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

Applicant	Dali Wireless, Inc.
Address	8618 Commerce Court, Burnaby, British Columbia, V5A 4N6, Canada
FCC ID	HCOT43DPAN2B
IC Label	10323A-T43DPAN2B
Model Number	T43-DPA-N2N
Product Description	1900, AWS Outdoor Remote Unit, Dual-Band
Date Sample Received	July 16th, 2012
Date Sample Tested	July 16th to December 2nd, 2012
Tested by	Guihua Sophie Piao
Approved by	Daryl Meerkerk
Report No.	T43-DPA-PAN.1.0
Test Results	Compliant

Revision History

Revision	Date	Reason For Change	Reviewed By	Author(s)
0.1	Nov 10, 2012	Initial Data		S. Piao
0.2	Nov 20, 2012	Frequency range correction		S. Piao
0.3	Dec 3, 2012	Passband gain and bandwidth added; Input OBW added; IMD test added; GSM test added.		S. Piao

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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
OBW	Occupied Bandwidth
PCS	Personal Communications Service
RF	Radio Frequency
RX	Receiver
TS	Time Slot
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, 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:
Guihua Sophie Piao
Function: Test Engineer
Date: December 03, 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, 24, 27 and Industry Canada RS-131 requirements for a dual band digital repeater.

Applicable Rule Parts	FCC CFR 47 Parts 2, 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	1900, AWS Outdoor Remote Unit, Dual-Band Bi-directional Distributed Antenna System/Repeater.

FCC ID	HCOT43DPAN2B
IC Label	10323A-T43DPAN2B
Model Name	*t*43™ – DPA-N2N
Operating Frequency	Downlink 1930 – 1995 MHz, Downlink 2110 – 2155 MHz,
Emission Designators	F9W, F9X, DXW, D7W, GXW, G7W
Modulations	GSM, WCDMA, CDMA2000, LTE5M
User Power Range and Control	There are NO user power controls
Test Item	Representative prototype
DC Voltage and Current into final amplifier	Powered 115 or 230 VAC
Type of Equipment	Fixed
Amplifier's rated mean power	43 dBm ±1 dB
Output signal coupling attenuation	40 dB

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

Signal Generator	Agilent	MXG-N5182A	MY50140256	CAL 26-Sep-2014

1.9 Test Procedure

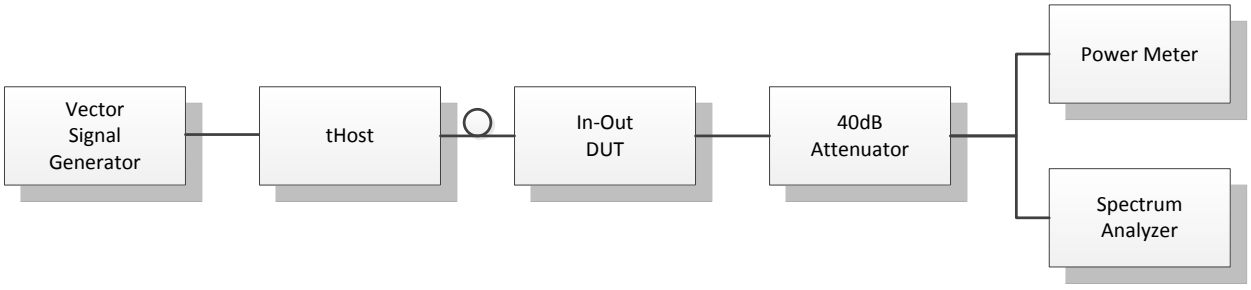
General

The *t*43 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 40 dB for the band under consideration.
The 1900 MHz (1930 – 1995 MHz) band and AWS (2110 – 2155 MHz) band were investigated. For 1900 MHz band, measurements were performed at four modulation types (GSM, WCDMA, CDMA2000, LTE5M) for the mid, lowest and highest frequency for declared bandwidths. For AWS band, 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-Table 3.

RF Passband Gain and Bandwidth

The procedure used was RSS-131 Issue 2. RF frequency response is measured by connecting a 50-ohm, resistive power meter to the RF output connector. With a nominal voltage and the internal gain control properly adjusted the RF output is measured by sweeping the input frequency**.**

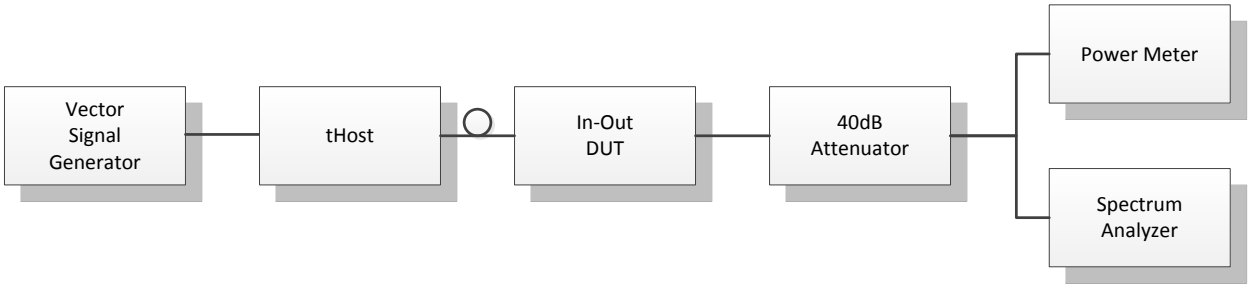
RF Passband Gain and Bandwidth Test Setup Diagram



RF Power Output

RF power is measured by connecting a 50-ohm, resistive power meter 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



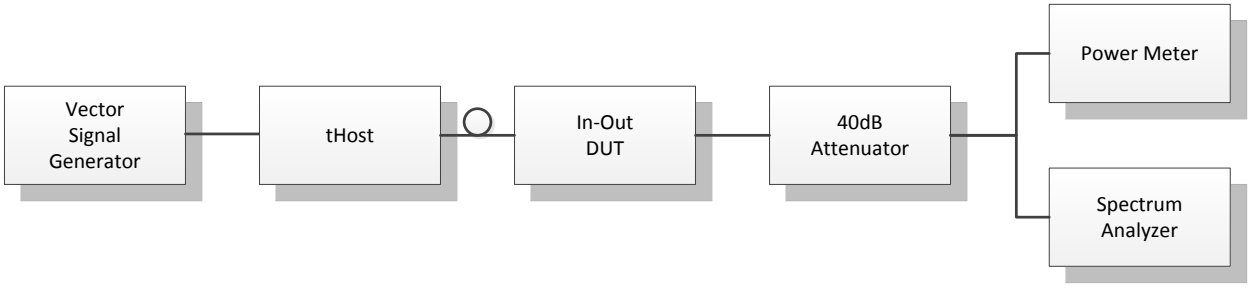
Band Edges Compliance

Band Edge Emission is measured by connecting a Spectrum Analyzer to the RF output connector.

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.

$$Corr(dB) = 10*\log (measRBW / actualRBW) \qquad (1.9.1)$$

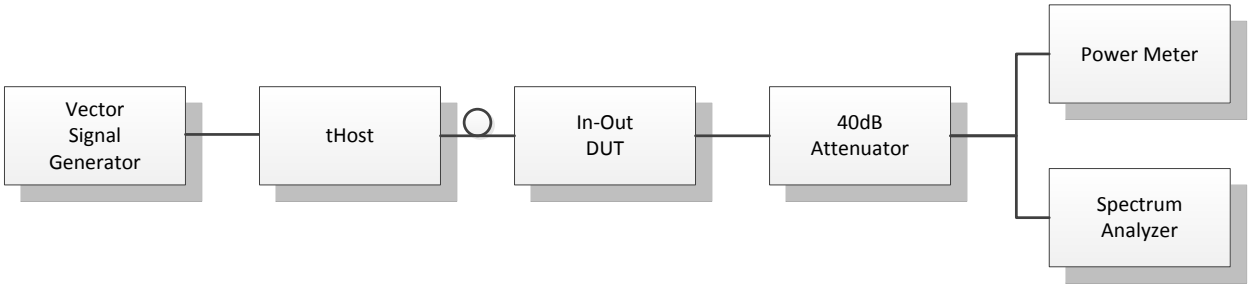
Band-Edges Test Setup Diagram



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.

