ENGINEERING STATEMENT

For Type Certification of

Midland Consumer Radio

Model No: 75-509
FCC ID: MMA75509

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 75-509 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.

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Rowland S. Johnson

Dated: March 22, 2000

A. INTRODUCTION

The following data are submitted in connection with this

request for type certification of the 75-509 transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The 75-509 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: MMA75509

   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 75-509 fully complied with that power limitation.
   e. The dc voltage and dc currents at final amplifier:

      Collector voltage: 4.3 Vdc
      Collector current: 0.52 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 75-509 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)

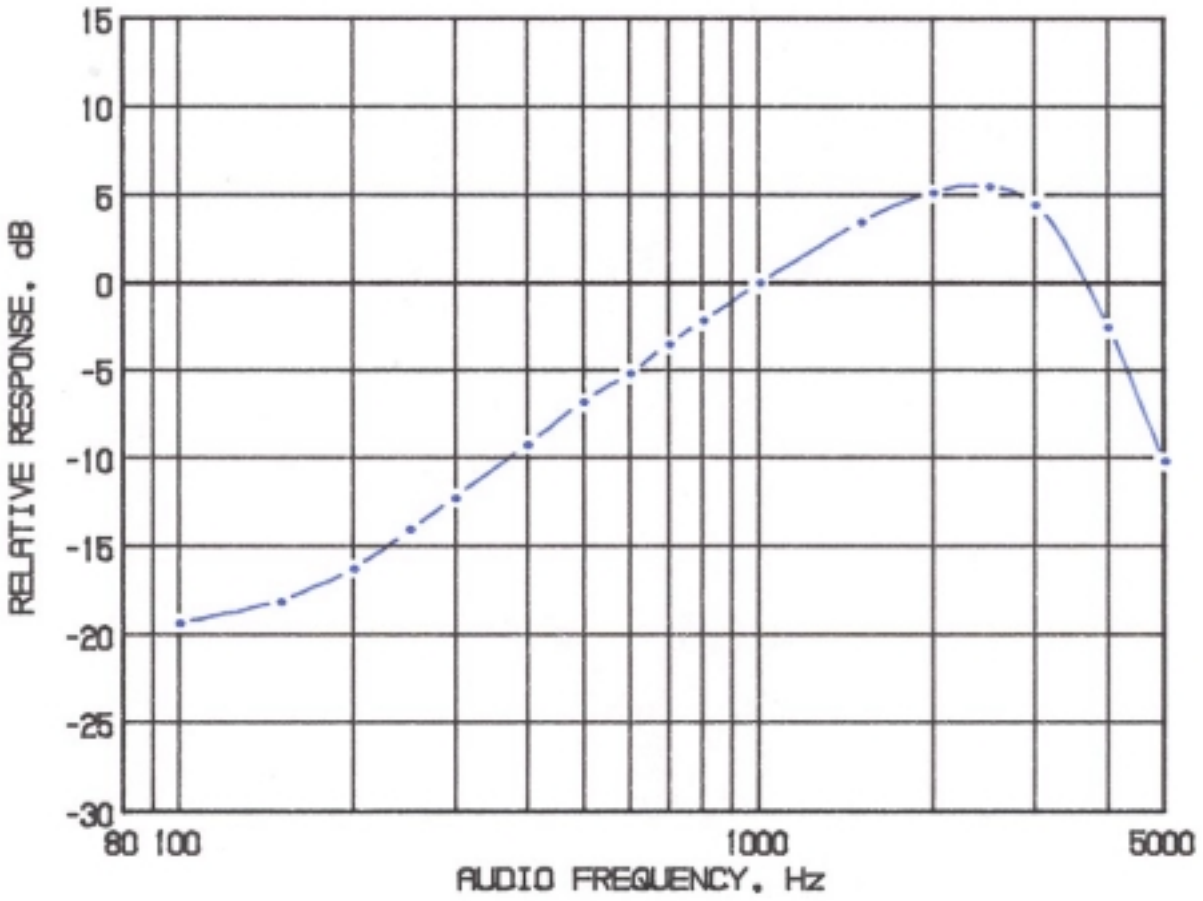
Figure 4 is a plot of the sideband envelope of the transmitter output taken with a Tektronix 494P spectrum analyzer. Modulation corresponded to conditions of 2.989(c)(1) and consisted of 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 2447 Hz, the frequency of maximum response. Measured modulation under these conditions was 2.3 kHz.

