Sanmina Canada ULC

EXHIBIT 2

Test Report

Applicant: Northern Telecom Ltd.

For Type Acceptance/Certification on:

AB6NT800MFRM

1 Introduction

This information is submitted in accordance with the FCC rules and regulations, Part 2, Subpart J, §2.1033 through §2.1057 and Industry Canada RSS 129 radio standard for Type Acceptance/Certification of the Northern Telecom's (Nortel Networks) CDMA 800 MHz Multicarrier Flexible Radio Module (MFRM).

This 800 MHz MFRM is intended for use in the Domestic Public Cellular Radio Telecommunications Service and is designed in accordance with the following standards:

- *CFR 47, Part 22, Subpart H, Domestic Public Cellular Radio Telecommunications Service*
- *TIA/EIA/IS-95-A, Mobile Station - Base Station Compatibility Standard for Dual-Mode Wideband Spread Spectrum Cellular System, May 1995*

1.1 Test Result Summary

Table 1 summarizes the measurement results for the CDMA 800 MHz MFRM for 1 Carrier and 3 Carrier configuration.

Table 1: Test Results Summary

FCC Measurement Specification	FCC Limit Specification	Description	Result
2.1046	22.913	RF Output Power	Compliant
2.1047	22.901	Modulation Characteristics	Not Applicable
2.1049	22.917	Occupied Bandwidth	OBW = 1.2625 MHz (1 Channel) OBW = 3.7270 MHz (3 Channel)
2.1051, 2.1057	22.917	Spurious Emissions at Antenna Terminals	Compliant
2.1053, 2.1057	22.917	Field Strength of Spurious Emissions	Compliant
2.1055		Frequency Stability	Compliant

2 Engineering Declaration

The CDMA 800 MHz Multicarrier Flexible Radio Module (MFRM) has been tested in accordance with the requirements contained in the Federal Communications Commission Rules and Regulations Parts 2 and 22 and Industry Canada Radio Standard Specification 129, issue 1.

To the best of my knowledge, these tests were performed in accordance with good engineering practices using measurement procedures consistent with industry or commission standards or previous Commission correspondance or guidance and demonstrate that this equipment complies with the appropriate standards. All tests were conducted on a representative sample of the equipment for which type acceptance/certification is sought.

Tested By: _____ _____

Signature *Date*

Mark Wojcik
EMC Technolgist
Sanmina ULC on behalf of Nortel Networks
Calgary, Alberta

_____ _____

Signature *Date*

Glen Moore
Technical Manager – RF/EMC Technical Manager
Sanmina ULC on behalf of Nortel Networks
Calgary, Alberta

3 Certification Application Requirements

3.1 Name of Applicant

The applicant is Northern Telecom (Nortel Networks) Limited.

3.2 Identification of Equipment

The equipment in this application for type acceptance is the Northern Telecom's (Nortel's) CDMA 800 MHz Multicarrier Flexible Radio Module (MFRM). The 800 MHz MFRM will be marketed under the model number NT800MFRM. The FCC ID number sought is AB6NT800MFRM.

3.3 Quantity Production

The 800 MHz MFRM will be produced in quantity.

3.4 Technical Description

See Exhibit 3.

3.5 Types of Emissions

The 800 MHz MFRM Assembly is designed to operate in digital mode. The emission type is F9W for CDMA mode. The emission designators are 1M25F9W (1 Channel), 2M50F9W (2 Channel and 3M73F9W (3 Channel). Testing was conducted in single channel mode, two channel and 3 channel mode to determine compliance.. The emission designators were calculated based on requirements of FCC Rule Part 2, Subpart C - Emissions, section 2.201 and Section 2.202.

For Single Carrier mode:

1M25F9W - 1.25 MHz nominal bandwidth, F9W as per request of American TCB

For Two Carrier mode:

1M25F9W - 2.50 MHz nominal bandwidth, F9W as per request of American TCB

For Three Carrier mode:

1M25F9W - 3.75 MHz nominal bandwidth, F9W as per request of American TCB

3.6 Frequency Range

The 800 MHz MFRM operates in the 800 MHz cellular band where the operating frequency ranges are 824 – 849 MHz for the Receiver and 869 – 894 MHz for the TransmitterRange of Operating Power

3.7 Power Operating range

The 800 MHz MFRM range of operating is 0 dBm to 47.6 dBm .

3.8 Maximum Power Rating

The maximum RF power output of the CDMA 800 MHz MFRM is 47.6 dBm.

3.9 Function of Each Active Circuit Device

See Exhibit 5 for a listing of devices incorporated in the MFRM.

3.10 Complete Circuit Diagrams

Exhibit 4 contains schematics of devices incorporated in the Transmit/Receive module. The rest of the RF chain consist of OEM equipment that has been submitted separately for FCC approvals.

The Power wave 800MHz multi-channel power amplifier is approved under FCC ID E675JS0047.

3.11 User Manual

See Exhibit 5.

3.12 Tune-Up Procedure

The tune-up tests will be performed as part of the factory testing on the MFRM. This procedure includes power output levels, spurious emissions, and occupied bandwidth. There are no user adjustments that will have any effect on these settings. No tune-up testing is required in the field.

3.13 Circuit Description for Frequency Determining and Stabilizing

The Global Positioning Satellite Timing Module (GPSTM) is the primary clock source in the system. It consists of two outputs:

EVEN_SEC Clock and,

SYS_CLK (at 8fc or 9.8304 MHz)

In addition, the GPSTM has a 10 MHz reference output that can be used to synchronize external measurement equipment during system testing.

The GPSTM distributes the primary clock signals directly to the Control Module (CM) and the CORE modules (see Exhibit 3) which in-turn distribute the clock signals to the digital modules and to the MFRM via the high speed optical link.

The GPSTM has a frequency stability of better than 1.0 parts per billion.

3.14 Circuit Description for Suppression of Spurious Radiation

The TX band pass filter in the DPM provides out of band emission rejection and permits only signals in the TX band to the antenna for emission. See Exhibit 3 – Technical Description for detailed explanation.

3.15 Circuit Description for Limiting Modulation

This systems employs digital modulation techniques producing CDMA forward and reverse channel air interfaces which are compatible with IS 95A and IS 97A technical standards.

3.16 Circuit Description for Limiting Power

A power detector is located in the MFRM. This circuit will accurately measure the RMS power of the composite CDMA waveform. The system will step down the output power if the detected signal exceed the maximum power setting of the system.

3.17 Photograph

See Exhibit 6.

3.18 Standard Test Conditions and Test Equipment

The MFRM was tested under the following standard test conditions unless otherwise noted:

Ambient temperature: 20 to 35 degrees C

Ambient humidity: 20 to 40%

DC supply voltage: -48 VDC (nominal)

3.19 EUT Identification List

The following table shows the identification of the components tested in this report

Equipment Description	Model /Part Number	Release Number	Serial Number
800 MHz Multicarrier Flexible Radio Module (comprised of main modules below):	N/A	N/A	N/A
a) DPM (Duplexer Module)	NNGS89DB	06	CLWVPP201T58
b) TRM (Tx/Rx Module)	NTGY10CA	R5	NNTM533BRFYQ

Equipment Description	Model /Part Number	Release Number	Serial Number
c) PAM (Power Amp Module)	NTGY70AA	R1	NNTM533BRF3V
d) FAM (Fan Module)	NTGS5652	01	NNTM53598589

3.20 Test Equipment List

Description	Manufacturer	Model	Serial Number	Cal. Due Date
9 kHz to 40GHz Spectrum Analyzer	HP	8542E	3705A00184	Nov. 28/01
9 kHz to 40 GHz, Spectrum Analyzer	Rohde & Schwarz	FSEK	DE22471	Oct . 08/01
RF Power Meter	HP	438A	3008A07337	June 21/01
30 dB Attenuator	Weinschel	66-30-34	BH4705	Verified before use
Biconolog Antenna 20 MHz to 2 GHz	Chase	3141	9707-1066	Aug. 4/01
Double Ridge Guide Antenna (1-18 GHz)	Liberty	EM-6952	314	June 14/01
1 – 18 GHz Low Noise Amplifier	Miteq	JS000121	51376	Verified before use
RF Cable	Sucoflex	N/A	9364/6	Verified before use
RF Cable	Sucoflex	N/A	9375/6	Verified before use

4 Transmitter Test and Measurement Results

4.1 RF Power Output

4.1.1 RF Power Output Requirements

FCC Part 2.1046 / IC RSS129 Sec. 9.2.3

(a) For transmitters other than single sideband, independent sideband and controlled carrier radiotelephone, power output shall be measured at the RF output terminals when the transmitter is adjusted in accordance with the tune-up procedure to give the values of current and voltage on the circuit elements specified in 2.983(d)(5). The electrical characteristics of the radio frequency load attached to the output terminals when this test is made shall be stated.

