ENGINEERING STATEMENT

For Type Certification of

Midland Consumer Radio

Model No: F-10
FCC ID: MMAF10

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 model F-10 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: May 3, 2001

A. INTRODUCTION

The following data are submitted in connection with this request for type certification of the model F-10 transceiver in

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

The model F-10 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(d)

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: MMAF10

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)
d. Maximum power permitted is 0.5 watts, and the model F-10 fully complied with that power limitation.
e. The dc voltage and dc currents at final amplifier:

Collector voltage: 4.4 Vdc
Collector current: 0.69 A

f. Function of each active semiconductor device is submitted as exhibit 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 exhibit 2.
k. A description of circuits and devices employed for suppression of spurious radiation and for limiting modulation is included in exhibit 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 model F-10 has a permanently attached built-in antenna without provisions for a coaxial connector.

Therefore RF power was determined by substitution.

TABLE 1

Operating Freq., MHz	Power watts into a dipole antenna
462.5625	0.49

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)

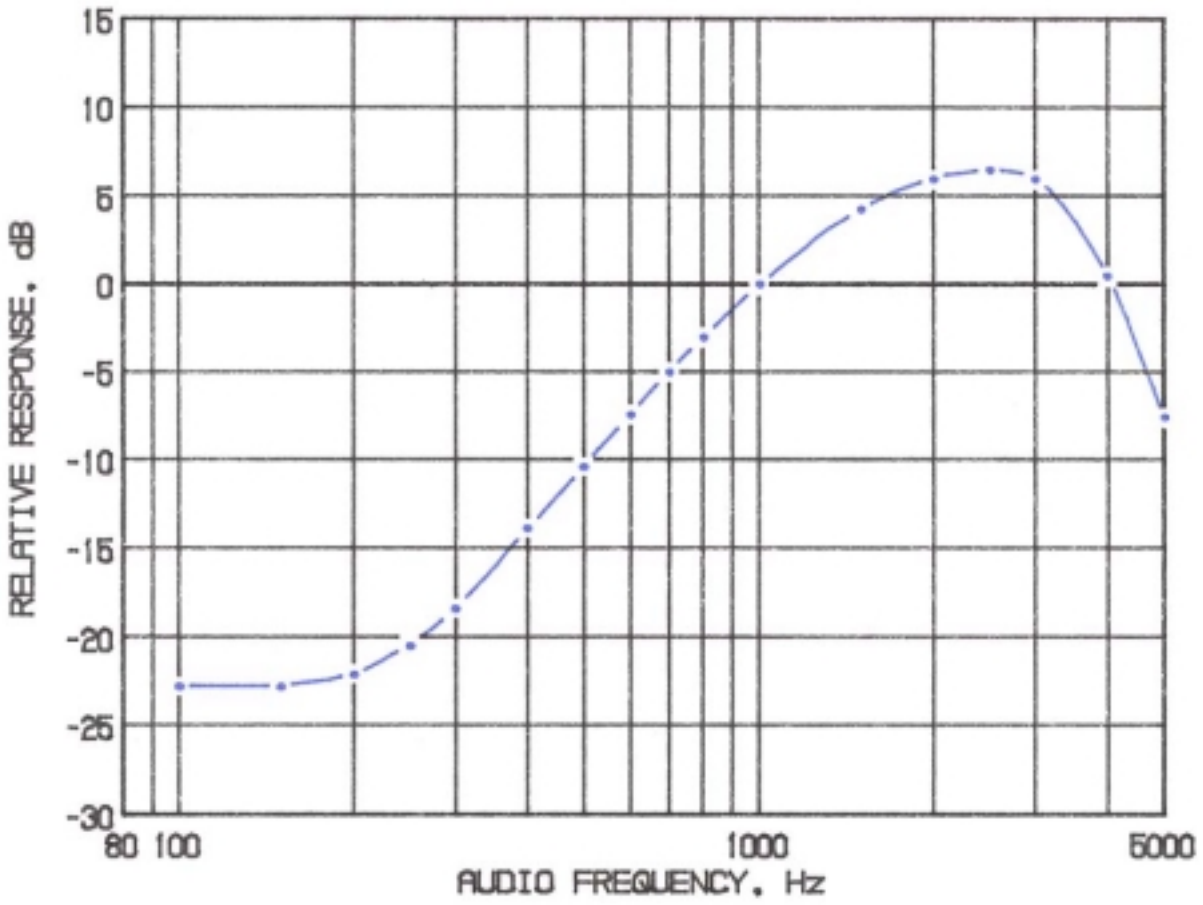
Figure 4 is a plot of the sideband envelope of the transmitter output taken with a Tektronix 494P spectrum analyzer. Modulation corresponded to conditions of 2.989(c)(1) and consisted of 2500 Hz tone at an input level 16 dB greater than that necessary to produce 50% modulation at 2806 Hz, the frequency of maximum response.

