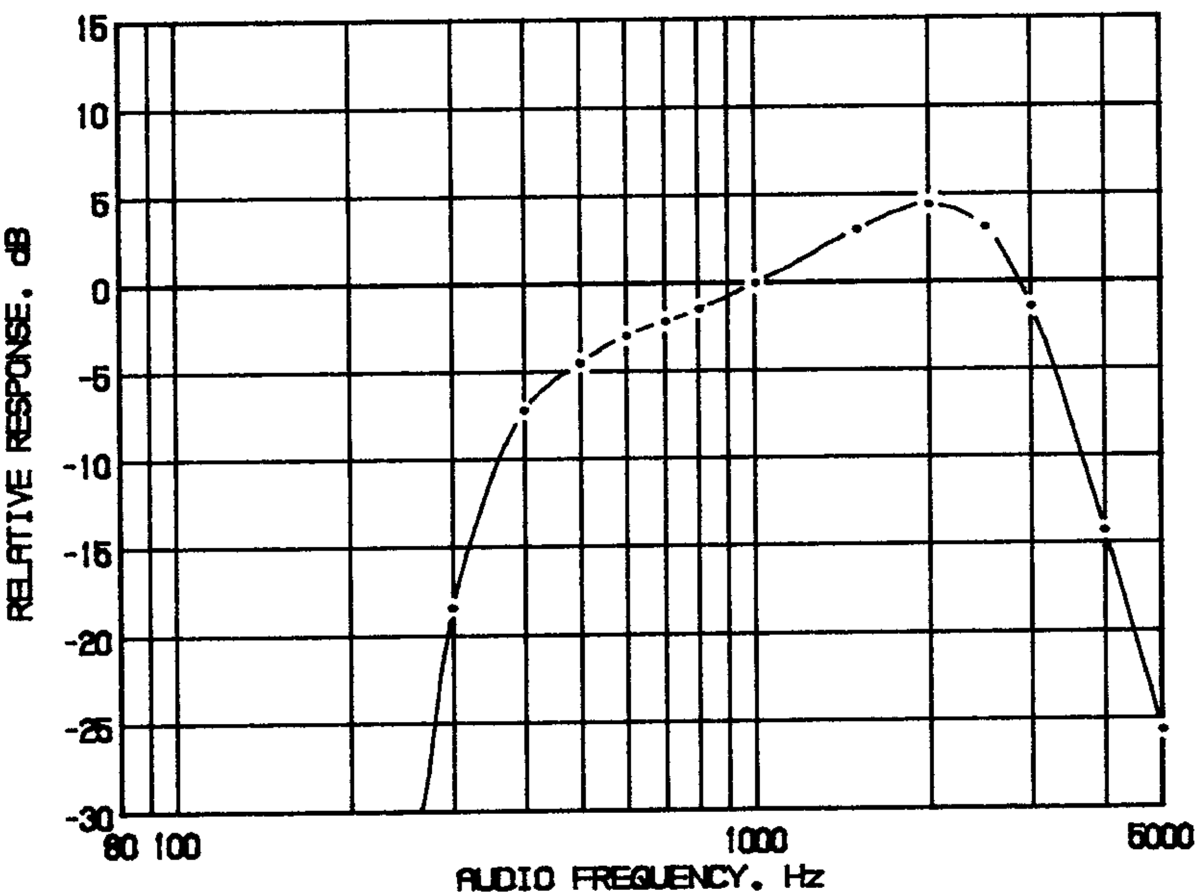
FIGURE 1

MODULATION FREQUENCY RESPONSE

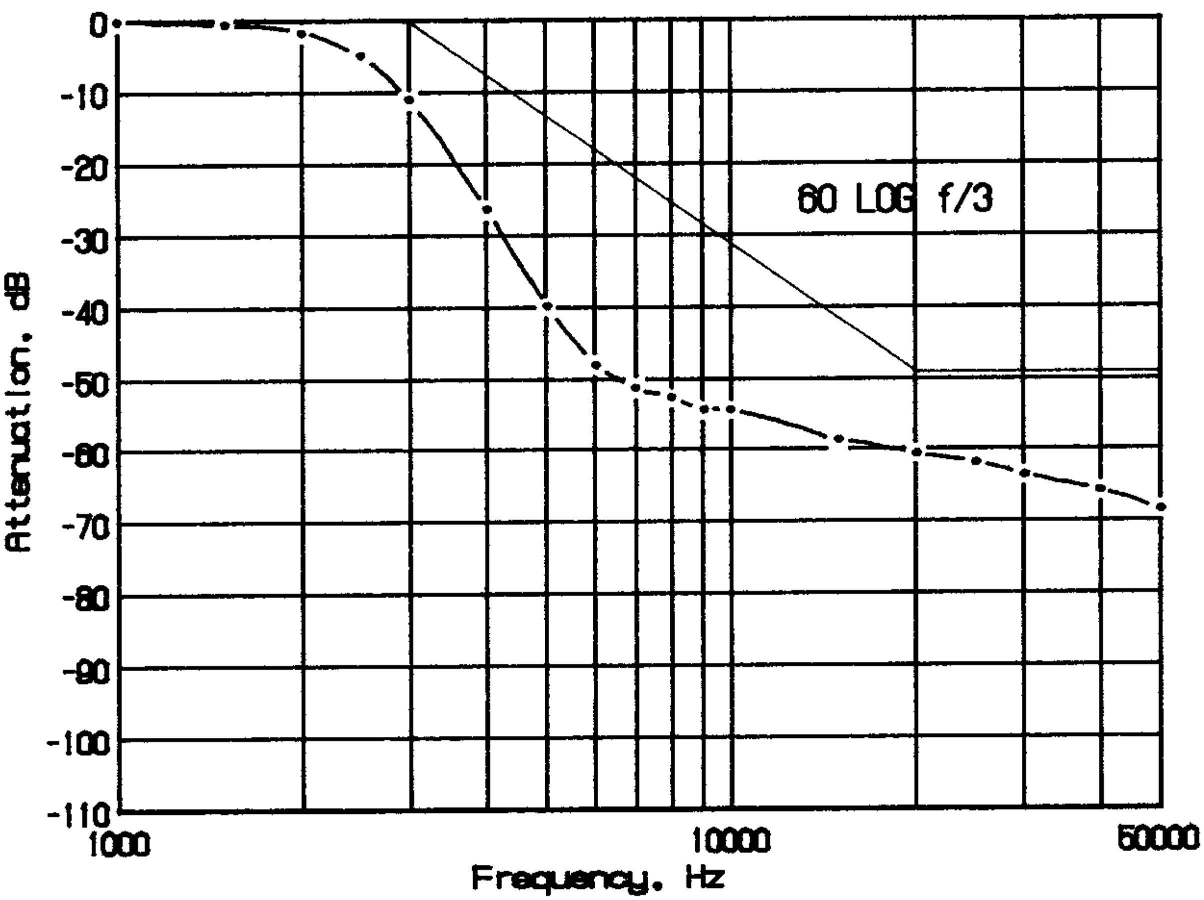


MODULATION FREQUENCY RESPONSE
FCC ID: F3JSP110

FIGURE 1

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE



AUDIO LOW PASS FILTER RESPONSE
FCC ID: F3JSP110

FIGURE 3

D. MODULATION CHARACTERISTICS (Continued)

The plot is within the limits imposed by Paragraph 90.211(c) for frequency modulation. The horizontal scale (frequency) is 10 kHz per division and the vertical scale (amplitude) is a logarithmic presentation equal to 10 dB per division.

Resolution bandwidth was 100 Hz; video bandwidth 1 kHz; max store display; 20 second scan time.

Necessary Bandwidth Computation -

$B_m = 2D + 2M$

12.5 kHz Channel: D = 2.5 kHz M = 3 kHz (5+6) 11KOF3E

E. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS (Paragraph 2.991 of the Rules)

The SP-110 transmitter was tested for spurious emissions at the antenna terminals while the equipment was modulated with a 2500 Hz signal, 16 dB above minimum input signal for 50% (2.5 kHz deviation) modulation at 2805 Hz, the frequency of highest sensitivity.

