

Northern Telecom
2305 Mission College Blvd.
Santa Clara, CA 95054-1591



November 4, 1998

Federal Communications Commission
Authorization and Evaluation Division
Equipment Authorization Branch
7435 Oakland Mills Road
Columbia, MD, 21046

RE: FCC ID: AB6MCBTS1900A

FCC Staff:

Attached please find Form 731 and related exhibits associated with Northern Telecom's **Class II Permissive Change Request** for the Nortel CDMA Metro Cell FRM 1901 Base Transceiver Station in accordance with the FCC Rules, Part 2, Section 2.1043.

The following changes are proposed:

- The Product Name has been changed from CCBTS to Nortel CDMA Metro Cell.
- The RFM mechanical packaging has changed from a single stand-alone unit to a Flexible Radio Module or FRM. Up to nine FRMs will be enclosed in an outdoor rack mount system known as a radio enclosure (RE).
- The TRM sub-module of the FRM has been modified to improve manufacturing yield performance. Redundant circuitry, which was used as a contingency during the previous design cycle, was removed and circuit pack barnacles were eliminated.

Please refer to the Introduction Section of the attached report for detailed information regarding the proposed changes.

The Following information is enclosed:

- Exhibit A – Label Information
- Exhibit B – Test Report
- Exhibit D – Circuit Schematics
- Exhibit F – Photographs
- Exhibit G – C95.1 Attestation

The Test Report Contain the results for all of the required measurements. The Nortel CDMA Metro Cell FRM 1901 continues to comply will all of the applicable requirements of the FCC Rules, Parts 2 and 24.

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A Request, pursuant to 47 CFR 0.459 of the commission's rules, that the following sections and documents be held **CONFIDENTIAL** due to their proprietary nature. We consider this leading edge technology developed by Nortel and our partners and being new technology, we do not wish to be disclosed or otherwise made available to our competition. Specifically, the Circuit Schematics contained in the Exhibit D of the application.

If you have any questions, please feel free to call me at (408) 565-2046 or e-mail at jshinn@nt.com.

Sincerely,

A handwritten signature in black ink, reading "John Shinn", followed by a long horizontal line extending to the right.

John Shinn, P.E.
Corporate FCC Single Point Contact
Homologation Engineering

(408) 565-2046 (Voice)
(408) 565-2575 (FAX)

Exhibit B

Test Report

Introduction

The following information is submitted for Type Acceptance of a Broadband PCS Base Station for Northern Telecom, Inc., in accordance with Part 24, Subpart E and Part 2, subpart J of the FCC Rules and Regulations. The measurement procedures were in accordance with the requirements of Part 2.999.

Measurement Results Summary

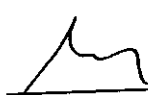
Table 1 is a summary of the measurement results for the BTS.

Table 1: Measurement Results Summary

FCC Measurement Specification	FCC Limit Specification	Description	Result
2.985	24.232	RF Power Output	Passed
2.987		Modulation Characteristics	Not Applicable
2.989		Occupied Bandwidth	OBW _(max) = 1262.5 kHz
2.991, 2.997	24.238	Spurious Emissions at Antenna Terminals	Passed
2.993, 2.997	24.238	Field Strength of Spurious Radiation	Passed
2.995	24.235	Frequency Stability	Passed

Declaration of the Accuracy of Data

The undersigned attests to the accuracy of the measurement data contained in this document.

 Oct. 15/98

Stephen Cassidy
Radio Compliance Engineer
Nortel Technology

Name of Test: 2.985 RF Power Output

1.0 FCC Requirements

1.1 FCC Part 24.232

(a) Base stations are limited to 1640 Watts peak equivalent isotropically radiated power (e.i.r.p.) with an antenna height up to 300 meters HAAT. See 24.53 for HAAT calculation method. Base station antenna heights may exceed 300 meters with a corresponding reduction in power. In no case may the peak output power of a base station transmitter exceed 100 Watts.

(c) Peak transmit power must be measured over any interval of continuous transmission using instrumentation calibrated in terms of an rms-equivalent voltage. The measurement results shall be properly adjusted for any instrument limitations, such as detector response times, limited resolution bandwidth capability when compared to the emission bandwidth, sensitivity, etc., so as to obtain a true peak measurement for the emission in question over the full bandwidth of the channel.

2.0 Test Results

Table 2 shows the test results for RF Output Power.

Table 2: Test Results for RF Output Power

Channel #	Frequency (MHz)	Measured RF Output Power (dBm)	Maximum Rated Power (dBm)	Limit (dBm)
25	1931.25	41.5	41.6	50
150	1937.50	41.5	41.6	50
275	1943.75	41.4	41.6	50
325	1946.25	41.4	41.6	50
350	1947.50	41.6	41.6	50
375	1948.75	41.6	41.6	50
425	1951.25	41.4	41.6	50
550	1957.50	41.4	41.6	50
675	1963.75	41.4	41.6	50
725	1966.25	41.3	41.6	50
750	1967.50	41.3	41.6	50
775	1968.75	41.4	41.6	50
825	1971.25	41.4	41.6	50

Name of Test: 2.989 Occupied Bandwidth

1.0 FCC Requirements

1.1 FCC Part 2.989

The occupied bandwidth, 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:...

2.0 Test Results

Table 3 shows the results for Occupied Bandwidth.

Table 3: Test Results for Occupied Bandwidth

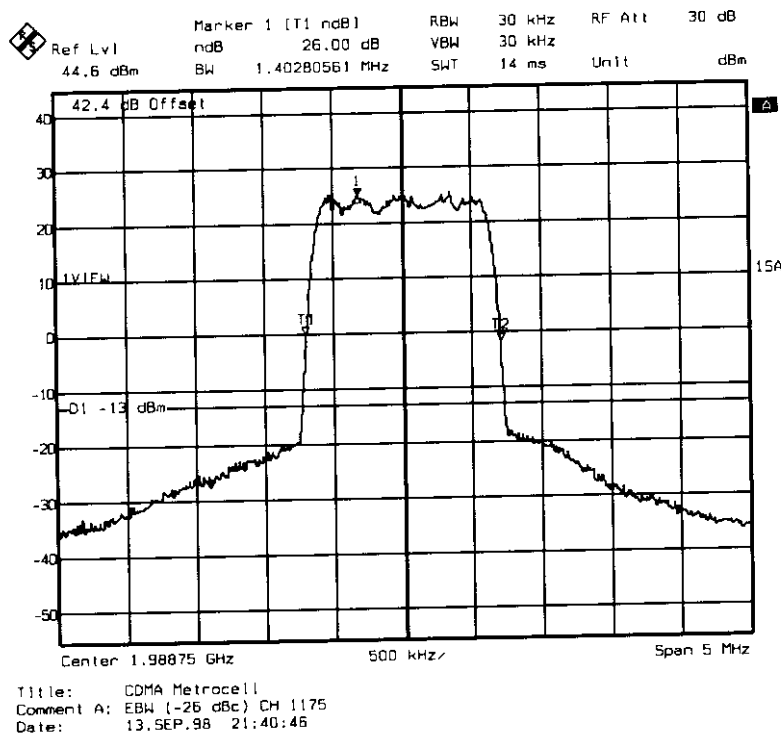
Channel #	Frequency (MHz)	Measured Occupied Bandwidth (KHz)
25	1931.25	1262.5
150	1937.50	1262.5
275	1943.75	1262.5
325	1946.25	1262.5
350	1947.50	1262.5
375	1948.75	1262.5
425	1951.25	1262.5
550	1957.50	1262.5
675	1963.75	1262.5
725	1966.25	1262.5
750	1967.50	1262.5
775	1968.75	1262.5
825	1971.25	1262.5
850	1972.50	1262.5
875	1973.75	1262.5
925	1976.25	1262.5
1050	1982.50	1262.5
1175	1988.75	1262.5

The BTS was configured to transmit at maximum power. Measurements were made at frequencies which were at the bottom and top of each of the licensed blocks.

