SCOTT®

Perfection Is Our Standard

SERVICE MANUAL

MODEL
LT-112B

SERVICE PUBLICATION #

H.H. Scott

The LT-112B Scottkit®

FM Broadcast Monitor Tuner

Your new Scottkit represents an exceptional achievement. It was developed by the same engineering team responsible for revolutionizing the hifi component industry through the introduction of new concepts in circuitry, design and styling. It is the culmination of years of research and planning. When you have completed your Scottkit, you can be sure it is the equal of superb H. H. Scott factory-wired components. The quality of your finished kit is assured because: The same conservatively rated, factory-tested parts are specified for Scottkits as for Scott factory-wired components. Kits utilize time-tested Scott circuitry, redesigned to assure perfect performance after just a few hours of instructive work at home.

The Scott full-size, full-color instruction book is designed to make kit-building fool-proof. You can automatically correct any errors you may make.

Before a new Scottkit is marketed, it is completely pretested.

1. Instruction book drafts are hand colored for an evaluation run by many statistically selected consumers. This consumer panel consists of doctors, businessmen, office and factory workers, housewives, engineers, students . . . many of whom have never built a kit before. Each builder notes any suggested changes in the instruction book draft, and returns the draft with the completed kit to the Scott Engineering Department.

2. Each of the completed kits is carefully tested and evaluated. Typical figures from the *consumer*-built units are used for determining specifications.

3. All instruction book drafts are thoroughly examined for notes by the consumer panel, and worthwhile changes are included in the finished book.

This careful evaluation and testing means your Scottkit will be easy to build and give you many years of trouble-free service. Relax . . . have fun . . . you are about to build a superb piece of high fidelity equipment.

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Technical Specifications for the Model LT-112B Broadcast Monitor FM Tuner Kit

Usable Sensitivity (IHF) – 3% THD, Noise & Hum	1.9 uV
Cross Modulation Rejection (Spurious Response Rej.)	90 dB
Signal-to-Noise Ratio	65 dB
Hum (ref. 75 kHz deviation)	–70 dB
Total Harmonic Distortion	0.8%
Frequency Deviation (Drift)	less than 0.02%
Frequency Response	50-15,000 Hz + 1dB
Capture Ratio	4 dB
Selectivity (400 kHz off channel)	45 dB
AM Suppression	55 dB
19 kHz Pilot Suppression	40 dB
38 kHz Sub-carrier Suppression	60 dB
Separation, Stereo (1,000 Hz)	35 dB
Audio Output (ref. 75 kHz deviation)	1.2 vrms
Tuning Range	87-109 mHz
Accuracy of Calibration	0.5%
Output Amplifier Impedance	5,000 ohms
Minimum Recommended Load Resistance	15,000 ohms
Minimum Recommended Cable Capacitance	1,000 pf
Maximum Recommended Length of Output Cable	30 feet
Range of Line Voltage & Frequency	105-120V/50-60 Hz
(110/220 Volt Conversion Units)	(99-118V & 199-235V)
Power Consumption – AC ONLY	15 watts @ 117V

HiFi Dictionary

ac (alternating current—no longer designated AC): an electric current which alternates between a maximum in one direction (+) and a maximum in the other (−), passing through zero in between. The complete reversal and return to the starting value is called one cycle. Also applied to an alternating voltage, thus: "ac voltage." The number of cycles in one second is the frequency, in cycles per second, the new international designation for which is "hertz," abbreviated "Hz" (formerly "cps"). See sine wave.

acoustics (architectural): those characteristics of a concert hall or room which modify the sound produced by a source and affect the quality of the sound reaching one's ears.

AF (audio frequency): a frequency between 20 and 20,000 Hz (cycles per second).

AGC (automatic gain control): a circuit that provides a relatively constant signal level output regardless of the variations in input level.

alignment: adjusting the values of the components of a tuner (such as capacitors, inductors) for optimum performance.

AM (amplitude modulation): the method of transmission in which a signal of constant frequency (the carrier) is varied in amplitude in accordance with the signal (voice or music).

ampere: the practical unit of electric current. One ampere is produced by one volt acting across a resistance of one ohm.

amplifier: a device that increases the strength of electrical signals.

amplitude: a measure of the strength of a wave.

attenuation: reduction in amplitude of a wave. Attenuating a sound reduces its intensity.

balance: to make equal in strength, or symmetrical with respect to a reference point.

bias: a dc voltage in the input circuit of tube, transistor, or diode that determines the direct current (dc) through the device.

cable: a bundle of insulated wires. Also, one or more wires within a sheath.

capacitor (condenser): a device that is capable of storing electrical charge, consisting of two conductive surfaces separated by an insulating material – the di-electric. A capacitor blocks direct current but passes alternating current. The value of a capacitor is called its capacitance; it is expressed in decimal parts of a farad. See "Frequently Used Prefixes."

class A amplifier: a vacuum tube or transistor amplifier stage in which the bias value is chosen for plate or collector current flow throughout a full cycle of the signal. The average current flow with no signal applied is equal to the current flow with signal. This type of amplifier is normally used in preamplifier stages. As a power stage, its efficiency is low.

class B amplifier: an amplifier stage consisting of two tubes or two transistors in which the bias value is chosen for approximately zero plate or collector current when no signal is applied. Current flows during approximately half of the cycle in each device. The average current greatly increases with signal. This type of amplifier is normally used in power output stages; its efficiency is high.

coaxial cable: a cable with one (or more) insulated conductors completely surrounded by a cylindrical shield (see Cable). The shield reduces pickup of hum and noise.

converter: the section of a tuner that converts the incoming RF signal to a signal of fixed lower frequency, known as the intermediate frequency (abbreviated IF). Includes the oscillator and the converter device itself.

continuous power output, rms: the maximum power output capability of an amplifier over an extended period of time without exceeding rated distortion rather than on a short burst, as in music power. The standard test frequency is 1000 Hz (cycles per second).

carrier frequency: the frequency of the original unmodulated radio wave produced by a radio station.

capture ratio: a measure of the ability of an FM tuner to suppress the weaker of two signals of identical frequency, permitting the stronger signal alone to be heard.

cross-modulation: interference of one station by another stronger station, resulting from the interaction of their signals within the tuner. The ability of the tuner's front end to handle weak and strong signals. Expressed in dB, a higher number is usually more desirable.

crossover distortion: in a Class B push-pull amplifier, one output transistor (or tube) produces the positive part of the signal, and the other transistor the negative half. Crossover distortion occurs when the transfer from one transistor to the other does not take place smoothly. This form of distortion is particularly important because of its effect at low listening levels.

current: the movement of electrons through a conductor (see ampere).

cycle: (see ac).

damping: the ability of the amplifier to maintain control over the speaker. High damping assists a speaker in cleanly reproducing transients.

dB (decibel—no longer designated db): a unit of measurement for the power gain or loss in signal strength, expressed in logarithmic form. Specifically,

$$\text{dB gain or loss} = \log_{10} \frac{\text{power output}}{\text{power input}}$$

In terms of voltage or current, for a given impedance, dB

$$\text{gain or loss} = 20 \log_{10} \frac{\text{voltage or current output}}{\text{voltage or current input}}.$$

dc (direct current—no longer designated DC): a current that flows continuously in one direction.

de-emphasis: (see equalization).

detector: the section of a tuner that converts the modulated carrier to an audio output.

diode: device that conducts electricity in one direction only.

distortion: any unwanted change in the waveform of a signal.

efficiency: the ratio of the output power of a device to its input power, usually expressed in per cent.

equalization: modification of the frequency response of a device in a desired manner to achieve a specific result, such as reduction of background noise.

feedback: involves feeding a small part of the output of an amplifier back to the input. If the signal is fed back so as to cause a reduction in gain, it is called negative feedback. It provides a reduction in distortion.

field-effect transistor: a type of solid-state device which controls current flow by means of an electrostatic field. It has lower noise and generates less distortion than a normal "bi-polar" transistor.

filter: a circuit designed to pass certain ranges of frequency while restricting the passage of others.

flutter: rapid fluctuations in speed caused by mechanical deficiencies in turntables or tape recorders, resulting in variations in pitch.

FM (frequency modulation): the method of transmission in which a signal of constant amplitude (the carrier) is varied in frequency in accordance with the signal (voice or music).

frequencies: (see AC).

front end: the term used to describe the section of the tuner that selects the desired station, amplifies it and converts it to the IF frequency. Includes an RF amplifier and a converter.

fuse: a protective device that disconnects the circuit when the current exceeds a certain level.

gain: increase in signal strength. Usually expressed in decibels (db).

ground: a connection, intentional or accidental, between an electric circuit and the earth or a chassis serving in place of the earth.

harmonic distortion: the unwanted generation of additional signal components that are multiples of the fundamental frequency of the signal.

Hz (hertz): new international designation for cycles per second. See ac.

hum: a low-pitched, undesired sound usually caused by improper filtering of the ac power supply, or poor shielding of the same circuit. Hum is composed of the power line frequency and its harmonics.

IF (intermediate frequency): (see converter). It is easier to build a tuned (selective) amplifier for a fixed frequency than one that is adjustable over a range of frequencies. The intermediate frequency is produced in the converter. See converter.

IM (intermodulation distortion): the generation of unwanted signals by the interaction of two or more signals of different frequencies. IM products are usually not multiples of the frequencies of the input signals; that is, not harmonically related to them.

impedance: the property of a circuit that determines the amount of flow of alternating current where a given voltage is applied. It is measured in ohms.

insulator: a part that does not conduct electricity.

insulation: non-conductive material used to prevent the flow of electricity to undesired areas.

jack: an electrical receptacle into which a plug is inserted to complete an electric circuit.

lead: a wire that connects two or more points in a circuit (pronounced "leed").

limiter: an amplifier stage in an FM tuner that removes variations in the amplitude of the signal caused by atmospheric disturbances and man-made interference, which would otherwise cause noisy reception.

mixer: (see converter).

modulation: see AM and FM. The process of superimposing, music or voice on a carrier frequency.

monophonic (sometimes known as monaural reproduction): a transmission system combining all input signals in a single channel in such a manner that all reproduced sounds seem to emanate from the same location.

multiplex (mpx): a technique whereby two independent stereo signals are transmitted by a single FM station and then separated at the receiver for stereophonic reproduction.

music power or dynamic power (IHF standard): maximum power output of an amplifier that can be obtained without exceeding rated distortion measured over a time interval short enough so that power supply voltages have not changed from their no-signal values. These conditions are representative of the situation that occurs when music is being reproduced. Standard test frequency is 1000 Hz (cycles per second).

network: a combination of electrical components designed for a specific function.

nuvistor: a trade name for a sub-miniature highly dependable vacuum tube in a metal envelope.

ohm: the unit of resistance (see resistance).

oscillation: generation of an ac signal.

peak power: the maximum instantaneous power output capability of an amplifier. Twice the music or dynamic power.

phase: the time lag between two signals of identical frequency expressed in terms of parts of a complete cycle. Two ac signals are in phase when they reach their maximums simultaneously. They are out of phase when one signal reaches its maximum in one direction as the other signal reaches a maximum in the opposite direction.

potentiometer (abbreviated "pot"): a rotary control that introduces a variable amount of resistance into a circuit. Example: a volume or loudness control.

power: the time rate at which work is performed or energy expended. The power rating of an amplifier expresses the amount of energy it can provide per unit time, (to drive a loudspeaker). Power is expressed in watts. Watts = amperes times volts.

power bandwidth: the lowest frequency and the highest frequency for which the harmonic distortion measured at one-half of rated continuous power output is equal to the rated harmonic distortion.

printed circuit: an insulating board to which a layer of copper has been laminated and then etched, leaving conducting areas and lines that take the place of conventional wires to interconnect components like resistors and capacitors mounted on the board.

regeneration: (see feedback). Regeneration denotes positive feedback.

resistance: the property of a conductor that determines the current flow resulting from the application of a given voltage. The unit of resistance is the ohm (ohms = volts ÷ amperes).

resistor: a device designed to control the flow of current (see resistance). Resistors are made both fixed in value and adjustable (potentiometer).

RF (radio frequency): frequencies above the audible range (above 20,000 Hz (cycles per second)). Specifically those frequencies used to transmit radio (or TV) signals.

rumble: low-frequency noise and vibration mechanically generated in turntables and transmitted to the phono cartridge.

semi-conductor: a material, in crystalline form, used in diodes and transistors, that permits the flow of current to be controlled in degree and direction.

sensitivity: expresses the ability of an FM tuner to receive weak signals and still be able to suppress background noise. The rating is in terms of microvolts of signal required for a given number of db of quieting (suppression of noise). The IHF usable sensitivity rating takes into account hum and distortion as well as noise, which makes it a more meaningful figure. It is specified in microvolts for 30 dB level difference between signal and the sum of noise, hum, and distortion.

sensitivity: in an audio amplifier, the sensitivity is a measure of the power output corresponding to a given input. It is usually expressed in inverse form by specifying the input voltage required to obtain rated power output.

separation: stereo is produced by the use of two separate signal channels, right and left. If the channels interact, the stereo effect is reduced. Separation is expressed in terms of the dB difference between the signal in one channel and the amount that leaks into the other channel.

signal-to-noise ratio (s/n ratio): the ratio of desired program signal strength to the undesired background noise, expressed in dB. The greater the s/n ratio, the less noise will be audible during quiet passages.

sine wave: a smooth curve that varies periodically with time, going to a maximum in one direction, returning to zero, going to a maximum in the other direction and then returning to zero again. A pure tone without harmonics is a sine wave.

solid state: referring to the use of semi-conductors (diodes and transistors) as opposed to tubes.

spaghetti: cloth or plastic tubing designed to slide over uninsulated wire to prevent short circuits.

stability: the ability of a circuit to maintain its normal operating characteristics despite some change in operating conditions, such as temperature. It also refers to an audio amplifier's ability to operate without oscillating (producing an internally generated output signal) when loads of varying characteristics are connected, or the output circuit left open. Speakers have impedances that are not pure resistance and may act like capacitors over part of the frequency range and inductances at other frequencies.

stereophonic: program material (or the equipment designed for its use) providing reproduction in which the spatial location of the original source is conveyed to the listener through the use of separate right and left channels. Stereo provides the listener with a feeling of space and reality similar to that heard in the concert hall.

subsonic: frequencies below the normal range of human hearing (below 20 Hz (cycles per second)).

supersonic: frequencies above the normal range of human hearing (above 15,000-20,000 Hz (cycles per second)).

spurious response: the appearance of a station on the dial at points other than where it belongs. Expressed in dB, a higher number is usually more desirable.

terminal: a device providing convenient means for connection of a wire.

transformer: a device for changing voltage (and current) from one value to another without changing the electric energy. A power transformer changes line voltage to the values needed by the various circuits in an amplifier or tuner.

transient: a momentary, as opposed to a continuous, signal. Voice and music consist of a succession of transients—signals that change from instant to instant.

transistor: semi-conductive device in which the flow of electrons from one connection to another is controlled by varying the current or voltage applied to a third connection. Capable of amplifying a signal voltage or current, and of generating oscillations (ac).

tube: (vacuum tube) a glass or metal enclosed device in which controlled conduction occurs by means of a flow of electrons across a vacuum from one electrode (the cathode) to the other (anode). The control electrode is called a grid. Tubes are used for amplification and oscillation.

voltage: electromotive force, the equivalent of force or pressure in a mechanical system. The electromotive force required to push one ampere of current through one ohm of resistance is one volt.

Resistor Color Code

The color bands around the body of most resistors indicate the value of the resistance. The two bands close to end of the resistor body give the first two digits of the value, the third band represents the multiplier, and the fourth band (sometimes omitted) gives the tolerance. The size of the resistor gives an indication of the power rating (watts). A resistor rated at ½ watt has a diameter of ⅛", a one-watt resistor is ¼" in diameter, and a two watt resistor is 5/16". Precision resistors do not necessarily conform to this rating system.

COLOR CODE

Color	1st digit	2nd digit	Multiplier
black	0	0	1
brown	1	1	10
red	2	2	100
orange	3	3	1000
yellow	4	4	10,000
green	5	5	100,000
blue	6	6	1,000,000
violet	7	7	10,000,000
gray	8	8	100,000,000
white	9	9	1,000,000,000
gold			.1
silver			.01

Tolerance: Gold ± 5%
Silver ± 10%
No band ± 20%

Example:
Yellow (4)
Violet (7)
Red (100)
Gold (5%)

Resistance 47 x 100 = 4700 ohms (4.7K)
Tolerance: plus or minus 5%

FREQUENTLY USED PREFIXES IN ELECTRONICS

Symbol	Prefix	Multiplying Factor
$\mu\mu$ or mm*	micro-micro	10^{-12}
p	pico	10^{-12}
μ or m*	micro	1/1,000,000 (10^{-6})
m	milli	1/1000 (10^{-3})
K	kilo	1000 (10^{3})
M	mega	1,000,000 (10^{6})

* *For capacitors only. Example: 1 mfd = 1 microfarad.*

Section 1 — Getting Started

First, unpack the kit from the KIT-PAK® container. You should take care not to mislay any small items or packages. If you wish, you can work right inside the KIT-PAK®. It will help protect your work table. When you want to stop working for a few hours, just close the cover and put the whole kit away out of sight. You will find the KIT-PAK® cover an ideal rest for the instruction book.

1.1 Tools Required

A small screwdriver is provided with the kit. In addition, you will need a pair of long nose pliers, a regular size screwdriver (3/16″ wide blade), a pair of wire cutters, and a soldering iron. The soldering iron should have a rating between 35 and 55 watts and must have a small tip. It is extremely dangerous to use any iron of greater wattage as too much heat can damage the printed circuit boards. You will find a ¼″ hexagonal nut driver very useful for installing sheet metal screws.

1.2 Basic Electrical Assembly Procedure

Each switch, terminal strip, printed circuit board, etc., has a code number (S1, T1, PC1). Every pin or terminal on these parts and sub-assemblies is also numbered (Pin 1, Pin 2, etc.). For example, the instructions may call for a wire or component to be connected to S5-3. This means that you are to connect a wire to Pin 3 of S5. Another example: P1-2 means Pin 2 of P1.

There is a specific pictorial diagram which shows the actual connections in full color for each group of step-by-step instructions. Using the color pictorials and occasionally referring to the top and bottom view photographs (Section 1.8), will enable you to easily construct a kit equal to a factory-wired unit.

The parts and wires to be used are packed in transparent envelopes. For each wiring group of instructions, open the specified envelope and spread the contents out on your work table. The envelope number which appears in the wiring instructions will also appear on a card inside the transparent envelope. As the step-by-step instructions are followed, you will gradually use all the parts and wires in the transparent envelopes. Parts for more than one series of steps will sometimes be included in a single transparent envelope.

As each step is completed, place a check beside the step number so that you will not lose your place if you are interrupted.

The many wires used in the kit are of the proper length and have been stripped back. If, for example, a 10″ black wire is called for, select the black wires from the transparent envelope and with the ruler located on the inside cover of the kit box, select the correct 10″ wire. This is important, for if you use the wrong wire you may find that later on in the course of construction a wire will be too short.

1.3 Soldering And Wiring Instructions

All the solder ordinarily needed to assemble the kit is supplied. If for any reason additional solder is needed, make sure that you use 60/40 ROSIN CORE SOLDER. Under no circumstances should you use Acid Core Solder. All guarantees are voided if Acid Core Solder is used.

Soldering Instructions:

a. Before using the soldering iron, the tip must be tinned as follows: First heat up the iron. When the tip is hot, wipe it gently with a cloth till bright and shiny and apply a generous amount of solder. Remove any excess solder with the cloth. Repeat the process for all sides of the tip.

b. Make sure that all wires and terminals to be soldered are completely clean. Do not use fluxes or paste of any sort.

c. The wires should be mechanically secure before soldering. Make a single turn around the contact and then pinch the wire tightly with the long nose pliers. If the wire is too large to be bent, position the wire so that a good solder connection can still be made by holding the wire against the terminal when soldering.

d. Wires on resistors, capacitors, and similar components are generally longer than required to make the indicated connections; cut off this excess wire while adding the part to the chassis. The wires should be long enough to reach their destination, allowing a little left over (approximately ¼″) to make a good mechanical joint.

e. Place a flat side of the soldering iron tip against the joint to be soldered until it is heated.

f. Hold the end of the solder against the junction

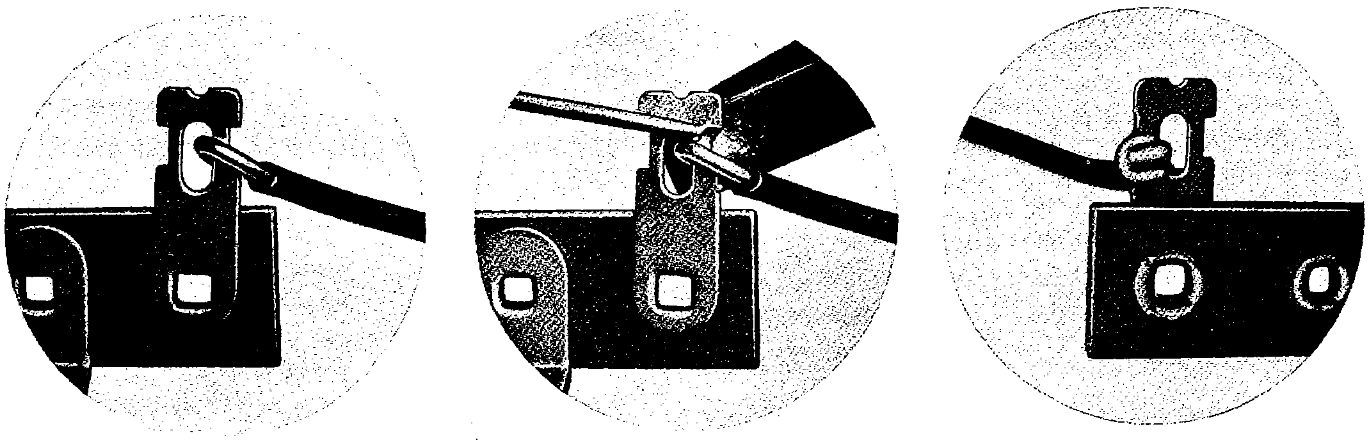


FIGURE A HOW TO SOLDER

of the tip of the iron and the terminal. This solder will immediately melt and quickly transfer more heat to the terminal, allowing the solder to flow around the joint. At this instant the joint must be hot enough to melt the solder by itself without the aid of the iron. Use only enough solder to flow smoothly over the joint.

g. As soon as the joint is covered with solder, remove the solder and then a second later, the iron. Do not allow the wire to move until the joint has hardened (about 5 seconds). A good solder joint is bright and shiny. After the solder hardens, check the joint for rigidity. If it is not firm and tight, reheat the joint and permit the solder already present to flow again. Usually a little more solder will have to be added.

h. When soldering diodes, it is advisable to use no more heat than necessary. Excessive heat can damage these components. Use a paper clip or an alligator clip as a heat absorber (sink) to protect the diodes.

i. The printed circuit boards may be supplied with either turret terminals (pins), bifurcated terminal-eyelets (a hollow slotted pin), or eyelets (metal-rimmed holes).

The procedure for soldering to the turret terminals is the same as given above in "c."

There are two methods for soldering to the bifurcated terminal-eyelets; the method used is dependent upon the side of the printed circuit board to which the wire is to be attached. If the wire is to be attached to the side of the board on which the components are located, the soldering is accomplished in the same manner as outlined above in this section. Mechanically attaching the wire to the bifurcated terminal-eyelet may be done by either wrapping the wire around the pin (as given above) or by dropping the wire in the slot and pinching the sides of the pin together. If the wire is to be attached to the etched side of the board (opposite side from the parts), then the wire is soldered into the hole of the bifurcated terminal-eyelet by the same method illustrated in the following paragraph for eyelets (tack soldering).

"Tack soldering" is somewhat different from the normal soldering procedure. It essentially consists of soldering a wire without mechanically attaching it first. The wire is held in place while soldering and the solder itself is used as both a mechanical and electrical connection. The procedure for "tack soldering" to eyelets is as follows:

1. The bare end of the wire going to the eyelet must be tinned by heating the end of the wire with the soldering iron and coating the wire with solder.
2. The soldering iron itself is tinned by placing a small amount of solder on the tip. It is not necessary for a big "glob" of solder to be left on the soldering iron. However, the iron should not be wiped completely clean.
3. Place the wire on the hole and apply the point of the soldering iron to the edge of the eyelet until the solder flows freely; push the wire in, then immediately remove the iron and hold the wire until the solder has hardened.

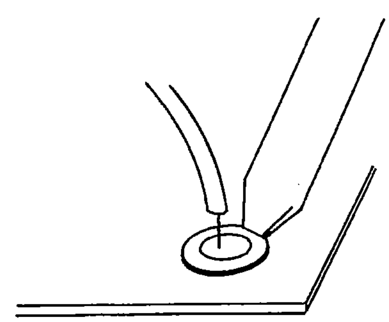


FIGURE B EYELET SOLDERING

j. In some cases additional wires have to be attached to some terminals that have been previously soldered. To do this, connect the wire to the terminal with a good mechanical joint, then heat the connection so that the solder already on that terminal will melt and hold the new wire. If you doubt the security of the connection, add a little more solder. Additional connections to eyelets and bifurcated terminal-eyelets are made in the same manner.

k. Keep the soldering iron clean and bright by an occasional gentle wipe with a cloth. The iron does not have to be cooled for this purpose.

If you have never done any soldering before, it would be an excellent idea to practice on scraps of wires before beginning. Some of the most common errors to avoid are insufficient solder to flow to the very bottom of large joints and not positioning the wires far enough away from each other to prevent shorts.

Be sure to place the wires or components in the same position as shown in the pictorial. Be as neat as possible: this will greatly cut down on mistakes, shorts and other difficulties. Neatness will also make it easier to check your wiring.

Wiring Instructions:

The symbol **(S)** after any connection, means that this connection and all other wires on the same pin should be soldered. A number will appear after the **(S)**. This number indicates exactly how many leads or wires are supposed to be connected to the terminal or pin in question. For example: "Connect an orange wire to T6-2 **(S3)**." The soldering number **(S3)** will always be in bold parenthesis so it can be found quickly. It indicates that there should be 3 wires or leads (including the orange one in this case) connected to Pin 2 of T6 and that all three of them are to be soldered. This provides an additional check for wiring errors.

Do not solder any connection that is not marked with an **(S)**. Other connections are still to be made to this point before it can be soldered. Frequently, one end of a wire or component will be soldered while the other end will not (for the moment). The **(S)** will only appear after the description of the end that is to be soldered. After completing the soldering, cross out the **(S)** symbol with your pencil indicating that it has been done. This is in addition to checking off each step. In this way you can glance over the assembly instructions and spot any **(S)** that has not been crossed out, indicating that you may have overlooked a joint to be soldered.

The instructions for assembling the kit have been arranged in a logical order to insure perfect results. Follow them exactly, checking off each step as completed.

1.4 Types of Wire

Regular hook-up wire: these are the standard insulated wires that you will be using most of the time. They will be found in transparent envelopes for the different portions of the assembly procedure. Bus wire is a term used to describe short pieces of uninsulated wire. A length of bus wire will be found in one of the transparent envelopes for the first steps.

Spaghetti: a hollow plastic insulating tubing. This tubing is slipped over bare wires to provide insulation.

Stranded wire: Wire composed of many small strands. When using stranded wire be careful to prevent a single strand from separating and accidentally shorting with an adjacent pin or terminal. To insure that this will not happen, carefully twist the strands starting from the insulation and work towards the end. When the strands are twisted tightly as shown in the illustration, check once again to be sure that no strands have separated.

Cable (ESS): Hollow tubing with a black or white outer insulation and a spiral metal shield inside.

Cable (ECT): An outer insulated vinyl tubing which covers an inner conductive vinyl shielding tubing with a bare grounding (drain) wire sandwiched between them.

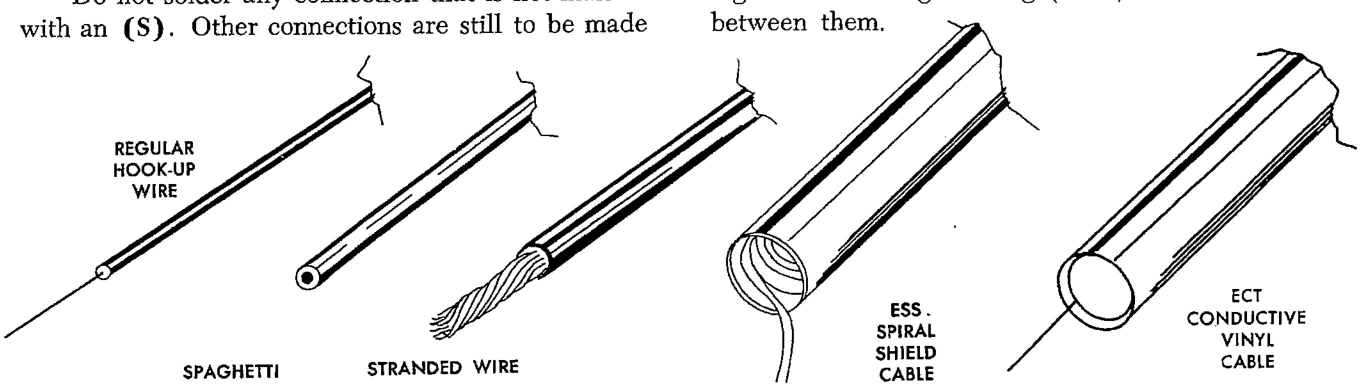


FIGURE C TYPES OF WIRE

VERY IMPORTANT

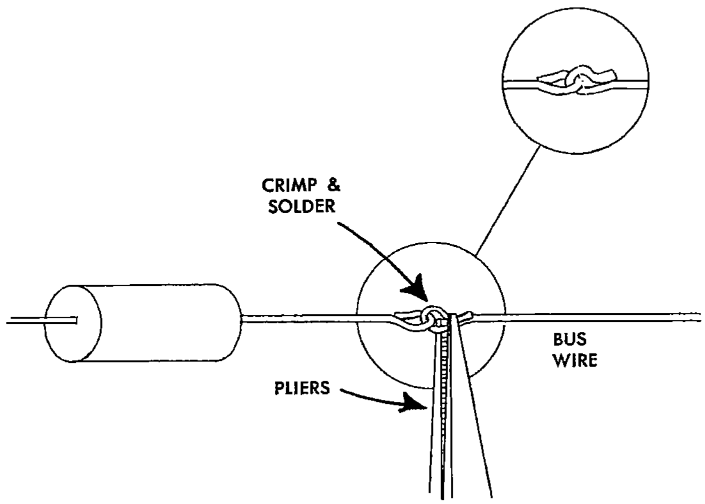


FIGURE D HOW TO SPLICE

1.5 What To Do If You Make A Mistake

No matter how careful you are, it is still possible that you may break something accidentally or cut a wire too short. If you work when tired or try to do too much too fast, the possibility of mishap increases greatly. Fortunately, it is easy to correct most errors.

a. Cutting a wire too short: If you cut the wire from one of the components too short, you can easily correct it by taking a small piece of bus wire and splicing it on as shown.

b. If a wire supplied is damaged: cut off a replacement from one of the four-foot pieces provided.

c. Breaking a terminal strip: the terminal strips are quite sturdy and will withstand a great deal of handling. If you are unlucky enough to break a terminal, make all connections to the small hole below the pin. Be careful to avoid having any of the bare wires touch the chassis. If the phenolic material cracks but does not break off, you can continue, as the wires themselves will keep the broken piece in place.

d. In the unlikely circumstance that the entire terminal strip breaks off, write to the Parts Department at the factory for a replacement. Drill out the rivet holding the broken strip, using a number 28 drill. Mount the replacement with a binder head 6/32 x 1/4 machine screw, lockwasher and nut.

1.6 The Double Check System

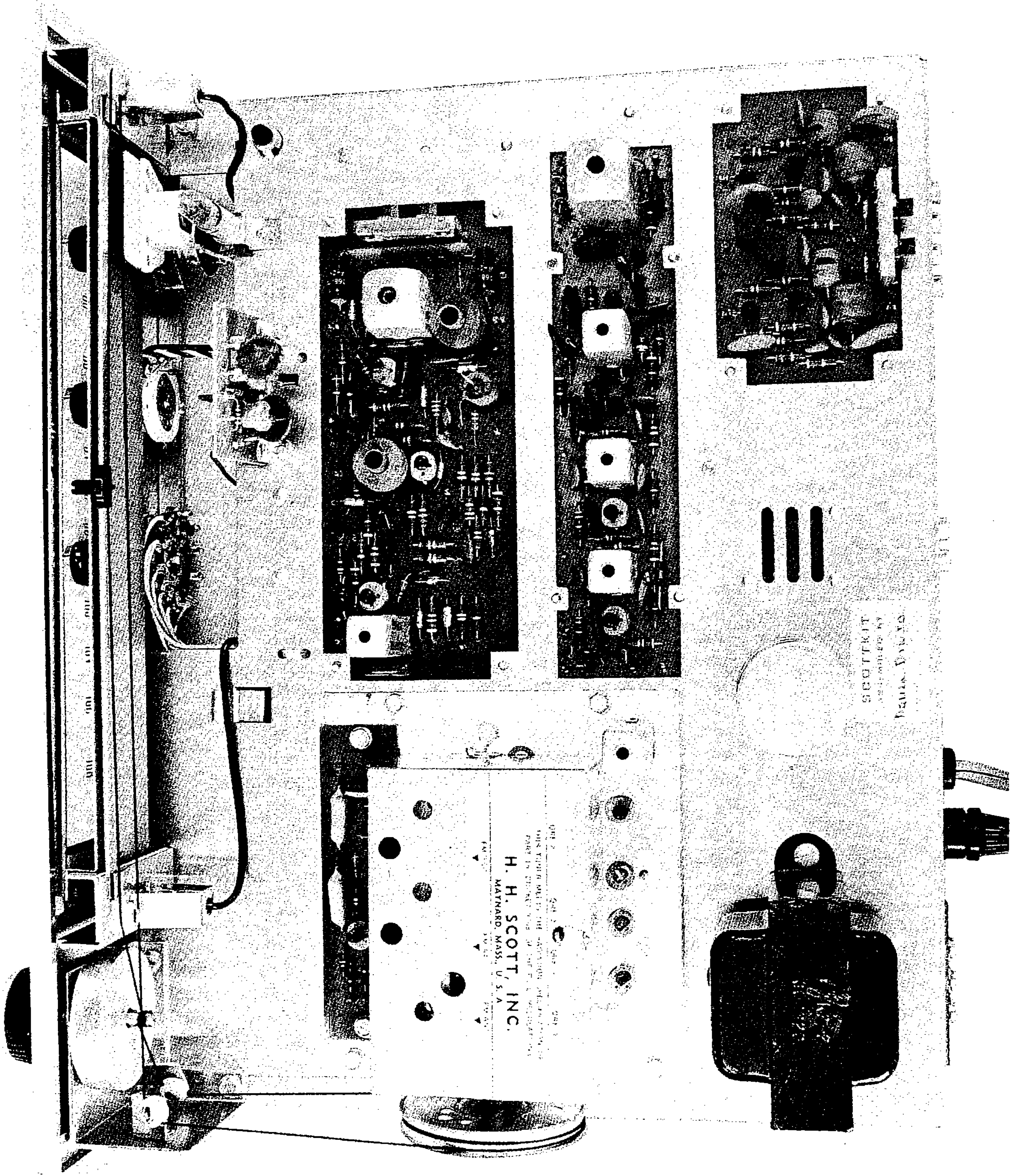
After finishing each sub-assembly, you will be referred to a DOUBLE CHECK SHEET to check over your work. This DOUBLE CHECK SHEET is most important in assuring error-free construction.

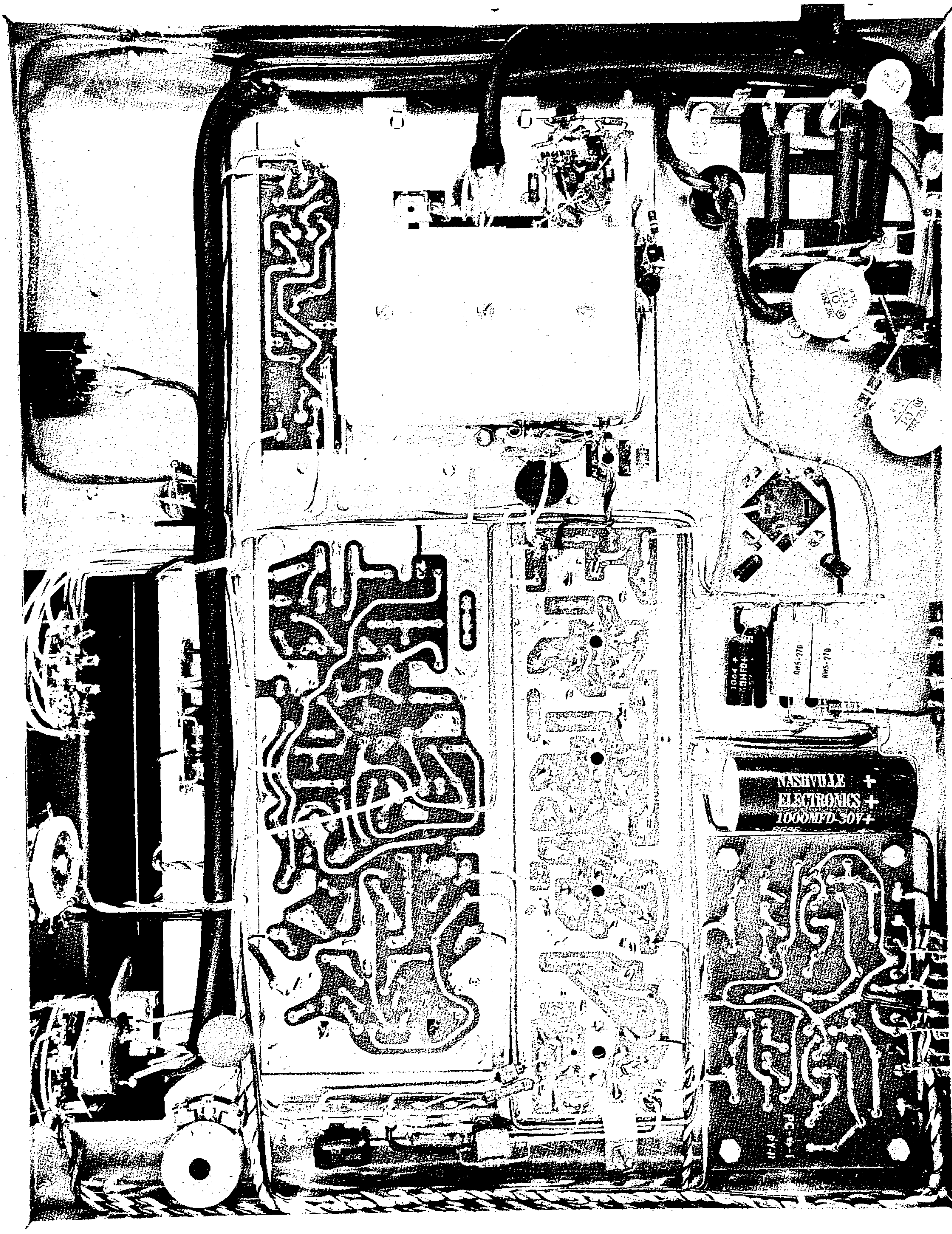
In our extensive evaluation tests we have had kits built by people with a wide variety of experience. Most of the kits worked perfectly upon completion. Of these people, virtually all of the successful builders took the time to follow this Double Check System, and most of them reported catching small errors. In those units that did not work, we discovered the malfunction could, in most cases, be traced directly to skipping the double check, carelessness, and working when overtired. Simple miswiring errors or short circuits prevented proper operation of the kit. Stop for a moment, RELAX, and be sure to check over your work.

An easy method of doing this has been provided. Ask a friend or another member of the family to help you. Have them look over charts AF-1, AR-1, etc. On these diagrams, a series of numbers have been placed next to each pin or terminal. These numbers indicate the number of wires and leads (including those from resistors or capacitors) that have been soldered to that pin. While you count off the number of wires on each pin and terminal, your assistant can check your count against the chart. When you count the wires going to Pin 1 of P1, your helper will observe that this agrees with his chart and place a small check mark on it. This will be continued until the entire kit is checked over.

WHILE YOU ARE COUNTING THE WIRES, YOU CAN ALSO BE CHECKING FOR SHORT CIRCUITS AND PROPER SOLDERING. It would be very handy if you had a tool with a small, sharp point (like an ice pick) to probe the connections and make certain they are soldered properly. A pencil with a sharp point can also be used. Even the most meticulous worker can make a mistake or have a poorly soldered joint. LOOK SHARP! Move every cable and wire a little to insure that it is not causing a short circuit with some other wire or pin.

If a mistake is caught and it involves a component which is now too short to reach the correct pin, refer to Figure D on splicing a piece of bus wire. This will work quite well and eliminate the need for purchasing a replacement. Make sure that you correctly measure the length of the pre-cut pre-stripped wires. This is important, for if you use the wrong wire, you may find that later on in the construction a wire will be too short.


H. H. SCOTT, INC.
MAYNARD, MASS. U.S.A.


NASHVILLE +
ELECTRONICS +
1000MFD-30V+

Section 2 — LT-112B Parts List

This parts list is broken down to cover each plastic envelope. The plastic envelopes are arranged in their order of use. Each plastic envelope contains the parts for a given Assembly Group.

