FCC CERTIFICATION TEST REPORT

for

Matric Limited
Hill City Road
R.R. #1 Box 421A
Seneca, PA 16346

FCC ID: K5B-TP105

May 14, 2001
Revised: June 18, 2001

WLL PROJECT #: 6182X

TABLE OF CONTENTS

Tables

Appendices

FCC CERTIFICATION TEST REPORT

for

FCC ID: K5B-TP105

1.0 Introduction

This report has been prepared on behalf of Matric Limited to support the attached Application for Equipment Authorization. The test and application are submitted for an Intentional Radiator under Part 15.249 of the FCC Rules and Regulations. The Equipment Under Test was the Matric Limited Model: TP 105 control transmitter.

All measurements herein 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. Calibration checks are made periodically to verify proper performance of the measuring instrumentation.

All measurements are 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.

All results reported herein relate only to the equipment tested. The measurement uncertainty of the data contained herein is ±2.3 dB. Refer to Appendix A for Statement of Measurement Uncertainty. This report shall not be used to claim product endorsement by NVLAP or any agency of the US Government.

1.1 Summary

The Matric Limited TP 105 complies with the limits for an Intentional Radiator under Part 15.249 of the FCC Rules and Regulations.

2.0 Description of Equipment Under Test (EUT)

The Matric Limited TP (Trigger Pad) 105 (EUT) is a hand-held industrial control transmitter operated by three (3)“AA” type batteries at 4.5VDC. The unit operates on three channels from 903.37 MHz to 921.37 MHz and is used to control various material handling and process control applications. The TP 105 unit contains 8 bush-buttons for control.

2.1 On-board Oscillators

The Matric Limited TP 105 contains the following oscillators: 3.686 MHz.

3.0 Test Configuration

To complete the test configuration required by the FCC, the TP 105 was configured to continuously transmit. The EUT is a standalone unit and contains no I/O ports or cables.

3.1 Testing Algorithm

The TP 105 was turned on and constantly transmitting. The unit was tested in all three orthogonal planes.

Worst case emissions are recorded in the data tables.

3.2 Conducted Emissions Testing

The TP 105 is battery-powered, therefore no conducted emissions testing was performed.

3.3 Radiated Emissions Testing

The EUT was placed on an 80 cm high 1 x 1.5 meters non-conductive 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. Biconical and log periodic broadband 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.

The output from the antenna was connected, via a preamplifier, to the input of the spectrum analyzer. The detector function was set to quasi-peak or peak, as appropriate. The measurement bandwidth on the spectrum analyzer system was set to at least 120 kHz, with all post-detector filtering no less than 10 times the measurement bandwidth. Measurements above 1 GHz were made with a 1 MHz measurement bandwidth.

3.3.1 Radiated Data Reduction and Reporting

To convert the raw spectrum analyzer radiated data into a form that can be compared with the FCC limits, it is necessary to account for various calibration factors that are supplied with the antennas and other measurement accessories. These factors are grouped into a composite antenna factor (AFc) and are supplied in the AFc column of Table 1. In addition, the Duty Cycle Correction Factor (Afd) is subtracted from the peak emission readings above 1 GHz. The AFc in dB/m is algebraically added to the Spectrum Analyzer Voltage in dbµV to obtain the Radiated Electric Field in dBµV/m. This level is then compared with the FCC limit.

Example:

Spectrum Analyzer Voltage: VdBµV

Composite Antenna Factor: AFcdB/m

Electric Field: EdBµV/m = VdBµV - AFd + AFcdB/m

To convert to linear units: Eµ V/m = antilog (EdBµV/m/20)

Data is recorded in Table 1.

Table 1: FCC 15.249 3M Radiated Emissions Data

CLIENT: Matric Limited
MODEL NO: Trigger Pad 105
TYPE/PART: 15.249
DATE: May 8, 2001
BY: Santo Lavorata
JOB #: 6182X
Tx Frequency: 906.44 (Channel 1, Low Frequency)

Frequency	Polarity	Azimuth	Ant Height	SA Level (QP)	AFc	E-Field	E-Field	Limit	Margin
MHz	H/V	Degree	m	dBuV	dB/m	dBuV/m	uV/m	uV/m	dB
906.44	V	248.0	1.5	54.9	28.2	83.1	14246.9	50000.0	-10.9
906.44	H	90.0	1.2	54.6	28.2	82.8	13763.2	50000.0	-11.2

Frequency	Polarity	Azimuth	Antenna Height	SA Level (PEAK)	AFd	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Degree	m	dBuV	dB	dB/m	dBuV/m	uV/m	uV/m	dB	
1812.28	H	225.0	1.0	59.2	-0.8	-7.1	51.3	366.5	500.0	-2.7	
1812.28	V	225.0	1.0	56.3	-0.8	-7.1	48.4	263.4	500.0	-5.6	
2719.32	H	225.0	1.0	52.2	-0.8	-4.9	46.5	211.8	500.0	-7.5	
2719.32	V	225.0	1.0	49.8	-0.8	-4.9	44.1	160.6	500.0	-9.9	
3625.76	H	248.0	1.0	54.8	-0.8	-3.7	50.3	327.5	500.0	-3.7	
3625.76	V	270.0	1.0	53.0	-0.8	-3.7	48.5	266.2	500.0	-5.5	
4532.04	H	22.0	1.0	53.7	-0.8	-2.8	50.1	320.8	500.0	-3.9	
4532.04	V	315.0	1.0	53.3	-0.8	-2.8	49.8	307.4	500.0	-4.2	
5438.64	H	225.0	1.0	48.2	-0.8	-2.0	45.4	185.7	500.0	-8.6	
5438.64	V	270.0	1.0	48.2	-0.8	-2.0	45.4	185.7	500.0	-8.6	
6345.08	H	0.0	1.0	44.0	-0.8	-0.2	43.0	141.1	500.0	-11.0	Amb
6345.08	V	0.0	1.0	44.0	-0.8	-0.2	43.0	141.1	500.0	-11.0	Amb
7251.52	H	202.0	1.0	49.3	-0.8	2.2	50.7	344.0	500.0	-3.2	
7251.52	V	180.0	1.0	49.0	-0.8	2.2	50.4	331.1	500.0	-3.6	
8157.96	V	112.0	1.0	47.8	-0.8	2.2	49.2	289.4	500.0	-4.7	
8157.96	H	225.0	1.0	47.8	-0.8	2.2	49.2	288.4	500.0	-4.8	
9064.40	V	180.0	1.0	47.0	-0.8	2.3	48.5	265.5	500.0	-5.5	
9064.40	H	202.0	1.0	46.5	-0.8	2.3	48.0	250.7	500.0	-6.0	

