

# Dust Networks

## TEST REPORT FOR

**802.15.4 Wireless Mesh Mote  
Model: ETERNA1**

**Tested To The Following Standards:**

**FCC Part 15 Subpart C Sections 15.207, 15.247  
and  
RSS 210 Issue 8**

**Report No.: 93690-12**

**Date of issue: October 23, 2012**



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.

## TABLE OF CONTENTS

Administrative Information .....	3
Test Report Information .....	3
Report Authorization .....	3
Test Facility Information .....	4
Site Registration & Accreditation Information .....	4
Summary of Results .....	5
Conditions During Testing .....	5
Equipment Under Test .....	6
Peripheral Devices .....	6
FCC Part 15 Subpart C .....	7
15.207 AC Conducted Emissions .....	7
-6dBc Occupied Bandwidth / RSS 210 99% Occupied Bandwidth .....	14
15.247(b)(3) RF Power Output .....	18
Bandedge .....	22
15.247(d) Conducted Spurious Emissions .....	26
15.247(d) Radiated Spurious Emissions .....	32
15.247(e) Power Spectral Density .....	39
Supplemental Information .....	43
Measurement Uncertainty .....	43
Emissions Test Details .....	43

## ADMINISTRATIVE INFORMATION

### Test Report Information

**REPORT PREPARED FOR:**

Dust Networks  
30695 Huntwood Avenue  
Hayward, CA 94544

Representative: Gordon Charles  
Customer Reference Number: X9074F

**DATE OF EQUIPMENT RECEIPT:****DATE(S) OF TESTING:****REPORT PREPARED BY:**

Dianne Dudley  
CKC Laboratories, Inc.  
5046 Sierra Pines Drive  
Mariposa, CA 95338

Project Number: 93690

October 8, 2012

October 8-18, 2012

### 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.  
110 Olinda Place  
Brea, CA 92823

## Site Registration & Accreditation Information

Location	CB #	Taiwan	Canada	FCC	Japan
Brea D	US0060	SL2-IN-E-1146R	3082D-2	100638	R-1256 C-1319 T-1660 G-255

## SUMMARY OF RESULTS

### Standard / Specification: FCC Part 15 Subpart C / RSS 210 Issue 8

Description	Test Procedure/Method	Results
Conducted Emissions	FCC Part 15 Subpart C Section 15.207 / ANSI C63.4 (2003)	Pass
-6dBc & 99% Occupied Bandwidth	FCC Part 15 Subpart C Section 15.247(a)(2) / KDB 558074 DO1 DTS MEAS GUIDEANCE / RSS 210 Issue 8	Pass
RF Power Output	FCC Part 15 Subpart C Section 15.247(b)(3) / KDB 558074 DO1 DTS MEAS GUIDEANCE	Pass
Bandedge	FCC Part 15 Subpart C / ITU-R 551 / KDB 558074 DO1 DTS MEAS GUIDEANCE	Pass
Conducted Spurious Emissions	FCC Part 15 Subpart C Section 15.247(d) / KDB 558074 DO1 DTS MEAS GUIDEANCE	Pass
Radiated Spurious Emissions	FCC Part 15 Subpart C Section 15.247(d) / KDB 558074 DO1 DTS MEAS GUIDEANCE	Pass
Power Spectral Density	FCC Part 15 Subpart C 15.247(e) / KD B558074 DO1 DTS MEAS GUIDEANCE	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)**

### **EQUIPMENT UNDER TEST**

#### **802.15.4 Wireless Mesh Mote**

Manuf: Dust Networks

Model: ETERNA1

Serial: 000D67

### **PERIPHERAL DEVICES**

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

#### **Eterna Serial Programmer**

Manuf: Dust Networks

Model: NA

Serial: NA

#### **Laptop**

Manuf: Lenovo

Model: X61

Serial: 7675CTO

## 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.

### 15.207 AC Conducted Emissions

#### Test Data Sheets

Test Location: CKC Laboratories, Inc. • 110 North Olinda Place • Brea, CA 92823 • 714-993-6112

Customer: **Dust Networks**  
 Specification: **15.207 AC Mains - Average**  
 Work Order #: **93690** Date: 10/10/2012  
 Test Type: **Conducted Emissions** Time: 11:12:52  
 Equipment: **802.15.4 Wireless Mesh Mote Module** Sequence#: 6  
 Manufacturer: Dust Networks Tested By: E. Wong  
 Model: ETERNA1 110V 60Hz  
 S/N: 000D67

#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	2/12/2011	2/12/2013
T1	ANP01910	Cable	RG-142	2/6/2012	2/6/2014
T2	ANP06085	Attenuator	SA18N10W-09	12/8/2010	12/8/2012
T3	AN02343	High Pass Filter	HE9615-150K-50-720B	1/4/2011	1/4/2013
T4	AN02128	50uH LISN-L1 (dB)	3816/2NM	8/1/2011	8/1/2013
	AN02128	50uH LISN-L2 (dB)	3816/2NM	8/1/2011	8/1/2013

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

Function	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote	Dust Networks	ETERNA1	000D67

#### Support Devices:

Function	Manufacturer	Model #	S/N
Eterna Serial Programmer	Dust Networks	NA	NA
Laptop	Lenovo	X61	7675CTO

**Test Conditions / Notes:**

<p>ETERNA1</p> <p>The EUT seeking modular approval is installed atop a blank support PCB as intended. Placed on the test bench, the EUT is connected to a support laptop via a section of data cable and Serial Programmer. The Support laptop issues command to exercise the EUT, setting the EUT in continuous transmit mode.</p> <p>Modulation: 802.15.4</p> <p>Freq range: 2405-2475MHz</p> <p>Freq: 2440MHz</p> <p>Firmware power setting = 8dBm</p> <p>Frequency range of measurement = 150kHz- 30MHz.</p> <p>150 kHz-30 MHz; RBW=9 kHz, VBW=9kHz</p> <p>Test environment conditions: 21°C, 52% Relative Humidity, 100kPa</p>
---

Ext Attn: 0 dB

**Measurement Data:**

Reading listed by margin.

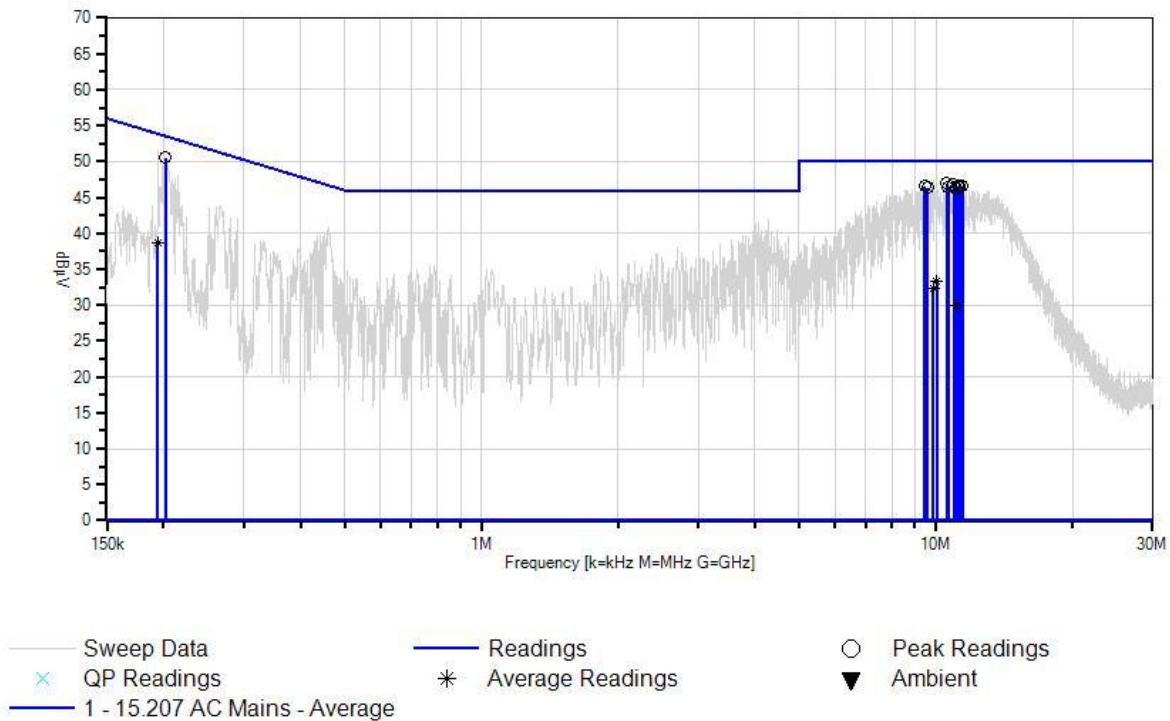
Test Lead: Black

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	201.632k	44.6	+0.1	+5.7	+0.1	+0.0	+0.0	50.5	53.5	-3.0	Black
2	10.562M	40.2	+0.3	+5.7	+0.2	+0.5	+0.0	46.9	50.0	-3.1	Black
3	10.950M	39.9	+0.3	+5.7	+0.2	+0.6	+0.0	46.7	50.0	-3.3	Black
4	11.247M	39.8	+0.3	+5.7	+0.2	+0.6	+0.0	46.6	50.0	-3.4	Black
5	11.445M	39.8	+0.3	+5.7	+0.2	+0.6	+0.0	46.6	50.0	-3.4	Black
6	11.166M	39.8	+0.3	+5.7	+0.2	+0.6	+0.0	46.6	50.0	-3.4	Black
7	9.454M	39.9	+0.3	+5.7	+0.2	+0.5	+0.0	46.6	50.0	-3.4	Black
8	10.643M	39.8	+0.3	+5.7	+0.2	+0.5	+0.0	46.5	50.0	-3.5	Black
9	11.292M	39.7	+0.3	+5.7	+0.2	+0.6	+0.0	46.5	50.0	-3.5	Black
10	9.598M	39.7	+0.3	+5.7	+0.2	+0.5	+0.0	46.4	50.0	-3.6	Black
11	11.121M	39.5	+0.3	+5.7	+0.2	+0.6	+0.0	46.3	50.0	-3.7	Black
12	194.360k	32.6	+0.1	+5.7	+0.2	+0.0	+0.0	38.6	53.8	-15.2	Black
Ave											
^	194.360k	45.5	+0.1	+5.7	+0.2	+0.0	+0.0	51.5	53.8	-2.3	Black
14	10.049M	26.7	+0.3	+5.7	+0.2	+0.5	+0.0	33.4	50.0	-16.6	Black
Ave											
^	10.049M	40.4	+0.3	+5.7	+0.2	+0.5	+0.0	47.1	50.0	-2.9	Black
16	9.869M	25.7	+0.3	+5.7	+0.2	+0.5	+0.0	32.4	50.0	-17.6	Black
Ave											



^	9.869M	40.7	+0.3	+5.7	+0.2	+0.5	+0.0	47.4	50.0	-2.6	Black
18	11.067M	23.1	+0.3	+5.7	+0.2	+0.6	+0.0	29.9	50.0	-20.1	Black
Ave											
^	11.067M	40.5	+0.3	+5.7	+0.2	+0.6	+0.0	47.3	50.0	-2.7	Black

