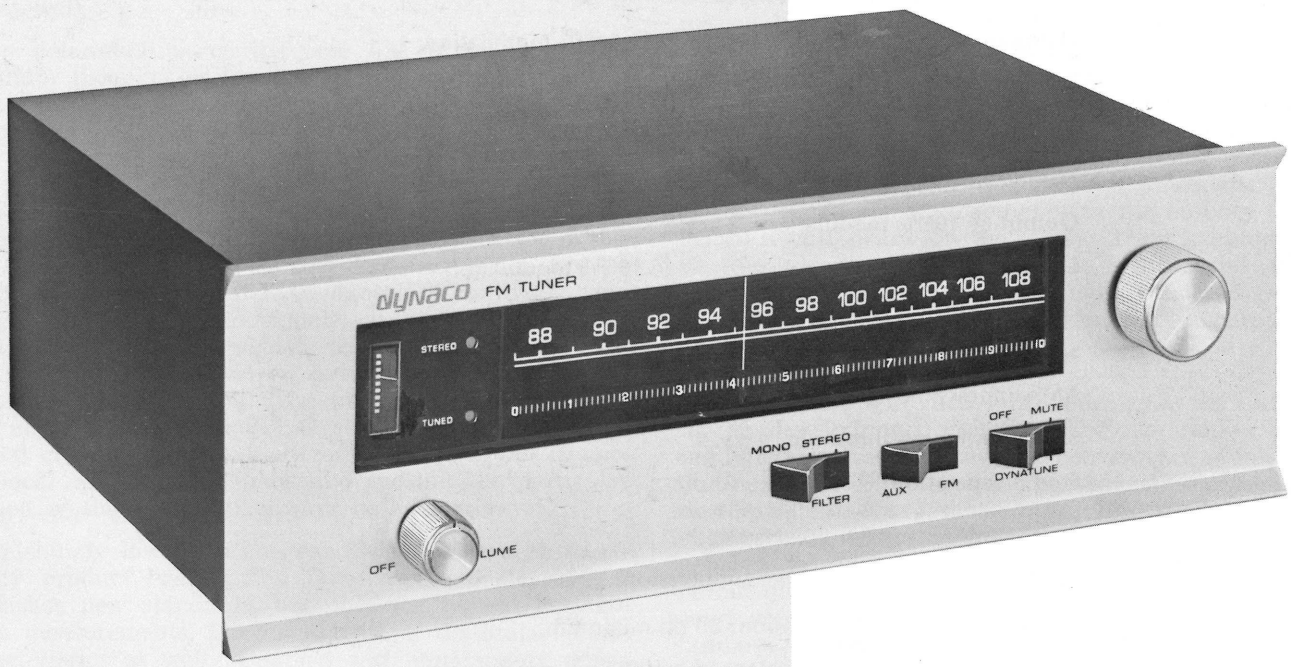
dynaco FM-5

SERIAL NUMBER

This number must be mentioned in all communications concerning this equipment.

INSTRUCTIONS FOR ASSEMBLY OPERATION



Price $1.00

929522

dynaco INC. COLES ROAD & CAMDEN AVENUE / POST OFFICE BOX 88 BLACKWOOD, N. J. 08012, U.S.A.

CONTENTS

SPECIFICATIONS

IHF sensitivity (noise and distortion down 30 db @ 100% modulation): 1.75 μv.

Input required for 40 db S/N @ 100% modulation: 2.0 μv.

Input required for 50 db S/N @ 100% modulation: 5.0 μv.

Frequency response before de-emphasis: 30 Hz to 52 kHz, $\pm$1 db.

De-emphasis time-constant: 75 μsec.

Frequency Response: 20 Hz to 15 kHz $\pm$ 1 dB

Harmonic distortion and IM distortion @ 100% modulation:
Mono—0.5% (0.25% typical).
Stereo—0.9% (0.5% typical).

Capture ratio: 1.5 db.

Muting threshold: 4 μv.

Output @ 100% modulation: 2 volts.

Ultimate signal to noise ratio: 65 db @ 100% modulation.

Drift: less than 0.02%.

Selectivity: 65 db alternate channel.

AM suppression: 58 db.

Stereo switching threshold: 4 μv.

Stereo separation: @ 1000 Hz, 40 db.
@ 50 Hz, 30 db.
@ 10 kHz, 30 db.

19 kHz and 38 kHz subcarrier suppression: 50 dB minimum

67 kHz SCA carrier suppression: 80 db minimum.

Antenna input: 72 ohm unbalanced and 300 ohm balanced.

Gain from Auxiliary Input: 28 dB

Front panel controls: Power/Volume; Tuning; Circuit Mode (off, muting, muting and Dynatune™); Mono, Stereo Filter, Stereo; Output (FM, Auxiliary).

Dimensions: 13 1/2" x 9" x 4 1/4" High.

Shipping weight: 11 lbs.

Power consumption: 10 watts, 120V or 240V, 50/60 Hz AC.

THE FM-5 DYNATUNER

INTRODUCTION

The Dynaco FM-5 is the culmination of more than 6 years of Dynaco design research with the avowed goal of exemplary performance under a wide range of reception conditions at modest cost. Its compact size nonetheless provides a generous layout for easy kit construction and outstanding serviceability. In addition, an exceptional degree of flexibility has been designed into this tuner for future contingencies.

The availability of an auxiliary high level input through the tuner's volume control enables tape playback, for example, with just a power amplifier and speakers. Alternatively, an accessory phono preamp module, Model PPM-5, will be offered for the FM-5 so that the AUX position will accommodate a magnetic cartridge input. In the distant future, if a compatible system of 4-channel multiplexing is approved, it is possible that the power supply and space allocations will accommodate it, and the necessary audio outputs are available.

The primary consideration in the development of each new Dynaco product is exceptional performance. The FM-5 delivers this in full measure. The design considerations necessary to achieve a premium quality kit lead automatically to a distinctly superior factory assembled unit as well.

The determination of the best FM tuner design for maximum listening enjoyment is not one which can be made entirely in the laboratory, nor can it be fully defined by specifications. Extensive field testing is a vital part of tuner design. Reception conditions vary so greatly that certain characteristics which favor reception in some instances may prove a handicap under different circumstances. Side-by-side listening comparisons of the FM-5 with tuners several times its cost demonstrate the FM-5's ability to reject the pervasive effects of multipath dispersion on strong urban signals, as well as to clearly receive weak or distant signals without noise or interference. A tuner can, however, only process the signal it receives from its antenna. The proper antenna is thus a vital adjunct to your music system. A section of this manual gives some suggestions in this regard, but competent local advice which takes into account the particular location of the tuner will always be advantageous.

Vanishingly low distortion has always been a hallmark of any product bearing the Dynaco name. The FM-5 establishes new standards, not only for typical in-phase stereo measurements, but for signals of dissimilar phase characteristics as well. Coupled with outstanding phase integrity in a solid state tuner, this yields exemplary results with any of the matrix-type 4-Dimensional (sometimes incorrectly called 4-Channel) broadcasting systems now proposed, including the ingeniously simple DYNAQUAD[tm] system developed by Dynaco.

Any successful high performance audio kit design must concomitantly deliver unchanging results over extended use. This also implies assurance that the standards set by the factory assembled units are consistently reproducible when even a novice properly assembles the kit. The more than 15 year old Dynaco reputation for consistently meeting conservative, detailed specifications is your best guarantee that the FM-5 will do just that. The two fiberglass etched circuit boards and the front end assembly (which contain all of the active circuitry) have been completely tested and aligned as a matched set for the kit, leaving nothing but their interconnection for the builder. The excellent specifications of the FM-5 are possible, and guaranteeable, unit to unit, lab model to production kit, because of the extraordinary uniformity which etched circuits provide, and the inherent stability of the circuit configuration.

The capability for the finest performance is of little value if it cannot be readily utilized in normal use. The consummate operating ease of the FM-5 is a case in point. You simply take your hand off the tuning knob as soon as the TUNED indicator is illuminated. The exclusive DYNATUNE[tm] circuit *automatically* fine-tunes the station. A stereo broadcast will *automatically* switch the tuner to stereo reception, and light the STEREO indicator too.

The FM-5 actually exceeds its own IHF specifications when it comes to listenable results. The IHF procedure for determining the distortion specification of a tuner allows readjustment of the source signal for the lowest measurable distortion. You the listener cannot do this. In the past you have had to rely on the uncertainty of "center of channel" meter systems, or on the even less precise signal strength maxima indications. The certainty of the DYNATUNE[tm] circuit automatically eliminates these variables, assuring reception with the lowest possible distortion. The DYNATUNE[tm] logic circuit senses the presence of the desired signal, together with the absence of noise, before it will switch on the audio. Then it *automatically* fine-tunes to the exact center of the FM channel (the minimum distortion point) in either mono or stereo. Such precise tuning is accomplished faster and more accurately than *any* other tuning system.

A clearly audible virtue of this design is the total elimination of switching transients in the operation of the muting function. And you have the convenience of interstation muting down to the levels of the weakest useable signals—in the vicinity of 4 microvolts! The result is absolute silence—or the station in correct tune. Only the FM-5 achieves this ultimate goal of a tuner. This refined muting circuit eliminates the possibility of damaging speakers or solid state amplifiers as a result of the low frequency "thumps" so common in the past with rapid dial manipulation. Yet so sophisticated is its operation that selectivity of adjacent channels is completely unaffected.

In urban locations where the FM-5's extreme sensitivity could have been a handicap, special care was taken in the design of the front end to accommodate extremely powerful signals without encroaching on adjacent weaker channels. The FM-5's suppression of spurious responses (cross-modulation) is notable among solid state tuners. Generous tolerance of overmodulation (an all-too-common broadcasting fault) yields low distortion signals in instances where others suffer.

Smooth flywheel action, a long uniformly spaced dial, and the most accessible and easiest to install dial stringing system ever, make the FM-5 a joy to use, and a breeze to construct. Only those who have built other tuners with similar dials can fully appreciate the latter.

The IF section utilizes two 4-pole ceramic filters for the optimum combination of alignment accuracy and stability, phase integrity and effective selectivity. The ideal selectivity curve is a 3-sided rectangle—unachievable in practice. Of the several approaches to this goal, the compromises in each must be weighed in the light of other criteria. The FM-5 demands an unusually high degree of alignment accuracy and stability to assure that prealigned circuit boards conform in all respects to a fully assembled unit when it has been aligned on completion. Too, the advent of DYNAQUAD[tm] and other similar matrix-type 4-Dimensional broadcasts demands an unusually high degree of phase linearity for maximum separation and low distortion reproduction. Such characteristics also lead naturally to better reception of even conventional stereo broadcasts. These goals tend to conflict with design criteria which favor the achievement of the most impressive figures for selectivity specifications. Indeed, some of the quoted selectivity figures are of dubious validity. Impressive figures can be obtained if phase linearity is ignored. The antenna becomes a much more significant factor where adjacent channel signals are possible, and alternate channel isolation is important.

Sensitivity—the most quoted tuner specification—is in fact of minimal concern for most users. The FM-5's specification of 1.75 microvolts closely approaches the accepted theoretical limit of signal strength, and yet retains great stability, notable spurious response rejection, and excellent AM (multipath) rejection. The steep limiting curve exemplified by the 50 db signal to noise ratio with only a 5 microvolt signal is of far greater significance than the IHF sensitivity. A signal should have a signal to noise ratio of at least 40 db (which occurs at only 2 microvolts) to be of acceptable listening quality. At normal signal levels, the typical signal to noise figure is 65 db!

Exceptional filtering of the 19 kHz multiplex pilot carrier, the 38 kHz multiplex subcarrier and of the 67 kHz SCA carriers assures freedom from interference beats with tape recorder oscillators when recording off the air.

More than with any other audio product, FM tuner specifications need to be evaluated with a somewhat jaundiced eye, and an appreciation that individually impressive figures do not necessarily yield the best listening results in the real world. Foremost is the limitation that most tuners are designed to meet criteria established by measurements made in a specially shielded room. Such results are not necessarily transposable to your living room. Neither the previous FM-3 Dynatuner nor the FM-5 were based on shielded room evaluations. The FM-3 established an enviable reputation for outperforming numerous tuners of far greater cost having apparently better specifications on paper.

The FM-5 is a break with the kit design philosophy of its FM-3 predecessor. The FM-3 was designed from the ground up to be wholly self-aligned by the builder on completion. Because of that recognized success, Dynaco thoroughly pursued over many months the possibility of a similar design using transistors. The characteristics of solid state devices preclude this approach. Thus the FM-5 evolved as a concept of highly stable performance which could be honed to perfection when factory aligned as a set of 3 matched subassemblies, capable of being tested as a fully operational tuner. Thus no adjustment of any nature should be made short of *complete* alignment facilities. Solid state reliability makes such adjustment unlikely for the life of the tuner.

INSTALLATION AND OPERATING INSTRUCTIONS

The highly refined and distilled engineering of the FM-5 combines the performance of far more costly and complex FM multiplex tuners with the operating ease and simplicity which has been a Dynaco tradition. Exhaustive engineering research has replaced needless adjustments, controls and indicators with automated functioning, freeing the listener to enjoy the results.

Normal operation leaves all 3 switches depressed to the right. Once the power switch is rotated to the desired volume level, you need only tune until the TUNED indicator is illuminated at the desired station. It is as simple as that.

AC Line Connection

The tuner is normally wired for the U.S. standard 120 volt, 60 Hz AC line. Alternative wiring to accommodate 240 volt operation, with either 50 or 60 Hz, is described later in the manual. The typical AC connection will be to a switched outlet on the control center or amplifier. Thus the tuner's power switch (on the volume control) may be left "on" with the volume control adjusted for compatibility with other sources. The AC outlet on the back panel of the FM-5 is controlled by the front panel power switch. Thus if no separate control center is needed in the system, the power amplifier may be switched through this outlet, and the FM-5 plugged into the wall outlet.

Antenna Connections

Three screw terminals are provided on the back panel for either 300 ohm balanced, or 72 ohm unbalanced antenna systems. A twinlead folded dipole antenna is supplied with the tuner and will suffice for all but the most difficult signal areas. It should be connected to the two outer (300 ohm) screw terminals. A later section of this manual will give you suggestions for other antennas if conditions require such.

Output Connections

A pair of shielded cables is supplied with the FM-5. These should be connected from the AUDIO OUT tuner sockets to the FM-MPX, RADIO or TUNER inputs of the control center or amplifier. The output level of the FM-5 is adjusted by the front panel volume control. The nominal output level at maximum setting from a fully modulated signal is 2 volts. You can also connect the tuner to any basic power amplifier which has an input sensitivity of less than 2 volts for full output.

The TAPE OUT sockets also provide a variable output level which is adjustable by the front panel volume control. These may be connected to the line inputs of a tape recorder.

Auxiliary Input

The third pair of audio sockets provides an *input* connection which is switched on the front panel. This signal is available at both the AUDIO OUT and TAPE OUT sockets. This input provides a maximum of 28 dB gain and is controllable by the volume control.

