Certification Test Report

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

Smart Technologies Inc.
Response PE/LE remote unit

FCC ID: QCISRP05
IC: 4302A-SRP05

Project Code C-0099029

(Report C-0099029-RA-1-1)

June 16, 2011

Prepared for:	Smart Technologies Inc.
Author:	Deniz Demirci Senior Wireless / 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:	SMART Technologies Inc. 3636 Research Road NW Calgary, AB T2L 1Y1 Canada
Customer Representative:	Dwane Flaman Email: dwaneflaman@smarttech.com Tel: (403) 407-4012 Fax: (403) 245-0366

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

Digitally signed by Deniz Demirci
Date: 2011.06.21 10:29:43 -06'00'

Prepared By: _____
Deniz Demirci
Senior Wireless / EMC Technologist

Digitally signed by Glen Moore
DN: cn=Glen Moore, c=CA, email=glen.moore@ntscorp.com

Reviewed By: _____
Glen Moore
Wireless/EMC Manager

Alex Mathews
2011.06.23 08:38:15 -06'00'

Approved By: _____
Alex Mathews
Quality Management Representative

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Register of revisions

Revision	Date	Description of Revisions
1	June 16, 2011	Initial release

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 Response PE/LE remote unit (ZigBee) from Smart Technologies 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
EUT	Response PE/LE remote unit	LE: 03-00158 PE: 03-00174
Device Classification	Portable	
Antenna	Integral 0 dBi (Reverse F Trace antenna)	
Modulation	O-QPSK	
EUT Size with Enclosure (H x W x D) (in mm)	150 x 50 x 30	
EUT Weight (in grams)	200	
Channels/Frequency Range	16 channels, 2405 MHz to 2480 MHz	
Functional Description	ZigBee based Remote Control Unit based on CC2533 SoC from Texas Instruments The Response Remote is a handheld remote device used for entering responses to tests. The PE version is intended for older school grades, and the LE version is intended for younger school grades.	

2.1.1 EUT POWERS

Voltage	2 x AA Battery operated (3 V, Battery operating endpoint: 2.2V)
Number of Feeds	N/A

2.2 EUT CABLES

Quantity	Model/Type	Routing		Shielded / Unshielded	Description	Cable Length (m)
		From	To			
N/A						

2.3 MODE OF OPERATION DURING TESTS

The EUT was tested while in continuous transmit mode, modulated signal with 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.
The EUT was measured with all three orientations. Both Response PE and Response LE models were tested, there were no difference found on spurious emissions
The EUT was tuned to mid channel for receiver emission tests
.
See details in the appendices

3.0 SUPPORT EQUIPMENT

None.

APPENDICES

APPENDIX A: 6 DB BANDWIDTH

A.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)

A.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.

A.3. Deviations

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

A.4. Test Procedure

FCC Publication 558074 and RSS 210.

A.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	1.619
26	2480	1.619

All final reported values are corrected values.

A.6. Operating Mode During Test

The EUT was tuned to a low, middle and high channel in continuous transmit mode, modulated signal with 100% duty cycle at maximum rated RF output power.

A.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

A.8. Test date

June 15, 2011

Figure 1 6 dB Bandwidth Low Channel

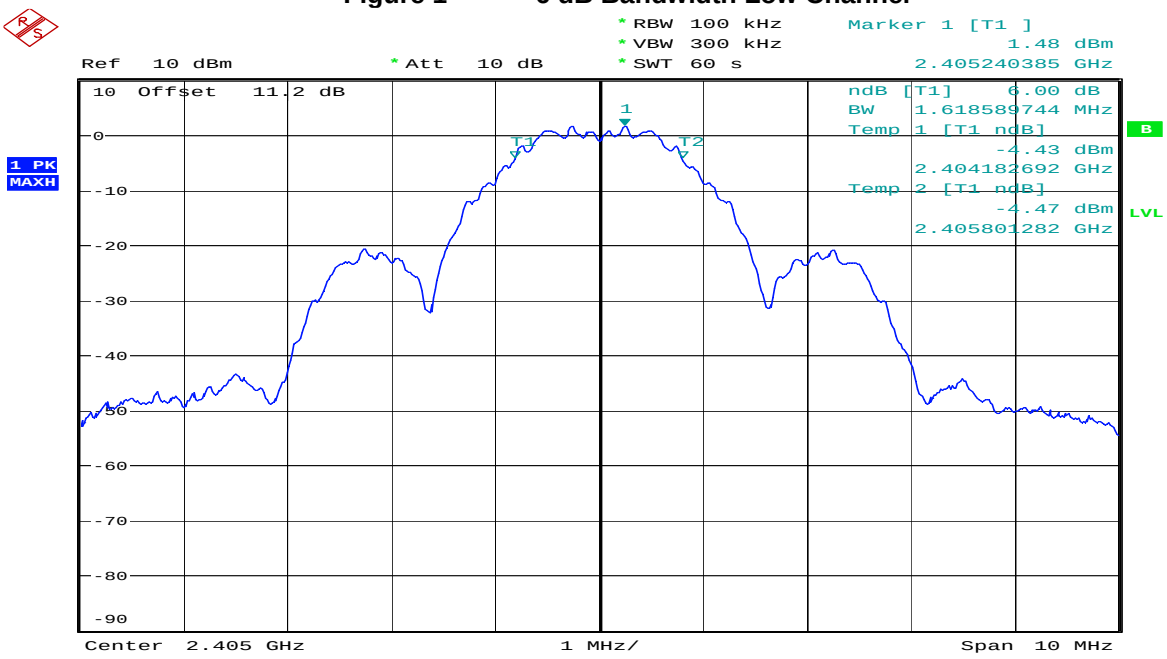


Figure 2 6 dB Bandwidth Mid Channel

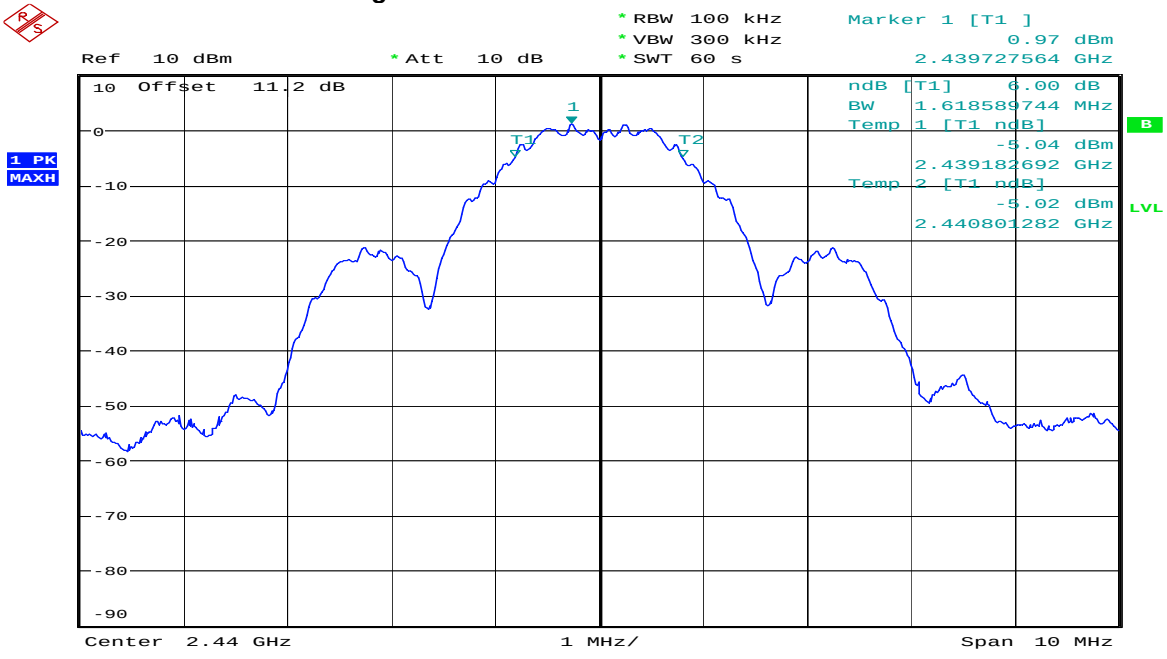
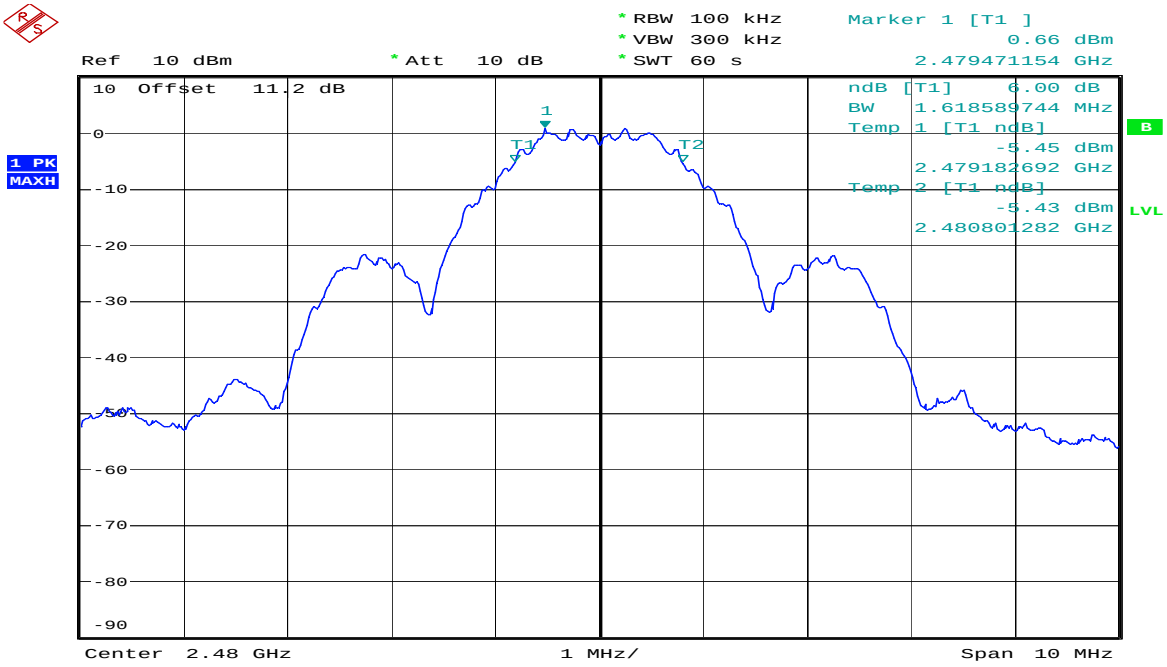


Figure 3 6 dB Bandwidth High Channel



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APPENDIX B: OCCUPIED BANDWIDTH

B.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

B.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.