Measurements were made with Tektronix 494P spectrum analyzer coupled to the transmitter output terminal through a Narda 765-20 power attenuator. A notch filter was used to attenuate the carrier.

During the tests, the transmitter was terminated in the 50 ohm attenuator. Power was monitored on a Bird 43 Thru-Line wattmeter; dc supply was 6.0 volts throughout the tests.

Spurious emissions were measured at 1.0 watts output throughout the RF spectrum from 12 (lowest frequency generated in the transmitter is 12.8 MHz) to the tenth harmonic of the carrier.

Any emissions that were between the required attenuation and the noise floor of the spectrum analyzer were recorded. Data are shown in Table 1.

F. DESCRIPTION OF RADIATED SPURIOUS MEASUREMENT FACILITIES

A description of the Hyak Laboratories' radiation test facility is a matter of record with the FCC. The facility meets ANSI 63.4-1992 and was accepted for radiation measurements from 25 to 1000 MHz on October 1, 1976 and is currently listed as an accepted site.

TABLE 1

TRANSMITTER CONDUCTED SPURIOUS
460.100, 6.0 Vdc Input

	Spurious Frequency MHz		dB Below Carrier Reference	
1.0 W				
	920.201		64	
	1380.302		>103	
	1840.402		>103	
	2300.503		>103	
	2760.603		96	
	3220.704		>102	
	3680.804		>100	
	4140.905		98	
	4601.005		>103	
	Required:	50+10Log(P) =	51	90.210(d)

All other emissions from 12 MHz to the tenth harmonic were 20 dB or more below FCC limit.

*Reference data only, more than 20 dB below FCC limit.

NOTE: Carrier notch filter used to increase dynamic range.

G. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION

Field intensity measurements of radiated spurious emissions from the SP-110 were made with a Tektronix 494P spectrum analyzer using Singer DM-105A calibrated dipole antennas below 1 GHz, and Polarad CA-L, and CA-S or EMCO 3115 from 1-5.0 GHz.

The transmitter and dummy load were located in an open field 3 meters from the test antenna. Supply voltage was a power supply with a terminal voltage under load of 6.0 Vdc.

Output power was 1.0 watts at 460.100 MHz operating frequency. The transmitter and test antennas were arranged to maximize pickup. Both vertical and horizontal test antennae polarization were employed.

Reference level for the spurious radiations was taken as an ideal dipole excited by 1.0 watts, the output power of the transmitter according to the following relationship:*

$$E = \frac{(49.2P_t)^{1/2}}{R}$$

where E = electric-field intensity in volts/meter

P_t = transmitter power in watts

R = distance in meters

for this case $$E = \frac{(49.2 \times 1.0)^{1/2}}{3} = 2.3 \text{ V/m}$$

Since the spectrum analyzer is calibrated in decibels above one milliwatt (dBm), a conversion, for convenience, was made from dBu to dBm.

2.3 volts/meter = 2.3×10^6 uV/m

dBu/m = $20\text{Log}_{10}(2.3\times10^6)$

= 127 dBu/m

Since 1 uV/m = -107 dBm, the reference becomes

127 - 107 = 20 dBm

*Reference Data for Radio Engineers, Fourth Edition, International Telephone and Telegraph Corp., p. 676.

G. FIELD STRENGTH MEASUREMENTS (Continued)

The transmitter and test antennae were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed.

The measurement system was capable of detecting signals 95 dB or more below the reference level. Measurements were made from the lowest frequency generated within the unit (12 MHz), to 10 times operating frequency. Data after application of antenna factors and line loss corrections are shown in Table 2.

TABLE 2

TRANSMITTER CABINET RADIATED SPURIOUS

460.100 MHz, 6.0 Vdc, 1.0 watts

Spurious Frequency MHz	dB Below Carrier Reference[1]
920.200	59V
1380.300	66V
1840.400	84V*
2300.500	79V*
2760.600	82H*
3220.700	80H
3680.800	89V*
4140.900	93V*
4601.000	95H*

Required: 50+10Log(P) = 51 90.210(d)

[1]Worst-case polarization, H-Horizontal, V-Vertical.

