Certification Test Report

CFR 47 FCC Part 15, Subpart C Section 15.247
Industry Canada RSS 210, Issue 7

On-Ramp Wireless eNode

FCC ID: XTE-ULPENODE100
IC: 8655A- ULPENODE100

Project Code CG-1386

(Report CG-1386-RA-1-3)
Revision: 3
(This report supersedes CG-1386-RA-1-2)

March 17, 2010

Prepared for:	On-Ramp Wireless Inc.
Author:	Deniz Demirci Senior Wireless / EMC Technologist
Approved by:	Nick Kobrosly Director of Canadian Operations

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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: March 31, 2010
Applicant:	On-Ramp Wireless Inc. 10902 Via Frontera, Suite 200 San Diego, CA 92127 USA Tel: (858) 592-6008
Customer Representative:	Rob Boesel / Jason Wilson Tel: (852) 312-8361 rob@onrampwireless.com / Jason.wilson@onrampwireless.com

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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 2 7.2.2
B	6 dB Bandwidth	No	No	No	Pass	FCC Subpart C 15.247 (a) (2)	RSS 210 Issue 7 A8.2 (a)
C	Occupied Bandwidth (99% emission bandwidth)	No	No	No	N/A	N/A	RSS-Gen Issue 2 4.6.1
D	Peak Power Output	No	No	No	Pass	FCC Subpart C 15.247 (b) (3)	RSS 210 Issue 7 A8.4 (4)
E	Power Spectral Density	No	No	No	Pass	FCC Subpart C 15.247 (e)	RSS 210 Issue 7 A8.2 (b)
F	Conducted Spurious Emissions (TX)	No	No	No	Pass	FCC Subpart C 15.247 (d)	RSS 210 Issue 7 A8.5
G	Conducted Spurious Emissions Band Edge	No	No	No	Pass	FCC Subpart C 15.247 (d)	RSS 210 Issue 7 A8.5
H	Duty Cycle	No	No	No	N/A	FCC Subpart C 15.35 (c)	RSS-Gen Issue 2 4.5
I	Radiated Spurious Emissions Band Edge	No	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 7 2.6, A8.5
J	Radiated Spurious Emissions (TX and RX)	No	No	No	Pass	FCC Subpart C 15.247, 15.205	RSS 210 Issue 7 2.6, A8.5 RSS Gen Issue 2 4.10

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

Prepared By:
Digitally signed by Deniz Demirci
Date: 2010.03.18 16:34:37 -06'00'
_____
Deniz Demirci
Senior Wireless / EMC Technologist

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Wireless / EMC Manager

Approved By:
Alex Mathews
2010.03.18 16:40:09 -06'00'
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Alex Mathews
Quality Management Representative

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Register of revisions

Revision	Date	Description of Revisions
1	February 5, 2010	Final release for customer review
2	February 26, 2010	Radiated band edge measurements revised per TCB recommendations (Appendix H)
3	March 17, 2010	AC Power line conducted spurious emissions added EUT RF power reduced for high channel measurements.

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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 On-Ramp Wireless eNode to FCC Part 15 Subpart C section 15.247 for DTS transmitter and the equivalent sections of Industry Canada's RSS 210, Issue 7

2.0 EUT DESCRIPTION

2.1 CONFIGURATION

	Name	Model	Revision / Description	Serial Number
EUT	On-Ramp Wireless eNode	ULPN100	6	10130051
Classification	Portable			
Operating Frequency Range	2402 MHz to 2476 MHz			
Modulation	SS DBPSK			
Size (m)	59.5 mm x 25.9 mm x 16.7 mm (2.341 in x 1.021 in x 0.659 in)			
Weight	14 grams			
Antenna Type/Gain	5dBi Antenna NEARSON Part # S151FL-L-RMM-2450S 2dBi Antenna NEARSON Part # S181FL-L-RMM- 2450S 1dBi Antenna Hyperlink Technologies Part # HG2401RD-MMCX			
Functional description	Ultra-Link Processing (ULP) provides wireless coverage to multiple eNodes via a network of one or more Access Points deployed over the intended coverage area. The ULP eNode is an RF communications module exposing an MMCX antenna port and digital signal pins for a low-power Serial Peripheral Interface Bus (SPI) for interfacing with application specific host devices. Typical applications for the eNode include sensor, metering and asset tracking data. Ultra-Link Processing is based upon a proprietary direct sequence spread spectrum (DSSS-DBPSK) communications protocol operating in the 2400-2483.5 MHz ISM band using 1 MHz channel spacing. It finds weak signals even in high noise environments, yielding extreme coverage, high level of immunity to interference, and significantly lowers the cost to deploy and operate a network.			
Physical Description	Single double sided PCB. Top side with MMCX connector poking through 2 piece metal EMI shield with two compartments. RF components and analog baseband circuitry are under smaller EMI shield compartment. Digital processing components are under larger EMI shield compartment. Bottom side of PCB is unshielded and contains minor support components as well as two 1 x 10 100 mil pitch PCB to PCB connectors.			

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2.2 EUT SET UP CONFIGURATION

Quantity	EUT Description	P/N	S/N	Rev
1	ULP eNode	550-0004-01	10130051	6
1	ULP eNode	550-0004-01	10130070	6
1	ULP eNode	550-0004-01	10130071	6

2.3 EUT POWER

Voltage	5 Volts
Number of Feeds	1
Gauge of cable	N/A
Current Draw	0.5 Amps
Special Requirements	Applied to 100 mil connector pin

2.4 EUT FREQUENCY LIST

Module	Signal	Frequency (MHz)
eNode	Real-time Clock	0.032768
eNode	System Clock	26.0
eNode	eASIC	84.0
eNode	Host Interface SPI	0-8.67
eNode	CPU to eASIC SPI	8.67

2.5 EUT SOFTWARE

Software Name	Software Release Number	Software Configuration
v2.8.1	0x1f000c	N/A

2.6 MODE OF OPERATION DURING TESTS

The EUT was tested in all configurations, all three orthogonal positions and antennas to determine worst case results with 100% duty cycle in low, mid and high channels in continuous Tx and Rx modes . See test appendices for specific EUT operating modes and conditions

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3.0 SUPPORT EQUIPMENT

3.1 CONFIGURATION

The following equipment was used as the host system for the EUT

Peripheral / Device Description	Manufacturer	Model	Serial Number
Engineering board providing SPI control and power to the eNode. Attached beneath eNode via 100 mil connector	On-Ramp	PCA 510-0005-3	SM92820427
Switch-mode power supply	CUI INC	3A-211DN05	P/N:ETS050400UTC-P5P-SZ
Laptop computer interacts with engineering board via RS232 comm cable to enable test modes.	Dell	Inspiron 8100	CN-03N642-12961-21K-8188
ESG Vector Signal Generator	Agilent	E4438C	US41461088

3.2 SUPPORT CABLE LIST

Quantity	Model	Routing		Description	Cable Length (m)
		From	To		
1	Generic RS-232 Serial Cable	Laptop in support room	Engineering board in RF chamber	To allow test control from laptop.	6

3.3 SUPPORT FREQUENCY LIST

Signal	Frequency (MHz)
Engineering Board Clock	26.0
Host to eNode Interface SPI	8.67
RS-232	0.115

4.0 TEST ENVIRONMENT

4.1 NORMAL TEST CONDITIONS

Temperature: 20 – 23 °C
Relative Humidity: 28 – 35 %
Atmospheric pressure: 883 – 890 mbar
Nominal test voltage: 120 VAC 60Hz

The values are the limits registered during the test period.

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APPENDICES

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APPENDIX A: POWER LINE CONDUCTED EMISSION

A.1. Base Standard & Test Basis

Base Standard	FCC PART 15.207 (a) RSS-Gen Issue 2 7.2.2
Test Basis	ANSI C63.4-2003
Test Method	SOP-CAG- EMC-02

A.2. Specifications

Frequency MHz	Limit (Class B)	
	Quasi-Peak dBµV	Average 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 C63.4-2003.
The EUT was pre tested in all modes including low, mid and high channel with the worst case test results being reported.

A.4. Deviations

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

A.5. Test setup

On Ramp Wireless eNode was installed onto the On Ramp engineering board PCA 510-0005-3.
CUI INC switch mode power supply was used to power up the engineering board.
DELL Inspiron 8100 laptop was used to configure engineering board and On Ramp Wireless eNode via RS232

A.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

A.7. Test date

March 16, 2010

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A.8. Test Results

Product Integrity Laboratory V2.5

Project Number:	CG-1386	**Tester:**	Deniz
Model:	OnRamp Wireless eNode	**Test ID:**	CE02tc-10m-1386
Comments:	Conf01: On-Ramp Wireless eNode Mid Channel, cont. Tx, Max Power, Switch-mode power supply CUI INC Model:3A-211DN05, P/N:ETS050400UTC-P5P-SZ 120VAC 60Hz		

Standard: FCC15_B

Voltage/Line	Frequency (MHz)	Measurement Detector	Measured Value (dBµV)	Correction Factors (dB)	Emission Level (dBµV)	Limit Type	Limit (dBµV)	Margin (dB)
AC 120V Line1A	0.151	QP	33.56	12.26	45.82	QP	65.94	**20.12**
AC 120V Line1A	0.266	QP	21.75	11.27	33.02	QP	61.24	**28.22**
AC 120V Line1A	3.829	QP	19.19	10.95	30.14	QP	56.00	**25.86**
AC 120V NeutralA	0.151	QP	33.89	12.16	46.05	QP	65.97	**19.92**
AC 120V NeutralA	0.390	QP	21.73	10.86	32.59	QP	58.06	**25.47**
AC 120V NeutralA	3.745	QP	18.50	10.85	29.35	QP	56.00	**26.65**
AC 120V Line1A	0.151	AV	6.62	12.13	18.75	AV	55.97	**37.22**
AC 120V Line1A	0.337	AV	16.60	11.03	27.63	AV	49.28	**21.65**
AC 120V Line1A	3.814	AV	13.53	10.95	24.48	AV	46.00	**21.52**
AC 120V NeutralA	0.150	AV	7.30	11.91	19.21	AV	55.99	**36.78**
AC 120V NeutralA	0.372	AV	22.13	10.89	33.02	AV	48.45	**15.43**
AC 120V NeutralA	3.664	AV	13.70	10.85	24.55	AV	46.00	**21.45**

The highest emission measured was 33.02 dBµV with average detector at 372 kHz. It has 15.43 dB margin to the FCC Part 15.207 and RSS-Gen Issue 2 7.2.2 limits.

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Figure 1 Conducted Emission 120 VAC Line - Quasi-peak Detector