Emission designator:

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

FIGURE 1

MODULATION FREQUENCY RESPONSE



MODULATION FREQUENCY RESPONSE
FCC ID: MMAF10

FIGURE 1

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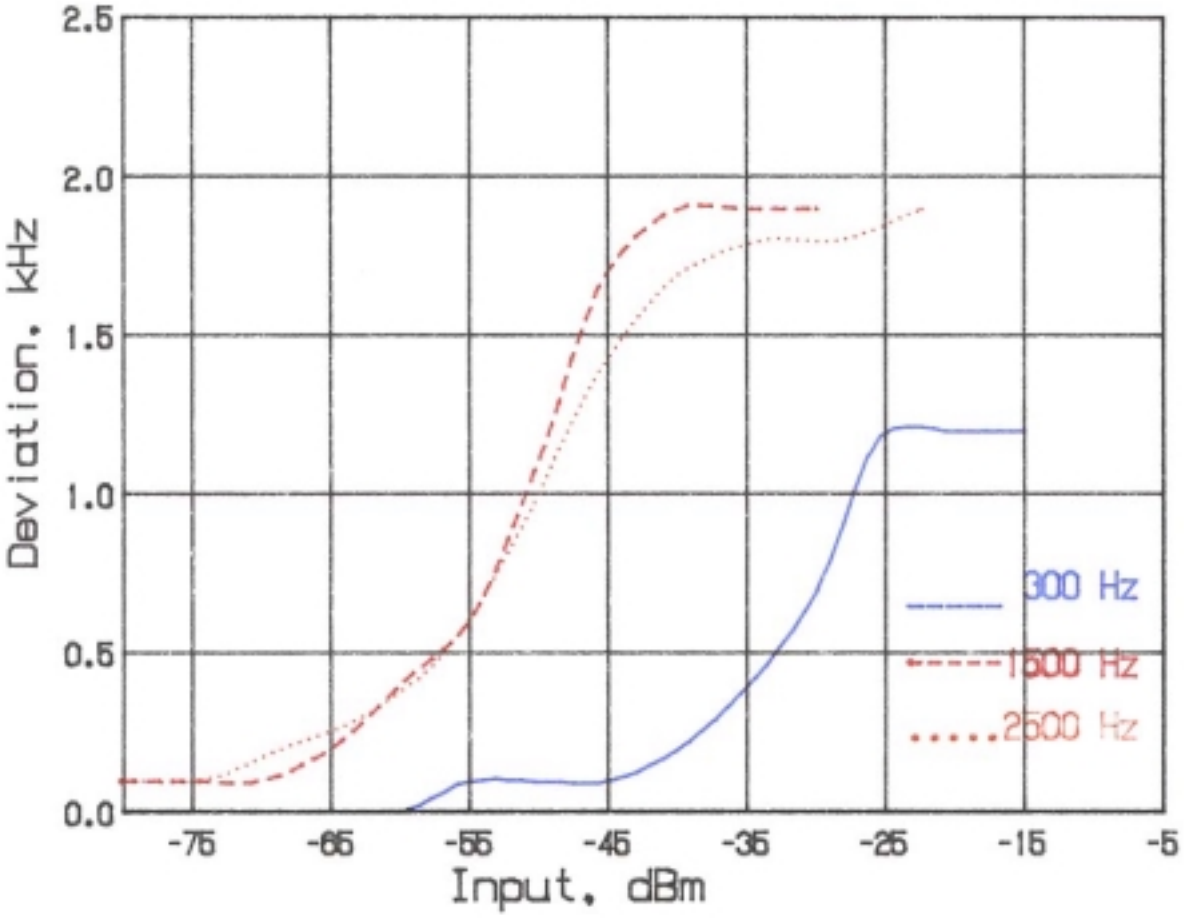
FIGURE 2

