



**DUST NETWORKS TEST REPORT**

**FOR THE**

**2.4 GHZ WIRELESS MOTE, M2040 & M2140**

**FCC PART 15 SUBPART C SECTIONS 15.209 & 15.247,  
SUBPART B SECTIONS 15.107, 15.109 & 15.111 CLASS A  
AND RSS-210 ISSUE 7**

**TESTING**

**DATE OF ISSUE: OCTOBER 26, 2007**

**PREPARED FOR:**

Dust Networks  
30695 Huntwood Avenue  
Hayward, CA 94544

**PREPARED BY:**

Mary Ellen Clayton  
CKC Laboratories, Inc.  
5046 Sierra Pines Drive  
Mariposa, CA 95338

P.O. No.: 2877  
W.O. No.: 87117

Date of test: September 26 - October 26, 2007

**Report No.: FC07-085**

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**ADMINISTRATIVE INFORMATION**

**DATE OF TEST:** September 26 –  
October 26, 2007

**DATE OF RECEIPT:** September 26, 2007

**REPRESENTATIVE:** Gordon Charles

**MANUFACTURER:**  
Dust Networks  
30695 Huntwood Avenue  
Hayward, CA 94544

**TEST LOCATION:**  
CKC Laboratories, Inc.  
5046 Sierra Pines Drive  
Mariposa, CA 95338

**TEST METHOD:** ANSI C63.4 (2003), RSS-210 Issue 7 and RSS GEN Issue 2

**PURPOSE OF TEST:** To perform the testing of the 2.4 GHz Wireless Mote, M2040 & M2140 with the requirements for FCC Part 15 Subpart C Sections 15.209 & 15.247, Subpart B Sections 15.107, 15.109 & 15.111 Class A and RSS-210 devices.

**APPROVALS**

Steve Behm, Director of Engineering Services

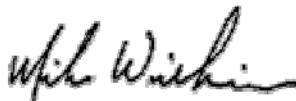
**QUALITY ASSURANCE:**

**TEST PERSONNEL:**



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Joyce Walker, Quality Assurance Administrative  
Manager



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Mike Wilkinson, EMC Engineer/Lab  
Manager

## FCC TO CANADA STANDARD CORRELATION MATRIX

Canadian Standard	Canadian Section	FCC Standard	FCC Section	Test Description
RSS GEN	7.1.4	47CFR	15.203	Antenna Connector Requirements
RSS GEN	7.2.1	47CFR	15.35(c)	Pulsed Operation
RSS GEN	7.2.2	47CFR	15.207	AC Mains Conducted Emissions Requirement
RSS 210	2.1	47CFR	15.215(c)	Frequency Stability Recommendation
RSS 210	2.2	47CFR	15.205	Restricted Bands of Operation
RSS 210	2.6	47CFR	15.209	General Radiated Emissions Requirement
RSS 210	A8.1	47CFR	15.247(a)(1)	Definition of FHSS
RSS 210	A8.1	47CFR	15.247(h)	Incorporation of Intelligence
RSS 210	A8.1(1)	47CFR	15.247(a)(1)	Minimum Channel Bandwidth
RSS 210	A8.1(1)	47CFR	15.247(g)	Hopping Sequence
RSS 210	A8.1(2)	47CFR	15.247(a)(1)	Carrier Separation
RSS 210	A8.1(2)	47CFR	15.247(a)(1)	Carrier Separation 2400 Alternative
RSS 210	A8.1(3)	47CFR	15.247(a)(1)(i)	Carrier Separation
RSS 210	A8.1(3)	47CFR	15.247(a)(1)(i)	Average Time of Occupancy
RSS 210	A8.1(3)	47CFR	15.247(a)(1)(i)	Number of Hopping Channels
RSS 210	A8.1(4)	47CFR	15.247(a)(1)(iii)	Average Time of Occupancy
RSS 210	A8.1(4)	47CFR	15.247(a)(1)(iii)	Number of Hopping Channels
RSS 210	A8.1(5)	47CFR	15.247(a)(1)(ii)	Max 20dB Bandwidth
RSS 210	A8.1(5)	47CFR	15.247(a)(1)(ii)	Average Time of Occupancy
RSS 210	A8.1(5)	47CFR	15.247(a)(1)(ii)	Number of Hopping Channels
RSS 210	A8.2(1)	47CFR	15.247(a)(2)	Minimum 6dB Bandwidth
RSS 210	A8.2(2)	47CFR	15.247(e)	Peak Power Spectral Density
RSS 210	A8.3(1)	47CFR	15.247(f)	Hybrid Systems - Time of Occupancy
RSS 210	A8.3(1)	47CFR	15.247(f)	Hybrid Systems - Power Spectral Density
RSS 210	A8.4(1)	47CFR	15.247(b)(2)	RF Power Output
RSS 210	A8.4(1)	NA	NA	EIRP Limit
RSS 210	A8.4(2)	47CFR	15.247(b)(1)	RF Power Output
RSS 210	A8.4(2)	NA	NA	EIRP Limit
RSS 210	A8.4(3)	47CFR	15.247(b)(1)	RF Power Output
RSS 210	A8.4(3)	NA	NA	EIRP Limit
RSS 210	A8.4(4)	47CFR	15.247(b)(3)	RF Power Output
RSS 210	A8.4(4)	NA	NA	EIRP Limit
RSS 210	A8.4(5)	47CFR	15.247(c)(1)	Directional Gain Requirements
RSS 210	A8.4(6)	47CFR	15.247(c)(2)	Beam Steering Antennas
RSS 210	A8.5	47CFR	15.247(d)	Spurious Emissions
	3082A-1		784962	Site File No.

Notes: Rule Sections for RSS 210 are taken from RSS 210 Issue 7

### **CONDITIONS DURING TESTING**

No modifications to the EUT were necessary during testing.

### **FCC 15.31(e) Voltage Variations**

Not applicable to this device because it is battery powered and a new battery was used.

### **FCC 15.31(m) Number Of Channels**

This device was tested on three channels.

### **FCC 15.33(a) Frequency Ranges Tested**

15.107 Conducted Emissions: 150 kHz – 30 MHz

15.109 Radiated Emissions: 30 kHz – 1000 MHz

15.111 Antenna Conducted Emissions: 30 MHz – 12500 MHz

15.209 Radiated Emissions: 30 MHz – 25000 MHz

15.247 Antenna Conducted Emissions: 20 MHz – 25000 MHz

### **FCC 15.203 Antenna Requirements**

The antenna has a unique RPMCX connector; therefore the EUT complies with Section 15.203 of the FCC rules.

### **EUT Operating Frequency**

The EUT was operating at 2405 MHz – 2480 MHz.

## **EQUIPMENT UNDER TEST (EUT) DESCRIPTION**

The customer declares the EUT tested by CKC Laboratories was representative of a production unit. The M2140 was chosen to be tested as the worst case model for complete testing.

The following model has been tested by CKC Laboratories: **M2140**

The manufacturer states that the following additional models are 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 models: **M2040 and M2510**

Models M2140 and M2040 contain exactly the same hardware, but the M2040 has the power amp disabled by the factory (firmware, not available to the end user). Partial testing was completed on model M2040 to ensure compliance in this mode.

## **EQUIPMENT UNDER TEST**

### **2.4 GHz Wireless Mote**

Manuf: Dust Networks  
Model: M2140  
Serial: NA  
FCC ID: pending

### **2.4 GHz Wireless Mote**

Manuf: Dust Networks  
Model: M2040  
Serial: NA  
FCC ID: pending

## **PERIPHERAL DEVICES**

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

### **2.4 GHz Host Wireless Embedded Network Manager**

Manuf: Dust Networks  
Model: D2140  
Serial: 00-17-0D-00-00-10-05-38

## REPORT OF EMISSIONS MEASUREMENTS

### TESTING PARAMETERS

#### TEMPERATURE AND HUMIDITY DURING TESTING

The temperature during testing was within +15°C and + 35°C.

