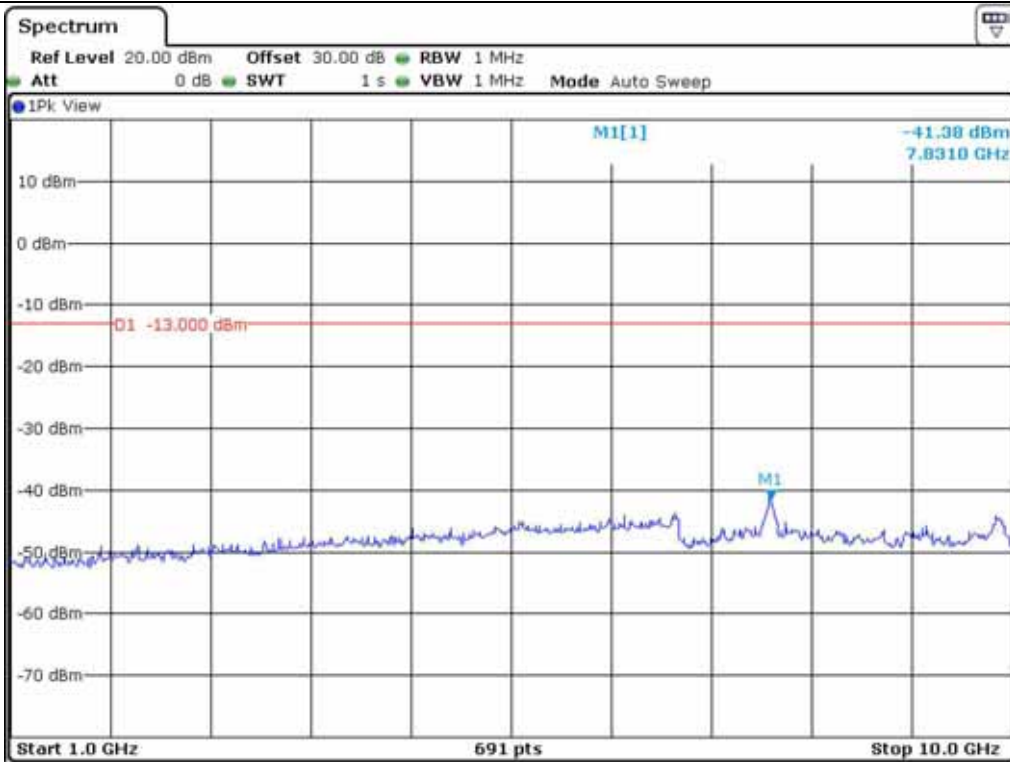
WCDMA – Middle Channel



WCDMA – Middle Channel



WCDMA – High Channel



WCDMA – High Channel

8. BAND EDGE MEASUREMENT

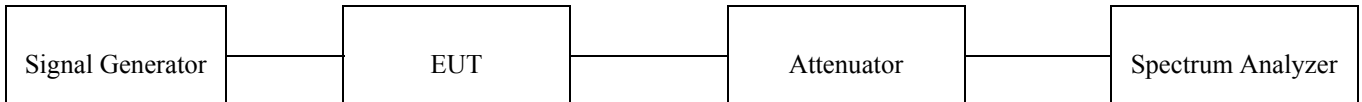
8.1 Operating environment

Temperature : 21 °C
 Relative humidity : 52 % 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)

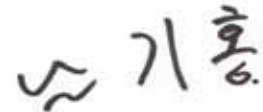
All test equipment used is calibrated on a regular basis.

8.4 Test data

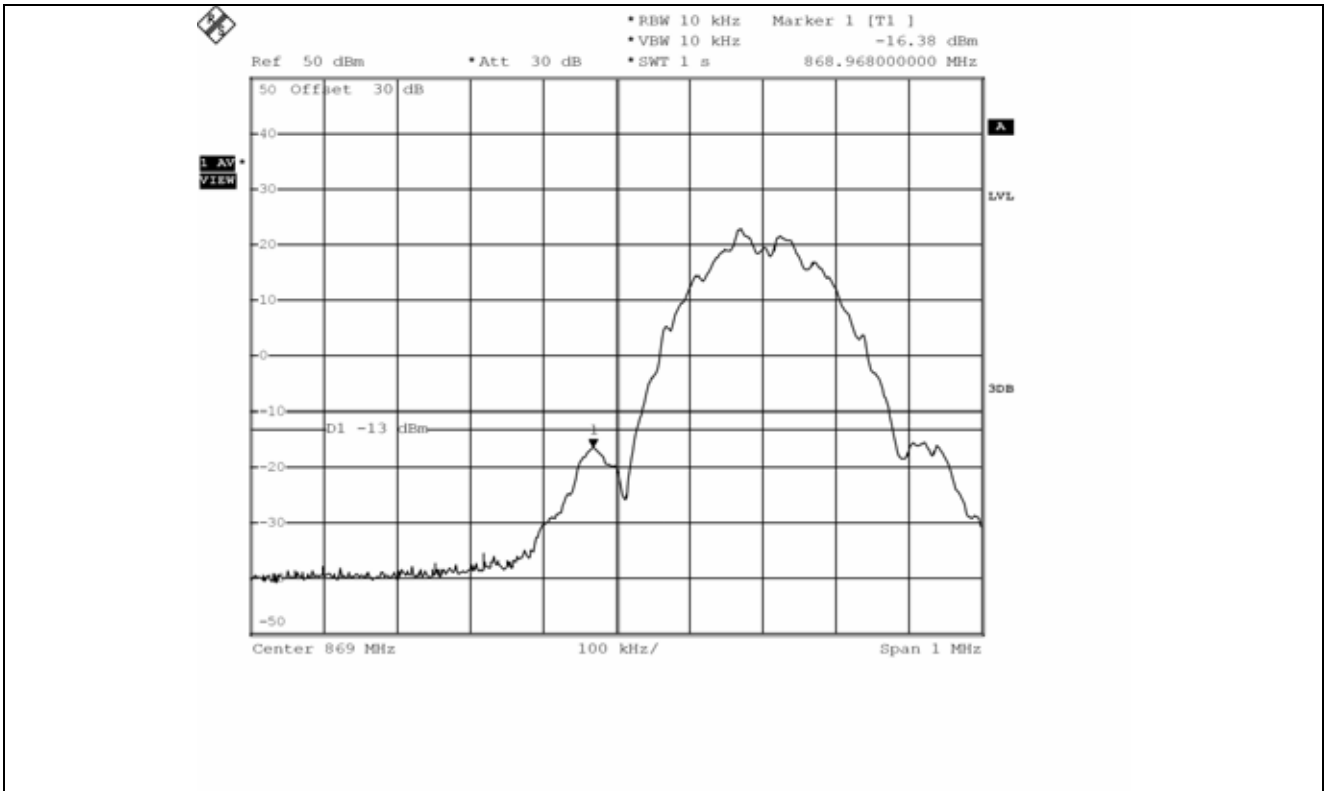
- Test Date : February 20, 2012
- Result : PASSED BY -3.35 dB at GSM Mode

Modulation	Channel	Measured Frequency (MHz)	Max. Measured Value (dBm)	Limit (dBm)	Margin (dB)
GSM	Low	868.982	-16.29	-13.00	-3.29
	High	894.026	-14.43		-1.43
EDGE	Low	868.968	-16.38		-3.38
	High	894.020	-15.17		-2.17
CDMA	Low	869.000	-23.93		-10.93
	High	894.000	-27.54		-14.54
1xEVDO	Low	869.000	-22.70		-9.70
	High	894.000	-27.83		-14.83
WCDMA	Low	869.000	-20.54		-7.54
	High	894.000	-22.74		-9.74

