8618 Commerce Court
Burnaby, BC V5A 4N6, Canada
PH: 1 604.420.7760
FAX: 1 604.420.7730
EMAIL: BBALSTON@DALIWIRELESS.COM

INDUSTRY CANADA RSS-131 AND FCC PARTS 2, 22, 24, 27 TEST REPORT

Applicant	Dali Wireless, Inc.
Address	8618 Commerce Court, Burnaby, British Columbia, V5A 4N6, Canada
FCC ID	HCOT30QSCPAN1B
IC Label	10323A-T30QSCPAN1B
Model Number	t30-QSCPA-N1N
Product Description	700, 850, 1900, AWS Indoor Remote Unit, Quad-Band
Date Sample Received	July 16th, 2012
Date Sample Tested	July 16th to August 3rd, 2012
Tested by	Bruce Balston
Approved by	Daryl Meerkerk
Report No.	T30-QSC-PAN.1.0
Test Results	Compliant

Revision History

Revision	Date	Reason For Change	Reviewed By	Author(s)
0.1	July 31, 2012	Initial release		A. Moldavanov
0.2	Aug 1, 2012	Data insertion		A. Moldavanov
0.3	Aug 5, 2012	Final remarks		A. Moldavanov

Table of Contents

ACRONYMS AND ABBREVIATIONS

ACLR	Adjacent Channel Leakage Ratio
ACPR	Adjacent Channel Power Ratio
BTS	Base Transceiver Station
CDMA	Code Division Multiple Access
CW	Continuous Wave
dB	deciBel (logarithmic ratio)
dBc	deciBels related to the RF carrier amplitude
dBm	deciBels related to 1 Mw
DL	Downlink
EDGE	Enhanced Data rates for Global (GSM) Evolution
EIRP	Effective Isotropic Radiated Power
E-UTRA	Enhanced UMTS Terrestrial Radio Access
FH	Frequency High (Top edge of band)
FL	Frequency Low (Bottom edge of band)
FM	Frequency Mid (Center of band)
GSM	Groupe Spéciale Mobile, Global System for Mobile communications
IF	Intermediate Frequency
IMD	Inter-Modulation Distortion
kHz	kilo Hertz
LTE	Long Term Evolution
MHz	Mega Hertz
NF	Noise Figure
PCS	Personal Communications Service
RF	Radio Frequency
RX	Receiver
TX	Transmit
UL	Uplink
UMTS	Universal Mobile Telecommunications System
WCDMA	Wideband Code Division Multiple Access
1xEVDO	CDMA Evolution Data Optimized

1.0 Overview

1.1 Scope

The purpose of this document is to present test results in the context of a full qualification test report for FCC Part 2, 22, 24, 27 as applicable to the equipment under test. The scope of this document is limited to the tests listed below in the downlink mode.

1.2 Attestation Statement

The device under test does fulfill the general approval requirements as identified in this test report.

This equipment has been tested in accordance with the standards identified in this test report. To the best of my knowledge and belief, these tests were performed using the measurement procedures described in this report. All instrumentation and accessories used to test products for compliance to the indicated standards are calibrated regularly in accordance with ISO 17025:2005 requirements.

I attest that the necessary measurements were made, under my supervision, at DALI WIRELESS, INC. located at 8618 Commerce Court, Burnaby, British Columbia, V5A 4N6, Canada.

Authorized Signatory:

Signature:
Bruce Balston
Function: Test Engineer
Date: August 1, 2012

1.3 Report Summary

Disclaimer	The test results relate only to the items tested.
Report Purpose	To demonstrate the DUT compliance with FCC Parts 2, 22, 24, 27 and Industry Canada RS-131 requirements for a quad band digital repeater.

Applicable Rule Parts	FCC CFR 47 Parts 2, 22, 24, 27; RSS-131
Test Procedures	ANSI/TIA-603-C: 2004

1.4 Test Environment

Test Facilities	Tests were performed by Dali Wireless Inc. located at 8618 Commerce Court, Burnaby, BC, V5A 4N6, Canada. Radiated spurious emission test was performed by QAI located at #16 - 211 Schoolhouse Street, Coquitlam, BC, V3K 4X9, Canada.
Test Conditions	Temperature: 25° C Relative Humidity: 60% Atmospheric Pressure: 98.1 kPa

1.5 Test Setup

Deviation to the rules	There was no deviation from the test standards.
Modification to the DUT	No modification was made to the DUT.
Test Exercise	The DUT was placed in continuous transmit mode of operation.

1.6 Device Under Test Information

Manufactured by	Dali Wireless Inc.
DUT Description	700, 850, 1900, AWS Indoor Remote Unit, Quad-Band Bi-directional Distributed Antenna System/Repeater.

FCC ID	HCOT30QSCPAN1B
IC Label	10323A-T30QSCPAN1B
Model Name	t30-QSCPA-N1N
Operating Frequency	Downlink 728 – 757 MHz, Downlink 869 – 894 MHz, Downlink 1930 – 1995 MHz, Downlink 2110 – 2155 MHz.
Emission Designators	F9W, F9X, DXW, D7W, GXW, G7W
Modulations	WCDMA, CDMA2000, LTE5M
User Power Range and Control	There are NO user power controls
Test Item	Production
DC Voltage and Current into final amplifier	Powered 115 or 230 VAC
Type of Equipment	Fixed

1.7 Measurement Uncertainty

Radio Frequency	±1 ppm
Total RF Power: Conducted	±1 dB
RF Power Density: Conducted	±2.75 dB
Spurious Emissions: Conducted	±3 dB

All Emissions: Radiated	±3.5 dB
Temperature	±1ºC
Humidity	±5 %
DC and Low Frequency Voltages	±3 %

1.8 Equipment List

Description	Manufacturer	Model	Serial Number	Cal Due Date
3 meter Semi-Anechoic Chamber	ETS Lindgren	S201	1030	N/R
Turntable	ETS Lindgren	2165	00043677	N/R
Mast	ETS Lindgren	2165	00077487	N/R
Antenna	Sunol Sciences	JB3	A120106	06-Jul-2013
EMI Receiver	Rohde & Schwarz	ESU40	100011	29-Mar-2013
Spectrum Analyzer	Agilent	MXA-N9020A	ATO 71849 MY50140401	CAL 10-26-2013
Power Meter	Agilent	U2000A	MY50000490	CAL 6-18-2013
Signal Generator	Agilent	MXG-N5182A	MY50142520	CAL 10-12-2013

1.9 Test Procedure

General

The *t*30 remote, is connected to the *t*Host in a manner consistent with a typical installation. A digital modulation signal generator is connected to the TX_IN port of the appropriate band of the *t*Host and spectrum analyzer is connected to the appropriate downlink antenna output through an attenuator, nominally 30 dB for the band under consideration.

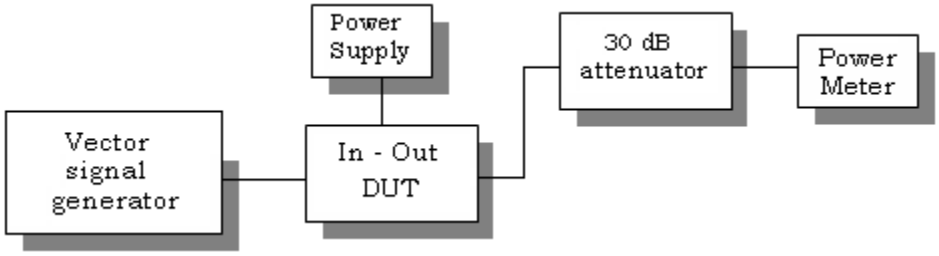
The 700 MHz (728 – 757 MHz), 800 MHz (869 – 894 MHz), PCS (1930-1995 MHz) and AWS (2110-2155 MHz) band was investigated. Measurements were performed at three

modulation types (WCDMA, CDMA2000, LTE5M) for the mid, lowest and highest frequency for declared bandwidths. The modulation types are described in detail in Table 1-4.

RF Power Output

RF power is measured by connecting a 50-ohm, resistive wattmeter to the RF output connector. With a nominal voltage and the amplifier properly adjusted the RF output is measured**.**

RF Output Power Test Setup Diagram

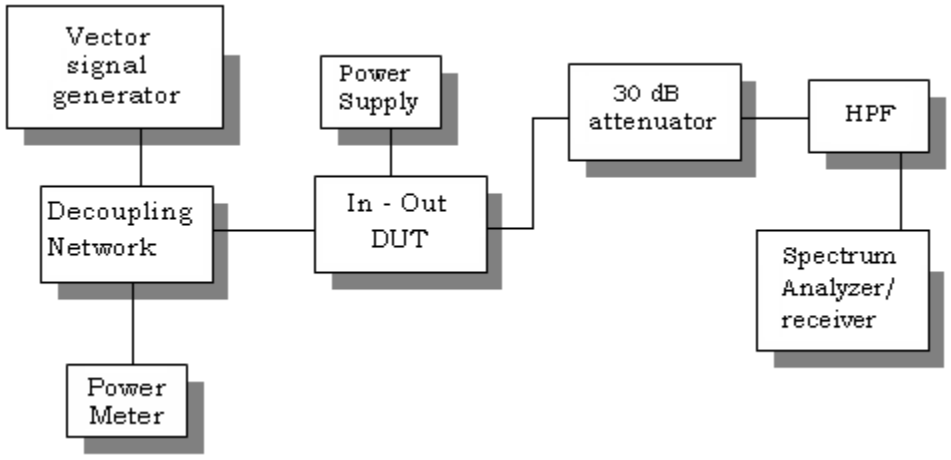


Band Edges Compliance

RF power is measured by connecting a 50-ohm, resistive wattmeter to the RF output.
The required measurement resolution bandwidth (RBW) is 1% of the emission bandwidth. Measurements were made at an RBW sufficient to show detail at edge of band. Therefore data presented must be corrected to the measurement bandwidth using the formula below. The data calculated according to the formula below should be added to the reading in the graph for the modulation under consideration.

$$Corr(dB) = 20*\log (measRBW / actualRBW) \quad (1.9.1)$$

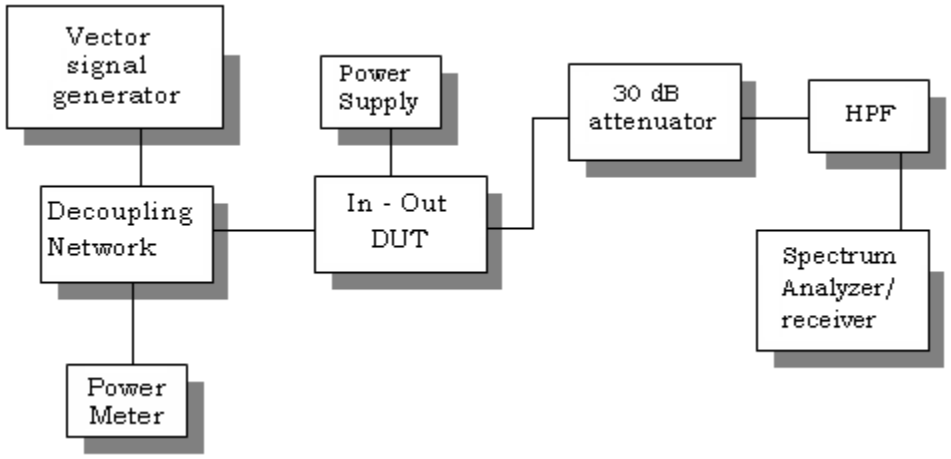
Band-Edges Test Setup Diagram



Spurious Emissions at Antenna Terminals

The procedure used was ANSI/TIA-603-C: 2004. The spectrum was scanned from 9 kHz to at least the tenth harmonic of the fundamental using a spectrum analyzer. Data on the following page shows the level of conducted spurious responses. For digital modulation, the carrier is modulated to its maximum extent. The measurements were made in accordance with standard ANSI/TIA-603-C: 2004. The maximum output power was set for each test.