Off / Volume Control

The power switch, which also controls the back panel AC outlet, is a part of the volume control. If the tuner is plugged into a switched AC outlet on the control center, the tuner's volume control will likely be left in the upper half of its range, where the tuner level will match the level of other inputs to the control amplifier.

Mono / Stereo Switch

In the MONO position all stations will be heard monophonically, and the stereo indicator will never light. This position may provide greater clarity in monophonic reception of *very* weak stereo broadcasts.

In the middle STEREO FILTER switch position, high frequency separation of stereo broadcasts is reduced, or blended, to improve the signal to noise ratio on weak stereo signals. In other respects, tuner operation is similar to the normal STEREO mode.

The normal position of this switch is the extreme right STEREO mode. The tuner switches automatically from mono to stereo operation, and lights the STEREO indicator whenever the tuned station is broadcasting the 19 kHz multiplex stereo pilot carrier signal. On rare occasions the station may forget to turn off the pilot carrier when they revert to mono broadcasting. In such a case, you will receive a mono broadcast even though the stereo indicator is lighted.

Without the pilot carrier, the tuner reverts to mono but the lowest noise will be obtained in the MONO position.

Off / Mute / Dynatune Switch

In the OFF position the muting circuitry and the automatic DYNATUNE circuitry is defeated. This permits extremely weak signals to be perceived, as there is no interstation noise suppression (muting). Tune for maximum vertical meter indication. The TUNED light will flicker on very weak signals of varying strength. For the reception of such signals it is best to operate in the MONO mode.

The middle switch position is preferred for normal operation with the highest tuning accuracy. The muting circuit eliminates all interstation noise. When the TUNED light comes on, let go of the tuning knob and switch to the extreme right DYNATUNE position. The automatic circuitry will then take over for precise tuning of the center of the channel for minimum distortion.

You may prefer to leave this switch in the DYNATUNE position most of the time, as this is the easiest method of operation. The proper tuning procedure here is to release the tuning knob as soon as the TUNED light indicates the desired station. "Fiddling" back and forth on the dial is not recommended with the switch in this position, for it may leave it on the "edge" of the correct zone. In such a case the automatic tuning circuitry may not be able to fully correct for lowest distortion reception.

AUX / FM Switch

The normal position is FM. The AUX position selects an alternate high level signal source, such as a tape playback amplifier, which is controlled by the tuner's volume control. In the AUX input mode, the tuner should be muted (off station) to avoid audio signal feed-through.

The inclusion of this switch and the additional output sockets on the back panel also provide contingency for future flexibility. An accessory phono preamp stage, Model PPM-5, will be offered for the FM-5, so that the AUX position will accommodate a magnetic cartridge input. In the distant future, if a system of 4-channel multiplexing is approved, it is possible that these provisions will accommodate it.

Signal Strength Meter

The meter circuit has been compensated to accurately show changes in signal strength at a very few microvolts, as well as those inordinately powerful signals above 30,000 microvolts. This can be of significant value in determining antenna orientation, or possibly the need for an attenuator for too strong a signal.

The operation of this meter circuit is such that normal signal levels will all indicate very similar levels near the center of the meter scale, even though they may vary over a wide range. Such signals do not normally present reception problems, and the meter is then unnecessary. Its circuit has been designed to be most meaningful when it can be most useful.

While a maximum meter indication will show the proper tuning zone, well within the Dynatune "window", it is possible that a minute reduction from the maximum meter indication may be observed as the Dynatune circuit takes over on signals strong enough to activate it, and the muting circuit. The Dynatune circuit enables far greater tuning precision than manual tuning with *any* meter system.

The Tuned and Stereo Indicator Lights

The TUNED indicator lights when you are on station. If the station is broadcasting in multiplex stereo, the STEREO light will also come on an instant later.

As the tuning dial approaches within 80 kHz of the station's broadcast frequency, the illumination of the TUNED light will indicate that the Dynatune circuit can take over. This will "lock on" that signal for the next 250 kHz. If the station is approached from the opposite direction, the same locking action will be observed in the reverse direction, starting again within 80 kHz of the broadcast frequency.

If the dial location is more than 80 kHz distant from the broadcast frequency, and the Dynatune switch is disengaged, the signal will be muted. To resume reception, the tuner will have to be re-tuned until the TUNED light is again illuminated.

Occasional lack of stereo separation when the STEREO indicator is lighted is possible if the station neglected to turn off its 19 kHz stereo pilot when broadcasting mono.

If either of these two lights flicker, it indicates exceedingly low signal strength (below 4 microvolts) or noise interference spikes of very high intensity. In such a case readjustment of the antenna for a better signal may be possible. Switching the muting switch "Off" may also prove useful.

Tuning a Station

The DYNATUNE™ circuit operates simultaneously with the muting circuit. If you wish to defeat muting, you cannot use DYNATUNE. While this circuit "locks in" a station well past the exact frequency as the tuning traverses the dial, selectivity between closely spaced stations is not impaired, and the second station can be tuned easily from the opposite direction.

The simplest tuning procedure is to move the dial deliberately, and release it as soon as the TUNED indicator lights. Allow DYNATUNE to do the rest. If you move the dial rapidly, you will hear no sound, and the indicator will not light at all.

Installing Your FM-5

Your FM-5 generates very little heat. It is unnecessary to provide ventilation, even with continuous duty operation. The FM-5 may be mounted in any position in a cabinet, and if desired, it may be stacked with a Dynaco PAT-4 preamplifier. If it is used with the Dynaco SCA-80 or SCA-80Q amplifier, adequate ventilation must be provided for the amplifier.

For panel mounting, an accessory PBK bracket kit is available from Dynaco for $2 postpaid. No CODs please. A single rectangular cutout 13″ by 3$^{13}/_{16}$″ is required in any panel up to one inch thick. Or, you can simply provide a shelf flush with the bottom of the opening. The rubber feet are not used in such mounting. In a cabinet which provides for "face up" mounting, the FM-5 can simply be supported in the cutout by its front panel.

CIRCUIT DESCRIPTION

The following brief explanation of the essential circuit features of the FM-5 may aid service personnel and the technically inclined hobbyist to understand the operation of this tuner. Those not interested in the technology may ignore this section.

Front End

The front end comprises a tuned RF input to an FET RF amplifier with interstage double tuning to the FET mixer. A transistor oscillator supplies the mixer. The last section of the four gang tuning capacitor tunes the oscillator. Circuit constants of the oscillator and mixer circuits have been adjusted to give uniform sensitivity over the entire FM band.

The AGC signal is picked up from the high side of the IF output, through a transistor amplifier, a double diode detector, and applied to the gate of the RF input FET.

IF Amplifier—Limiter—Detector

The IC intermediate frequency amplifier is followed by a 4-pole ceramic filter, another IF amplifier, then another 4-pole ceramic filter and a high gain limiting amplifier. The IF gain is so high, and the limiting action so effective that limiting occurs on input noise alone. Phase shift in an FM signal corresponds to amplitude nonlinearity or distortion in an audio amplifier. Accordingly, these IF circuits were designed for minimum phase shift across the pass band. This approach maintains low distortion of the audio signal all the way down into the noise, and permits useful reception of very weak signals.

A high gain IC amplifier drives a ratio detector which provides an emitter follower audio output. The audio goes through a phase compensation network and a low pass filter with a 67 kHz notch for SCA carrier rejection and through the muting FET.

Multiplex

The IC multiplex circuit is a cross-coupled multiplier demodulator which provides additional 67 kHz rejection. A low pass filter with dual notch rejection for 19 kHz and 38 kHz is followed by the deemphasis network. With the FM-AUX switch on the front panel in the FM position, the audio passes through the volume control and an audio amplifier with 28 dB of gain. The output impedance of the audio amplifier is 1000 ohms, which permits very long connecting cables with low losses. The AUDIO and TAPE outputs are paralleled and the level of each is dependent on the setting of the volume control.

Meter

The amplified meter circuit is specifically designed to reflect maximum differentiation of the weakest signals for optimum antenna orientation, while defining as well those signals which reach unusually high intensity. Meter feeds are obtained after the first 4-pole ceramic filter and after the limiting amplifier.

Muting

The audio muting action is controlled by a combined logic circuit which is fed by the detector output. It senses the detector's DC shift, and switches off the audio (mutes) when the variation from center exceeds 80 kHz. It is also activated by a second signal which is the output of a 150 kHz high pass filter. Any (interstation) noise at this point is amplified, and its presence switches off the audio.

Dynatune

This automatic tuning logic circuit may be thought of as a highly amplified closed loop tracking circuit with a narrow "window". The detector's DC output is amplified by a high gain operational amplifier. This output is fed back to the front end through a limiter in what may be considered a servo-loop. This signal controls the frequency of the oscillator, and tracks for zero DC at the detector output. With proper factory alignment, the zero DC detector output can be assured of being the preset minimum distortion point.

The output of the servo amplifier must be switched off, or it would lock on one signal all the time. The AFC "window" is controlled by the limiter independent of the muting action. When the DC level reaches a predetermined value at the detector output by the action of moving the dial, the muting logic circuit switches off the servo-loop before audible noise or distortion is observed. Only when the muting logic circuit perceives a lack of interstation noise will the audio (and the servo-loop) be switched on again.

Indicator Lights

The "Tuned" light is switched by the output of the muting logic circuit. The "Stereo" light is actuated by the same circuit, plus the presence of the 19 kHz multiplex carrier. It has a longer time constant, however, to avoid any audible noise accompanying its operation.

Power Supply

The full wave bridge rectified supply includes zener diode (shunt) regulation on the negative side, and series transistor regulation on the positive side.

GETTING THE MOST FROM YOUR TUNER

The simple 300 ohm twinlead folded dipole antenna supplied with your FM-5 will be convenient to use. Because of the extreme sensitivity and excellent quieting characteristic of your Dynatuner, this antenna will be capable of meeting the requirements in many typical installations.

This folded dipole type of antenna has equal pickup from opposite directions, and has maximum response to a signal coming from right angles (broadside) to the top of the "T". Therefore best reception will be achieved when it faces toward (points 90° from) the direction of the station. While such an antenna can be placed under a rug, or simply dangled from the back of the tuner, better reception will usually be obtained when it is mounted higher up. It can be tacked to the back of a cabinet, taped along wooden bookshelves, pinned along the back of a sofa or even against a wall. It should not be attached to any metal surfaces (these will tend to "absorb" the signal) and it should not be folded over, for this will adversely affect reception.

If you find that reception is not satisfactory with the antenna supplied and an outside, roof-mounted antenna is not practical, you may be able to improve directionality by using an ordinary set of TV "rabbit ears" of the simplest form. These have the added virtue of mobility in difficult areas. They can be turned to effect maximum pickup from different directions or moved to avoid particular room interference effects. They usually work best when they are extended horizontally. Connect them to the outer 300 ohm antenna screw terminals.

With any indoor antenna, the building structure may reduce its performance. This is particularly true of steel reinforced concrete structures, which often shield antennae all too well. Similarly, furniture placement and the movement of people through the room can affect the reception of some signals. Often the simplest solution is to fasten the antenna to the outside of a window ledge, or to a board mounted outside the window. Be careful that the lead-in is not squeezed by the window. If necessary, the lead-in (the portion which has the connecting lugs) may be extended with similar type wire.

Roof-Mounted Antennae

By far the most satisfactory results from any quality stereo FM tuner will be obtained with a roof-mounted, directional antenna. The general rule of thumb is that if a television set requires an external antenna, so too will an FM tuner. The same effects you see as "ghosts" on television are apparent as multipath dispersion in stereo FM. Such effects are most common in cities where tall buildings provide many signal reflections, but trees and hills can also cause similar effects.

When selecting an antenna, competent advice from a local dealer who has experience with various systems, and knows the needs of your location, can be of great help. Here are some general tips which may assist you.

There are three criteria by which an antenna should be judged: gain, directionality and front-to-back ratio. Gain is the amount of signal amplification provided. Directionality refers to the sharpness of its acceptance pattern in selecting one compass direction, and minimizing signals from widely divergent compass points. The front-to-back ratio is a separate element of directionality, in that it specifies the ability to reject a signal coming from the rear. Some highly directional antennae are capable of picking up signals from the rear almost as well as from the front, and thus have a low front-to-back ratio.

Yagi or log periodic antennae should be used, though they are more costly than the omni-directional (non-directional) designs. Non-directional antennae are more subject to multipath effects, and offer no more gain than the folded dipole, though the roof location may afford some improvement in reception of some signals.

In the city there is usually plenty of signal strength, but the reflections from surrounding buildings require good directionality and an excellent (high) front-to-back ratio for good stereo reception. Unfortunately, to obtain these, it is usually necessary to buy a high gain antenna. As a result you may find that you have such high signal intensities that some stations may come in at several points on the dial. These are known as images, or spurious responses, from which no tuner is immune. To overcome these, you can install an attenuator, or resistive network at the input terminals to "pad down" the signal. A type which can be switched out would enable you to pick up weak stations when desired. Write Dynaco for details.

For suburban locations, like those in "fringe areas", you need only consider gain if you are interested in receiving the maximum number of stations clearly. A strong local transmitter can impose special directional considerations, though.

If all of your stations are from one general direction, the antenna may be rigidly mounted facing that way. Or, if they are from two opposite directions, an antenna with reasonable gain and directivity, and a low front-to-back ratio may work well. However, if they are from many directions of the compass, you should use an antenna rotator.

If you are in a difficult reception area, you may find that changes in mast location, as well as its height, may effect improvements. In some cases, tilting the antenna off the horizontal is beneficial. Note that by far the most-used location is the least satisfactory: the chimney. Antennae are adversely affected by contamination, and heat affects the lead-in. A chimney supplies both in abundance.

The best antennae for FM use are cut specifically for the FM band, which lies between TV channels 6 and 7. Most television antennae also provide reasonable FM sensitivity, and these, with a single lead-in, can be used with a two-set coupler, or splitter, to provide slightly reduced signals to both FM and TV. Some television antenna systems actually reject the FM band. This may be the case in some apartment house distribution systems, though the more recent ones include FM as a rule.

If two antennae are mounted on the same mast, locate them at least 3 feet apart to minimize interference between them. Do not connect the terminals of one antenna to the terminals of a different antenna so as to use a single downlead. Always use separate lead-ins. This is quite a different matter from "stacking" or properly combining two similar antennas in close proximity to obtain a boosted more directional signal in extreme fringe locations.

Lead-In Wire

There are three basic criteria in selecting the appropriate lead-in: impedance matching (to avoid unnecessary signal loss), signal loss characteristic (expressed in db/100 feet), and shielding, or intrinsic resistance to interference.

There are two impedances of FM systems: 72 (or 75) ohms, and 300 ohms. The FM-5 provides for direct connection of either. The majority of antennae are designed for 300 ohm systems, but matching transformers, or baluns, may be used to convert from one antenna impedance to the other lead-in impedance with minimum signal loss. There are several types of 300 ohm lead-in, but only one 72 ohm in common use—coaxial shielded RG-59U. For extremely long runs, RG-11U is a lower loss equivalent.