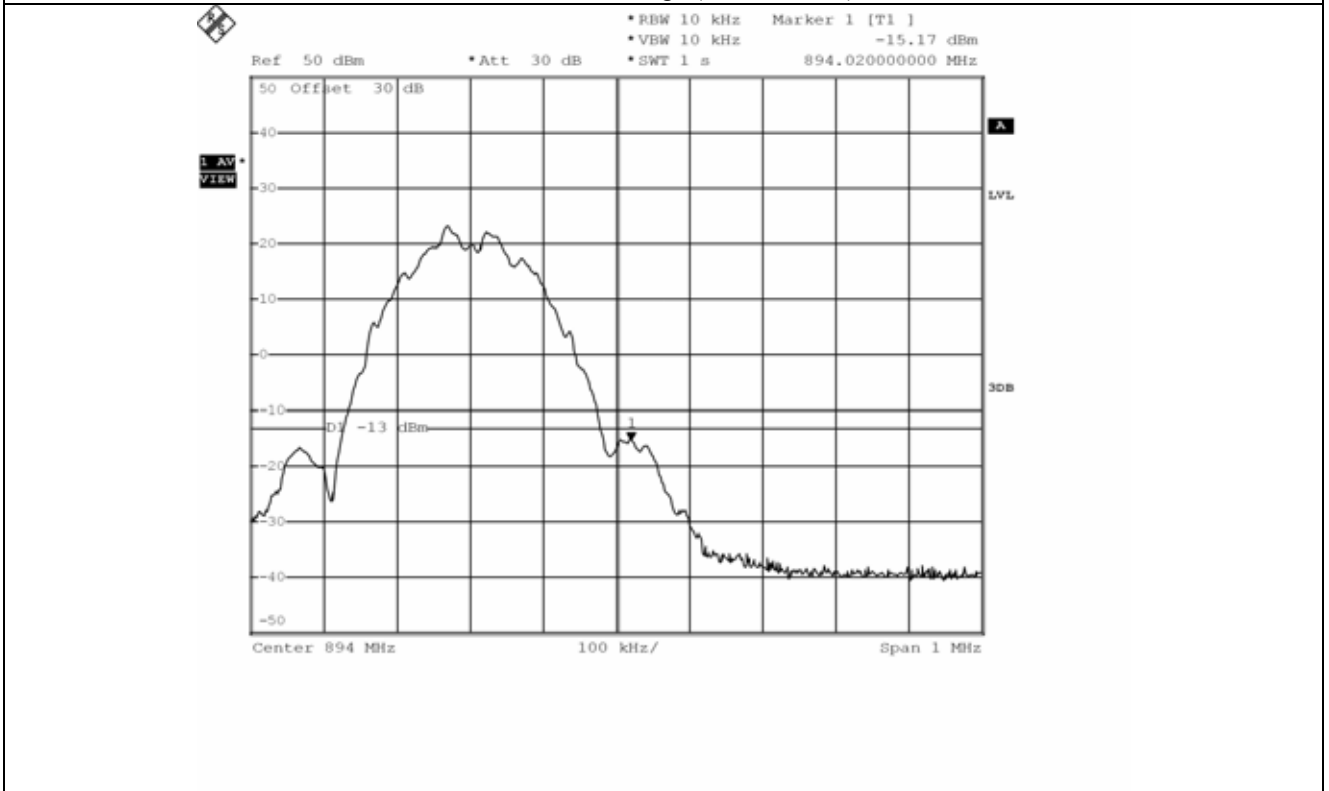
According to Part 22H, out of band emission shall be attenuated by $43 + 10 \log (P)$ dBc, equates to -13.0dBm.



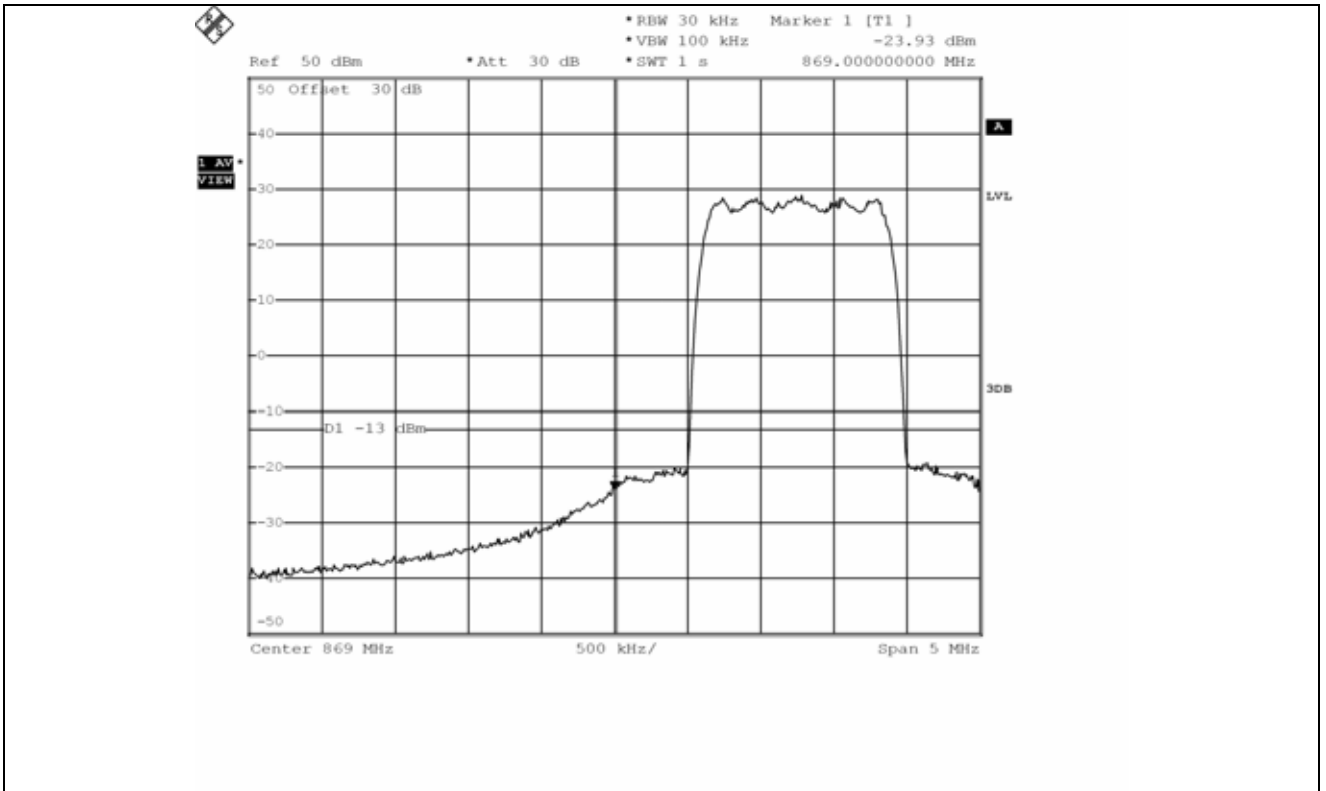
Tested by: Ki-Hong, Nam / Senior Engineer



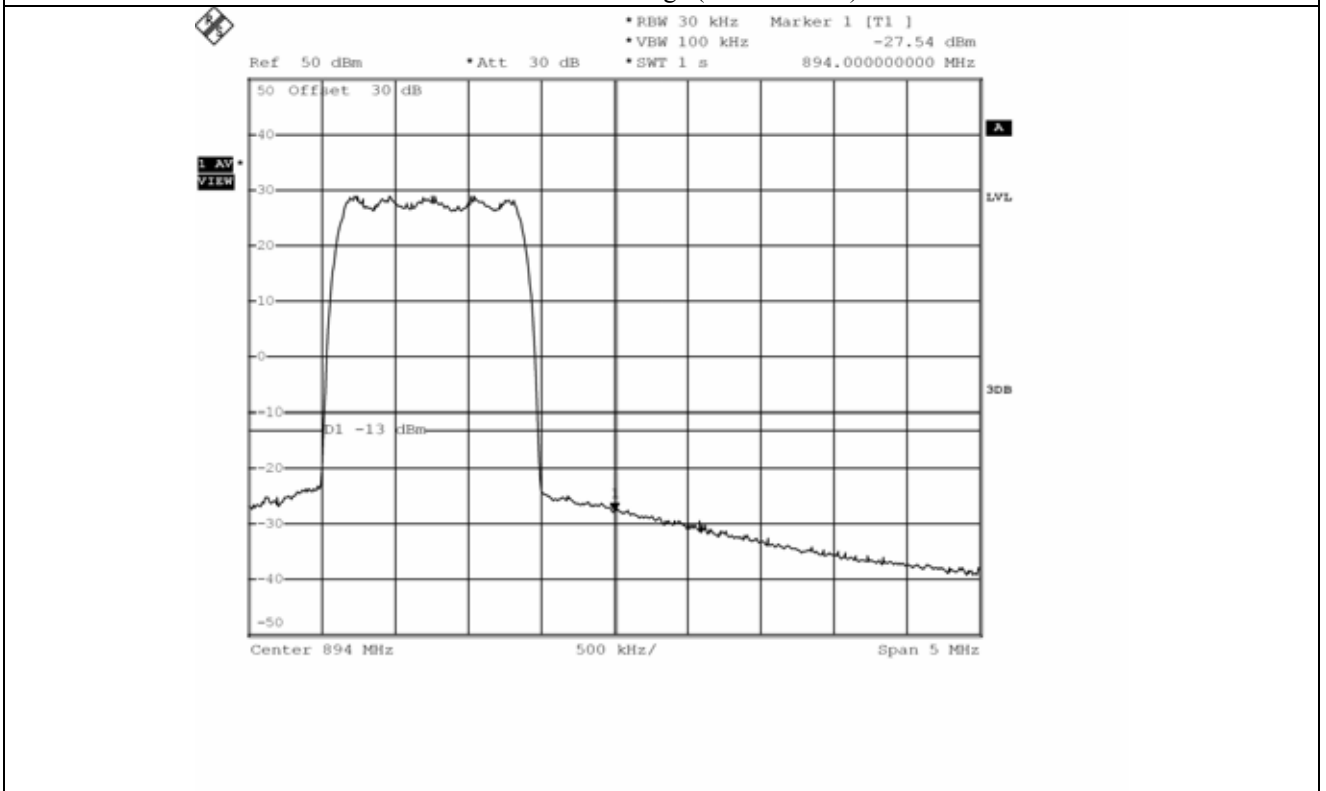
EDGE – Band Edge (Low Channel)



