

Dust Networks

TEST REPORT FOR

2.4GHz Wireless Mote, M2510

Tested To The Following Standards:

ETSI EN 300 328 V1.7.1

Report No.: 91302-11

Date of issue: February 9, 2011



TESTING
CERT #803.01, 803.02,
803.05, 803.06

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

REPORT PREPARED BY:

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

Project Number: 91302

DATE OF EQUIPMENT RECEIPT:

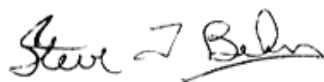
January 23, 2011

DATE(S) OF TESTING:

January 23-24, 2011

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.
22116 23rd Drive, S.E. Suite A
Bothell WA, 98021-4413

SUMMARY OF RESULTS

Standard / Specification: ETSI EN 300 328 V1.7.1

| Description | Test Procedure/Method | Results |
|-----------------------------------|-----------------------|---------|
| Technical Requirements | Sub clause 4.3 | |
| | | |
| 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 |
|-----------------------|
| None |
| |

EQUIPMENT UNDER TEST

The following model has been tested by CKC Laboratories: **M2510**

The manufacturer states that the following additional model is 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 model: **M2140**

EQUIPMENT UNDER TEST

2.4GHz Wireless Mote

Manuf: Dust Networks
Model: M2510
Serial: NA

2dBi Antenna

Manuf: NA
Model: NA
Serial: NA

PERIPHERAL DEVICES

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

TTL Converter

Manuf: B&B Electronics
Model: 232LPTTL33
Serial: 0069810016

Laptop

Manuf: Dell
Model: Inspiron
Serial: NA

EQUIPMENT DETAILS

| Frequencies of Selected Test Channels | |
|---------------------------------------|------------|
| Lowest Channel | (2405) MHz |
| Middle Channel | (2440) MHz |
| Highest Channel | (2475)MHz |

Equipment specifications for equipment using FHSS

| Equipment Installation Type | Stand Alone, Plug-in Radio or Combination |
|--------------------------------|---|
| Modulation Type | FHSS |
| Number of Hopping Channels | (...) |
| Adaptive Frequency Hopping | Used / Not Used |
| Minimum Channel Separation | (...) |
| Maximum Dwell Time per Channel | (...) |
| Operating Frequency Range(s) | 2400-2483.5 MHz |
| List of intended Antennas | (...) |

Equipment specifications for DSSS / Other types of modulation

| Equipment Installation Type | Plug-in Radio |
|------------------------------|-----------------|
| Modulation Type | DSSS / 802.15.4 |
| Operating Frequency Range(s) | 2405-2475 MHz |
| List of intended Antennas | +2 dBi antenna |

ETSI EN 300 328 V1.7.1

4.3 TECHNICAL REQUIREMENTS

4.3.1 Maximum Transmit Power

Ambient Temperature: 21°C

Relative Humidity: 34%

Test Engineer: A del Angel

| Test Equipment | | | | | |
|----------------|---------------------|------------------|--------------|------------|------------|
| Asset/Serial # | Description | Model | Manufacturer | Cal Date | Cal Due |
| 02872 | Spectrum Analyzer | E4440A | Agilent | 8/25/2009 | 8/25/2011 |
| P05747 | Attenuator | PE7004-20 | Pasternack | 3/18/2010 | 3/18/2012 |
| 03121 | Cable | 32026-2-29080-84 | Astrolab | 10/23/2009 | 10/23/2011 |
| 02907 | Multimeter | 87 | Fluke | 5/11/2009 | 5/11/2011 |
| 03193 | Power Supply | PS50050 | HQ | 12/2/2010 | 12/2/2012 |
| 02757 | Temperature Chamber | F100/350-8 | Bemco | 1/30/2011 | 1/30/2013 |