Emission designator:

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

FIGURE 1

MODULATION FREQUENCY RESPONSE

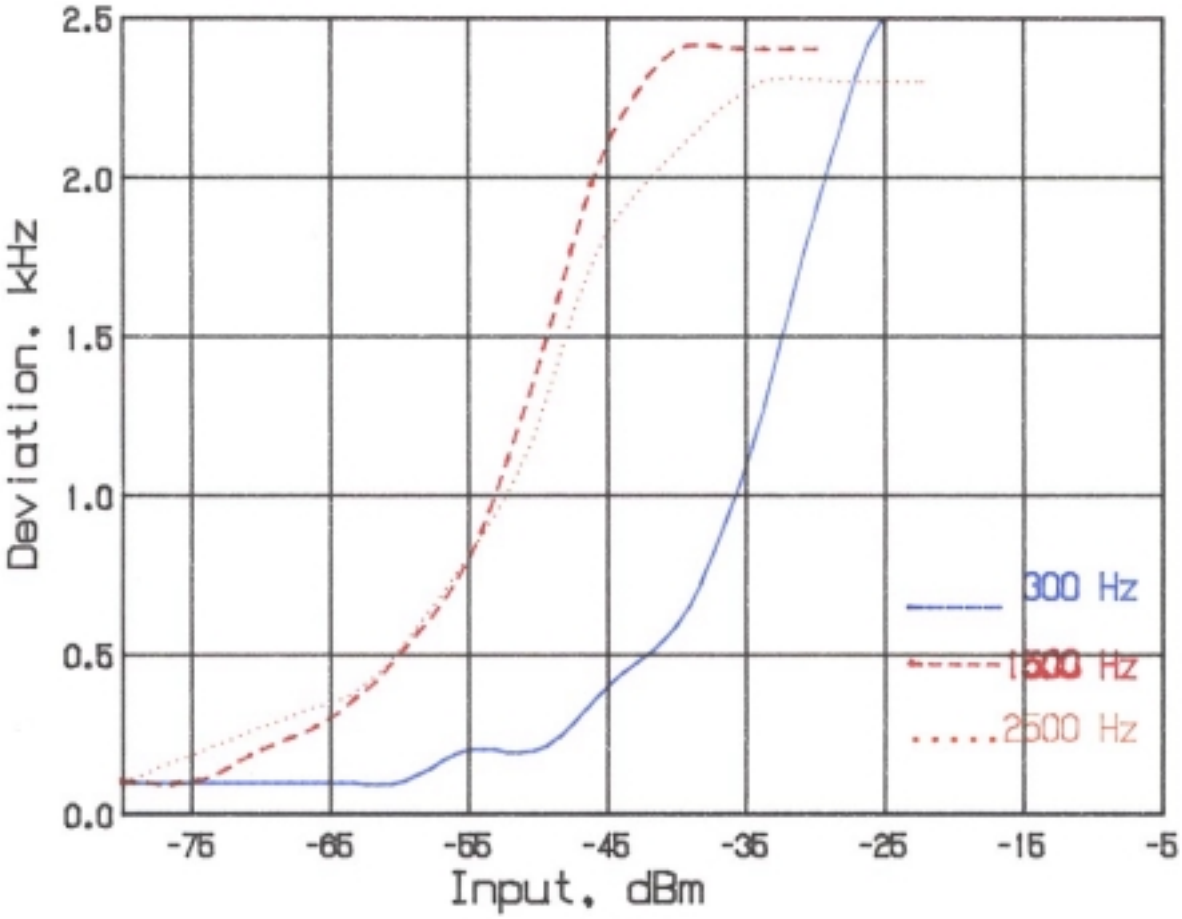


MODULATION FREQUENCY RESPONSE