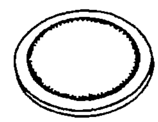
Check off each part just before each Assembly Group is used. Do not open any plastic envelope until you reach the appropriate step. This will eliminate the possibility of losing some of the small parts.

If you should accidentally damage or misplace any parts, write to the LABORATORY KIT SERVICE DEPARTMENT at the factory immediately.

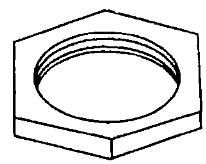
Extra three-foot lengths of purple insulated wire and purple/white insulated wire have been supplied with the first step. They can be used to replace any missing wires or ones accidentally damaged. Simply cut off the length required (a convenient ruler is printed on the inside cover of the KIT-PAK®) and a strip of 1/4″ of insulation at each end, being careful not to knick the wire. If you have to replace a twisted pair, first evenly twist the correct length of purple and purple/white wires together and then cut them.

Carefully check your complete KIT-PAK® for parts before throwing away any packing materials.

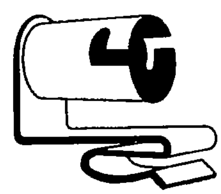
Env. #1	Mechanical Assembly	
1	H-LW-3/8L	Lockwasher, fine toothed
1	H-N-3/8 x 5/8	Hex nut, large brass
3	H-N-3/8 x 1/2B	Hex nuts, brass
1	E-RCV-1	Solder shield, grey fish paper
1	RCV-50K-PH	STEREO THRESHOLD potentiometer
1	V-PL-49	Light bulb, 2 volt, 0.06 amp
1	J-3-ST-6	Phone jack
2	F-SB-1/2	1/2 amp slo-blo fuse (includes 1 spare) Type 3AG-S/B (also two F-SB-0.3, 1/3 amp slo-blo fuses for 110/220 volt models)
1	XF-3AG	Fuse post w/lockwasher, rubber washer and nut
1	X-PL-U4-7	Light bulb socket
7	H-SMS-6 x 1/4HW	Sheet metal screws (includes 1 spare)
1	H-LW-3/8	Lockwasher, coarse toothed



LOCKWASHER

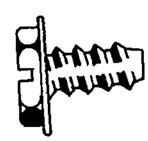


HEX NUT



LIGHT BULB SOCKET

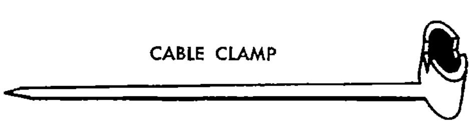
Env. #2	Electrical Subassembly	
1	RC11-1M	1 megohm 1/4w resistor (brown, black, green)
1	RC11-68K	68,000 ohm 1/4w resistor (blue, grey, orange)
14		Wires
2		Spare wires, purple and purple/white
1		10″ spaghetti
1		18″ #22 bus wire

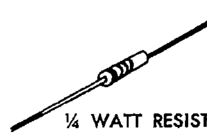


SHEET METAL SCREW

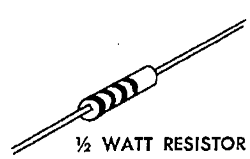
Env. #3	Electrical Assembly Group 1	
2	H-MS-632 x 1/4B	Machine screws
1	H-N-3/8 x 1/2B	Hex nut, brass
1	A-CL-503-P	Cable clamp
1	RC11-100K	100,000 ohm 1/4w resistor (brown, black, yellow)
9		Wires

CABLE CLAMP





1/4 WATT RESISTOR



1/2 WATT RESISTOR

Env. #4 **Electrical Assembly Group 2**

1	A-CL-503-P	Cable clamp
12		Wires

Env. #5 **Electrical Assembly Group 3**

1	CC-.02	.02 mfd ceramic capacitor
1	CM20-390	390 pf mica capacitor
1	L-RFC-.01	10 mh r.f. choke
1	RC11-5.6K	5,600 ohm ¼w resistor (green, blue, red)
2	RP-5.2K-1	5,200 ohm 1% precision resistor
1	RC11-12K	12,000 ohm ¼w resistor (brown, red, orange)
1	L-RFC-80	80 μh r.f. choke
1	DZ-12	Diode, 12 volt zener
2	RW5-270	270 ohm, 5w wirewound resistor
1	CETM 1000/30	1000 mfd/30v tubular capacitor (electrolytic)
1	RC21-180	180 ohm ½w resistor (brown, grey, brown)
1	CETM 10/25	10 mfd/25v tubular capacitor (electrolytic)
1		Wire

Env. #6 **Electrical Assembly Group 4**

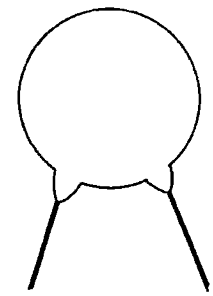
2	SR2-7.5	Silicon rectifiers
1	RC21-820K	820,000 ohm ½w resistor (grey, red, yellow)
2	CC-.0047/1.4KV	.0047 ceramic capacitor, high voltage (or a CC-.01/1KV)
2	L-RF-1S	1 μh choke
1	ECT-3/16v	ECT conductive vinyl shielded cable
1	CC-.001/1KV	.001 mfd ceramic capacitor, high voltage
8		Wires (includes 1 heavy white wire and 1 heavy blue wire for 110/220 volt models only)

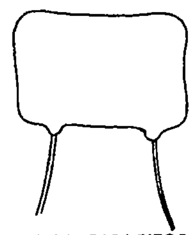
Env. #7 **Electrical Assembly Group 5**

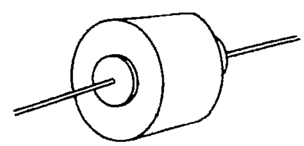
2	X-PL-U4-5	Dial light sockets
1	RC21-10	10 ohm ½w resistor (brown, black, black)
2	A-CL-503-P	Cable clamps
1	CC-120	120 pf ceramic capacitor
2	CETM 2/25	2 mfd/25v tubular capacitors (electrolytic)
5		Wires

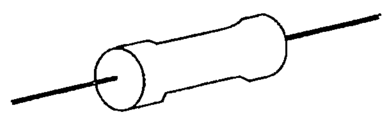
Env. #8 **Final Mechanical Assembly**

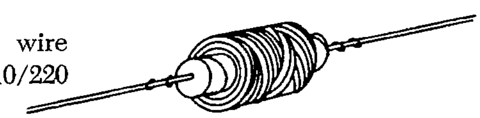
1	A-DC-6	Dial cord
1	A-SP-3	Dial cord spring
3	H-N-⅜ x ½B	Hex nuts
1	H-N-⅜ x ⅝S	Shouldered hex nut
1	A-P-SR-2	Dial pointer

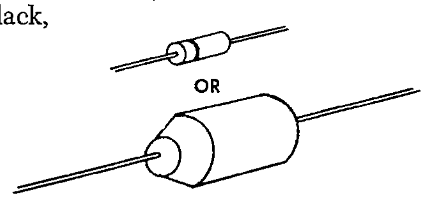

CERAMIC CAPACITOR


MICA CAPACITOR

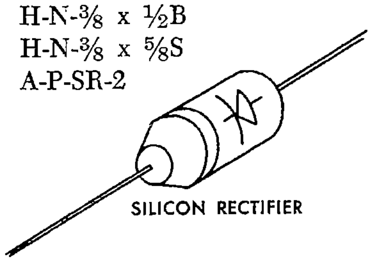

L-RFC-.01- CHOKE

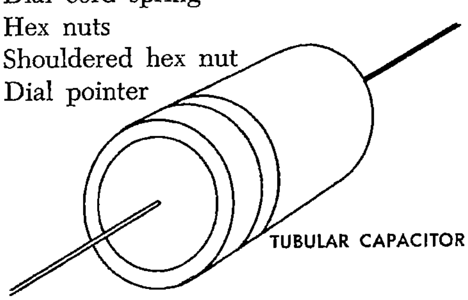

PRECISION RESISTOR

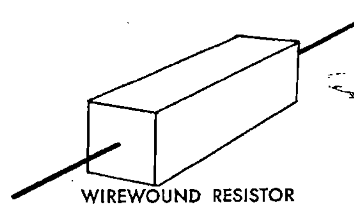

L-RFC-80 CHOKE



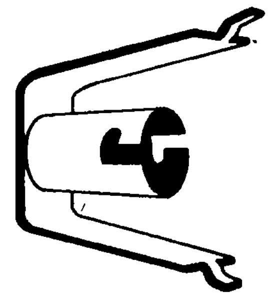
DIODE


SILICON RECTIFIER


TUBULAR CAPACITOR


WIREWOUND RESISTOR

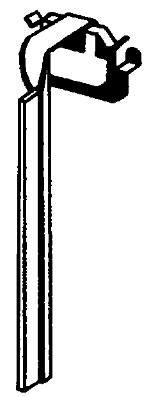
3	V-PL-1847	Meter and dial light bulbs
4	H-SMS-6 x ½HW	Sheet metal screws, ½" long
4	A-FT-1	Plastic feet
1		Label
5	H-SMS-6 x ⅜BBS	Thread cutting screws, black (includes 1 spare)
9	H-SMS-6 x ¼HW	Sheet metal screws (includes spares)



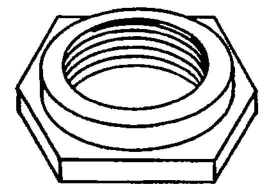
DIAL LIGHT SOCKET

Parts Packed in KIT-PAK® and PART-PAK® Boxes

1	A-BC-40	Top Cover
1	A-BC-23	Bottom Cover
1	A-MC-21 assembly	Main chassis with its assembled parts*
1	A-CB-29 assembly	Flywheel bracket with pulleys
1	A-FW-B	Flywheel assembly
1	CEC 250/50-1000/30	250 mfd/50v and 1000 mfd/30V electrolytic capacitor
1	SRW-44-11	FUNCTION switch
1	SRW-34-5	METER switch
1	SRW-24-8	SELECTOR switch
1	A-DGC-2 with MSS-8	Dial glass chassis assembly with MSS-8 meter
1	E-LT-AV-R	Solder (25 grams)
1	E-LT-AT-1	Alignment tool
1	E-LT-SD	Screwdriver
1	N-LT-112B-1	Panel with dial glass N-D-FM-21
3	KN-P-6LTT	Knobs (small)
1	KN-P-10PTT	Knob (tuning)
2	WAC-3A	Audio interconnecting cables
1	Z-ANT-FM-2	FM Antenna (folded dipole)
1	**Z-PC-NS-2 assembly	Interstation noise muting wired PC board (Blank PC board number—PC-124)



DIAL POINTER

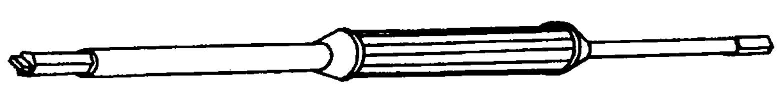


SHOULDERED HEX NUT

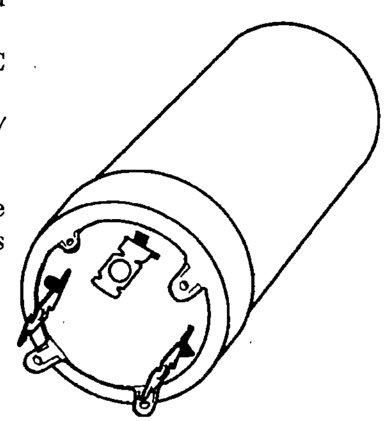
*Major parts mounted on AMC-21 main chassis consist of:

1	Z-FM-16K assembly	Prealigned front end
1	**Z-PC-MI-1 assembly	Multipath indicator wired PC board (Blank PC board number—PC-122)
1	**Z-PC-IF-1 assembly	Prealigned IF amplifier wired PC board (Blank PC board number—PC-107)
1	**Z-PC-MX-11 assembly	Prealigned multiplex wired PC board (Blank PC board number—PC-109)
1	**Z-PC-01 assembly	Output wired PC board (Blank PC board number—PC-112)
1	TR-2-2	Power transformer (TR-2-3 for 110/220 volt power transformer)

**If it is necessary to order a replacement PC board, be sure to specify the ASSEMBLY number. The blank PC board number is the PC board minus components.



ALIGNMENT TOOL



ELECTROLYTIC CAPACITOR

Section 3 — Kit Construction

3.1 Mechanical Assembly

Env. #1

Having read "Getting Started," you are now ready to start building your kit. Proceed slowly, read carefully and enjoy yourself.

The smaller parts for Section 3.1 Mechanical Assembly are located in Envelope #1. The larger parts for this section, and those that follow, are located in the various PART-PAK's® throughout the KIT-PAK.®

Note: Use the extra H-SMS-6 x ¼HW sheet metal screw in Envelope #1 to tap (prestart) the holes in the chassis **before** mounting the mechanical subassemblies. This procedure will make it easier to assemble the mechanical parts, and will reduce the possibility of stripping a screw and/or the chassis.

Install:

1. The flywheel bracket as shown in Fig. 1, using two H-SMS-6 x ¼HW sheet metal screws.
2. The flywheel into the flywheel bracket as shown in Fig. 2, using one fine-toothed H-LW-⅜L lockwasher and one large H-N-⅜ x ⅝ hex nut.
3. The dial chassis on the main chassis as shown in Fig. 3, using four H-SMS-6 x ¼HW sheet metal screws.

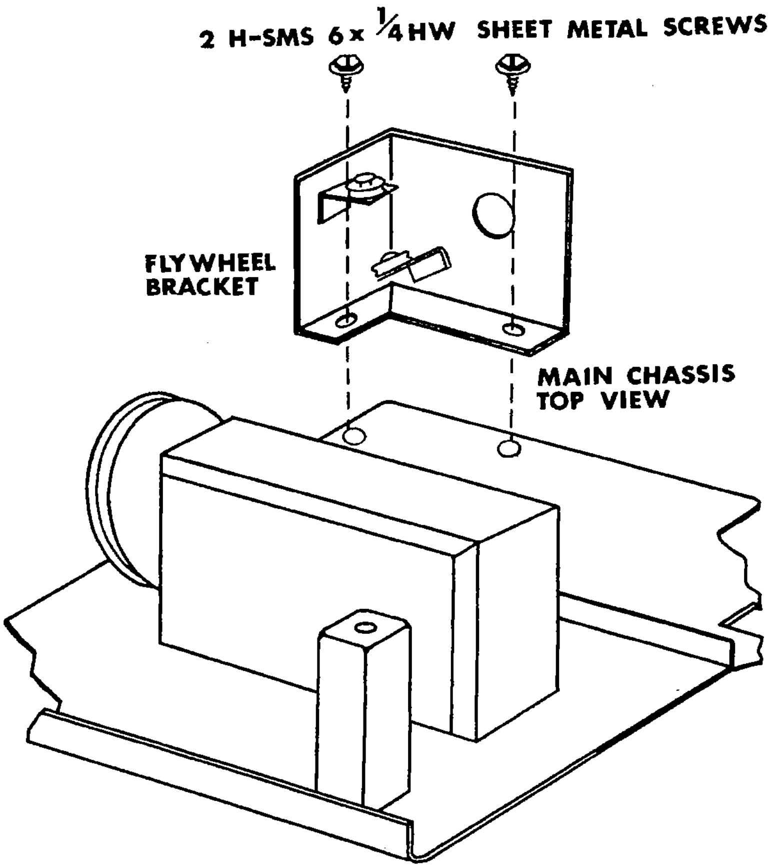


FIG.1

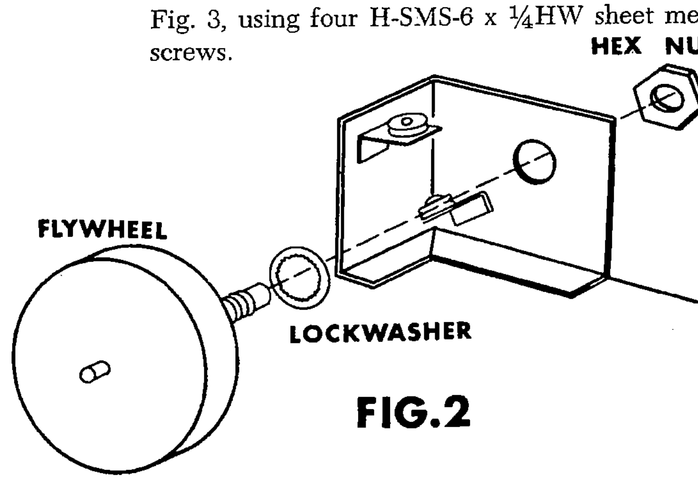


FIG.2

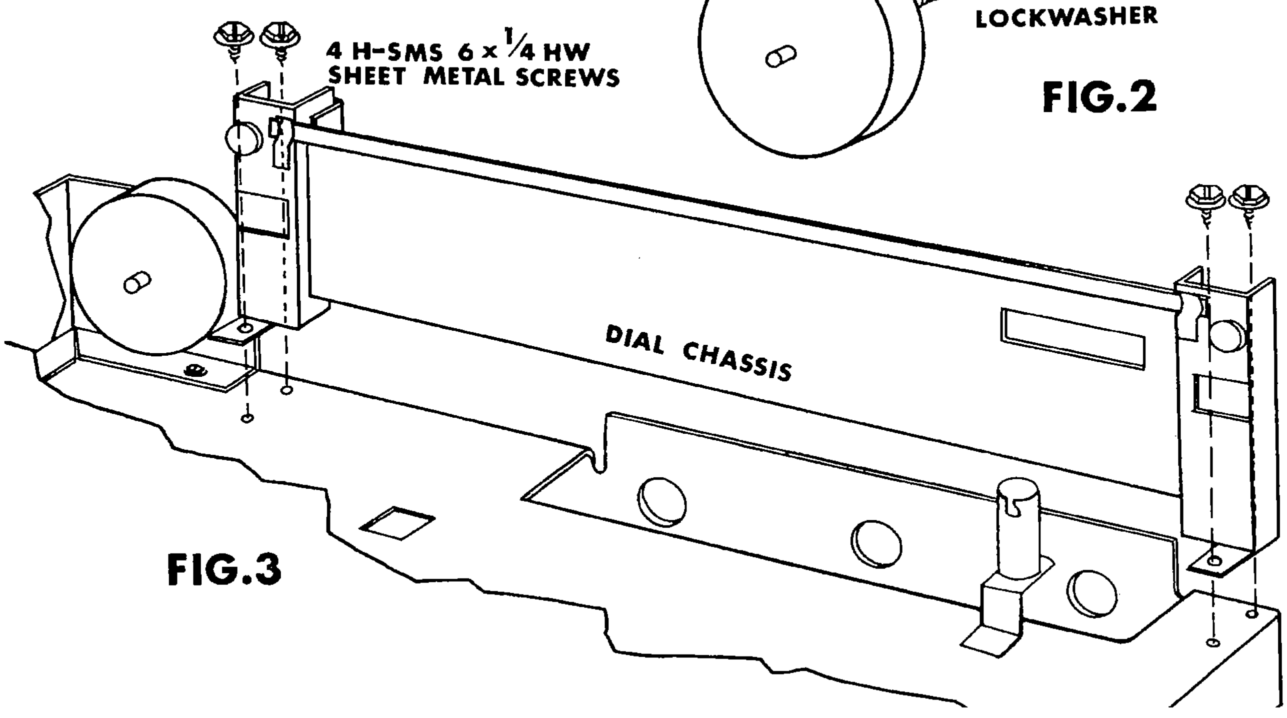
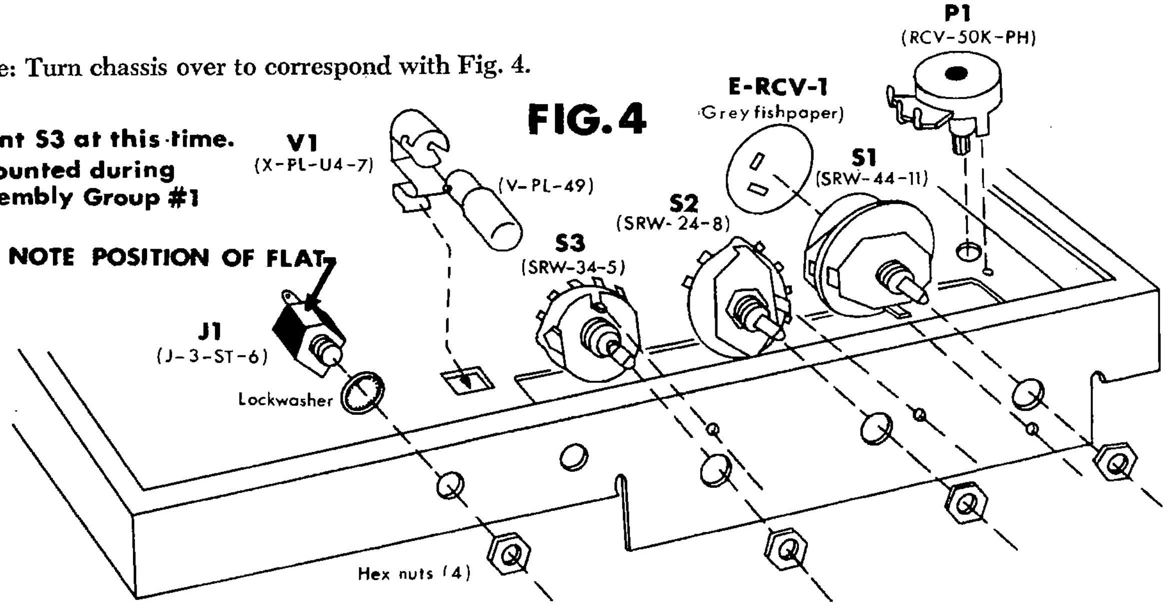


FIG.3

Note: Turn chassis over to correspond with Fig. 4.

Do NOT mount S3 at this time. S3 will be mounted during Electrical Assembly Group #1

FIG. 4

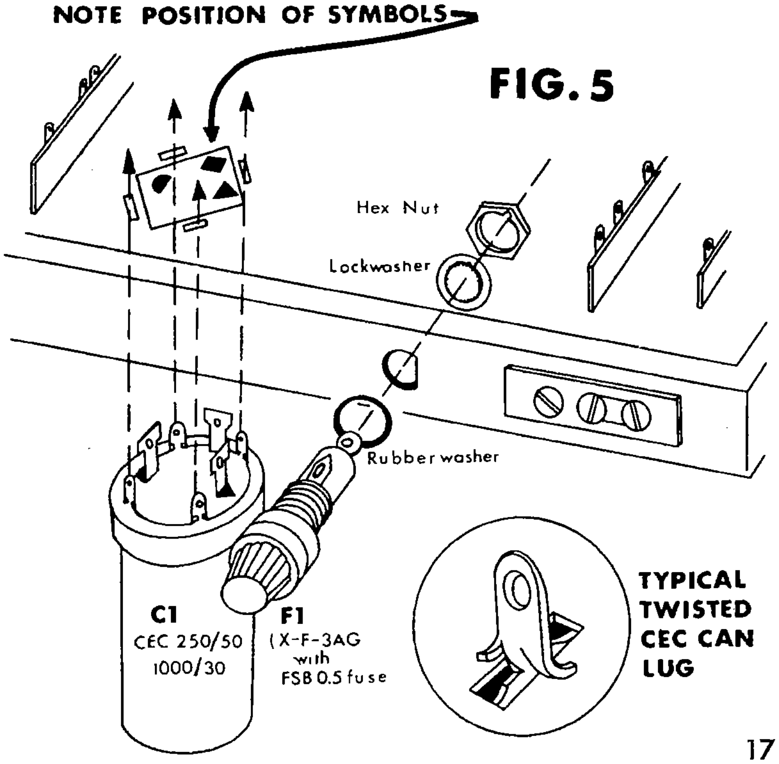


Be sure that the correct switch is in the correct position. Set the switch into its proper hole and rotate until the locating lug falls into the keyhole. The lugs on the switch will lock the switch in position after the hex nut has been tightened. The part number (Example: SRW-44-11) will be found stamped on the part.

4. The FUNCTION switch SRW-44-11 as shown in Fig. 4, using one H-N-3/8 x 1/2B hex nut and one E-RCV-1 solder shield (grey fish paper). When fitting the solder shield over the two rear pins of the switch it may be necessary to cut a slot for one of the pins. Fit the solder shield to the switch before mounting the switch.

NOTE POSITION OF SYMBOLS

FIG. 5



5. The SELECTOR switch SRW-24-8 as shown in Fig. 4, using one H-N-3/8 x 1/2B hex nut.

6. The STEREO THRESHOLD ADJUST RCV-50K-PH as shown in Fig. 4. Push the potentiometer down using the locating lug as a guide until both prongs snap outward on the other side of the chassis.

7. The VPL-49 light bulb into the light bulb socket, X-PL-U4-7. Before assembling to the main chassis, pry open the light bulb socket clip, if necessary, so that it can fit onto the chassis. Install the light bulb socket as shown in Fig. 4.

8. The phone jack J-3-ST-6 as shown in Fig 4. Since this phone jack has no locating lug, be sure to orient the pins as shown in Fig. 4 and hold the phone jack in place while tightening the hex nut. Use one H-LW-3/8 coarse-toothed lockwasher and one H-N-3/8 x 1/2B hex nut.

9. The XF-3AG fuse post into the rear of the main chassis as shown in Fig. 5, using a rubber washer, lockwasher and hex nut. Be sure to orient the pins exactly as shown in Fig. 5. Install a 0.5 amp slo-blo fuse into the fuse holder cap and install the fuse cap by pushing in and twisting clockwise.

> On 110/220 volt models use 0.5 amp slo-blo fuse on 110 volts and 0.3 amp slo-blo fuse on 220 volts.

10. The electrolytic capacitor CEC-250/50 — 1000/30 as shown in Fig. 5. Be careful to position the capacitor so that the symbols on the bottom of the can are exactly as shown in Fig. 5. Twist the four outside lugs with pliers approx. 90 degrees until can is tightly in place.

3.2 Electrical Assembly

Electrical Subassemblies of S3 and PC5
Env. #2

You are now starting the electrical assembly of your LT-112B. Carefully follow the diagrams to make sure all wires are placed in the correct position.

A ruler is printed on the inside cover of the KIT-PAK.® Use this ruler to select the correct length of wire. Wire lengths may vary by ¼″.

With the screwdriver supplied, punch a hole in the top of one of the PART-PAK® boxes. Insert the shaft and bushing of switch S3 (SRW-34-5) into the hole, with the locating lug at 12 o'clock. This will hold the switch in place while you wire to it. Dress (route) wires as shown in Fig. 6.

Connect:

1. A 1M ¼w resistor (brown, black, green) from S3-6 to S3-5.
2. A 68K ¼w resistor (blue, grey, orange) from S3-7 **(S1)** to S3-9.
3. A 12¼″ orange/white wire to S3-2 **(S1)**.
4. An 11½″ grey/white wire to S3-3 **(S1)**.
5. A 10¼″ blue wire to S3-4 **(S1)**.
6. A 7½″ blue/white wire to S3-5 **(S2)**.
7. A 6½″ green/white wire to S3-8 **(S1)**.
8. A 12″ orange wire to S3-9.
9. A 4¼″ orange wire to S3-9 **(S3)**.
10. A 10″ grey wire to S3-10 **(S1)**.
11. A 10¾″ green wire to S3-11 **(S1)**.
12. A 12″ blue/white wire to S3-12 **(S1)**.

This completes the subassembly of S3. It will be mounted after the subassembly of PC Board 5, which follows. See Fig. 7. PC5 is the Interstation Noise Muting assembly, which acts as an electronic switch that turns on part of the I.F. Amplifier (PC1) when tuned to a station. Handle the PC boards by the edge so as not to leave impurities on the etching.

Connect:

1. An 11″ white wire to PC5-7 **(S1)**.
2. A 3″ black wire to PC5-2 **(S1)**.
3. A 5¾″ twisted yellow and black wire. Yellow to PC5-5 **(S1)**. Black to PC5-3 **(S1)**.
4. A 14¾″ twisted red and black/white wire. Red to PC5-4 **(S1)**. Black/white to PC5-1 **(S1)**.

Electrical Assembly Group 1
Env. #3

1. Mount PC5 as shown in Fig. 7 using two H-MS-632 x ¼B machine screws.
2. Mount S3, SRW-34-5, as shown in Fig. 4 page 17, using one H-N-⅜ x ½B hex nut in the same manner as you mounted S1 and S2.

Connect:

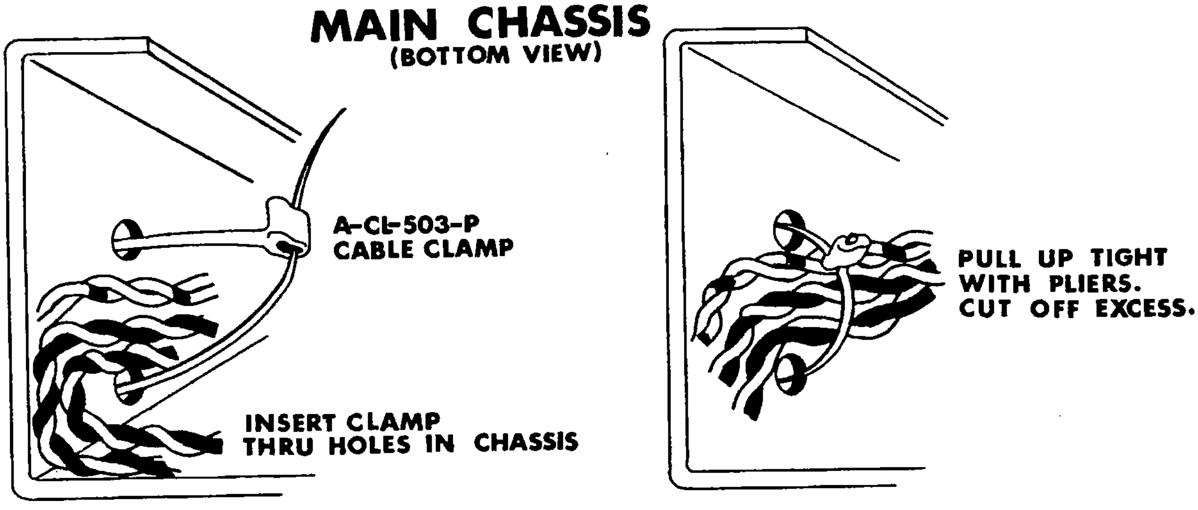
3. Using the entire length of bus wire, insert through S1-11. Cut and wrap at S1-9 **(S1)**. Please note explanation on page 19.
4. A 16¾″ twisted yellow and black wire. Black to S1-12. Yellow to S1-11 **(S2)**.
5. A 15″ twisted red and black wire. Black to S1-12 **(S2)**. Red to S1-8 **(S1)**.
6. A 21½″ twisted green and black/white wire. Green to J1-3 **(S1)**. Black/white to J1-1 **(S1)**.
7. A 22″ black wire to J1-2 **(S1)**.
8. A 12¼″ green/white wire to PC2-18 **(S1)**.
9. A 100K ¼w resistor (brown, black, yellow) from S2-8 **(S1)** to S2-11.
10. A 17¼″ red wire to S2-11 **(S2)**.
11. The twisted yellow and black wire from PC5. Yellow to S2-3 **(S1)**. Black to S2-4 **(S1)**.
12. A 3½″ black wire from S2-10 **(S1)** to PC2-21 **(S1)**.
13. A 10″ black/white wire from S2-9 **(S1)** to PC2-8 **(S1)**.
14. Dress the grey/white wire and the grey wire from S3 across the chassis and through the cutout as shown.
15. The orange/white wire from S3-2 to T6-5.
16. The blue/white wire from S3-12 to T6-4.
17. The orange wire from S3-9 to T6-3.
18. The green wire from S3-11 to T6-2.
19. The white wire from PC5 to S3-6.
20. Dress the twisted red and black/white wire from PC5 as shown.
21. An 8″ white wire from S3-6 **(S3)** to PC4-3 **(S1)**.
22. The orange wire from S3-9 to PC2-13 **(S1)**.
23. Install the cable clamp A-CL-503-P as shown on Group #1 drawing and Fig. 8, page 21.

Electrical Assembly Group 2
Env. #4

Connect:

1. The twisted red and black/white wire from PC5. Red to PC1-8 **(S1)**. Black/white to PC1-9 **(S1)**.
2. The green/white wire from PC2-18 to PC3-3 **(S1)**.
3. A 6¼" green wire from PC2-15 **(S1)** to PC3-1 **(S1)**.
4. A 5¼" orange wire from T6-3 to PC2-6 **(S1)**.
5. An 8½" yellow wire from PC1-10 **(S1)** to J3-2 **(S1)**.
6. A 5½" yellow wire from T6-1 to PC1-11 **(S1)**.
7. A 5½" yellow wire from T6-1 to PC2-4 **(S1)**.
8. The twisted red and black wire from S1. Red to PC3-4 **(S1)**. Black to J2-2 **(S1)**.
9. The black wire from J1 to J2-4.
10. The twisted yellow and black wire from S1. Yellow to PC3-8 **(S1)**. Black to J2-8.
11. A 4¾" black wire from G1 to J2-8 **(S2)**.
12. The twisted green and black/white wire from J1. Green to J2-3. Black/white to J2-5.
13. A 1½" piece of bus wire with a 1" piece of spaghetti from PC3-6 **(S1)** to J2-4 **(S2)**.
14. Using the entire length of bus wire, insert through J2-3, then J2-1 to PC3-5 **(S1)**. Cut and wrap at J2-3 **(S2)**. At J2-1 **(S2)**.*
15. Using the entire length of bus wire, insert through J2-5, then J2-7 to PC3-7 **(S1)**. Cut and wrap at J2-5 **(S2)**. At J2-7 **(S2)**.*
16. A 1½" piece of bus wire with a 1" piece of spaghetti from J3-1 to J3-4 **(S1)**.
17. A 2" piece of black wire from T2-A **(S1)** to J3-1 **(S2)**.
18. A 5½" orange wire from T2-1 to C1-2 **(S1)**.
19. A 6¾" red wire from T2-2 to PC3-2 **(S1)**.
20. The red wire from S2 to T2-2.
21. An 11" red wire from T2-2 to PC2-7 **(S1)**.
22. A 7" white wire from J3-3 **(S1)** to PC1-22 **(S1)**.
23. A 5¼" white wire from PC1-20 **(S1)** to PC1-16 **(S1)**.
24. Install the cable clamp A-CL-503-P as shown on Group #2 drawing and Fig. 8.

FIG. 8
MAIN CHASSIS
(BOTTOM VIEW)



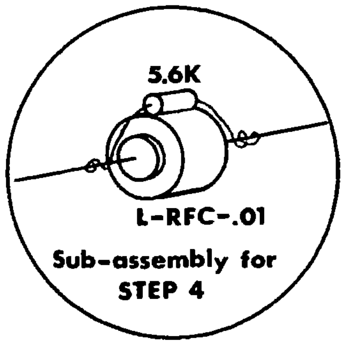
*A wire passing through a pin counts as two connections.

You have now completed the wiring of the output audio amplifier, Z-PC-01 PC board assembly (PC3). The audio amplifier strengthens the audio signals coming from the multiplex, Z-PC-MX-11 PC board assembly (PC2). It makes the audio signals strong enough to be fed down long interconnecting cables into the power amplifier.

Electrical Assembly Group 3
Env. #5

Connect:

1. A .02 mfd ceramic capacitor from P1-2 **(S1)** to PC2-20 **(S1)**.
2. A 6" white wire from P1-1 **(S1)** to PC2-12 **(S1)**.
3. A 390 pf mica capacitor from T6-A **(S1)** to T6-3.

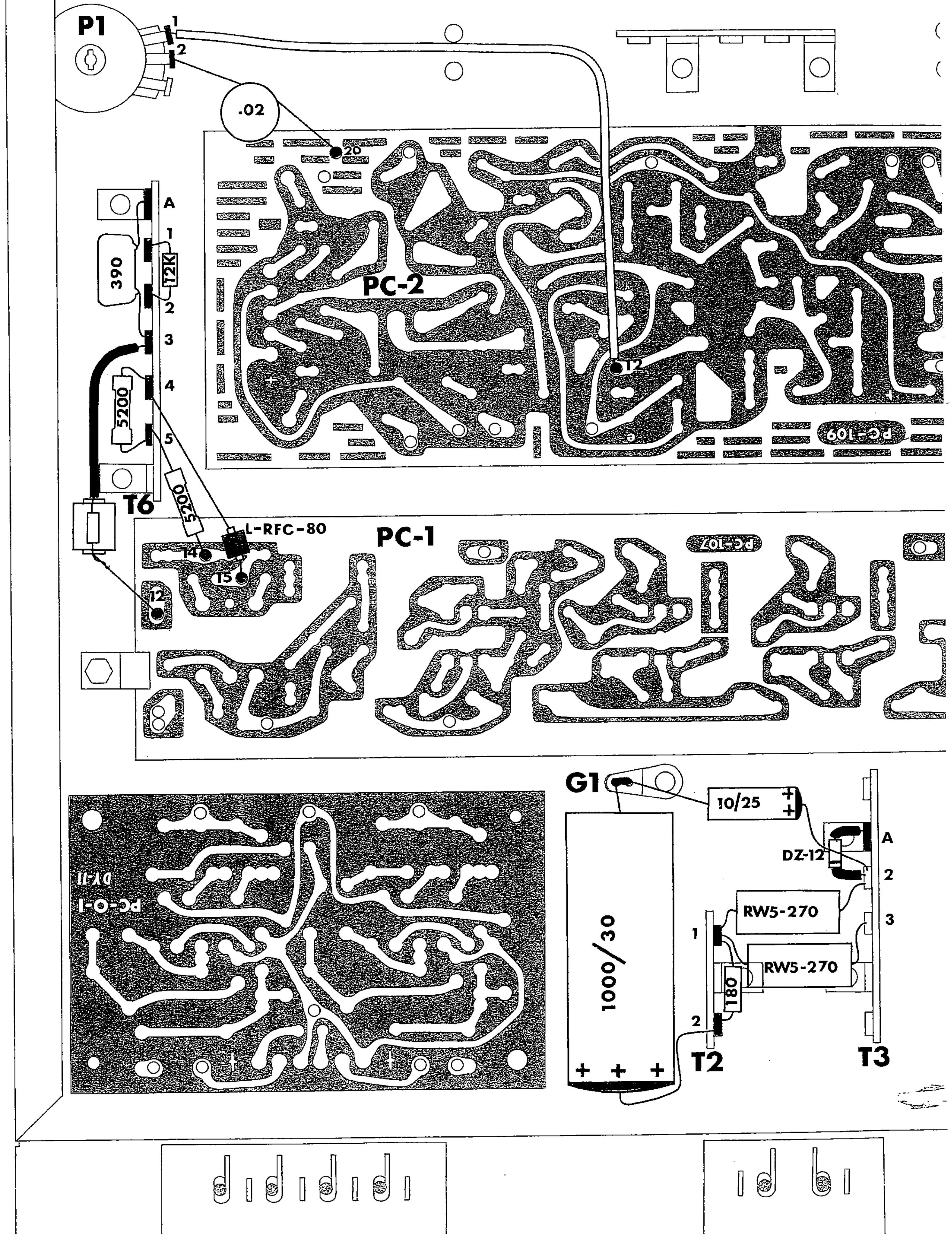


4. Subassemble a 5.6K ¼w resistor (green, blue, red) to an L-RFC-.01 choke (the larger one) as shown in the insert drawing. Solder each resistor wire to each choke wire after wrapping. Then connect one wire of the L-RFC-.01 choke to PC1-12 **(S1)**. Use 1" spaghetti on the other wire and connect to T6-3 **(S4)**.
5. **A 5.2K (or 5200) precision resistor from T6-4 to T6-5.
6. A 12K ¼w resistor (brown, red, orange) from T6-1 **(S3)** to T6-2 **(S2)**.
7. **A 5.2K (or 5200) precision resistor from T6-5 **(S3)** to PC1-14 **(S1)**. Keep the wire to PC1-14 a maximum of ⅜".
8. **An L-RFC-80 choke from T6-4 **(S3)** to PC1-15 **(S1)**. Use the full wire length from the choke to T6-4.
9. **The banded (or pointed) end of a DZ12 diode to T3-2. Use ¼" piece of spaghetti on each wire. The other end to T3-A **(S1)**. This diode may have a different configuration from the sketch. See Parts List for alternate configuration.
10. A 270 ohm wirewound 5w resistor from T2-1 to T3-2.
11. A 270 ohm wirewound 5w resistor from T2-1 to T3-3.
12. The plus or red end of a 1000/30 tubular capacitor to T2-2. The other end to G1.
13. A 180 ohm ½w resistor (brown, grey, brown) from T2-2 **(S5)** to T2-1 **(S4)**.
14. The plus or red end of a 10/25 tubular capacitor to T3-2. The other end to G1 **(S3)**. Be careful to dress the wire from the red end of the capacitor away from the DZ12 diode and terminal T3-A to prevent shorting. Keep the body of the capacitor away from the adjacent 270 ohm resistor to prevent overheating.

