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ENGINEERING STATEMENT

For Type Acceptance of

Cobra Electronics Corporation

Model No: HH37ST

FCC ID: BBOHH37ST

I am an Electronics Engineer, a principal in the firm of Hyak Laboratories, Inc., Springfield, Virginia. My education and experience are a matter of record with the Federal Communications Commission.

Hyak Laboratories, Inc. has been authorized by Cobra Electronics Corporation to make type acceptance measurements on the HH37ST transceiver. These tests were made by me or under my supervision in our Springfield laboratory.

Test data and documentation required by the FCC for type acceptance are included in this report. It is submitted that the above-mentioned transceiver meets all applicable FCC requirements.

Rowland S. Johnson

Dated: April 16, 1998

A. INTRODUCTION

The following data are submitted in connection with this request for type acceptance of the HH37ST transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The HH37ST is a double sideband amplitude modulated transmitter/receiver combination intended for mobile operation in the citizens radio service. The transmitter has 40-channel capability in the 26.965 - 27.405 MHz band utilizing phase locked loop (PLL) technology.

B. GENERAL INFORMATION REQUIRED FOR TYPE ACCEPTANCE (Paragraph 2.983 of the Rules)

1. Name of applicant: Cobra Electronics Corporation

2. Identification of equipment: FCC ID: BBOHH37ST

   a. The equipment identification label is shown in Appendix 1.

   b. Photographs of the equipment are included in Appendix 2.

3. Quantity production is planned.

4. Technical description:

   a. 6k00A3E emission
   b. Frequency range: 26.965 - 27.405 MHz
   c. Operating power of transmitter is fixed at the factory at less than 4 watts, and can be reduced to 1 watt.
   d. Maximum power rating under 95.635(c) of the Rules is 4 watts.
   e. The dc voltage and dc currents at final amplifier:

      Collector voltage: 11.9 V
      Collector current: 0.69 mA @ 13.8 Vdc input.

   f. Function of each active semiconductor device: See Appendix 3.
   g. Complete circuit diagram is included as Appendix 4.
   h. A draft instruction book is submitted as Appendix 5.
   i. The transmitter tune-up procedure is included in Appendix 6.
   j. A description of circuits for stabilizing frequency is included in Appendix 7.
   k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in Appendix 8.
   l. Not applicable.

B. GENERAL INFORMATION...(Continued)

5. Data for 2.985 through 2.997 follow this section.

6. RF Power Output (Paragraph 2.985(a),(b)(1) of the Rules)

RF power output in the AM mode was measured with a Bird 4421 RF power meter and a Narda 765-20 50 ohm dummy load. (The transmitter was tuned by the factory according to the procedure of Exhibit 4.) Power was measured with a supply voltage of 13.8 volts, and indicated:

Channel	Power, W	
	Hi	Low
1	3.6	0.8
21	3.4	0.8
40	3.2	0.8

C. MODULATION CHARACTERISTICS

1. AF Frequency Response

A curve showing frequency response of the transmitter is shown in Figures 1a and 1b for "normal" and "ST" respectively. **A description of the "ST" mode is included on page 18 following.** Reference level was taken as a 1 kHz tone with 50% modulation, as measured on a Data Tech 209 modulation meter, using a Audio Precision TRMS voltmeter and tracking generator.

2. Modulation Limiting

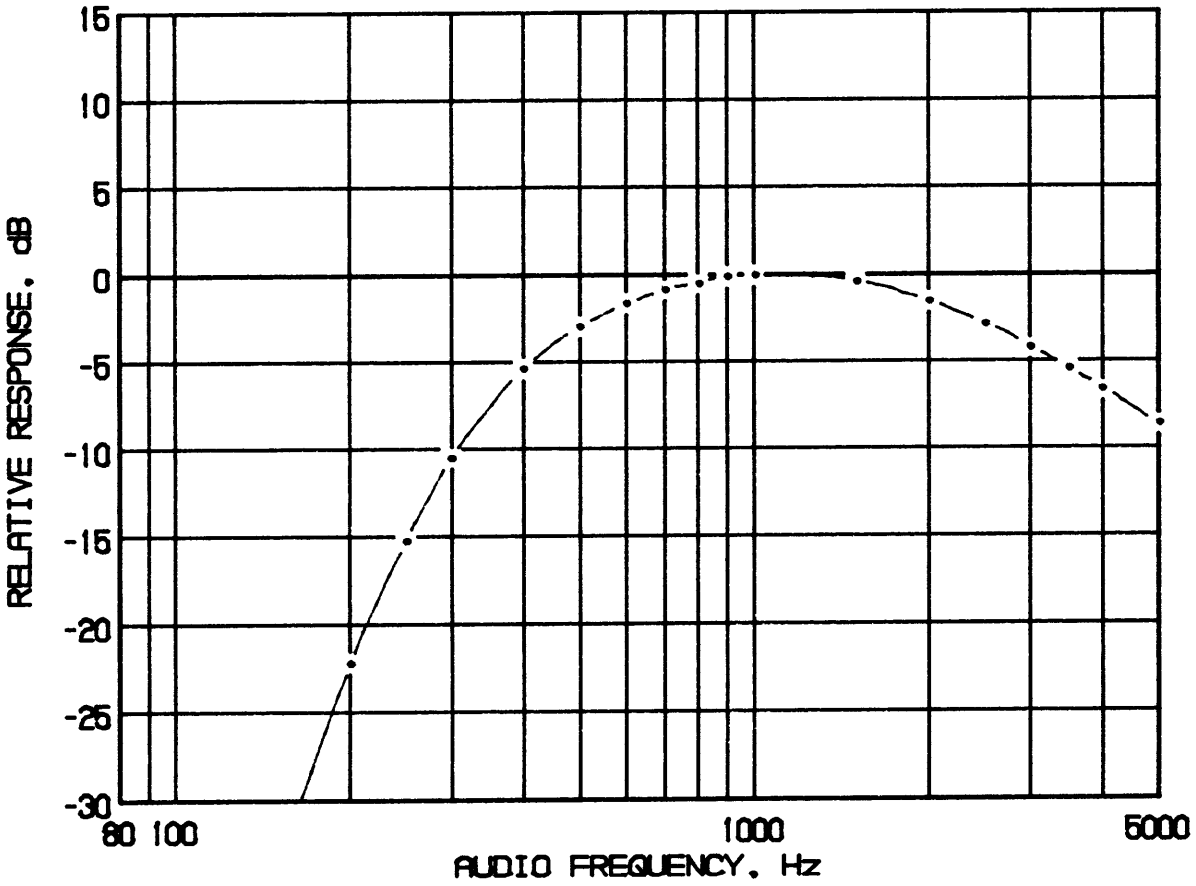
Curves of AM modulation limiting for both positive and negative peaks are shown in Figures 2a, 2b, (normal) and 2c, 2d, ((ST) respectively. Characteristics at 300, 1010 Hz (N), 1820 Hz (ST), and 2500 Hz are shown using a Data Tech 209 modulation meter. Signal level was established with a Audio Precision TRMS voltmeter and tracking generator. The curves show compliance with Paragraph 95.633(d) of the Rules.

3. Modulation Limiter Attack Time

Modulation limiter attack time was measured by applying to the microphone input terminals a pulsed tone at 2500 Hz, 16 dB above the level required for 50% modulation at the frequency of maximum response, 1010 (N) or 1820 (ST) Hz. The spectrum analyzer was tuned to upper and lower fourth- order sidebands in the time domain. Sweep speed was 100 milliseconds per division. Plots are included as Figures 3a, 3b (N) and 3c, 3d (ST). Any transients observed in excess of 33 dB attenuation as referenced to the carrier were less than 20 ms in duration.