Test Data

Rated output power dBm / dBW: N/A

Antenna assembly gain dBi = +2

Duty cycle of the equipment during the test x=1

| TEST CONDITIONS | | TRANSMITTER POWER (dBm) | | |
|-------------------------|------------------|-------------------------|------------------------|------------------------|
| | | Lowest Frequency | Middle Frequency | Highest Frequency |
| $T_{nom}(21)^{\circ}C$ | $V_{nom}(3)V$ | Av=6.8dBm Pk=8.8dBm | Av=6.2dBm Pk=8.2dBm | Av=6.0dBm Pk=8.0dBm |
| $T_{min}(-20)^{\circ}C$ | $V_{min}(2.55)V$ | Av=6.2dBm Pk=8.2dBm | Av=7.6dBm Pk=9.6dBm | Av=6.0dBm Pk=8.0dBm |
| | $V_{max}(3.45)V$ | Av=6.2dBm Pk=8.2dBm | Av=7.6dBm Pk=9.6dBm | Av=6.0dBm Pk=8.0dBm |
| $T_{max}(55)^{\circ}C$ | $V_{min}(2.55)V$ | Av=5.4dBm Pk=7.4dBm | Av=4.8dBm Pk=6.8dBm | Av=4.3dBm Pk=6.3dBm |
| | $V_{max}(3.45)V$ | Av=5.4dBm Pk=7.4dBm | Av=4.8dBm Pk=6.8dBm | Av=4.4dBm Pk=6.4dBm |
| Measurement Uncertainty | | 3.703 dB | | |

Note: After obtaining the channel output power the following formula was used to obtain the MAX EIRP,
 $P = A + G + 10 \log (1/x)$ where P is the EIRP, A is the average output power obtained with PSA measurement, G is the numerical gain of the antenna in dBi (+2), and x is the observed duty cycle (100% or 1 in our case).

Test Setup Photos





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

Ambient Temperature: 21°C

Relative Humidity: 34%

Test Engineer: A del Angel

| Test Equipment | | | | | |
|----------------|-------------------|------------------|--------------|------------|------------|
| Asset/Serial # | Description | Model | Manufacturer | Cal Date | Cal Due |
| 02872 | Spectrum Analyzer | E4440A | Agilent | 8/25/2009 | 8/25/2011 |
| P05747 | Attenuator | PE7004-20 | Pasternack | 3/18/2010 | 3/18/2012 |
| 03121 | Cable | 32026-2-29080-84 | Astrolab | 10/23/2009 | 10/23/2011 |

Test Data

Antenna assembly gain dBi = +2

Duty cycle of the equipment during the test x=1

| TESTS | Measured Power Density | | |
|-------------------------|------------------------|------------------|-------------------|
| | Lowest Frequency | Middle Frequency | Highest Frequency |
| Measured Power Density | 7.2dBm /MHz | 6.6dBm /MHz | 6.3dBm /MHz |
| Measurement Uncertainty | 1×10^{-5} | | |

Note: After obtaining the channel output power the following formula was used to obtain the MAX EIRP Spectral Density, $PD = D + G + 10 \log (1/x)$ where PD is the Power Density, D is the Power Density obtained with PSA measurement, G is the numerical gain of the antenna in dBi (+2), and x is the observed duty cycle (100% or 1 in our case).

Test Setup Photos



4.3.3 Frequency Range

Ambient Temperature: 21°C

Relative Humidity: 34 %

Engineer Name: A del Angel

| Test Equipment | | | | | |
|----------------|---------------------|------------------|--------------|------------|------------|
| Asset/Serial # | Description | Model | Manufacturer | Cal Date | Cal Due |
| 02872 | Spectrum Analyzer | E4440A | Agilent | 8/25/2009 | 8/25/2011 |
| P05747 | Attenuator | PE7004-20 | Pasternack | 3/18/2010 | 3/18/2012 |
| 03121 | Cable | 32026-2-29080-84 | Astrolab | 10/23/2009 | 10/23/2011 |
| 02907 | Multimeter | 87 | Fluke | 5/11/2009 | 5/11/2011 |
| 03193 | Power Supply | PS50050 | HQ | 12/2/2010 | 12/2/2012 |
| 02757 | Temperature Chamber | F100/350-8 | Bemco | 1/30/2011 | 1/30/2013 |

