SEA COM CORPORATION

APPLICATION FOR CERTIFICATION

MODEL SEA 157S VHF TRANSCEIVER

AND DSC CONTROLLER

CONTAINS:

LIST OF EXHIBITS:

EXHIBIT A and EXHIBITS 1 THROUGH 13

October 21, 2010

FCC IDENTIFIER: YIBSEA157S

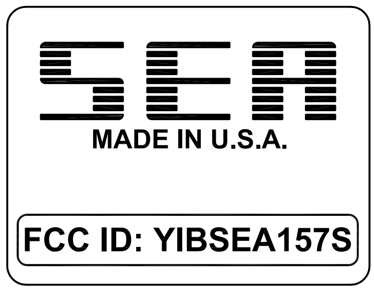
LIST OF EXHIBITS

LIST OF FIGURES

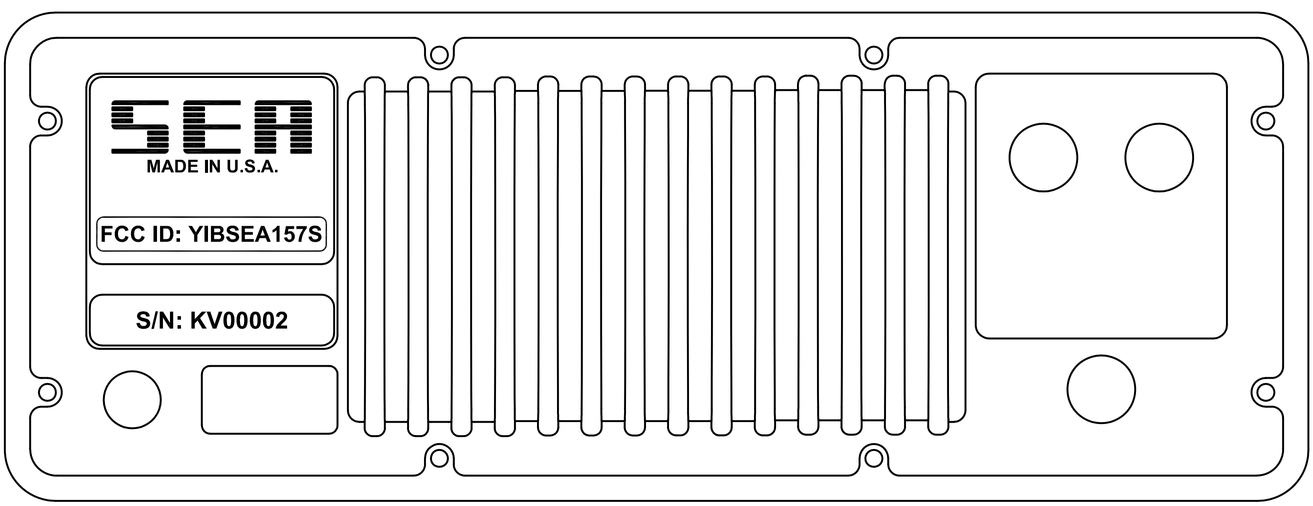
LIST OF FIGURES, continued

FCC IDENTIFICATION LABEL SAMPLE

SAMPLE EQUIPMENT LABEL FOR SEA 157s



REAR PANEL DRAWING OF SEA 157s SHOWING LABEL LOCATION



FCC IDENTIFIER: YIBSEA157s

EXHIBIT 1

INTRODUCTION

SEA COM Corporation of Mountlake Terrace, WA (SEA) is pleased to submit this Application for Certification of our VHF FM Marine Transceiver/DSC Controller, Model SEA 157S. SEA COM Corporation seeks Certification of the model SEA 157S under CFR 47 Part 80.203 and Part 90.203.

The Model SEA 157S is designed to meet the requirements of Part 80 as it pertains to vhf radiotelephones for use on boats and ships and at private (simplex) marine coast stations. The model SEA 157S is capable of simplex or semi-duplex operation as appropriate on all currently authorized marine vhf frequencies in the 156-162 MHz band. It also contains all international (ITU) channels. Furthermore, the model SEA 157S is equipped with an integral DSC Controller which complies with the general requirements for Class D in accordance with 80.203(n), 80.225, Rec. ITU-R M.493-9, "Digital Selective-Calling System for use in the Maritime Mobile Service"and RTCM paper 56-95/SC101-STD.

The SEA 157S also meets the requirements of Part 90-Private Land Mobile Radio Services 90.20 Public Safety Pool and 90.35 Industrial/Business Pool.

Basic features of the SEA 157S VHF FM Transceiver/DSC Controller include a transmitter frequency range of 156.0 to 157.5 MHz controlled by a 12.5 kHz step frequency synthesizer. The transceiver can operate in either simplex or semi-duplex modes. The receiver can operate over a range of 155 to 164 MHz. Transmitter and receiver channel selection is controlled by the front panel keypad. A list of standard vhf channel frequencies is pre-stored in read-only-memory by channel number. Direct frequency entry is not allowed. The transmitter develops 25 watts or 1 watt of carrier power and power level may be selected by the operator. Automatic reduction of carrier power to 1 watt is provided on channels 13 (156.650 MHz), 67 (156.375 MHz), 75 (156.775 MHz), and 76 (156.825 MHz). A manual high power override capability is provided for channels 13 and 67 per Part 80.215(g)(2. The operating system does not allow voice transmission on the digital selective calling channel (70), 156.525 MHz.

Operating requirements compliance. The SEA 157S is equipped to operate on all currently authorized channels in the 156-162 MHz band. Its operator on/off select, transmit/receive select and channel select controls are all readily accessible and can be quickly changed by the operator by pressing the keypad buttons. The SEA 157S is fully capable of operation in compliance with the following requirements as they apply to telephony operations in the 156-162 MHz band:

Land (private coast): Parts 80.67(a), 80.71
Ships: Parts 80.80, 80.143, 80.1

Compulsory ships compliance: The SEA 157S is capable of complying with these requirements as they pertain to vhf radiotelephones or vhf watch receivers operating in the 156-162 MHz band:

Subpart R (300 Gross tons): Parts 80.871, 80.873, 80.874. See Exhibits 4 and 5 for transmitter power output and modulation characteristics. See Exhibit 12 for receiver sensitivity measurements and statements concerning certain receiver characteristics required by Part 80.874.

Subpart S (Small passenger boats): Parts 80.905, 80.911, 80.913. See Exhibits 4 and 5 for transmitter power output and modulation characteristics. See Exhibit 12 for receiver sensitivity measurements.

Subpart T (Vessels on the Great Lakes): Parts 80.956, 80.959, 80.961. See Exhibit 4 for transmitter power output. See Exhibit 12 for receiver sensitivity measurements.

Subpart U (Bridge-to-Bridge Act): Parts 80.1011 and 80.1013 The SEA 157S is capable of transmission and reception on 156.650 MHz (Channel 13).

Subpart E (General Technical Standards): The SEA 157S incorporates a VHF DSC Controller which complies with the general requirements for Class D as specified in 80.203(n), 80.225, Rec. ITU-R M.493-9 and RTCM 56-95/SC101-STD.

Part 90-Private Land Mobile Radio Services
Subpart B-Public Safety Radio Pool 90.20

Part 90-Private Land Mobile Radio Services
Subpart C-Industrial/Business Radio Pool 90.35

NAME OF APPLICANT, Part 2.1033(c)(1)

--- Manufacturer and Applicant ---

SEA COM CORPORATION
7030 220th Street SW
Mountlake Terrace WA, 98043

EQUIPMENT IDENTIFICATION, Part 2.1033(c)(2)

Model SEA 157S, VHF FM Transceiver/DSC Controller

FCC Identifier: YIBSEA157S

INSTALLATION AND OPERATING INSTRUCTIONS, Part 2.1033(c)(3)

See Enclosed PRELIMINARY MAINTENANCE MANUAL

EXHIBIT 2

TECHNICAL DESCRIPTION, Part 2.1033(c)

TYPES OF EMISSION, Parts 2.1033(c)(4), 80.207(d), 90.207(c)

VOICE Mode: 16K0F3E and 11K2F3E
DSC Mode: 13K5G2D
GMSK Mode: 11K2F2D

FREQUENCY RANGE, Part 2.1033(c)(5):

Transmit: 156.0 to 157.5 MHz
Receive: 155.0 to 164.0 MHz

RANGE OF OPERATING POWER LEVELS, Part 2.1033(c)(6):

Two carrier power levels are provided: 25 watts and 1 watt. Power level is held constant by a closed-loop operating from a sample of the RF output. See Part 2.1033(c)(10) below for details.

MAXIMUM POWER LEVEL, Part 2.1033(c)(7): 25 watts carrier.

The transmitter complies with 80.215 and 90.215 concerning allowable maximum power, manual and automatic power reduction and manual power override.

DC VOLTAGES AND CURRENTS APPLIED TO FINAL AMPLIFIER,

Part 2.1033(c)(8):

Test conditions:

DC voltage measured at pin 3 (Hi dc) of RF power amplifier module U16 which is the dc power input point to final power amplifier stage (See transmitter schematic diagram in Preliminary Maintenance Manual.) DC current measured into same pin as above. Transmitter operated on a frequency in the middle of its range and set to 25 watts average output power.

DC Voltage: 13.6 Volts DC Current: 5.5 Amps

TUNE-UP PROCEDURE, Part 2.1033(c)(9)

See SEA 157S Preliminary Maintenance Manual (Enclosed), Chapter 4, "Installation" and Chapter 6, "Maintenance".

FREQUENCY DETERMINING AND STABLILIZATION CIRCUITS, Part 2.1033(c)(10)

Block and schematic diagrams referenced below are located in Section 7 of the Preliminary Maintenance Manual. See the List Of Figures for aid in locating applicable reference drawings.

FREQUENCY SYNTHESIZER:

GENERAL: Refer to the functional block and schematic diagrams. The SEA 157S makes use of a multi-loop synthesizer system to provide conversion frequencies for the Receiver, and the Transmitter. The Main Transmitter synthesizer also serves as the first conversion loop for the Main Receiver and consists of the voltage controlled oscillator (VCO) Q1, RF buffers/amplifiers Q4 and Q3, synthesizer LSI chip U10, reference oscillator VCTCXO Y1, and the loop filter.

VCO: The low-noise VCO is a grounded-gate JFET oscillator operating in two frequency bands as selected by Q2 and D2. D2 is "off" for transmit and L5 and L6 set the frequency band to the 155-159mHzrange. D2 is "on" for receive and L6 sets the 176.4-185.4mHz receiver local oscillator (LO) range. The tuning voltage from the loop filter is applied to varactors D4 and D5. The tuning voltage ranges from 1 to 4 volts. As the cathodes of D4 and D5 are referenced to the +8 volt supply, lower voltages correspond to higher frequencies. The entire VCO and two stage buffer is on a separate pc board located in a shielded “pocket” in the chassis casting.

VCO RF AMPLIFIERS: Q4 and Q3 amplify the VCO signal up to +10 dBm (10 mW) nominal. The signal is then fed to the receiver mixer U3 via a resistive attenuator and also to the transmitter pre-driver Q10 via the Main Board diode D3. D3 is turned "on" only during transmission to supply approximately +10 dBm excitation to the transmitter amplifier chain.

SYNTHESIZER CHIP: A sample of the amplified VCO signal is derived from the output of Q3 and fed to the N and A dividers of U10. The N and A divider modulus is preset by the microcomputer via the clock, data and enable digital lines. The total frequency division (N and A) reduces the RF signal down to a 12.5kHz comparison frequency at U10's internal phase detector. For example, the total division for transmission on 156.80mHzis 156,800/12.5 = 12544. For a receive frequency of 156.mHz the required LO frequency is 156.80mHz+ 21.40mHz= 178.20mHzrequiring a division factor of 178.200/12.5 = 14,256.

The 21.85mHz master reference oscillator is divided by a fixed 1748 modulus to produce the 12.5kHz reference frequency. The U10 phase detector output at pin 5 is tri-state and drives the loop filter. A separate lock detect (LD) output from U10 pin 14 goes low when out of lock. The LD signal is fed back to the microcomputer which disables the transmitter while in the unlocked state thus preventing the transmission of RF power outside the maximum frequency difference limits prescribed by Parts 80.209, 90.213, and 90.214”.

MASTER REFERENCE OSCILLATOR: The master clock is provided by highly stable VCTCXO at 21.85mHz Y1. This oscillator has a specified frequency stability of +/-1ppm from –20 to 70 degrees C. The oscillator output is connected the input of the CMOS gate of the synthesizer IC, U10 pin 1. The output of this gate, U10 pin 2 provides a buffered 21.85mHz signal to the main and Channel 70 receiver boards.

LOOP FILTER: R64 on the main PCB and R3,R4,R13,C2,C4,C5,and C19 on the VCO PCB comprise the synthesizer loop filter

DESCRIPTION OF MODULATION LIMITING, POWER LIMITING AND SPURIOUS RADIATION SUPPRESSION CIRCUITRY, Part 2.1033(c)(10)

MODULATION CIRCUIT:

TRANSMITTER AUDIO PROCESSING: After a 20dB boost by amplifier IC U21, located on the main PCB, microphone audio is sent to be processed by the digital signal processor (DSP), U13, located on the Mezzanine PCB. The microphone audio signal is applied to the MICIN input of 16-bit audio CODEC, U8, where it is digitized and sent to the DSP. The DSP then feeds it through a digital filter/limiter process which filters the transmitter audio with a 3kHz lowpass filter. It then applies a 6db per octave pre-emphasis, limits the audio in a low distortion process and finally filters the audio again with a 3kHz lowpass filter. This method maximizes the average voice energy within the set deviation limit while minimizing audio harmonic distortion levels.

DSC DATA: The digital modulation signal is generated internally in a phase continuous digital sine wave generator. It is then fed into the transmitter audio processing (within the DSP) at the input of the pre-emphasis and then applied at a level below the limiting threshold of the audio processing and factory calibration for a modulation index of 2.

FREQUENCY DEVIATION CONTROL: The transmitter peak deviation is controlled digitally by a factory set deviation multiplier constant which is stored in flash memory (U3 and U4). D2 on the VCO PCB is switched "on" during receive mode to switch VCO ranges and to insure that no modulation is applied to the synthesizer during receive operation.

TRANSMIT AMPLIFIER CHAIN:

GENERAL: Referring to Sheet 4 of the Mainboard Schematic Diagram, the transmit amplifier chain of the SEA 157S consists of the discrete RF amplifiers Q10 and Q9 and a two-stage hybrid RF power amplifier module U16.

PRE-DRIVERS: The buffered output signal from the frequency synthesizer is first amplified by Q10 and its output is coupled to the input of Q9. Q9 further amplifies the signal and applies it to the input (IN) of the power amplifier module U16. The RF signal from Q9 is however only available to the input of the power amplifier module when in the transmit mode and 13Vdc is present on 13V_TX bus to power Q10.

FINAL AMPLIFIER: U16 is a hybrid power amplifier module containing two gain stages. When the radio is on, 13.6Vdc is applied to the power amplifier module at all times. The power amplifier module will however only produce RF power when the radio is in the transmit mode and the RF signal from Q9 is available at the module input (IN). The amount of RF output produced by the power amplifier module is dependent on the level of bias voltage available to pin 2(PA) of the power amplifier module and to Q9 via R5, R6, and L5. This bias voltage is controlled by the amplifier consisting of Q5, Q13 and their associated components and the amount of control voltage available at the 1W_25W bus.

ANTENNA INTERFACE CIRCUITS:

TRANSMIT/RECEIVE SWITCHING: Antenna changeover between transmit and receive is accomplished by the PIN diode switches D33 on the Mainboard and D1 on the Receiver Board. In the transmit mode, voltage is applied to the 13_VTX bus and current passes through R43, R72, R62, L7, R2, R2A, L1, and D33 on the mainboard and finally to ground through L1 and D1 on the Receiver board. This current through D33 causes it to become forward biased and pass RF power from the power amplifier module to the low-pass filter consisting of L2, L3, L4, and their associated capacitors.

FCC IDENTIFIER: YIBSEA157S

The DC current flow though D1 also causes it to become forward biased and short-circuits the input to the receiver. The short-circuit in addition causes the input impedance of the 1/4 wave matching section comprised of C1, L1, and, C2 on the Receiver board to become high and effectively isolates the receiver from the transmitter RF.

