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

Applicant	Dali Wireless, Inc.
Address	8618 Commerce Court, Burnaby, British Columbia, V5A 4N6, Canada
FCC ID	HCOT43DSCN2B
Model Number	t43-DSC-N2N
Product Description	700, 850 outdoor Remote Unit, Dual-Band
Date Sample Received	July 16th, 2012
Date Sample Tested	July 16th to November 28th, 2012
Tested by	Guihua Sophie Piao
Approved by	Daryl Meerkerk
Report No.	T43-PSC-PAN.1.0
Test Results	Compliant

Revision History

Revision	Date	Reason For Change	Reviewed By	Author(s)
0.1	Nov 09, 2012	Initial Data		S. Piao
0.2	Nov 28, 2012	Occupied Bandwidth of Input Signal was given for comparison; GSM modulation added.		S. Piao
0.3	Dec 03, 2012	Input and output OBW were put side by side; Intermodulation summary table added; Passband gain and bandwidth added.	S. Piao	A. Moldavanov

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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, 22, 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: November 28, 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, 27 and Industry Canada RS-131 requirements for a dual band digital repeater.

Applicable Rule Parts	FCC CFR 47 Parts 2, 22, 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 Outdoor Remote Unit, Dual-Band Bi-directional Distributed Antenna System/Repeater.

FCC ID	HCOT43DSCN2B
Model Name	*t*43™ – DSC-N2N
Operating Frequency	Downlink 728 – 757 MHz, Downlink 869 – 894 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	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	MY52090907	10-Oct-2014
Power Meter	Agilent	U2000A	MY52010490	18-Jun-2013
Signal Generator	Agilent	MXG-N5182A	MY50140256	26-Sep-2014
Signal Generator	Agilent	EXG-N5172A	MY5130179	19-Jul-2014

1.9 Test Procedure

General

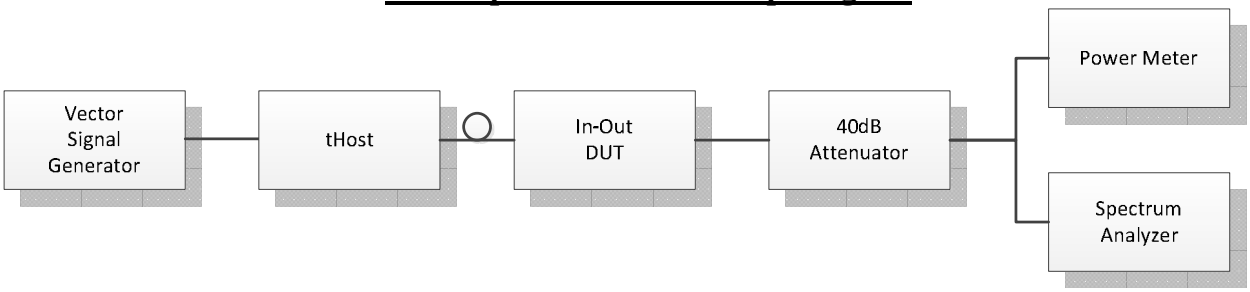
The *t*43 remote, is connected to the *t*Host in a manner consistent with a typical installation. A digital modulation signal generator is connected to the TX_IN port of the appropriate band of the *t*Host and spectrum analyzer is connected to the appropriate downlink antenna output through an attenuator, nominally 40 dB for the band under consideration.

The 700 MHz (728 – 757 MHz) band and 850 MHz (869 – 894 MHz) band were investigated. Measurements were performed at four modulation types (GSM, 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 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



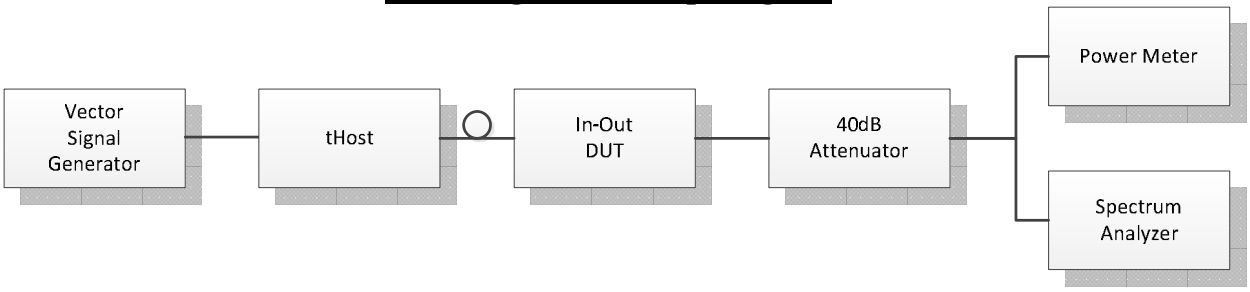
Band Edges Compliance

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.

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

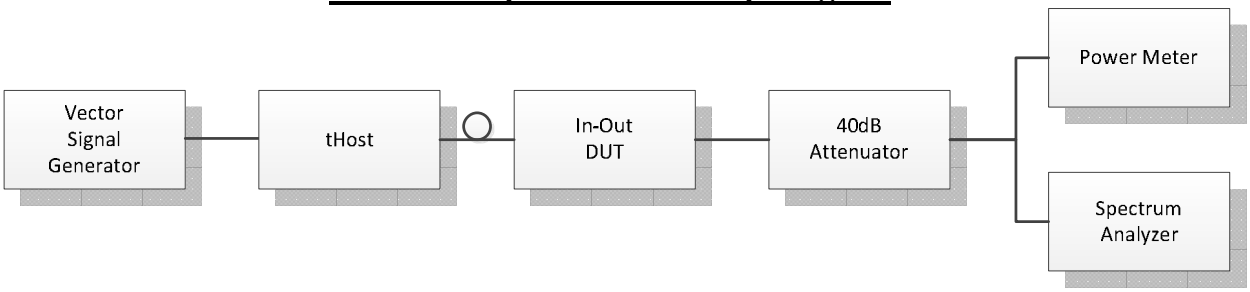
Band-Edges Test Setup Diagram



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.

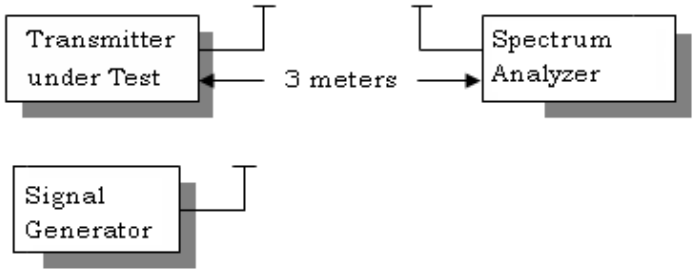
Conducted Spurious Test Setup Diagram



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

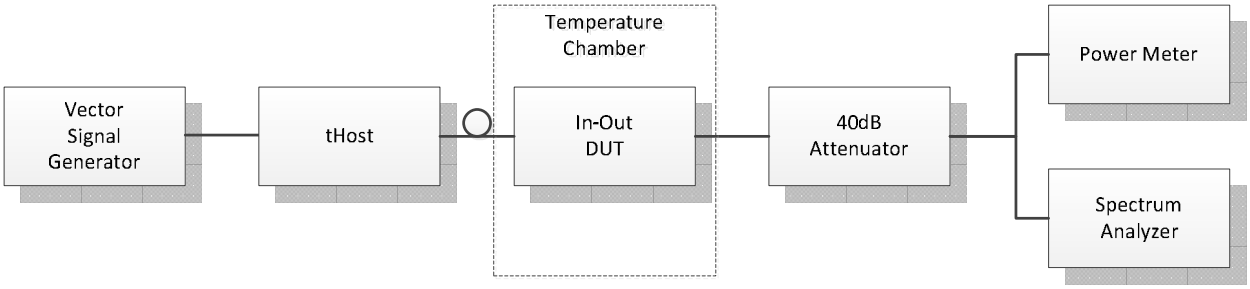


Equipment placed 80 cm above ground on a rotating table platform.

