Nemko Test Report:	5L0470RUS1
Applicant:	Kemp-Meek Manufacturing 101 Park Central Mineola, TX 75773
Equipment Under Test:	COLLECTOR-P
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
Authorized By:	 David Light, Senior Wireless Engineer
Date:	21 December 2005

Table of Contents

Section 1. Summary of Test Results

Manufacturer: Kemp-Meek Manufacturing

Model No.: COLLECTOR-P

Serial No.: NA

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
☐	Family Listing		

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

Summary Of Test Data

NAME OF TEST	PARA. NO.	SPEC.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dBμV	NA
Channel Separation	15.247(a)(1)	Greater of 25 kHz or 20 dB Bandwidth	COMPLIES
Pseudorandom Hopping Algorithm	15.247(a)(1)		COMPLIES NOTE1
Time of Occupancy	15.247(a)(1)(ii)	≤ 0.4 sec in 20 sec	COMPLIES
20 dB Occupied Bandwidth	15.247(a)(1)	≤ 1 MHz	COMPLIES
Peak Power Output	15.247(b)	1 Watt	COMPLIES
Spurious Emissions (Antenna Conducted)	15.247(c)	-20 dBc	COMPLIES
Spurious Emissions (Radiated)	15.247(c)	Table 15.209(a)	COMPLIES

Footnotes:

NOTE 1 CUSTOMER WILL PROVIDE IN DOCMENTATION

NA THE EUT IS BATTERY POWERED DEVICE

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

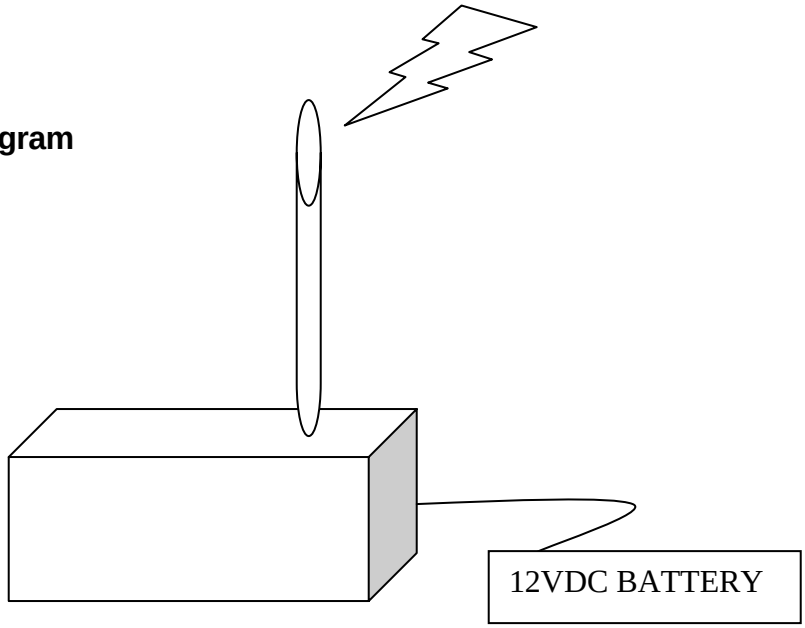
General Equipment Information

Frequency Band:	☒ 902 – 928 MHz ☐ 2400 – 2483.5 MHz
Number of Channels:	50
Operating Frequencies:	922.7 to 927.9
Channel Spacing:	100 kHz
User Frequency Adjustment:	Software controlled

Theory of Operation

FREQUENCY HOPPER TX TO COMMUNICATE WITH METERS

System Diagram



Section 3. Channel Separation

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
TESTED BY: Kevin Rose	DATE: October 8, 2005

Test Results: Complies.