The occupied bandwidth was measured using the channel power (99% power) feature of the spectrum analyzer which had the following settings:

Resolution Bandwidth:	30 KHz
Video Bandwidth:	30 KHz
Span:	5 MHz
Attenuation:	30 dB
Reference Level:	44.6 dBm
Ref. Level Offset:	42.4 dB
Level Range:	100 dB
Sweep Time:	14 ms

Figure 5: Sample Plot for Emission Bandwidth



The reference level for spurious emissions at the antenna terminals was taken from the measured output power (41.6 dBm = 14.5 Watts). Therefore the spurious emissions must be attenuated by at least $43 + 10 \log (14.5) = 54.6$ dB. The measured output power was 41.6 dBm; therefore the limit is $41.6 - 54.6 = -13$ dBm.

Figure 6: Sample Plot for Ch. 25 (1st Adjacent MHz)

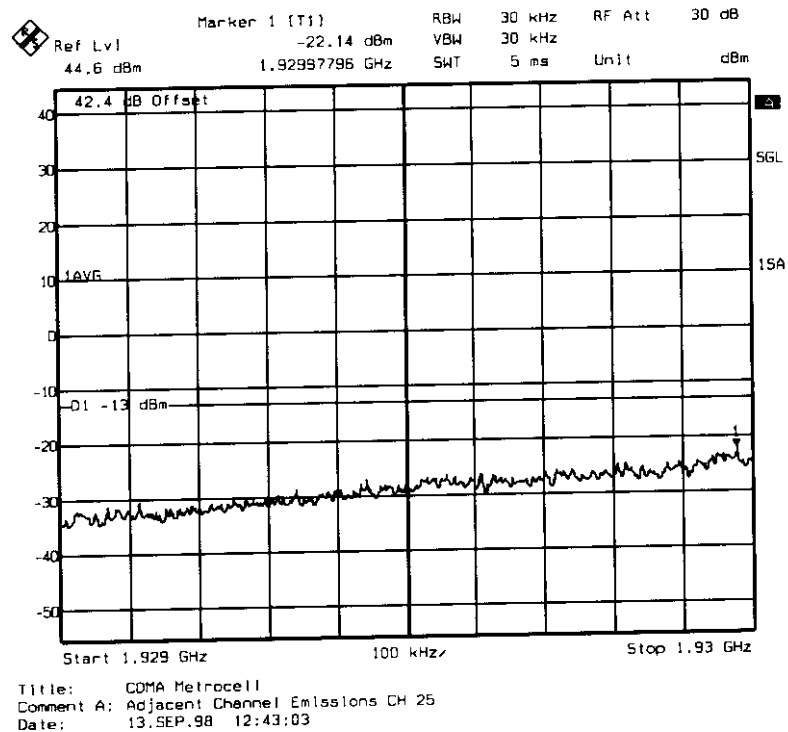


Figure 8: Sample Plot for Ch. 1175 (1st Adjacent MHz)

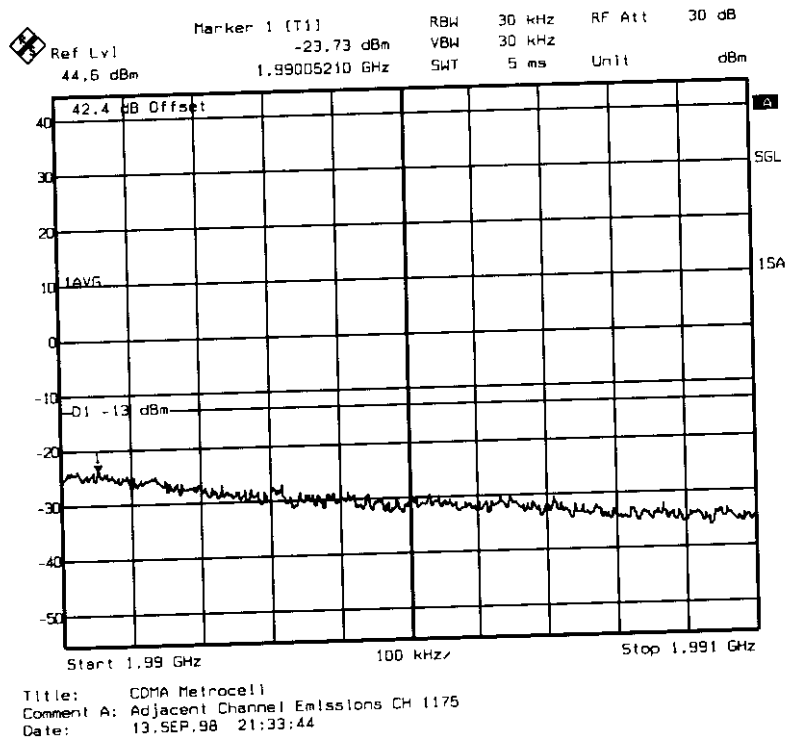


Figure 10: Sample Plot for Ch. 375 (5 MHz Span)