Date: 10/10/2012 Time: 11:12:52 Dust Networks WO#: 93690  
15.207 AC Mains - Average Test Lead: Black 110V 60Hz Sequence#: 6 Ext ATTN: 0 dB



Test Location: CKC Laboratories, Inc. • 110 North Olinda Place • Brea, CA 92823 • 714-993-6112

Customer: **Dust Networks**  
 Specification: **15.207 AC Mains - Average**  
 Work Order #: **93690** Date: 10/10/2012  
 Test Type: **Conducted Emissions** Time: 11:17:48  
 Equipment: **802.15.4 Wireless Mesh Mote** Sequence#: 7  
 Manufacturer: Dust Networks Tested By: E. Wong  
 Model: ETERNA1 110V 60Hz  
 S/N: 000D67

**Test Equipment:**

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	2/12/2011	2/12/2013
T1	ANP01910	Cable	RG-142	2/6/2012	2/6/2014
T2	ANP06085	Attenuator	SA18N10W-09	12/8/2010	12/8/2012
T3	AN02343	High Pass Filter	HE9615-150K-50-720B	1/4/2011	1/4/2013
	AN02128	50uH LISN-L1 (dB)	3816/2NM	8/1/2011	8/1/2013
T4	AN02128	50uH LISN-L2 (dB)	3816/2NM	8/1/2011	8/1/2013

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

Function	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote*	Dust Networks	ETERNA1	000D67

**Support Devices:**

Function	Manufacturer	Model #	S/N
Eterna Serial Programmer	Dust Networks	NA	NA
Laptop	Lenovo	X61	7675CTO

**Test Conditions / Notes:**

ETERNA1  
 The EUT seeking modular approval is installed atop a blank support PCB as intended. Placed on the test bench, the EUT is connected to a support laptop via a section of data cable and Serial Programmer. The Support laptop issues command to exercise the EUT, setting the EUT in continuous transmit mode.

Modulation: 802.15.4  
 Freq range: 2405-2475MHz

Freq: 2440MHz  
 Firmware power setting = 8dBm

Frequency range of measurement = 150kHz- 30MHz.  
 150 kHz-30 MHz; RBW=9 kHz, VBW=9kHz

Test environment conditions: 21°C, 52% Relative Humidity, 100kPa

Ext Attn: 0 dB

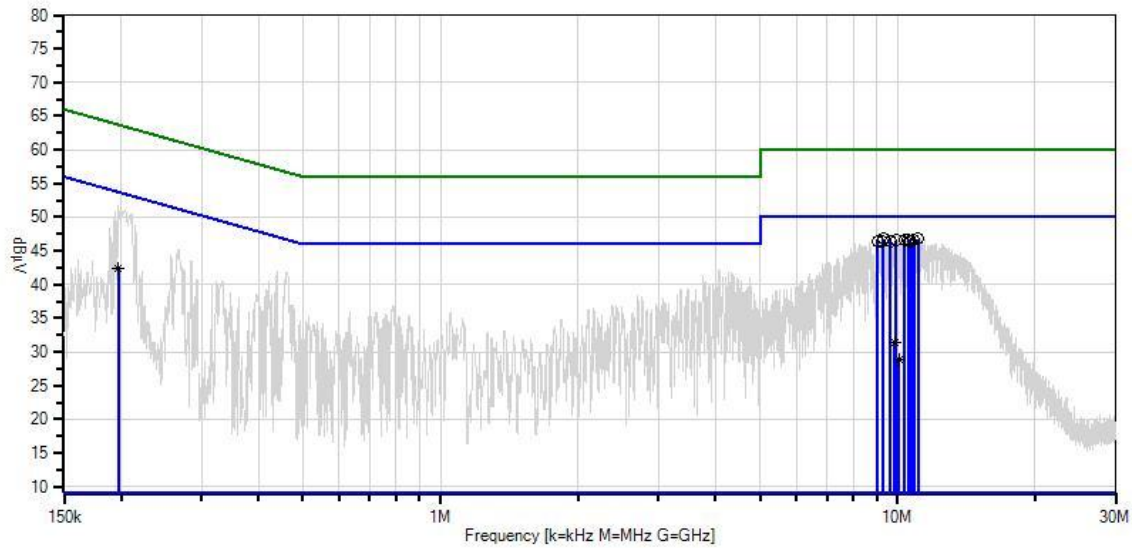
**Measurement Data:**

Reading listed by margin.

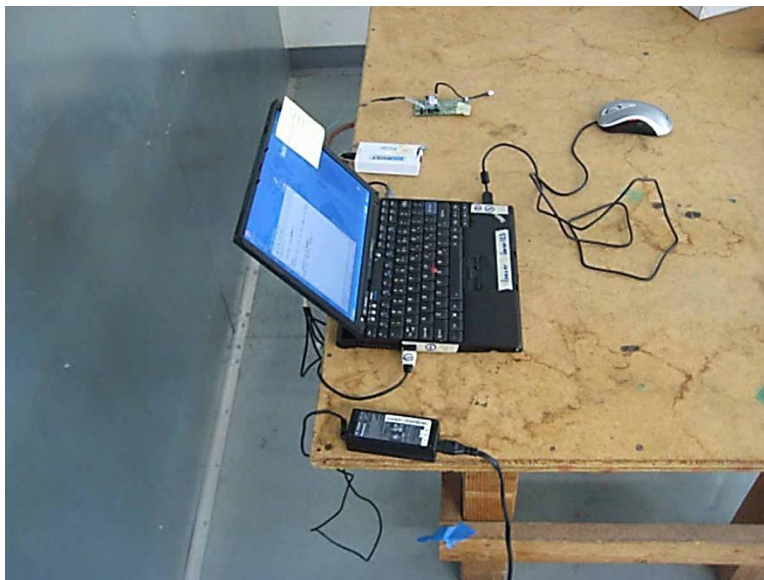
Test Lead: White

#	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	9.301M	40.0	+0.3	+5.7	+0.2	+0.6	+0.0	46.8	50.0	-3.2	White
2	11.112M	39.9	+0.3	+5.7	+0.2	+0.7	+0.0	46.8	50.0	-3.2	White
3	10.346M	39.9	+0.3	+5.7	+0.2	+0.6	+0.0	46.7	50.0	-3.3	White
4	10.544M	39.9	+0.3	+5.7	+0.2	+0.6	+0.0	46.7	50.0	-3.3	White
5	10.851M	39.7	+0.3	+5.7	+0.2	+0.7	+0.0	46.6	50.0	-3.4	White
6	9.923M	39.8	+0.3	+5.7	+0.2	+0.6	+0.0	46.6	50.0	-3.4	White
7	9.058M	39.8	+0.3	+5.7	+0.2	+0.5	+0.0	46.5	50.0	-3.5	White
8	9.265M	39.7	+0.3	+5.7	+0.2	+0.6	+0.0	46.5	50.0	-3.5	White
9	9.661M	39.7	+0.3	+5.7	+0.2	+0.6	+0.0	46.5	50.0	-3.5	White
10	10.589M	39.6	+0.3	+5.7	+0.2	+0.6	+0.0	46.4	50.0	-3.6	White
11	10.697M	39.6	+0.3	+5.7	+0.2	+0.6	+0.0	46.4	50.0	-3.6	White
12	197.268k	36.4	+0.1	+5.7	+0.1	+0.0	+0.0	42.3	53.7	-11.4	White
Ave											
^	197.268k	45.8	+0.1	+5.7	+0.1	+0.0	+0.0	51.7	53.7	-2.0	White
^	193.632k	45.0	+0.1	+5.7	+0.2	+0.0	+0.0	51.0	53.9	-2.9	White
15	9.869M	24.5	+0.3	+5.7	+0.2	+0.6	+0.0	31.3	50.0	-18.7	White
Ave											
^	9.869M	40.4	+0.3	+5.7	+0.2	+0.6	+0.0	47.2	50.0	-2.8	White
17	10.085M	22.1	+0.3	+5.7	+0.2	+0.6	+0.0	28.9	50.0	-21.1	White
Ave											
^	10.085M	40.4	+0.3	+5.7	+0.2	+0.6	+0.0	47.2	50.0	-2.8	White

Date: 10/10/2012 Time: 11:17:48 Dust Networks WO#: 93690  
15.207 AC Mains - Average Test Lead: White 110V 60Hz Sequence#: 7 Ext ATTN: 0 dB



**Test Setup Photos**



## -6dBc Occupied Bandwidth / RSS 210 99% Occupied Bandwidth

### Test Conditions / Setup

Customer: **Dust Networks**  
 Specification: **-6 dB Bandwidth / RSS 210 99% Bandwidth**  
 Work Order #: **93690** Date: 10/10/2012  
 Test Type: **Conducted Emissions** Time: 13:19:00  
 Equipment: **802.15.4 Wireless Mesh Mote** Sequence#: 2  
 Manufacturer: Dust Networks Tested By: E. Wong  
 Model: ETERNA1 110V 60Hz  
 S/N: 000D67

#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	2/12/2011	2/12/2013
T3	AN02946	Cable	32022-2-2909K-36TC	8/8/2011	8/8/2013

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

Function	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote*	Dust Networks	ETERNA1	000D67

#### Support Devices:

Function	Manufacturer	Model #	S/N
Eterna Serial Programmer	Dust Networks	NA	NA
Laptop	Lenovo	X61	7675CTO

#### Test Conditions / Notes:

The EUT seeking modular approval is installed atop a blank support PCB as intended. Placed on the test bench, the EUT is connected to a support laptop via a section of data cable and Serial Programmer. The Support laptop issues command to exercise the EUT, setting the EUT in continuous transmit mode. Emission profile measured at the antenna port.