Measurement Data: See attached plot

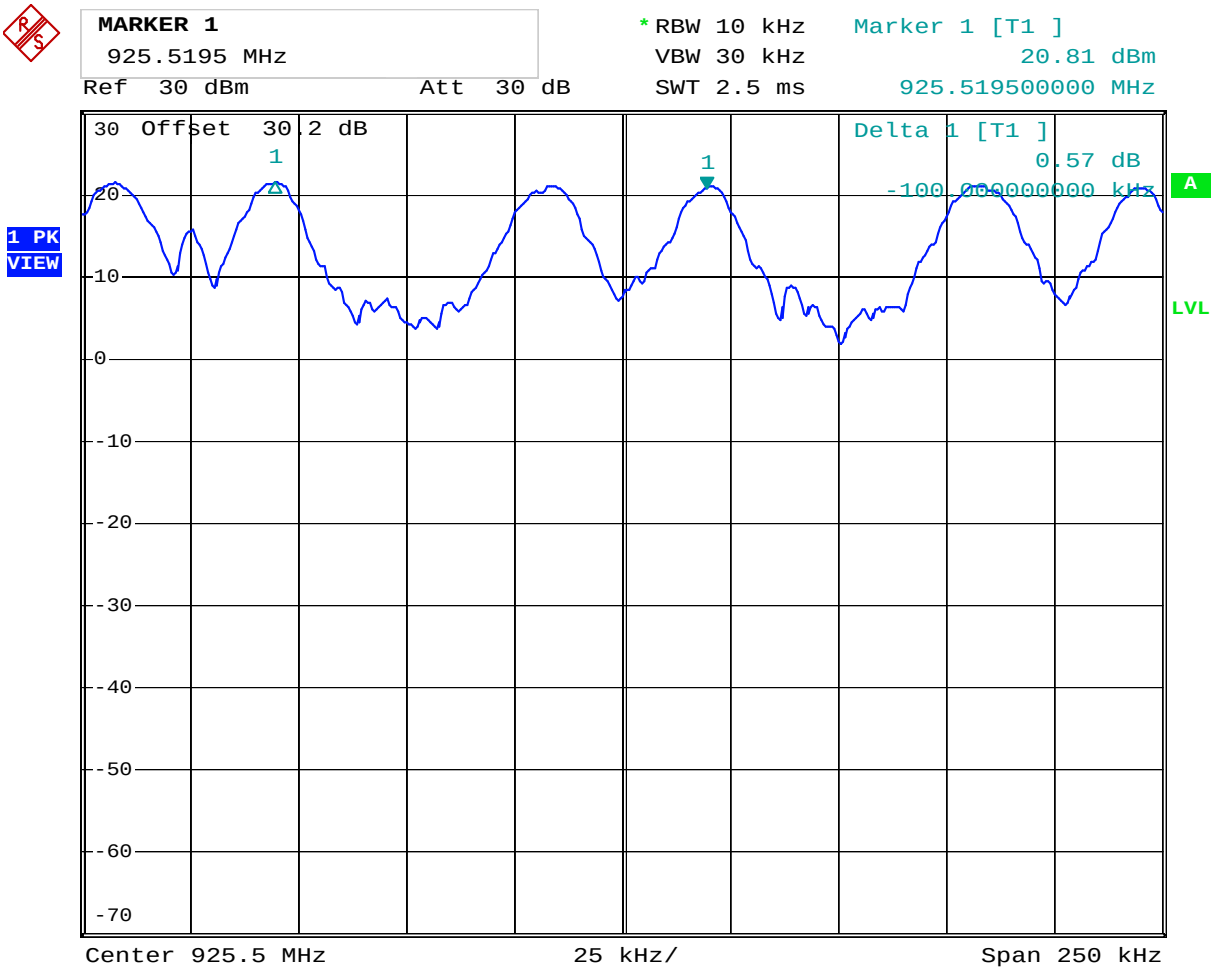
Equipment Used: 1472, 1464, 1081, 1471

Measurement Uncertainty: +/- 1.7 dB

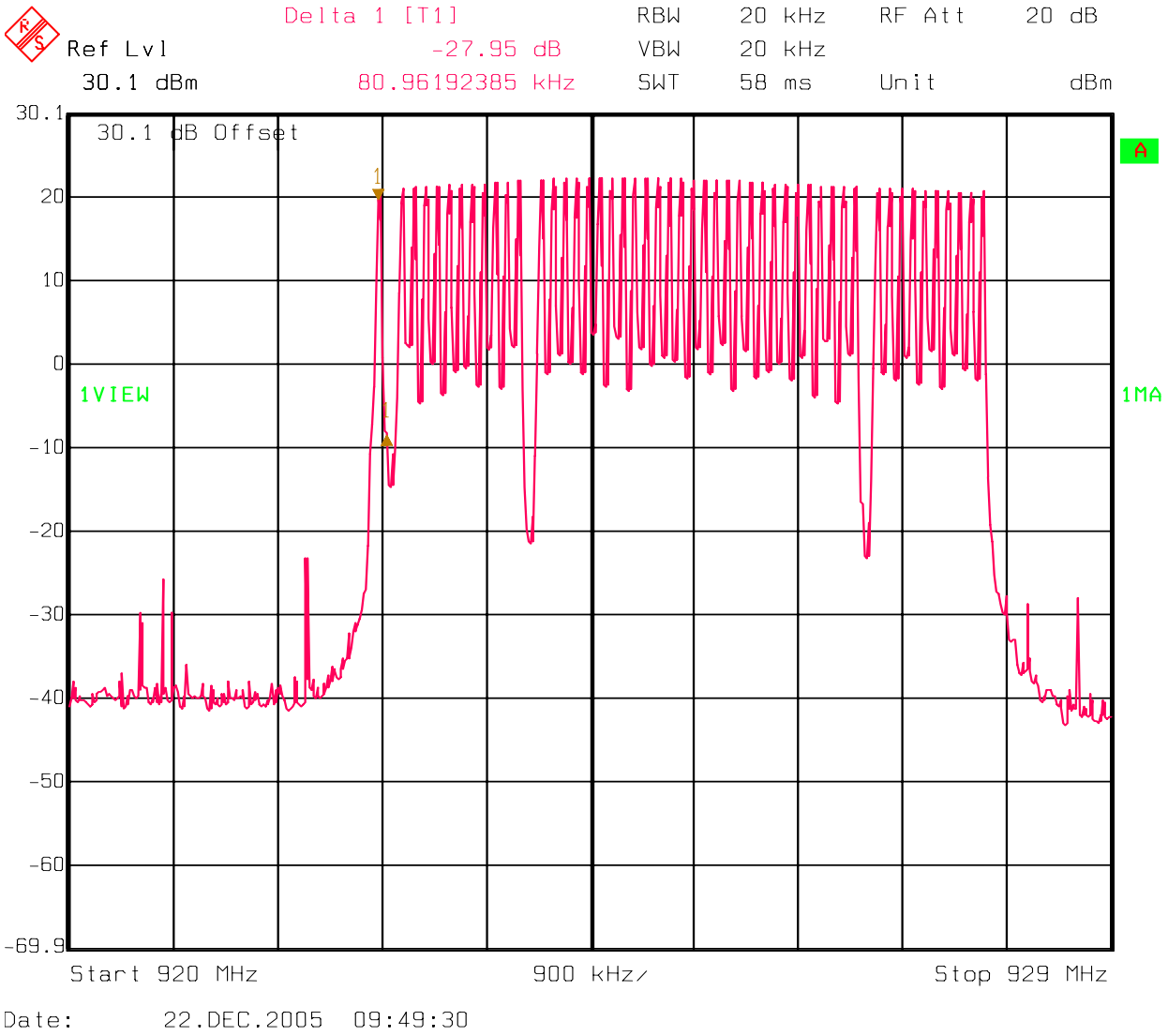
Temperature: °21C

Relative Humidity: 46%

Channel Separation



Date: 19.AUG.2005 14:36:56


Delta 1 [T1]
RBW 20 kHz
RF Att 20 dB
Ref Lvl
-27.95 dB
VBW 20 kHz
30.1 dBm
80.96192385 kHz
SWT 58 ms
Unit dBm
30.1 dB Offset
A
1VIEW
1MA
30.1
20
10
0
-10
-20
-30
-40
-50
-60
-69.9
Start 920 MHz
900 kHz/
Stop 929 MHz
Date: 22.DEC.2005 09:49:30

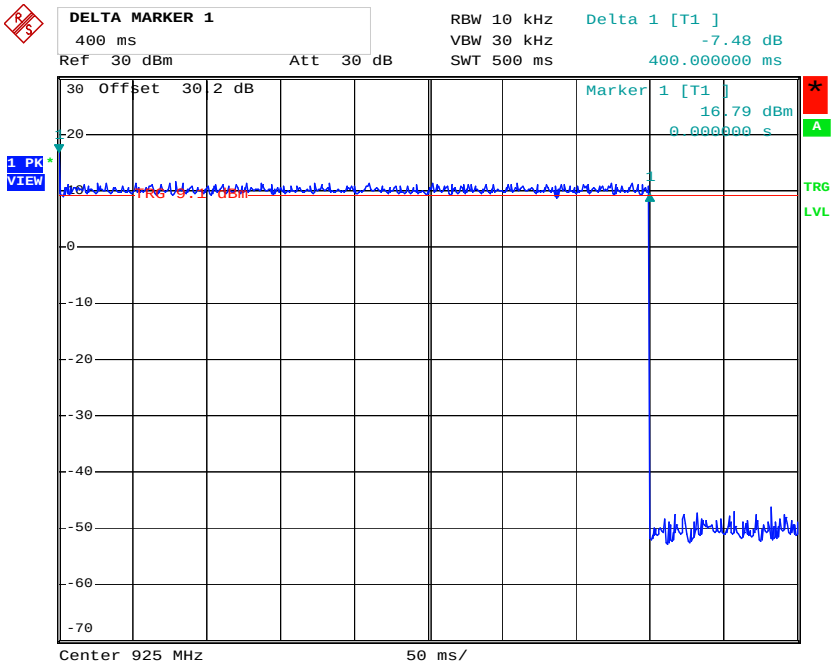
Section 4. Time of Occupancy

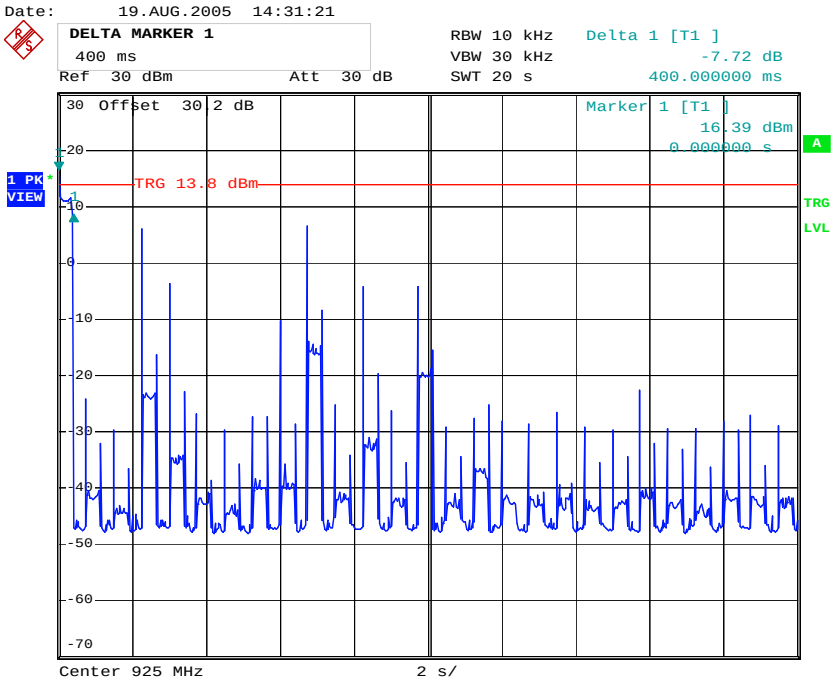
NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)
TESTED BY: Kevin Rose	DATE: October 9, 2005

Test Results: Complies.

Equipment Used: 1472, 1659, 1081, 1471

Measurement Data: See attached plot





Date: 19.AUG.2005 14:29:54

400 mS in 20 seconds

Section 5. Occupied Bandwidth and Bandedges

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(1)(i)
TESTED BY: Kevin Rose	DATE: October 9, 2005

Test Results: Complies.

Measurement Data: See attached plots.

