Spurious Emissions Compliance Report for the AWS 1.7/2.1 GHz MFRM-3 Beta FCC Part 27

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Release Control Record

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Approvals

Function	Name	Job title	Signature	Date
Document Release Approval	Steve Tippet	Manager, Product Engineering and Verification		22nd Aug 2007
Author	Denis Lalonde	Radio Compliance Discipline Leader		August 22, 2007
Technical Reviewer	Jacques Rollin	EMC Advisor	for J.R.	Aug. 22/07

Accreditations

Solectron EMS Canada Inc.'s (SDE) test facilities are accredited by the Standards Council of Canada (SCC) to ISO/IEC 17025 in accordance with the scope of accreditation outlined at the following web site http://palcan.scc.ca/specs/pdf/95_e.pdf [2]. The SCC is a signatory of the APLAC [15] and ILAC [16] Mutual Recognition Arrangements.

FCC Part 27 is not currently on SDE's SCC scope of accreditation. SDE laboratory discipline specialists have ensured our laboratory has the required documentation, test equipment, and technical expertise to test to this standard.

Solectron EMS Canada Inc.'s (SDE) quality management system is registered to ISO 9001: 2000 [17] and its processes are documented in the SDE Quality Manual [4] and Lab Operations Manual [5].

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1 Executive Summary

At the request of Nortel Networks, Solectron EMS Canada Inc. has evaluated the system's radiated spurious emissions. This report describes the test results of the FCC Part 27 radiated emissions tests performed on the AWS 1.7/2.1 GHz MFRM-3 Beta system.

On the basis of measurements performed in July and August 2007, the AWS 1.7/2.1 GHz MFRM-3 Beta is verified to be compliant with the radiated spurious emissions requirements of FCC Part 27. The test data included in this report apply to the product titled above manufactured by Nortel Networks.

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2 Scope and Purpose

At the request of Nortel Networks, Solectron EMS Canada Inc. has evaluated the system's radiated spurious emissions. This report describes the test results of the FCC Part 27 radiated emissions tests performed on the AWS 1.7/2.1 GHz MFRM-3 Beta system.

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3 Compliance Summary

This section summarizes all the measurements performed on AWS 1.7/2.1 GHz MFRM-3 Beta and its compliance to FCC Part 27.

Table 3-1: Compliance Results Summary

Product Summary			
Product Name:	AWS 1.7/2.1 GHz MFRM-3 Beta	Project Leader:	William Kwong
Product Code:	Refer to Customer Information and System Components and Inventory on pages 10 and 19.	EMC Engineer:	Denis Lalonde
Product Release:		Tester:	M. Lee, and D. Lalonde
Product Status:	Not Available	Date:	July 27 to August 1, 2007

Test Cases [1]					
Completed	**Description**	**Specification**	**Test Results**		**Notes**
			Pass	Fail	
■	Radiated Spurious Emissions (E-field)	FCC Part 27	■	□	

1. All the emissions measurements were performed at Solectron EMS Canada Inc. Kanata, Ontario.

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4 Equipment Under Test (EUT)

4.1 Product Functional Description

The MFRM-3 is an evolution of the FRM (SFRM/MFRM/MFRM-2) CDMA MetroCell product, bringing a 3-sector 3-carrier system into a single radio module. It is an environmentally sealed module to allow installation into both outdoor and indoor systems. The MFRM-3 electronic assemblies are enclosed within EMI shield, thus providing maximum protection for RE/RI EMC. Fiber connectivity is used for data transfer with the digital equipment and allows the optional remote installation of the radio module. The MFRM-3 has a new Tri-Duplexor Preselector Module (TDPM), which will essentially provide the functionality of three separate MFRM/MFRM-2 duplexers. Images of an MFRM-3 are shown in the following three figures.

Figure 4-1: MFRM-3 radio module

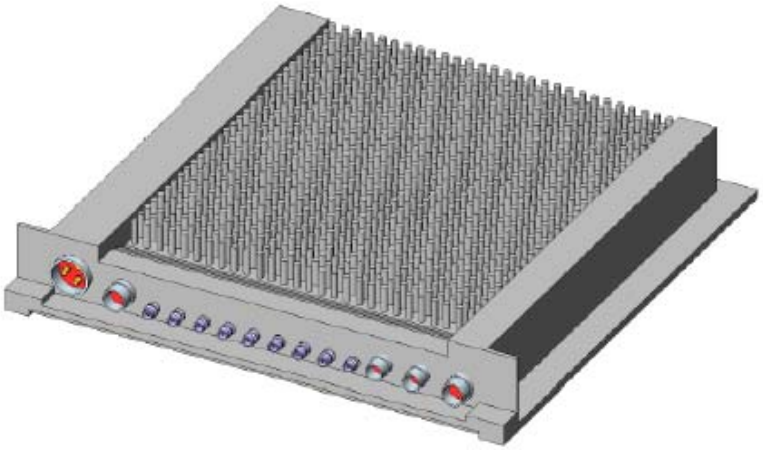

Figure 4-2: Fully assembled MFRM-3

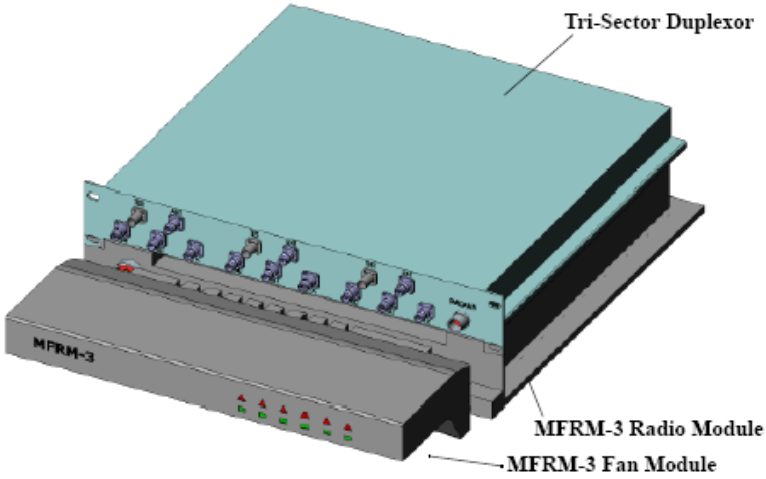

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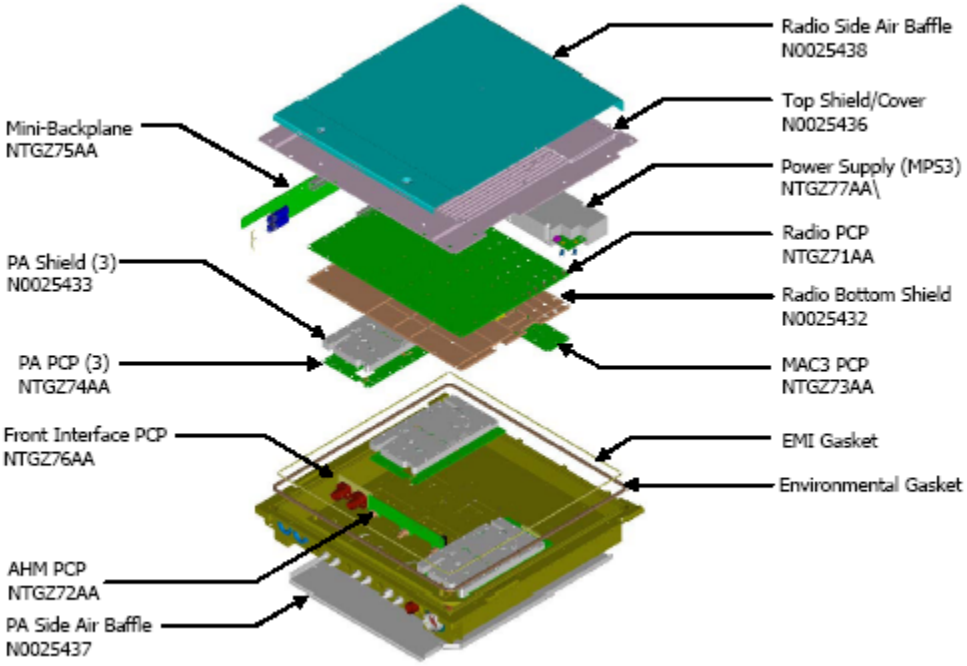
Figure 4-3: Exploded view of an MFRM-3 radio module



The configurations of the 1.7/2.1GHz AWS MFRM-3 that were tested are shown in the Section

4.2 System Modifications

No modifications to the EUT were made during testing.

4.3 Customer Information

Company Name	Nortel Networks
Mailing Address	3500 Carling Avenue, Ottawa, Ontario, Canada, K2H 8E9
Product Name	AWS 1.7/2.1 GHz MFRM-3 Beta
Model Number	1.7/2.1GHz Tri- Duplexor Preselector Module (TDPM) (PEC code: NTGZ83AAE5) 1.7/2.1 GHz AWS MFRM-3 Radio Module (PEC code: NTGZ70CAE5) Fan Assembly Module-3 (FAM-3) (PEC code: NTGZ85AA)
Primary Contact	Amir Mostafavi
Title	Technical Project Manager
Phone	613-763-5401
E-mail	mailto:mamir@nortel.com

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4.4 Power Requirements

The power requirements for the AWS 1.7/2.1 GHz MFRM-3 Beta are in the following tables.