The relative humidity was between 20% and 75%.

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 dB $\mu$ V/m, the spectrum analyzer reading in dB $\mu$ V was corrected by using the following formula. This reading was then compared to the applicable specification limit.

<b>SAMPLE CALCULATIONS</b>		
	Meter reading	(dB $\mu$ V)
+	Antenna Factor	(dB)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dB $\mu$ 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. When conducted emissions testing was performed, a 10 dB external attenuator was used with internal offset correction in the analyzer.

<b>MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE</b>			
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 were 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.

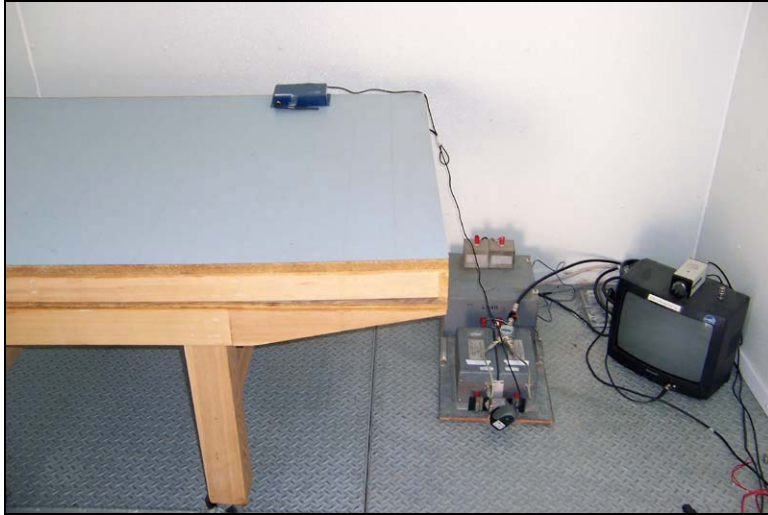
### **Average**

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.



**FCC 15.107 – AC CONDUCTED EMISSIONS**

**Test Setup Photos**



## Test Data Sheets

Test Location: CKC Laboratories, Inc. • 4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer:	<b>Dust Networks</b>	Date:	10/2/2007
Specification:	<b>FCC 15.107(b) Class A - AVE</b>	Time:	9:33:28 AM
Work Order #:	<b>87117</b>	Sequence#:	12
Test Type:	<b>Conducted Emissions</b>	Tested By:	Mike Wilkinson
Equipment:	<b>2.4 GHz Wireless Mote</b>		120V 60Hz
Manufacturer:	Dust Networks		
Model:	M2140		
S/N:	N/A		

### Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
LISN, 8028-50-TS-24-BNC	8379276, 280	05/07/2007	05/07/2009	1248 & 1249

### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	N/A

### Support Devices:

Function	Manufacturer	Model #	S/N
2.4 GHz Host Wireless Embedded Network Manager	Dust Networks	D2140	00-17-0D-00-00-10-05-38

### Test Conditions / Notes:

EUT is an 802.15.4 transmitter. EUT is in the receive mode. EUT is installed in and powered by the host manager, which is connected to the AC mains. The temperature was 22.5°C and the humidity was 46%. Frequency range investigated was 150 kHz to 30 MHz RBW = CISPR VBW = CISPR.

### Transducer Legend:

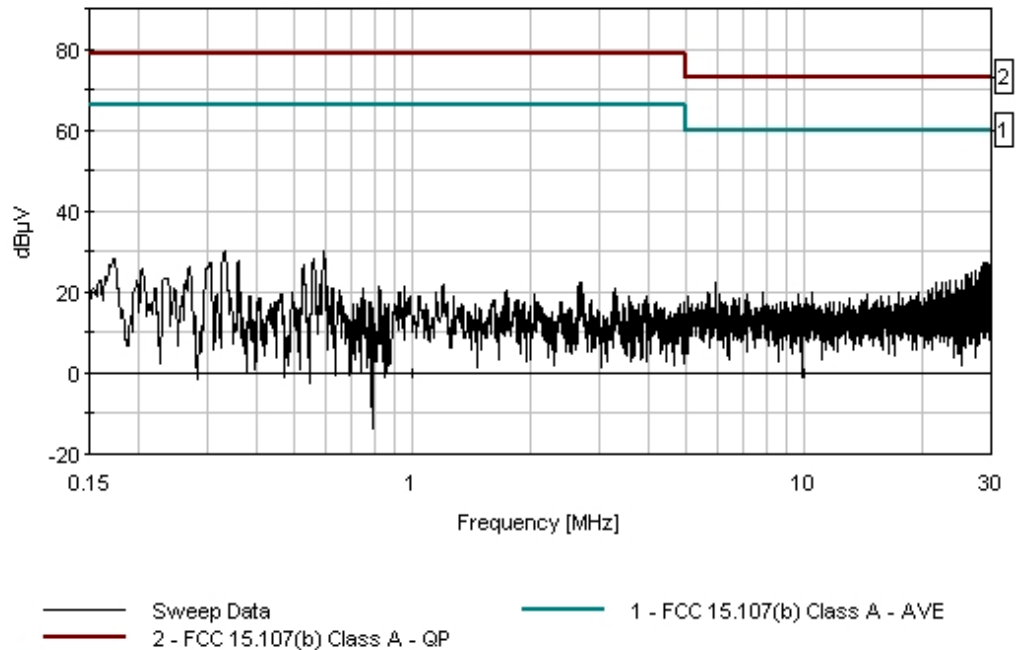
T1=Filter 150kHz HP AN02609	T2=MACOND
T3=LISN - BK	T4=ANP05624 (10dB Attn)

### Measurement Data: Reading listed by margin. Test Lead: Black

#	Freq MHz	Rdng dB $\mu$ V	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V	Spec dB $\mu$ V	Margin dB	Polar Ant
1	29.383M	14.9	+0.1	+1.4	+1.2	+9.7	+0.0	27.3	60.0	-32.7	Black
2	29.075M	14.8	+0.1	+1.4	+1.2	+9.7	+0.0	27.2	60.0	-32.8	Black
3	28.794M	14.6	+0.1	+1.4	+1.2	+9.7	+0.0	27.0	60.0	-33.0	Black
4	29.705M	14.4	+0.2	+1.4	+1.2	+9.7	+0.0	26.9	60.0	-33.1	Black
5	28.513M	14.0	+0.1	+1.4	+1.2	+9.7	+0.0	26.4	60.0	-33.6	Black
6	28.198M	13.9	+0.1	+1.4	+1.2	+9.7	+0.0	26.3	60.0	-33.7	Black

7	29.116M	13.7	+0.1	+1.4	+1.2	+9.7	+0.0	26.1	60.0	-33.9	Black
8	29.671M	13.6	+0.2	+1.4	+1.2	+9.7	+0.0	26.1	60.0	-33.9	Black
9	27.287M	12.8	+0.1	+1.4	+1.2	+9.7	+0.0	25.2	60.0	-34.8	Black
10	27.273M	12.7	+0.1	+1.4	+1.2	+9.7	+0.0	25.1	60.0	-34.9	Black
11	26.670M	12.6	+0.1	+1.3	+1.1	+9.7	+0.0	24.8	60.0	-35.2	Black
12	27.876M	12.3	+0.1	+1.4	+1.2	+9.7	+0.0	24.7	60.0	-35.3	Black
13	29.986M	12.0	+0.2	+1.4	+1.2	+9.7	+0.0	24.5	60.0	-35.5	Black
14	25.759M	12.0	+0.1	+1.3	+1.1	+9.7	+0.0	24.2	60.0	-35.8	Black
15	27.314M	11.8	+0.1	+1.4	+1.2	+9.7	+0.0	24.2	60.0	-35.8	Black

