KYODO

VHF FM MOBILE RADIO

KG107-15A/B

High Power Model

20-40W

136-150MHz or 146-174MHz

SERVICE MANUAL

1-5 Specifications

1-5-1 General

Frequency range:	KG107-15A40 KW/N 136 to 150 MHz KG107-15B40 KW/N 146 to 174 MHz
Number of zones and channels:	2 zones selectable, and maximum 99 programmed channels/zone
Number of programmed SCAN channels:	99 channels maximum
Channel spacing:	Wide-band: 20 kHz, 25 kHz, or 30 kHz Narrow-band: 12.5 kHz
Channel bandwidth:	RX = 3 MHz, TX = 6 MHz
Mode of operation:	Single or dual frequency simplex press-to-talk system
Antenna impedance:	50 ohm unbalanced
Power supply:	13.6 V DC ±20% negative ground
Power consumption:	5 A at 20 watts power output 10 A at 40 watts power output
Environmental conditions:	Ambient temperature -30°C to +60°C Relative humidity 95% at +35°C
Dimensions (main transceiver unit):	178 mm width 44 mm height 204 mm depth
Weight (main transceiver unit):	1.8 kg

1-5-2 Transmitter

RF power output:	20 to 40 watts, continuously variable
Maximum frequency deviation:	Wide-band: ±5 kHz Narrow-band: ±2.5 kHz
Frequency stability:	Wide-band: ±0.0005% Narrow-band: ±0.0003%
Frequency response:	Within +1, -3 dB of 6 dB/octave pre-emphasis from 0.3 to 3 kHz, 1 kHz reference

Signal to noise ratio:	Wide-band:	More than 50 dB at 1 kHz 70% modulation
	Narrow-band:	More than 45 dB at 1 kHz 70% modulation
Modulation distortion:	Less than 3% at 1 kHz 70% modulation	
Spurious and harmonics:	More than 70 dB down below rated power	

1-5-3 Receiver

Intermediate frequency:	1st IF	21.6 MHz
	2nd IF	455 kHz
Frequency stability:	Wide-band: Narrow-band:	±0.0005% ±0.0003%
Sensitivity:	Less than 0.35 µV for 20 B noise quieting	
	Less than 0.25 µV for 12 dB SINAD	
Squelch sensitivity:	Less than 0.25 µV	
Bandwidth:	More than 12 kHz for 6 dB down	
Selectivity:	More than 70 dB at 25 kHz point	
Blocking:	More than 90 dB	
Intermodulation:	More than 70 dB	
Spurious responses:	More than 80 dB	
AF response:	Within +1, -3 dB of 6 dB/octave de-emphasis from 0.3 to 3 kHz, 1 kHz reference	
AF output:	More than 2 watts into 4 ohm load, 0 dBm ±3 dB at 600 ohm balanced line	
	External speaker:	4 watts into 4 ohm load
AF distortion:	Less than 5% at 1 kHz 70% modulation	
Signal to noise ratio:	Wide-band:	More than 50 dB at 1 kHz 70% modulation
	Narrow-band:	More than 45 dB at 1 kHz 70% modulation

4. CIRCUIT DESCRIPTION

4-1 RX Section

The RF input signal incoming from the antenna passes through the lowpass filter, the antenna relay, and the bandpass filter (BPF-1) in succession to undergo amplification by Q1. The amplified signal passes through the bandpass filter (BPF-2) to be applied as the input to the DBM-1 (diode, double-balanced mixer).

The DBM-1 is to mix the amplified RF signal with the 1st local oscillator (LO) signal to develop the 1st IF signal at 21.6 MHz as its mixed output.

The output signal is further amplified by Q2, followed by still further amplification by Q3 after the initially amplified signal being applied to the crystal filter (XF-1). The finally amplified signal is applied to IC-1 as its input. At IC-1, the 1st IF signal at 21.6 MHz is converted into 455 kHz through the 2nd mixer. The 455 kHz signal passes through the 455 kHz ceramic filter (CF-1) to obtain an AF signal via the limiting amplifier and discriminating circuit.