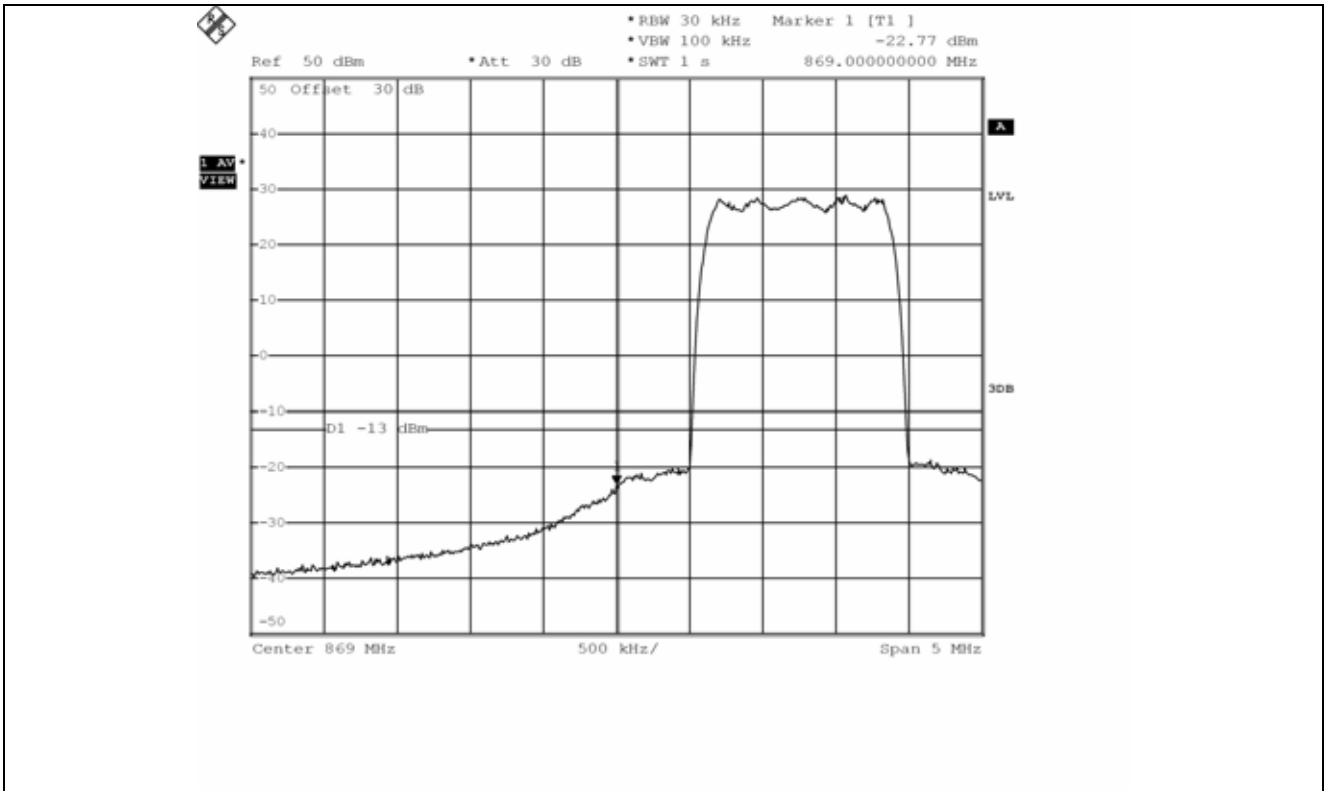
1xEVDO – Band Edge (High Channel)



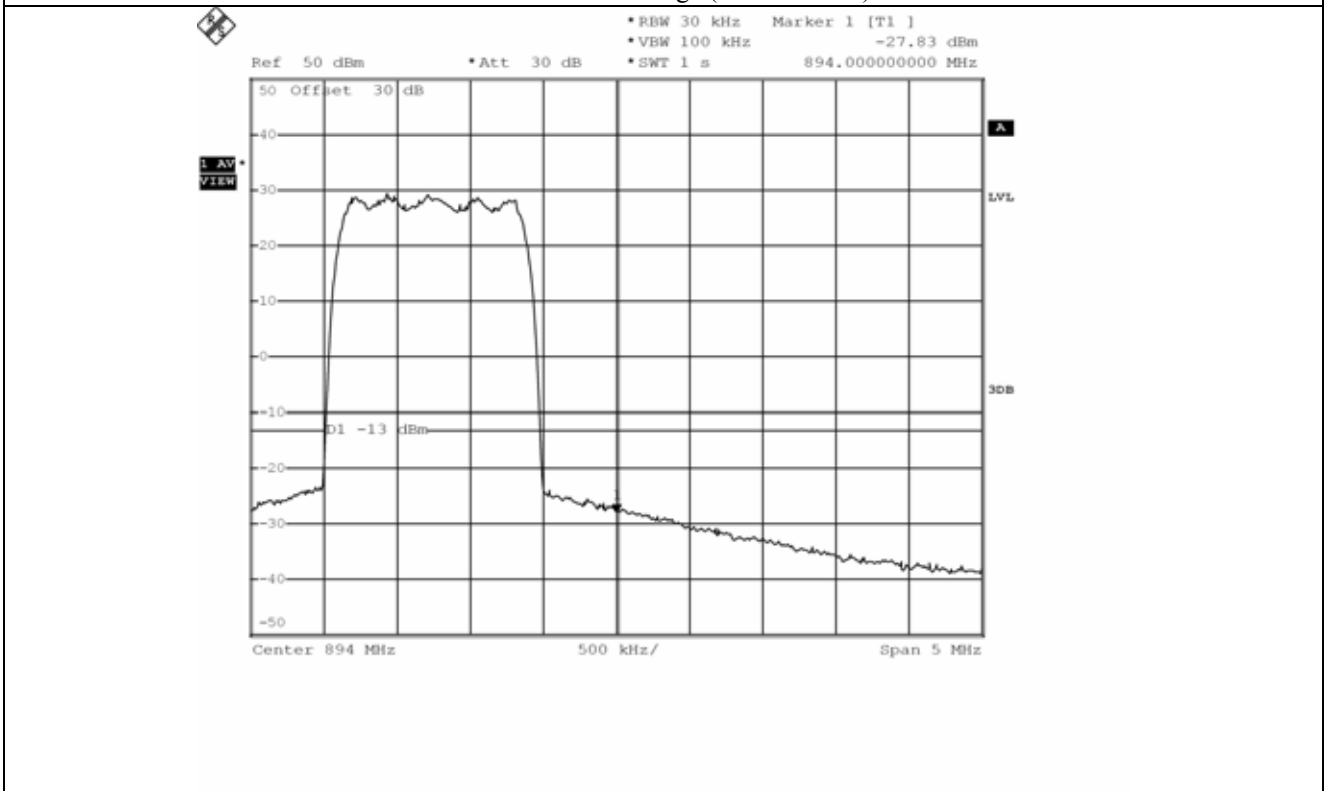
CDMA – Band Edge (Low Channel)



