Certification Test Report

CFR 47 FCC Part 15, Subpart C Section 15.247
Industry Canada RSS 210, Issue 8

Energy Aware Technology Inc.
Power Tab IHD
PTMK2USB
PTMK2UART

FCC ID # W72-PTMK2
IC # 8253A-PTMK2

Project Code C-0099752

(Report C-0099752-RA-1-2)
This report supersedes report C-0099752-RA-1-1

March 2, 2011

Prepared for:	Energy Aware Technology Inc.
Author:	Lixin Wang EMC Technologist
Approved by:	Nick Kobrosly Director of Canadian Operations

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:	Energy Aware Technology Inc. 604-134 Abbott Street Vancouver, BC. V6B 2K4 Tel: 604-638-7763 www.energy-aware.com
Customer Representative:	Name: Lauren Kulokas Title: Vice President, Operations Phone #: (604) 282-7698 Email Address: lauren.kulokas@energy-aware.com

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)	RSS-Gen Issue 3 7.2.4
B	6 dB Bandwidth	No	No	No	Pass	FCC Subpart C 15.247 (a) (2)	RSS 210 Issue 8 A8.2 (a)
C	Occupied Bandwidth (99% emission bandwidth)	No	No	No	N/A	N/A	RSS-Gen Issue 3 4.6.1
D	Peak Power Output	No	No	No	Pass	FCC Subpart C 15.247 (b) (3)	RSS 210 Issue 8 A8.4 (4)
E	Power Spectral Density	No	No	No	Pass	FCC Subpart C 15.247 (e)	RSS 210 Issue 8 A8.2 (b)
F	Duty Cycle Correction Factor	No	No	No	N/A	FCC Subpart C 15.35 (c)	RSS-Gen Issue 3 4.5
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	Radiated Spurious Emissions Band Edge	No	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 8 2.5, A8.5
J	Radiated Spurious Emissions (TX and RX)	No	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 8 2.5, A8.5 RSS Gen Issue 3 section 4.10 and section 6 for RX

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

Lixin Wang
2011.03.03
13:31:20 -07'00'

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: 2011.03.03 14:07:44 -07'00'

Reviewed By: _____
Glen Moore
Wireless/EMC Manager

Alex Mathews
2011.03.03
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Approved By: _____
Alex Mathews
Quality Management Representative

Table of Contents

Register of revisions

Revision	Date	Description of Revisions
1	February 14, 2011	Initial release
2	March 2, 2011	Release with review update

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 Power Tab IHD PTMK2USB and PTMK2UART from Energy Aware Technology Inc. to FCC Part 15 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

	Name	Model	Revision	Serial Number
EUT	Power Tab IHD	PTMk2UART PTMK2USB	A.E	10/52/001 USB unit 10/52/007 UART unit 10/52/003 USB unit
Power Supply	Ten Pao DC 5V DC Adapter	S003HU0500050	N/A	N/A
Device Classification	Mobile			
Antenna	Johanson 2450AT45A100 Integral antenna. Maximum peak gain: 0.4 dBi.			
Modulation	offset quadrature phase shift keying			
EUT Size with Enclosure (H x W x D) (in mm)	80 x108 x 30			
EUT Weight (in grams)	135g			
Channels/Frequency Range	802.15.4 compliant (16 channels, 2400-2480MHz, 5MHz spacing)			
Functional Description	Wireless, handheld, Zigbee-compliant, In Home Display. Connects to Smart Meter to display energy consumption information in real time. Powered by single AA NiMH cell, and rechargeable using 5V 500mA DC adapter. This device has USB and UART versions.The PCBs for both devices are identical, USB capability was added to the USB version by populating more parts on the PCB. In order to add USB functionality, the port on the back of the product was changed from a 6-SIP male UART connector to a USB Mini-B connector. Single USB-UART transceiver IC (FTDI FT232R) which allows the device to appear as a USB serial port was added when connected to a computer. This IC requires a few filter capacitors, a bulk capacitor and a ferrite bead to operate. It generates its own clock frequency internally, and is only powered on when the device is plugged in with a USB cable.			

2.1.1 EUT POWERS

Voltage	AA Type battery powered.
Number of Feeds	1

2.2 EUT CABLES

Quantity	Model/Type	Routing		Shielded / Unshielded	Description	Cable Length (m)
		From	To			
1	DC Power Cable	Power Supply	EUT	Unshielded	Power Cable	1.9

2.3 MODE OF OPERATION DURING TESTS

The Power Tab IHD was tested while in Continuous Transmit (100% duty cycle) 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 a level of "3" operate at the intended maximum power output available to the end user at low and middle channels. High channel (Channel 26) was set to a reduced level of "-15" as maximum per C-0099752-NOD-03.
EUT was tested with unit transmitting or receiving while ac powered from Switching Power Supply Model: S003HU0500050.
Both PTMK2USB and PTMK2UART samples were tested and their emissions profiles were not different.
For all radiated tests, EUT was tested in three orthogonal planes with the worst case results reported.

3.0 SUPPORT EQUIPMENT

None.

APPENDICES

APPENDIX A: POWER LINE CONDUCTED EMISSION

A.1. Base Standard & Test Basis

Base Standard	FCC PART 15.207 (a) RSS-Gen Issue 3 7.2.4
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 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 Power Tab IHD was tuned to middle channel in continuous transmit mode and 100 % duty cycle at maximum rated RF output power(setting 3). EUT powered from Switching Power Supply Model: S003HU0500050.
Both PTMK2USB and PTMK2UART samples were tested and worst result reported.

A.5. Test Results

Product Integrity Laboratory V2.5

Project Number: C-0099752 **Tester:** Lixin Wang
Model: Energy Aware - Power Tab Mk2 **Test ID:** CE02tc-10m-0099752
Comments: 120 VAC, 60 Hz. PTMK2USB/PTMK2UART placed flat on table, Tx stream Channel 18 (2440 MHz). 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	0.359	Average	21.18	11.00	32.18	Average	48.76	**16.58**
120 VAC, Line	0.580	Average	19.10	10.78	29.88	Average	46.00	**16.12**
120 VAC, Line	3.172	Average	18.21	10.91	29.12	Average	46.00	**16.88**
120 VAC, Neutral	0.357	Average	17.17	10.92	28.09	Average	48.80	**20.71**
120 VAC, Neutral	0.584	Average	16.91	10.72	27.63	Average	46.00	**18.37**
120 VAC, Neutral	3.269	Average	15.39	10.83	26.22	Average	46.00	**19.78**
120 VAC, Line	0.358	Quasi Peak	31.18	11.00	42.18	Quasi Peak	58.79	**16.61**
120 VAC, Line	0.577	Quasi Peak	29.35	10.78	40.13	Quasi Peak	56.00	**15.87**
120 VAC, Line	3.113	Quasi Peak	26.31	10.91	37.22	Quasi Peak	56.00	**18.78**
120 VAC, Neutral	0.357	Quasi Peak	24.76	10.91	35.67	Quasi Peak	58.80	**23.13**
120 VAC, Neutral	0.581	Quasi Peak	24.10	10.72	34.82	Quasi Peak	56.00	**21.18**
120 VAC, Neutral	3.258	Quasi Peak	23.41	10.83	34.24	Quasi Peak	56.00	**21.76**

Note: Line emissions were measured of PTMK2USB unit and Neutral emissions were measured of PTMK2UART unit.

Both PTMK2USB and PTMK2UART unit were tested, and emission frequencies were identical. USB unit got slightly higher measurements in Line and UART unit got slightly higher measurement in Neutral. Measurements reported with the worst case. Line measured from the USB unit and Neutral measured from the UART unit.

The emission measured with the least margin to the applicable limit was 40.13 dBµV with Quasi Peak detector at 0.577 MHz. It has a 15.87 dB margin to the FCC Part 15.207 and RSS-Gen Issue 3 limits.

A.6. 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

A.7. Test date March 1,2011

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

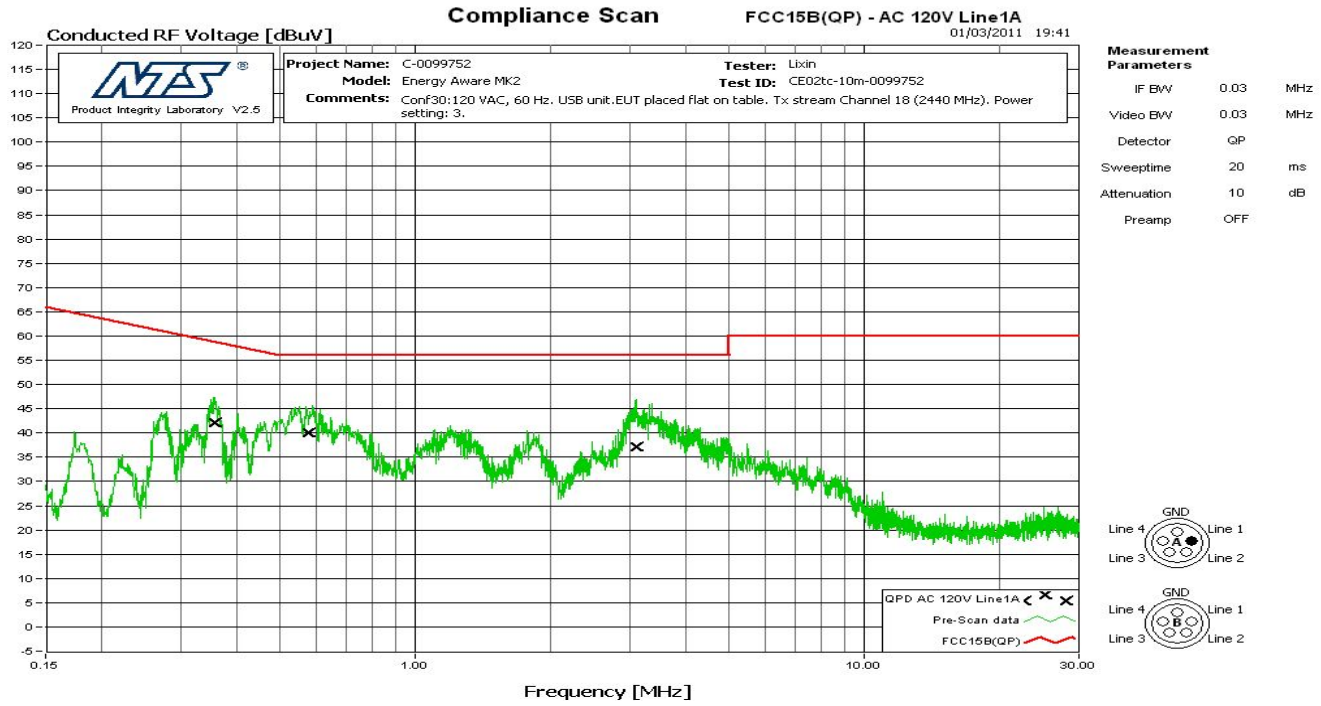


Figure 2 Conducted Emission Line 150 kHz – 30 MHz Average Detector USB unit

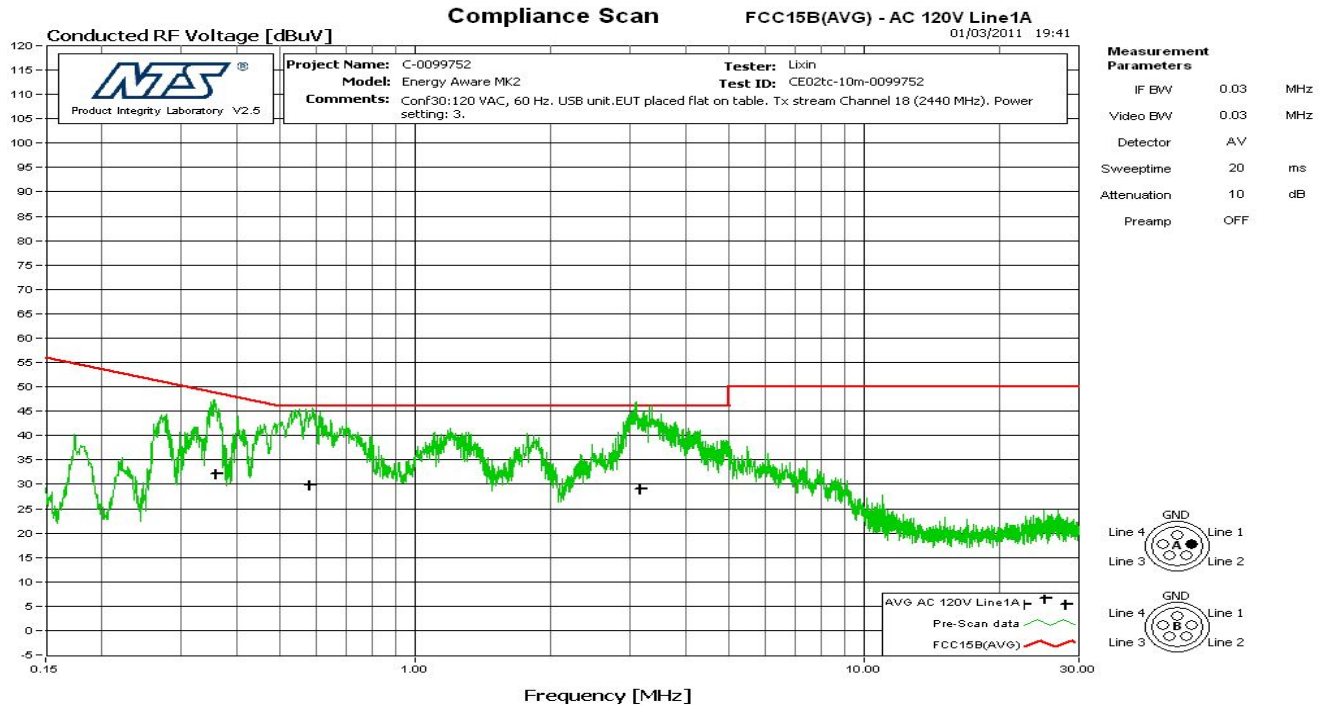


Figure 3 Conducted Emission Neutral 150 kHz – 30 MHz Quasi-peak Detector UART unit