RG-59U is used in many apartment house distribution systems and cable TV systems for it has relatively low signal loss and good life expectancy and very good shielding. It is fairly expensive and somewhat bulky, and the installation of connectors is a nuisance, but it is still preferred by many installers where interference, such as from motor vehicles, is a problem.

The most popular 300 ohm lead-in is the flat "ribbon" twinlead. It is the least expensive, has fairly low signal loss (at least when it is new), and low bulk, so it can be run (though with adverse effect on signal) under carpets and along walls with minimum unsightliness. Since it has no shielding, installers try to avoid horizontal runs as much as possible, stay away from metal surfaces like gutters and downspouts, and twist it about once each foot to reduce interference pickup. Twinlead is more subject than most to the effects of weather, and it should be replaced after about 3 years in most localities.

In fringe areas where maximum signal transmission is important, a special open wire 300 ohm twinlead uses plastic spacers to support the two conductors with a minimum of loss. It, too, has no shielding capability, and is affected by the elements. Weather resistance has been improved with some types of oval twinlead, both hollow and foam-filled, at the expense of considerable bulk and increased cost.

The most recent variation is shielded 300 ohm cable. It is the most expensive, with moderate signal loss, and is the bulkiest of all. It is well shielded and has good life expectancy, so it is preferred by many installers in urban areas.

The right choice of antenna and lead-in can take maximum advantage of the FM-5's superior performance. The antenna system is a substantially greater factor than any tuner design characteristic in achieving good reception of weak signals. The Dynatuner's front end has such low noise that it is doubtful if any form of booster or antenna amplifier can provide a signal with any listenable improvement over that directly from the antenna.

The critical listener may well spend as much for the antenna system as for the FM-5, but such a combination will accomplish far more than a rudimentary antenna attached to tuners several times the cost of the FM-5.

OPERATION OUTSIDE THE UNITED STATES CONNECTIONS FOR 240 VOLT AC LINE

The power transformer supplied in the FM-5 may be connected for a 240 volt AC line as well as for the standard 120 volt AC line, which is how the transformer is wired unless this manual is stamped "240 volt". The transformer has dual primary windings. They are connected in parallel for 120 volts, and in series for 240 volts. The notes to steps 93 and 94 of the wiring instructions, and the diagram on the pictorial insert detail the 240 volt connections.

The 1/10 ampere (100 ma) slo-blo fuse supplied with 120 volt wiring should be replaced with a 1/16 ampere (62 ma) slo-blo fuse when the tuner is wired for 240 volt use.

The FM-5 is designed for use with either 50 Hz or 60 Hz current. Variations of line voltage up to 10% from nominal value will not affect performance.

The standard 75 μsec FM de-emphasis time constant used in the United States is used in many other countries as well. If your location uses the alternative 50 μsec de-emphasis (common in Europe), capacitors C-64 and C-65 on the PC-26 board should each be changed to .0056 mfd.

ASSEMBLY INSTRUCTIONS

Assembly of the FM-5 is exceptionally simple when compared to other kits. The preassembled etched circuit boards have saved you much of the work, and the assembly that remains is arranged in an open, uncluttered layout that makes wiring quick and easy. The construction time will be only a few hours, but it is best to work slowly and carefully rather than worry about the time.

Construction will be greatly simplified if you have someone help you by reading the steps aloud, selecting the required parts, and preparing the necessary wire lengths as you proceed.

When you unpack your kit, check off the components against the parts list at the back of the manual. You can identify unfamiliar parts by matching them to the pictorial diagram or photograph.

Have the proper tools at hand before starting assembly. You will need a pencil-type soldering iron of 30- to 60-watt rating with a small tip, long nosed pliers, diagonal cutting pliers, a medium-sized screwdriver, and 60/40 *rosin core* solder not larger than 1/16" diameter. You will also find a damp sponge or cloth helpful to wipe the tip of the iron clean periodically. An inexpensive wire stripping tool is helpful, but some people prefer a single-edged razor blade for removing the insulation.

A good solder connection does not require a large amount of solder around the joint. A well-made connection looks smooth and shiny because the solder *flows into the joint* when both parts are hot enough.

There are four steps to making a good solder connection:

1. Make a good mechanical connection.
2. Heat *both* parts with the tip of the iron *at the junction.*
3. Apply solder to the *junction* until it melts and flows.
4. Allow the connection to cool undisturbed.

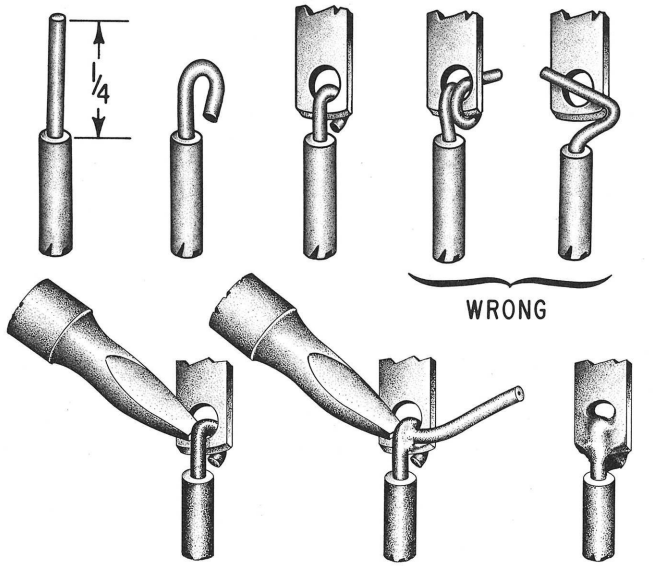
ALL SOLDERING MUST BE DONE WITH A GOOD GRADE OF ROSIN CORE SOLDER.

Under no circumstances should acid core solder be used. Unmarked solder, cheap solder or any of doubtful origin should be discarded, and *separate solder fluxes should never be used.* The warranty is voided on any equipment in which acid core solder or acid type fluxes have been used. Silver solder is not suitable. The recommended solder is 60/40 (60% tin, 40% lead) *ROSIN CORE.* Do not confuse this with 40/60, which is harder to use.

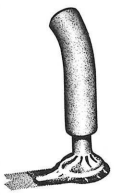
If you have a soldering gun, it should be used with care, especially when working on the circuit boards. A soldering gun can provide more heat than is necessary, with some risk that an unskilled user might damage the board, and because it requires some time to heat each time the trigger is squeezed, many users tend to make poor solder connections simply because they do not wait long enough for it to reach its operating temperature each time.

You should realize that many of the more delicate components are less likely to be damaged in the soldering process if you use a hot iron for a short time, rather than a cooler iron for a longer period. You will also make a better connection with the hot iron. If you keep the iron clean by wiping the tip frequently, and occasionally add a small amount of solder to the tip, it will aid the transfer of heat to the connection. Do not allow too much solder to build up on the tip, though, or it may fall onto adjacent circuitry.

One of the best ways to make a good mechanical connection is to bend a small hook in the end of the wire, and then to crimp the hook onto the terminal lug. The amount of bare wire exposed need not be exactly ¼-inch, but if it is too long, the excess might touch another terminal lug or the chassis. Do not wrap the wire around the lug more than one time, as this makes the connection difficult to remove if an error is made.



When soldering a lead to an eyelet on a circuit board or front end, you may wish to apply the iron to one side of the board while the tinned wire end is pressed into the solder-filled eyelet from the opposite side. When the eyelet is heated, the wire enters easily, but be careful that you *do not push the wire all the way into the eyelet up to the insulation.* If you do, you will not be able to see if you have made a secure connection, or if more solder is needed to provide a smooth flow from the wire, to the eyelet, and onto the circuitry on the board.



WIRING THE KIT

The position of all wire leads should follow the diagram and photograph closely, bearing in mind that the pictorial diagram has necessarily been distorted somewhat to show all connections clearly. See that uninsulated wires do not touch each other unless, of course, they are connected to the same point. It is especially important that uninsulated wires or component leads or terminals do not touch the chassis accidentally.

Whenever one wire is to be soldered to a connection such as a lug terminal or eyelet, the instructions will indicate this by the symbol (S). If more than one wire is to be soldered to the same point, the instructions will cite the number of wires that should be connected to that point when it is to be soldered. If no soldering instruction is specifically given, do not solder; other connections will be made to that point before soldering is called for.

When the instructions refer to "tinning" a wire, apply the iron to the bared wire end, and after a moment, touch the solder to the wire so that the solder lightly coats the wire. This makes it easier to get a good connection when the wire is inserted into an eyelet, for example.

Check your work after each step, and make sure the entire step has been completed. When you are satisfied that it has been correctly done, check the space provided and go on to the next step. Be sure you read carefully the explanatory paragraphs in the assembly instructions.

Many of the wiring steps will call for "preparing" a wire of a certain length and color. This involves cutting the necessary length of wire and stripping ¼ inch of insulation from each end. This is most easily done with wirestrippers, but diagonal cutters can be used if you are careful not to nick the wire and weaken it. With stranded wire such as transformer leads and line cords, be particularly careful not to cut the strands when stripping the ends.

The two etched circuit boards and the "front end" have been completely in-circuit tested at the factory. They have been precisely aligned as a matched set. When handling them be particularly careful that you do not disturb any of the adjustments on the variable resistors and the variable capacitor which are mounted on them. Since these assemblies include all of the active components, this assures their operation to specification as a complete tuner. Only the interconnection of these parts is left to you.

Transistor equipment, unlike much tube equipment, will not tolerate wiring errors, sloppy or incomplete soldering. TAKE THE TIME TO BE NEAT AND ACCURATE, and your tuner will operate properly at first, and for many years to come.

Two sizes of screws and nuts are supplied with the kit: the small #4 size, and the large #6 size. For your convenience, no #4 lockwashers are supplied. Use #6 lockwashers when #4 hardware is called for. A "set" of hardware includes one each screw, nut and lockwasher.

All mounting screws are installed from the *outside* of the chassis, and a lockwasher is used under each nut, except when otherwise specified.

Also supplied are 3 #6 self-tapping screws, which can be identified by their blue color and scored tip. These should be separated from the rest of the hardware and set aside until called for when installing the "front end" in the instructions.

Mechanical Assembly

Select the front panel (the one with the large cutout), and place it so that the wings at the ends are toward you.

1( ) Select one of the DPTT rocker switches. These have 8 lugs. Select one ¾" #4 screw, one of the tubular spacers, and a small lockwasher. Install the screw in the left (outside) mounting hole of position DS. Slip on the lockwasher, followed by the spacer, and thread it into the switch, but do not tighten it yet. No nuts are needed to secure any of these switches.

2( ) Select the DPDT switch (6 lugs), a ¾" #4 screw, and one of the tubular spacers. Place the switch in location AS and insert the screw into the mounting hole between the switches, through switch AS, then through the spacer, threading it into the flange of switch DS. Tighten both screws. No lockwasher is used on switch AS.

3( ) Select the remaining DPTT switch, another ¾" #4 screw, and a tubular spacer. Insert the screw through the panel and the right flange of AS, then through the spacer, and thread it into the switch installed at MS. Do not tighten this screw yet.

4( ) Select the remaining ¾" screw, the remaining spacer, and a small lockwasher. Install the screw in the last switch mounting hole, then the washer, the spacer, and thread it into the switch. Tighten both screws.

5( ) Select the volume control, and slip a ⅜" lockwasher on its shaft. Install it at location VC, and fasten it with a ⅜" nut. Position it so that the lugs are facing to the left as in the pictorial diagram, and tighten the nut securely.

6( ) Set the front panel aside for a moment and select the long black-front sub-panel and the two blue lamp covers. Handle the black-finished pieces with care to avoid fingerprints or scratches on the exposed portions. Insert the two lamp covers through the round holes from the black side of the panel. Each is a snug fit. These should *not* be forced all the way through to where the cap touches the panel. Leave about ⅛" clearance so that when the meter cover is installed next, these will be held tightly against the cover.

7( ) Select the black meter cover, the meter, and two #6 sheet metal screws. Remove the wire wrapped around the meter lugs. Bend the lugs to the rear for clearance, and insert the meter from the black side of the sub-panel with its scale toward the outer edge. *See that the meter scale is seated in the cutout,* and install the meter cover so that it encloses the meter and lamp covers. Fasten it in place with the two screws through the holes in the rear *nearest the blue lamp covers,* tightening these securely.

8( ) Select the T-shaped lamp bracket and two #6 sheet metal screws. Install the bracket so that it projects outwards, in similar fashion to the bracket at the other end of the sub-panel, and secure it *carefully* (check the alignment of the meter scale in the cutout) with the two screws.

9( ) Select the two clip-type lamp holders, two ground lugs, and two each #4 screws and nuts. Install a lamp holder at each end of the sub-panel on the *front* (black side) of each lamp bracket, with the connecting lugs pointing towards the center of the panel. Insert the screw through holder from the clip side, through the bracket, the ground lug, and secure it with a nut. The ground lug should point towards the top (angled flange) of the panel.

10( ) Select a #6 screw and lockwasher, and one of the brass pulley supports. Insert the screw from the bottom of the right angle bracket adjacent to the meter, add the lockwasher on top, and attach the support to the bracket.

11( ) Select the two tubular dial lamps with white reflectors, and install them in the holder clips. The amount of light on the dial can be adjusted by rotating these lamps. The suggested position of the lamp nearest the meter has the white reflector positioned away from the meter. The other lamp faces the reflector in the *same* direction, to reduce the brilliance from that source.

12( ) With three sets of #4 hardware fasten the sub-panel assembly to the front panel assembly. Insert the screws from the outside of the panel.

13( ) Select a #6 screw and lockwasher, and the remaining pulley support. Insert the screw from the front of the panel in the corner hole above switch DS. Add the lockwasher, and attach the support.

14( ) Select the tuning shaft assembly, a ⅜" lockwasher, and ⅜" nut. Slip the lockwasher on the threaded portion of the shaft, and install the assembly in the hole below the pulley support. The loop of the "hairpin" spring should point to the adjacent upper corner of the panel.

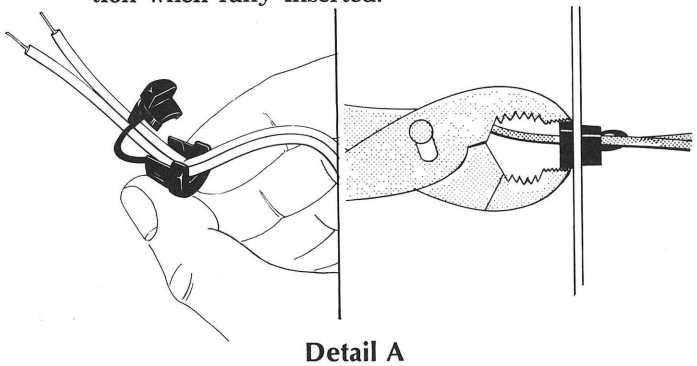
15( ) Set the front panel aside, and select the back panel, the two 3-socket audio output strips, and eight sets of #4 hardware. Install the two strips on the *inside* of the back panel (the unprinted side). Note that in each case the socket with the separate *short* ground lug toward the outside of the strip should be nearest the center of the panel.