TRANSMIT/RECEIVE ANTENNA FILTERING: The 7-section low-pass filter comprised of C4, L1, C5, C7, L2, C126, C8, L3, C127, C9, L4, and C10 provides VHF and UHF attenuation of the transmitter harmonics and receiver images.

AUTOMATIC RF POWER CONTROL (APC) AND TX LOGIC:

In transmit mode a negative feedback control system continuously monitors and if necessary, corrects the output power level at the antenna terminals. C119 samples the RF voltage at the RF power amplifier module output terminal (4). Diode D34 converts this RF signal to a DC level representing the output power level. This DC power level signal is fed to one channel of the internal A/D converter of CPU IC, U1, located on the Mezzanine board. The digitized signal is processed by a power control routine, which, through the D/A converter U17, drives the DC amplifier consisting of Q5 and Q13 to provide the correct DC supply voltage to Q9 and bias to the power amplifier module U16. This RF power level closed-loop system thus maintains the RF output power at the proper level. Two references are used in the control routine which correspond to 1 watt or 25 watt output levels. When adjusted according to the alignment instructions, the APC system will closely maintain the 1W or 25W output level (as selected) over a wide range of power supply voltage and ambient temperatures. In the unlikely event that the automatic power control system should fail, the power amplifier cannot produce much more 30 watts.

EXHIBIT 3

INTRODUCTION TO TRANSMITTER MEASUREMENTS, Part 2.1033(c)(14)

Exhibits 4 through 9 on the following pages present the required measured transmitter performance data for parts 2.1046 through 2.1057. The appropriate Part 80 and Part 90 references are also included in each exhibit.

Please note: Receiver data and measurements for receiver type acceptance per 80.874 can be found in Exhibit 11.

MEASUREMENT PROCEDURES, Parts 2.947, 2.1041

Specific measurement procedures and test setup diagrams are presented along with the resultant data for each of the tests prescribed by parts 2.1046 through 2.1057.

CERTIFICATION OF TEST DATA, Part 2.909

Please see page 3-2 for the test supervisor's statement.

TEST EQUIPMENT LIST, pp. 2.947(d)

The equipment used for the tests is listed on page 3-3

STATEMENT OF TEST SUPERVISOR, Part 2.911

This is to certify that the undersigned supervised the technical tests included in this report and to the best of my knowledge, the data and facts are correct.

The engineering qualifications of the undersigned are as follows:

Experience
1957-1962: Electronic Technician in the fields of Radio Communications and Electronic Instrumentation.
1962-Present: Electronic Design Engineer in the fields of Radio Communications, Electronic Instrumentation, Analog and RF circuit design and testing.
(See Attached Resume.)

Licenses
Holder of Radiotelephone licenses for over 50 years and holder of Amateur Radio licenses WN7YNC, W7YNC, KD7PI since 1955. Present holder of General Radiotelephone Operator License #PG-13-13839 and Advanced Class Amateur Radio license W7YNC.

Professional Affiliations
IEEE: Institute of Electrical and Electronics Engineers
ISA: The Instrumentation, Systems, and Automation Society
SAE: Society of Automotive Engineers
SEMA: Specialty Equipment Market Association

Should you require further information regarding this application, please contact me at SEA COM Corporation at (425)771-2182 or my mobile phone at (206)-910-1104.

Signed,

OCT 21, 2010

Harold G. Middleton   Date
Project Engineer
SEA COM Corporation
7030 220th Street SW
Mountlake Terrace WA, 98043

TEST EQUIPMENT LIST, Part 2.947(d)

ITEM	DESCRIPTION	MODEL
1.	Audio Analyzer/Generator	HP 8903A
2.	Audio Step Attenuator	HP 350A
3.	RF Wattmeter	Bird 4410a, 4410-6 Element
4.	100W, 30dB Attenuator	JWF IND. 50FH-030-100
5.	Power Splitter	Mini-Circuits ZFDC-10-1
7.	Oscilloscope	Tektronix 2465A
8.	Spectrum Analyzer	HP 8568B
9.	DC Power Supply	Primary Power Systems 1021
10.	Digital Voltmeter	Fluke 75
11.	RF Signal Generator	Rohde & Schwarz SME02
12.	Frequency Counter	HP 5384A
13.	Frequency Standard	HP 58503A
14.	Environmental Chamber	Tenney TJR-16
15.	DC Power Supply	NEWMAR 115-12-35
16.	Modulation Analyzer	HP 8901A
17.	Plotter	HP 7470A
18.	20dB Attenuator	Mini Circuits CAT-20

EXHIBIT 4

RF POWER OUTPUT, Parts 2.1046(a), 2.1046(c) and 80.215

APPLICABLE RULES:

Part 80.215(a)(2):	F3E emissions rated by carrier power.
Part 80.215(c)(1):	Coast stations allowed 50 W max., 156-162 MHz.
Part 80.215(e)(1):	Ship stations 156-162 MHz, 25 watts max., reducible to one watt or less.
Part 80.215(g):	Ship station carrier power at least 8 watts, not greater than 25 watts. Battery supply voltage between 12.2 and 13.7 vdc.
Part 80.215(g)(1):	Transmitter reducible to 1 watt or less.
Part 80.215(g)(2):	Automatic carrier reduction to one watt or less on 156.375 and 156.650 MHz with manual override capability to full power.
Part 80.911(d):	Transmit power at least 15 watts after 10 minutes operation with 11.5 V supply.
Part 80.959(c):	Transmit power at least 10 watts after 10 minutes operation with 11.5 V supply.

PROCEDURE:

The transmitter was tested on two frequencies, 156.050 MHz and 157.425 MHz, representing the lower and upper edges of the transmitter's tuning range. The radio was tuned up in accordance with the alignment procedure in the Preliminary Maintenance Manual. A 50 ohm power attenuator was attached to the antenna terminals. No modulation was applied during the tests.

The radio was powered through its normally supplied power cable by a laboratory power supply. Power supply voltage was normally set to 13.6 VDC.

Please refer to the test set-up diagram, Figure 4.1.

Prior to making the actual power measurements, the test setup was calibrated to compensate for losses between the transmitter output and the spectrum analyzer display. The spectrum analyzer reference level was adjusted so that the carrier line just touched the top screen graticule. This occured at a reference level of -6.5dBm indicating 44-(-6.5) = 50.5 dB loss between transmitter and spectrum analyzer.

The transmitter was keyed on each of the two test frequencies at the 25 and 1 watt power levels. Readings were taken from both the spectrum analyzer and the wattmeter.

The wattmeter slug was changed from the 25 watt version used in the 25 watt tests to a one watt version for the one watt tests. The manufacturer states the accuracy of the wattmeter is ± 5% for full scale deflection.

Operating note per 80.215(g)(3): When either of channels 13 (156.650 MHz) or 67 (156.375 MHz) is selected for transmission in the USA channels mode, the transmitter power is automatically reduced to one watt. The transmitter power can be manually overridden back to full 25 watt power on these two channels by pressing and holding down the "ENT" key during transmission.

To ensure compliance with 80.215(g), another test was performed in which the power supply voltage was varied from 13.7 down to 12.2 vdc while in the 25 watt mode on 156.05 MHz. The wattmeter was monitored for any variation in power from the 25 watt level.

A final test was run to ensure the transmitter is capable of compliance with Parts 80.911(d) and 80.959(c). The transmitter was operated continuously for 10 minutes with 11.5 volts at its supply terminals. The wattmeter was monitored to see if the output power remained above 15 watts.

RESULTS:

Frequency MHz	Power Setting	Wattmeter Watts	Wattmeter Equiv.dBm	Spectrum Analyzer, dBm
156.050	25 W	24.5	+44	-6.4 + 50.5 = +44.1
157.425	25 W	24.3	+44	-6.5 + 50.5 = +44.0
156.050	1 W	0.90	+30	-20.7 + 50.5 = +29.8
157.425	1 W	0.90	+30	-20.8 + 50.5 = +29.7

Since the wattmeter was deflected full scale in each condition above, and the full scale wattmeter accuracy is 5%, the actual power is known within .25 dB. The spectrum analyzer is not quite as accurate in measuring absolute power but serves to insure that emission limitations are not violated during the tests.

In the second test the output power dropped from 24.5 to 21.5 watts as the power supply voltage was varied from 13.7 down to 12.2 vdc.

In the final test, the output power started at 19.0 watts and after 10 minutes it was still 18.8 watts.

FIGURE 4.1

TEST SETUP
RF POWER OUTPUT
2.1046(a)(c)

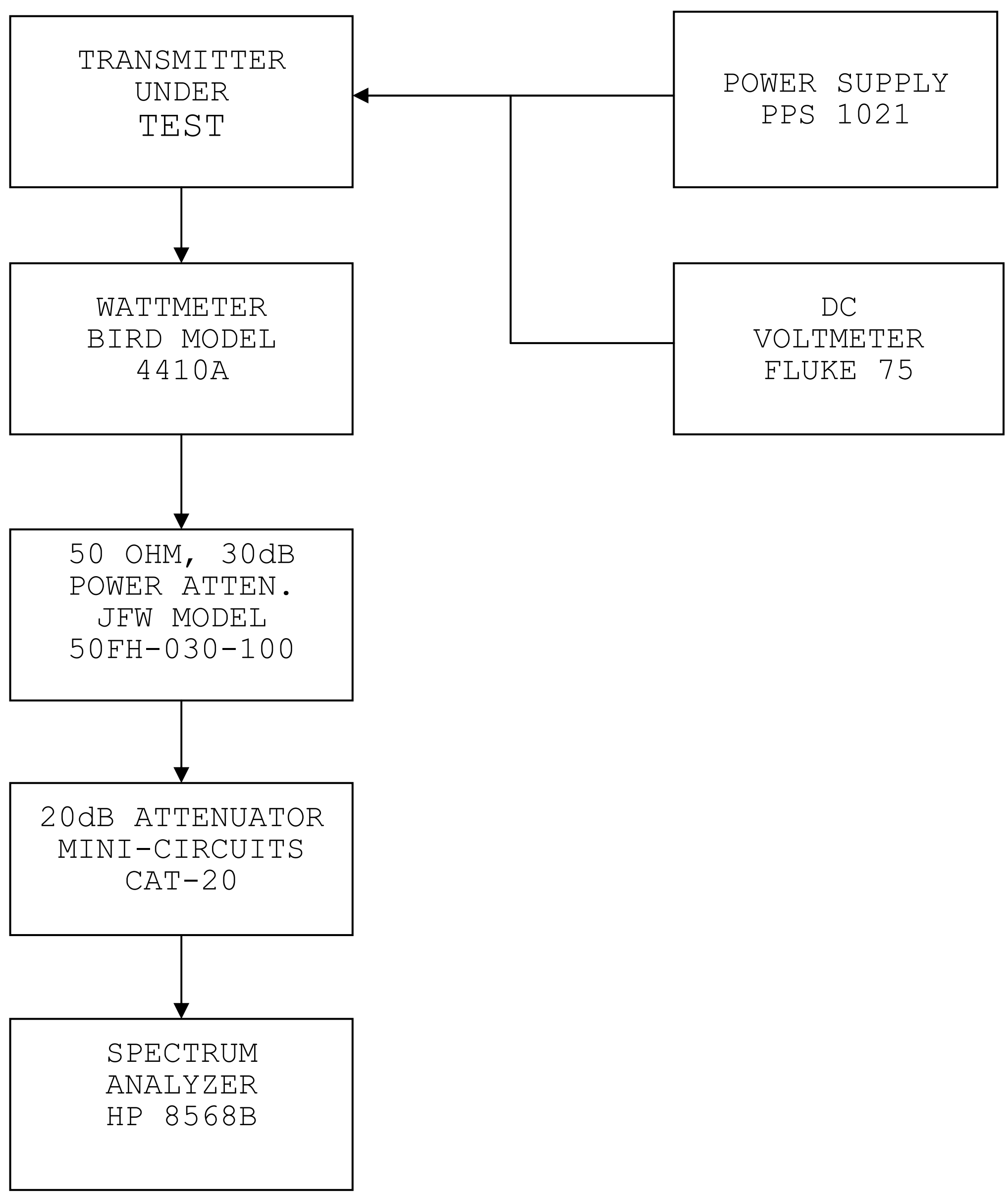


EXHIBIT 5

MODULATION FREQUENCY RESPONSE AND MODULATION LIMITING, PARTS 2.1047(a)(b)

APPLICABLE RULES:

Parts 80.205(a),(b),: 80.213(d)	Maximum frequency deviation for F3E emission is 5 kHz (5 kHz = 100%).
Parts 80.213(a)(2): 80.873(b) 80.911(b)	Must maintain peak modulation between 75 and 100%.
Part 80.213(b):	Modulation limiter required.

PROCEDURE:

The transceiver and test equipment were set up as shown in Figure 5.1. The transmitter was tuned up on the desired test frequency in accordance with the instruction manual. A 50 ohm resistive power attenuator was attached to the antenna terminals.

The transmitter was modulated by connecting an audio analyzer/generator, variable from 100 to 5000 Hz with constant output amplitude, to the microphone input terminals through an audio step attenuator.

An oscilloscope was used to monitor both the amount of clipping at the CODEC output (Pin 3 on VCO module) and the audio input voltage at the microphone terminals.

The frequency modulation analyzer serves as a calibrated receiver. Its demodulated baseband audio output bandwidth was set to 15 kHz at -3dB. Its output amplitude is a linear function of transmitter peak deviation or percent modulation. The audio voltmeter was calibrated so that 0 dB represented 100% percent modulation or 5 kHz peak deviation.

Three tests were conducted. The first test used an audio drive level that did not quite cause audio clipping at the frequency of highest gain in the transmitter audio circuits. The second test was at a medium audio drive level sufficient to produce 100% modulation at some audio frequency. The third test was performed at an audio drive level sufficient to produce audio limiter clipping at frequencies between 300 and 3000 Hz. The peak-peak sinusoidal microphone terminal levels were recorded and compared with the level produced at the microphone terminals by the normally supplied microphone.

RESULTS:

Audio voltage at microphone input terminals:

Test 1, Low audio drive: 14 mV p-p
Test 2, Med. audio drive: 40 mV p-p
Test 3, High audio drive: 110 mV p-p

Plots of modulation level vs. frequency are provided in Figures 5.2, 5.3, and 5.4 resulting from the three tests. In each case zero dB represents 100% modulation (5 kHz peak deviation).

The effect of pre-emphasis is readily seen in Figure 5.2 for modulating frequencies below about 1000 Hz. Attenuation of the audio lowpass filter dominates the response above 3000 Hz.

During normal voice transmission, the peak to peak audio voltage at the microphone terminals is approx. 40 mV. Inspection of the deviation measuring instrument indicate peak deviation averaging about 90% or 4.5 kHz.

Three additional modulation plots which display deviation vs. audio drive level at 500 Hertz, 1000 Hertz and 2500 Hertz are provided in Figures 5.5, 5.6 and 5.7. In each case, the applied audio level was varied from a level 30 dB below the nominal 0 dB reference level of 40 mV peak-to-peak to a level 20 dB above nominal. These plots demonstrate that the transmitter modulation limiter operates effectively over the nominal voice bandpass.

AUDIO LOWPASS FILTER RESPONSE, Part 2.1047(a):

APPLICABLE RULE:

Part 80.213(e):	Audio low pass filter required between modulation limiter and modulated RF stage. Attenuation relative to 1 kHz from 3 to 20 kHz must be 60 log(f/3)dB or at least 50dB above 20 kHz.

PROCEDURE:

Note: In the SEA 157S, most audio processing is accomplished by the system DSP chip. Microphone audio is pre-amplified and applied to the CODEC which in turn drives the DSP chip. The audio signal is then subjected to the necessary signal manipulation through use of software controlled digital routines. (SEE "Description of Modulation Limiting, Power Limiting and Spurious Radiation Suppression Circuitry" on Page 2-3 of this report for a description of this processing).

See Figure 5.8 for the test setup diagram. A constant amplitude audio sine wave generator was connected to the CODEC microphone input, (Pin 18, U8).

The audio generator was first adjusted to 1000 Hz and its amplitude was set such that the CODEC audio output, (Pin 12 of U8) produced a reading on the audio voltmeter of zero dB as a reference.