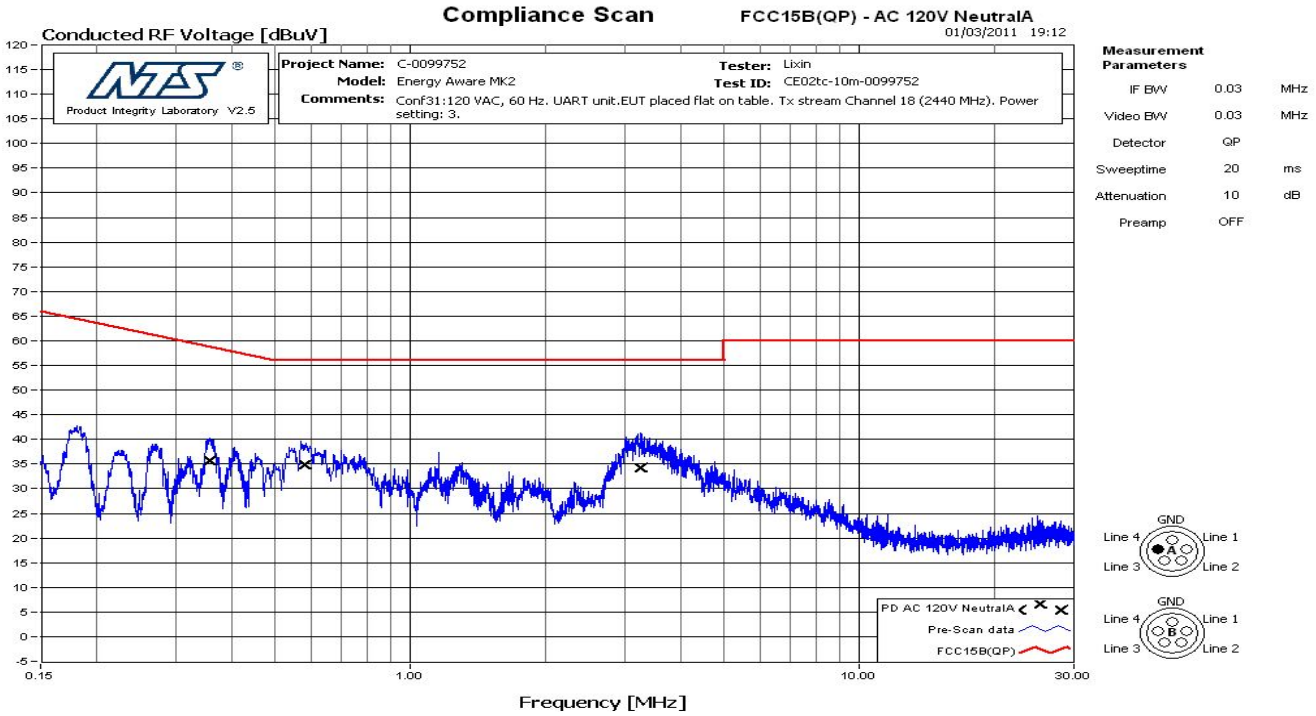
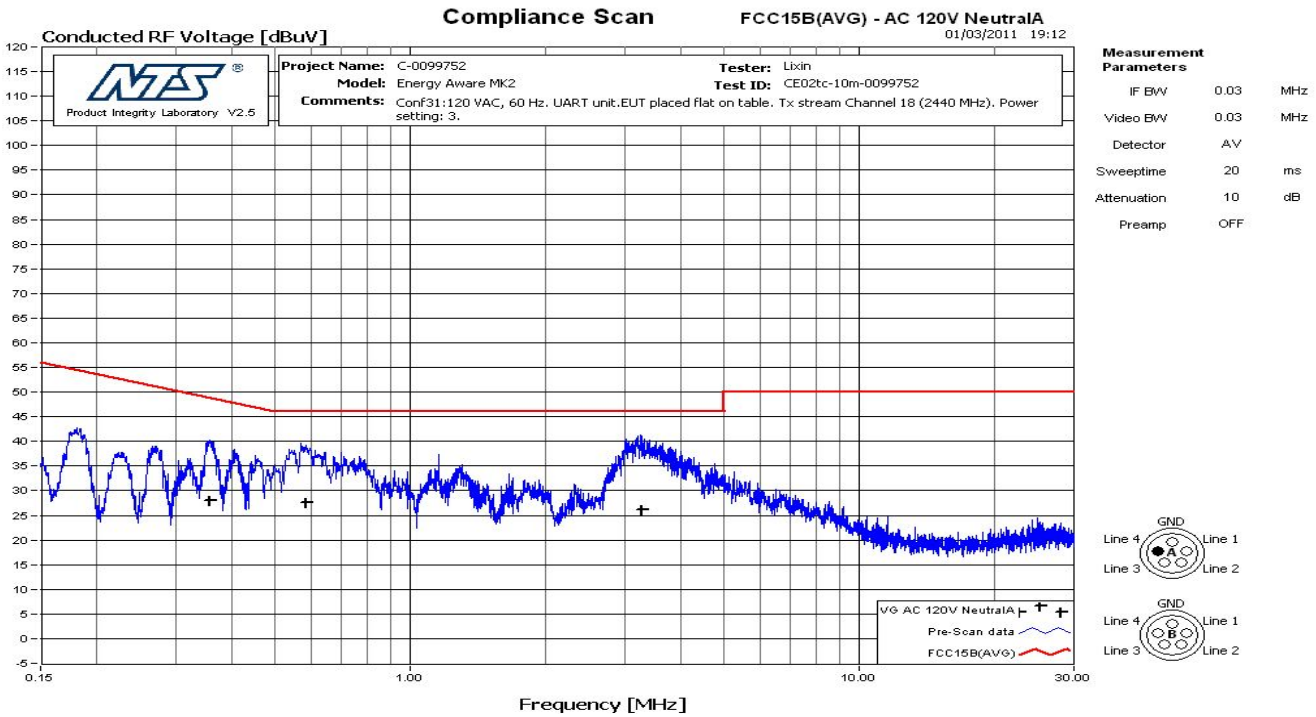


Figure 4 Conducted Emission Neutral 150 kHz – 30 MHz Average Detector UART unit



Plots below were only peak measurements versus Average limit to show the difference between the USB and UART unit. Test result see table above.

Figure 5 Conducted Emission Line 150 kHz – 30 MHz UART unit

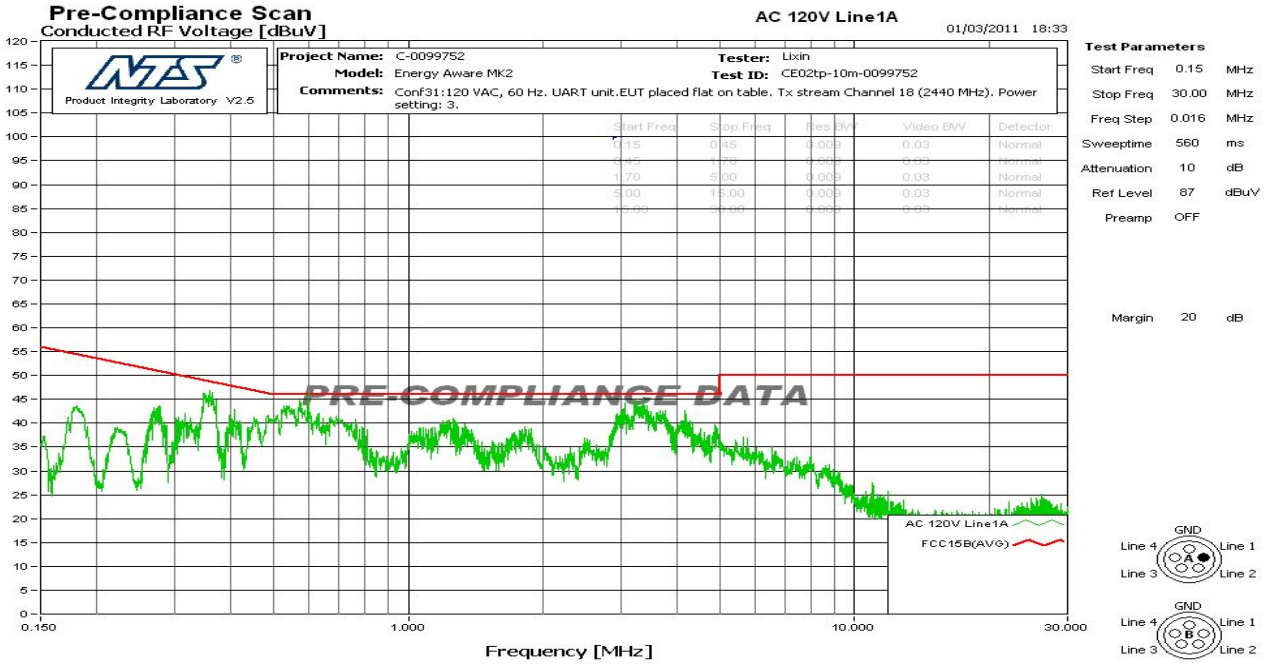


Figure 6 Conducted Emission Line 150 kHz – 30 MHz USB unit

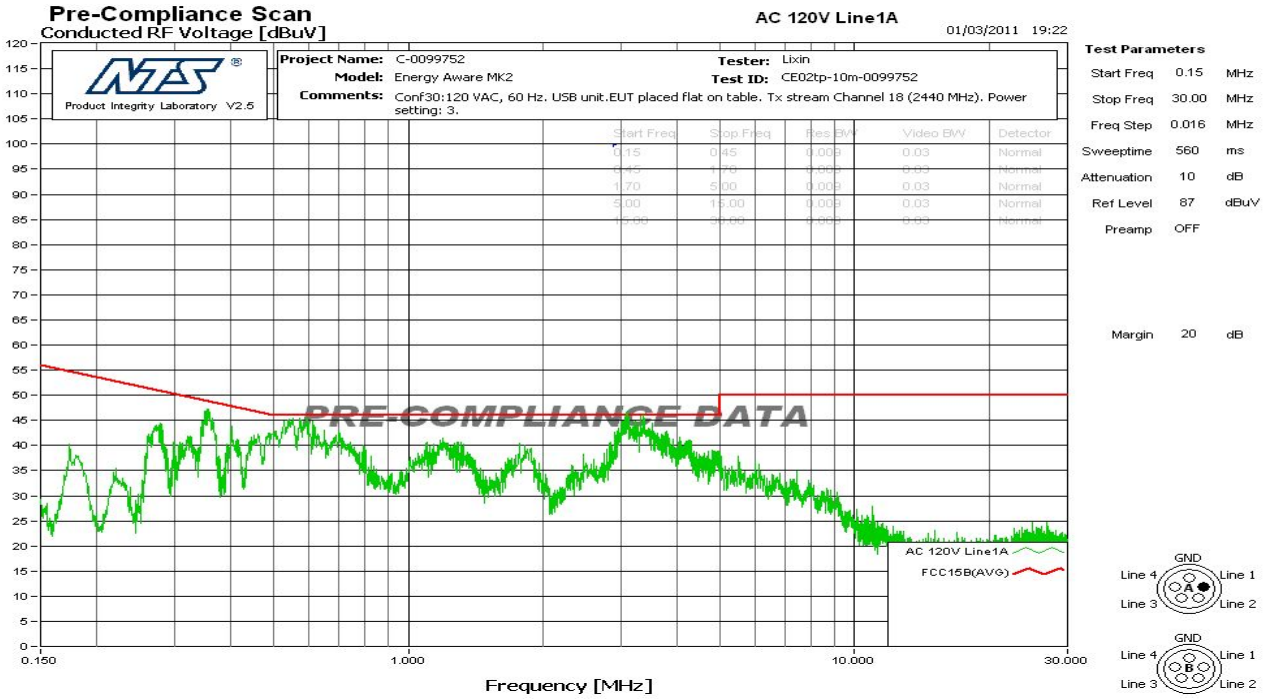


Figure 7 Conducted Emission Neutral 150 kHz – 30 MHz UART unit

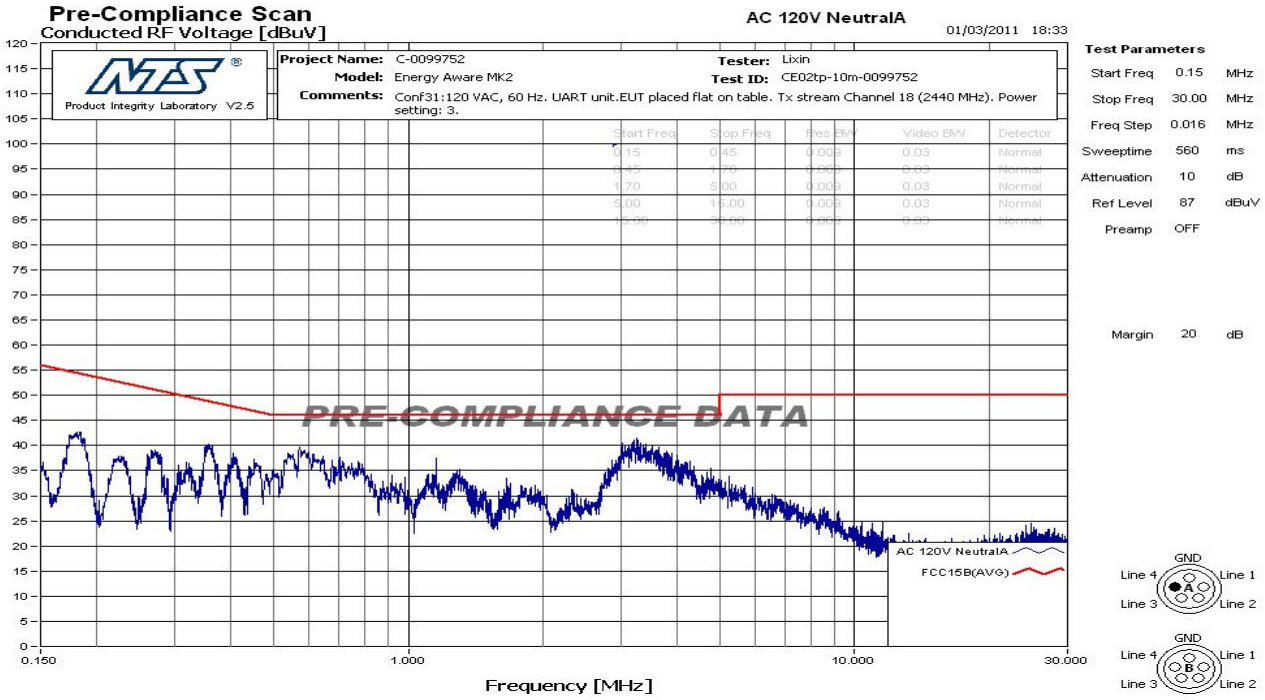
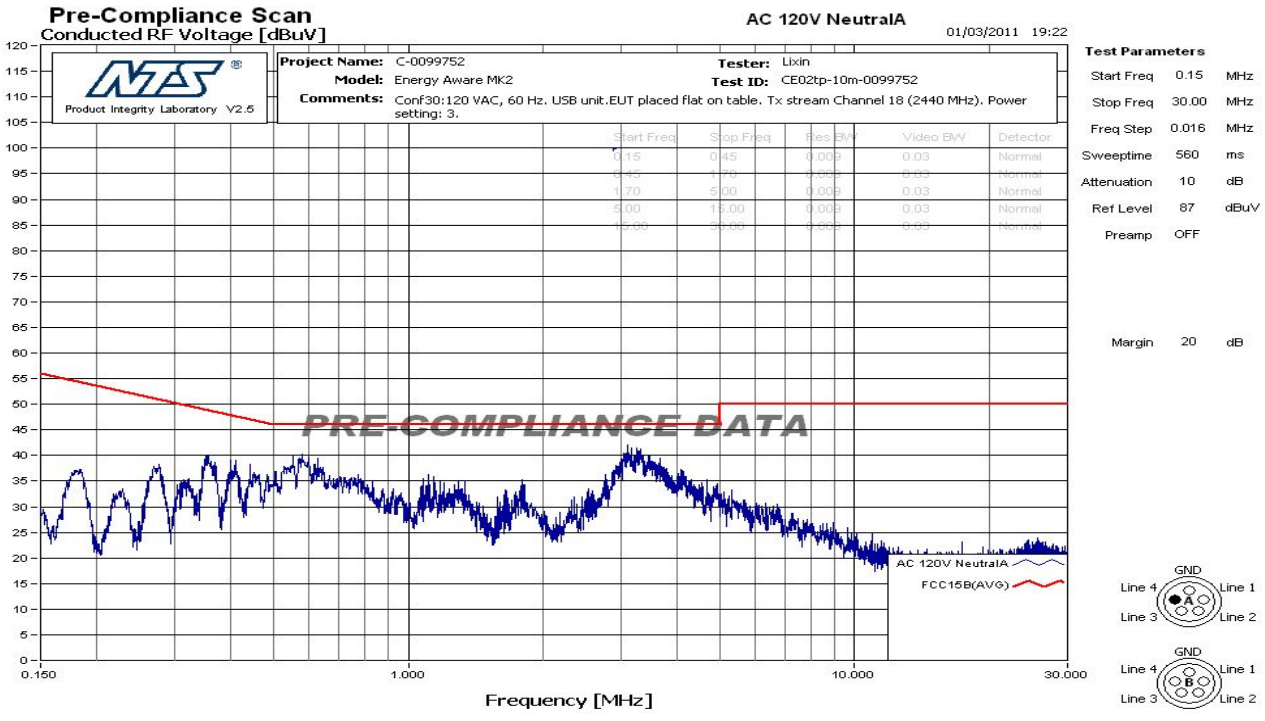


Figure 8 Conducted Emission Neutral 150 kHz – 30 MHz USB unit



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	1.619
18	2440	1.603
26	2480	1.603

All final reported values are corrected values.