Frequency Stability

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

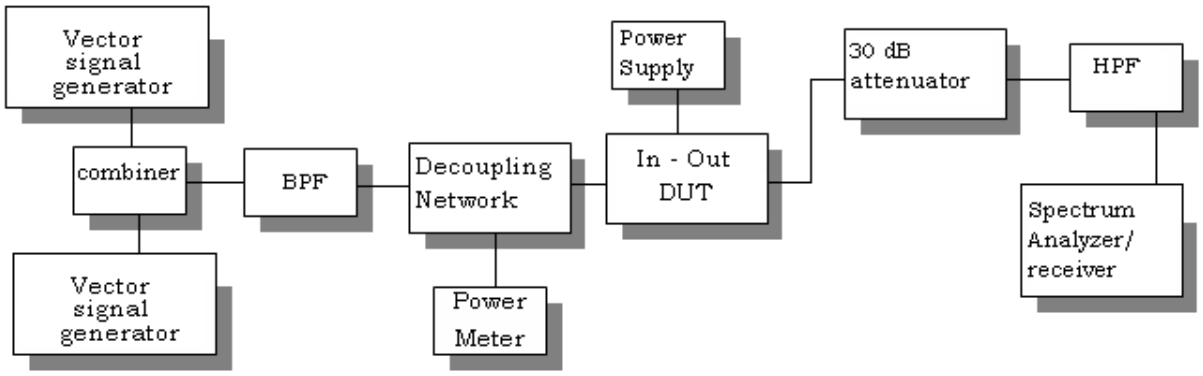
Frequency Stability Test Setup Diagram



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.

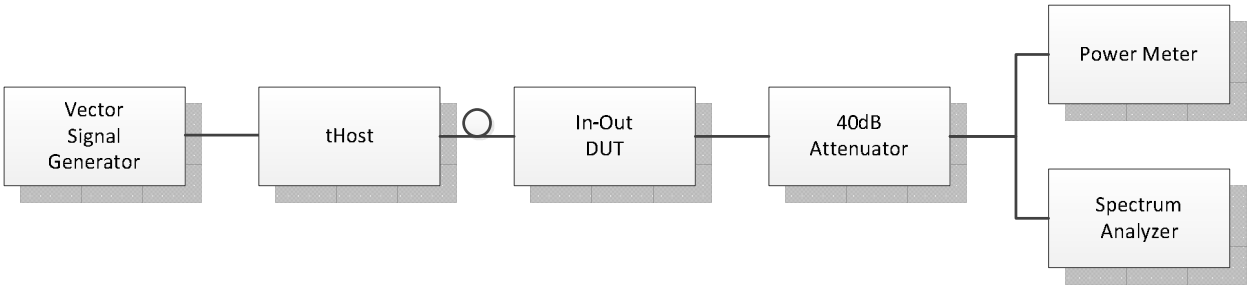
Intermodulation Test Setup Diagram



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



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 1 700 MHz DL Measurement Matrix

Modulation	# Carriers	Notation	Frequency (MHz)
GSM	1	GSM-8TS	728.4, 742.5, 756.6
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 2 850 MHz DL Measurement Matrix

Modulation	# Carriers	Carrier	Frequency (MHz)
Modulation	# Carriers	Carrier	Frequency (MHz)
GSM	1	GSM-8TS	869.4, 881.5, 893.6
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 DL Modulation Waveforms

Notation	Waveform	Bandwidth (MHz)
GSM-8TS	3GPP TS45	0.2
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 four modulations (GSM-8TS, F1C-C2K, DL1C-WCDMA, LTE5M) for the mid, lowest and highest frequency within the 700 MHz (728 – 757 MHz) and 850 MHz (869 – 894 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

Frequency, MHz	Output power, dBm	Bandwidth, MHz	Limit, dBm
F1C-C2K modulation			
730.5	43.6	1.25	43 ± 1
742.5	43.5		
754.5	43.5		
DL1C-WCDMA modulation			
730.5	43.6	5	43 ± 1
742.5	43.5		
754.5	43.6		
LTE5M modulation			
730.5	43.5	5	43 ± 1
742.5	43.5		
754.5	43.5		
GSM-8TS modulation			
728.4	43.7	0.2	43 ± 1
742.5	43.3		
756.6	43.5		

850 MHz band

Frequency, MHz	Output power, dBm	Bandwidth, MHz	Limit, dBm
F1C-C2K modulation			
871.5	43.4	1.25	43 ± 1
881.5	43.4		

891.5	43.6		
DL1C-WCDMA modulation			
871.5	43.5	5	43 ± 1
881.5	43.5		
891.5	43.5		
LTE5M modulation			
871.5	43.4	5	43 ± 1
881.5	43.7		
891.5	43.4		
GSM-8TS modulation			
869.4	43.3	0.2	43 ± 1
881.5	43.6		
893.6	43.4		

Table 4 Output Power Measurement

Conclusion: As the table above indicates, the maximum power output value of 43.7 dBm was obtained with **LTE5M** modulation at 881.5MHz bandwidth of 5MHz (850 band) and with GSM-8TS modulation at 728.4MHz bandwidth of 200kHz (700 band).

3.0 Occupied Bandwidth

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 700 MHz (728 – 757 MHz) and 850 MHz (869 – 894 MHz) band.

The occupied bandwidth of input signal and output signal are shown in section 3.2 in Figures A1-8 (700 MHz band) and A9-16 (850 MHz 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

Full results for occupied bandwidth measurements are shown in Table **5**.

3.2 Input and Output Signal Figure A1-A8

700 MHz band

Fig. A1. F1C-C2K (Input)

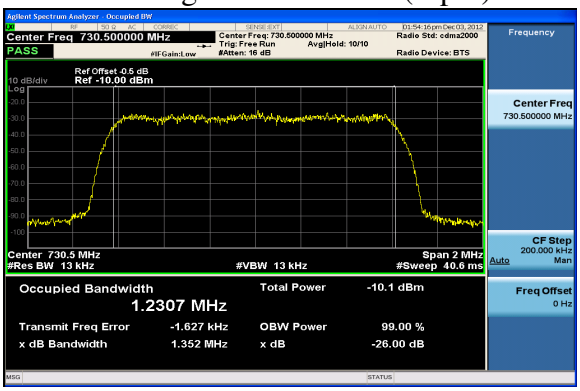


Fig. A2. F1C-C2K (Output)

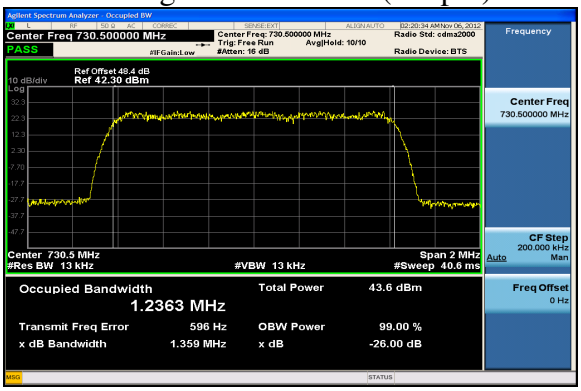


Fig. A3. DL1C-WCDMA (Input)

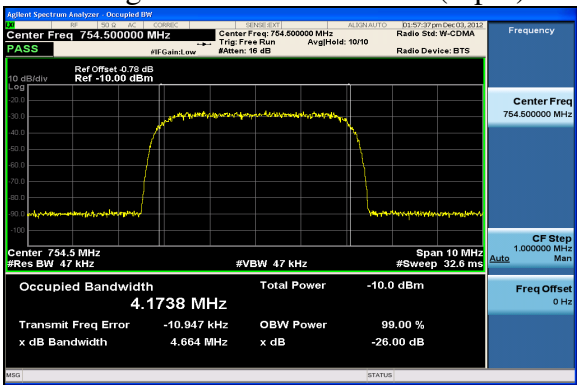


Fig. A4. DL1C-WCDMA (Output)

