2. MODEL AM-2250

POWER AMPLIFIER SECTION

RATED OUTPUT POWER 2-CHANNELS DRIVEN	25 watts per channel, minimum RMS at 8 ohms from 20 to 20,000 Hz with no more than 0.2% total harmonic distortion.
POWER BANDWIDTH (IHF)	10 Hz to 40 kHz/8 ohms (Total Harmonic Distortion: 0.2%)
SIGNAL TO NOISE RATIO (IHF)	
PHONO	Better than 75 dB
AUX	Better than 95 dB
RESIDUAL NOISE	Less than 0.7 mV at 8 ohms
CHANNEL SEPARATION (IHF) PHONO	Better than 45 dB at 1,000 Hz
DAMPING FACTOR	More than 50 (1 kHz, 8 ohms)
OUTPUT SPEAKERS	A, B (4 to 16 ohms)/A+B (8 to 16 ohms)
HEADPHONE	4 to 16 ohms

PREAMPLIFIER SECTION

INPUT SENSITIVITY/IMPEDANCE	
PHONO	3 mV/47 kohms
AUX	150 mV/100 kohms
TUNER	150 mV/100 kohms
TAPE MONITOR	PIN: 150 mV/100 kohms DIN: 30 mV/80 kohms
OUTPUT LEVEL/IMPEDANCE	
TAPE REC	PIN: 150 mV/100 kohms DIN: 30 mV/80 kohms
FREQUENCY RESPONSE	
PHONO (RIAA EQUALIZATION)	30 Hz to 15 kHz +1 dB, –1 dB
TUNER, AUX, TAPE MONITOR	10 Hz to 40 kHz +0 dB, –1 dB
TONE CONTROL BASS	±8 dB at 100 Hz
TREBLE	±6 dB at 10 kHz
LOUDNESS CONTROL	+9 dB at 100 Hz, +4 dB at 10 kHz (Volume control set at –30 dB position)

MISCELLANEOUS

SEMICONDUCTORS	Transistors: 3, Diodes: 4, ICs: 2
POWER REQUIREMENTS	120V, 60 Hz for U.S.A. and Canada 220V, 50 Hz for Europe except U K. 240V, 50 Hz for U K. 110/220/240V, 50/60 Hz Switchable for other countries
DIMENSIONS	380 (W) x 130 (H) x 220 (D) mm (15 x 5.1 x 8.7) inches
WEIGHT	6.2 kg (13.6 lbs)

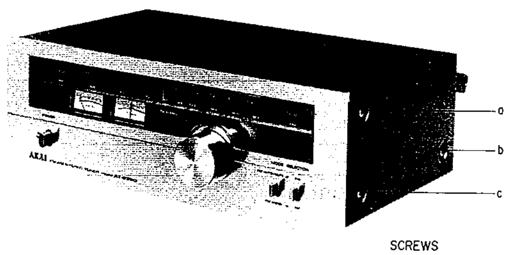
* For improvement purposes, specifications and design are subject to change without notice.

II. DISMANTLING OF UNIT

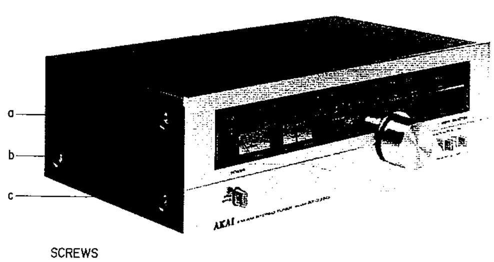
In case of trouble, etc. necessitating dismantling, please dismantle in the order shown in the photographs. Reassemble in reverse order.

