



**Nemko Test Report:** 11677RUS1rev1

**Applicant:** Banner Engineering Corp.  
9714 10<sup>th</sup> Avenue North  
Minneapolis, MN 55441  
USA

**Equipment Under Test:  
(E.U.T.)** DX80 2.4GHz

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

**FCC Identifier:** UE300dx80-2400

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

**TESTED BY:**

A handwritten signature in black ink, appearing to read 'David Light'.

David Light, Wireless Engineer

**DATE:** 16 June, 2008

**APPROVED BY:**

A handwritten signature in black ink, appearing to read 'Michael Cantwell'.

Mike Cantwell, Frontline Manager

**DATE:** 18 June, 2008

**Total Number of Pages:** 23

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**Section 1. Summary of Test Results**

Manufacturer: Banner Engineering Corp.

Model No.: DX80 2.4GHz

Serial No.: 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 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. NONE

See " Summary of Test Data".



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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	NA
Channel Separation	15.247(a)(1)	Greater of 25 kHz or 20 dB Bandwidth	Complies
Time of Occupancy	15.247(a)(1)(ii)	$\leq$ 0.4 sec in 20 sec	Complies
20 dB Occupied Bandwidth	15.247(a)(1)	$\leq$ 1 MHz	Complies
Peak Power Output	15.247(b)	1 Watt	NA
Spurious Emissions (Antenna Conducted)	15.247(c)	-20 dBc	NA
Spurious Emissions (Radiated)	15.247(c)	Table 15.209(a)	NA

**Footnotes:**

Reason for Class II change:

- 1) Reduce the FHSS time slot boundaries from 7.8 mS per slot to as slow as 1.9 mS per slot, while leaving the maximum ON time unchanged at 1.2 mS.
- 2) Reduce the ON time to 0.5 or 0.33 mS, with time slot boundaries to as low as 0.64 mS.
- 3) Reduce the number of channels to (as few as) the minimum number required by FCC Part 15.247(a)(1)(iii), or 15 channels. These 15 channels would be a subset of the existing 27 channels. They may or may not be the 15 lowest channels of the existing 27, though that is how they were chosen for the test sample.
- 4) Increase the number of consecutive Tx's on a single frequency from the present one (hop every Tx event) to as many as eight (eight short burst transmissions and then a channel hop.)

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

### **General Equipment Information**

**Frequency Band:**  902 – 928 MHz  
 2400 – 2483.5 MHz

**Frequency Range of Sample:** 2401 to 2482 MHz

**Number of Channels:** 15 to 27

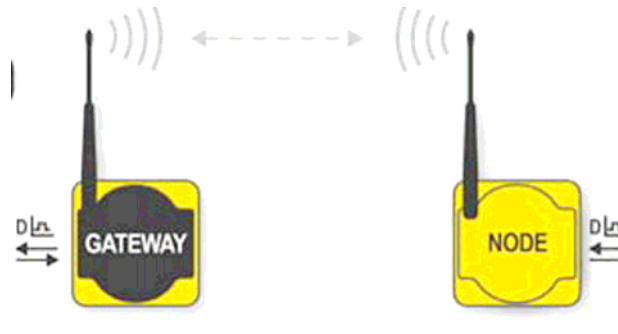
**Channel Spacing:** 3 MHz

**User Frequency Adjustment:** Software controlled

**Description of EUT**

Frequency hopping spread spectrum transceiver used to monitor industrial sensors and controls.

**System Diagram**



**Section 3. Channel Requirements**

NAME OF TEST: Channel Separation	PARA. NO.: 15.247(a)(1)(iii)
TESTED BY: David Light	DATE: 16 June 2008

