

October 8, 2001

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

Attention: Applications Examiner

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

Equipment: Nokia UltraSite EDGE 1900 MHz Base Station Transceiver Module  
FCC ID: L7KTSPB-01

Specification: for a 47 CFR 24 Licensed Certification

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Dear Examiner:

The following application for Grant of Equipment Authorization is presented on behalf of Nokia Inc. dba Nokia Networks for the Licensed Certification of their Model: UltraSite EDGE 1900MHz Base Station (BTS) Transceiver Module.

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 Station (BTS) Transceiver Module.

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

Sincerely,

A handwritten signature in blue ink, appearing to read "Chris Harvey".

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:** Nokia UltraSite EDGE 1900 MHz Base Station

**FCC ID:** L7KTSPB-01

**Specification:** 47 CFR 24

**On Behalf of the Applicant:** Nokia Inc. dba Nokia Networks  
6000 Connection Drive  
Irving, TX 75039

**Manufacturer:** Nokia Inc. dba Nokia Networks  
6000 Connection Drive  
Irving, TX 75039

**Manufacturer's Representative** Mr. Steve Mitchell

**Test Date(s):** 14-20 Aug. 2001

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## 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.



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Liming Xu  
EMC Engineer, MET Laboratories

### Summary of Test Results

These tests were conducted on a sample of the equipment for the purpose of demonstrating compliance with Part 24, of 47 CFR. All tests were conducted using measurement procedure ANSI C63.4-1992.

Type of Submission/Rule Part:	Original Filing/Part 24
EUT:	Nokia Networks Ultrasite EDGE BTS Transceiver Module
FCC ID:	L7KTSPB-01
Type of Emissions:	343KGXW (GMSK) 333KGXW (8PSK)
RF Power output:	GMSK :1.5 Watts at lowest channel of PCS band 1.4 Watts at highest channel of PCS band 37.0 Watts at all other channels 8PSK 5.0Watts at lowest channel of PCS band 2.8 Watts at highest channel of PCS band 45.0Watts at all other channels
Frequency Range (MHz):	1850-1910 receive and 1930-1990 Transmit (1930.2-1989.8)
Frequency Stability:	+/- 20 Hz

### Summary of Test Data

Name of Test	FCC Rule Part/Section	Results
Radiated Spurious Emissions	2.1053; 24.238(a)	Complies
Occupied Bandwidth	2.1049	Complies
RF Power Output	2.1046; 24.232(a),(c)	Complies
Spurious Emissions at Antenna Terminals	2.1051; 24.238(a)	Complies
Spurious Emissions at Antenna Terminals Frequency Block Edges	2.1051; 24.238(b)	Complies
Frequency Stability over temperature variations	2.1055(a)(1)	Complies
Frequency Stability over supply Voltage variations	2.1055(d)(1)	Complies
Modulation Characteristics	2.1047(a)	Complies

**1.0 INTRODUCTION**

The following data is presented on behalf of the Applicant, Nokia Inc. dba Nokia Networks, as verification of the compliance of the Nokia Base Station (BTS) Transceiver Module, UltraSite EDGE 1900 MHz 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 semi-anechoic chamber (Equivalent to an 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	9/14/02	annual
EMCO	Biconical Antenna 3104	3/21/02	annual
EMCO	EMCO Log Periodic Antenna	11/01/01	annual
EMCO	Double Ridge Guided Horn	2/27/02	annual
Hewlett Packard	8594EM Analyzer	1/8/02	annual

**4.0 EQUIPMENT UNDER TEST CONFIGURATION**

The Base Station (BTS) Transceiver Module was configured with AC/DC power supply modules and an external PC to program the EUT to output a 8-PSK/GMSK Modulation type PCS 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), ©
- 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 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. 2001**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 in a 3 meter semi-anechoic chamber (equivalent to an Open Area Test Site). The unit was scanned over the frequency range of the lowest system oscillator value to 20 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 45 watts:

$$P_o = 45 \text{ W}$$

the radiated power level of all spurious emissions must be attenuated by at least  $43 + 10\log(P_o)$  below  $P_o$ , yielding:

$$P_o \& [43 + 10\log(45)] \text{ ' } \& 13\text{dBm}$$

**6.1.4 RESULTS:**

All of the measurable radiated emissions are related to the digital device portion of the EUT, and thus are compared to the 47CFR 15 Class B field strength limit. Mathematical calculations indicate that these field strengths yield radiated power levels greater than 30 dB below the -13 dBm limit for spurious emissions from the transmitter portion of the EUT calculated above. There were no observable radiated emissions from the transmitter portion of the EUT.

