

**FCC Part 95(F) Test Report**

for  
**Gateway Communications Inc.**

on the  
**VHF Data Transceiver**  
**Model: DG200**  
**FCC ID: NAUDG200**

Test Report: 3041334  
Date of Report: April 22, 2003



A2LA Certificate Number: 1755-01

<b>Test Performed by:</b> Intertek Testing Services 1365 Adams Court Menlo Park, CA 94025	<b>Test Authorized by:</b> Gateway Communications Inc. 904 S. Park Ave., Tucson, AZ 85719
--	--



Warwick Hersey



**Prepared by:** *Sergeiy Marker* **Date:** 4/25/03  
Sergeiy Marker, EMC Manager



**Reviewed by:** *David Chernomordik* **Date:** 4/25/03  
David Chernomordik, EMC Technical Manager



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**1.0 Job Description**

1.1 Client Information

The EUT has been tested at the request of

**Company:** Gateway Communications Inc.  
904 S. Park Ave.,  
Tucson, AZ 85719

**Name of contact:** Tom Moore  
**Telephone:** (520) 882-8730  
**Fax:** (520) 624-2727

1.2 Equipment under test (EUT)

**Equipment type:** VHF Data Transceiver

**Model number(s):** DG200

**Part or serial number:** 000001

**Manufacturer:** SAME as above.

**Use of Product:** Data Transceiver, RTU in the 218-219 MHz Service.

**Production is planned:**  Yes,  No

**Technical Specifications:**

Tx/Rx range	218.0125 to 218.4875 MHz- Seg.A 218.5125 to 218.9875 MHz-Seg.B
Modulation Type(M)	GFSK (BT = .3)
Deviation (D)	+/-3 kHz
Channel Spacing	12.5 kHz
Number of Channels	78 (39 in each segment A & B)
Frequency Stability	+/- 2.5 ppm (-30 to +80°C)
Data Rate	4800 bps synchronous
Tx Power (ERP)	0.5 to 4.0 W (27 dBm to 36 dBm with 3 dBm steps)
Antenna connector	Mini UHF
Detachable antenna ?	Yes
Power Supply	13.6 VDC @ 1.8 A max
RS-232 connector	DB-9 (full port), Modular connector (3 wire)

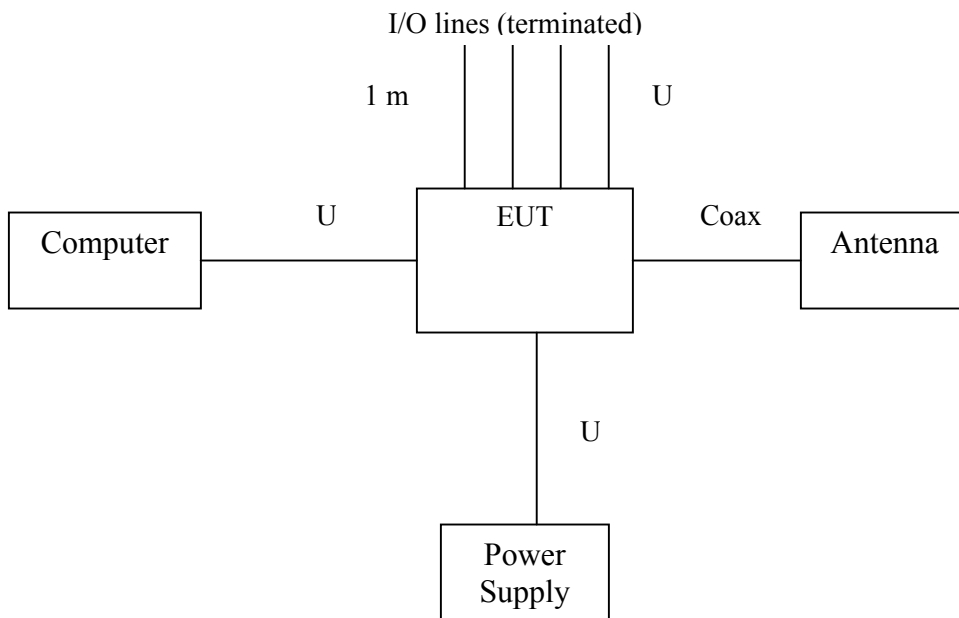
**EUT receive date:** 4/14/03  
**EUT received condition:** Good condition prototype  
**Test start date:** 4/14/03  
**Test end date:** 4/16/03

1.3 Test plan reference

FCC Part 2.1033, FCC Part 95 (F)

1.4 System test configuration

1.4.1 System block diagram & Support equipment



<b>S:</b> Shielded	<b>U:</b> Unshield	<b>F:</b> With Ferrite Core
--------------------	--------------------	-----------------------------

Support equipment					
Equip. #	Equipment	Manufacturer	Model #	S/N #	FCC ID
1	Computer	Compaq	Armada	Not labeled	N/A
2	Power Supply	BK Precision	1630	14602817	N/A
3	Antenna	Not labeled	Not labeled	Not labeled	N/A

Note: A quarter-wave antenna supplied for the testing is representative of the performance of a typical vehicular mounted antenna as recommended in the installation instructions

#### 1.4.2 Justification

The system was configured for testing in a typical manner in accordance with ANSI C63.4 standard. During testing, the peripheral locations were varied with respect to the EUT.

#### 1.4.3 Mode(s) of operation

The EUT was powered and fully operational. Several frequencies and different power levels were used in accordance with a test plane.

#### 1.5 Modifications required for compliance

Intertek Testing Services implemented no modifications.

**2.0 Test Summary**

FCC RULE	DESCRIPTION OF TEST	RESULT	PAGE
2.1046	Output Power	4.0 W	8
95.855	Effective Radiated Power	4.0 W	12
2.1051 95.857(b)	Spurious and Out-of-Band Emission at Antenna Terminals	Worst case Freq.: 436.1 MHz Margin: -17.0 dB	13
2.1053 95.857(b)	Spurious Radiated Emissions	Worst case Freq.: 476.975 MHz Margin: -2.6 dB	32
15.109(a)	Radiated Emissions from digital parts and receiver	Worst case Freq.: 78.0 MHz Margin: -4.9 dB	35
2.1049	Occupied Bandwidth	8.13 kHz	38
2.1055	Frequency Stability Vs. Temperature Vs. Voltage	1.87 ppm 0.05 ppm	42
15.107(a)	AC Line conducted Emissions	N/A	

**3.0 RF POWER OUTPUT**

3.1 Test Description

Requirement:	FCC § 2.1046
Output Power:	

3.2 Test Procedure

The EUT was positioned on a non-conductive table, 0.8m above the floor. The output power at the middle frequencies of each frequency segments was measured at antenna terminals with a 10 dB attenuator and spectrum analyzer. During the measurement, the resolution and video bandwidth of the spectrum analyzer were set to 300 and 100 kHz respectively.

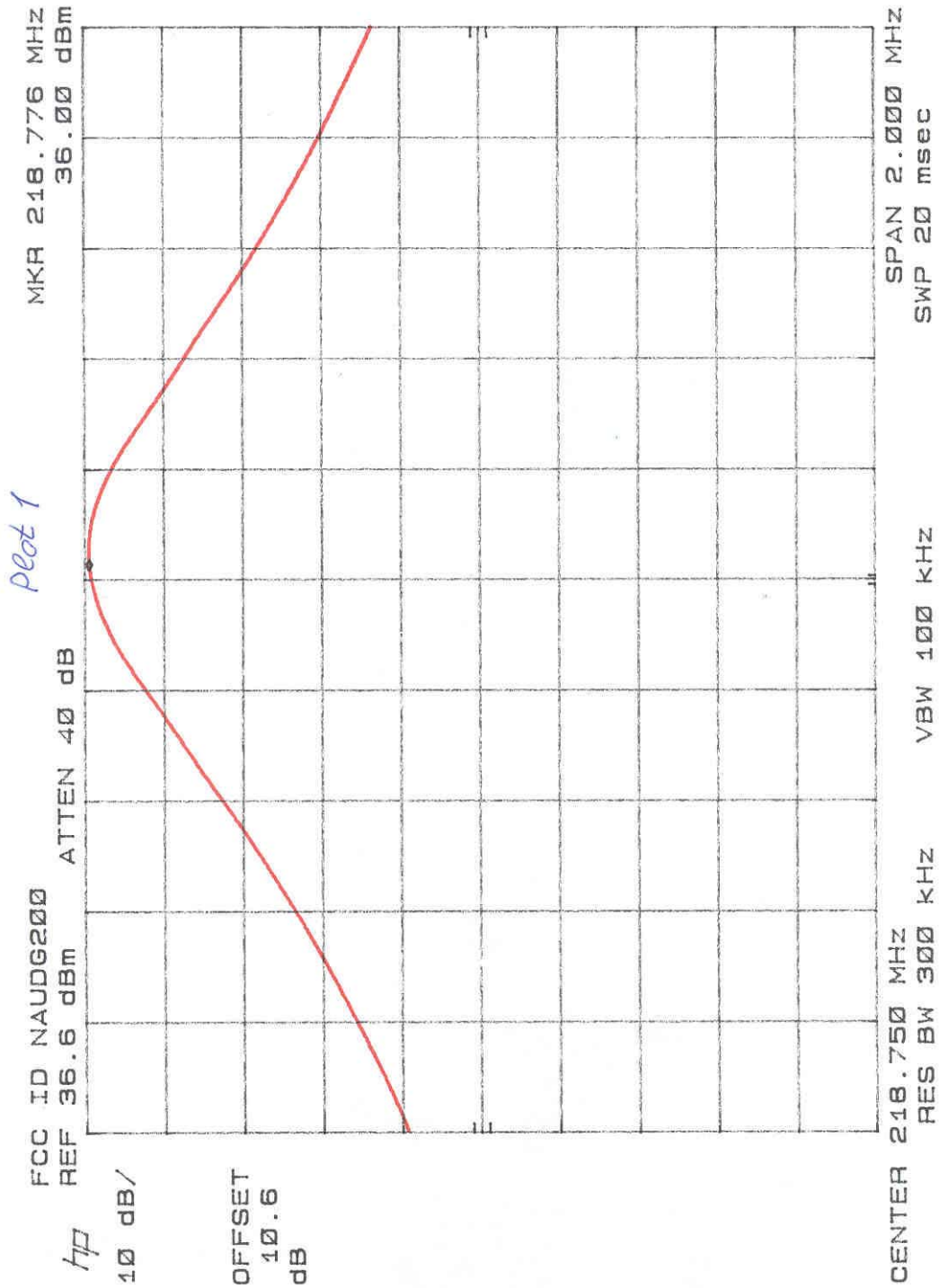
3.3 Test Results

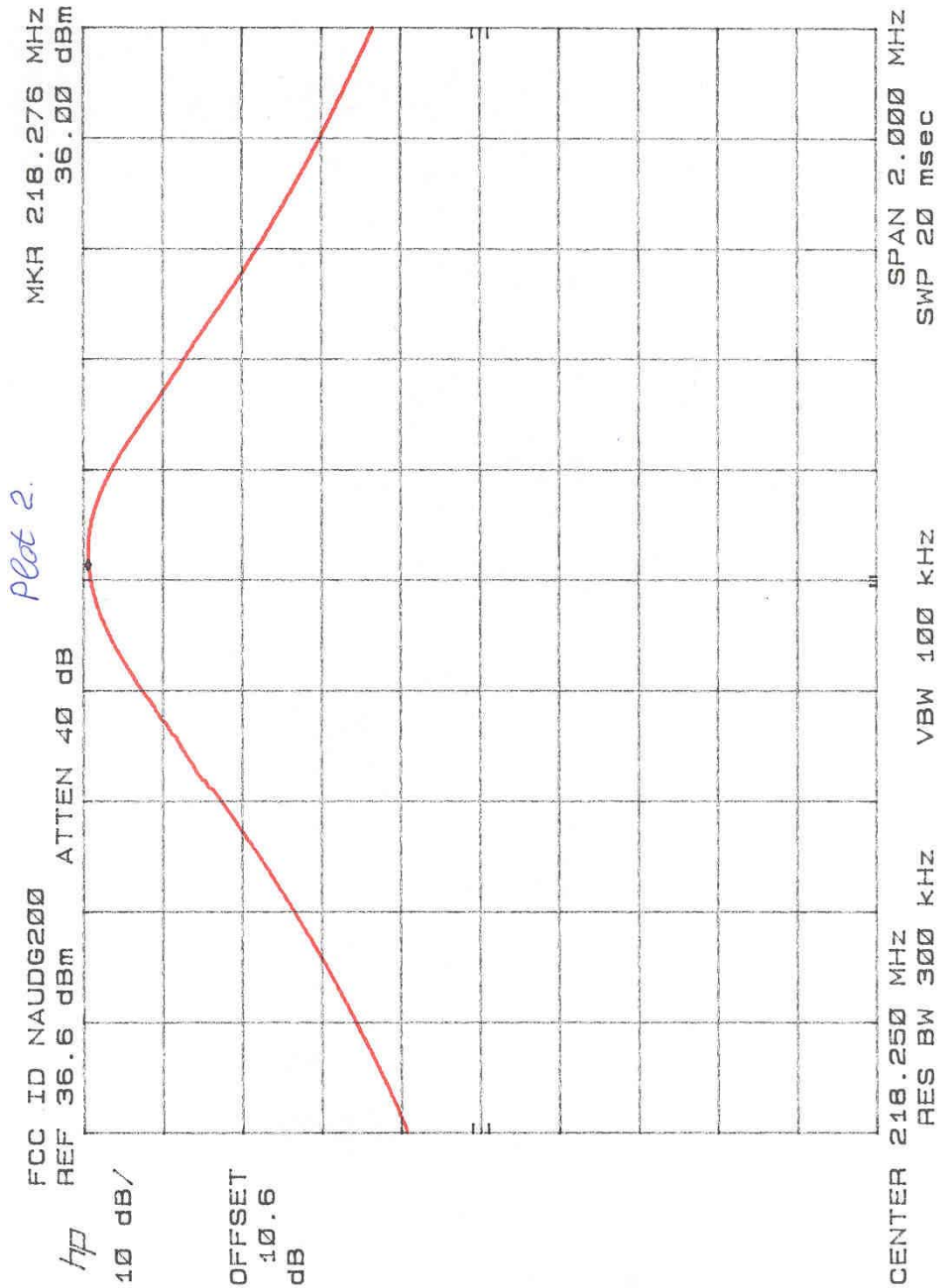
<i>Test Conditions:</i>	<i>Offset = 10.6 dB</i>		<i>Test Result</i>
<b>Frequency</b>	<b>Attenuator</b>	<b>Cable Loss</b>	<b>Output Power Reading</b>
<b>MHz</b>	<b>dB</b>	<b>dB</b>	<b>dBm</b>
218.250	10.2	0.4	36.0
218.750	10.2	0.4	36.0

