

Dust Networks

TEST REPORT FOR

2.4GHz Wireless Mote, M2510

Tested To The Following Standards:

FCC Part 15 Subpart C Sections 15.247 and RSS-210 Issue 8

Report No.: 91302-12

Date of issue: February 9, 2011



TESTING
CERT #803.01, 803.02,
803.05, 803.06

This test report bears the accreditation symbol indicating that the testing performed herein meets the test and reporting requirements of ISO/IEC 17025 under the applicable scope of EMC testing for CKC Laboratories, Inc.

We strive to create long-term, trust based relationships by providing sound, adaptive, customer first testing services. We embrace each of our customers' unique EMC challenges, not as an interruption to set processes, but rather as the reason we are in business.

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Dust Networks
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REPORT PREPARED BY:

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Project Number: 91302

DATE OF EQUIPMENT RECEIPT:

January 23, 2011

DATE(S) OF TESTING:

January 23-29, 2011

Report Authorization

The test data contained in this report documents the observed testing parameters pertaining to and are relevant for only the sample equipment tested in the agreed upon operational mode(s) and configuration(s) as identified herein. Compliance assessment remains the client's responsibility. This report may not be used to claim product endorsement by A2LA or any government agencies. This test report has been authorized for release under quality control from CKC Laboratories, Inc.

A handwritten signature in black ink that reads "Steve Behm".

Steve Behm
Director of Quality Assurance & Engineering Services
CKC Laboratories, Inc.

Test Facility Information



Our laboratories are configured to effectively test a wide variety of product types. CKC utilizes first class test equipment, anechoic chambers, data acquisition and information services to create accurate, repeatable and affordable test results.

TEST LOCATION(S):
CKC Laboratories, Inc.
22116 23rd Drive, S.E. Suite A
Bothell WA, 98021-4413

Site Registration & Accreditation Information

Location	CB #	Japan	Canada	FCC
Bothell	US0081	R-2296, C-2506, T-1489 & G-284	3082C-1	318736

SUMMARY OF RESULTS

Standard / Specification: FCC Part 15 Subpart C 15.247 and RSS-210 Issue 8

Description	Test Procedure/Method	Results
6dB Bandwidth	FCC Part 15 Subpart C Section 15.247(a)(2) / KDB 558074	Pass
RF Power Output	FCC Part 15 Subpart C Section 15.247(b)(3) / KDB 558074	Pass
Conducted Spurious Emissions	FCC Part 15 Subpart C Section 15.247(d) / KDB 558074	Pass
Radiated Spurious Emissions	FCC Part 15 Subpart C Section 15.247(d) / KDB 558074	Pass
Peak Power Spectral Density	FCC Part 15 Subpart C Section 15.247(e) / KDB 558074	Pass
99% Bandwidth	RSS-210 Issue 8	Pass

Conditions During Testing

This list is a summary of the conditions noted for or modifications made to the equipment during testing.

Summary of Conditions
None

EQUIPMENT UNDER TEST (EUT)

The following model has been tested by CKC Laboratories: **M2510**

The manufacturer states that the following additional model is identical electrically to the one which was tested, or any differences between them do not affect their EMC characteristics, and therefore they meet the level of testing equivalent to the tested model: **M2140**

EQUIPMENT UNDER TEST

2.4 GHz Wireless Mote

Manuf: Dust Networks
Model: M2510
Serial: NA
FCC ID: SJC-M2140

2dBi Antenna

Manuf: NA
Model: NA
Serial: NA

PERIPHERAL DEVICES

The EUT was tested with the following peripheral device(s):

TTL Converter

Manuf: B&B Electronics
Model: 232LPTTL33
Serial: 0069810016

Laptop

Manuf: Dell
Model: Inspiron 600m
Serial: NA

FCC PART 15 SUBPART C

This report contains EMC emissions test results under United States Federal Communications Commission (FCC) 47 CFR 15C requirements for Unlicensed Radio Frequency Devices, Subpart C - Intentional Radiators.

15.247(a)(2)6dB Bandwidth

Test Setup

Temp: 21°C
Humidity: 34%
Pressure: 102.4kPa
Frequency Range: 2405-2475MHz
RBW: 100 kHz
VBW: 300 kHz
Sweep: Auto

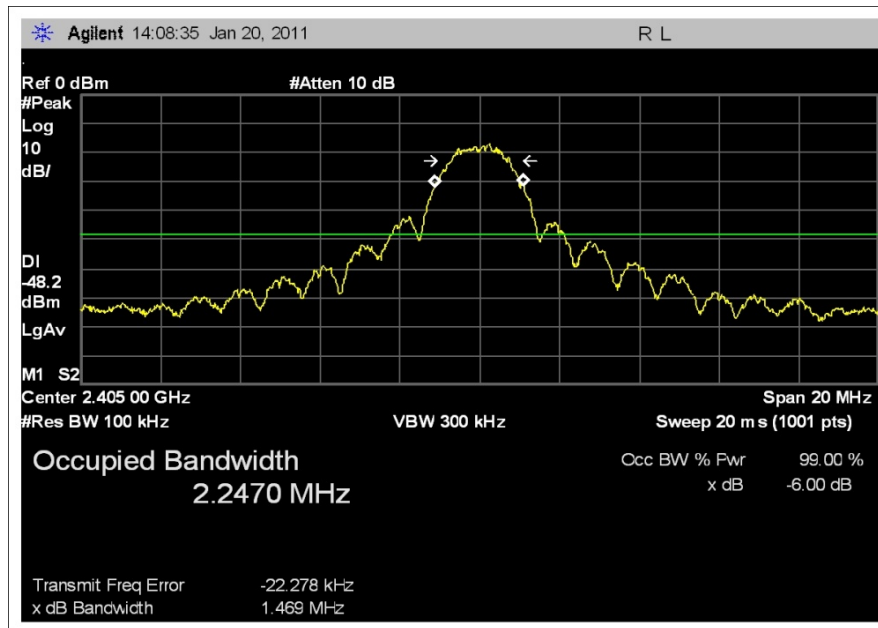
EUT's antenna port is connected to the Spectrum analyzer through a cable and a 20dB attenuator.
EUT is connected to the support laptop through a TTL RS232 adaptor.
Support laptop is setting the EUT in the proper mode (TX) and channels:
LOW: 2405MHz
MID: 2440MHz
HIGH: 2475MHz

Engineer Name: A. del Angel

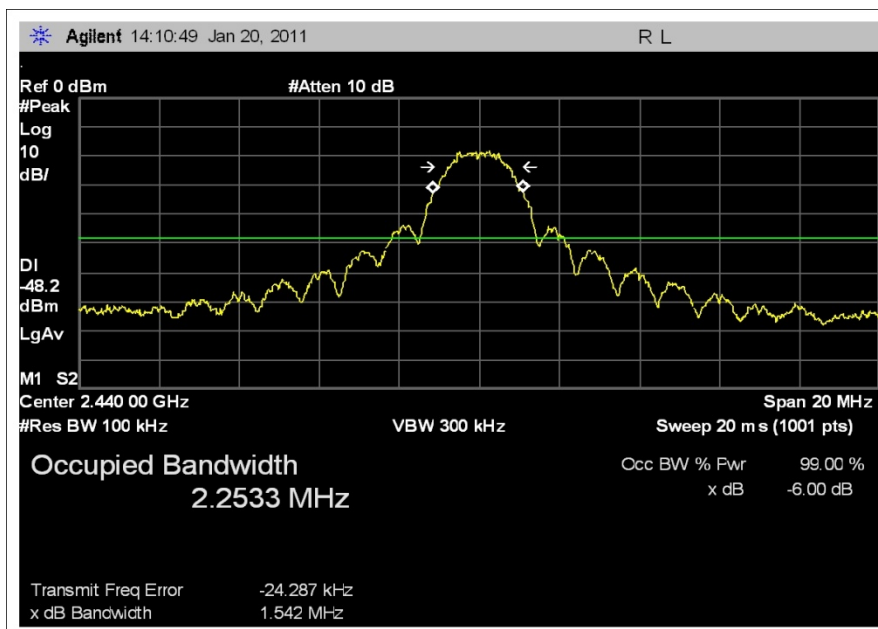
Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
02872	Spectrum Analyzer	E4440A	Agilent	8/25/2009	8/25/2011
P05747	Attenuator	PE7004-20	Pasternack	3/18/2010	3/18/2012
03121	Cable	32026-2-29080-84	Astrolab	10/23/2009	10/23/2011

