

December 15, 1999

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

Attention: Applications Examiner

Applicant: Nokia Telecommunications, Inc.
6000 Connection Drive, Irving, Texas 75039

Equipment: PCS Base Transmitter Station (BTS), Model: MetroSite 1900
FCC ID: L7KVTPA-01

Specification: for a 47 CFR 24 Licensed Certification

Dear Examiner:

The following application for Grant of Equipment Authorization is presented on behalf of Nokia Telecommunications, Inc. for the Licensed Certification of their Model: MetroSite 1900, PCS Base Transmitter Station (BTS).

Enclosed, please find a complete data and documentation package demonstrating that this device complies with the technical requirements of 47 CFR 24, for a Base Transmitter Station (BTS).

If you have any questions, please contact the undersigned, who is authorized to act as Agent.

Sincerely,

Chris Harvey, Director
EMC Laboratory
MET Laboratories, Inc.

MET Laboratories, Inc. *Safety Certification - EMI - Telecom Environmental Simulation*

914 WEST PATAPSCO AVENUE • BALTIMORE, MARYLAND 21230-3432 • PHONE (410) 354-3300 • FAX (410) 354-3313

ENGINEERING TEST REPORT

in support of the
Application for Grant of Equipment Authorization

EQUIPMENT:	PCS Base Transmitter Station (BTS), Model: MetroSite 1900
FCC ID:	L7KVTPA-01
Specification:	47 CFR 24
On Behalf of the Applicant:	Nokia Telecommunications, Inc. 6000 Connection Drive Irving, TX 75039
Manufacturer:	Nokia Telecommunications, Inc. 6000 Connection Drive Irving, TX 75039
Manufacturer's Representative	Mr. Steve Mitchell
Test Date(s):	Aug 12 thru 24, 1999

ENGINEERING STATEMENT

I ATTEST: the measurements shown in this report were made in accordance with the procedures indicated, and that the emissions from this equipment were found to be within the limits applicable. I assume full responsibility for the accuracy and completeness of these measurements. On the basis of the measurements made, the equipment tested is capable of operation in accordance with the requirements of Part 24 of the FCC Rules under normal use and maintenance.

Liming Xu
EMC Engineer, MET Laboratories

1.0 INTRODUCTION

The following data is presented on behalf of the Applicant, Nokia Telecommunications, Inc., as verification of the compliance of the Nokia PCS Base Transmitter Station (BTS), MetroSite 1900 to the requirements of 47 CFR 24.

2.0 TEST SITE

All testing was conducted at MET Laboratories, Inc., 914 West Patapsco Avenue, Baltimore, Maryland 21230-3493. Radiated emissions measurements were performed on a three-meter open area test site (OATS). A complete site description is on file with the FCC Laboratory Division as 31040/SIT/MET.

3.0 TEST EQUIPMENT USED

Manufacturer	Equipment	Calibration Due Date @ time of testing	Cal. Interval
Hewlett Packard	8563A Spectrum Analyzer	5/29/00	annual
EMCO	Biconical Antenna 3104	1/27/00	annual
EMCO	EMCO Log Periodic Antenna	3/20/00	annual
EMCO	Double Ridge Guided Horn	3/20/00	annual
Hewlett Packard	8594EM Analyzer	11/18/99	annual
Solar	LISN	6/30/00	annual

4.0 EQUIPMENT UNDER TEST CONFIGURATION

The Base Transmitter Station (BTS) was configured with AC power supply modules and an external PC to program the EUT to output a PCS (i.e.GMSK Modulation type) cellular RF signal. The EUT with host external computer was configured for maximum signal gain and bandwidth. The EUT was operated in a manner representative of the typical usage of the equipment. During all testing, system components were manipulated within the confines of typical usage to maximize each emission.

5.0 TEST TYPE(S)

- 5.1 Radiated Emissions: 47 CFR 2.1053, , 24.238(a)
- 5.2 Occupied Bandwidth: 47 CFR 2.1049
- 5.3 RF Power Output: 47 CFR 2.1046, 24.232(a), (c)
- 5.4 Spurious Emission at Antenna Terminals: 47 CFR 2.1051, 24.238(a)
- 5.5 Spurious Emission at Antenna Terminals at Frequency Block edges +/- 1 MHz, 47 CFR 2.1051, 24.238(b)
- 5.6 Frequency Stability over temperature variations: 47 CFR 2.1055(a)(1)
- 5.7 Frequency Stability over variations in supply voltage: 47 CFR 2.1055(d)(1)
- 5.8 AC Line Conducted Emissions: 47 CFR 15.107
- 5.9 Modulation Characteristics: 47 CFR 2.1047(a)

6.0 TEST RESULTS**6.1 TEST TYPE:** Radiated Emissions**6.1.1 TECHNICAL SPECIFICATION:** 2.1053; 24.238(a)**6.1.2 TEST DATE(S):** 17 Aug. 1999**6.1.3 MEASUREMENT PROCEDURES:**

As required by §2.1053, *field strength of spurious radiation measurements* were made in accordance with the general procedures of ANSI C63.4-1992 "Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz". Preliminary radiated emission measurements were performed inside a shielded chamber with all digital signal generators on and terminated. The frequency list from the preliminary measurements was used as a guide for making final measurements on a 10 meter open area test site. The unit was scanned over the frequency range of the lowest system oscillator value to 9 GHz. The Radiated Spurious Emissions *Limit* is obtained by the following:

Based on an output power (as measured at the output of the Amplifier) of 1.1 watts:

$$P_o = 1.1 \text{ W}$$

As per 2.1053 (a), it is assumed this power is to be fed to a half-wave tuned dipole. Using a conversion formula for distance, the field strength at one meter can be derived:

$$E(V/m)_{1m} = \frac{\sqrt{49.2 \times 1.1}}{1}$$

$$E(V/m)_{1m} = 7.357 \text{ V/m or } 137.2 \text{ dB}\mu\text{V/m @ } 1m$$

As per 24.238(a), the spurious emissions must be attenuated by $43 + 10\log(P)$ which is:

$$43 + 10\log(1.1) = 43.41 \text{ dB}$$

Therefore, the limit for spurious emissions is:

$$137.2 \text{ dB}\mu\text{V/m} - 43.41 \text{ dB} = 93.80 \text{ dB}\mu\text{V/m @ } 1m$$

At 3 meters measurement distance, the limit is;

$$E(V/m)_{3m} = \frac{\sqrt{49.2 \times 1.1}}{3}$$

$$E(V/m)_{3m} = 2.45 \text{ V/m or } 127.7 \text{ dB}\mu\text{V}$$

According to 24.238(a), all signals must be attenuated by 43.41 dB. Therefore, the limit for spurious emissions for a test distance of 3 meters is:

$$127.7 - 43.4 = 83.3 \text{ dB}\mu\text{V/m @ } 3m$$

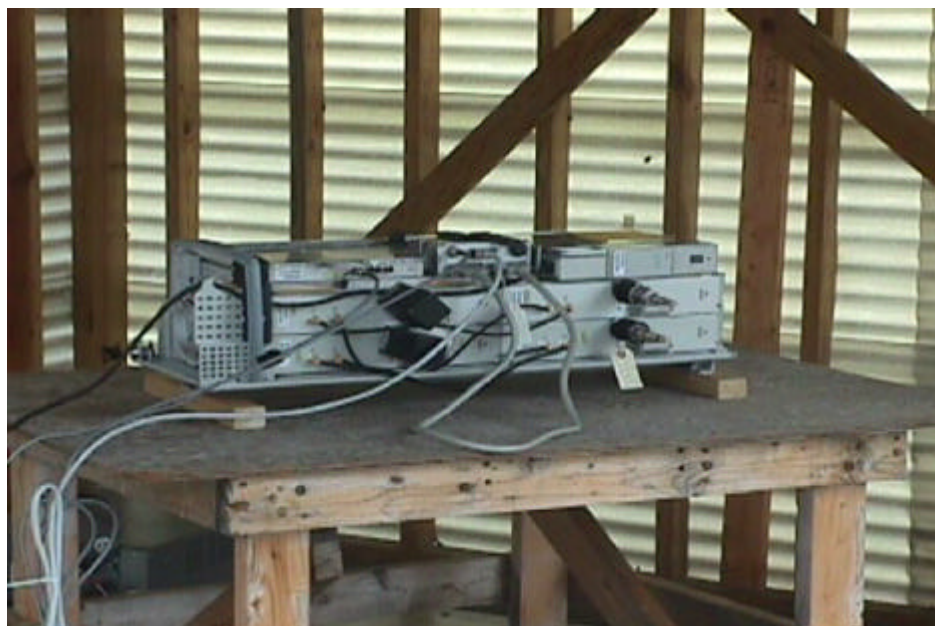
6.1.4 RESULTS:

Frequency (MHz)	Azimuth (Degrees)	Polarity	Height (m)	Raw Amplitude (dBμV)	A.C.F. (dB/m)	cable loss (dB)	D.C.F. (dB) 3m to 10m	Corrected Amplitude (dBμV/m)	Limit (dBμV/m) at 1 m	Limit (dBμV/m) at 10 m
*73.80	0	H	2	14.2	8.3	1.6	-10.46	13.6	n/a	39
*73.80	90	V	3	16.19	8.4	1.6	-10.46	15.7	n/a	39
*74.80	0	H	2	15.79	8.1	1.6	-10.46	15.0	n/a	39
*74.80	0	V	3	16.13	8.5	1.6	-10.46	15.7	n/a	39
*207.50	90	H	3	12.94	17.9	2.7	-10.46	23.1	n/a	43.5
*207.50	90	V	3	13.46	18.0	2.7	-10.46	23.7	n/a	43.5
*390.50	0	H	3	13.68	19.0	3.9	-10.46	26.1	n/a	46.4
*390.50	0	V	2.5	13.64	19.1	3.9	-10.46	26.1	n/a	46.4
*510.50	90	H	3	12.62	18.2	4.5	-10.46	24.9	n/a	46.4
*510.50	0	V	3	12.75	17.6	4.5	-10.46	24.4	n/a	46.4
*730.50	0	H	2.5	13.27	22.6	5.6	-10.46	31.0	n/a	46.4
*730.50	90	V	3	13.2	21.8	5.6	-10.46	30.2	n/a	46.4
3905.40	0	H	1	28.7	32.9	1.0	1 m limit	62.6	93.8	n/a
3905.40	0	V	1	27.53	32.3	1.0	1 m limit	60.8	93.8	n/a
9763.50	0	H	1	24.37	38.1	1.0	1 m limit	63.5	93.8	n/a
9763.50	0	V	1	24.53	37.5	1.0	1 m limit	63.0	93.8	n/a
17574.30	0	H	1	25.7	45.5	1.0	1 m limit	72.2	93.8	n/a
17574.30	0	V	1	25.2	45.0	1.0	1 m limit	71.2	93.8	n/a

Equipment meets the specifications of 2.10532; 24.238(a)

*— These emissions were related to the digital electronics, and thus are measured against the 47 CFR 15 Class A limit. These emissions are significantly below the limit for spurious emissions (93.8 dBμV/m @ 1 m or 83.3 dBμV/m @ 3 m)

Photograph of Radiated Emissions Test Configuration



6.2 TEST TYPE: Occupied Bandwidth**6.2.1 TECHNICAL SPECIFICATION:** 47CFR2.1049**6.2.2 TEST DATE(S):** 17 Aug. 1999**6.2.3 MEASUREMENT PROCEDURES:**

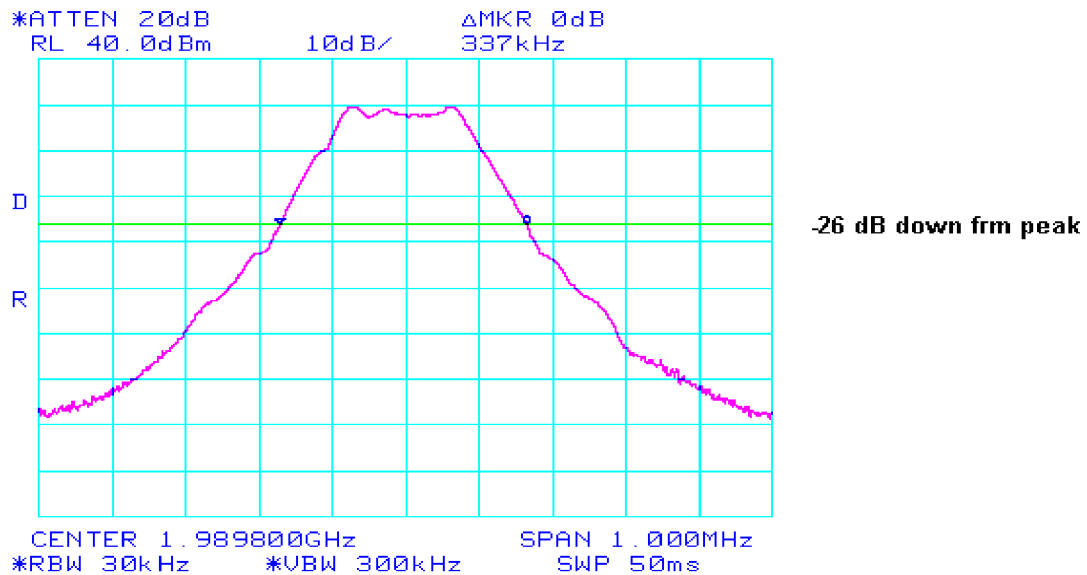
As required by §2.1049 of CFR 47, *occupied bandwidth measurements* were made on the Base Transmitter Station (BTS). The EUT was configured to transmit an PCS GMSK modulated carrier signal. Using a bandwidth of 300Hz, we determined the occupied bandwidth of the emission at the center of the selectable channel range.

6.2.4 RESULTS:

Equipment complies with Section 2.1049. Plots of the occupied bandwidth, as measured at the RF output port follows:

Determination of Emission Bandwidth of the Fundamental Emission as defined by 26 dB down points.

emi9574



6.3 TEST TYPE: RF Power Output**6.3.1 TECHNICAL SPECIFICATION: 47CFR2.1046 and 24.232(a), (c)****6.3.2 TEST DATE(S): 12 Aug 1999****6.3.3 MEASUREMENT PROCEDURES:**

As required by §2.1046 of CFR 47, *RF power output measurements* were made at the RF output terminals using an attenuator and spectrum analyzer. This test was performed with carrier modulated by an PCS GSMK modulation signal.

Plots of the RF output Power level of the Digitally modulated carrier, as measured at the RF output are included on the following page .

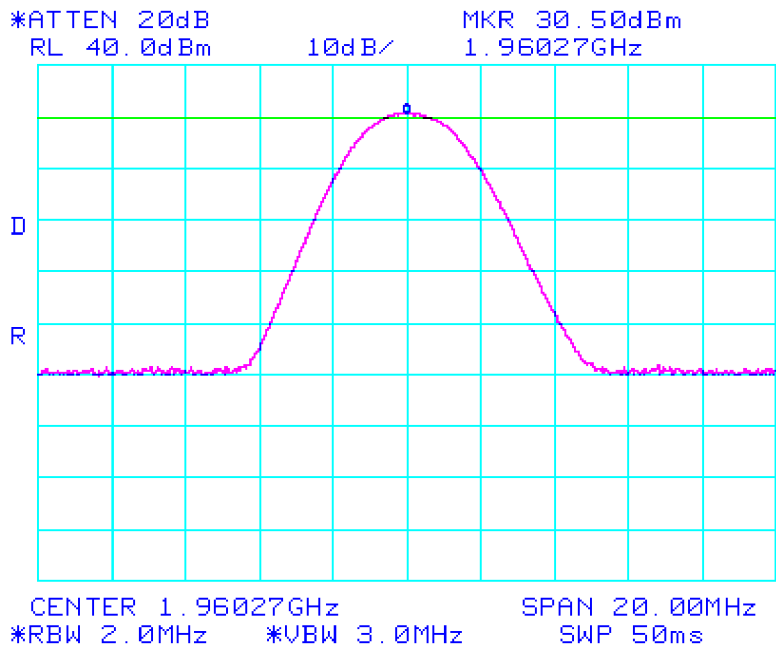
6.3.4 RESULTS:

Equipment complies with 47CFR 2.1046 and 24.232(a). The Base Transmitter Station (BTS) does not exceed 100 W (or 50 dBm) at the carrier frequency.