B.3. Test Procedure

RSS-Gen Issue 3

B.4. Test Results

Channel	Frequency (MHz)	Occupied Bandwidth (MHz)
11	2405	2.612
18	2440	2.612
26	2480	2.612

All final reported values are corrected values

B.5. Operating Mode During Test

The EUT was tuned to a low, middle and high channel in continuous transmit mode, modulated signal with 100% duty cycle at maximum rated RF output power.

B.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

B.7. Test date

June 15, 2011

Figure 4 Occupied Bandwidth Low Channel

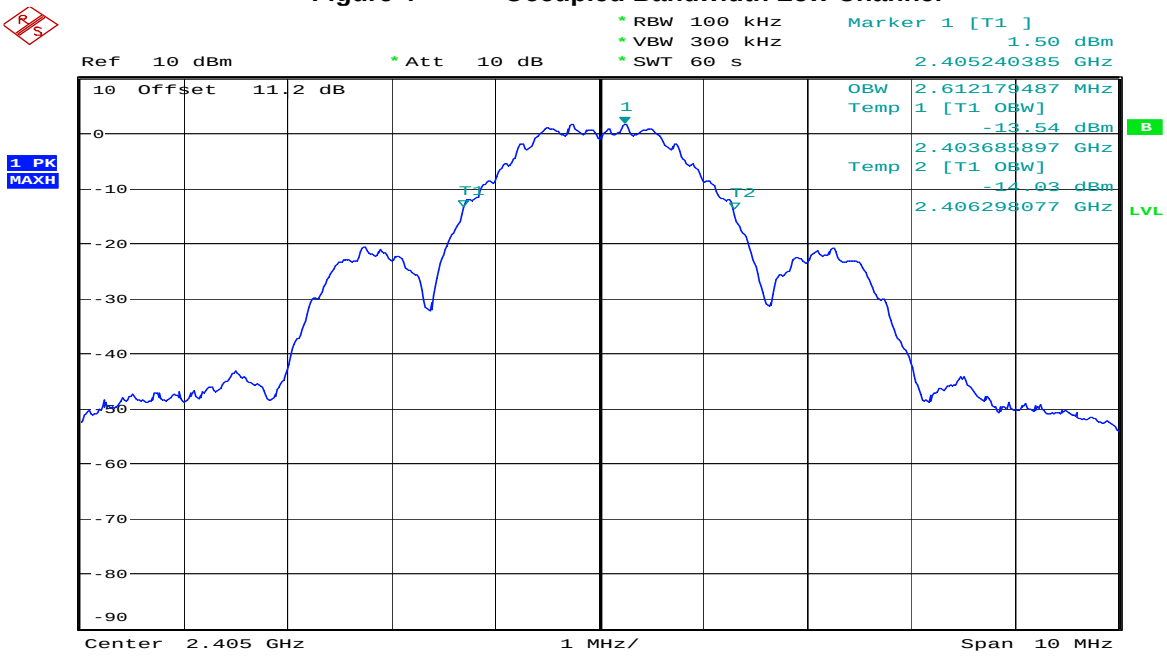

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Figure 5 Occupied Bandwidth Mid Channel

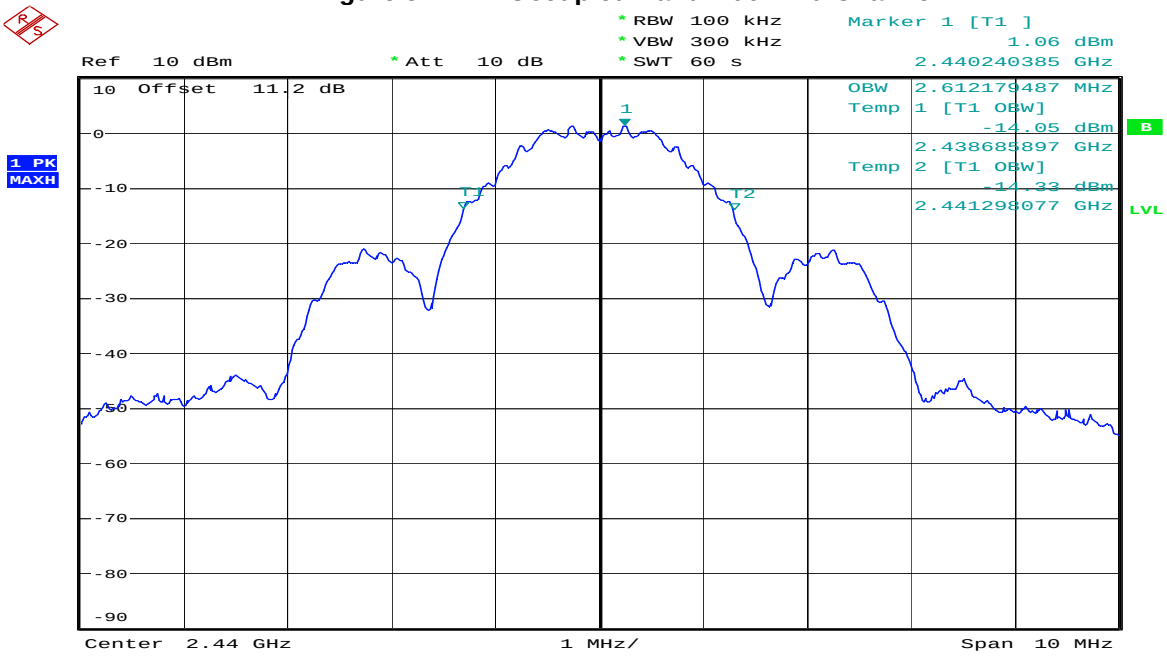

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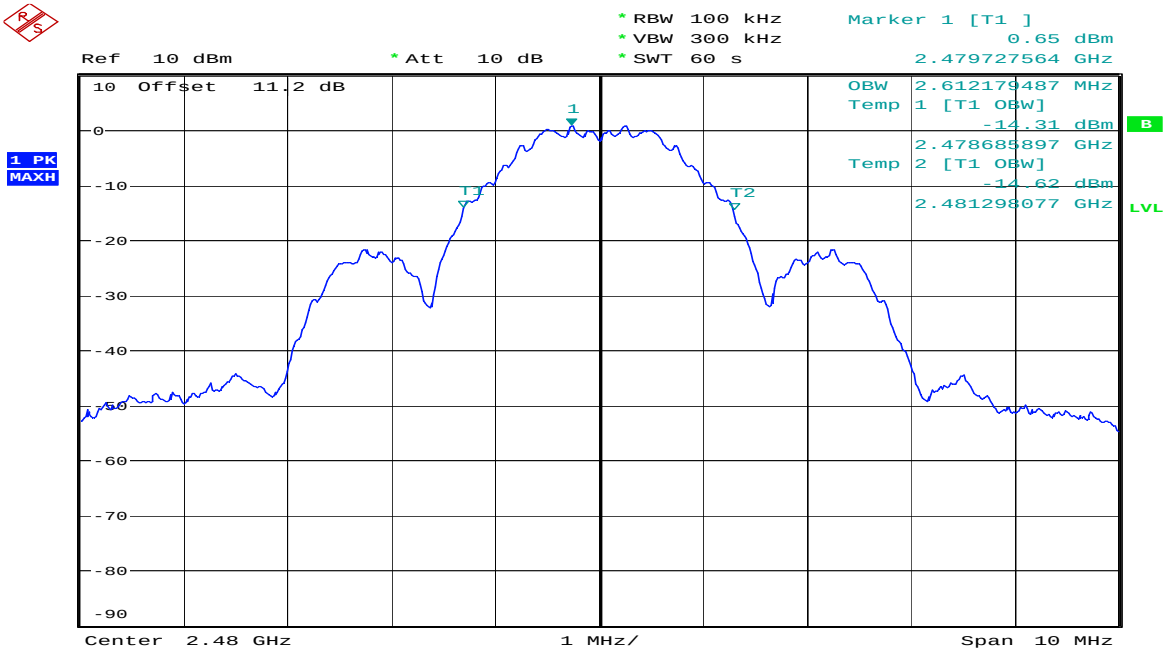
Figure 6 Occupied Bandwidth High Channel



APPENDIX C: PEAK POWER OUTPUT

C.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

C.2. Specifications

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

C.3. Test Procedure

FCC Publication 558074 and RSS-Gen Issue 3 4.8

C.4. Operating Mode During Test

The EUT was tuned to a low, middle and high channel in continuous transmit mode, modulated signal with 100% duty cycle at maximum rated RF output power.