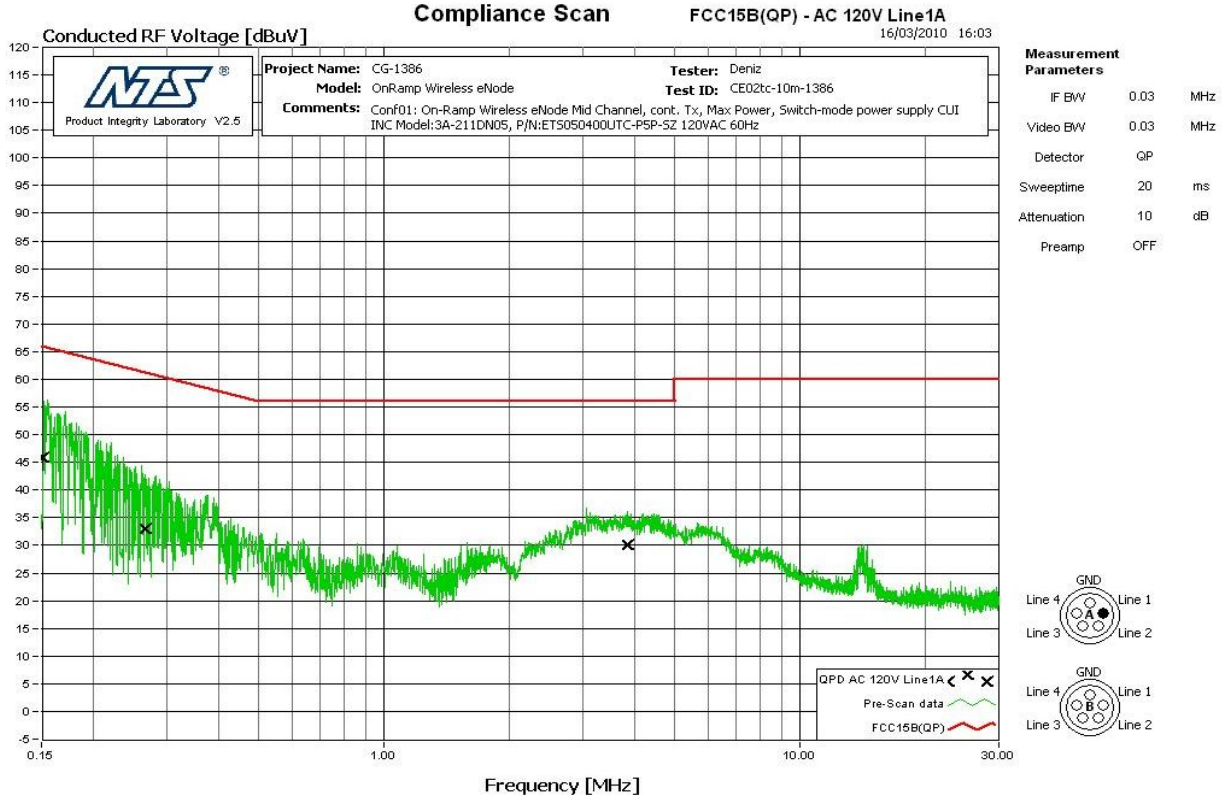

Figure 2 Conducted Emission 120 VAC Return - Quasi-peak Detector

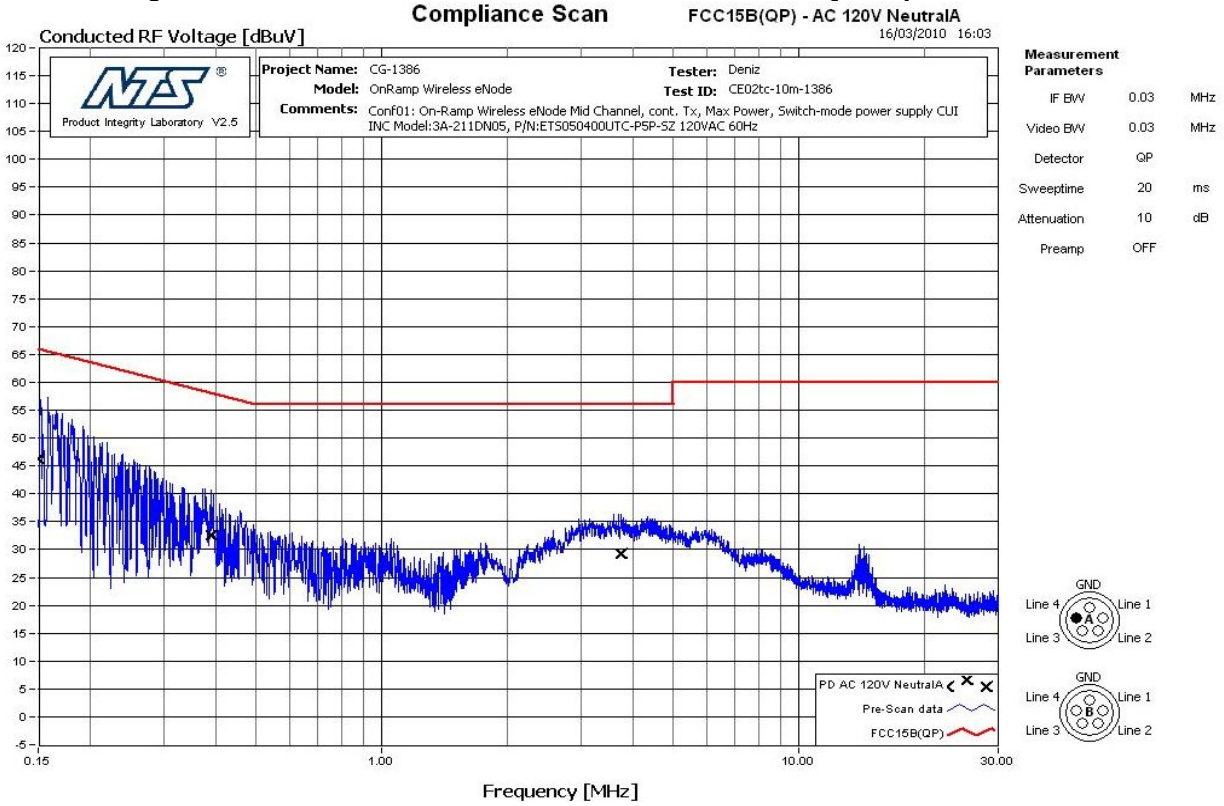

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Figure 3 Conducted Emission 120 VAC Line - Average Detector

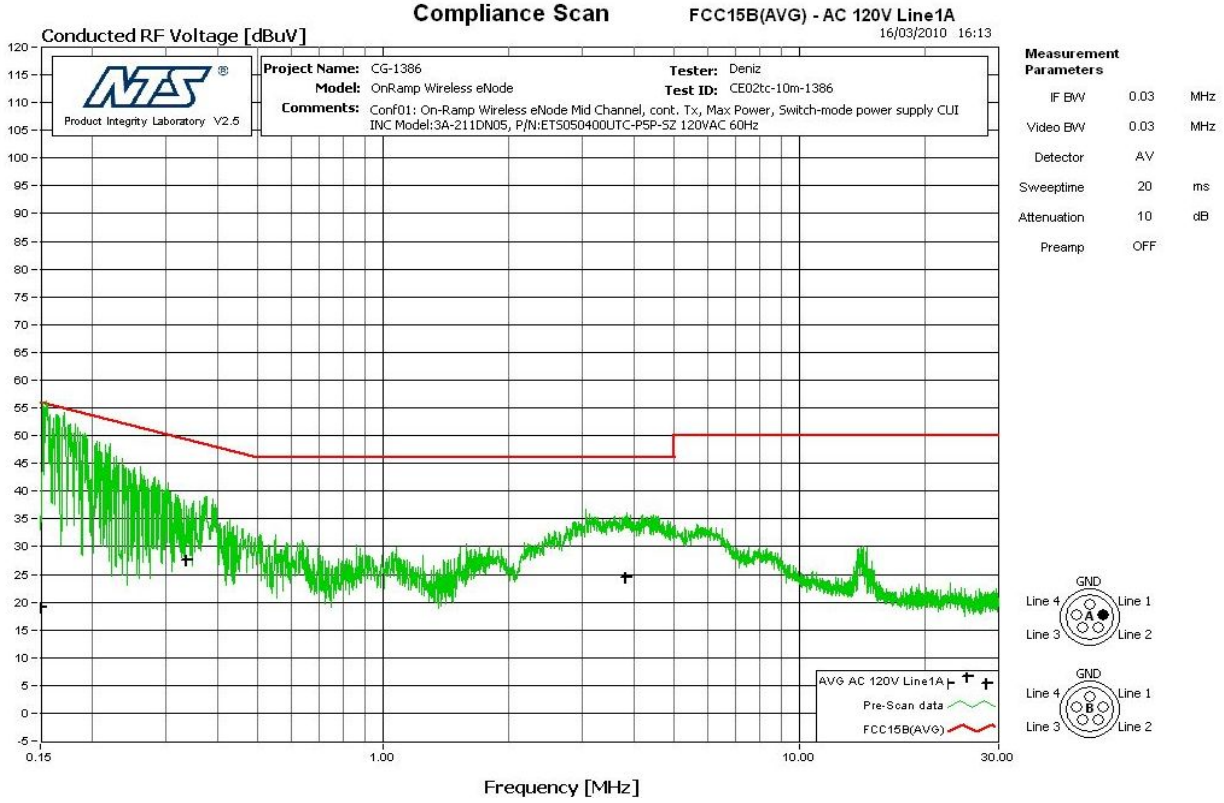
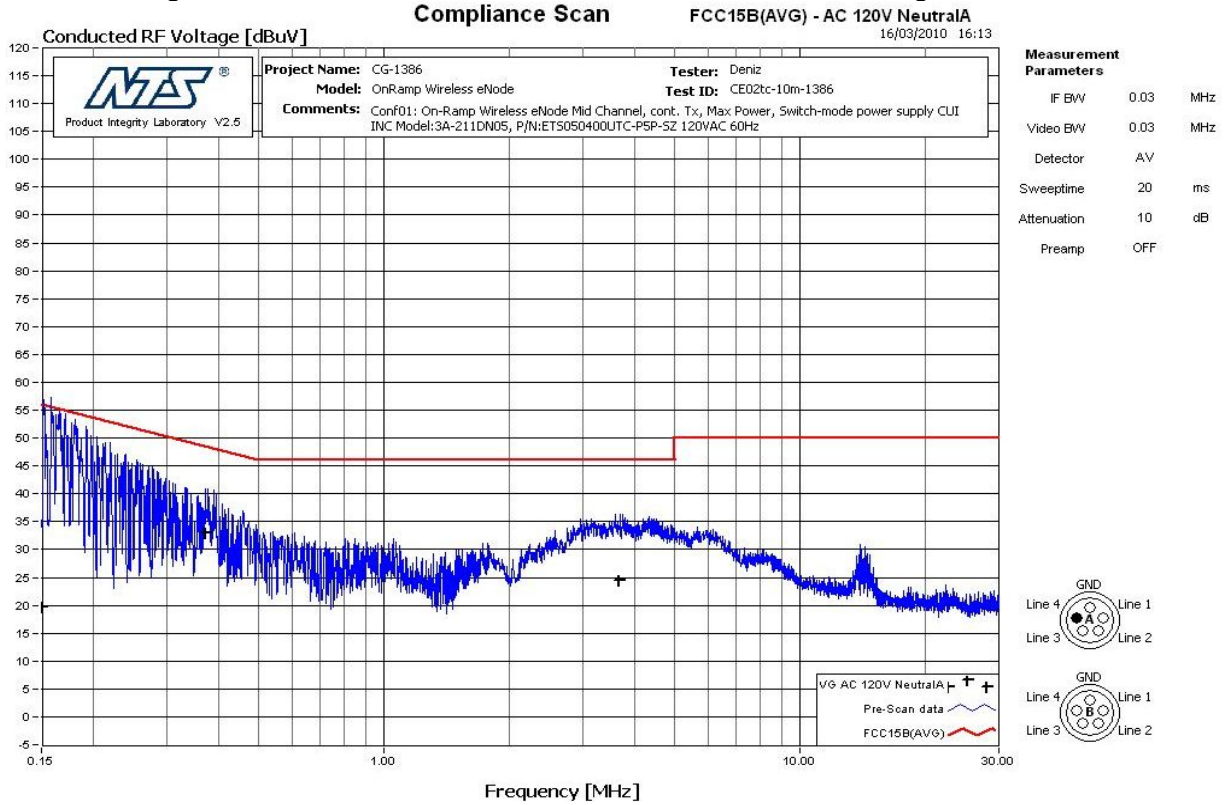


Figure 4 Conducted Emission 120 VAC Return - Average Detector



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APPENDIX B: 6 DB BANDWIDTH

B.1. Base Standard & Test Basis

Base Standard	FCC PART 15.247 (a) (2) RSS 210 Issue 7 A8.2 (a)
Test Basis	ANSI C63.10 RSS-Gen Issue 2 4.6.2
Test Method	ANSI C63.10 RSS 210 Issue 7 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

ANSI C63.10 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)
Low	2402	0.661
Mid	2440	0.691
High	2476	0.631

All final reported values are corrected values.

B.6. Operating Mode During Test

The EUT was tuned to a low, middle and high channel in continuous transmit mode at maximum rated RF output power and 100% duty cycle. Power level setting was adjusted to # 59 for high channel measurement

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

Started: February 3, 2010 Completed: February 24, 2010

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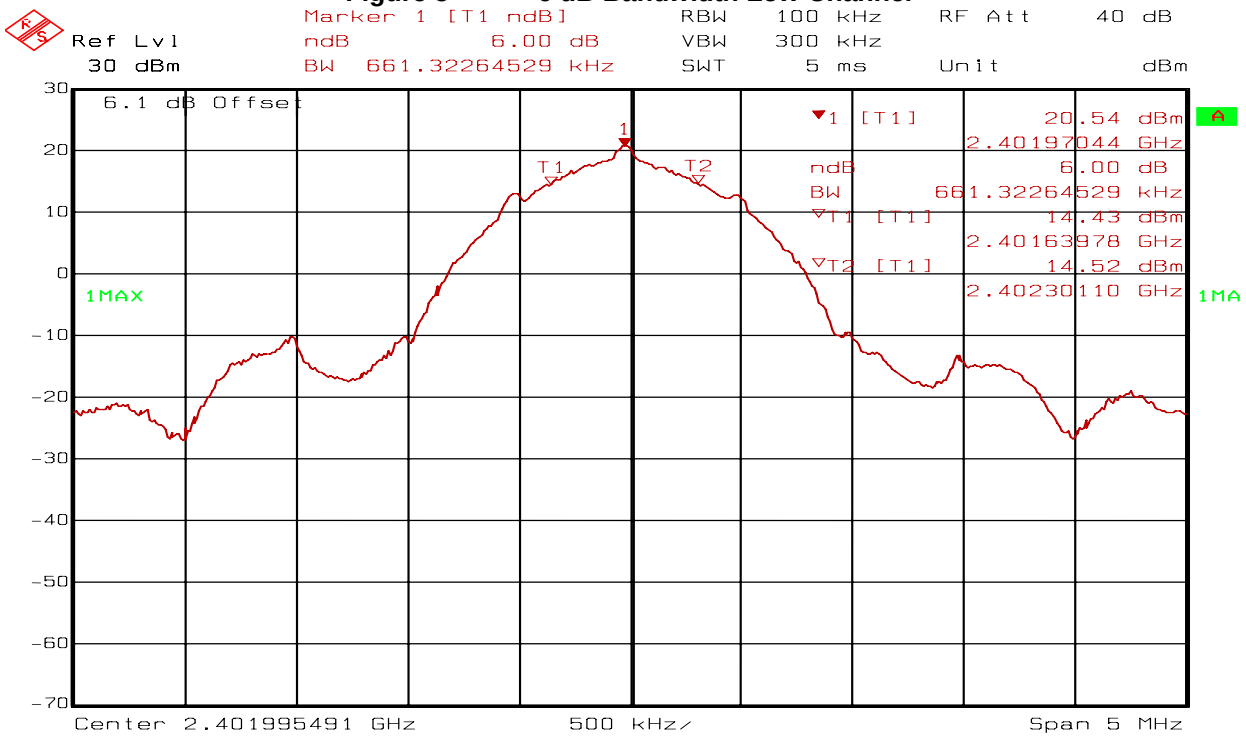
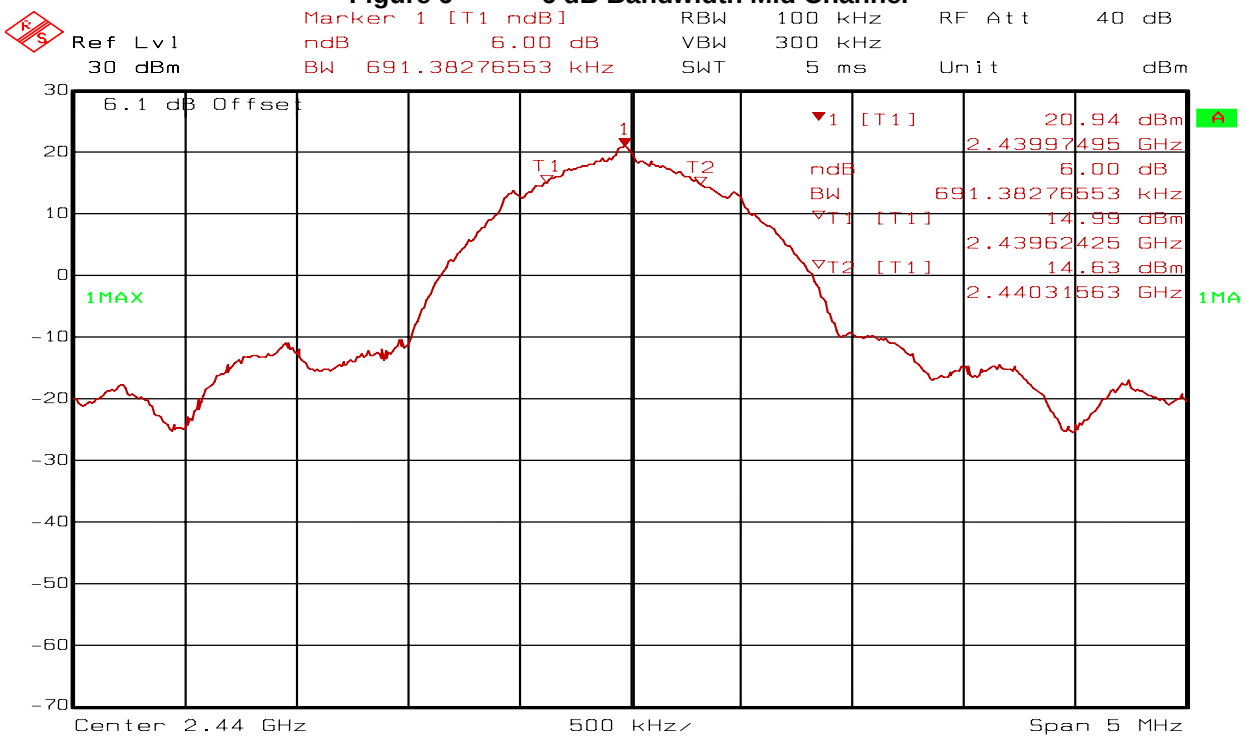
Figure 5 6 dB Bandwidth Low Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Low Channel 2402 MHz, SS DBPSK, Max Power 100% Duty cycle
Date: 3.FEB.2010 14:35:23