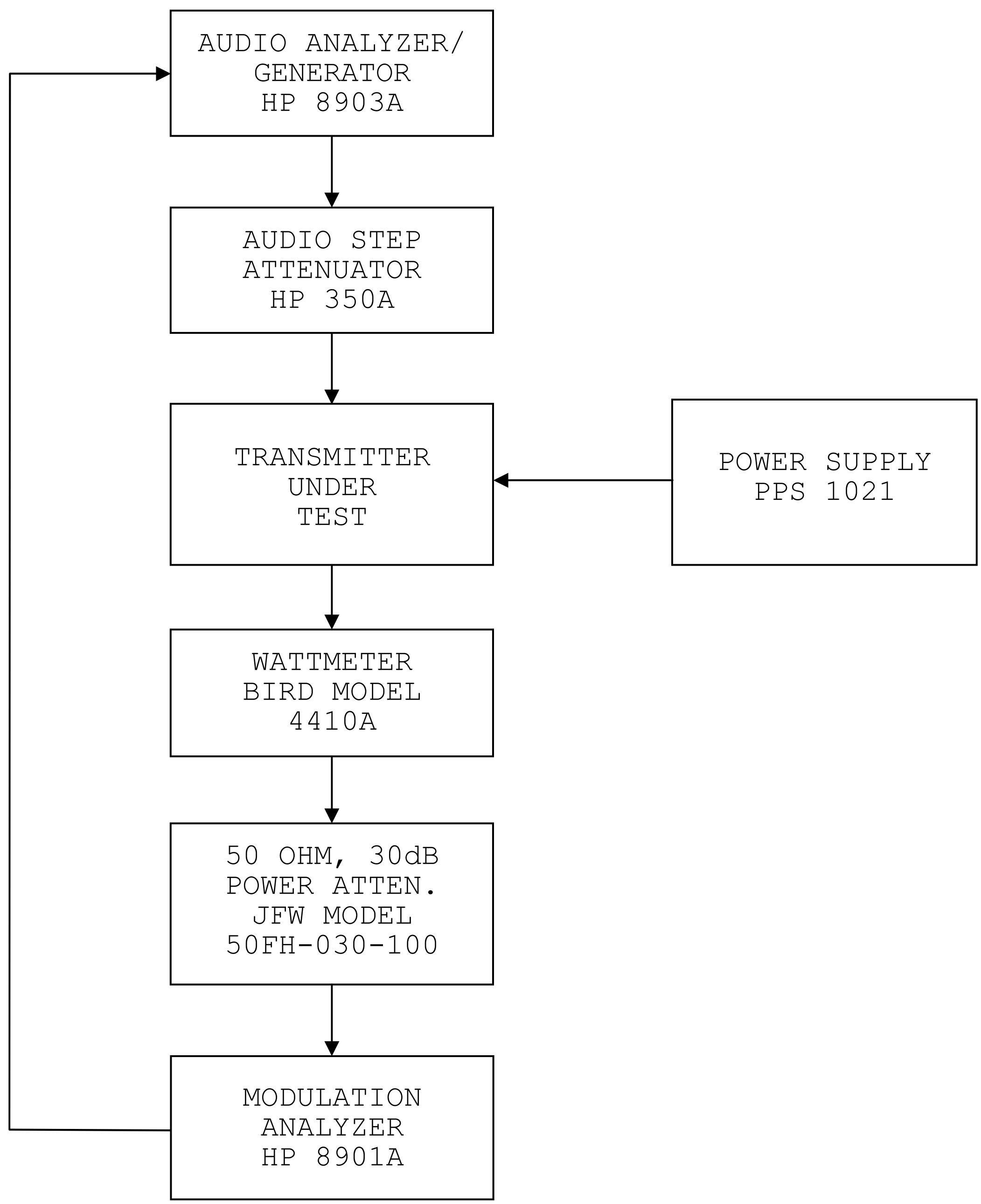
The audio generator frequency was then increased in steps to 100 kHz and adequate data was taken from the audio voltmeter to allow a smooth plot of attenuation vs. frequency.

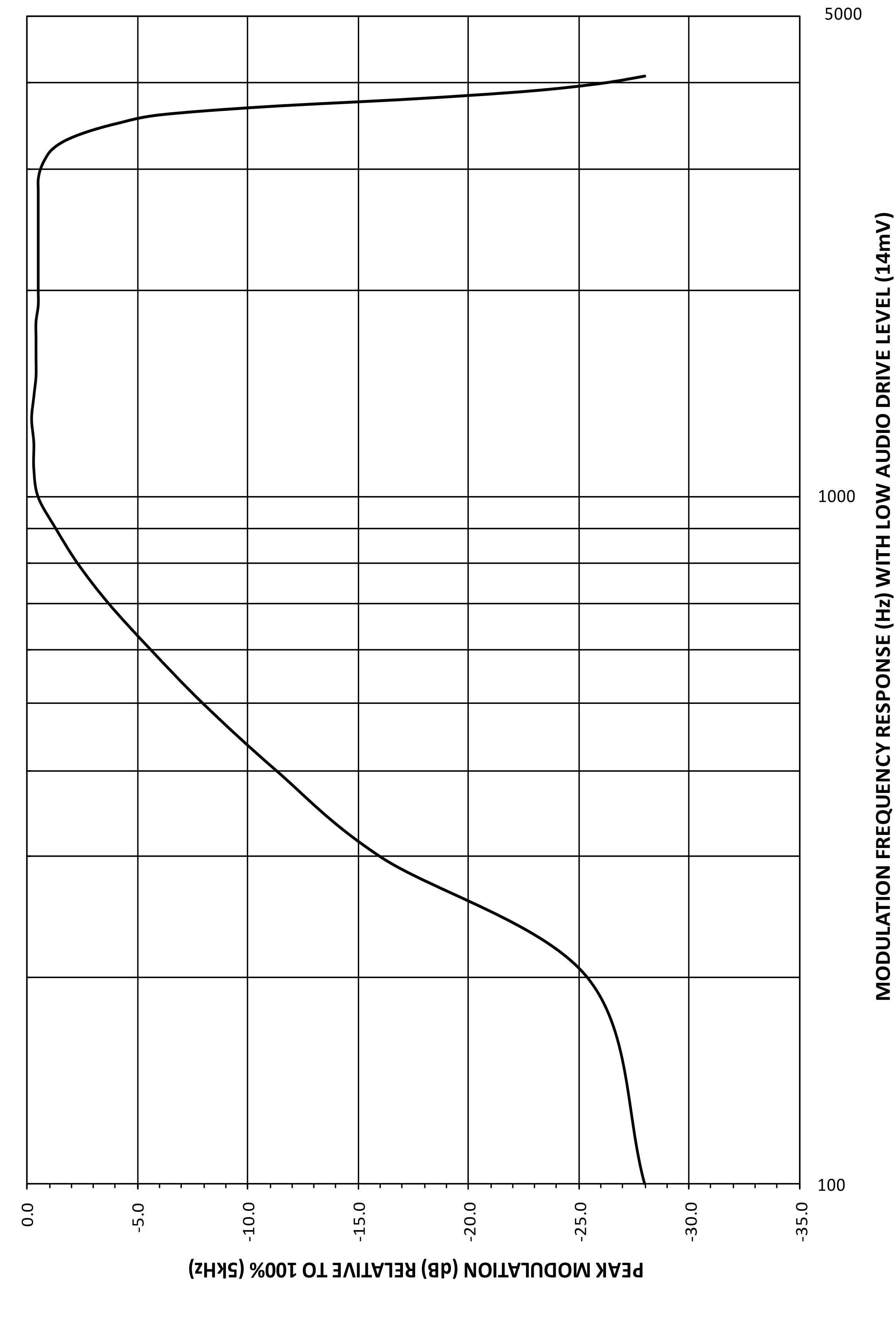
RESULTS:

Please see Figure 5.9 for the frequency response plot of the audio low pass filter between 1 kHz and 100 kHz. The filter complies with the required attenuation limits. The filter noise floor is reached at approximately 5 kHz.

FIGURE 5.1

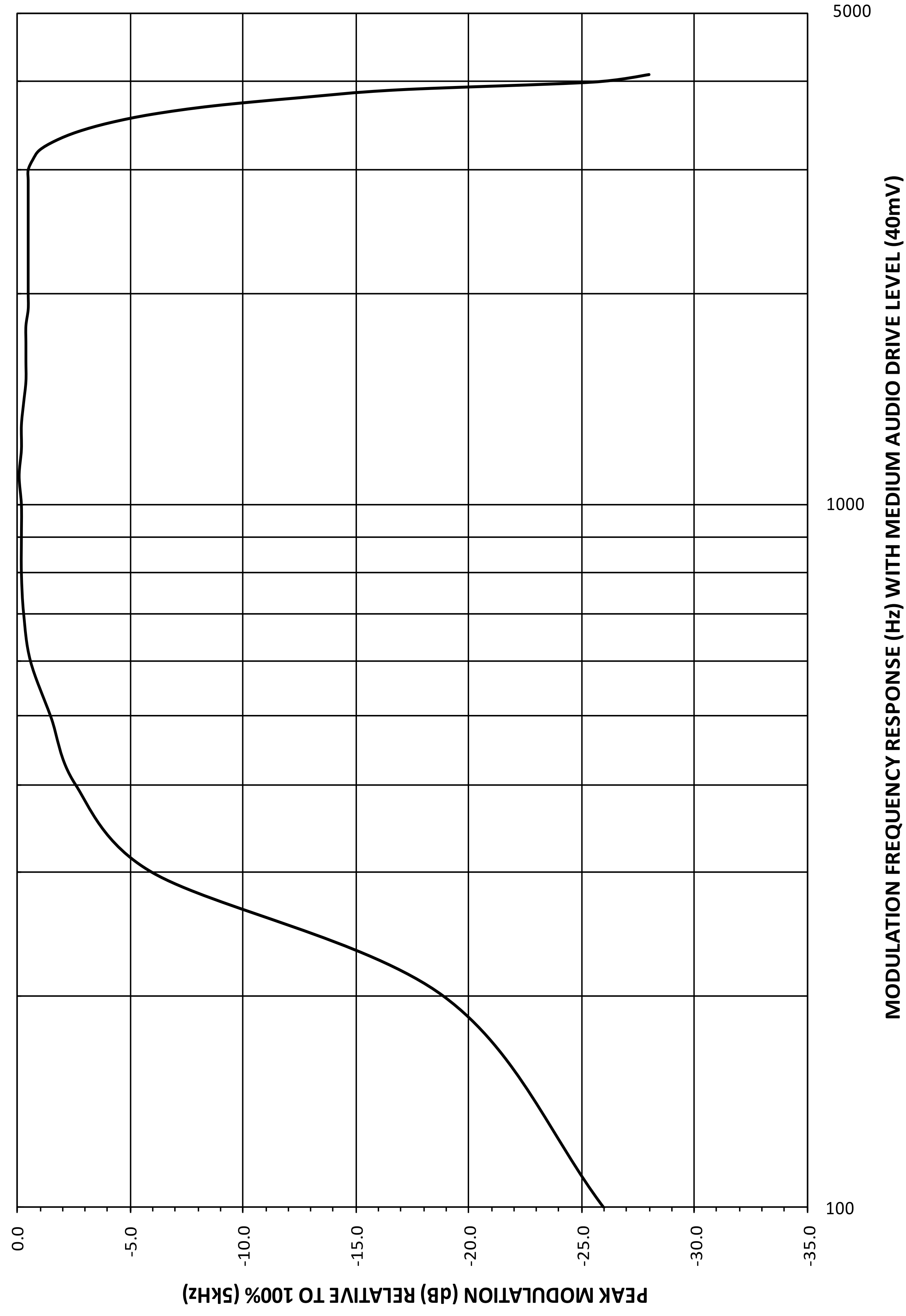
TEST SETUP
MODULATION FREQUENCY RESPONSE
AND MODULATION LIMITING
2.1047(a)(b)





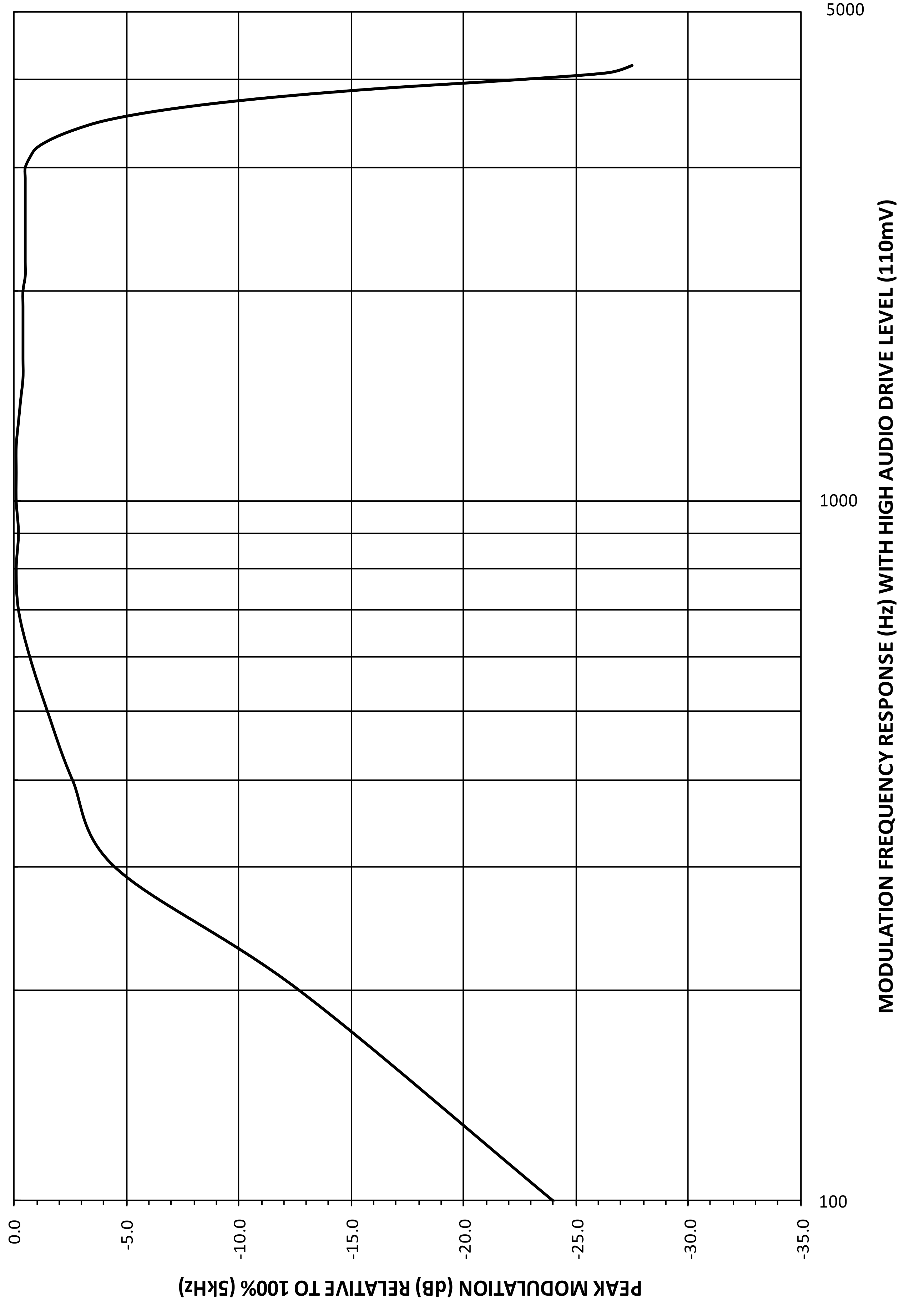
FCC PART 2.1047 (a) (b)

Figure 5.2



FCC PART 2.1047 (a) (b)

Figure 5.3



FCC PART 2.1047 (a) (b)

