

EMC TEST REPORT for Intentional Radiator
No. SH12010206-001

Applicant : RAE Systems Inc.
3775 N. 1st St., San Jose, California USA 95134

Manufacturer : RAE Systems Inc.
3775 N. 1st St., San Jose, California USA 95134

Product Name : RAEMesh Radio

Type/Model : RM900A

SUMMARY

The equipment complies with the requirements according to the following standard(s):

47CFR Part 15 (2010): Radio Frequency Devices

ANSIC63.4 (2003): American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

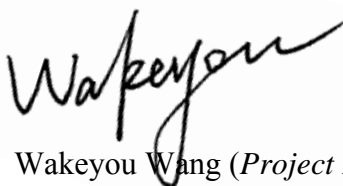
RSS-210 Issue 8 (December 2010): Low-power Licence-exempt Radiocommunication Devices (All Frequency Bands): Category I Equipment

RSS-Gen Issue 3 (December 2010): General Requirements and Information for the Certification of Radiocommunication Equipment

RSS-310 Issue 3 (December 2010): Licence-exempt Radio Apparatus (All Frequency Bands): Category II Equipment

Date of issue: Jan 11, 2012

Prepared by:



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Description of Test Facility

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1. General Information

1.1 Applicant Information

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3775 N. 1st St., San Jose, California USA 95134

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Manufacturer: RAE Systems Inc.
3775 N. 1st St., San Jose, California USA 95134

Sample received date : Nov 10, 2011
Date of test : Nov 10, 2011 ~ Dec 20, 2011

1.2 Identification of the EUT

Equipment: RAEMesh Radio
Type/model: RM900A
FCC ID: SU3RM900A
IC: Not applied

1.3 Technical specification

Operation Frequency Band: 906 - 924 MHz
Modulation: O-QPSK
Antenna Designation: Omnidirectional antenna, Chip antenna
Gain of Antenna: 1.3dBd (3.5dBi) for Omnidirectional antenna;
-3.7dBd (-1.5dBi) for Chip antenna
Rating: DC 3.3V powered by the debug board
Description of EUT: Here is one model only.
The EUT is a wireless RF module for data transmission
(IEEE 802.15.4 compliant Zigbee-ready transceiver).

Channel Description:

Channel Identifier	Frequency (MHz)	Channel Identifier	Frequency (MHz)
1	906	6	916
2	908	7	918
3	910	8	920
4	912	9	922
5	914	10	924

Software applied: SSCOM3.2

1.4 Mode of operation during the test / Test peripherals used

Within this test report, both transmitter and receiver modes of EUT were tested. While testing transmitter mode of the EUT, the internal modulation was applied. While testing receiver mode of EUT, the signal generator with a transmitting antenna generating 916MHz sine wave is put in close proximity to the EUT. For the EUT can be used in any axes as the user wants, it was set up in three axis (X, Y, Z) while the antenna always was kept vertically and performed test. The three axes were tested one by one while the test receiver worked as “max hold” continuously and the highest reading among the whole test procedure was recorded. Maximum allowable power level setting in the controlling software is -8dBm as showed below:

```
Performance test application (AT86RF212 / AT91SAM7X256)
Settings:
(C) : Channel = 1
(P) : Channel page = 0
(W) : Tx power = -8 dBm
(N) : Number of test frames = 100
(L) : Frame length (PSDU) = 100
(A) : ACK request = ACK requested
(F) : Frame retry enabled = true
(M) : CSMA enabled = true
(T/R/O/I) : Operating mode Tx/Rx/Off/Promiscuous = Tx
(E) : Energy scan on all channels
(U) : Continuous transmission on current channel
(D) : Transmit a continuous wave pulse on current channel
(V) : Get sensor data, i.e. supply voltage
(B) : Set into Low-Power mode
(S) : Start test
```