Modulation: 802.15.4

Freq range: 2405-2475MHz

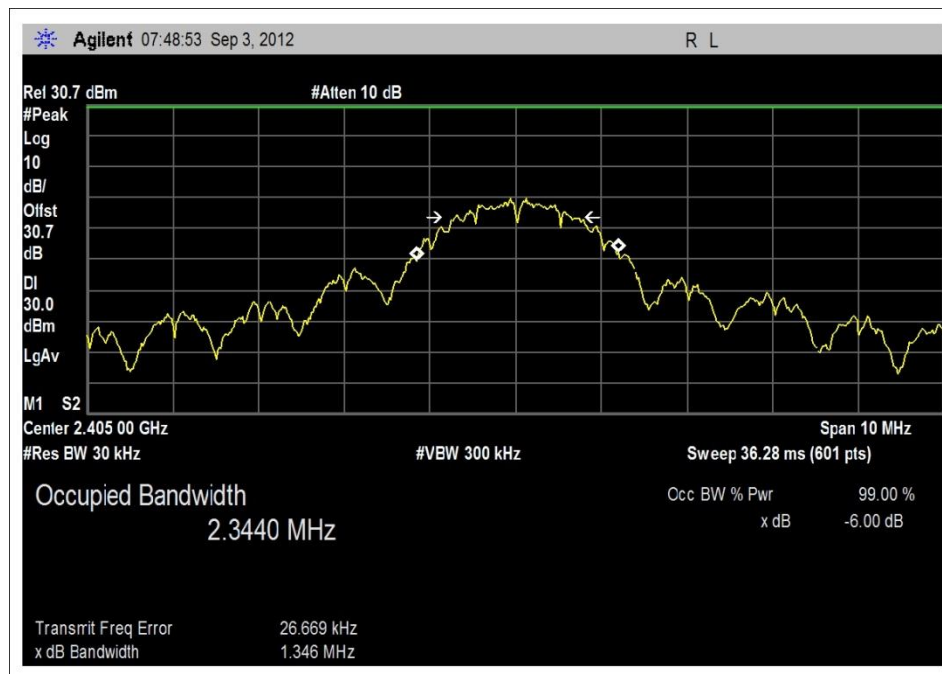
Freq: 2405MHz, 2440MHz, 2475MHz

Firmware power setting = 8dBm

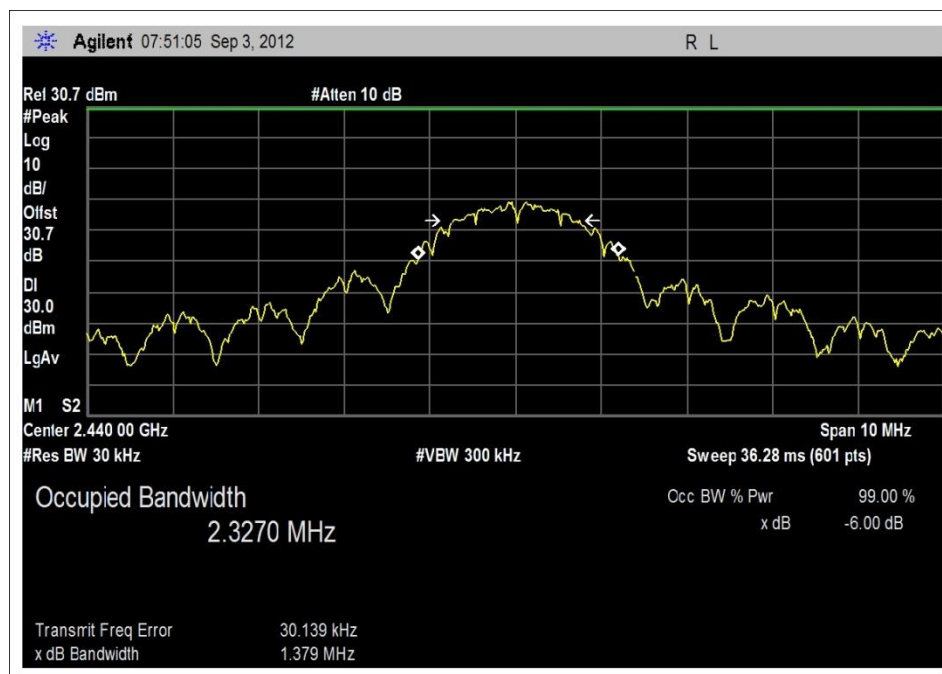
Measurement procedure In Accordance With FCC document KDB558074 D01 DTS Meas Guidance V02, 7.1

Test environment conditions: 21°C, 52% Relative Humidity, 100kPa

### Test Plots

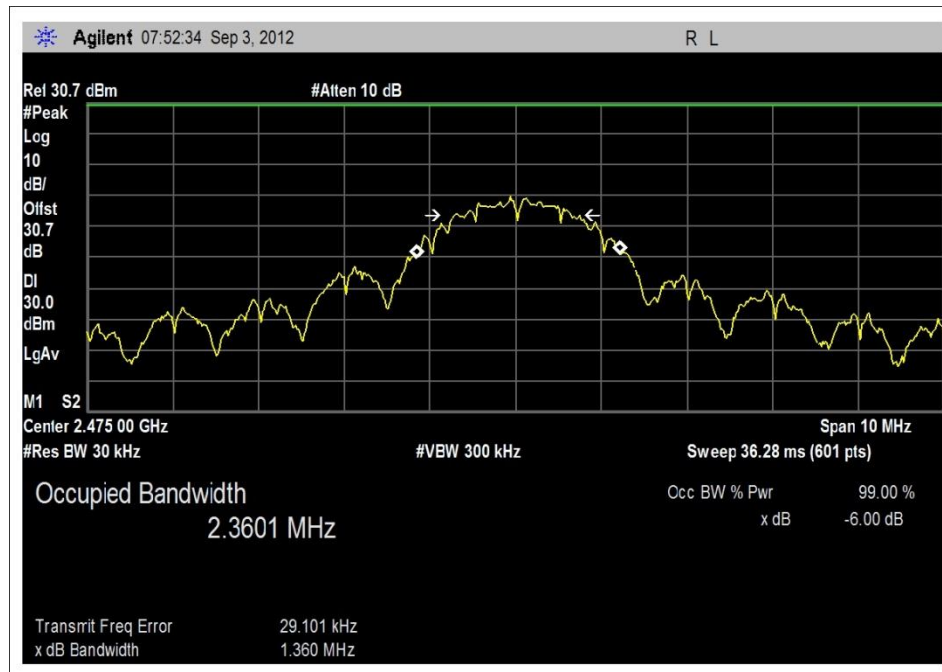


2405MHz



2440MHz

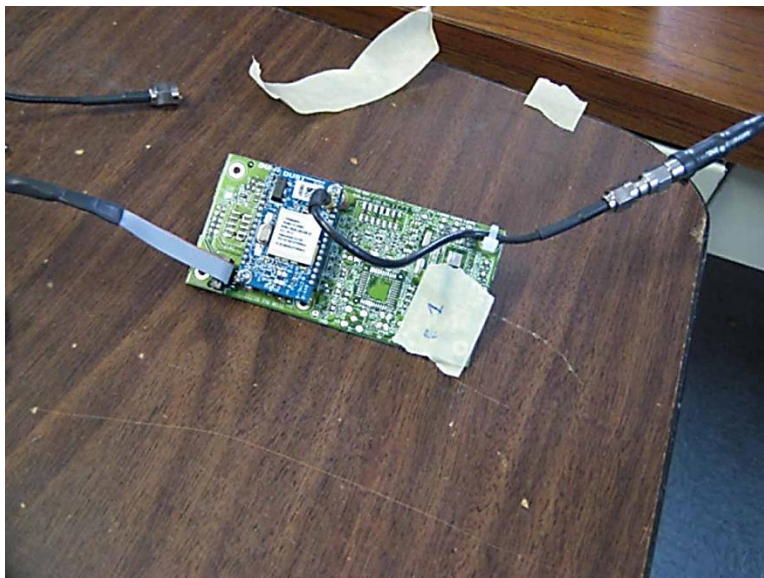




2475MHz



**Test Setup Photos**



## 15.247(b)(3) RF Power Output

### Test Conditions / Setup

Customer: **Dust Networks**  
 Specification: **RF Output Power**  
 Work Order #: **93690**  
 Test Type: **Conducted Emissions**  
 Equipment: **802.15.4 Wireless Mesh Mote**  
 Manufacturer: **Dust Networks**  
 Model: **ETERNA1**  
 S/N: **000D67**

Date: 10/10/2012  
 Time: 13:19:00  
 Sequence#: 2  
 Tested By: E. Wong  
 110V 60Hz

### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	2/12/2011	2/12/2013
T3	AN02946	Cable	32022-2-2909K-36TC	8/8/2011	8/8/2013

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

Function	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote*	Dust Networks	ETERNA1	000D67

### Support Devices:

Function	Manufacturer	Model #	S/N
Eterna Serial Programmer	Dust Networks	NA	NA
Laptop	Lenovo	X61	7675CTO

### Test Conditions / Notes:

The EUT seeking modular approval is installed atop a blank support PCB as intended. Placed on the test bench, the EUT is connected to a support laptop via a section of data cable and Serial Programmer. The Support laptop issues command to exercise the EUT, setting the EUT in continuous transmit mode. Emission profile measured at the antenna port.

Modulation: 802.15.4

Freq range: 2405-2475MHz

Firmware power setting = 8dBm

Measurement procedure In Accordance With FCC document KDB558074 D01 DTS Meas Guidance V02, 8.1.1

2405MHz = 8.03dBm **(0.0064W)**

2440MHz = 8.00dBm **(0.0063W)**

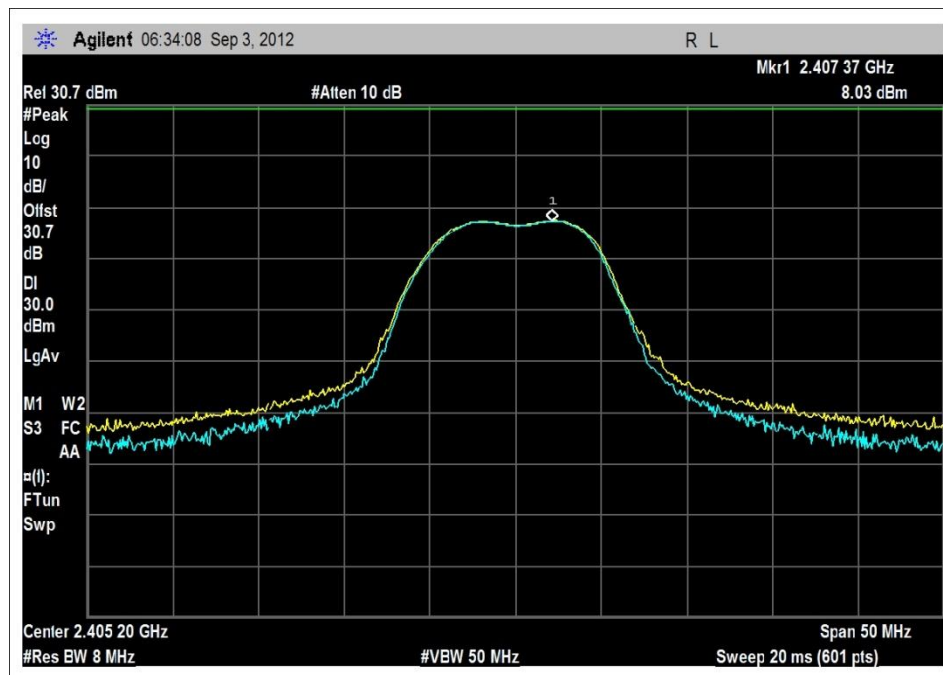
2475MHz = 7.99dBm **(0.0063W)**

Test environment conditions: 21°C, 52% Relative Humidity, 100kPa

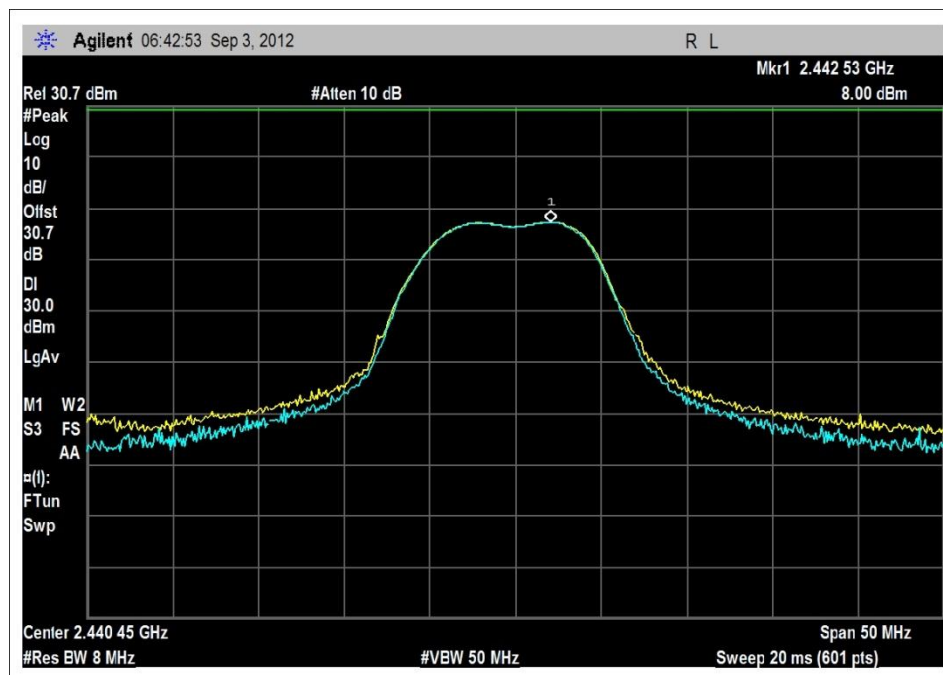
15.31(e) compliance: the supply voltage was varied between 85% and 115% of the nominal rated supply voltage, the following change in the Fundamental signal level was observed.

