



DUST NETWORKS TEST REPORT
FOR THE
2.4 GHZ WIRELESS MOTE, M2140 & M2040
ETSI EN 301 489-17 V1.2.1 (2002-08)
TESTING

DATE OF ISSUE: OCTOBER 10, 2007

PREPARED FOR:

Dust Networks
30695 Huntwood Avenue
Hayward, CA 94544

PREPARED BY:

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5046 Sierra Pines Drive
Mariposa, CA 95338

P.O. No.: 2877
W.O. No.: 87117

Date of test: September 26 - October 2, 2007

Report No: ETS07-043B

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ADMINISTRATIVE INFORMATION

DATE OF TEST: September 26 –
October 2, 2007

DATE OF RECEIPT: September 26, 2007

REPRESENTATIVE: Gordon Charles

MANUFACTURER:
Dust Networks
30695 Huntwood Avenue
Hayward, CA 94544

TEST LOCATION:
CKC Laboratories, Inc.
5046 Sierra Pines Drive
Mariposa, CA 95338

TEST METHOD*: ETSI EN 301 489-17 V1.2.1 (2002-08) and ETSI EN 301 489-1 V1.6.1 (2005-09)

*Note: 89/336/EEC Article 7.1 stipulates that a national standard transposed from the harmonized standard published in the OJ is to be used. However, for convenience and to reduce confusion, the date of the CENELEC harmonized standard is used in the report. Should questions arise, the national standard transposed from the harmonized (BS EN) is the official standard used.

PURPOSE OF TEST: To perform the testing of the 2.4 GHz Wireless Mote, M2140 & M2040 with the requirements for ETSI EN 301 489-17 V1.2.1 devices.

APPROVALS

QUALITY ASSURANCE:

Steve Behm, Director of Engineering Services

Joyce Walker, Quality Assurance Administrative Manager

TEST PERSONNEL:

Mike Wilkinson, EMC Engineer/Lab Manager

SUMMARY OF RESULTS

Test	Specification/Method	Results
Radiated Emissions	EN55022 (1998) Class 1 ETSI EN 301 489-1 V1.6.1 (2005-09)	Pass
Mains Conducted Emissions	EN55022 (1998) Class 1 ETSI EN 301 489-1 V1.6.1 (2005-09)	Pass
Harmonic Emissions	EN61000-3-2 (2000 w/A1: 01) ETSI EN 301 489-1 V1.6.1 (2005-09)	NA
Voltage Fluctuations and Flicker Emissions	EN61000-3-3 (1995) ETSI EN 301 489-1 V1.6.1 (2005-09)	NA
Radiated Immunity	EN61000-4-3 (2002 w/A1: 02) ETSI EN 301 489-1 V1.6.1 (2005-09)	Pass
Electrostatic Discharge	EN61000-4-2 (1995 w/A1: 98 & A2: 01) ETSI EN 301 489-1 V1.6.1 (2005-09)	Pass
Electrical Fast Transient Burst	EN61000-4-4 (1995 w/A1 & A2: 01) ETSI EN 301 489-1 V1.6.1 (2005-09)	NA
Conducted Immunity	EN61000-4-6 (1996 w/A1: 01) ETSI EN 301 489-1 V1.6.1 (2005-09)	NA
Transients and Surges	ISO 7637-2 ETSI EN 301 489-1 V1.6.1 (2005-09)	NA
Voltage Dips & Interrupts	EN61000-4-11 (2004) ETSI EN 301 489-1 V1.6.1 (2005-09)	NA
Surge	EN61000-4-5 (1995 w/A1: 01) ETSI EN 301 489-1 V1.6.1 (2005-09)	NA

NA = Not Applicable

CONDITIONS DURING TESTING

No modifications to the EUT were necessary during testing. 2 models of EUT are covered in this report (M2140 & M2040). The M2140 only was chosen to be tested for immunity as both models contain exactly the same hardware, but the M2040 has the power amp disabled by the factory (firmware, not available to the end user).

TEMPERATURE AND HUMIDITY DURING TESTING

The temperature during testing was within +15°C and + 35°C.
The relative humidity was between 20% and 75%.

EQUIPMENT UNDER TEST (EUT) DESCRIPTION

The customer declares the EUT tested by CKC Laboratories was representative of a production unit. The M2140 was chosen to be tested as the worst case model for complete testing.

The following model has been tested by CKC Laboratories: **M2140**

The manufacturer states that the following additional models are 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 models: **M2040 and M2510**

Models M2140 and M2040 contain exactly the same hardware, but the M2040 has the power amp disabled by the factory (firmware, not available to the end user). Partial testing was completed on model M2040 to ensure compliance in this mode.

EQUIPMENT UNDER TEST

2.4 GHz Wireless Mote

Manuf: Dust Networks
Model: M2140
Serial: NA

PERIPHERAL DEVICES

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

2.4 GHz Host Wireless Embedded Network Manager

Manuf: Dust Networks
Model: D2140
Serial: 00-17-0D-00-00-10-05-38

Support Computer

Manuf: Micron
Model: Client Pro Vxe
Serial: 211791-0001

Support Monitor

Manuf: Micron
Model: RMD5L11CM
Serial: 8205L1128430

Support Spectrum Analyzer

Manuf: HP
Model: 8593EM
Serial: 3624A00159

Support Horn Antenna

Manuf: EMCO
Model: 3115
Serial: 3006-3413

EUT OPERATING FREQUENCY

The EUT was operating at 2.4 GHz.