B.6. Operating Mode During Test

The Power Tab IHD was tuned to a low, middle and high channel in continuous transmit mode and 100 % duty cycle at maximum rated RF output power (setting 3). Power level was reduced (setting -15) for high channel (Ch 26)

B.7. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

B.8. Test date

February 8, 2011

Figure 9 6 dB Bandwidth Low Channel

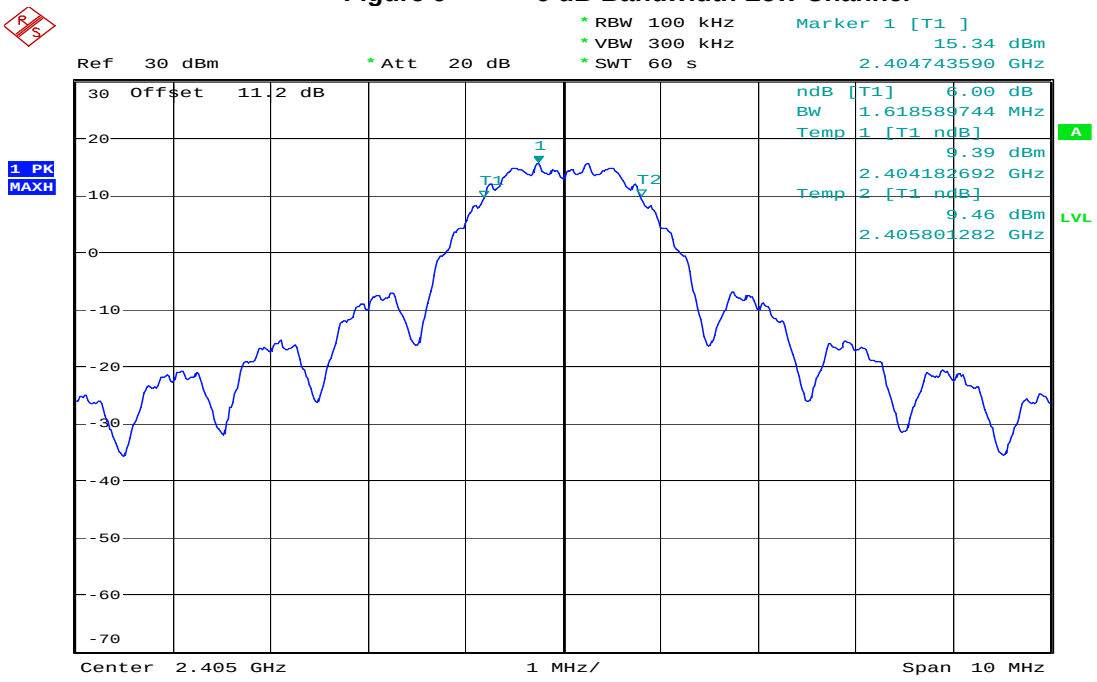


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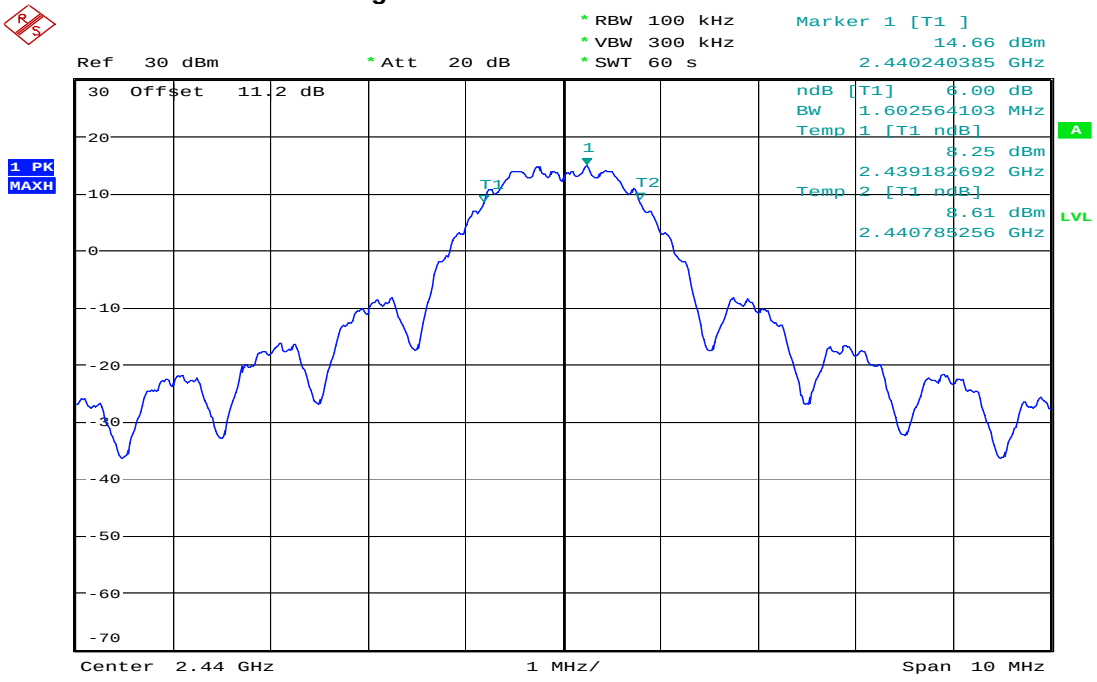
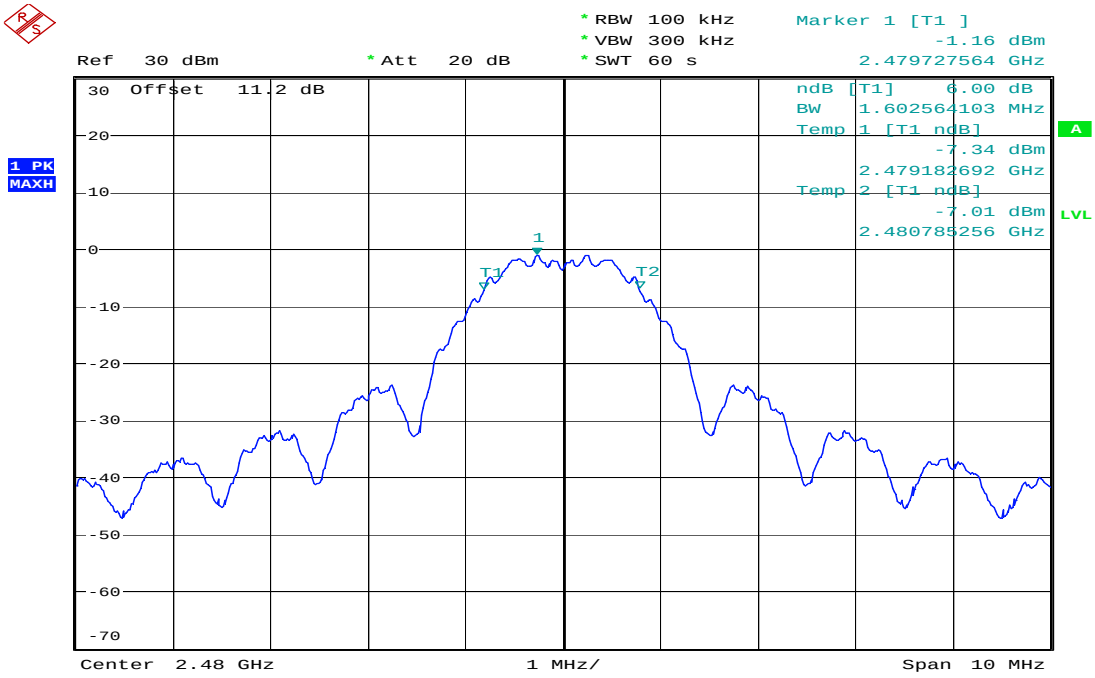
Figure 10 6 dB Bandwidth Mid Channel



Date: 8.FEB.2011 05:35:08

Figure 11 6 dB Bandwidth High Channel



Date: 8.FEB.2011 06:11:42

APPENDIX C: OCCUPIED BANDWIDTH

C.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

C.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.

C.3. Test Procedure

RSS-Gen Issue 2

C.4. Test Results

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
11	2405	2.452
18	2440	2.404
26	2480	2.436

All final reported values are corrected values

C.5. Operating Mode During Test

The Power Tab IHD was tuned to a low, middle and high channel in continuous transmit mode and 100 % duty cycle at maximum rated RF output power (setting 3). Power level was reduced (setting -15) for high channel (Ch 26).

C.6. Tested By

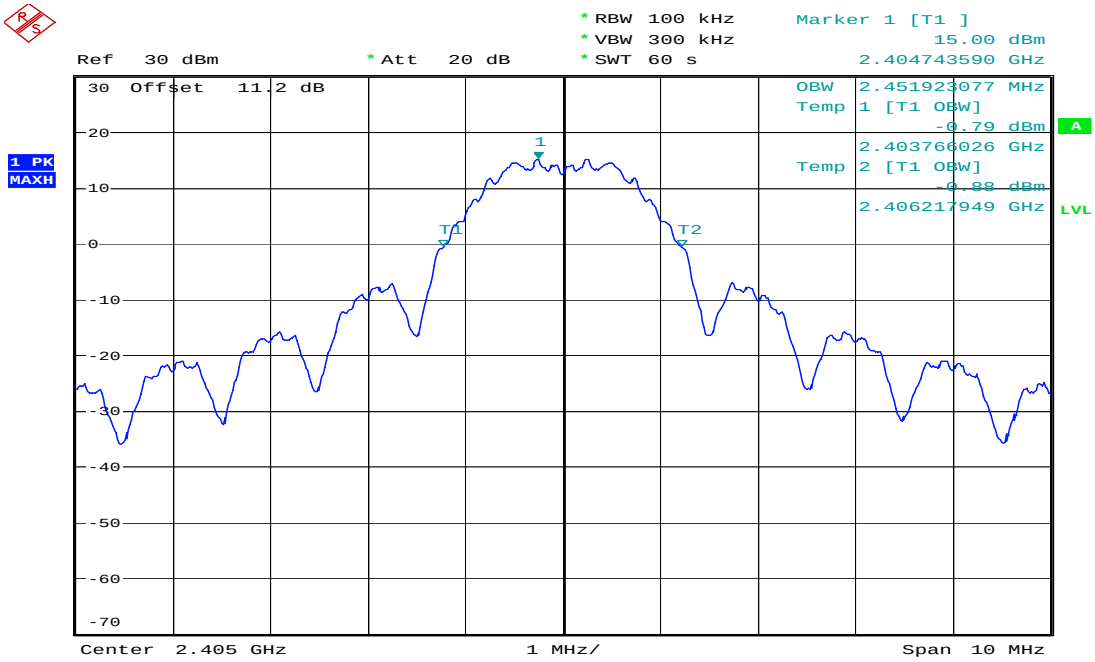
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

C.7. Test date

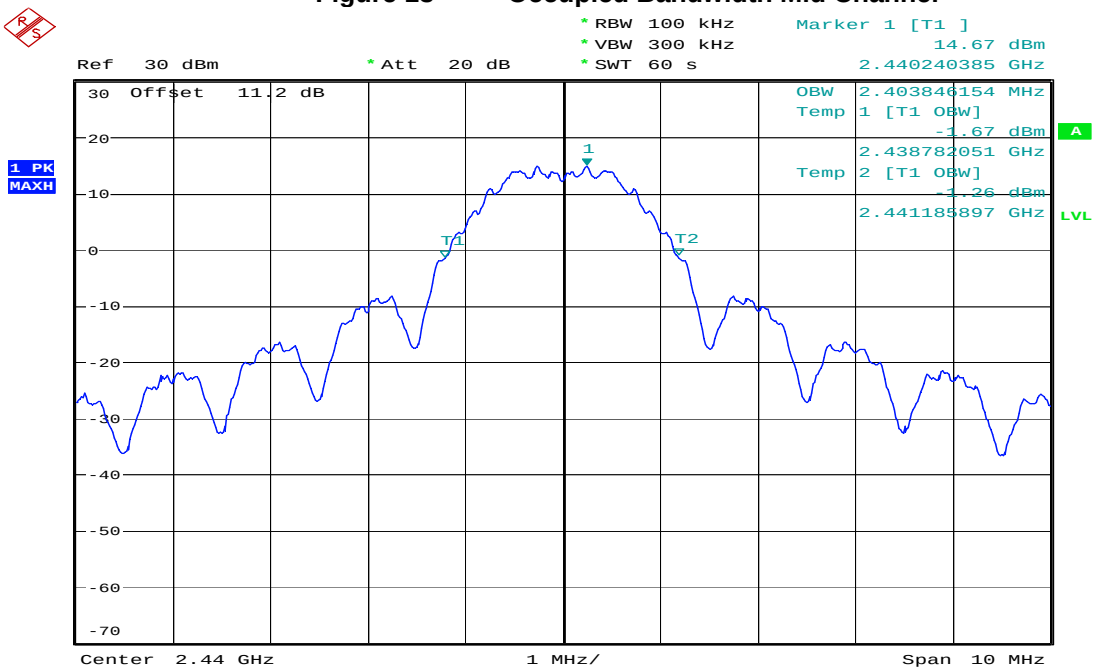
February 8, 2011

Figure 12 Occupied Bandwidth Low Channel



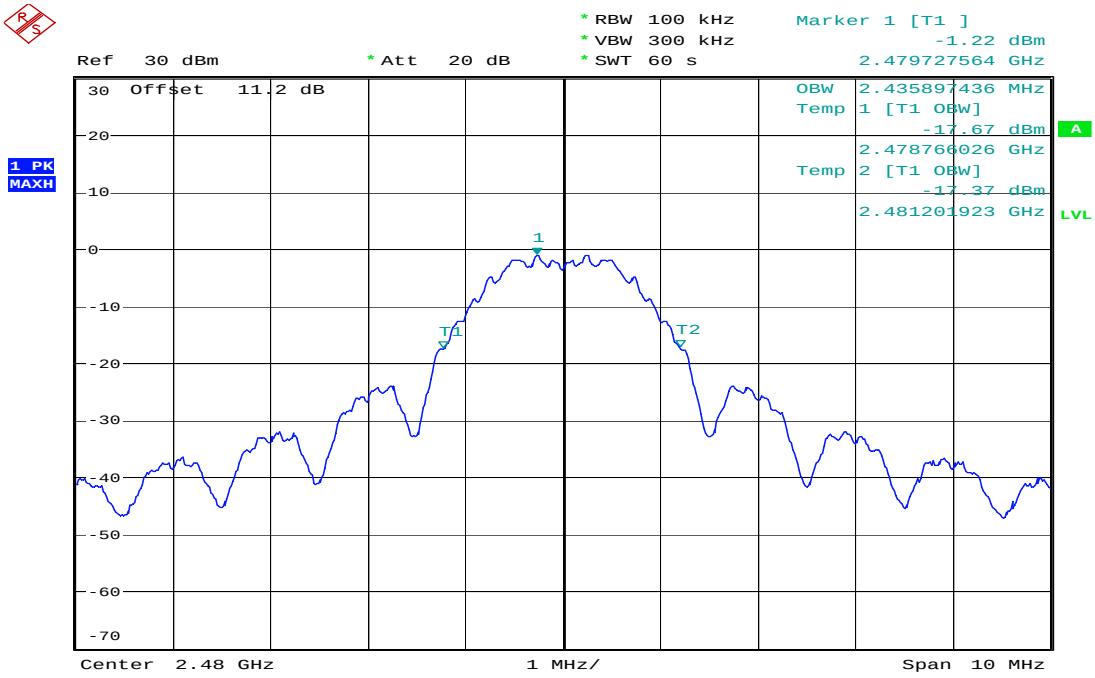
Date: 8.FEB.2011 04:51:44

Figure 13 Occupied Bandwidth Mid Channel



Date: 8.FEB.2011 05:37:41

Figure 14 Occupied Bandwidth High Channel



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APPENDIX D: PEAK POWER OUTPUT

D.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

D.2. Specifications

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

D.3. Test Procedure

FCC Publication 558074 and RSS-Gen Issue 3 4.8

D.4. Operating Mode During Test

The Power Tab IHD was tuned to a low, middle and high channel in continuous transmit mode and 100 % duty cycle at maximum rated RF output power (setting 3). Power level was reduced (setting -15) for high channel (Ch 26).

