



**Nemko Test Report:** 44215RUS1Rev2

**Applicant:** WatchGuard Video  
3001 Summit Ave.  
Plano, TX 75074  
USA

**Equipment Under Test:** MIC-WRL-TRN-400  
**(E.U.T.)**

**FCC ID:** YJV-TRN400

**In Accordance With:** **FCC Part 15, Subpart C, 15.247 &  
Industry Canada, RSS-210, Issue 8**  
Frequency Hopping Transmitters

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

**TESTED BY:**   
\_\_\_\_\_  
David Light, Senior Wireless Engineer

**DATE:** 15 June 2010

**APPROVED BY:**   
\_\_\_\_\_  
Michael Cantwell, GM

**DATE:** 8-Dec-2011

**Total Number of Pages:** 32

## Table of Contents

|   |           |
|---|-----------|
| <b>SECTION 1. SUMMARY OF TEST RESULTS</b>       | <b>3</b>  |
| <b>SECTION 2. EQUIPMENT UNDER TEST (E.U.T.)</b> | <b>5</b>  |
| <b>SECTION 3. CHANNEL SEPARATION</b>            | <b>7</b>  |
| <b>SECTION 4. TIME OF OCCUPANCY</b>             | <b>10</b> |
| <b>SECTION 5. PEAK POWER OUTPUT</b>             | <b>13</b> |
| <b>SECTION 6. SPURIOUS EMISSIONS (RADIATED)</b> | <b>14</b> |
| <b>SECTION 7. RECEIVER SPURIOUS</b>             | <b>20</b> |
| <b>SECTION 8. TEST EQUIPMENT LIST</b>           | <b>21</b> |
| <b>ANNEX A - TEST DETAILS</b>                   | <b>22</b> |
| <b>ANNEX B - TEST DIAGRAMS</b>                  | <b>30</b> |

**Nemko USA, Inc.**

FCC PART 15, SUBPART C & Industry Canada RSS-210

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

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## **Section 1. Summary of Test Results**

Manufacturer: WatchGuard Video

Model No.: MIC-WRL-TRN-400

Sample No.: 1

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 & Industry Canada RSS-210, Issue 8 for Frequency Hopping Spread Spectrum devices. Radiated tests were conducted in accordance with ANSI C63.4-2003. Radiated emissions are made in a semi-anechoic chamber. A description of the test facility is on file with the FCC and Industry Canada.



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".



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FCC PART 15, SUBPART C &amp; Industry Canada RSS-210

EQUIPMENT: MIC-WRL-TRN-400

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

PROJECT NO.: 44215RUS1

**Summary Of Test Data**

| NAME OF TEST                              | PARA. NO.                    | RESULT   |
|---|------------------------------|----------|
| Powerline Conducted Emissions             | 15.207(a)/RSS-Gen 7.2.2      | NA       |
| Channel Separation                        | 15.247(a)(1)/RSS-210 A8.1(b) | Complies |
| Time of Occupancy                         | 15.247(a)(1)/RSS-210 A8.1(c) | Complies |
| 20 dB Occupied Bandwidth                  | 15.247(a)(1)/RSS-210 A8.1(c) | Complies |
| Peak Power Output                         | 15.247(b)/RSS-210 A8.4(1)    | Complies |
| Spurious Emissions<br>(Antenna Conducted) | 15.247(d)(RSS-210 A8.5       | NT       |
| Spurious Emissions (Radiated)             | 15.247(d)/RSS-210 A8.5       | Complies |
| Receiver Spurious Emissions               | RSS-Gen 7.2.3                | Complies |

**Footnotes:**

- 1) The EUT is powered by 3.6 Vdc Lithium battery.
- 2) The EUT has an integral antenna. All tests were performed radiated.

**Revision:** Original release was 16-Jun-2010. Report reviewed 12-Aug-2011 and determined to be valid but no statements were made in the Rev1 release stating that. Report re-reviewed 8-Dec-2011 and judged to be a valid report with no changes.

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

**Frequency Band:**  902 – 928 MHz  
 2400 – 2483.5 MHz  
 5725 – 5850 MHz

**Operating Frequency Range:** 902.25 to 927.50 MHz

**Spread Spectrum Technique:** FHSS

**Modulation Type:** FSK

**Emission Designator:** 200KF1D

**Number of Channels:** 50 to 51

**Channel Spacing:** 500 kHz

**20 dB Bandwidth:** 200 kHz

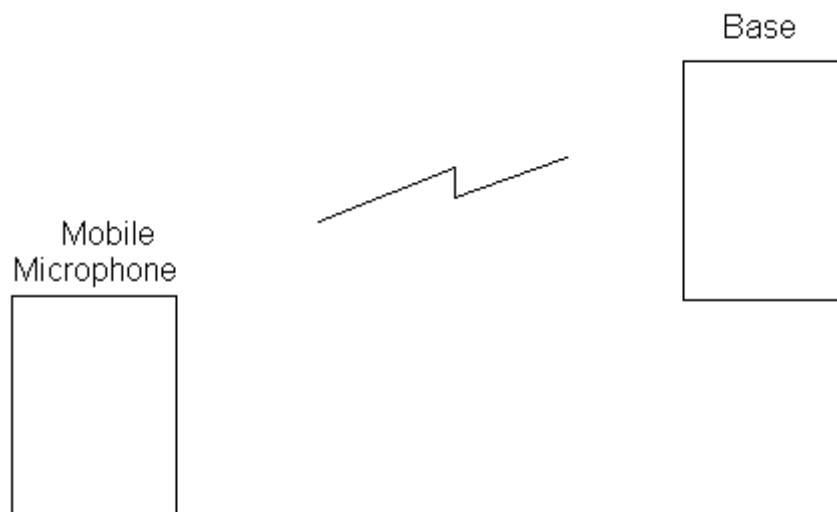
**Transmitter ON time:** 361.62 mS in 20 seconds

**Input power:** 3.6 Vdc

**User Frequency Adjustment:** None

**Description of EUT**

Microphone system is comprised of one MIC-WRL-TRN-400 "Transmitter" component and one MIC-WRL-CHG-400 "Base" component. These two components operate as a pair and comprise the operational wireless microphone system.