* Reference data only, more than 20 dB below FCC limit.

All other spurious from 12 MHz to 4.6 GHz were 20 dB or more below FCC limit.

H. FREQUENCY STABILITY
(Paragraph 2.995(a)(2) and 90.213 of the Rules)

Measurement of frequency stability versus temperature was made at temperatures from -30°C to +50°C. At each temperature, the unit was exposed to test chamber ambient a minimum of 60 minutes after indicated chamber temperature ambient had stabilized to within ±2° of the desired test temperature. Following the 1 hour soak at each temperature, the unit was turned on, keyed and frequency measured within 2 minutes. Test temperature was sequenced in the order shown in Table 3, starting with -30°C.

A Thermotron S1.2 temperature chamber was used. Temperature was monitored with a Keithley 871 digital thermometer. The transmitter output stage was terminated in a dummy load. Primary supply was 6.0 volts. Frequency was measured with a HP 5385A frequency counter connected to the transmitter through a power attenuator. Measurements were made at 460.100 MHz. No transient keying effects were observed.

TABLE 3

FREQUENCY STABILITY vs. TEMPERATURE

460.100 MHz; 6.0 Vdc; 1.0 W

Temperature, °C	Output Frequency, MHz	p.p.m.
-29.2	460.100275	0.6
-19.7	460.100360	0.8
-10.1	460.099667	-0.7
0.6	460.099735	-0.6
9.9	460.100325	0.7
20.5	460.100414	0.9
29.9	460.100205	0.4
40.5	460.100321	0.7
50.3	460.100482	1.0

Maximum frequency error: 460.100482
460.100000

\+ .000482 MHz

FCC Rule 90.213(a) specifies .00025% or a maximum of ± .001150 MHz, which corresponds to:

High Limit	460.101150 MHz
Low Limit	460.098850 MHz

I. FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE (Paragraph 2.995(d)(2) of the Rules)

Oscillator frequency as a function of power supply voltage was measured with a HP 5385A frequency counter as supply voltage provided by an HP 6264B variable dc power supply was varied from ±15% above the nominal 6.0 volt rating. A Fluke 197 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20°C ambient.

TABLE 4

FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE

460.100 MHz, 6.0 Volts Nominal, 1.0 W

%	Supply Voltage	Output Frequency, MHz	p.p.m.
115	6.90	460.100420	-0.4
110	6.60	460.100418	-0.1
105	6.30	460.100417	-0.2
100	6.00	460.100414	-0.1
95	5.70	460.100411	0.0
90	5.40	460.100408	-0.1
85	5.10	460.100408	-0.1
80	4.80*	460.099574	-0.4

Maximum frequency error: 460.100420
460.100000

\+ .000420 MHz

*MFR rated battery end-point

FCC Rule 90.213(a) specifies .00025% or a maximum of ± .001150 MHz, corresponding to:

High Limit	460.101150 MHz
Low Limit	460.098850 MHz

J. TRANSIENT FREQUENCY BEHAVIOR (Paragraph 90.214 of the Rules)

Plot identified as Figure 5 demonstrates TFB for 12.5 kHz channel operation. (Procedure is included as Appendix 9.)

