SERVICE MANUAL

SFM—90

KLH RESEARCH AND DEVELOPMENT CORP.
30 Cross Street, Cambridge, Massachusetts 02139

KLH MODEL FIFTY FOUR

SPECIFICATIONS

The following specifications have been derived in accordance with the institute of High Fidelity (IHF) Standard of Measurement (IHF-A-201 and IHF-T-100) in all cases where IHF standards exist. Furthermore, the amplifier power output specifications are stated in adherence to the proposed regulations of the Federal Trade Commission (FTC). The various figures, then, are **not** comparable with the loosely derived and vaguely stated specifications of many current components.

The specifications below are intended to provide complete information about the Model Fifty-Four — not thumbnail comparisons with other units of different manufacturers.

Measurements:
17 7/8 W x 5 3/4 H x 14 1/4 D

Cabinet:
Walnut Veneer and Textured Black Finished Steel

Electrical Specs include:
All silicon solid-state circuitry
4 gang FET FM front end
All IC FM IF with 2 ceramic filters
IC AM circuit
IC MPX
IC Phono Preamp

Amplifier Section:

RMS power, into 4 or 8 ohms, all channels operating: ..... 4 x 25 watts

RMS power — 2 channel mode 8 ohms, all channels operating: ..... 2 x 60 watts

Harmonic Distortion ..... less than 0.5%

Intermodulation (IM) Distortion ... (60 & 7000 Hz, 4:1 SMPTE) 0.5%

Power Bandwidth into 8 ohms ... 16-30,000 Hz

Frequency Response (1 watt) ..... 20-20,000 Hz (± 2dB)

Damping Factor at 8 ohms
4 channel mode ..... greater than 20
2 channel mode ..... greater than 10

Hum and Noise Below Rated Output (volume control at maximum):
Auxiliary, High Level Inputs ..... —70 dB
Phono Inputs ..... —63 dB

Sensitivity for Rated Output:
Phono ..... 2.5 mV
Auxiliary ..... 250 mV
Tape Monitor ..... 250 mV
Phono Overload Margin ..... 26 dB

Input Impedances:
Phono ..... 47,000 ohms
Auxiliary ..... 100,000 ohms
Tape Monitor ..... 50,000 ohms

Tape Output Level (for 30% FM modulation, 50% AM modulation, or 2.5 mV at Phono input): ..... 250 mV

Tape Output Impedance: ..... 1200 ohms

FM Tuner Section

Usable Sensitivity ..... 1.8 uV
Alternate Channel Selectivity ..... 46 dB
Spurious Response Rejection ..... 80 dB
Image Rejection ..... 70 dB
AM Suppression ..... 40 dB
+ Signal to noise ratio ..... in excess of 60 dB with any input signal greater than 10 uV
Capture Ratio ..... 2 dB
Frequency Response .... 20-15,000 Hz ± 2 dB
Harmonic Distortion at 100% Modulation 0.3%
+ Stereo Separation at 1 kHz ..... 34 dB
+ Stereo Separation at 10 kHz ..... 20 dB
+ Stereo Harmonic Distortion 0.8%
Multiplex S/N Ratio, including SCA, and 19 and 38 kHz spurious outputs .... 60 dB

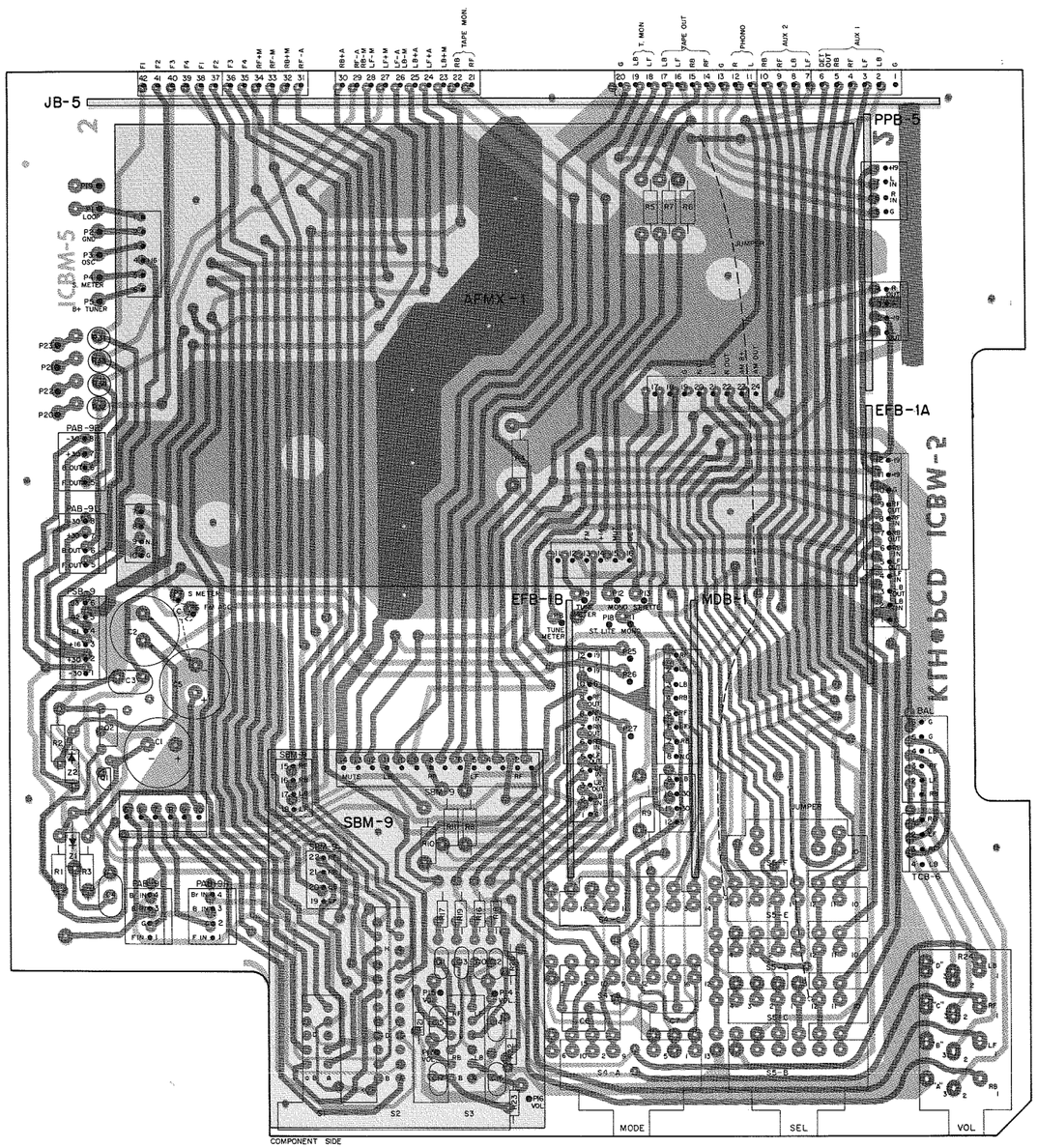
AM Tuner Section:

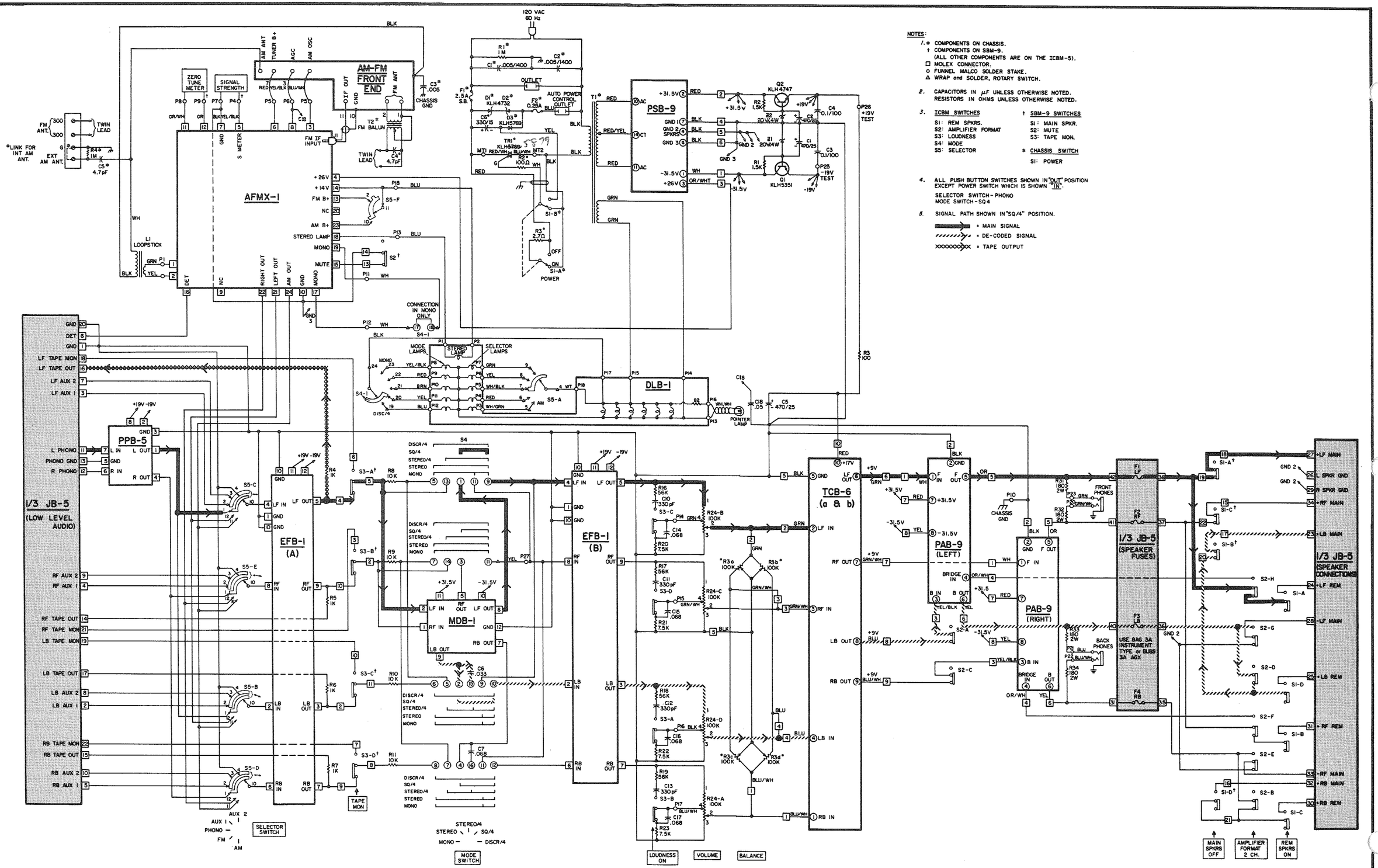
Usable Sensitivity ..... 300 uV/meter
+ Signal to Noise Ratio (Ultimate) ..... greater than 50 dB
+ AGC Action ..... greater than 50 dB RF signal change for 10 dB change in audio output
Image Rejection ..... 35 dB
IF Rejection ..... 35 dB
Frequency Response ..... 20-3500 Hz + 0, —6 dB
Distortion (at 90% Modulation) 1.5%
Selectivity ..... 25 dB

NOTE: + means no IHF standard exists for measurement of this parameter.

* A TRADEMARK of RESEARCH & DEVELOPMENT CORP.

Interconnect Board Schematic





M-54 SCHEMATIC

FUNCTION OF MODE SWITCH, SELECTOR SWITCH AND AMPLIFIER FORMAT SWITCH

ALTHOUGH THE FUNCTIONS OF THESE SWITCHES CAN BE ACCURATELY DETERMINED BY STUDY OF THE OVERALL SCHEMATIC, A BRIEF DISCUSSION IS IN ORDER TO HELP IN TROUBLE SHOOTING AND SIGNAL TRACING.

SELECTOR SWITCH

The selector switch is connected after the five sources AM, FM, Phono, Aux 1, and Aux 2, but before the Tape Output and Tape Monitor input. It determines the program source and the tape output source. In addition to selecting the source, the switch performs the function of routing mono or stereo signals to all four outputs so that all speakers will have a signal no matter what position the Mode Switch is in.

- AM, The mono output of the AM tuner is connected to all four channels and the AM circuit B+ is activated.
- FM, The L channel is fed into LF and LB channels, the R channel into the RF and RB channels and the FM B+ is activated.
- Phono, As in FM, except that FM B+ is off.
- Aux 1, Each of the four discrete input channels is fed to the corresponding channel of the receiver.
- Aux 2, As above for Aux 1, except that the FM B+ is activated so that an FM detector output signal fed to the rear panel output is available for connection eventually to an external 4 channel FM decoder.

MODE SWITCH

This switch is connected after the Tape Monitor inputs and acts on all sources to accomplish the five functions Mono, Stereo, Stereo/4, SQ/4, and DISC/4.

