



**Compliant**  
**Report for testing to**  
**ETSI EN 300 328 V1.7.1 (2006-10)**

**Electromagnetic Compatibility and Radio Spectrum Matters (ERM);**  
**Wideband Transmission Systems;**  
**Data Transmission Equipment Operating in the 2,4 GHz ISM Band**  
**and Using Wide Band Modulation Techniques**  
**for the**  
**2.4 GHZ WIRELESS MOTE, M2140 & M2040**

**DATE OF ISSUE: NOVEMBER 26, 2007**

**PREPARED FOR:**

Dust Networks  
30695 Huntwood Avenue  
Hayward, CA 94544

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

**PREPARED BY:**

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Date of test: September 26 - October 2, 2007

**Report No.: ETS07-043A**

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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

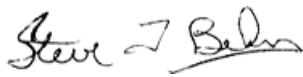
**TEST METHOD\*:** ETSI EN 300 328 V1.7.1 (2006-10)

\*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 300 328 V1.7.1 devices.

## APPROVALS

### QUALITY ASSURANCE:

A handwritten signature in black ink that reads "Steve Behm".

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Steve Behm, Director of Engineering Services

A handwritten signature in black ink that reads "Joyce Walker".

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Joyce Walker, Quality Assurance Administrative Manager

### TEST PERSONNEL:

A handwritten signature in black ink that reads "Mike Wilkinson".

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Mike Wilkinson, EMC Engineer/Lab Manager

## 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

### 2.4 GHz Wireless Mote

Manuf: Dust Networks  
Model: M2040  
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

Frequencies of Selected Test Channels	
Lowest Channel	2405 MHz
Middle Channel	2445 MHz
Highest Channel	2480 MHz

Equipment specifications for equipment using FHSS

Equipment Installation Type	Plug-in Radio
Modulation Type	802.15.4
Operating Frequency Range(s)	2400-2483.5 MHz
List of intended Antennas	2.0 dBi Omni Directional Antenna

### LIST OF MEASUREMENTS

ETSI EN 300 328		
Clause	PARAMETER TO BE MEASURED	√ if tested
<b>4.3</b>	<b>Technical Requirements</b>	
4.3.1	Maximum Transmit Power	√
4.3.2	Maximum Spectral Power Density	√
4.3.3	Frequency Range	√
4.3.6	Transmitter Conducted Spurious emissions Operating	√
4.3.6	Transmitter Radiated Spurious emissions Operating	√
4.3.6	Transmitter Conducted Spurious emissions Standby	√
4.3.6	Transmitter Radiated Spurious emissions Standby	√
4.3.7	Receiver Conducted Spurious Emissions	√
4.3.7	Receiver Radiated Spurious Emissions	√

### MEASUREMENT UNCERTAINTIES

Note: Each table has individual measurement uncertainties listed. Reported uncertainties represent expanded uncertainties expressed at approximately the 95% confidence level using a coverage factor of k=2. The uncertainty represents a compilation of the worst case data obtained from all CKC Laboratory Test sites.

### CONDITIONS DURING TESTING

No modifications to the EUT were necessary during testing.

Ambient Temperature: 19°C

Relative Humidity: 31%

# **Maximum Transmit Power**

## **CLAUSE 4.3.1**

**Rated output power 10 dBm /-20 dBW**

**Antenna assembly gain 2.0 dBi (when applicable)**

Duty cycle of the equipment during the test x=100

TEST CONDITIONS		TRANSMITTER POWER (dBm)					
		Lowest frequency		Middle frequency		Highest frequency	
		A	P	A	P	A	P
$T_{nom}(20)^{\circ}C$	$V_{nom}(3.0)V$	7.9	9.9	7.6	9.6	7.4	9.4
$T_{min}(-20)^{\circ}C$	$V_{min}(2.55)V$	7.4	9.4	5.95	7.98	4.9	6.9
	$V_{max}(3.45)V$	7.4	9.4	5.95	7.98	4.9	6.9
$T_{max}(+55)^{\circ}C$	$V_{min}(2.55)V$	7.2	9.2	5.63	7.63	4.26	6.26
	$V_{max}(3.45)V$	7.2	9.2	5.63	7.63	4.26	6.26
Measurement uncertainty		3.703 dB					