AUDIO LIMITER CHARACTERISTICS

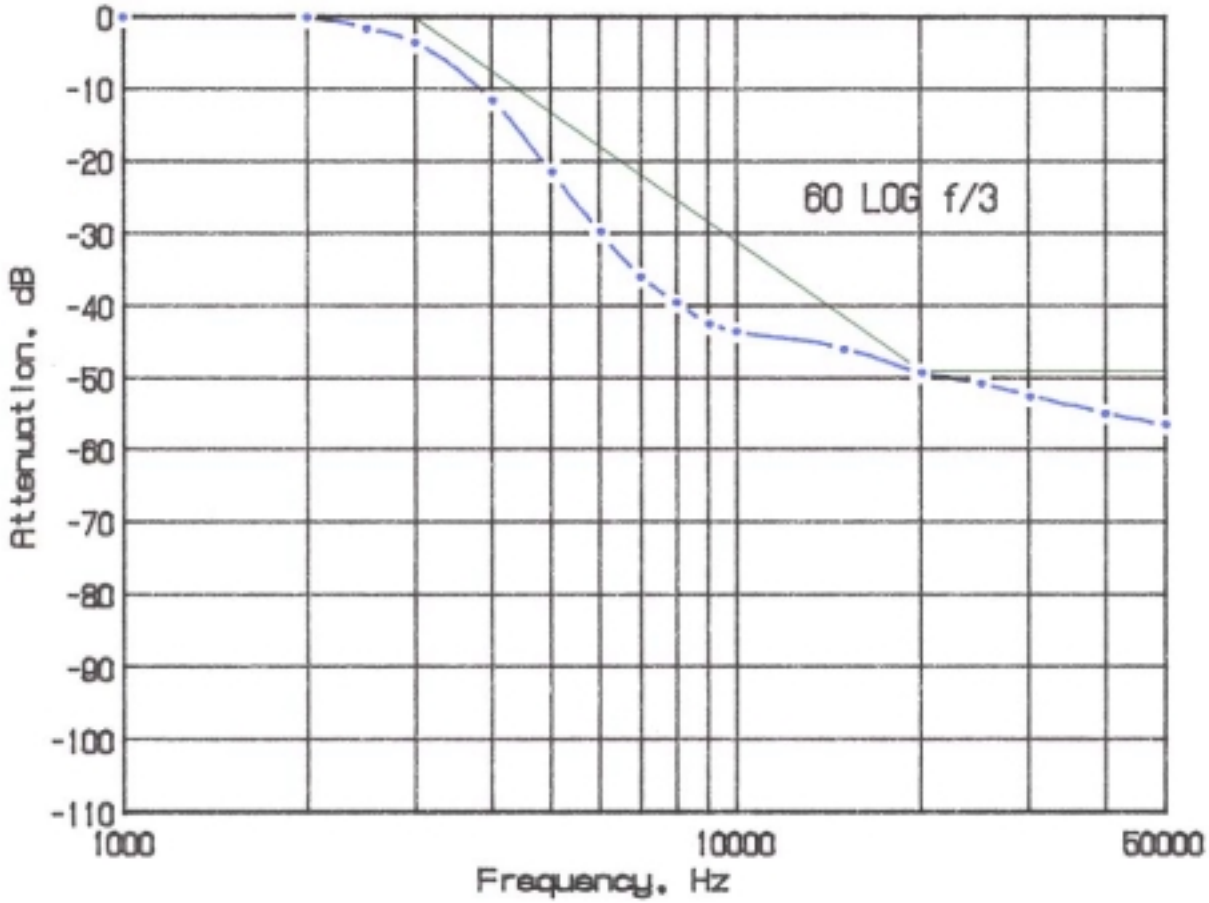


AUDIO LIMITER CHARACTERISTICS
FCC ID: MMAF10

FIGURE 2

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE

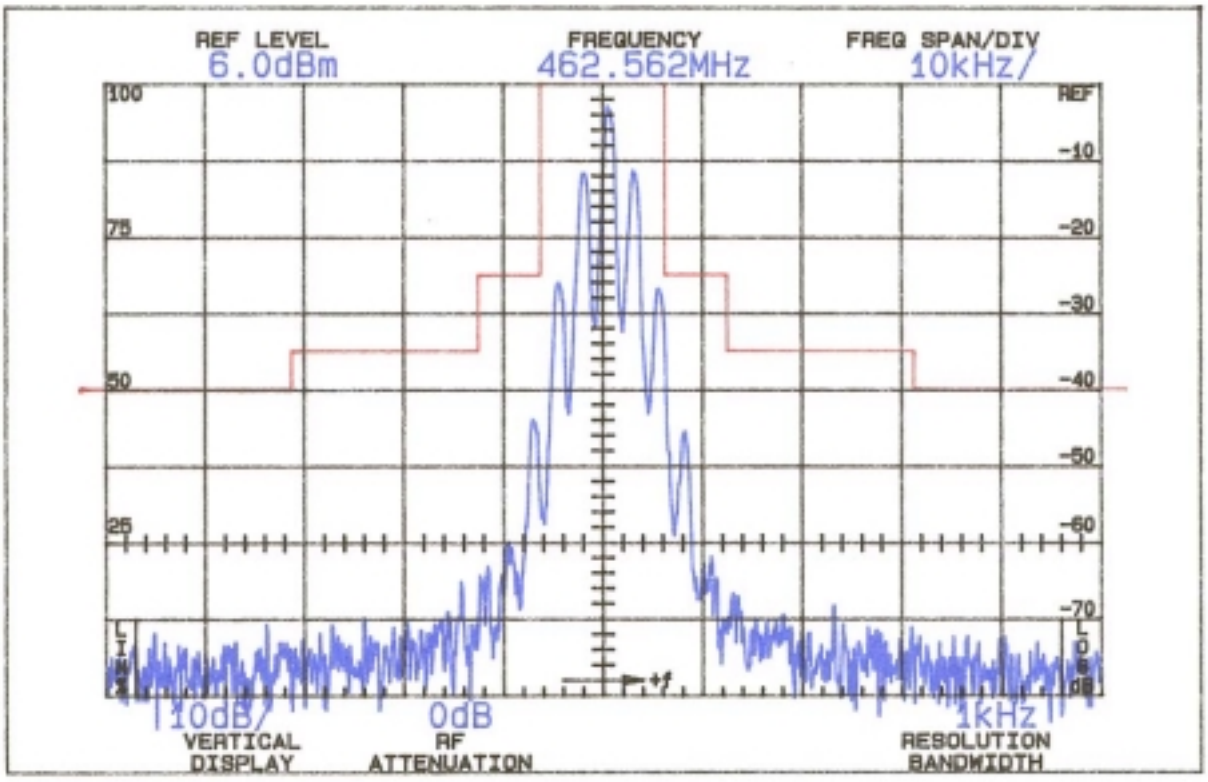


AUDIO LOW PASS FILTER
RESPONSE
FCC ID: MMAF10

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 = 0.49)

OCCUPIED BANDWIDTH
FCC ID: MMAF10

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 model F-10 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. MEASUREMENTS OF SPURIOUS RADIATION

Spurious emissions from the model F-10 were made by substitution with a Tektronix 494P spectrum analyzer using Singer DM-105 for the measurements to 1 GHz, and EMCO 3115 horn to 4.5 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.

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, 0.49 watts

Spurious	dB Below

Frequency MHz	Carrier Reference[1]
462.565	0
2312.815	55V
2775.377	51V
3237.940	57V
4625.627	56H

Required: 43+10 Log(P) = 40