FCC Limit (Part 22.913)

The maximum effective radiated power (ERP) of base transmitters and cellular transmitters must not exceed 500 Watts.

IC Limit (RSS129 Sec. 9.2.3)

The output power shall be capable of being adjusted to within +/-1.0 dB of the manufacturer's rated power.

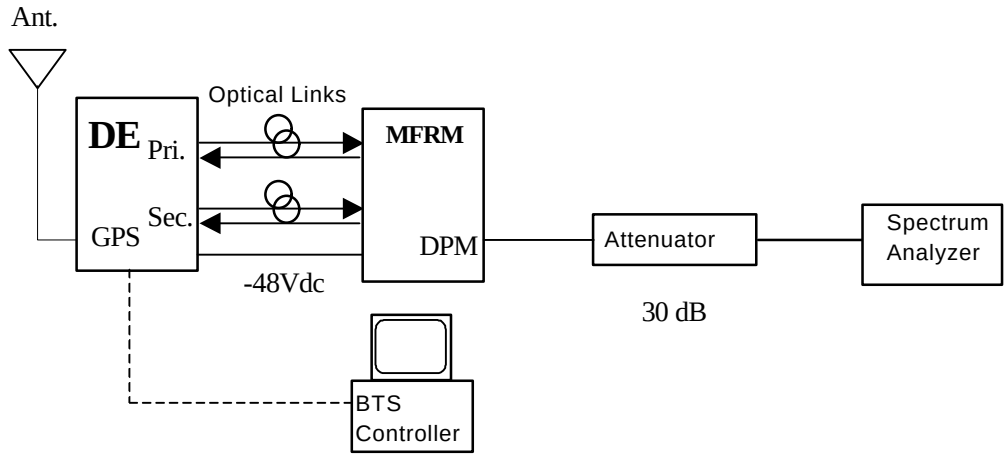
4.1.2 Test Method

The CDMA/Base station was setup via the BTS controller to enable the MFRM to transmit at maximum power. Measurements were made on channels at the bottom, middle and top of the licensed bands. The RF output power was measured using the power meter.

4.1.3 Test Setup

The set-up used for the MFRM RF output power test is illustrated in Figure 1.

Figure 1: Test Setup for RF Power Output Measurement



4.1.4 Test Result

The 800 MHz MFRM complies with the requirement. The maximum measured RF output power from the MFRM was +47.3 dBm. The RF power output measured on different channels is shown in Table 2.

Table 2(A) : RF Output Power of 800 MHz MFRM in (1) Carrier

Channel Number (Band)	Frequency (MHz)	Measured RF Output Power (dBm)	Maximum Rated Power (dBm)	FCC Limit (dBm)
8 (A)	870.24	46.240	47.30	50
293 (A)	878.79	46.300	47.30	50
374 (B)	881.22	46.282	47.30	50
616 (B)	888.78	46.183	47.30	50
758 (B')	892.74	46.240	47.30	50

Table 2(B) : RF Output Power of 800 MHz MFRM in (2) Carrier

Channel Numbers (Band)	Frequencies (MHz)	Measured RF Output Power (dBm)	Maximum Rated Power (dBm)	FCC Limit (dBm)
8 (A), 49 (A)	870.24, 871.47	47.15	47.30	50

Note: As measurements were done on all channels used for 2 carrier configuration in 3 carrier and single carrier mode, power measurements were verified on one 2 carrier configuration only.

Table 2(C) : RF Output Power of 800 MHz MFRM in (3) Carrier

Channel Numbers (Band)	Frequencies (MHz)	Measured RF Output Power (dBm)	Maximum Rated Power (dBm)	FCC Limit (dBm)
8, 49, 90 (A)	870.24, 871.47, 872.70	46.260	47.30	50
211, 252, 293 (A)	876.33, 877.56, 878.99	46.200	47.30	50
374, 415, 456 (B)	881.22, 882.45, 883.075	46.290	47.30	50
534, 575, 616 (B)	886.02, 887.25, 888.48	46.284	47.30	50

4.2 Occupied Bandwidth (Digital)

4.2.1 Occupied Bandwidth Requirements

FCC Part 2.1049

The OBW, that is the frequency bandwidth such that, below its lower and above its upper frequency limits, the mean powers radiated are each equal to 0.5 percent of the total mean power radiated by a given emission shall be measured under the following conditions as applicable:

(g) Transmitter in which the modulating base band comprises not more than three independent channels - when modulated by the full complement of signals for which the transmitter is rated. The level of modulation for each channel should be set to that prescribed in rule parts applicable to the services for which the transmitter is intended. If specific modulation levels are not set forth in the rules, the tests should provide the manufacturer's maximum rated condition.

(h) Transmitters employing digital modulation techniques - when modulated by an input signal such that its amplitude and symbol rate represent the maximum rated conditions under which the equipment will be operated. The signal shall be applied through any filter networks, pseudo-random generators or other devices required in normal service. Additionally, the occupied bandwidth shall be shown for operation with any devices used for modifying the spectrum when such devices are optional at discretion of the user.

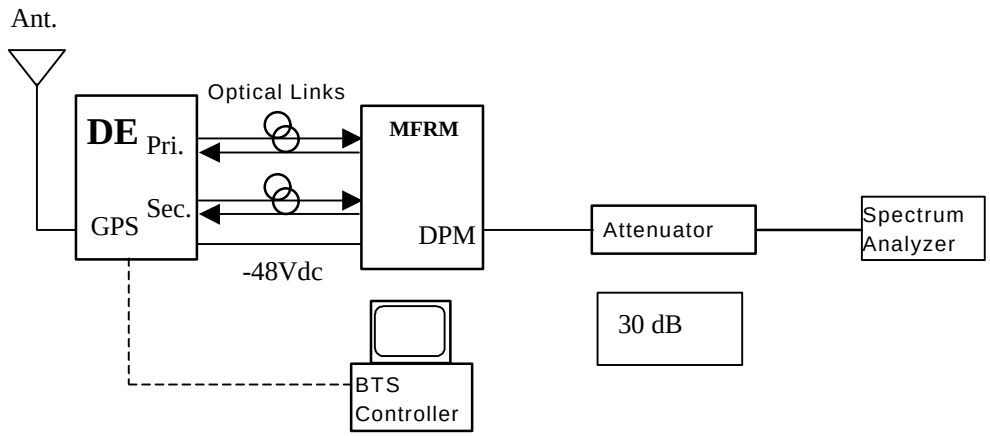
4.2.2 Test Method

The Base station was setup via the BTS controller to enable the MFRM to transmit at maximum power. Measurements were made on channels at the bottom, middle and top of the licensed bands. The occupied bandwidth was measured using the 99% channel power feature of the spectrum analyzer. The measurement was conducted in single carrier mode (1 Carrier), 2 Carrier and in multi-carrier mode (3 Carrier) configuration.

4.2.3 Test Setup

The set-up used for the MFRM Occupied bandwidth test is illustrated in Figure 2.

Figure 2: Test Setup for RF Power Output Measurement



4.2.4 Test Results

The measured output power from the Base Station was 47.6 dBm. The Base Station complies with the requirement. Table 1 shows the measured occupied bandwidth at the different channels. Figure 3 shows a plot of the maximum measured occupied bandwidth of 1262.525 kHz (1 Channel) and Figure 4 shows a plot of the maximum measured occupied bandwidth of 3727.000 kHz (3 Channel). To minimize test data Figure 3 and Figure 4 are sample plots for 1 carrier and 3 carrier configuration. There were no issues with the other channels listed below. Note only one 2 carrier configuration was tested as all other occupied BW measurements were consistent, and had no noticeable variation in OBW.