ETSI EN 301 489-17 CLAUSE 7 APPLICABILITY OVERVIEW

Phenomenon	Application	Equipment Test Requirement			Reference Subclause in ETSI EN 301 489
		Radio and ancillary equipment for fixed use (base station equipment)	Radio and ancillary equipment for vehicular use (mobile equipment)	Radio and ancillary equipment for portable use (portable equipment)	
Radiated Emission	Enclosure of ancillary equipment	Applicable for stand alone testing	Applicable for stand alone testing	Applicable for stand alone testing	EN 301 489-1 8.2
Conducted Emission	DC Power input/output port	Applicable	Applicable	Not Applicable	EN 301 489-1 8.3
Conducted Emission	AC mains input/output port	Applicable	Not Applicable	Not Applicable	EN 301 489-1 8.4
Harmonic Current Emissions	AC mains input port	Applicable	Not Applicable	Not Applicable	EN 301 489-1 8.5
Voltage Fluctuations and Flicker	AC mains input port	Applicable	Not Applicable	Not Applicable	EN 301 489-1 8.6
Conducted Emission	Telecommunicatio n port	Applicable	Applicable	Not Applicable	EN 301 489-1 8.7
RF electromagnetic field (80 MHz to 1 000 MHz)	Enclosure	Applicable	Applicable	Applicable	EN 301 489-1 9.2
Electrostatic Discharge	Enclosure	Applicable	Applicable	Applicable	EN 301 489-1 9.3
Fast transients common mode	Signal, Telecommunicatio n and control ports, DC and AC power ports	Applicable	Not Applicable	Not Applicable	EN 301 489-1 9.4
RF common mode 0,15 MHz to 80 MHz	Signal, Telecommunicatio n and control ports, DC and AC power ports	Applicable	Applicable	Not Applicable	EN 301 489-1 9.5
Transients and surges	DC power input ports	Not Applicable	Applicable	Not Applicable	EN 301 489-1 9.6
Voltage dips and interruptions	AC mains power input ports	Applicable	Not Applicable	Not Applicable	EN 301 489-1 9.7
Surges, line to line and line to ground	AC mains power input ports, telecommunication ports	Applicable	Not Applicable	Not Applicable	EN 301 489-1 9.8

REPORT OF EMISSIONS MEASUREMENTS

TESTING PARAMETERS

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 μ V/m, the spectrum analyzer reading in dB μ V was corrected by using the following formula. This reading was then compared to the applicable specification limit.

SAMPLE CALCULATIONS		
	Meter reading	(dB μ V)
+	Antenna Factor	(dB)
+	Cable Loss	(dB)
-	Distance Correction	(dB)
-	Preamplifier Gain	(dB)
=	Corrected Reading	(dB μ V/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. 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. When conducted emissions testing was performed, a 10 dB external attenuator was used with internal offset correction in the analyzer.

MEASURING EQUIPMENT BANDWIDTH SETTINGS PER FREQUENCY RANGE			
TEST	BEGINNING FREQUENCY	ENDING FREQUENCY	BANDWIDTH SETTING
CONDUCTED 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 "Peak" mode. Whenever a "Quasi-Peak" or "Average" reading is listed as one of the highest readings, this is indicated as a "Q" or an "A" in the appropriate table. 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/receiver readings were recorded all emissions at their peak value as the frequency band selected was scanned. By combining this function with another feature of the measuring device called "peak hold," the measuring device had the ability to measure transients 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

When the true peak values exceeded or were within 2 dB of the specification limit, quasi-peak measurements were taken using the quasi-peak detector.

Average

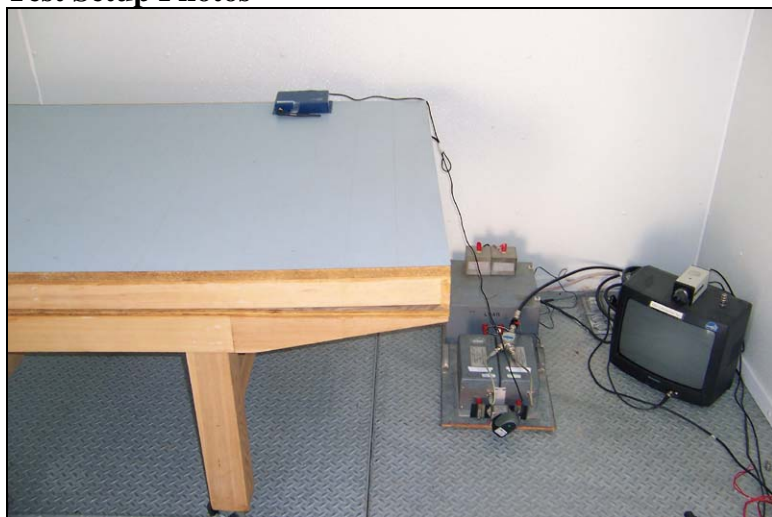
For certain frequencies, average measurements may be made using the spectrum analyzer/receiver. To make these measurements, the test engineer reduces the video bandwidth on the measuring device until the modulation of the signal is filtered out. At this point the measuring device is set into the linear mode and the scan time is reduced.

Ambient Temperature: 22.5°C

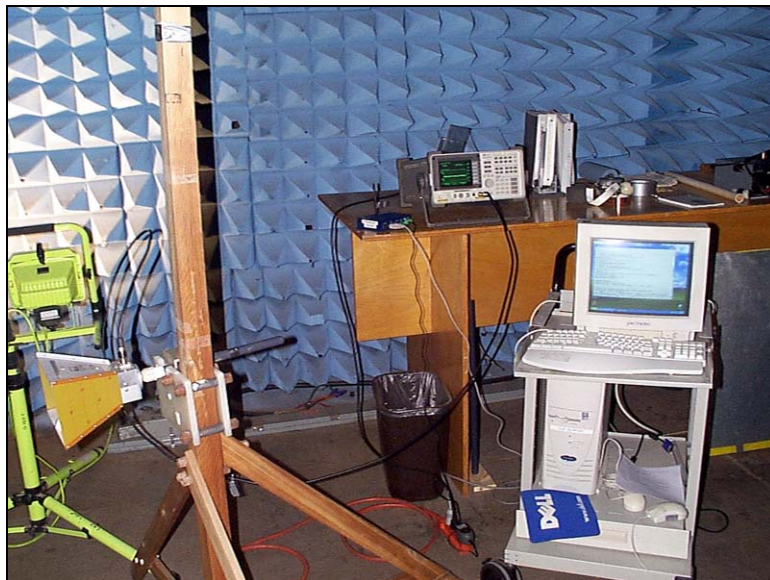
Relative Humidity: 46%

CONDUCTED EMISSIONS

Test Setup Photos



SUPPORT EQUIPMENT



Test Data Sheets

Test Location: CKC Laboratories, Inc. • 4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer: **Dust Networks**
 Specification: **EN55022 B COND [AVE]**
 Work Order #: **87117**
 Test Type: **Conducted Emissions**
 Equipment: **2.4 GHz Wireless Mote**
 Manufacturer: Dust Networks
 Model: M2140
 S/N: N/A

Date: 10/2/2007
 Time: 9:18:31 AM
 Sequence#: 9
 Tested By: Mike Wilkinson
 230V 50Hz

Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
LISN, 8028-50-TS-24-BNC	8379276, 280	05/07/2007	05/07/2009	1248 & 1249

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	N/A

Support Devices:

Function	Manufacturer	Model #	S/N
2.4 GHz Host Wireless Embedded Network Manager	Dust Networks	D2140	00-17-0D-00-00-10-05-38

Test Conditions / Notes:

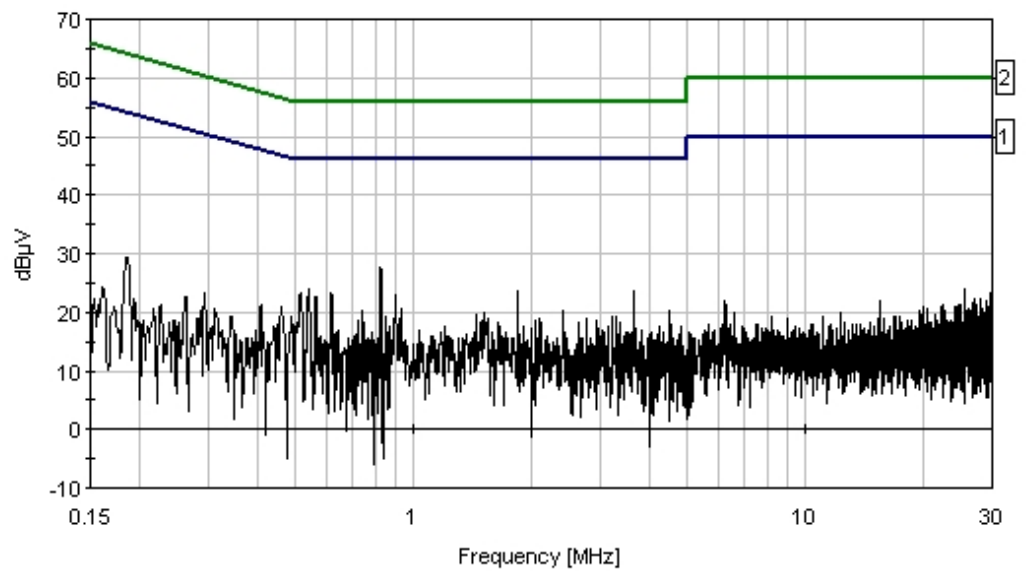
EUT is an 802.15.4 transmitter. EUT is in the receive mode. EUT is installed in and powered by the host manager which is connected to the AC mains. The temperature was 22.5°C and the humidity was 46%. Frequency range investigated was 150 kHz to 30 MHz RBW = CISPR VBW = CISPR.

Transducer Legend:

T1=Filter 150kHz HP AN02609	T2=MACOND
T3=LISN - BK	T4=ANP05624 (10dB Attn)

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	825.574k	17.1	+0.2	+0.4	+0.2	+9.7	+0.0	27.6	46.0	-18.4	Black
2	540.510k	13.3	+0.3	+0.3	+0.2	+9.7	+0.0	23.8	46.0	-22.2	Black
3	1.851M	13.1	+0.1	+0.5	+0.3	+9.7	+0.0	23.7	46.0	-22.3	Black
4	3.658M	13.0	+0.1	+0.6	+0.3	+9.7	+0.0	23.7	46.0	-22.3	Black
5	514.330k	13.0	+0.3	+0.3	+0.2	+9.6	+0.0	23.4	46.0	-22.6	Black
6	617.593k	12.6	+0.2	+0.3	+0.3	+9.8	+0.0	23.2	46.0	-22.8	Black
7	898.469k	12.4	+0.2	+0.4	+0.2	+9.7	+0.0	22.9	46.0	-23.1	Black
8	563.780k	12.1	+0.2	+0.3	+0.3	+9.7	+0.0	22.6	46.0	-23.4	Black
9	185.633k	18.9	+0.2	+0.2	+0.2	+9.7	+0.0	29.2	54.2	-25.0	Black
10	928.238k	10.2	+0.2	+0.4	+0.2	+9.7	+0.0	20.7	46.0	-25.3	Black
11	459.790k	10.6	+0.2	+0.3	+0.2	+9.6	+0.0	20.9	46.7	-25.8	Black
12	737.583k	9.6	+0.2	+0.4	+0.2	+9.8	+0.0	20.2	46.0	-25.8	Black
13	4.509M	9.6	+0.0	+0.6	+0.3	+9.7	+0.0	20.2	46.0	-25.8	Black
14	2.417M	9.5	+0.1	+0.5	+0.3	+9.7	+0.0	20.1	46.0	-25.9	Black
15	1.515M	9.3	+0.1	+0.5	+0.3	+9.7	+0.0	19.9	46.0	-26.1	Black

CKC Laboratories, Inc. Date: 10/2/2007 Time: 9:18:31 AM Dust Networks WO#: 87117
EN55022 B COND [AVE] Test Lead: Black 230V 50Hz Sequence#: 9
Dust Networks M/N M2140 (EXTATTN)



— Sweep Data — 1 - EN55022 B COND [AVE] — 2 - EN55022 B COND [QP]



Test Location: CKC Laboratories, Inc. • 4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer: **Dust Networks**

Specification: **EN55022 B COND [AVE]**

Work Order #: **87117**

Test Type: **Conducted Emissions**

Equipment: **2.4 GHz Wireless Mote**

Manufacturer: **Dust Networks**

Model: **M2140**

S/N: **N/A**

Date: 10/2/2007

Time: 9:23:12 AM

Sequence#: 10

Tested By: Mike Wilkinson

230V 50Hz

Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
LISN, 8028-50-TS-24-BNC	8379276, 280	05/07/2007	05/07/2009	1248 & 1249

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	N/A

Support Devices:

Function	Manufacturer	Model #	S/N
2.4 GHz Host Wireless Embedded Network Manager	Dust Networks	D2140	00-17-0D-00-00-10-05-38

Test Conditions / Notes:

EUT is an 802.15.4 transmitter. EUT is in the receive mode. EUT is installed in and powered by the host manager which is connected to the AC mains. The temperature was 22.5°C and the humidity was 46%. Frequency range investigated was 150 kHz to 30 MHz RBW = CISPR VBW = CISPR.

