ENGINEERING STATEMENT

For Certification of

COBRA ELECTRONICS CORPORATION

Model No. PR-2000WX
FCC ID: BBOPR2000WX

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 Cobra Electronics Corporation to make certification measurements on the PR-2000WX transceiver. These tests were made by me or under my supervision in our Springfield laboratory.

Test data and documentation required by the FCC for certification are included in this report. The data verifies that the above mentioned transceiver meets FCC requirements and certification is requested.

____
Rowland S. Johnson

Dated: June 15, 2000

A. INTRODUCTION

The following data are submitted in connection with this request for type acceptance of the PR-2000WX transceiver in accordance with Part 2, Subpart J of the FCC Rules.

The PR-2000WX is a hand-held, battery operated, UHF, frequency modulated, 3 W 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 (Paragraph 2.983 of the Rules)

1. Name of applicant: Cobra Electronics Corporation

2. Identification of equipment: FCC ID: BBOPR2000WX

   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 3 watts.
   d. Maximum power permitted under FCC Part 95 (interstitial) is 5 watts ERP. The PR-2000WX fully complied with that power limitation.
   d. The dc voltage and dc currents at final amplifier:

      Collector voltage: 8.9 Vdc
      Collector current: 0.55 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.

B. GENERAL INFORMATION (continuted)

   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 2.985 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 power was 2.6 watts. (The transmitter was tuned by the factory.)

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 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 paragraphs 2.987(b) 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 60Logf/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. <u>Occupied Bandwidth</u> (Paragraphs 2.989(c), 90.209(b)(4), 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 2.989(c)(1) and consisted of 2500 Hz.

C. MODULATION CHARACTERISTICS (continued)

tone at an input level 16 dB greater than that necessary to produce 50% modulation at 2149 Hz, the frequency of maximum response. Measured modulation under these conditions was 3.2 kHz.

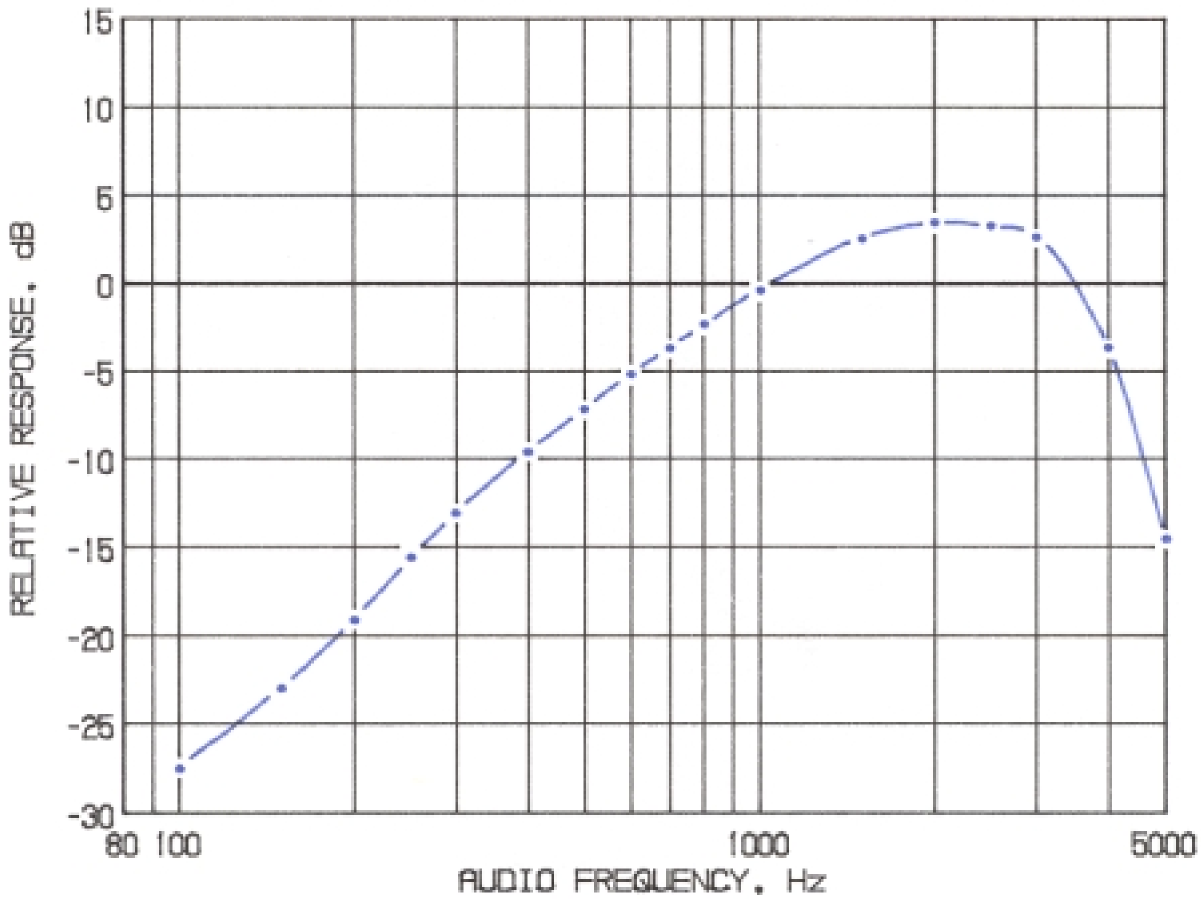
The plot is within the limits imposed by Paragraph 90.211(h) for frequency modulation. The horizontal scale (frequency) is 10 kHz per division and the vertical scale (amplitude) is a logarithmic presentation equal to 10 dB per division.