Table 3: Occupied Bandwidth of 800 MFRM (1 Carrier)

Channel Number (Band)	Frequency (MHz)	Measured Occupied Bandwidth (kHz) (1 Carrier)
8 (A)	870.240	1262.525
293 (A)	878.790	1262.525
374 (B)	881.220	1262.525
616 (B)	888.780	1262.525
758 (B')	892.740	1262.525

Table 5: Occupied Bandwidth of 800 MFRM (2 Carrier)

Channel Number (Band)	Frequencies (MHz)	Measured Occupied Bandwidth (kHz) (3Carrier)
8 (A), 49 (A)	870.24, 871.47	3727.000

Table 4: Occupied Bandwidth of 800 MFRM (3 Carrier)

Channel Number (Band)	Frequency (MHz)	Measured Occupied Bandwidth (kHz) (3Carrier)
8, 49, 90 (A)	870.24, 871.47,	3727.000
211, 252, 293	876.33, 877.56,	3727.000
374, 415, 456	881.22, 882.45,	3727.000
534, 575, 616	886.02, 887.25,	3727.000

Figure 3: Plot of Occupied Bandwidth: 1 Carrier (Channel 616)

1 Carrier OBW
Channels 616
Fundamental Frequencies: 893.78 MHz
OBW 1.26 MHz
Output Power as measured with Power meter: 47.2 dBM

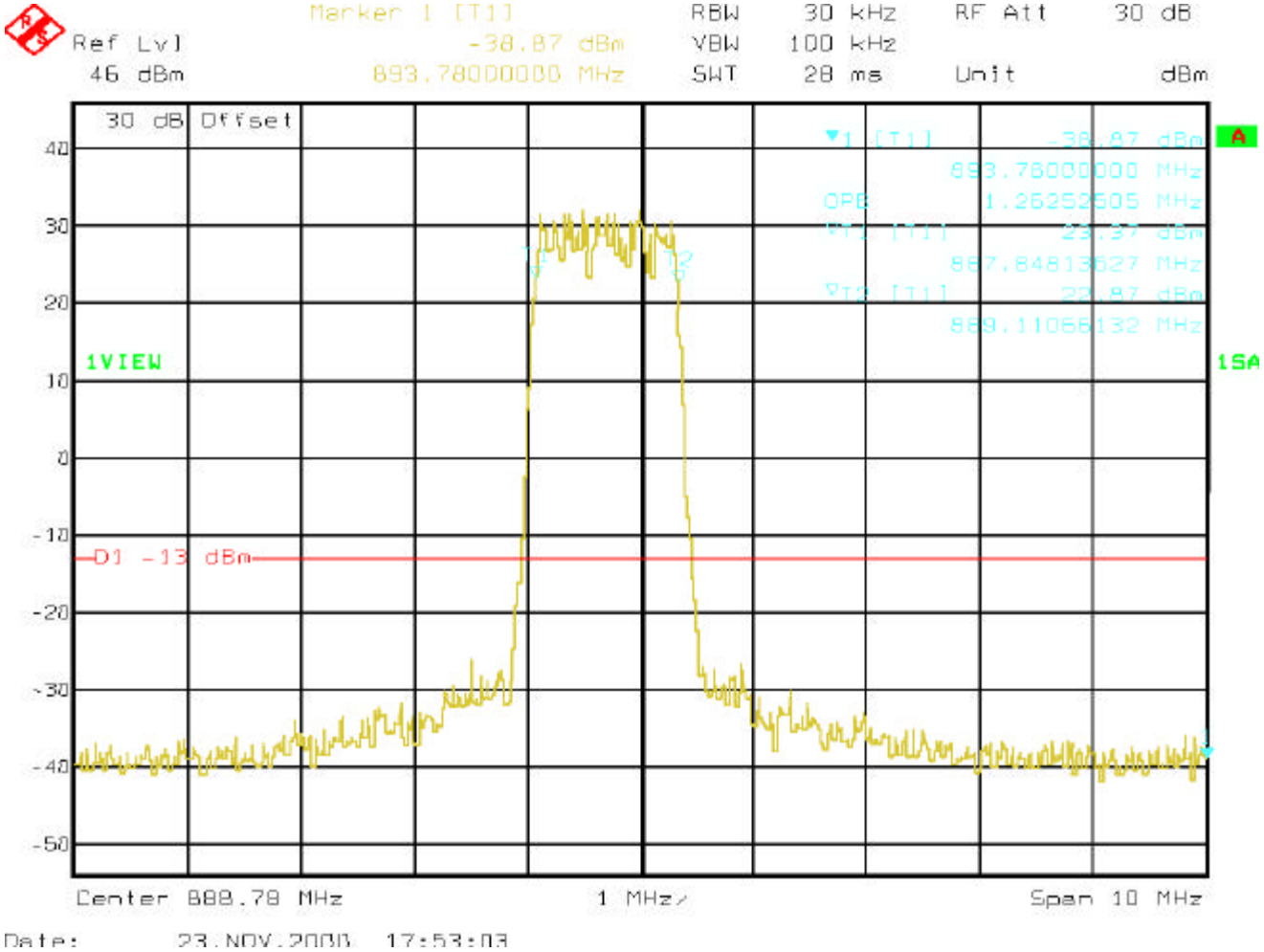
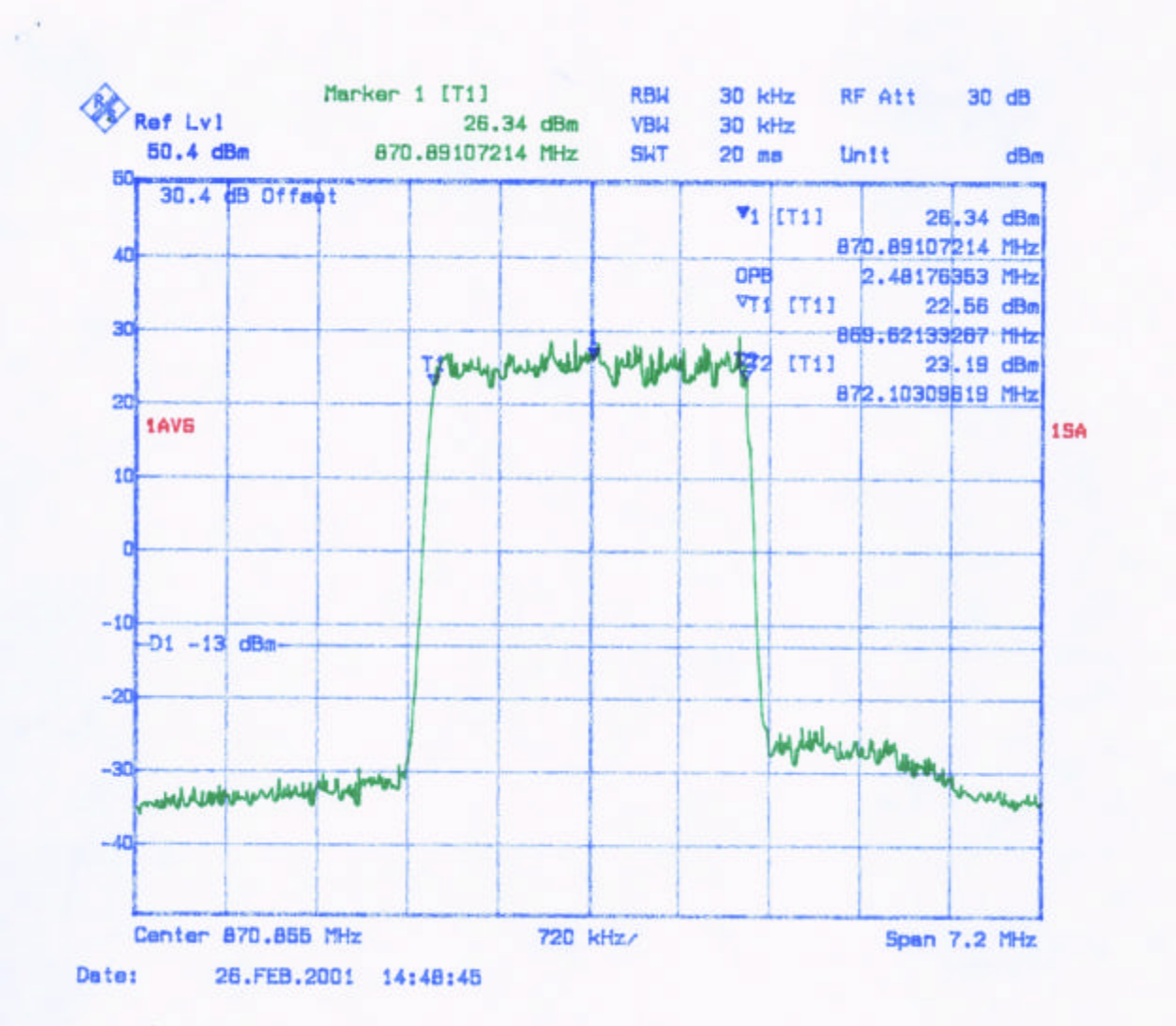
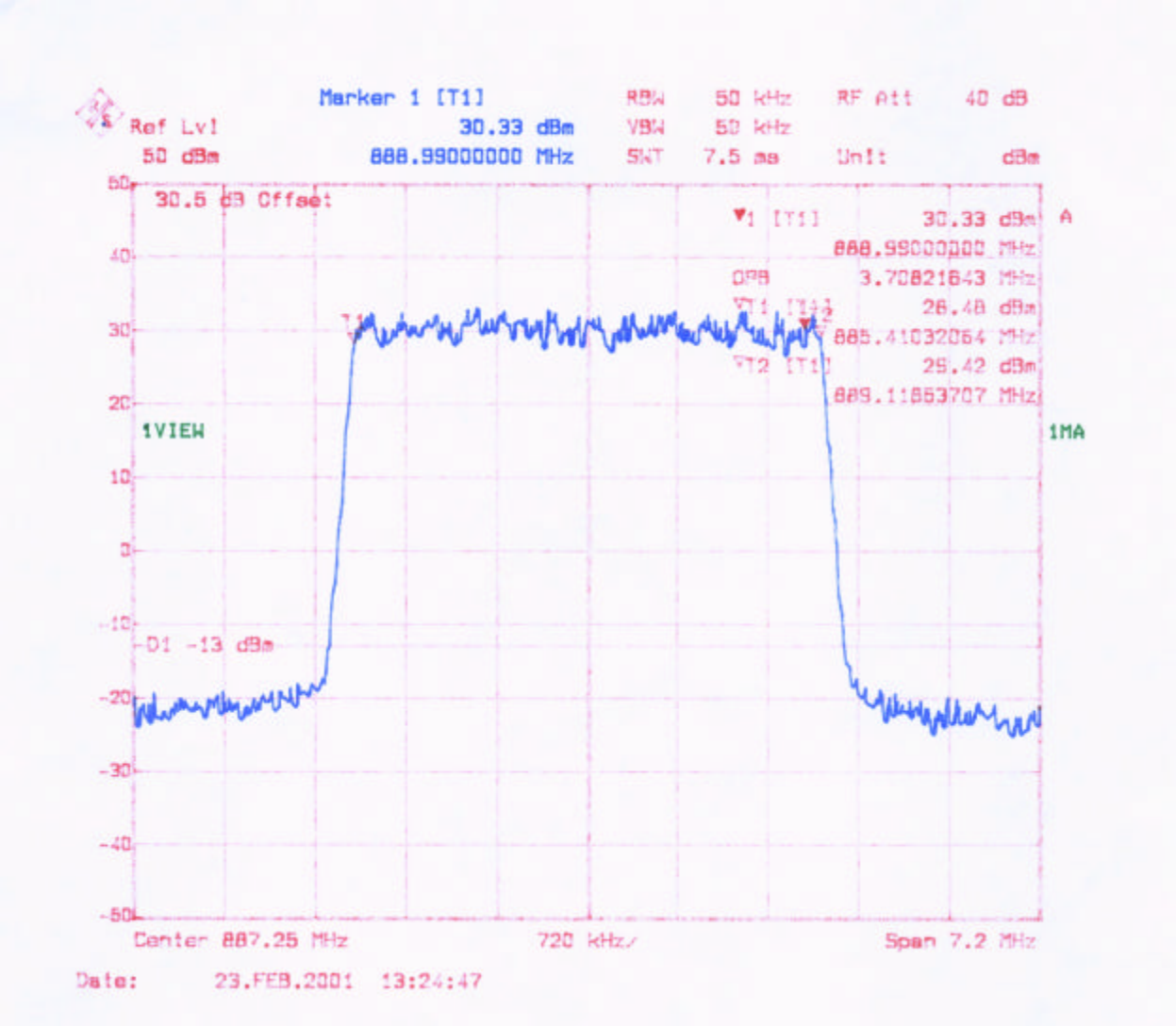