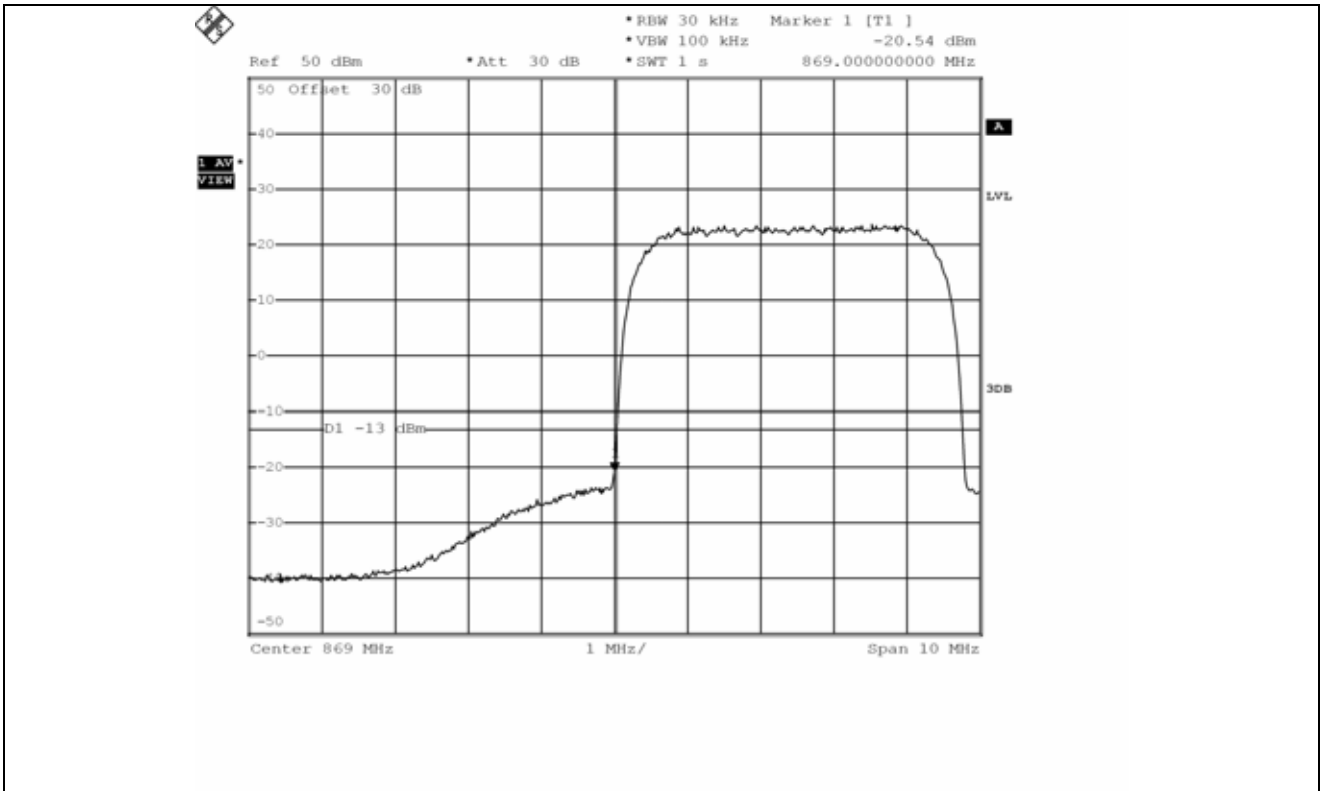
CDMA – Band Edge (High Channel)



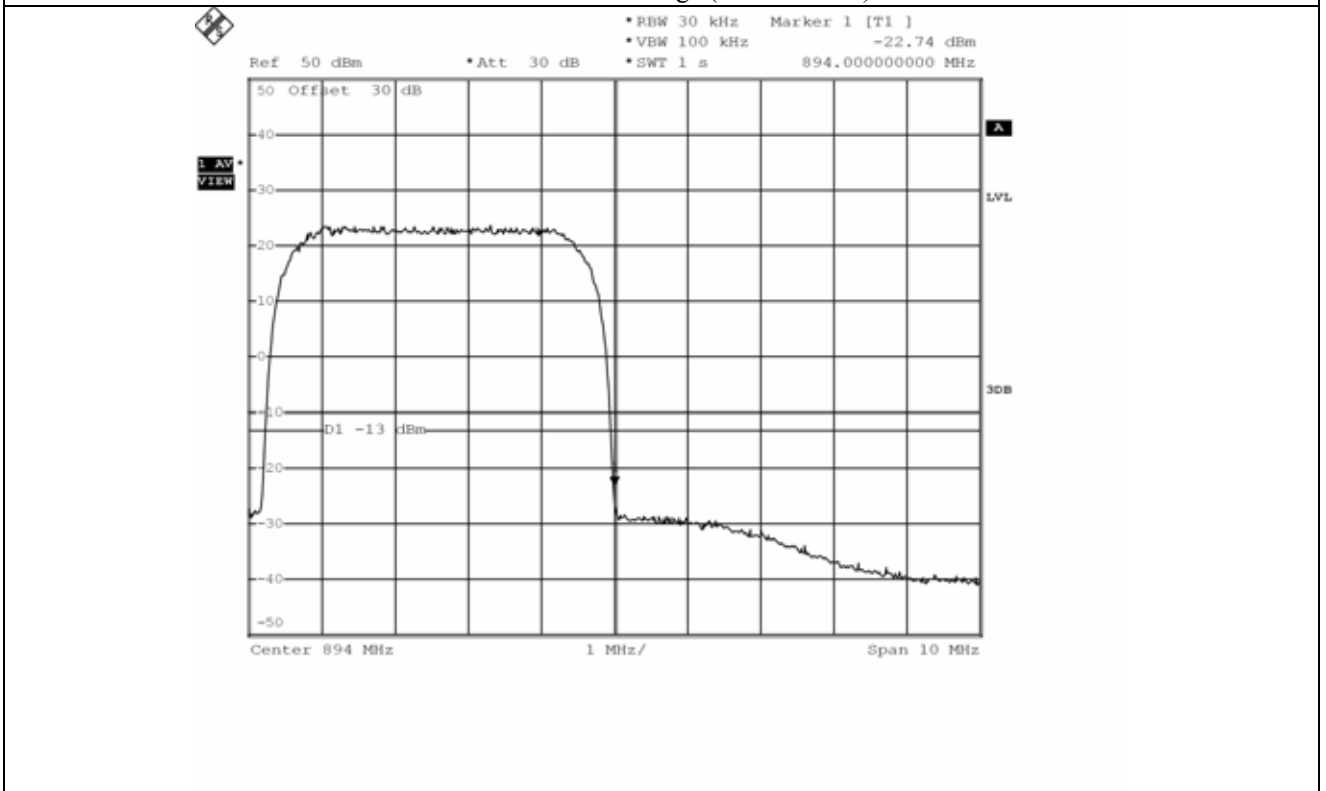
1xEVDO – Band Edge (Low Channel)



1xEVDO – Band Edge (High Channel)



WCDMA – Band Edge (Low Channel)



WCDMA – Band Edge (High Channel)

9. INTERMODULATION TEST

9.1 Operating environment

Temperature : 20 °C
 Relative humidity : 51 %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

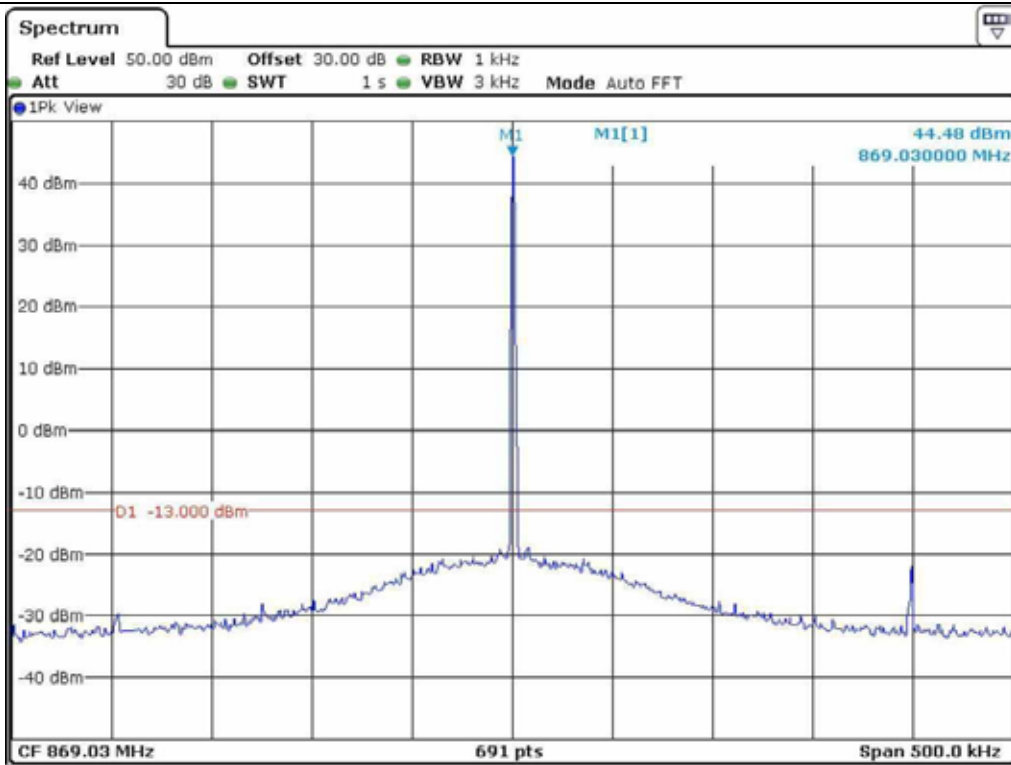
9.4.1 Test Result for peak power

- Test Date : February 21, 2012
- Test Result : Pass
- Modulation : No-Modulation