**System Diagram**

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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* MIC-WRL-TRN-400

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### **Section 3. Channel Separation**

|                                  |                                       |
|----------------------------------|---------------------------------------|
| NAME OF TEST: Channel Separation | PARA. NO.: 15.247(a)(1)               |
| TESTED BY: David Light           | RSS-210 A8.1(b)<br>DATE: 14 June 2010 |

**Test Results:** Complies.

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

Measured 20 dB bandwidth: 200 kHz  
Channel Separation: 500 kHz

**Equipment Used:** 1464-1082-802

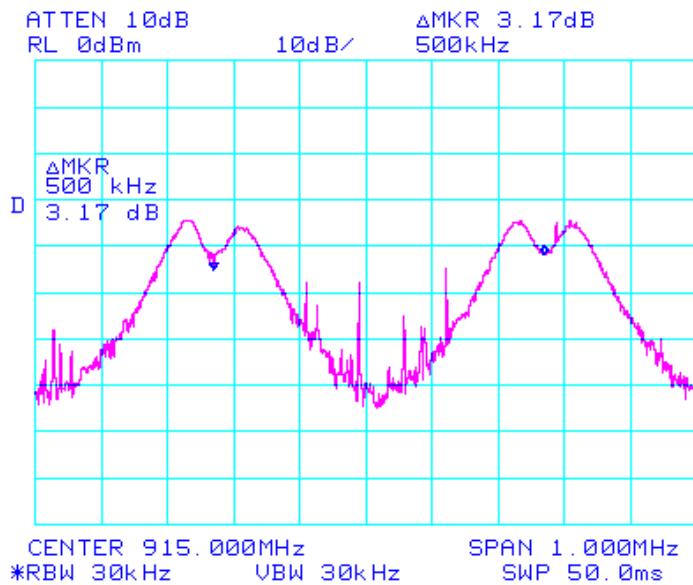
**Measurement Uncertainty:** 1X10<sup>-7</sup>ppm

**Temperature:** 22 °C

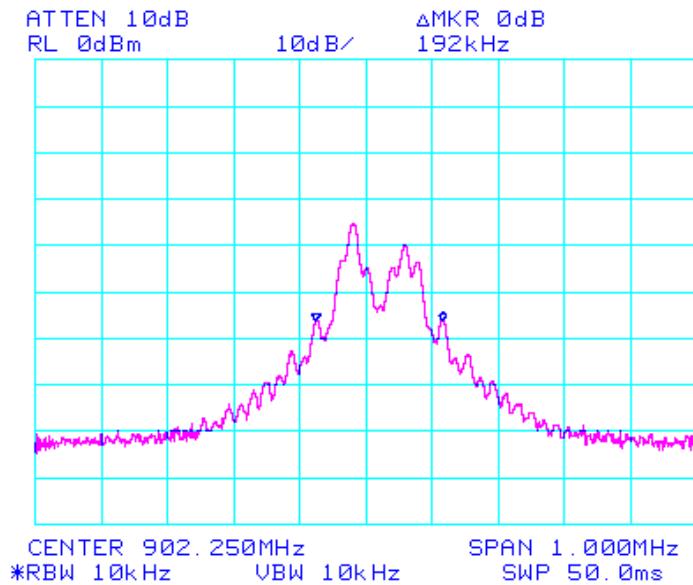
**Relative Humidity:** 35 %

**Test Data**

## Channel Separation

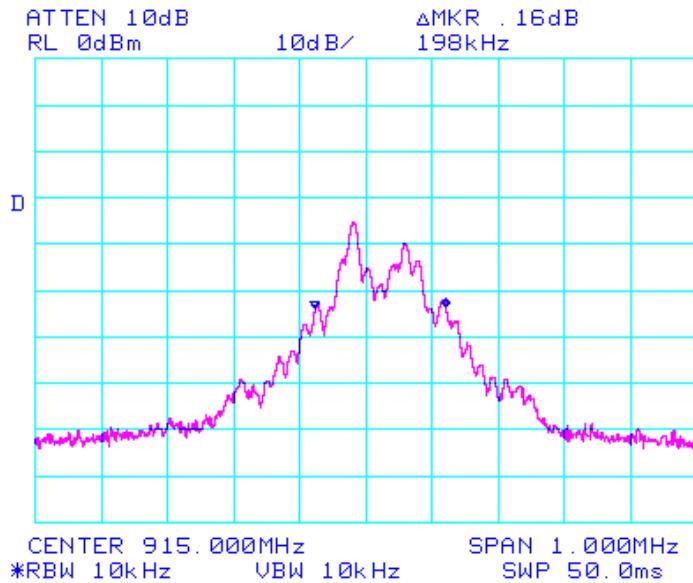


## Low Channel

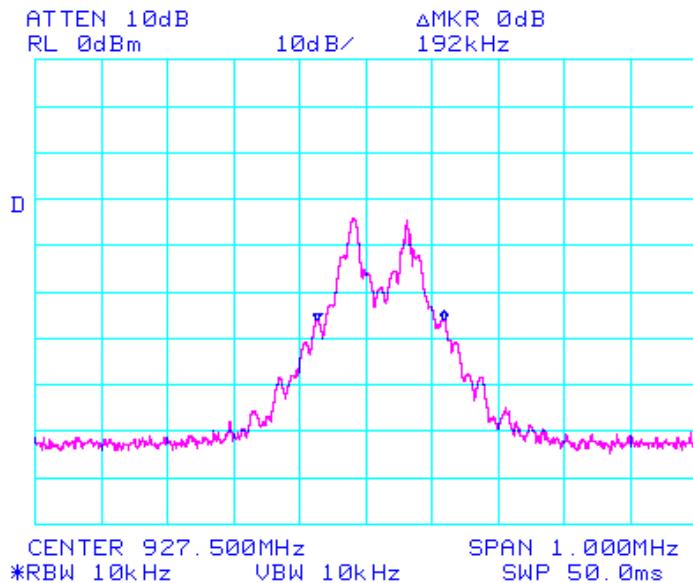


**Test Data – 20 dB Bandwidth**

Mid Channel



High Channel



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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

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

|                                 |                         |
|---------------------------------|-------------------------|
| NAME OF TEST: Time of Occupancy | PARA. NO.: 15.247(a)(1) |
| TESTED BY: David Light          | RSS-210 A8.1(c)         |
|                                 | DATE: 14 June 2010      |