Figure 4: Plot of Occupied Bandwidth: 2 Carrier



2 Carrier OBW
Channels 8 and 49
Fundamental Frequencies: 870.24 MHz, 871.47 MHz
OBW 2.48 MHz
Output Power as measured with Power meter: 47.2 dBM

Figure 4: Plot of Occupied Bandwidth: 3 Carrier



3 Carrier OBW
Channels 534, 575, 616
Fundamental Frequencies: 886.02 MHz, 887.25 MHz, 888.48 MHz
OBW 3.71 MHz
Output Power as measured with Power meter: 47.3 dBM

4.3 Spurious Emissions at Antenna Terminals (Digital Mode)

4.3.1 Spurious Emissions Requirements

FCC Part 2.1051

Conducted spurious emissions shall be attenuated below the level of emissions of the carrier frequency by at least 43 + 10[log(mean output power in watts)] or must not exceed a level of -13 dBm.

FCC Part 2.1057 - Frequency spectrum to be investigated

The spectrum should be investigated from the lowest radio generated in the equipment up to at least the 10th harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and sub harmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

4.3.2 Test Method

The BTS digital enclosure was configured via the BTS controller to enable the MFRM to transmit at maximum power. Measurements were made on channels at the bottom, middle and top of the licensed bands. The following spectrum analyzer settings were used for the measurement of the antenna port (DPM output) spurious emissions:

Adjacent 1MHz to indicated cellular band (Upper and Lower)

Resolution Bandwidth:	30 KHz (1 carrier, 2 carrier), 50 KHz (3 carrier)
Video Bandwidth:	30 KHz (1 carrier, 2 carrier), 50 KHz (3 carrier)
Video Average:	10 Averages
Span:	1 MHz
Attenuation:	30 dB
Ref. Level:	50 dBm
Ref. Level Offset:	30.0 dB

All spectrum analyzer settings were coupled as per the manufacturers reccomendations to improve measurement time, without compromising data

All other Spurious Emissions up to 10 GHz

Resolution Bandwidth:	1 MHz (1 carrier, 2 carrier, 3 carrier)
Video Bandwidth:	1 MHz(1 carrier, 2 carrier, 3 carrier)
Video Average:	10 Averages
Span:	Set accordingly
Attenuation:	30 dB
Ref. Level:	50 dBm
Ref. Level Offset:	30.0 dB

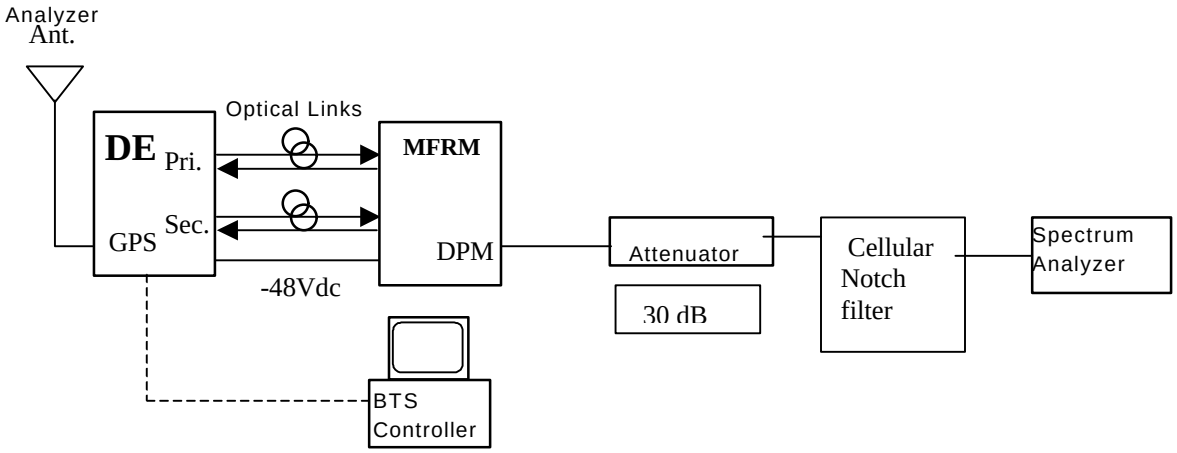
For out of band spurious emissions a Notch Filter was used to improve the dynamic range of the spectrum analyzer and prevent non linearity in the measurement system.

The emissions were investigated up to 10 GHz (the 10th harmonic of the fundamental emission) for all carrier configurations (1, 2, 3) (FCC PART 22).

4.3.3 Test Setup

The set-up used for the MFRM Antenna Port (DPM) Spurious Emission test is illustrated in Figure 5.

