

Intertek Testing Services

FCC 15.247 & 15.249 CERTIFICATION APPLICATION FOR

WiData Corporation

Tracking System Tag

Model: TFF-1000-00AA

FCC ID: NSQTFF-1000-00AA

Job # J99002777

Report # J99002777A

Number of Pages: 17pp. + Supporting Data and Documents

Date of Report: March 1, 1999

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The results contained in this report were derived from measurements performed on the identified test samples. Any implied performance of other samples on this report is dependent on the representative of the samples tested.



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1.0 Summary of Tests**WiData Corporation - Model No.: TFF-1000-00AA**
FCC ID: NSQTFF-1000-00AA

TEST	REFERENCE	RESULTS
Max. Output power	15.247(b)	Pass
6 dB Bandwidth	15.247(a)(2)	Pass
Max. Power Density	15.247(d)	Pass
Out of Band Antenna Conducted Emission	15.247(c)	N/A
Out of Band Radiated Emission	15.247(c), 15.249	Pass
Radiated Emission in Restricted Bands	15.35(b)(c), 15.249	Pass
AC Conducted Emission	15.207	Pass
Radiated Emission from Digital Part	15.109	Pass
Radiated Emission from Receiver L.O.	15.109	Not Applicable
Processing Gain Measurements	15.247(e)	Provided by applicant
Antenna Requirement	15.203	Provided by applicant

Test Engineer: _____
Xi-Ming Yang

Date: _____

EMC Site Manager: _____
David Chernomordik

Date: _____

2.0 General Description

2.1 Product Description

A production version of the sample was received on February 9, 1999 in good condition.

Overview of 2.4 GHz Tracking System

Applicant	WiData Corporation
Trade Name & Model No.	WiData Corporation, TFF-1000-00AA
FCC Identifier	NSQTFF-1000-00AA
Use of Product	Tracking System Tag
Manufacturer & Model of Spread Spectrum Module	WiData Corporation
Type of Transmission	Direct Sequence
Rated RF Output (mW)	1
Frequency Range (MHz)	2441.8 for DSSS, 2446.5 for OOC
Number of Channel(s)	1
Antenna(s) & Gain, dBi	2.1
Processing Gain Measurements	☐ Will be provided to ITS for submission with the application ☒ Will be provided directly to the FCC reviewing engineer by the client or manufacturer of the spread spectrum module
Antenna Requirement	☒ The EUT uses a permanently connected antenna. ☐ The antenna is affixed to the EUT using a unique connector which allows for replacement of a broken antenna, but DOES NOT use a standard antenna jack or electrical connector. ☐ The EUT requires professional installation (attach supporting documentation if using this option).
Manufacturer name & address	WiData Corporation 1259 Oakmead Parkway Sunnyvale, California 94086

2.2 Related Submittal(s) Grants

None.

2.3 Test Methodology

Both AC mains line-conducted and radiated emissions measurements were performed according to the procedures in ANSI C63.4 (1992). Radiated tests were performed at an antenna to EUT distance of 3 meters, unless stated otherwise in the "**Data Sheet**" of this Application. All other measurements were made in accordance with the procedures in part 2 of CFR 47.

2.4 Test Facility

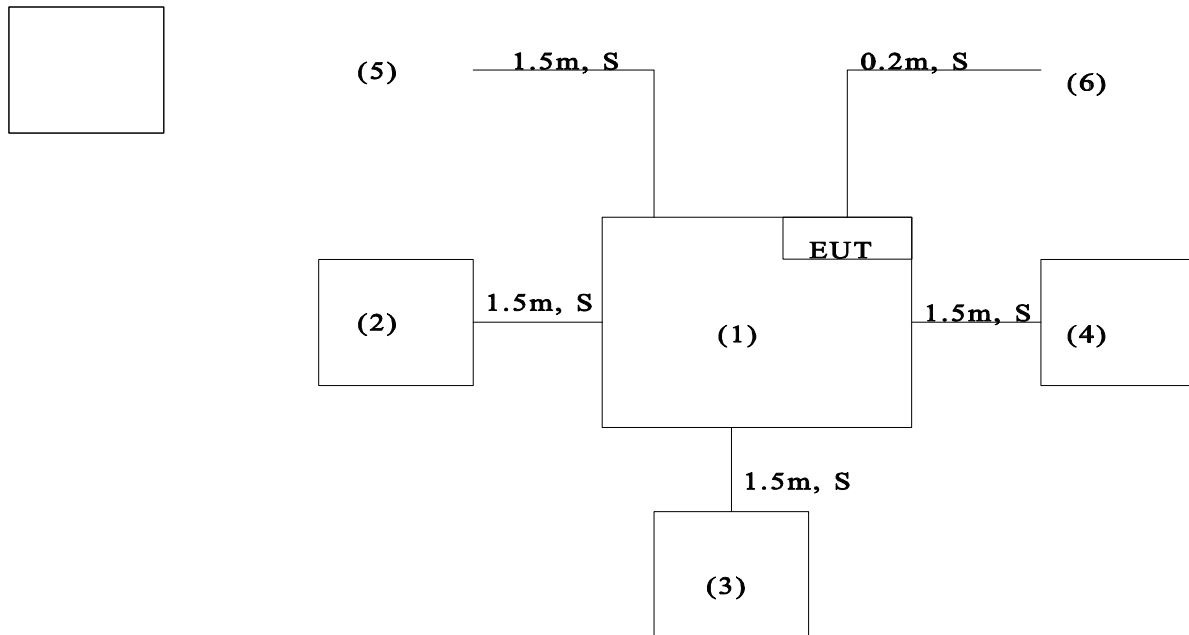
The open area test site and conducted measurement facility used to collect the radiated data is site . This test facility and site measurement data have been fully placed on file with the FCC and NVLAP accredited.

3.0 System Test Configuration

3.1 Support Equipment and description

Item #	Description	Model No.	Serial No.	FCC ID
1	Notebook Laptop Computer	6100T	N6SD818101718	L4PK6000T200
2	HP Printer	2225C+	2921S45711	DSI6XU2225
3	Compaq Keyboard	KPQ-E99AC	160648-101DOM	EW41CPQ2479A
4	Dell Mmonitor	D1428-HS	02922CV22495	GWGPM04E1X
5	Datatronics Modem	1200CK	07-247336	E2050V1200CK
6	Percon RF Antenna	8912-0057-00	-	-

3.2 Block Diagram of Test Setup



* = EUT
** = No ferrites on video cable

S = Shielded;
U = Unshielded

F = With Ferrite

3.3 Justification

For emission testing, the equipment under test (EUT) was configured for testing in a typical fashion (as a customer would normally use it). During testing, all cables were manipulated to produce worst case emissions.

For radiated emission measurements, the EUT is attached to a cardboard box (if necessary) and placed on the wooden turntable. If the EUT attaches to peripherals, they are connected and operational (as typical as possible). The EUT is wired to transmit full power without modulation.

The signal is maximized through rotation and placement in the three orthogonal axes. The antenna height and polarization are varied during the search for maximum signal level. The antenna height is varied from 1 to 4 meters. Detector function is in peak mode. Radiated emissions are taken at three meters unless the signal level is too low for measurement at that distance. If necessary, a pre-amplifier is used and/or the test is conducted at a closer distance.

All readings are extrapolated back to the equivalent three meter reading using inverse scaling with distance.

3.4 Software Exercise Program

The EUT exercise program used during radiated and conducted testing was designed to exercise the various system components in a manner similar to a typical use. For emissions testing, the units were setup to transmit continuously to simplify the measurement methodology. Care was taken to ensure proper power supply voltages during testing.

3.5 Mode of Operation During Test

Transmitting and receiving modes.

3.6 Modifications Required for Compliance

The following modifications were installed during compliance testing in order to bring the product into compliance (Please note that this list does not include changes made specifically by WiData Corporation prior to compliance testing):

No modifications were installed by Intertek Testing Services.

3.7 Additions, deviations and exclusions from standards

No additions, deviations or exclusion have been made from standard.

4.0 Measurement Results

4.1 Maximum Conducted Output Power at Antenna Terminals, FCC Rules 15.247(b):

[X] The antenna port of the EUT was connected to the input of a power meter. Power was read directly and cable loss correction was added to the reading to obtain power at the EUT antenna terminals.

[] The antenna port of the EUT was connected to the input of a spectrum analyzer. The analyzer was set for maximum RES BW and power was read directly in dBm. External attenuation and cable loss were compensated for using the OFFSET function of the analyzer.

For antennas with gains of 6 dBi or less, maximum allowed transmitter output is 1 watt (+30 dBm).

For antennas with gains greater than 6 dBi, transmitter output level must be decreased by an amount equal to (GAIN - 6) dBm.

Max. antenna gain = 2.1 dBi		
Frequency (MHz)	Output in dBm	Output in mWatt
Mid Ch (one channel only)	-0.6	0.9

Cable loss: 0 dB

External Attenuation: 0 dB

Cable loss, external attenuation:

[] included in OFFSET function

[X] added to SA raw reading

EUT Transmit Antenna Gain(dBi) + dBm max. output level = 1.6dBm (36 dBm or less)

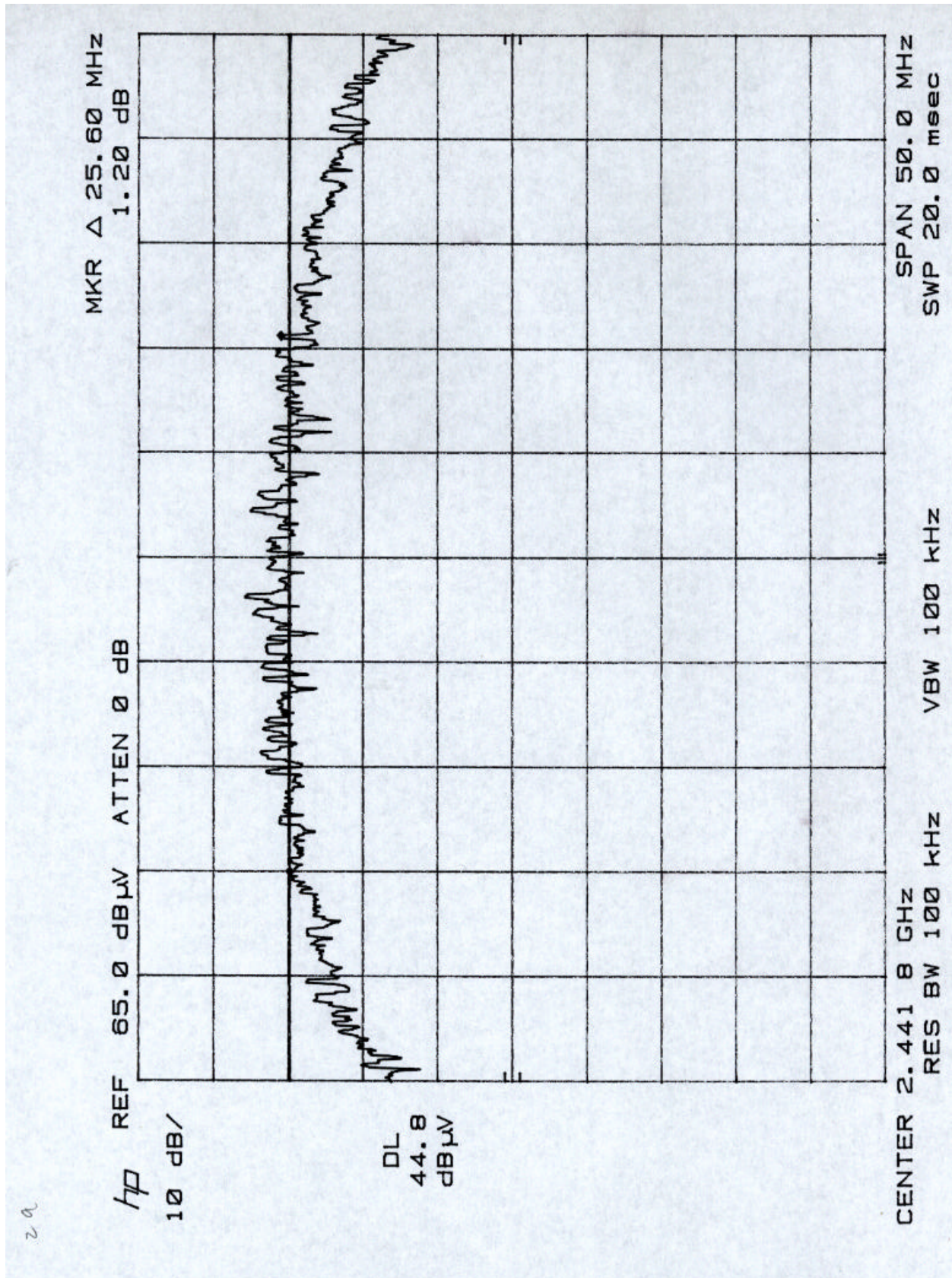
4.2 Minimum 6 dB RF Bandwidth, FCC Rule 15.247(a)(2):

The antenna port of the EUT was connected to the input of a spectrum analyzer. Analyzer RES BW was set to 100 kHz. For each RF output channel investigated, the spectrum analyzer center frequency was set to the channel carrier. A PEAK output reading was taken, a DISPLAY line was drawn 6 dB lower than PEAK level. The 6 dB bandwidth was determined from where the channel output spectrum intersected the display line.