The Spurious Radiated Emissions were measured from 1GHz to 20GHz for the Transceiver Module installed into configurations 1 through 6. There were no detectable spurious emissions in that frequency range. The following is a summary of the differences of each of the configurations:

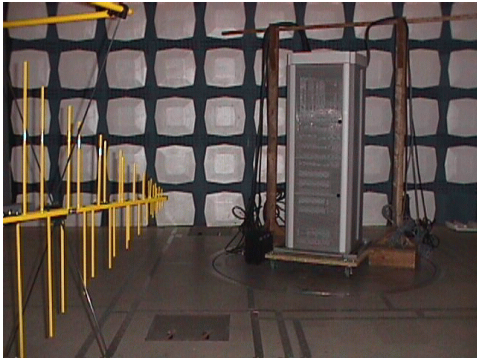
Configuration 1: Outdoor Enclosure IBBU with AC power  
 Configuration 2: Indoor Enclosure IBBU AC power  
 Configuration 3: Indoor Full Enclosure, 24VDC power  
 Configuration 5: Indoor Midi Enclosure, -48VDC power  
 Configuration 6: Outdoor Midi Enclosure, 24VDC power

note: there was no configuration 4 tested in this test program.

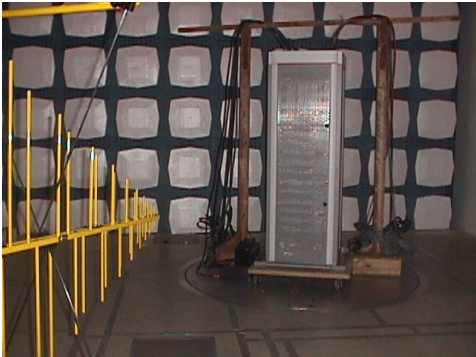
Photograph of Radiated Emissions  
Test Configuration



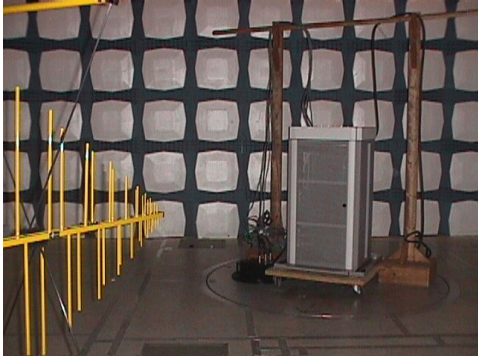
Config. 1



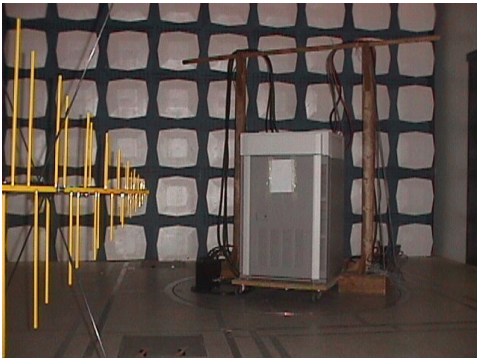
Config. 2



Config. 3



Config. 5



Config. 6

6.2 TEST TYPE: Occupied Bandwidth

6.2.1 TECHNICAL SPECIFICATION: 47CFR2.1049

6.2.2 TEST DATE(S): 14 Aug. 2001

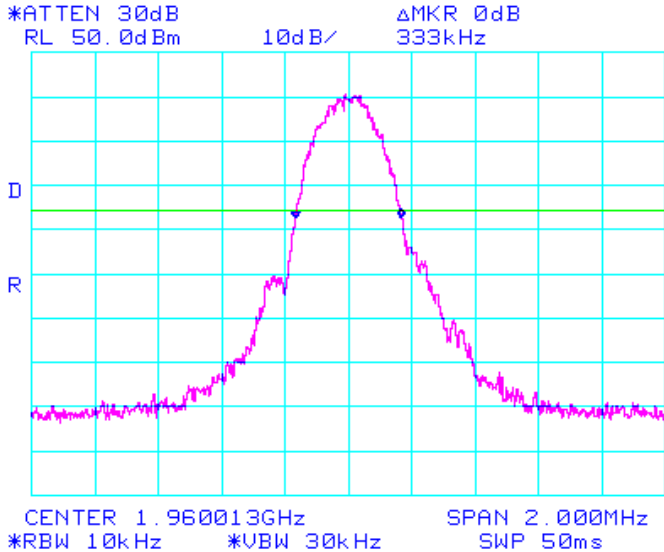
6.2.3 MEASUREMENT PROCEDURES:

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 a PCS GSMK or 8-PSK modulated carrier signal. Using a bandwidth of 10KHz, we determined the occupied bandwidth of the emission at the center of the selectable channel range.

