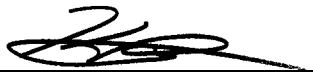
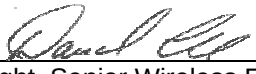
Nemko Test Report:	6L0434RUS1 rev 1
Applicant:	J & M Corp. 1415 South Cherry Ave Tucson AZ 85746
Equipment Under Test:	CFRG-BT01
In Accordance With:	**FCC Part 15, Subpart C, 15.247** Frequency Hopping Transmitters
Tested By:	Nemko USA Inc. 802 N. Kealy Lewisville, Texas 75057-3136

TESTED BY:  **DATE:** **September 28,2006**

Kevin Rose, Wireless Engineer

APPROVED BY:  **DATE:** **September 28,2006**

David Light, Senior Wireless Engineer

Total number of pages: 35

Table of Contents

Section 1. Summary of Test Results

Manufacturer: J & M Corporation

Name: CFRG-BT01

Model Number: CFRG-BT01

Serial Number: None

General: **All measurements are traceable to national standards.**

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 15, Subpart C, Paragraph 15.247 for Frequency Hopping Spread Spectrum devices. Radiated tests were conducted is accordance with ANSI C63.4-2003. Radiated emissions are made on an open area test site. A description of the test facility is on file with the FCC.

☒	New Submission	☐	Production Unit
☐	Class II Permissive Change	☒	Pre-Production Unit

THIS TEST REPORT RELATES ONLY TO THE ITEM(S) TESTED.

THE FOLLOWING DEVIATIONS FROM, ADDITIONS TO, OR EXCLUSIONS FROM THE TEST SPECIFICATIONS HAVE BEEN MADE.
See " Summary of Test Data".

NVLAP LAB CODE: 100426-0

Nemko USA Inc. authorizes the above named company to reproduce this report provided it is reproduced in its entirety and for use by the company's employees only.

Any use which a third party makes of this report, or any reliance on or decisions to be made based on it, are the responsibility of such third parties. Nemko USA Inc. accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report. This report applies only to the items tested.

Summary of Test Data

NAME OF TEST	PARA. NO.	RESULT
Powerline Conducted Emissions	15.207(a)	N/A
Channel Separation	15.247(a)(1)	Complies
Time of Occupancy	15.247(a)(1)(ii)	Complies
20 dB Occupied Bandwidth	15.247(a)(1)	Not defined
Peak Power Output	15.247(b)	Complies
Spurious Emissions (Antenna Conducted)	15.247(c)	N/A
Spurious Emissions (Radiated)	15.247(c)	Complies

Footnotes:

N/A (The EUT has a integral antenna.)

The EUT has a 9VDC battery
EUT was tested with a new battery

Section 2. Equipment Under Test (E.U.T.)

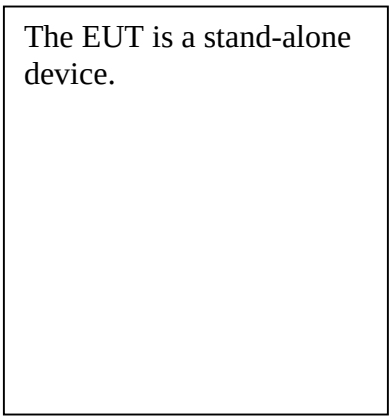
General Equipment Information

Frequency Band:	☐ 902 – 928 MHz ☒ 2400 – 2483.5 MHz
Channel Frequencies:	2402 to 2480 MHz
Number of Channels:	79
Channel Spacing:	1MHz
User Frequency Adjustment:	Software controlled

Description of DUT

The CFRG-BT01 allows the end user to connect Bluetooth devices such as cellular telephones to J&M Corporations CFRG Units

System Diagram



Section 3. Channel Separation

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
TESTED BY: Kevin Rose	DATE: August 29, 2006

Test Results: Complies.

Measurement Data: See 20 dB BW plot
Measured 20 dB bandwidth: 840 kHz
Channel Separation: 1MHz