Table 4-1: -52 VDC power requirement

Feed	Voltage	Current drawn during testing
A	-52.5 VDC	61 A

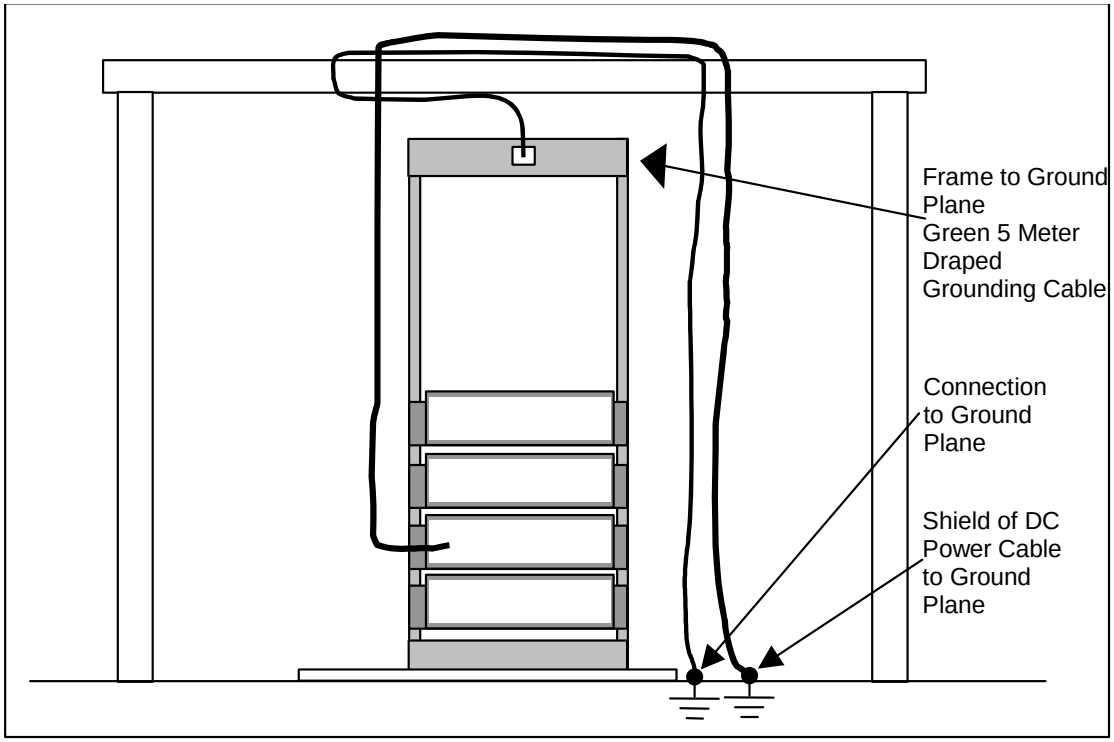
Table 4-2: +30 VDC power requirement

Feed	Voltage	Current drawn during testing
A	+30 VDC	121A

4.5 Grounding Requirements

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

Figure 4-4: System grounding



4.6 Clocks / Oscillators / Switching Power Supply Frequencies

The maximum clock frequency used to determine radiated emissions (RE) for FCC Part 15 is 2.153 GHz.

Table 4-3 lists all the clock sources (for example, discrete crystals, VCXOs, and DC/DC converter switching frequencies) used in the EUT.

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Table 4-3: EUT clock frequencies per circuit pack

Circuit pack	Part number	Fundamental frequencies (MHz)
1.7/2.1 GHz AWS MFRM-3 Radio Module	NTGZ70CA	0.1536, 2.5, 7.3728, 19.2, 19.6608, 25, 31.9488, 33, 39.3216, 63.8976, 66, 78.6432, 96, 100, 638.976, excluding all Transmission Carriers' Frequencies in Table 4-4
1.7/2.1GHz TDPM	NTGZ70CAE5	None
FAM-3	NTGZ85AA	None

3 carriers per MFRM-3 radio were used for 1.7/2.1 GHz AWS MFRM-3 PI testing. The transmission carriers' channels and frequencies are broken down in the following table.

Table 4-4: Transmission Carriers' Channels and Frequencies for Four MFRM-3

Radio	Band	Channel	Frequency (MHz)
Radio 1	AWS – Band	375	2128.75
		400	2130.00
		425	2131.25
Radio 2	AWS – Band	525	2136.25
		550	2137.50
		575	2138.75
Radio 3	AWS – Band	675	2143.75
		700	2145.00
		725	2146.25
Radio 4	AWS – Band	825	2151.25
		850	2152.50
		875	2153.75

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4.7 EUT Interfaces and Cables

Table 4-5 identifies all possible cables that can be used with the system.

Table 4-5: System cables

Cable ref.	Cable designation	Permanently connected (Yes/No)	Interface description	Connection point	Length (m)	Quantity	Termination during testing
1	-52 VDC power cable	YES	Shielded DC power cable	MFRM-3 Main DC Power Connector	10	1 per MFRM-3	Inline DC filter and –52 VDC power supply
2	+30 VDC power cable	YES	Shielded DC power cable	MFRM-3 Main DC Power Connector	10	1 per MFRM-3	Inline DC filter and +30 VDC power supply
3	Ground cable	YES	AWG 2 electrical cable	Frame ground	3	1	Earth ground
4	Antenna RF cables	YES	Radio RF output via a coaxial cable	TDM Alpha /Beta/ Gamma antenna port connector	6-10	3 per MFRM-3	Load RF attenuators set
5	Multimode Tx/Rx optical fiber	YES	SC-SC optical connection	MFRM-3 Fiber Optics Connector	10	1 per MFRM-3	CORE-2 module in digital shelf of a BTS
6	Alarm cable (Nortel PEC code: NTGZ8610)	YES	Unshielded customer alarm cable	Loopback	0.05	1 per MFRM-3	Not terminated

4.8 Support Equipment

The following tables indicate the support equipment used during testing.

Table 4-6: Test support equipment for radiated emissions test cases, provided by Nortel

Description	Make	Model number	Serial number	Calibr. due
Personal computer	Dell	OPTILEX GX1	2XNKE	Not required
Personal computer	Dell	OPTILEX GX520	5MK7391	Not required
Capacitor bank (DC power filter)	Nortel	N/A	N/A	Not Required

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Table 4-7: Inventory list of support equipment – Digital Shelf of an Indoor Metrocell BTS, provided by Nortel

Reference	Component	Nortel PEC Code	Release Number	Serial Number
SE_1	Digital Rack (AC) (BTS 61)	NTGS35AA	70	SNMN5300M6DH
SE_1.4	BIP	NTGS36AA	10	SNMN5300M6NJ
		NTGS26AA	17	SNMN5300M6LJ
SE_1.3	Digital Shelf	NTGS20AA	12	SNMN5300M57H
SE_1.3.1	CEM 64	NTBW70BA	15	NNTM5387FTNH
SE_1.3.2	CEM 64	NTBW70BA	15	NNTM5387X0YF
SE_1.3.3	CEM 64	NTBW70BA	15	NNTM5387G1RV
SE_1.3.4	CEM 192	NTRZ80BA	3	NNTM74X0WPJK
SE_1.3.5	CEM 192	NTRZ80BA	52	NNTMDV02T4YL
SE_1.3.6	CEM 192	NTRZ80BA	50	NNTM74X194G4
SE_1.3.7	CEM 192	NTRZ80BA	3	NNTM74X0WPK4
SE_1.3.8	Blank	N/A	N/A	N/A
SE_1.3.9	Blank	N/A	N/A	N/A
SE_1.3.10	CEM 64	NTRZ80AA	2	NNTM74XOTYRL
SE_1.3.11	CEM 64	NTRZ80AA	2	NNTM74XOTVEW
SE_1.2.1	Blank	N/A	N/A	N/A
SE_1.2.1	Blank	N/A	N/A	N/A
SE_1.2.2	GPSTM	NTBW50AA	9	NNTM74TC1348
SE_1.2.3	Blank	N/A	N/A	N/A
SE_1.2.4	CM-2	NTBW40BA	4	NNTM84C02C22
SE_1.2.5	CM-2	NTBW40BA	4	NNTM74X0WWVV
SE_1.2.6	CORE-2	NTBW30BA	12	NNTM74X1DTY0
SE_1.2.7	CORE-2	NTBW30BA	12	NNTM74X1DV0G
SE_1.2.8	Blank	N/A	N/A	N/A
SE_1.1	COOLING UNIT	NTGS18AB	3	NNTMCL000118

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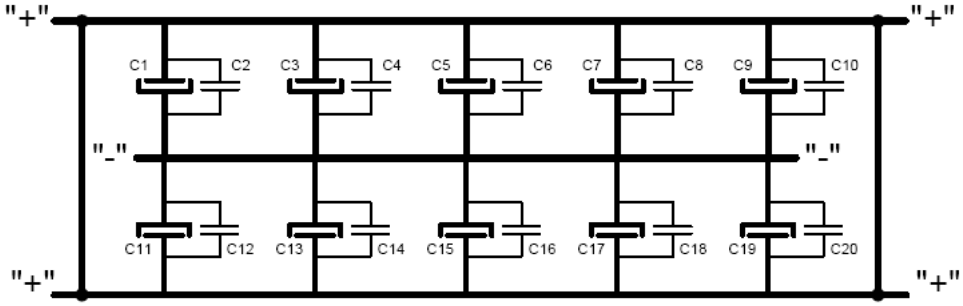
The MFRM-3 product has strict limitation on external power lines inductance. Due to this limitation, the auxiliary DC filter that includes 2 parallel arrays of capacitors was used throughout the test program to compensate for excessive external inductance and reduce noise coming from external power supply. The EUTs external DC cables were connected through the auxiliary DC filter to external power supplies, with auxiliary DC filter between battery and return DC power lines. The DC filter is a parallel array of capacitors and is illustrated in Figure 4-5.

