

# Dust Networks

## TEST REPORT FOR

**802.15.4 Wireless Mesh Mote  
Model: ETERNA2**

**Tested To The Following Standards:**

**ETSI EN 300 328 V1.7.1**

**Report No.: 93692-14**

**Date of issue: October 29, 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.

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## 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

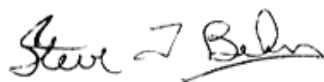
Project Number: 93692

October 8, 2012

October 8-19, 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, which appears to read "Steve Behm", is written over a horizontal line.

**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

## SUMMARY OF RESULTS

**Standard / Specification: ETSI EN 300 328 V1.7.1**

Description	Test Procedure/Method	Results
<b>Technical Requirements</b>	<b>Sub clause 4.3</b>	
Maximum Transmit Power	Sub clause 4.3.1	Pass
Maximum E.I.R.P. Spectral Density	Sub clause 4.3.2	Pass
Frequency Range	Sub clause 4.3.3	Pass
Frequency Hopping Requirements	Sub clause 4.3.4	NA
Dwell Time	Sub clause 4.3.4.1	NA
Hopping Channel	Sub clause 4.3.4.2	NA
Hopping Sequence	Sub clause 4.3.4.3	NA
Medium Access Protocol	Sub clause 4.3.5	NA
Transmitter Spurious Emissions	Sub clause 4.3.6	Pass
Receiver Spurious Emissions	Sub clause 4.3.7	Pass

NA = Not Applicable

## Conditions During Testing

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

Summary of Conditions
The EUT seeking modular approval is 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. Conducted measurement was performed at the antenna port, radiated /enclosure emission was measured with antenna port terminated into 50 Ohm load and also with integral 1.5 dBi chip antenna installed. Spurious emission was performed with Stub filter circuit implemented on the device with 1.5dBi integral antenna. This data test report is valid for removable antenna with antenna gain not to exceed 4.9dBi.

## EQUIPMENT UNDER TEST

### EQUIPMENT UNDER TEST

#### 802.15.4 Wireless Mesh Mote

Manuf: Dust Networks

Model: ETERNA2

Serial: 0012a7\*

\* Note: This unit has integral 1.5 dBi chip antenna installed.

\*\* Note: This unit has non-integral antenna.

#### 802.15.4 Wireless Mesh Mote

Manuf: Dust Networks

Model: ETERNA2

Serial: 0018e4\*\*

### PERIPHERAL DEVICES

The EUT was tested with the following peripheral devices:

#### Eterna Serial Programmer

Manuf: Dust Networks

Model: NA

Serial: NA

#### Laptop

Manuf: Lenovo

Model: X61

Serial: 7675CTO

## EQUIPMENT DETAILS

Frequencies of Selected Test Channels	
Lowest Channel	2405 MHz
Middle Channel	2440 MHz
Highest Channel	2475 MHz

Equipment specifications for DSSS / Other types of modulation

Equipment Installation Type	Stand Alone, Plug-in Radio or Combination
Modulation Type	802.15.4
Operating Frequency Range(s)	2400-2483.5 MHz
List of intended Antennas	Not to exceed 4.9 dBi

## ETSI EN 300 328 V1.7.1

### 4.3 TECHNICAL REQUIREMENTS

#### 4.3.1 Maximum Transmit Power

Ambient Temperature: 21°C

Relative Humidity: 52%

Test Engineer: E. Wong

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
AN02869	Spectrum Analyzer	E4440A	Agilent	2/12/2011	2/12/2013
AN02946	Cable	32022-2-2909K-36TC	AstroLab, Inc.	8/8/2011	8/8/2013
AN01878	Temperature Chamber	S 1.2 Mini-Max	Thermotron Corp.	4/1/2011	4/1/2013