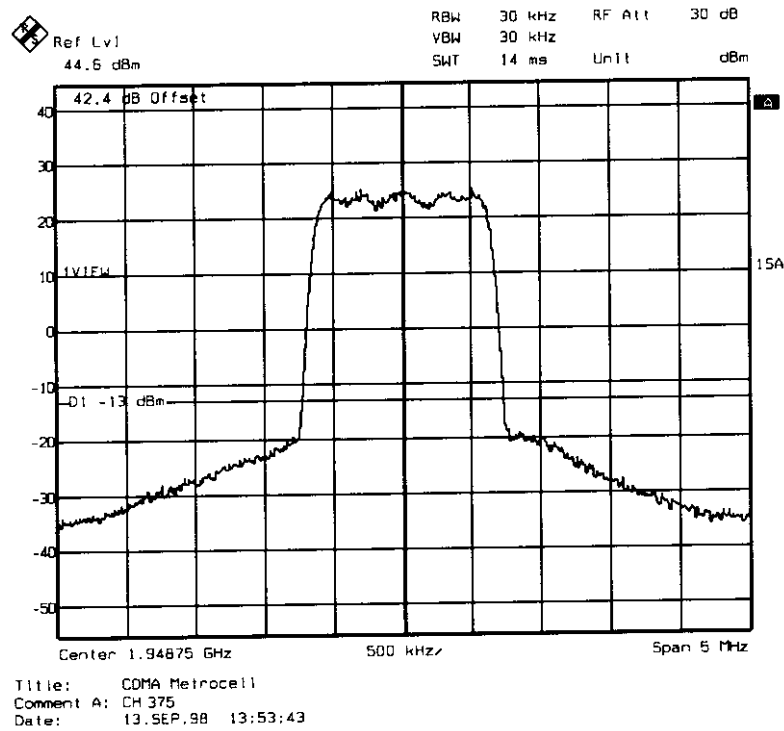


Figure 12: Sample Plot for 3 - 8 GHz Span

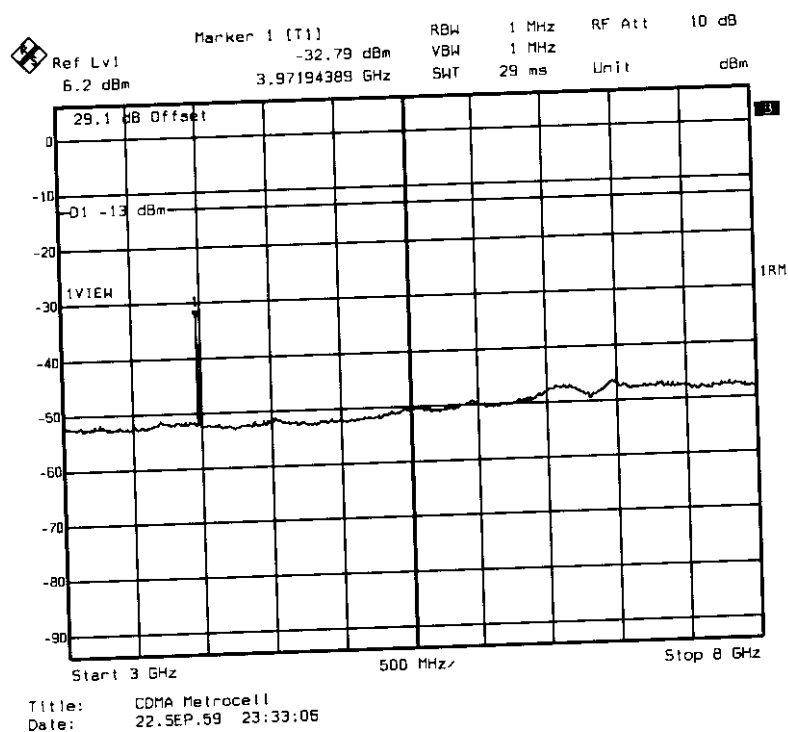
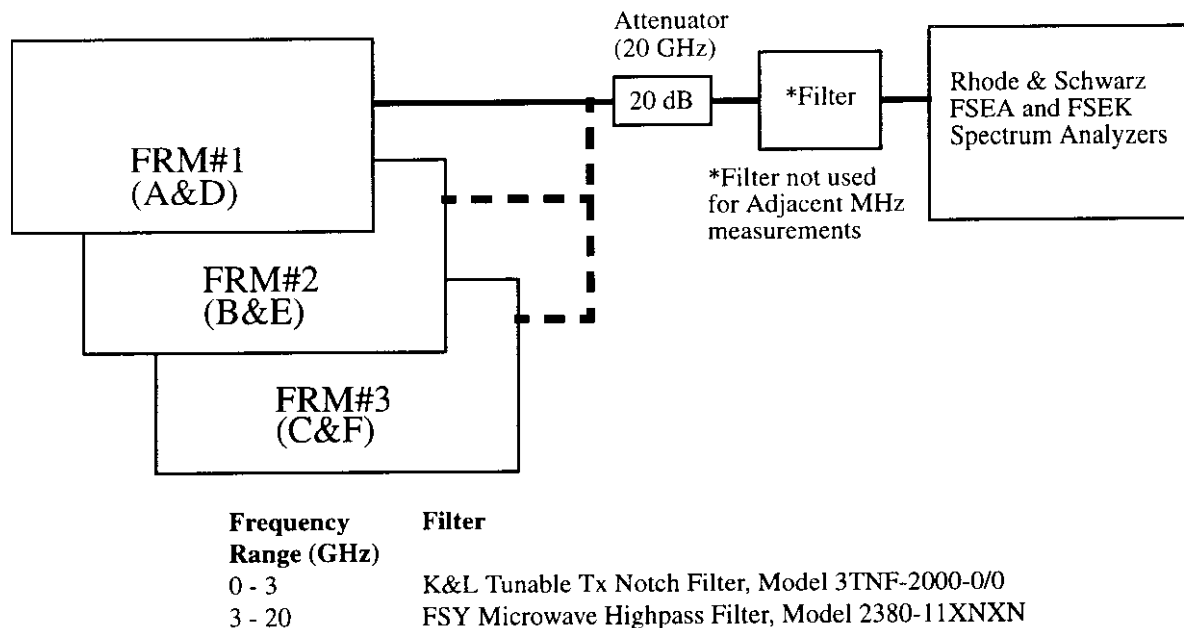


Figure 14: Test Configuration for Spurious Emissions at Antenna Terminals



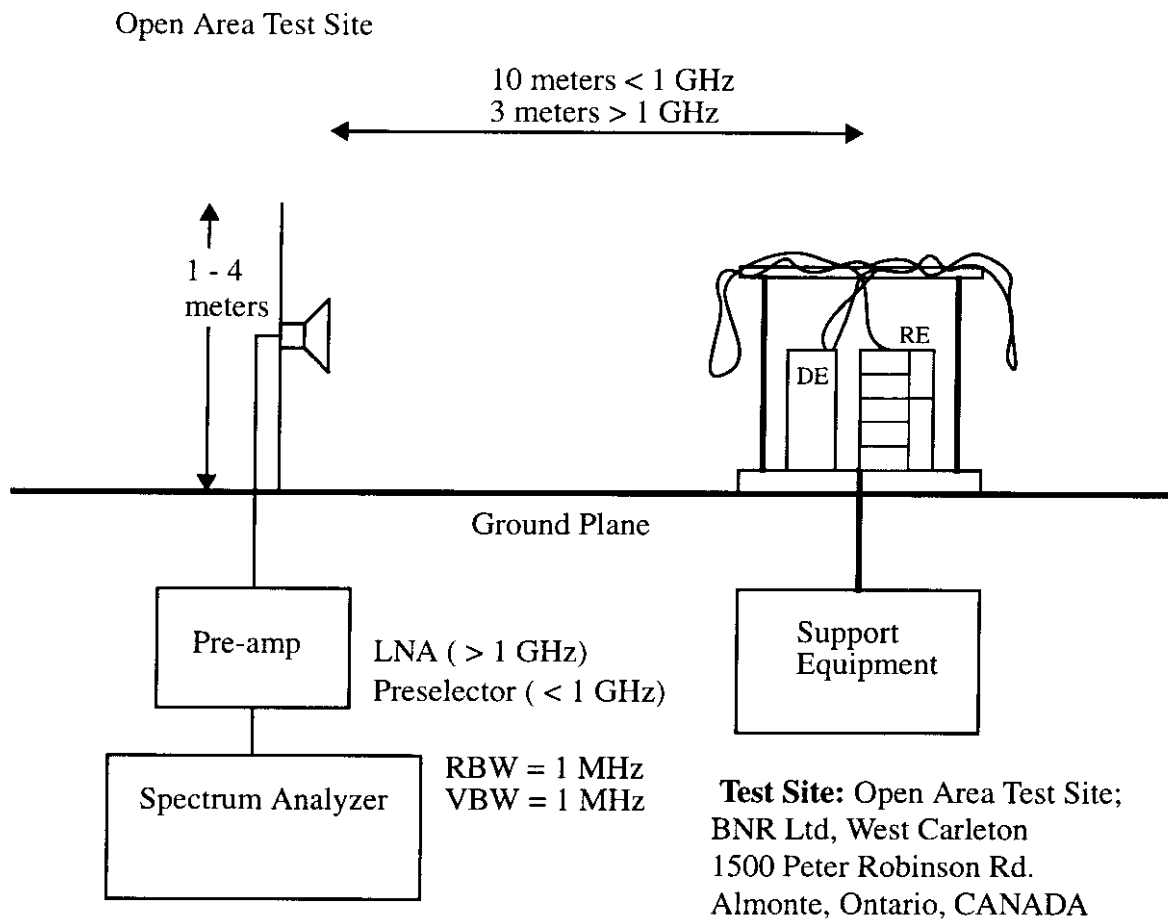
For adjacent channel emissions, the BTS nominal carrier frequency was adjusted to the high and low edge channels for each of the three FRMs.