1. MODEL AT-2250

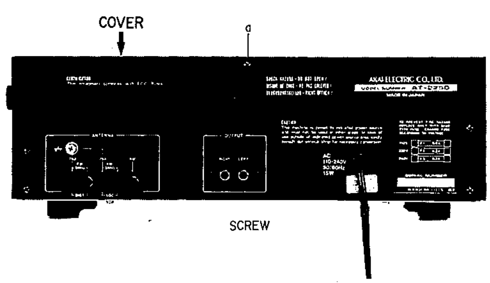
1



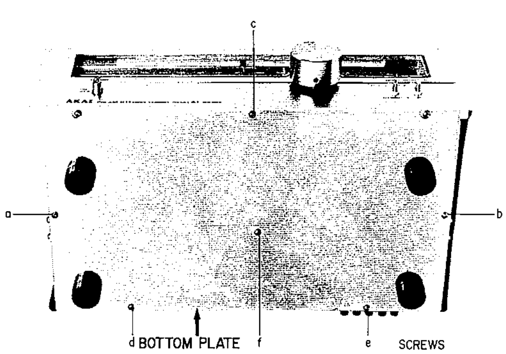
2



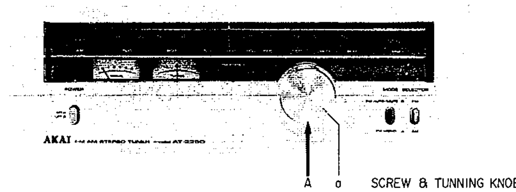
3



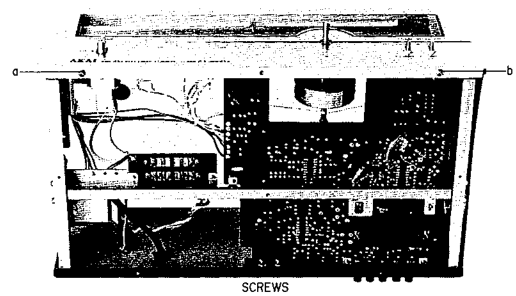
4



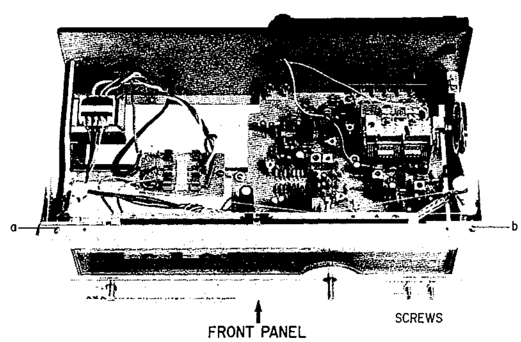
5



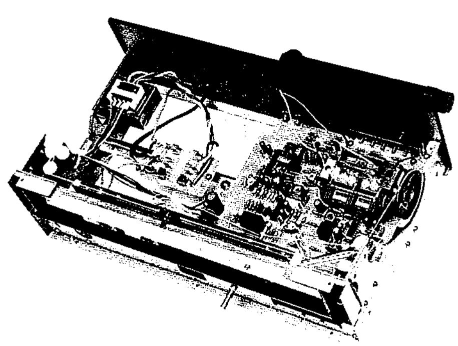
6



7

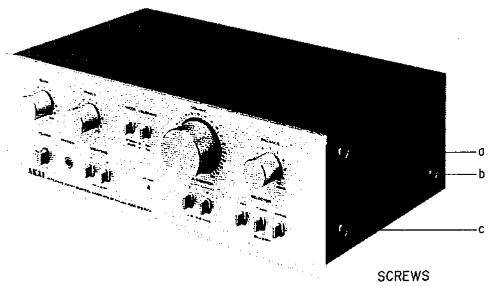


8



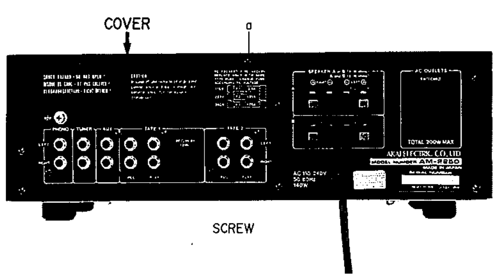
2. MODEL AM-2250

1

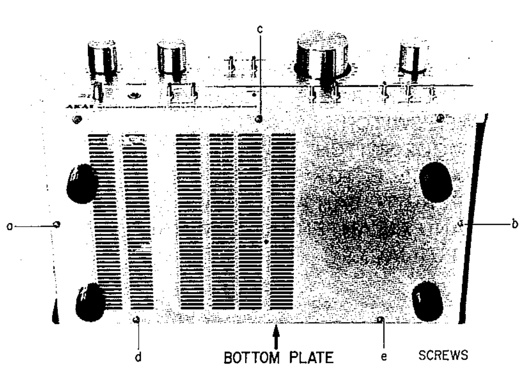


2

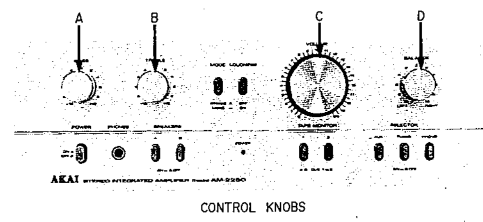
3



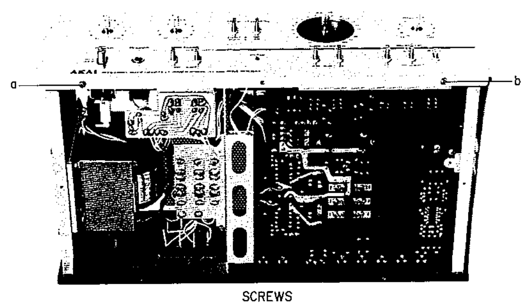
4



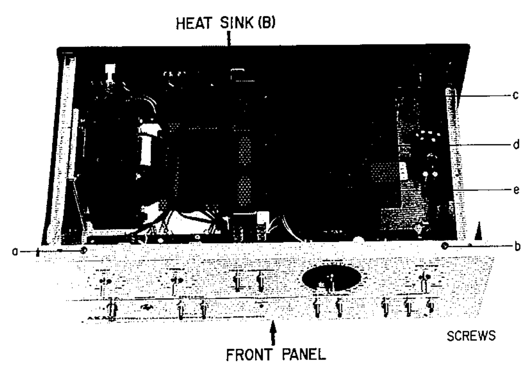
5



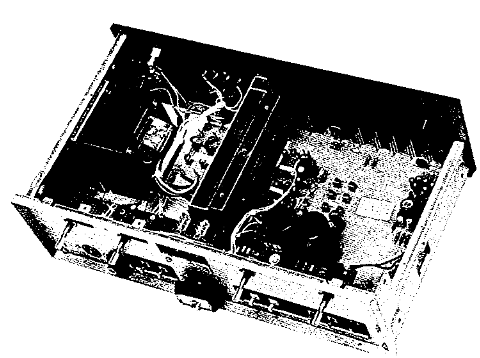
6



7



8



III. CONTROLS

1. MODEL AT-2250

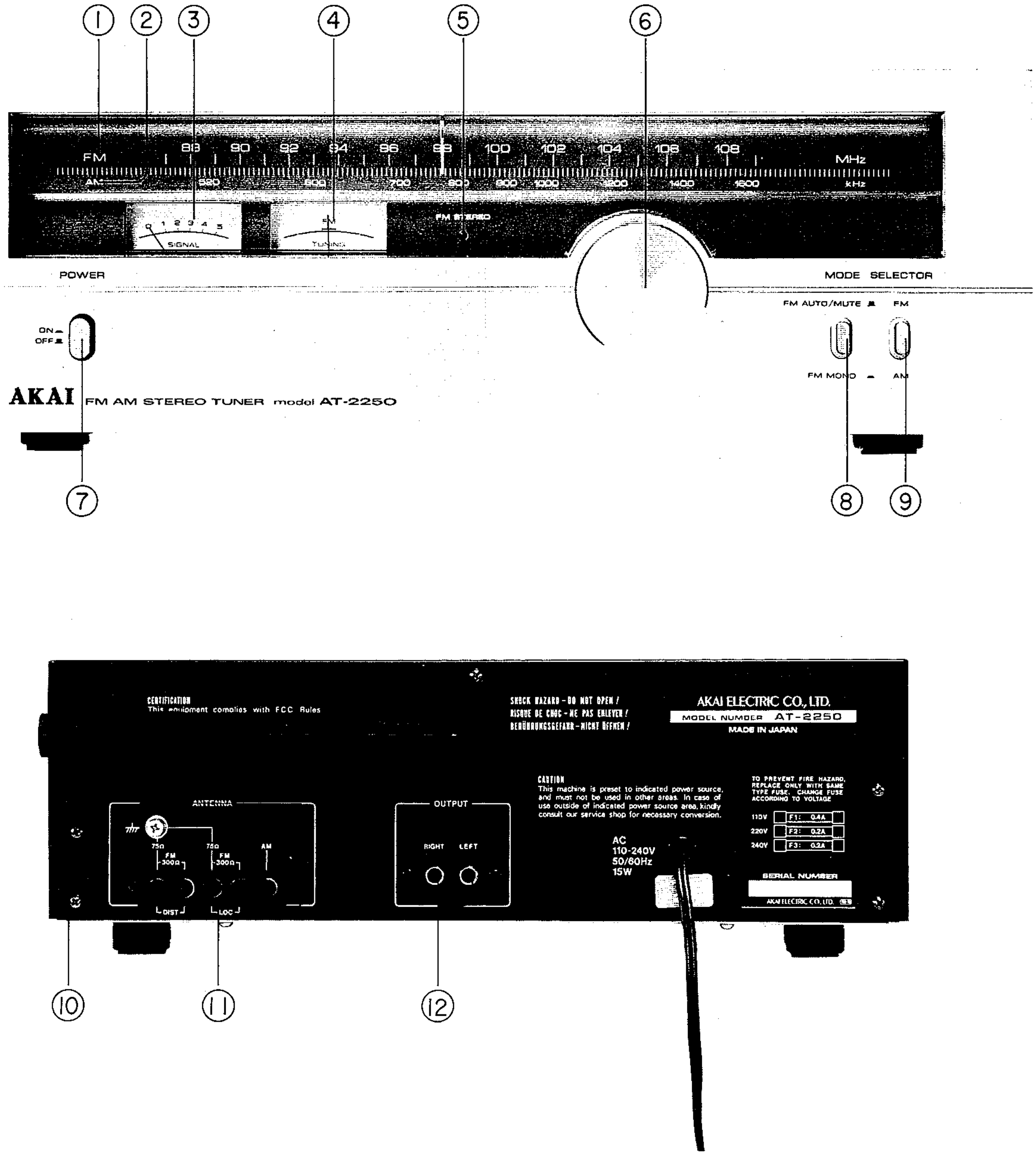


Fig. 1 Controls AT-2250

1. FM DIAL SCALE
2. AM DIAL SCALE
3. SIGNAL STRENGTH METER
4. FM CENTER TUNING METER
5. FM STEREO LAMP
6. TUNING KNOB
7. POWER SWITCH
8. FM MODE SWITCH
9. FM/AM SELECTOR SWITCH
10. AM FERRITE BAR ANTENNA
11. FM AND AM ANTENNA TERMINALS
12. OUTPUT JACKS

