ENGINEERING STATEMENT

For Type Certification of

Cobra Electronics Corporation

Model No: 19DX-III

FCC ID: BBO19DXIII

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 certification measurements on the 19DX-III 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 certification are included in this report. It is submitted that the above-mentioned transceiver meets all applicable FCC requirements.

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Rowland S. Johnson

Dated: September 5, 2000

A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the 19DX-III transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The 19DX-III is a double sideband amplitude modulated transmitter/receiver combination intended for mobile (vehicle) applications 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 CERTIFICATION (Paragraph 2.983 of the Rules)

1. Name of applicant: Cobra Electronics Corporation

2. Identification of equipment: FCC ID: BBO19DXIII

   a. The equipment identification label is submitted as a separate exhibit.

   b. Photographs of the equipment are submitted as a separate exhibit.

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.
   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: 13.4 V
      Collector current: 0.56 mA @ 13.8 Vdc input.

   f. Function of each active semiconductor device: Submitted as a separate exhibit.
   g. Complete ciruit diagram is submitted as a separate exhibit.
   h. A draft instruction book is submitted as a separate exhibit.
   i. The transmitter tune-up procedure is submitted as

a separate exhibit.



B. GENERAL INFORMATION…(Continued)

j. A description of circuits for stabilizing frequency is included in Appendix 1.
k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in Appendix 2.
l. Not applicable.

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 |
|---|---|
| 1 | 3.7 |
| 21 | 3.6 |
| 40 | 3.6 |

C. MODULATION CHARACTERISTICS

1. AF_Frequency_Response

A curve showing frequency response of the transmitter is shown in Figure 1. Reference level was taken as a 1 kHz tone with 50% modulation, as measured on a Data Tech 209 modulation meter, using Audio Precision System One digital voltmeter and tracking generator.

2. Modulation_Limiting

Curves of AM modulation limiting for both positive and negative peaks are shown in Figures 2a and 2b, respectively. Characteristics at 300, 940, and 2500 Hz are shown using a Data Tech 209 modulation meter. Signal level was established with a Audio Precision System One

digital voltmeter. The curves show compliance with Paragraph 95.633(d) of the Rules.



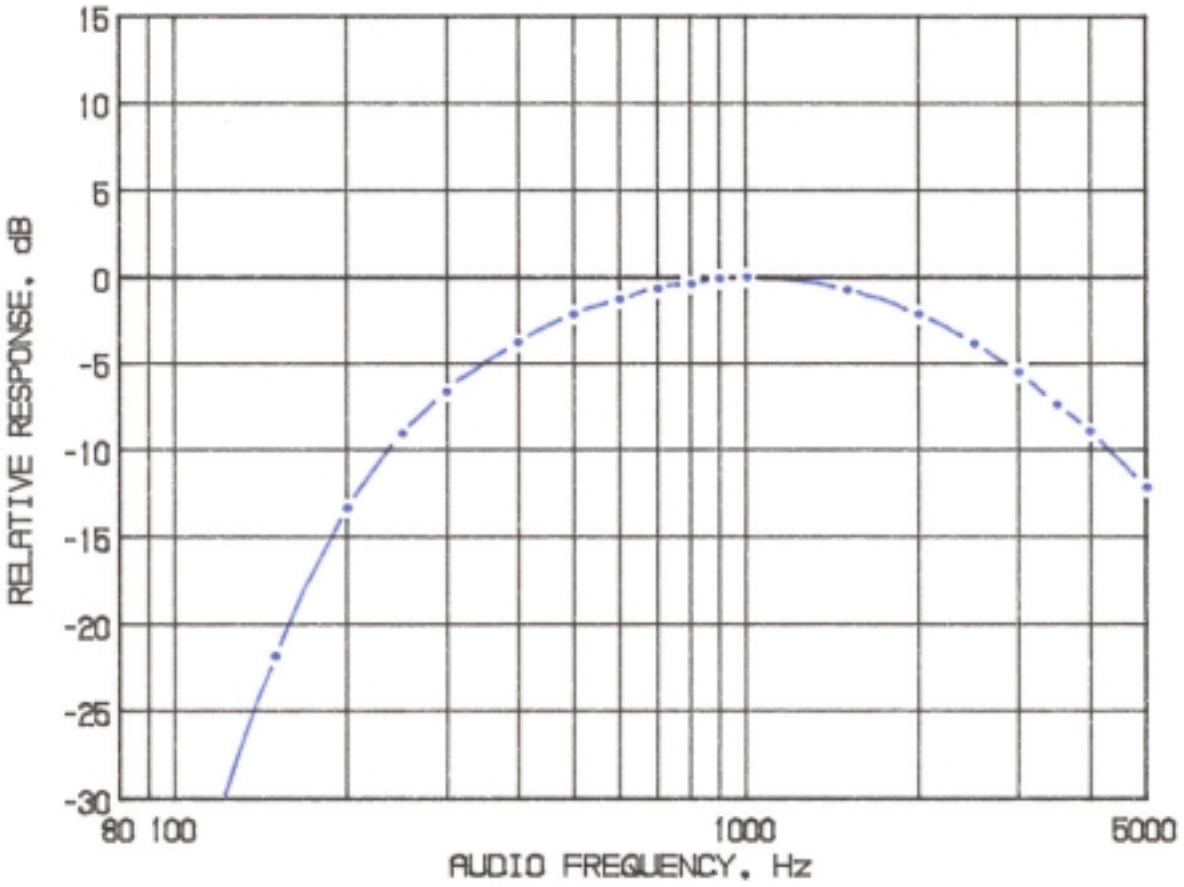
C. MODULATION REQUIREMENTS…(Continued)

