

Dust Networks

TEST REPORT FOR

Device Name: 2.4GHz Wireless Mote
Model: M2510

Tested To The Following Standards:

ETSI EN 300 328 V1.8.1
Partial Testing

Report No.: 96194-4

Date of issue: November 14, 2014



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: DX1249F

DATE OF EQUIPMENT RECEIPT:**DATES OF TESTING:****REPORT PREPARED BY:**

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

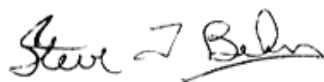
Project Number: 96194

October 8, 2014

October 9 – 13, 2014

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". The signature is written in a cursive style and is positioned above 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.
5046 Sierra Pines Drive
Mariposa, CA 95338

Software Versions

CKC Laboratories Proprietary Software	Version
EMITest Emissions	5.00.14
Immunity	5.00.07

Site Registration & Accreditation {

Location	CB #	Taiwan	Canada	FCC	Japan
Mariposa A	US0103	SL2-IN-E-1147R	3082A-2	90477	A-0136

SUMMARY OF RESULTS

Standard / Specification: ETSI EN 300 328 V1.8.1

Test Procedure/Method	Description	Modification*	Results
Technical Requirements	Sub clause 4.3.2		
Sub clause 4.3.2.1	RF Power Output	NA	Pass ¹
Sub clause 4.3.2.2	Power Spectral Density	NA	Pass
Sub clause 4.3.2.3	Duty Cycle, Tx Sequence, Tx-gap	NA	NA ₁
Sub clause 4.3.2.4	Medium Utilisation (MU) Factor	NA	Pass ¹
Sub clause 4.3.2.5	Adaptivity	NA	NA ₂
Sub clause 4.3.2.6	Occupied Channel Bandwidth	NA	Pass
Sub clause 4.3.2.7	Transmitter Unwanted Emissions in the OOB Domain	NA	Pass
Sub clause 4.3.2.8	Transmitter Unwanted Emissions in the Spurious Domain	NA	NP
Sub clause 4.3.2.9	Receiver Spurious Emissions	NA	NP
Sub clause 4.3.2.10	Receiver Blocking	NA	NA ₂

NA₁ = Not Applicable; Test only applies to devices that employ FHSS. The manufacturer declares that the EUT does not employ FHSS

NA₂ = Not Applicable; Test only applies to adaptive equipment. The manufacturer declares that the EUT does not have an adaptive mode.

NP = Not Performed per request of the manufacturer; test data located in a separate report.

Pass¹ = Deviations in testing and EUT configuration have been reviewed by CKC Certification Services, LLC, NB 0976 and have been determined to meet the essential requirements of the directive.

***Modifications / 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 employs a removable antenna, so all measurements were taken through conducted measurements. The EUT is considered non-adaptive equipment using wide band modulations other than FHSS. The device was tested in its highest output power mode as a non-adaptive device.
No modifications were made during testing.

EQUIPMENT UNDER TEST

The following model has been tested by CKC Laboratories: **2.4GHz Wireless Mote, Model: M2510.**

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

EQUIPMENT UNDER TEST

2.4GHz Wireless Mote

Manuf: Dust Networks

Model: M2510

Serial: 48e573

Number of channels: 15

Installation: Mobile

Operating voltage/frequency: 2.75-3.6VDC

Design Phase: Representative of Production

PERIPHERAL DEVICES

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

Laptop Computer

Manuf: Lenovo

Model: X61

Serial: DN527

AC-DC Adapter

Manuf: Lenovo

Model: 45N0121

Serial: 11S45N0121Z1ZHXU28G92M

ETSI EN 300 328 V1.8.1

4.3.2 TECHNICAL REQUIREMENTS

4.3.2.1 RF Power Output

Ambient Temperature: 22°C

Relative Humidity: 37%

Test Engineer: Eddie Mariscal

Test Setup / Conditions

The EUT is directly connected to the power sensor. The EUT is configured to continuously transmit. The EIRP measurements will be gathered via conducted measurements using the following formula:

$$\text{EIRP} = A + G + Y$$

A = conducted measurement in dBm

G = Antenna Assembly gain in dBi

Y = Beamforming gain in dB

Maximum Antenna Gain: 4dBi

The test was repeated for extreme conditions.