*Note: Reading of SA includes 10.6 dB Offset(Attenuator + Cable loss)*

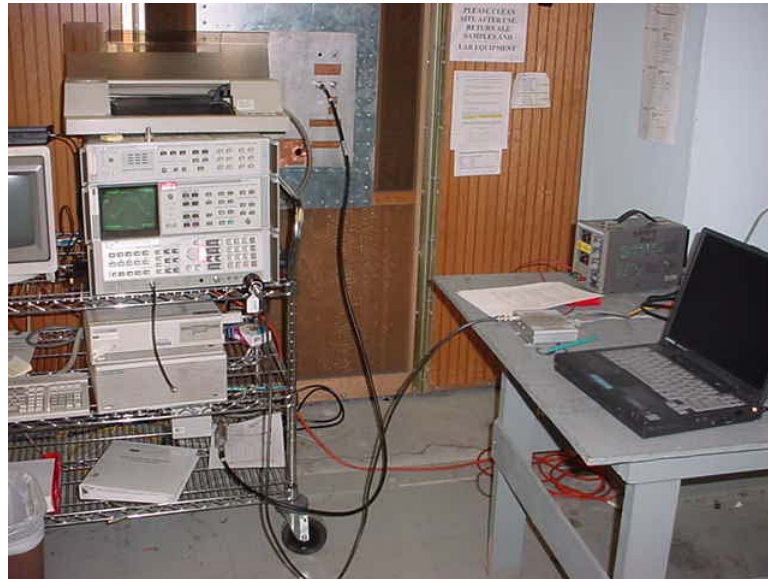
Plots on the following two pages show the peak measurement scan made at the middle of frequency segments A & B







3.5 Test Configuration Photograph



#### 4.0 EFFECTIVE RADIATED POWER

##### 4.1 Test Description

<b>Requirement:</b>	FCC § 95.855
<b>Effective Radiated Power (ERP):</b>	=< 4.0 watts (36 dBm)

##### 4.2 Test Procedure

The ERP was calculated using equation:

$$\text{ERP}_{\text{dBm}} = P_{\text{dBm}} + G_{\text{dBd}}$$

Where: P = Output Power  
G = Antenna Gain

##### 4.3 Test Results

Transceiver output power is 4 watts. FCC § 95.855 limit for ERP of mobile RTU is 4 watts. Therefore, the maximum antenna gain allowed is 0 dBd.

**5.0 SPURIOUS AND OUT-OF-BAND EMISSIONS AT ANTENNA TERMINAL**

5.1 Test Description

<b>Requirement:</b>	FCC § 2.1051 & §95.857(b)
<b>Spurious and out of band emission at antenna terminals</b>	1). 0 dB within authorized frequency segment 2). 28 dB on frequency removed from midpoint of the assigned frequency segment by more than 250 kHz up to and including 750 kHz. 3). 35 dB on frequency removed from midpoint of the assigned frequency segment by more than 750 kHz up to and including 1250 kHz. 4). $43 + 10\log P(W)$ on frequency removed from midpoint of the assigned frequency segment by more than 1250 kHz.

5.2 Test Procedure

The EUT was positioned on a non-conductive table, 0.8m above the floor.

The measurements of unnecessary radiation are performed using the lowest and highest frequencies of each frequency segments with a 10 dB attenuator and spectrum analyzer. During the measurement, the resolution and video bandwidth of the spectrum analyzer were set as follows:

1. 100 Hz for measuring emissions up to and including 250 kHz from the edge the authorized frequency segment.
2. 10 kHz for measuring emission more than 250 kHz from the edge of authorized frequency segment
3. Video bandwidth shall not be less than Resolution bandwidth

5.3 Test Results

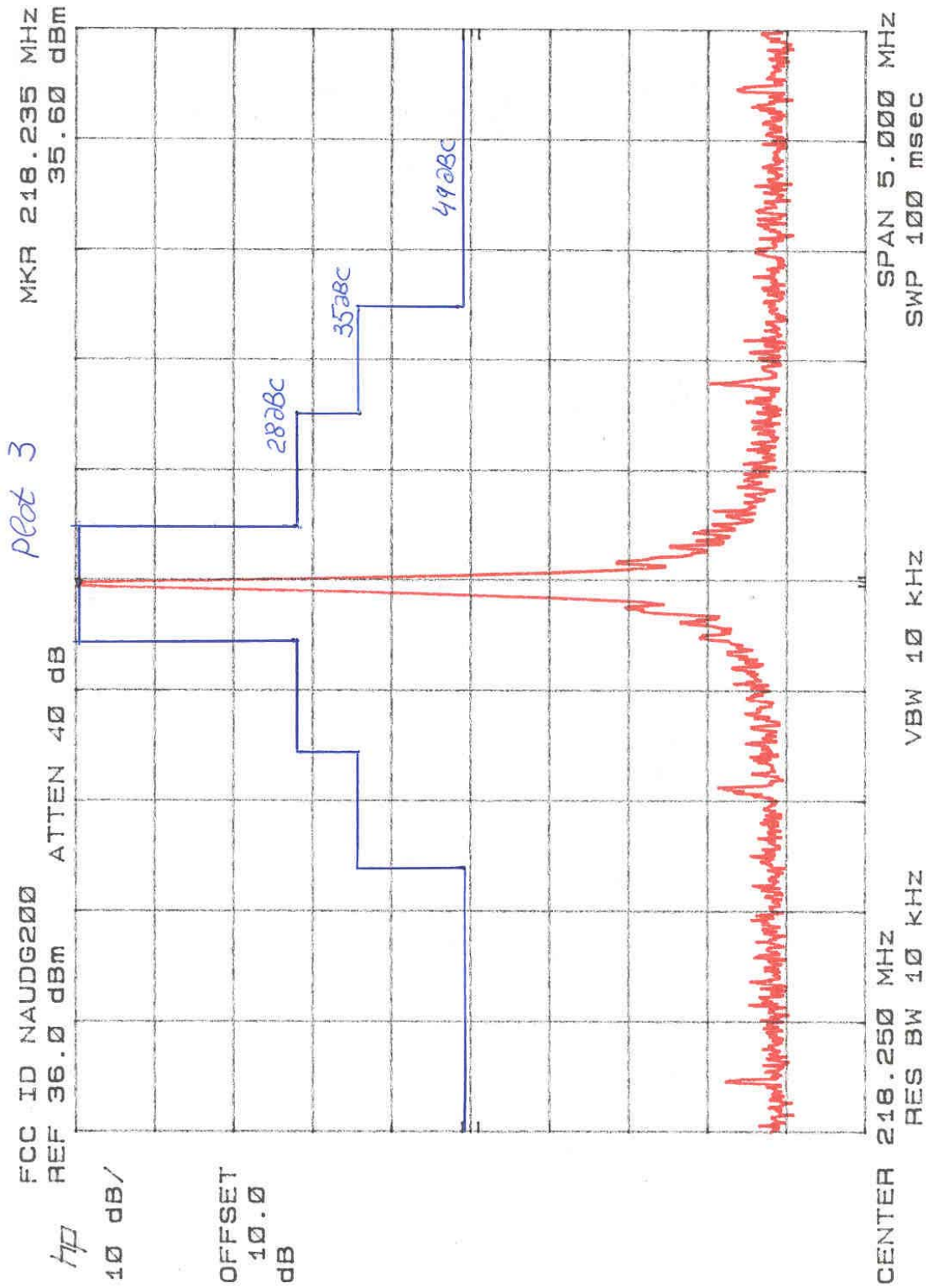
Maximum Power Level = 36 dBm

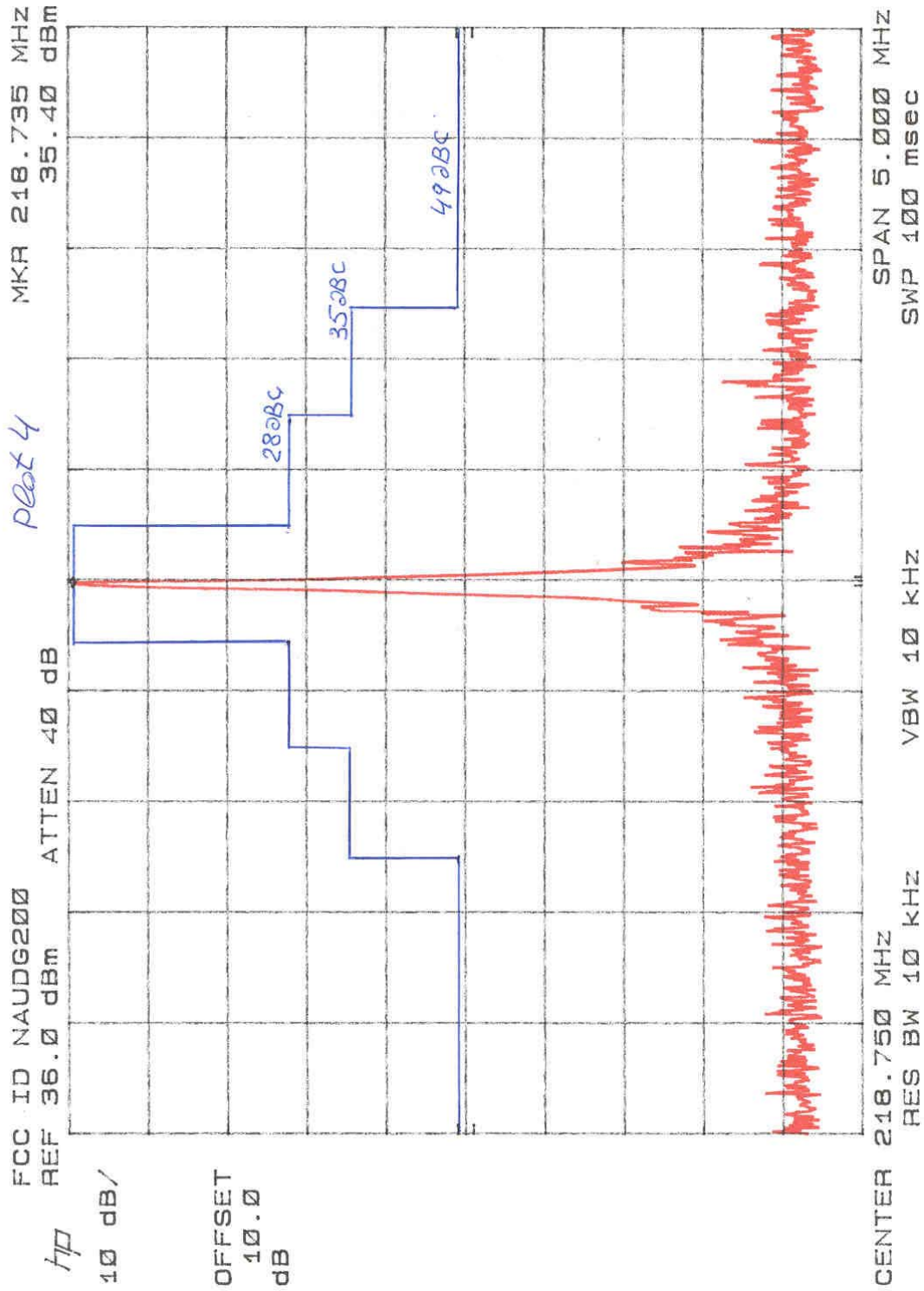
Plot No.	Plot Description	Comments
3	Emission mask for segment A	
4	Emission mask for segment B	
5	Emission from 30 to 217.75 MHz	Limit = $P - (43 + 10 \log P(W)) = -13$ dBm
6	Emission from 217.750 to 218.000 MHz	Test result = - 22.8 dBm
7	Emission at lowest edge of seg. A (218.0125 MHz)	Test result (delta) = 64.4 dB
8	Emission at highest edge of seg. A (218.4875 MHz)	Test result (delta) = 69.2 dB
9	Emission from 218.500 to 218.750 MHz	Test result = - 22.6 dBm
10	Emission from 218.250 to 218.500	Test result = - 22.4 dBm
11	Emission at lowest edge of seg. B (218.5125 MHz)	Test result (delta) = 68.8 dB
12	Emission at highest edge of seg. B (218.9875 MHz)	Test result (delta) = 69.8 dB
13	Emission from 219.000 to 219.250 MHz	Test result = - 25.2 dBm
14	Emission from 219.250 to 1000 MHz	Limit = $P - (43 + 10 \log P(W)) = -13$ dBm
15	Emission from 1000 to 2200 MHz	Limit = $P - (43 + 10 \log P(W)) = -13$ dBm