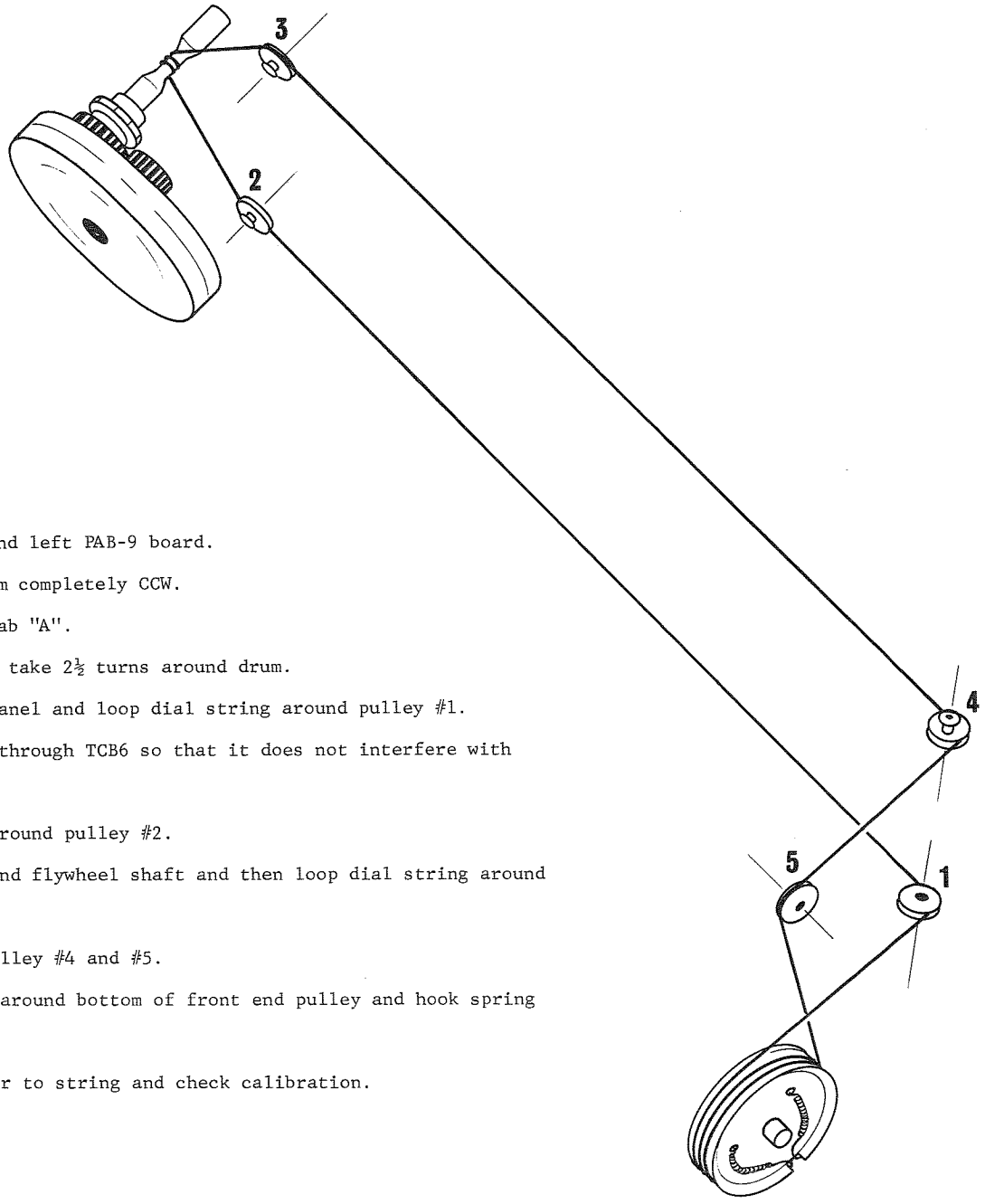
- Mono: In this position, signals present at any of the 4 input channels are combined into one signal which is then fed to all 4 output channels.
- Stereo: Here, LF & LB signals are combined into one signal and fed to the two left output channels. Similarly, RF & RB are combined and fed to the 2 right output channels.
- Stereo/4: The LF & RF inputs are fed directly to the LF & RF output channels with no blending. At frequencies below about 1 kHz, LF is fed to LB output channel. Above about 1 kHz, LB & RB output channels are fed from the SQ decoder LB and RB outputs.
- SQ/4: The LF and RF inputs are always connected to the inputs of a CBS type SQ decoder. In this position, the 4 outputs of the SQ decoder are fed to the 4 output channels.
- DISC/4: Each input channel is fed directly to its corresponding output, with no mixing.

AMPLIFIER FORMAT SWITCH

This switch sets the receiver up for use either in a quadraphonic set-up with four speakers or in a stereo setup with only two speakers. In the four channel format (button out) each of the four internal channels drives its own power amplifier and each amplifier can be connected via the Main and Remote speaker switches to its corresponding speakers.

In the two channel format, connections are changed at the back power amplifier inputs and at the front main speaker (-) terminals. Specifically, the back amplifiers are driven at a special "bridging" input by the output signals of the corresponding front amplifier in slave fashion. This develops a signal at the back amplifier outputs identical to but out of phase with the output of the front amplifier. Since the speakers are now connected between the outputs of the front and back amplifiers;this doubles the output voltage and permits up to 70 watts output to be delivered to each front main speaker. All other speakers (back main, front remote, and back remote) are disconnected from the amplifiers entirely. Neither + or - speaker terminal is at receiver ground potential in this mode and must not be grounded externally. Nor can they be connected to each other in any fashion.

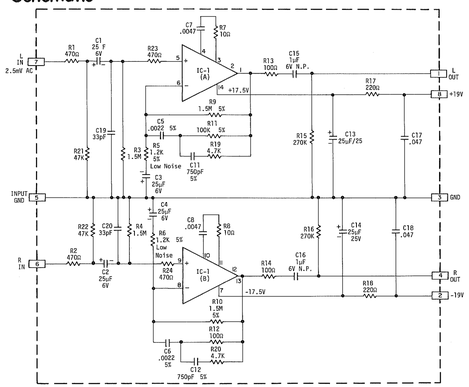
Dial Stringing Assembly



1. Remove top cover and left PAB-9 board.
2. Turn front end drum completely CCW.
3. Hook spring onto tab "A".
4. Following diagram, take 2½ turns around drum.
5. Set M54 on front panel and loop dial string around pulley #1.
6. Dress dial string through TCB6 so that it does not interfere with any wires.
7. Loop dial string around pulley #2.
8. Take 2½ turns around flywheel shaft and then loop dial string around pulley #3.
9. Continue around pulley #4 and #5.
10. Place dial string around bottom of front end pulley and hook spring to tab "B".
11. Attach dial pointer to string and check calibration.

