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ENGINEERING STATEMENT

For Type Certification of

MIDLAND CONSUMER RADIO

Model No: 75-503
FCC ID: MMA75503

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 Midland Consumer Radio to make type certification measurements on the 75-503 transceiver. These tests 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. The data verifies that the above mentioned transceiver meets FCC requirements and Type Certification is requested.



Rowland S. Johnson

Dated: February 24, 1999

A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the 75-503 transceiver in accordance with Part 2, Subpart J of the FCC Rules.

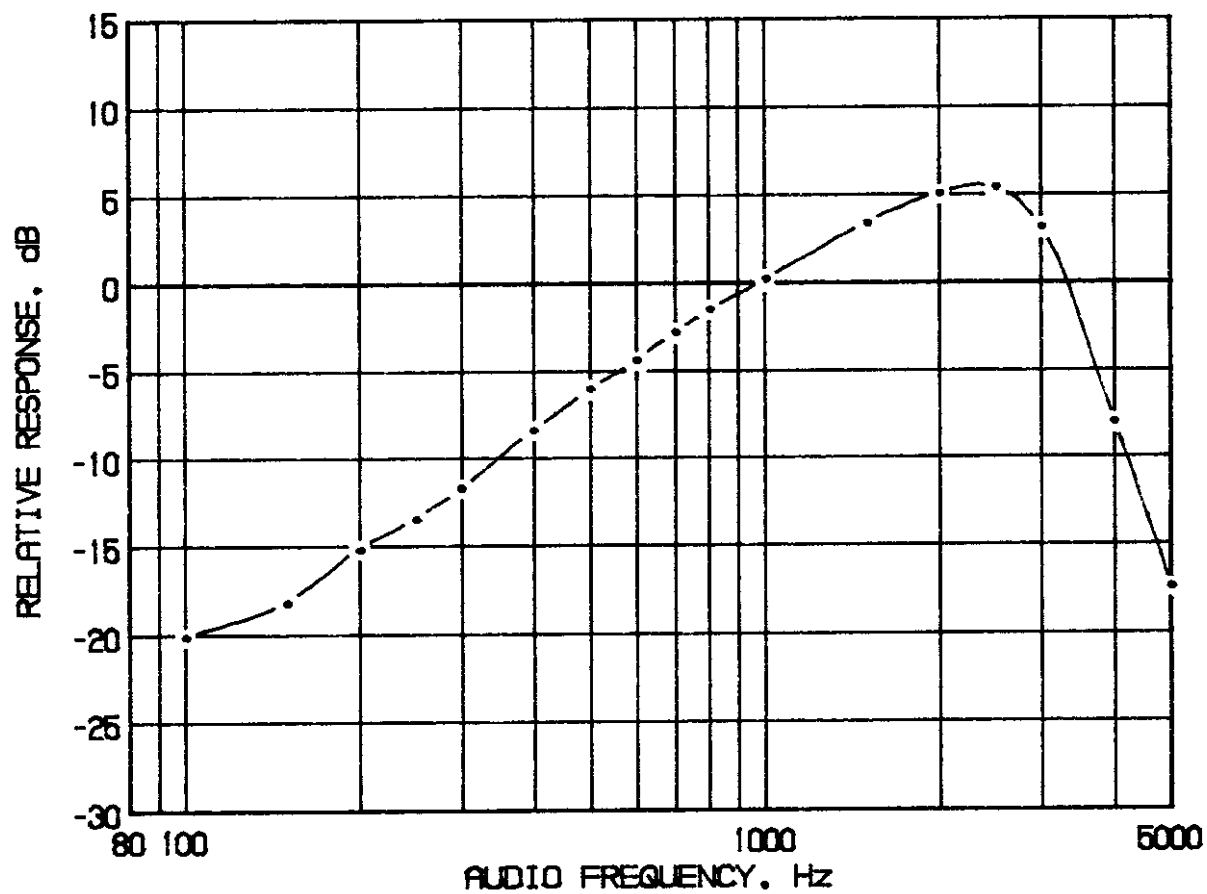
The 75-503 is a portable, battery operated, UHF, frequency modulated transceiver intended for 12.5 kHz channel family radio service applications in the 462.5625-467.7125 MHz band. It operates from a nominal 4.5 Vdc battery supply. Output power rating is 0.100 watts ERP.