Transducer Legend:

T1=Filter 150kHz HP AN02609	T2=MACOND
T3=LISN - WT	T4=ANP05624 (10dB Attn)

Measurement Data:

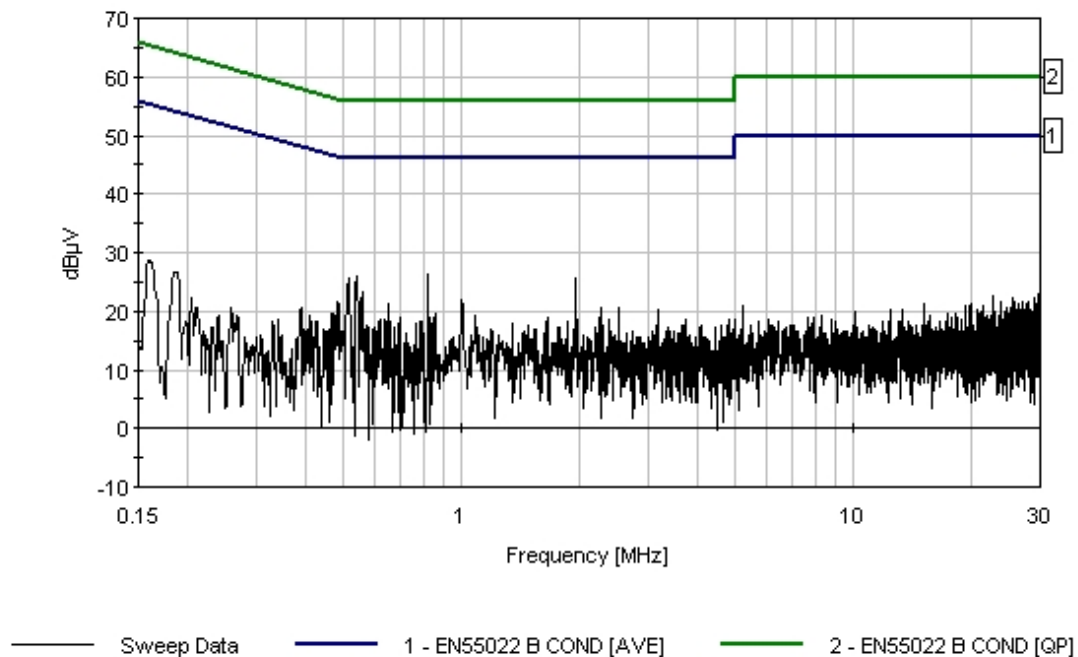
Reading listed by margin.

Test Lead: White

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB	T4 dB	Dist Table	Corr dBμV	Spec dBμV	Margin dB	Polar Ant
1	823.393k	15.5	+0.2	+0.4	+0.4	+9.7	+0.0	26.2	46.0	-19.8	White
2	539.782k	15.2	+0.3	+0.3	+0.3	+9.7	+0.0	25.8	46.0	-20.2	White
3	515.057k	15.1	+0.3	+0.3	+0.3	+9.6	+0.0	25.6	46.0	-20.4	White
4	1.957M	15.1	+0.1	+0.5	+0.2	+9.7	+0.0	25.6	46.0	-20.4	White
5	558.690k	12.9	+0.3	+0.3	+0.2	+9.7	+0.0	23.4	46.0	-22.6	White
6	1.005M	11.4	+0.2	+0.4	+0.2	+9.8	+0.0	22.0	46.0	-24.0	White

7	485.242k	11.2	+0.2	+0.3	+0.3	+9.6	+0.0	21.6	46.2	-24.6	White
8	653.954k	10.5	+0.2	+0.3	+0.3	+9.8	+0.0	21.1	46.0	-24.9	White
9	2.268M	10.1	+0.1	+0.5	+0.2	+9.7	+0.0	20.6	46.0	-25.4	White
10	2.523M	9.9	+0.1	+0.5	+0.3	+9.7	+0.0	20.5	46.0	-25.5	White
11	3.165M	9.7	+0.1	+0.5	+0.3	+9.7	+0.0	20.3	46.0	-25.7	White
12	859.026k	8.9	+0.2	+0.4	+0.3	+9.7	+0.0	19.5	46.0	-26.5	White
13	159.454k	17.2	+1.4	+0.2	+0.3	+9.7	+0.0	28.8	55.5	-26.7	White
14	468.516k	9.2	+0.2	+0.3	+0.3	+9.6	+0.0	19.6	46.5	-26.9	White
15	1.086M	8.5	+0.2	+0.4	+0.2	+9.8	+0.0	19.1	46.0	-26.9	White

CKC Laboratories, Inc. Date: 10/2/2007 Time: 9:23:12 AM Dust Networks WO#: 87117
EN55022 B COND [AVE] Test Lead: White 230V 50Hz Sequence#: 10
Dust Networks M/N M2140 (EXTATTN)



RADIATED EMISSIONS

Test Setup Photos







Test Data Sheets

Test Location: CKC Laboratories, Inc. • 4933 Sierra Pines Dr. • Mariposa, CA 95338 • 1-800-500-4EMC (4362)

Customer: **Dust Networks**
 Specification: **EN55022 A RADIATED**
 Work Order #: **87117** Date: 10/1/2007
 Test Type: **Maximized Emissions** Time: 13:24:05
 Equipment: **2.4 GHz Wireless Mote** Sequence#: 6
 Manufacturer: Dust Networks Tested By: Mike Wilkinson
 Model: M2140
 S/N: 092607A

Test Equipment:

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
Chase CBL6111C	2456	12/30/2006	12/30/2008	01991
Bilog				
HP 8447D Preamp	1937A02604	03/14/2007	03/14/2009	00099

Equipment Under Test (* = EUT):

Function	Manufacturer	Model #	S/N
2.4 GHz Wireless Mote*	Dust Networks	M2140	092607A

Support Devices:

Function	Manufacturer	Model #	S/N
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Test Conditions / Notes:

EUT is an 802.15.4 transmitter. EUT is in Receiver mode Channel 0. The temperature was 22°C and the humidity was 46%. Frequency range investigated was 30 to 1000 MHz RBW = 120 kHz VBW = 300 kHz.