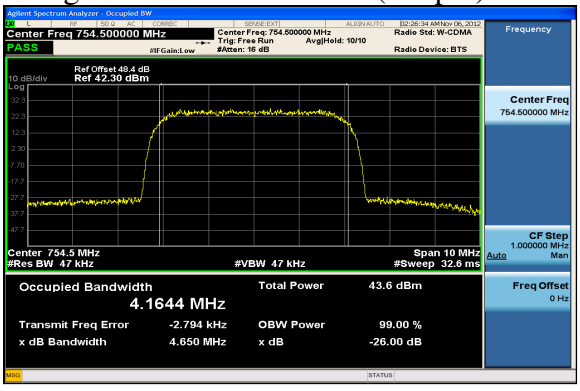


Fig. A5. LTE5M (Input)

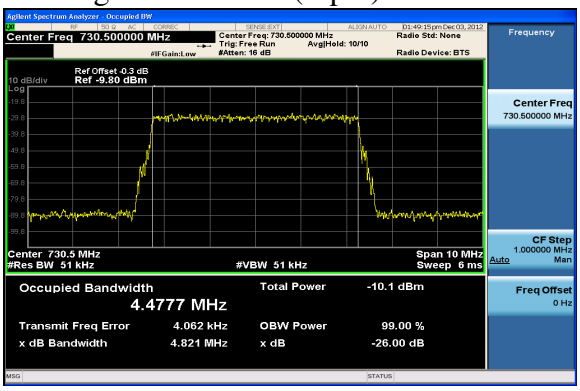


Fig. A6. LTE5M (Output)

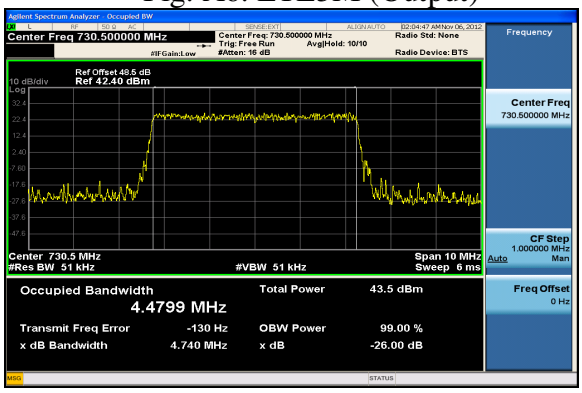


Fig. A7. GSM-8TS (Input)

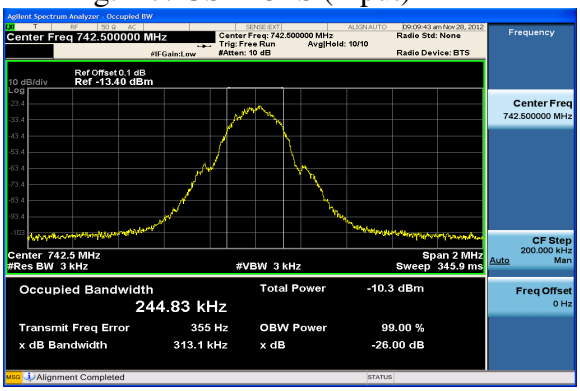
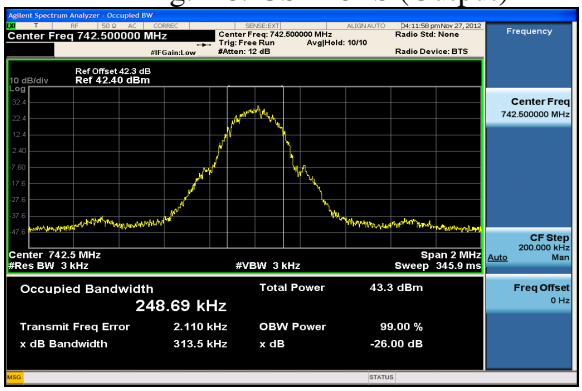


Fig. A8. GSM-8TS (Output)



850 MHz band

Fig. A9. F1C-C2K (Input)

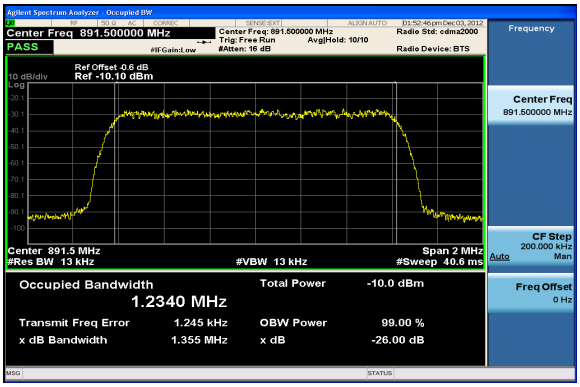


Fig. A10. F1C-C2K (Output)

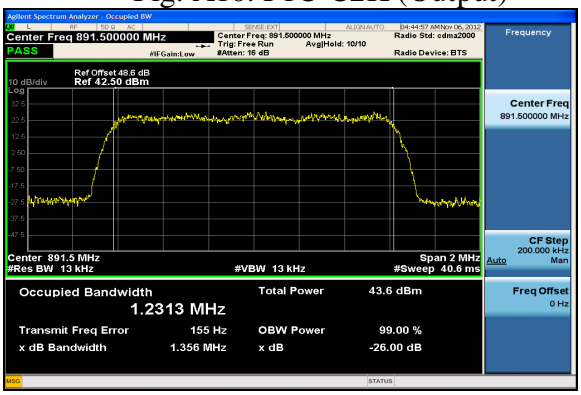


Fig. A11. DL1C-WCDMA (Input)

Fig. A12. DL1C-WCDMA (Output)

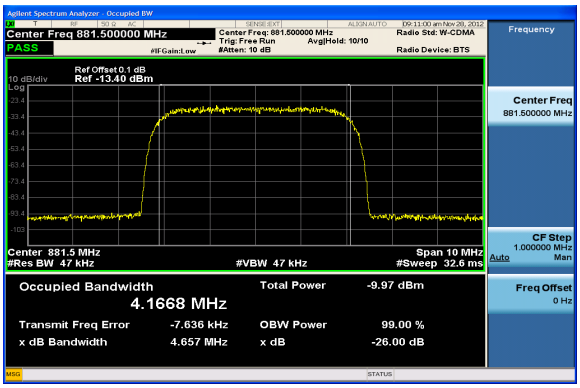


Fig. A13. LTE5M (Input)

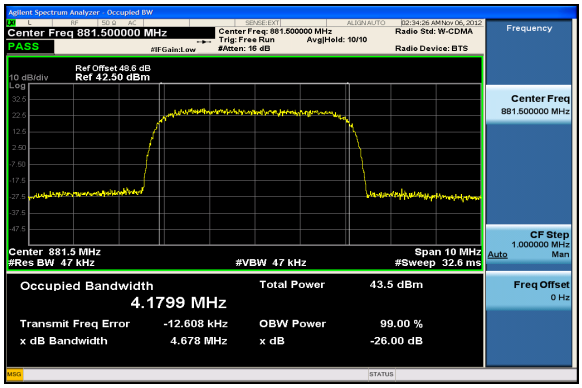


Fig. A14. LTE5M (Output)

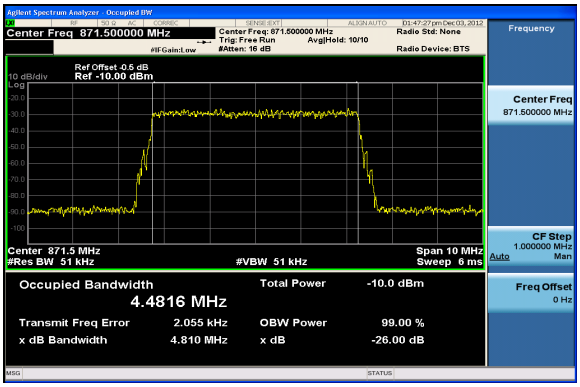


Fig. A15. GSM-8TS (Input)