Figure 6 6 dB Bandwidth Mid Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Mid Channel 2440 MHz, SS DBPSK, Max Power 100% Duty cycle
Date: 3.FEB.2010 15:24:42

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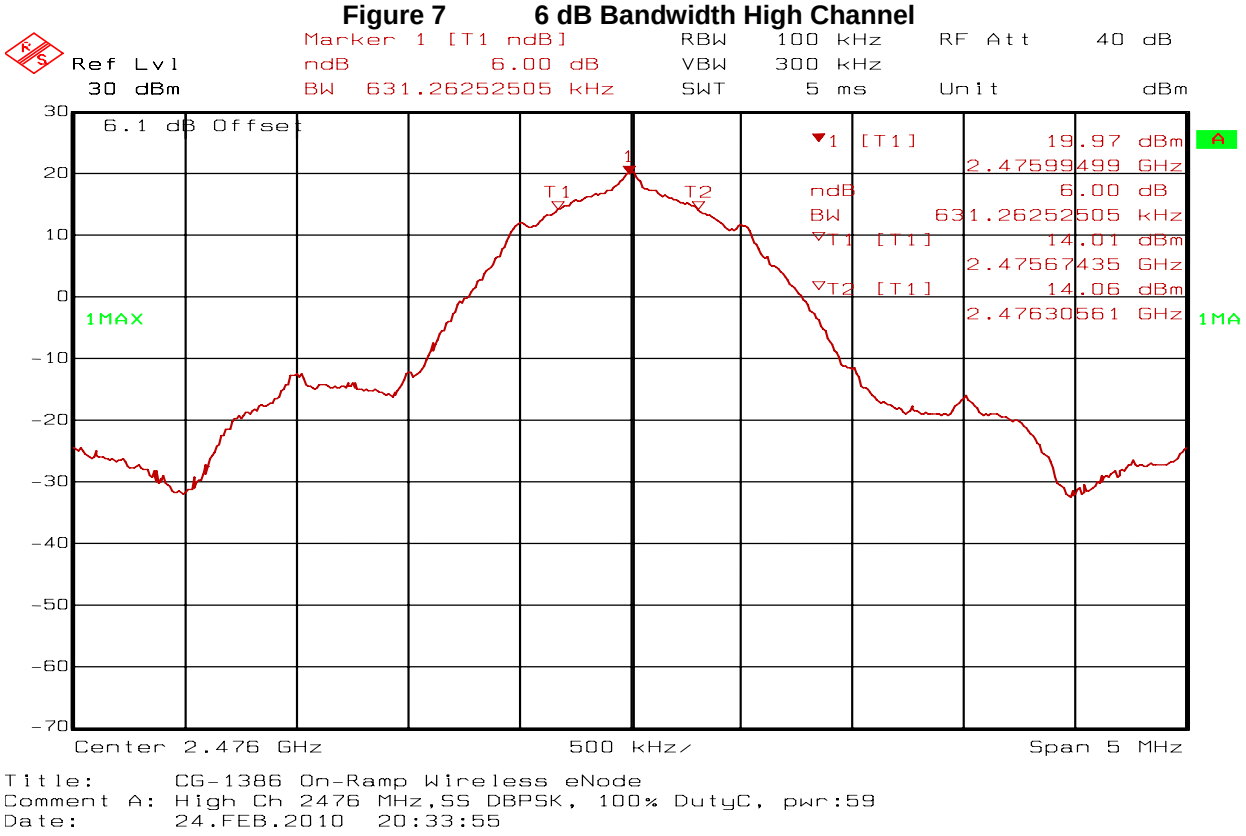
Figure 7 6 dB Bandwidth High Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: High Ch 2476 MHz,SS DBPSK, 100% DutyC, pwr:59
Date: 24.FEB.2010 20:33:55

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APPENDIX C: OCCUPIED BANDWIDTH

C.1. Base Standard & Test Basis

Base Standard	RSS-Gen Issue 2 4.6.1
Test Basis	RSS-Gen Issue 2 4.6.1
Test Method	RSS-Gen Issue 2 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)
Low	2402	1.433
Mid	2440	1.483
High	2476	1.363

All final reported values are corrected values

C.5. Operating Mode During Test

The EUT was tuned to a low, middle and high channel in continuous transmit mode at maximum rated RF output power and 100% duty cycle. Power level setting was adjusted to # 59 for high channel measurement

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

Started: February 3, 2010 Completed: February 24, 2010

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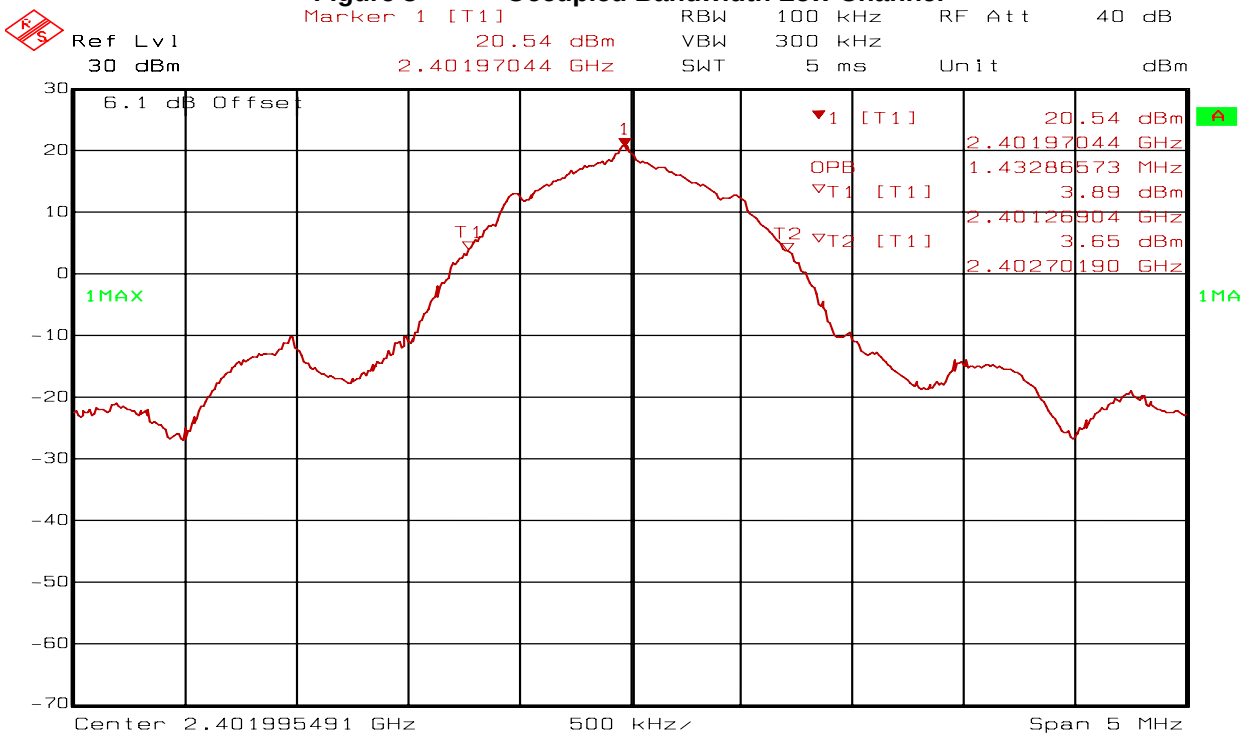
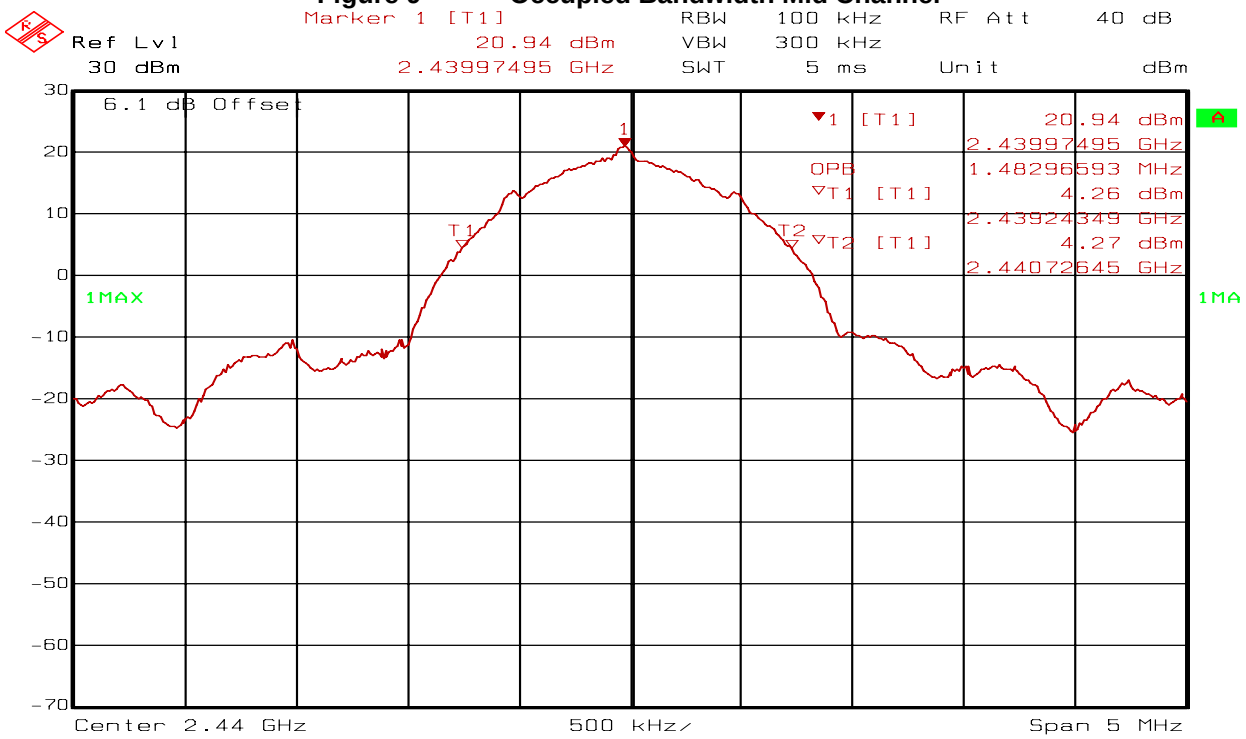
Figure 8 Occupied Bandwidth Low Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Low Channel 2402 MHz, SS DBPSK, Max Power 100% Duty cycle
Date: 3.FEB.2010 14:34:26

Figure 9 Occupied Bandwidth Mid Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Mid Channel 2440 MHz, SS DBPSK, Max Power 100% Duty cycle
Date: 3.FEB.2010 15:25:29

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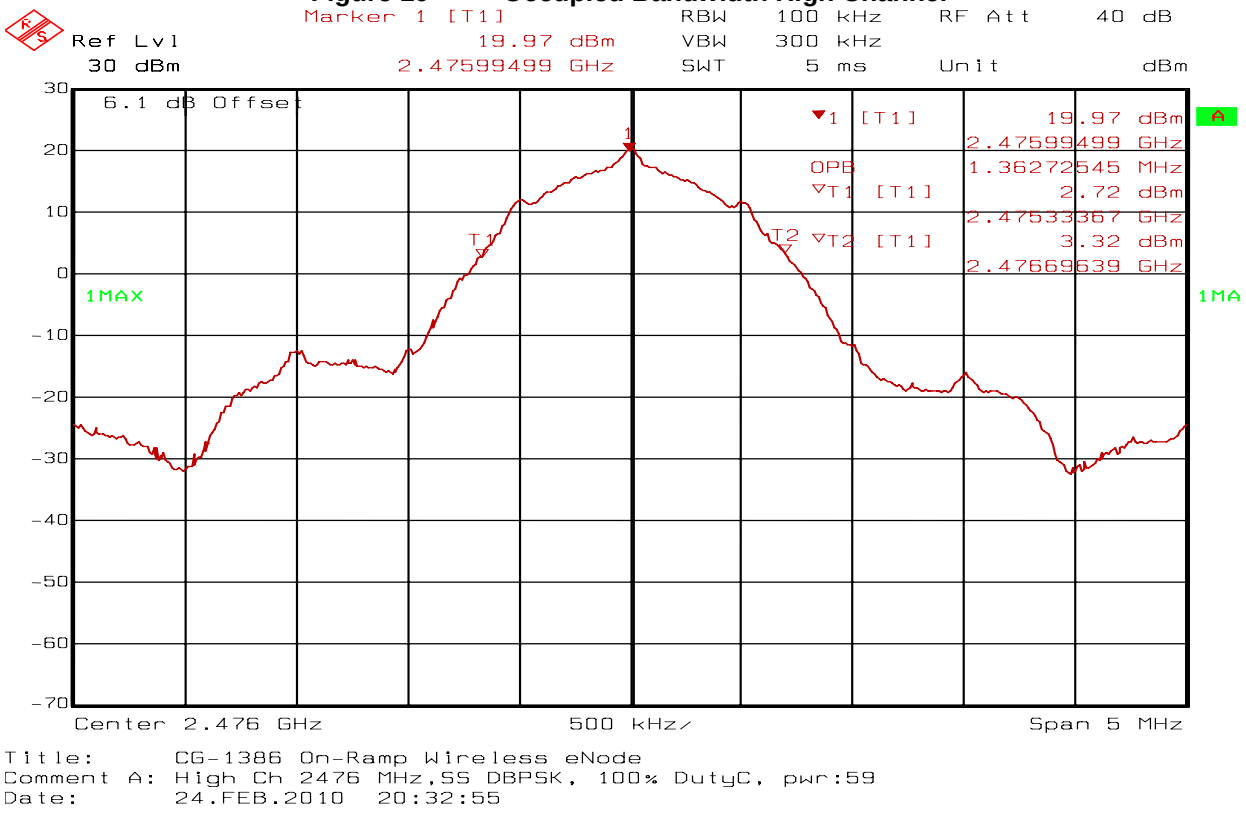
Figure 10 Occupied Bandwidth High Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: High Ch 2476 MHz,SS DBPSK, 100% DutyC, pwr:59
Date: 24.FEB.2010 20:32:55