FIGURE 1a

TRANSMITTER FREQUENCY RESPONSE

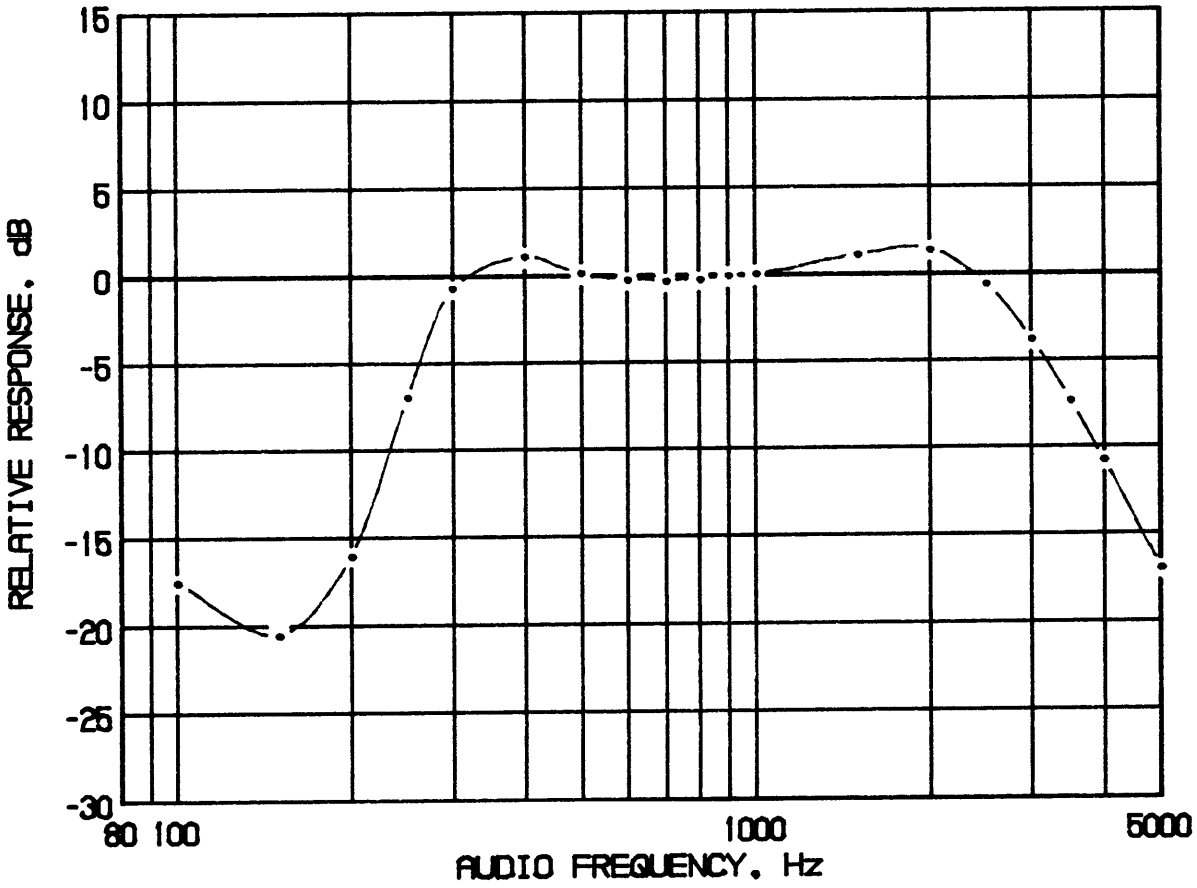


TRANSMITTER FREQUENCY RESPONSE
MODEL HH37ST (Normal)

FIGURE 1a

FIGURE 1b

TRANSMITTER FREQUENCY RESPONSE

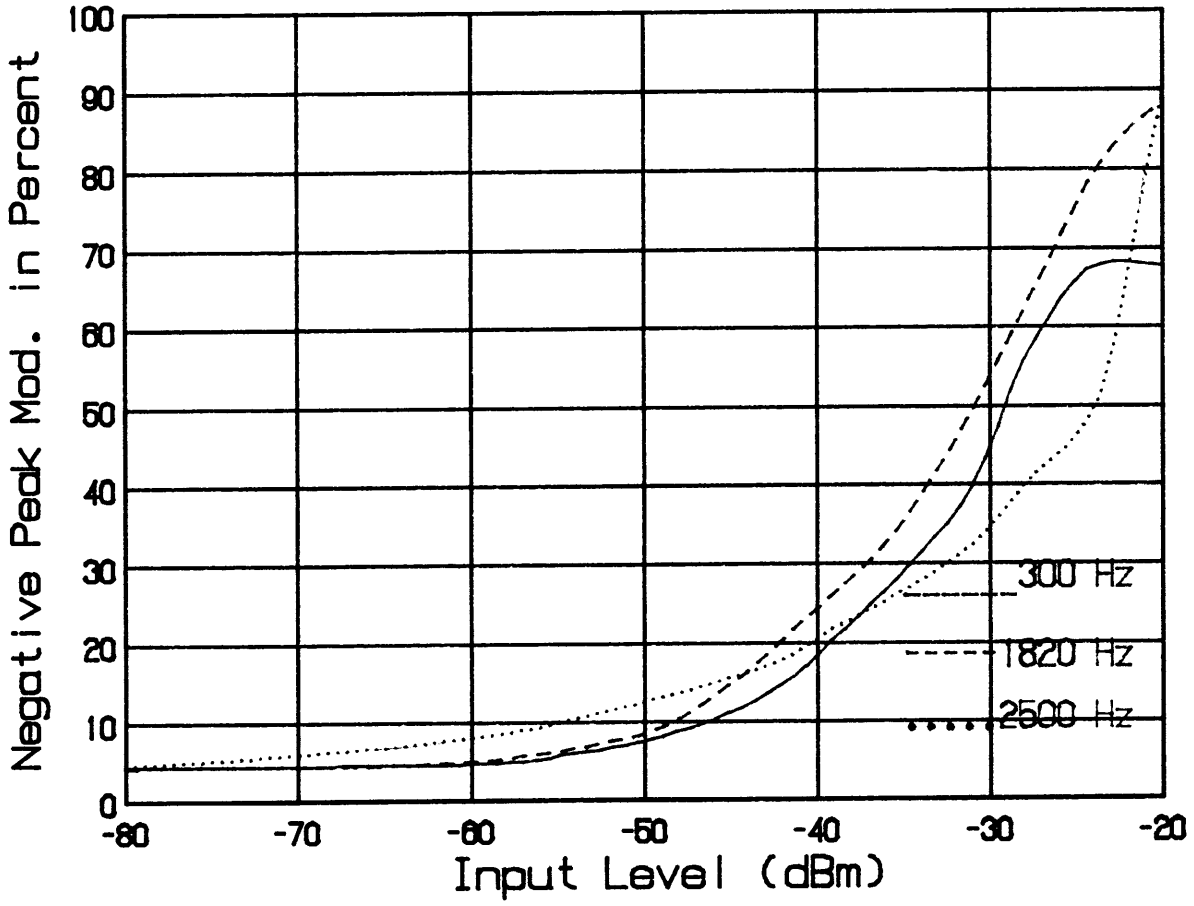


TRANSMITTER FREQUENCY RESPONSE
MODEL HH37ST (ST Mode)