With the exception of two wires, you have now completed the wiring of the multiplex Z-PC-MX-11 PC board assembly (PC2). This assembly receives its audio input from the I.F. strip, Z-PC-IF-1 PC board assembly (PC1). When the radio station is broadcasting a stereo signal, the multiplex assembly automatically switches from monophonic to stereophonic operation and separates the "left" and "right" signals from the I.F. audio input.

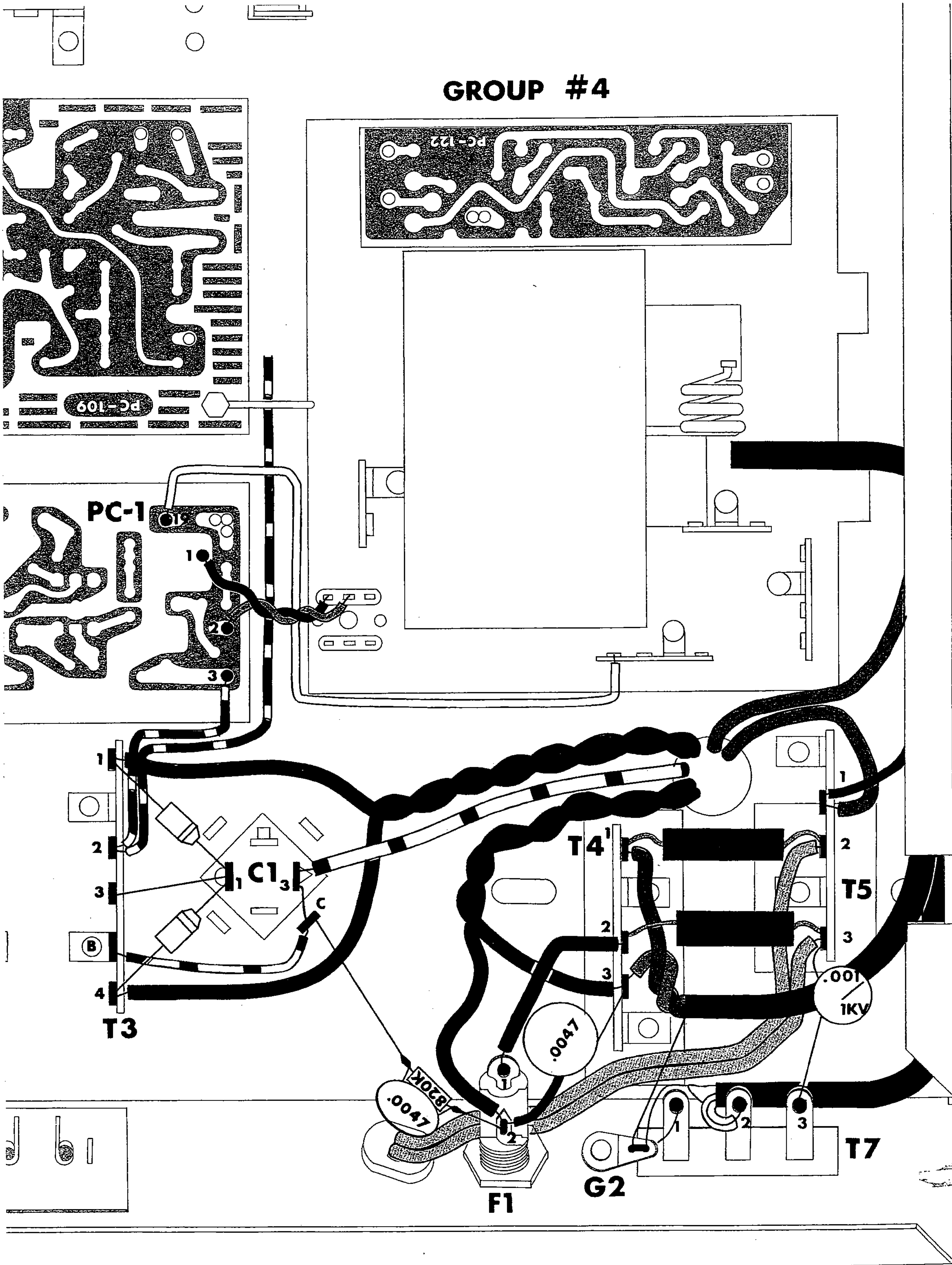
** Do NOT overheat this component while soldering.

GROUP #3



P1
1
2
.02
20
A
1
390
12K
2
3
4
5200
5
T6
5200
L-RFC-80
PC-2
T2
PC-1
T4
T5
12
G1
10/25
A
DZ-12
2
RW5-270
3
1
RW5-270
180
2
1000/30
T2
T3

GROUP #4



PC-122
PC-109
PC-1
19
1
2
3
T3
1
2
3
B
4
C1
1
3
C
T4
1
2
3
T5
1
2
3
.001
1KV
.0047
.0047
820K
F1
1
2
G2
T7
1
2
3

Electrical Assembly Group 4
Env. #6

Connect:

1. A 3" red/white wire from T3-2 to PC1-3 **(S1)**.
2. A 10½" red/white wire from T3-2 **(S5)**. The other end of this wire will be connected later.
3. A 2" black/white wire from T3-B **(S1)** to C1-C.
4. Using the entire length of bus wire, insert through C1-3 to C1-C.
5. The banded end of an SR2-7.5 silicon rectifier to C1-1. The other end to T3-1.
6. The banded end of an SR2-7.5 silicon rectifier to C1-1. The other end to T3-4.
7. Twist the two red wires from the power transformer. Connect one red wire to T3-1 **(S2)**, and the other red wire to T3-4 **(S2)**.
8. The red/yellow wire from the power transformer to C1-3 **(S2)**.
9. Using the entire length of bus wire, insert through T3-3 **(S2)** to C1-1 **(S3)**.
10. One end of the AC line cord to T5-2 and the other end to T5-3.

ON ALL UNITS WITH 110/220V POWER TRANSFORMERS, STEP 11, IN BRACKETS, SHOULD BE OMITTED. REFER TO CONSTRUCTION STEPS IN "110/220V Conversion," Page 30 FOR CORRECT WIRING. FOR DOMESTIC 117V UNITS STEP 11 SHOULD BE COMPLETED.

11. Twist the two black wires from the power transformer. Connect one black wire to T4-3, and the other black wire to F1-2. See Section 3.3, Page 30 for 110/220V conversion units.

12. Subassemble a .0047 high voltage ceramic capacitor to an 820K ½w resistor (grey, red, yellow). Solder the capacitor wires to the resistor wires.
13. The 820K ½w resistor (grey, red, yellow) with capacitor from F1-2 to C1-C **(S3)**. Keep the wire to F1-2 short. Do not burn the red transformer wire!
14. A 2" heavy black wire from T4-2 to F1-1 **(S1)**.
15. A .0047 high voltage ceramic capacitor from F1-2 **(S3)** to T4-3. Use ½" spaghetti on the end connected to F1-2.
16. Straighten all kinks and twist the ends together tightly before inserting a 23½" twisted heavy green and blue wire into a 21" ECT cable. See Fig. 9. Dress the cable under the chassis flange as shown. Connect the blue wire to T4-3 **(S3)** and the green wire to T4-1. The other end of the wires will be connected later. Pull out about 1" of the bare wire that is inside the tubing and connect to G2. Keep the bare wire clear of T4-2 and T4-3.
17. An L-RF-1S choke from T4-2 **(S2)** to T5-3.
18. An L-RF-1S choke from T4-1 **(S2)** to T5-2 **(S2)**.
19. Dress the longest of the green power transformer wires under the chassis flange as shown. Connect the shorter of the green power transformer wires to T5-1. If this wire is too long you may trim to fit.
20. A 14" black wire to T5-1 **(S2)**. The other end will be connected later.
21. Take the large black cable from the preassembled front end and connect the insulated wire to T7-2 **(S1)**, and the shield through G2 **(S3)*** to T7-1 **(S1)**.
22. A .001 high voltage ceramic capacitor from T5-3 **(S3)** (keep this end short) to T7-3 **(S1)**.
23. The white wire from the preassembled front end to PC1-19 **(S1)**.
24. The twisted blue and black wire from the preassembled front end. Blue to PC1-2 **(S1)**. Black to PC1-1 **(S1)**.

FIG. 9

*A wire passing through a pin counts as two connections.

You have now completed the wiring of the power supply and the intermediate frequency (IF) amplifier strip. The power supply consists of the power transformer, the capacitor can C1, the fuse post F1 and the components wired to T2, T3, T4 and T5. The power supply converts the alternating current from the wall outlet to low voltage, direct current. The I.F. strip Z-PC-IF-1 PC board assembly (PC1) operates at a frequency of 10,700,000 cycles per second (10.7 MHz). It provides sensitivity, rejection of unwanted stations, elimination of static and conversion of the 10.7 MHz signal to music and speech.

Electrical Assembly Group 5
Env. #7

Connect:

1. The green/white wire from S3 to PC4-2 **(S1)**.
2. The blue/white wire from S3 to PC4-1 **(S1)**.
3. The blue wire from S3 to PC4-5 **(S1)**.
4. The black wire from T5-1 to T1-B **(S1)**.
5. An 8½" red/white wire from T1-3 to PC4-6 **(S1)**.
6. The red/white wire from the preassembled front end to T1-3.
7. The red/white wire from T3-2 to T1-3.
8. A 3" red/white wire from T1-3 **(S4)** to PC2-5 **(S1)**.
9. A 5" white wire from PC4-4 **(S1)** to PC1-21 **(S1)**.
10. The black wire from PC5-2 to T1-A **(S1)**.
11. The wire from one of the dial light sockets to T1-2. Drop socket through cutout in chassis for future installation as shown in Fig. 12, Page 31.
12. The wire from the other dial light socket to T1-2. Drop socket through cutout in chassis for future installation as shown in Fig. 12, Page 31.
13. The wire from the meter light to T1-1. If this wire is too long it may be trimmed to fit.
14. A 10 ohm ½w resistor (brown, black, black) from T1-1 **(S2)** to T1-2.
15. The heavy green wire from the power transformer to V1-2. If this wire is too long you may trim to fit.
16. A 4¼" green wire from V1-2 **(S2)** to T1-2 **(S4)**.
17. The heavy twisted blue and green wires in the ECT cable. Be sure none of the inner section of the ECT is showing. Blue to S1-13 **(S1)**. Green to S1-14 **(S1)**.
18. A 3" blue wire from V1-1 **(S1)** to PC2-10 **(S1)**.
19. Install two A-CL-503-P cable clamps through holes indicated, encircling as many wires as possible. This should include all the wires that are parallel to PC2 in the immediate vicinity of the cable clamp.

Note: Turn chassis right side up to complete the wiring of PC2 and M1.

Refer to Page 8, Section 1.3i, for the following 3 steps.

20. A 120 pf ceramic capacitor to standup eyelets PC2-11 **(S1)** and PC2-12 **(S1)**. See Page 27 for location.
21. The plus or red end of a 2/25 tubular capacitor to standup eyelets PC2-14 **(S1)** and the other end to PC2-2 **(S1)**. See Page 27 for location.
22. The plus or red end of a 2/25 tubular capacitor to standup eyelets PC2-17 **(S1)** and the other end to PC2-3 **(S1)**. See Page 27 for location.
23. The grey wire from S3 to M1-1 **(S1)**. The grey/white wire from S3 to M1-2 **(S1)**.
24. Refer to PC1 as shown in Fig. 10 and Page 65. Clip out R330, a 10K resistor (brown, black, orange).
25. Refer to PC1 as shown in Fig. 10 and Page 65. Clip out R328, a 220 ohm resistor (red, red, brown).
26. Pick up unit and shake clippings loose. Check your work with the double check chart AM-1. Watch for cold solder joints and short circuits.

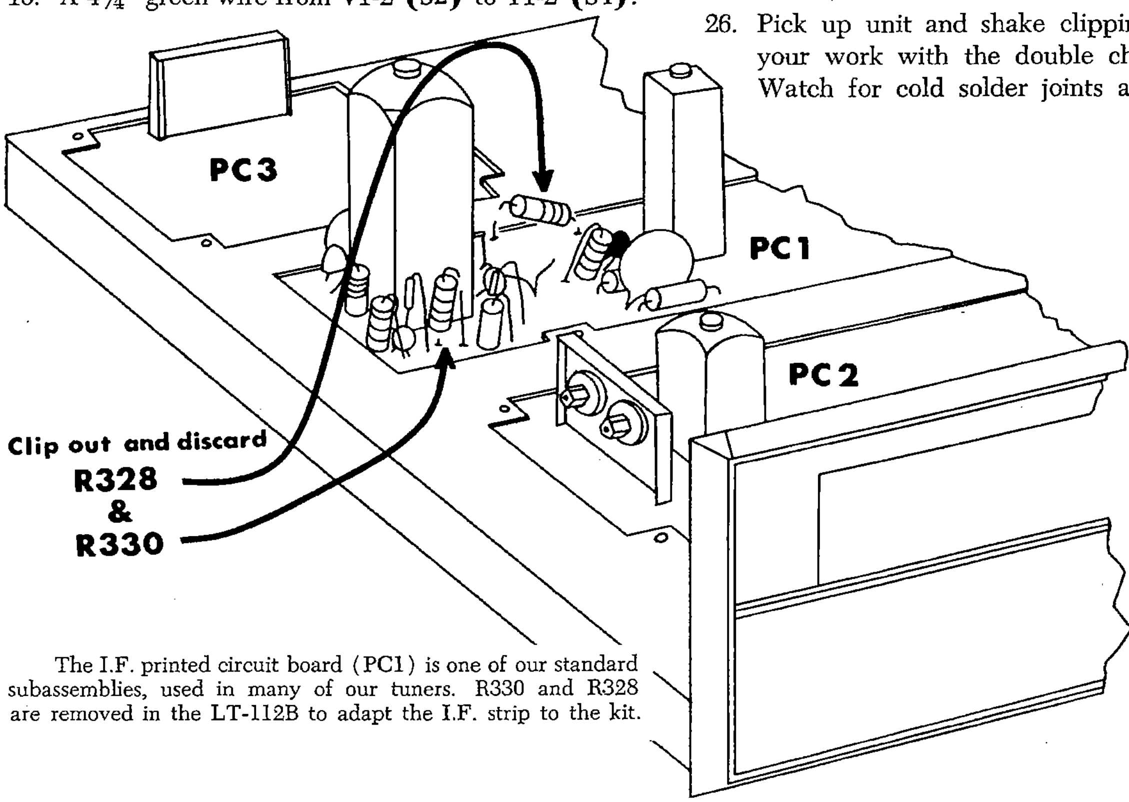
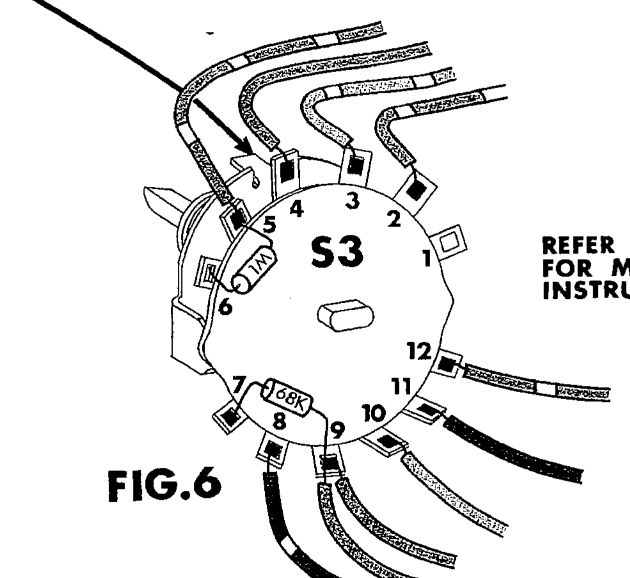


FIG. 10

The I.F. printed circuit board (PC1) is one of our standard subassemblies, used in many of our tuners. R330 and R328 are removed in the LT-112B to adapt the I.F. strip to the kit.

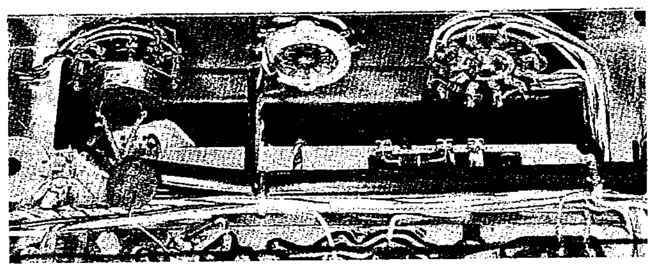
GROUP #1

NOTE LOCATING LUG AT 12 O'CLOCK



REFER TO FIG. 4 FOR MOUNTING INSTRUCTIONS OF S3

FIG.6



A-CL-503-P CABLE CLAMP

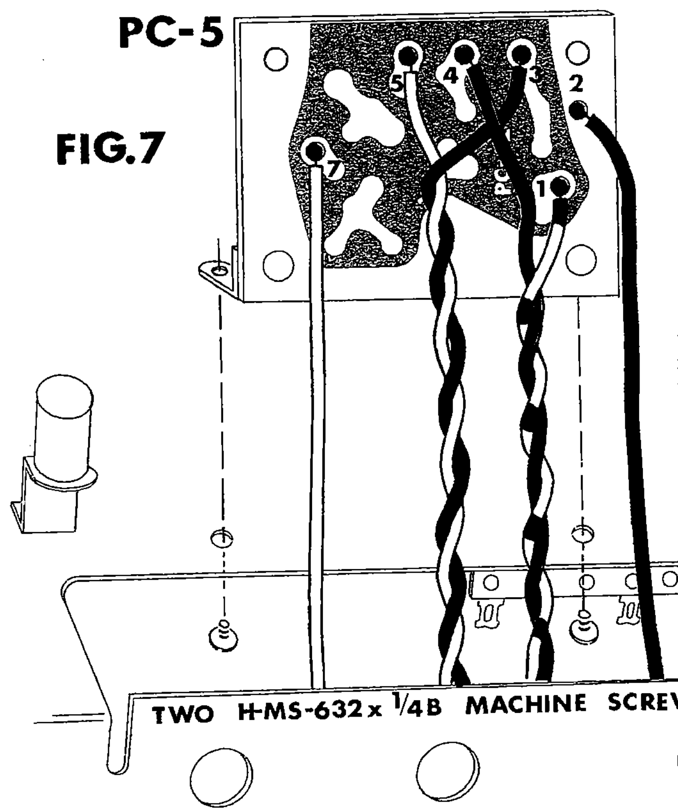
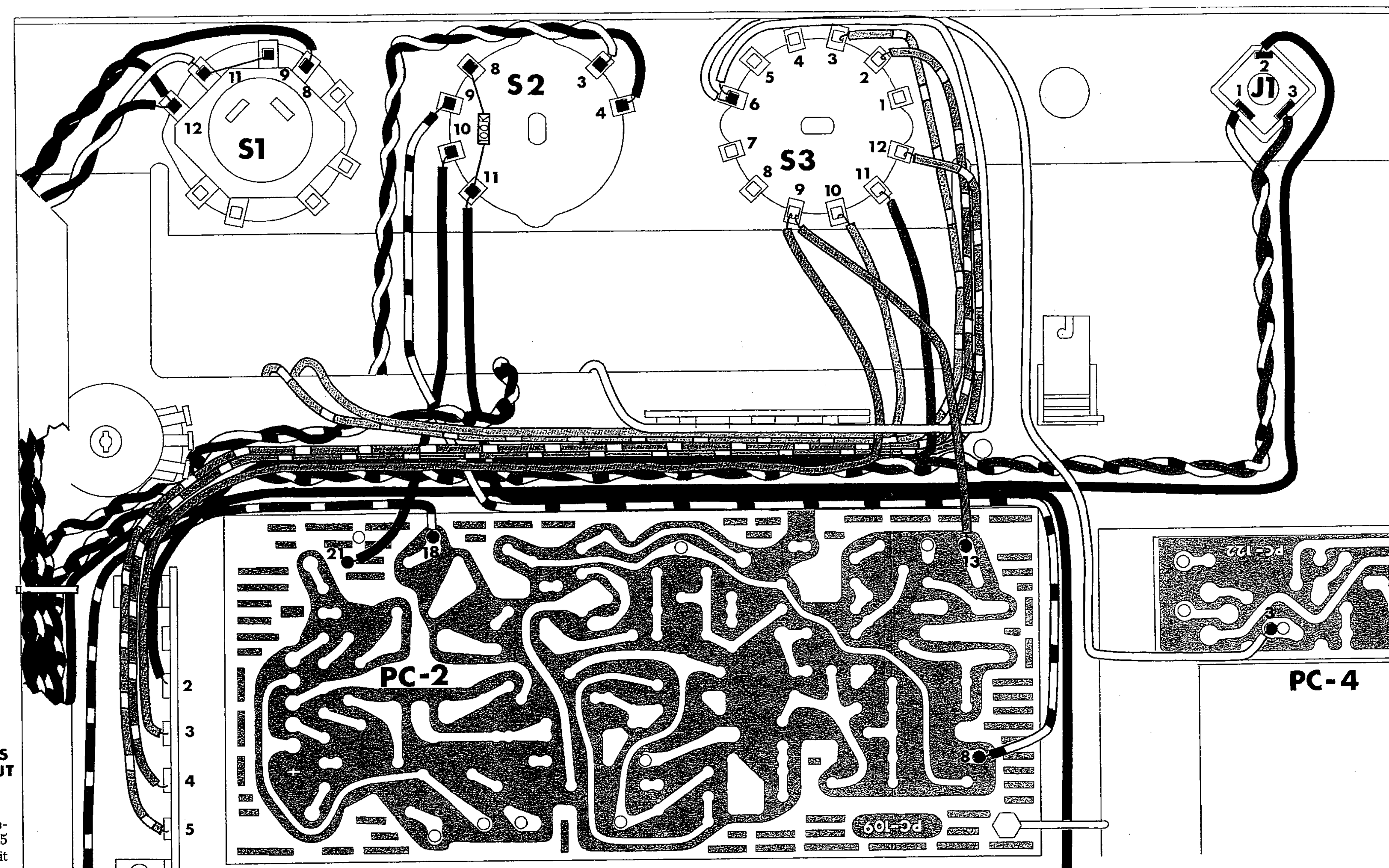


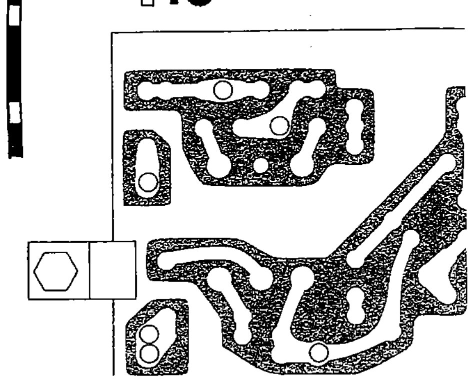
FIG.7

FRONT OF CHASSIS TOP VIEW

DRESS WIRES THRU CUTOUT IN CHASSIS

Make wire connections to PC-5 first, then mount it to the top of the chassis as indicated.

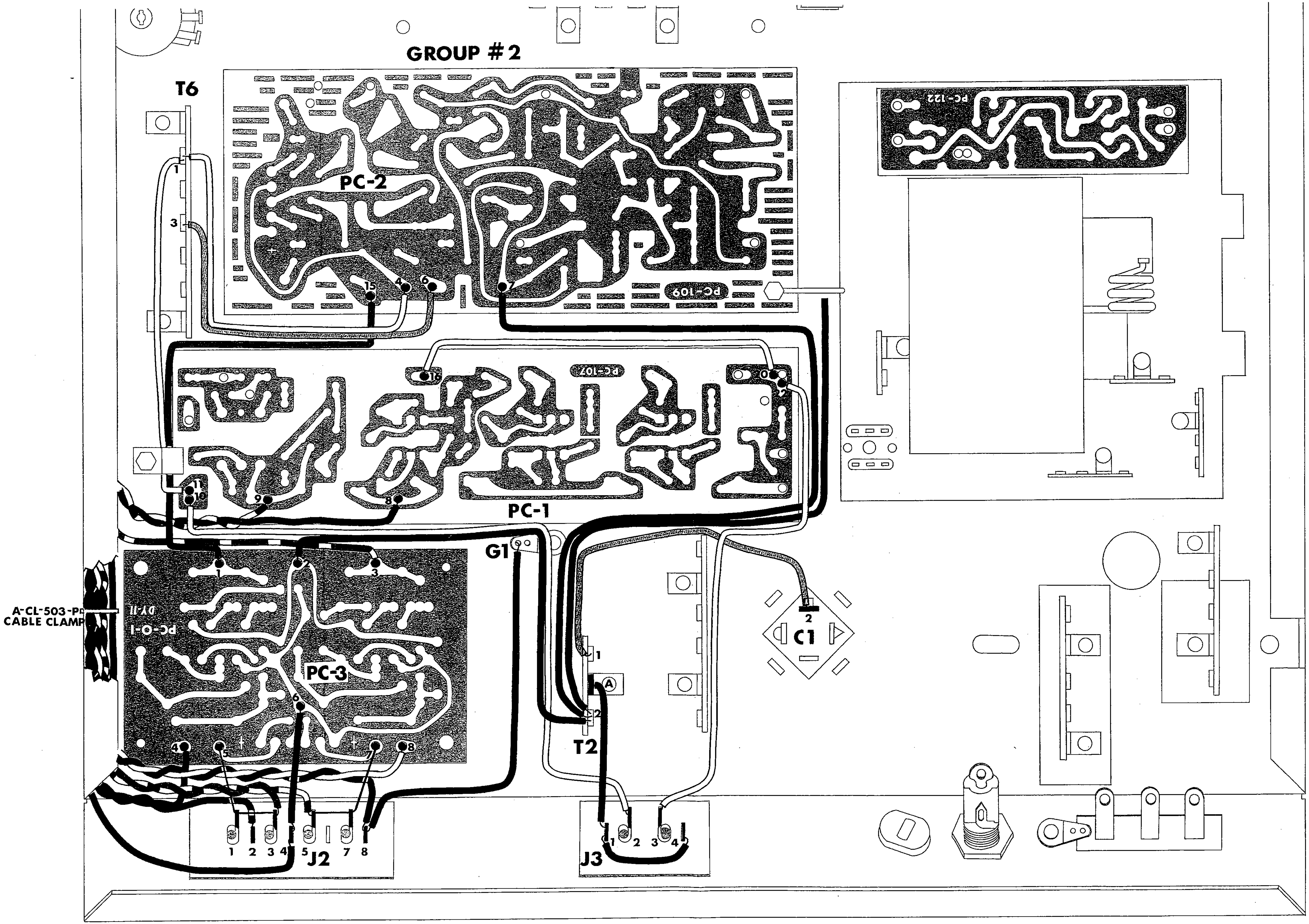


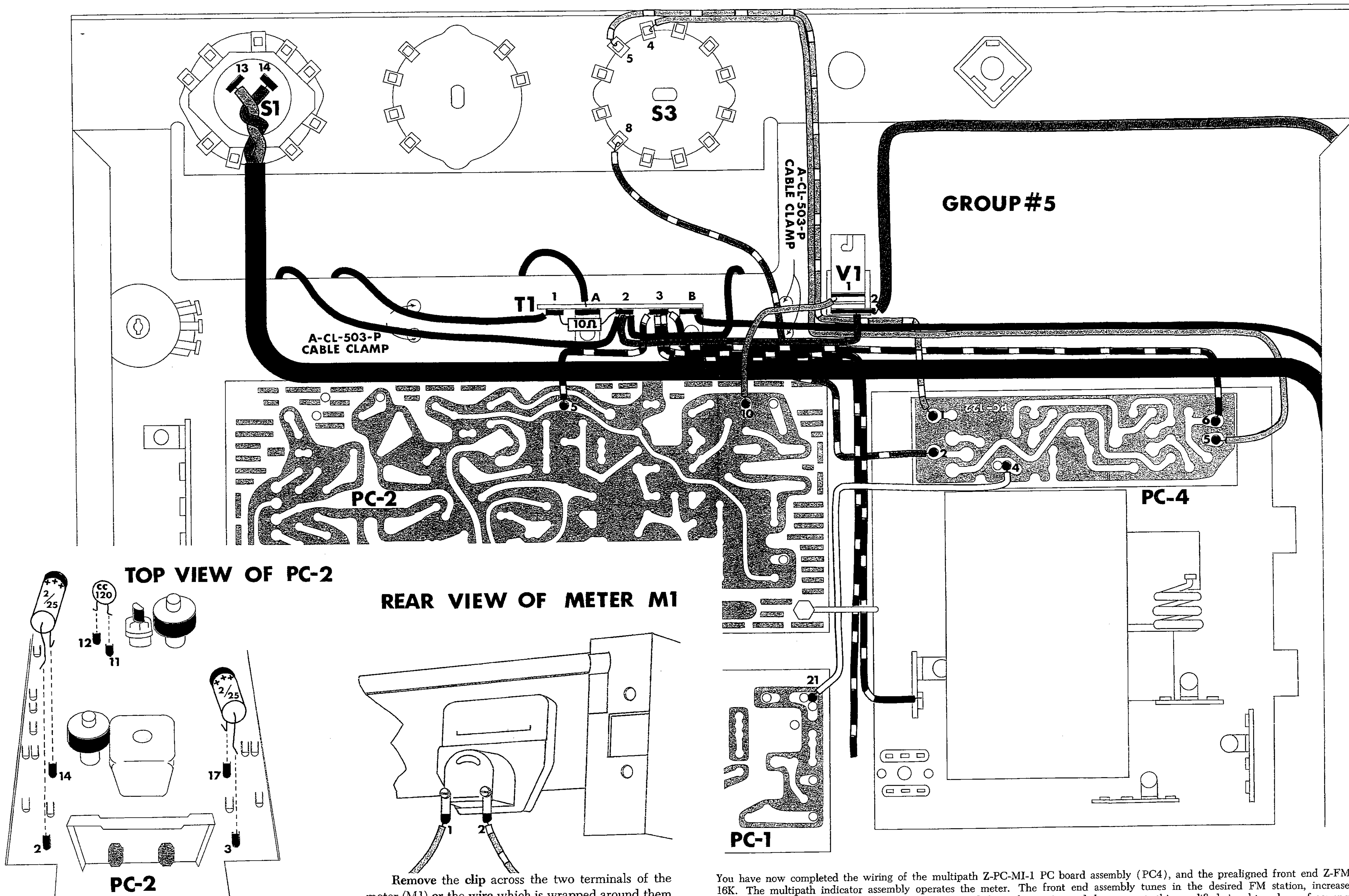


Note: Some eyelets are partially obstructed by components which are already mounted on the PC boards. Wires to be connected to these eyelets may be tack soldered, instead of being pushed through the eyelet. The bare end of the wires going to PC boards should be trimmed to 1/8" length.

When soldering to the PC boards on the LT-112B, you will find it much easier to apply the soldering iron to the same side of the board to which the wire is attached. See diagram on Page 8 for position of wire. Place the tip of the soldering iron against the edge of the eyelet being careful not to burn the insulation. The insulation on the wire should not touch the PC board; otherwise, a good electrical contact cannot be made.

Note: When connecting "bus" wire in this step, it is much easier to hold the complete bundle of "bus" wire in one hand and feed the free end of the wire through the appropriate pins. The free end of the wire is then crimped around the last pin, and the wire is pulled tight, and the other end of the wire can be clipped off and wrapped around the first pin.


GROUP # 2
T6
PC-2
PC-109
PC-1
PC-107
PC-122
PC-3
PC-O-I
DY-11
A-CL-503-P
CABLE CLAMP
G1
T2
C1
J2
J3



TOP VIEW OF PC-2

Turn chassis until the left side is facing you. The front will be to your right.

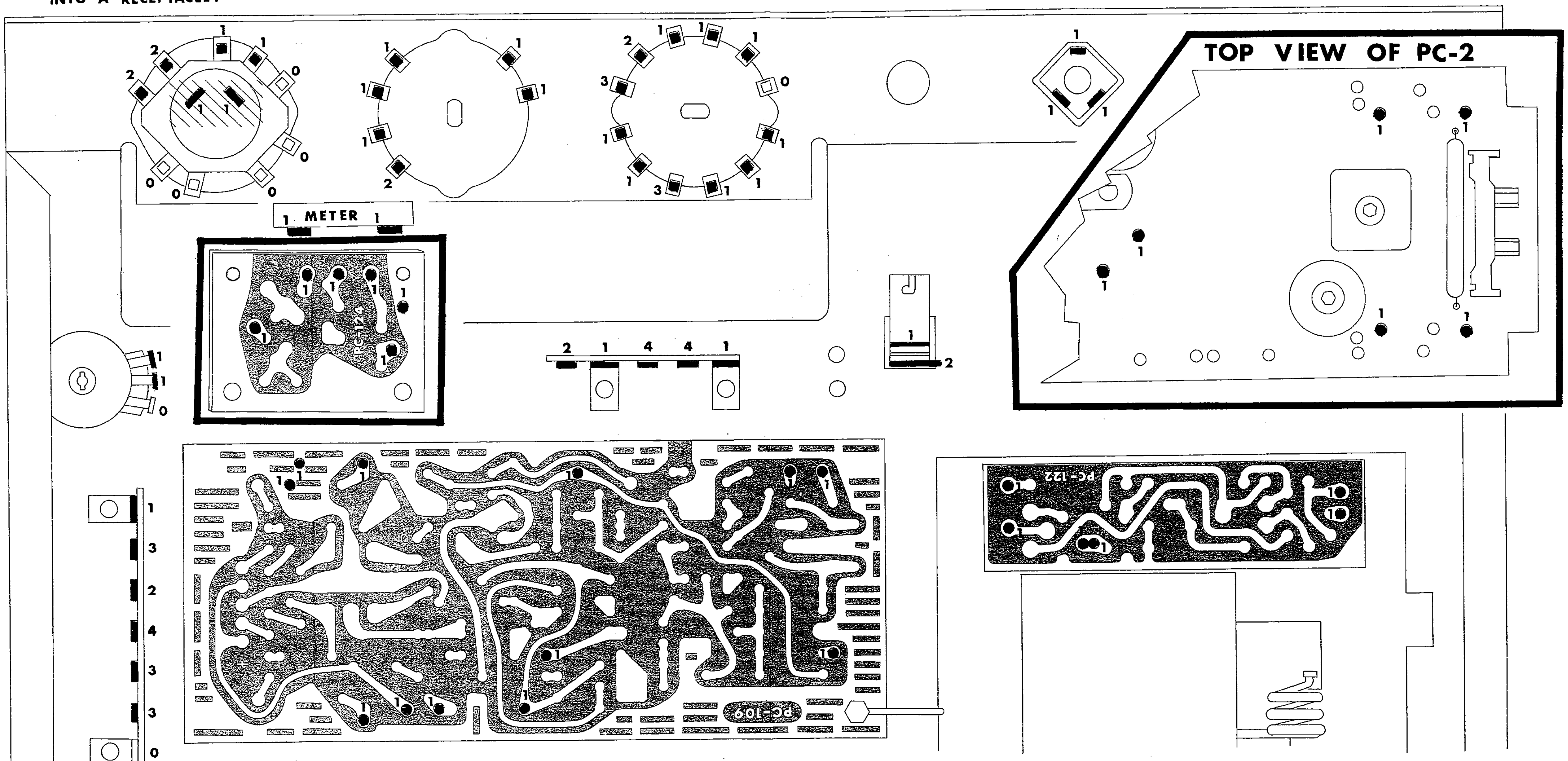
REAR VIEW OF METER M1

Remove the **clip** across the two terminals of the meter (M1) **or** the **wire** which is wrapped around them (whichever is the case). If a wire is used, it may be necessary to cut it in the middle and unwrap each end.

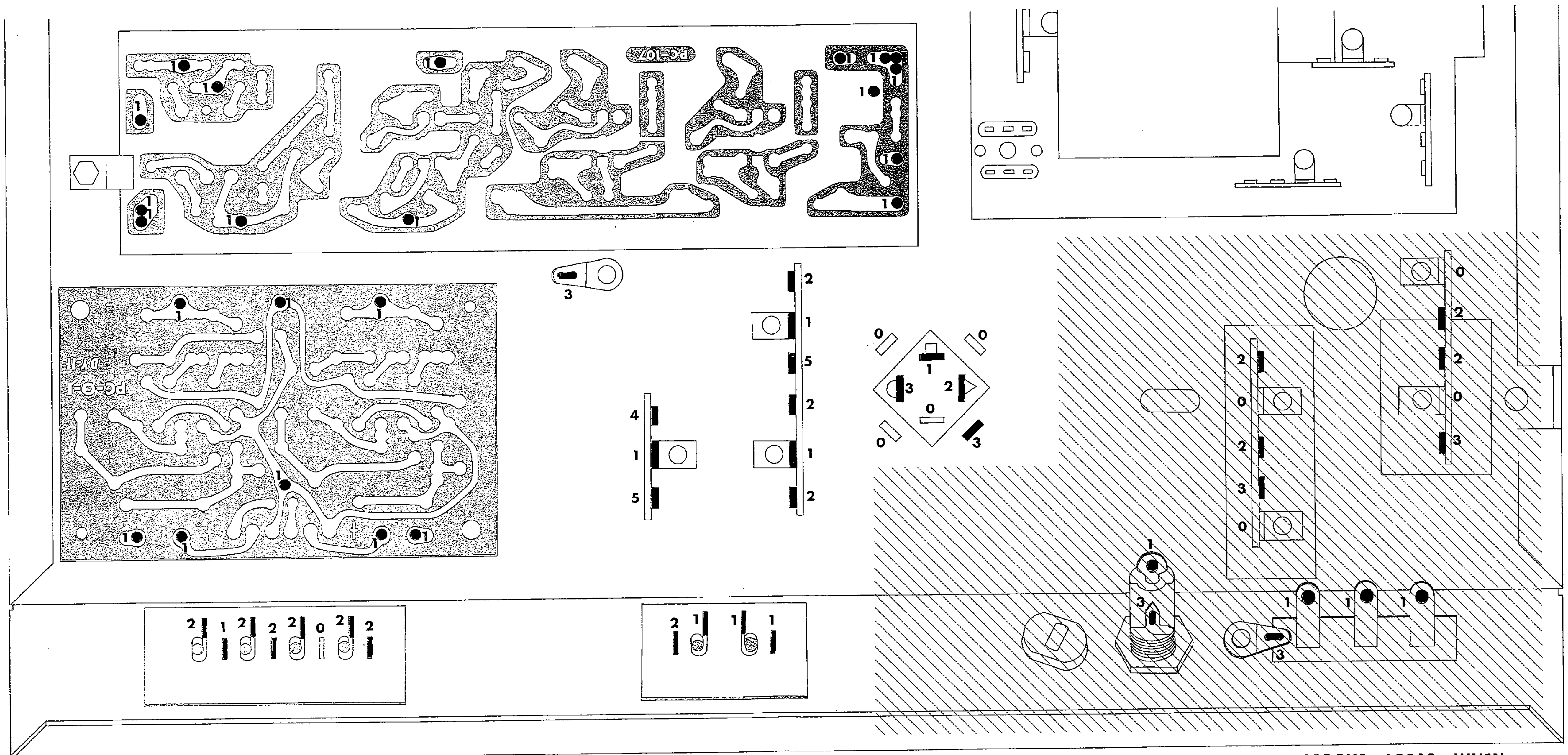
You have now completed the wiring of the multipath Z-PC-MI-1 PC board assembly (PC4), and the prealigned front end Z-FM-16K. The multipath indicator assembly operates the meter. The front end assembly tunes in the desired FM station, increases the strength of the very weak radio frequency signal from the station and then converts this amplified signal to a lower frequency of 10.7 mHz for further processing by the I.F. strip. A basic block diagram, Page 42 will show you how all the above sections are electrically connected.