**Test Results:** Complies.

**Measurement Data:** See 20 dB BW plot

Measured 20 dB bandwidth: 5.61 kHz max  
Channel Separation: 3 MHz

**Equipment Used:** 1659-1082-1472

**Measurement Uncertainty:** +/- 1x10<sup>-7</sup> ppm

**Temperature:** 22°C

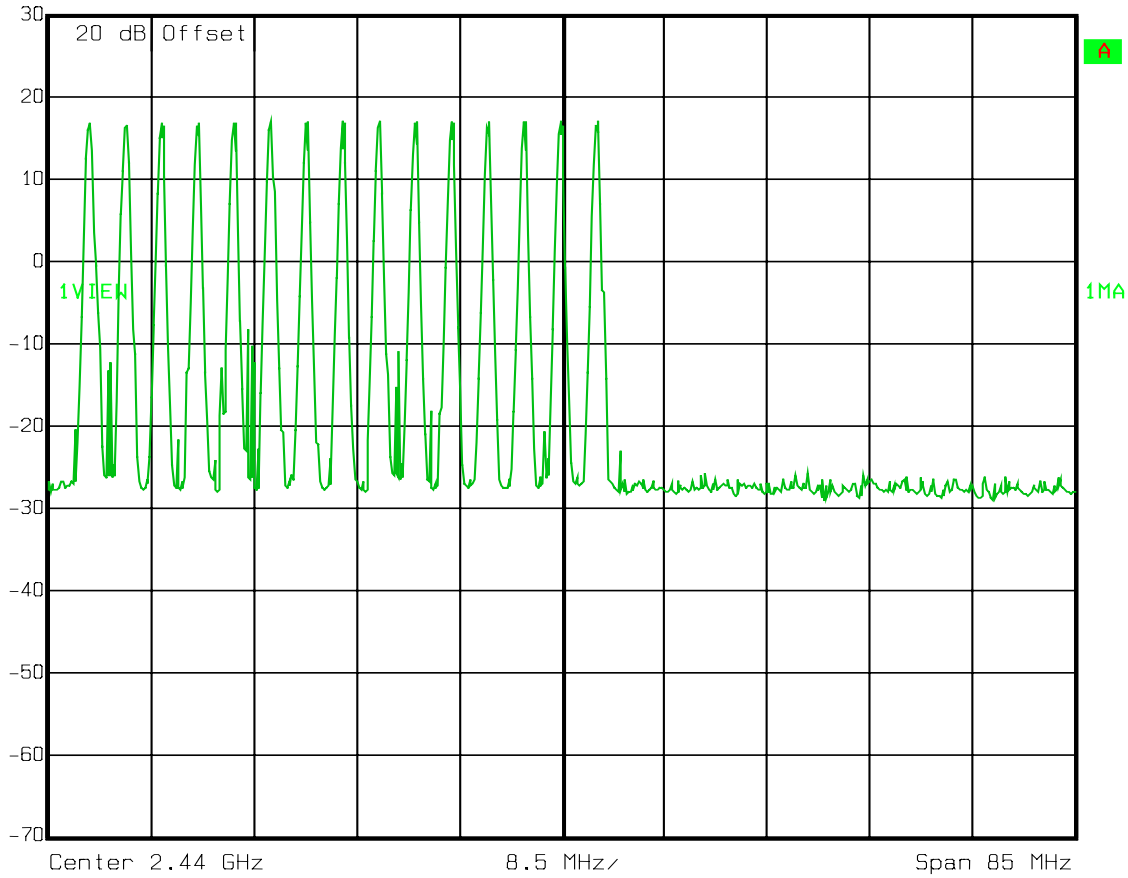
**Relative Humidity:** 45%

### 15 Hopping Channels



Ref Lvl  
