



**Nemko Test Report:** 5L0303RUS2rev1

**Applicant:** Heads Up Technologies  
2033 Chennault Drive  
Suite 100  
Carrollton, Texas 75006

**Equipment Under Test:  
(E.U.T.)** XMC050

**In Accordance With:** **FCC Part 15, Subpart C, 15.247**  
Frequency Hopping Transmitters

**Tested By:** Nemko Dallas Inc.  
802 N. Kealy  
Lewisville, Texas 75057-3136

**Authorized By:**   
Tom Tidwell, Frontline Group Manager

**Date:** February 26, 2006

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**Section 1. Summary of Test Results**

Manufacturer: Heads Up Technologies

Model No.: XMC050

Serial No.: 817000003

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 in 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**

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**Summary Of Test Data**

NAME OF TEST	PARA. NO.	SPEC.	RESULT
Powerline Conducted Emissions	15.207(a)	48 dB $\mu$ V	N/A*
Channel Separation	15.247(a)(1)	Greater of 25 kHz or 20 dB Bandwidth	Complies
Pseudorandom Hopping Algorithm	15.247(a)(1)		Complies
Time of Occupancy	15.247(a)(1)(ii)	$\leq 0.4$ sec in 30 sec	Complies
20 dB Occupied Bandwidth	15.247(a)(1)	$\leq 1$ 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

\*This device does not connect to the AC mains. It is battery powered with 4.5 Vdc.

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

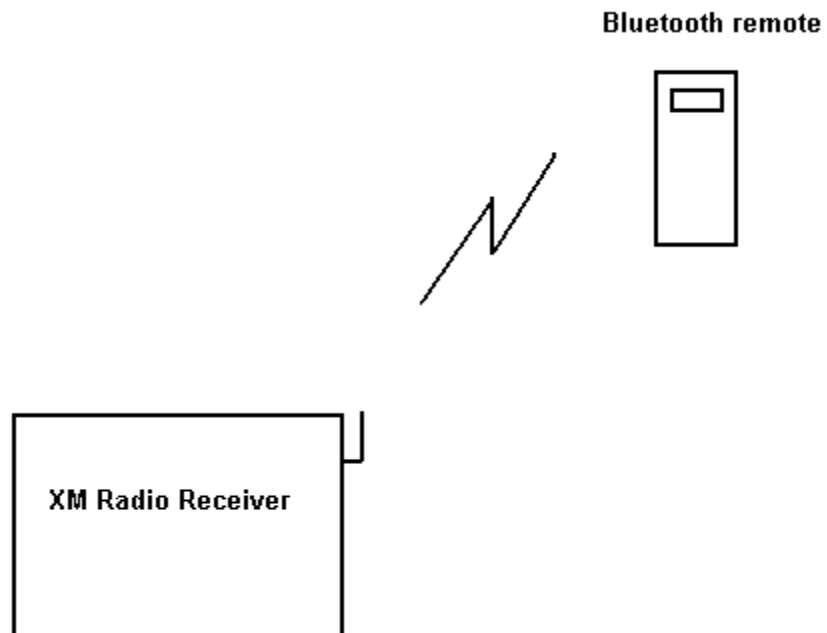
### **General Equipment Information**

<b>Frequency Band:</b>	<input type="checkbox"/> 902 – 928 MHz <input checked="" type="checkbox"/> 2400 – 2483.5 MHz (2402 to 2480 MHz)
<b>Number of Channels:</b>	79
<b>Channel Spacing:</b>	1 MHz
<b>Standard Test Voltage:</b>	4.5 Vdc
<b>User Frequency Adjustment:</b>	Software controlled

## **Description of EUT**

This is an XM Radio wireless remote controller used to communicate with Heads Up Technologies Bluetooth radio part numbers XMD076A, XMD075A or XMR050.

## **System Diagram**



**Section 3. Channel Separation**

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)
TESTED BY: David Light	DATE: 6/22/2005

