

A. INTRODUCTION

The following data are submitted in connection with this request for type acceptance of the G-9 transceiver in accordance with Section 2, of FCC Rules.

The G-9 is a hand-held, battery operated, UHF, frequency modulated, 1.4 W ERP(d) transceiver intended for voice communications applications in the 462.5500 - 462.7250 MHz band under Part 95 in the GMRS service.

B. GENERAL INFORMATION REQUIRED FOR TYPE ACCEPTANCE
(Section 2.1033 of the Rules)

1. Name of applicant: Midland Consumer Radio
2. Identification of equipment: FCC ID: MMAG9
 - a. The equipment identification label is submitted as a separate exhibit.
 - b. Photographs of the equipment are submitted as separate exhibits.
3. Quantity production is planned.
4. Technical description:
 - a. 16k0F3E emission
 - b. Frequency range: 462.5500-462.7250 MHz.
 - c. Operating power of transmitter is fixed at the factory at 2 watts (conducted).
 - d. Maximum power permitted under FCC Part 95 (interstitial) is 5 watts ERP. The G-9 fully complied with that power limitation.
 - d. The dc voltage and dc currents at final amplifier:

Collector voltage: 5.8 Vdc
Collector current: 0.82 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.

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B. GENERAL INFORMATION (continued)

- 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 2.
- l. Not applicable.

5. Data for 2.1046 through 2.1057 follow this section.

C. RF POWER OUTPUT (Section 2.1046 of the Rules)

ERP(d), determined by substitution, was 1.4 W.

D. MODULATION CHARACTERISTICS (Section 2.1047)

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 TRMS voltmeter and tracking generator.

2. Modulation limiting curves are shown in Figure 2, using a Boonton 8220 modulation meter. Signal level was established with an Audio Precision System One. The curves show compliance with Section 2.1047 and 95.633(b).

3. Figure 3 is a graph of the post-limiter low pass filter which meets the requirements of paragraph 95.633(b) in providing a roll-off of $60\log f/3$ dB where f is audio frequency in kHz. Measurements were made following EIA RS-152B with an Audio Precision System One on the Boonton 8220 modulation meter audio output.

4. Occupied Bandwidth (Section 2.1047 and 95.629(a) 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 2.1049(c)(1) and consisted of a 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 2697 Hz, the frequency of maximum response.

C. MODULATION CHARACTERISTICS (continued)

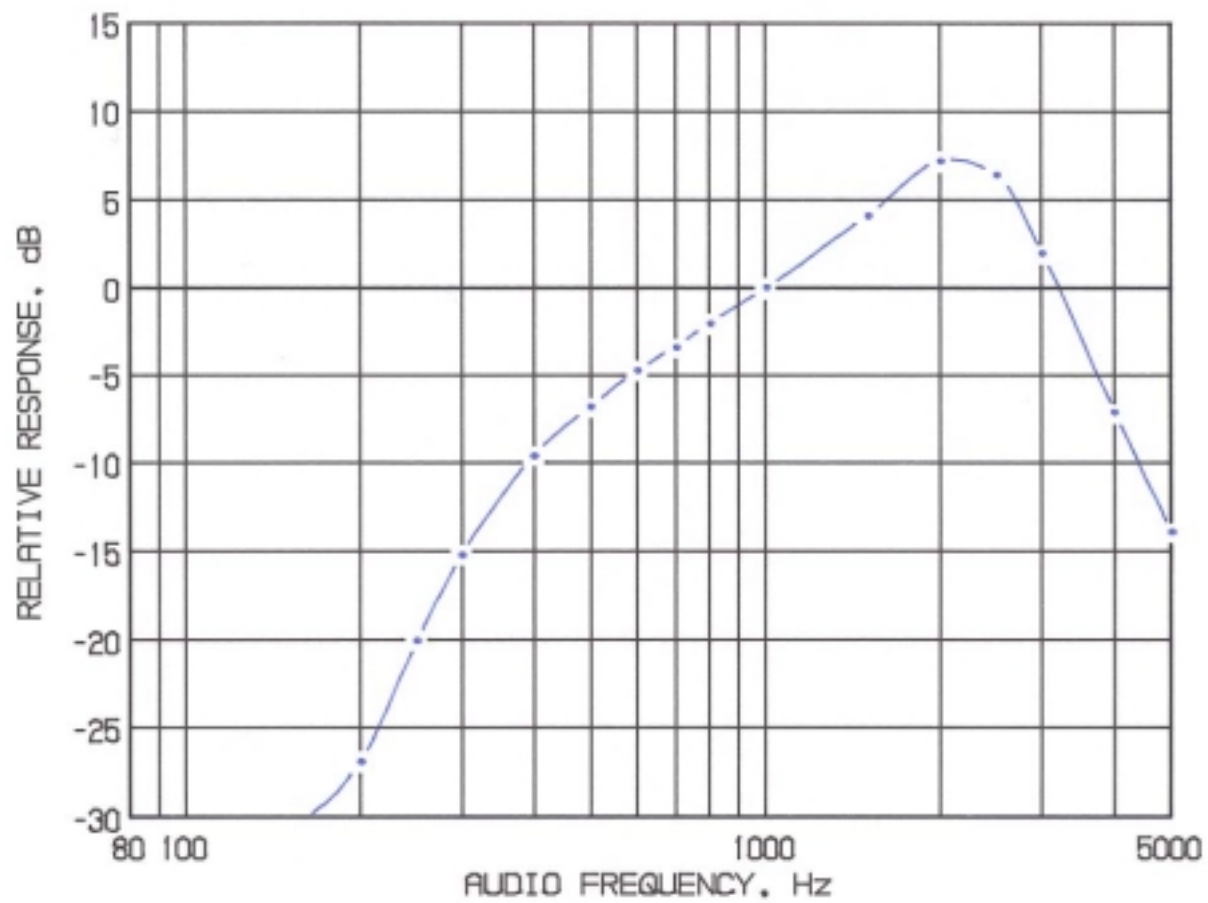
The plot is within the limits imposed by Section 2.1049 and 95.635(b)(1)(3)(7) for frequency modulation. The horizontal scale (frequency) is 10 kHz per division and the vertical scale (amplitude) is a logarithmic presentation equal to 10 dB per division.