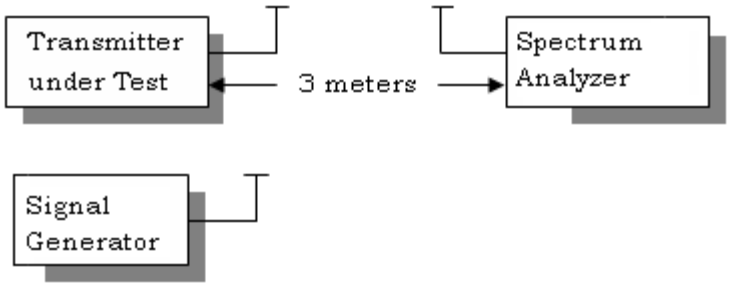
Conducted Spurious Test Setup Diagram



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

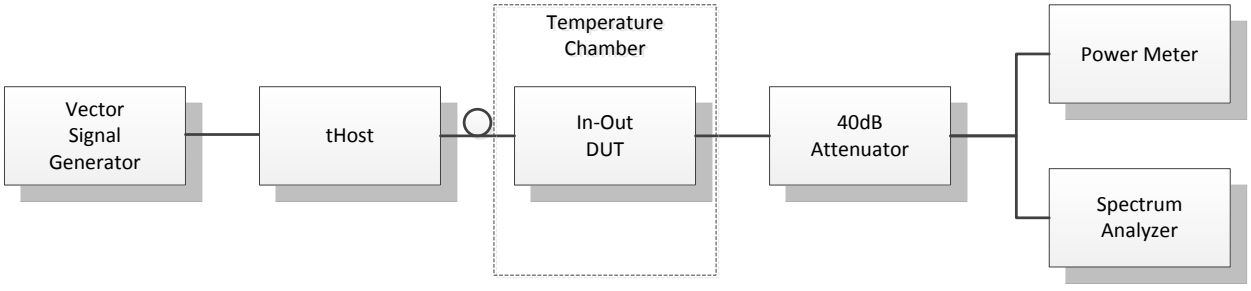


Equipment placed 80 cm above ground on a rotating table platform.

Frequency Stability

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

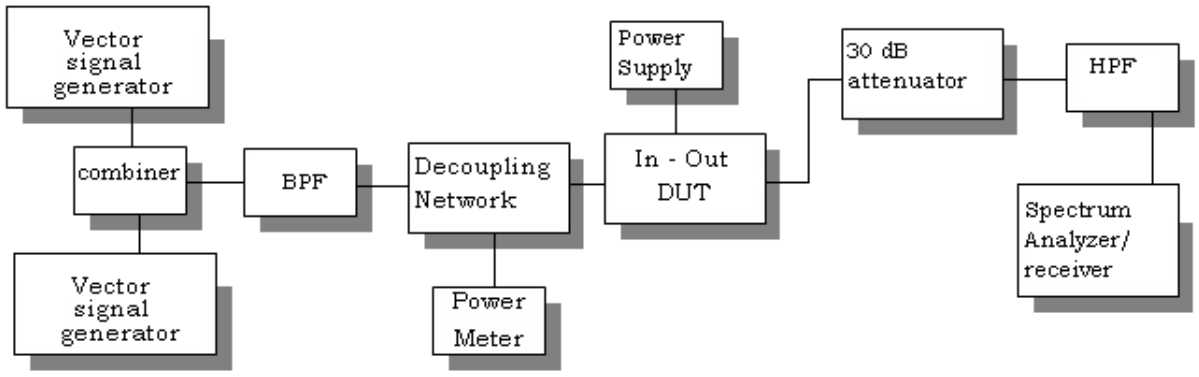
Frequency Stability Test Setup Diagram



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.
All signals were modulated.

Intermodulation Test Setup Diagram



1.10 Operational Description

The Dali Wireless t43™ dual-band outdoor Distributed Antenna System (oDAS) provides effortless mobile coverage extension and capacity enhancement of GSM, CDMA, WCDMA, LTE and other wireless networks. Built on patented Digital Pre-Distortion (DPD), Crest Factor Reduction (CFR) algorithms, and patented n-way Doherty PA configurations, Dali repeaters offer a breakthrough in efficiency, linearity and instantaneous bandwidth. 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.
The outdoor DAS is comprised of a *tHost* that is connected to the RF output of the base station, and multiple *t43*™remotes located in areas that the base station signal cannot reach (gaps created by natural or manmade obstacles, tunnels and subways, or inside large buildings) as well as simulcast in a DAS configuration 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 *t43*™s, in a star, daisy-chain or hybrid star/daisy-chain configuration. The *t43*™s can be installed 15km to 40km away from the *tHost*™. Both *tHost*™and *t43*™ contain a digital processing section and an RF processing section. For bidirectional optical communication between *tHost*™ and *t43*™s over single single-mode fiber cable, SFP optical transceivers with built in wave division multiplexing (WDM) system are used.

1.11 Measurement Configuration

Table 1. 1900 MHz DL Measurement Matrix

Modulation	# Carriers	Notation	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
GSM	1	GSM-8TS	1930.4, 1962.5, 1994.6

Table 2. AWS DL Measurement Matrix

Modulation	# Carriers	Notation	Frequency (MHz)
Modulation	# Carriers	Carrier	Frequency (MHz)
WCDMA	1	DL1C-WCDMA	2112.5, 2132.5, 2152.5
CDMA2000	1	F1C-C2K	2112.5, 2132.5, 2152.5
LTE5M	1	LTE5M	2112.5, 2132.5, 2152.5

Note: AWS band was not licensed to GSM per 3GPP TS45 specifications. So the GSM modulation was not tested.

Table 3. DL Modulation Waveforms

Notation	Waveform	Bandwidth (MHz)
DL1C-WCDMA	3GPP TS25	5
F1C-C2K	3GPP2	1.25
LTE5M	3GPP TS36	5
GSM-8TS	3GPP TS45	0.2

2.0 Passband Gain and Bandwidth

2.1 Methodology

Measurements were performed at CW signal for sweeping across the measured frequency span.

Test data is shown in section 2.2 for each band (Figures A1 – A4).

A brief summary of applicable IC specification (RSS-131) is listed in the table below.

4.2 Passband Gain and Bandwidth
Adjust the internal gain control of the equipment under test to the nominal gain for which equipment certification is sought. With the aid of a signal generator and spectrum analyser, measure the 20 dB bandwidth of the amplifier (i.e. at the point where the gain has fallen by 20 dB). Measure the gain-versus-frequency response of the amplifier from the midband frequency f0 of the passband up to at least f0 + 250% o the 20 dB bandwidth.