**Test Results:** Complies.

#### **Measurement Data:**

Maximum Dwell Time On Any Channel: 361.62 mS/20 seconds

**Equipment Used:** 1464-1082-802

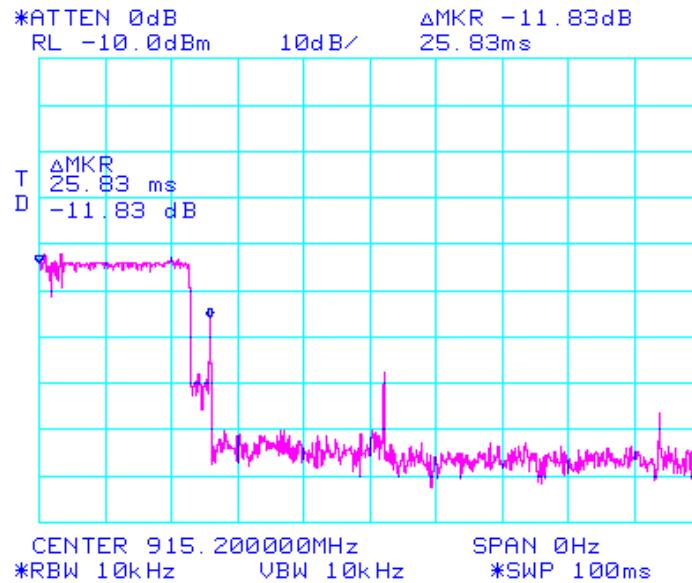
**Measurement Uncertainty:** 1X10<sup>-7</sup> ppm

**Temperature:** 22 °C

**Relative Humidity:** 35 %

**Test Data – Time of Occupancy**

Pulse Width



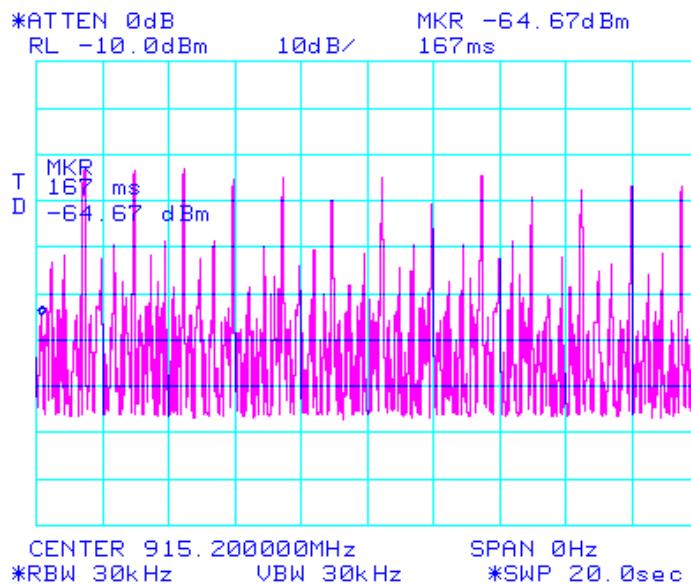
$$\text{Duty Cycle Correction} = 20 \log (25.83/100) = -11.78 \text{ dB}$$

**Test Data – Time of Occupancy**

Transmitter ON time

$$14 \text{ hops} @ 25.83 \text{ msec} = 361.62 \text{ msec}$$

Limit = 400 msec



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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

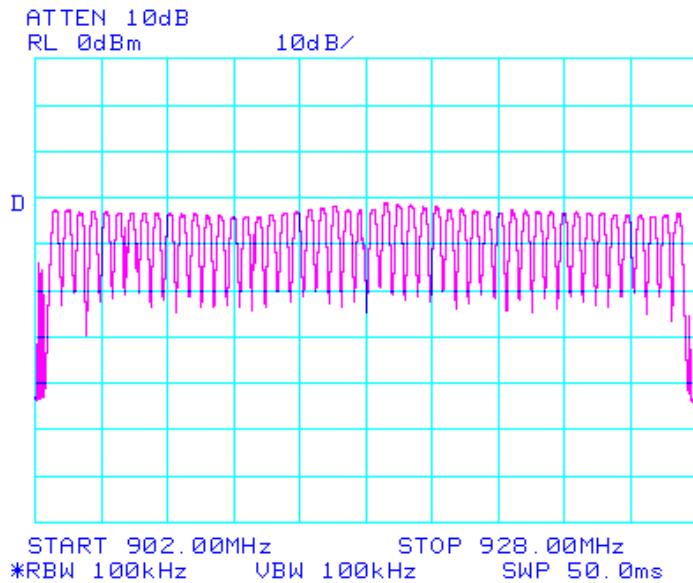
*EQUIPMENT:* MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

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**Test Data – Time of Occupancy**

Number of hopping channels = 50



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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

## Section 5. Peak Power Output

|                                 |                       |
|---------------------------------|-----------------------|
| NAME OF TEST: Peak Power Output | PARA. NO.: 15.247 (b) |
| TESTED BY: David Light          | RSS-210 A8.4(1)       |
|                                 | DATE: 14 June 2010    |

**Test Results:** Complies.**Measurement Data:** See attached plots.Detachable antenna?  Yes  No

| Frequency (MHz)          | Peak Power (dBm) | Peak Power (mW) | Antenna Type    | Gain (dBi) | EIRP (dBm) | EIRP (mW) |
|--------------------------|------------------|-----------------|-----------------|------------|------------|-----------|
| 902.25                   | 22.3             | 169.8           | Hybrid monopole | -10        | 12.3       | 17.0      |
| 915.00                   | 21.0             | 125.9           | Hybrid monopole | -10        | 11.0       | 12.6      |
| 927.50                   | 18.3             | 67.6            | Hybrid monopole | -10        | 8.3        | 6.8       |
| Maximum EIRP (mW): 17.0* |                  |                 |                 |            |            |           |

\*The EIRP was measured using the signal substitution method. Peak output power is calculated using the stated antenna gain.

- This device was tested at +/- 15% input power per 15.31(e), with no variation in output power.
- For battery powered equipment, the device was tested with a fresh battery per 15.31(e).
- The device was tested on three channels per 15.31(l).
- This test was performed radiated.

**Equipment Used:** 1464-1484-1485-1480-993-1016-791**Measurement Uncertainty:** 1.7 dB**Temperature:** °C**Relative Humidity:** %**Analyzer Settings:** RBW/VBW = 1 MHz Peak Detector

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FCC PART 15, SUBPART C & Industry Canada RSS-210

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

EQUIPMENT: MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

## **Section 6. Spurious Emissions (Radiated)**

|   |                      |
|---|----------------------|
| NAME OF TEST: Spurious Emissions (Radiated) | PARA. NO.: 15.247(d) |
| TESTED BY: David Light                      | RSS-210 A8.5         |
|   | DATE: 14 June 2010   |

### **Test Results:**

Complies. The worst case emission was 49.1 dB $\mu$ V/m at 8235 MHz. This is 4.9 dB below the specification limit of 54 dB $\mu$ V/m.