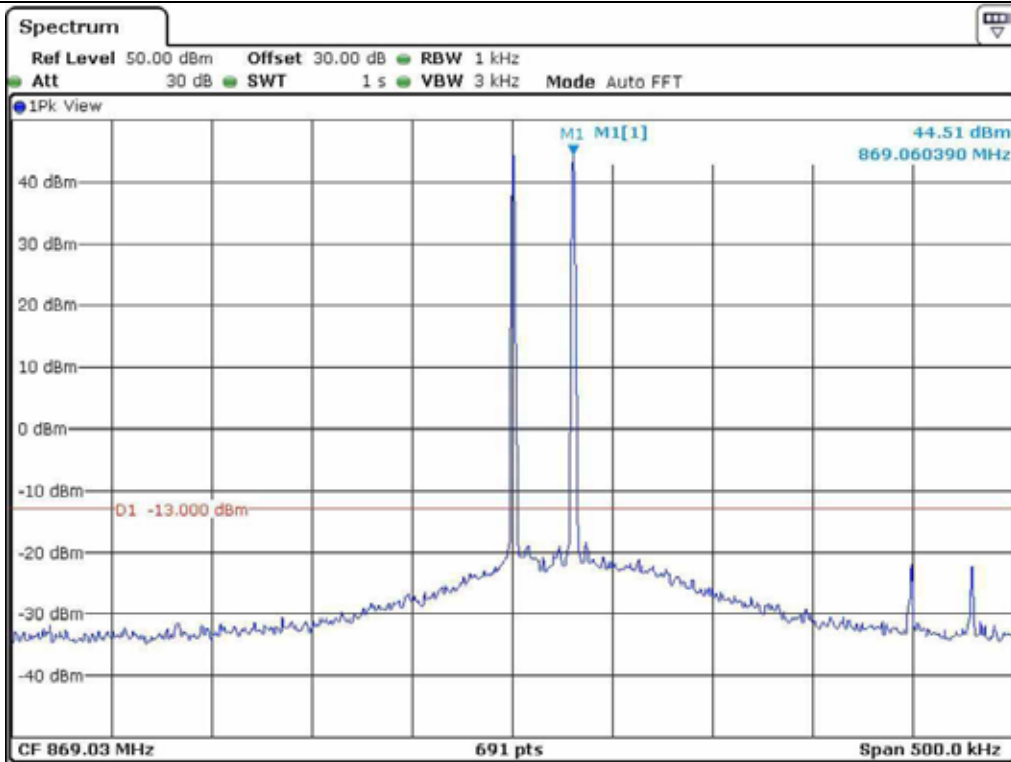
Frequency (MHz)	Number of Input Channel	Input Power (dBm)	Output Power (dBm)
869.030	1	-9.90	44.48
869.030 & 869.06	2	-9.80	44.51
869.030 & 869.06 & 869.09	3	-9.80	44.49
893.970	1	-9.70	44.50
893.970 & 893.940	2	-9.90	44.51
893.970 & 893.940 & 893.9210	3	-9.80	44.50

남기홍

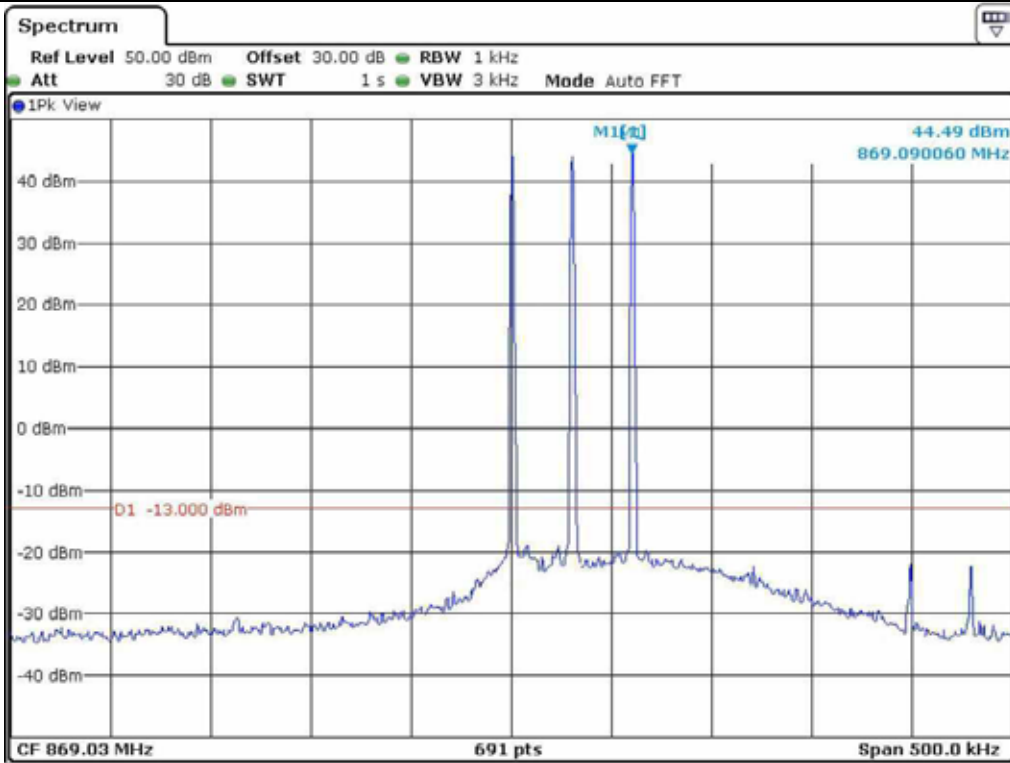
Tested by: Ki-Hong, Nam / Senior Engineer



