ENGINEERING STATEMENT

For Type Certification of

MIDLAND CONSUMER RADIO

Model No: 75-445
FCC ID: MMA75445

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 75-445 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: October 19, 2000

A. INTRODUCTION

The following data are submitted in connection with this request for Type Certification of the 75-445 transceiver in

accordance with Part 2, Subpart J of the FCC Rules.

The 75-445 is a 12.5 kHz bandwidth, UHF, frequency modulated transceiver intended for hand-held, portable applications in the 464 - 469 MHz (itinerant) band. It operates from a 4.5-volt battery pack. Output power rating is 1 watt.

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

1. Name of applicant: Midland Consumer Radio

2. Identification of equipment: MMA75445

   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: 464-469 MHz. (See channel list Appendix 5.)
   c. Operating power of transmitter is fixed at the factory at 1 watt.
   d. Maximum power permitted under Part 90 of the FCC is 350 watts, and the 75-445 fully complied with those power limitations.
   e. The dc voltage and dc currents at final amplifier:
      Collector voltage: 4.4 Vdc
      Collector current: 0.5 A
   f. Function of each active semiconductor device: See Appendix 1.
   g. Complete circuit 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.

   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.

B. GENERAL INFORMATION...(Continued)

5. Data for 2.985 through 2.997 follow this section.

C. RF POWER OUTPUT (Paragraph 2.985(a) of the Rules)

RF power output was measured with a Bird 4421 RF power meter and a Narda 765-20 attenuator as a 50 ohm dummy load. Maximum conducted power measured was 0.86 watts. (The transmitter was tuned by the factory.) ERP(d) was 0.98 watts. (See Table 2.)

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 a Audio Precision System One TRMS voltmeter and tracking generator.

2. Modulation limiting curves are shown in Figure 2 for narrow channel operation using a Boonton 8220 modulation meter. Signal level was established with a Audio Precision System One TRMS voltmeter. The curves show compliance with paragraphs 2.987(b), and 90.211(c).

3. Figure 3 is a graph of the post-limiter low pass filter which meets the requirements of paragraph 90.211(d)(1) in providing 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 selective voltmeter on the Boonton 8220 modulation meter audio output.

4. Occupied Bandwidth
(Paragraphs 2.989(c), 90.209(b)(4) and 90.210(d) of the Rules)

Figure 4 is a plot of the sideband envelope of the transmitter taken with a Advantest R3361A 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 2890 Hz, the frequency of maximum response.

For the 12.5 kHz channelization, RBW was 100 Hz, VBW 100 Hz, max hold, multiple scan per 90.210(d)(4).

All plots have unmodulated carrier as 0 dBm reference.

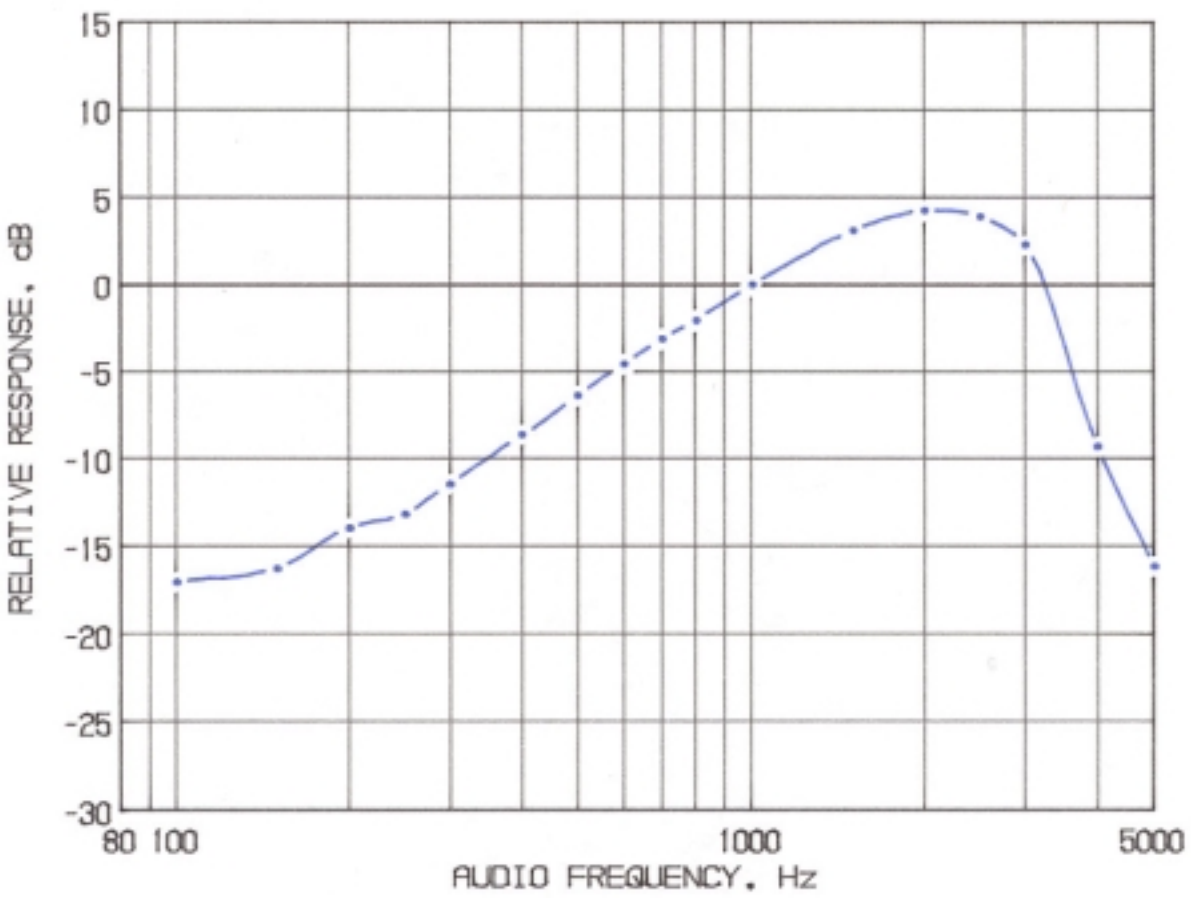
Emission designators: (2D + 2F)

