



FCC Certification Test Report
for
Highway Technologies, Inc.
NB31032

January 15, 2002

Prepared for:

Highway Technologies, Inc.
81 Texaco Road
Mechanicsburg, PA 17050

Prepared By:

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FCC Certification Test Program

FCC Certification Test Report for the Highway Technologies, Inc. AR-103 Wizard NB31032

January 15, 2002

WLL JOB# 6919

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Abstract

This report has been prepared on behalf of Highway Technologies, Inc. to support the attached Application for Equipment Authorization. The test report and application are submitted for a Citizens Band (CB) radio under Part 95 of the FCC Rules and Regulations. This Federal Communication Commission (FCC) Certification Test Report documents the test configuration and test results for a Highway Technologies, Inc. AR-103 Wizard.

Testing was performed on an Open Area Test Site (OATS) of Washington Laboratories, Ltd, 7560 Lindbergh Drive, Gaithersburg, MD 20879. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

The Highway Technologies, Inc. AR-103 Wizard complies with the limits for a Citizens Band (CB) radio under Part 95 of the FCC Rules and Regulations.

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1 Introduction

1.1 Compliance Statement

The Highway Technologies, Inc. AR-103 Wizard complies with the limits for a Citizens Band (CB) radio device under Part 95 of the FCC Rules and Regulations.

1.2 Test Scope

Tests for spurious radiated and conducted emissions were performed. All measurements were performed according to the 1992 version of ANSI C63.4. The measurement equipment conforms to ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation.

1.3 Contract Information

Customer:	Highway Technologies, Inc. 81 Texaco Road Mechanicsburg, PA 17050
Purchase Order Number:	1165
Quotation Number:	59604

1.4 Test Dates

Testing was performed from December 17, 2001 to January 9, 2002.

1.5 Test and Support Personnel

Washington Laboratories, LTD	Chad Beattie, Santo Lavorata
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1.6 Abbreviations

A	Ampere
Ac	alternating current
AM	Amplitude Modulation
Amps	Amperes
b/s	bits per second
BW	Bandwidth
CE	Conducted Emission
Cm	centimeter
CW	Continuous Wave
DB	decibel
Dc	direct current
EMI	Electromagnetic Interference
EUT	Equipment Under Test
FM	Frequency Modulation
G	giga - prefix for 10^9 multiplier
Hz	Hertz
IF	Intermediate Frequency
K	kilo - prefix for 10^3 multiplier
M	Mega - prefix for 10^6 multiplier
M	Meter
μ	micro - prefix for 10^{-6} multiplier
NB	Narrowband
LISN	Line Impedance Stabilization Network
RE	Radiated Emissions
RF	Radio Frequency
Rms	root-mean-square
SN	Serial Number
S/A	Spectrum Analyzer
V	Volt

2 Equipment Under Test

2.1 EUT Identification & Description

The AR-103 WIZARD is a safety device which broadcasts prerecorded traffic alert and warning voice messages to the motoring public to prevent accidents and improve traffic flow. It employs the Citizens Band radio to air these messages. The messages are transmitted at regular fixed intervals of 30, 60, or 90 seconds as determined by the operator of the WIZARD. Three messages - each with a length of up to 18 seconds - may be recorded for transmission. A typical message takes 12 seconds. The WIZARD can broadcast any one of the prerecorded messages on 2 selected CB radio channels in a sequential manner. As an example, MESSAGE # 2 might be selected for broadcast. It will be transmitted on channel A (the first CB channel assigned). Immediately thereafter, the same message could be broadcast on channel B if a second CB channel was assigned and active. With a standard configuration, the operator can choose channel 3, 9, 17, 19, 21, or 36. Channel 19 is the favorite channel because it is the choice of truckers. However, on request to the factory, any of the 40 normal CB channels may be designated as one of the 6 available.

A UNIDEN (brand) Citizens Band transceiver model PRO 510 XL as produced by the manufacturer is used as the transmitter for the WIZARD. The F.C.C. I.D. number for this transceiver is AMW3K2-317. Please refer to the appropriate documents for this make and model of transceiver for details on the operation of this device.

Table 1. Device Summary

ITEM	DESCRIPTION
Manufacturer:	Highway Technologies, Inc.
FCC ID Number	NB31032
EUT Name:	Wizard
Model:	AR-103
FCC Rule Parts:	§95
Frequency Range:	26.965 Mhz to 27.405 MHz
Maximum Output Power:	4W
Modulation:	AM, SSB
Necessary Bandwidth:	8 kHz
Keying:	Manual Automatic
Type of Information:	Voice
Number of Channels:	40
Power Output Level	Fixed
Antenna Type	Connector
Frequency Tolerance:	0.005 %
Emission Type(s):	A3E
Interface Cables:	None
Power Source & Voltage:	12VDC

2.2 Test Configuration

The AR-103 was configured with a client-provided antenna. The antenna provided was a commercially available CB antenna.

2.3 Testing Algorithm

The AR-103 was operated by keying the microphone for continuous transmission.

The transmitter was modulated with a 2500 Hz sine wave, at an input level 16 dB greater than that to produce 50% modulation at 1000 Hz. For radiated emissions, the antenna port was terminated into a 50 Ω load. Worst-case emission levels are provided in the test results data.

2.4 Test Location

All measurements herein were performed at Washington Laboratories, Ltd. test center in Gaithersburg, MD. Site description and site attenuation data have been placed on file with the FCC's Sampling and Measurements Branch at the FCC laboratory in Columbia, MD. Washington Laboratories, Ltd. has been accepted by the FCC and approved by NIST NVLAP (NVLAP Lab Code: 200066-0) as an independent FCC test laboratory.

2.5 Measurements

2.5.1 References

ANSI C63.2 Specifications for Electromagnetic Noise and Field Strength Instrumentation

ANSI C63.4 American National Standard for Methods of Measurement of Radio-Noise Emissions from Low-Voltage Electrical and Electronic Equipment in the Range of 9 kHz to 40 GHz

Land Mobile FM or PM Communications Equipment Measurement and Performance Standards (ANSI/TIA/EIA-603-93)

2.6 Measurement Uncertainty

All results reported herein relate only to the equipment tested. For the purposes of the measurements performed by Washington Laboratories, the measurement uncertainty is ± 2.3 dB. This has been calculated for a *worst-case situation* (radiated emissions measurements performed on an open area test site).

The following measurement uncertainty calculation is provided:

$$\text{Total Uncertainty} = (A^2 + B^2 + C^2)^{1/2}/(n-1)$$

where:

A = Antenna calibration uncertainty, in dB = 2 dB

B = Spectrum Analyzer uncertainty, in dB = 1 dB

C = Site uncertainty, in dB = 4 dB

n = number of factors in uncertainty calculation = 3

Thus, Total Uncertainty = $0.5 (2^2 + 1^2 + 4^2)^{1/2} = \pm 2.3$ dB.

3 Test Equipment

Table 2 shows a list of the test equipment used for measurements along with the calibration information.

Table 2: Test Equipment List

Equipment	Serial Number	Date Calibrated	Calibration Due
Sunol Science, Inc. Biconical Log Periodic Antenna JB1 (Site 1)	A090501	9/21/01	9/21/02
Electrometrics BIA-30	00034	712/01	712/021
Hewlett-Packard Spectrum Analyzer: HP 8568B (Site 1)	2928A04750	6/29/01	6/29/02
Hewlett-Packard Quasi-Peak Adapter: HP 85650A (Site 1)	3303A01786	6/29/01	6/29/02
Hewlett-Packard RF Preselector: HP 85685A (Site 1)	2817A00744	6/29/01	6/29/02
Hewlett-Packard 8656A Signal Generator	00395	10/16/01	10/16/01
Solar Electronics LISN 8012-50-R-24-BNC	8379493	9/18/01	9/18/02
Solar Electronics LISN 8028-50-TS-24-BNC	N/A	9/18/01	9/18/02
Leader LFG-1300S Function Generator	9111142	N/A	N/A
B&K Precision 4040A Sweep/Function Generator	N/A	N/A	N/A
Hewlett Packard 8564E Spectrum Analyzer	3643A00657	4/11/01	4/11/02

4 Test Results

4.1 RF Power Output: (FCC Part §2.1046)

The output from the transmitter was connected to a directional coupler. The forward power was read with a power meter.

