Certification Test Report

CFR 47 FCC Part 15, Subpart C Section 15.247 and FCC Subpart B
Industry Canada RSS 210, Issue 8
And ICES-003

Rainforest Automation
RAVEn

FCC ID # YCXRFA-Z106
IC # 8919A-RFAZ106
Project Code C-0101991

(Report C-0101991-RA-1-2)
Revision: 2
This report supersedes C-0101991-RA-1-1

June 02, 2011

Prepared for:	Rainforest Automation
Author:	Lixin Wang EMC Technologist
Approved by:	Nick Kobrosly Director of Canadian Operations

Confidentiality Statement: This report and the information contained herein represent the results of testing articles/products identified and selected by the client. The tests were performed to specifications and/or procedures approved by the client. National Technical Systems ("NTS") makes no representations expressed or implied that such testing fully demonstrates efficiency, performance, reliability, or any other characteristic of the articles being tested, or similar products. This report should not be relied upon as an endorsement or certification by NTS of the equipment tested, nor does it represent any statement whatsoever as to its merchantability or fitness of the test article or similar products for a particular purpose. This document shall not be reproduced except in full without written approval from National Technical Systems ("NTS") and the customer.

Report Summary

Test Facility:	**National Technical Systems, Canada** Product Integrity Laboratory 5151-47th Street, N.E. Calgary Alberta T3J 3R2
Accreditation Numbers:	0214.22 Electrical 0214.23 Mechanical Accredited by A2LA The American Association for Laboratory Accreditation CLIENTS SERVED: All interested parties FIELDS OF TESTING: Electrical/Electronic, Mechanical/Physical ACCREDITATION DATE:: May 14, 2009 VALID TO: December 31, 2011
Applicant:	Rainforest Automation 34 W 7th Avenue V5Y 1L6 Vancouver, BC Canada
Customer Representative:	Name: Jacques Farges Phone #: 604-630-4287 Email Address: jfarges@rainforestautomation.com

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Test Summary

Appendix	Test/Requirement Description	Deviations* from:			Pass / Fail	Applicable FCC Rule Parts	Applicable Industry Canada Rule Parts
		Base Standard	Test Basis	NTS Procedure			
A	Power line Conducted Emission	No	No	No	Pass	FCC Subpart C 15.207 (a) FCC Subpart B 15.107	RSS-Gen Issue 3 7.2.4 ICES-003 Issue 4
B	6 dB Bandwidth	No	No	No	Pass	FCC Subpart C 15.247 (a) (2)	RSS 210 Issue 8 A8.2 (a)
C	26 dB BAndwidth	No	No	No	N/A	FCC Publication 558074	RSS Gen Issue 3 4.6
D	Occupied Bandwidth (99% emission bandwidth)	No	No	No	N/A	N/A	RSS-Gen Issue 3 4.6.1
E	Peak Power Output	No	No	No	Pass	FCC Subpart C 15.247 (b) (3)	RSS 210 Issue 8 A8.4 (4)
F	Power Spectral Density	No	No	No	Pass	FCC Subpart C 15.247 (e)	RSS 210 Issue 8 A8.2 (b)
G	Conducted Spurious Emissions	No	No	No	Pass	FCC Subpart C 15.247 (d)	RSS 210 Issue 8 A8.5
H	Conducted Spurious Emissions Band Edge	No	No	No	Pass	FCC Subpart C 15.247 (d)	RSS 210 Issue 8 A8.5
I	Duty Cycle Correction factor	No	No	No	N/A	FCC Subpart C 15.35 (c)	RSS-Gen Issue 3 4.5
J	Radiated Spurious Emissions Band Edge	No	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 8 2.5, A8.5
K	Radiated Spurious Emissions (TX and RX)	No	No	No	Pass	FCC Subpart C 15.247, 15.205 FCC Sbupart B 15.109	RSS 210 Issue 8 2.5, A8.5 RSS Gen Issue 3 section 4.10 and section 6 for RX ICES-003 Issue 4

Test Result: The product presented for testing complied with test requirements as shown above.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Signatures:

Lixin Wang
2011.06.07
16:17:24 -06'00'

Prepared By: _____
Lixin Wang
EMC Technologist

Glen
Moore

Digitally signed by Glen Moore
DN: cn=Glen Moore, c=CA, email=glen.moore@ntscorp.com
Date: 2011.06.07 16:44:59 -06'00'

Reviewed By: _____
Glen Moore
Wireless/EMC Manager

Alex Mathews
2011.06.07
17:33:38
-06'00'

Approved By: _____
Alex Mathews
Quality Management Representative

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Table of Contents

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Register of revisions

Revision	Date	Description of Revisions
1	May 13, 2011	Initial release
2	June 02, 2011	Release with updated transmitting antenna gain from client

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

1.0 INTRODUCTION

1.1 PURPOSE

The purpose of this document is to describe the tests applied by NTS Canada to demonstrate compliance of the RAVEn from Rainforest Automation to FCC Part 15 Subpart B, Subpart C section 15.247 for DTS transmitter and the equivalent sections of Industry Canada's RSS 210, Issue 8

2.0 EUT DESCRIPTION

2.1 CONFIGURATION

Description of EUT

	Name	Model	Revision	Serial Number
EUT	RFA-Z106	2.3	RFA-Z106	N/A
Power Supply	N/A			
Classification	Mobile			
Antenna	Integral, PCB trace, Maximum peak gain: 2.88 dBi.			
Modulation	0-QPSK			
EUT Size with Enclosure (H x W x D) (in mm)	6 0 x 20 x 5			
Channels/Frequency Range	16 channels, 2405 MHz -2480 MHz			
Functional Description	The device is a Zigbee Smart Energy Certified device using a PCB trace antenna to operate in the band 2405-2480 MHz inclusive, using channels 11 to 26. The output power is controlled through firmware as one of 4 power levels, 0, 1, 2 and 3. The purpose of the firmware is to communicate bidirectional information between the user of the device, and a ZigBee sensor or metering device, hereafter called the "Target Device". Communication to the Target Device can possibly occur through intermediary Zigbee mesh devices. Information from the Target Device is processed, and the processed information communicated to a PC through a USB serial port to other software. The firmware begins by searching for a Target Device . The firmware starts on a channel other than channel 26, at power level 3. If no Target Device is found on a channel, the next channel is tried. To change to channel 26, first the power level is lowered from 3 to 2, then the channel switched to channel 26. To change from channel 26, the channel is first changed from channel 26, then the power level increased from 2 to 3. For each Target Device found, an attempt is made to "join" with it, and when this is successful, all other Target Devices are ignored. Special test firmware is instead provided on the device for the purposes of certification testing. This firmware transmits or receives over channels 11 through 26, allowing output power to be varied. Firmware is controlled through a terminal window such as Hyperterminal.			

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

2.1.1 EUT POWERS

Voltage	USB powered from computer
Number of Feeds	N/A

2.2 EUT CABLES

Quantity	Routing		Shielded / Unshielded	Description	Cable Length (m)
	From	To			
1	Support Laptop	EUT	Shielded	USB extension	4.8

Note: USB extension cable was used to simulate vertical USB port.

2.3 MODE OF OPERATION DURING TESTS

The RAVEn was tested while Continuous Transmit and Receive modes. The EUT was tuned to a low, middle, and high channel to perform power, occupied bandwidth and spurious/harmonic tests.
While transmitting, the EUT was setup to operate at the intended maximum power output available to the end user (Setting "3").
Power level was reduced for Channel 26 (high channel) and set to "2" during the tests. This level will be implemented by Rainforest Automation in the production.

Support equipments described below were used for configuring the EUT and provide power to EUT via USB port. EUT was connected to the laptop during test.

3.0 SUPPORT EQUIPMENT

3.1 CONFIGURATION

Co-locate support equipment

Name	Model	Serial Number
Acer Laptop	Aspire one 532h-2807	LUSAL0D301021350861601
AC/DC adaptor of Acer laptop	ADP-40TH A LPS	ADT AP0400100201811BA2P101

4.0 TEST ENVIRONMENT

4.1 NORMAL TEST CONDITIONS

Temperature: 20 – 23 °C
Relative Humidity: 28 – 35 %
Atmospheric pressure: 883 – 890 mbar

The values are the limits registered during the test period.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDICES

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX A: POWER LINE CONDUCTED EMISSION

A.1. Base Standard & Test Basis

Base Standard	FCC PART 15.207 (a) FCC PART 15.107 RSS-Gen Issue 3 7.2.4 ICES-003 Issue 4
Test Basis	ANSI C63.4-2009 CAN/CSA-CEI/IEC CISPR 22-02
Test Method	SOP-CAG- EMC-02

A.2. Specifications

Frequency	**Limit FCC Part 15 RSS-Gen and ICES-003 Class B**	
	Quasi-Peak	**Average**
MHz	**dBµV**	**dBµV**
0.150 – 0.500	66 to 56[1]	56 to 46[1]
0.500 – 5.00	56	46
5.00 – 30.00	60	50

Note 1: decrease with the logarithm of the frequency

A.3. Test Procedure

ANSI C63.4-2009.

A.4. Operating Mode During Test

The RAVEn was tuned to low channel in continuous transmit mode and 100 % duty cycle at maximum rated RF output power (setting 3). EUT powered from Acer support computer.

.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

A.5. Test Results

Product Integrity Laboratory V2.5

Project Number: C-0101991 **Tester:** James MacKay
Model: Rainforest Automation - RAVEn **Test ID:** CE02c-10m-0101991
Comments: Conf01: 120 VAC. 60 Hz to support computer. EUT in Tx (continuous, modulated) mode on Channel 11. Power setting = 3.

Standard: FCC15_B

Voltage/Line	Frequency (MHz)	Measurement Detector	Measured Value (dBµV)	Correction Factors (dB)	Emission Level (dBµV)	Limit Type	Limit (dBµV)	Margin (dB)
120 VAC Line	0.1563	Average	23.36	12.31	35.67	Average	55.66	**19.99**
120 VAC Line	0.1525	Quasi Peak	40.95	12.39	53.34	Quasi Peak	65.86	**12.52**
120 VAC Line	0.1914	Average	18.23	11.81	30.04	Average	53.98	**23.94**
120 VAC Line	0.1953	Quasi Peak	34.43	11.77	46.20	Quasi Peak	63.81	**17.61**
120 VAC Line	0.2593	Average	8.91	11.30	20.21	Average	51.45	**31.24**
120 VAC Line	0.2641	Quasi Peak	27.17	11.28	38.45	Quasi Peak	61.30	**22.85**
120 VAC Line	0.4028	Average	6.37	10.91	17.28	Average	47.80	**30.52**
120 VAC Line	0.4011	Quasi Peak	19.30	10.92	30.22	Quasi Peak	57.83	**27.61**
120 VAC Neutral	0.1563	Average	22.24	12.24	34.48	Average	55.66	**21.18**
120 VAC Neutral	0.1506	Quasi Peak	41.02	12.35	53.37	Quasi Peak	65.97	**12.60**
120 VAC Neutral	0.2037	Average	14.98	11.61	26.59	Average	53.46	**26.87**
120 VAC Neutral	0.2084	Quasi Peak	32.45	11.57	44.02	Quasi Peak	63.27	**19.25**
120 VAC Neutral	0.2349	Average	12.54	11.37	23.91	Average	52.27	**28.36**
120 VAC Neutral	0.2387	Quasi Peak	29.94	11.35	41.29	Quasi Peak	62.14	**20.85**
120 VAC Neutral	0.3282	Average	1.22	10.98	12.20	Average	49.50	**37.30**
120 VAC Neutral	0.3272	Quasi Peak	22.95	10.99	33.94	Quasi Peak	59.52	**25.58**

The emission measured with the least margin to the applicable limit was 53.34 dBµV with Quasi Peak detector at 0.1525 MHz. It has a 12.52 dB margin to the FCC Part 15 and RSS-Gen Issue 3 and ICES-003 Quasi peak limits.

A.6. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: James MacKay
Function: Compliance Specialist

A.7. Test date

March 10, 2011

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 1 Conducted Emission Line 150 kHz – 30 MHz Quasi-peak Detector

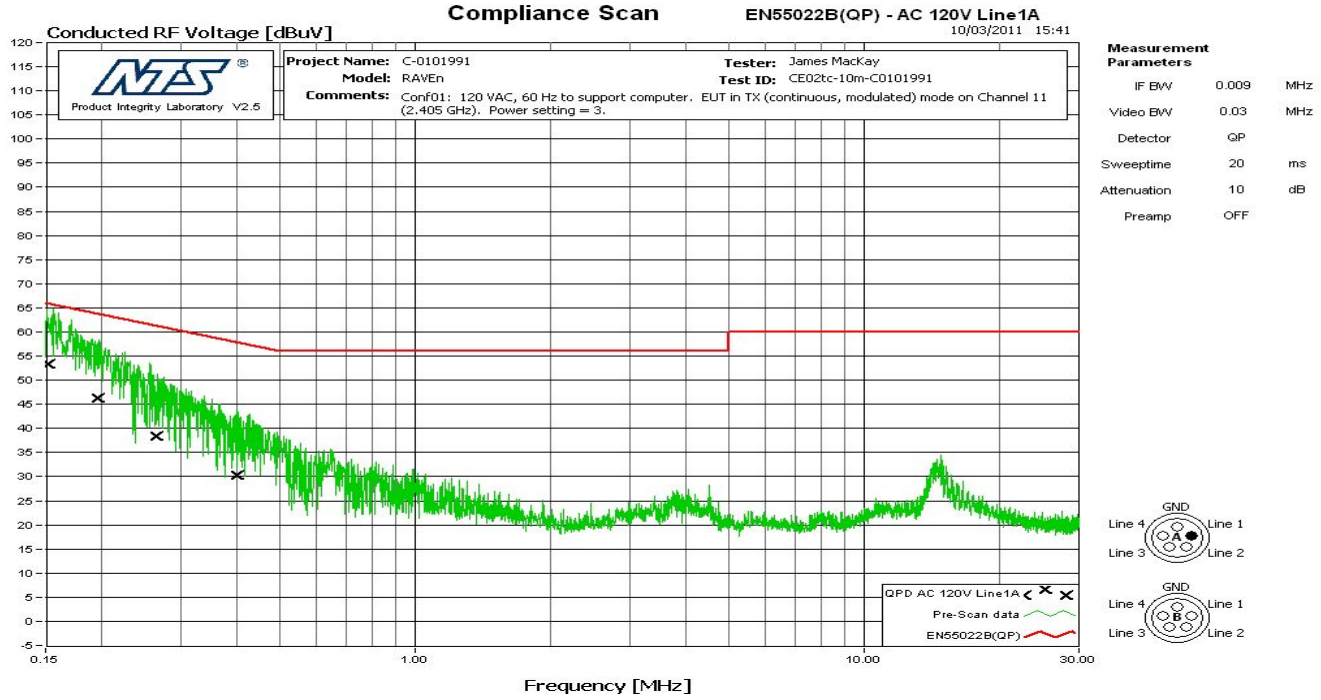
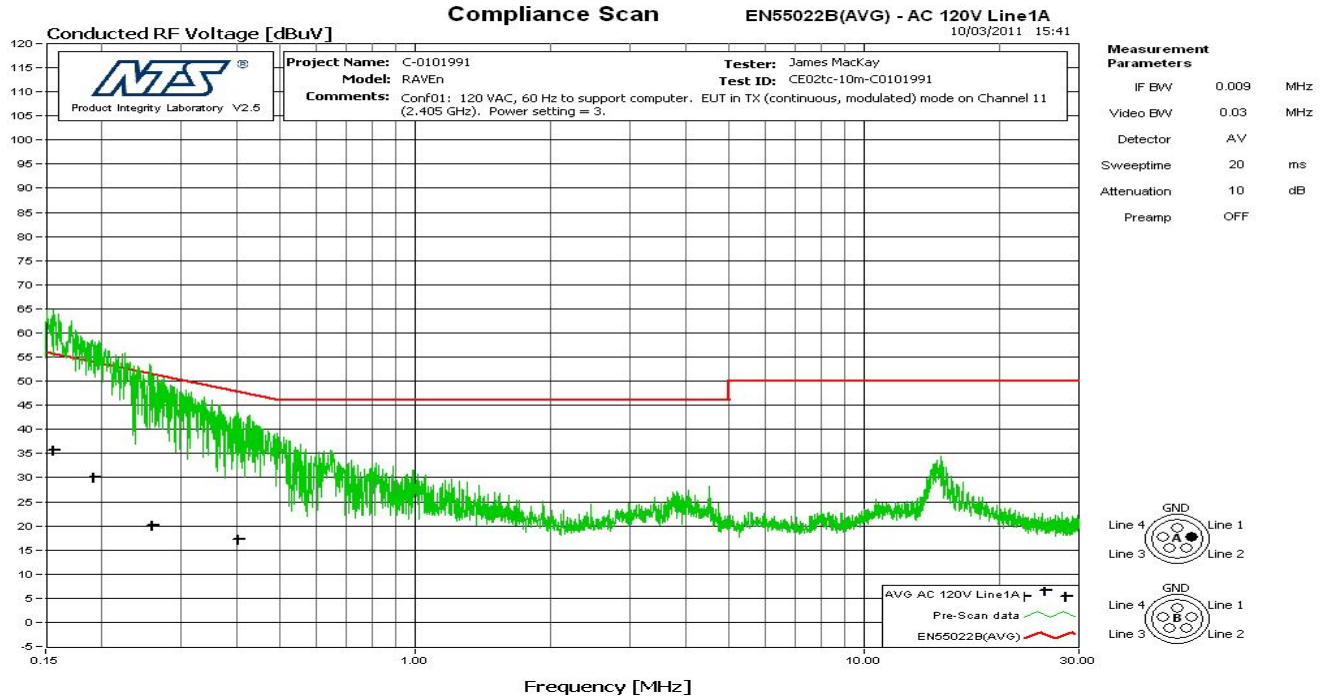