D.5. Test Results

Compliant – The maximum peak power was 18.43 dBm as measured conducted at the RF output port

D.6. Test Data Summary

Channel	Frequency (MHz)	Peak RF power (dBm)
11	2403.40	18.43
18	2439.64	17.86
26	2479.32	2.24

Device antenna gain 0.4 dBi.

All final reported values are corrected values

D.7. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

D.8. Test date

February 8, 2011

Figure 15 Low Channel

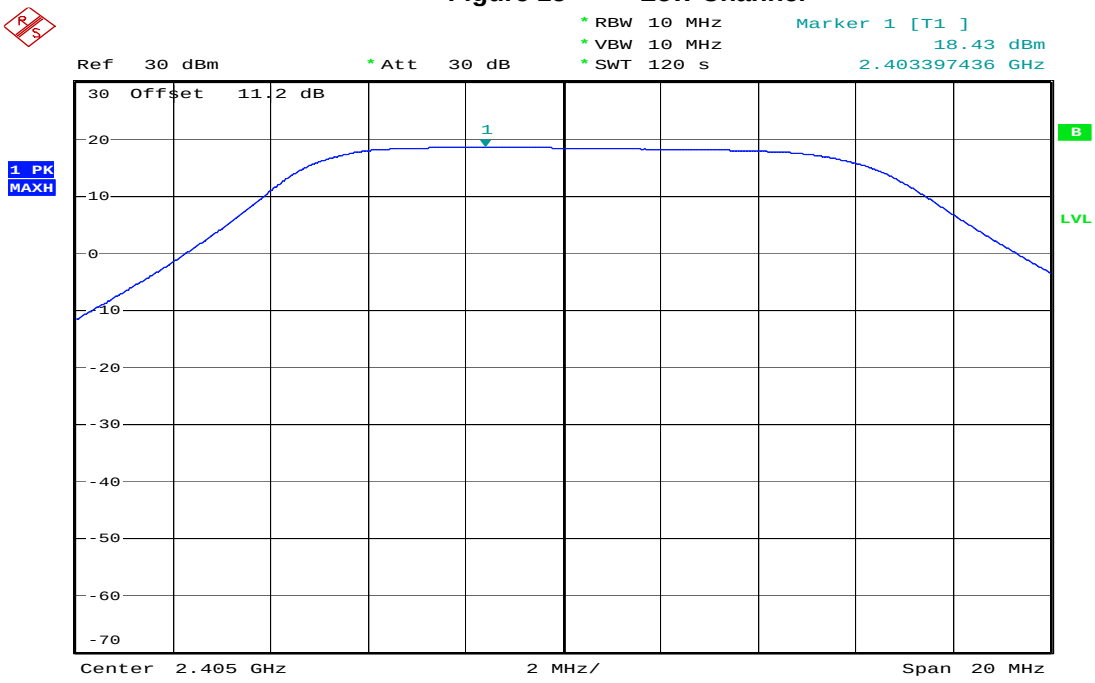

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Figure 16 Mid Channel

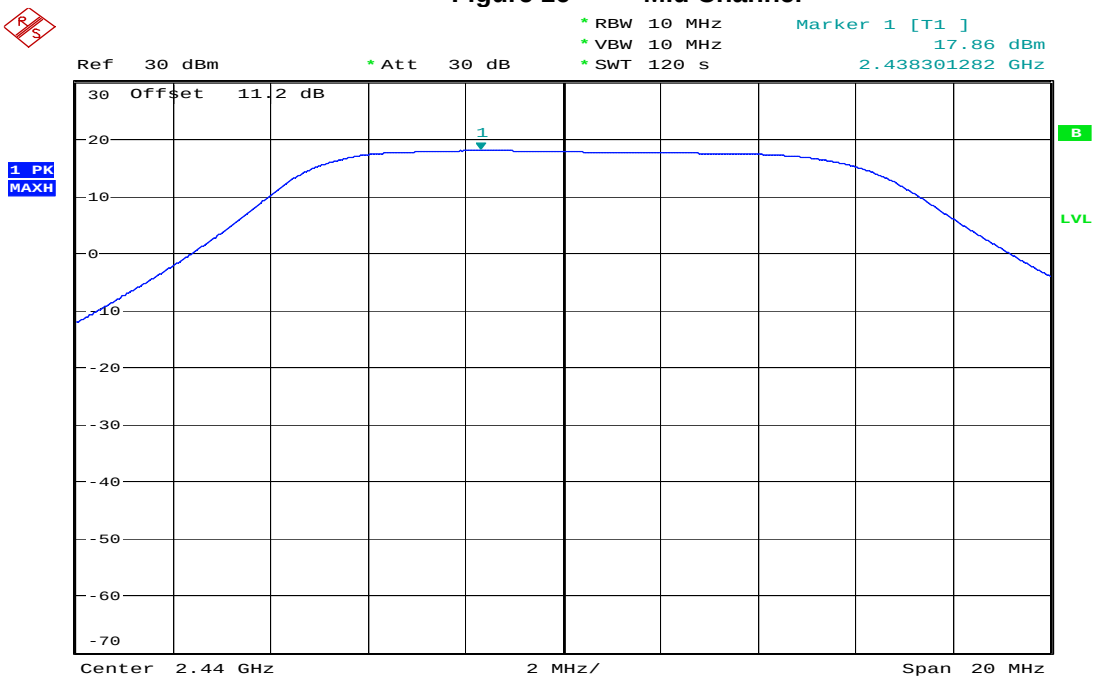

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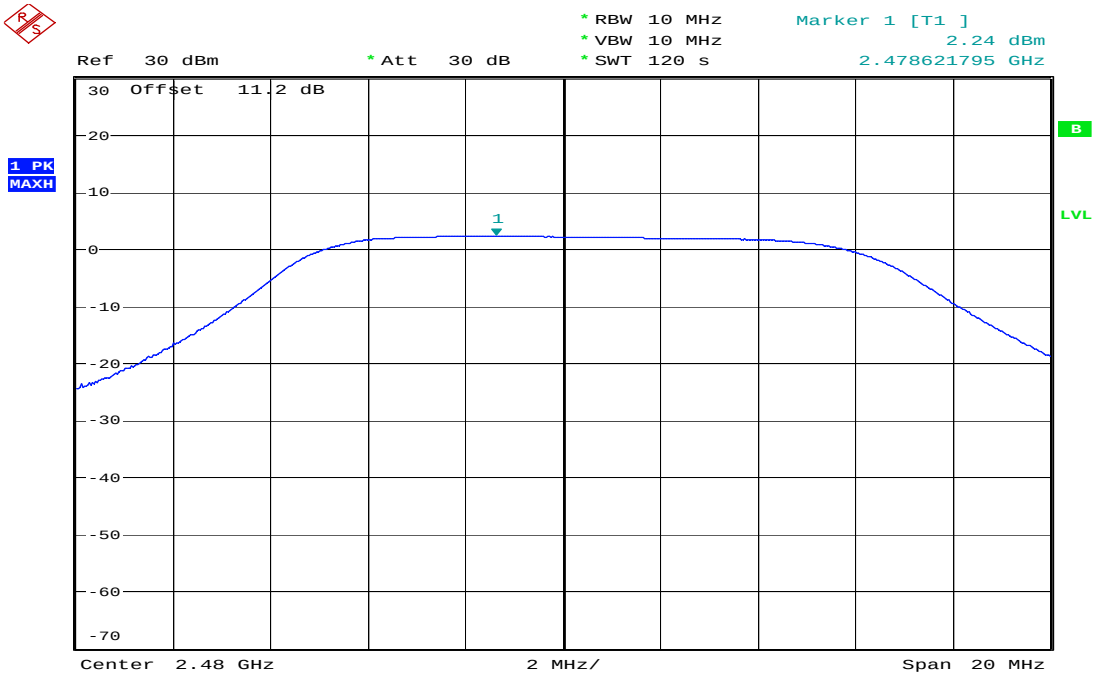
Figure 17 High Channel



Date: 8.FEB.2011 06:20:05

APPENDIX E: POWER SPECTRAL DENSITY

E.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)

E.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.

E.3. Test Procedure

FCC Publication 558074 and RSS 210 Issue 8 A8.2 (b)

E.4. Operating Mode During Test

The Power Tab IHD was tuned to a low, middle and high channel in continuous transmit mode and 100 % duty cycle at maximum rated RF output power (setting 3). Power level was reduced (setting -15) for high channel (Ch 26).

E.5. Test Results

Compliant. The maximum measured power spectral density was 4.39 dBm as measured conducted at the RF output port

E.6. Test Data Summary

Channel	Frequency (MHz)	PSD (dBm)
11	2405.42	4.39
18	2440.08	3.75
26	2480.08	-11.33

Device antenna gain: 0.4 dBi.

All final reported values are corrected values

E.7. Tested By

This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

E.8. Test date

February 8, 2011

Figure 18 Low Channel

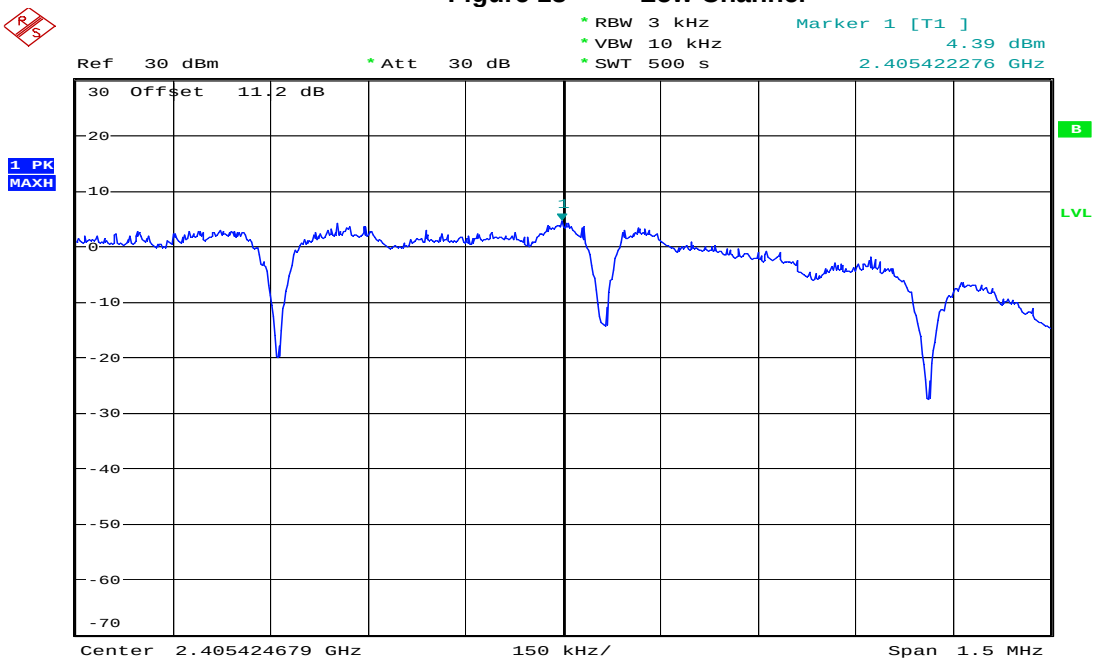


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Figure 19 Mid Channel

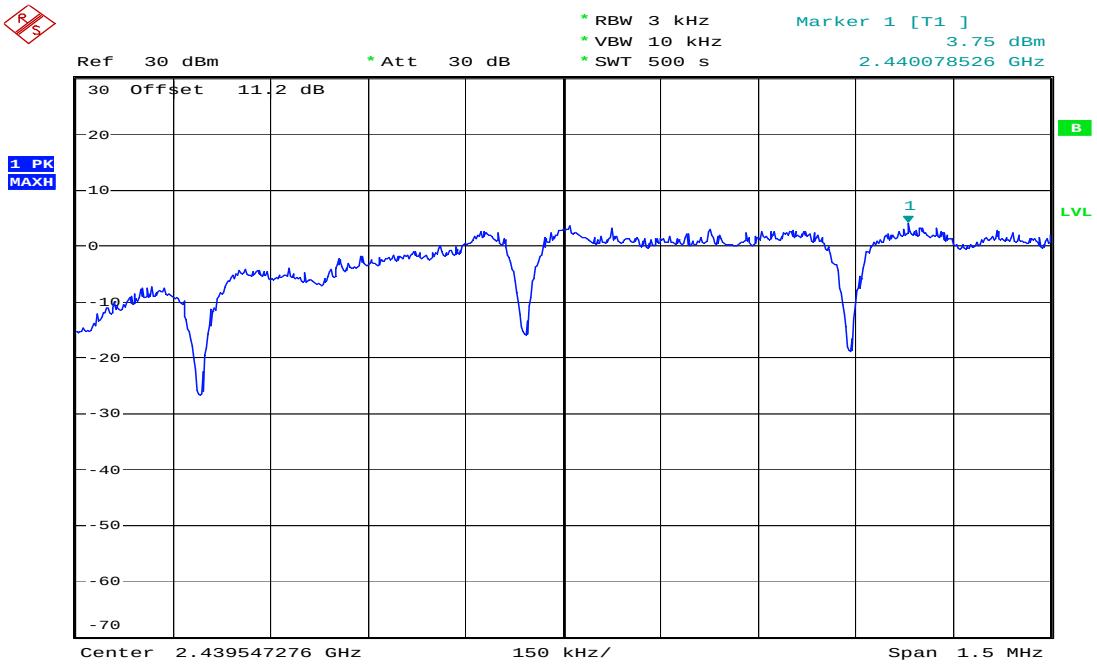

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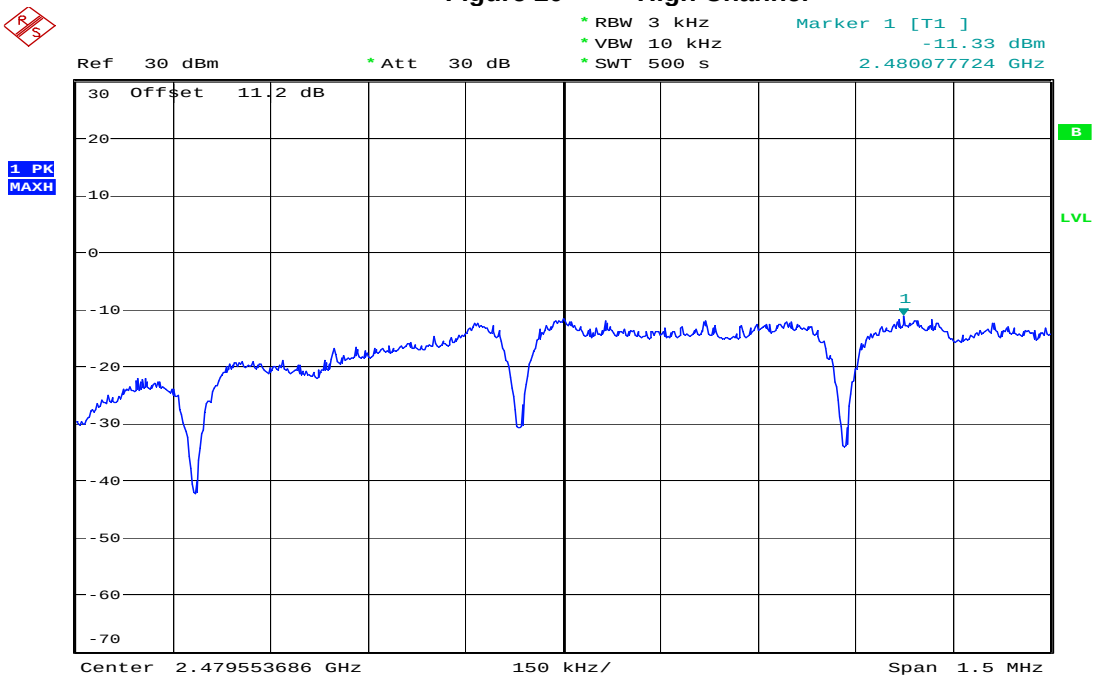
Figure 20 High Channel



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APPENDIX F: DUTY CYCLE CORRECTION FACTOR

F.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

F.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.