	2405MHz			2445 MHz			2475MHz		
3.45V	8.46 dBm	0.0070W		8.68 dBm	0.0074W		8.79dBm	0.0076W	
3.00V	8.03 dBm	0.0063W		8.00 dBm	0.0063W		7.99dBm	0.0063W	
2.55V	6.06 dBm	0.0040W		6.29 dBm	0.0043W		6.35dBm	0.0043W	

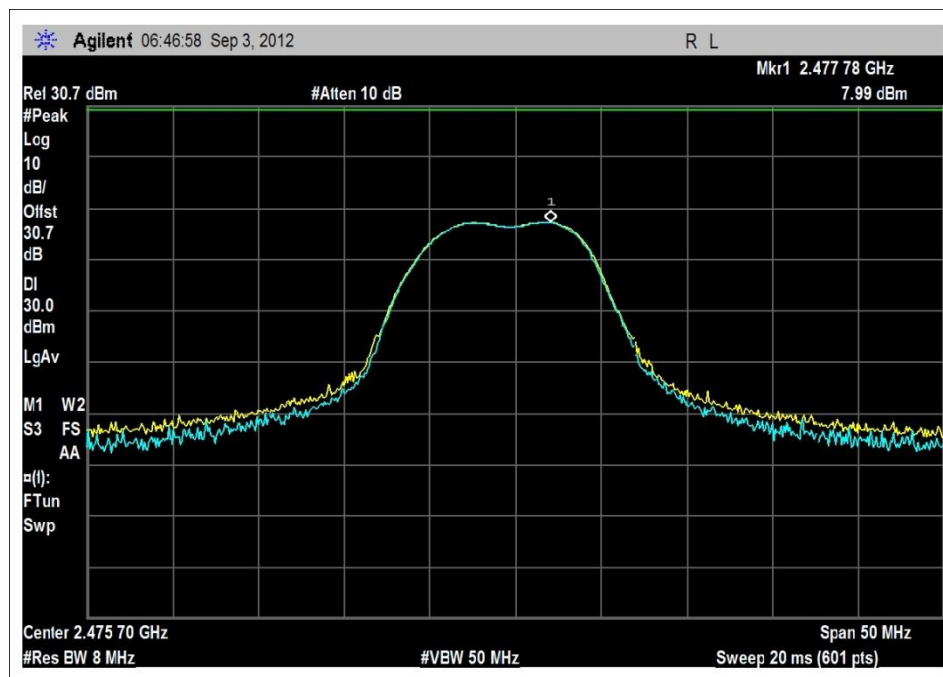
### Test Data



2405MHz



2440MHz



2475MHz

**Test Setup Photos**





## Bandedge

### Test Conditions / Setup

Customer: **Dust Networks**  
 Specification: **Bandedge plot**  
 Work Order #: **93690**  
 Test Type: **Conducted Emissions**  
 Equipment: **802.15.4 Wireless Mesh Mote**  
 Manufacturer: **Dust Networks**  
 Model: **ETERNA1**  
 S/N: **000D67**

Date: 10/10/2012  
 Time: 13:19:00  
 Sequence#: 2  
 Tested By: E. Wong  
 110V 60Hz

### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	2/12/2011	2/12/2013
T3	AN02946	Cable	32022-2-2909K-36TC	8/8/2011	8/8/2013

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

Function	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote*	Dust Networks	ETERNA1	000D67

### Support Devices:

Function	Manufacturer	Model #	S/N
Eterna Serial Programmer	Dust Networks	NA	NA
Laptop	Lenovo	X61	7675CTO

### Test Conditions / Notes:

The EUT seeking modular approval is installed atop a blank support PCB as intended. Placed on the test bench, the EUT is connected to a support laptop via a section of data cable and Serial Programmer. The Support laptop issues command to exercise the EUT, setting the EUT in continuous transmit mode. Emission profile measured at the antenna port.

Modulation: 802.15.4

Freq range: 2405-2475MHz

Freq: 2405MHz, 2440MHz, 2475MHz

Firmware power setting = 8dBm

Uncorrected Rdng is in dBm

$E(\text{dBuV/m}) = \text{EIRP}(\text{dBm}) - 20 \log(d) + 104.8$

$\text{EIRP} = \text{Conducted power} + \text{Antenna gain}$

This data sheet includes

Duty cycle correction factor of  $-20 \log 27/100 = -11.3\text{dB}$

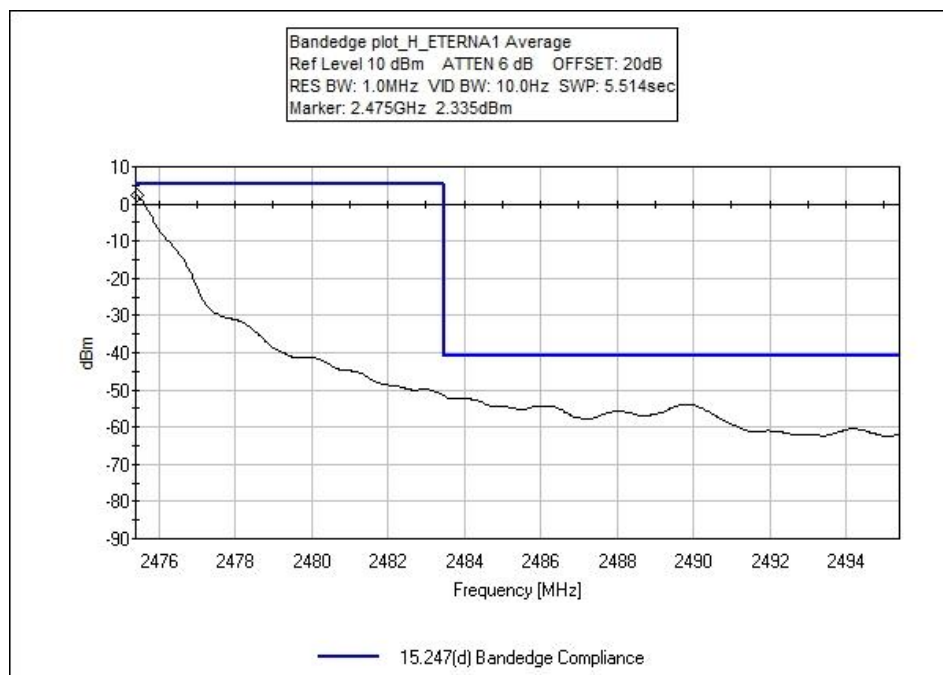
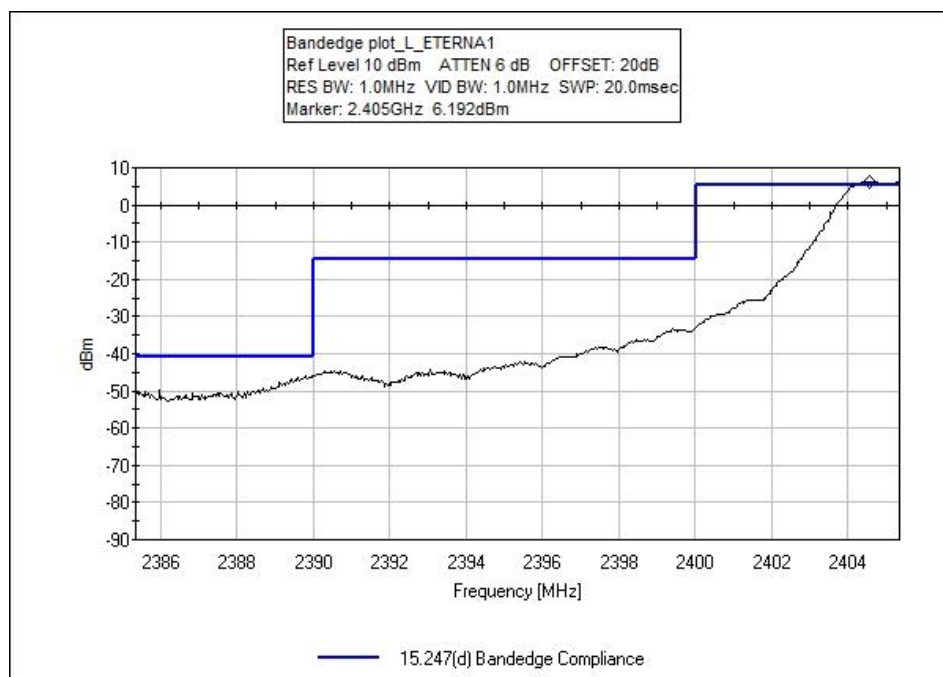
Antenna Gain of 6.6dBi

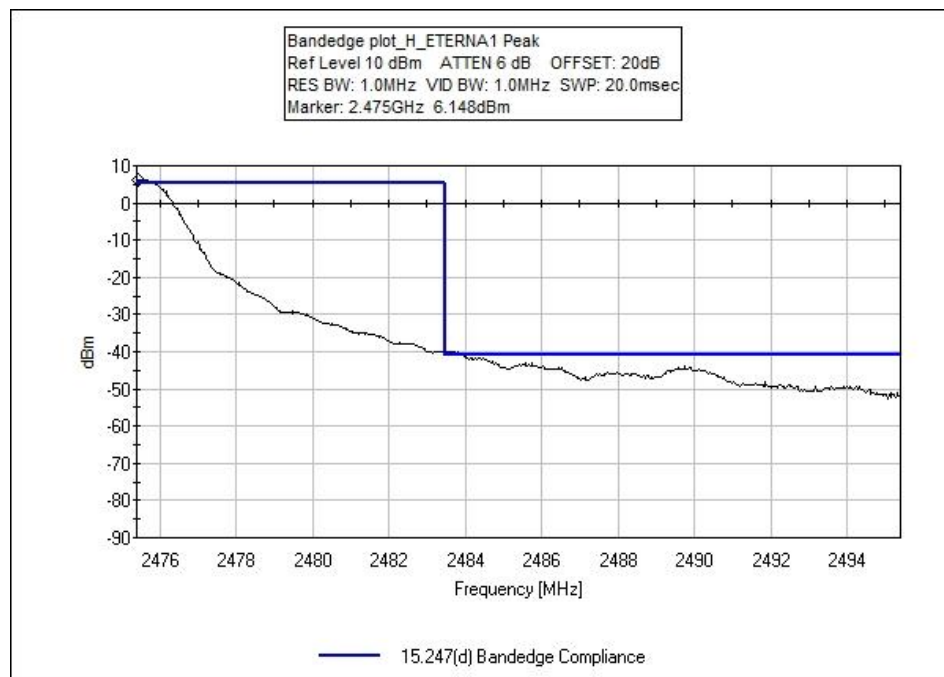
Conducted power to radiated field correction factor of 55.3dB (300meter), 75.3 dB(30 Meter), 95.3 dB( 3 meter).