C.5. Test Results

Compliant – The maximum peak power was 4.42 as measured conducted at the RF output port

C.6. Test Data Summary

Channel	Frequency (MHz)	Peak RF power (dBm)
11	2405	4.42
18	2440	3.97
26	2480	3.59

All final reported values are corrected values

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

June 15, 2011

Figure 7 Low Channel

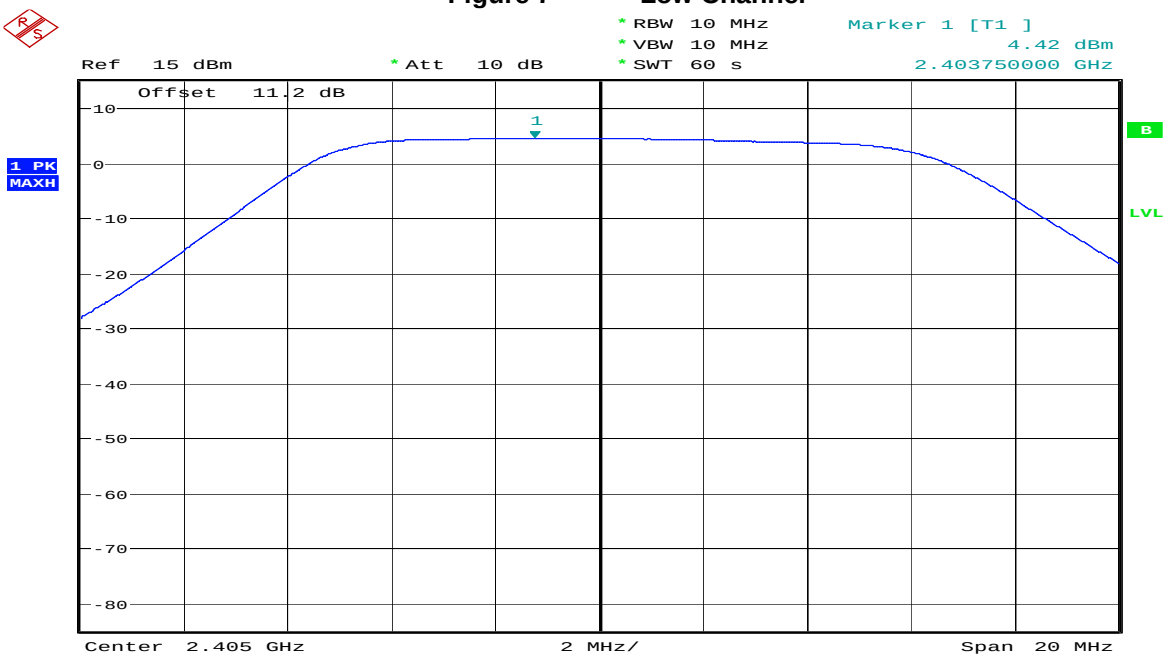


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Figure 8 Mid Channel

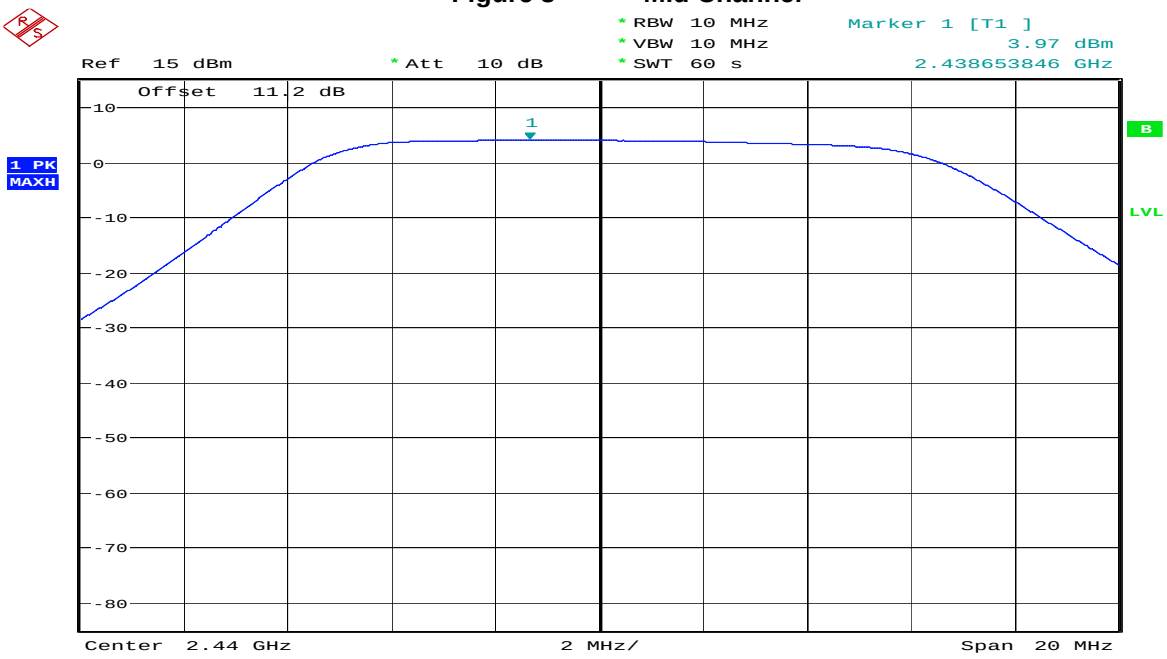

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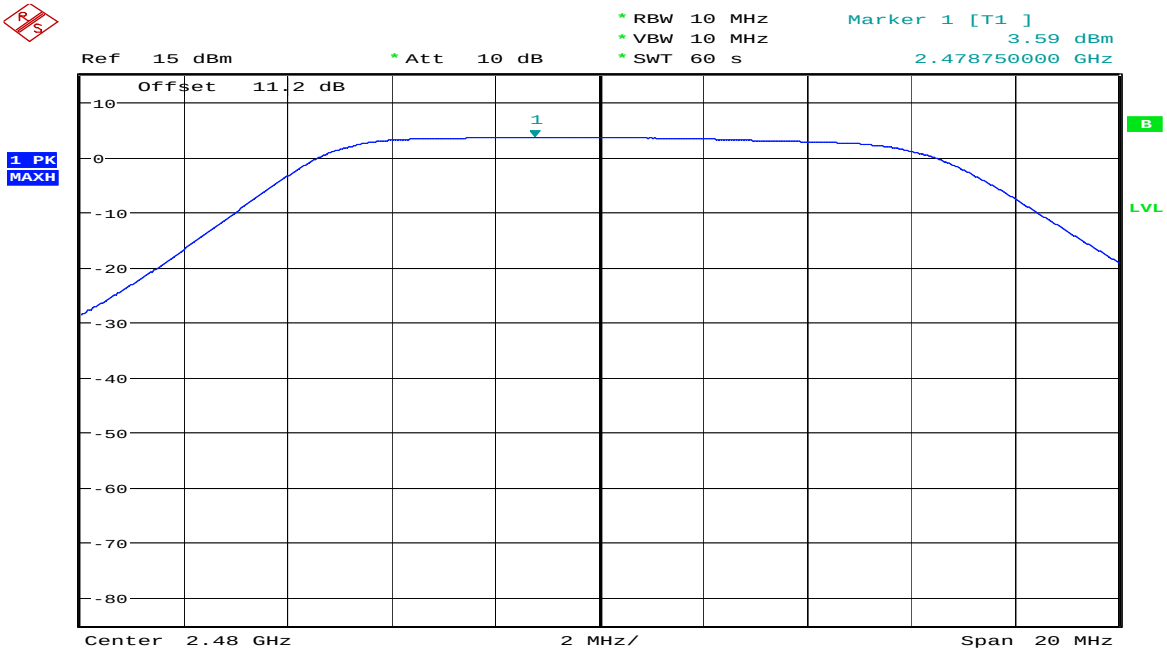
Figure 9 High Channel



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APPENDIX D: POWER SPECTRAL DENSITY

D.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)

D.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.

D.3. Test Procedure

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

D.4. Operating Mode During Test

The EUT was tuned to a low, middle and high channel in continuous transmit mode, modulated signal with 100% duty cycle at maximum rated RF output power.

D.5. Test Results

Compliant. The maximum measured power spectral density was -9.16 dBm as measured conducted at the RF output port