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APPENDIX D: PEAK POWER OUTPUT

D.1. Base Standard & Test Basis

Base Standard	FCC 15.247 RSS 210 Issue 7 A8.4 (4)
Test Basis	FCC 15.247 as per ANSI C63.10 RSS-Gen Issue 2 4.8
Test Method	ANSI C63.10 and RSS-Gen Issue 2 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

ANSI C63.10, 6.10.3

T is the transmission pulse duration over which the unlicensed wireless device is on and transmitting at its maximum power control level.
T = 2.10 seconds (see appendix G)
Set resolution bandwidth (RBW) = 1 MHz. Set the span to encompass the entire emission bandwidth (EBW) of the signal. Use automatic setting for analyzer sweep time.
Check the sweep time to determine which procedure to use,
Sweep time = 5 ms,
Sweep time << T

ANSI C63.10, 6.10.3.1 Method 1—spectral trace averaging

a) Set span to encompass the entire EBW of the signal.
b) Set RBW = 1 MHz.
c) Set VBW ≥ 3 MHz.
d) Use sample detector mode if bin width (i.e., span/number of points in spectrum display) < 0.5 RBW. Otherwise, use peak detector mode
e) Use a video trigger with the trigger level set to enable triggering only on full power pulses. Unlicensed wireless device must operate at full control power for entire sweep of every sweep. If the device transmits continuously, with no off intervals or reduced power intervals, the trigger may be set to “free run.” Power-gated sweeping may be used to ensure the analyzer sweeps only while the device is transmitting.
f) Trace average across 100 traces in power averaging mode.
g) Compute power by integrating the spectrum across the 26 dB EBW of the signal. The integration can be performed using the spectrum analyzer band-power measurement function with band limits set equal to the EBW band edges or by summing power levels in each 1 MHz band in linear power terms. The 1 MHz band power levels to be summed can be obtained by averaging, in linear power terms, power levels in each frequency bin across the 1 MHz.

D.4. Operating Mode During Test

The EUT was tuned to a low, middle and high channel in continuous transmit mode at maximum rated RF output power and 100% duty cycle. Power level setting was adjusted to # 59 for high channel measurement

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D.5. Test Results

Channel	Frequency (MHz)	Peak Power (dBm)
Low	2402	18.03
Mid	2440	18.60
High	2476	17.73

Compliant – The maximum peak power was 18.60 dBm measured conducted at the integral antenna input

All final reported values are corrected values

D.6. Tested By

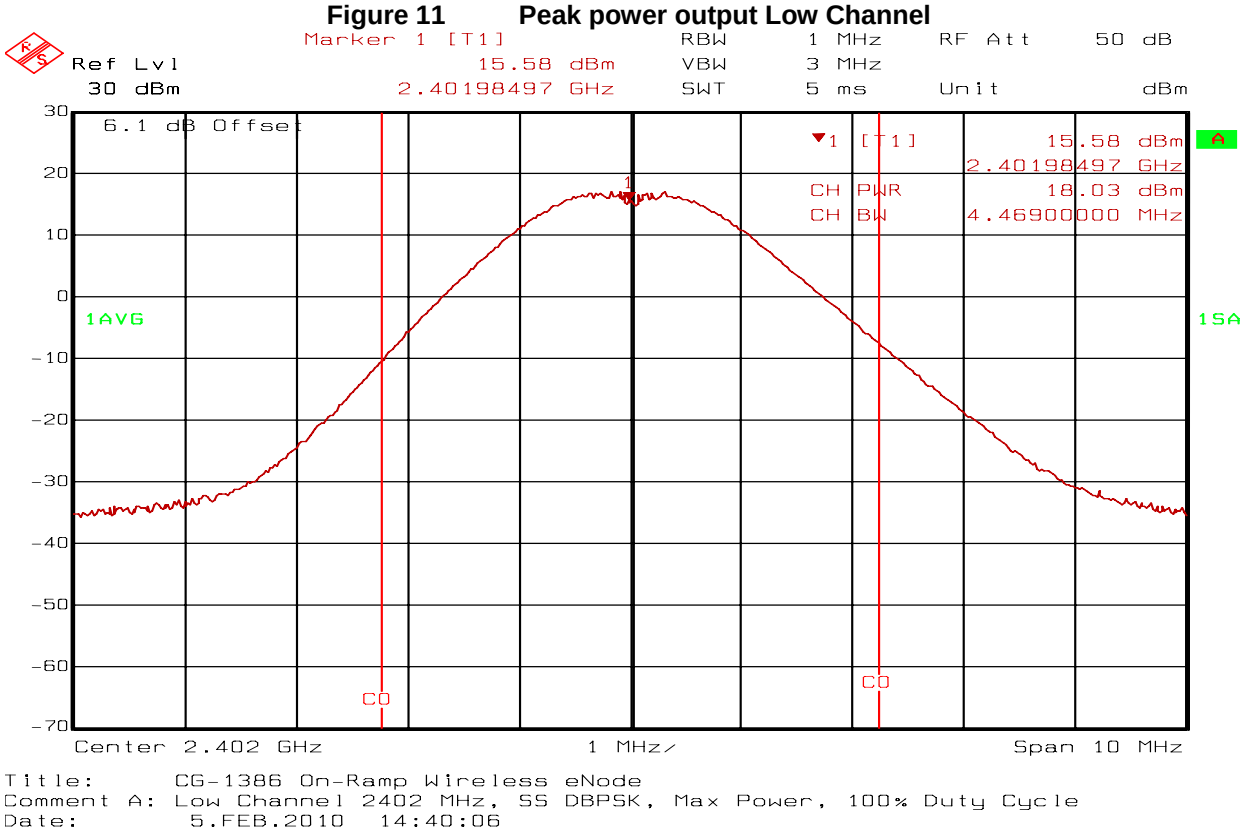
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.

Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

D.7. Test date

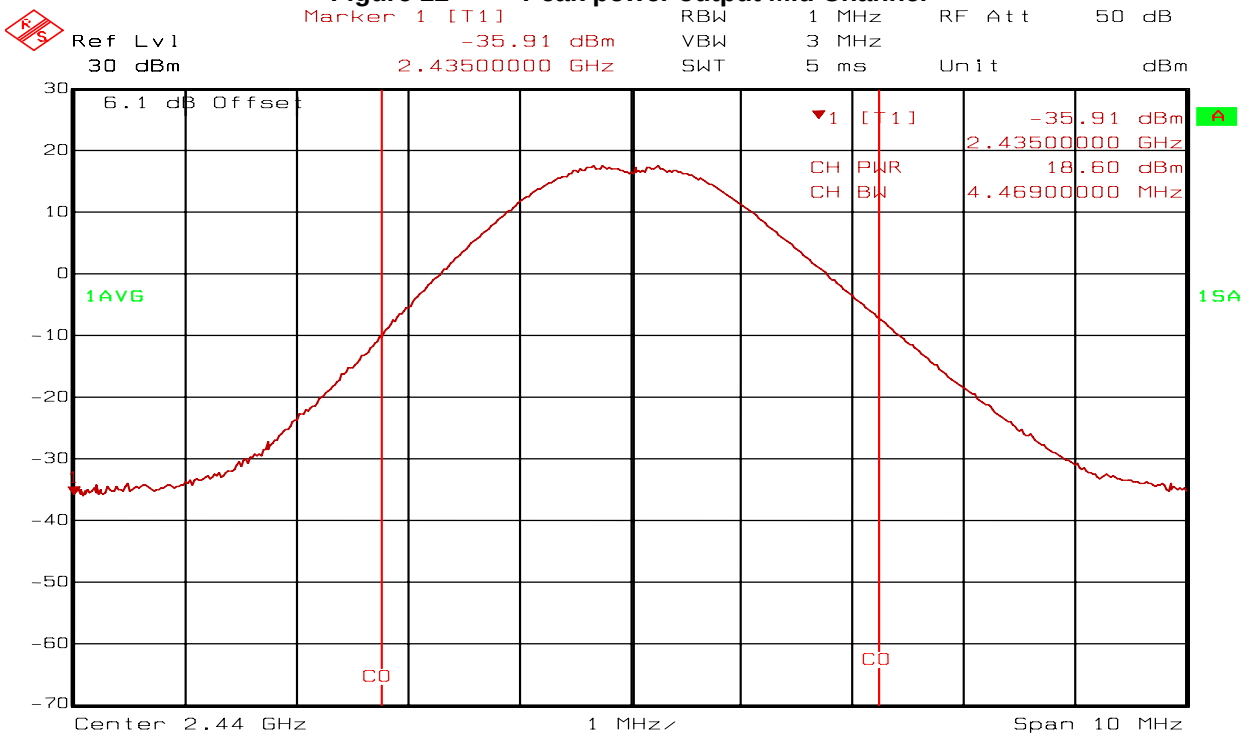
Started: February 5, 2010 Completed: February 24, 2010

Figure 11 Peak power output Low Channel



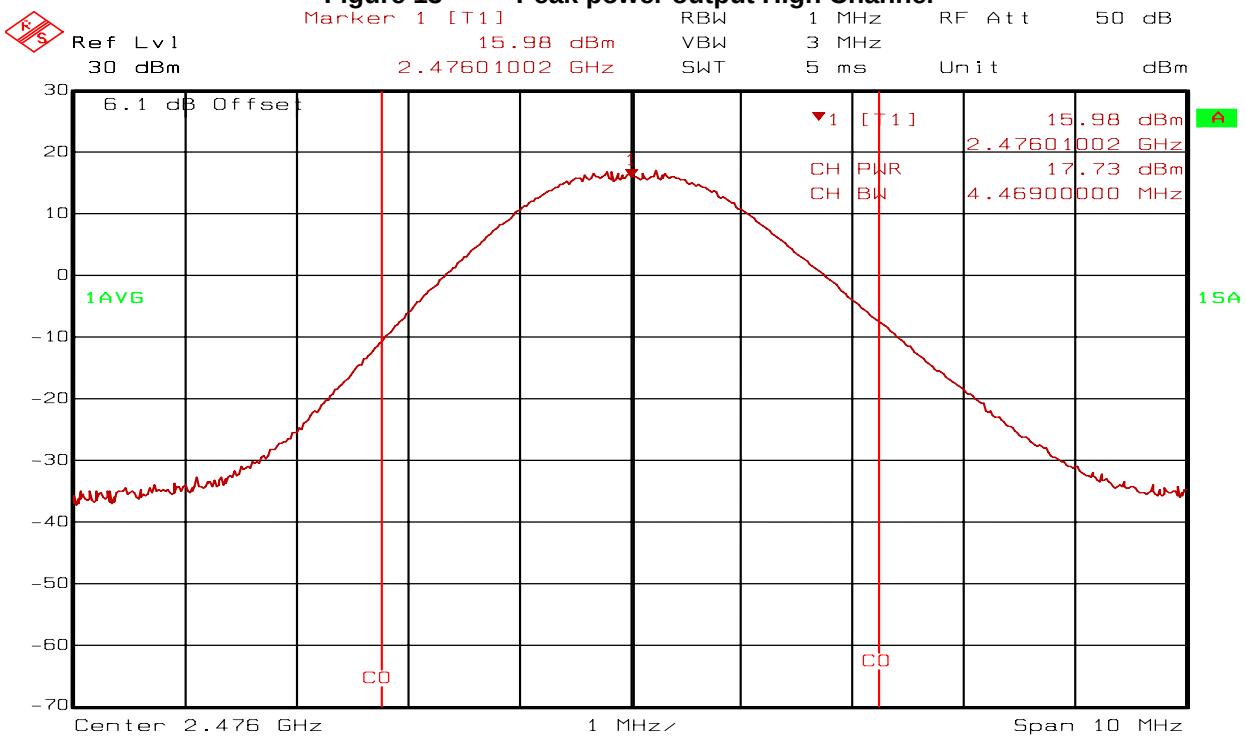
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 12 Peak power output Mid Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Mid Ch 2440 MHz, SS DBPSK, Max Power, 100% Duty Cycle
Date: 5.FEB.2010 14:41:58

Figure 13 Peak power output High Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: High Ch 2476 MHz,SS DBPSK, 100% DutyC, pwr:59
Date: 24.FEB.2010 20:15:39

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: POWER SPECTRAL DENSITY

E.1. Base Standard & Test Basis

Base Standard	FCC 15.247 (e) RSS 210 Issue 7 A8.2 (b)
Test Basis	FCC 15.247 as per ANSI C63.10 RSS 210 Issue 7 A8.2 (b)
Test Method	ANSI C63.10 and RSS 210 Issue 7 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

ANSI C63.10, 6.11.2.4

a) Set RBW = 3 kHz b) Set VBW ≥ 9 kHz c) Set Sweep time to Automatic
d) Use a peak detector. A sample detector mode can be used only if the following conditions can be achieved with automatic sweep time and adjusting the bin width.
1) Bin width (i.e., span/number of points in spectrum display) < 0.5 RBW.
2) The transmission pulse or sequence of pulses remains at maximum transmit power throughout each of the 100 sweeps of averaging and that the interval between pulses is not included in any of the sweeps.
e) Use a video trigger (or RF gating) with the trigger level set to enable the sweep only during full power pulses. Transmitter shall operate at full control power for entire sweep of every sweep. If the device transmits continuously, with no off intervals or reduced power intervals, the trigger may be set to free run.
f) Trace average 100 traces in power averaging mode. Do not use video averaging mode.