The AF signal is then separated into the audio signal and the noise signal necessary for squelch control.

The audio signal passes through the lowpass filter (IC-2 (1/2)), the delay circuit consisting of Q6, Q7, and IC-3, and the lowpass filter (Q8) for application to DC-controlled volume control IC-4. The output signal from IC-4 passes in succession through the high-pass filter of IC-5 (1/2), the integrating circuit of IC-5 (1/2), and the squelch gate circuit (Q10) to undergo power amplification by IC-6. The power-amplified signal is applied to the speaker to radiate acoustic energy therefrom.

The squelch noise signal undergoes amplification by IC-1 and IC-2 (1/2) and detection by DC, to become a DC signal.

The DC signal passes through the switching circuit consisting of IC-1 and Q4 to obtain the input to the microcomputer (IC403).

The microcomputer develops the squelch gate signal as its output depending on the status.

4-2 TX Section

The transmit signal from the PLL (phase-locked loop) unit undergoes amplification by Q201 and IC201 and further power amplification by Q204. The amplified signal emerges, via the relay circuit and the lowpass filter, from the antenna as its output. Part of the output is detected by D203 to drive the APC circuit consisting of IC202 (1/2) and Q203 and to obtain the rated output.

In cases where reflected powers are predominant or the ambient temperature rise is excessive, both Q205 and Q206 initiate operation, thereby reducing the TX output for the protection of the TX section.

4-3 Modulator Section

The audio signal incoming from the microphone undergoes AGC amplification and further amplification by IC408 and IC8 (1/2). The amplified audio signal passes through the pre-emphasis circuit consisting of C76 and R84 before it is amplitude-limited by the limiting amplifier IC8 (1/2). The amplitude-limited signal passes through the lowpass filter consisting of L9 and L10 to become a modulating signal to be applied to the gate of TX VCO FET (Q302).

4-4 VCO Section

This section incorporates two oscillation circuits, Q301 and Q302. Whereas Q301 (RX VCO) is for use with RX 1st local oscillator (LO) (F-21.6 MHz), and Q302 (TX VCO) is to initiate oscillations at the transmit frequency.

These oscillators can be switched over by means of the press-to-talk switch, Q306, and Q309.

Either oscillator output is amplified by the buffer amplifier (IC 301) to become the input signal to RX 1st LO (Q303), TX amplifier (Q304) and a part of the prescaler (IC104). The RX LO signal is amplified by Q303 to cause the 1st mixer DBM-1 to drive.

The transmit signal is amplified by Q304 and the amplified signal becomes the input signal to the TX section. The PLL circuit when unlocked causes Q305 and Q308 to operate, thereby turning "OFF" the TX output.

4-5 PLL Section

On designating the address data of EP-ROM IC101 corresponding to channel number by the microcomputer IC403, the data signal goes to PLL IC102 as its input.

The PLL IC102 is to frequency divide both the reference frequency and the frequency incoming from the VCO in accordance with the ROM data and to develop their difference frequency output, thereby controlling the VCO oscillation frequency.

The 1.5 MHz reference frequency is obtained by dividing the 12.00 MHz oscillation frequency of TCXO (X101) into one-eighth (1/8) by means of IC103.

The VCO signal undergoes frequency division of 1/64 and 1/65 by prescaler IC104 and these signals are applied to the PLL IC as its inputs.

5. MAINTENANCE INSTRUCTIONS

5-1 General

The KG107 radio has been designed to ensure a high degree of reliability over a long trouble-free service life without maintenance efforts.

However, occasional inspections and adjustments are required to maintain the radio in the optimal conditions.