For these measurements, the resolution bandwidth of the spectrum analyzer was set to at least 1% of the emission bandwidth. In this case the emission bandwidth measured was 1402.8 KHz. Therefore the resolution bandwidth was set to 30 KHz. The spectrum analyzer had the following settings:

Resolution Bandwidth: 30 KHz
Video Bandwidth: 30 KHz
Span: 1 MHz
Attenuation: 30 dB
Reference Level: 44.6 dBm
Ref. Level Offset: 42.4 dB
Level Range: 100 dB
Sweep Time: Coupled
Video Average: Enabled (50 samples)

The emissions were investigated up to the tenth harmonic of the fundamental emission (20 GHz). The measured level of the emissions was recorded and compared to the -13 dBm limit.

Figure 15: Test Configuration for Radiated Spurious Emissions



Each FRM was configured to transmit at maximum power. FRM #1 was set to channel 25 (1931.25 MHz), FRM #2 was set to channel 475 (1953.75 MHz) and FRM #3 was set to channel 825 (1971.25 MHz).

Measurements were made according to the procedures outlined in ANSI C63.4.

The emissions were investigated up to the tenth harmonic of the fundamental emission (20 GHz). The measured level of the emissions was recorded and compared to the limit.

Name of Test: 2.995 Frequency Stability

1.0 FCC Requirements

1.1 FCC Part 24.235

The frequency stability shall be sufficient to ensure that the fundamental emission stays within the authorized frequency block.

2.0 Test Results

Table 6 shows the results for Frequency Stability versus Temperature Variation.

Table 6: Test Results for Frequency Stability versus Temperature

Temperature (°C)	Maximum Carrier Frequency Deviation (Hz)	10 MHz GPS Reference (MHz)
-30	15.4	10.00000003
-20	14.9	10.00000002
-10	15.4	10.00000001
0	14.4	10.00000002
10	18.6	10.00000002
20	16.7	10.00000002
30	16.3	10.00000002
40	21.0	10.00000001
50	17.1	10.00000002

Table 7 shows the results for Frequency Stability versus Power Supply Voltage.

Table 7: Test Results for Frequency Stability versus Power Supply Voltage

Power Supply Voltage	Maximum Carrier Frequency Deviation (Hz)	10 MHz GPS Reference (MHz)
-40.8 VDC	17.4	10.00000001
-48 VDC (Nominal)	18.3	10.00000001
-55.2 VDC	19.0	10.00000001

was recorded from the time the transmitter was keyed-on for a period of ten minutes using an HP CDMA Cell Site Test system. Also the frequency of the 10 MHz reference sourced from the GPS module was measured using a frequency counter with a rubidium clock reference.

Table 8: Measurement Equipment List (continued)

Equipment Description	Manufacturer	Model No.	Serial No.	Cal. Due Date
Attenuator (20 dB) 100W	Weinschel	48-20-33	BA8950	N/A
Attenuator (20 dB) 100W	Weinschel	6069	BE1306	N/A
Attenuator (10 dB) 2W	Hewlett Packard	6069	BE1306	N/A
Directional Coupler	Narda	8491A	45907	N/A
Environmental Chamber	Thermotron	WP-2000- THCM4- 25-25-RR	17103/P4517	99/05/12

Table 9: EUT Identification List

Equipment Description		Technical Status	Manufacturer	Serial No.
Sys. #2	FRM #1 DPM TRM PAM	NTGS5113 NTGS58BA N1 NTGS57AA P7	Celwave Nortel Nortel/Spectrian	NNTM53508ETM NNTM5350BED8 NNTM5350831H
	FRM #2 DPM TRM PAM	NTGS5113 NTGS58BA N1 NTGS57AA P7	Celwave Nortel Nortel/Spectrian	NNTM53508DWP NNTM53508FLG NNTM535086VF
	FRM #3 DPM TRM PAM	NTGS5113 NTGS58BA N1 NTGS57AA P7	Celwave Nortel Nortel/Spectrian	NNTM535088J7 NNTM5350885T NNTM5350833K
	FRM #4 DPM TRM PAM	NTGS5114 NTGS58BA N1 NTGS57AA P7	Celwave Nortel Nortel/Spectrian	NNTM535088XK NNTM5350BEPJ NNTM5350837P
	FRM #5 DPM TRM PAM	NTGS5114 NTGS58BA N1 NTGS57AA P7	Celwave Nortel Nortel/Spectrian	NNTM535088YL NNTM5350886U NNTM5350835M
	FRM #6 DPM TRM PAM	NTGS5114 NTGS58BA N1 NTGS57AA P7	Celwave Nortel Nortel/Spectrian	1063PI NNTM53508FA6 NNTM5350832J
	FRM #7 DPM TRM PAM	NTGS5115 NTGS58BA N1 NTGS57AA P7	Celwave Nortel Nortel/Spectrian	NNTM5350893R NNTM53508EC7 NNTM532L9AW6
	FRM #8 DPM TRM PAM	NTGS53EA NTGS58BA N1 NTGS57AA P7	Celwave Nortel Nortel/Spectrian	NNTM5350890N NNTM53508GFC NNTM53508FKF
	FRM #9 DPM TRM PAM	NTGS53FA NTGS58BA N1 NTGS57AA P7	Celwave Nortel Nortel/Spectrian	NNTM5350894T NNTM535088G5 NNTM535082XD

Table 9: EUT Identification List (continued)

Serial No.	Manufacturer	Equipment Description		
		Technical Status	Sys. #1	
			FRM #1	DPM TRM PAM
			FRM #2	DPM TRM PAM
NNTM535088H6	Celwave Nortel	NTGS53DA NTGS58BA N1 NTGS57AA P7		
NNTM535088WJ	Celwave Nortel	NTGS53EA NTGS58BA N1 NTGS57AA P7		
NNTM5350895U	Celwave Nortel	NTGS53FA NTGS58BA N1 NTGS57AA P7	FRM #3	DPM TRM PAM

- End of Section -

EUT Identification List

Table 9 is a identification list of the equipment tested in this report.

Measurement Equipment List

Table 8 is a list of all of the measurement equipment used in this report.