Photograph of Antenna Conducted Spurious Emissions and
RF Power Output Test Configuration



Power Output at Center of Authorized Band
emi9574



6.4 TEST TYPE: Spurious Emissions at Antenna Terminals**6.4.1 TECHNICAL SPECIFICATION: 2.1051; 24.238(a)****6.4.2 TEST DATE(S): 18 Aug. 1999****6.4.3 MEASUREMENT PROCEDURES:**

As required by §2.1051 of CFR 47, *spurious emissions at antenna terminal measurements* were made at the RF output terminals using a 50 Ω attenuator and spectrum analyzer set for a 30 kHz bandwidth. This test was performed with Digitally modulated carrier signals. The Digital signal generator was adjusted for continuous transmit on frequencies in both the uplink and down-link frequency bands. The frequency spectrum was investigated from 9.0 KHz to 9.0 GHz. For measuring emissions above 2 GHz, a high-pass filter was used to eliminate the fundamental transmit frequency to prevent possible saturation effects on the front end of the spectrum analyzer.

6.4.4 RESULTS:

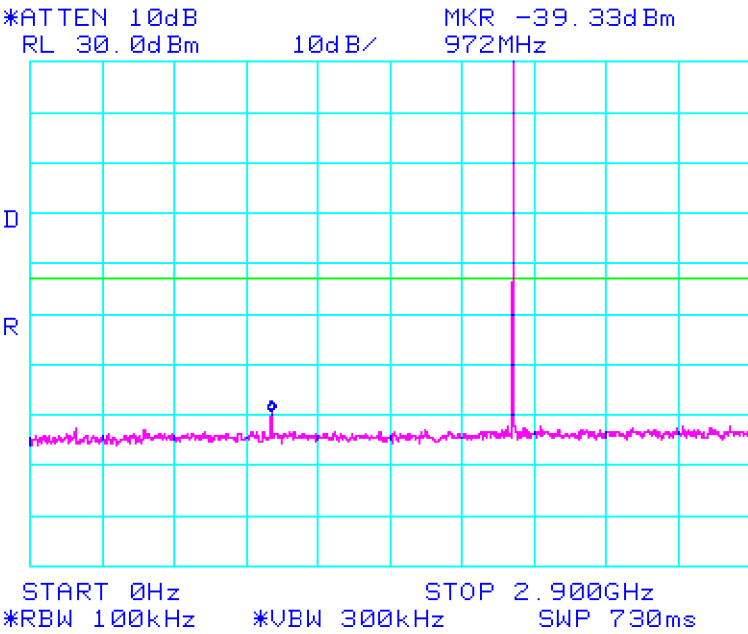
Equipment complies with Section 2.1051 and 24.238(a)

SUMMARY OF SPURIOUS EMISSIONS AT ANTENNA TERMINALS - UpLink

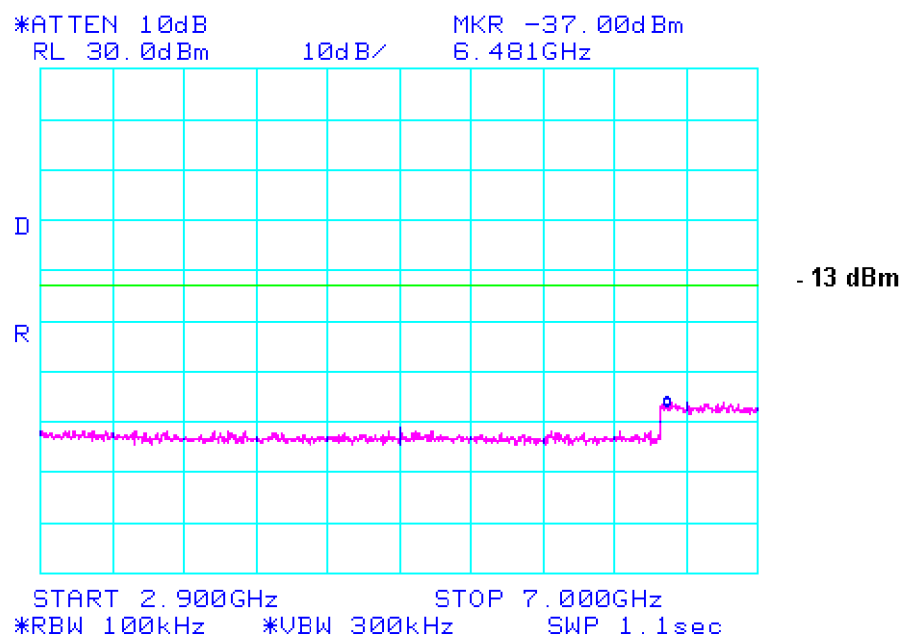
Frequency Range	Emission Frequency	Emission Level (dBm)	Limit (dBm)
9k - 2 MHz	none	none	-13.1
2MHz - 850 MHz	none	none	-13.1
850MHz - 2.4 GHz	972.0 MHz	-39.33	-13.1
2.4 - 9 GHz	6.481 GHz	-34.25	-13.1
9-15 GHz	14.293GHz	-29.5	-13.1
9 - 20 GHz	19.975GHz	-24.83	-13.1

The following plots are included to illustrate compliance with the requirements of 47 CFR Part 24.238(a):

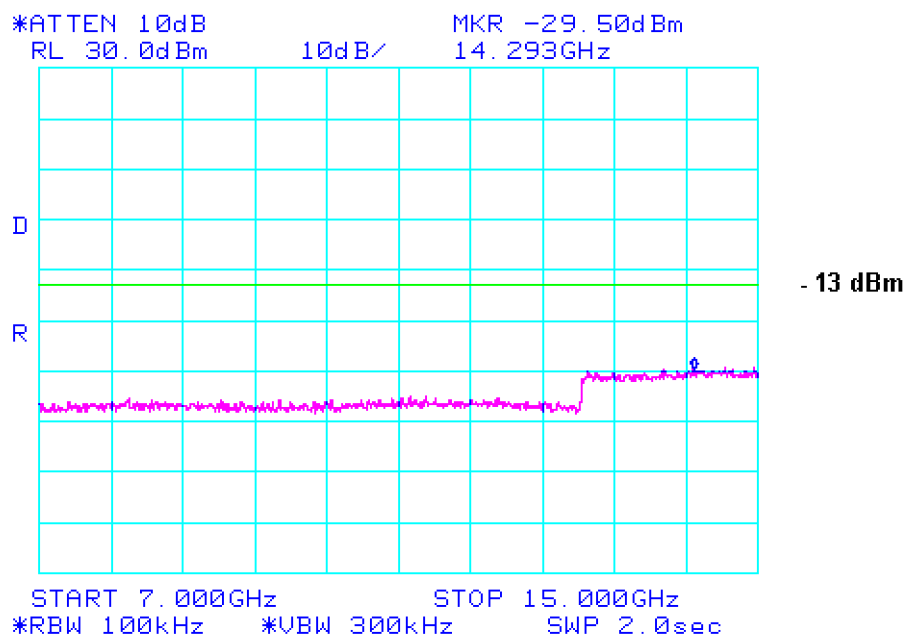
Conducted Spurious Emissions at antenna terminals
emi9574