FIGURE 1b

FIGURE 2d

AM MODULATION LIMITING - NEGATIVE PEAKS



MODULATION LIMITING CHARACTERISTICS

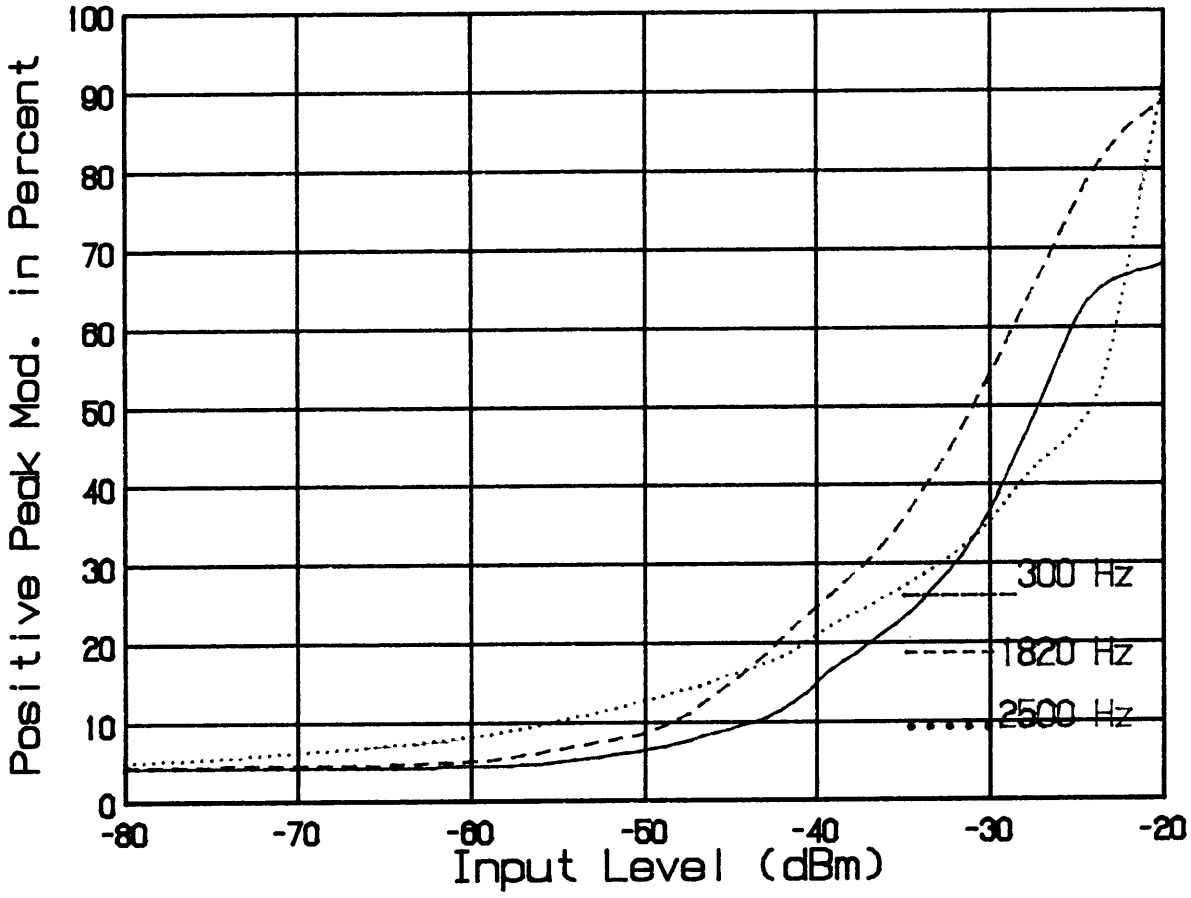
Percent modulation as a function of input level at microphone jack in dBm for 300 Hz, 1820 Hz, and 2500 Hz tones.

MODULATION LIMITING NEGATIVE PEAKS
MODEL HH37ST

FIGURE 2d (ST Mode)

FIGURE 2c

AM MODULATION LIMITING - POSITIVE PEAKS



MODULATION LIMITING CHARACTERISTICS

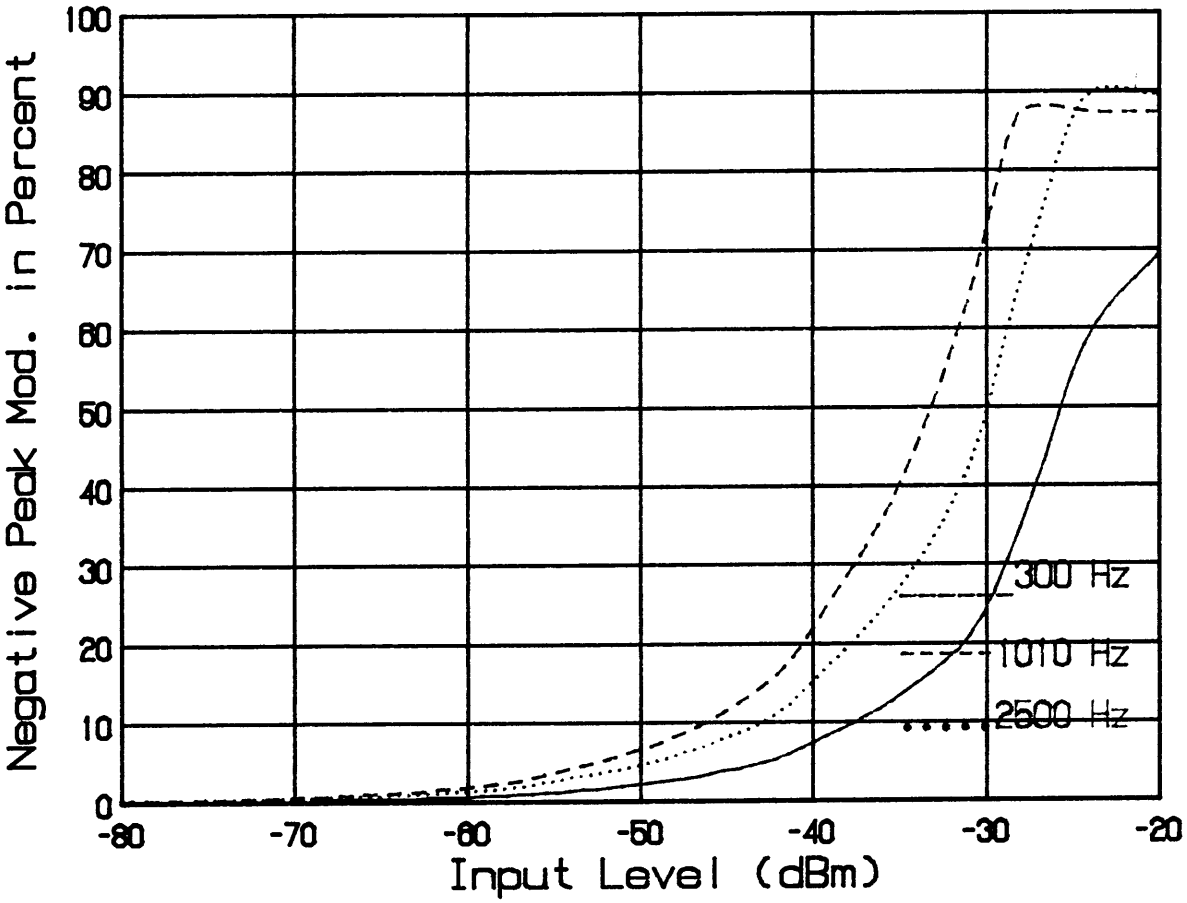
Percent modulation as a function of input level at microphone jack in dBm for 300 Hz, 1820 Hz, and 2500 Hz tones.

MODULATION LIMITING POSITIVE PEAKS
MODEL HH37ST

FIGURE 2c (ST Mode)

FIGURE 2b

AM MODULATION LIMITING - NEGATIVE PEAKS



MODULATION LIMITING CHARACTERISTICS

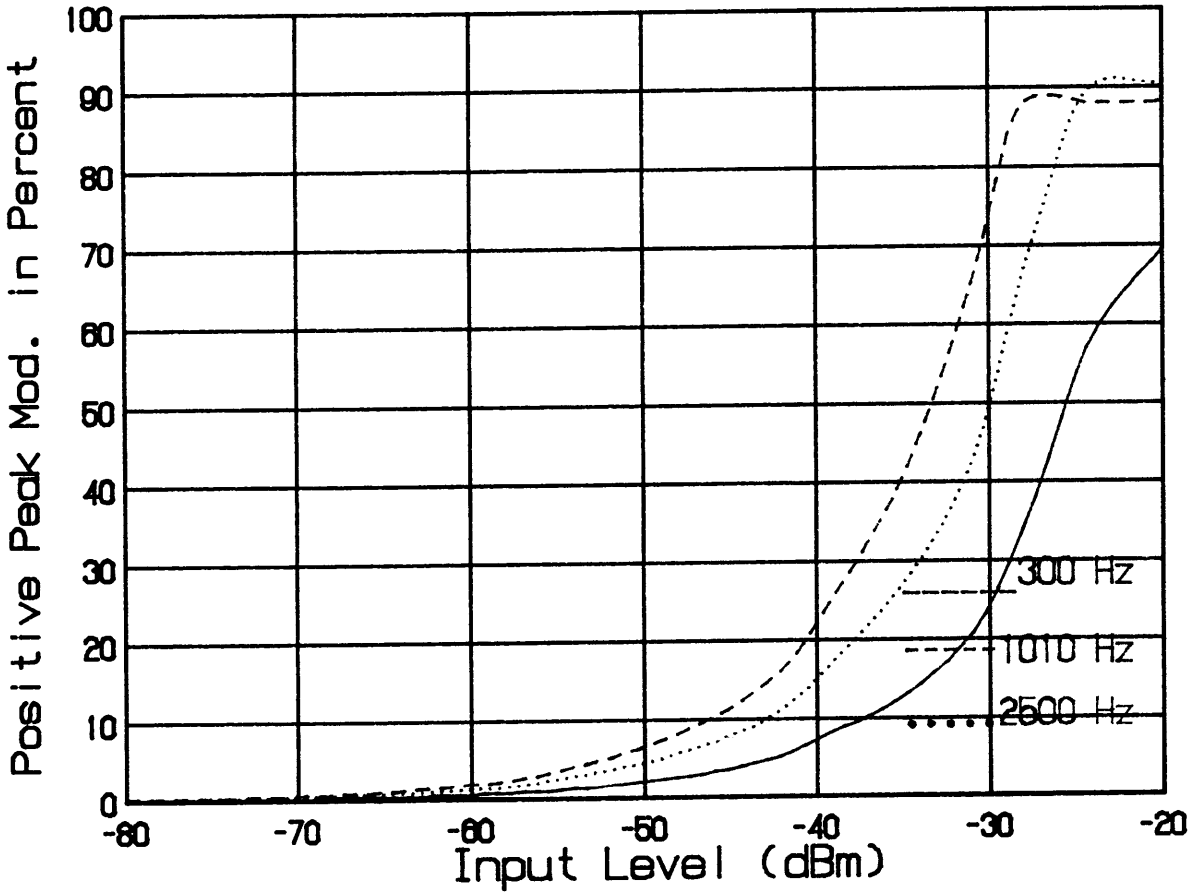
Percent modulation as a function of input level at microphone jack in dBm for 300 Hz, 1010 Hz, and 2500 Hz tones.