5. Emission Designator Calculation:

(2D + 2F) 2x5.0 + 2x3.0 = 16k0F3E

FIGURE 1

MODULATION FREQUENCY RESPONSE

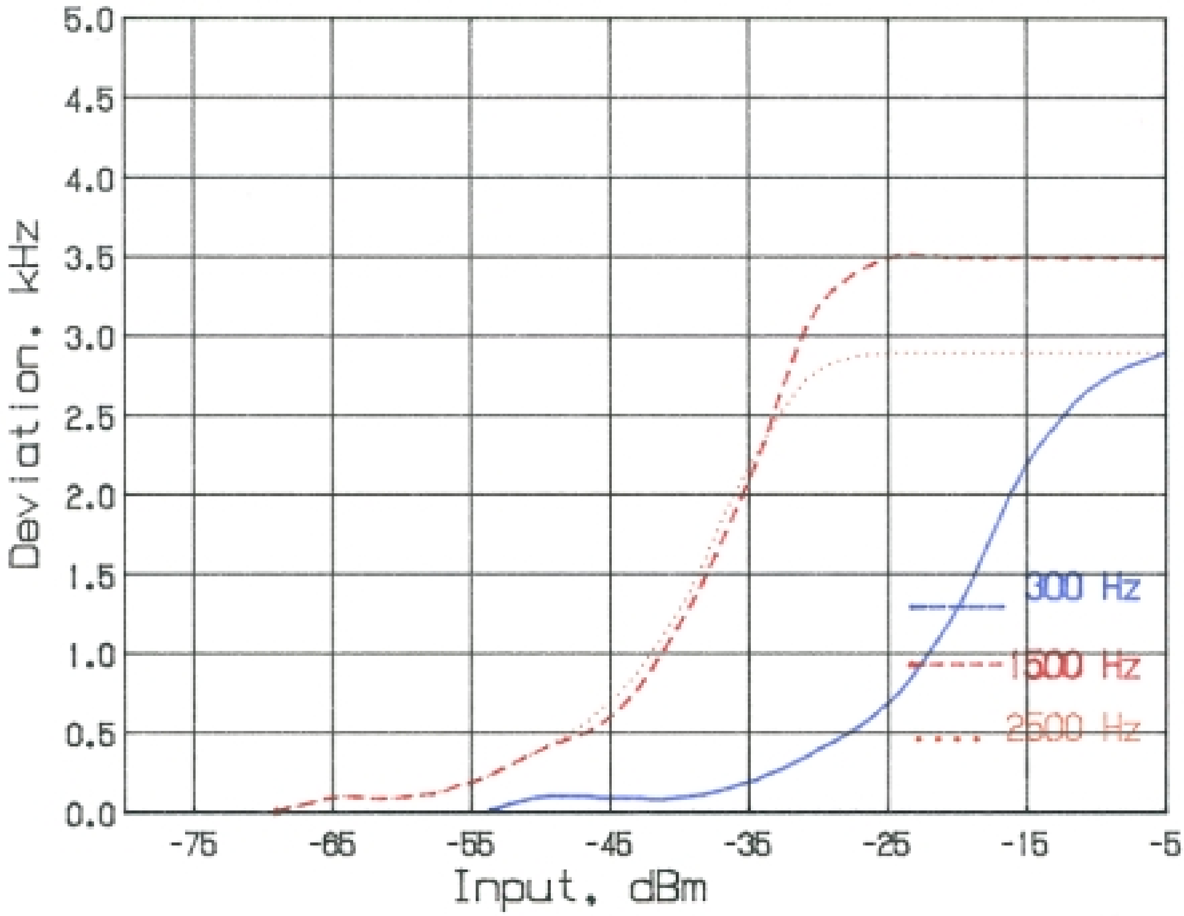


MODULATION FREQUENCY RESPONSE
FCC ID: BBOPR2000WX

FIGURE 1

FIGURE 2

AUDIO LIMITER CHARACTERISTICS

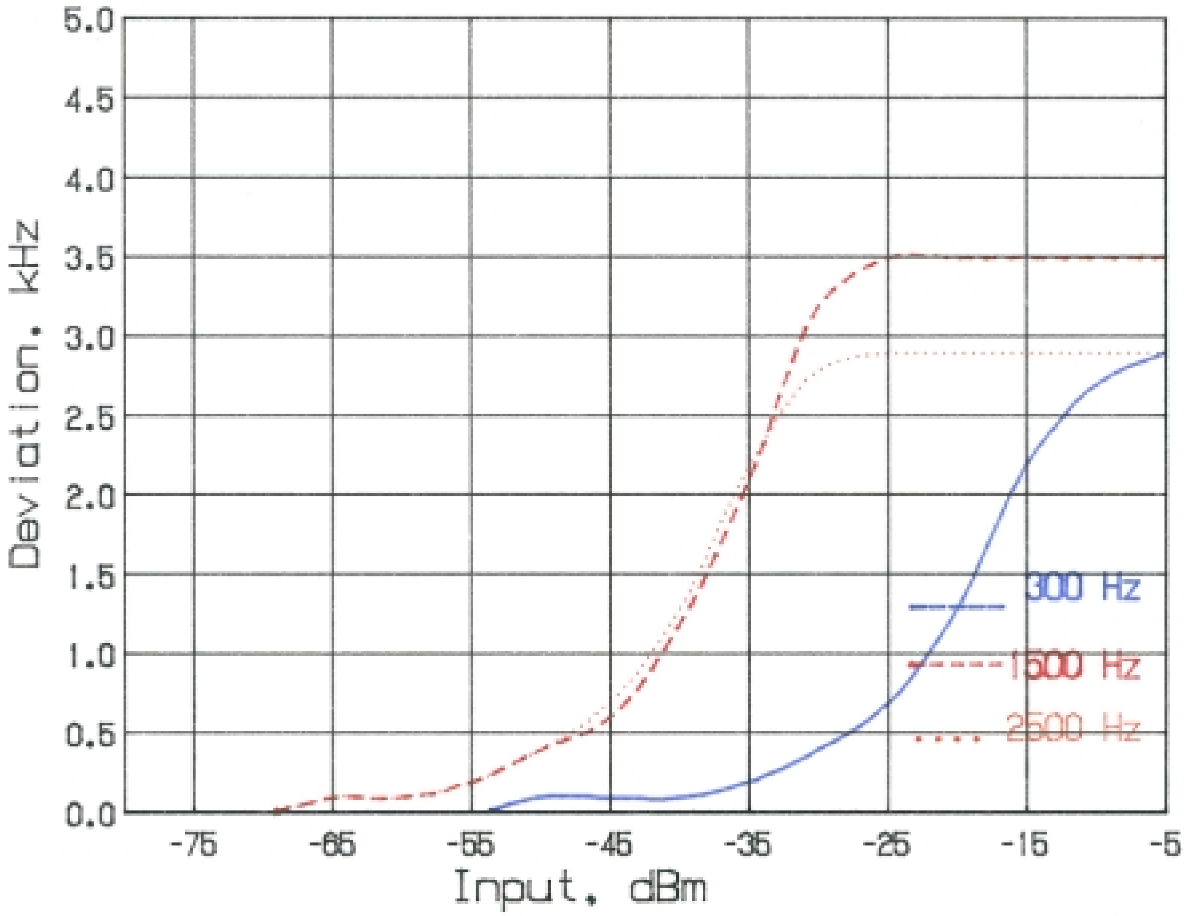


AUDIO LIMITER CHARACTERISTICS
FCC ID: BBOPR2000WX

FIGURE 2

FIGURE 3

AUDIO LOW PASS FILTER RESPONSE

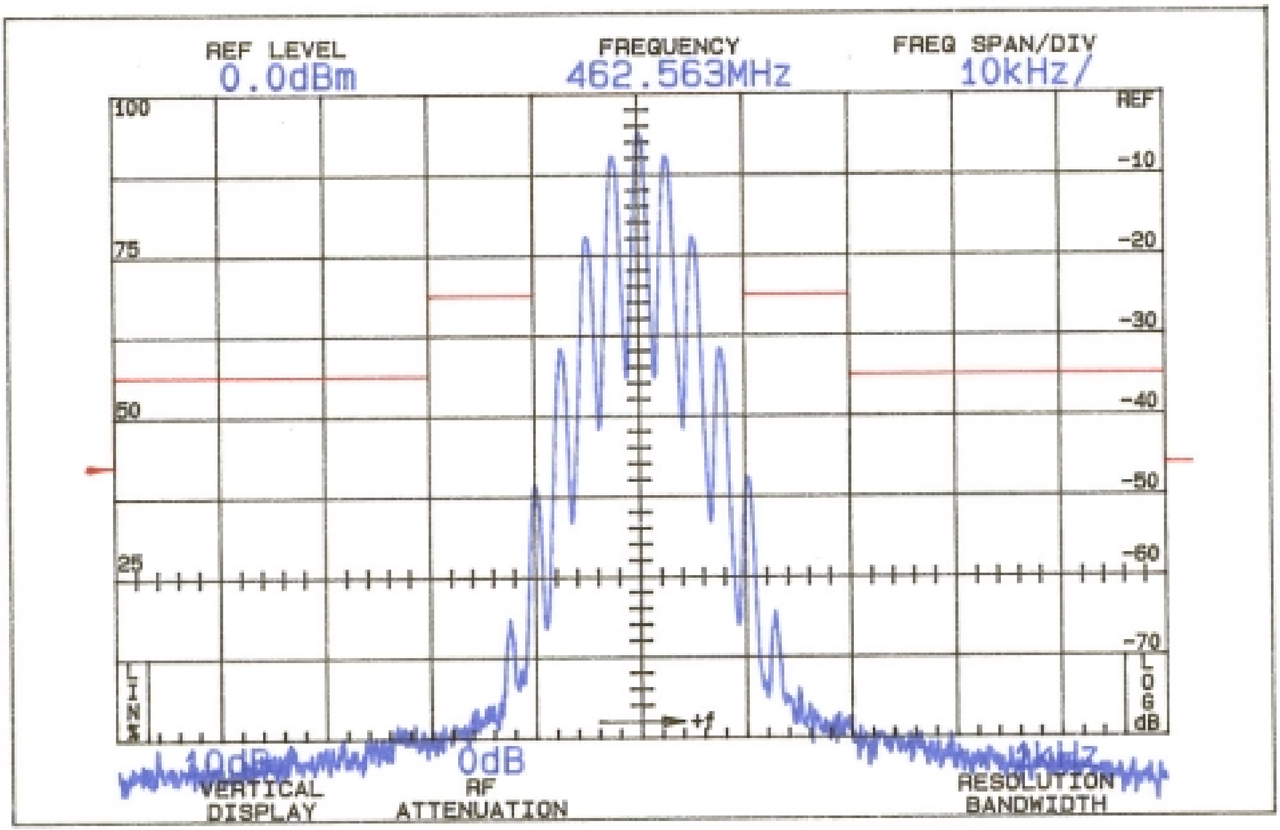


AUDIO LOW PASS FILTER RESPONSE
FCC ID: BBOPR2000WX

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, 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+10LogP = 47 (P = 2.6W)

OCCUPIED BANDWIDTH
FCC ID: BBOPR2000WX

FIGURE 4

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

The PR-2000WX 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 2149 Hz, the frequency of highest sensitivity.

Measurements were made with Tektronix 494P spectrum analyzer coupled to the transmitter output terminal through Narda 765-20 microwave power attenuator.

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 9.0 volts throughout the tests.

Spurious emissions were measured throughout the RF spectrum from 12.8 MHz (lowest frequency generated in the transmitter) to 4.7 GHz. Any emissions that were between the required attenuation and the noise floor of the spectrum analyzer were recorded. Data are shown in Table 1.

TABLE 1

TRANSMITTER CONDUCTED SPURIOUS
462.5625 MHz, 9.0 Vdc, 2.6 W

Spurious Frequency MHz	dB Below Carrier Reference
925.126	72
1387.689	92
1850.252	82
2312.815	94
2775.378	98
3237.941	>100
3700.504	>100
4163.067	92
4625.630	>100
Required: 43+10Log(P)	47

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

F. DESCRIPTION OF MEASUREMENT FACILITIES

A description of the Hyak Laboratories' radiation test facility is a matter of record with the FCC. The facility was approved for radiation measurements from 25 to 2000WX MHz on October 1, 1976 and is currently listed as an acceptable site.