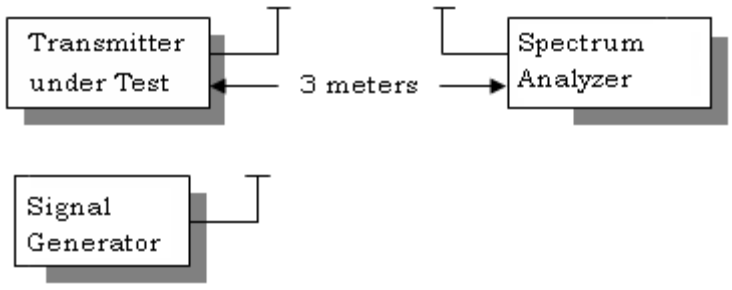
Conducted Spurious Test Setup Diagram



Radiated Spurious Emissions

The spectrum was scanned from 30 MHz to at least the tenth harmonic of the fundamental. All digital modulation signals were used to perform this test. This test was conducted per ANSI/TIA-603-C: 2004 using the substitution method.

Radiated Spurious Test Setup Diagram



Equipment placed 80 cm above ground on a rotating table platform.

Frequency Stability

All test conditions and measurement procedures were performed in accordance with FCC CFR47 part 2 subpart J Clause 2.1055.

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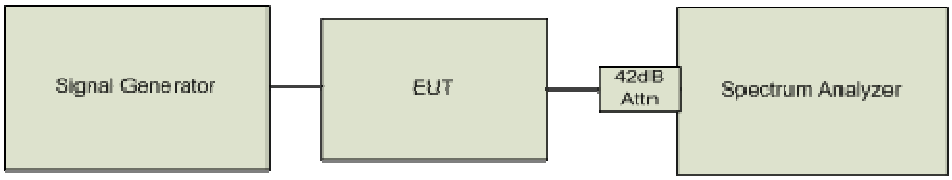
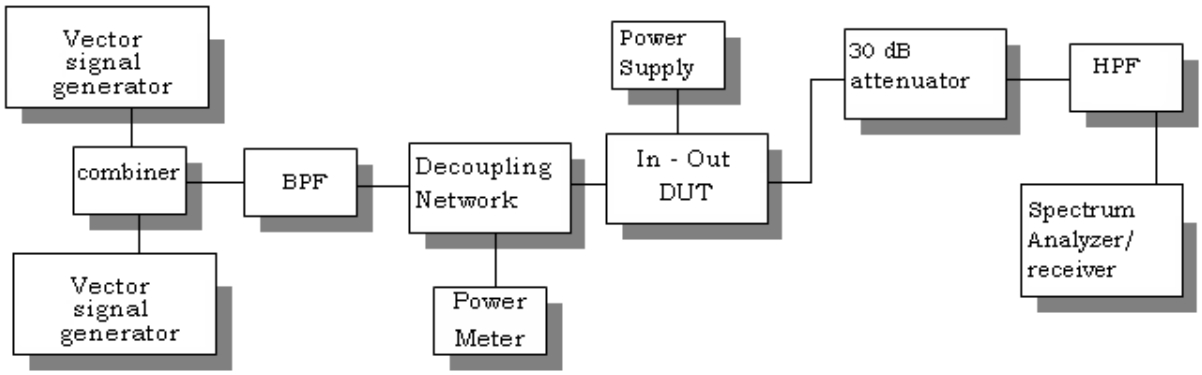
Frequency Stability Test Setup Diagram



Intermodulation Product Spurious Emissions

The procedure used was ANSI/TIA-603-C: 2004. The spectrum was scanned from 9 kHz to at least the tenth harmonic of the fundamental using a spectrum analyzer. The modulation type was tested using the two-tone / three tone test method. The input power to the amplifier was set at maximum drive level by combining the two tones. The two tones were chosen in such a way (1) the third order intermodulation product frequencies are located within the pass band of the DUT and (2) they produce the worst-case emissions out of band.

Intermodulation Test Setup Diagram



1.10 Operational Description

The Dali Wireless Transcend t30™ quad-band indoor Distributed Antenna System (iDAS) provides effortless mobile coverage extension and capacity enhancement of GSM, CDMA, WCDMA, LTE, TD-SCDMA, and WiMAX wireless networks operating inside enclosed environments. Based on Dali's software configurable radio (SCR) systems for broadband applications with a comprehensive suite of proprietary digital signal processing (DSP) and radio frequency (RF) technologies, Dali iDAS brings leading edge flexibility, efficiency, control, linearity and instantaneous bandwidth to all mobile networks. The optical connection

is entirely digital ensuring that retransmitted signals are not degraded in any Way. The system is software configurable offering seamless upgrades to the system. Dali's Transcend t30™ DAS model # DW-010-3274-04 is a quad band, 700-850-1900MHz-AWS unit with 1W average output power per band. This model number comprises a single tHost™ and a single t30™ remote as representative of the entire DAS system. The indoor DAS is comprised of a *tHost* that is connected to the RF output of the base station(s), and multiple *t30*™ remote units located in areas that the base station signal cannot reach to provide optimum coverage and capacity in wireless networks. A Single optical fiber interface, based on the CPRI standard, is used to connect the *tHost*™ with a number of *t30*™ units, in a star, daisy-chain, or hybrid star/daisy-chain configuration. The *t30*™ remote units can be installed 15km to 40km away from the *tHost*™ *unit*. Both, *tHost*™ *unit* and *t30*™ unit contain a digital processing section and an RF processing section.

1.11 Measurement Configuration

Table 1. 700 MHz DL Measurement Matrix

Modulation	**# Carriers**	**Notation**	**Frequency (MHz)**
WCDMA	1	DL1C-WCDMA	730.5, 742.5, 754.5
CDMA2000	1	F1C-C2K	730.5, 742.5, 754.5
LTE5M	1	LTE5M	730.5, 742.5, 754.5

Table 2. 800 MHz DL Measurement Matrix

Modulation	# Carriers	Carrier	Frequency (MHz)
WCDMA	1	DL1C-WCDMA	871.5, 881.5, 891.5
CDMA2000	1	F1C-C2K	871.5, 881.5, 891.5
LTE5M	1	LTE5M	871.5, 881.5, 891.5

Table 3. PCS DL Measurement Matrix

Modulation	**# Carriers**	**Carrier**	**Frequency (MHz)**
WCDMA	1	DL1C-WCDMA	1932.5 1962.5 1992.5
CDMA2000	1	F1C-C2K	1932.5 1962.5 1992.5
LTE5M	1	LTE5M	1932.5 1962.5 1992.5

Table 4. AWS DL Measurement Matrix

Modulation	# Carriers	Carrier	Frequency (MHz)
WCDMA	1	DL1C-WCDMA	2112.4, 2132.5, 2152.6
CDMA2000	1	F1C-C2K	2111.25 2132.5, 2153.75
LTE5M	1	LTE5M	2112.6 2132.5, 2152.5

Table 5. DL Modulation Waveforms

Notation	Waveform	Bandwidth (MHz)
DL1C-WCDMA	3GPP TS25	5
F1C-C2K	3GPP2	1.25
LTE5M	3GPP TS36	5

2.0 Output Power

2.1 Methodology

Measurements were performed at three modulations (F1C-C2K, DL1C-WCDMA, LTE5M) for the mid, lowest and highest frequency within the 700 MHz (730 – 755 MHz), 800 MHz (871 – 892 MHz), PCS (1930-1995 MHz) and AWS (2100-2155 MHz) band.

Worst-case data is shown in section 2.3 for the all bands.

A brief summary of applicable FCC specifications is listed in the table below.

2.1046 Measurements required: RF power output.
(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in § 2.1033(c)(8). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

2.2 Interpretation

Full results for output power measurements are shown in the table below:

2.3 Results

700 MHz band

F1C-C2K modulation			
Frequency, MHz	**Output power, dBm**	**Bandwidth, MHz**	**Limit, dBm**
730.5	30.448	1.25	31.5
742.5	31.222		
754.5	31.085		
DL1C-WCDMA modulation			
730.5	29.997	5	31.5
742.5	31.340		
754.5	30.828		
LTE5M modulation			
730.5	29.967	5	31.5
742.5	31.261		
754.5	30.824		

800 MHz band

F1C-C2K modulation			
Frequency, MHz	**Output power, dBm**	**Bandwidth, MHz**	**Limit, dBm**
871.5	31.110	1.25	31.5
881.5	31.247		
891.5	31.021		
DL1C-WCDMA modulation			
871.5	30.330	5	31.5
881.5	30.277		
891.5	30.135		
LTE5M modulation			
871.5	30.214	5	31.5
881.5	30.270		
891.5	30.133		

PCS band

F1C-C2K modulation			
Frequency, MHz	**Output power, dBm**	**Bandwidth, MHz**	**Limit, dBm**
1932.5	29.145	1.25	31.5
1962.5	29.597		
1992.5	31.203		
DL1C-WCDMA modulation			
1932.5	29.489	5	31.5
1962.5	30.269		
1992.5	30.755		
LTE5M modulation			
1932.5	29.373	5	31.5
1962.5	28.984		
1992.5	30.684		

AWS band

F1C-C2K modulation			
Frequency, MHz	**Output power, dBm**	**Bandwidth, MHz**	**Limit, dBm**
2112.5	30.356	1.25	31.5
2132.5	31.417		
2152.5	29.935		
DL1C-WCDMA modulation			
2112.5	29.743	5	31.5
2132.5	30.616		
2152.5	29.788		
LTE5M modulation			
2112.5	30.733	5	31.5
2132.5	30.872		
2152.5	30.359		

Table 6. Output power measurements.

Conclusion: As the table 6 indicates, the maximum power output value of 31.4 dBm was obtained with F1C-C2K modulation at 2132.5 MHz bandwidth of 1.25 MHz (AWS band).

3.0 Occupied Bandwidth

3.1 Methodology

Measurements were performed at three modulations (F1C-C2K, DL1C-WCDMA, LTE5M) for the mid, lowest and highest frequency within the 700 MHz (730 – 755 MHz), 800 MHz (871 – 892 MHz), PCS (1930-1995 MHz) and AWS (2100-2155 MHz) band.

Worst-case data is shown in the figures in sections 3.2 in Figures A1-3 (700 MHz band), A4-6 (800 MHz band), A7-9 (PCS band), A10-12 (AWS band)

A brief summary of applicable FCC specifications is listed in the table below.

2.1049 Measurements required: Occupied bandwidth.
The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured

The plots below are for reference purposes only. Full results for occupied bandwidth measurements are shown in Table **7**.