DOUBLE CHECK CHART AM-1 (CONTINUED NEXT PAGE)

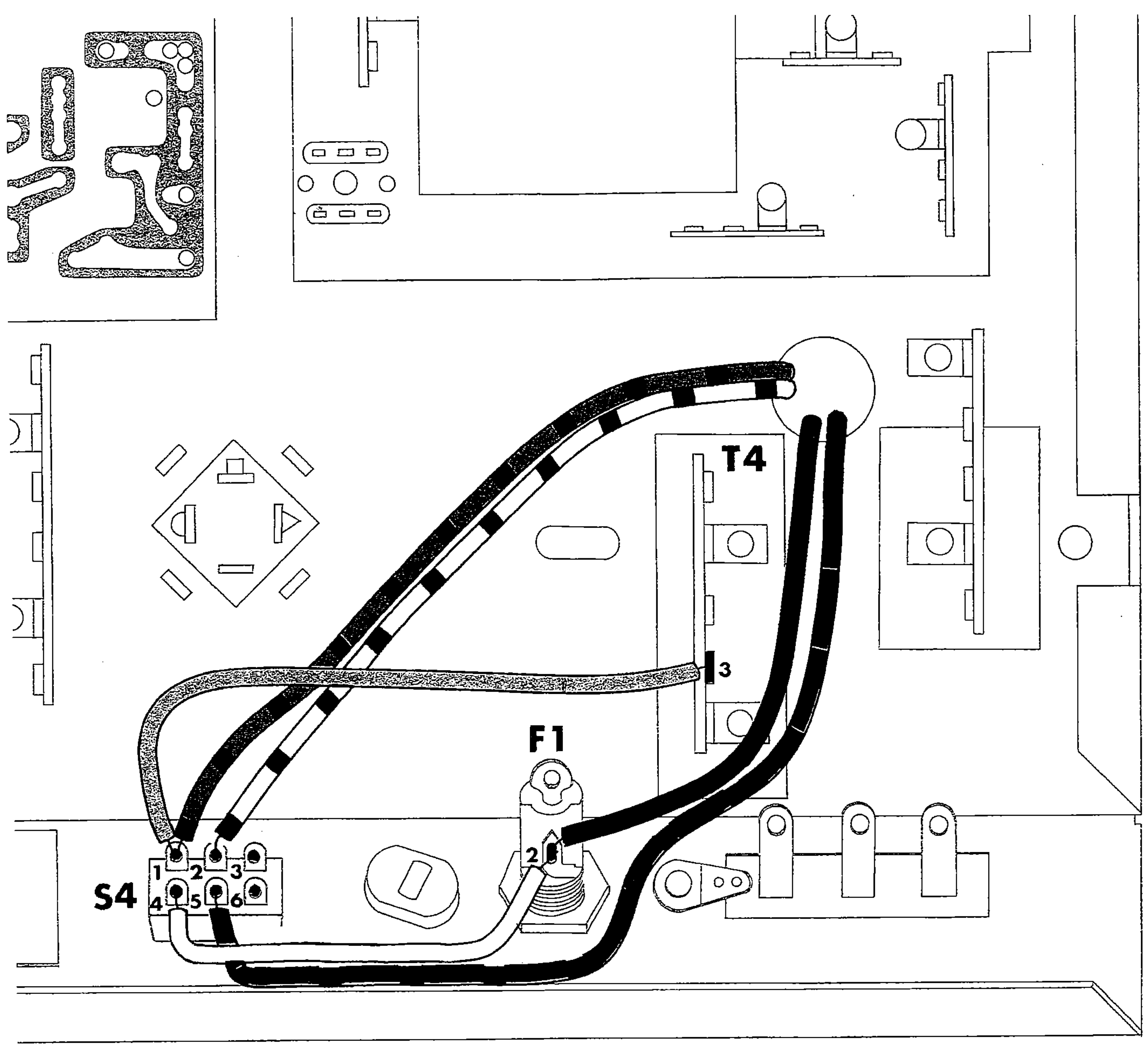
RED SLASHES INDICATE HAZARDOUS AREAS WHEN UNIT IS PLUGGED INTO A RECEPTACLE!



DOUBLE CHECK CHART AM-1 (Page 2)



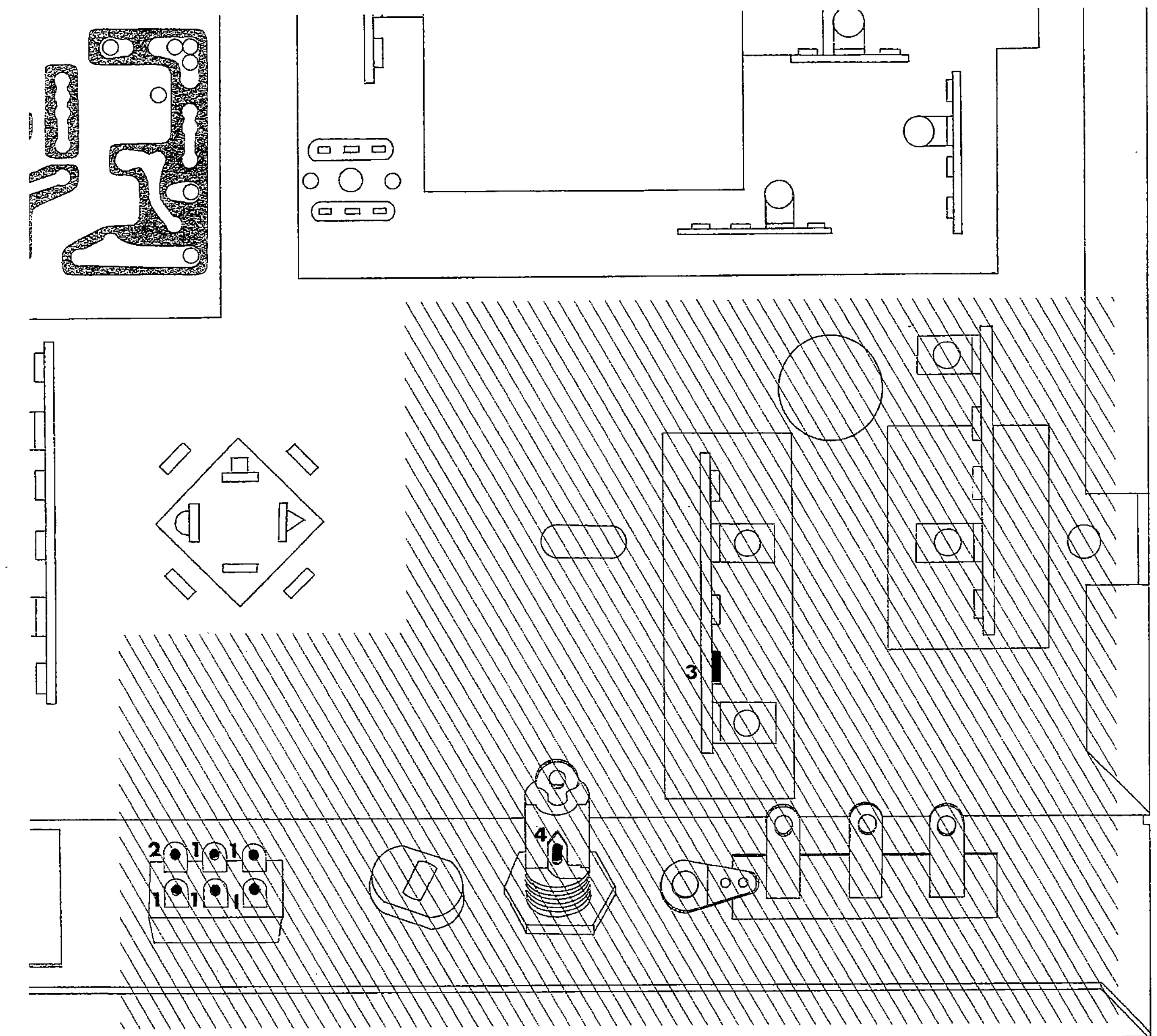
RED SLASHES INDICATE HAZARDOUS AREAS WHEN UNIT IS PLUGGED INTO A RECEPTACLE!



3.3 110/220 Volt Conversion Units

Connect:

1. The black wire from the power transformer to F1-2.
2. A ¾" bus wire from S4-3 **(S1)** to S4-6 **(S1)**.
3. The yellow/black wire from the power transformer to S4-2 **(S1)**.
4. The red/black wire from the power transformer to S4-5 **(S1)**.
5. A 4" heavy white wire from S4-4 **(S1)** to F1-2 **(S3)**.
6. A 4½" heavy blue wire from T4-3 **(S3)** to S4-1.
7. The green/black wire from the power transformer to S4-1 **(S2)**.
8. Check your work with the double check chart AM-2.



AM-2 DOUBLE CHECK CHART

(REFER TO AM-1 FOR THE REMAINDER OF THE DOUBLE CHECK CHART)

RED SLASHES INDICATE HAZARDOUS AREAS WHEN UNIT IS PLUGGED INTO A RECEPTACLE !

3.4 Final Mechanical Assembly

Env. #8

Installing the Dial Light Bulbs and Sockets, and Meter Light Bulb

1. Install the dial lights and sockets as shown in Fig. 12.
   Install the meter light bulb as shown in Fig. 12.

Dial Stringing

2. Attach the dial cord to the dial cord spring as shown in Fig. 11. If one loop of the dial cord is smaller, then loop the smallest end over the dial cord spring and pull lightly until the dial cord is inside the loop in the spring. Refer to Fig. 12 to familiarize yourself with the general layout of the dial cord.

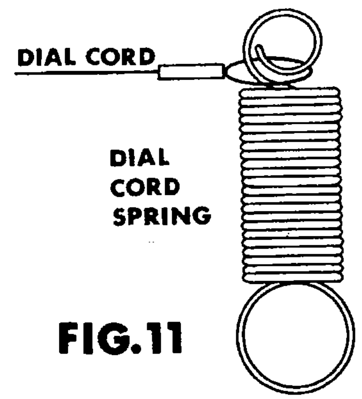


FIG. 11

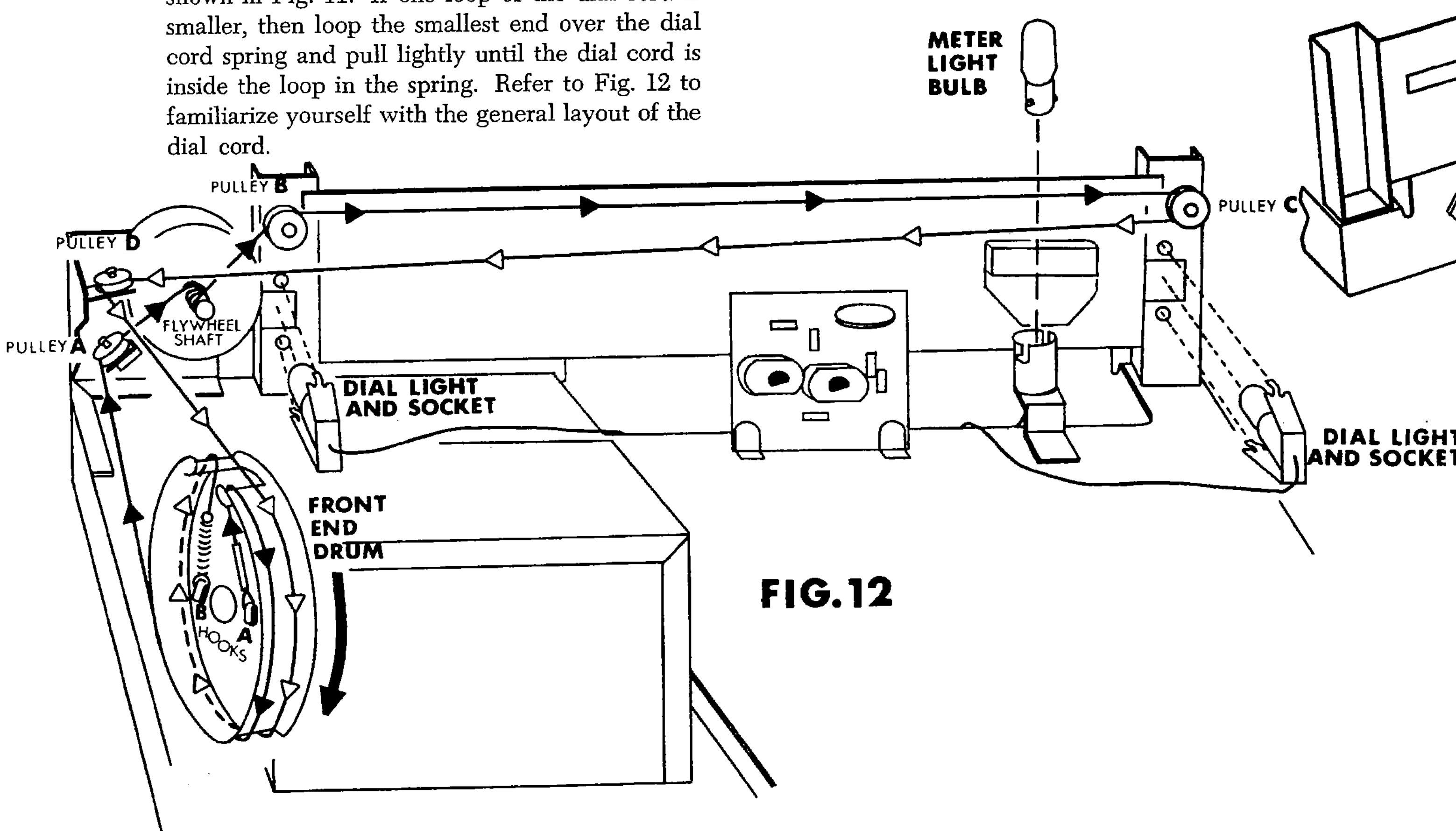


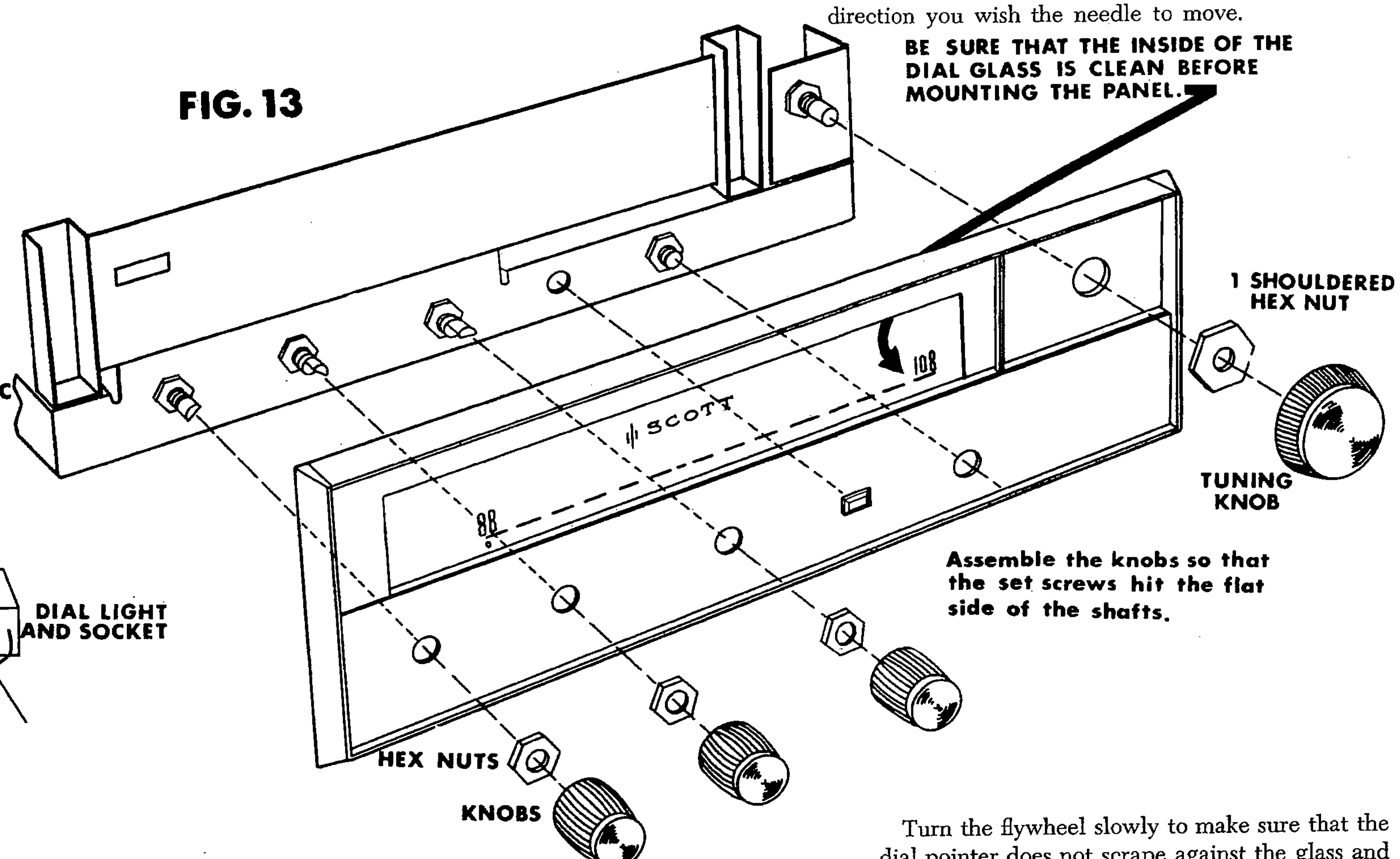
FIG. 12

3. Turn the front end drum in the direction shown in Fig. 12 until the slot in the drum is at the top of the front end cover.
4. Hook the fixed loop of the dial cord over hook "A."
5. Hold the dial cord tightly, run the dial cord out through the slot and follow the arrows to pulley "A."
6. Loop the dial cord around pulley "A" and bring the dial cord over the top of the flywheel shaft. Make three complete turns around the shaft and place the dial cord over pulley "B," around pulley "C" and around pulley "D."
7. Hold the dial cord tightly. Starting from the top of the front end drum, thread the dial cord once around the drum and then through the slot. Stretch the spring slightly until its loop can be placed over hook "B."

Front Panel Assembly

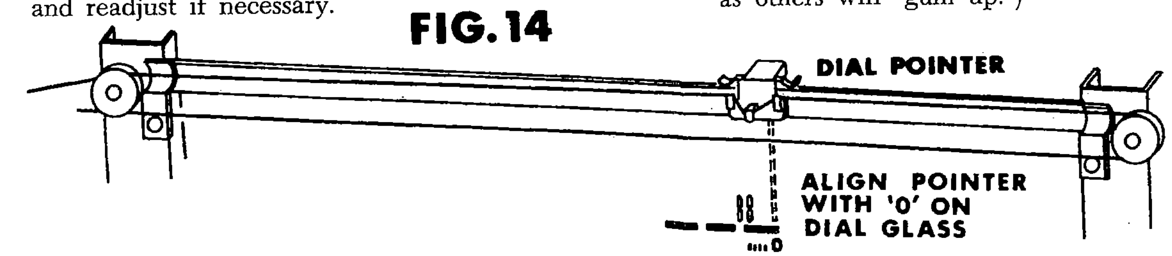
8. Install the front panel as shown in Fig. 13 using three H-N-3/8 x 1/2B hex nuts for the FUNCTION, SELECTOR, and METER switches and one H-N-3/8 x 5/8S shouldered hex nut for the tuning knob. Install the knobs as shown in Fig. 13.

FIG. 13



9. Turn the front end drum all the way in the direction shown in Fig. 12. Hang the dial pointer on the bar near the dial cord so that the white pointer drops between the dial glass and the black background, as shown in Fig. 14. Align the dial pointer with "0" on the dial glass. With the left-hand forefinger press down on the top of the dial pointer to hold it in the "0" position while you thread the dial cord through the hooks on the back of the dial pointer. Check the "0" position and readjust if necessary.

FIG. 14



Meter Needle Off Center

In a few cases when the air is very dry (relative humidity low), static electricity may make the meter needle become charged and move away from the center of the meter. This is normal. You may discharge the meter by wetting your finger and wiping it across the front or rear face of the meter in the direction you wish the needle to move.

Turn the flywheel slowly to make sure that the dial pointer does not scrape against the glass and that the action of the dial pointer is smooth. If the pointer scrapes against the glass, bend the pointer from the top so that it is exactly vertical between the dial glass and the black background, and perpendicular to the calibration line. (A very small amount of silicon oil in the center of the nylon pulleys and on the dial track will sometimes make the tuning action feel smoother. Great care must be taken not to get any oil on the dial cord as it will then slip. Only silicon oil should be used as others will "gum up.")

Section 4 — Alignment Procedure Without Instruments

Two methods are provided for aligning the tuner. One is the unique and simple EZ-A-LIGN® method which eliminates the necessity of using complex test equipment, while insuring top quality results. The factory prealigned front end, IF amplifier, and multiplex circuits make it possible to use a simple, quick, touch-up alignment procedure. This procedure utilizes the tuner's front panel meter and the noise that is normally generated in the front end as a signal source.

The use of the normally generated interstation noise completely eliminates the need of outside signal sources such as laboratory signal generator or radio stations. This white noise makes it possible to achieve maximum IF bandwidth and sensitivity, with minimum distortion.

The second method is the conventional process which necessitates the use of high quality laboratory techniques and instrumentation. This is outlined in Section 8, "Technical Service Instructions."

Whichever method you use, you must make your first prealignment checks using the procedure below. Even for those of you who can obtain the required laboratory test equipment, we highly recommend that you follow the complete home alignment procedure given in this Section, as it is doubtful that you will be able to achieve greatly improved performance with instruments. Take your time and follow the step-by-step instructions below:

4.1 Prealignment Checks and Adjustments

Do not make any adjustments on any of the subassemblies unless directed to do so; many of these have been permanently set at the factory.

As shown on the Double Check Chart AM-1, Pages 28, 29, and Double Check Chart AM-2, Page 30, the red slashes indicate hazardous areas when the unit is plugged in. Keep your hands away from these areas when the tuner is plugged in.

a. Set the tuner up on its side with the transformer down, so that you may observe both the top and bottom.

On the rear of the tuner, disconnect the INTERNAL line cord antenna by loosening the terminal screws and pushing the jumper aside. Uncoil the dipole antenna and connect it to the EXTERNAL antenna terminals. See Fig. 15.

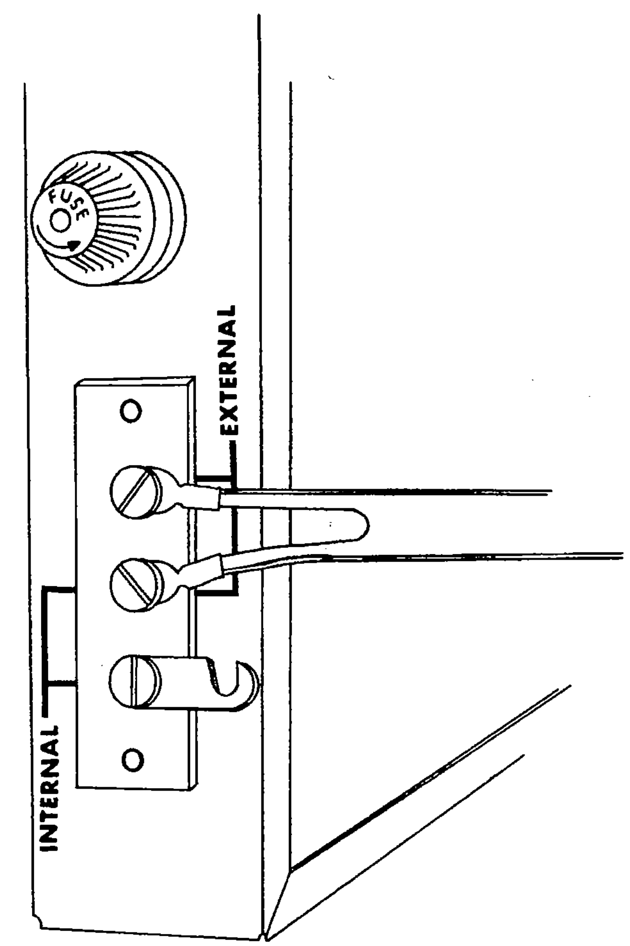
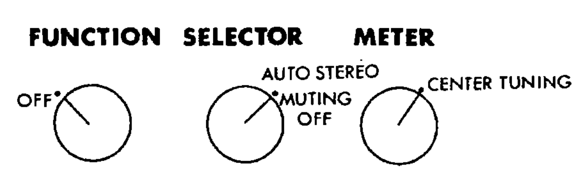


FIG. 15

For those of you who have 110/220 volt conversion units, switch the LINE VOLTAGE SWITCH to the correct power line voltage. If you don't know the voltage, contact your local electrical power plant.

b. Set the tuner front panel controls as follows:



c. Please read all of Section 4.1c before proceeding.

Plug the line cord into an ac outlet. Never use dc or you will destroy the tuner.

Watch the STEREO light for a momentary flash on and off **once** as you switch the FUNCTION switch to NORMAL. If you happen to be tuned to a stereo station, the STEREO light will stay on. If it does not flash, then turn the FUNCTION switch to OFF, **disconnect the power cord** and check the unit for miswires.

d. Make sure the dial lights and meter light come on. Check the entire unit for overheating or smoking of any of the components. If any of the components are overheating or smoking, immediately turn the FUNCTION switch to OFF, **disconnect the power cord** and check the unit for miswires.

If the above procedure has been successfully completed you may proceed. If any of the following checks are not satisfactory then turn the FUNCTION switch to OFF, **disconnect the power cord** and carefully check for miswires. Refer to Section 7, Operational Troubleshooting Without Instruments, for instructions on isolating any miswires to specific areas of your LT-112B.

e. Turn the FUNCTION switch OFF and connect the the audio cables supplied from the Left and Right Outputs of the tuner to the Left and Right Tuner Inputs of your amplifier. See Section 5, Installation and Operating Instructions, page 40, for details in making connections to your tuner.

Set the two LEVEL controls at the rear of the tuner, on PC3 the Output Audio Amplifier board, completely clockwise as viewed from the rear.

f. Set the FUNCTION switch to NORMAL. Turn on the amplifier and set its SELECTOR switch to TUNER. Increase the amplifier's LOUDNESS (volume) control enough to hear hiss (white noise) and/or a station from the tuner.

The meter needle should move as you tune continuously across the dial. When not tuned to a station it should be in the middle between the two larger rectangles or close to it.

g. Tune to a point where no station is heard.

Set the METER switch to SIGNAL STRENGTH.

Locate the Meter Zero Adjust potentiometer (R9) on the Multipath assembly PC4 board (Z-PC-MI-1). See Fig. 19. Adjust the potentiometer until the meter needle points to "0" on the top scale off the meter. As you tune across the dial the meter needle should move up-scale as you tune in each station, and then back down as you tune away from the station.

h. Turn the METER switch to MULTIPATH.

Tune across the dial. With some exceptions, the meter needle should act in much the same way that it did in the SIGNAL STRENGTH position. The major exception is, when tuned to a station, the needle may swing down-scale in tempo with the music or speech.

i. Tune to a point on the dial where no station is heard.

Set the SELECTOR switch to AUTO STEREO-MUTING ON.

Locate the Muting Threshold Adjust potentiometer (R1) on the Muting assembly PC5 board (Z-PC-NS-2). See Fig. 19. Turn the potentiometer fully counterclockwise as seen from the top of the tuner. With the potentiometer in this position you should now hear hiss (noise), which may be quieter than it was when in the MUTING OFF position.

Turn the potentiometer clockwise until the hiss disappears and a little beyond. In most cases the correct setting of the potentiometer will be almost halfway up.

Switch the SELECTOR switch to MONO-MUTING ON; you should not be able to hear hiss.

With the SELECTOR switch in the AUTO STEREO-MUTING OFF and the MONO-MUTING OFF positions, this hiss should re-appear.

Leave the SELECTOR switch in the MONO-MUTING OFF position.

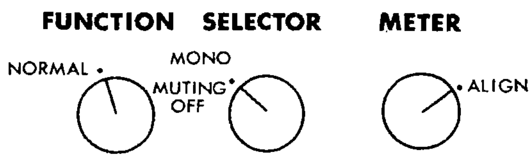
If all of the above Prealignment Checks are satisfactory, then you can go ahead with the Alignment Procedure. If the checks are not satisfactory, then turn the FUNCTION switch to OFF, **disconnect the power cord** and carefully check the tuner over for miswires. Refer to Section 7 for assistance in locating miswires.

4.2 EZ-A-LIGN Procedure

Do not make any adjustments on any of the subassemblies unless directed to do so; many of these have been permanently set at the factory.

a. Place the tuner on its right side with the transformer down. It should still be connected to the amplifier so that you are still able to hear the tuner.

Set the tuner front panel controls as follows:



The antenna should still be connected.

Carefully tune for an area on the dial where only interstation noise is heard and no station is received. Do **not** move the tuning dial again until instructed to do so.

Remove the antenna and use a piece of bus wire to connect the two EXTERNAL ANTENNA terminals together.

b. Please read all of Section 4.2b before proceeding.

ALIGNMENT TOOL

FIG. 16

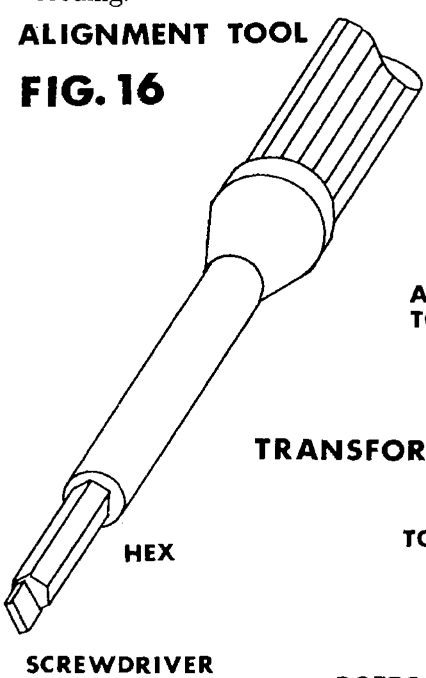
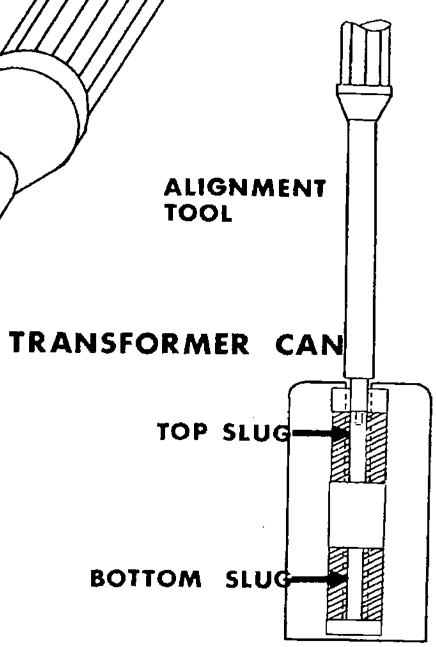


FIG. 17



Locate the alignment tool as shown in Fig. 16. Throughout the alignment you need use only the combination hex and screwdriver end.

All the transformer cans (see Fig. 17) contain compressed powdered iron slugs which are threaded into the body of the transformer for adjustment. Be careful not to push down too hard when seating the tool into the slot or hex openings.

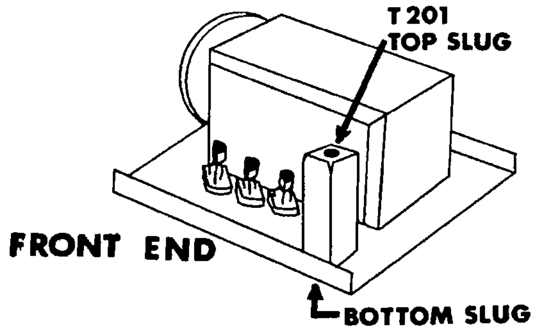
In all of the following adjustments you should **not** have to adjust the slugs more than ½ turn in either direction from its original position. Exceptions to this may be the top of T201 (secondary of 1st IF can) and T304 (secondary of detector can), where you should not exceed one full turn in either direction. The lettering on the side of the alignment tool will guide you in figuring a full or partial turn.

In the following steps you will be adjusting the slugs for maximum meter indication. At the same time you should be listening to the hiss (noise) from the speakers, since maximum hiss will occur at the same point as maximum meter indications.

If at any time during the alignment procedure you hear a radio station, go back to the beginning of Section 4.2 Alignment Procedure and begin again. In extreme cases where you may be living next to a radio station, the bottom cover may have to be installed for the Alignment Procedure to prevent reception of the station.

In adjusting for maximum meter indication, turn the slug to obtain maximum meter reading and slightly beyond and then turn back the slug to maximum so that it is mechanically centered at the maximum noise point. During most of the adjustments, the meter action will be very slight, thus you will have to look very carefully to insure a maximum meter reading.

FIG. 18



c. See Fig. 18 to locate T201 which is on the front end.

Insert the alignment tool into the top slug of T201 (secondary of 1st IF can) and adjust for maximum meter indication.

Repeat for the bottom slug of T201.

Go back to the top slug of T201 and touch up the adjustment.

Adjustments on the following IF transformers will be done in the same manner.

Refer to the IF Amplifier, Z-PC-IF-1, PC Board Component Layout on page 65 for the location of the following IF transformer cans: Adjust the top and bottom slugs of T301, T302, T303 and T304 for maximum meter indication.

Repeat the entire procedure above (Section 4.2c) once more.

d. Set the METER switch to CENTER TUNING.

Adjust the top slug of T304 (secondary of detector can) until the meter needle is centered between the two larger black rectangles.

e. Remove the bus wire from the EXTERNAL ANTENNA terminals and reconnect the dipole antenna to these terminals.

Set the SELECTOR switch to AUTO STEREO-MUTING OFF.

Tune to a point where no station is received.

Locate the Stereo Threshold Control (R605) on the chassis, as shown in Fig. 19.

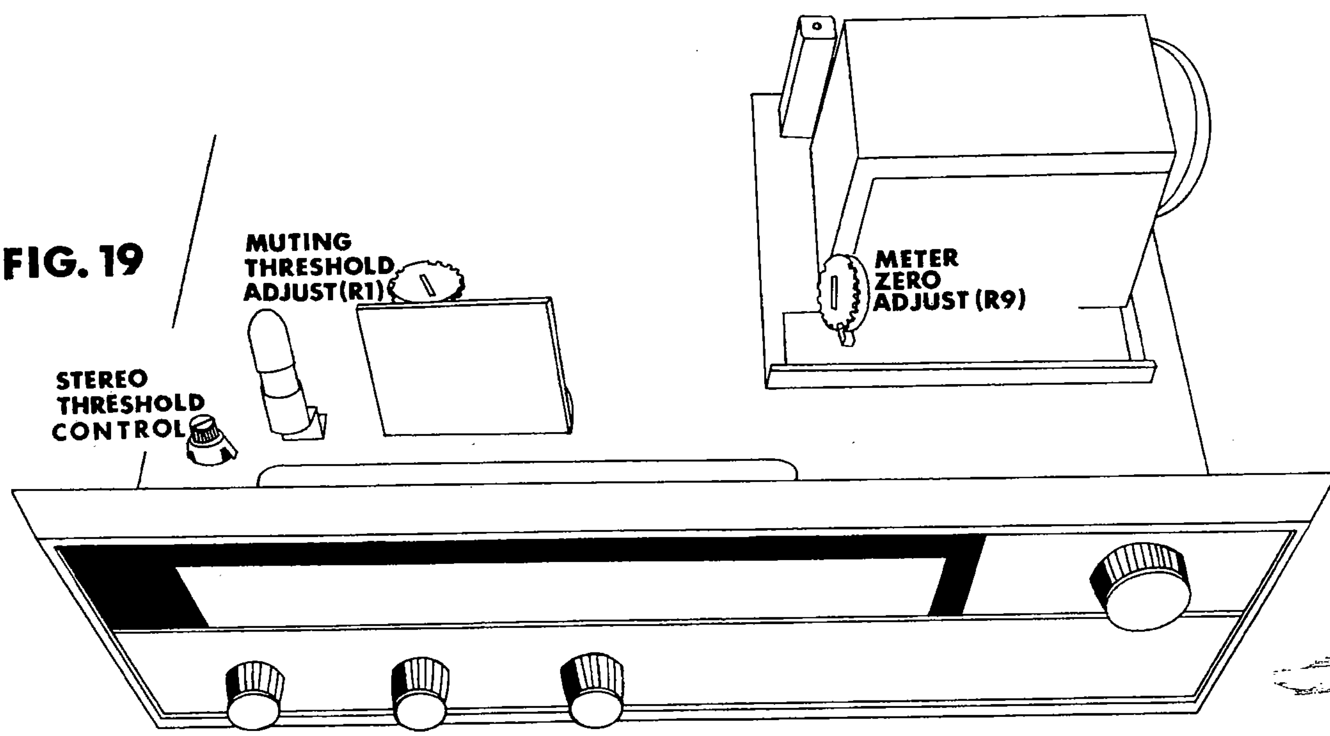
Turn the Stereo Threshold Control completely counterclockwise, as seen from the top of the chassis. The STEREO indicator light should now come on.

Slowly turn the control clockwise until the light just goes off. This is the normal setting for the Stereo Threshold Control.

If the STEREO indicator light does not come on using the above procedure, turn the Stereo Threshold Control completely counterclockwise and then ¼ turn clockwise. The STEREO indicator light should now come on when you tune to an FM station which is broadcasting in stereo.

Once you have installed the bottom and top covers, the tuner will be completed.

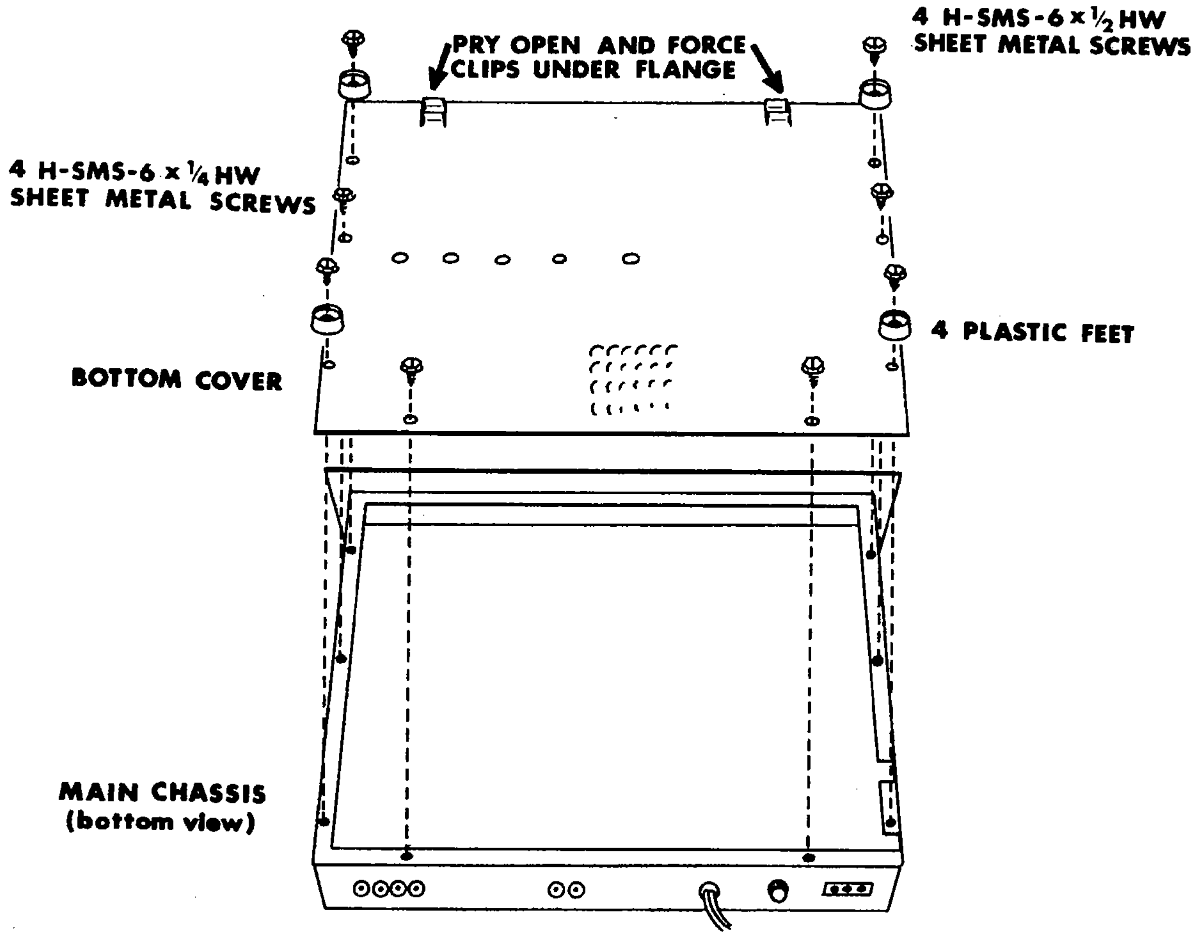
FIG. 19



4.3 Bottom Cover Installation

Install the bottom cover as shown in Fig. 20 using four H-SMS-6 x 1/4HW sheet metal screws. Install the four plastic feet as shown in Fig. 20 using four H-SMS-6 x 1/2HW sheet metal screws.

FIG. 20



4.4 Stereo Separation Adjustments

The multiplex section of your LT-112B has been prealigned at the factory to exacting standards. Satisfactory operation should be obtained with the present setting of the Left and Right Separation control. All other controls on Z-PC-MX-11 should not be adjusted (L501, L502, T501 and T502). However, if you wish, it may be possible to slightly increase the stereo separation by following the procedure given in Section 7, Operational Troubleshooting Without Instruments. The stereo separation adjustments can only be made when receiving a stereo station that broadcasts announcements or test signals on either the left or right channel for at least one minute.

4.5 Dial Calibration Check

Tune across the dial to several stations whose broadcast frequency is known. If the dial pointer is above or below the known broadcast frequency for all the stations, then move the dial pointer as described in Section 3.4, Step 9, until the pointer is exactly on a station in the middle of the dial.

4.6 Top Cover Installation

Install the top cover as shown in Fig. 21 using four H-SMS-6 x 3/8BBS screws.