G. FIELD STRENGTH MEASUREMENTS OF SPURIOUS RADIATION

Field intensity measurements of radiated spurious emissions from the PR-2000WX were made with a Tektronix 494P spectrum analyzer using Singer DM-105A calibrated test antennae for the measurements to l GHz, Polarad CA-L for 1-2.4 GHz, Polarad CA-S for 2.4-4.3 GHz, and Polarad CA-M for 4.3-7 GHz. The transmitter and dummy load were located in an open field 3 meters from the test antenna. Supply voltage was a power supply with a terminal voltage under load of 12 Vdc. Output power was 2.6 watts at the 462.5625 MHz operating frequency. The transmitter and test antennae were arranged to maximize pickup. Both vertical and horizontal test antenna polarization were employed.

G. FIELD STRENGTH MEASUREMENTS (Continued)

Reference level for the spurious radiations was taken as an ideal dipole excited by 2.6 watts, the output power of the transmitter according to the following relationship:*

$$E = \frac{(49.2P_t)^{1/2}}{R}$$

where E = electric-field intensity in volts/meter

P_t = transmitter power in watts

R = distance in meters

for this case E = $\frac{(49.2 \times 2.6)^{1/2}}{3}$ = 3.8 V/m

Since the spectrum analyzer is calibrated in decibels above one milliwatt (dBm), a conversion, for convenience, was made from dBu to dBm.

$$3.8 \text{ volts/meter} = 3.8 \times 10^6 \text{ uV/m}$$

$$\text{dBu/m} = 20 \text{ Log}_{10} (3.8 \times 10)^6$$

$$= 130 \text{ dBu/m}$$

Since 1 uV/m = -107 dBm, the reference becomes

$$130 - 107 = 23 \text{ dBm}$$

The measurement system was capable of detecting signals 90 dB or more below the reference level. Measurements were made from the lowest frequency generated within the unit to 10 times operating frequency, 4.7 GHz. Data after application of antenna factors and line loss corrections are shown in Table 2.

____

*Reference Data for Radio Engineers, Fourth Edition, International Telephone and Telegraph Corp., p. 676.

TABLE 2

TRANSMITTER CABINET RADIATED SPURIOUS
462.5625 MHz, 9.0 Vdc, 2.6 Watts

Frequency MHz	dB Below Carrier Reference[1]
925.125	64
1387.688	55
1850.252	65
2312.817	64
2775.379	74
3237.942	80
3701.506	74
4163.069	73
4626.629	87

Required: 43+10Log(2.6) = 47

[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.

H. FREQUENCY STABILITY

(Paragraph 2.995(a)(2) 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 3, 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 9.0 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 3

462.5625 MHz, 9.0 V Nominal, 2.6 watts

Temperature, °C	Output Frequency, MHz	p.p.m.
-29.8	462.560296	-4.8
-19.6	462.560697	-3.9
- 9.3	462.561281	-2.6
0.2	462.562069	-0.9
9.8	462.562800	0.6
19.8	462.562765	0.6
30.3	462.562700	0.4
40.2	462.562886	0.8
50.4	462.563645	2.5

Maximum frequency error: 462.560296
462.562500

- .002204 MHz

FCC Rule 95.621(b) specifies .0005% or a maximum of ± .002313 MHz, which corresponds to:

High Limit	462.564813 MHz
Low Limit	462.560187 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 digital frequency counter as supply voltage provided by an HP 6264B variable dc power supply was varied from ±15% above the nominal 9.0 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 o^C ambient.

TABLE 4

462.5625 MHz, 20°C, 9.0 V Nominal, 2.6 watts

%	Supply Voltage	Output Frequency, MHz	p.p.m.

115	10.35	462.562811	0.7
110	9.90	462.562789	0.6
105	9.45	462.562738	0.5
100	9.00	462.562765	0.6
95	8.55	462.562742	0.5
90	8.10	462.562744	0.5
85	7.65	462.562763	0.6
*	7.20	462.562773	-0.3

Maximum frequency error: 462.562811
462.562500

*Low Battery Indicator Threshold + .000311 MHz

FCC Rule 95.621(b) specifies .0005% or a maximum of ±.002313 MHz, corresponding to:

High Limit 462.564813 MHz
Low Limit 462.560187 MHz

APPENDIX 1

FUNCTION OF DEVICES

Reference	Type	Function
ΘΡ1	2ΣΧ4226	ΡΞ ΡΦ ΑΜΠ
ΘΡ2	2ΣΧ4226	ΡΞ $1^{\Sigma\tau}$ μιξερ
ΘΡ3	ΚΤΧ3880	ΡΞ ΙΦ ΑΜΠ
ΘΡ4	ΚΤΑ1504	ΑΥΔΙΟ ΠΑΤΗ
ΘΡ5	ΚΤΑ1504	ΑΥΔΙΟ ΜΥΤΕ
ΘΡ6	ΚΡΧ104Σ	ΑΥΔΙΟ ΜΥΤΕ
ΘΠ1	ΚΤΑ1504	Π.ΣΑςΕ ΣΩΙΤΧΗΙΝΓ
ΘΡΣ1	ΚΡΑ105Σ	ΡΞ Β+ ΣΩΙΤΧΗΙΝΓ
ΘΧΣ1	ΚΡΧ104Σ	ΡΞ ΧΑΛΛ ΔΕΧΤ
ΘΧΣ2	ΚΤΧ3875	ΡΞ ΧΤΧΣΣ ΔΕΤ
ΘΧΣ3	ΚΡΧ104Σ	ΧΑΛΛ ΜΥΤΕ
ΘΗΛ1	ΚΡΧ104Σ	ΗΙ/ΛΟΩ ΧΟΝΤΡΟΛ
ΘΤΣ1	ΚΡΑ105Σ	ΤΞ ΣΩΙΤΧΗΙΝΓ
ΘΤΣ2	2ΣΧ3875	ΤΞ ΣΩΙΤΧΗΙΝΓ
ΘΤΣ3	ΚΡΧ104Σ	ΤΞ ΣΩΙΤΧΗΙΝΓ
ΘΤΣ4	ΚΡΑ105Σ	ΤΞ ΣΩΙΤΧΗΙΝΓ

ΘΤΣ5	ΚΡΑ105Σ	ΤΞ Β+ ΣΩΙΤΧΗΙΝΓ
ΘΤΣ6	ΚΡΧ104Σ	ΤΞ Β+ ΣΩΙΤΧΗΙΝΓ
ΘΤΣ7	ΚΡΑ101Σ	ΜΙΧ ΑΜΠ Β+ ΣΩΙΤΧΗΙΝΓ
ΘΓ1	ΚΤΑ1276	9 ς ΡΕΓΥΛΑΤΟΡ
ΘΓ2	ΚΤΑ1505	9 ς ΡΕΓΥΛΑΤΟΡ
ΘΓ3	ΚΤΧ3875Σ	9 ς ΡΕΓΥΛΑΤΟΡ
ΘΤ1	2ΣΧ4226	ΤΞ ΒΥΤΤΕΡ
ΘΤ2	2ΣΧ4226	ΤΞ ΔΡΙςΕΡ
ΘΤ3	ΒΡΦ9482	ΤΞ ΑΜΠ
ΘΤ4	ΚΡΧ104Σ	ΡΞ Β+ ΣΩ ΑΤ ΤΞ ΜΟΔΕ
ΘΤ5	ΚΡΧ104Σ	ΩΞ ΣΩ ΑΤ ΤΞ ΜΟΔΕ
ΘΒ1	ΚΡΑ110Σ	ΛΑΜΠ ΣΩΙΤΧΗΙΝΓ
Θ1	2ΣΧ4226	Ρ/ΤΞ ΒΥΤΤΕΡ
Θ31	ΚΡΧ104Σ	ςΧΟ
Θ32	2ΣΧ5084	ςΧΟ
Θ33	2ΣΧ5084	ςΧΟ
ΘΩ1	2ΣΧ4226	ΡΦ ΑΜΠ
ΘΩ2	2ΣΧ4226	1στ ΜΙΞ
ΘΩ4	2ΣΧ4226	ςΧΟ
ΘΩ5	2ΣΧ4226	ςΧΟ
ΙΧ1	ΤΒ31202	ΠΛΛ ΙΧ
ΙΧ2	ΔΒΛ 5019	ΦΜ ΙΦ ΙΧ
ΙΧ3	ΜΣΕΛΠ	6 στ ΦΙΛΤΕΡ ΙΧ
ΙΧ4	ΜΧ14053	ΑΝΑΛΟΓ ΣΩΙΤΧΗ
ΙΧ5	ΙΛ 358Φ	ΧΑΛΛ ΔΕΤ
ΙΧ6	ΙΛ 324Φ	ΔΕ–ΕΜΠΗΑΣΙΣ ΑΝΔ 300Ηζ ΗΠΦ
ΙΧ7	ΙΛ 386	ΑΥΔΙΟ ΠΟΩΕΡ ΑΜΠ
ΙΧ8	ΤΚ11450	ΡΕΓΥΛΑΤΟΡ
ΙΧ9	ΙΛ 358Φ	ΤΞ ΑΠΧ
ΙΧ10	ΤΜΠ87Χ21ΔΦ	ΧΠΥ
ΙΧ11	ΙΛ 324	ΤΞ ΠΡΕ–ΕΜΠΗΑΣΙΣ ΑΝΔ 300Ηζ ΗΠΦ
ΙΧ12	24Χ02	ΕΕ–ΠΡΟΜ