Figure 5.4

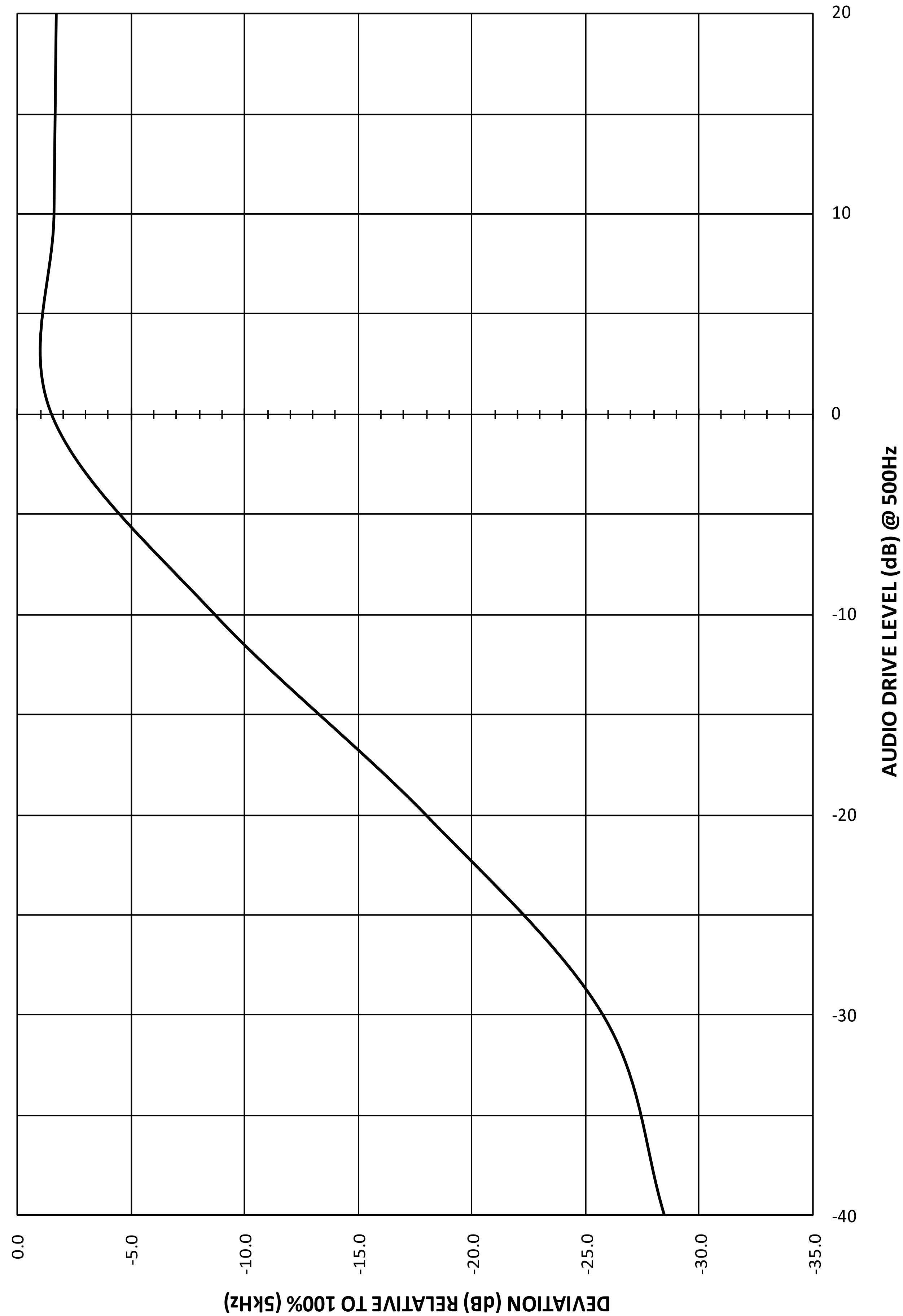
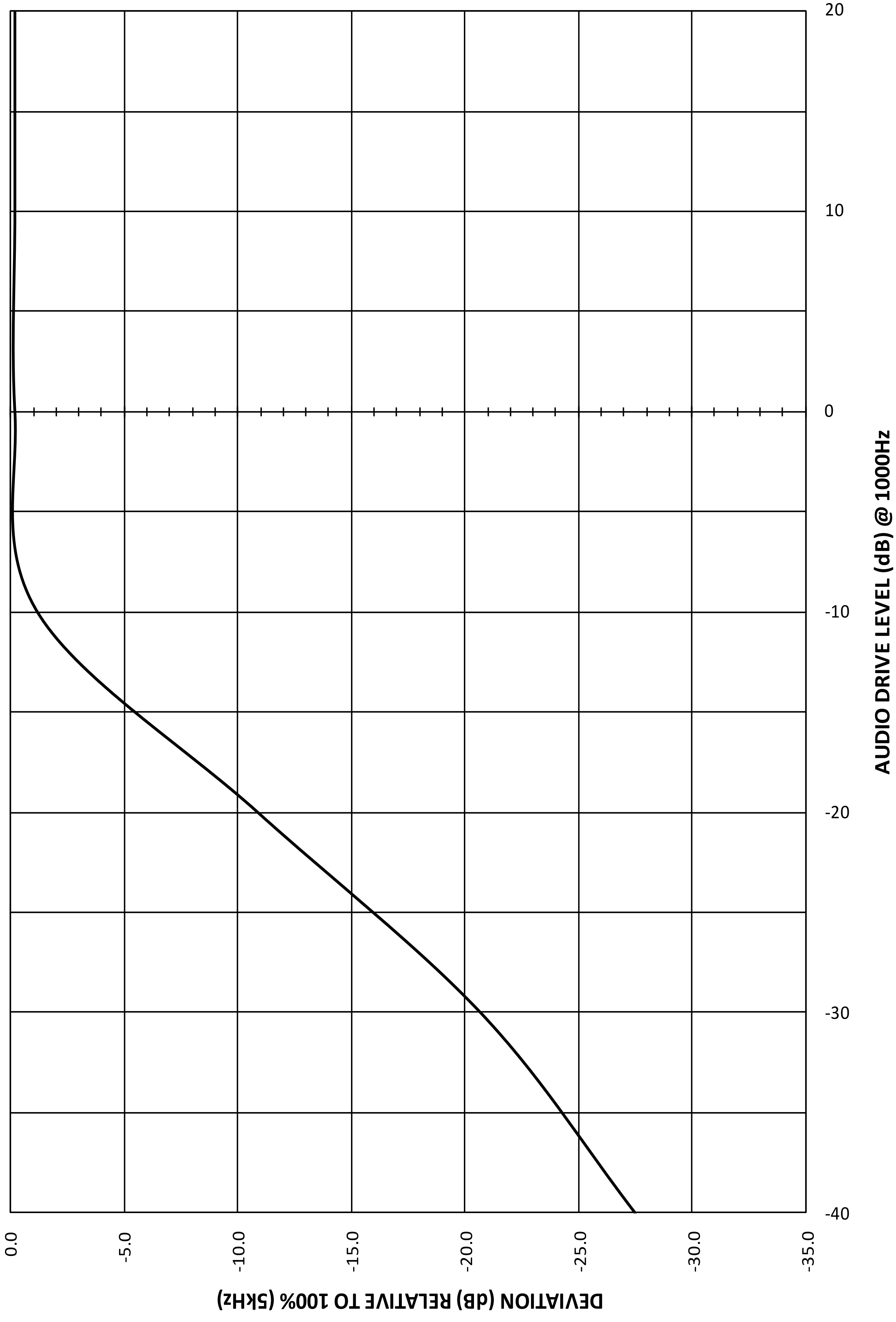
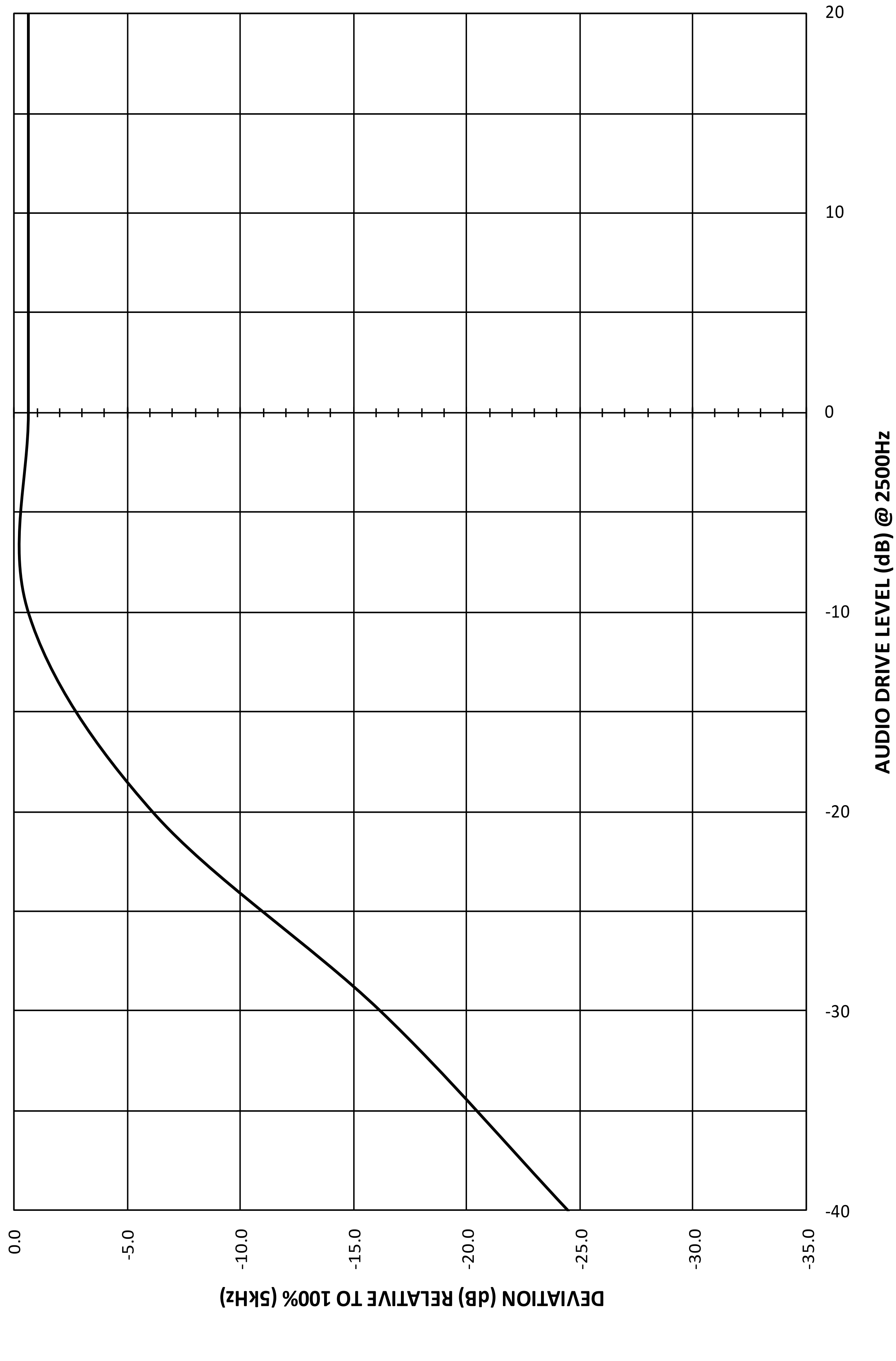


Figure 5.5 **FCC PART 2.1047 (a) (b)**



FCC PART 2.1047 (a) (b)

Figure 5.6

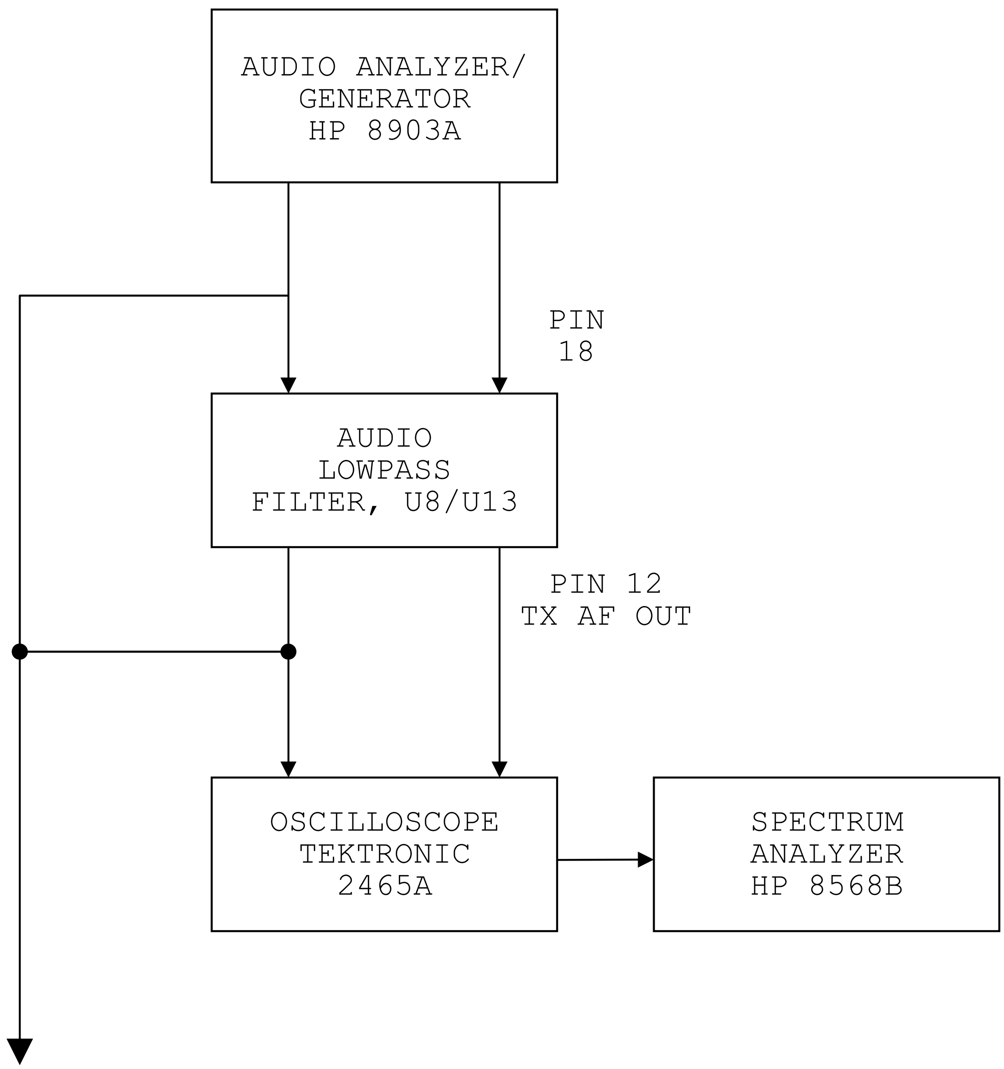


FCC PART 2.1047 (a) (b)

Figure 5.7

FIGURE 5.8

TEST SETUP
FREQUENCY RESPONSE OF
AUDIO LOWPASS FILTER
2.1047(a)



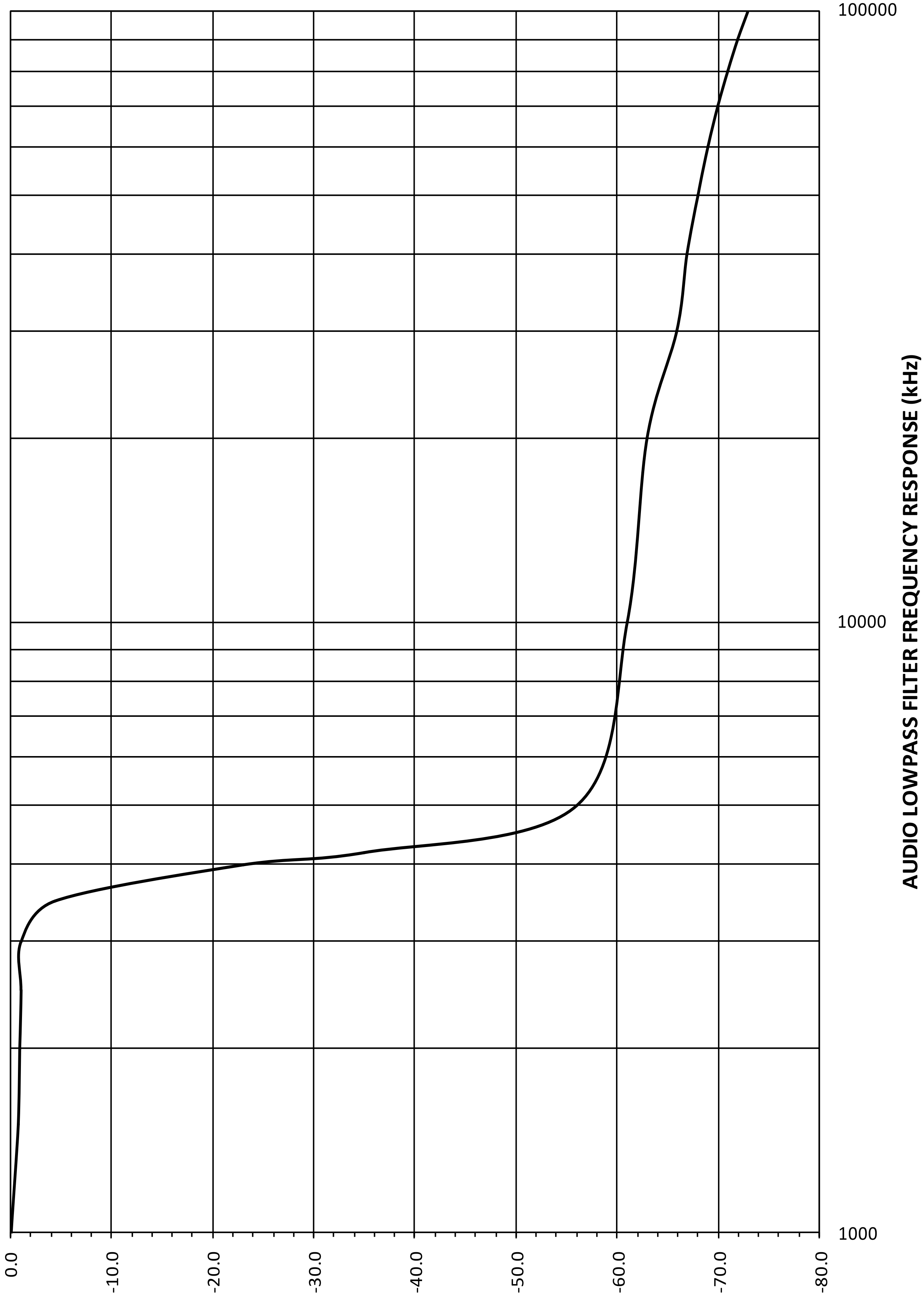


Figure 5.9

FCC PART 2.1047 (e)

EXHIBIT 6

OCCUPIED BANDWIDTH MEASUREMENT, Part 2.1049(c)(1)

APPLICABLE RULES:

Part 80.205(a): Authorized bandwidth 20 kHz for F3E emission with 5 kHz peak deviation.