**Measurement Data:** See attached table.

**Duty Cycle Calculation:** Refer to page 11

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

Notes:

- For handheld devices, the EUT was tested on three orthogonal axis'
- The device was tested from 30 MHz to the tenth harmonic of the highest fundamental frequency
- The device was tested on three channels
- All emissions within 20 dB of the specification limit are reported.

**Equipment Used:** 1464-1484-1485-1480-993-1016-791

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

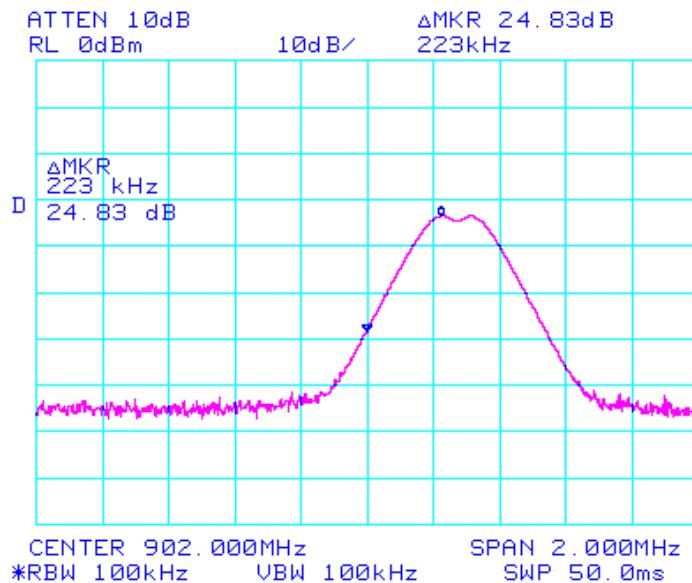
**Temperature:** 22 °C

**Relative Humidity:** 35 %

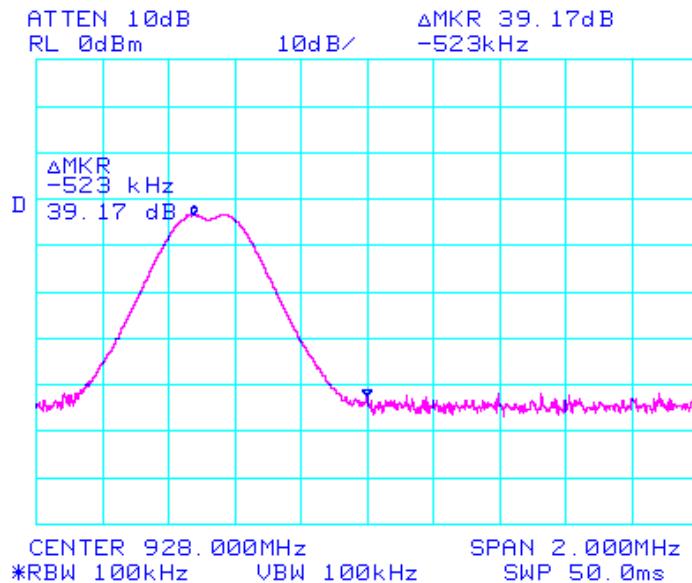
**Analyzer Settings:** RBW/VBW = 1 MHz Peak detector

**Test Data - Radiated Emissions**

## Low Band Edge



## Upper Band Edge



## Test Data - Radiated Emissions – Lowest Channel

| #  | Freq<br>MHz | Rdng<br>dB $\mu$ V | Cable      |      | Pre-A |       | Horn |      | Dist<br>Table | Corr<br>dB $\mu$ V/m | Spec<br>dB $\mu$ V/m | Margin<br>dB | Polar<br>Ant |
|----|-------------|--------------------|------------|------|-------|-------|------|------|---------------|----------------------|----------------------|--------------|--------------|
|    |             |                    | Duty<br>dB | dB   | dB    | dB    | dB   | dB   |               |                      |                      |              |              |
| 1  | 2706.75     | 47.7               | +0.8       | +2.8 | -32.7 | +29.3 | +0.0 | 36.2 | 54.0          | -17.8                | 54.0                 | -17.8        | Horiz        |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 2  | 3609.00     | 49.3               | +0.8       | +2.8 | -32.7 | +30.3 | +0.0 | 38.8 | 54.0          | -15.2                | 54.0                 | -15.2        | Horiz        |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 3  | 4511.25     | 47.2               | +1.0       | +3.1 | -32.5 | +32.0 | +0.0 | 39.1 | 54.0          | -14.9                | 54.0                 | -14.9        | Horiz        |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 4  | 5413.50     | 48.0               | +1.2       | +3.5 | -31.8 | +33.6 | +0.0 | 54.5 | 74.0          | -19.5                | 74.0                 | -19.5        | Horiz        |
|    |             |                    | +0.0       |      |       |       |      |      |               |                      |                      |              |              |
| 5  | 5413.50     | 48.0               | +1.2       | +3.5 | -31.8 | +33.6 | +0.0 | 42.8 | 54.0          | -11.2                | 54.0                 | -11.2        | Horiz        |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 6  | 6315.75     | 47.8               | +1.3       | +3.9 | -31.3 | +34.9 | +0.0 | 56.6 | 74.0          | -17.4                | 74.0                 | -17.4        | Horiz        |
|    |             |                    | +0.0       |      |       |       |      |      |               |                      |                      |              |              |
| 7  | 6315.75     | 47.8               | +1.3       | +3.9 | -31.3 | +34.9 | +0.0 | 44.9 | 54.0          | -9.1                 | 54.0                 | -9.1         | Horiz        |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 8  | 7218.00     | 44.8               | +1.2       | +3.9 | -32.2 | +35.8 | +0.0 | 41.8 | 54.0          | -12.2                | 54.0                 | -12.2        | Horiz        |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 9  | 8120.25     | 47.3               | +1.4       | +4.3 | -33.0 | +37.6 | +0.0 | 57.6 | 74.0          | -16.4                | 74.0                 | -16.4        | Horiz        |
|    |             |                    | +0.0       |      |       |       |      |      |               |                      |                      |              |              |
| 10 | 8120.25     | 47.3               | +1.4       | +4.3 | -33.0 | +37.6 | +0.0 | 45.9 | 54.0          | -8.1                 | 54.0                 | -8.1         | Horiz        |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 11 | 9022.50     | 48.0               | +1.4       | +4.1 | -33.7 | +37.0 | +0.0 | 56.8 | 74.0          | -17.2                | 74.0                 | -17.2        | Horiz        |
|    |             |                    | +0.0       |      |       |       |      |      |               |                      |                      |              |              |
| 12 | 9022.50     | 48.0               | +1.4       | +4.1 | -33.7 | +37.0 | +0.0 | 45.1 | 54.0          | -8.9                 | 54.0                 | -8.9         | Horiz        |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 13 | 2706.75     | 48.7               | +0.8       | +2.8 | -32.7 | +29.3 | +0.0 | 37.2 | 54.0          | -16.8                | 54.0                 | -16.8        | Vert         |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 14 | 3609.00     | 49.5               | +0.8       | +2.8 | -32.7 | +30.3 | +0.0 | 39.0 | 54.0          | -15.0                | 54.0                 | -15.0        | Vert         |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 15 | 4511.25     | 48.8               | +1.0       | +3.1 | -32.5 | +32.0 | +0.0 | 40.7 | 54.0          | -13.3                | 54.0                 | -13.3        | Vert         |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 16 | 5413.50     | 47.8               | +1.2       | +3.5 | -31.8 | +33.6 | +0.0 | 54.3 | 74.0          | -19.7                | 74.0                 | -19.7        | Vert         |
|    |             |                    | +0.0       |      |       |       |      |      |               |                      |                      |              |              |
| 17 | 5413.50     | 47.8               | +1.2       | +3.5 | -31.8 | +33.6 | +0.0 | 42.6 | 54.0          | -11.4                | 54.0                 | -11.4        | Vert         |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 18 | 6315.75     | 46.5               | +1.3       | +3.9 | -31.3 | +34.9 | +0.0 | 55.3 | 74.0          | -18.7                | 74.0                 | -18.7        | Vert         |
|    |             |                    | +0.0       |      |       |       |      |      |               |                      |                      |              |              |
| 19 | 6315.75     | 46.5               | +1.3       | +3.9 | -31.3 | +34.9 | +0.0 | 43.6 | 54.0          | -10.4                | 54.0                 | -10.4        | Vert         |
|    | Ave         |                    | -11.7      |      |       |       |      |      |               |                      |                      |              |              |
| 20 | 7218.00     | 47.3               | +1.2       | +3.9 | -32.2 | +35.8 | +0.0 | 56.0 | 74.0          | -18.0                | 74.0                 | -18.0        | Vert         |
|    |             |                    | +0.0       |      |       |       |      |      |               |                      |                      |              |              |