**Test Results:** Complies.

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

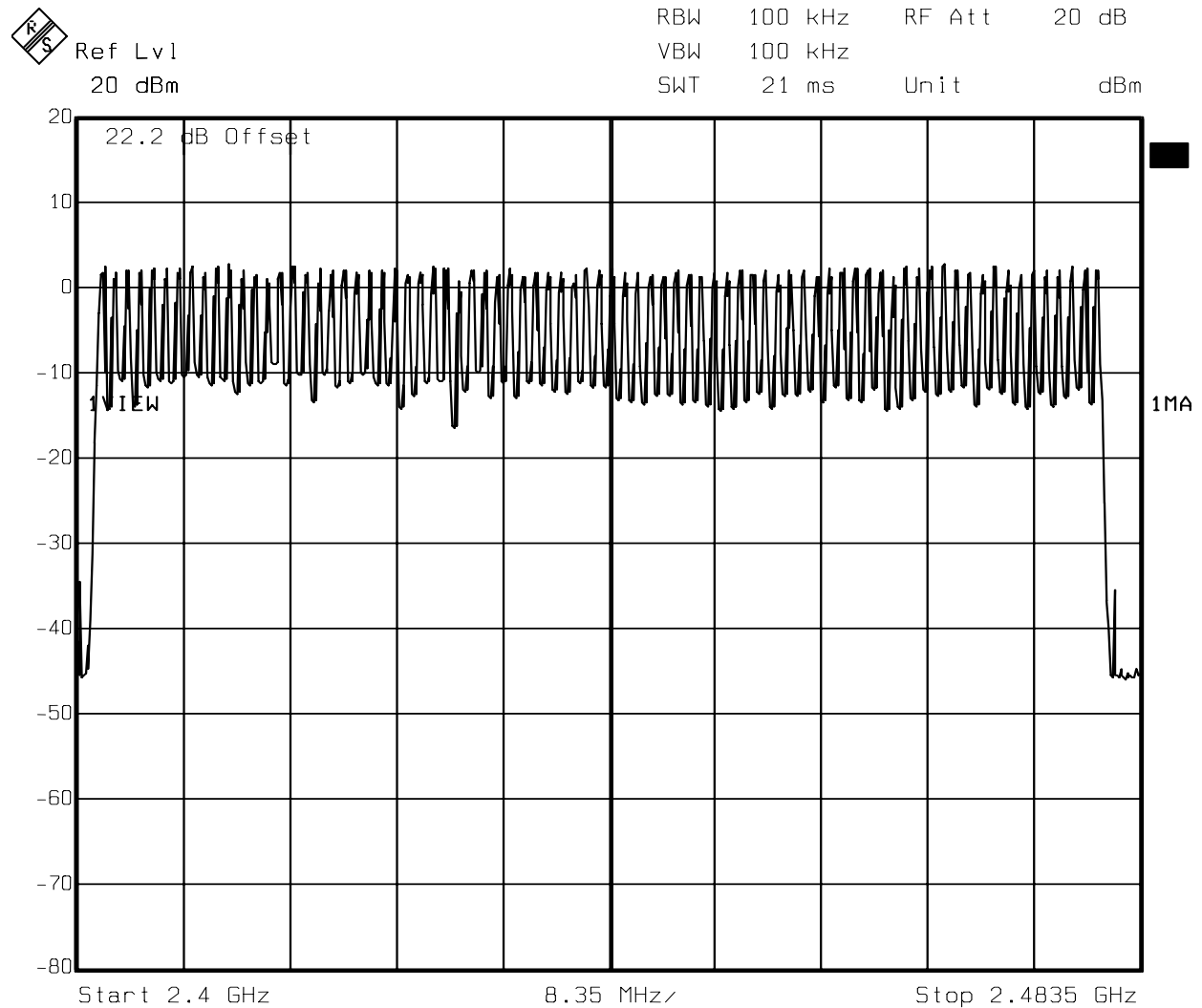
**Equipment Used:** 1036-1083-1470-1469

**Measurement Uncertainty:** +/-  $1 \times 10^{-7}$  ppm

**Temperature:** 25 °C

**Relative Humidity:** 65 %

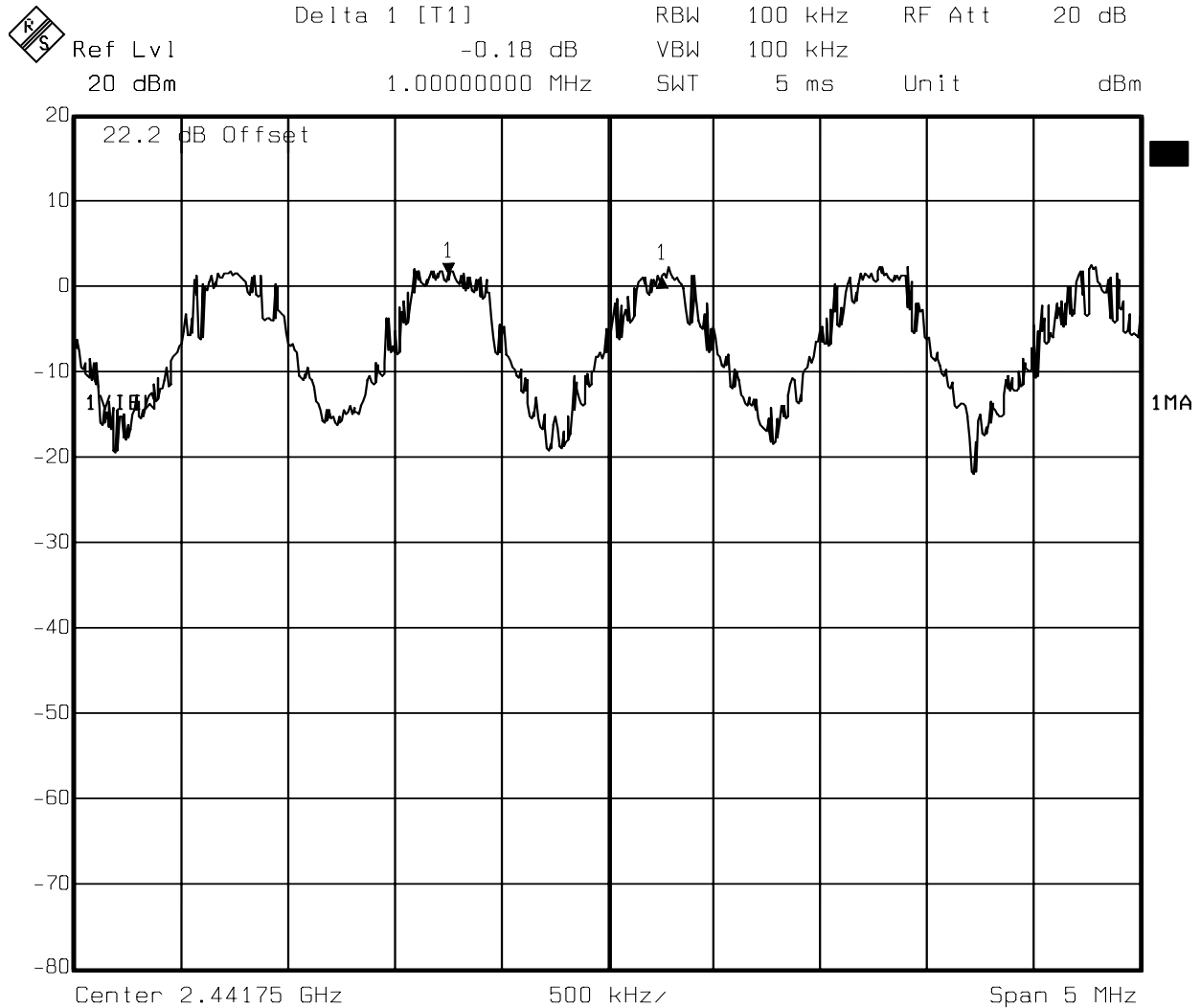
# Number of Channels



Date: 22.JUN.2005 08:38:46

79 Hopping Channels



**Channel Separation**

Date: 22.JUN.2005 08:43:32

Channel separation = 1 MHz

## **Section 4. Time of Occupancy**

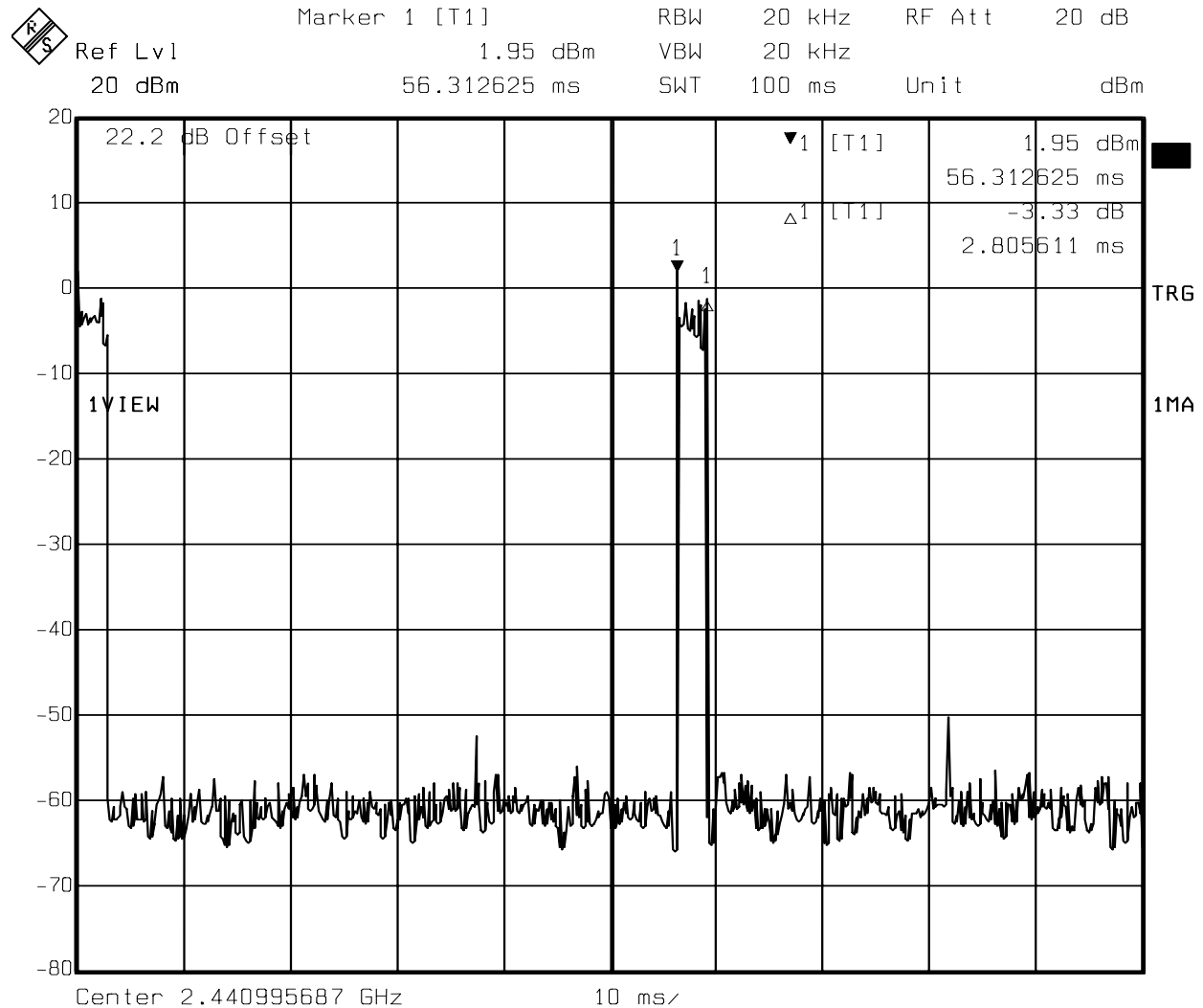
NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)
TESTED BY: David Light	DATE: 6/22/2005