2. Test Specification

2.1 Instrument list

Equipment	Type	Manu.	Internal no.	Cal. Date	Due date
Test Receiver	ESIB 26	R&S	EC 3045	2011-10-21	2012-10-20
Semi-anechoic chamber	-	Albatross project	EC 3048	2011-5-21	2012-5-20
Bilog Antenna	CBL 6112D	TESEQ	EC 4206	2011-5-16	2013-5-15
Horn antenna	HF 906	R&S	EC 3049	2011-5-13	2013-5-12
Pre-amplifier	Pre-amp 18	R&S	EC 3222	2011-4-12	2012-4-11
Test Receiver	ESCS 30	R&S	EC 2107	2011-10-21	2012-10-20
A.M.N.	ESH2-Z5	R&S	EC 3119	2011-1-10	2012-1-9
A.M.N.	ESH3-Z5	R&S	EC 2109	2011-1-10	2012-1-9
High Pass Filter	WHKX 1.0/15G- 10SS	Wainwright	EC4297-1	2011-2-8	2012-2-7
High Pass Filter	WHKX 2.8/18G- 12SS	Wainwright	EC4297-2	2011-2-8	2012-2-7
High Pass Filter	WHKX 7.0/1.8G- 8SS	Wainwright	EC4297-3	2011-2-8	2012-2-7
Band Reject Filter	WRCGV 2400/2483- 2390/2493- 35/10SS	Wainwright	EC4297-4	2011-2-8	2012-2-7

2.2 Test Standard

47CFR Part 15 (2010)
 ANSI C63.4 (2003)
 RSS-210 Issue 8 (December 2010)
 RSS-Gen Issue 3 (December 2010)
 RSS-310 Issue 3 (December 2010)

2.3 Test Summary

This report applies to tested sample only. This report shall not be reproduced in part without written approval of Intertek Testing Service Shanghai Limited.

TEST ITEM	FCC REFERANCE	IC REFERANCE	RESULT
Radiated emission	15.249 & 15.205	RSS-210 Issue 8 Annex A2.9 & Clause 2.2	Pass
Assigned bandwidth (20dB bandwidth)	15.215(c)	-	Pass
Occupied bandwidth	-	RSS-Gen Issue 3 Clause 4.6.1	Pass
Power line conducted emission	15.207	RSS-Gen Issue 3 Clause 7.2.4	Pass
Spurious emission for receiver	15B	RSS-310 Issue 3 Clause 3.1	Pass

2.4 Data rate VS power

The data rate of EUT is fixed and cannot be adjusted.