Frequency (MHz)	Max. 6 dB Bandwidth (kHz)
2441.75	25,600

Refer to the following plots for 6 dB bandwidth sharp:

Plot 2a: 6 dB RF Bandwidth



4.3 Maximum Power Density Reading, FCC Rule 15.247(d):

The spectrum analyzer RES BW was set to 3 kHz. The START and STOP frequencies were set to the band edges of the maximum output passband. If there is no clear maximum amplitude in any given portion of the band, it may be necessary to make measurements at a number of bands defined by several START and STOP frequency pairs. The specification calls for a 1 second interval at each 3 kHz bandwidth; total SWEEP TIME is calculated as follows:

$$\text{SWEEP TIME (SEC)} = (\text{Fstop, kHz} - \text{Fstart, kHz}) / 3 \text{ kHz}$$

Antenna output of the EUT was coupled directly to spectrum analyzer; if an external attenuator and/or cable was used, these losses are compensated for with the analyzer OFFSET function.

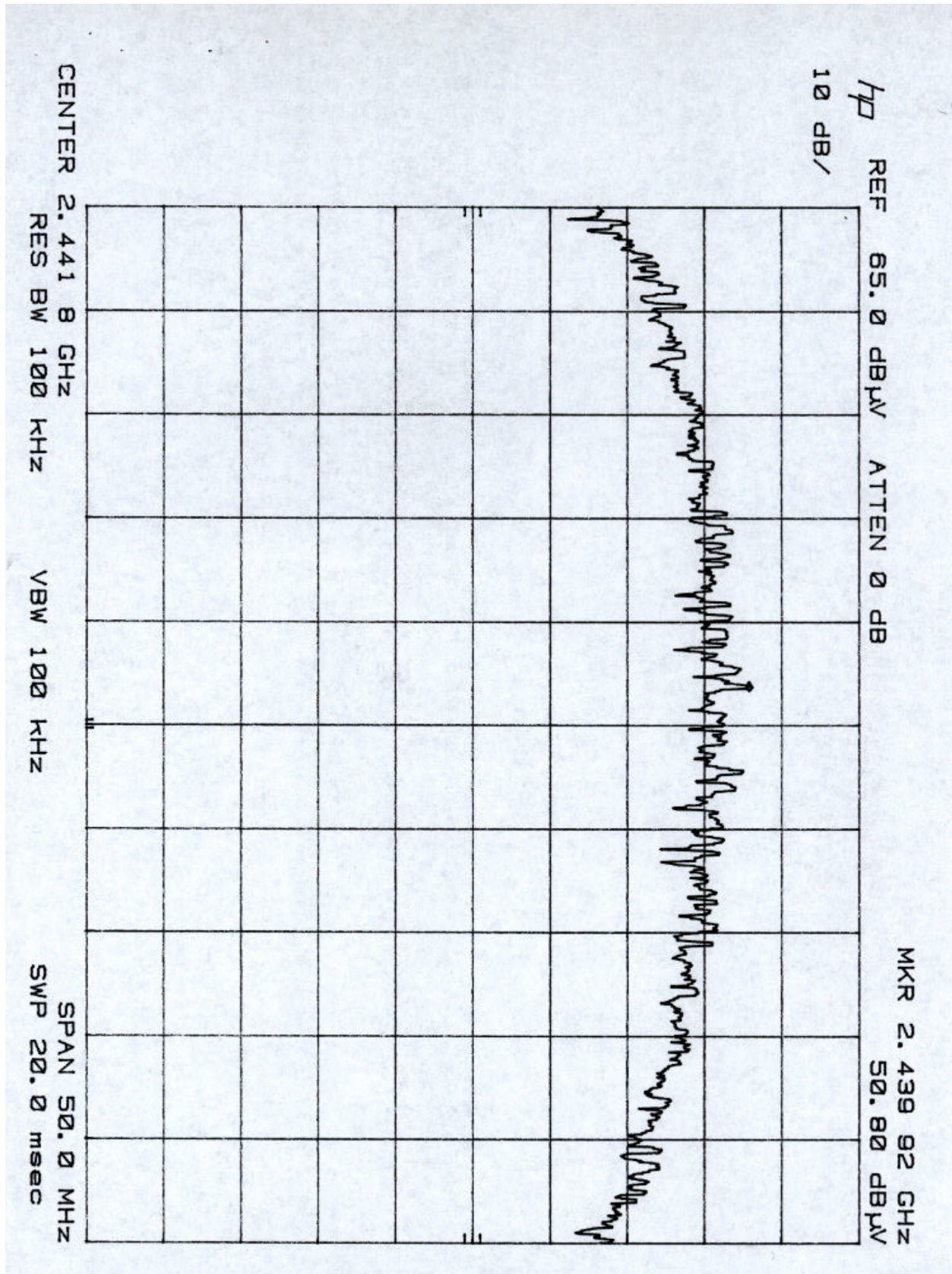
Frequency (MHz)	Power Density (dBm)
2439.7	-20.9

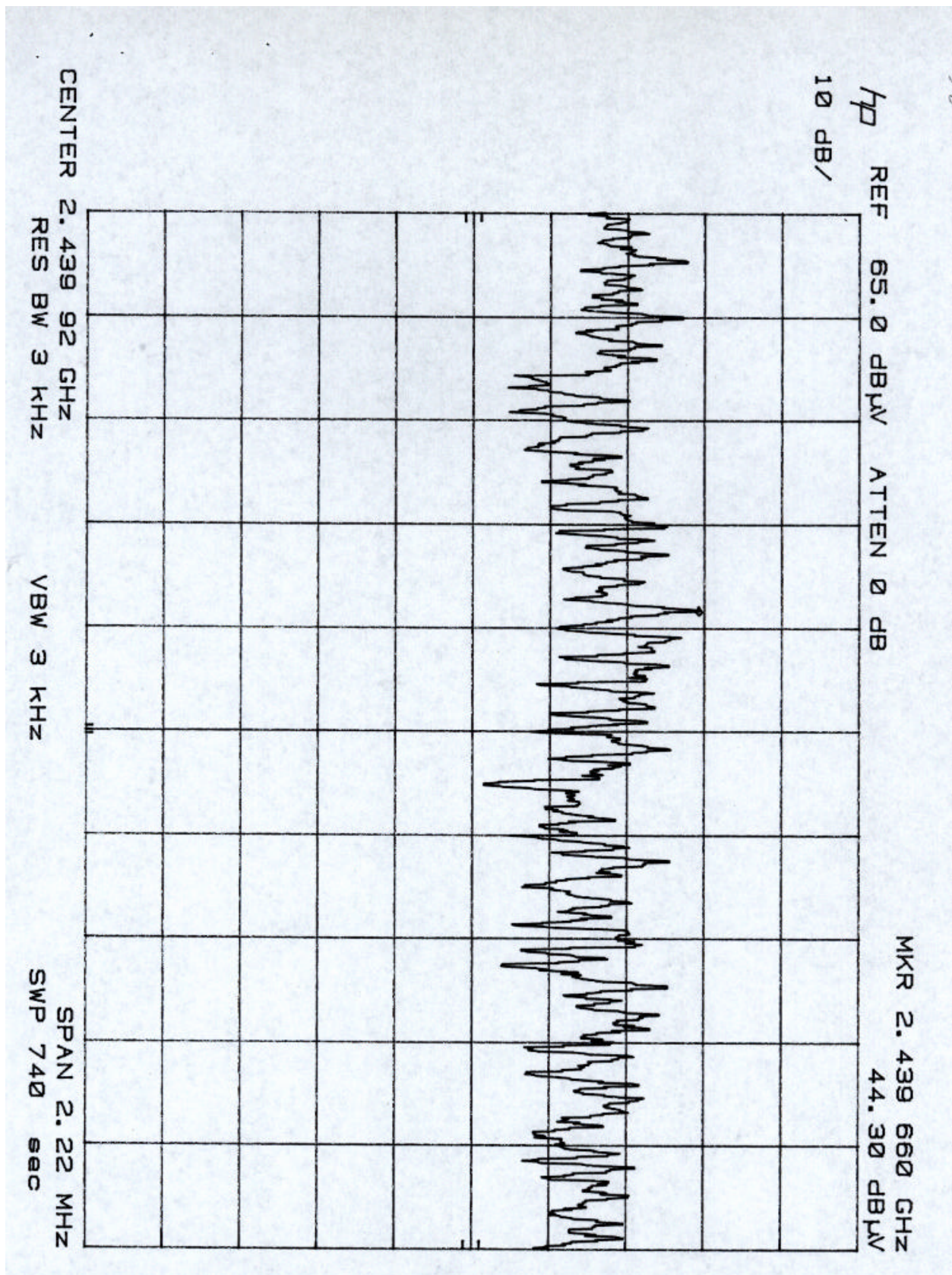
Frequency Span = 2.22 MHz

Sweep Time = Frequency Span/3 kHz
= 740 seconds

Refer to the following plot for power density data:

Plot 3a-3b: Power Density





ITS Intertek Testing Services

Company: WiDATA Wireless Resource Management
Project #: J99002777
Model: TFF-1000-00AA (DSS)
Engineer: Xi-Ming Yang
Date of test: February 11, 1999

FCC15.247 Radiated Emissions

Frequency	Antenna	Reading	Antenna	Cable	Pre-amp	Distance	Duty	Corrected	Limit	Margin
MHz	Polarity	dB(uV)	Factor	Loss	dB	Factor	Cycle	Reading	dB(uV/m)	dB
2441.8	V	59.1	27.9	2.1	0.0	0.0	-20.0	69.1*		
2441.8	V	52.0	27.9	2.1	0.0	0.0	-20.0	62.0		
2400.0	V							#40.2*	74.0	-33.8
2400.0	V							#33.4	54.0	-20.6
2483.5	V							^41.4*	74.0	-32.6
2483.5	V							^34.3	54.0	-19.7
4883.5	V	41.8	32.5	3.5	-28.1	0.0	-20.0	29.7*	74.0	-44.3
4883.5	V	39.6	32.5	3.5	-28.1	0.0	-20.0	27.5	54.0	-26.5
7325.2	V	39.9	36.9	4.5	-28.0	0.0	-20.0	33.3*	74.0	-40.7
7325.2	V	28.5	36.9	4.5	-28.0	0.0	-20.0	21.9	54.0	-32.1
12208.7	V	42.7	39.1	5.7	-39.1	0.0	-20.0	28.4*	74.0	-45.6
12208.7	V	34.0	39.1	5.7	-39.1	0.0	-20.0	19.7	54.0	-34.3
19534.0	V	40.0	40.3	7.5	-23.3	-9.5	-20.0	35.0*	74.0	-39.0
19534.0	V	32.0	40.3	7.5	-23.3	-9.5	-20.0	27.0	54.0	-27.0
21975.7	V	41.0	40.3	9.7	-24.2	-9.5	-20.0	37.3*	74.0	-36.7
21975.7	V	31.0	40.3	9.7	-24.2	-9.5	-20.0	27.3	54.0	-26.7

- Note:
1. All measurement were made at 3 meters
 2. Negative signs (-) in the margin column signify levels below the limit.
 3. Readings with * are peak-readings.
 4. Reading with # is calculated from fundamental minus 28.6 dB (from plot 4a5).
 5. Reading with ^ is calculated from fundamental minus 27.7 dB (from plot 4a6).
 6. Duty cycle see plot C

4.4 Out of Band Conducted Emissions, FCC Rule 15.247(c), 15.249:

In any 100 kHz bandwidth outside the EUT passband, the RF power produced by the modulation products of the spreading sequence, the information sequence, and the carrier frequency shall be at least 20 dB below that of the maximum in-band 100 kHz emission, or else shall meet the general limits for radiated emissions at frequencies outside the passband, whichever results in lower attenuation.

All other types of emissions from the EUT shall meet the general limits for radiated frequencies outside the passband.

☒ Not required

☐ See attached data sheet

4.5 Out of Band Radiated Emissions (for emissions in 4. above that are less than 26 dB below carrier), FCC Rule 15.247(c), 15.249:

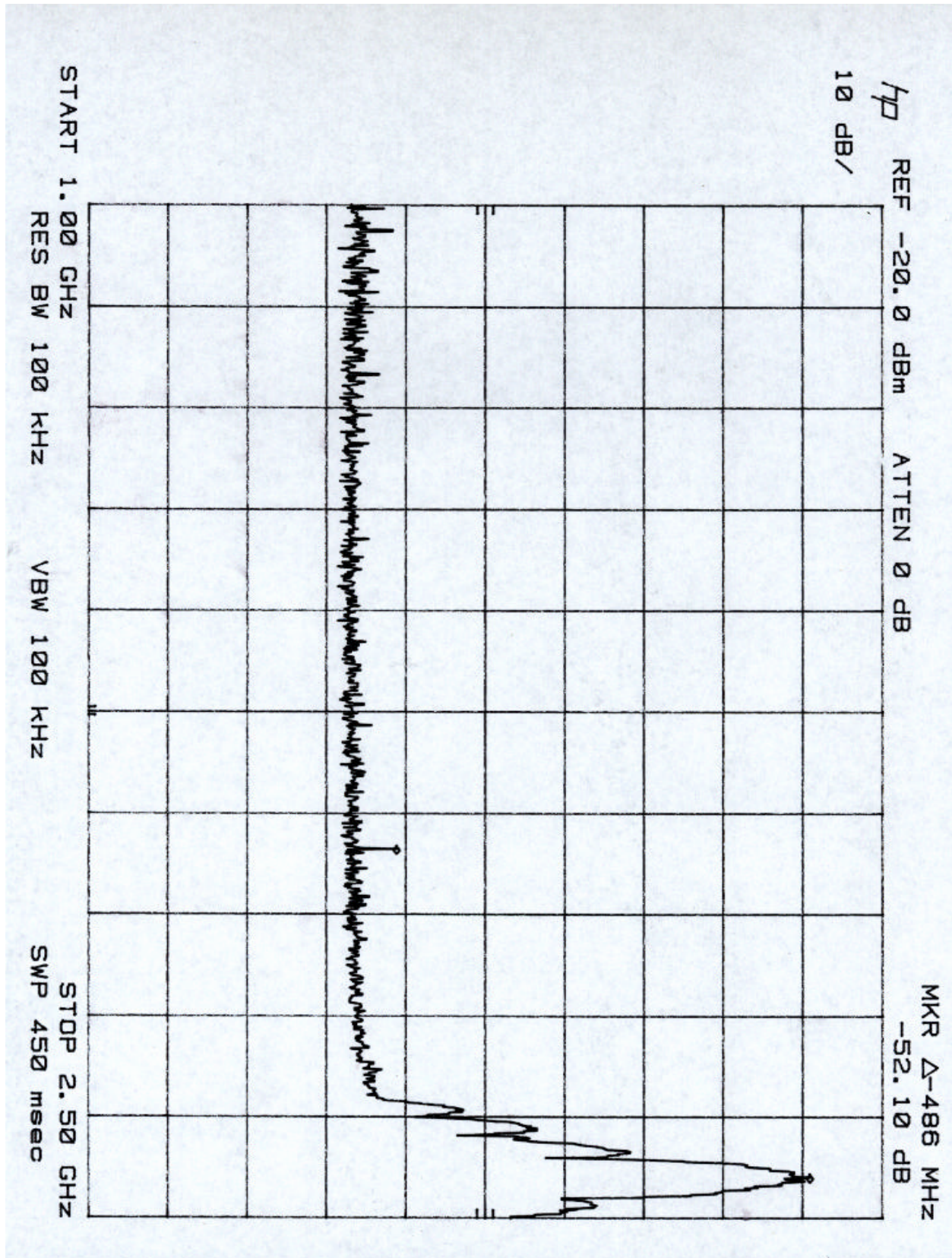
For out of band emissions that are close to or that exceed the 20 dB attenuation requirement described in the specification, radiated measurements were performed at a 3 m separation distance to determine whether these emissions complied with the general radiated emission requirement.