CKC Laboratories, Inc. Date: 10/2/2007 Time: 9:33:28 AM Dust Networks WVO#: 87117  
 FCC 15.107(b) Class A - AVE Test Lead: Black 120V 60Hz Sequence#: 12  
 Dust Networks M/N M2140 (EXTATTN)



Test Location: CKC Laboratories, Inc. •4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer: **Dust Networks**  
 Specification: **FCC 15.107(b) Class A - AVE**  
 Work Order #: **87117** Date: 10/2/2007  
 Test Type: **Conducted Emissions** Time: 9:30:28 AM  
 Equipment: **2.4 GHz Wireless Mote** Sequence#: 11  
 Manufacturer: Dust Networks Tested By: Mike Wilkinson  
 Model: M2140 120V 60Hz  
 S/N: N/A

**Test Equipment:**

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
LISN, 8028-50-TS-24-BNC	8379276, 280	05/07/2007	05/07/2009	1248 & 1249

**Equipment Under Test (\* = EUT):**

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	N/A

**Support Devices:**

Function	Manufacturer	Model #	S/N
2.4 GHz Host Wireless Embedded Network Manager	Dust Networks	D2140	00-17-0D-00-00-10-05-38

**Test Conditions / Notes:**

EUT is an 802.15.4 transmitter. EUT is in the receive mode. EUT is installed in and powered by the host manager which is connected to the AC mains. The temperature was 22.5°C and the humidity was 46%. Frequency range investigated was 150 kHz to 30 MHz RBW = CISPR VBW = CISPR.

**Transducer Legend:**

T1=Filter 150kHz HP AN02609	T2=MACOND
T3=LISN - WT	T4=ANP05624 (10dB Attn)

**Measurement Data:**

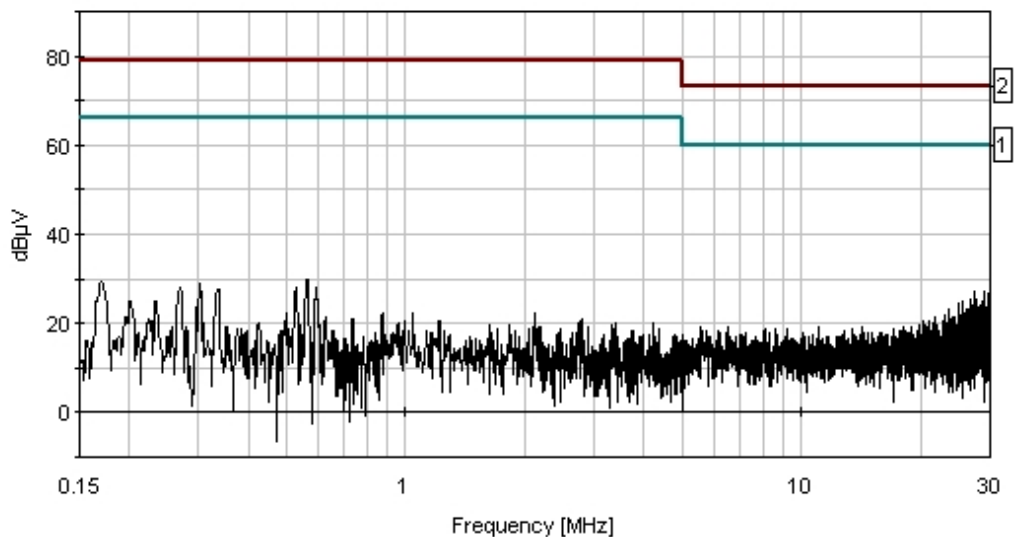
Reading listed by margin.

Test Lead: White

#	Freq MHz	Rdng dB $\mu$ V	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dB $\mu$ V	Spec dB $\mu$ V	Margin dB	Polar Ant
1	28.972M	14.9	+0.1	+1.4	+1.2	+9.7	+0.0	27.3	60.0	-32.7	White
2	27.478M	14.6	+0.1	+1.4	+1.2	+9.7	+0.0	27.0	60.0	-33.0	White
3	29.603M	14.4	+0.2	+1.4	+1.2	+9.7	+0.0	26.9	60.0	-33.1	White
4	29.006M	14.2	+0.1	+1.4	+1.2	+9.7	+0.0	26.6	60.0	-33.4	White
5	29.925M	13.2	+0.2	+1.4	+1.2	+9.7	+0.0	25.7	60.0	-34.3	White
6	26.896M	13.0	+0.1	+1.4	+1.3	+9.7	+0.0	25.5	60.0	-34.5	White
7	27.807M	12.8	+0.1	+1.4	+1.2	+9.7	+0.0	25.2	60.0	-34.8	White

8	28.705M	12.6	+0.1	+1.4	+1.2	+9.7	+0.0	25.0	60.0	-35.0	White
9	25.663M	12.5	+0.1	+1.3	+1.3	+9.7	+0.0	24.9	60.0	-35.1	White
10	29.870M	12.4	+0.2	+1.4	+1.2	+9.7	+0.0	24.9	60.0	-35.1	White
11	25.073M	12.2	+0.1	+1.3	+1.3	+9.7	+0.0	24.6	60.0	-35.4	White
12	27.766M	12.2	+0.1	+1.4	+1.2	+9.7	+0.0	24.6	60.0	-35.4	White
13	28.417M	11.7	+0.1	+1.4	+1.2	+9.7	+0.0	24.1	60.0	-35.9	White
14	25.060M	11.6	+0.1	+1.3	+1.3	+9.7	+0.0	24.0	60.0	-36.0	White
15	27.156M	11.5	+0.1	+1.4	+1.2	+9.7	+0.0	23.9	60.0	-36.1	White

CKC Laboratories, Inc. Date: 10/2/2007 Time: 9:30:28 AM Dust Networks WVO#: 87117  
 FCC 15.107(b) Class A - AVE Test Lead: White 120V 60Hz Sequence#: 11  
 Dust Networks MN M2140 (EXTATTN)



— Sweep Data  
 — 1 - FCC 15.107(b) Class A - AVE  
 — 2 - FCC 15.107(b) Class A - QP

**FCC 15.109 – RADIATED EMISSIONS**

**Test Setup Photos**





## Test Data Sheets

Test Location: CKC Laboratories, Inc. • 4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer: **Dust Networks**  
 Specification: **15.109 CLASS A**  
 Work Order #: **87117** Date: 10/1/2007  
 Test Type: **Maximized Emissions** Time: 13:24:05  
 Equipment: **2.4 GHz Wireless Mote** Sequence#: 6  
 Manufacturer: Dust Networks Tested By: Mike Wilkinson  
 Model: M2140  
 S/N: 092607A

### Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
Chase CBL6111C	2456	12/30/2006	12/30/2008	01991
Bilog				
HP 8447D Preamp	1937A02604	03/14/2007	03/14/2009	00099

### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	092607A

### Support Devices:

Function	Manufacturer	Model #	S/N
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### Test Conditions / Notes:

EUT is an 802.15.4 transmitter. EUT is in Receiver mode Channel 0. The temperature was 22.5°C and the humidity was 46%. Frequency range investigated was 30 to 1000 MHz RBW = 120 kHz VBW = 300 kHz.