Figure 5: Test Setup for Antenna Port Spurious Emission Measurement



4.3.4 Test Results

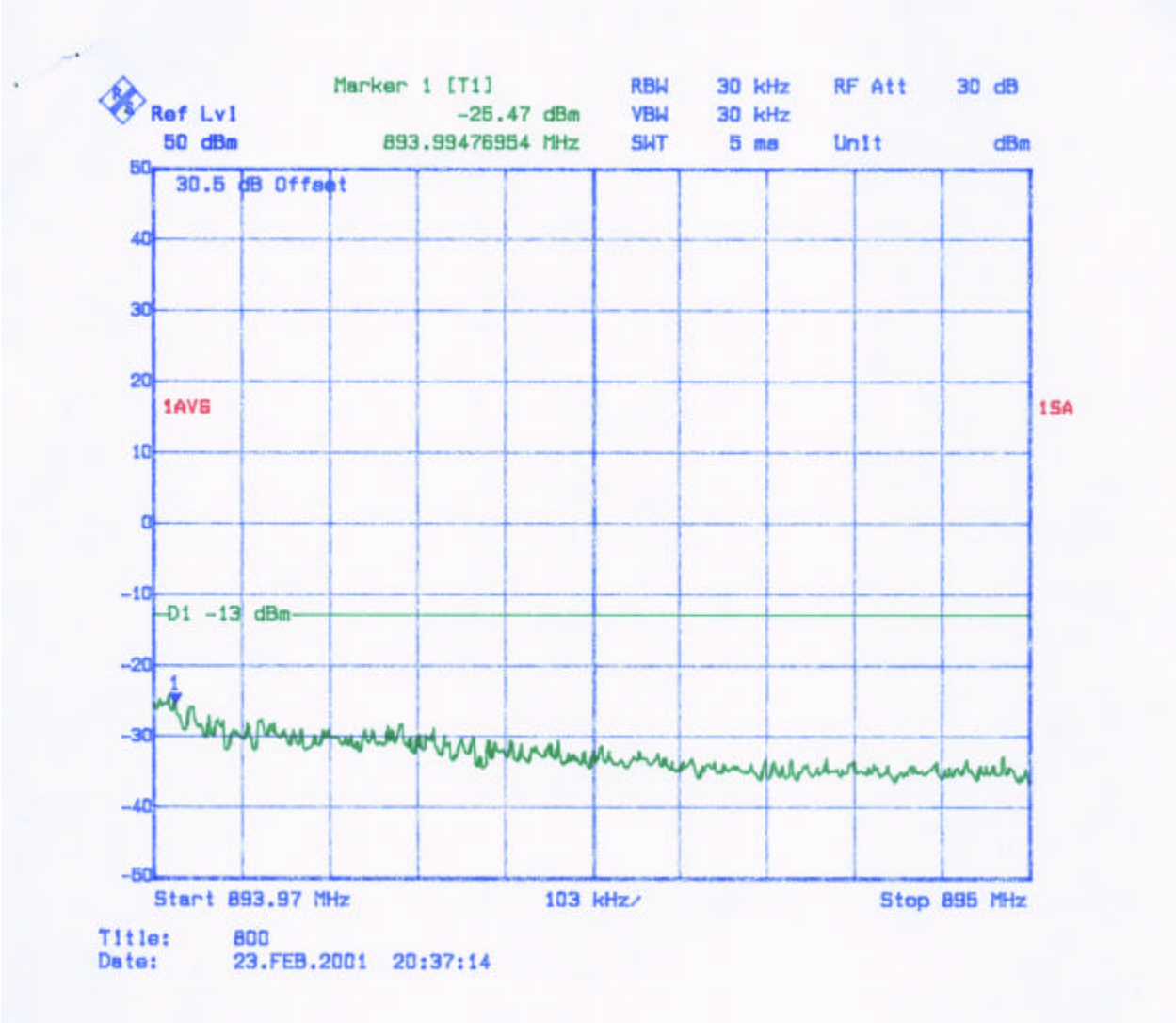
The frequency spectrum from 10 kHz to 10 GHz was scanned for emissions using a 30 kHz resolution bandwidth within channel bandwidth and a 1 MHz resolution bandwidth for outside channel bandwidth. The MFRM complies with the limit of –13 dBm. A minimum margin of 14 dB at band edge was achieved. Table 4 shows the spurious emissions at the antenna port of the MFRM. Figures 4-12 show the band edge emissions at the adjacent valid CDMA channel. No other out of band emissions were detected from 10 kHz to 10 GHz.). See plots below 2 Carrier mode, as no emissions were detected in any mode of operations, therefore to reduce file size samples of the two carrier data has been provided.

Table 5: Spurious Emissions at the 800 MFRM Antenna Port

Frequency (MHz)	Spurious Emissions Level (dBm)	FCC Limit (dBm)	Margin (dB)
869.04 (lower edge of Ch. 251)	-37 (Instrumentation Noise Floor)	-13	24
879.99 (upper edge of Ch. 251)	-36 (Instrumentation Noise Floor)	-13	23
880.02 (lower edge of Ch. 616)	-40 (Instrumentation Noise Floor)	-13	27

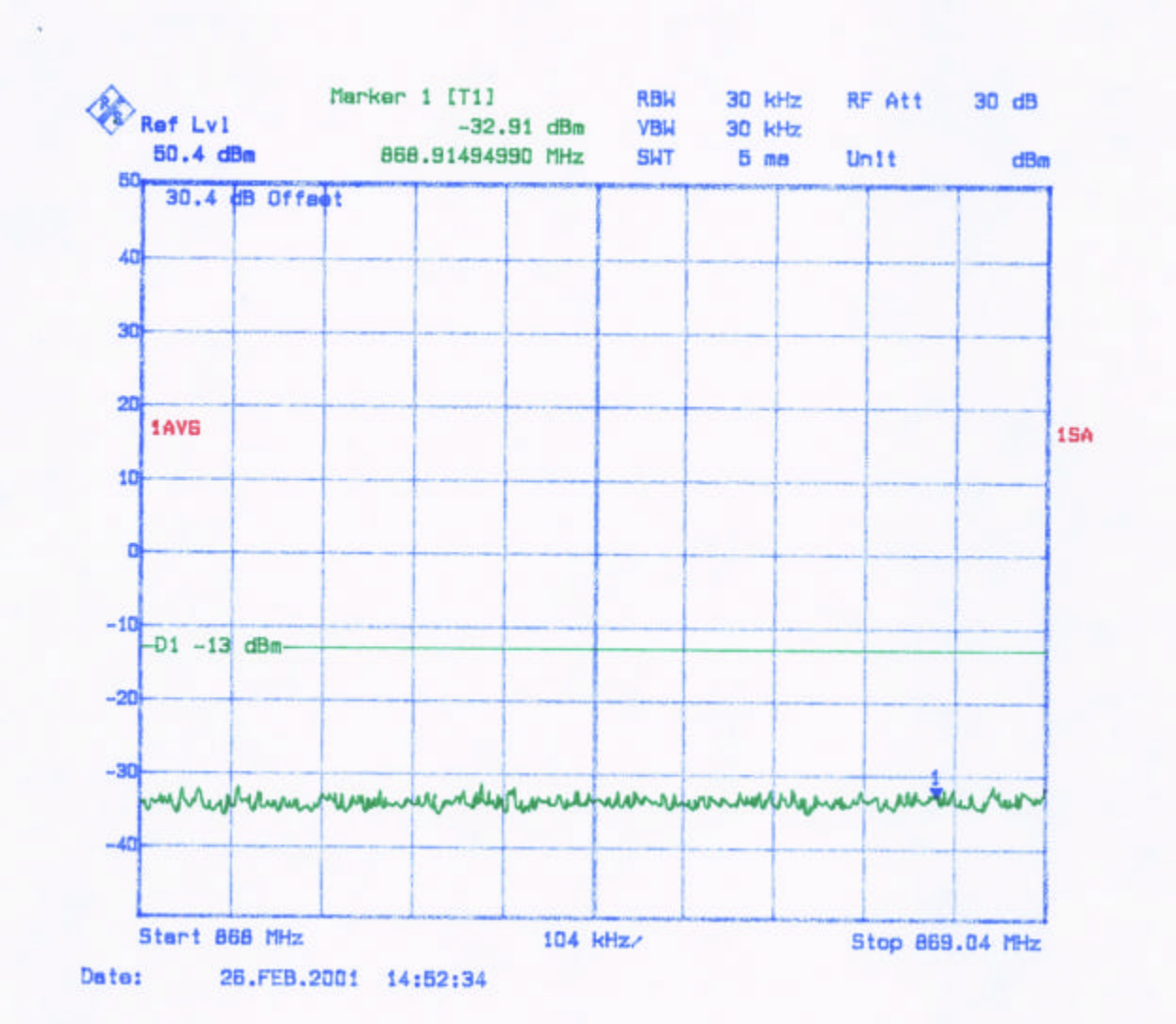
Frequency (MHz)	Spurious Emissions Level (dBm)	FCC Limit (dBm)	Margin (dB)
889.98 (upper edge of Ch. 616)	-35 (Instrumentation Noise Floor)	-13	22
891.51 (lower edge of Ch. 758)	-38 (Instrumentation Noise Floor)	-13	25
893.97 (upper edge of Ch. 758)	-35 (Instrumentation Noise Floor)	-13	22

Figure 7: Spurious Emissions – 1 Carrier (Upper Band edge, adjacent 1 Mhz)