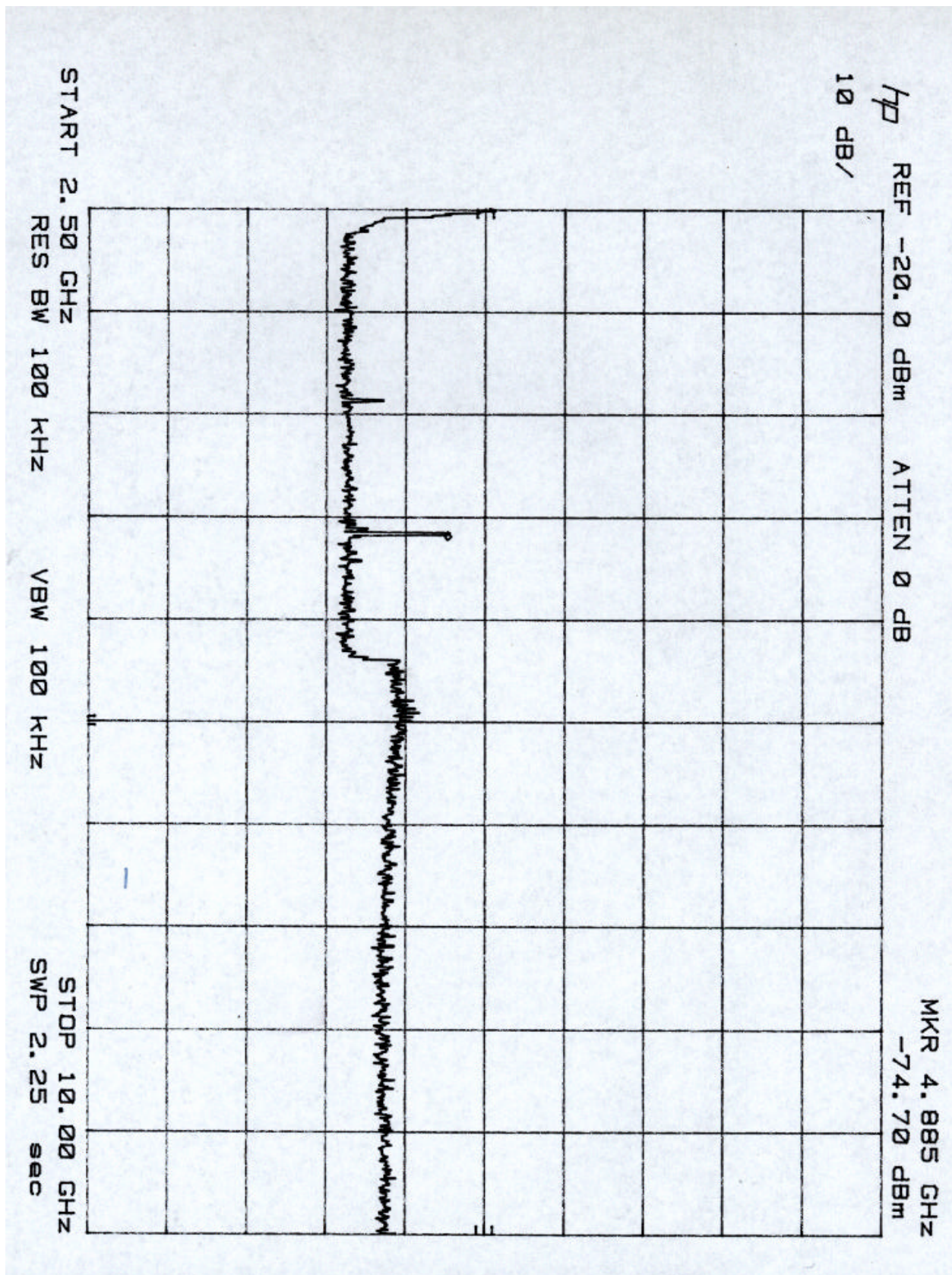
☐ Not required

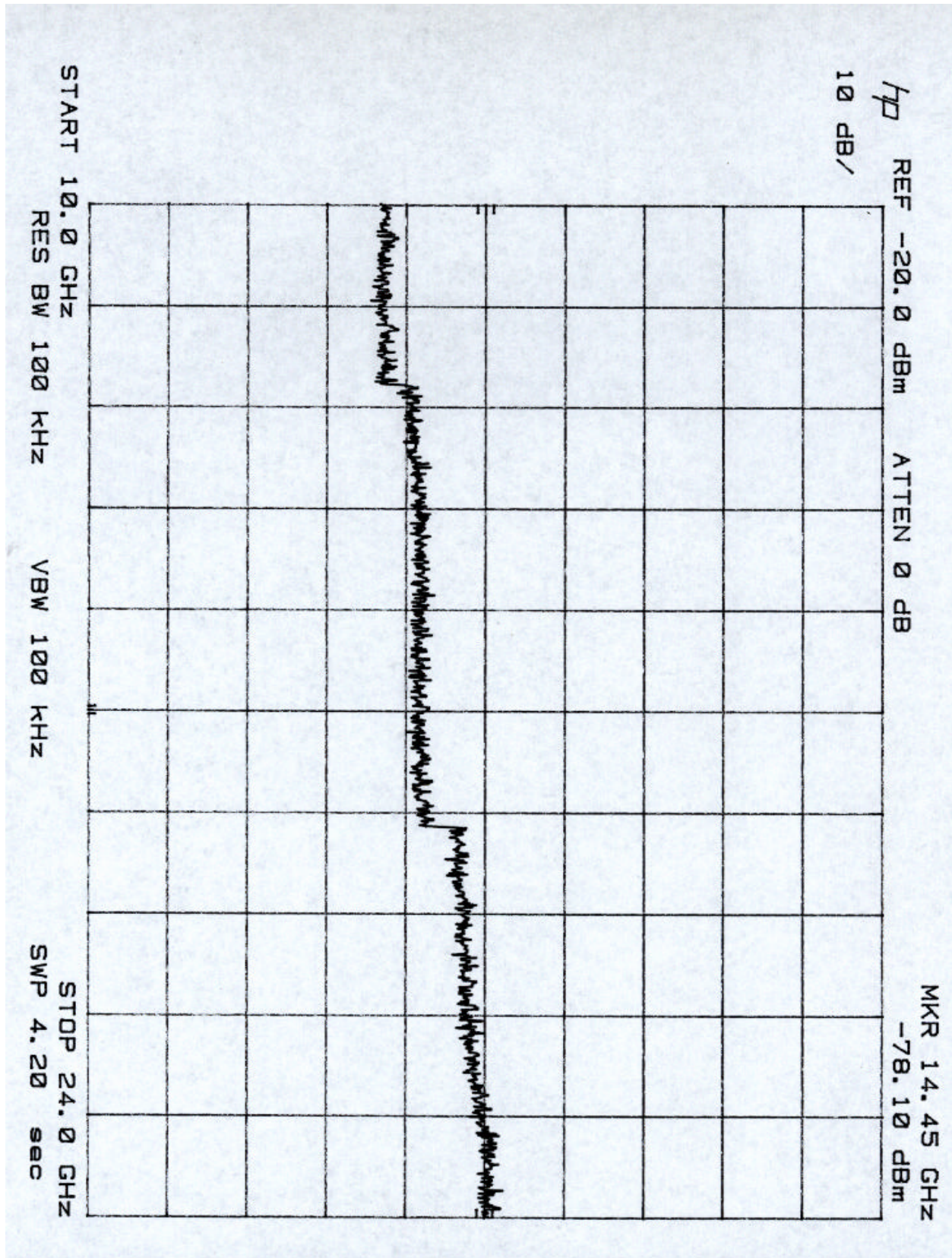
☒ See attached data sheet

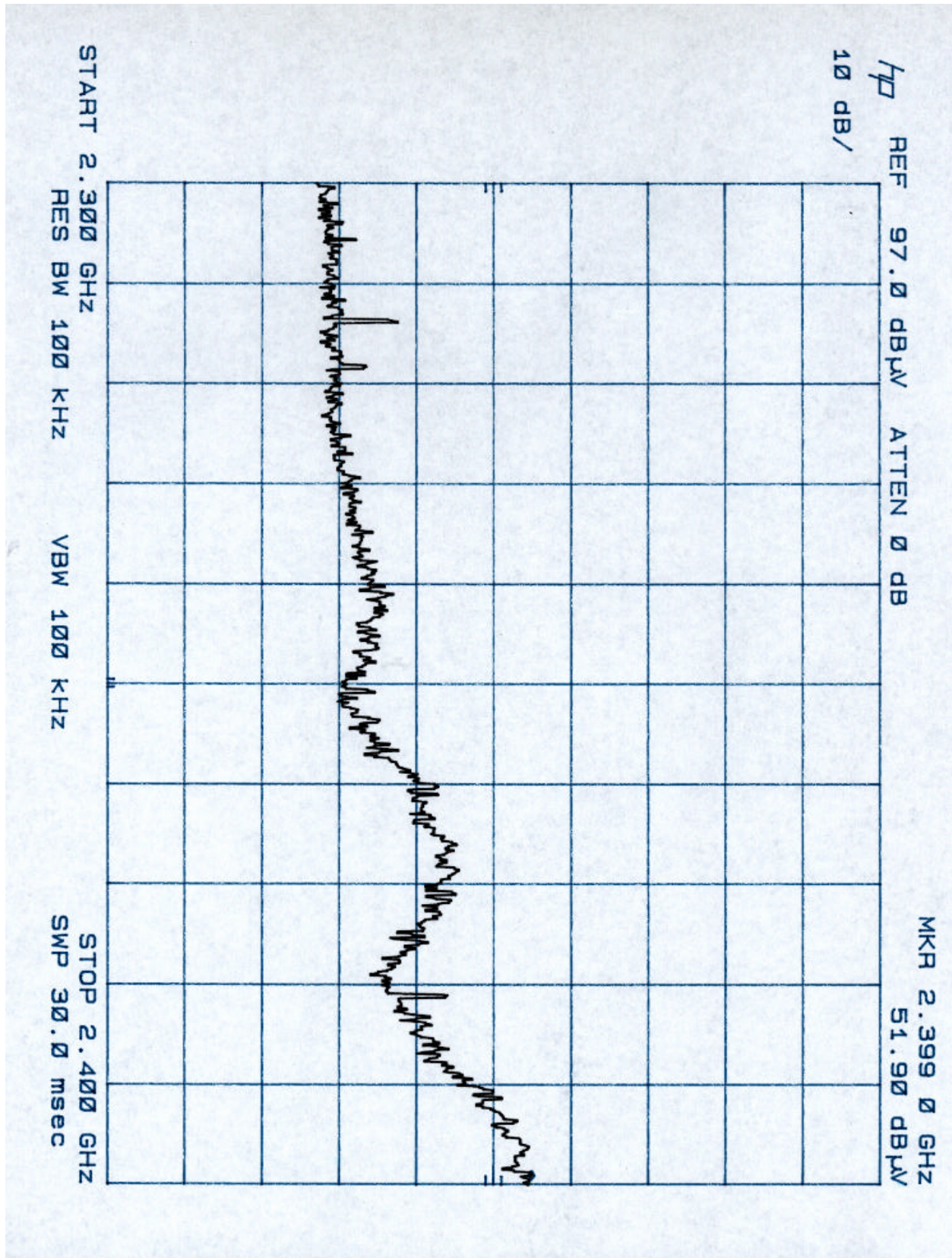
Out of Band Radiated Emission Per FCC Rule Part 15.247:

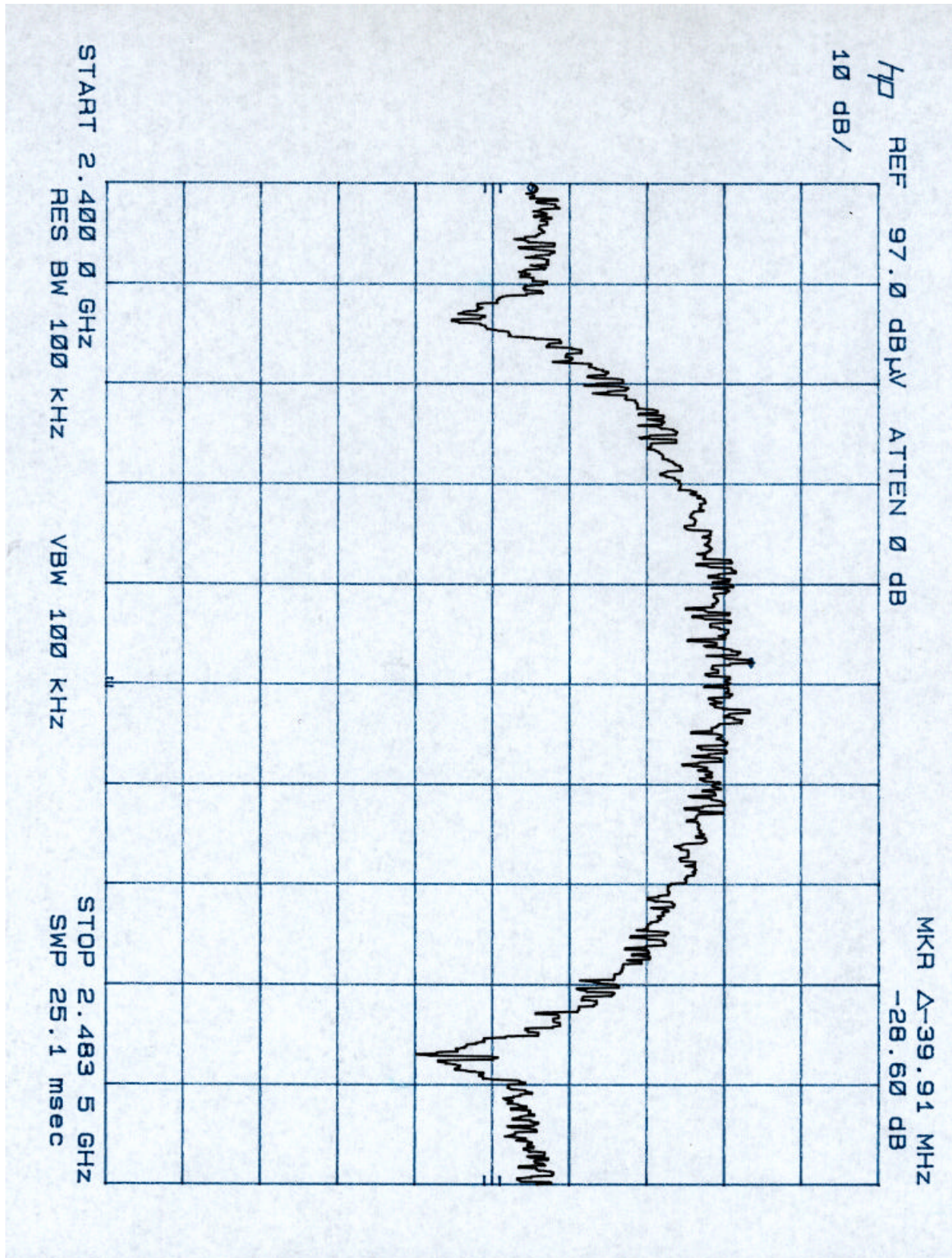
Plot Number	Plot Description
4a.1	Out of Band Radiated Emission at close distance, 1 Ghz - 2.5 GHz
4a.2	Out of Band Radiated Emission at close distance, 2.5 Ghz - 10 GHz
4a.3	Out of Band Radiated Emission at close distance, 10 Ghz - 24 GHz
4a.4	Out of Band Radiated Emission at 3m distance, 2.3 Ghz - 2.4 GHz
4a.5	In Band Radiated Emission at 3m, 28.6 db attenuation at band edge 2.4 GHz
4a.6	In Band Radiated Emission at 3m, 27.7 dB attenuation at band edge 2.483 GHz
4a.7	Out of Band Radiated Emission at 3m, 2.4835 Ghz - 2.57 GHz