3.2 Results - Figures A1 - A12

700 MHz band

Fig. A1. F1C-C2K

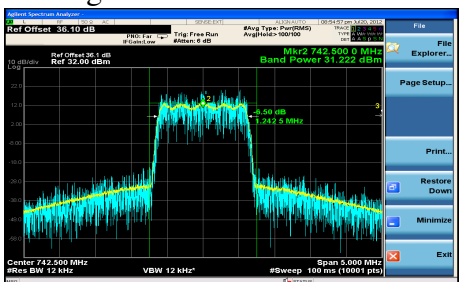


Fig. A2. LTE5M

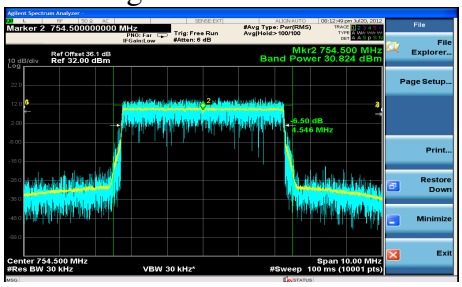
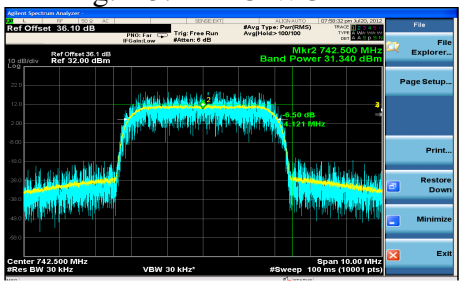


Fig. A3. DL1C-WCDMA



800 MHz band

Fig. A4. F1C-C2K

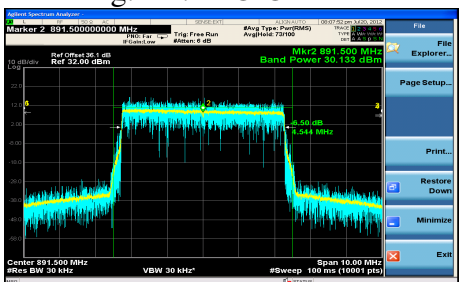


Fig. A5. LTE5M

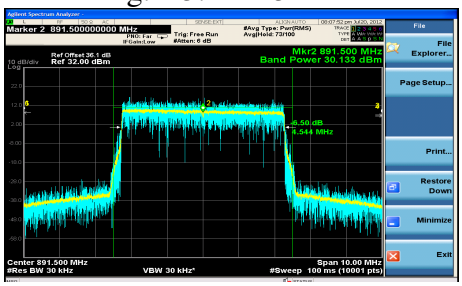
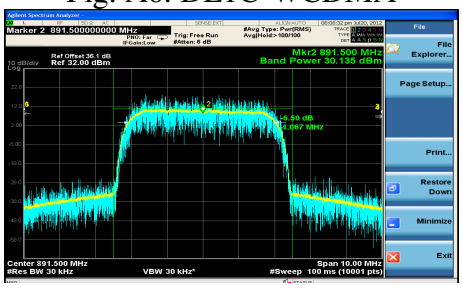


Fig. A6. DL1C-WCDMA



PCS band

Fig. A7. F1C-C2K

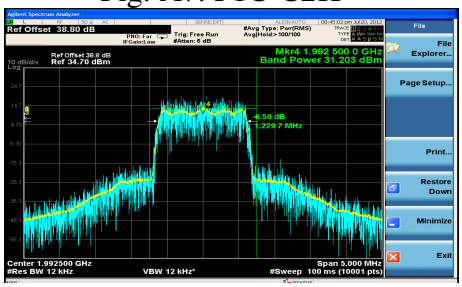


Fig. A8. LTE5M

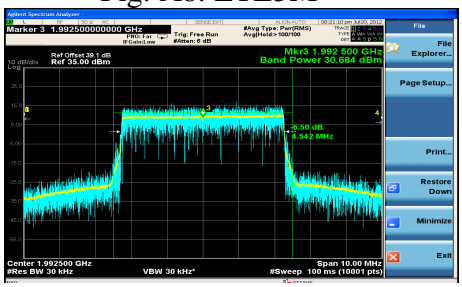
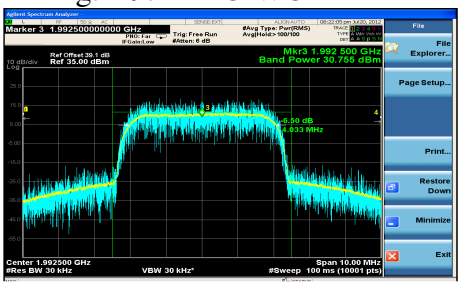


Fig. A9. DL1C-WCDMA



AWS band

Fig. A10. F1C-C2K

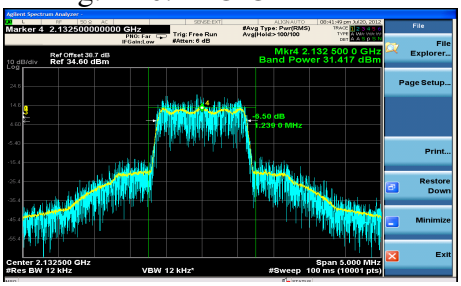


Fig. A11. LTE5M

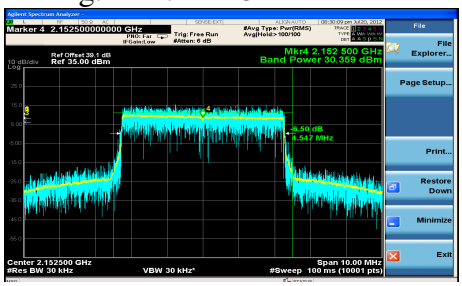


Fig. A12. DL1C-WCDMA

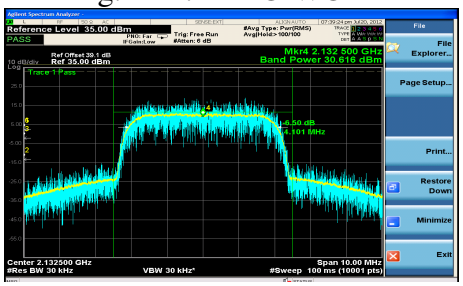


Figure A1, A4, A7, A10 – occupied bandwidth for CDMA2000 modulation at 1.25MHz bandwidth for 700 MHz, 800 MHz, PCS, and AWS band, appropriately. A2, A5, A8, A11 - LTE5M modulation at 5MHz bandwidth for 700 MHz, 800 MHz, PCS, and AWS band, , appropriately. A3, A6, A9, A12 - WCDMA modulation at 5MHz bandwidth for 700 MHz, 800 MHz, PCS, and AWS band, appropriately.

Conclusion: As the table below indicates, the minimum occupied bandwidth value of 1.2351 MHz (AWS band) was obtained with F1C-C2K modulation (bandwidth of 1.25 MHz).

700 MHz band

Modulation	Occupied Bandwidth, MHz
DL1C-WCDMA	4.1721
F1C-C2K	1.2352
LTE5M	4.4735

800 MHz band

Modulation	Occupied Bandwidth, MHz
DL1C-WCDMA	4.0791
F1C-C2K	1.2376
LTE5M	4.5462

PCS band

Modulation	Occupied Bandwidth, MHz
DL1C-WCDMA	4.0334
F1C-C2K	1.2406
LTE5M	4.544

AWS band

Modulation	Occupied Bandwidth, MHz
DL1C-WCDMA	4.1715
F1C-C2K	1.2351
LTE5M	4.4733

Table 7. Occupied bandwidth measurements.

4.0 Conducted Spurious Emissions

4.1 Methodology

All test conditions and measurement procedures were performed in accordance with FCC CFR47 part 2 subpart J Clause 2.1051.

The data is shown in the figures C1 – C8 for 700 MHz, 800 MHz, PCS, and AWS band, appropriately, in section 4.3.

For each plot lowest, mid, and highest frequency were used and data accumulated for each plot in a max hold/pause sequence. Data was collected for all eight modulations, worst-case is shown.

In the figures provided, both the peak detector (yellow trace) and average detector (blue trace) have been used. The ”43+10*log P” limit (see below in green) is of -13dBm/1MHz and is shown in the figures.

A brief summary of the applicable FCC specifications are listed in the table below.

2.1051 Measurements required: Spurious emissions at antenna terminals.
The radio frequency voltage or powers generated within the equipment and appearing on a spurious frequency shall be checked at the equipment output terminals when properly loaded with a suitable artificial antenna. Curves or equivalent data shall show the magnitude of each harmonic and other spurious emission that can be detected when the equipment is operated under the conditions specified in§ 2.1049 as appropriate. The magnitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be specified.

2.1057 Frequency spectrum to be investigated.
(a) In all of the measurements set forth in §§ 2.1051 and 2.1053, the spectrum shall be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the frequency shown below:
(1) If the equipment operates below 10 GHz: to the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower.

27.53 Emission limits.
(d) (3) *Out-of-band emission limit.* On any frequency outside of the frequency ranges covered by the ACP tables in this section, the power of any emission must be reduced below the unmodulated carrier power (P) by at least 43 + 10 log (P) dB..
(f) For operations in the 698–746 MHz band, the power of any emission outside a licensee’s frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least $43 + 10 \log_{10}(P)$ dB.
(g) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee’s frequency block shall be attenuated below the transmitter power (P) by at least $43 + 10 \log_{10}(P)$ dB.
(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee’s frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

22.917 Emission limits.
(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

24.238 Emission limitations for Broadband PCS equipment.
(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

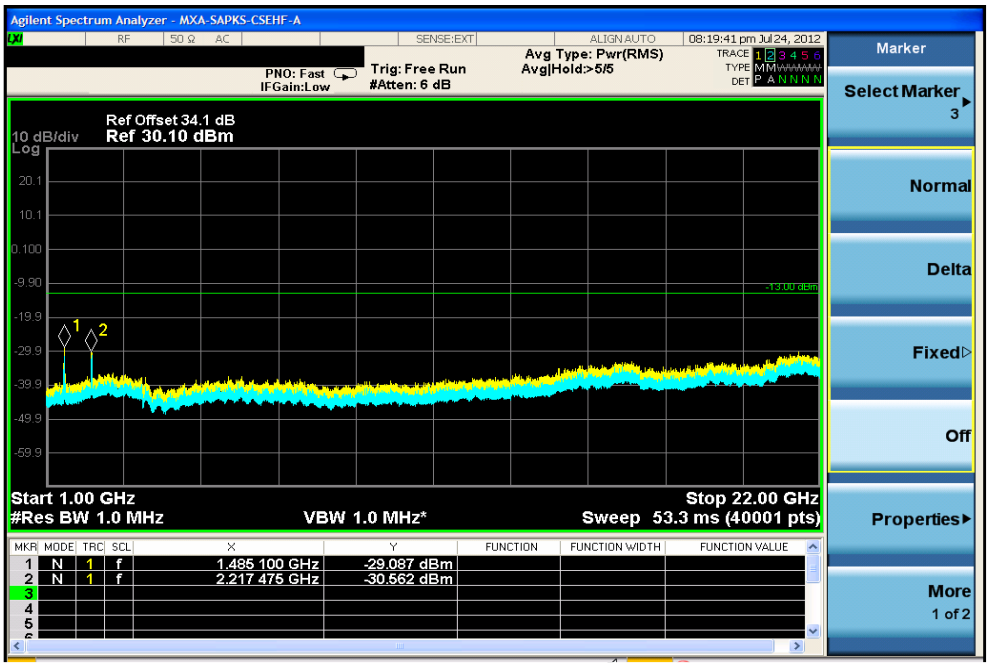
The limit is = -13 dBm.

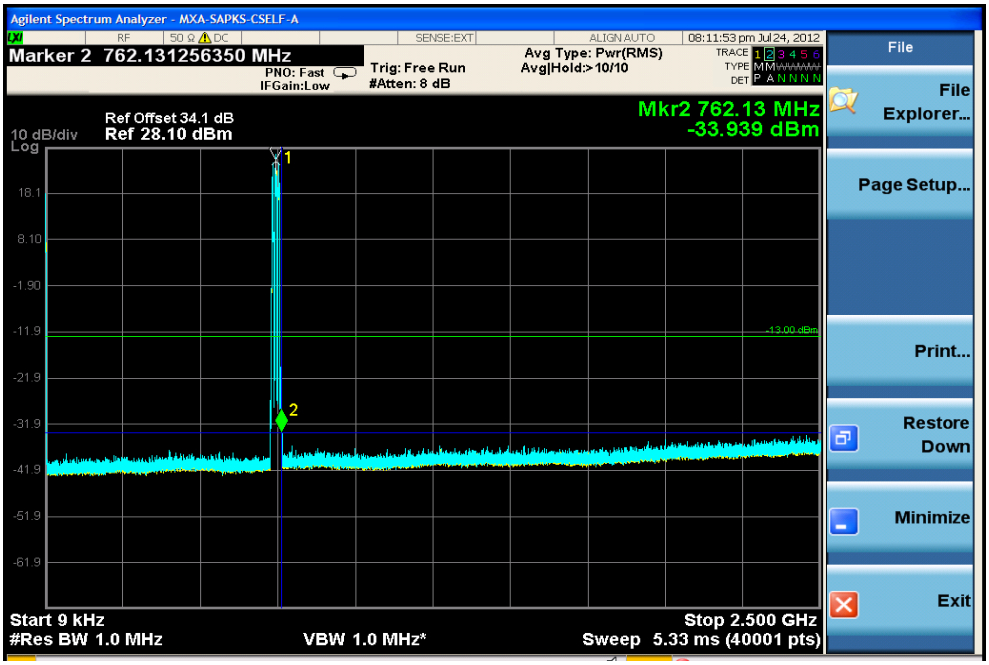
4.2 Interpretation

Peak trace is shown in yellow, average trace in blue. Green line is a limit of -13dBm, applies to the AVG trace.