Minimum Power Level = 27 dB

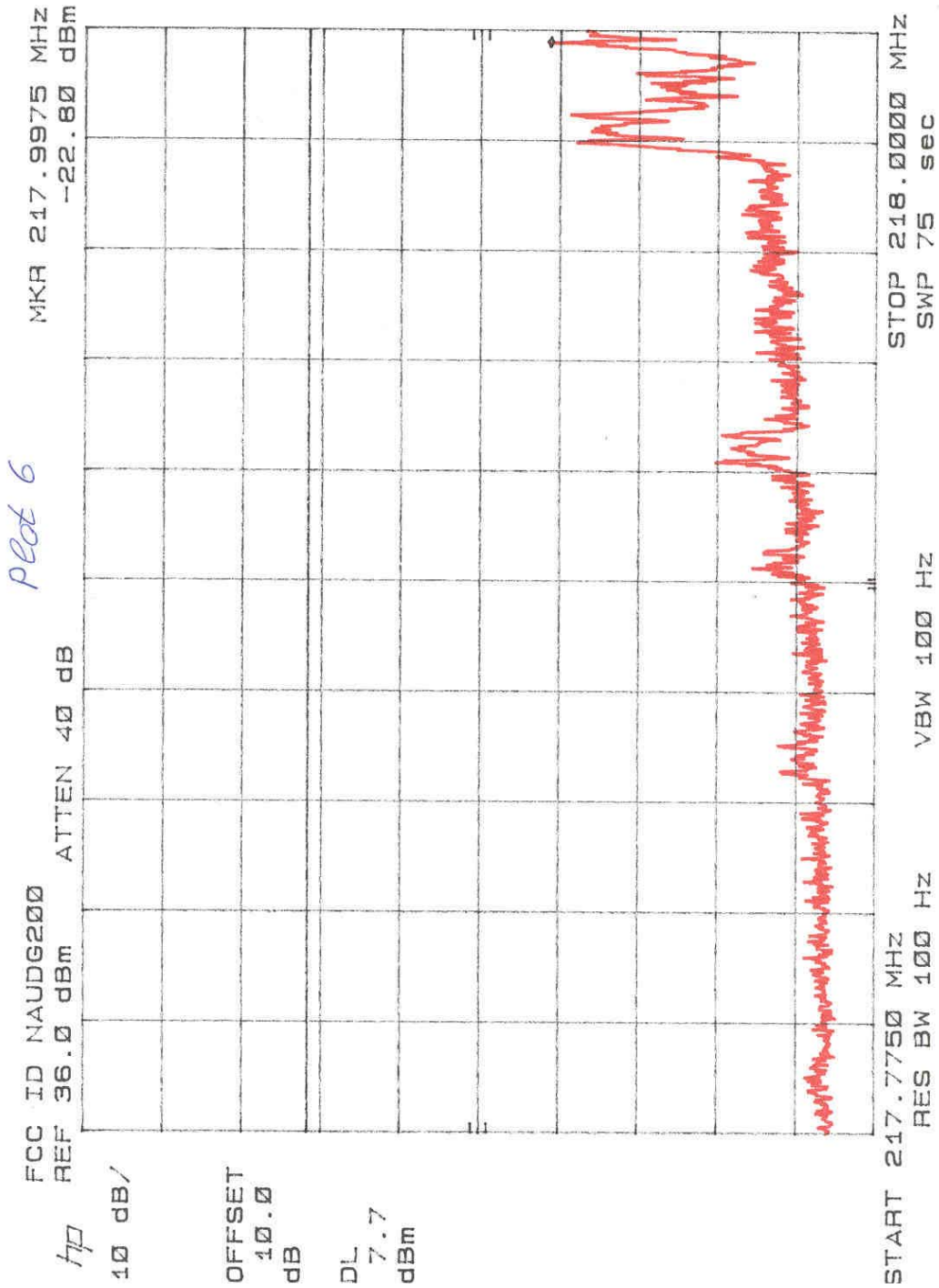
16	Emission at highest edge of seg. B (218.9875 MHz)	Test result (delta) = 69.8 dB
17	Emission from 219.000 to 219.250 MHz	Test result = - 32.6 dBm
18	Emission at lowest edge of seg. A (218.0125 MHz)	Test result (delta) = 69.4 dB
19	Emission from 217.750 to 218.000 MHz	Test result = - 39.6 dBm

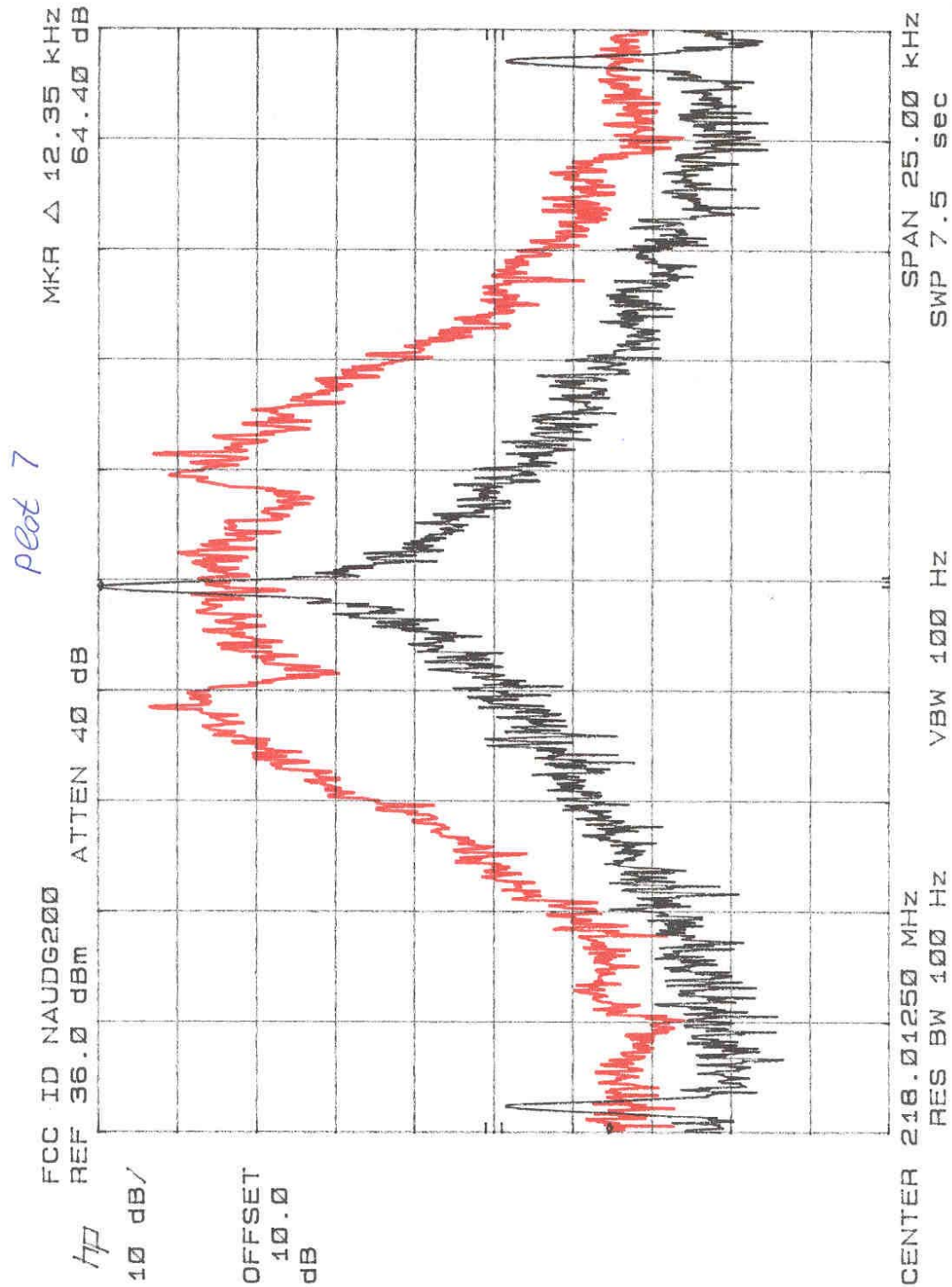
Please see the following pages for emission test result.