Figure 4-5: Auxiliary DC Filter



where :
C1, C3, C5, C7, C9, C11, C13, C15, C17, C19 : 10000 µF -10/+50% ; 100 VDC ; +85°C ; GAA Panasonic 052571 ; USA.

C2, C4, C6, C8, C10, C12, C14, C16, C18, C20 : 0.68 µF ; 250 V.

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4.9 System Set-up and Test Configurations

Three carriers per Radio were used for the AWS 1.7/2.1 GHz MFRM-3 Beta tests. Refer to Table 4-4.

The MFRM-3 operated at full RF power during all PI tests. 47.3 dBm (53.7 W) was present at every TDM Antenna sector output connector. The total power for all 3 sectors was 161.1 W (52.1 dBm).

4.9.1 Configuration 1

Configuration 1 is presented in Figure 4-6. This configuration was used for Radiated Emissions testing because it maximized emissions by co-operating the maximum number (4) of MFRM-3 in a single frame (Radio Rack). Each MFRM-3 was linked by fiber optics to a CORE-2 module in the digital shelf (BTS). The digital rack with the digital shelf was used as support equipment, and was placed in the AFC support room. The DC filter was connected between the MFRM-3s and DC power supply. This configuration was tested with +30 VDC input voltage.

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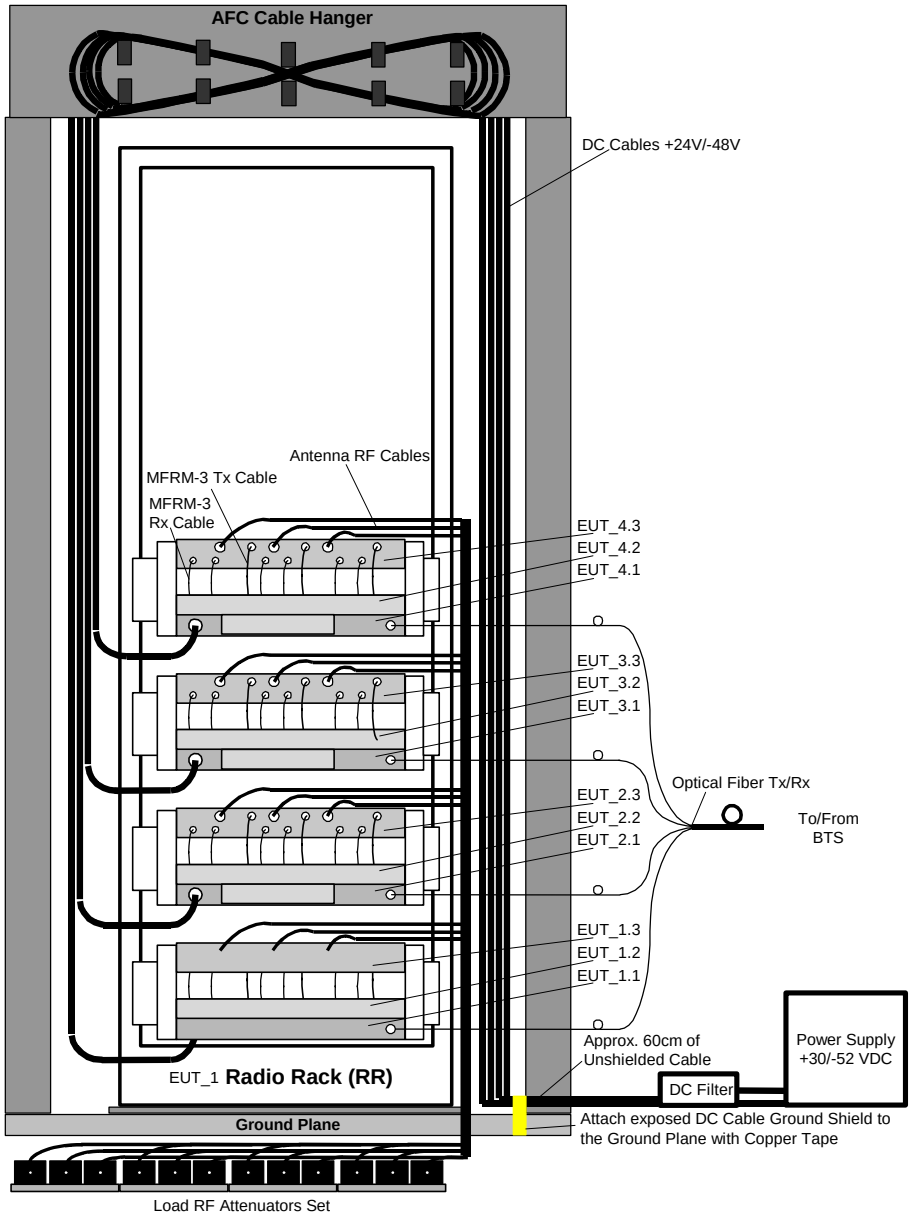
Figure 4-6: Setup for Radiated Emissions Test Configuration on Four 1.7/2.1GHz AWS MFRM-3



4.9.2 Configuration 2

Configuration 2 had an identical set-up and optical fiber connections as Configuration 1, however, the four MFRM-3 were operating at –52 VDC input voltage, instead of +30 VDC input voltage.

Inventory of the test equipment can be found in section System Components and Inventory on page 19.

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4.10 EUT Operations and Software

The system booted from an off state to a fully enabled state only requiring input to start test routines. DMI access was not required for the tests. The software requirement for the PC and the MFRM-3 Beta System are shown in Table 4-8. Traffic flow and Vortex set-up between the MFRM-3 and Indoor BTS can be found in

Figure 4-7 and Figure 4-8.

Table 4-8: BTS Software Requirements for 1.7/2.1 GHz AWS Beta MFRM-3 System

Software	Description	Functionality	Release	Interface
MFRM-3	MFRM-3 Application Software	Operates and debug MFRM-3 system	mfrmthree150fy	All 1.7/2.1 GHz AWS MFRM-3 interfaces
Vortex	BTS Manager	Commission, operate and monitor the BTS	1501	10 Base-T connection to CM-2

Figure 4-7: Traffic flow and Vortex set-up for the 1.7/2.1 GHz AWS MFRM-3 (BTS Side 0)