2. MODEL AM-2250

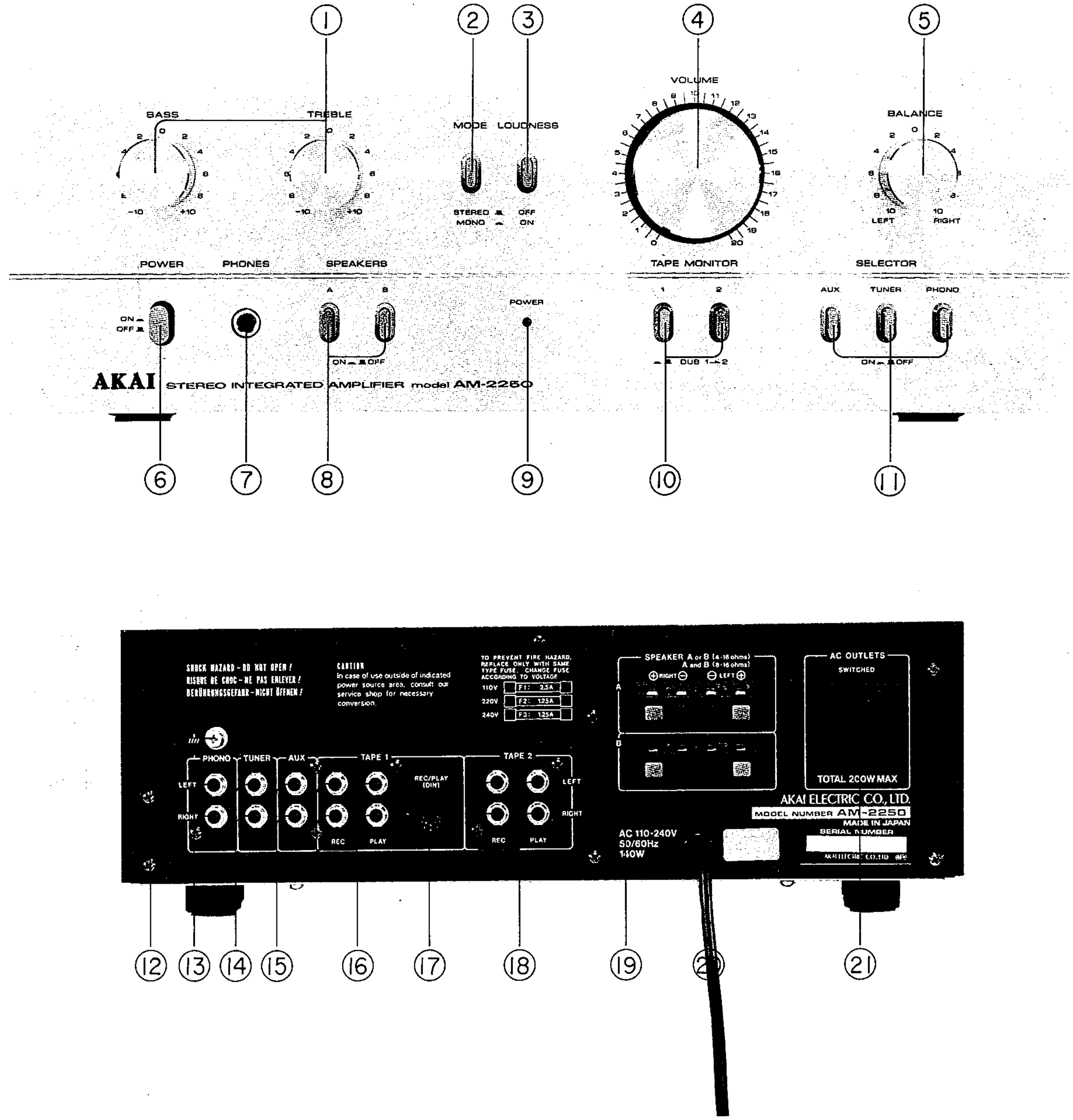


Fig. 2 Controls AM-2250

1. TONE CONTROLS
2. MODE SWITCH
3. LOUDNESS SWITCH
4. VOLUME CONTROL
5. STEREO BALANCE CONTROL
6. POWER SWITCH
7. HEADPHONE JACK
8. SPEAKER SYSTEM SELECTOR SWITCH
9. POWER INDICATOR LAMP
10. TAPE MONITOR SWITCHES
11. INPUT SELECTOR
12. GROUND TERMINAL
13. PHONO TERMINALS
14. TUNER TERMINALS
15. AUX TERMINALS
16. TAPE 1 SYSTEM REC/PB TERMINALS
17. TAPE 1 SYSTEM DIN JACK
18. TAPE 2 SYSTEM REC/PB TERMINALS
19. A and B SYSTEM SPEAKER TERMINALS
20. AC CORD
21. EXTRA AC OUTLETS