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, 940 Hz. The spectrum analyzer was tuned to upper and lower fourth-order sidebands in the time domain. Horizontal sweep of the analyzer was triggered in synchronism with the tone turn-on. Sweep speed was 100 milliseconds per division. Plots are included as Figures 3a and 3b. Any transients observed in excess of 33 dB attenuation as referenced to the carrier were less than 20 ms in duration.

FIGURE 1

TRANSMITTER FREQUENCY RESPONSE



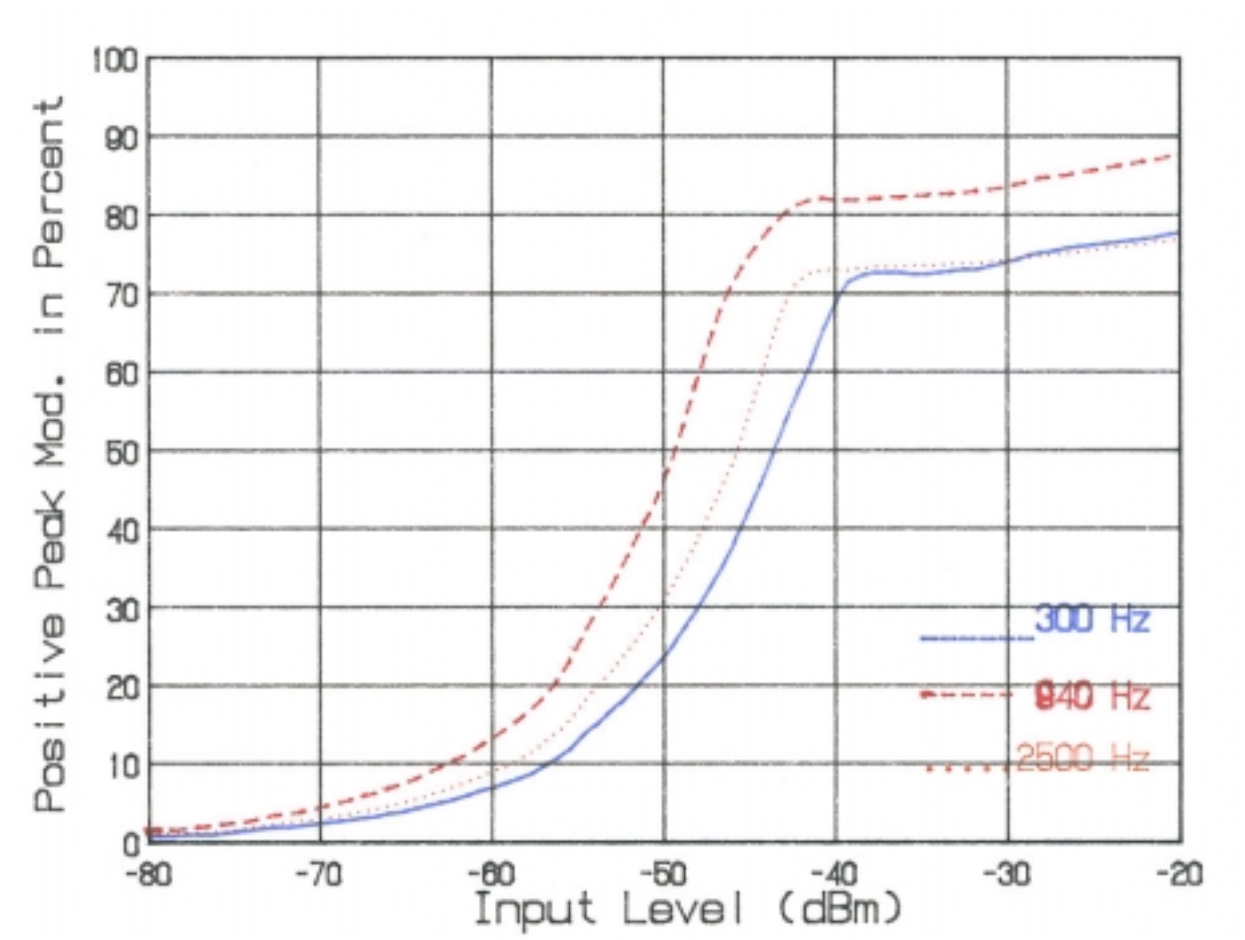
TRANSMITTER FREQUENCY RESPONSE
FCC ID: BBO19DXIII