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

All other spurious from 21.25 MHz to the tenth harmonic were 20 dB or more below FCC limit.

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, 0.49 W

Temperature, °C	Output Frequency, MHz	p.p.m.
-20.1	462.562331	-0.4
- 9.9	462.562344	-0.3
- 0.8	462.562390	-0.2
10.2	462.562299	-0.4
20.2	462.562588	0.2
30.1	462.562412	-0.2
40.2	462.562169	-0.7
50.1	462.562315	-0.4

Maximum frequency error: 462.562169
462.562500

\- .000331 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; 0.49 W

Supply_Voltage		Output_Frequency,_MHz	p.p.m.
5.17	115%	462.562331	-0.4
4.95	110%	462.562424	-0.2
4.73	105%	462.562525	0.1
4.50	100%	462.562588	0.2
4.28	95%	462.562613	0.2
4.05	90%	462.562622	0.3
3.83	85%	462.562611	0.2
3.60	80%	462.562590	0.2

Maximum frequency error: 462.562331
462.562500

+ .000169 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
Model F-10

ΣΕΜΙΧΟΝΔΥΧΤΟΡΣ ΑΝΔ ΦΥΝΧΤΙΟΝΣ

ΤΡΑΝΣΙΣΤΟΡ

ΘΡ1	2ΣΧ4226	Ν.Ε.Χ	ΡΞ ΡΦ ΑΜΠ.