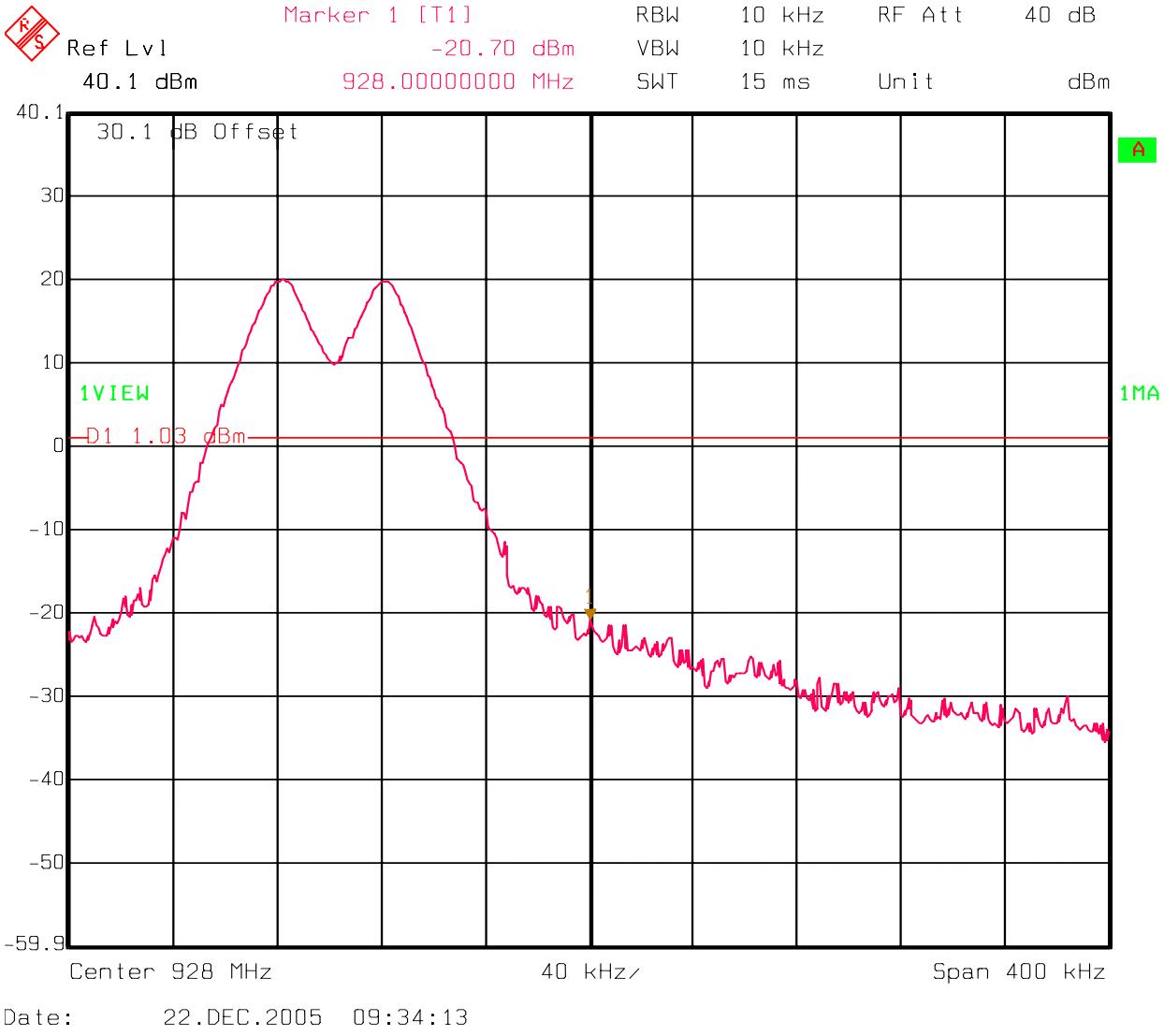
Equipment Used: 1472, 1081, 1471, 1659.