30 dBm

RBW 300 kHz RF Att 40 dB  
VBW 300 kHz  
SWT 5 ms Unit dBm



Date: 16.JUN.2008 10:47:14

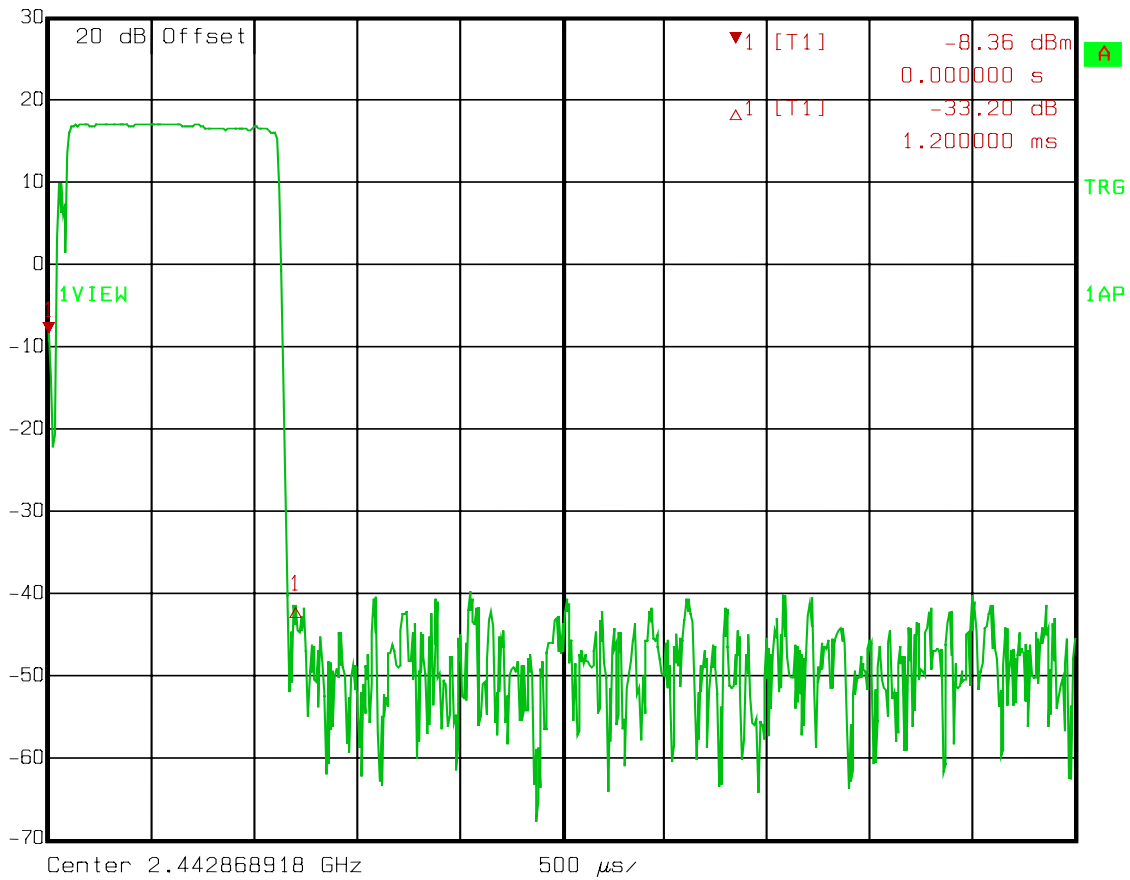


Average Time of Occupancy

1 Burst 1.2 mS ON time/7.2 mS Hop Time



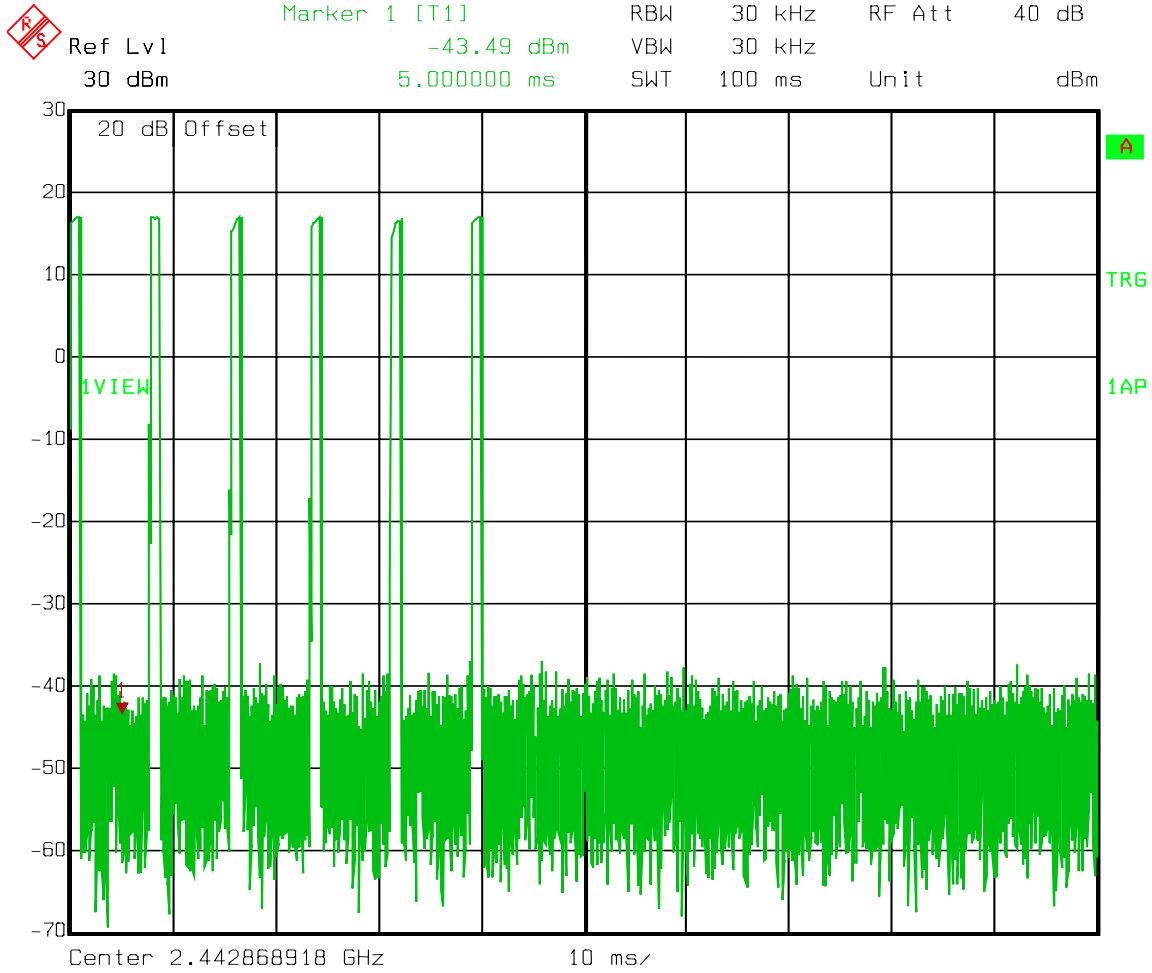
Marker 1 [T1] RBW 30 kHz RF Att 40 dB  
Ref Lvl 30 dBm -8.36 dBm VBW 30 kHz  
0.000000 s SWT 5 ms Unit dBm