Operating voltage range: 2.75VDC to 3.6VDC

Operating temperature range: -40°C to +85°C.

Test Equipment					
Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
03285	Power Sensor	Agilent	U2004A	4/15/2014	4/15/2016
01879	Temperature Chamber	Thermotron	S-1.2 Min.	11/15/2012	11/15/2014
02242	Thermometer	Omega	HH-26K	5/2/2014	5/2/2016
02138	Attenuator	Weinschel	54-10	2/13/2013	2/13/2015
03358	Cable	Astrolab	32026-2-29094K-48TC	2/7/2013	2/7/2015

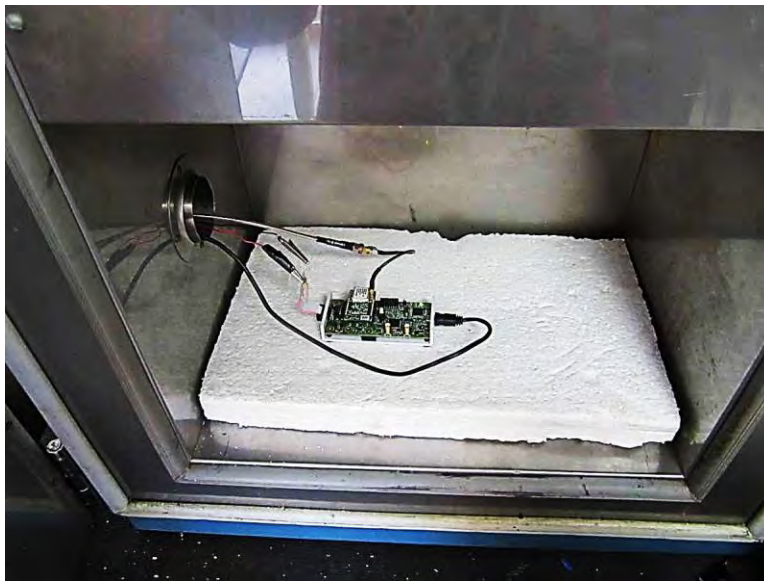
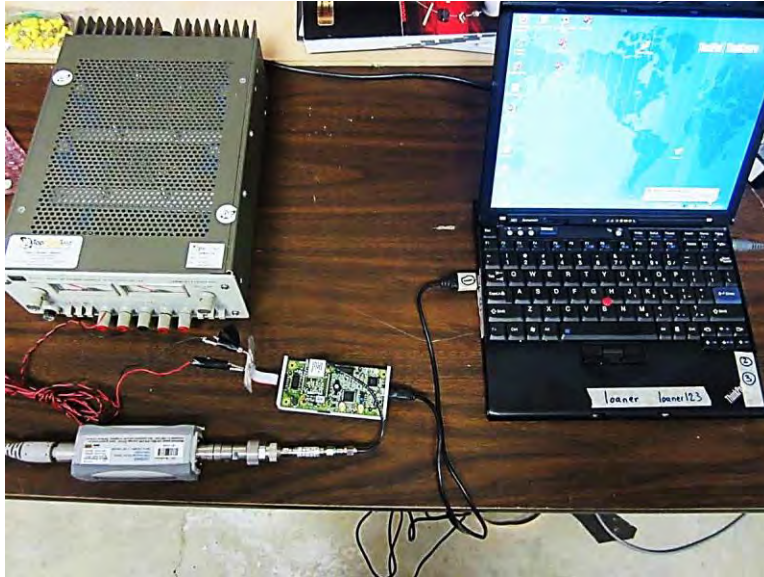
Test Data

TEST CONDITIONS		TRANSMITTER EIRP POWER (dBm)		
		2405MHz	2440MHz	2475MHz
$T_{nom}(20)^{\circ}C$	$V_{nom}(3.0)V$	10.69	9.88	9.31
	$V_{min}(2.75)V$	10.57	9.73	8.91
	$V_{Max}(3.6)V$	10.96	10.3	9.44
$T_{min}(-40)^{\circ}C$	$V_{nom}(3.0)V$	10.07	9.51	8.92
	$V_{min}(2.75)V$	9.86	9.29	8.67
	$V_{Max}(3.6)V$	10.49	9.93	9.29
$T_{max}(85)^{\circ}C$	$V_{nom}(3.0)V$	8.32	7.85	5.82
	$V_{min}(2.75)V$	8.05	7.56	5.54
	$V_{Max}(3.6)V$	8.8	8.26	6.61
Limit		EIRP \leq 20dBm		
Measurement Uncertainty		0.67dB		

Note: Power reported above includes corrections for cable loss and antenna gain.