Table 1 (Cont'd.): FCC 15.249 3M Radiated Emissions Data

CLIENT: Matric Limited
MODEL NO: Trigger Pad 105
TYPE/PART: 15.249
DATE: May 23, 2001
BY: Greg Snyder
JOB #: 6182X
Tx Frequency: 912.37 MHz (Channel 4, Mid Frequency)

Frequency	Polarity	Azimuth	Ant Height	SA Level (QP)	AFc	E-Field	E-Field	Limit	Margin
MHz	H/V	Degree	m	dBuV	dB/m	dBuV/m	uV/m	uV/m	dB
912.37	H	270.0	1.5	56.7	28.3	85.0	17728.1	50000.0	-9.0
912.37	V	270.0	1.0	54.5	28.3	82.8	13761.4	50000.0	-11.2

Frequency	Polarity	Azimuth	Antenna Height	SA Level (PEAK)	AFd	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Degree	m	dBuV	dB	dB/m	dBuV/m	uV/m	uV/m	dB	
1824.90	V	225.0	1.0	59.5	-0.8	-7.1	51.6	382.3	500.0	-2.3	
2737.36	V	225.0	1.0	52.0	-0.8	-4.9	46.3	207.6	500.0	-7.6	
3649.80	V	270.0	1.0	50.8	-0.8	-3.7	46.3	207.3	500.0	-7.6	
4562.15	V	270.0	1.0	49.0	0.0	-2.7	46.3	205.4	500.0	-7.7	
5474.70	V	315.0	1.0	46.5	-0.8	-2.0	43.7	153.2	500.0	-10.3	
6450.16	V	0.0	1.0	45.1	-0.8	0.2	44.5	167.8	500.0	-9.5	Amb
7299.60	V	315.0	1.0	46.3	-0.8	2.2	47.7	242.7	500.0	-6.3	Amb
8212.04	V	22.0	1.0	46.3	-0.8	2.2	47.7	242.7	500.0	-6.3	Amb
9124.42	V	0.0	1.0	44.0	-0.8	2.4	45.6	189.6	500.0	-8.4	Amb
1824.90	H	225.0	1.0	56.7	-0.8	-7.1	48.8	276.9	500.0	-5.1	
2737.36	H	315.0	1.0	49.5	-0.8	-4.9	43.8	155.7	500.0	-10.1	
3649.80	H	248.0	1.0	49.8	-0.8	-3.7	45.3	184.8	500.0	-8.6	
4562.15	H	22.0	1.0	48.5	-0.8	-2.7	45.0	176.9	500.0	-9.0	
5474.70	H	22.0	1.0	46.0	-0.8	-2.0	43.2	144.6	500.0	-10.8	
6450.16	H	225.0	1.0	44.6	-0.8	0.2	44.0	158.4	500.0	-10.0	Amb
7299.60	H	0.0	1.0	45.8	-0.8	2.2	47.2	229.1	500.0	-6.8	
8212.04	H	202.0	1.0	46.6	-0.8	2.2	48.0	251.2	500.0	-6.0	Amb
9124.42	H	202.0	1.0	46.0	-0.8	2.4	47.6	238.7	500.0	-6.4	Amb

Table 1 (Cont'd.): FCC 15.249 3M Radiated Emissions Data

CLIENT: Matric Limited
MODEL NO: Trigger Pad 105
TYPE/PART: 15.249
DATE: May 23, 2001
BY: Greg Snyder
JOB #: 6182X
Tx Frequency: 921.37 MHz (Channel 7, High Frequency)

Frequency	Polarity	Azimuth	Ant Height	SA Level (QP)	AFc	E-Field	E-Field	Limit	Margin
MHz	H/V	Degree	m	dBuV	dB/m	dBuV/m	uV/m	uV/m	dB
921.37	V	202.0	1.4	53.4	28.4	81.8	12333.9	50000.0	-12.2
921.37	H	90.0	1.2	52.0	28.4	80.4	10497.9	50000.0	-13.6

Frequency	Polarity	Azimuth	Antenna Height	SA Level (PEAK)	AFd	AFc	E-Field	E-Field	Limit	Margin	
MHz	H/V	Degree	m	dBuV	dB	dB/m	dBuV/m	uV/m	uV/m	dB	
1842.80	V	225.0	1.0	55.3	-0.8	-7.0	47.5	238.2	500.0	-6.4	
2764.41	V	225.0	1.0	50.2	-0.8	-4.8	44.6	169.5	500.0	-9.4	
3685.57	V	270.0	1.0	47.5	-0.8	-3.6	43.1	142.4	500.0	-10.9	
4607.27	V	270.0	1.0	48.6	0.0	-2.7	45.9	197.1	500.0	-8.1	
5528.78	V	315.0	1.0	44.3	-0.8	-2.0	41.5	119.5	500.0	-12.4	
6450.16	V	0.0	1.0	45.0	-0.8	0.2	44.4	165.9	500.0	-9.6	Amb
7371.64	V	315.0	1.0	45.4	-0.8	2.2	46.8	218.8	500.0	-7.2	Amb
8293.11	V	22.0	1.0	45.7	-0.8	2.2	47.1	226.5	500.0	-6.9	Amb
9214.57	V	0.0	1.0	44.5	-0.8	2.5	46.2	203.5	500.0	-7.8	Amb
1842.80	H	225.0	1.0	56.3	-0.8	-7.0	48.5	267.3	500.0	-5.4	
2764.41	H	315.0	1.0	47.3	-0.8	-4.8	41.7	121.4	500.0	-12.3	
3685.57	H	248.0	1.0	49.5	-0.8	-3.6	45.1	179.3	500.0	-8.9	
4607.27	H	22.0	1.0	49.0	-0.8	-2.7	45.5	188.2	500.0	-8.5	
5528.78	H	22.0	1.0	46.7	0.0	-2.0	44.7	172.7	500.0	-9.2	
6450.16	H	225.0	1.0	44.5	-0.8	0.2	43.9	156.6	500.0	-10.1	Amb
7371.64	H	0.0	1.0	46.0	-0.8	2.2	47.4	234.4	500.0	-6.6	
8293.11	H	202.0	1.0	44.8	-0.8	2.2	46.2	204.2	500.0	-7.8	Amb
9214.57	H	202.0	1.0	45.8	0.0	2.5	48.3	259.2	500.0	-5.7	Amb

Table 2: System Under Test

FCC ID: K5B-TP105

EUT: Matric Limited Trigger Pad 105; M/N: TP 105

Table 3: Interface Cables Used

The TP 105 is a battery-powered stand-alone unit; therefore no ports or cables are utilized.