E.4. Operating Mode During Test

The EUT was tuned to a low and middle channel in continuous transmit mode at maximum rated RF output power and 100% duty cycle. Power level setting was adjusted to # 59 for high channel measurement

E.5. Test Results

Compliant. The maximum measured power spectral density was -5.49 dBm as measured conducted at the integral antenna input

E.6. Test Data Summary

Channel	Frequency (MHz)	Power Spectral Density (dBm)
Low	2402	-6.01
Mid	2440	-5.49
High	2476	-5.64

All final reported values are corrected values

E.7. Tested By

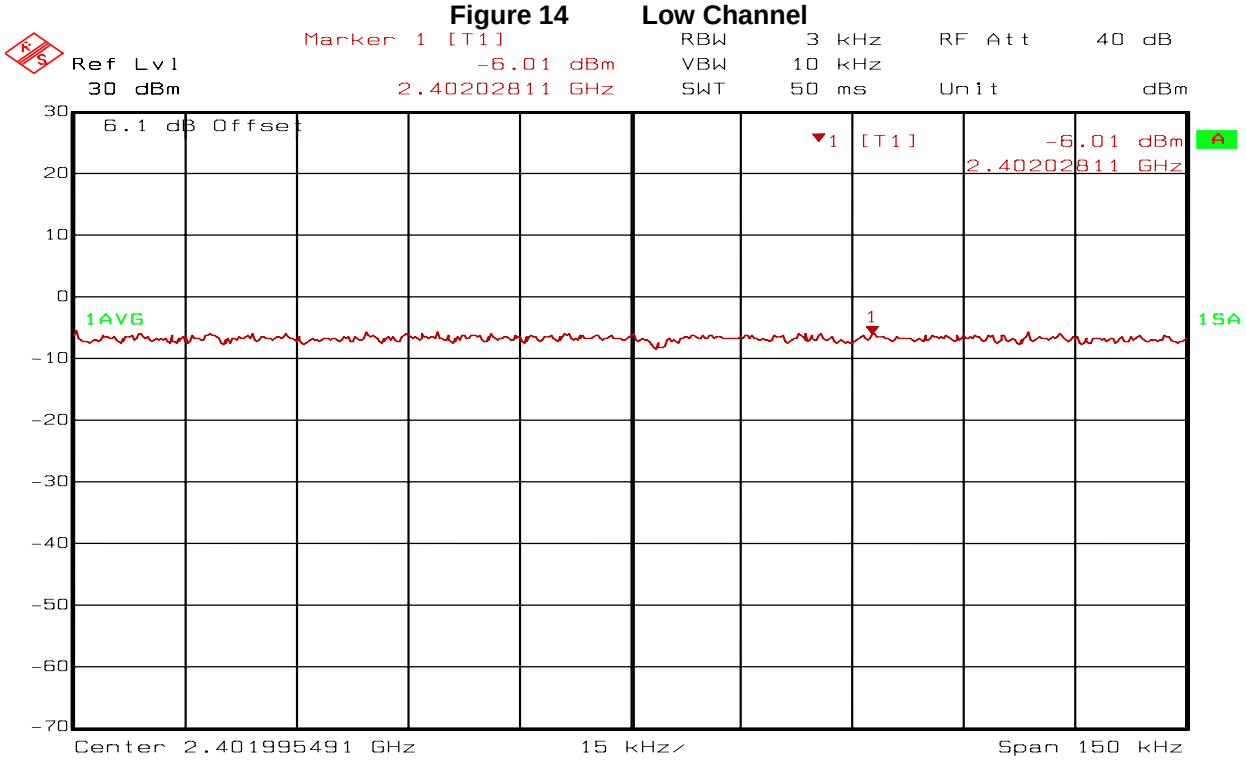
This testing was conducted in accordance with the ISO 17025:2005 scope of accreditation, table 1; Quality Manual.
Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

E.8. Test date

Started: February 3, 2010 Completed: February 24, 2010

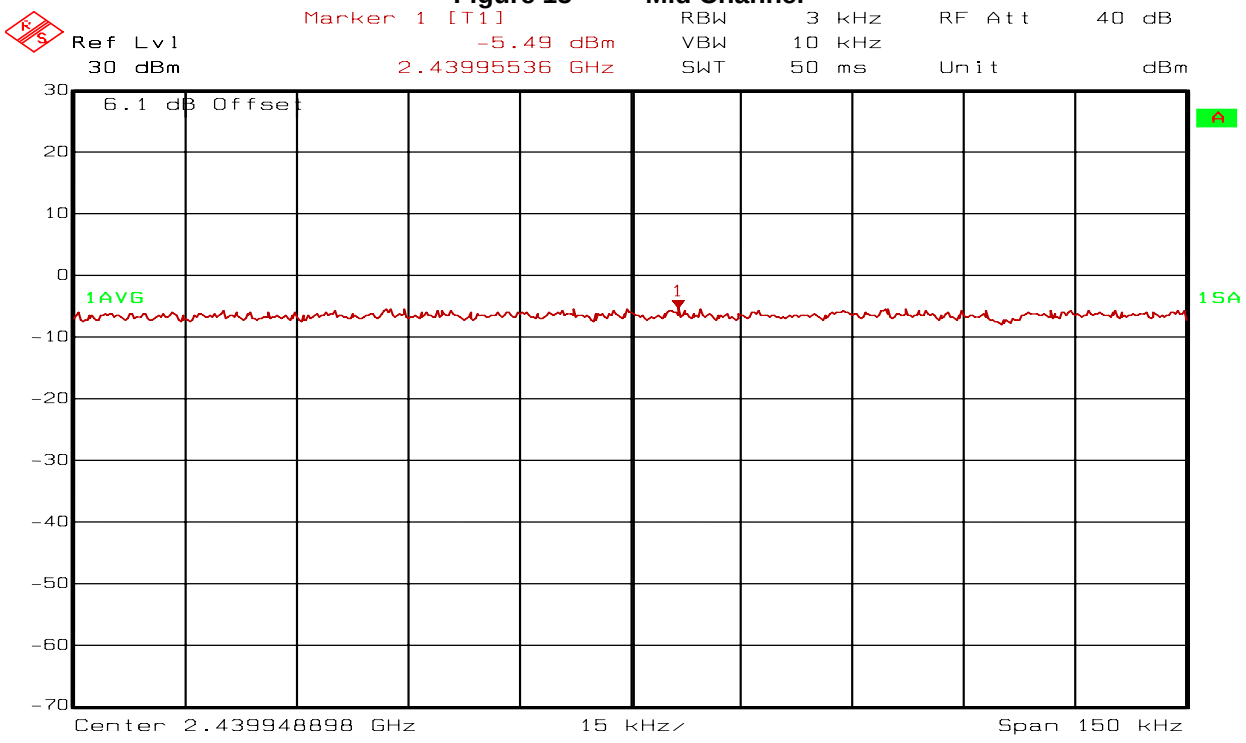
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 14 Low Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Low Channel 2402 MHz, SS DBPSK, Max Power 100% Duty cycle
Date: 3.FEB.2010 14:01:19

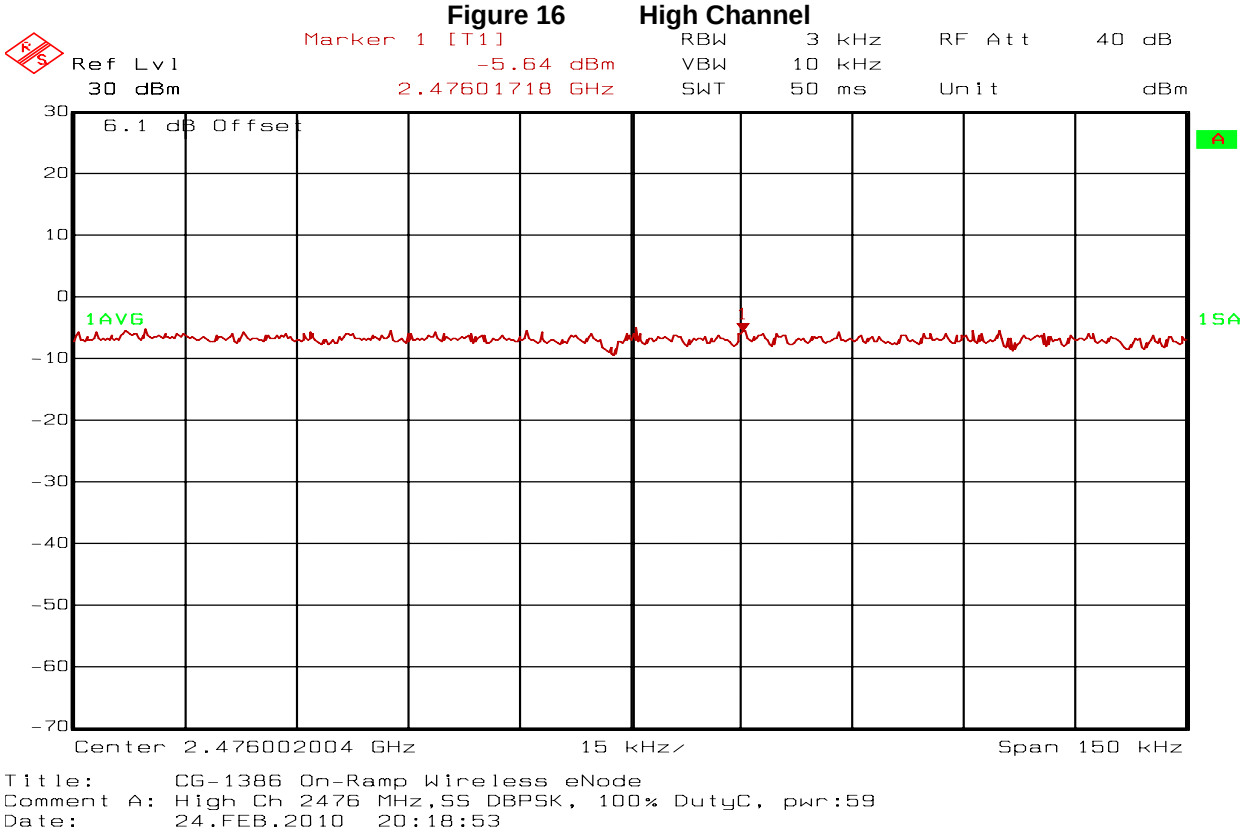
Figure 15 Mid Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Mid Channel 2440 MHz, SS DBPSK, Max Power 100% Duty cycle
Date: 3.FEB.2010 15:32:36

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 16 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 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 7 A8.5
Test Basis	RF conducted as per ANSI C63.10 RSS-210 Issue 7 A8.5
Test Method	RF conducted as per ANSI C63.10 RSS-210 Issue 7 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

ANSI C63.10

F.4. Operating Mode During Test

The EUT was tuned to a low, middle and high channel in continuous transmit mode at maximum rated RF output power with 100% duty cycle. Power level setting was adjusted to # 59 for high channel measurement

F.5. Test Results Summary

Compliant.

The worst case emission was 54.54 dB below the carrier power in low channel at 6.952 GHz

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.

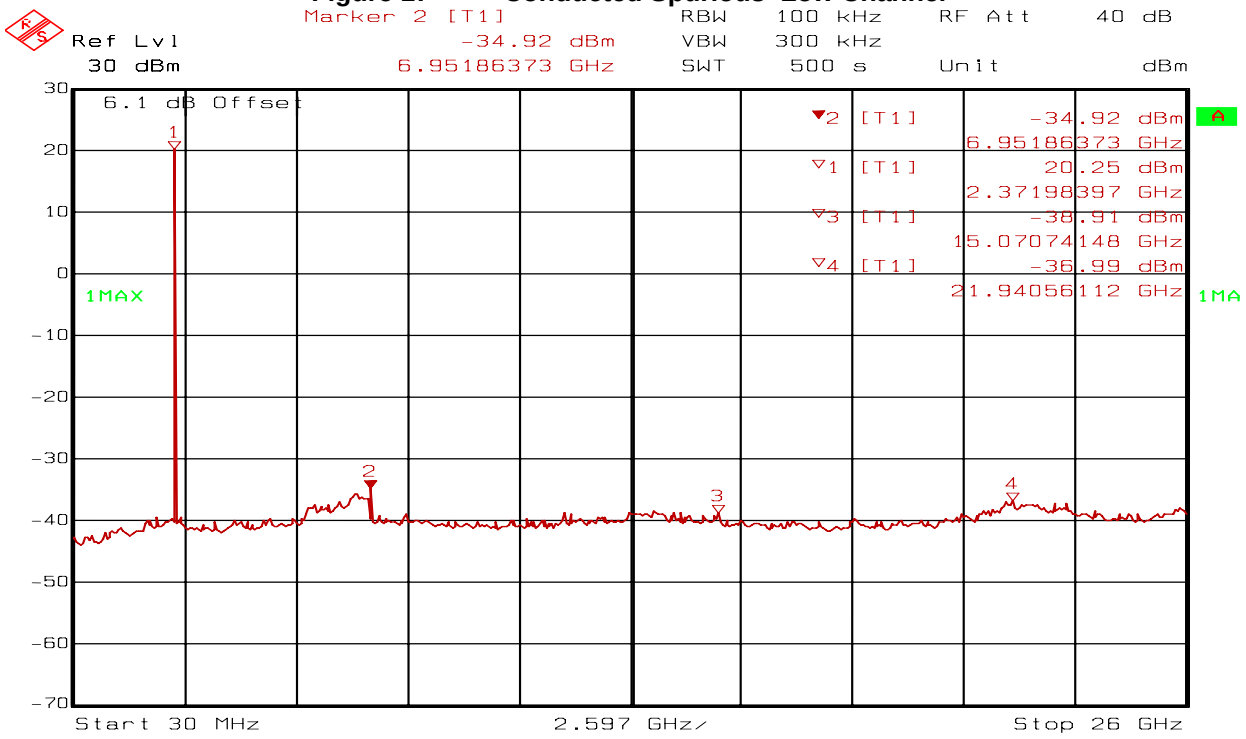
Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