IV. PRINCIPAL PARTS LOCATION

1. MODEL AT-2250

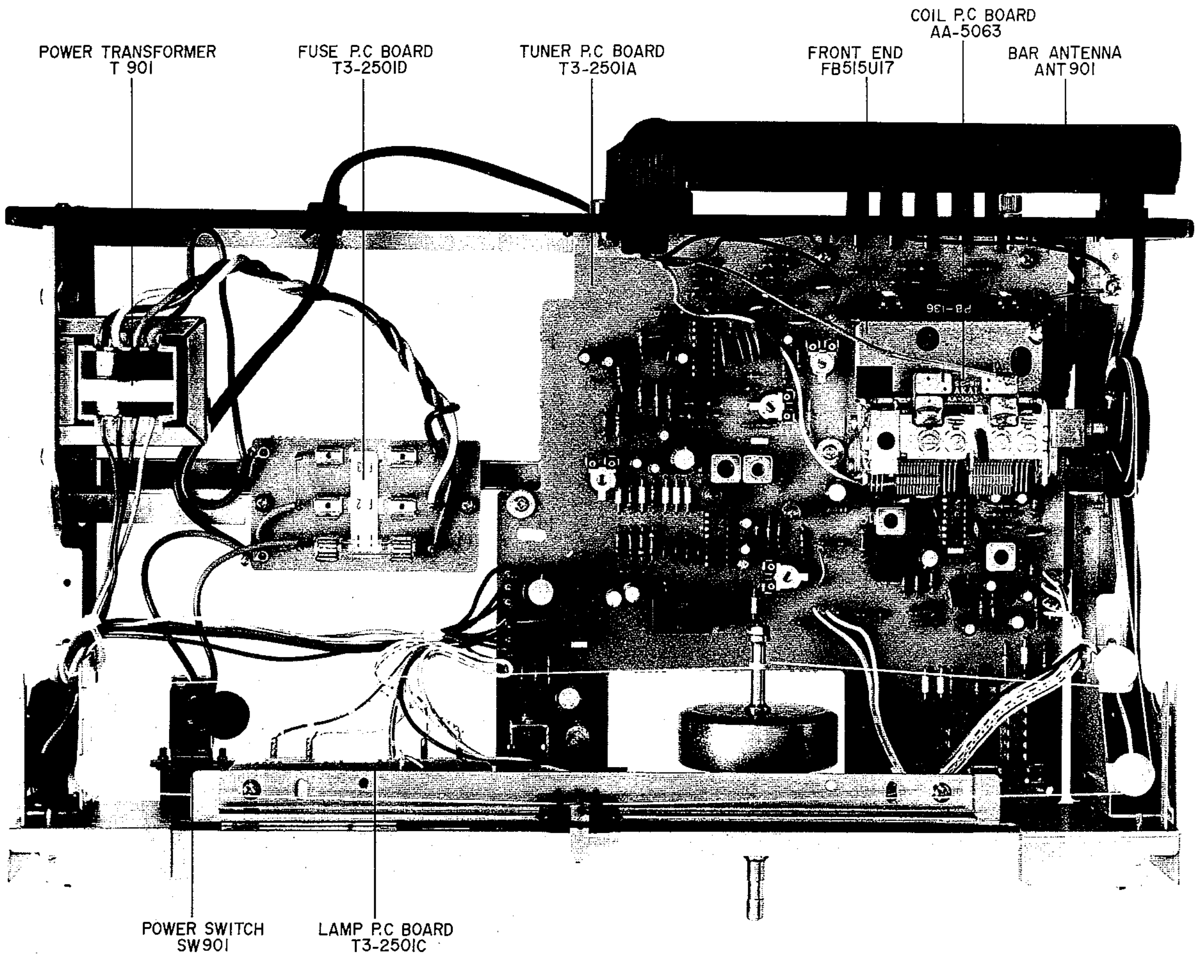


Fig. 3 Top View

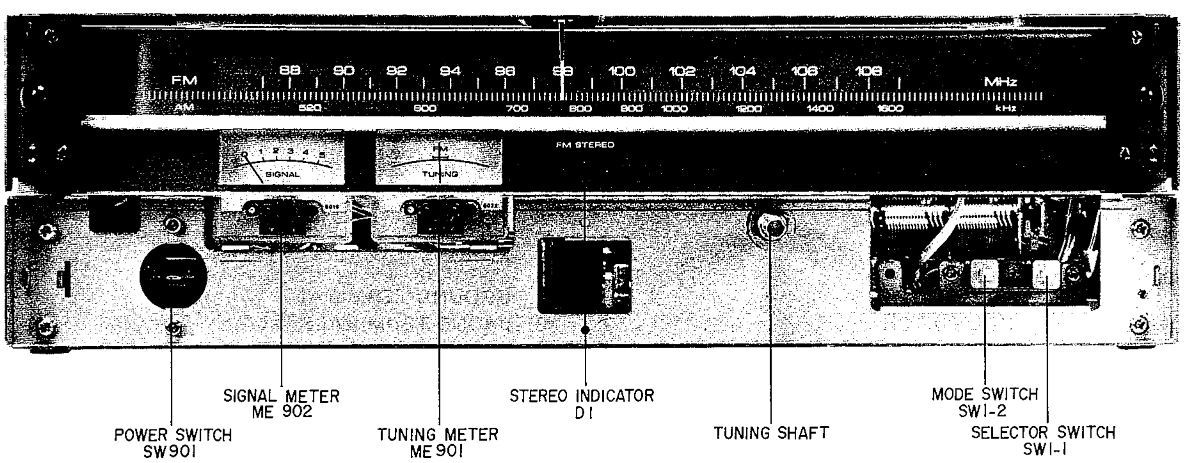


Fig. 4 Front View

2. MODEL AM-2250

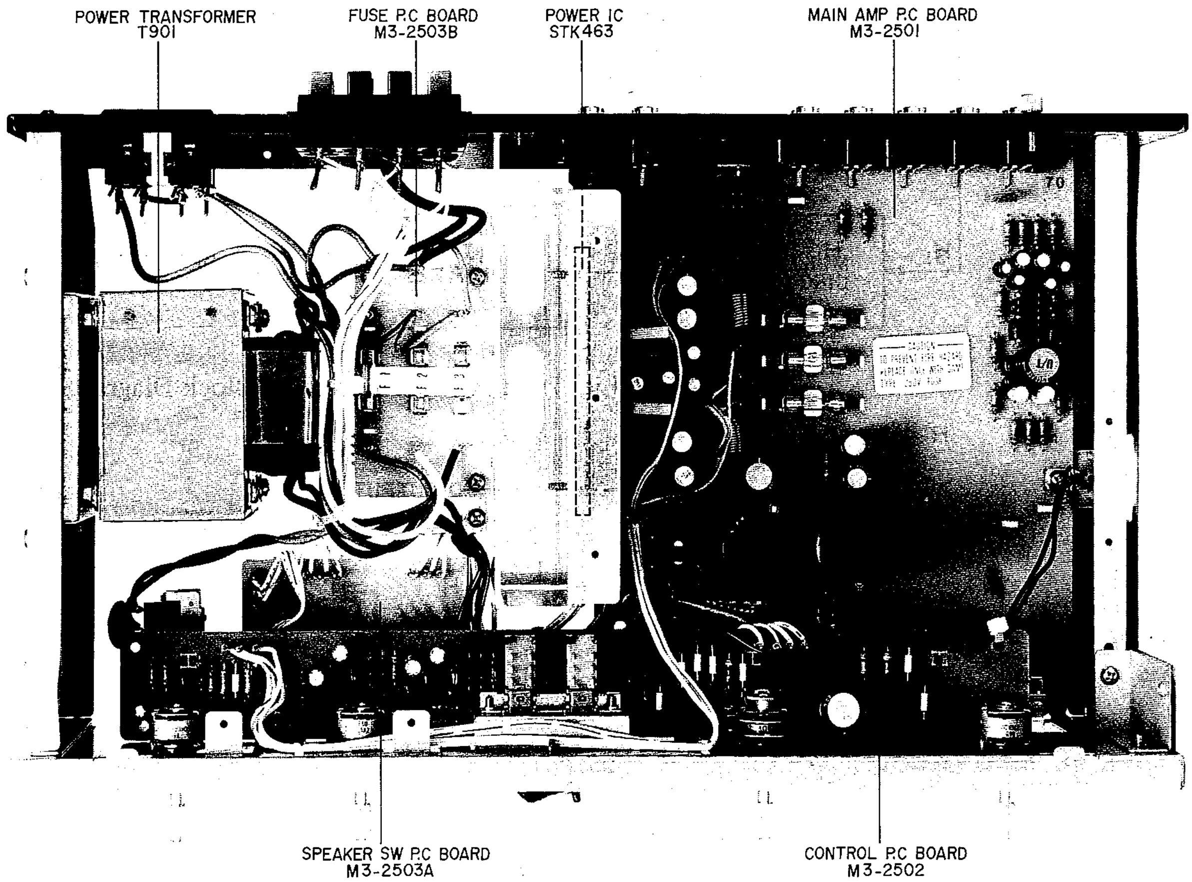


Fig. 5 Top View

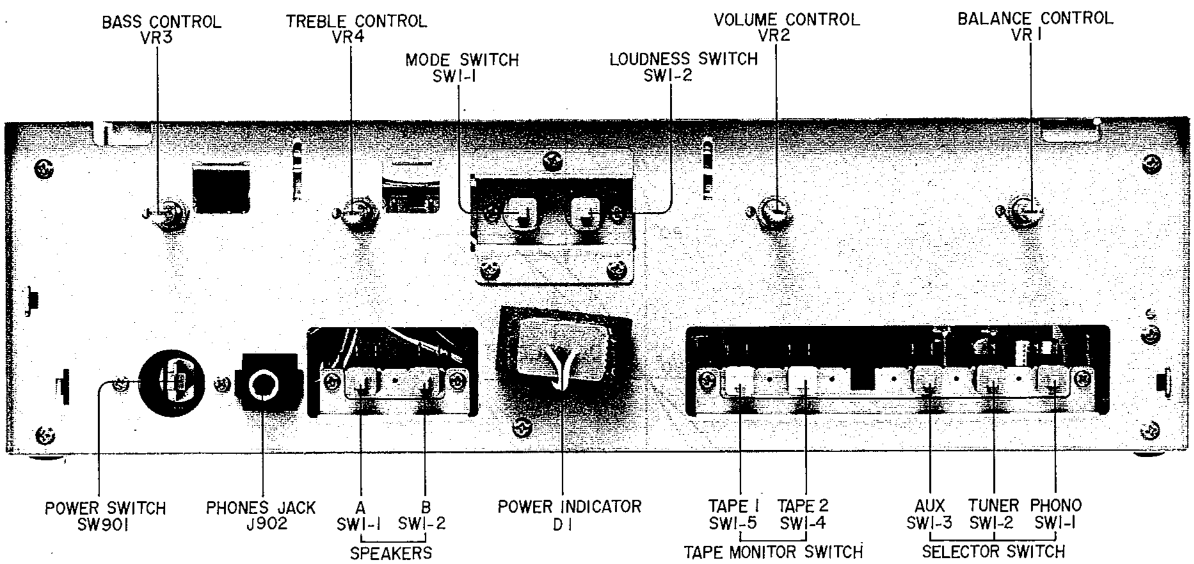


Fig. 6 Front View

V. OPERATING PRINCIPLES OF QUADRATURE DETECTION SYSTEM

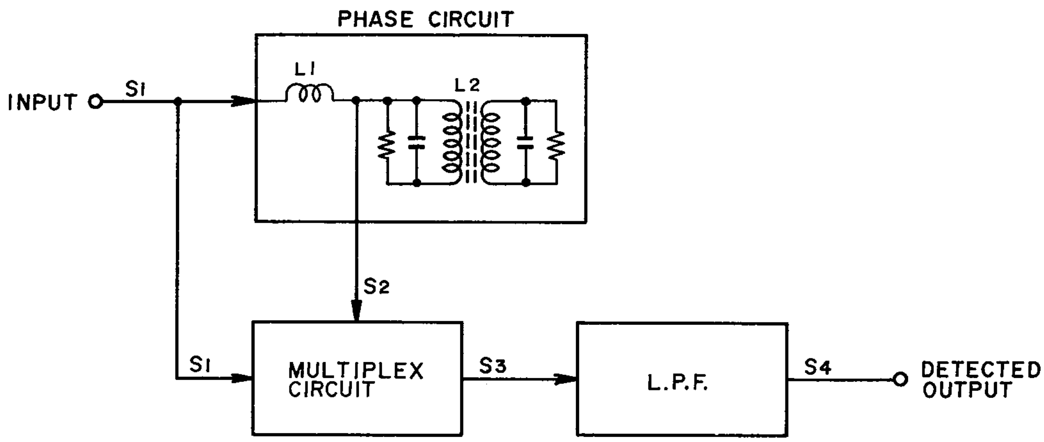


Fig. 7 Quadrature Detection Block Diagram

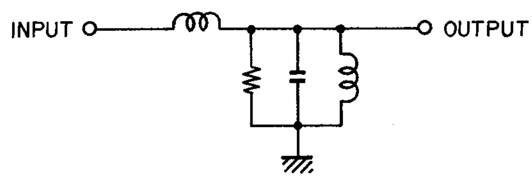


Fig. 8 Single Tuning Type

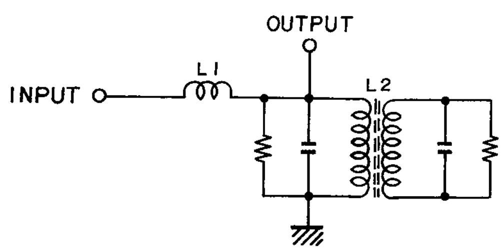


Fig. 9 Double Tuning Type

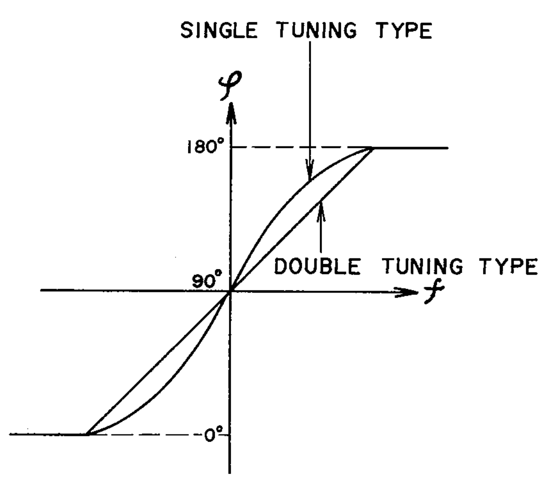


Fig. 10 Tuning Curve

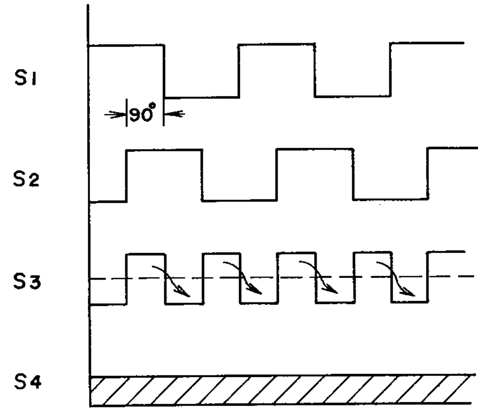


Fig. 11 Output at Non-modulation

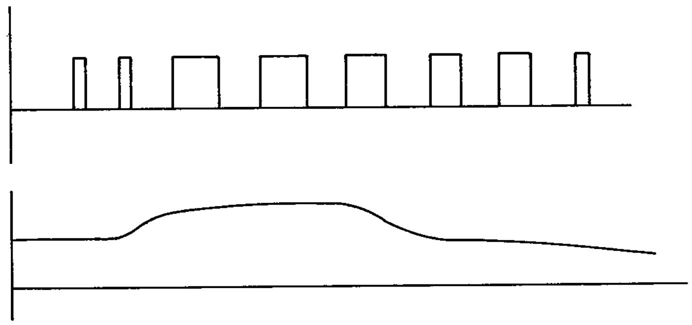


Fig. 12 Output at Modulation Time

The Quadrature Detection Circuit is comprised of a Phase Circuit, a Multiplier Circuit and a Low Pass Filter (L.P.F.) as shown in Fig. 7.
There are two types of Phase Circuits, the Single tuning type shown in Fig. 8 and the Double tuning type shown in Fig. 9. However, because with the double tuning type there is less frequency deviation in relation to carrier frequency, linearity is improved as shown in Fig. 10 and phase distortion is reduced, this type phase circuit is employed in the AT-2250.