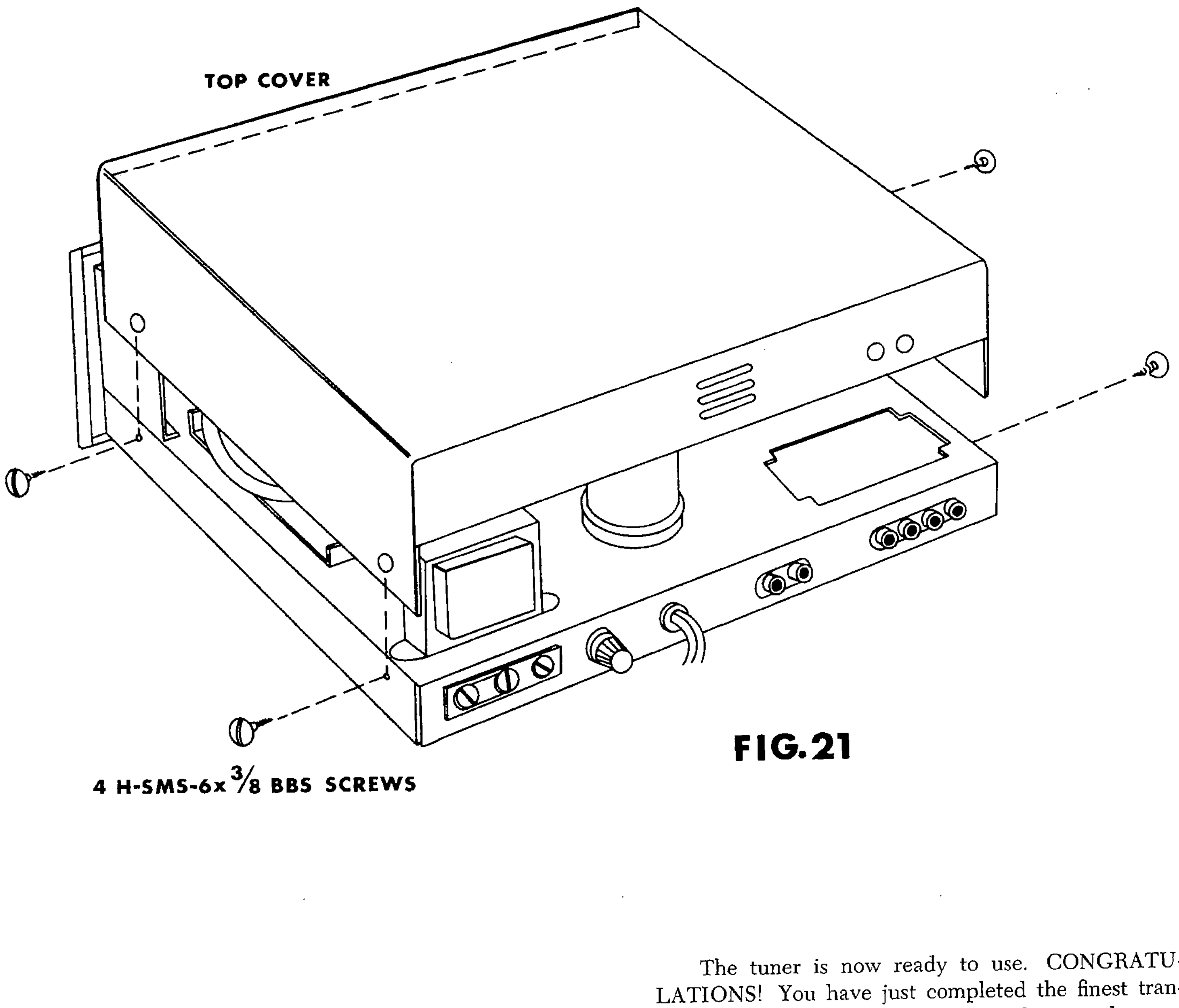


FIG. 21

The tuner is now ready to use. CONGRATULATIONS! You have just completed the finest transistor FM tuner kit available. To make sure that you obtain the maximum enjoyment from your handiwork, turn to the next section on "Installation and Operating Instructions."

Section 5 — Installation and Operating Instructions

Installation

Your Scott Tuner can be placed on a table or bookshelf, in existing furniture like an end table, buffet, or room divider, or in a specially designed equipment cabinet. A handsome hand-rubbed wood accessory case is available from your dealer in finishes to blend with your decor. Wherever the tuner is placed, some provision should be made for ventilation: at least several inches behind the unit where air may circulate freely. If it is installed in a cabinet, the cabinet should have an open back. If the ventilation is inadequate, excessive drift will occur in the FM section (the tuner going off station by itself) and the life of the internal components may be appreciably shortened. Under no circumstances should be tuner be operated so close to a heat producing unit (a power amplifier, for example) that it becomes hot to the touch. See Custom Mounting Template, Section 9, for the mounting procedure.

If the tuner is to be placed in a cabinet with an amplifier, place the tuner below the amplifier or beside it. Never mount a vacuum tube amplifier below the tuner, as the heat from the amplifier will cause drift in the tuner. If you wish to mount a solid state amplifier in the cabinet with the tuner, you may mount the tuner above the amplifier, if and only if you leave four inches of ventilated space between the two components.

The panel is not designed to support the weight of the unit for vertical mounting. Therefore, a vertical supporting panel must be installed so that the unit may be fastened to it by screws into the chassis bottom plate. Ventilation is now a greater problem because air can be trapped within the unit. For this reason, the back and the bottom of the cabinet must be left open and/or a ventilating fan installed in the cabinet. See Custom Mounting Template, Section 9, for hardware and mounting procedure.

Connecting and Using Your LT-112B Tuner

On the next page, two photographs show how to connect the LT-112B to the rest of your music system and indicate the functions of the various controls. Careful study of these two figures and the additional material which follows will enable any member of your family to operate the tuner properly.

Antenna

The tuner is designed to receive FM stations from either an internal or an external antenna. Antenna connections are made on the terminal strip marked ANTENNA, located on the rear of the tuner.

The INTERNAL ANTENNA utilizes the line cord (power cord) and the house wiring as the antenna; thus it is a compromise quite suitable in strong signal areas free from signal reflections (multipath distortions). Depending upon terrain, strong signal areas are usually those within 25 miles of the FM radio transmitter sites. If the house or apartment wiring is in conduit (metal pipes), then the ability to pick up stations will be somewhat reduced, since only the line cord is acting as an antenna.

To use the INTERNAL ANTENNA, make sure the shorting jumper between the two INTERNAL screw terminals is connected as shown in Fig. 22, on page 40, and do not connect any external antenna. The line cord should be completely uncoiled and then moved around until the best location is found for receiving maximum signal strength of the FM station. The best line cord location for one station may not be the best for another. When it is difficult to properly receive several stations, then an external antenna should be used.

In positioning any type of antenna for reception of maximum signal strength, turn the METER function switch to SIGNAL STRENGTH. The meter will read highest when the signal is at its best. Refer to page 41 for the instructions in "Operating Your LT-112B Tuner."

In areas of noise and poor signal pickup, it will be necessary to use a properly located FM folded dipole indoor antenna, or a directional antenna on the roof.

To connect an external antenna, disconnect the shorting jumper from the terminal screw marked **300 ohm.** Connect the external antenna to the EXTERNAL terminal screws marked **GND** and **300 ohm,** as shown on page 40, "Connecting Your LT-112B Tuner."

An FM folded dipole antenna is supplied with the tuner and should be more than adequate for reception of most FM stations. The leads are connected to the EXTERNAL terminal screws as directed above. The dipole should then be opened up to a full "T" shape with the cross-bar of the "T" horizontal. To position the antenna, tune in a fairly weak station which is located in the general direction of most of the stations that you wish to receive. While watching the SIGNAL STRENGTH indication on the meter, with the antenna opened up, rotate it in a horizontal plane until the signal is strongest and the highest meter reading is obtained. The background noise should now be lowest.

In some locations a **directional antenna on the roof** is necessary. Even if you have good mono FM reception with the indoor dipole or the INTERNAL antenna, you may need a roof antenna for FM stereo. If you live in a fringe area (weak signal area), you will need a directional roof antenna in order to increase the signal strength sufficiently for the tuner to receive stations without background noise. A high gain directional antenna should be used to increase the signal strength instead of a booster amplifier since it increases the unwanted noise along with the signal, and signals from local stations may overload the booster. Where stations are located in different directions or when you must "tune out" multipath reflections, you may also need a rotator.

The directional antenna is connected and oriented in the same manner as the dipole, which is described above on page 37. Some of the better directional antennas are multi-element yagi, "Log-Periodic" and "Ve Log" types. You can use either a standard FM antenna or an existing TV antenna; make certain the TV antenna has sufficient gain and that it is not one of those designed to reject the FM band. A double-pole, double-throw switch designed for this purpose should be incorporated in some accessible place so that the TV antenna can be switched to either the television set or the LT-112B. Both the tuner and the TV set should not be in operation at the same time (nor hooked up and off) on the same antenna, if you wish to obtain maximum sensitivity. If you are located in an area where both TV and FM signals come in very strong, then it would be permissible to use a TV hybrid antenna coupler, which would permit the use of the same antenna for your TV set and FM tuner simultaneously. This will result in a slight loss of signal but usually can be afforded if signals are strong to begin with.

In areas of extremely high noise interference, such as a busy highway where automobile ignition systems produce electrical disturbances, the following system is suggested:

Mount a multi-element yagi antenna or its equivalent at some point as far removed from the source of disturbance as possible, preferably making the lead-in not much longer than 50 feet. Connect a 300 - 72 ohm transformer on the mast and run a 72 ohm shielded antenna lead-in wire to a 72 - 300 ohm transformer located on the back of the tuner. Since the yagi antenna or its equivalent is extremely directional, it is important that it be positioned for the best reception of desired stations.

Multipath

Multipath reception occurs when the tuner's antenna picks up the radio station signal not only from the radio station's antenna, but also at a later time from one or more reflections. The signal can be reflected off most any large object such as a building or a mountain. See Fig. 22 below. Multipath reception may degrade FM tuner performance by producing distortion in the sound, increasing background noise and reducing the quality of stereo. In most installations a certain amount of multipath reception will be inevitable. Fortunately in the majority of cases it is not necessary to completely eliminate multipath reception because the natural characteristics of FM tuners compensate for much of this type of difficulty. Multipath reception can usually be reduced by the correct positioning of the antenna such that only one signal is predominantly received.

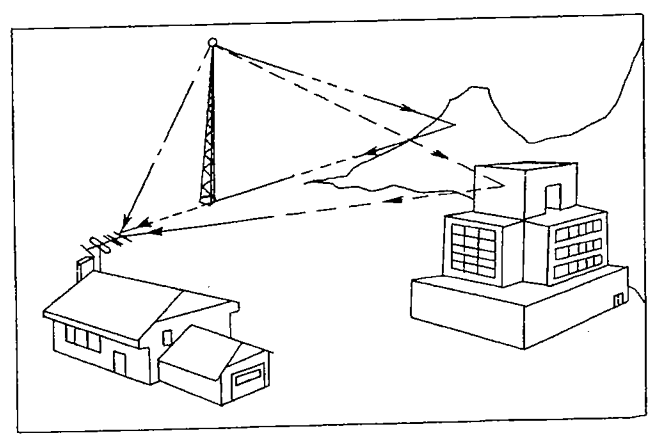


Figure 22. Multipath Reception, The Receiving of Direct and Reflected Signals

The special meter circuits in your LT-112B have been designed to give you an approximate indication of the relative multipath signal. For the few cases when multipath reception is causing a degradation of FM tuner performance, the following procedure is suggested:

Refer to page 40 for the instructions in "Operating Your LT-112B Tuner."

First, tune in the desired radio station, using the CENTER TUNING meter indication, to exact center. This is normally the best and most convenient method of proper tuning.

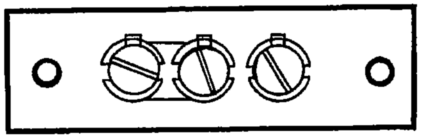
Secondly, the tuner's directional antenna should be rotated (or the indoor dipole oriented) to obtain maximum relative SIGNAL STRENGTH as indicated on the meter. In the majority of cases this will adequately reduce multipath reception, the exception being when the tuner's antenna is surrounded by many reflective objects which cause severe multipath reception.

Thirdly, turn the METER switch to the MULTIPATH position. If the tuner is not tuned properly or if the multipath reception is excessive, then the meter needle will read lower than it did for SIGNAL STRENGTH and it will not be steady, but instead it will swing downward in tempo with the music or speech. The louder the sound and the more severe multipath is, the larger the downward needle swing will be. For a given station, multipath reception can often be reduced by orienting the antenna (to receive the signal by only one predominant path) so that the meter needle does not swing downward in tempo with the transmitter's modulation, and/or by retuning the receiver slightly. If the meter needle is swinging downscale in tempo with the music or speech and you do not hear any degradation of tuner performance, then the tuner is compensating for multipath and you should not be concerned. With no meter indication of multipath you probably do not have multipath reception. It will be difficult to see much meter indication of multipath reception for low SIGNAL STRENGTH readings.

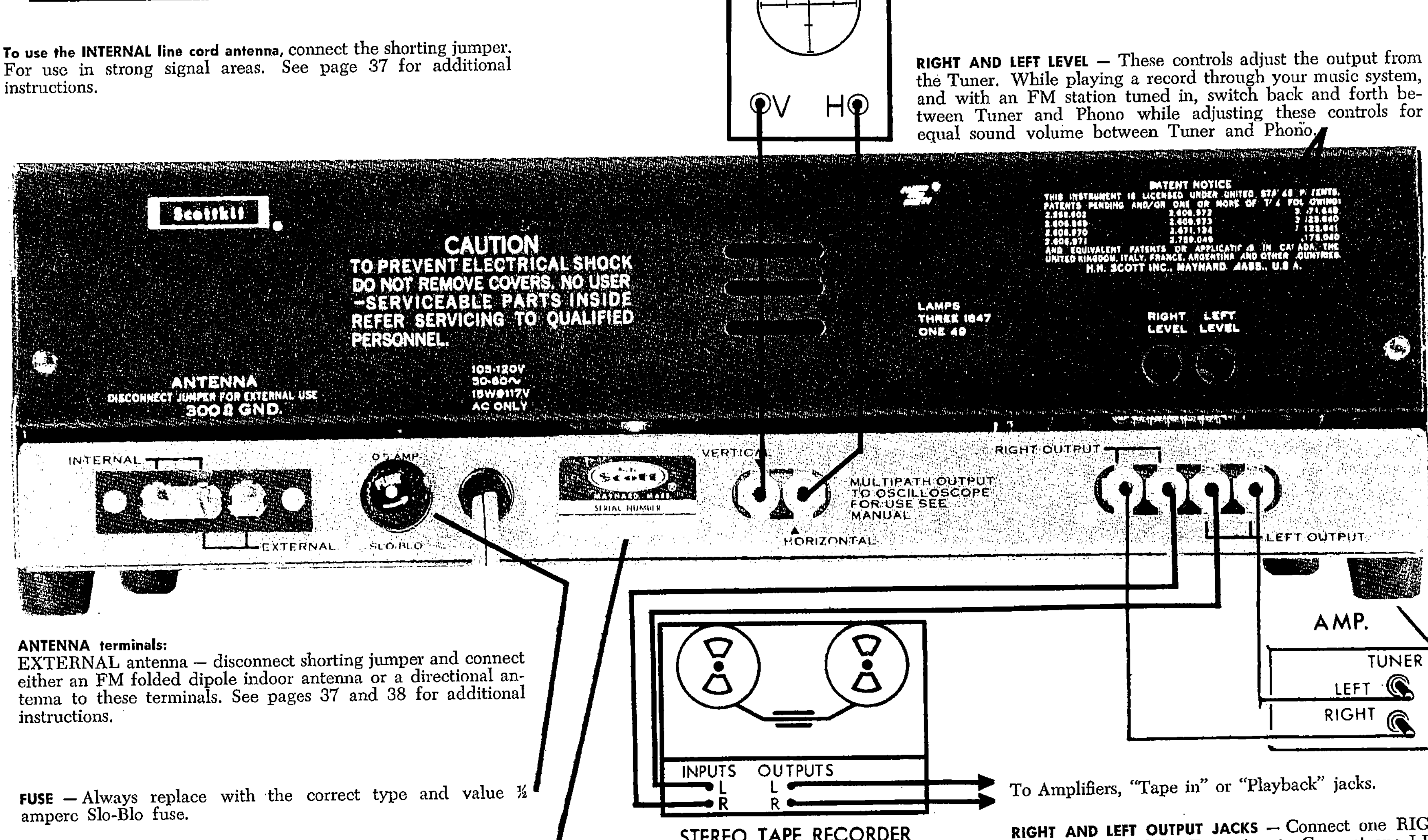
An oscilloscope is the best indicator for multipath reception, but it is an addition that is rarely necessary. Interpretation of the waveforms on the oscilloscope are somewhat complicated and thus will require a degree of familiarity. However, for your convenience, output jacks for this use have been provided on the rear of the tuner.

A more detailed discussion of multipath reception and the use of the oscilloscope indicator will be found in the following Section 6, "Tuner Theory and Circuit Description."

Connecting Your LT-112B Broadcast Monitor FM Tuner



To use the INTERNAL line cord antenna, connect the shorting jumper. For use in strong signal areas. See page 37 for additional instructions.



Connections for Multipath Oscilloscope Indicator. See pages 38 and 43.

RIGHT AND LEFT LEVEL — These controls adjust the output from the Tuner. While playing a record through your music system, and with an FM station tuned in, switch back and forth between Tuner and Phono while adjusting these controls for equal sound volume between Tuner and Phono.

ANTENNA terminals:
EXTERNAL antenna — disconnect shorting jumper and connect either an FM folded dipole indoor antenna or a directional antenna to these terminals. See pages 37 and 38 for additional instructions.

FUSE — Always replace with the correct type and value ½ ampere Slo-Blo fuse.

SERIAL NUMBER — In case of difficulty always refer to model and serial number in your correspondence.

To Amplifiers, "Tape in" or "Playback" jacks.

RIGHT AND LEFT OUTPUT JACKS — Connect one RIGHT output to amplifier's RIGHT Tuner input. Connect one LEFT output to amplifier's LEFT Tuner input. The other RIGHT and LEFT outputs may be used with a tape recorder to record FM programs directly from the Tuner. Adjust the tape recorder's input level controls for proper recording level.

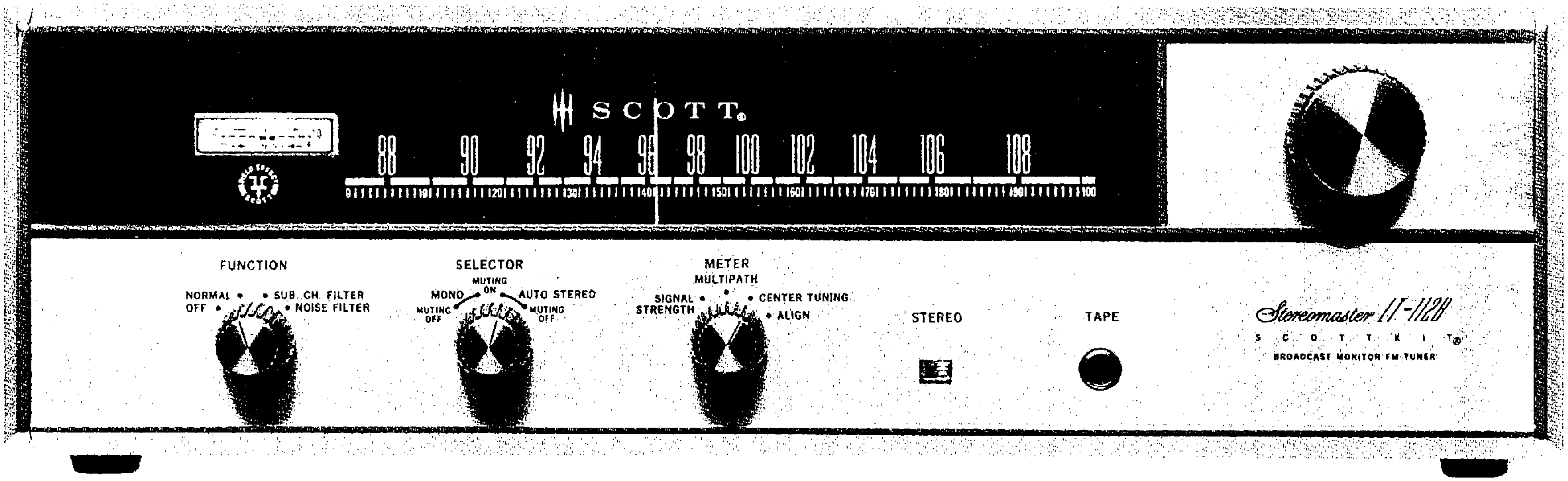
Operating Your LT-112B Broadcast Monitor FM Tuner

FUNCTION Switch
OFF – Turns the Tuner off. In the other three positions the Tuner is on.
NORMAL – Used for stations with sufficient strength to provide noiseless reception.
SUB-CHANNEL FILTER – Reduces interference or noise on a stereo signal only. (It affects the sub-channel only and has no effect on the main channel.)
NOISE FILTER – Reduces noise on both mono and stereo stations. It slightly reduces high frequency response.

STEREO LIGHT
Will light when you are receiving a stereo broadcast, if the SELECTOR switch is in in either of the AUTO STEREO positions.

TAPE OUTPUT JACK
A portable tape recorder or a set of high impedance headphones can be connected to this convenient front panel output. The jack will accept the standard three-conductor phone plugs found on most popular stereo headphones.

FM TUNING KNOB
Selects the desired FM station.

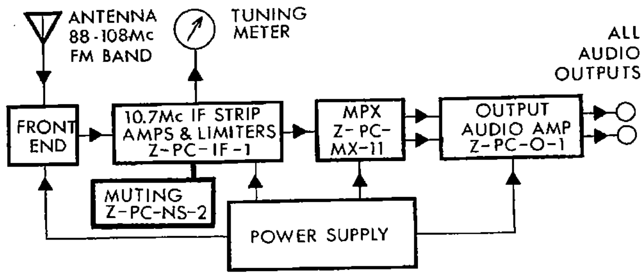


SELECTOR switch
MONO/MUTING OFF – This position (fully counterclockwise) provides monophonic reception of both mono and stereo broadcasts; the Tuner will not switch to stereo automatically, but will stay in mono. It also turns off the muting, and you will then hear interstation noise.
MONO/MUTING ON – This position (middle left) operates the Tuner in mono as above, with the addition of the muting circuit, which eliminates most of the interstation noise as you tune from one station to another. The very weak stations will also be muted.
AUTO STEREO/MUTING ON – For receiving the stronger stations, you will find it convenient to use this position (middle right) most of the time. In this position the Tuner will automatically switch into stereo if you are tuned to a stereo broadcast (indicated by the STEREO light). When tuning back to a mono station, the Tuner will automatically switch to mono. In addition, the muting circuit (interstation noise suppressor) will be in operation in the same manner as with the MONO/MUTING ON position.
AUTO STEREO/MUTING OFF – This position (fully clockwise) provides the automatic stereo feature as in the AUTO STEREO/MUTING ON position, but the muting circuit will be off as it is in the MONO/MUTING OFF position.

METER & METER switch positions
SIGNAL STRENGTH – For this switch position, the top scale on the meter indicates the relative strength of the signal. Tune for the highest number on the meter. This position is very useful for orienting your antenna for maximum signal pickup by rotating the antenna while watching the meter for the highest indication.
MULTIPATH – Using this switch position, the top scale on the meter gives an approximate indication of the multipath signal. See page 40 for additional instructions.
CENTER TUNING – For precise tuning to the center of the FM channel. Turn the FM Tuning Knob so that the meter pointer is between the two large black squares on bottom scale of the meter. With all but the weakest signals any point on the large black squares themselves is also satisfactory. (Each division is about 25 kHz.) This position of the meter switch allows tuning to stations too weak to be indicated on the SIGNAL STRENGTH position. Center tuning provides maximum separation and minimum distortion.
ALIGN – Used only to align the Tuner (see alignment instructions).

Section 6 — Tuner Theory and Circuit Description

BASIC BLOCK DIAGRAM OF LT-112B

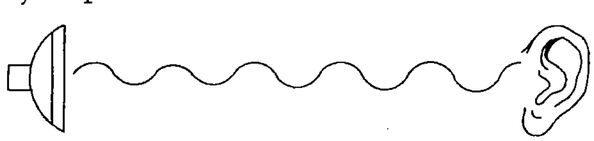


6.1 Basic Frequency Modulation Theory

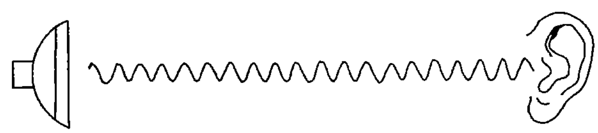
In your home, you hear stereo . . . the sounds from the left side of the stage from a speaker placed on the left side of your room, the sounds from the right side of the stage from the right, where they belong. Stereo sound is really an aural version of 3-D photography . . . you hear two slightly different sound "pictures" . . . and get a realistic sound spread across your living room.

A single FM Station broadcasts both stereo channels. The listener needs only an FM tuner equipped for multiplex plus the usual accoutrements of stereo (two speakers and a dual channel amplifier). Operation is simple. You just tune to one stereo station as you do now for regular mono FM broadcasts, your LT-112B automatically switches to stereo, and you hear stereophonic sound with all the advantages of FM. FM multiplex stereo is a pretty remarkable feat —two separate signals from one station. Let us see how it is done.

When you listen to FM through your loudspeakers, you hear sounds, such as music, speech, and even (sigh!) commercials. These sounds result from pressure waves in the air created by the motion of the loudspeaker cones. If the loudspeaker cone moves back and forth twenty times a second, it creates 20 alterations of sound pressure (cycles) every second. A 20 hertz (cycle-per-second) sound wave produces very deep or low tone in the bass region.



If the loudspeaker cone moves back and forth 20,000 times a second, it creates 20,000 hertz. Such a sound is so high pitched and in the extreme treble region that most people are not able to hear it.



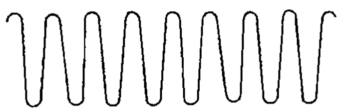
Human beings are capable of hearing sounds as low as 20 hertz. Any sound above 20,000 hertz is referred to as ultrasonic because it is above the range of human hearing.

Most good FM tuners are capable of reproducing these supersonic frequencies above 20,000 hertz ("Hz" for short). Though you cannot hear them, these supersonic frequencies are used very effectively for multiplex. At a carrier frequency of 38,000 hertz (Hz), high above the sounds you can hear, the second (stereo information) signal is added on. While you can't hear this second signal, your FM multiplex stereo tuner can, and will convert this into sound you can hear—stereo sound.

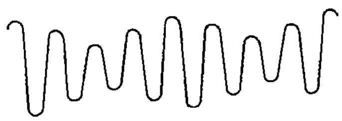
a. How Frequency Modulation Is Transmitted

Let's start with a broadcast station assigned to 100 mHz (megahertz) in the 88-108 mHz FM band. In order to receive this station, you tune in to 100 mHz on the dial. Whatever is being transmitted by the broadcast station (music or speech) will be received. The 100 mHz signal (properly called the "carrier" frequency) is completely inaudible. What you eventually hear is the signal that has been super-imposed on the 100 mHz carrier frequency.

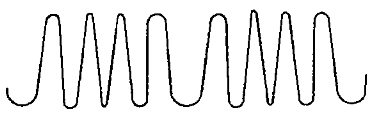
Superimposing a signal is accomplished by making the carrier change in some manner. For example, we can make the carrier get stronger and weaker. Or we can make it go faster and slower. These various methods of changing the carrier (100 mHz in our example) are known as "modulation."



(a) This is a visual representation of the 100 mHz carrier. Nothing is being done to it. It is simply moving along, wiggling back and forth 100 million times a second (100 mHz).



(b) Now it is being changed (or modulated) by making it stronger and weaker. This is amplitude modulation (AM).



(c) Here it is being changed (or modulated) by making it vary faster and slower. This is frequency modulation (FM).

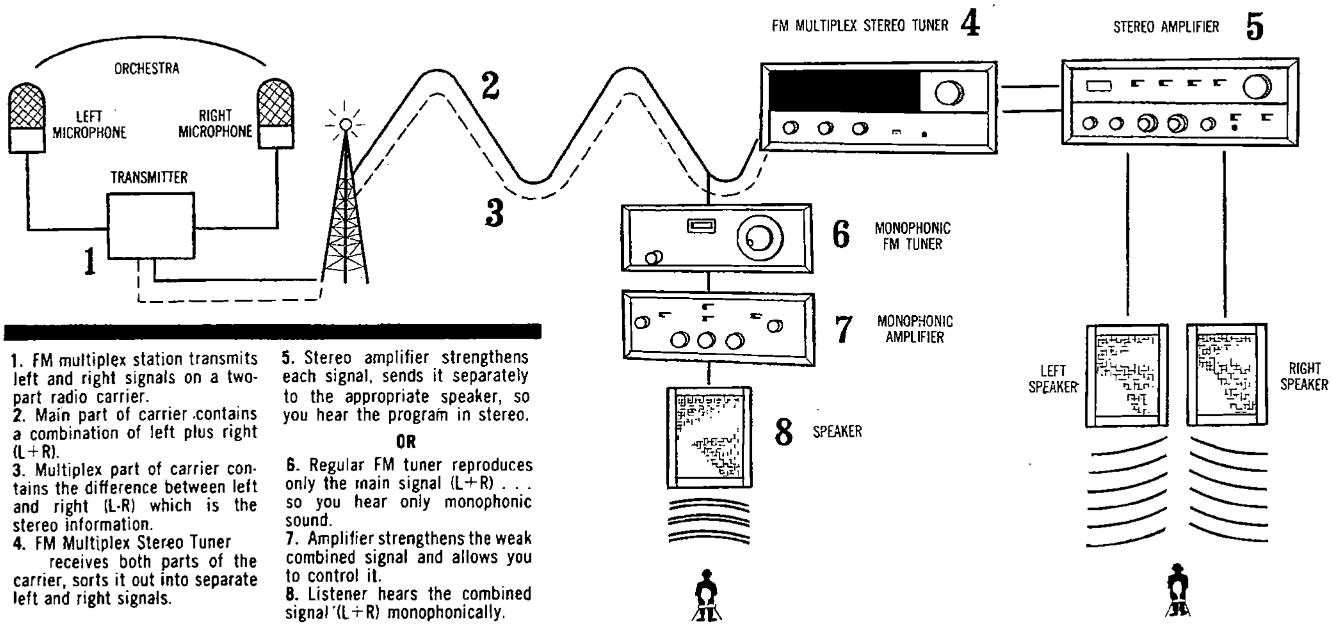
Let's see how this is done. A man is playing a piano in the broadcasting studio. He strikes a low note, say a 50 hertz note. If this is an AM station, the 50 Hz tone is used to vary the amplitude of the broadcasting station's 100 mHz carrier. The transmitted carrier gets stronger and weaker at a rate of 50 times per second.

Meanwhile, back at the tuner, the dial has been set to 100 mHz. The tuner receives the modulated 100 mHz carrier. The tuner is designed to pick out the modulation (information) and reject the carrier. Only the 50 Hz tone comes out of the tuner.

Let's repeat the process, this time using an FM transmitter. The 50 Hz piano note makes the 100 mHz carrier alternate a little faster and a little slower 50 times a second without varying its amplitude at all. The tuner, set to 100 mHz, receives the total signal and separates the 50 Hz tone from its carrier.

What is the difference in performance between FM and AM? FM sounds better. One reason for this better sound is that FM stations are not as crowded as the AM stations in respect to their carrier frequencies. As a result, FM stations can transmit the full range of audible frequencies (from below 50 Hz to above 15,000 Hz) and not interfere with stations adjacent to them on the dial. Another reason (a true technical advantage) is that FM is almost completely free from the noise and interference associated with AM. Most static-producing phenomena, like lightning, atmospheric conditions, and machines, affect the amplitude of the carrier but have little effect on the frequency. Since AM works on amplitude, these interferences are heard over an AM radio as "static." However, FM does not respond to variations in amplitude – only to changes in frequency. Since this bothersome interference is mainly an amplitude variation, you practically never hear it on FM.

HOW MULTIPLEX STEREO WORKS



1. FM multiplex station transmits left and right signals on a two-part radio carrier.
2. Main part of carrier contains a combination of left plus right (L+R).
3. Multiplex part of carrier contains the difference between left and right (L-R) which is the stereo information.
4. FM Multiplex Stereo Tuner receives both parts of the carrier, sorts it out into separate left and right signals.
5. Stereo amplifier strengthens each signal, sends it separately to the appropriate speaker, so you hear the program in stereo.

OR

6. Regular FM tuner reproduces only the main signal (L+R) . . . so you hear only monophonic sound.
7. Amplifier strengthens the weak combined signal and allows you to control it.
8. Listener hears the combined signal (L+R) monophonically.

b. Basic Tuner Theory

A tuner converts the radio signal from the antenna to an audio signal of sufficient strength to drive the audio amplifier.

The radio frequency signals from broadcast stations are received by the antenna. These signals may be as weak as 2 millionths of a volt. The radio frequency (RF) amplifier must strengthen these very weak signals tremendously while adding a minimum amount of noise. This strengthened RF signal is then fed to the converter section of the front end.

The converter section consists of a Local Oscillator and a Mixer. The Local Oscillator produces an RF signal which is combined with the strengthened RF signal from the radio signal. These two signals are combined in the Mixer to produce what is called the Intermediate Frequency (IF).

This fixed Intermediate Frequency is used because it is much easier to design a high-gain amplifier for one frequency than it is to design it to be adjustable over a wide range of frequencies. The converter section in the front end (the RF Amplifier and Mixer-Oscillator) changes all incoming frequencies (anywhere from 88 mHz to 108 mHz) to the Intermediate Frequency (10.7 mHz).

The IF strip consists of the IF Amplifiers, Limiters and Detector.

The Intermediate Frequency signal from the converter is amplified by the IF Amplifiers several hundred times to increase its strength still further.

The amplified IF signal is fed to a noise-reducing circuit called the Limiter. The Limiter removes noises caused by man-made interference (motors, etc.) and natural static, virtually eliminating interference.

The next section in the tuner is called the Detector. The Detector separates the program material (music or speech) from the Intermediate Frequency signal.

The signal now goes through the multiplex section of the tuner. If the station is broadcasting a monophonic program, the multiplex section passes the signal without change, identical signals being present at the "right" and "left" output jacks.

When the station is broadcasting a stereo signal, the multiplex section automatically senses it and separates the "right" signal from the "left" signal to produce stereo signals at the output jacks.

6.2 Antennas and Multipath

a. Antenna and Multipath Theory

An introduction to the use of antennas and the basic theory of multipath reception is given in Section 5 – Installation and Operating Instructions, on pages 37 through 39. The presentation here assumes that the reader understands that material. In reading the remainder of Section 6, you may wish to occasionally refer to the HiFi Dictionary on pages 3 through 5.

As previously mentioned, in the majority of cases the natural characteristics of FM tuners compensate for multipath reception. Occasionally multipath will be severe enough to cause degradation of FM tuner reception. This occurs when the reflected signal(s) and the signal that comes directly from the radio transmitter are of similar strength. These signals add (combine) in amplitude (strength) and in phase. The direct and reflected signals are delayed from each other, the longer signal path taking more time to reach the tuner's antenna. Since frequency modulation is really a specialized form of phase modulation, the tuner is sensitive to the combined phases of the sum of the direct and reflected multipath signal(s). This combined phase is unfortunately not the same as exists in the original direct signal. With multipath the combined signal has thus experienced an additional amount of phase shift which varies with the modulation of the broadcast transmitter. This additional amount of modulation is not linear and causes distortion of the original frequency modulated RF signal. Since frequency modulation and phase modulation are interrelated, the amount of multipath distortion will be approximately proportional to the audio modulation frequency and the difference in strength of the direct and reflected signals, as well as the delay between them. Thus for a given amount of delay and ratio of signal strengths (multipath conditions), there will be very little audible distortion with monophonic program material which has a limited or poor audio high frequency response (say under 5,000 Hz). The same station with the same multipath conditions, broadcasting full audio frequency range (or at least up to 12,000 Hz) monophonic material will have noticeable distortion in the treble range and for overtones. If this same broadcast were in stereophonic sound, substantially more distortion would be heard than in the case of mono reception, because the stereophonic signals occupy an ultrasonic frequency spectrum (before they are processed by the multiplex demodulator).

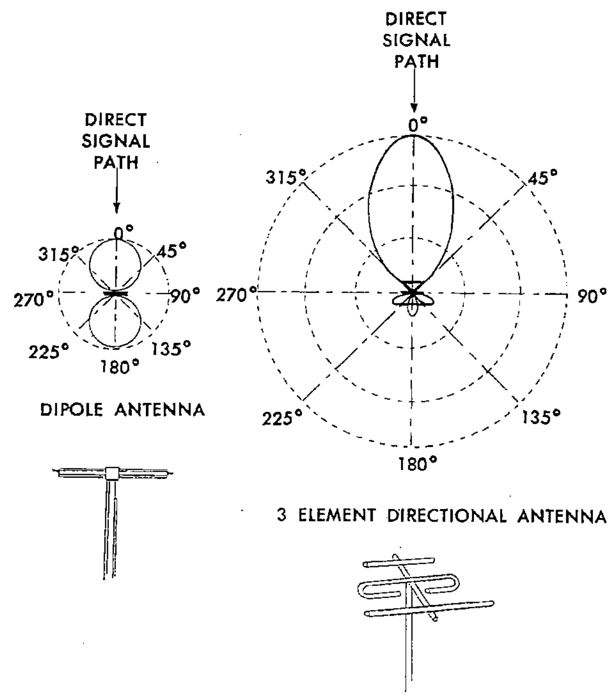
It is therefore desirable to reduce multipath signals before they get to the tuner with a properly installed and oriented antenna. Multipath in FM reception is exactly the same phenomenon as ghosts or multiple images in television reception. Good stereo FM reception like good color television reception, is more dependent on a good antenna system installation than mono FM reception and black and white television reception, since in both cases (stereo and color TV) the signals occupy a higher frequency range and are more affected by multipath and weak signals.

The primary parts of an antenna system consist of the antenna proper and the lead-in; the other parts, if they are employed, could be the mast, antenna rotor, lightning arrester, insulators and guy wires. Improper installation of these parts can degrade the performance of the antenna system. The function of the antenna proper is to convert RF radiated electrical energy in the air to electrical energy in the lead-in (transmission line) for introduction to and processing by the tuner, after the opposite process has taken place at the transmitter. Antennas are reciprocal devices, that is, in general the properties of a transmitting or receiving antenna are identical. The major exception being that the transmitting antennae have to be constructed to handle kilowatts of power from the transmitter as compared to microwatts in the receiving antenna.

An antenna is a passive circuit element. It cannot generate power of its own, that is, it cannot take small amounts of signal power and increase their strength like an amplifier. Antenna gain (sensitivity) is increased in one direction from the antenna only at the expense of gain in some other direction(s). The sensitivity patterns in the horizontal plane of a dipole and a three-element directional antenna may be seen in Figure 23. The curved pattern around each antenna indicates a line of equal sensitivity to a signal of given strength. Note that the sensitivity of the three-element antenna occurs predominately in one direction at the expense of virtually no sensitivity in other directions. In practice, the dipole antenna is commonly used as a "reference" (or "comparison") antenna to compute the relative gain of directional antennas. If the dipole is a "reference" and arbitrarily given a gain of one, then the gain of directional antennas may be found by taking the ratio of distances at the extremities of the patterns of equal sensitivity. This ratio is normally expressed in decibels. Thus in the simplified example in Figure 23, the three-element directional antenna has a gain of 3 times or 10 dB at a given frequency. (Actually it is impossible for a three-element yagi to have as high a gain as the 10 dB given in the above example, since such a high gain requires an antenna with eight elements or more.)

Unlike an RF antenna booster amplifier, when the gain of a directional antenna is used to increase the signal strength of various FM stations, noise is *not* simultaneously increased. Thus the signal-to-noise ratio will be improved with a good antenna, whereas it may not be improved with an amplifier.

FIG. 23 SENSITIVITY PATTERNS



The half-wave folded dipole antenna is the type normally used alone in FM, or as the unit from which many more complex forms of directive FM antennas are constructed. Any receiving antennas must be effectively a half wavelength of the transmitted frequency, or a multiple of it in length. Taking the center frequency of the FM band (about 100 mKz) as an example, the half-wave antenna should be about 54 inches long. If the antenna dimensions are not correct, its elements will not be tuned to the desired frequency(ies) (they will not resonate) and there would probably be a gain of less than one (a signal loss), resulting in insufficient signal strength to operate the tuner. This is why a UHF TV antenna cannot be used for either the VHF TV or FM bands. Many VHF TV antennas are designed to exclude the FM band. The more frequencies (broadband) that an antenna is designed to cover, the lower its gain will be. However, unless we wish to monitor only one station for special purposes, an FM antenna should have good gain over the entire FM band, 88 to 108 mHz. The folded dipole (such as the one supplied to you) is designed for the center of the band and only covers about 4 mHz in frequency (bandwidth) instead of the full 20 mHz. Thus, in general, the dipole should only be used in strong signal areas. To properly cover the entire FM band requires a well-designed, multi-element directional antenna.