**Test Results:** Complies.

**Measurement Data:**

Maximum Dwell Time On Any Channel: 5.6 mS/100 mS  
235 mS/32 seconds

## Time of Occupancy



Date: 22.JUN.2005 08:48:54

2.8 mS per pulse x 2 = 5.6 mS

Duty cycle correction =  $20 \log (5.6/100) = -25.0 \text{ dB}$

**Dwell Time**

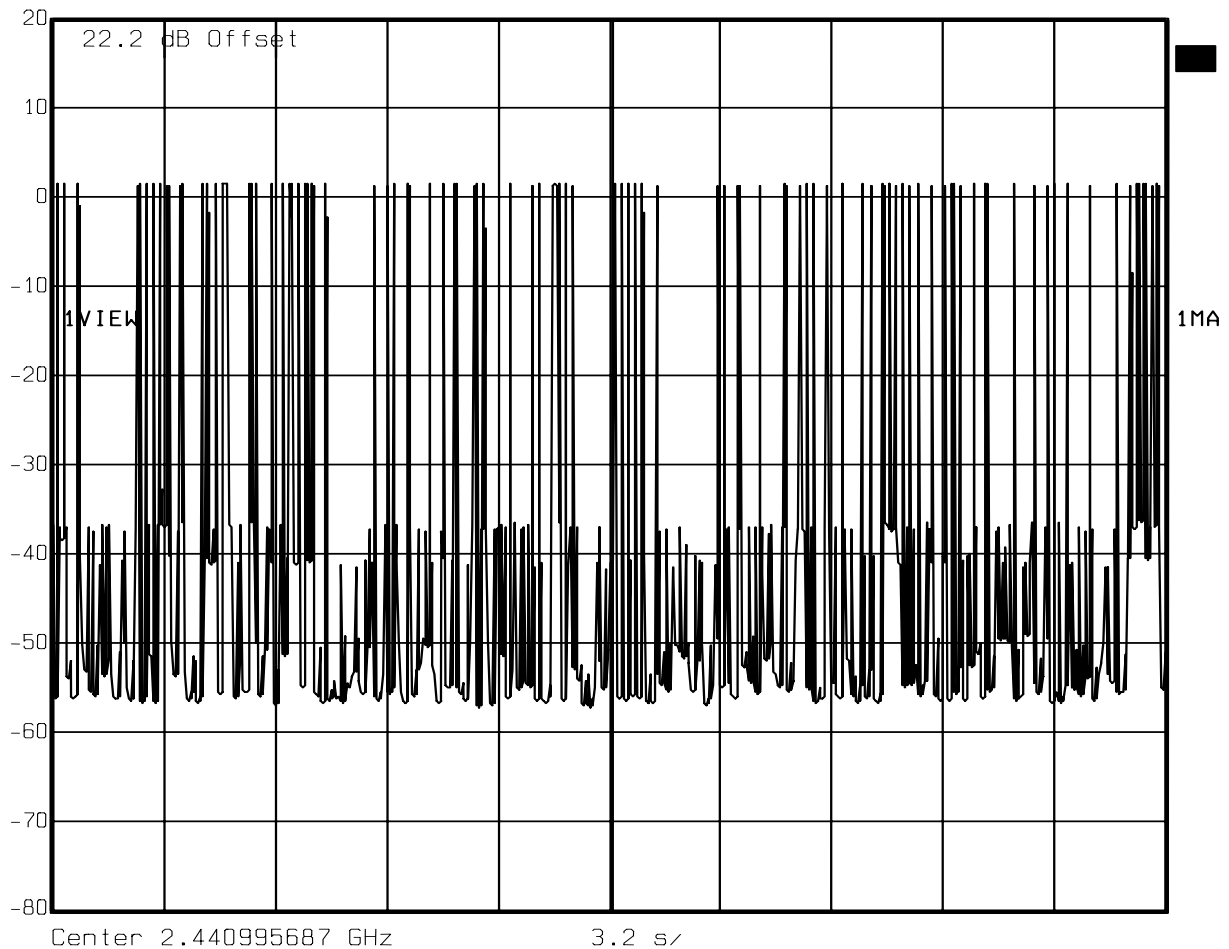
Ref Lvl

20 dBm

RBW 20 kHz RF Att 20 dB

VBW 20 kHz

SWT 32 s Unit dBm



Date: 22.JUN.2005 08:54:56

Dwell time = 84 hops within 32 seconds at 2.8 mS per pulse = 235.2 mS within allotted time

## Section 5. Occupied Bandwidth

NAME OF TEST: Occupied Bandwidth	PARA. NO.: 15.247(a)(1)(i)
TESTED BY: David Light	DATE: 6/22/2005