Table 4: Measurement Equipment Used

The following equipment is used to perform measurements:

Hewlett-Packard Spectrum Analyzer: HP8564E

Hewlett-Packard Spectrum Analyzer: HP8568B

Hewlett-Packard Spectrum Analyzer: HP8593A

Hewlett-Packard Quasi-Peak Adapter: HP85650A

Hewlett-Packard Preselector: HP85685A

Hewlett-Packard Preamplifier: HP8449B

Antenna Research Associates, Inc. Biconical Log Periodic Antenna: LPB-2520A (Site 2)

Antenna Research Associates, Inc. Horn Antenna: DRG-118/A

Solar 50 Ω/50 µH Line Impedance Stabilization Network: 8012-50-R-24-BNC

Solar 50 Ω/50 µH Line Impedance Stabilization Network: 8028-50-TS-24-BNC

AH Systems, Inc. Portable Antenna Mast: AMS-4 (Site 2)

AH Systems, Inc. Motorized Turntable (Site 2)

RG-214 semi-rigid coaxial cable

RG-223 double-shielded coaxial cable

EXHIBIT 1

DUTY CYCLE CALCULATIONS

The following page shows spectrum analyzer plots of the transmitter coding. The following calculations show the worst-case 100 ms duty cycle correction used for calculating the average level of the carrier, harmonics, and emissions.

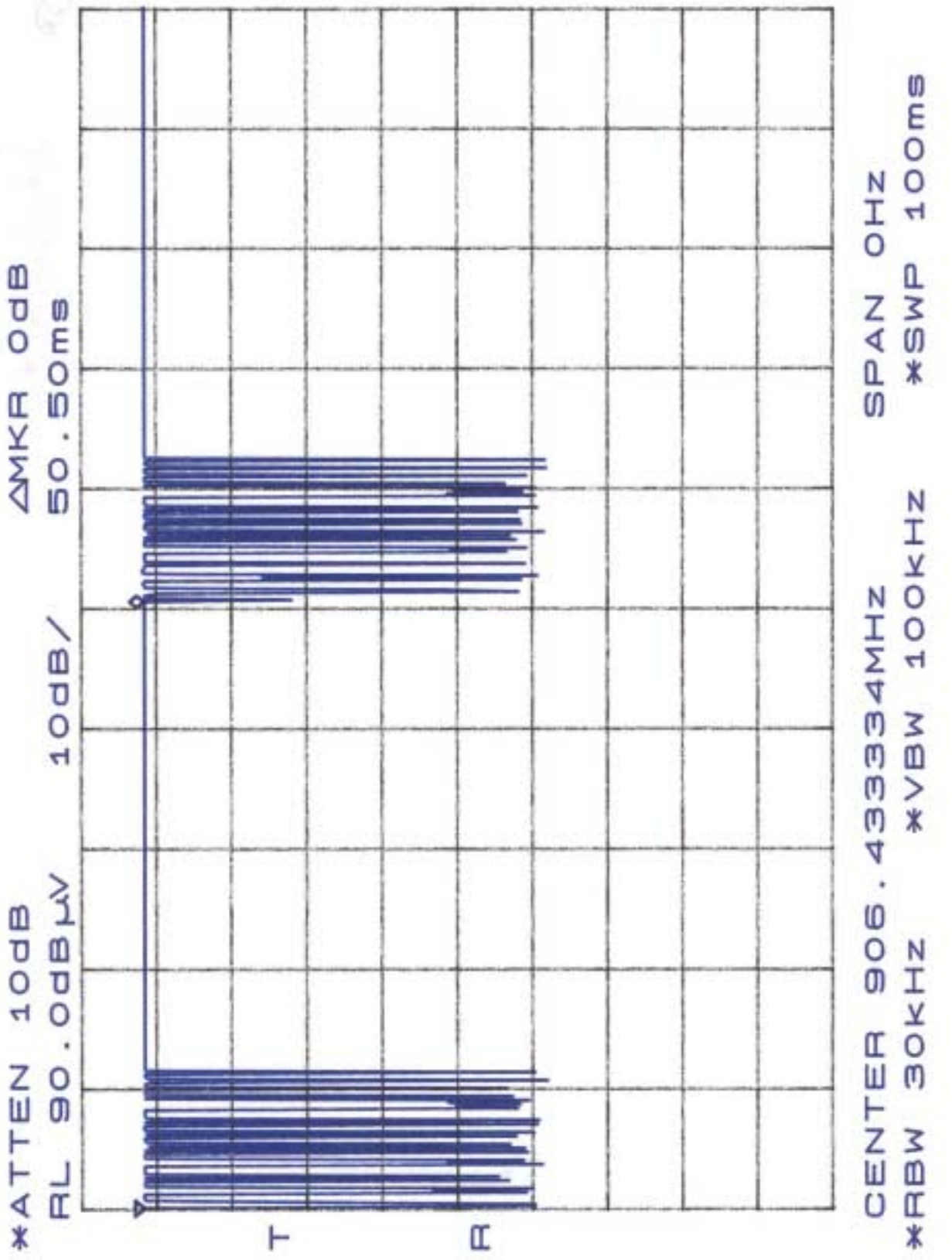
Plot 1 shows that the transmitter on time over a 100 ms period and the pulse train period of 50.5 ms. The pulse widths are shown in Plots 2 through 6. From these plots, the following duty cycle correction factor is calculated.