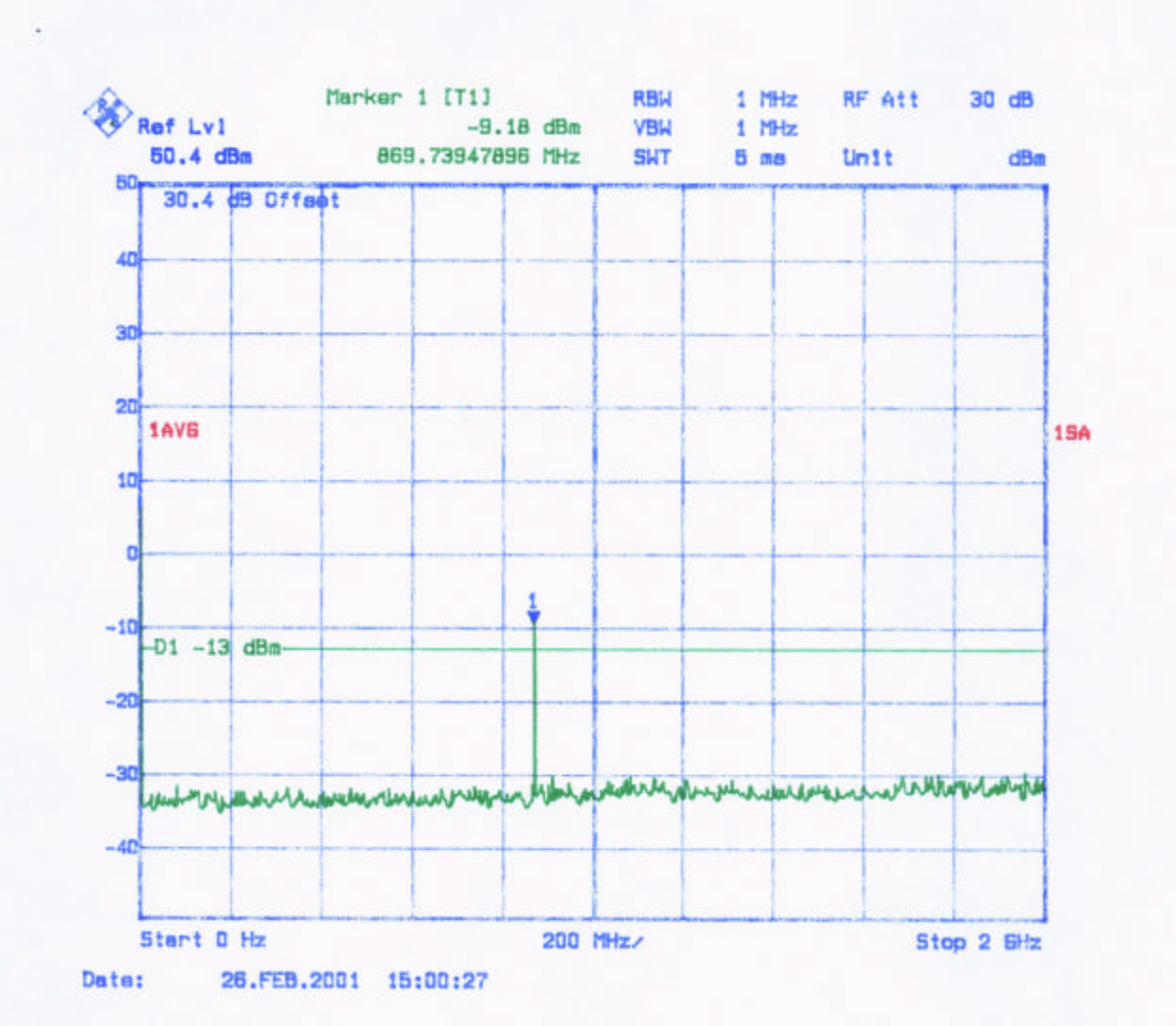
Single Carrier
Channel Number: 758
Band: B'
Fundamental Frequency: 892.74 MHz
Output power as measured with Power meter: 47.2 dBM
Adjacent 1 MHz, extrene upper band edge of celluar band
Note: Measurements were done on upper and lower band edge of each cellular band , no spurious emmissions were detected in any case, therefore to reduce file size plots of the extreme band edges only have been provided for review.

Figure 8: Spurious Emissions – 2 Carrier (Lower Band edge, adjacent 1 Mhz)



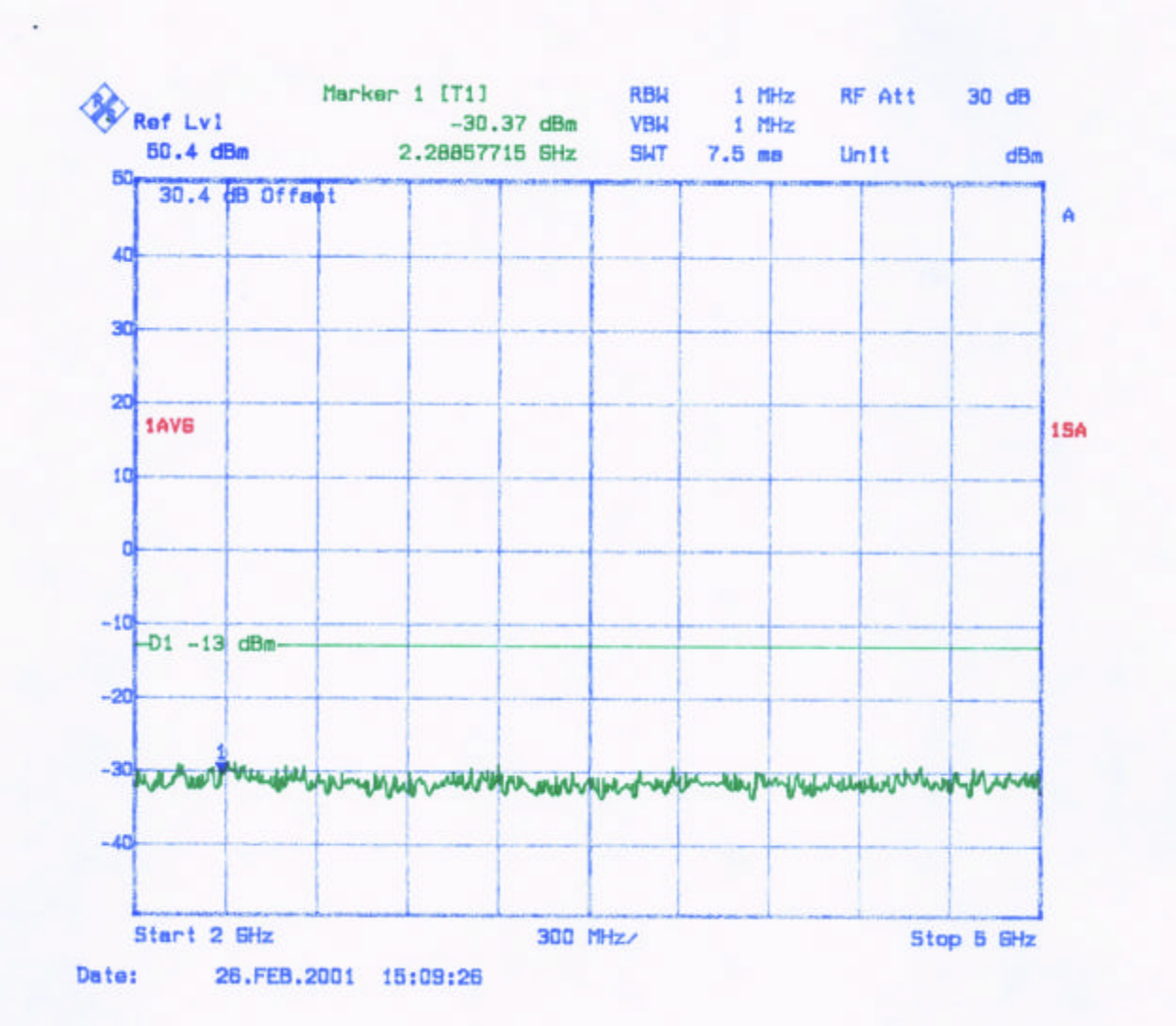
Two Carrier Mode
Channel Numbers: 8, 49
Band: B'
Fundamental Frequencies: 870.24 Mhz, 871.47 MHz
Output power as measured with Power meter: 47.2 dBM
Adjacent 1 MHz, lower band edge (of complete cellular band)
Note: Measurements were done on upper and lower band edge of each cellular band , no spurious emmissions were detected in any case, therefore to reduce file size plots of the extreme band edges only have been provided for review.