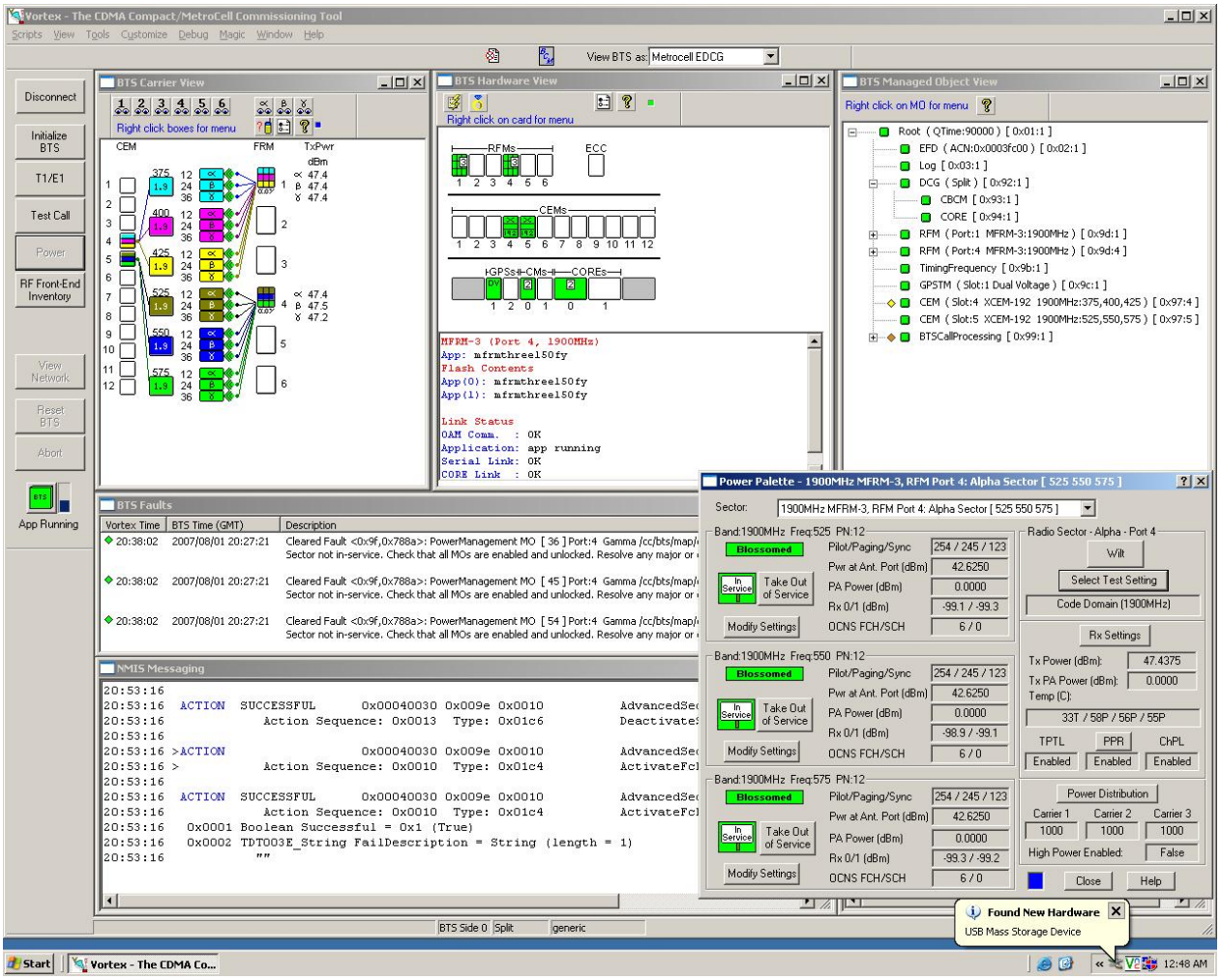

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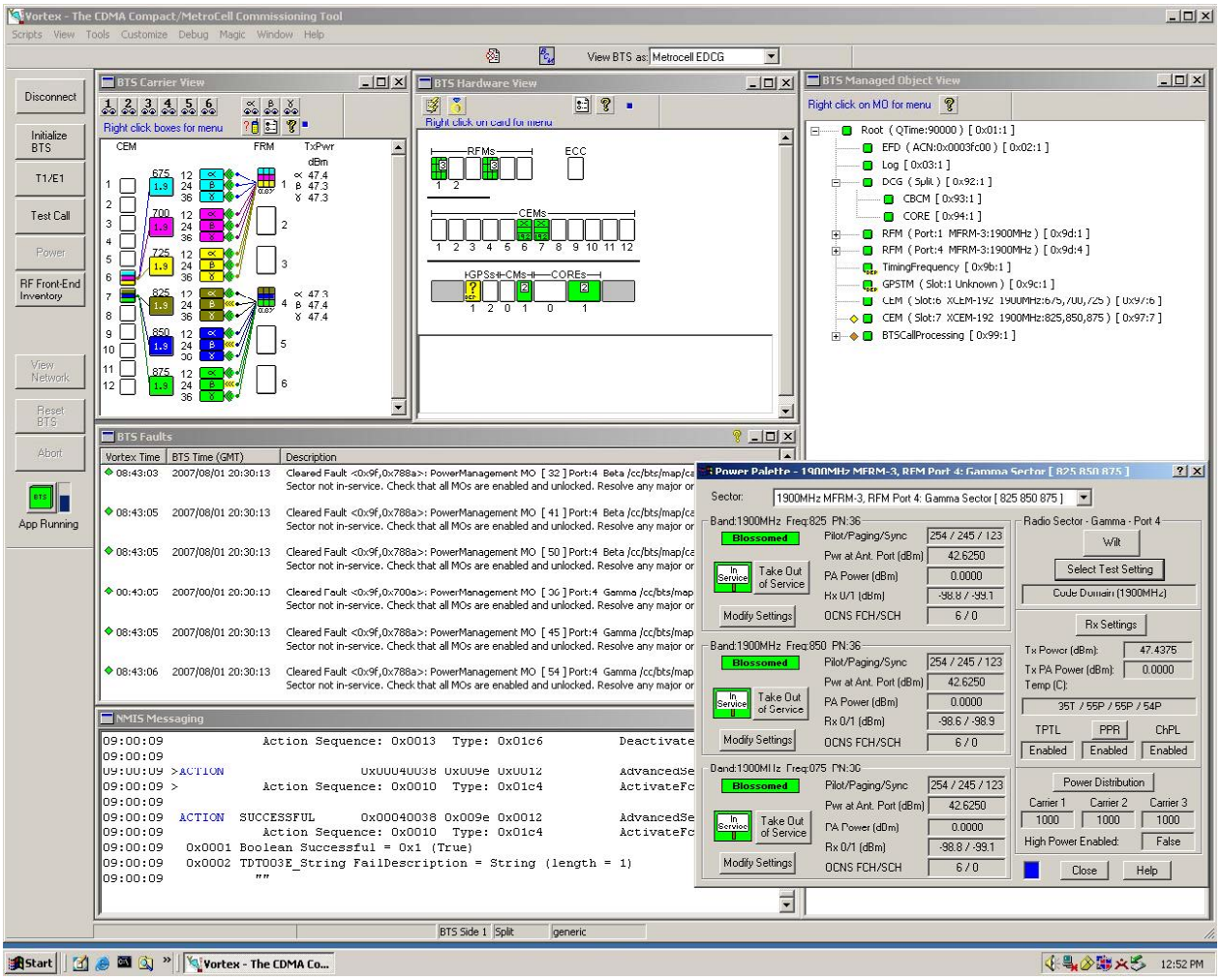
Figure 4-8: Traffic flow and Vortex set-up for the 1.7/2.1 GHz AWS MFRM-3 (BTS Side 1)



4.11 System Components and Inventory

The components and inventories of the EUT are provided in the following tables.

Table 4-9: 1.7/2.1GHz AWS beta MFRM-3 System Components

Component	Code	Quantity
Radio Rack	NTRZ51AA	1
1.7/2.1 GHz AWS MFRM-3 Radio Module	NTGZ70CAE5	4
1.7/2.1GHz TDPM	NTGZ70CAE6	4
FAM-3	NTGZ85AA	4

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Table 4-10: 1.7/2.1 GHz AWS MFRM-3 Inventory List for Radiated Emissions Test Cases

Reference	Component	Nortel PEC Code	Release Number	Serial Number
EUT_1	Radio Rack	NTRZ51AA	03	NNTMGY000N2D
EUT_1.1	1.7/2.1 GHz AWS MFRM-3 Radio Module	NTGZ70CAE5	B2	NNTMEEW01027
EUT_1.2	1.7/2.1GHz TDPM	NTGZ83AAE6	N1	FING010EY003
EUT_1.3	FAM-3	NTGZ85AA	01	NNTM84G100T9
EUT_2.1	1.7/2.1 GHz AWS MFRM-3 Radio Module	NTGZ70CAE5	B2	NNTMEEW01029
EUT_2.2	1.7/2.1GHz TDPM	NTGZ83AAE6	N1	FING010EY005
EUT_2.3	FAM-3	NTGZ85AA	01	NNTM84G100T2
EUT_3.1	1.7/2.1 GHz AWS MFRM-3 Radio Module	NTGZ70CAE5	B2	NNTMEEW01024
EUT_3.2	1.7/2.1GHz TDPM	NTGZ83AAE6	N1	FING010EY000
EUT_3.3	FAM-3	NTGZ85AA	01	NNTM84G100T4
EUT_4.1	1.7/2.1 GHz AWS MFRM-3 Radio Module	NTGZ70CAE5	B2	NNTMEEW0102D
EUT_4.2	1.7/2.1GHz TDPM	NTGZ83AAE6	N1	FING010EY00M
EUT_4.3	FAM-3	NTGZ85AA	01	NNTM84G100T7

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5 General Test Conditions

5.1 Test Facility

Radiated emissions testing were performed in a 10-meter Ambient Free Chamber (AFC). The AFC consists of a shielded room lined with ferrite tiles and anechoic material. It is located in the Solectron EMS Canada Inc facilities on 21 Richardson Side Road, Kanata, Ontario, Canada.

Facility accreditation information is located in the Accreditation Section on page 2 of this test report.

5.2 Measurement Instrumentation

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.

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6 E-field Radiated Emissions

E-field Radiated Emissions tests are performed to assure that 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
FCC Part 2.1053, 2.1057 FCC Part 27.53 (g)	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 [19], 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 27.53 (g)

For operations in the 1710-1755 MHz and 2110-2155 MHz bands, the power of any emission outside a licensee's frequency block shall be attenuated below the transmitter power (P) by at least 43 + 10 log10 (P) dB.

(1) Compliance with this provision is based on the use of measurement instrumentation employing a resolution bandwidth of 1 megahertz or greater.

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6.1.2 Test Facility Information

Location: SDE 10-meter AFC

Date tested: Recorded in the pre-scan plots included in Section 8.3.

Tested by: Recorded in the pre-scan plots included in Section 8.3.

6.1.3 Test Configurations

For radiated emissions test cases, the EUT hardware configuration/software load used are described in Section 4.9 and Section 4.10 on page 16 and 18 respectively.