This measurement was performed using a deviation from the established method which has been determined to be an equivalent measurement method.

Test Setup Photos



4.3.2.2 Power Spectral Density

Ambient Temperature: 22°C

Relative Humidity: 35%

Test Engineer: Eddie Mariscal

Test Setup / Conditions

The EUT's antenna port is directly connected to the spectrum analyzer.

RBW = 10kHz; VBW = 30kHz

Maximum Antenna gain: 4.0dBi

Test Equipment

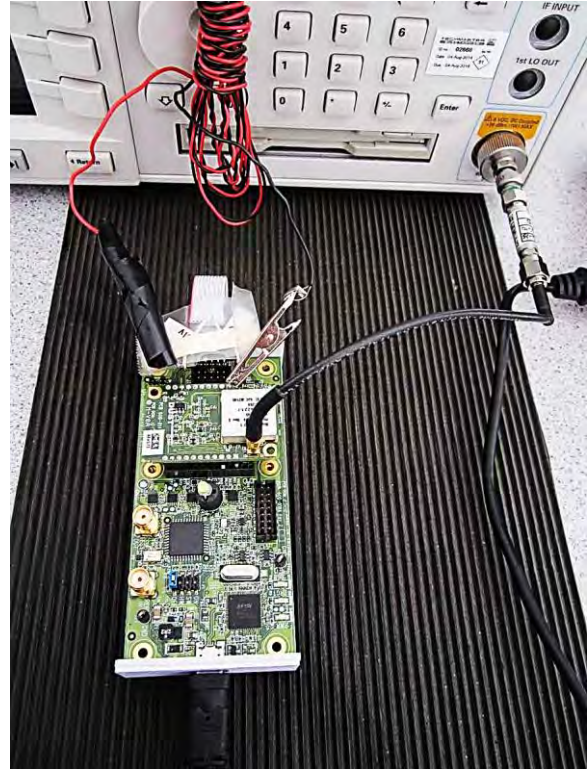
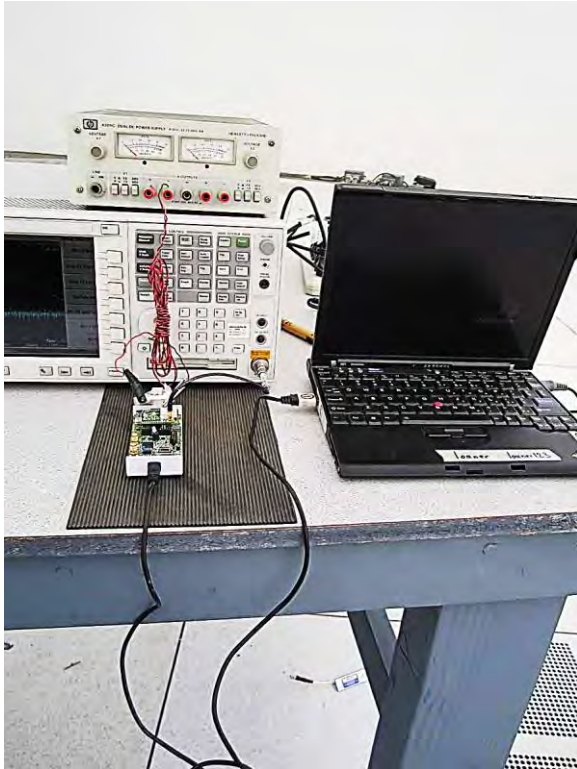
Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
02668	Spectrum Analyzer	Agilent	E4446A	8/4/2014	8/4/2015
02138	Attenuator	Weinschel	54-10	2/13/2013	2/13/2015

Test Data

TESTS	Measured Power Density dBm/MHz (EIRP)		
	2405MHz	2440MHz	2475MHz
	9.35	8.77	7.82
Limit	10dBm/MHz		
Test Result	PASS		
Measurement Uncertainty	0.67dB		

Note: Power reported above includes corrections for cable loss and antenna gain.