Test Data

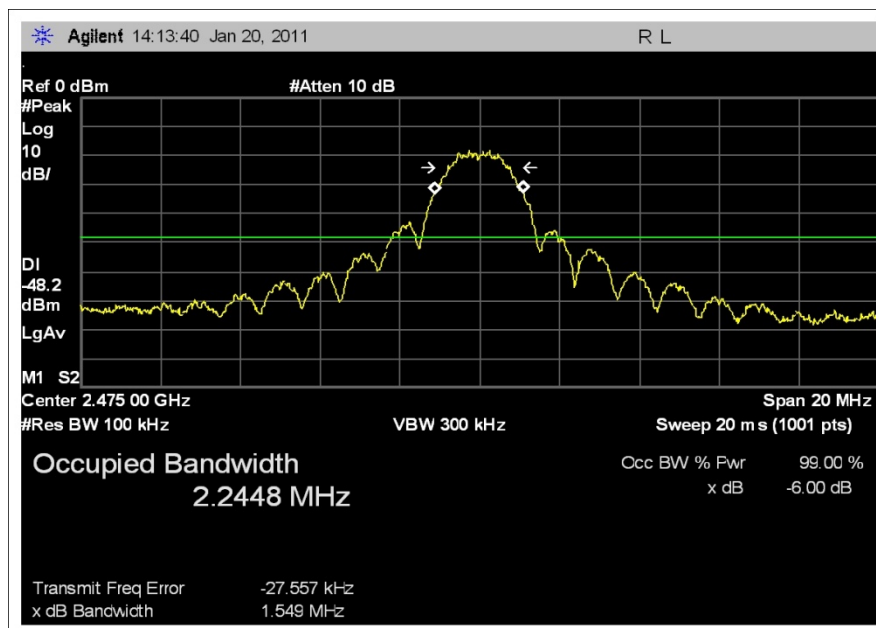
Frequency (MHz)	6dB Bandwidth (kHz)	15.247(a)(2)Limit	Result
2405	1469	>500kHz	Pass
2440	1542	>500kHz	Pass
2475	1549	>500kHz	Pass



Low



Mid



High

Test Setup Photos





15.247(b)(3) RF Power Output

Test Setup

Temp: 21°C
 Humidity: 34%
 Pressure: 102.4kPa
 Frequency Range: 2405-2475MHz
 RBW: 3MHz
 VBW: 8MHz
 Sweep: Auto

EUT's antenna port is connected to the Spectrum analyzer through a cable and a 20dB attenuator.
 EUT is connected to the support laptop through a TTL RS232 adaptor.
 Test is being performed with a fresh battery to satisfy FCC15.31 (e) voltage variations on power.
 Support laptop is setting the EUT in the proper mode (TX) and channels:
 LOW: 2405MHz
 MID: 2440MHz
 HIGH: 2475MHz

Engineer Name: A. del Angel

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
02872	Spectrum Analyzer	E4440A	Agilent	8/25/2009	8/25/2011
P05747	Attenuator	PE7004-20	Pasternack	3/18/2010	3/18/2012
03121	Cable	32026-2-29080-84	Astrolab	10/23/2009	10/23/2011

Test Data

Frequency (MHz)	RF Output Power (dBm)	15.247(b)(3)Limit	Result
2405	7.2	30dBm	Pass
2440	6.6	30dBm	Pass
2475	6.4	30dBm	Pass

Test Setup Photos





15.247(d) Conducted Spurious Emissions

Test Data Sheets

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717

Customer: **Dust Networks**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **91269** Date: 1/23/2011
 Test Type: **Conducted Emissions** Time: 12:18:24
 Equipment: **2.4 GHz Wireless Mote** Sequence#: 1
 Manufacturer: Dust Networks Tested By: Armando del Angel
 Model: M2510 3Vdc
 S/N: NA

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN03121	Cable	32026-2-29080-84	10/23/2009	10/23/2011
	AN02872	Spectrum Analyzer	E4440A	8/25/2009	8/25/2011
T2	ANP05747	Attenuator	PE7004-20	3/18/2010	3/18/2012

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2510	NA
2dBi Antenna	NA	NA	NA

Support Devices:

Function	Manufacturer	Model #	S/N
TTL Converter	B&B Electronics	232LPTTL33	0088525046
Laptop	Dell	Inspiron 600m	NA

Test Conditions / Notes:

Temperature: 21°C
 Humidity: 34%
 Pressure: 102.1kPa
 Freq. Range: 9kHz - 26000MHz
 RBW: 100kHz
 VBW: 300kHz
 Sweep: Auto
 Mode: TX

EUT is connected to the support laptop through a TTL Converter.
 The TTL converter is connected to the support laptop through a RS233 (serial) cable.
 Support laptop is setting the EUT in the proper mode and channels:
 LOW = 2405MHz
 MID = 2440MHz
 HIGH = 2475MHz

Ext Attn: 0 dB

Measurement Data:

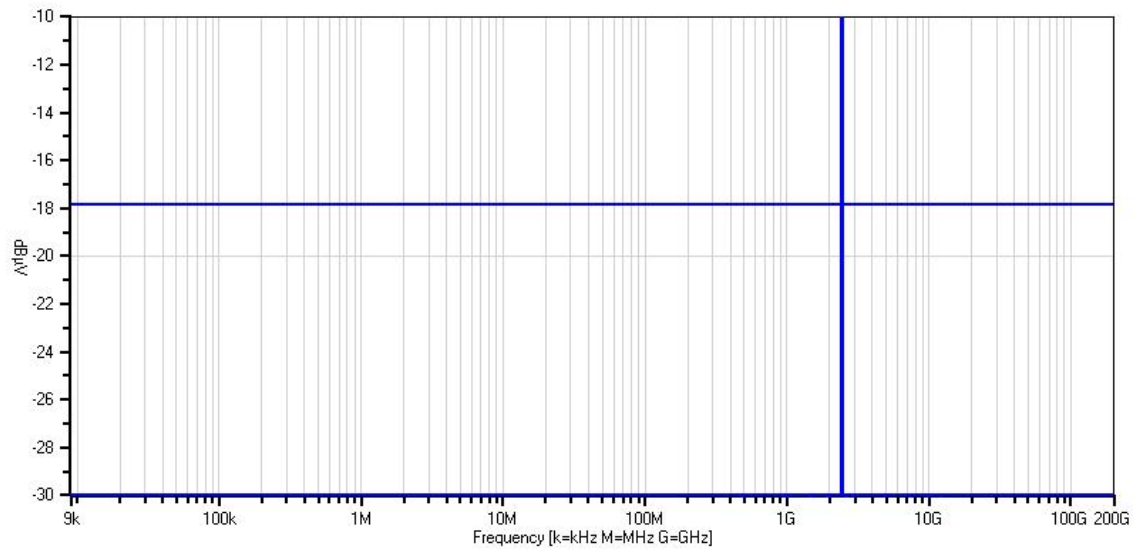
Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB			Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2405.200M Ambient	-18.2	+1.3	+20.1			+0.0	3.2	-17.8 Fundamental	+21.0	Anten
2	2440.220M Ambient	-19.2	+1.3	+20.1			+0.0	2.2	-17.8 Fundamental	+20.0	Anten
3	2475.200M Ambient	-19.2	+1.3	+20.1			+0.0	2.2	-17.8 Fundamental	+20.0	Anten
4	1979.988M	-57.4	+1.2	+20.2			+0.0	-36.0	-17.8 HIGH	-18.2	Anten
5	1951.987M	-58.4	+1.2	+20.2			+0.0	-37.0	-17.8 MID	-19.2	Anten
6	1923.986M	-59.4	+1.2	+20.2			+0.0	-38.0	-17.8 LOW	-20.2	Anten
7	7321.460M	-61.4	+2.4	+20.3			+0.0	-38.7	-17.8 MID	-20.9	Anten
8	7213.480M	-61.6	+2.5	+20.3			+0.0	-38.8	-17.8 LOW	-21.0	Anten
9	7318.580M	-62.2	+2.4	+20.3			+0.0	-39.5	-17.8 MID	-21.7	Anten
10	7216.360M	-63.0	+2.5	+20.3			+0.0	-40.2	-17.8 LOW	-22.4	Anten
11	7423.600M	-64.6	+2.3	+20.3			+0.0	-42.0	-17.8 HIGH	-24.2	Anten
12	7426.360M	-65.4	+2.3	+20.3			+0.0	-42.8	-17.8 HIGH	-25.0	Anten
13	2884.980M	-70.2	+1.6	+20.1			+0.0	-48.5	-17.8 LOW	-30.7	Anten
14	2886.960M	-70.7	+1.6	+20.1			+0.0	-49.0	-17.8 LOW	-31.2	Anten
15	4948.965M	-72.9	+2.0	+20.2			+0.0	-50.7	-17.8 HIGH	-32.9	Anten
16	4808.960M	-73.4	+2.0	+20.2			+0.0	-51.2	-17.8 LOW	-33.4	Anten
17	2968.985M	-73.1	+1.6	+20.1			+0.0	-51.4	-17.8 HIGH	-33.6	Anten
18	4878.965M	-74.2	+2.0	+20.2			+0.0	-52.0	-17.8 MID	-34.2	Anten
19	2970.970M	-73.7	+1.6	+20.1			+0.0	-52.0	-17.8 HIGH	-34.2	Anten
20	4880.960M	-74.8	+2.0	+20.3			+0.0	-52.5	-17.8 MID	-34.7	Anten
21	4950.955M	-74.9	+2.0	+20.2			+0.0	-52.7	-17.8 HIGH	-34.9	Anten
22	4810.970M	-75.4	+2.0	+20.2			+0.0	-53.2	-17.8 LOW	-35.4	Anten
23	495.105M	-81.5	+0.5	+20.1			+0.0	-60.9	-17.8 HIGH	-43.1	Anten
24	481.255M	-81.6	+0.5	+20.1			+0.0	-61.0	-17.8 LOW	-43.2	Anten