Corr(dB $\mu$ V/m) = Rdng(dB) + Cables(dB) + PreA(dB) + Horn(dB) + Duty Cycle(dB)

Readings are Peak unless otherwise indicated.

**Test Data - Radiated Emissions – Continued****Lowest Channel**

| #  | Freq<br>MHz    | Rdng<br>dB $\mu$ V | Cable         |      | Cable |       | Pre-A |      | Horn |       | Dist<br>Table | Corr<br>dB $\mu$ V/m | Spec<br>dB $\mu$ V/m | Margin<br>dB | Polar<br>Ant |
|----|----------------|--------------------|---------------|------|-------|-------|-------|------|------|-------|---------------|----------------------|----------------------|--------------|--------------|
|    |                |                    | Duty<br>dB    | dB   | dB    | dB    | dB    | dB   | dB   | dB    |               |                      |                      |              |              |
| 21 | 7218.00<br>Ave | 47.3               | +1.2<br>-11.7 | +3.9 | -32.2 | +35.8 | +0.0  | 44.3 | 54.0 | -9.7  | Vert          |                      |                      |              |              |
| 22 | 8120.25        | 46.8               | +1.4<br>+0.0  | +4.3 | -33.0 | +37.6 | +0.0  | 57.1 | 74.0 | -16.9 | Vert          |                      |                      |              |              |
| 23 | 8120.25<br>Ave | 46.8               | +1.4<br>-11.7 | +4.3 | -33.0 | +37.6 | +0.0  | 45.4 | 54.0 | -8.6  | Vert          |                      |                      |              |              |
| 24 | 9022.50        | 50.7               | +1.4<br>+0.0  | +4.1 | -33.7 | +37.0 | +0.0  | 59.5 | 74.0 | -14.5 | Vert          |                      |                      |              |              |
| 25 | 9022.50<br>Ave | 50.7               | +1.4<br>-11.7 | +4.1 | -33.7 | +37.0 | +0.0  | 47.8 | 54.0 | -6.2  | Vert          |                      |                      |              |              |

**Mid Channel**

| #  | Freq<br>MHz    | Rdng<br>dB $\mu$ V | Cable         |      | Cable |       | Pre-A |      | Horn |       | Dist<br>Table | Corr<br>dB $\mu$ V/m | Spec<br>dB $\mu$ V/m | Margin<br>dB | Polar<br>Ant |
|----|----------------|--------------------|---------------|------|-------|-------|-------|------|------|-------|---------------|----------------------|----------------------|--------------|--------------|
|    |                |                    | Duty<br>dB    | dB   | dB    | dB    | dB    | dB   | dB   | dB    |               |                      |                      |              |              |
| 1  | 2745.00<br>Ave | 51.2               | +0.8<br>-11.7 | +2.9 | -32.7 | +29.4 | +0.0  | 39.9 | 54.0 | -14.1 | Vert          |                      |                      |              |              |
| 2  | 3660.00<br>Ave | 49.7               | +0.8<br>-11.7 | +2.8 | -32.6 | +30.5 | +0.0  | 39.5 | 54.0 | -14.5 | Vert          |                      |                      |              |              |
| 3  | 4575.00<br>Ave | 47.8               | +1.0<br>-11.7 | +3.1 | -32.5 | +32.3 | +0.0  | 40.0 | 54.0 | -14.0 | Vert          |                      |                      |              |              |
| 4  | 5490.00        | 48.8               | +1.2<br>+0.0  | +3.5 | -31.8 | +33.6 | +0.0  | 55.3 | 74.0 | -18.7 | Vert          |                      |                      |              |              |
| 5  | 5490.00<br>Ave | 48.8               | +1.2<br>-11.7 | +3.5 | -31.8 | +33.6 | +0.0  | 43.6 | 54.0 | -10.4 | Vert          |                      |                      |              |              |
| 6  | 6405.00        | 49.2               | +1.3<br>+0.0  | +3.9 | -31.5 | +35.1 | +0.0  | 58.0 | 74.0 | -16.0 | Vert          |                      |                      |              |              |
| 7  | 6405.00<br>Ave | 49.2               | +1.3<br>-11.7 | +3.9 | -31.5 | +35.1 | +0.0  | 46.3 | 54.0 | -7.7  | Vert          |                      |                      |              |              |
| 8  | 7320.00        | 49.3               | +1.2<br>+0.0  | +4.0 | -32.2 | +35.8 | +0.0  | 58.1 | 74.0 | -15.9 | Vert          |                      |                      |              |              |
| 9  | 7320.00<br>Ave | 49.3               | +1.2<br>-11.7 | +4.0 | -32.2 | +35.8 | +0.0  | 46.4 | 54.0 | -7.6  | Vert          |                      |                      |              |              |
| 10 | 8235.00        | 51.2               | +1.3<br>+0.0  | +4.3 | -33.3 | +37.3 | +0.0  | 60.8 | 74.0 | -13.2 | Vert          |                      |                      |              |              |
| 11 | 8235.00<br>Ave | 51.2               | +1.3<br>-11.7 | +4.3 | -33.3 | +37.3 | +0.0  | 49.1 | 54.0 | -4.9  | Vert          |                      |                      |              |              |
| 12 | 9150.00        | 48.8               | +1.3<br>+0.0  | +4.3 | -33.8 | +37.0 | +0.0  | 57.6 | 74.0 | -16.4 | Vert          |                      |                      |              |              |