Table 8: Measurement Equipment List

Equipment Description	Manufacturer	Model No.	Serial No.	Cal. Due Date
Spectrum Analyzer	Rohde & Schwarz	FSEK	DE25179	99/07/31
Spectrum Analyzer	Rohde & Schwarz	FSEA	DE14732	98/12/29
Spectrum Analyzer	Hewlett Packard	8568B	2338A03010	99/01/02
Spectrum Analyzer	Hewlett Packard	8564E	3517A00305	99/01/01
RF Preslector	Hewlett Packard	85685A	2724A00554	99/01/02
Signal Generator	Hewlett Packard	83732A	3314A00190	98/10/04
Pre-amplifier	Nortel	1-20 GHz	A3	99/08/07
DC Power Source	Hewlett Packard	6012B	2732A-01950	99/06/23
Power Meter	Hewlett Packard	438A	2822A05129	99/04/02
Power Sensor	Hewlett Packard	8481D	3318A08319	98/12/05
Power Sensor	Hewlett Packard	8481A	1550A07043	99/03/29
Power Sensor	Hewlett Packard	8482A	3318A23516	99/09/22
Rubidium Source	UTC	2008	A1010	99/07/02
Modulation Domain Analyzer	Hewlett Packard	53310A	3121A01217	99/04/06
CDMA Cell Site Test Set	Hewlett Packard	8921A	3612A03018	99/05/12
PCS Interface	Hewlett Packard	83236B	3711J01597	99/05/12
Digital Multimeter	Fluke	87	63760583	99/11/24
BILOG Antenna	Chase	CBL611	1011.ANT	98/12/30
Horn Antenna	EMCO	3115	9104-3679	98/11/21
Tunable Notch Reject Filter	K&L	3TNF-2000	5	N/A
Highpass Filter	FSY Microwave	2380-11XNXN	003	N/A

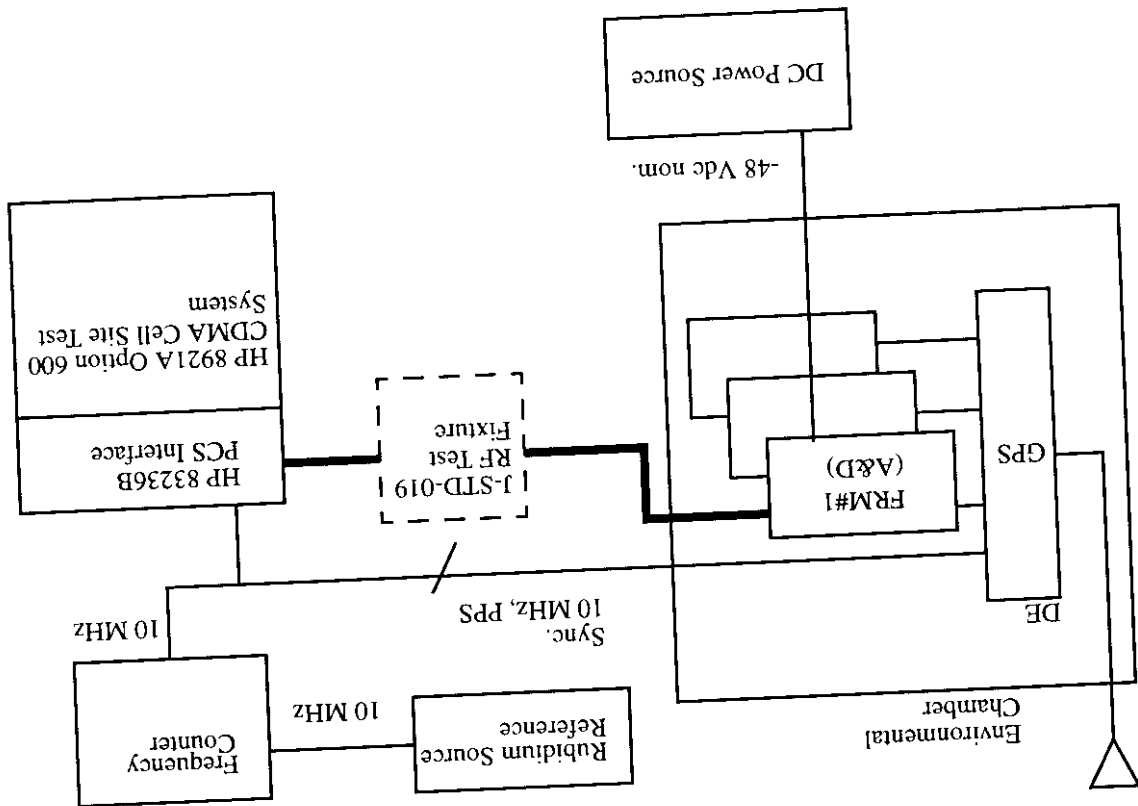
The maximum frequency deviation was found to be 21.0 Hz or (0.011 ppm). This deviation is more than sufficient to ensure that the fundamental emission stays within the authorized frequency block. Therefore the BTS complies with the requirement.

Test Procedure

3.0

The equipment was configured as shown in Figure 16.

Figure 16: Test Configuration for Frequency Stability



The BTS was configured to transmit at maximum power at channel 25 (1931.25 MHz).

At 20 centigrade ambient temperature, measurements were made with the primary supply voltage set to 85, 100 and 115 percent of the nominal value. The nominal primary supply voltage for the FRM was -48 VDC.

The BTS was subjected to ambient temperatures from -30 to +50 centigrade at intervals of 10 centigrade. A period of at least 3 hours was allowed prior to measurement to ensure that all of the components of the oscillator circuit had stabilized at each temperature.

At each of the above specified ambient temperatures, the maximum carrier deviation

The 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:

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

Where,

E = Field Strength in Volts/meter,
R = Measurement distance in meters,
P_t = Transmitter Rated Power in Watts,
G = Gain of Ideal Dipole (linear)

Therefore:

$$E\left(\frac{m}{V}\right) = \frac{1}{10} \cdot \sqrt{30 \cdot 31.6 \cdot 1.64}$$

$$E = 3.94 \text{ V/m} = 131.9 \text{ dB}\mu\text{V/m}$$

The spurious emissions must be attenuated by at least 43 + 10 log (31.6) = 58 dB
Therefore the field strength limit at 10 meters is:

$$E = 131.9 \text{ dB}\mu\text{V/m} - 58 \text{ dB} = 73.9 \text{ dB}\mu\text{V/m}$$

And at 3 meters is:

$$E = 84.4 \text{ dB}\mu\text{V/m}$$

Name of Test: 2.993 Field Strength of Spurious Radiation

1.0 FCC Requirements

1.1 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.

1.2 FCC Part 2.993

(a) 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 emission.

2.0 Test Results

Table 5 shows the results for radiated spurious emissions measurements.