12.5 kHz 2x2.5 + 2x3 = 11k0F3E

D = rated system deviation, kHz.
F = maximum audio frequency, kHz.

FIGURE 1

MODULATION FREQUENCY RESPONSE

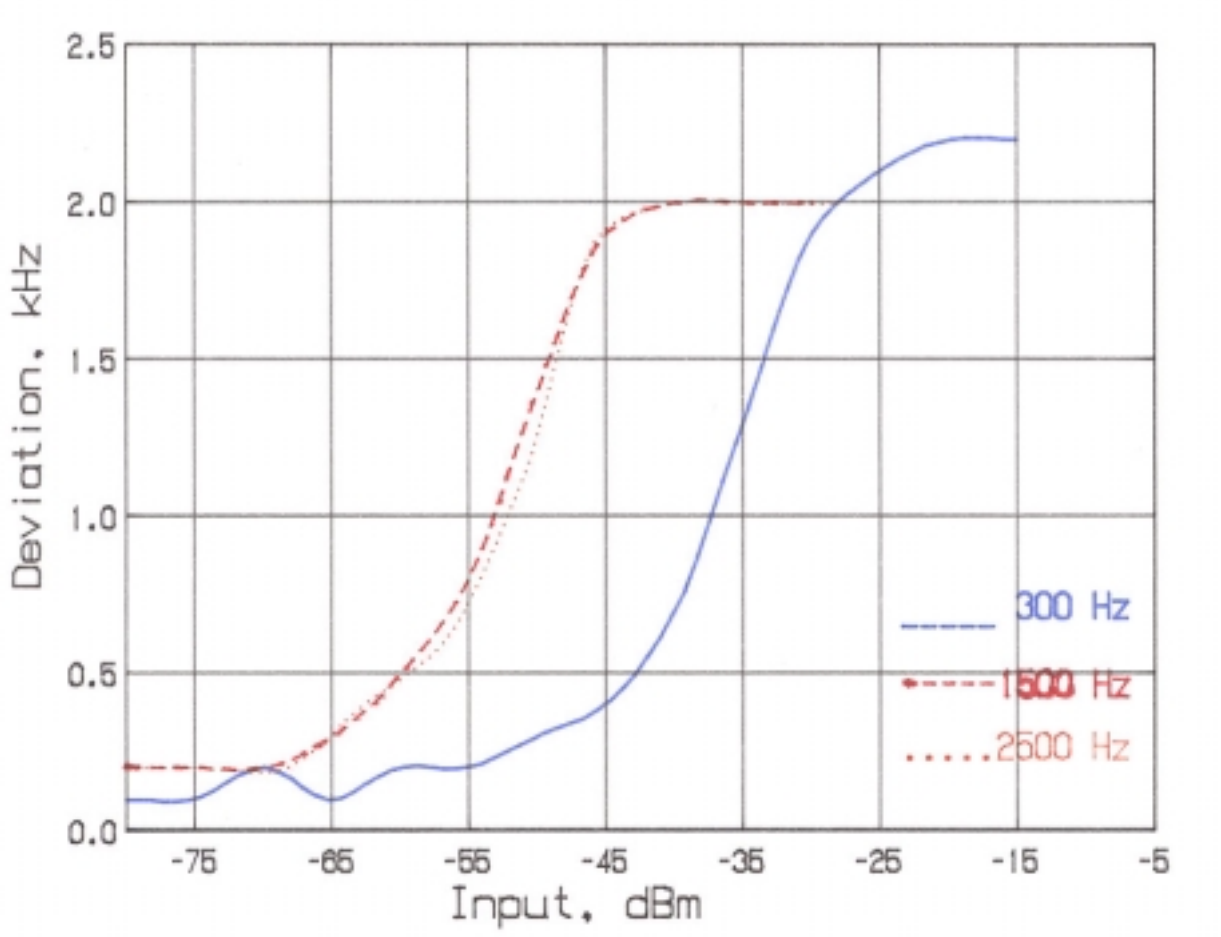


MODULATION FREQUENCY
RESPONSE
FCC ID: MMA75445

FIGURE 1

FIGURE 2

AUDIO LIMITER CHARACTERISTICS

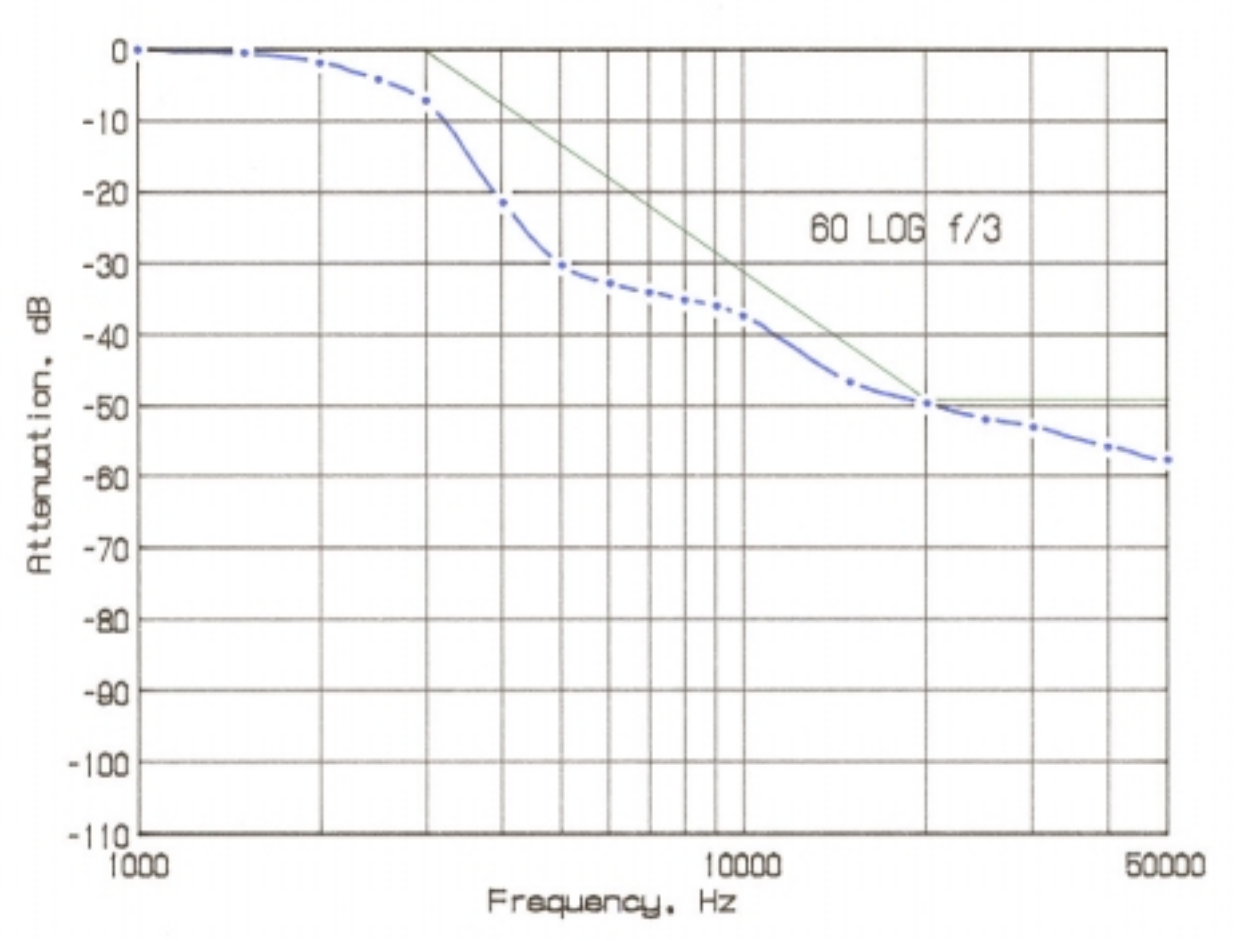


AUDIO LIMITER CHARACTERISTICS
FCC ID: MMA75445

FIGURE 2

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE

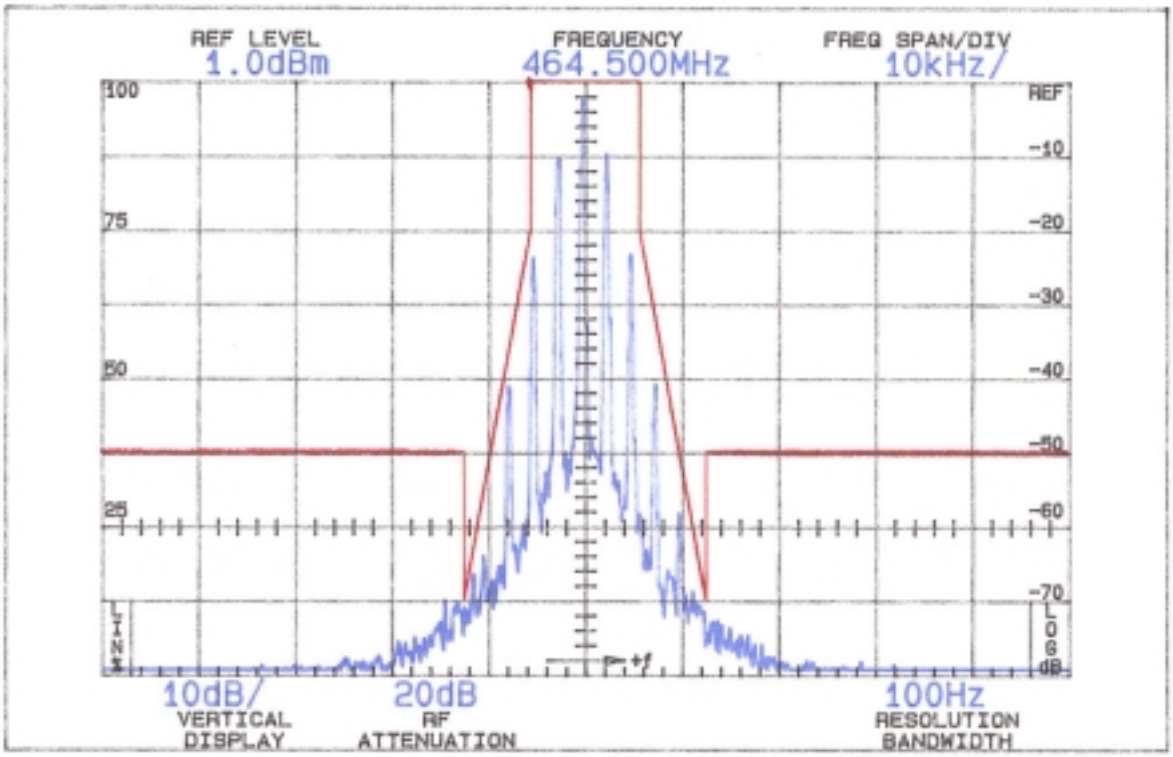


AUDIO LOW PASS FILTER RESPONSE
FCC ID: MMA75445

FIGURE 3

FIGURE 4

OCCUPIED BANDWIDTH



	ATTENUATION IN dB BELOW MEAN OUTPUT POWER Required
On any frequency from the center of the authorized bandwidth f_o to 5.625 kHz removed from f_o.	0 (>5.625 kHz)
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 5.625 kHz but no more than 12.5 kHz: at least 7.27 (f_d - 2.88 kHz) dB.	70 (@ 12.5 kHz)
On any frequency removed from the center of the authorized bandwidth by a displacement frequency (f_d in kHz) of more than 12.5 kHz.	50+10LogP = 50 (>12.5 kHz) (P = 0.98W)

OCCUPIED BANDWIDTH