Pre Amp Board

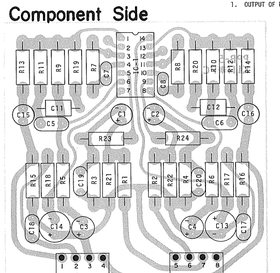
Schematic



NOTES:

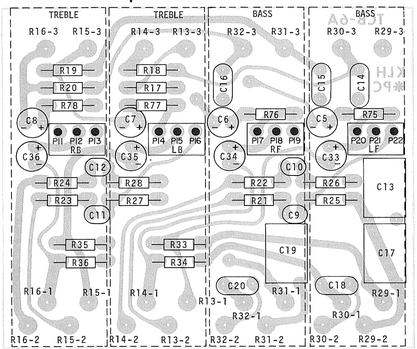
1. OUTPUT OF PPB-5 = 250mV AC 1000Hz

Component Side

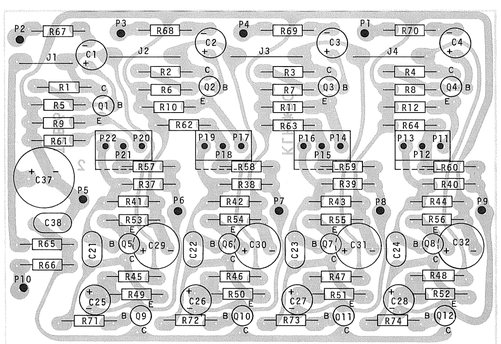


Tone Control

TCB-6A Component Side

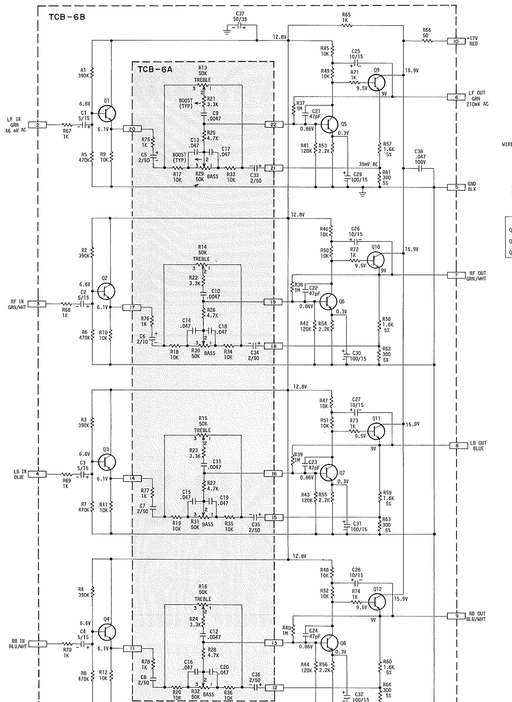


TCB-6B Component Side



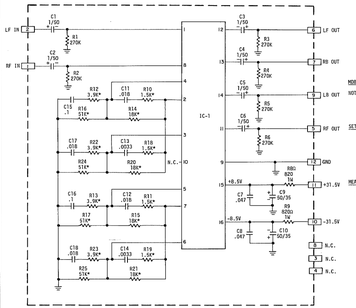
COMPONENT SIDE
FACES FRONT OF UNIT

TCB-6 A&B Schematic



Matrix Decoder Board

Schematic



MDB TEST PROCEDURE

NOTE: Proceed with the set-up and measurements for left channel, then repeat set-up and measurements for the right channel. Right channel component reference numbers are indicated in parenthesis ( ).

SET-UP

1. Set Mode Switch to SQ-4.
2. Connect an Audio Generator to the left (right) front Aux.-1 input.
3. Terminate the right (left) front input with a short or 560-Ω resistor.
4. Set generator output to obtain 1 volt frequency to 1kHz.
5. Adjust generator output to obtain 1 volt at pin 2 (1) of MDB-1.

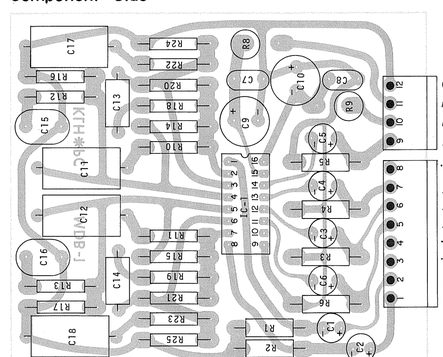
MEASUREMENTS

GENERATOR FREQUENCY	MDB PIN NO. Left (Right)		ACCEPTABLE VOLTAGE RANGE
1kHz	6	(5)	.95 - 1.26
1kHz	7	(8)	.95 - 1.26
1kHz	10	(10)	.69 - .89
20Hz	6&7	(10)	.470 - .69
20kHz	6&7	(10)	.61 - .89

NOTES:

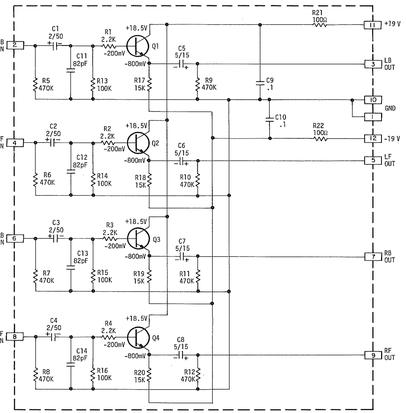
1. * R10-R20 LOW NOISE ZE
2. C11-C14-C17-C18 ARE POLYSTYRENE 63V, 2%

Component Side



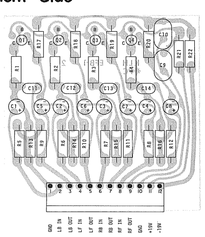
Emitter Follower Board

Schematic



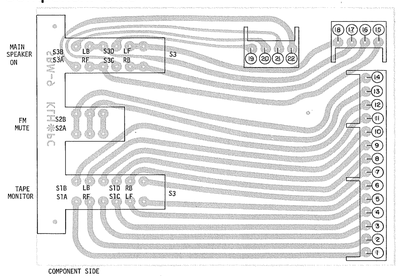
NOTES:
1. OUTPUT OF EFB-1A = 250mV AC
2. INPUT TO EFB-1B = 240mV AC