FIGURE 1

5

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, 940 Hz, and 2500 Hz tones.

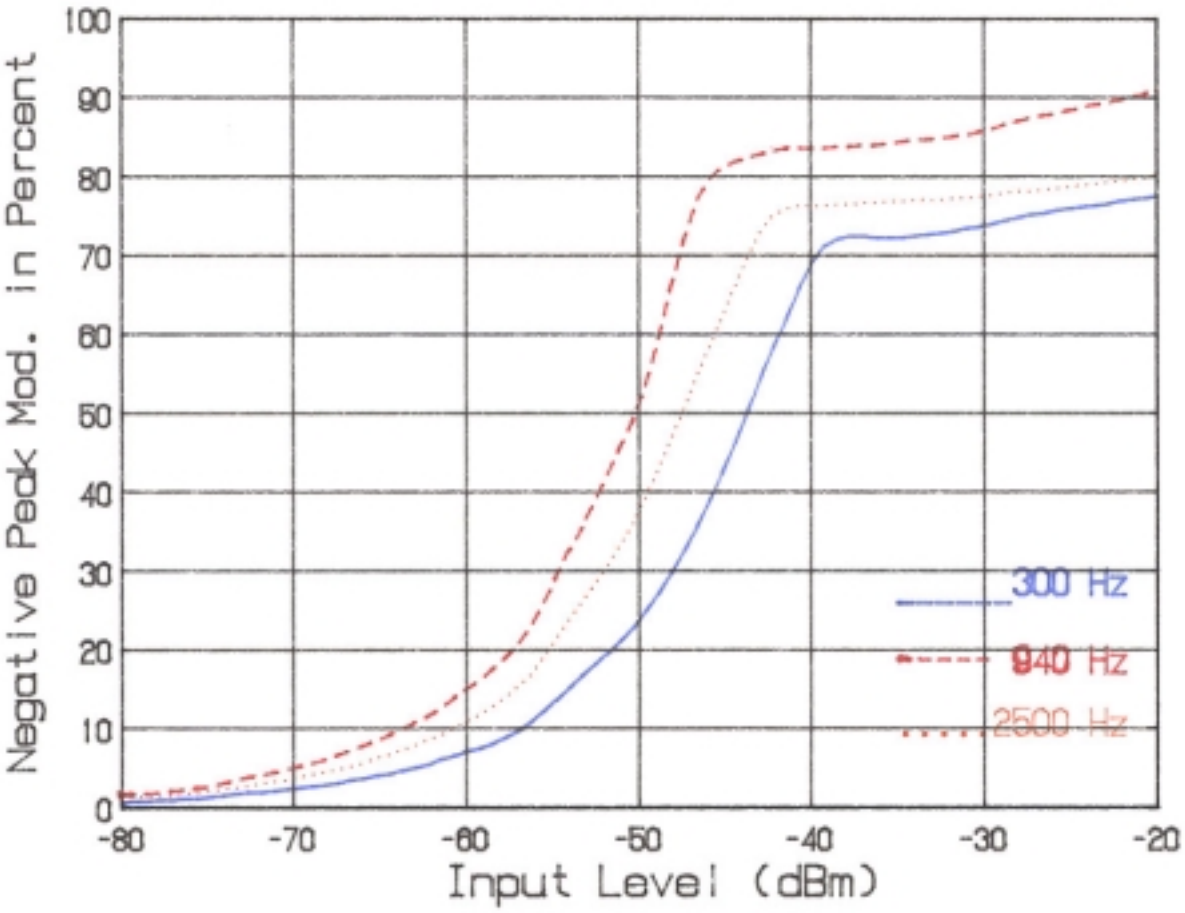
MODULATION LIMITING POSITIVE PEAKS
FCC ID: BBO19DXIII