ON TIME PER PULSE TRAIN:

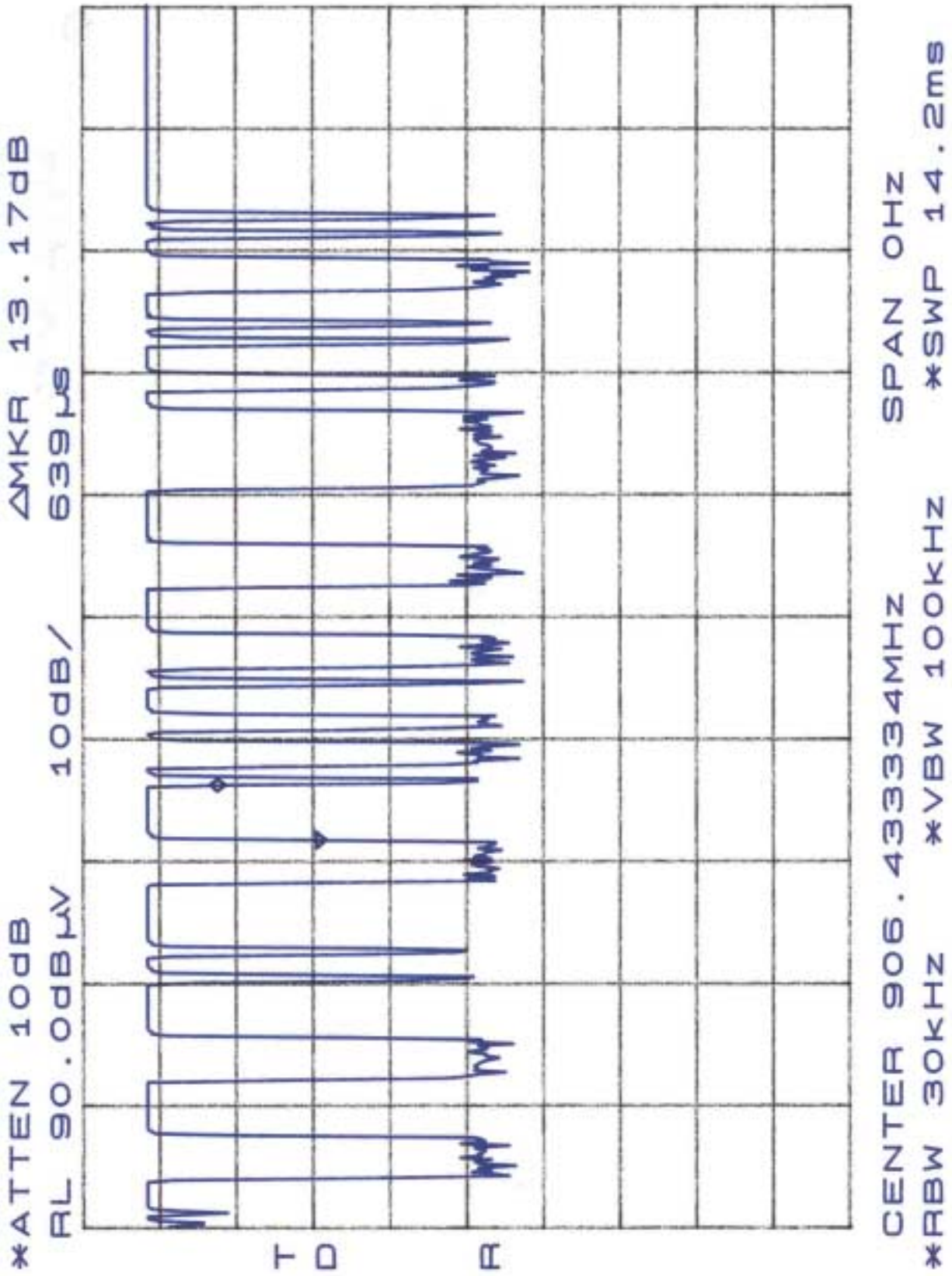
(5 x 639 µs) + (6 x 189 µs) + (3 x 237 µs) + (4 x 331 µs) + (1 x 734 µs) + 38.8 ms
= 45.9 ms ON TIME PER 50.5 ms Pulse Train

