

# **EXHIBIT 2B**

**Test Report Provided by  
Solectron (Ottawa)**

**Applicant: Nortel Networks**

**For Class II Permissive  
Change on:**

**AB6NT1900MFRM2**



## **Spurious Emissions Test Report for the MFRM-2 FCC Part 24 and Industry Canada RSS-133**

**Document Number:** KP000576-TR-RAD-04-01  
**Release Date:** December 4, 2003

**Prepared for:** Nortel Networks  
3500 Carling avenue  
Ottawa, Ontario  
Canada, K2H 8E9

**Author:** Denis Lalonde  
Radio Compliance Discipline Leader

**C-MAC Engineering Inc.**  
**A Solectron Company**  
21 Richardson Side Road,  
Kanata, Ontario, K2K 2C1  
<http://www.solectrontechnicalctr.com/>



---

© Copyright C-MAC Engineering Inc. December 4, 2003

The master of this document is stored on an electronic database and is "write-protected" and may be altered only by authorized persons at C-MAC Engineering Inc. Viewing of the master document electronically ensures access to the current issue. Any hard copies must be regarded as uncontrolled copies.

C-MAC Engineering Inc. accepts no liability for the content of this document except when it is reproduced in its entirety by a method acceptable to C-MAC Engineering Inc.

---

## Release Control Record

This document is based on CEI document template KG000347-TR-EMC-03.

| Release no. | Reason for change | Date released    |
|-------------|-------------------|------------------|
| 01          | Original version  | December 4, 2003 |

## Approvals

| Function                  | Name           | Job title                          | Signature                                                                                          |
|---------------------------|----------------|------------------------------------|----------------------------------------------------------------------------------------------------|
| Document Release Approval | Steve Tippet   | Manager, Design Validation Centre  | <br>4 Dec 2003   |
| Author                    | Denis Lalonde  | Radio Compliance Discipline Leader | <br>Dec 4, 2003  |
| Technical Reviewer        | Jacques Rollin | EMC Advisor                        | <br>Dec 4 2003 |

## Accreditations

C-MAC Engineering EMC test facilities are accredited by the Standards Council of Canada (SCC) in accordance with the scope of accreditation outlined in <http://www.scc.ca/scopes/reg126-eng-s.pdf>.



Through a Mutual Recognition Agreement (MRA) between the National Voluntary Laboratory Accreditation Program (NVLAP) and SCC, the accreditation status of this facility is valid for the U.S.

C-MAC Engineering is ISO 9001:2000 and ISO/IEC 17025 certified and its processes are documented in the C-MAC Engineering Quality Manual [3] and Lab Operations Manual [4].

# Table of Contents

|                                                                     |           |
|---------------------------------------------------------------------|-----------|
| <b>RELEASE CONTROL RECORD.....</b>                                  | <b>2</b>  |
| <b>APPROVALS .....</b>                                              | <b>2</b>  |
| <b>ACCREDITATIONS .....</b>                                         | <b>2</b>  |
| <b>TABLE OF CONTENTS .....</b>                                      | <b>3</b>  |
| <b>LIST OF FIGURES .....</b>                                        | <b>4</b>  |
| <b>LIST OF TABLES .....</b>                                         | <b>4</b>  |
| <b>1. EXECUTIVE SUMMARY.....</b>                                    | <b>6</b>  |
| <b>2. SCOPE AND PURPOSE .....</b>                                   | <b>7</b>  |
| <b>3. COMPLIANCE SUMMARY.....</b>                                   | <b>8</b>  |
| <b>4. EQUIPMENT UNDER TEST (EUT) .....</b>                          | <b>9</b>  |
| 4.1 PRODUCT FUNCTIONAL DESCRIPTION .....                            | 9         |
| 4.2 MANUFACTURER INFORMATION.....                                   | 10        |
| 4.3 POWER REQUIREMENTS.....                                         | 10        |
| 4.4 GROUNDING REQUIREMENTS .....                                    | 10        |
| 4.5 CLOCKS / OSCILLATORS / SWITCHING POWER SUPPLY FREQUENCIES ..... | 11        |
| 4.6 SYSTEM COMPONENTS .....                                         | 11        |
| 4.7 EUT INTERFACES AND CABLES .....                                 | 12        |
| 4.8 SUPPORT EQUIPMENT .....                                         | 13        |
| 4.9 SYSTEM SET-UP AND TEST CONFIGURATIONS .....                     | 13        |
| 4.10 EUT OPERATIONS AND SOFTWARE.....                               | 14        |
| 4.11 SYSTEM MODIFICATIONS .....                                     | 15        |
| 4.12 SYSTEM INVENTORY LIST .....                                    | 15        |
| <b>5. GENERAL TEST CONDITIONS .....</b>                             | <b>16</b> |
| 5.1 TEST FACILITY .....                                             | 16        |
| 5.2 MEASUREMENT INSTRUMENTATION.....                                | 16        |
| <b>6. E-FIELD RADIATED EMISSIONS .....</b>                          | <b>17</b> |
| 6.1 TEST SPECIFICATION .....                                        | 17        |
| 6.1.1 Limits.....                                                   | 17        |
| 6.1.1.1 FCC Part 2.1053.....                                        | 17        |
| 6.1.1.2 FCC Part 2.1057.....                                        | 17        |
| 6.1.1.3 FCC Part 24.238.....                                        | 17        |
| 6.1.1.4 RSS-133 Section 6.3 .....                                   | 18        |
| 6.1.2 Field strength limit equivalent .....                         | 18        |
| 6.2 TEST FACILITY INFORMATION.....                                  | 19        |

|           |                                            |           |
|-----------|--------------------------------------------|-----------|
| 6.3       | TEST CONFIGURATIONS .....                  | 19        |
| 6.4       | TEST PROCEDURE.....                        | 19        |
| 6.5       | TEST RESULTS.....                          | 20        |
| 6.6       | PRESCAN MEASUREMENT UNCERTAINTIES .....    | 21        |
| 6.7       | CALCULATION OF THE COMPLIANCE MARGIN.....  | 22        |
| 6.8       | TEST CONCLUSION .....                      | 22        |
| 6.9       | TEST EQUIPMENT LIST .....                  | 22        |
| <b>7.</b> | <b>REFERENCES .....</b>                    | <b>24</b> |
| 7.1       | APPLICABLE DOCUMENTS.....                  | 24        |
| 7.2       | REFERENCE DOCUMENTS.....                   | 24        |
| <b>8.</b> | <b>APPENDICES .....</b>                    | <b>25</b> |
| 8.1       | APPENDIX A: GLOSSARY .....                 | 25        |
| 8.2       | APPENDIX B: TEST SET-UP PHOTOGRAPHS .....  | 27        |
| 8.3       | APPENDIX C: RADIATED EMISSIONS PLOTS ..... | 28        |

## List of Figures

|                                                               |    |
|---------------------------------------------------------------|----|
| FIGURE 4-1: MFRM-2 PICTURE .....                              | 9  |
| FIGURE 4-2: SYSTEM GROUNDING.....                             | 10 |
| FIGURE 4-3: HARDWARE SET-UP FOR EMISSIONS .....               | 14 |
| FIGURE 4-4: EUT SHELF CONFIGURATION .....                     | 15 |
| FIGURE 8-1: MFRM-2 RADIATED EMISSION SET-UP.....              | 27 |
| FIGURE 8-2: E-FIELD RADIATED EMISSIONS, 30 – 1000 MHz .....   | 28 |
| FIGURE 8-3: E-FIELD RADIATED EMISSIONS, 1 GHz – 10 GHz .....  | 29 |
| FIGURE 8-4: E-FIELD RADIATED EMISSIONS, 10 GHz – 18 GHz ..... | 30 |
| FIGURE 8-5: E-FIELD RADIATED EMISSIONS, 18 GHz – 20 GHz ..... | 31 |