Transducer Legend:

T1=Cable - Site D 10m 9k-1G	T2=AMP AN00099
T3=ANT AN01991 25-1000MHz	

Measurement Data: Reading listed by margin. Test Distance: 3 Meters

#	Freq MHz	Rdng dBμV	T1 dB	T2 dB	T3 dB		Dist Table	Corr dBμV/m	Spec dBμV/m	Margin dB	Polar Ant
1	32.778M	34.4	+1.6	-27.2	+17.5		-10.0	16.3	40.0	-23.7	Vert
2	131.194M	32.1	+3.4	-27.0	+11.7		-10.0	10.2	40.0	-29.8	Vert
3	229.528M	25.6	+4.7	-26.5	+11.2		-10.0	5.0	40.0	-35.0	Vert
4	163.891M	26.7	+3.8	-26.8	+10.3		-10.0	4.0	40.0	-36.0	Horiz
5	196.669M	25.0	+4.1	-26.7	+9.1		-10.0	1.5	40.0	-38.5	Horiz
6	327.781M	22.6	+5.6	-26.6	+14.2		-10.0	5.8	47.0	-41.2	Horiz

HARMONIC AND VOLTAGE FLUCTUATION AND FLICKER EMISSIONS

Standard	Test	Pass/Fail
EN61000-3-2	Harmonic Emissions	NA
EN61000-3-3	Voltage Fluctuations and Flicker Emissions	NA

NA = Not Applicable per the standard.

REPORT OF IMMUNITY MEASUREMENTS

EUT Setup: EUT is a 802.15.4, 2.4GHz radio for low power wireless networks. EUT is operating in normal mode (transmitting and receiving). EUT is communicating with the remote support Manager which is connected via a serial cable to the support computer. EUT was also tested in the standby mode.

Monitoring: Performance Criteria in operating mode was evaluated by monitoring the support computer which is displaying the results of data sent to The EUT and received from the EUT. Performance Criteria in standby mode was evaluated by monitoring the support spectrum analyzer, which is connected to a horn antenna, for unwanted transmissions.

RADIATED IMMUNITY

Test Equipment

Equipment	Asset #	Manufacturer	Model #	Serial #	Cal Date	Cal Due
Amplifier	01446	AR	50W1000A	14509	12/27/06	12/27/08
Antenna, Biconilog	01468	EMCO	3143	9403-1020	NCR	NCR
Directional Coupler	02576	Werlatone	C5571	11363	5/23/06	5/23/08
SA RF Section	00092	HP	8568B	2235A02425	1/22/07	1/22/09
SA Display	00091	HP	85662A	2237A04323	1/22/07	1/22/09
Signal Generator	01870	Marconi	2022D	119259/016	8/28/06	8/28/08
Signal Generator	01469	HP	8673C	2822A00551	4/4/06	4/4/08
Function Generator	02219	BK Precision	4011	259-05324	7/18/07	7/18/09
Power Meter	02189	HP	437B	2912U01300	1/12/07	1/12/09
Power Sensor	02392	HP	8482A	2652A16108	1/12/07	1/12/09
Antenna, Horn	01689	EMC	1010	Ampex	NCR	NCR
Directional Coupler	P05303	ATM	C223E	F293606-03	7/10/07	7/10/09

NCR = No Calibration Required

Test Setup Photos



Radiated Immunity (EN61000-4-3) in accordance with ETSI EN 301 489-1

Tested By: Mike Wilkinson

Frequency Range MHz	Modulation	Test Distance	Front V/H	Back V/H	Left Side V/H	Right Side V/H	Performance Criterion
80-1000	80% 1kHz AM	1m	Pass	Pass	Pass	Pass	CT / CR / A
1400-2000	80% 1kHz AM	1m	Pass	Pass	Pass	Pass	CT / CR / A

V = Vertical H = Horizontal

➤ CT=Continuous [phenomena applied to] Transmitters

➤ CR=Continuous [phenomena applied to] Receivers

Notes: 3V/m. Tested in normal operation mode.

Radiated Immunity (EN61000-4-3) in accordance with ETSI EN 301 489-1

Tested By: Mike Wilkinson

Frequency Range MHz	Modulation	Test Distance	Front V/H	Back V/H	Left Side V/H	Right Side V/H	Performance Criterion
80-1000	80% 1kHz AM	1m	Pass	Pass	Pass	Pass	Standby / A
1400-2000	80% 1kHz AM	1m	Pass	Pass	Pass	Pass	Standby / A

V = Vertical H = Horizontal

Notes: 3V/m. Tested in standby operation mode.

Radiated Immunity Performance Criteria (ETSI EN 301 489-17 Subclause 6.3 and 6.5)

Criteria	During Test	After test
A	<p>Operate as intended May show degradation of performance * No loss of function No unintentional transmissions</p> <p><i>For Transmitters CT - tests shall be repeated in standby mode.</i></p> <p><i>For transceivers-CR only: Under no circumstances shall the transmitter operate unintentionally during the test.</i></p>	<p>Operate as intended No degradation of performance * No loss of function No loss of stored data or user programmable functions</p>

*See standard for more detail.

Ambient Temperature: 23.3°C

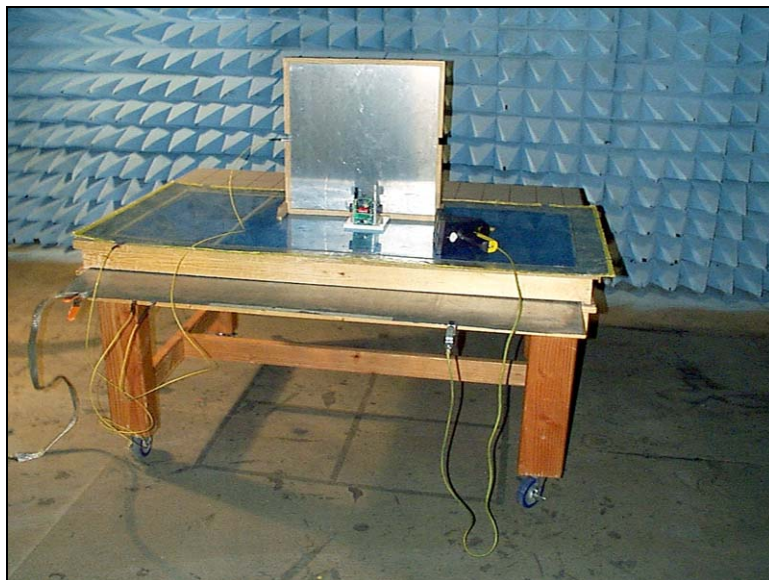
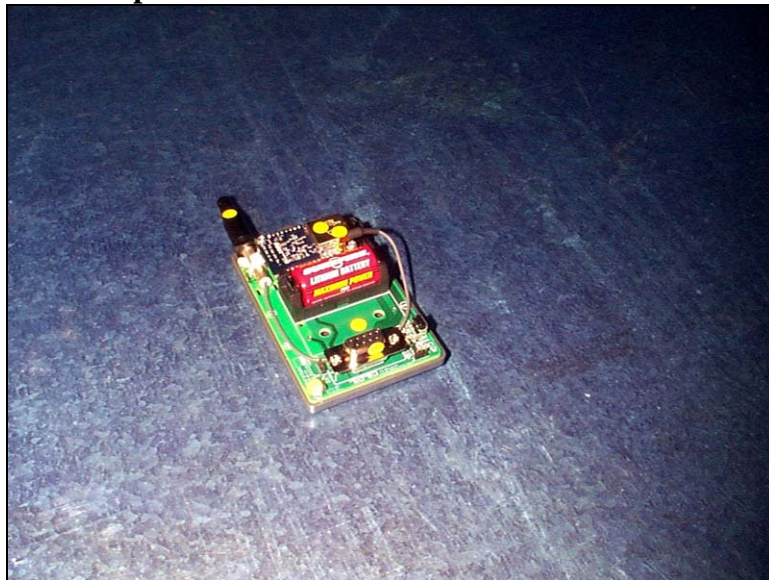
Relative Humidity: 45%