3. Radiated emission

Test result: **PASS**

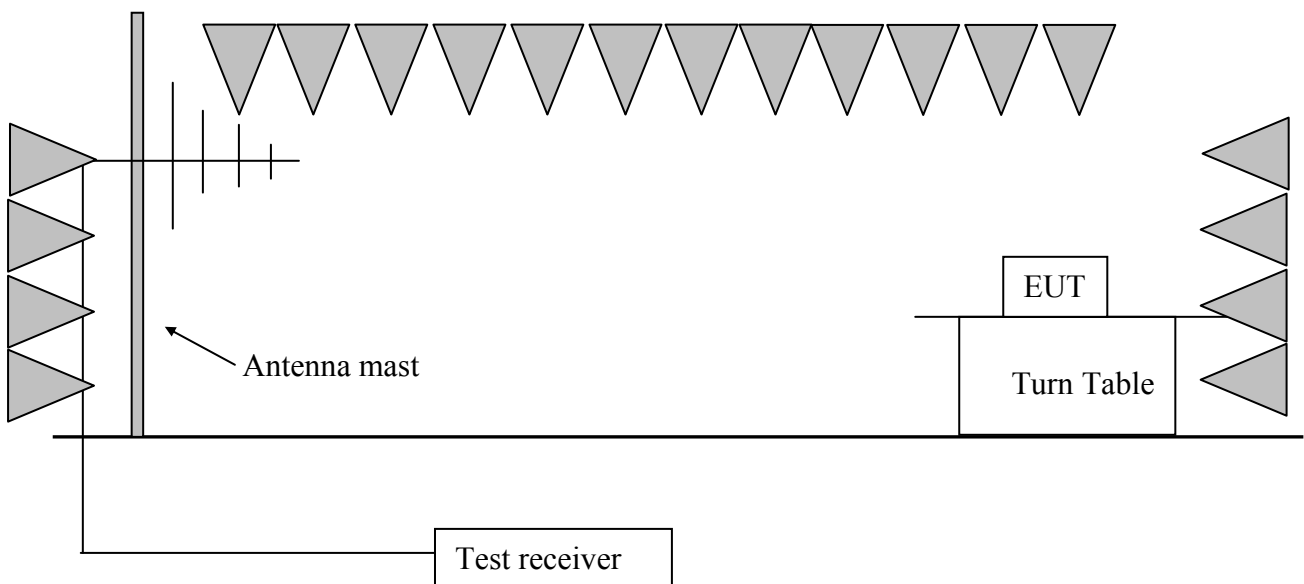
3.1 Test limit

Fundamental Frequency (MHz)	Fundamental limit (dBuV/m)	Harmonic limit (dBuV/m)
<input checked="" type="checkbox"/> 902 - 928	94	54
<input type="checkbox"/> 2400 - 2483.5	94	54
<input type="checkbox"/> 5725 - 5875	94	54
<input type="checkbox"/> 24000 - 24250	108	68

The radiated emissions which fall in the restricted bands, as defined in §15.205(a), must also comply with the radiated emission limits specified in §15.209(a) showed as below:

Frequency (MHz)	Field Strength (dBuV/m)	Measurement Distance (m)
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960	54.0	3

3.2 Test Configuration



3.3 Test procedure and test setup

The measurement was applied in a semi-anechoic chamber. While testing for spurious emission higher than 1GHz, if applied, the pre-amplifier would be equipped just at the output terminal of the antenna.

The EUT and simulators were placed on a 0.8m high wooden turntable above the horizontal metal ground plane. The turn table rotated 360 degrees to determine the position of the maximum emission level. The EUT was set 3 meters away from the receiving antenna which was mounted on an antenna mast. The antenna moved up and down between from 1meter to 4 meters to find out the maximum emission level.

The radiated emission was measured using the Spectrum Analyzer with the resolutions bandwidth set as:

RBW = 100kHz, VBW = 300kHz (30MHz~1GHz for PK)

RBW = 1MHz, VBW = 3MHz (>1GHz for PK);

RBW = 1MHz, VBW = 10Hz (>1GHz for AV);

3.4 Test protocol

Radiated emission from Omnidirectional Antenna

CH	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	V	906.69	23.80	97.70	/	/	PK
	V	906.69	23.80	92.70	94.00	1.30	QP
	V	1501.00	-11.50	57.00	74.00	17.00	PK
	V	1501.00	-11.50	46.30	54.00	7.70	AV
	V	1661.34	-10.50	59.90	74.00	14.10	PK
	V	1661.34	-10.50	48.50	54.00	5.50	AV
	V	1831.66	-9.60	61.70	74.00	12.30	PK
	V	1831.66	-9.60	50.80	54.00	3.20	AV
	V	2162.32	-8.20	53.30	74.00	20.70	PK
	V	2162.32	-8.20	42.60	54.00	11.40	AV
	V	2332.67	-7.60	55.50	74.00	18.50	PK
	V	2332.67	-7.60	44.50	54.00	9.50	AV
	V	3665.33	-3.80	48.40	74.00	25.60	PK
	V	3665.33	-3.80	38.00	54.00	16.00	AV
M	V	916.41	23.90	97.60	/	/	PK
	V	916.41	23.90	92.40	94.00	1.60	QP
	V	1721.66	-10.30	58.50	74.00	15.50	PK
	V	1721.66	-10.30	47.30	54.00	6.70	AV
	V	1825.30	-9.60	52.70	74.00	21.30	PK
	V	1825.30	-9.60	41.90	54.00	12.10	AV
	V	2267.84	-8.10	50.90	74.00	23.10	PK
	V	2267.84	-8.10	40.50	54.00	13.50	AV
	V	2332.67	-7.60	51.80	74.00	22.20	PK
	V	2332.67	-7.60	40.60	54.00	13.40	AV
	V	3675.16	-3.80	47.30	74.00	26.70	PK
	V	3675.16	-3.80	36.80	54.00	17.20	AV