25	488.245M	-81.8	+0.5	+20.1	+0.0	-61.2	-17.8	-43.4	Anten
							MID		
26	12197.470 M	-88.1	+3.7	+20.5	+0.0	-63.9	-17.8	-46.1	Anten
							MID		
27	1484.720M	-85.5	+1.1	+20.2	+0.0	-64.2	-17.8	-46.4	Anten
							HIGH		
28	9897.950M	-88.0	+2.8	+20.2	+0.0	-65.0	-17.8	-47.2	Anten
							HIGH		
29	988.985M	-86.8	+0.8	+20.1	+0.0	-65.9	-17.8	-48.1	Anten
							HIGH		
30	9901.950M	-88.9	+2.8	+20.2	+0.0	-65.9	-17.8	-48.1	Anten
							HIGH		
31	1464.060M	-87.2	+1.1	+20.1	+0.0	-66.0	-17.8	-48.2	Anten
							MID		
32	991.000M	-87.1	+0.8	+20.1	+0.0	-66.2	-17.8	-48.4	Anten
							HIGH		
33	976.990M	-87.3	+0.8	+20.1	+0.0	-66.4	-17.8	-48.6	Anten
							MID		
34	2614.880M	-87.8	+1.4	+20.0	+0.0	-66.4	-17.8	-48.6	Anten
							HIGH		
35	974.970M	-87.7	+0.8	+20.1	+0.0	-66.8	-17.8	-49.0	Anten
							MID		
36	2598.700M	-88.4	+1.4	+20.0	+0.0	-67.0	-17.8	-49.2	Anten
							HIGH		
37	962.000M	-87.9	+0.8	+20.1	+0.0	-67.0	-17.8	-49.2	Anten
							LOW		

CKC Laboratories, Inc. Date: 1/23/2011 Time: 12:18:24 Dust Networks WO#: 91269
 15.247(d) Conducted Spurious Emissions Test Lead: Antenna Port Antenna Port Sequence#: 1 Ext ATTN: 0 dB



— Sweep Data
 ○ Peak Readings
 * Average Readings
 — Readings
 × QP Readings
 ▼ Ambient
 — 1 - 15.247(d) Conducted Spurious Emissions

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717

Customer: **Dust Networks**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **91269**
 Test Type: **Conducted Emissions**
 Equipment: **2.4 GHz Wireless Mote**
 Manufacturer: **Dust Networks**
 Model: **M2510**
 S/N: **NA**

Date: 1/23/2011
 Time: 12:36:30
 Sequence#: 3
 Tested By: Armando del Angel
 3Vdc

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN03121	Cable	32026-2-29080-84	10/23/2009	10/23/2011
	AN02872	Spectrum Analyzer	E4440A	8/25/2009	8/25/2011
T2	ANP05747	Attenuator	PE7004-20	3/18/2010	3/18/2012

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2510	NA
2dBi Antenna	NA	NA	NA

Support Devices:

Function	Manufacturer	Model #	S/N
TTL Converter	B&B Electronics	232LPTTL33	0088525046
Laptop	Dell	Inspiron 600m	NA

Test Conditions / Notes:

Temperature: 21°C
 Humidity: 34%
 Pressure: 102.1kPa
 Freq. Range: 2380 - 2405MHz
 RBW: 100kHz
 VBW: 300kHz
 Sweep: Auto
 Mode: TX

EUT is connected to the support laptop through a TTL Converter.
 The TTL converter is connected to the support laptop through a RS233 (serial) cable.
 Support laptop is setting the EUT in the proper mode and channels:
 LOW = 2405MHz

Ext Attn: 0 dB

Measurement Data:

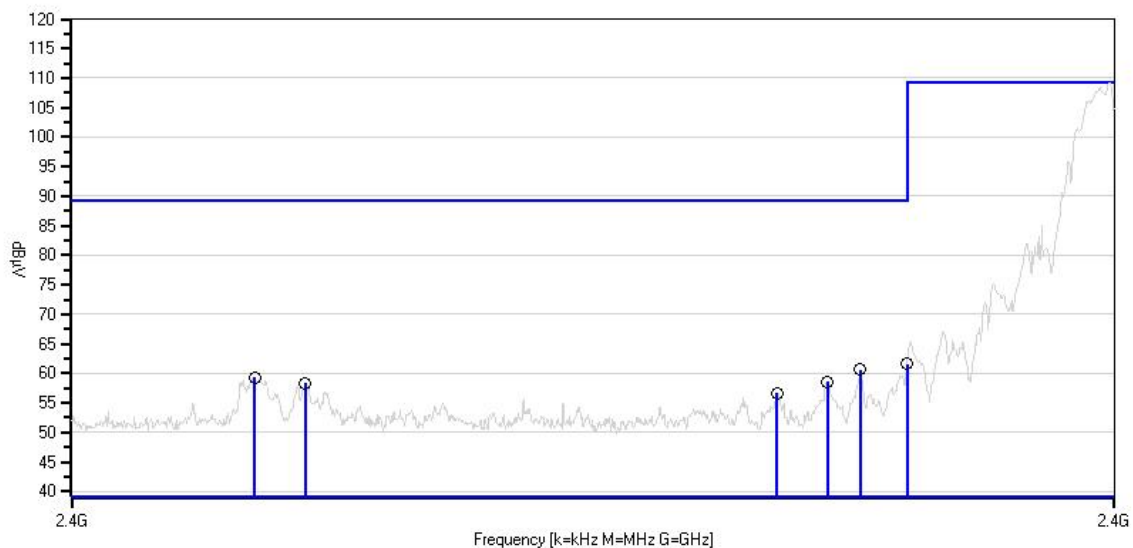
Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2400.000M	40.2	+1.3	+20.1			+0.0	61.6	89.2	-27.6	Anten
2	2400.000M	40.2	+1.3	+20.1			+0.0	61.6	89.2	-27.6	Anten
3	2398.875M	39.2	+1.3	+20.1			+0.0	60.6	89.2	-28.6	Anten
4	2384.375M	37.9	+1.3	+20.1			+0.0	59.3	89.2	-29.9	Anten

5	2398.100M	37.2	+1.3	+20.1	+0.0	58.6	89.2	-30.6	Anten
6	2385.575M	37.0	+1.3	+20.1	+0.0	58.4	89.2	-30.8	Anten
7	2396.875M	35.3	+1.3	+20.1	+0.0	56.7	89.2	-32.5	Anten

CKC Laboratories, Inc. Date: 1/23/2011 Time: 12:36:30 Dust Networks WO#: 91269
15.247(d) Conducted Spurious Emissions Test Lead: Antenna Port Antenna Port Sequence#: 3 Ext ATTN: 0 dB



Sweep Data
 ○ Peak Readings
 * Average Readings
 1 - 15.247(d) Conducted Spurious Emissions
 Readings
 × QP Readings
 ▼ Ambient

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717

Customer: **Dust Networks**
 Specification: **15.247(d) Conducted Spurious Emissions**
 Work Order #: **91269**
 Test Type: **Conducted Emissions**
 Equipment: **2.4 GHz Wireless Mote**
 Manufacturer: **Dust Networks**
 Model: **M2510**
 S/N: **NA**

Date: 1/23/2011
 Time: 12:27:30
 Sequence#: 2
 Tested By: Armando del Angel
 3Vdc

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN03121	Cable	32026-2-29080-84	10/23/2009	10/23/2011
	AN02872	Spectrum Analyzer	E4440A	8/25/2009	8/25/2011
T2	ANP05747	Attenuator	PE7004-20	3/18/2010	3/18/2012

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2510	NA
2dBi Antenna	NA	NA	NA

Support Devices:

Function	Manufacturer	Model #	S/N
TTL Converter	B&B Electronics	232LPTTL33	0088525046
Laptop	Dell	Inspiron 600m	NA