FIGURE 2a



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, 940 Hz, and 2500 Hz tones.

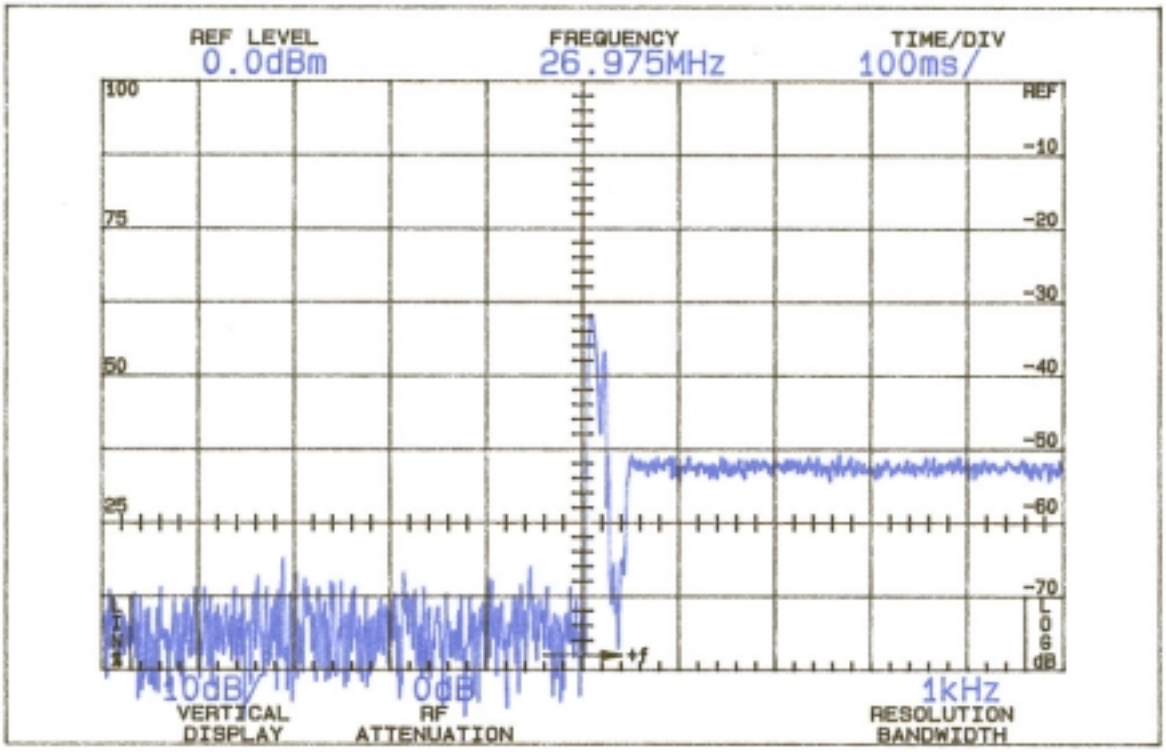
MODULATION LIMITING NEGATIVE PEAKS
FCC ID: BBO19DXIII

FIGURE 2b



FIGURE 3a

MODULATION LIMITER ATTACK TIME



Measurement_Conditions: 16 dB over 50% modulation level at 940 Hz with 2500 Hz tone, upper fourth order sideband; horizontal scale 100 ms/div.