**Test Results:** Complies.

**Measurement Data:** See attached plots.

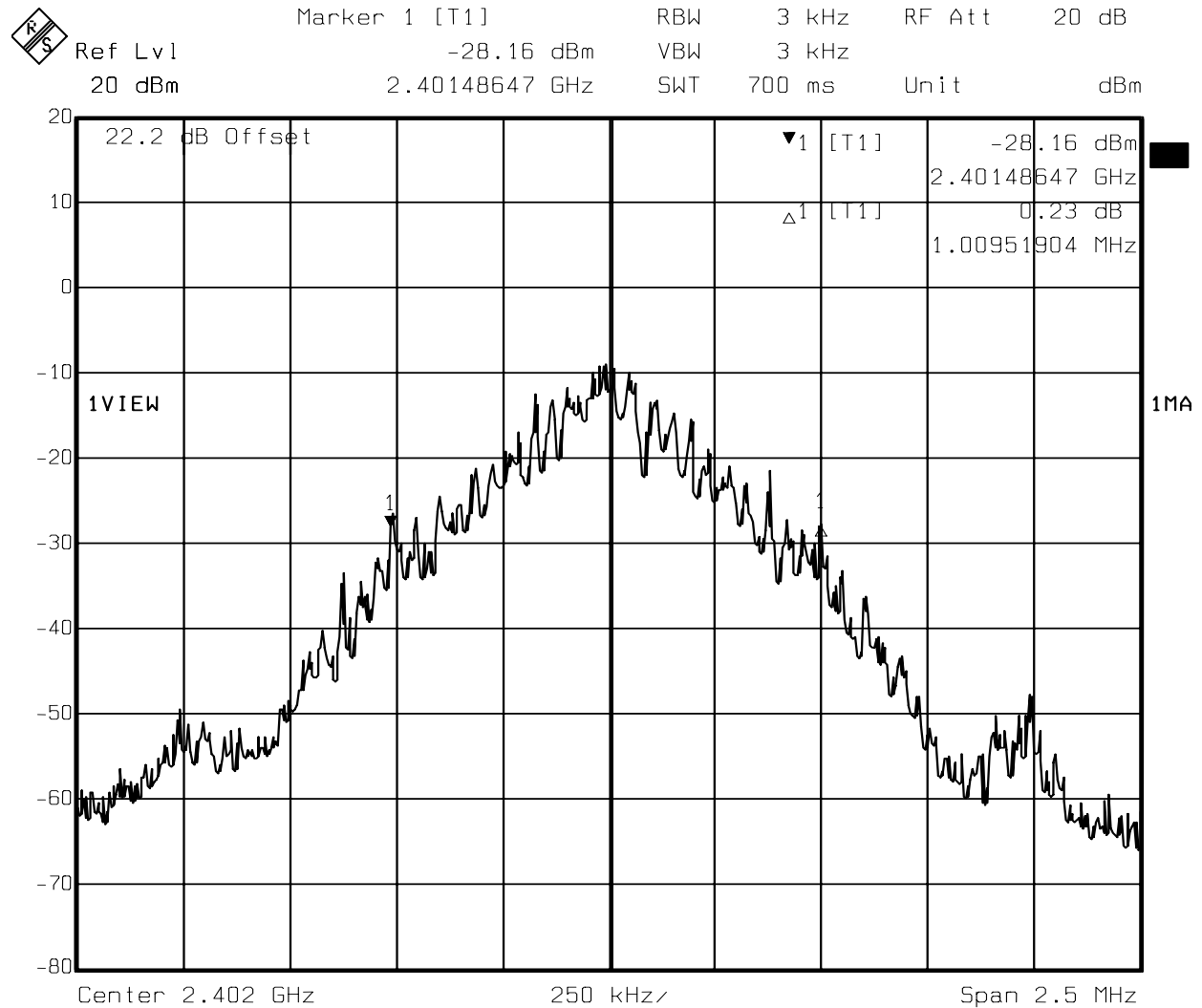
**Equipment Used:** 1036-1083-1470-1469

**Measurement Uncertainty:** +/-  $1 \times 10^{-7}$  ppm

**Temperature:** 23 °C

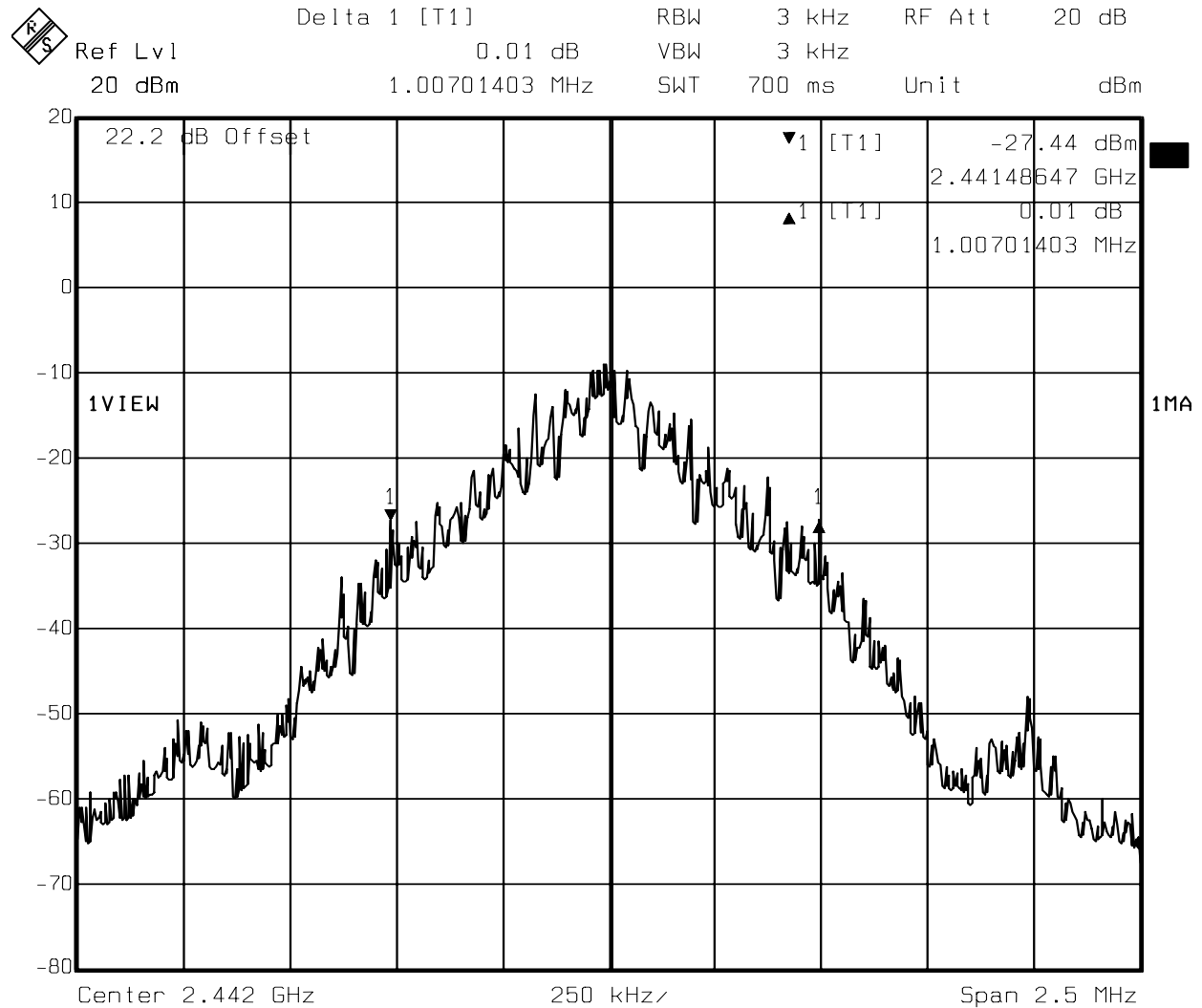
**Relative Humidity:** 60 %

## Low Channel



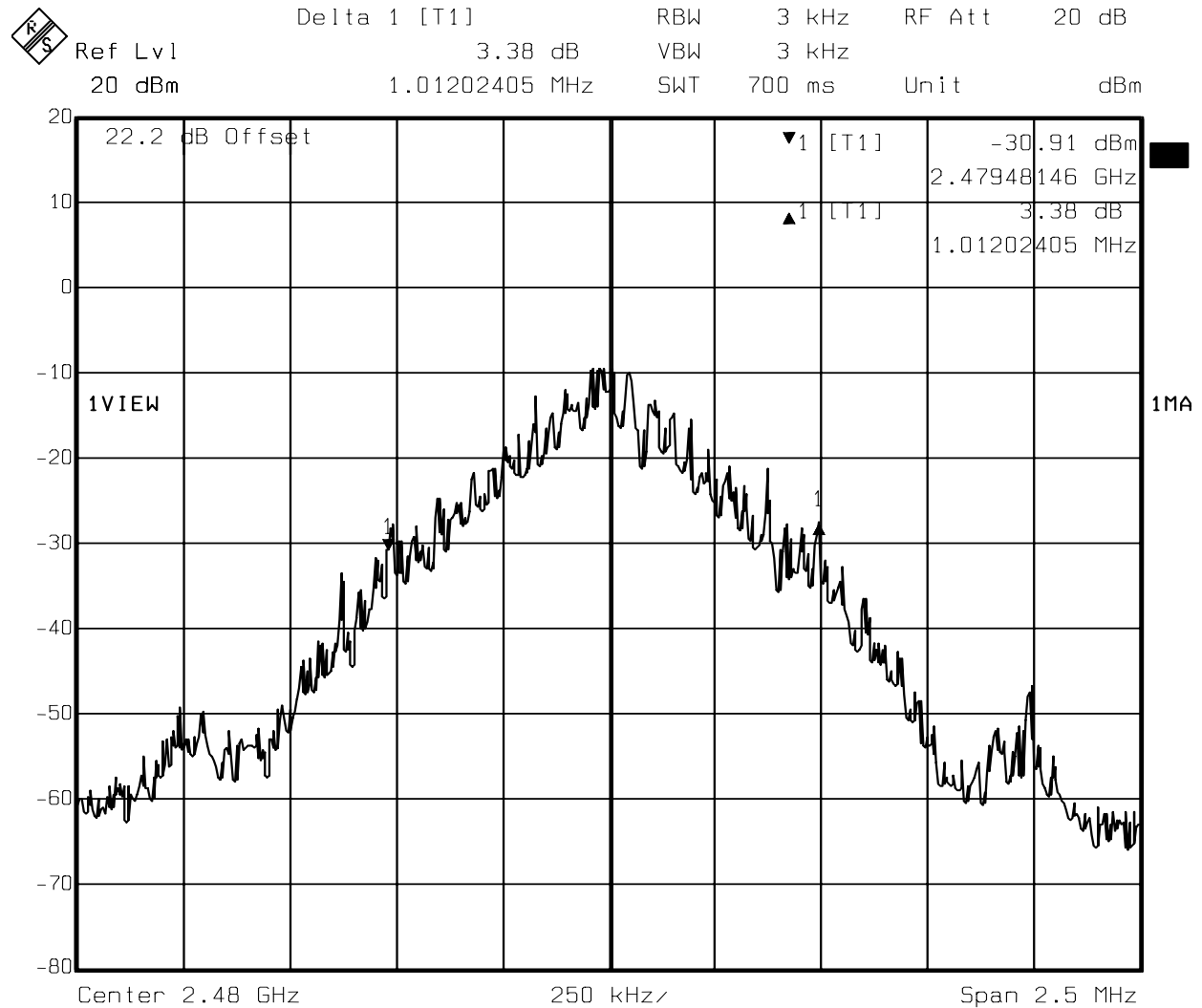
Date: 22.JUN.2005 09:01:21

# Mid Channel



Date: 22.JUN.2005 09:10:36

## High Channel



Date: 22.JUN.2005 09:16:07



**Section 6. Peak Power Output**

NAME OF TEST: Peak Power Output	PARA. NO.: 15.247 (b)
TESTED BY: David Light	DATE: 6/22/2005

**Test Results:** Complies.

**Measurement Data:** See attached plots.  
Detachable antenna? ☐ Yes ☒ No  
Conducted data was obtained from Heads Up's XM radio model  
XMD076A (FCC ID: TGVXMSC63). This is the same radio contained  
in XM remote except it has SMA antenna connection.

Model	Type	Manufacturer	Gain (dBi)	E.I.R.P. (dBm)
A5645	Dipole	GigaAnt	2	5
Peak power output at antenna port(dBm): 3 dBm				

The device was tested using 3 new AAA batteries.