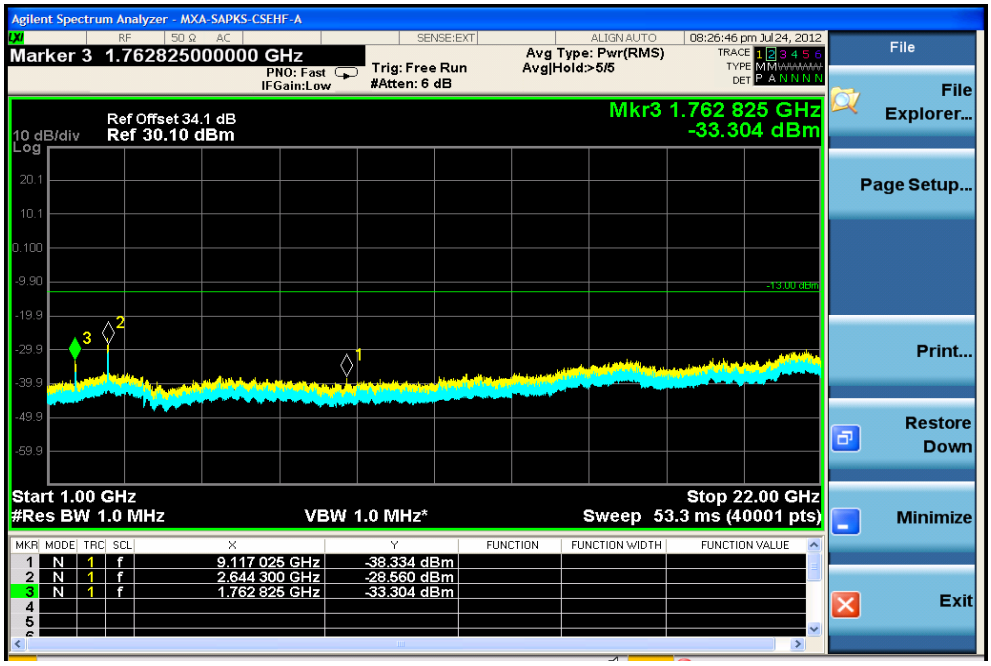
4.3 Results – Figures B1 – B8

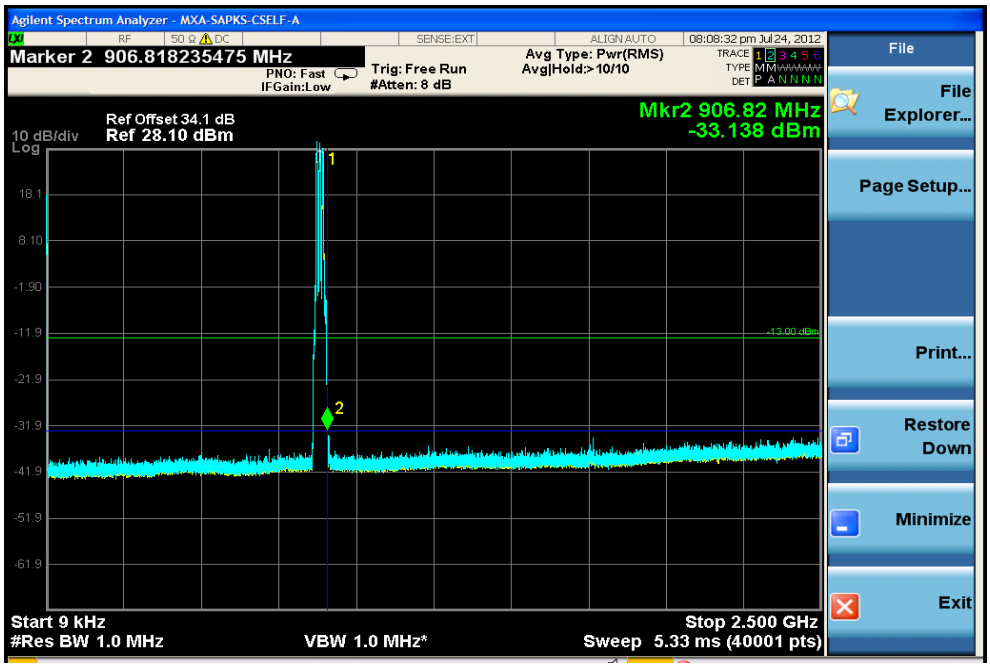
700 MHz band



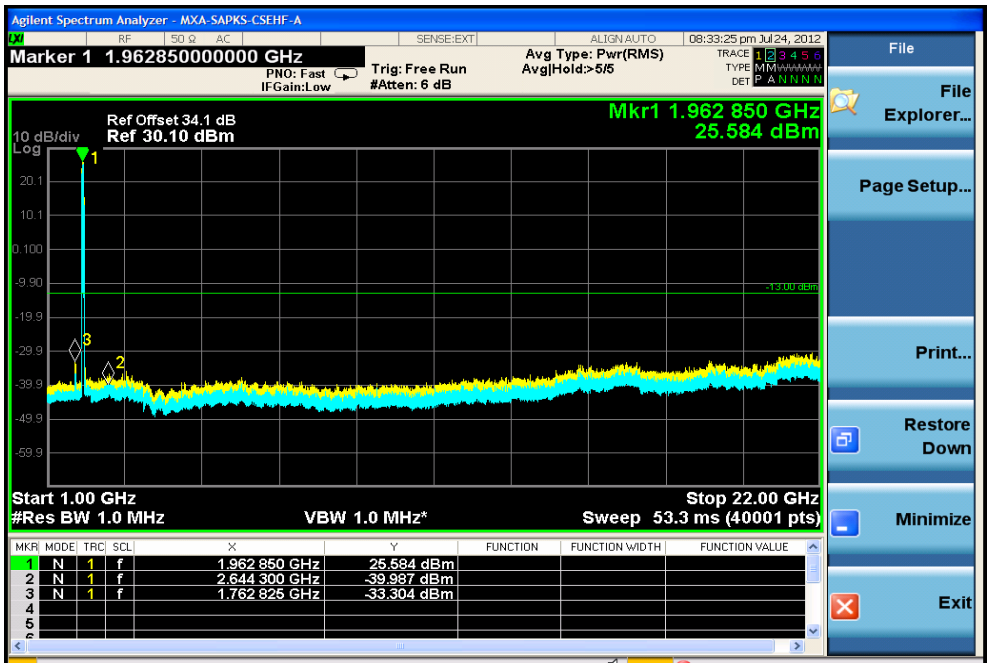


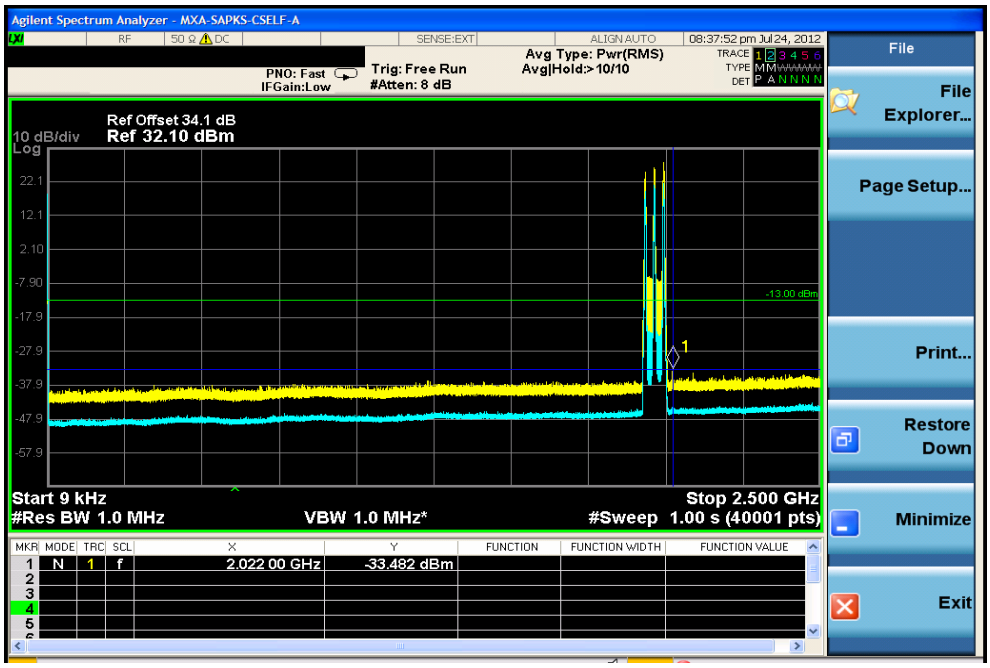
800 MHz


Agilent Spectrum Analyzer - MXA-SAPKS-CSEHF-A
RF 50 Ω AC
SENSE:EXT
ALIGN AUTO
08:26:46 pm Jul 24, 2012
Marker 3 1.762825000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 6 dB
Avg Type: Pwr(RMS)
Avg|Hold:>5/5
TRACE 1 2 3 4 5 6
TYPE M M W W W W
DET P A N N N N
Ref Offset 34.1 dB
10 dB/div
Log
Ref 30.10 dBm
Mkr3 1.762 825 GHz
-33.304 dBm
20.1
10.1
0.100
-9.90
-19.9
-29.9
-39.9
-49.9
-59.9
-13.00 dBm
Start 1.00 GHz
#Res BW 1.0 MHz
VBW 1.0 MHz*
Stop 22.00 GHz
Sweep 53.3 ms (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 9.117 025 GHz -38.334 dBm
2 N 1 f 2.644 300 GHz -28.660 dBm
3 N 1 f 1.762 825 GHz -33.304 dBm
4
5
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit

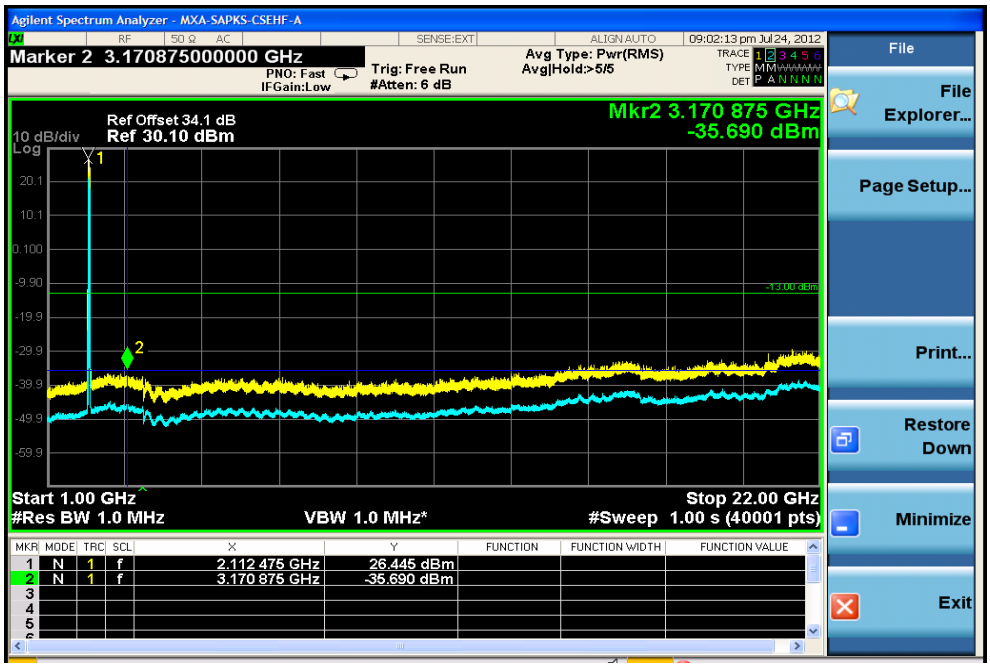

Agilent Spectrum Analyzer - MXA-SAPKS-CSELF-A
RF 50 Ω DC
SENSE:EXT
ALIGN AUTO
08:08:32 pm Jul 24, 2012
Marker 2 906.818235475 MHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 8 dB
Avg Type: Pwr(RMS)
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M M W W W W
DET P A N N N N
Ref Offset 34.1 dB
10 dB/div
Log
Ref 28.10 dBm
Mkr2 906.82 MHz
-33.138 dBm
18.1
8.10
-1.90
-11.9
-21.9
-31.9
-41.9
-51.9
-61.9
-13.00 dBm
Start 9 kHz
#Res BW 1.0 MHz
VBW 1.0 MHz*
Stop 2.500 GHz
Sweep 5.33 ms (40001 pts)
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit

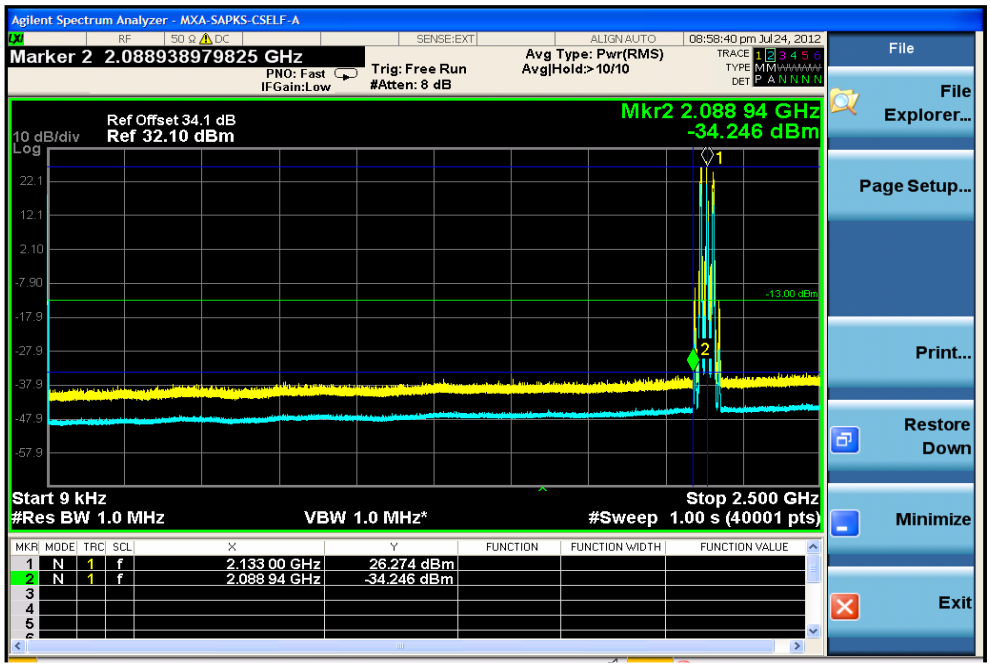
PCS band


Agilent Spectrum Analyzer - MXA-SAPKS-CSEHF-A
RF 50 Ω AC
SENSE:EXT
ALIGN AUTO
08:33:25 pm Jul 24, 2012
Marker 1 1.962850000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 6 dB
Avg Type: Pwr(RMS)
Avg|Hold:>5/5
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P A N N N N
Ref Offset 34.1 dB
10 dB/div
Log
Ref 30.10 dBm
Mkr1 1.962 850 GHz
25.584 dBm
20.1
10.1
0.100
-9.90
-19.9
-29.9
-39.9
-49.9
-59.9
-13.00 dBm
Start 1.00 GHz
#Res BW 1.0 MHz
VBW 1.0 MHz*
Stop 22.00 GHz
Sweep 53.3 ms (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 1.962 850 GHz 25.584 dBm
2 N 1 f 2.644 300 GHz -39.987 dBm
3 N 1 f 1.762 825 GHz -33.304 dBm
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit


Agilent Spectrum Analyzer - MXA-SAPKS-CSELF-A
RF 50 Ω DC
SENSE:EXT
ALIGN AUTO
08:37:52 pm Jul 24, 2012
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 8 dB
Avg Type: Pwr(RMS)
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P A N N N N
Ref Offset 34.1 dB
10 dB/div
Log
Ref 32.10 dBm
22.1
12.1
2.10
-7.90
-17.9
-27.9
-37.9
-47.9
-57.9
-13.00 dBm
Start 9 kHz
#Res BW 1.0 MHz
VBW 1.0 MHz*
Stop 2.500 GHz
#Sweep 1.00 s (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.022 00 GHz -33.482 dBm
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit

AWS band


Agilent Spectrum Analyzer - MXA-SAPKS-CSEHF-A
RF 50 Ω AC
SENSE:EXT
ALIGN AUTO
09:02:13 pm Jul 24, 2012
Marker 2 3.170875000000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 6 dB
Avg Type: Pwr(RMS)
Avg|Hold:>5/5
TRACE 1 2 3 4 5 6
TYPE M M W W W W
DET P A N N N N
Ref Offset 34.1 dB
10 dB/div
Ref 30.10 dBm
Log
Mkr2 3.170 875 GHz
-35.690 dBm
20.1
10.1
0.100
-9.90
-19.9
-29.9
-39.9
-49.9
-59.9
-13.00 dBm
Start 1.00 GHz
#Res BW 1.0 MHz
VBW 1.0 MHz*
Stop 22.00 GHz
#Sweep 1.00 s (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.112 475 GHz 26.445 dBm
2 N 1 f 3.170 875 GHz -35.690 dBm
3
4
5
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit


Agilent Spectrum Analyzer - MXA-SAPKS-CSELF-A
RF 50 Ω DC
SENSE:EXT
ALIGN AUTO
08:58:40 pm Jul 24, 2012
Marker 2 2.088938979825 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 8 dB
Avg Type: Pwr(RMS)
Avg|Hold:>10/10
TRACE 1 2 3 4 5 6
TYPE M M W W W W
DET P A N N N N
Ref Offset 34.1 dB
10 dB/div
Ref 32.10 dBm
Log
Mkr2 2.088 94 GHz
-34.246 dBm
22.1
12.1
2.10
-7.90
-17.9
-27.9
-37.9
-47.9
-57.9
-13.00 dBm
Start 9 kHz
#Res BW 1.0 MHz
VBW 1.0 MHz*
Stop 2.500 GHz
#Sweep 1.00 s (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 2.133 00 GHz 26.274 dBm
2 N 1 f 2.088 94 GHz -34.246 dBm
3
4
5
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit

On the plots shown the low, middle and high channel are presented.

There were no emissions detected within 20 dB of limit.
The peak trace is also shown to illustrate the peak to average ratio of approximately 11 dB.

Data was collected for all signals (average measurement) within 20 dB of limit.
No signals were found within 20 dB of limit.

5.0 Band Edge

5.1 Methodology

Measurements were performed at three worst case modulations (WCDMA, CDMA2000, and LTE5M) for the lowest and highest frequency within the band.

Worst-case data is shown in the figures C1 – C6 (700 MHz band), C7 – C12 (800 band), C13-C18 (PCS band), and C14-C24 (AWS band) in section 5.2 and 5.3.

27.53 Emission limits.
(f) For operations in the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 $\log_{10}$ (P) dB.
(g) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 $\log_{10}$ (P) dB.
(g) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 $\log_{10}$ (P) dB.
(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

22.917 Emission limits.
(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

24.238 Emission limitations for Broadband PCS equipment.
(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

The required measurement resolution bandwidth (RBW) is 1% of the emission bandwidth. Measurements were made at the RBW sufficient to show detail at edge of band. Therefore data presented must be corrected to the measurement bandwidth using the formula (1.9.1). The data in the following tables must be added to the reading in the graph for the modulation under consideration.

High end

700 MHz band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	15	10	3.5
DL1C-WCDMA	30	45	-3.5
LTE5M	30	45	-3.5

800 MHz band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	30	13.5	6.94

DL1C-WCDMA	30	46	-3.7
LTE5M	30	48	-4.1

PCS band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	15	12	1.94
DL1C-WCDMA	30	50	-4.4
LTE5M	30	50	-4.4

AWS band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	15	12	1.94
DL1C-WCDMA	30	51	-4.6
LTE5M	30	51	-4.6

Low end

700 MHz band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	15	16	-0.56
DL1C-WCDMA	30	48	-4.1
LTE5M	30	40	-2.5

800 MHz band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	15	13.5	0.9
DL1C-WCDMA	30	51	-4.6
LTE5M	30	51	-4.6

PCS band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)

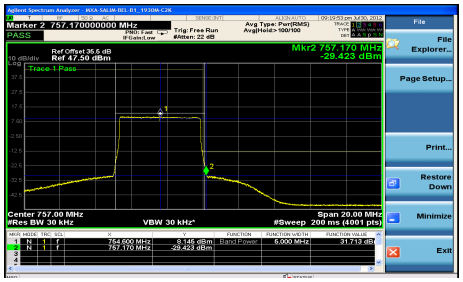
F1C-C2K	15	12	1.94
DL1C-WCDMA	30	51	-4.6
LTE5M	30	51	-4.6

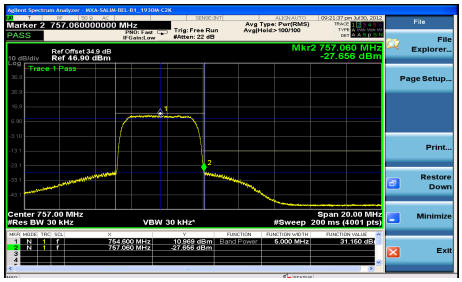
AWS band

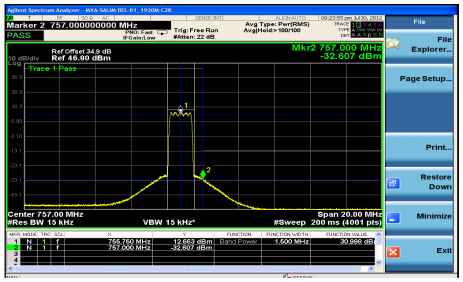
Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	15	15	0
DL1C-WCDMA	30	50	-4.4
LTE5M	30	50	-4.4

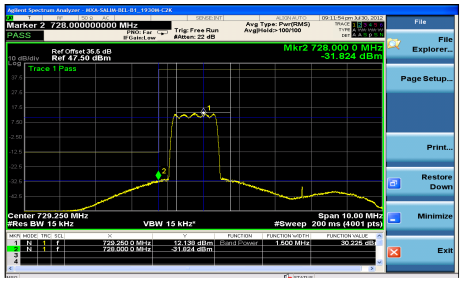
5.2 Results – Figures C1- C24 (Plots)