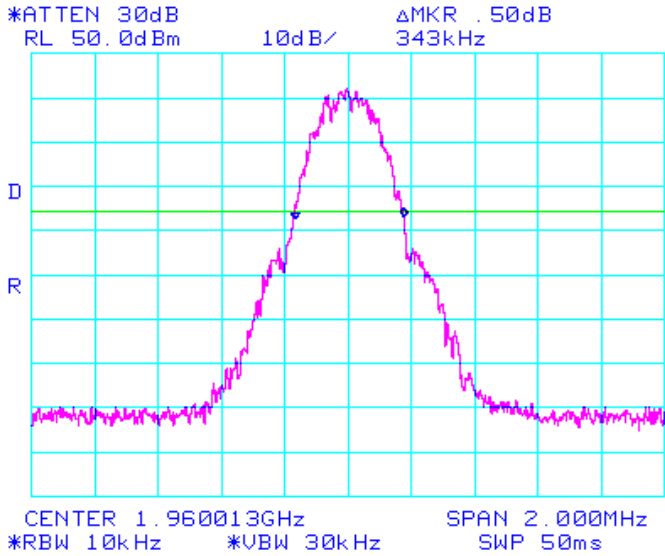
6.2.4 RESULTS:

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

Occupied B/W 8PSK; PL-16, ARFCN 661 Met11107



Occupied B/W GMSK; PL-0, ARFCN 661 Met11107





**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):** 14-15 Aug. 2001

**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 a GMSK or 8-PSK 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 .

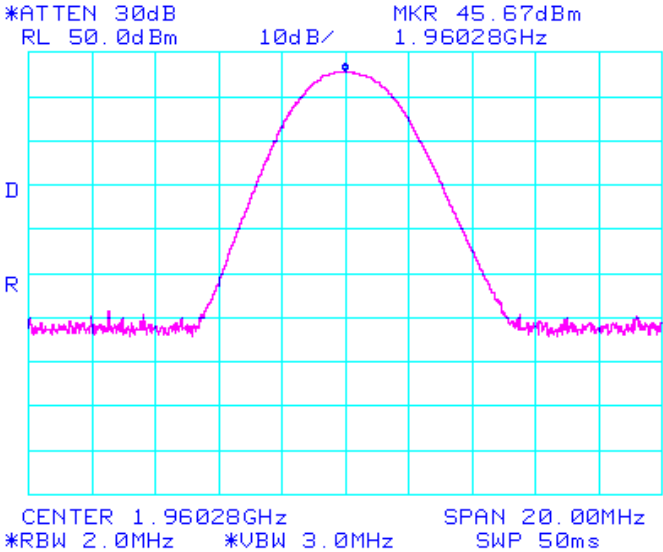
**6.3.4 RESULTS:**

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

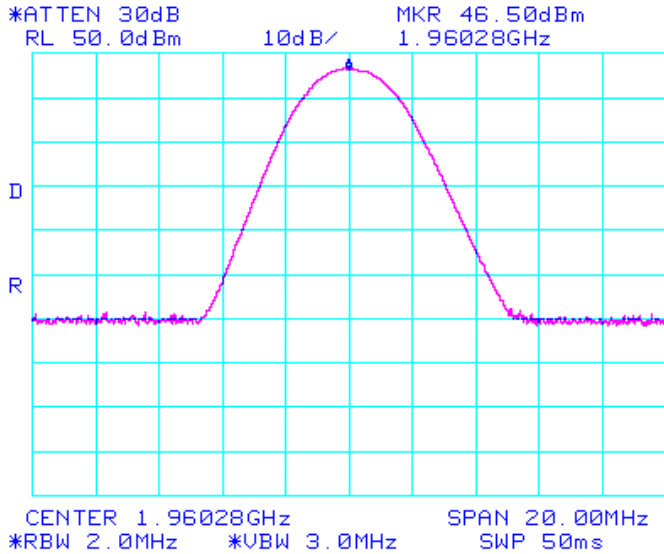
The following pages show measurements of RF Power output which is summarized below:

GMSK :	1.5 Watts at lowest channel of PCS band
	1.4 Watts at highest channel of PCS band
	37.0 Watts at all other channels
8PSK:	5.0Watts at lowest channel of PCS band
	2.8 Watts at highest channel of PCS band
	45.0Watts at all other channels

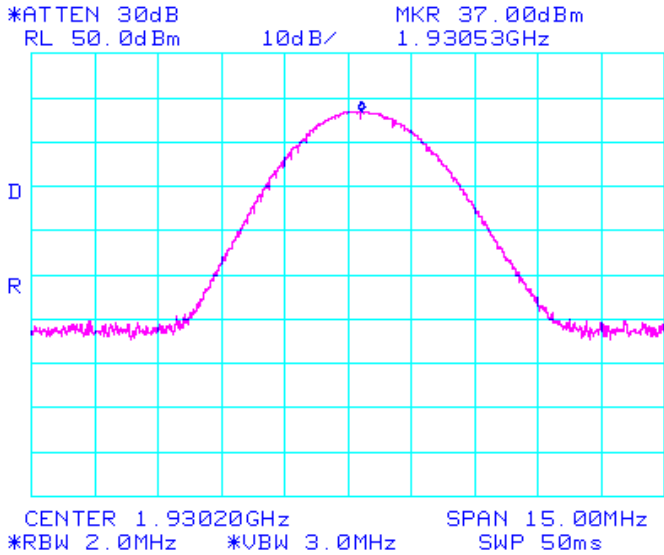
RF power output at antenna port GMSK; PL-0, ARFCN 661 Met11107



RF power output at antenna port 8PSK; PL-16, ARFCN 661 Met11107

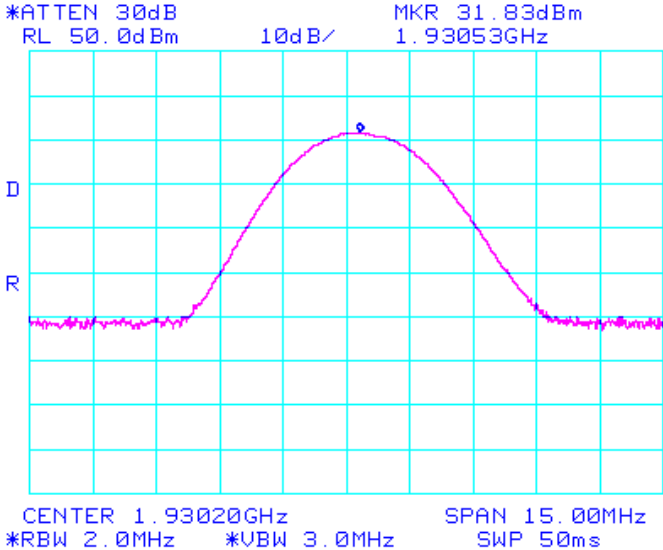


RF power at Low side of block A 8PSK PL-22 Met11107

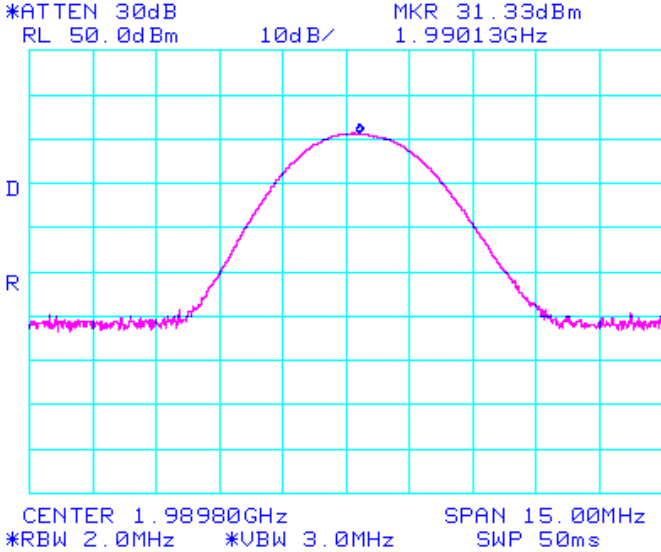




RF power at Low side of block A GMSK; PL-7 Met11107



RF power at High side of block C GMSK; PL-7 Met11102



**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):** 14-15 Aug. 2001

**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 S attenuator and spectrum analyzer set for a 100 kHz bandwidth. This test was performed with Digitally modulated carrier signals. The EUT was adjusted for continuous transmission on frequencies across the operating band. The frequency spectrum was investigated from 9.0 KHz to 20.0 GHz.