MODULATION LIMITING NEGATIVE PEAKS
MODEL HH37ST

FIGURE 2b (Normal)

FIGURE 2a

AM MODULATION LIMITING - POSITIVE PEAKS



MODULATION LIMITING CHARACTERISTICS

Percent modulation as a function of input level at microphone jack in dBm for 300 Hz, 1010 Hz, and 2500 Hz tones.

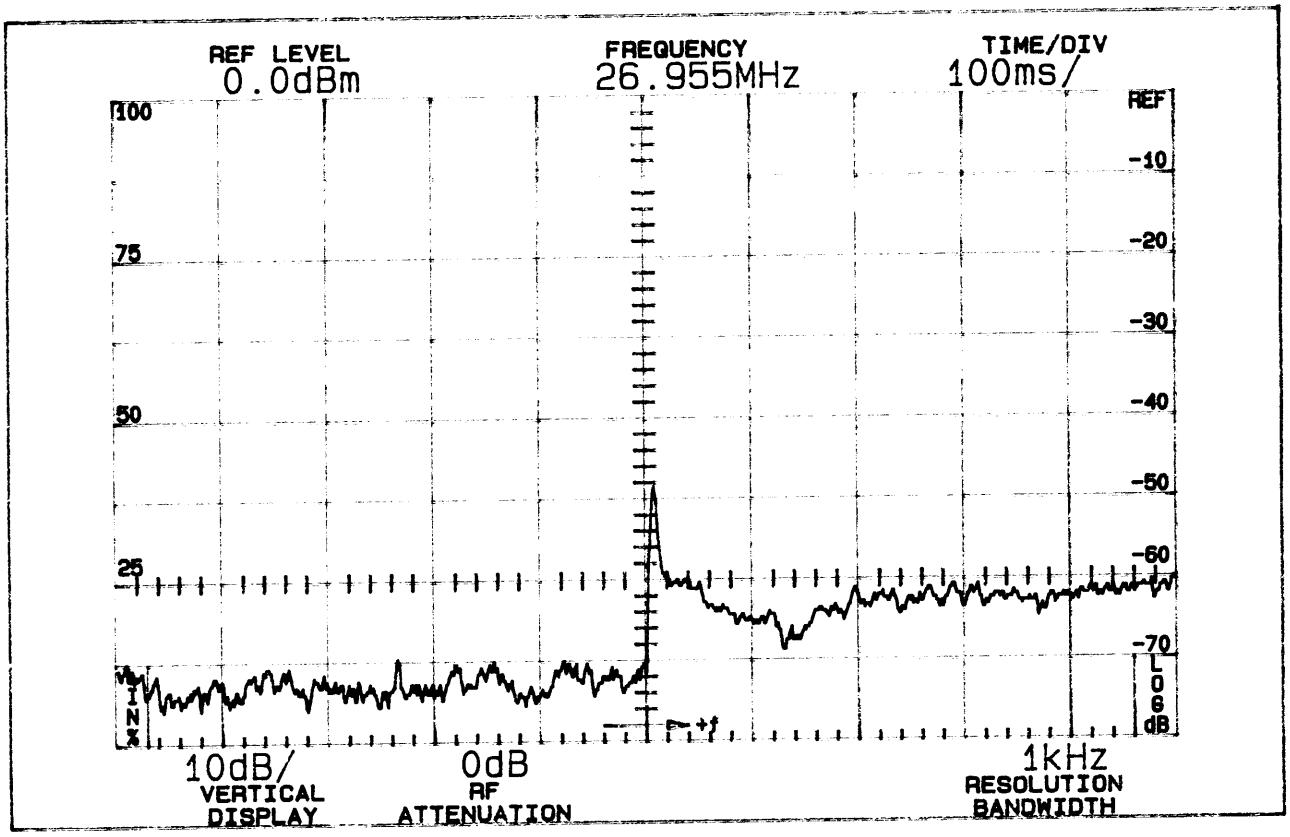
MODULATION LIMITING POSITIVE PEAKS
MODEL HH37ST

FIGURE 2a (Normal)

A: \HH37HSTL.CDW

FIGURE 3d

MODULATION LIMITER ATTACK TIME



Measurement Conditions: 16 dB over 50% modulation level at 1820 Hz with 2500 Hz tone, lower fourth order sideband; horizontal scale 100 ms/div.

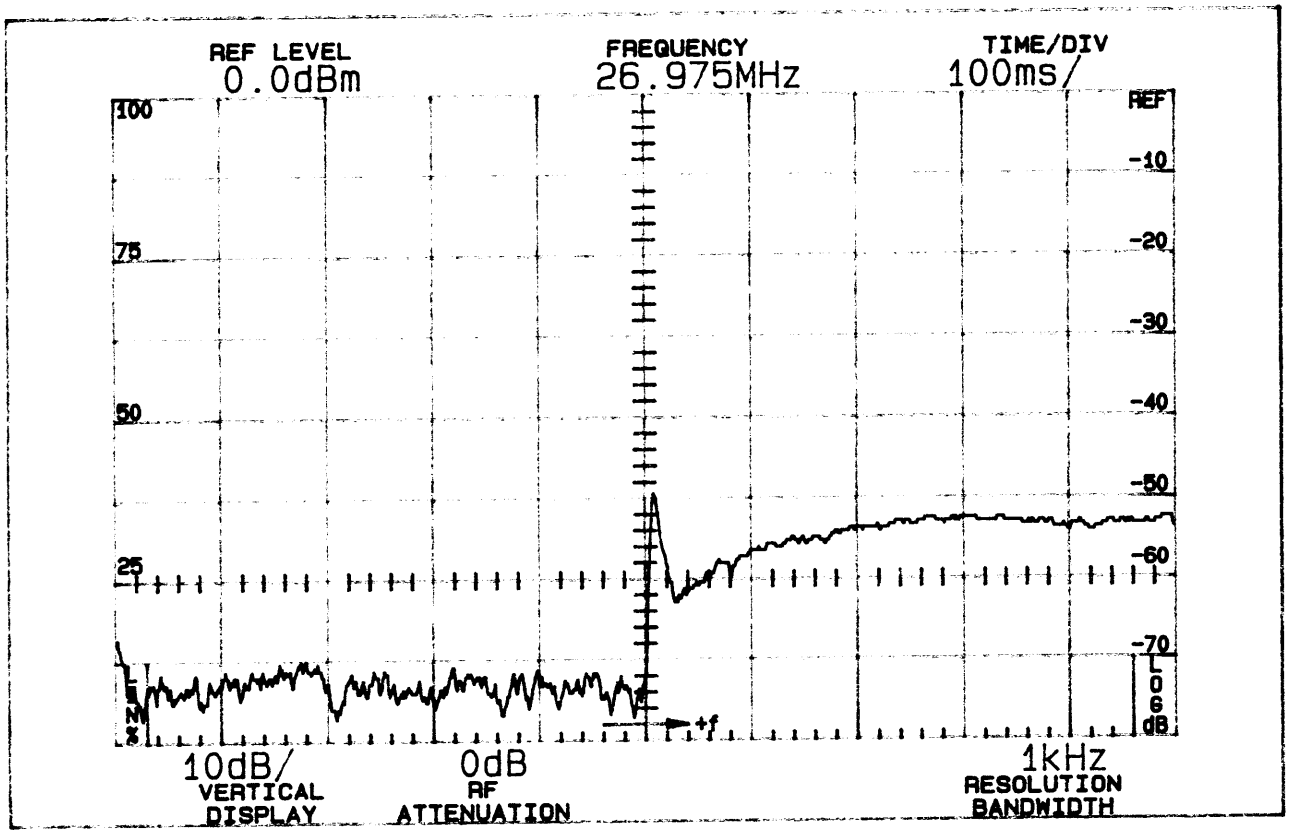
LOWER FOURTH-ORDER SIDEBAND
LIMITER ATTACK TIME
FCC ID: BBOHH37ST

FIGURE 3d (ST Mode)

A: \HH37HSTH.CBW

FIGURE 3c

MODULATION LIMITER ATTACK TIME



Measurement Conditions: 16 dB over 50% modulation level at 1820 Hz with 2500 Hz tone, upper fourth order sideband; horizontal scale 100 ms/div.