H	V	924.20	23.90	97.30	/	/	PK
	V	924.20	23.90	92.10	94.00	1.90	QP
	V	1490.98	-11.60	51.60	74.00	22.40	PK
	V	1490.98	-11.60	41.50	54.00	12.50	AV
	V	1771.54	-9.90	56.10	74.00	17.90	PK
	V	1771.54	-9.90	45.70	54.00	8.30	AV
	V	1821.64	-9.60	51.40	74.00	22.60	PK
	V	1821.64	-9.60	40.90	54.00	13.10	AV
	V	2172.34	-8.10	49.80	74.00	24.20	PK
	V	2172.34	-8.10	40.30	54.00	13.70	AV
	V	2332.67	-7.60	49.80	74.00	24.20	PK
	V	2332.67	-7.60	40.10	54.00	13.90	AV
	V	2983.67	-5.80	53.10	74.00	20.90	PK
	V	2983.67	-5.80	42.70	54.00	11.30	AV
	V	3685.37	-3.80	46.30	74.00	27.70	PK
	V	3685.37	-3.80	35.60	54.00	18.40	AV
	V	5629.26	0.40	44.40	74.00	29.60	PK
	V	5629.26	0.40	34.30	54.00	19.70	AV

- Remark: 1. For fundamental emission test, no pre-amplifier is employed.
 2. The Pulse-repetition frequency for fundamental emission is higher than 20Hz. Therefore, the QP detector is applied for fundamental emission test.
 3. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
 4. Corrected Reading = Original Receiver Reading + Correct Factor
 5. Margin = limit – Corrected Reading
 6. If the PK reading is lower than AV limit, the AV test can be elided.
 7. The shaded data is the fundamental emission.
 8. Both emissions on “horizontal” and “vertical” axes were assessed and the worse test data was listed in this report.

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
 Gain of Preamplifier = 32.00dB, Original Receiver Reading = 10dBuV.
 Then Correct Factor = 30.20 + 2.00 – 32.00 = 0.20dB/m; Corrected Reading = 10dBuV + 0.20dB/m = 10.20dBuV/m
 Assuming limit = 54dBuV/m, Corrected Reading = 10.20dBuV/m, then Margin = 54 -10.20 = 43.80dBuV/m

Radiated emission from Chip Antenna

CH	Antenna	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
L	V	906.69	23.80	93.40	/	/	PK
	V	906.69	23.80	88.20	94.00	5.80	QP
	V	1551.10	-11.20	49.80	74.00	24.20	PK
	V	1551.10	-11.20	39.60	54.00	14.40	AV
	V	1661.34	-10.50	60.80	74.00	13.20	PK
	V	1661.34	-10.50	49.90	54.00	4.10	AV
	V	1831.66	-9.60	57.10	74.00	16.90	PK
	V	1831.66	-9.60	46.50	54.00	7.50	AV
	V	2162.32	-8.20	54.00	74.00	20.00	PK
	V	2162.32	-8.20	43.70	54.00	10.30	AV
	V	2843.69	-6.10	51.90	74.00	22.10	PK
	V	2843.69	-6.10	41.20	54.00	12.80	AV
	V	3154.31	-5.30	49.80	74.00	24.20	PK
	V	3154.31	-5.30	38.40	54.00	15.60	AV
M	V	916.41	23.90	92.40	/	/	PK
	V	916.41	23.90	87.40	94.00	6.60	QP
	V	1661.30	-10.50	58.90	74.00	15.10	PK
	V	1661.30	-10.50	47.60	54.00	6.40	AV
	V	1825.76	-9.60	52.20	74.00	21.80	PK
	V	1825.76	-9.60	41.80	54.00	12.20	AV
	V	2167.19	-8.10	50.90	74.00	23.10	PK
	V	2167.19	-8.10	40.50	54.00	13.50	AV
	V	2865.65	-6.00	50.70	74.00	23.30	PK
	V	2865.65	-6.00	40.10	54.00	13.90	AV
	V	3616.70	-3.80	48.60	74.00	25.40	PK
V	3616.70	-3.80	39.20	54.00	14.80	AV	
H	V	924.20	23.90	89.90	/	/	PK