5. Emission Designator Calculation:

$$(2D + 2F) \quad 2 \times 5.0 + 2 \times 3.0 = 16k0F3E$$

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FIGURE 1

MODULATION FREQUENCY RESPONSE



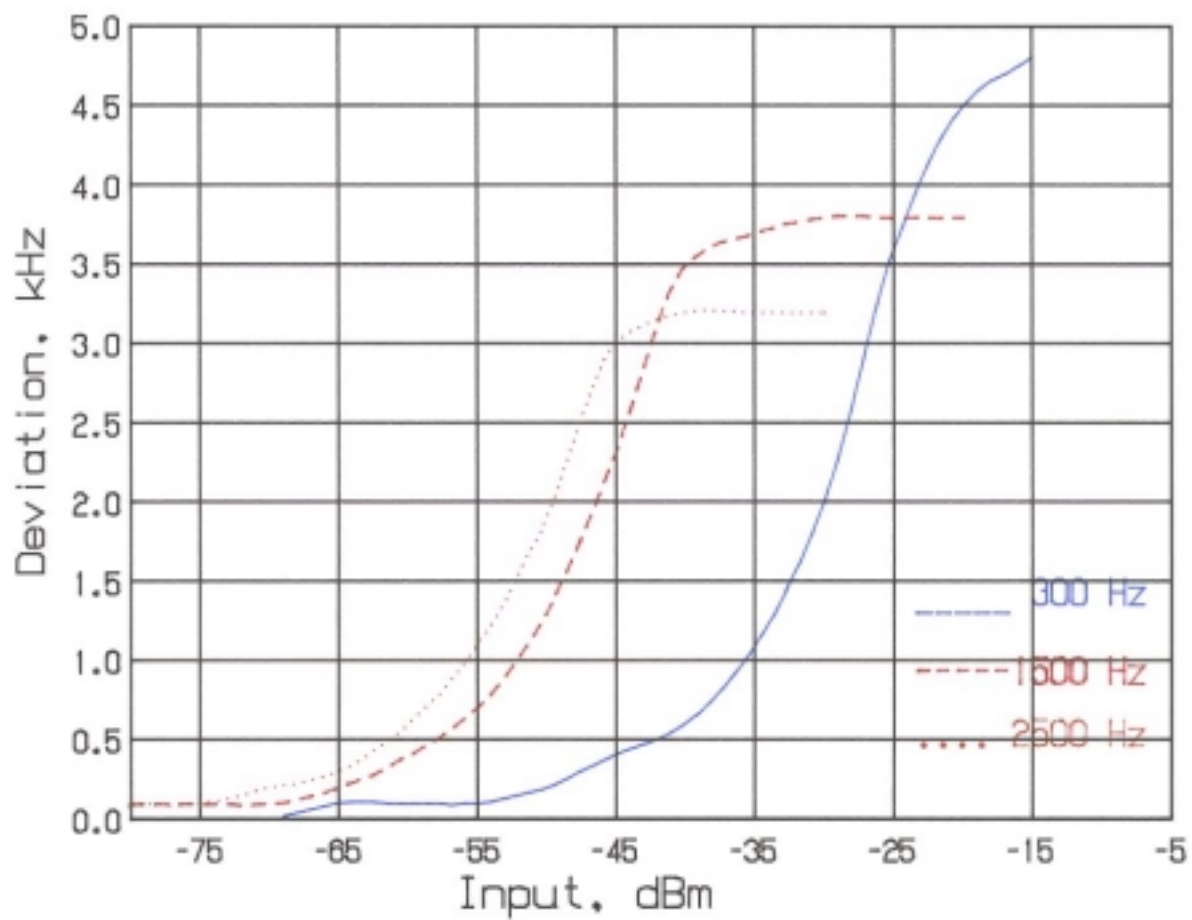
MODULATION FREQUENCY RESPONSE
FCC ID: MMAG9