5-2 Necessary Tools and Measuring Equipment

It is recommended that the undermentioned measuring equipment and maintenance tools be properly stored in your maintenance shop for ready use

1. Circuit Tester
2. RF Power Meter
3. Vacuum-Tube Voltmeter
4. AF Generator (600 ohms, 100 through 10,000 Hz)
5. Linear Detector
6. Distortion Meter/Level Meter
7. Directional Coupler
8. Standard Signal Generator
9. Frequency Counter
10. Spectrum Analyzer

5-3 Precautions in Inspection and Adjustments

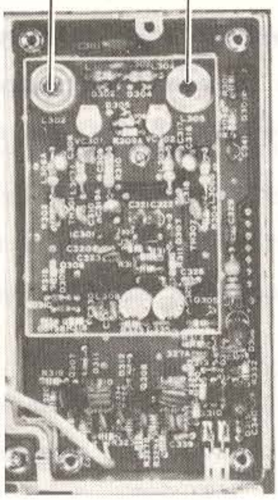
1. Always use standard-tip screwdrivers that best fit core slots in adjustment. Be very slow and cautious in turning the cores.
2. In adjusting the VCO, never turn trimmer capacitors or cores with an ordinary screwdriver. Be sure to use an RF screw-drivers. Otherwise, adjustments may result in failure due to the effect of stray capacitances.
3. Keep all measuring instruments calibrated at all times for availability of accurate measurements.

5-4 Adjustment Items and Procedures

All items, 5-4-1 through 5-4-3 that follow, have been precisely adjusted at our factory before shipment.

Need for readjustment of these items at site might arise depending on the circumstances, except that need for readjustment will seldom occur as to items 5-4-3 (3) and (4).

5-4-1 VCO/PLL Adjustments



1. Receive VCO Adjustment

   Connect a voltmeter to TP103 on PLL Unit and adjust Trimmer Capacitor L302 with a coredriver to read 3V on the voltmeter.

2. Transmit VCO Adjustment

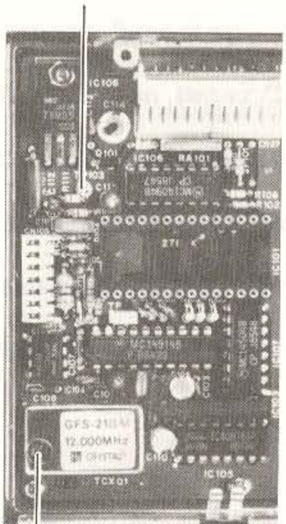
   Put the KG107 in transmit mode and adjust Trimmer Capacitor L305 to read 3V on a voltmeter connected to TP103.

3. Verification of Transmit (Receive) Frequency

   Under TX mode, verify transmitting frequency. If within ±1 ppm at room temperature, it's OK. Never turn trimmer capacitor in TCXO.

   If tolerances of ±1 ppm are exceeded, readjust the transmit frequency by turning the trimmer capacitor.

   After verification, apply a signal from the standard signal generator to the antenna to see that the receiver remains fully sensitive when a programmed frequency signal is applied to the receiver.



(Note that the foregoing also serves for verification of EP-ROM programs.)

PRECAUTIONS:

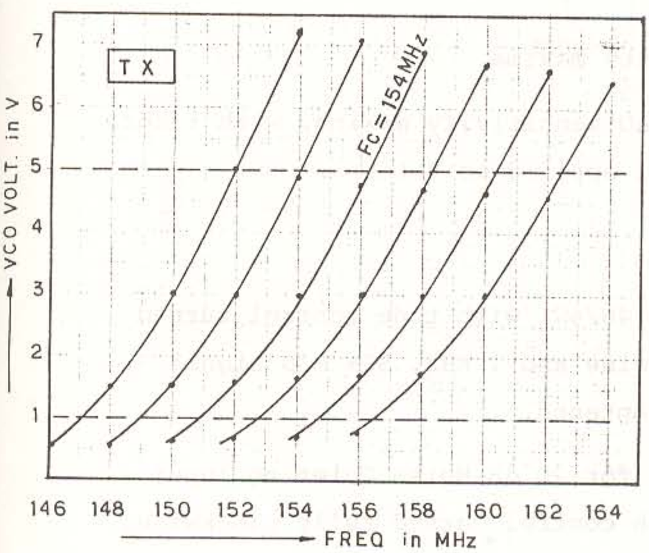
The radio performs trouble-free operation within the VCO voltage range, 1 to 5V, as read on a voltmeter connected to TP103.