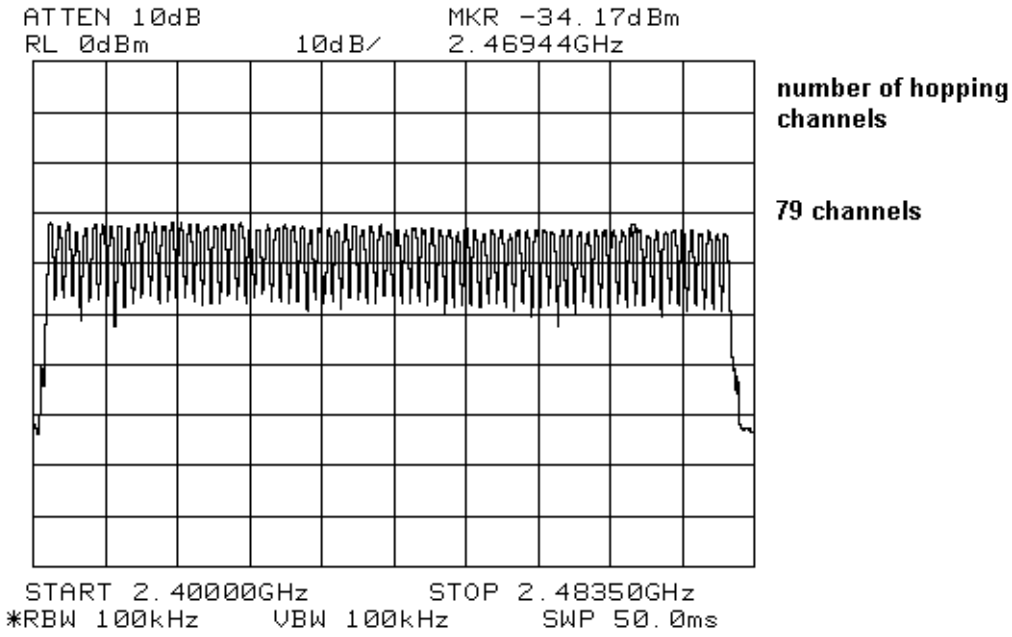
Equipment Used: 1464 1081 802

Measurement Uncertainty: +/- 1.7 dB

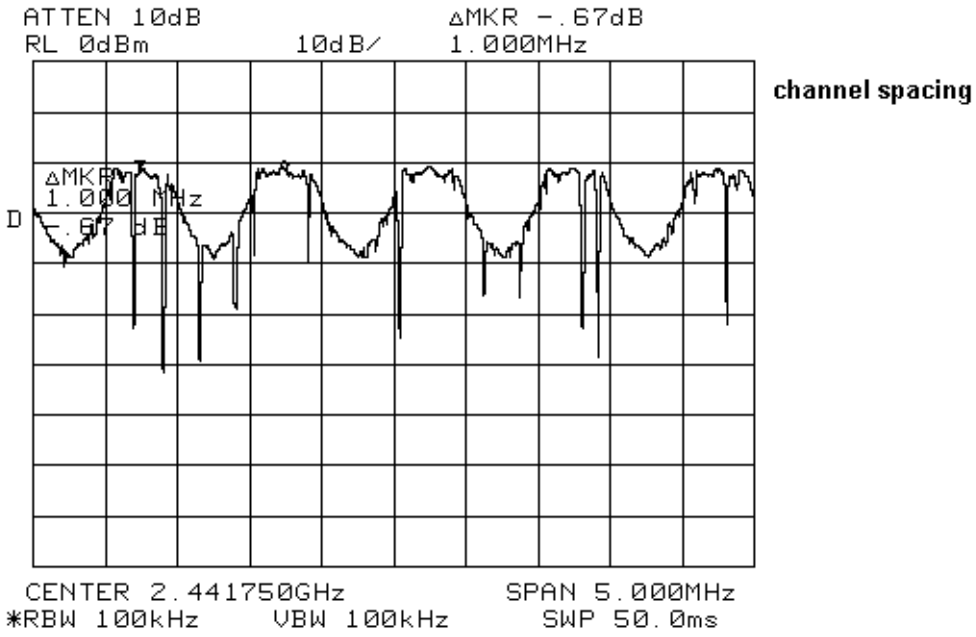
Temperature: 20°C

Relative Humidity: 46%

Number of hopping channels = 79



Channel separation



Section 4. Time of Occupancy

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)(iii)
TESTED BY: Kevin Rose	DATE: August 29, 2006

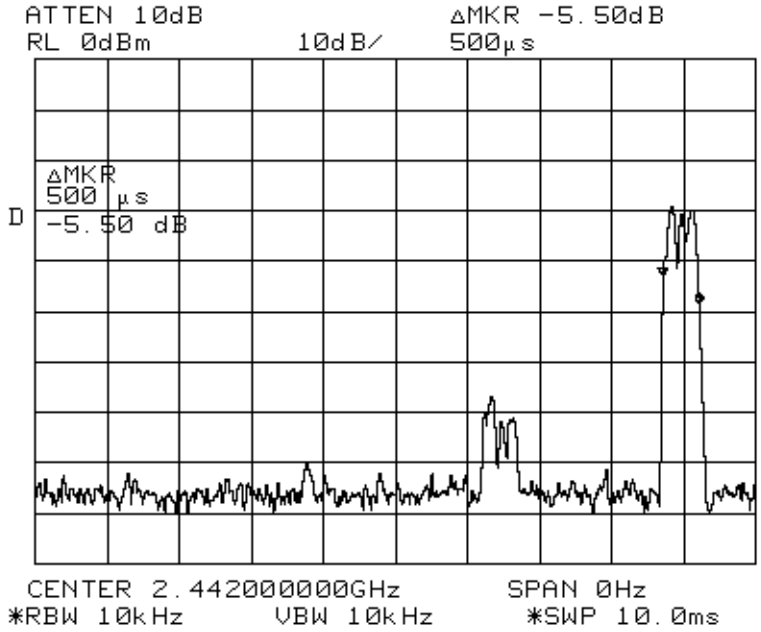
Test Results: Complies.