Tested By: Mike Wilkinson

Model tested: M2140 (high power)

Duty cycle of the equipment during the test x=100

TEST CONDITIONS		TRANSMITTER POWER (dBm)					
		Lowest frequency		Middle frequency		Highest frequency	
		A	P	A	P	A	P
$T_{nom}(20)^{\circ}C$	$V_{nom}(3.0)V$	-3.2	-1.2	-3.6	-1.6	-4.8	-2.8

Tested By: Mike Wilkinson

Model tested: M2040 (low power)

Note :  $A_v$  is the average power as defined in clause 7.2.1 step 2 (P)

$P_k$  is the peak power as defined in clause 7.2.1 step 4 (C+G)

The manufacturer declares that the maximum achievable on time with this equipment is 4.5% duty cycle, which is less than the requirements of section 4.3.1. Therefore, average measurements are obtained directly using a spectrum analyzer.

### LIMITS: (CLAUSE 4.3.1.2)

Under all test conditions	= < -10 dBW e.i.r.p.
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### Test Equipment

Asset	Name	Manufacturer	Model	Serial	Cal Date	Cal Due
01879	Oven	Thermotron	S-1.2 Min.	11899	12/21/2006	12/21/2008
00762	Power Supply, DC	HP	6205C	2228A01775	7/19/2007	7/19/2009
02660	Spectrum Analyzer	Agilent	E4446A	US44300407	1/03/2007	1/03/2009
P00756	Digital Multimeter	Fluke	70	55230270	4/12/2006	4/12/2008

### Test Setup Photo



Ambient Temperature: 19°C

Relative Humidity: 31%

**MAXIMUM SPECTRAL POWER DENSITY**

**CLAUSE 4.3.2**

TESTS	Measured Power Density		
	lowest frequency	middle frequency	highest frequency
Measured power density	7.795/100kHz	7.539/100kHz	7.286/100kHz
Measurement uncertainty	$1 \times 10^{-5}$		

Tested By: Mike Wilkinson

**LIMITS: Clause 4.3.2.2**

Under normal test conditions only	10mW / MHz EIRP. (other than FHSS)
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**Test Equipment**

Asset	Name	Manufacturer	Model	Serial	Cal Date	Cal Due
02660	Spectrum Analyzer	Agilent	E4446A	US44300407	1/03/07	1/03/09

**Test Setup Photo**





Ambient Temperature: 19°C

Relative Humidity: 31%

## TRANSMITTER FREQUENCY RANGE

## CLAUSE 4.3.3

TEST CONDITIONS		FREQUENCY (MHz) at which power envelope crosses -80 dBm/Hz	
		lowest	highest
$T_{nom}(20)^{\circ}C$	$V_{nom}(3.0)V$	2401.9	2482.80
$T_{min}(-20)^{\circ}C$	$V_{min}(2.55)V$	2401.02	2483.32
	$V_{max}(3.45)V$	2401.02	2483.32
$T_{max}(+55)^{\circ}C$	$V_{min}(2.55)V$	2401.02	2482.95
	$V_{max}(3.45)V$	2401.02	2482.95
Measured frequencies (lowest and highest)		$f_L = 2401.02 \text{ MHz}$ $f_H = 2483.32 \text{ MHz}$	
Measurement uncertainty		$5.774 \times 10^{-10}$	

Tested By: Mike Wilkinson

## LIMITS: Clause 4.3.4.2

Under all test conditions	$f_L > 2400 \text{ MHz}$ $f_H < 2483.5 \text{ MHz}$
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## Test Equipment

Asset	Name	Manufacturer	Model	Serial	Cal Date	Cal Due
01879	Oven	Thermotron	S-1.2 Min.	11899	12/21/2006	12/21/2008
00762	Power Supply, DC	HP	6205C	2228A01775	7/19/2007	7/19/2009
02660	Spectrum Analyzer	Agilent	E4446A	US44300407	1/03/2007	1/03/2009
P00756	Digital Multimeter	Fluke	70	55230270	4/12/2006	4/12/2008

