ENGINEERING STATEMENT

For Type Certification of

Midland Consumer Radio

Model No: 75-511
FCC ID: MMA75511

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 75-511 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: July 24, 2000

A. INTRODUCTION

The following data are submitted in connection with this

request for type certification of the 75-511 transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The 75-511 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. MFR rated output power is 0.5 watts ERP.

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

1. Name of applicant: Midland Consumer Radio

2. Identification of equipment: FCC ID: MMA75511

   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. 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 75-511 fully complied with that power limitation.
   e. The dc voltage and dc currents at final amplifier:

      Collector voltage: 4.3 Vdc
      Collector current: 0.50 A

   f. Function of each active semiconductor device: See Appendix 1.
   g. Complete schematic diagram is submitted as a separate exhibit.
   h. A draft instruction manual is submitted as a separate exhibit.
   i. The transmitter tune-up procedure is submitted as a separate exhibit.

   j. A description of circuits for stabilizing frequency is included in Appendix 2.
   k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in Appendix 3.
   l. Not applicable.

5. Data for 2.985 through 2.997 follow this section.

C. RF Power Output (Paragraph 2.985(a) of the Rules)

The 75-511 has a permanently attached built-in antenna without provisions for a coaxial connector.

Therefore RF power output was calculated, see Table 1. (The transmitter was tuned by the factory.

TABLE 1

Operating Freq., MHz	Power watts into a dipole antenna
462.5625	0.498

D. MODULATION CHARACTERISTICS

1. A curve showing frequency response of the transmitter is shown in Figure 1. Reference level was audio signal output from a Boonton 8220 modulation meter with one kHz deviation. Audio output was measured with an Audio Precision System One integrated test system.

2. Modulation limiting curves are shown in Figure 2, using a Boonton 8220 modulation meter. Signal level was established with a Audio Precision System One integrated test system. The curves show compliance with paragraphs 2.987(b).

3. Figure 3 is a graph of the post-limiter low pass filter which provides a roll-off of 60Logf/3 dB where f is audio frequency in kHz. Measurements were made following EIA RS-152B with an Audio Precision System One integrated test system on the Boonton 8220 modulation meter audio output.

4. Occupied Bandwidth
(Paragraphs 2.989(c) of the Rules)

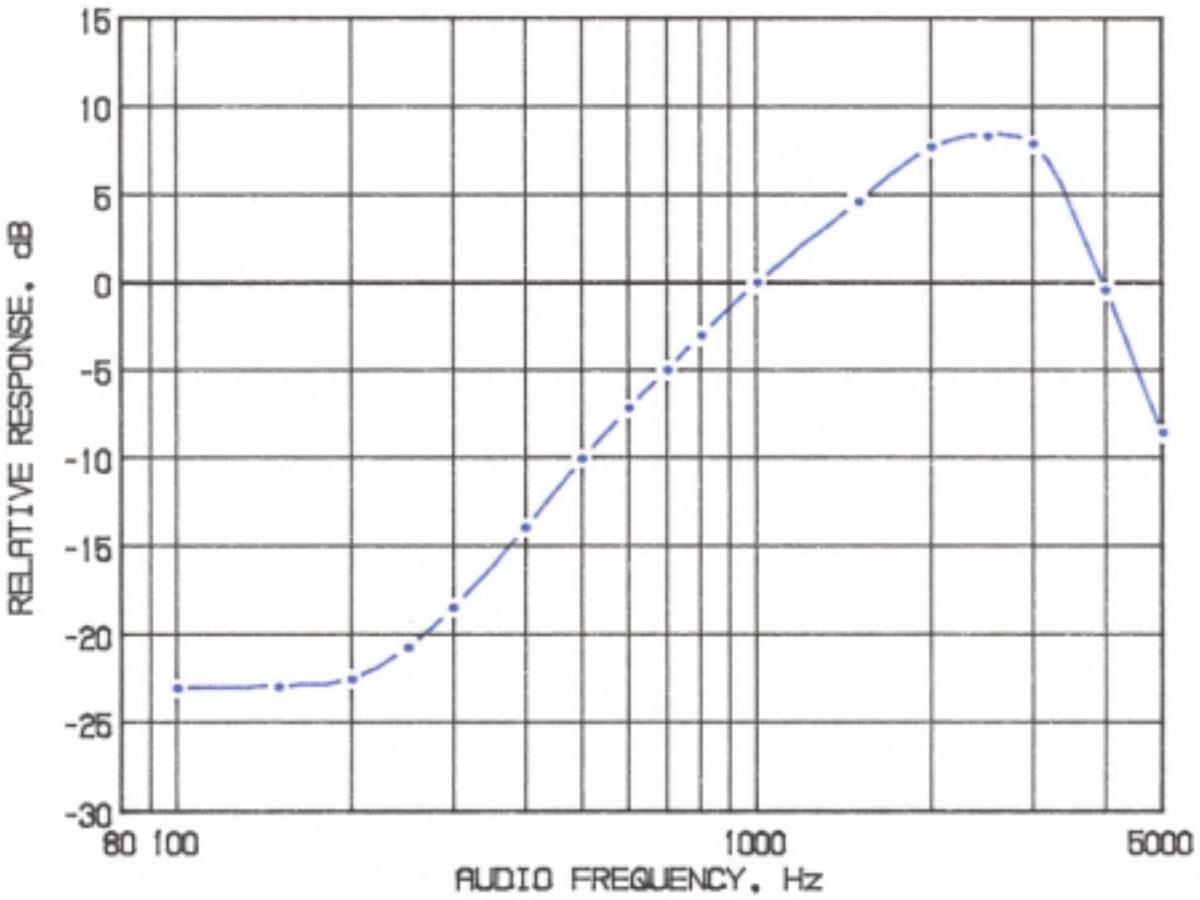
Figure 4 is a plot of the sideband envelope of the transmitter output taken with a Tektronix 494P spectrum analyzer. Modulation corresponded to conditions of 2.989(c)(1) and consisted of 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 2996 Hz, the frequency of maximum response. Measured modulation under these conditions was 2.4 kHz.