Table 5: Test Results for Spurious Emissions

Frequency (MHz)	Antenna Polarization	Measured Level (dBμV)	Correction Factor (dB)	Corrected Level (dBμV/m)	Limit (dBμV/m) @ 3m
3942.5 (2 x Tx)	Horizontal	53.8	6.5	60.3	84.4

The field strength is calculated by adding the correction factor to the measured level to obtain the corrected level. A sample calculation is as follows:

$$\text{Correction Factor}_{\text{(dB)}} = \text{Cable Losses}_{\text{(dB)}} + \text{Antenna Factor}_{\text{(dB)}} - \text{pre-amplifier gain}_{\text{(dB)}}$$

$$\text{Correction Factor}_{(\text{dB})} = 8.8 \text{ dB} + 32.4 \text{ dB} - 34.7 \text{ dB} = 6.5 \text{ dB}$$

$$\text{Corrected Level (dB}_{\text{H/V}}\text{)} = \text{Measured Level (dB}_{\text{H/V}}\text{)} + \text{Correction Factor (dB)}$$

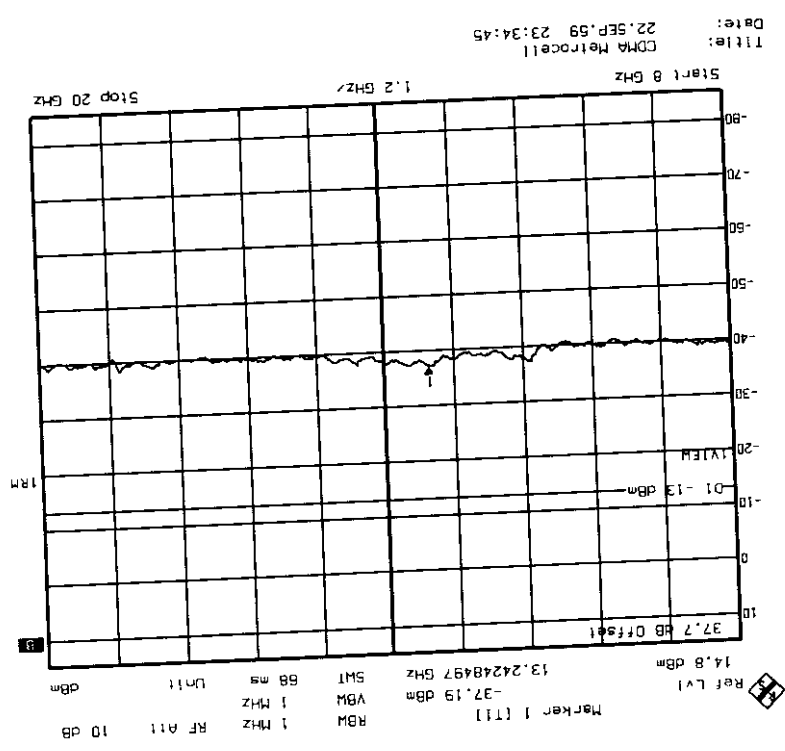
$$\text{Corrected Level} = 53.8 + 6.5 = 60.3 \text{ dB}\mu\text{V/m}$$

All spurious emissions were below the limit by greater than 20 dB. The highest emission level is shown in Table 5. The BTS complies with the requirement.

3.0 Test Procedure

The equipment was configured as shown in Figure 15.

Figure 13: Sample Plot for 8 - 20 GHz Span



From the results shown in Table 4, the BTS complies with the requirement.

Test Procedure

The equipment was configured as shown in Figure 14.

3.0

Figure 11: Sample Plot for 0 - 3 GHz Span

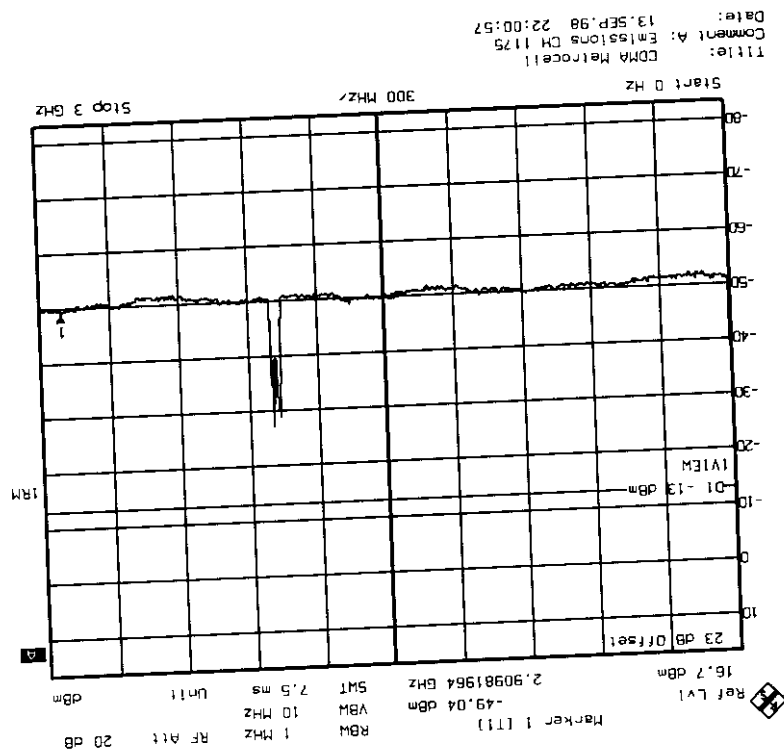


Figure 9: Sample Plot for Ch. 1175 (1991 - 1994 MHz)

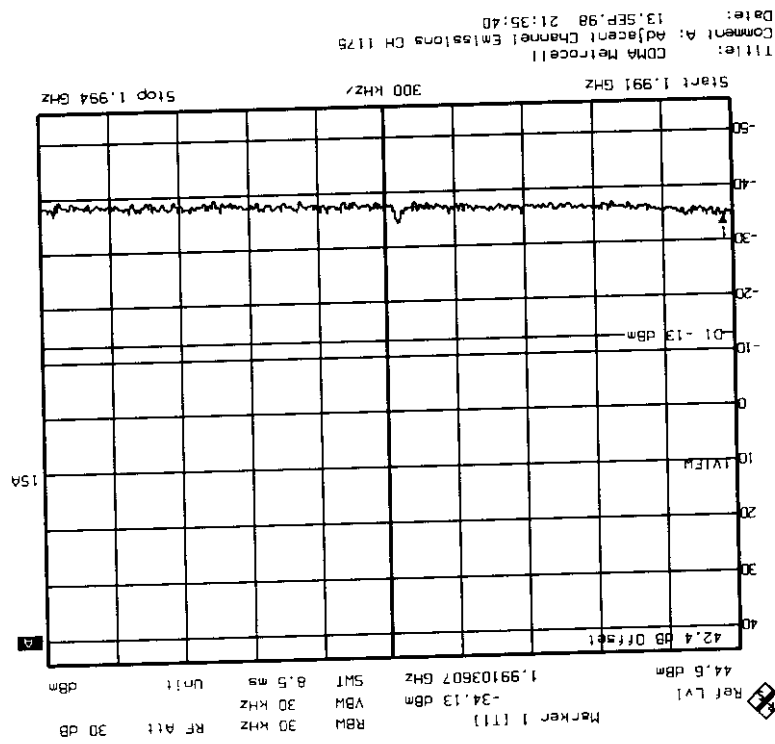


Figure 7: Sample Plot for Ch. 25 (1926 - 1929 MHz)