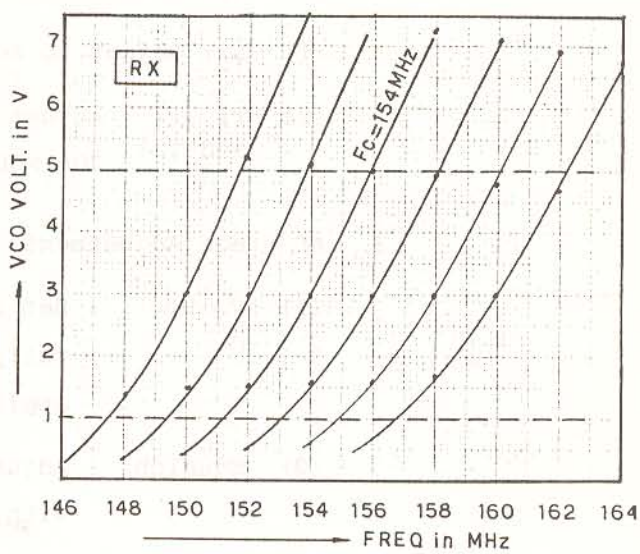
Adjust trimmer capacitor to read 3V (mid-position) on the voltmeter in case of single channel.

In case of multichannel, verify VCO voltages for the lowest and the highest frequencies and perform centering so that all fall between 1 and 5V.

Note that the frequency vs. VCO voltage curve inclination of RX is steeper than that of TX (i.e., the bandwidth of RX is narrower).

Be sure to refer to the characteristic curve in adjusting RX.



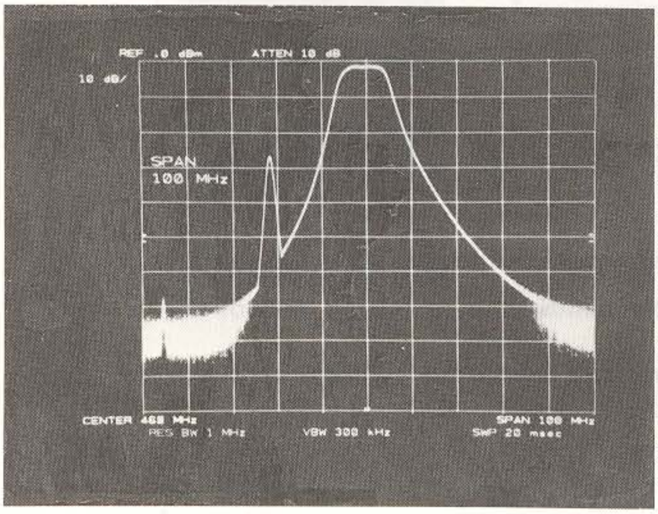


5-4-2 Adjustments of RX Section

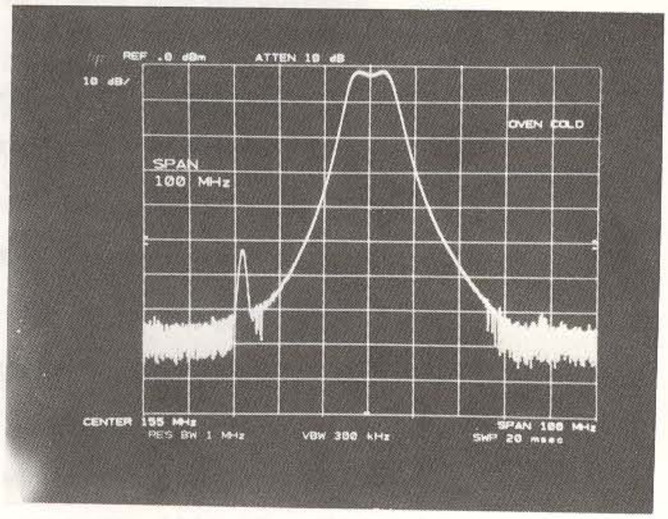
1. RF Stage Adjustment

Adjust BPF1 and BPF2 for maximum sensitivity points (with a screwdriver).