Test Setup Photos



4.3.1.5 Medium Utilization (MU) Factor

Ambient Temperature: 22°C

Relative Humidity: 34 %

Engineer Name: Eddie Mariscal

Test Setup / Conditions

The EUT's antenna port is directly connected to the Power Sensor.

Deviation: Power sensor is unable to perform measurements at 1MS/s, however during RF Output Power measurements, the EUT was set to continuous transmit mode, therefore allowing measurements over a shorter observation period.

Manufacturer Declared Duty cycle = 43.4%

P burst values in mW:

Low: 11.72

Mid: 9.73

High: 8.53

Test Equipment

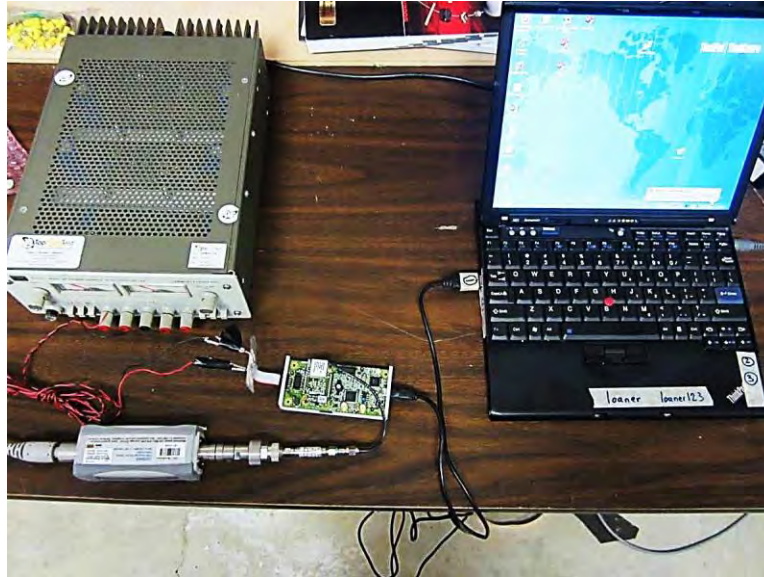
Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
03285	Power Sensor	Agilent	U2004A	4/15/2014	4/15/2016
02138	Attenuator	Weinschel	54-10	2/13/2013	2/13/2015

Test Data

TESTS	MU=(P/100mW)* Duty Cycle		
	2405MHz	2440MHz	2475MHz
Medium Utilization (MU) Factor	5.09%	4.22%	3.70%
Limit	< 10%		
Test Result	PASS		
Measurement Uncertainty	1.1%		

The MU calculations are performed in accordance with the requirements of this section, however the input parameters are from sections including deviations in measurement method.

Test Setup Photos



4.3.2.6 Occupied Channel Bandwidth

Ambient Temperature: 22°C

Relative Humidity: 37%

Test Engineer: Eddie Mariscal

Test Setup / Conditions

The EUT's antenna port is directly connected to the spectrum analyzer.

Declared OCBW = 2.7MHz

Span = 5.4MHz;