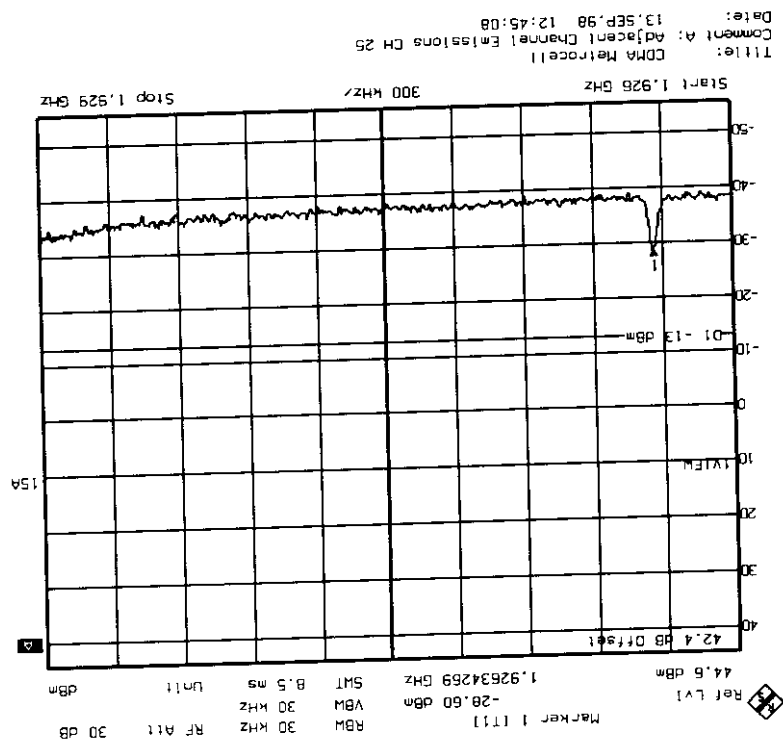


Table 4 shows the results for Spurious Emissions at Antenna Terminals.

Table 4: Test Results for Spurious Emissions at Antenna Terminals

Frequency (MHz)	Spurious Emissions Level (dBm)	Limit (dBm)	Margin (dB)
(@ Ch. 25)	-22.1 (1st Adjacent MHz)	-13	9.1
(@ Ch. 375)	-23.4 (1st Adjacent MHz)	-13	10.4
(@ Ch. 425)	-21.8 (1st Adjacent MHz)	-13	8.8
(@ Ch. 775)	-22.7 (1st Adjacent MHz)	-13	9.7
(@ Ch. 825)	-23.8 (1st Adjacent MHz)	-13	10.8
(@ Ch. 1175)	-23.7 (1st Adjacent MHz)	-13	10.7
0 - 3000	-22.2 @ 1926.34 MHz (Tx-4.9 MHz)	-13	9.2
3000 - 8000	-32.8 @ 3.972 GHz (2Tx)	-13	19.8
8000 - 20000	-37.2 (noise floor)	-13	24.2

Notes:

Figure 6 and Figure 7 show sample plots for the case when the transmitter was tuned to Channel 25 (lowest channel in Tx band).

Figure 8 and Figure 9 show sample plots for the case when the transmitter was tuned to Channel 1175 (highest channel in Tx band).

Figure 10 shows a sample plot for the case when the transmitter was tuned to Channel 375 (highest channel in Blocks A&D).

Figure 11 to Figure 13 show sample plots for frequency spans from 0 to 20 GHz

Name of Test: 2.991 Spurious Emissions at Antenna Terminals

1.0 FCC Requirements

1.1 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.

(b) Compliance with these provisions is based on the use of measurement instrumentation employing a resolution bandwidth of 1 MHz or greater. However, in the 1 MHz bands immediately outside and adjacent to the frequency block a resolution bandwidth of at least one percent of the emission bandwidth is defined as emission of the transmitter may be employed. The emission bandwidth is defined as the width of the signal between two points, one below the carrier center frequency and one above the carrier center frequency, outside of which all emissions are attenuated at least 26 dB below the transmitter power.

(c) When measuring the emission limits, the nominal carrier frequency shall be adjusted as close to the licensee's frequency block edges, both upper and lower, as the design permits.

(d) The measurements of emission power can be expressed in peak or average values, provided they are expressed in the same parameters as the transmitter power.

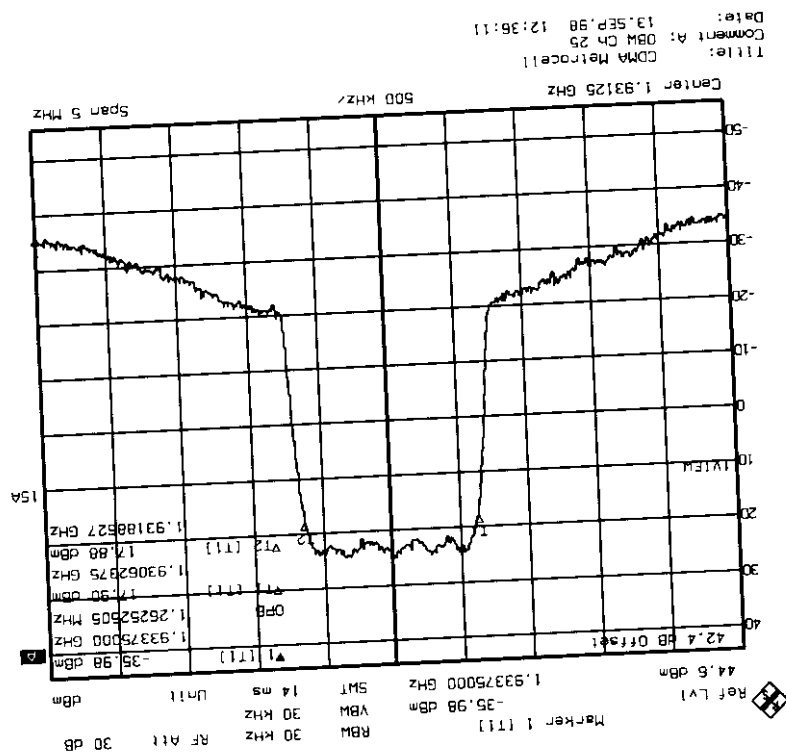
2.0

Test Results

The emission bandwidth was found to be 1402.8 KHz. A sample plot for the emission bandwidth measurement is shown in Figure 5. This value was used to determine the resolution bandwidth required for measurements in the first adjacent MHz outside the licensee's frequency block.

Figure 3 shows a sample plot for case of the maximum measured occupied bandwidth. The maximum occupied bandwidth was found to be 1262.5 KHz.

Figure 3: Sample Plot for Occupied Bandwidth



Test Procedure

3.0

The equipment was configured as shown in Figure 4.

Figure 4: Test Configuration for Occupied Bandwidth

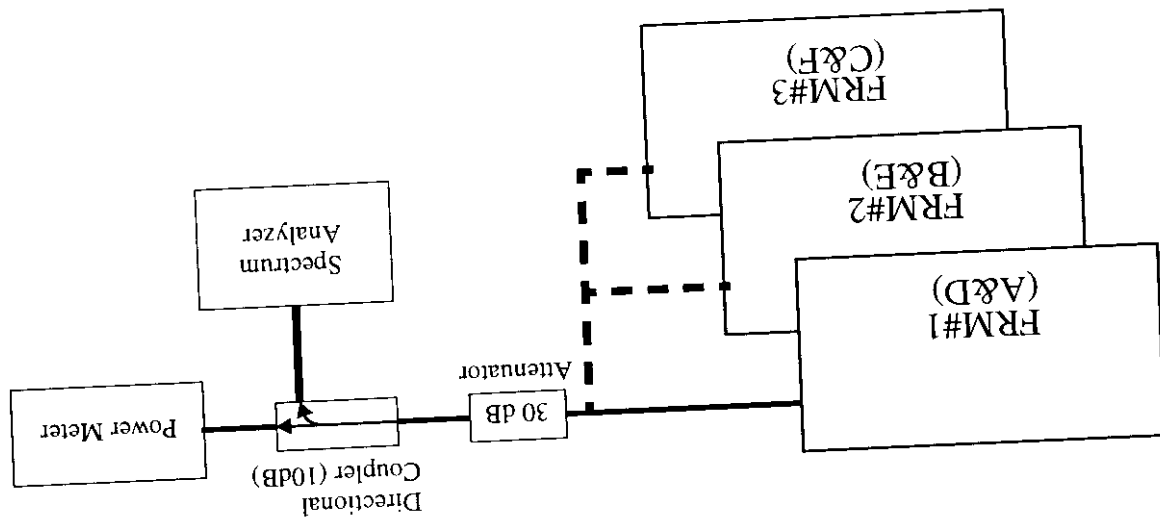


Table 2: Test Results for RF Output Power (continued)