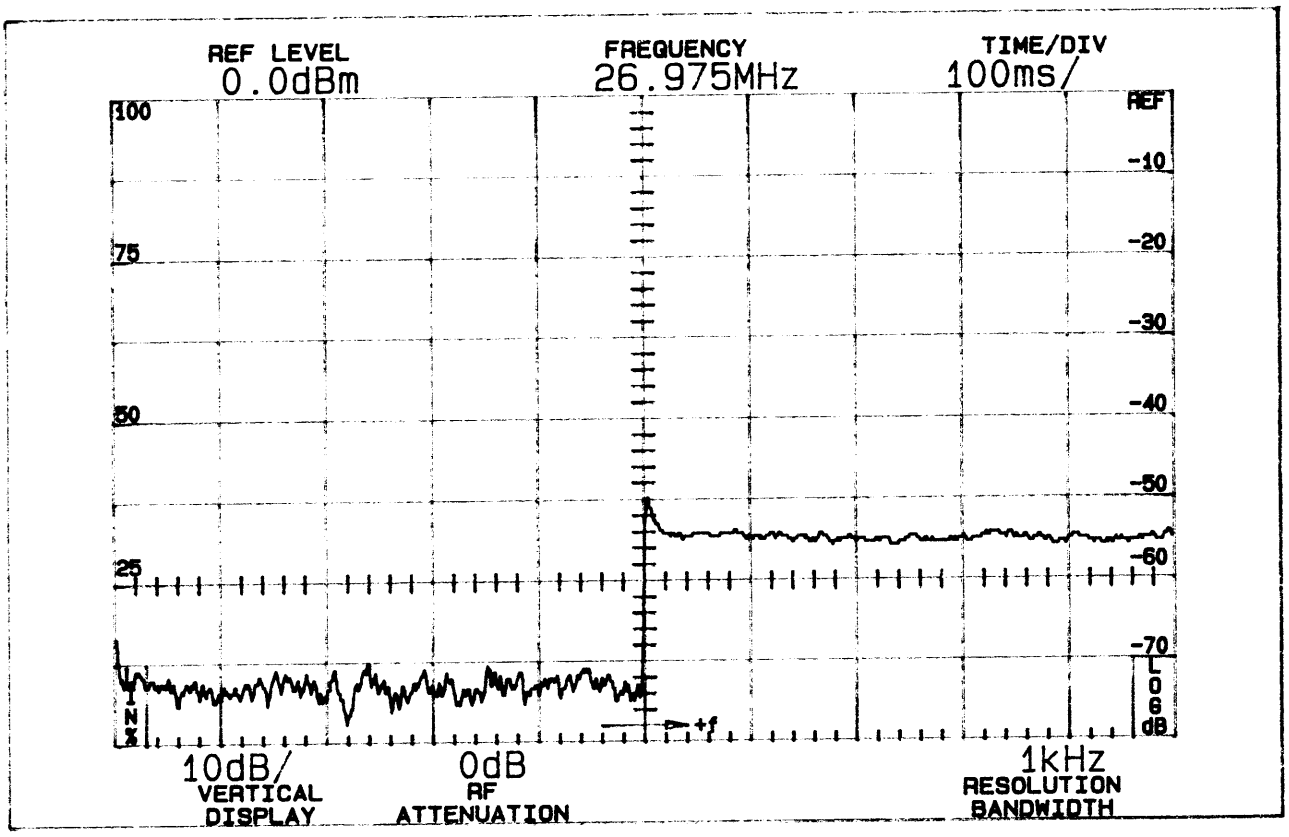
UPPER FOURTH-ORDER SIDEBAND
LIMITER ATTACK TIME
FCC ID: BBOHH37ST

FIGURE 3c (ST Mode)

A: \HH37HOBR.CBW

FIGURE 3a

MODULATION LIMITER ATTACK TIME



Measurement Conditions: 16 dB over 50% modulation level at 1010 Hz with 2500 Hz tone, upper fourth order sideband; horizontal scale 100 ms/div.

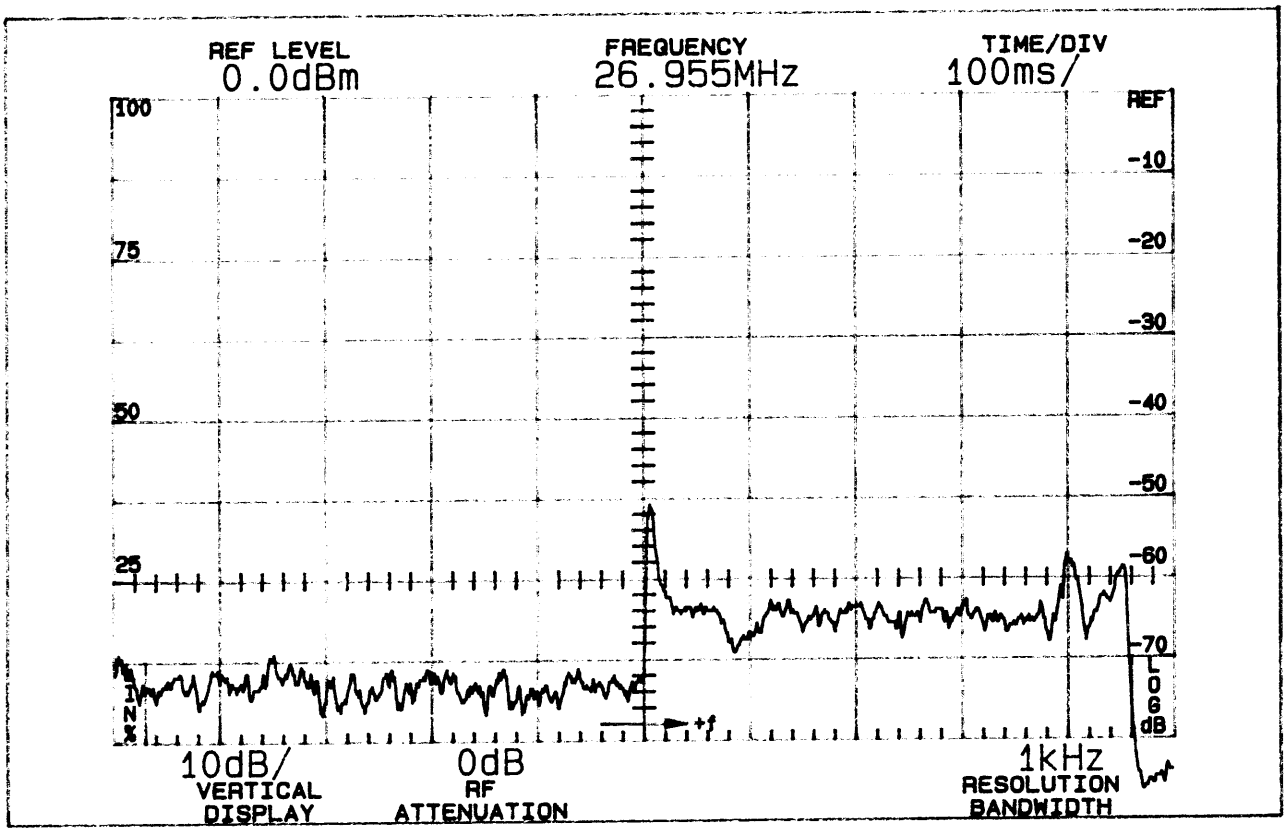
UPPER FOURTH-ORDER SIDEBAND
LIMITER ATTACK TIME
FCC ID: BBOHH37ST

FIGURE 3a (Normal)

A: \HH37LOSR.CSW

FIGURE 3b

MODULATION LIMITER ATTACK TIME



Measurement Conditions: 16 dB over 50% modulation level at 1010 Hz with 2500 Hz tone, lower fourth order sideband; horizontal scale 100 ms/div.