ELECTROSTATIC DISCHARGE

Test Equipment

Equipment	Asset #	Manufacturer	Model #	Serial #	Cal Date	Cal Due
ESD Simulator	02337	Schaffner	NSG 435	001493	12/18/06	12/18/08

Test Setup Photos





ESD - Indirect Discharge (EN61000-4-2) in accordance with ETSI EN 301 489-1

Tested By: Mike Wilkinson

Location on EUT	<u>Indirect Discharge</u> Contact ± 2 & 4 kV		Performance Criteria / Met
	VCP	HCP	
Front	Pass	Pass	TT TR / B
Back	Pass	Pass	TT TR / B
Left Side	Pass	Pass	TT TR / B
Right Side	Pass	Pass	TT TR / B

VCP = Vertical coupling plane HCP = Horizontal coupling plane

➤ TT=Transient [phenomena applied to] Transmitters

➤ TR=Transient [phenomena applied to] Receivers

Notes: Tested in normal operation mode.

ESD - Direct Discharge (EN61000-4-2) in accordance with ETSI EN 301 489-1

Tested By: Mike Wilkinson

Location on EUT	<u>Direct Discharge</u>		Performance Criteria / Met
	Contact ± 2 & 4 kV	Air $\pm 2, 4, 6$ & 8 kV	
Front	Pass	Pass	TT TR / B
Back	Pass	Pass	TT TR / B
Left Side	Pass	Pass	TT TR / B
Right Side	Pass	Pass	TT TR / B
Top	Pass	Pass	TT TR / B

➤ TT=Transient [phenomena applied to] Transmitters

➤ TR=Transient [phenomena applied to] Receivers

Notes: Tested in normal operation mode.

ESD - Indirect Discharge (EN61000-4-2) in accordance with ETSI EN 301 489-1

Tested By: Mike Wilkinson

Location on EUT	<u>Indirect Discharge</u>		Performance Criteria / Met
	Contact ± 2 & 4 kV		
	VCP	HCP	
Front	Pass	Pass	Standby / B
Back	Pass	Pass	Standby / B
Left Side	Pass	Pass	Standby / B
Right Side	Pass	Pass	Standby / B

VCP = Vertical coupling plane HCP = Horizontal coupling plane

Notes: Tested in standby operation mode.

ESD - Direct Discharge (EN61000-4-2) in accordance with ETSI EN 301 489-1

Tested By: Mike Wilkinson

Location on EUT	<u>Direct Discharge</u>		Performance Criteria / Met
	Contact ± 2 & 4 kV	Air $\pm 2, 4, 6$ & 8 kV	
Front	Pass	Pass	Standby / B
Back	Pass	Pass	Standby / B
Left Side	Pass	Pass	Standby / B
Right Side	Pass	Pass	Standby / B
Top	Pass	Pass	Standby / B

➤ TT=Transient [phenomena applied to] Transmitters

➤ TR=Transient [phenomena applied to] Receivers

Notes: Tested in standby operation mode.

ESD Performance Criteria (ETSI EN 301 489-17 Subclause 6.4 and 6.6)

Criteria	During Test	After test
B	May show loss of function May show degradation of performance * No unintentional transmissions <i>For transceivers-CR only:</i> Under no circumstances shall the transmitter operate unintentionally during the test.	Functions shall be self-recoverable Operate as intended after recovering No degradation of performance * No loss of stored data or user programmable functions

*See standard for more detail.

ELECTRICAL FAST TRANSIENT BURST

Electrical Fast Transient Burst (EFTB) Power Cable (EN61000-4-4) in accordance with ETSI EN 301 489-1

EFTB insertion point	+ 1 kV	- 1 kV	Performance Criteria / Met
Line to Ground	NA	NA	NA
Neutral to Ground	NA	NA	NA
Protective Earth (PE) to Ground	NA	NA	NA
Line/Neutral/PE to Ground	NA	NA	NA

NA=Not Applicable because the EUT is battery powered.

Electrical Fast Transient Burst (EFTB) Signal, I/O, DC Ports (EN61000-4-4) in accordance with ETSI EN 301 489-1

Cable tested	+ 0.5 kV pass / fail	- 0.5 kV pass / fail	Performance Criterion
Signal Lines	NA	NA	NA
Control Lines	NA	NA	NA
DC power input	NA	NA	NA

NA=Not Applicable because the EUT has no DC power lines and all signal lines are shorter than 3 meters.

TRANSIENTS AND SURGES

Transients and Surges in the Vehicle Environment - 12 V DC Supply (ISO 7637-1) in accordance with ETSI EN 301 489-1

Test Pulse	Pass/fail	Performance Criterion
1	NA	NA
2	NA	NA
3a	NA	NA
3b	NA	NA
4	NA	NA
7	NA	NA

NA = Not Applicable because the EUT has no DC power lines.