Channel #	Frequency (MHz)	Measured RF Output Power (dbm)	Maximum Rated Power (dbm)	Limit (dbm)
850	1972.50	41.4	41.6	50
875	1973.75	41.4	41.6	50
925	1976.25	41.3	41.6	50
1050	1982.50	41.4	41.6	50
1175	1988.75	41.3	41.6	50

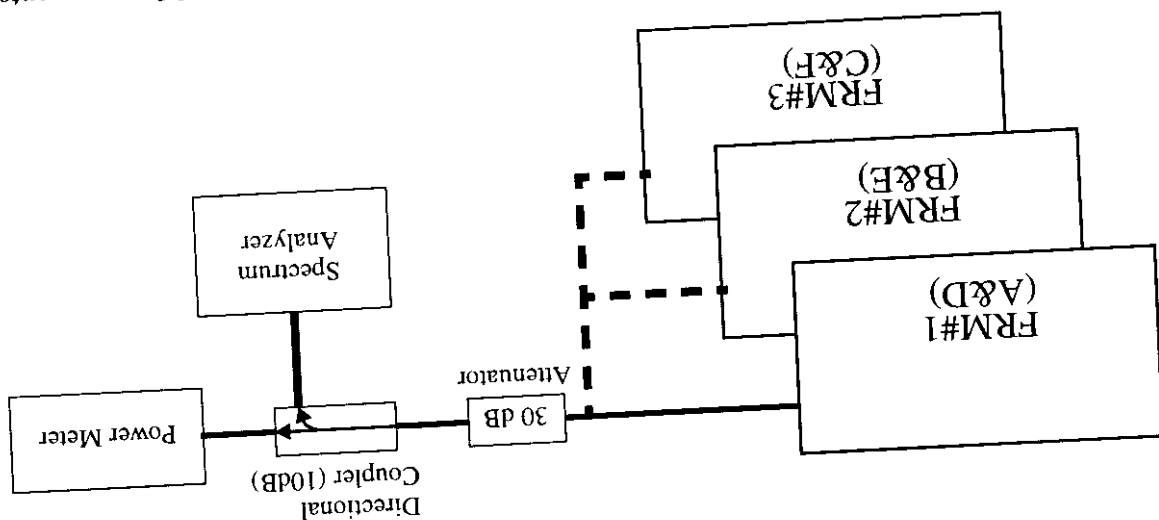
From the results shown in Table 2, the BTS complies with the requirement.

Test Procedure

3.0

The equipment was configured as shown in Figure 2.

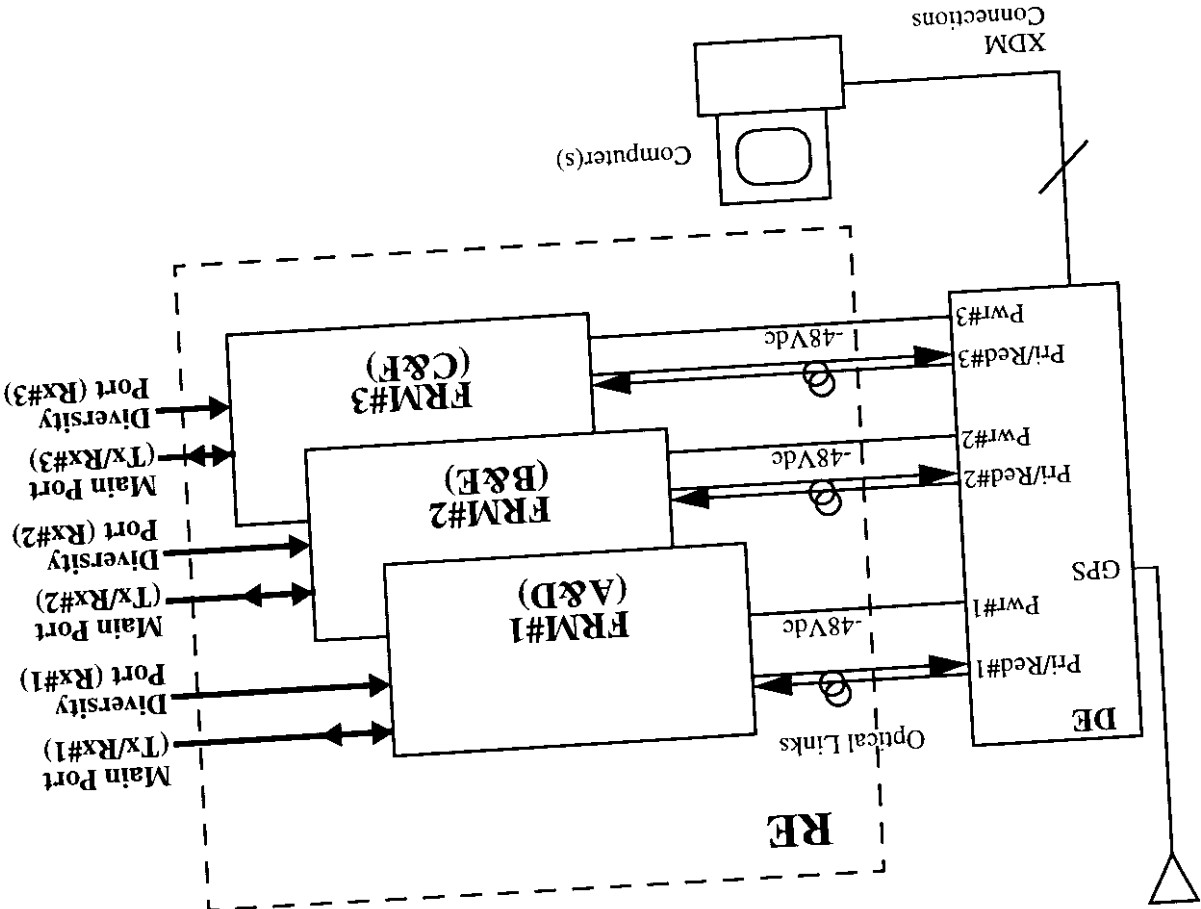
Figure 2: Test Configuration for Output Power



Each FRM was configured to transmit at maximum power. Measurements were made at frequencies which were at the bottom, middle and top of each of the licensed blocks.

The output power was measured using a Hewlett Packard power meter Model 438A

Figure 1 shows the general test setup used during testing of the BTS.
Figure 1: General Test Setup



The base station was configured as shown in Figure 1. The base station forward channel was configured with multiple code channels simultaneously as described in Table 6.5.2-1 (Base Station Test Model) of ANSI J-STD-019 Recommended Minimum Performance Requirements for Base Stations Supporting 1.8 to 2.0 GHz Code Division Multiple Access (CDMA) Personal Stations

Measurement Results

The following section contains the measurement results.