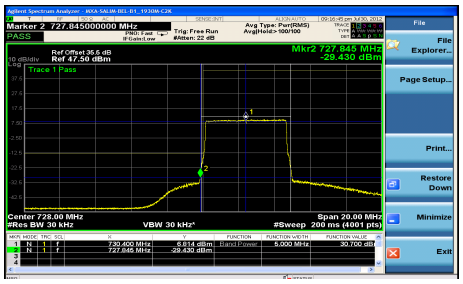
700 MHz band

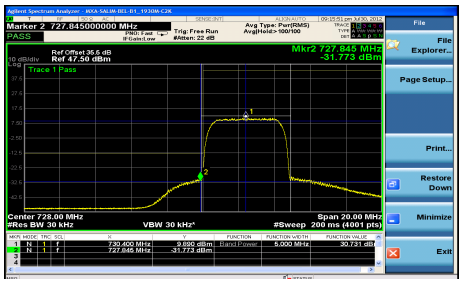




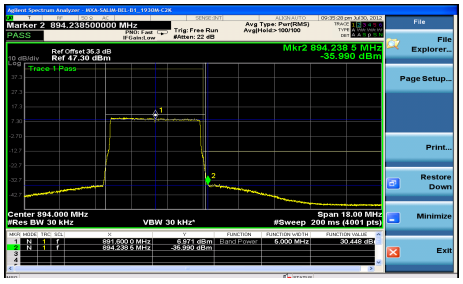


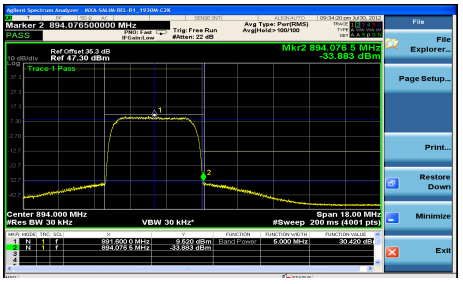


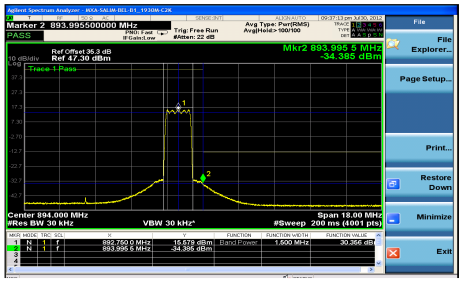


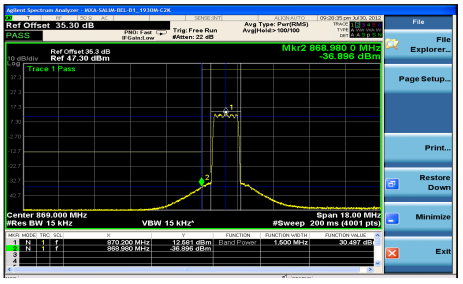


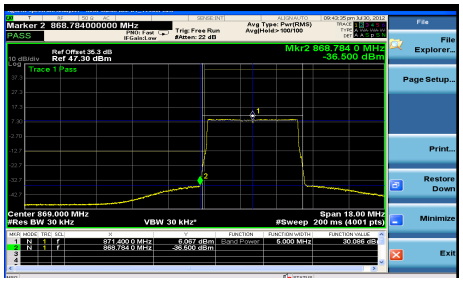
800 MHz band

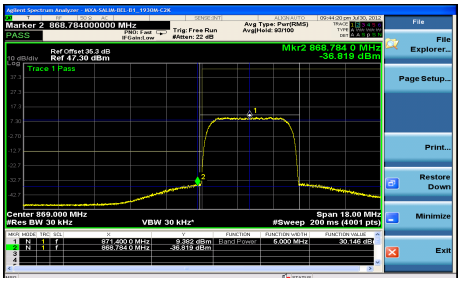




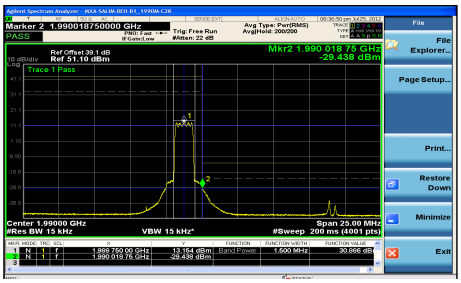


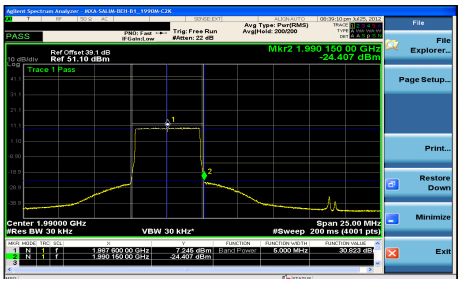


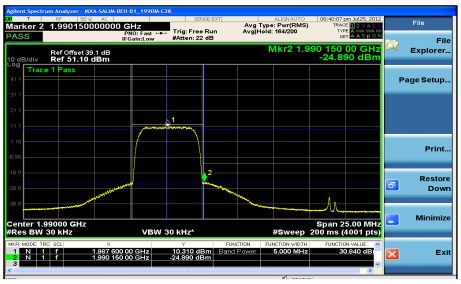


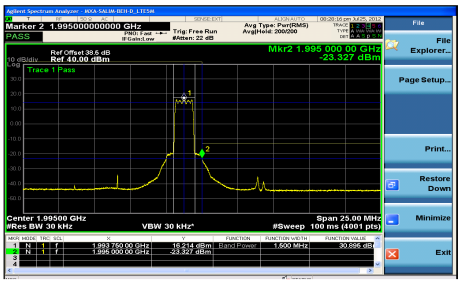


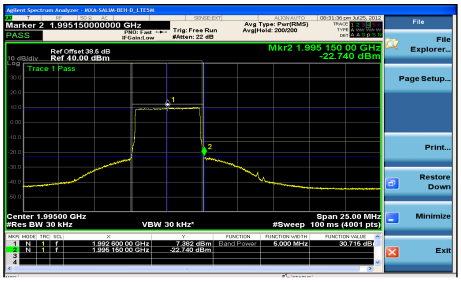
PCS band

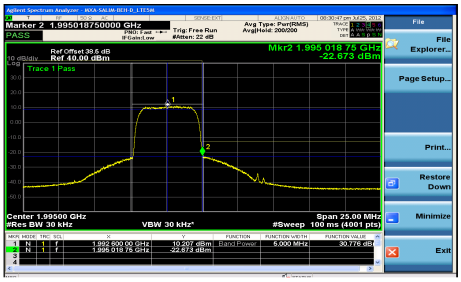

Marker 2 1.9900187500000 GHz
PASS
Ref Offset 39.1 dB
10 dB/div Ref 51.10 dBm
Mkr2 1.990 018 75 GHz
-29.438 dBm
Trace 1 Pass
Center 1.99000 GHz
#Res BW 15 kHz
VBW 15 kHz*
Span 25.00 MHz
#Sweep 200 ms (4001 pts)
1 N 1 f 1.988 760 00 GHz 13.164 dBm
2 N 1 f 1.990 018 75 GHz -29.438 dBm
Band Power 1.500 MHz 30.886 dB
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit


Marker 2 1.9900187500000 GHz
PASS
Ref Offset 39.1 dB
10 dB/div Ref 51.10 dBm
Mkr2 1.990 150 00 GHz
-24.407 dBm
Trace 1 Pass
Center 1.99000 GHz
#Res BW 30 kHz
VBW 30 kHz*
Span 25.00 MHz
#Sweep 200 ms (4001 pts)
1 N 1 f 1.987 600 00 GHz 7.246 dBm
2 N 1 f 1.990 150 00 GHz -24.407 dBm
Band Power 5.000 MHz 30.923 dB
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit

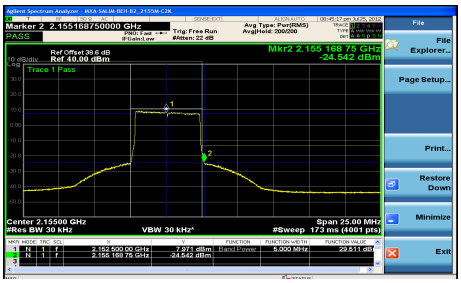

Marker 2 1.9901500000000 GHz
PASS
Ref Offset 39.1 dB
10 dB/div Ref 51.10 dBm
Mkr2 1.990 150 00 GHz
-24.890 dBm
Trace 1 Pass
Center 1.99000 GHz
#Res BW 30 kHz
VBW 30 kHz*
Span 25.00 MHz
#Sweep 200 ms (4001 pts)
1 N 1 f 1.987 600 00 GHz 10.310 dBm
2 N 1 f 1.990 150 00 GHz -24.890 dBm
Band Power 5.000 MHz 30.840 dB
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit

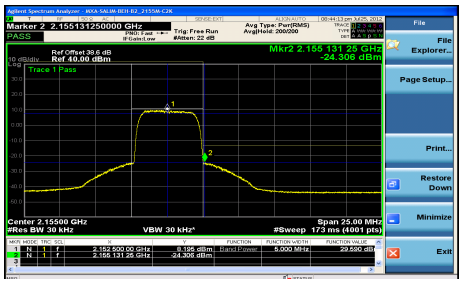

Marker 2 1.9950000000000 GHz
PASS
Ref Offset 38.6 dB
10 dB/div Ref 49.00 dBm
Mkr2 1.995 000 00 GHz
-23.327 dBm
Trace 1 Pass
Center 1.99500 GHz
#Res BW 30 kHz
VBW 30 kHz*
Span 25.00 MHz
#Sweep 100 ms (4001 pts)
1 N 1 f 1.993 760 00 GHz 16.214 dBm
2 N 1 f 1.996 000 00 GHz -23.327 dBm
Band Power 1.500 MHz 30.886 dB
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit

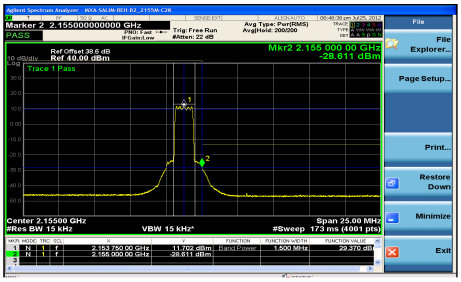

Marker 2 1.9951500000000 GHz
PASS
Ref Offset 38.6 dB
10 dB/div Ref 49.00 dBm
Mkr2 1.995 150 00 GHz
-22.740 dBm
Trace 1 Pass
Center 1.99500 GHz
#Res BW 30 kHz
VBW 30 kHz*
Span 25.00 MHz
#Sweep 100 ms (4001 pts)
1 N 1 f 1.992 930 00 GHz 7.992 dBm
2 N 1 f 1.996 150 00 GHz -22.740 dBm
Band Power 5.000 MHz 30.715 dB
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit

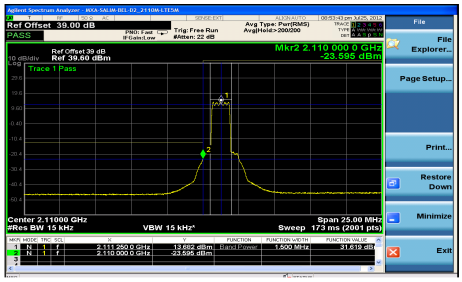

Marker 2 1.9950187500000 GHz
PASS
Ref Offset 38.6 dB
10 dB/div Ref 49.00 dBm
Mkr2 1.995 018 75 GHz
-22.673 dBm
Trace 1 Pass
Center 1.99500 GHz
#Res BW 30 kHz
VBW 30 kHz*
Span 25.00 MHz
#Sweep 100 ms (4001 pts)
1 N 1 f 1.992 930 00 GHz 10.207 dBm
2 N 1 f 1.996 018 75 GHz -22.673 dBm
Band Power 5.000 MHz 30.776 dB
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit

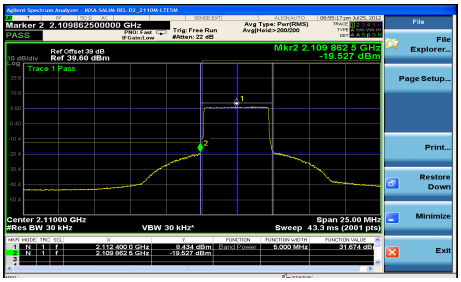
AWS band

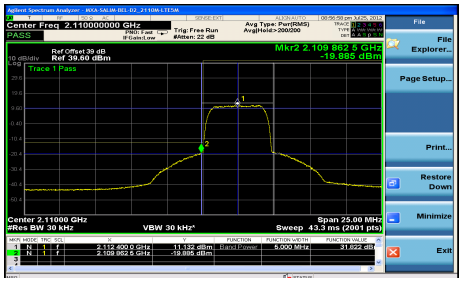












5.3 Results – Figures C1- C24 (Tables)

Low end

700 MHz band

Modulation	Freq (MHz)	Reading (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result