Ground reflection factor of 6dB ( 9kHz-30MHz), 4.7dB (30 - 1000) MHz, 0 dB 1000-25000MHz

Test environment conditions: 21°C, 52% Relative Humidity, 100kPa

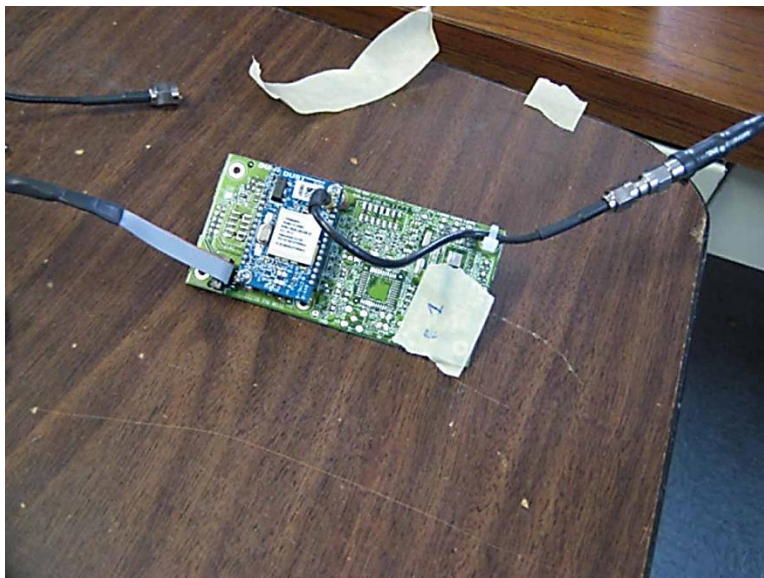
### Test Data







**Test Setup Photos**



## 15.247(d) Conducted Spurious Emissions

### Test Data Sheets

Test Location: CKC Laboratories, Inc. • 110 North Olinda Place • Brea, CA 92823 • 714-993-6112

Customer: **Dust Networks**

Specification: **15.247(d) / 15.209 Conducted Spurious Emissions**

Work Order #: **93690**

Date: 10/10/2012

Test Type: **Conducted Emissions**

Time: 13:19:00

Equipment: **802.15.4 Wireless Mesh Mote**

Sequence#: 2

Manufacturer: Dust Networks

Tested By: E. Wong

Model: ETERNA1

110V 60Hz

S/N: 000D67

#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	2/12/2011	2/12/2013
T1	ANConducted	Test Data		NCR	NCR
	Power to Radiated	Adjustment			
	Field conversion				
	factor				
T2	ANGND	Test Data		NCR	NCR
	reflection_CORR	Adjustment			
T3	AN02946	Cable	32022-2-2909K-36TC	8/8/2011	8/8/2013
T4	AN02744	High Pass Filter	11SH10-3000/T10000-O/O	6/13/2012	6/13/2014
T5	AN_Duty Cycle	Duty Cycle		NCR	NCR
	Correction	Correction Factor			
T6	AN6.6dBi	Test Data		NCR	NCR
	Antenna_CORR	Adjustment			

NCR= No Calibration Required.

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

Function	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote*	Dust Networks	ETERNA1	000D67

#### Support Devices:

Function	Manufacturer	Model #	S/N
Eterna Serial Programmer	Dust Networks	NA	NA
Laptop	Lenovo	X61	7675CTO

# **Test Conditions / Notes:**

The EUT seeking modular approval is installed atop a blank support PCB as intended. Placed on the test bench, the EUT is connected to a support laptop via a section of data cable and Serial Programmer. The Support laptop issues command to exercise the EUT, setting the EUT in continuous transmit mode. Emission profile measured at the antenna port.

Modulation: 802.15.4

Freq range: 2405-2475MHz

Freq: 2405MHz, 2440MHz, 2475MHz

Firmware power setting = 8dBm

EIRP Measurement procedure In Accordance With FCC document KDB558074 D01 DTS Meas Guidance V02, 8.1

This data is only valid for the transmitter using antenna with antenna gain not to exceed 6.6dBi

Frequency range of measurement = 9 kHz- 25GHz.

9kHz -150 kHz; RBW=200 Hz, VBW=200 Hz; 150 kHz-30 MHz; RBW=9 kHz, VBW=9 kHz;30 MHz-1000 MHz; RBW=120 kHz, VBW=120 kHz,1000 MHz-25000 MHz; RBW=1 MHz, VBW=1 MHz.

Test environment conditions: 21°C, 52% Relative Humidity, 100kPa

Uncorrected Rdng is in dBm

$E(dBuV/m) = EIRP(dBm) - 20 \log(d) + 104.8$

$EIRP = \text{Conducted power} + \text{Antenna gain}$

This data sheet includes

Duty cycle correction factor of  $-20 \log 27/100 = -11.3dB$

Antenna Gain of 6.6dBi

Conducted power to radiated field correction factor of 55.3dB (300meter), 75.3 dB (30 Meter), 95.3 dB ( 3 meter).

Ground reflection factor of 6dB ( 9kHz-30MHz), 4.7dB (30 - 1000) MHz, 0 dB 1000-25000MHz

Ext Attn: 0 dB

## **Measurement Data:**

Reading listed by margin.

Test Lead: Ant Port

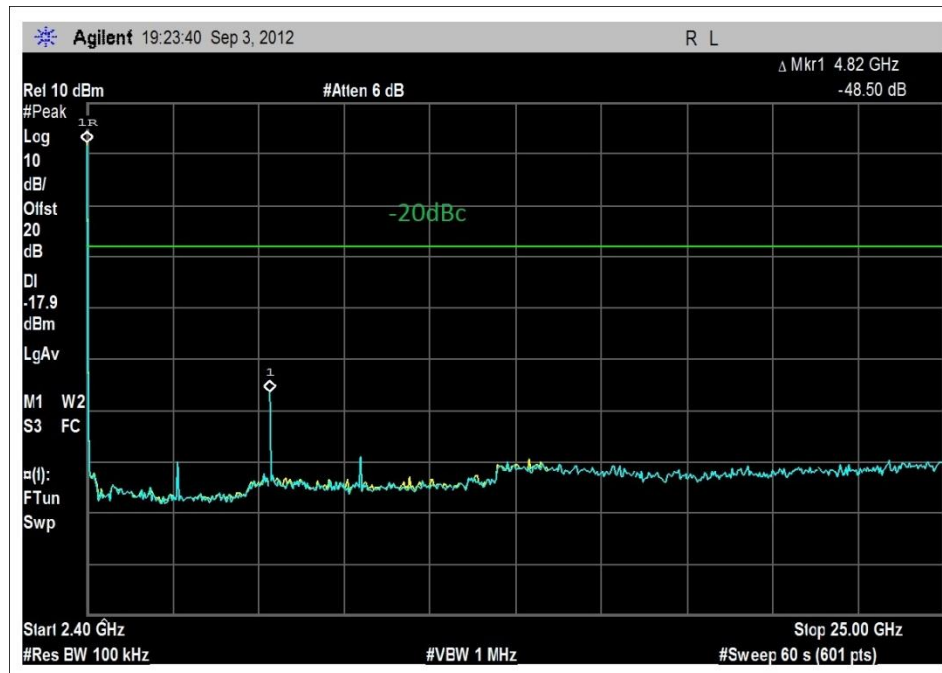
#	Freq MHz	Rdng dBμV	T1 T5 dB	T2 T6 dB	T3 dB	T4 dB	Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	7318.667M	-38.3	+95.3	+0.0	+1.2	+0.4	+0.0	53.9	54.0	-0.1	Ant P
	Ave		-11.3	+6.6							
^	7318.667M	-30.9	+95.3	+0.0	+1.2	+0.4	+0.0	61.3	54.0	+7.3	Ant P
			-11.3	+6.6							
3	4879.233M	-45.7	+95.3	+0.0	+1.0	+0.6	+0.0	46.5	54.0	-7.5	Ant P
	Ave		-11.3	+6.6							
^	4879.233M	-38.9	+95.3	+0.0	+1.0	+0.6	+0.0	53.3	54.0	-0.7	Ant P
			-11.3	+6.6							
5	4949.033M	-49.3	+95.3	+0.0	+1.0	+0.5	+0.0	42.8	54.0	-11.2	Ant P
	Ave		-11.3	+6.6							
^	4949.033M	-42.7	+95.3	+0.0	+1.0	+0.5	+0.0	49.4	54.0	-4.6	Ant P
			-11.3	+6.6							
7	7423.600M	-51.6	+95.3	+0.0	+1.2	+0.4	+0.0	40.6	54.0	-13.4	Ant P
	Ave		-11.3	+6.6							
^	7423.600M	-44.5	+95.3	+0.0	+1.2	+0.4	+0.0	47.7	54.0	-6.3	Ant P
			-11.3	+6.6							

9	12197.667 M	-63.0	+95.3 -11.3	+0.0 +6.6	+1.6	+0.3	+0.0	29.5	54.0	-24.5	Ant P
10	4809.170M	-65.5	+95.3 -11.3	+0.0 +6.6	+1.0	+0.6	+0.0	26.7	54.0	-27.3	Ant P
11	12027.333 M Ave	-72.5	+95.3 -11.3	+0.0 +6.6	+1.6	+0.4	+0.0	20.1	54.0	-33.9	Ant P
^	12027.333 M	-64.1	+95.3 -11.3	+0.0 +6.6	+1.6	+0.4	+0.0	28.5	54.0	-25.5	Ant P
13	4810.000M Ave	-78.3	+95.3 -11.3	+0.0 +6.6	+1.0	+0.6	+0.0	13.9	54.0	-40.1	Ant P