Component Side



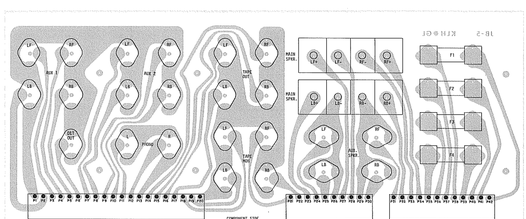
Mode Switch Board

Component Side



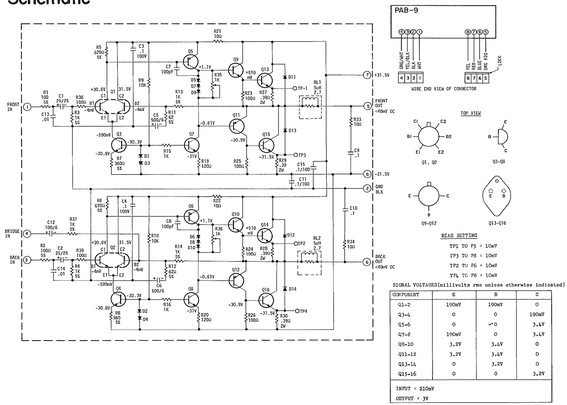
Jack Board

Component Side



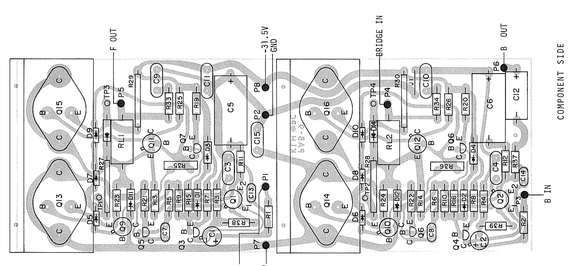
Power Amp Board

Schematic



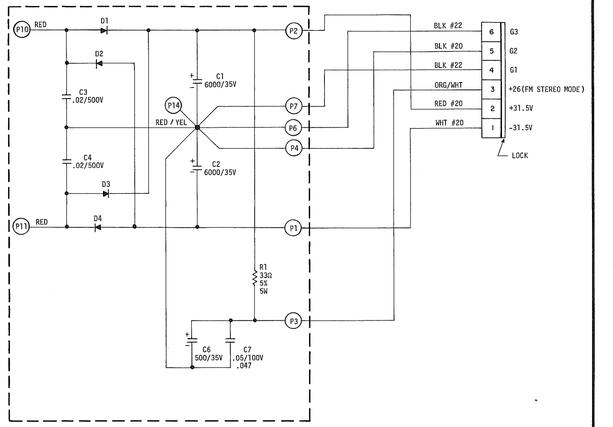
CKT/POINT	E	B	C
Q1-2	100mV	100mV	0
Q3-4	0	0	100mV
Q5-6	0	~0	3.4V
Q7-8	100mV	0	3.4V
Q9-10	3.2V	3.4V	0
Q11-12	3.2V	3.4V	0
Q13-14	0	3.2V	0
Q15-16	0	0	3.2V

Component Side

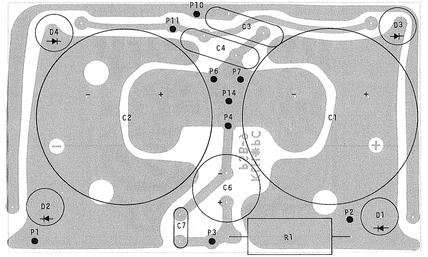


Power Supply Board

Schematic



Component Side



RF ELECTRONICS & PARTS LIST

AFMX-1 PCB

	CAPACITORS	
C1	1uf Elec.	000784
C3	2uf Elec.	000800
C5	10uf/25v Elec.	001493
C16	10uf/15v Elec.	000783
C17	100uf/15v Elec.	000785
C44	1uf Elec.	000784
C45,C46	2uf Elec.	000800
C47	5uf Elec.	004881
C48	10uf Elec.	000783
C55	100uf/15v Elec.	000785
C59	2uf Elec.	000800
C60,C61,C62,C63	1uf Elec.	000784
	INDUCTORS	
L1	Osc. Trans. (L0)	005717
L2	IF Trans. (L11)	005523
L3	IF Trans. (L12)	005524
L4	IF Trans. (L21)	005525
L5	IF Trans. (L22)	005526
L6,L7	Choke 55uH	000495
L9	Detector Txfr.	004841
L10,L11	MX Coil 19kHz	004197
L12	MX Coil 30kHz	004196
	POTENTIOMETERS	
R16	Trimpot 120k	005774
R37	Trimpot 50k (Mute)	004265
R39	Trimpot 10k (Phase)	001499
	SEMICONDUCTORS	
D1,D4	FET Mute T.I. SX3820	005868
D2,D3,D5,D6,D7,D8,D9,D10	Diode Gold Bond	000128
D11	Diode Gold Bond	000128
IC-1,IC-2	IC uA719	005500
IC-3	IC RCA CA 3088E	005527
IC-4	IC uA767	004793
Q1	Trans. 2N3392	000704
Q2	Trans. Mot. MPSU-45	004747
Q3	Trans. National 4792	006050
Q4,Q5,Q7,Q8,Q9	Trans. Audio 2N3392A	000704
Q10	Trans. PNP	004746
Q11	FET Mute T.I. SX3820	005868
Q12,Q13	Trans. 704 2N3392	000704
	MISCELLANEOUS	
F1,F2	Ceramic Filter	004754
F3	MX Filter Assembly	004842

DLB-1

	MISCELLANEOUS	
PL1 thru PL11	Dial lamp	005867

EFB-1

	CAPACITORS	
C1,C2,C3,C4	2uf/50v Elec.	000800
C5,C6,C7,C8	5uf/15v Elec.	004881
	SEMICONDUCTORS	
Q1,Q2,Q3,Q4	NPN Silicon	005378

ICBM-5

	CAPACITORS	
C1,C2,C5	470uf/25v Elec.	005853
	POTENTIOMETERS	
R24	Volume Control	005713
	SEMICONDUCTORS	
Q1	PNP SKA 6712	005351
Q2	NPN Darlington MPSU-45	004747
Z1,Z2	Zener Diode	005770
	MISCELLANEOUS	
S1,S2,S3	Switch, pushbutton ICBM-5	005712
S4	Mode switch	005846
S5	Source switch	005761

JB-5

	MISCELLANEOUS	
Speaker fuse	Littelfuse 3A,8AG	005775

MDB-1

	CAPACITORS	
C1,C2,C3,C4,C5,C6	luf/50v Elec.	000784
	SEMICONDUCTORS	
IC-1	SQ Decoder	005813

PAB-9

	CAPACITORS	
C1,C2	25uf/25v Elec.	004882
C5,C6	500uf/6v Elec.	005827
C12	100uf/6v Elec.	000194
	POTENTIOMETERS	
R35,R36	1k Ohm Bias Pots	004485
	RESISTORS	
RL1,RL2	2.7 Ohm 5uH	005754
R27,R28,R29,R30	0.39 Ohm 10% 2W	005826
	SEMICONDUCTORS	
D1-D10	Diode	005768
D11,D12,D13,D14	Diode	005769
Q1,Q2	NPN Transistor 2N3908	005806
Q3,Q4	NPN Transistor Mot. EL614	005811
Q5,Q6	PNP Transistor Mot. EL664	005809
Q7,Q8	NPN Transistor Mot. EL613	005810
Q9,Q10	NPN Transistor 2N2102	005807
Q11,Q12	PNP Transistor 2N4036	005808
Q13,Q16	NPN Transistor 2N3055	004367

PPB-5

	CAPACITORS	
C1,C2,C3,C4	25uf/6v Elec.	001719
C13,C14	25uf/25v Elec.	004882
C15,C16	luf/5v Elec.	005761
	SEMICONDUCTORS	
IC-1	Fairchild UA739C or Signetic TBA241	005764

PARTS LIST (cont'd.)