FCC ID: MMA75509

FIGURE 1

FIGURE 2

AUDIO LIMITER CHARACTERISTICS



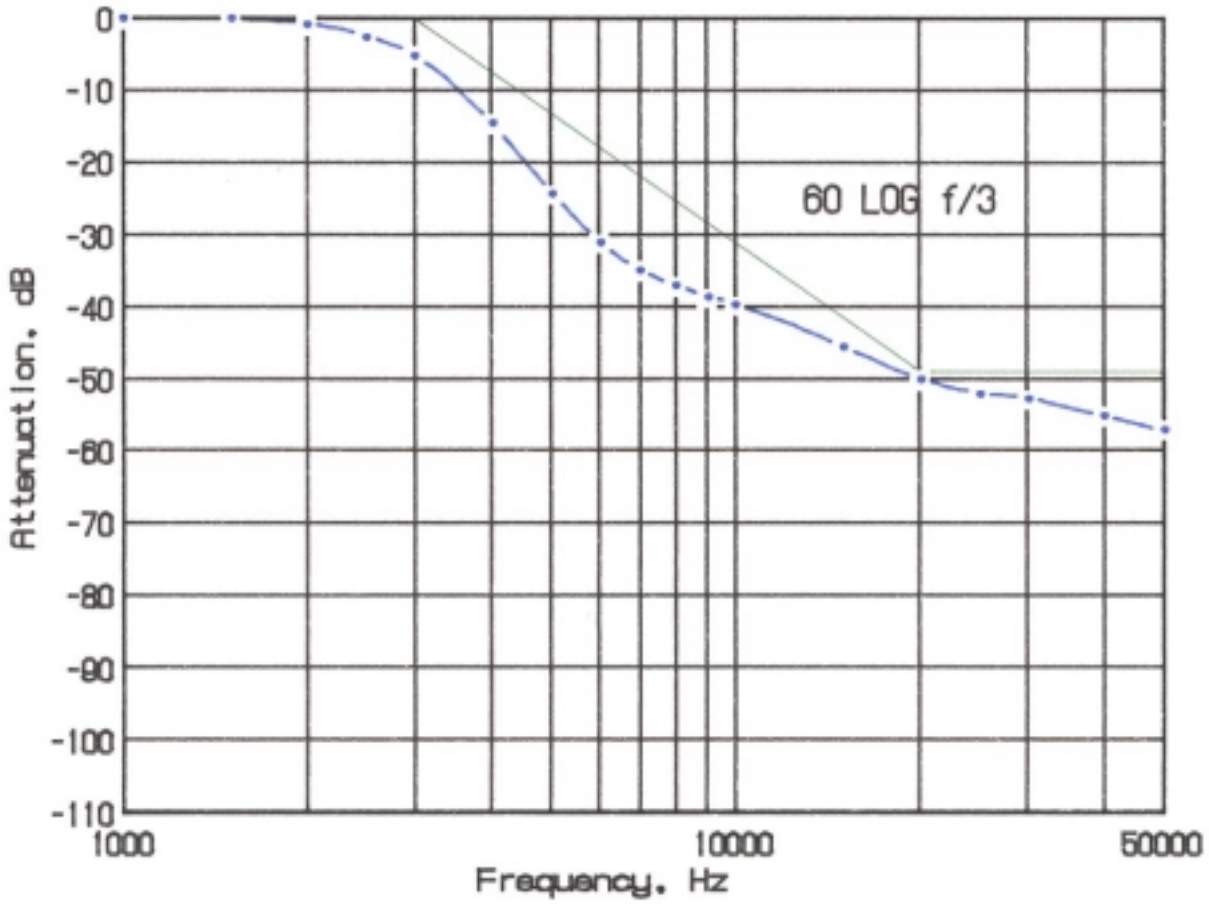
NOTE: Deviation at 300 Hz did not exceed 2.5 kHz.