When one is trying to discriminate between direct and reflected signals in order to eliminate multipath or to eliminate interference from unwanted stations, an antenna rotor with a highly directive antenna that has a good (high) front-to-back ratio is a necessity. The higher the gain of an antenna, the more directive it is; that is, it has a narrower beamwidth (measured in degrees of an angle). This may be seen by comparing the sensitivity pattern of the dipole and the three-element directional antenna, as seen in Figure 23. The dipole sensitivity pattern is very broad (a "figure 8"), and it is bi-directional. The three-element directional antenna sensitivity pattern is narrow, and it is uni-directional. Since an antenna is not a perfect device, attempts to increase sensitivity and directivity in one direction results in some sensitivity occurring in other undesirable directions, such as off to the rear and the sides of a directional antenna. You may note this from the sensitivity pattern of the three-element antenna shown in the figure. Front-to-back ratio is the comparison of the sensitivity in front of the antenna (the side that is aimed toward the station) to the sensitivity of the rear (180°) of the antenna, usually expressed in decibels. Thus the dipole has no front-to-back ratio and the directional antenna does.

In order to obtain the maximum signal energy from the antenna, the antenna must be properly matched impedance-wise to the lead-in (transmission line), which in turn must be matched to the tuner. While the characteristic impedance of the simple dipole is 72 ohms, it unfortunately varies considerably over the FM band. By making a folded dipole, the impedance is changed to approximately 300 ohms and the impedance variation over the band is reduced, making a better broadband antenna for FM use. The impedance of the antenna at its terminals (or a given point) is the ratio of the voltage to the current at its terminals (or at that point). The 300 ohm folded dipole antenna should feed a 300 ohm twin-lead which in turn should be connected to the 300 ohm terminals of the tuner. However, if we wish to use a 72 ohm transmission line (coaxial cable) with a directional antenna, there should be a 300 ohm to 72 ohm balun (impedance matching transformer) mounted on the antenna mast and connected between the antenna and line, and a 72 ohm to 300 ohm balun connected between the line and the tuner and mounted on the tuner. It must be realized that there will be a slight signal loss with the baluns, but if they are of good quality the loss will be less than from the mismatch. If both ends of the transmission line are mismatched, then: a) signal reflections along the line will occur, possibly producing a local effect of multipath; b) the line will act as a long wire antenna thus increasing the possibilities of multipath reception; and c) a signal loss will occur. With a mismatch at one end of the transmission line only, situations b) and c) will occur.

If an open 300 ohm twin-lead is routed next to metal objects (antenna mast, guy wires, house-heating ducts and wiring), then its impedance will be affected and some or all of the above situations will occur. Ideally, if an open line (such as 300 ohm unshielded twin-lead) must be run parallel to metal objects for several feet, it should be kept a quarter wavelength (about 2½ feet) or more away from the metal object. If an open line crosses a metal object, such as a water pipe, it should be kept a minimum of 6 inches away. By putting approximately one twist per foot in 300 ohm unshielded twin-lead, the affects produced from proximity to metal objects will be slightly reduced and the susceptibility of the twin-lead to picking up automobile ignition noise and other static interferences will also be reduced. With coaxial cable or shielded twin-lead cable, these problems will not occur, but there will be a slightly greater signal loss with these cables than with high quality open twin-lead.

One very common way that people unknowlingly mismatch antenna systems is by connecting two (or more) receivers, such as an FM tuner and a TV set, onto the same antenna and lead-in without using an impedance matching network or a diplexer (for two sets), or a double-pole double-throw antenna lead-in switch (see Section 5). Two sets connected simultaneously to the lead-in or transmission line causes the line to terminate with 150 ohms instead of 300 ohms, whether or not the sets are turned on. In strong signal areas many of the above difficulties will be such that they may not be too noticeable with monophonic reception, but may be more noticeable with stereophonic reception.

If you would like to use your antenna in the FM band only, you would do very well with *either* a properly designed broadband Yagi or a properly designed log periodic dipole array (LPDA). The LPDA was developed under an Air Force contract just a few years ago. For some typical numbers, the specifications of a good six-element broadband Yagi FM antenna might be: at 88 mHz a gain of 9 dB and front-to-back ratio of 16 dB, and at 108 mHz a gain of 11 dB and a front-to-back ratio of 18 dB, and in the center of the FM band a beamwidth (directivity) of 60°. Beware of the specifications that give miles of range instead of dB gain at different frequencies. Miles of range do not really mean very much because the type of geographical terrain and proximity of objects higher than the antenna can, in some cases, make a "250-mile antenna" be a 25-mile antenna.

If you wish to use one antenna for both the FM and TV bands, you would probably want to choose a properly designed LPDA, remembering that there are two TV bands, VHF and UHF. A good log periodic dipole array maintains a high gain, a good sensitivity pattern and a good impedance consistency over a much wider bandwidth than does the Yagi. For apartment dwellers, building restrictions may prevent the use of an outdoor or roof-top antenna, and the apartment house TV distribution booster systems may be designed to exclude the FM bands. Under these situations, "rabbit ears" will produce better results than a folded dipole under the rug or on the wall, because they can easily be adjusted for best reception of each station.

To summarize, for an FM band antenna, the more elements there are, the higher its gain, the greater its directivity and the higher its front-to-back ratio will be over the entire FM band. An antenna that is made for both the TV and FM bands must have more elements on it for a given gain over all the bands than an antenna that has been designed for the same gain over the FM band only.

As is evident from all of the above, there is more to purchasing and correctly installing a good antenna system than many people may realize. Properly installing the lead-in is almost as important as properly installing the antenna. A good antenna system is one of the best investments that you can make to complement a high quality tuner such as the LT-112B.

b. Using a Multipath Oscilloscope Indicator

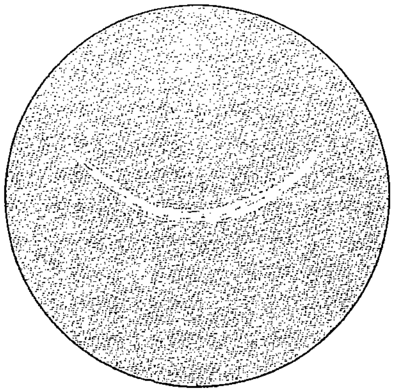
The LT-112B tuner has provisions for visually observing multipath signals on an oscilloscope. While an oscilloscope is the best indicator for multipath reception, it is an addition that will rarely be necessary, especially if a good antenna system was correctly installed, using the built-in multipath indicator. Interpretation of the waveforms on the oscilloscope are somewhat complicated and the following material will require a degree of familiarity with the use and operation of an oscilloscope, as well as additional technical knowledge.

The phono output jacks for use with a Multipath Oscilloscope Indicator are located on the rear of the LT-112B. These jacks are marked VERTICAL and HORIZONTAL for connection to the corresponding imputs of an oscilloscope, as shown on page 40 of this book.

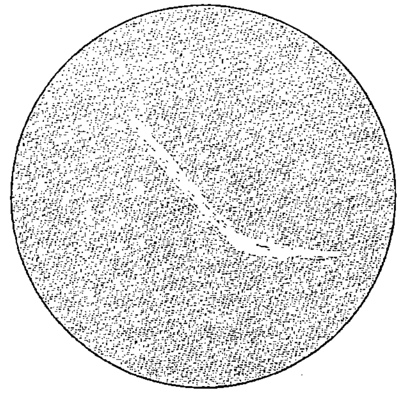
The Horizontal voltage is obtained from the tuner's ratio detector output (Low Composite Audio Output) ahead of the Multiplex circuit and deemphasis network. This voltage is proportional to the deviation (amount of frequency modulation of the FM transmitter). The horizontal gain control on the scope should be adjusted so that 100% modulation (±75 kHz deviation) will cause one-third to full-beam deflection on the scope screen. The Vertical voltage is obtained from the AGC bus at the junction of the AGC detector diodes. This voltage is approximately proportional to an FM station's instantaneous signal strength, including the incidental amplitude modulation. Stations with a stronger signal will produce higher voltages. The automatic gain control circuit with its relatively long-time constant will produce adequate vertical deflection voltages from weak as well as strong stations.

The output voltages at these two jacks are normally between 50 and 100 millivolts peak-to-peak depending upon the degree of modulation and the signal strength of the FM station. (±75 kHz deviation will produce about 250 millivolts peak-to-peak output from the tuner.) Thus an oscilloscope indicator of **full scale** sensitivity of 50 mV peak-to-peak must be used. It should also have a frequency response from 10 to 100,000 Hz or wider. Dc oscilloscopes may be used but are not required since the LT-112B has a Signal Strength Meter. Less sensitive scopes require an external amplifier with the same frequency response. The input impedance of the scope (or amplifier, if it is used) should be 200,000 ohms or more. The total shunt capacity of the shielded connecting cable and the input to the scope (or amplifier) should be less than 100 pf for the Horizontal output, and may be up to 10 times larger for the Vertical output.

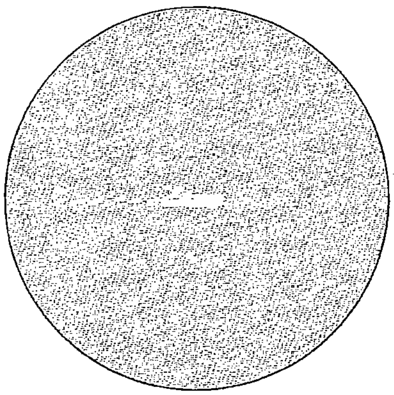
Once the oscilloscope has been connected, tune to an FM station and observe the pattern. A normal scope pattern with little or no multipath and high modulation will resemble a shallow bowl. Depending



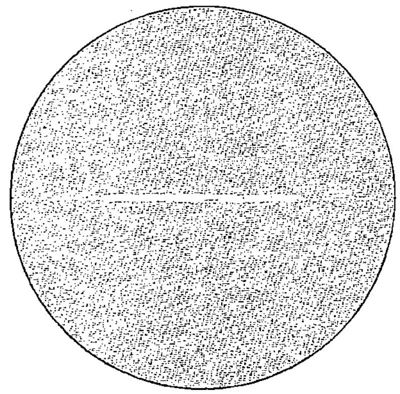
Little or No Multipath
With High Modulation



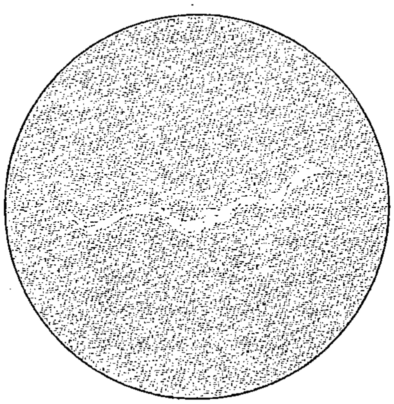
Incorrect Tuning
Tuned to Left Side of Center
and
Little or No Multipath With
High Modulation



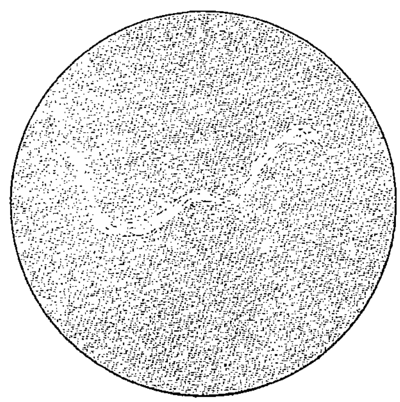
Little or No Multipath
With Low Modulation or
19 kHz Pilot



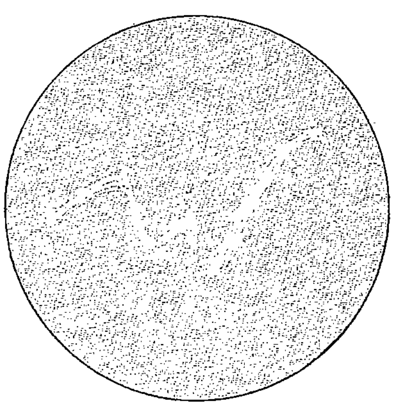
No Station (Noise)
or
Very Weak Station With
High Modulation



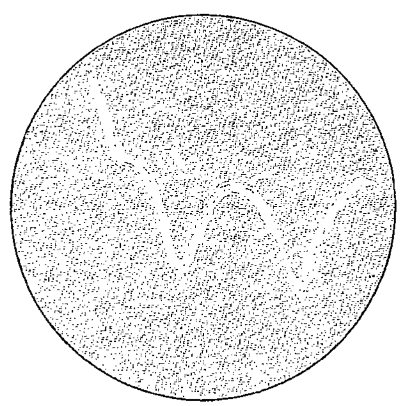
Moderate Multipath



Multipath



Severe Multipath



Severe Multipath

FIG. 24 MULTIPATH OSCILLOSCOPE PATTERNS

upon the scope or amplifier phasing, the pattern may be upside down. A normal scope pattern with little or no multipath and low modulation will be a short fuzzy line. A lopsided bowl indicates inaccuracy of tuning (or possible harmless multipath caused by nearby signal reflections). A weak station will be a broad fuzzy line. Scope patterns with ridges and zig-zags indicate multipath reception. The steeper these ridges, the worse the multipath. When multipath reception is indicated, the antenna should be rotated (or moved, or the lead-in routing changed) to obtain a scope pattern that is as close to the shallow bowl pattern as possible. In most cases if only moderate multipath reception is occuring, the natural characteristics of the FM tuner will largely compensate for the difficulty.

Figure 24, Multipath Oscilloscope Patterns," shows some of these patterns presented in a slightly idealized form. With practice you should be able to tell at a glance the condition of the FM signal you are receiving.

6.3 Detailed Tuner Theory

While reading the detailed tuner theory, you will probably want to refer to the Detailed Block Diagram, Section 6.5, page 59 and the Schematics in Section 8.1, pages 62 through 70 inclusive.

a. Front End

The "front end" is comprised of the RF Amplifier, Local Oscillator, and the Mixer. It is the part of the tuner that is actually tuned when you select a station.

The desired station is selected and its signal is amplified by the RF Amplifier in the front end, Q201 and Q202.

The amount of amplification that can be achieved in such a tuned-RF amplifier is limited by engineering considerations, the chief of which has to do with stability.

Additional gain is obtained by means of the superheterodyne principle. This involves conversion of the received signal to a fixed frequency of much lower value (10.7 mHz in FM reception as against the RF range of 88-108 mHz). Stable amplification and greatly improved selectivity are afforded by the fixed-frequency, intermediate-frequency, or IF Amplifier, as it is called. In addition, the bandwidth is essentially constant for the entire tuning range — an important consideration, especially with multiplex. Practically all of the receivers and tuners sold today are superheterodyne receivers.

The conversion of the received RF radio signal to a fixed frequency, referred to in the previous paragraph, is accomplished by means of a "beat" phenomenon. This is performed by the converter, which is a frequency-changing device consisting of a Local Oscillator (Q204) and a frequency Mixer (Q203). The Local Oscillator generates a signal within the tuner whose frequency is varied by the tuning (variable) capacitor so that it is always 10.7 mHz higher than the frequency of the incoming radio station. In the converter the two voltages of different frequency, the RF signal voltage and the voltage generated by the Oscillator, are fed to the input of the frequency Mixer. These voltages "beat" or heterodyne within the Mixer to produce a plate current which consists of new frequencies that are the sum and difference of the original frequencies.

On the output of the Mixer is a tuned circuit, which is the first IF Transformer (T201). It is adjusted to select only one beat frequency; the frequency of 10.7 mHz which is equal to the difference between the radio signal frequency and the oscillator frequency.

One of the basic problems inherent in front end design is drift. FM works on such high frequencies that even the slightest change of value of one of the electronic components can cause the tuner to go off station. A conventional way of keeping a tuner on station is to provide an auxiliary circuit, called AFC. Automatic frequency control (AFC) automatically adjusts the frequency of the oscillator so that when it "beats" with the RF signal voltage, the correct intermediate frequency is always produced. It is often used to compensate for slight changes in the receiver local oscillator frequency or inaccurate tuning. AFC has several inherent drawbacks, however, which are: (1) the AFC Circuit itself usually adds distortion to the received signal. (2) AFC usually attenuates low frequency response. (3) AFC tends to pull to strong stations. This is a disadvantage when you want to receive a weak station next to a strong station. Of course, if you switch off the AFC, you will receive the weak station, but then the tuner will probably drift.

To overcome these limitations of AFC, the front end in your kit was carefully designed in a manner which does not require AFC. Particular attention was given to the Local Oscillator to obtain an inherently stable design, plus accurate temperature compensation to prevent frequency drift as the tuner temperature varied.

Automatic gain control (AGC) should not be confused with automatic frequency control (AFC), for they are two quite different things.

Automatic gain control (AGC) regulates the gain or amplification of the tuner so that it will be highly sensitive to very weak signals and automatically adjust to handle very strong signals. The ability to handle very strong signals means that the tuner's selectivity will always be high. Selectivity is the ability of a tuner to separate stations that are very close together. AGC regulates the gain of the RF Amplifier and also the IF Amplifier, so that the gain for these stages is less for a strong signal (such as a nearby station) and greater for a weak signal (such as a distant station). When the signal strength at the antenna changes, the AGC circuit regulates the resultant changes in the voltage output of the Front End and the IF Amplifier stages.

Some of the reasons why H. H. Scott front ends give superior results are: (1) Use of carefully selected high gain, low noise field effect transistors (FET). (2) Silver plating on the front end housing and its components to reduce circuit losses to a minimum and provide maximum gain (sensitivity). (3) Factory alignment of the front end subassembly to assure optimum performance. (4) Silver-plated shielding on all sides to conform with FCC specifications in order that the Local Oscillator will not radiate and interfere with nearby television sets and other FM tuners. (5) Virtual elimination of spurious responses and cross-modulation, which is helped by the complete silver-plated shielding. An extremely important characteristic of the front end is its ability to reduce this interference of spurious response and cross-modulation, which causes station reception at many different places on the dial in addition to the one place it should be. This is, of course, an undesirable characteristic because strong stations can appear at a point on the dial where reception of a weaker station is desired.

b. IF Amplifier or Strip

In your LT-112B, the IF strip consists of three Intermediate Frequency Amplifiers, two Limiters, the Ratio Detector, the AGC Detector (diodes D301 and D302), and the Tuning Meter circuitry. This complete section is usually referred to as an IF Amplifier because the two Limiters also amplify the IF signal as well as the three IF Amplifiers. The IF strip is the printed circuit board assembly Z-PC-IF-1. The IF Amplifier circuitry starts on the front end with T201.

The three IF Amplifiers consist of: the first IF Transformer T201 (located on the front end), the first transistor IF Amplifier Q301 (on the PC board), the second IF Transformer T301 with its amplifier Q302, the third IF Transformer T302 with its amplifier Q303, and associated circuitry.

As previously mentioned, the three IF Amplifiers provide the additional gain and selectivity that the front end is unable to give.

High IF Amplifier gain is necessary to achieve high sensitivity, which is the ability of the tuner to receive weak signals (distant stations). Sensitivity will be discussed in more detail later.

The IF Amplifier (along with the Limiters) must be sufficiently selective as to amplify only the station to which you are tuned and completely reject any other signals that might be passed by the tuner's front end to the IF Amplifier. Most of the selectivity of a tuner is provided by the IF Amplifiers. Selectivity is determined primarily by the shape of the IF Amplifier filter characteristic. The more nearly perpendicular the IF curve sides, the better the tuner can separate adjacent signals. If the sides are at an angle rather than perpendicular, they will not separate nearby stations nearly as well.

The IF Amplifier should pass any desired signal, weak or strong, without distortion, otherwise high audio distortion will result. The amount of distortion present when receiving a very weak signal is determined primarily by the shape of the top of the IF characteristic. The more nearly rectangular the curve over the bandwidth of the station, the lower is the distortion. Some manufacturers provide tremendous amplification to the signal in the IF Amplifiers by means of a narrow-band peaked selectivity curve. While this may result in apparently high sensitivity, it also results in very high audio distortion, particularly during high level passages of music (wide deviation).

The IF bandwidth of the LT-112B is about 250 kHz as compared to some narrow-band tuners that are less than 100 kHz. The excellent IF Amplifier filter characteristics (shape of the response) and wide-bandwidth of Scott tuners results in low distortion and superior stereo (multiplex) performance.

The two Limiters consist of: the Limiter Transformer T303, the first Limiter Q304, the second Limiter Q305, and associated circuitry.

In addition to amplification, the Limiters perform a function that is responsible for a large part of the noise-reducing properties of FM. It is based on the fact that noise — whether nature's static, such as lightning, or man-made disturbances, such as electric motor noise — occurs largely as amplitude modulation. Through a process known as limiting, this amplitude modulation is removed, leaving only the desired frequency modulated signal.

The Detector stage consists of the Transformer T304, the two diodes D303 and D304, and associated circuitry.

After limiting, we are ready to derive the audio signal from its carrier. This is done in the Detector. There are two basic types of FM detectors; the Foster-Seeley Discriminator and the Ratio Detector. The Ratio Detector has the advantage of providing additional limiting, and it is this type of detector which is used in H. H. Scott's FM tuners.

Ideally, the Detector does not distort the audio signal in any way as it is extracted from the carrier. A measure of the ability of the tuner's detector to do this perfectly is the frequency bandwidth of the detector – the wider and more linear this characteristic, the more nearly perfect job it can do. The LT-112B utilizes a 2½ mHz detector, more than twice the bandwidth of many other tuners.

A wide-band Ratio Detector also gives a more favorable "capture ratio." It is characteristic of FM reception that if there are two signals on the same frequency, the weaker signal will be completely rejected as long as it is weaker than the other signal by a specified amount. This "specified amount" is known as the "capture ratio." The ideal tuner would have a capture ratio such that interference, which is only slightly weaker than the desired signal itself, would be completely rejected. The wide-band detector and wide IF's provide the unsurpassed capture ratio of H. H. Scott tuners.

One of the most important overall criteria of the tuner is its sensitivity, which is a measure of its ability to receive weak signals. Sensitivity can be expressed as the amount of signal required at the antenna terminals to give a certain ratio of audio output to background noise, usually 20 dB. This means that the background noise is 20 dB below the audio signal, or a distortion of 10%.

This sensitivity rating does not take into consideration the quality of the audio signal, and is not a really accurate guide to the performance of a high-fidelity tuner. After all, what is the use of hearing a weak signal when it is so badly distorted that it is virtually unlistenable? The Institute of High Fidelity (IHF) has devised a sensitivity rating known as "Usable Sensitivity." This indicates the amount of signal required at the antenna terminals to obtain less than 3% of total hum, noise, and distortion (–30 dB) relative to the audio signal. This is a much more severe criterion. Measurements made by this strict standard assure you that H. H. Scott tuners like the LT-112B are the most sensitive on the market.

c. Meter Circuitry

In the SIGNAL STRENGTH position of the METER function switch, the METER is connected to the AGC voltage (developed in the IF Amplifier), by way of the Multipath Indicator printed circuit board assembly, Z-PC-MI-1. The single transistor circuit in this assembly acts as a dc current amplifier (emitter follower) to drive the tuning METER, thereby avoiding loading down the high impedance AGC bus. This AGC voltage is reasonably proportional to the strength of the incoming signal so that the meter gives an indication of the relative signal strength of different stations. This makes it extremely useful to orient an antenna system in the direction of maximum signal pickup.

The EZ-A-LIGN® method uses the front panel Meter as a test instrument, allowing precise alignment without extensive equipment.

In both the ALIGN and CENTER TUNING positions of the METER function switch, the METER is switched from the IF strip AGC voltage to the secondary of the Detector circuit. The EZ-A-LIGN® procedure uses these two positions.

In the ALIGN position the METER measures the amount of noise that reaches the Detector circuitry. As the LT-112B is aligned, the gain of the IF strip increases, thus giving an increased meter indication, and simultaneously producing the correct IF Amplifier response. This position can also be used as a signal strength position for orienting your antenna on extremely weak signals for long distance pickups.

In the CENTER TUNING position the METER is placed across the secondary of the Detector in a bridge circuit to accurately measure the center of the broadcast channel. This allows extremely accurate tuning to the center of the channel for minimum distortion on all stations plus maximum separation on stereo stations. In this position each scale division is approximately 25 kHz.

With multipath reception, the direct and reflected signals add (vectorially) in both amplitude and phase. (See Section 6.2.) Since the frequency of the station varies with modulation (the basis of FM), the total signal strength of the signal received will vary with the instantaneous frequency change, because the relative phases of the direct and reflected signals have changed. This results in FM distortion as well as amplitude modulation of the original signal. The Multipath Indicator printed circuit board assembly, Z-PC-MI-1, essentially measures the amplitude modulation and produces a direct current in opposition to the signal strength indicating current flowing through the meter. As the modulation of the station changes from soft to loud, this opposing current will vary and the meter indication will fluctuate, thus indicating the presence of multipath. Both the amplitude and signal strength signals are obtained from the AGC bus voltage, with the METER function switch in the MULTIPATH position. In this switch position the single transistor stage of the Multipath Indicator circuit assembly operates as a noise amplifier which is reflexed to provide dc current amplification to drive the METER.

d. Muting

The Interstation Noise Muting circuit consists of the printed circuit board assembly Z-PC-NS-2. It is comprised of two transistors, Q1 (a dc amplifier) and Q2 (an electronic switch). Q2 turns the B+ supply voltage on and off for the two Limiters, Q304 and Q305, which are on the IF Amplifier assembly, Z-PC-IF-1. When the Limiters are off, the noise between FM radio stations will be muted or eliminated. In actuality the interstation noise level drops over 50 dB when muted. The circuit is controlled by the AGC voltage from the IF Amplifier. When the Muting Threshold Adjust potentiometer (R1) is correctly adjusted, and the SELECTOR switch is in either of the two MUTING ON positions, an RF signal of 25 to 35 microvolts or more will increase the AGC voltage enough to turn on Q2 so that it will conduct and thus provide B+ for the Limiters to operate. The circuit will mute both interstation noise and weak stations that would not normally be listened to.

e. Multiplex Stereo

The Multiplex section is comprised of the ZPC-MX-11 multiplex printed circuit board assembly.

Due to the complexity of the multiplex section we will discuss the operation of both the transmitter and tuner.

Multiplexing is a method of broadcasting two or more signals from one FM transmitter. This means that a single FM station can broadcast both the right and left channels of a stereophonic source from records, tapes, or live performances.

Visualize a symphony orchestra spread out before you on the stage. One microphone is positioned on the left side of the stage and another on the right. The left microphone picks up sounds mostly from the instruments on the left side, while the right microphone picks up mostly that from the right side.

These signals from the left and the right microphones are sent separately (usually by wideband program transmission lines) to the FM broadcast transmitter. The multiplex section of the transmitter, known as the multiplex modulator, alternately connects the modulation input of the transmitter to the two program lines. This alternate connection occurs at a rate of 38,000 times per second and each program line is "sampled" 38,000 times. This is well above the uppermost frequency audible to the human ear and therefore the switching transients are completely inaudible. In addition to this, a 19,000 Hz synchronizing or pilot signal is generated by the multiplex modulator.

The composite signal thus generated by switching is transmitted by the FM broadcasting station as frequency modulation.

The same composite signal is obtained at the output of the FM detector of an FM tuner which is tuned to receive this FM broadcasting station. If no further sections (except for audio amplifiers) would exist in the FM tuner, the audible signal would be the average of the sampled left and right microphone signals — mathematically the sum of the left and right signals. This is what the "monophonic" listener would hear.

In order to hear the original left and right signals as separate left and right signals, the FM tuner must go through the exact reverse operation of the multiplex transmitter. Here, the composite signal from the FM detector is alternately connected to the left and right audio amplifiers. This is the job of the multiplex section of the FM tuner.

In order to get exactly the same left and right audio signals, this alternate connection must occur at the exact same frequency (38,000 Hz) and at the exact same time. For this reason, the system of stereo demodulation used in all H. H. Scott tuners is known as a "time division" or "time switching" multiplex system.

To do all this, the multiplex section of the FM tuner must be in exact step with the transmitter — it must be synchronized. The 19,000 Hz pilot or synchronizing signal transmitted by the FM multiplex broadcasting station is used by the multiplex section to determine the exact amount of time when the left audio amplifier is to be connected to the composite signal of the FM detector and the right audio amplifier is to be disconnected — and the exact moment of time when the reverse action occurs.

There are a few factors which modify the actual operation of the multiplex system from the simplified approach shown above. The first is that switching creates some extremely high frequencies (here well above 100,000 Hz and the FCC does not allow FM broadcast stations to broadcast any multiplex stereo signals above 53,000 Hz. Therefore, the broadcaster has to use filters to remove the switching transients above 53,000 Hz. Secondly, the FCC specifies a ratio of monophonic (sum) signal to stereophonic information. All this results in a slightly altered composite signal which requires that the multiplex section of the FM tuner have a set of separation controls which permit the recovery of the original left and right audio signals without any spillover (or feedthrough) between the two channels.

Thirdly, the FCC specifies that the maximum modulation of an FM transmitter can be 100% (or 75 kHz deviation) and that all broadcasted signals must be contained within this 100%. In order to have a compromise between good synchronization and a minimum loss of loudness, maximum stereo modulation is specified as 90% and maximum pilot signal as 10%. The major effect is that stereo stations may not sound quite as "loud" as mono stations.

Important Features of Good Multiplex Tuners:

Even before multiplex, wide-band tuner design gave superior reception. The research on VHF FM receivers performed 25 years ago by Major Armstrong, inventor of FM, clearly demonstrated the inherent advantage of wide-band circuitry. H. H. Scott perfected the first commercially successful FM tuner employing these fundamentals. The Notes on Tuners found in the beginning of this Section explain the inner workings of Scott wide-band design, and some of its tremendous advantages.

Because of the subtleties of wide-band circuitry, most manufacturers continued to produce relatively narrow-band tuners which could give adequate but not the best results with regular monophonic FM. It remained for the FCC to point out the superiority of wide-band design in receiving multiplex: The FCC-approved multiplex system ". . . like any multiplex transmission, will increase energy transmission at the edges of the channel involved. Accordingly, for optimum stereophonic reception, the (tuner's) bandwidth . . . must be considerably greater than that of monophonic (tuners) . . ."* H. H. Scott tuners have always had the wider bandwidth needed, and H. H. Scott's enormous experience with wideband design gives your LT-112B a clear-cut advantage.

The multiplex circuit should be able to separate out the right and left channels without crosstalk between channels. Crosstalk occurs when sound from the right channel creeps into the left channel signal and vice versa. If enough of this occurs, you will hear the sound monophonically. It takes elaborate filtering and careful design to avoid this. Sharp cutoff filters are also required to prevent interference between the background music channel and the stereo channel, and these are located in the Output Amplifiers.

* See paragraph 36, FCC Report and Order, Docket No. 13506, 4/19/61. Emphasis ours.

f. Output Audio Amplifier

The Output Audio Amplifier consists of Q1, Q2, Q101, Q102, the Left and Right Level Controls R7 and R8, and associated circuitry which is on the ZPC-0-1 Output Amplifier printed circuit board.

After the audio signal has been derived from its carrier in the detector, it goes through the multiplex section to be processed from mono to stereo (when it is stereo) and then to the Output Audio Amplifier, which is the final stage of the LT-112B FM tuner.

This final stage is one of filtering, equalization and amplification of the audio signal.

Just as on a record, the transmitted FM signal has its high frequencies emphasized. Tonal balance is restored in the receiver by means of de-emphasized high-frequency response, which still further reduces any noise that may be present, which consists largely of high frequencies. This is a process of equalization.

Further audio amplification is necessary in order to increase the audio voltage coming from the multiplex section to one of sufficient strength to drive the audio amplifier.

Two types of filtering are performed in this stage. One is to eliminate the no longer needed 19 kHz pilot and 38 kHz switching signals to avoid difficulties with power amplifiers and tape recorders as outlined below. The other type of filtering is the subchannel filter, also described below.

You will probably want to use FM multiplex stereo as a source for good home tape recording. Unless the multiplex equipment includes special filtering, the tape recordings may produce a series of beats and whistles along with music. The LT-112B has the necessary safeguards of carefully designed filters to insure perfect recordings. To further facilitate the use of the tuner with portable tape recorders, a front panel stereo tape output (in addition to the ones on the rear) is included.

Noise is a more severe problem with multiplex than with ordinary monophonic reception. The multiplex sub-carrier is more prone to pick up background interference when the signal is weak than is the main carrier. A switchable sub-channel noise filter is very useful in such cases. This kind of sub-channel filter has no effect on the main carrier which supplies the sum of the right and left stereo signals. It merely acts on the sub-carrier where the stereo difference signal is being transmitted. Such a filter has no detrimental effect on the overall frequency response of the stereo program material, unlike conventional noise filters which attenuate the high frequencies of the audible music along with the noise. This filter mostly reduces the high frequency separation above 3000 Hz thus concentrating its effect on the region of noise and not the fundamental frequencies of music..

6.4 Circuit Description

While reading the circuit description you will probably want to refer to the Detailed Block Diagram, Section 6.5, page 59 and the Schematics in Section 8.1, pages 62 through 70, inclusive.

a. Front End Circuit Description

The RF Amplifier consists of Q201 and Q202; two field effect transistors (FET) which have high transconductance. These FET's were chosen for their ability to provide a good noise figure, good over-load characteristics, good circuit stability and to provide for a wide range of Automatic Gain Control. AGC is applied to the gate of Q201 through a 220k resistor (R209), and the AGC filter before the resistor.

The RF Amplifier is of the cascode type which uses a grounded-source FET voltage amplifier, which is neutralized (Q201), followed by a grounded gate (Q202). The cascode RF Amplifier performs with the low noise of a triode and the gain of a pentode, as well as providing excellent isolation between the mixer and antenna. The high isolation reduces oscillator radiation and greatly improves spurious response.

The Local Oscillator consists of Q204, a silicon transistor. The circuit is a Hartley oscillator with shunt feed. With a separate oscillator transistor it is possible to achieve greater frequency stability. The temperature coefficients and values of C221 and C222 have been chosen for optimum temperature-frequency stability. This circuit is extremely frequency-stable with wide temperature variations. Its supply voltage is regulated so that variations in line voltage do not affect the frequency of oscillation.

The Mixer stage, Q203, is a field effect transistor. The oscillator voltage is directly coupled to the Mixer gate. The input and output voltages of the RF Cascode Amplifier drain tank (C210, C211, C212 & L205) are capacitively coupled through C209 from Q202 and through C213 to the Mixer source. R205 provides biasing for the Mixer FET.

The 68 ohm resistor, R206, and the 5 pf capacitor, C216, prevent UHF oscillation within the Mixer stage.

By using FET's in the front end for Q201, Q202 and Q203, Scott has been able to achieve an even lower noise figure than with any of its earlier tube or Nuvistor versions. This is because the FET's operate at room temperatures and not at temperatures which have been elevated with vacuum tube filaments (over 700°C). Also the FET's have a better noise figure than transistors because there is only a single carrier movement (no hole movement, only electrons move). Furthermore, the very low output-to-input capacitance of field effect transistors has resulted in excellent signal isolation, thus achieving better spurious response rejection than was heretofore possible with conventional vacuum tubes or RF transistors.

b. IF Amplifier Circuit Description

The schematic in Section 8.1 on page 64 shows the complete IF Amplifier, Z-PC-IF-1. The input signal for the IF Amplifier comes from the FM front end which also contains the first IF Transformer. Its output is coupled through a .001 pf coupling capacitor directly into the base of the first IF Transistor. Bias for this transistor is applied through a 47,000 ohm resistor, and automatic gain control through a 2,200 ohm resistor. The collector of the transistor is connected directly to a tap of the primary of the first IF Transformer and no neutralization is used. The second IF stage is connected in exactly the same manner as the first IF stage, except that it receives no automatic gain control voltage. The third IF stage has to deliver power. It is connected directly across the major portion of the complete primary and a 33 pf capacitor is used for neutralization. This stage delivers power to drive both the automatic gain control (AGC) diodes (D301 and D302) and the Limiter. The Limiter is a two-stage cascoded limiter having a considerable amount of DC feedback from the junction of the two 330 ohm emitter resistors of the second Limiter back into the base of the first Limiter. Therefore, any variations in gain of those two transistors with signal is compensated for and the two transistors are always operated with their best limiting characteristics. The last Limiter drives a ratio detector of 2½ mHz bandwidth and is connected in a conventional circuit, except that both outputs of the detector are available or either of the two may be grounded.

The overall IF selectivity is 45 decibels or more on alternate channel, fully modulated FM signal when tested according to the IHFM-T-100 standard of measurements for tuners.

All transistors in this circuit, both IF Amplifier and Limiter, are of the same type and can be interchanged without changing their performance. The automatic gain control circuit operates as follows: the output voltage of the third IF Amplifier is rectified by a peak-to-peak detector and provides reverse bias for the first IF Amplifier, thereby reducing its gain. This negative voltage is also available for automatic gain control of the FM front end. The negative voltage applied to the base of the first IF Transistor, of course, also lowers its emitter voltage.

c. Meter Circuitry

As previously mentioned, the tuning METER is switched to the Detector circuit for the ALIGN and CENTER TUNING positions.

In the ALIGN position the METER is across the 25 mfd, C323 capacitor and measures the dc voltage produced in the Detector circuit. Since the Ratio Detector during alignment does not quite fully limit from noise alone, the METER can act as a noise voltmeter when the LT-112B is being aligned.

In the CENTER TUNING position the METER is connected in a bridge circuit. The center tap of the secondary of T304 with the two matched diodes, D303 and D304, and the two 5.2k ohm precision resistors, R602 and R603, form the four legs of the bridge. When the LT-112B is tuned to the center of the broadcast channel, the current through the two diodes is identical, resulting in no current through the METER.

The tuning METER in both the SIGNAL STRENGTH and MULTIPATH positions is connected to the Multipath Indicator printed circuit board assembly, Z-PC-MI-1.

The Multipath Indicator assembly contains a single NPN silicon transistor, Q1. It obtains its dc control signal by way of Resistor R7 (47k) from the AGC Detector Diodes (D301 and D302) located on the IF Amplifier assembly, Z-PC-IF-1. The signal at the AGC bus (junction of D301 and D302) consists of a dc component (relative signal strength) and an ac component (amplitude modulation due to multipath and station modulation).

The emitter current of Q1 develops a voltage across the 330 ohm Resistor (R2), which varies as a function of dc and ac components from the AGC bus. The Meter is connected to this voltage on R2 through R6. The 10,000 ohm Meter Zero Adjust potentiometer (R8) is in a voltage divider circuit between the 12 volt supply and ground and it provides a dc offset voltage so that with the tuning METER connected to the arm of the potentiometer and the emitter of Q1 (top of R2), it will indicate "0" on the top scale of the METER when tuned off-station. The presence of signal produces a negative voltage at the junction of the AGC diodes, D301 and D302, resulting in a less negative voltage at the emitter of Q1, producing a signal strength indication.

With the METER function switch in the MULTIPATH position, the 0.22 mfd capacitor (C1) is connected into the circuit across R7, thus enabling the ac components to be fed to the base of Q1 (through C1). The amplified ac components on the 1,500 ohm collector resistor (R1) are fed through the 0.22 mfd coupling capacitor (C2) to the peak-to-peak diodes (D1 and D2) which produces a positive voltage which, in turn, is fed through the 10,000 ohm resistor (R3) back to the base of Q1. With amplitude modulation due to multipath signals, this positive voltage will fluctuate, thereby causing a similarly fluctuating positive voltage on the emitter, thus in turn causing the meter to fluctuate downward.

d. Muting

The Interstation Noise Muting printed circuit board, Z-PC-NS-2, uses two silicon transistors as a Schmidt trigger circuit which is controlled by the varying dc level of the AGC bus. The AGC voltage is fed through an 82k resistor (R3) to the base of Q1, a dc amplifier. Q2 acts as a switch which varies the B+ supply voltage to the IF Amplifier Limiters (Q304 and Q305 on Z-PC-IF-1 assembly), thereby turning them on and off. The B+ supply for the Limiters is obtained from the emitter of Q2. AGC voltage increases negatively to a maximum in the center of the station's channel. As the AGC voltage increases, the bias of Q1 will amplify the dc voltage and conduct less, which in turn will cause Q2 to conduct more, its collector thus going more negative. With the SELECTOR switch in either of the two MUTING ON positions, the collector of Q2 is connected to R1, the 3 megohm Muting Threshold Adjust potentiometer (terminal 3 connected to terminal 5). With the switch in this position the voltage from the collector of Q2 will be fed back to the base of Q2, causing its bias to go even more negative than it was with the AGC voltage alone. This in turn will be amplified and Q2 will go into full conduction (switched on) to supply the B+ voltage to the IF Amplifier Limiters so that they will operate, and the station will not be muted. R1, the Muting Threshold Adjust potentiometer, adjusts the dc feedback to enable the Schmidt trigger circuit to switch at the desired AGC level. With the SELECTOR switch in either of the MUTING OFF positions the feedback loop of Q2 to Q1, which also provides the forward bias of Q1, will be disconnected so that Q2 will remain in full conduction and the IF Amplifier Limiters will operate.

e. Multiplex Circuit Description

For the description which follows you may find it helpful to refer to the Detailed Block Diagram, Section 6.5, page 59 and Figures 25 and 26, the Multiplex Schematics on page 58.

Ever since the Federal Communications Commission authorized the broadcasting of stereophonic sound from FM stations, a considerable number of circuits have been developed to demodulate the composite stereophonic into left and right audio signals. The circuit that has proven to be most satisfactory has been a switching circuit where the multiplex demodulator alternately switches the composite signal from the FM detector to the left and right audio outputs. Usually, this involves the use of an amplifier between the FM detector and the demodulator so that sufficient signal will be available for demodulation. This circuit also involves the use of two audio amplifiers where the differential gain between the two audio amplifiers was adjusted to obtain the best separation.