## List of Tables

|                                              |    |
|----------------------------------------------|----|
| TABLE 3-1: COMPLIANCE RESULTS SUMMARY .....  | 8  |
| TABLE 4-1: POWER REQUIREMENTS.....           | 10 |
| TABLE 4-2: EUT FUNDAMENTAL FREQUENCIES ..... | 11 |
| TABLE 4-3: SYSTEM COMPONENTS .....           | 11 |
| TABLE 4-4: SYSTEM CABLES .....               | 12 |
| TABLE 4-5 SUPPORT EQUIPMENT .....            | 13 |
| TABLE 4-6 MFRM-2 CHANNEL ASSIGNMENT .....    | 13 |

|                                                                                  |    |
|----------------------------------------------------------------------------------|----|
| TABLE 4-7: INVENTORY LIST .....                                                  | 15 |
| TABLE 6-1: E-FIELD RADIATED EMISSIONS REQUIREMENTS.....                          | 17 |
| TABLE 6-2: PRESCAN SPURIOUS EMISSIONS LIMITS FOR FCC PART 24 AND IC RSS-133..... | 19 |
| TABLE 6-3: PRESCAN E-FIELD RADIATED EMISSIONS TEST RESULTS .....                 | 21 |
| TABLE 6-4: SUBSTITUTION MEASUREMENT TEST RESULTS .....                           | 21 |
| TABLE 6-5: TEST EQUIPMENT USED FOR E-FIELD RADIATED EMISSIONS .....              | 22 |

# 1. Executive Summary

The MFRM-2 is a 1-sector, 3 carrier product, similar to the MFRM except that the MPAM and MTRM from the MFRM are integrated into a single module for MFRM-2. The resulting new module, named the MFRM-2 Radio Module, consists of the following: a wide voltage range Power Entry Module (WR MPEM); a High Power Converter Assembly (WR HCPA); a Radio Power Supply Unit (PSU); a transceiver card; a power amplifier (PA); interface cables; and mechanical assemblies.

At the request of the Customer Development group, C-MAC Engineering has evaluated the system radiated spurious emissions. This report describes the test results of the FCC Part 24 and Industry Canada RSS-133 radiated emissions tests performed on the MFRM-2 system.

This document outlines the regression test performed for a new cycle of the 1900 MHz CDMA Multi-carrier Flexible Radio Module-2 (MFRM-2). The Regression tests for MFRM-2 are required to file a permissive class change on the MFRM-2 product. Testing was conducted on a single indoor frame configured with 3 MFRM-2 modules.

On the basis of measurements performed in December 2003, the MFRM-2 is verified to be compliant with the radiated emissions requirements of FCC Part 24 and Industry Canada RSS-133. The test data included in this report apply to the product titled above manufactured by Nortel Networks.

## 2. Scope and Purpose

At the request of the Customer Development group, C-MAC Engineering has evaluated the system radiated spurious emissions. This report describes the test results of the FCC Part 24 and Industry Canada RSS-133 radiated emissions tests performed on the MFRM-2 system.



### 3. Compliance Summary

This section summarizes all the measurements performed on MFRM-2 and its compliance to FCC Part 24 and Industry Canada RSS-133.

**Table 3-1: Compliance Results Summary**

| Product Summary         |                              |                         |                 |      |                             |
|-------------------------|------------------------------|-------------------------|-----------------|------|-----------------------------|
| Product Name:           |                              | MFRM-2                  | Project Leader: |      | Steve Tippet                |
| Product Code:           |                              | NTGY30BA                | EMC Engineer:   |      | Denis Lalonde               |
| Product Release:        |                              | P4                      | Tester:         |      | Rick Poirier, Denis Lalonde |
| Product Status:         |                              |                         | Date:           |      | December 2 - 3, 2003        |
| Test Cases <sup>1</sup> |                              |                         |                 |      |                             |
| Completed               | Description                  | Specification           | Test Results    |      | Notes                       |
|                         |                              |                         | Pass            | Fail |                             |
| ■                       | Radiated Emissions (E-field) | FCC Part 24             | ■               | □    |                             |
| ■                       | Radiated Emissions (E-field) | Industry Canada RSS-133 | ■               | □    |                             |

1. All the emissions measurements were performed at C-MAC Engineering Inc., Kanata, Ontario.

## 4. Equipment Under Test (EUT)

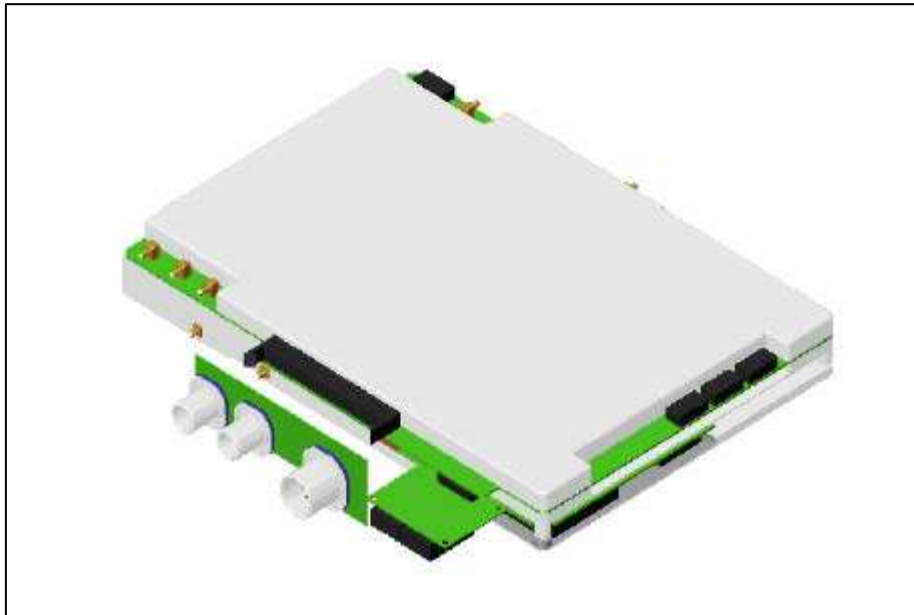
### 4.1 Product Functional Description

The MFRM-2 is a 1-sector, 3 carrier product, similar to the MFRM except that the MPAM and MTRM from the MFRM are integrated into a single module for MFRM-2. The resulting new module, named the MFRM-2 Radio Module, consists of the following: a wide voltage range Power Entry Module (WR MPEM); a High Power Converter Assembly (WR HCPA); a Radio Power Supply Unit (PSU); a transceiver card; a power amplifier (PA); interface cables; and mechanical assemblies.

This document outlines the regression test performed for a new cycle of the 1900 MHz CDMA Multi-carrier Flexible Radio Module-2 (MFRM-2). The Regression tests for MFRM-2 are required to file a permissive class change on the MFRM-2 product. Testing was conducted on a single indoor frame configured with 3 MFRM-2 modules.

The MFRM-2 Radio Brick is shown in Figure 4-1.

**Figure 4-1: MFRM-2 picture**



## 4.2 Manufacturer Information

Company Name Nortel Networks  
Mailing Address 3500 Carling avenue, Ottawa, Ontario, Canada, K2H 8E9  
Product Name MFRM-2  
Primary Technical Contact James Loo  
Title CDMA BTS RF Systems Development  
Phone 613-765-2441  
E-mail james.loo@nortelnetworks.com

## 4.3 Power Requirements

For the purposes of EMC testing, the power requirements were as follows:

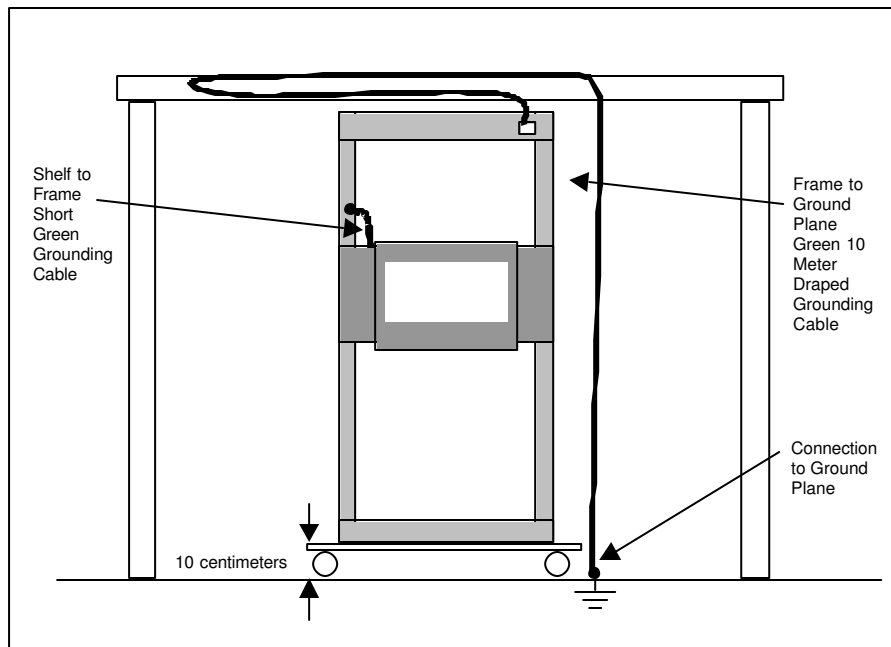
Table 4-1: Power Requirements

| Voltage  | Current  |
|----------|----------|
| -48 V DC | 70 A max |

## 4.4 Grounding Requirements

For the purposes of the EMC testing, the system was grounded in the same manner as its typical installation as shown in Figure 4-2.

Figure 4-2: System grounding



## 4.5 Clocks / Oscillators / Switching Power Supply Frequencies

Table 4-2 lists all the clock sources (e.g., discrete crystals and VCXOs) used in the configurations under test (and, where appropriate, the sub-multiples when clock division has been employed for distribution to other circuit packs).

**Table 4-2: EUT Fundamental Frequencies**

| Circuit Pack   | Fundamental Frequencies (MHz)                         |
|----------------|-------------------------------------------------------|
| Digital clocks | 24.0, 39.3216, 63.6976, 78.6432, 638.976              |
| Radio signals  | 9.8304, 19.2, 88.5, Tx_Freq + 9.8303, Tx_Freq - 153.6 |

Note: The tests in this document were done with Tx\_Freq = 1960.0 MHz

## 4.6 System Components

The system tested consists of the following units, as shown in Table 4-3 and Figure 4-1.

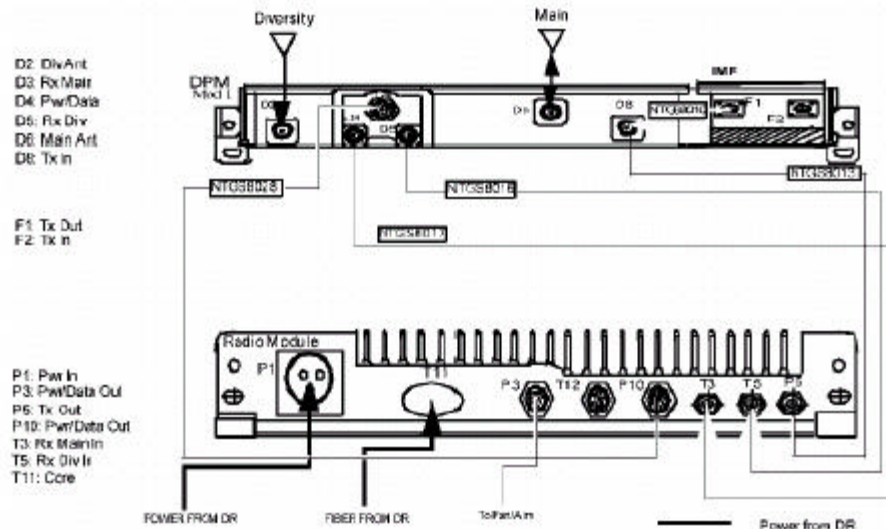
**Table 4-3: System Components**

| Component | Code     | Release | Quantity |
|-----------|----------|---------|----------|
| MFRM-2    | NTGY30BA | P4      | 3        |

## 4.7 EUT Interfaces and Cables

The system contained the following interfaces, as shown in Table 4-4:

Table 4-4: System Cables



Note: Subsequent 800MHz configurations will be illustrated with the optional IMF installed. Use the following table to determine the provisional cable requirements.

| CABLE TYPE | PEC      | FROM CONNECTOR                    | TO CONNECTOR                                   | NOTE |
|------------|----------|-----------------------------------|------------------------------------------------|------|
| RF         | NTGS8017 | D3 - DPM - Rx Main out            | T3 - Radio Module - Rx in                      | 2    |
| RF         | NTGS8016 | D5 - DPM - Rx Div out             | T5 - Radio Module - Rx in                      | 1    |
| RF         | NTGS8013 | P5 - Radio Module - Tx out        | D8 - DPM - Tx in (w/o IMF) or F2 - IMF - Tx in | 1    |
| RF         | NTGS8010 | F1 - IMF - Tx out                 | D8 - DPM - Tx in                               | 4    |
| Pwr/Data   | NTGS8028 | P10 - Radio Module - Pwr/Data out | D4 - DPM - Pwr/Data in                         | 1    |

NOTE: \* The IMF and NTGS8010 IMF jumper cable are to be provisioned together (optional).

1. This cable is part of the module assembly.

2. This cable is provisional.

## 4.8 Support Equipment

The support equipment is defined in Table 4-5.

**Table 4-5 Support Equipment**

| Quantity | Description               | Model                            | Release        | Serial Number                                |
|----------|---------------------------|----------------------------------|----------------|----------------------------------------------|
| 1        | PC                        | Dell GX200                       |                | 1337086                                      |
| 1        | Metrocell AC Digital Rack | NTGS35AA                         | 76             | SNMN5300M6DH                                 |
| 1        | Metrocell Radio Rack      | NTGS65AA                         |                | 1026236                                      |
| 1        | Core Module               | NTGS30AA                         | AK             | NNTM53597W7F                                 |
| 1        | Control Module            | NTGS40AA                         | EW             | NNTM532XY69H                                 |
| 1        | GPSTM                     | NTGS50AA                         | 14             | NNTM74TM3HGA                                 |
| 2        | XCEM                      | NTGS63BA<br>NTGS63BA             | 14<br>N2       | NNTM533BR6BU<br>NNTM533BRELC                 |
| 3        | 1900 MHz DPM              | NTGS53AA<br>NTGS53AA<br>NTGS53AA | 05<br>05<br>05 | CLWVPP201L64<br>CLWVPP201R1G<br>CLWVMM1009WH |
| 3        | FAM                       | NTGY60AH<br>NTGY60AH<br>NTGY60AH | N1<br>N1<br>N1 | SNMN5300MC0<br>NNTM533GR74T<br>NNTM533GR76V  |
| 2        | Fiber Cables              | NTGY5521                         |                |                                              |
| 1        | Indoor Alarm MDF Cable    | NTGS3518                         |                |                                              |

## 4.9 System Set-up and Test Configurations

The configuration used for radiated emissions is presented in Table 4-6, and Figure 4-3.

**Table 4-6 MFRM-2 channel assignment**

| Carrier        | Channel | Base-band configuration | Output Power |
|----------------|---------|-------------------------|--------------|
| Left carrier   | 575     | IS-95                   | 45.3 dBm     |
| Center carrier | 600     | IS-95                   |              |
| Right carrier  | 625     | IS-95                   |              |

Each MFRM-2 has its transmitter output connected to a 50 ohm load.

**Figure 4-3: Hardware set-up for Emissions**



## 4.10 EUT Operations and Software

The software used to operate the system consisted of a software load representative of the latest production.

All three radios were set to simultaneously transmit on 3 CDMA (1.25 MHz) channels. The channels were 575, 600, and 625. The center frequency of this 3 carrier signal was 1960 MHz.

The BTS is configured via the control and data PC using the Nortel commissioning software tool Vortex. This PC is also used to configure the MFRM-2. Configuration, and control of the MFRM-2 is achieved by manipulating the base drivers provided by the software team. These software drivers used during the Beta cycle are the same drivers that will be used in the final application code.