Table 3. RF Power Output

Frequency	Level	Limit	Pass/Fail
Low Channel (3) 26.985 MHz	3.55 Watts	4 Watts	Pass
Mid Channel (19)	3.39 Watts	4 Watts	Pass

27.185 MHz			
High Channel (36) 27.365 MHz	3.24 Watts	4 Watts	Pass

4.2 Occupied Bandwidth: (FCC Part §2.1049)

Occupied bandwidth was performed by coupling the output of the EUT to the input of a spectrum analyzer.

FCC Part 95.633 states that the 26 dB bandwidth of the modulated carrier shall be 8 kHz.

Three Citizen's Band Channels were tested, Channel 3 (26.98 MHz), Channel 19 (27.18 MHz), and Channel 36 (27.36 MHz). At full modulation, the occupied bandwidth was measured as reported in Table 4 with the emissions plots shown in Figure 1, Figure 2 and Figure 3:

Table 4. Occupied Bandwidth Results

Frequency	Bandwidth	Limit	Pass/Fail
Low Channel MHz	6.28 kHz	8 kHz	Pass
Mid Channel MHz	6.05 kHz	8 kHz	Pass
High Channel MHz	6.28 kHz	8 kHz	Pass

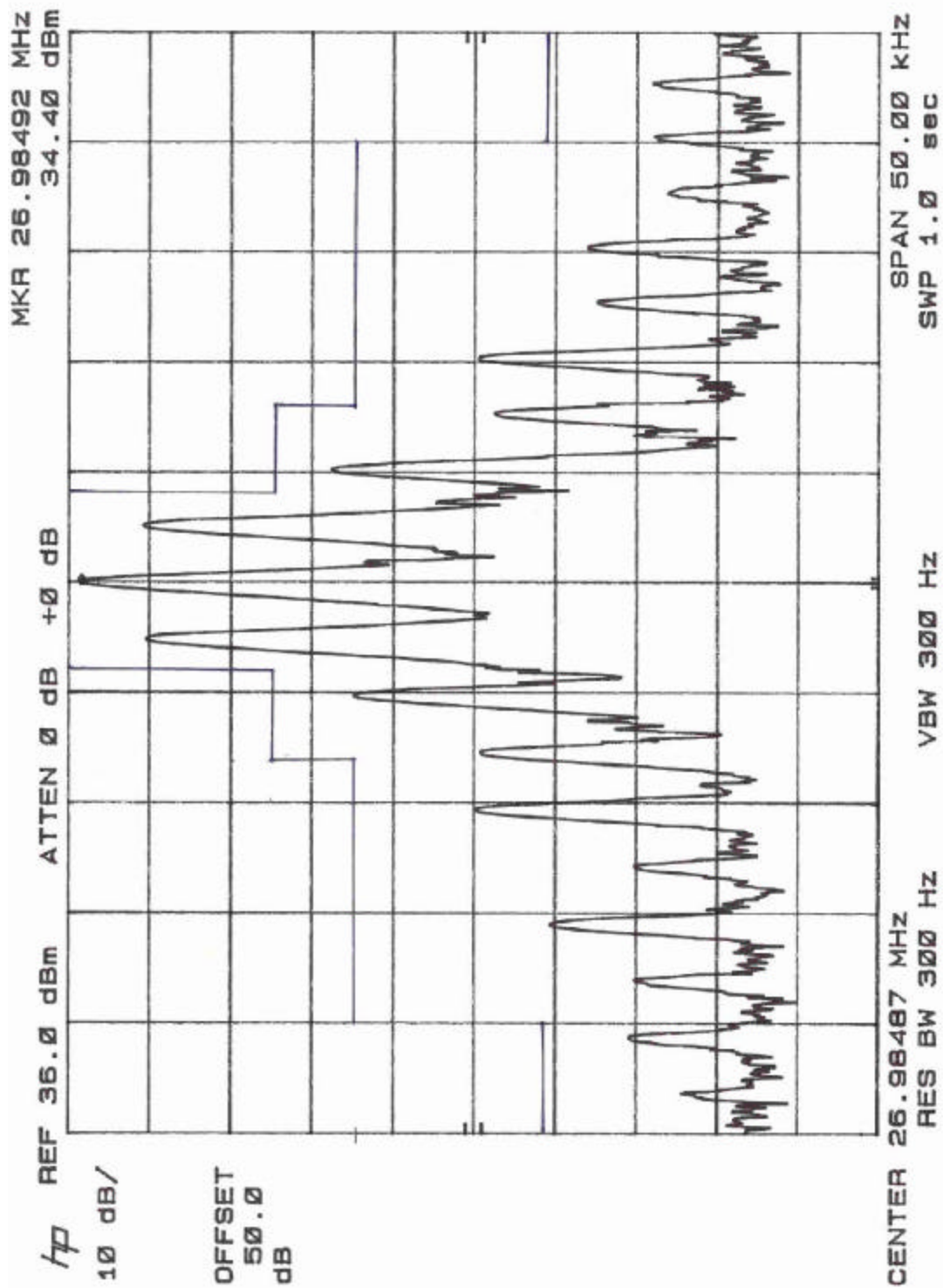


Figure 1. Occupied Bandwidth, Channel 3 (26.98 MHz)

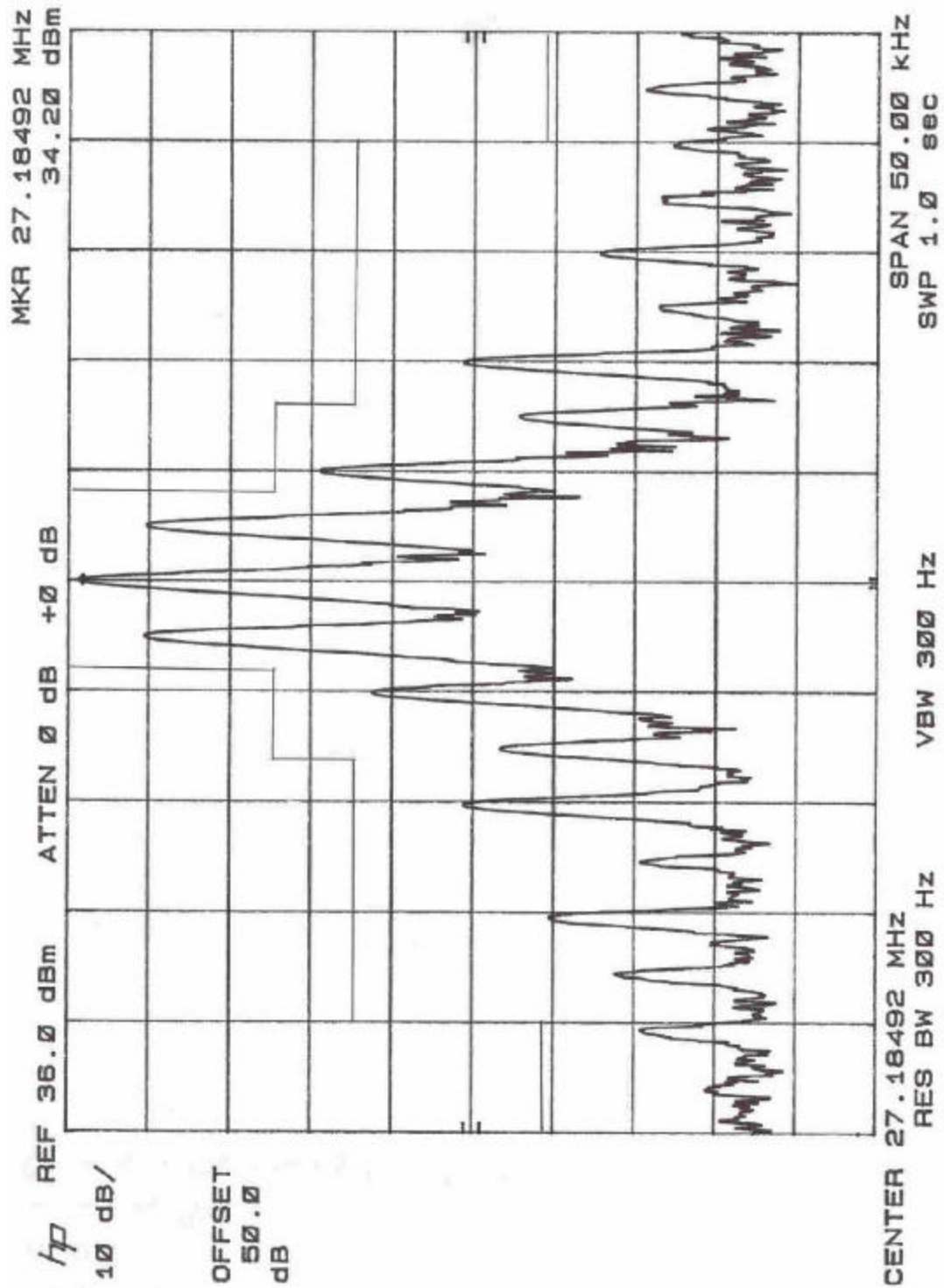


Figure 2. Occupied Bandwidth, Channel 19 (27.18 MHz)