Date: 16.JUN.2008 10:50:47

**Average Time of Occupancy**

1.2 mS ON time/7.2 mS Hop Time

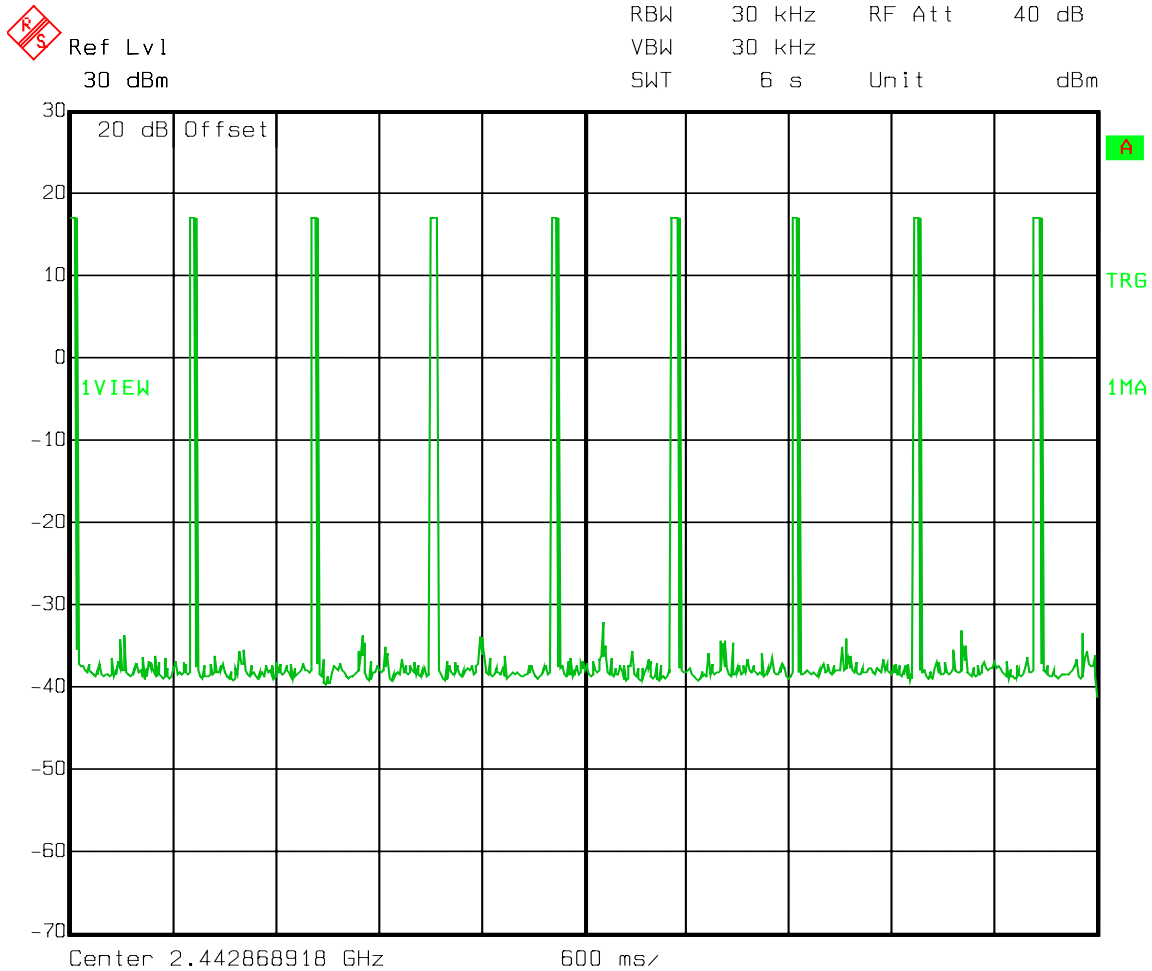


Date: 16.JUN.2008 10:49:08

**Average Time of Occupancy**

1.2 mS ON time/7.8 mS Hop Time

64.8 mS in 6 seconds



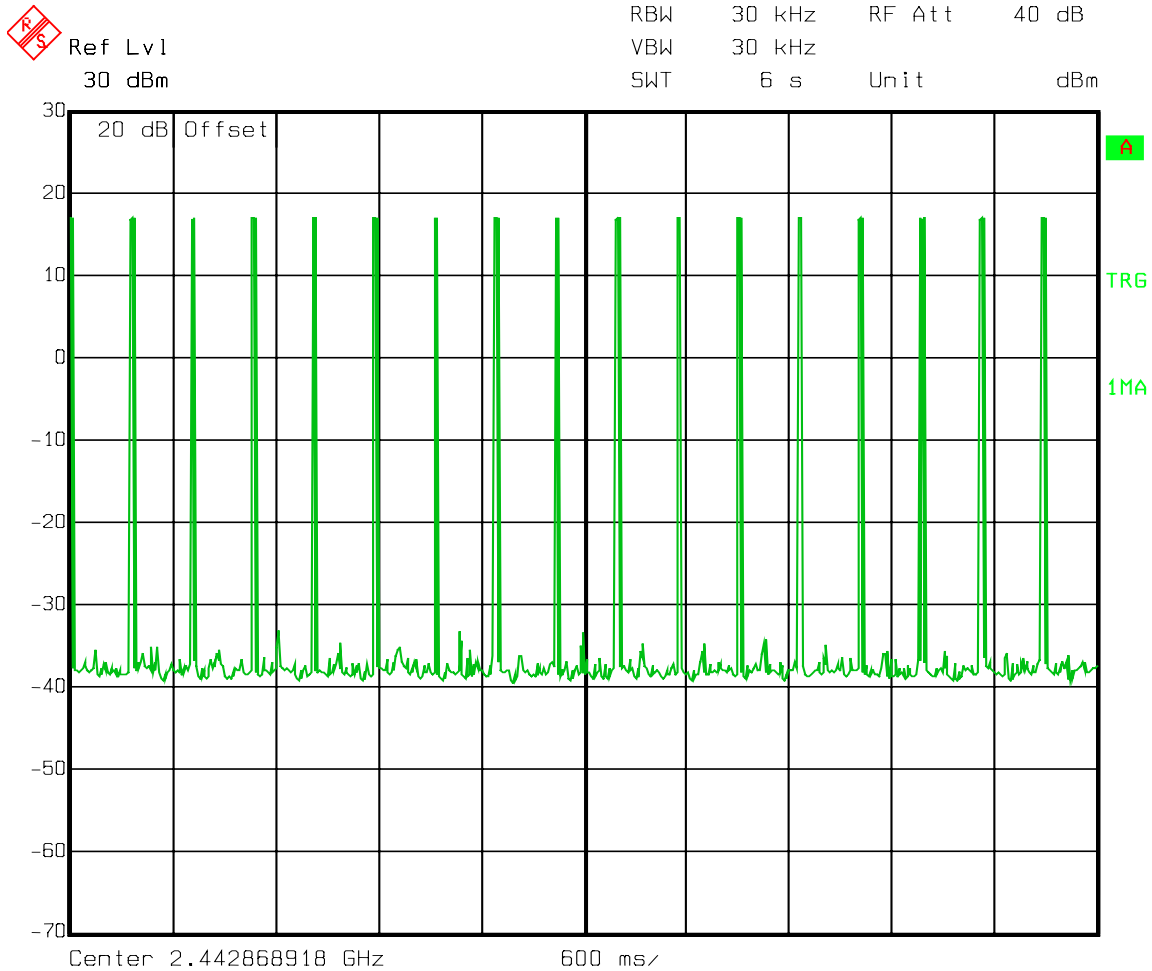
Date: 16.JUN.2008 10:57:19

**Average Time of Occupancy**

15 Channels