Test Conditions / Notes:

Temperature: 21°C Humidity: 34% Pressure: 102.1kPa Freq. Range: 2475 - 2500MHz RBW: 100kHz VBW: 300kHz Sweep: Auto Mode: TX
EUT is connected to the support laptop through a TTL Converter. The TTL converter is connected to the support laptop through a RS233 (serial) cable. Support laptop is setting the EUT in the proper mode and channels: HIGH = 2475MHz

Ext Attn: 0 dB

Measurement Data:

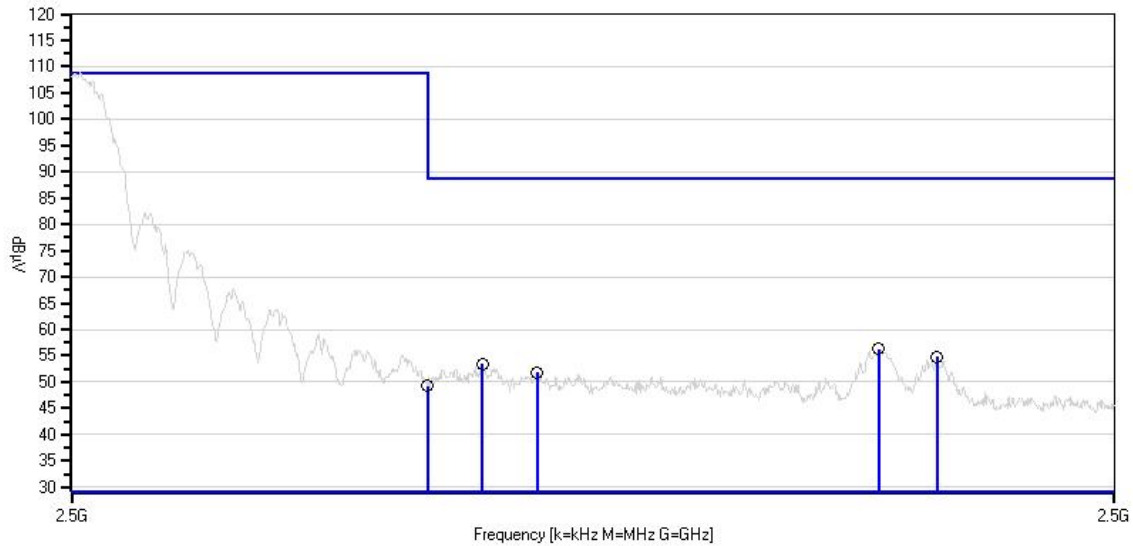
Reading listed by margin.

Test Lead: Antenna Port

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	dB	dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	2494.325M	34.9	+1.3	+20.1			+0.0	56.3	88.8	-32.5	Anten
2	2495.725M	33.4	+1.3	+20.1			+0.0	54.8	88.8	-34.0	Anten
3	2484.825M	32.0	+1.3	+20.1			+0.0	53.4	88.8	-35.4	Anten

4	2486.125M	30.4	+1.3	+20.1	+0.0	51.8	88.8	-37.0	Anten
5	2483.500M	27.9	+1.3	+20.1	+0.0	49.3	88.8	-39.5	Anten

CKC Laboratories, Inc. Date: 1/23/2011 Time: 12:27:30 Dust Networks WO#: 91269
15.247(d) Conducted Spurious Emissions Test Lead: Antenna Port Antenna Port Sequence#: 2 Ext ATTN: 0 dB



— Sweep Data
○ Peak Readings
* Average Readings
— Readings
× QP Readings
▼ Ambient
— 1 - 15.247(d) Conducted Spurious Emissions

Test Setup Photos



15.247(d) Radiated Spurious Emissions

Test Data

Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717

Customer: **Dust Networks**

Specification: **15.247(d) Radiated Spurious Emissions**

Work Order #: **91587**

Date: 1/28/2011

Test Type: **Radiated Scan**

Time: 13:55:48

Equipment: **2.4 GHz Wireless Mote**

Sequence#: 1

Manufacturer: Dust Networks

Tested By: Armando del Angel

Model: M2510

S/N: NA

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02872	Spectrum Analyzer	E4440A	8/25/2009	8/25/2011
T2	AN01467	Horn Antenna-ANSI C63.5 Calibration	3115	5/7/2010	5/7/2012
T3	AN03121	Cable	32026-2-29080-84	10/23/2009	10/23/2011
T4	AN03123	Cable	32026-2-29801-12	10/23/2009	10/23/2011
T5	ANP05542	Cable	Heliac	10/23/2009	10/23/2011
T6	AN01271	Preamplifier	83017A	9/17/2009	9/17/2011
T7	AN03116	High Pass Filter	11SH10-00313	1/26/2011	1/26/2013
T8	AN01316	Preamplifier	8447D	5/21/2010	5/21/2012
T9	AN01993	Biconilog Antenna	CBL6111C	10/9/2009	10/9/2011
T10	ANP05360	Cable	RG214	11/8/2010	11/8/2012
T11	ANP05366	Cable	RG-214	10/20/2009	10/20/2011
T12	AN00052	Loop Antenna	6502	6/8/2010	6/8/2012
T13	AN02742	Active Horn Antenna-ANSI C63.5 Antenna Factors (dB)	AMFW-5F-18002650-20-10P	11/10/2010	11/10/2012
T14	AN02763-69	Waveguide	Multiple	9/2/2010	9/2/2012
T15	ANP05425	Cable	PE35591-120	12/17/2009	12/17/2011
T16	ANP05428	Cable	PE35591-60	12/17/2009	12/17/2011

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2510	NA
2dBi Antenna	NA	NA	NA

Support Devices:

Function	Manufacturer	Model #	S/N
TTL Converter	B&B Electronics	232LPTTL33	0088525046
Laptop	Dell	Inspiron 600m	NA

Test Conditions / Notes:

Temperature: 21°C

Humidity: 34%

Pressure: 102.1kPa

Freq. Range: 30-13000MHz

Freq. Range: 9kHz-26GHz

RBW: 9-250kHz = 200Hz

0.250-30MHz = 9kHz

30-1000MHz = 100kHz

1-26GHz = 1MHz

VBW: 9-250kHz = 600Hz

0.250-30MHz = 27kHz

30-1000MHz = 300kHz

1-26GHz = 10Hz

Sweep: Auto

Mode: TX

EUT is raised 80cm from the ground plane with styrofoam.

EUT is at 3m from the receive antenna.

EUT is connected to the support laptop through a TTL Converter.

The TTL converter is connected to the support laptop through a RS232 (serial) cable.

Antenna port connected to +2 dBi Antenna.

Support laptop is setting the EUT in the proper mode and channels:

LOW = 2405MHz

MID = 2440MHz

HIGH = 2475MHz

Note: Due to runtime limitations on the EUT (Modulated signal runtime <1 min), emission maximization is being performed with CW signals in both vertical & horizontal polarizations. Recorded results are only for the polarization(s) where the highest emissions were found.

Ext Attn: 0 dB

Measurement Data:

Reading listed by margin.