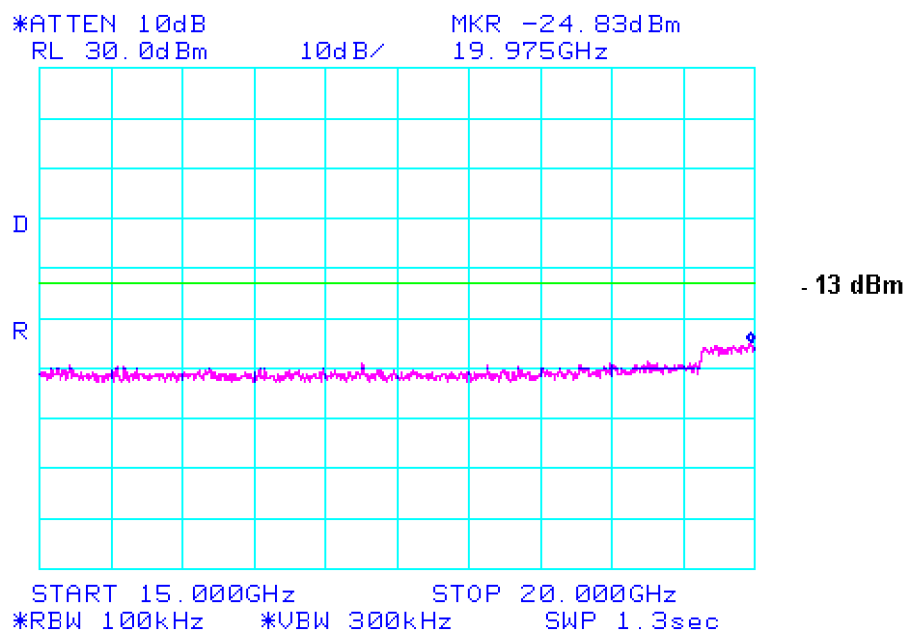
Conducted Spurious Emissions at Antenna terminals
emi9574



Conducted Spurious Emissions at Antenna Terminals
emi9574



Conducted Spurious Emissions as measured at Antenna Terminals
emi9574



6.5 TEST TYPE: Spurious Emissions at Antenna Terminals at Block Edges +/- 1 MHz**6.5.1 TECHNICAL SPECIFICATION:** 2.1051; 24.238(b)**6.5.2 TEST DATE(S):** 18 Aug. 1999**6.5.3 MEASUREMENT PROCEDURES:**

As recommended in FCC Part 24, 1% of the 26dB bandwidth was chosen to measure the peak of any emission inside the 1.0 MHz frequency band adjacent to each frequency block edge. All other frequencies were measured using a 1.0 MHz RBW. The unit was exercised using signal types required by §2.1049.

6.5.4 Results:

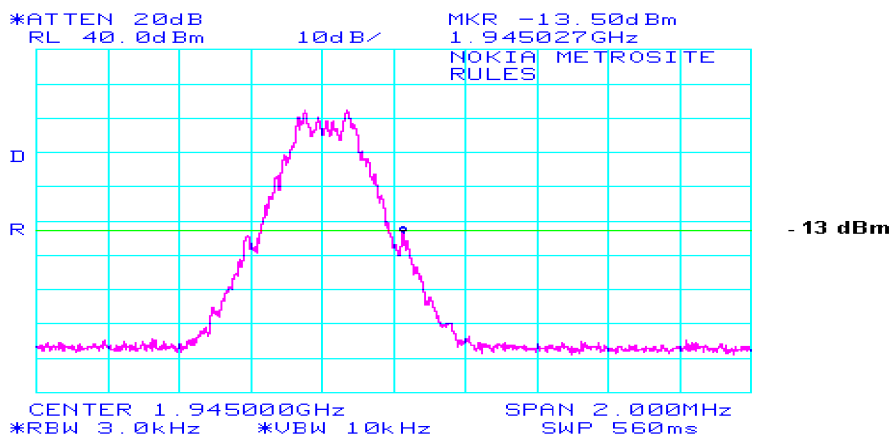
Modulation products outside of this band are attenuated at least $43 + 10 \log(P)$ below the level of the modulated carrier. A Plot of the spurious emissions at +/- 1 MHz around the transmit frequency, as measured at the antenna port, appears on the following page.

SPURIOUS EMISSION FREQUENCY BLOCKS

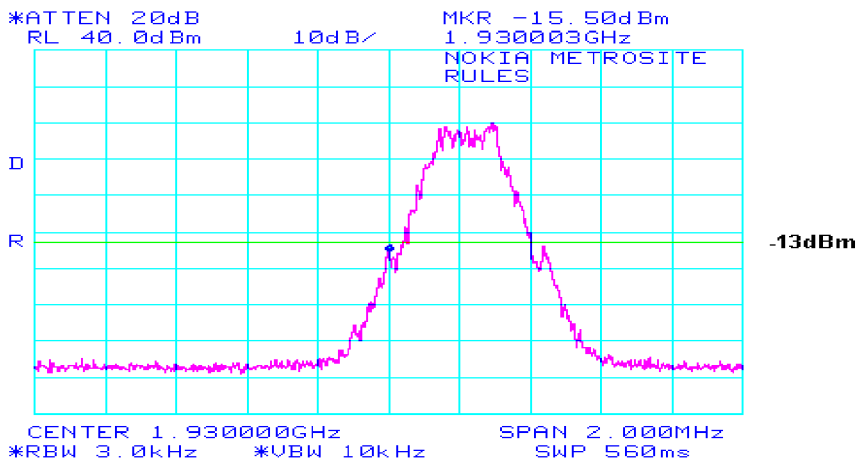
Frequency Block (MHz)	Low Frequency (CH #)	Hi Frequency (CH #)
A (1930 - 1945)	513 (1930.2)	584 (1944.8)
B (1950 - 1965)	613 (1950.2)	684 (1964.8)
C (1975 - 1990)	738 (1975.2)	809 (1989.8)
D (1945 - 1950)	588 (1945.2)	609 (1949.8)
E (1965 - 1970)	688 (1965.2)	709 (1969.8)
F (1970 - 1975)	713 (1970.2)	734 (1974.8)

Plots of the spurious emissions as measured at the extremes of each frequency block appear on the following pages.

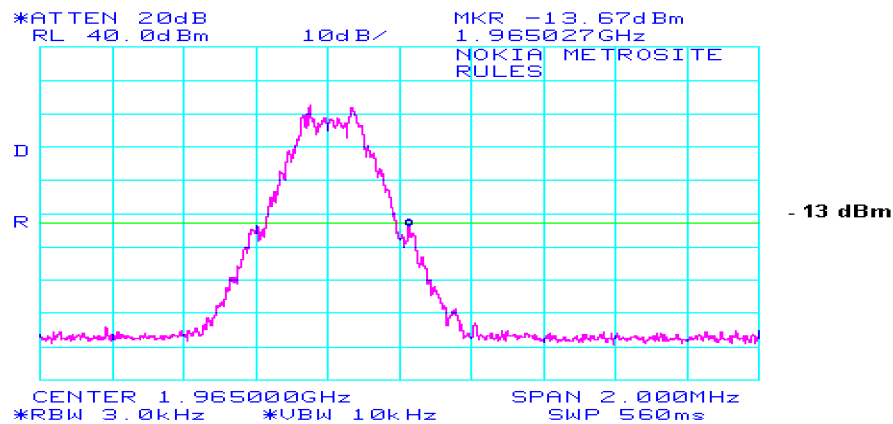
Spurious Emissions at Frequency Block edges +/- 1 MHz
Hi side of Block A
emi9574a