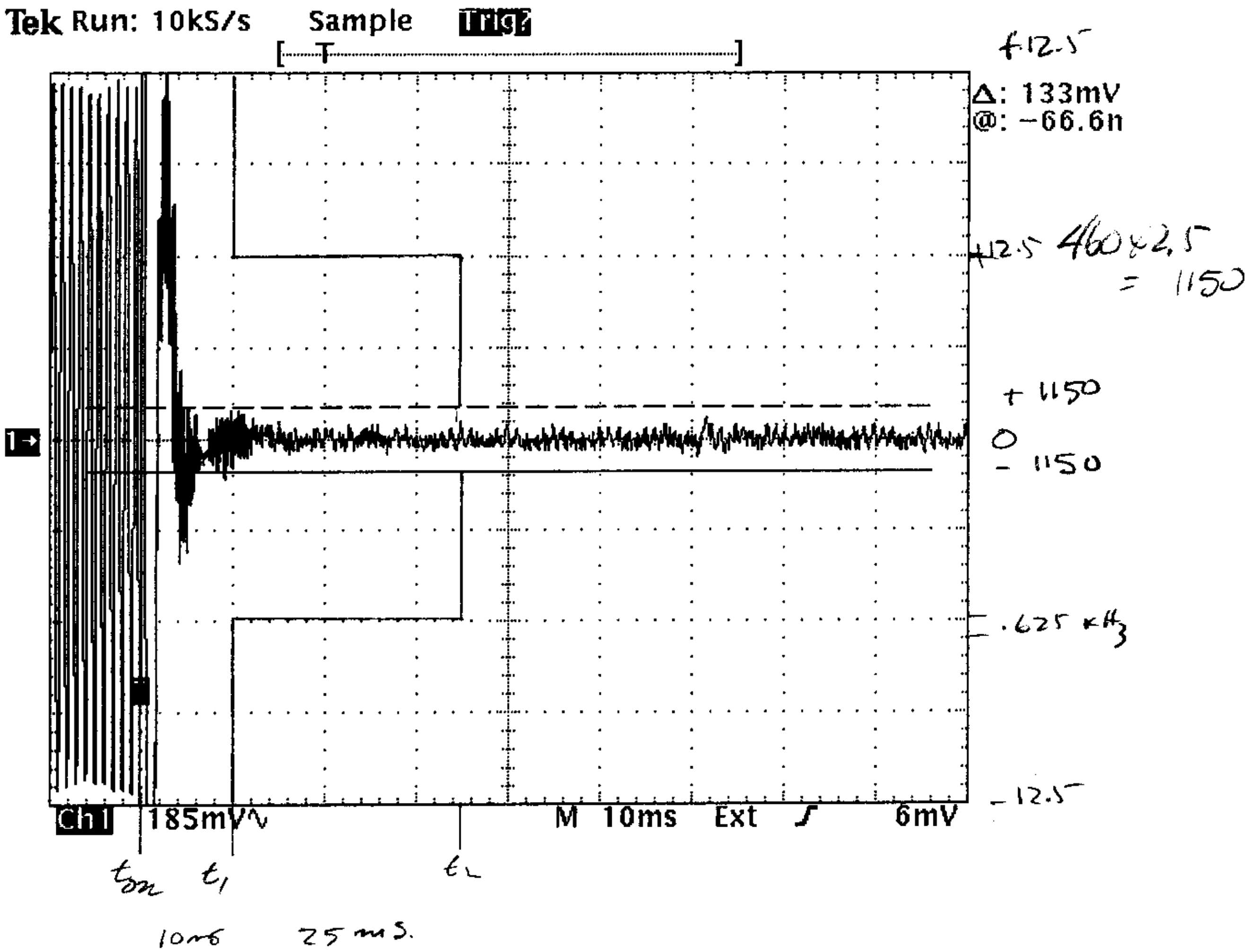
FIGURE 5a

TRANSIENT FREQUENCY BEHAVIOR

(TURN-ON PLOT FOLLOWS THIS SHEET)

TURN-ON
TRANSIENT FREQUENCY BEHAVIOR
FCC ID: F3JSP110

FIGURE 5a (F3E, 12.5 kHz)


Tek Run: 10kS/s Sample Trig?
Δ: 133mV
@: -66.6n
Ch1 185mV∿ M 10ms Ext 6mV
f12.5
+12.5 460×2.5 = 1150
+1150
0
-1150
.625 kHz
-12.5
t_{on} t_1 t_2
10ms 25ms.