F.7. Test date

Started: February 3, 2010 Completed: February 24, 2010

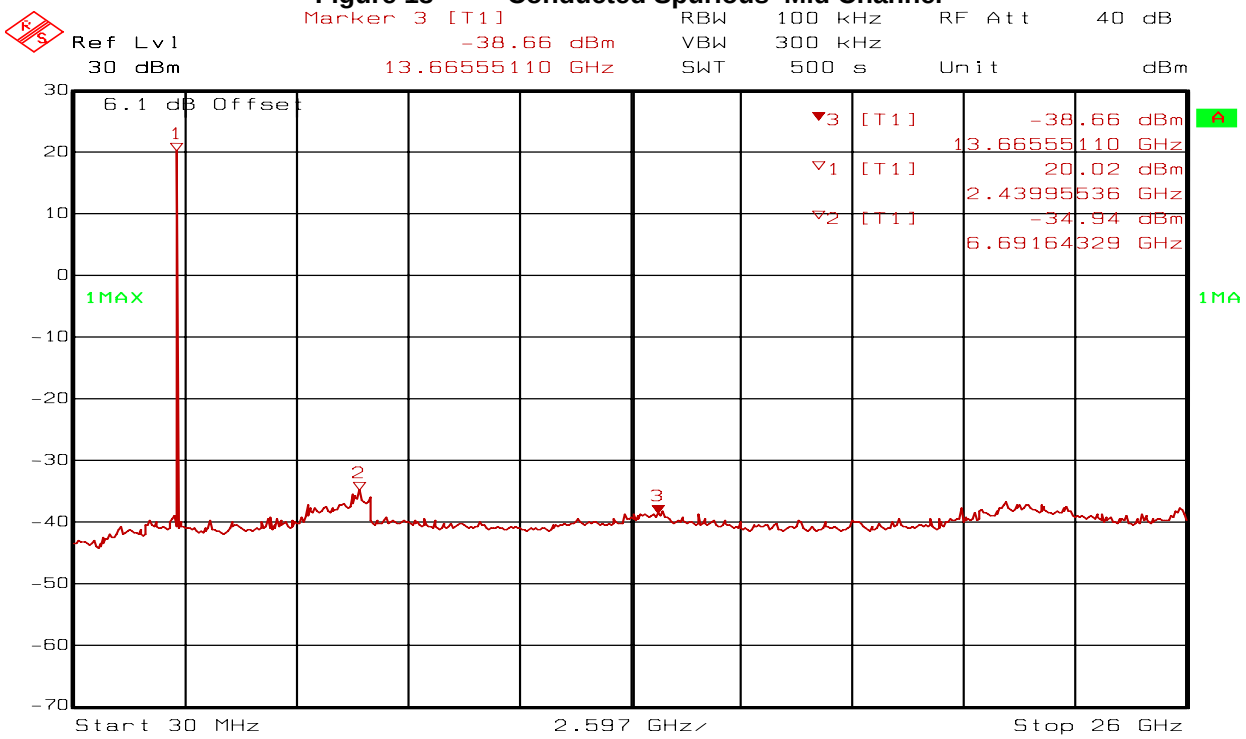
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 17 Conducted Spurious Low Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Low Channel 2402 MHz, SS DBPSK, Max Power 100% Duty cycle
Date: 3.FEB.2010 14:58:44

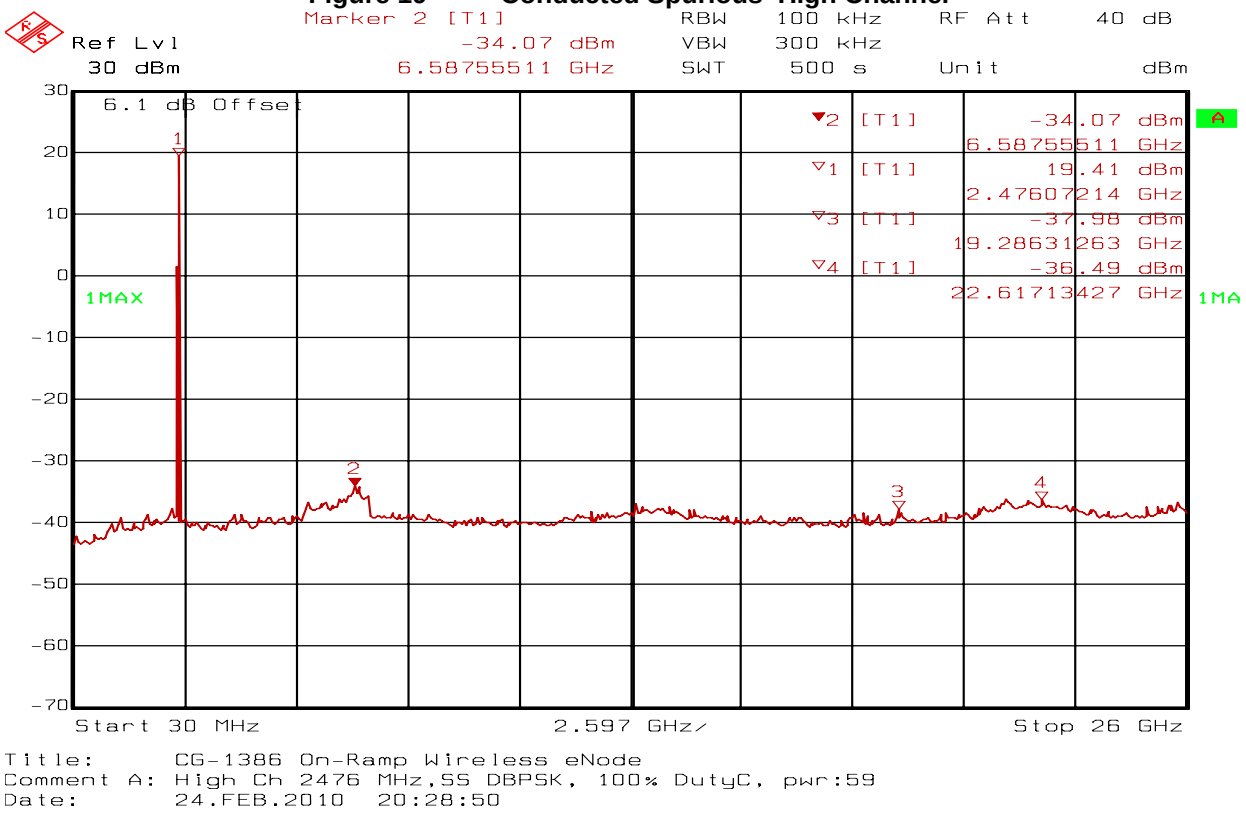
Figure 18 Conducted Spurious Mid Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Mid Channel 2440 MHz, SS DBPSK, Max Power 100% Duty cycle
Date: 3.FEB.2010 15:44:50

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.

Figure 19 Conducted Spurious 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 BAND EDGE

G.1. Base Standard & Test Basis

Base Standards	FCC CFR Title 47 – Telecommunications, Chapter I Part 15.247 (d) RSS-210 Issue 7 A8.5
Test Basis	RF conducted as per ANSI C63.10 RSS-210 Issue 7 A8.5
Test Method	RF conducted as per ANSI C63.10 RSS-210 Issue 7 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

ANSI C63.10

G.4. Operating Mode During Test

The EUT was tuned to a low and high channel in continuous transmit mode at maximum rated RF output power and maximum duty cycle. Power level setting was adjusted to # 59 for high channel measurement

G.5. Test Results

Compliant.

Channel	Frequency (MHz)	Conducted band edge (dB)
Low	2400.0	41.92
High	2483.5	59.54

Worst case spurious emission was 41.92 dB below the carrier

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.

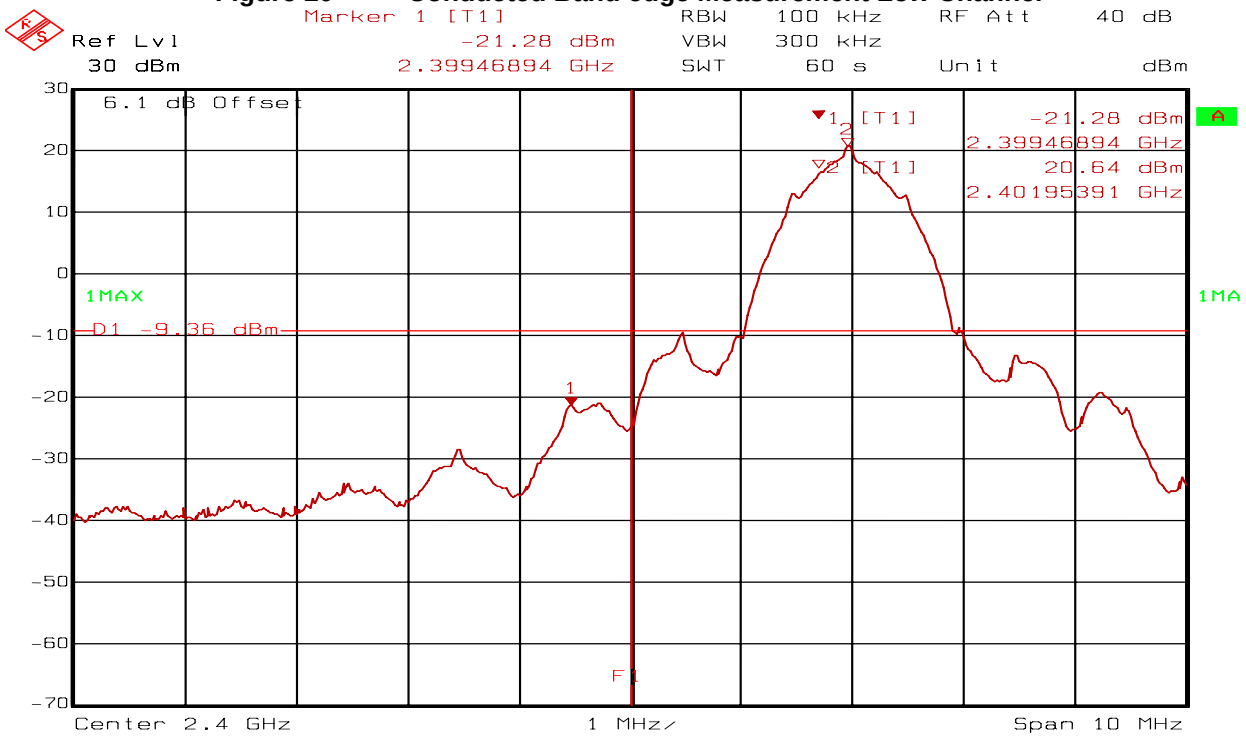
Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

G.7. Test date

Started: February 3, 2010 Completed: February 24, 2010

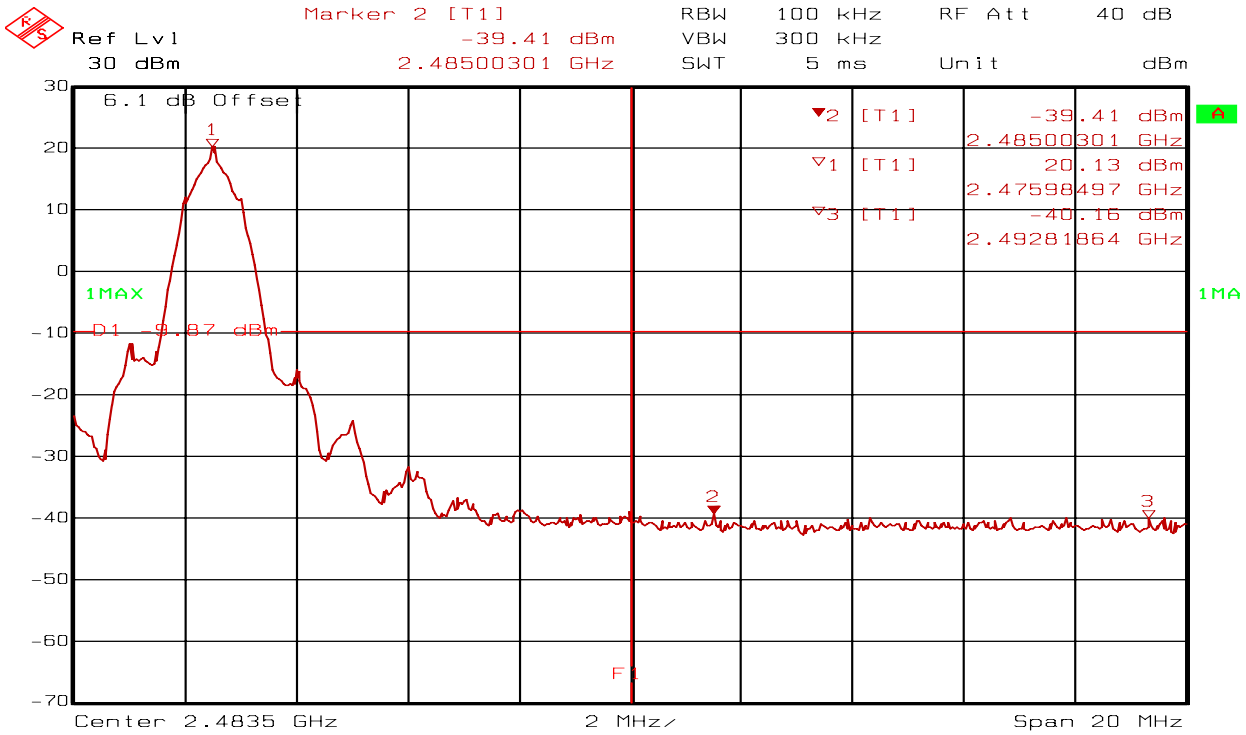
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 20 Conducted Band edge Measurement Low Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Low Channel 2402 MHz, SS DBPSK, Max Power 100% Duty cycle
Date: 3.FEB.2010 15:02:57

Figure 21 Conducted Band edge Measurement High Channel



Title: CG-1386 On-Ramp Wireless eNode
Comment A: High Ch 2476 MHz,SS DBPSK, 100% DutyC, pwr:59
Date: 24.FEB.2010 20:40:08

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: DUTY CYCLE

H.1. Base Standard & Test Basis

Base Standard	FCC 15.35 (c) RSS-Gen Issue 2 4.5
Test Basis	FCC 15.35 (c) as per ANSI C63.10 RSS-Gen Issue 2 4.5
Test Method	NTS Calgary SOP CAG EMC 02 Emission Test Methods and Zero span

H.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.