Figure 9: Spurious Emissions – 2 Carrier (10 KHz to 2 GHz)



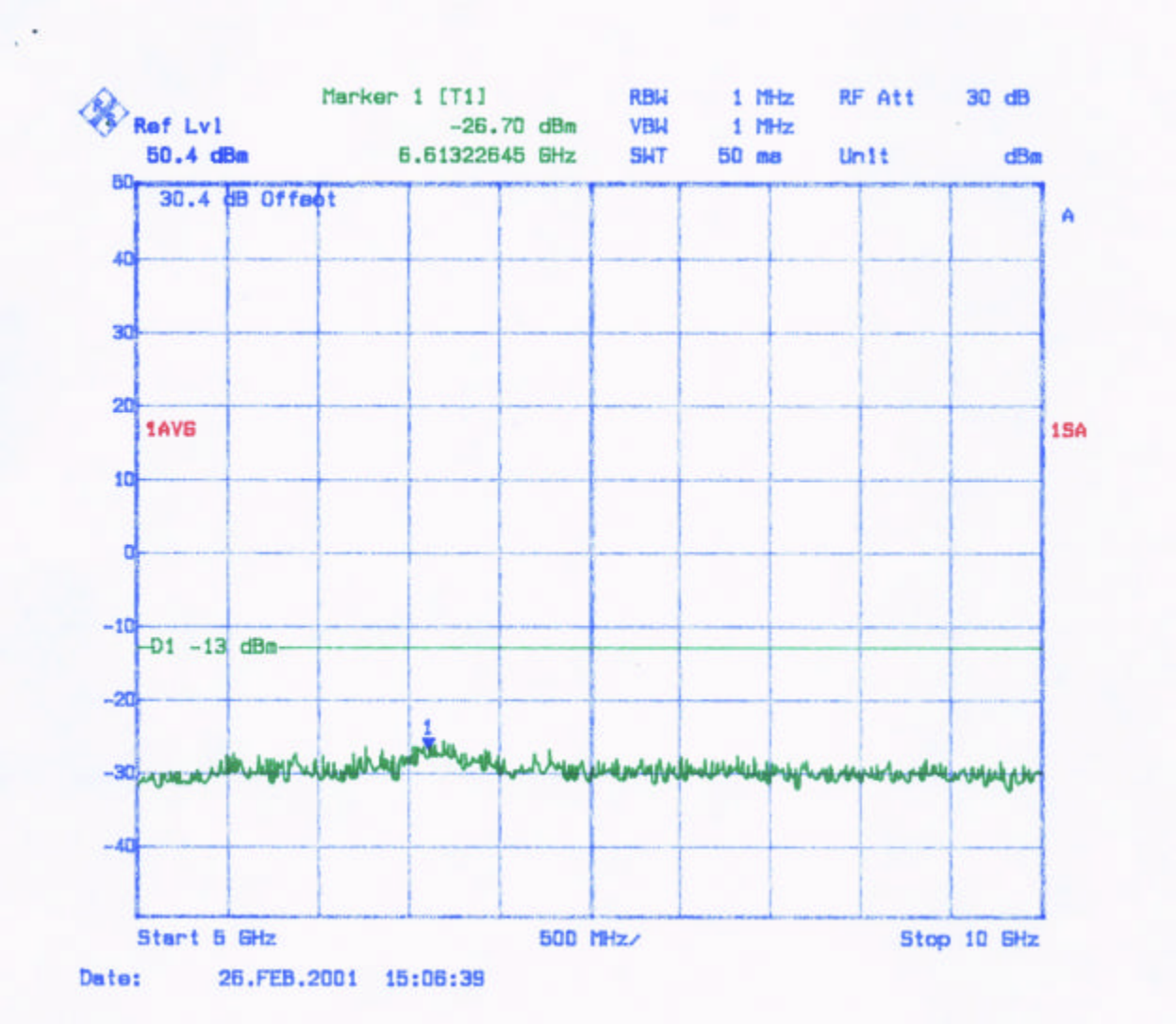
Two Carrier Mode
Channel Numbers: 8, 49
Band: B'
Fundamental Frequencies: 870.24 Mhz, 871.47 MHz
Output power as measured with Power meter: 47.2 dBM
Note: Spurious emissions Measurements were done in all modes of operation (1 carrier, 2 carrier, 3 carrier) of each cellular band , no spurious emmissions were detected in any case, therefore to reduce file size plots of the 2 carrier test case have been provided only.
review.

Figure 10: Spurious Emissions – 2 Carrier (2 GHz to 5 GHz)



Two Carrier Mode
Channel Numbers: 8, 49
Band: B'
Fundamental Frequencies: 870.24 Mhz, 871.47 MHz
Output power as measured with Power meter: 47.2 dBM
Note: Spurious emissions Measurements were done in all modes of operation (1 carrier, 2 carrier, 3 carrier) of each cellular band , no spurious emmissions were detected in any case, therefore to reduce file size plots of the 2 carrier test case have been provided only.

Figure 11: Spurious Emissions – 2 Carrier (5 GHz to 10 GHz)



Two Carrier Mode
Channel Numbers: 8, 49
Band: B'
Fundamental Frequencies: 870.24 Mhz, 871.47 MHz
Output power as measured with Power meter: 47.2 dBM
Note: Spurious emissions Measurements were done in all modes of operation (1 carrier, 2 carrier, 3 carrier) of each cellular band , no spurious emmissions were detected in any case, therefore to reduce file size plots of the 2 carrier test case have been provided only.

4.3.5 Frequency Stability Requirements

FCC Part 2.1055

(a) The frequency stability shall be measured with variation of ambient temperature as follows:

(1) From -30 ^{o} to +50 ^{o} centigrade for all equipment except that specified in subparagraphs (2) and (3) of this paragraph.

(b) Frequency measurements shall be made at the extremes of the specified temperature range and at intervals of not more than 10^{o} centigrade through the range. A period of time sufficient to stabilize all of the components of the oscillator circuit at each temperature level shall be allowed prior to frequency measurement. The short term transient effects on the frequency of the transmitter due to keying (except for broadcast transmitters) and any heating element cycling normally occurring at each ambient temperature level also shall be shown. Only the portion or portions of the transmitter containing the frequency determining and stabilizing circuitry need be subjected to the temperature variation test.

(d) The frequency stability shall be measured with variation of primary supply voltage as follows:

(1) Vary primary supply voltage from 85 to 115 percent of the nominal value for other than hand carried battery equipment.

(2) For hand carried, battery powered equipment, reduce primary supply voltage to the battery operating end point which shall be specified by the manufacturer.

(3) The supply voltage shall be measured at the input to the cable normally provided with the equipment, or at the power supply terminals if cables are not normally provided. Effects on frequency of transmitter keying (except for broadcast transmitters) and any heating element cycling at the nominal supply voltage and at each extreme also shall be shown.

(e) When deemed necessary, the Commission may require tests of frequency stability under conditions in addition to those specifically set out in paragraphs (a), (b), (c) and (d) of this section. (For example, measurements showing the effect of proximity to large metal objects, or of various types of antennas, may be required for portable equipment.)

FCC Limit (Part 22.913)

The frequency stability shall be better than +/- 2.5 ppm over a temperature range of -30 to +50 degrees C.

4.3.6 Results

The Base station incorporates a GPS module from Trimble Navigation. This 10 MHz GPS reference is used to synchronize the entire Base Station. The GPS module has a frequency stability of 0.8 ppb over the range of –5^{o} C to 70 ^{o}C. The Base Station complies with the requirement. Should this reference frequency vary by more than 5ppb, the complete transmit chain will be disabled in the BTS.

4.4 RF Radiation Exposure

An internal Nortel document, "RF Exposure Guidelines for Cellular and PCS Antenna Sites" (Document no: SI-EMR-R01.4), is used for the deployment and installation of Nortel's wireless base station equipment with respect to the control of Electromagnetic Radiation (EMR) exposure. The objective of this document is to provide guidance on where antennas can be deployed, how to calculate power densities and safe distances, and how to protect users from excessive exposure to electromagnetic radiation.

4.5 Field Strength of Spurious and Harmonic Radiation

4.5.1 Radiated Emissions Requirements

FCC Part 2.1053

(a) Measurements was made to detect spurious emissions radiated directly from the cabinet, control circuits, power leads, or intermediate circuit elements under normal conditions of installation and operation. Curves or equivalent data were supplied showing the magnitude of each harmonic and other spurious emission. For this test, single sideband, independent sideband, and controlled carrier transmitters shall be modulated under the conditions specified in paragraph 2.989(c) as appropriate. For equipment operating on frequencies below 890 MHz, an Open Field Test is normally required, with the measuring instrument antenna located in the far field at all test frequencies. In event it is either impractical or impossible to make open field measurements (e.g. a broadcast transmitter installed in a building) measurement will be accepted of the equipment as installed. Such measurements must be accompanied by a description of the site where the measurements were made showing the location of any possible source of reflections which might distort the field strength measurements. Information submitted shall include the relative radiated power of each spurious emission with the reference to the rated power output of the transmitter, assuming all emissions are radiated from half-wave dipole antennas.

(b) Measurements specified in paragraph (a) of this section shall be made for the following equipment:

(1) Those in which the spurious emission are required to be 60 dB or more below the mean power of the transmitter.

(2) All equipment operating on frequencies higher than 25 MHz

(3) All equipment where the antenna is an integral part of, and attached directly to the transmitter.

(4) Other types of equipment as required, when deemed necessary by the Commission.

FCC Part 2.1057 - Frequency spectrum to be investigated

The spectrum was investigated from the lowest radio generated in the equipment up to at least the 10th harmonic of the carrier frequency or to the highest frequency practicable in the present state of the art of measuring techniques, whichever is lower. Particular attention should be paid to harmonics and sub harmonics of the carrier frequency. Radiation at the frequencies of multiplier stages should be checked. The amplitude of spurious emissions which are attenuated more than 20 dB below the permissible value need not be reported.