F.3. Duty Cycle Correction Factor Result

Worst case Duty Cycle correction factor was provided by customer: 42.06%.
See duty cycle attestation exhibit

20log(0.4206)= -7.52 dB

Details of duty cycle calculation as following:

Goal:	Calculate the worse case time a ZigBee Node will be in TX Mode in any 100ms Time Window. With the result, a TX Duty Cycle Correction Factor can be used to increase FCC compliance Margin. Correction Factor is: 20*Log10(Duty Cycle)
Procedure:	In order to calculate the worse case TX on time, Ember started by reviewing the IEEE 802.15.4 MAC and PHY constants. In addition, Ember used the slotted ACK LIFS and SIFS scenarios. Each scenario is described below.
Worst Case Scenario:	The worst case scenario utilizes LIFS, and a TX, RX ACK, TX, RX ACK… from a single node. It has been proven through calculation, this scenario keeps the node in TX Mode for the longest period of time.
Summary:	When using EmberZNet Stack SW, the TX duty cycle: 42%

IEEE 802.15.4-2003 2.4 GHz PHY Constants

Data Rate	250000	bits / sec
	31250	bytes / sec
Symbols/byte	2	sym / bytes
Symbol Timing	62500	sym / sec
	0.000016	sec / sym
Byte Timing	0.000032	sec / byte
PHY PSDU	6	bytes
Max Length	127	bytes
Total Packet Length	133	bytes
Maximum Time TX PKT	0.004256	sec

Long Frame Scenario:

1) TX Frame — Assume Frame is Data Frame
2) Wait for ACK
3) RX ACK
4) CPU Processing of ACK
5) Wait for Backoff
6) Repeat 1)

MAC-Level Calculation (LIFS)

Long InterFrame Spacing (Slotted w/ ACK)

Long Frame	127	bytes
Data Frame Payload	102	bytes
ACK Frame	5	bytes
tack	12	sym
LIFS	40	sym
Backoff Period	20	sym
Maximum Backoff	31	
Backoff Required	2	
Backoff Time	300	sym

Transmit Time

TX Time (Packet)	0.004256	
Total TX Time (sec)	0.004256	

NOT Transmit time (RX or Idle)

Wait for ACK (tack)	0.000192	
RX Time (ACK)	0.000352	
Backoff Time (tbo)	0.0048	(Backoff Time * Backoff Period)
CPU Processing (tcpu)	0.0002	(0.2ms average on EM2xx running EmberZNet)
CCA Assessment (tcca)	0.000128	(averaged over 8 symbols in RX Mode)
Turn Around Time (RX to TX)	0.000192	(After CCA, Radio turns over to TX in 12 symbols)
Total Off Time (sec)	0.005864	

Total Time (ttotal)	0.01012
Number of RX/TX cycles in 100ms	9.881422925

Worse Case (100ms window)	
TX Frame 9.88142292 times	0.042055336
RX or IDLE 9.88142292 times	0.057944664
Sum	0.1

MAC TX Duty Cycle	**42.06%**

APPENDIX G: CONDUCTED SPURIOUS EMISSIONS (TX)

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. Test Procedure

FCC Publication 558074

G.4. Operating Mode During Test

The Power Tab IHD was tuned to a low, middle and high channel in continuous transmit mode and 100 % duty cycle at maximum rated RF output power (setting 3). Power level was reduced (setting -15) for high channel (Ch 26).

G.5. Test Results Summary

Compliant.

TX Channel	Worst Case Spurious Frequency (MHz)	Emission Level (dBc)
11	71.62	-55.65
18	4857.76	-60.22
26	154.85	-53.80

TX mode: The worst case spurious emission was 53.80 dB below the carrier at Channel 26.

All final reported values are corrected values

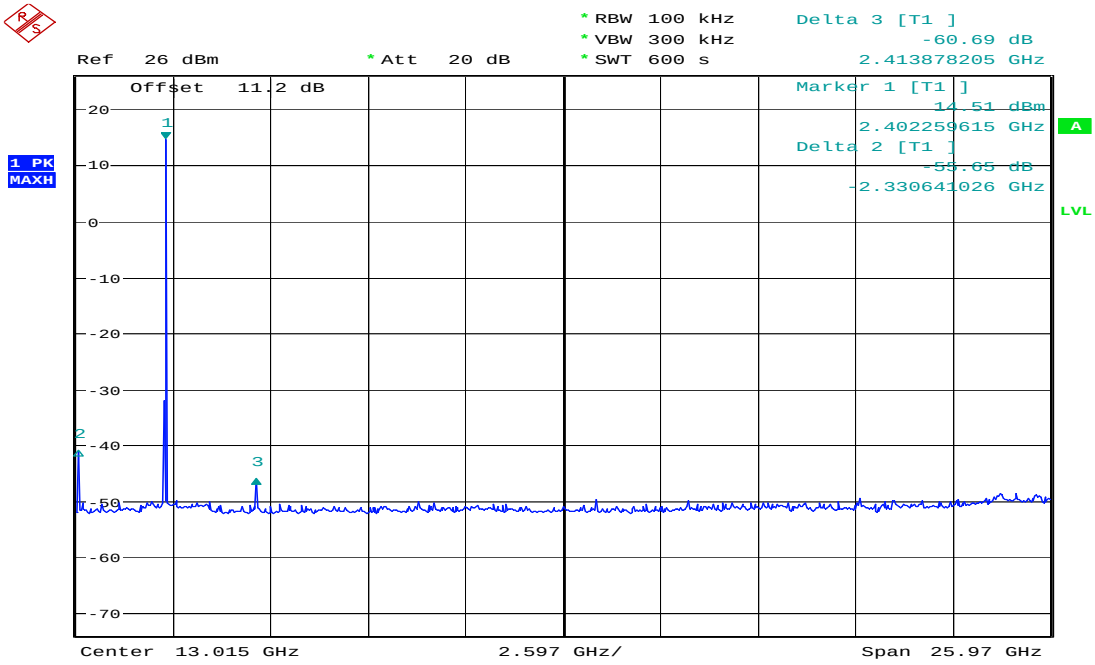
G.6. Tested By

This testing was conducted in accordance with the ISO 17025: 2005 scope of accreditation, table 1; Quality Manual.
Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

G.7. Test date

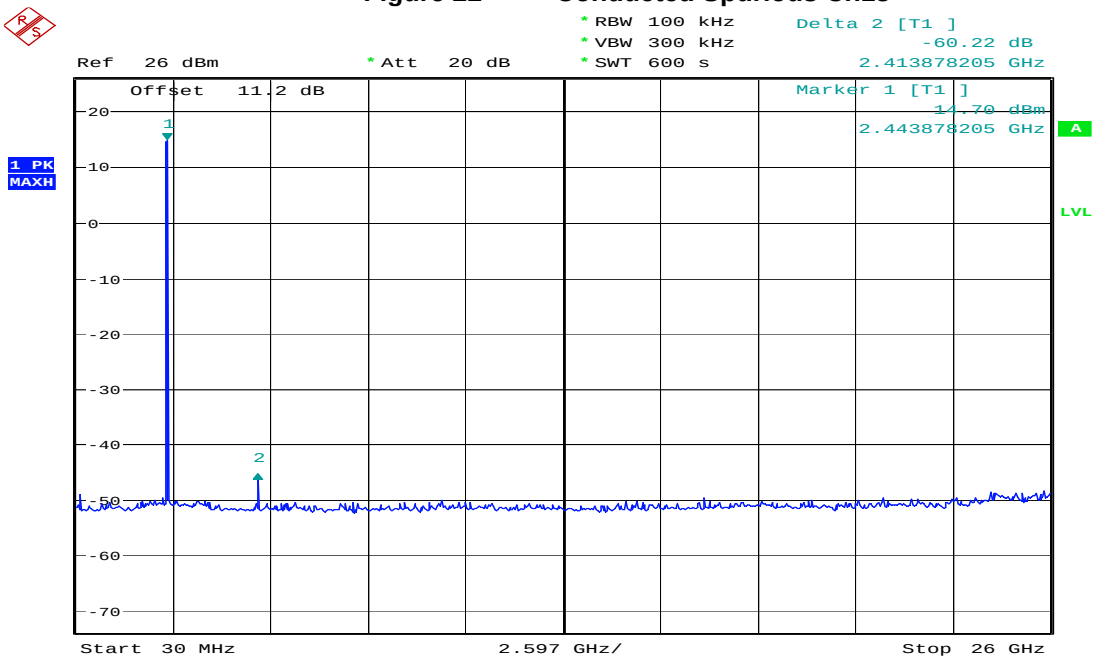
February 8, 2011

Figure 21 Conducted Spurious Ch11



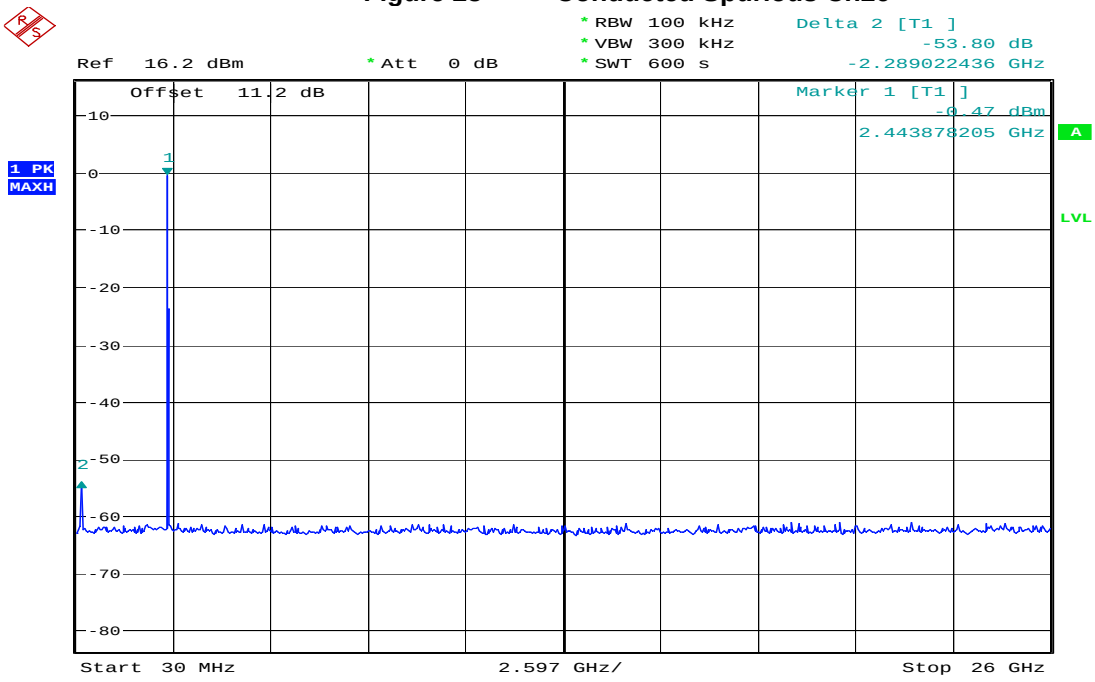
Date: 8.FEB.2011 08:04:26

Figure 22 Conducted Spurious Ch18



Date: 8.FEB.2011 08:31:33

Figure 23 Conducted Spurious Ch26



Date: 8.FEB.2011 07:22:09

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. Test Procedure

FCC Publication 558074

H.4. Operating Mode During Test

The Power Tab IHD was tuned to a low and high channel in continuous transmit mode and 100 % duty cycle at maximum rated RF output power (setting 3). Power level was reduced (setting -15) for high channel (Ch 26). In addition, Ch 25 was measured with maximum rated RF power

H.5. Test Results

Compliant.

