



Nemko Test Report: 2171RUS1

Applicant: RF Monolithics, Inc.
4441 Sigma Road
Dallas, Texas 75244
USA

Equipment Under Test: DM1810 Mesh Modules
(E.U.T.)

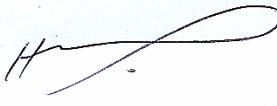
In Accordance With: FCC Part 15, Subpart C, 15.247
Digital Transmission System Transmitter

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

TESTED BY: 

David Light, Senior Wireless Engineer

DATE : 12 April 2007

APPROVED BY: 

Harry Ward, Verifier

DATE : 13th April 2007

Number of Pages: 34

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Section 1. Summary of Test Results

Manufacturer: RF Monolithics, Inc.

Model No.: DM1810-916MN (Node Module)
DM1810-916MR (Router Module)
DM1810-916MB (Base station Module)

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 Digital Transmission Systems. 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".



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Summary Of Test Data

| NAME OF TEST | PARA. NO. | RESULT |
|-------------------------------|---------------------|----------|
| Powerline Conducted Emissions | 15.207(a) | NA |
| Minimum 6 dB Bandwidth | 15.247(a)(2) | Complies |
| Maximum Peak Power Output | 15.247(b)(3) | Complies |
| Conducted Spurious Emissions | 15.247(d) | NT |
| Radiated Spurious Emissions | 15.247(d)/15.209(a) | Complies |
| Peak Power Spectral Density | 15.247(e) | Complies |

Footnotes:

NA – The device is battery powered.

NT – The device has integral antenna(s).

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

Frequency Band (MHz): 902-928 2400-2483.5 5725-5850

Operating Frequency of Test Sample: 916.5 +/-200 kHz

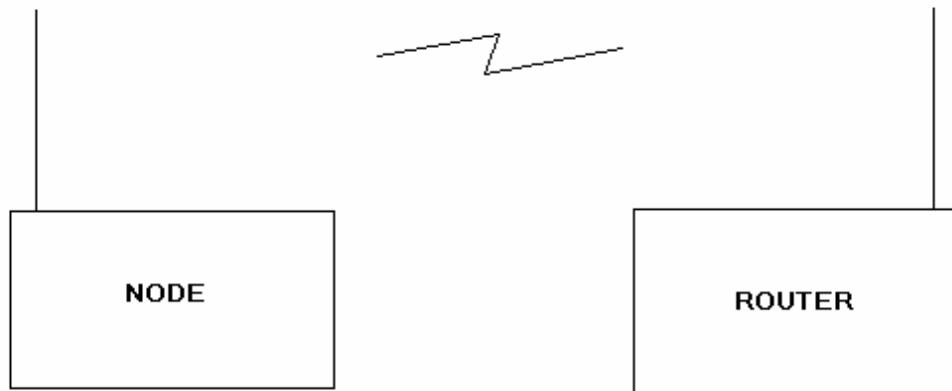
Channel Spacing: Single channel operation

User Frequency Adjustment: None

Input Power:

Description of EUT

The DM1800 family is designed for adding wireless mesh network connectivity to a wide range of monitoring and control systems. The device operates on a single channel in the 900 MHz ISM band.

System Diagram

Nemko USA, Inc.

EQUIPMENT: DM1800 Mesh Modules

FCC PART 15, SUBPART C

Digital Transmission Systems

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Section 3. Occupied Bandwidth

| | |
|----------------------------------|-------------------------|
| NAME OF TEST: Occupied Bandwidth | PARA. NO.: 15.247(a)(2) |
| TESTED BY: David Light | DATE: 12 April 2007 |

Test Results: Complies.

Measurement Data: See 6 dB BW plot

Measured 6 dB bandwidth:

1.07 MHZ

Channel Separation:

NA

Test Conditions: 40 %RH
22 °C

Measurement Uncertainty: $\pm 1 \times 10^{-7}$ ppm

Test Equipment Used: 1464-1484-1485-993

Nemko USA, Inc.

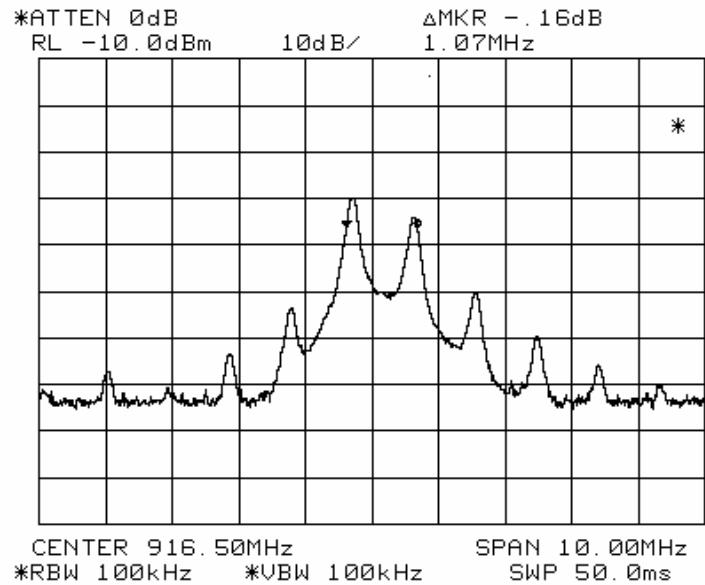
EQUIPMENT: DM1800 Mesh Modules

FCC PART 15, SUBPART C

Digital Transmission Systems

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Test Data – Occupied Bandwidth



Section 4. Maximum Peak Output Power

| | |
|---|-------------------------|
| NAME OF TEST: Maximum Peak Output power | PARA. NO.: 15.247(b)(3) |
| TESTED BY: David Light | DATE: 12 April 2007 |

Test Results: Complies.**Measurement Data:** Refer to attached data

Maximum PEAK conducted power is estimated to be 5.8 mW (7.6dBm) max based on stated antenna gain of 0 dBi.