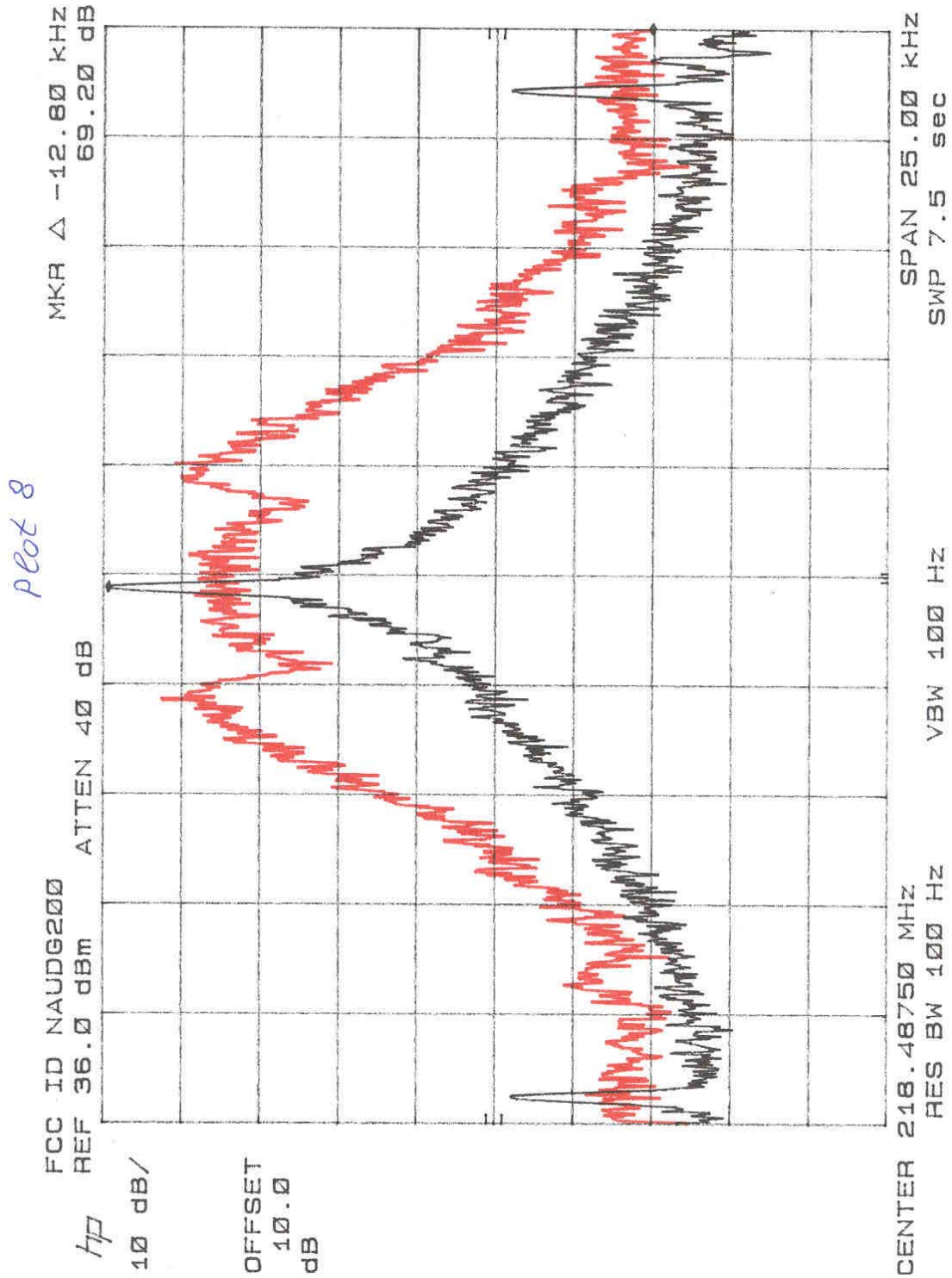


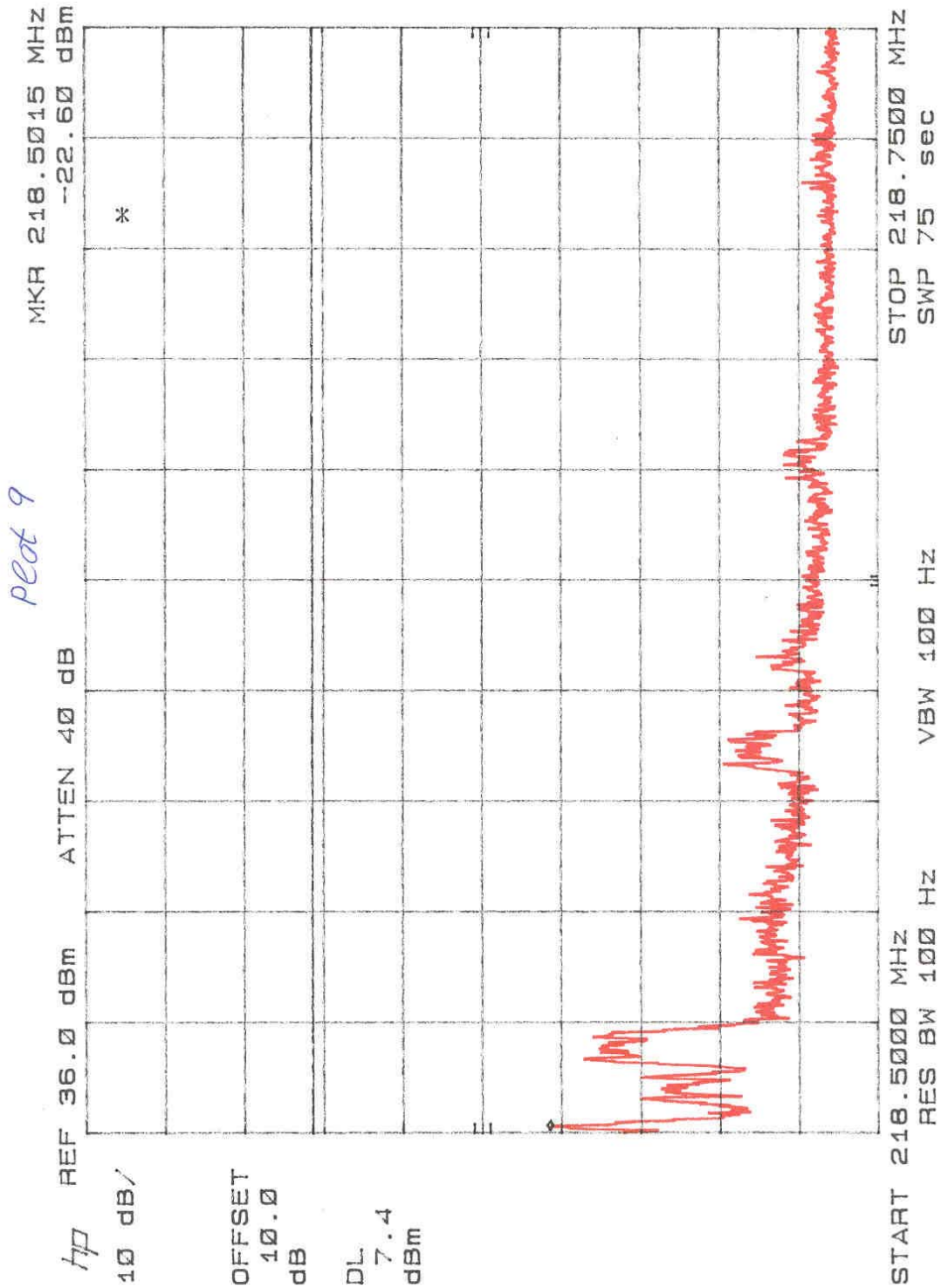


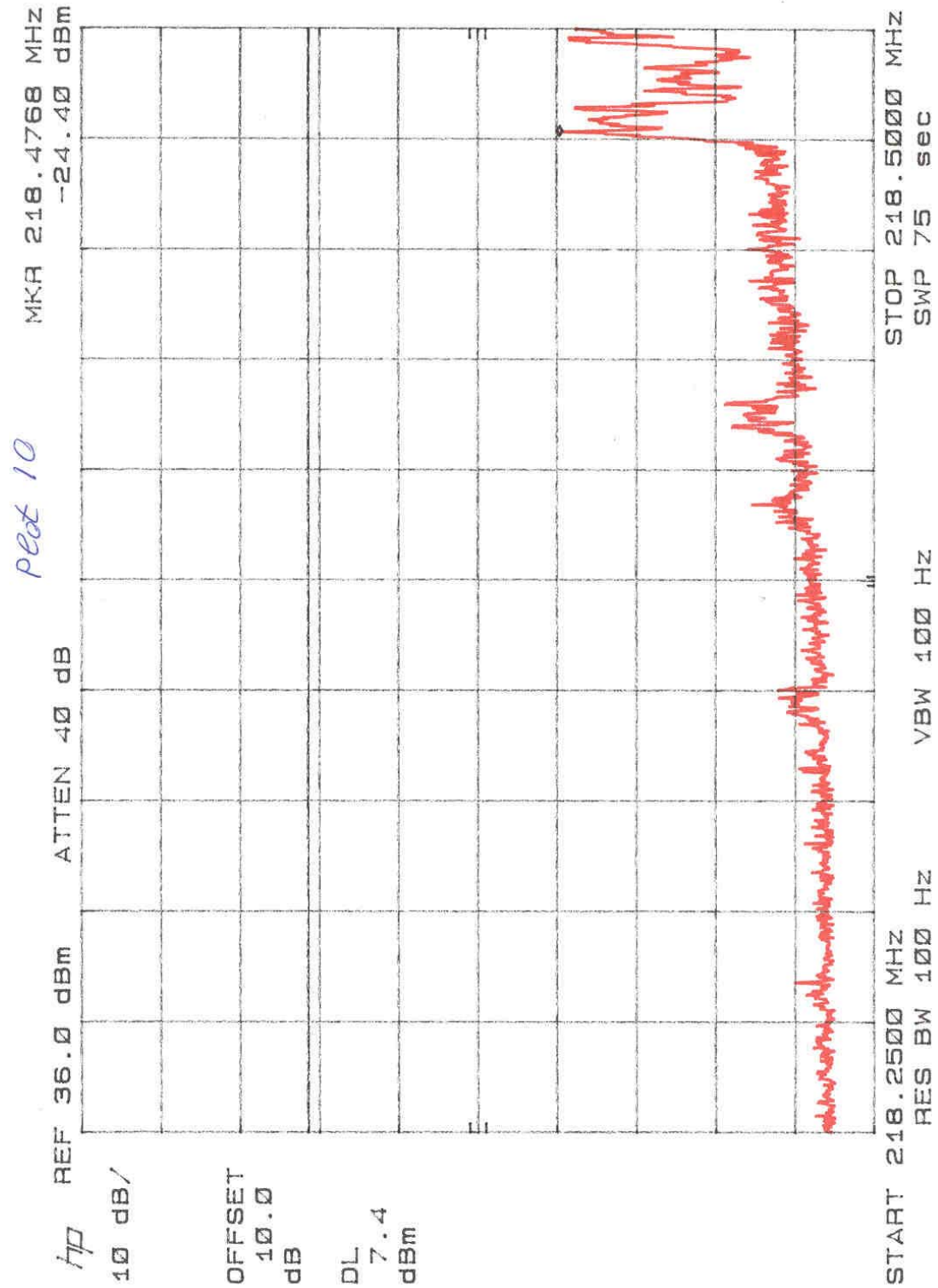


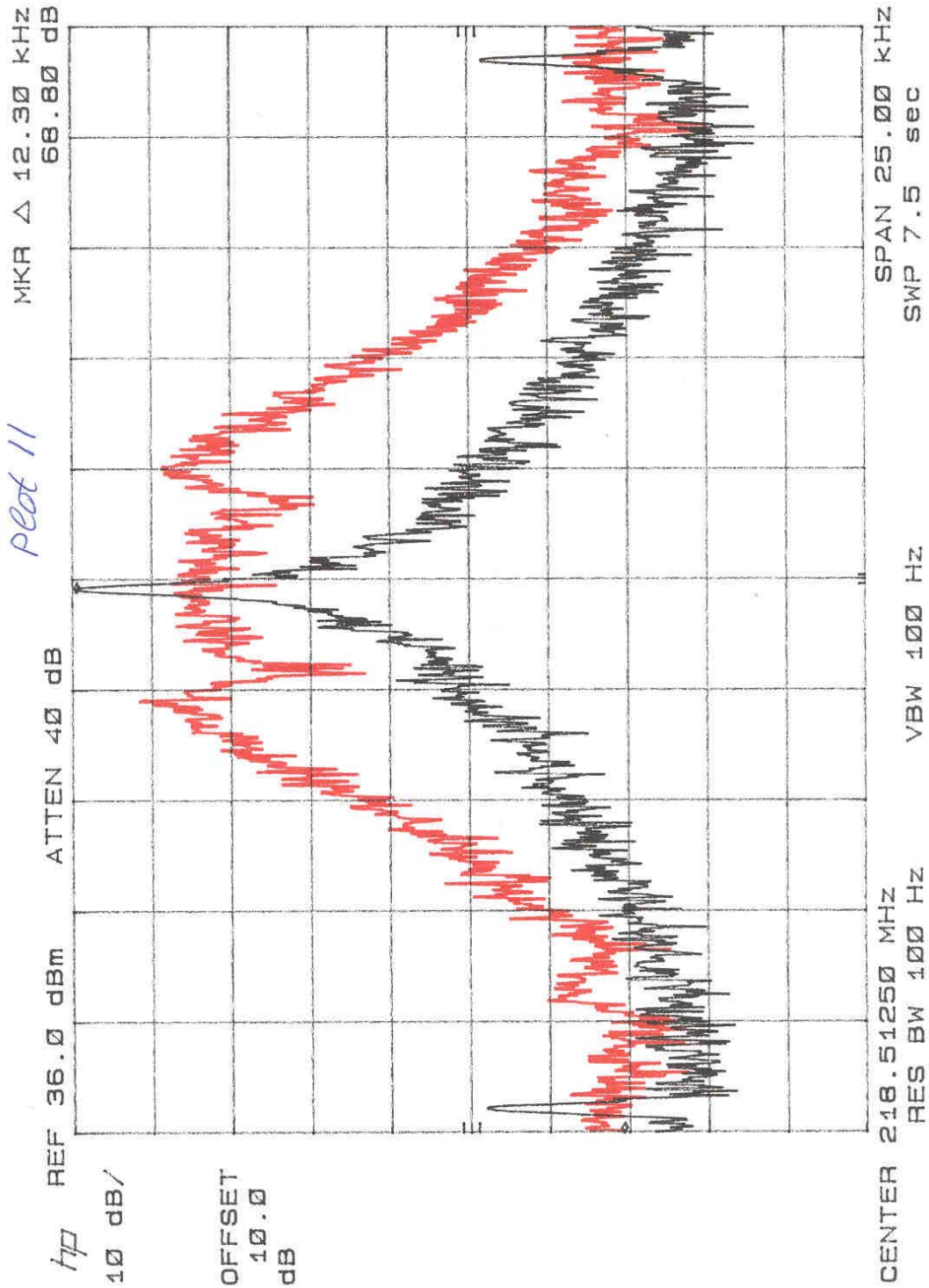


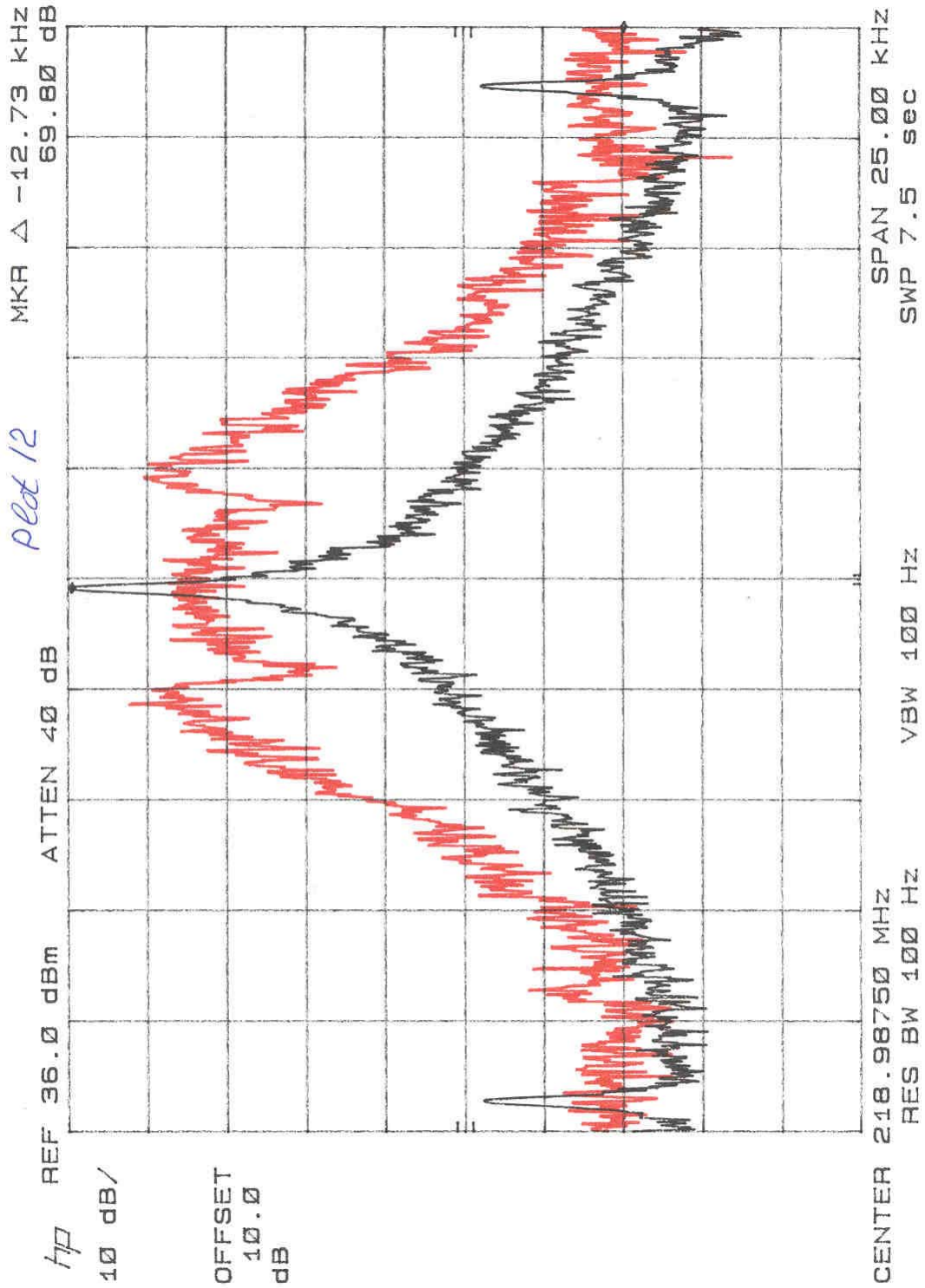


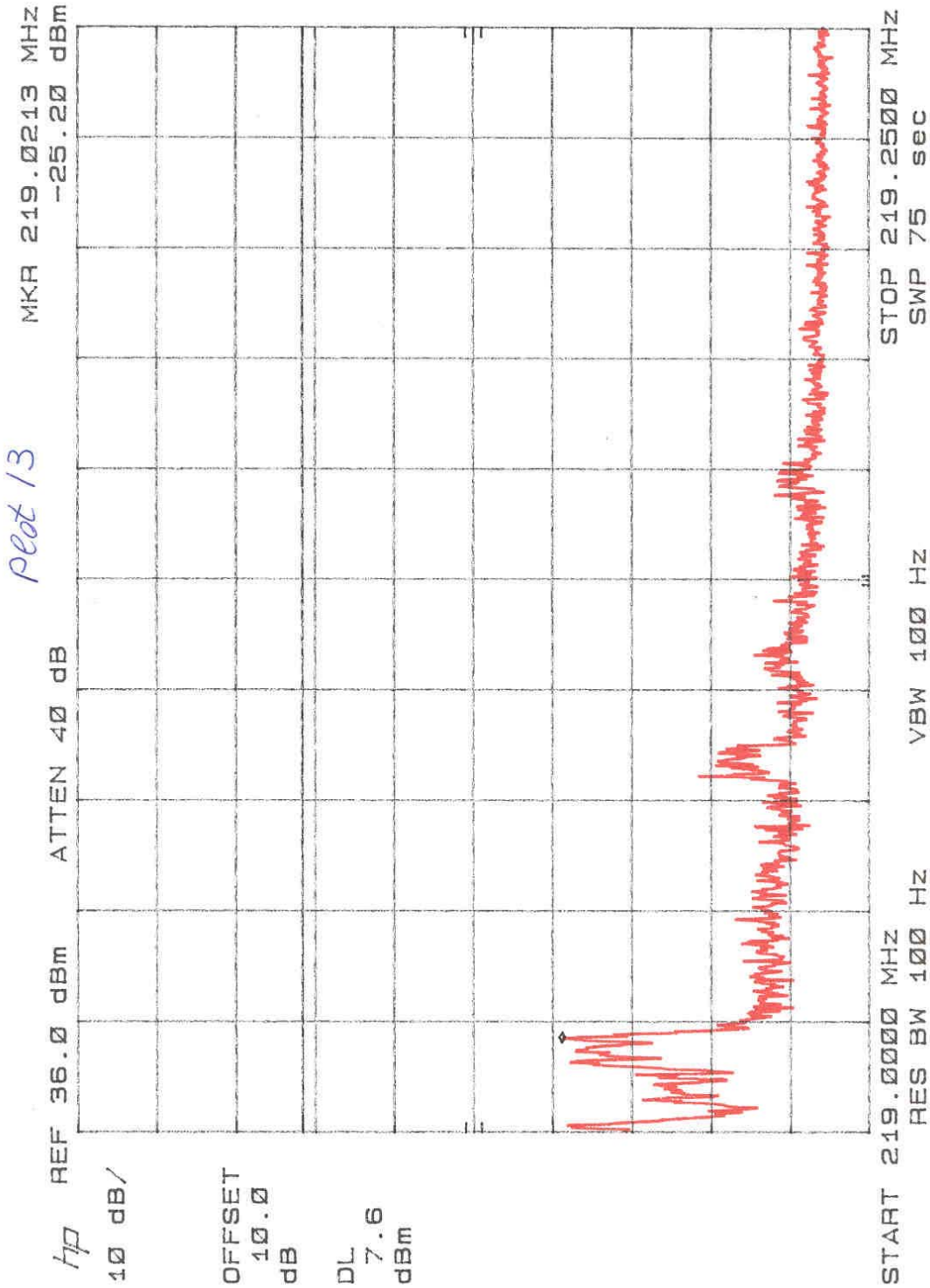




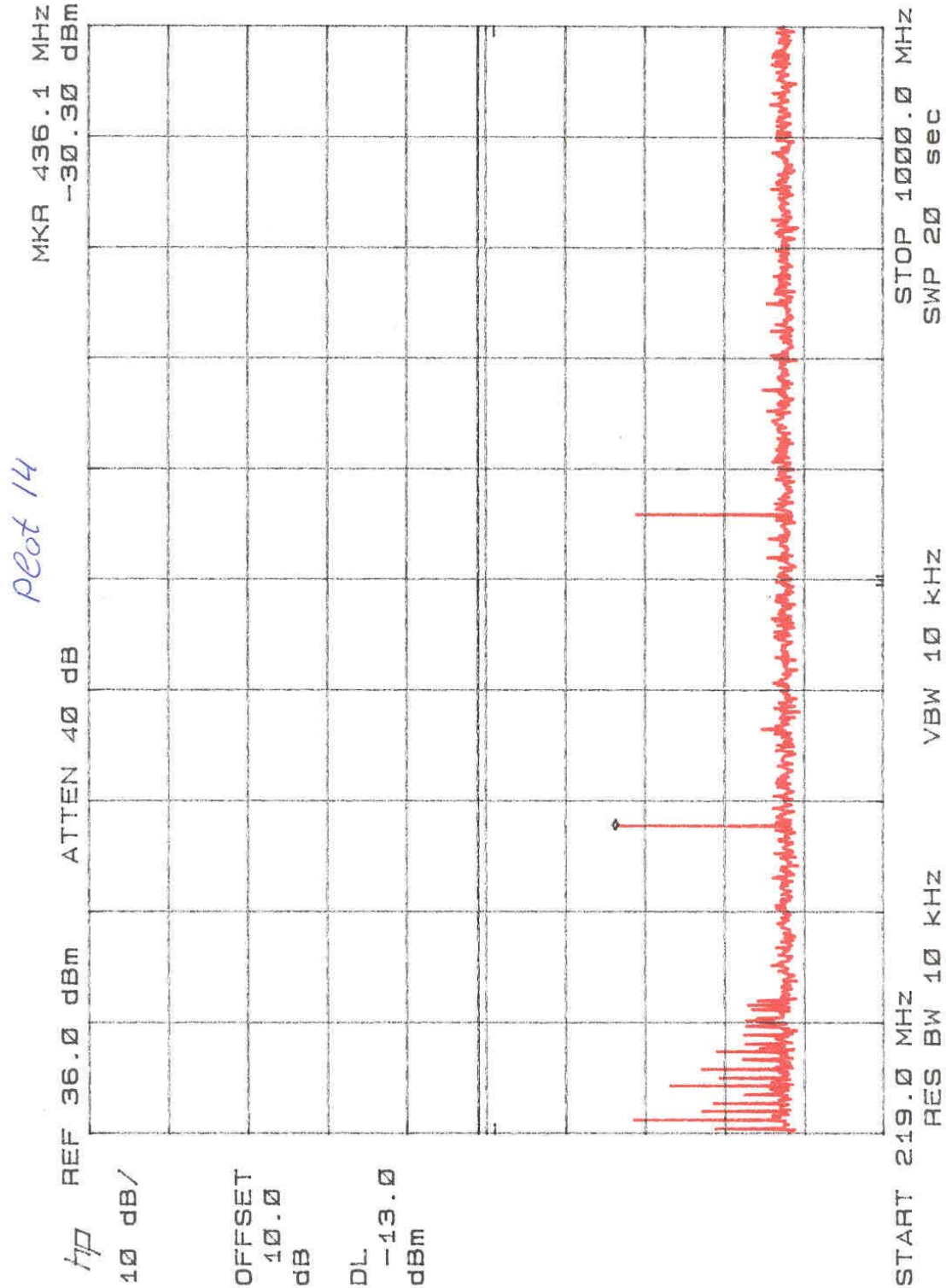


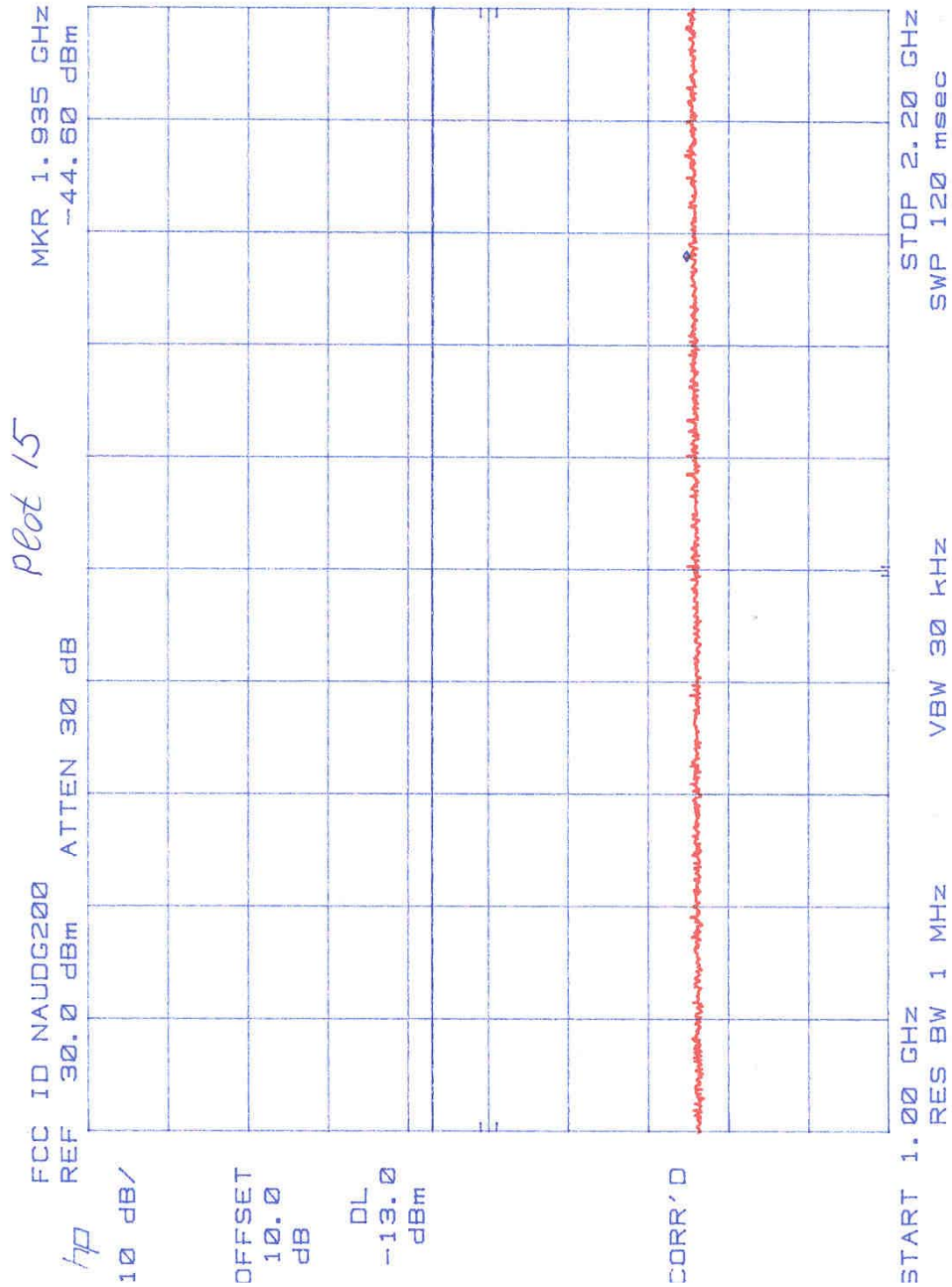


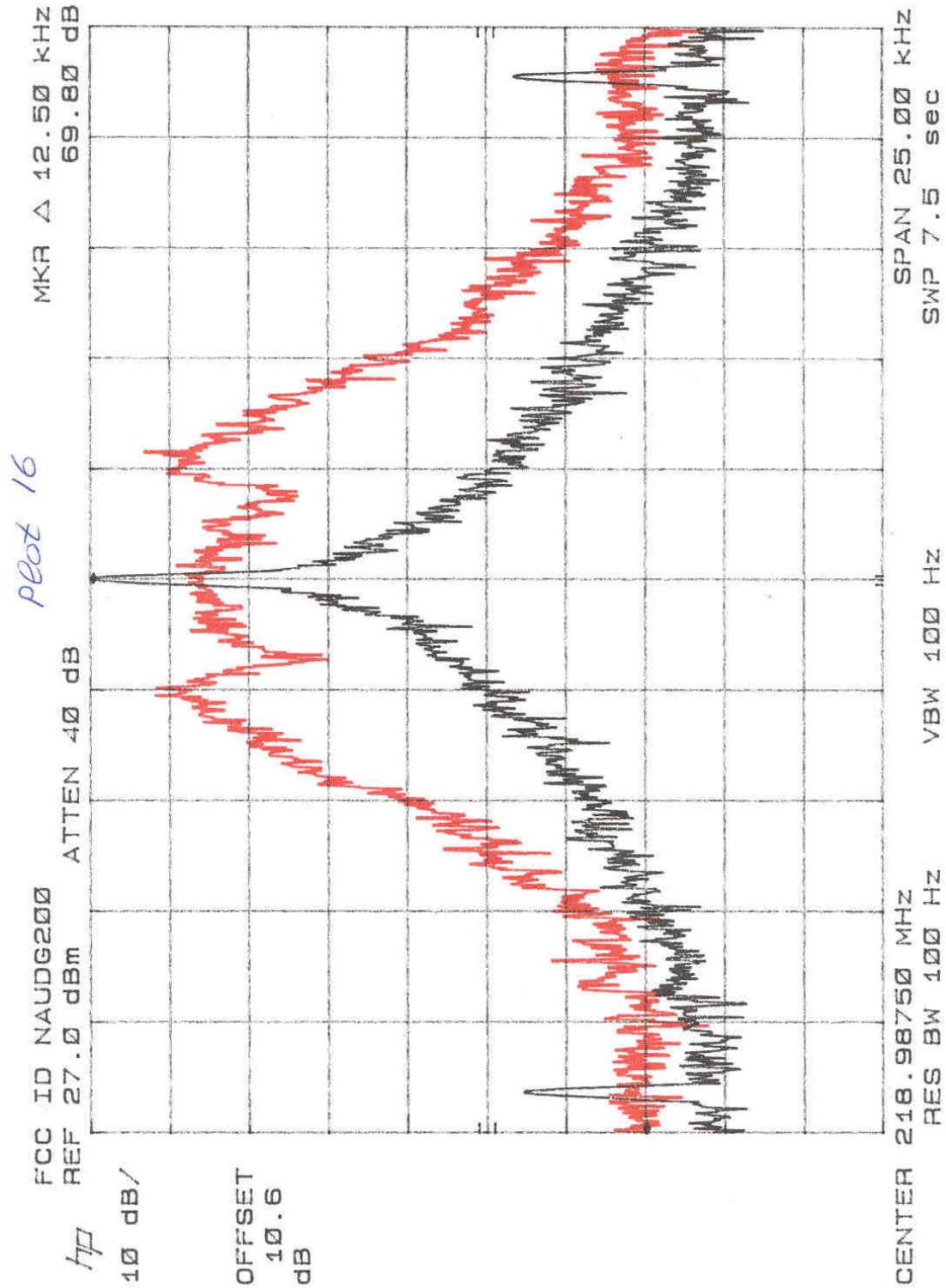


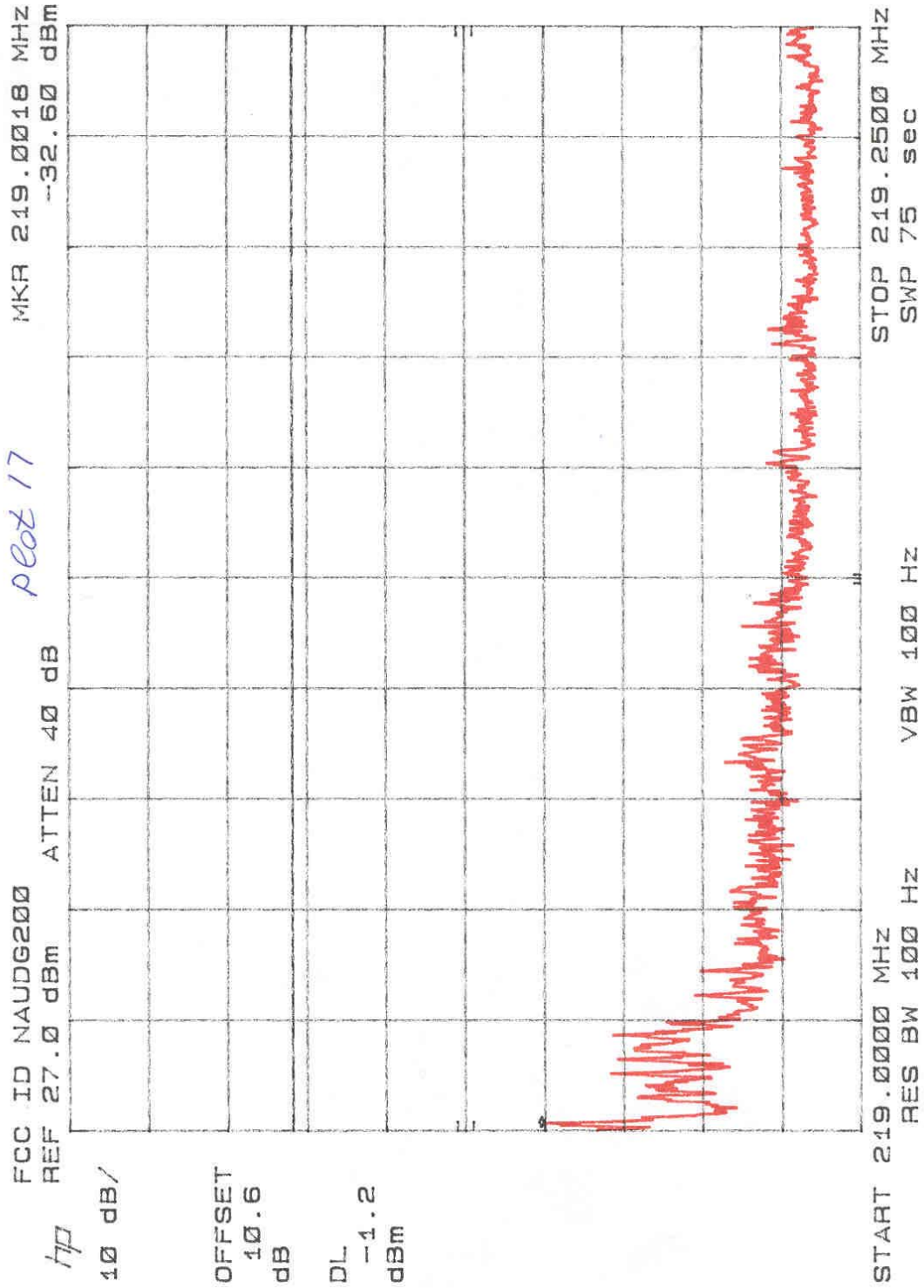


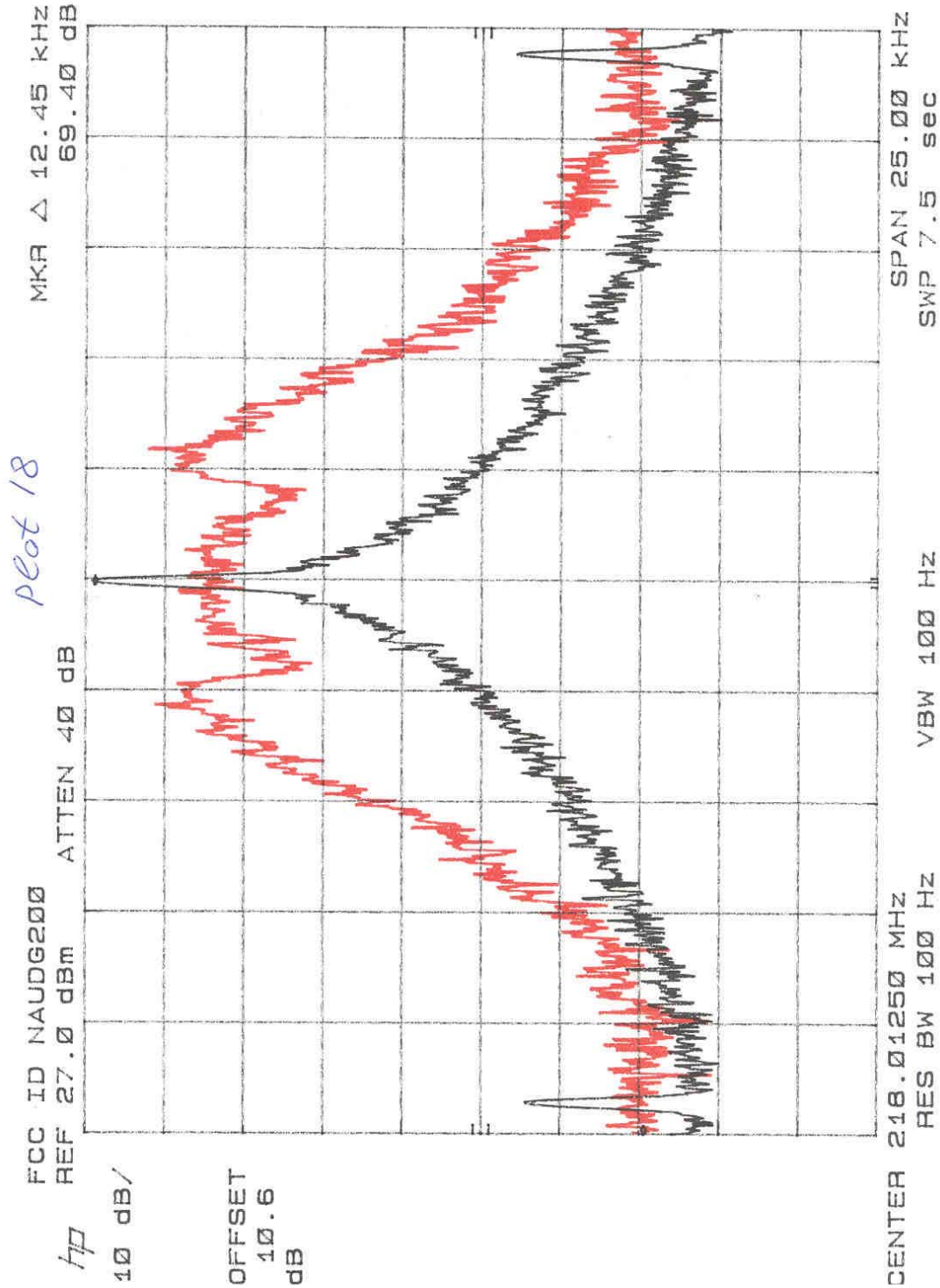


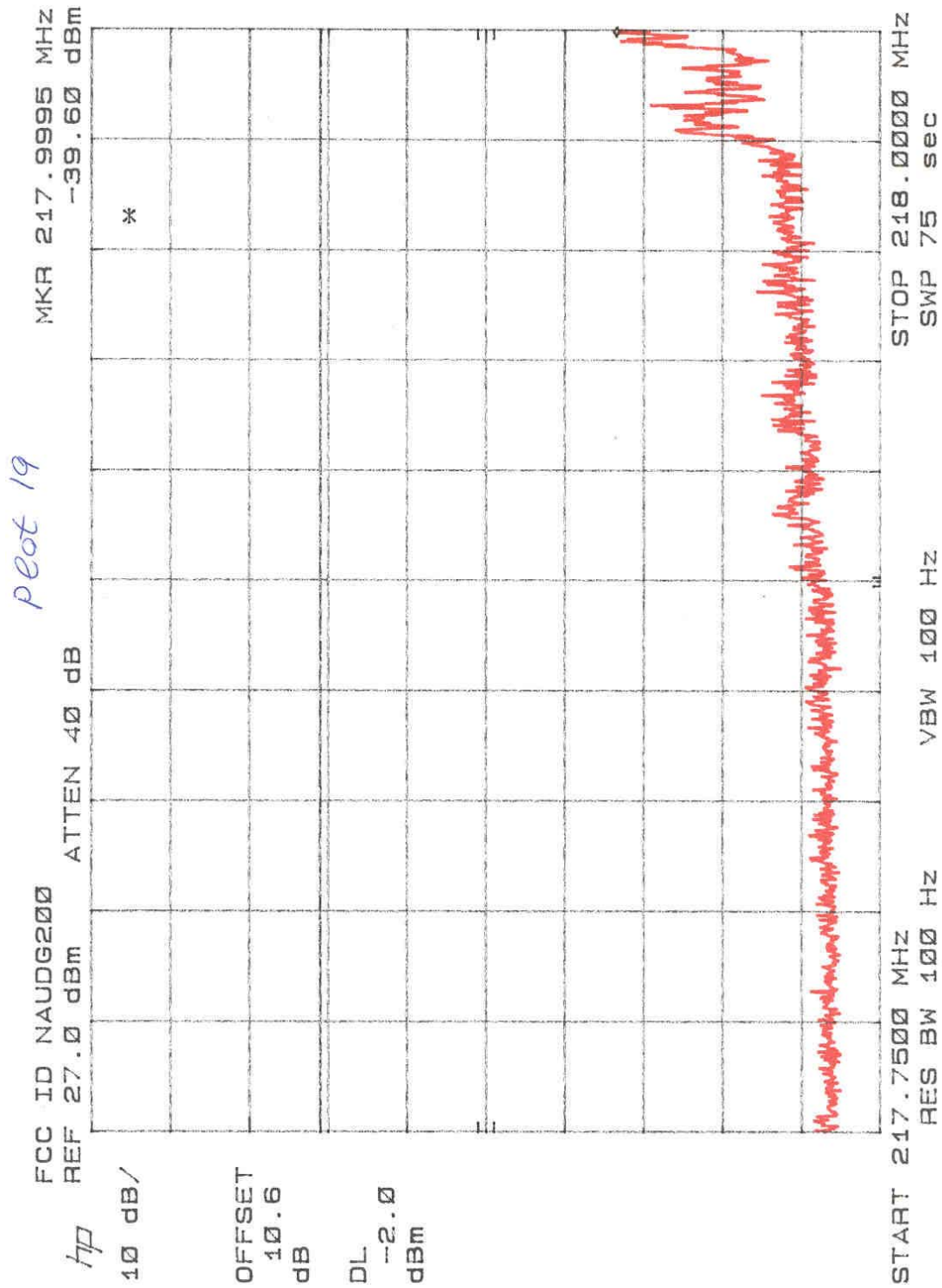




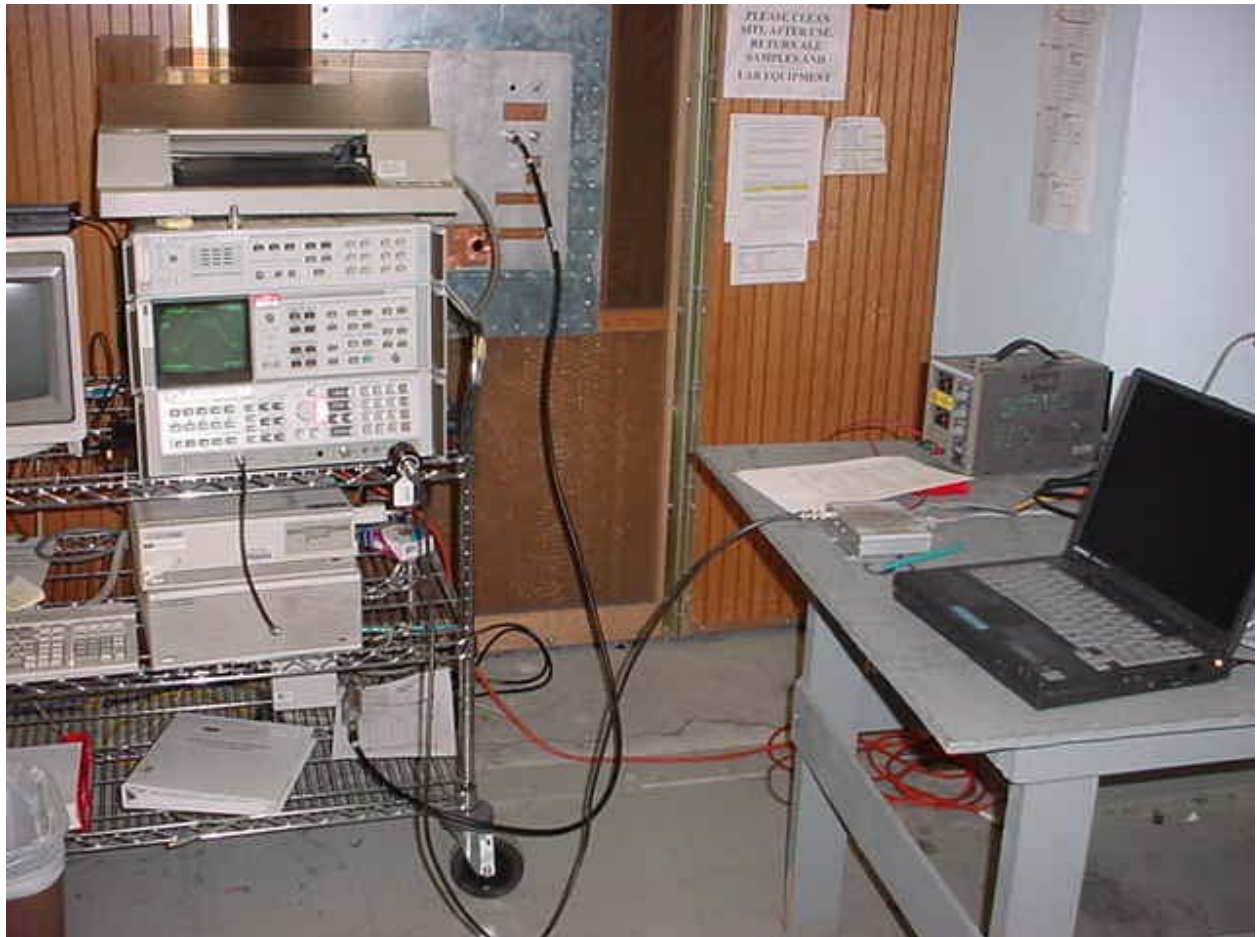








5.4 Test Configuration Photograph



**6.0 SPURIOUS RADIATED EMISSIONS**

**6.1 Test Description**

<b>Requirement:</b>	FCC § 2.1053, § 95.857(b)
<b>Spurious Radiated Emission:</b>	Spurious Radiated Emission attenuation must be more than $43 + 10\log P(W)$

**6.2 Test Procedure**

- A) The transmitter was placed on a wooden turntable. Antenna terminals were connected to the 50 Ohm Dummy load.