FCC ID: MMA75445

FIGURE 4 (2.5 kHz)

D. MODULATION CHARACTERISTICS (Continued)

The plot is within the limits imposed by Paragraph 90.211(c) for frequency 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.

Resolution bandwidth was 100 Hz; video bandwidth 1 kHz; max store display; 20 second scan time.

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

The 75-445 transmitter was tested 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% (2.5 kHz deviation) modulation at 2890 Hz, the frequency of highest sensitivity.

Measurements were made with Tektronix 494P spectrum analyzer coupled to the transmitter output terminal through a Narda 765-20 power attenuator. A notch filter was used to attenuate the carrier.

During the tests, the transmitter was terminated in the 50 ohm attenuator. Power was monitored on a Bird 43 Thru-Line wattmeter; dc supply was 4.5 volts throughout the tests.

Spurious emissions were measured throughout the RF spectrum from 21.5 (lowest frequency generated in the transmitter) to the tenth harmonic of the carrier.

Any emissions that were between the required attenuation and the noise floor of the spectrum analyzer were recorded. Data are shown in Table 1.

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 meets ANSI 63.4-1992 and was accepted for radiation measurements from 25 to 1000 MHz on October 1, 1976 and is currently listed as an accepted site.

TABLE 1

TRANSMITTER CONDUCTED SPURIOUS
464.500, 4.5 Vdc Input

Spurious Frequency MHz	dB Below Carrier Reference

929.000	72	
1393.498	>100	
1857.997	92	
2322.496	>100	
2786.995	>100	
3251.494	>100	
3715.994	>100	
4180.493	>100	
4644.992	>100	
Required:	50	90.210(d)

All other emissions from 21.5 MHz to the tenth harmonic were 20 dB or more below FCC limit.

NOTE: Carrier notch filter used to increase dynamic range.

G. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION

Field intensity measurements of radiated spurious emissions from the 75-445 were made with a Tektronix 494P spectrum analyzer using Emco 3121 calibrated test antennas for the measurements to 1 GHz, and Emco 3115 horn from 1 GHz to 5 GHz.