16( ) Select the 3-lug screw terminal strip, one set of #4 hardware, and one each #4 screw, nut and ground lug. Install the strip on the *outside* of the panel with the connecting lugs nearest the bottom of the panel. The ground lug is used in place of a lockwasher on the end of the strip nearest the center of the panel, pointing toward the bottom of the panel.

17( ) Select the AC outlet, one set of #4 hardware, and one each #4 screw, nut and ground lug. Install the outlet from the *inside* of the panel. The ground lug is used in place of a lockwasher on the end of the outlet nearest the center of the panel, and points toward the center.

18( ) Select the fuse holder. Remove the nut and lockwasher, leaving the rubber washer in place. Install the holder with the lockwasher and nut on the inside of the panel, noting that a flat on one side mates with a corresponding portion of the hole marked "fuse" on the panel.

19( ) Select the line cord and the plastic strain relief. Separate the two conductors at the end of the line cord for about 6 inches, and mark the cord with a pencil 8 inches from the end. Cut off 4 inches from one conductor, and strip ¼" of insulation from both wires *if necessary*. Twist together the separate strands of each conductor. Bend the cord sharply back on itself at the pencil mark, and squeeze the bend with pliers to form a sharp "V". Install the strain relief at the "V" as shown in detail A, with the small end of the strain relief nearest the bared wire ends. Use pliers to squeeze the two halves of the strain relief together around the wire, to partially shape the wire before insertion. Then grasp only the larger diameter part of the relief with the tips of the pliers as shown, squeeze it fully closed, and insert the bared ends and the relief from *outside* the back panel through the remaining hole in the panel. The relief will snap into its locked position when fully inserted.



Detail A

20( ) Set the back panel aside, and select the chassis bottom plate, the 4 rubber feet, and 4 sets of #6 hardware. A foot is mounted in each corner hole of the chassis by turning the bottom plate over so it rests on the two flanges, placing a foot over the hole with the recess facing you, and forcing the screw fully into the recess in the foot. Secure each with a lockwasher and nut.

21( ) Select the power transformer, the 2-lug terminal strip, and two sets of #6 hardware. Mount the transformer so that the side with *four* leads is nearest the edge of the chassis. Install the terminal strip under the lockwasher and nut at the rear of the transformer, positioned as in the diagram.

22( ) Select the "front end", the 3 special blued thread-cutting screws, and 3 small lockwashers. Be careful when handling the front end that you do not touch the adjusting screw which may protrude slightly from one of the side holes. *Place a lockwasher on each screw first* and install the front end alongside the power transformer. If the special screws supplied have been lost, obtain replacements from Dynaco. Too long a screw here will damage the front end, requiring its replacement at your expense.

This completes the mechanical assembly portion of the construction. Set the chassis aside, and place the front panel before you.

Wiring

1( ) Prepare a 6½" red wire. Connect one end to AS lug #2. (S). Connect the other end to VC lug #3. (S). Position this wire above the switches, under the sub-panel.

2( ) Prepare a 7" green wire. Connect one end to AS lug #5. (S). Position this wire under the switches, along the bottom of the panel, and connect the other end to VC lug #6. (S).

3( ) Prepare an 8" black wire, but remove ¾" of insulation from one end. Thread the longer bared end through MS lug #2 from the *top*, then through the center of the switch, and connect it to MS lug #4. *Solder both* lugs.

4( ) Prepare a 2" green wire. Connect one end to MS lug #6. (S). Position this wire under the switches and connect the other end to AS lug #6.

5( ) Prepare a 7" green wire. Connect one end to AS lug #6. (S-2).

6( ) Select the .0082 mfd capacitor. Cut each lead to ⅜". Position the capacitor below MS and connect one lead to MS lug #7. (S). Connect the other lead to MS lug #5.

7( ) Prepare a 1½" red wire. Connect one end to MS lug #5. (S-2). Connect the other end to AS lug #3.

8( ) Prepare a 7½" red wire. Connect one end to AS lug #3. (S-2).

9( ) Prepare a 4½" green wire, but remove ¾" of insulation from one end. Thread the longer bared end through DS lug #3 from the *top*, and connect it to DS lug #8. Do not solder at this time. Connect the other end to MS lug #3. (S).

10( ) Prepare a 6" black wire. Connect one end to DS lug #8. (S-2).

11( ) Prepare a 4¼" red wire, but remove ¾" of insulation from one end. Thread the longer bared end through DS lug #7 from the *bottom*, then through the center of the switch, and connect it to DS lug #5. *Solder both* lugs.

12( ) Prepare a 3½" red wire. Connect one end to MS lug #1. Connect the other end to DS lug #6.

13( ) Prepare a 6½" red wire. Connect one end to DS lug #6. (S-2).

14( ) Prepare a 7" green wire, but remove 1" of insulation from one end. Thread the longer bared end through DS lug #4 from the *bottom*, then across the top of the switch, and connect it to DS lug #2. *Solder both* lugs. Now check to make sure that none of the 3 bare wire jumpers on this switch touch other than their intended lugs.

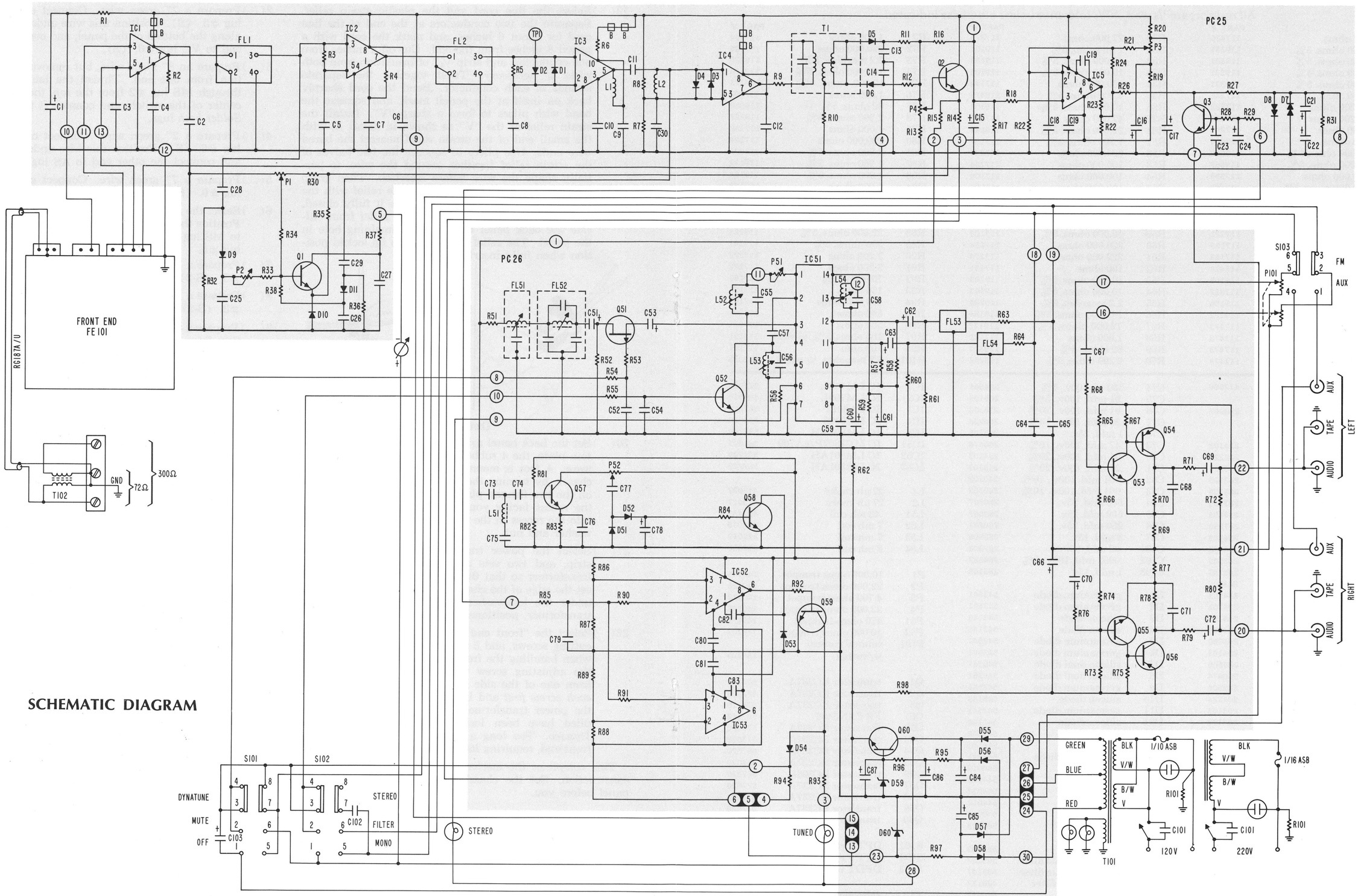
15( ) Prepare a 9" black wire. Connect one end to DS lug #1.

16( ) Select the 1.0 mfd electrolytic capacitor. Cut each lead to ½". Position capacitor straight out from DS and connect positive (+) lead to DS lug #3. (S-2). Connect the other lead to DS lug #1. (S-2).

17( ) Strip bare two ¾" pieces of wire. Connect one between the left lamp holder lug #1 and the adjacent ground lug. Connect the other between right lamp holder lug #3 and the adjacent ground lug. *Solder all four* lugs.

18( ) Prepare a 10½" green wire. Connect one end to the left lamp holder lower lug #2. (S). Connect the other end to the right lamp holder lower lug #4.

NOW TURN TO PAGE 15



SCHEMATIC DIAGRAM

PARTS LIST FOR SCHEMATIC DIAGRAM

All resistors are 1/4 watt, 10% tolerance unless otherwise indicated.

		PART #
R1	47 ohms	117470
R2	330 ohms, 5%	119331
R3	330 ohms, 5%	119331
R4	330 ohms, 5%	119331
R5	330 ohms, 5%	119331
R6	240 ohms	117241
R7	2,200 ohms	117222
R8	1,200 ohms	117122
R9	240 ohms	117241
R10	68 ohms	117680
R11	5,600 ohms, 5%	119562
R12	5,600 ohms, 5%	119562
R13	39,000 ohms	117393
R14	10,000 ohms, 5%	119103
R15	100 ohms	117101
R16	47,000 ohms	117473
R17	100,000 ohms	117104
R18	2,200 ohms	117222
R19	15,000 ohms	117153
R20	15,000 ohms	117153
R21	470,000 ohms	117474
R22	10,000 ohms, 5%	119103
R23	8,200 ohms	117822
R24	1 megohm, 5%	119105
R25	2,200 ohms, 5%	119222
R26	47,000 ohms	117473
R27	47,000 ohms	117473
R28	47,000 ohms	117473
R29	47,000 ohms	117473
R30	27,000 ohms	117273
R31	1 megohm, 5%	119105
R32	10,000 ohms, 5%	119103
R33	10,000 ohms, 5%	119103
R34	100,000 ohms	117104
R35	4,700 ohms, 5%	119472
R36	10,000 ohms, 5%	119103
R37	47,000 ohms	117473
R38	22,000 ohms, 5%	119223
R51	1,300 ohms, 5%	119132
R52	220,000 ohms	117224
R53	100,000 ohms	117104
R54	100,000 ohms	117104
R55	100,000 ohms	117104
R56	150 ohms	117151
R57	3,900 ohms, 5%	119392
R58	3,900 ohms, 5%	119392
R59	10,000 ohms, 5%	119103
R60	220,000 ohms	117224
R61	220,000 ohms	117224
R62	100 ohms	117101
R63	10,000 ohms, 5%	119103
R64	10,000 ohms, 5%	119103
R65	2.2 megohm, 5%	119225
R66	180,000 ohms, 5%	119184
R67	12,000 ohms, 5%	119123
R68	1,000 ohms	117102
R69	82 ohms, 5%	119820
R70	2,200 ohms, 5%	119222
R71	1,000 ohms	117102
R72	220,000 ohms	117224
R73	2.2 megohm, 5%	119225
R74	180,000 ohms, 5%	119184
R75	12,000 ohms, 5%	119123
R76	1,000 ohms	117102
R77	82 ohms, 5%	119820
R78	2,200 ohms, 5%	119222
R79	1,000 ohms	117102
R80	220,000 ohms	117224
R81	8,200 ohms, 5%	119822
R82	1,200 ohms, 5%	119122
R83	1,000 ohms, 5%	119102
R84	1,000 ohms	117102
R85	100,000 ohms	117104
R86	22,000 ohms, 5%	119223
R87	390 ohms, 5%	119391
R88	22,000 ohms, 5%	119223
R89	390 ohms, 5%	119391
R90	2,200 ohms	117222
R91	2,200 ohms	117222
R92	10,000 ohms	117103
R93	150 ohms	117151
R94	100,000 ohms	117104
R95	560 ohms	117561
R96	560 ohms	117561
R97	150 ohms, 5%, 1/2 watt	113151
R98	100 ohm	117101
R101	3.3 megohm, 1/2 watt	112335