AUDIO LIMITER CHARACTERISTICS
FCC ID: MMA75509

FIGURE 2
6

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE

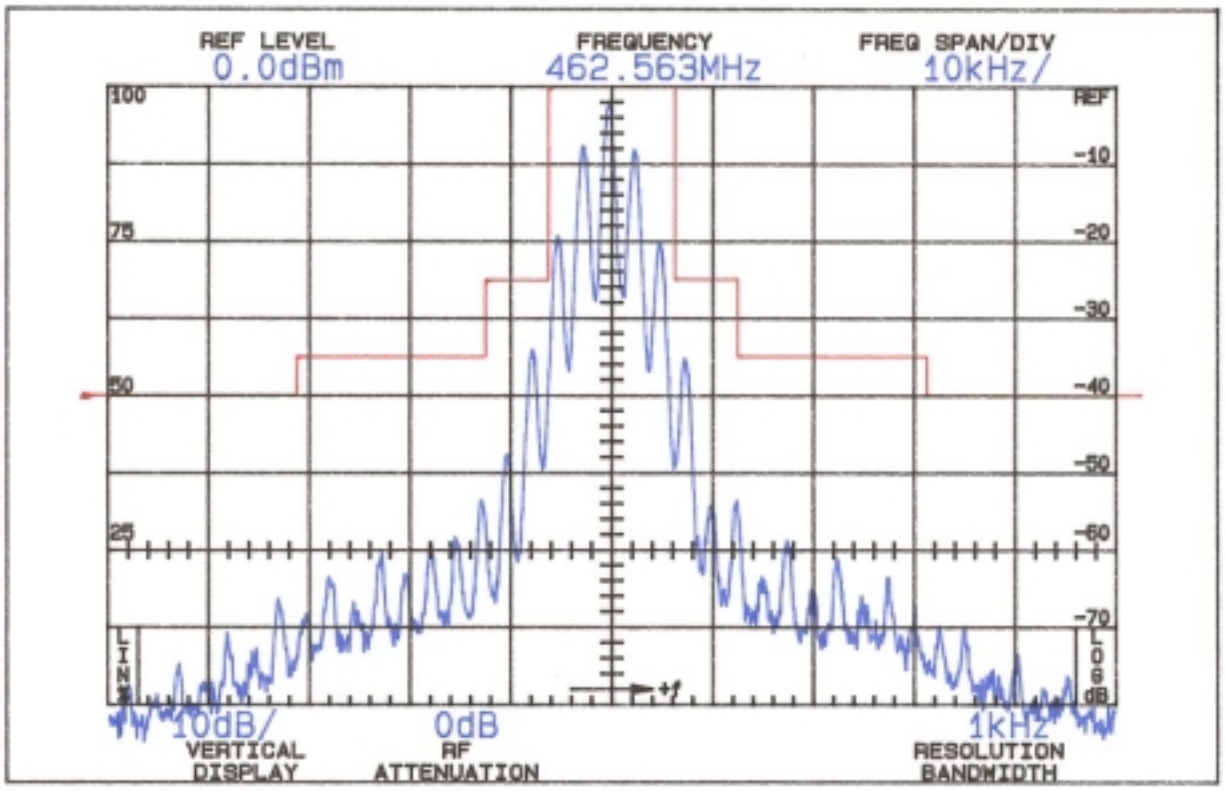


AUDIO LOW PASS FILTER
RESPONSE
FCC ID: MMA75509

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
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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 75-509 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 75-509 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 (21.25 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

462.5625 MHz, 4.5 Vdc, 0.498 watts

Spurious Frequency	Radiated Field	dB Below Carrier

MHz	uV/m @ 3M	Reference[1]
462.562	1650297	0V
925.176	1772	59V
1387.686	973	65V*
1850.250	745	67H*
2312.810	1264	62V*
2775.372	174	80H*
3237.936	223	77V*
3700.500	1248	62V*
4163.062	560	69H*
4625.622	934	65V*

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 21.25 MHz to the tenth harmonic were 20 dB or more below FCC limit.