Measurement Data:

Maximum Dwell Time On Any Channel: 158 mS/31.6 seconds

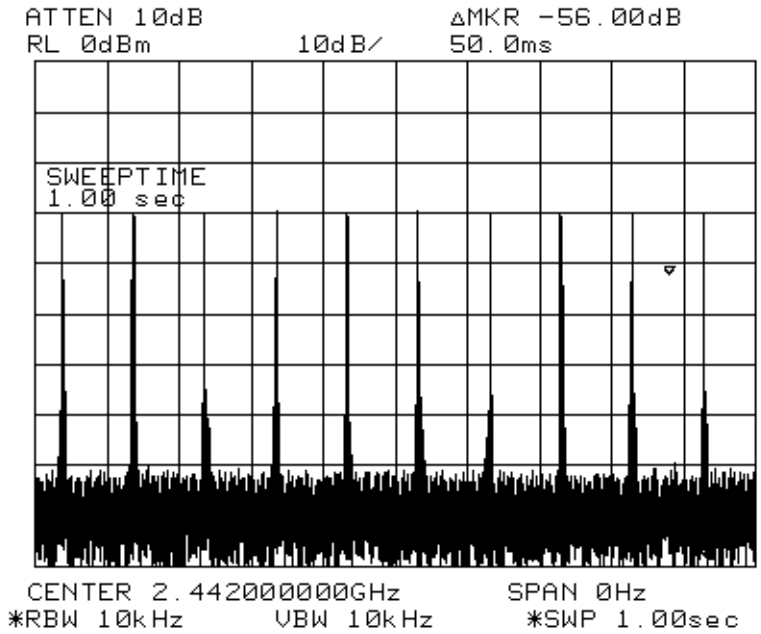
Equipment Used: 1659-802-1980

Pulse width



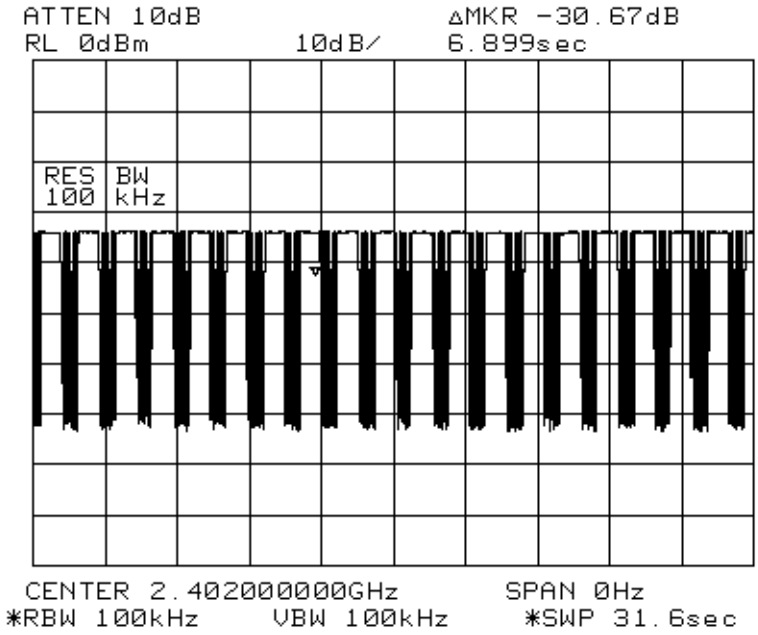
pulse width

One second graph



10 500usec pulses in one second

31.6 second graph



316 500us pulses in 31.6 seconds

Section 5. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(1)
TESTED BY: Kevin Rose	DATE: August 29, 2006

Test Results: Complies.

Measurement Data: See attached plots.