		PART #
B	ferrite bead	417590
C1	200 mfd, 15v.	283207
C2 to C12	.01 mfd, 100v., 20%	234103
C13	220 pf, 5%	245221
C14	220 pf, 5%	245221
C15	1 mfd, 25v.	283105
C16	1 mfd, 25v.	283105
C17	1 mfd, 25v.	283105
C18	.01 mfd, 100v., 20%	234103
C19	33 pf, NPO	247330
C20	.01 mfd, 100v., 20%	234103
C21	5 mfd, 15v.	283505
C22	5 mfd, 15v.	283505
C23	1 mfd, 25v.	283105
C24	5 mfd, 15v.	283505
C25	.01 mfd, 100v., 20%	234103
C26	.01 mfd, 100v., 20%	234103
C27	.01 mfd, 100v., 20%	234103
C28	5.6 pf, NPO	244050
C29	5.6 pf, NPO	244050
C30	.01 mfd, 100v., 20%	234103
C51	5 mfd, 15v.	283505
C52	.47 mfd, 100v., 10%	260474
C53	5 mfd, 15v.	283505
C54	.22 mfd, 100v., 10%	204224
C55	.01 mfd, 33v., 5%	263103
C56	.01 mfd, 33v., 5%	263103
C57	.1 mfd, 100v., 10%	204104
C58	.0022 mfd, 33v., 5%	263222
C59	.01 mfd, 100v., 20%	234103
C60	200 mfd, 15v.	283207
C61	5 mfd, 15v.	283505
C62	5 mfd, 15v.	283505
C63	5 mfd, 15v.	283505
C64	.0082 mfd, 100v., 5%	264822
C65	.0082 mfd, 100v., 5%	264822
C66	200 mfd, 15v.	283207
C67	1 mfd, 25v.	283105
C68	.001 mfd, 100v., 10%	240102
C69	1 mfd, 25v.	283105
C70	1 mfd, 25v.	283105
C71	.001 mfd, 100v., 10%	240102
C72	1 mfd, 25v.	283105
C73	360 pf, 100v., 5%	254361
C74	560 pf, 100v., 5%	254561
C75	.01 mfd, 100v., 5%	205103
C76	.01 mfd, 100v., 20%	234103
C77	.22 mfd, 100v., 10%	204224
C78	1 mfd, 25v.	283105
C79	.47 mfd, 100v., 10%	260474
C80	.01 mfd, 100v., 20%	234103
C81	.01 mfd, 100v., 20%	234103
C82	.001 mfd, 100v., 10%	240102
C83	.001 mfd, 100v., 10%	240102
C84	500 mfd, 25v.	280507
C85	500 mfd, 25v.	280507
C86	250 mfd, 25v.	280257
C87	5 mfd, 15v.	283505
C101	.02 mfd, 500v.	227203
C102	.0082 mfd, 100v., 5%	264822
C103	1 mfd, 15v.	283105
D1	germanium diode	543541
D2	germanium diode	543541
D3	silicon diode	543148
D4	silicon diode	543148
D5	germanium diode	543541
D6	germanium diode	543541
D7	silicon dual diode	546361
D8	silicon dual diode	546361
D9	germanium diode	543541
D10	silicon diode	543148
D11	germanium diode	543541
D51	silicon diode	543148
D52	silicon diode	543148
D53	silicon diode	543148
D54	germanium diode	543541
D55	silicon diode	544012
D56	silicon diode	544012
D57	silicon diode	544012
D58	silicon diode	544012
D59	zener diode	540014
D60	zener diode	540113
FE101	front end	553503
FL1	4-pole ceramic filter	505107
FL2	4-pole ceramic filter	505107
FL51	phase comp. filter	420122
FL52	67 kHz filter	420022
FL53	19 kHz filter	420100
FL54	19 kHz filter	420100
IC1	IC LM703L	587010
IC2	IC LM703L	587010
IC3	IC CA3012	587012
IC4	IC LM3028	587028
IC5	IC LM301AH	587709
IC51	IC MC1307P/μA769	587307
IC52	IC LM301AH	587709
IC53	IC LM301AH	587709
L1	27 μh choke	413027
L2	27 μh choke	413027
L51	.43 mh coil	422431
L52	7 mh coil	422019
L53	7 mh coil	422019
L54	8 mh coil	422038
P1	10,000 ohms trimpot	140103
P2	22,000 ohms trimpot	140223
P3	4,700 ohms trimpot	140472
P4	22,000 ohms trimpot	140223
P51	470 ohms trimpot	140471
P52	10,000 ohms trimpot	140103
P101	volume control w/switch	180203
Q1	transistor BC237A	577020
Q2	transistor BC237A	577020
Q3	transistor BC237A	577020
Q51	FET 2N5462	597462
Q52	transistor BC237A	577020
Q53	transistor BC237A	577020
Q54	transistor BC308B	567070
Q55	transistor BC237A	577020
Q56	transistor BC308B	567070
Q57	transistor BC237A	577020
Q58	transistor BC237A	577020
Q59	transistor BC237A	577020
Q60	transistor D40D2	574001
S101	DPTT rocker switch	337001
S102	DPTT rocker switch	337001
S103	DPDT rocker switch	334006
T1	ratio detector	432022
T101	power transformer	464122
T102	RF balun	414022

19( ) Prepare a 13″ red wire and a 14½″ black wire. Connect one end of the red wire to AS lug #4. (S). Connect one end of the black wire to AS lug #1. (S). Place these wires *below* switch DS to the left, and twist them together uniformly throughout their length to within one inch of the shorter end. Place the pair off the panel to the left.

20( ) Prepare a 13½″ red wire, and connect one end to VC lug #2. (S).

21( ) Prepare a 14″ green wire, and connect one end to VC lug #5. (S). Twist together this wire, and the red wire in step 20 to within one inch of the shorter end. Place this pair to the left, under all the other wires and then perpendicular to the panel at AS.

22( ) Prepare a 13½″ black wire, but remove ¾″ of insulation from one end. Thread the longer bared end through VC lug #4, and connect it to VC lug #1. *Solder both* lugs.

23( ) Prepare a 9″ black wire, and connect one end to VC lug #7. Place this wire off the panel to the *right*.

24( ) Select the .02 mfd disc capacitor and the insulating sleeving. Cut each capacitor lead to ¾″. Slip ½″ of insulating sleeving on each lead. Position the capacitor to the right and connect one lead to VC lug #7. (S-2). Connect the other lead to VC lug #8.

25( ) Prepare both a 10″ black wire and also a 6½″ green wire. Start with the green wire ½″ longer than the black wire, and twist them together until one inch of the green wire remains. Using the ½″ different ends, connect the black wire to the lower meter lug #2. (S). Connect the green wire to meter lug #1. (S). Connect the free end of the green wire from underneath to MS lug #1. (S-2). Bend the free end of the black wire perpendicular to the panel at MS.

Set the front panel assembly aside for the moment, and select the main chassis bottom plate. The front end has 3 groups of unnumbered eyelets—a total of 9—with #1 next to the chassis. In addition, a ground tab is located near eyelet #1 at the bottom, and another (unused) ground tab is next to eyelet #8 at the top.

You will be connecting wires to these eyelets on the front end and later on the circuit boards. A good connection is more assured if the wire is first "tinned" by heating it with the soldering iron and applying a small amount of solder to the tip of the wire before it is connected to the eyelet. In most cases, it is easiest to heat the solder-filled eyelet until the solder melts, and then insert the wire, making sure the iron now touches the eyelet and the bared wire so that a smooth flow of solder is apparent. Then remove the iron, and hold the wire steady while the connection cools. Afterwards, wiggle the wire to be sure the connection is secure. There should be a smooth, shiny flow of solder from the wire to the eyelet, and from the eyelet to the board, obscuring the eyelet. If in doubt reheat the connection and add a bit more solder. Use reasonable care, for grossly excessive heating may cause the copper circuitry to separate from the board. If this happens, you can make a repair by soldering a piece of bare wire along the affected area.

Be very careful not to "bridge" solder across adjacent eyelets on the front end, where they are closely spaced. Also, do not let any specks of solder fall onto the boards where they could create a bridge on that circuitry which would cause a malfunction and be very difficult to locate later, to say nothing of possible damage to components.

26( ) Prepare a 2¼″ black wire. Connect one end to the front end *ground tab* near FE eyelet #1. (S). There is no hole in this tab, so connection is a bit more difficult. First "tin" the tab with sufficient solder to have a convenient connecting surface, and then solder the wire to the surface. Double check the security of this connection after it cools completely.

27( ) Prepare a 3¾″ green wire. Connect one end to the *front* side (nearest the ground tab) of FE eyelet #1. (S).

28( ) Prepare a 3¼″ red wire. Connect one end to the *front* side of FE eyelet #5. (S).

29( ) With two #6 sheet metal screws install the front panel assembly on the chassis bottom plate. The volume control VC is nearest the power transformer. Use only the front *corner* holes, and install the screws loosely to permit the panel to be tilted out slightly for easier working. Position the twisted wires from AS lugs #1 and #4 off the left side of the chassis and all the other wires straight back from the front panel flat against the chassis.

30( ) Select the shorter circuit board PC-25, two of the L-shaped mounting brackets, and 4 sets of #4 hardware. *Be very careful not to disturb* the settings of the four small trimmer resistors on the board. The numbered eyelets are located along the bottom edge of the board. Install the brackets on the components side of the board with the base extending away from the board. Insert the screw from the circuit side. Ignore any center hole in the edge of the board.

Now support the board in an upright position with the eyelets on top, so that the next 7 wires may be installed from the *back* (components side).

31( ) Prepare a 2½″ green wire. Connect one end to the *back* of PC-25 eyelet #2. (S).

32( ) Prepare a 2½″ red wire. Connect one end to the back of PC-25 eyelet #3. (S).

33( ) Prepare a 2½″ black wire. Connect one end to the back of PC-25 eyelet #4. (S).

34( ) Prepare a 5″ black wire. Connect one end to the back of PC-25 eyelet #7. (S).

35( ) Prepare a 2½″ red wire. Connect one end to the back of PC-25 eyelet #9. (S).

36( ) Prepare a 2½″ green wire. Connect one end to the back of PC-25 eyelet #11. (S).

37( ) Prepare a 1¾″ black wire. Connect one end to the back of PC-25 eyelet #13. (S).

To make future connections to eyelets faster, you may wish to take time now to "tin" the free end of every wire now protruding from the chassis, including the front end and the PC-25 board. This is easier than tinning each wire as you connect it.

38( ) Temporarily bend the 7 wires across the components side of the PC-25 board towards the opposite edge. Lay the board on the chassis on top of the wires coming from the switches, with the eyelets towards the front panel, in line with the front end eyelets, and with the components side of the board faced down.

39( ) Connect the short red wire from switch DS lug #7 to eyelet #6 of the PC-25 board. (S).

40( ) Connect the black wire from the *ground tab* near FE eyelet #1 to PC-25 eyelet #12. (S).

41( ) Connect the green wire from FE eyelet #1 to PC-25 eyelet #8. (S).

42( ) Connect the black wire from the meter to PC-25 eyelet #5. (S).

43( ) Connect the red wire from FE eyelet #5 to PC-25 eyelet #10. (S).

44( ) Select two sets of #4 hardware. Stand the PC-25 board upright and allow the 8 single wires plus one twisted pair from the switches to pass under the board to the rear of the chassis. Fasten the brackets to the chassis. It will make future connections easier if you observe the sequence of these wires on the diagram and put them in that order under PC-25 when you tighten the mounting bolts.

45( ) Connect the black wire from PC-25 eyelet #13 to the *back* of FE eyelet #2. (S).

46( ) Connect the green wire from PC-25 eyelet #11 to the back of FE eyelet #3. (S).

47( ) Select the PC-26 circuit board, the 2 remaining L-shaped brackets, and four sets of #4 hardware. Attach the brackets to the components side of the board as before, with the eyelets at the bottom. Be sure you do not disturb the settings of the 2 trimmer resistors on the board. Now support the board in an upright position with the eyelets on top so that the next wire connection can be made to the *components* side of the board.

Note that the eyelets on PC-26 are close together in some cases where adjacent eyelets represent the same circuit connection. Because of space limitations a couple of the eyelets are not separately numbered. They are all in sequence along the edge of the board, so you should have no difficulty determining the location of each eyelet.

48( ) Prepare a 5½″ green wire. Tin each end and connect one end to the back of PC-26 eyelet #5. (S). Connect the other end to the back of PC-26 eyelet #23. (S).

49( ) Prepare a 6½″ black wire. Connect one end to the back of PC-26 eyelet #27. (S).

50( ) Prepare an 8½″ red wire and also a 10½″ green wire. Start with the green wire ½″ longer than the red wire and twist them together until one inch of the red wire remains. Using the ½″ different ends, connect the green wire to PC-26 eyelet #22. (S). Connect the red wire to PC-26 eyelet #20. (S).

51( ) Temporarily bend the twisted pair of wires from PC-26 and also the single wire from PC-26 across the components side of the PC-26 board past the opposite edge.

52( ) Lay the PC-26 board components side facing down at the rear of the chassis with the eyelets toward the PC-25 board. Separate the wires coming from the switches so that they may be readily identified. Some of these wires may seem unduly long, but eventually they should all be positioned to pass under the PC-25 board between eyelets 4 and 6. If you have not done so before, these wires should be tinned before connecting them to the eyelets.

In the following steps, connecting references to eyelets will refer to the PC-26 board.

53( ) Position the long black wire from DS lug #1 under all the other wires, and connect it to eyelet #24. (S).

54( ) Connect the black wire from VC lug #4 to eyelet #21. (S).

55( ) Connect the red wire from AS lug #3 to eyelet #19. (S).

56( ) Connect the green wire from AS lug #6 to eyelet #18. (S).

57( ) Connect the green wire from VC lug #5 to eyelet #17. (S).

58( ) Connect the red wire of the twisted pair from VC lug #2 to eyelet #16. (S).

59( ) Connect the red wire from DS lug #6 to eyelet #13. (S).

60( ) Connect the black wire from MS lug #2 to eyelet #10. (S).

61( ) Connect the green wire from DS lug #4 to eyelet #8. (S).

62( ) Connect the black wire from DS lug #8 to eyelet #2. (S).

63( ) Connect the black wire from PC-25 eyelet #7 to eyelet #25. (S).

64( ) Connect the red wire from PC-25 eyelet #9 to eyelet #15. (S).

65( ) Connect the black wire from PC-25 eyelet #4 to eyelet #7. (S).

66( ) Connect the red wire from PC-25 eyelet #3 to eyelet #6. (S).

67( ) Connect the green wire from PC-25 eyelet #2 to eyelet #1. (S).

68( ) Heat eyelet #30 until its solder melts and insert the red power transformer lead. (S).

69( ) Heat eyelet #29 until its solder melts and insert the green power transformer lead. (S).

70( ) Heat eyelet #26 until its solder melts and insert the blue power transformer lead. (S).

71( ) Connect the *white* power transformer lead (do not confuse it with the violet & white or the black & white leads) to the lower lug #4 of the right lamp holder on the front panel. (S-2).

72( ) Select the two indicator lamps. Install the one with the red lead in the bottom blue lamp cover on the front panel. Install the one with the white lead in the top blue cover. Push each lamp all the way into the cover, which is a snug fit. Place all 4 lamp leads down between the power transformer and the front end. Twist together the two blue lamp leads at the ends and "tin" them. Heat eyelet #28 of PC-26 until its solder melts, and insert the twisted pair. (S-2).

73( ) Select the prepared piece of coaxial cable. Heat FE eyelet #8 until its solder melts, and insert the (side) shield strands of one end into the *back* of this eyelet. (S). Push the cable down against the chassis toward the power transformer. Heat FE eyelet #9 until its solder melts, and insert the adjacent end of the center conductor into the back of this eyelet. (S).

Now it is wise to check carefully each of the eyelets to which a wire is connected on both sides of both boards, and the front end, to make sure that a smooth shiny flow of solder is apparent from the wire to the circuitry. If in doubt reheat the connection and add a bit more solder. Any possibility of a loose wire or improper connection is much easier to correct now.

74( ) Select two sets of #4 hardware. Stand the PC-26 board upright, and secure the brackets to the chassis.

75( ) "Tin" the end of the white lead from the upper indicator lamp on the front panel (you may wish to shorten it), heat eyelet #9 of PC-26 until its solder melts, and insert it into the back. (S).

76( ) "Tin" the red lead from the lower front panel indicator lamp, heat eyelet #3 of PC-26 until its solder melts, and insert it into the back. (S).

77( ) Connect the gray transformer lead to lug #2 (the grounded lug) of the 2-lug terminal strip. (S).

Set the main chassis aside for a moment, and select the back panel assembly. Place it with the AC outlet to the right.