Test Conditions: 40 %RH
22 °C**Measurement Uncertainty:** +/-1.7 dB**Test Equipment Used:** 1464-1484-1485-993

- 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(m).
- This test was performed radiated.

Test Data – Peak Power

| <u>EIRP Substitution Method</u> | | | | | | | | | | |
|--|---------------------------|--------------------------------|-------------------------|-------------------------|---------------------------------------|---|----------------|----------------|----------|-----------------------------|
| Page <u>1</u> of <u>1</u> | | | | | | | | | | |
| Job No.: | 2171 | | Date: 4/12/2007 | | | Complete <input checked="" type="checkbox"/> X Preliminary _____ | | | | |
| Specification: | 15.247(b)(3) | | Temperature(°C): 40 | | | | | | | |
| Tested By: | David Light | | Relative Humidity(%) 22 | | | | | | | |
| E.U.T.: | DM1800 | | | | | | | | | |
| Configuration: | Tx modulated signal | | | | | | | | | |
| Sample No: | 1/2/3/4 | | | | | | | | | |
| Location: | AC 3 | | RBW: 2 MHz | | | Measurement | | | | |
| Detector Type: | Peak | | VBW: 3 MHz | | | Distance: 3 m | | | | |
| Test Equipment Used | | | | | | | | | | |
| Antenna: | 993 | | Directional Coupler: | | | | | | | |
| Pre-Amp: | | | Cable #1: 1484 | | | | | | | |
| Filter: | | | Cable #2: 1485 | | | | | | | |
| Receiver: | 1464 | | Cable #3: | | | | | | | |
| Attenuator #1 | | | Cable #4: | | | | | | | |
| Attenuator #2: | | | Mixer: | | | | | | | |
| Additional equipment used: | | | | | | | | | | |
| Measurement Uncertainty: +/-1.7 dB | | | | | | | | | | |
| Frequency (MHz) | Meter Reading (dBm) | Substitution Level (dBm) | | Pre-Amp Gain (dB) | Substitution Antenna Gain (dBi) | EIRP (dBm) | Limit (dBm) | Margin (dB) | Polarity | Comments |
| 916.5 | -29.8 | 0.2 | | 0 | 5.8 | 6.0 | 36.0 | -30.0000 | H | Upright straight antenna |
| 916.5 | -30.6 | -0.6 | | 0 | 5.8 | 5.2 | 36.0 | -30.8000 | H | Horizontal straight antenna |
| 916.5 | -28.6 | 1.4 | | 0 | 5.8 | 7.2 | 36.0 | -28.8000 | H | Upright coil antenna |
| 916.5 | -28.2 | 1.8 | | 0 | 5.8 | 7.6 | 36.0 | -28.4000 | H | Horizontal coil antenna |
| Notes: EIRP = Substitution level (dBm) + Substitution antenna gain (dBi) | | | | | | | | | | |

Section 5. Radiated Spurious Emissions

| | |
|---|-----------------------|
| NAME OF TEST: Radiated Spurious Emissions | PARA. NO.: 15.247 (d) |
| TESTED BY: David Light | DATE: 12 April 2007 |

Test Results: Complies.**Measurement Data:** See attached table.**Test Conditions:** 40 %RH
22 °C**Measurement Uncertainty:** +/-3.6 dB**Test Equipment Used:** 1464-1484-1485-993-1016-759-760-791**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 per 15.33
- The device was tested on three channels per 15.31(l).
- No emissions were detected within 20 dB of the specification limit therefore none are reported per 15.31(o). Band edge data is presented below.

RBW=VBW=100 kHz below 1000 MHz

RBW=VBW=1 MHz above 1000 MHz (Peak)

RBW=VBW = 1 MHz (Average) **(Duty Cycle)****Average reading (dBm) = Peak reading (dBm) + duty cycle (dB)**