6.1.4 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 documented in the Solectron EMC Test Procedures document [10]. The test was performed as per the relevant test procedures in ANSI C63.4 [6] and TIA-603-C [9]:

- The EUT was placed on a turntable inside the AFC (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 grounded in accordance with its installation specifications. No additional grounding connections were connected.
- For tests between **30 MHz and 10 GHz** the receive antenna (bi-log/horn) was placed at a 10 m distance from the EUT. An initial scan was performed to find emissions (frequencies) requiring detail measurement. The pre-scan 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, and for horizontal and vertical polarizations of the receiving antenna. 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.
- Between 30 MHz and 1 GHz measurements at discrete frequencies, the detector mode was quasi-peak (QP) unless otherwise noted. Above 1 GHz measurements were made with an average detector mode (AVG) unless otherwise noted. Above 1 GHz the corresponding peak level can be no more than 20 dB above this limit.
- For **all the above frequency ranges** optimization was performed based on the pre-scan data. For each identified 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 (were applicable) of the search antenna. The maximum level measured was recorded.
- A 2.1 GHz notch filter was used while measuring emissions between 30 MHz and 4 GHz. A 3 GHz high pass filter was used while measuring emissions between 4 and 10 GHz. The losses of each filter were previously evaluated with a calibrated Network Analyzer (HP 8753C, asset number: SSG012382, calibration due date: February 7th, 2008) and a calibrated Signal Generator (Anritsu 69369A, asset number: SSG012138, calibration due date: October 4th, 2007).

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- The highest emissions were re-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.

6.1.5 Test Results: E-field Radiated Emissions

This section presents the E-field radiated emissions results. Optimized emissions are presented in the table(s) below, while pre-scan plots of all measurements including marked peaks appear in Appendix C: Radiated Emissions Plots on page 33.

Positive margin values in the "RE Test Results" table(s) below indicate a **PASS** while negative margin values indicate a **FAILURE** to meet the requirement.

6.1.5.1 Configuration 1: Four 2100 MHz MFRM-3 (+30 VDC Input Voltage)

Pre-scan results between 10 kHz to 1000 MHz and 10 GHz to 26.5 GHz show no emissions present that require optimization.

Table 6-2: +30 VDC RE Test Results @ 10m (1-10 GHz)

Parameter	Unit	Emission 1	Emission 2	Emission 3
Frequency	MHz	4274.7	6412.3	8580.0
Azimuth	deg	342	356	4
Height	cm	309	232	267
Polarization		Horiz.	Vert.	Vert.
Meter Reading	dB(μV)	43.8	56.2	41.3
Detector	PK, QP, AV	AV	AV	AV
Gain / Loss Factor	dB	-31.7	-28.0	-25.8
Transducer Factor	dB	32.2	34.2	37.8
Level	dB(μV/m)	44.3	62.4	53.3

Note: Emissions 1, 2, and 3 were the highest second, third, and fourth harmonic of the broadcast frequency of four 2100 MHz MFRM-3.

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6.1.5.2 Configuration 2: Four MFRM-3 (-52 VDC Input Voltage)

Pre-scan results between 10 kHz to 1000 MHz and 10 GHz to 26.5 GHz show no emissions present that require optimization.

Table 6-3: -52 VDC RE Test Results @ 10m (1-10 GHz)

Parameter	Unit	Emission 1	Emission 2	Emission 3
Frequency	MHz	4290.5	6413.2	8578.3
Azimuth	deg	327	359	0
Height	cm	117	235	115
Polarization		Vert.	Vert.	Vert.
Meter Reading	dB(μV)	50.9	54.5	36.0
Detector	PK, QP, AV	AV	AV	AV
Gain / Loss Factor	dB	-31.7	-28.0	-25.8
Transducer Factor	dB	32.3	34.2	37.8
Level	dB(μV/m)	51.5	60.7	48.0

Note: Emissions 1, 2, and 3 were the highest second, third, and fourth harmonic of the broadcast frequency of four 2100 MHz MFRM-3.

Substitution measurements were performed in the 1 to 10 GHz band. The highest signals from Configuration 1 and 2 were used. Test results can be found in Table 6-4.

No significant signals associated with the transmitter were observed in the 10 kHz to 1 GHz and 10 GHz to 26.5 GHz bands. The system actually passed the FCC Part 15 Subpart B Class B limits in the 30 MHz to 1 GHz and 10 GHz to 26.5 GHz bands.

Pre-scan plots of the radiated E-field emissions measured are included in Appendix C: Radiated Emissions Plots on page 33.

Table 6-4: Substitution Measurement Test Results

Conf	Freq. (MHz)	Signal generator level (dBm)	Cable loss (dB)	Pol	Antenna gain (dB)	Prescan meter reading (dBuV)	Substitution meter reading (dBuV)	ERP (dBm)	Limit (dBm)	Margin (dB)
1	4274.7	-51.9	2.5	H	10.5	43.8	43.8	-46.1	-13	33.1
	6412.7	-34.2	3.2	V	11.8	56.2	56.2	-27.8	-13	14.8
	8580	-45.6	3.7	V	11.4	41.3	41.3	-40.1	-13	27.1
2	4290.5	-44.9	2.5	V	10.3	50.9	50.9	-39.3	-13	26.3
	6413.2	-35.9	3.2	V	11.8	54.5	54.5	-29.5	-13	16.5
	8578	-50.9	3.7	V	11.4	36	36	-45.4	-13	32.4

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6.2 Prescan Measurement Uncertainties

Uncertainty evaluation has been calculated according to the method described in CISPR 16 [8].

The expanded measurement instrumentation uncertainty (with a 95 % level of confidence) on E-field RE is ± 3.8 dB between 10 kHz and 30 MHz, ± 4.5 dB between 30 MHz and 1 GHz, ± 5.9 dB between 1 GHz and 10 GHz, ± 5.8 dB between 10 GHz and 18 GHz, and ± 5.5 dB between 18 GHz and 26.5 GHz.

6.3 Calculation of the Compliance Margin

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

ERP = Signal generator level – Cable losses + Antenna gain – Half wave dipole gain (2.2 dB)

Margin = Limit - ERP

6.4 Test Conclusion

The worst-case margin is 14.8 dB at 6412.7 MHz to FCC Part 27 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 27 requirements.

6.5 Test Equipment List

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

Description	Make	Model number	Asset number	Calibr. due
Spectrum Analyzer HP8566B (AFC #1)	Hewlett Packard	8566B	SSG012521	4/13/2008
Spec. A, RF PreSelector, HP85685A	Hewlett Packard	85685A	SSG012010	4/13/2008
Attenuator	Weinschel	6070-20	SSG013016	4/13/2008
Double Ridged Horn	Emco	3115	SSG012298	1/17/2008
Power Supply	Hewlett Packard	6216A	SSG013063	2/8/2008
Pre-Amplifier	BNR	LNA	SSG012360	2/8/2008
Quasi-Peak Adapter, HP85650A, (EMI # 2)	Hewlett Packard	85650A	SSG012433	10/4/2007
EMC Cable # 5, Sucoflex Cable	Huber & Suhner	104PEA	SSG012359	2/8/2008
EMC Cable # 2, Sucoflex Cable	Huber & Suhner	106A	SSG012453	2/5/2008
Spectrum Analyzer Display, HP 85662A	Hewlett Packard	85662A	SSG012433	4/13/2008
EMC Cable # 25, Sucotest Cable	Huber & Suhner	ST18/Nm/Nm/36	SSG012788	2/8/2008
Bilog Antenna	Antenna Research Associates	LPB 2520A	SSG012299	12/21/2007

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Description	Make	Model number	Asset number	Calibr. due
Spectrum Analyzer - Portable	Hewlett Packard	8564E	SSG012069	3/19/2008
RF Amplifier, HP8447 # 1	Agilent	8447D	SSG013045	10/6/2007
Horn Antenna (18 - 26.5 GHz)	Emco	3160-09	SSG012292	12/21/2007
EMC Cable # 14, Sucoflex Cable	Huber & Suhner	104PEA	SSG012041	10/2/2007
EMC Cable # 1, Sucoflex Cable	Huber & Suhner	106A	SSG012454	2/5/2008
EMC Cable # H3, 10-18 GHz, Utiflex Cable	Micro-Coax	UFA 210B-1-1500-504504	SSG012376	12/21/2007
EMC Cable # H4, 26.5-40 GHz, Sucoflex	Huber & Suhner	102A	SSG013084	12/21/2007
Substitution Signal Generator	Anritsu	69369A	SSG012138	10/04/2007
Substitution Antenna	EMCO	3115	SSG012508	01/02/2008
Substitution RF Cable	Micro-Coax	UFA 210B-1-1500-504504	SSG012376	12/21/2007
2.1 GHz Band pass Filter	Microwave Circuits	N0321401	4217-01	Calibrate before use
3 GHz High pass Filter	FSY Microwave	HR2380-11XNXN	002	Calibrate before use
Network Analyzer	Hewlett Packard	8153	SSG012381	2/7/2008

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.