Input signal S1 in divided into the part which enters the direct multiplier circuit and the part which passes the phase circuit and enters the multiplier circuit. The signal supplied to the phase circuit as always 90° phase delayed at L1. Also because at Non-modulation time, L2 is tuned to 10.7 MHz, if modulation is applied and S1 is changed from 10.7 MHz, phase deviation at L2 will take place proportionately in relation to this changed part and this becomes S2 signal which is delayed in relation to S1.

At Non-modulation, because as shown in Fig. 11, input signal S1 and 90° phase delayed (by means of L1) signal S2 are switched by means of the multiplier circuit, the output signal becomes S3.
Because this S3 passes the low pass filter and becomes S4 fixed direct current, the detector output is zero.
Then, when modulation is applied, because the switched output is varied according to the degree of modulation, and the output which passed the low pass filter becomes the pulsating current part as shown in Fig. 12 detector output is obtained.

VI. OPERATING PRINCIPLES OF PLL CIRCUIT EMPLOYED IN STEREO DEMODULATION CIRCUIT

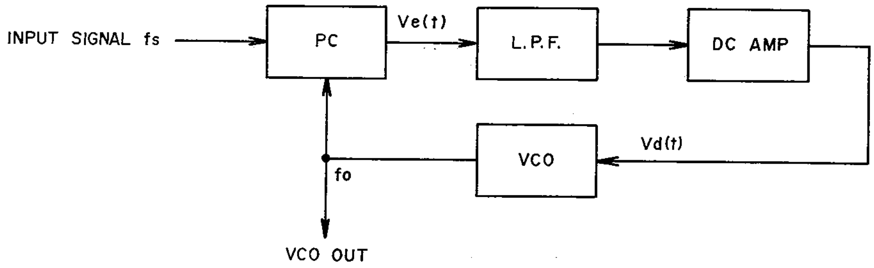


Fig. 13 PLL Circuit

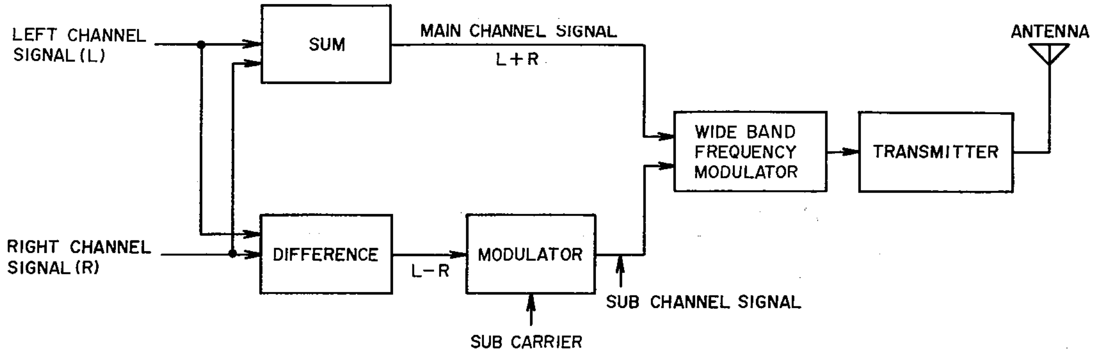


Fig. 14 FM Broadcasting System Diagram

To separate FM stereo broadcast signal received to date into left and right signals, a 19 kHz pilot signal was successively multiplier to form a 38 kHz signal and stereo separation was effected from this. However, with this multiplier system, change in coils due to wear occurred and adjustment points were numerous, etc. Therefore, this model employs a newly developed PLL circuit which produces an exceedingly accurate 38 kHz switching signal.