Radiated Emissions

Test Data – Horizontal Monopole Antenna

| Measurement Data: Reading listed by frequency. | | | | Test Distance: 3 Meters | | | | | | |
|--|--------------------|---------------------|--|-------------------------|-------|---------------|----------------------|----------------------|--------------|--------------|
| Freq MHz | Rdng dB μ V | Horn 2 GHz dB | Cable dB | Cable dB | Pre-A | Dist Table | Corr dB μ V/m | Spec dB μ V/m | Margin dB | Polar Ant |
| 1833.0 | 54.8 | +27.2 -2.5 | +0.7 80 dB μ V/m limit is -20 dBc from carrier | +2.1 | -32.1 | +0.0 | 50.2 | 80.0 | -29.8 | Vert |
| 2749.5 | 51.8 | +29.4 +0.0 | +0.8 | +2.9 | -32.7 | +0.0 | 52.2 | 54.0 | -1.8 | Vert |
| 3666.0 | 51.2 | +30.5 +0.0 | +0.8 | +2.8 | -32.3 | +0.0 | 53.0 | 54.0 | -1.0 | Vert |

| Measurement Data: Reading listed by frequency. | | | | Test Distance: 3 Meters | | | | | | |
|--|--------------------|---------------------|--|-------------------------|-------|---------------|----------------------|----------------------|--------------|--------------|
| Freq MHz | Rdng dB μ V | Horn 2 GHz dB | Cable dB | Cable dB | Pre-A | Dist Table | Corr dB μ V/m | Spec dB μ V/m | Margin dB | Polar Ant |
| 1833.0 | 60.8 | +27.2 -2.5 | +0.7 80 dB μ V/m limit is -20 dBc from carrier | +2.1 | -32.1 | +0.0 | 56.2 | 80.0 | -23.8 | Horiz |
| 2749.5 | 48.3 | +29.4 +0.0 | +0.8 | +2.9 | -32.7 | +0.0 | 48.7 | 54.0 | -5.3 | Horiz |
| 3666.0 | 45.5 | +30.4 +0.0 | +0.8 | +2.8 | -32.3 | +0.0 | 47.2 | 54.0 | -6.8 | Horiz |
| 5499.0 | 42.8 | +33.8 +0.0 | +1.2 | +3.5 | -31.7 | +0.0 | 49.6 | 54.0 | -4.4 | Horiz |

Radiated Emissions**Test Data – Vertical Monopole Antenna**

Measurement Data: Reading listed by frequency. Test Distance: 3 Meters

| Freq MHz | Rdng dB μ V | Horn | Cable | Cable | Pre-A | Dist Table | Corr dB μ V/m | Spec dB μ V/m | Margin dB | Polar Ant |
|----------------|--------------------|-----------------------|----------------------|-------|-------|---------------|---|----------------------|--------------|--------------|
| | | 2 GHz dB | Duty dB | dB | dB | | | | | |
| 1665.5 | 55.2 | +25.8 -2.5 +0.0 | +0.7 +2.1 +0.0 | +1.9 | -31.9 | +0.0 | 49.2 | 54.0 | -4.8 | Vert |
| 1833.0 | 59.8 | +27.2 -2.5 +0.0 | +0.7 +2.1 +0.0 | +2.1 | -32.1 | +0.0 | 55.2 80 dB μ V/m limit is -20 dBc from carrier | 80.0 | -24.8 | Vert |
| 2749.5 | 51.2 | +29.4 +0.0 +0.0 | +0.8 +2.9 +0.0 | +2.9 | -32.7 | +0.0 | 51.6 | 54.0 | -2.4 | Vert |
| 3666.0 | 52.5 | +30.5 +0.0 +0.0 | +0.8 +2.8 +0.0 | +2.8 | -32.3 | +0.0 | 54.3 | 74.0 | -19.7 | Vert |
| Average | | +30.8 +0.0 | +0.9 | +2.9 | -32.1 | +0.0 | 41.5 | 54.0 | -12.5 | Vert |
| | | +0.0 | -6.0 | | | | Average | | | |

Measurement Data: Reading listed by frequency. Test Distance: 3 Meters

| Freq MHz | Rdng dB μ V | Horn | Cable | Cable | Pre-A | Dist Table | Corr dB μ V/m | Spec dB μ V/m | Margin dB | Polar Ant |
|-------------|--------------------|---------------|--------------|-------|-------|---------------|---|----------------------|--------------|--------------|
| | | 2 GHz dB | dB | dB | dB | | | | | |
| 1833.5 | 59.8 | +27.2 -2.5 | +0.7 +2.1 | +2.1 | -32.1 | +0.0 | 55.2 80 dB μ V/m limit is -20 dBc from carrier | 80.0 | -24.8 | Horiz |
| 1935.1 | 54.2 | +28.0 -2.5 | +0.7 +2.2 | +2.2 | -32.4 | +0.0 | 50.2 | 54.0 | -3.8 | Horiz |
| 2749.5 | 49.7 | +29.4 +0.0 | +0.8 +2.9 | +2.9 | -32.7 | +0.0 | 50.1 | 54.0 | -3.9 | Horiz |
| 3666.0 | 46.5 | +30.5 +0.0 | +0.8 +2.8 | +2.8 | -32.3 | +0.0 | 48.3 | 54.0 | -5.7 | Horiz |

Test Data – Horizontal Coil Antenna

Measurement Data: Reading listed by frequency. Test Distance: 3 Meters

| Freq MHz | Rdng dB μ V | Horn | Cable | Cable | Pre-A | Dist Table | Corr dB μ V/m | Spec dB μ V/m | Margin dB | Polar Ant |
|-------------|--------------------|---------------|--------------|-------|-------|---------------|---|----------------------|--------------|--------------|
| | | 2 GHz dB | dB | dB | dB | | | | | |
| 1833.5 | 57.3 | +27.2 -2.5 | +0.7 +2.1 | +2.1 | -32.1 | +0.0 | 52.7 80 dB μ V/m limit is -20 dBc from carrier | 80.0 | -27.3 | Vert |
| 2749.5 | 48.5 | +29.4 +0.0 | +0.8 +2.9 | +2.9 | -32.7 | +0.0 | 48.9 | 54.0 | -5.1 | Vert |
| 3666.0 | 51.5 | +30.5 +0.0 | +0.8 +2.8 | +2.8 | -32.3 | +0.0 | 53.3 | 54.0 | -0.7 | Vert |