78( ) Prepare two pieces of black wire, each 1¾" long. Connect one end of the first wire to the *pair* of *short* ground lugs between audio sockets #1 and #2. (S). Be sure the pair of lugs is soldered together. Connect the other end of this wire to the pair of short ground lugs between sockets #4 and #5. (S).

79( ) Connect the second piece of wire to the single *short* ground lug to the right of socket #3. (Do *not* solder.) Connect the other end of this wire to the lug to the right of socket #6. (S).

80( ) Prepare a 1½" red wire. Bend the lug of audio socket #1 sharply to the left so that it lies almost parallel to the back panel (but does not short against nearby hardware) and connect one end of the wire to socket #1. Connect the other end to socket #2. (S).

81( ) Prepare a 1½" green wire. Bend the lug of socket #4 sharply to the left, but not enough to short against nearby hardware, and connect one end of the wire to socket #4. Connect the other end to socket #5. (S).

82( ) Select the 3.3 megohm resistor, color coded orange, orange, green. Cut each lead to ½". Connect one lead to AC socket #1. Connect the other lead to the ground lug adjacent to AC socket #1. (S).

83( ) Prepare a 2¼" black wire. Connect one end to AC socket lug #1. (S-2). Connect the other end to the fuse holder tip lug #1.

84( ) "Tin" the shorter end of the AC line cord and connect it to the fuse holder tip lug #1. (S-2).

NOTE: If this unit is obtained in Canada, do not *solder.*

85( ) Prepare a 1½" black wire. Connect one end to the ground lug adjacent to lug #1 of the 3-screw terminal strip. (S). Connect the other end to lug #2 of that strip.

86( ) Select the antenna matching coil. Note that there are two single wires, and a twisted pair. The two single wires are interchangeable, but are insulated from each other. If undue heat or stress breaks down the enamel insulation between them, the tuner will not perform well. It is suggested that the end of the coil with the twisted pair be positioned farther from the panel for ease of installation. Connect the twisted pair to the 3-screw terminal strip lug #2. Connect one single wire to lug #1. (S). Connect the other single wire to lug #3.

87( ) Select two #6 sheet metal screws and install the back panel loosely on the chassis with one screw at each rear corner to permit the panel to be tilted outwards for working.

88( ) Connect the (side) shield strands of the coaxial cable from the front end to lug #2 of the 3-screw terminal strip. (S-3). Connect the center conductor to lug #3. (S-2). Now make sure the coil is properly placed clear of each of the lugs.

89( ) Select the red and green twisted pair of wires from PC-26. Connect the red wire to audio socket #1. (S-2). Connect the green wire to audio socket #4. (S-2).

90( ) Select the red and black twisted pair of wires from switch AS. Connect the red wire to audio socket #3. (S). Connect the black wire to audio socket #6. (S).

91( ) Connect the black wire from PC-26 to the short lug to the right of audio socket #3. (S-2).

92( ) Place the black wire from the volume control VC lug #7 around the outside of the power transformer and connect it to AC socket lug #2.

93( ) Twist together the violet and the violet & white transformer leads and connect them both to AC socket lug #2. (S-3).

NOTE. If this unit is to be used with a 240 volt AC line, connect only the violet lead to lug #2 of the AC socket. (S-2). Connect the violet & white lead to lug #1 of the 2-lug terminal strip.

94( ) Twist together the black and the black & white transformer leads, and connect them both to the fuse holder side lug #2. (S-2).

NOTE: If this unit is obtained in Canada, twist together the black and the black and white transformer leads and connect them to lug #1 of the 2-lug terminal strip. (Do not *solder).*

NOTE: If this unit is to be used with a 240 volt AC line, connect only the black lead to lug #2 of the fuse holder. (S). Connect the black & white lead to lug #1 of the 2-lug terminal strip. (S-2).

95( ) "Tin" the remaining end of the AC line cord and connect it to the volume control VC lug #8. (S-2). Be *certain* that all the strands of wire are soldered to this lug, and that there is *no possibility* for any of them to touch the outer casing of the control.

96( ) Tilt the back panel into its upright position. Be careful you do not pinch the red and white lamp wires. Secure it with two more #6 sheet metal screws. Install two more sheet metal screws to secure the front panel. Tighten all 8 screws. Be sure none of the screws cut the insulation on adjacent wiring.

This completes the wiring of your Dynatuner. You should check carefully for any insecure connections, and for any possibility of bare wires contacting other than the intended terminal. Turn the unit upside down and shake out any bits of solder or pieces of wire or insulation. The general placement of wires should conform to the photograph of the inside of the chassis. The 10 wires from the switches should pass under the PC-25 board between eyelets 4 and 6. This keeps them away from critical front end circuitry.

Final Assembly

1( ) Turn the protruding pulley shaft on the front end fully *counterclockwise*. Select a set screw, the L-shaped Allen wrench for it, and the 4" drum pulley. Insert the set screw in the pulley hub and install the pulley on the front end shaft so that the opening in the rim points to lug #2 of the 2-lug terminal strip behind the power transformer. The pulley hub should be flush with the top of the front end shaft when you tighten the set screw.

2( ) Select one of the small fiber washers, and one of the nylon pulleys. Install the washer on the vertical brass pulley support near the meter, and then add the pulley.

3( ) Select the two remaining fiber washers, and two nylon pulleys. Install one washer on the horizontal pulley support at the opposite end of the front panel, then a pulley, the other washer, and the last pulley.

4( ) Select the prepared dial cord and the dial cord spring. Attach the spring to one end, and hold the cord from the opposite end so that it falls free, to remove any tendency to tangle or twist. You should avoid twisting it during installation for best operation.

5( ) Turn the front end pulley fully *clockwise* so that the opening in its rim points toward the center of the front panel. Loop the free end of the dial cord over the tab (1) of the pulley nearest the meter. Maintain a steady slight tension on the cord while you bring it through the opening in the rim, and wrap it clockwise almost ¼ turn around the rim of the large pulley, then counterclockwise around the adjacent nylon pulley (2). Then across the front panel and over the top of the nylon pulley (3) nearest the panel, and down past the outside of the tuning shaft (4). Take 2½ complete counterclockwise turns around the tuning shaft, and then bring it up on the *outside* of the rear nylon pulley (5). Carry it clockwise over the top of the pulley, across the front of the tuner, and take almost a full turn clockwise around the large pulley. Bring it through the opening in the rim, and secure it by engaging the spring over the tab (6).

You may find that the dial cord seems short at first. There will be some stretching the first few times the dial is operated. If necessary to avoid deforming the spring (it will normally stretch to double its length) temporarily connect it with a short piece of wire, or reduce the wrap around the tuning shaft to 1½ turns.

6( ) With the dial in its original position for stringing, with the pulley opening towards the center of the panel, select the dial pointer and slip it over the top of its track. There should be a small amount of fore-and-aft play in this pointer, but if it is more than ⅛", you can *carefully* squeeze its mounting surfaces together. Do not squeeze them too tightly, or the tuning mechanism will not run freely. Slide the pointer to within ½" of the end of the dial above switch DS and slip the front strand of the dial cord through the 3 tabs of the pointer to secure it. First place it under the bottom tab, and then snap it over the outer tabs while holding the pointer on the track. This is an approximate position, and if the dial was assembled properly the pointer should traverse the panel as the tuning shaft is rotated.

7( ) Select the flywheel and two set screws. Install the set screws, and then slide the flywheel onto the tuning shaft with the grooved-out side facing the front of the tuner. With its rear surface flush with the end of the shaft, tighten both set screws.

8( ) Select the gold front plate, the two ⅜" nuts, and the plastic dial. Although the dial has been treated to resist static charge and fingerprints, handle it lightly, and only by the edges to keep it clear. Install the dial on the front panel, place the front plate over it, and secure them with nuts on the two shafts. If you find that the controls or switches do not clear the cutouts properly, their hardware can be loosened to shift them slightly to correct this.

9( ) Insert a set screw in each of the knobs. Install the large one on the tuning shaft. The small one should be installed on the volume control so that the indicator is at 7 o'clock when the control is switched off.

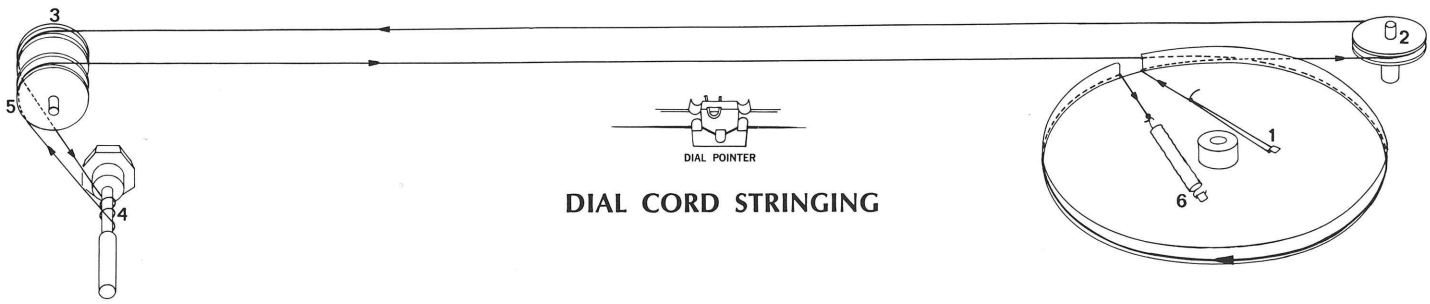
10( ) Turn the tuning knob until the pointer is at the extreme left of the dial. Align the pointer with the index mark above the "0" at the end of the dial by holding the dial cord and sliding the pointer along it. The stations should now appear at the proper locations on the dial.

11( ) Insert the fuse in the fuse holder on the back panel.

NOTE: If this unit is obtained in Canada, select the pigtail fuse and the insulating sleeving. Cut the fuse leads to ¾" and slip ½" of the sleeving on each lead. Connect one lead to lug #1 of the 2-lug terminal strip. (S-3). Connect the other lead to the fuseholder tip lug #1. (S-3).

12( ) Slide the cover over the tuner, and secure it with the 5 sheet metal screws. The 5th one is installed at the center of the back panel.

You may wish to secure the Allen wrench for the set screws with tape either inside the chassis, or under the bottom plate.



DIAL CORD STRINGING

WARRANTY AND SERVICE POLICIES

The FM-5 has been carefully engineered to provide many years of musical enjoyment without difficulty. Each factory-assembled FM-5 has been subjected to a full complement of performance tests prior to shipment. Every FM-5 circuit board and front end in the kit has been tested and aligned in operation as a fully functioning unit to verify its performance capability. Nevertheless, through damage in transit, faulty kit assembly, or human error, service may sometimes be required.

To provide rapid and reliable service, Dynaco has authorized competent, well-equipped service facilities in several localities in the United States and Canada, in addition to its service facility at the factory. These stations are authorized to make repairs in and out of warranty under the terms listed below. Service is always available at the factory, but you will often find a more convenient facility locally. Write to Dynaco for the name of the service station nearest you.

It is the owner's responsibility to take or send the unit freight prepaid to the service facility. In the event that you incorrectly diagnose which unit is faulty, please understand that you will be responsible for a check-out charge on any properly performing kit or factory-assembled unit submitted for testing.

Shipment should be made via United Parcel Service or Bus Package Express (or CN or CP Express in Canada) wherever possible. REA Express is an alternative (sometimes Air rates are lower than surface rates). DO NOT USE PARCEL POST FOR IT IS NOT A SAFE METHOD OF SHIPPING ELECTRONIC EQUIPMENT. Neither the factory nor the service stations have the facilities to process Parcel Post claims, so should damage occur due to Parcel Post shipment, any broken or damaged parts will be replaced at the owner's expense at net prices.

Always pack the unit properly in the original carton with all the protective inserts, and preferably in the plastic bag. If the carton is not available, the unit should be double-packed with adequate cushioning material between the cartons. Insure it for the full factory-assembled value. You may, if you wish, remove the flywheel to minimize the risk of damage in transit.

Include with the returned unit the following information: 1) Your name and complete shipping address (Post Office box numbers are not suitable); 2) the serial number (from the cover of this manual), *together with a copy of your dated bill of sale;* 3) the symptoms, complete, but preferably brief. If the problem is intermittent, this *must* be noted.

Warranties apply to the original purchaser only; they are not transferable. They do not apply to units which have been physically or electrically abused, or to units which have been modified without prior factory authorization. The use of non-Dynaco replacement parts may in some instances void the warranty. If you suspect a defect in the power transformer, the leads must be unsoldered, not cut for its return. The warranty on the transformer is void if the leads have been cut too short for re-use.

Dynaco maintains a Technical Services Department to help you locate the source of, and possibly correct a problem yourself. You may write or telephone. When writing, mention the serial number of the FM-5, describe the antenna you are using, and any tests you have performed.

Optimum tuner performance depends on its accurate alignment, and such alignment can be performed only with a full set of test equipment as specified elsewhere in this manual. Thus the need to replace any components on either circuit board incurs some doubt as to the tuner's ability to meet its full specifications. The factory may be able to tell you if it deems advisable the return of the complete unit for alignment, if you indicate whatever parts you find to be in need of replacement. *The return of a single circuit board is inadequate to assure proper alignment, and a single circuit board submitted for repair will be returned unserviced.*

WARRANTY FOR FACTORY ASSEMBLED UNITS

The FM-5/A is warranted for a full year from the purchase date, including parts and labor and shipment costs *from* the service facility to the owner (within the U.S. or Canada). The owner is responsible for shipment *to* the service facility, and must submit a copy of the dated bill of sale. A 90 day warranty is provided on the service work performed, including shipment both ways, labor and parts.

WARRANTY FOR KIT-BUILT UNITS

The components in an FM-5 kit are warranted for a full year from the purchase date. If a defective component is found in a completed circuit board, module, or kit, simply return that individual part to the *factory* prepaid, and it will be replaced at no charge. Local service stations are not obligated to supply separate parts.

If you cannot locate the source of the difficulty, ship the *entire* FM-5 to the nearest authorized service station or to the factory for service. *Individual circuit boards will be returned unserviced.* In-warranty parts will be replaced at no charge, although a nominal service fee will be charged for the labor to diagnose, correct, and test the unit to ensure that it meets factory specifications. Shipping charges to and from the service facility are the owner's responsibility. Units will be returned on a COD basis via UPS wherever possible. A 90 day warranty is provided on the service work performed, including shipment both ways, labor and parts.

This warranty is void if the kit has not been completely assembled, or if other than rosin core solder has been used. Units assembled with acid core solder or paste flux will be returned unserviced.

SERVICE BEYOND THE WARRANTY PERIOD

Dynaco establishes maximum labor fees which may be charged by its service facilities (plus the cost of parts, and shipping charges) without prior approval by the owner. A current list of authorized service stations, and the established fee for any unit will be supplied on request. Dynaco cannot assume responsibility for service at other than Dynaco authorized service stations.

Dynaco reserves the right to limit the service facility or the established fees to two years from the date of purchase. Dynaco assumes no liability or responsibility for damages or injuries sustained in the assembly or operation of this equipment.