Channel/Measurement	Frequency (MHz)	Emission Level (dBc)
11 (Lower band edge)	2399.94	-41.29
25 (Upper band edge)	2483.95	-50.09
26 (Upper band edge)	2483.88	-35.17

Worst case spurious emission was 35.17 dB below the carrier at Channel 26

All final reported values are corrected values

H.6. Tested By

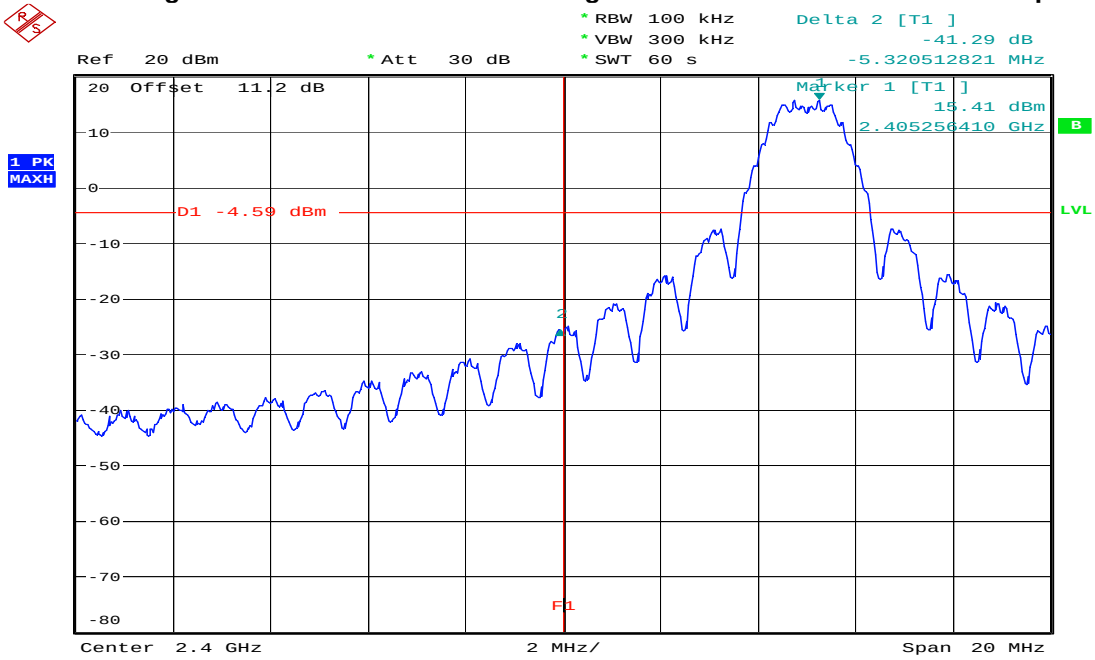
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

H.7. Test date

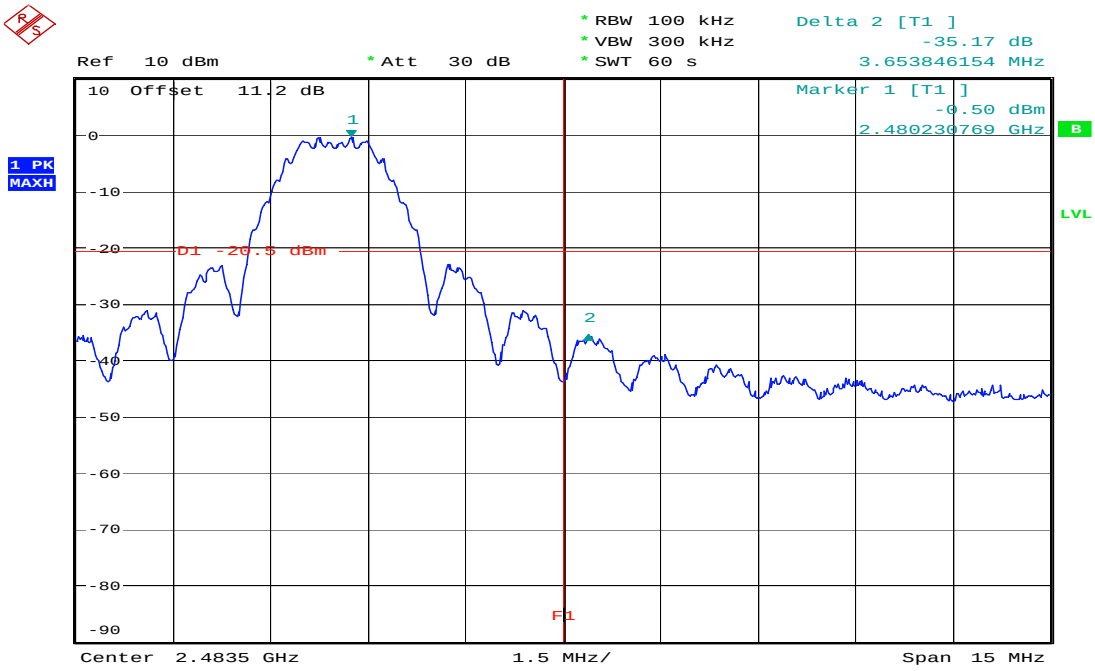
February 8, 2011

Figure 24 Conducted Band edge Measurement Ch11 with max Tx power



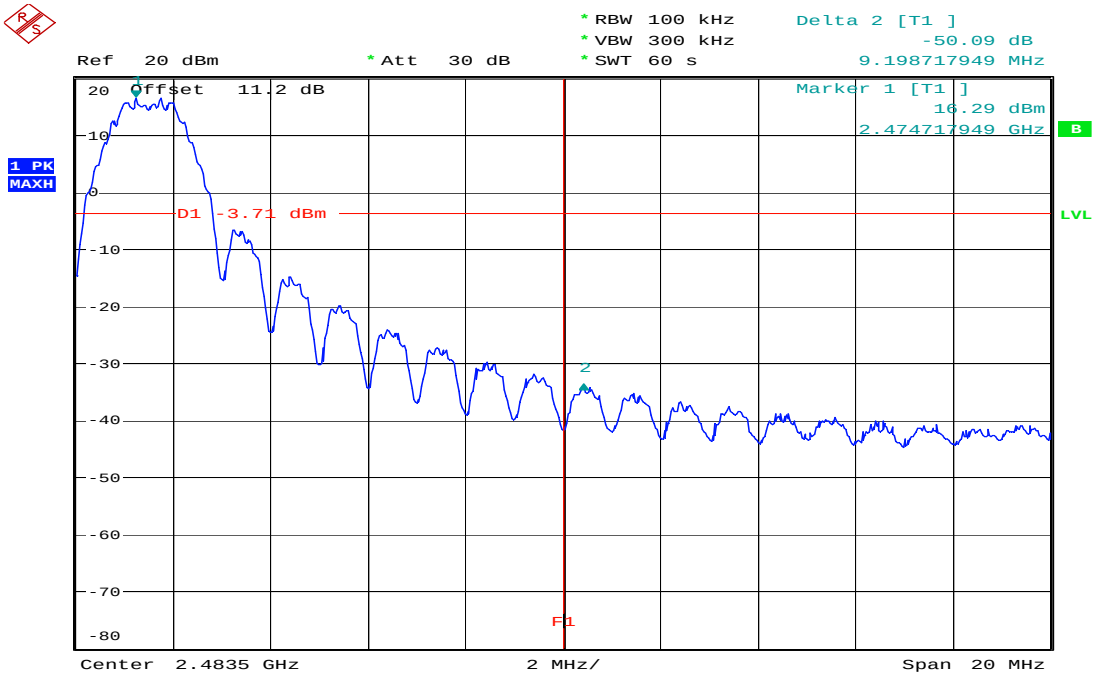
Date: 8.FEB.2011 07:36:12

Figure 25 Conducted Band edge Measurement Ch26 with reduced Tx power



Date: 8.FEB.2011 06:53:50

Figure 26 Conducted Band edge Measurement Ch25 with max Tx power



Date: 8.FEB.2011 07:28:00

APPENDIX I: RADIATED SPURIOUS EMISSIONS BAND EDGE

I.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 2.5 A8.5
Test Basis	FCC Publication 558074 Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz,
Test Method	NTS Radiated Emissions Test Method SOP-CAG-EMC-02 and FCC Publication 558074

I.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.

I.3. Test Procedure

RF radiated measurement at 3 meters distance.

FCC Publication 558074
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, and then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation.

I.4. Operating Mode During Test

The Power Tab IHD was tuned to the low channel in continuous transmit mode at maximum rated RF output power (Setting “3”). High channel was set in continuous transmit mode at a reduced RF power level setting of “-15”. EUT was set to operating at 100% duty cycle. EUT was tested in 3 orthogonal planes with the worst case results reported.
In addition, Ch25 was measured with maximum rated RF power

I.5. Test Results

Compliant

Channel	Frequency (MHz)	Detector	Band Edge Emission Level (dBµV/m)	Duty cycle Correction Factor (dB)	Band Edge Corrected Value (dBµV/m)	Limit (dBµV/m)	Margin (dB)
11	2390.00	PK	67.21	N/A	67.21	73.98	6.77
11	2390.00	AV	57.13	-7.52	49.61	53.98	4.37
26	2483.50	PK	67.91	N/A	69.78	73.98	4.20
26	2483.50	AV	61.13	-7.52	53.61	53.98	0.37
25	2484.04	PK	70.30	N/A	70.30	73.98	3.68
25	2483.50	AV	59.71	-7.52	52.19	53.98	1.79

Maximum emission measured was at channel 26 with RF power setting of "-15" at 2483.5MHz. It has 0.37 dB margin to the 15.209 average limits.

I.6. Sample Calculations

Part 15.209 Average Limit: 500 µV/m @ 3m = 20*Log (500) = 53.98 dBµV/m, Peak limit = 73.98 dBµV/m

Band Edge Emission Level or Carrier Emission Level (dBµV/m) = Measured level (dBµV) + Receive antenna factor (dB) + Receive cable loss (dB) – LNA gain (dB)

Average Band Edge Corrected value (dBµV/m) = Band Edge Emission Level (dBµV/m) - Duty cycle correction factor (dB)

Note:

Duty Cycle Correction Factor was used for Average measurements per FCC Publication 558074.

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

February 07, 2011

Figure 27 Low Channel Peak

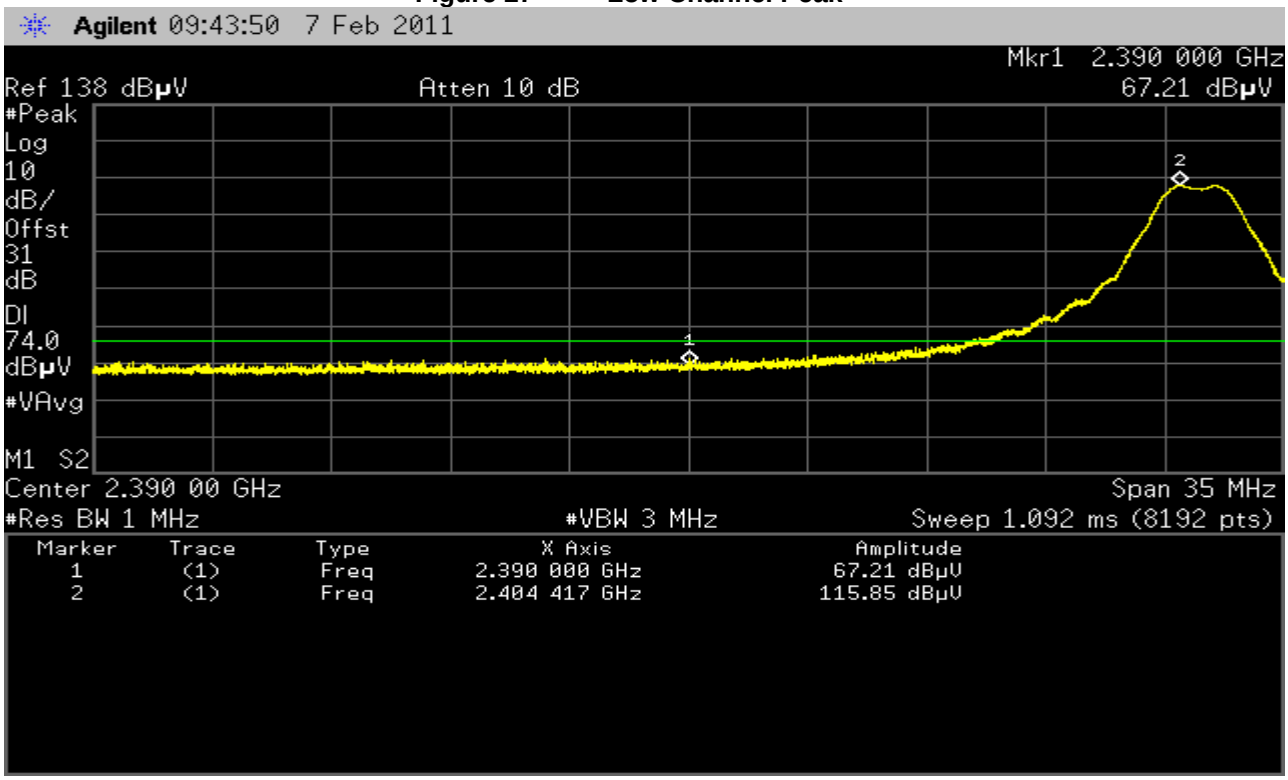


Figure 28 Low Channel Video Average

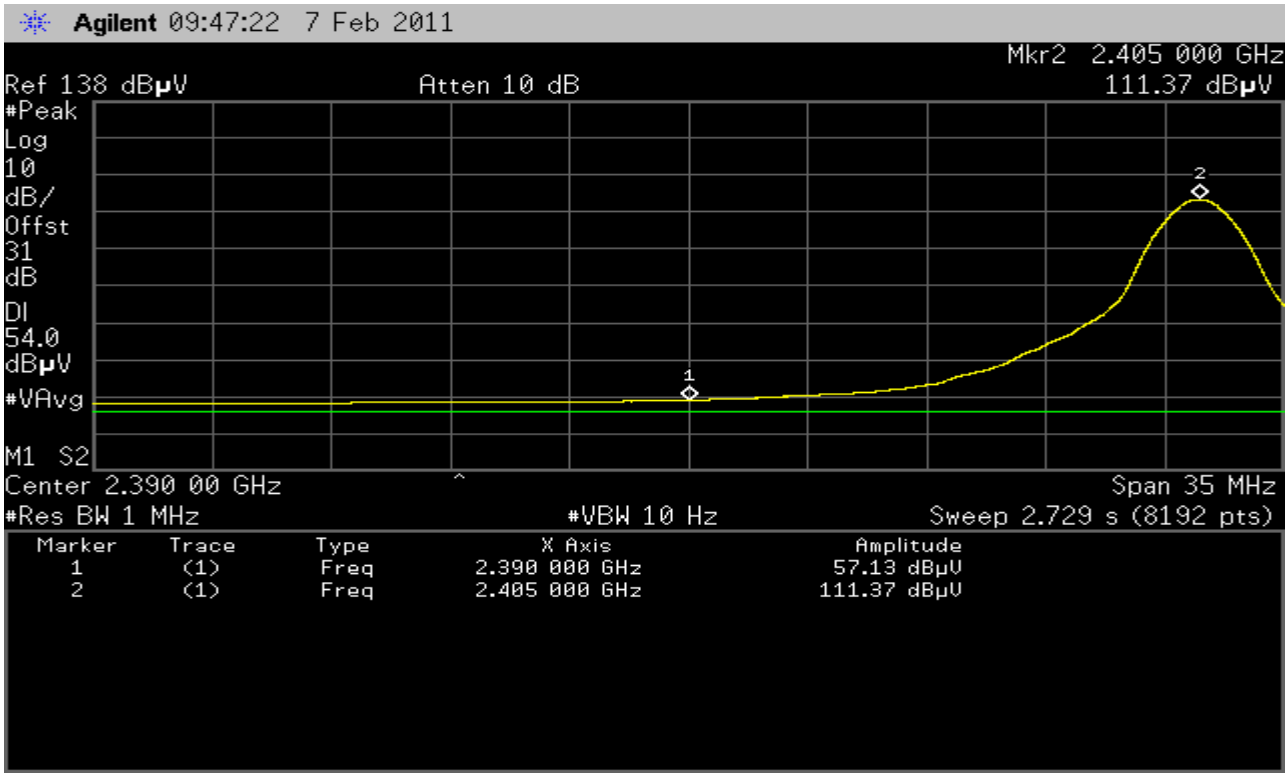


Figure 29 High Channel Peak (Channel 26)