D.6. Test Data Summary

Channel	Frequency (MHz)	PSD (dBm)
11	2405	-9.16
18	2440	-9.69
26	2480	-9.87

All final reported values are corrected values

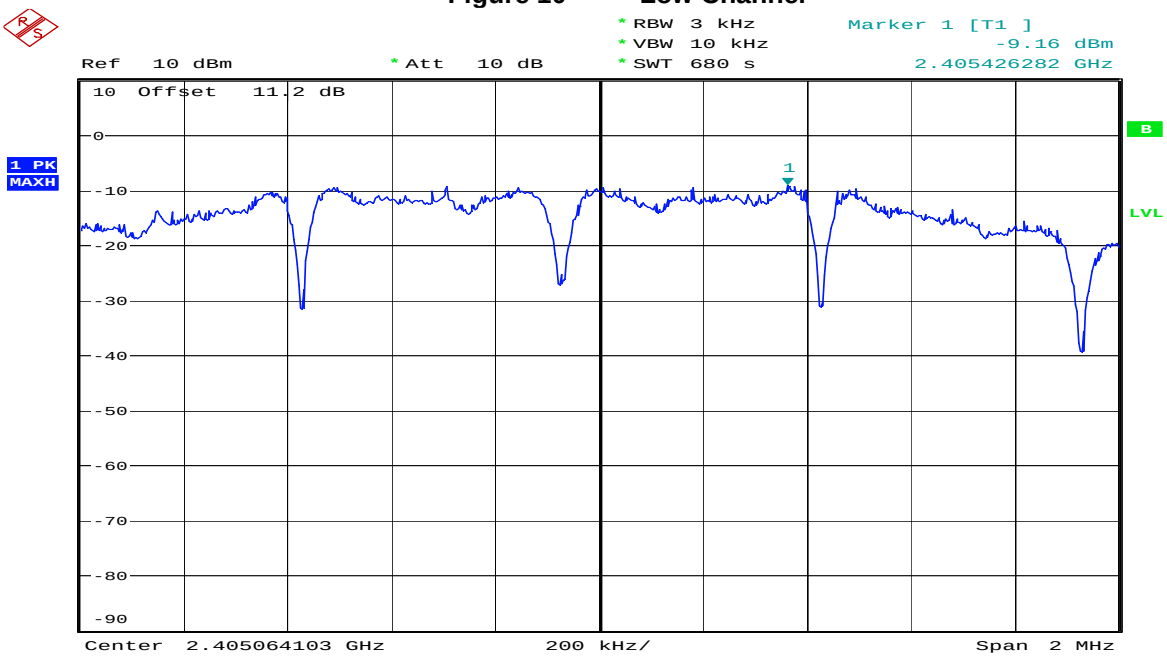
D.7. Tested By

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

D.8. Test date

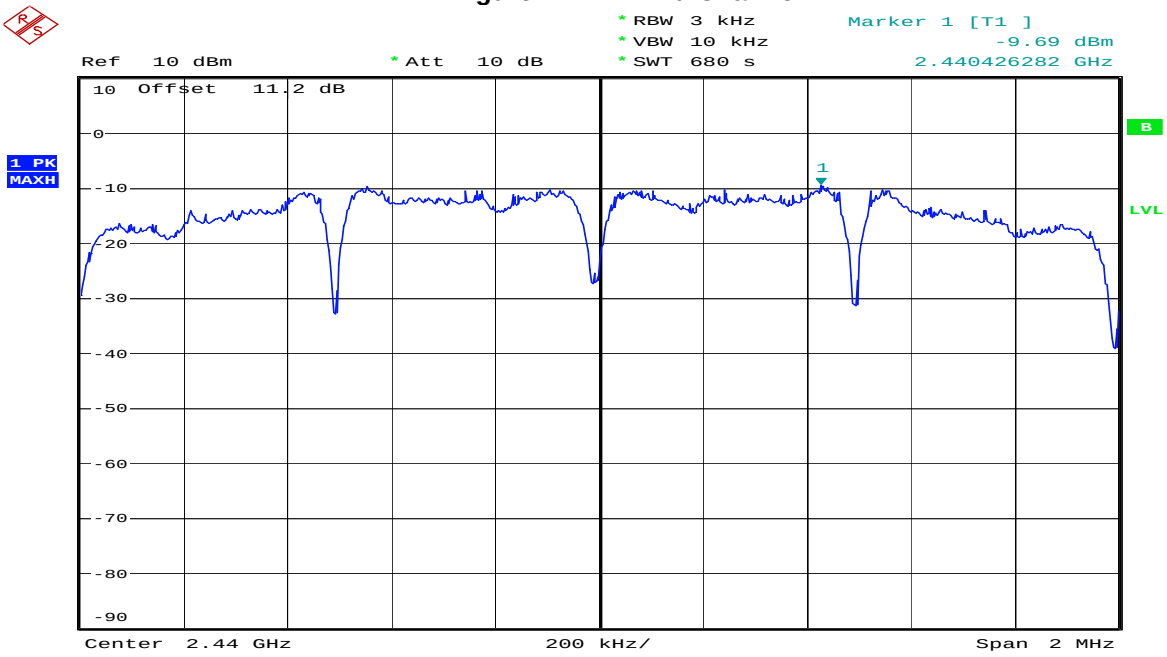
June 15, 2011

Figure 10 Low Channel



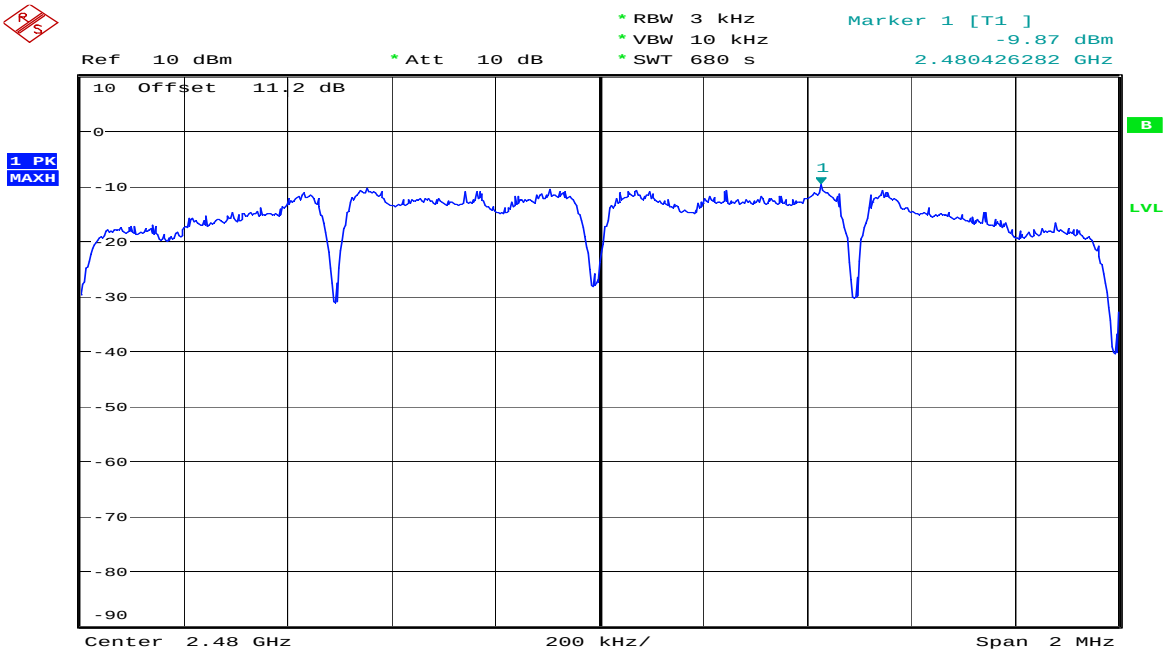
Date: 15.JUN.2011 11:42:26

Figure 11 Mid Channel



Date: 15.JUN.2011 12:08:53

Figure 12 High Channel



Date: 15.JUN.2011 12:38:09

APPENDIX E: DUTY CYCLE CORRECTION FACTOR

E.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

E.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.

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

Zero span.

E.5. Operating Mode During Test

The EUT was tuned to Channel 26 operating at maximum rated RF output power and maximum operating duty cycle.