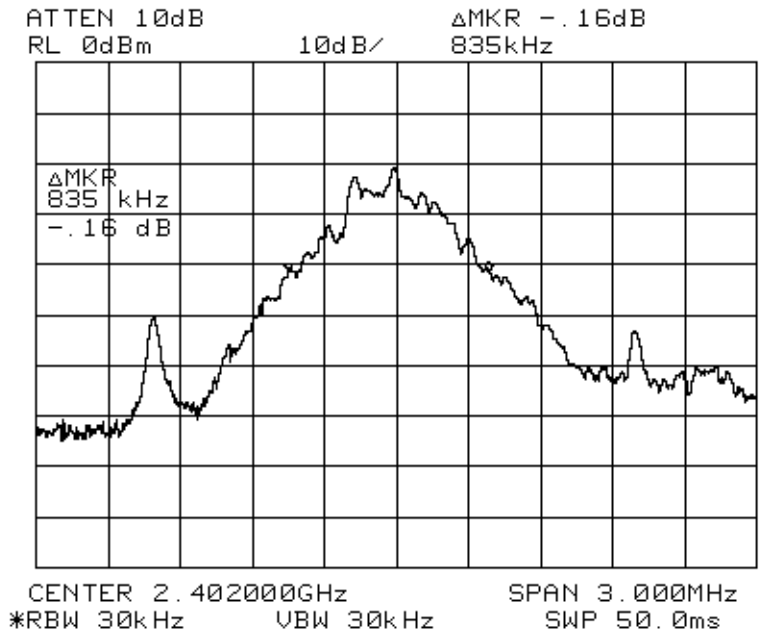
Equipment Used: 1464 1081 802

Measurement Uncertainty: +/- 1.7 dB

Temperature: 20°C

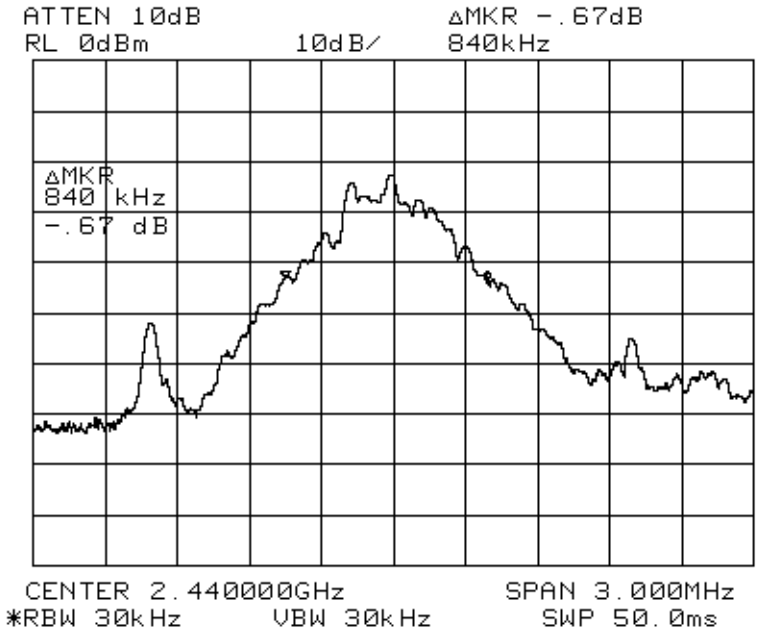
Relative Humidity: 46%

Lower channel 20 dB Bandwidth



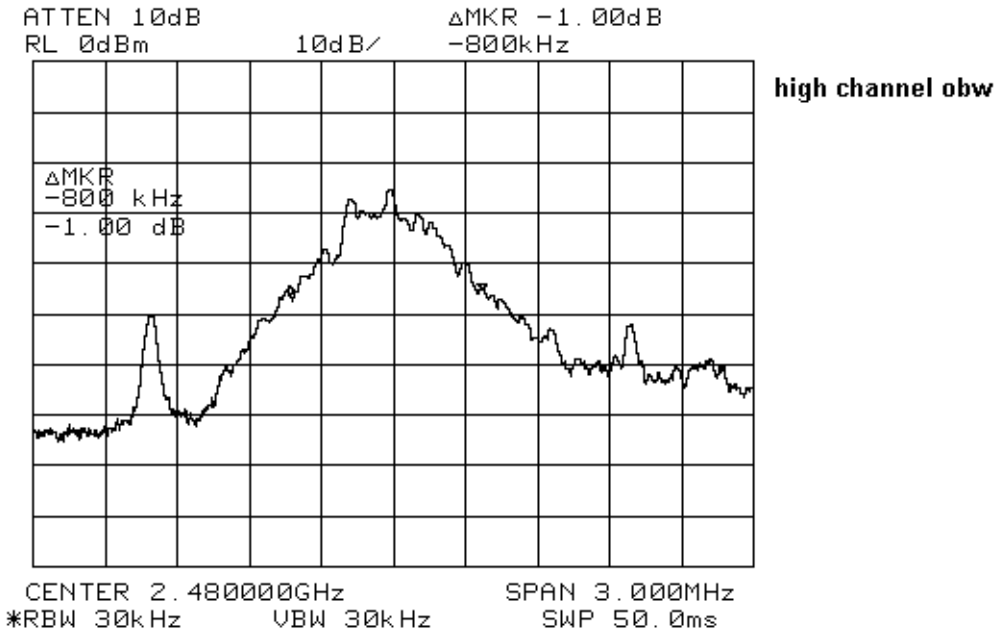
low channel OBW

Mid channel 20 dB Bandwidth



mid channel obw

High channel 20 dB Bandwidth



Section 5. Peak Power Output

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: Kevin Rose	DATE: August 29, 2006

Test Results: Complies.

Measurement Data: See attached plots.

Detachable antenna? ☐ Yes ☒ No
If yes, state the type of non-standard connector used:

Antennas:

Model	Type	**Manufacturer**	**Gain (dBi)**	**E.I.R.P. (dBm)**
NONE		J & M Corp.	1.2	3.2
Peak power output at antenna port(dBm): 2				

Equipment Used: 1484-1485-993-1464

2dBm was calculated by taking the peak ERIP minus the known antenna gain.
Peak detector was used.
RBW/VBW = 2MHz/3MHz

Measurement Uncertainty: +/- 1.7 dB

Temperature: 20°C

Relative Humidity: 46%

15.31(e): The DUT was tested at +/- 15% input voltage on both power supplies. This had no effect on output power.

Field Strength