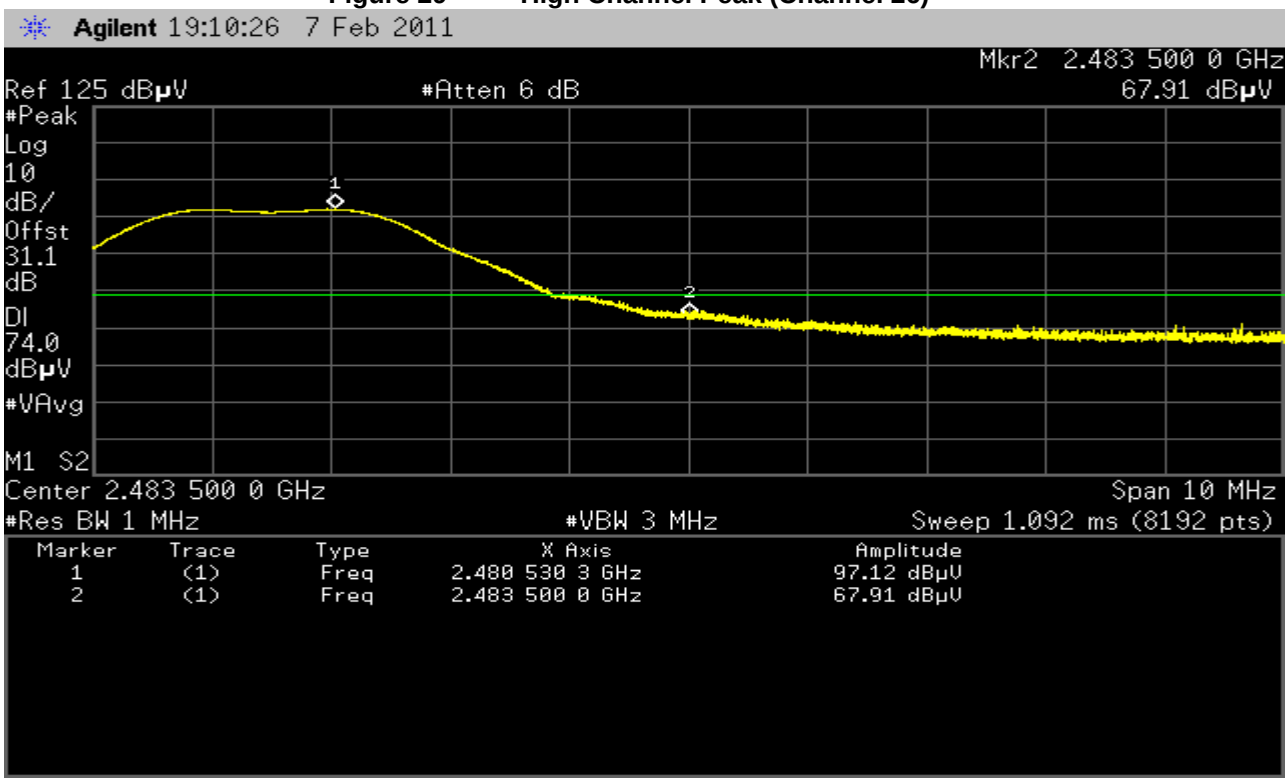


Figure 30 High Channel Video Average (Channel 26)

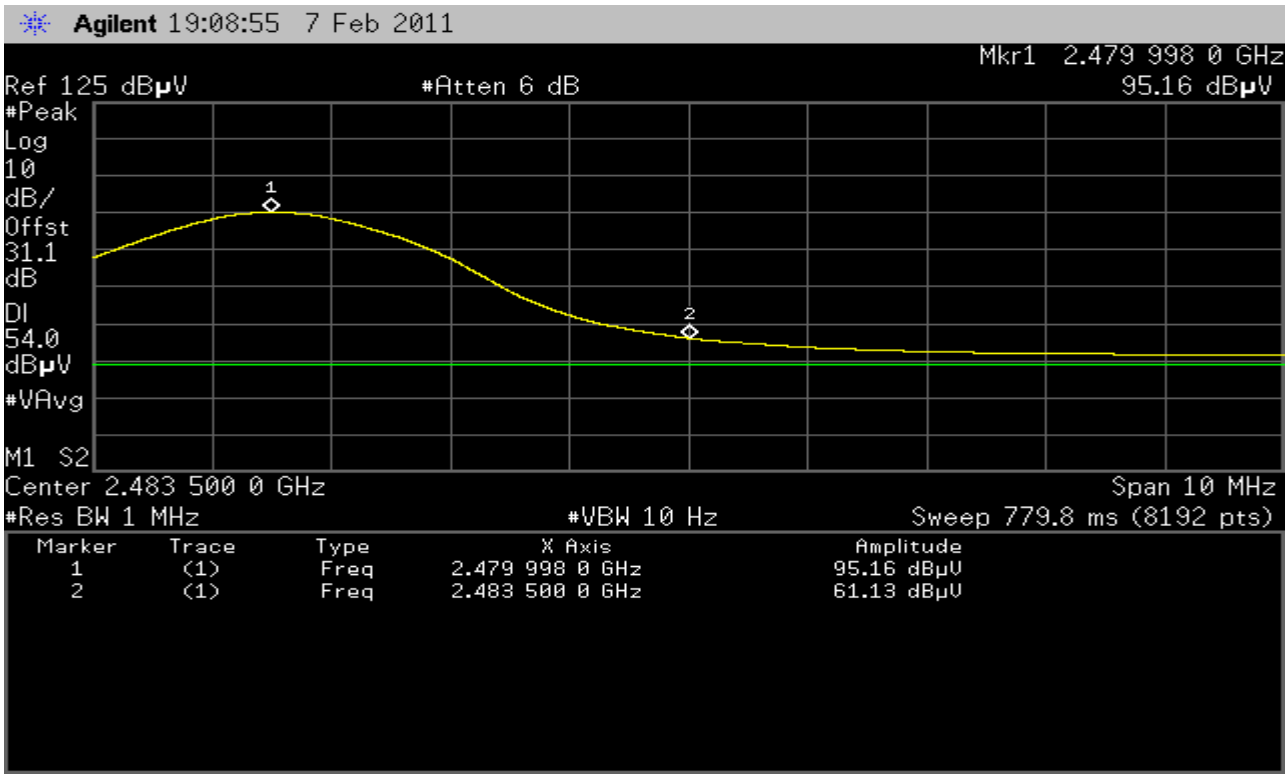


Figure 31 High Channel Peak (Channel 25)

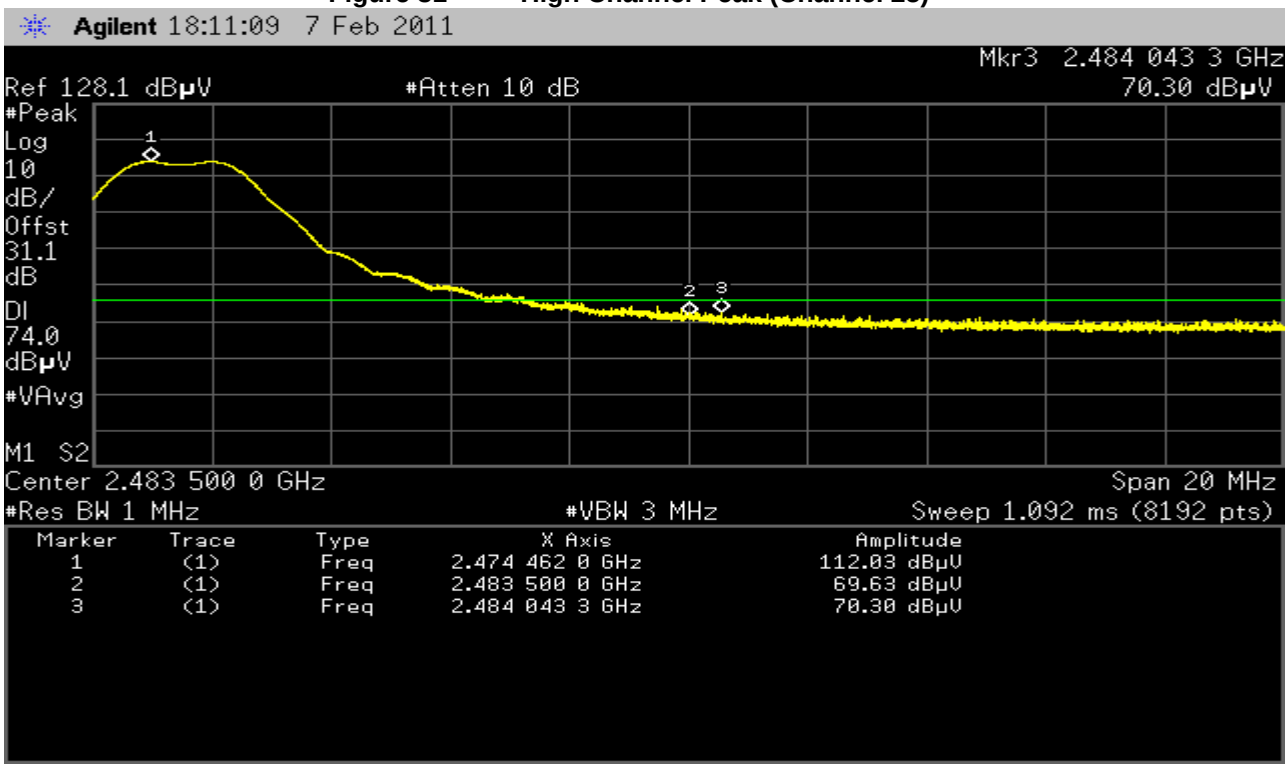
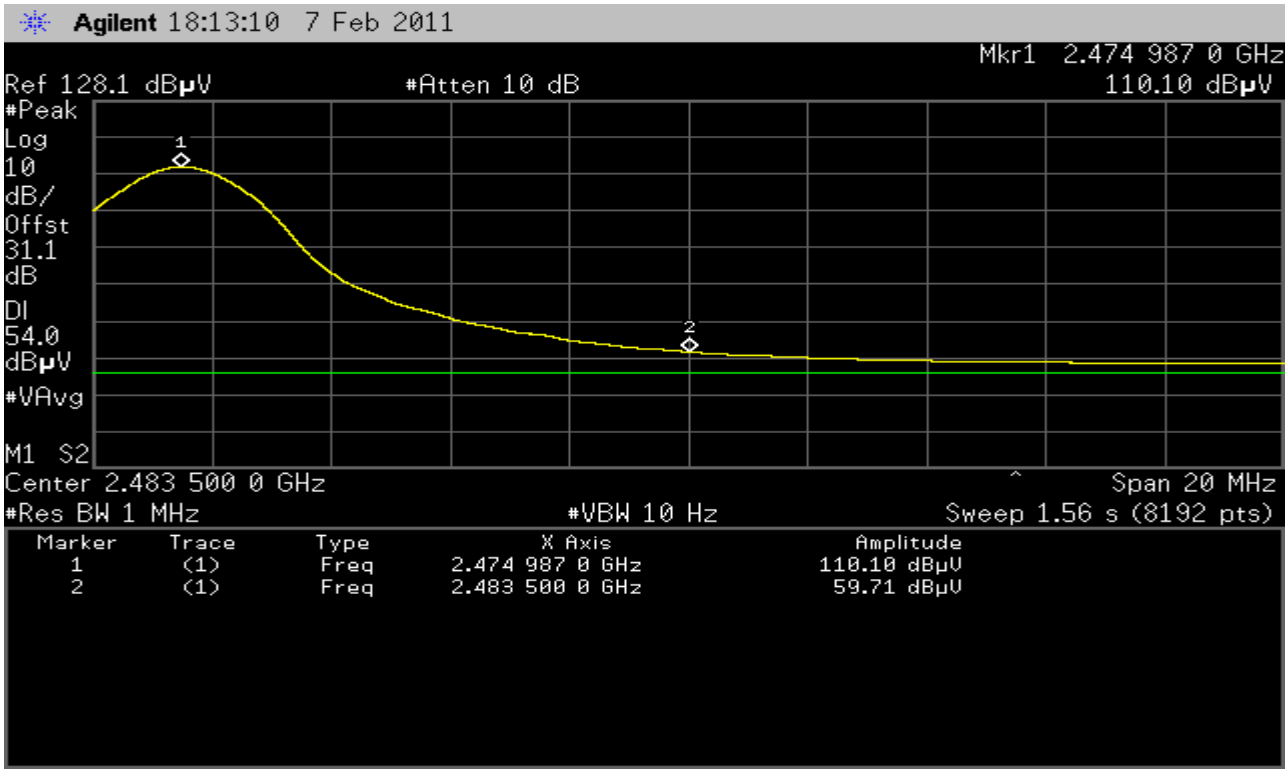


Figure 32 High Channel Video Average (Channel 25)



APPENDIX J: RADIATED SPURIOUS EMISSIONS (TX AND RX)

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 section 2.5 and A8.5 RSS Gen Issue 3 section 4.10 and 6 for RX emissions
Test Basis	ANSI C63.4-2003 Methods of Measurement of Radio Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz, FCC Publication 558074
Test Method	NTS Radiated Emissions Test Method SOP-CAG-EMC-02 and FCC Publication 558074

Specifications: FCC 15.205 and RSS 210 Issue 7 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. 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.

J.2. Test Procedure

FCC Publication 558074:
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, and then correct the reading by subtracting the peak-average correction factor, derived from the appropriate duty cycle calculation. EUT was tested from 30MHz to 26 GHz for Tx mode.
RSS-Gen :
The EUT was tested from 30 MHz to 7.5 GHz for Rx mode.

J.3. Operating Mode During Test

The Power Tab IHD was tuned to the low and mid in continuous transmit mode at maximum rated RF output power (Setting 3) for all TX spurious emissions. High channel was set to a continuous transmit mode at a reduced RF power level of setting "-15". EUT was set to operate at 100% duty cycle.
For receiver spurious emissions the Power Tab IHD was tuned to the receive only mode at mid channel. EUT was tested in 3 orthogonal planes with the worst case results reported.

J.4. Test Results

Compliant. Worst case results reported

J.4.1 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	4871.90	PEAK	44.77	Average	53.98	9.21
V-pol	4872.11	PEAK	44.11	Average	53.98	9.87

The worst case Rx spurious emission was 44.77 dBµV/m at 3m distance with peak detector at 4871.90 MHz. It has 9.21 dB margin to the average limits.

All final reported values are corrected values

J.4.2 Tx mode 30-1000 MHz Test Result

Product Integrity Laboratory V2.5

Project Numb C-0099752 **Tester:** Lixin wang
Model: Energy Aware - PMTK2 ZIGBEE **Test ID:** RE02c-10m-0099752
Comments: 120 VAC, 60 Hz.UART unit. EUT placed upright on table, with power cord at the bottom. Tx stream Channel 11 (2405 MHz). 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)
Horizonatl	263.120	18.77	Quasi Peak	-10.32	8.45	Quasi Peak	37.00	28.55	100.0	55.0
Horizontal	548.914	23.74	Quasi Peak	-5.24	18.50	Quasi Peak	37.00	18.50	132	224
Vertical	45.605	32.83	Quasi Peak	-17.67	15.16	Quasi Peak	30.00	14.84	378	344
Vertical	94.703	30.27	Quasi Peak	-15.64	14.63	Quasi Peak	30.00	15.37	236	48
Vertical	280.253	27.80	Quasi Peak	-9.99	17.81	Quasi Peak	37.00	19.19	140	100
Vertical	392.263	26.28	Quasi Peak	-8.26	18.02	Quasi Peak	37.00	18.98	173	175

Note: Horizontal 263.120MHz was emission of PTMK2USB unit.

Both PTMK2USB and PTMK2UART unit were tested, and emission frequencies were identical, worst case results reported.