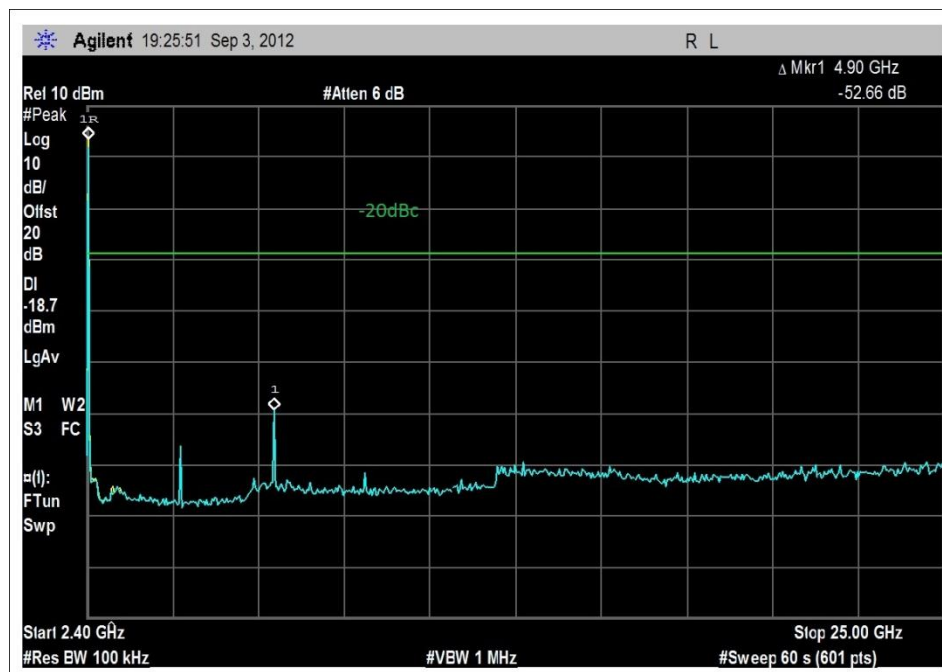
Date: 10/10/2012 Time: 13:19:00 Dust Networks WO#: 93690  
15.247(d) / 15.209 Conducted Spurious Emissions Test Lead: Ant Port 110V 60Hz Sequence#: 2 Ext ATTN: 0 dB



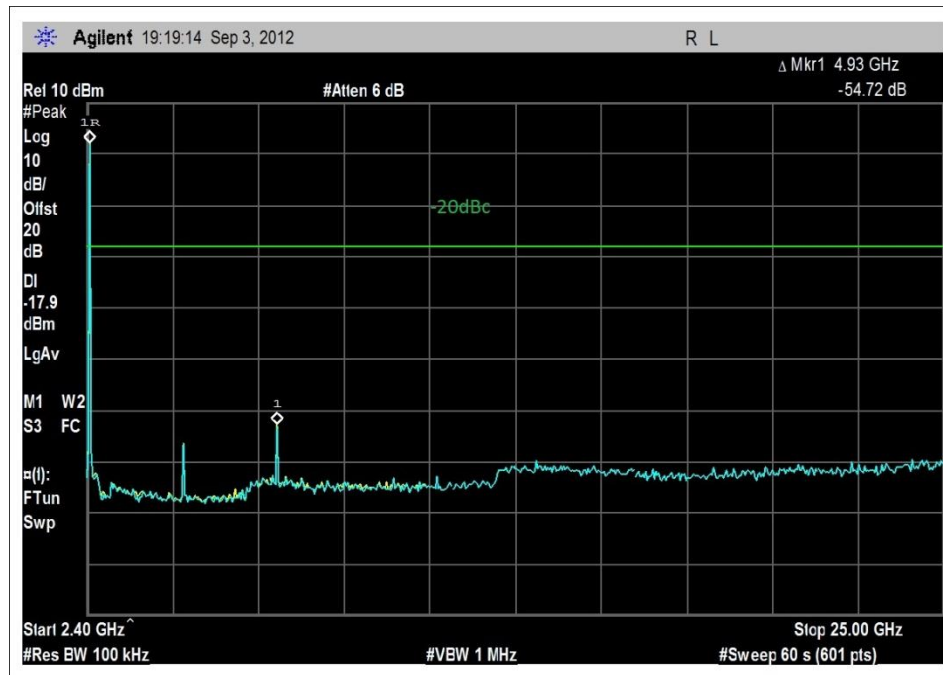
- Sweep Data
- Readings
- Peak Readings
- × QP Readings
- \* Average Readings
- ▼ Ambient
- 1 - 15.247(d) / 15.209 Conducted Spurious Emissions



2405MHz



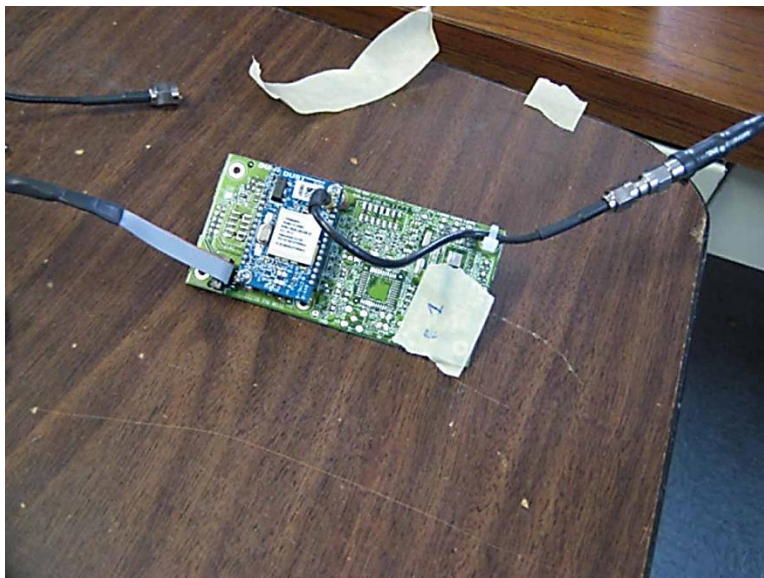
2440MHz



2475MHz



**Test Setup Photos**



## 15.247(d) Radiated Spurious Emissions

### Test Data Sheets

Test Location: CKC Laboratories, Inc. • 110 North Olinda Place • Brea, CA 92823 • 714-993-6112

Customer: **Dust Networks**

Specification: **15.247(d) / 15.209 Radiated Spurious Emissions**

Work Order #: **93690**

Date: 10/12/2012

Test Type: **Radiated Scan**

Time: 15:55:03

Equipment: **802.15.4 Wireless Mesh Mote**

Sequence#: 3

Manufacturer: Dust Networks

Tested By: E. Wong

Model: ETERNA1

S/N: 000D67

#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
T1	AN02672	Spectrum Analyzer	E4446A	9/4/2012	9/4/2014
	AN00010	Preamp	8447D	3/29/2012	3/29/2014
	AN00851	Biconilog Antenna	CBL6111C	5/16/2012	5/16/2014
T2	ANP04382	Cable	LDF-50	8/30/2012	8/30/2014
	ANP05555	Cable	RG223/U	6/19/2012	6/19/2014
	ANP05569	Cable	RG-214/U	6/19/2012	6/19/2014
T3	AN01646	Horn Antenna	3115	4/13/2012	4/13/2014
T4	AN02947	Cable	32022-29094K-29094K-72TC	8/8/2011	8/8/2013
T5	ANP05988	Cable	LDF1-50	3/12/2012	3/12/2014
T6	AN00787	Preamp	83017A	4/8/2011	4/8/2013
T7	AN02744	High Pass Filter	11SH10-3000/T10000-O/O	6/13/2012	6/13/2014
	AN01413	Horn Antenna-ANSI C63.5 Antenna Factors (dB)	84125-80008	12/2/2010	12/2/2012
	AN00314	Loop Antenna	6502	6/29/2012	6/29/2014

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

Function	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote*	Dust Networks	ETERNA1	000D67

#### Support Devices:

Function	Manufacturer	Model #	S/N
Eterna Serial Programmer	Dust Networks	NA	NA
Laptop	Lenovo	X61	7675CTO



**Test Conditions / Notes:**

The EUT seeking modular approval is installed atop a blank support PCB as intended. Placed on Styrofoam block of 80 cm thickness, the EUT is connected to a support laptop via a section of data cable and Serial Programmer. The Support laptop issues command to exercise the EUT, setting the EUT in continuous transmit mode. The Antenna port is connected to a 50 Ohm load.

Modulation: 802.15.4

Freq range: 2405-2475MHz

Freq: 2405MHz, 2440MHz, 2475MHz

Firmware power setting = 8dBm

Measurement procedure In Accordance With FCC document KDB558074 D01 DTS Meas Guidance V02, 8.1

Frequency range of measurement = 9 kHz- 25GHz.

9kHz -150 kHz; RBW=200 Hz, VBW=200 Hz; 150 kHz-30 MHz; RBW=9 kHz, VBW=9 kHz; 30 MHz-1000 MHz; RBW=120 kHz, VBW=120 kHz, 1000 MHz-25000 MHz; RBW=1 MHz, VBW=1 MHz.

Test environment conditions: 21°C, 52% Relative Humidity, 100kPa

For measurement in the freq range 1- 25GHz, the Test site was setup with RF absorbing material covering the ground plane meeting validation criterion called out in CISPR 16-1-4:2007

Emission profile of the EUT rotated along three orthogonal axes was investigated. Recorded data represent worse case emission.

The device was tested in tandem, sharing the same platform; 10 cm apart with another product transmitting at non-conflicting frequency. Non-associated data is not presented on this data sheet.

Ext Attn: 0 dB

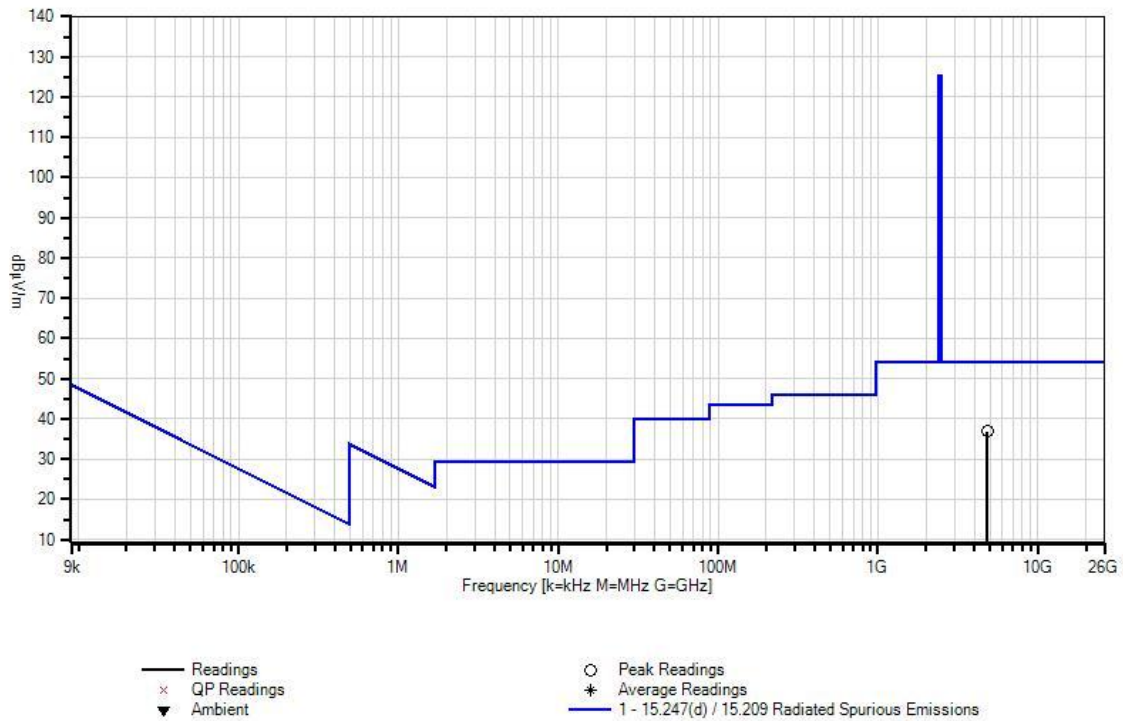
**Measurement Data:**

Reading listed by margin.