E.6. Test Results

Duty cycle correction factor = 20*log (1.4135*15/100) = - 13.47 dB

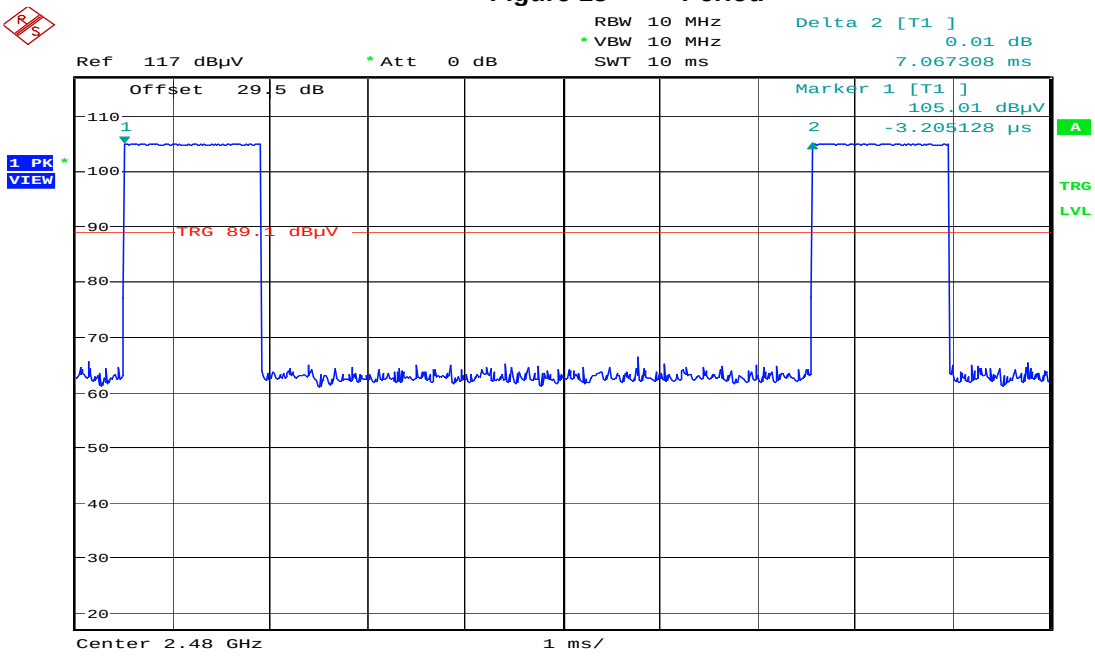
E.7. Tested By

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

June 13, 2011

Figure 13 Period



Date: 13.JUN.2011 09:51:46

Figure 14 On Time

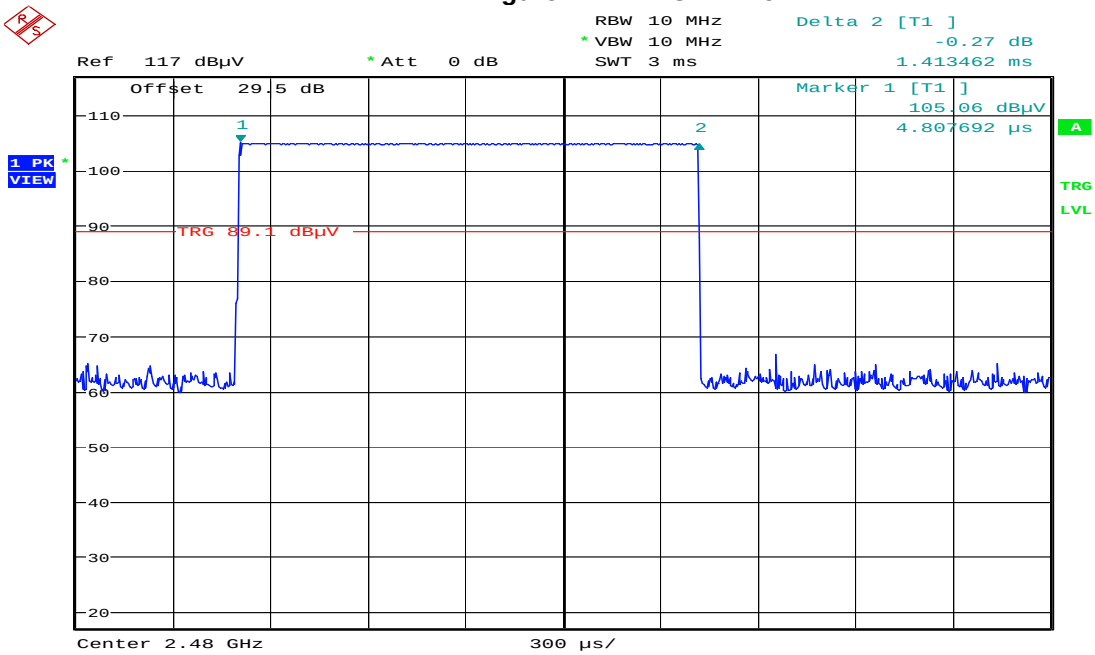


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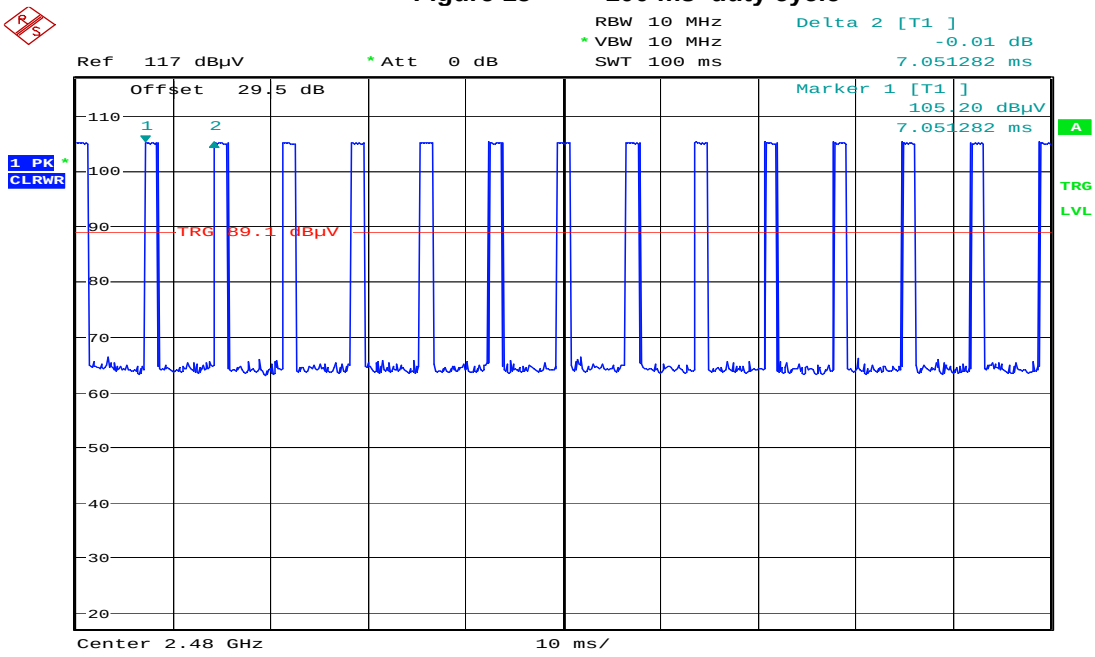
Figure 15 100 ms duty cycle



Date: 13.JUN.2011 09:49:59

APPENDIX F: CONDUCTED SPURIOUS EMISSIONS (TX)

F.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

F.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)).

F.3. Test Procedure

FCC Publication 558074

F.4. Operating Mode During Test

The EUT was tuned to a low, middle and high channel in modulated signal with 100% duty cycle at maximum rated RF output power.

F.5. Test Results Summary

Compliant.

TX Channel	Worst Case Spurious Frequency (MHz)	Emission Level (Relative to carrier) (dBc)
11	7188.397	-37.19
18	7313.253	-36.50
26	7438.109	-40.37

The worst case spurious emission was 36.50 dB below the carrier at Channel 18.

All final reported values are corrected values

F.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

F.7. Test date

June 16, 2011

Figure 16 Conducted Spurious Ch11

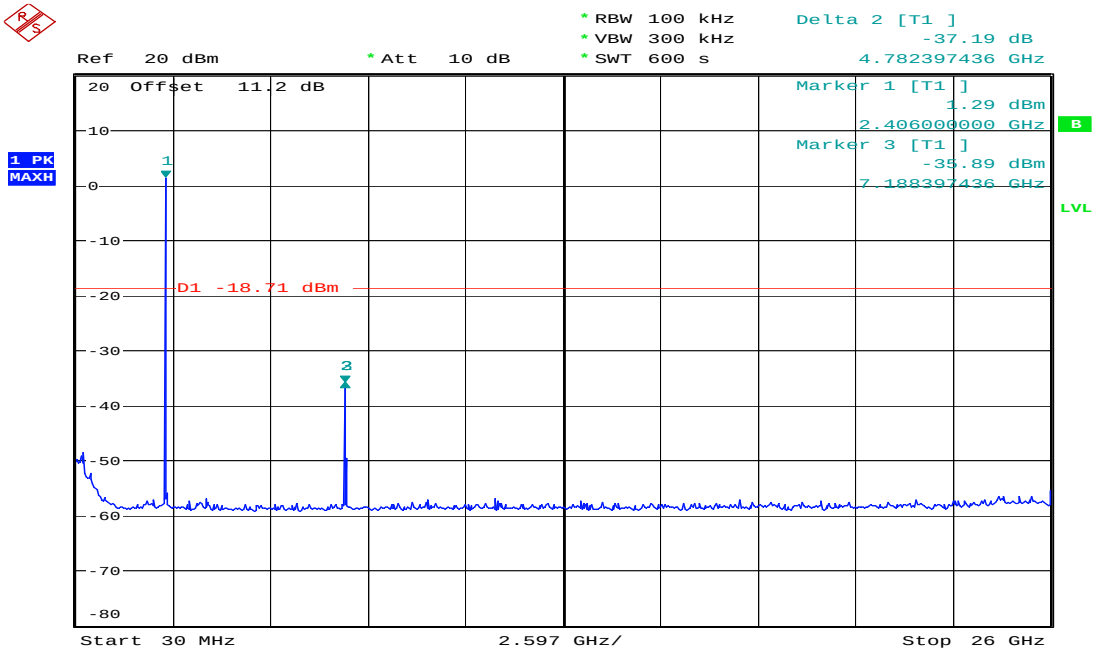


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Figure 17 Conducted Spurious Ch18