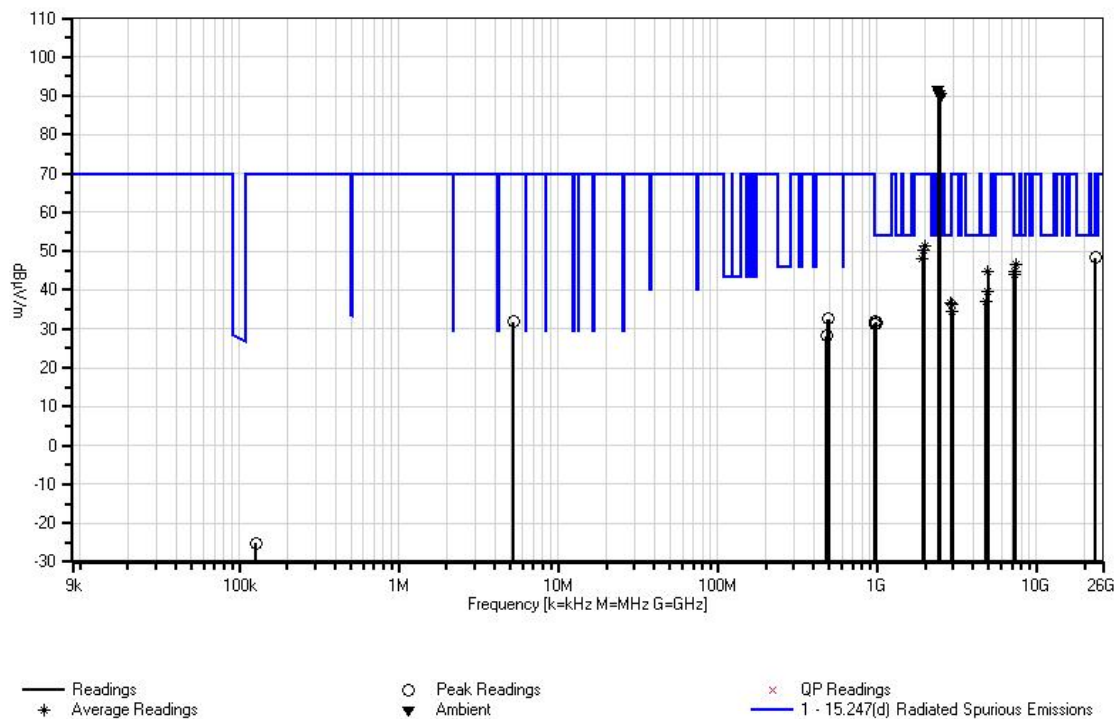
Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
			T5	T6	T7	T8					
			T9	T10	T11	T12					
			T13	T14	T15	T16					
	MHz	dBμV	dB	dB	dB	dB	Table	dBμV/m	dBμV/m	dB	Ant
1	2405.472M	53.9	+0.0	+27.9	+1.3	+0.3	+0.0	91.8	90.0	+1.8	Verti
	Ambient		+2.7	-34.5	+40.2	+0.0	253		LOW Fundamental		122
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
2	2439.454M	55.5	+0.0	+27.9	+1.3	+0.3	+0.0	90.7	90.0	+0.7	Verti
	Ambient		+2.7	-34.5	+37.5	+0.0	138		MID Fundamental		117
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					
3	2474.532M	57.4	+0.0	+27.9	+1.3	+0.2	+0.0	90.0	90.0	+0.0	Verti
	Ambient		+2.8	-34.4	+34.8	+0.0	270		HIGH Fundamental		117
			+0.0	+0.0	+0.0	+0.0					
			+0.0	+0.0	+0.0	+0.0					

4	7423.524M Ave	36.1	+0.0 +5.3 +0.0 +0.0	+36.2 -34.6 +0.0 +0.0	+2.3 +0.9 +0.0 +0.0	+0.5 +0.0 +0.0 +0.0	+0.0 360	46.7 54.0 HIGH	-7.3	Verti 129
5	7321.475M Ave	34.4	+0.0 +5.2 +0.0 +0.0	+36.1 -34.6 +0.0 +0.0	+2.4 +0.9 +0.0 +0.0	+0.5 +0.0 +0.0 +0.0	+0.0 124	44.9 54.0 MID	-9.1	Verti 118
6	4948.932M Ave	37.7	+0.0 +4.3 +0.0 +0.0	+33.1 -33.7 +0.0 +0.0	+2.0 +0.8 +0.0 +0.0	+0.4 +0.0 +0.0 +0.0	+0.0 175	44.6 54.0 HIGH	-9.4	Verti 121
7	4880.984M Ave	33.0	+0.0 +4.2 +0.0 +0.0	+33.0 -33.7 +0.0 +0.0	+2.0 +0.8 +0.0 +0.0	+0.4 +0.0 +0.0 +0.0	+0.0 124	39.7 54.0 MID	-14.3	Verti 118
8	4810.940M Ave	30.4	+0.0 +4.2 +0.0 +0.0	+32.9 -33.8 +0.0 +0.0	+2.0 +0.8 +0.0 +0.0	+0.4 +0.0 +0.0 +0.0	+0.0 199	36.9 54.0 LOW	-17.1	Verti 127
9	2885.993M Ave	34.4	+0.0 +3.0 +0.0 +0.0	+28.8 -34.3 +0.0 +0.0	+1.6 +3.0 +0.0 +0.0	+0.3 +0.0 +0.0 +0.0	+0.0 91	36.8 54.0 LOW	-17.2	Verti 182
10	1979.958M Ave	54.1	+0.0 +2.5 +0.0 +0.0	+28.1 -34.7 +0.0 +0.0	+1.2 +0.0 +0.0 +0.0	+0.3 +0.0 +0.0 +0.0	+0.0	51.5 70.0 HIGH	-18.5	Horiz 113
11	1952.049M Ave	53.2	+0.0 +2.5 +0.0 +0.0	+28.0 -34.8 +0.0 +0.0	+1.2 +0.0 +0.0 +0.0	+0.3 +0.0 +0.0 +0.0	+0.0 360	50.4 70.0 MID	-19.6	Horiz 116
12	23425.397 M	39.2	+0.0 +0.0 +0.0 -14.1	+0.0 +0.0 +0.0 +0.6	+0.0 +0.0 +0.0 +14.9	+0.0 +0.0 +0.0 +7.8	+0.0	48.4 70.0	-21.6	Verti 100
13	1924.040M Ave	51.3	+0.0 +2.5 +0.0 +0.0	+27.8 -34.9 +0.0 +0.0	+1.2 +0.0 +0.0 +0.0	+0.3 +0.0 +0.0 +0.0	+0.0	48.2 70.0 LOW	-21.8	Horiz 115
14	974.680M	31.7	+0.0 +0.0 +24.1 +0.0	+0.0 +0.0 +2.0 +0.0	+0.8 +0.0 +2.2 +0.0	+0.0 -29.0 +0.0 +0.0	+0.0 170	31.8 54.0 MID	-22.2	Verti 150
15	988.880M	30.9	+0.0 +0.0 +24.3 +0.0	+0.0 +0.0 +2.1 +0.0	+0.8 +0.0 +2.4 +0.0	+0.0 -28.9 +0.0 +0.0	+0.0 152	31.6 54.0 HIGH	-22.4	Verti 100
16	961.910M	31.5	+0.0 +0.0 +23.9 +0.0	+0.0 +0.0 +2.0 +0.0	+0.8 +0.0 +2.2 +0.0	+0.0 -29.1 +0.0 +0.0	+0.0 150	31.3 54.0 LOW	-22.7	Verti 127

17	7216.218M Ave	33.6	+0.0 +5.2 +0.0 +0.0	+36.0 -34.6 +0.0 +0.0	+2.5 +1.0 +0.0 +0.0	+0.5 +0.0 +0.0 +0.0	+0.0 12	44.2	70.0 LOW	-25.8	Verti 123
18	2928.028M Ave	34.0	+0.0 +3.1 +0.0 +0.0	+28.9 -34.2 +0.0 +0.0	+1.6 +2.5 +0.0 +0.0	+0.3 +0.0 +0.0 +0.0	+0.0 53	36.2	70.0 MID	-33.8	Verti 123
19	2969.924M Ave	32.5	+0.0 +3.1 +0.0 +0.0	+29.0 -34.2 +0.0 +0.0	+1.6 +2.2 +0.0 +0.0	+0.3 +0.0 +0.0 +0.0	+0.0 360	34.5	70.0 HIGH	-35.5	Verti 100
20	495.000M	41.0	+0.0 +0.0 +17.9 +0.0	+0.0 +0.0 +1.3 +0.0	+0.5 +0.0 +1.5 +0.0	+0.0 -29.6 +0.0 +0.0	+0.0 282	32.6	70.0 HIGH	-37.4	Verti 157
21	487.920M	41.0	+0.0 +0.0 +17.8 +0.0	+0.0 +0.0 +1.3 +0.0	+0.5 +0.0 +1.5 +0.0	+0.0 -29.6 +0.0 +0.0	+0.0 250	32.5	70.0 MID	-37.5	Verti 101
22	5.249M	62.0	+0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.1 +0.0	+0.0 +0.0 +0.2 +0.0	+0.0 +0.0 +9.6 +0.0	-40.0 360	31.9	70.0	-38.1	Verti 100
23	480.880M	36.8	+0.0 +0.0 +17.7 +0.0	+0.0 +0.0 +1.3 +0.0	+0.5 +0.0 +1.5 +0.0	+0.0 -29.6 +0.0 +0.0	+0.0 217	28.2	70.0 LOW	-41.8	Verti 100
24	126.400k	45.0	+0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.0 +0.0	+0.0 +0.0 +0.1 +0.0	+0.0 +0.0 +9.7 +0.0	-80.0	-25.2	70.0	-95.2	Verti 100

CKC Laboratories, Inc. Date: 1/28/2011 Time: 13:55:48 Dust Networks WO#: 91587
 15.247(d) Radiated Spurious Emissions Test Distance: 3 Meters Vertical Sequence#: 1 Ext ATTN: 0 dB



Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717

Customer: **Dust Networks**
 Specification: **15.247(d) Radiated Spurious Emissions**
 Work Order #: **91587**
 Test Type: **Radiated Scan**
 Equipment: **2.4 GHz Wireless Mote**
 Manufacturer: **Dust Networks**
 Model: **M2510**
 S/N: **NA**