**Test Setup Photo**



Ambient Temperature: 19°C

Relative Humidity: 31%

## TRANSMITTER CONDUCTED SPURIOUS EMISSIONS

## CLAUSE 4.3.6

### Transmitter Operating

SPURIOUS EMISSIONS LEVEL					
Lowest Channel			Highest Channel		
f (MHz)	Band- width** (kHz)	Level (dBm)	f (MHz)	Band- width** (kHz)	Level (dBm)
7336.22	100	-41.7	7441.1	100	-39.4
9621.96	100	-47.3	4960.98	100	-41.2
4810.96	100	-51.2	9781.94	100	-60.5
Measurement uncertainty			0.673 dB		

Tested By: Mike Wilkinson

\*\* Bandwidth = the measuring receiver bandwidth

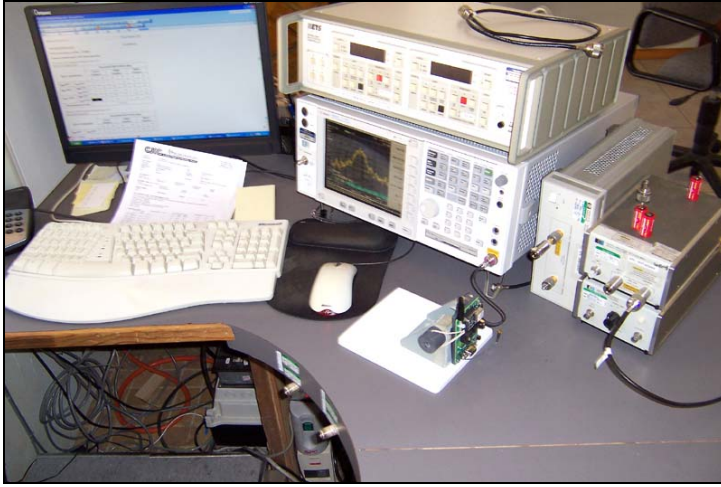
### LIMITS: Clause 4.3.4.2

Frequency Range	30 MHz to 12.75 GHz
Limit	See EN 300 328, Tables 2 & 3

### Test Equipment

Asset	Name	Manufacturer	Model	Serial	Cal Date	Cal Due
02660	Spectrum Analyzer	Agilent	E4446A	US44300407	1/03/07	1/03/09

**Test Setup Photo**



Ambient Temperature: 19°C

Relative Humidity: 31%

## TRANSMITTER RADIATED SPURIOUS EMISSIONS

## CLAUSE 4.3.6

### Transmitter Operating

SPURIOUS EMISSIONS LEVEL					
Lowest Channel			Highest Channel		
f (MHz)	Band- width** (kHz)	Level (dBm)	f (MHz)	Band- width** (kHz)	Level (dBm)
7215.95	100	-51.8	7440.1	100	-50.2
4810.95	100	-54.8	4966.9	100	-54.2
Measurement uncertainty			3.703 dB		

Tested By: Mike Wilkinson

\*\* Bandwidth = the measuring receiver bandwidth

### LIMITS: Clause 4.3.4.2

Frequency Range	30 MHz to 12.75 GHz
Limit	See EN 300 328, Tables 2 & 3

### Test Equipment

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
Chase CBL6111C Bilog	2456	12/30/2006	12/30/2008	01991
HP 8447D Preamp	1937A02604	03/14/2007	03/14/2009	00099
EMCO 3115 Horn Antenna	8006-3413	03/17/2007	03/17/2009	00327
HP 8449B Preamp	3008A00301	12/13/2006	12/13/2008	2010
Cable 40 GHz	N/A	04/23/2007	04/23/2009	P01403
3M SITE CBL WO MAST CBL	N/A	03/23/2007	03/23/2009	CAB-SITED3M
10M SITE CBL MAST CBL	N/A	03/23/2007	03/23/2009	CAB-SITED10M

