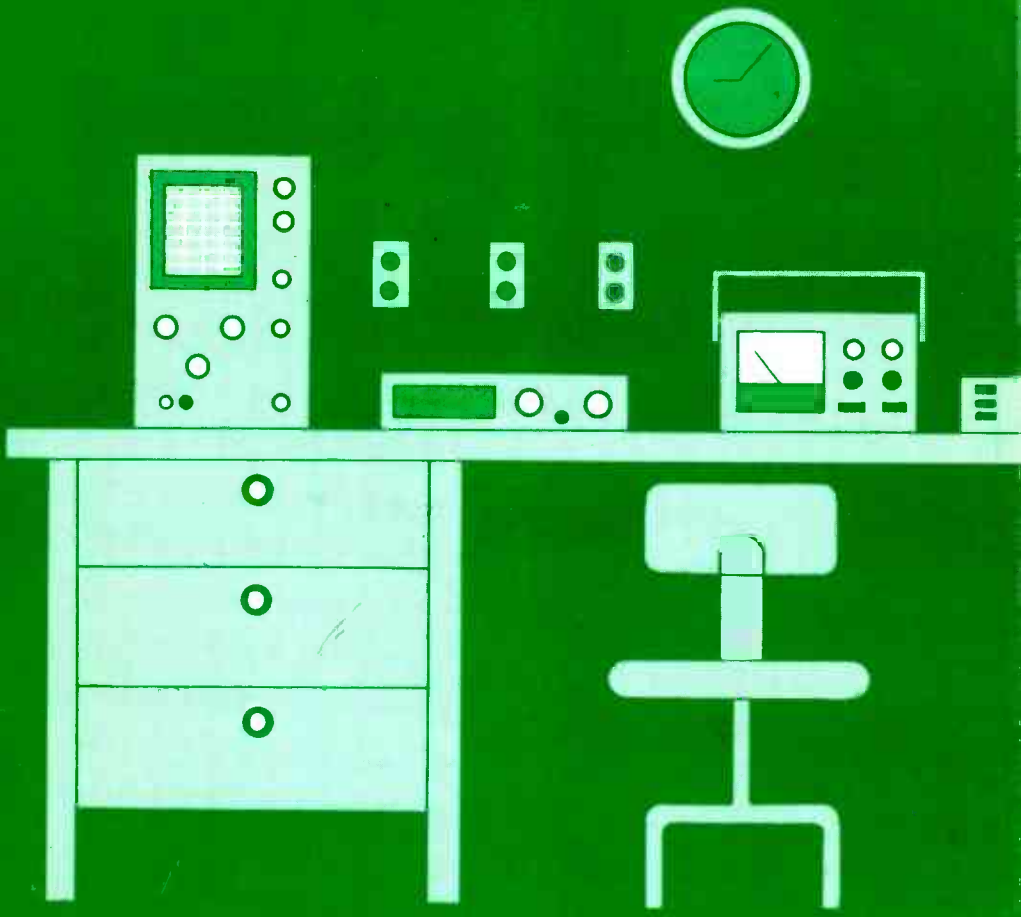

- The Great Venture (Part Two)
  Your Own TV Servicing Business:
  Building Your Workbench and Stock Supply
- Electronic Tuning

nri journal

March/April 1975

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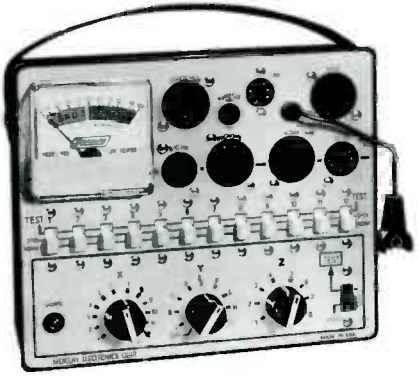
COMPACT TUBE-TESTER KIT



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In this issue, NRI technical consultant James Crudup continues his series of articles dealing with the triumphs and pitfalls of establishing a TV servicing business. Also, NRI presents a discussion of that recent development in television technology, electronic tuning.

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The Great Venture:

Your Own TV Servicing Business

Part Two

by James Crudup, C.E.T.

Any profit-making service business must be operated in an efficient and productive manner. To be efficient and productive, a service shop should be designed to ensure a smooth workflow. Time lost because of unnecessary trips, misplaced equipment and a poorly designed work area will cost you money.

Stocking a sufficient and adequate supply of parts is good business practice because it cuts down on inventory control and allows for faster turnover of money. Having the right part on hand to fix a set while a customer waits for it can be impressive to the customer and vital to a new, small business.

Probably the most important single item in a serviceman's shop is the workbench. It should be sturdy, well-designed, and comfortable to work at. Both time and money can be saved if the bench is strategically positioned in the shop. Because "time is money," income can be lost when unnecessary motions and trips are made in a poorly organized service shop.

Depending on the size of the shop, you may require more than one workbench. The location of the workbench is very important. Before you start construction of the bench, give a great deal of consideration to where the bench is to be located. A drawing of a shop with the workbench in position may be helpful. One possible shop layout is shown in Figure 1.

Since it's unlikely that you will find a sturdy, adequate workbench that can be purchased in assembled form, you will probably end up building your own. Figure 2 shows a satisfactory workbench. It shouldn't be too wide because it would then be difficult to reach the areas in the back. The bench should include electric outlets to accommodate test equipment. Allow adequate current capability for test equipment and the equipment being serviced.