These multiplex circuits, which predate the LT-112B, had to be switched from monophonic to stereophonic operation by connecting the two audio amplifiers to either the stereo demodulator diodes, or to a separate network connected directly to the detector of the composite signal amplifier. This required at least the equivalent of a double-pole, double-throw switch.

In order to have such circuits switch automatically from monophonic to stereophonic operation, double-pole, double-throw relays, or at least four diodes were used for this purpose, adding further to the complexity of the circuit.

Investigations and further development over the years produced the LT-112B and showed that the multiplex demodulator diodes themselves could also perform the function of switching from monophonic to stereophonic operation.

Figure 25, page 58 shows such a circuit, which is a portion of the LT-112 multiplex section. Here, the FM detector is of the conventional wideband variety, except that the detector circuit itself is floating and not grounded, so that two terminals are available. Across the output of the detector is a trap circuit tuned to 67 kHz to remove any background music signal usually centered at this frequency. This signal would cause undesirable audible whistles when listening to FM stereo if the station did broadcast such a service. The FM detector circuit is grounded with two groups of resistors, first an 18,000 ohm (R533), and the two 10,000 ohm separation potentiometers. This way a "high" and a "low" output of opposite phase is obtained. The "high" output is also connected to the center tap of the secondary of the 38 kHz oscillator transformer (T502). Here, the oscillator voltage is, in effect, connected in series with the composite signal and applied in opposite phase to two sets of detector diodes. At the moment the upper portion of the detector secondary has a positive voltage, diodes D509 and D510 will conduct to permit the composite signal from the "high" output of the detector to pass through the secondary of the 38 kHz oscillator transformer to the two 10,000 ohm resistors to the left output terminals. Whenever the polarity of the 38 kHz signal is reversed, the opposite pair of diodes, D507 and D508 will conduct and will permit the signal to pass to the right output.

Since the efficiency of switching for stereo demodulation is not 100%, the composite signal is also fed to the left and right outputs, but in opposite phase from the "low" detector output. Here, the two 10,000 ohm separation potentiometers feed the opposite phase signal through two 10,000 ohm resistors to the left and right outputs, respectively. Also, the stereo separation at the left and at the right output can be adjusted separately. These outputs are, of course, connected to de-emphasis circuits and to further audio amplifiers which also have very sharp cutoff 15 kHz filters to prevent any ultrasonic component from being recorded as a whistle when using a tape recorder.

Whenever the FM station does not broadcast stereo, it is desirable to switch the multiplex circuit to monophonic operation as shown in Figure 25. In stereophonic operation, the switch is, in effect, grounded and bias is applied to the 38 kHz oscillator to permit it to function. The 38 kHz oscillator is synchronized by the 19 kHz pilot signal from the FM station. In order to switch the multiplex circuit to mono, the switch is connected to a positive voltage of approximately 12 volts. The voltage first biases the 38 kHz oscillator in reverse, and thereby prevents a 38 kHz output. Secondly, this positive voltage applied to the 33 k resistor, will also apply a positive voltage to the center tap of the secondary of the oscillator transformer and allows both direct and signal current to flow through diodes D501 and D504 and resistors R504 and R509. The DC control current flows to ground partly through the separation controls and partly through 10,000 ohm resistors, R506 and R507. Diodes D502 and D503 will be reversed biased.

Since in stereophonic operation the diodes conduct at only alternate half cycles, signal current from the FM detector will appear at the left and right outputs only half the time, but flowing through two 10,000 ohm resistors in parallel. In mono operation, it will flow at all times through only one 10,000 ohm resistor. Audio output level remains constant in mono and stereo.

In order to have automatic switching from mono to stereo, a control circuit is required, a schematic of which is shown in Figure 26, page 58 which is also a portion of the LT-112B multiplex section. Here, two transistors Q504 and Q505 are arranged in a switching circuit. In normal monophonic operation, the first switching transistor conducts to some degree, and the second transistor is fully turned on with a voltage drop from collector to emitter of almost zero.

When a multplex signal is received, the 19 kHz pilot signal from the FM detector is amplified in a separate two-stage amplifier (not shown in Figure 26) and the output of this 19 kHz amplifier is rectified partly to obtain a negative control voltage with respect to the 25 volt supply. This relatively negative voltage is then fed through the two 10,000 ohm resistors, R519 and R518, to the base of the first switching transistor, causing it to conduct more current. The voltage drop across its 10,000 ohm collector resistor R509 increases and reduces the base current of the second transistor, thereby reducing its collector current. In order to have this second transistor switch off, positive dc feedback is applied from its emitter through the 2,200 ohm resistor R516 to the emitter of the first transistor, thereby causing the first transistor to conduct more, and turning the second transistor off. Therefore, the voltage drop on the collector of the second transistor has now decreased from 12 volts to almost zero volts.

The decrease in collector current of the second transistor Q505 changes the voltage drop across the 1,000 ohm series collector resistor R525 which is used to turn on further transistors (Q506 and Q502 not shown in this diagram), causing a stereo indicator light to operate.

This group of circuits could be used, without any further modification, to switch automatically from monophonic to stereophonic operation according to whether stations are being received with mono or stereo modulation. However, off-station there is enough noise output from the FM detector to give the 19 kHz pilot circuit the same amount of signal as the pilot signal normally broadcast from the FM station. Under these conditions, the stereo indicator would light off-station and the multiplex circuit would be switched to stereo. This is a common failing of most automatic multiplex circuits.

Further refinements were made to prevent the circuit from switching to stereo unless the minimum signal-to-noise ratio exists.

For this fully automatic switching, the detector output is connected to a high-pass filter which passes noise above 75 kHz since an FM detector can produce signals of 150 kHz and higher when the tuner is tuned off station. The amount of high frequency noise reaching the noise amplifier can be adjusted by shunting the output of this filter with the 50,000 ohm threshold control. The output of the noise amplifier is rectified in a peak-to-peak detector D502 and D503, which produces a reverse bias to the first 19 kHz amplifier. Thus, the 19 kHz amplifier cannot operate unless the noise at the output of the FM detector has decreased to such a value which will not cause further reverse bias of this 19 kHz amplifier.

The sensitivity of this switching circuit is adjusted so that it does not switch the multiplex demodulator circuit over to stereo unless the amount of the amplified pilot signal is well in excess of that required for good synchronization of the 38 kHz oscillator. This, in effect, removes noise modulation of this oscillator and will permit listening to stereo with an improved signal-to-noise ratio.

The switching circuit is also designed to require a higher signal-to-noise ratio for switching to stereo than for switching back to mono, preventing the multiplex section from continually switching as a marginal stereo signal fades in and out.

Figure 30 in Section 8.1, page 67 shows the complete automatic multiplex circuit. The circuits in Figures 25 and 26 are portions of this circuit. It may also be of interest that there is only a single-pole, single-throw switch required to make this circuit perform as either an automatic mono-stereo circuit or to operate in mono only. Here, operating bias for the 19 kHz amplifier is removed completely.

f. Output Audio Amplifier Circuit Description

Since there are now two audio channels (Left and Right) coming from the Multiplex section, the amplifiers, filters and equalizers are duplicated on the Output Audio Amplifier printed circuit board.

Each of the amplifiers, which consist of Q1 and Q2 or Q101 and Q102, are feedback pairs. The FM 75 microsecond de-emphasis network is part of the feedback circuit.

For 100% modulation (± 75 kHz), the audio output voltage coming from the Ratio Detector, and measured between the two outputs, is about 150 millivolts. This signal is reduced to about 40 millivolts when going through the Multiplex section. The Audio Amplifiers increase this signal to about 1.2 volts, one which is of sufficient strength to drive most audio preamps or power amplifiers.

The output impedance of the complete Audio Amplifier board is quite low, 5000 ohms, thus allowing use of long cables. This impedance will go up when the LEVEL controls, R7 and R107, are turned down. In some power amplifiers with shorting type inputs, slight cross-talk between the tuner and phono inputs may be noticed when the LEVEL controls are fully clockwise, as viewed from the rear of the LT-112B. Under these circumstances it may be advantageous to turn down the LEVEL controls in order to increase the output impedance of the LT-112B and thus decrease the audio current going through the shorted input in the power amplifier.

On the output of each of the Audio Amplifiers in the LT-112B, is an M-derived filter. It has notches at 19 kHz and 38 kHz, acting as a low-pass filter.

If you have stayed with us throughout – congratulations – and we hope that we have added to your understanding and enjoyment of your Scott LT-112B tuner.

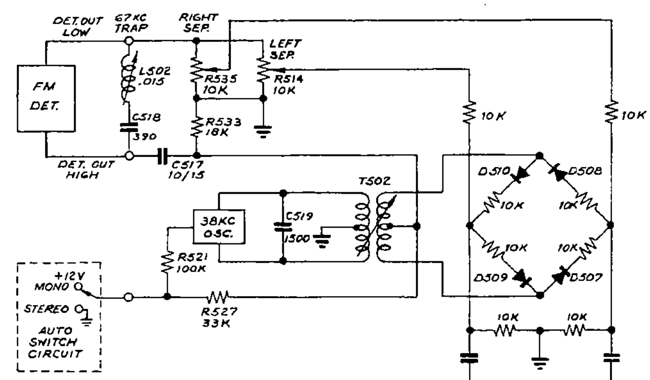
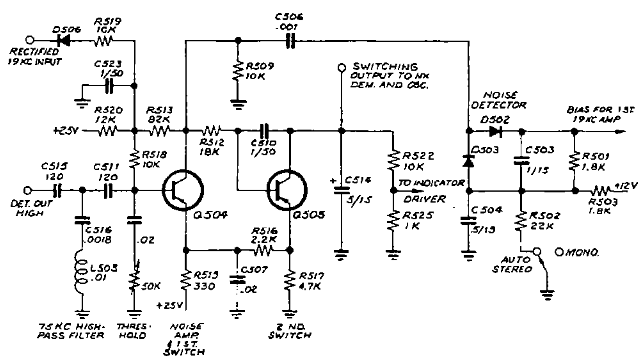
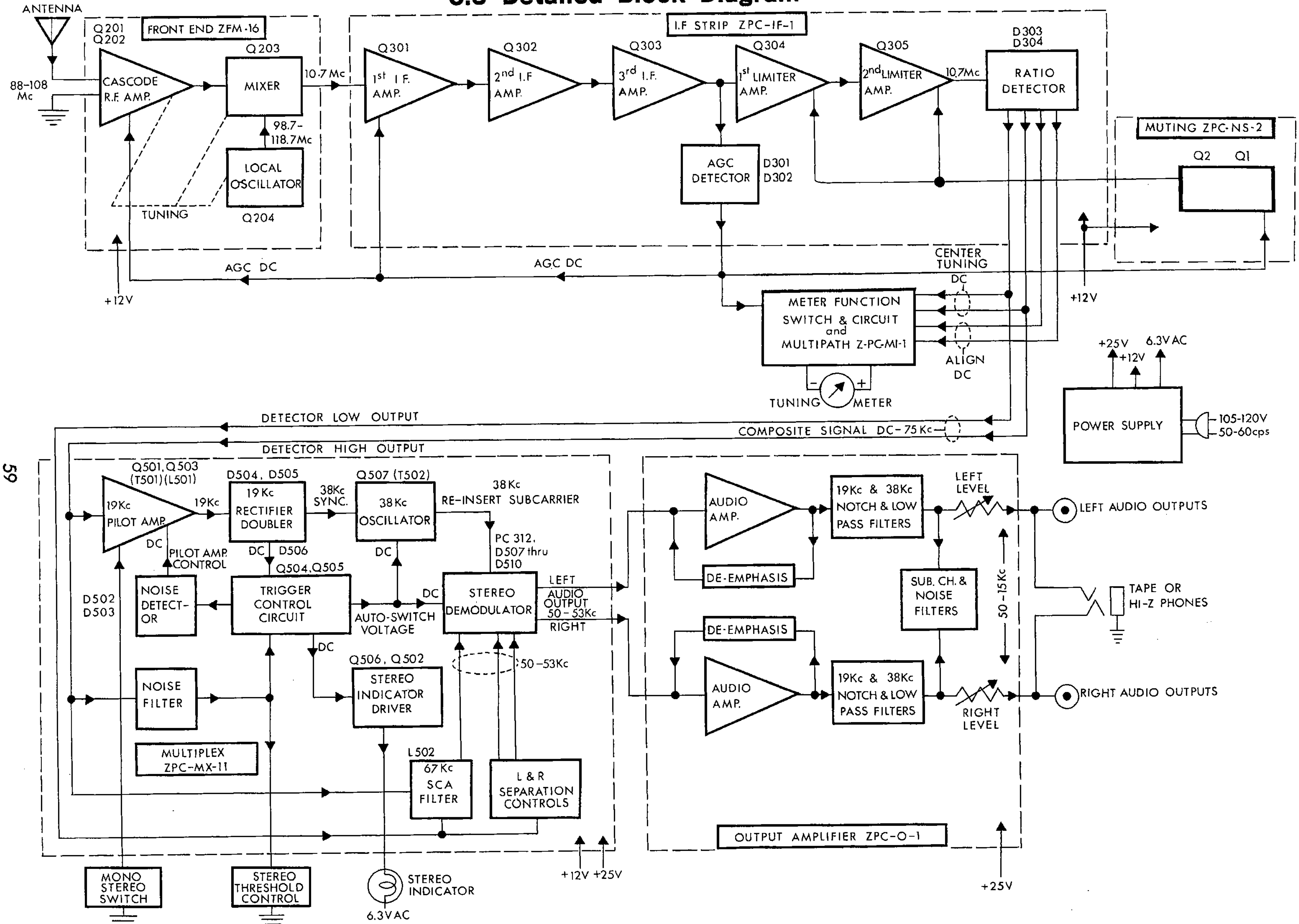


FIG. 25
MPX DEMODULATOR CIRCUIT



CONTROL CIRCUIT
FIG. 26

6.5 Detailed Block Diagram



Section 7 — Operational Trouble-Shooting Without Instruments

Note: Red areas on construction groups indicate presence of high voltage. When trouble-shooting with the LT-112B plugged in, use extreme caution in these areas. For Sections 7.1 through 7.6 inclusive, the tuner should be turned off and unplugged. Occasional reference to the printed circuit board layouts in Section 8 may be helpful.

The following trouble-shooting guides are broken down under specific difficulties. Read down the list of possible difficulties until your problem is found and then check the indicated wires or connections under each heading.

Make sure that all transistors and FET's are in their sockets and all controls are correctly set. The pins of the transistors and FET's must be correctly oriented when plugging them back into their sockets (see page 72).

7.1 No Output — Both Channels

Check level controls, SELECTOR switch and Muting Threshold Adjust.

Red wire shorted to chassis or not connected from PC3-2 to T2-2.

Red/white wire shorted to chassis or not connected from PC1-3 to T3-2.

Red wire from PC2-7 to T2-2, shorted or not connected.

Red/white wire from PC2-5 to T1-3 and from T1-3 to T3-2 shorted or not connected.

Red wire from PC1-8 to PC5-4 shorted or not connected.

Black/white wire from PC1-9 to PC5-1 shorted or not connected.

Check the wires and their points of connection between S1 and PC3 and J2, for shorts.

Make sure transistors Q304, Q305 on PC1 (Z-PC-IF-1) and Q2 on PC5 (Z-PC-NS-2) are in their sockets.

7.2 No Signal — Noise Only

Red/white wire from T1-3 to the front end not connected.

Make sure all transistors and FET's on the front end are in their sockets.

7.3 Low Signal (Very Weak Output)

Make sure all transistors are in sockets in PC1.

Check both level controls — make sure that they are moved off the extreme counter-clockwise position as viewed from the rear of chassis.

Blue/white wire from T6-4 to S3-12 shorted to chassis.

LRFC-80 from T6-4 to PC1-15 shorted to chassis.

5.2k precision resistor from T6-5 to PC1-14 shorted to chassis.

Orange wires: from T6-3 to S3-9, from S3-9 to PC2-13, from T6-3 to PC2-6 not connected or shorted to chassis.

Yellow wires: from PC1-11 to T6-1, from T6-1 to PC2-4 not connected.

The subassembly of the 5.6k resistor and the L-RFC-.01 choke not connected or shorted.

7.4 No Output — One Channel

Check level controls and make sure transistors on PC-3 are all in the socket.

Green or black/white wires from J1 to J2 shorted to chassis, or to the black wire.

Bus wires from PC3 to J2 not connected or shorted to chassis.

Green/white wire from PC2-18 to PC3-3 shorted to chassis or not connected.

Green wire from PC2-15 to PC3-1 shorted to chassis or not connected.

Check the wires and their points of connection between S1 and PC3 and J2 for shorts.

7.5 Stereo Light On at All Times

Check setting of stereo threshold adjust.

White wire from P1-1 to PC2-12 shorted to chassis.

Blue wire from V1-1 to PC2-10 shorted to chassis (bulb is very bright).

Make sure transistors in PC2 are plugged in.

7.6 Stereo Light Off at All Times

Check setting of stereo threshold adjust.

Check that transistors in PC2 are plugged in.

Make sure stereo bulb has not burned out (filament open) due to a miswire to V1.

7.7 No Output

With the tuner on and connected to an amplifier, touch the following points with the metal end of a screwdriver. Hold the screwdriver by the handle and touch the metal shaft with your forefinger as you touch each point. Keep your other hand away from the metal chassis, preferably in your pocket. As you touch each point, a hum or click should be heard in the speakers if the stages after the point touched are operating. Example: Hum occurring when PC1-12 is touched, indicates that PC2 and PC3 are passing the signal and that there are no open joints or shorted connections. The first two points will check out the right or left channel. The last four points check out the operation of both channels.

When a point is reached where there is no hum or click, check for mis-wires, cold or unsoldered joints, etc., around the immediate area.

Left	Right
PC3-1	PC3-3
PC2-15	PC2-18
PC2-4	PC2-4
PC2-6	PC2-6
PC1-11	PC1-11
PC1-12	PC1-12

7.8 Stereo Separation Adjustments

The multiplex section of your LT-112B has been pre-aligned at the factory. Satisfactory operation should be obtained with the present setting of the left and right separation controls. It may be possible to slightly increase stereo separation by following the procedure below. This adjustment can only be made when receiving a stereo station that broadcasts one channel at a time for at least one minute. In order to adjust both separation controls, the stereo station must broadcast on one channel and then on the other. In some areas a few of the stations operate in this manner for stereo checks or during speech announcements.

(1) If you are able to receive a stereo station as described above, then you may proceed as follows: Connect the LT-112B Tuner to an antenna and a stereo amplifier as outlined in Section 5, "Installation and Operating Instructions." Put the equipment into operation with the Tuner controls set as follows: FUNCTION switch at NORMAL, SELECTOR switch at AUTOMATIC STEREO and METER switch at CENTER TUNING. Carefully tune in a stereo station that is broadcasting on one channel only.

(2) Locate the Z-PC-MX-11 multiplex PC Board Component Layout, on page 66, for reference. During these adjustments you will only move the left and right separation controls. DO NOT ADJUST L501, L502, T501 and T502.

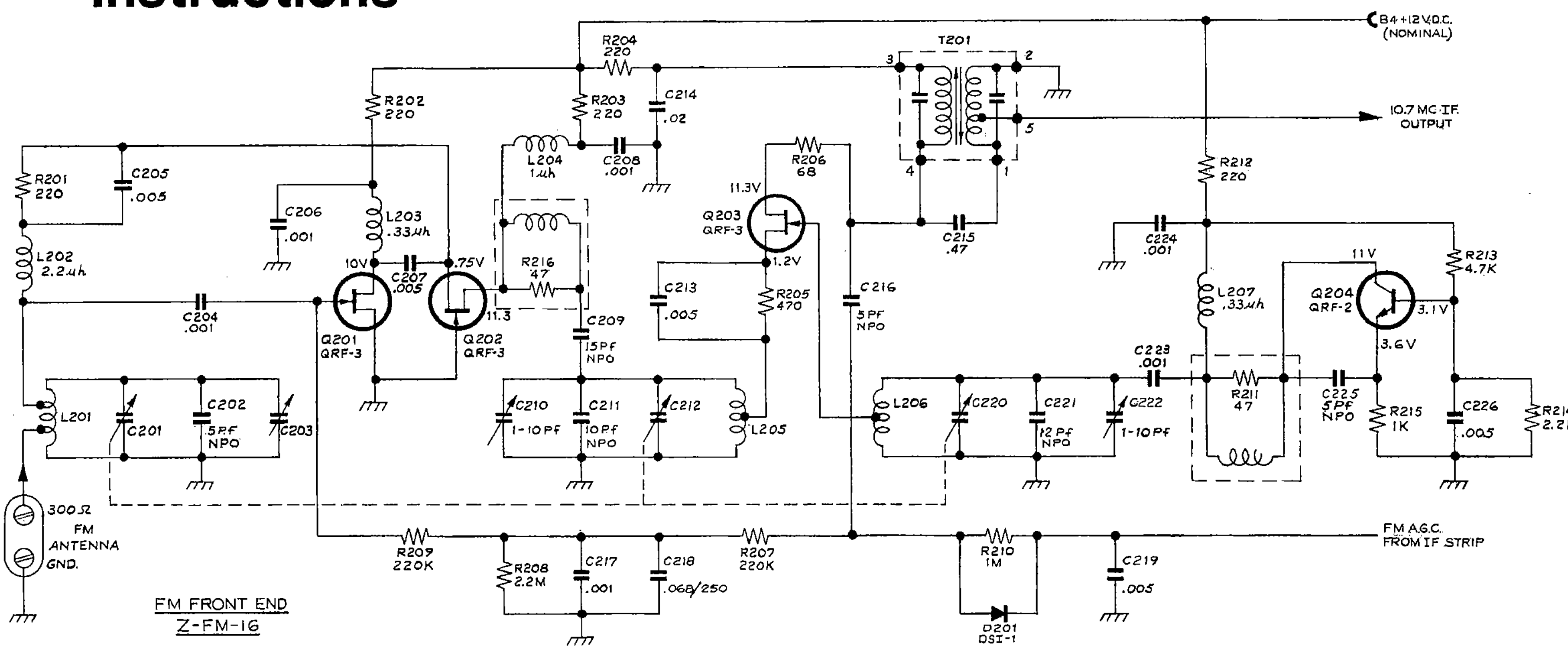
(3) Locate the two separation controls on the multiplex PC board labeled L. and R. SEP. Without moving the controls, mark each of them with crayon (or ink) to indicate their exact present position. These marks or lines will serve as a reference and allow the controls to be returned to their present position in case you are unable to complete the separation adjustments. (Most one-channel announcements are very short in duration.)

(4) If the station is broadcasting on the right channel only or their announcer is speaking on the right channel only, then you should hear this loudly on the right speaker and very faintly on the left speaker. (If the station is broadcasting on the left channel only, this would be reversed.) On the amplifier turn off the right channel that has sound, so that you are only listening to the left or faint channel. (If the station is broadcasting on the left channel only, this would be reversed.) If you have a Scott amplifier, this can be done either by turning the SELECTOR switch to L INPUT or rotating the (Stereo) BALANCE control to its maximum counter-clockwise position. It will probably be necessary to turn up the volume on the remaining (quiet) channel so you can easily hear the program material.

(5) With the station broadcasting on the right channel, adjust the L. SEP. control while listening to the left channel for minimum sound. This is maximum separation. (If the announcer is speaking on the left channel, then adjust the R. SEP. control for minimum sound in the right channel.) For this adjustment you should have to move the SEP. controls very little. If you are unable to detect any difference in the loudness of the program, then return the control to its original position.

(6) Repeat steps 4 and 5 above when the station broadcasts on the left channel only (or right as the case may be).

Section 8
Technical Service Instructions

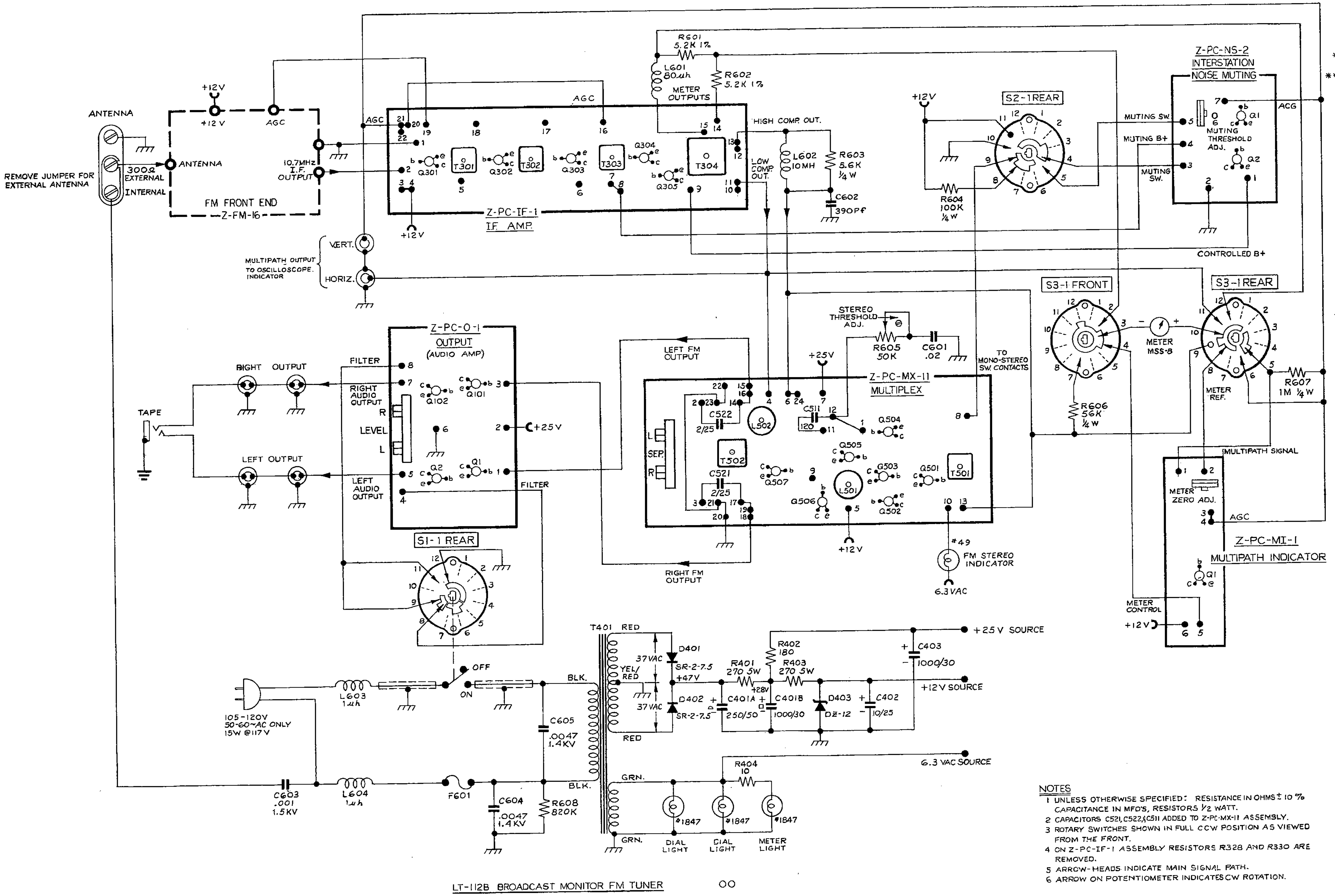


HIGHEST SERIES NO.
R216
C226
L207
D201
T201
Q204

NOTES

1. UNLESS OTHERWISE SPECIFIED: RESISTANCE IN OHMS ±10% CAPACITANCE IN MFD'S, RESISTORS 1/4 WATT.
2. INDICATED SUPPLY VOLTAGES MAY VARY ABOVE OR BELOW NOMINAL VOLTAGE SHOWN FROM MODEL TO MODEL.
3. D C VOLTAGES ±15% MEASURED WITH 20 Ω/V VOM.
4. ARROW-HEADS INDICATE MAIN SIGNAL PATH.

FIG. 27 FM Front End



VOLTAGES

UNLESS OTHERWISE SPECIFIED:
ALL VOLTAGES POSITIVE DC±15% MEASURED WITH 20KΩ/V VOM AND 117 VAC LINE. 300 OHM LOAD ON EXTERNAL ANTENNA TERMINALS, TUNER OFF STATION AND FUNCTION SWITCH IN "NORMAL" POSITION, SELECTOR SWITCH IN "MONO-MUTING OFF", METER SWITCH IN "SIGNAL STRENGTH" POSITION.

* VOLTAGES MEASURED UNDER SAME CONDITIONS AS ABOVE, ONLY SELECTOR SWITCH IN "MONO-MUTING ON" POSITION.

** VOLTAGES MEASURED UNDER SAME CONDITIONS AS ABOVE ONLY SELECTOR SWITCH IN "AUTO STEREO-MUTING OFF" WITH STEREO SIGNAL FED INTO TUNER.

	e	b	c
Z-PC-IF-1			
Q301	1.75V	2V	11V
Q302	1.75V	2V	11V
Q303	1.5V	2V	10V
Q304	.1V	.9V	2.5V
*Q304	0V	0V	0V
Q305	1.8V	2.5V	7.4V
*Q305	0V	0V	0V
Z-PC-O-1			
Q1	4.4V	4.2V	1.2V
Q2	1V	1.2V	9.2V
Q101	4.4V	4.2V	1.2V
Q102	1V	1.2V	9.2V
Z-PC-MX-11			
Q501	11V	10V	1.5 TO 7V
Q502	0V	.7V	1.1V
Q503	.7V	13V	23V
Q504	23V	22V	21V
Q505	15.5V	22V	.65V
Q506	0V	.1V	.7V
Q507	7.6V	8.3V	0V
**Q501	11V	11V	0V
**Q502	0V	0V	2.7V
**Q503	.8V	1.4V	23.5V
**Q504	23V	23V	10V
**Q505	12V	12V	12V
**Q506	0V	.5V	0V
**Q507	9V	9V	0V
Z-PC-NS-2			
Q1	0V	.47V	9.4V
*Q1	0V	.66V	.19V
Q2	8.7V	9.4V	9.4V
*Q2	0V	.19V	11.8V
Z-PC-MI-1			
Q1	1.4V	2V	5.4V

AGC VOLTAGE

−1.5V TO −1.8V WITH 1000μV SIGNAL FED TO EXTERNAL ANTENNA TERMINALS WITH THE UNIT OPERATING.

S1 FUNCTION SWITCH (SRW-44-11)

POSITION	FUNCTION
1	OFF
2	NORMAL
3	SUB CH. FILTER
4	NOISE FILTER

S2 SELECTOR SWITCH (SRW-24-8)

POSITION	FUNCTION
1	MONO-MUTING OFF
2	MONO-MUTING ON
3	AUTO STEREO-MUTING ON
4	AUTO STEREO-MUTING OFF

S3 METER SWITCH (SRW-34-5)

POSITION	FUNCTION
1	SIGNAL STRENGTH
2	MULTIPATH
3	CENTER TUNING
4	ALIGN

F601 FUSE

0.5 AMP SLO-BLO

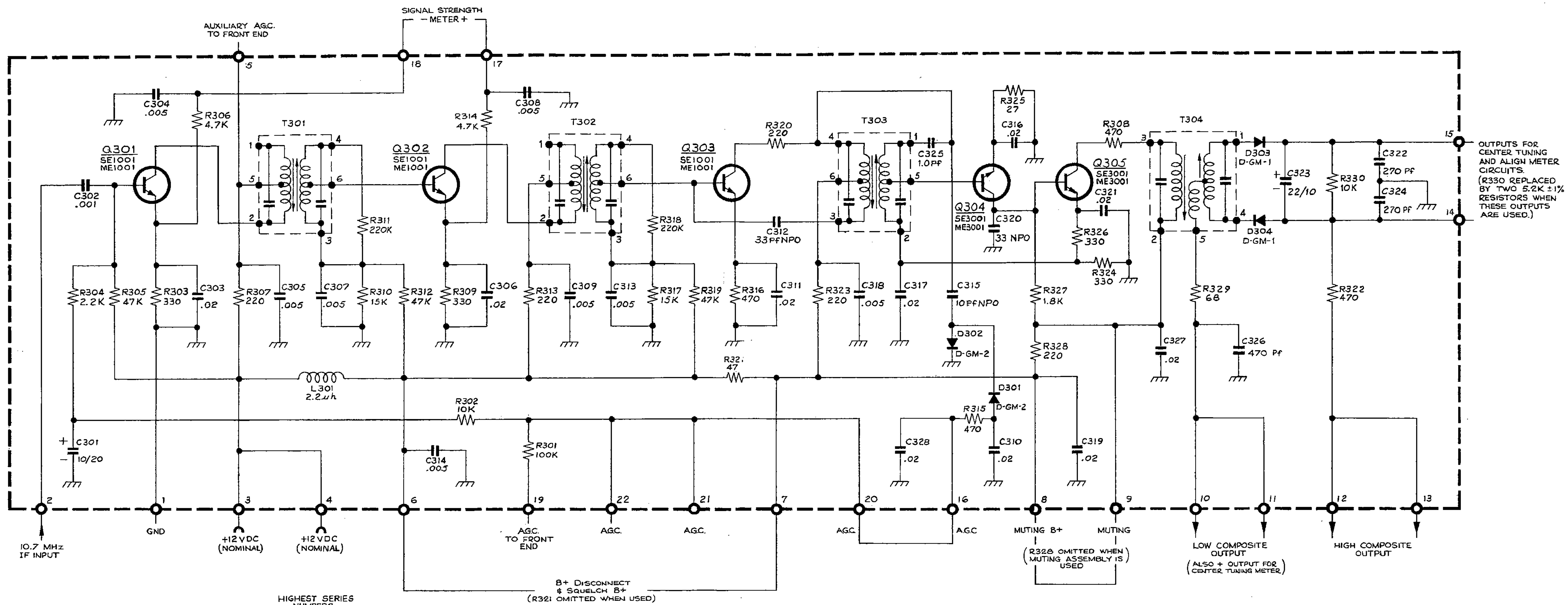
HIGHEST SERIES NUMBERS

R404	R608
C404	C605
D403	L603
T401	F601

NOTES

1. UNLESS OTHERWISE SPECIFIED: RESISTANCE IN OHMS ± 10% CAPACITANCE IN MFD'S, RESISTORS ½ WATT.
2. CAPACITORS C521, C522 & C511 ADDED TO Z-PC-MX-11 ASSEMBLY.
3. ROTARY SWITCHES SHOWN IN FULL CCW POSITION AS VIEWED FROM THE FRONT.
4. ON Z-PC-IF-1 ASSEMBLY RESISTORS R328 AND R330 ARE REMOVED.
5. ARROW-HEADS INDICATE MAIN SIGNAL PATH.
6. ARROW ON POTENTIOMETER INDICATES CW ROTATION.

FIG. 28 LT-112B Tuner



FM IF AMPLIFIER

HIGHEST SERIES NUMBERS
R330
C328
D304
L301
T304
Q305

NOTES

1. UNLESS OTHERWISE SPECIFIED: RESISTANCE IN OHMS ±10% RESISTORS ½ WATT, CAPACITANCE IN MFD'S.
2. D.C. VOLTAGES ±15% MEASURED WITH 20 KΩ/V VOM.
3. INDICATED SUPPLY VOLTAGES MAY VARY ABOVE OR BELOW NOMINAL VOLTAGE SHOWN FROM MODEL TO MODEL.
4. ARROW-HEADS INDICATE MAIN SIGNAL PATH.

Z-PC-IF-I   02

FIG. 29 FM IF Amplifier

8.2 PC Board Component Layout with Resistance Measurements

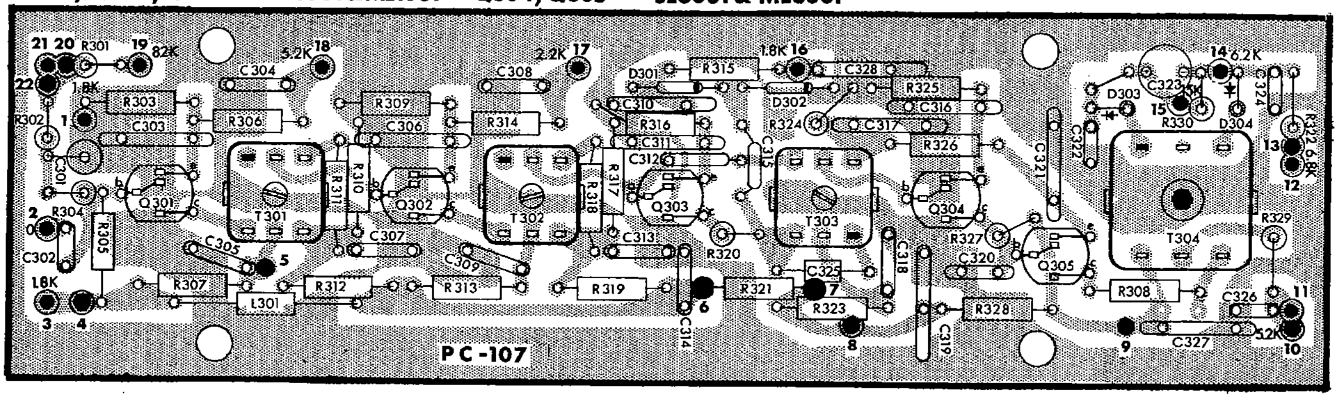
Resistance Measurements

Note

1) All measurements made with PC boards wired into completed tuner, with line cord disconnected (power mains disconnected).
2) All resistance measurements made with a Triplett Model 630 VOM.
3) Negative side of VOM battery to ground.
4) All controls set as below.