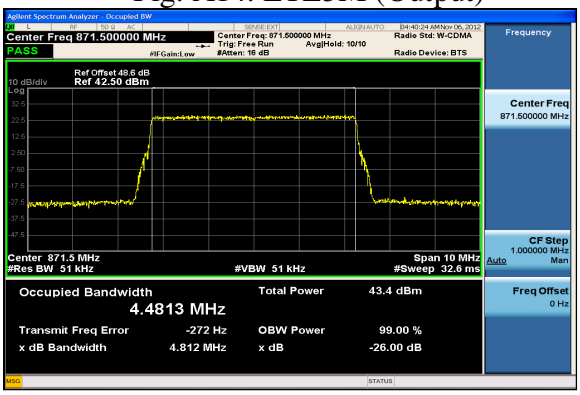
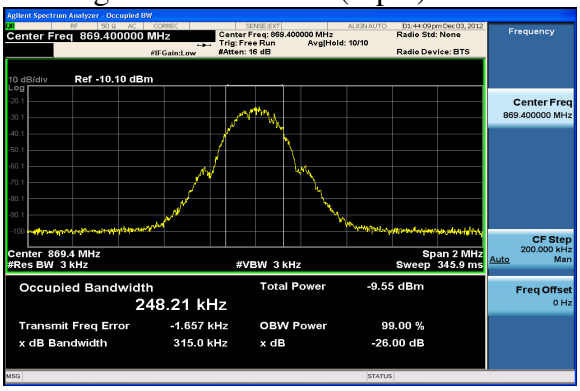


Fig. A16. GSM-8TS (Output)



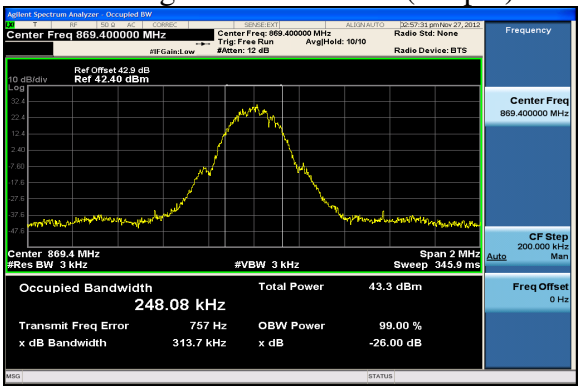


Figure A1, A2, A9, A10 – occupied bandwidth for input and output signals CDMA2000 modulation at 1.25MHz bandwidth for 700 and 850 MHz. A3, A4, A11, A12 – occupied bandwidth for input and output signals WCDMA modulation at 5MHz bandwidth for 700 MHz and 850 MHz band, appropriately. A5, A6, A13, A14 – occupied bandwidth for input and output signals LTE5M modulation at 5MHz bandwidth for 700 MHz and 850 MHz band, appropriately. A7, A8, A15, A16 - occupied bandwidth of input and output signals GSM modulation at 200kHz bandwidth for 700MHz and 850MHz band, appropriately.

700 MHz band

Modulation	OBW (MHz) @ low frequency	OBW (MHz) @ center frequency	OBW (MHz) @ high frequency	OBW (MHz) of Input
F1C-C2K	1.236	1.23	1.235	1.23
DL1C-WCDMA	4.16	4.16	4.16	4.16
LTE5M	4.48	4.47	4.47	4.48
GSM-8TS	0.246	0.249	0.249	0.245

850 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	4.17	4.18	4.16	4.17
LTE5M	4.48	4.47	4.47	4.48
GSM-8TS	0.248	0.248	0.245	0.248

Table 5. Occupied bandwidth measurements (Output signal)

Note: The difference of the output signal and input signal bandwidth is less than 10kHz.The spectrum shapes of output are similar to the input.

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 worst case data is shown in the figures B1 – B4 for 700 MHz and in the figures B5 – B8 850 MHz 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 4 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.
(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.

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

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.

700 MHz band

Fig. B1. GSM-8TS

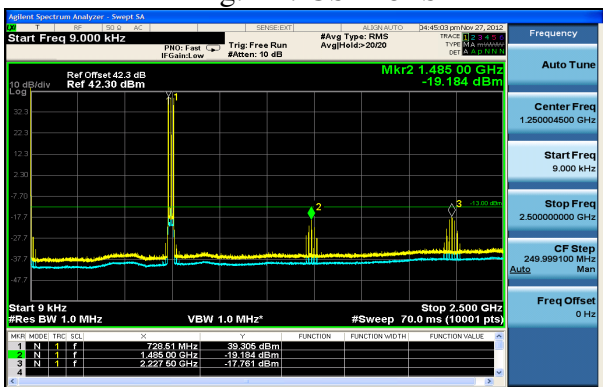


Fig. B2. F4C-C2K

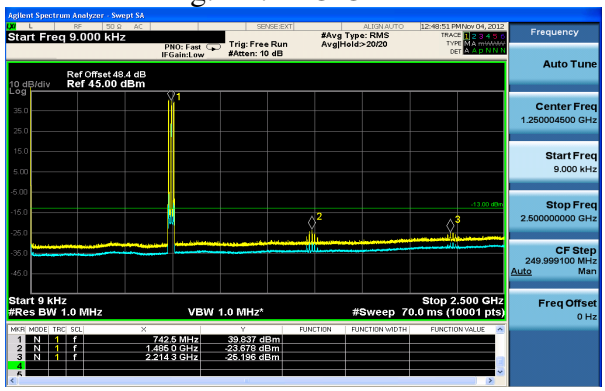


Fig. B3. GSM-8TS

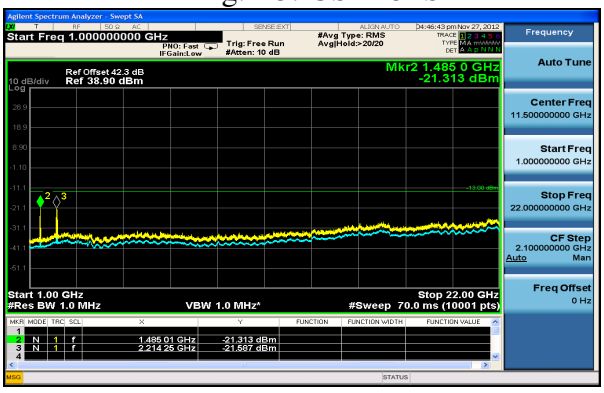
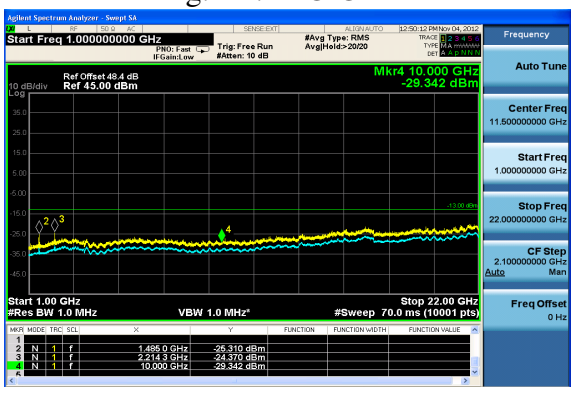