A better result can be obtained by measurement using a tracking generator.



UHF (468 MHz)



VHF (155 MHz)

2. IF Stage Adjustment

(1) L3: Adjust to sensitivity maxima.

(2) T1, T2 and T3: Adjust to SINAD sensitivity maxima, with 1 kHz, 70% MOD signal applied to Antenna.

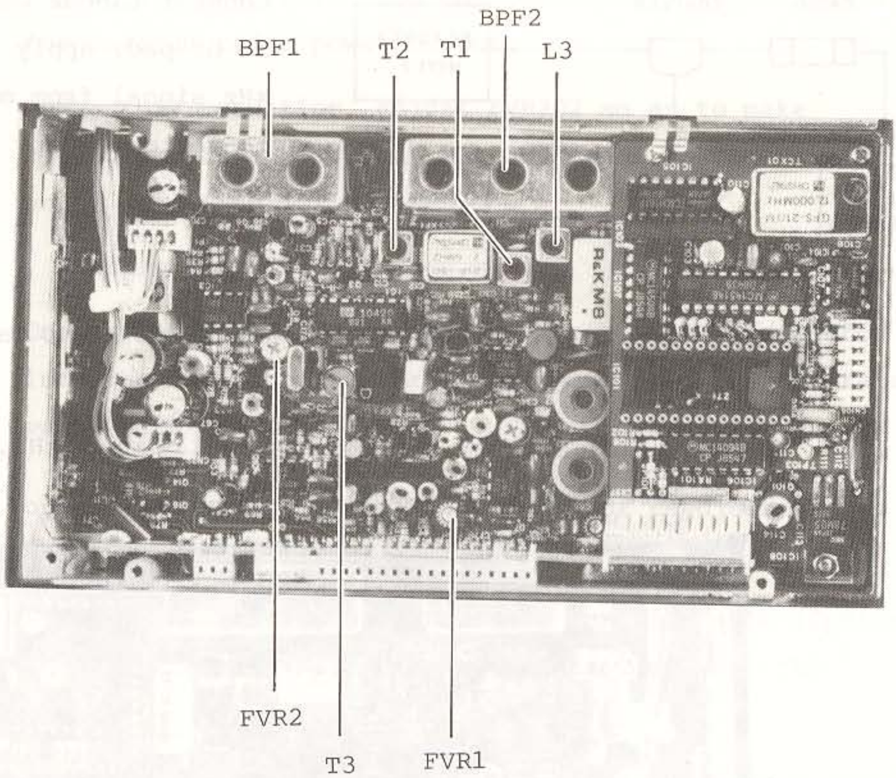
3. AF Stage Adjustment

(1) Volume : Set FVR2 to 4W/4Ω, with tone control turned fully clockwise and 1 kHz, 50% MOD signal applied to Antenna.

(2) Squelch : Adjust FVR1 for 20 dB Noise Quieting Input, with squelch control turned fully clockwise.

(3) Clock Oscillation:

Verify clock oscillation frequency falls within 12.5 kHz ±2 kHz, with Frequency Counter connected to TP1.

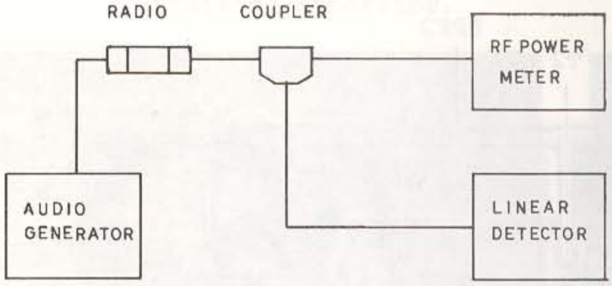


5-4-3 Adjustments of Transmitter Section

(1) Transmitter Output:

Adjust power with FVR201 in PA. Turning clockwise decreases power.