Figure 2 Conducted Emission Line 150 kHz – 30 MHz Average Detector USB unit



Note: The EN55022B limit was used to show the compliance to CISPR 22.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 3 Conducted Emission Neutral 150 kHz – 30 MHz Quasi-peak Detector

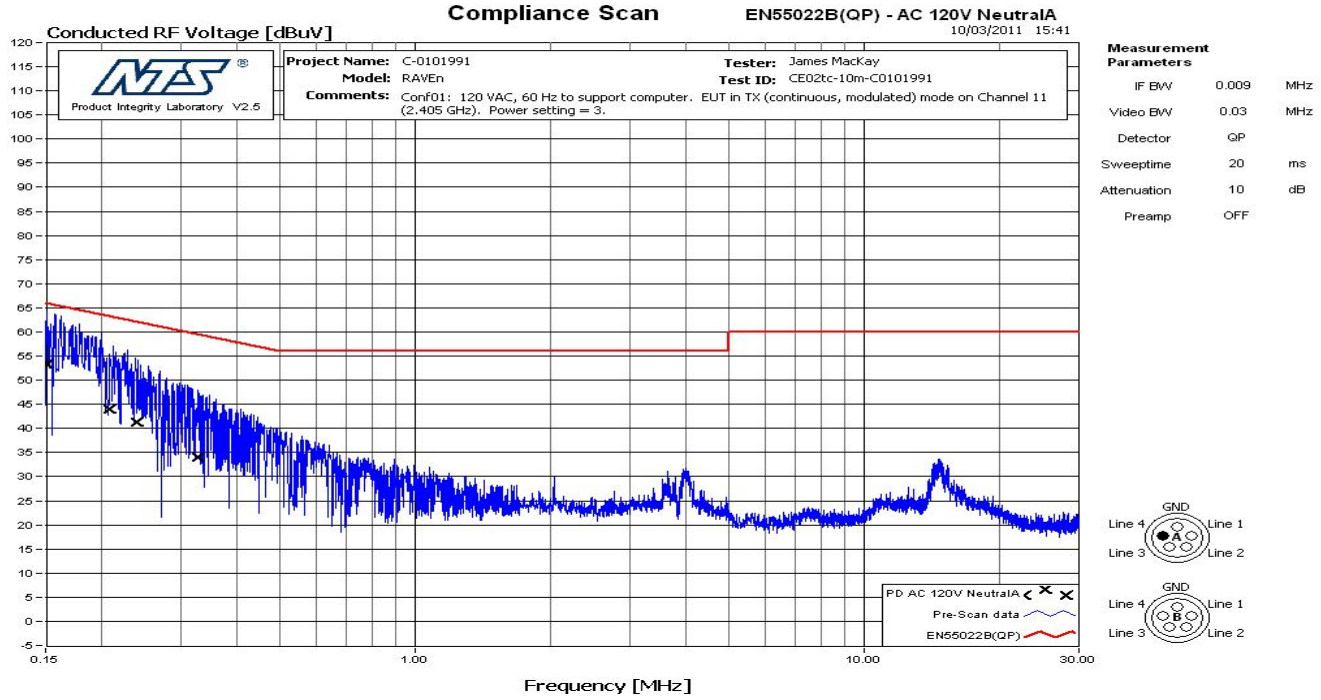
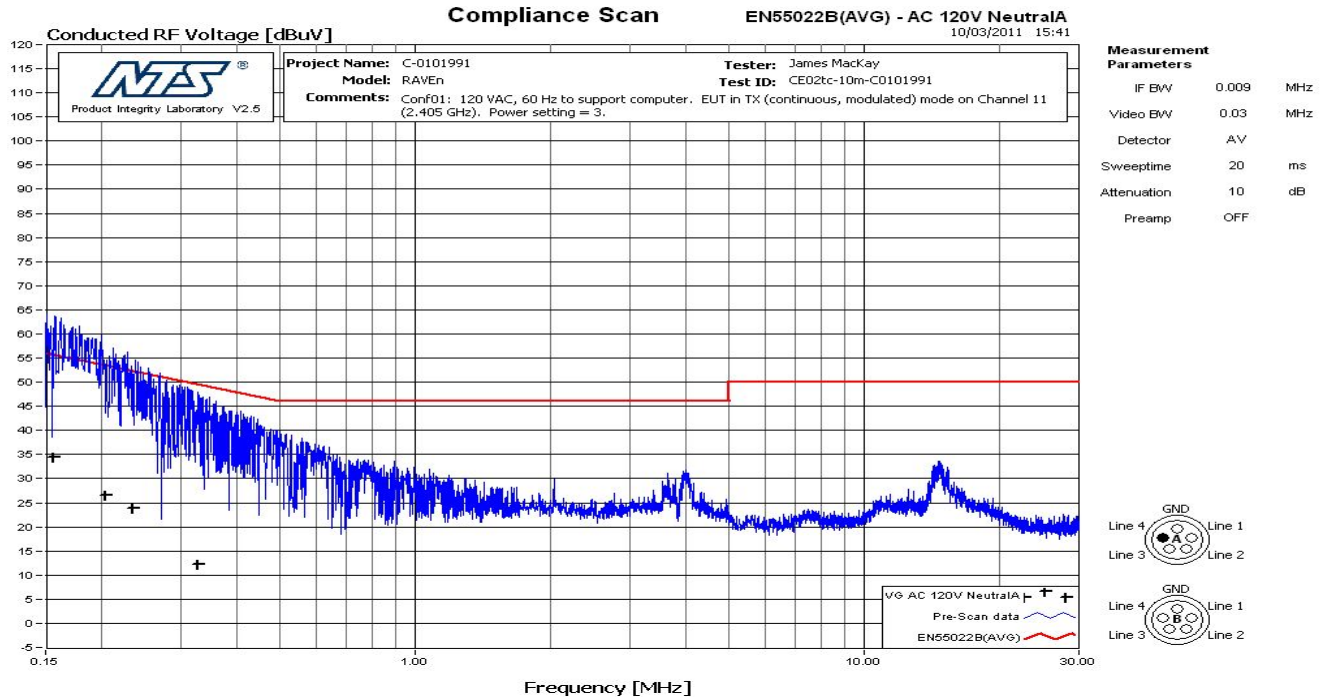


Figure 4 Conducted Emission Neutral 150 kHz – 30 MHz Average Detector



Note: The EN55022B limit was used to show the compliance to CISPR 22.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 5 Conducted Emission Test Setup

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX B: 6 DB BANDWIDTH

B.1. Base Standard & Test Basis

Base Standard	FCC PART 15.247 (a) (2) RSS 210 Issue 8 A8.2 (a)
Test Basis	FCC Publication 558074 RSS-Gen Issue 3 4.6.2
Test Method	FCC Publication 558074 RSS 210 Issue 8 A8.2 (a)

B.2. Specifications

15.247 2) Systems using digital modulation techniques may operate in the 902–928 MHz, 2400–2483.5 MHz, and 5725–5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

B.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
None						

B.4. Test Procedure

FCC Publication 558074 and RSS 210.

B.5. Test Results

The EUT is in compliance with the requirement as specified above

Channel	Frequency (MHz)	6 dB Bandwidth (MHz)
11	2405	1.586
18	2440	1.619
26	2480	1.667

All final reported values are corrected values

B.6. Operating Mode During Test

The EUT was tuned to a low and middle channel, operating at maximum rated RF output power with maximum power Setting 3. For High channel; Power setting “2” was used in order to reduce power.EUT was set to transmit at 100% duty cycle.

B.7. Tested By

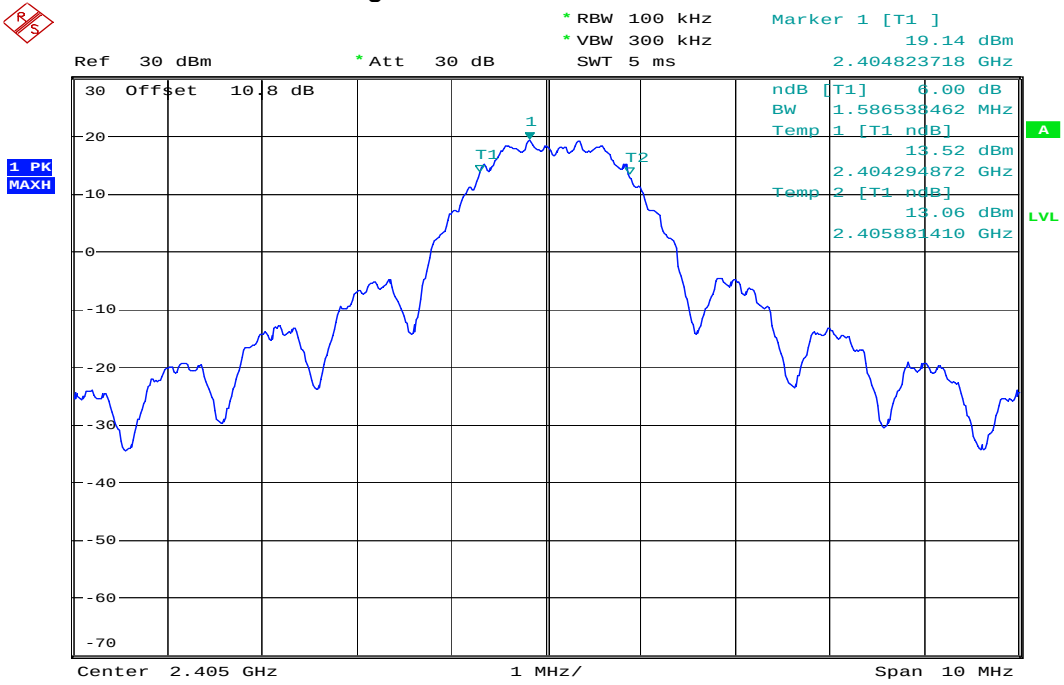
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Lixin Wang
Function: EMC Technologist

B.8. Test date

March 3, 2011

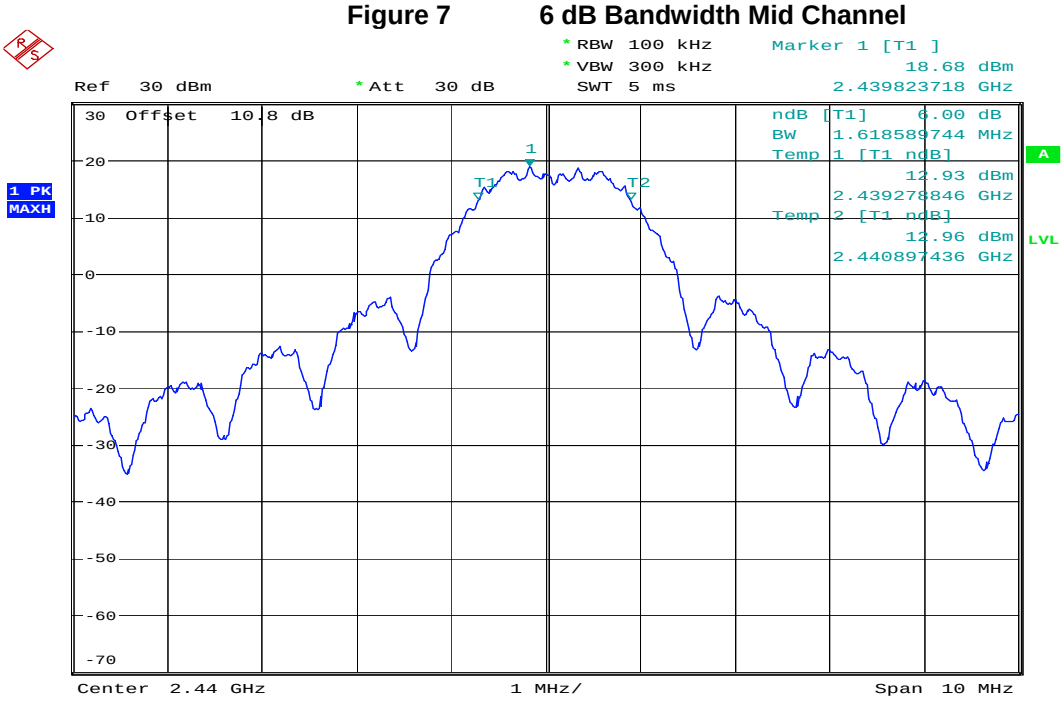
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 6 6 dB Bandwidth Low Channel



Date: 3.MAR.2011 07:33:07

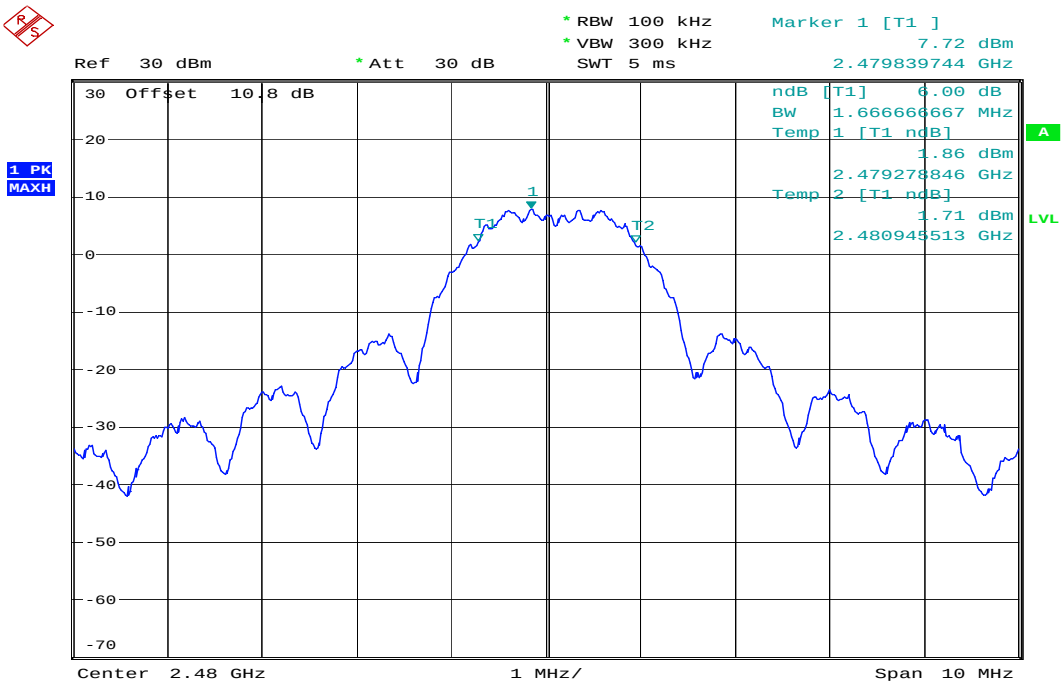
Figure 7 6 dB Bandwidth Mid Channel



Date: 3.MAR.2011 07:34:55

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 8 6 dB Bandwidth High Channel



Date: 3.MAR.2011 07:46:02

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX C: 26 DB BANDWIDTH

C.1. Base Standard & Test Basis

Base Standard	FCC Publication 558074
Test Basis	FCC Publication 558074
Test Method	FCC Publication 558074 and RSS Gen Issue 3 4.6,

C.2. Specifications

FCC publication 558074 Section 15.247(b) Power output Power Option 2 Method 1: Compute power by integrating the spectrum across the 26dB EBW of the signal.