1. PLL CIRCUIT OPERATION

PLL circuit is a king of feedback circuit and is comprised of a Phase Comparator (PC), a Low Pass Filter (LPF), a Direct Current Amplifier (DC Amp.), and a Voltage Control Oscillator (VCO) as shown in Fig. 13. The PC compares input signal Fs and VCO oscillator output and generates the difference in signal voltage Ve(t) proportionately to this phase deviation. This Ve(t) passes LPF and the DC Amp. and becomes control voltage. This control voltage supplied to VCO and VCO oscillation frequency is DC controlled. When there is no input signal Fs, because there is also no Ve(t), control voltage Vd(t) becomes zero, and VCO maintains a *Free-running oscillation frequency. When a signal enters, VCO oscillation frequency Fo is controlled to narrow the difference between Fs by means of feedback as described above, and the PLL circuit assumes a synchronous condition. This is referred to as input signal lock. (In case the difference between Fo and Fs is too large, the differential signal frequency becomes high and is reduced at the LPF. However, because the VCO control voltage does not change, PLL will not stay within the *lock range).

Because of the ability of the signal interference removing LPF to accumulate the previous voltage in case the PLL deviates from within the lock range due to certain interference, the original condition is quickly reinstated.

*Free running frequency: Oscillating frequency when there is no input signal.

*Lock range: At the condition in which the VCO oscillation frequency is locked to the input signal, the lock range is the oscillating frequency in which when the input signal changes, the PLL maintains it's input signal lock condition.

Accordingly, in case Fs is changed inside the PLL lock range, VCO oscillation frequency always follows this, and a no frequency deviation and no phase difference signal is obtained. In other words, VCO oscillation frequency can be locked to Fs.

2. STEREO DEMODULATION CIRCUIT

As shown in Fig. 14 for FM broadcasts, the sum signal (L+R) consists of left signal (L) and right signal (R) and the audio frequency band of this signal in its original form is frequency modulated.

On the other hand, the difference signal of both (L−R) is changed to high frequency through the use of the sub carrier, and is referred to as the sub channel signal. The carrier is further frequency modulated and sent to the FM stereo transmitter. Accordingly, for composite stereo signal demodulation, the sub carrier used for demodulation at the transmitter must be the same uniform 38 kHz signal as the frequency and phase. If the 38 kHz waveform is asymmetrical, channel separation will become poor.

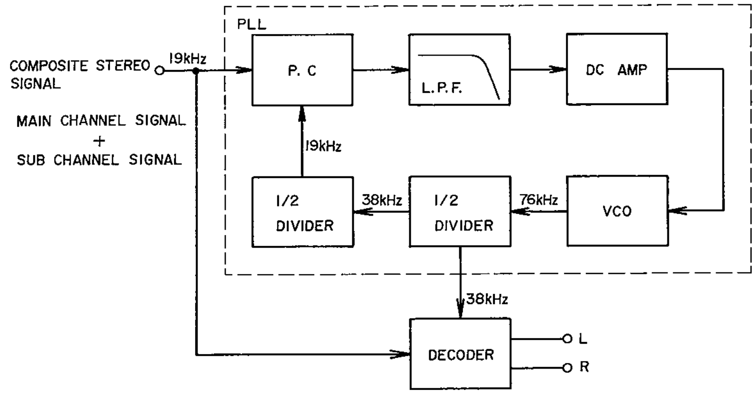


Fig. 15 MPX IC Function

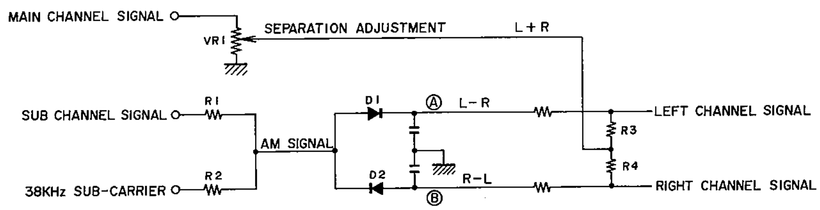


Fig. 16 Multiplex Decoder

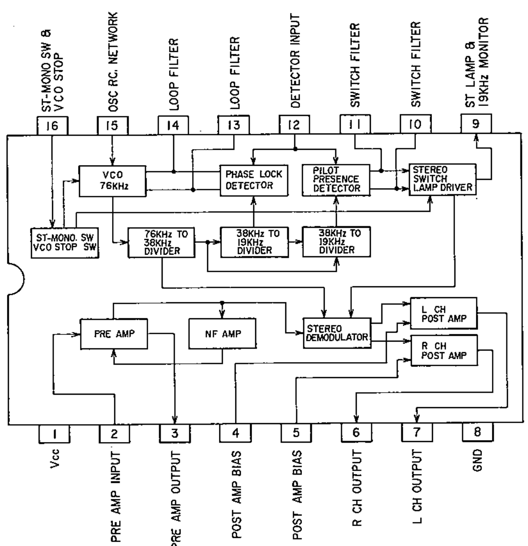


Fig. 17 μPC1161C Block Diagram

At the PLL employed MPX stereo demodulator circuit, as shown in Fig. 15 first a 76 kHz signal is oscillated and when this passes the divider, a symmetrical 38 kHz signal is obtained.

This 38 kHz sub carrier is supplied to the multiplex decoder together with the sub channel of the composite stereo signal. At the multiplex decoder, left and right channel audio signals are separated in order as shown in Fig. 16.

The 38 kHz sub carrier composited with the sub channel signal of which the carrier part was removed when sub channel signal and sub carrier passed R1 R2 produces the regular AM wave. Then, because this envelop is detected by mutually reverse polarity connected diodes D1 and D2, L–R signal is emitted at point Ⓐ and R–L signal at point Ⓑ.

Also, because main channel signal (L+R) is supplied to R3, R4 center point, Ⓐ Ⓑ point voltage is added and subtracted and becomes

(L+R) + (L–R) = 2L (left channel)

(L+R) + (R–L) = 2R (right channel)

The level of the main channel signal (L+R) can be adjusted by means of variable resistor VR (VR1) for optimum separation.

However, please refer to Fig. 17 for the Block Diagram of PLL IC μPC1161C used in the model AT-2250.