- B) The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height was varied from 1 to 4 m, antenna polarization was varied and turn table was rotated 360° in order to identify the maximum level of emissions from the EUT (Veut).
- C) The frequency range up to tenth harmonic of the fundamental frequency was investigated.
- D) Then EUT was replaced with Substitution Antenna:
  - a) Half-wave Dipole up to 1 GHz
  - b) Horn antenna above 1 GHz
 and a Signal generator
- E) Step B and C were repeated
- F) Output power (Vg) of the signal generator (input signal to the substitution antenna) was adjusted to receive the same signal on the spectrum analyzer as with EUT
- G) Radiated power of the spurious emissions was calculated as power supplied to the substitution antenna plus substitution antenna gain in dBd. Result was compared against the limit.

Note: Limit for spurious emission radiated power is  
 $P(\text{dBm}) - [43 + 10\text{Log}P(\text{Watts})] = -13 \text{ dBm}$

**6.3 Test Results:**

<b>Test Result:</b>	EUT PASSED Spurious Radiation test with margin 2.8 dB @ 436.975 MHz
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See the following page for test data



**Spurious Radiated Emissions**

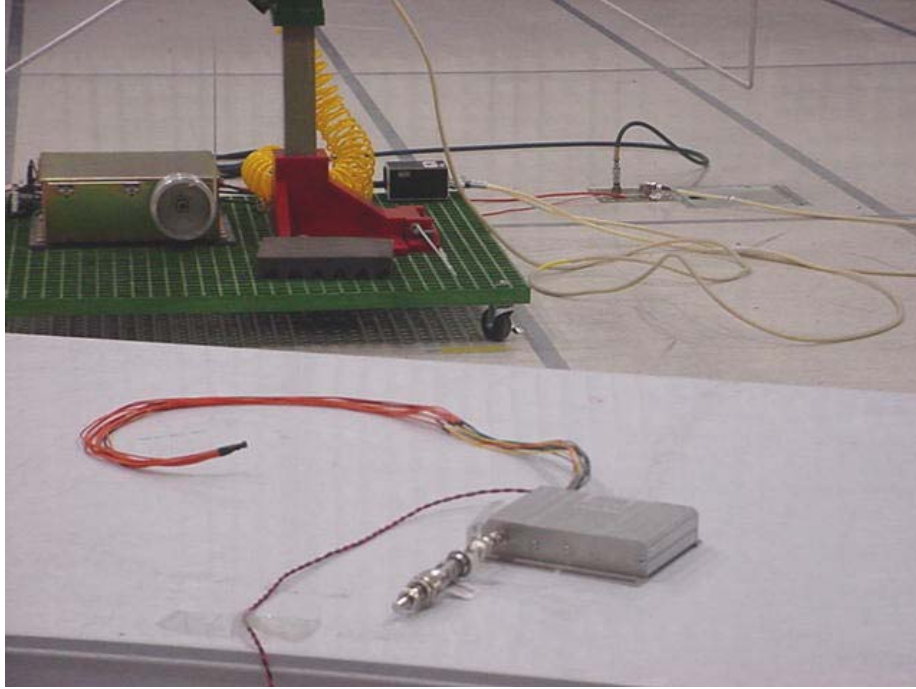
**Company:** Gateway Communication  
**Project #:** 3041334  
**Model:** DG200  
**Engineer:** Sergey Marker  
**Date of test:** April 15,2003  
**Test Condition:** Continue transmitting

Harmonics Frequency	Antenna Pol	Reading Veut	Signal Gener. Vg	Antenna Gain	Spurious ERP	Limit	Margin
MHz	H/V	dBμV	dBm	dBd	dBm	dBm	dB
436.975	H	95.3	-15.8	0	-15.8	-13.0	-2.8
655.45	H	76.4	-27.8	0	-27.8	-13.0	-14.8
873.925	H	70.7	-28.0	0	-28.0	-13.0	-15.0
1092.4	H	84.1	-22.8	3.5	-19.3	-13.0	-6.3
1310.875	H	73.8	-34.7	4.5	-30.2	-13.0	-17.2
1529.35	V	66.0	-43.5	5.0	-38.5	-13.0	-25.5
1747.825	V	68.7	-37.6	5.3	-32.3	-13.0	-19.3
1966.3	V	63.1	-43.3	5.7	-37.6	-13.0	-24.6
2184.75	H	54.4	-52.7	6.3	-46.4	-13.0	-33.4