Transients and Surges in the Vehicle Environment - 24 V DC Supply (ISO 7637-2) in accordance with ETSI EN 301 489-1

Test Pulse	Pass/fail	Performance Criterion
1a	NA	NA
1b	NA	NA
2	NA	NA
3a	NA	NA
3b	NA	NA
4	NA	NA

NA = Not Applicable because the EUT has no DC power lines.

Ambient Temperature: °C

Relative Humidity: %

CONDUCTED IMMUNITY

Conducted Immunity (EN61000-4-6) in accordance with ETSI EN 301 489-1

Cable Tested:	Amplitude	Frequency Range	Pass/fail	Performance Criteria / Met
AC Power	3 Vrms	.150-80MHz	NA	NA
Signal Line	3 Vrms	.150-80MHz	NA	NA

NA=Not Applicable because the EUT is battery powered and all signal lines are shorter than 3 meters.

VOLTAGE DIPS AND INTERRUPTS

Voltage Dips & Interrupts (EN61000-4-11) in accordance with ETSI EN 301 489-1

Interrupts (% of nominal)	Time	Pass/fail	Performance Criteria
30% of nominal	10ms	NA	NA
60% of nominal	100ms	NA	NA
>95% of nominal	5 secs	NA	NA

NA=Not Applicable because the EUT is battery powered.

SURGE

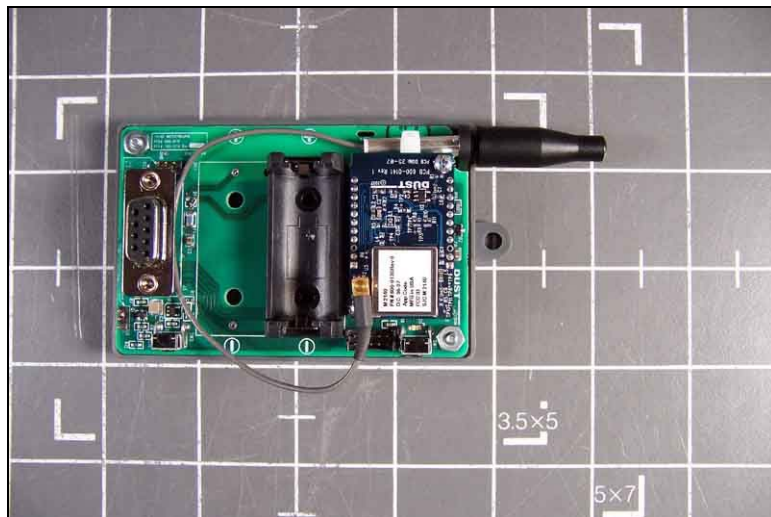
Surge -AC Mains (EN61000-4-5) in accordance with ETSI EN 301 489-1

Voltage level	Insertion points:	0 degrees input +voltage-	90 degrees input +voltage-	180 degrees input +voltage-	270 degrees input +voltage-	Performance Criteria
.5 kV	Line 1 – line 2	NA	NA	NA	NA	NA
1 kV	Line 1 – ground	NA	NA	NA	NA	NA
1 kV	Line 2 – ground	NA	NA	NA	NA	NA

NA=Not Applicable because the EUT is battery powered.