### Test Data

Rated output power: 8.26 dBm

Antenna assembly gain: Not to exceed 4.9 dBi

Duty cycle of the equipment during the test  $x=99\%$

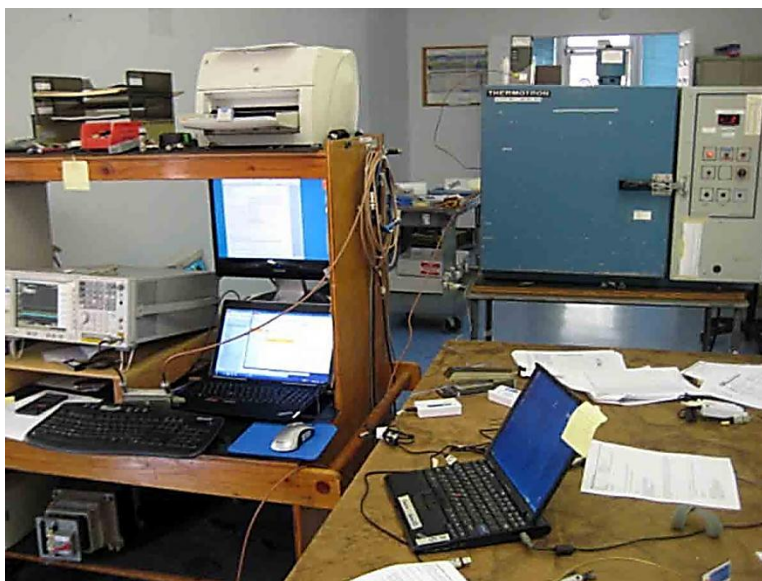
TEST CONDITIONS		TRANSMITTER POWER (dBm)		
		2405MHz	2440MHz	2475MHz
$T_{nom}(25)^{\circ}C$	$V_{nom}(3.0)V$	12.90	12.91	13.16
$T_{min}(-20)^{\circ}C$	$V_{nom}(3.0)V$	12.42	12.28	12.77
$T_{max}(55)^{\circ}C$	$V_{nom}(3.0)V$	12.42	12.28	12.77
Measurement Uncertainty		3.703 dB		

Note: At 99.99% duty cycle,  $P_k=Ave$ . Reported transmitter power is EIRP, where EIRP= measured conducted power +Antenna gain of 4.9dBi. Extreme voltage condition is not applicable. The equipment under test is designed for operation as part of and powered by another system or piece of equipment.

### **LIMITS**

Under all test conditions	= < -10 dBW / 20dBm
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### Test Setup Photos





### 4.3.2 Maximum E.I.R.P. Spectral Density

Ambient Temperature: 21°C

Relative Humidity: 52%

Test Engineer: E. Wong

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
AN02869	Spectrum Analyzer	E4440A	Agilent	2/12/2011	2/12/2013
AN02946	Cable	32022-2-2909K-36TC	AstroLab, Inc.	8/8/2011	8/8/2013

#### Test Data

TESTS	Measured Power Density dBm/MHz ( EIRP)		
	2405MHz	2440MHz	2475MHz
	9.73	9.82	9.96
Measurement Uncertainty	$1 \times 10^5$ dB		

Note: Antenna assembly gain: Not to exceed 4.9 dBi

#### LIMITS

Under normal test conditions only	10mW/MHz , 10dBm/MHz
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**Test Setup Photos**



### 4.3.3 Frequency Range

Ambient Temperature: 21°C

Relative Humidity: 52%

Engineer Name: E. Wong

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
AN01878	Temperature Chamber	S 1.2 Mini-Max	Thermotron Corp.	4/1/2011	4/1/2013
AN02672	Spectrum Analyzer	E4446A	Agilent	9/4/2012	9/4/2013
AN02946	Cable	32022-2-2909K-36TC	AstroLab, Inc.	8/8/2011	8/8/2013

### Test Data

TEST CONDITIONS		FREQUENCY (MHz) at which Power Envelope Crosses -80 dBm/Hz	
		Lowest	Highest
$T_{nom}(25)^{\circ}C$	$V_{nom}(3.0)V$	2400.867	2479.083
$T_{min}(-20)^{\circ}C$	$V_{min}(3.0)V$	2400.901	2479.119
$T_{max}(55)^{\circ}C$	$V_{min}(3.0)V$	2400.835	2479.048
Measured Frequencies (Lowest And Highest)		$f_L = 2400.835$ $f_H = 2479.119$	
Measurement Uncertainty		$5.774 \times 10^{-10}$ dB	

Note: Antenna assembly gain: Not to exceed 4.9 dBi

### LIMITS

Under all test conditions	$f_L > 2400$ MHz $f_H < 2483.5$ MHz
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**Test Setup Photos**