J.4.3 TX Mode 1-25 GHz Test Result

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	4808.87	PK	61.21	N/A	N/A	PK	73.98	12.77
	H-pol	12027.52	PK	55.95	N/A	N/A	PK	73.98	18.03
	V-pol	4811.02	PK	59.95	N/A	N/A	PK	73.98	14.03
	V-pol	12022.37	PK	55.22	N/A	N/A	PK	73.98	18.76
	V-pol	19235.80	PK	57.42	N/A	N/A	PK	73.98	16.56
18	H-pol	4878.92	PK	63.18	N/A	N/A	PK	73.98	10.80
	H-pol	7318.48	PK	59.56	N/A	N/A	PK	73.98	14.42
	H-pol	12202.33	PK	59.51	N/A	N/A	PK	73.98	14.47
	V-pol	4878.85	PK	59.36	N/A	N/A	PK	73.98	14.62
	V-pol	7318.33	PK	59.50	N/A	N/A	PK	73.98	14.48
	V-pol	12197.33	PK	58.18	N/A	N/A	PK	73.98	15.80
	V-pol	19515.80	PK	55.39	N/A	N/A	PK	73.98	18.59
26	H-pol	4958.85	PK	45.96	N/A	N/A	PK	73.98	28.02
	V-pol	4958.92	PK	44.32	N/A	N/A	PK	73.98	29.66
11	H-pol	4809.93	AV	53.39	-7.52	45.87	AV	53.98	8.11
	H-pol	12022.27	AV	43.99	-7.52	36.47	AV	53.98	17.51
	V-pol	4809.9	AV	51.77	-7.52	44.25	AV	53.98	9.73
	V-pol	12022.33	AV	42.89	-7.52	35.37	AV	53.98	18.61
	V-pol	19243.93	AV	44.74	-7.52	37.22	AV	53.98	16.76
18	H-pol	4879.82	AV	55.17	-7.52	47.65	AV	53.98	6.33
	H-pol	7318.57	AV	48.40	-7.52	40.88	AV	53.98	13.10
	H-pol	12202.25	AV	48.18	-7.52	40.66	AV	53.98	13.32
	V-pol	4879.83	AV	50.53	-7.52	43.01	AV	53.98	10.97
	V-pol	7318.53	AV	48.50	-7.52	40.98	AV	53.98	13.00
	V-pol	12202.37	AV	46.51	-7.52	38.99	AV	53.98	14.99
	V-pol	19515.97	AV	46.89	-7.52	39.37	AV	53.98	14.61
26	H-pol	4958.97	AV	33.13	-7.52	25.61	AV	53.98	28.37
	V-pol	4958.98	AV	29.48	-7.52	21.96	AV	53.98	32.02

Worst case spurious emission was 47.65 dBµV/m at 4879.82 MHz with horizontal polarization in Channel 18. It has 6.33 dB margin to the average limit.

Note:
Plots were not provided in order to reduce file size

J.5. 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

Total correction factor (dB) = Receive antenna factor (dB) + Receive cable loss (dB) + High pass filter loss (dB) – LNA gain (dB)

Radiated emission level (dBµV/m) = Measured level (dBµV) + Total correction factor (dB)

Average Spurious Corrected value (dBµV/m) = Radiated Emission Level (dBµV/m) - Duty cycle correction factor (dB)

J.6. 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.7. Test date

Test started: February 07, 2011 Test completed: February 28, 2011.

Figure 33 Radiated Emissions 30-1000 MHz Horizontal Polarity USB Unit

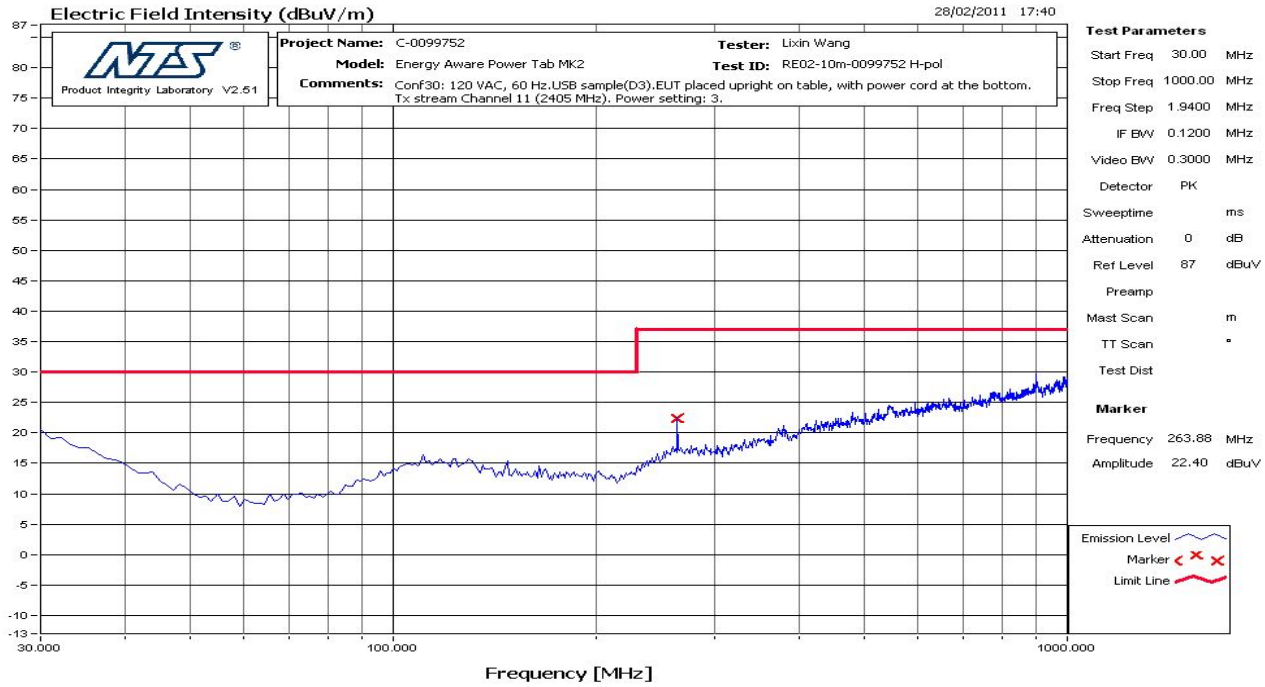
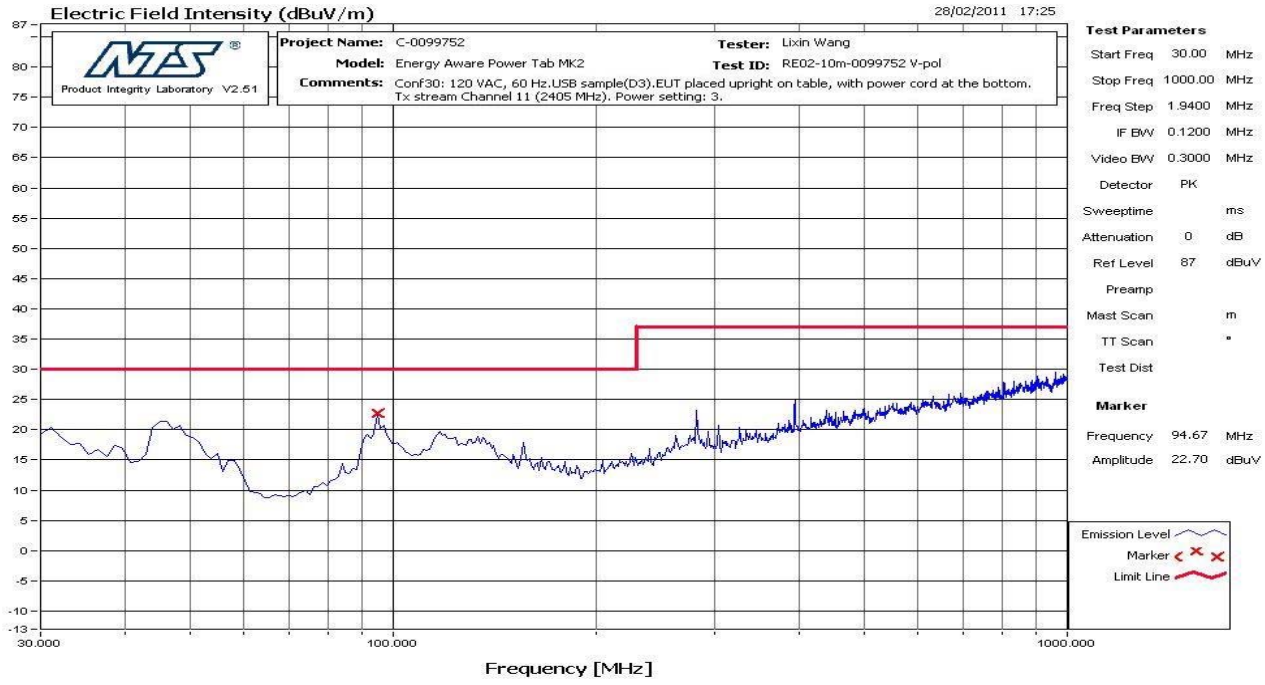


Figure 34 Radiated Emissions 30-1000 MHz Vertical Polarity USB Unit



Above plots were peak maxima, used for frequency identification. See table for data.

Figure 35 Radiated Emissions 30-1000 MHz Horizontal Polarity UART Unit

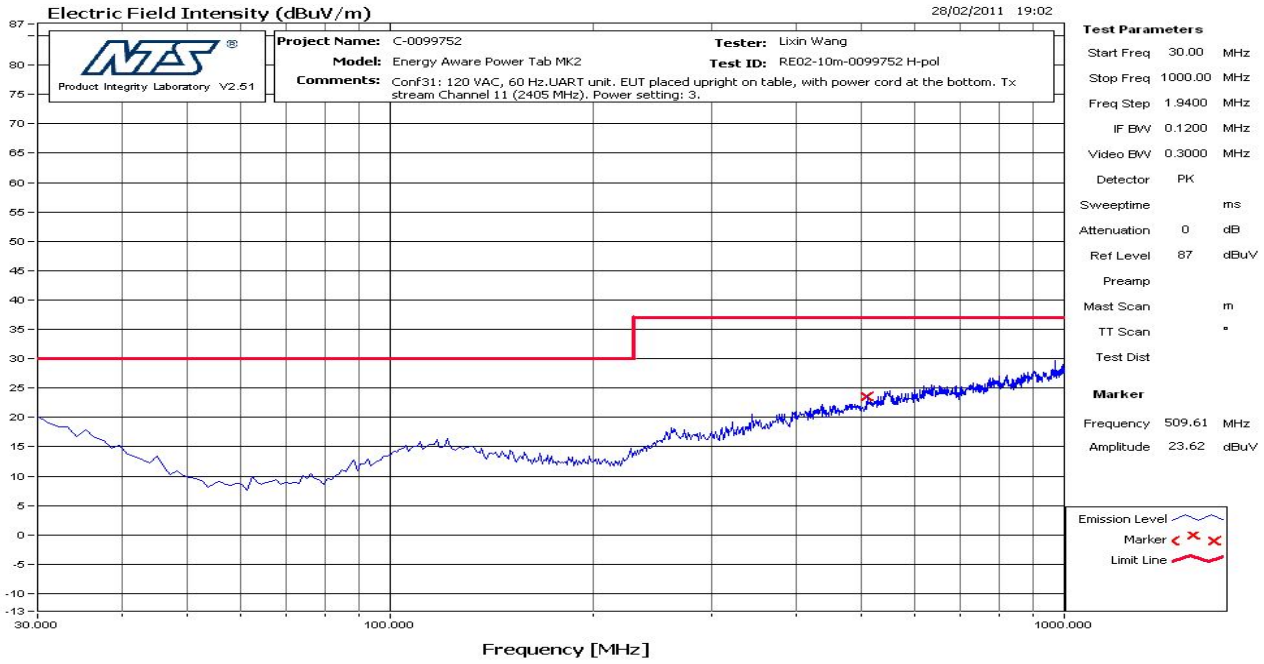
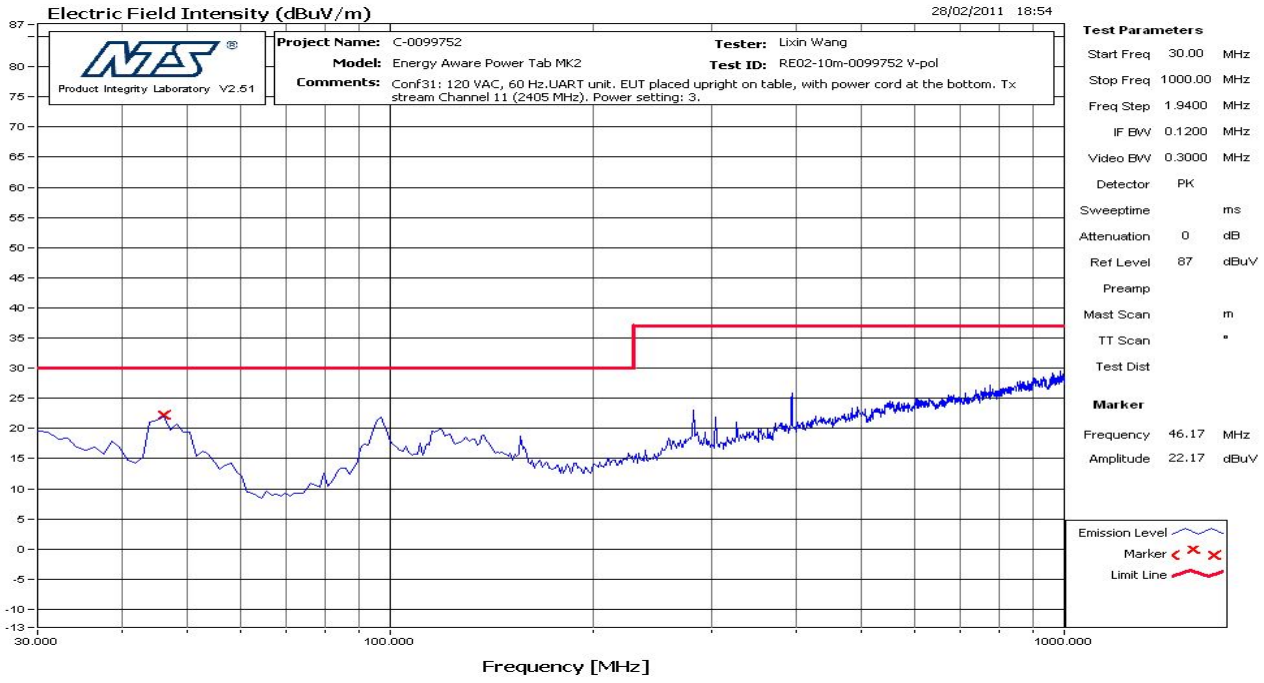


Figure 36 Radiated Emissions 30-1000 MHz Vertical Polarity UART Unit



Above plots were peak maxima, used for frequency identification. See table for data.

APPENDIX K: TEST EQUIPMENT LIST

Descriptions	Manufacturer	Type/Model	Serial #	Cal Due	Cal Date
Table Top LISN	EMCO	3825	CG0367	29JAN12	29JAN09
Test Receiver	Rohde & Schwarz	ESMI	CG0433	04MAY11	04MAY10
			CG0434	04MAY11	04MAY10
Bilog Antenna	Teseq	CBL 6112D	CG1177	14SEP12	14SEP10
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
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
High pass filter f >1000 MHz	MicroTronics	HPM14576	CG0963	13NOV11	13NOV09
High pass filter f >2800 MHz	MicroTronics	HPM50111	CG0964	N/A	N/A
LNA 1 GHz - 18 GHz	Miteq	JSD00121	CG0761	13NOV11	13NOV09
LNA 18 GHz - 26.5 GHz	Miteq	JSD00119	CG0482	02OCT11	02OCT09
Signal Analyzer 20 Hz – 26.5 GHz	Rohde & Schwarz	FSQ	CG1462	20DEC11	20DEC10
Spectrum Analyzer	HP	8564E	CG0352	01DEC11	01DEC10
Spectrum Analyzer	Agilent	E4446A	CGRenta-l1292	09SEP12	09SEP10
Attenuator	Weinschel	10 dB	19981	N/A	N/A
RF cable	Sucoflex	104	115776	N/A	N/A
LNA DC Power Supply	Xantrex	LXO 30-2	CG0493	N/A	N/A
HPIB Extender	HP	37204	CG0110	N/A	N/A
Turntable and Mast Controller	EMCO	2090	CG0161	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.

END OF DOCUMENT