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

1. Name of applicant: Midland Consumer Radio
2. Identification of equipment: FCC ID: MMA75503
 - 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. 11k0F3E emission
 - b. Frequency range: 462.5625 - 467.7125 MHz.
 - c. Operating power of transmitter is fixed at the factory at less than 0.5 W ERP.
 - d. Maximum power permitted is 0.5 watts, and the 75-503 fully complied with that power limitation.
 - e. The dc voltage and dc currents at final amplifier:

Collector voltage: 4.4 Vdc
Collector current: 0.21 A
 - f. Function of each active semiconductor device:
See Appendix 3.
 - g. Complete circuit diagram is included in 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.
5. Data for 2.985 through 2.997 follow this section.

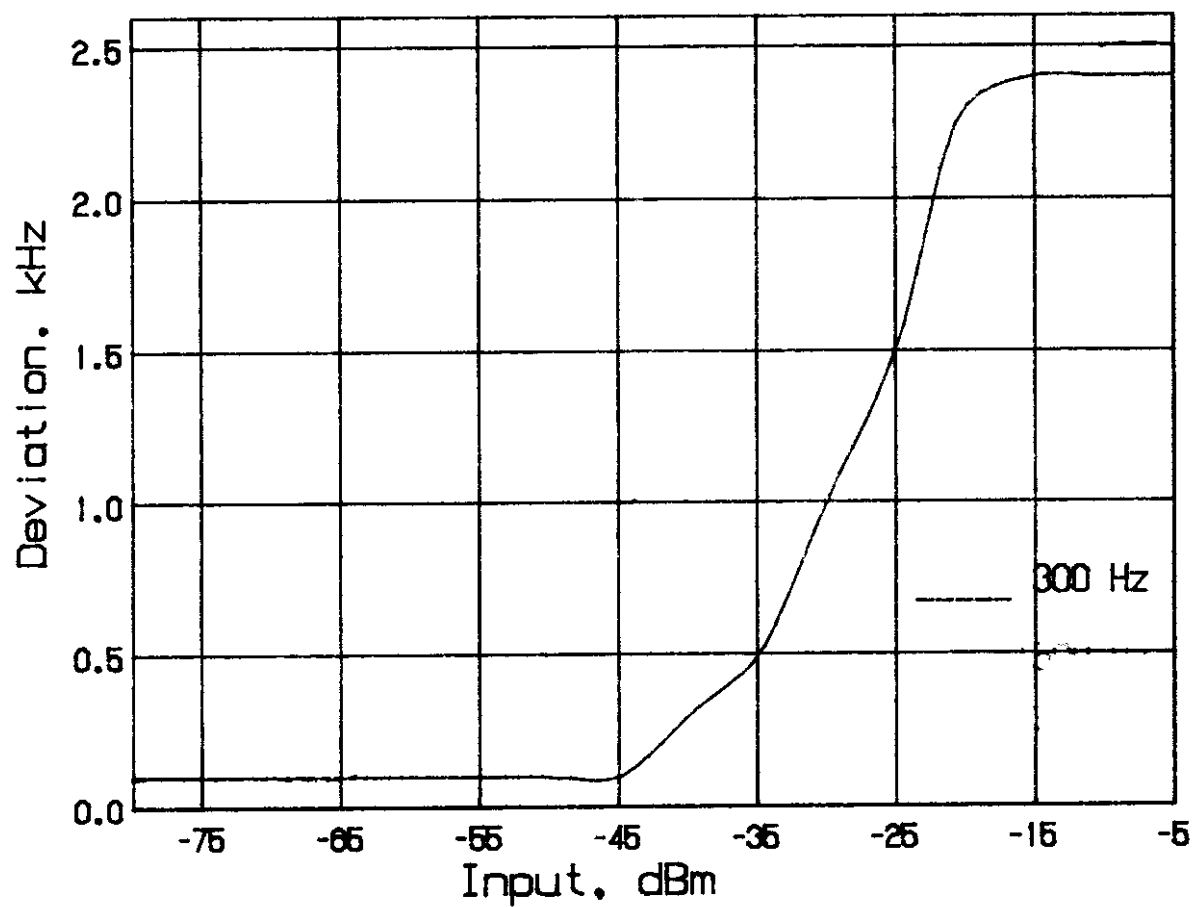
FIGURE 1
MODULATION FREQUENCY RESPONSE



MODULATION FREQUENCY RESPONSE
FCC ID: MMA75503

FIGURE 1

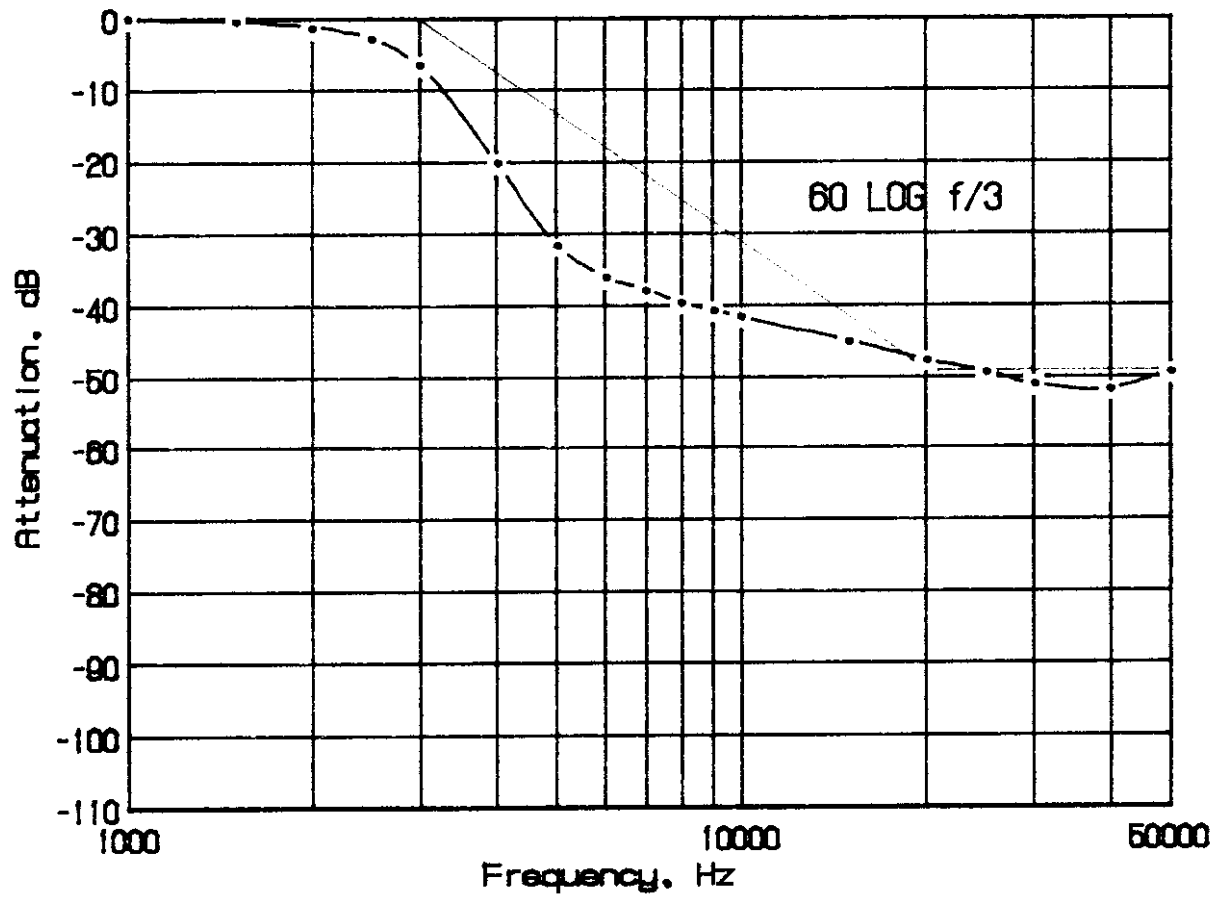
FIGURE 2
AUDIO LIMITER CHARACTERISTICS



AUDIO LIMITER CHARACTERISTICS
FCC ID: MMA75503

FIGURE 2

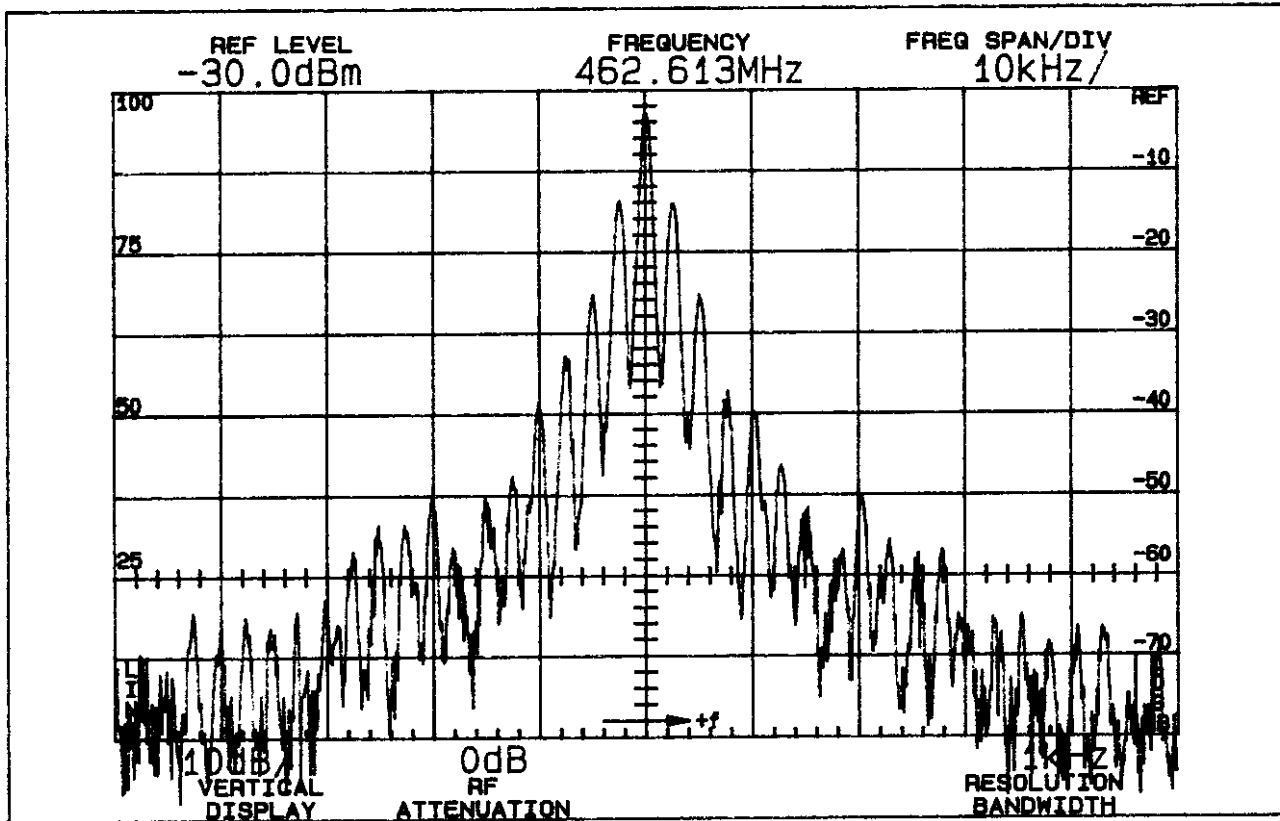
FIGURE 3
AUDIO LOW PASS FILTER RESPONSE



AUDIO LOW PASS FILTER
RESPONSE
FCC ID: MMA75503

FIGURE 3

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, 12.5 kHz
(6.25-12.5 kHz)

25

On any frequency more than 100%,
up to and including 250% of the
authorized bandwidth (12.5-31.25
kHz)

35

On any frequency removed from
the assigned frequency by more
than 250% of the authorized
bandwidth (over 31.25 kHz)

$$43 + 10 \log P = 33$$

$$(P = 0.092 \text{ W})$$

OCCUPIED BANDWIDTH
FCC ID: MMA75503

FIGURE 4

D. MODULATION CHARACTERISTICS (Continued)

The plots are within FCC limits. The horizontal scale (frequency) is 10 kHz per division and the vertical scale (amplitude) is a logarithmic presentation equal to 10 dB per division.