SUBMITTAL PHOTOGRAPHS

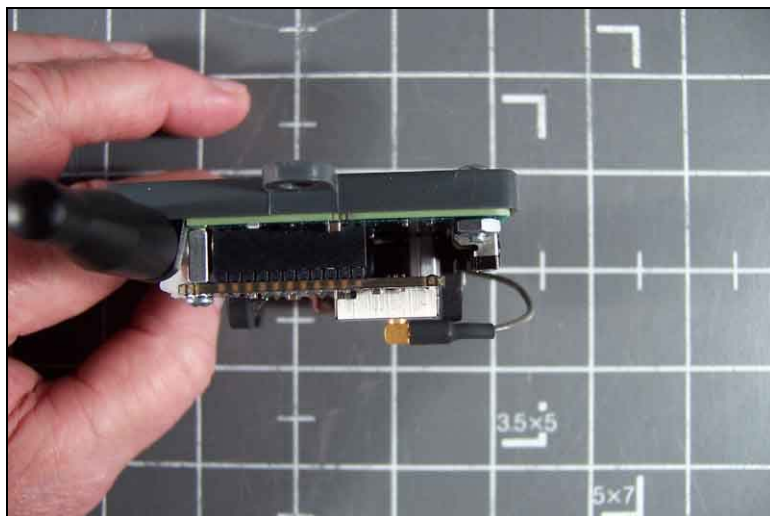
Overall Front



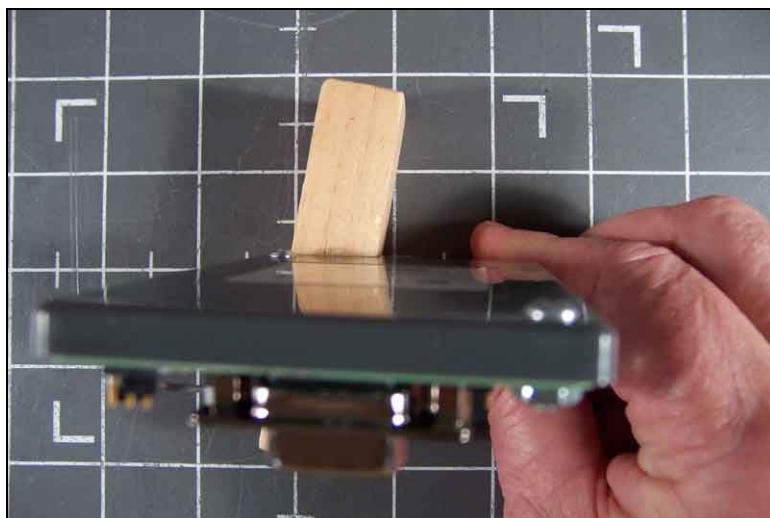
Overall Back



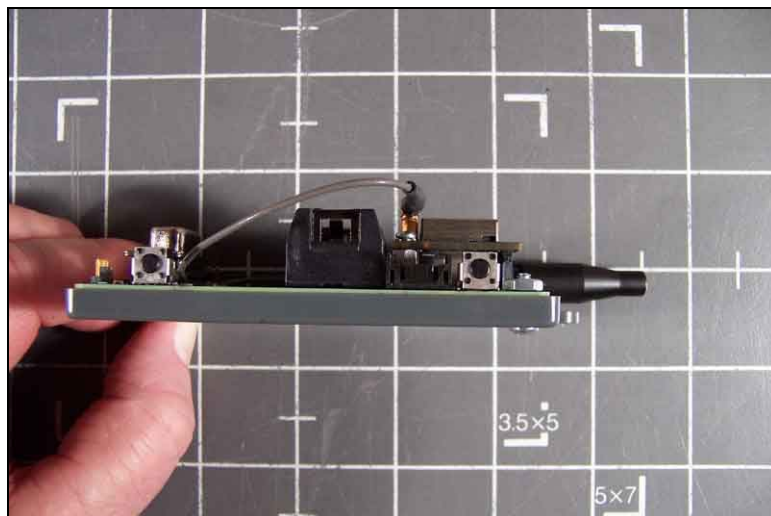
Overall Top



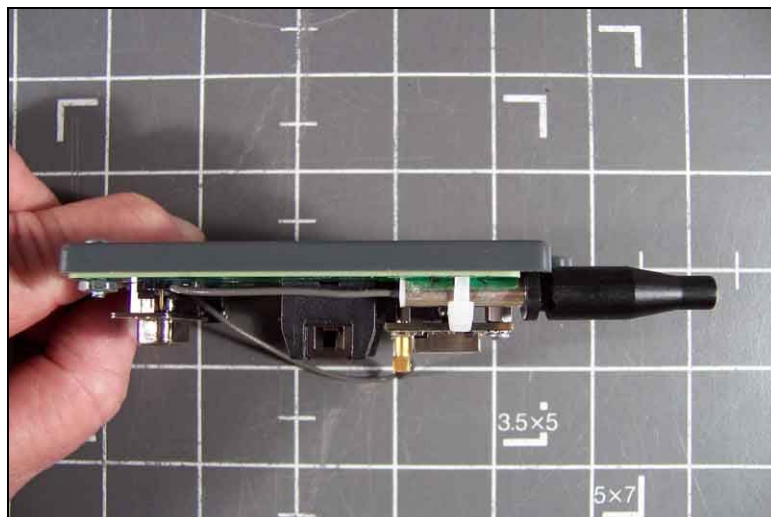
Overall Bottom



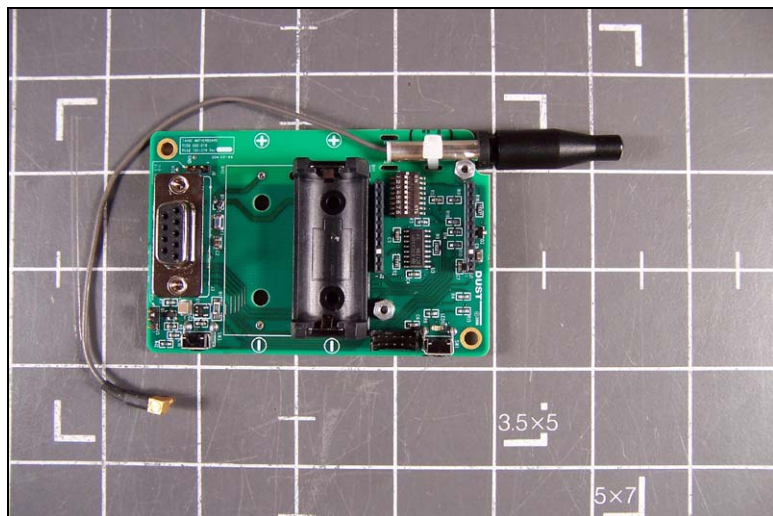
Overall Left



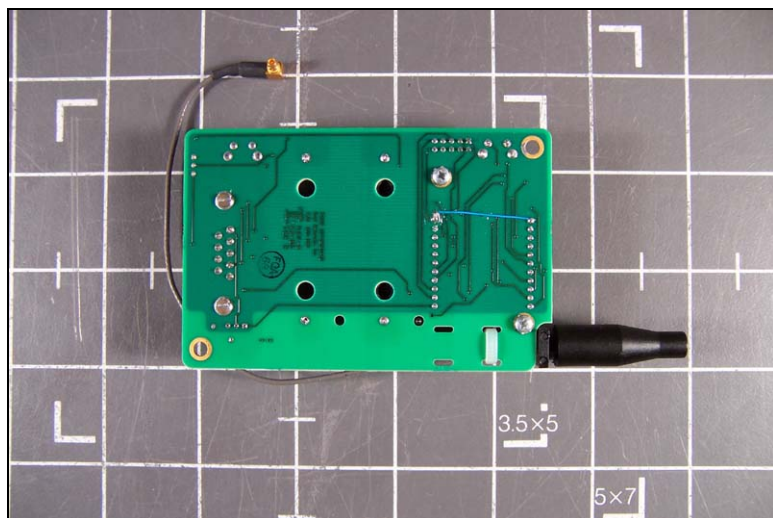
Overall Right



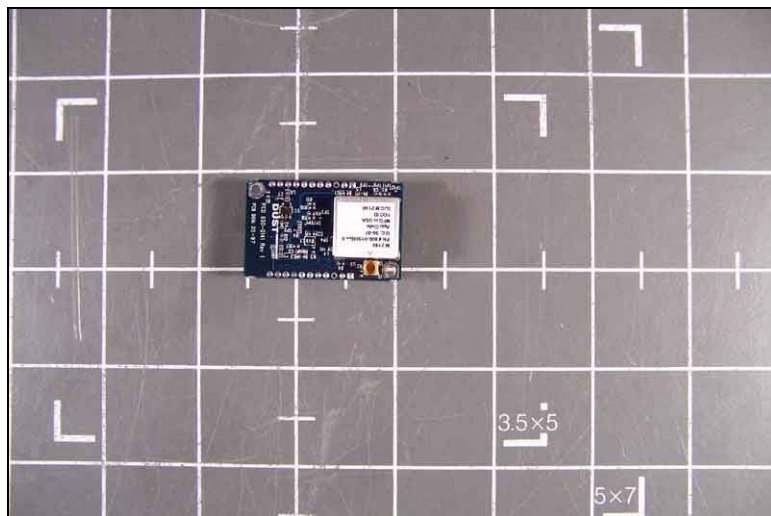
Main PCB Front



Main PCB Back



Transmitter PCB Front



Transmitter PCB Back