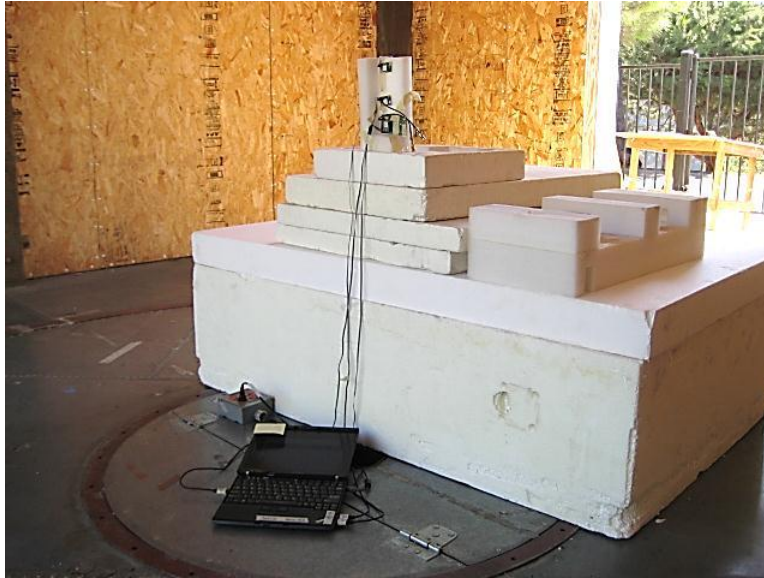
Test Distance: 3 Meters

#	Freq	Rdng	T1	T2	T3	T4	Dist	Corr	Spec	Margin	Polar
	MHz	dBμV	T5	T6	T7		Table	dBμV/m	dBμV/m	dB	Ant
1	4810.500M	28.0	+0.0	+8.1	+32.9	+0.7	+0.0	36.9	54.0	-17.1	Horiz
			+5.9	-39.3	+0.6				ye1		

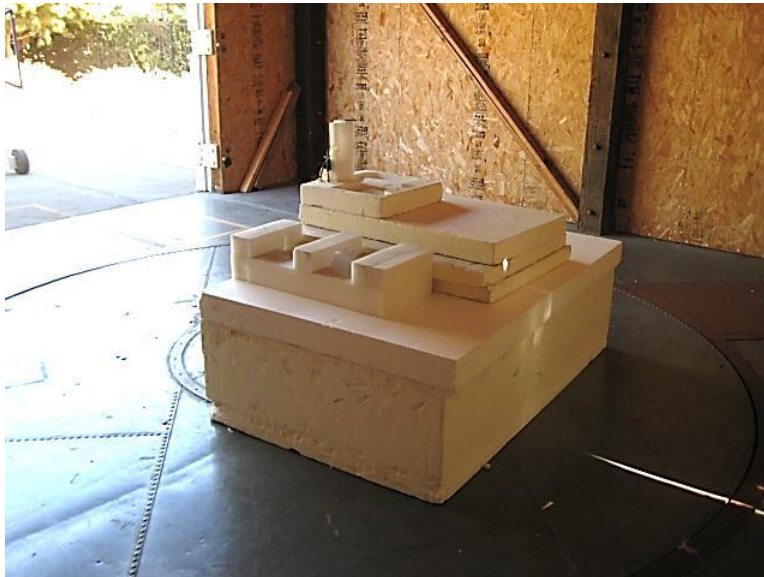
Date: 10/12/2012 Time: 15:55:03 Dust Networks WO#: 93690  
15.247(d) / 15.209 Radiated Spurious Emissions Test Distance: 3 Meters Sequence#: 3 Ext ATTN: 0 dB



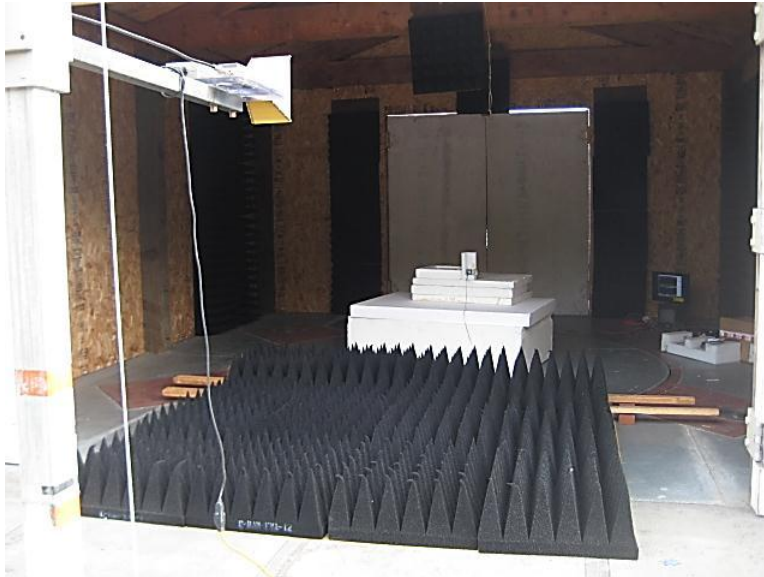
**Test Setup Photos**



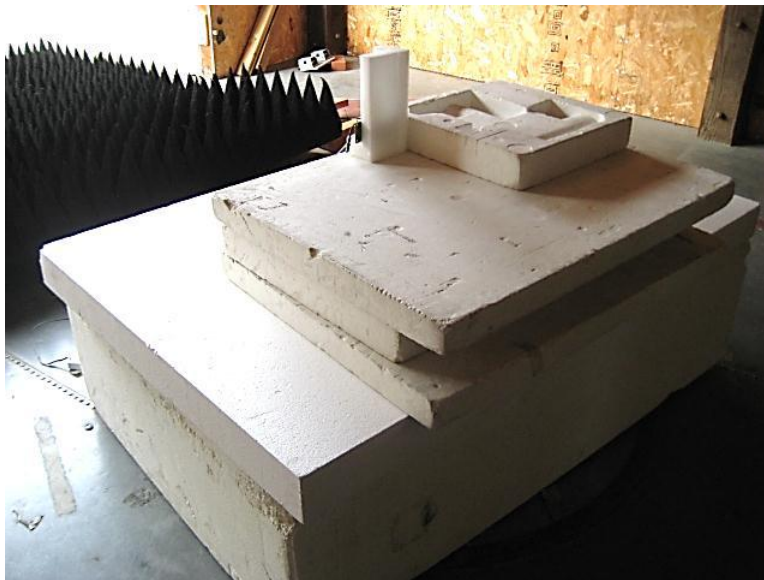
9kHz-1GHz



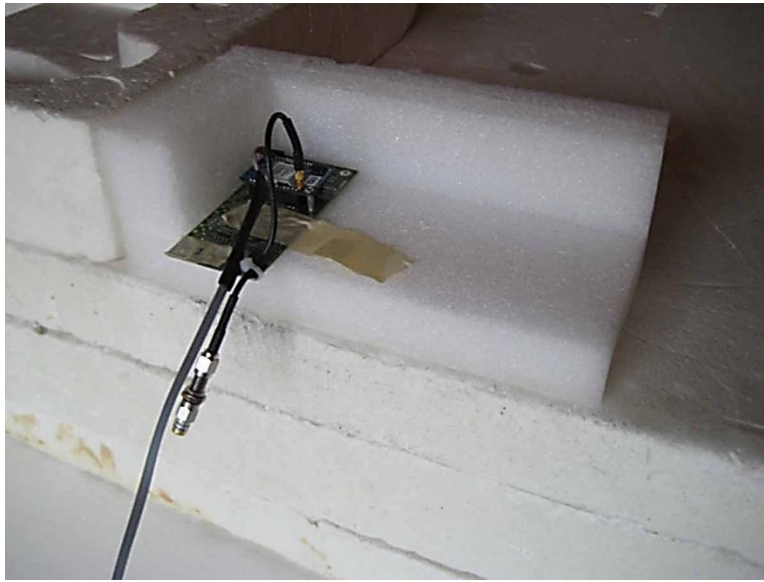
9kHz-1GHz



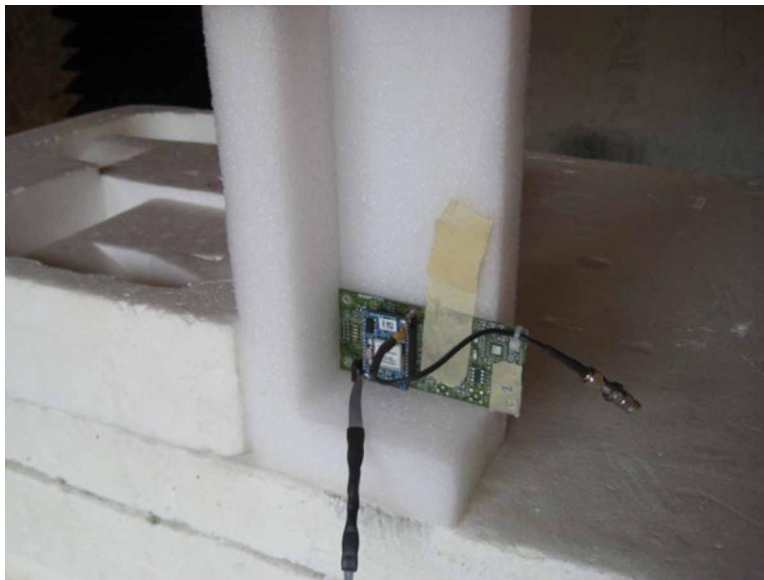
1-25GHz



1-25GHz

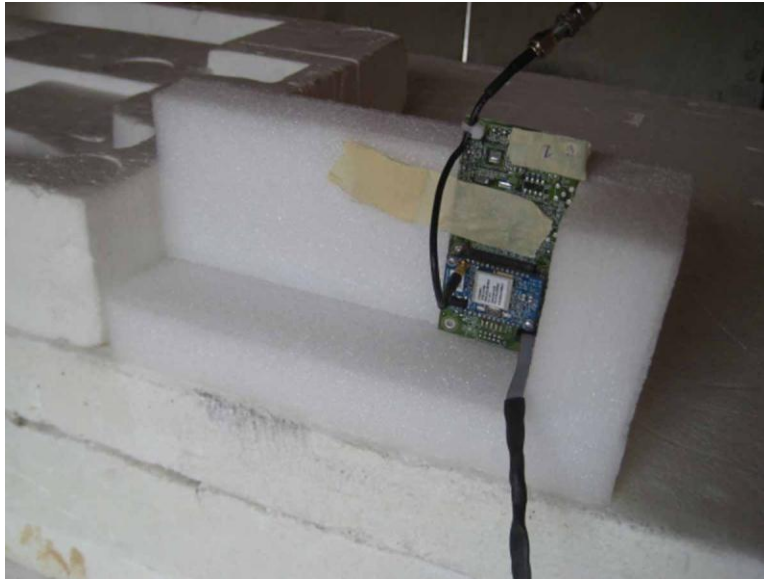


X AXIS



Y AXIS





Z AXIS

## 15.247(e) Power Spectral Density

### Test Conditions / Setup

Customer: **Dust Networks**  
 Specification: **Maximum Power Spectral Density**  
 Work Order #: **93690** Date: 10/10/2012  
 Test Type: **Conducted Emissions** Time: 13:19:00  
 Equipment: **802.15.4 Wireless Mesh Mote** Sequence#: 2  
 Manufacturer: Dust Networks Tested By: E. Wong  
 Model: ETERNA1 110V 60Hz  
 S/N: 000D67

#### Test Equipment:

ID	Asset #	Description	Model	Calibration Date	Cal Due Date
	AN02869	Spectrum Analyzer	E4440A	2/12/2011	2/12/2013
T3	AN02946	Cable	32022-2-2909K-36TC	8/8/2011	8/8/2013

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

Function	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote*	Dust Networks	ETERNA1	000D67

#### Support Devices:

Function	Manufacturer	Model #	S/N
Eterna Serial Programmer	Dust Networks	NA	NA
Laptop	Lenovo	X61	7675CTO

#### Test Conditions / Notes:

The EUT seeking modular approval is installed atop a blank support PCB as intended. Placed on the test bench, the EUT is connected to a support laptop via a section of data cable and Serial Programmer. The Support laptop issues command to exercise the EUT, setting the EUT in continuous transmit mode. Emission profile measured at the antenna port.