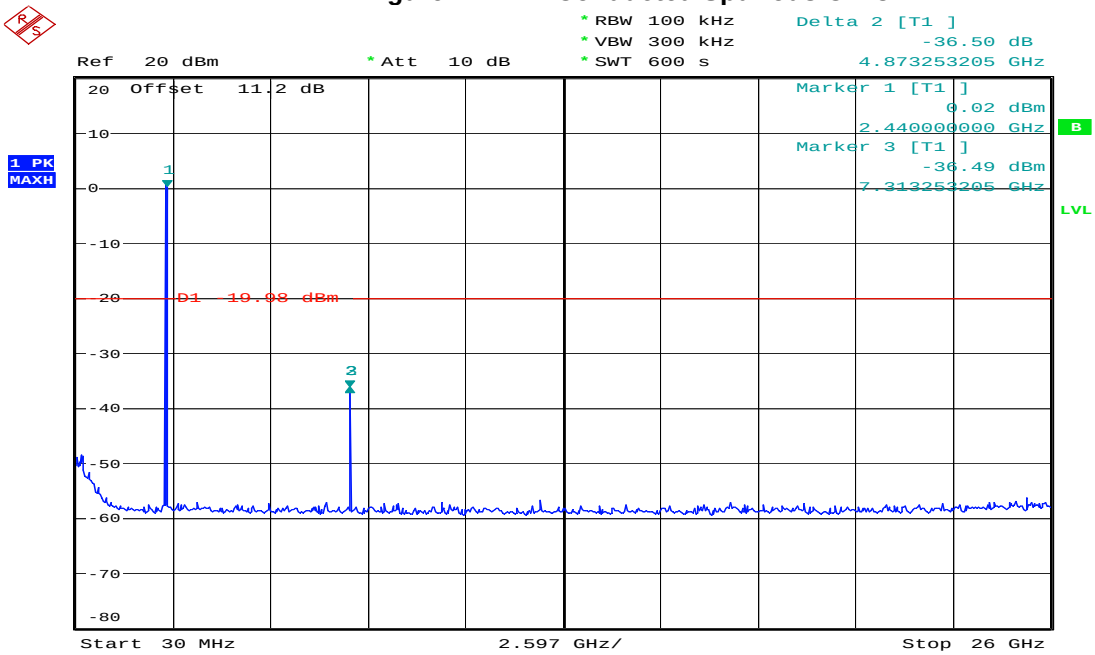

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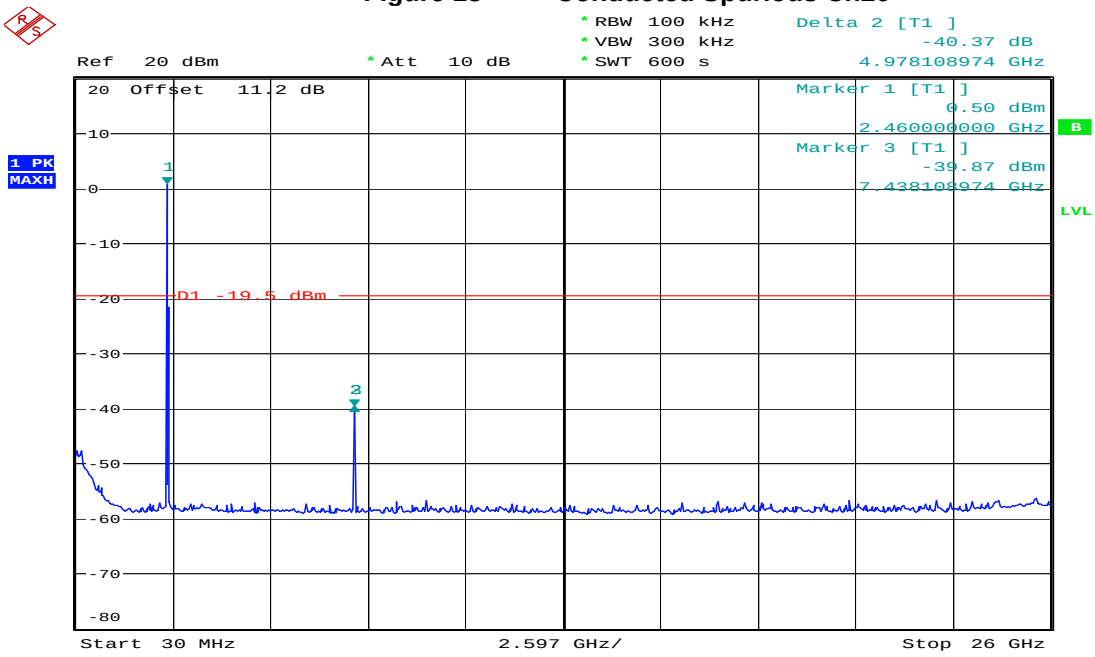
Figure 18 Conducted Spurious Ch26



Date: 16.JUN.2011 06:58:08

APPENDIX G: CONDUCTED SPURIOUS EMISSIONS BAND EDGE

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

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)).

G.3. Test Procedure

FCC Publication 558074

G.4. Operating Mode During Test

The EUT was tuned to a low and high channel in continuous transmit mode and modulated signal with 100% duty cycle at maximum rated RF output power.

G.5. Test Results

Compliant.

Channel/Measurement	Frequency (MHz)	Emission Level (Relative to carrier) (dBc)
11 (Lower band edge)	2400.00	-55.18
26 (Upper band edge)	2483.50	-45.87

Worst case spurious emission was 45.87 dB below the carrier at Channel 26

All final reported values are corrected values

G.6. Tested By

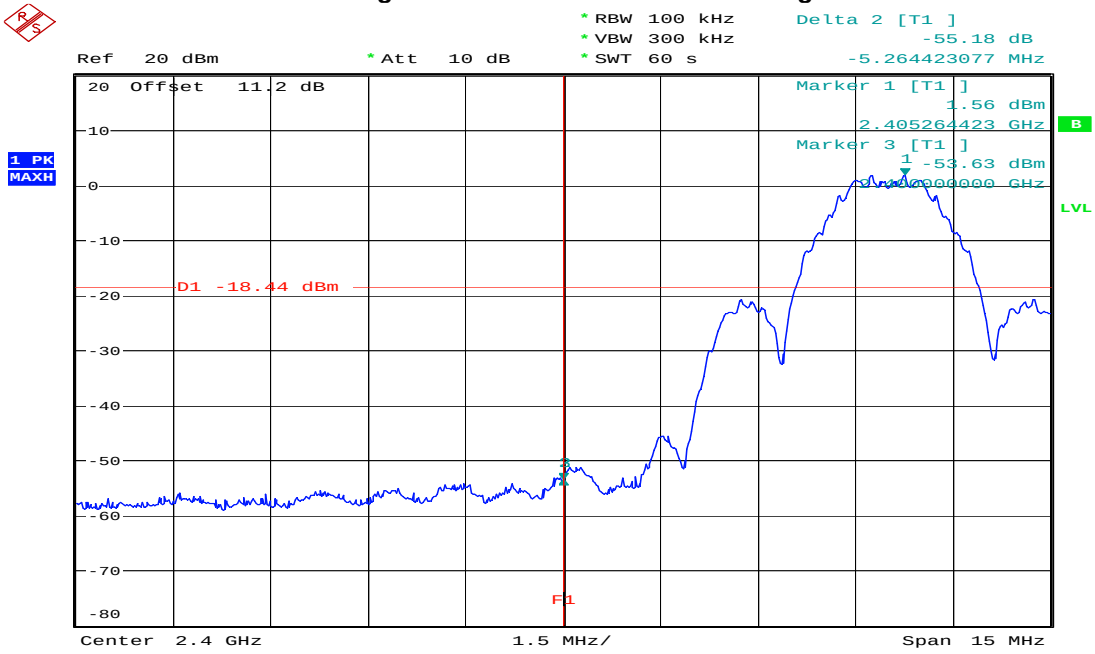
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

G.7. Test date

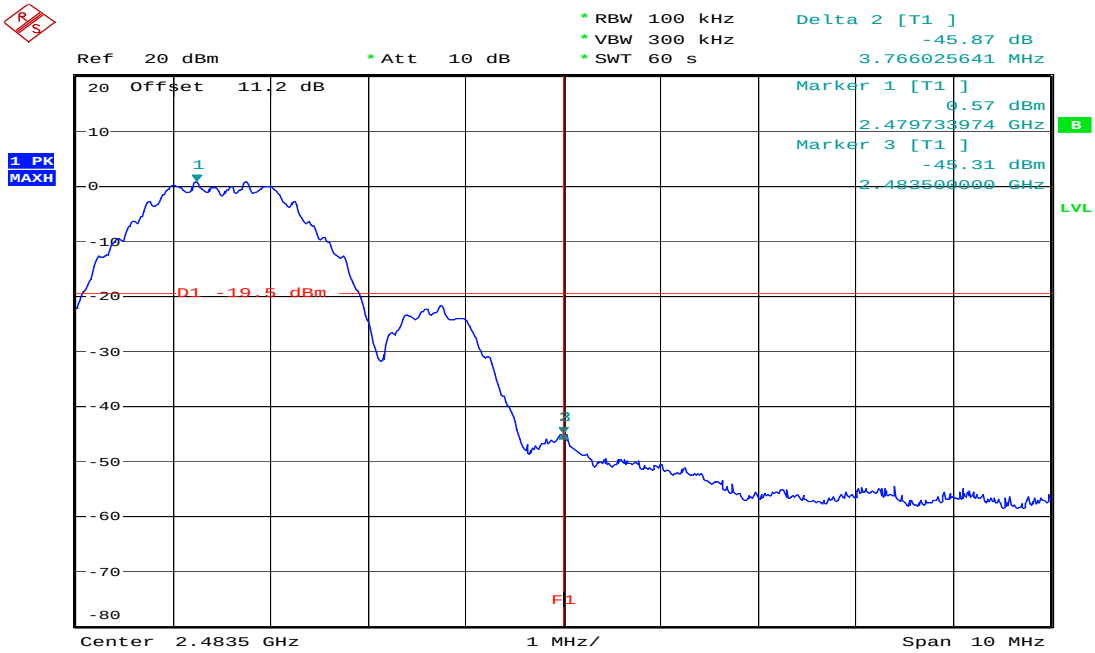
June 16, 2011

Figure 19 Conducted Band edge Ch11



Date: 16.JUN.2011 07:23:28

Figure 20 Conducted Band edge Ch26



Date: 16.JUN.2011 07:16:25

APPENDIX H: RADIATED SPURIOUS EMISSIONS BAND EDGE

H.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 FCC Publication 558074, DA 00-705 and ANSI C63.10: 2009
Test Method	NTS Radiated Emissions Test Method SOP-CAG-EMC-02 and FCC Publication 558074, DA 00-705 and ANSI C63.10: 2009

H.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.

H.3. Test Procedure

RF radiated measurement at 3 meters distance.

FCC Publication 558074 and ANSI C63.10: 2009

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.

FCC Publication DA 00-705 and ANSI C63.10: 2009

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) required by measurement procedure ANSI C63.4-1992 (hereafter C63.4).

STEP 1) Perform an in-band field strength measurement of the fundamental emission using the RBW and detector function required by C63.4 and our Rules for the frequency being measured. For example, for a device operating in the 902-928 MHz band under Section 15.249, use a 120 kHz RBW with a CISPR QP detector (a peak detector with 100 kHz RBW may alternatively be used). For transmitters operating above 1 GHz, use a 1 MHz RBW, a 1 MHz VBW, and a peak detector (as required by Section 15.35). 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.