= 45.9 ms/50.5 ms = 0.9089 Duty Cycle
= 91% Duty Cycle
= -0.83 dB AFd

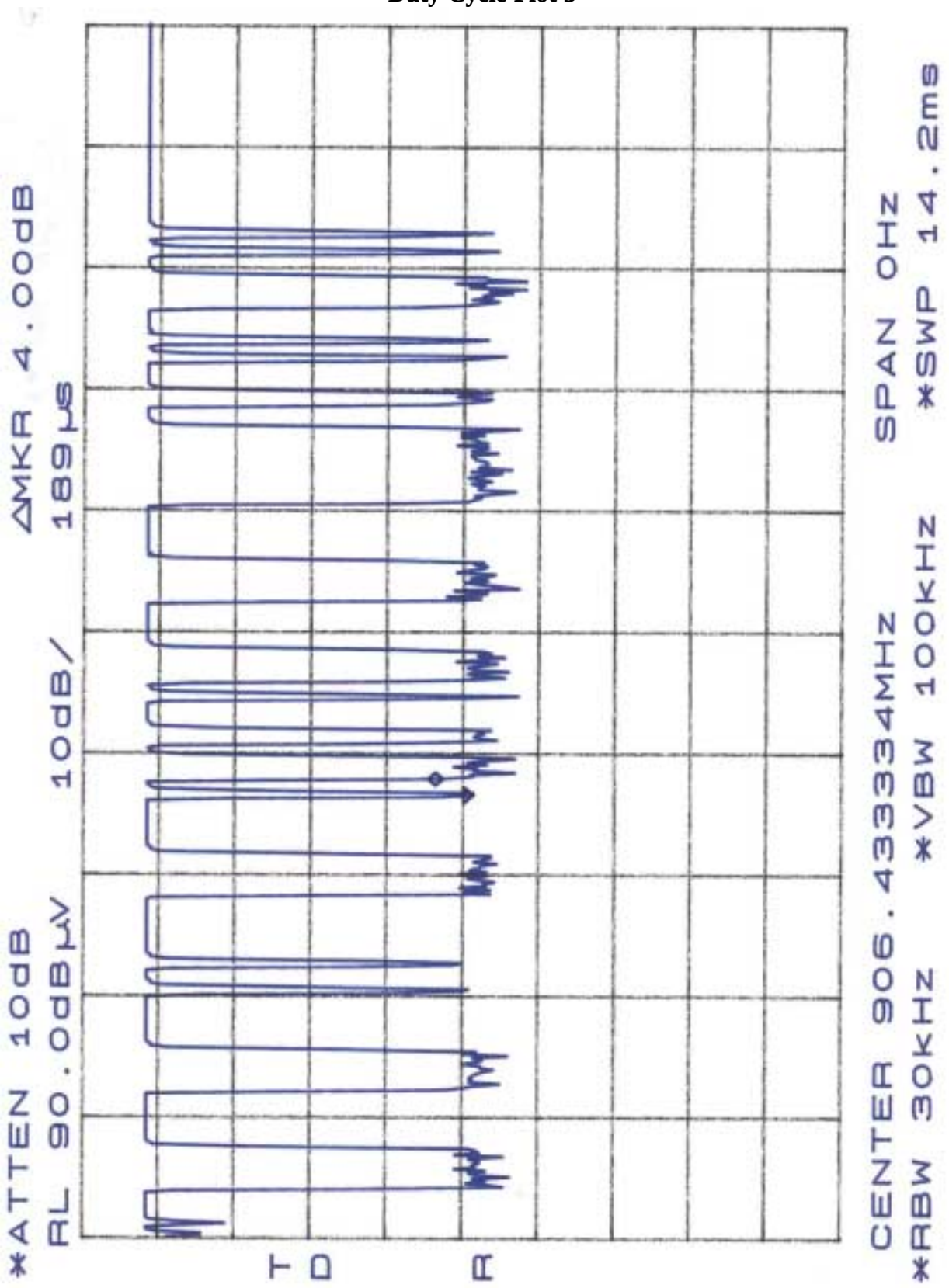
Duty Cycle Plot 1