**Test Setup Photo**



Ambient Temperature: 19°C

Relative Humidity: 31%

## TRANSMITTER CONDUCTED SPURIOUS EMISSIONS

## CLAUSE 4.3.6

### Transmitter on Standby

SPURIOUS EMISSIONS LEVEL					
Lowest Channel			Highest Channel		
f (MHz)	Band- width** (kHz)	Level (dBm)	f (MHz)	Band- width** (kHz)	Level (dBm)
9618.00	100	-60	7440.06	100	-56.9
4809.00	100	-61.8	9916.59	100	-62.7
7215.3	100	-60	4959.12	100	-63.3
Measurement uncertainty			0.673 dB		

Tested By: Mike Wilkinson

\*\* Bandwidth = the measuring receiver bandwidth

### LIMITS: Clause 4.3.4.2

<b>Frequency Range</b>	<b>30 MHz to 12.75 GHz</b>
<b>Limit</b>	<b>See EN 300 328, Tables 2 &amp; 3</b>

### Test Equipment

Asset	Name	Manufacturer	Model	Serial	Cal Date	Cal Due
02660	Spectrum Analyzer	Agilent	E4446A	US44300407	1/03/07	1/03/09

**Test Setup Photo**





Ambient Temperature: 19°C

Relative Humidity: 31%

## TRANSMITTER RADIATED SPURIOUS EMISSIONS

## CLAUSE 4.3.6

### Transmitter on Standby

SPURIOUS EMISSIONS LEVEL					
Lowest Channel			Highest Channel		
f (MHz)	Band- width** (kHz)	Level (dBm)	f (MHz)	Band- width** (kHz)	Level (dBm)
7215.95	100	-51.8	7440.1	100	-50.2
4810.95	100	-54.8	4966.9	100	-54.2
Measurement uncertainty			3.703 dB		

Tested By: Mike Wilkinson

\*\* Bandwidth = the measuring receiver bandwidth

### LIMITS: Clause 4.3.4.2

Frequency Range	30 MHz to 12.75 GHz
Limit	See EN 300 328, Tables 2 & 3

Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
Chase CBL6111C Bilog	2456	12/30/2006	12/30/2008	01991
HP 8447D Preamp	1937A02604	03/14/2007	03/14/2009	00099
EMCO 3115 Horn Antenna	8006-3413	03/17/2007	03/17/2009	00327
HP 8449B Preamp	3008A00301	12/13/2006	12/13/2008	2010
Cable 40 GHz	N/A	04/23/2007	04/23/2009	P01403
3M SITE CBL WO MAST CBL	N/A	03/23/2007	03/23/2009	CAB-SITED3M
10M SITE CBL MAST CBL	N/A	03/23/2007	03/23/2009	CAB-SITED10M

**Test Setup Photo**



Ambient Temperature: 19°C

Relative Humidity: 31%

# RECEIVER CONDUCTED SPURIOUS EMISSIONS

## CLAUSE 4.3.7

FREQUENCY (MHz)	MEASUREMENT BANDWIDTH (MHz)	SPURIOUS EMISSION LEVEL (dBm)
7335.6	100	-58.5
7214.4	100	-59.5
9780.8	100	-60.9
9619.2	100	-61.8
4890.4	100	-62
2445.2	100	-63
2404.8	100	-63.6
4809.6	100	-63.7
2480.2	100	-938
4960.5	100	-63.8
Measurement uncertainty	3.703 dB	