Measurement Uncertainty: +/- 1.7 dB

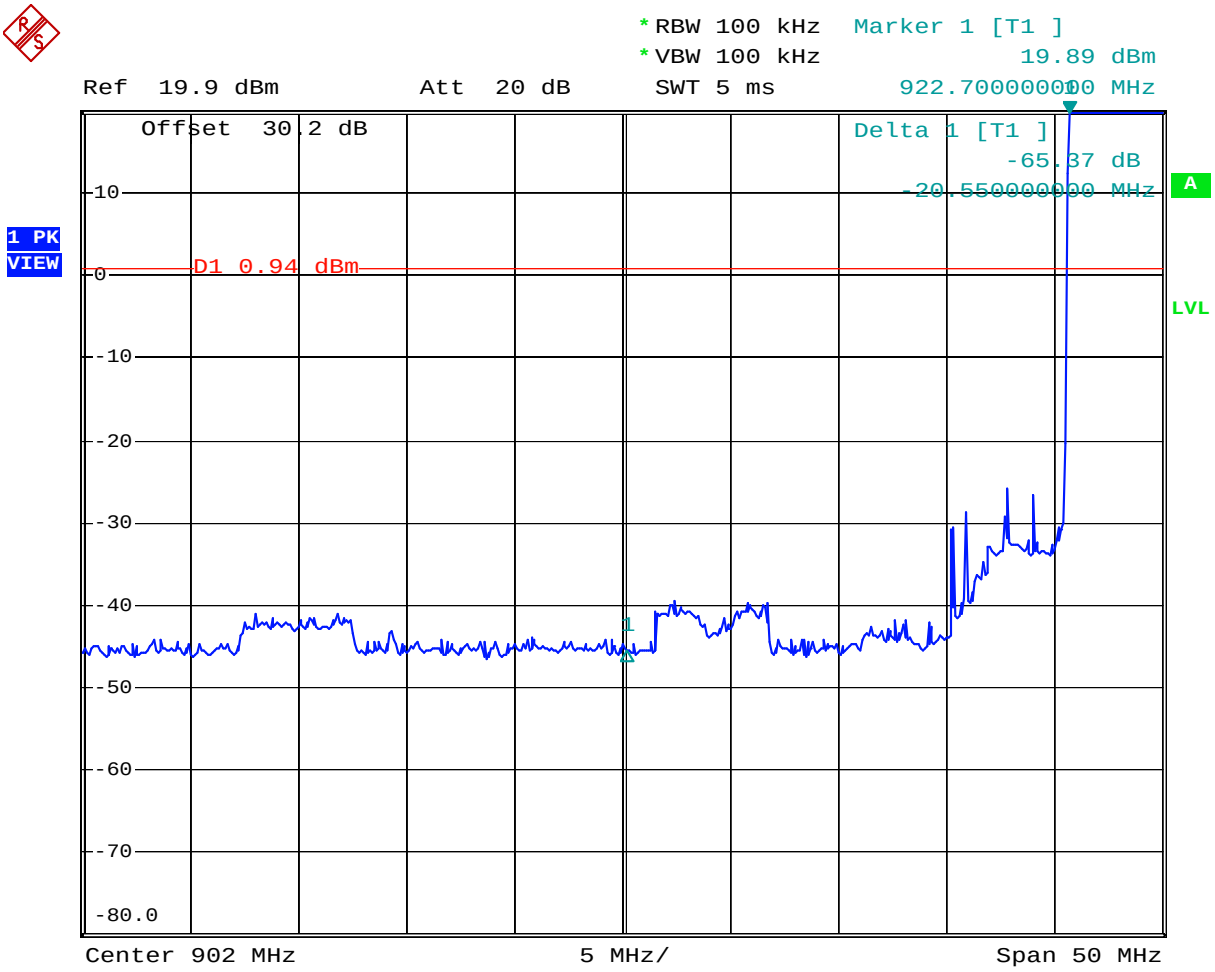
Temperature: 22°C

Relative Humidity: 46%

UPPER BAND EDGE

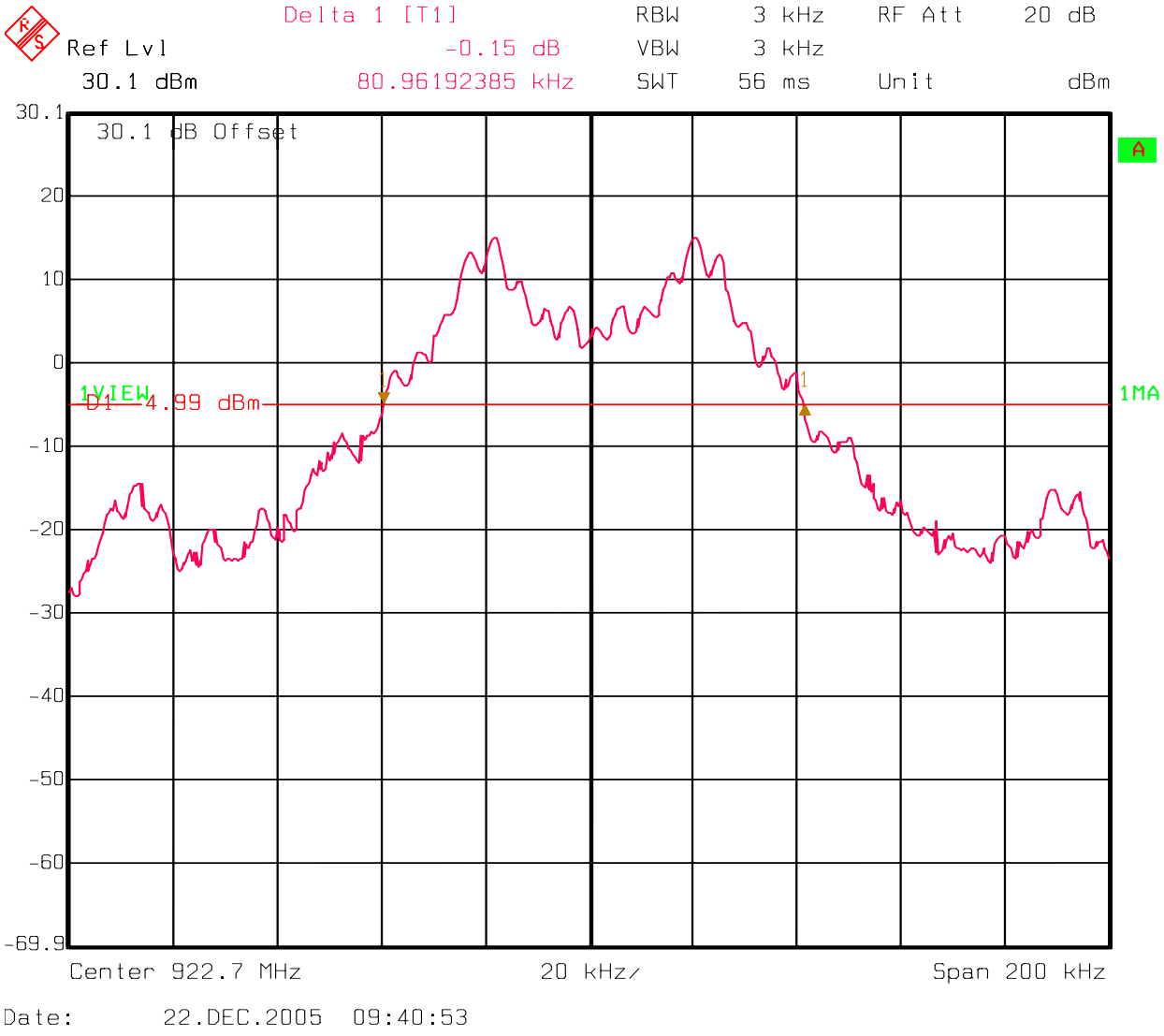


LOWER BANDEDGE

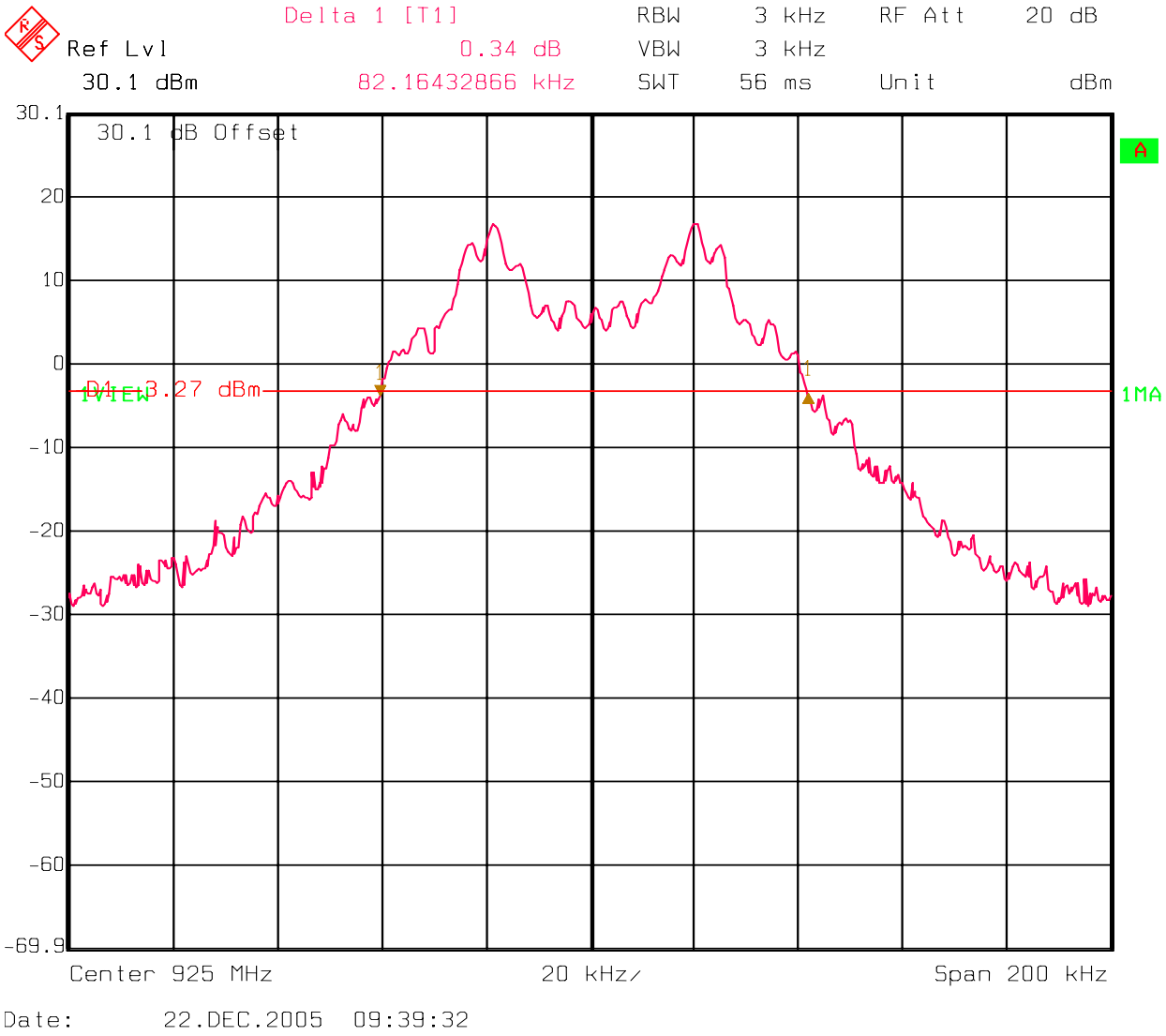


Date: 19.AUG.2005 12:58:43

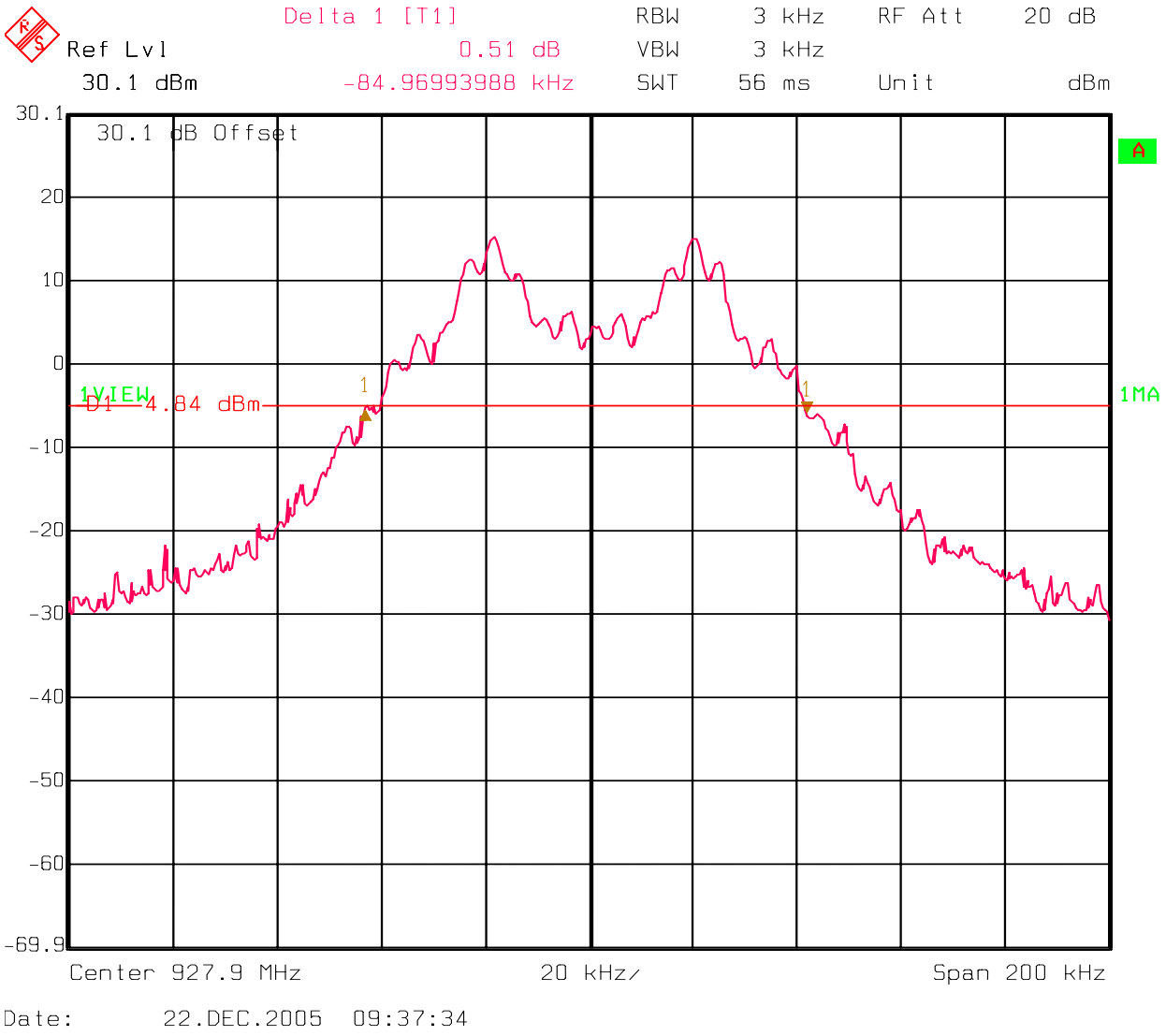
LOW CHANNEL OBW



MID CHANNEL OBW



HIGH CHANNEL OBW



Section 6. Peak Power Output

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: Kevin Rose	DATE: October 9, 2005

Test Results: Complies.

Measurement Data: See attached plots.
Detachable antenna? ☒ Yes ☐ No
If yes, state the type of non-standard connector used:

Antennas: **Monopole**

Model	Type	Conduct power	**Gain (dBi)**	**E.I.R.P. (dBm)**
MUF9000NGP	Low channel 922.7Mhz	19.78	2.15	21.94
MUF9000NGP	Mid channel 925Mhz	21.22	2.15	23.37
MUF9000NGP	High channel 927.9Mhz	19.4	2.15	21.55
Peak power output at antenna port(dBm):				