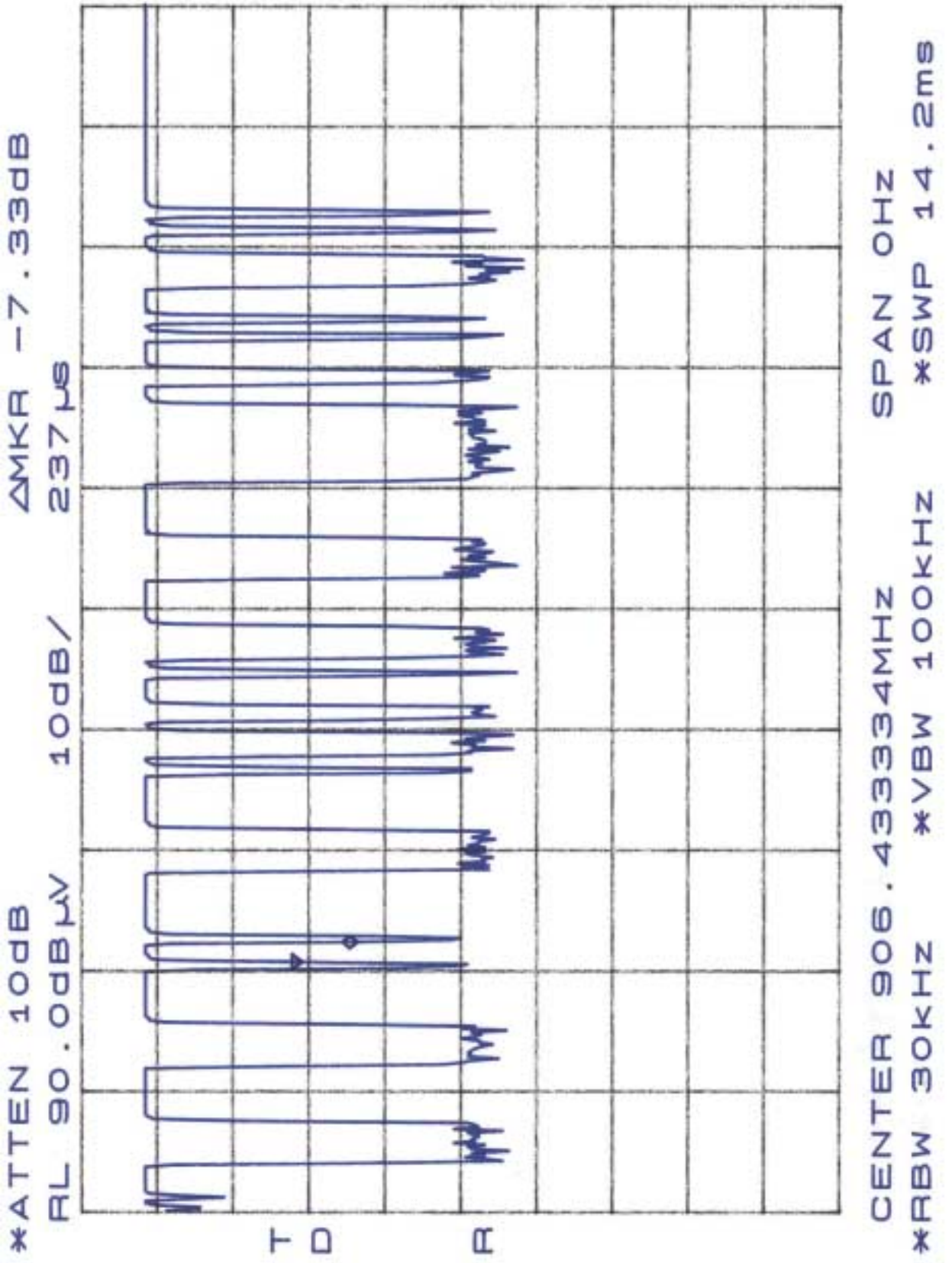
Duty Cycle Plot 2



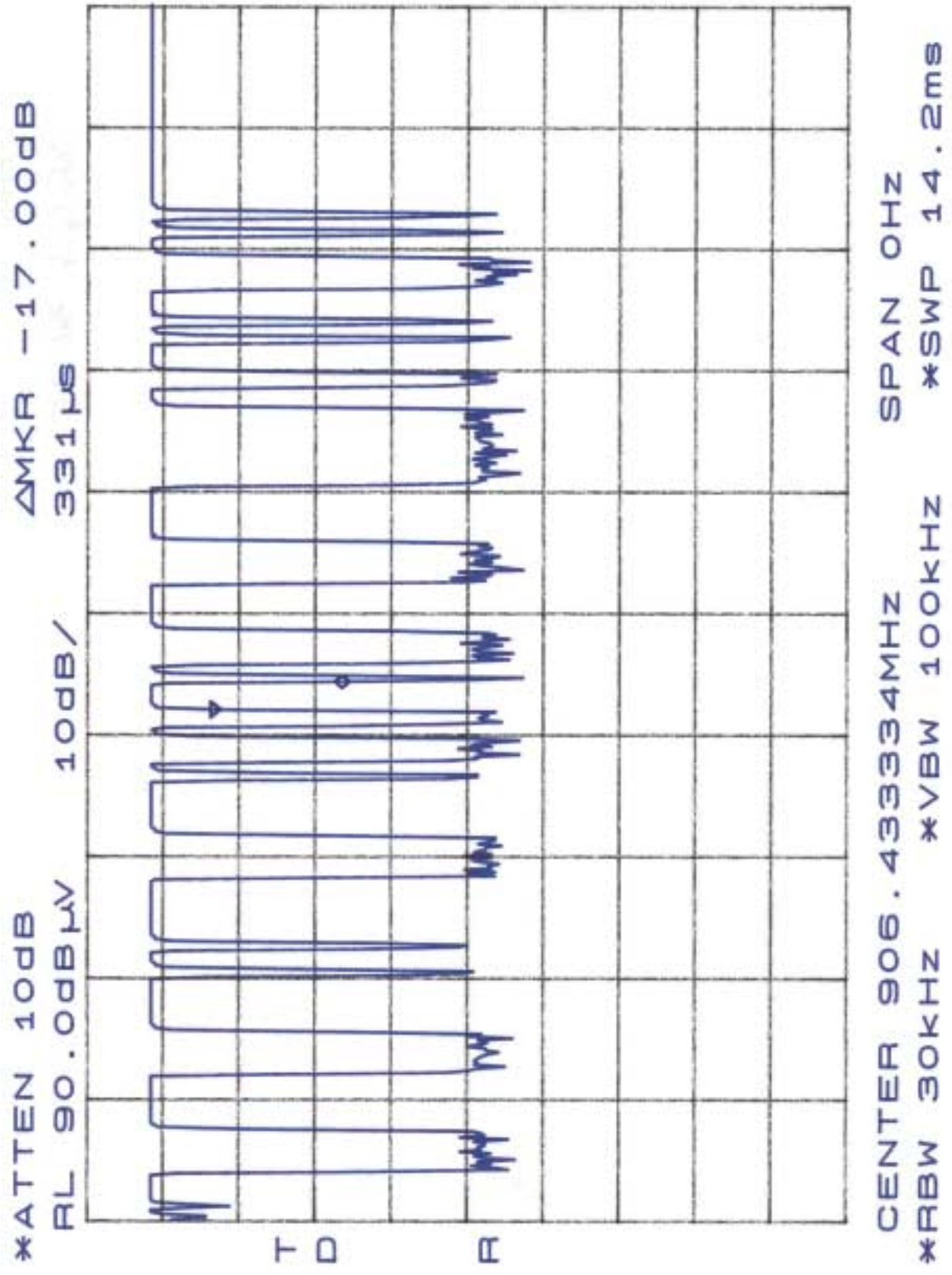
Duty Cycle Plot 3



Duty Cycle Plot 4