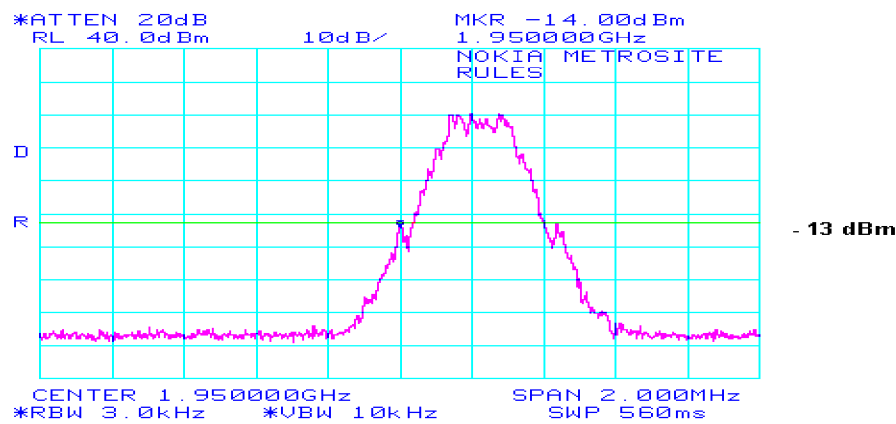
Spurious Emissions at Frequency Block edges +/- 1 MHz
Lo side of Block A
emi9574a



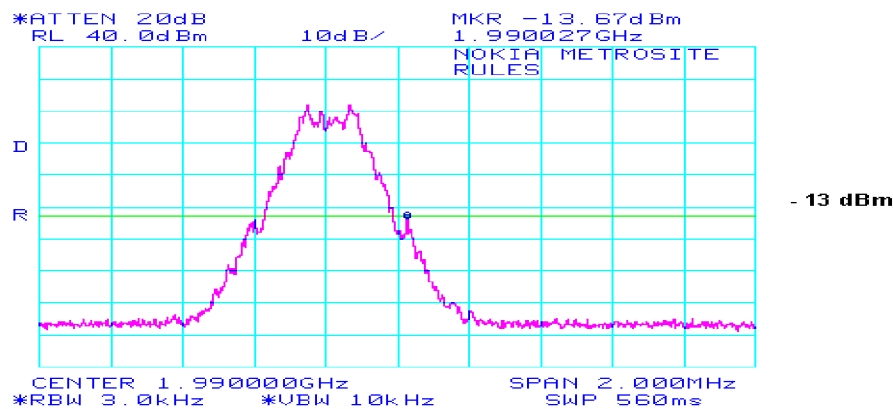
Spurious Emissions at Frequency Block edges +/- 1 MHz
Hi side of Block B
emi9574a



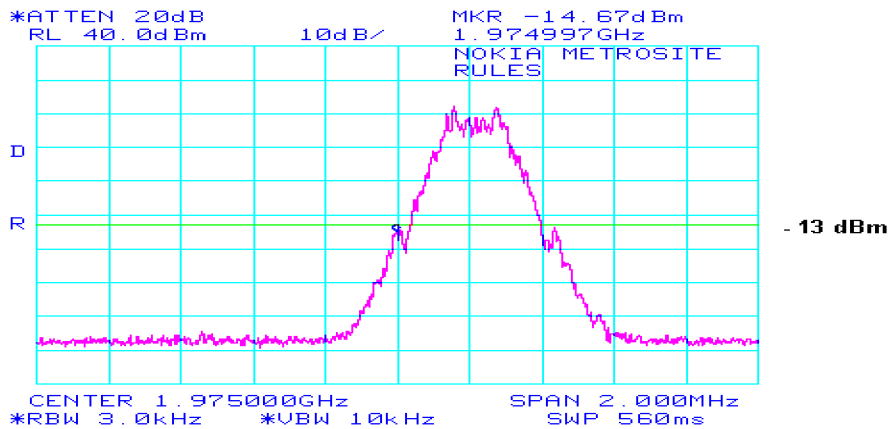
Spurious Emissions at the Frequency Block edge +/- 1 MHz
Lo side of Block B
emi9574a



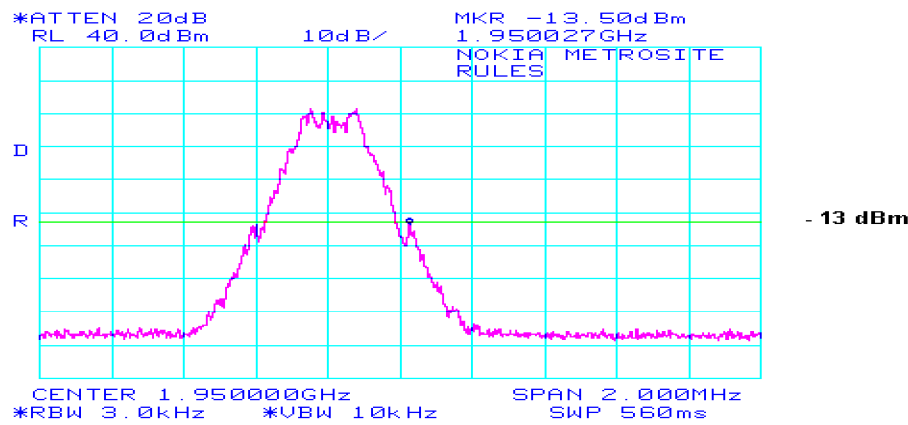
Spurious Emissions at Frequency Block edges +/- 1 MHz
Hi side of Block C
emi9574a



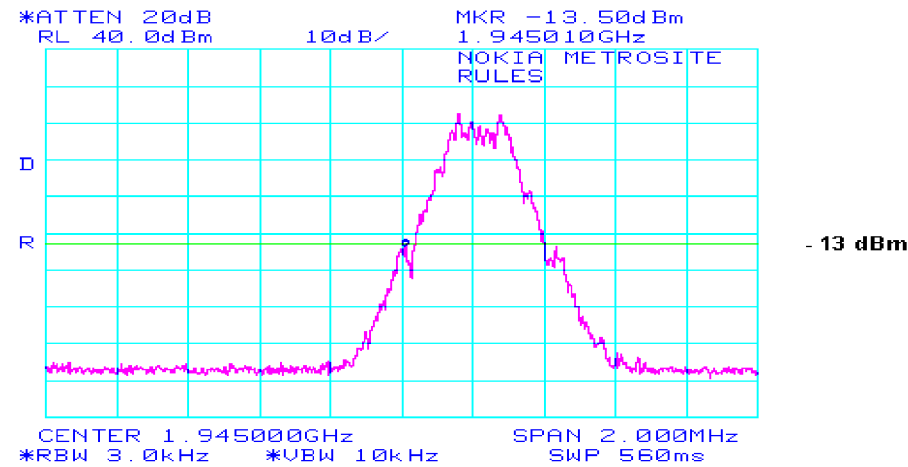
Spurious Emissions at Frequency Block edges +/- 1 MHz
Lo side of Block C
emi9574a



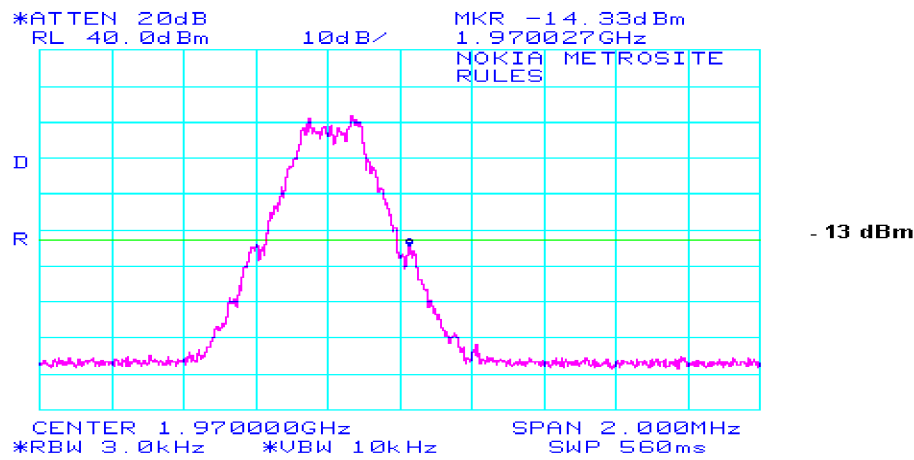
Spurious Emissions at Frequency Block edge +/- 1 MHz
Hi side of Block D
emi9574a