Radiated Emissions**Test Data – Horizontal Coil Antenna (continued)**

Measurement Data: Reading listed by frequency. Test Distance: 3 Meters

| Freq MHz | Rdng dB μ V | Horn | Cable | Cable | Pre-A | Dist Table | Corr dB μ V/m | Spec dB μ V/m | Margin dB | Polar Ant |
|-------------|--------------------|---------------|-------|-------|---|---------------|----------------------|----------------------|--------------|--------------|
| | | 2 GHz dB | | | | | | | | |
| 1833.0 | 59.0 | +27.2 -2.5 | +0.7 | +2.1 | -32.1 | +0.0 | 54.4 | 80.0 | -25.6 | Horiz |
| | | | | | 80 dB μ V/m limit is -20 dBc from carrier | | | | | |
| 2749.5 | 46.2 | +29.4 +0.0 | +0.8 | +2.9 | -32.7 | +0.0 | 46.6 | 54.0 | -7.4 | Horiz |
| 3666.0 | 46.0 | +30.5 +0.0 | +0.8 | +2.8 | -32.3 | +0.0 | 47.8 | 54.0 | -6.2 | Horiz |

Test Data – Vertical Coil Antenna

Measurement Data: Reading listed by frequency. Test Distance: 3 Meters

| Freq MHz | Rdng dB μ V | Horn | Cable | Cable | Pre-A | Dist Table | Corr dB μ V/m | Spec dB μ V/m | Margin dB | Polar Ant |
|-------------|--------------------|---------------|-------|-------|-------|---------------|----------------------|----------------------|--------------|--------------|
| | | 2 GHz dB | | | | | | | | |
| 1833.0 | 54.7 | +27.2 -2.5 | +0.7 | +2.1 | -32.1 | +0.0 | 50.1 | 80.0 | -29.9 | Vert |
| 2749.5 | 48.2 | +29.4 +0.0 | +0.8 | +2.9 | -32.7 | +0.0 | 48.6 | 54.0 | -5.4 | Vert |
| 3666.0 | 51.0 | +30.5 +0.0 | +0.8 | +2.8 | -32.3 | +0.0 | 52.8 | 54.0 | -1.2 | Vert |

Measurement Data: Reading listed by frequency. Test Distance: 3 Meters

| Freq MHz | Rdng dB μ V | Horn | Cable | Cable | Pre-A | Dist Table | Corr dB μ V/m | Spec dB μ V/m | Margin dB | Polar Ant |
|-------------|--------------------|---------------|-------|-------|-------|---------------|----------------------|----------------------|--------------|--------------|
| | | 2 GHz dB | | | | | | | | |
| 1833.0 | 59.5 | +27.2 -2.5 | +0.7 | +2.1 | -32.1 | +0.0 | 54.9 | 80.0 | -25.1 | Horiz |
| 3666.0 | 46.7 | +30.5 +0.0 | +0.8 | +2.8 | -32.3 | +0.0 | 48.5 | 54.0 | -5.5 | Horiz |

* NOTE – All measurements are PEAK unless otherwise noted. See duty cycle calculation on page 17.