Page 1 of 1 Complete x

Job No.: 6L0434R Date: 8/29/2006 Preliminary

Specification: 15.247 Temperature(°C): 22

Tested By: Kevin Rose Relative Humidity(%) 42

E.U.T.: CFRG

Configuration: Transmitting full power EUT had a new battery during the test

Sample No: 1

Location: AC 3 RBW: 2MHz Measurement

Detector Type: Peak VBW: 3MHz Distance: 3 m

Test Equipment Used

Antenna: 993 Directional Coupler:

Pre-Amp: 1016 Cable #1: 1484

Filter: Cable #2: 1485

Receiver: Cable #3:

Attenuator #1 Cable #4:

Attenuator #2: Mixer:

Additional equipment used:

Measurement Uncertainty: +/-3.6 dB

Frequency (MHz)	Meter Reading (dBm)	Correction Factor (dB)		Pre-Amp Gain (dB)	Substitution Antenna Gain (dBi)		EIRP (dBm)	EIRP (mW)	Polarity	Comments
2402	-39.5	34.9		0	7.8		3.2	2.1086	V	
2440	-40.0	34.9		0	7.8		2.7	1.8793	V	
2480	-40.7	34.9		0	7.8		2.0	1.5996	V	
2402	-42.5	36.8		0	7.8		2.1	1.6218	H	
2440	-43.1	36.8		0	7.8		1.5	1.4125	H	
2480	-43.5	36.8		0	7.8		1.1	1.2882	H	

Notes:

Section 6. Spurious Emissions (Antenna Conducted)

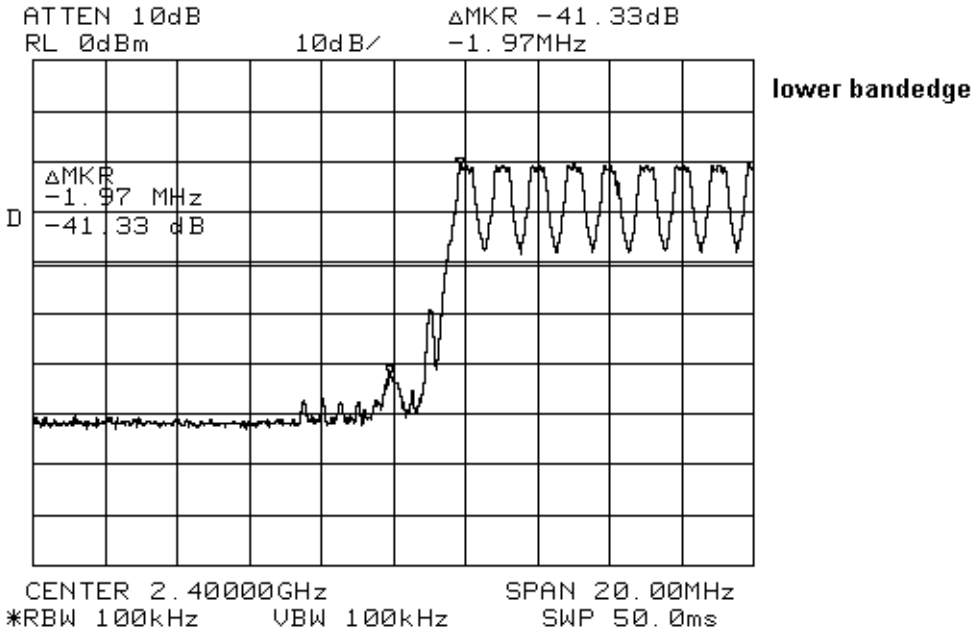
NAME OF TEST: Spurious Emissions (Antenna Conducted)	PARA. NO.: 15.247(c)
TESTED BY:	DATE:

Test Results: N/A

EUT has an integral antenna. Lower bandedge data provided was taken as a radiated measurement.

Equipment Used: 1464-802-1484

Lower bandedge 20dBc



Section 7. Spurious Emissions (Radiated)

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: Kevin Rose	DATE: August 29, 2006

Test Results: Complies.

Measurement Data: See attached table.

Equipment Used: 1484 1485 1464 993 760 759 1306 1034 1522 1284.

Measurement Uncertainty: +/-1.7 dB

Temperature: 20°C

Relative Humidity: 46%

All measurement were made with 1MHz RBW and 1MHz VBW for peak and 1MHz RBW and 10Hz VBW for average measurements.

During the test the EUT was transmitting continuous and hopping function was disabled.

#	Freq MHz	Rdng dBµV	Cable dB	Cable dB	Pre-A dB	Horn dB	Dist Table	Corr dBµV/m	Spec dBµV/m	Margin dB	Polar Ant
1	2483.5	43.5	+0.8	+2.3	+32.8	+29.0	+0.0	42.8	54.0	-11.2	Vert
2	2483.5	42.5	+0.8	+2.3	+32.8	+29.0	+0.0	41.8	54.0	-12.2	Horiz

Note: All readings are Peak 1MHz RBW and 1MHz VBW

There were no emissions detected within 20 dB of the specification limit. The device was tested at 2402, 2440 and 2480 MHz. Upper bandedge data for 2480 MHz is provided.

EUT was tested on all three orthogonal axles

The power was varied +/- 15%

The device was tested from 30 MHz to the tenth harmonic of the highest carrier frequency.

Radiated Photographs

FRONT VIEW

REAR VIEW

Section8. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1484	Cable	Storm PR90-010-072	N/A	09/26/05	09/05/06
1485	Cable	Storm PR90-010-216	N/A	09/26/05	09/05/06
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/14/05	01/15/07
993	Horn antenna	A.H. Systems SAS-200/571	XXX	08/01/05	08/02/07
760	Antenna biconical	Electro Metrics MFC-25	477	08/04/06	08/04/07
759	ANTENNA, LOG PERIODIC	A.H. SYSTEMS SAS-200/510	556	02/13/06	02/13/07
1306	Antenna biconical	Nemko USA, Inc. BCON 30300	212	02/10/06	02/10/07
1034	ANTENNA,LP	A.H. SYSTEMS SAS-200/510	121	03/13/06	03/13/07
1522	Cable Assy, LAB 5 - D OATS	Nemko USA, Inc. Site D OATS	N/A	05/09/06	05/09/07
1284	Spectrum analyzer display	Hewlett Packard 8566B	1811A00223	02/16/06	02/16/07
1081	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	06/15/06	06/15/07
802	Near Field Probe Set	EMCO 7405	103	N/A	N/A

ANNEX A - TEST DETAILS

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)

Minimum Standard: Frequency hopping systems shall have hopping channel carrier frequencies separated by a minimum of 25 kHz or the 20 dB bandwidth of the hopping channel, whichever is greater.

NAME OF TEST: Time of Occupancy PARA. NO.: 15.247(a)(1)(ii)

Minimum Standard:

Frequency Band (MHz)	20 dB Bandwidth	No. of Hopping Channels	Average Time of Occupancy
902 - 928	<250 kHz	50	=<0.4 sec. in 20 sec.
902 – 928	=>250 kHz	25	=<0.4 sec. in 10 sec.
2400 – 2483.5	-----	75	=<0.4 sec. in 30 sec.
5725 – 5850	-----	75	=<0.4 sec. in 30 sec.

Method Of Measurement:

The spectrum analyzer is set as follows:

RBW: 1 MHz
VBW: = RBW
Span: 0 Hz
LOG dB/div.: 10 dB
Sweep: Sufficient to see one hop time sequence.
Trigger: Video

The occupancy time of one hop is measured as above. The average time of occupancy is calculated over the appropriate period of time from above table (10, 20, or 30 seconds).