Date: 1/28/2011
 Time: 14:03:02
 Sequence#: 2
 Tested By: Armando del Angel

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02872	Spectrum Analyzer	E4440A	8/25/2009	8/25/2011
T2	AN01467	Horn Antenna- ANSI C63.5 Calibration	3115	5/7/2010	5/7/2012
T3	AN03121	Cable	32026-2-29080-84	10/23/2009	10/23/2011
T4	AN03123	Cable	32026-2-29801-12	10/23/2009	10/23/2011
T5	ANP05542	Cable	Helix	10/23/2009	10/23/2011
T6	AN01271	Preamp	83017A	9/17/2009	9/17/2011

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2510	NA
2dBi Antenna	NA	NA	NA

Support Devices:

Function	Manufacturer	Model #	S/N
TTL Converter	B&B Electronics	232LPTTL33	0088525046
Laptop	Dell	Inspiron 600m	NA

Test Conditions / Notes:

Temperature: 21°C
 Humidity: 34%
 Pressure: 102.1kPa
 Freq. Range: 2378-2405MHz
 RBW: 1MHz
 VBW: 10Hz
 Sweep: Auto
 Mode: TX

EUT is raised 80cm from the ground plane with styrofoam.
 EUT is at 3m from the receive antenna.
 EUT is connected to the support laptop through a TTL Converter.
 The TTL converter is connected to the support laptop through a RS232 (serial) cable.
 Antenna port connected to +2 dBi Antenna.
 Support laptop is setting the EUT in the proper mode and channels:
 LOW = 2405MHz

Note: Due to runtime limitations on the EUT (Modulated signal runtime <1 min), emission maximization is being performed with CW signals in both vertical & horizontal polarizations. Recorded results are only for the polarization(s) where the highest emissions were found.

Ext Attn: 0 dB

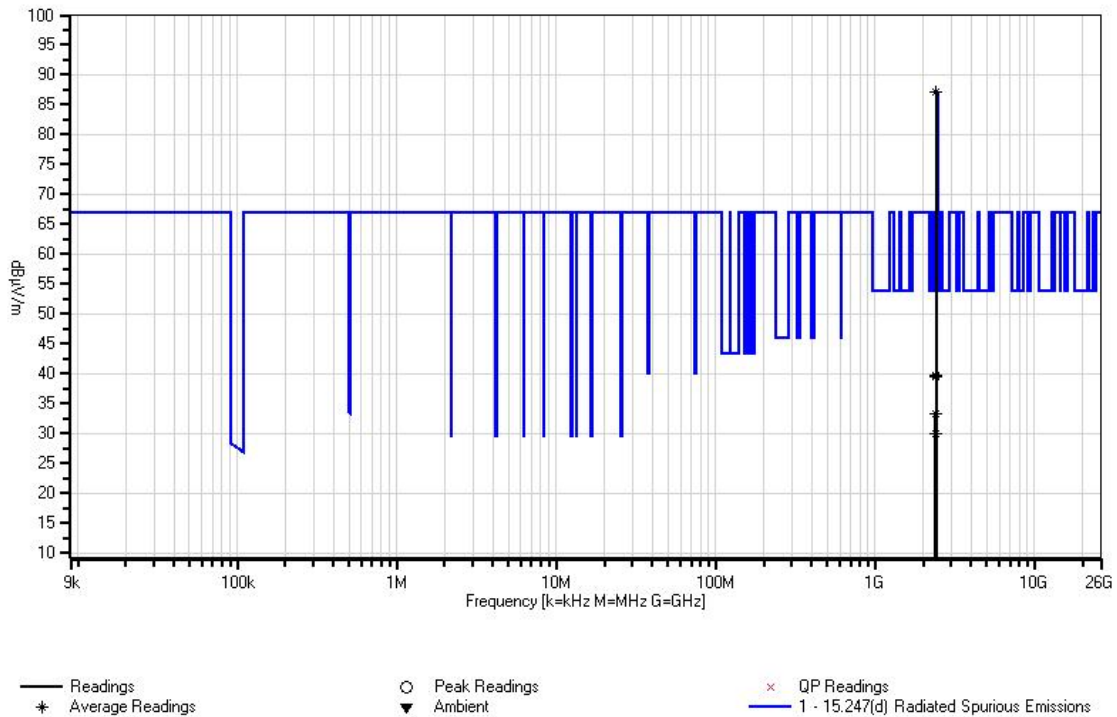
Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dB μ V	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	2404.973M Ave	89.4	+0.0 +2.7	+27.9 -34.5	+1.3	+0.3	+0.0 253	87.1	87.1	+0.0	Verti 122
2	2384.426M Ave	35.4	+0.0 +2.7	+28.0 -34.5	+1.3	+0.3	+0.0 253	33.2	54.0	-20.8	Verti 122
3	2390.000M Ave	32.1	+0.0 +2.7	+28.0 -34.5	+1.3	+0.3	+0.0 253	29.9	54.0	-24.1	Verti 122
4	2400.000M Ave	42.1	+0.0 +2.7	+27.9 -34.5	+1.3	+0.3	+0.0 253	39.8	67.1	-27.3	Verti 122
5	2399.978M Ave	41.9	+0.0 +2.7	+27.9 -34.5	+1.3	+0.3	+0.0 253	39.6	67.1	-27.5	Verti 122
6	2396.981M Ave	35.5	+0.0 +2.7	+27.9 -34.5	+1.3	+0.3	+0.0 253	33.2	67.1	-33.9	Verti 122

CKC Laboratories, Inc. Date: 1/28/2011 Time: 14:03:02 Dust Networks WO#: 91587
15.247(d) Radiated Spurious Emissions Test Distance: 3 Meters Vertical Sequence#: 2 Ext ATTN: 0 dB



Test Location: CKC Laboratories, Inc. • 22116 23rd Drive SE, Suite A • Bothell, WA 98021 • (425) 402-1717

Customer: **Dust Networks**
 Specification: **15.247(d) Radiated Spurious Emissions**
 Work Order #: **91587**
 Test Type: **Radiated Scan**
 Equipment: **2.4 GHz Wireless Mote**
 Manufacturer: **Dust Networks**
 Model: **M2510**
 S/N: **NA**

Date: 1/28/2011
 Time: 14:09:31
 Sequence#: 3
 Tested By: Armando del Angel

Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02872	Spectrum Analyzer	E4440A	8/25/2009	8/25/2011
T1	AN01467	Horn Antenna- ANSI C63.5 Calibration	3115	5/7/2010	5/7/2012
T2	AN03121	Cable	32026-2-29080-84	10/23/2009	10/23/2011
T3	AN03123	Cable	32026-2-29801-12	10/23/2009	10/23/2011
T4	ANP05542	Cable	Heliac	10/23/2009	10/23/2011
T5	AN01271	Preamp	83017A	9/17/2009	9/17/2011

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2510	NA
2dBi Antenna	NA	NA	NA

Support Devices:

Function	Manufacturer	Model #	S/N
TTL Converter	B&B Electronics	232LPTTL33	0088525046
Laptop	Dell	Inspiron 600m	NA

Test Conditions / Notes:

Temperature: 21°C
 Humidity: 34%
 Pressure: 102.1kPa
 Freq. Range: 2475-2500MHz
 RBW: 1MHz
 VBW: 10Hz
 Sweep: Auto
 Mode: TX

EUT is raised 80cm from the ground plane with styrofoam.
 EUT is at 3m from the receive antenna.
 EUT is connected to the support laptop through a TTL Converter.
 The TTL converter is connected to the support laptop through a RS232 (serial) cable.
 Antenna port connected to +2 dBi Antenna.
 Support laptop is setting the EUT in the proper mode and channels:
 HIGH = 2475MHz

Note: Due to runtime limitations on the EUT (Modulated signal runtime <1 min), emission maximization is being performed with CW signals in both vertical & horizontal polarizations. Recorded results are only for the polarization(s) where the highest emissions were found.