### Transducer Legend:

T1=Cable - Site D 10m 9k-1G	T2=AMP AN00099
T3=ANT AN01991 25-1000MHz	

### Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	32.778M	34.4	+1.6	-27.2	+17.5	-10.0	16.3	39.1	-22.8	Vert
2	131.194M	32.1	+3.4	-27.0	+11.7	-10.0	10.2	43.5	-33.3	Vert
3	163.891M	26.7	+3.8	-26.8	+10.3	-10.0	4.0	43.5	-39.5	Horiz
4	327.781M	22.6	+5.6	-26.6	+14.2	-10.0	5.8	46.4	-40.6	Horiz
5	229.528M	25.6	+4.7	-26.5	+11.2	-10.0	5.0	46.4	-41.4	Vert
6	196.669M	25.0	+4.1	-26.7	+9.1	-10.0	1.5	43.5	-42.0	Horiz



**FCC 15.111 – ANTENNA POWER EMISSIONS**

**Test Setup Photos**



## Test Data Sheets

Test Location: CKC Laboratories, Inc. • 4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer: **Dust Networks**

Specification: **FCC 15.111**

Work Order #: **87117**

Date: 9/27/2007

Test Type: **Maximized Emissions**

Time: 12:50:46

Equipment: **2.4 GHz Wireless Mote**

Sequence#: 4

Manufacturer: Dust Networks

Tested By: Mike Wilkinson

Model: M2140

S/N: 092607A

### Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660

### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	092607A

### Support Devices:

Function	Manufacturer	Model #	S/N
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### Test Conditions / Notes:

EUT is an 802.15.4 transmitter and is operating on the Low, Mid and High channels as noted in the data sheet readings. EUT is in Receiver mode. Channel 0 Low = 2405 MHz, Channel 8 Mid = 2445 MHz, Channel 15 High = 2480 MHz. The temperature was 22.5°C and the humidity was 46%. Frequency range investigated was 30 to 12500 MHz RBW = 100 kHz VBW = 100 kHz.

### Transducer Legend:

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### Measurement Data:

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dB $\mu$ V	dB	dB	dB	dB	Dist Table	Corr dB $\mu$ V	Spec dB $\mu$ V	Margin dB	Polar Ant
1	7335.600M	48.5					+0.0	48.5	50.0	-1.5	None
									Mid Channel		
2	7214.400M	47.5					+0.0	47.5	50.0	-2.5	None
									Low Channel		
3	9780.800M	46.1					+0.0	46.1	50.0	-3.9	None
									Mid Channel		
4	9619.200M	45.2					+0.0	45.2	50.0	-4.8	None
									Low Channel		
5	4890.400M	45.0					+0.0	45.0	50.0	-5.0	None
									Mid Channel		
6	2445.200M	44.8					+0.0	44.8	50.0	-5.2	None
									Mid Channel		
7	2404.800M	44.0					+0.0	44.0	50.0	-6.0	None
									Low Channel		
8	4809.600M	43.4					+0.0	43.4	50.0	-6.6	None
									Low Channel		

**FCC 15.209/15.247(d) – RADIATED EMISSIONS**

**Test Setup Photos**





## Test Data Sheets

Test Location: CKC Laboratories, Inc. • 4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer: **Dust Networks**  
 Specification: **FCC 15.209/15.247(d)**  
 Work Order #: **87117**  
 Test Type: **Maximized Emissions**  
 Equipment: **2.4 GHz Wireless Mote**  
 Manufacturer: Dust Networks  
 Model: M2140  
 S/N: 092607A

Date: 10/1/2007  
 Time: 15:30:36  
 Sequence#: 7  
 Tested By: Mike Wilkinson

### Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
Chase CBL6111C Bilog	2456	12/30/2006	12/30/2008	01991
HP 8447D Preamp	1937A02604	03/14/2007	03/14/2009	00099
EMCO 3115 Horn Antenna	8006-3413	03/17/2007	03/17/2009	00327
HP 8449B Preamp	3008A00301	12/13/2006	12/13/2008	2010

### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	092607A

### Support Devices:

Function	Manufacturer	Model #	S/N
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### Test Conditions / Notes:

EUT is an 802.15.4 transmitter and is operating on the Low, Mid and High channels as noted in the data sheet readings. EUT is transmitting continuously with modulation Channel 0 Low = 2405 MHz, Channel 8 Mid = 2445 MHz, Channel 15 High = 2480 MHz. The temperature was 22.5°C and the humidity was 46%. Frequency range investigated was 30 to 25000 MHz RBW = CISPR VBW = CISPR.

### Transducer Legend:

T1=Cable - Site D 10m 9k-1G	T2=AMP AN00099
T3=ANT AN01991 25-1000MHz	T4=AMP HF - S/N 301
T5=ANT AN00327 900MHz-18.5GHz	T6=Cable - Site D 3m 9k - 20G
T7=Cable Semiflex ANP01403	

### Measurement Data:

Reading listed by margin.

Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	Reading listed by margin.			T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
			T1 dB	T2 dB	T3 dB						
1	9621.260M	28.5	+0.0 +37.9	+0.0 +11.0	+0.0 +4.3	-34.1	+0.0	47.6	54.0	-6.4	Vert
Low Channel											
2	7336.000M	29.8	+0.0 +36.5	+0.0 +9.4	+0.0 +3.7	-33.6	+0.0	45.8	54.0	-8.2	Vert
Mid Channel											
3	7211.130M	29.2	+0.0 +36.2	+0.0 +9.4	+0.0 +3.7	-33.3	+0.0	45.2	54.0	-8.8	Horiz
Low Channel											
4	32.778M	34.4	+1.6	-27.2	+17.5		+0.0	26.3	40.0	-13.7	Vert
Low Channel											
5	4810.200M	29.8	+0.0 +33.2	+0.0 +7.2	+0.0 +3.0	-33.9	+0.0	39.3	54.0	-14.7	Horiz
Low Channel											

6	7441.010M	19.9	+0.0	+0.0	+0.0	-33.9	+0.0	36.0	54.0	-18.0	Vert
	Ave		+36.8	+9.4	+3.8				High Channel		
^	7441.010M	32.0	+0.0	+0.0	+0.0	-33.9	+0.0	48.1	54.0	-5.9	Vert
			+36.8	+9.4	+3.8				High Channel		
8	7216.060M	19.9	+0.0	+0.0	+0.0	-33.3	+0.0	35.9	54.0	-18.1	Vert
	Ave		+36.2	+9.4	+3.7				Low Channel		
^	7216.060M	35.0	+0.0	+0.0	+0.0	-33.3	+0.0	51.0	54.0	-3.0	Vert
			+36.2	+9.4	+3.7				Low Channel		
10	4960.950M	22.3	+0.0	+0.0	+0.0	-34.0	+0.0	32.3	54.0	-21.7	Vert
	Ave		+33.5	+7.4	+3.1				High Channel		
^	4960.950M	41.6	+0.0	+0.0	+0.0	-34.0	+0.0	51.6	54.0	-2.4	Vert
			+33.5	+7.4	+3.1				High Channel		
12	4891.000M	22.0	+0.0	+0.0	+0.0	-34.1	+0.0	31.7	54.0	-22.3	Vert
	Ave		+33.4	+7.4	+3.0				Mid Channel		
^	4891.000M	44.8	+0.0	+0.0	+0.0	-34.1	+0.0	54.5	54.0	+0.5	Vert
			+33.4	+7.4	+3.0				Mid Channel		
14	4810.960M	21.6	+0.0	+0.0	+0.0	-33.9	+0.0	31.1	54.0	-22.9	Vert
	Ave		+33.2	+7.2	+3.0				Low Channel		
^	4810.940M	38.9	+0.0	+0.0	+0.0	-33.9	+0.0	48.4	54.0	-5.6	Vert
			+33.2	+7.2	+3.0				Low Channel		
16	131.194M	32.1	+3.4	-27.0	+11.7		+0.0	20.2	43.5	-23.3	Vert
									Low Channel		
17	163.891M	26.7	+3.8	-26.8	+10.3		+0.0	14.0	43.5	-29.5	Horiz
									Low Channel		
18	327.781M	22.6	+5.6	-26.6	+14.2		+0.0	15.8	46.0	-30.2	Horiz
									Low Channel		
19	229.528M	25.6	+4.7	-26.5	+11.2		+0.0	15.0	46.0	-31.0	Vert
									Low Channel		
20	196.669M	25.0	+4.1	-26.7	+9.1		+0.0	11.5	43.5	-32.0	Horiz
									Low Channel		