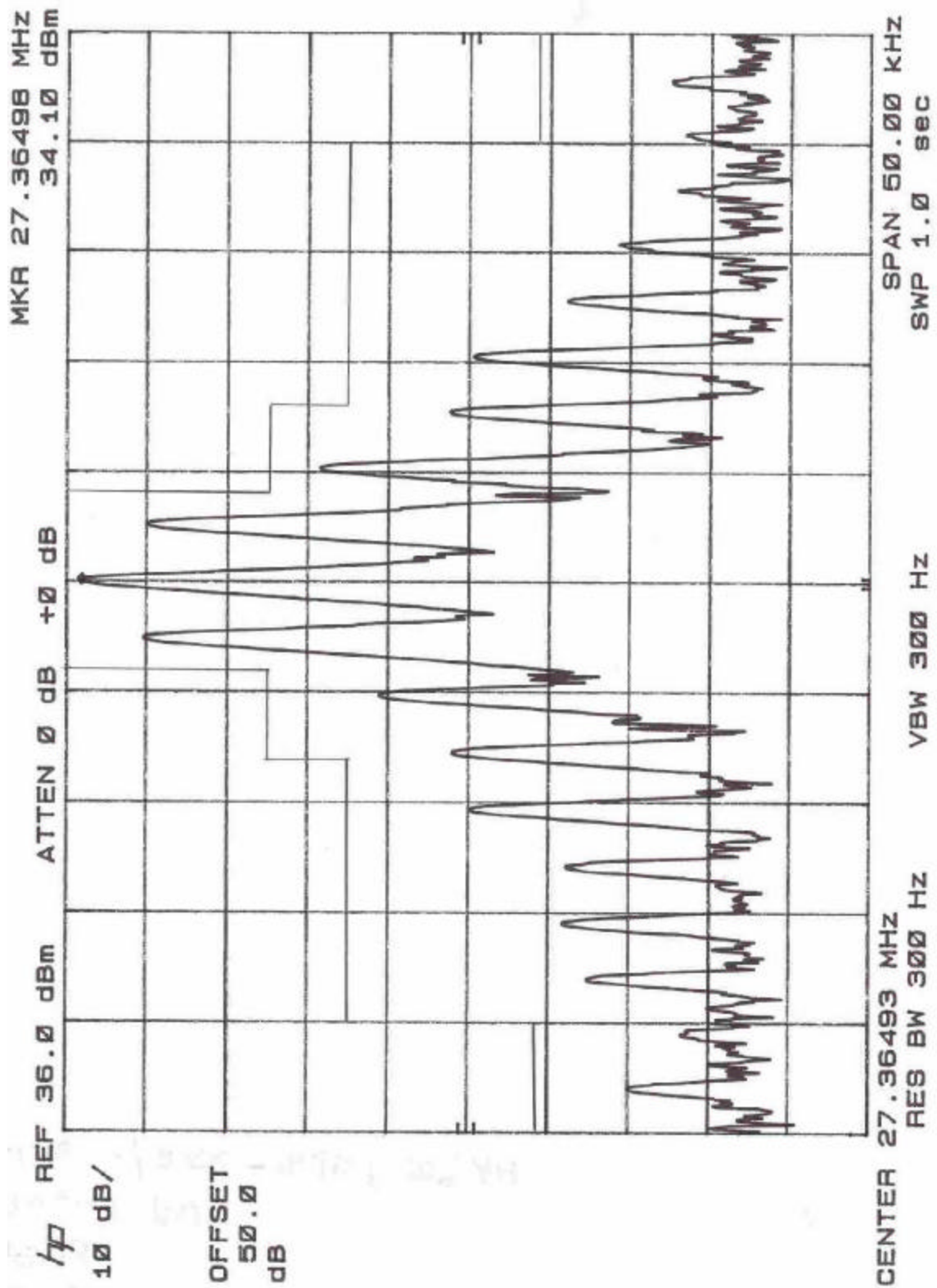


Figure 3. Occupied Bandwidth, Channel 36 (27.36 MHz)

4.3 Spurious Emissions at Antenna Terminals (FCC Part §2.1051)

The EUT must comply with requirements for spurious emissions at antenna terminals. The limits are shown in the following table.

Table 5. Conducted Spurious Emission Limits

Frequency	Fundamental	Harmonic Limit (-dBc)
Low Channel		
Fundamental	36 dBm	
Harmonics		-60 dBc
Mid Channel		
Fundamental	36 dBm	
Harmonics		-60 dBc
High Channel		
Fundamental	36 dBm	
Harmonics		-60 dBc