Fig. B4. F4C-C2K



850 MHz Band

Fig. B5. GSM-8TS

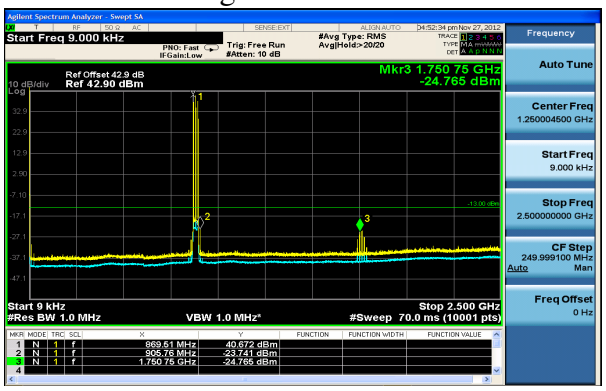


Fig. B6. F3C-LTE5M

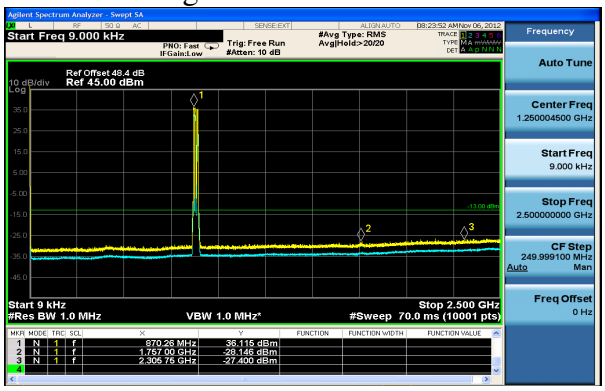


Fig. B7. GSM-8TS

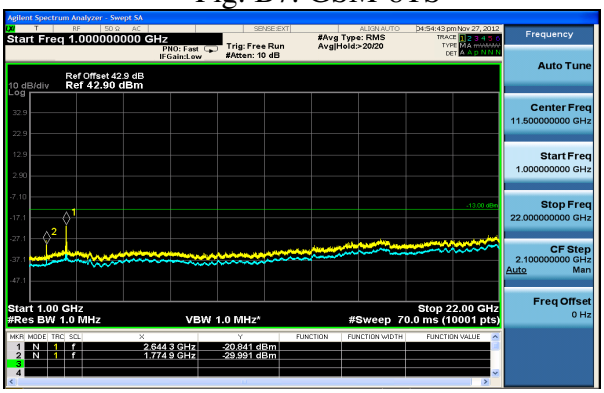
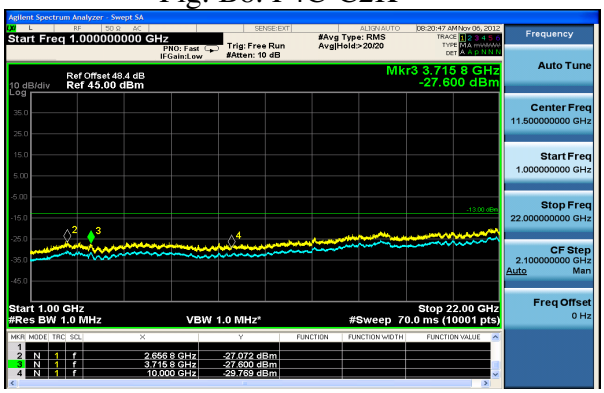


Fig. B8. F4C-C2K



5.0 Band Edge

5.1 Methodology

Measurements were performed at four modulations (GSM-8TS, DL1C-WCDMA, F1C-C2K, and LTE5M) for the lowest and highest frequency within the band.

Test data is shown in the figures C1 – C8 (700 MHz band) and in the figures C9 – C16 (850 MHz band) in section 5.2, and in the tables in section 5.3.

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.

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	13	13	0
DL1C-WCDMA	30	47	1.95
LTE5M	30	47	1.95
GSM-8TS	3	3	0

850 MHz 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
GSM-8TS	3	3	0

Low end

700 MHz band

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

850 MHz 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
GSM-8TS	3	3	0

5.2 Results – Figures C1 - C16 (Plots)

700 MHz band

Fig. C1. F1C-C2K at low edge

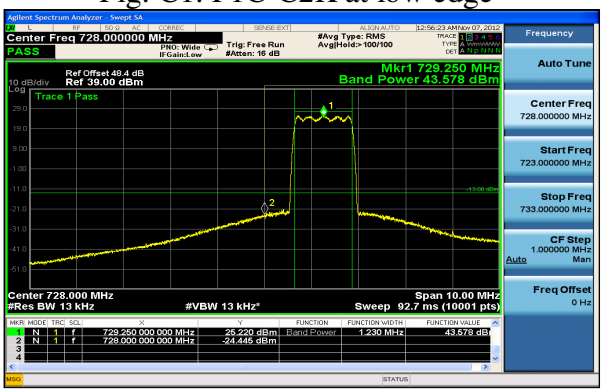


Fig. C2. F1C-C2K at high edge

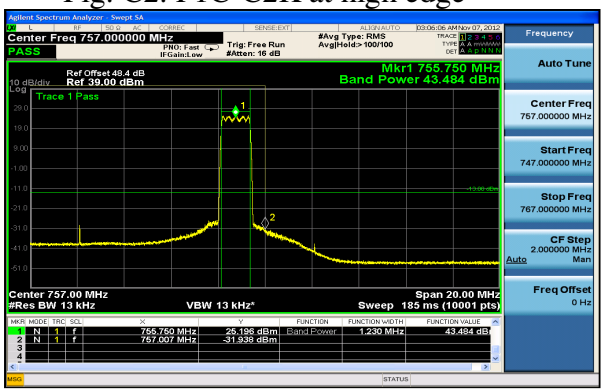


Fig. C3. DL1C-WCDMA at low edge

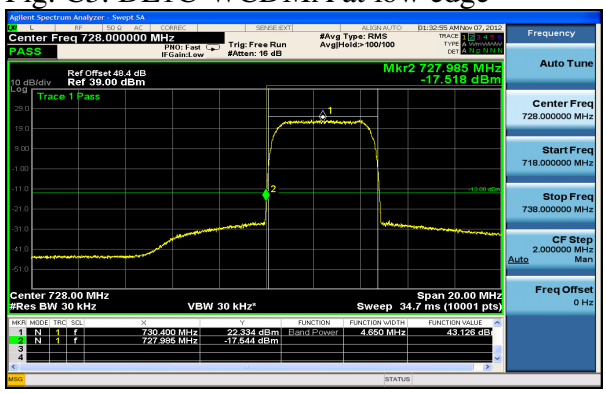


Fig. C4. DL1C-WCDMA at high edge

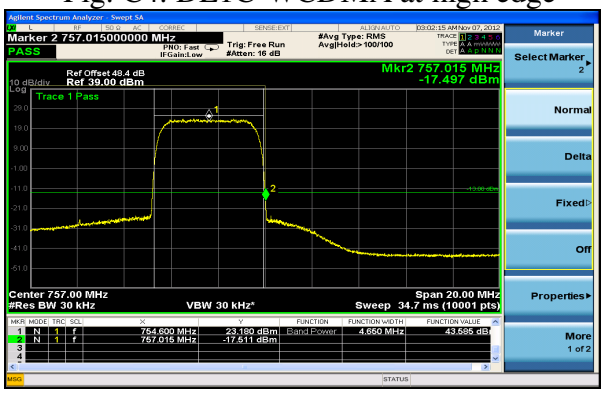


Fig. C5. LTE5M at low edge

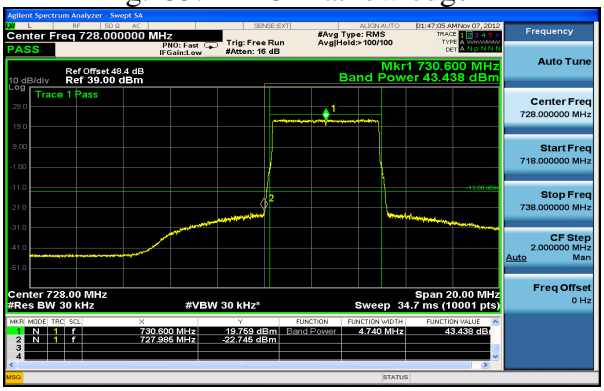


Fig. C6. LTE5M at high edge

Fig. C7. GSM-8TS at low edge

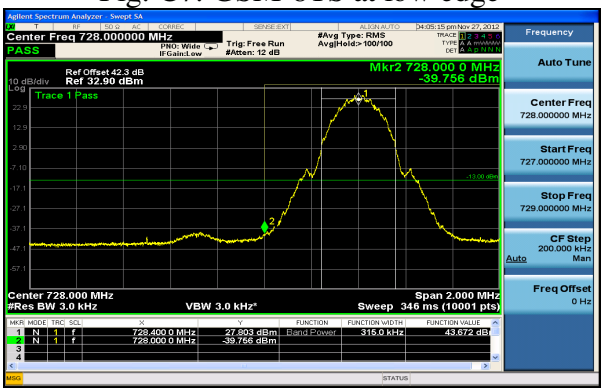
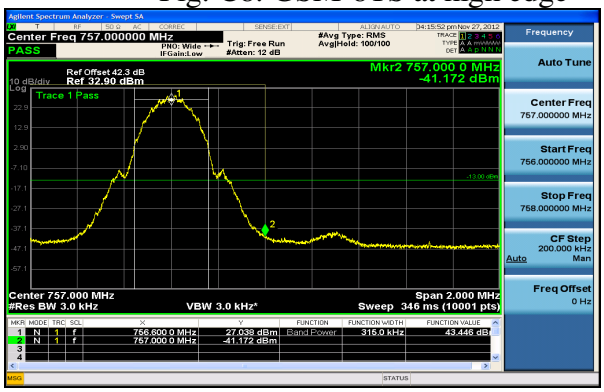