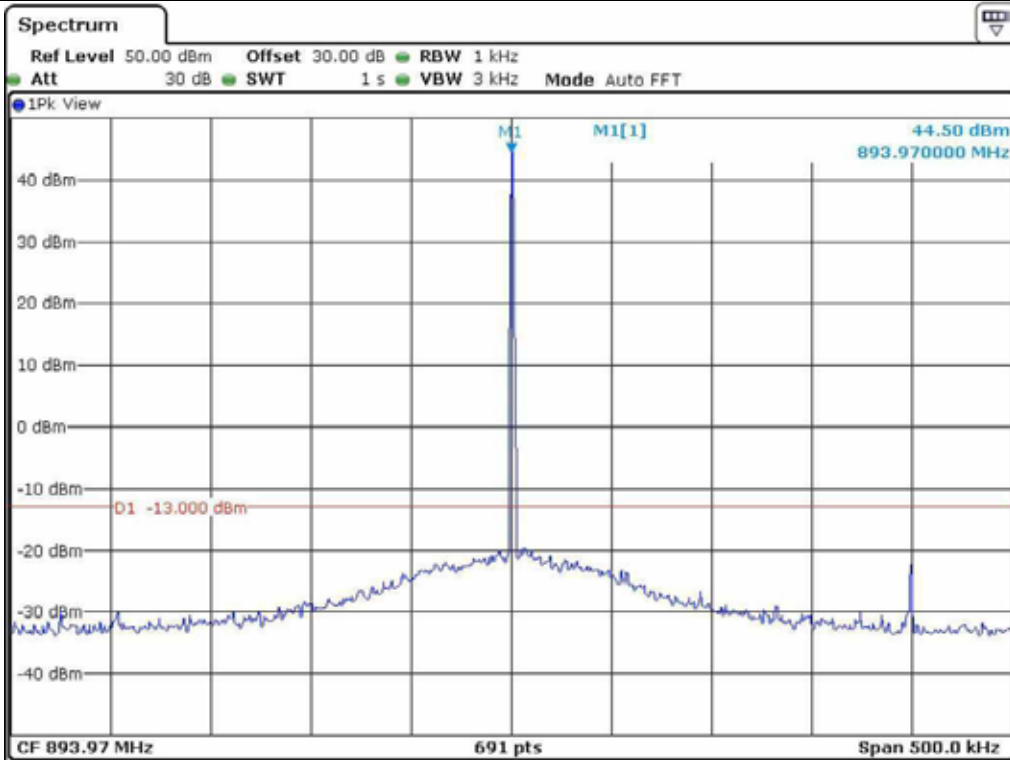
Low Channel – 1 input signal



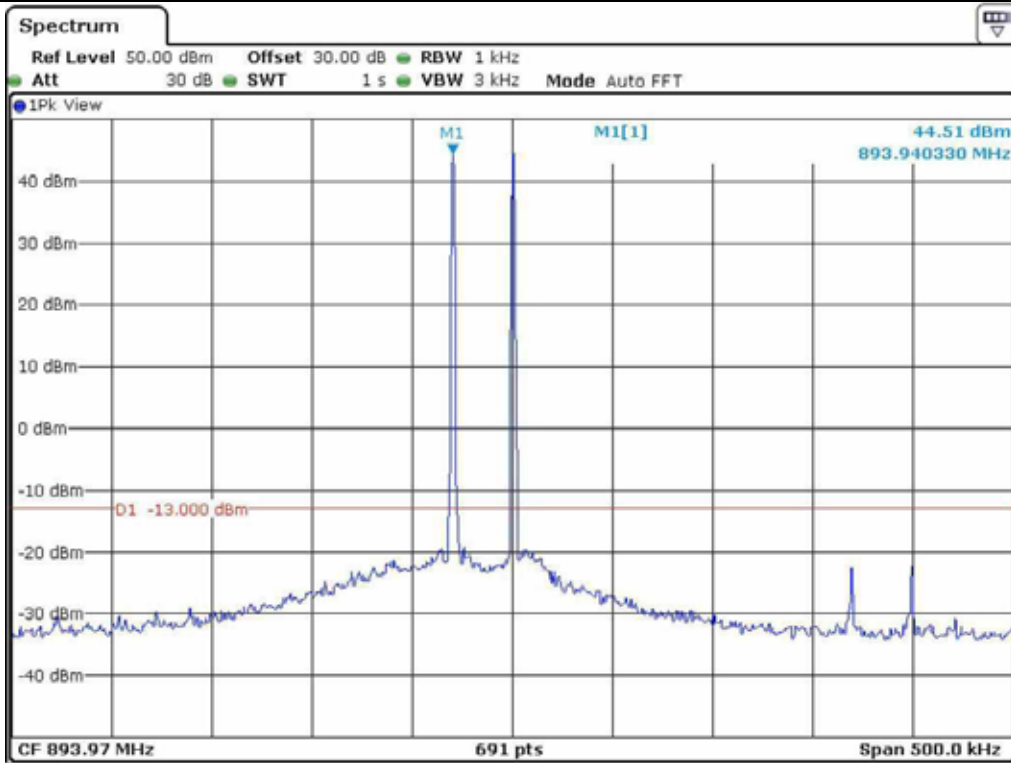
Low Channel – 2 input signals



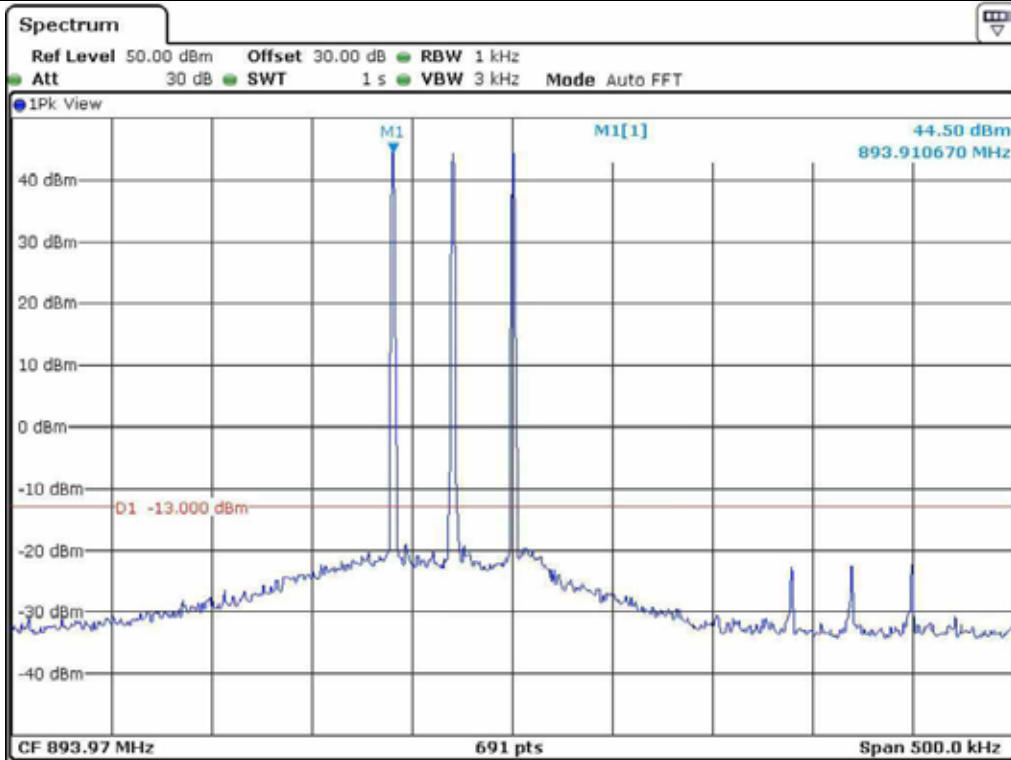
Low Channel – 3 input signals



High Channel – 1 input signal



High Channel – 2 input signals



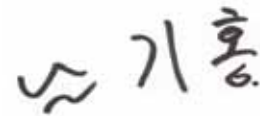
High Channel – 3 input signals

9.4.2 Test Result for Spurious emission

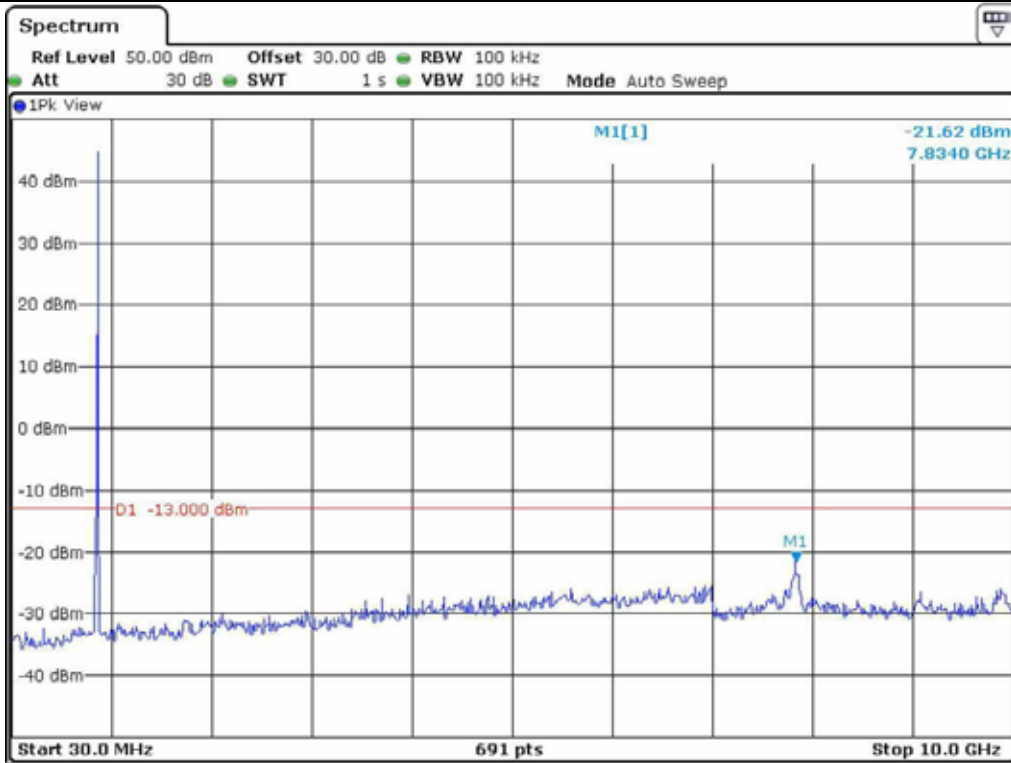
- Test Date : February 21, 2012
- Test Result : Pass
- Modulation : No-Modulation

Frequency (MHz)	Number of Input Channel	Measured Value	Result
869.030	1	< -13 dBm	Pass
869.030 & 869.06	2		
869.030 & 869.06 & 869.09	3		
893.970	1	< -13 dBm	Pass
893.970 & 893.940	2		
893.970 & 893.940 & 893.9210	3		