C.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
None						

C.4. Test Procedure

FCC Publication 558074 and RSS Gen issue 3 4.6. Span set to capture the whole transmitting signal and RBW was set to 1% of span.

C.5. Test Results

Channel	Frequency (MHz)	26 dB Bandwidth (MHz)
11	2405	2.778
18	2440	2.803
26	2480	2.818

All final reported values are corrected values

C.6. Operating Mode During Test

The EUT was tuned to a low and middle channel, operating at maximum rated RF output power with maximum power Setting 3. For High channel; Power setting “2” was used in order to reduce power.EUT was set to transmit at 100% duty cycle.

C.7. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

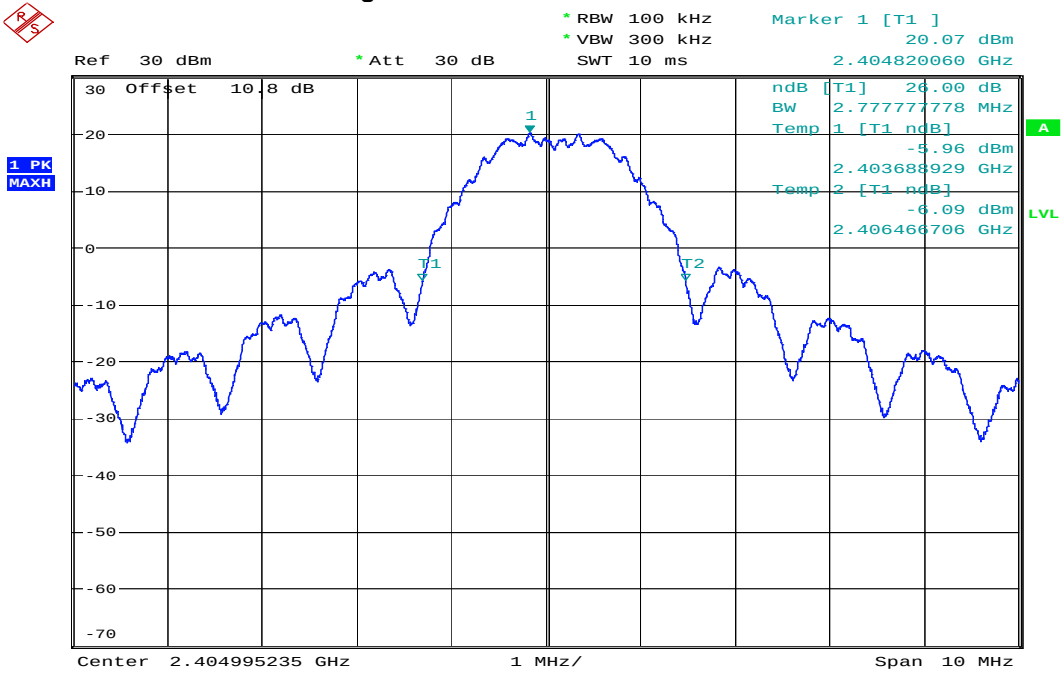
Name: Lixin Wang
Function: EMC Technologist

C.8. Test date

March 14, 2011

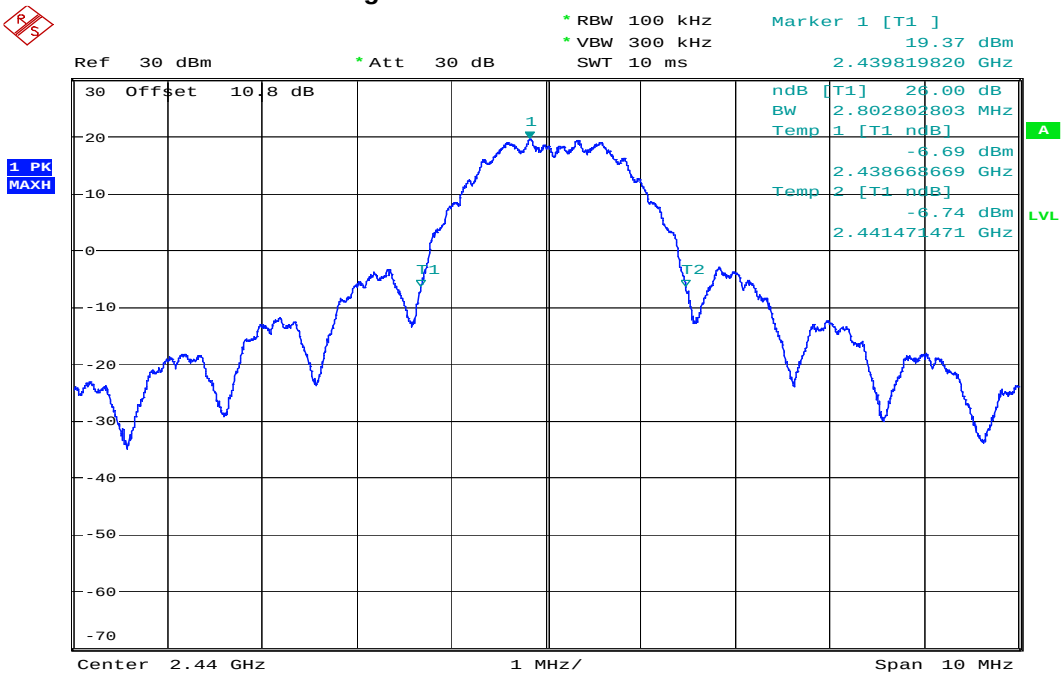
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 9 26 dB Bandwidth Low Channel



Date: 14.MAR.2011 14:09:29

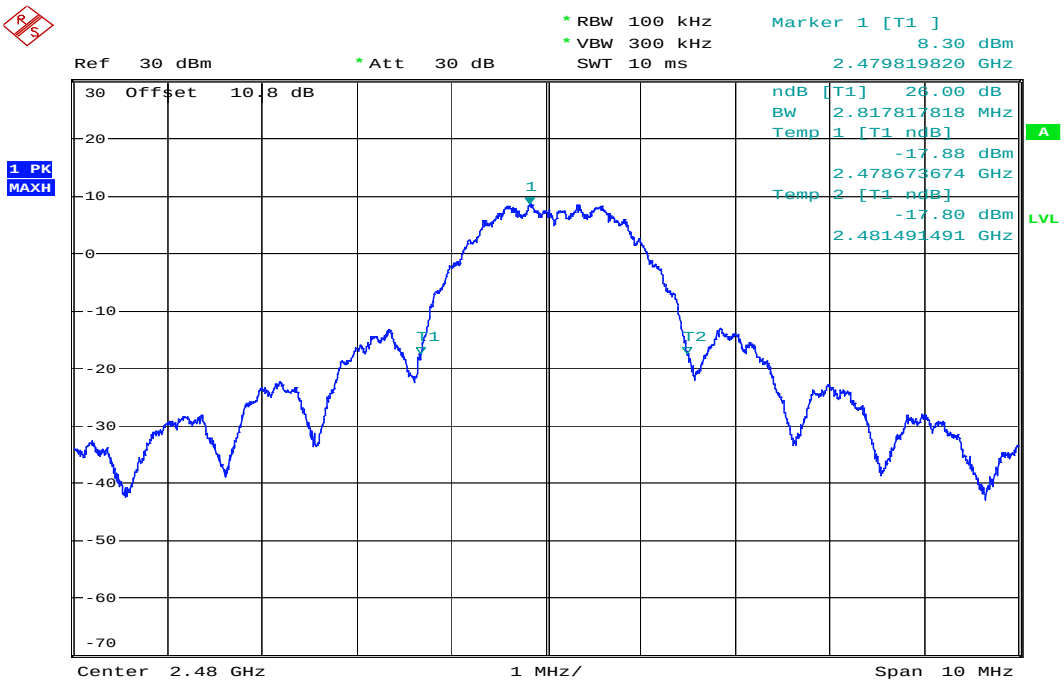
Figure 10 26 dB Bandwidth Mid Channel



Date: 14.MAR.2011 14:12:41

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 11 26 dB Bandwidth High Channel



Date: 14.MAR.2011 14:14:47

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX D: OCCUPIED BANDWIDTH

D.1. Base Standard & Test Basis

Base Standard	RSS-Gen Issue 3 4.6.1
Test Basis	RSS-Gen Issue 3 4.6.1
Test Method	RSS-Gen Issue 3 4.6.1

D.2. Specifications

4.6.1 When an occupied bandwidth value is not specified in the applicable RSS, the transmitted signal bandwidth to be reported is to be its 99% emission bandwidth, as calculated or measured.

D.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
None						

D.4. Test Procedure

RSS-Gen Issue 3

D.5. Test Results

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
11	2405	2.356
18	2440	2.420
26	2480	2.484

All final reported values are corrected values

D.6. Operating Mode During Test

The EUT was tuned to a low and middle channel, operating at maximum rated RF output power with maximum power Setting 3. For High channel; Power setting “2” was used in order to reduce power. EUT was set to Transmit at 100% duty cycle.

D.7. Sample Calculation

NA

D.8. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Lixin Wang
Function: EMC Technologist

D.9. Test date

March 3, 2011

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 12 Occupied Bandwidth Low Channel

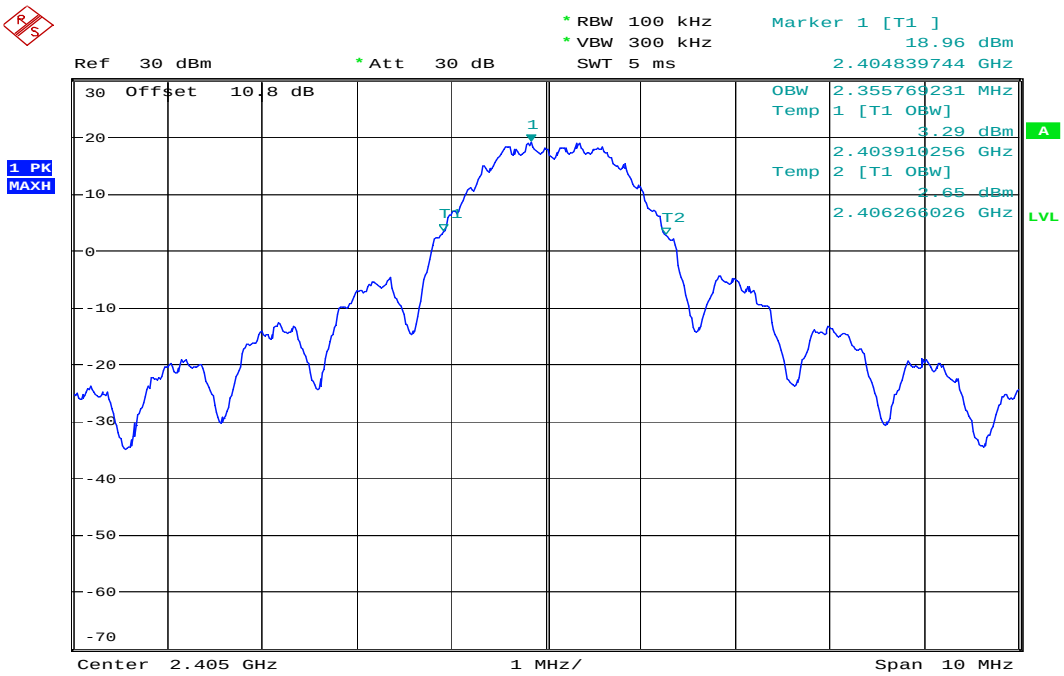
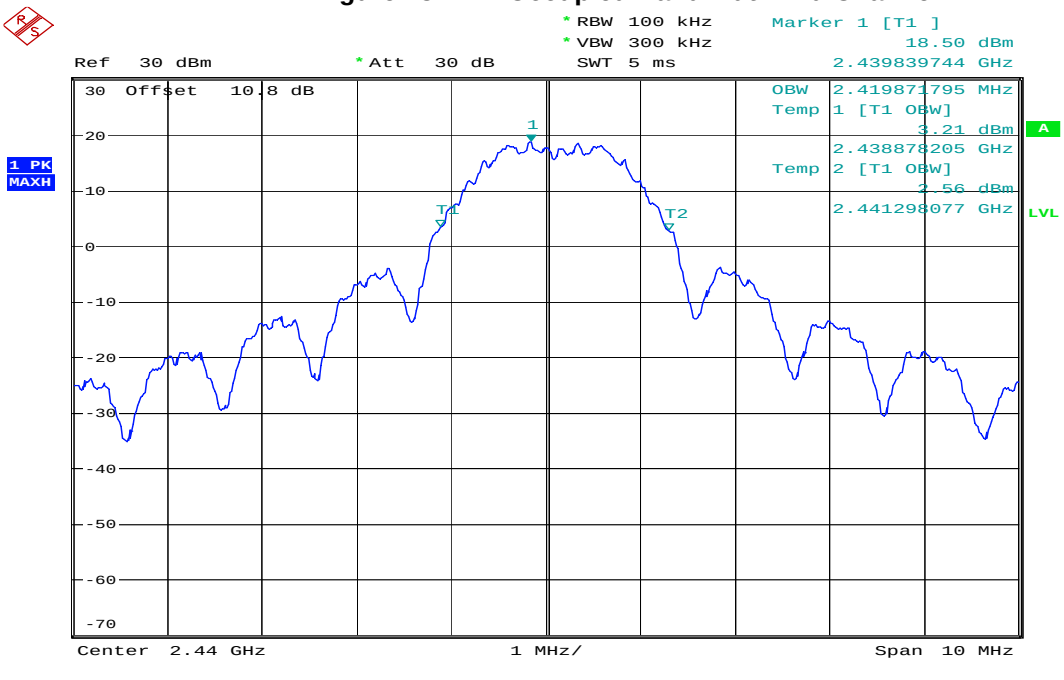
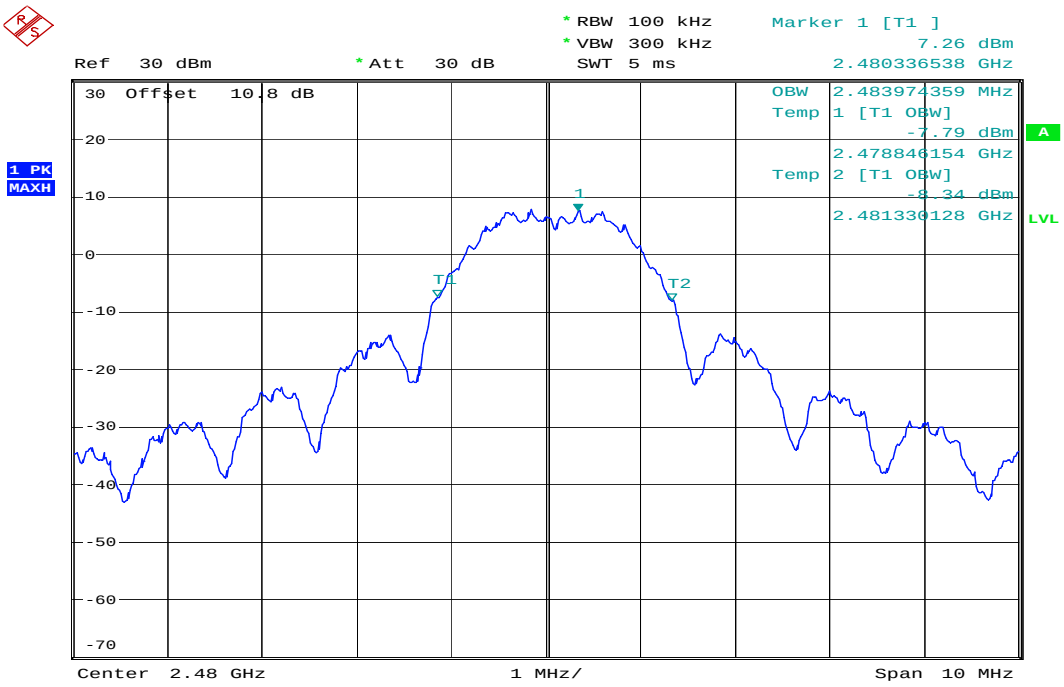