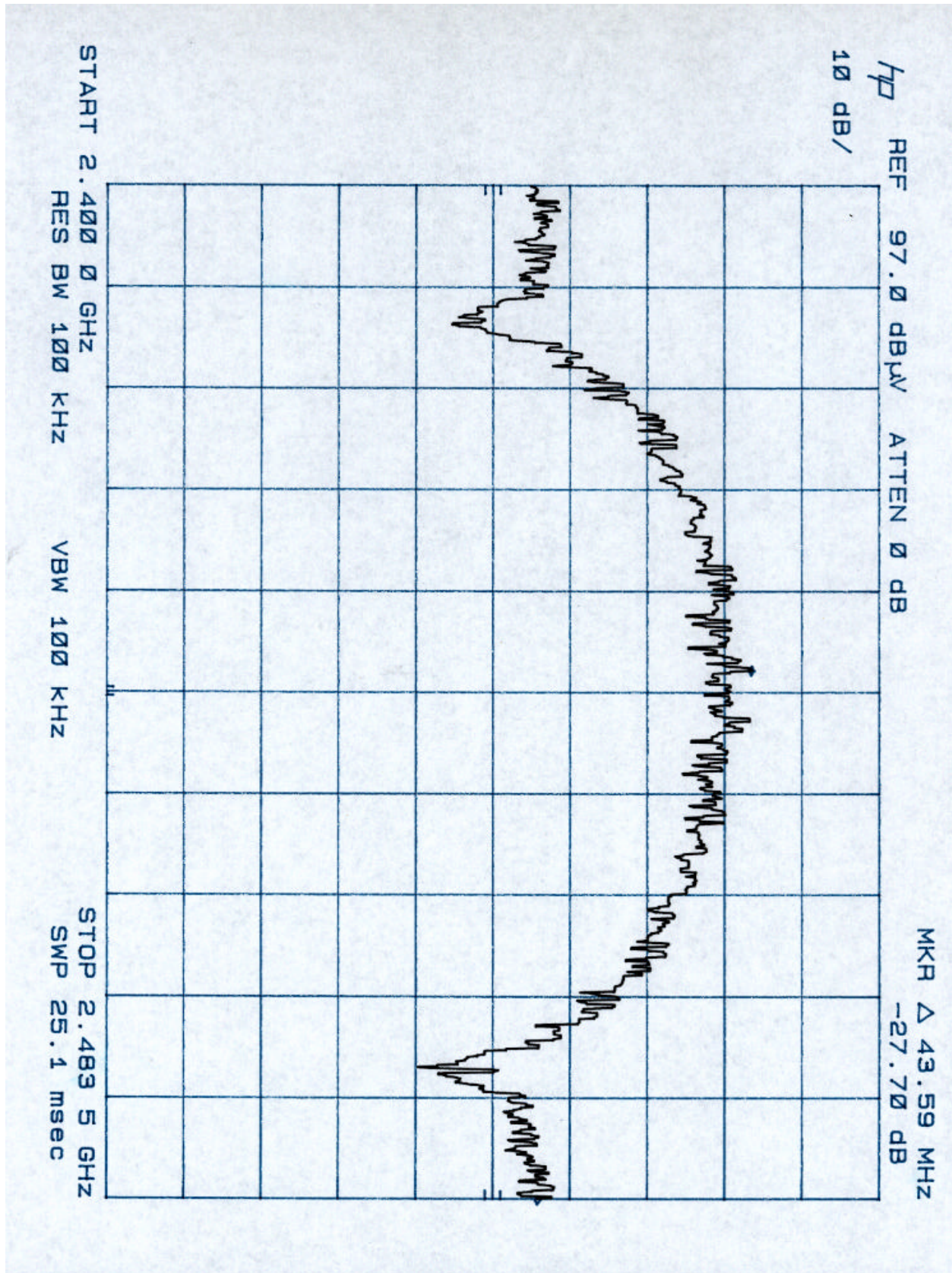


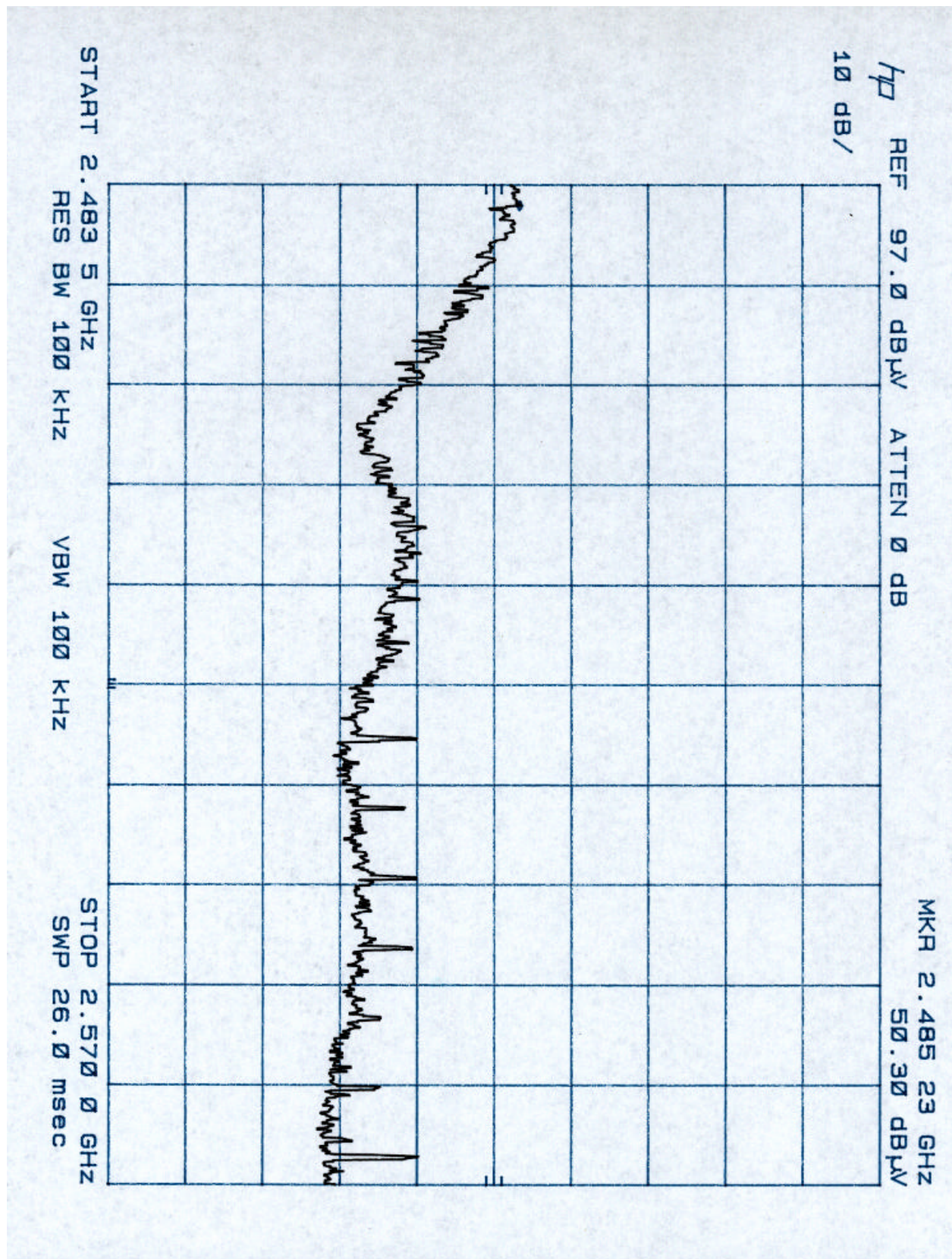






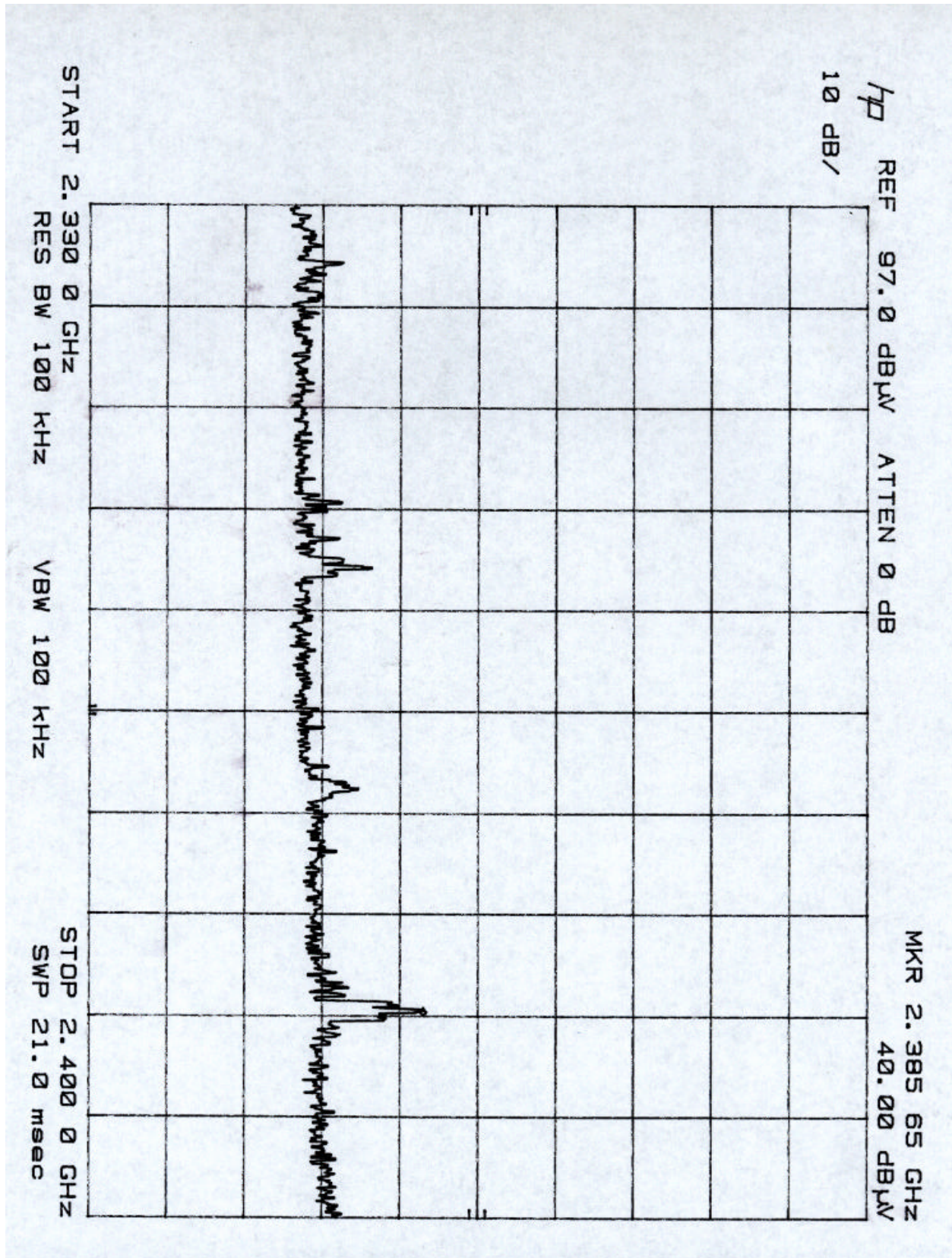


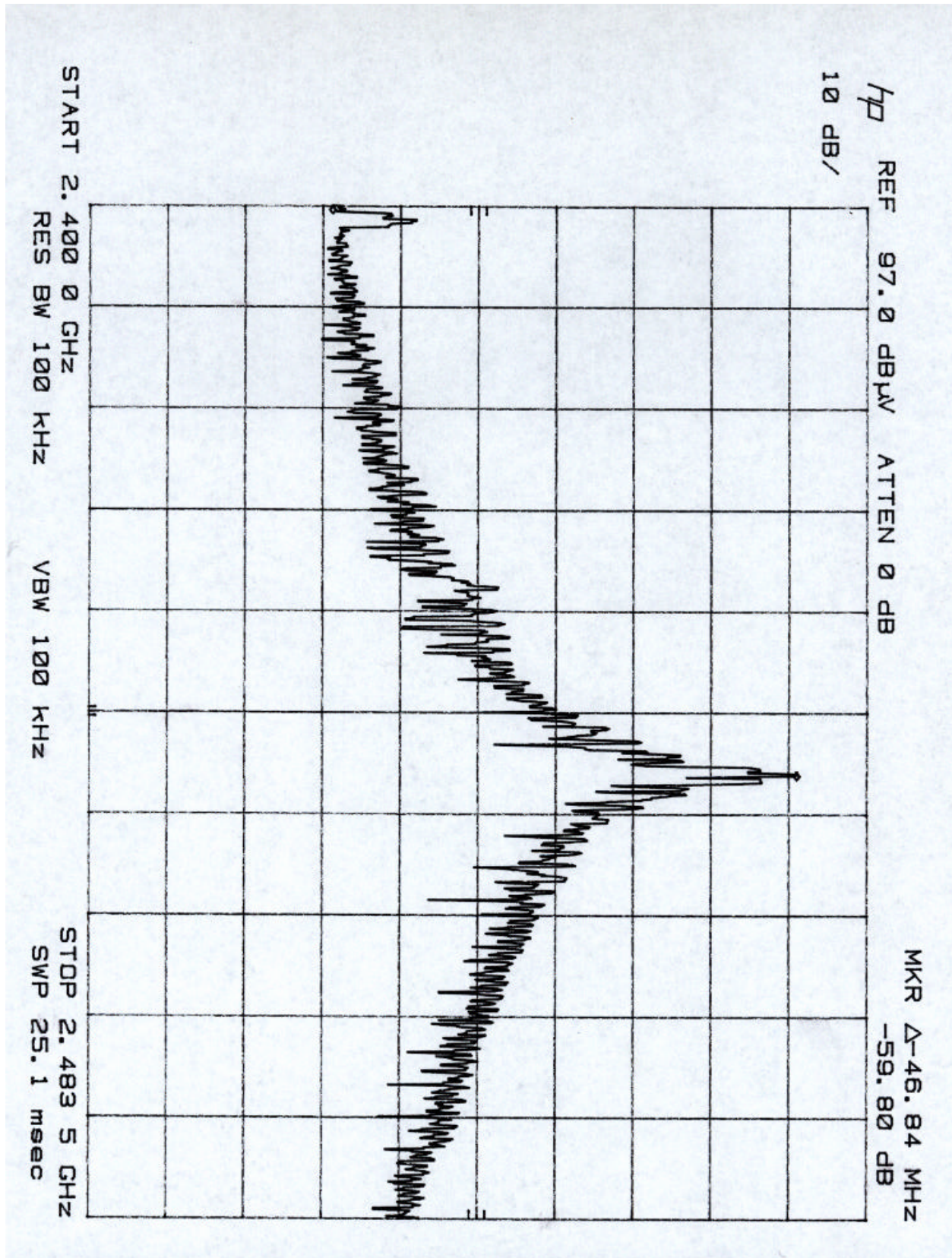


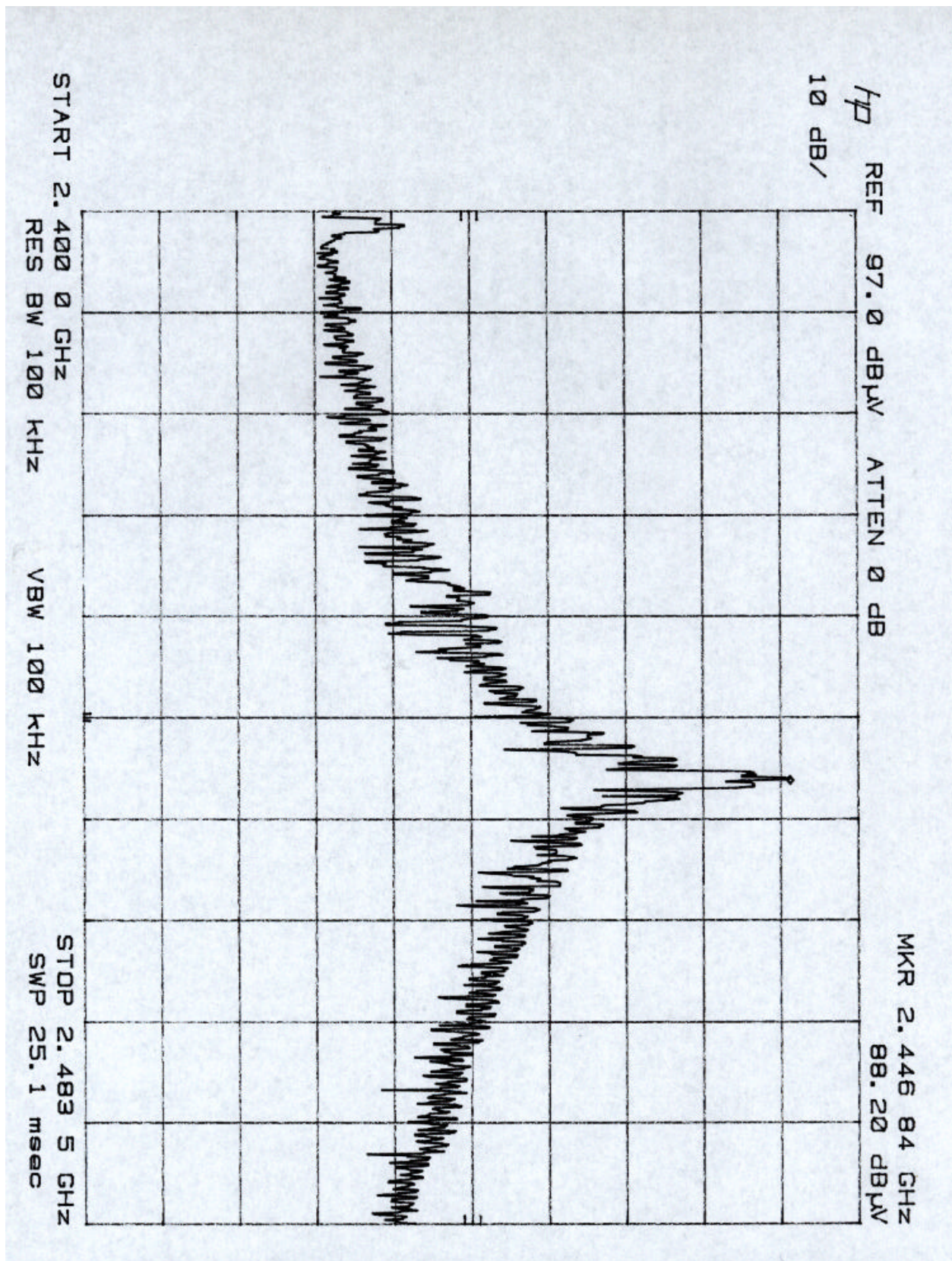


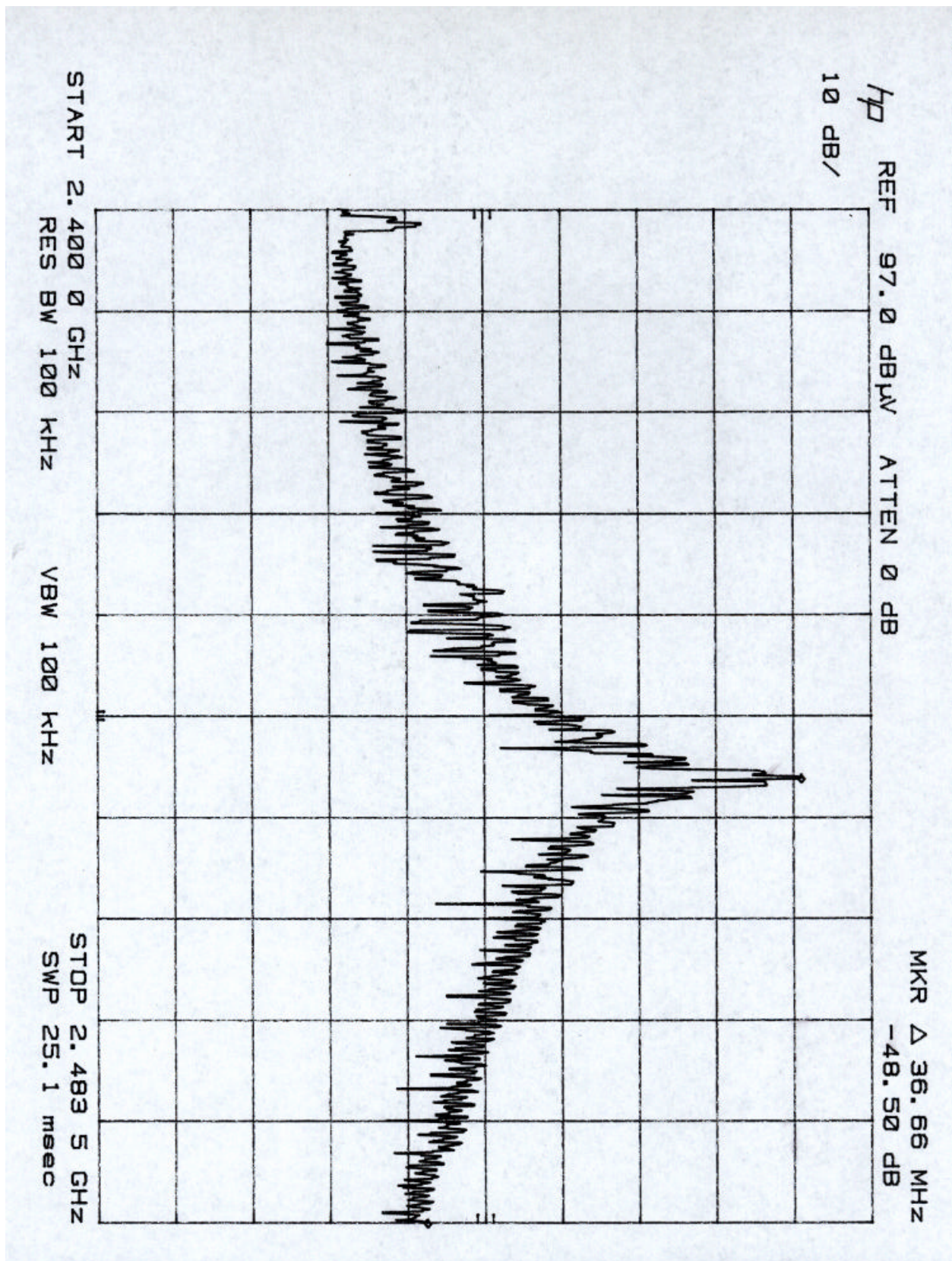
Out of Band Radiated Emission Per FCC Rule Part 15.249:

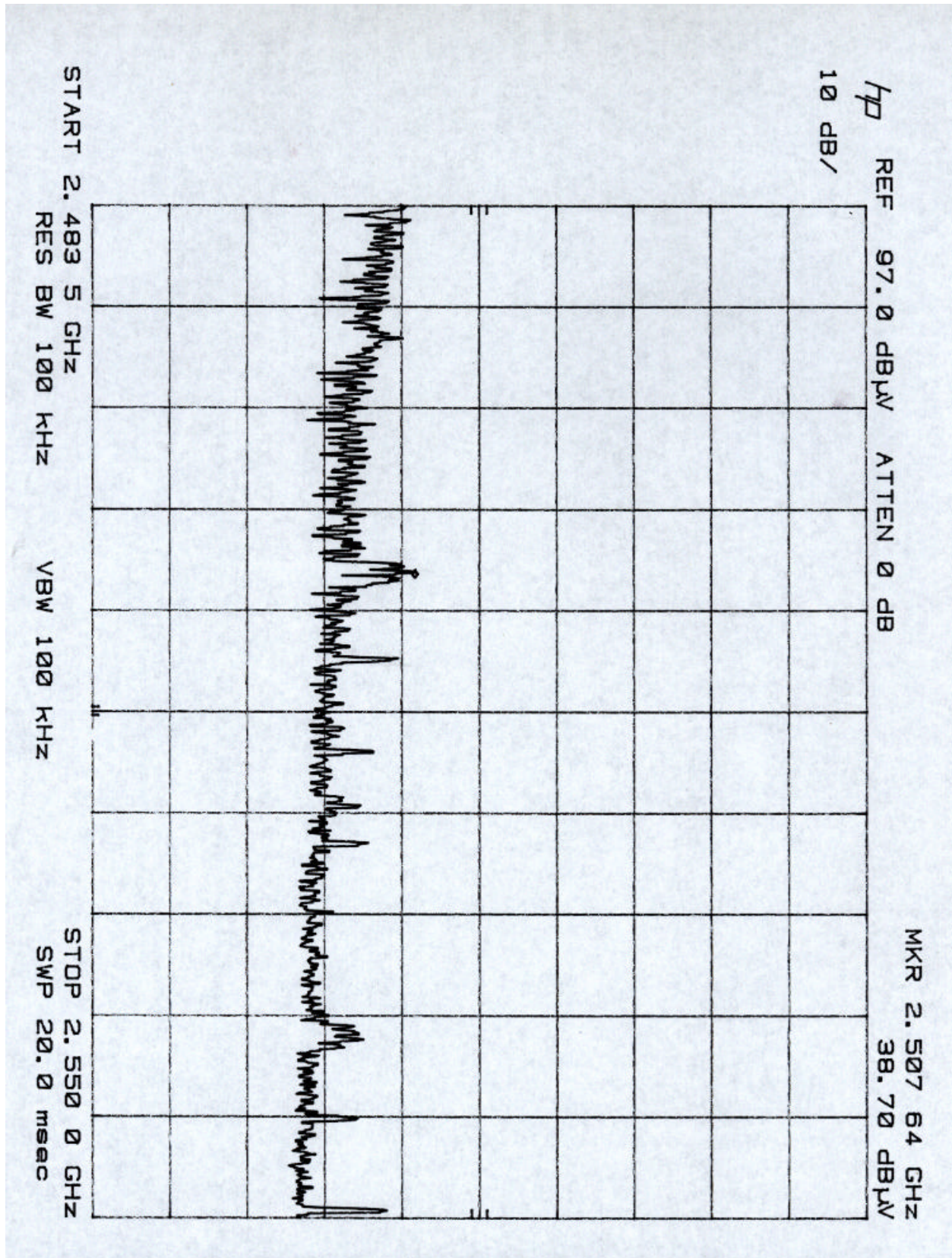
Plot Number	Plot Description
1	Out of Band Radiated Emission at 3m with pre-amp, 2.33 Ghz - 2.4 GHz
2	In Band Radiated Emission at 3m with pre-amp, 59.8 attenuation at 2.4 GHz
3	In Band Radiated Emission at 3m with pre-amp, 88.2 dBuV at fundamental
4	In Band Radiated Emission at 3m with pre-amp 48.5 dB attenuation at 2.4835 GHz
5	Out of Band Radiated Emission at 3m with pre-amp, 2.4835 Ghz - 2.55 GHz
6	Out of Band Radiated Emission at close distance, 1 Ghz - 2.5 GHz
7	
8	

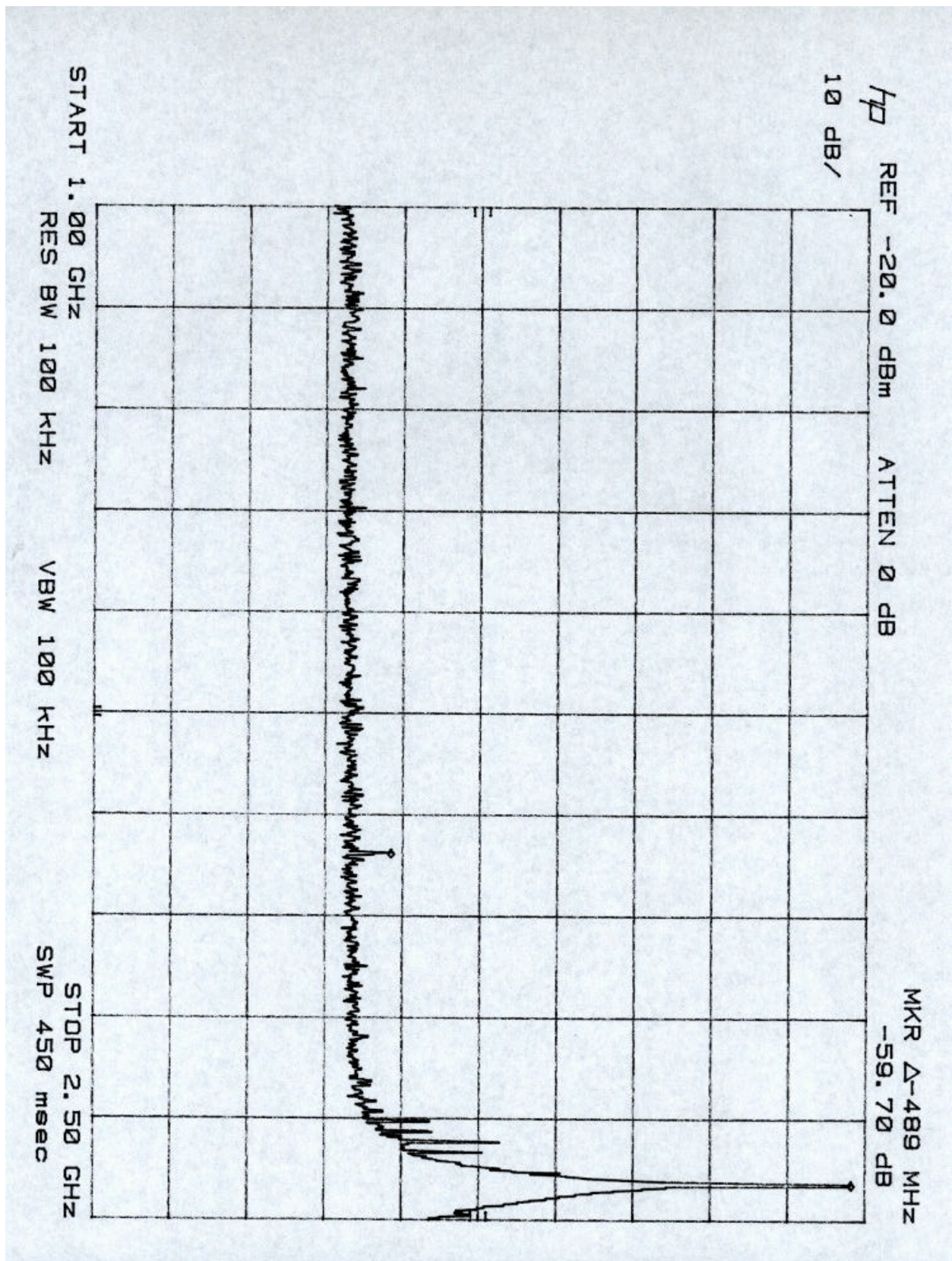


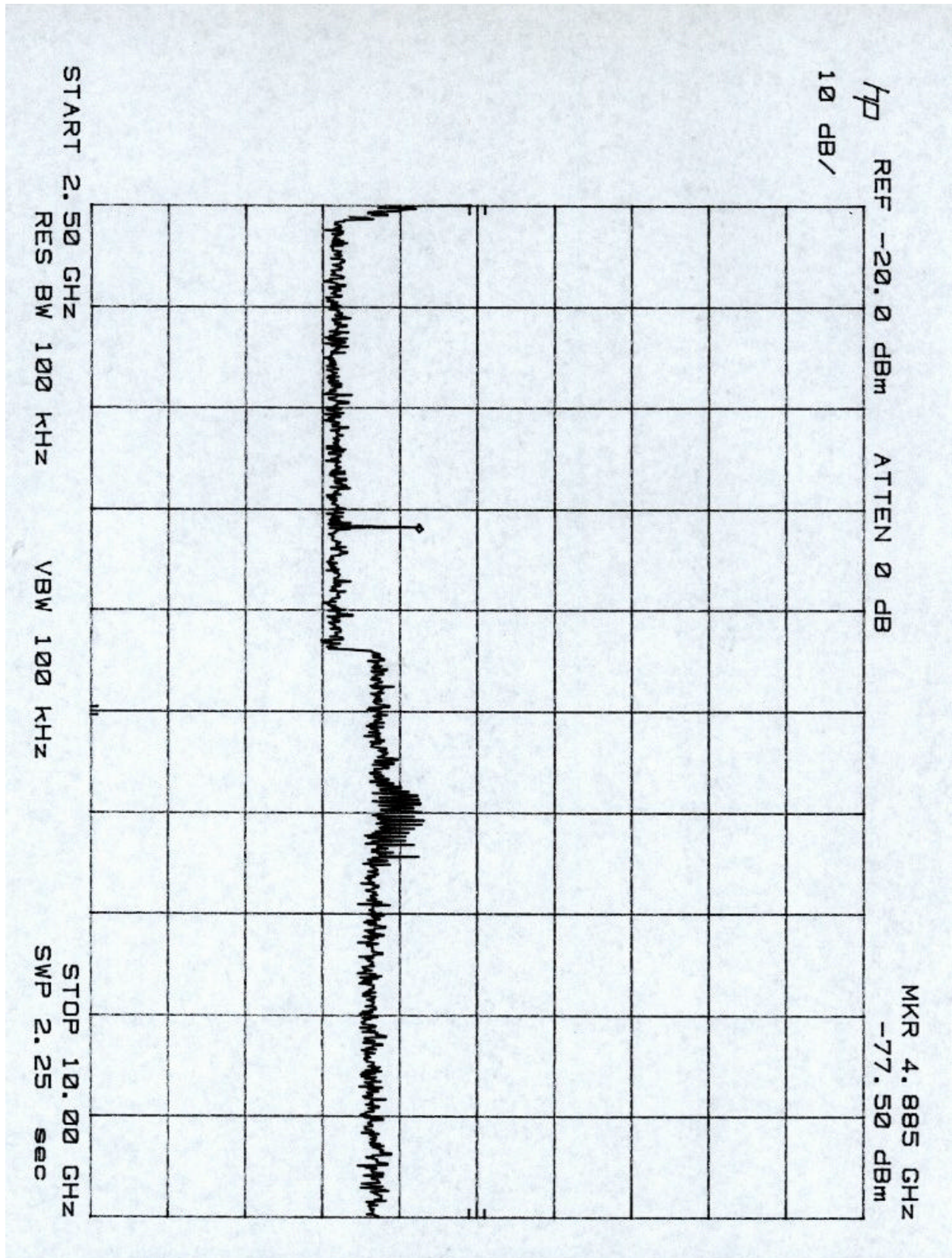


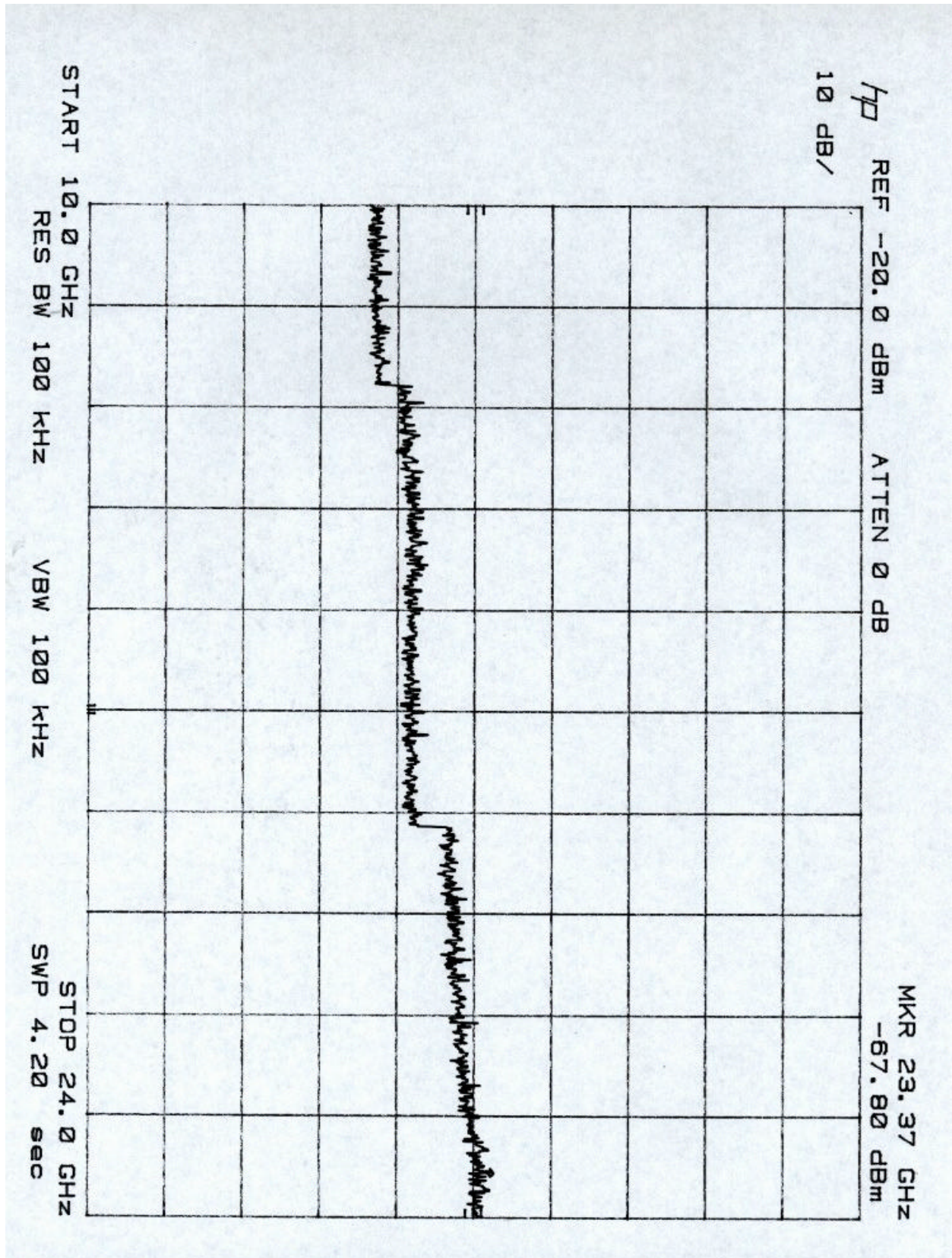












4.6 Transmitter Radiated Emissions in Restricted Bands, FCC Rule 15.35(b), (c), 15.249:

Radiated emission measurements were performed from 30 MHz to <24,000> MHz. Analyzer resolution is 100 kHz or greater for 30 MHz to 1000 MHz, 1 MHz for >1000 MHz.