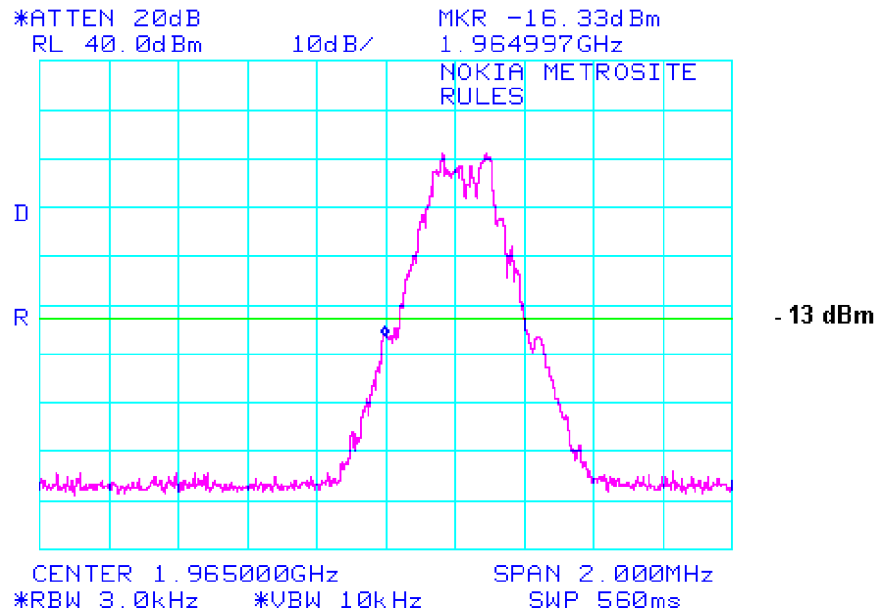
Spurious Emissions at Frequency Block edge +/- 1 MHz
Lo side of Block D
emi9574a



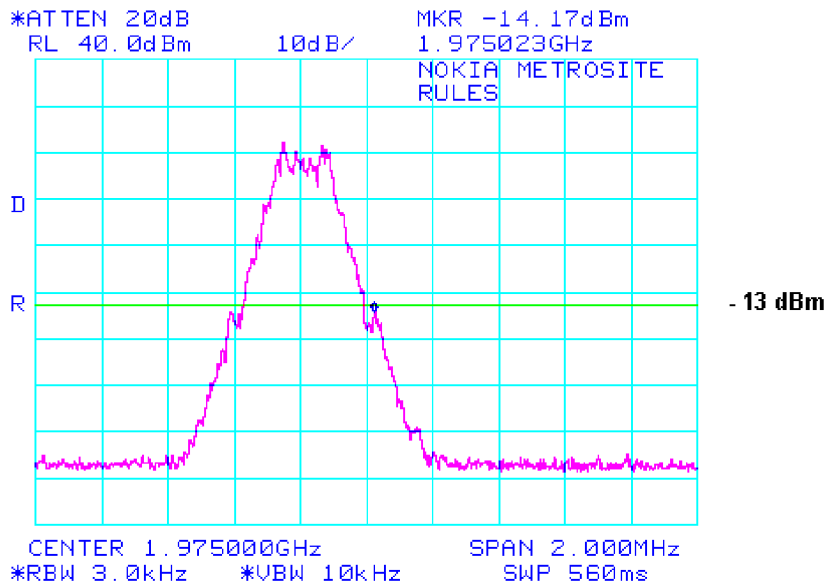
Spurious Emissions at Frequency Block edges +/- 1 MHz
Hi side of Block E
emi9574a



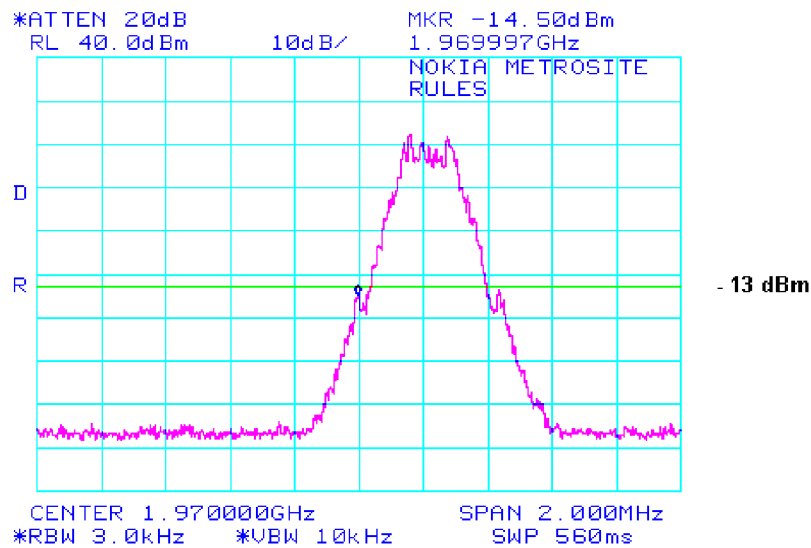
Spurious Emissions at Frequency Block edges +/- 1 MHz
Lo side of Block E
emi9574a



Spurious Emissions at Frequency Block edges +/- 1 MHz
Hi side of Block F
emi9574a



Spurious Emissions at Frequency Block edges +/- 1 MHz
Lo side of Block F
emi9574a



6.6 TEST TYPE: Frequency Stability over Temperature Variations**6.6.1 TECHNICAL SPECIFICATION: 2.1055(a)(1)****6.6.2 TEST DATE(S):** 20 Aug. 1999**6.6.3 MEASUREMENT PROCEDURES:**

As required by §2.1055(a)(1) of CFR 47, *frequency tolerance measurements* were made over the temperature range of -30°C to +50°C. The frequency measurements were made using direct input to a spectrum analyzer. Climatic control was accomplished using an environmental simulation chamber. The temperature was first lowered to -30°C and then raised hourly in 10° increments. The unit remained in the chamber during temperature transitions and during the measurement process.

6.6.4 Carrier Frequency Limits

CARRIER FREQUENCY TOLERANCE LIMIT

Channel 661 Carrier Frequency (GHz)	Deviation Limit= $\pm 0.005\%$ (kHz)	Carrier Frequency Limit (GHz)
1.960	- 98 (- 0.005%)	1.9599902
1.960	+ 98 (+ 0.005%)	1.9600098

6.6.5 Results:

Frequency tolerance of carrier signal: +/- 0.005% for a temperature variation from - 30°C to + 50°C at normal supply voltage.

CARRIER FREQUENCY DEVIATIONS DUE TO TEMPERATURE INSTABILITY

Temperature (°C)	Carrier Frequency (CH 661) (GHz)	Frequency Deviation (Hz)	Deviation Limit (kHz)
-30	1.960000	0	± 98
-20	1.960000	0	± 98
-10	1.960000	0	± 98
0	1.960000	0	± 98
+10	1.960000	0	± 98
+20	1.960000	0	± 98
+30	1.960000	0	± 98
+40	1.960000	+ 30	± 98
+50	1.960000	- 50	± 98

The unit meets the requirements of 2.1055 (a)(1)

6.7 TEST TYPE: Frequency Stability over Voltage Variations**6.7.1 TECHNICAL SPECIFICATION:** 2.1055(d)(1)**6.7.2 TEST DATE(S):** 19 Aug 1999**6.7.3 MEASUREMENT PROCEDURES:**

As required by §2.1055(d)(1) of CFR 47, *frequency tolerance measurements* were made over changes in the supply voltage to the EUT from 85% to 115% of the nominal supply voltage using a variac to vary the AC supply. The frequency measurements were made using direct input to a spectrum analyzer.