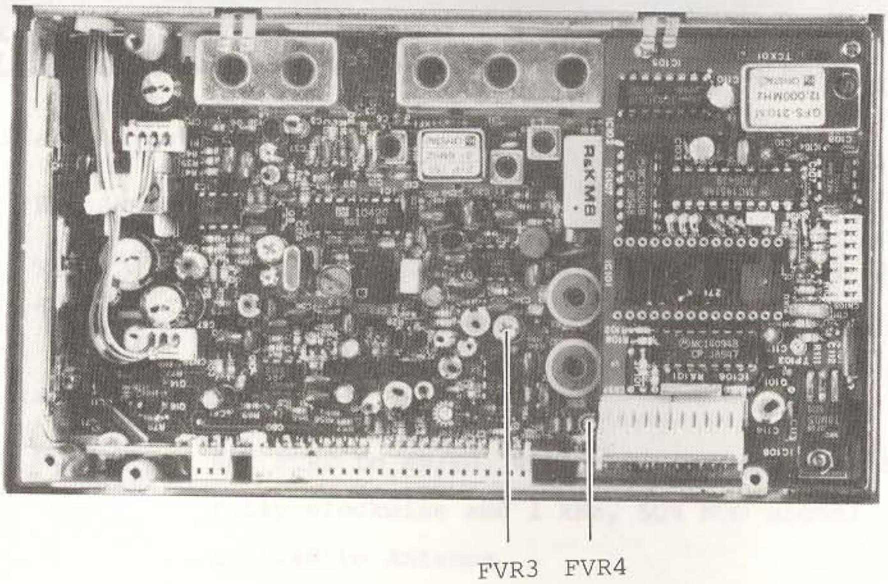
(2) Frequency Deviation:



Connect Linear Detector to 20 dB pad, apply -14 dB, 1 kHz signal from microphone connector.

Then, adjust FVR4 to obtain a reading of 5 kHz (at max.) on the linear detector.

Further, adjust FVR3 to make the deviation 3 kHz, with input level down to -34 dBm (1 kHz).



(3) Power Protector (No need for readjustment at the site, as a rule)

This has the function of restricting maximum current, with the antenna open.

Adjusting procedure steps are as follows:

1) Adjust FVR201 to reduce RF output power to one-half the rated output.

   Read collector voltage $V_{1/2}$ of APC transistor (2SA1359) on a voltmeter connected to the collector.

2) Unplug antenna cable from the connector. Adjust FVR201 for maximum radio power output.

3) Under this condition, adjust FVR202 so as to make collector voltage (Vo) of 2SA1359 equal to the voltage under condition 1.