PROFESSIONAL SERVICE ALIGNMENT

(FOR QUALIFIED PERSONNEL WITH THE PROPER EQUIPMENT ONLY)

There is no provision for any home alignment of the FM-5, and under no circumstances should any adjustments be made without the following service equipment:

1. Sound Technology 1000A FM alignment generator, or the equivalent, such as a Measurements Corporation Model 88 or 210A generator, plus a suitable multiplex generator with adjustable pilot level, and an accurate 67 kHz oscillator.
2. Oscilloscope—Hewlett Packard 130C or equivalent with its Diode Probe and a 10:1 Probe.
3. AC voltmeter with rms scale.
4. DC voltmeter, with 0.5 volt or less full scale; 10 megohms input impedance.
5. Intermodulation Analyzer.

Operate both the tuner and the instruments for at least 20 minutes prior to alignment.

IF Alignment

Locate a dial setting between stations. Switch the tuner to MONO, Dynatune OFF, and maximum volume. Tune the generator to the same frequency with 200 kHz deviation and a 3000 μv output. Connect the diode probe to the scope vertical input, with a sensitivity of 10 mv/cm. Set the scope's horizontal external sensitivity for 1 v/cm, with the sweep ("external" or "horizontal") output of the generator connected to the horizontal input.

The diode probe connected to TP 1 of PC-25 will show tuning as a bandpass curve. Center the curve on the scope display with the tuning knob. The IF secondary, accessible through a hole in the front panel, is the *only* adjustment on the front end. Seek the best combination of symmetry and amplitude.

Detector

Reduce the sweep to 75 kHz, but be careful not to touch the tuning of either the generator or the FM-5. Connect the DC voltmeter (on its most sensitive scale) to the tuner chassis and to eyelet #1 on PC-25. Adjust the secondary (top) of the detector transformer T 1 for zero. Disconnect the diode probe. Switch the generator to external modulation and connect IM analyzer to it. The IM signal should be in a 1:1 ratio to allow for de-emphasis. Adjust the IM analyzer level for 100% modulation as indicated on the modulation meter. Connect the tuner output to the IM analyzer. Adjust the primary (bottom) of the detector transformer for minimum IM. Remove IM analyzer.

Audio Level

Maintain 3000 μv signal level and switch to 400 Hz modulation. Adjust trimpot P 4 on PC-25 for 2 volts audio output from tuner with the volume control fully up.

Muting Threshold

Switch to MUTE, attenuate the generator output to 8 μv (assuming the use of a 2:1 balun), and adjust trimpot P 52 on PC-26 until the audio just mutes off. Adjust trimpot P 52 until audio just comes on (actually 4 μv).

Dynatune

Return the generator to 3000 μv. Connect the DC probe to eyelet #1 on PC-25. Retune for zero if necessary. Then switch the mute switch to DYNATUNE. If the zero indication changes *at all*, adjust trimpot P 3 on PC-25 for zero.

67 kHz Filtering

From an external oscillator connect an *accurate* 67 kHz source to the external modulation input of the FM generator. Connect the 10:1 probe to the negative side (the top end) of C 51. While observing the 67 kHz on the scope, adjust filter FL 52 for minimum amplitude.

Multiplex

Switch to STEREO. Connect the stereo generator to the external input of the FM generator. Connect the 10:1 probe to the vertical input of the scope, and set the internal sweep to approximately 2 milliseconds/cm. Connect the probe to eyelet #11 on PC-26. Peak both the 19 kHz coils L 52 and L 53 for maximum vertical deflection. Go back and forth.

Reduce the pilot level on the multiplex generator to 5%. Adjust trimpot P 51 until the STEREO light goes out. Then adjust trimpot P 51 until the STEREO light just comes on. The STEREO light should come on at 5% of the total modulation. Return pilot level at generator to 10%. Move the probe to eyelet #12 on PC-26 and adjust the 38 kHz coil L 54 for maximum vertical deflection. Remove probe.

With 1 kHz modulation on the left channel only, observe the right channel output and adjust first the 38 kHz coil L 54 and then the 19 kHz coil L 53 for minimum indication (maximum separation). Compare left and right separation. Switch to 10 kHz modulation on the left channel and adjust filter FL 51 for minimum indication (maximum separation).

Meter Adjustment

Switch to MONO and decrease FM generator output to 10 μv. Set trimpot P 1 on PC-25 for 25% meter deflection. Increase the FM output to 30,000 μv. Set trimpot P 2 for full scale meter deflection.

Service Note: The TUNED indicator lamp is a part of the muting circuit. If it is *open*, the audio will remain muted, even on a station. Switching the muting *off* will enable signal reception until the lamp is replaced. If the lamp is *shorted*, the muting circuit will not work and there will be noise between stations in all switch positions.

KIT PARTS LIST

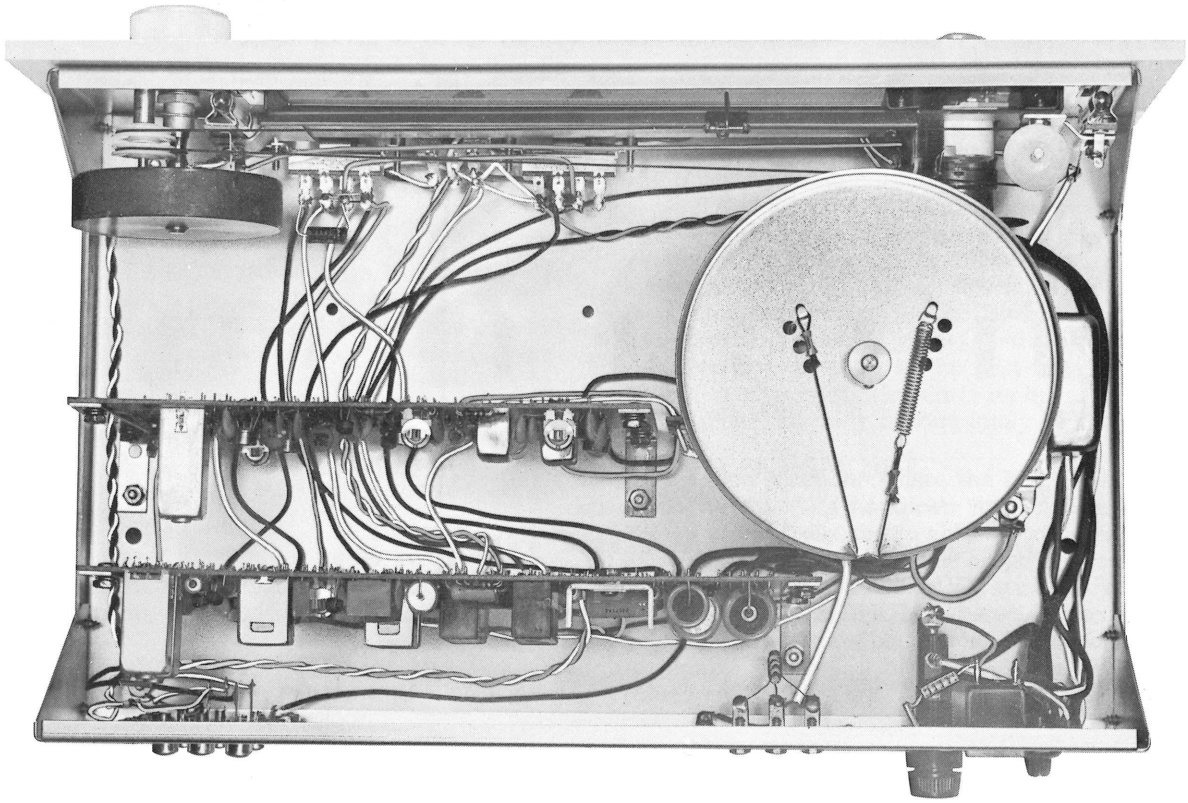
Parts of similar type which do not change performance will sometimes be included as a matter of expediency. This will account for slight variations in value and appearance.

		PART #
1	Chassis bottom plate	711622
1	Chassis front panel	711322
1	Chassis back panel	711222
1	Chassis sub-panel (black front)	711722
1	Circuit board assembly, PC-25	957025
1	Circuit board assembly, PC-26	957026
1	Cover	711022
1	Front End assembly	553503
1	Front plate—gold	769022
1	Transformer, power	464122
1	Transformer, power (Canada only)	464123
1	AC outlet	351001
1	Antenna	312316
1	Bracket, lamp holder	710122
4	Bracket, circuit board	710422
2	Cable, audio connecting	321072
1	Cable, coaxial shielded, 7"	320187
1	Dial plate, plastic	844022
1	Flywheel	715022
1	Fuse holder, with hardware	341001
1	Knob, small	764185
1	Knob, large	764184
2	Lamp holder, clip type	376022
1	Line cord	322092
1	Pulley, tuning, 4" diameter	717022
2	Socket strip, audio, 3 outputs	355003
2	Switch, rocker, DPTT (8 lugs)	337001
1	Switch, rocker, DPDT (6 lugs)	334006
1	Terminal strip, 3 screw	373003
1	Terminal strip, 2 lug	372001
1	Volume control with switch	180203
1	Wire, hookup, black	
1	Wire, hookup, green	
1	Wire, hookup, red	
1	Card, warranty	
1	Manual, instruction	

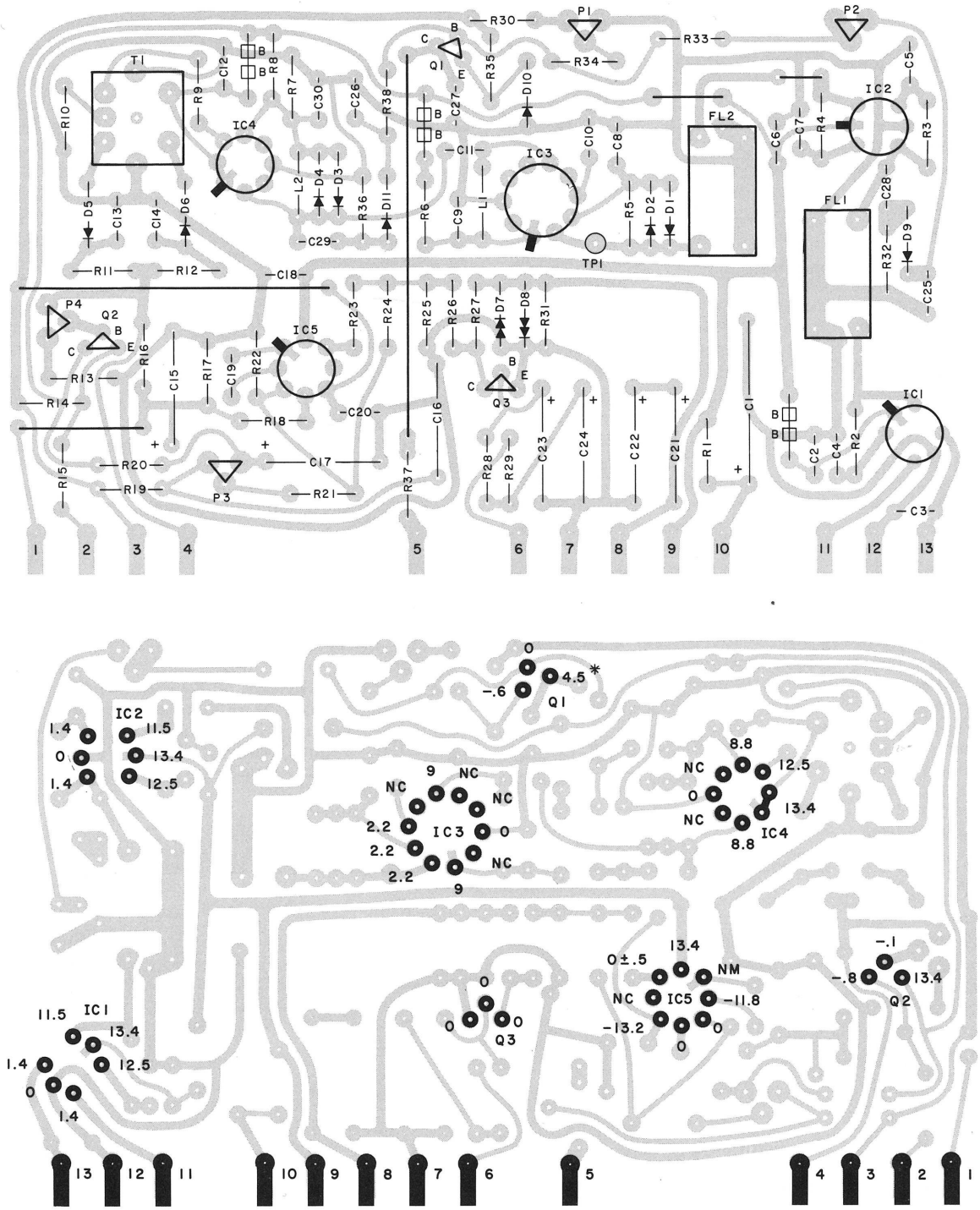
Hardware Envelope		PART #
4	Foot, rubber	859001
1	Fuse, 1/10 ampere slo-blo	342101
1	Fuse, 1/10 amp. slo-blo pigtail (Canada only)	342102
4	Ground lug	639308
38	Lockwasher, #6	617305
2	Lockwasher, 3/8"	617065
29	Nut, hexagonal, #4-40	614245
6	Nut, hexagonal, #6-32	614355
4	Nut, hexagonal, 3/8"	614065
4	Screw, machine, #4-40 x 3/4"	611205
29	Screw, machine, #4-40 x 1/4"	611245
8	Screw, machine, #6-32 x 5/16"	611355
3	Screw, self-tapping, #6 blue	613345
17	Screw, sheet metal, #6	612339
5	Set screw, 3/16" Allen head	613834
4	Spacer, tubular aluminum	660261
1	Strain relief, plastic	895001
3	Washer, fiber	876022
1	Wrench, Allen #5	968522

Small Parts Box		
1	antenna coil, balun, tubular	414022
1	capacitor, .02 mfd disc ceramic	227203
1	capacitor, .0082 mfd, 5% mylar	264822
1	capacitor, 1.0 mfd electrolytic	283105
1	dial cord assembly	890022
2	lamp, dial, tubular	526008
1	lamp, indicator, blue & white leads	526112
1	lamp, indicator, blue & red leads	526012
2	lamp cover, blue plastic	834022
1	meter	508022
1	meter cover, black	711522
1	pointer, dial	737022
3	pulley, nylon	894022
2	pulley support, brass	733122
1	resistor, 3.3 megohm, 1/2 watt	112335
1	sleeving, insulating	893001
1	spring, dial cord	712122
1	tuning shaft assembly	733022

Do not remove the teflon tape from the angled flange of the sub-panel.