Equipment Used: 1472,, 1081, 1471, 2072, 2071

Measurement Uncertainty: +/- 1.7 dB

Temperature: 22°C

Relative Humidity: 46%

Section 7. Spurious Emissions (Antenna Conducted)

NAME OF TEST: Spurious Emissions (Antenna Conducted)	PARA. NO.: 15.247(c)
TESTED BY: Kevin Rose	DATE: October 9, 2005

Test Results: Complies.

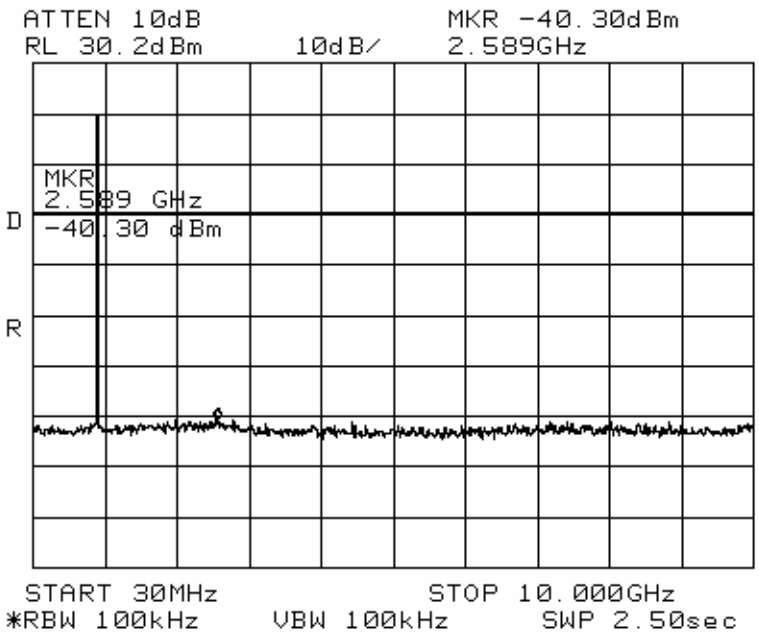
Measurement Data: See attached plots.

Equipment Used: 1472, 1464, 1081, 1471

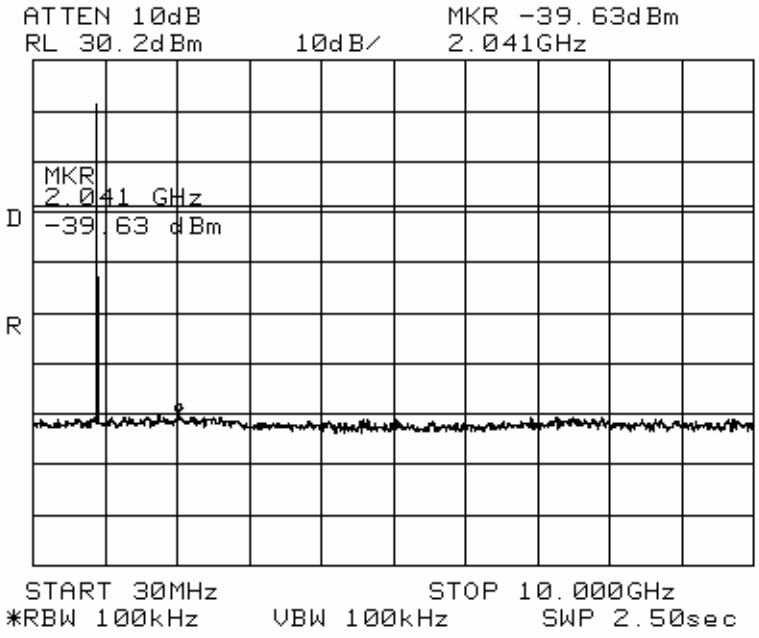
Measurement Uncertainty: +/- 1.7 dB

Temperature: 22°C

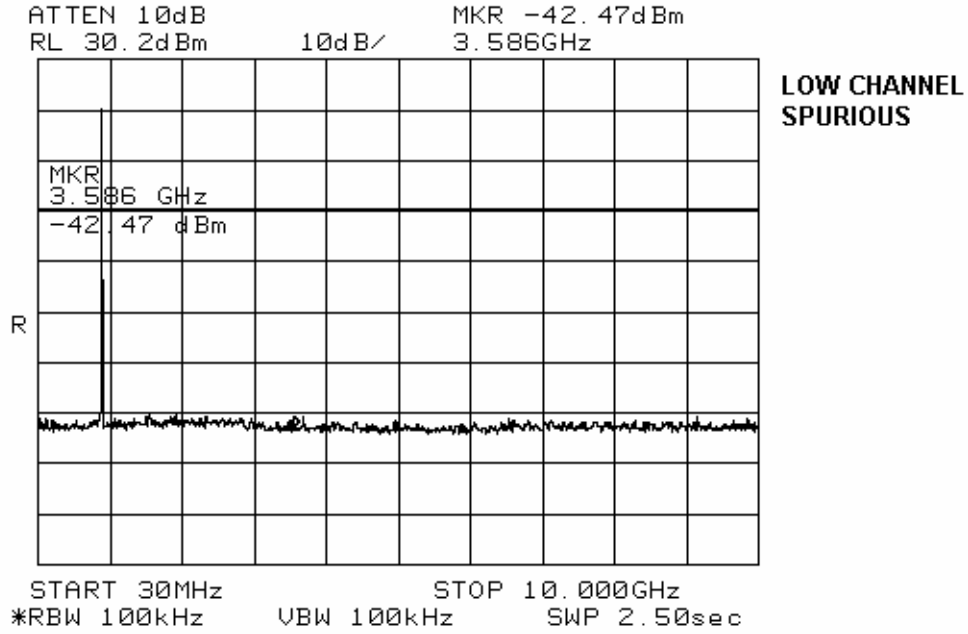
Relative Humidity: 46%



HIGH CHANNEL SPURIOUS



MID CHANNEL SPURIOUS



LOW CHANNEL SPURIOUS

Section 8. Spurious Emissions (Radiated)

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: Kevin Rose	DATE: October 9, 2005

Test Results: Complies.

Measurement Data: See attached table.