FIGURE 1

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FIGURE 2

AUDIO LIMITER CHARACTERISTICS



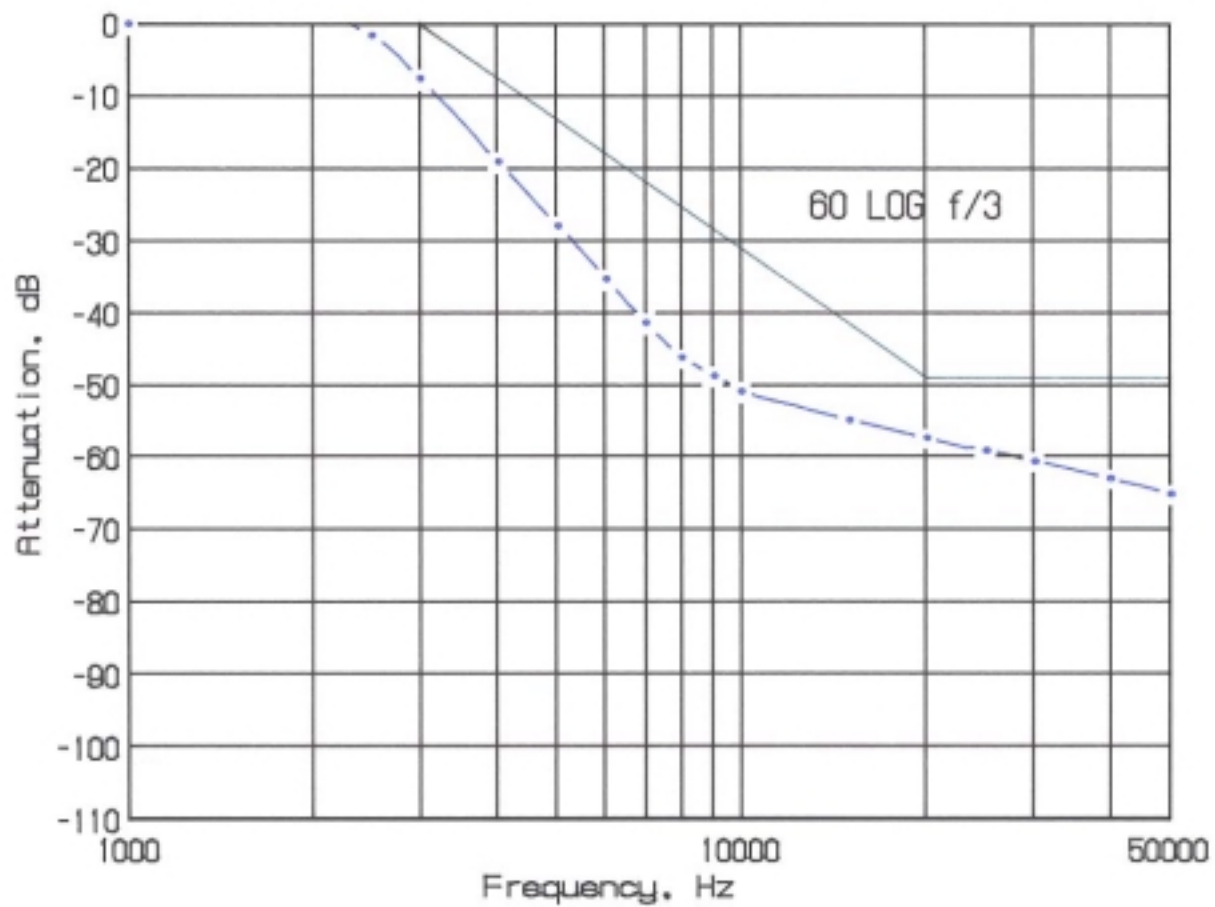
AUDIO LIMITER CHARACTERISTICS
FCC ID: MMAG9