Full results for passband gain and bandwidth measurements are shown in table 10:

2.2 Results – Figures A1- A4

1900 MHz band

Fig. A1. Passband Bandwidth

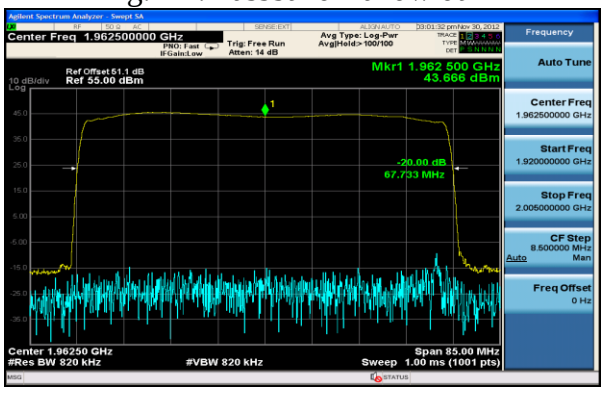
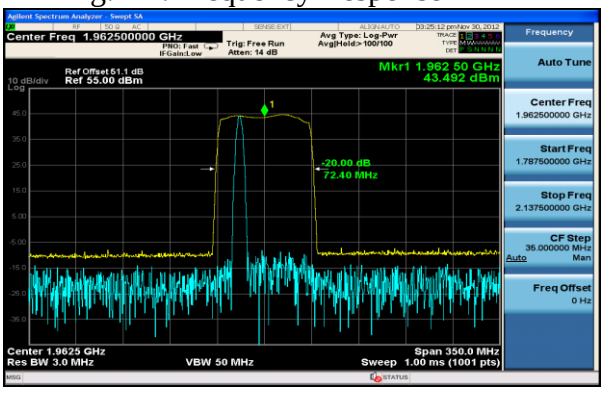


Fig. A2. Frequency Response



AWS band

Fig. A3. Passband Bandwidth

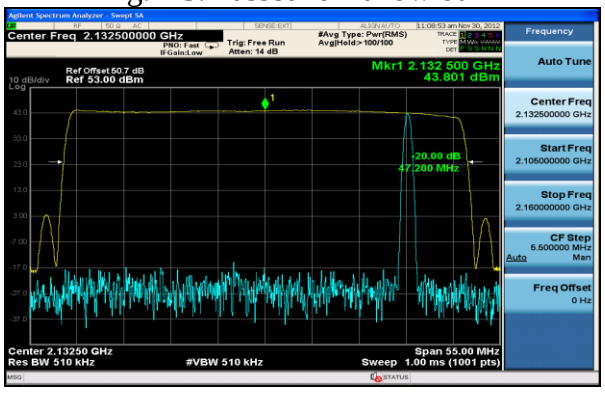
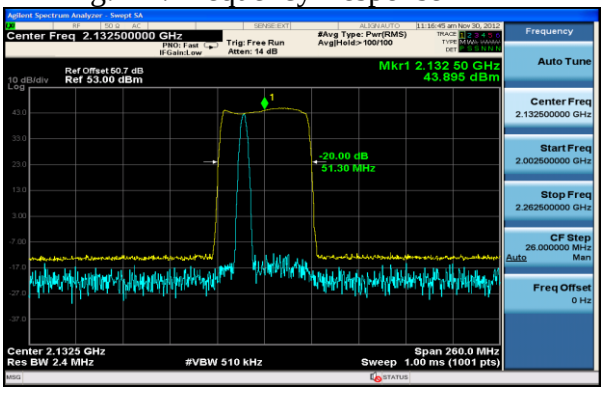


Fig. A4. Frequency Response



Operating Band	Nominal Input @ tHost (dBm)	Passband Gain	Passband Bandwidth (MHz)
1900	-17	60.7	67.733
AWS	-17	60.8	47.2

Table 4. RF Output Passband Gain and Bandwidth

3.0 Output Power

3.1 Methodology

Measurements were performed at four modulations (GSM-8TS, F1C-C2K, DL1C-WCDMA, LTE5M) for the mid, lowest and highest frequency within the 1900 MHz (1930 – 1995 MHz).

Measurements were performed at three modulations (F1C-C2K, DL1C-WCDMA, LTE5M) for the mid, lowest and highest frequency within the AWS (2110 – 2155) band.

Worst-case data is shown in section 3.3 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.

3.2 Interpretation

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

3.3 Results

1900 MHz band

F1C-C2K modulation			
Frequency, MHz	**Output power, dBm**	**Bandwidth, MHz**	**Limit, dBm**
1932.5	43.5	1.25	43 ± 1
1962.5	43.5		
1992.5	43.6		
DL1C-WCDMA modulation			
1932.5	43.5	5	43 ± 1
1962.5	43.5		
1992.5	43.6		
LTE5M modulation			
1932.5	43.5	5	43 ± 1
1962.5	43.4		
1992.5	43.6		
GSM-8TS modulation			
1930.4	43.3	5	43 ± 1
1962.5	43.1		
1994.6	43.3		

AWS band

F1C-C2K modulation			
Frequency, MHz	**Output power, dBm**	**Bandwidth, MHz**	**Limit, dBm**
2112.5	43.5	1.25	43 ± 1
2132.5	43.4		
2152.5	43.6		
DL1C-WCDMA modulation			
2112.5	43.6	5	43 ± 1
2132.5	43.6		
2152.5	43.5		
LTE5M modulation			
2112.5	43.6	5	43 ± 1
2132.5	43.6		
2152.5	43.3		

Table 5. Output Power Measurement

Conclusion: As the table above indicates, the maximum power output meets the specification on the low, middle and high channel with any of the three modulations applied.

4.0 Occupied Bandwidth

4.1 Methodology

Measurements were performed at four modulations (GSM-8TS, F1C-C2K, DL1C-WCDMA, LTE5M) for the mid, lowest and highest frequency within the 1900 MHz (1930 – 1995 MHz).

Measurements were performed at three modulations (F1C-C2K, DL1C-WCDMA, LTE5M) for the mid, lowest and highest frequency within the AWS (2110 – 2155MHz) band.

Worst-case data is shown in the figures in sections 4.2 in Figures B1-4 (1900 MHz band) and B5-7 (AWS band).

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

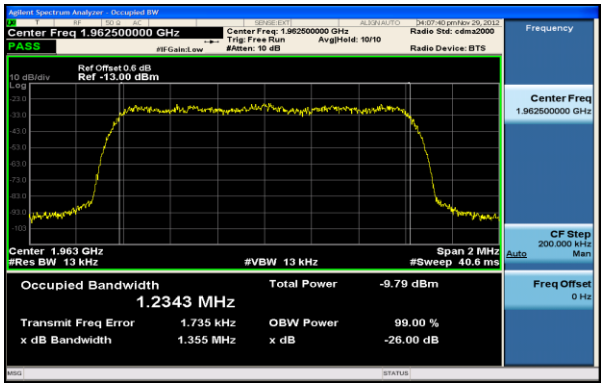
2.1049 Measurements required: Occupied bandwidth.
The occupied bandwidth, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured

The plots below are for reference purposes only. Full results for occupied bandwidth measurements are shown in Table 6.