1.2 mS ON time/3.9 mS Hop time

122.4 mS in 6 seconds



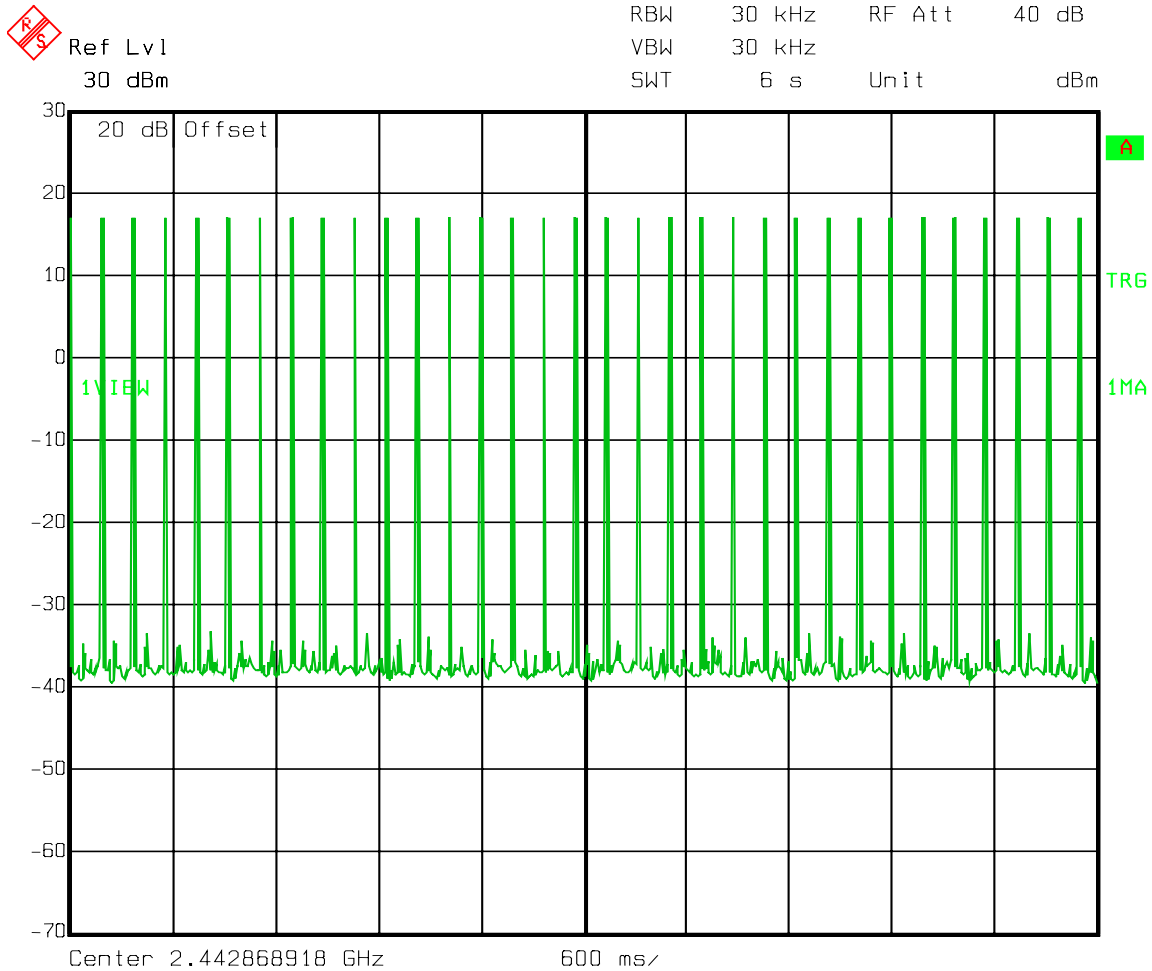
Date: 16.JUN.2008 11:30:07

**Average Time of Occupancy**

15 channels

1.2 mS ON time/2.0 mS Hop time

237.6 mS in 6 seconds



Date: 16.JUN.2008 11:32:55

**Average Time of Occupancy**

15 channels

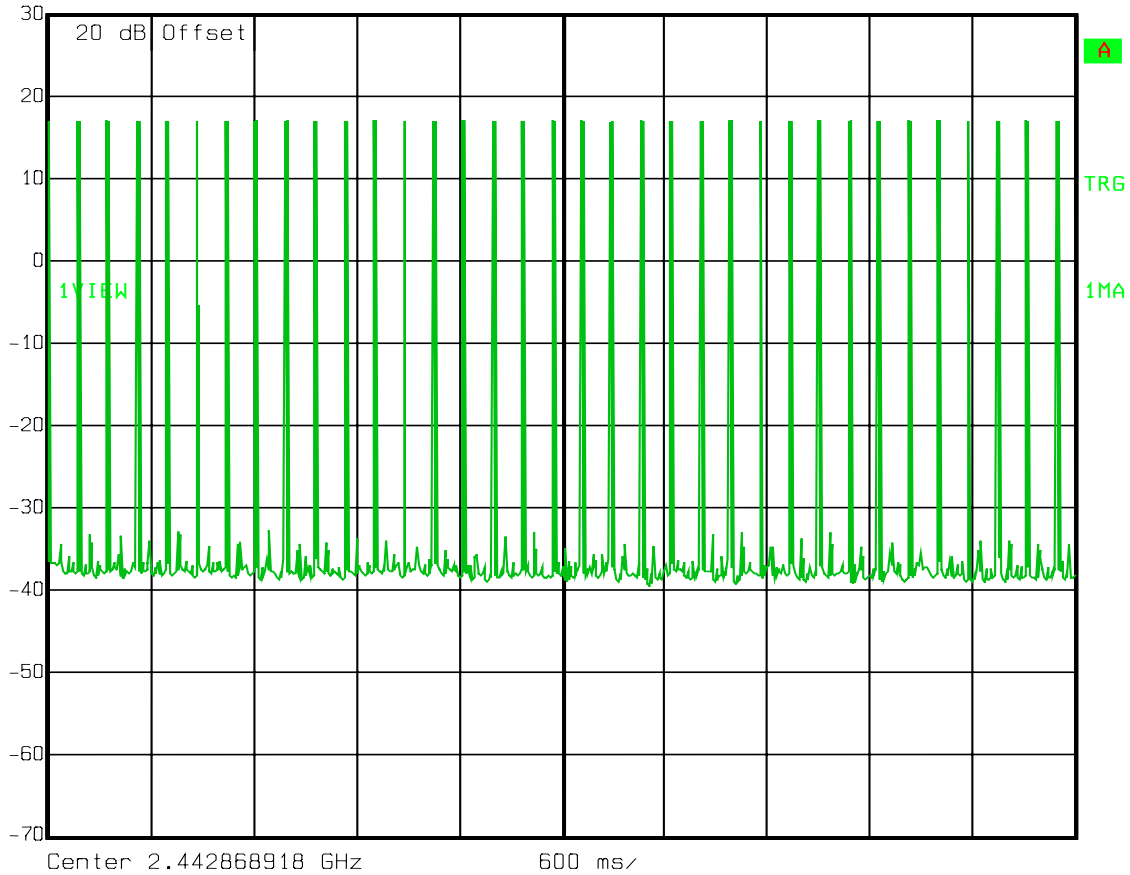
1.2 mS ON time/1.90 mS Hop time