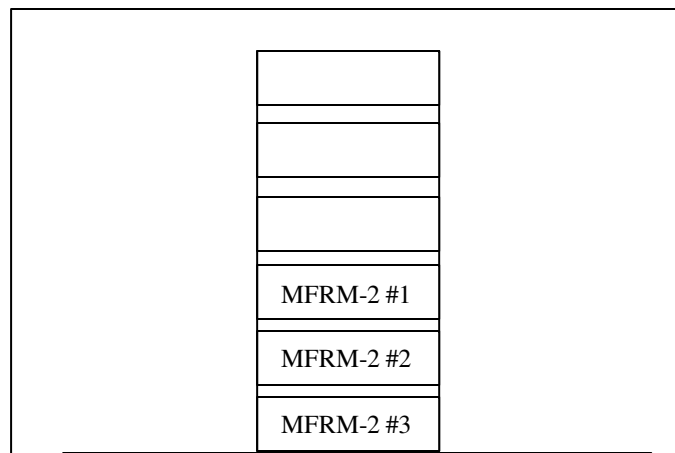
## 4.11 System Modifications

No modifications to the EUT were necessary in order to comply with FCC Part 24 and IC RSS-133.

## 4.12 System Inventory List

The EUT configuration is presented in Figure 4-4 and described in Table 4-7.

**Figure 4-4: EUT shelf configuration**



**Table 4-7: Inventory List**

| Item | Component | Code     | Release Number | Serial Number |
|------|-----------|----------|----------------|---------------|
| 1    | MFRM-2    | NTGY30BA | P4             | NNTM533GRVGU  |
| 2    | MFRM-2    | NTGY30BA | P4             | NNTM533GRLEH  |
| 3    | MFRM-2    | NTGY30BA | P4             | NNTM533GRWKY  |



## 5. General Test Conditions

### 5.1 Test Facility

Radiated emissions testing was performed in a 10-meter Ambient Free Chamber (AFC). The AFC consists of a shielded room lined with ferrite tiles and anechoic material.

This test facility is accredited by the Standards Council of Canada (SCC) [2]. Through a Mutual Recognition Agreement (MRA) between the National Voluntary Laboratory Accreditation Program (NVLAP) and SCC, the accreditation status of this facility is valid for the U.S.

### 5.2 Measurement Instrumentation

The measurement instrumentation conforms to ANSI C63.2-1996 [7] and CISPR 16 [8]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.

## 6. E-field Radiated Emissions

E-field Radiated Emissions tests are performed to assure that the product does not produce excess amounts of radiated emissions that could interfere with licensed radiators.

### 6.1 Test Specification

The system was tested to the following requirements, listed in Table 6-1:

**Table 6-1: E-field Radiated Emissions Requirements**

| Requirement                                | Country of Application |
|--------------------------------------------|------------------------|
| RSS-133                                    | Canada                 |
| FCC Part 2.1053, 2.1057<br>FCC Part 24.238 | USA                    |

#### 6.1.1 Limits

##### 6.1.1.1 FCC Part 2.1053

Measurements shall be made to detect spurious emissions that may be radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data shall be supplied showing the magnitude of each harmonic and other spurious emissions. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph (c) of FCC 2.1049 [12], as appropriate.

Information submitted shall include the relative radiated power of each spurious emission with reference to the rated power output of the transmitter, assuming all emissions are radiated from half wave dipole antennas.

##### 6.1.1.2 FCC Part 2.1057

The spectrum should be investigated from the lowest radio frequency signal generated in the equipment, without going below 9 kHz, up to at least the tenth harmonic of the highest fundamental frequency or to 40 GHz, whichever is lower. Particular attention should be paid to harmonics and sub harmonics of the carrier frequency as well as to those frequencies removed from the carrier by multiples of the oscillator frequency. Radiation at the frequencies of multiplier stages should also be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

##### 6.1.1.3 FCC Part 24.238

- (a) On any frequency outside a licensee's frequency block, the power of any emission shall be attenuated below the transmitter power (P) by at least  $43 + 10 \log (P)$  dB.

#### 6.1.1.4 RSS-133 Section 6.3

##### Out of Block Emissions

- (i) In the first 1.0 MHz bands immediately outside and adjacent to the licensee's frequency block, the power of emissions (per 1% of the emission bandwidth) shall be attenuated below the transmitter output power P (in watts) by at least  $43 + 10 \log_{10}(P)$ , dB. It is only required to use the plots from (a) and (b) to demonstrate that the out of blocks A and C emissions are met. (ii) After the first 1.0 MHz, the power of emissions shall be attenuated below the transmitter output power by at least  $43 + 10 \log_{10}(P)$ , dB, per any MHz of bandwidth. (Note: If the test result using 1% of the emission bandwidth is used, then power integration over 1.0 MHz is required; alternatively, the spectrum analyzer resolution and video bandwidths can be increased to 1.0 MHz for this measurement). The search for these emissions shall be from the lowest frequency internally generated or used in the device (local oscillator, intermediate or carrier frequency), or 30 MHz, whichever is the lowest frequency, to the 5th harmonic of the highest frequency generated or used, without exceeding 40 GHz.

#### 6.1.2 Field strength limit equivalent

The FCC and Industry Canada emission attenuation requirement is equivalent to measuring an Effective Radiated Power (ERP) of -13 dBm. This ERP can be approximated by measuring the field strength of radiated emissions.

The Prescan reference level for spurious radiation was taken with reference to an ideal dipole antenna excited by the rated output power according to the following relationship:

$$E\left(\frac{V}{m}\right) = \frac{1}{R(m)} \sqrt{30 \times P_t \times G}$$

Where,

E=Field Strength in Volts/meter,

R = Measurement distance in meters,

P<sub>t</sub> = Transmitter Rated Power in Watts= 33.9 W

G = Gain of Ideal Dipole (linear)= 1.64

Therefore:

$$E\left(\frac{V}{m}\right) = \frac{1}{10} \sqrt{30 \times 33.9 \times 1.64}$$

$$E = 4.08 \text{ V/m} = 132.2 \text{ dB}\mu\text{V/m at 10 m}$$

The spurious emissions must be attenuated by at least  $43 + 10 \log(33.9) = 58.3 \text{ dB}$

Therefore the field strength limit at 10 meters is:

$$E = 132.2 \text{ dB}\mu\text{V/m} - 58.3 \text{ dB} = 73.9 \text{ dB}\mu\text{V/m at 10m}$$

The limit at 3 meters is:  $E = 84.4 \text{ dB}\mu\text{V/m}$

The limit at 1m is:  $E = 93.9 \text{ dB}\mu\text{V/m}$

The approximated field strength specification levels are shown in Table 6-2.

**Table 6-2: Prescan Spurious emissions limits for FCC Part 24 and IC RSS-133**

| Frequency Range (MHz) | Measurement distance (m) | Field strength equivalent of -13 dBm ERP limit (dBuV/m) |
|-----------------------|--------------------------|---------------------------------------------------------|
| 30 - 1000             | 10                       | 73.9                                                    |
| 1000 - 10000          | 10                       | 73.9                                                    |
| 10000 - 18000         | 3                        | 84.4                                                    |
| 18000 - 20000         | 1                        | 93.9                                                    |

The worst emissions observed during prescan measurements were then re-evaluated using the substitution test method.

## 6.2 Test Facility Information

**Location:** C-MAC AFC  
**Date tested:** December 2 to 3, 2003  
**Tested by:** Rick Poirier, Rob Trasher, Denis Lalonde

## 6.3 Test Configurations

For radiated emissions test cases, the EUT hardware configuration/software load used is described in Sections 4.9 and 4.10.

One configuration of the equipment was evaluated; the 3 channels each contained an IS-95 signal.

## 6.4 Test Procedure

Verifications of the test equipment and AFC were performed prior to the installation of the EUT in accordance with the quality assurance procedures in KP000270-LP-EMC-01-DF [9]. The test was performed as per the relevant Test procedures: ANSI C63.4-1992 [5].

The system was tested in the following manner:

- The EUT was placed on a turntable inside the AFC and it was configured as in normal operation. The system and its cables were separated from the ground plane by an insulating support 10 mm in height. The system was connected to the grounding system, in accordance with its installation specifications. No additional grounding connections are allowed.