4.2 Results - Figures B1 – B7

1900 MHz band

Fig. B1. F1C-C2K in and out



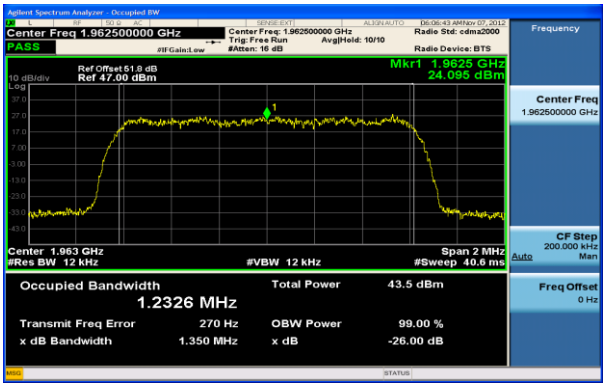


Fig. B2. LTE5M in and out

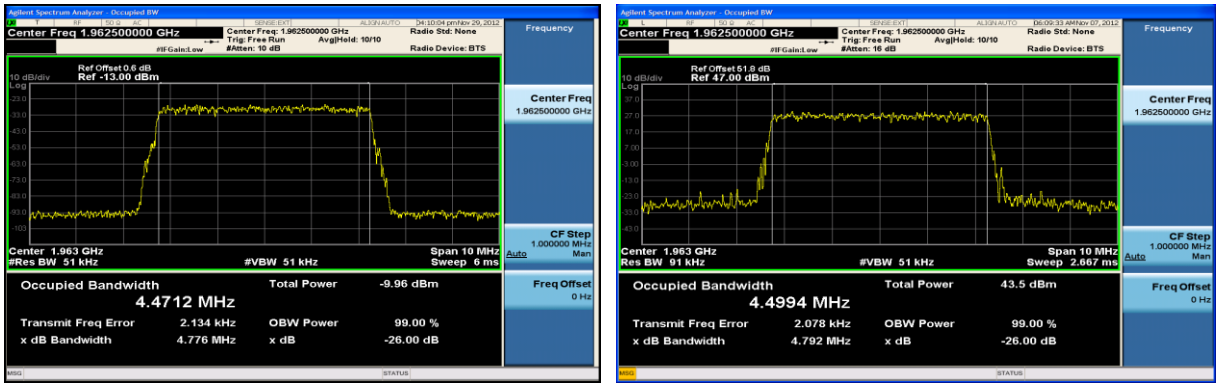


Fig. B3. DL1C-WCDMA in and out

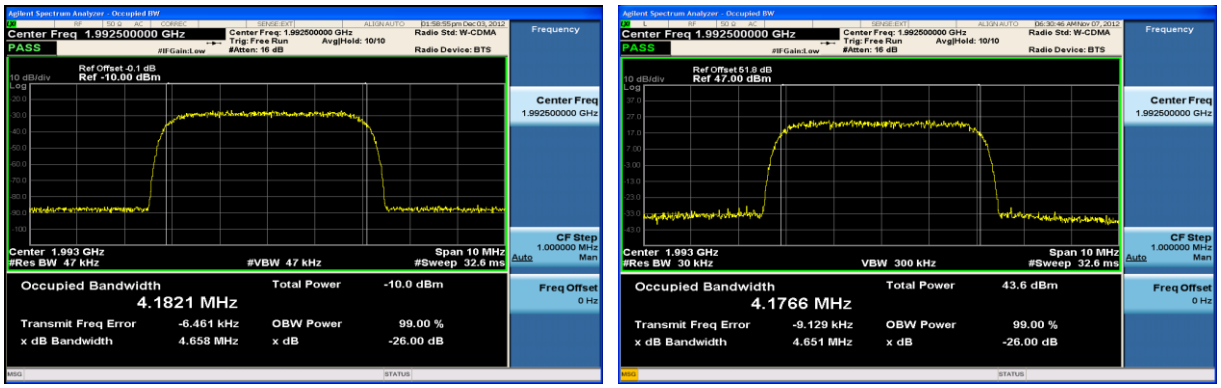
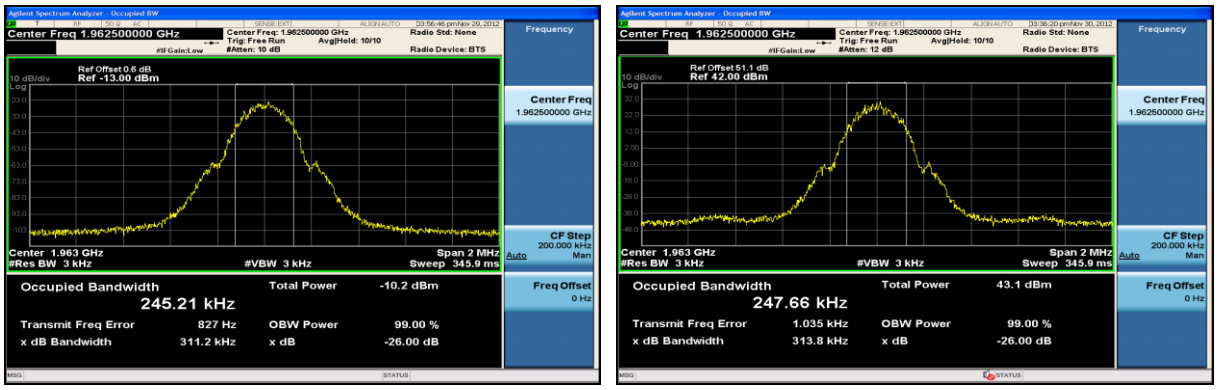