Ext Attn: 0 dB

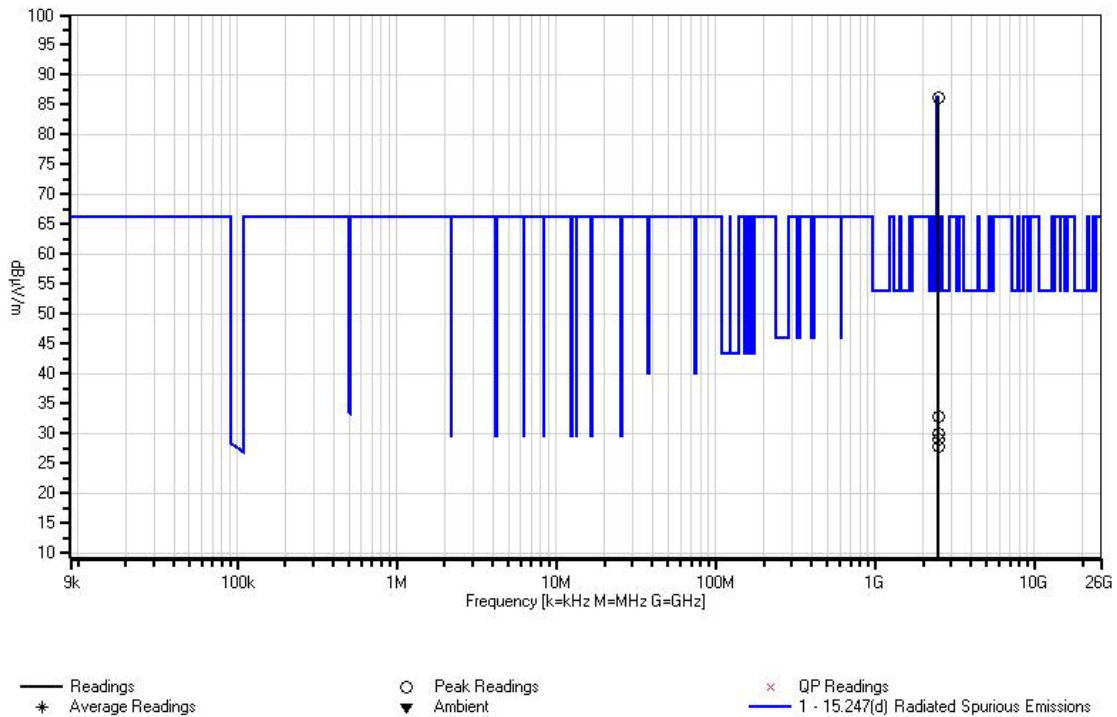
Measurement Data:

Reading listed by margin.

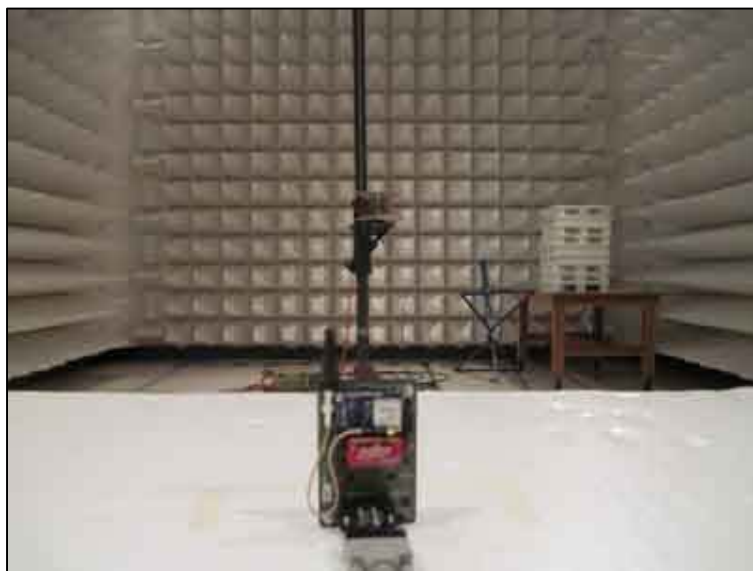
Test Distance: 3 Meters

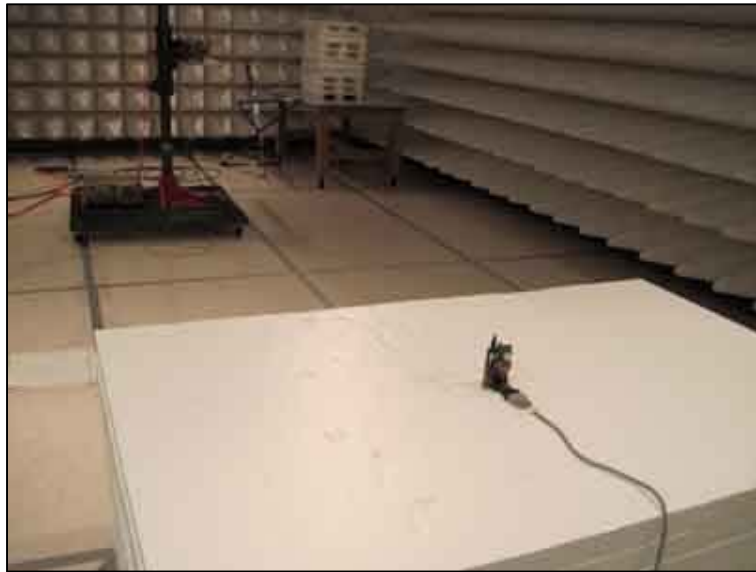
#	Freq MHz	Rdng dB μ V	T1 T5 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB μ V/m	Spec dB μ V/m	Margin dB	Polar Ant
1	2475.000M	88.5	+27.9 -34.4	+1.3	+0.2	+2.8	+0.0 270	86.3	86.3	+0.0	Verti 117
2	2494.275M	35.1	+27.9 -34.4	+1.3	+0.2	+2.8	+0.0 270	32.9	54.0	-21.1	Verti 117
3	2495.675M	32.1	+27.9 -34.4	+1.3	+0.2	+2.8	+0.0 270	29.9	54.0	-24.1	Verti 117
4	2484.725M	31.2	+27.9 -34.4	+1.3	+0.2	+2.8	+0.0 270	29.0	54.0	-25.0	Verti 117
5	2483.500M	30.1	+27.9 -34.4	+1.3	+0.2	+2.8	+0.0 270	27.9	54.0	-26.1	Verti 117

CKC Laboratories, Inc. Date: 1/28/2011 Time: 14:09:31 Dust Networks WO#: 91587
15.247(d) Radiated Spurious Emissions Test Distance: 3 Meters Vertical Sequence#: 3 Ext ATTN: 0 dB



Test Setup Photos





15.247(e) Peak Power Spectral Density

Test Setup

Temp: 21°C
 Humidity: 34%
 Pressure: 102.4kPa
 Frequency Range: 2405-2475MHz
 RBW: 3 kHz
 VBW: 9 kHz
 Span: 300 kHz
 Sweep: 100 s

EUT's antenna port is connected to the Spectrum analyzer through a cable and a 20dB attenuator.
 EUT is connected to the support laptop through a TTL RS232 adaptor.
 Support laptop is setting the EUT in the proper mode (TX) and channels:
 LOW: 2405MHz
 MID: 2440MHz
 HIGH: 2475MHz

Engineer Name: A. del Angel

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
02872	Spectrum Analyzer	E4440A	Agilent	8/25/2009	8/25/2011
P05747	Attenuator	PE7004-20	Pasternack	3/18/2010	3/18/2012
03121	Cable	32026-2-29080-84	Astrolab	10/23/2009	10/23/2011

Test Data

Frequency (MHz)	PSD (dBm)	15.247(e) Limit	Result
2405	-2.3	8dBm/3kHz	Pass
2440	-2.9	8dBm/3kHz	Pass
2475	-3.3	8dBm/3kHz	Pass

Test Setup Photos



RSS-210

99% Occupied Bandwidth

Test Setup

Temp: 21°C
Humidity: 34%
Pressure: 102.4kPa
Frequency Range: 2405-2475MHz
RBW: 100 kHz
VBW: 300 kHz
Sweep: Auto

EUT's antenna port is connected to the Spectrum analyzer through a cable and a 20dB attenuator.
EUT is connected to the support laptop through a TTL RS232 adaptor.
Support laptop is setting the EUT in the proper mode (TX) and channels:
LOW: 2405MHz
MID: 2440MHz
HIGH: 2475MHz