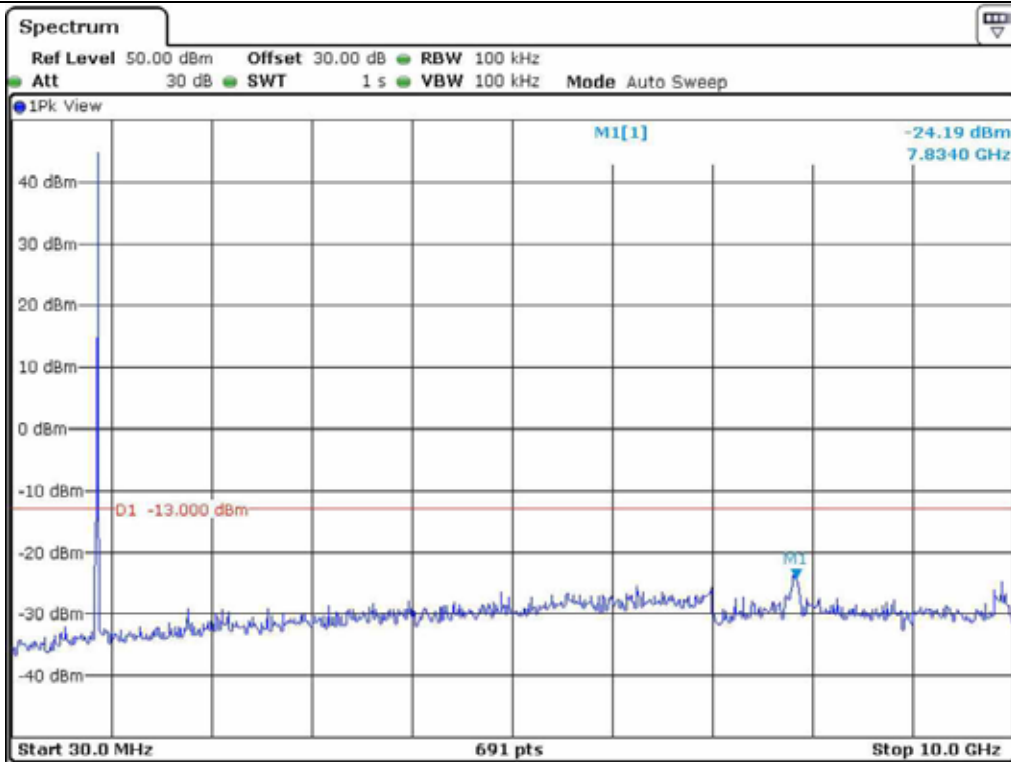
Remark: Intermodulation products must be attenuated below the rated power of the EUT at least $43 + 10\log (P_w)$, equivalent to -13 dBm. Please refer to test data hereinafter.



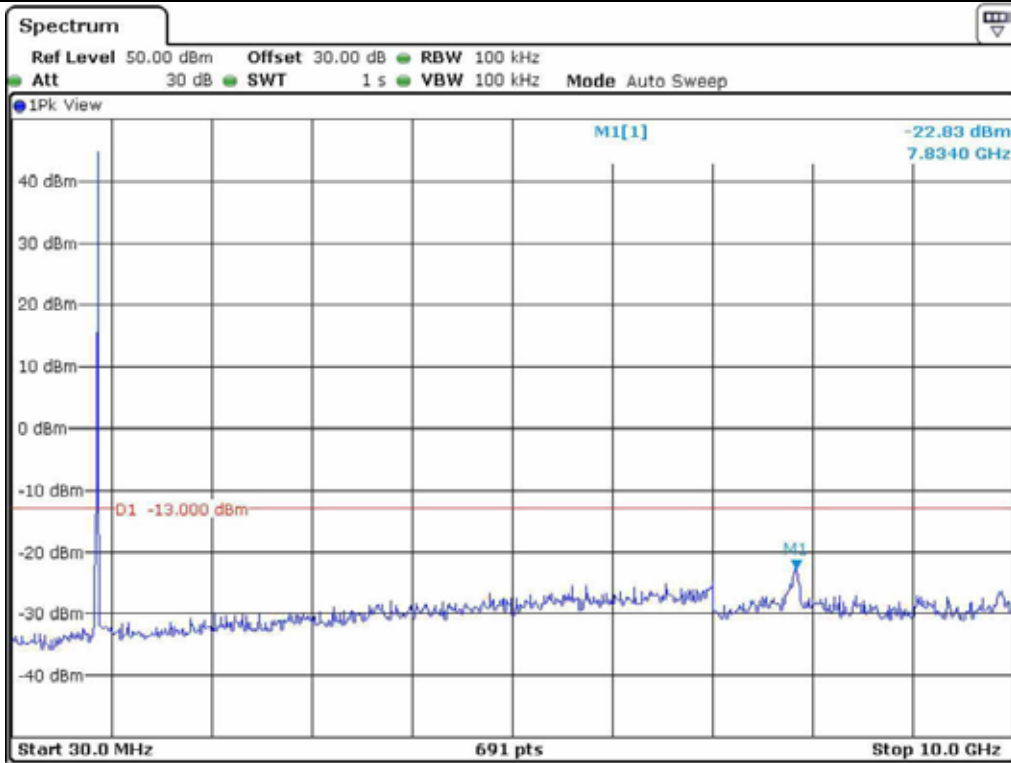
Tested by: Ki-Hong, Nam / Senior Engineer