p 101

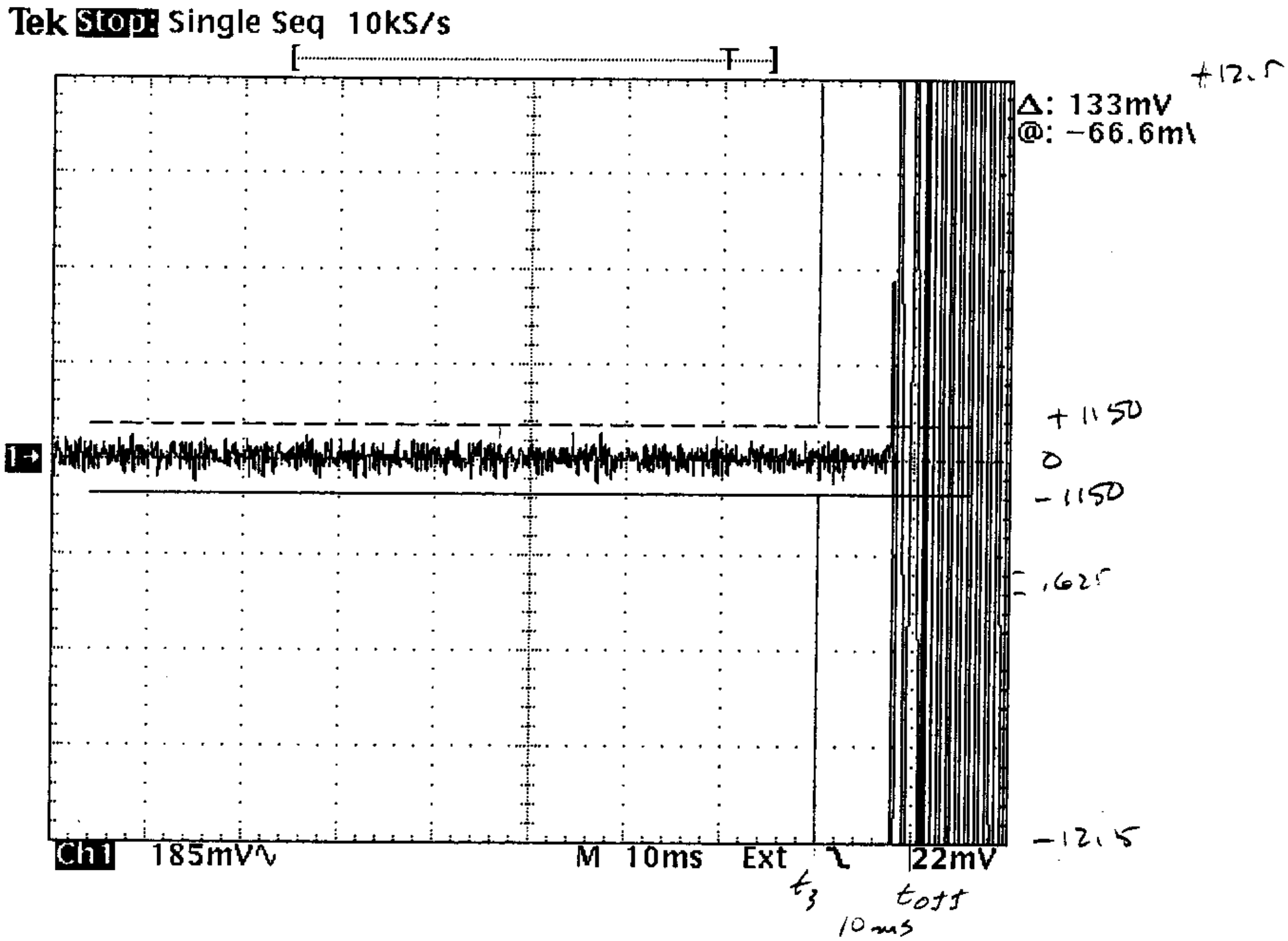
FIGURE 5b

TRANSIENT FREQUENCY BEHAVIOR

(TURN-OFF PLOT FOLLOWS THIS SHEET)