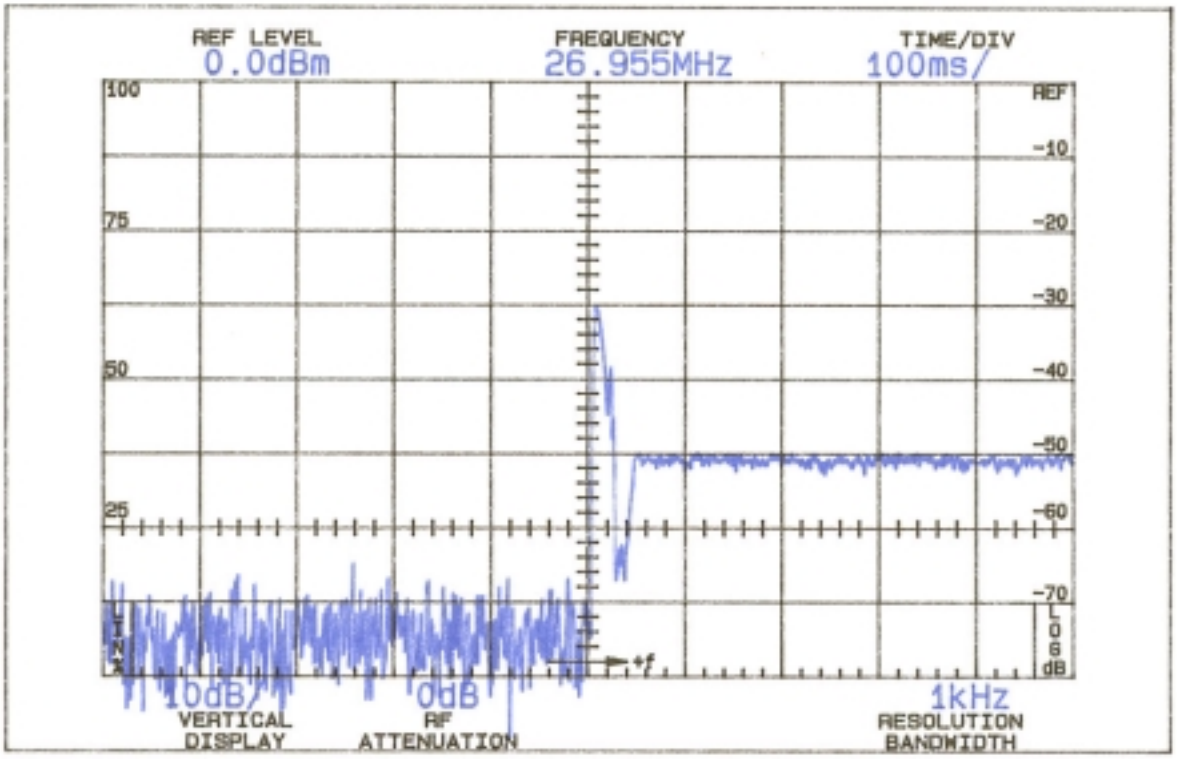
UPPER FOURTH-ORDER SIDEBAND
LIMITER ATTACK TIME
FCC ID: BBO19DXIII

FIGURE 3a



FIGURE 3b

MODULATION LIMITER ATTACK TIME



Measurement_Conditions: 16 dB over 50% modulation level at 940 Hz with 2500 Hz tone, lower fourth order sideband; horizontal scale 100 ms/div.