RBW = 56kHz; VBW = 3xRBW

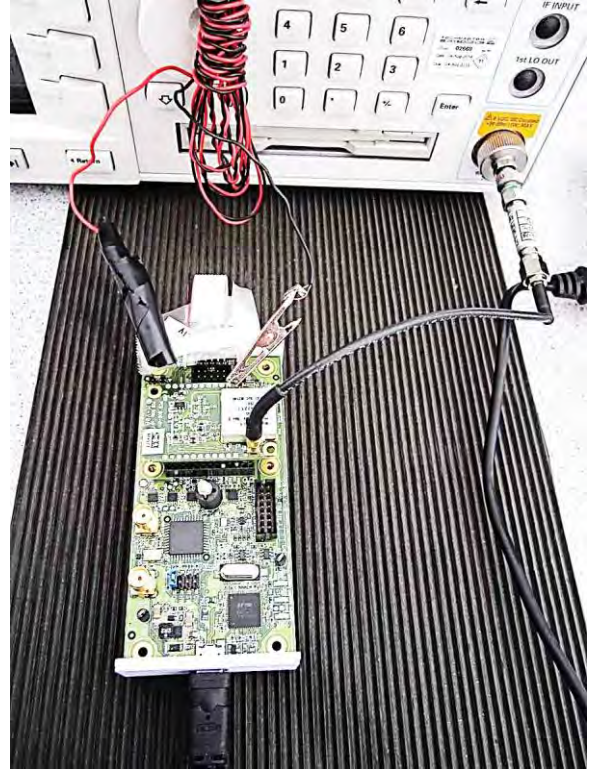
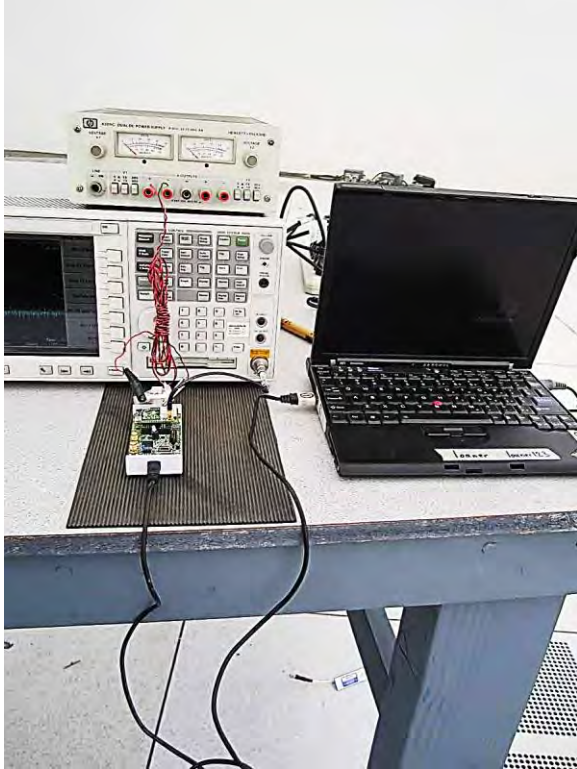
Test Equipment

Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
02668	Spectrum Analyzer	Agilent	E4446A	8/4/2014	8/4/2015
02138	Attenuator	Weinschel	54-10	2/13/2013	2/13/2015

Test Data

TESTS	Occupied Channel Bandwidth (MHz)		
	2405MHz	2440MHz	2475MHz
99% OBW	2.2436	2.2379	2.2502
Limit	$\leq 20\text{MHz}$		
Test Result	Pass		
Measurement Uncertainty	1.0%		

Test Setup Photos



4.3.2.7 Transmitter Unwanted Emissions in the OOB Domain

Ambient Temperature: 22°C

Relative Humidity: 37%

Test Engineer: Eddie Mariscal

Test Setup / Conditions

The EUT's antenna port is directly connected to the spectrum analyzer.

EUT is located inside the temperature chamber and is connected to the spectrum analyzer through a measurement cable. All readings are adjusted to account for attenuator and cable loss.