APPENDIX 2

CIRCUITS AND DEVICES TO STABILIZE FREQUENCY, SUPPRESS SPURIOUS EMISSIONS AND LIMIT MODULATION

THREE (3) PAGE THEORY OF OPERATION
FOLLOWS THIS SHEET

CIRCUITS AND DEVICES TO
STABILIZE FREQUENCY, etc.
FCC ID: BBOPR2000WX

APPENDIX 2

7.THEORY OF OPERATION

Circuit Compositions and Operation Theory

The basic explanation for the circuit composition the one board controlling the analog circuit parts and the digital circuit parts.

Receiver

Transmission parts are composed in the double conversion system, which has the 1st IF Frequency of 21.7 MHz and 2nd IF Frequency of 450 kHz. With the saw filter, which has an excellent band characteristic and sharp characteristic, the 2 poles MCF used in the 1st IF, and the sensitivity repression is reduced for the more stable reception.

RF Frontend

The signal received by the antenna will be transmitted to the band pass filter through the antenna switching circuit consisted of LT8,LT7, LT9, CT21, CT22 and C24. The front RF amplifier transistor QR1 consists of the saw filter and input/output band pass filter.

Saw filter has the bandwidth of approximately 4 MHz, primarily diminishes the other signal rather then the 1st IF image and other signal within the reception band and amplifies only the necessary signal within the RF.

1st Mixer

The receiver signal which has been amplified in the RF fronted is provided to the base of the 1st mixer QR2. The 1st L/O signal provide from the VCO is supplied to the emitter of QR2 and converted to the 1st IF 21.7 MHz.

1st IF Filter and 1st IF Amplifier

The signal covered by QR2 to 21.7 MHz, the 1st frequency, change its impedance through CR22, LR6 and then is infused to the fundamental MCF which has the center frequency of 21.7 MHz and the width of +/-3.75 kHz.

Here, the signal reduces the image and other unwanted signal for the 2nd IF, and changes its impedance again through the CR24. Then the signal is infused to the QR3, the 1st IF amplifier. The signal infused to the QR3 is amplified approximately by 20 dB in other to acquire the required reception sensitivity, and infused to the IC2 which functions as the 2nd mixer, the 2nd IF amplifier, and the FM detector.

2nd Mixer, and IF, FM Detector (IC2)

The receiver IF signal of 21.7 MHz, which has been infused to IC2 is mixed with the 2nd L/O signal of 21.250MHz, and converted to 450 kHz, the 2nd IF frequency. The receiver signal converted to the 2nd IF frequency passed through the CF2, the ceramic filter of 450 kHz again. After the limiting inside the IC2 and the FM demodulating by the quadrature detector inside the IC2, the signal offers the output through the 9th pin of IC2.

The 2nd L/O signal of 21.250MHz, which infused to the IC2 filters and uses directly the crystal of 21.250 MHz. The squelch circuit is composed to detect the noised from the received signal demodulate in the 9th pin of the IC2. For this purpose, the noise filter is using the OP amplifier inside the IC2.

De-Emphasis and 300 Hz HPF (IC6)

The audio signal which has been FM demodulate in the IC2 is supplies to the IC6 which function as the De-emphasis and 300 Hz HPF.

Since the IC6D has the 300 Hz HPF with the 1st characteristics and the De-emphasis characteristic with the corner frequency of approximately 200 Hz, and IC6A, the IC6B, and the IC6C has the 300 Hz HPF with the 6th characteristics, they function as a normal De-emphasis and also reduce the signal such as CTCSS to unwanted noised from the speaker. Audio Power Amplifier (IC7)

The received audio signal, which has been adjusted to the appropriate volume in the VR401 are supplied to the 2nd pin of the IC7 amplified approximately by 20 dB. Then, it turns up the speaker with the maximum output of 0.7 Watts.

The 7th pin of the IC7 is the audio mute terminal. If a voltage supply to the 6th pin of the IC7 is supplied to this terminal, the IC7 stops functioning as the audio power amplifier regardless of the signal supplied to the 2nd pin of the IC7, and there is no sound emitter from the speaker.

Transmitter

The transmission parts of the FRS-1000 are designed to amplify the RF signal oscillated and modulated by the synthesizer to approximately 2.3(0.5) W by the power transistor of QT3.