## FCC 15.247(a)(2)/RSS-210 - 99% BANDWIDTH

### *Test Equipment:*

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660

### *Equipment Under Test (\* = EUT):*

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	092607A

### *Support Devices:*

Function	Manufacturer	Model #	S/N
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### *Test Conditions / Notes:*

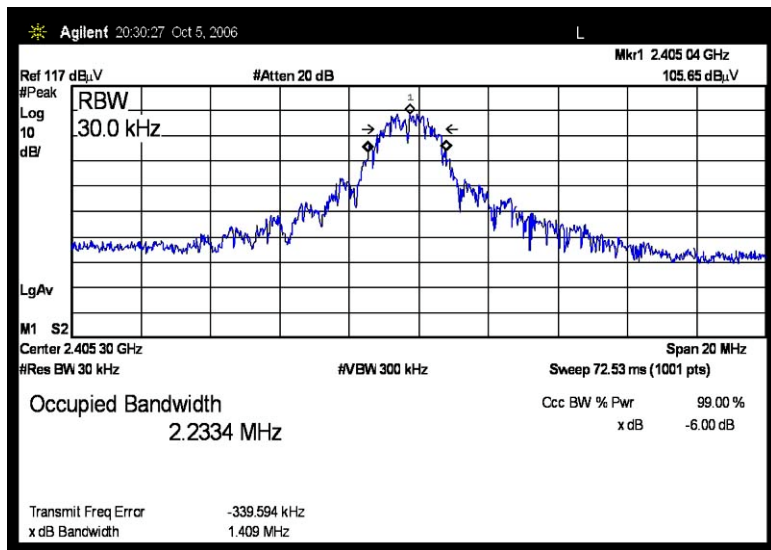
EUT is an 802.15.4 transmitter and is operating on the Low, Mid and High channels. EUT is transmitting continuously with modulation. Channel 0 Low = 2405 MHz, Channel 8 Mid = 2445 MHz, Channel 15 High = 2480 MHz. The temperature was 22.5°C and the humidity was 46%.

### Test Setup Photos



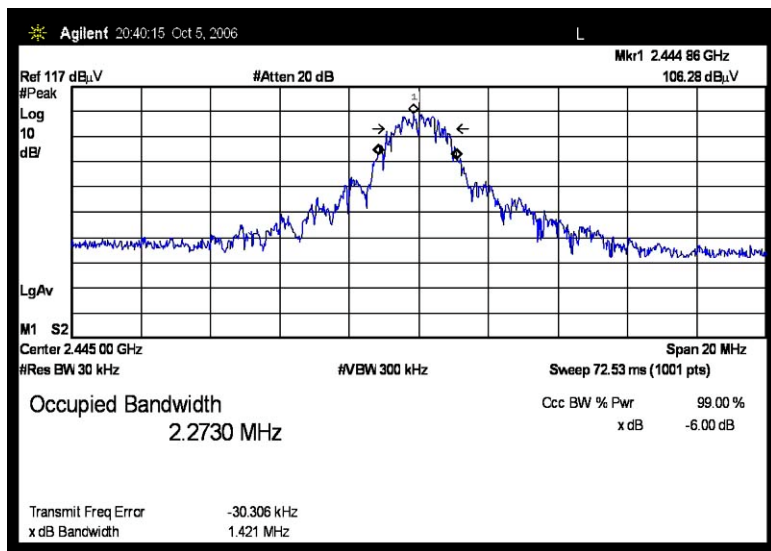
### Test Plots

#### FCC 15.247(a)(2)/RSS-210 - 99% BANDWIDTH - LOW CHANNEL



M2140

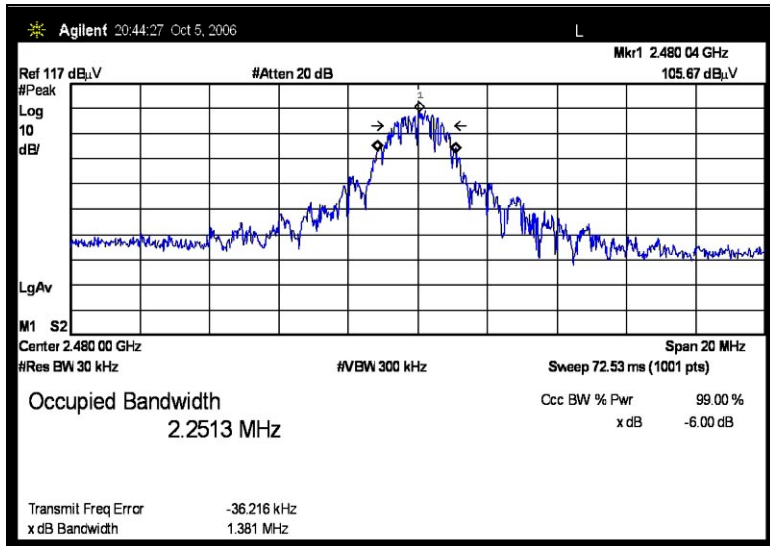
#### FCC 15.247(a)(2)/RSS-210 - 99% BANDWIDTH - MID CHANNEL



M2140



**FCC 15.247(a)(2)/RSS-210 - 99% BANDWIDTH - HIGH CHANNEL**



M2140

**FCC 15.247(b)(3) – RF POWER OUTPUT**

**Test Setup Photos**



## Test Data Sheets

Test Location: CKC Laboratories, Inc. • 4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer: **Dust Networks**

Specification: **15.247(b)(3)**

Work Order #: **87117**

Date: 9/27/2007

Test Type: **Maximized Emissions**

Time: 08:26:26

Equipment: **2.4 GHz Wireless Mote**

Sequence#: 1

Manufacturer: Dust Networks

Tested By: Mike Wilkinson

Model: M2140

S/N: 092607A

### Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660

### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	092607A

### Support Devices:

Function	Manufacturer	Model #	S/N
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### Test Conditions / Notes:

EUT is an 802.15.4 transmitter and is operating on the Low, Mid and High channels as noted in the data sheet readings. EUT is transmitting continuously with modulation. Channel 0 Low = 2405 MHz, Channel 8 Mid = 2445 MHz, Channel 15 High = 2480 MHz. The temperature was 22.5°C and the humidity was 46%. SA RBW = 3 MHz. Measurements made with a new battery installed.

### Transducer Legend:

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### Measurement Data:

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dB $\mu$ V	Reading listed by margin.				Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar Ant
1	2404.560M	114.9					+0.0	114.9	137.0	-22.1	None
									Low Channel		
2	2444.560M	114.6					+0.0	114.6	137.0	-22.4	None
									Mid Channel		
3	2479.560M	114.4					+0.0	114.4	137.0	-22.6	None
									High Channel		

Test Location: CKC Laboratories, Inc. • 4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer: **Dust Networks**  
 Specification: **15.247(b)(3)**  
 Work Order #: **87117** Date: 9/27/2007  
 Test Type: **Maximized Emissions** Time: 14:06:58  
 Equipment: **2.4 GHz Wireless Mote** Sequence#: 5  
 Manufacturer: Dust Networks Tested By: Mike Wilkinson  
 Model: M2040  
 S/N: 092607B

**Test Equipment:**

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660

**Equipment Under Test (\* = EUT):**

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2040	092607B

**Support Devices:**

Function	Manufacturer	Model #	S/N
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**Test Conditions / Notes:**

EUT is an 802.15.4 transmitter and is operating on the Low, Mid and High channels as noted in the data sheet readings. EUT is transmitting continuously with modulation Channel 0 Low = 2405 MHz, Channel 8 Mid = 2445 MHz, Channel 15 High = 2480 MHz. The temperature was 22.5°C and the humidity was 46%. Frequency range investigated was Carrier RBW = 3 MHz. Measurements made with a new battery installed.