252 mS in 6 seconds



Ref Lvl  
30 dBm

RBW 30 kHz RF Att 40 dB  
VBW 30 kHz  
SWT 6 s Unit dBm



Date: 16.JUN.2008 11:35:49

Average Time of Occupancy

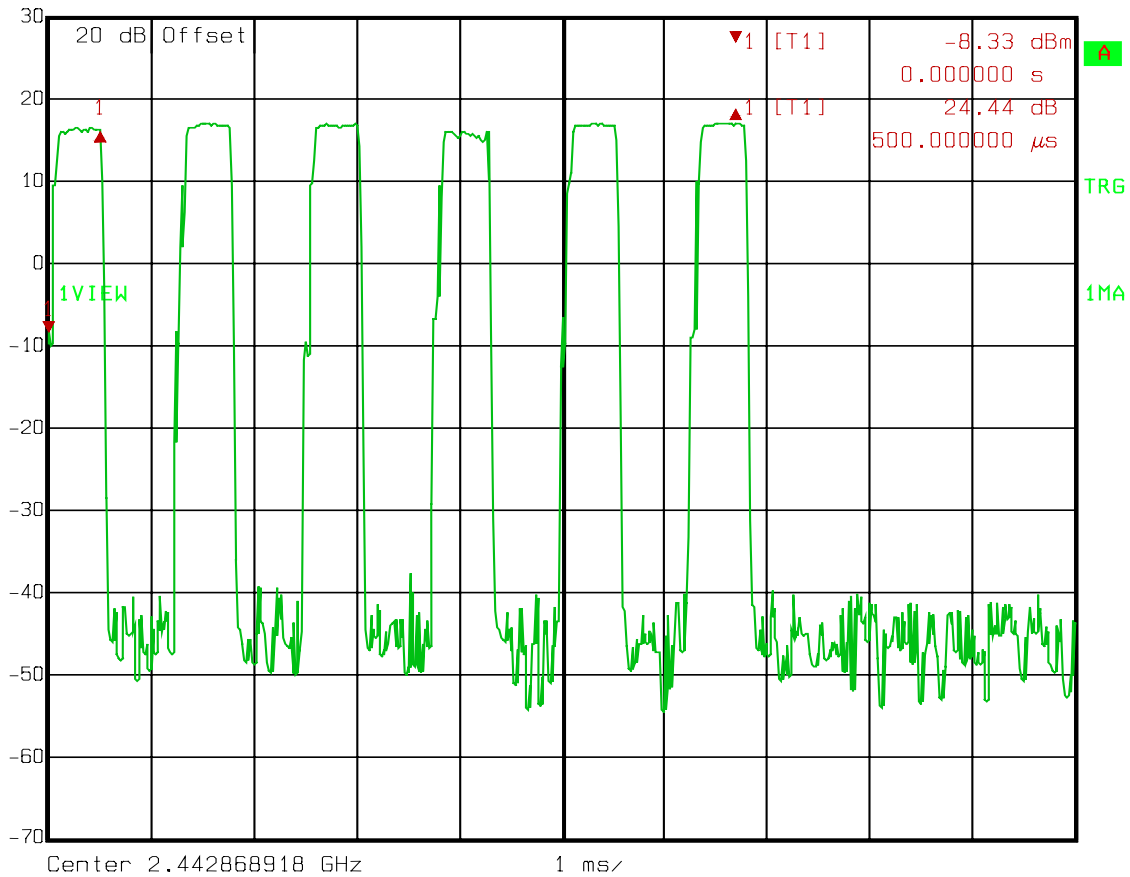
15 channels

0.5 mS On time/ 1.3 mS Hop time

3.0 mS per burst



Delta 1 [T1]	RBW	30 kHz	RF Att	40 dB
Ref Lvl	24.44 dB	VBW	30 kHz	
30 dBm	500.000000 $\mu$ s	SWT	10 ms	Unit dBm