- For tests between 30 MHz and 1 GHz a broadband bilog antenna was placed at a 10 m distance; a horn antenna, placed also at 10 m distance from the EUT, was used for high frequency measurements between 1 GHz and 10 GHz. The horn antenna was moved to a 3 m distance for measurements between 10 and 18 GHz. The measuring distance was further reduces to 1 m for measurements between 18 GHz and 20 GHz.
- A pre-scan was performed to find emissions (frequencies) requiring detail measurement. The pre-scan (using a peak detector) was performed by rotating the system 360 degrees while recording all emissions (frequency and amplitude). This procedure was repeated for antenna heights of 1 to 4 meters, in steps of 1 meter, and for horizontal and vertical polarizations of the receiving antenna (for measurements above 30 MHz).
- Prescan optimization was performed based on the pre-scan data. All frequencies, having emission levels within 10 dB of the specification(s) limits, were optimized. For each such frequency, the EUT was rotated in azimuth over 360 degrees and the direction of maximum emission was noted. Antenna height was then varied from 1 to 4 meters at this azimuth to obtain maximum emissions. The procedure was repeated for both horizontal and vertical polarizations of the search antenna. Then the maximum level measured was recorded.
- The frequency range investigated was 30 MHz to 20 GHz.
- Above 30 MHz and up to 1 GHz, a resolution bandwidth of 120 kHz was used.
- Above 1 GHz, a 1 MHz resolution bandwidth and 1 MHz video bandwidth were used.
- The highest emissions were evaluated using the substitution method. This is accomplished by replacing the EUT by a calibrated antenna, cable and signal generator. This equipment is used to transmit a signal that will generate a RF meter reading level identical to the one recorded when the EUT was present.

## 6.5 Test Results

This section presents the E-field radiated emissions results for all the test cases considered. These measurements were taken using a peak detector and compared to the specification limit lines. Graphical representations of the measurements taken appear in Appendix C: Radiated Emissions Plots on page 28.

Note that a positive margin value in the “E-field Radiated Emissions Test Results” table below indicates a PASS and a negative margin value indicates a FAILURE.

Table 6-3 lists the highest emissions measured. All other emission of this configuration had more than 20 dB margin:

**Table 6-3: Prescan E-field Radiated Emissions Test Results**

| Parameter           |              | Unit           | Emission 1 | Emission 2 | Emission 3 |
|---------------------|--------------|----------------|------------|------------|------------|
| Frequency           |              | (MHz)          | 3920       | 5880       | 7840       |
| Antenna             | Azimuth      | (deg.)         | 352        | 340        | 335        |
|                     | Height       | (cm)           | 246        | 101        | 235        |
|                     | Polarization |                | Vert.      | Vert.      | Vert.      |
| Meter Reading       |              | (dB $\mu$ V)   | 61.3       | 32.4       | 31.0       |
| Detector            |              |                | AVG        | AVG        | AVG        |
| Gain / Loss Factor  |              | (dB)           | -32.2      | -27.9      | -26.5      |
| Transducer Factor   |              | (dB)           | 32.2       | 34.2       | 37.0       |
| Level               |              | (dB $\mu$ V/m) | 61.3       | 38.7       | 41.5       |
| Limit (approximate) |              | (dB $\mu$ V/m) | 73.9       | 73.9       | 73.9       |

Pre-scan plots of the radiated E-field emissions measured are included in Appendix C: Radiated Emissions Plots on page 28.

Substitution measurements were performed in the 1 to 10 GHz band. No significant signals associated with the transmitter were observed in the 30 MHz to 1 GHz band and in the 10 GHz to 20 GHz band.

**Table 6-4: Substitution Measurement Test Results**

| Freq. (MHz) | Signal generator level (dBm) | Cable loss (dB) | Pol | Antenna gain (dB) | Prescan meter reading (dB $\mu$ V) | Substitution meter reading (dB $\mu$ V) | ERP (dBm) | Limit (dBm) | Margin (dB) |
|-------------|------------------------------|-----------------|-----|-------------------|------------------------------------|-----------------------------------------|-----------|-------------|-------------|
| 3920        | -34.5                        | 4.5             | V   | 8.7               | 61.3                               | 61.3                                    | -30.3     | -13         | 17.3        |
| 5880        | -61.9                        | 5.0             | V   | 10.1              | 32.4                               | 32.4                                    | -56.8     | -13         | 43.8        |
| 7840        | -56.9                        | 6.0             | V   | 9.3               | 31.0                               | 31.0                                    | -53.6     | -13         | 40.6        |

## 6.6 Prescan Measurement Uncertainties

The expanded measurement uncertainty (with a 95% level of confidence) on E-field radiated emissions measurements are:  $\pm 5.0$  dB between 30 MHz and 1 GHz and  $\pm 5.6$  dB between 1 GHz and 10 GHz.

Uncertainty evaluation has been calculated according to the method described in NAMAS NIS 81 (May 1994), "The Treatment of Uncertainty in EMC Measurements" [14].

## 6.7 Calculation of the Compliance Margin

The following illustrates the manner in which the compliance margin is calculated:

$$\text{ERP} = \text{Signal generator level} - \text{Cable losses} + \text{Antenna gain}$$

$$\text{Margin} = \text{Limit} - \text{ERP}$$

## 6.8 Test Conclusion

The worst-case margin is 17.3 dB at 3920 MHz to FCC Part 24 and Industry Canada RSS-133 spurious emissions requirements. This worst case margin was calculated using a substitution measurement.

Since all measured emissions indicate positive margins, it can be declared that the EUT has passed the radiated Spurious Emission tests with respect to FCC Part 24 and Industry Canada RSS-133 requirements.

## 6.9 Test Equipment List

Table 6-5: Test Equipment used for E-field Radiated Emissions

| Model        | Description                                     | Serial Number | Cal. Due  |
|--------------|-------------------------------------------------|---------------|-----------|
| 8447D        | Pre Amplifier #2                                | 2944A06919    | 4-Mar-04  |
| LNA-A5       | LNA 1-18GHz                                     | A5            | 6-Feb-04  |
| DB95-0040R   | Microwave Amplifier + heat sink, K(m)-K(m)      | 003           | 14-Jan-04 |
| 3115         | Double Ridge Guide Horn                         | 9711-5314     | 19-Dec-03 |
| 2420/A       | Bilog - 30MHz-1000MHz                           | 1113          | 19-Dec-03 |
| 3160-09      | Horn w/ mtg support, 18-26.5GHz, K(f) connector | 9501-1031     | 27-Dec-03 |
| 106/A        | AFC Bulkhead #2                                 | 1060          | 18-Feb-04 |
| 106/A        | AFC Bulkhead #1                                 | 1061          | 18-Feb-04 |
| Utiflex UFA  | K(m)-K(m), 18-26.5GHz, L=92cm                   | 99F2324       | 26-Dec-03 |
| Utiflex UFA  | N(m)-N(m), L=2.9m                               | 99KS0792      | 17-Apr-04 |
| Utiflex UFB  | K(m)-K(m), 18-26.5GHz, L=3.6m                   | 96F0849       | 26-Dec-03 |
| 8564E        | 9kHz-40GHz SA                                   | 2895          | 3-Sep-04  |
| EMI Software | EMI Software                                    | V 3.02        | n/a       |
| 8566B        | (AFC#1) SA                                      | 3014A07256    | 25-Jul-04 |
| 8566B        | (AFC#1) Display Unit                            | 3026A20026    | 25-Jul-04 |
| 85685A       | (AFC#1) RF Preselector                          | 3010A01085    | 25-Jul-04 |
| 85650A       | (AFC#1) QPA                                     | 3107A01549    | 25-Jul-04 |
| SC99V        | Dual mast & turntable ctrl'r                    | 120498-1      | n/a       |

| Model       | Description             | Serial Number | Cal. Due  |
|-------------|-------------------------|---------------|-----------|
| 3115        | Double Ridge Guide Horn | 2703          | 19-Feb-04 |
| 68247B      | 20 GHz max frequency    | 984004        | 16-Dec-03 |
| SUCO 104PEA | Signal generator output | 10241/4PEA    | n/a       |

The measurement instrumentation conforms to ANSI C63.2 [7] and CISPR 16 [8]. Calibration of the measurement instrumentation is maintained in accordance with the supplier's recommendations, or as necessary to ensure its accuracy.