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

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

H.5. Operating Mode During Test

On-Ramp Wireless eNode normal operating mode with maximum duty cycle

H.6. Test Results

On time (2.10 second) is longer than 0.1 second
Therefore the duty cycle correction factor do not apply

H.7. Tested By

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

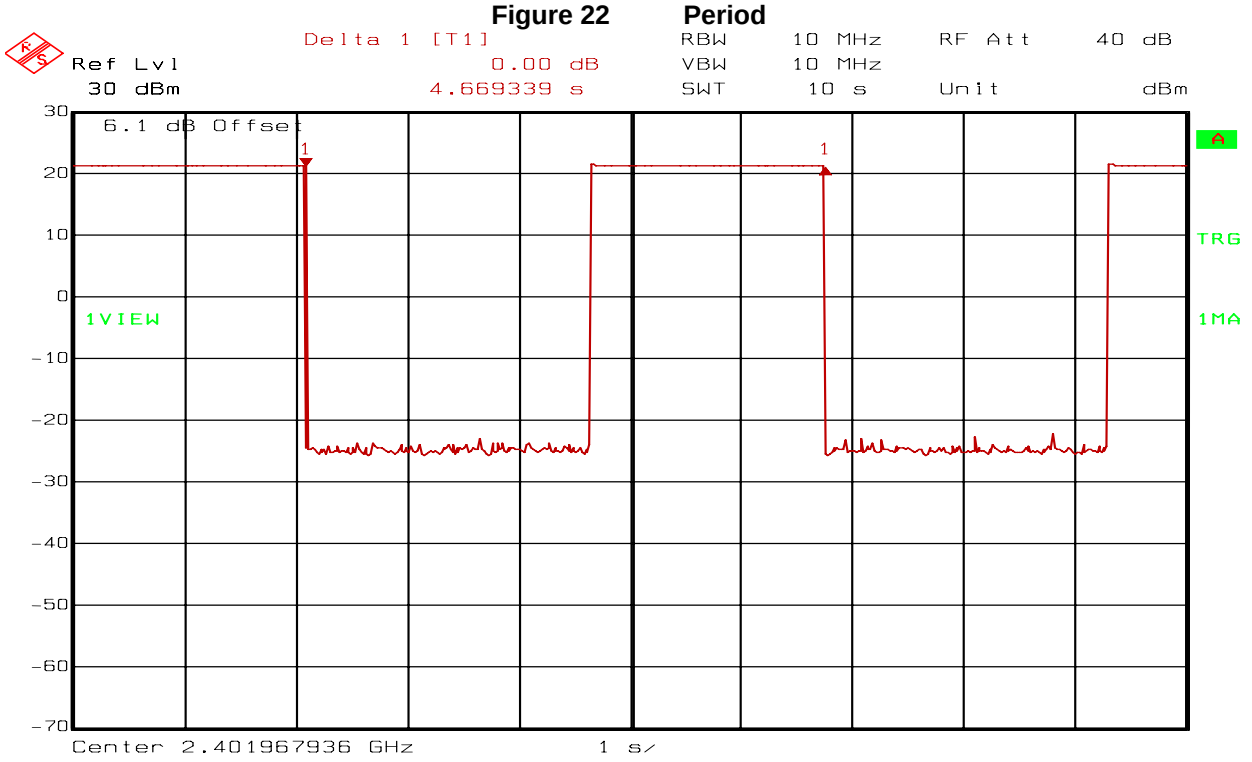
Name: Deniz Demirci
Function: Senior EMC / Wireless Technologist

H.8. Test date

February 3, 2010

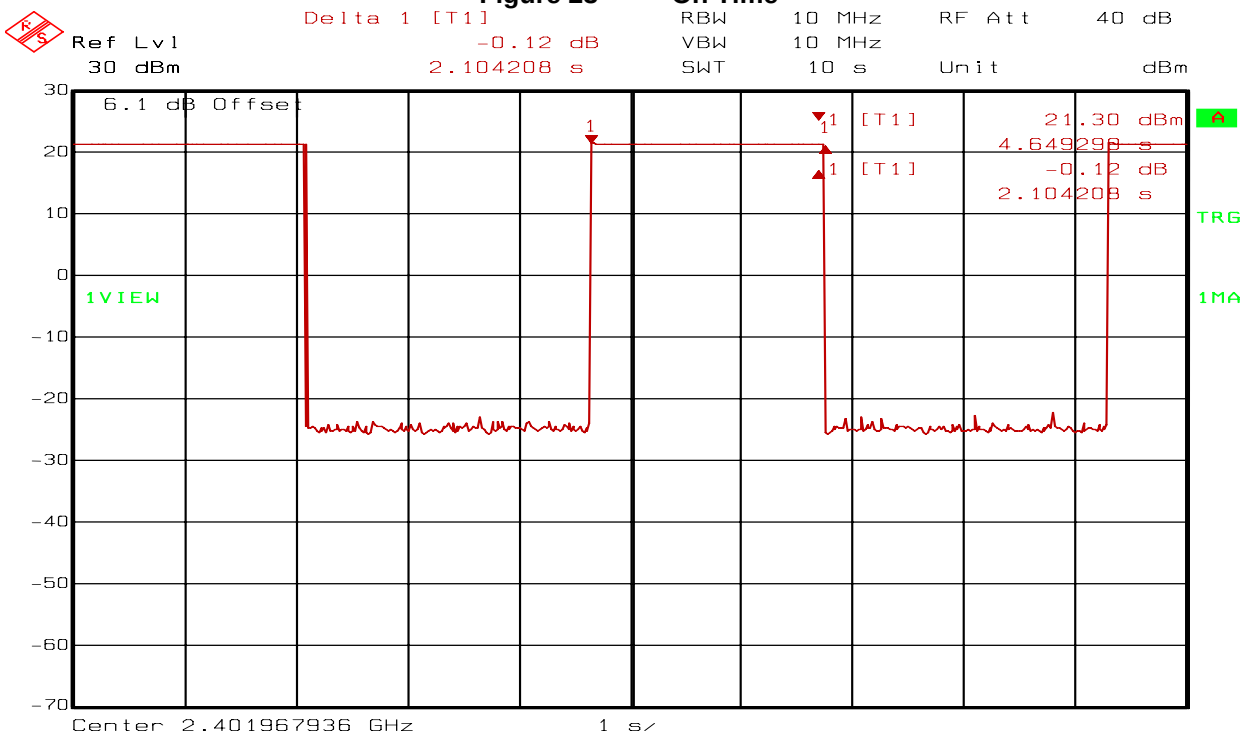
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 22 Period



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Low Channel 2402 MHz, SS DBPSK, Max Power
Date: 3.FEB.2010 10:28:59

Figure 23 On Time



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Low Channel 2402 MHz, SS DBPSK, Max Power
Date: 3.FEB.2010 10:27:56

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: 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 7 A8.5
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,
Test Method	NTS Radiated Emissions Test Method SOP-CAG-EMC-02 and ANSI C63.10

I.2. Specifications

FCC 15.205 and RSS 210 Issue 7 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.

I.3. Test Procedure

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
Marker delta method was used to correct the reading using RBW = 100 kHz and VBW = 300 kHz (Section 6.9.3 of ANSI C63.10: 2009)

I.4. Operating Mode During Test

The EUT was tested in three orthogonal orientations with three different antennas tuned to a low and high channel in continuous transmit mode at maximum rated RF output power with 100% duty cycle.
Power level setting was adjusted to # 59 for high channel measurements for all type of antennas.

I.5. Test Results

Compliant

Worst case emissions observed with the 5 dBi antenna when antenna and EUT was in horizontal orientation

Frequency (MHz)	Polarization	Measured Carrier Level (dBµV/m)	Marker Delta (dB)	Detector	Measured / Calculated level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
2390.0	Horizontal	-	-	Peak	62.80	73.98	11.18
2390.0	Horizontal	-	-	Average	49.51	53.98	4.47
2483.5	Horizontal	124.79	-65.98	Peak	58.81	73.98	15.17
2483.5	Horizontal	119.88	-65.98	Average	53.90	53.98	0.08

All final reported values are corrected values. Worst case emissions presented.

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
Measured / Calculated level (dBµV/m) = Measured carrier level (dBµV/m) - Marker Delta (dB)

I.7. Tested By

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

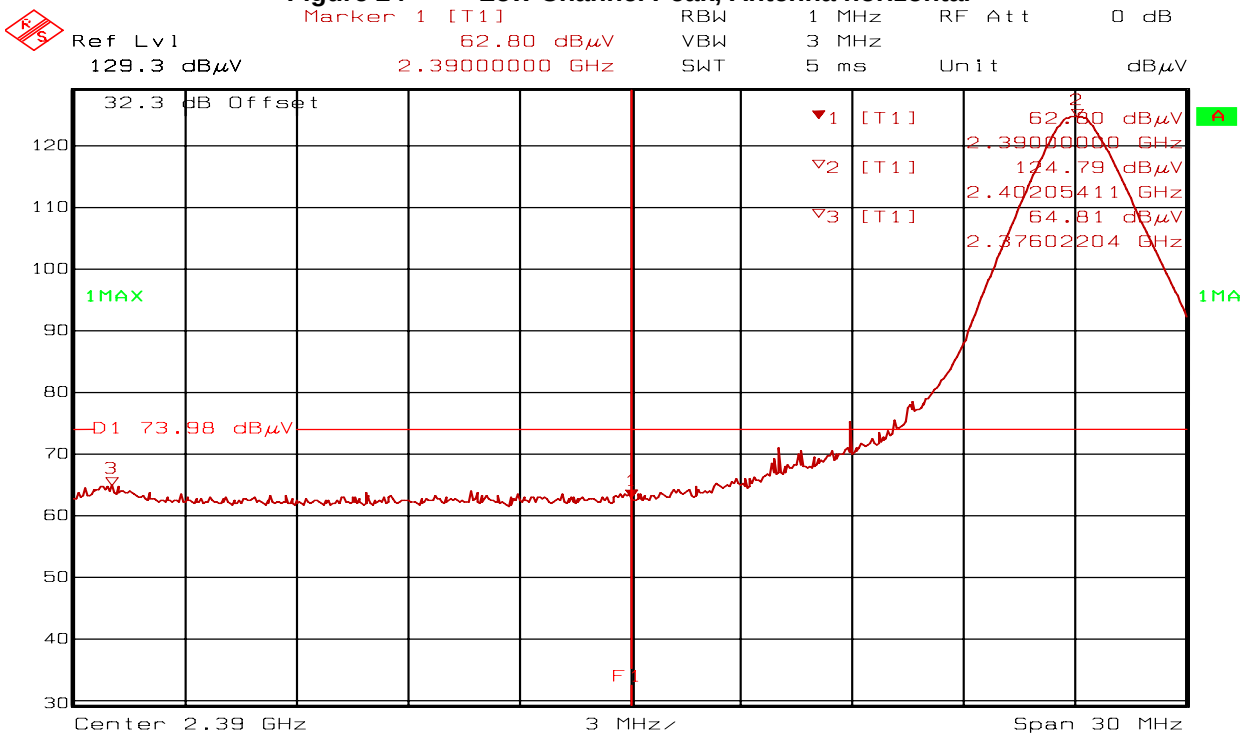
Name: Deniz Demirci
Function: Senior Wireless / EMC Technologist

I.8. Test date

Started: February 4, 2010 Completed: February 24, 2010

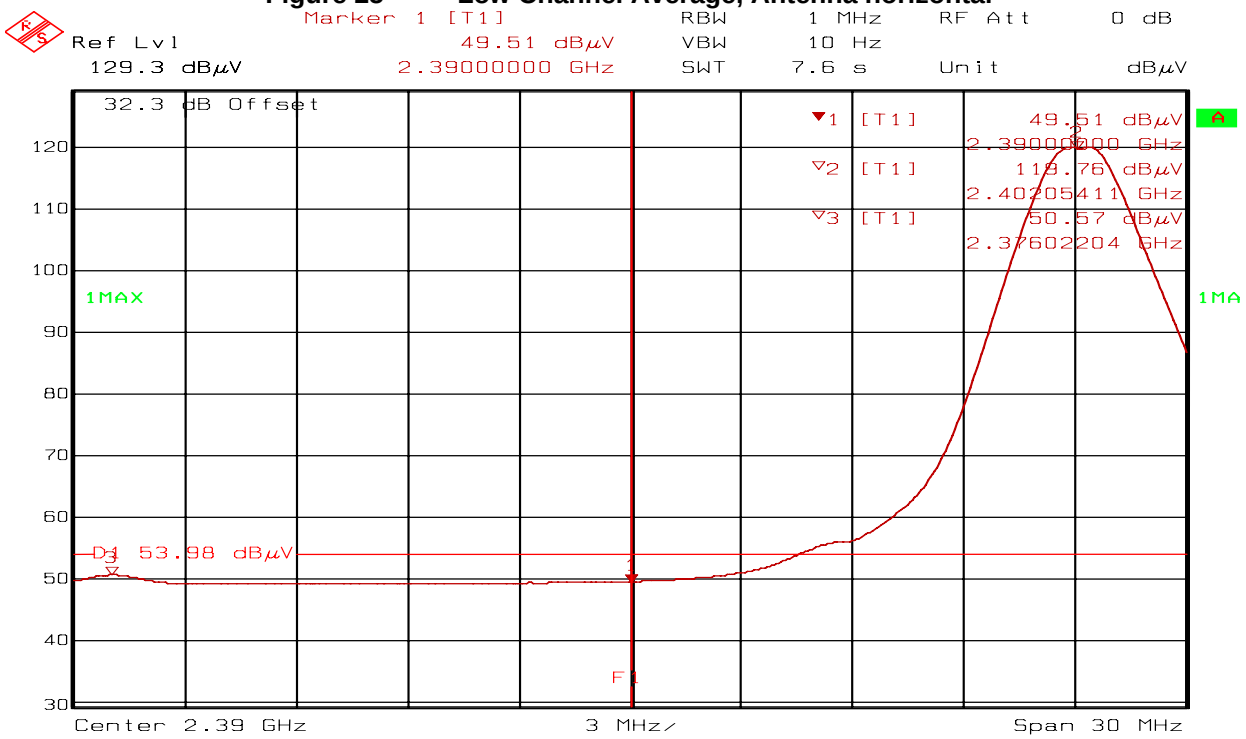
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 24 Low Channel Peak, Antenna horizontal