Avg. time of occupancy = (period from table/duration of one hop)/no. of channels multiplied by the duration of one hop.

For instance:

If a 2.4 GHz system has a measured hop duration time of 1 msec. and uses 75 channels, then the average time of occupancy would be:

(30 sec./.001 sec.)/75 chan. = 400 x 1 msec. = 400 msec. or 0.4 sec. in 30 sec.

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(2)

Minimum Standard:

Frequency Band (MHz)	Maximum 20 dB Bandwidth
902 - 928	500 kHz
2400 – 2483.5	Not defined
5725 – 5850	1 MHz

Method Of Measurement:

The spectrum analyzer is set as follows:

RBW: At least 1% of span/div.
VBW: >RBW
Span: Sufficient to display 20 dB bandwidth
LOG dB/div.: 10 dB
Sweep: Auto

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Peak Power Output PARA. NO.: 15.247(b)

Minimum Standard:

Frequency Band (MHz)	No. of Hopping Channels	Maximum Peak Power Output at Antenna Port
902 - 928	at least 50	1 watt
902 – 928	25 - 49	0.25 watts
2400 – 2483.5	75	1 watt
5725 – 5850	75	1 watt

If transmitting antennas of directional gain greater than 6 dBi are used, the power shall be reduced by the amount in dB that the directional gain of the antenna exceeds 6 dBi.

Systems operating in the 2400-2483.5 MHz band that are used exclusively for fixed, point to point operation may employ transmitting antennas with directional gain greater than 6 dBi provided the maximum peak output power is reduced by 1 dB for every 3 dB that the directional gain of the antenna exceed 6 dBi.

Systems operating in the 5725 – 5850 MHz band that are used exclusively for fixed, point-to-point operation may employ transmitting antennas with directional gain greater than 6 dBi without any corresponding reduction in transmitter peak output power.

Direct Measurement Method For Detachable Antennas:
If the antenna is detachable, a peak power meter is used to measure the power output with the transmitter operating into a 50 ohm load. The dBi gain of the antenna(s) employed shall be reported.

Calculation Of EIRP For Integral Antenna:

If the antenna is not detachable from the circuit then the Peak Power Output is derived from the peak radiated field strength of the fundamental emission by using the plane wave relation $GP/4\pi R^2 = E^2/120\pi$ and proceeding as follows:

$$P = \frac{E^2 R^2}{30G} = \frac{E^2 3^2}{30G}$$

where,

P = the equivalent isotropic radiated power in watts
E = the maximum measured field strength in V/m
R = the measurement range (3 meters)
G = the numeric gain of the transmit antenna in relation to an isotropic radiator

The RBW of the spectrum analyzer shall be set to a value greater than the measured 20 dB occupied bandwidth of the E.U.T.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Spurious Emissions at Antenna Terminals PARA. NO.: 15.247(c)

Minimum Standard: In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits. Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (μV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC

Method Of Measurement:

30 MHz - 10th harmonic plot
RBW: 100 kHz
VBW: 300 kHz
Sweep: Auto
Display line: -20 dBc

Lower Band Edge
RBW: At least 1% of span/div.
VBW: >RBW
Span: As necessary to display any spurious at band edge.
Sweep: Auto
Center Frequency: 902 MHz, 2400 MHz, or 5725 MHz
Marker: Peak of fundamental emission
Marker Δ: Peak of highest spurious level below center frequency.

Upper Band Edge
RBW: At least 1% of span/div.
VBW: >RBW
Span: As necessary to display any spurious at band edge.
Sweep: Auto
Center Frequency: 928 MHz, 2483.5 MHz, or 5850 MHz
Marker: Peak of fundamental emission
Marker Δ: Peak of highest spurious level above center frequency.

Number of channels tested:

Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

NAME OF TEST: Radiated Spurious Emissions PARA. NO.: 15.247(c)

Minimum Standard: In any 100kHz bandwidth outside the frequency band in which the transmitter is operating, emissions shall be at least 20 dB below the fundamental emission or shall not exceed the following field strength limits:

Emissions falling in the restricted bands of 15.205 shall not exceed the following field strength limits:

Frequency (MHz)	Field Strength (μV/m @ 3m)	Field Strength (dB @ 3m)
30 - 88	100	40.0
88 - 216	150	43.5
216 - 960	200	46.0
Above 960	500	54.0