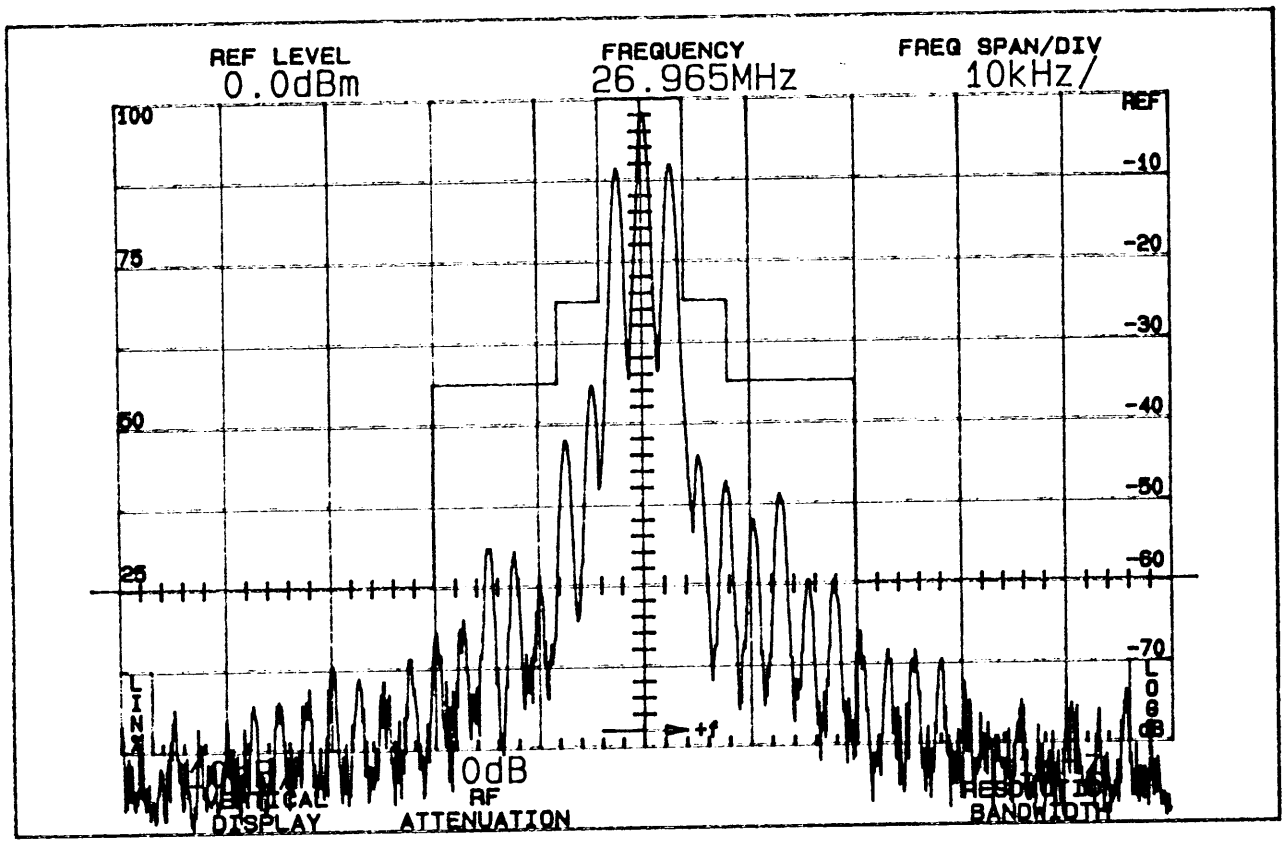
LOWER FOURTH-ORDER SIDEBAND
LIMITER ATTACK TIME
FCC ID: BBOHH37ST

FIGURE 3b (Normal)

A: \HH37STH.CGM

FIGURE 4d

OCCUPIED BANDWIDTH



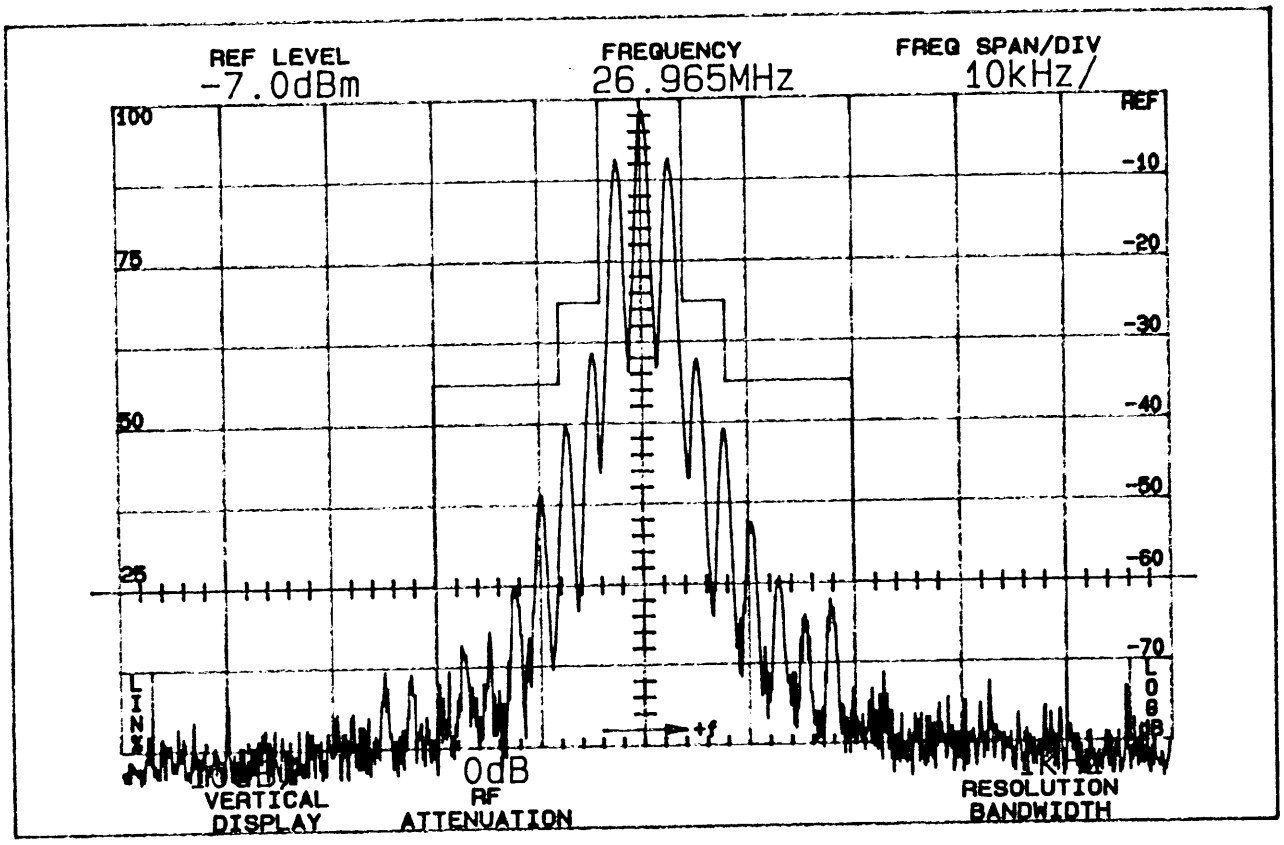
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 8kHz (4-8kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (8-20kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth	60

OCCUPIED BANDWIDTH
FCC ID: BBOHH37ST

FIGURE 4d ("ST" Mode 0.8W)

FIGURE 4c

OCCUPIED BANDWIDTH



	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 8kHz (4-8kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (8-20kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth	60