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Low Ch, SS DBPSK, MaxPwr 100% DutyC, 5dBi Antenna Horizontal
Date: 4.FEB.2010 9:45:18

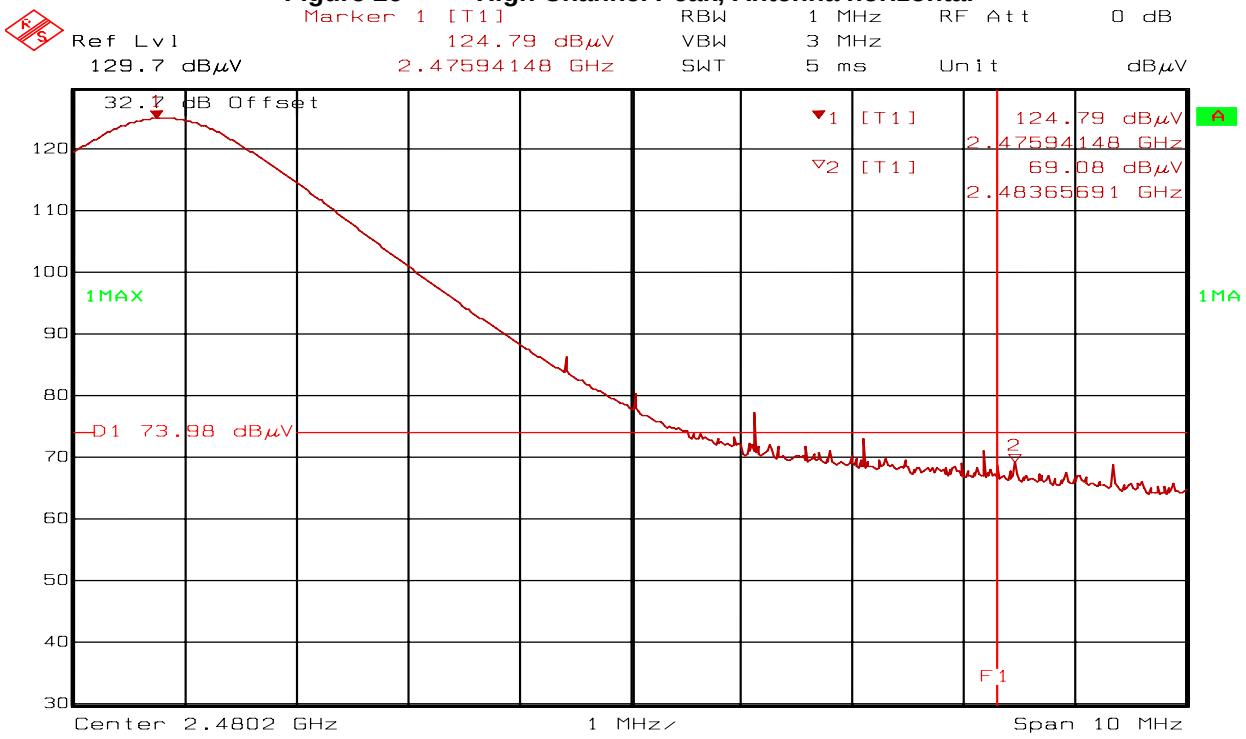
Figure 25 Low Channel Average, Antenna horizontal



Title: CG-1386 On-Ramp Wireless eNode
Comment A: Low Ch, SS DBPSK, MaxPwr 100% DutyC, 5dBi Antenna Horizontal
Date: 4.FEB.2010 9:47:07

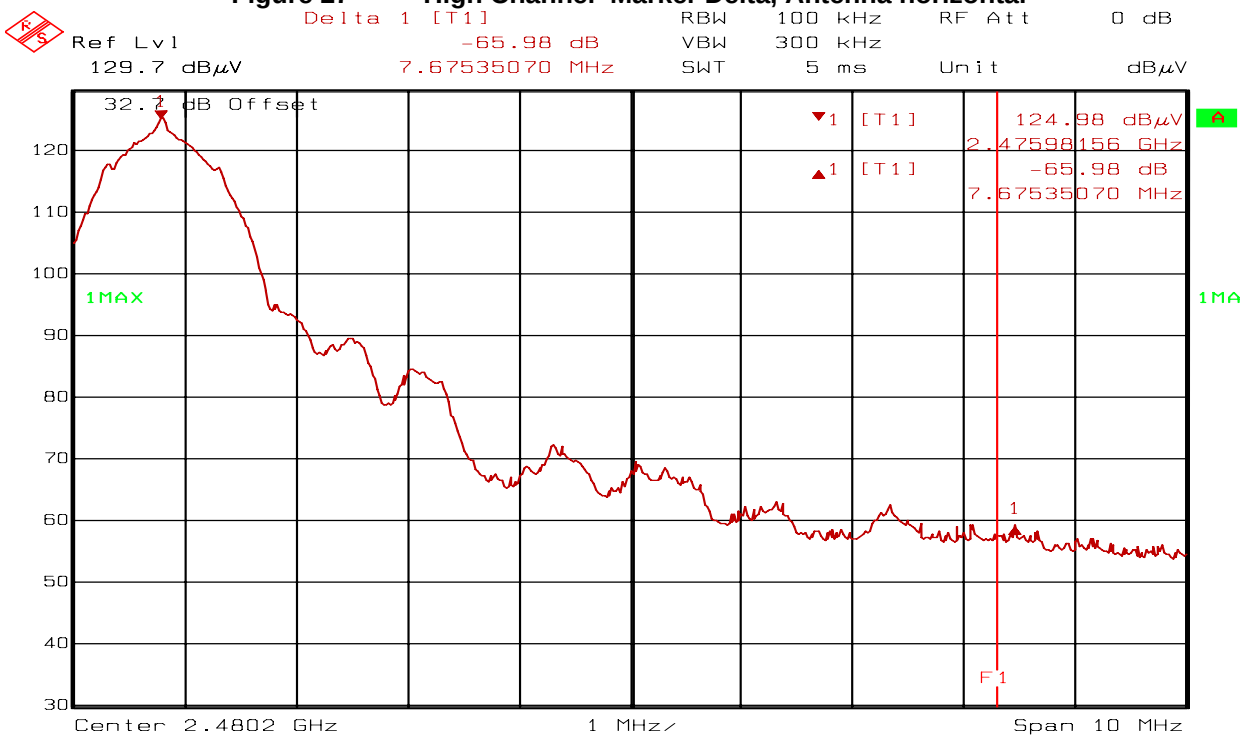
The test results contained in this report refer exclusively to the product(s) presented for testing. The test results do not cover models or products not referred herein. This test report should not be published or duplicated in whole or part without permission from the testing body and the customer.

Figure 26 High Channel Peak, Antenna horizontal



Title: CG-1386 On-Ramp Wireless eNode
Comment A: High Ch,SS DBPSK, 100% DutyC, 5dBi Antenna Horizontal pwr:59
Date: 24.FEB.2010 19:45:29

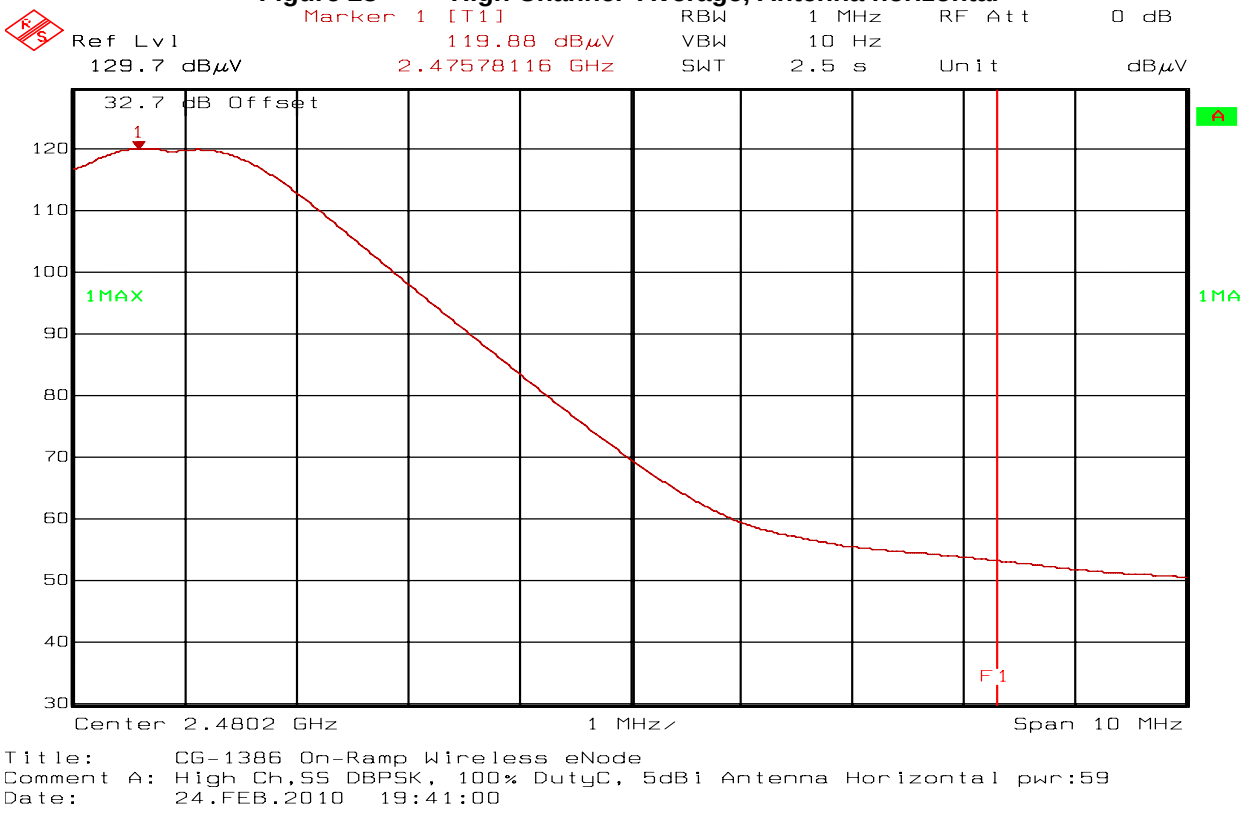
Figure 27 High Channel Marker Delta, Antenna horizontal



Title: CG-1386 On-Ramp Wireless eNode
Comment A: High Ch, SS DBPSK 100% DutyC, 5dBi Antenna Horizontal
Date: 24.FEB.2010 18:29:41

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 28 High Channel Average, Antenna horizontal



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 (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 7 2.6 and A8.5 RSS Gen Issue 2 4.10 and 7.2.3 Receiver Spurious Emission
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, ANSI C63.10
Test Method	NTS Radiated Emissions Test Method SOP-CAG-EMC-02 and ANSI C63.10

J.2. Specifications

FCC 15.205 and RSS 210 Issue 7 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.

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J.3. Test Procedure

J.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

J.3.2 RSS Gen Issue 2, 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.

Spurious Emission Limits for Receivers

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

J.4. Operating Mode During Test

The EUT was tested in three orthogonal orientations with three different antennas tuned to a low, mid and high channel in continuous transmit mode at maximum rated RF output power with 100% duty cycle
Power level was adjusted to # 59 for high channel measurements for all type of antennas.
Worst case emissions below observed with the 5 dBi antenna

For Rx spurious emissions: The EUT was tuned to receive only mode in mid channel with three different antennas

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J.5. Test Results

Pass, Worst case results reported

J.5.1 Rx mode

There were no measurable emissions observed in Rx mode.

Maximum measured peak noise floor was 44.89 dBµV/m at 7450 MHz with RBW= 1 MHz, VBW= 3 MHz
Which has 9.09 dB margin to the RSS Gen Issue 2, 4.10 Receiver Spurious Emission Average limit

J.5.2 TX Mode

Channel	Frequency (MHz)	Polarization	Detector	Measured level (dBµV/m)	Limit (dBµV/m)	Margin (dB)
Low	4803.92	Horizontal	Peak	54.93	73.98	19.05
	4804.09	Horizontal	Average	48.81	53.98	5.17
	4803.91	Vertical	Peak	50.03	73.98	23.95
	4804.02	Vertical	Average	42.83	53.98	11.15
Mid	4880.11	Horizontal	Peak	52.04	73.98	21.94
	4880.11	Horizontal	Average	45.79	53.98	8.19
	4879.86	Vertical	Peak	55.33	73.98	18.65
	4880.07	Vertical	Average	50.65	53.98	3.33
High	4952.03	Horizontal	Peak	52.76	73.98	21.22
	4952.07	Horizontal	Average	46.13	53.98	7.85
	4952.01	Vertical	Peak	55.16	73.98	18.82
	4952.09	Vertical	Average	51.40	53.98	2.58

Worst case spurious emissions were observed with 5 dBi antenna with antenna and EUT were in horizontal positions on the table

Worst case peak spurious emission was 51.40 dBµV/m at 4952.09 MHz vertical polarization in high channel. It has 2.58 dB margin to the average limit.

Note:

Plots were not provided in order to reduce file size

J.6. 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

J.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

J.8. Test date

Started: February 4, 2010, Completed: February 24, 2010

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APPENDIX K: TEST EQUIPMENT LIST

Type	Manufacturer	Model	Asset #	Cal Due	Cal Date
Bilog Antenna	Teseq	CBL 6112B	CG0314	21SEP10	29OCT08
Horn Antenna (Rx) 1 GHz – 18 GHz	EMCO	3115	CG0103	06MAR11	30SEP08
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	CG0317	01DEC10	01DEC08
LNA 18GHz < f < 26.5GHz	Miteq	JSD00119	CG0482	02OCT11	02OCT09
High pass filter f > 1000 MHz	MicroTronics	HPM14576	CG0963	01DEC10	01DEC08
High pass filter f > 2800 MHz	MicroTronics	HPM50111	CG0964	N/A	N/A
Spectrum Analyzer 9 kHz – 40 GHz	Rohde & Schwarz	FSEK-20	CG0118	06AUG10	06AUG09
Test Receiver	Rohde & Schwarz	ESMI	CG0433 CG0434	04MAY10	04MAY09
Table Top LISN	EMCO	3825	CG0367	29JAN11	29JAN09
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.

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END OF DOCUMENT

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