PSB-9

	CAPACITORS	
C1,C2	6000uf/35v	005721
C6	500uf/35v	004612
	RESISTORS	
R1	35 Ohm/5W 5%	005912
	SEMICONDUCTORS	
D1,D2,D3,D4	Rectifier Silicon	004567

SBM-9

	MISCELLANEOUS	
	Pushbutton switch 3 station	005711

TCB-6A

	CAPACITORS	
C5,C8,C33,C36	2uf/50v Elec.	000800
	POTENTIOMETERS	
R13-14,R15-16, R29-30,R31-32	Dual 50k Ohm	005657

TCB-6B

	CAPACITORS	
C1,C4	5uf/15v Elec.	004881
C25,C28	10uf/15v Elec.	000783
C29,C32	100uf/15v Elec.	000785
C37	50uf/35v Elec.	005794
	SEMICONDUCTORS	
Q5,Q8	Trans. NPN T.I. SKA6710	005350

MAIN CHASSIS PARTS

	CAPACITORS	
C6	330uf/15v Elec.	005343
	INDUCTORS	
	Power Transformer	005897
	Loopstick Antenna	005964
	POTENTIOMETERS	
	Balance Control	005660
	SEMICONDUCTORS	
D1,D2	Zener Diode 4.7v	004327
D3	Rectifier	005769
	Triac	005879

	COMPLETE SUBASSEMBLIES	
AFMX-1	AM/FM/MX Board	D00435
DLB-1	Dial Light Board	D00436
EFB-1	Emitter Follower Board	D00438
Front End		005714
ICBM-5	Interconnect Board	D00439
JB-5	Jack Board	D00440
MDB-1	Decoder Board	D00442
PAB-9	Power Amp Board	D00444
PPB-5	Pre Amp Board	D00446
PSB-9	Power Supply Board	D00447
SBM-9	Mode Switch Board	D00448
TCB-6A	Tone Control Board	D00450
TCB-6B	Tone Control Board	D00452
TCB-6 Complete	Tone Control Board	D00453
	MISCELLANEOUS	
	Fuse 3A,8AG	005775
	Outer Carton	006070
	AC Receptacle (Black)	000383
	AC Receptacle (Red)	005650
	Fuseholder (Red)	005924
	Fuseholder (Black)	005925
	Fuse 2.5A 3AG-SB	005923
	Fuse 0.2A 3AG	005922
	Screened fuse cover	005881
	Thumbscrew	005783
	Dial Cord Assembly	006040
	Spring	006039
	Flywheel bracket and Pulley Assembly	E01475
	COSMETIC PARTS	
	Top cover, Wood	005743
	Screen, ventilating	005666
	Foot	005876
	Side cover, Painted	005727
	Knob-pushbutton	005615
	Knob-tuning	005608
	Pushbutton power switch knob	005609
	Knob-tone control	005605
	Knob-volume, source, mode	005607
	Knob-balance	005606
	Front panel incl. end caps	005614
	AC switch bushing	005668
	Dial window	005958
	Tune knob, escutcheon	005899
	Meter signal	005659
	Pointer-illuminated	005745
	Dial graphics and scale	006017

AFMX-1 Alignment Procedure

PRELIMINARY ADJUSTMENTS

DC REGULATOR

With unit plugged into 120V AC line adjust DC Regulator pot R16 on AFMX-1 for 14V DC TP "P3"

FM-IF and DETECTOR ALIGNMENT

STEP	TUNER SWITCHES & DIAL SETTINGS	COUPLING	GENERATOR FREQUENCY	GENERATOR MODULATION	GENERATOR RF OUTPUT µV	MONITOR	ADJUSTMENTS & INDICATIONS
1. A. Detector Secondary	Point of no local interference around 90 Mhz Mono Mode.	-------	-------	-------	-------	Tuning Meter or TP-1 / DC VTVM	Short J-1 to remove the input to the IF filters. Adjust the detector secondary (top slug of L9) for center of tuning meter. (0 Volts DC at TP-1.)
B. Detector Primary	"	Antenna Terminals. 300 ohms Bal. Input.	Same as FM dial.	75kHz deviation 400 Hz modulation. Mono mode.	1 kµV	Scope and AC VTVM on speaker output.	Adjust Detector Primary (Bottom slug of L9) for maximum output.
2. IF Adjustments.	"	"	"	"	Decrease RF OUTPUT until noise appears in signal.	Tuning Meter or TP-1/DC VTVM at 0 Volts. Scope and AC VTVM on speaker output.	Adjust front end IF Primary and Secondary (T2) and Antenna Coil (T1) for maximum output and symmetry.

FM FRONT END ALIGNMENT

STEP	TUNER SWITCHES & DIAL SETTINGS	COUPLING	GENERATOR FREQUENCY	GENERATOR MODULATION	GENERATOR RF OUTPUT µV	MONITOR	ADJUSTMENTS & INDICATIONS
1. A. Dial Calibration.	FM station around 90 Mhz.	------	------	------	-------	Tuning Dial	If dial calibration error exceeds 300 kHz, adjust oscillator coil (LO) to correct dial error.
B.	FM station around 106 Mhz.	------	------	------	-------	"	If the calibration is incorrect, set the dial to 2 times the error in the opposite direction. Example: If the reading is 500 kHz high, Set the dial 1Mhz low. Adjust oscillator trimmer (TCO) to receive station at new setting.
C.	FM station around 90 Mhz.	------	------	------	-------	"	*Recheck station at 90 Mhz. Reset station to its correct location with the oscillator coil (LO). Repeat steps B & C, if necessary.
2. Antenna & Mixer.	Point of no local interference around 90 Mhz.	Antenna Terminals. 300 ohms Bal. Input.	Same as FM dial.	400 Hz 75 kHz deviation Mono Mode.	Decrease RF output until noise appears in signal.	Scope & AC VTVM on speaker output.	Adjust (IF), (CLR), & (LA) coils for maximum symmetrical output.
	Point of no local interference around 106 Mhz.	"	"	"	"	"	Adjust (TCR) & (TCA) top and bottom trimmer for maximum symmetrical output.