Figure 13 Occupied Bandwidth Mid Channel



The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 14 Occupied Bandwidth High Channel



Date: 3.MAR.2011 08:01:55

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX E: PEAK POWER OUTPUT

E.1. Base Standard & Test Basis

Base Standard	FCC 15.247 RSS 210 Issue 8 A8.4 (4)
Test Basis	FCC 15.247 as per FCC Publication 558074 RSS-Gen Issue 3 4.8
Test Method	FCC Publication 558074 and RSS-Gen Issue 3 4.8

E.2. Specifications

The maximum peak output power shall not exceed 30 dBm in the 2400 MHz- 2483.5 MHz band

E.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

E.4. Test Procedure

RSS-Gen Issue 3 4.8 and FCC Publication 558074, Section 15.247(b) – Power output - Power output Option 2 - Method 1: Set RBW=1MHz, VBW=3MHz, Span=10MHz, Sweep points: 1999, span/number of points in spectrum display=5.0025<0.5 RBW. Detector: Sample. Trace average 100 traces in power averaging mode. Computing power by integrating the spectrum across 26dB EBW of the signal.

E.5. Operating Mode During Test

The EUT was tuned to a low and middle channel, operating at maximum rated RF output power with maximum power Setting 3. For High channel; Power setting “2” was used in order to reduce power. EUT was set to transmit with 100% duty cycle.

E.6. Test Results

Compliant – The maximum peak power was 20.93 dBm as measured conducted at the RF output port

E.7. Sample Calculation

Final Conducted Peak Power = Measurement + Cable loss + Attenuation used.

E.8. Test Data Summary

Channel	Frequency (MHz)	Peak RF power (dBm)
11	2405	20.93
18	2440	20.62
26	2480	9.92

Antenna gain: 2.88 dBi.
All final reported values are corrected values

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

E.9. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

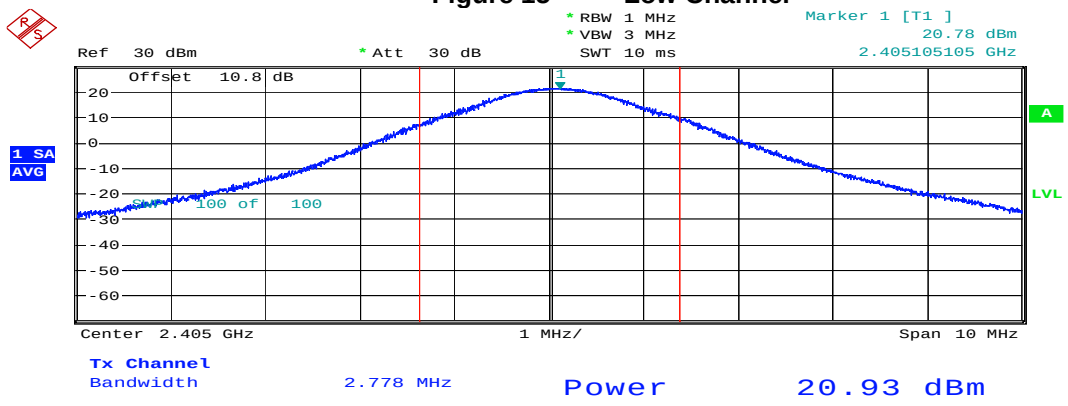
Name: Lixin Wang
Function: EMC Technologist

E.10. Test date

March 14, 2011

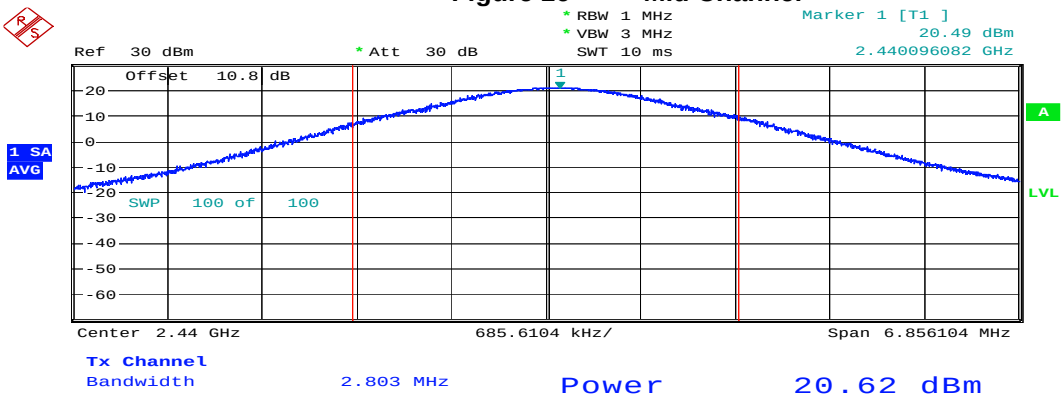
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 15 Low Channel



Date: 14.MAR.2011 15:39:52

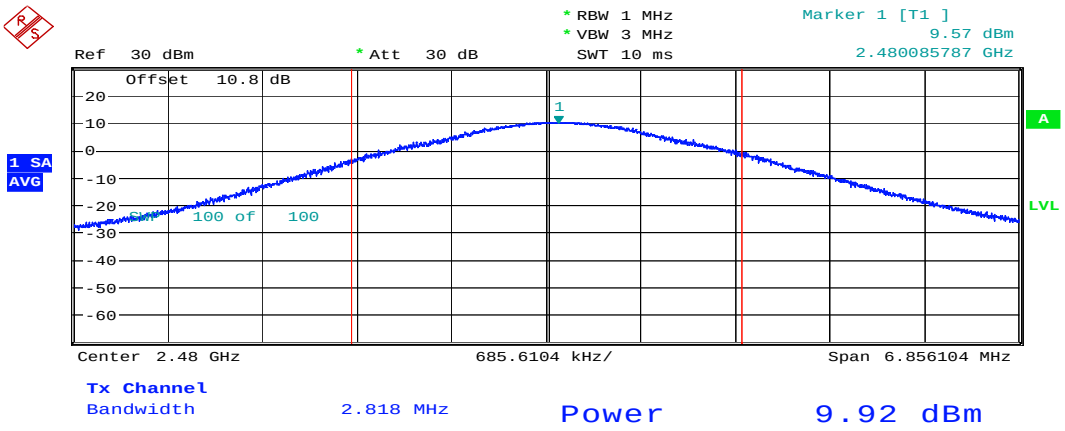
Figure 16 Mid Channel



Date: 14.MAR.2011 15:46:21

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 17 High Channel



Date: 14.MAR.2011 15:49:31

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX F: POWER SPECTRAL DENSITY

F.1. Base Standard & Test Basis

Base Standard	FCC 15.247 (e) RSS 210 Issue 8 A8.2 (b)
Test Basis	FCC 15.247 as per FCC Publication 558074 RSS 210 Issue 8 A8.2 (b)
Test Method	FCC Publication 558074 and RSS 210 Issue 8 A8.2 (b)

F.2. Specifications

15.247 e) For digitally modulated systems, the power spectral density conducted from the intentional radiator to the antenna shall not be greater than 8 dBm in any 3 kHz band during any time interval of continuous transmission.

F.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

F.4. Test Procedure

FCC Publication 558074 Section 15.247(e) – Power spectral density - PSD option 2 and RSS 210 Issue 8 A8.2 (b): Set RBW=3KHz, VBW=10KHz. Sweep time: Auto. Sweep points: 1999, Span: 2MHz, Span/number of points in spectrum display=1.0005<0.5 RBW. Detector: Sample. Trace average: 100 traces in power averaging mode.

F.5. Operating Mode During Test

The EUT was tuned to a low and middle channel, operating at maximum rated RF output power with maximum power Setting 3. For High channel; Power setting “2” was used in order to reduce power. EUT was set to transmit at 100% duty cycle.

F.6. Test Results

Compliant. The maximum measured power spectral density was 5.11 dBm/3kHz

F.7. Sample Calculation

None

F.8. Test Data Summary

Channel	Frequency (MHz)	PSD (dBm)
11	2404.638	4.92
18	2440.516	5.11
26	2479.647	-6.41

All final reported values are corrected values

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

F.9. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Lixin Wang
Function: EMC Technologist

F.10. Test date

March 14, 2011

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 18 Low Channel

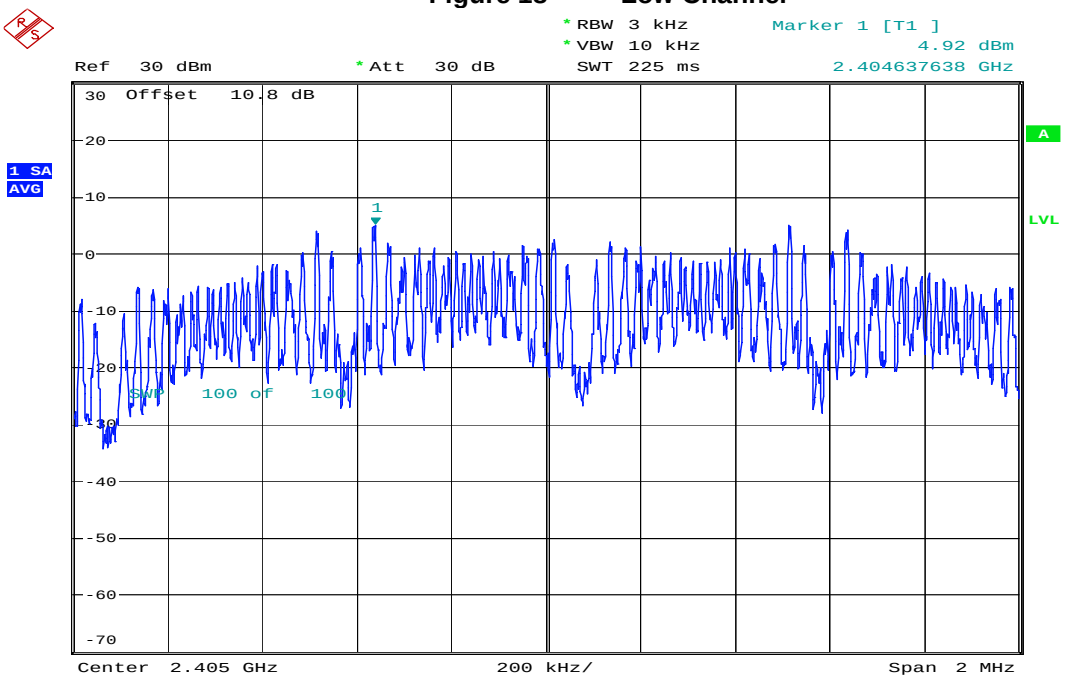
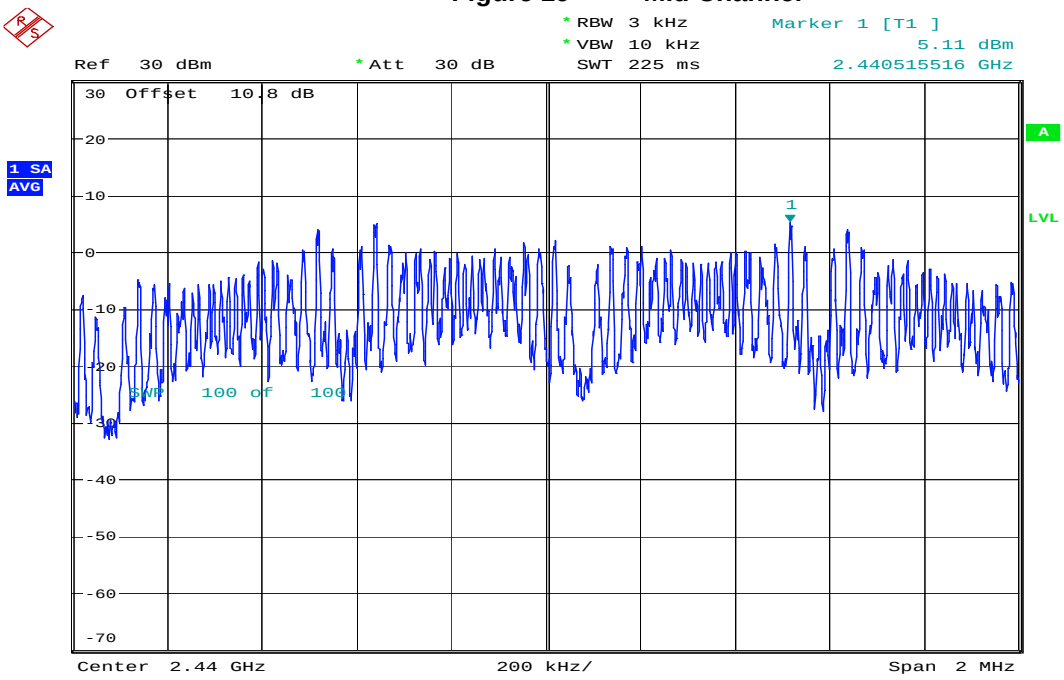
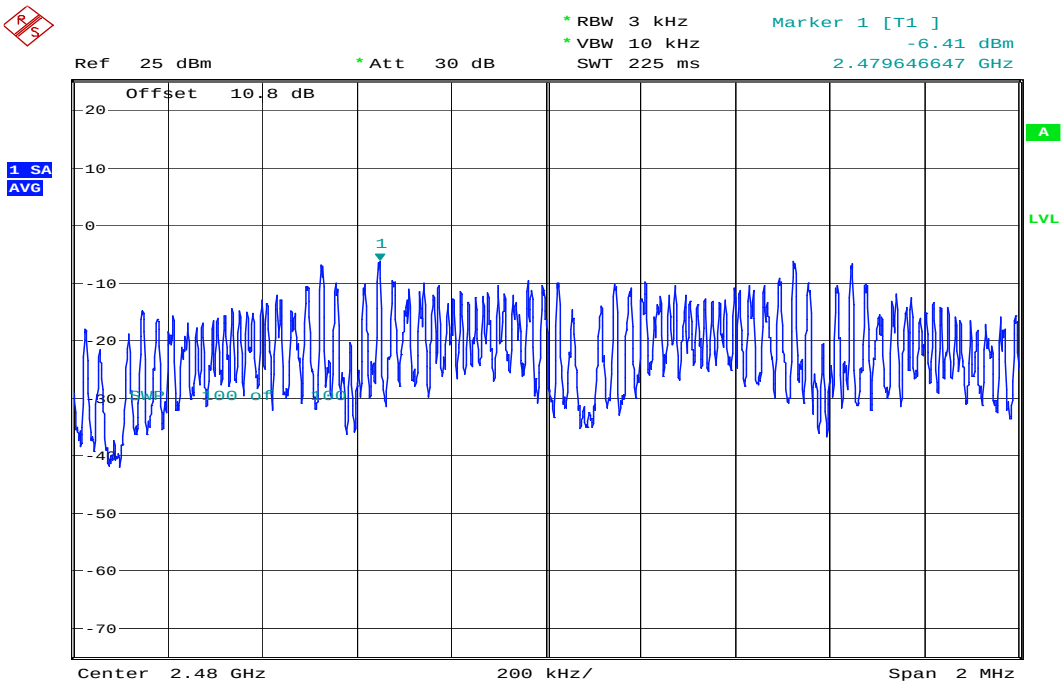


Figure 19 Mid Channel



The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 20 High Channel



The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX G: CONDUCTED SPURIOUS EMISSIONS

G.1. Base Standard & Test Basis

Base Standards	FCC CFR Title 47 – Telecommunications, Chapter I Part 15.247 (d) RSS-210 Issue 8 A8.5
Test Basis	RF conducted as per FCC Publication 558074 RSS-210 Issue 8 A8.5
Test Method	RF conducted as per FCC Publication 558074 RSS-210 Issue 8 A8.5

G.2. Specifications

(d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

G.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

G.4. Test Procedure

FCC Publication 558074

G.5. Operating Mode During Test

The EUT was tuned to a low and middle channel, operating at maximum rated RF output power with maximum power Setting 3. For High channel; Power setting “2” was used in order to reduce power. EUT was set to transmit at 100% duty cycle.