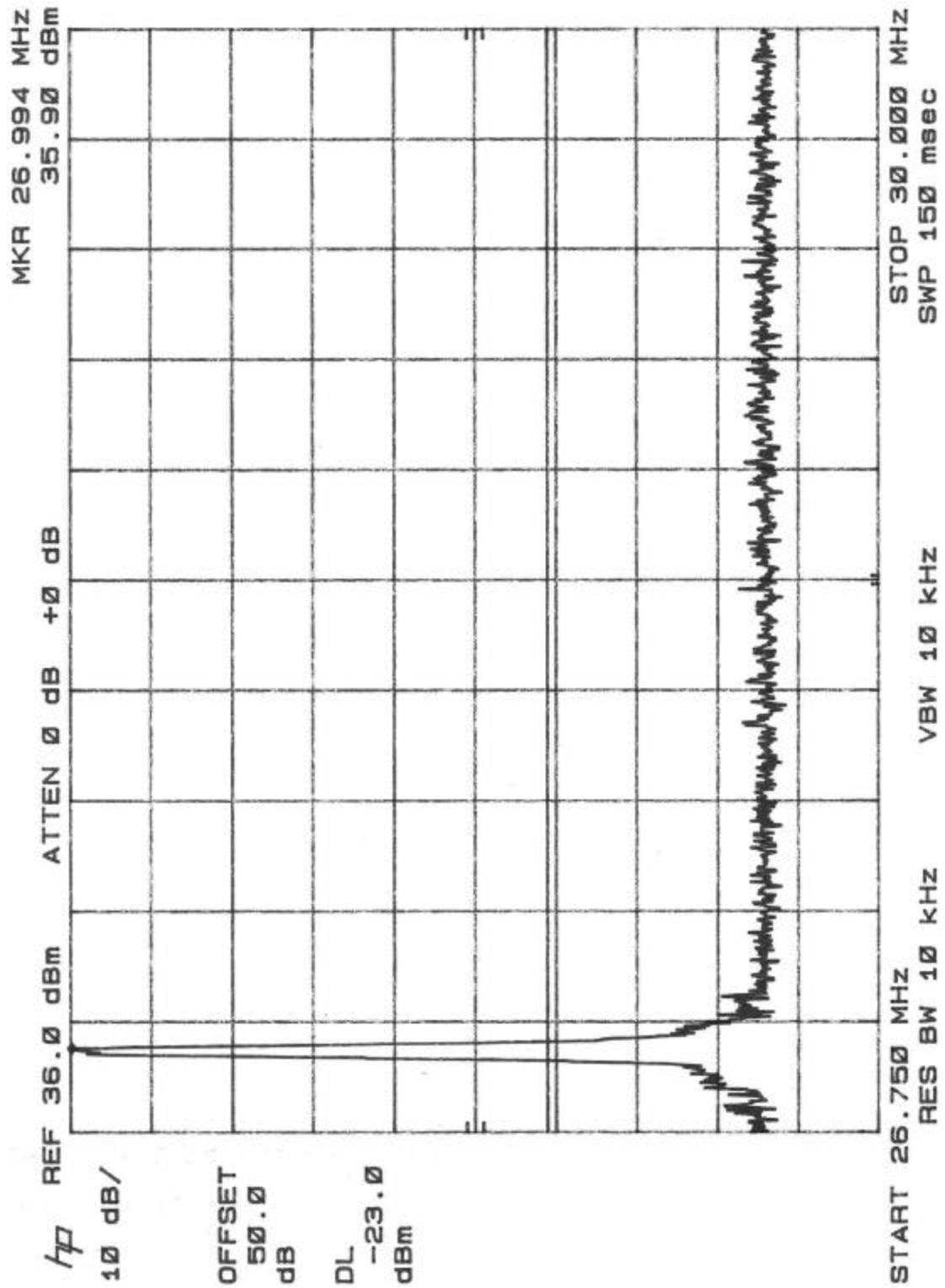


Figure 4. Conducted Spurious Emissions: Ch. 3 Plot 1

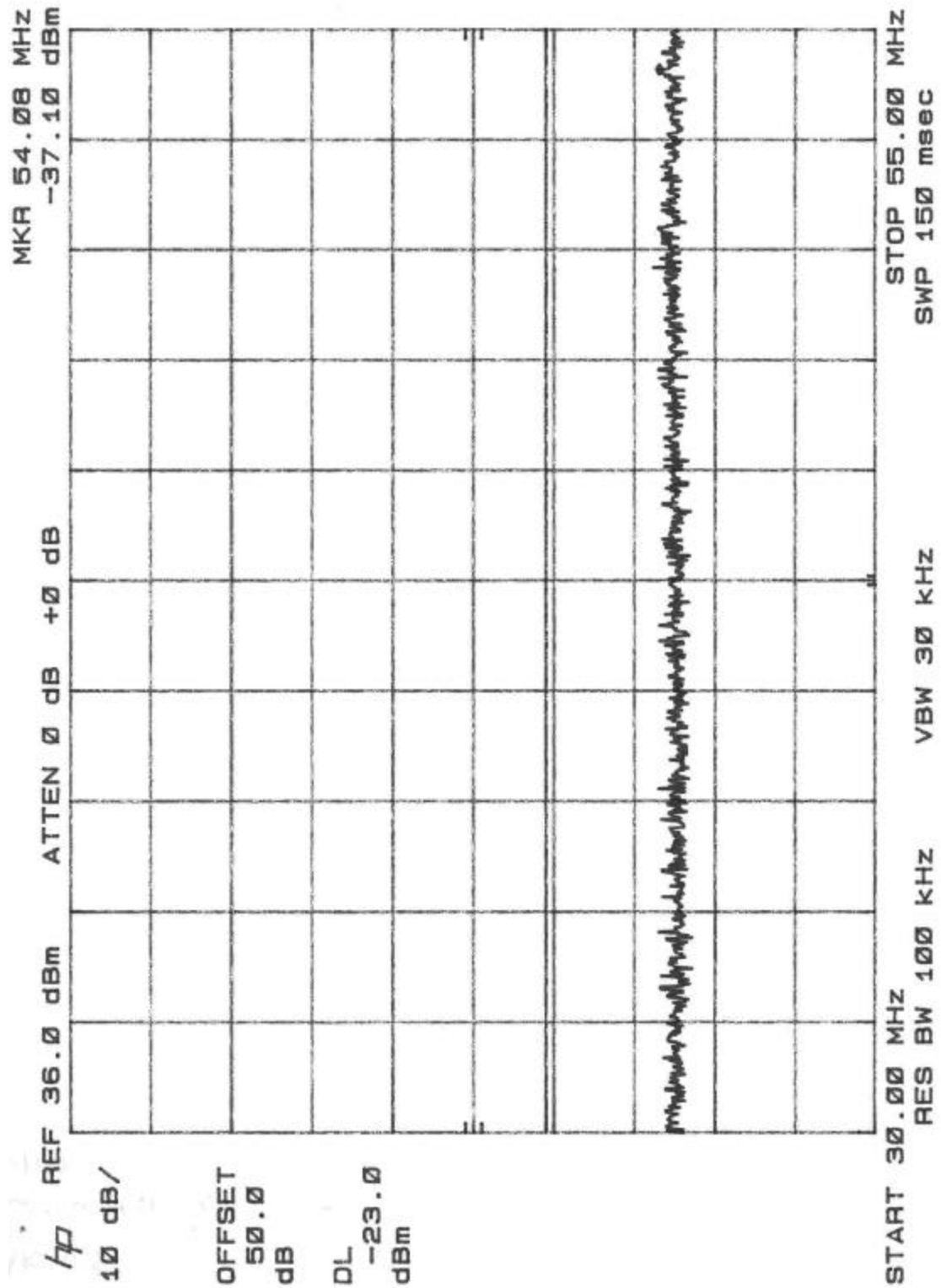


Figure 5. Conducted Spurious Emissions: Ch. 3 Plot 2

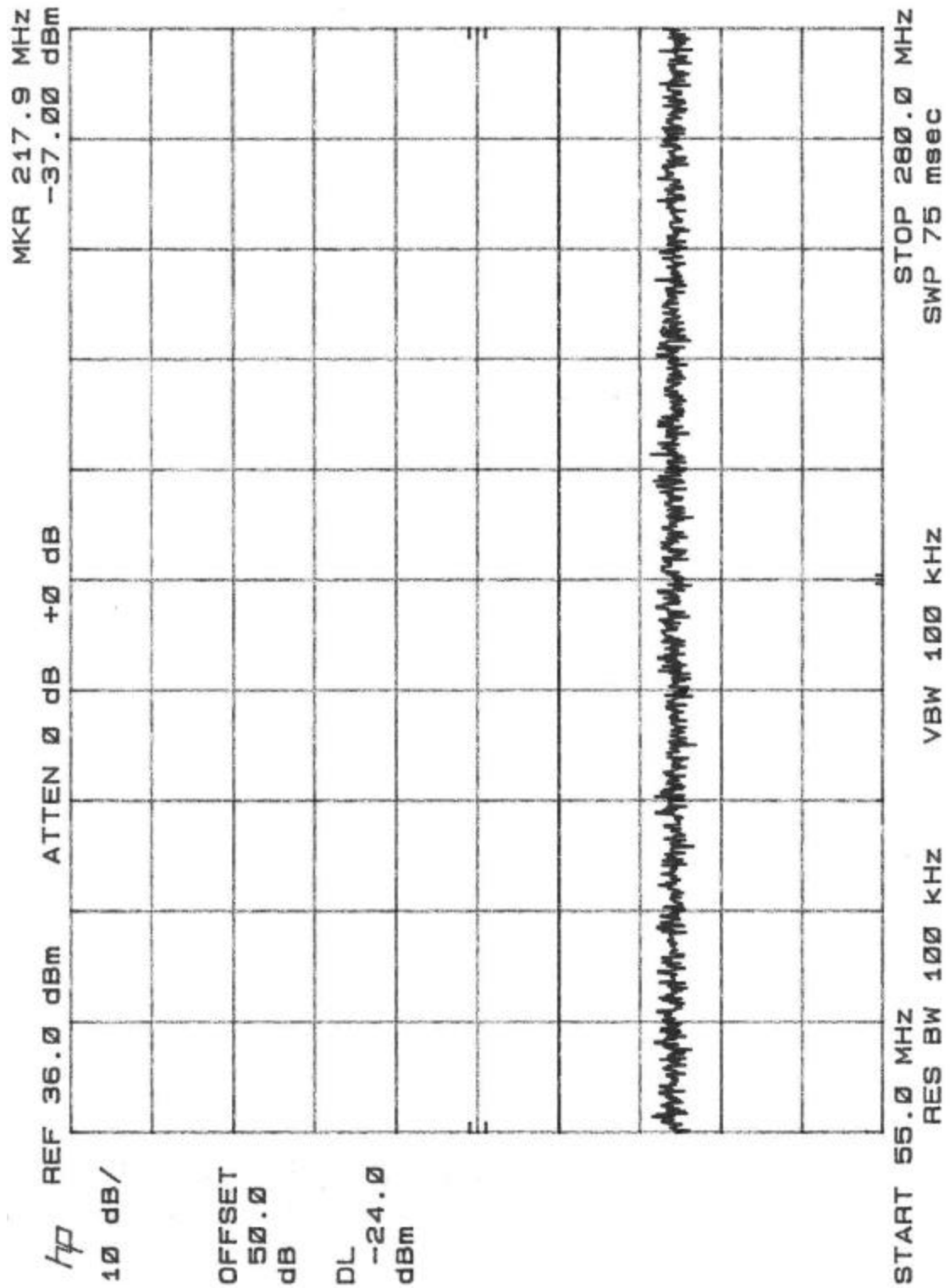


Figure 6. Conducted Spurious Emissions: Ch. 3 Plot 3

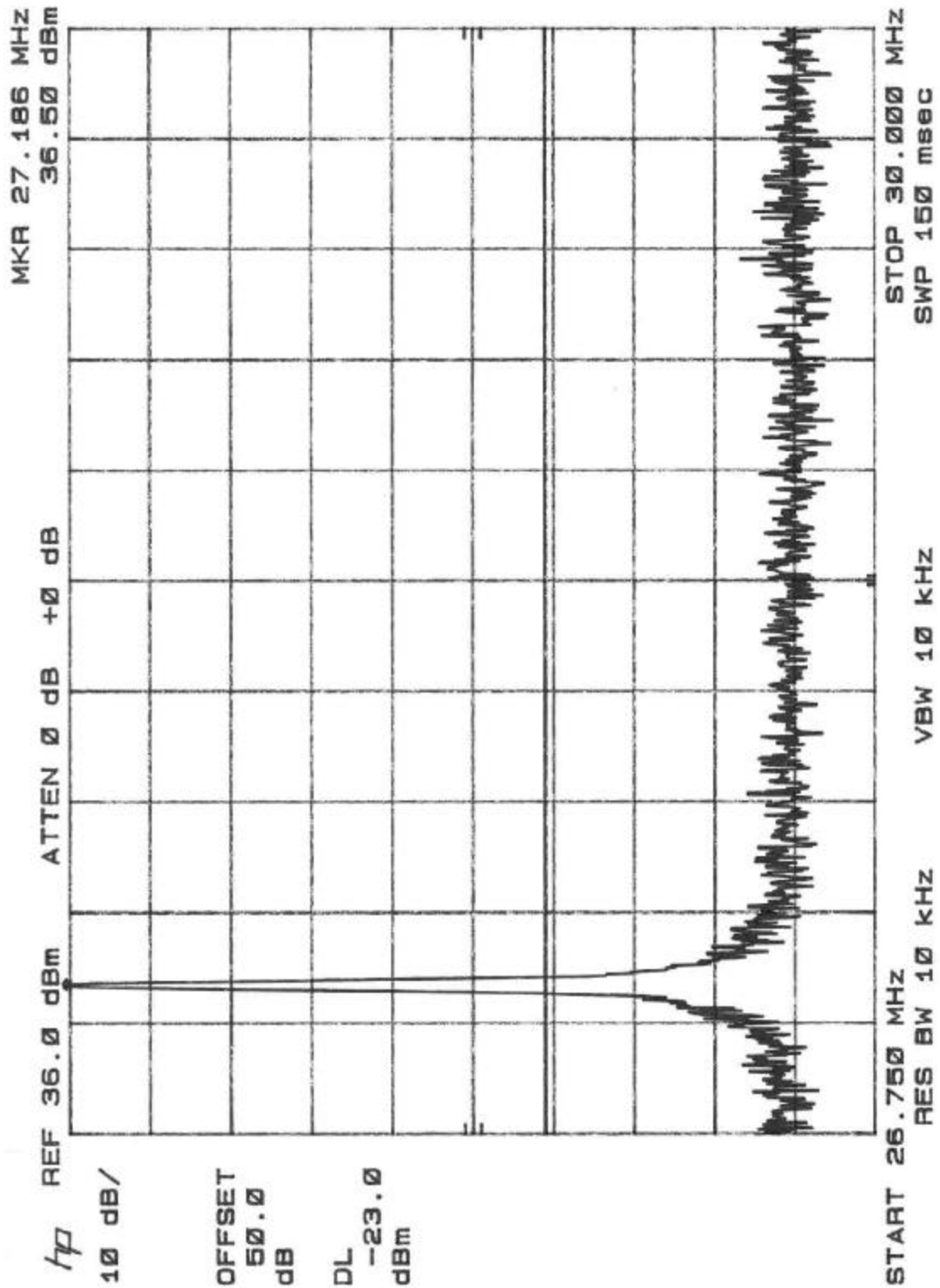


Figure 7. Conducted Spurious Emissions: Ch. 19 Plot 1

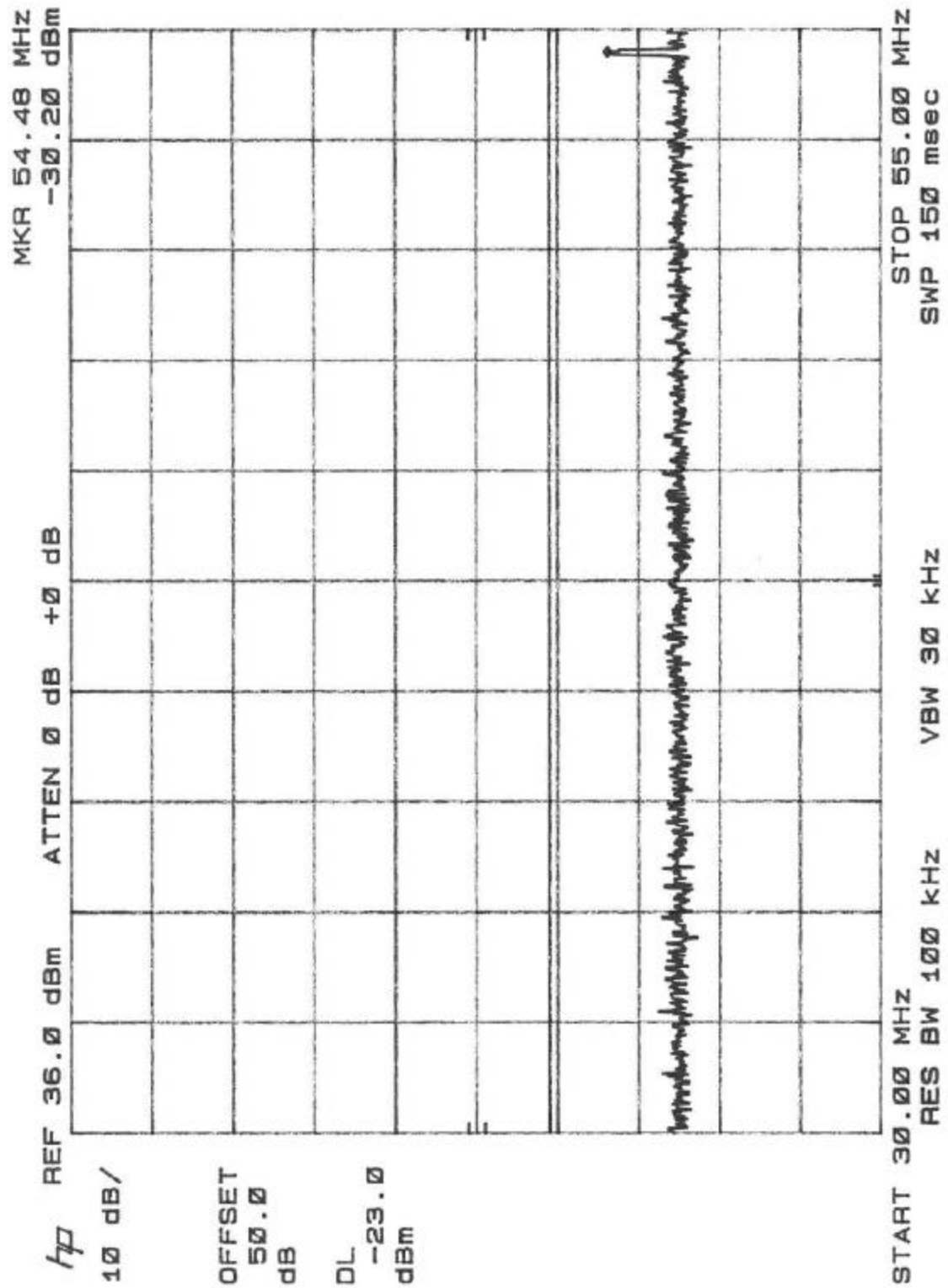