Emission designator:

(2M + 2D) (2 x 3 kHz) + (2 x 2.5 kHz) = 11k0F3E

FIGURE 1

MODULATION FREQUENCY RESPONSE



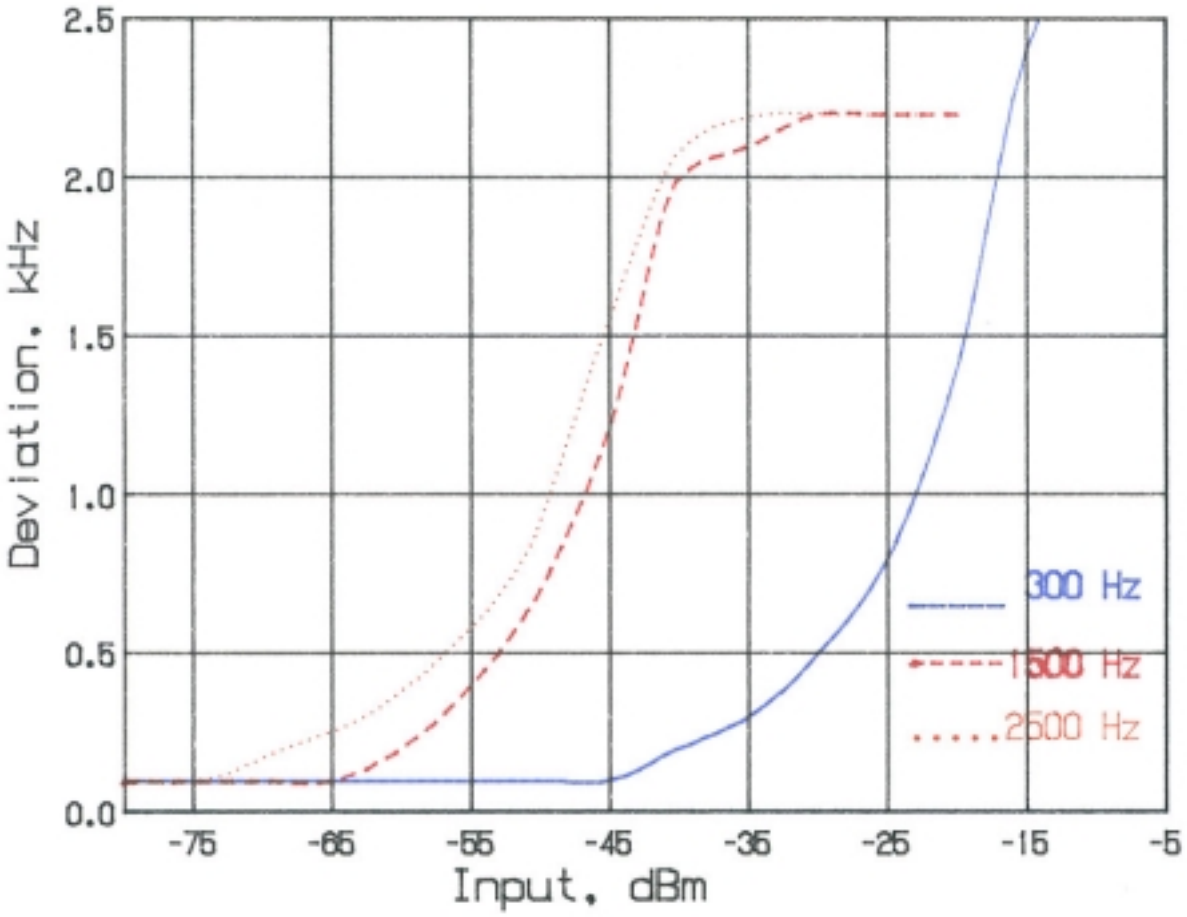
MODULATION FREQUENCY RESPONSE
FCC ID: MMA75511