LOWER FOURTH-ORDER SIDEBAND
LIMITER ATTACK TIME
FCC ID: BBO19DXIII

FIGURE 3b



C. MODULATION CHARACTERISTICS (Continued)

4. Occupied_Bandwidth_-_AM
(Paragraph 2.989(c) of the Rules)

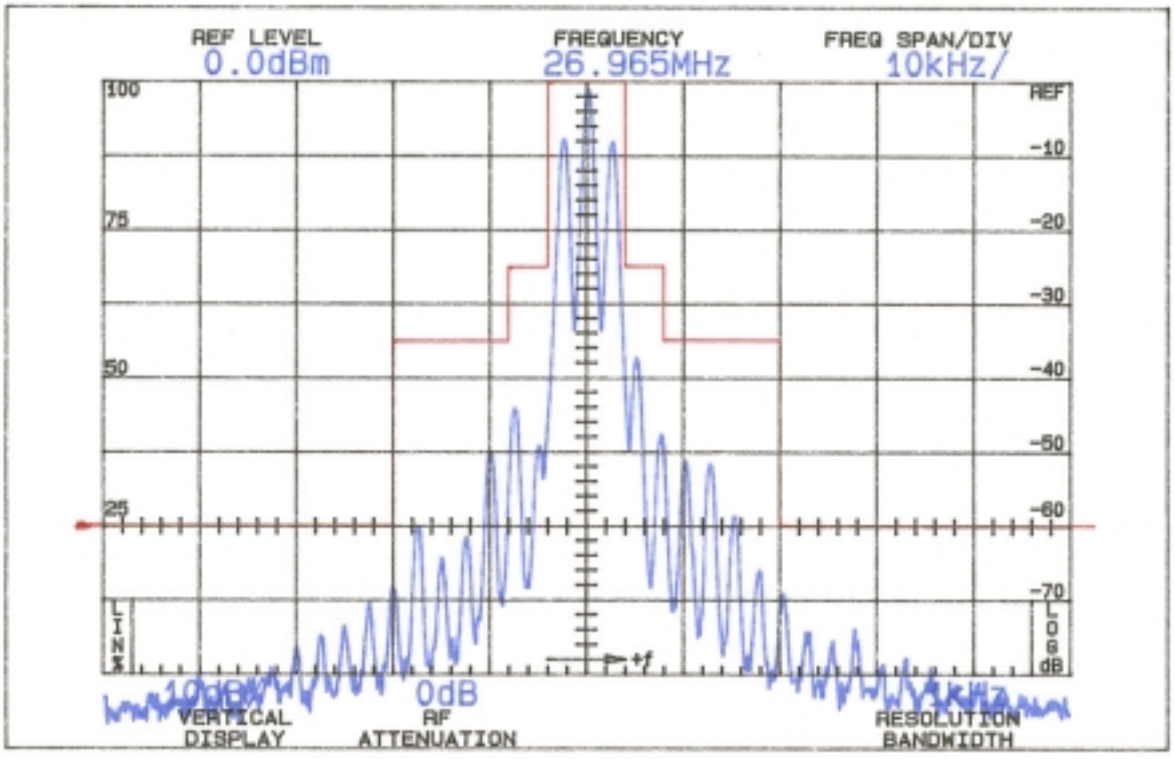
Figure 4 is a plot of the sideband envelope of the transmitter taken from a Tektronix 494P spectrum analyzer. Modulation corresponded to conditions of 2.989(a) and consisted of 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 940 Hz, the frequency of maximum response. Measured modulation under these conditions was 86% positive, 88% negative.

The plot is 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.**

FIGURE 4

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: BBO19DXIII

FIGURE 4



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

The 19DX-III transmitter was tested in the AM mode for spurious emissions at the antenna terminals while the equipnment was modulated with a 2500 Hz signal, 16 dB above minimum input signal for 50% modulation at 940 Hz, the frequency of highest sensitivity.

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 attenuation at the second harmonic and higher 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 10.24 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. |
|---|---|---|
| 1 | 53.930 | 62 |
| 1 | 80.895 | 70 |
| 1 | 107.860 | 67 |
| 1 | 134.825 | 72 |
| 1 | 161.790 | 66 |
| 1 | 188.755 | 73 |
| 1 | 215.720 | 76 |
| 1 | 242.685 | 73 |
| 1 | 269.650 | 67 |
| 21 | 54.430 | 65 |
| 21 | 81.645 | 70 |

| | | |
|---|---|---|
| 21 | 108.860 | 67 |
| 21 | 136.075 | 74 |
| 21 | 163.290 | 68 |
| 21 | 190.505 | 71 |
| 21 | 217.720 | 76 |
| 21 | 244.935 | 79 |
| 21 | 272.150 | 67 |
| | | |
| 40 | 54.810 | 67 |
| 40 | 82.215 | 70 |
| 40 | 109.620 | 67 |
| 40 | 137.025 | 74 |
| 40 | 164.430 | 70 |
| 40 | 191.835 | 71 |
| 40 | 219.240 | 75 |
| 40 | 246.645 | 71 |
| 40 | 274.050 | 68 |
| | Required: | 60 |

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



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 19DX-III 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 3.7 watts. The supply voltage was 13.8 volts. The transmitter and test antennae were arranged according to OCE 42 to maximize pickup. The device has no accessory ports. Both vertical and horizontal test antenna polarization were employed.