Tested By: Mike Wilkinson

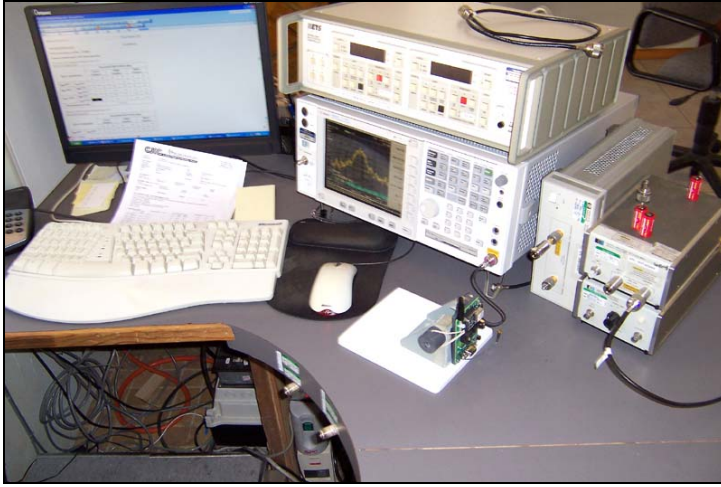
## LIMITS: Clause 4.3.5.2

Frequency Range	30 MHz to 12.75 GHz
Limit	See EN 300 328, Table 4 & 5

## Test Equipment

Asset	Name	Manufacturer	Model	Serial	Cal Date	Cal Due
02660	Spectrum Analyzer	Agilent	E4446A	US44300407	1/03/07	1/03/09

**Test Setup Photo**



Ambient Temperature: 19°C

Relative Humidity: 31%

## RECEIVER RADIATED SPURIOUS EMISSIONS

## CLAUSE 4.3.7

FREQUENCY (MHz)	MEASUREMENT BANDWIDTH (MHz)	SPURIOUS EMISSION LEVEL (dBm)
9621.26	100	-49.5
7336.0	100	-51.2
7211.13	100	-51.8
4810.21	100	-49.3
32.778	100	-70.7
7441.01	100	-48.9
7216.06	100	-61.1
4960.95	100	-64
4891.0	100	-65.1
4810.96	100	-65.9
Measurement uncertainty	.673 dB	

Tested By: Mike Wilkinson

## LIMITS: Clause 4.3.5.2

Frequency Range	30 MHz to 12.75 GHz
Limit	See EN 300 328, Table 4 & 5

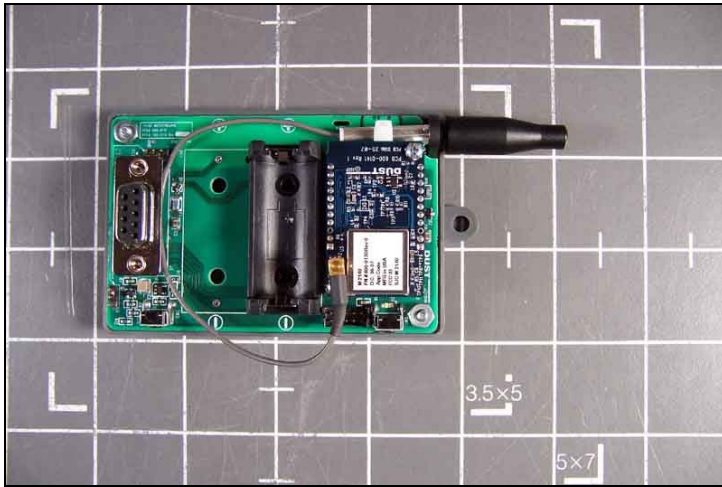
Function	S/N	Calibration Date	Cal Due Date	Asset #
Agilent E4446A SA	US44300407	01/03/2007	01/03/2009	02660
Chase CBL6111C Bilog	2456	12/30/2006	12/30/2008	01991
HP 8447D Preamp	1937A02604	03/14/2007	03/14/2009	00099
EMCO 3115 Horn Antenna	8006-3413	03/17/2007	03/17/2009	00327
HP 8449B Preamp	3008A00301	12/13/2006	12/13/2008	2010
Cable 40 GHz	N/A	04/23/2007	04/23/2009	P01403
3M SITE CBL WO MAST CBL	N/A	03/23/2007	03/23/2009	CAB-SITED3M
10M SITE CBL MAST CBL	N/A	03/23/2007	03/23/2009	CAB-SITED10M