TURN-OFF
TRANSIENT FREQUENCY BEHAVIOR
FCC ID: F3JSP110

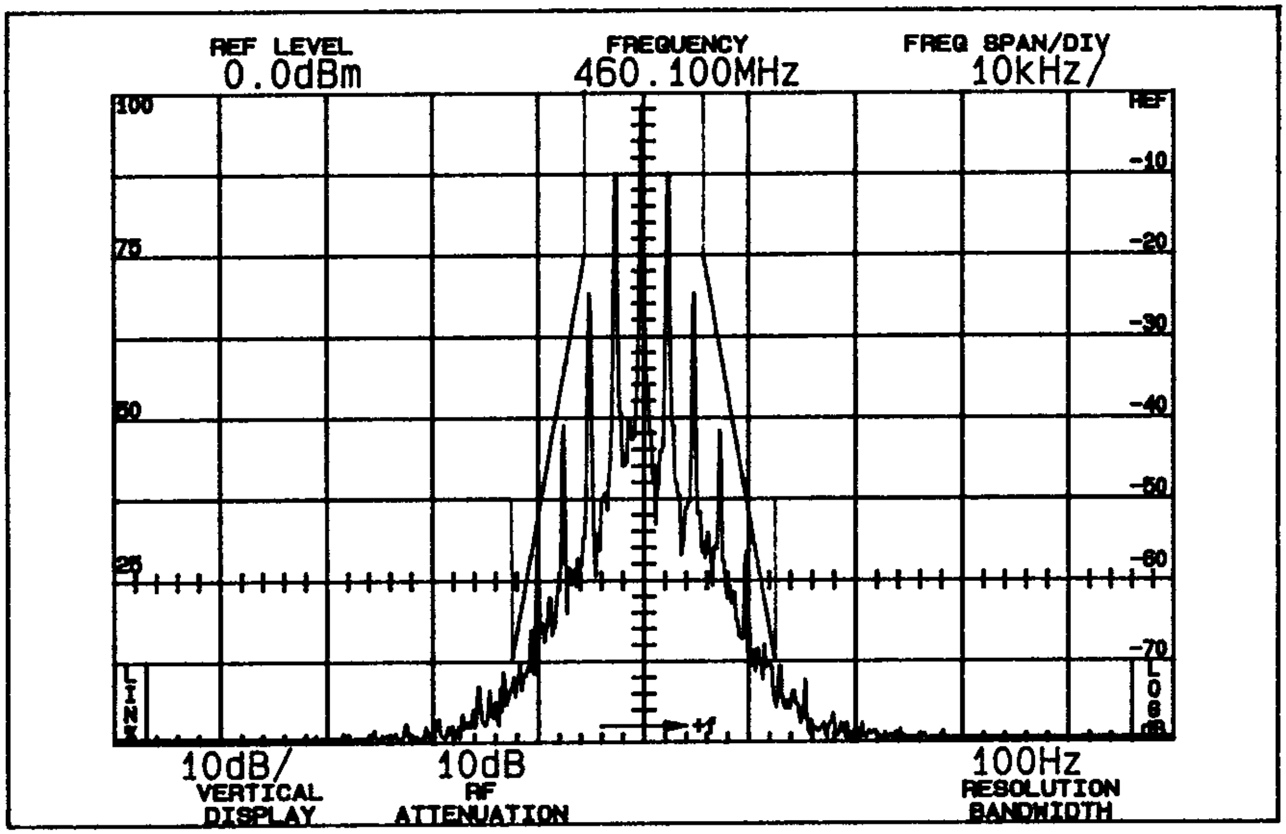
FIGURE 5b (F3E, 12.5 kHz)


Tek Stop: Single Seq 10kS/s
T
Δ: 133mV
@: -66.6mV
+12.5
+1150
0
-1150
.625
-12.5
Ch1 185mV∿
M 10ms Ext ↘ 22mV
t3
toff
10ms