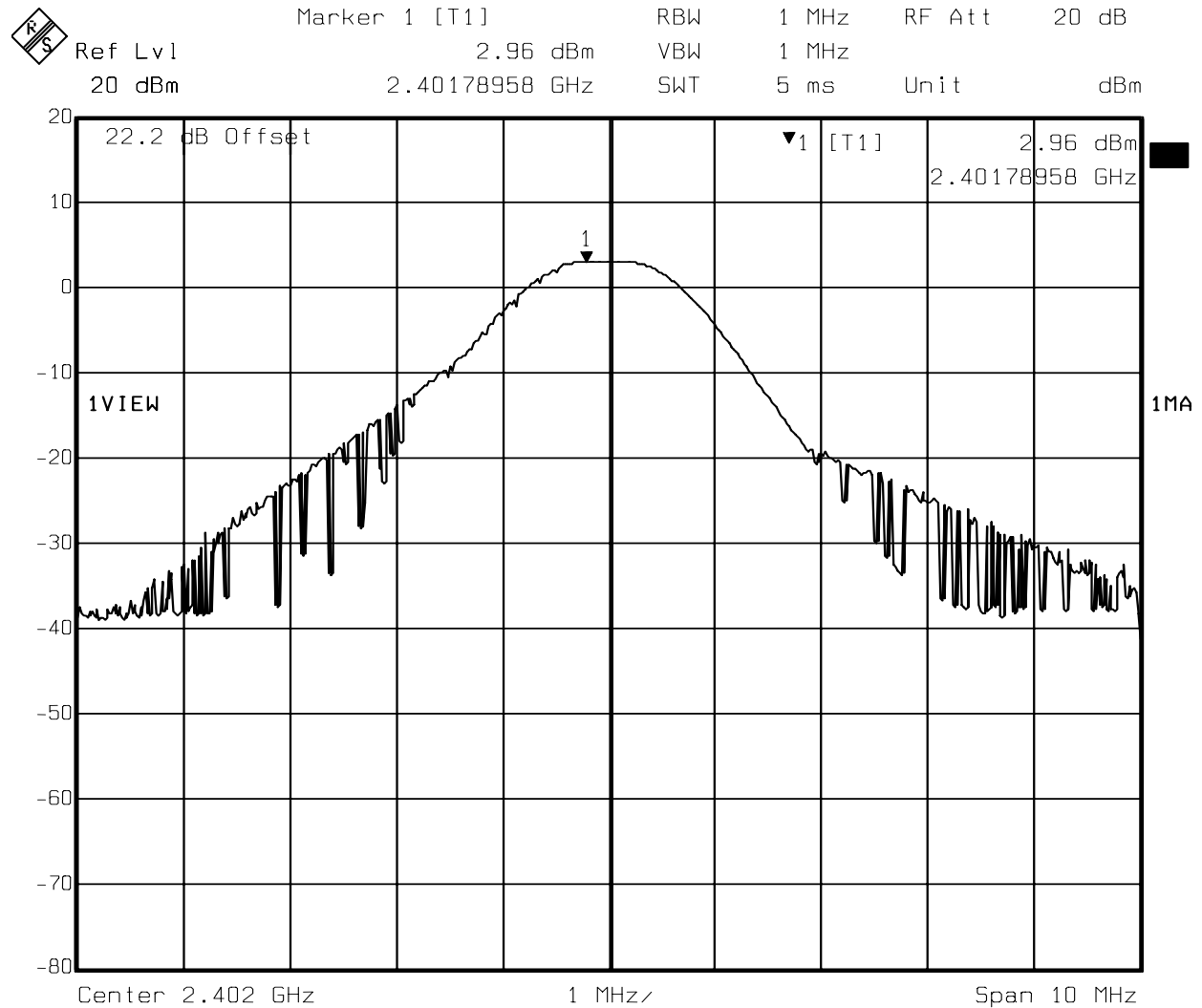
**Equipment Used:** 1036-1083-1470-1469

**Measurement Uncertainty:** +/- 1.7 dB

**Temperature:** 23 °C

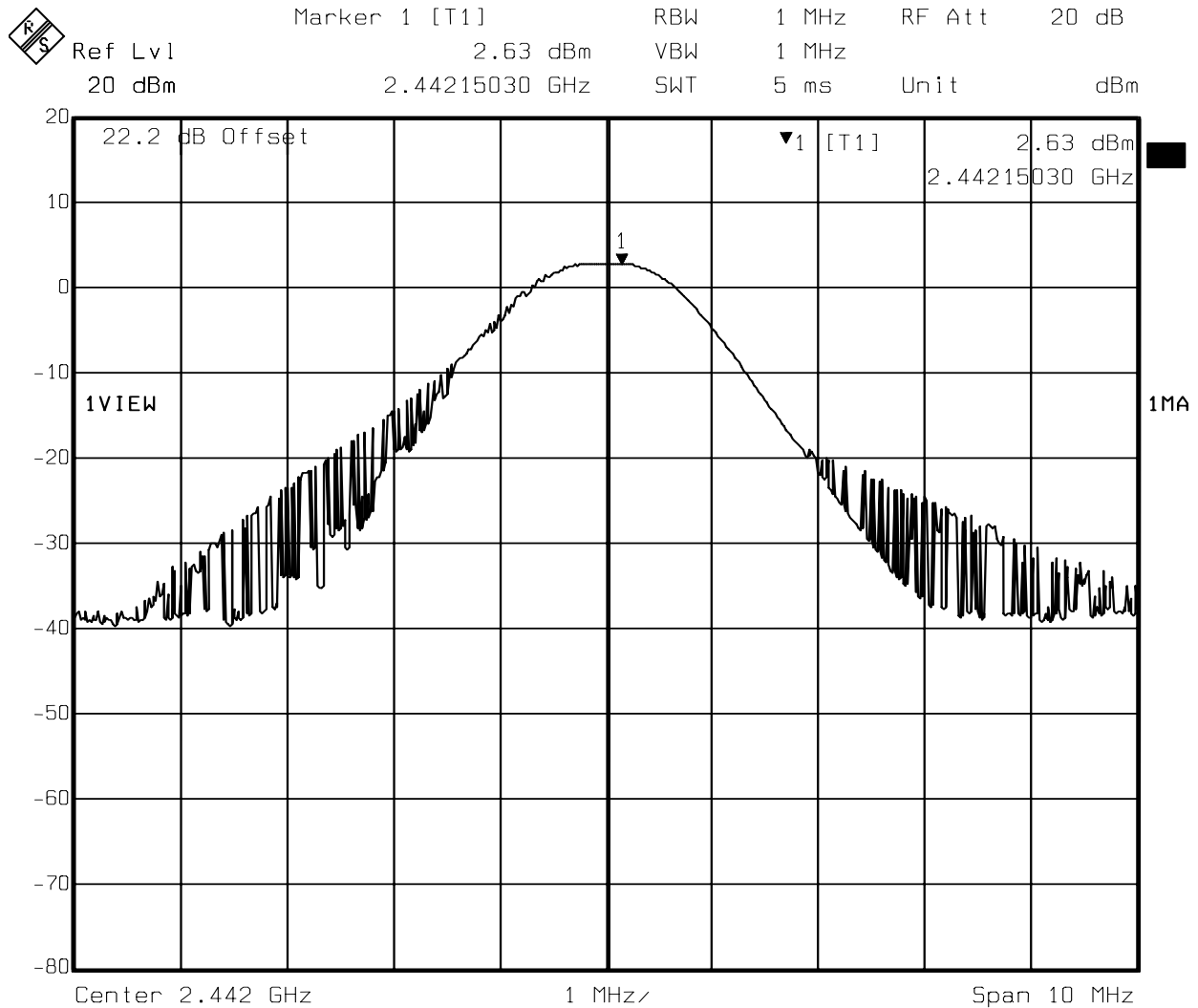
**Relative Humidity:** 60 %

## Low Channel



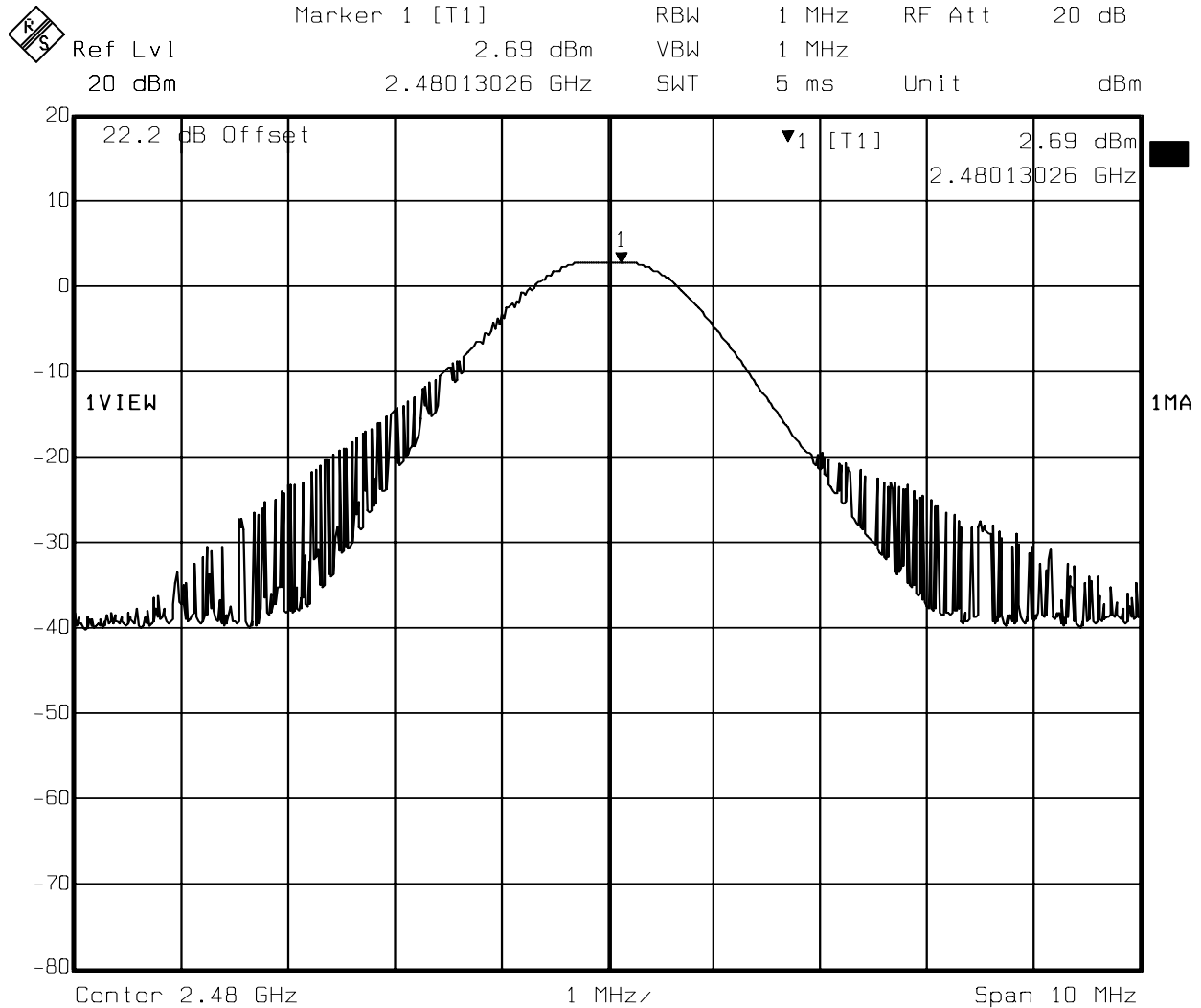
Date: 22.JUN.2005 09:03:47

## Mid Channel



Date: 22.JUN.2005 09:11:47

## High Channel



Date: 22.JUN.2005 09:17:01

**Section 7. Spurious Emissions (Antenna Conducted)**

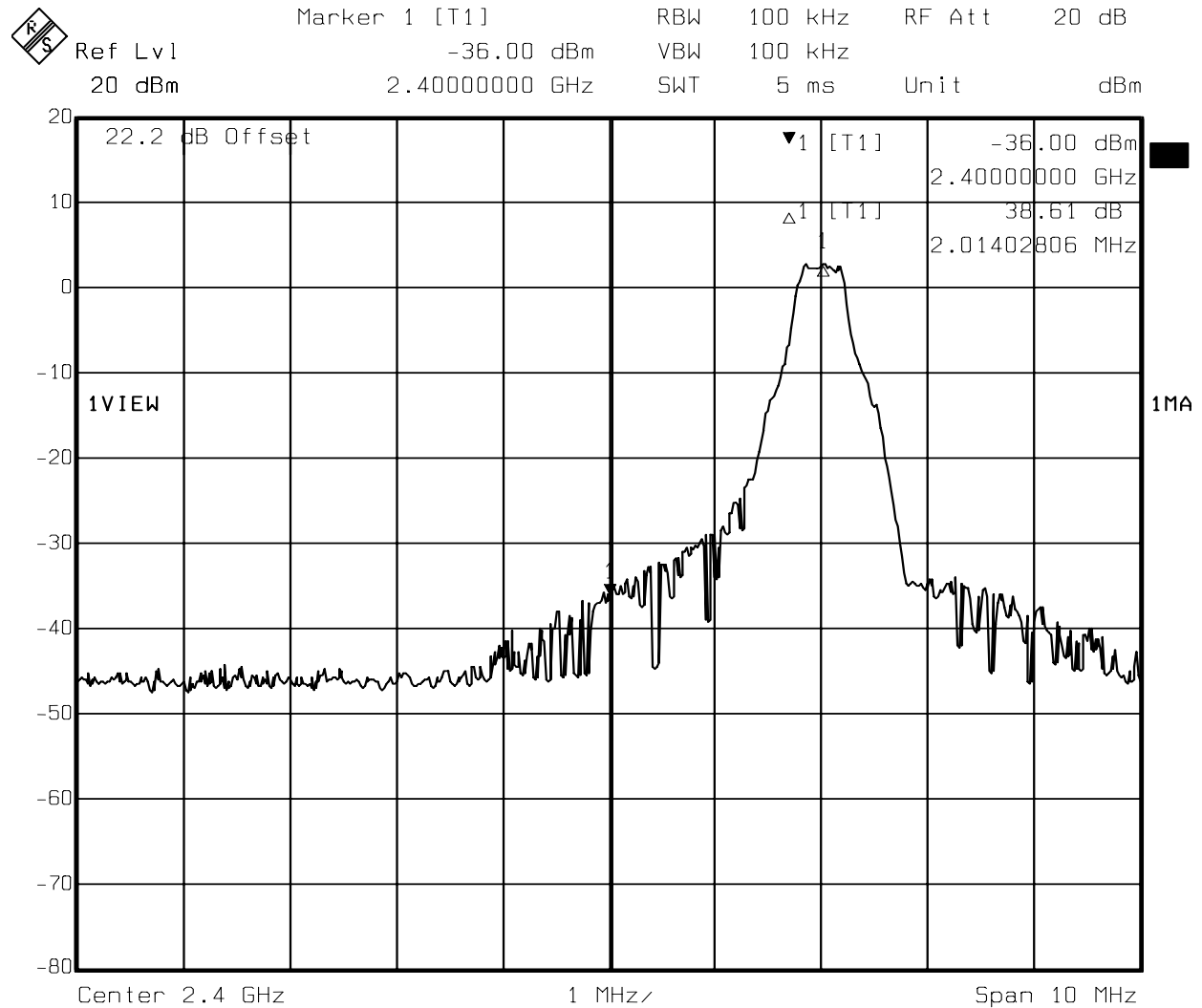
NAME OF TEST: Spurious Emissions (Antenna Conducted)	PARA. NO.: 15.247(c)
TESTED BY: David Light	DATE: 6/22/2005

**Test Results:** Complies.

Conducted data was obtained from Heads Up's XM radio model XMD076A. This is the same radio contained in XM remote except it has SMA antenna connection.

**Measurement Data:** See attached plots.**Equipment Used:** 1036-1083-1470-1469**Measurement Uncertainty:** +/- 1.7 dB**Temperature:** 23 °C**Relative Humidity:** 60 %