MULTIPLEX ALIGNMENT

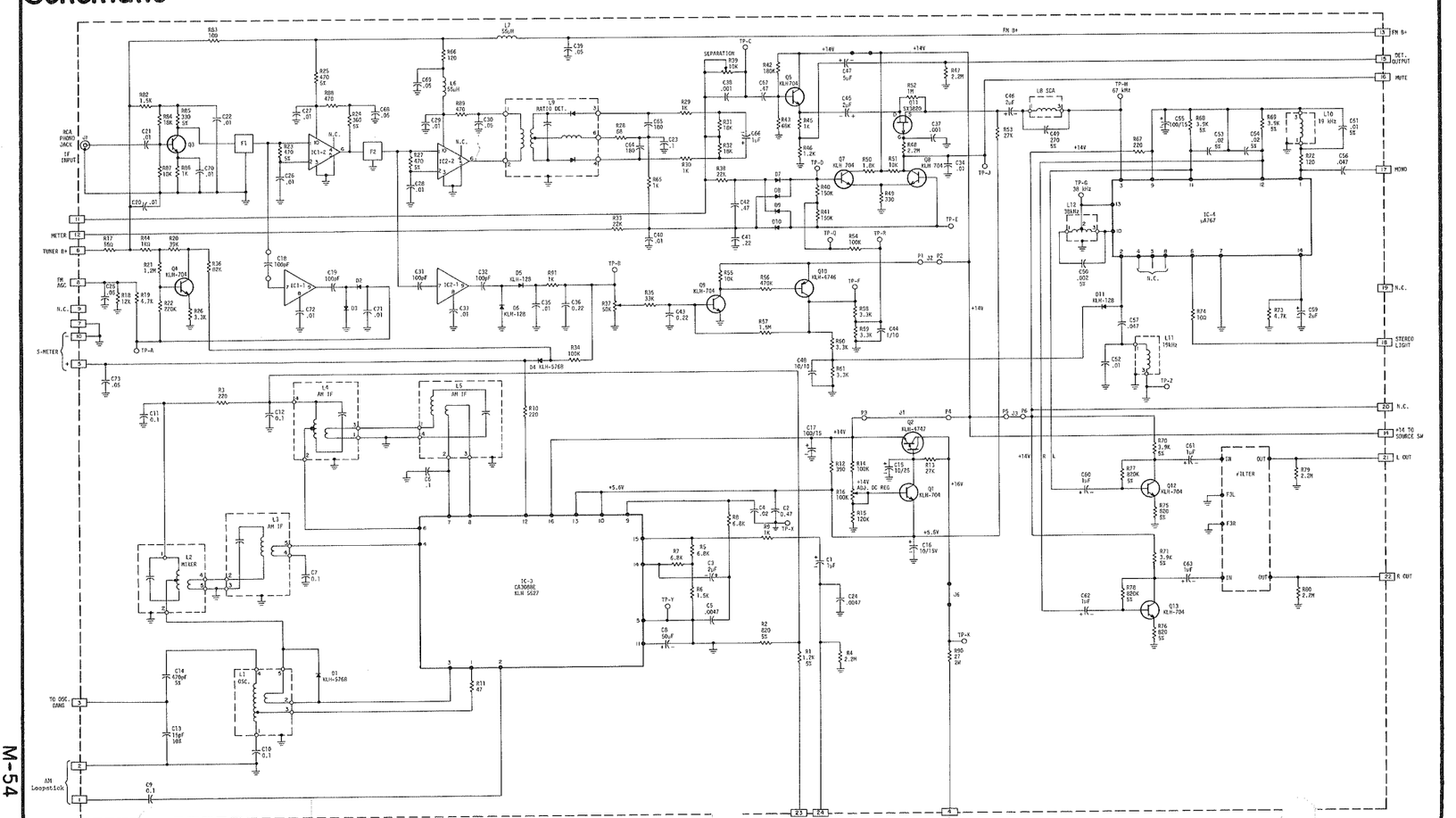
STEP	TUNER SWITCHES & DIAL SETTINGS	COUPLING	GENERATOR FREQUENCY	GENERATOR MODULATION	GENERATOR RF OUTPUT µV	MONITOR	ADJUSTMENTS & INDICATIONS
1.- MPX 19 & 38kHz Adjustments.	Adjust separation Pot. 889 max. CCW as seen from front of unit. FM Stereo Mode Point of no local intereference. Mute off.	Antenna Terminals. 300 ohms Bal. Inputs.	Same as FM dial.	75 kHz deviation. 400 Hz 5% Pilot Level. Stereo Mode. Left Ch.	1 kµV	TPG/scope	Peak L10, L11, L12 for maximum output.
2. A. Separation	FM Stereo Mode. Mute off. Point of no local interference. Mute off	"	"	75 kHz deviation. 400 Hz 8% Pilot Level. Stereo Mode. Right Ch.	"	VTVM on left output.	Adjust L10 & L11 (White) for minimum output. Adjust separation pot (R39) for minimum output and MX light.
B.	"	"	"	75 kHz deviation. 400 Hz 8% Pilot Level. Stereo Mode. Left Ch.	"	VTVM on right output.	Check separation and adjust R39 for equal left to right and right to left separation. Typically 30 db each channel.
3. Auto-stereo/ mute adjustment.	FM Mono Mode. Point of no local interference. Mute on.	"	"	"	7.5 µV	"	Adjust mute threshold pot for muting action.