**Transducer Legend:**

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**Measurement Data:** Reading listed by margin. Test Distance: None

#	Freq MHz	Rdng dBµV	dB				Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	2405.000M	103.8					+0.0	103.8	137.0	-33.2	None
Low Channel											
2	2444.620M	103.4					+0.0	103.4	137.0	-33.6	None
Mid Channel											
3	2479.560M	102.2					+0.0	102.2	137.0	-34.8	None
High Channel											

**FCC 15.247(d) – ANTENNA CONDUCTED SPURIOUS EMISSIONS**

**Test Setup Photos**



## Test Data Sheets

Test Location: CKC Laboratories, Inc. • 4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer: **Dust Networks**

Specification: **15.247(d) Dust M2140**

Work Order #: **87117**

Date: 9/26/2007

Test Type: **Maximized Emissions**

Time: 15:24:37

Equipment: **2.4 GHz Wireless Mote**

Sequence#: 2

Manufacturer: Dust Networks

Tested By: Mike Wilkinson

Model: M2140

S/N: 092607A

### Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660

### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	092607A

### Support Devices:

Function	Manufacturer	Model #	S/N
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### Test Conditions / Notes:

EUT is an 802.15.4 transmitter and is operating on the Low, Mid and High channels as noted in the data sheet readings. EUT is transmitting continuously with modulation. Channel 0 Low = 2405 MHz, Channel 8 Mid = 2445 MHz, Channel 15 High = 2480 MHz. The temperature was 22.5°C and the humidity was 46%. Frequency range investigated was 20 to 25000 MHz RBW = 100 kHz VBW = 100 kHz.

### Transducer Legend:

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### Measurement Data:

Reading listed by margin.

Test Distance: None

#	Freq MHz	Rdng dB $\mu$ V	dB				Dist Table	Corr dB $\mu$ V/m	Spec dB $\mu$ V/m	Margin dB	Polar Ant
1	7441.100M	67.6					+0.0	67.6	88.8	-21.2	None
									High Channel		
2	4960.980M	65.8					+0.0	65.8	88.8	-23.0	None
									High Channel		
3	7216.220M	65.5					+0.0	65.5	88.8	-23.3	None
									Low Channel		
4	7336.220M	65.3					+0.0	65.3	88.8	-23.5	None
									Mid Channel		
5	4890.960M	64.5					+0.0	64.5	88.8	-24.3	None
									Mid Channel		
6	4810.960M	55.8					+0.0	55.8	88.8	-33.0	None
									Low Channel		
7	9621.960M	47.3					+0.0	47.3	88.8	-41.5	None
									Low Channel		
8	9917.920M	46.8					+0.0	46.8	88.8	-42.0	None
									High Channel		
9	9781.940M	46.5					+0.0	46.5	88.8	-42.3	None
									Mid Channel		

## FCC 15.247(d) - BAND EDGE

### Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660

### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	092607A

### Support Devices:

Function	Manufacturer	Model #	S/N
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### Test Conditions / Notes:

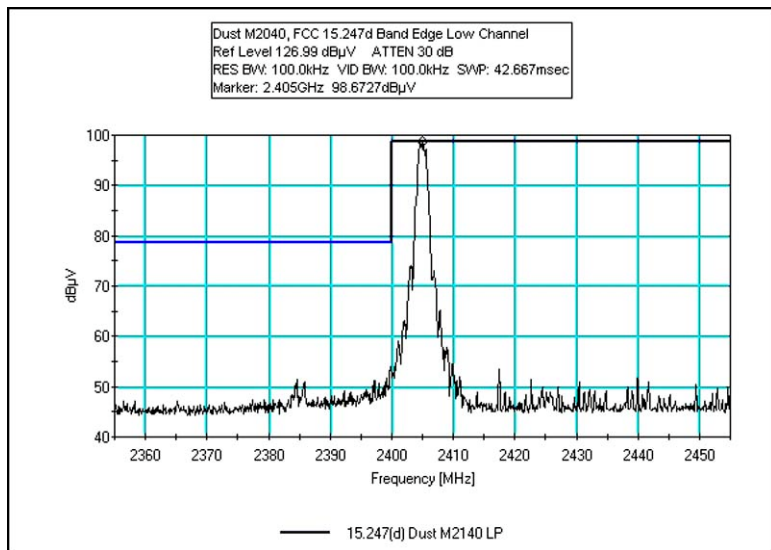
EUT is an 802.15.4 transmitter and is operating on the Low, Mid and High channels. EUT is transmitting continuously with modulation. Channel 0 Low = 2405 MHz, Channel 8 Mid = 2445 MHz, Channel 15 High = 2480 MHz. The temperature was 22.5°C and the humidity was 46%.

### Test Setup Photos



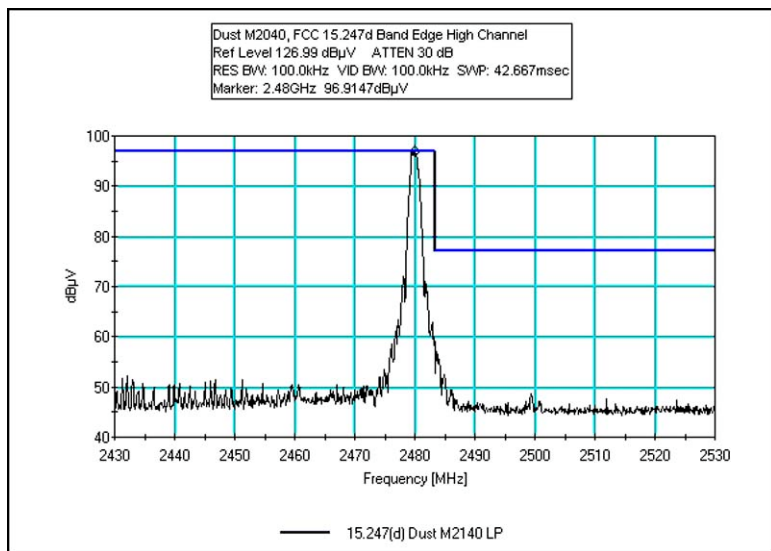
**Test Plots**

**FCC 15.247(d) BAND EDGE - LOW CHANNEL**



M2040

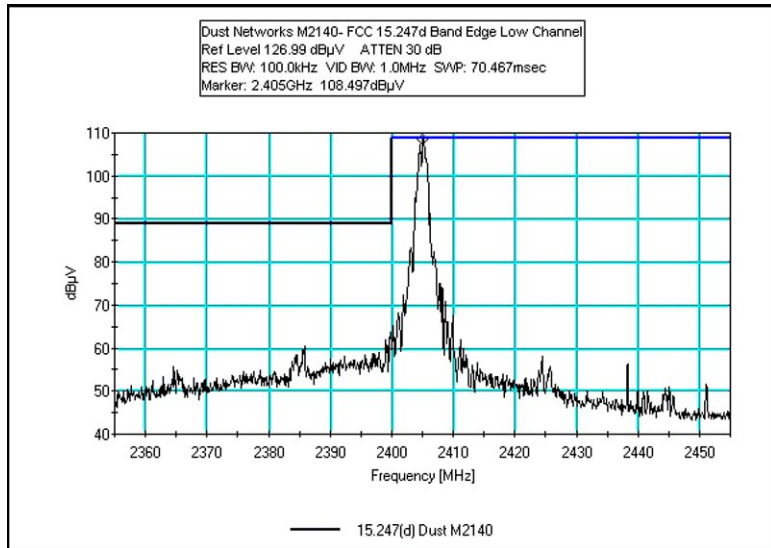
**FCC 15.247(d) BAND EDGE - HIGH CHANNEL**