Pre-emphasis and 300 Hz HPF. Limiter (IC11D, 11C)

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

3 kHz LPF (IC11B, IC11A)

After passing the IC11C limiter, the signal is combined with the CTCSS tone at the digital circuits, passes the RV3, 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.

TX Power (QT3)

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 2.3W here passes the TX LPF of the 2nd characteristic of the LT5 and the LT6, 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.

Voltage Control Oscillator (VCO)

The VCO of oscillates 462.5625 MHz to 462.7250 MHz under the transmission condition and 440.8620 MHz to 441.025 MHz under the reception condition. The VCO consists of the clip oscillator of the Q32, and contains the oscillator frequency of approximately 21.7MHz during the transmission/reception conversion. That is since the VCO should oscillate relatively low frequency during reception compared to transmission, the D202 is directly biased by the Q31.
Therefore as a result, the C205 is added in parallel to the resonance circuit of the VCO to oscillate a low frequency. During transmission, a relatively high frequency should be oscillating compared to reception. Therefore, the D202 is adversely biased by the QR2, and as a result, the C205, which is added unparallel to the circuit of the VCO is removed to oscillate the desired transmission frequency.
The IC1 PLL IC controls the VCO in order to oscillate the accurate frequency. The IC1 PLL IC controls the VCO in order to oscillate accurate frequency. The output frequency of the VCO is supplied to the IC1 PLL IC immediately. At the IC1, TCXO(21.250MHz) by the TCXO-1 is compared to the output frequency of the VCO.
The VCO is controlled the loop filter consisted of the RL10, RL11, and the CL10, CL11, CL12 in order to oscillate the stable frequency wanted for the radio.
The VCO controlled voltage which ahs passed the loop filter is supplies to the D201 varactor diode, and the VCO an oscillate the PLL programmed frequency by the capacity variation in the D201. In addition, the L203 on the VCO circuit function as frequency for the VCO to be properly controlled by the IC203 PLL IC.

RX/TX Buffer Amplifier (Q1)

The RF signal oscillate at the VCO is provide to the Q1 RX 1st mixer through the Q1 during the reception, and is provide to the QT2 power driver amplifier through the QT3 during the transmission.

PLL Frequency Synthesizer (IC2)

The PLL synthesizer of the signal loop PLL circuit with the reference of 6.25 kHz. The IC2 PLL IC includes all the function such as the reference oscillator, the driver, the phase detector, the lock detector, and the programmable divider.

At the reference oscillator, the 12.8 MHz TCXO of the TCXO-1 is connected to the pin 2,3 of the IC2 to oscillate the frequency of 21.250MHz. The TCXO (21.250MHz) is the temperature compensation circuit to maintain the frequency within the allowable error range even under a low temperature of -20□.

The phase detector sends out the output power to the loop filter through 10 pin of the IC2. 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.

The programmable decider divider maintains the desired frequency with control from the CPU. The dividing ratio, "N" to oscillate the desired frequency is as below:

N = VCO oscillation frequency / reference frequency

If the desired frequency is 462.5625 MHz

N = 462.5625 MHz / 0.00625 MHz = 74010

CTCSS PROCESSING

RX CTCSS Tone Processing

The received CTCSS tone is sent out through 9th pin of the IC2, and supplies to the IC3 switching capacitor filter through the IC4 analog switch. The voice signal, which cans effectors the reception of the CTCSS tone is decreased enough at the IC3. The cut off frequency at the IC3 is adjusted by the IC10 CPU to suit the characteristic of the CTCSS tone.

The CTCSS tone received at the IC3 is supplies to the 19th pin of the IC10 CPU, and receives the desired CTCSS tone.

TX CTCSS Tone Processing

The TX CTCSS tone composed at the IC10 CPU is properly reduce at the R54.55 and supplies to IC11B, IC11A and supplies to the RVM1 TX deviation semi.

CPU and MEMORY

The IC10 CPU controls most of the control functions of the PR-2000WX.

The IC10 CPU has the internal ROM in the capacity of 16 K byte, and the program for the operation of the IC20.

When the power of turned on, the IC10 reads the data necessity for the operation from the IC20 EEPROM, and decide the operation channel, frequency, etc.

If the user alters any parameter of the radio, the IC10 updates the altered parameter to the IC20.

8. Alignment instructions

WARNING

Any repairs or adjustments should be made under the supervision of a qualified radiotelephone technician.

TRANSMITTER

1.Power Supply Voltage

The Power supply voltage should be set for 9.0VDC measured at the radio during transmit. Periodically check the power supply voltage during the alignment procedure.