Fig. C8. GSM-8TS at high edge



850 MHz band

Fig. C9. F1C-C2K at low edge

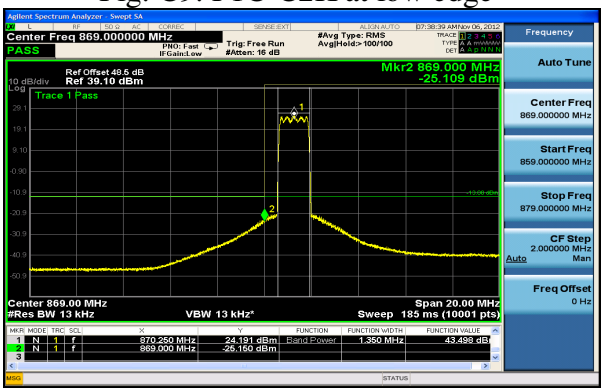


Fig. C10. F1C-C2K at high edge

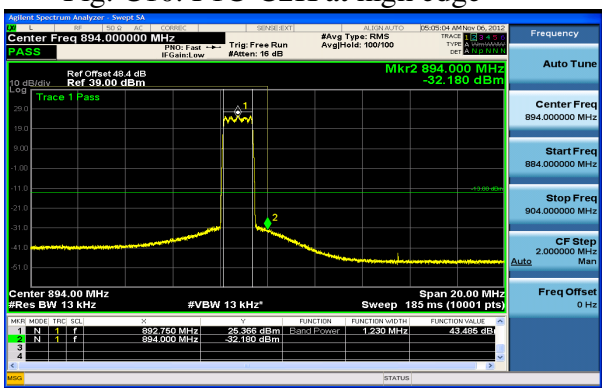


Fig. C11. DL1C-WCDMA low edge

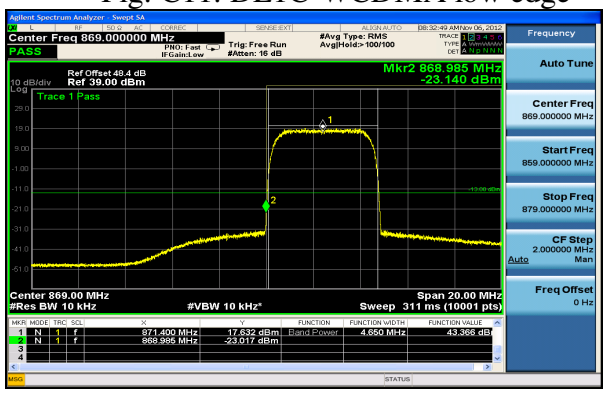


Fig. C12. DL1C-WCDMA high edge

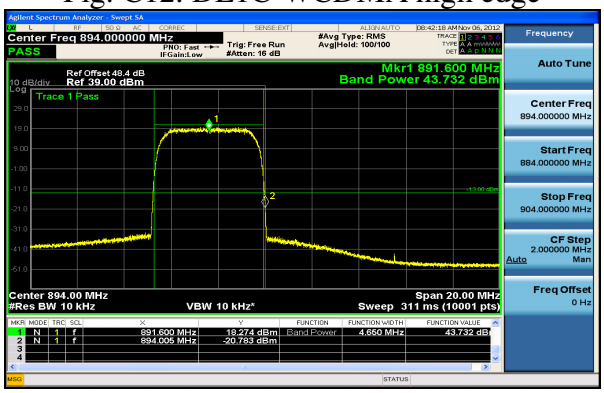


Fig. C13. LTE5M low edge

Fig. C14. LTE5M high edge

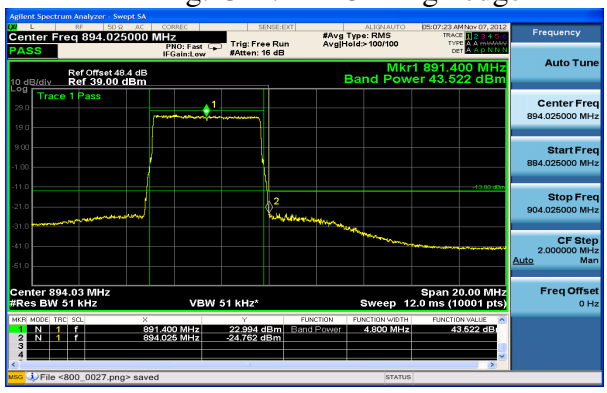


Fig. C15. GSM-8TS low edge

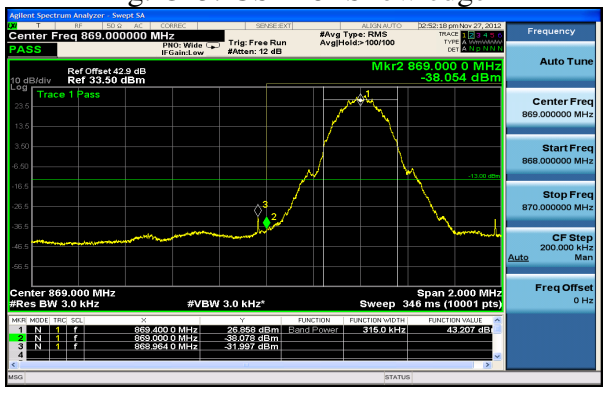
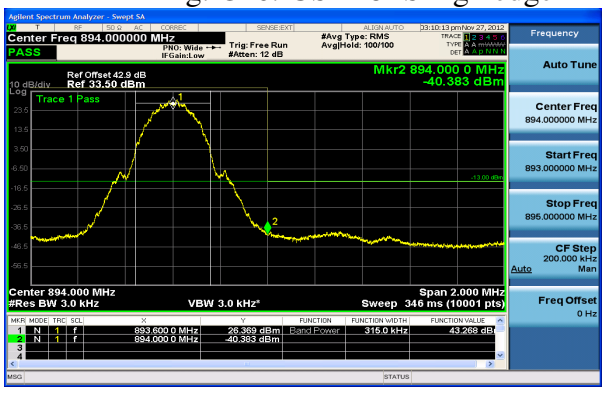


Fig. C16. GSM-8TS high edge



5.3 Results – Summary of Band Edge Emission

Low end

700 MHz band

Modulation	Carrier Freq (MHz)	Edge (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	729.25	-24.445	0	-13	11.45	PASS
WCDMA	730.4	-17.544	1.95	-13	2.59	PASS
LTE5M	730.6	-22.745	1.95	-13	7.8	PASS
GSM-8TS	728.4	-39.756	0	-13	26.756	PASS

850 MHz band

Modulation	Carrier Freq (MHz)	Edge (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	870.25	-25.15	0	-13	12.15	PASS
WCDMA	871.4	-23.017	6.7	-13	3.32	PASS
LTE5M	871.6	-24.355	-0.26	-13	11.62	PASS
GSM-8TS	869.4	-41.172	0	-13	28.172	PASS

High end

700 MHz band

Modulation	Carrier Freq (MHz)	Edge (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	755.75	-31.938	0	-13	18.94	PASS
WCDMA	754.4	-17.511	1.95	-13	2.56	PASS
LTE5M	754.6	-20.642	1.95	-13	5.69	PASS
GSM-8TS	756.6	-38.054	0	-13	25.054	PASS

850 MHz band

Modulation	Carrier Freq (MHz)	Edge (dBm)	Correction factor, dB	Limit (dBm)	Margin (dB)	Result
CDMA2000	892.75	-32.18	0	-13	19.18	PASS
WCDMA	891.4	-20.783	6.7	-13	1.08	PASS
LTE5M	891.6	-24.762	-0.26	-13	12.02	PASS
GSM-8TS	893.6	-40.383	0	-13	27.383	PASS

Table 6. Band edge measurements.