**6.4.4 RESULTS:**

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

Frequency Range	Emission Frequency	Emission Level (dBm)	Limit (dBm)
9 kHz - 2.9 GHz	none	none	-13.1
2.9 GHz - 8.0 GHz	6.725 GHz	-16.17	-13.1
8.0 GHz - 14.0 GHz	none	none	-13.1
14.0 GHz - 20.0 GHz	none	none	-13.1

Equipment complies with Section 2.1051 and 24.238(a). Note, the signal at approximately 1960 MHz is the carrier signal and not a spurious emission. Spurious emissions for both GMSK and 8PSK modulation types were measured. Data contained in this report represents the worst case, which was for GMSK modulation.











**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):** 15 Aug. 2001

**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 3 KHz RBW. The unit was exercised using signal types required by §2.1049.

**6.5.4 Results:**

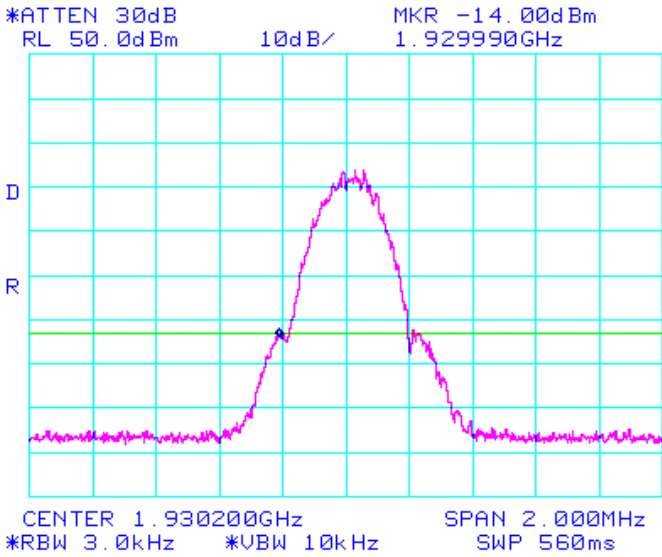
Modulation products outside of this band are attenuated at least  $43 + 10 \text{ Log (P)}$  below the level of the modulated carrier. A Plot of the spurious emissions at +/- 1 MHz around the transmit frequency, as measured at the antenna port, appears on the following page.

SPURIOUS EMISSION FREQUENCY BLOCKS

Frequency Block (MHz)	Low Frequency (CH #)	Hi Frequency (CH #)
A (1930 - 1945)	512 (1930.2)	585 (1944.8)
B (1950 - 1965)	612 (1950.2)	685 (1964.8)
C (1975 - 1990)	737 (1975.2)	810 (1989.8)
D (1945 - 1950)	587 (1945.2)	610 (1949.8)
E (1965 - 1970)	687 (1965.2)	710 (1969.8)
F (1970 - 1975)	712 (1970.2)	735 (1974.8)

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

Spur emission at frequency block edges Low side of Block A GMSK; PL-7  
ARFCN 512 Met 11107

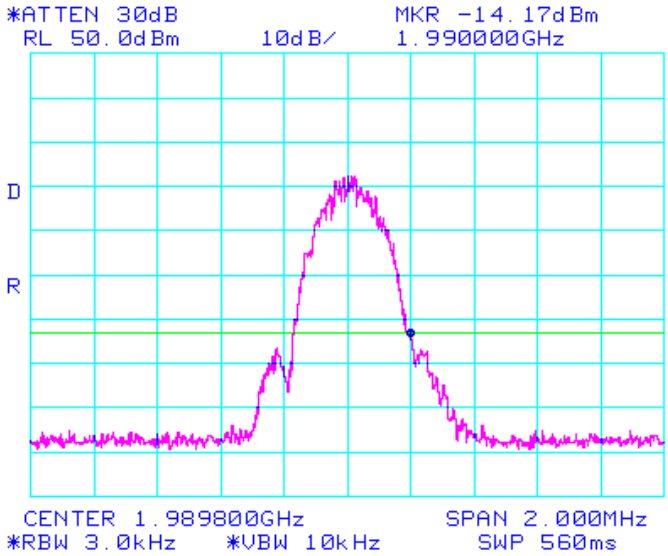








Spur emissions at frequency block edge 8PSK; High side of block C  
PL-23, ARFCN 810 Met11107



**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. 2001

**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 -30EC to +50EC. 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 -30EC and then raised hourly in 10E increments. The unit remained in the chamber during temperature transitions and during the measurement process.