VII. LEVEL DIAGRAM

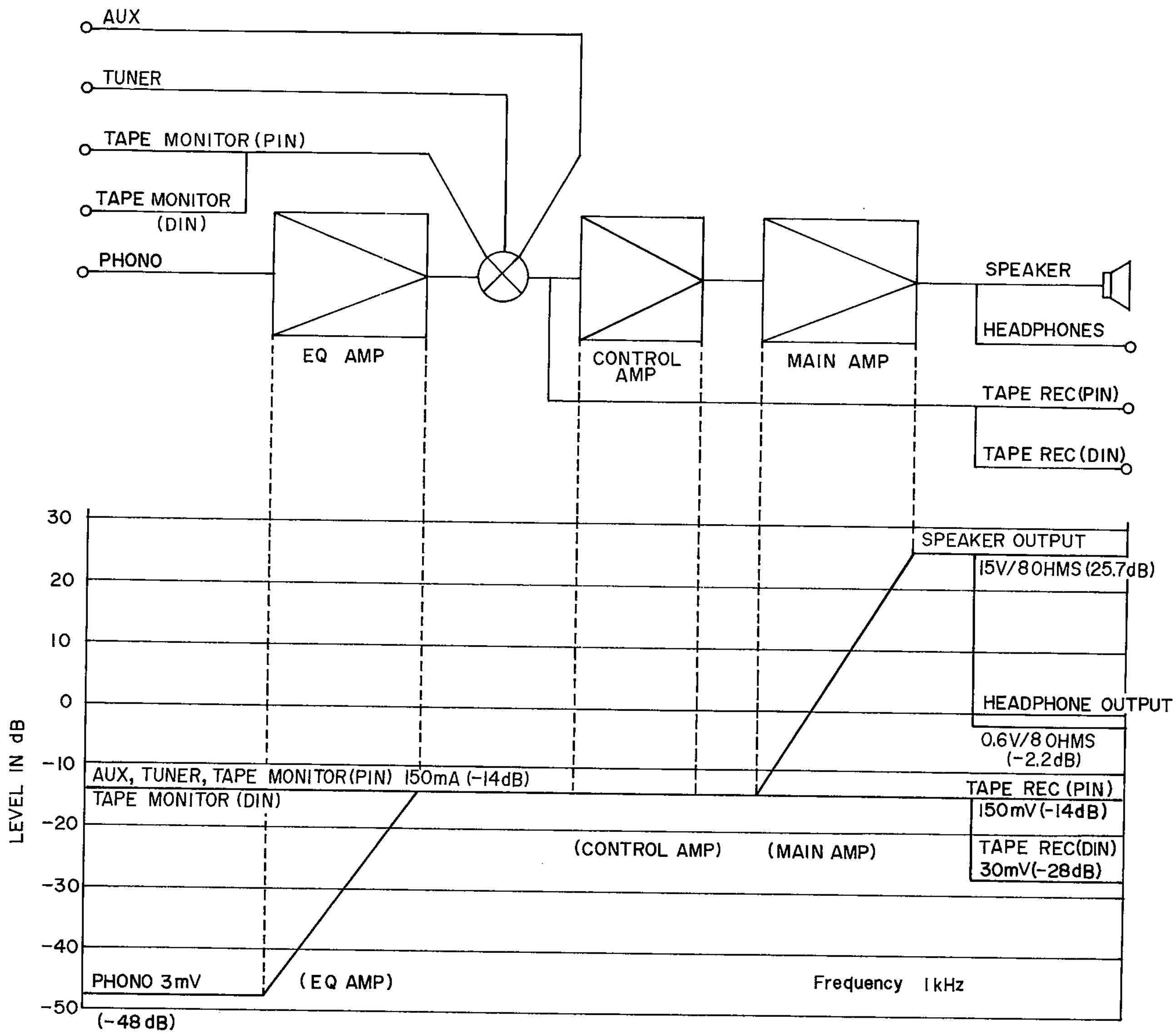


Fig. 18 Level Diagram AM-2250

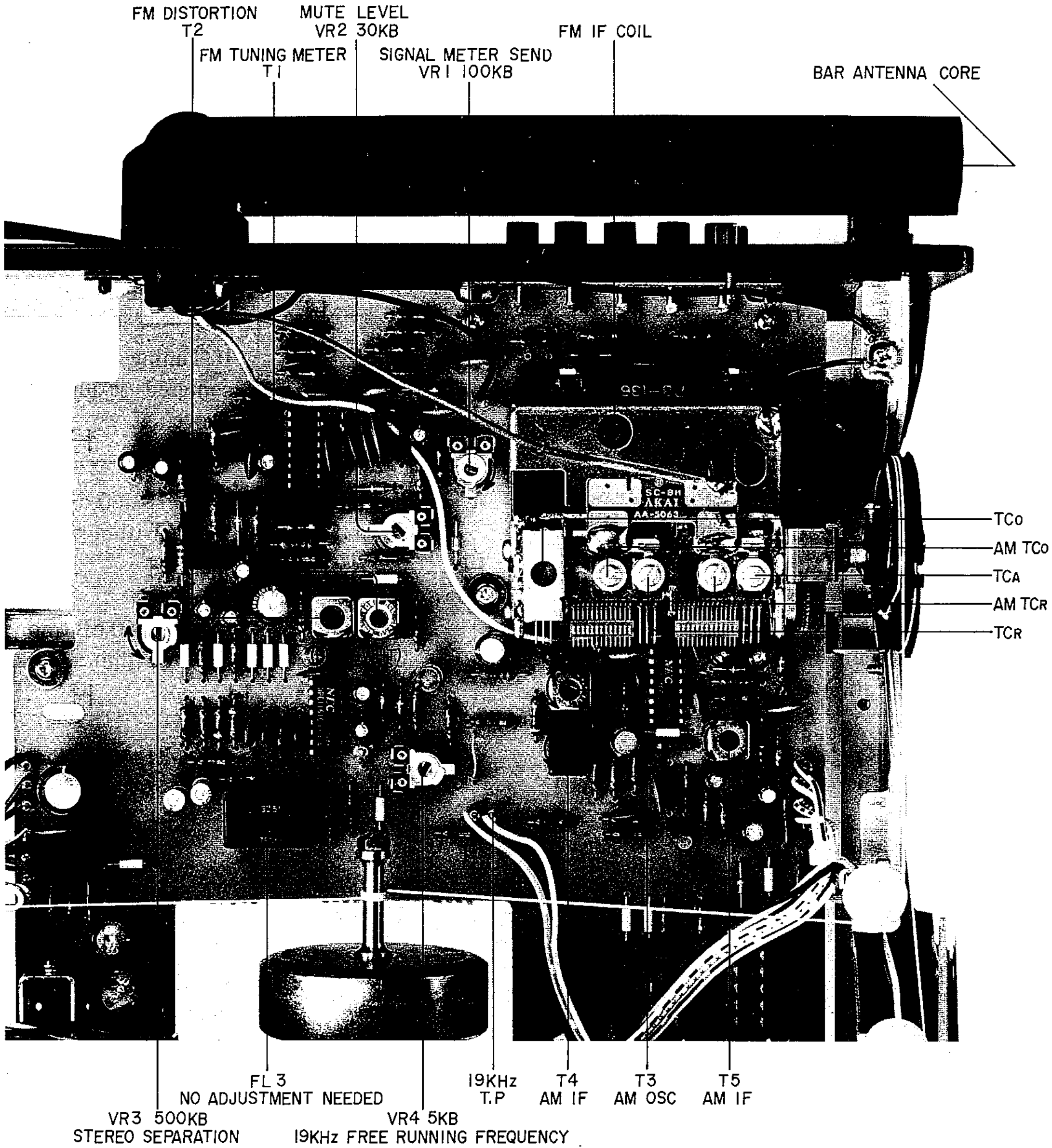


Fig. 19 Tuner P.C Board T3-2501A

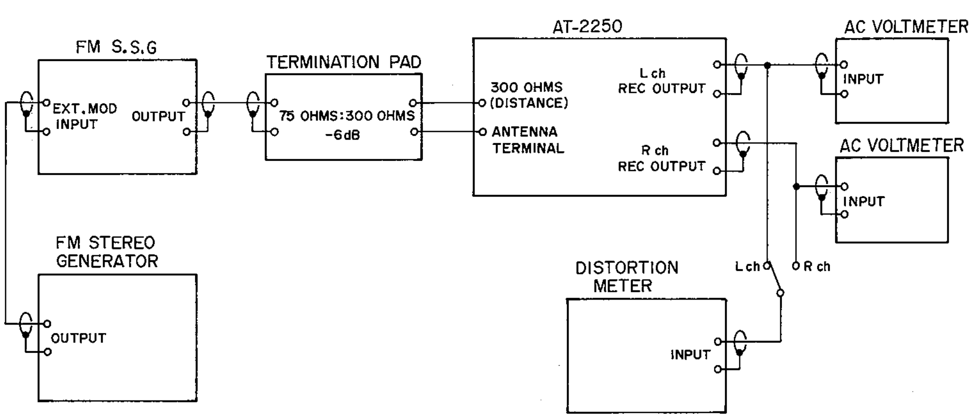


Fig. 20 Instrument Connections

1. FM TUNER SECTION ADJUSTMENT (Refer to Figs. 19, 20)

Step	Adjustment Item	Adjustment Point	Result	Remarks
1	Tuning Meter Centering	T1 (WHT) (Tuner P.C Board)	Centered Tuning Meter Indication	SELECTOR to FM MODE to FM MONO. Tunes only noise without interference from broadcasting.
2	Distortion Factor	T2 (BLU) (Tuner P.C Board)	Less than 0.1% Distortion Factor	98 MHz, 60 dB (mono) input. Less than 0.1% on both channels. See NOTE 1.
3	Confirmation of Tuning Meter Indication			If Tuning Meter Indication is not centered re-adjust Step 1 and 2 above.
4	High Range Scale Indication	TCo (Front End)	Maximum Output	108 MHz, 60 dB (mono) input. Error: Within ±250 kHz.
5	Confirmation of Low Range Scale Indication		Maximum Output	88 MHz, 60 dB (mono) input. Error: Within ±250 kHz.
6	High Range Sensitivity	TCR, TCA (Front End)	Less than 3% Distortion Factor	108 MHz, Less than 6 dB (mono) input.
7	Confirmation of Low Range Sensitivity		Less than 3% Distortion Factor	88 MHz, Less than 6 dB (mono) input. See NOTE 2.
8	Confirmation of Mid Range Sensitivity		Less than 3% Distortion Factor	98 MHz, Less than 6 dB (mono) input. See NOTE 2.
9	Mute Level	VR2 30 kB (Tuner P.C Board)	No Signal emitted from Output	MODE to FM AUTO/MUTE. 98 MHz, 15 dB (mono) input.
10	PLL IC Free Running Frequency	VR4 5 kB (Tuner P.C Board)	19.00 kHz	Frequency Counter to Test Point. (Tuner P.C Board) See NOTE 3.
11	Confirmation of Stereo Indicator Lighting			98 MHz, 60 dB (stereo) input. Unlet stereo indicator indicates no stereo separation.
12	Stereo Separation (Left→Right)	VR3 500 kB (Tuner P.C Board)	More than 42 dB	98 MHz, 60 dB (stereo), Lch input. Minimum output of R ch.