G.6. Test Results

Compliant,
Worst case spurious emission was 52.35 dB below the carrier at Channel 11.

All final reported values are corrected values

G.7. Tested By

This testing was conducted in accordance with the ISO 17025: 2005 scope of accreditation, table 1; Quality Manual.

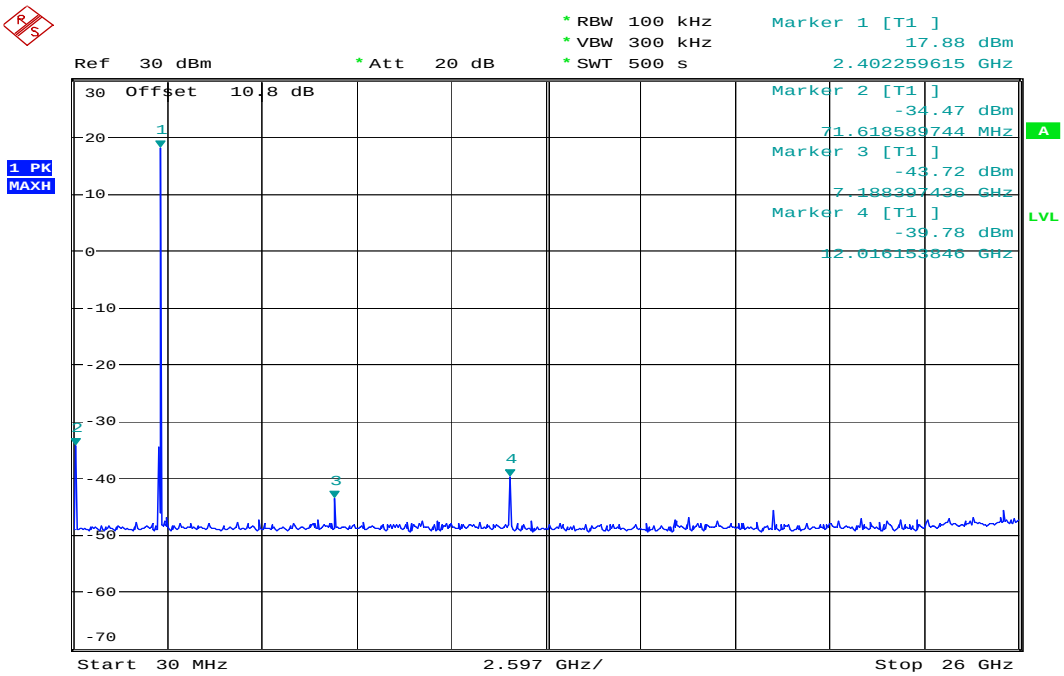
Name: Lixin Wang
Function: EMC Technologist

G.8. Test date

March 03, 2011

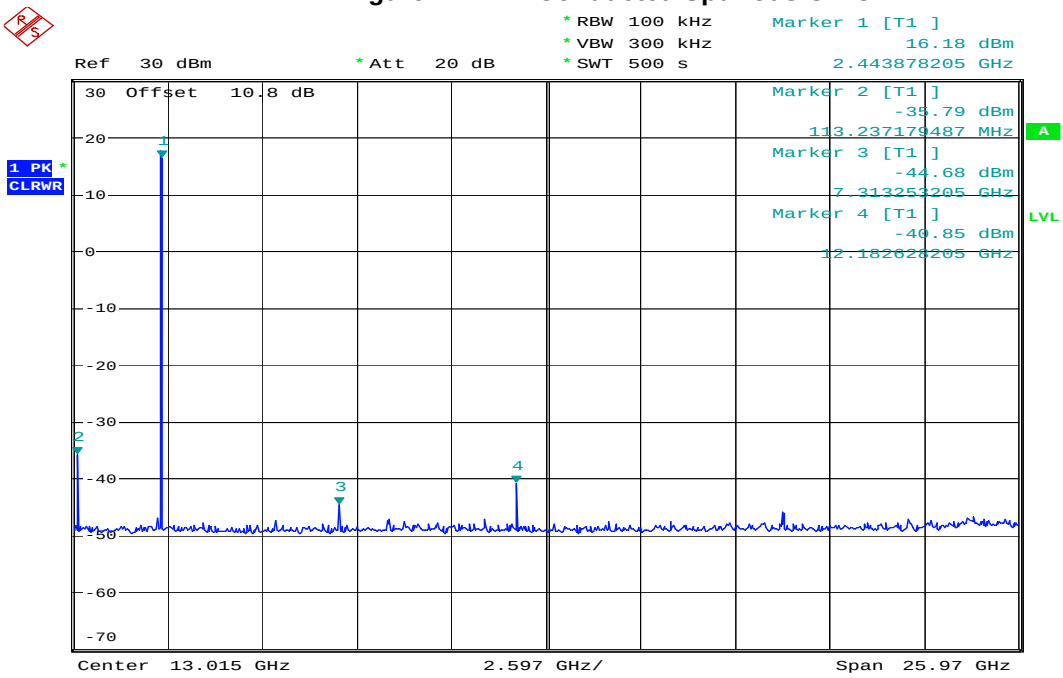
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 21 Conducted Spurious Ch11



Date: 3.MAR.2011 11:45:05

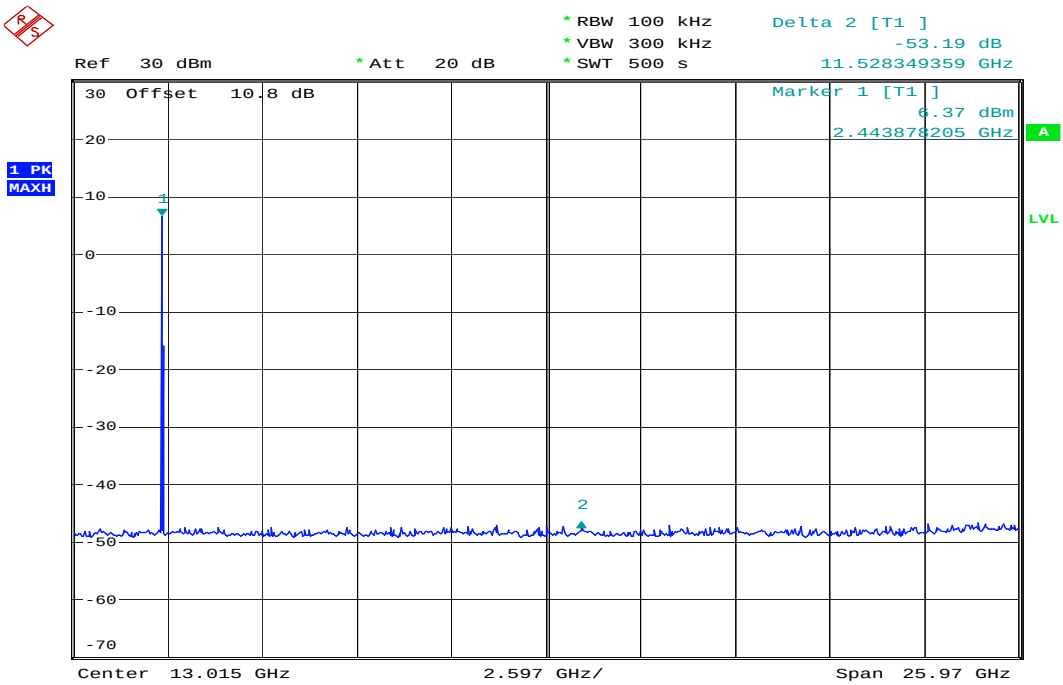
Figure 22 Conducted Spurious Ch18



Date: 3.MAR.2011 12:03:26

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 23 Conducted Spurious Ch26



The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX H: CONDUCTED SPURIOUS EMISSIONS BAND EDGE

H.1. Base Standard & Test Basis

Base Standards	FCC CFR Title 47 – Telecommunications, Chapter I Part 15.247 (d) RSS-210 Issue 8 A8.5
Test Basis	RF conducted as per FCC Publication 558074 RSS-210 Issue 8 A8.5
Test Method	RF conducted as per FCC Publication 558074 RSS-210 Issue 8 A8.5

H.2. Specifications

15.247 (d) In any 100 kHz bandwidth outside the frequency band in which the spread spectrum or digitally modulated intentional radiator is operating, the radio frequency power that is produced by the intentional radiator shall be at least 20 dB below that in the 100 kHz bandwidth within the band that contains the highest level of the desired power, based on either an RF conducted or a radiated measurement, provided the transmitter demonstrates compliance with the peak conducted power limits. If the transmitter complies with the conducted power limits based on the use of RMS averaging over a time interval, as permitted under paragraph (b)(3) of this section, the attenuation required under this paragraph shall be 30 dB instead of 20 dB. Attenuation below the general limits specified in §15.209(a) is not required. In addition, radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) (see §15.205(c)).

H.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

H.4. Test Procedure

FCC Publication 558074

H.5. Operating Mode During Test

The EUT was tuned to low channel, operating at maximum rated RF output power with maximum power Setting 3. For High channel; Power setting “2” was used in order to reduce power. Also channel 25 was tested with maximum power setting 3. EUT was set to transmit at 100% duty cycle.

H.6. Test Results

Compliant
Worst case spurious emission was 36.73 dB below the carrier at Channel 26 (High channel)

H.7. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

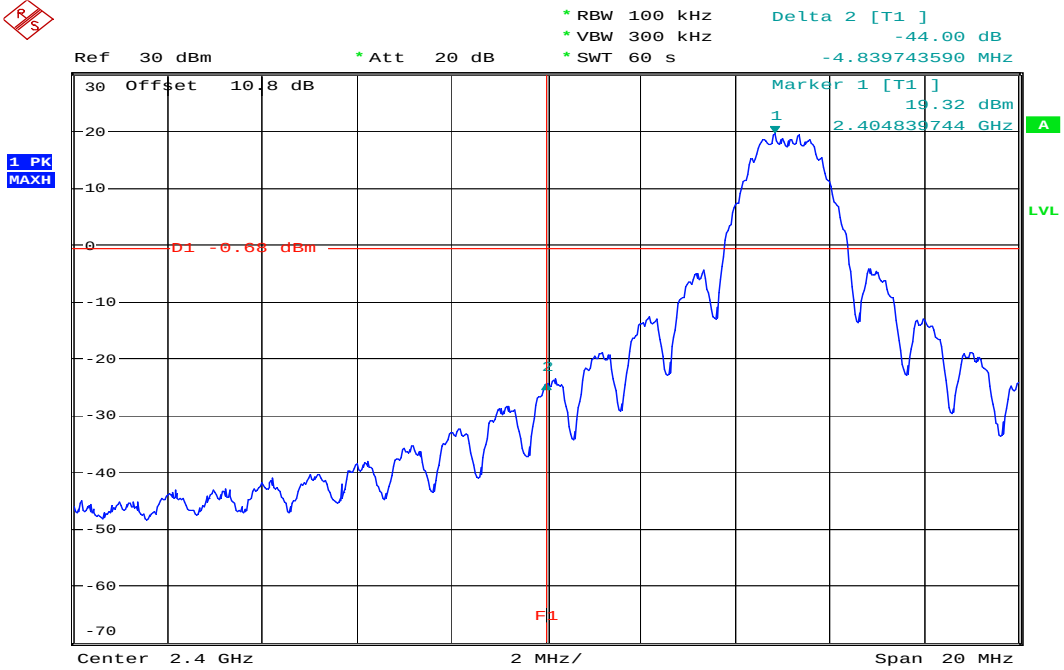
Name: Lixin Wang
Function: EMC Technologist

H.8. Test date

March 04, 2011

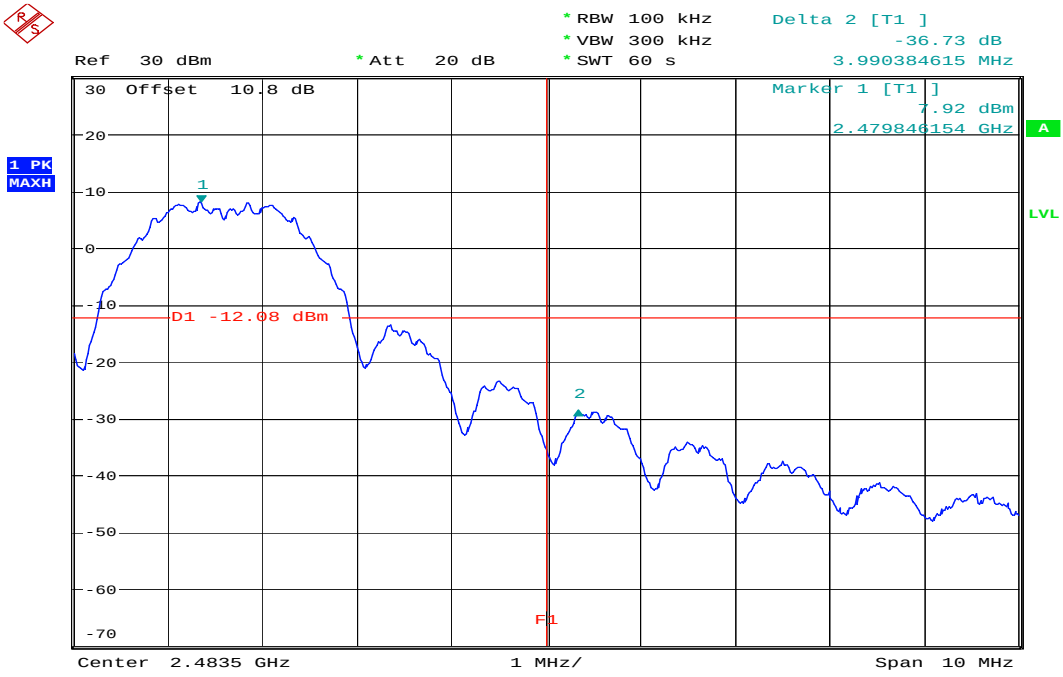
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 24 Conducted Band edge Measurement Ch11 with max Tx power