**6.6.5 Results:**

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

**CARRIER FREQUENCY DEVIATIONS DUE TO TEMPERATURE INSTABILITY**

Temperature (EC)	Carrier Frequency (CH 661) (GHz)	Frequency Deviation (Hz)	Deviation Limit (Hz)
-30	1.95993235	40	± 98
-20	1.95993237	20	± 98
-10	1.95993237	20	± 98
0	1.95993239	0	± 98
+10	1.95993239	0	± 98
+20	1.95993239	0	± 98
+30	1.95993239	0	± 98
+40	1.95993239	0	± 98
+50	1.95993237	- 20	± 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):** 20 Aug 2001

**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/DC supply. The frequency measurements were made using direct input to a spectrum analyzer.

**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	DC Voltage 24V	Carrier Frequency (GHz)	Deviation (Hz)	Deviation Limit (Hz)
85 %	20.4	1.95993227	10	$\pm 98$
100 %	24	1.95993228	0	$\pm 98$
115 %	27.6	1.95993228	0	$\pm 98$

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

Percentage of Rated Supply	DC Voltage 48V	Carrier Frequency (GHz)	Deviation (Hz)	Deviation Limit (Hz)
85 %	40.8	1.95993230	0	$\pm 98$
100 %	48	1.95993230	0	$\pm 98$
115 %	55.2	1.95993230	0	$\pm 98$

Percentage of Rated Supply	AC Voltage (VAC @ 60 Hz)	Carrier Frequency (GHz)	Deviation (Hz)	Deviation Limit (Hz)
85 %	178.5	1.95993230	0	$\pm 98$
100 %	210	1.95993230	0	$\pm 98$
115 %	241.5	1.95993230	0	$\pm 98$

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

**6.9 TEST TYPE:** Modulation Characteristics

**6.9.1 TECHNICAL SPECIFICATION:** 2.1047(a)

**6.9.2 TEST DATE(S):** 15 Aug. 2001

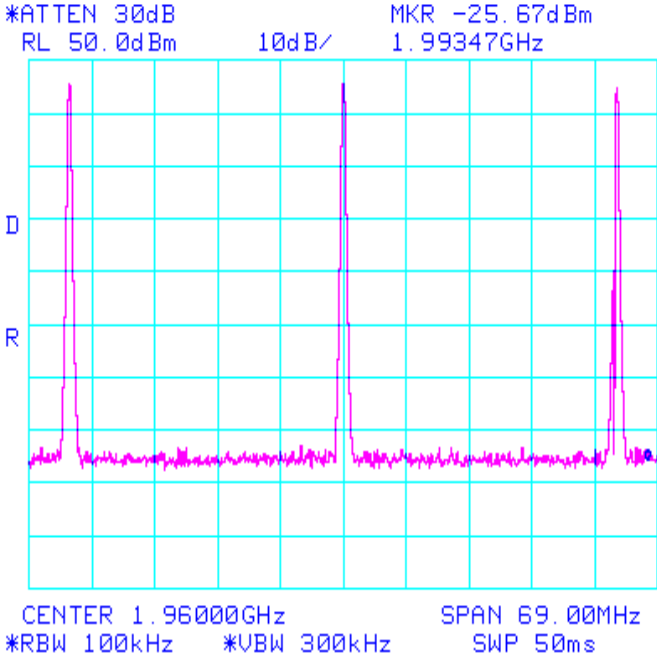
**6.9.3 MEASUREMENTS REQUIRED:**

The UltraSite 1900 PCS BTS uses GMSK or 8-PSK modulation. In GMSK/8-PSK modulation, voice or data 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..."