Modulation: 802.15.4

Freq range: 2405-2475MHz

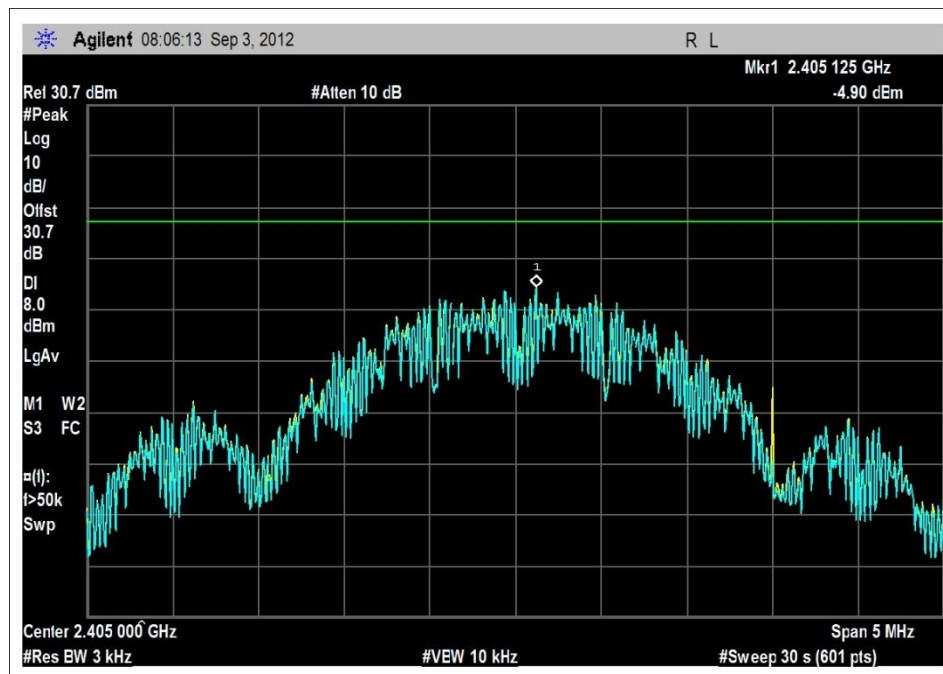
Freq: 2405MHz, 2440MHz, 2475MHz

Firmware power setting = 8dBm

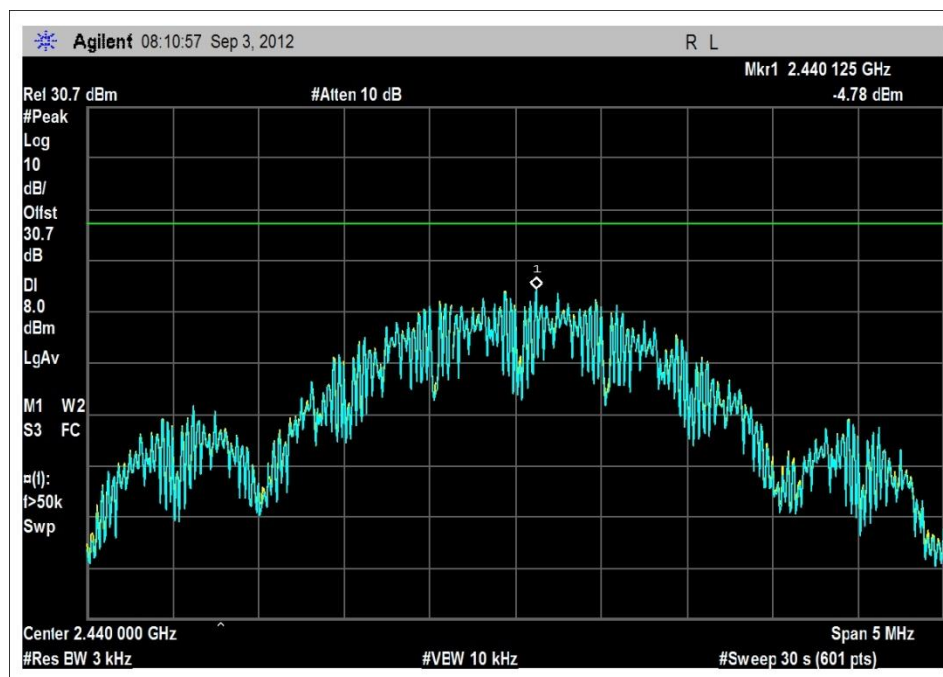
Measurement procedure In Accordance With FCC document KDB558074 D01 DTS Meas Guidance V02 , 9.1

Test environment conditions: 21°C, 52% Relative Humidity, 100kPa

**Test Data**

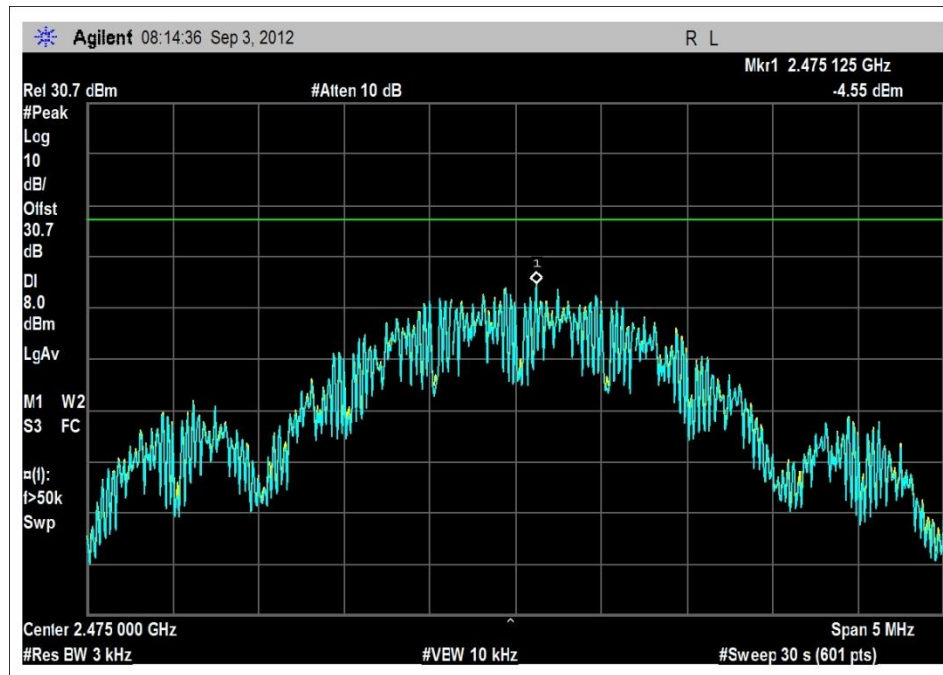


2405MHz



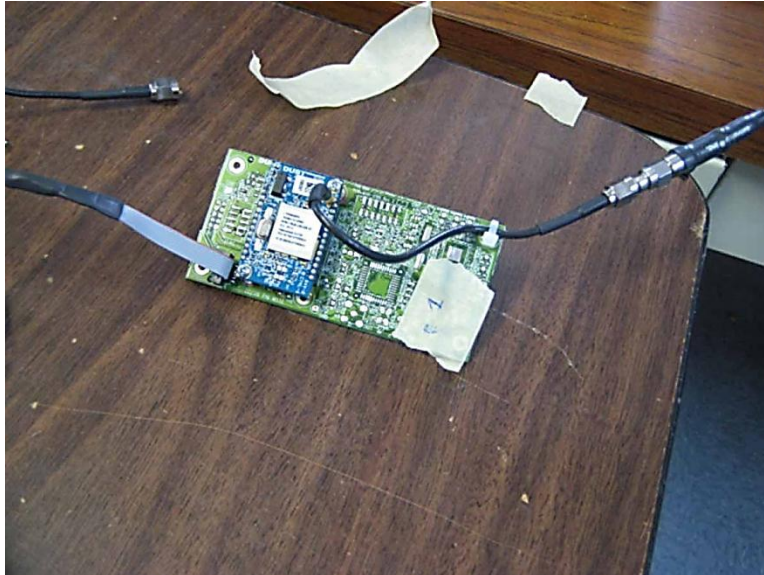
2440MHz





2475MHz

**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

Unless otherwise indicated, the following configuration parameters are used for equipment setup: 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.

SAMPLE CALCULATIONS		
	Meter reading	(dBμV)
+	Antenna Factor	(dB)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dBμV/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. Unless otherwise specified, 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	9 kHz	150 kHz	200 Hz
RADIATED 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 "positive peak" detector mode. Whenever a "quasi-peak" or "average" reading was recorded, the measurement was annotated with a "QP" or an "Ave" on the appropriate rows of the data sheets. In cases where quasi-peak or average limits were employed and data exists for multiple measurement types for the same frequency then the peak measurement was retained in the report for reference, however the numbering for the affected row was removed and an arrow or carrot ("^") was placed in the far left-hand column indicating that the row above takes precedence for comparison to the limit. 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 or receiver recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature called "peak hold," the measurement device had the ability to measure intermittent 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

Quasi-peak measurements were taken using the quasi-peak detector when the true peak values exceeded or were within 2 dB of a quasi-peak specification limit. Additional QP measurements may have been taken at the discretion of the operator.

##### Average

Average measurements were taken using the average detector when the true peak values exceeded or were within 2 dB of an average specification limit. Additional average measurements may have been taken at the discretion of the operator. If the specification or test procedure requires trace averaging, then the averaging was performed using 100 samples or as required by the specification. All other average measurements are performed using video bandwidth averaging. 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.