V	924.20	23.90	84.80	94.00	9.20	QP
V	1661.32	-10.50	56.70	74.00	17.30	PK
V	1661.32	-10.50	45.30	54.00	8.70	AV
V	1821.64	-9.60	55.60	74.00	18.40	PK
V	1821.64	-9.60	44.90	54.00	9.10	AV
V	2172.34	-8.10	57.20	74.00	16.80	PK
V	2172.34	-8.10	46.10	54.00	7.90	AV
V	2503.01	-7.10	54.90	74.00	19.10	PK
V	2503.01	-7.10	44.00	54.00	10.00	AV
V	3004.01	-5.70	48.20	74.00	25.80	PK
V	3004.01	-5.70	37.80	54.00	16.20	AV
V	3655.31	-3.80	47.30	74.00	26.70	PK
V	3655.31	-3.80	37.60	54.00	16.40	AV
V	4336.67	-2.80	48.20	74.00	25.80	PK
V	4336.67	-2.80	37.80	54.00	16.20	AV

4. Assigned bandwidth (20dB bandwidth)

Test result: **PASS**

4.1 Limit

Intentional radiators must be designed to ensure that the 20 dB bandwidth of the emission is contained within the allocated frequency band as clause 3.1 shows.

If frequency stability is not specified in the regulations, it is recommended that the fundamental emission be kept within at least the central 80% of the permitted band in order to minimize the possibility of out-of-band operation.

4.2 Test Configuration

See clause 3.2.

4.3 Test procedure and test setup

The 20dB Bandwidth per FCC §15.215(c) is measured using the Spectrum Analyzer.

4.4 Test protocol

20dB bandwidth (MHz)	80% of permitted band (MHz)	Result
905.60 ~ 924.40	904.60 ~ 925.40	Pass

5. Power line conducted emission

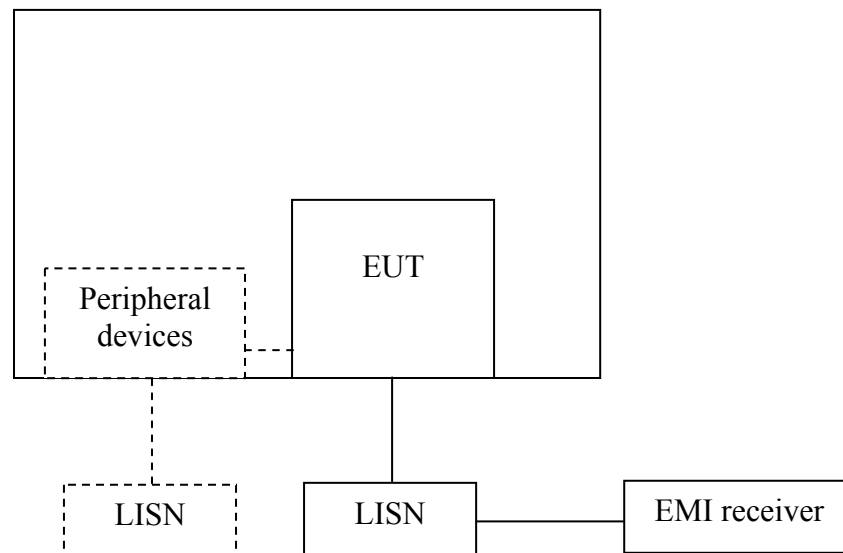
Test result: Pass

5.1 Limit

Frequency of Emission (MHz)	Conducted Limit (dBuV)	
	QP	AV
0.15-0.5	66 to 56*	56 to 46 *
0.5-5	56	46
5-30	60	50

* Decreases with the logarithm of the frequency.

5.2 Test configuration



For table top equipment, wooden support is 0.8m height table

For floor standing equipment, wooden support is 0.1m height rack.