### 4.3.6 Transmitter Spurious Emissions

#### 4.3.6 Transmitter Conducted Spurious Emissions

Ambient Temperature: 21°C

Relative Humidity: 52%

Engineer Name: E. Wong

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
AN02869	Spectrum Analyzer	E4440A	Agilent	2/12/2011	2/12/2013
AN02946	Cable	32022-2-2909K-36TC	AstroLab, Inc.	8/8/2011	8/8/2013
AN02744	High Pass Filter	11SH10-3000/T10000-O/O	K & L	6/13/2012	6/13/2014

#### Test Data

SPURIOUS EMISSIONS LEVEL					
Lowest Channel			Highest Channel		
F (MHz)	Band-width** (kHz)	Level (dBm)	F (MHz)	Band-width** (kHz)	Level (dBm)
4810.97	100	-70.5	4949	100	-40.9
7216.17	100	-38.9	7426.17	100	-42.0
9617.97	100	-59.3	9902.03	100	-57.9
12027.1	100	-69.7		100	
Measurement Uncertainty			0.673 dB		

\*\* Bandwidth = the measuring receiver bandwidth

#### LIMITS

Frequency Range	Limit when Operating
30 MHz to 1 GHz	-36 dBm
above 1 GHz to 12,75 GHz	-30 dBm
1,8 GHz to 1,9 GHz	-47 dBm
5,15 GHz to 5,3 GHz	-47 dBm



**Test Setup Photos**



### 4.3.6 Transmitter Radiated Spurious Emissions

Ambient Temperature: 21°C

Relative Humidity: 52%

Test Engineer: E. Wong

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
AN02672	Spectrum Analyzer	E4446A	Agilent	9/4/2012	9/4/2014
AN00010	Preamp	8447D	HP	3/29/2012	3/29/2014
AN00851	Biconilog Antenna	CBL6111C	Chase	5/16/2012	5/16/2014
ANP04382	Cable	LDF-50	Andrew	8/30/2012	8/30/2014
ANP05555	Cable	RG223/U	Pasternack	6/19/2012	6/19/2014
ANP05569	Cable	RG-214/U	Pasternack	6/19/2012	6/19/2014
AN01646	Horn Antenna	3115	Emco	4/13/2012	4/13/2014
AN02947	Cable	32022-29094K-29094K-72TC	Astrolab	8/8/2011	8/8/2013
ANP05988	Cable	LDF1-50	Andrew	3/12/2012	3/12/2014
AN00787	Preamp	83017A	HP	4/8/2011	4/8/2013
AN02744	High Pass Filter	11SH10-3000/T10000-O/O	K & L	6/13/2012	6/13/2014

### Test Data

SPURIOUS EMISSIONS LEVEL					
Lowest Channel			Highest Channel		
F (MHz)	Band-width** (kHz)	Level (dBm)	F (MHz)	Band-width** (kHz)	Level (dBm)
4809.981M	100	-68	4951.000M	100	-61
Measurement Uncertainty			0.673 dB		

\*\* Bandwidth = the measuring receiver bandwidth

**Note: antenna terminated to 50 Ohm load**

SPURIOUS EMISSIONS LEVEL					
Lowest Channel			Highest Channel		
F (MHz)	Band-width** (kHz)	Level (dBm)	F (MHz)	Band-width** (kHz)	Level (dBm)
4809 H X	100	-61.3	4950.9 H Y	100	-61.3
Measurement Uncertainty			0.673 dB		

Note: Integral 1.5dBi chip antenna with stub filter installed. EUT SN: 3812AD

#### LIMITS

Frequency Range	Limit when Operating
30 MHz to 1 GHz	-36 dBm
above 1 GHz to 12,75 GHz	-30 dBm
1,8 GHz to 1,9 GHz	-47 dBm
5,15 GHz to 5,3 GHz	-47 dBm