### Test Setup Photos



## **SUBMITTAL PHOTOGRAPHS**

Overall Front

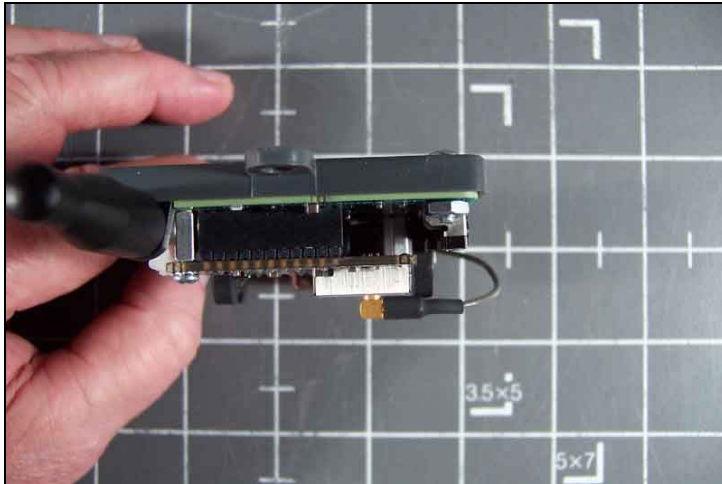


Overall Back

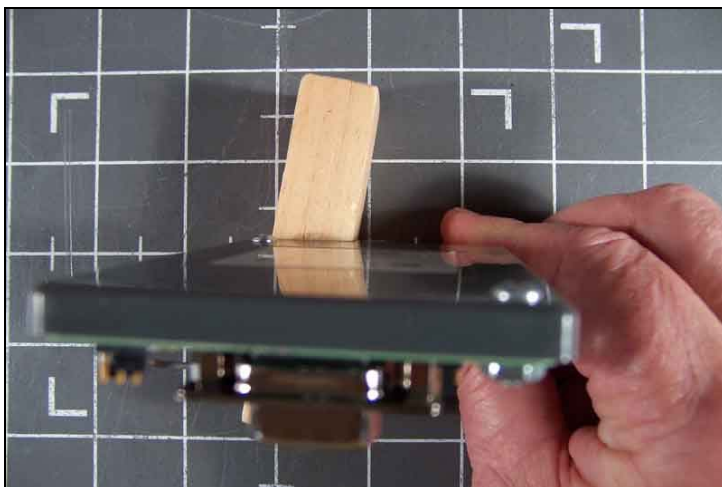




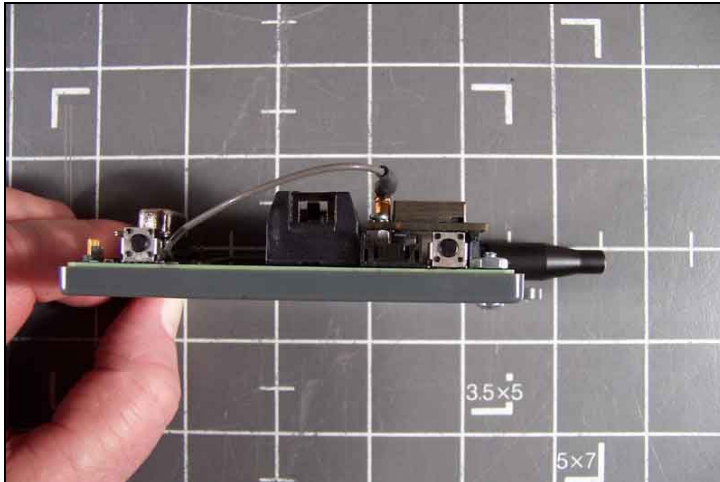
Overall Top



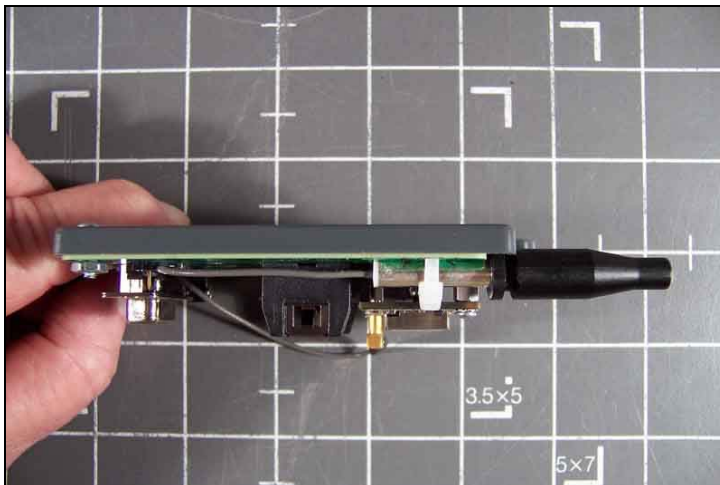