Date: 4.MAR.2011 05:54:42

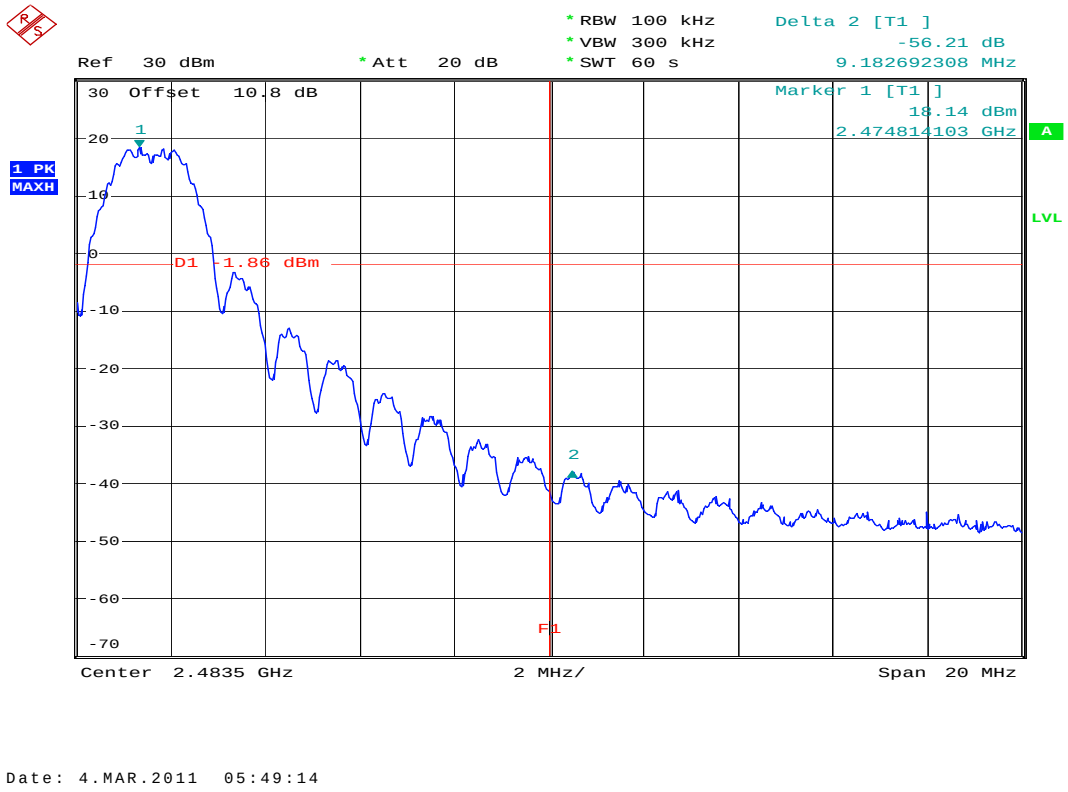
Figure 25 Conducted Band edge Measurement Ch26 with reduced Tx power



Date: 4.MAR.2011 05:37:11

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 26 Conducted Band edge Measurement Ch25 with max Tx power



The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX I: DUTY CYCLE CORRECTION FACTOR

I.1. Base Standard & Test Basis

Base Standard	FCC 15.35 (c) RSS-Gen Issue 3 4.5
Test Basis	FCC 15.35 (c) as per FCC Publication 558074 RSS-Gen Issue 3 4.5
Test Method	Zero Span

I.2. Specifications

15.35 (c) Unless otherwise specified, e.g. §15.255(b), when the radiated emission limits are expressed in terms of the average value of the emission, and pulsed operation is employed, the measurement field strength shall be determined by averaging over one complete pulse train, including blanking intervals, as long as the pulse train does not exceed 0.1 seconds. As an alternative (provided the transmitter operates for longer than 0.1 seconds) or in cases where the pulse train exceeds 0.1 seconds, the measured field strength shall be determined from the average absolute voltage during a 0.1 second interval during which the field strength is at its maximum value. The exact method of calculating the average field strength shall be submitted with any application for certification or shall be retained in the measurement data file for equipment subject to notification or verification.

I.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

I.4. Test Procedure

As per FCC 15.35 with spectrum analyzer in Zero span mode.

I.5. Operating Mode During Test

The EUT was tuned to Low channel (Ch Mid) with 10% duty cycle operating mode as the worst case of EUT normal operation per client.

I.6. Test Results

Duty cycle correction factor = 20*log(0.822/8.160) = -19.94 dB

I.7. Tested By

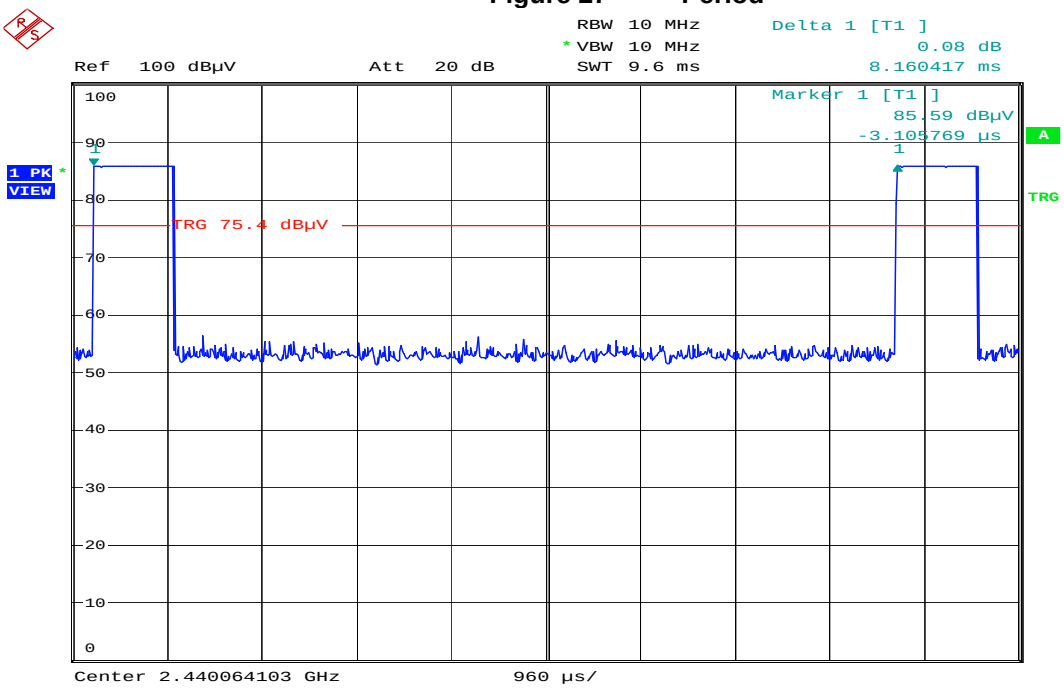
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Lixin Wang
Function: EMC Technologist

I.8. Test date

May 13, 2011

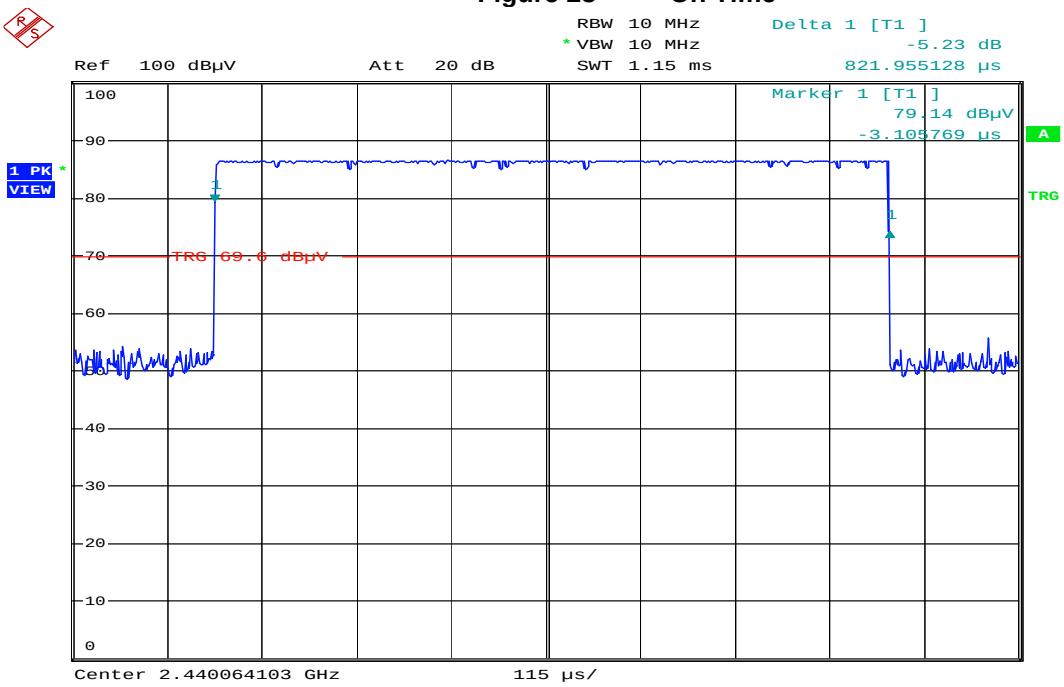
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 27 Period



Date: 13.MAY.2011 11:27:37

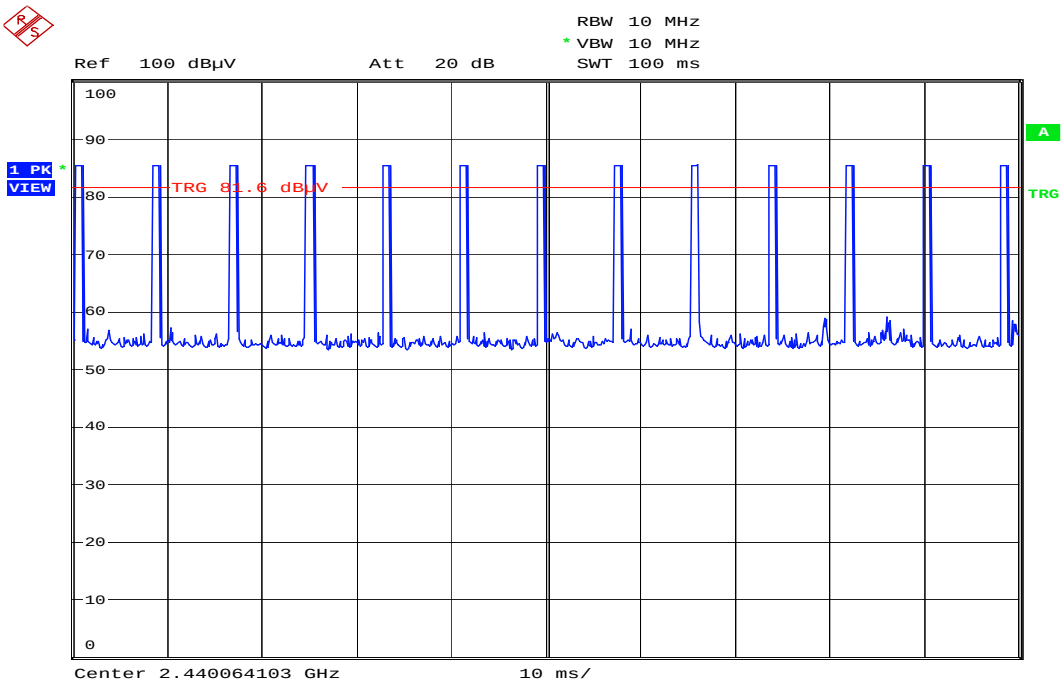
Figure 28 On Time



Date: 13.MAY.2011 11:23:09

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 29 100 ms Time Slot



Date: 13.MAY.2011 11:30:50

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX J: RADIATED SPURIOUS EMISSIONS BAND EDGE

J.1. Base Standard & Test Basis

Base Standard	FCC CFR Title 47 – Telecommunications, Chapter I Part 15.209 – Radio Frequency Devices, Part 15.205 – Restricted bands of operation RSS 210 Issue 8 A8.5
Test Basis	ANSI C63.4: 2009 FCC Publication 558074
Test Method	NTS Radiated Emissions Test Method SOP-CAG-EMC-02 FCC Publication 558074

J.2. Specifications: FCC 15.205 and RSS 210 Issue 8 2.2 Restricted bands of operation.

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1]0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	N/A
13.36–13.41	N/A	N/A	N/A

(b) The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector. Above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

J.3. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

J.4. Test Procedure

RF radiated measurement at 3 meters distance per FCC Publication 558074 and ANSI C63.10: 2009
558074 (c) (2) Radiated emission test: Applies to harmonics/spurs that fall in the restricted bands listed in section 15.205. The maximum permitted average field strength is listed in section 15.209. A pre-amp (and possibly a high-pass filter) is necessary for this measurement.
For measurements above 1 GHz, set RBW = 1 MHz, VBW = 10 Hz, Sweep: Auto. If the emission is pulsed, modify the unit for continuous operation, use the settings shown above, then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation.

FCC Publication 913591:
In making radiated band edge measurements, there can be a problem obtaining meaningful data since a measurement instrument that is tuned to a band edge frequency may also capture some in-band signals when using the resolution bandwidth (RBW) as specified by measurement procedure ANSI C63.4-1992, unless precautions are followed. The following technique may be used for determining band edge compliance in an effort to ensure that the proper precautions are followed.
STEP 1 - Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function for the frequency being measured, as required by C63.4 and FCC Rules.
Repeat the measurement with an average detector (i.e., 1 MHz RBW with 10 Hz VBW).
STEP 2 - Choose a spectrum analyzer span that encompasses both the peak of the fundamental emission and the band edge emission under investigation. Set the analyzer RBW to 1% of the total span (but never less than 30 kHz) with a video bandwidth equal to or greater than the RBW. Record the peak levels of the fundamental emission and the relevant band edge emission (i.e., run several sweeps in peak hold mode). Observe the stored trace and measure the amplitude delta between the peak of the fundamental and the peak of the band edge emission. This is not a field strength measurement; it is only a relative measurement to determine the amount by which the emission drops at the band edge relative to the highest fundamental emission level.
STEP 3 - Subtract the delta measured in step (2) from the field strengths measured in step (1). The resultant field strengths (CISPR QP, average, or peak, as appropriate) are then used to determine band edge compliance as required by Section 15.205.
STEP 4 - The above delta measurement technique may be used for measuring emissions that are up to two standard bandwidths away from the band edge, where a standard bandwidth is the bandwidth specified by C63.4 for the frequency being measured. For example, for band edge measurements in the restricted band that begins at 2483.5 MHz, C63.4 specifies a measurement bandwidth of at least 1 MHz. Therefore you may use the delta technique for measuring emissions up to 2 MHz removed from the band edge. Radiated emissions that are removed by more than two standard bandwidths must be measured in the conventional manner.

J.5. Operating Mode During Test

The EUT was tuned to low channel (Ch11) and high channel (Ch25), operating at maximum rated RF output power with maximum power Setting 3 at 100% duty cycle. For High channel (Ch26); Power setting 2 was used in order to reduce power.(See C0101991-NOD-01)

Channel 12, 13 and Channel 14 operating at maximum rated RF output power with power Setting 3 at 100% duty cycle was tested for the intermodulation product with 32MHz crystal for the 2310-2390 MHz restricted band.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Channel 21, 22 and Channel 23 operating at maximum rated RF output power with power Setting 3 at 100% duty cycle was tested for the intermodulation product with 32MHz crystal for the 2483.5-250MHz restricted band.

They all got about the same as Channel 11 intermodulation product with 32MHz crystal at 2373MHz.