FIGURE 2

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FIGURE 3

AUDIO LOW PASS FILTER RESPONSE



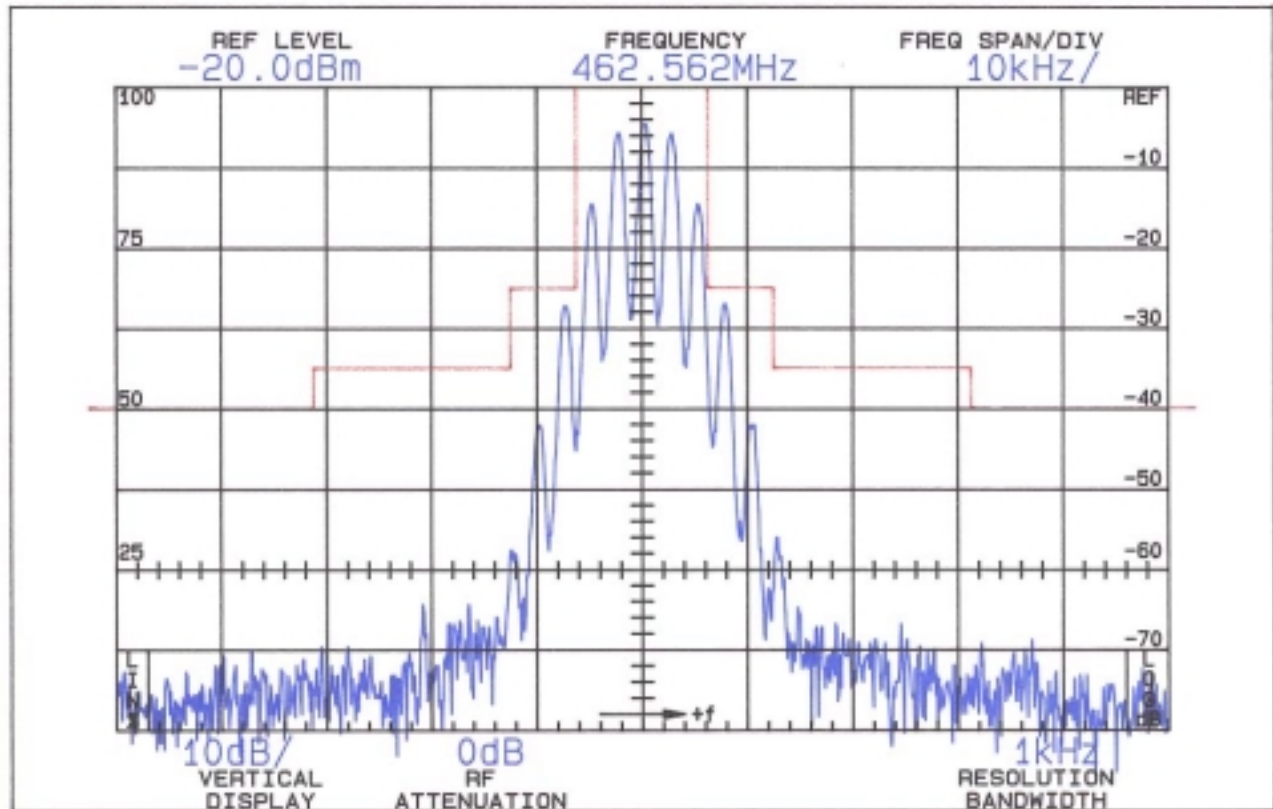
AUDIO LOW PASS FILTER RESPONSE
FCC ID: MMAG9

FIGURE 3

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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, 20 kHz
(10-20 kHz)

25

On any frequency more than 100%,
up to and including 250% of the
authorized bandwidth (20-50 kHz)

35

On any frequency removed from
the assigned frequency by more
than 250% of the authorized
bandwidth (over 50 kHz)

$$43 + 10 \log P = 44$$

(P = 1.4W ERP(d))

OCCUPIED BANDWIDTH
FCC ID: MMAG9

FIGURE 4

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E. SPURIOUS EMISSIONS AT THE ANTENNA TERMINALS

Not applicable, permanently attached antenna.