6.0 Field Strength of Spurious Radiation

6.1 Methodology

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

Worst-case data is shown in the figures D1 – D2 in section 6.3.

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.

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 margins exceeds 20 dB.

6.3 Results – Figure D1 - D2

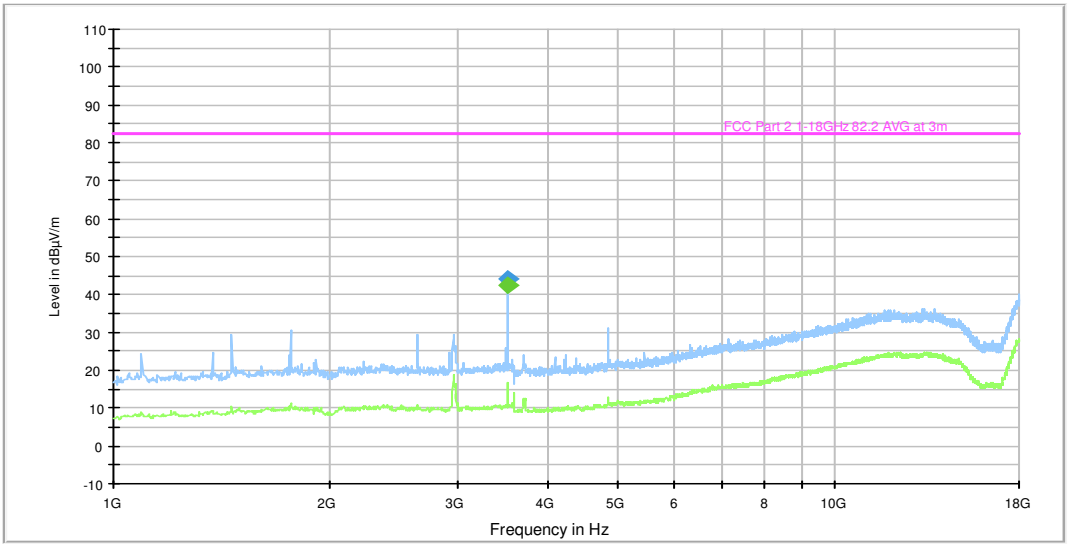


Figure D1. Data for radiated spurious emission 1 – 18 GHz is presented where the blue line shows the peak max hold and the green line shows the average max hold.

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

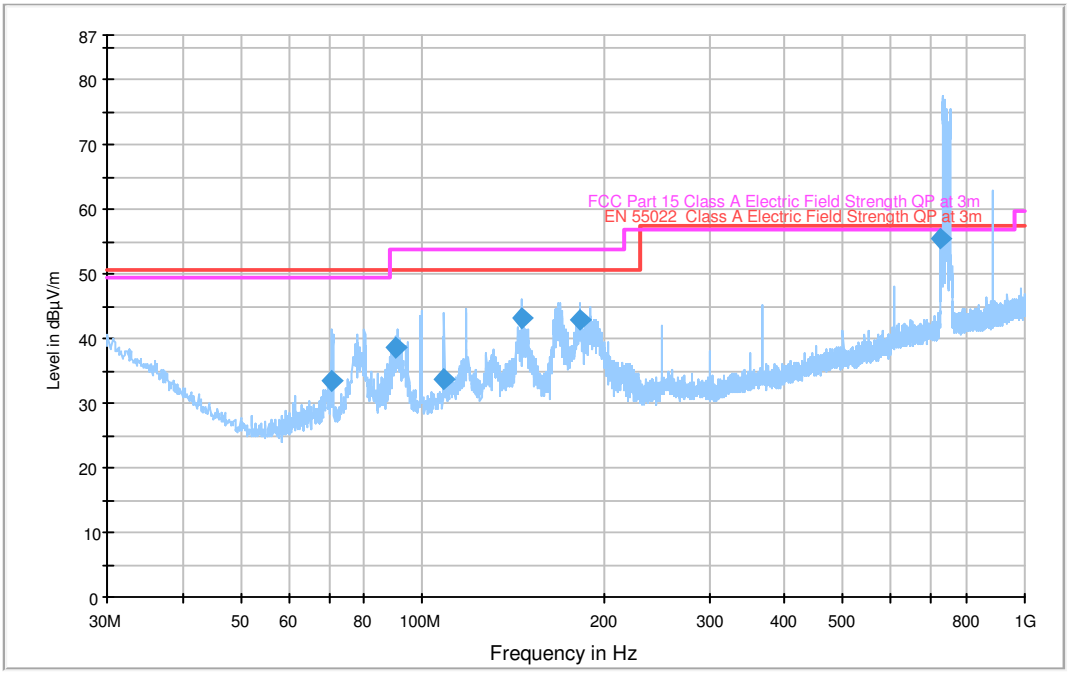


Figure D2. Data for radiated spurious emission 30MHz – 1GHz is presented where the blue line shows the peak max hold and the blue dots show the quasi-peak measurement (Reference use only)

Frequency (MHz)	QuasiPeak (dBµV/m)	Meas. Time (ms)	Bandwidth (kHz)	Antenna height (cm)	Polarity	Turntable position (deg)	Pk	Margin (dB)	Limit (dBµV/m)
31.47292	19.1	1000.00	120.000	300	H	348	25.5	20	39.1
89.95028	26.3	1000.00	120.000	100	V	22	40	17.2	43.5
99.08408	23.8	1000.00	120.000	227	V	349	35.7	19.7	43.5
108.52968	21.6	1000.00	120.000	390	V	348	34.9	21.9	43.5
118.39968	25.9	1000.00	120.000	320	H	108	36.9	17.6	43.5
139.99984	28.5	1000.00	120.000	400	H	108	31.4	15	43.5
146.41352	32.5	1000.00	120.000	100	V	107	36.3	11	43.5
183.01292	32.4	1000.00	120.000	349	H	252	35.1	11.1	43.5
192.64924	30.6	1000.00	120.000	360	H	240	34.1	12.9	43.5
200.092	28.2	1000.00	120.000	100	V	22	31.5	15.3	43.5
250	36.1	1000.00	120.000	100	V	222	37.8	10.3	46.4
366.002	32.3	1000.00	120.000	220	H	248	33.5	14.1	46.4
724.52586	21.1	1000.00	120.000	299	V	22	27	25.3	46.4

Radiated Emission Data – 10m Distance at OATS (Reference use only)

The maximum quasi-peak at 146MHz (32.5dBuV/m) is equivalent to ERP of -54.42 dBm which has greater than 20 dB margin from -13 dBm ERP limit. Therefore substitution method is not required as no signals are within 20dB of limit.

7.0 Frequency Stability

7.1 Methodology

Measurements were performed at CW.

Data is shown in the table 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.
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.

7.2 Results -

Band	Error in PPM	Compliant
700 MHz	0.0	Yes
850 MHz	0.0	Yes

Table 7. Frequency error in ppm

8.0 Intermodulation

8.1 Methodology

Measurements were performed at four modulations (GSM, CDMA 2000, WCDMA, LTE5M). For 700 MHz band, 2 carrier of each modulation (2-tone test) were tested. Two tests were done for low and high edge of the operating band.

For 850 MHz band, similarly with 700 MHz band, 2-tone test was done with GSM and CDMA 2000. 3 tones were tested with WCDMA and LTE modulation. The three channels created the third product of IMD right adjacent to the band edge and the higher product IMD was most severe out of band. Only one test of each was conducted for WCDMA and LTE IMD.

Worst-case data is shown in the figures in sections 8.2 in Figures E1 – E6.
Out of band emission due to intermodulation is lower than -13dBm limit.