Duty Cycle Plot 5



Duty Cycle Plot 6

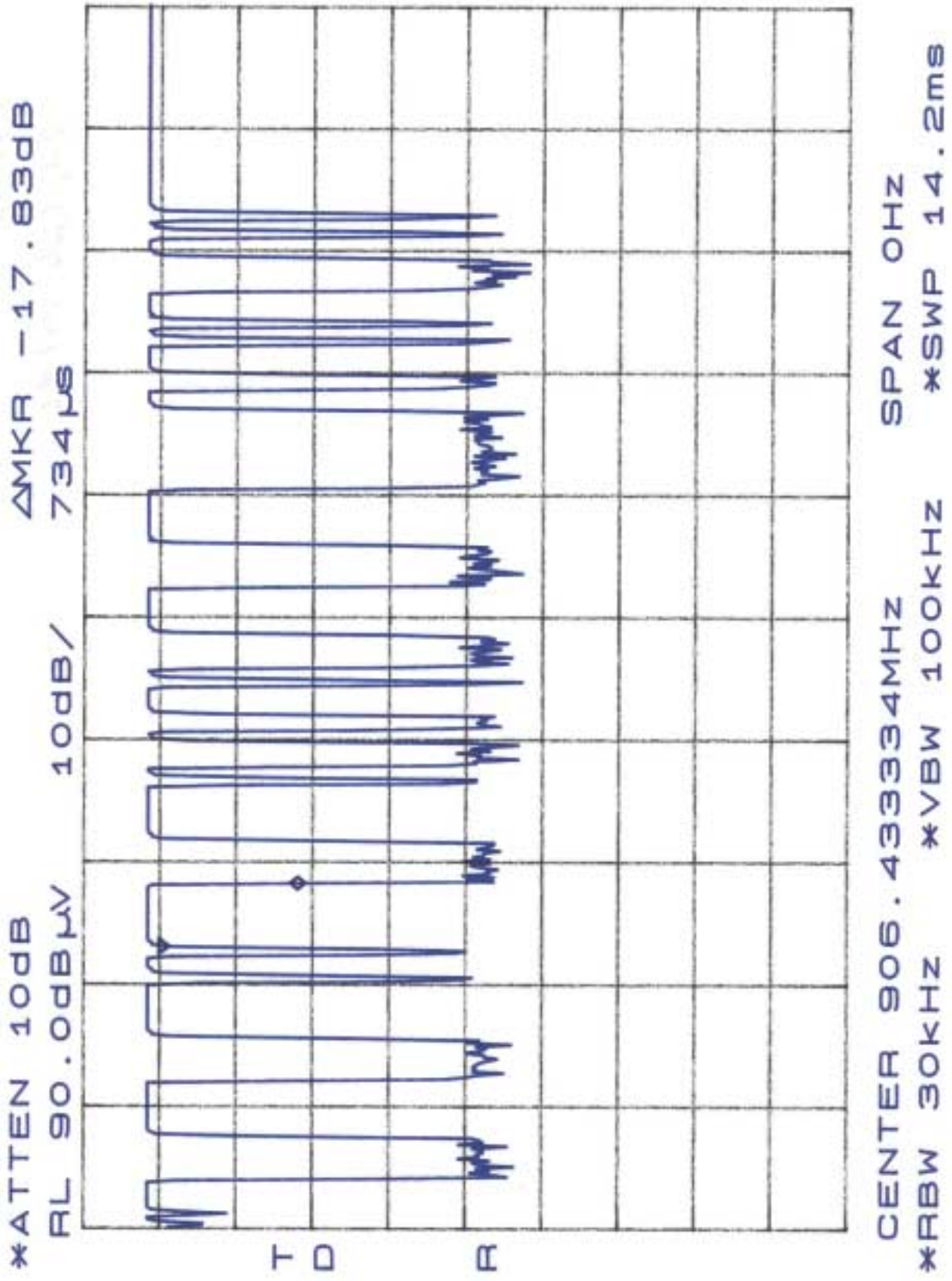
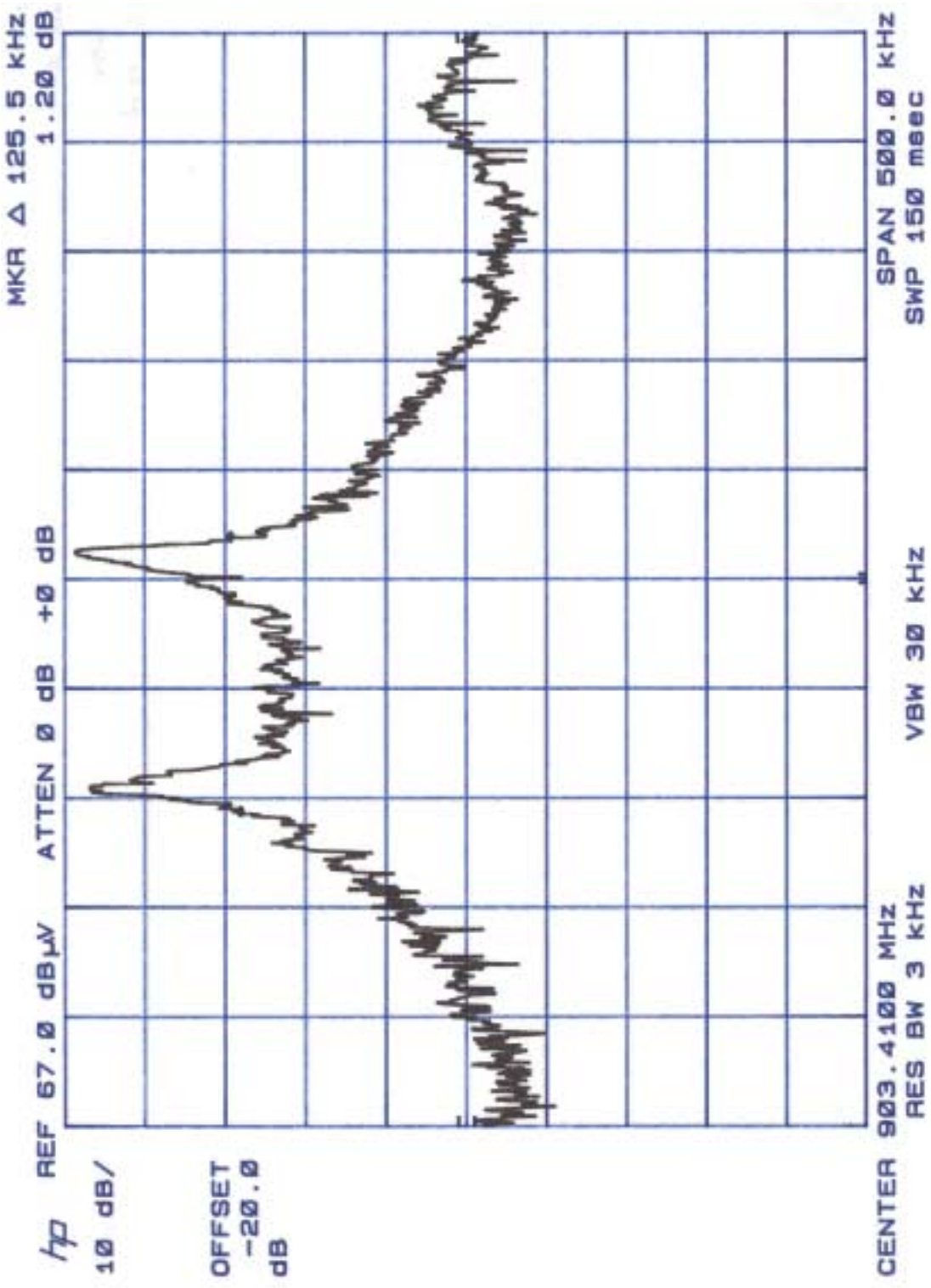