The transmitter with the normally supplied antenna 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. Output power was 0.86 watts (conducted) at the 464.500 MHz operating frequency. The transmitter and test antenna were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed

TABLE 2

TRANSMITTER CABINET RADIATED SPURIOUS
464.500 MHz, 4.5 Vdc

Frequency MHz	Field Intensity uV/m @ 3 m	dB Below Carrier Reference
464.503	2317395	0
929.001	2570	59V
1393.502	1047	67V
1858.000	1413	64V
2322.499	1334	65H
2786.999	733	70V
3251.500	3090	57V
3752.996	2065	61H
4180.497	1097	66H
4644.997	288	78V*

Required: 50+10Log(0.98) = 50

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

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

All other spurious from 12.8 MHz to 4.7 GHz were 20 dB or more below FCC limit.

ERP (dipole):

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

$= (2.317395x3)^2/49.2$

$= 0.98$

H. FREQUENCY STABILITY
(Paragraph 2.995(a)(2) and 90.213 of the Rules)

Measurement of frequency stability versus temperature was made at temperatures from -30°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 -30°C.

A Thermotron S1.0 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 464.500 MHz. No transient keying effects were observed.

TABLE 3

FREQUENCY STABILITY vs. TEMPERATURE

464.500 MHz; 4.5 Vdc

Temperature, °C	Output Frequency, MHz	p.p.m.
-29.7	464.499988	0.0
-19.8	464.500488	1.1
-10.6	464.501092	2.4
0.5	464.501155	2.5
10.5	464.500681	1.5
20.3	464.499632	-0.8
29.6	464.499350	-1.4
40.1	464.499079	-2.0
50.0	464.499231	-1.7

Maximum frequency error: 464.501155
464.050000
+ .001155 MHz

FCC Rule 90.213(a) specifies .00025% or a maximum of ± .001161 MHz, which corresponds to:

High Limit	464.501161 MHz
Low Limit	464.498839 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. 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
464.500 MHz, 4.5 Volts Nominal

%	Supply Voltage	Output Frequency, MHz	p.p.m.
115	5.17	464.500541	1.2
110	4.95	464.500202	0.4
105	4.73	464.499871	-0.3
100	4.50	464.499632	-0.8
95	4.28	464.499473	-1.1
90	4.05	464.499377	-1.3

85	3.83	464.499320	-1.5
80	3.60*	464.499145	-1.8

Maximum frequency error: 464.499145
464.050000
- .000855 MHz

*MFR rated battery end-point

FCC Rule 90.213(a) specifies .00025% or a maximum of ± .001161 MHz, corresponding to:

High Limit	464.501161 MHz
Low Limit	464.498839 MHz

J. TRANSIENT FREQUENCY BEHAVIOR
(Paragraph 90.214 of the Rules)

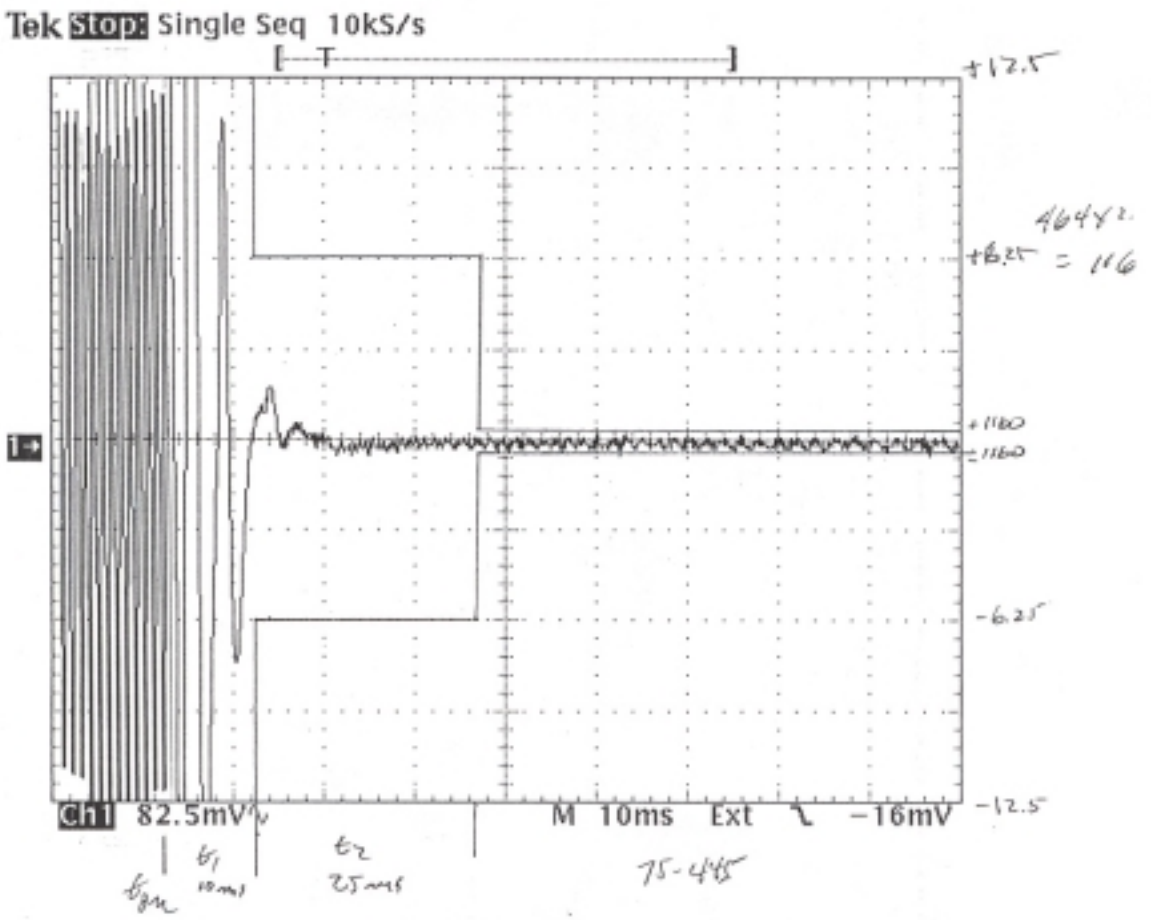
Plots identified as Figure 5 through 6 demonstrate TFB for 12.5 kHz channel operation.