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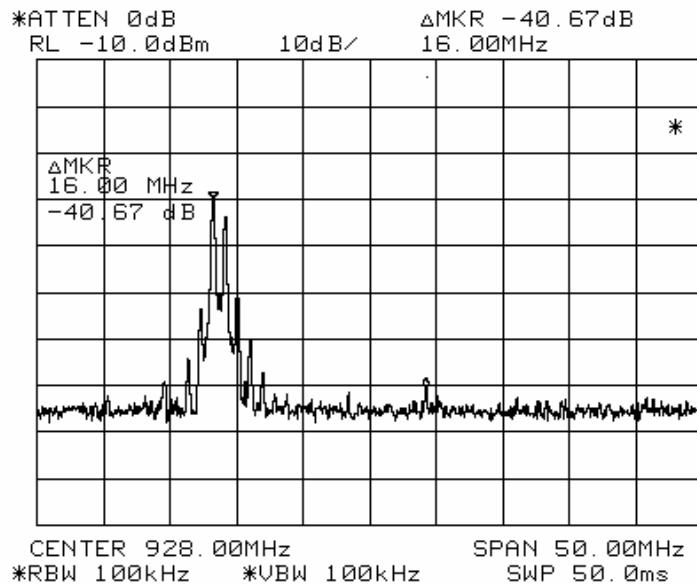
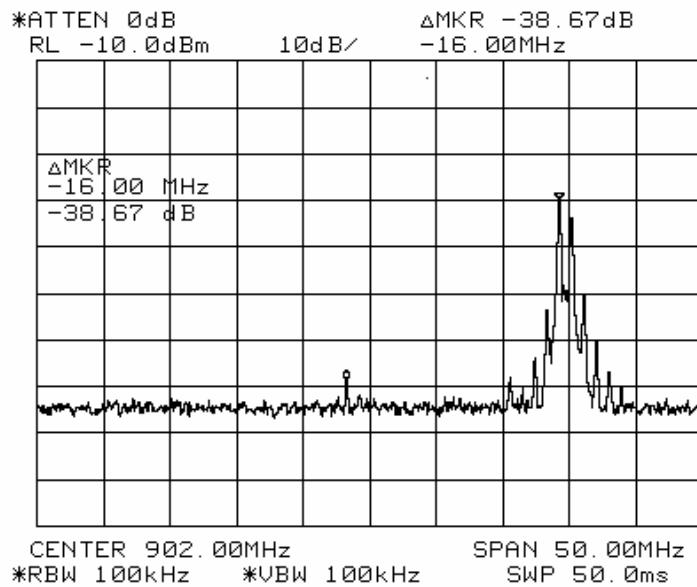
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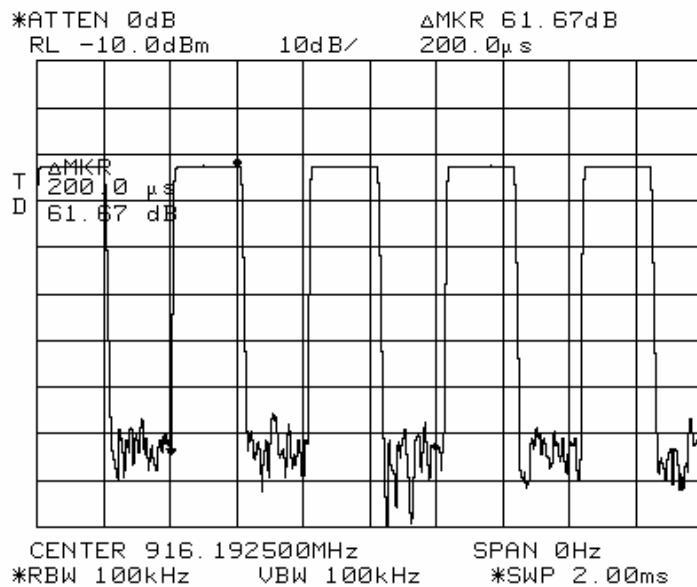
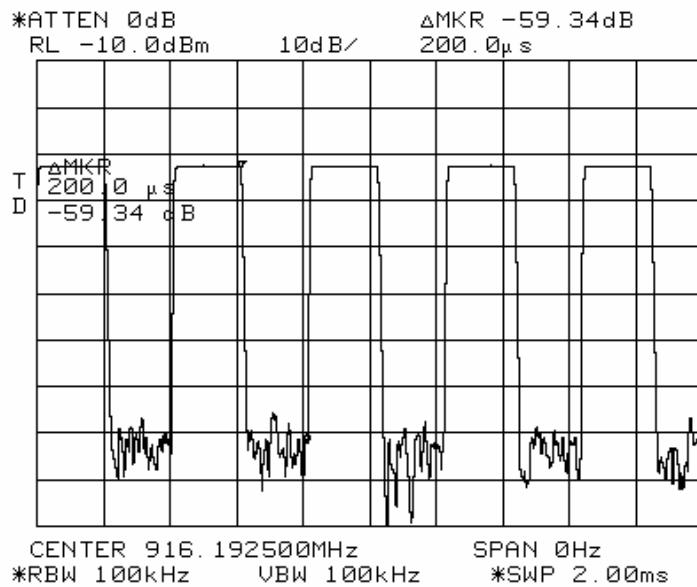
Digital Transmission Systems

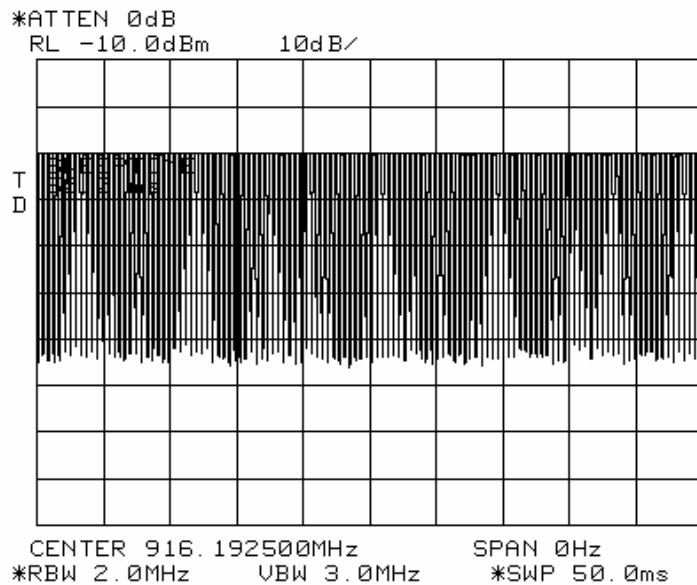
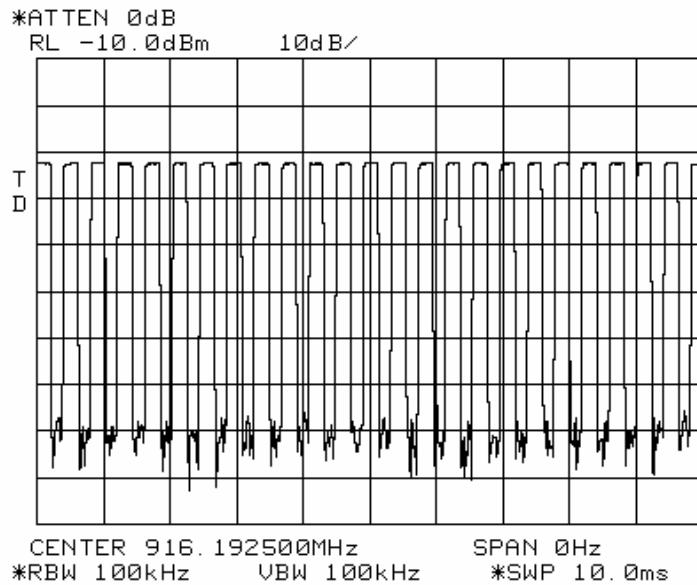
Test Report No.: 2171RUS1