8.2 Results - Figures E1 – E6

700 MHz band

Fig. E1. 2 tones LTE5M at low edge

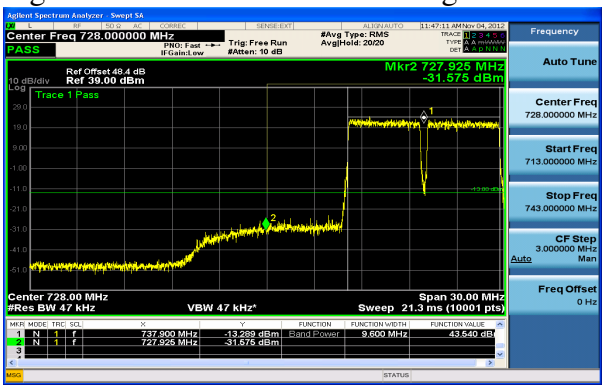


Fig. E2. 2 tones WCDMA at high edge

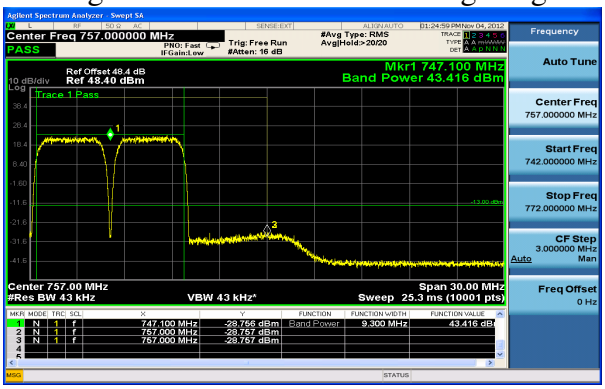
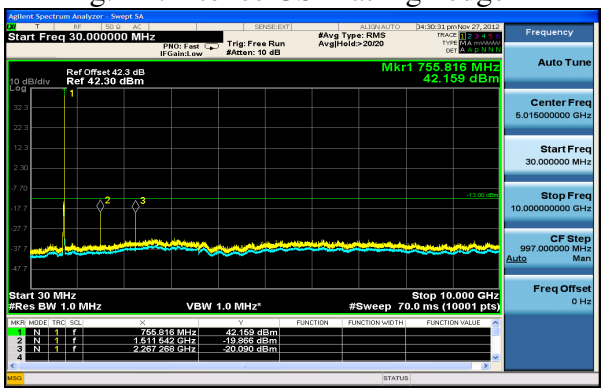


Fig. E3. 2 tones GSM at low edge

Fig. E4. 2 tones GSM at high edge



Modulation	Carriers Location (MHz)	Highest intermod product (dBm) at 1MHz RBW	Limit, (dBm)	Margin, (dBm)	Mark
GSM	755.6, 756.2	-19.9	-13	-6.2	Pass
	728.8, 729.4	-18.1		-65.1	
CDMA 2000	750.75, 753.25	-23.5		-10.2	
	731.75, 734.25	-21.8		-8.8	
LTE5M	744.6, 749.6	-26.9		-13.9	
	735.4, 740.4	-22.7		-9.7	
WCDMA	744.6, 749.6	-26.2		-13.2	
	735.4, 740.4	-22.9		-9.9	

Table 8. Level of intermodulation product for 700 MHz band.

850 MHz band

Fig. E5. 3 tones WCDMA

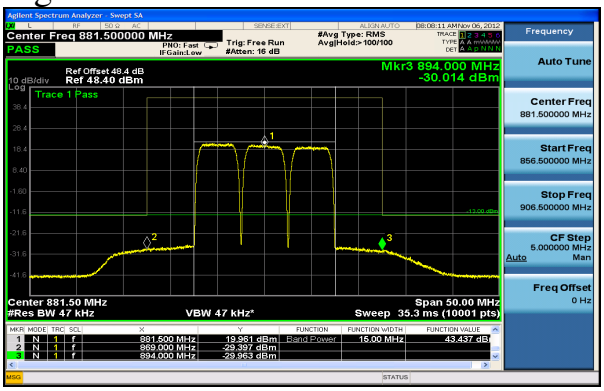


Fig. E6. 2 tones GSM at high edge

Modulation	Carriers Location (MHz)	Highest intermod product (dBm) at 1MHz RBW	Limit, (dBm)	Margin, (dBm)	Mark
GSM	892.6, 893.2	-18.2	-13	-5.2	Pass
	869.8, 870.4	-19.1		-6.1	
CDMA 2000	872.75, 875.25	-23.6		-10.6	
	887.75, 890.25	-34.0		-21.0	
LTE5M	876.5, 881.5, 886.5	-25.6		-12.6	
WCDMA	876.5, 881.5, 886.5	-25.5		-12.5	

Table 9. Level of intermodulation product for 850 MHz band.

9.0 Passband Gain and Bandwidth

9.1 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.

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 the table below:

9.2 Results

700 MHz band

Fig. A1. Passband Bandwidth

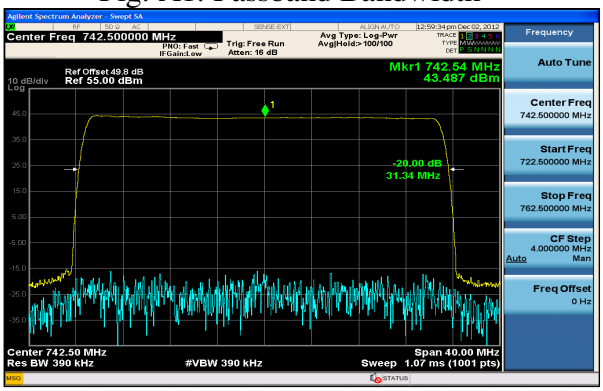
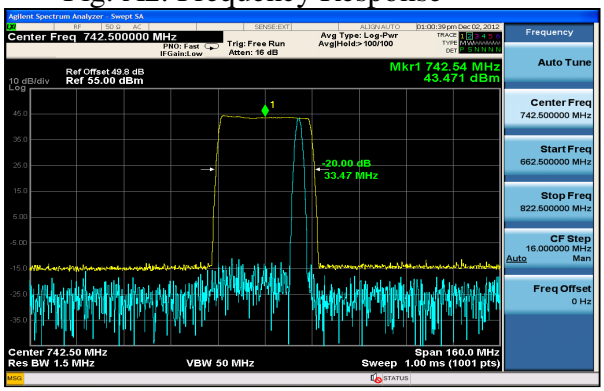


Fig. A2. Frequency Response



850 MHz band

Fig. A3. Passband Bandwidth

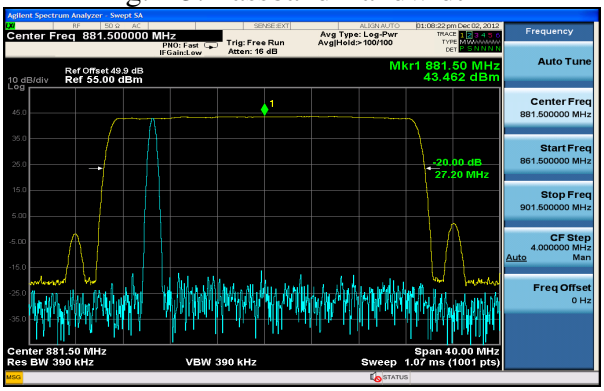
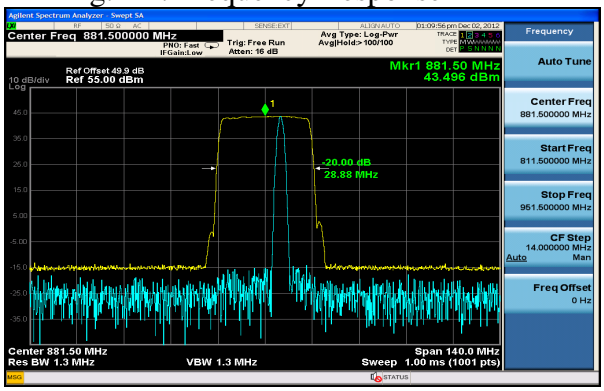


Fig. A4. Frequency Response



Operating Band	Nominal Input @ tHost (dBm)	Passband Gain	Passband Bandwidth (MHz)
700	-17	60.5	31.34
850	-17	60.5	27.2

Table 10 RF Output Passband Gain and Bandwidth