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

The 75-503 has a permanently attached antenna. There is no connector for an external antenna. Therefore, no antenna terminal conducted measurements were made.

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 was accepted for radiation measurements from 25 to 1000 MHz on October 1, 1976 and is currently listed as an accepted site.

G. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION

Field intensity measurements of radiated spurious emissions from the 75-503 were made with a Tektronix 494P spectrum analyzer using Singer DM-105 for the measurements to 1 GHz, and EMCO 3115 horn to 4.8 GHz.

The transmitter was 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 Vdc.

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 100 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

462.6125 MHz, 4.5 Vdc, 0.100 watts

<u>Spurious Frequency MHz</u>	<u>Radiated Field uV/m @ 3M</u>	<u>dB Below Carrier Reference</u> ¹
462.613	707945.8	0.0
925.226	13963.7	34.1V
1387.838	2555.6	48.9V
1850.451	2992.3	47.5H
2313.064	398.6	65.0V*
2775.677	4270.7	44.4H
3238.290	680.0	60.4H*
3700.902	959.4	57.4V*
4163.515	105.9	76.5V*
4626.128	54.3	82.3H*

Required: $43 + 10 \log(P) = 33$ ¹Worst-case polarization, H-Horizontal, V-Vertical.

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

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

Power Calculation:

$$\begin{aligned}
 P &= (FI \cdot 3)^2 / 49.2 \\
 &= (0.708 \cdot 3)^2 / 49.2 \\
 &= 0.092 \text{ W}
 \end{aligned}$$

H. FREQUENCY STABILITY
(Paragraph 2.995(a)(2))

Measurement of frequency stability versus temperature was made at temperatures from -20°C to $+50^{\circ}\text{C}$. 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 $\pm 2^{\circ}$ 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 -20°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 4.5 volts. Frequency was measured with a HP 5385A frequency counter connected to the transmitter through a power attenuator. Measurements were made at 462.6125 MHz. No transient keying effects were observed.

TABLE 3

FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE

462.6125 MHz, 4.5 Vdc, 0.100W

<u>Temperature, $^{\circ}\text{C}$</u>	<u>Output Frequency, MHz</u>	<u>P.P.M.</u>
-19.5	462.612589	0.2
- 9.8	462.612777	0.6
0.1	462.612912	0.9
10.4	462.612867	0.8
20.3	462.612551	0.1
30.1	462.612171	-0.7
40.2	462.612000	-1.1
49.7	462.612304	-0.4
Maximum frequency error:	462.612000 <u>462.612500</u>	
	- .000500 MHz	

FCC Rule 95.627(b) specifies .00025% (2.5 ppm) or a maximum of ± 0.001157 MHz, which corresponds to:

High Limit	462.613657 MHz
Low Limit	462.611343 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 $\pm 15\%$ above the nominal 4.5 volt rating to below the battery end point. 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

462.6125 MHz, 4.5 Vdc Nominal; 0.100W

<u>Supply Voltage</u>		<u>Output Frequency, MHz</u>	<u>P.P.M.</u>
5.17	115%	462.612564	0.1
4.95	110%	462.612563	0.1
4.73	105%	462.612557	0.1
4.50	100%	462.612551	0.1
4.28	95%	462.612544	0.1
4.05	90%	462.612541	0.1
3.83	85%	462.612539	0.1
3.60*	80%	462.612538	0.1
Maximum frequency error:		462.612564	
		<u>462.612500</u>	
		+ .000064 MHz	

FCC Rule 95.627(b) specifies .00025% (2.5 ppm) or a maximum of ± 0.001157 MHz, corresponding to:

High Limit	462.613657 MHz
Low Limit	462.611343 MHz

*Battery end point.

APPENDIX 1

EQUIPMENT IDENTIFICATION LABEL

SKETCH OF IDENTIFICATION LABEL
FOLLOWS THIS SHEET

(Label location is shown in photographs, Appendix 2)

EQUIPMENT IDENTIFICATION LABEL
FCC ID: MMA75503

APPENDIX 1