EQUIPMENT: DM1800 Mesh Modules

Band Edges



Duty Cycle**ON Time****OFF Time**

Duty Cycle

Duty Cycle Correction (dB) = $20\log(\text{Time on}/100\text{mS}) = 20\log(50/100) = -6 \text{ dB}$

Nemko USA, Inc.

EQUIPMENT: DM1800 Mesh Modules

FCC PART 15, SUBPART C

Digital Transmission Systems

Test Report No.: 2171RUS1

Section 6. Peak Power Spectral Density

| | |
|---|----------------------|
| NAME OF TEST: Peak Power Spectral Density | PARA. NO.: 15.247(e) |
| TESTED BY: David Light | DATE: 12 April 2007 |

Test Results: Complies.

Measurement Data: See attached data..

Test Conditions: 44 %RH
22 °C

Measurement Uncertainty: +/-1.7 dB

Test Equipment Used: 993-1464-1484-1485

Note: This test was performed radiated.

Peak Power Spectral Density

| <u>EIRP Substitution Method</u> | | | | | | | | | | |
|--|---------------------------|--------------------------------|--|--------------------------------|---------------------------------------|-------------------|----------------|----------------------|----------|--------------------------|
| Page <u>1</u> of <u>1</u> | | Job No.: <u>2171</u> | | Date: <u>4/12/07</u> | | Complete <u>X</u> | | | | |
| Specification: <u>15.247</u> | | Temperature(°C): <u>44</u> | | | | Preliminary _____ | | | | |
| Tested By: <u>David Light</u> | | Relative Humidity(%) <u>22</u> | | | | | | | | |
| E.U.T.: <u>DM1800</u> | | | | | | | | | | |
| Configuration: <u>Tx modulated carrier</u> | | | | | | | | | | |
| Sample No: <u>1/2/3/4</u> | | | | RBW: <u>3 kHz</u> | | | | | | |
| Location: <u>AC 3</u> | | | | VBW: <u>3 kHz</u> | | | | Measurement | | |
| Detector Type: <u>Peak</u> | | | | Sweep Time: <u>500 Seconds</u> | | | | Distance: <u>3</u> m | | |
| Test Equipment Used | | | | | | | | | | |
| Antenna: <u>993</u> | | | | Span <u>1.5 MHz</u> | | | | | | |
| Pre-Amp: _____ | | | | Directional Coupler: _____ | | | | | | |
| Filter: _____ | | | | Cable #1: <u>1484</u> | | | | | | |
| Receiver: <u>1464</u> | | | | Cable #2: <u>1485</u> | | | | | | |
| Attenuator #1 _____ | | | | Cable #3: _____ | | | | | | |
| Attenuator #2: _____ | | | | Cable #4: _____ | | | | | | |
| Additional equipment used: _____ | | | | | | | | | | |
| Measurement Uncertainty: <u>+/-3.6 dB</u> | | | | | | | | | | |
| Frequency (MHz) | Meter Reading (dBm) | Substitution Level (dBm) | | Pre-Amp Gain (dB) | Substitution Antenna Gain (dBi) | EIRP (dBm) | Limit (dBm) | Margin (dB) | Polarity | Comments |
| 916.5 | -35.6 | -5.6 | | 0 | 5.8 | 0.2 | 8.0 | -7.8000 | H | Upright monopole density |
| 916.5 | -32.6 | -2.6 | | 0 | 5.8 | 3.2 | 8.0 | -4.8000 | H | Flat monopole density |
| 916.5 | -35.2 | -5.2 | | 0 | 5.8 | 0.6 | 8.0 | -7.4000 | H | Upright coil density |
| 916.5 | -34.0 | -4.0 | | 0 | 5.8 | 1.8 | 8.0 | -6.2000 | H | Vertical coil density |
| Notes: _____ | | | | | | | | | | |

EIRP = Substitution Level (dBm) + Substitution Antenna Gain (dBi)

Nemko USA, Inc.