F. MEASUREMENTS OF SPURIOUS RADIATION
(Section 2.1053, 95.635(b)(7) of the Rules)

Field intensity measurements of radiated spurious emissions from the G-9 were by substitution made with a Tektronix 494P spectrum analyzer using Singer DM-105A calibrated test antennae 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 on an open area test site 3 meters from the test antenna. Supply voltage was a power supply with a terminal voltage under load of 6.0 Vdc. The transmitter and test antenna were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed.

TABLE 1

TRANSMITTER CABINET RADIATED SPURIOUS
462.5625 MHz, 6.0 Vdc, 1.4 W ERP(d)

<u>Frequency</u> <u>MHz</u>	<u>dB Below</u> <u>Carrier</u> <u>Reference</u> ¹
462.563	0
925.126	52V
1387.689	49V
1850.252	45V
2312.811	50V

$$\text{Required: } 43 + 10\text{Log}(1.4) = 44$$

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

All other spurious from 21.25 MHz to 4.7 GHz were 20 dB or more below FCC limit.

G. FREQUENCY STABILITY
(Section 2.1055 and 95.621(b) 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 2, starting with -30°C.

A Thermotron S1.2 temperature chamber was used. Temperature was monitored with a Keithley 871 digital temperature probe. The transmitter output stage was terminated in a dummy load. Primary supply was 6.0 volts. Frequency was measured with a HP 5385A digital frequency counter connected to the transmitter through a power attenuator. Measurements were made at 462.5625 MHz. No transient keying effects were observed.

TABLE 2

462.5625 MHz, 6.0 V Nominal, 1.4 watts ERP(d)

<u>Temperature, °C</u>	<u>Output_Frequency,_MHz</u>	<u>p.p.m.</u>
-29.7	462.562257	-0.5
-20.1	462.562514	0.0
-10.2	462.562798	0.6
0.3	462.562873	0.8
10.9	462.562771	0.6
20.7	462.562472	-0.1
29.8	462.562365	-0.3
40.2	462.562261	-0.5
50.5	462.563092	1.3

Maximum frequency error: 462.563092
462.562500
+ .000592 MHz

FCC Rule 95 specifies .0005% or a maximum of $\pm .002313$ MHz, which corresponds to:

High Limit 462.564813 MHz
Low Limit 462.560187 MHz

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H. FREQUENCY STABILITY AS A FUNCTION OF SUPPLY VOLTAGE (Section 2.1055 and 95.621(b) 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 from $\pm 15\%$ above the nominal 6.0 volt rating to below the battery end

point. A Keithley 197 digital voltmeter was used to measure supply voltage at transmitter primary input terminals. Measurements were made at 20 °C ambient.

TABLE 3

462.5625 MHz, 20°C, 6.0 V Nominal, 1.4 watts ERP(d)

<u>%</u>	<u>Supply_Voltage</u>	<u>Output_Frequency,_MHz</u>	<u>p.p.m.</u>
115	6.9	462.562814	0.7
110	6.6	462.562651	0.3
105	6.3	462.562541	0.1
100	6.0	462.562472	-0.1
95	5.7	462.562434	-0.1
90	5.4	462.562418	-0.2
85	5.1	462.562414	-0.2
80	4.8*	462.562425	-0.2

Maximum frequency error: 462.562814
462.562500

*Low battery limit + .000314 MHz

FCC Rule 95 specifies .0005% or a maximum of $\pm .002313$ MHz, corresponding to:

High Limit 462.564813 MHz
Low Limit 462.560187 MHz

10 APPENDIX 1

ΣΕΜΙΧΟΝΔΥΧΤΟΡΣ ΑΝΔ ΦΥΝΧΤΙΟΝΣ

ΤΡΑΝΣΙΣΤΟΡ

ΘΡ1	2ΣΧ4226	N.E.X	ΡΕ ΡΦ ΑΜΠ.
ΘΡ2	2ΣΧ4226	N.E.X	1ΔΣΤ ΜΙΕΡ.