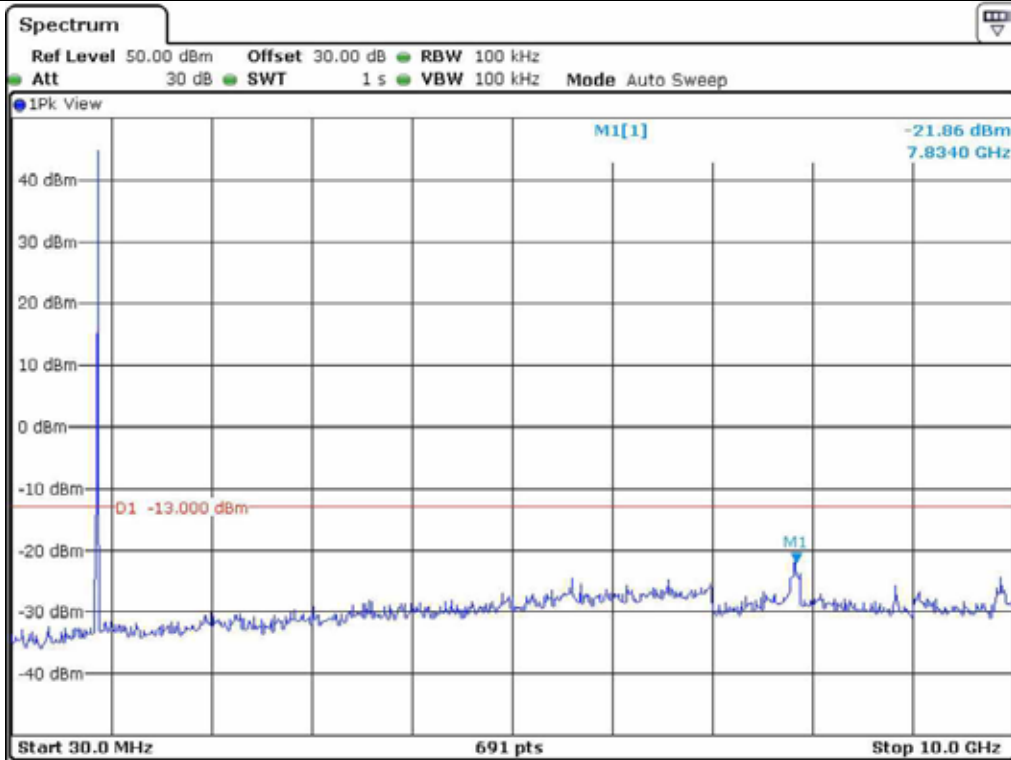
Low Channel – 1 input signal



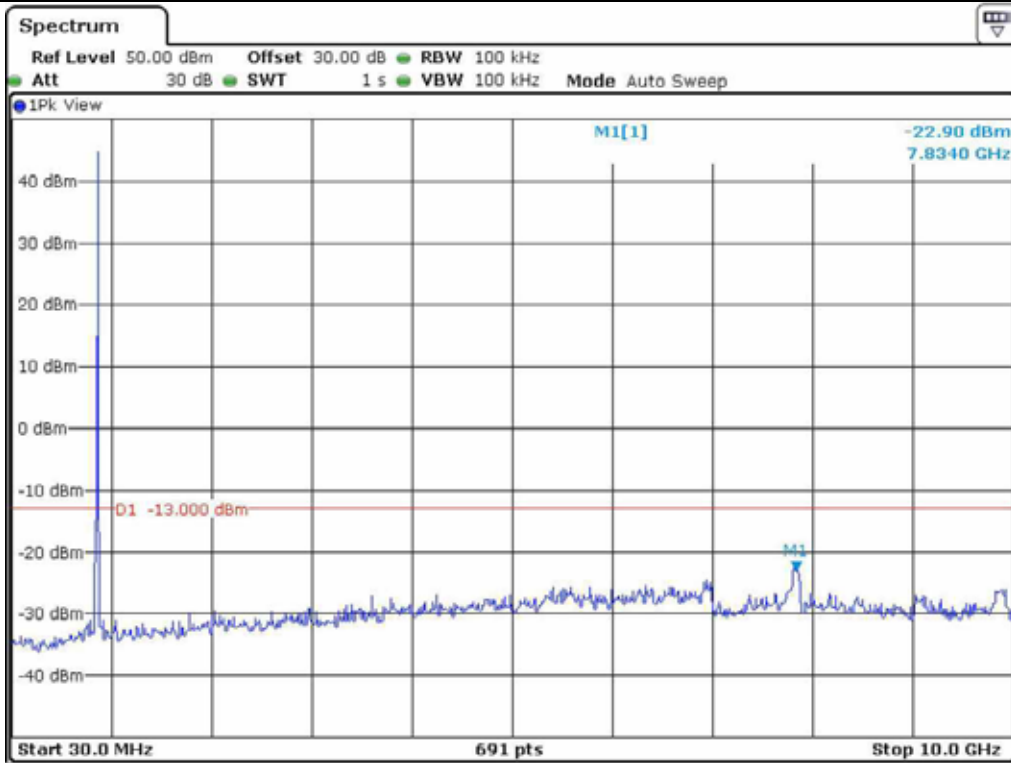
Low Channel – 2 input signals



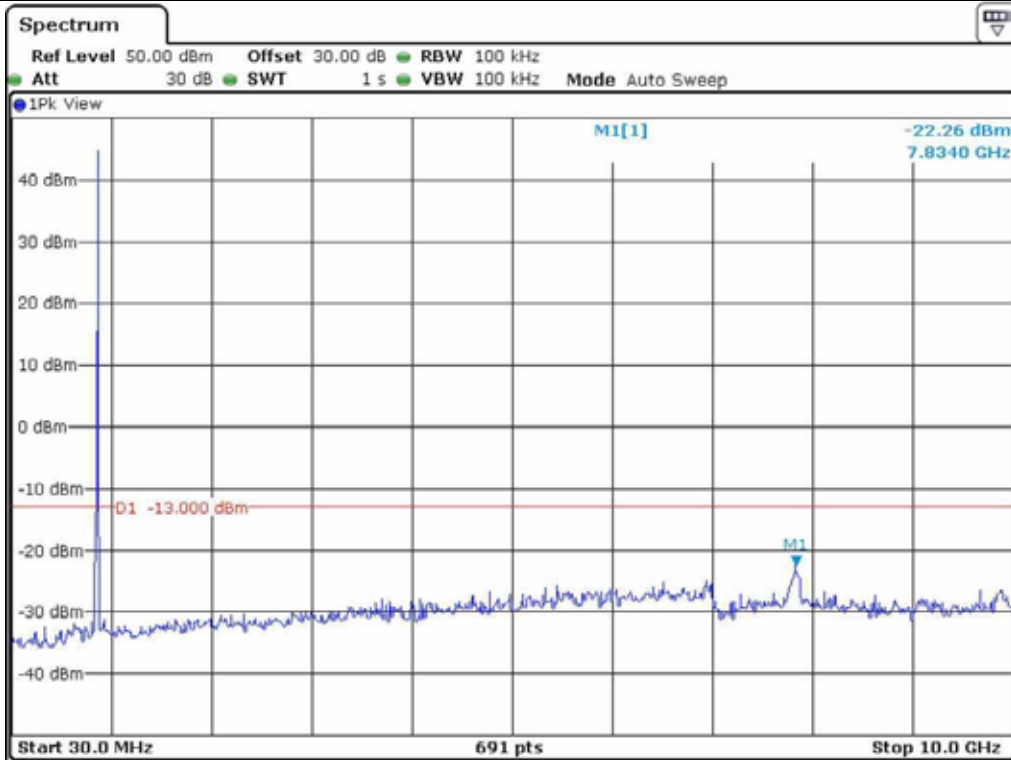
Low Channel – 3 input signals



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 10th 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.

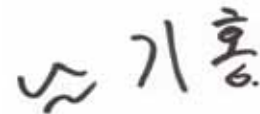
10.4 Test data

- 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 ~ 9 GHz
- Measurement distance : 3 m
- Result : PASSED BY -47.61 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)
Test Data for Low Channel								
869.03	75.30	7.63	-0.18	H	3.33	4.12	-	-
	78.17	9.17		V		5.66	-	-
Test Data for Middle Channel								
881.50	75.50	7.87	-0.36	H	3.33	4.18	-	-
	78.33	9.50		V		5.81	-	-
Test Data for High Channel								
893.97	75.17	7.50	-0.53	H	3.33	3.64	-	-
	78.67	9.83		V		5.97	-	-
38.00	29.17	-64.83	1.22	V	0.50	-64.11	-13.00	-51.11
42.83	28.50	-64.50	1.53	H	1.50	-61.47	-13.00	-48.47
136.80	35.33	-65.01	2.57	H	1.83	-60.61	-13.00	-47.61
163.86	32.67	-65.83	2.92	H	2.17	-60.74	-13.00	-47.74
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

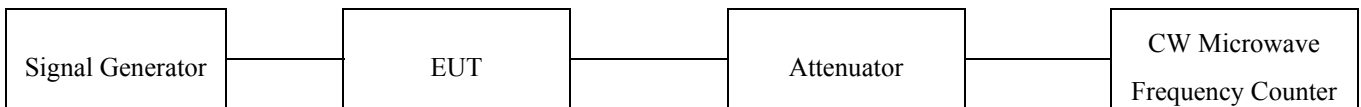
11.1 Operating environment

Temperature : 20 °C
 Relative humidity : 52 % 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)
□ -	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 Counter	US39270295	Dec. 30, 2011 (1Y)
■ -	67-30-43	Aeroflex Weinschel	Power Attenuator	CA5760	Nov. 30, 2011 (1Y)
■ -	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 21 ~ 22, 2012
 - Result : PASSED

Temperature (°C)	Input Freq. (Hz)	Measured Freq. (Hz)	Result (PPM)	Limit
-30	881 500 000	881 500 002	0.002 3	Within the Authorized Frequency block
-20		881 500 001	0.001 1	
-10		881 500 001	0.001 1	
0		881 500 000	0.000 0	
10		881 500 000	0.000 0	
20		881 500 002	0.002 3	
30		881 500 001	0.001 1	
40		881 500 001	0.001 1	
50		881 500 002	0.002 3	

남기홍

Tested by: Ki-Hong, Nam / Senior Engineer

12. FREQUENCY STABILITY WITH VOLTAGE VARIATION

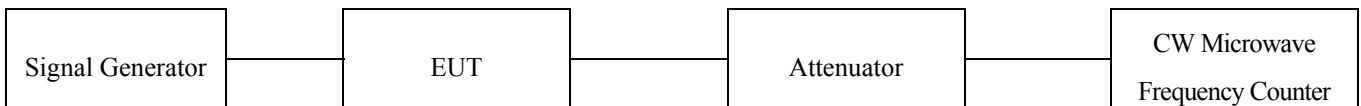
12.1 Operating environment

Temperature : 20 °C
 Relative humidity : 52 % 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

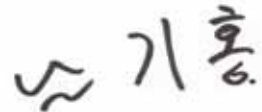
	Model Number	Manufacturer	Description	Serial Number	Last Cal. (Interval)
□ -	E4432B	HP	Signal Generator	US38440950	June 10, 2011 (1Y)
■ -	SMJ100A	R/S	Signal Generator	101038	Feb. 01, 2012 (1Y)
□ -	FSP	R/S	Spectrum Analyzer	100017	Mar. 15, 2011 (1Y)
□ -	8564E	HP	Spectrum Analyzer	3650A00756	Jun. 10, 2011 (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 21 ~ 22, 2012
 - Result : PASSED

Voltage (Vac)	Input Freq. (Hz)	Measured Freq. (Hz)	Result (PPM)	Limit
138 (115 %)	881 500 000	881 500 002	0.002 3	Within the Authorized Frequency block
120 (100 %)		881 500 002	0.002 3	
102 (85 %)		881 500 001	0.001 1	



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 $f/1500 \text{ mW/cm}^2$ for the frequency range between 300 MHz and 1500 MHz.

The electric field generated for a 1 mW/cm^2 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^2 , Z = Impedance of free space, 377Ω

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 $P (\text{mW}) = P (\text{W}) / 1000$, $d (\text{cm}) = 100 * d (\text{m})$

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

Where

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

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^2)	FCC Limit
(dBm)	(mW)	Log	Linear	(cm)	@ 80 cm Separation	(mW/cm^2)
44.50	28 183.8	2.0	1.58	78.14	0.55	0.58

According to above table, safe distance, $D = 0.282 * \sqrt{(28\ 183.8 * 1.58) / 0.58} = 78.14 \text{ cm}$.

For getting power density at 20 cm separation in above table, following formula was used.

$$S = P * G / (4\pi * R^2) = 28\ 183.8 * 1.58 / (4 * 3.14 * 80^2) = 0.55$$

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.