H.4. Operating Mode During Test

The EUT was tuned to the low and high channel in continuous transmit mode, modulated signal with 100% duty cycle at maximum rated RF output power
The EUT was measured with all three orientations, EUT flat on the table and horizontal receive antenna position were found as the worst case. The worst case emissions presented

H.5. Test Results

Compliant

Tx Channel	Spurious frequency (MHz)	Detector	Measured level (dBµV/m)	Marker delta (dB)	Duty cycle correction factor (dB)	Calculated level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
11	2388.654	Peak	59.22	N/A	N/A	59.22	73.98	14.76
11	2390.000	Average	44.88	N/A	-13.47	31.41	53.98	22.57
26	2483.500	Peak	*103.97	-43.50	N/A	60.47	73.98	13.51
26	2483.500	Average	*101.55	-43.50	-13.47	44.58	53.98	9.40

* These measured levels are the maximum carrier levels in order to determine calculated levels with marker delta method.

Maximum emission measured was at channel 26 at 2483.5MHz. It has 9.40 dB margin to the 15.209 average limits.
All final reported values are corrected values.

H.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

Calculated level (dBµV/m) = Measured level (dBµV/m) + Marker delta (dB) + Duty cycle correction factor (dB)

Measured level (dBµV/m) = Receiver measured level (dBµV) + Receive antenna factor (dB) + Receive antenna cable loss (dB)

Note: Duty Cycle Correction Factor was used for Average measurements per FCC Publication 558074 and ANSI C63.10: 2009

Marker delta method was used per FCC publication DA 00705 and ANSI C63.10: 2009

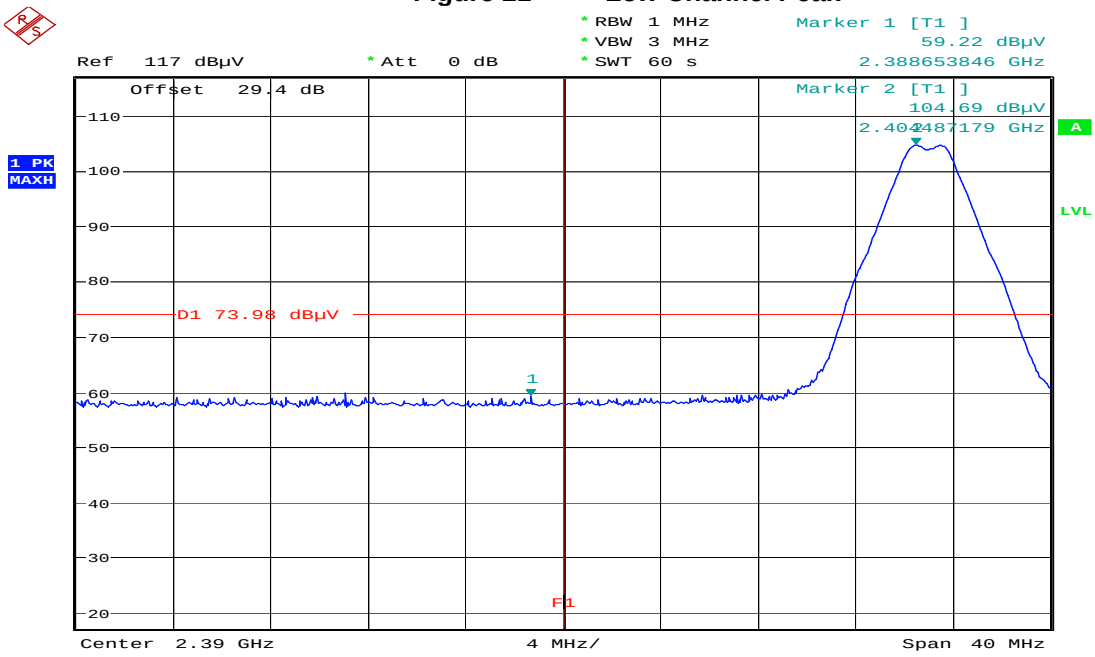
H.7. Tested By

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

H.8. Test date

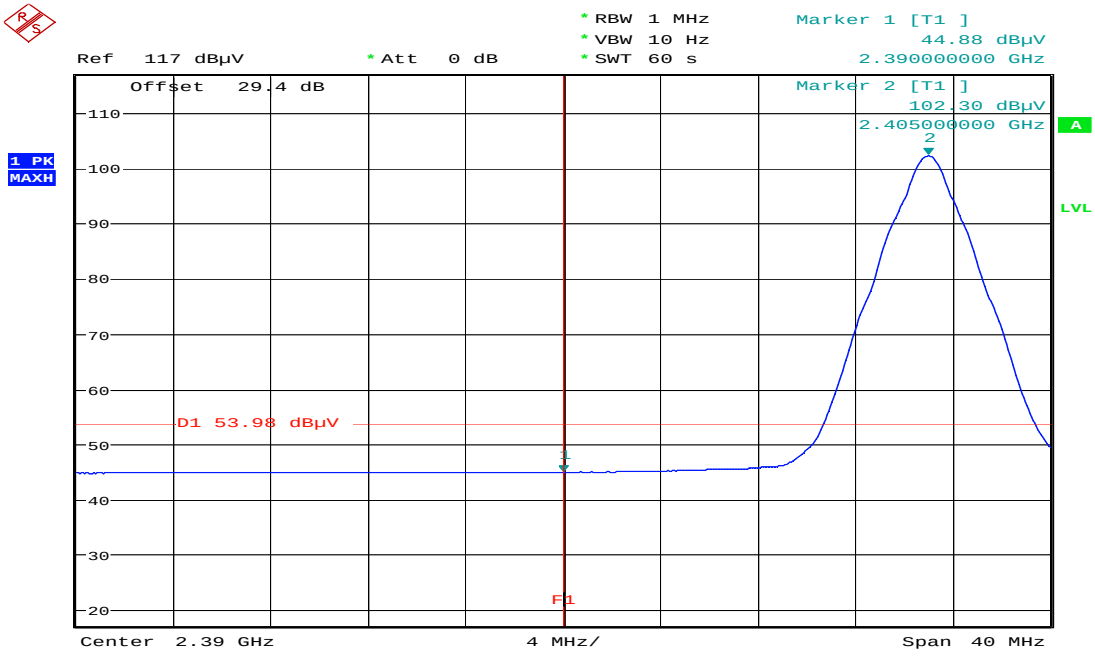
Started: June 13, 2011 Completed: June 14, 2011