6.7.4 Carrier Frequency Limits

CARRIER FREQUENCY TOLERANCE LIMIT

Channel 661 Carrier Frequency (GHz)	Deviation Limit= $\pm 0.005\%$ (kHz)	Carrier Frequency Limit (GHz)
1.960	- 98 (- 0.005%)	1.9599902
1.960	+ 98 (+ 0.005%)	1.9600098

6.7.5 Results:

Frequency tolerance of carrier signal: $\pm 0.005\%$ for a variation in primary voltage from 85% to 115% of the **rated supply**.

Percentage of Rated Supply	AC Voltage (VAC @ 60 Hz)	Carrier Frequency (GHz)	Deviation (Hz)	Deviation Limit (kHz)
85 %	97.75	1.960	0	± 98
100 %	115	1.960	0	± 98
115 %	132.25	1.960	0	± 98

The unit meets the requirements of 2.1055 (d)(1)

Photograph of Antenna Conducted
Spurious Emissions Test Configuration



6.8 TEST TYPE: Line Conducted Emissions

6.8.1 TECHNICAL SPECIFICATION: 15.107(b)

6.8.2 TEST DATE(S): 19 Aug. 1999

6.8.3 MEASUREMENT PROCEDURES:

The measurements were performed over the frequency range of 0.45 MHz to 30 MHz using a 50 Ω /50 μ H LISN as the input transducer to an EMI/Field Intensity Meter. The measurements were made with the detector set for "peak", "quasi-peak", and "average" amplitude within an IF bandwidth of 9 kHz. The tests were conducted in a RF-shielded enclosure.

6.8.4 RESULTS:

Equipment complies with Section 15.107(b)

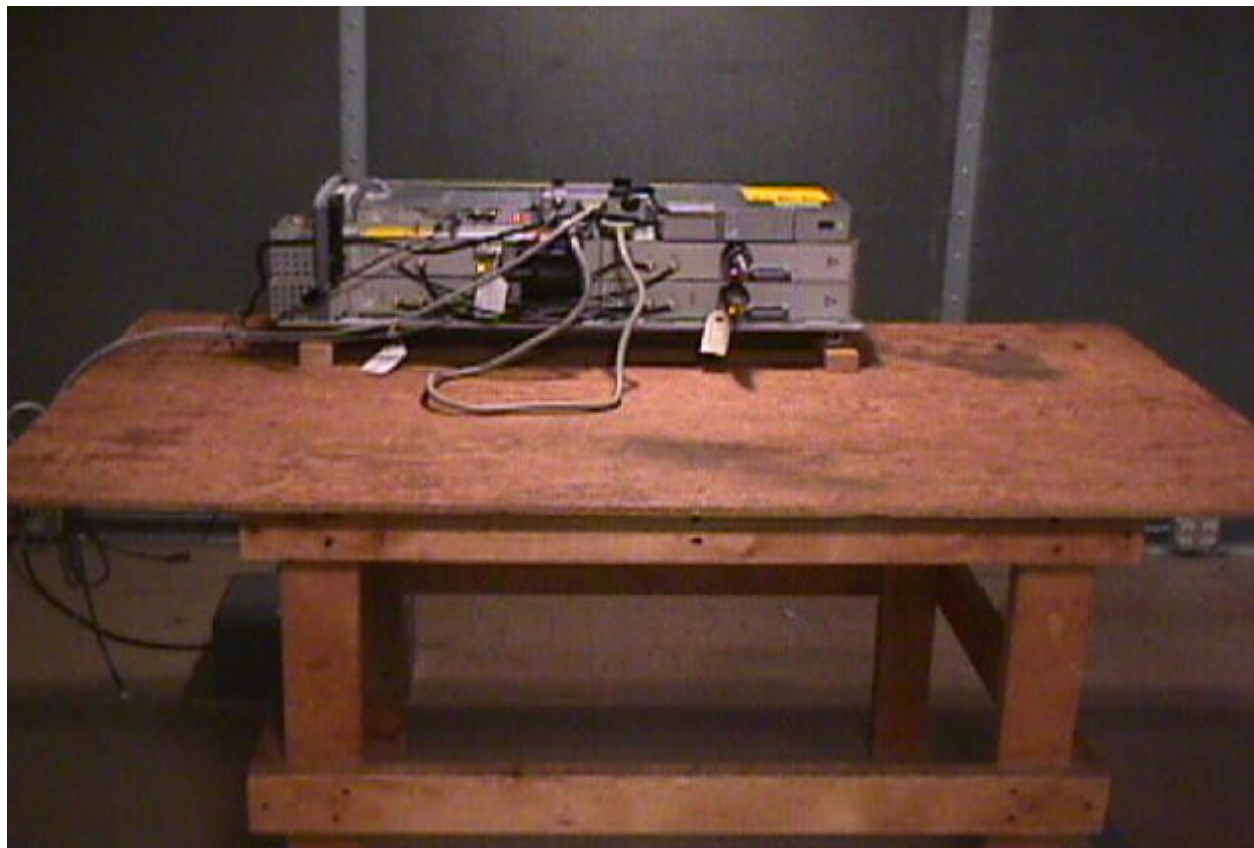
SUMMARY OF SPURIOUS EMISSIONS AT AC Mains Terminals - Phase

Frequency (MHz)	Emission Quasi-Peak Level (dBuV)	Limit (dBuV)
0.45	31.1	69.0
7.02	37.7	69.0
29.5	18.2	69.0

SUMMARY OF SPURIOUS EMISSIONS AT AC Mains Terminals - Neutral

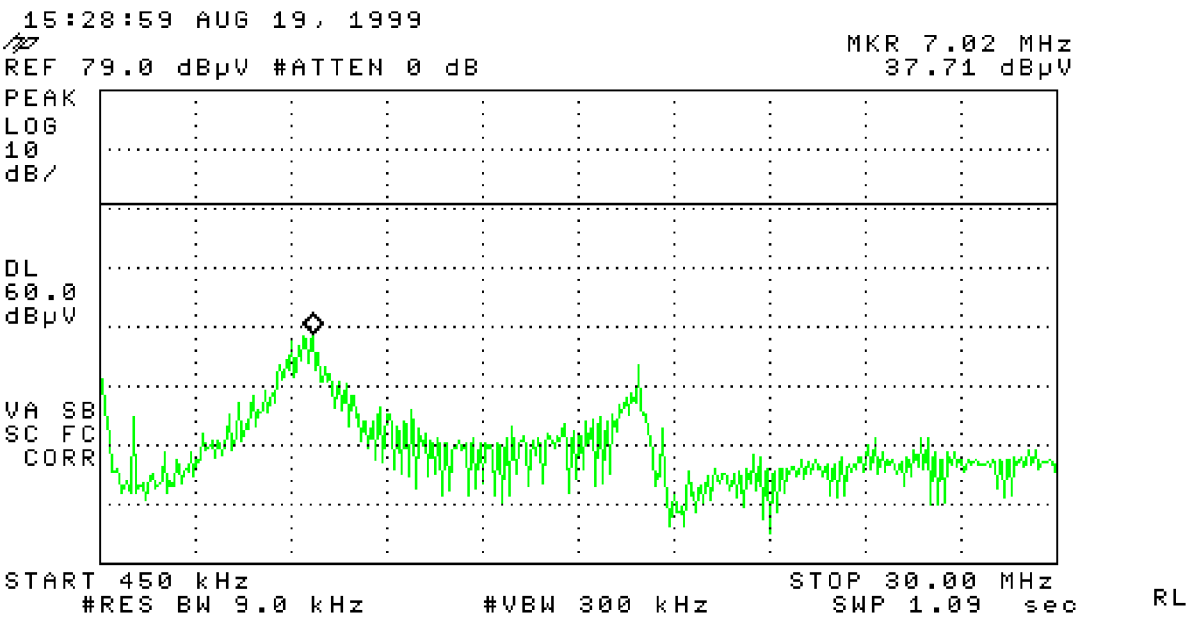
Frequency (MHz)	Emission Quasi-Peak Level (dBuV)	Limit (dBuV)
0.45	30.8	69.0
7.02	25.7	69.0
29.5	18.8	69.0

The following plots illustrate compliance with the applicable specification.