THE SPECTRUM WAS SEARCHED TO THE 10th HARMONIC

15.205 Restricted Bands

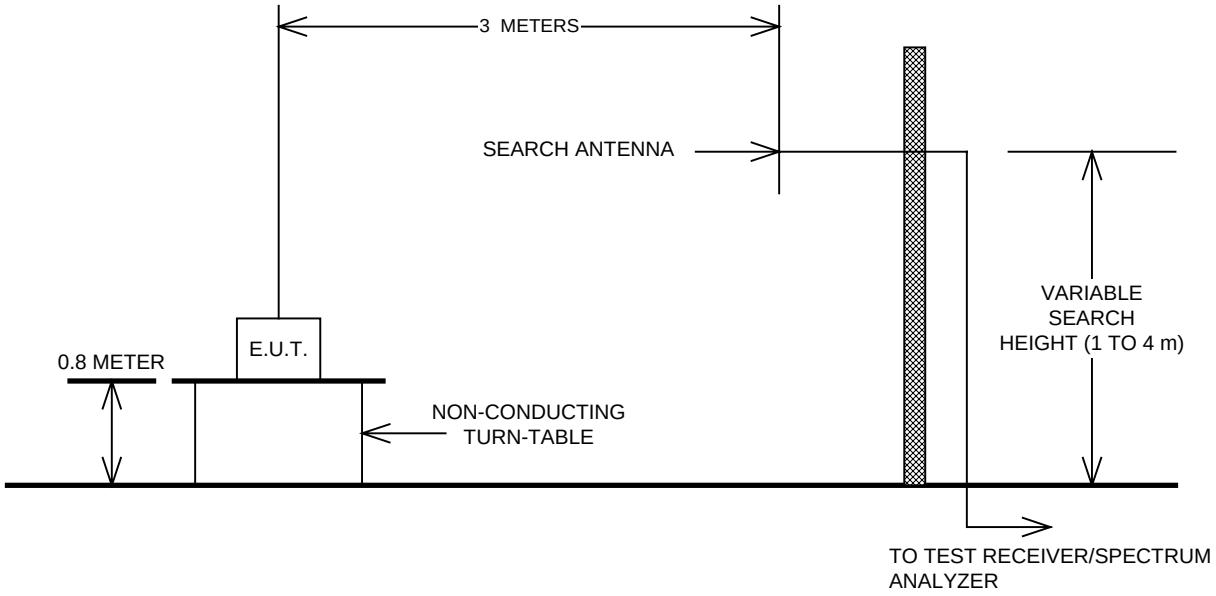
MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	74.8-75.2	1660-1710	10.6-12.7
6.26775-6.26825	108-121.94	1718.8-1722.2	13.25-13.4
6.31175-6.31225	123-138	2200-2300	14.47-14.5
8.291-8.294	149.9-150.05	2310-2390	15.35-16.2
8.362-8.366	156.52475-156.52525	2483.5-2500	17.7-21.4
8.37625-8.38675	156.7-156.9	2655-2900	22.01-23.12
8.41425-8.41475	162.0125-167.17	3260-3267	23.6-24.0
12.29-12.293	167.72-173.2	3332-3339	31.2-31.8
12.51975-12.52025	240-285	3345.8-3358	36.43-36.5
12.57675-12.57725	322-335.4	3600-4400	Above 38.6
13.36-13.41	1718		

Number of channels tested:

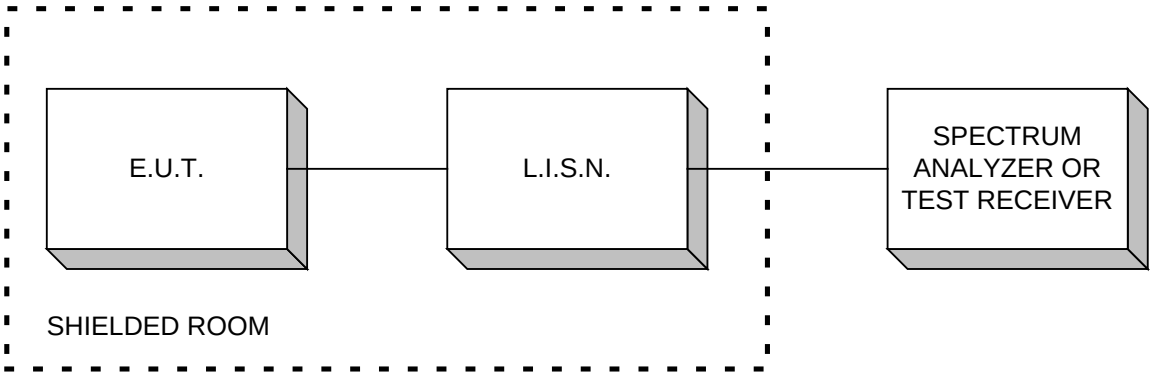
Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

ANNEX B - TEST DIAGRAMS

Test Site For Radiated Emissions



Conducted Emissions



Peak Power At Antenna Terminals