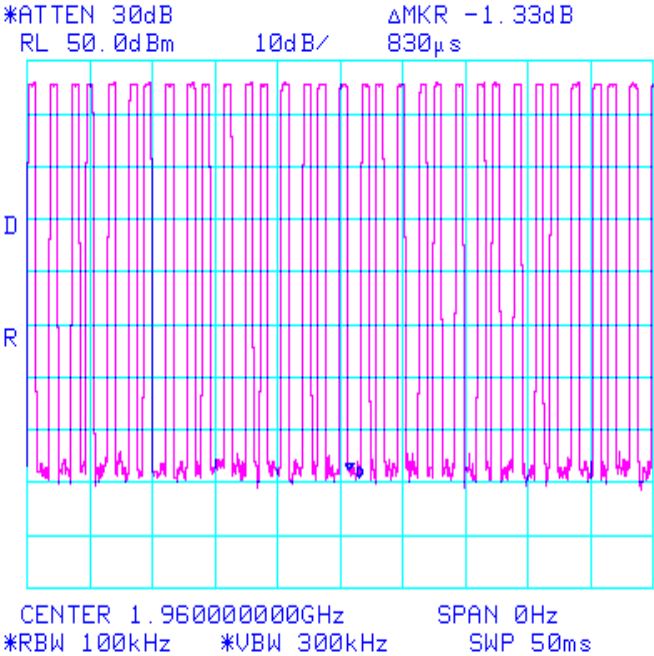
**6.9.4 RESULTS:**

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

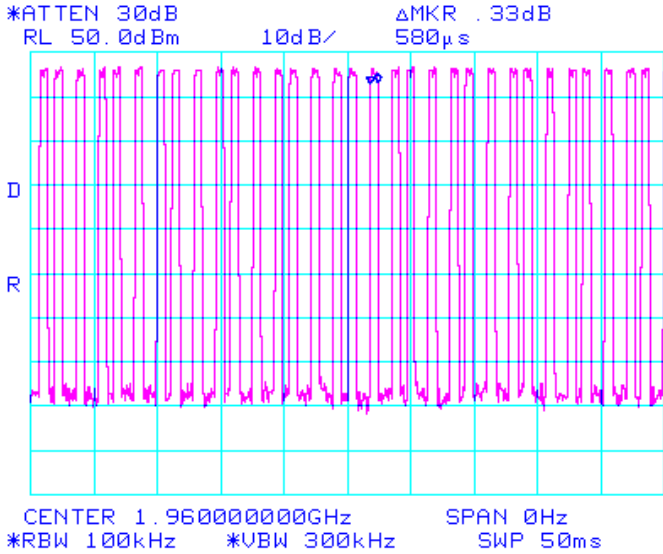
Modulation Characteristics GMSK; PL-0, ARFCN 512, 661 and 810 Met11107



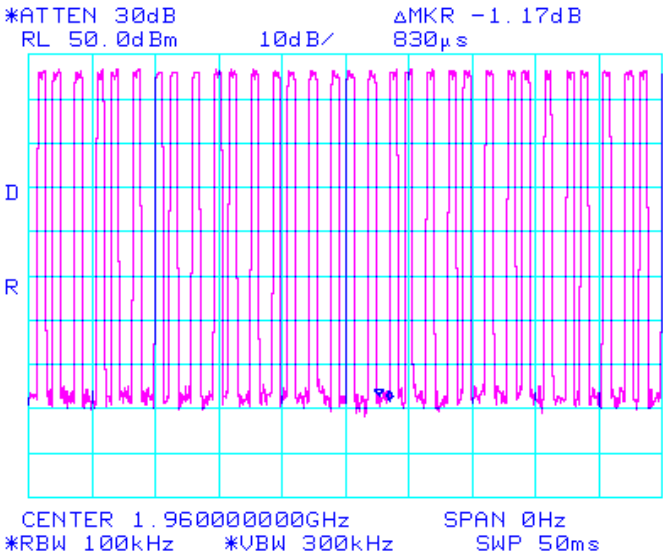
Modulation Characteristics GMSK; PL-0, ARFCN 661  
Frequency hopping w/ 3 time slots



Modulation Characteristics 8PSK; PL-16, ARFCN 661 Met11107  
Frequency hopping w/ 3 time slots



Modulation Characteristics 8PSK; PL-16, ARFCN 661 Met11107  
Frequency hopping w/ 3 time slots





Modulation Characteristics 8PSK; PL-16, ARFCN 512, 661 and 810 Met11107