## 7. References

### 7.1 Applicable documents

1. KP000576-TP-EMC-02-01 EMC Compliance Test Plan for the 1900 MHz MFRM-2

### 7.2 Reference documents

2. Standards Council of Canada Scope of Accreditation Letter SCC 1003-15/163 dated 2001-02-16 (Scope of accreditation is effective until 2002-10-05 and includes FCC Part 15 and ICES-003).
3. Federal Communications Commission Letter dated May 25, 1999 (in response to submission EF-00049-99, Measurement facility located at Kanata Anechoic chamber (3 & 10 meters), FCC Registration Number 94326).
4. C-MAC Engineering Inc. Quality Manual, Document No. KG000347-QD-QM-01-04, Issue 04, December 2001.
5. C-MAC Engineering Inc. Lab Operations Manual, Document No. KG000347-QD-LAB-01-01, Issue 01, January 2002.
6. ANSI C63.4-2001, Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz, 17 July 1992, 6 June 2001.
7. ANSI C63.2-1996, American National Standard for Electromagnetic Noise and Field Strength Instrumentation, 10 Hz to 40 GHz – Specifications.
8. CISPR 16-1, Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1: Radio Disturbance and Immunity Measuring Apparatus, Edition 2.0, 1999-10.
9. C-MAC Engineering Inc., EMC General Lab Test Procedure, KP000270-LP-EMC-01-DF Feb 2002.
10. Code of Federal Regulations (Washington, DC: Federal Communications Commission), Title 47, Chapter 1, Part 15.
11. Code of Federal Regulations (Washington, DC: Federal Communications Commission), Title 47, Chapter 1, Part 24.
12. Code of Federal Regulations (Washington, DC: Federal Communications Commission), Title 47, Chapter 1, Part 2.
13. 2 GHz Personal Communications Services, Industry Canada, RSS-133, Issue 2, Revision 1, November 6, 1999
14. NAMAS Publication NIS 81: “The Treatment of Uncertainty in EMC Measurements”, Edition 1, May 1994.

## 8. Appendices

### 8.1 Appendix A: Glossary

Included below are definitions and abbreviations of terms used in this document.

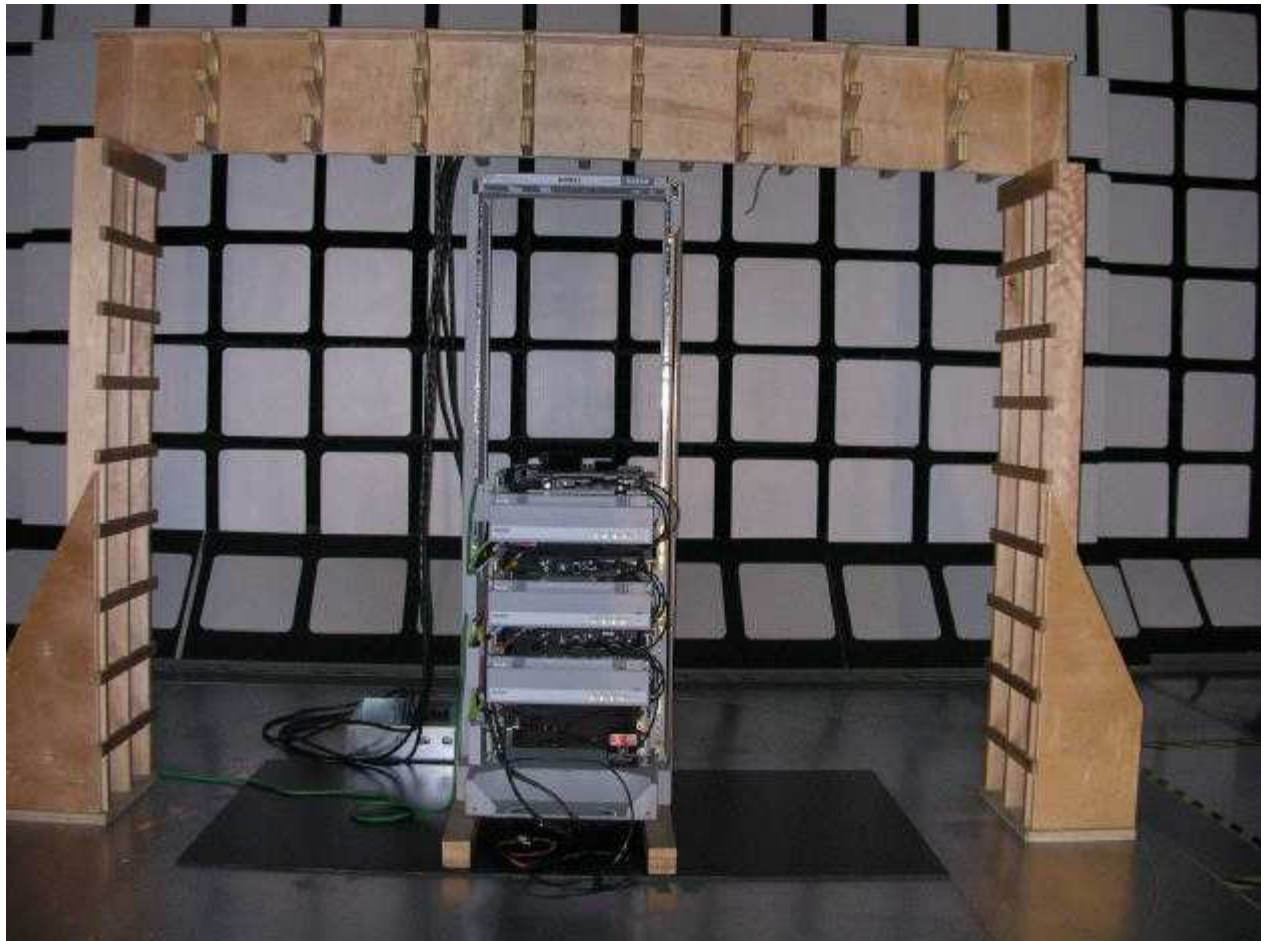
| Term      | Definition                                                                    |
|-----------|-------------------------------------------------------------------------------|
| AD        | Average Detector                                                              |
| AE        | Auxiliary Equipment                                                           |
| AFC       | Ambient Free Chamber                                                          |
| AM        | Amplitude modulation                                                          |
| ANSI      | American National Standards Institute                                         |
| CSA       | Canadian Standards Association                                                |
| dB        | Decibel                                                                       |
| DC        | Direct Current                                                                |
| EMC       | Electromagnetic Compatibility                                                 |
| EUT       | Equipment Under Test                                                          |
| FCC       | Federal Communications Commission, USA                                        |
| GND       | Ground                                                                        |
| IC        | Industry Canada                                                               |
| LISN      | Line Impedance Stabilization Network                                          |
| MU        | Measurement Uncertainty                                                       |
| NA        | Not Applicable                                                                |
| NAMAS     | National Measurement Accreditation Service                                    |
| NBS/ NIST | National Bureau of Standards / National Institute of Standards and Technology |
| PA        | Broadband Power Amplifier                                                     |
| PK        | Peak Detector                                                                 |
| RBW       | Resolution Bandwidth                                                          |
| RE        | Radiated Emissions                                                            |
| RF        | Radio-Frequency                                                               |
| RMS       | Root-mean-square                                                              |
| RSS       | Radio Standards Specification                                                 |
| SA        | Spectrum Analyzer, the ANSI C63.2 Compliant EMI meter                         |
| SCC       | Standards Council of Canada                                                   |
| T         | 50 $\Omega$ Coaxial Termination (conducted emissions / immunity)              |
| UL        | Underwriters Laboratories, Inc.                                               |
| UUT       | Unit Under Test                                                               |

| Term    | Definition                                       |
|---------|--------------------------------------------------|
| VBW     | Video Bandwidth                                  |
| ERP     | Effective Radiated Power                         |
| MFRM    | Multi-carrier Flexible Radio Module              |
| CDMA    | Code Division Multiple Access                    |
| BTS     | Base-station Transceiver System                  |
| WR MPEM | Wide voltage Range Power Entry Module            |
| WR HCPA | Wide voltage Range High Power Converter Assembly |
| PSU     | Power Supply Unit                                |

## 8.2 Appendix B: Test Set-up Photographs

This appendix presents all the set-ups used to cover all the tests presented in this Test Report.