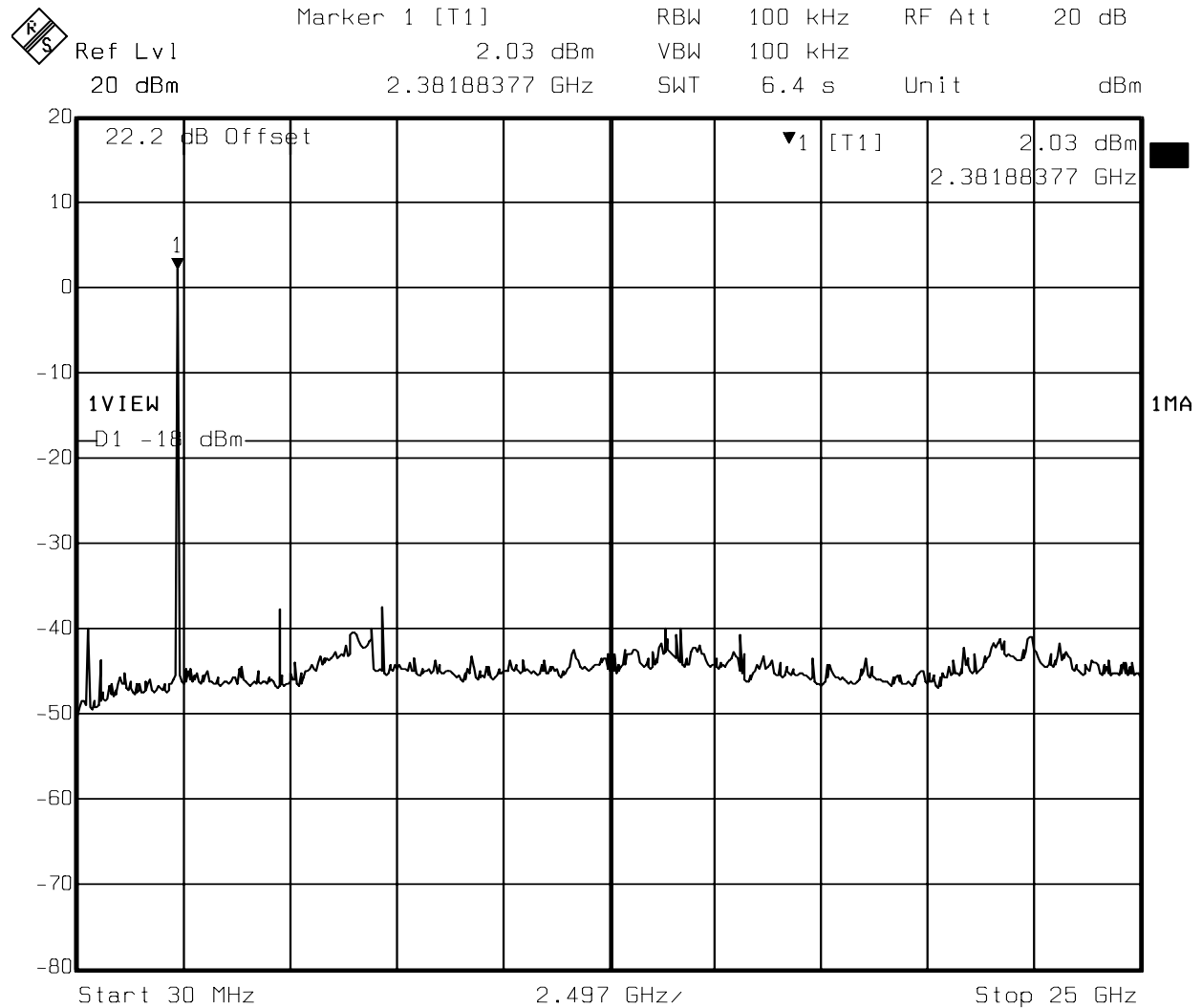
## Low Channel



Date: 22.JUN.2005 09:05:40

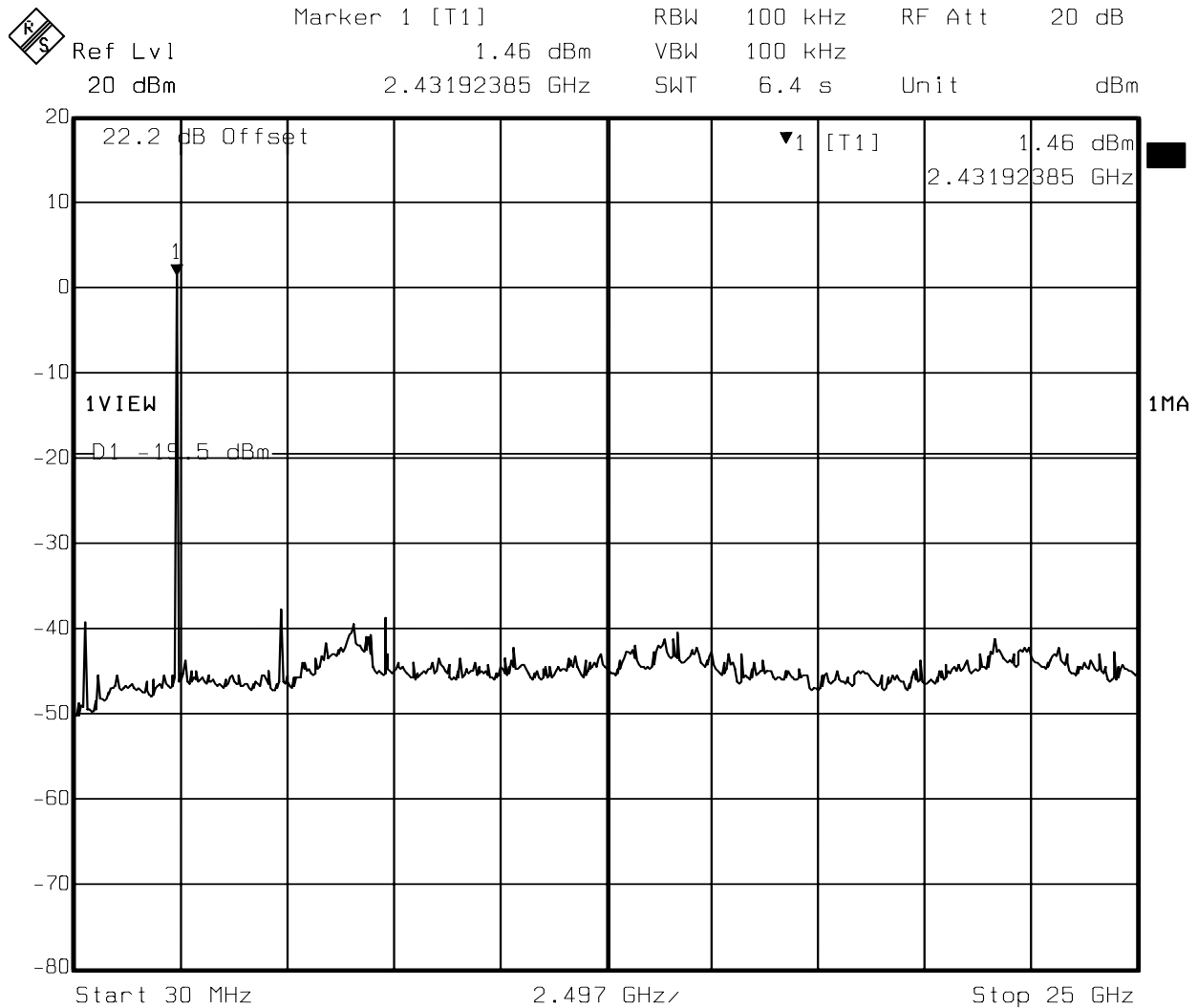
## Lower Band Edge

## Low Channel



Date: 22.JUN.2005 09:06:58

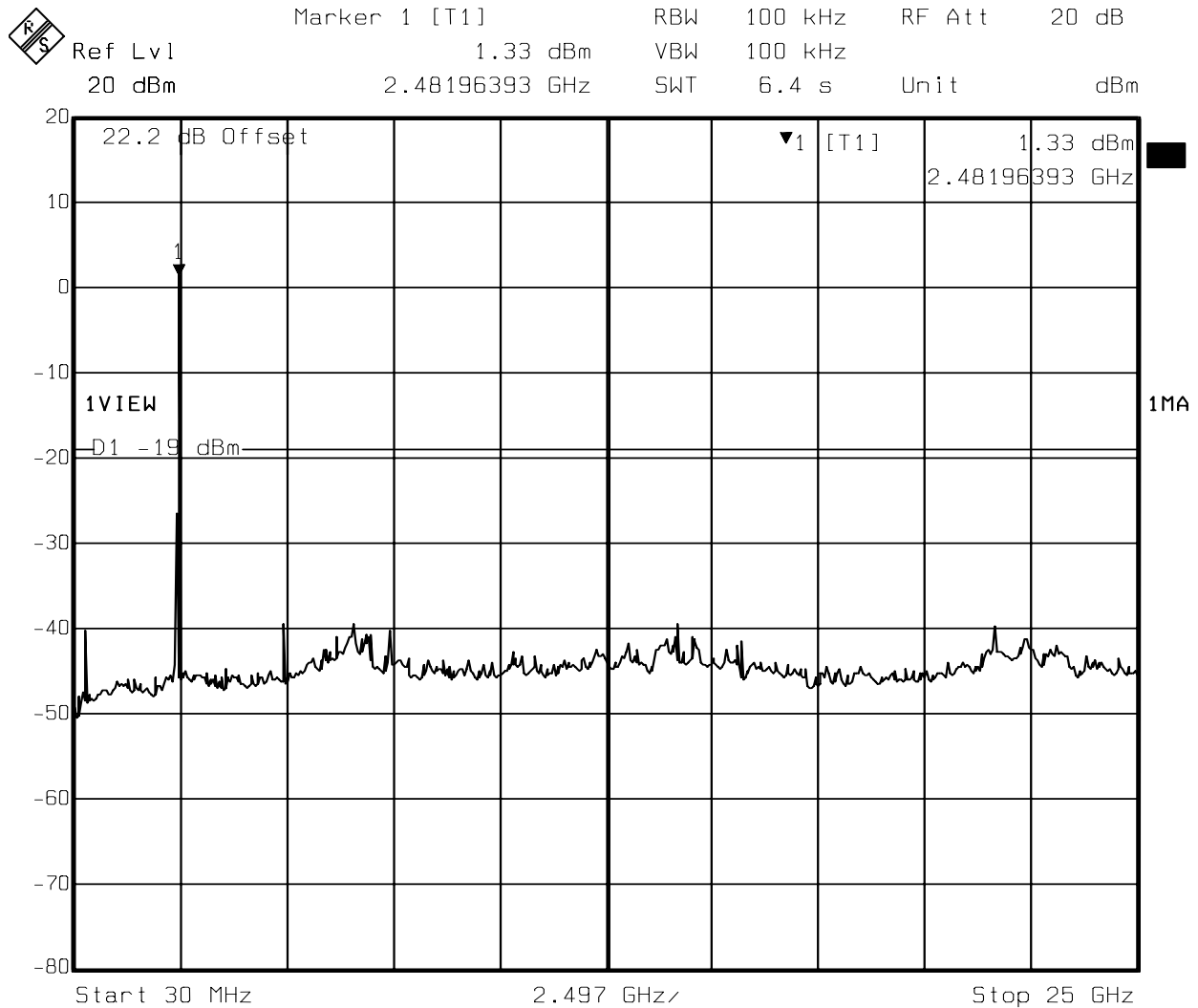
## Mid Channel



Date: 22.JUN.2005 09:13:40



## High Channel



Date: 22.JUN.2005 09:19:13

**Section 8. Spurious Emissions (Radiated)**

NAME OF TEST: Spurious Emissions (Radiated)	PARA. NO.: 15.247(c)
TESTED BY: David Light	DATE: 6/22/2005

**Test Results:** Complies.

**Measurement Data:** See attached table.

**Duty Cycle Calculation:**

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

$20 \log (5.6/100) = 25$  (Refer to plot in section 3)