J.6. Test Results

Compliant

Channel	Frequency (MHz)	Detector	Carrier Emission Level (dBµV/m)	Band Edge Emission Level (dBµV/m)	Duty cycle Correction Factor (dB)	Marker Delta (dBc)	Band Edge Corrected Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
11	2373.65	PK	N/A	63.71	N/A	N/A	63.71	73.98	10.27
11	2373.21	AV	N/A	55.54	-19.94	N/A	35.60	53.98	18.38
26	2483.50	PK	109.43	79.20	N/A	-38.24	71.19	73.98	2.79
26	2483.50	AV	N/A	70.30	-19.94	N/A	50.36	53.98	3.62
25	2483.50	PK	N/A	67.87	N/A	N/A	67.87	73.98	6.11
25	2483.50	AV	N/A	56.49	-19.94	N/A	36.55	53.98	17.43

Maximum peak measurement was 79.20 dBµV/m at 2483.50 MHz at channel 26. Carrier Emission Level was 109.43 dBµV/m; Marker Delta Measurement with 100 kHz RBW was –38.24 dBc. Corrected value of the emission on 2483.5 MHz was 71.19 dBµV/m. It has 2.79 dB margin to the 15.209 limits.
All final reported values are corrected values. Worst case emissions presented

J.7. Sample Calculations

Part 15.209 Average Limit: 500 µV/m @ 3m = 20*Log (500) = 53.98 dBµV/m, Peak limit = 73.98 dBµV/m
Radiated emission level (dBµV/m) = Measured level (dBµV) + Receive antenna factor (dB) + Receive cable loss (dB) – LNA gain (dB)
Corrected value (dBµV/m) = Radiated emission level (dBµV/m) - Duty cycle correction factor (dB)

J.8. Tested By

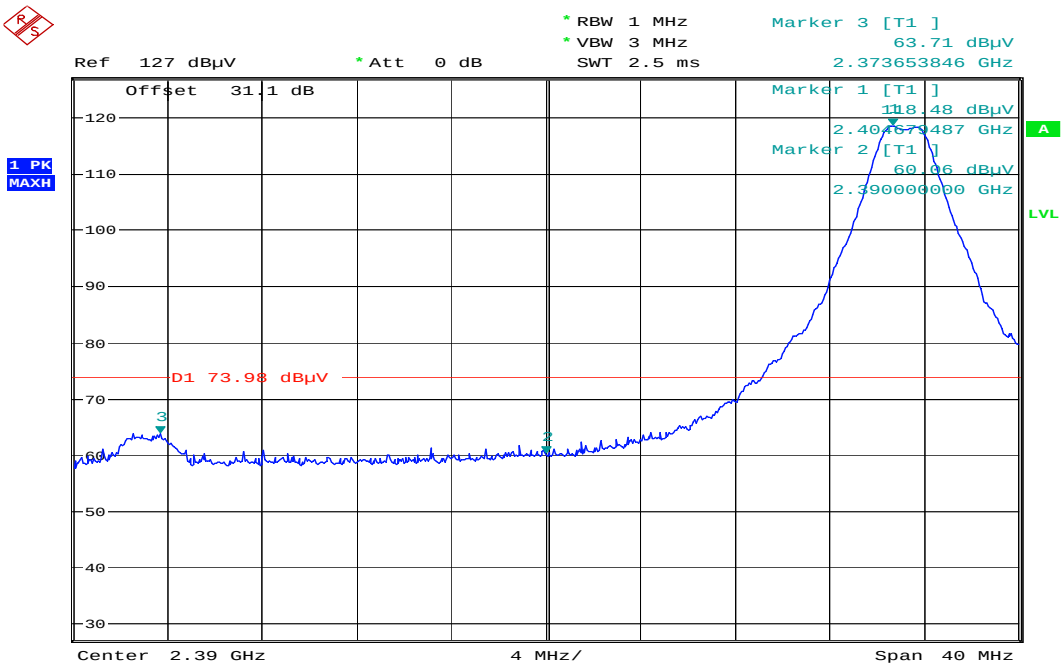
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Lixin Wang
Function: EMC Technologist

J.9. Test date

Test started: February 25, 2011 Test completed: February 28, 2011

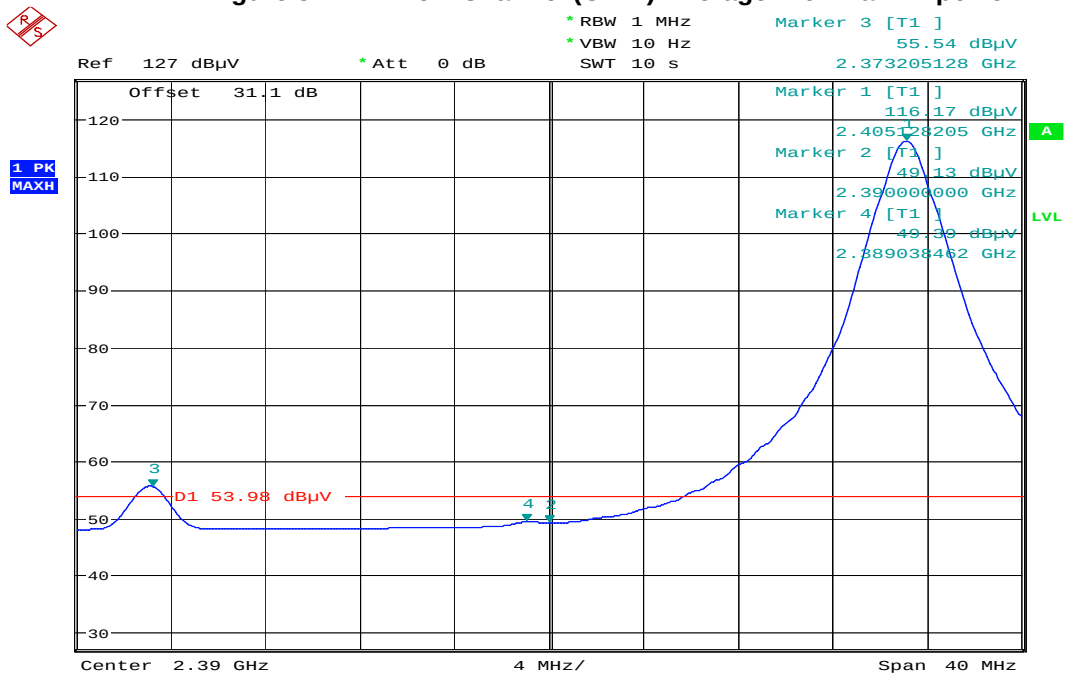
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 30 Low Channel (Ch11) Peak with max Tx power



Date: 25.FEB.2011 12:26:29

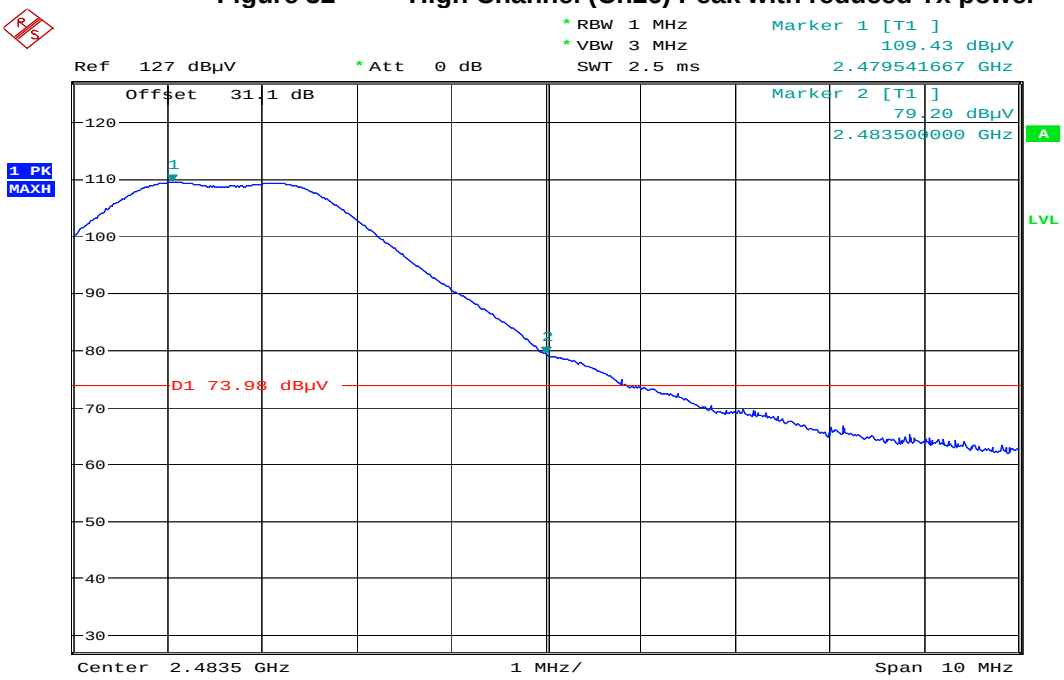
Figure 31 Low Channel (Ch11) Average with max Tx power



Date: 25.FEB.2011 12:30:21

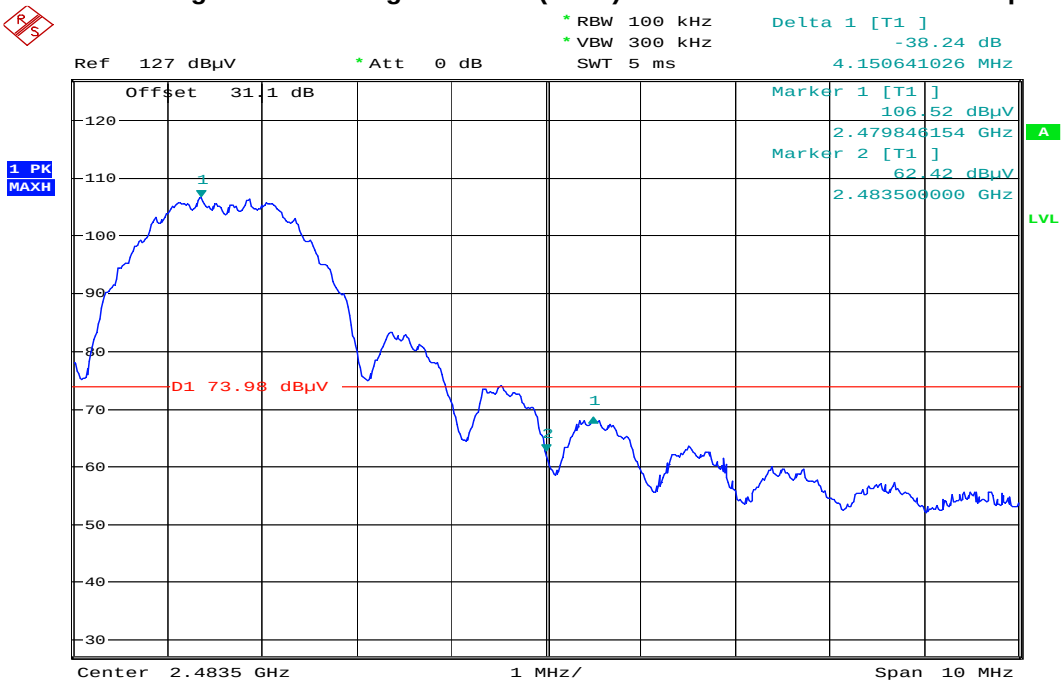
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 32 High Channel (Ch26) Peak with reduced Tx power



Date: 28.FEB.2011 06:24:59

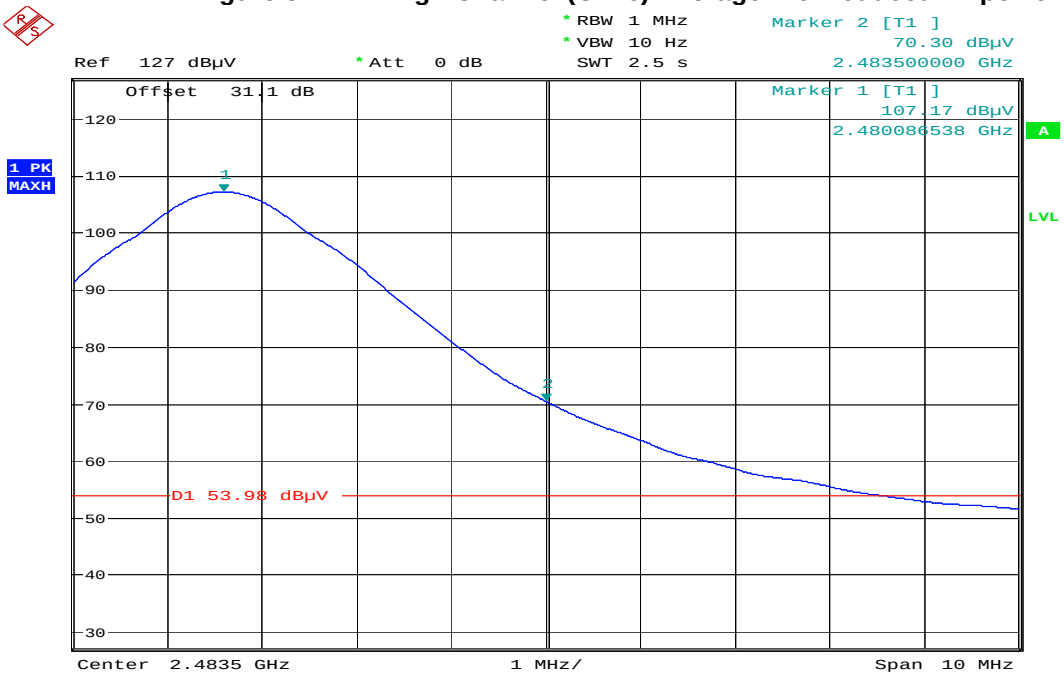
Figure 33 High Channel (Ch26) Marker-Delta with reduced Tx power



Date: 28.FEB.2011 06:30:51

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

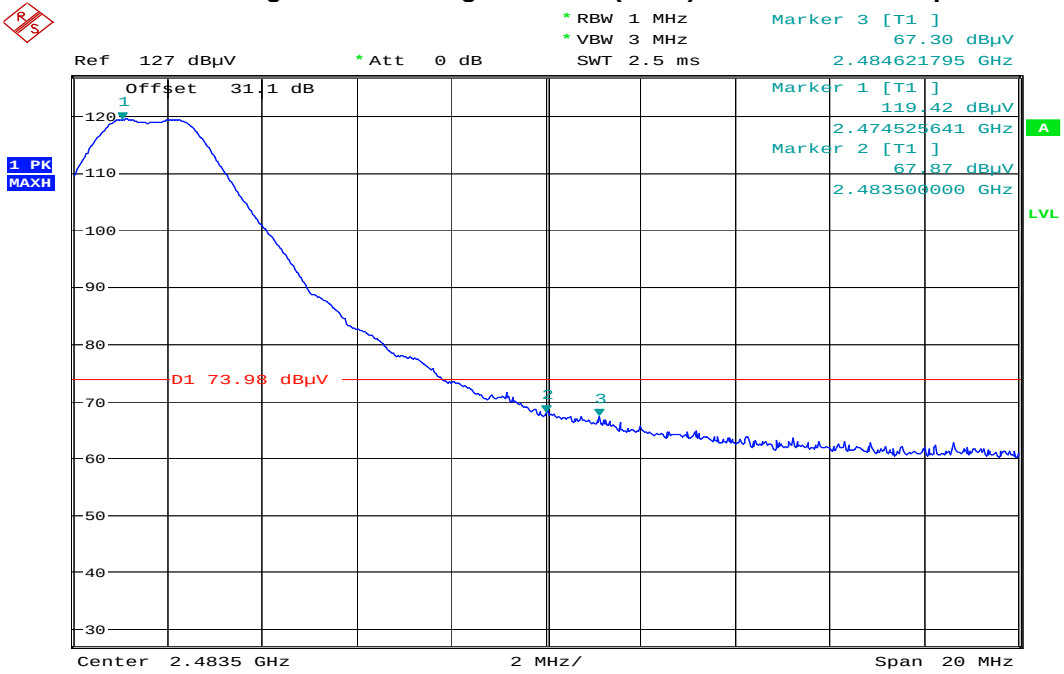
Figure 34 High Channel (Ch26) Average with reduced Tx power