See Appendix 4 for test description.

FIGURE 5

TRANSIENT FREQUENCY BEHAVIOR

12.5 kHz Turn On



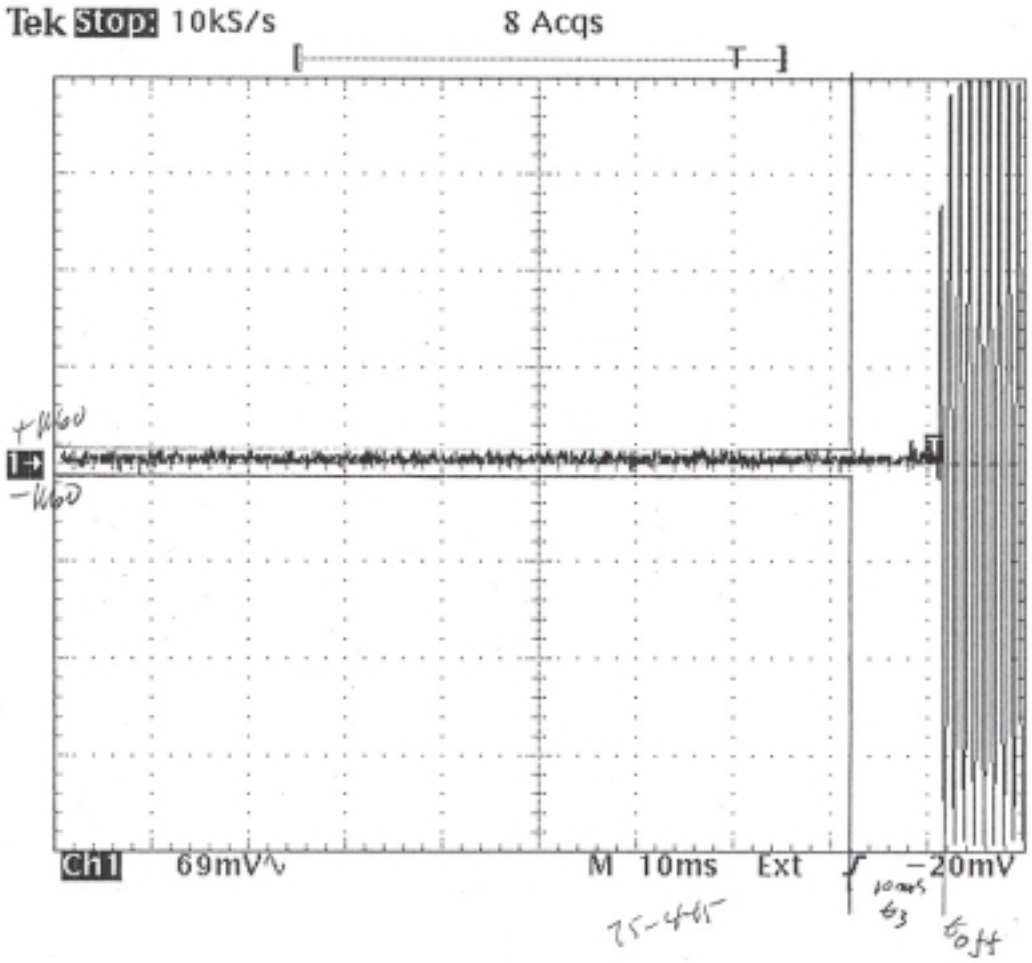
TRANSIENT FREQUENCY
BEHAVIOR
FCC ID: MMA75445

FIGURE 5 (Turn On)

FIGURE 6

TRANSIENT FREQUENCY BEHAVIOR

12.5 kHz Turn Off



TRANSIENT FREQUENCY
BEHAVIOR
FCC ID: MMA75455

FIGURE 6 (Turn Off)