M2040

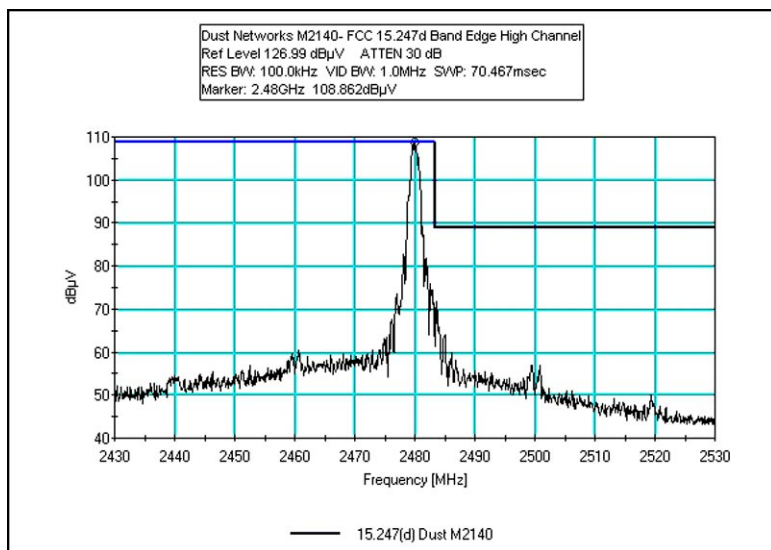


### FCC 15.247(d) BAND EDGE - LOW CHANNEL



M2140

### FCC 15.247(d) BAND EDGE - HIGH CHANNEL



M2140

## FCC 15.247(d) - BAND EDGE OATS TESTING

### Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
Chase CBL6111C Bilog	2456	12/30/2006	12/30/2008	01991
HP 8447D Preamp	1937A02604	03/14/2007	03/14/2009	00099
EMCO 3115 Horn Antenna	8006-3413	03/17/2007	03/17/2009	00327
HP 8449B Preamp	3008A00301	12/13/2006	12/13/2008	2010

### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	092607A

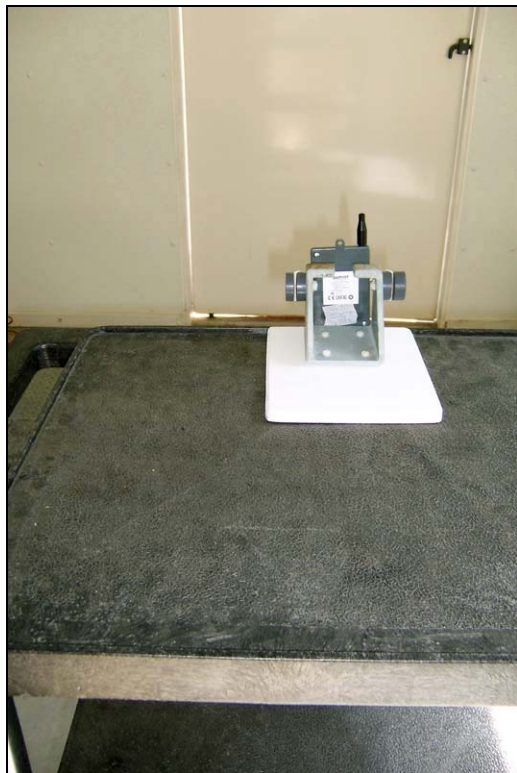
### Support Devices:

Function	Manufacturer	Model #	S/N
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### Test Conditions / Notes:

EUT is an 802.15.4 transmitter and is operating on the Low and High channels as noted in the data sheet readings. EUT is transmitting continuously with modulation Channel 0 Low = 2405 MHz, Channel 15 High = 2480 MHz. The temperature was 22.5°C and the humidity was 46%.

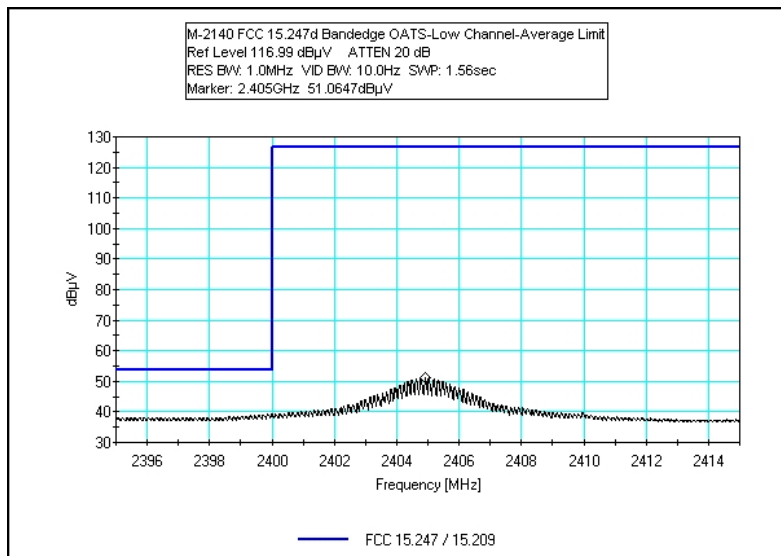
## Test Setup Photos



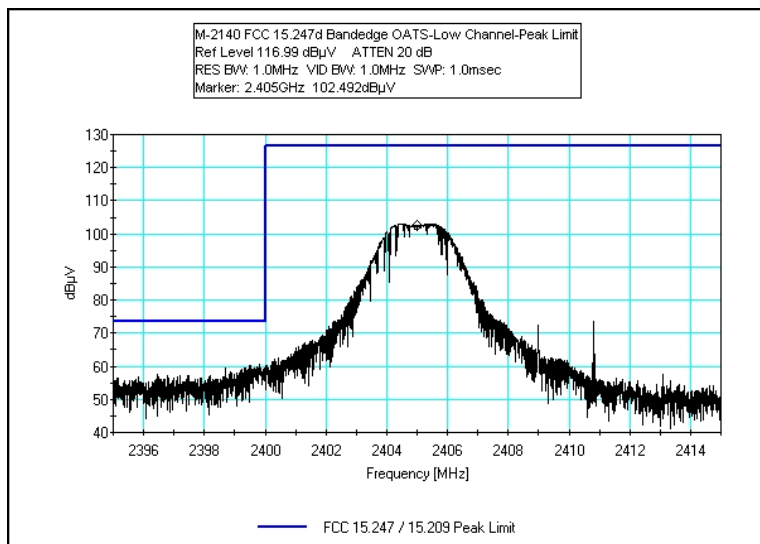


## Test Plots

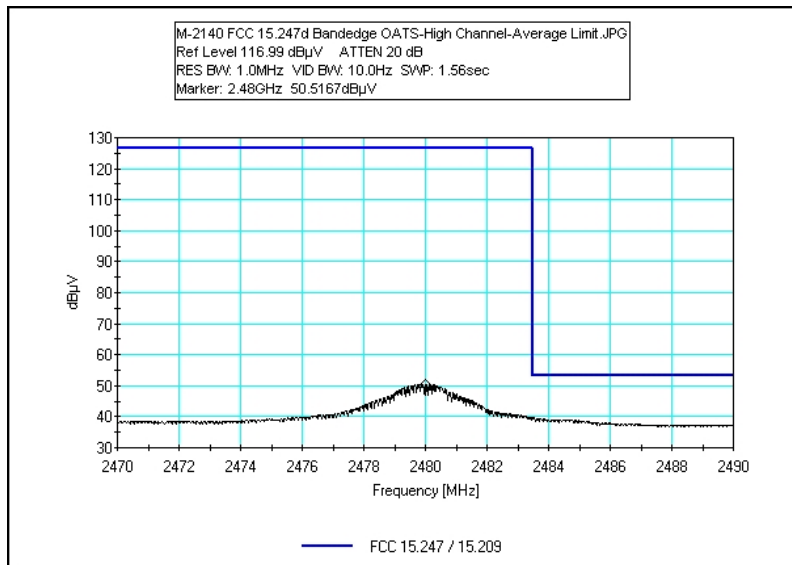
### FCC 15.247(d) BAND EDGE - LOW CHANNEL AVERAGE