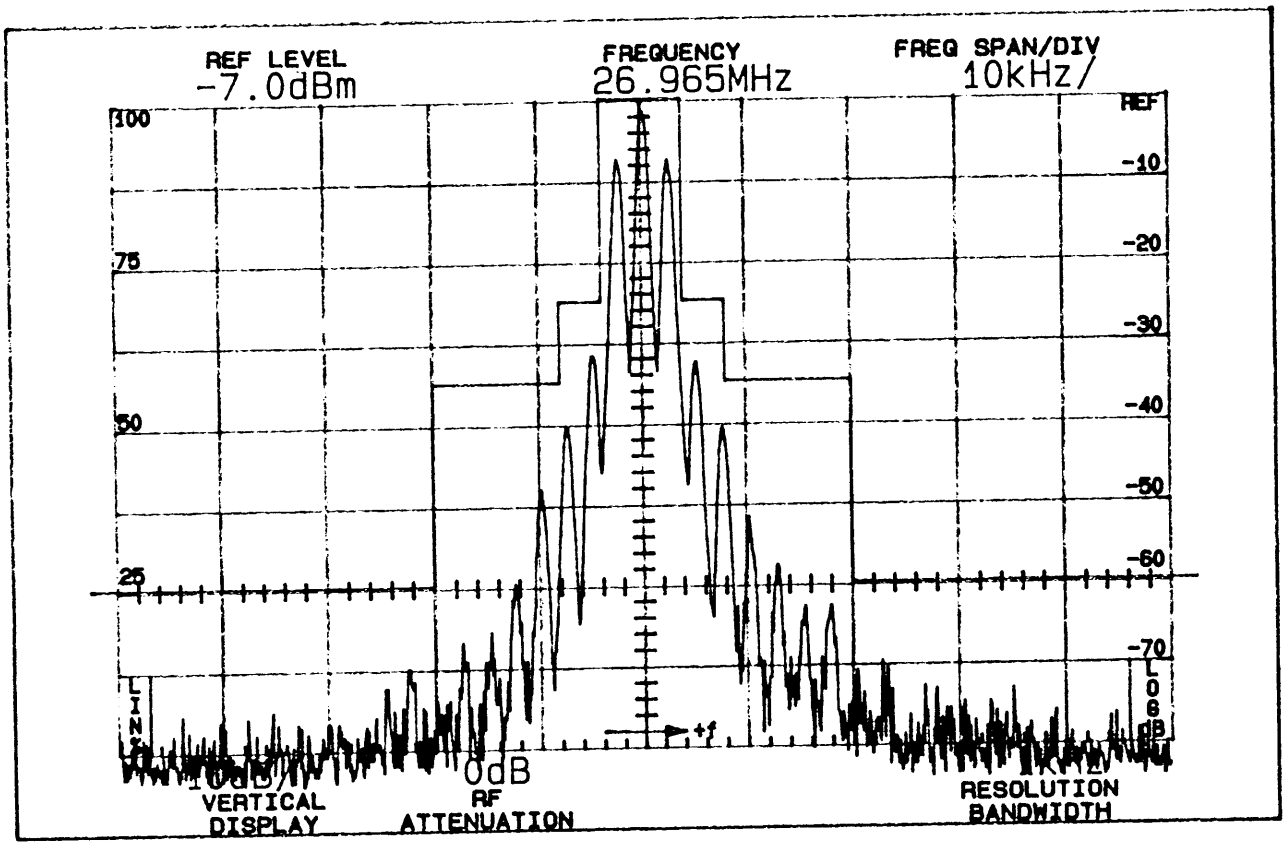
OCCUPIED BANDWIDTH
FCC ID: BBOHH37ST

FIGURE 4c ("ST" Mode 3.6W)

A:\HH37LO.DEM

FIGURE 4b

OCCUPIED BANDWIDTH



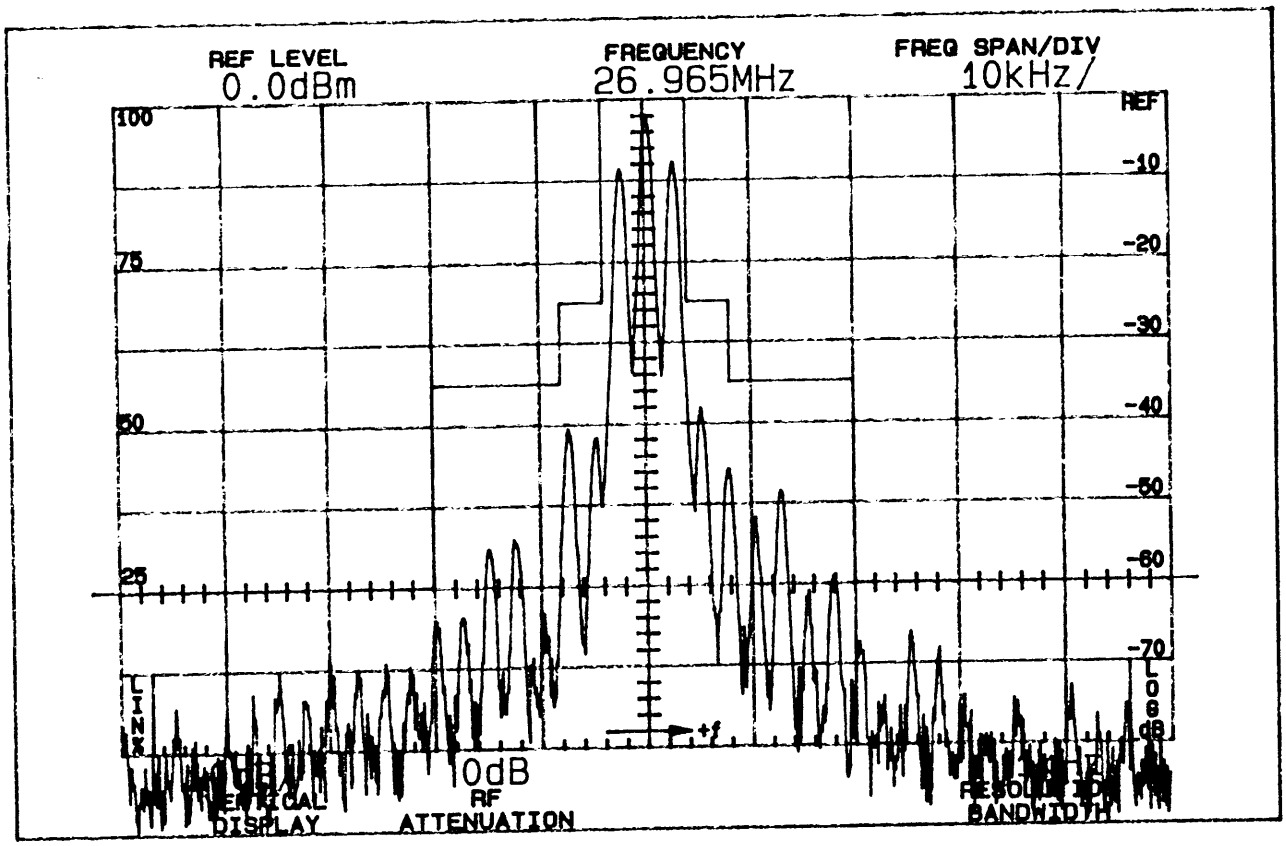
	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 8kHz (4-8kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (8-20kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth	60

OCCUPIED BANDWIDTH
FCC ID: BBOHH37ST

FIGURE 4b (Normal 0.8W)

FIGURE 4a

OCCUPIED BANDWIDTH



	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency more than 50% up to and including 100% of the authorized bandwidth, 8kHz (4-8kHz)	25
On any frequency more than 100%, up to and including 250% of the authorized bandwidth (8-20kHz)	35
On any frequency removed from the assigned frequency by more than 250% of the authorized bandwidth	60

OCCUPIED BANDWIDTH
FCC ID: BBOHH37ST

FIGURE 4a (Normal 3.6W)

C. MODULATION CHARACTERISTICS (Continued)

4. Occupied Bandwidth - AM
(Paragraph 2.989(c) of the Rules)

Figures 4a and 4b are plots of the sideband envelope of the transmitter taken from a Tektronix 494P spectrum analyzer for both power levels. Modulation corresponded to conditions of 2.989(a) and consisted of 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 1010 Hz, the frequency of maximum response. Measured modulation under these conditions was 90% positive, 89% negative.

Figures 4c and 4d are plots under the same conditions as above but in the "ST" mode using 1820 Hz as the 50% reference. Modulation was positive 85% and 87% negative.