ΘΡ3	KTX3880Σ	K.E.X	1ος Τ ΙΦ ΑΜΠ.
ΘΡ5	KPX104Σ	K.E.X	TONE ΔΕΤ.
ΘΡ6	KTA1504Σ	K.E.X	ΣΘΥΕΛΑΧΗ ΜΥΤΕ.
ΘΤ1	2ΣΧ4226	N.E.X	ΤΞ ΒΥΦΦΕΡ.
ΘΤ2	2ΣΧ4226	N.E.X	ΤΞ ΠΟΩΕΡ ΔΡΙΞΕ ΑΜΠ.
ΘΤ3	NE5510279A	N.E.X	ΤΞ ΠΟΩΕΡ ΦΙΝΑΛ ΑΜΠ.
ΘΦ1	2ΣΧ4226	N.E.X	ΒΥΦΦΕΡ.
ΘΦ2	KPX110Σ	K.E.X	ΡΞ Β+ ΣΩΙΤΧΗΙΝΓ ΑΤ ΤΞ.
ΘΣ1	KPA105Σ	K.E.X	ΡΞ Β+ ΣΩΙΤΧΗΙΝΓ.
ΘΣ2	KPA105Σ	K.E.X	ΠΟΩΕΡ ΣΑΞΕ ΧΟΝΤΡΟΛ.
ΘΣ3	KPA105Σ	K.E.X	ΤΞ Β+ ΣΩΙΤΧΗΙΝΓ.
ΘΣ4	KPX104Σ	K.E.X	ΤΞ Β+ ΣΩΙΤΧΗΙΝΓ.
ΘΣ5	KPA110Σ	K.E.X	ΒΑΧΚ ΛΙΓΗΤ ΛΕΔ ΣΩΙΤΧΗΙΝΓ.
ΘΣ7	KPA101Σ	K.E.X	ΠΤΤ Σ/Ω
ΘΣ9	KPX110Σ	K.E.X	ΧΑΛΛ ΜΥΤΕ
Θ1	2ΣΧ4226	N.E.X	ΡΞ ΒΥΦΦΕΡ.
Θς1	KPX104Σ	K.E.X	ΡΞ/ΤΞ ςΧΟ ΣΩΙΤΧΗΙΝΓ.
Θς2	2ΣΧ4226	N.E.X	Ο.Σ.Χ
ΘΒ1	KTX3875Σ	K.E.X	ΛΟΩ ΒΑΤΤ. ΔΕΤ.
ΘΒ1	KTX3875Σ	K.E.X	ΠΟΩΕΡ Η/Λ ΧΟΝΤΡΟΛ

INTEGRATED CIRCUIT

IX1	KA3361	ΣΑΜΣΥΝΓ	2ος Δ ΜΙΞΕΡ ΙΦ ΑΝΔ ΦΜ ΔΕΤΕΧΤ
IX2	TMPI87X807Y	ΤΟΣΗΒΑ	ΧΠΥ
IX3	NOM2070	Θ.P.X	ΑΥΔΙΟ ΠΟΩΕΡ ΑΜΠ.
IX4	TB31202ΦN	ΤΟΣΗΒΑ	ΠΛΛ ΦΡΕΘΥΕΝΧΨ ΣΨΝΤΗΣΙΖΕΡ
IX5	TK71530	TOKO	ΡΕΓΥΛΑΤΟΡ
IX6	LM324	NATIONAL	ΠΡΕ-ΕΜΠΑΣΙΣ ΛΙΜΙΤΤΕΡ ΑΝΔ ΜΙΧ
IX8	LM324	NATIONAL	ΧΤΧΣΣ ΤΟΝΕ ΔΕΤ.
IC10	LM324	NATIONAL	DE-EMPASIS TONE FILTER

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY,

SUPPRESS SPURIOUS EMISSIONS AND LIMIT MODULATION

The PLL synthesizer of the G-9 (GMRS) consists of the signal loop PLL circuit with the reference of 6.25 kHz. The IC4 PLL IC includes all the functions such as the reference oscillator, the driver, the phase detector, the lock detector, and the programmable divider.

At the reference oscillator, the 21.25 MHz TCXO of the CTX1 is connected to the pin 11 of the IC4 to oscillate the frequency of 21.25 MHz. The TCXO (21.25 MHz) is the temperature compensation circuit to maintain the frequency within the allowable error range even under a low temperature of -30.

The phase detectors send out the output power to the loop filter through 3 pin of the IC4. If the oscillation frequency of the VCO is low compared to the reference frequency, the phase detector sends out the output power in positive pulse. If the oscillation frequency of the VCO is high, phase detector sends out the output power in negative pulse. Therefore, the VCO can maintain the frequency set.

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 2 watts 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 AND DEVICES TO
STABILIZE FREQUENCY, etc.
FCC ID: MMAG9

APPENDIX 2