AM ALIGNMENT

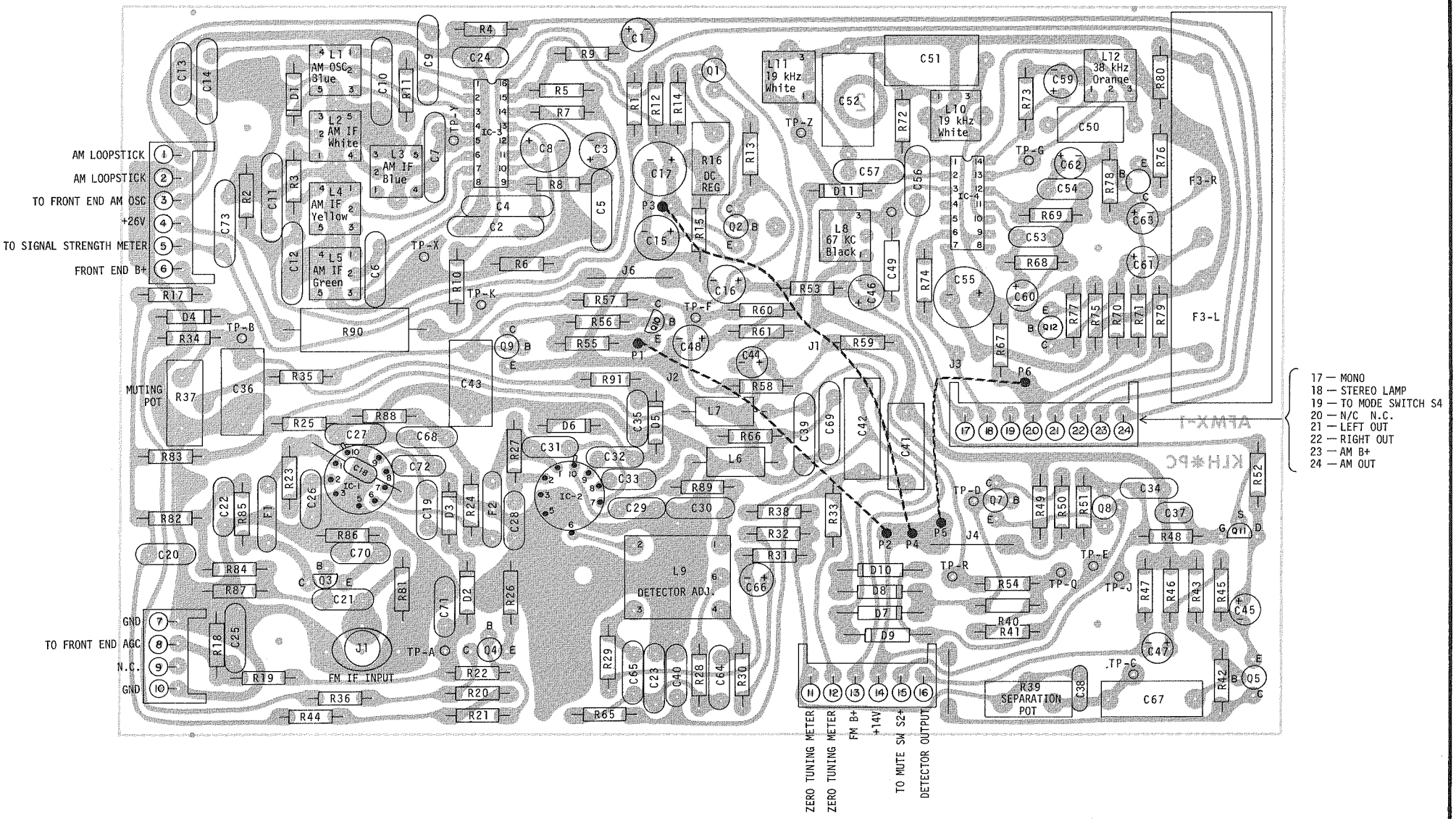
STEP	TUNER SWITCHES & DIAL SETTINGS	COUPLING	GENERATOR FREQUENCY	GENERATOR MODULATION	GENERATOR RF OUTPUT µV	MONITOR	ADJUSTMENTS & INDICATIONS
1. IF Alignment.	Point of no local interference.	--------	--------	--------	--------	Speaker Output	Tune all IF coils (L2 to L5 inclusive) for maximum output.
2. Dial Calibration.	Local station around 600 kHz.	--------	--------	--------	--------	Meter & Dial	Adjust oscillator coil (L1) for maximum meter indication at the correct dial setting.
	Local station around 1400 kHz.	--------	--------	--------	--------	"	Adjust oscillator trimmer (AM) for maximum meter indication at the correct dial setting.
3. RF Alignment.	Point of no local interference around 600 kHz.	Loop of wire near AM ferrite-rod.	Same as AM Dial setting.	30% modulation 400 Hz.	As low as possible.	Speaker output.	Adjust antenna coil Loopstick and mixer coil AM for maximum output.
	Point of no local interference around 1400 kHz.	"	"	"	"	"	Adjust antenna trimmer for maximum output.

AM/FM/MX

Schematic

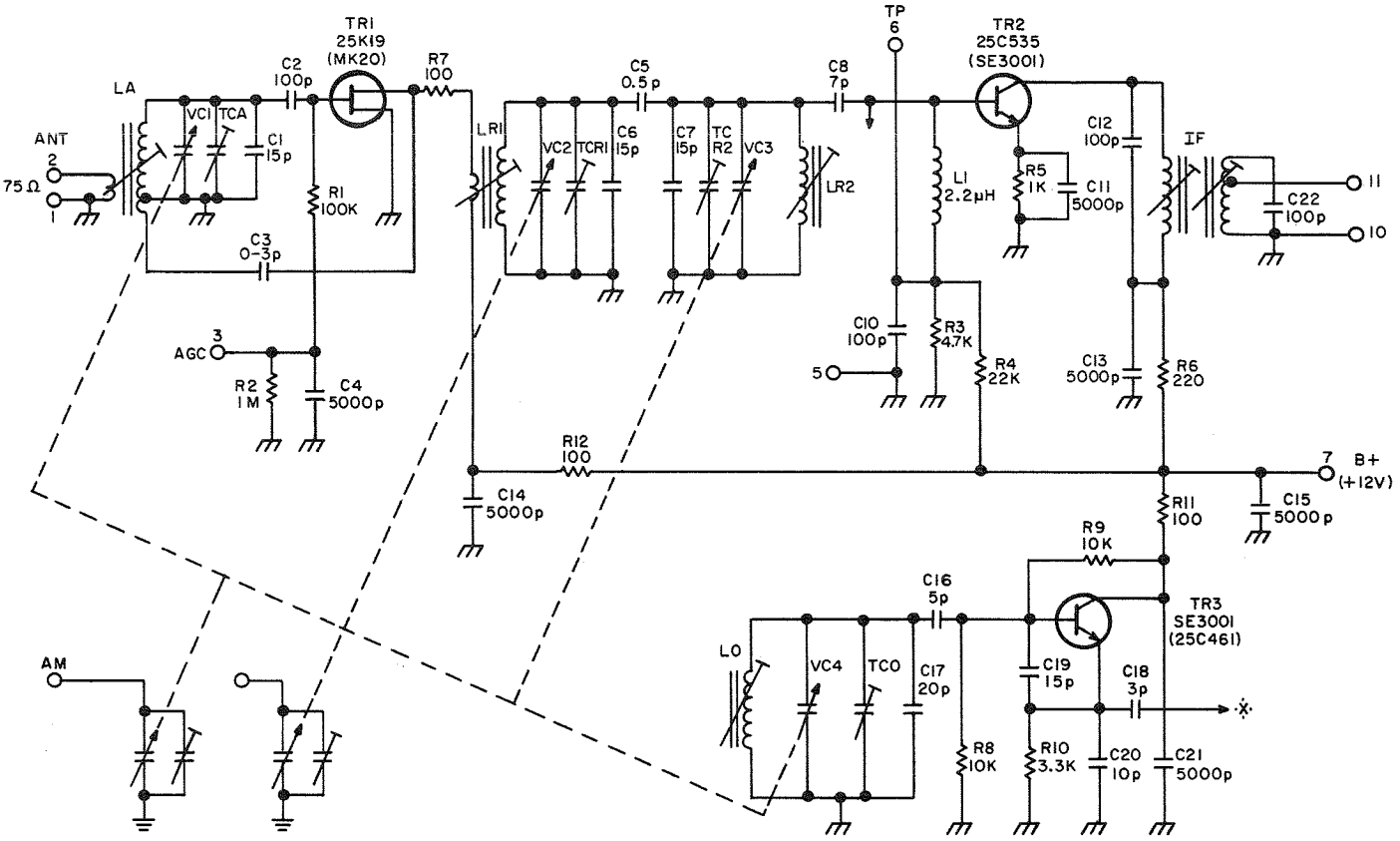


Component Side



Front End

Schematic



Component Side

ALPS TUNER