13	Stereo Separation (Right→Left)	VR3 500 kB (Tuner P.C Board)	More than 42 dB	98 MHz, 60 dB (stereo), Rch input. Minimum output of L ch.
14	Signal Meter Sensitivity	VR1 100 kB (Tuner P.C Board)	Indicator at "4.5"	98 MHz 100 dB (mono) input.

Chart 1

NOTES: 1. When the distortion factor is not less than 0.1% in Step 2, adjust by turnning the Front End IF Coil core but not more than one turn.
2. In the event that distortion factors in Steps 7 and 8 are not less than 3%, readjust Front End Trimmer Condensers TCR and TCA to obtain a minimum average distortion factor at 88, 98 and 108 MHz (same distortion factor at all three points).
3. PLL IC free running frequency must be an exact 19.00 kHz.

2. AM TUNER SECTION ADJUSTMENT (Refer to Fig. 19)

Step	Adjustment Item	Adjustment Point	Result	Remarks
1	Low Range Scale Indication	T3 (RED) (Tuner P.C Board)	Maximum Output	SELECTOR to AM. 520 kHz 50 dB input. TUNING INDICATOR to 520 kHz. Error: Within 2%
2	High Range Scale Indication	AM TCo (Front End)	Maximum Output	1,400 kHz 50 dB input. TUNING INDICATOR to 1,400 kHz Error: Within 2%
3	Low Range Sensitivity	Bar Antenna core T4, T5 (BLK) (Tuner P.C Board)	Maximum Output Minimum Distortion Factor	520 kHz 50 dB input. Less than 10% Distortion Factor.
4	High Range Sensitivity	AM TCR (Front End)	Maximum Output Minimum Distortion Factor	1,400 kHz 50 dB input. Less than 10% Distortion Factor.

Chart-2

NOTE: For best results, repeat Steps 1 through 4 two or three times.

IX. TUNING CORD THREADING

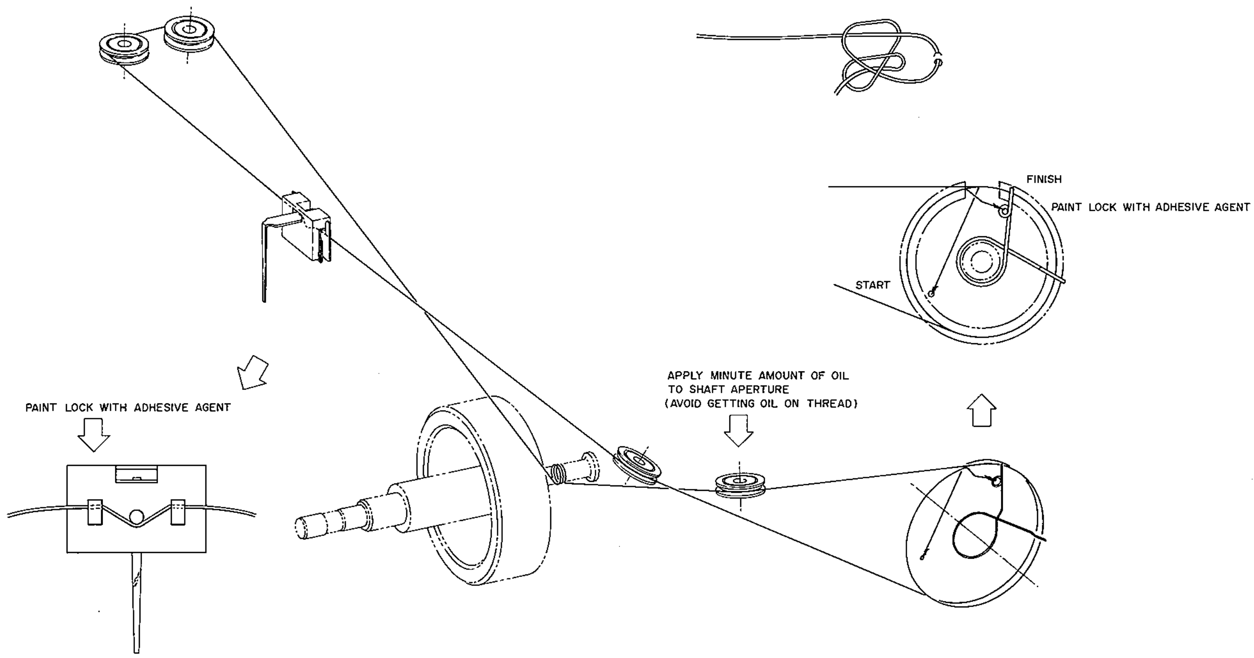


Fig. 21 Tuning Cord Threading

X. CLASSIFICATION OF VARIOUS P.C BOARDS

1. P.C BOARD TITLE AND IDENTIFICATION NUMBER

1) Model AT-2250

P.C Board	Number of P.C Board
Tuner P.C Board	T3-2501A
LED P.C Board	T3-2501B
Lamp P.C Board	T3-2501C
Fuse P.C Board	T3-2501D
Antenna P.C Board	AA-5063

Chart-3

2) Model AM-2250

P.C Board	Number of P.C Board
Main Amp P.C Board	M3-2501
Control Amp P.C Board	M3-2502
Speaker SW P.C Board	M3-2503A
Fuse P.C Board	M3-2503B
LED P.C Board	M3-2503C

Chart-4