APPENDIX 1

ΣΕΜΙΧΟΝΔΥΧΤΟΡΣ ΑΝΔ ΦΥΝΧΤΙΟΝΣ

ΘΣ2	ΚΡΑ105Σ	Κ.Ε.Χ	ΡΞ ΠΟΩΕΡ ΣΑçΕΙΝΓ ΣΩΙΤΧΗΙΝΓ
ΘΣ3	ΚΡΧ104Σ	Κ.Ε.Χ	ΤΞ ΣΩΙΤΧΗ
ΘΤ3	ΒΡΦ9482Τ1	ΜΟΤΟΡΟΛΑ	ΤΞ ΠΟΩΕΡ ΦΙΝΑΛ ΑΜΠ
ΘΧ1	ΚΡΧ104Σ	Κ.Ε.Χ	ΧΑΛΛ ΔΕΤ

ΘΣ4	KPX104Σ	K.E.X	TΞ ΣΩITXHINΓ
ΘΣ5	KPA105Σ	K.E.X	MIX B+ ΣΩITXH
ΘΣ8	KTX3875Σ	K.E.X	XTXΣΣ ΔET.
Θ1	2ΣX5084	TOΣHIBA	PΞ ΛOXAΛ OYTΠYT
Θ31	KPX104Σ	K.E.X	PΞ/TΞ ςXO ΣΩITXHINΓ
Θ32	2ΣX5084	TOΣHIBA	O.Σ.X
Θ33	2ΣX5084	TOΣHIBA	BYΦΦEP
ΘP1	2ΣX5084	TOΣHIBA	PΞ PΦ AMΠ
ΘP2	2ΣX5084	TOΣHIBA	1ɘΣT MIΞEP
ΘP3	KTX3880Σ	K.E.X	1ɘΣT IΦ AMΠ
ΘT1	2ΣX5084	TOΣHIBA	TΞ ΠOΩEP ΔPIςE AMΠ
ΘT2	2ΣX5084	TOΣHIBA	TΞ BYΦΦEP
ΘB1	KPA110Σ	K.E.X	ΛXΔ BAXK ΛIГHT ΣΩITXHINΓ
ΘP4	KTA1504	K.E.X	AYΔIO ΠATH ΣΩITXH
ΘΣ1	KPA105Σ	K.E.X	PΞ B+ ΣΩITXHINΓ
ΘΣ4	KPA105Σ	K.E.X	TΞ B+ ΣΩITXHINΓ
ΘΣ3	KPX104Σ	K.E.X	TΞ B+ ΣΩITXHINΓ
ΘΣ6	KPA101Σ	K.E.X	ΠTT ΔETEXTOP
ΘΣ7	KPX110Σ	K.E.X	ΔXΣ ΣΩITXHINΓ

IX9	24ΩX02ϑ	XATAΛΨST	EEΠPOM
IX8	MΣEΛΠ	NATIONAΛ	XTXΣΣ/ΔXΣ ΦIΛTEP
IX10	IΩ4053	INTEГPAΛ	ANAΛOГ ΣΩITXH
IX1	KA3361X	ΣAMΣYNГ	2ɘNΔ MIΞEP,IΦ,ANΔ
IX12	TB31202ΦN	TOΣHIBA	ΠΛΛ ΦPEΘYENXΨ ΣΨNTHEΣIZEP
IX7	TMΠ8721ΔΦ	TOΣHIBA	XΠY
IX4	TK11430	TOKO	PEГYΛATOP
IX3	NϑM2070	ϑ.P.X	AYΔIO ΠOΩEP AMΠ
IX2	KIA324Φ	K.E.X	ΠPE–EMΠHAΣIΣ ANΔ 300Hζ HΠΦ
IX11	KIA324Φ	K.E.X	ΔE–EMΠHAΣIΣ ANΔ 300Hζ HΠΦ
IX5	IΛ358	INTEГPAΛ	XAΛΛ–ΔET

FUNCTION OF DEVICES
FCC ID: MMA75445

APPENDIX 1

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

A 12.5 MHz referenced TCXO PLL circuit establishes and stabilizes output frequency.

CIRCUITS AND DEVICES TO
STABILIZE FREQUENCY
FCC ID: MMA75445

APPENDIX 2

APPENDIX 3

CIRCUITS TO SUPPRESS SPURIOUS RADIATION,
LIMIT MODULATION AND CONTROL POWER

CIRCUITS TO SUPPRESS SPURIOUS RADIATION

The transmitted signal of approximately 7 mW combined at the driver TR is supplied to the base of the QT3 amplifier. The transmitted signal amplified to 1.00 W here passes the TX LPF of

the 2nd 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 LT7.

CIRCUITS TO LIMIT MODULATION

The voice signal input from the microphone is pre-emphasized at the IC11D, and at the same time, the components below 300 Hz are reduced to minimize the influence to the CTCSS tone. The signal which come out of the IC11D is limited to a certain amplitude at the IC11C for the voice signal not to exceed the allowable bandwidth assigned for transmission.