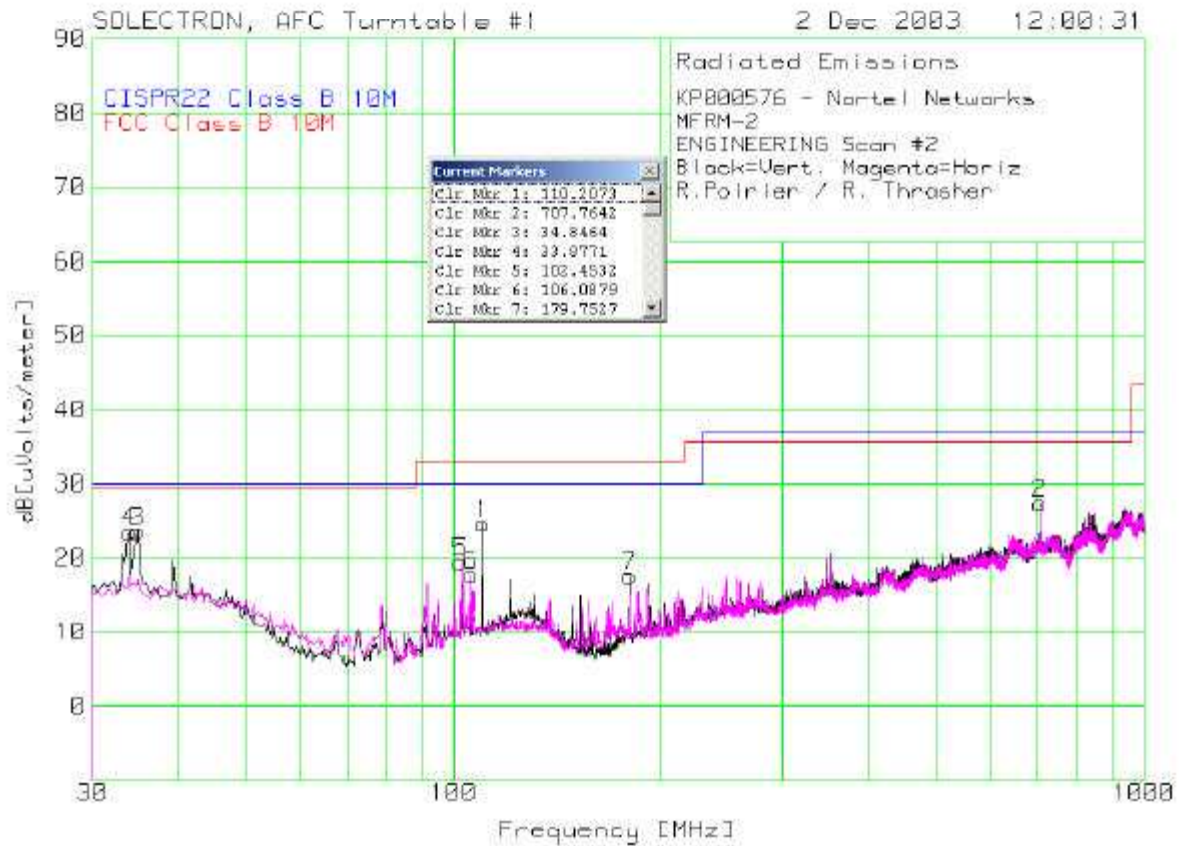
Figure 8-1: MFRM-2 radiated emission set-up



## 8.3 Appendix C: Radiated Emissions Plots

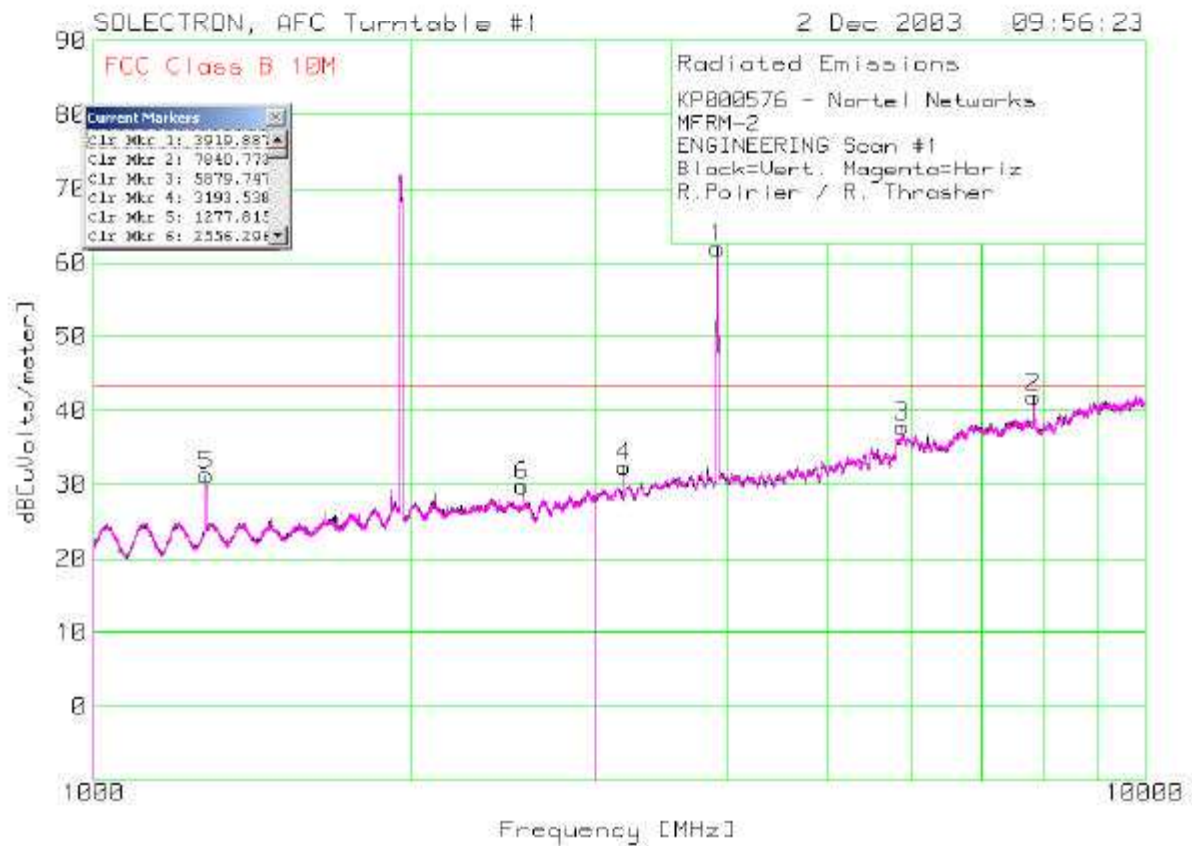
This appendix presents all radiated emissions plots for the test cases measured.