Test Data

| TEST CONDITIONS | | FREQUENCY (MHz) at which Power Envelope Crosses -30dBm/100kHz | |
|--|------------------|---|-------------|
| | | Lowest | Highest |
| $T_{nom}(21)^{\circ}C$ | $V_{nom}(3)V$ | 2402.825MHz | 2477.100MHz |
| $T_{min}(-20)^{\circ}C$ | $V_{min}(2.55)V$ | 2402.920MHz | 2476.980MHz |
| | $V_{max}(3.45)V$ | 2402.920MHz | 2477.085MHz |
| $T_{max}(55)^{\circ}C$ | $V_{min}(2.55)V$ | 2402.800MHz | 2476.945MHz |
| | $V_{max}(3.45)V$ | 2402.840MHz | 2477.090MHz |
| Measured Frequencies (Lowest And Highest) | | $f_L = 2402.800MHz$ $f_H = 2477.100MHz$ | |
| Measurement Uncertainty | | 5.774×10^{-10} | |

Test Setup Photos





4.3.6 Transmitter Spurious Emissions

4.3.6 Transmitter Conducted Spurious Emissions

Ambient Temperature: 21°C

Relative Humidity: 34%

Test Engineer: A del Angel

| Test Equipment | | | | | |
|----------------|-------------------|------------------|--------------|------------|------------|
| Asset/Serial # | Description | Model | Manufacturer | Cal Date | Cal Due |
| 02872 | Spectrum Analyzer | E4440A | Agilent | 8/25/2009 | 8/25/2011 |
| P05747 | Attenuator | PE7004-20 | Pasternack | 3/18/2010 | 3/18/2012 |
| 03121 | Cable | 32026-2-29080-84 | Astrolab | 10/23/2009 | 10/23/2011 |

Test Data

| SPURIOUS EMISSIONS LEVEL | | | |
|-----------------------------|--------------------|--------------------------|-------------|
| Fundamental Frequency (MHz) | Band-width** (kHz) | Spurious Frequency (MHz) | Level (dBm) |
| 2405 | 100 | 1923 | -37.6 |
| 2405 | 100 | 2884 | -49.6 |
| 2405 | 100 | 7213 | -41 |
| 2440 | 100 | 7321 | -41.5 |
| 2440 | 100 | 1951 | 36.5 |
| 2475 | 100 | 1979 | -35.4 |
| 2475 | 100 | 7423 | -43.3 |
| Measurement Uncertainty | | 0.673 dB | |

** Bandwidth = the measuring receiver bandwidth

Test Setup Photos





4.3.6 Transmitter Radiated Spurious Emissions

Ambient Temperature: 21°C

Relative Humidity: 34%

Test Engineer: A del Angel

| Test Equipment | | | | | |
|----------------|-------------------|------------------|--------------|------------|------------|
| Asset/Serial # | Description | Model | Manufacturer | Cal Date | Cal Due |
| 02872 | Spectrum Analyzer | E4440A | Agilent | 8/25/2009 | 8/25/2011 |
| 03121 | Cable | 32026-2-29080-84 | Astrolab | 10/23/2009 | 10/23/2011 |
| 01467 | Horn Antenna | 3115 | EMCO | 5/7/2010 | 5/7/2012 |
| 01993 | Biconilog Antenna | CBL6111C | Chase | 10/9/2009 | 10/9/2011 |
| P05360 | Cable | RG214 | Belden | 11/8/2010 | 11/8/2012 |
| P05366 | Cable | RG-214 | Belden | 10/20/2009 | 10/20/2011 |
| 01316 | Preamplifier | 8447D | HP | 5/21/2010 | 5/21/2012 |
| P05542 | Cable | Helix | Andrews | 10/23/2009 | 10/23/2011 |
| 03123 | Cable | 32026-2-29801-12 | Astrolab | 10/23/2009 | 10/23/2011 |
| 03209 | Preamplifier | 83051A | Agilent | 10/29/2010 | 10/29/2012 |