CDMA2000	729.3	-31.8	-0.56	-13	19.4	PASS
WCDMA	729	-31.7	-4.1	-13	22.8	PASS
LTE5M	729	-29.4	-2.5	-13	16.4	PASS

800 MHz band

Modulation	Freq (MHz)	Reading (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	871	-36.9	0.9	-13	23.0	PASS
WCDMA	871	-36.8	-4.6	-13	28.4	PASS
LTE5M	871	-36.5	-4.6	-13	28.1	PASS

PCS band

Modulation	Freq (MHz)	Reading (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	1931	-32.8	1.94	-13	17.9	PASS
WCDMA	1931	-30.1	-4.6	-13	21.7	PASS
LTE5M	1932	-27.0	-4.6	-13	18.6	PASS

AWS band

Modulation	Freq (MHz)	Reading (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	2111	-23.6	0	-13	10.6	PASS
WCDMA	2112	-19.9	-4.4	-13	11.3	PASS
LTE5M	2112	-19.5	-4.4	-13	10.9	PASS

High end

700 MHz band

Modulation	Freq (MHz)	Reading (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result

CDMA2000	754	-32.6	3.5	-13	16.1	PASS
WCDMA	754	-27.7	-3.5	-13	18.2	PASS
LTE5M	754	-29.4	-3.5	-13	19.9	PASS

800 MHz band

Modulation	Freq (MHz)	Reading (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	891	-34.4	6.94	-13	14.46	PASS
WCDMA	891	-33.9	-3.7	-13	24.6	PASS
LTE5M	891	-36.0	-4.1	-13	27.1	PASS

PCS band

Modulation	Freq (MHz)	Reading (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	1990	-23.3	1.94	-13	8.36	PASS
WCDMA	1990	-24.9	-4.4	-13	16.3	PASS
LTE5M	1990	-29.4	-4.4	-13	20.8	PASS

AWS band

Modulation	Freq (MHz)	Reading (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	2152	-28.6	1.94	-13	13.7	PASS
WCDMA	2152	-24.3	-4.6	-13	15.9	PASS
LTE5M	2153	-24.5	-4.6	-13	16.1	PASS

Table 8. Band edge measurements.

6.0 Field Strength of Spurious Radiation

6.1 Methodology

Measurements were performed at three modulations (F1C-C2K, DL1C-WCDMA, LTE5M) for the mid, lowest and highest frequency within the band.

Worst-case data is shown in the figures E1 – E2 in section 6.3.

A brief summary of the applicable FCC specifications are listed in the table below.

27.53 Emission limits.
(f) For operations in the 698–746 MHz band, the power of any emission outside a licensee's frequency band(s) of operation shall be attenuated below the transmitter power (P) within the licensed band(s) of operation, measured in watts, by at least 43 + 10 $\log_{10}$ (P) dB.
(g) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 $\log_{10}$ (P) dB.
(g) For operations in the 1710–1755 MHz and 2110–2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 $\log_{10}$ (P) dB.
(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater. However, in the 1 megahertz bands immediately outside and adjacent to the licensee's frequency block, a resolution bandwidth of at least one percent of the emission bandwidth of the fundamental emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

22.917 Emission limits.
(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

24.238 Emission limitations for Broadband PCS equipment.
(a) *Out of band emissions.* The power of any emission outside of the authorized operating frequency ranges must be attenuated below the transmitting power (P) by a factor of at least 43 + 10 log(P) dB.

Thus the required attenuation = 43+10*Log (P) dB and the limit = -13dBm (82.2 dBµV/m) ERP for average detector.

6.2 Interpretation

All test conditions and measurement procedures were performed in accordance with FCC CFR47 part 2 subpart J Clause 2.1053. Substitution method as prescribed under ANSI/TIA-603-C section 2.2.12 and 22.17 is not required for all signal margin exceeds 20 dB.

6.3 Results – Figure D1 - D2

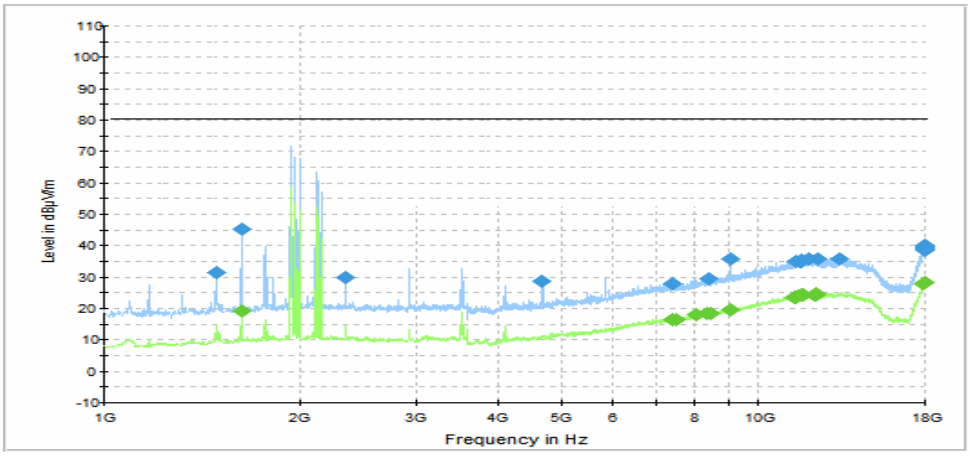


Figure D1. Data for radiated spurious emission 1 – 18 GHz is presented.

No signals were detected within 20dB of limit. Substitution method is required on all signals within 20dB of limit.

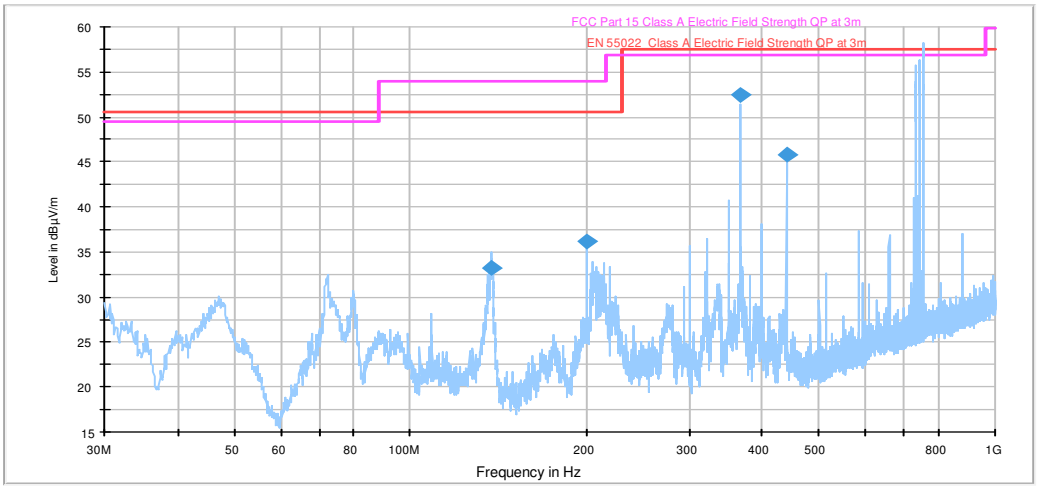


Figure D2. Data for radiated spurious emission 30MHz – 1GHz is presented.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Corr. (dB)	Margin (dB)	Limit (dBµV/m)
137.520680	33.2	1000.00	120.000	200.0	H	99.0	14.8	49.0	82.2
200.020680	36.2	1000.00	120.000	147.0	H	76.0	14.6	46.0	82.2
365.996360	52.4	1000.00	120.000	100.0	H	142.0	17.3	29.8	82.2
439.197880	45.8	1000.00	120.000	100.0	H	319.0	19.0	36.4	82.2

.

No other emissions were detected within 20dB of limit.

7.0 Frequency Stability

7.1 Methodology

Measurements were performed at CW.

Data plot is shown in the figure E1 – E4 in section 7.2.

A brief summary of the applicable FCC specifications are listed in the table below.

2.1055 Frequency stability.
(a) Unless noted elsewhere, transmitters used in the services governed by this part must have a minimum frequency stability as specified in the following. The frequency stability shall be measured with variation of ambient ambient temperature as follows from -30° to +50° centigrade for all equipment… Vary primary supply voltage from85 to 115 percent of the nominal value

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

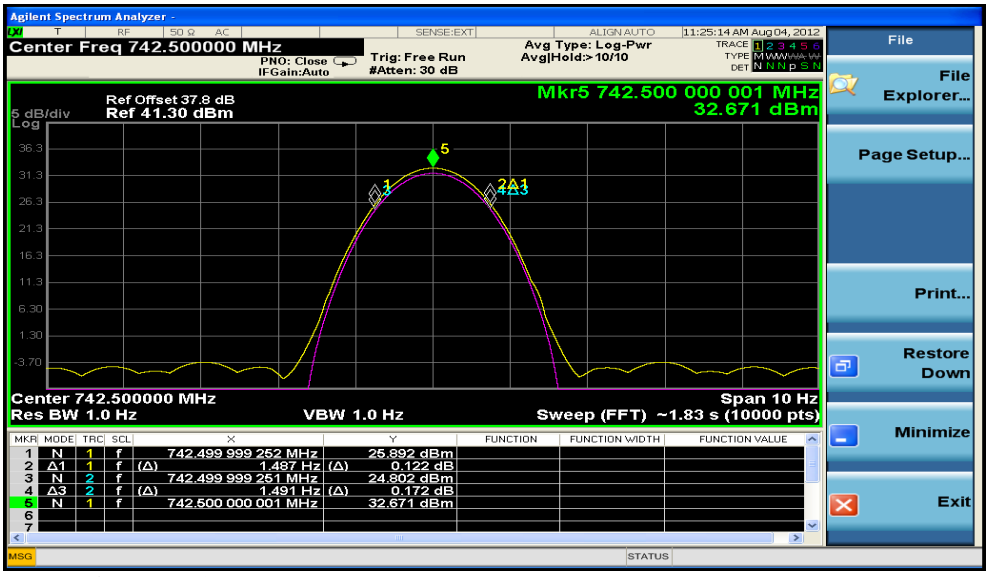
24.235 Frequency stability.
The frequency stability shall be sufficient to ensure that the fundamental emission stay within the authorized bands of operation.

22.355 Frequency tolerance.
Except as otherwise provided in this part, the carrier frequency of each transmitter in the Public Mobile Services must be maintained within tolerances given in Table C–1 of this section.
TABLE C–1—FREQUENCY TOLERANCE FOR TRANSMITTERS IN THE PUBLIC MOBILE SERVICES
Frequency range (MHz) 2110 to 2220 ..... 10.0 ppm

All test conditions and measurement procedures were performed in accordance with FCC CFR47 part 2 subpart J Clause 2.1055.

Data was collected continuously over temperature range of -40C to 55C using a max hold function. Worst-case data is shown on aggregate plot.

7.2 Results - Figures E1 – E4



. **Figure E1**. Data for frequency stability is presented for 700 MHz.