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FCC PART 15, SUBPART C & Industry Canada RSS-210  
 FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER  
 EQUIPMENT: MIC-WRL-TRN-400 PROJECT NO.: 44215RUS1

|    |         |      |      |      |       |       |      |      |      |      |      |
|----|---------|------|------|------|-------|-------|------|------|------|------|------|
| 13 | 9150.00 | 48.8 | +1.3 | +4.3 | -33.8 | +37.0 | +0.0 | 45.9 | 54.0 | -8.1 | Vert |
|    | Ave     |      |      |      | -11.7 |       |      |      |      |      |      |

**Test Data - Radiated Emissions – Continued****Mid Channel**

| #  | Freq<br>MHz | Rdng<br>dB $\mu$ V | Cable<br>Duty<br>dB | Cable<br>dB | Pre-A<br>dB | Horn<br>dB | Dist<br>Table | Corr<br>dB $\mu$ V/m | Spec<br>dB $\mu$ V/m | Margin<br>dB | Polar<br>Ant |
|----|-------------|--------------------|---------------------|-------------|-------------|------------|---------------|----------------------|----------------------|--------------|--------------|
| 14 | 2745.00     | 50.7               | +0.8                | +2.9        | -32.7       | +29.4      | +0.0          | 39.4                 | 54.0                 | -14.6        | Horiz        |
|    | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |
| 15 | 3660.00     | 50.2               | +0.8                | +2.8        | -32.6       | +30.5      | +0.0          | 40.0                 | 54.0                 | -14.0        | Horiz        |
|    | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |
| 16 | 4575.00     | 45.3               | +1.0                | +3.1        | -32.5       | +32.3      | +0.0          | 37.5                 | 54.0                 | -16.5        | Horiz        |
|    | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |
| 17 | 5490.00     | 49.0               | +1.2                | +3.5        | -31.8       | +33.6      | +0.0          | 55.5                 | 74.0                 | -18.5        | Horiz        |
|    |             | +0.0               |                     |             |             |            |               |                      |                      |              |              |
| 18 | 5490.00     | 49.0               | +1.2                | +3.5        | -31.8       | +33.6      | +0.0          | 43.8                 | 54.0                 | -10.2        | Horiz        |
|    | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |
| 19 | 6405.00     | 46.3               | +1.3                | +3.9        | -31.5       | +35.1      | +0.0          | 55.1                 | 74.0                 | -18.9        | Horiz        |
|    |             | +0.0               |                     |             |             |            |               |                      |                      |              |              |
| 20 | 6405.00     | 46.3               | +1.3                | +3.9        | -31.5       | +35.1      | +0.0          | 43.4                 | 54.0                 | -10.6        | Horiz        |
|    | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |
| 21 | 7320.00     | 47.0               | +1.2                | +4.0        | -32.2       | +35.8      | +0.0          | 55.8                 | 74.0                 | -18.2        | Horiz        |
|    |             | +0.0               |                     |             |             |            |               |                      |                      |              |              |
| 22 | 7320.00     | 47.0               | +1.2                | +4.0        | -32.2       | +35.8      | +0.0          | 44.1                 | 54.0                 | -9.9         | Horiz        |
|    | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |
| 23 | 8235.00     | 49.7               | +1.3                | +4.3        | -33.3       | +37.3      | +0.0          | 59.3                 | 74.0                 | -14.7        | Horiz        |
|    |             | +0.0               |                     |             |             |            |               |                      |                      |              |              |
| 24 | 8235.00     | 49.7               | +1.3                | +4.3        | -33.3       | +37.3      | +0.0          | 47.6                 | 54.0                 | -6.4         | Horiz        |
|    | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |
| 25 | 9150.00     | 46.7               | +1.3                | +4.3        | -33.8       | +37.0      | +0.0          | 55.5                 | 74.0                 | -18.5        | Horiz        |
|    |             | +0.0               |                     |             |             |            |               |                      |                      |              |              |
| 26 | 9150.00     | 46.7               | +1.3                | +4.3        | -33.8       | +37.0      | +0.0          | 43.8                 | 54.0                 | -10.2        | Horiz        |
|    | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |

**Highest Channel**

| # | Freq<br>MHz | Rdng<br>dB $\mu$ V | Cable<br>Duty<br>dB | Cable<br>dB | Pre-A<br>dB | Horn<br>dB | Dist<br>Table | Corr<br>dB $\mu$ V/m | Spec<br>dB $\mu$ V/m | Margin<br>dB | Polar<br>Ant |
|---|-------------|--------------------|---------------------|-------------|-------------|------------|---------------|----------------------|----------------------|--------------|--------------|
| 1 | 2782.50     | 47.7               | +0.8                | +2.9        | -32.7       | +29.4      | +0.0          | 36.4                 | 54.0                 | -17.6        | Vert         |
|   | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |
| 2 | 3710.00     | 46.7               | +0.8                | +2.8        | -32.5       | +30.6      | +0.0          | 36.7                 | 54.0                 | -17.3        | Vert         |
|   | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |
| 3 | 4637.50     | 46.8               | +1.0                | +3.2        | -32.5       | +32.5      | +0.0          | 39.3                 | 54.0                 | -14.7        | Vert         |
|   | Ave         |                    |                     | -11.7       |             |            |               |                      |                      |              |              |
| 4 | 5565.00     | 48.2               | +1.2                | +3.5        | -31.9       | +33.7      | +0.0          | 54.7                 | 74.0                 | -19.3        | Vert         |
|   |             | +0.0               |                     |             |             |            |               |                      |                      |              |              |