Test Data

| SPURIOUS EMISSIONS LEVEL | | | |
|-----------------------------|--------------------|--------------------------|-------------|
| Fundamental Frequency (MHz) | Band-width** (kHz) | Spurious Frequency (MHz) | Level (dBm) |
| 2405 | 100 | 4808 | -46.4 |
| 2405 | 100 | 7213 | -46.4 |
| 2405 | 100 | 9617 | -42.7 |
| 2440 | 100 | 4880 | -48.3 |
| 2440 | 100 | 7318 | -45.6 |
| 2440 | 100 | 9761 | -43.9 |
| 2475 | 100 | 9897 | -45.7 |
| Measurement Uncertainty | | 0.673 dB | |

** Bandwidth = the measuring receiver bandwidth

Test Setup Photos





4.3.7 Receiver Spurious Emissions

4.3.7 Receiver Conducted Spurious Emissions

Ambient Temperature: 21°C

Relative Humidity: 34%

Test Engineer: A del Angel

| Test Equipment | | | | | |
|----------------|-------------------|------------------|--------------|------------|------------|
| Asset/Serial # | Description | Model | Manufacturer | Cal Date | Cal Due |
| 02872 | Spectrum Analyzer | E4440A | Agilent | 8/25/2009 | 8/25/2011 |
| P05747 | Attenuator | PE7004-20 | Pasternack | 3/18/2010 | 3/18/2012 |
| 03121 | Cable | 32026-2-29080-84 | Astrolab | 10/23/2009 | 10/23/2011 |

Test Data

| SPURIOUS EMISSIONS LEVEL | | | |
|-----------------------------|--------------------|--------------------------|-------------|
| Fundamental Frequency (MHz) | Band-width** (kHz) | Spurious Frequency (MHz) | Level (dBm) |
| N/A | 100 | 2402 | -55.1 |
| N/A | 100 | 2437 | -53.2 |
| N/A | 100 | 2472 | -54.7 |
| Measurement Uncertainty | | 0.673 dB | |

Test Setup Photos





4.3.7 Receiver Radiated Spurious Emissions

Ambient Temperature: 21°C

Relative Humidity: 34%

Test Engineer: A del Angel

| Test Equipment | | | | | |
|----------------|-------------------|------------------|--------------|------------|------------|
| Asset/Serial # | Description | Model | Manufacturer | Cal Date | Cal Due |
| 02872 | Spectrum Analyzer | E4440A | Agilent | 8/25/2009 | 8/25/2011 |
| 03121 | Cable | 32026-2-29080-84 | Astrolab | 10/23/2009 | 10/23/2011 |
| 01467 | Horn Antenna | 3115 | EMCO | 5/7/2010 | 5/7/2012 |
| 01993 | Biconilog Antenna | CBL6111C | Chase | 10/9/2009 | 10/9/2011 |
| P05360 | Cable | RG214 | Belden | 11/8/2010 | 11/8/2012 |
| P05366 | Cable | RG-214 | Belden | 10/20/2009 | 10/20/2011 |
| 01316 | Preamplifier | 8447D | HP | 5/21/2010 | 5/21/2012 |
| P05542 | Cable | Heliac | Andrews | 10/23/2009 | 10/23/2011 |
| 03123 | Cable | 32026-2-29801-12 | Astrolab | 10/23/2009 | 10/23/2011 |
| 03209 | Preamplifier | 83051A | Agilent | 10/29/2010 | 10/29/2012 |

Test Data

| SPURIOUS EMISSIONS LEVEL | | | |
|-----------------------------|--------------------|--------------------------|-------------|
| Fundamental Frequency (MHz) | Band-width** (kHz) | Spurious Frequency (MHz) | Level (dBm) |
| 2405 | 100 | 2402 | -51.7 |
| 2440 | 100 | 2437 | -52.1 |
| 2475 | 100 | 2472 | -54.8 |
| Measurement Uncertainty | | 0.673 dB | |

Test Setup Photos