Part 80.211(f): Attenuation with respect to mean power: At least 25 dB, removed 50 to 100% of authorized bandwidth; 35 dB for 100 to 250%; 43 + 10 log (mean power) for greater than 250%.

PROCEDURE:

Please refer to Figure 6.1 for the test setup used.

The tests were performed at two frequencies, 156.05 MHz and 157.425 MHz, one each near the lower and upper edges of the transmitter frequency range, and at each frequency the transmitter was operated first at the 25 watt carrier level, then at the 1 watt carrier level. The transmitter was initially tuned up in accordance with the instruction manual. A 50 ohm resistive power attenuator was attached to the antenna terminals. The normally supplied power cable was used between the laboratory power supply and the transmitter. The power supply was set to 13.6 vdc at its output terminals.

The calibration procedure for the spectrum analyzer absolute power reference display level was the same as for the RF Power Output Test, Exhibit 4. For each power level the spectrum analyzer reference level was adjusted to reflect mean power at the top of the graticule. The in-line wattmeter was monitored to insure that the 25 watt or 1 watt carrier power output level was maintained as appropriate for the test being conducted.

Sinusoidal audio modulation at 2500 Hz was applied to the microphone terminals. The transmitter audio gain is maximum at 2500 Hz. The sine wave amplitude was first set to produce 50% modulation (2.5 kHz peak deviation as measured by the modulation analyzer's peak deviation indicator) and its amplitude was then increased by 16 dB before the spectrum analyzer plots were taken.

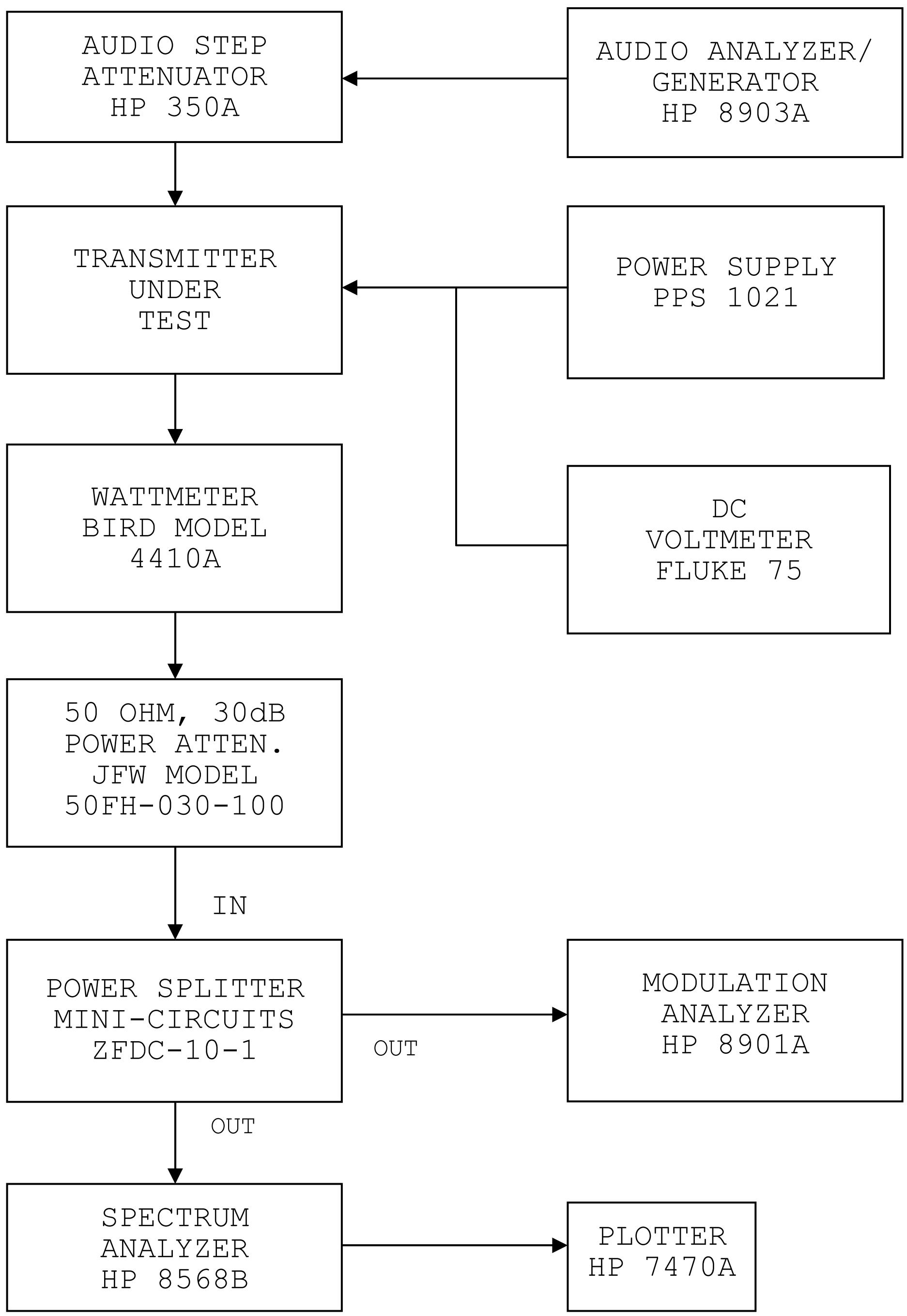
RESULTS:

Spectrum plots for the four measurements are presented in Figures 6.2, 6.3, 6.4, and 6.5. Emission limits described by 80.211(f) are also plotted for the appropriate power level.

FCC IDENTIFIER: YIBSEA157S

FIGURE 6.1

TEST SETUP
OCCUPIED BANDWIDTH
2.1049(c)(1)



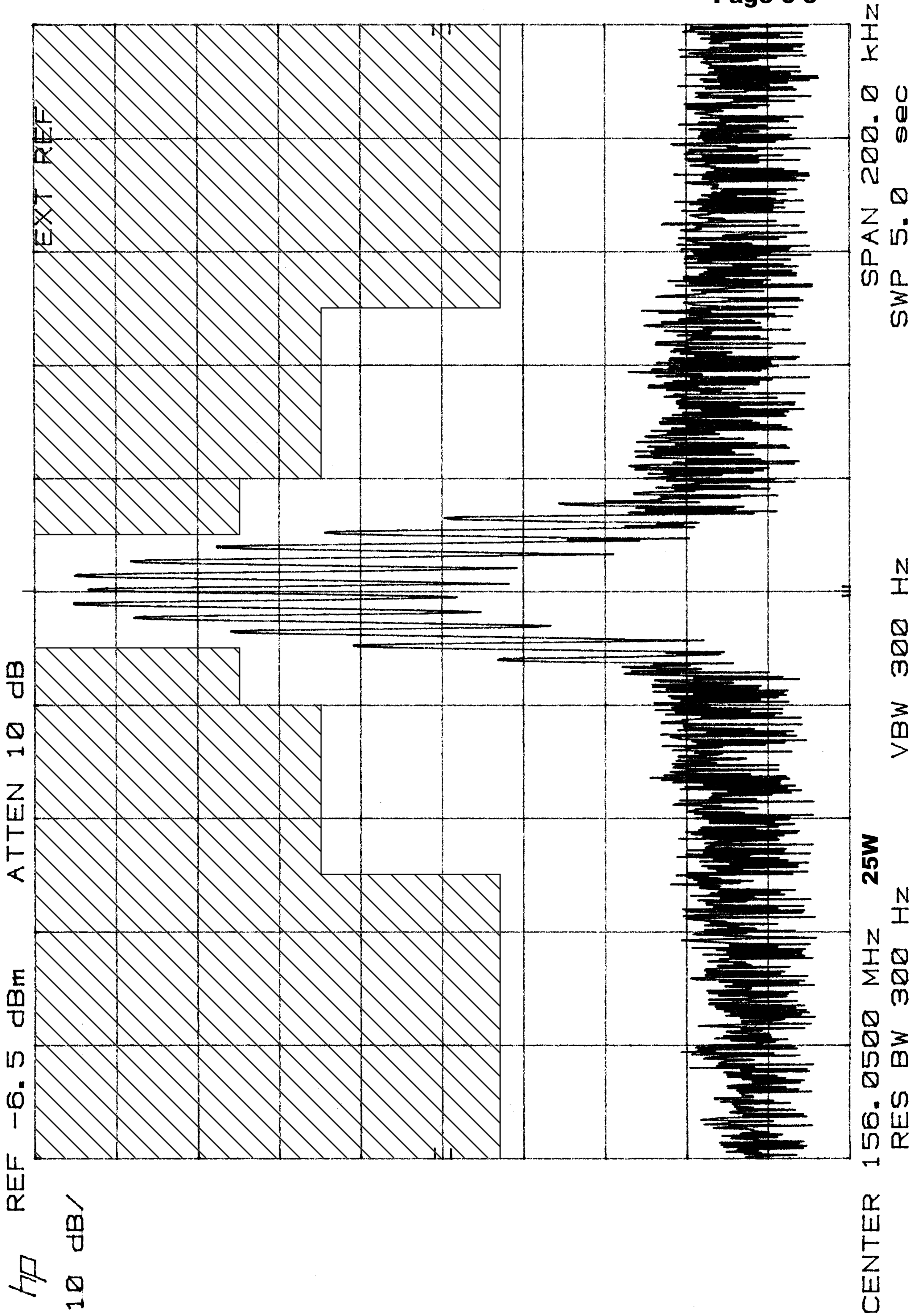


Figure 6.2

FCC PART 2.1049(c)(1)