**Test Data - Radiated Emissions – Continued****Highest Channel**

| #  | Freq<br>MHz | Rdng<br>dB $\mu$ V | Cable         | Cable | Pre-A | Horn  | Dist<br>Table | Corr<br>dB $\mu$ V/m | Spec<br>dB $\mu$ V/m | Margin<br>dB | Polar<br>Ant |
|----|-------------|--------------------|---------------|-------|-------|-------|---------------|----------------------|----------------------|--------------|--------------|
|    |             |                    | Duty<br>dB    | dB    | dB    | dB    |               |                      |                      |              |              |
| 5  | 5565.00     | 48.2               | +1.2<br>-11.7 | +3.5  | -31.9 | +33.7 | +0.0          | 43.0                 | 54.0                 | -11.0        | Vert         |
| 6  | 6492.50     | 46.7               | +1.3<br>+0.0  | +4.0  | -31.7 | +35.2 | +0.0          | 55.5                 | 74.0                 | -18.5        | Vert         |
| 7  | 6492.50     | 46.7               | +1.3<br>-11.7 | +4.0  | -31.7 | +35.2 | +0.0          | 43.8                 | 54.0                 | -10.2        | Vert         |
| 8  | 7420.00     | 47.8               | +1.2<br>+0.0  | +4.1  | -32.0 | +35.9 | +0.0          | 57.0                 | 74.0                 | -17.0        | Vert         |
| 9  | 7420.00     | 47.8               | +1.2<br>-11.7 | +4.1  | -32.0 | +35.9 | +0.0          | 45.3                 | 54.0                 | -8.7         | Vert         |
| 10 | 8347.50     | 48.8               | +1.2<br>+0.0  | +4.4  | -33.5 | +37.1 | +0.0          | 58.0                 | 74.0                 | -16.0        | Vert         |
| 11 | 8347.50     | 48.8               | +1.2<br>-11.7 | +4.4  | -33.5 | +37.1 | +0.0          | 46.3                 | 54.0                 | -7.7         | Vert         |
| 12 | 9275.00     | 47.5               | +1.2<br>+0.0  | +4.4  | -33.8 | +37.1 | +0.0          | 56.4                 | 74.0                 | -17.6        | Vert         |
| 13 | 9275.00     | 47.5               | +1.2<br>-11.7 | +4.4  | -33.8 | +37.1 | +0.0          | 44.7                 | 54.0                 | -9.3         | Vert         |
| 14 | 2782.50     | 47.3               | +0.8<br>+0.0  | +2.9  | -32.7 | +29.4 | +0.0          | 47.7                 | 74.0                 | -26.3        | Horiz        |
| 15 | 2782.50     | 47.3               | +0.8<br>-11.7 | +2.9  | -32.7 | +29.4 | +0.0          | 36.0                 | 54.0                 | -18.0        | Horiz        |
| 16 | 3710.00     | 46.7               | +0.8<br>-11.7 | +2.8  | -32.5 | +30.6 | +0.0          | 36.7                 | 54.0                 | -17.3        | Horiz        |
| 17 | 4637.50     | 46.3               | +1.0<br>-11.7 | +3.2  | -32.5 | +32.5 | +0.0          | 38.8                 | 54.0                 | -15.2        | Horiz        |
| 18 | 5565.00     | 47.5               | +1.2<br>-11.7 | +3.5  | -31.9 | +33.7 | +0.0          | 42.3                 | 54.0                 | -11.7        | Horiz        |
| 19 | 6492.50     | 45.7               | +1.3<br>+0.0  | +4.0  | -31.7 | +35.2 | +0.0          | 54.5                 | 74.0                 | -19.5        | Horiz        |
| 20 | 6492.50     | 45.7               | +1.3<br>-11.7 | +4.0  | -31.7 | +35.2 | +0.0          | 42.8                 | 54.0                 | -11.2        | Horiz        |
| 21 | 7420.00     | 46.2               | +1.2<br>+0.0  | +4.1  | -32.0 | +35.9 | +0.0          | 55.4                 | 74.0                 | -18.6        | Horiz        |
| 22 | 7420.00     | 46.2               | +1.2<br>-11.7 | +4.1  | -32.0 | +35.9 | +0.0          | 43.7                 | 54.0                 | -10.3        | Horiz        |
| 23 | 8347.50     | 47.2               | +1.2<br>+0.0  | +4.4  | -33.5 | +37.1 | +0.0          | 56.4                 | 74.0                 | -17.6        | Horiz        |
| 24 | 8347.50     | 47.2               | +1.2<br>-11.7 | +4.4  | -33.5 | +37.1 | +0.0          | 44.7                 | 54.0                 | -9.3         | Horiz        |
| 25 | 9275.00     | 44.7               | +1.2<br>-11.7 | +4.4  | -33.8 | +37.1 | +0.0          | 41.9                 | 54.0                 | -12.1        | Horiz        |

**Nemko USA, Inc.**

FCC PART 15, SUBPART C & Industry Canada RSS-210

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

## **Section 7. Receiver Spurious**

|   |                          |
|---|--------------------------|
| NAME OF TEST: Spurious Emissions (Radiated) | PARA. NO.: RSS-Gen 7.2.3 |
| TESTED BY: David Light                      | DATE: 14 June 2010       |

**Test Results:** Complies. The worst case emission was 35.4 dB $\mu$ V/m at 928 MHz. This is 10.6 dB below the specification limit of 40 dB $\mu$ V/m.