Figure 8-2: E-field Radiated Emissions, 30 – 1000 MHz



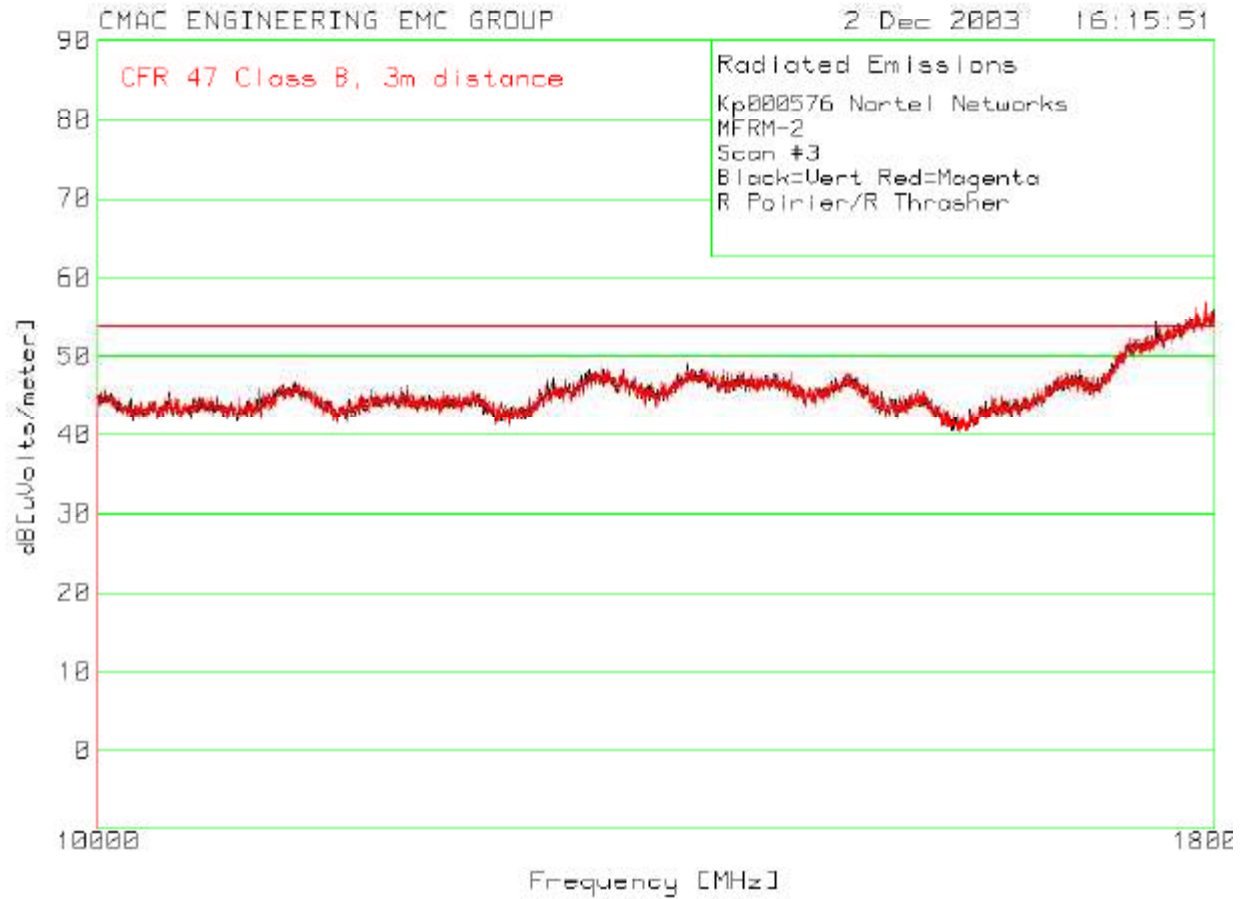
Note: the 110.2 MHz signal was an intermittent signal. It disappeared when we tried to optimize it.

Figure 8-3: E-field Radiated Emissions, 1 GHz – 10 GHz



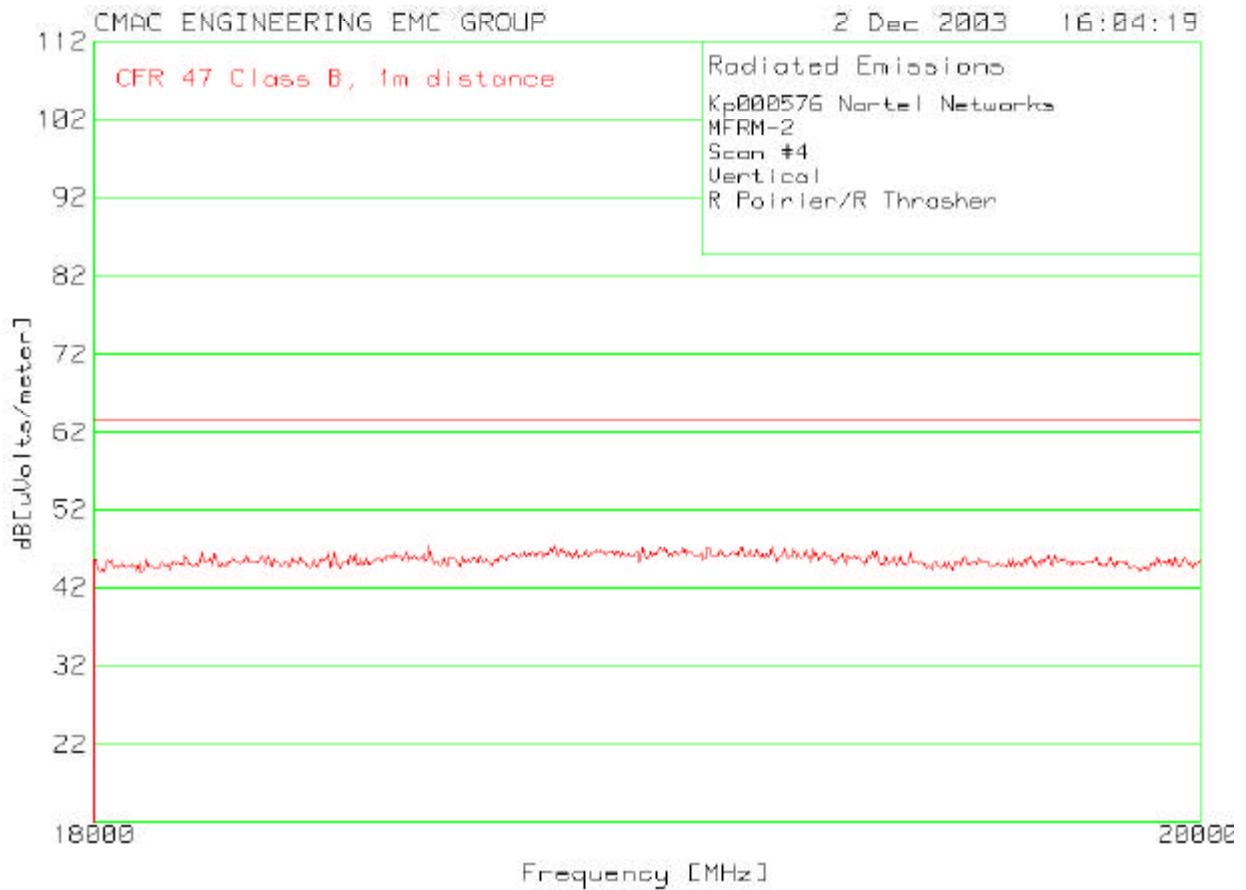
Note: the 1960 MHz emission is RF leakage of the transmitter signal from the three 50 ohms terminations.

Figure 8-4: E-field Radiated Emissions, 10 GHz – 18 GHz



Note: the red trace is the horizontal polarization measurement and the black trace is the vertical polarization measurement.

**Figure 8-5: E-field Radiated Emissions, 18 GHz – 20 GHz**



Note: this scan was repeated on the 4 sides of the EUT with both vertical and horizontal polarizations. Identical test results were observed.



## **C-MAC ENGINEERING INC. A Solelectron Company**

# **Spurious Emissions Test Report for the MFRM-2 FCC Part 24 and Industry Canada RSS-133**



---

© Copyright C-MAC Engineering Inc. December 4, 2003

The master of this document is stored on an electronic database and is “write-protected” and may be altered only by authorized persons at C-MAC Engineering Inc. Viewing of the master document electronically ensures access to the current issue. Any hard copies must be regarded as uncontrolled copies.

C-MAC Engineering Inc. accepts no liability for the content of this document except when it is reproduced in its entirety by a method acceptable to C-MAC Engineering Inc.

---