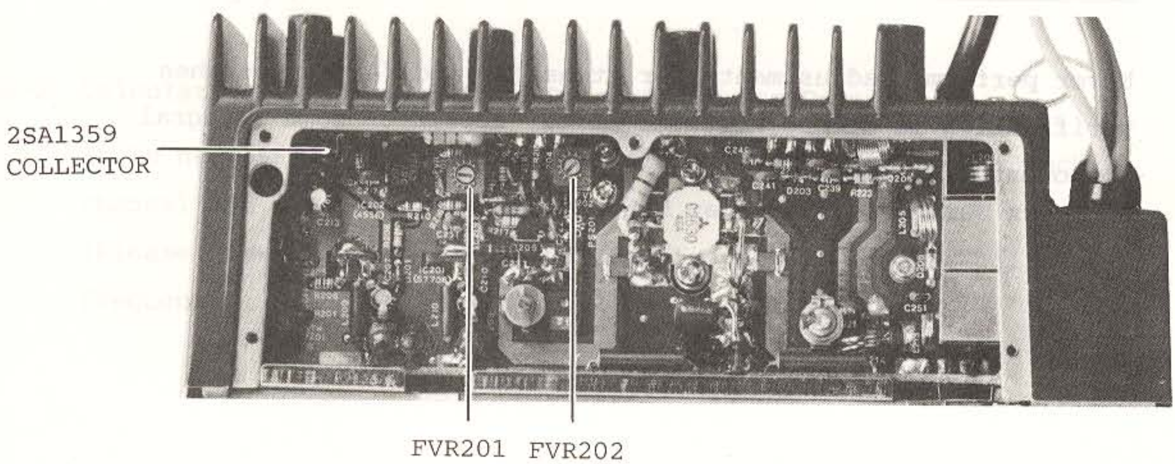
   That is, $V_o = V_{1/2}$

4) On completion of FVR202 adjustment, plug ANT connector into the mating connector and restore power to the rated value with FVR201.

(4) Microphone Compressor Circuit (No need for readjustment at the site, as a rule.)

1) Prepare the testing 34-PIN Remote Control Cable (Option) and interconnect Main Unit and Controller with the cable.

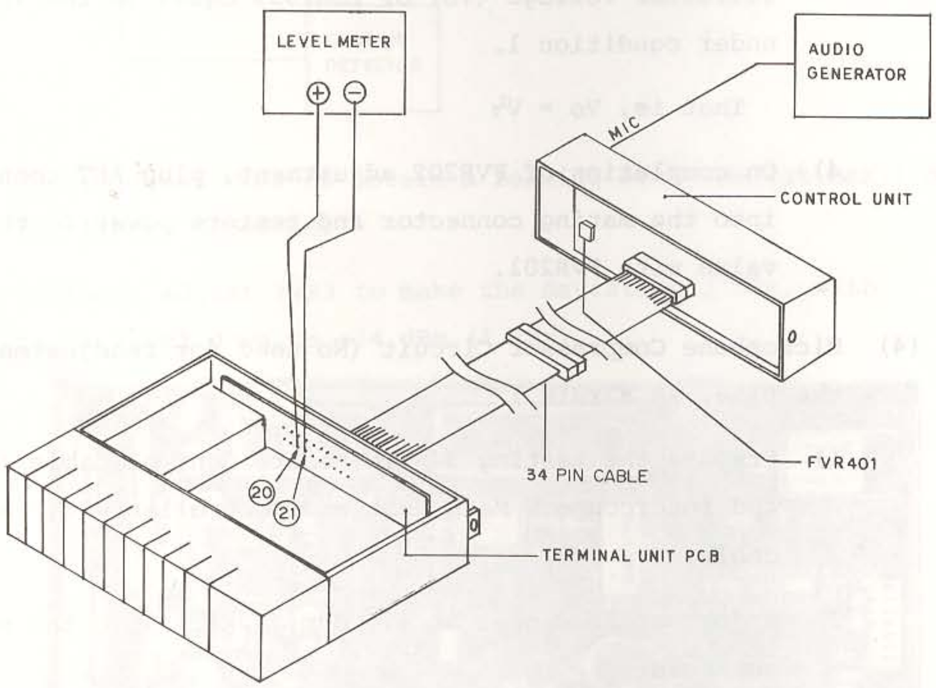
2) Inject an AF signal at -14 dBm (1 kHz) into the microphone connector.



3) Connect level meter to pins (20) and (21) on CN6P (pins (20) and (21) on terminal unit CN6S on the radio side may be substituted).

Adjust FVR401 so as to make the output level of (20), (21) 200 mV ±20 mV.

4) Lower the microphone input level to -34 dBm (1 kHz) and check the level -10 dB down.



PRECAUTIONS:

Never perform readjustments for items (3) and (4) except when verification is deemed necessary after repair of some integral component, for instance.

6. EP-ROM PROGRAMMING INSTRUCTION

6-1 Calculating the "Reference Division Rate" Address Data

REFERENCE DIVISION RATE "R"

The Reference Division Rate must always be calculated for both the transmit and the receive frequencies.

The 12.00 MHz TCXO output signal is divided by 8 to provide a 1.5 MHz Reference Frequency.

