Dust Networks

TEST REPORT FOR

802.15.4 Wireless Mesh Mote
Model: ETERNA1

Tested To The Following Standard:

EN 300 328 V1.9.1

Report No.: 98876-9

Date of issue: January 4, 2017

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.

A2LA ACCREDITED
Testing Certificates:
803.01, 803.02, 803.05, 803.06

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ADMINISTRATIVE INFORMATION

Test Report Information

REPORT PREPARED FOR:

Dust Networks
32990 Alvarado-Niles Road, Suite 910
Union City, CA 94587

Representative: Gordon Charles
Customer Reference Number: 8783B

DATE OF EQUIPMENT RECEIPT:
DATE(S) OF TESTING:

REPORT PREPARED BY:

Terri Rayle
CKC Laboratories, Inc.
5046 Sierra Pines Drive
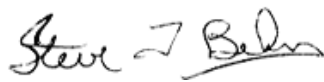Mariposa, CA 95338

Project Number: 98876

November 29, 2016
November 29-30, 2016

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.

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

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.03.02

SUMMARY OF RESULTS

Standard / Specification: EN 300 328 V1.9.1

Test Procedure/Method	Description	Modifications	Results
Transmitter Parameters			
Sub clause 4.3.1.2	RF Power Output	NA	Pass
Sub clause 4.3.1.3	Duty Cycle, Tx Sequence, Tx-gap	NA	NP
Sub clause 4.3.1.4	Accumulated Transmit Time, Frequency Occupation & Hopping Sequence	NA	Pass
Sub clause 4.3.1.5	Hopping Frequency Separation	NA	NP
Sub clause 4.3.1.6	Medium Utilisation (MU) Factor	NA	NP
Sub clause 4.3.1.7	Adaptivity	NA	NP
Sub clause 4.3.1.8	Occupied Channel Bandwidth	NA	NP
Sub clause 4.3.1.9	Transmitter Unwanted Emissions in the OOB Domain	NA	NP
Sub clause 4.3.1.10	Transmitter Unwanted Emissions in the Spurious Domain - Conducted	NA	NP
Sub clause 4.3.1.10	Transmitter Unwanted Emissions in the Spurious Domain - Radiated	NA	NP
Receiver Parameters			
Sub clause 4.3.1.11	Receiver Spurious Emissions - Conducted	NA	NP
Sub clause 4.3.1.11	Receiver Spurious Emissions - Radiated	NA	NP
Sub clause 4.3.1.12	Receiver Blocking	NA	NA1

NA = Not Applicable

NA1 = Not applicable because the EUT is non-adaptive equipment.

NP = CKC Laboratories was not contracted to perform test.

Modifications During Testing

This list is a summary of the modifications made to the equipment during testing.

Summary of Conditions
No modifications were made during testing.

Modifications listed above must be incorporated into all production units.

Conditions During Testing

This list is a summary of the conditions noted to the equipment during testing.

Summary of Conditions
The testing performed was to show compliance to the updated standard version from V1.8.1 to V1.9.1. Only tests results required to show continued compliance are included in this report.

EQUIPMENT UNDER TEST

During testing numerous configurations may have been utilized. The configurations listed below support compliance to the standard(s) listed in the Summary of Results section.

Configuration 1

Equipment Tested:

Device	Manufacturer	Model #	S/N
802.15.4 Wireless Mesh Mote	Dust Networks	ETERNA1	00170d000058c07f

Support Equipment:

Device	Manufacturer	Model #	S/N
Laptop Computer	Lenovo	X61	LV-L6XN2
Raspberry Pi	PIMORONI	M1 3501-A0 C3	NA
Network Manager	Dust Networks	DLM6000-01EE	NA
Eterna Serial Programmer	Dust Networks	DC9010	NA
Eterna Serial Programmer	Dust Networks	DC9010	NA

General Product Information:

Product Information	Manufacturer-Provided Details
Equipment Type:	Plug-In Card (Module)
Manufacturer declares the Type of FHSS:	Non-Adaptive
Operating Frequency Range:	2405MHz to 2475MHz
Conducted Output Power:	+8dBm
Modulation Type(s):	OQPSK
Nominal Channel Bandwidth(s):	2.7MHz
Number of TX Chains:	1
Number of RX Chains:	1
Antenna Gain (A):	4.8dBi
Beamforming Gain (Y):	NA
Antenna Connection Type:	Integral
Nominal Input Voltage:	3.0V
Operating Temperature Range:	-45C to +85C
Firmware / Software used for Test:	HTML5 Terminal
Geo-Location Capability:	Not Supported

Adaptive Mode(s)

Product Information	Manufacturer-Provided Details
Adaptivity Type:	NA
Number of Hopping Frequencies:	15
Manufacturer declares the Average Dwell Time per Channel:	10ms
Manufacturer declares the Max Channel Occupancy Time:	<4.5ms

NA = Not Applicable

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4.3.1 TECHNICAL REQUIREMENTS

4.3.1.2 RF Power Output

Test Setup/Conditions			
Test Location:	Brea Lab A	Test Engineer:	S. Yamamoto
Test Method:	EN 300 328 v1.9.1 §5.3.2	Test Date(s):	11/29/2016
Configuration:	1		
Test Setup:	The EUT output is connected through an attenuator to a fast power sensor.		