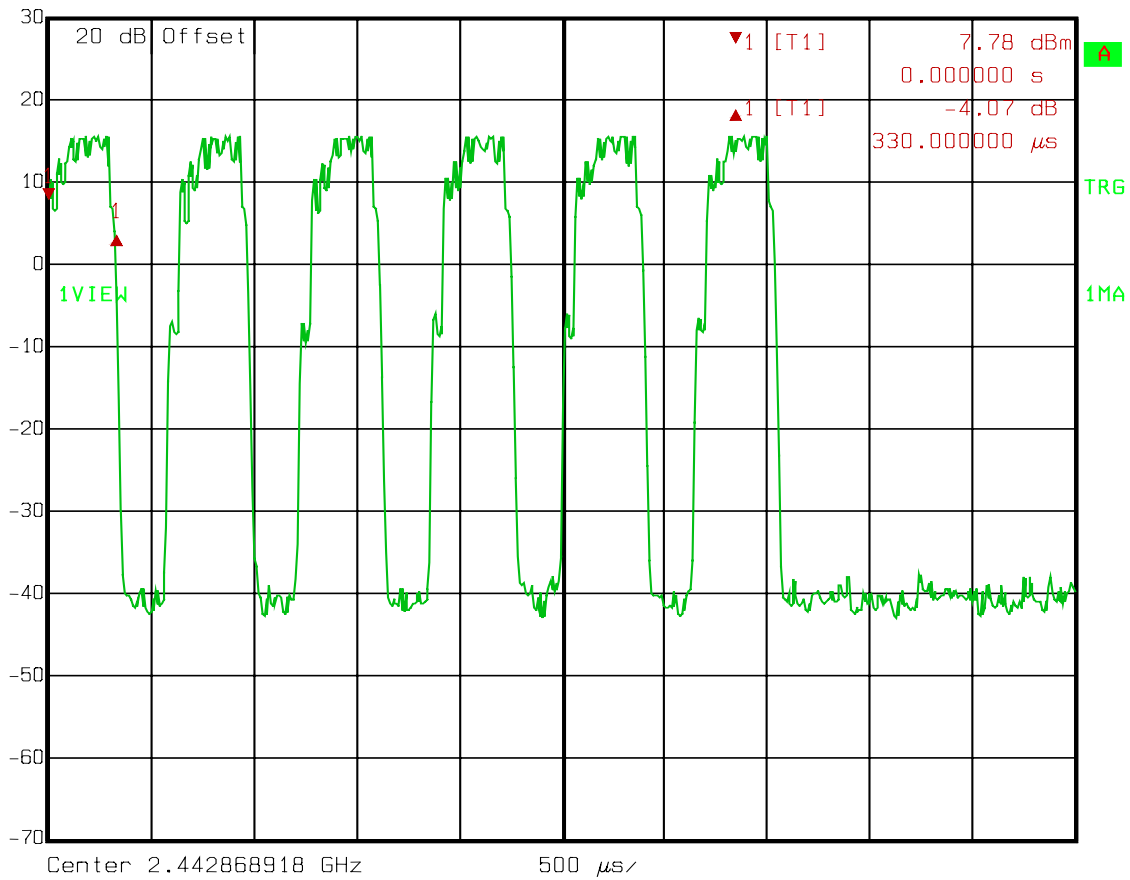
Date: 16.JUN.2008 13:00:34

**Average Time of Occupancy**

0.33 mS On time / 0.64 mS hop time



Delta 1 [T1] RBW 30 kHz RF Att 40 dB  
 Ref Lvl 30 dBm -4.07 dB VBW 30 kHz  
 330.000000  $\mu$ s SWT 5 ms Unit dBm