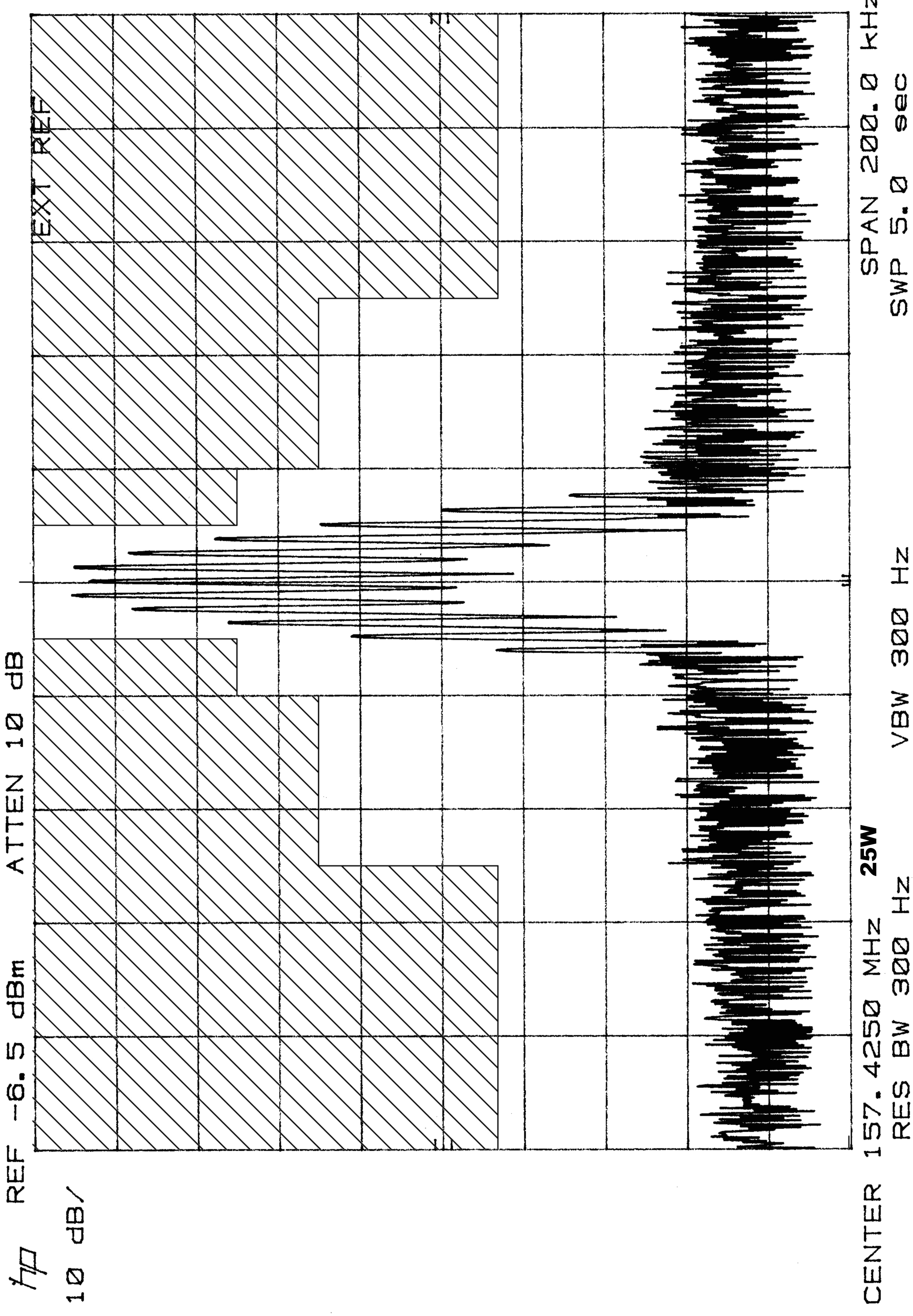


Figure 6.3 **FCC PART 2.1049(c)(1)**

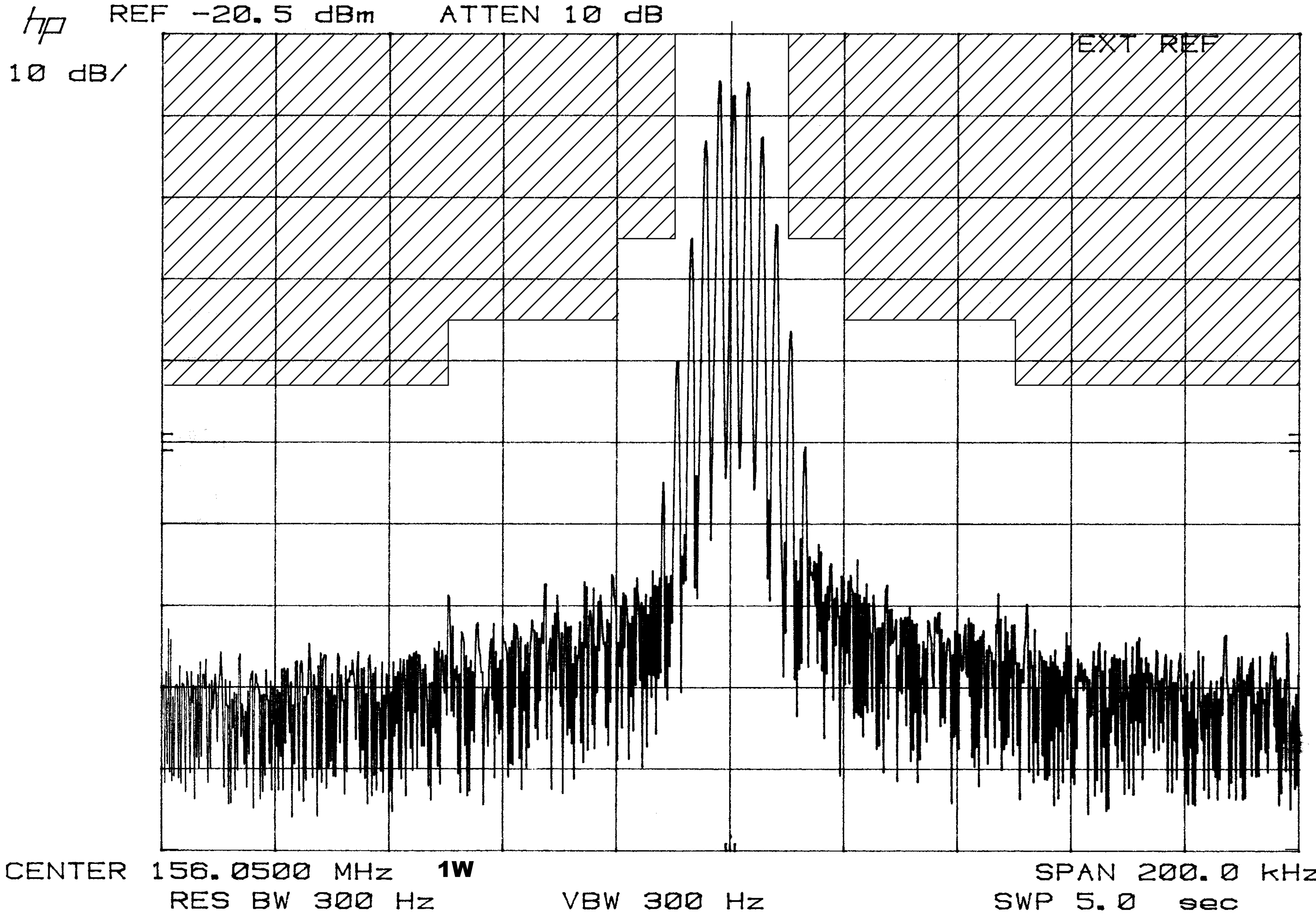


Figure 6.4 **FCC PART 2.1049(c)(1)**

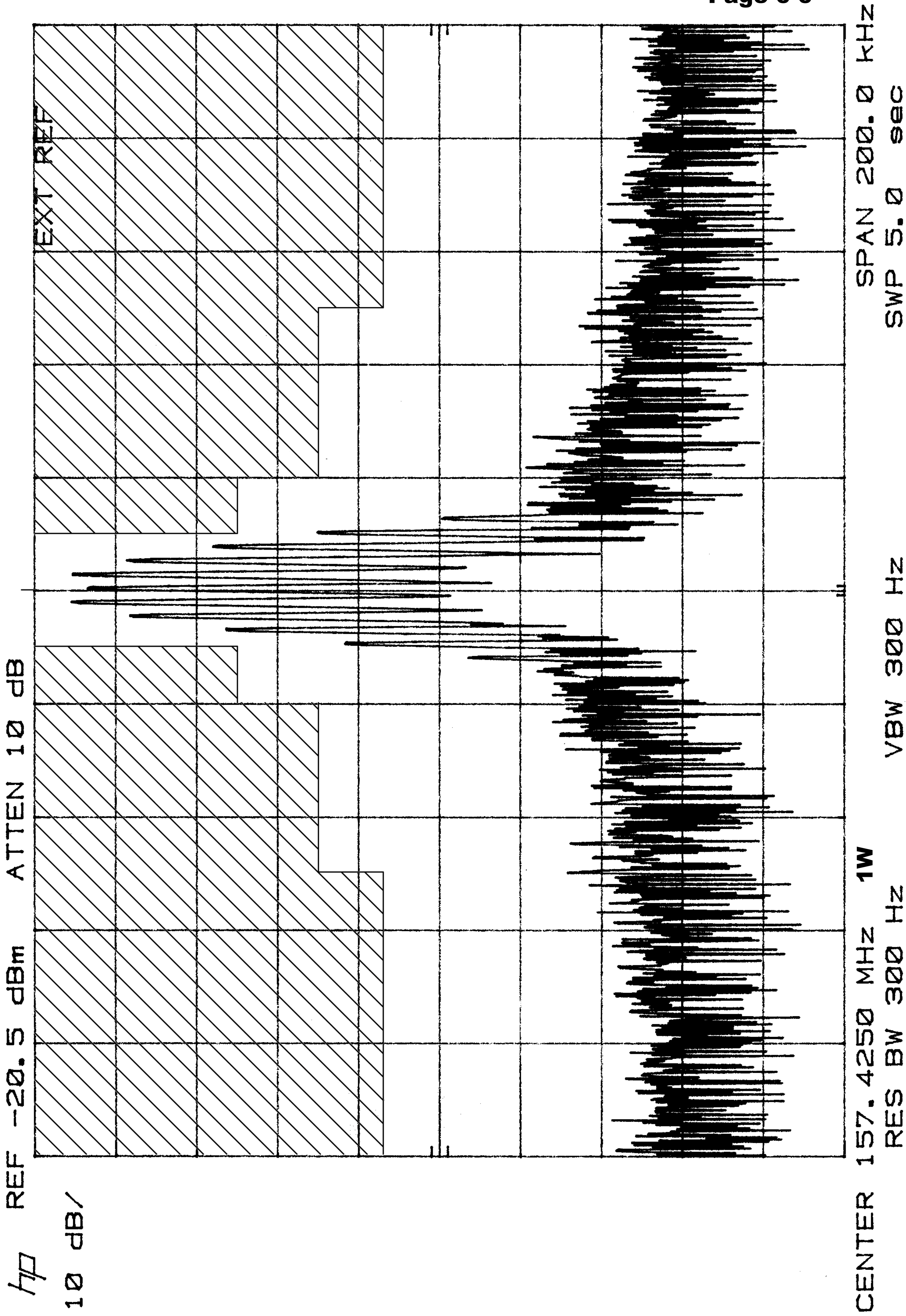


Figure 6.5 FCC PART 2.1049(c)(1)

EXHIBIT 6

OCCUPIED BANDWIDTH MEASUREMENT, Part 2.1049(c)(1)

APPLICABLE RULES:

Part 80.205(a): Authorized bandwidth 20 KHz for F3E emission with 5 KHz deviation.

Part 80.207(a): Authorizes the brief use of DSC signals (13K5G2D emission designator) in accordance with Part 80.225.

PROCEDURE:

The SEA 157S was set up as shown in Figure 6.1.

The internal DSC Controller was set up to generate a constant dot pattern of the type that initiates all DSC calls. This consists of an FSK signal with two tones at 1700 Hz ±400 Hz. The dot pattern is alternating MARK (1300 Hz) and SPACE (2099 Hz) tones generated at a 1200 baud rate. The DSC operates exclusively on these tones and at this baud rate. The SEA 157S produces a continuous phase bandpass filtered FSK signal.

The first test frequency selected was the DSC calling frequency of 156.525 MHz (Channel 70). The equipment was set to the test frequency and the 1 watt power output level was verified. The dot pattern was then initiated and the resulting emission measured. The emission spectrum plot is presented in Figure 6.6.

The second test frequency selected was 156.050 (Channel 01A). The equipment was set to the test frequency and the power output level of 25 watts was verified. The dot pattern was then initiated and the resulting emission measured. The emission spectrum plot is presented in Figure 6.7

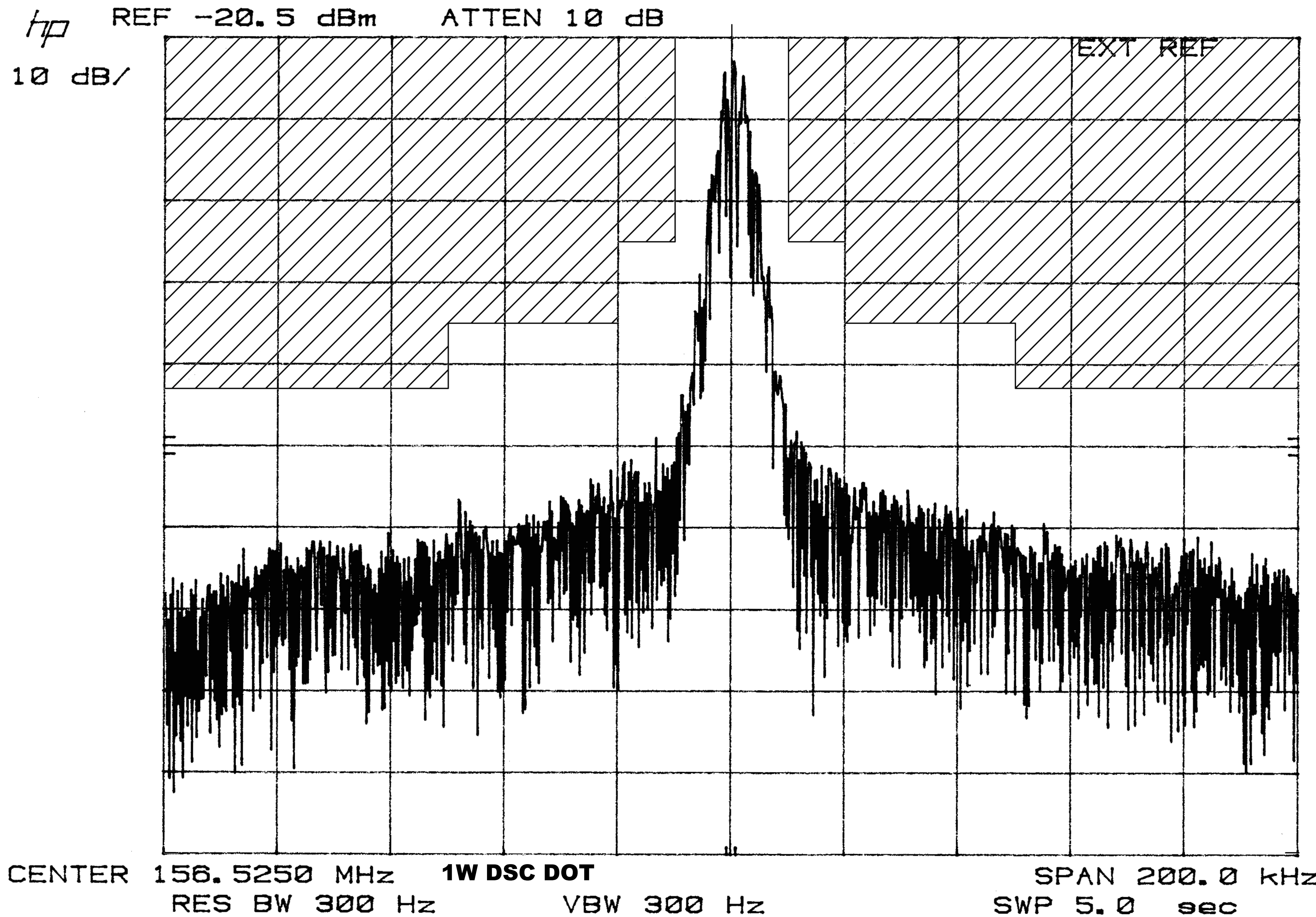


Figure 6.6

FCC PART 2.1049(c)(1)

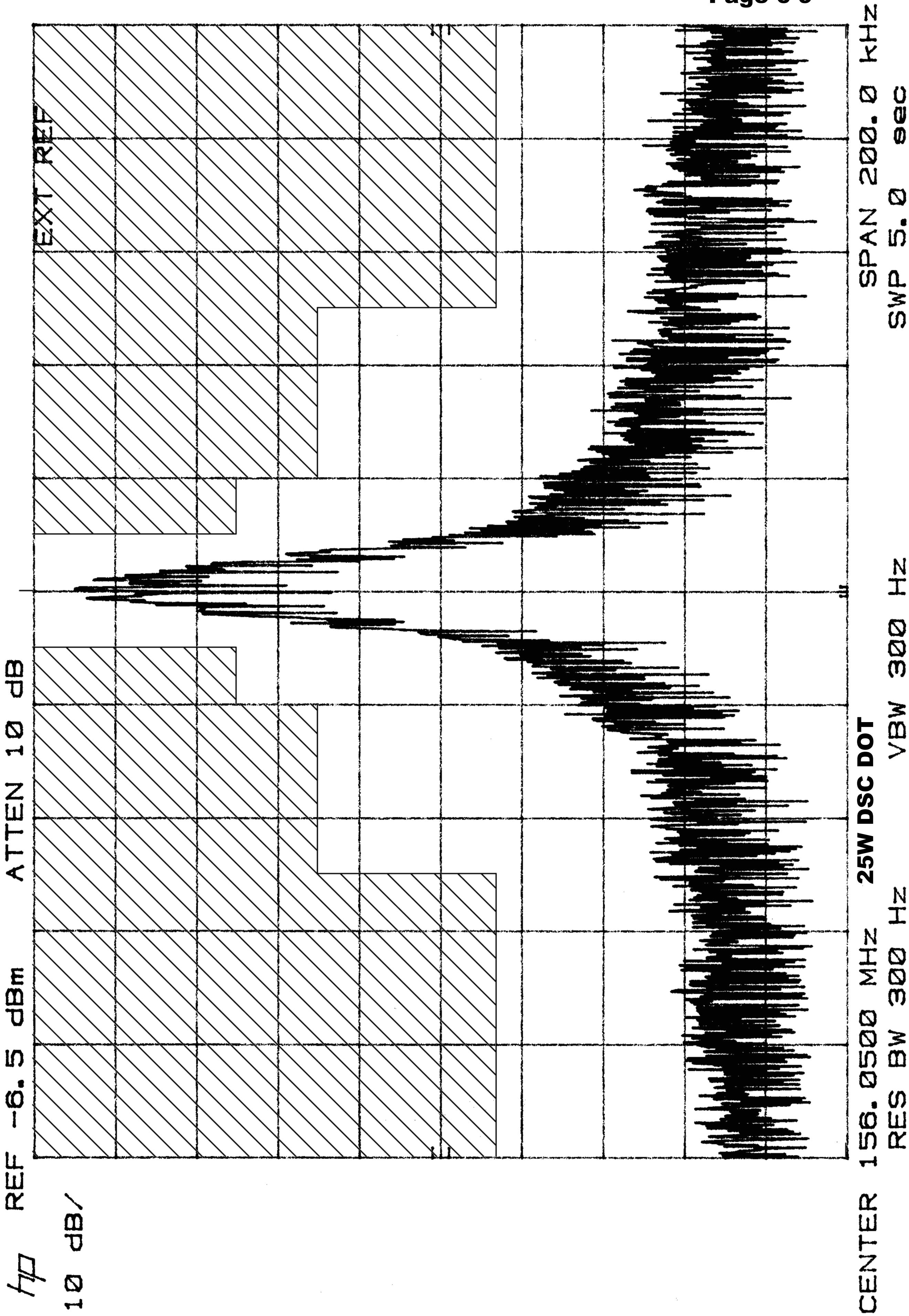


Figure 6.7

FCC PART 2.1049(c)(1)

EXHIBIT 6

OCCUPIED BANDWIDTH MEASUREMENT, Part 2.1049(c)(1)

APPLICABLE RULES:

Part 90.207: Part 90.209(5):	Voice F3E operation with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth.
Part 90.210(d):	Attenuation related to highest emission: (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB. (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ($f_d$in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d-2.88 kHz) dB. (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ($f_d$in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is lesser.