The plots are within the limits imposed by Paragraph 95.631(b)(1,3) for double sideband AM 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.

NOTE: CW carrier reference was 0 dBm, top of analyzer screen. Approximately 1 dB of carrier shift occured.

The Sound Tracker (TM) was designed to enhance the quality of sound of the CB radio by compressing transmitted audio as a function of audio frequency thereby improving signal-to-noise ratio in a similarly equipped receiver.

Maximum modulation percentage of the compressed audio remains within intended maximum and transient modulation limits.

Receiver audio on a non-"ST" receiver sounds normal but does not have the benefit of the compandor derived improvement in signal-to-noise ratio.

Compliance with Para 95.413 (a)(6) and (7) is not affected since no distinctive sound effect is transmitted.

Data presented shows compliance with all requirements regarding frequency response, limiting, and occupied bandwidth.

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

The HH37ST transmitter was tested in the AM mode 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% modulation at 1010 Hz, the frequency of highest sensitivity. No significant change was observed when the "ST" mode (1820 Hz) was used.

Measurements were made with Tektronix 494P spectrum analyzer coupled to the transmitter output terminal through Narda 765-20 50 ohm power attenuation.

In order to improve measurement system dynamic range, a series trap tuned to the carrier frequency was used on the Narda attenuator output. The trap, which had negligible shunt attenuation at the second harmonic and high frequencies, provided 26 dB attenuation of the fundamental. The trap was not used during close-in (within 10 MHz of the carrier) spurious measurements.

During the tests, the transmitter was terminated in the Narda 765-20 dummy load. Power was monitored on a Bird 43 Thru-Line wattmeter; dc supply was 13.8 volts throughout the tests.

Spurious emission was measured at both power settings on Channels 1, 21, and 40 throughout the RF spectrum from 10.240 to 300 MHz. Any emissions that were between the 60 dB attenuation required and the 100 dB noise floor of the spectrum analyzer were recorded. Data are shown in Table.

TABLE 1

TRANSMITTER CONDUCTED SPURIOUS

13.8 Vdc Input

Channel	Spurious Frequency MHz	dB Below Unmod Carrier Ref. 3.6 W	0.8 W
1	53.930	69	72
1	80.895	77	72
1	107.860	88	88
1	134.825	78	76
1	161.790	94	89
1	188.755	93	88
1	215.720	96	104
1	242.685	87	83
1	269.650	102	93
21	54.430	71	74
21	81.645	78	72
21	108.860	92	87
21	136.075	80	78
21	163.290	96	89
21	190.505	91	86
21	217.720	98	102
21	244.935	86	80
21	272.150	100	93
40	54.810	74	75
40	82.215	78	72
40	109.620	98	86
40	137.025	80	78
40	164.430	96	89
40	191.835	90	84
40	219.240	102	95
40	246.645	85	80
40	274.050	101	93
	Required:	60	60

All other spurious were more than 20 dB below required 60 dB suppression.

A notch filter was used to attenuate the carrier.

E. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION (Paragraph 2.993(a)(b,2) of the Rules)

Field intensity measurements of radiated spurious emissions from the HH37ST transmitter were made with a Tektronix 494P spectrum analyzer and dummy load located in an open field 3 meters from the test antenna. Output power was 3.6 watts. The supply voltage was 13.8 volts. The transmitter and test antennae were arranged according to OCE 42 to maximize pickup. Measurements were made with and without accessory cable. Both vertical and horizontal test antenna polarization were employed.

Measurements were made from 10.240 MHz to 10 times the maximum operating frequency of 26.965 or 269.65 MHz.

Reference level for the spurious radiations was taken as an ideal dipole excited by 3.6 watts, the output power of the transmitter according to the following relationship:*

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

where E = electric-field intensity in volts/meter

P_t = transmitter power in watts

R = distance in meters

for this case $E = \frac{(49.2 \times 3.6)^{1/2}}{3} = 4.4$ V/m

Since the spectrum analyzer is calibrated in decibels above one milliwatt (dBm):

4.4 volts/meter = 4.4×10^6 uV/m

dBu/m = 20 $\text{Log}_{10}(4.4 \times 10^6)$

= 133 dBu/m

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

133 - 107 = 26 dBm

Representing a conversion for convenience, from dBu to dBm. The measurement system was capable of detecting signals 100 dB or more below the carrier reference level. Data, including antenna factor and line loss corrections, are shown in Table 2.

*Reference Data for Radio Engineers, International Telephone and Telegraph Corporation, Sixth Edition.

F. FIELD STRENGTH MEASUREMENTS (Continued)

TABLE 2

TRANSMITTER CABINET RADIATED SPURIOUS
Channel 1, 26.965 MHz; 3.6 watts

	dB Below Carrier Reference			
	Without Accessories		With Accessories	
Frequency, MHz	(V)	(H)	(V)	(H)
53.930	88	102	82	68
80.895	101	95	67	82
107.860	90	78	81	85
134.825	88	86	76	68
161.790	70	83	103	86
188.755	83	83	88	86
215.720	83	77	83	78
242.685	86	78	91	82
269.650	99	95	97	88
Required:	60	60	60	60

Any unlisted spurious were more than 80 below carrier reference from 10.240 to 270.000 MHz.

F. FREQUENCY STABILITY
(Paragraph 2.995(a)(1) of the Rules)

Measurement of frequency stability versus temperature was made at temperatures from -30°C to +50°C in 10° increments. At each temperature, the unit was exposed to the test chamber ambient a minimum of 60 minutes after indicated chamber temperature ambient had stabilized to within ±2° of the desired test temperature. Following a 30 minute 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. The transmitter output stage was terminated in a dummy load. Primary supply was 13.8 volts. Frequency was measured with a HP 5385A digital frequency counter connected to the transmitter through a power attenuator. Measurements were made on Channel 9, 27.065 MHz. No transient keying effects were observed.

H. ADDITIONAL REQUIREMENTS FOR TYPE ACCEPTANCE
(Paragraph 95.665 of the Rules)

The HH37ST meets the applicable provision of 95.665(a).

External controls are limited to the following per 95.665(a):

1. Primary power connection
2. Microphone
3. RF output power connection
4. External earphone and mike
5. On-off switch (combined with receiver volume control)
6. Not applicable, AM only
7. Not applicable, AM only
8. Transmitting frequency selector
9. Transmit-receive switch
10. See #1
11. Not applicable

The serial number of each unit will be implemented in accordance with 95.667.

A copy of Part 5, Subpart D, of the FCC rules for the Citizens Band Radio Service, current at the time of packing of the transmitter, must be furnished with each CB transmitter marketed per 95.669.

I. PLL RESTRICTIONS
(Per Public Notice of April 27, 1978)

The HH37ST meets the following conditions specified in the April 27, 1978 notice:

1. All frequency-determining elements, including crystals, PLL integrated circuits and channel selector switches are permanently wired and soldered in place.

2. The PLL integrated circuit has no more than six active leads and is BCD encoded.

3. The channel selection mechanism has only 40 positions.

4. The PLL integrated circuit has no "spare" or undedicated leads.

5. A copy of the PLL data sheet is shown in Appendix 9.

APPENDIX 1

EQUIPMENT IDENTIFICATION LABEL

LABEL AND LOCATION PHOTO FOLLOWS THIS SHEET

G. FREQUENCY STABILITY (Continued)

TABLE 3

Temperature	Output Frequency, MHz
-29.2	27.065397
-19.8	27.065400
- 9.7	27.065406
-0.2	27.065359
9.9	27.065275
20.5	27.065140
30.4	27.065011
40.4	27.064904
50.4	27.064810
Maximum frequency error:	27.065406
	27.065000
	+ .000406 MHz

FCC Rule 95.625(b) specifies .005% or a maximum of ± .001353 MHz.

G. 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 digital frequency counter as supply voltage provided by an HP 6264B variable dc power supply was varied ±15% from the nominal 13.8 volt rating. A Keithley 197 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20°C ambient.

TABLE 4

Supply Voltage	Output Frequency, MHz
15.87	27.065170
15.19	27.065164
14.49	27.065153
13.80	27.065140
13.11	27.065127
12.42	27.065116
11.73	27.065106
9.60*	27.065069
Maximum frequency error:	27.065170
	27.065000
	+ .000170 MHz

FCC Rule 95.625(b) specifies .005% or a maximum of ± .0001353 MHz.
No effects on frequency related to keying the unit were observed.

*MFG rated end point when operated on batteries.