Measurements were made from 10.24 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 3.7 watts, the output power of the transmitter according to the following relationship:*

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

R

where E = electric-field intensity in volts/meter

$P_t$ = transmitter power in watts

R = distance in meters

for this case $E = \frac{(49.2 \times 3.7)^{1/2}}{3} = 4.5$ V/m

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

4.5 volts/meter = $4.5 \times 10^6$ uV/m

dBu/m = 20 $\text{Log}_{10}(4.5 \times 10^6)$

= 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; 3.7 watts

| Frequency, MHz | dB Below Carrier Reference |
|---|---|
| 53.930 | 73H |
| 80.895 | 82V |
| 107.860 | 67H |
| 134.825 | 70H |
| 161.790 | 68V |
| 188.755 | 73H |
| 215.720 | 79H |
| 242.685 | 66H |

| | | |
|---|---|---|
| 269.650 | | 85V |
| Required: | | 60 |

V/H: Worst-case test ant. polarization.

Any unlisted spurious were more than 80 below carrier reference from 10.24 to 269.650 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.



G. FREQUENCY STABILITY (Continued)

TABLE 3

| Temperature | Output_Frequency,_MHz |
|---|---|
| -29.4 | 27.065016 |
| -20.1 | 27.065009 |
| - 9.8 | 27.065055 |
| 0.0 | 27.065069 |
| 9.8 | 27.065050 |
| 20.6 | 27.064988 |
| 29.8 | 27.064915 |
| 40.5 | 27.064851 |
| 50.0 | 27.064807 |

Maximum frequency error: 27.064807
27.065000
- .000193 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 | 27.064997 |
| 15.18 | 27.064995 |
| 14.49 | 27.064991 |
| 13.80 | 27.064988 |
| 13.11 | 27.064984 |
| 12.42 | 27.064981 |
| 11.73 | 27.064978 |

Maximum frequency error: 27.064978
27.065000
- .000022 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.



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

The 19DX-III meets the applicable provision of 95.665(a).

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

1. Primary power connection
2. Internal Microphone
3. RF output power connection
4. N/A
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 19DX-III 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 submitted as a separate exhibit.



## APPENDIX 1

## CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

All 40 channels of transmitting, and receiving, frequencies are provided by PLL (Phase Locked Loop) circuitry.

The purpose of the PLL is to provide a multiple number of frequencies from VCO (Voltage Controlled Oscillator) with quartz crystal accuracy and stability from on crystal oscillator reference frequency.

The reference crystal oscillator frequency is 10.24 MHz.

CIRCUITS AND DEVICES TO
STABILIZE FREQUENCY
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APPENDIX 1

APPENDIX 2

CIRCUITS FOR SUPPRESSION SPURIOUS RADIATION

The tuning circuit between frequency synthesizer and final amp Q704 and 4-stage "PI" network C718, C719, L711, C721, L712, C725, L725, L713 and C723 in the Q704 output circuit serve to suppress spurious radiation. This network serves to impedance match Q704 to the antenna and to reduce spurious content to acceptable levels in the frequency synthesizer.

CIRCUITS FOR LIMITING MODULATION

A portion of the modulating voltage is rectified by D402 which turns on IC401 attenuating the mic input. The resulting feedback loop keeps the modulation below 100 percent for inputs approximately 40 dB greater than that required to produce 50 percent modulation.

CIRCUITS FOR LIMITING POWER

During factory alignment, tuning is adjusted so that the actual power is from 3.6 to 3.9 watts. There are no other controls for adjusting power.

DEVICES AND CIRCUITS TO SUPPRESS SPURIOUS RADIATION AND LIMIT MODULATION
FCC ID: BBO19DXIII

APPENDIX 2