EXHIBIT 2

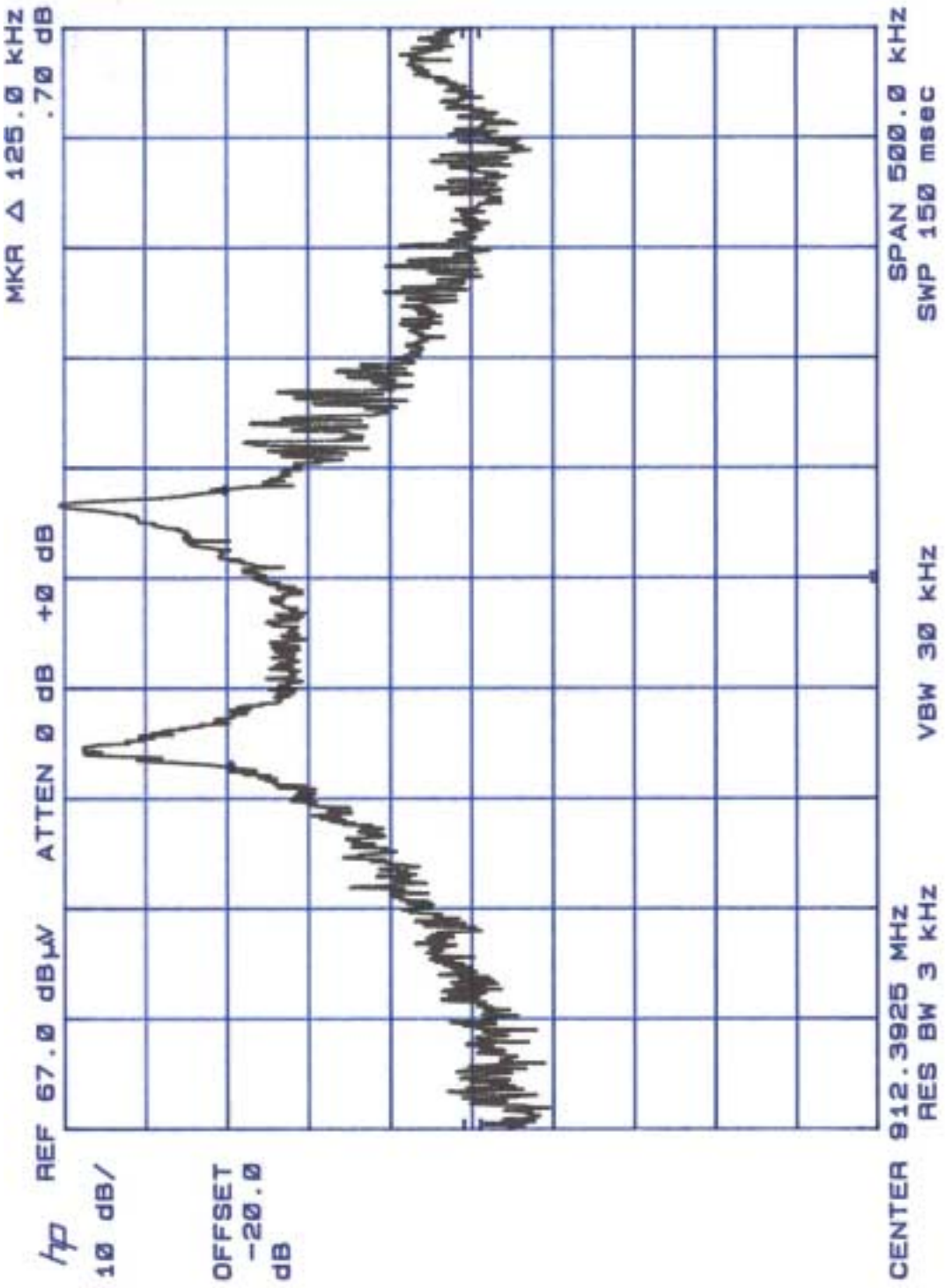
CARRIER BANDWIDTH DATA

The 20 dB modulated bandwidth data are contained in the following plots.

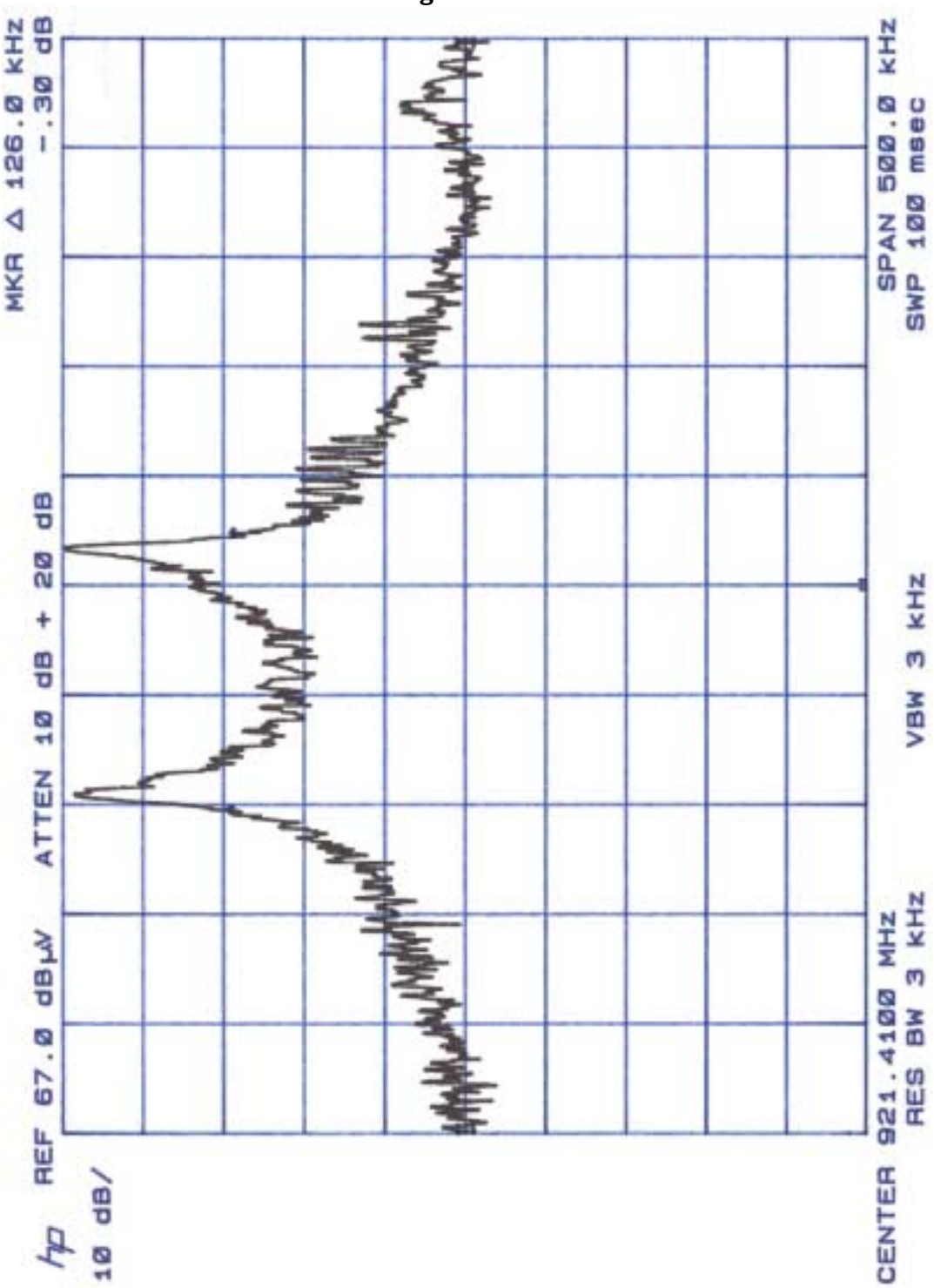
Bandwidth Plots
Low Channel



Bandwidth Plots
Mid Channel



Bandwidth Plots
High Channel



Appendix A

Statement of Measurement Uncertainty

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 = $0.5\,(2^2 + 1^2 + 4^2)^{1/2}$ = ±2.3 dB.