Figure 8. Conducted Spurious Emissions: Ch. 19 Plot 2

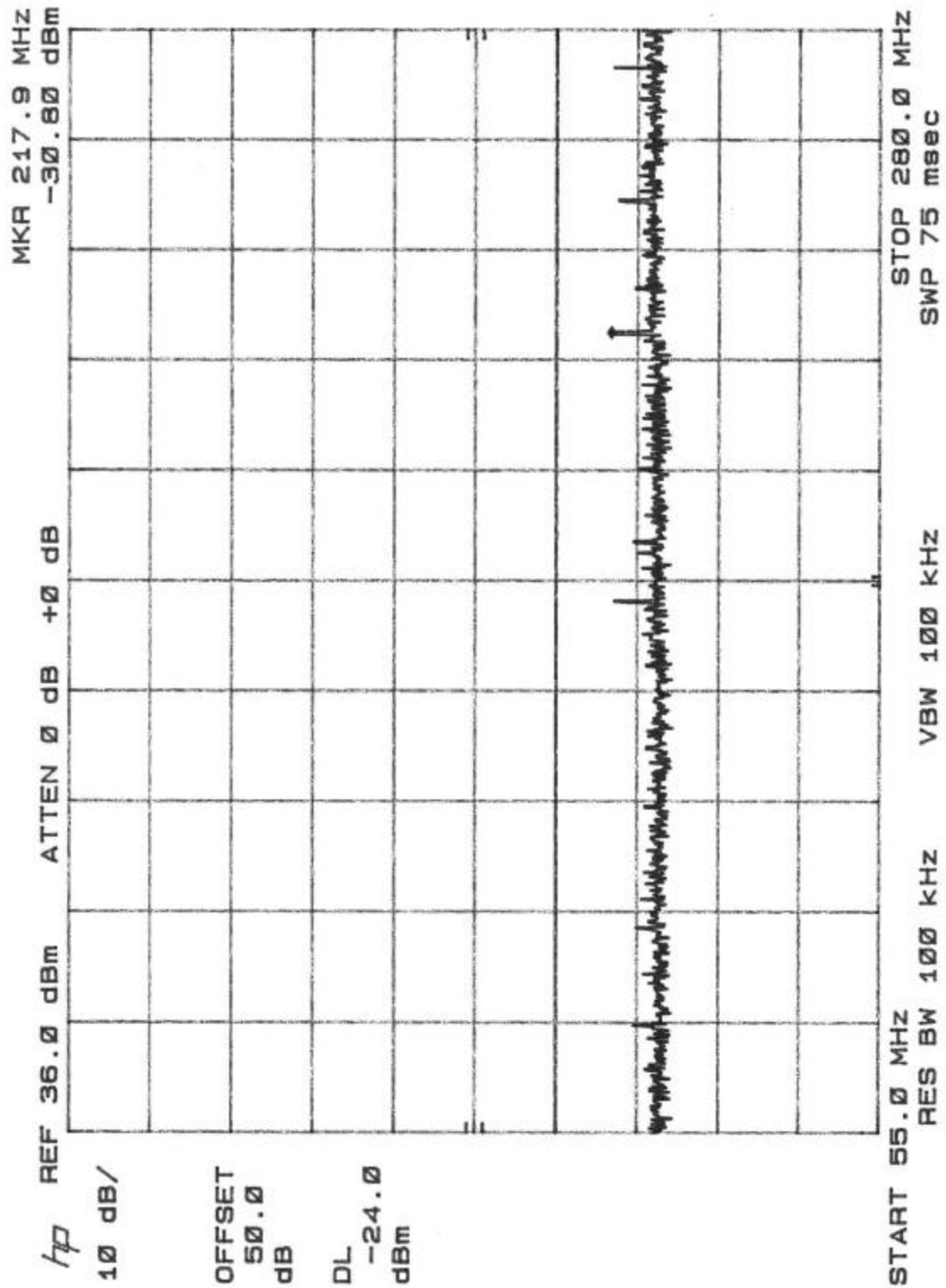


Figure 9. Conducted Spurious Emissions: Ch. 19 Plot 3

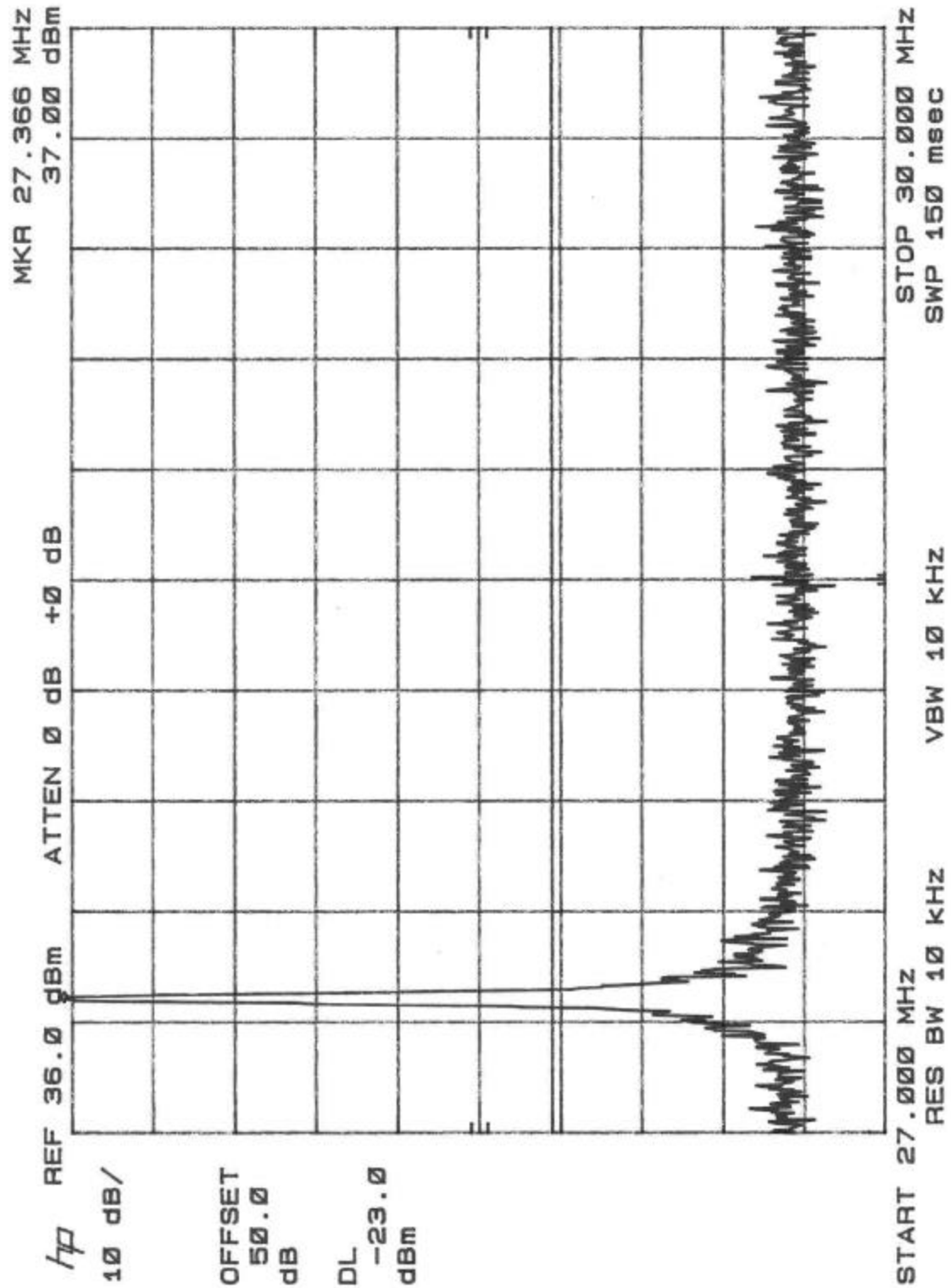


Figure 10. Conducted Spurious Emissions: Ch. 36 Plot 1

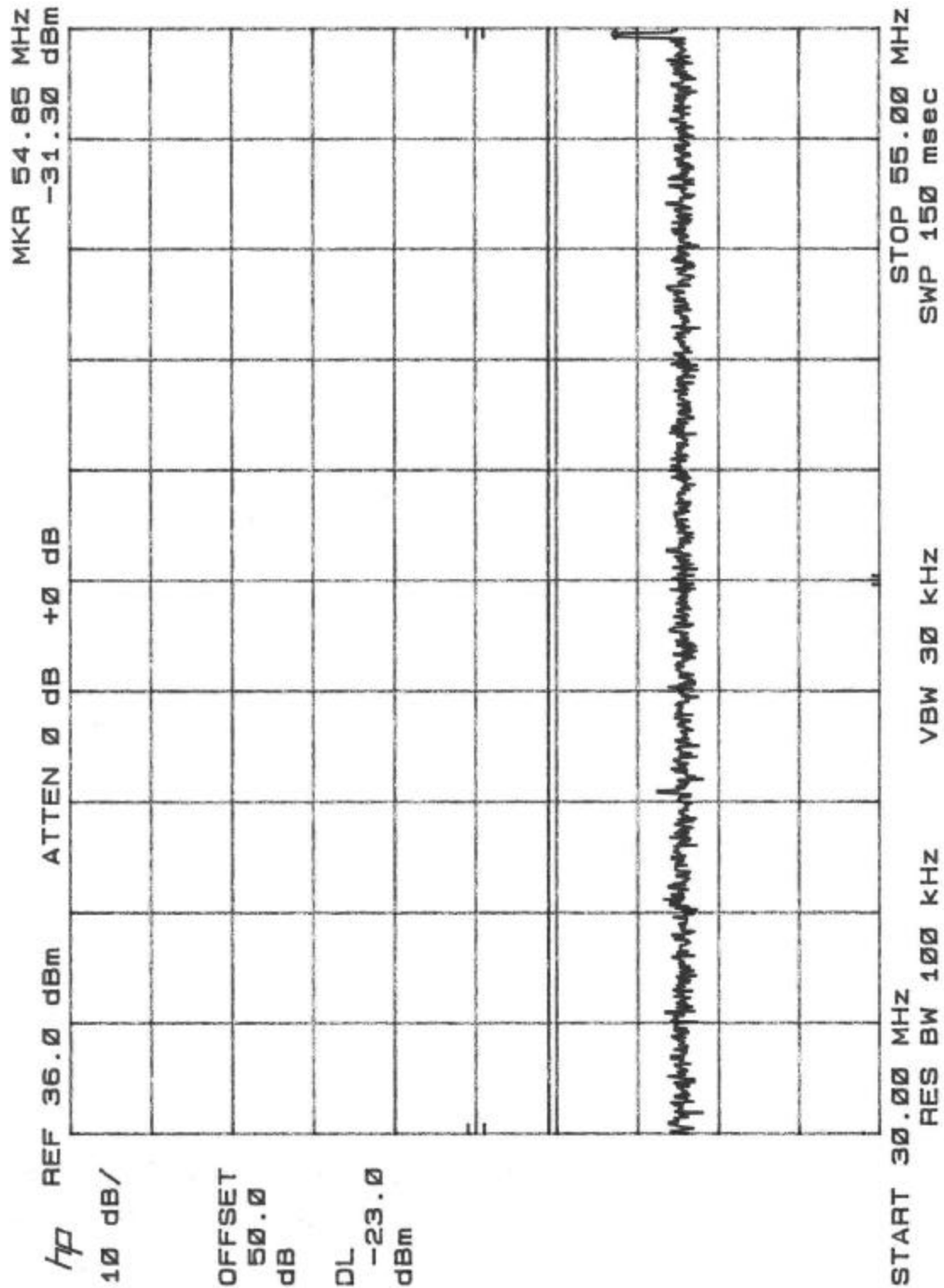


Figure 11. Conducted Spurious Emissions: Ch. 36 Plot 2

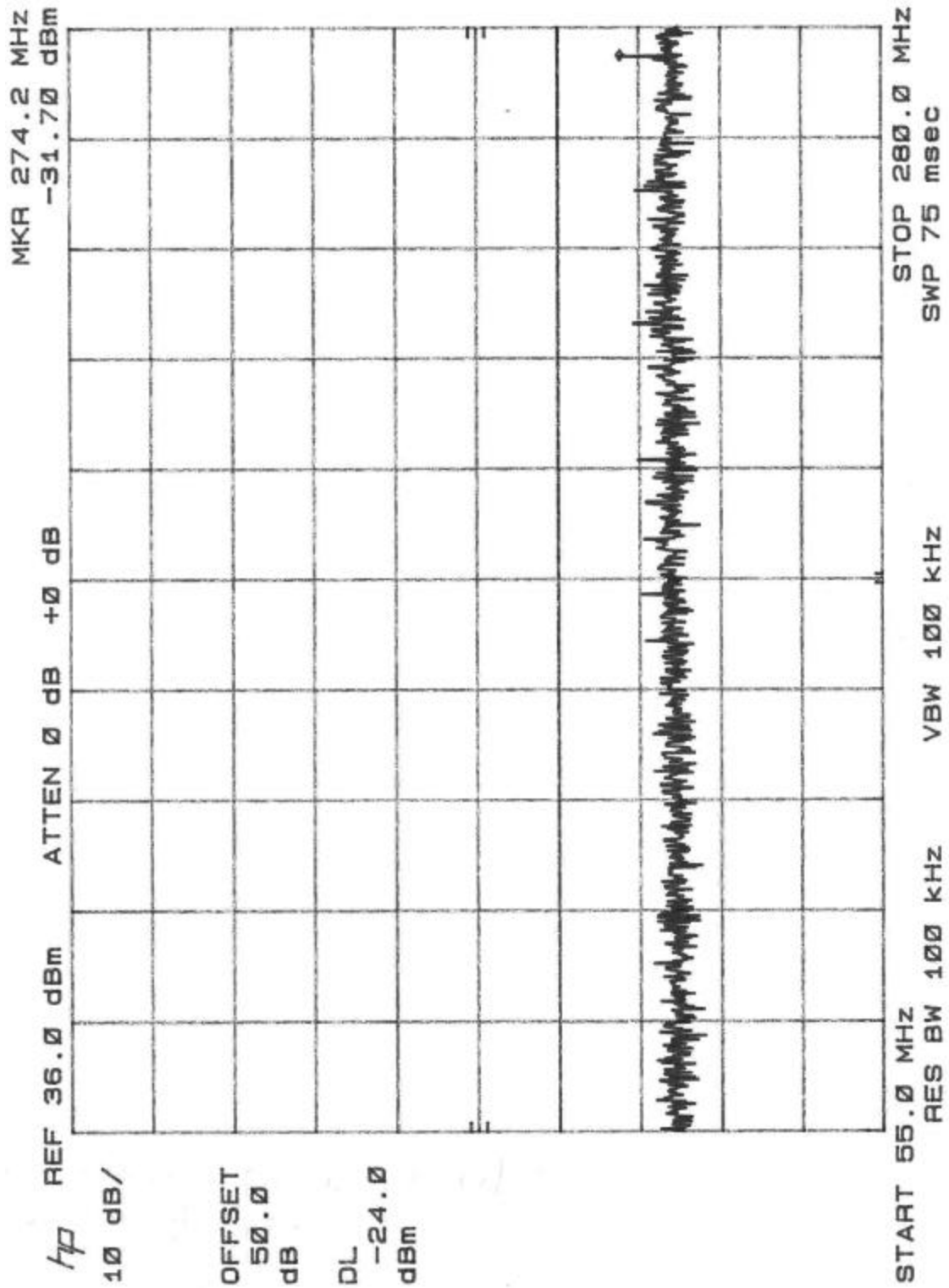


Figure 12. Conducted Spurious Emissions: Ch. 36 Plot 3

4.4 Radiated Spurious Emissions: (FCC Part §2.1053)

The EUT must comply with requirements for radiated spurious emissions. The limits are as shown in the following table.

Table 6. Radiated Spurious Emissions Limits

Frequency	Fundamental	Harmonic Level (-dBc or E-Field)
Fundamental	36 dBm	
Harmonics		-60 dBc (-24 dBm)
FCC Mask		

4.4.1 Test Procedure

The EUT was placed on motorized turntable for radiated testing on a 3-meter open field test site. The emissions from the EUT were measured continuously at every azimuth by rotating the turntable. Receiving antennas were mounted on an antenna mast to determine the height of maximum emissions. The height of the antenna was varied between 1 and 4 meters. The peripherals were placed on the table in accordance with ANSI C63.4-1992. Cables were varied in position to produce maximum emissions. Both the horizontal and vertical field components were measured.