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7 References

7.1 Applicable documents

1. K0001398-TP-EMC-01-01, EMC Compliance Test Plan for AWS 17/2.1 GHz MFRM-3 Beta

7.2 Reference documents

2. Standards Council of Canada, Scope of Accreditation for Solectron EMS Canada Inc. outlined at the following web site http://palcan.scc.ca/specs/pdf/95_e.pdf
3. Industry Canada, RSS 212, Test Facilities and Test Methods for Radio Equipment, Issue 1 (Provisional), February 27, 1999.
4. Solectron EMS Canada Inc. Quality Manual, K0000608-QD-QM-01-09, July 4 2006.
5. Solectron EMS Canada Inc. Lab Operations Manual KG000347-QD-LAB-01-08, July 4 2006.
6. ANSI C63.4-2003 for FCC CFR 47 and ANSI C63.4-2001 for Telcordia, Methods of Measurement of Radio-Noise Emission from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz, 06 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 Publications (2003), Specification for Radio Disturbance and Immunity Measuring Apparatus and Methods - Part 1: Radio Disturbance and Immunity Measuring Apparatus.
9. TIA-603-C, Land Mobile FM or PM Communications Equipment Measurement and Performance Standards, August 2004
10. Solectron EMS Canada Inc., EMC General Lab Test Procedure, KP000270-LP-EMC-01-08, July 6, 2006.
11. CISPR 22 (1997 / A2 2002), Title: Information technology equipment - Radio disturbance characteristics - Limits and methods of measurement.
12. FCC Rules for Radio Frequency Devices, Title 47 of the Code of Federal Regulations, Part 15, U.S. Federal Communications Commission, 2005.
13. ICES-003 Issue 4 (2004), “Spectrum Management: Interference-causing equipment standard (Digital Apparatus)”
14. Lab34 Edition 1, “The Expression of Uncertainty in EMC Testing”, UKAS, August 2002.
15. APLAC, Asia Pacific Laboratory Accreditation Cooperation, Website (http://www.aplac.org)
16. ILAC, International Laboratory Accreditation Cooperation, Website (http://www.ilac.org/)
17. ISO 9001:2000, Quality Management Systems – Requirements, third edition, 2000/12/15.

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18. Code of Federal Regulations (Washington, DC: Federal Communications Commission), Title 47, Chapter 1, Part 27.
19. Code of Federal Regulations (Washington, DC: Federal Communications Commission), Title 47, Chapter 1, Part 2.
20. 2 GHz Personal Communications Services, Industry Canada, RSS-133, Issue 2, Revision 1, November 6, 1999
21. NAMAS Publication NIS 81: “The Treatment of Uncertainty in EMC Measurements”, Edition 1, May 1994.
22. Industry Canada, RSS 212, Test Facilities and Test Methods for Radio Equipment, Issue 1 (Provisional), February 27, 1999.

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8 Appendices

8.1 Appendix A: Glossary

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

Term	Definition
1xRTT	IS-2000 Spreading Rate 1, i.e., using the same channel bandwidth as IS-95 (1.25 MHz), or one times the current RTT
AD	Average Detector
AE	Auxiliary Equipment
AFC	Ambient Free Chamber
AM	Amplitude modulation
ANSI	American National Standards Institute
BTS	Base-station Transceiver System
BTS	Base Station Transceiver Subsystem
CDMA	Code Division Multiple Access
CEM	Channel Element Module
CEM192	1xRTT CEM with six CSM5000 supporting 192 voice calls
CEM64	1xRTT CEM with two CSM5000 supporting 64 voice calls
CSA	Canadian Standards Association
dB	Decibel
DC	Direct Current
DR	Digital Rack
EMC	Electromagnetic Compatibility
ERP	Effective Radiated Power
EUT	Equipment Under Test
FCC	Federal Communications Commission, USA
FL	Forward Link
FOM	Fiber Optic Microcell
FRM	Flexible Radio Module
GND	Ground
IC	Industry Canada
LISN	Line Impedance Stabilization Network
MCBTS	Multi-Carrier Base Station Transceiver Subsystem
MFRM	Multi-carrier Flexible Radio Module
MU	Measurement Uncertainty
NA	Not Applicable

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Term	Definition
NAMAS	National Measurement Accreditation Service
NBS/ NIST	National Bureau of Standards / National Institute of Standards and Technology
PA	Broadband Power Amplifier
PK	Peak Detector
PSU	Power Supply Unit
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 Ω Coaxial Termination (conducted emissions / immunity)
TDM	Tri-Sector Duplexer Module
UL	Underwriters Laboratories, Inc.
UUT	Unit Under Test
VBW	Video Bandwidth
WR HCPA	Wide voltage Range High Power Converter Assembly
WR MPEM	Wide voltage Range Power Entry Module

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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: AWS 1.7/2.1 GHz MFRM-3 Beta Radiated Emission Set-up (Configuration 1 and 2 – Front View)

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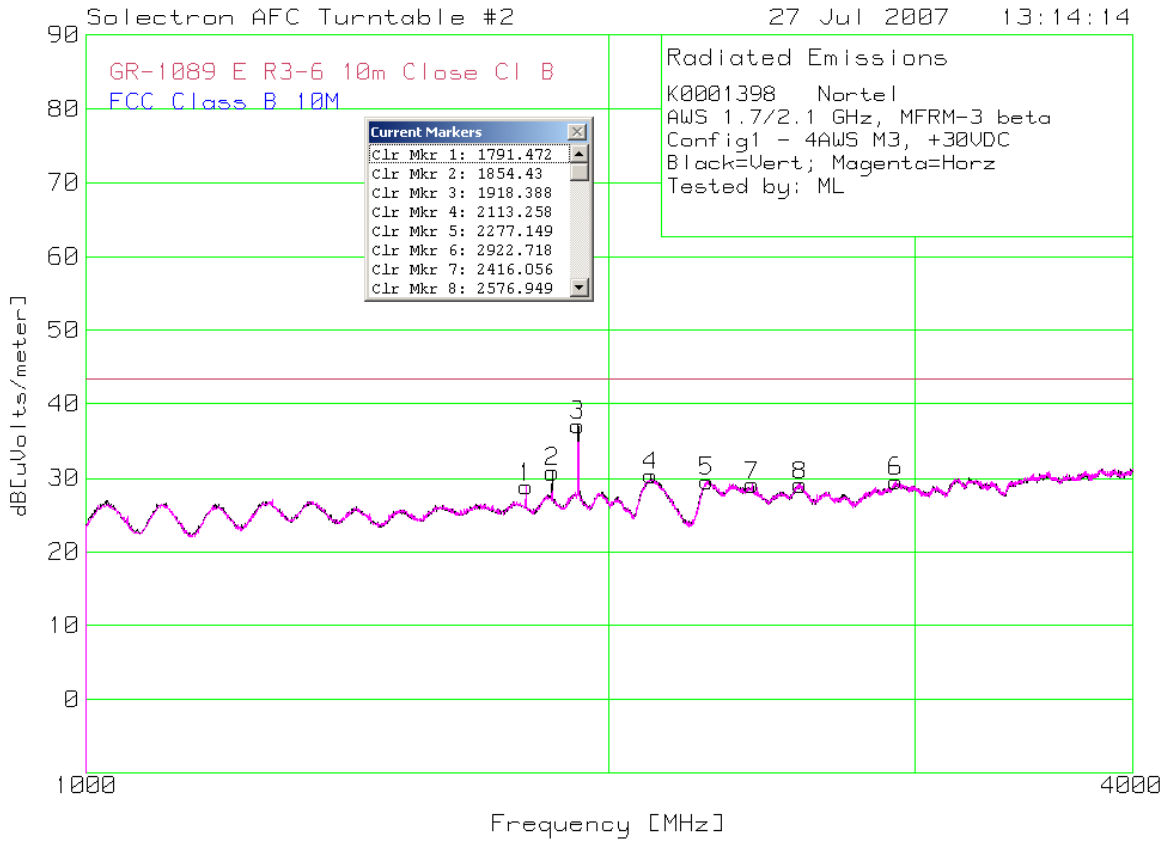
8.3 Appendix C: Radiated Emissions Plots

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

Radiated emissions were measured between the frequency ranges of 10 kHz to 26.5 GHz. No significant signals associated with the transmitter were observed in the 10 kHz to 1 GHz and the 10 GHz to 26.5 GHz ranges.

8.3.1 Configuration 1: Four 2100 MHz Beta MFRM-3 (+30 VDC Input Voltage)

Figure 8-2: RE 1 – 4 GHz



Note: A 2100 MHz notch filter was placed between the horn antenna and pre-amplifier during this Radiated Emissions plot.