Figure 21 Low Channel Peak



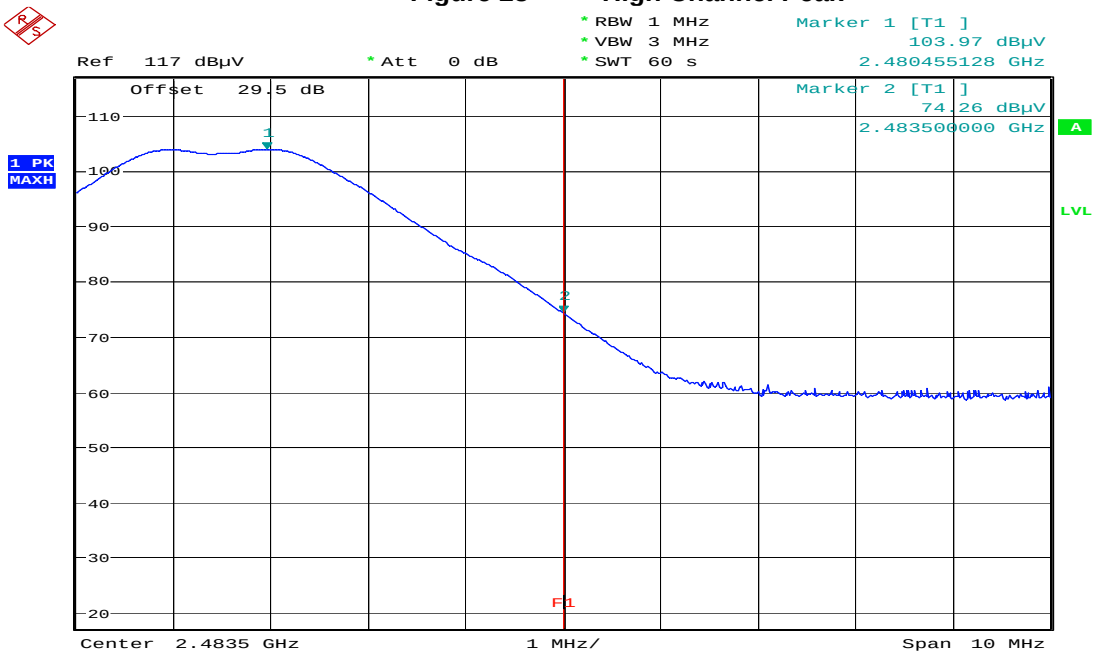
Date: 14.JUN.2011 07:04:47

Figure 22 Low Channel Average



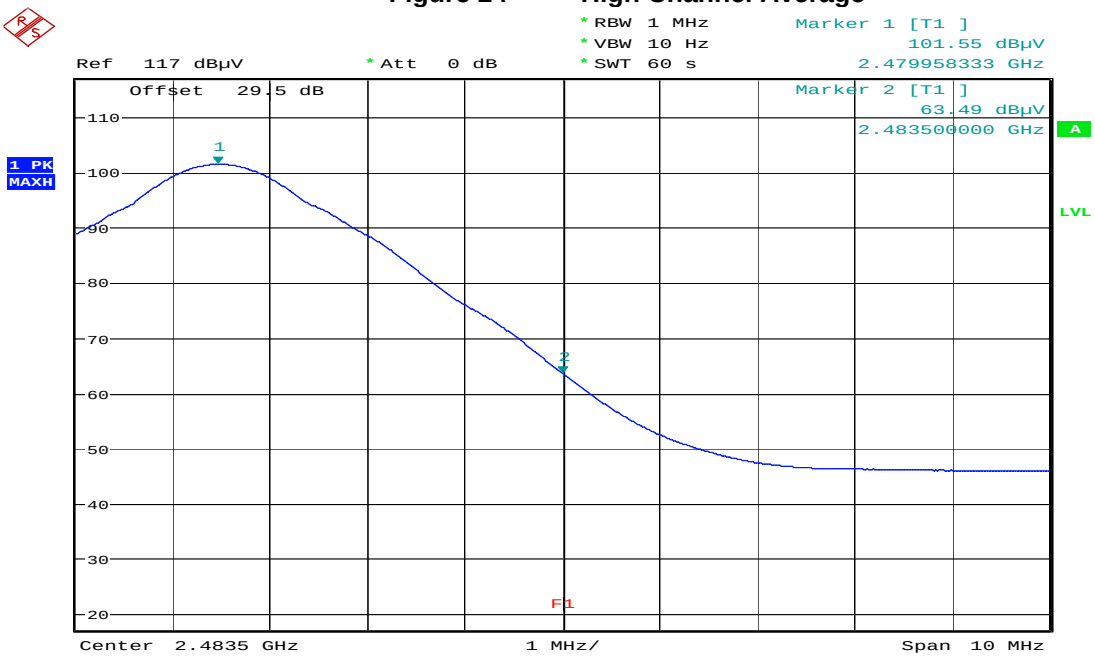
Date: 14.JUN.2011 07:13:10

Figure 23 High Channel Peak



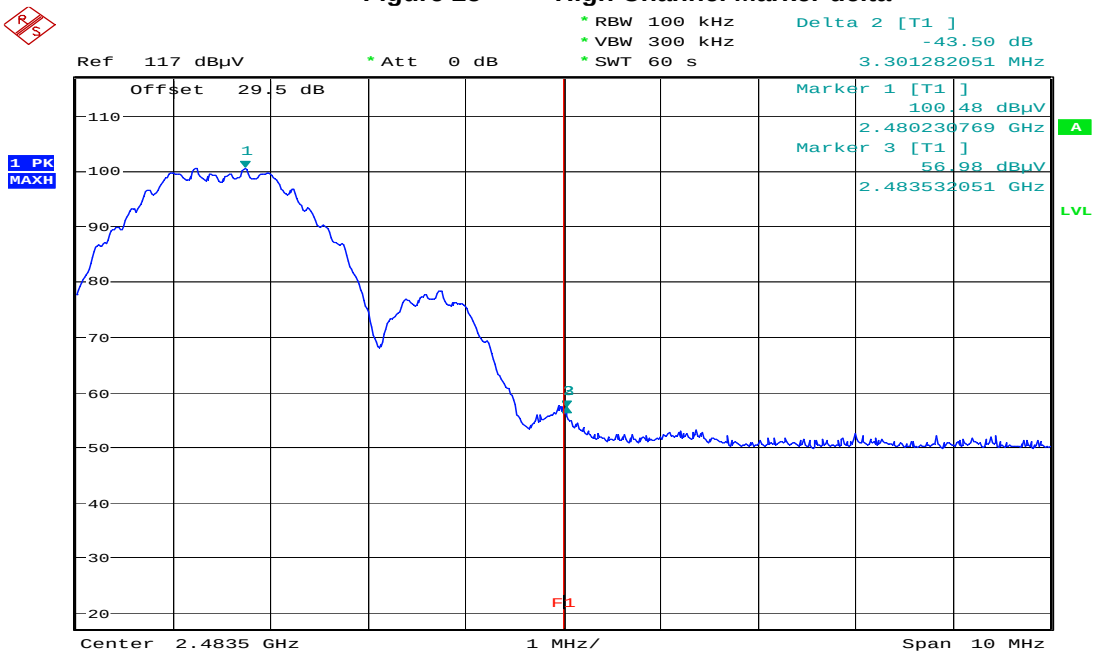
Date: 13.JUN.2011 11:14:23

Figure 24 High Channel Average



Date: 13.JUN.2011 11:17:25

Figure 25 High Channel Marker delta



Date: 13.JUN.2011 11:24:05

APPENDIX I: RADIATED SPURIOUS EMISSIONS (TX AND RX)

I.1. Base Standard & Test Basis

Base Standard	FCC CFR Title 47 – Telecommunications, Chapter I Part 15.205 – Restricted bands of operation RSS 210 Issue 8 2.5 and A8.5 RSS Gen Issue 3 4.10 and 6 for Receiver Spurious Emission
Test Basis	ANSI C63.4: 2009, ANSI C63.10: 2009 FCC Publication 558074
Test Method	NTS Radiated Emissions Test Method SOP-CAG-EMC-02, RSS Gen Issue 3, FCC Publication 558074

I.2. Specifications:

I.2.1. FCCC 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. 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.2.2. 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

I.3. Test Procedure

I.3.1. Tx Spurious measurements

FCC Publication 558074 and ANSI C63.10: 2009
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.

I.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.

The EUT was tested from 30 MHz to 10 GHz for Rx mode.

I.4. Operating Mode During Test

The EUT was tuned to the low, mid and high channel in continuous transmit mode, modulated signal with 100% duty cycle at maximum rated RF output power for TX spurious emissions.
The EUT was tuned to receive only mode at mid channel for receiver spurious emissions
The EUT was measured with all three orientations. Both Response PE and Response LE models were tested, there were no difference found on spurious emissions.
EUT flat on the table was found as the worst case. The worst case emissions presented

I.5. Sample Calculations

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)

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

Calculated level (dBµV/m) = Measured spurious emission (dBµV/m) + Duty cycle correction factor (dB)

I.6. Tested By

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

Name:	Lixin Wang	Deniz Demirci
Function:	EMC Technologist	Senior Wireless / EMC Technologist

I.7. Test date

Started: June 13, 2011 Completed: June 15, 2011

I.8. Test Results

Compliant.

I.5.1 Rx mode, 30 MHz to 10 GHz (RSS Gen Issue 3 section 4.10 and 6 for RX emissions)

RX Channel	Spurious Frequency (MHz)	Polarity	Detector	Measured spurious emission (dBµV/m @ 3m)	Limit (dBµV/m)	Margin (dB)
18	4879.967	Horizontal	Average	44.57	53.98	9.41
18	4880.017	Vertical	Average	41.92	53.98	12.06

The worst case Rx spurious emission was 44.57 dBµV/m at 3m distance with average detector at 4879.967 MHz. It has 9.41 dB margin to the average limits.

I.5.2 TX Mode 30 MHz to 26 GHz (FCC 15.205 and RSS 210)

Tx Channel	Spurious Frequency (MHz)	Polarity	Detector	Measured spurious emission (dBµV/m)	Duty Cycle correction factor (dB)	Calculated level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
11	4809.600	Vertical	Peak	43.95	N/A	43.95	73.98	30.03
11	4809.950	Vertical	Average	35.78	-13.47	22.31	53.98	31.67
11	7213.536	Horizontal	Peak	61.81	N/A	61.81	73.98	12.17
11	7215.964	Horizontal	Average	51.48	-13.47	38.01	53.98	15.97
11	7213.514	Vertical	Peak	60.26	N/A	60.26	73.98	13.72
11	7215.953	Vertical	Average	50.42	-13.47	36.95	53.98	17.03
18	4880.033	Horizontal	Peak	46.07	N/A	46.07	73.98	27.91
18	4879.983	Horizontal	Average	39.23	-13.47	25.76	53.98	28.22
18	4880.983	Vertical	Peak	44.74	N/A	44.74	73.98	29.24
18	4879.916	Vertical	Average	36.24	-13.47	22.77	53.98	31.21
18	7318.429	Horizontal	Peak	63.10	N/A	63.10	73.98	10.88
18	7321.050	Horizontal	Average	52.58	-13.47	39.11	53.98	14.87
18	7318.530	Vertical	Peak	62.70	N/A	62.70	73.98	11.28
18	7318.924	Vertical	Average	51.87	-13.47	38.40	53.98	15.58
26	4959.233	Horizontal	Peak	46.52	N/A	46.52	73.98	27.46
26	4959.917	Horizontal	Average	37.52	-13.47	24.05	53.98	29.93
26	4959.067	Vertical	Peak	46.03	N/A	46.03	73.98	27.95
26	4958.967	Vertical	Average	34.53	-13.47	21.06	53.98	32.92
26	7438.450	Horizontal	Peak	61.63	N/A	61.63	73.98	12.35
26	7438.733	Horizontal	Average	50.63	-13.47	37.16	53.98	16.82
26	7438.400	Vertical	Peak	59.19	N/A	59.19	73.98	14.79
26	7438.617	Vertical	Average	47.86	-13.47	34.39	53.98	19.59

Worst case spurious emission was 63.10 dBµV/m at 7318.429 MHz with horizontal polarization in Channel 18. It has 10.88 dB margin to the peak limit.

Note: Plots were not provided in order to reduce file size, All final reported values are corrected values.

APPENDIX J: TEST EQUIPMENT LIST

Descriptions	Manufacturer	Type/Model	Serial #	Cal Due	Cal Date
Test Receiver	Rohde & Schwarz	ESAI	CG0123	03JUN12	03JUN10
			CG0124	03JUN12	03JUN10
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
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
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