Fig. B4. GSM-8TS in and out



AWS band

Fig. B5. F1C-C2K in and out

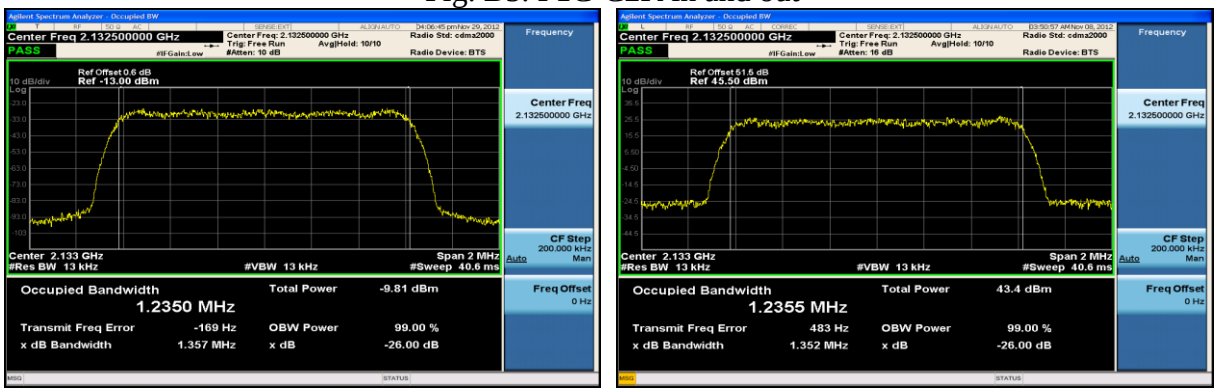


Fig. B6. LTE5M in and out

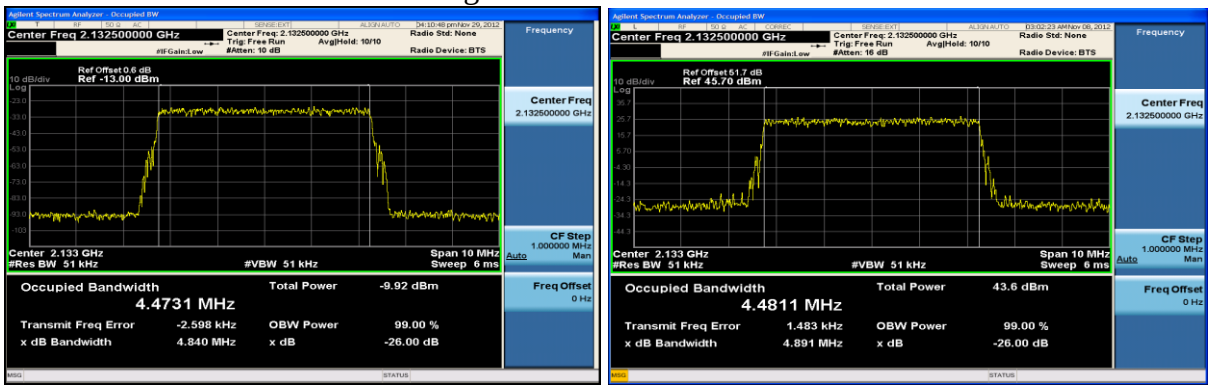


Fig. B7. DL1C-WCDMA in and out

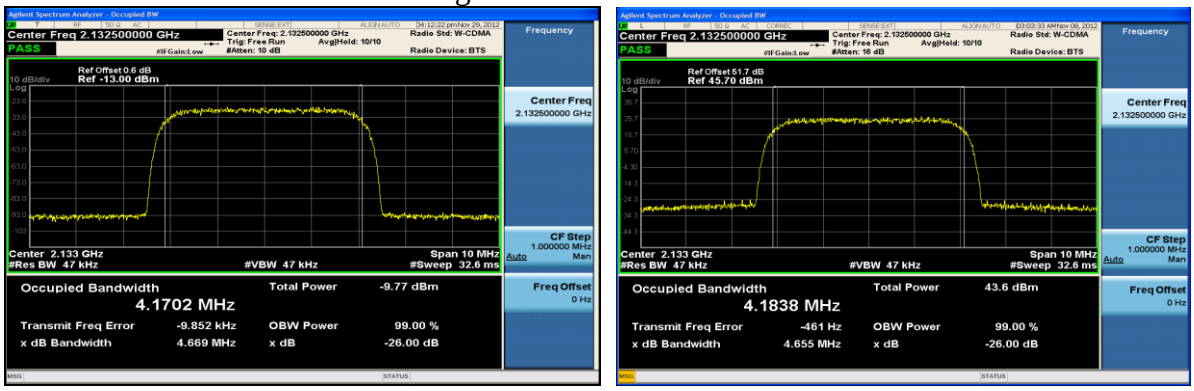


Figure B1, B5– occupied bandwidth for CDMA2000 modulation at 1.25MHz bandwidth for 1900 MHz and AWS band, appropriately. B2, B6 - LTE5M modulation at 5MHz bandwidth for 1900 MHz and AWS MHz band, appropriately. B3, B7, - WCDMA modulation at 5MHz bandwidth for 1900 MHz and AWS MHz band, appropriately. B4 – GSM-8TS modulation at 200kHz band width for 1900 MHz.

1900 MHz band

Modulation	OBW (MHz) @ low frequency	OBW (MHz) @ center frequency	OBW (MHz) @ high frequency	OBW (MHz) of input
F1C-C2K	1.23	1.23	1.23	1.23
DL1C-WCDMA	4.16	4.17	4.18	4.18
LTE5M	4.48	4.5	4.47	4.47
GSM-8TS	0.248	0.248	0.242	0.245

AWS band

Modulation	OBW (MHz) @ low frequency	OBW (MHz) @ center frequency	OBW (MHz) @ high frequency	OBW (MHz) of input
F1C-C2K	1.23	1.23	1.235	1.235
DL1C-WCDMA	4.16	4.18	4.16	4.17
LTE5M	4.47	4.48	4.48	4.47

Table 6. Occupied Bandwidth Measurements (Output signal)

Conclusion: The difference of the output signal and input signal bandwidth is less than 20kHz.The spectrum shapes of output are similar to the input.

5.0 Conducted Spurious Emissions

5.1 Methodology

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

The worst case data is shown in the figures C1 – C4 for 1900 MHz and AWS band, appropriately, in section 5.3.

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 4 modulations in 1900 MHz band and 3 modulations in AWS band. The 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.
(h) 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.

5.2 Interpretation

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

5.3 Results – Figures C1 – C4

On the plots below shown the low, middle and high channel are simultaneously presented. The emission level is below the limit, so the conducted emission is compliant with the FCC standard.

1900 MHz band

Fig. C1. CDMA 2000 emission 9kHz-2.5GHz

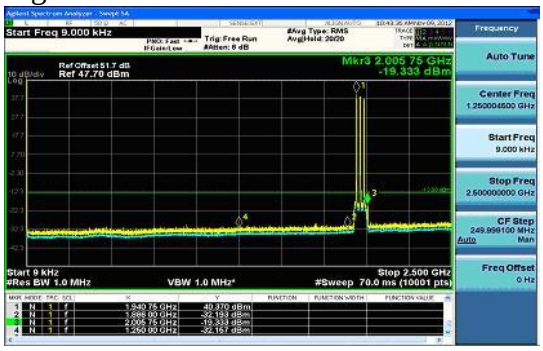


Fig C2. GSM emission 9kHz-2.5GHz

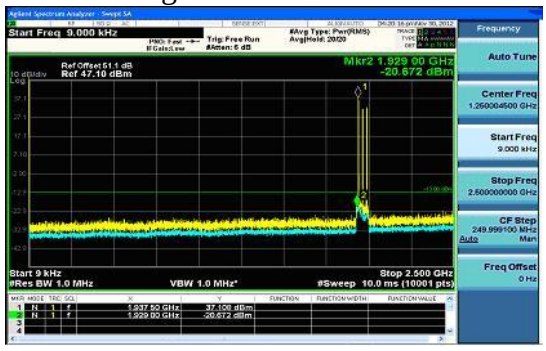


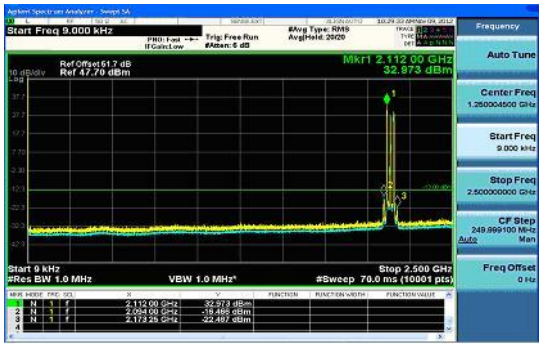
Fig. C3. WCDMA emission 1GHz-22GHz

Fig. C4. GSM emission 1GHz-22GHz

AWS Band

Fig. C5. WCDMA emission 9kHz-2.5GHz

Fig. C6. LTE5M emission 1GHz-22GHz


Start Freq 9.000 kHz
Ref Offset 51.7 dB
Ref 47.70 dBm
Mkr1 2.112 00 GHz
32.973 dBm
Start 9 kHz
#Res BW 1.0 MHz
VBW 1.0 MHz
Stop 2.500 GHz
#Sweep 70.0 ms (10001 pts)
Frequency
Auto Tune
Center Freq
Start Freq
Stop Freq
CF Step
Freq Offset


Display Line -13.00 dBm
Ref Offset 51.7 dB
Ref 47.70 dBm
Mkr4 21.542 2 GHz
-22.173 dBm
Start 1.00 GHz
#Res BW 1.0 MHz
VBW 1.0 MHz
Stop 22.00 GHz
#Sweep 70.0 ms (10001 pts)
Display
Annotation
Title
Graticule
Display Line
System Display Settings

6.0 Band Edge

6.1 Methodology

Measurements were performed at four modulations (GSM, WCDMA, CDMA2000, and LTE5M) for the lowest and highest frequency within the 1900MHz (1930-1995MHz) band.

Measurements were performed at three modulations (WCDMA, CDMA2000, and LTE5M) for the lowest and highest frequency within the AWS (2110-2155MHz) band.

Test data is shown in the figures D1 – D8 (1900 MHz band) and D9 – D14 (AWS band) in section 6.2, and in the tables in section 6.3.

27.53 Emission limits.
(h) 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

1900 MHz band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	13	13	0
DL1C-WCDMA	30	47	1.95
LTE5M	30	47	1.95
GSM-8TS	3	3	0

AWS band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	13	13	0
DL1C-WCDMA	10	47	6.7
LTE5M	51	48	-0.26

Low end

1900 MHz band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	13	13	0
DL1C-WCDMA	30	47	1.95
LTE5M	47	48	0.09
GSM-8TS	3	3	0

AWS band

Modulation	Measured RBW, kHz	Actual RBW, kHz	Correction (dB)
F1C-C2K	13	13	0
DL1C-WCDMA	30	47	1.95
LTE5M	47	48	0.09