4.5.2 Test Method

4.5.2.1 Test Site

Radiated emissions testing was performed at Nortel Product Integrity Laboratory in the 10 meter Ambient Free Chamber located at 5111 47th Street NE, Calgary, Alberta Canada.

4.5.2.2 Test Procedure

Radiated emission measurements were performed according to the procedures outlined in Section 8 of the ANSI C63.4 standard.

The measurement distance between the center of the measurement antenna and the periphery of equipment under test was 10 meters.

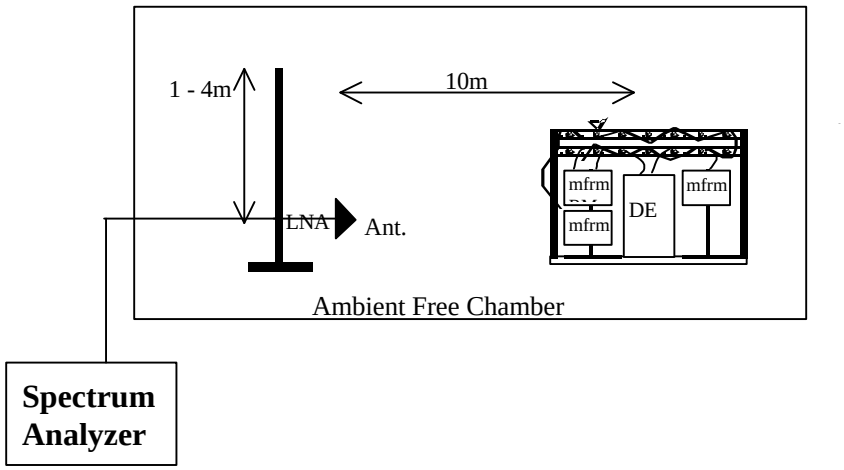
In order to maximize all emission levels from the equipment, the emissions were searched with the receive antenna at varied height levels. The equipment was rotated a full 360 degrees on the turntable with the receive antenna at varying height levels (1 to 4 meters). Tests were made with the antenna positioned in both the horizontal and vertical planes of polarization.

The DE was setup with six MFRMs transmitting on channel 283 at maximum power.

A complete scan of the emissions from 1 GHz to 18 GHz was completed. Quasi-peak detector was used for measurements up to 1GHz. For emissions above 1 GHz the peak detector function was used with an RBW of 1 MHz.

From 1 GHz to 18 GHz was broken-up into two ranges with the first being 1 GHz – 4 GHz, without an Low Noise Amplifier (LNA) and the second being 4 GHz – 18 GHz, with an LNA.

4.5.3 Test Setup



4.5.4 Test Results

The worst case radiated spurious emission was 62.1 dBuV/M @10 meters in horizontal polarization. This is 11.8 dB below the FCC limit of 73.9 dBuV/M @ 10 meters

Table 6: Spurious Emissions: Measured Discrete Frequencies

Description	Frequency (MHz)	Measured Level (dB/uV)	Correction Factors	Level Converted to dBM ERP	Final Level (dBu/v)@ 10 m	Pass Margin db (to dbm limit)
3 Carrier (800 H-Pol)	1971.94	20.77	36.41	-35.7	57.2	22.7
3 Carrier (800 H-Pol)	2662.33	20.60	40.53	-31.8	61.1	18.8
3 Carrier (800 H-Pol)	3289.57	20.77	41.86	-30.8	62.1	16.2

NOTE 1:
As the FCC had not sent out an official notice at the time these tests were conducted on the requirement to perform the substitution method above 1 GHz, the measurements above were taken were reported in dBuV/m at a 10 meter distance. These values have been theoretically converted to dbm with the technical justification provided below.

NOTE 2:
The above measurments are worst case as a peak detector was used. Due to the random noise like phenomena of the CDMA wave form and high peak to average ratio (is also present for leakage of fundamental harmonics) these signals would be significantly reduced (to noise floor levels as they are only 3 db above the noise floor of the measurement system used) if an average detector was used as per the FCC Rules for measurements above 1 GHz.

NOTE 3:
Add 2.15 dB to ERP levels to realize EIRP values

Technical Paper on measurement substitution Method above 1 GHz (based on FM 103)

If the power radiated is **P**, the field strength **E** produced by an isotropic radiating system in free space is given by:

E (V/m) = SQRT {$\mathbf{Z_o}$ **P**/ 4 π}/**d**

Where:
$\mathbf{Z_o}$ is the impedance of free space, and
d is the distance between the measuring point and the radiating system

With $\mathbf{Z_o}$ = **120** $\boldsymbol{\pi}$ **Ω**, the following results:

E (V/m) = SQRT {**30 P**}/**d**

If the isotropic radiating system is replaced by an antenna having gain **G**, the field strength in free space is given by:

E (V/m) = SQRT {**30 PG**}/**d**

For the **λ/2** dipole, **G** assumes the value of **1.64**. Then

$\mathbf{E}_{\lambda/2\ \text{dipole}}$(V/m) = **7** SQRT {**P**}/**d**

Because of reflection from ground, the measuring antenna will be in the combined field due to the direct and reflected rays. Since the path length will be different, there will be a phase shift between the two rays.

With horizontal polarization having:

$(\mathbf{h_S} + \mathbf{h_E})^2/\ \mathbf{d}^2 << 1$

where:
$\mathbf{h_S}$ is the height of the radiating system above the ground, and
$\mathbf{h_E}$ is the height of the point where the resultant filed strength is considered, this resultant filed strength can assume the following maximum value:

$\mathbf{E}_{\lambda/2\ \text{dipole}}$ (V/m) = [**7** SQRT {**P**}/**d**] 2 Sin ($\mathbf{2\pi\ h_S\ h_E/\ \lambda d}$)

Maximum filed strength will occur when:

Sin ($\mathbf{2\pi\ h_S\ h_E/\ \lambda d}$) = 1

where

$\mathbf{h_S\ h_E/\ \lambda d}$ = **1/4, 3/4, 5/4, …**

Thus, for distances for which the value of $\mathbf{h_S\ h_E/\ \lambda d}$ << **1/4,** the Sine may be replaced by the argument:

$\mathbf{E}_{\lambda/2\ \text{dipole}}$ (V/m) = [**7** SQRT {**P**}/**d**] ($\mathbf{4\pi\ h_S\ h_E/\ \lambda d}$)

and no maximum will occur.

However, depending on the measuring distance chosen, the case sin $\alpha = 1$ where $\alpha = 2\pi h_S h_E / \lambda d$ may occur within the frequency range 300 MHz to 1000 MHz. Should this occur at a frequency f_g, the Sine will decrease for frequencies above this value and becomes zero for the frequency $f = 2 f_g$.

In order to avoid errors due to this effect, the height h_E must be varied until the maximum, corresponding to sin $\alpha = 1$ is obtained. To do this, the height must be varied over a range of 3 to 1 for most unfavourable case.

For example, if h_S = 1m, h_E = 2.5m and d= 10m, the value of $h_S h_E / \lambda d$ is ¼ at 300 MHz. For this example the next minimum will occur at sin $\alpha = 0$, which is at 600 MHz.

In order to check the disposition of the measuring apparatus, a horizontal l/2 dipole fed from signal generator may be used in place of the apparatus being tested. The field strength generated may be calculated from the frequency formula if P is the power fed into the dipole. In this manner, it may be possible, by substitution, to determine the noise power radiated by the apparatus under test.

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Example:

$E_{dBuV/m}$= 122.92dBuV/m
Antenna = dipole
d = 10m

P (dBm) =10Log(1000* (d *(10 $^{(EdBuV/m/20)}$ /(2*7*1000000)))^2)
= 10Log(1000*(10*(10^(122.92/20)/(7*2*1000000)))^2)
= 30 dBm

Calculation for measured dBuV values in Table 6

1. Frequency of emission @ 10 meters 1971.94 , measured dBuV value: 57.2

P (dBm) =10Log(1000* (d *(10 $^{(EdBuV/m/20)}$ /(2*7*1000000)))^2)
= 10Log(1000*(10*(10^(57.2/20)/(7*2*1000000)))^2)
= -35.7 dBm

2. Frequency of emission @ 10 meters 2662.33, measured dBuV value: 61.1

P (dBm) =10Log(1000* (d *(10 $^{(EdBuV/m/20)}$ /(2*7*1000000)))^2)
= 10Log(1000*(10*(10^(61.1/20)/(7*2*1000000)))^2)
= -31.8 dBm

3. Frequency of emission @ 10 meters 3289.57, measured dBuV value: 62.1

P (dBm) =10Log(1000* (d *(10 $^{(EdBuV/m/20)}$ /(2*7*1000000)))^2)
= 10Log(1000*(10*(10^(62.1/20)/(7*2*1000000)))^2)
= -30.8 dBm