#### Test Setup Photos







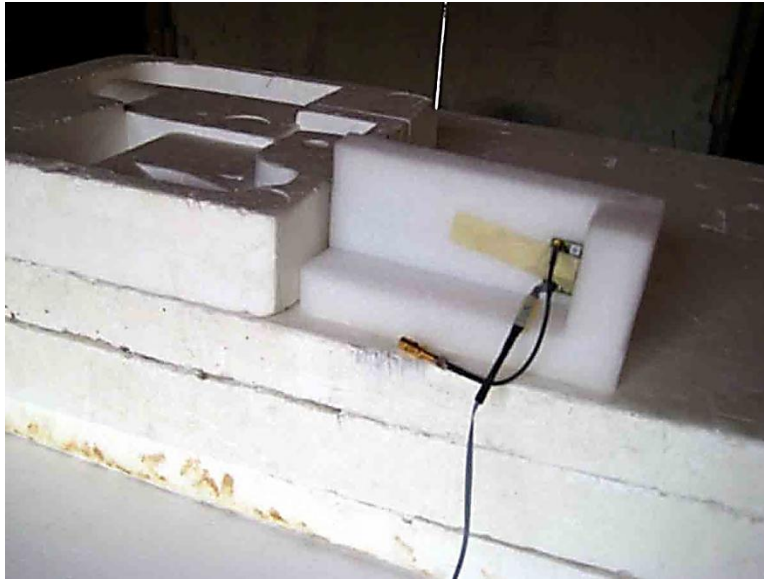




X AXIS



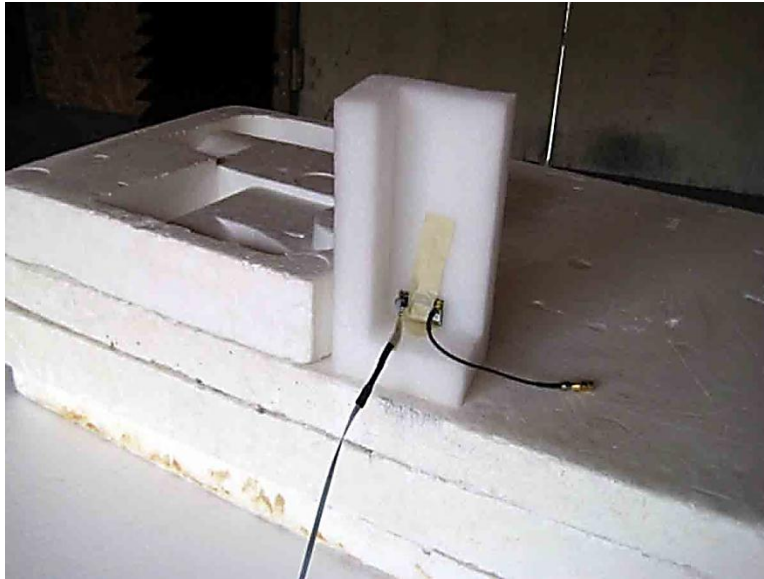
X AXIS



Y AXIS



Y AXIS



Z AXIS



Z AXIS



### 4.3.7 Receiver Spurious Emissions

#### 4.3.7 Receiver Conducted Spurious Emissions

Ambient Temperature: 21°C

Relative Humidity: 52%

Test Engineer: E. Wong

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
AN02869	Spectrum Analyzer	E4440A	Agilent	2/12/2011	2/12/2013
AN02946	Cable	32022-2-2909K-36TC	AstroLab, Inc.	8/8/2011	8/8/2013

#### Test Data

FREQUENCY (MHz)	MEASUREMENT BANDWIDTH (MHz)	SPURIOUS EMISSION LEVEL (dBm)
2402.5	0.1	-60.4
2472.5	0.1	-59.47
Measurement Uncertainty	.673 dB	

NA: No emissions found.

#### LIMITS

Frequency Range	Limit
30 MHz to 1 GHz	-57 dBm
above 1 GHz to 12,75 GHz	-47 dBm

**Test Setup Photos**



### 4.3.7 Receiver Radiated Spurious Emissions

Ambient Temperature: 21°C

Relative Humidity: 52%

Test Engineer: E. Wong

Test Equipment					
Asset/Serial #	Description	Model	Manufacturer	Cal Date	Cal Due
AN02869	Spectrum Analyzer	E4440A	Agilent	2/12/2011	2/12/2013
AN02946	Cable	32022-2-2909K-36TC	AstroLab, Inc.	8/8/2011	8/8/2013

#### Test Data

FREQUENCY (MHz)	MEASUREMENT BANDWIDTH (MHz)	SPURIOUS EMISSION LEVEL (dBm)
2402.5	0.1	-60.4
2472.5	0.1	-59.47
Measurement Uncertainty		.673 dB

NA: No emissions found.

#### LIMITS

Frequency Range	Limit
30 MHz to 1 GHz	-57 dBm
above 1 GHz to 12,75 GHz	-47 dBm

**Test Setup Photos**