PC-25



THIS VIEW IS OF THE CIRCUIT SIDE OF BOARD

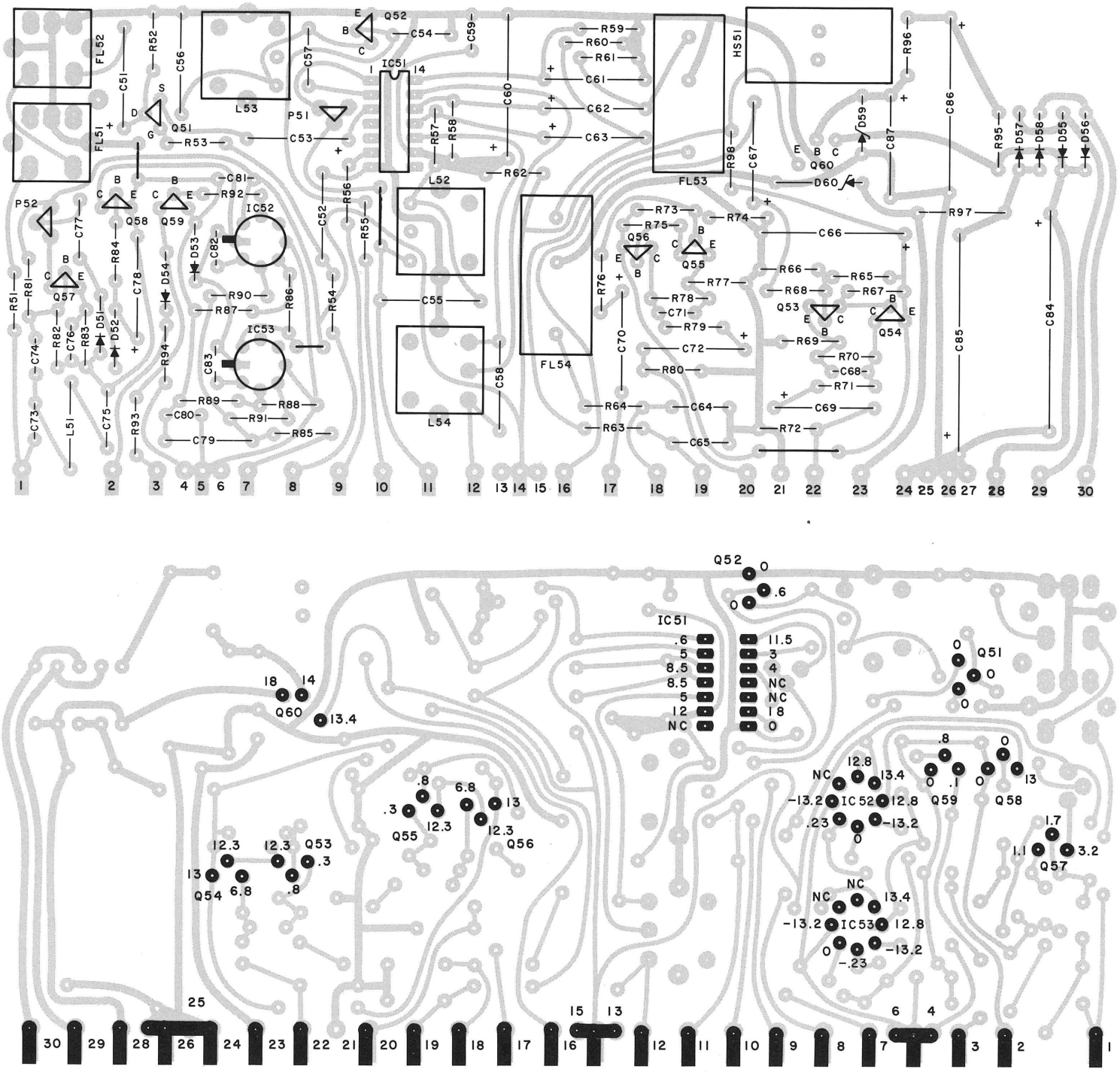
VOLTAGE TEST POINTS

Measured with VTVM or TVM with at least 10 megohms input impedance. All measurements taken with a 1500 μv input (unless otherwise noted), MONO mode, with muting switch in DYNATUNE. Chassis is ground reference. Be careful the meter does not short to adjacent circuit points or damage may result.

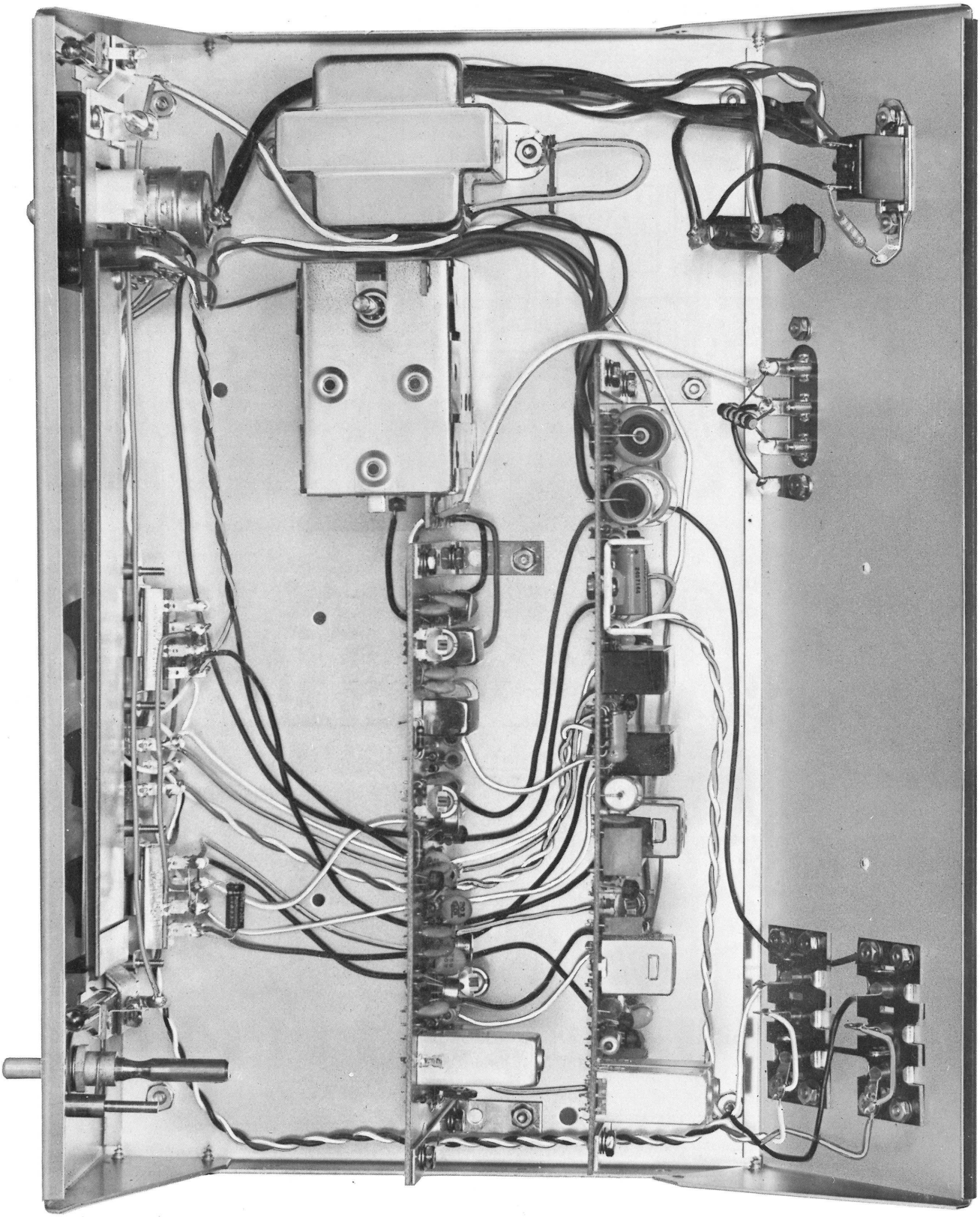
* @ full scale deflection of tuning meter
NC = No Connection

NM = Not Measurable (no meaning)

PC-26

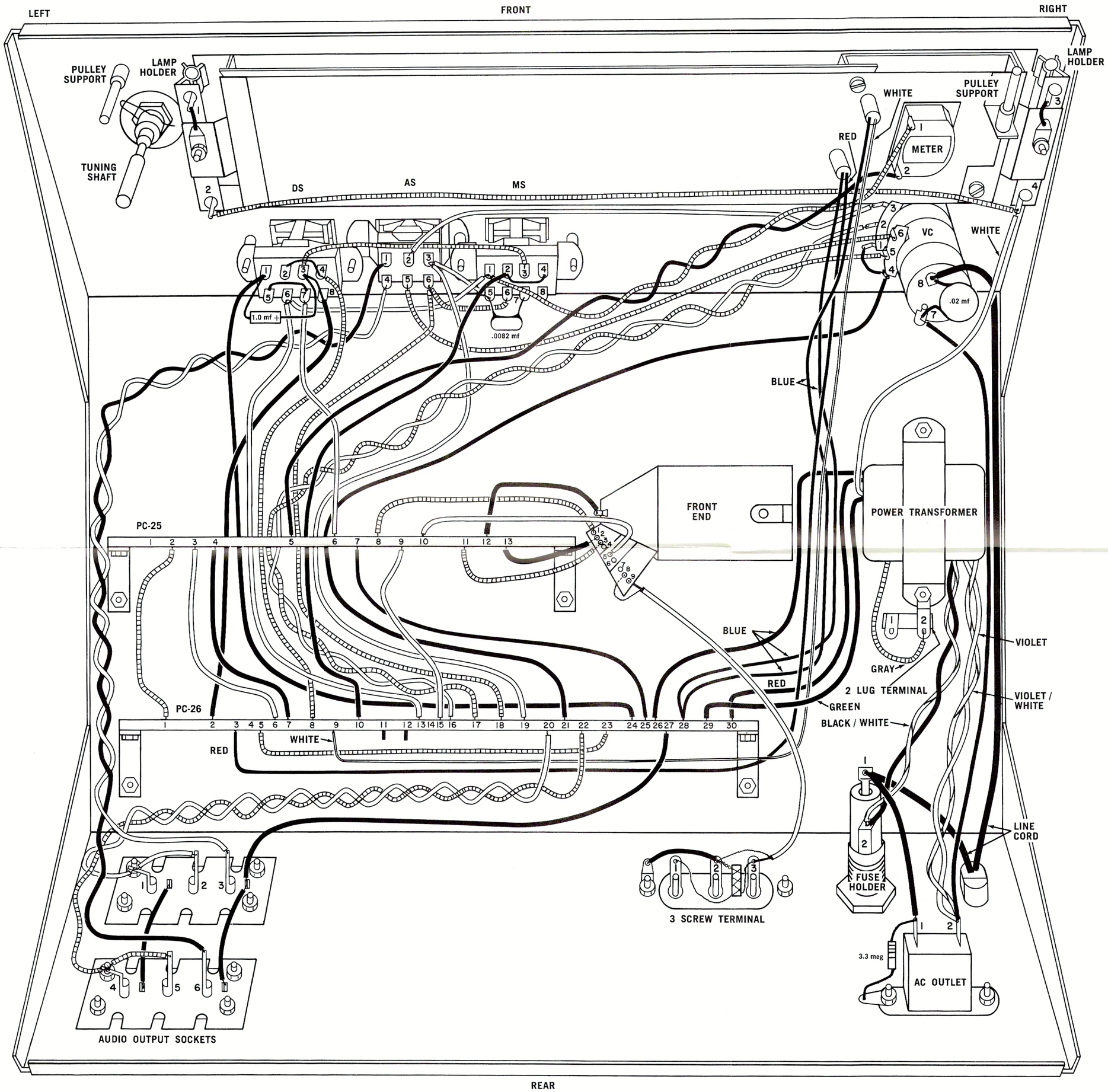


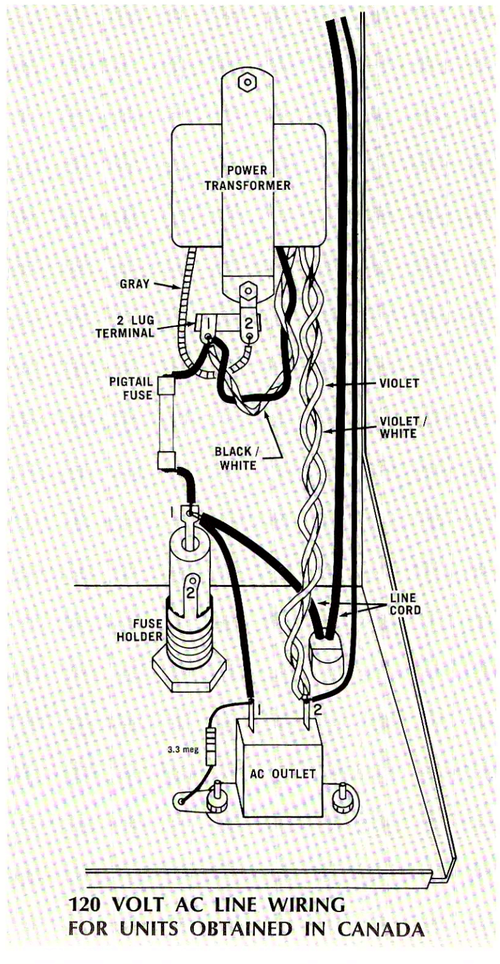
THIS VIEW IS OF THE CIRCUIT SIDE OF BOARD



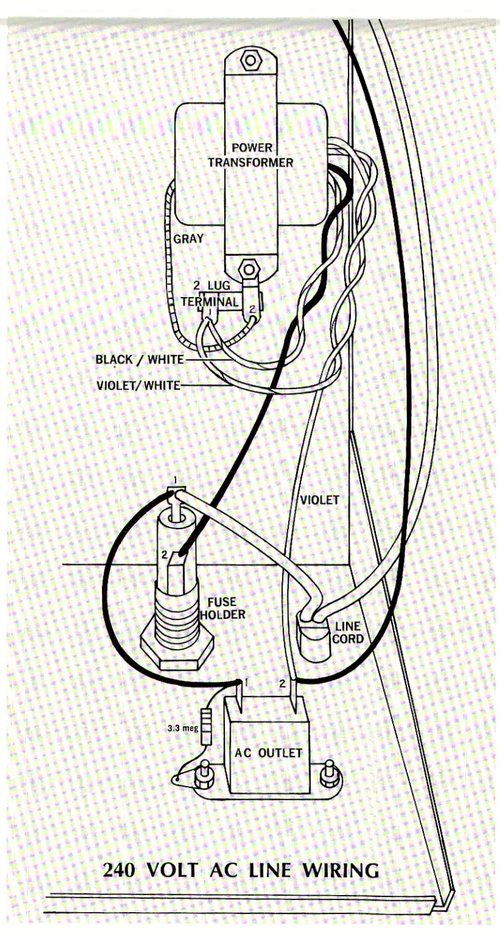
Printed in U.S.A.

FM-5 PICTORIAL DIAGRAM





120 VOLT AC LINE WIRING
FOR UNITS OBTAINED IN CANADA



240 VOLT AC LINE WIRING