A:\SP110OBW.OBW

FIGURE 4

OCCUPIED BANDWIDTH



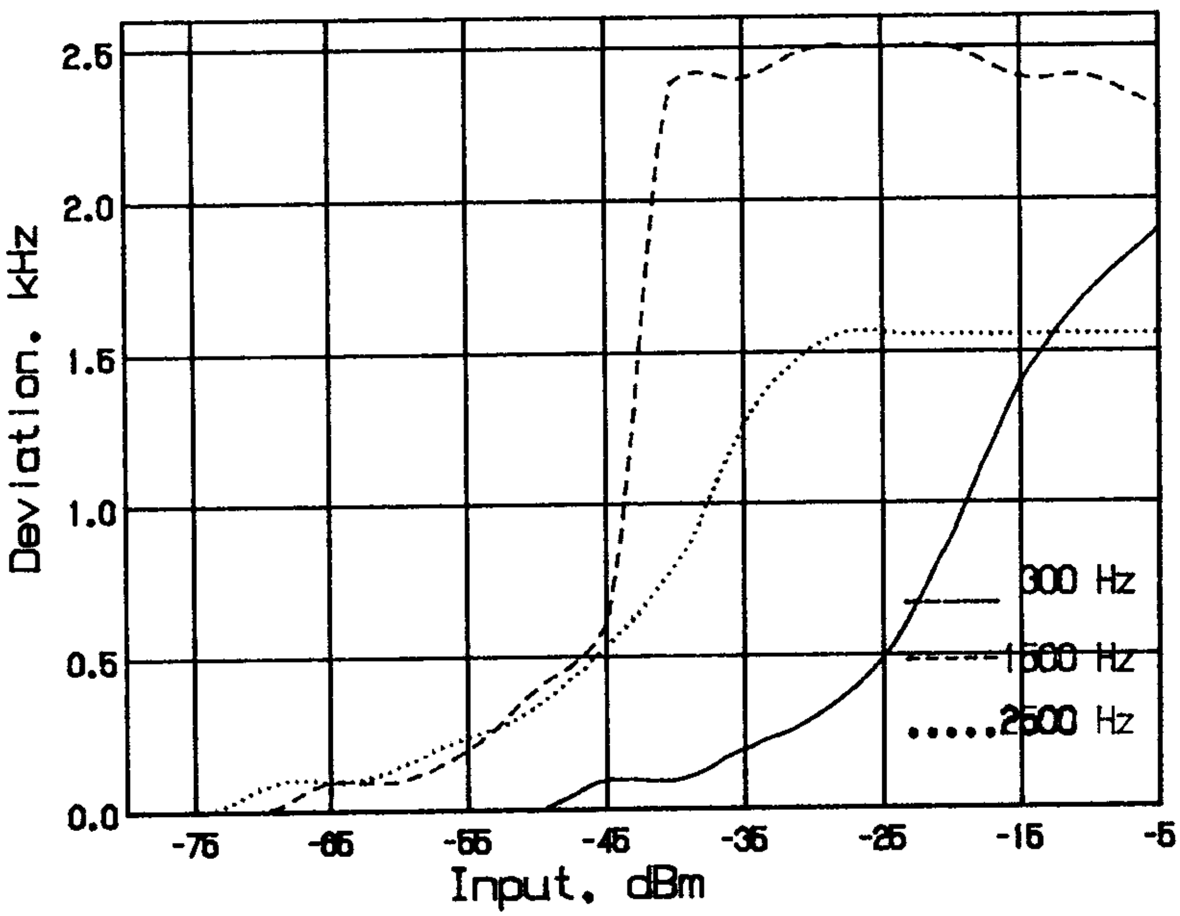
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency from the center of the authorized bandwidth f_o to 5.625 kHz removed from f_o.	0 (>5.625 kHz)
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: at least 7.27 (f_d - 2.88 kHz) dB.	70 (@ 12.5 kHz)
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.	50+10LogP = 51 (>12.5 kHz) (P = 1.0W)

OCCUPIED BANDWIDTH (F3E 1.0W)
FCC ID: F3JSP110

FIGURE 4

FIGURE 2

AUDIO LIMITER CHARACTERISTICS



AUDIO LIMITER CHARACTERISTICS
FCC ID: F3JSP110

FIGURE 2