Duty Cycle Calculation:

Duty Cycle correction factor(dB) = 20 log (rf_{ON} in ms/100ms)

Equipment Used: 993, 1484, 1485, 1464, 1016, 791,760,759, 1481

Measurement Uncertainty: +/- 3.7 dB

Temperature: 22°C

Relative Humidity: 46%

ALL EMISSION WERE INVESTIGATED FROM 30MHz TO 9.5GHz

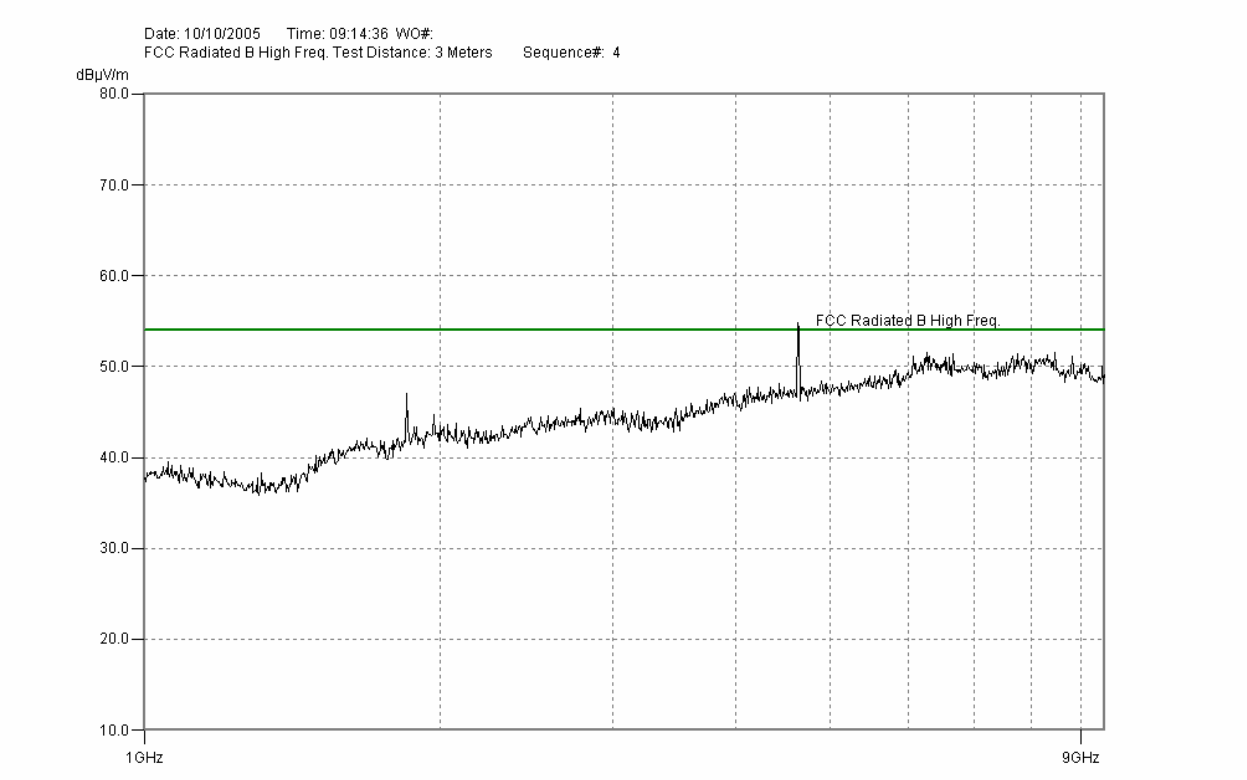
RBW=VBW=1 MHz > 1 GHz Peak Detector was used.

Average measurements were made with RBW=1MHz and VBW=10Hz

RBW=VBW=100 kHz <1 GHz Peak Detector was used.

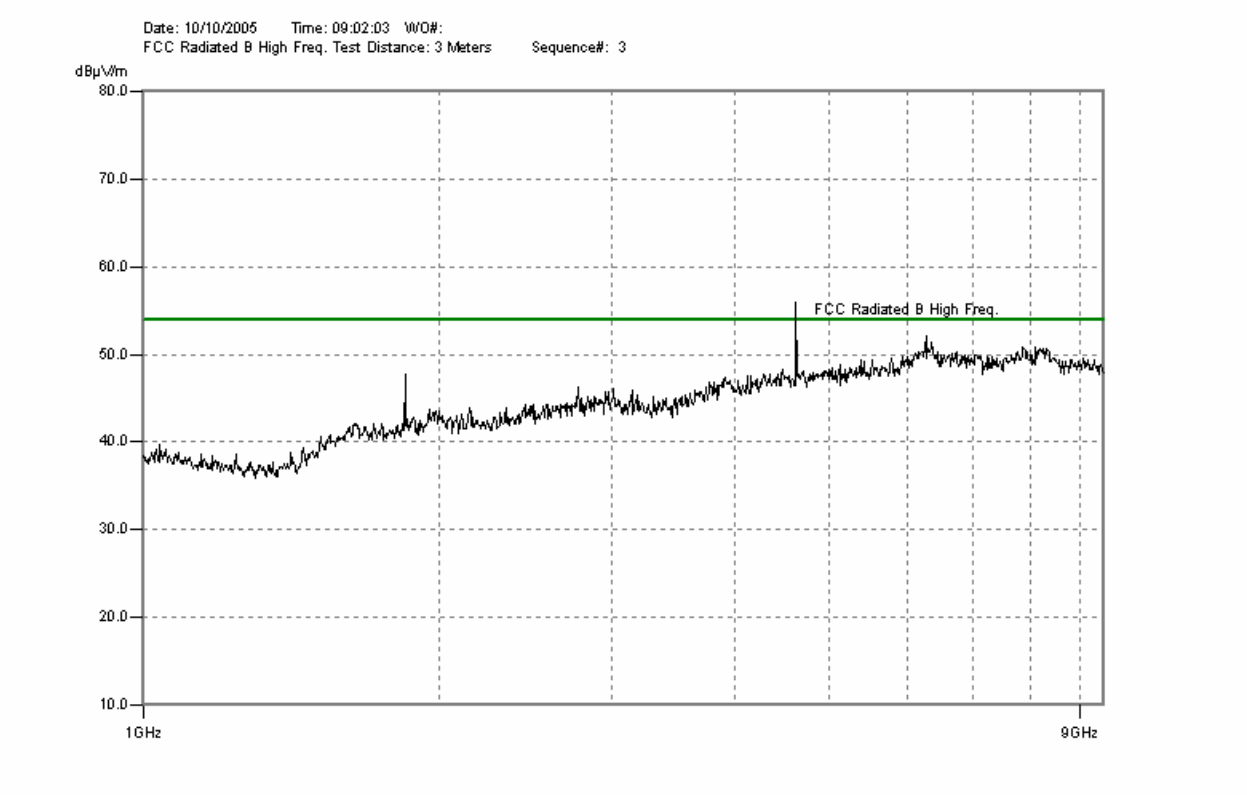
The device was tested with a fully charged battery.

VERTICAL HIGH CHANNEL



Frequency (MHz)	SPECTRUM ANALYZER READING	EQUIPMENT CORRECTION FACTORS	CORRECTED READINGS.	SPEC	MARGIN	PEAK/ AVG	POL
4,639.56	51.8	4.6	56.4	74	-17.6	Peak	Vert
4,639.56	48	4.6	52.6	54	-1.4	Ave	Vert
5,826.89	42	7.6	49.6	54	-4.4	Peak	Vert
5,867.78	41.5	7.7	49.2	54	-4.8	Peak	Vert
6,004.07	41.3	8.1	49.4	54	-4.6	Peak	Vert
6,072.22	42.7	8.4	51.1	54	-2.9	Peak	Vert