**Equipment Used:** 1464-1484-1485-1304-1016-759-760-791

**Measurement Uncertainty:** +/- 3.6 dB

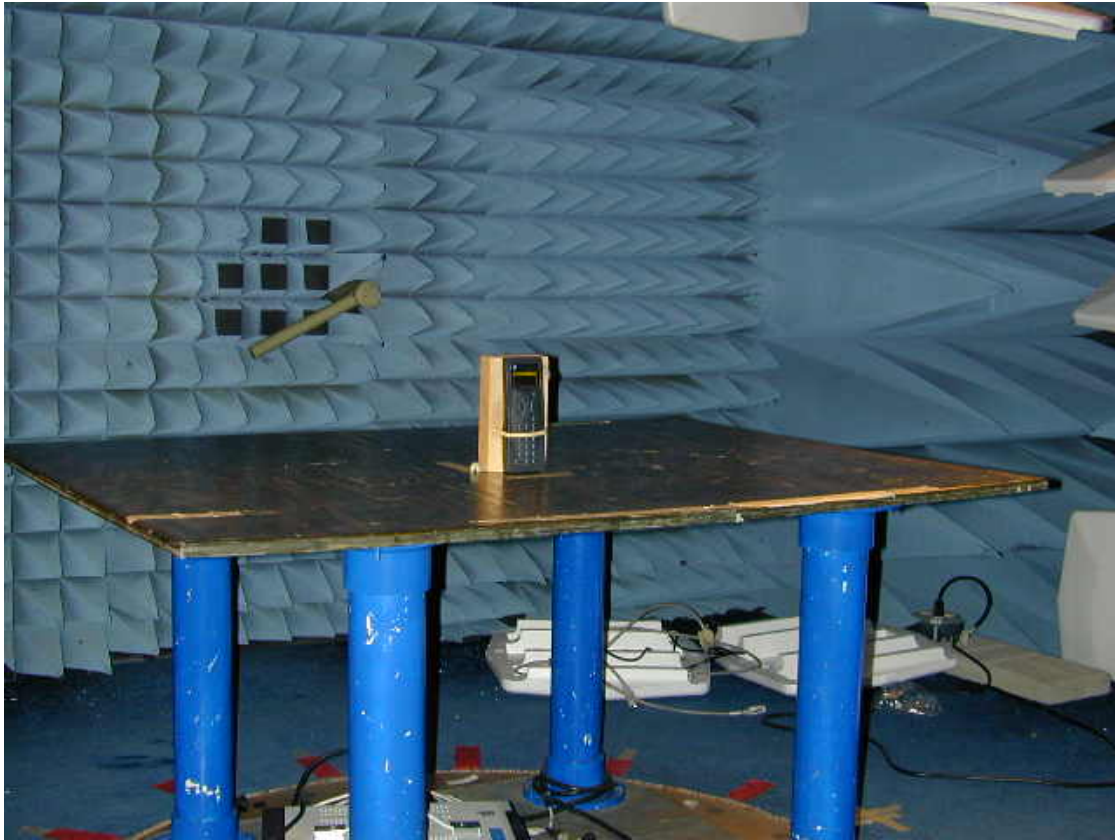
**Temperature:** 25 °C

**Relative Humidity:** 65 %

## Test Data - Radiated Emissions

Radiated Emissions								
Page 1 of 1								
Job No.: 5L0303		Date: 6/22/2005						
Specification: 15.247/15.205		Temperature(°C): 23						
Tested By: David Light		Relative Humidity(%) 60						
E.U.T.: Bluetooth radio - Remote control unit								
Configuration: Tx continuous wave at Highest, Lowest and mid band								
Sample Number: 1								
Location: AC 3		RBW: 1 MHz						
Detector Type: Peak		Peak VBW: 1 MHz						
		Average VBW 1 kHz						
Test Equipment Used								
Antenna: 1304		Directional Coupler: #N/A						
Pre-Amp: 1016		Cable #1: 1484						
Filter: #N/A		Cable #2: 1485						
Receiver: 1464		Cable #3: #N/A						
Attenuator #1: #N/A		Cable #4: #N/A						
Attenuator #2: #N/A		Mixer: #N/A						
Measurement Uncertainty: +/- 3.6 dB								
Frequency (MHz)	Meter Reading (dBuV)	Antenna Factor (dB)	Cable Loss (dB)	Pre-Amp Gain (dB)	Corrected Reading (dBuV/m)	Peak Limit (dBuV/m)	Average Limit (dBuV/m)	Detector / Polarity
								Tx High
2483.5	49.0	28.2	3.1	28.2	52.1	74		P/V
2483.5	24.0	28.2	3.1	28.2	27.1		54	A/V
4960.0	51.5	33.8	4.3	32.6	57.0		54	P/V
4960.0	26.5	33.8	4.3	32.6	32.0			A/V
7440.5	48.8	36.2	5.3	32.5	57.8		54	P/V
7440.5	23.8	36.2	5.3	32.5	32.8			A/V
2483.5	52.8	28.2	3.1	28.2	55.9	74		P/H
2483.5	27.8	28.2	3.1	28.2	30.9		54	A/H
4960.0	57.0	33.8	4.3	32.6	62.5			P/H
4960.0	32.0	33.8	4.3	32.6	37.5			A/H
7440.5	57.2	36.2	5.3	32.5	66.2			P/H
7440.5	32.2	36.2	5.3	32.5	41.2			A/H
								Tx Mid
4884.0	53.7	33.8	4.3	32.6	59.2	74		P/V
4884.0	28.7	33.8	4.3	32.6	34.2		54	A/V
7326.0	47.2	36.2	5.3	32.5	56.2	74		P/V
7326.0	22.2	36.2	5.3	32.5	31.2		54	A/V
4884.0	54.5	33.8	4.3	32.6	60.0	74		P/H
4884.0	29.5	33.8	4.3	32.6	35.0		54	AH
7326.0	52.2	36.2	5.3	32.5	61.2	74		P/H
7326.0	27.2	36.2	5.3	32.5	36.2		54	AH
								Tx Low
4804.0	56.5	33.8	4.3	32.6	62.0	74		P/H
4804.0	31.5	33.8	4.3	32.6	37.0		54	AH
7206.0	53.5	36.2	5.3	32.5	62.5	74		P/H
7206.0	28.5	36.2	5.3	32.5	37.5		54	A/H
4804.0	54.3	33.8	4.3	32.6	59.8	74		P/V
4804.0	29.3	33.8	4.3	32.6	34.8		54	A/V
7206.0	47.2	36.2	5.3	32.5	56.2	74		P/V
7206.0	22.2	36.2	5.3	32.5	31.2		54	A/V
Note: The spectrum was searched from 30 MHz to 25 GHz. All emissions are reported.								
The unit was tested on three axis' with upright on end being worse case.								
Average measurements were made using 1 kHz VBW and applying -25 dB duty cycle correction								

**Radiated Photographs**



## Section 9. Test Equipment List

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1484	Cable 2.0-18.0 Ghz	Storm PR90-010-072	N/A	08/26/04	08/26/05
1485	Cable 2.0-18.0 Ghz	Storm PR90-010-216	N/A	08/02/04	08/02/05
1464	Spectrum analyzer	Hewlett Packard 8563E	3551A04428	01/14/05	01/15/07
1304	HORN ANTENNA	ELECTRO METRICS RGA-60	6151	09/22/03	09/22/05
1016	Pre-Amp	HEWLETT PACKARD 8449A	2749A00159	11/12/04	11/12/05
759	ANTENNA, LOG PERIODIC	A.H. SYSTEMS SAS-200/510	556	07/23/04	07/23/05
760	Antenna biconical	Electro Metrics MFC-25	477	06/22/04	06/22/05
791	PREAMP, 25dB	ICC LNA25	398	11/12/04	11/12/05
1036	SPECTRUM ANALYZER	ROHDE & SCHWARZ FSEK30	830844/006	03/22/04	03/23/06
1469	10 db Attenuator DC 18 Ghz	MCL Inc. BW-S10W2 10db-2WDC	NONE	CBU	N/A
1470	10 db Attenuator DC 18 Ghz	MCL Inc. BW-S10W2 10db-2WDC	NONE	CBU	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: Pseudorandom Hopping Algorithm	PARA. NO.: 15.247(a)(1)
--	-------------------------

**Minimum Standard:**

The system shall hop to channel frequencies that are selected from a pseudorandomly ordered list of hopping frequencies. Each frequency must be used equally on average by each transmitter. The system receivers shall have input bandwidths that match the hopping channel bandwidths of their transmitters and shall shift frequencies in synchronization with the transmitted signals.



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:

$(30 \text{ sec.} / .001 \text{ sec.}) / 75 \text{ chan.} = 400 \times 1 \text{ msec.} = 400 \text{ msec. or } 0.4 \text{ sec. in } 30 \text{ sec.}$

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)
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**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 ( $\mu\text{V/m}$ @ 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:**UUUU30 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: &gt;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  $\Delta$ : Peak of highest spurious level below center frequency.Upper Band Edge

RBW: At least 1% of span/div.

VBW: &gt;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  $\Delta$ : 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 ( $\mu\text{V/m}$ @ 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

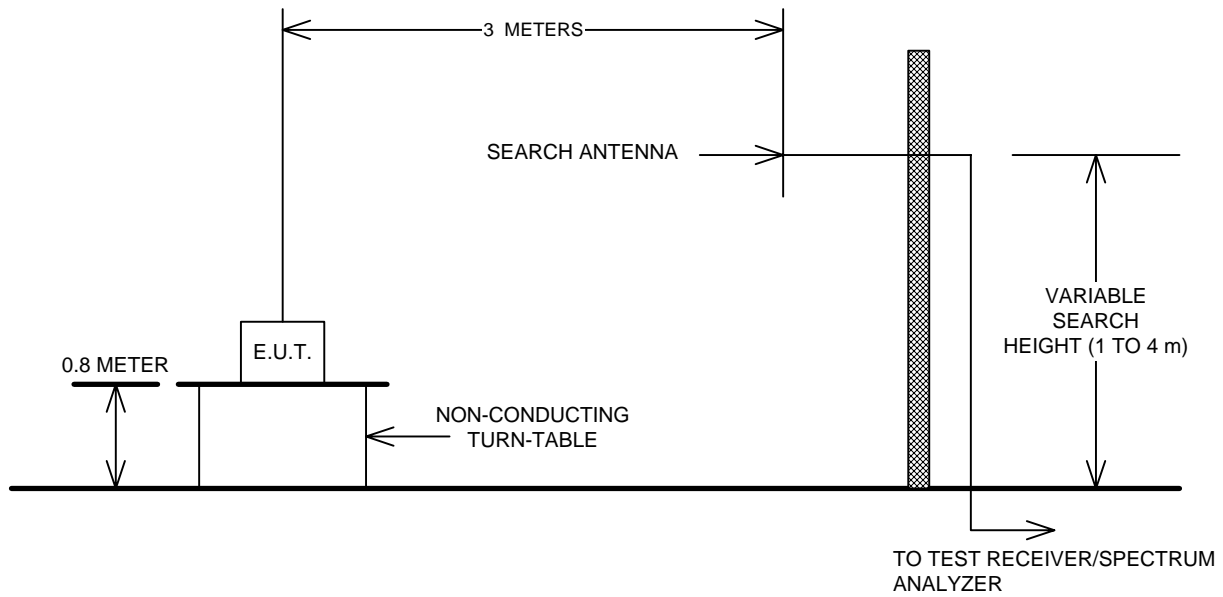
MHz	MHz	MHz	GHz
0.09-0.11	16.42-16.423	399.9-410	4.5-5.25
0.495-0.505	16.69475-16.69525	608-614	5.35-5.46
2.1735-2.1905	16.80425-16.80475	960-1240	7.25-7.75
4.125-4.128	25.5-25.67	1300-1427	8.025-8.5
4.17725-4.17775	37.5-38.25	1435-1626.5	9.0-9.2
4.20725-4.20775	73-74.6	1645.5-1646.5	9.3-9.5
6.125-6.218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





**Peak Power At Antenna Terminals**