METER function switch – "Center Tuning"
FUNCTION rotary switch – "Off"
SELECTOR rotary switch – "Automatic Stereo," "Muting-Off"
Stereo Separation controls – set for maximum separation
LEVEL controls – both maximum clockwise

Q301, Q302, Q303 – SE1001 & ME1001 Q304, Q305 – SE3001 & ME3001



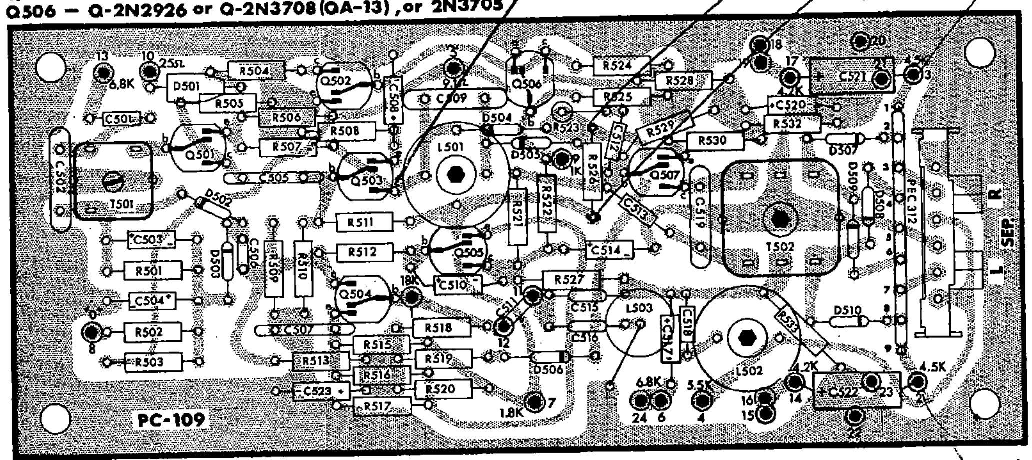
I.F. AMPLIFIER Z-PC-IF-1 **00**

Z-PC-IF-1 Parts List

PC BOARD	PC-107
C301	CTT-10/20
C302	CC-.001
C303, C306, C310, C311, C316, C317, C319, C321, C327, C328	CC-.02
C304, C305, C307, C308, C309, C313, C314	CC-.005
C318	
C312, C320	CC-33NPO
C315	CC-10NPO
C322, C324	CC-270-10%
C323	CTT-22/10
C325	CC-1.0
C326	CC-470-10%
D301, D302	D-GM-2
D303, D304	D-GM-1
L301	LRFC-2.2 μh
Q301, Q302, Q303,	Fairchild SE-1001 or Micro-Electronics ME-1001
Q304, Q305	Fairchild SE-3001 or Micro Electronics ME-3001

R301	RC21-100K
R302, R330	RC21-10K
R303, R309, R324, R326	RC21-330
R305, R312, R319	RC21-47K
R304	RC21-2.2K
R306, R314	RC21-4.7K
R307, R313, R320, R323, R328	RC21-220
R308, R315, R316, R322	RC21-470
R310, R317	RC21-15K
R311, R318	RC21-220K
R321	RC21-47
R325	RC21-27
R327	RC21-1.8K
R329	RC21-68
T301, T302, T303	TRV-10.7-PC
T304	TRV-10.7D-PC

Q501, Q504, Q505, Q507 — S1990, 2N3964, 2N3702
Q502 — Q-2N3705
Q503 — SE 1001
Q506 — Q-2N2926 or Q-2N3708 (QA-13), or 2N3705



MULTIPLEX Z-PC-MX-11

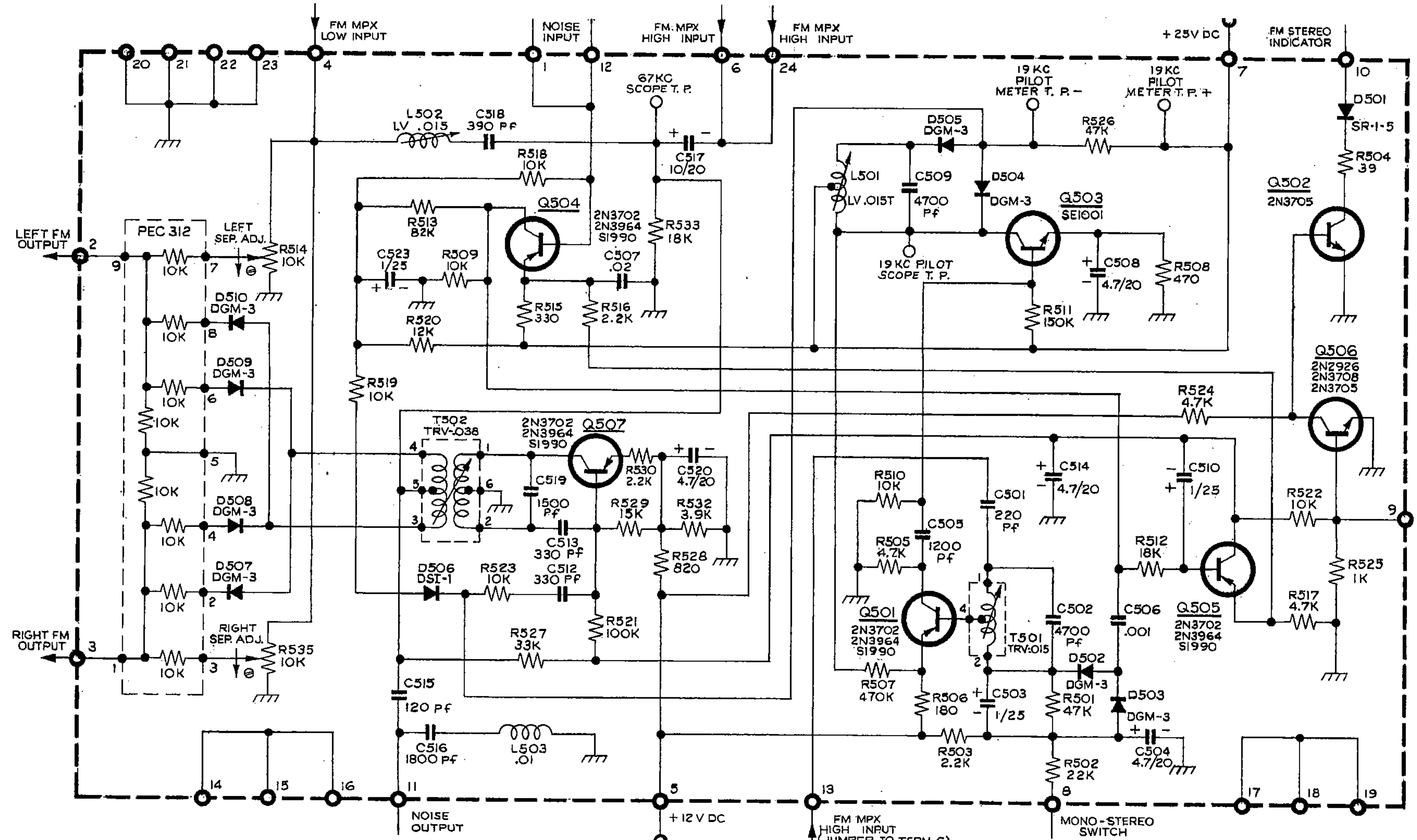
1) Sep pots C/W
2) T501 L501 MAX
3) Mod 1KC L
Remove Q501 505
Pec 312-1 to H
Pec 312-9 to V
Zero BT T502

Z-PC-MX-11 Parts List

PC BOARD	PC-109
C501	CPT-220
C502, C509	CM20-4700
C503, C510, C523	CTT-1/25
C504, C508, C514, C520	CTT-4.7/20
C505	CC-.0012-10%
C506	CC-.001
C507	CC-.02
C511,* C515	CC-120-10%
C512, C513	CPT-330
C516	CC-1800-10%
C517	CTT-10/20
C518	CPT-390
C519	CM20-1500
C521,* C522*	CETM-2/25
D501	SR-1-5
D502, D503, D504, D505, D507, D508, D509, D510	D-GM-3
D506	DSI-1
L501	LV-.015T-PC
L502	LV-.015-PC
L503	LRFC-.01
PEC312	PEC-312
Q501, Q504, Q505	2N3702 2N3964 S1990
Q502	2N3705 (See note on R504)
Q503	Fairchild SE-1001
Q506	2N2926 2N3708 2N3705
R501, R526	RC21-47K
R502	RC21-22K
R503	RC21-2.2K
R504	RC21-39 (This value may have to be padded, see page 72.)
R505, R517, R524	RC21-4.7K
R506	RC21-180
R507	RC21-470K
R508	RC21-470
R509, R510, R518, R519, R522, R523	RC21-10K
R511	RC21-150K
R512, R533	RC21-18K
R513	RC21-82K
R514-R535	RCV-2x10K-PC
R515	RC21-330
R516, R530	RC21-2.2K
R520	RC21-12K
R521	RC21-100K
R525	RC21-1K
R527	RC21-33K
R528	RC21-820
R529	RC21-15K
R532	RC21-3.9K
T501	TRV-.015T-PC
T502	TRV-.038TT-PC

Repl XTRS

* Parts not on assembly (added by kit builder).



AUTOMATIC MULTIPLEX DEMODULATOR

NOTES:

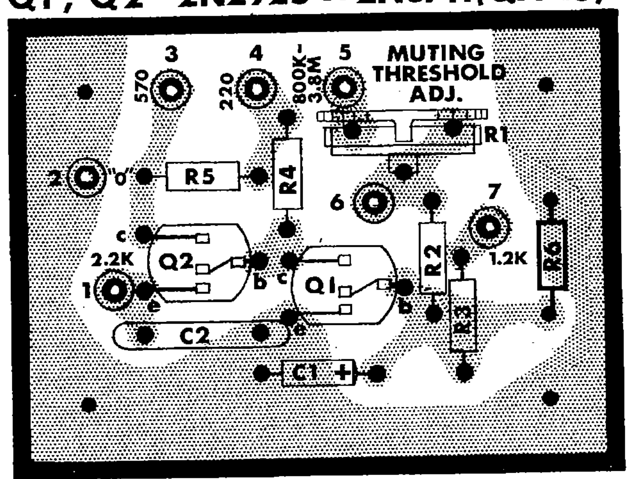
1. UNLESS OTHERWISE SPECIFIED: RESISTANCE IN OHMS ±10% CAPACITANCE IN MFD'S, RESISTORS 1/2 WATT.
2. ARROWS ON POTENTIOMETERS INDICATE CW ROTATION.
3. PILOT ADJ. — USING 2000 OHM/V METER, MEASURE 4V MIN. DC. SEE INSTRUCTIONS.
4. INDICATED SUPPLY VOLTAGES MAY VARY ABOVE OR BELOW NOMINAL VOLTAGE SHOWN, FROM MODEL TO MODEL.
5. ARROW-HEADS INDICATE MAIN SIGNAL PATH.

HIGHEST SERIES NUMBERS
C523
D510
L503
Q507
R535
T502

Z-PC-MX-11 06

FIG. 30 Multiplex

Q1, Q2 - 2N2925 or 2N3711(QA-15)

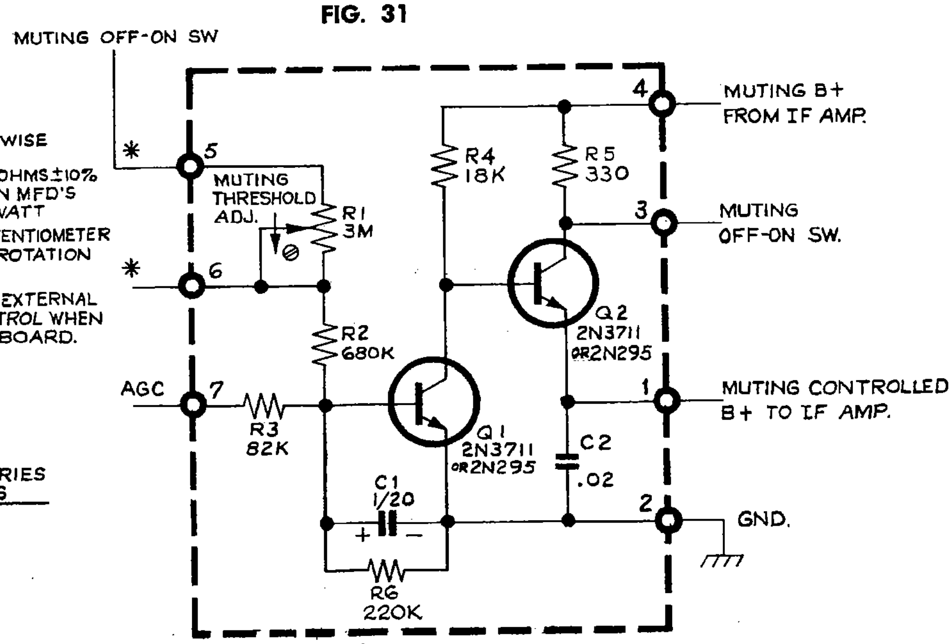


INTERSTATION NOISE MUTING Z-PC-NS-2 00

FIG. 31

NOTES:

1. UNLESS OTHERWISE SPECIFIED: RESISTANCE IN OHMS±10% CAPACITANCE IN MFD'S RESISTORS 1/4 WATT
2. ARROW ON POTENTIOMETER INDICATES CW ROTATION
3. * FOR USE WITH EXTERNAL MUTING CONTROL WHEN R1 IS NOT ON BOARD.



HIGHEST SERIES NUMBERS

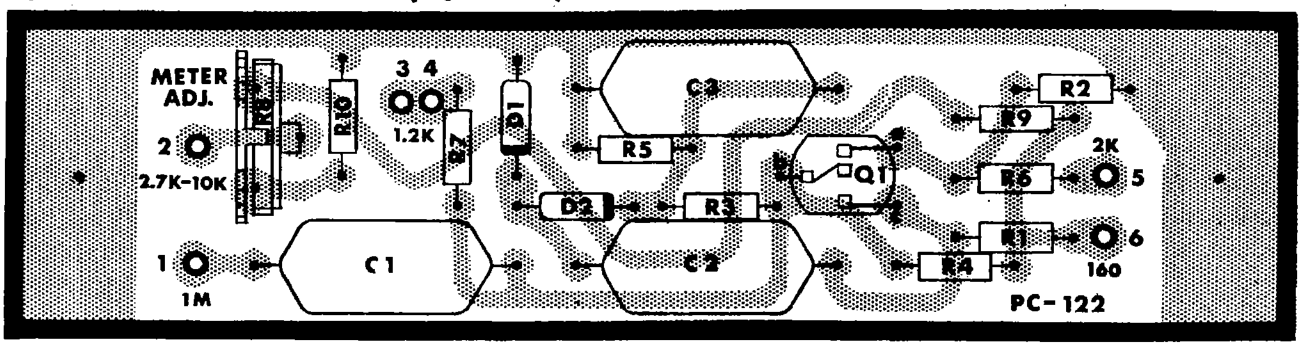
C2
R6
Q2

INTERSTATION NOISE MUTING Z-PC-NS-2 01

Z-PC-NS-2 Parts List

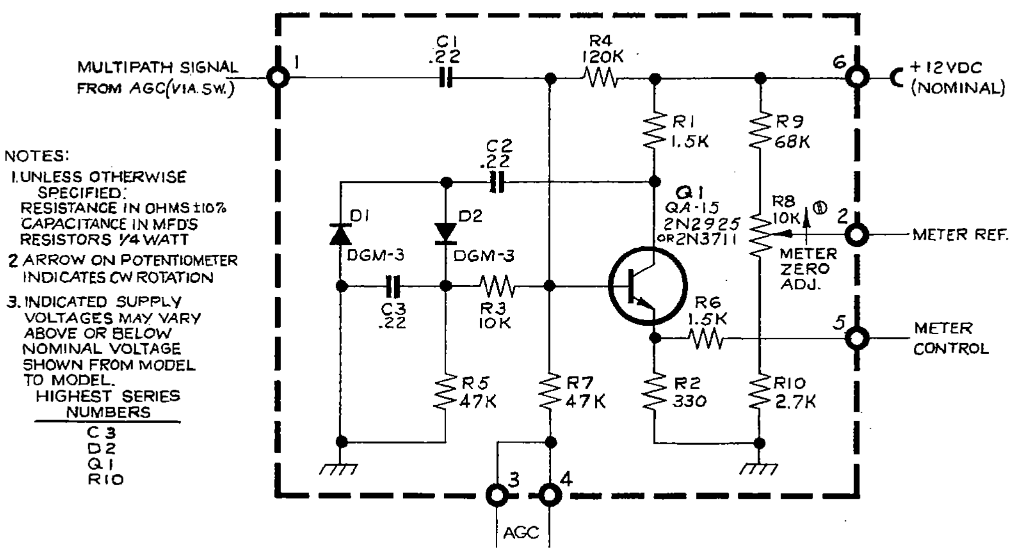
PC BOARD	PC-124	R1	RCV-3M-PCM
		R2	RC11-680k
C1	CTT-1/25	R3	RC11-82k
C2	CC-.02	R4	RC11-18k
		R5	RC11-330
Q1, Q2	QA-15, 2N3711, 2N2925	R6	RC11-220k

Q1 - 2N2925 or 2N3711 (QA-15)



MULTIPATH INDICATOR Z-PC-MI-1 **00**

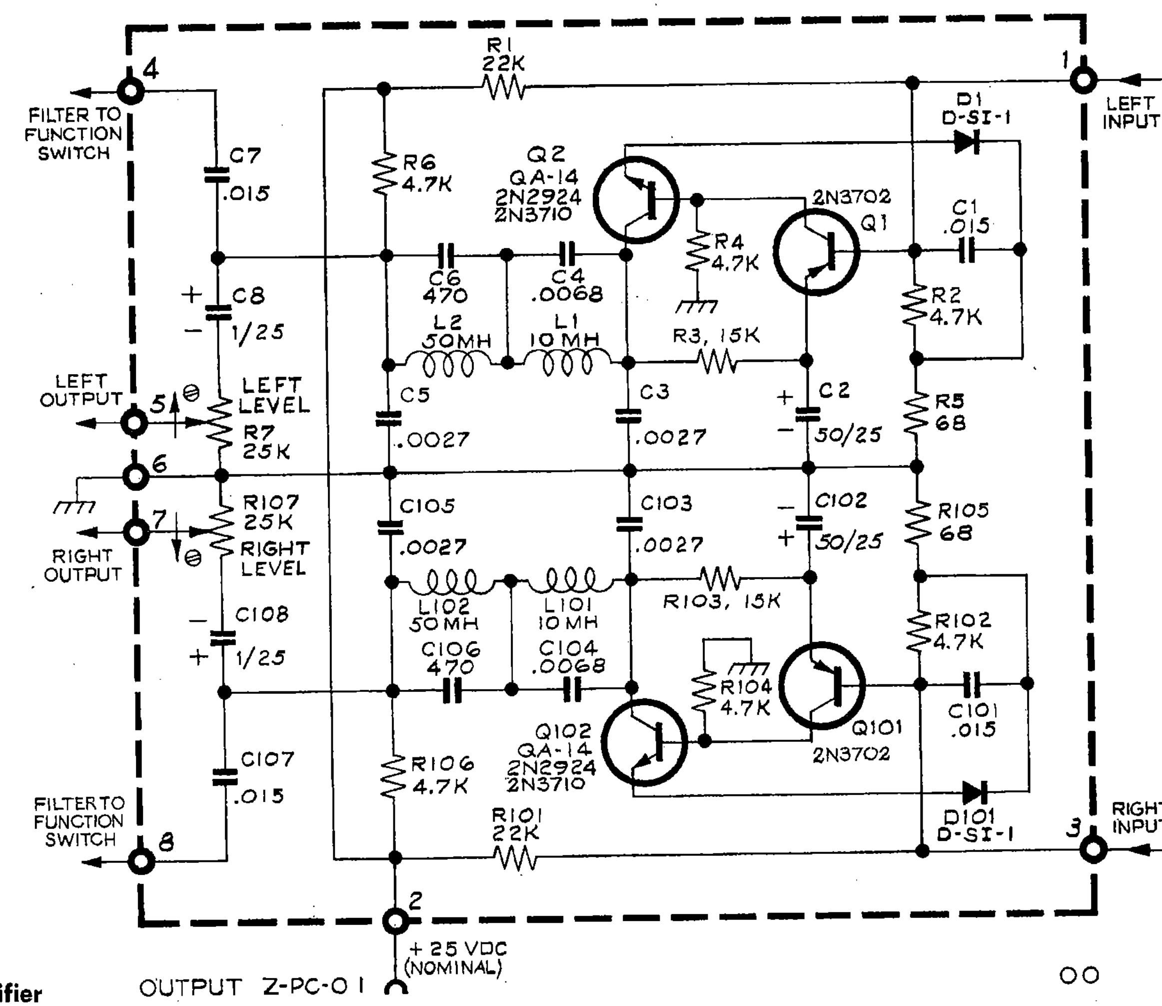
FIG. 32



MULTIPATH INDICATOR Z-PC-MI-1 OO

Z-PC-MI-1 Parts List

PC BOARD	PC-122	R2	RC11-330
C1, C2, C3	CMM-.22/250	R3	RC11-10k
D1, D2	DGM-3	R4	RC11-120k
Q1	QA-15, 2N3711, 2N2925	R5, R7	RC11-47k
R1, R6	RC11-1.5k	R8	RCV-10k-PCM
		R9	RC11-68k



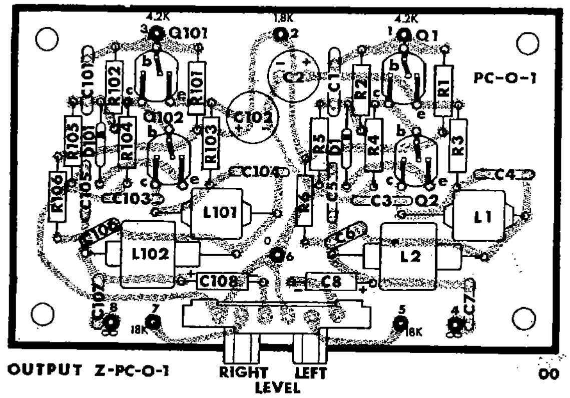
NOTES:
1. UNLESS OTHERWISE SPECIFIED:
RESISTANCE IN OHMS ±10%
CAPACITANCE IN MFD'S.
RESISTORS 1/2 WATT
2. ARROWS ON POTENTIOMETERS INDICATE CW ROTATION
3. INDICATED SUPPLY VOLTAGES MAY VARY ABOVE OR BELOW NOMINAL VOLTAGE SHOWN FROM MODEL TO MODEL.
4. ARROW-HEADS INDICATE MAIN SIGNAL PATH.

HIGHEST SERIES NUMBERS

C8	C108
D1	D101
L2	L102
Q2	Q102
R7	R107

FIG. 33
Output Audio Amplifier

Q1, Q101 – 2N3702
Q2, Q102 – QA-14, 2N3710 & 2N2924



Output Z-PC-0-1

Z-PC-01 Parts List

C1, C101, C7, C107	CC-.015-10%	Q1, Q101	2N3702
C2, C102	CEPC-50/15	Q2, Q102	2N3710, 2N2924, QA-14
C3, C103, C5, C105	CC-2700-10%	R1, R101	RC21-22K
C4, C104	CC-6800-10%	R2, R102, R4, R104, R6, R106	RC21-4.7K
C6, C106	CC-470-10%	R3, R103	RC21-15K
C8, C108	CTT-1/25	R5, R105	RC21-68
D1, D101	DSI-1	R7-R107	RCV-2 x 25K-PC
L1, L101	LRFC-.01		
L2, L102	LRFC-.05		

8.3 Test and Service Procedures with Instruments

a. General Service Notes & Transistor Precautions

Service, other than replacement of pilot lights, is usually not required. If the tuner is not operating properly, all external connections should be checked to make sure that the difficulty is in the tuner. Generally, it is advisable to replace the connection to the tuner with a tape recorder or similar device to check out the amplifier performance. If the difficulty appears to be located in the tuner, the level controls should be first checked to insure that they are rotated away from their extreme counter-clockwise positions. Then, the transistors should be checked by replacing them with new ones, one by one. **Transistor defects frequently do not show up in a transistor tester.** A field effect transistor (FET) is a specific kind of transistor, thus the material which follows is applicable. Only operation in the tuner will insure the proper operation of transistors. Transistors may be checked for shorts as outlined below.

Transistor Electrical and Mechanical Precautions

1. All cracked printed circuit boards should be replaced.
2. Only 60 watt or smaller soldering irons are to be used because larger ones emit too much heat and will cause the circuit boards to de-laminate or possibly crack. Use as little heat as possible to obtain good solder connections.
3. PC boards should be handled only by the edges. Do not put fingers across the boards.
4. Be exceptionally careful to install the **correct transistor** in the **correct socket**; and **correctly install** the transistor into the socket.

Transistor Test Precautions

1. The cases of some of the transistors we are using are "hot" (have voltage on them) so be very careful not to short them.
2. Be sure the right transistor is in the right socket.

3. All clip leads, scope probes, and meter leads should be insulated so that only the tip of the lead will be bare. This is to prevent accidental shorting.

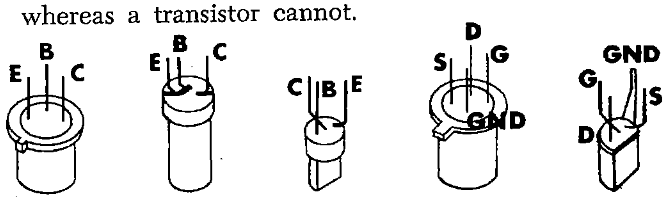
4. Never check any voltage by sparking against chassis.

5. When checking transistors for shorts, use only X1,000 scale on meter because X1 and X10 may provide too much current for the transistor to take. Only power transistors can be tested on X100,000 or X1 range. There is 350 ma on the X1 range and 30v on the X100,000 range (Triplett 630 VOM).

6. Check all transistors in unit for heat dissipation. If it is uncomfortable to the touch, then it is no good. Shut power off immediately.

Some Transistor Characteristics

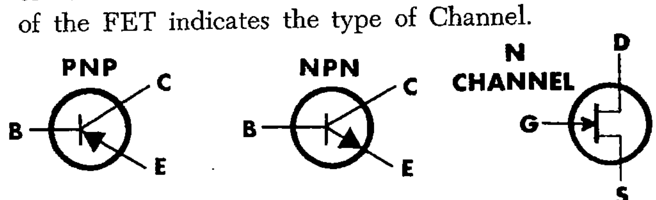
1. A tube can withstand prolonged overload whereas a transistor cannot.



TRANSISTORS FET'S

2. NPN pos. voltage on collector with respect to the emitter. PNP neg. voltage on collector with respect to the emitter for proper operation. For N Channel FET's, the drain (D) should have a pos. voltage with respect to the source (S) and for P Channel the polarity is reversed. The FET illustration below shows an N Channel (arrow going in); the type used in the Z-FM-16K front end in the LT-112B.

3. Arrow on the emitter indicates the direction of current flow in the transistor. Arrow on the gate of the FET indicates the type of Channel.



TRANSISTORS FET

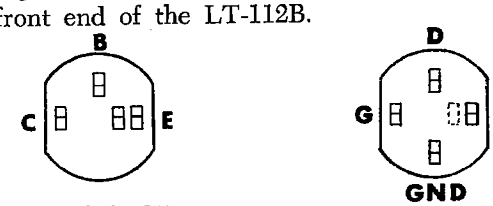
Transistor Installation Precautions

The transistor sockets are of a type which will allow the use of several different styles of pin breakout. It is, therefore, most important that both the transistor and the socket breakout be known so that no installation problems arise.

To aid in properly orienting the transistors in their sockets, the chassis and/or applicable layout diagrams will have the letter "C" beside the COLLECTOR pin contact.

The XQ-4R socket is designed to accept TO-5 lead spaced transistors using the three outside pin connections. The pin connection inboard of the emitter pin connection is externally connected to the base pin connection so that transistors having an "inline" pin breakout may be substituted. **When installing non "inline" type transistors, be sure that the inboard connection is not used.**

Some FET's are symmetrical devices and thus the leads used for the drain and source can be physically reversed as shown in the device and sockets drawings; this is the situation for Q201 of the Z-FM-16K front end of the LT-112B.



TRANSISTOR FET

Pilot Light Replacement

1. To replace the two dial indicator lights or the tuning meter indicator light, the top cover must be removed. Remove the dial indicator lights by squeezing in on the spring clips and pulling backwards. These three lights should be replaced only with bayonet type 6.3 volt #1847 bulbs. This is a 5000-hour life bulb.

2. To replace the STEREO indicator light, the bottom cover must be removed. This light should only be replaced with a bayonet type 2.0 volt, 60 ma #49 bulb. The voltage across this bulb should be such that it will last 5000 hours. For proper bulb-life the voltage across it, when illuminated, should not exceed 1.2 volts DC (as read with a Triplett 630 VOM). The current limiting resistor, R504, on the MPX PC board, should be chosen somewhat between 33 and 56 ohms so that the voltage across the STEREO indicator bulb is between 0.9 and 1.2 volts DC. If the bulb burns out too frequently, then the value of the resistor should be higher. This variation is due to the different saturation voltages of Q502.

Dial Cord Replacement

1. If the dial cord should break, a replacement may be ordered from our Parts Department by specifying number ADC-6. If a new dial cord spring is required, number ASP-3 should be specified.

2. Remove the top cover. Remove the broken dial cord from the unit along with the dial indicator and dial cord spring.

3. For complete instructions on dial stringing, refer to Section 3.4 "Final Mechanical Assembly," on page 31. Pointer installation is on this same page and follows front panel assembly.

b. FM Tuner Alignment With Instruments

Note: No attempt should be made to align the tuner or repair it unless the person so doing has had extensive experience in tuner alignment and repair procedures and has the necessary laboratory equipment. Without proper experience or equipment, **the repairman may seriously damage the tuner.** To insure that your LT-112B will be properly serviced, we suggest that you contact one of the following: Scott Warranty Service Stations (for an up-to-date list write H. H. Scott, Inc., Maynard, Mass.), your local Scott Dealer (some of whom are properly equipped for servicing Scott units) or the Technical Services Dept., H. H. Scott, Inc., Maynard, Mass. The alignment instructions which follow are abbreviated and assume that the repairman has had extensive experience in tuner alignment.

Equipment Required

FM Signal Generator (Measurements 210A or 210AB, Boonton 202H, Marconi 995A/2M or equivalents)

High Quality Vacuum Tube Volt Meter (.001 to 10 volts ac minimum full scale)

Oscilloscope (500 kHz minimum bandwidth. Should have both horizontal and vertical inputs for checking IF bandwidth, etc.)

Distortion Analyzer, Harmonic (400 Hz null filter may be used if FM Generator modulation frequency can be adjusted)

10.7 MHz Marker Generator or Crystal Oscillator

Audio Oscillator (Hewlett-Packard 200CD or equivalent with balanced output to ground—oscillator with unbalanced outputs cannot be used with MPX generator)

FM Multiplex Stereo Generator (H. H. Scott Model 830 or equivalent)

(The last two items are for MPX alignment)

Note: No attempt should be made to align the LT-112B unless the FM signal generator is capable of calibrated output attenuation down to 2 μV. Under no circumstances should a normal TV sweep generator be used, as this type of signal generator will normally radiate spurious signals giving false indications on alignment. Since the harmonic distortion of the LT-112B is so low, it is necessary that the FM Signal Generator and audio oscillator combination have less than 0.5% total harmonic distortion for ±75 kHz deviation. Also, since the LT-112B stereo separation is high, the MPX generator and FM signal generator combination should be capable of producing at least 40 dB separation. If the generators do not perform with high enough quality, then it will not be possible to align the LT-112B to meet specifications.

Preliminary Checks

Before plugging the power cord in, remove the top and bottom covers and inspect the LT-112B for defects such as: broken wafers, cracked terminals and PC boards, loose transformers, binding tuning condenser, broken components, lead dress, wire scrap in unit and so forth. Make certain all transistors and nuvistors are firmly seated in correct sockets. Turn unit on and check power supply voltages (should be within ±15%): At the top of C401B or junction of R401 and R403 should be +25 volts. At the top of the zener diode, D403 (a DZ-12 diode), should be +12 volts.

Equipment Setup for Mono Checks and Alignment

Set the controls of the LT-112B as follows: SELECTOR switch to MONO MUTING-OFF, FUNCTION switch to NORMAL, METER switch to CENTER TUNING, and LEVEL controls full clockwise (as seen from rear). Connect the FM signal generator directly to the 300 ohm antenna input of the tuner using a matching impedance network if necessary. The Channel L audio output of the LT-112B then feeds into the distortion analyzer and VTVM (ac). The scope is used to monitor the output of the tuner or the analyzer. If the harmonic distortion analyzer is not available for distortion and sensitivity measurements, then use a 400 Hz null filter and modulate the signal generator with a variable audio oscillator (so you can tune in the null). When using the 400 Hz null, the Channel L audio output of the LT-112B then feeds into the 400 Hz null filter and from the null filter to the oscilloscope and VTVM in parallel. If no null filter is available (a schematic for making one of these very simple and useful devices is available from the Engineering Dept., H. H. Scott, Inc., Maynard, Mass.) the tuner can still be serviced. However, it will not be possible to measure the tuner's "Usable Sensitivity" as per IHF standards, or to align the detector.

Mono Performance Checks and Adjustments

Before proceeding with the alignment of the Front End and IF Amplifier, it is advisable to first check the mono performance of the tuner. If the tuner more than meets specifications, then all or part of the alignment procedure does not have to be performed. For example, if the tuner meets calibration and sensitivity specs, but does not meet distortion specs, chances are that the Front End does not need alignment, but the IF Amplifier does. **These mono performance checks and adjustment should also be made after the Front End and IF Amplifier alignment procedures have been completed.**

Unless otherwise specified, all checks below are taken with ±75 kHz deviation from the FM generator, and the tuning METER should read in the center or any point on the two large black squares in the center.

1. Measure IHF Usable Sensitivity of tuner with about 2.0 μV RF input **to the EXTERNAL antenna terminals** (or 4 μV from 50 ohm generators with matching impedance network which converts to 300 ohms). Note that 4 μV output of generator is equivalent to less than 4 μV on tuner input due to drop through the matching impedance network. Must obtain 30 dB of signal-to-noise and distortion (IHF Usable Sensitivity) at 92, 98 and 106 MHz.

2. Check distortion, 1k μV input to antenna terminals. 400 Hz – max. dist. of 0.8%. Audio output of tuner should be about 1.2 volts rms, with ±75 kHz deviation. Check audio output of both L & R channels.

3. For hum check, remove modulation from generator. Meter reading should drop at least 60 dB below 1.2 volt audio output reference.

4. Perform de-emphasis check on both R & L channels. With 400 Hz ±75 kHz deviation modulation, take an audio output voltage reference. Change modulation to 8 kHz ±75 kHz deviation. Output should decrease 12 ±2 dB from reference.

5. Check dial calibration against broadcast stations. Max. tolerance ±0.2 MHz.

6. Switch the METER function switch to SIGNAL STRENGTH. The meter needle should read "0" on the top scale with no RF signal (tuned off-station). If it does not, then adjust the Meter Zero Adjust on the Multipath Indicator Z-PC-MI-1 board for a "0" indication. Check the action of the meter needle with the METER function switch in both the SIGNAL STRENGTH and MULTIPATH positions to see if an increase in meter reading is obtained with a corresponding increase in FM generator voltage from "0" μV and up into the tuner.

Check the multipath indication as follows: Note the meter reading with the METER function switch in the SIGNAL STRENGTH position and an RF signal of 1 KμV, 400 Hz modulation and ±150 kHz deviation. The meter should read above ½ scale. Turn the METER function switch to MULTIPATH. The meter reading should go downscale to around "0" or below (it may be pegged). Return the METER function switch to the CENTER TUNING position and leave it there.

7. Turn the SELECTOR switch to the MONO MUTING-ON position. With 400 Hz modulation and ±75 kHz deviation, check the switching level of the Muting circuit, Z-PC-NS-2. All RF signals from 25 to 35 μV or above should **not** be muted (squelched). Adjust the Muting Threshold Adjust potentiometer on the Muting PC board if necessary. (The adjustment method given in Section 4.1 i, on page 32, is suggested.)

Front End Alignment

1. Oscillator Adjustments: This may be done with either an FM generator or a broadcast station as outlined below. However, if a generator is used it should have its frequency calibrated against stations or a standard, and the output of the generator should be between 5 to 10 μV.

The oscillator trimmer on the top of the front end and the oscillator coil enclosed in the bottom shielded section of the front end are used to adjust dial tracking. Tune to a station on the low end of the dial (88-94 MHz) whose broadcast frequency is known. If the station is higher in frequency than it should be, turn the oscillator trimmer screw slightly counterclockwise until the station is shifted to the proper point on the dial. Now check a station of known broadcast frequency on the high end of the dial (102-108 MHz) to determine that proper tracking has been maintained across the entire band.

If stations on the low end of the dial are tracked correctly but the stations on the high end of the dial are received at a higher frequency, tune to a station on the low end of the dial whose frequency is known. Remove the small tab from the shielded section on the bottom of the front end and slightly squeeze the oscillator coil closer together. Keeping the dial in the same place, turn the oscillator trimmer counterclockwise until the station is back at its original point. Tune to the high end of the scale and note that the stations have come down slightly in frequency. These adjustments should be continued until the high end and low end of dial track perfectly.

If the low end of the dial tracks correctly, but the high end of the dial is low, the reverse procedure is used. That is, the oscillator coil is spread slightly apart and the oscillator trimmer is turned clockwise.

2. RF Mixer, Trimmer and Coil Adjustments: Connect the FM generator to the antenna terminals and at 92 MHz, adjust the mixer coil for maximum output. With the FM generator and the tuner at 106

MHz adjust the mixer trimmer for maximum output. Repeat these adjustments until no further improvement can be noted.

3. Antenna, Coil and Trimmer Adjustments: With the FM generator and the tuner at 92 MHz, inject a very weak signal into the antenna terminals. Adjust the antenna coil for maximum output. With the FM generator and tuner at 106 MHz, adjust the antenna trimmer for maximum output. Repeat these adjustments until no further improvement is noted.

IF Amplifier Alignment Procedure

1. If there is any question as to whether or not the IF transformers are peaked at 10.7 MHz, then they should be realigned with a 10.7 MHz Mark Generator or Crystal Oscillator. (This is quite likely in a tuner kit when the builder has inadvertently turned the slugs too far.) If an IF transformer has been replaced then it will be necessary to use a 10.7 MHz generator.

With the SELECTOR switch still in the MONO MUTING–OFF position, turn the METER function switch to ALIGN. Tune the tuner off station and short out the antenna terminals. Loosely couple a 10.7 MHz signal into the front end or with an alligator clip go onto the body of C302 on the IF PC board. The meter should deflect slightly (about 2 divisions), but the detector should not be in full limiting (meter needle too far right).

Align the primary and secondary of T201, T301, T302, T303 and T304 for maximum meter deflection. As you align, keep reducing the 10.7 MHz signal so that you are able to see needle movement while aligning the transformers. Remove the 10.7 MHz generator when completed, and return the METER function switch to CENTER TUNING.

2. IF Amplifier and Limiter Alignment: Connect the output of the FM generator to the antenna terminals of the LT-112B. Take the output to the scope and VTVM from the outputs on the rear chassis of the LT-112B. Turn the LT-112B on using the FUNCTION switch in the NORMAL position.

Attenuate the output of the FM signal generator down to 3 μV. The FM generator should be internally modulated with a 400 Hz signal and set for $\pm$75 kHz deviation (100% modulation). With the alignment tool, peak the top and bottom slugs of T201, T301, T302, T303 for maximum audio output and undistored signal. Each transformer should be checked several times until no further improvement is noted.

3. FM Detector Alignment: With about 3 μV of signal from the generator, adjust tuner for symmetrical output on the scope. Increase the signal from the generator to about 1K μV. Adjust the primary and secondary of T304 (detector can) for maximum audio output and note audio output voltage. Adjust the detector secondary (T304 top slug) for "zero" center tuning on the meter and adjust the primary for minimum distortion on the audio analyzer. (The primary of T304 is the bottom slug.) During the detector alignment the audio output voltage should not drop more than 2 dB. If you are unable to meet distortion specs with proper CENTER TUNING indication then check the detector diodes, D303, D304 and make sure that they are matched.

4. Go through the Mono Performance checks and Adjustments procedure again.

Equipment Setup for Stereo Checks and Alignment

Set the controls on the LT-112B as follows: SELECTOR switch to AUTOMATIC STEREO, all other controls should be in the same positions as given above for the Mono Checks and Alignment. The test equipment setup is also as given above, except that either the audio oscillator or FM multiplex stereo generator will be used to externally modulate the FM signal generator. The audio oscillator will modulate the FM signal generator for the 67 kHz null filter adjustment. For all other stereo checks and adjustments connect the audio oscillator to the FM multiplex stereo generator which is in turn connected to the FM signal generator. (When connecting the audio oscillator to the Scott 830 MPX generator, it must be done with the balanced output to ground connection from the audio oscillator.) The output phase of the FM multiplex stereo generator should be frequently checked, for if it is off even slightly, your alignment will cause the tuner to have poor separation when tuned to a station.

Stereo Performance Checks

Before proceeding with the alignment of the multiplex section of the tuner, it is advisable to first check the stereo performance of the tuner. If the tuner more than meets the stereo separation specifications, then the alignment procedure does not have to be performed. Check stereo separation for both the R and L channels. It should exceed 35 dB at 400 Hz. If stereo separation is low, first check the FUNCTION switch to make sure it is in the NORMAL position and not in the SUB. CH. FILTER position. Secondly check the tuning METER to make sure you are tuned to the center of the carrier. These two conditions must be met before proceeding with the MPX alignment. The METER switch should be kept in the CENTER TUNING position for the stereo checks and adjustments.

67 kHz Null Filter

Modulate the FM generator with exactly 67 kHz and a deviation of 7.5 kHz (10% modulation). Attach an oscilloscope probe to the 67 kHz Test Point, the junction of C515 and C517, Null L502, for minimum 67 kHz as seen on the scope.

19Kc Pilot Level

Turn R and L separation pots (R514 and R535) fully clockwise. Connect the FM multiplex generator to the FM generator and turn the 19 kHz pilot on. Connect a low capacitance scope probe (less than 25 pf) to the 19 kHz Test Point, the collector of Q503. If a low capacity scope probe is not available, you may use a VOM or a VTVM and connect it across R526 (47K). For the VTVM connect the ground side on the B+ 25 volt line (peak for minus volts).

Peak T501 and L501 for maximum scope indication at the 19 kHz Test Point (15 volts peak-to-peak minimum) or for a maximum voltage across R526 as read with the VOM or VTVM (4 to 8 volts dc).

38Kc Oscillator

MPX generator should now be modulated with 400 Hz on one channel. Remove transistor Q501 to kill 19 kHz pilot. Remove transistor Q505 to switch unit into stereo. Attach scope to audio output. Two scope methods may be used to synchronize the 38 kHz oscillator. One is to feed the X and Y inputs of the scope with the R and L outputs from the tuner and adjust T502 for a zero beat. The other method is to feed either output of the tuner into the Y input of the scope and adjust T502 for a zero beat or a reasonably stable 400 Hz sine wave.

Replace transistors Q501 and Q505.

Separation

Modulate the L channel of the MPX generator. Attach scope and VTVM (ac) to the R output channel of the tuner. Adjust L501 for minimum 400 Hz audio output. This will only require a minor adjustment of the L501 slug.

Now adjust the Right Separation control, R535, for minimum audio output. Modulate the R channel of the MPX generator and monitor the L output of the tuner with the scope and VTVM (ac). Adjust the Left Separation control, R514, for minimum audio output. Repeat above adjustment of the pots only until maximum separation has been obtained. Stereo separation should be at least 35 dB at 400 Hz. If it is not possible to meet the separation specs then recheck the IF Amplifier for proper alignment.

Stereo Threshold

1. Turn to a spot on the dial where only inter-station noise is heard. This point will most probably be found at either extreme end of the tuning dial.
2. Turn the SELECTOR switch to the AUTOMATIC STEREO MUTING–OFF position.
3. Turn the Stereo Threshold control (on top of the chassis) to maximum counter-clockwise position. The unit will now switch into stereo, and the stereo light will come on and remain on constantly.
4. Slowly turn the Stereo Threshold control clockwise until the light goes off.

If you are unable to set the Stereo Threshold control as outlined in Steps 1-4, then set the FM generator for an output of 5 μV into the tuner and modulate it with the MPX generator. Adjust the Stereo Threshold control until the light just comes on.

The LT-112B is now set to switch automatically to Stereo on all multiplex stations of reasonable strength.

If a special adjustment is necessary in a particular location, the control may be adjusted to fit that location.

Turning the top chassis Stereo Threshold control **counter-clockwise will reduce the sensitivity** of the switching circuit (that is, more signal strength in stereo will be required to switch the tuner to stereo operation); while turning the control **clockwise will increase the sensitivity** of the switching circuit.