Table 7: Radiated Emission Test Data, Channel 3

CLIENT: Trafcon/HTI
MODEL NO: AR103
DATE: 1/7/02
CLK SPEED(S): 27 MHz CB Transmit Frequencies
BY: Chad M. Beattie
JOB #: 6919
CONFIGURATION: CH 03
EIRP substitution using HP8656B Asset#00395 cal due:10.16.02; EM BIA30 Asset#00034 cal due: 07/12/02

Frequency	Polarity	Azimuth	Ant	SA Level	AFc	E-Field	Signal	Antenna	ERP	LIMIT	Margin
MHz	H/V	Degree	Height	(QP)	dB/m	dBuV/m	Generator	Gain		dBm	dB
			m	dBuV	dB/m	dBuV/m	dBm	dBi		dBm	dB
26.98	V	225.00	1.0	45.2	18.8	64.0	-23.7	-15.7	-41.5	--	--
53.97	V	180.00	1.0	41.6	13.4	55.0	-34.5	-6.3	-42.9	-24	-18.9
80.95	V	90.00	1.5	33.4	9.2	42.6	-53.0	1.4	-53.7	-24	-29.7
107.94	V	270.00	1.0	35.8	12.4	48.2	-46.0	-3.1	-51.2	-24	-27.2
134.92	V	45.00	1.0	21.8	11.3	33.1	-56.2	-0.2	-58.5	-24	-34.5
161.90	V	90.00	1.0	43.6	10.4	54.0	-30.1	-0.7	-32.9	-24	-8.9
188.89	V	135.00	1.0	34.6	11.4	46.0	-43.4	-1.5	-47.0	-24	-23.0
215.87	V	135.00	1.0	42.4	13.4	55.8	-36.0	0.5	-37.6	-24	-13.6
242.85	V	45.00	1.0	29.6	14.3	43.9	-47.8	2.9	-47.0	-24	-23.0
269.85	V	45.00	1.0	26.0	15.1	41.1	-44.6	0.2	-46.5	-24	-22.5
26.98	H	225.00	3.8	43.5	18.8	62.3	0.2	-15.7	-17.6	--	--
53.97	H	45.00	3.7	42.0	13.4	55.4	-25.5	-6.3	-33.9	-24	-9.9
80.95	H	180.00	3.4	37.3	9.2	46.5	-43.0	1.4	-43.7	-24	-19.7
107.94	H	270.00	3.4	39.5	12.4	51.9	-42.8	-3.1	-48.0	-24	-24.0
134.92	H	135.00	2.5	32.3	11.3	43.6	-51.5	-0.2	-53.8	-24	-29.8
161.90	H	135.00	2.0	51.1	10.4	61.5	-32.6	-0.7	-35.4	-24	-11.4
188.89	H	22.50	1.7	40.6	11.4	52.0	-42.9	-1.5	-46.5	-24	-22.5
215.87	H	90.00	2.3	51.0	13.4	64.4	-33.4	0.5	-35.0	-24	-11.0
242.85	H	135.00	1.7	40.7	14.3	55.0	-43.4	2.9	-42.6	-24	-18.6
269.85	H	225.00	1.7	34.9	15.1	50.0	-44.8	0.2	-46.7	-24	-22.7

Table 8: Radiated Emission Test Data, Channel 19

CLIENT: Trafcon/HTI
MODEL NO: AR103
DATE: 1/7/02
CLK SPEED(S): 27 MHz CB Transmit Frequencies
BY: Chad M. Beattie
JOB #: 6919
CONFIGURATION: CH 19
EIRP substitution using HP8656B Asset#00395 cal due:10.16.02; EM BIA30 Asset#00034 cal due: 07.12.02

Frequency	Polarity	Azimuth	Ant	SA Level	AFc	E-Field	Signal	Antenna	ERP	Limit	Margin
MHz	H/V	Degree	Height	(QP)	dB/m	dBuV/m	Generator	Gain		dBm	dB
			m	dBuV	dB/m	dBuV/m	dBm	dBi			
27.18	V	225.00	1.0	42.3	18.7	61.0	-26.9	-15.7	-44.7	--	-20.7
54.37	V	0.00	1.0	30.1	13.3	43.4	-46.4	-6.4	-54.9	-24	-30.9
81.54	V	45.00	1.8	34.4	9.3	43.7	-52.0	1.4	-52.7	-24	-28.7
108.74	V	270.00	1.0	34.8	12.4	47.2	-46.0	-3.2	-51.3	-24	-27.3
135.92	V	45.00	1.0	22.1	11.2	33.3	-56.0	-0.2	-58.3	-24	-34.3
163.11	V	90.00	1.5	41.8	10.6	52.4	-31.6	-0.7	-34.4	-24	-10.4
190.29	V	135.00	1.0	29.2	11.5	40.7	-49.5	-1.5	-53.1	-24	-29.1
217.48	V	315.00	1.0	42.5	13.5	56.0	-36.4	0.7	-37.8	-24	-13.8
244.65	V	135.00	1.0	30.0	14.3	44.3	-47.5	2.7	-46.9	-24	-22.9
271.85	V	315.00	1.0	26.7	15.2	41.9	-43.8	0.0	-45.9	-24	-21.9
27.18	H	180.00	3.7	42.5	18.7	61.2	-1.2	-15.7	-19.0	--	5.0
54.37	H	0.00	4.0	41.8	13.3	55.1	-26.5	-6.4	-35.0	-24	-11.0
81.54	H	180.00	3.8	38.2	9.3	47.5	-42.0	1.4	-42.7	-24	-18.7
108.74	H	90.00	3.7	41.7	12.4	54.1	-36.3	-3.2	-41.6	-24	-17.6
135.92	H	135.00	3.0	33.1	11.2	44.3	-51.0	-0.2	-53.3	-24	-29.3
163.11	H	135.00	2.0	50.7	10.6	61.3	-33.1	-0.7	-35.9	-24	-11.9
190.29	H	180.00	2.1	37.2	11.5	48.7	-47.0	-1.5	-50.6	-24	-26.6
217.48	H	90.00	1.5	49.5	13.5	63.0	-34.9	0.7	-36.3	-24	-12.3
244.65	H	135.00	1.8	40.8	14.3	55.1	-43.5	2.7	-42.9	-24	-18.9
271.85	H	225.00	1.2	37.5	15.2	52.7	-42.4	0.0	-44.5	-24	-20.5

Table 9: Radiated Emission Test Data, Channel 36

CLIENT: Trafcon/HTI
MODEL NO: AR103
DATE: 1/2/02
CLK SPEED(S): 27 MHz CB Transmit Frequencies
BY: S. Lavorata
JOB #: 6919
CONFIGURATION: CH 36
EIRP substitution using HP8656B Asset#00395 cal due:10.16.02; EM BIA30 Asset#00034 cal due: 07.12.02

Frequency	Polarity	Azimuth	Ant	SA Level	AFc	E-Field	Signal	Antenna	ERP	Limit	Margin
MHz	H/V	Degree	Height	(QP)	dB/m	dBuV/m	Generator	Gain	dBm	dBm	dB
27.36	V	22.00	1.0	54.7	18.7	73.4	-13.7	-15.7	-31.5	--	-7.5
54.71	V	0.00	1.0	30.1	13.2	43.3	-46.6	-6.4	-55.1	-24	-31.1
82.08	V	0.00	1.5	32.1	9.4	41.5	-54.1	1.4	-54.8	-24	-30.8
109.45	V	0.00	1.0	37.7	12.5	50.2	-42.0	-3.4	-47.5	-24	-23.5
136.81	V	45.00	1.0	27.0	11.1	38.1	-52.4	0.0	-54.5	-24	-30.5
164.19	V	293.00	1.0	48.6	10.7	59.3	-27.0	-0.7	-29.8	-24	-5.8
191.54	V	315.00	1.0	43.4	11.6	55.0	-36.7	-1.5	-40.3	-24	-16.3
218.89	V	315.00	1.0	54.9	13.7	68.6	-25.1	0.9	-26.3	-24	-2.3
246.27	V	315.00	1.0	38.6	14.4	53.0	-37.7	2.6	-37.2	-24	-13.2
273.63	V	22.00	1.0	38.7	15.2	53.9	-33.0	-0.3	-35.4	-24	-11.4
27.36	H	135.00	3.2	42.1	18.7	60.8	-1.7	-15.7	-19.5	--	4.5
54.71	H	112.00	3.5	34.2	13.2	47.4	-34.5	-6.4	-43.0	-24	-19.0
82.08	H	135.00	3.5	36.7	9.4	46.1	-43.2	1.4	-43.9	-24	-19.9
109.45	H	225.00	3.5	37.6	12.5	50.1	-39.8	-3.4	-45.3	-24	-21.3
136.81	H	90.00	3.5	34.5	11.1	45.6	-49.3	0.0	-51.4	-24	-27.4
164.19	H	225.00	3.0	44.5	10.7	55.2	-40.3	-0.7	-43.1	-24	-19.1
191.54	H	270.00	2.0	47.0	11.6	58.6	-37.4	-1.5	-41.0	-24	-17.0
218.89	H	225.00	1.5	52.1	13.7	65.8	-32.8	0.9	-34.0	-24	-10.0
246.27	H	45.00	1.5	37.8	14.4	52.2	-46.0	2.6	-45.5	-24	-21.5
273.63	H	22.00	1.0	40.8	15.2	56.0	-39.4	-0.3	-41.8	-24	-17.8