6.2 Results – Figures D1- D16 (Plots)

1900 MHz band

Fig. D1. F1C-C2K at low edge

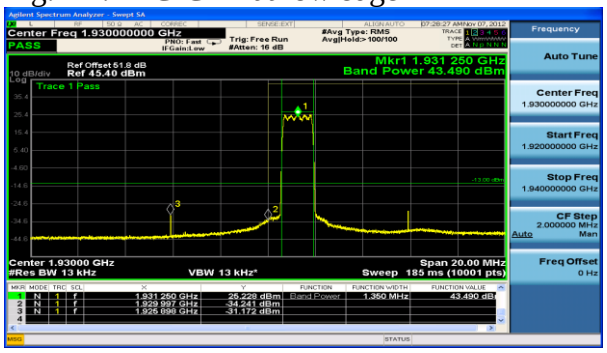


Fig. D2. F1C-C2K at high edge

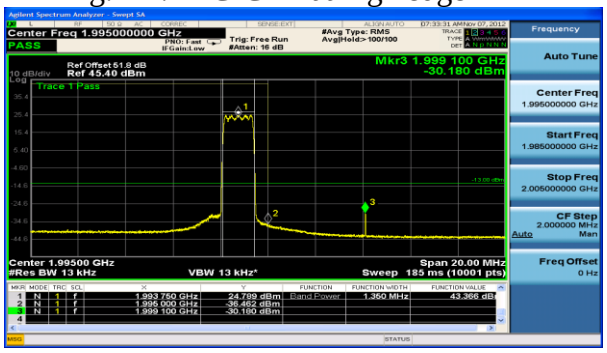


Fig. D3. DL1C-WCDMA at low edge

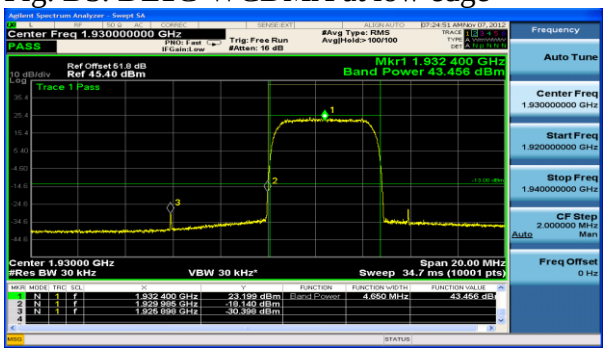


Fig. D4. DL1C-WCDMA at high edge

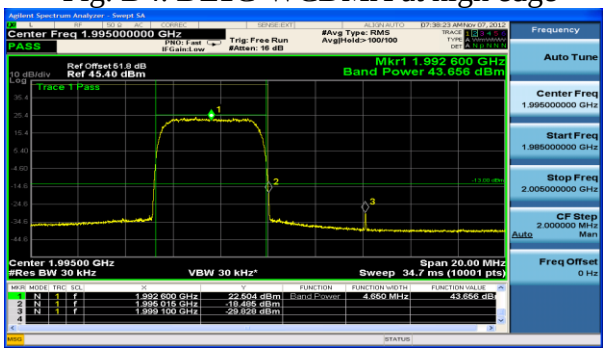


Fig. D5. LTE5M at low edge

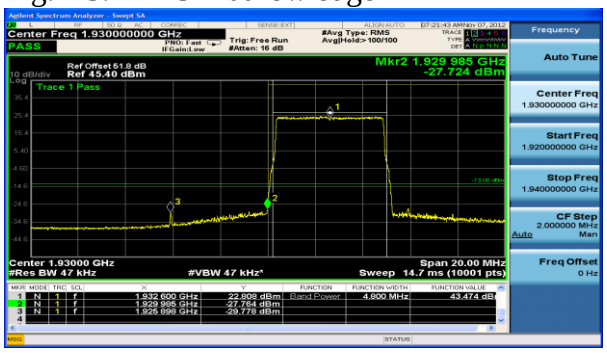


Fig. D6. LTE5M at high edge

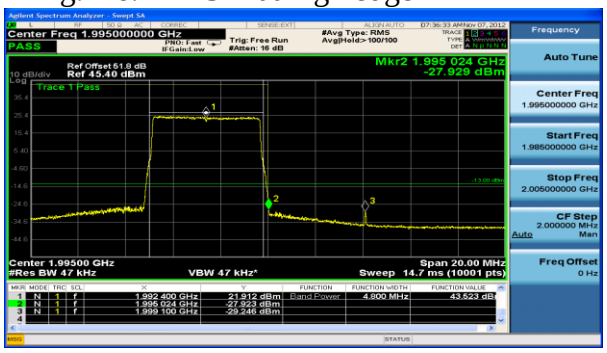


Fig. D7. GSM-8TS at low edge

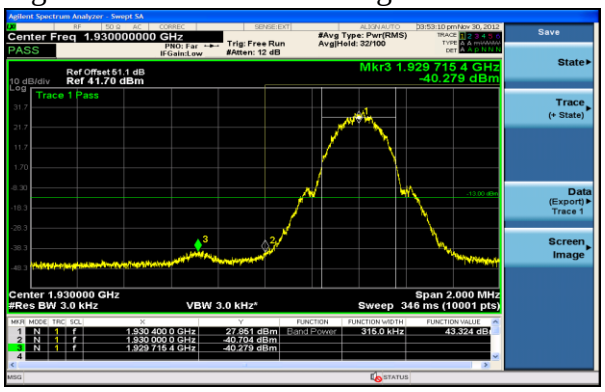
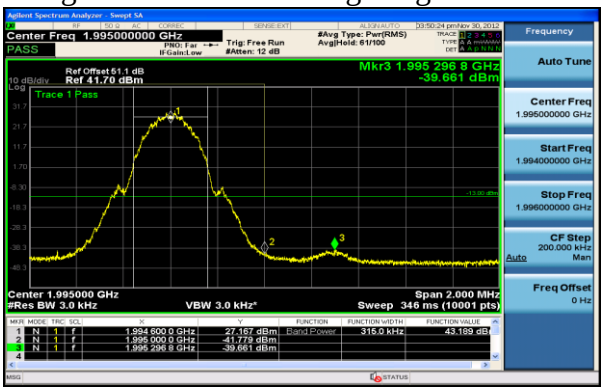