Power:

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

$= (1.650297)^2/49.2$

$= 0.498$ 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.
-20.3	462.562293	-0.4
-10.7	462.562142	-0.8
- 0.6	462.563244	-0.6
10.1	462.562306	-0.4
20.8	462.562472	-0.1
30.1	462.562342	-0.3
41.3	462.562404	-0.2
51.2	462.562972	1.0

Maximum frequency error: 462.562972
462.562500

+ .000472 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%	462.562477	0.0
4.95	110%	462.562457	-0.1
4.73	105%	462.562457	-0.1
4.50	100%	462.562472	-0.1
4.28	95%	462.562494	0.0
4.05	90%	462.562517	0.0
3.83	85%	462.562535	0.1
3.60*	80%	462.562546	0.1

Maximum frequency error: 462.562546
462.562500

\+ .000046 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
75-509

Reference	Type	Function
QR1	2SC4226	RX RF AMP.
QR2	2SC422	1'ST MIXER
QR3	KTC388	1'ST IF AMP.
QR4	KRC110S	SQUELCH MUTE
QR5	KTC387	VOX AUDIO AMP.
QT1	2SC4226	TX BUFFER

QT2	2SC4226	TX POWER DRIVE AMP.
QT3	BFG135A	TX POWER FINAL AMP.
QT4	KRC104S	RX B+ SWITCHING AT TX
QS1	KRA105S	RX B+ SWITCHING
QS2	KRA105S	POWER SAVE CONTROL
QS3	KRA105S	TX B+ SWITCHING
QS4	KRC104S	TX B+ SWITCHING
QS5	KRA105S	MIC AMP B+ SWITCHING
QS6	KRA105S	BACK LIGHT LED SWITCHING
QS7	KRA101S	PTT SWITCHING
QS8	KRC104S	BACK LIGHT LED SWITCHING
Q31	KRC104S	RX/TX VCO SWITCHING
Q32	2SC4226	O.S.C
Q33	2SC4226	BUFFER
Q1	2SC4226	RX BUFFER

INTEGRATED CIRCUIT

IC1	DBL5018V	2^{ND} MIXER IF AND FM DETECTOR
IC2	NJM2070	AUDIO POWER AMP
IC3	KS88C21208	CPU
IC4	KB8825	PLL FREQUENCY SYNTHESIZER
IC6	DBL358	Audio Amp/Limiter/L.P. Filter

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.

CIRCUITS AND DEVICES TO
STABILIZE FREQUENCY
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APPENDIX 2

APPENDIX 3

CIRCUITS TO SUPPRESS SPURIOUS RADIATION
AND LIMIT MODULATION

Circuitry to Suppress Spurious Emissions

The transmitted signal of approximately 7 mW, combined at the Pll module is supplied to the base of the QT3 amplifier. The transmitted signal amplified to 0.5 W here passes the TX LPF of the 2^{nd} characteristic of the LT4 and the LT5, and RX/TX switching takes place by the DT2. After this, the signal is provided to the

antenna the TX LPF of the 1st characteristics, consisted of the LT6.

Circuitry to Limit Modulation and Audio Low Pass Filter

The voice signal input from the microphone is pre-emphasized at the IC06A. The signal, which comes out of the IC6B, is limited to a certain amplitude for the voice signal not to exceed the allowable bandwidth assigned for transmission.

CIRCUITS TO SUPPRESS SPURIOUS
RADIATION AND LIMIT MODULATION

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APPENDIX 3