FIGURE 1

5

FIGURE 2

AUDIO LIMITER CHARACTERISTICS

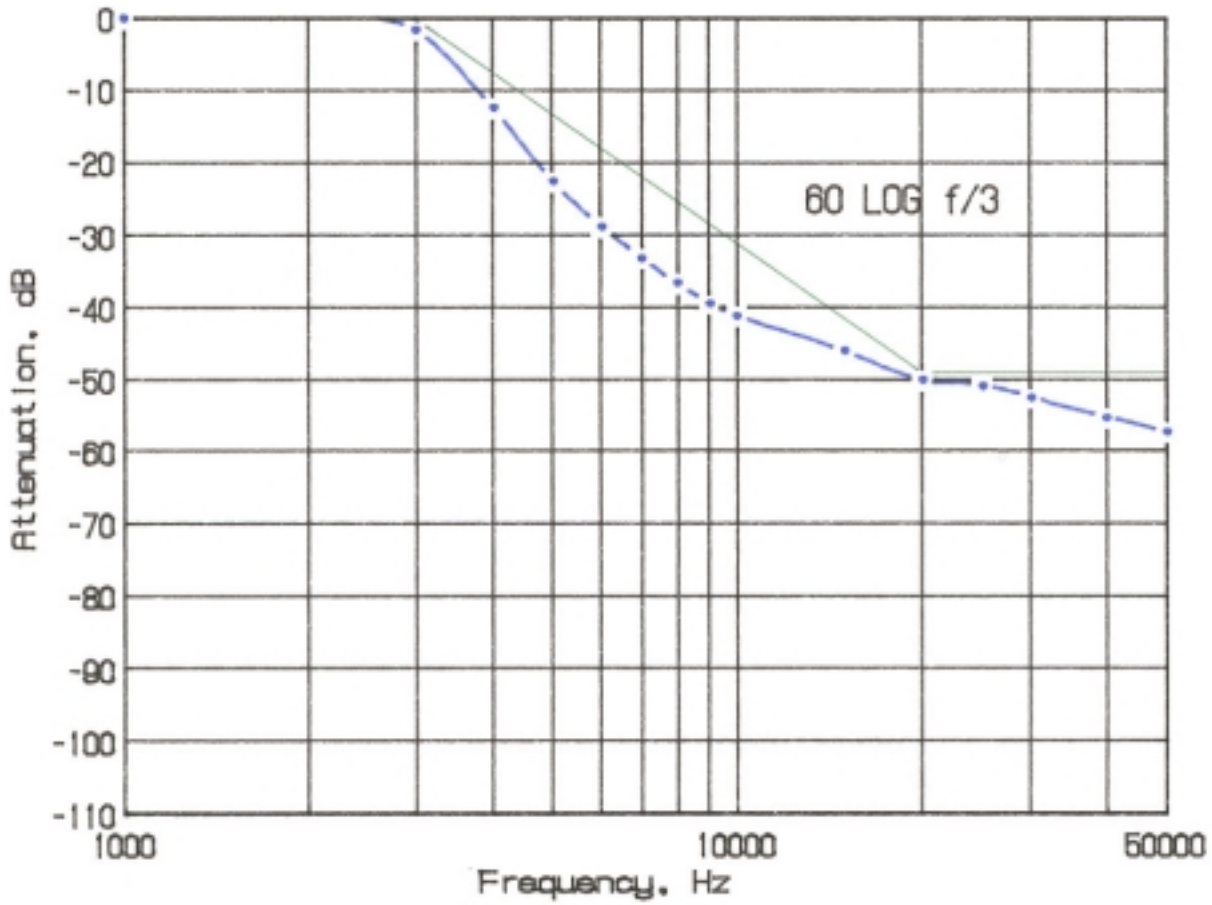


AUDIO LIMITER CHARACTERISTICS
FCC ID: MMA75511

FIGURE 2

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE

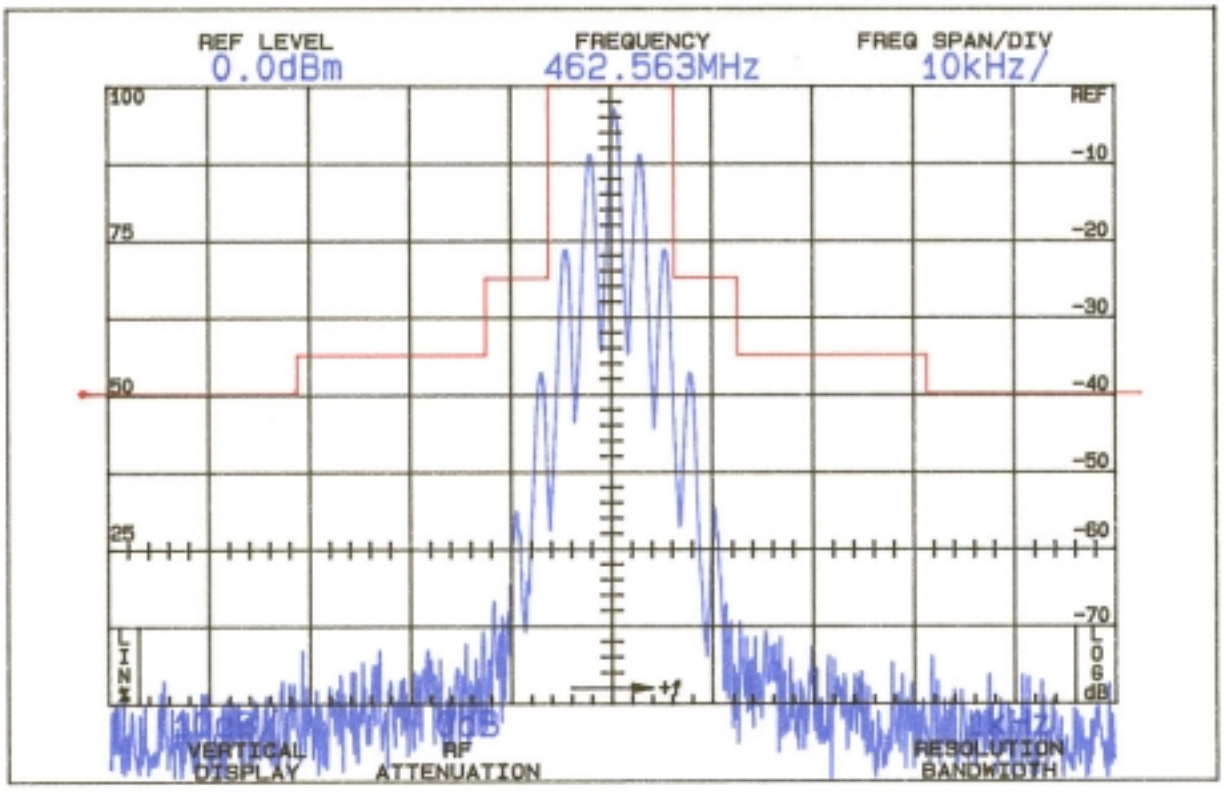


AUDIO LOW PASS FILTER
RESPONSE
FCC ID: MMA75511

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+10LogP = 40 (P = 0.498)

OCCUPIED BANDWIDTH
FCC ID: MMA75511

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 75-511 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 75-511 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 4.5 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 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

462.5625 MHz, 4.5 Vdc, 0.498 watts

Spurious Frequency	Radiated Field	dB Below Carrier

MHz	uV/m @ 3M	Reference[1]
462.563	1650061	0V
925.125	614	69V*
1387.688	281	75V*
1850.248	283	75H*
2312.809	1004	64V*
2775.371	120	83V*
3237.932	268	76H*
3700.494	299	75V*
4163.053	1018	64V*
4625.615	1123	63V*

Required: 43+10 Log(P) = 40

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

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

All other spurious from lowest frequency generated to the tenth harmonic were 20 dB or more below FCC limit.

Power:

$P = (F.I.x3)^2/49.2$

$= (1.650061)^2/49.2$

$= 0.498$ W

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

Measurement of frequency stability versus temperature was made at temperatures from -20°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 -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 462.5625 MHz. No transient keying effects were observed.