Fig. D8. GSM-8TS at high edge



AWS band

Fig. D9. F1C-C2K at low edge

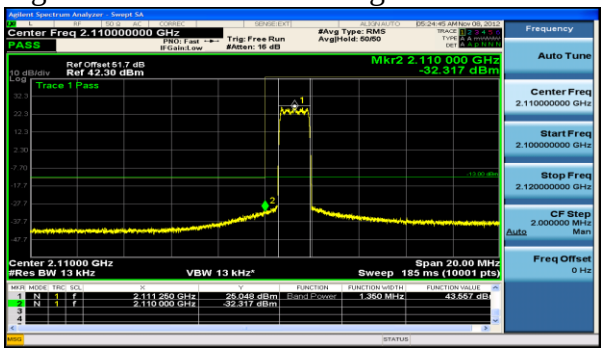


Fig. D10. F1C-C2K at high edge

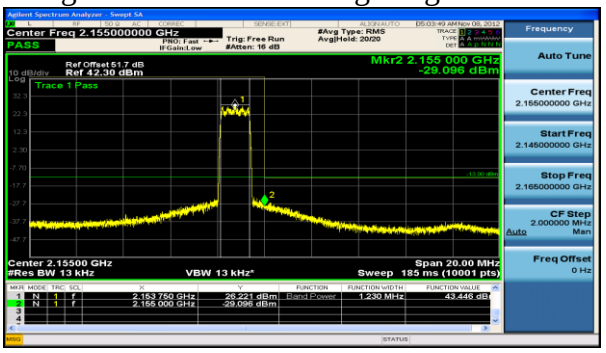


Fig. D11. DL1C-WCDMA at low edge

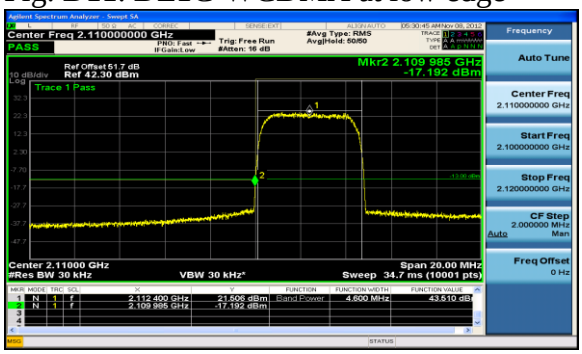


Fig. D10. DL1C-WCDMA at high edge

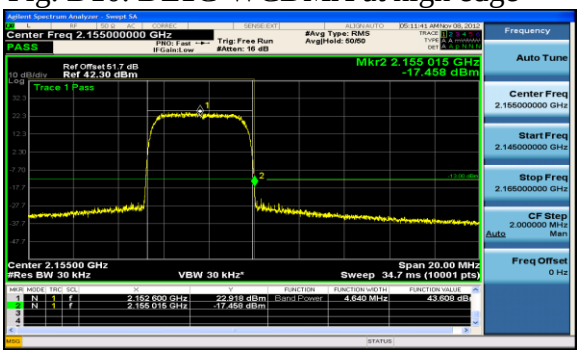


Fig. D13. LTE5M at low edge

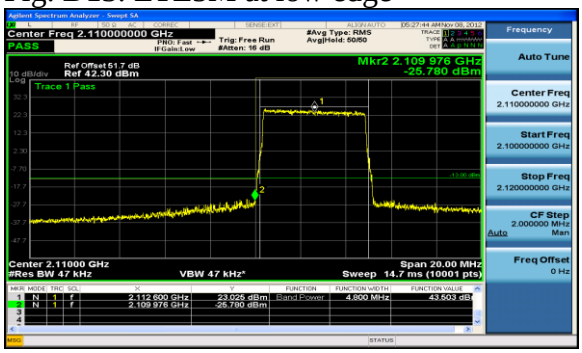
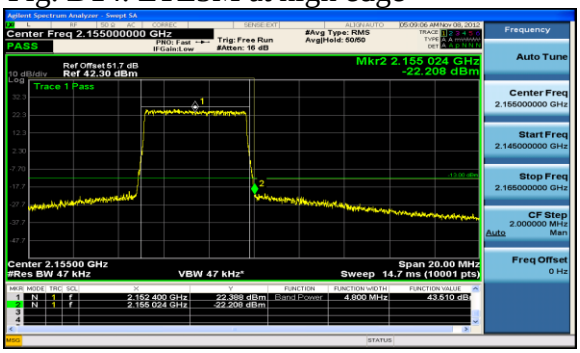


Fig. D14. LTE5M at high edge



6.3 Results – Summary of Band Edge Emission

Low end

1900 MHz band

Modulation	Carrier Freq (MHz)	Edge (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	1931.25	-34.241	0	-13	21.241	PASS
WCDMA	1932.4	-18.14	1.95	-13	3.19	PASS
LTE5M	1932..6	-27.764	0.09	-13	14.674	PASS
GSM-8TS	1930.4	-40.279	0	-13	27.279	PASS

AWS band

Modulation	Carrier Freq (MHz)	Edge (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	2111.25	-32.317	0	-13	19.317	PASS
WCDMA	2112.4	-17.192	1.95	-13	2.242	PASS
LTE5M	2112.6	-25.78	0.09	-13	12.69	PASS

High end

1900 MHz band

Modulation	Freq (MHz)	Reading (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	1993.75	-36.462	0	-13	23.462	PASS
WCDMA	1992.4	-18.485	1.95	-13	3.535	PASS
LTE5M	1992.6	-27.923	0.09	-13	14.833	PASS
GSM-8TS	1994.6	-39.661	0	-13	26.661	PASS

AWS band

Modulation	Freq (MHz)	Reading (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	2153.75	-29.096	0	-13	16.096	PASS
WCDMA	2152.4	-17.458	1.95	-13	2.508	PASS
LTE5M	2152.6	-22.208	0.09	-13	9.118	PASS

Table 7. Band edge measurements

7.0 Field Strength of Spurious Radiation

7.1 Methodology

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

Worst-case data is shown in the figures E1 – E2 in section 7.3.

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

27.53 Emission limits.
(h) 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 dB:V/m) ERP for average detector.

7.2 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 margins exceeds 20 dB.

7.3 Results – Figure E1 - E2

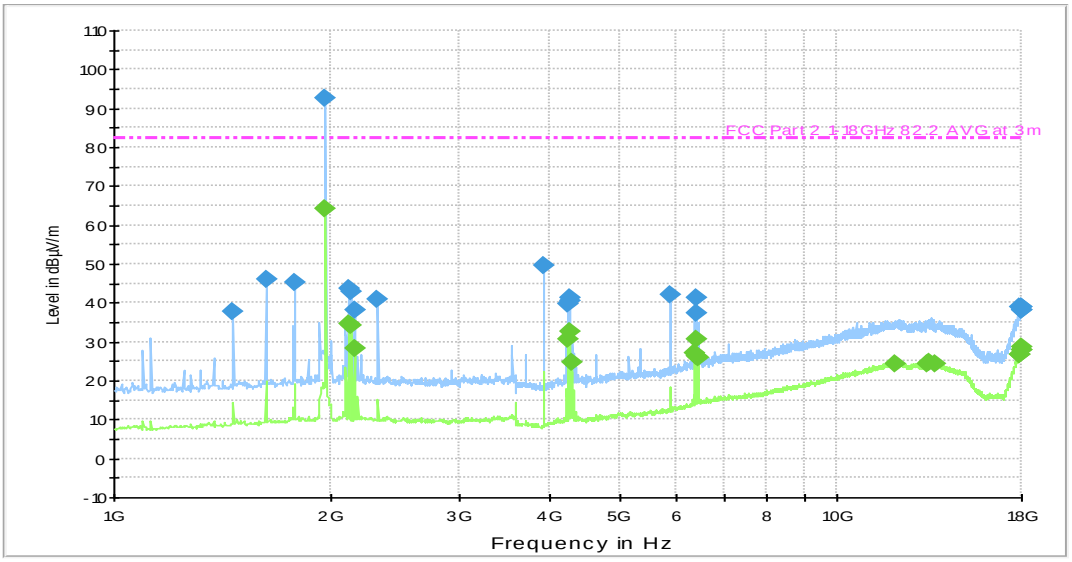


Figure E1. Data for radiated spurious emission 1 – 18 GHz is presented.

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

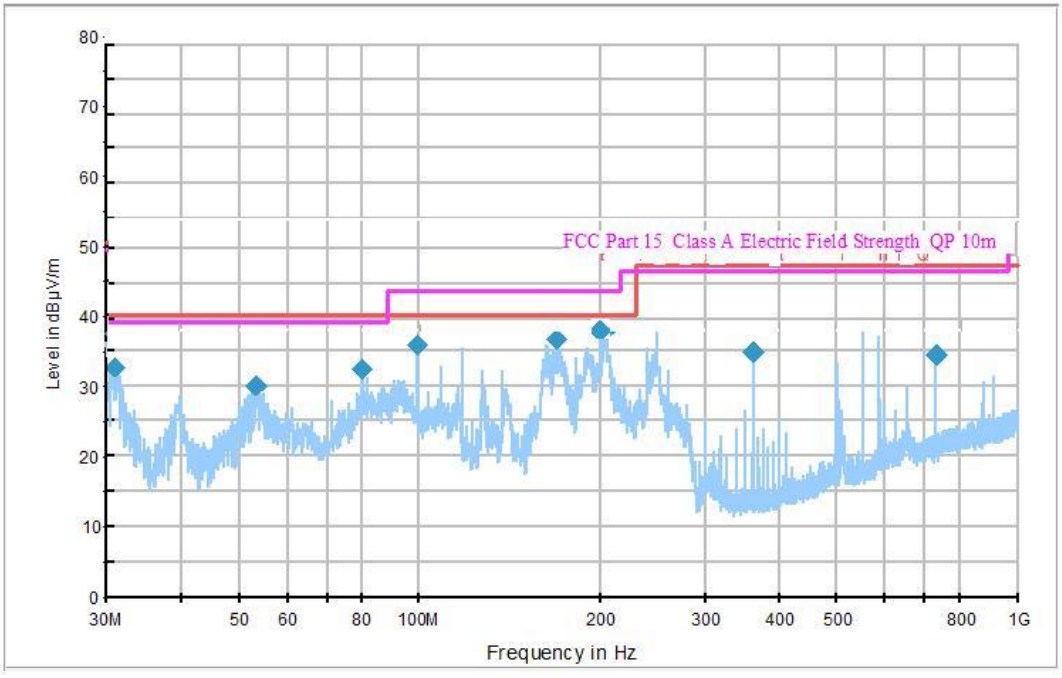


Figure E2. Data for radiated spurious emission 30MHz – 1GHz is presented.