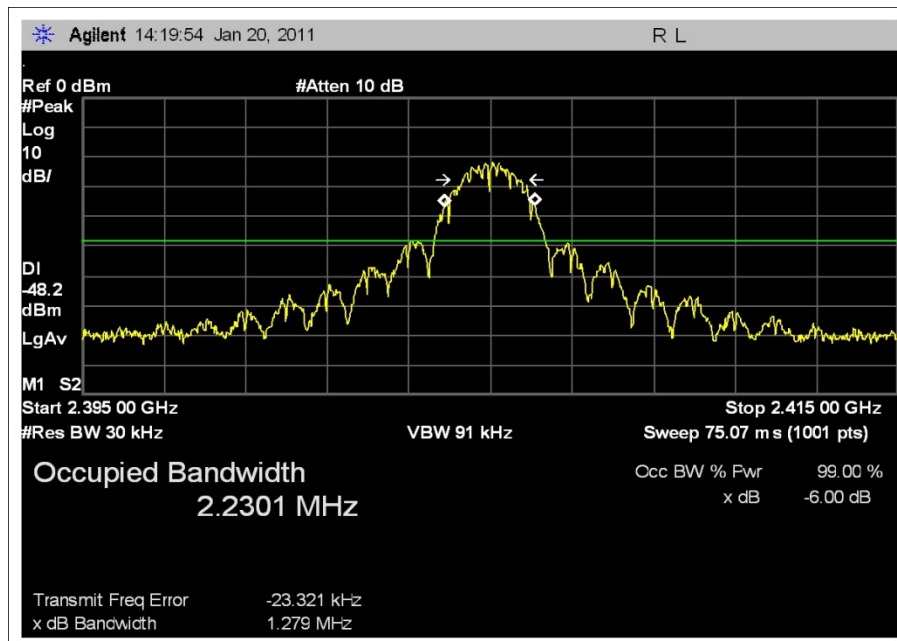
Engineer Name: A. del Angel

Test Equipment

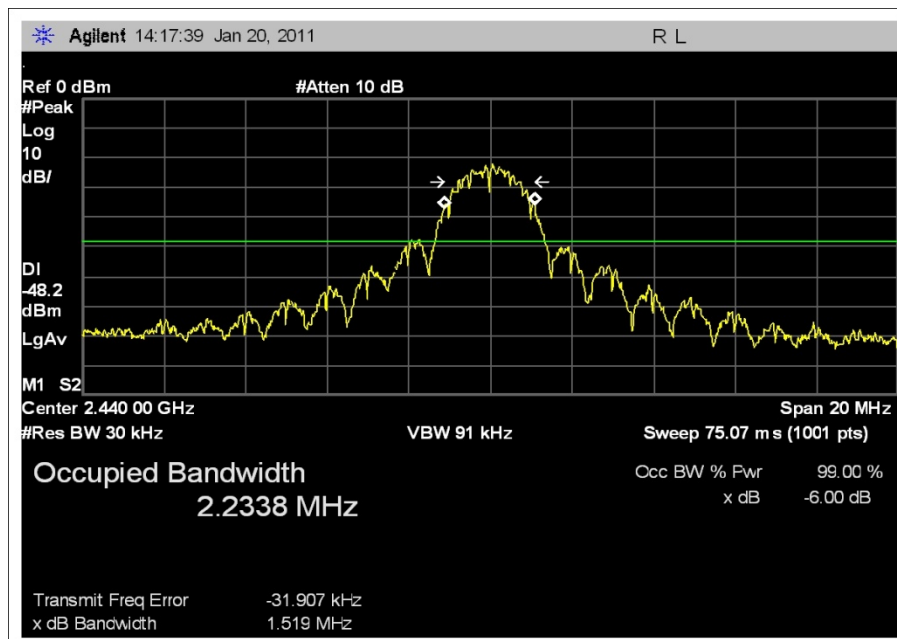
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
02872	Spectrum Analyzer	E4440A	Agilent	8/25/2009	8/25/2011
P05747	Attenuator	PE7004-20	Pasternack	3/18/2010	3/18/2012
03121	Cable	32026-2-29080-84	Astrolab	10/23/2009	10/23/2011

Test Data

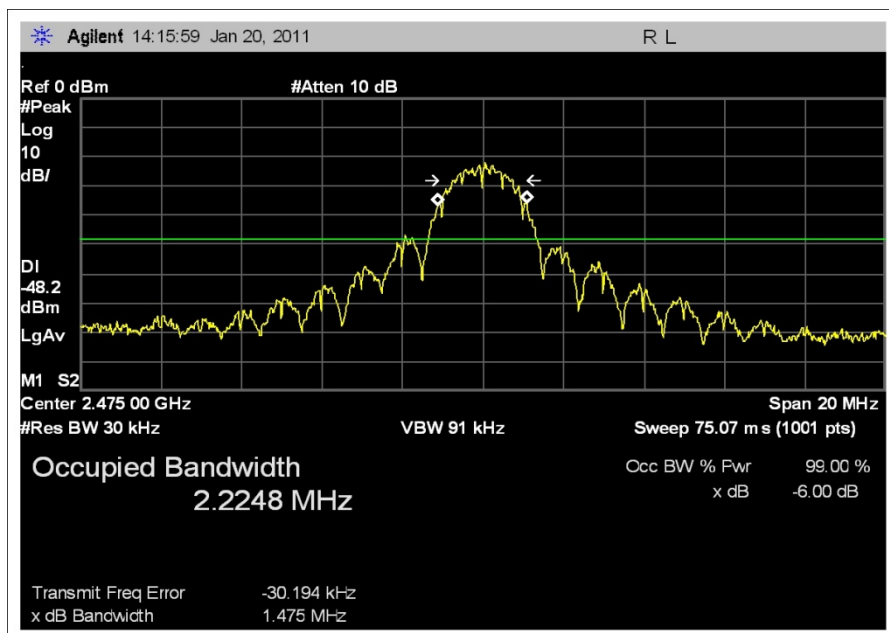
Frequency (MHz)	99% Bandwidth (kHz)	RSS-210 99% Bandwidth Limit	Result
2405	2230	>500kHz	Pass
2440	2233	>500kHz	Pass
2475	2224	>500kHz	Pass



Low



Mid



High

Test Setup Photos





SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Uncertainty Value	Parameter
4.73 dB	Radiated Emissions
3.34 dB	Mains Conducted Emissions
3.30 dB	Disturbance Power

The reported measurement uncertainties are calculated based on the worst case of all laboratory environments from CKC Laboratories, Inc. test sites. Only those parameters which require estimation of measurement uncertainty are reported. The reported worst case measurement uncertainty is less than the maximum values derived in CISPR 16-4-2. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of $k=2$. Compliance is deemed to occur provided measurements are below the specified limits.

Emissions Test Details

TESTING PARAMETERS

The cables were routed consistent with the typical application by varying the configuration of the test sample. Interface cables were connected to the available ports of the test unit. The effect of varying the position of the cables was investigated to find the configuration that produced maximum emissions. Cables were of the type and length specified in the individual requirements. The length of cable that produced maximum emissions was selected.

The equipment under test (EUT) was set up in a manner that represented its normal use, as shown in the setup photographs. Any special conditions required for the EUT to operate normally are identified in the comments that accompany the emissions tables.

The emissions data was taken with a spectrum analyzer or receiver. Incorporating the applicable correction factors for distance, antenna, cable loss and amplifier gain, the data was reduced as shown in the table below. The corrected data was then compared to the applicable emission limits. Preliminary and final measurements were taken in order to ensure that all emissions from the EUT were found and maximized.

CORRECTION FACTORS

The basic spectrum analyzer reading was converted using correction factors as shown in the highest emissions readings in the tables. For radiated emissions in $\text{dB}\mu\text{V}/\text{m}$, the spectrum analyzer reading in $\text{dB}\mu\text{V}$ was corrected by using the following formula. This reading was then compared to the applicable specification limit.

SAMPLE CALCULATIONS		
	Meter reading	(dB μ V)
+	Antenna Factor	(dB)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dB μ V/m)

TEST INSTRUMENTATION AND ANALYZER SETTINGS

The test instrumentation and equipment listed were used to collect the emissions data. A spectrum analyzer or receiver was used for all measurements. The following table shows the measuring equipment bandwidth settings that were used in designated frequency bands. For testing emissions, an appropriate reference level and a vertical scale size of 10 dB per division were used.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED EMISSIONS	150 kHz	30 MHz	9 kHz
RADIATED EMISSIONS	30 MHz	1000 MHz	120 kHz
RADIATED EMISSIONS	1000 MHz	>1 GHz	1 MHz

SPECTRUM ANALYZER/RECEIVER DETECTOR FUNCTIONS

The notes that accompany the measurements contained in the emissions tables indicate the type of detector function used to obtain the given readings. Unless otherwise noted, all readings were made in the "Peak" mode. Whenever a "Quasi-Peak" or "Average" reading is listed as one of the highest readings, this is indicated as a "QP" or an "Ave" on the appropriate rows of the data sheets. The following paragraphs describe in more detail the detector functions and when they were used to obtain the emissions data.

Peak

In this mode, the spectrum analyzer/receiver readings recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature of the measuring device called "peak hold," the measuring device had the ability to measure transients or low duty cycle transient emission peak levels. In this mode the measuring device made a slow scan across the frequency band selected and measured the peak emission value found at each frequency across the band.

Quasi-Peak

When the true peak values exceeded or were within 2 dB of the specification limit, quasi-peak measurements were taken using the quasi-peak detector.

Average

For certain frequencies, average measurements may be made using the spectrum analyzer/receiver. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.