EQUIPMENT: DM1800 Mesh Modules

FCC PART 15, SUBPART C

Digital Transmission Systems

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Section 7. Receiver Spurious Emissions

| | |
|---|------------------------|
| NAME OF TEST: Receiver Spurious Emissions | PARA. NO.: RSS-Gen 4.8 |
| TESTED BY: Brian Boyea | DATE: 18 April 2007 |

Test Results: Complies.

Measurement Data: There were no emissions detected above the noise floor. Worst case noise floor level was 29.9 dB μ V/m at 750 MHz.

Test Conditions: 45 %RH
 25 °C

Measurement Uncertainty: +/-3.7 dB

Test Equipment Used: 993-760-1311-1016-1514-1659-BOATS

Section 8. Test Equipment List

| Nemko ID | Description | Manufacturer Model Number | Serial Number | Calibration Date | Calibration Due |
|----------|---------------------------|-----------------------------|---------------|------------------|-----------------|
| 759 | ANTENNA, LOG PERIODIC | A.H. SYSTEMS SAS-200/510 | 556 | 03/30/07 | 03/30/08 |
| 760 | Antenna biconical | Electro Metrics MFC-25 | 477 | 01/19/07 | 01/19/08 |
| 1016 | Pre-Amp | HEWLETT PACKARD 8449A | 2749A00159 | 04/20/06 | 04/20/07 |
| 791 | PREAMP, 25dB | Nemko USA, Inc. LNA25 | 398 | 04/20/06 | 04/20/07 |
| 1464 | Spectrum analyzer | Hewlett Packard 8563E | 3551A04428 | 01/24/07 | 01/24/09 |
| 1484 | Cable | Storm PR90-010-072 | N/A | 10/02/06 | 10/02/07 |
| 1485 | Cable | Storm PR90-010-216 | N/A | 10/02/06 | 10/02/07 |
| 993 | Horn antenna | A.H. Systems SAS-200/571 | XXX | 08/01/05 | 08/02/07 |
| 1311 | ANTENNA, LOG PERIODIC | EMCO 3146 | 1753 | 01/18/07 | 01/18/08 |
| 1514 | CABLE ASSY, LAB 2- B OATS | Nemko USA, Inc. SITE B OATS | N/A | 06/08/06 | 06/08/07 |
| 1554 | Amplifier, RF | RF Consultants LNA-25 | 0 | 09/29/06 | 09/29/07 |
| 1659 | Spectrum Analyzer | Rhode & Schwarz FSP | 973353 | 01/24/07 | 01/24/09 |
| B OATS | Open Area Test Site | Nemko USA, Inc. None | B | 03/21/06 | 03/21/07 |

Nemko USA, Inc.

EQUIPMENT: DM1800 Mesh Modules

FCC PART 15, SUBPART C

Digital Transmission Systems

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ANNEX A - TEST DETAILS

Nemko USA, Inc.

EQUIPMENT: DM1800 Mesh Modules

FCC PART 15, SUBPART C
Digital Transmission Systems
Test Report No.: 2171RUS1

NAME OF TEST: Occupied Bandwidth

PARA. NO.: 15.247(a)(2)

Minimum Standard: The minimum 6 dB bandwidth shall be at least 500 kHz

NAME OF TEST: Maximum Peak Output Power

PARA. NO.: 15.247(b)(3)

Minimum Standard: The maximum peak output power shall not exceed 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.

Substitution Antenna Method for Integral Antennas:

The peak field strength of the carrier is measured in a worst-case configuration with a RBW > 5 times the occupied bandwidth of the transmitted waveform. For cases where the RBW of the test instrument is not sufficient, the power is measured using a peak power meter instead of the spectrum analyzer.

The RBW of the spectrum analyzer shall be set to a value greater than the measured 6 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: Occupied Bandwidth

PARA. NO.: 15.247(a)(2)

Minimum Standard: Systems using digital modulation techniques may operate in the 902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz bands. The minimum 6 dB bandwidth shall be at least 500 kHz.

Method Of Measurement:

The spectrum analyzer is set as follows:

RBW = VBW = 100 kHz.

Span: Sufficient to display 6 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: Spurious Emissions(conducted) | 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 (μ 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 IS SEARCHED TO THE 10th HARMONIC OF THE HIGHEST FREQUENCY GENERATED IN THE EUT.

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 (μ 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 |

NAME OF TEST: Transmitter Power Density

PARA. NO.: 15.247(d)

Minimum Standard: The transmitted power density averaged over any 1 second interval shall not be greater than +8 dBm in any 3 kHz bandwidth.

Method Of Measurement: The spectrum analyzer is set as follows:

RBW: 3 kHz

VBW: >3 kHz

Span: => measured 6 dB bandwidth

Sweep: Span(kHz)/3 (i.e. for a span of 1.5 MHz the sweep rate is $1500/3 = 500$ sec.

LOG dB/div.: 2 dB

Note: For devices with spectrum line spacing =< 3 kHz, the RBW of the analyzer is reduced until the spectral lines are resolved. The measurement data is normalized to 3 kHz by summing the power of all the individual spectral lines within a 3 kHz band in linear power units.

For Devices With Integral Antenna:

For devices with non-detachable antennas, the received field strength is peaked and the spectrum analyzer is set as above. The peak emission level is then measured and converted to a field strength by adding the appropriate antenna factor and cable loss. This field strength is then converted to an equivalent isotropic radiated power using the same method as described for Peak Power output.