Date: 28.FEB.2011 06:28:44

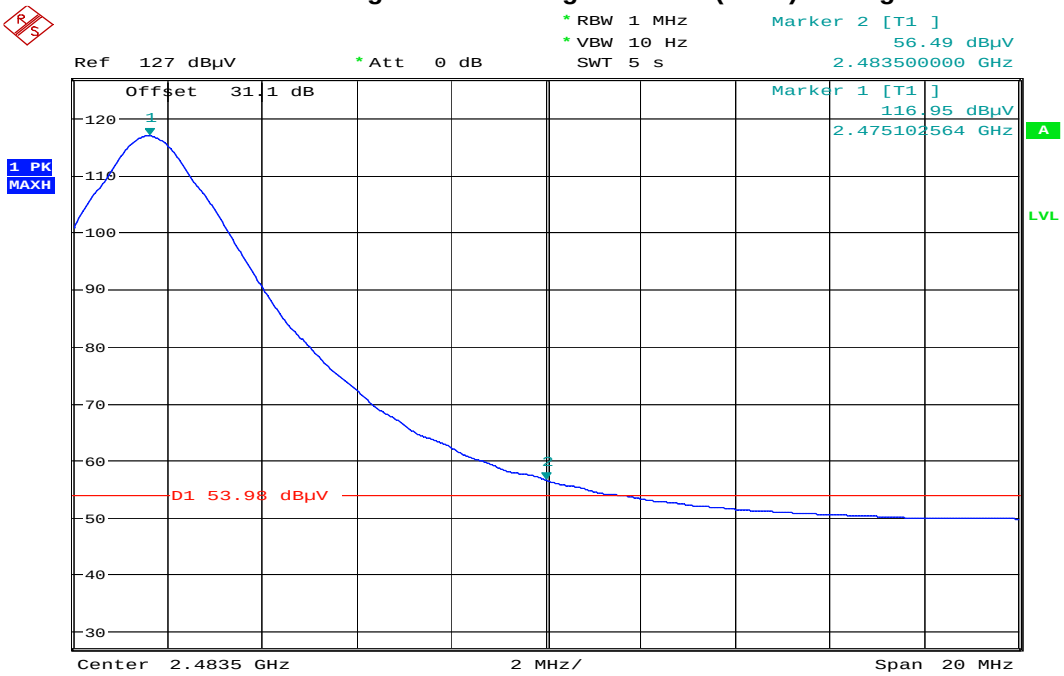
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 35 High Channel (Ch25) Peak with max Tx power



Date: 28.FEB.2011 06:48:00

Figure 36 High Channel (Ch25) Average



Date: 28.FEB.2011 06:50:02

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX K: RADIATED SPURIOUS EMISSIONS (TX AND RX)

K.1. Base Standard & Test Basis

Base Standard	FCC CFR Title 47 – Telecommunications, Chapter I Part 15.209 – Radio Frequency Devices, Part 15.205 – Restricted bands of operation Part 15.109 – Radiated Emission Limits for Un-intentional Radiators RSS 210 Issue 8 2.5 and A8.5 RSS Gen Issue 3 4.10 and 6 for Receiver Spurious Emission ICES-003 Issue 4 Emission test method and limits for digital apparatus
Test Basis	ANSI C63.4: 2009 FCC Publication 558074
Test Method	NTS Radiated Emissions Test Method SOP-CAG-EMC-02, RSS Gen Issue 3, FCC Publication 558074

K.2. Specifications:

K.2.1 FCC 15.205 and RSS 210 Issue 8 2.2 Restricted bands of operation.

(a) Only spurious emissions are permitted in any of the frequency bands listed below:

MHz	MHz	MHz	GHz
0.090–0.110	16.42–16.423	399.9–410	4.5–5.15
[1]0.495–0.505	16.69475–16.69525	608–614	5.35–5.46
2.1735–2.1905	16.80425–16.80475	960–1240	7.25–7.75
4.125–4.128	25.5–25.67	1300–1427	8.025–8.5
4.17725–4.17775	37.5–38.25	1435–1626.5	9.0–9.2
4.20725–4.20775	73–74.6	1645.5–1646.5	9.3–9.5
6.215–6.218	74.8–75.2	1660–1710	10.6–12.7
6.26775–6.26825	108–121.94	1718.8–1722.2	13.25–13.4
6.31175–6.31225	123–138	2200–2300	14.47–14.5
8.291–8.294	149.9–150.05	2310–2390	15.35–16.2
8.362–8.366	156.52475–156.52525	2483.5–2500	17.7–21.4
8.37625–8.38675	156.7–156.9	2690–2900	22.01–23.12
8.41425–8.41475	162.0125–167.17	3260–3267	23.6–24.0
12.29–12.293	167.72–173.2	3332–3339	31.2–31.8
12.51975–12.52025	240–285	3345.8–3358	36.43–36.5
12.57675–12.57725	322–335.4	3600–4400	N/A
13.36–13.41	N/A	N/A	N/A

((b) The field strength of emissions appearing within these frequency bands shall not exceed the limits shown in §15.209. At frequencies equal to or less than 1000 MHz, compliance with the limits in §15.209 shall be demonstrated using measurement instrumentation employing a CISPR quasi-peak detector.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

above 1000 MHz, compliance with the emission limits in §15.209 shall be demonstrated based on the average value of the measured emissions. The provisions in §15.35 apply to these measurements.

K.2 2 Specifications FCC Part 15.109 and ICES-003

Frequency (MHz)	FCC Part 15[1] /ICES003 Class B at 10m distance (dBµV/m)
30 – 230	30.00 QP @ 10m
230 – 1000	37.00 QP @ 10m

Note: FCC Part 15.109(g): As an alternative to the radiated emission limits shown in paragraphs (a) and (b) of this section, digital devices may be shown to comply with the standards contained in the Third Edition of International Electrotechnical Commission ("IEC"), International Special Committee on Radio Interference (CISPR) Pub. 22 (1997), "Information Technology Equipment – Radio Disturbance Characteristics – Limits and Methods of Measurement."

K.2.3 Specifications RSS Gen Issue 3 section 4.10 and 6 for RX spurious emissions

Spurious Frequency (MHz)	Field Strength (microvolt/m at 3 metres)
30-88	100
88-216	150
216-960	200
Above 960	500

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

K.3. Test Procedure

K.3.1 Tx Spurious measurements

RF radiated measurement at 3 meters distance.

For measurements above 1 GHz, RBW = 1 MHz, VBW = 3 MHz were used for peak measurements, RBW = 1 MHz, VBW = 10 Hz were used for average measurements

K.3.2 RSS Gen Issue 3, 4.10 Receiver Spurious Emission

The receiver shall be operated in the normal receive mode near the mid-point of the band over which the receiver is designed to operate.

Unless otherwise specified in the applicable RSS, the radiated emission measurement is the standard measurement method (with the device's antenna in place) to measure receiver spurious emissions.

Radiated emission measurements are to be performed using a calibrated open-area test site. As an alternative, the conducted measurement method may be used when the antenna is detachable. In such a case, the receiver spurious signal may be measured at the antenna port.

For either method, the search for spurious emissions shall be from the lowest frequency internally generated or used in the receiver (e.g. local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the higher, to at least 3 times the highest tuneable or local oscillator frequency, whichever is the higher, without exceeding 40 GHz.

For emissions below 1 GHz, measurements shall be performed using a CISPR quasi-peak detector and the related measurement bandwidth. As an alternative to CISPR quasi-peak measurement, compliance with the emission limit can be demonstrated using measuring equipment employing a peak detector with the same measurement bandwidth as that for CISPR quasi-peak measurements. Above 1 GHz, measurements shall be performed using an average detector and a resolution bandwidth of 300 kHz to 1 MHz.

K.4. Deviations

Deviation Number	Time & Date	Description and Justification of Deviation	Deviation Reference			Approval
			Base Standard	Test Basis	NTS Procedure	
none						

K.5. Operating Mode During Test

The EUT was tuned to a low and middle channel, operating at maximum rated RF output power with maximum power Setting 3 at 100% duty cycle. For High channel; Power setting 2 was used in order to reduce power.(See C-0101991-NOD-01).

The EUT was tuned to middle channel (Ch18) operating with receive mode.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

K.6. Sample Calculations

Part 15.209
Average Limit for above 960 MHz = 500 µV/m @ 3m = 20*Log (500) = 53.98 dBµV/m
Peak Limit for above 960 MHz = Average Limit + 20 (dB) = 73.98 dBµV/m

K.7. Test Results

Compliant. Worst case results reported

K.7.1 Rx mode for RSS Gen Issue 3 section 4.10 and 6 for RX emissions

Antenna Polarization	Frequency (MHz)	Detector	Radiated emission level (dBµV/m)	Limit type	Limit (dBµV/m)	Margin (dB)
H-pol	2499.74	Average	45.04	Average	53.98	8.94
V-pol	1000.03	Average	40.22	Average	53.98	13.76
V-pol	2488.86	Average	46.42	Average	53.98	7.56

The worst case Rx spurious emission was 46.42 dBµV/m at 3m distance with average detector at 2488.86 MHz. It has 7.56 dB margin to the average limits.

All final reported values are corrected values

K.7.2 Tx mode 30-1000 GHz for FCC 15.109 and ICES-003

Product Integrity Laboratory V2.5

Project Number: C-0101991 **Tester:** David Raynes
Model: Rainforest Automation - RAVEn **Test ID:** RE02-10m-0101991
Comments: 120 VAC, 60 Hz to support computer. EUT in Tx (continuous, modulated) mode on Channel 11. Power setting = 3.

Standard: CISPR22_B **Measurement Distance:** <1GHz 10 meters; >1GHz 3 meters

Antenna Polarization	Frequency (MHz)	Measured Level (dBµV)	Measurement Detector	Correction Factors (dB/m)	Emission Level (dBµV/m)	Limit Line	Limit (dBµV/m)	Margin (dB)	Mast Height (cm)	Turntable Angle (degrees)
Vertical	226.5032	29.08	Quasi Peak	-13.37	15.71	Quasi Peak	30.00	14.29	114.3	357.3
Vertical	366.6004	33.11	Quasi Peak	-8.67	24.44	Quasi Peak	37.00	12.56	400.1	27.5
Vertical	744.0122	29.90	Quasi Peak	-3.52	26.38	Quasi Peak	37.00	10.62	203.0	321.6
Horizontal	262.6437	29.79	Quasi Peak	-10.38	19.41	Quasi Peak	37.00	17.59	323.1	116.4
Horizontal	366.6022	35.03	Quasi Peak	-9.43	25.60	Quasi Peak	37.00	11.40	196.8	136.6
Horizontal	575.9888	29.14	Quasi Peak	-5.98	23.16	Quasi Peak	37.00	13.84	110.5	77.4
Horizontal	744.2004	31.14	Quasi Peak	-3.91	27.23	Quasi Peak	37.00	9.77	381.1	356.2

1. Positive Margin indicates a Pass
2. EUT faces normal to antenna at 10.6° turntable position.
3. Correction Factors include all factors between the receiving antenna and the receiver, including the antenna.

The worst case spurious emission was 27.23 dBµV/m at 10m distance with Quasi Peak detector at 744.2004 MHz. It has 9.77 dB margin to the Quasi Peak limits.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

K.7.3 TX Mode 1-25 GHz for FCC 15.205 and RSS 210

Channel	Antenna Polarization	Frequency (MHz)	Detector	Radiated emission level (dBµV/m)	Duty Cycle Correction Factor (dB)	Corrected Level (dBµV/m)	Limit type	Limit (dBµ V/m)	Margin (dB)
11	H-pol	4809.35	PK	52.71	N/A	N/A	PK	73.98	21.27
	H-pol	12023.02	PK	62.15	N/A	N/A	PK	73.98	11.83
	V-pol	4809.18	PK	57.27	N/A	N/A	PK	73.98	16.71
	V-pol	12023.05	PK	62.05	N/A	N/A	PK	73.98	11.93
	H-pol	19237.03	PK	56.92	N/A	N/A	PK	73.98	17.06
18	H-pol	4881.30	PK	52.17	N/A	N/A	PK	73.98	21.81
	H-pol	7322.03	PK	58.53	N/A	N/A	PK	73.98	15.45
	H-pol	12203.22	PK	63.34	N/A	N/A	PK	73.98	10.64
	V-pol	4879.27	PK	56.53	N/A	N/A	PK	73.98	17.45
	V-pol	7318.82	PK	58.34	N/A	N/A	PK	73.98	15.64
	V-pol	12203.22	PK	61.01	N/A	N/A	PK	73.98	12.97
	H-pol	19516.83	PK	59.89	N/A	N/A	PK	73.98	14.09
26	H-pol	4961.10	PK	46.47	N/A	N/A	PK	73.98	27.51
	V-pol	4959.32	PK	48.32	N/A	N/A	PK	73.98	25.66
11	H-pol	4810.22	AV	43.55	-19.94	23.61	AV	53.98	30.37
	H-pol	12023.35	AV	51.15	-19.94	31.21	AV	53.98	22.77
	V-pol	4809.90	AV	49.44	-19.94	29.5	AV	53.98	24.48
	V-pol	12023.20	AV	51.05	-19.94	31.11	AV	53.98	22.87
	H-pol	19246.03	AV	39.21	-19.94	19.27	AV	53.98	34.71
18	H-pol	4879.98	AV	42.84	-19.94	22.9	AV	53.98	31.08
	H-pol	7319.02	AV	47.40	-19.94	27.46	AV	53.98	26.52
	H-pol	12198.38	AV	52.18	-19.94	32.24	AV	53.98	21.74
	V-pol	4880.20	AV	47.85	-19.94	27.91	AV	53.98	26.07
	V-pol	7319.02	AV	47.67	-19.94	27.73	AV	53.98	26.25
	V-pol	12198.22	AV	49.51	-19.94	29.57	AV	53.98	24.41
	H-pol	19526.07	AV	40.89	-19.94	20.95	AV	53.98	33.03
26	H-pol	4959.27	AV	34.13	-19.94	14.19	AV	53.98	39.79
	V-pol	4959.32	AV	36.98	-19.94	17.04	AV	53.98	36.94

The emission with least margin to the applied limit was 63.34 dBµV/m measured with peak detector at 12203.22 MHz. It has 10.64 dB margin to the FCC Part 15.247 and RSS 210 limits.

All final reported values are corrected values. Worst case emissions presented
Plots were not provided in order to reduce file size

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

K.8. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name:	Lixin Wang	David Raynes
Function:	EMC Technologist	Senior EMC Technologist

K.9. Test date

Test started: 25 February, 2011 Test Completed: March 4, 2011

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

APPENDIX L: MEASUREMENT EQUIPMENT

Type	Manufacturer	Model	Asset #	Cal Due	Cal Date
Table Top LISN	EMCO	3825	CG0367	29JAN12	29JAN09
Bilog Antenna	Teseq	CBL 6112D	CG1177	14SEP12	14SEP10
Horn Antenna (Rx) 1 GHz – 18 GHz	EMCO	3115	CG0368	08SEP11	08SEP09
Standard Gain Horn (Rx) 18 GHz – 26.5 GHz	EMCO	3160-09	CG0075	N/A (1)	27NOV01
LNA 1 GHz < f < 18 GHz	Miteq	JSD00121	CG0761	13NOV11	13NOV09
LNA 18GHz < f < 26.5GHz	Miteq	JSD00119	CG0482	02OCT11	02OCT09
High pass filter f > 1000 MHz	MicroTronics	HPM14576	CG0963	13NOV11	13NOV09
High pass filter f > 2800 MHz	MicroTronics	HPM50111	CG0964	N/A	N/A
Signal Analyzer 20 Hz – 26.5 GHz	Rohde & Schwarz	FSQ	CG1462	20DEC11	20DEC10
Spectrum Analyzer	HP	8564E	CG0352	01DEC11	01DEC10
Test Receiver	Rohde & Schwarz	ESMI	CG0433 CG0434	04MAY11	04MAY09
HPIB Extender	HP	37204	CG0181	N/A	N/A
Mast Controller	EMCO	2090	CG0179	N/A	N/A
Turntable Controller	EMCO	2090	CG0178	N/A	N/A

(1): As per manufacturer recommend, this item does not require periodic calibration. Its electromagnetic performance is almost exclusively depended on the physical dimension of the horn. A thorough mechanical check is all that is needed to guarantee the antenna performance.

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

END OF DOCUMENT

The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.