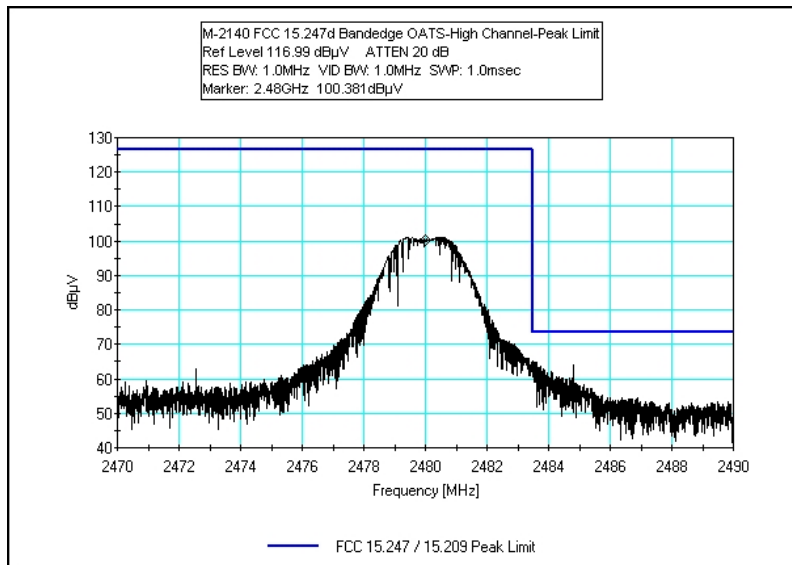
### FCC 15.247(d) BAND EDGE - LOW CHANNEL PEAK



### FCC 15.247(d) BAND EDGE - HIGH CHANNEL AVERAGE



### FCC 15.247(d) BAND EDGE - HIGH CHANNEL PEAK



## FCC 15.247(e) - PEAK POWER SPECTRAL DENSITY

### Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660

### Equipment Under Test (\* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	092607A

### Support Devices:

Function	Manufacturer	Model #	S/N
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### Test Conditions / Notes:

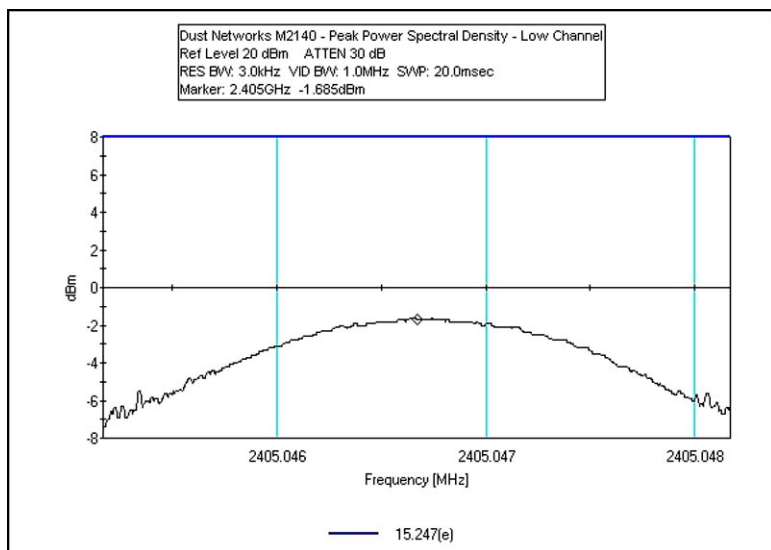
EUT is an 802.15.4 transmitter and is operating on the Low, Mid and High channels. EUT is transmitting continuously with modulation. Channel 0 Low = 2405 MHz, Channel 8 Mid = 2445 MHz, Channel 15 High = 2480 MHz. The temperature was 22.5°C and the humidity was 46%.

### Test Setup Photos



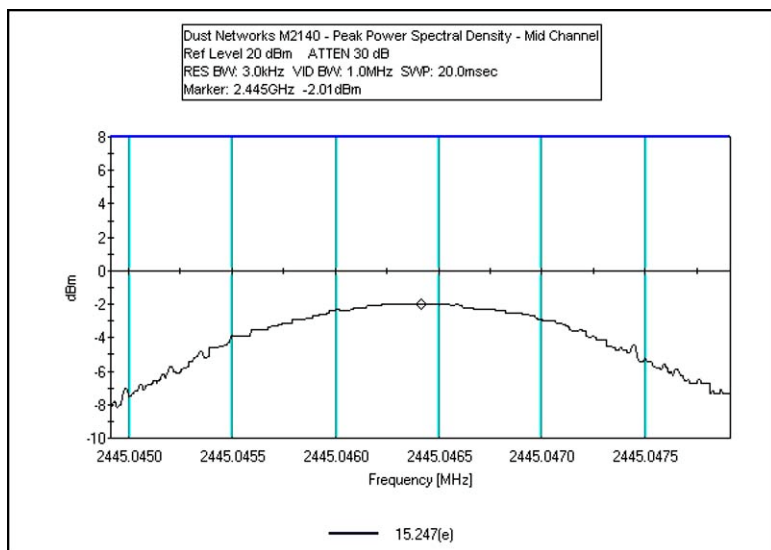
**Test Plots**

**FCC 15.247(e) PEAK POWER SPECTRAL DENSITY - LOW CHANNEL**



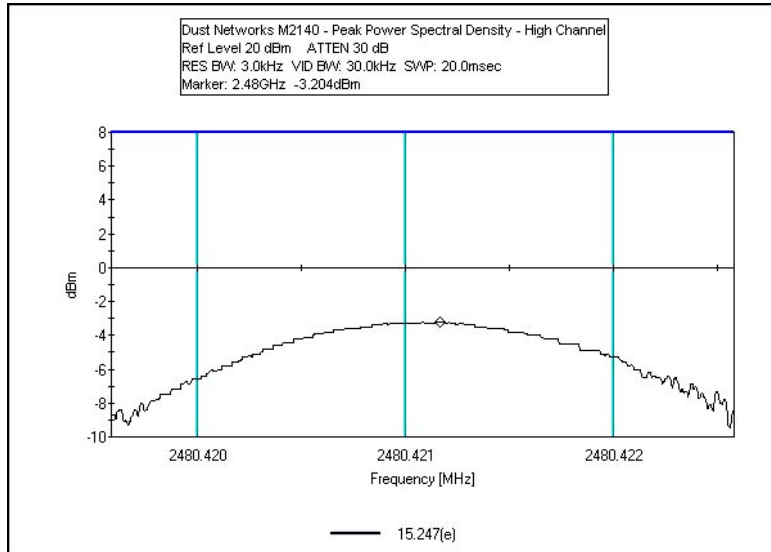
M2140

**FCC 15.247(e) PEAK POWER SPECTRAL DENSITY - MID CHANNEL**



M2140

### FCC 15.247(e) PEAK POWER SPECTRAL DENSITY - HIGH CHANNEL



M2140