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.

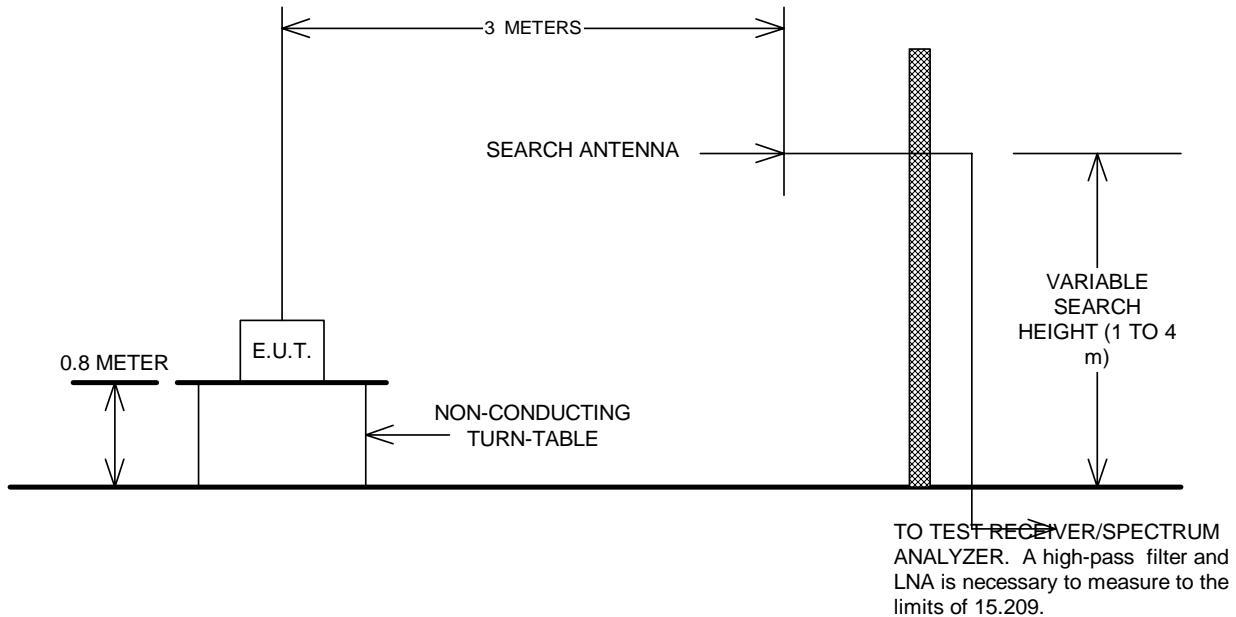
EQUIPMENT: DM1800 Mesh Modules

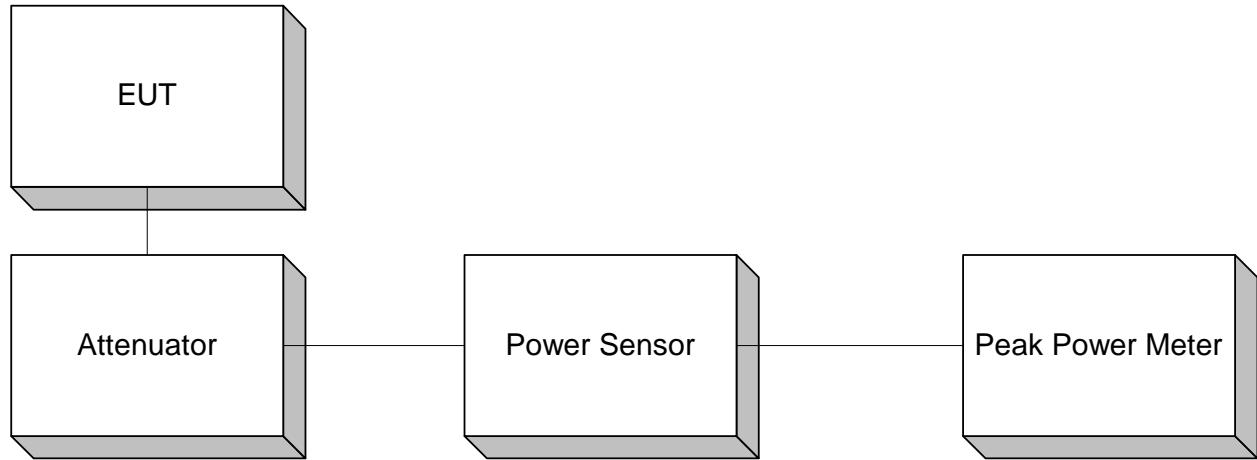
FCC PART 15, SUBPART C

Digital Transmission Systems

Test Report No.: 2171RUS1

ANNEX B - TEST DIAGRAMS

Test Site For Radiated Emissions

Peak Power At Antenna Terminals

Note: A spectrum analyzer may be substituted for Peak Power Meter given that the measurement bandwidth is sufficient to capture the 6 dB bandwidth of the transmitter.

**Minimum 6 dB Bandwidth
Peak Power Spectral Density
Spurious Emissions (conducted)**