Overall Bottom



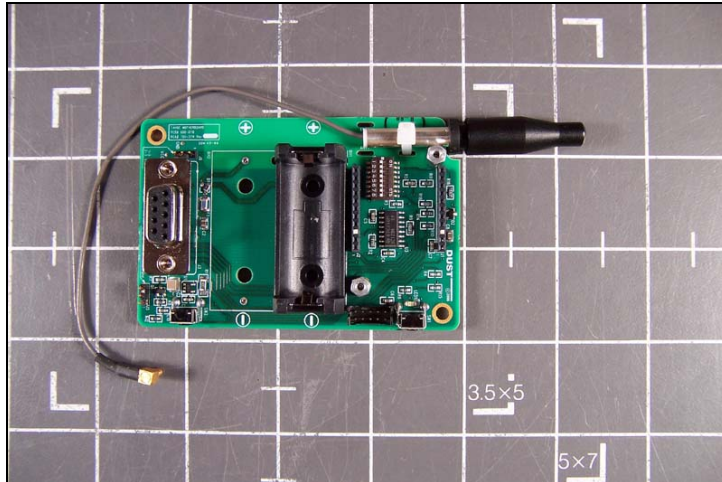
Overall Left



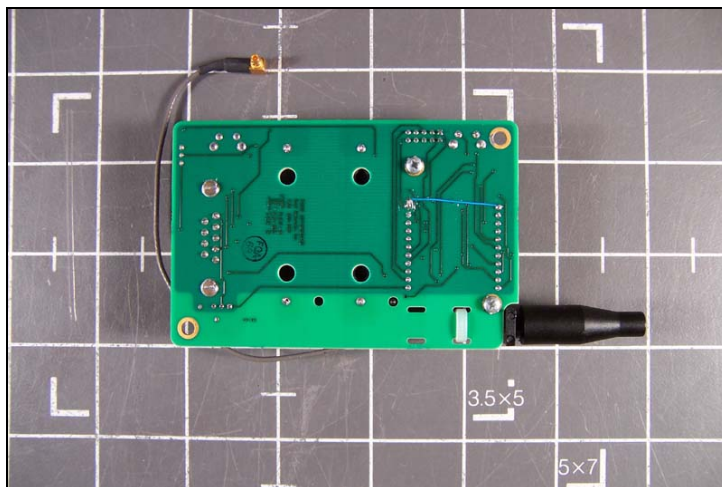
Overall Right



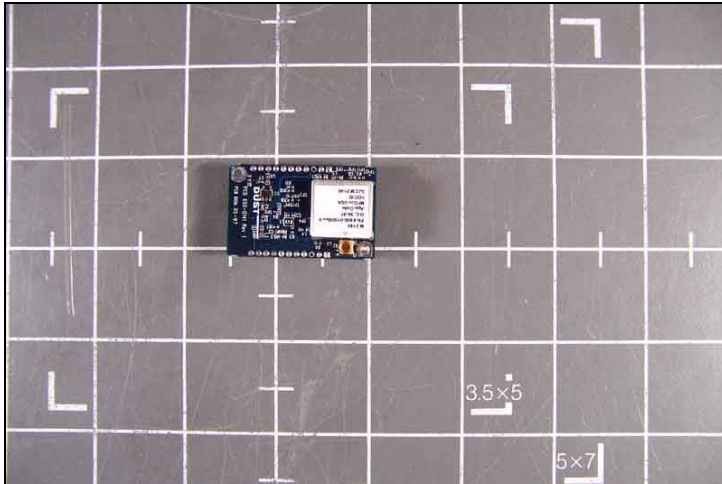
Main PCB Front



Main PCB Back



Transmitter PCB Front



Transmitter PCB Back