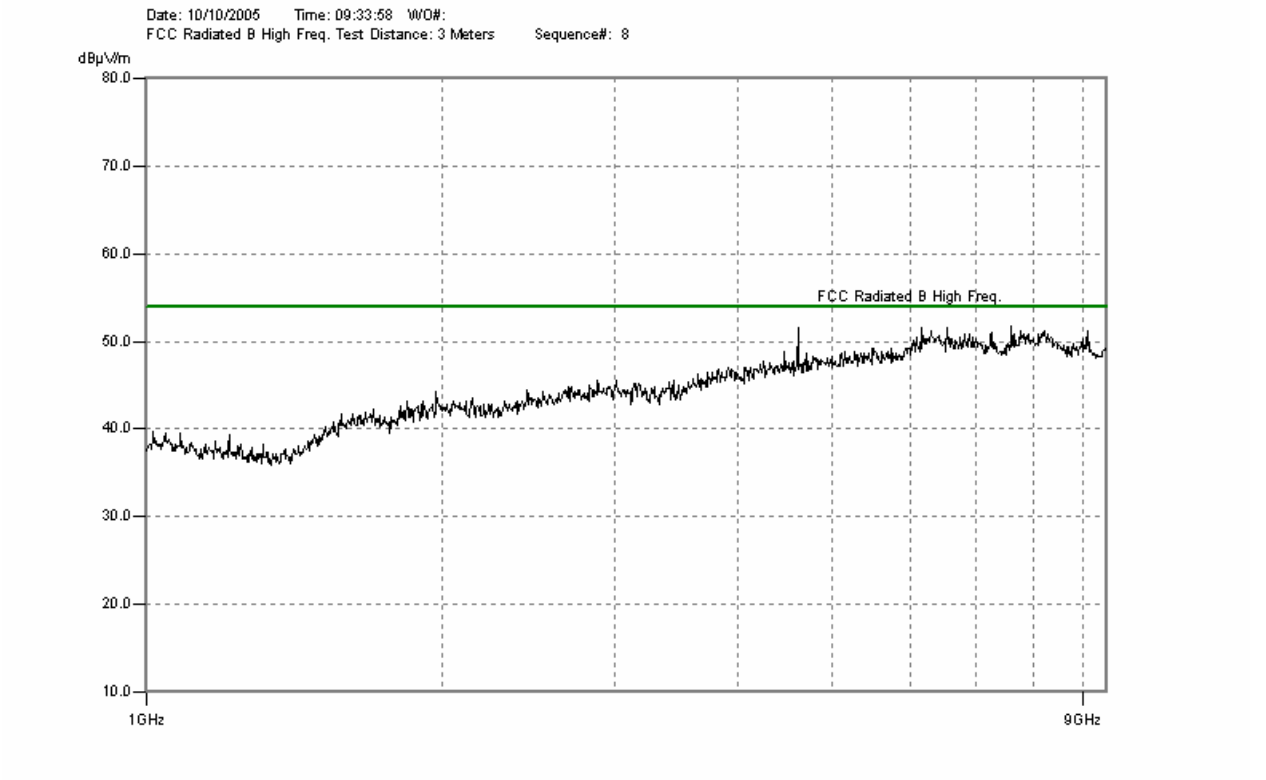
VERTICAL MID CHANNEL



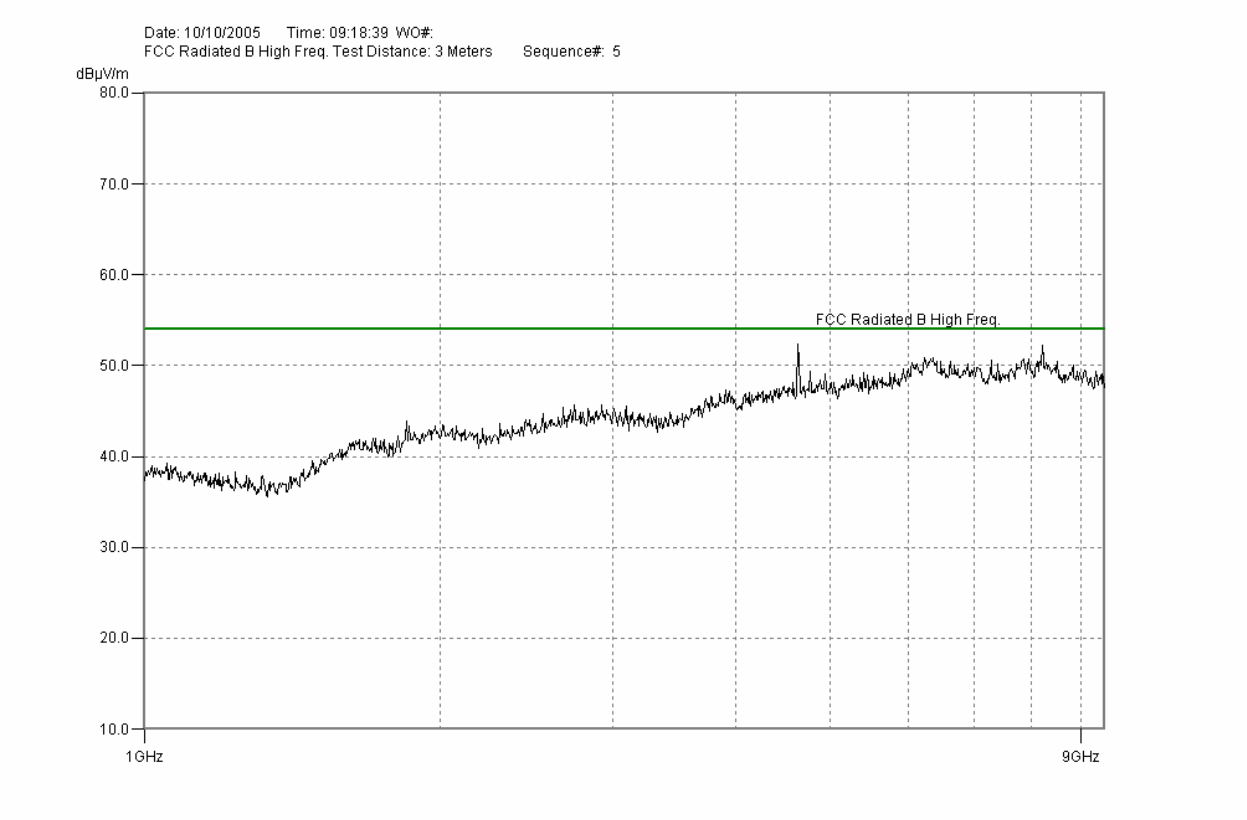
Frequency (MHz)	SPECTRUM ANALYZER READING	EQUIPMENT CORRECTION FACTORS	CORRECTED READINGS.	SPEC	MARGIN	PEAK/ AVG	POL
4,624.89	52.3	4.7	57	74	-17	Peak	Vert
4,624.89	49.3	4.7	54	54	0	Ave	Vert

VERTICAL LOW CHANNEL

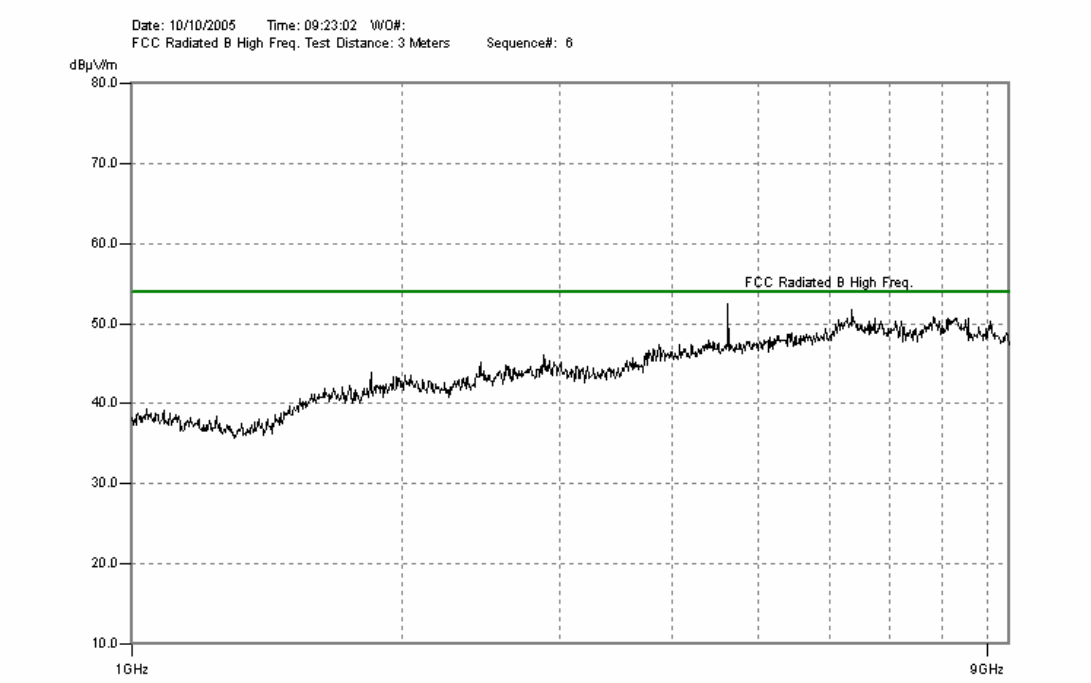
Frequency (MHz)	SPECTRUM ANALYZER READING	EQUIPMENT CORRECTION FACTORS	CORRECTED READINGS.	SPEC	MARGIN	PEAK/ AVG	POL
4,613.53	52	4.5	56.5	74	-17.5	Peak	Vert
4,613.53	48.8	4.5	53.3	54	-0.7	Ave	Vert