TABLE 3

FREQUENCY STABILITY AS A FUNCTION OF TEMPERATURE
462.5625 MHz, 4.5 Vdc, 0.498 W

Temperature, °C	Output Frequency, MHz	p.p.m.
-20.1	462.561457	-2.3
- 9.7	462.561576	-2.0
- 0.8	462.561959	-1.2
10.2	462.562555	0.1
20.8	462.562725	0.5
31.1	462.562314	-0.4
40.3	462.562119	-0.8
50.5	462.562548	0.1
Maximum frequency error:	462.561457	
	462.562500	
	- .001043 MHz	

FCC Rule 95.627(b) specifies .00025% (2.5 p.p.m.) or a maximum of ±0.001156 MHz, which corresponds to:

High Limit	462.563656 MHz
Low Limit	462.561344 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 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

462.5625 MHz, 4.5 Vdc Nominal; 0.498W

Supply_Voltage		Output_Frequency,_MHz	p.p.m.
5.17	115%	462.562820	0.7
4.95	110%	462.562768	0.6
4.73	105%	462.562742	0.5
4.50	100%	462.562725	0.5
4.28	95%	462.562726	0.5
4.05	90%	462.562735	0.5
3.83	85%	462.562750	0.5
3.60*	80%	462.562760	0.6

Maximum frequency error: 462.562820
462.562500

\+ .000320 MHz

FCC Rule 95.627(b) specifies .00025% (2.5 p.p.m. or a maximum of ±0.001156 MHz, corresponding to:

High Limit	462.563656 MHz
Low Limit	462.561344 MHz

*Battery end point.

APPENDIX 1

FUNCTION OF DEVICES
75-511

Q1	2SC4226	N.E.C	RX/TX VCO BUFFER
Q31	KRC104S	K.E.C	RX/TX VCO SWITCHING
Q32	2SC4226	N.E.C	O.S.C
Q33	2SC4226	N.E.C	BUFFER
QR1	2SC4226	N.E.C	RX RF AMP.
QR2	2SC4226	N.E.C	1'ST MIXER
QR3	KTC3880S	K.E.C	1'ST IF AMP.
QR5	KTC3875S	K.E.C	CTCSS DET.

QR6	KTA1504ST1(G)	K.E.C	AUDIO PATH SWITCH
QT1	2SC4226	N.E.C	TX BUFFER
QT2	2SC4226	N.E.C	TX POWER DRIVE AMP.
QT3	BLT70	PHILIPS	TX POWER FINAL AMP.
QT4	KRC104S	K.E.C	TX SWITCH
QS1	KRA105S	K.E.C	RX B+ SWITCHING
QS2	KRA105S	K.E.C	RX P/S SWITCHING
QS3	KRA105S	K.E.C	TX B+ SWITCHING
QS4	KRC104S	K.E.C	TX B+ SWITCHING
QS5	KRA105S	K.E.C	VOX OUT SWITCHING
QS6	KRA105S	K.E.C	LCD BACK LIGHT SWITCHING
QS7	KRA101S	K.E.C	PTT DETECTOR

IC1	DBL5018V	DAEWOO	2'ND MIXER,IF,AND FM DETECTOR
IC2	NJM2070	J.R.C	AUDIO POWER AMP.
IC3	KS57C21208	SAMSUNG	CPU
IC4	KB8825	SAMSUNG	PLL FREQUENCY SYSTHESIZER
IC5	TK71330	TOKO	REGULATOR
IC6	LM324	NATIONAL	PRE-EMPHASIS AND 300Hz HPF
IC7	24WC02J	HOLTEK	EEPROM
IC8	LM324	NATIONAL	CTCSS LOWPASS FILTER
IC9	LM324	NATIONAL	DE-EMPHASIS AND 300Hz HPF

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

SYNTHESIZER

A phase locked loop (PLL) circuit establishes and stabilizes operating frequency.

The data for producing necessary frequencies is established by the CPU on the digital board.

The frequency stability of the TX/RX is maintained by the TCXO, which generates a stable frequency of 21.25 MHz.

APPENDIX 3

CIRCUITS TO SUPPRESS SPURIOUS RADIATION
AND LIMIT MODULATION

Circuitry to Suppress Spurious Emissions

A low-pass filter with LT4, LT5 and LT7 attenuates harmonics.

Circuitry to Limit Modulation and Audio Low Pass Filter

The voice signal input from the microphone is pre-emphasized at IC6D and at IC6C so the voice signal does not exceed the allowable bandwidth assigned for transmission.

After limiter, IC6, the signal is combined with the CTCSS tone at the digital circuits, passes VR1, and is supplied to the 3 kHz LPF which has the 4^{th} order characteristics and adjusts the assigned frequency band width not to exceed the allowable range.