ΘΡ2	2ΣΧ4226	N.E.X	1ǝΣΤ ΜΙΞΕΡ
ΘΡ3	ΚΤΧ3880Σ	K.E.X	1ǝΣΤ ΙΦ ΑΜΠ.
ΘΡ4	ΚΡΧ110Σ	K.E.X	ΣΘΥΕΛΧΗ ΜΥΤΕ
ΘΡ5	ΚΤΧ3875Σ	K.E.X	ςΟΞ ΑΥΔΙΟ ΑΜΠ.
ΘΤ1	2ΣΧ4226	N.E.X	ΤΞ ΒΥΦΦΕΡ
ΘΤ2	2ΣΧ4226	N.E.X	ΤΞ ΠΟΩΕΡ ΔΡΙςΕ ΑΜΠ.
ΘΤ3	ΒΛΤ 70	ΠΗΙΛΙΠΣ	ΤΞ ΠΟΩΕΡ ΦΙΝΑΛ ΑΜΠ.
ΘΤ4	ΚΡΧ104Σ	K.E.X	ΡΞ Β+ ΣΩΙΤΧΗΙΝΓ ΑΤ ΤΞ
ΘΣ1	ΚΡΑ105Σ	K.E.X	ΡΞ Β+ ΣΩΙΤΧΗΙΝΓ
ΘΣ2	ΚΡΑ105Σ	K.E.X	ΠΟΩΕΡ ΣΑςΕ ΧΟΝΤΡΟΛ
ΘΣ3	ΚΡΑ105Σ	K.E.X	ΤΞ Β+ ΣΩΙΤΧΗΙΝΓ
ΘΣ4	ΚΡΧ104Σ	K.E.X	ΤΞ Β+ ΣΩΙΤΧΗΙΝΓ
ΘΣ5	ΚΡΑ105Σ	K.E.X	ΜΙΧ ΑΜΠ Β+ ΣΩΙΤΧΗΙΝΓ
ΘΣ7	ΚΡΑ101Σ	K.E.X	ΠΤΤ ΣΩΙΤΧΗΙΝΓ
ΘΣ8	ΚΡΧ104Σ	K.E.X	ΒΑΧΚ ΛΙΓΗΤ ΛΕΔ ΣΩΙΤΧΗΙΝΓ
Θς1	ΚΡΧ104Σ	K.E.X	ΡΞ/ΤΞ ςΧΟ ΣΩΙΤΧΗΙΝΓ
Θς2	2ΣΧ4226	N.E.X	Ο.Σ.Χ
ΘΦ1	2ΣΧ4226	N.E.X	ΡΞ ΒΥΦΦΕΡ

ΙΝΤΕΓΡΑΤΕΔ ΧΙΡΧΥΙΤ

ΙΧ1	ΔΒΛ5018ς	ΔΑΕΩΟΟ	2ǝΝΔ ΜΙΞΕΡ ΙΦ ΑΝΔ ΦΜ ΔΕΤΕΧΤΟΡ
ΙΧ2	Νϑ Μ2070	ϑ.Ρ.Χ	ΑΥΔΙΟ ΠΟΩΕΡ ΑΜΠ.
ΙΧ3	ΚΣ88Χ21208	ΣΑΜΣΥΝΓ	ΧΠΥ
ΙΧ4	ΚΒ8825	ΣΑΜΣΥΝΓ	ΠΛΛ ΦΡΕΘΥΕΝΧΨ ΣΨΝΤΗΕΣΙΖΕΡ
ΙΧ5	ΤΚ71330	ΤΟΚΟ	ΡΕΓΥΛΑΤΟΡ
ΙΧ6	ΔΒΛ358	ΔΑΕΩΟΟ	ΠΡΕ–ΕΜΠΗΑΣΙΣ ΑΝΔ ΜΙΧ ΑΜΠ, ΛΙΜΙΤΤΕΡ.
ΙΧ7	24ΩΧΟ2ϑ	ΧΤΙ	ΕΕΠΡΟΜ

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY

The PLL synthesizer of the F-10 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 programmable divider.

At the reference oscillator, the 21.250 MHz TCXO of the TCXO-1 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 withen the allowable error range even under a low temperature of -30.

The phase detector 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 referenced frequency, the phase detector sends out the output power in positive pulse. If the oscillation frequency of the VCO is high, phase detector send out can maintain the frequency set.

CIRCUITS AND DEVICES TO
STABILIZE FREQUENCY
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APPENDIX 2

APPENDIX 3

CIRCUITS TO SUPPRESS SPURIOUS RADIATION
AND LIMIT MODULATION

CIRCUITS TO SUPPRESS SPURIOUS RADIATION

The transmitted signal of approximately 7mW, combined at the PLL module is supplied to the base of the QT3 amplifier. The transmitted signal amplified to 0.5 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 LT6.

CIRCUITS TO LIMIT MODULATION

The voice signal input from the microphone is pre-emphasized at the IC6A. The signal which comes out of the DM1 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