Date: 16.JUN.2008 13:03:00



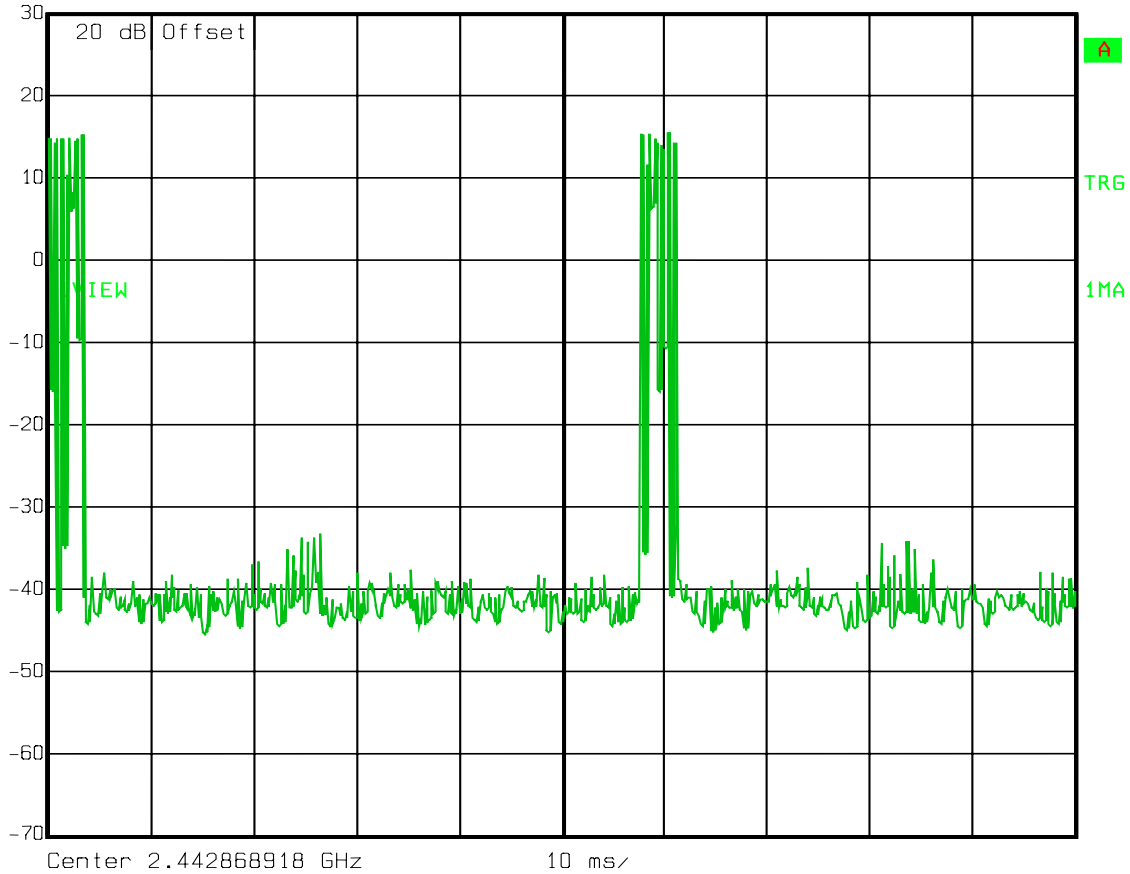
**Average Time of Occupancy**

0.33 mS ON time / 0.65 mS hop time



Ref Lvl  
30 dBm

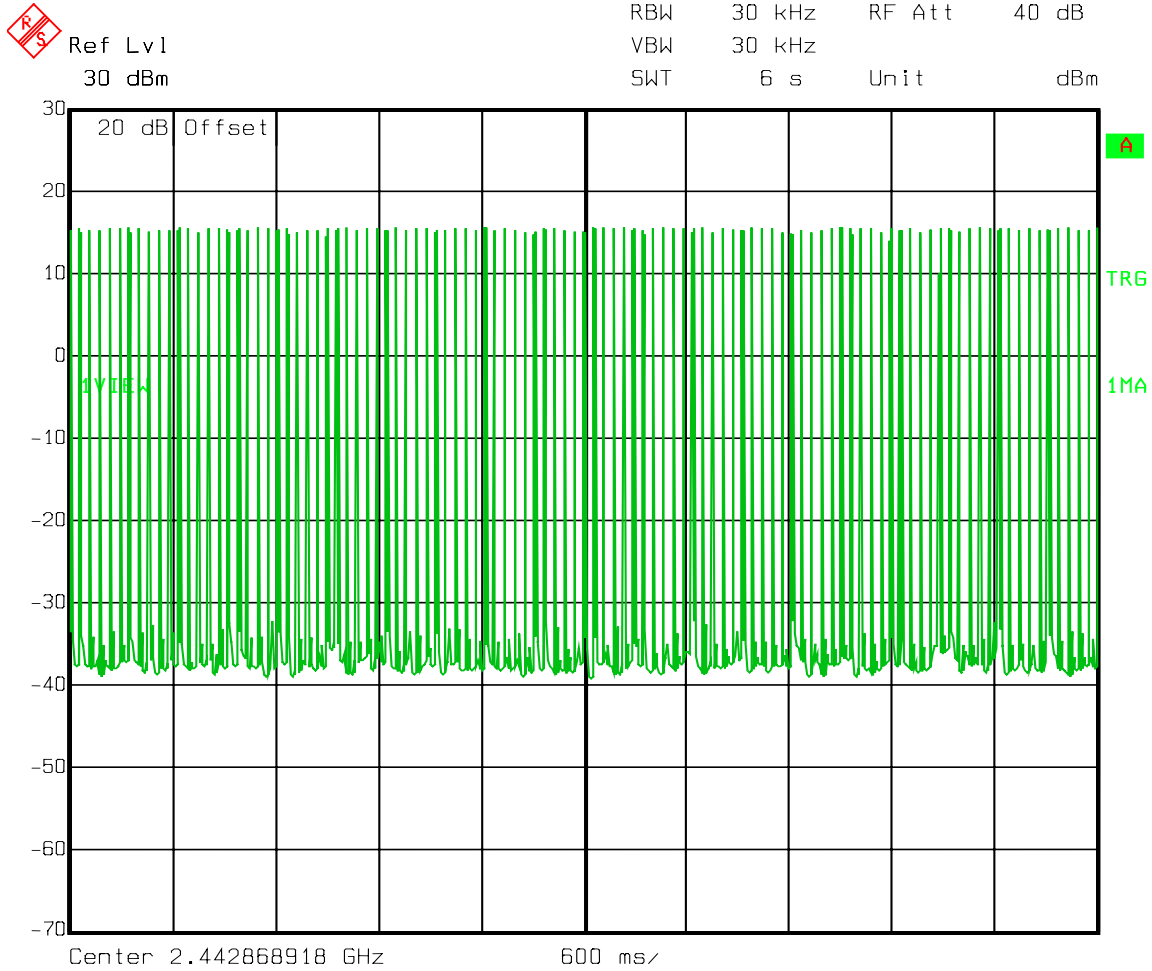
RBW 30 kHz RF Att 40 dB  
VBW 30 kHz  
SWT 100 ms Unit dBm



Date: 16.JUN.2008 13:03:37

Average Time of Occupancy

0.33 mS ON time / 0.65 mS hop time



Date: 16.JUN.2008 13:04:10

**Section 4. Test Equipment List**

Nemko ID	Description	Manufacturer Model Number	Serial Number	Calibration Date	Calibration Due
1659	Spectrum Analyzer	Rhode & Schwarz FSP	973353	01/24/07	01/24/09
1082	CABLE 2m	Astrolab 32027-2-29094-72TC	N/A	CBU	N/A
1472	20db Attenuator DC 18 Ghz	Omni Spectra 20600-20db	NONE	CBU	N/A

**Nemko USA, Inc.**

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* DX80 2.4GHz

TEST REPORT

NO.:11677RUS1rev1

## **ANNEX A - TEST DETAILS**

NAME OF TEST: Time of Occupancy	PARA. NO.: 15.247(a)(1)(ii)
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**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	-----	15	=<0.4 sec. in 0.4 times the number of hopping channels (sec).
5725 – 5850	-----	75	=<0.4 sec. in 30 sec.

**Method Of Measurement:**

The spectrum analyzer is set as follows:

RBW/VBW: 30 kHz  
 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./0.001 sec.)/75 chan. = 400 x 1 msec. = 400 msec. or 0.4 sec. in 30 sec.

**Nemko USA, Inc.**

FCC PART 15, SUBPART C

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* DX80 2.4GHz

TEST REPORT

NO.:11677RUS1rev1