Environmental Conditions			
Temperature (ºC)	22	Relative Humidity (%):	44

Test Equipment					
Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
C00094	Attenuator	Weinschel	33-20-34	3/5/2015	3/5/2017
03494	RF Powerhead	ETS Lindgren	7002-006	11/26/2016	11/26/2018
01878	Temperature Chamber	Thermotron Corp	S 1.2 Mini-Max	5/15/2015	5/15/2017
P05947	Temperature Probe	Fluke	51	5/24/2016	5/24/2018

Maximum Output Power (dBm EIRP) – Adaptive Mode						
Declared Antenna Gain, G (dBi): 4.8						
Declared Beam Forming Gain, Y (dB): NA						
Frequency (MHz)	Operational Mode	T_{Low}	$T_{Nominal}$	T_{High}	Limit	Results
2400-2483.5	Normal hopping	11.2	11.6	10.9	≤20	Pass
Max Deviation from Nominal:		-				

Parameter Definitions:

Parameter	Value
T_{Low}	-45C
$T_{Nominal}$	+22C
T_{High}	+85C
$V_{Nominal}$	3.0

4.3.1.4 Accumulated Transmit Time / Minimum Frequency Occupation & Hopping Sequence

Test Setup/Conditions

Test Location:	Brea Lab A	Test Engineer:	S. Yamamoto
Test Method:	EN 300 328 v1.9.1 §5.3.4	Test Date(s):	11/29/2016
Configuration:	1		
Test Setup:	The EUT output is connected through an attenuator to a spectrum analyzer.		

Environmental Conditions

Temperature (ºC)	22	Relative Humidity (%):	43

Test Equipment

Asset#	Description	Manufacturer	Model	Cal Date	Cal Due
02672	Spectrum Analyzer	Agilent	E4446A	9/30/2015	9/30/2017
03430	Attenuator	Aeroflex/Weinschel	75A-10-12	11/2/2015	11/2/2017
02946	Cable	Astrolab Inc.	32022-2-2909K-36TC	11/2/2015	11/2/2017

Accumulated Transmit Time – Adaptive Mode

Option 1: Measurement
Observation Period: 400*N_{Min} (ms)

$$N_{Min} = \begin{cases} 15 \\ 15/{Min\ Hopping\ Separation\ (MHz)} \end{cases}; whichever\ is\ greater$$

Frequency (MHz)	Mode	Number Bursts per Obs. Period	Measured Burst Duration (ms)	Accumulated TX Time (ms)	Limit (ms)	Results
2420	Normal hopping maximum dwell time and duty cycle	29	4.6	160	≤400	Pass
		19	1.4			
2470	Normal hopping maximum dwell time and duty cycle	28	4.6	154	≤400	Pass
		18	1.4			

Frequency Occupation

Option 1: Measurement
Observation Period: 4*N*Dwell Time (ms)

Frequency (MHz)	Mode	Maximum Dwell Time (ms)	Hops per obs. period	Limit	Results
2420	Normal hopping	13.2	≥1	≥1	Pass
2470	Normal hopping	13.2	≥1	≥1	Pass

Number of Hoping Frequencies (N)

$$N_{Min} = \begin{cases} 15 \\ 15/{Min\ Hopping\ Separation\ (MHz)} \end{cases}; whichever\ is\ greater$$

Operational Mode	Measured Number of Frequencies	Limit	Results
Normal hopping	15	15	Pass

Spectrum Utilization – Adaptive Mode

Minimum Utilization = 70% x 83.5 MHz = 58.45 MHz

Operational Mode	-20dBc (F_L)	-20dBc(F_H)	Utilization (%)	Limit (%)	Results
Normal hopping	2402.894	2477.107	88.8	≥70	Pass

Test Setup Photo

SUPPLEMENTAL INFORMATION

Measurement Uncertainty

Parameter Uncertainty	Actual	Limit	Unit of Measure
Uncertainty Parameter	Actual	Limit	Unit of Measure
Occupied Channel Bandwidth	1	5	%
RF output power, conducted	0.67	1.5	dB
Power Spectral Density, conducted	0.67	3	dB
Unwanted Emissions, conducted	0.67	3	dB
All emissions, radiated	3.73	6	dB
Temperature	1	3	ºC
Humidity	3.4	5	%
DC and low frequency voltages	2	3	%
Time	1.1	5	%

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.