RBW = 1MHz; VBW = 3MHz

Maximum Antenna gain: 4.0dBi

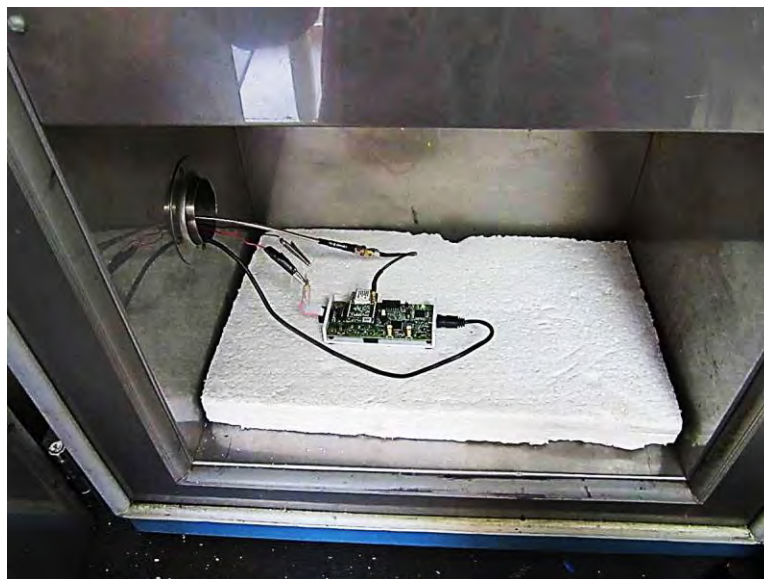
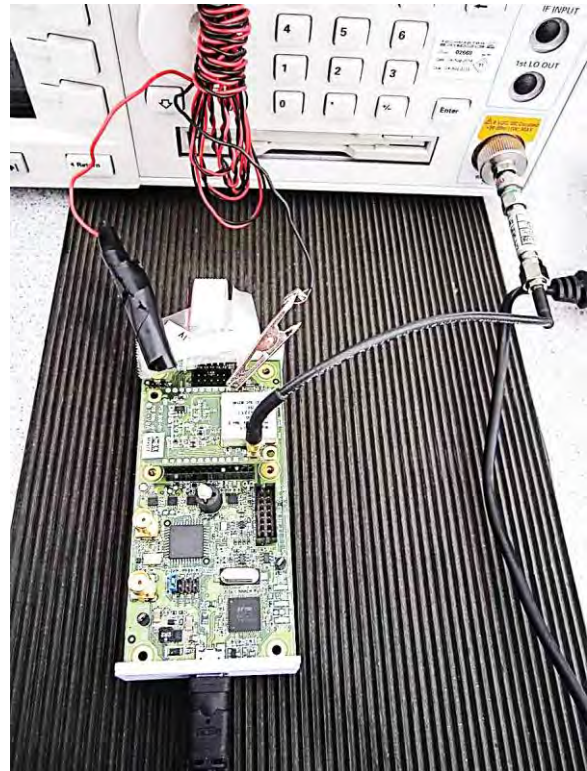
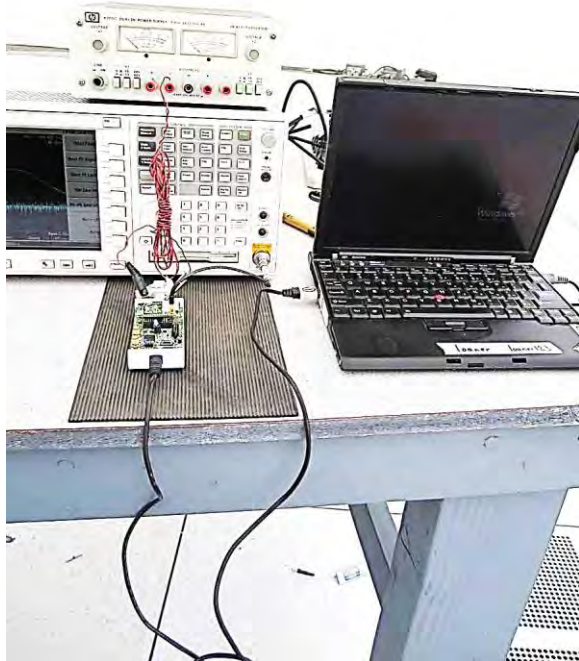
Test Equipment					
Asset #	Description	Manufacturer	Model	Cal Date	Cal Due
02668	Spectrum Analyzer	Agilent	E4446A	8/4/2014	8/4/2015
01879	Temperature Chamber	Thermotron	S-1.2 Min.	11/15/2012	11/15/2014
02242	Thermometer	Omega	HH-26K	5/2/2014	5/2/2016
02138	Attenuator	Weinschel	54-10	2/13/2013	2/13/2015
03356	Cable	Astrolab	32026-2-29094K-48TC	2/7/2013	2/7/2015

Test Data

Unwanted emissions in the OOB Domain						
Frequency (MHz)	Transmit Channel	Measurement (dBm/MHz EIRP)			Limit (dBm/MHz EIRP)	Pass/Fail
		-40°C	20°C	+85°C		
2399.95	Low	-28.9	-29.75	-30.52	-20	PASS
2397.59	Low	-33.37	-33.62	-33.82	-10	PASS
2484.44	High	-36.28	-36.19	-37.05	-10	PASS
2486.02	High	-38.25	-38.7	-39.51	-20	PASS
Measurement Uncertainty		0.67dB				

Note: Reported emissions are EIRP, where EIRP = measured conducted power + Antenna gain

Test Setup Photos



SUPPLEMENTAL INFORMATION

Measurement Uncertainty

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.