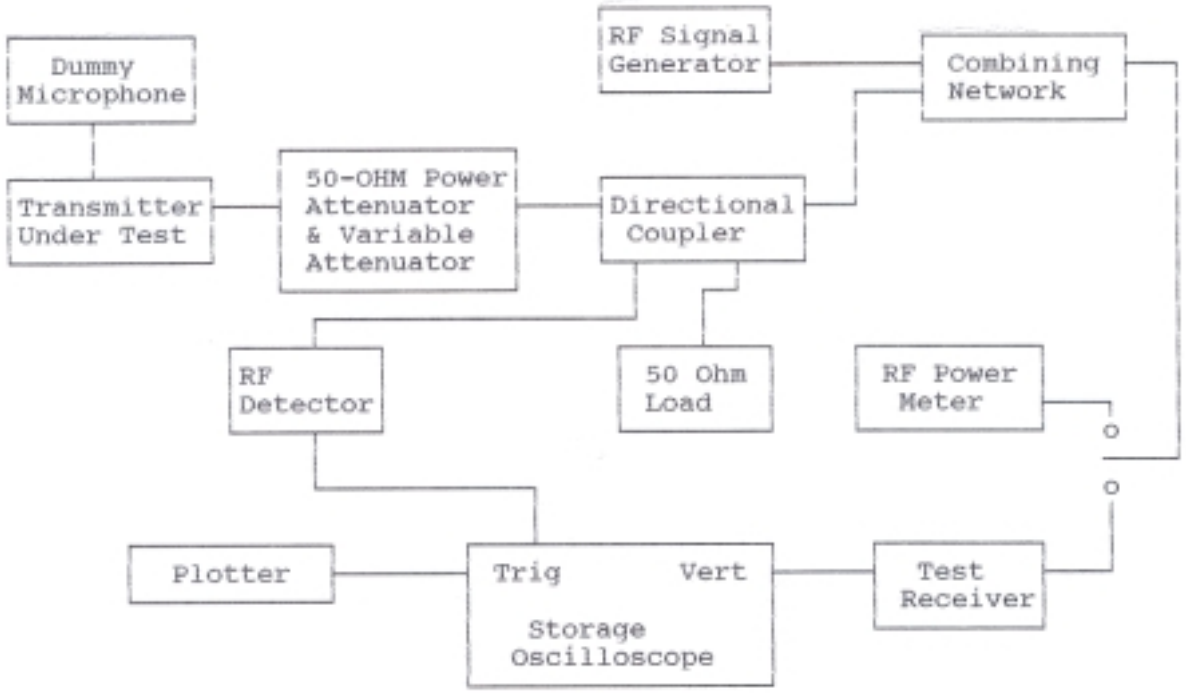
After passing the IC11C limiter, the signal is combined with the CTCSS tone at the digital circuits, passes the RV5, and is supplied to the 3 kHz LPF has the 4th characteristics and adjusts the assigned frequency band width not to exceed the allowable range.

APPENDIX 4

TRANSIENT FREQUENCY BEHAVIOR (90.214) TEST PROCEDURE

Para. 2.995(a)(b)(d) Frequency stability

90.214 Transient Frequency Behavior
(continued)



90.214 TRANSIENT FREQUENCY BEHAVIOR

REQUIREMENTS: In the 300 - 500 MHz frequency band, transient frequencies must be within the maximum frequency difference limits during the time interval indicated below for 25 kHz channels:

Time Interval	Maximum Frequency	Radios 300 - 500 MHz
t_1	±25.0 kHz	10.0 ms
t_2	±12.5 kHz	25.0 ms
t_3	±25.0 kHz	10.0 ms

End of t_2 to beginning of t_3: 2.5 ppm.

TEST PROCEDURE: TIA/EIA TS603, PARA. 2.219, the levels were set as follows:

1. Using the variable attenuator, the transmitter level was set to 40 dB below the test receivers maximum input level, then the transmitter was turned off.

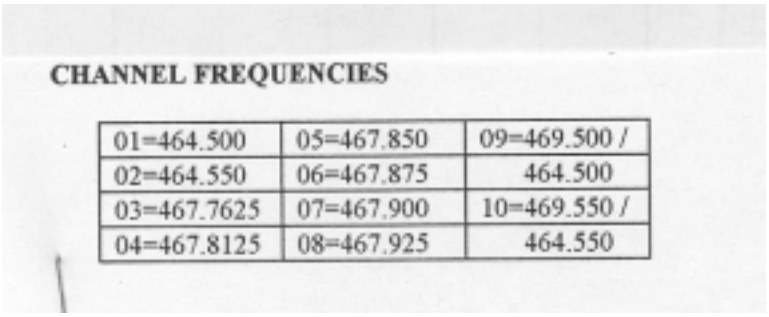
2. With the transmitter off, the signal generator was set 20 dB below the level of the transmitter in the above step (this level was maintained with the signal generator throughout the test).

3. Reduce the attenuation between the transmitter and the RF detector by 30 dB.

4. With the levels set as above the transient frequency behavior was observed & recorded.

APPENDIX 5

CHANNEL FREQUENCIES



CHANNEL FREQUENCIES

01=464.500	05=467.850	09=469.500 /
02=464.550	06=467.875	464.500
03=467.7625	07=467.900	10=469.550 /
04=467.8125	08=467.925	464.550