5.3 Test procedure and test set up

The EUT are connected to the main power through a line impedance stabilization network (LISN). This provides a 50Ω/50uH coupling impedance for the measuring equipment. The peripheral devices are also connected to the main power through a LISN that provides a 50Ω/50uH coupling impedance with 50Ω termination.

Both sides (Line and Neutral) of AC line are checked for maximum conducted interference. In order to find the maximum emission, the relative positions of equipment and all of the interface cables must be changed according to ANSI C63.4 on conducted measurement. The bandwidth of the test receiver is set at 9 kHz.

5.4 Test protocol

Frequency	Correct Factor (dB)	Corrected Reading (dBuV)		Limit (dBuV)		Margin (dB)	
		QP	AV	QP	AV	QP	AV
0.17 (L)	3.00	18.00	8.74	64.94	54.94	46.94	46.20
0.23 (N)	3.00	13.82	7.23	62.42	52.42	48.60	45.19
0.43 (L)	3.00	23.61	21.30	57.28	47.28	33.67	25.98
1.24 (L)	3.00	10.51	6.34	56.00	46.00	45.49	39.66
1.78 (N)	3.00	10.85	7.14	56.00	46.00	45.15	38.86
3.38 (L)	3.00	6.96	2.98	56.00	46.00	49.04	43.02
Remark: 1. Correction Factor (dB) = LISN Factor (dB) + Cable Loss (dB). 2. Margin (dB) = Limit - Corrected Reading.							

6. Occupied Bandwidth

Test Status: Tested

6.1 Test limit

None

6.2 Test Configuration

See clause 3.2.

6.3 Test procedure and test setup

The occupied bandwidth per RSS-Gen Issue 3 Clause 4.6.1 was measured using the Spectrum Analyzer.

6.4 Test protocol

Temperature : 22 °C
Relative Humidity : 43 %

Channel	Occupied Bandwidth (kHz)	Max. reading (kHz)
L	731	731
M	704	
H	711	

7. Spurious emission for receiver

Test result: Pass

7.1 Test limit

The spurious emission shall test through 3 times tuneable or local oscillator frequency whichever is the higher, without exceeding 40 GHz.

1) If a conducted measurement is made, no spurious output signals appearing at the antenna terminals shall exceed 2nW per any 4 kHz spurious frequency in the band 30-1000 MHz, or 5nW above 1 GHz.

2) If a radiated measurement is made, all spurious emissions shall comply with the limits of Table below:

Frequency (MHz)	Field Strength (dBuV/m)	Measurement Distance (m)
30 - 88	40.0	3
88 - 216	43.5	3
216 - 960	46.0	3
Above 960	54.0	3

7.2 Test Configuration

Please refer to clause 3.2

7.3 Test procedure and test setup

Please refer to clause 3.2

7.4 Test protocol

Polarization	Frequency (MHz)	Correct Factor (dB/m)	Corrected Reading (dBuV/m)	Limit (dBuV/m)	Margin (dB)	Detector
H	66.93	8.20	32.10	40.00	7.90	PK
H	166.07	12.90	35.70	43.50	7.80	PK
H	245.77	12.70	42.30	46.00	3.70	PK
H	432.38	18.70	40.00	46.00	6.00	PK
H	749.24	22.50	38.40	46.00	7.60	PK
V	191.34	12.30	34.80	43.50	8.70	PK
V	247.72	12.80	34.90	46.00	11.10	PK
V	502.36	19.70	33.80	46.00	12.20	PK

- Remark: 1. Correct Factor = Antenna Factor + Cable Loss (-Amplifier, is employed)
 2. Corrected Reading = Original Receiver Reading + Correct Factor
 3. Margin = limit – Corrected Reading

Example: Assuming Antenna Factor = 30.20dB/m, Cable Loss = 2.00dB,
 Original Receiver Reading = 10dBuV.
 Then Correct Factor = 30.20 + 2.00 = 32.20dB/m; Corrected Reading = 10dBuV + 32.20dB/m = 42.20dBuV/m
 Assuming limit = 54dBuV/m, Corrected Reading = 42.20dBuV/m, then Margin = 54 -42.20 = 11.80dBuV/m