Data is included of the worst case configuration (the configuration which resulted in the highest emission levels). A sample calculation, configuration photographs and data tables of the emissions are included. All measurements were performed with peak detection unless otherwise specified.

The data on the following pages list the significant emission frequencies, the limit and the margin of compliance.

ITS Intertek Testing Services

Company: WiDATA Wireless Resource Management
Project #: J99002777
Model: TFF-1000-00AA (DSS)
Engineer: Xi-Ming Yang
Date of test: February 11, 1999

FCC15.247 Radiated Emissions

Frequency	Antenna	Reading	Antenna	Cable	Pre-amp	Distance	Duty	Corrected	Limit	Margin
MHz	Polarity	dB(uV)	Factor	Loss	dB	Factor	Cycle	Reading	dB(uV/m)	dB
2441.8	V	59.1	27.9	2.1	0.0	0.0	-20.0	69.1*		
2441.8	V	52.0	27.9	2.1	0.0	0.0	-20.0	62.0		
2400.0	V							#40.2*	74.0	-33.8
2400.0	V							#33.4	54.0	-20.6
2483.5	V							^41.4*	74.0	-32.6
2483.5	V							^34.3	54.0	-19.7
4883.5	V	41.8	32.5	3.5	-28.1	0.0	-20.0	29.7*	74.0	-44.3
4883.5	V	39.6	32.5	3.5	-28.1	0.0	-20.0	27.5	54.0	-26.5
7325.2	V	39.9	36.9	4.5	-28.0	0.0	-20.0	33.3*	74.0	-40.7
7325.2	V	28.5	36.9	4.5	-28.0	0.0	-20.0	21.9	54.0	-32.1
12208.7	V	42.7	39.1	5.7	-39.1	0.0	-20.0	28.4*	74.0	-45.6
12208.7	V	34.0	39.1	5.7	-39.1	0.0	-20.0	19.7	54.0	-34.3
19534.0	V	40.0	40.3	7.5	-23.3	-9.5	-20.0	35.0*	74.0	-39.0
19534.0	V	32.0	40.3	7.5	-23.3	-9.5	-20.0	27.0	54.0	-27.0
21975.7	V	41.0	40.3	9.7	-24.2	-9.5	-20.0	37.3*	74.0	-36.7
21975.7	V	31.0	40.3	9.7	-24.2	-9.5	-20.0	27.3	54.0	-26.7

- Note:
1. All measurement were made at 3 meters
 2. Negative signs (-) in the margin column signify levels below the limit.
 3. Readings with * are peak-readings.
 4. Reading with # is calculated from fundamental minus 28.6 dB (from plot 4a5).
 5. Reading with ^ is calculated from fundamental minus 27.7 dB (from plot 4a6).
 6. Duty cycle see plot C

ITS Intertek Testing Services

Company: WiDATA Wireless Resource Management
Project #: J99002777
Model: TFF-1000-00AA (OOK)
Engineer: Xi-Ming Yang
Date of test: Febuary 11, 1999

FCC15.249 Radiated Emissions

Frequency	Antenna	Reading	Antenna	Cable	Pre-amp	Distance	Duty	Corrected	Limit	Margin
MHz	Polarity	dB(uV)	Factor	Loss	dB	Factor	Cycle	Reading	dB(uV/m)	dB
2446.5	V	65.0	27.9	2.1	0.0	0.0	-10.5	84.5*	114.0	-29.5
2446.5	V	59.8	27.9	2.1	0.0	0.0	-10.5	79.3	94.0	-14.7
2385.7	V							#36.3*	74.0	-37.7
2385.7	V							#31.1	54.0	-22.9
2400.0	V							^24.7*	74.0	-49.3
2400.0	V							^19.5	54.0	-34.5
2483.5	V							@36.0*	74.0	-38.0
2483.5	V							@30.8	54.0	-23.2
4892.9	V	41.0	32.5	3.5	-28.1	0.0	-10.5	38.4*	74.0	-35.6
4892.9	V	34.7	32.5	3.5	-28.1	0.0	-10.5	32.1	54.0	-21.9
7339.4	V	44.8	36.9	4.5	-28.0	0.0	-10.5	47.7*	74.0	-26.3
7339.4	V	38.4	36.9	4.5	-28.0	0.0	-10.5	41.3	54.0	-12.7
9785.9	H	34.0	37.8	5.3	-27.4	0.0	-10.5	39.2*	74.0	-34.8
9785.9	H	24.0	37.8	5.3	-27.4	0.0	-10.5	29.2	54.0	-24.8
12232.3	H	43.0	39.1	5.7	-39.1	0.0	-10.5	38.2*	74.0	-35.8
12232.3	H	31.0	39.1	5.7	-39.1	0.0	-10.5	26.2	54.0	-27.8

- Note:
1. All measurement were made at 3 meters
 2. Negative signs (-) in the margin column signify levels below the limit.
 3. Readings with * are peak-readings.
 4. Reading with # is calculated from fundamental minus 48.2 dB (from plot 1 & 3).
 5. Reading with ^ is calculated from fundamental minus 59.8 dB (from plot 2).
 6. Reading with @ is calculated from fundamental minus 48.5 dB (from plot 4).
 7. Duty cycle see plot A



Company: WiDATA Wireless Resource Management
Project #: J99002777
Model: TFF-1000-00AA (OOK)
Engineer: Xi-Ming Yang
Date of test: February 11, 1999

FCC15.249 Radiated Emissions

Frequency	Antenna	Reading	Antenna	Cable	Pre-amp	Distance	Duty	Corrected	Limit	Margin
MHz	Polarity	dB(uV)	Factor	Loss	dB	Factor	Cycle	Reading	dB(uV/m)	dB
14678.8	V	40.9	40.1	6.7	-37.4	0.0	-10.5	39.8*	74.0	-34.2
14678.8	V	31.0	40.1	6.7	-37.4	0.0	-10.5	29.9	54.0	-24.1
17125.3	H	43.1	42.0	7.3	-38.8	0.0	-10.5	43.1*	74.0	-30.9
17125.3	H	31.5	42.0	7.3	-38.8	0.0	-10.5	31.5	54.0	-22.5
19572.1	H	41.0	40.3	7.5	-23.3	-9.5	-10.5	45.5*	74.0	-28.5
19572.1	H	31.5	40.3	7.5	-23.3	-9.5	-10.5	36.0	54.0	-18.0
22018.7	V	40.5	40.3	9.7	-24.2	-9.5	-10.5	46.3*	74.0	-27.7
22018.7	V	31.0	40.3	9.7	-24.2	-9.5	-10.5	36.8	54.0	-17.2
24465.0	V	40.0	40.3	7.4	-24.2	-9.5	-10.5	43.5*	74.0	-30.5
24465.0	V	32.0	40.3	7.4	-24.2	-9.5	-10.5	35.5	54.0	-18.5

- Note:
1. All measurement were made at 3 meters
 2. Negative signs (-) in the margin column signify levels below the limit.
 3. Readings with * are peak-readings.
 4. Duty cycle see plot A

4.7 AC Line Conducted Emission, FCC Rule 15.207:

☒ [X] Not required; battery operation only

☐ [] Test data attached

4.10 Radiated Emissions from Digital Section of Transceiver (Transmitter) FCC Ref: 15.109

- ☐ Not required - No digital part
- ☒ Test results are attached
- ☒ Included in the separate DOC report.

4.11 Radiated Emissions from Receiver Section of Transceiver (L.O. Radiation), FCC Ref: 15.109, 15.111

- ☒ Not required - EUT operation above 960 MHz only
- ☐ Not required - EUT is transmitter only
- ☐ Not performed; exempt until June 1999
- ☐ Test results are attached

ITS Intertek Testing Services

Company: WiDATA Wireless Resource Management
Project #: J99002777
Model: TFF-1000-00AA
Engineer: Xi-Ming Yang
Date of test: February 9, 1999

FCC15.209 Radiated Emissions

Frequency	Antenna	Reading	Antenna	Cable	Pre-amp	Distance	Corrected	Limit	Margin
MHz	Polarity	dB(uV)	Factor	Loss	dB	Factor	Reading	dB(uV/m)	dB
30.5	V	14.0	11.2	0.0	0.0	0.0	25.2	40.0	-14.8
122.1	V	15.0	6.4	0.0	0.0	0.0	21.4	43.5	-22.1
183.1	V	16.0	8.7	0.0	0.0	0.0	24.7	43.5	-18.8
396.8	H	14.0	15.1	0.0	0.0	0.0	29.1	46.0	-16.9
488.4	H	10.9	17.1	0.0	0.0	0.0	28.0	46.0	-18.0
610.4	H	10.8	18.7	0.0	0.0	0.0	29.5	46.0	-16.5

Note: 1. All measurement were made at 3 meters
2. Negative signs (-) in the margin column signify levels below the limit.

4.12 Processing Gain Measurements, FCC Rule 15.247(e)

The processing gain shall be determined from the ratio in dB of the signal to noise ratio with the system spreading code turned OFF, to the signal to noise ratio with the system spreading code turned ON, as measured at the demodulated output of the receiver. The processing gain shall be at least 10 dB for a direct sequence spread spectrum system.

	Refer to attached test procedure and data sheets.
X	Refer to circuit analysis and processing gain calculations provided by manufacturer.

4.13 Transmitter Duty Cycle Calculation and Measurements, FCC Rule 15.35(b), (c)

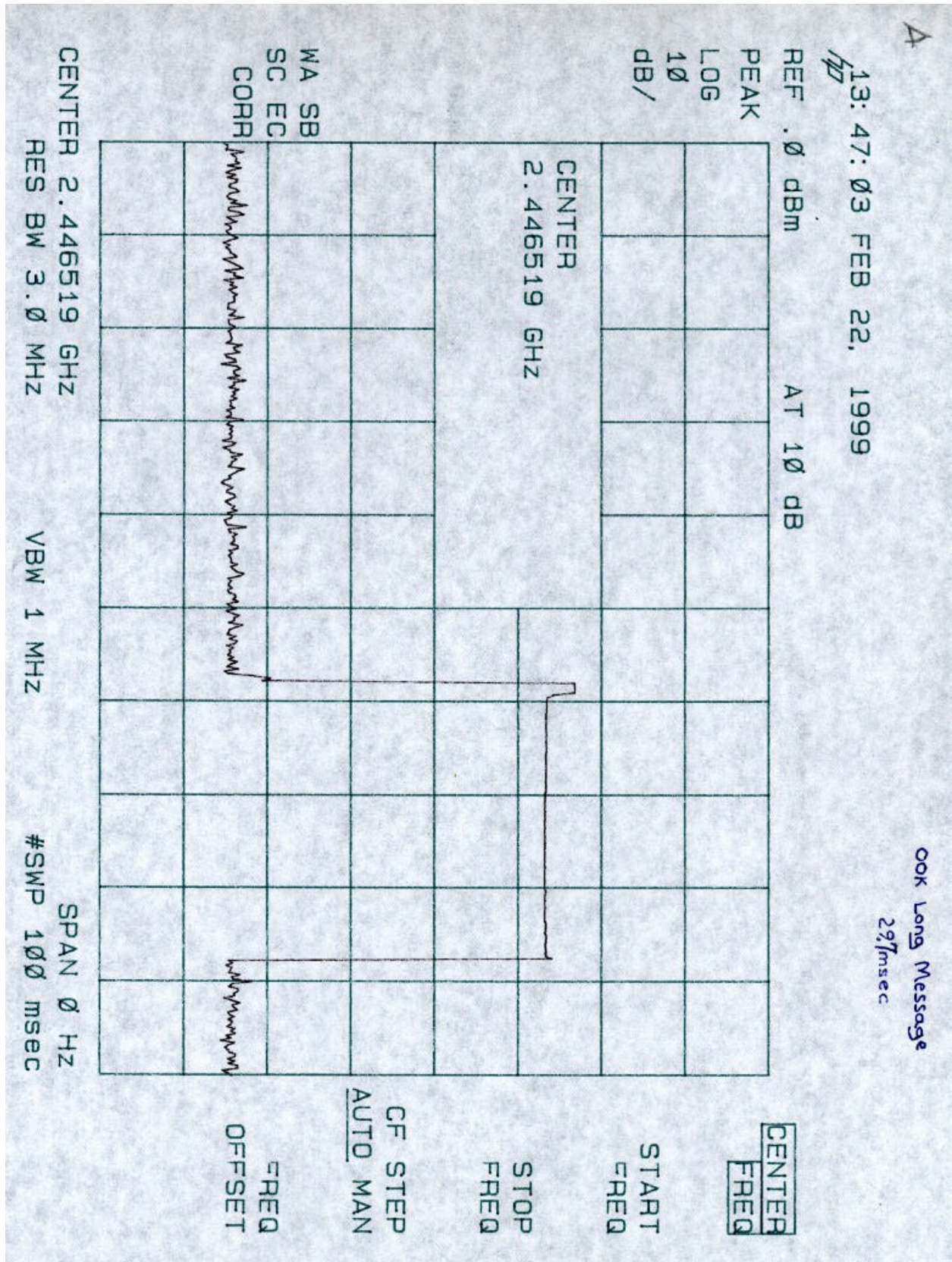
The EUT antenna output port was connected to the input of the spectrum analyzer. The analyzer center frequency was set to EUT RF channel carrier. The SWEEP function on the analyzer was set to ZERO SPAN. The transmitter ON time was determined from the resultant time-amplitude display:

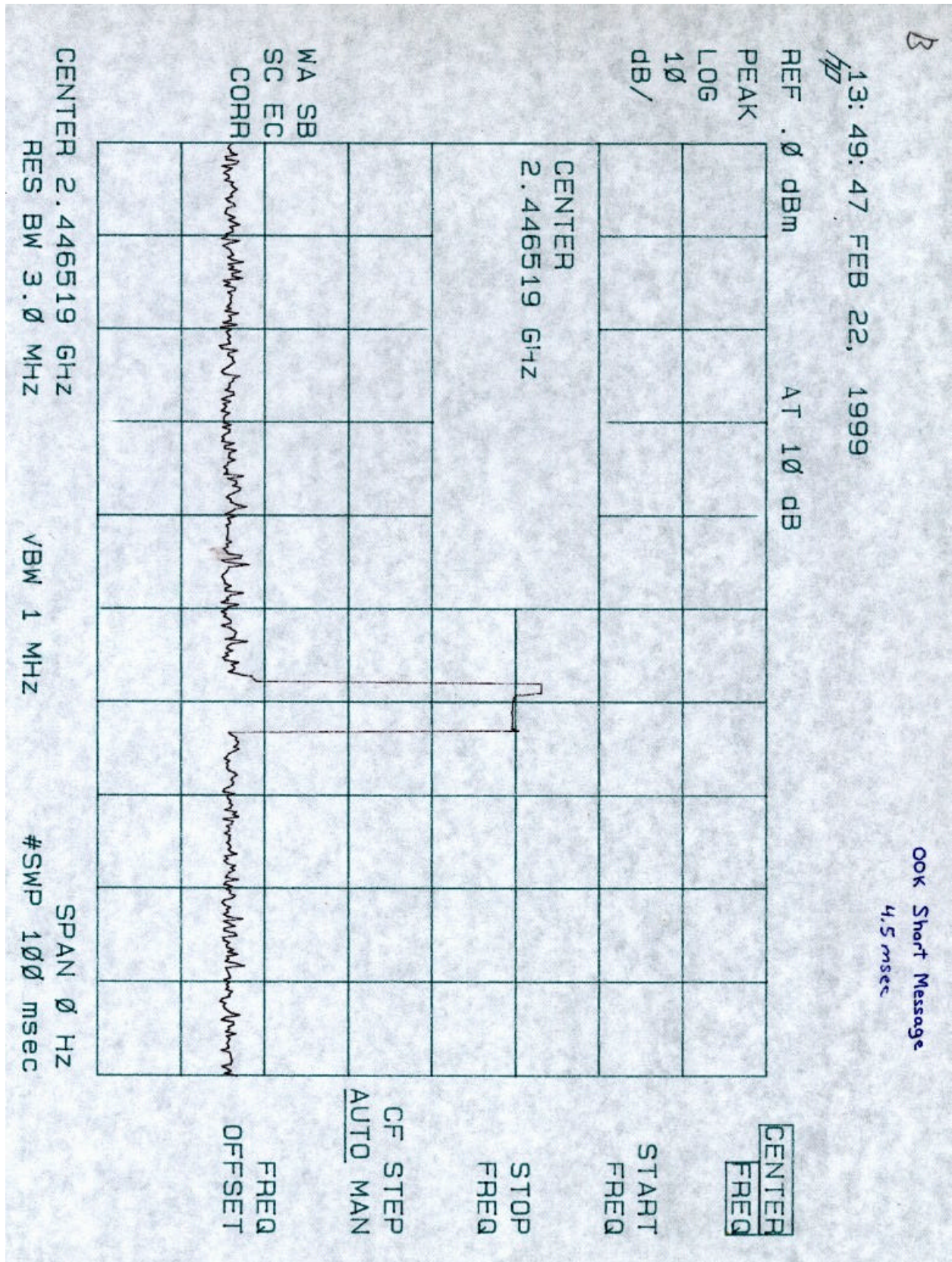
Duty cycle = Maximum ON time in 100 msec/100

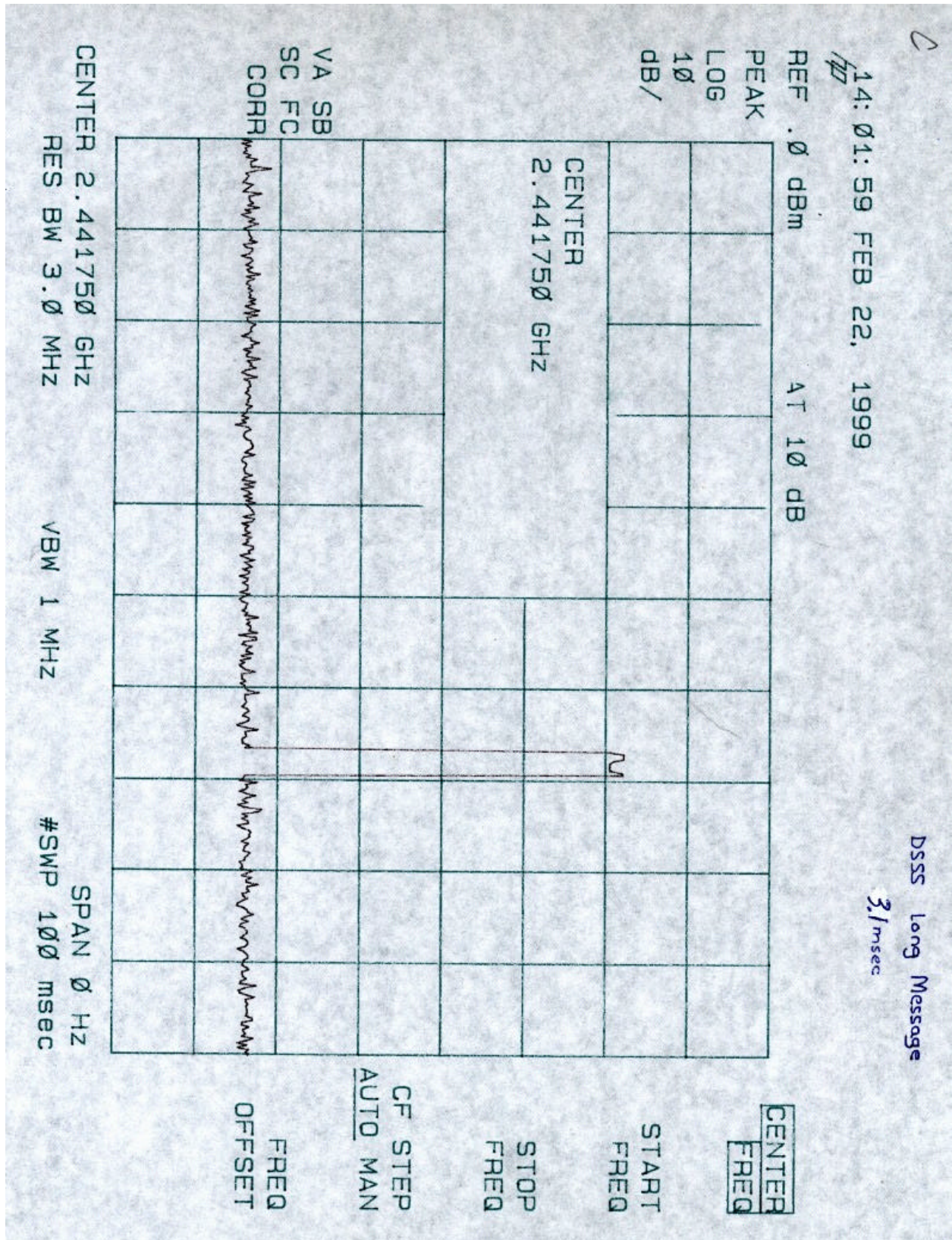
Duty cycle correction, dB = $20 * \log(\text{DC})$

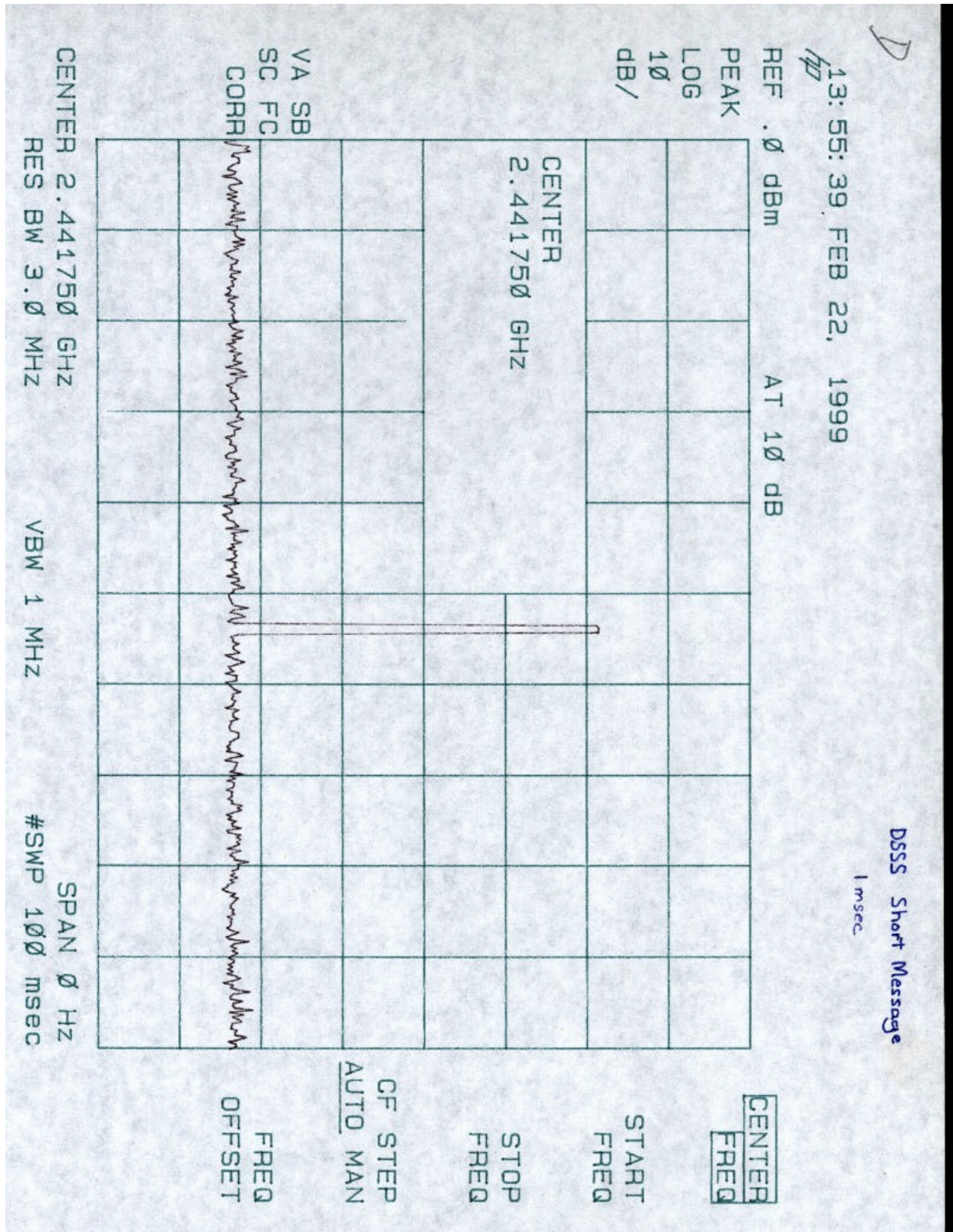
	See attached spectrum analyzer chart(s) for transmitter timing
X	See transmitter timing diagram provided by manufacturer

Plots A-D









6.0 List of Exhibits

<i>Exhibit 1</i>	ID Label Format
<i>Exhibit 2</i>	ID Label Location
<i>Exhibit 3</i>	Equipment Photographs
<i>Exhibit 4</i>	Block Diagram
<i>Exhibit 5</i>	Circuit Diagram
<i>Exhibit 6</i>	This Test Report
<i>Exhibit 7</i>	Test Setup Photos
<i>Exhibit 8</i>	Instruction Manual
<i>Exhibit 9</i>	Antenna Information