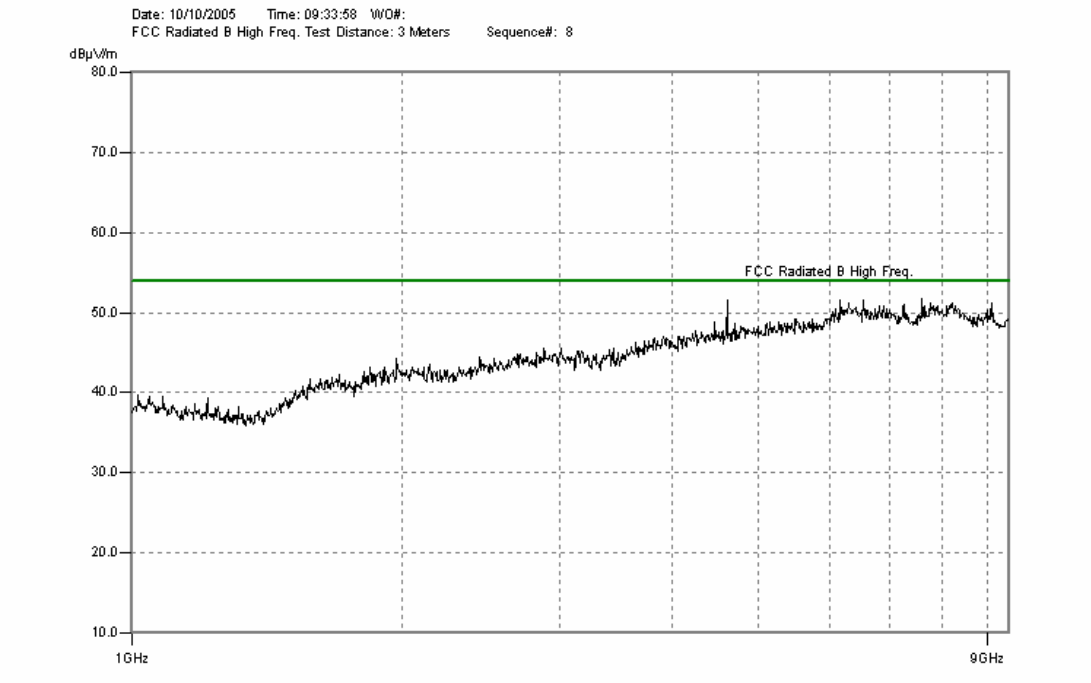
HORIZONTAL HIGH CHANNEL



HORIZONTAL MID CHANNEL



HORIZONTAL LOW CHANNEL



Radiated Photographs (Worst Case Configuration)

FRONT VIEW

REAR VIEW

Section 9. Test Equipment List

Nemko ID	Description	Manufacturer / Model Number	Serial Number	Calibration Date	Calibration Due
1472	20db Attenuator DC 18 Ghz	Omni Spectra / 20600-20db	NONE	CBU	N/A
1464	Spectrum analyzer	Hewlett Packard / 8563E	3551A04428	01/15/07	01/15/07
1081	CABLE 2m	Astrolab / 32027-2-29094-72TC	N/A	CBU	N/A
1471	10 db Attenuator DC 18 Ghz	MCL Inc. / BW-S10W2 10db-2WDC	NONE	CBU	N/A
1659	Spectrum Analyzer	Rhode & Schwarz / FSP	973353	10/02/03	10/02/05
993	Horn antenna	A.H. Systems / SAS-200/571	XXX	08/01/05	08/01/07
1484	Cable 2.0-18.0 Ghz	Storm / PR90-010-072	N/A	09/18/05	09/18/06
1485	Cable 2.0-18.0 Ghz	Storm / PR90-010-216	N/A	09/18/05	09/18/06
1016	Pre-Amp	HEWLETT PACKARD / 8449A	2749A00159	11/12/04	11/12/05
791	PREAMP, 25dB	ICC / LNA25	398	11/12/04	11/12/05
760	Antenna biconical	Electro Metrics / MFC-25	477	01/23/05	01/23/06
759	ANTENNA, LOG PERIODIC	A.H. SYSTEMS / SAS-200/510	556	01/23/05	01/23/06
2071	Power Sensor	Agilent / E9304A	MY41495174	n/a	n/a
2072	Power Meter	HP / SAS-200/510	9/30/2005	03/12/04	09/30/06

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	1 MHz
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

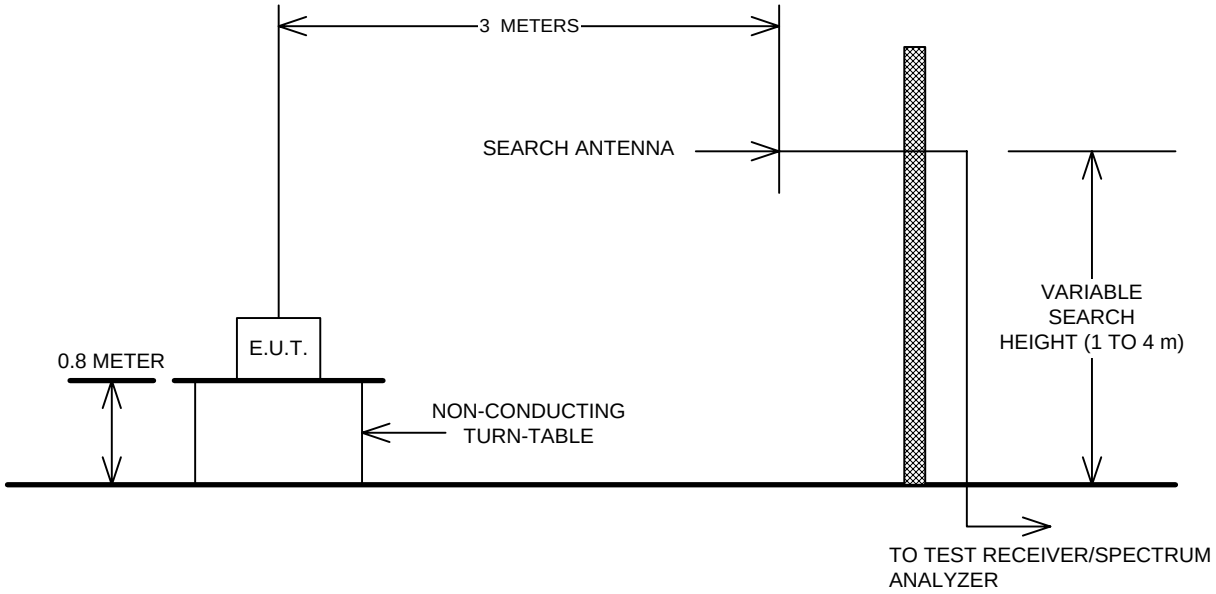
MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218	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:

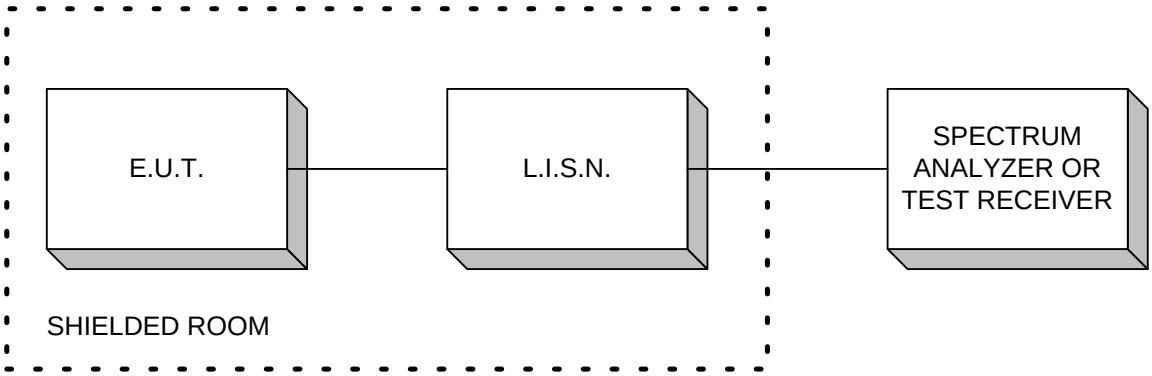
Tuning range	Number of channels tested	Channel location in band
1 MHz or less	1	middle
1 to 10 MHz	2	top and bottom
more than 10 MHz	3	top, middle, bottom

ANNEX B - TEST DIAGRAMS

Test Site For Radiated Emissions



Conducted Emissions



Peak Power At Antenna Terminals

A power meter can also be used instead of the Spectrum Analyzer