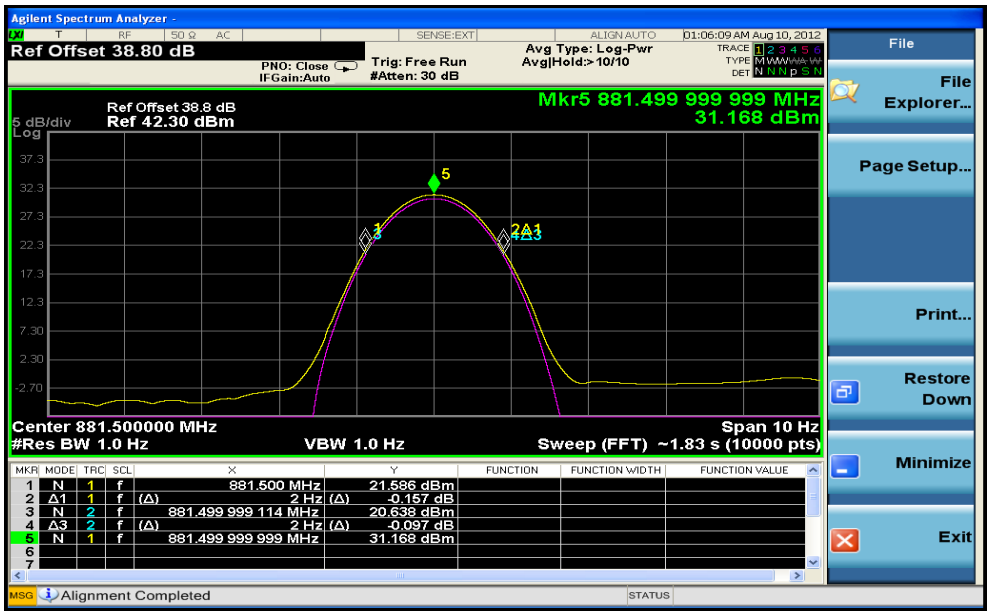


Figure E2. Data for frequency stability is presented for 800 MHz.

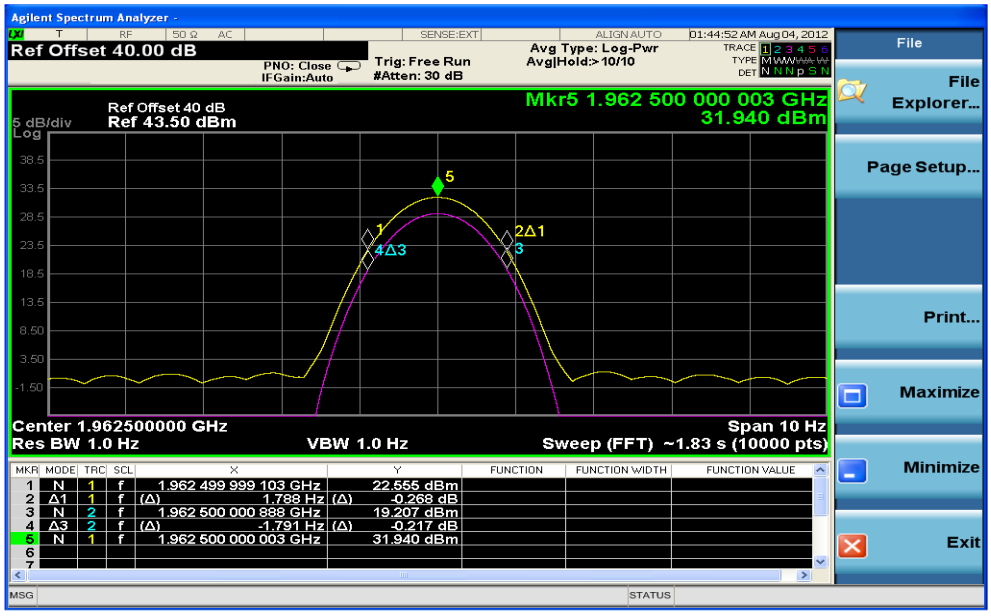


Figure E3. Data for frequency stability is presented for PCS band.

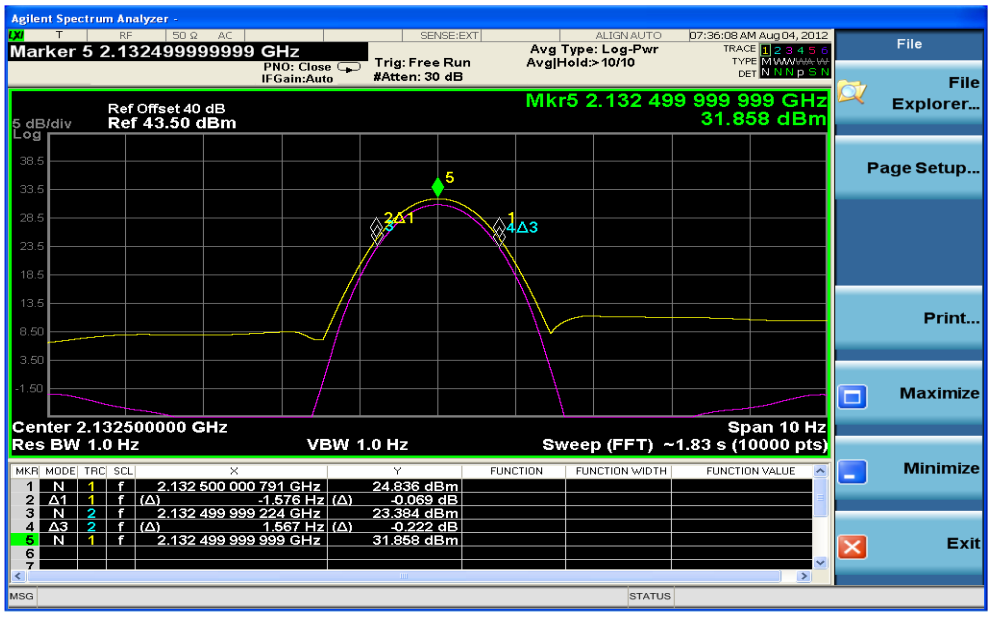


Figure E4. Data for frequency stability is presented for AWS band.

Band	Delta A (Hz)	Delta B (Hz)	Error (Hz)	PPM
700 MHz	1.487	1.491	0.004	5.38E-6
800 MHz	2.0	2.0	< 0.001	< 1.25E-6
PCS	1.788	1.791	0.003	1,53E-6
AWS	1.576	1.567	0.009	4.2E-6

Table 9. Calculation of frequency error in ppm.

8.0 Intermodulation

8.1 Methodology

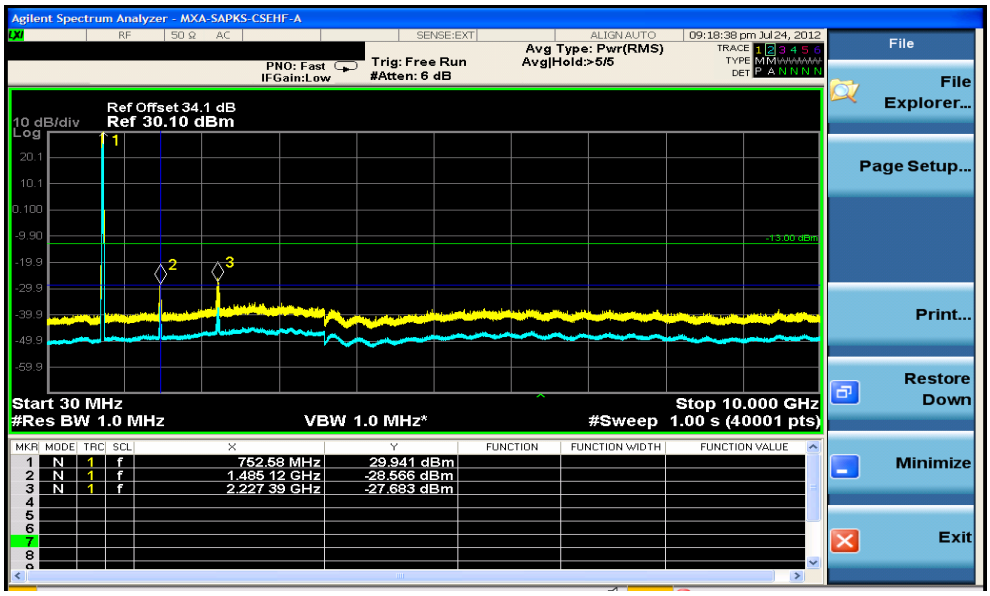
Measurements were performed at three modulations (F1C-C2K, DL1C-WCDMA, LTE5M) for the mid, lowest and highest frequency within the 700 MHz (730 – 755 MHz), 800 MHz (871 – 892 MHz).

Worst-case data is shown in the figures in sections 3.2 in Figures F1 - F2.

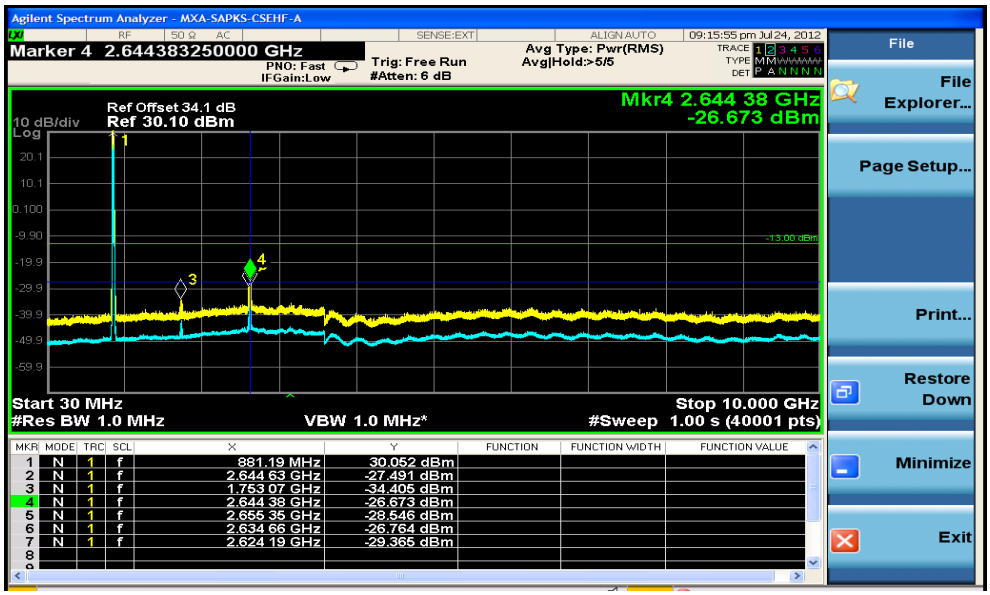
A brief summary of applicable FCC specifications is listed in the table below.

8.2 Results - Figures F1 - F2

700 MHz band



800 MHz band


Agilent Spectrum Analyzer - MXA-SAPKS-CSEHF-A
RF 50 Ω AC
SENSE:EXT
ALIGN AUTO
09:15:55 pm Jul 24, 2012
Marker 4 2.644383250000 GHz
PNO: Fast
IFGain:Low
Trig: Free Run
#Atten: 6 dB
Avg Type: Pwr(RMS)
Avg|Hold:>5/5
TRACE 1 2 3 4 5 6
TYPE M WWWWW
DET P A N N N N
Ref Offset 34.1 dB
10 dB/div
Log
Ref 30.10 dBm
Mkr4 2.644 38 GHz
-26.673 dBm
20.1
10.1
0.100
-9.90
-19.9
-29.9
-39.9
-49.9
-59.9
-13.00 dBm
Start 30 MHz
#Res BW 1.0 MHz
VBW 1.0 MHz*
Stop 10.000 GHz
#Sweep 1.00 s (40001 pts)
MKR MODE TRC SCL X Y FUNCTION FUNCTION WIDTH FUNCTION VALUE
1 N 1 f 881.19 MHz 30.052 dBm
2 N 1 f 2.644 63 GHz -27.491 dBm
3 N 1 f 1.753 07 GHz -34.405 dBm
4 N 1 f 2.644 38 GHz -26.673 dBm
5 N 1 f 2.655 35 GHz -28.546 dBm
6 N 1 f 2.634 66 GHz -26.764 dBm
7 N 1 f 2.624 19 GHz -29.365 dBm
File
File Explorer...
Page Setup...
Print...
Restore Down
Minimize
Exit