PROCEDURE:

Referring to the test setup Figure 6.1, the transmitter was tested at 25 Watts output at a frequency of 157.250mHz, the nationwide public safety interoperability calling channel.

The calibration procedure for the spectrum analyzer absolute power reference display level was the same as for the RF Power Output Test, Exhibit 4. The spectrum analyzer reference level was adjusted to reflect mean power at the top of the graticule. The in-line wattmeter was monitored to insure that the 25 watt level was maintained.

Sinusoidal audio modulation at 2500 Hz was applied to the microphone terminals. The transmitter audio gain is maximum at 2500 Hz. The sine wave amplitude was first set to produce 50% modulation (1.25kHz peak deviation as measured by the modulation analyzer's peak deviation indicator) and its amplitude was then increased by 16 dB before the spectrum analyzer plots were taken.

RESULTS:

The spectrum plot for the measurement is presented in Figure 6.8. Emission limits described by 90.210(d) are plotted for the appropriate power level.

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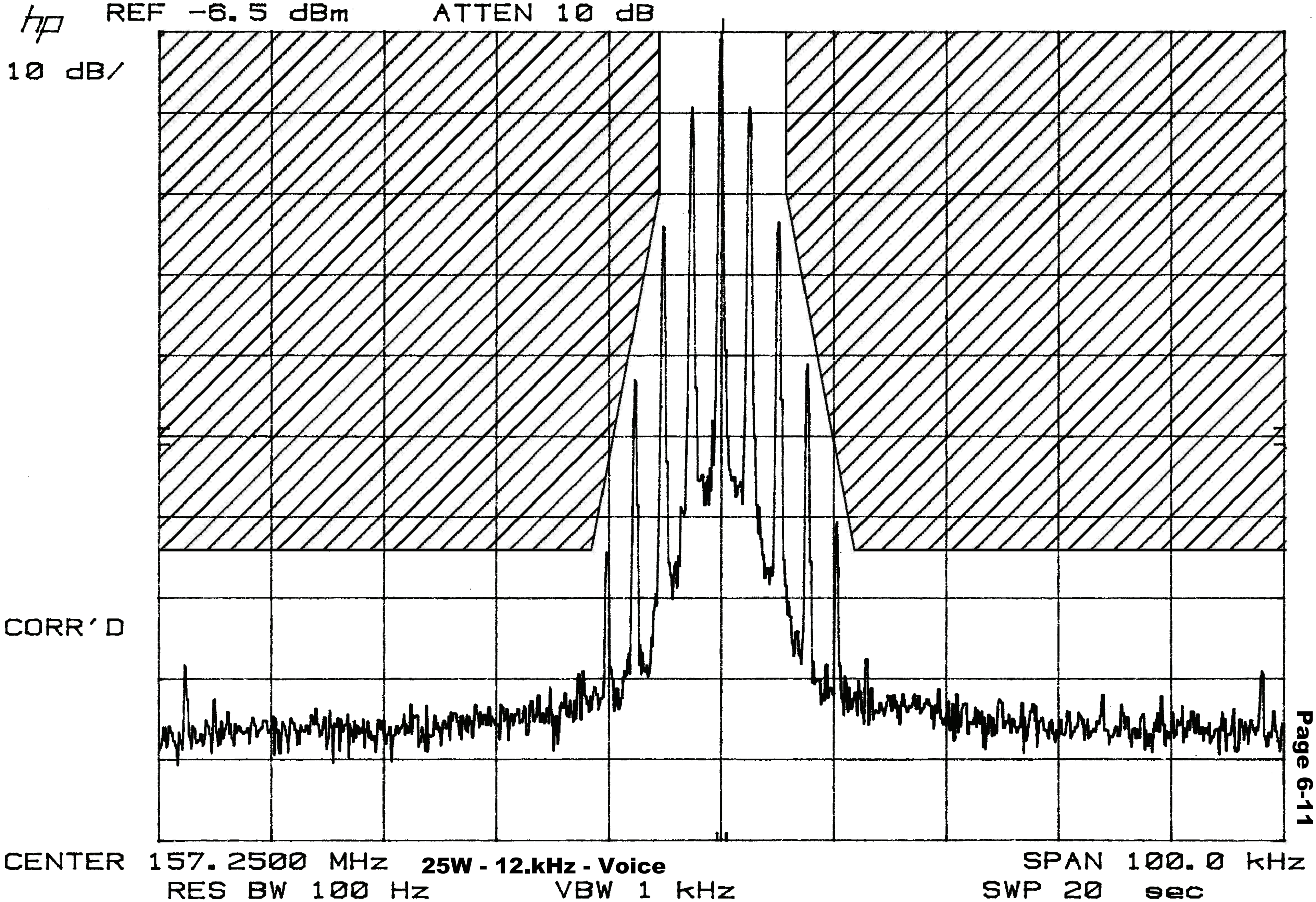


25W - 12.kHz - Voice

Figure 6.8 **FCC PART 2.1049(c)(1) - 90.210(d)**

EXHIBIT 6

OCCUPIED BANDWIDTH MEASUREMENT, Part 2.1049(h)

APPLICABLE RULES:

Part 90.207: Part 90.209(5):	GMSK F2D operation with a 12.5 kHz channel bandwidth will be authorized a 11.25 kHz bandwidth.
Part 90.210(d):	Attenuation related to highest emission: (1) On any frequency from the center of the authorized bandwidth f_0 to 5.625 kHz removed from f_0: Zero dB. (2) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ($f_d$in kHz) of more than 5.625 kHz but no more than 12.5 kHz: At least 7.27(f_d–2.88 kHz) dB. (3) On any frequency removed from the center of the authorized bandwidth by a displacement frequency ($f_d$in kHz) of more than 12.5 kHz: At least 50 + 10 log (P) dB or 70 dB, whichever is lesser.

PROCEDURE:

Referring to the test setup Figure 6.1, the transmitter was tested in the GMSK mode at a power level of 25 Watts at a frequency of 157.250mHz. The source of modulation in this test was however digital via the RS232 port of the radio. The audio input path is disabled while in the GMSK mode.

The calibration procedure for the spectrum analyzer absolute power reference display level was the same as for the RF Power Output Test, Exhibit 4. The spectrum analyzer reference level was adjusted to reflect mean power at the top of the graticule. The in-line wattmeter was monitored to insure that the 25 watt level was maintained.

The transmitter modulation gain was adjusted for a maximum deviation of 2.0kHz as measured by the modulation analyzer's peak deviation indicator. As digital modulation is absolute, increasing the modulation level externally is not possible thus limiting the maximum possible deviation to 2kHz.

RESULTS:

The spectrum plot for the measurement is presented in Figure 6.9. Emission limits described by 90.210(d) are plotted for the appropriate power level.

FCC IDENTIFIER: YIBSEA157S

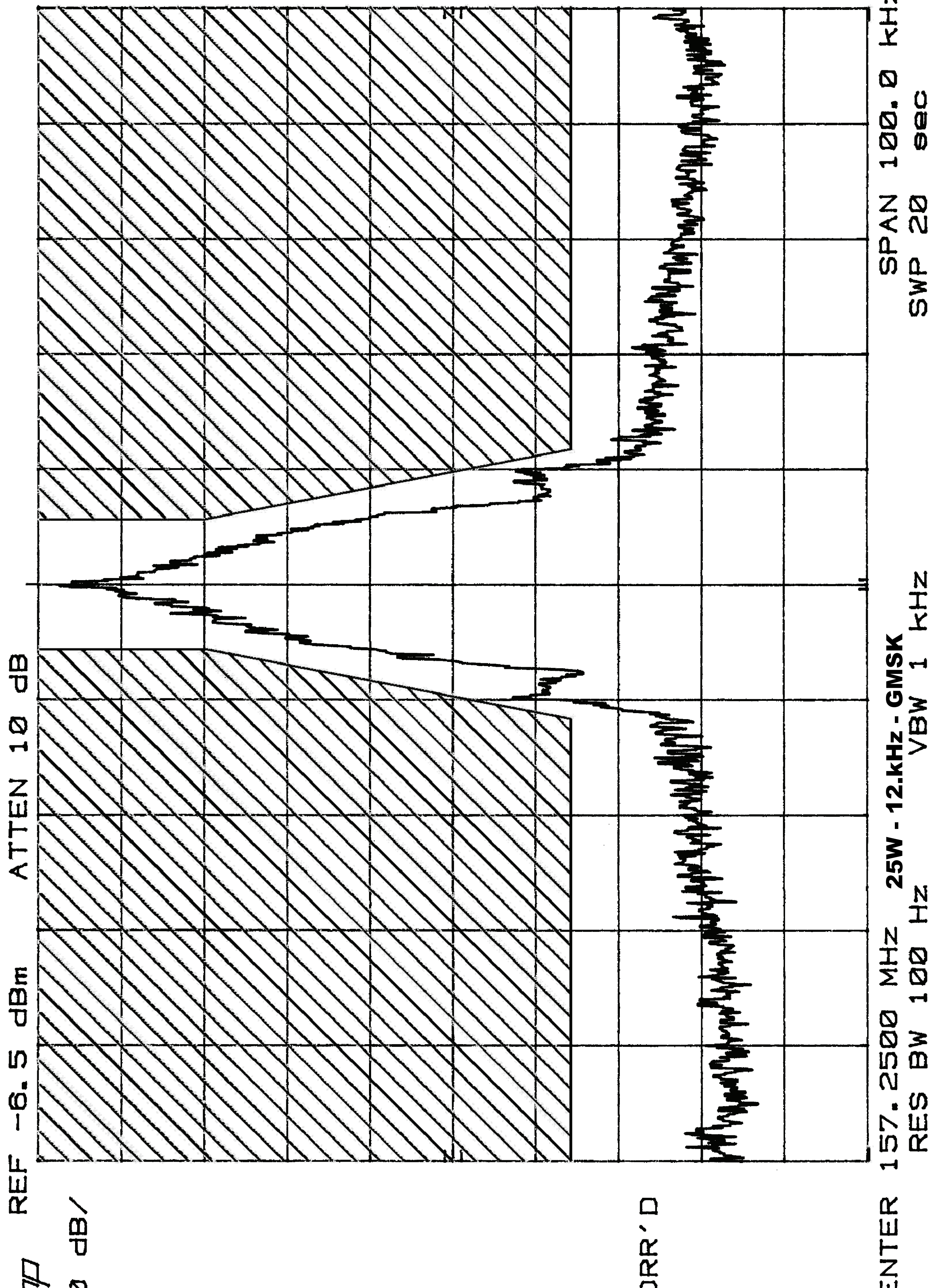


Figure 6.9 **FCC PART 2.1049(c)(1) - 90.210(d)**

EXHIBIT 7

SPURIOUS EMISSIONS AT ANTENNA TERMINALS, Part 2.1051

APPLICABLE RULES:

2.1057: Frequencies investigated should include from lowest radio frequency generated to 10th harmonic of carrier frequency, etc.

80.211(f)(3): Spurious emissions should be attenuated at least 43 + 10 log (mean power) dB.

PROCEDURE:

Please refer to Figure 7.1 for the test setup diagram.

Spurious emission tests were performed for two transmitter output frequencies, 156.05 MHz and 157.425 MHz, one each near the lower and upper frequency range of the transmitter. The transmitter was tuned up in accordance with the alignment procedure in the instruction manual. The transmitter dc power supply and modulation conditions were the same as those used for the Occupied Bandwidth Test, Exhibit 6. The in-line wattmeter was monitored to insure that the desired 25 watt or 1 watt carrier output level was maintained during spurious emission testing.

The frequency spectrum was carefully searched in accordance with Part 2.1057 from below the lowest radio frequency generated in the unit (21.850 MHz) to 1600 MHz, which is greater than ten times the highest frequency of the transmitter. This was done for each of the two transmitter fundamental output frequencies.

The spectrum investigation included but was not limited to the following list of frequencies:

Frequency	Description
21.850 MHz = fmo	Master carrier crystal oscillator.
2fmo, 3fmo, etc.	Harmonics of the above up to 70th.
2fo, 3fo, etc.	Harmonics of the desired channel frequency up to the 10th.
fo/2, fo/3, fo/4	Subharmonics of the desired channel.

NOTE: This transmitter uses NO multiplier stages.

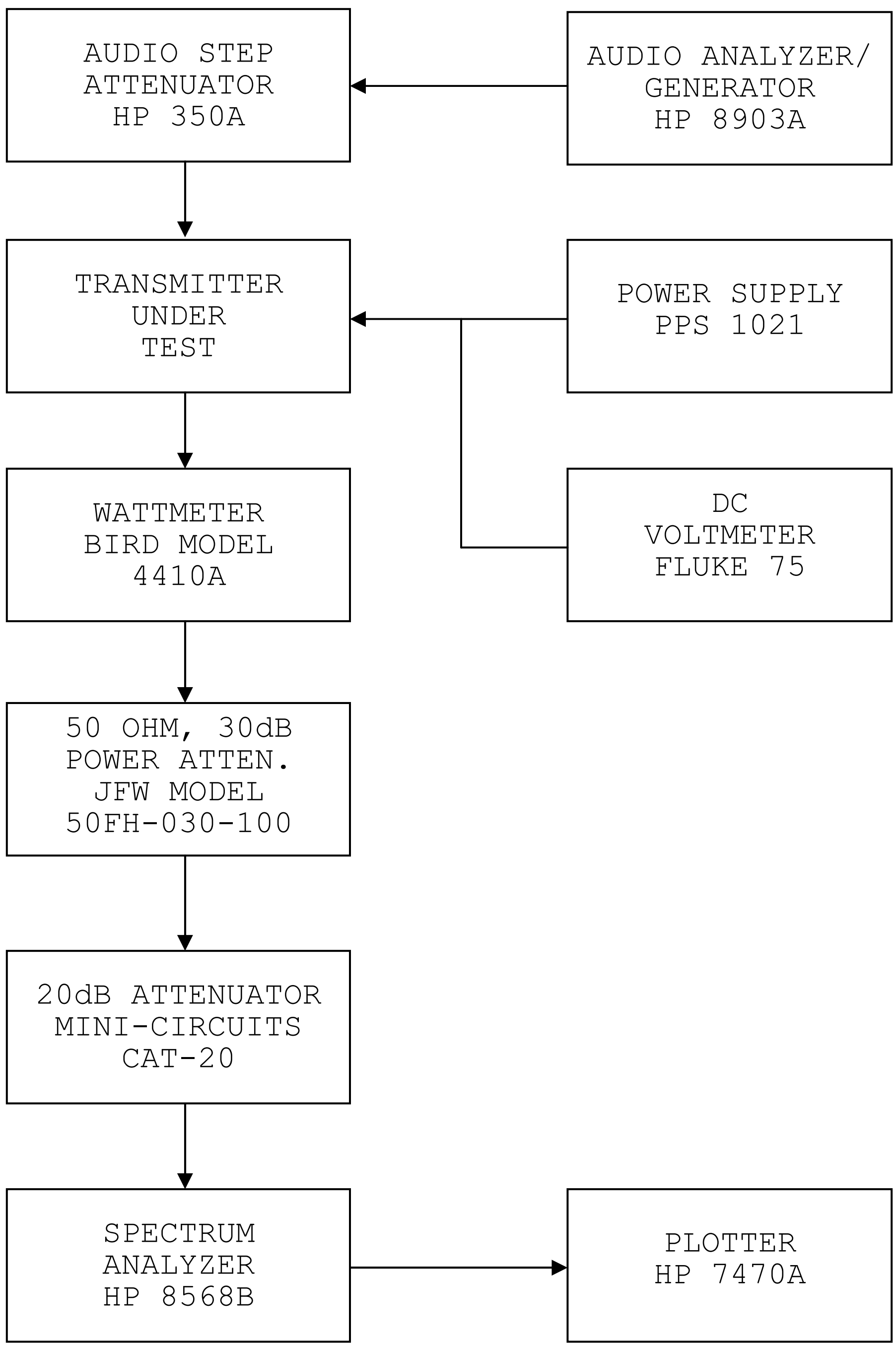
Four spectrum plots were generated; one for each of the four combinations of output frequency and power. The plots are wideband scans (0 to 1600 MHz) to give a indication of spurious outputs relative to the appropriate carrier mean power level. The reference level of the spectrum analyzer was set so that rated power,44dBm (25 Watts) or 30dBm (1 Watt) as appropriate, was displayed at the very top of the plot at the carrier frequency. A limit line is drawn on the plots at the maximum permitted spurious levels of -57dB for 25 Watts and -43dB for 1 Watt.