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Margin (dB)	Limit (dBµV/m)
30.8612	33.1	1000.00	120.000	149	V	73	6.0	39.1
52.8612	30.0	1000.00	120.000	149	V	73	9.1	39.1
80.154	32.5	1000.00	120.000	370	H	278	6.6	39.1
99.154	35.6	1000.00	120.000	370	H	278	7.9	43.5
170.12	36.1	1000.00	120.000	100	V	157	7.2	43.5
200.018	37.9	1000.00	120.000	100	V	44	5.6	43.5
380.0	34.9	1000.00	120.000	119	V	86	11.5	46.4
731.99	34.8	1000.00	120.000	149	V	22	11.6	46.4

Radiated Emission Data – 10m Distance Final at the OATS

The maximum quasi-peak at 200 MHz (37.9 dBµV/m) is equivalent to ERP of -49.02 dBm which has greater than 20 dB margin from -13 dBm ERP limit. Therefore substitution method is not required as no signals are within 20 dB of limit.

8.0 Frequency Stability

8.1 Methodology

Measurements were performed at CW.

Data is shown in the table in section 8.2.

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 table.

8.2 Results

Band	Error in PPM	Compliant
1900 MHz	0.0	Yes
AWS	0.0	Yes

Table 8. Frequency error in ppm.

9.0 Intermodulation

9.1 Methodology

Measurements were performed at four modulations (GSM, CDMA2000, WCDMA, LTE5M) in 1900MHz band.

Measurements were performed at three modulations (CDMA2000, WCDMA, LTE5M) in AWS band

2 carriers of each modulation (2-tone test) were tested. Two tests were done for low and high edge of the operating band. The carriers were selected to create the third product of IMD right adjacent to the band edge and the higher product IMD produced worst out of band emission.

Worst-case data is shown in the figures in sections 9.2 in Figures F1 – F6.
Out of band emission due to intermodulation is lower than -13dBm limit.

9.2 Results - Figures F1 – F6

1900 MHz band

Fig F1 DL2C-WCDMA at low edge

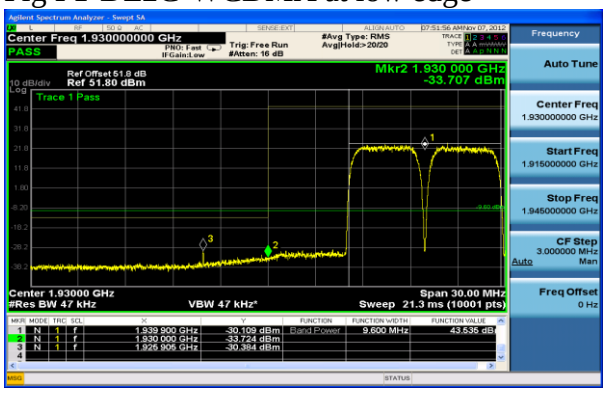


Fig F2 2C-LTE5M at high edge

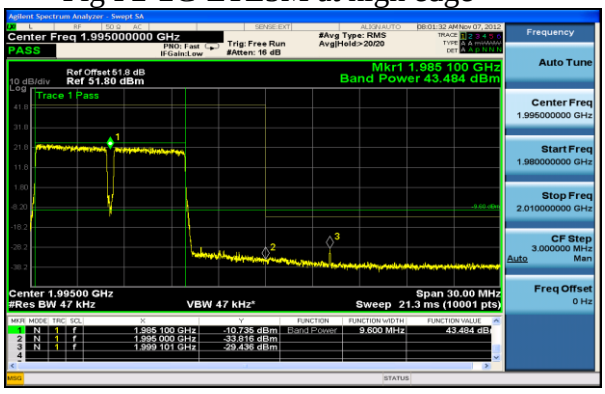


Fig F3 F2C-C2K at low edge

Fig F4 F2C-GSM at high edge

Modulation	Carrier Locations (MHz)	Highest intermod product (dBm) 1MHz RBW	Limit, (dBm)	Margin, (dBm)	Mark
GSM	1993.6, 1994.2	-21.7	-13	8.7	Pass
	1930.8, 1931.4	-21.5		8.5	
CDMA 2000	1988.75, 1991.25	-20.2		7.2	
	1933.75, 1936.25	-20.3		7.3	
LTE5M	1982.6, 1987.6	-20.4		7.4	
	1937.4, 1942.4	-21.5		8.5	
WCDMA	1982.6, 1987.6	-21.0		8	
	1937.4, 1942.4	-20.9		7.9	

Table 9. Level of intermodulation product for 1900 MHz band.

AWS band

Fig F5 2C-LTE5M at low edge

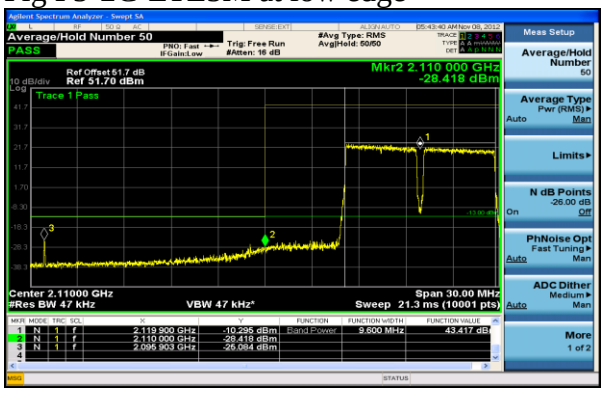
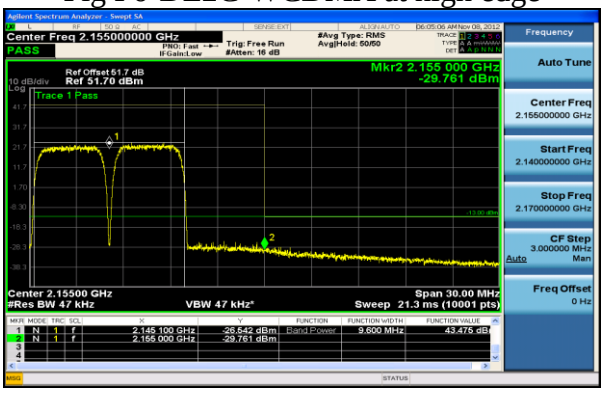


Fig F6 DL2C-WCDMA at high edge



Modulation	Carrier Locations (MHz)	Highest intermod product (dBm) 1MHz RBW	Limit, (dBm)	Margin, (dBm)	Mark
GSM	2153.6, 2154.2	-18.3	-13	5.3	Pass
	2110.8, 2111.4	-18.6		5.6	
CDMA 2000	2148.75, 2151.25	-19.7		6.7	
	2113.75, 2116.25	-20.2		7.2	
LTE5M	2142.6, 2147.6	-19.9		6.9	
	2117.4, 2122.4	-19.3		6.3	
WCDMA	2142.6, 2147.6	-19.7		6.7	
	2117.4, 2122.4	-18.9		5.9	

Table 10. Level of intermodulation product for AWS band.