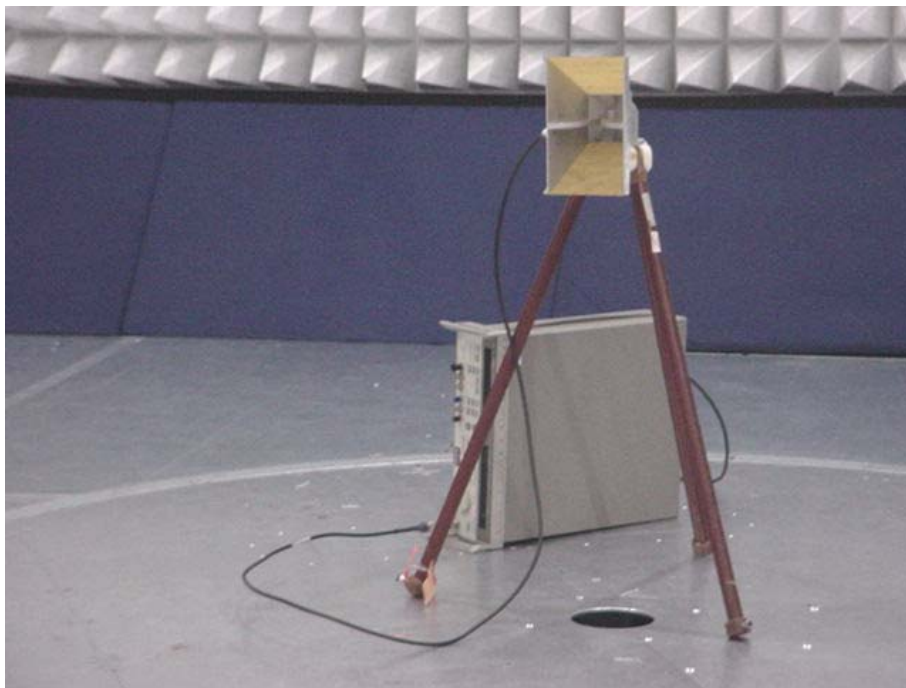
Notes: a) Numbers with a minus sign in margin column are below the limit.

b) Spurious ERP = Vg + G(dBd)

**6.4 Test Configuration Photographs**



**Direct Measurements from EUT**



**Substitution Antenna above 1 GHz**

**7.0 RADIATED EMISSION FROM DIGITAL PARTS AND RECEIVER**

7.1 Test description

<b>Requirement:</b>	FCC § 15.109(a)
<b>Radiated Emission:</b>	Class B Limit

7.2 Test Procedure

The transmitter was placed on a wooden turntable and antenna terminal was connected to the ¼ wave antenna.

The measurement antenna was placed at a distance of 3 meters from the EUT. During the tests, the antenna height was varied from 1 to 4 m, antenna polarization was changed, and turn table was rotated 360° in order to identify the maximum level of emissions from the EUT.

7.3 Test Results:

<b>Test Result:</b>	EUT PASSED Radiated Emission test with margin 4.9 dB @ 394.7 MHz
---------------------	--