MAXIMUM EMISSIONS TEST SETUP FOR LINE CONDUCTED EMISSIONS

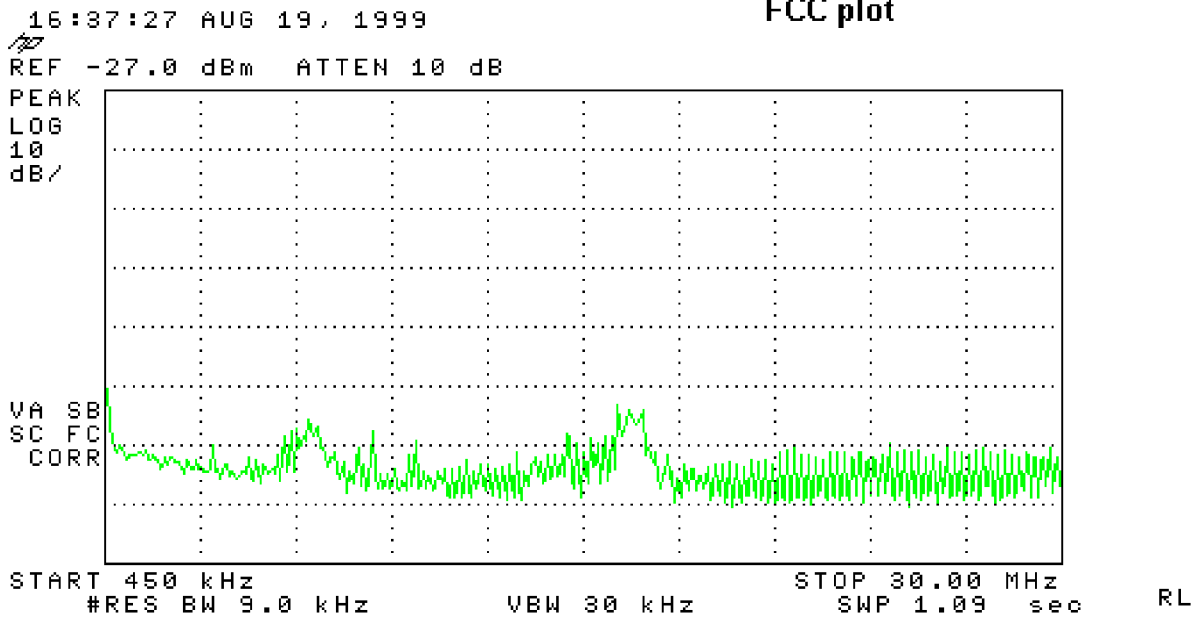
Line Conducted Emissions - Phase
emi9574



Line Conducted Emissions - Neutral
emi9574

450kHz - 30 MHz

FCC plot



6.9 TEST TYPE: Modulation Characteristics**6.9.1 TECHNICAL SPECIFICATION:** 2.1047(a)**6.9.2 TEST DATE(S):** 20 Aug. 1999**6.9.3 MEASUREMENTS REQUIRED:**

The Metrosite 1900 PCS Transmitter uses GMSK modulation. In GMSK modulation, voice information is digitized and coded into a bit stream. The bits are conveyed through precise phase changes in the carrier. Section 2.1047 (a) states, "A curve of equivalent data showing the frequency response of the audio modulating circuit over a range of 100 Hz to 5000 Hz shall be submitted..."

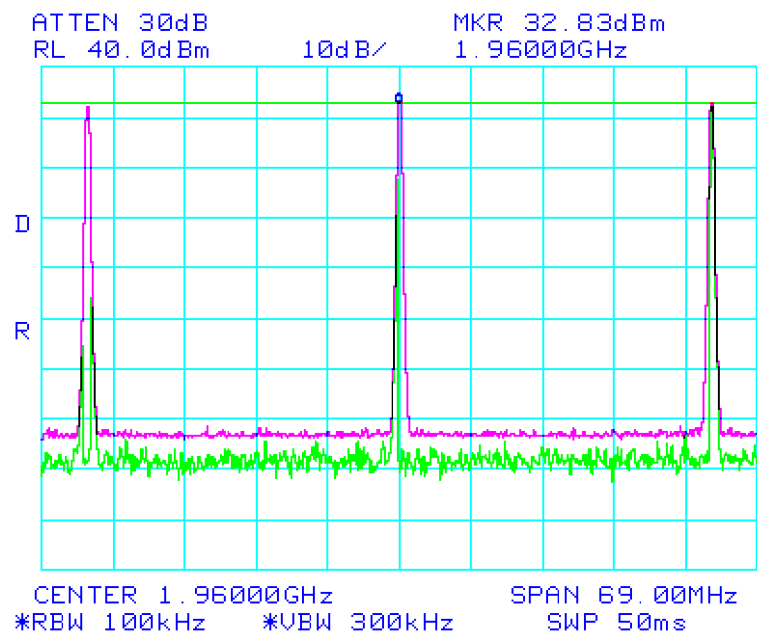
The following plots give a detailed explanation of the modulation scheme used in the Transmitters of the PCS system.



TEST SETUP FOR MODULATION CHARACTERISTICS

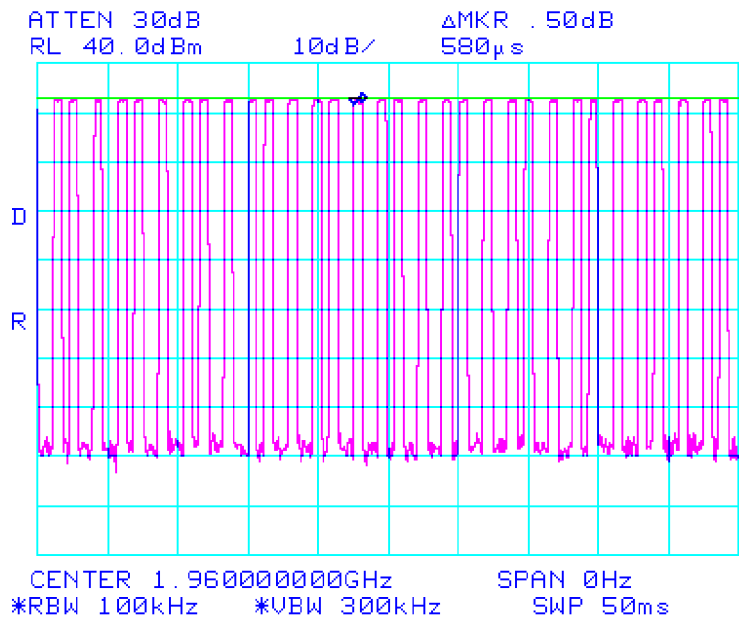
Modulation Characteristics - Sec. 2.987
Frequency Hopping

emi9574



Modulation Characteristics
Frequency Hopping w/3 time slots active
single channel

emi9574a



Modulation Characteristics
Frequency Hopping w/3 timeslots
emi9574a