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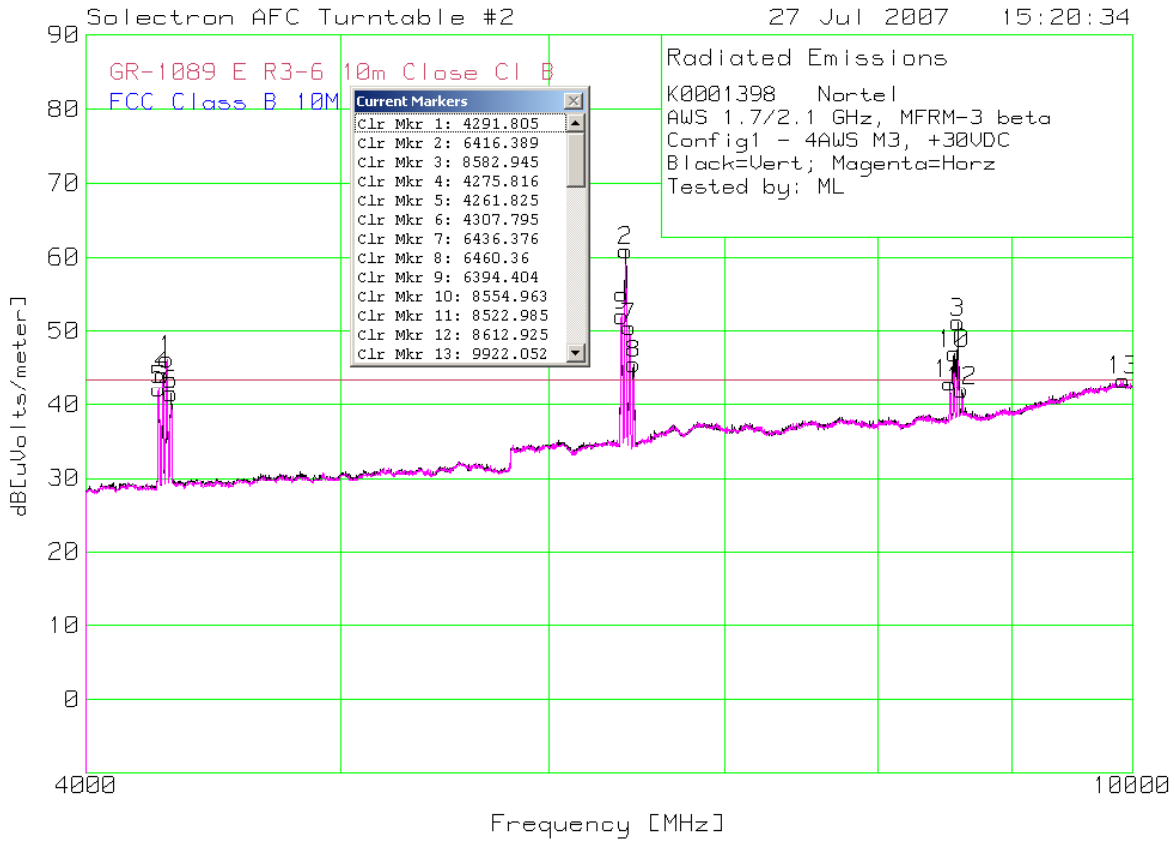
Figure 8-3: RE 4 – 10 GHz



Note: A high pass filter was placed between the horn antenna and pre-amplifier during this Radiated Emissions plot.

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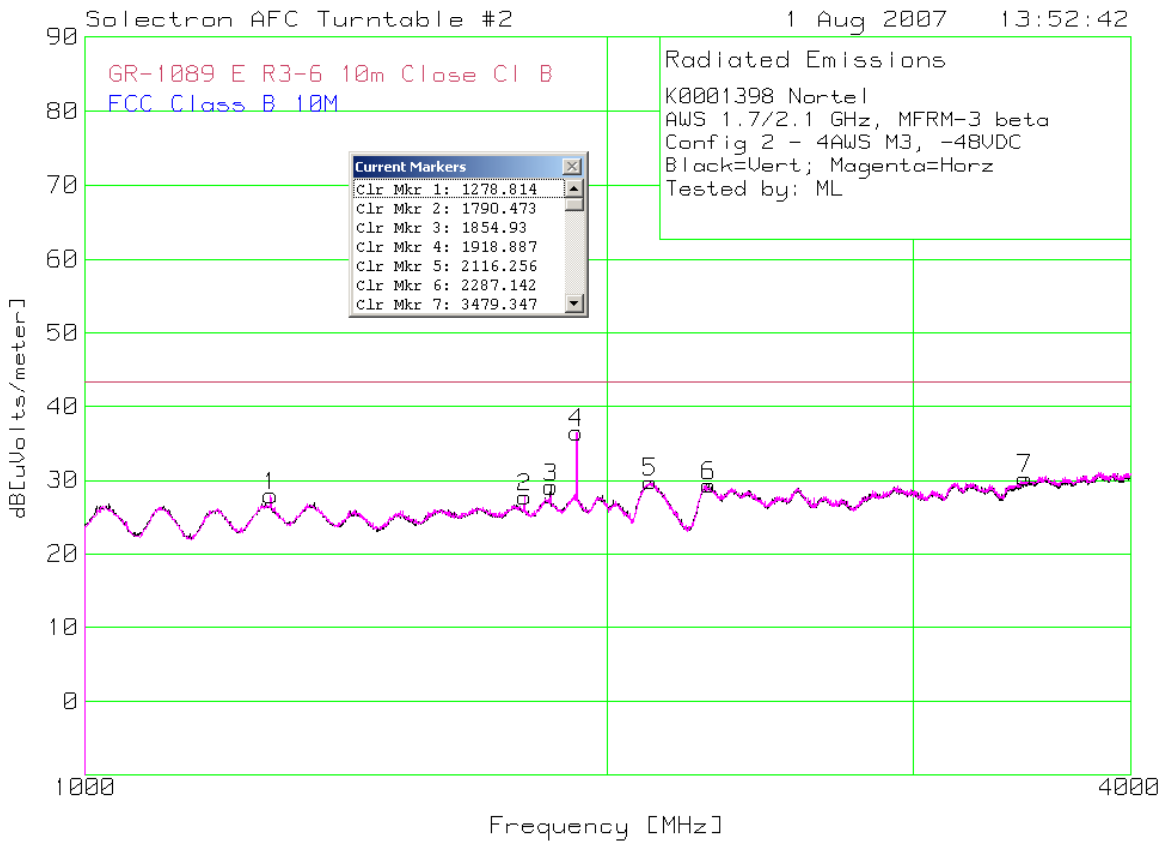
8.3.2 Configuration 2: Four Beta MFRM-3 (-52 VDC Input Voltage)

Figure 8-4: RE 1 – 4 GHz



Note: A 2100 MHz notch filter was placed between the horn antenna and pre-amplifier during this Radiated Emissions plot.

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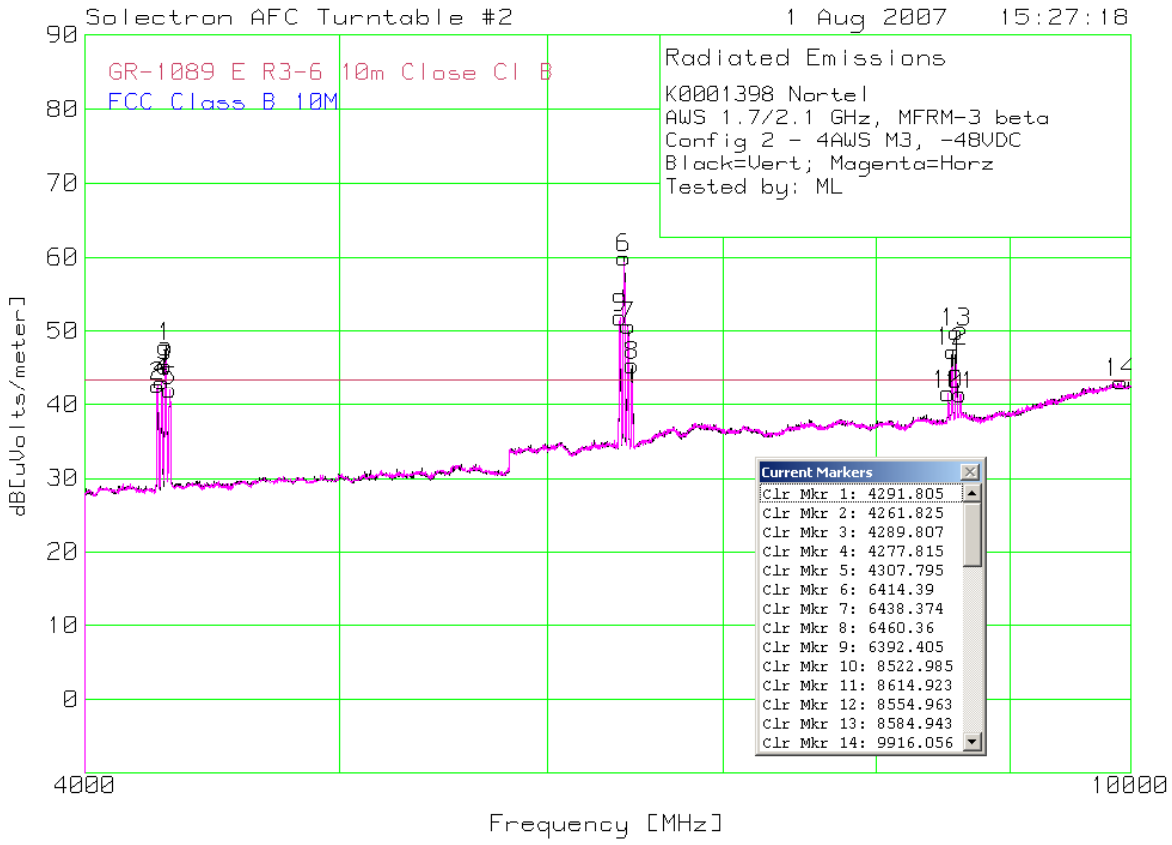
Figure 8-5: RE 4 – 10 GHz



Note: A high pass filter was placed between the horn antenna and pre-amplifier during this Radiated Emissions plot.