**Measurement Data:** This was the only emission within 20 dB of the specification limit.

**Equipment Used:** 1464-1484-1485-1480-993-1016-791

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

**Temperature:** 22 °C

**Relative Humidity:** 35 %

**Analyzer Settings:** Emissions < 1 GHz RBW/VBW=100 kHz Peak detector  
Emissions > 1 GHz RBW/VBW=1 MHz Peak detector

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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

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## **Section 8. Test Equipment List**

| Asset Tag | Description          | Manufacturer    | Model              | Serial #   | Last Cal    | Next Cal    |
|-----------|----------------------|-----------------|--------------------|------------|-------------|-------------|
| 802       | Near Field Probe Set | EMCO            | 7405               | 103        | CNR         | NA          |
| 993       | Antenna, Horn        | A.H. Systems    | SAS-200/571        | 162        | 09-Sep-2009 | 09-Sep-2011 |
| 1016      | Preamplifier         | Hewlett Packard | 8449A              | 2749A00159 | 23-Jun-2009 | 23-Jun-2010 |
| 1082      | Cable, 2m            | Astrolab        | 32027-2-29094-72TC |            | CBU         | NA          |
| 1464      | Spectrum Analyzer    | Hewlett Packard | 8563E              | 3551A04428 | 27-Feb-2009 | 27-Feb-2011 |
| 1480      | Antenna, Bilog       | Schaffner-Chase | CBL6111C           | 2572       | 28-Jan-2009 | 28-Jan-2010 |
| 1484      | Cable                | Storm           | PR90-010-072       |            | 23-Jun-2009 | 23-Jun-2010 |
| 1485      | Cable                | Storm           | PR90-010-216       |            | 23-Jun-2009 | 23-Jun-2010 |

**Nemko USA, Inc.**

FCC PART 15, SUBPART C & Industry Canada RSS-210

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

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## **ANNEX A - TEST DETAILS**

**Nemko USA, Inc.**

FCC PART 15, SUBPART C & Industry Canada RSS-210

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

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. Alternatively, frequency hopping systems operating in the 2400-2483.5 MHz band may have hopping channel carrier frequencies that are separated by 25 kHz or two-thirds of the 20 dB bandwidth of the hopping channel, whichever is greater, provided the systems operate with an output power no greater than 125 mW.

NAME OF TEST: Time of Occupancy

PARA. NO.: 15.247(a)(1)

**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 0.4 seconds multiplied by the number of hopping channels employed. |
| 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

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.

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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

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NAME OF TEST: Occupied Bandwidth

PARA. NO.: 15.247(a)(1)

**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      |

**Nemko USA, Inc.**

FCC PART 15, SUBPART C &amp; Industry Canada RSS-210

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

**EQUIPMENT:** MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

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

**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 ( $\mu$ 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:**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: &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 Δ: 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 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      |

**Nemko USA, Inc.**

FCC PART 15, SUBPART C &amp; Industry Canada RSS-210

FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER  
*EQUIPMENT: MIC-WRL-TRN-400*

PROJECT NO.: 44215RUS1

NAME OF TEST: Radiated Spurious Emissions

PARA. NO.: 15.247(d)

**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      |

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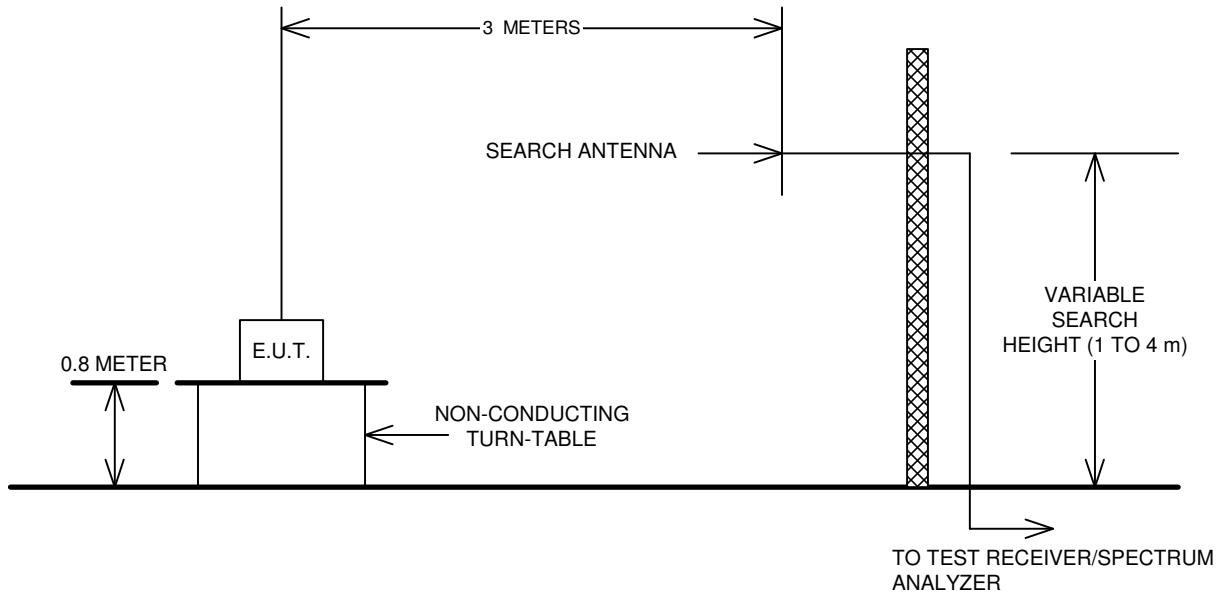
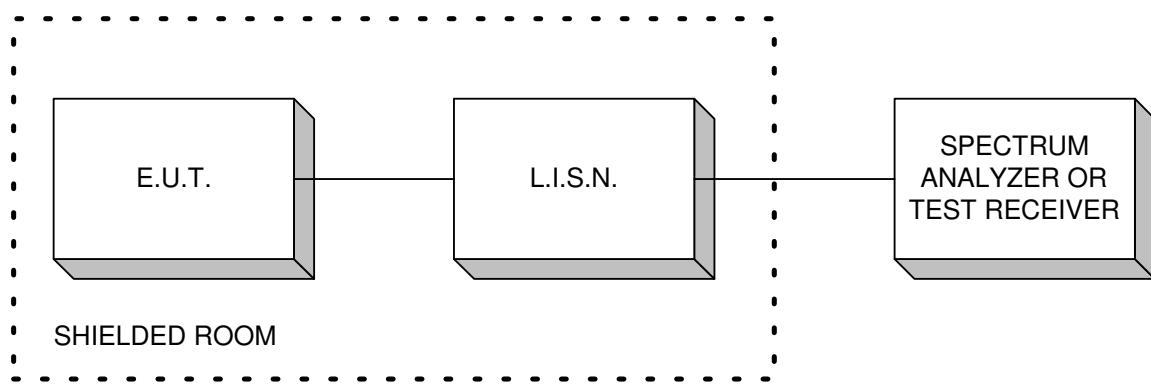
FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

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## **ANNEX B - TEST DIAGRAMS**

**Test Site For Radiated Emissions****Conducted Emissions**

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FREQUENCY HOPPING SPREAD SPECTRUM TRANSMITTER

*EQUIPMENT:* MIC-WRL-TRN-400

PROJECT NO.: 44215RUS1

**Peak Power at Antenna Terminals**