See the following page for test data

**Standard:** FCC 15.109(a)

**Measurement Uncertainty:** 3.92 dB

**Test:** Radiated Emissions

**Temperature:** 24°C

**Frequency Range:** 30 MHz to 1000 MHz

**Relative Humidity:** 58%

**Limit:** Class B

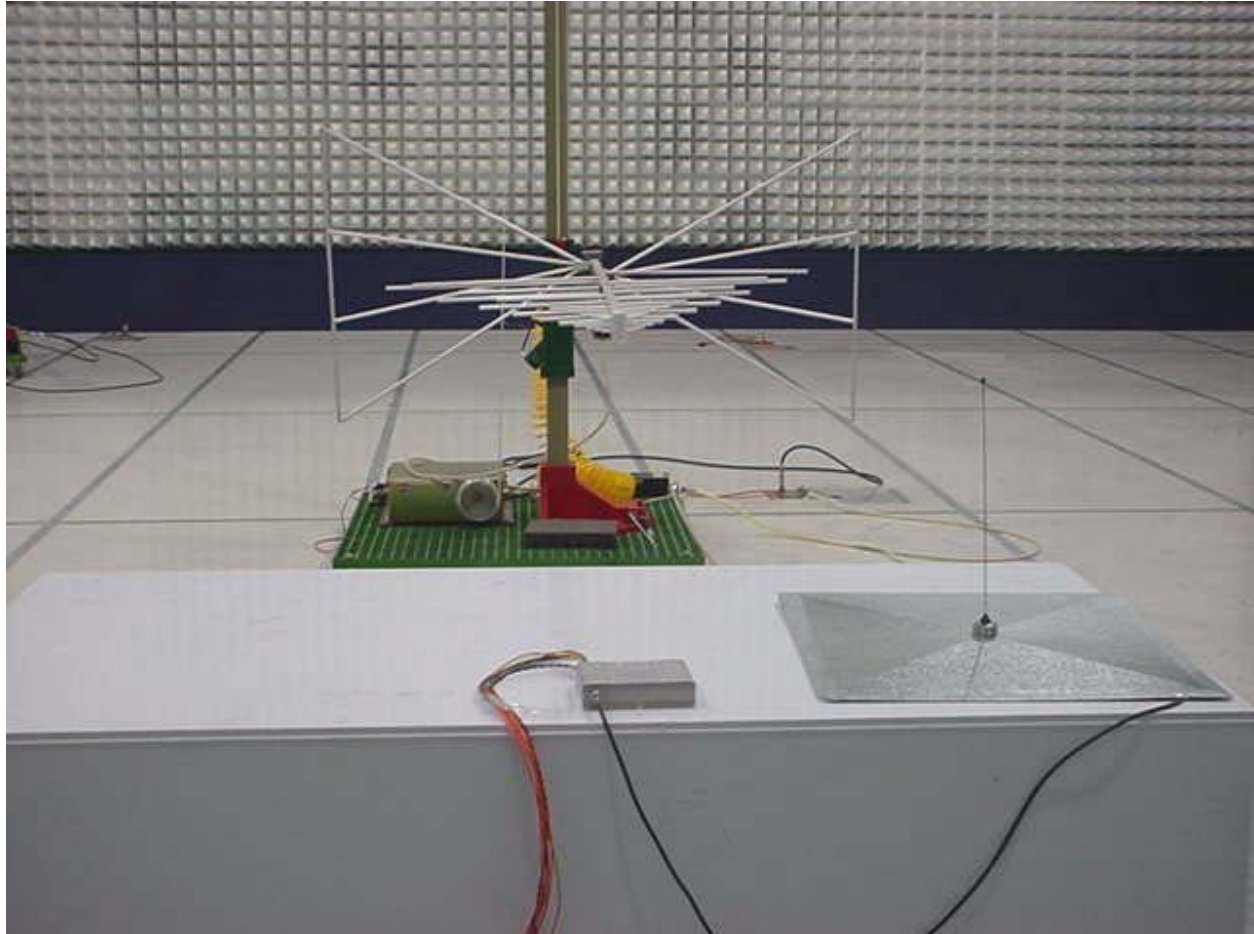
**Measurement Distance:** 3 meters

Quasi peak measurements were made at the highest points and found to be as below:

Frequency	Antenna Polariz.	Quasi Pk FS	Limit	Margin	RA	AG	CF	AF	Ext. Atten.
MHz	V/H	dBμV/m	dBμV/m	dB	dBμV	dB	dB	dB(1/m)	dB
78.0	H	35.2	40.0	-13.5	49.0	32.3	0.8	6.0	3.0
84.0	V	31.4	40.0	-8.6	52.8	32.3	0.8	7.1	3.0
96.0	V	25.7	43.5	-17.8	46.8	32.3	0.9	7.4	3.0
120.0	V	34.1	43.5	-9.4	55.2	32.3	1.0	7.1	3.0
394.7	H	41.1	46.0	-4.9	52.6	32.3	1.9	15.9	3.0
592.1	H	36.0	46.0	-10.0	43.7	32.5	2.3	19.5	3.0

- Note: a) A complete scan from 30-2200 MHz was made with antenna oriented horizontally and vertically.
- b) All emissions not reported are at least 10 dB below the limits
- c) Analyzer setting: below 1 GHz RBW ≥ 100 kHz, VBW ≥ 100 kHz  
above 1 GHz RBW ≥ 1 MHz, VBW ≥ 1 MHz  
Detector mode: below 1 GHz Quasi-peak  
Above 1 MHz Average
- d) Numbers with a minus sign in margin column are below the limit.

7.4 Test Configuration Photograph



**8.0 OCCUPIED BANDWIDTH**

8.1 Test description

<b>Requirement:</b>	FCC §2.1049
---------------------	-------------

8.2 Test Procedure

The antenna was disconnected from the transmitter and the short cable was connected to the transmitter RF output. The RF output was connected to the input of the spectrum analyzer through 10 dB attenuator.

The resolution bandwidth of the spectrum analyzer was set approximately 1% of the authorized bandwidth of the transmitter.

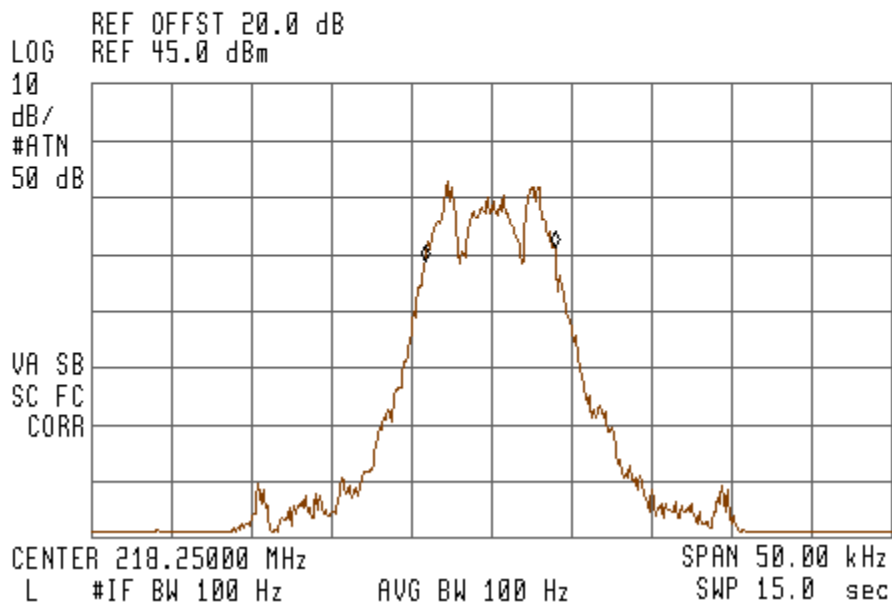
The 99% Power bandwidth was measured and found equal 8.13 kHz.

8.3 Test Results

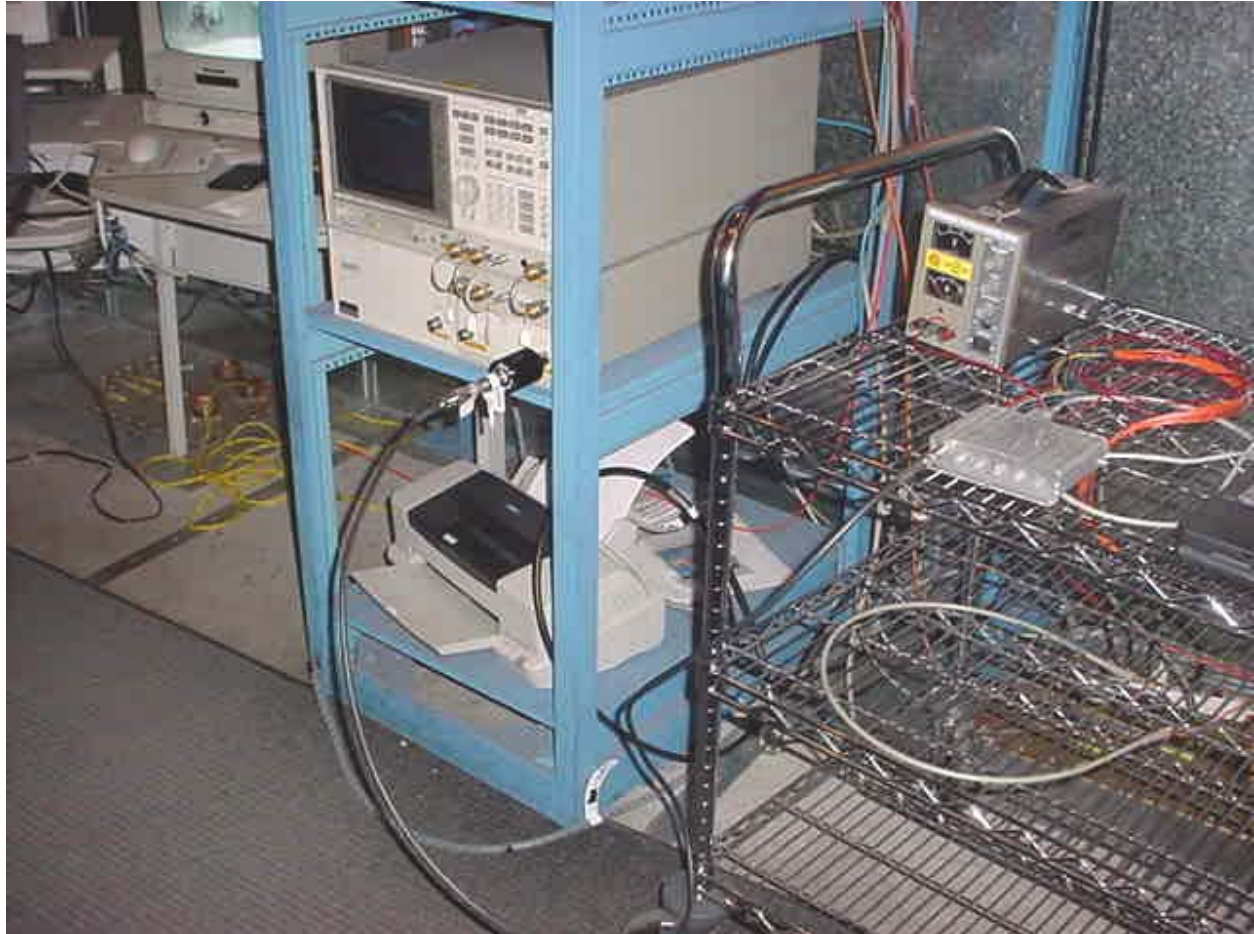
**Test Result:** The Occupied Bandwidth is 8.13 kHz

18:20:09 APR 15, 2003

ACTV DET: PEAK  
MEAS DET: PEAK QP AVG  
MKR $\Delta$  8.13 kHz  
2.63 dB



8.4 Test Configuration Photograph





**9.0 AC LINE CONDUCTED EMISSIONS**

9.1 Test Description

<b>Parameter:</b>	ANSI C63.4
<b>Requirement:</b>	FCC § 15.107

9.2 Test Procedure

The EUT was connected to the DC power supply.

9.3 Test Results

Not applicable, the EUT is battery powered only.

**10.0 FREQUENCY STABILITY**

## 10.1 Test description

<b>Requirement:</b>	FCC § 1.1055
<b>Frequency Tolerance:</b>	Within 0.00025% (2.5ppm)

## 10.2 Test Procedure

The ppm frequency error of the transmitter was calculated by:

$$ppm\ error = \left( \frac{MCF}{ACF} - 1 \right) \cdot 10^6$$

Where MCF is the Measured Carrier Frequency in MHz  
ACF is the Assigned Carrier Frequency in MHz

## 10.2.1 Frequency Stability vs. Temperature

The equipment under test was connected to an external DC power supply and the RF output was connected to a frequency counter via feed through attenuators. The EUT was placed inside the temperature chamber.

The temperature stability was measured with variation of ambient temperature as follows:

- a) From -30°C to +50°C with intervals of 10°C
- b) After the temperature stabilized for approximately 20 minutes, the frequency of the output signal was recorded from the counter.

## 10.2.2 Frequency Stability vs. Voltage

At room temperature (25 ±5°C), an external variable DC power supply was connected to the EUT. The frequency of the transmitter was measured for 115%, 100% and 85% of the nominal operating input voltage.

10.3 Test Results

<b>Frequency Stability vs Temperature</b>		
ACF (MHz): 218.75		Limit: 2.5ppm
Temperature, C	MCF (MHz)	PPM Error
50	218.74968	-1.462857143
40	218.74978	-1.005714286
30	218.74992	-0.365714286
20	218.75001	0.045714286
10	218.75016	0.731428571
0	218.75023	1.051428571
-10	218.75033	1.508571428
-20	218.75036	1.645714286
-30	218.75041	1.874285714

<b>Frequency Stability vs Voltage</b>			
ACF (MHz): 218.75			Limit: 2.5 ppm
%	Voltage	MCF (MHz)	PPM Error
115	15.64	218.75001	0.05
100	13.60	218.75001	0.05
85	11.56	218.75001	0.05

10.4 Test Configuration Photograph



**11.0 TEST EQUIPMENT**

Measurement equipment used for compliance testing utilized the equipment on the following list:

Equipment	Manufacturer	Model/Type	Serial #	Cal Int	Cal Due
BI-Log Antenna	EMCO	3143	9509-1160	12	9/19/03
Dipole Antenna	CDI	Roberts	331	12	9/10/03
Horn Antenna	EMCO	3115	9170-3712	12	6/02/03
Horn Antenna	EMCO	3115	8812-3049	12	4/03/04
Pre-Amplifier	Sonoma Inst.	310	185634	12	4/30/03
Pre-Amplifier	Miteq	AMF-4D-001180-24-10P	799159	12	4/30/03
RF Filter Section	Hewlett Packard	85460A	3448A00267	12	7/16/03
EMI Receiver	Hewlett Packard	8546A	3710A00373	12	7/16/03
Spectrum Analyzer w/8650 QP Adapter	Hewlett Packard	8568B	1912A0053 2521A01021	12	11/20/03
Spectrum Analyzer w/85650 QP Adapter	Hewlett Packard	8566B	2416A00317 2043A00251	12	4/30/03
Signal Generator	Hewlett Packard	83732A	3222A00119	12	5/04/03
Digital Counter	Leader	LDC-825	1010046	12	9/03/03
Environmental Chamber	B-M-A Inc.	TH-64	2287	12	5/22/03