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8.4 Appendix D: RF Characterization of the Filters Used in the Radiated Emissions Testing.

This appendix presents the RF characterization of the notch filter and the high pass filter. The notch filter (Nortel item, made by Microwave Circuits Inc., model number: N0321401, serial number: 4217-01) was used in the range of 1000 to 4000 MHz radiated emissions measurements. The high pass filter (Solectron item, made by FSY Microwave, model number: HR 2380-11XNXN, serial number: 002) was used in the range of 4000 to 18000 MHz radiated emissions measurements.

Figure 8-6: Characteristic of the Microwave Circuit Inc. Notch Filter in the range of 1640 to 2640 MHz

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Figure 8-7: Characteristic of the Microwave Circuit Inc. Notch Filter in the range of 3 to 4000 MHz

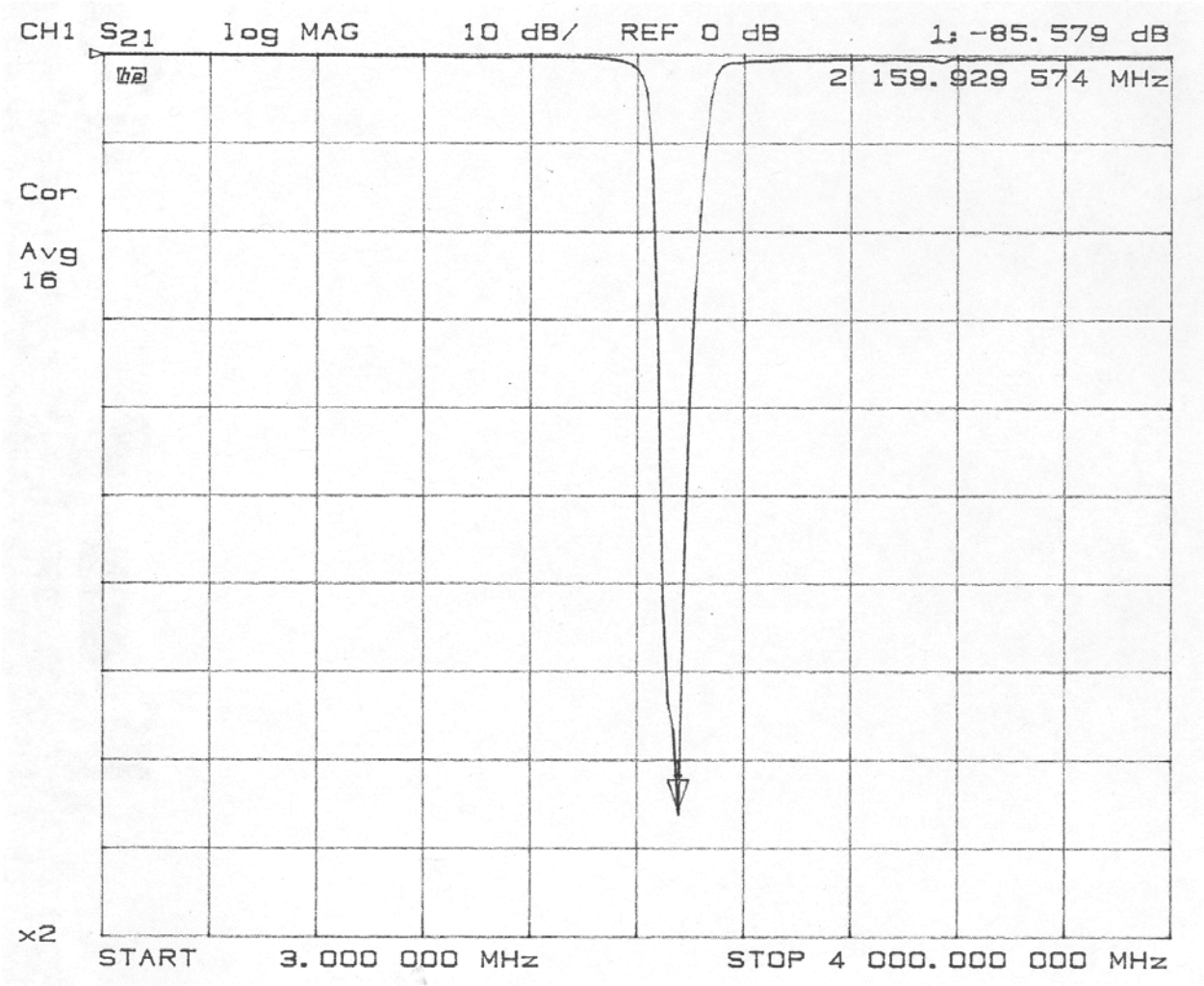

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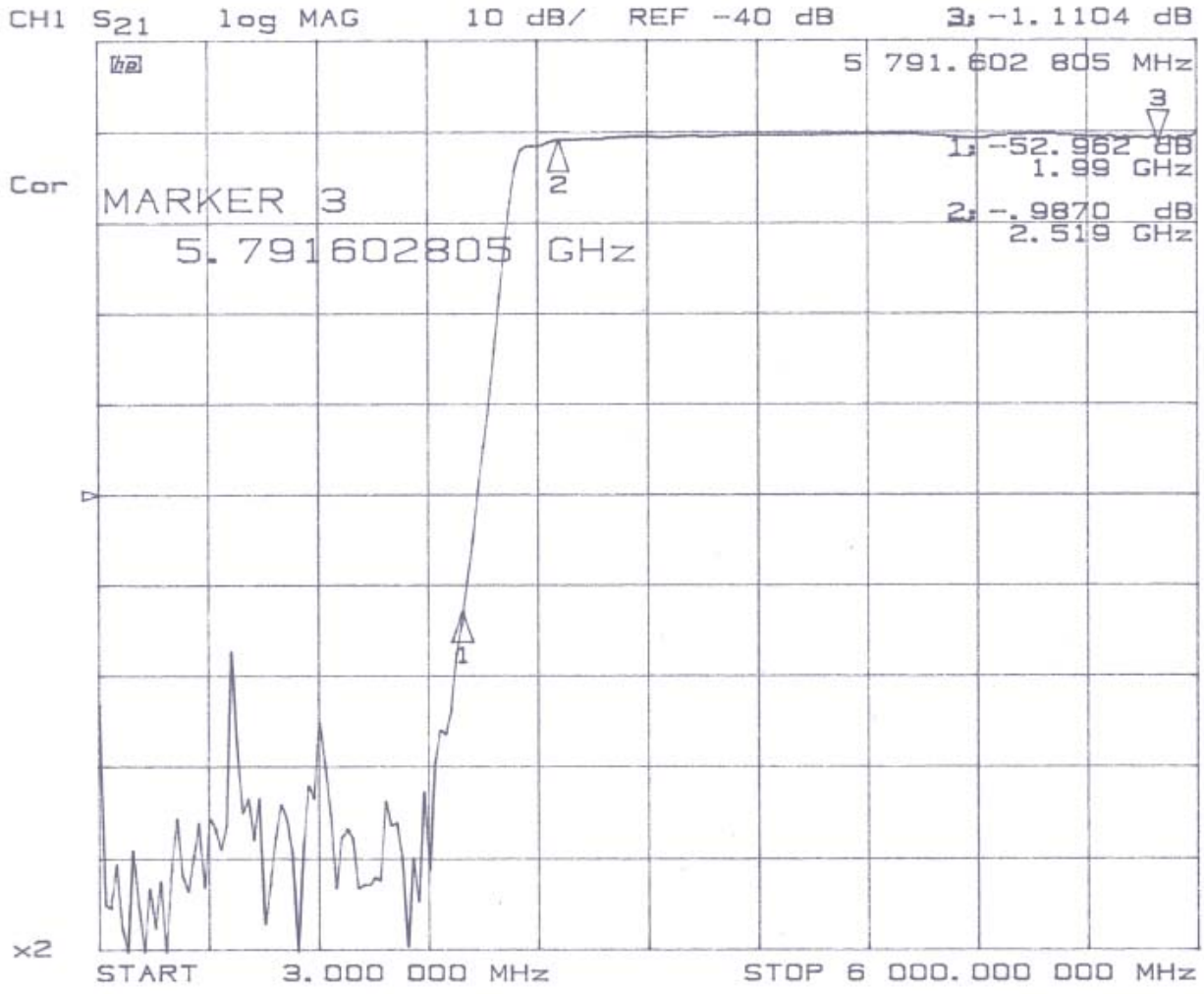
Figure 8-8: Characteristic of the FSY Microwave High Pass Filter in the range of 3 to 6000 MHz



Note: The high pass filter was also evaluated between 6 and 21 GHz. Less than 1dB of insertion loss was observed in that range.

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Design and Engineering

Spurious Emissions Compliance Report for the AWS 1.7/2.1 GHz MFRM-3 Beta FCC Part 27

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