RESULTS:

See Figure 7.2 for the 156.050 MHz, 25 watt case.
See Figures 7.3 for the 157.425 MHz, 25 watt case.
See Figures 7.4 for the 156.050 MHz, 1 watt case.
See Figures 7.5 for the 157.425 MHz, 1 watt case.

FIGURE 7.1

TEST SETUP
SPURIOUS EMISSIONS AT
ANTENNA TERMINALS



IDENTIFIER: YIBSEA157S

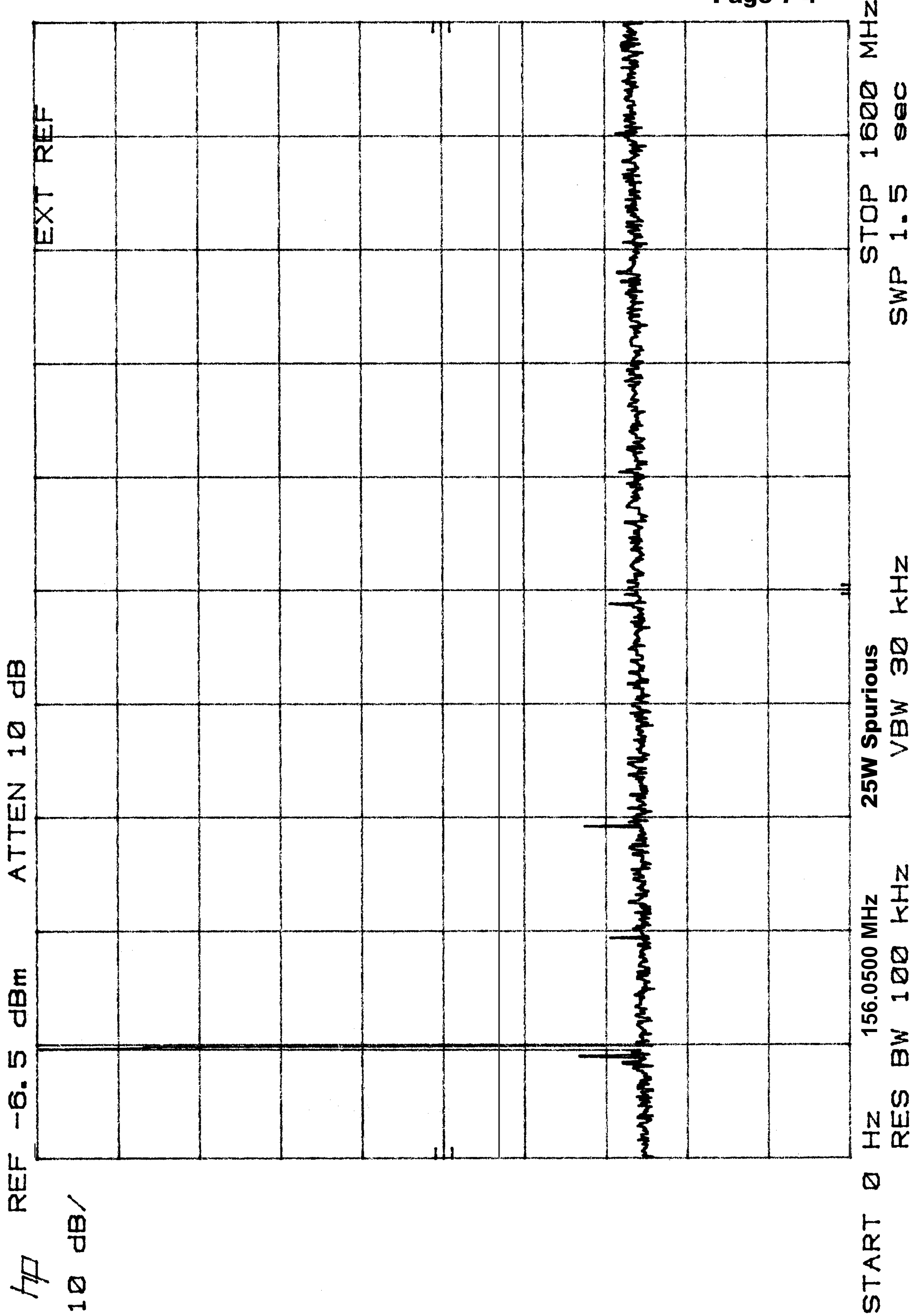


Figure 7.2

FCC PART 2.1051

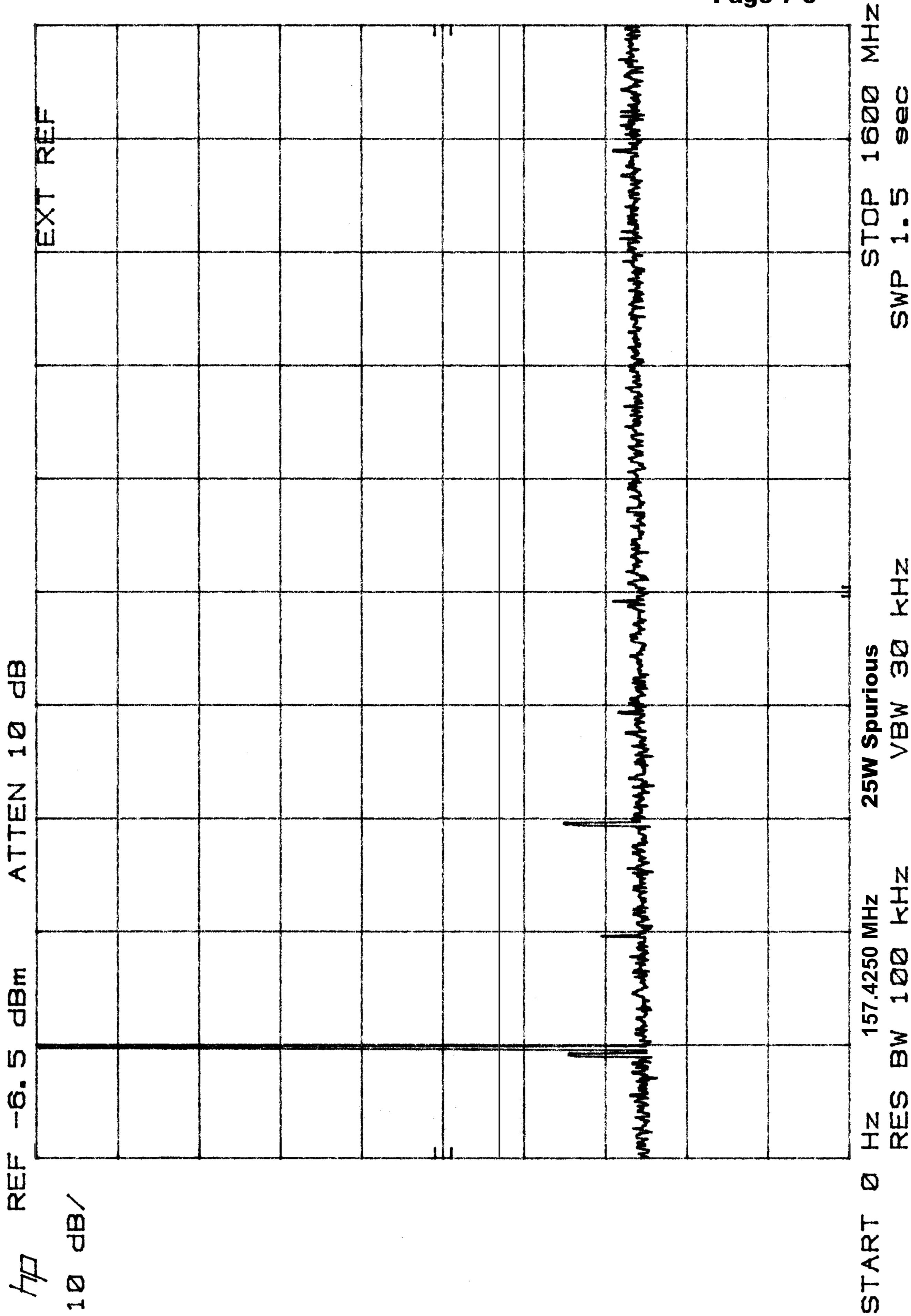


Figure 7.3 FCC PART 2.1051

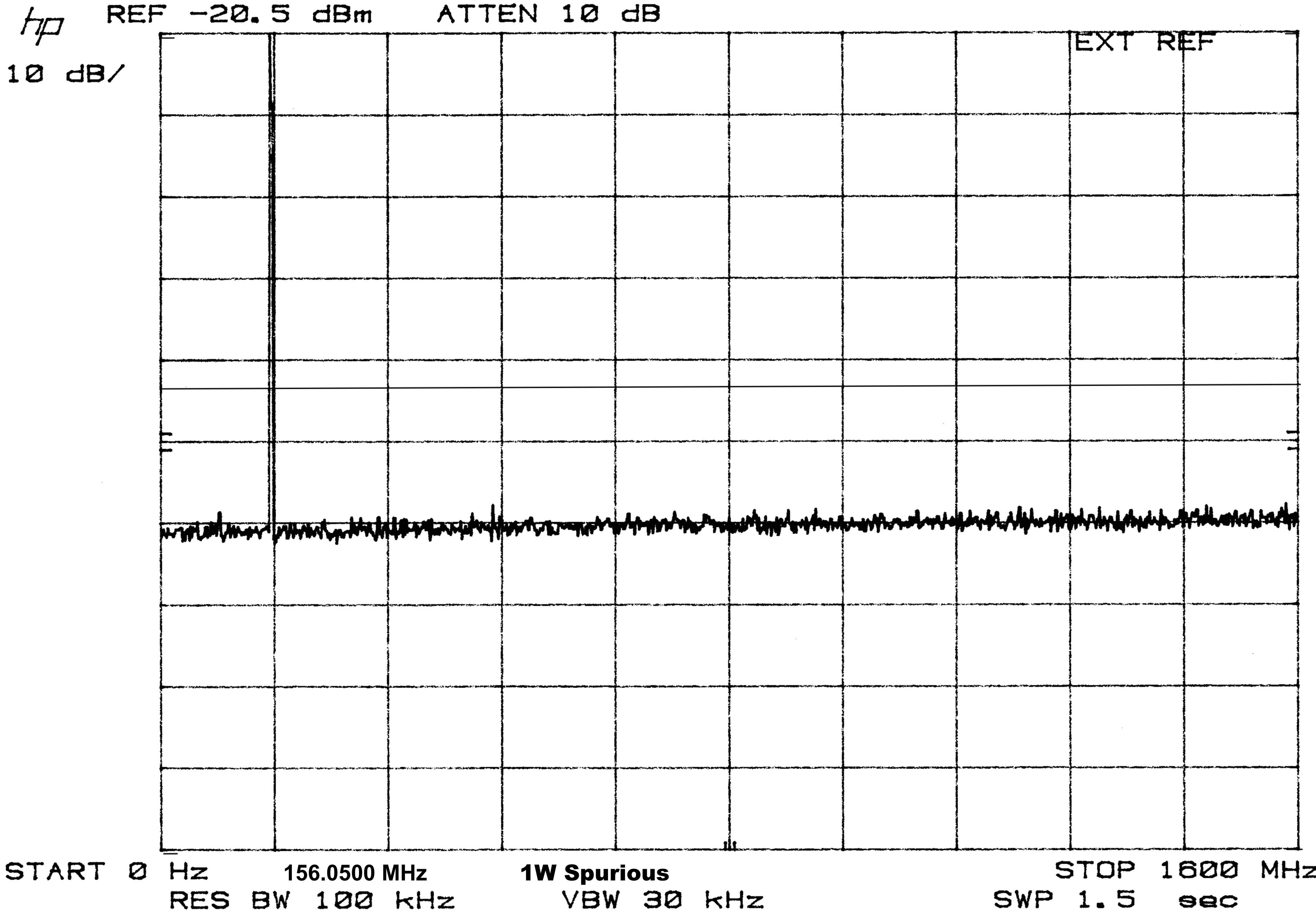


Figure 7.4

FCC PART 2.1051

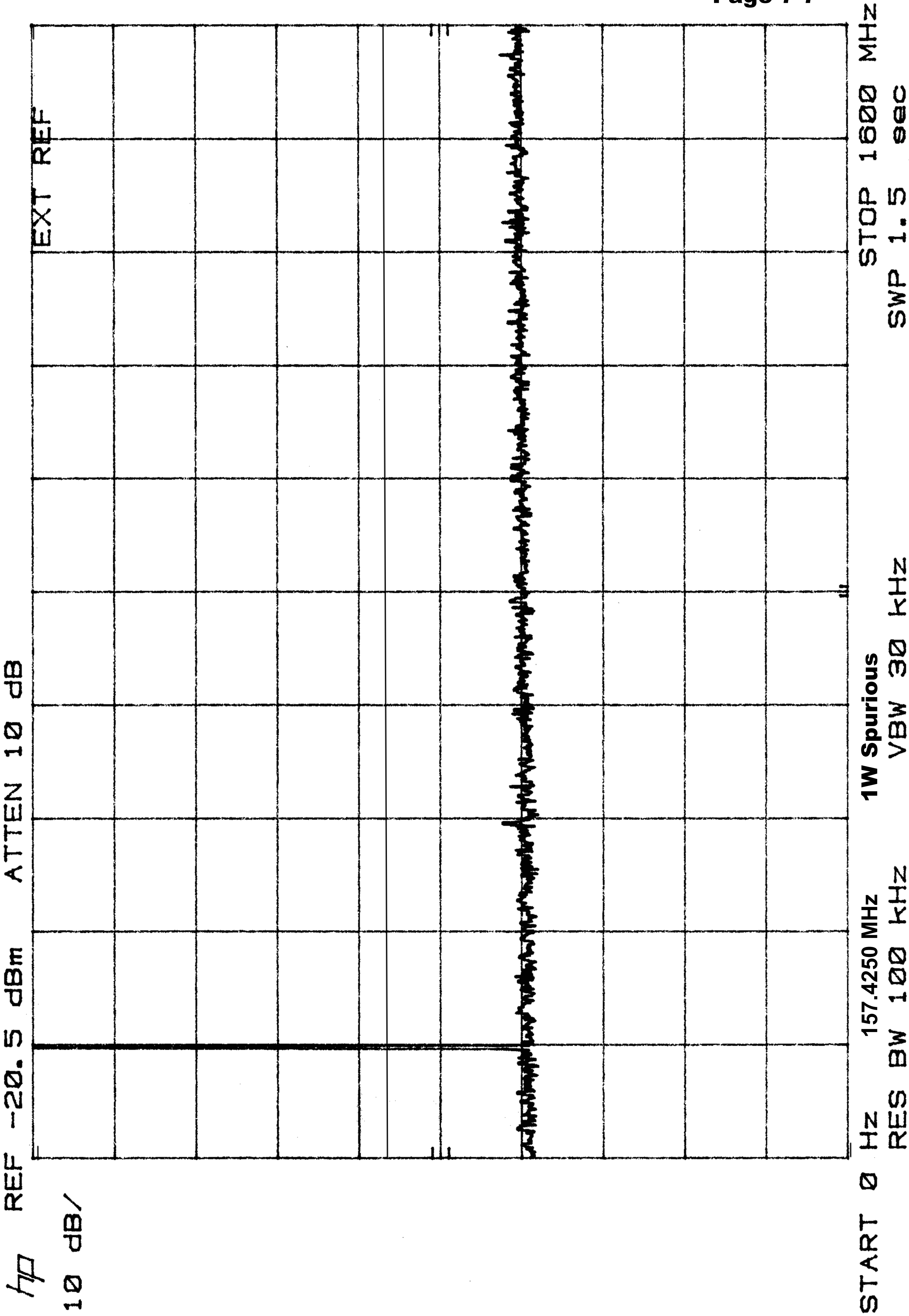


Figure 7.5

FCC PART 2.1051