This Reference Frequency is sampled and divided by the "Reference Division Rate" to determine the channel spacings.

e.g. 12.00 MHz/8 = 1.5 MHz

then 1.5 MHz/(Channel spacing) = Reference Division Rate

as follows:

Channel Spacings	Calculations		Ref. Div. Rate "R"
25 kHz	1.5 MHz/25 kHz	=	60
15 kHz	1.5 MHz/15 kHz	=	100
12.5 kHz	1.5 MHz/12.5 kHz	=	120
10 kHz	1.5 MHz/10 kHz	=	150
5 kHz	1.5 MHz/5 kHz	=	300

Next it is necessary to determine the address information by referring to the attached "A - D CONVERSION LIST".

e.g. 12.5 kHz channel spacing

= Reference Division Rate "R"

= 120

⇓

8 7 0

6-2 Calculating the Transmit and Receive Address Data

It is necessary to calculate the following information for each channel and for both the transmit and receive frequencies required. (Please note: The receive frequency is the 1st local oscillator frequency).

D = Basic Division Rate

d = Prescaler Division Rate

N = Number of Complete Divisions

R = Remainder of the Basic Division Rate

(a) "D" Calculation

"D" is obtained by dividing the frequency required by the channel spacing required.

(b) "d" Calculation

"d" is the prescaler division rate, and it is fixed at 64.

(c) "N" and "A" Calculation

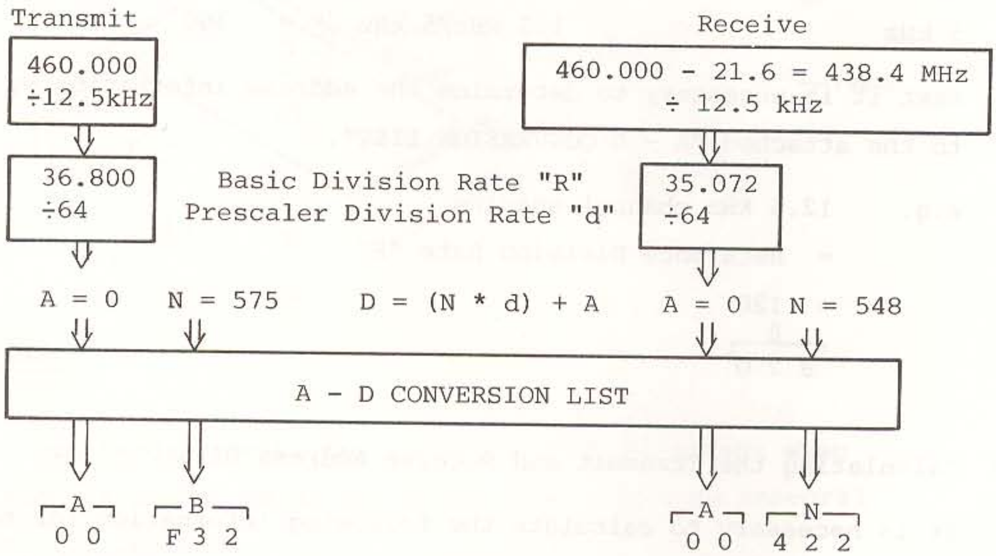
"N" and "A" are calculated using the following equation:

D = (N * d) + A

(d) Example Calculation

e.g.

Channel # 1, 460.000 MHz, Simplex, 12.5 kHz Channel Spacing



6-3 Input of Address Data

	ADDRESS															
Channel #1 address	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
	RX(A)		RX(N)			RX(R)		TX(A)			TX(N)			TX(R)		
Buffer input data	00	00	04	02	02	08	07	00	00	00	0F	03	02	08	07	00
Channel #2 address	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E	1F
	RX(A)		RX(N)			RX(R)		TX(A)			TX(N)			TX(R)		
Buffer input data	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF
Channel #3 address	20	21	22	23	24	25	26	27	28	29	2A	2B	2C	2D	2E	2F
	RX(A)		RX(N)			RX(R)		TX(A)			TX(N)			TX(R)		
Buffer input data	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF	FF