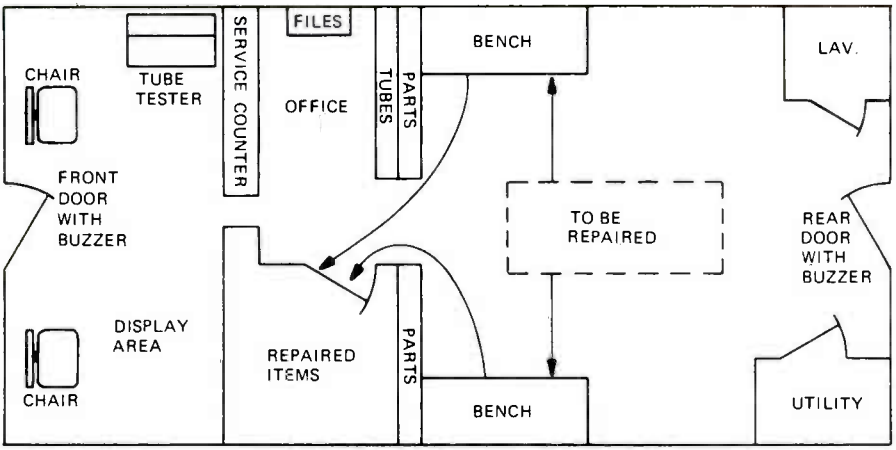


FIGURE 1.

This workbench is of all-wood construction and is assembled with screws and bolts to ensure rigidity. A work surface 36 inches wide and six feet in length is provided to accommodate large television receivers. The formica-covered two-inch thick bench top is strong enough to support heavy television receivers. Formica is very smooth and easy to clean. Sharp chassis corners will not mar it, and a hot soldering iron accidentally laid on the surface will cause an unmistakable odor before charring the surface.

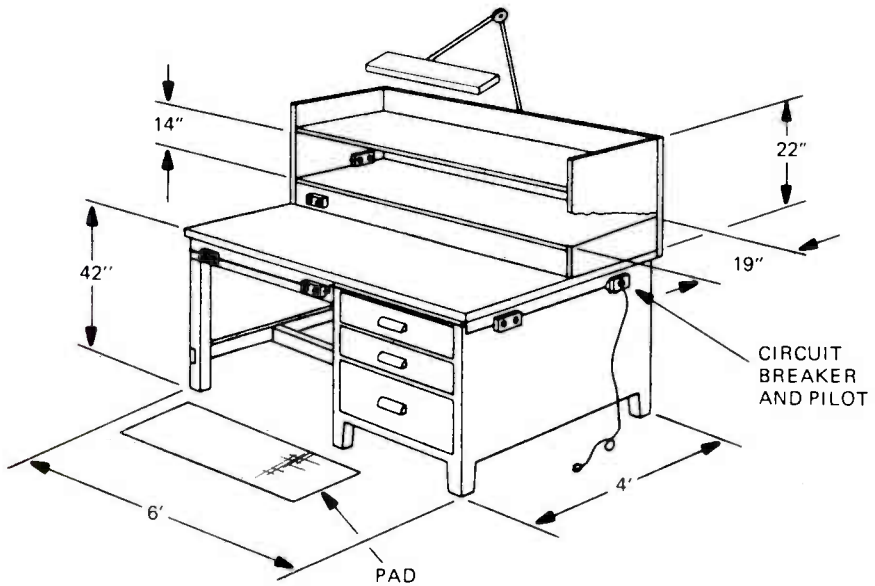


FIGURE 2.

A wide shelf at the back is provided for test equipment. Although a bench with a place provided for each unit of test equipment may present a more finished appearance, the arrangement of Figure 2 is often used because of its flexibility. The test equipment can be moved close to the unit being serviced, or it can be moved back out of the way. In addition, new test instruments may be added to the bench without the necessity of reconstructing a panel.

Drawers are provided to store hand tools, electric drills and bits, extra soldering irons and tips, test leads and many other items. Small parts such as resistors, capacitors, tubes, and transformers may be stored on shelves, in drawers, and in bins built alongside, above, and near the bench.

Standing at the bench for long periods can be very tiring; therefore, a high stool should be provided for those times when work can be done efficiently and conveniently while sitting down. A footrest, to help relieve fatigue when sitting down, is run across the front of the bench about 6 to 8 inches from the floor. A soft rubber pad placed on the floor helps to ease foot fatigue.

For men of average height, a bench three and one-half feet high is just about the right height. For the most comfortable working conditions, a very short man may have to reduce the height of the bench or a tall man may have to increase it.

After the bench construction is completed, electric outlets are installed. The layout of the electric outlets should be designed so as to keep the bench top free of line cords. Figure 3 shows the wiring of the outlets of Figure 2. The outlets along the back of the shelf are for test equipment; those under the shelf are for receivers and other equipment to be repaired. The front outlets are for a soldering iron, electric drill and various other items, such as a vacuum cleaner for cleaning the shop.

SHOP TEST EQUIPMENT

Most of us are aware that there is no substitute for good tools. This holds true for electronic equipment. The old cliche "you get what you pay for" should be taken seriously.

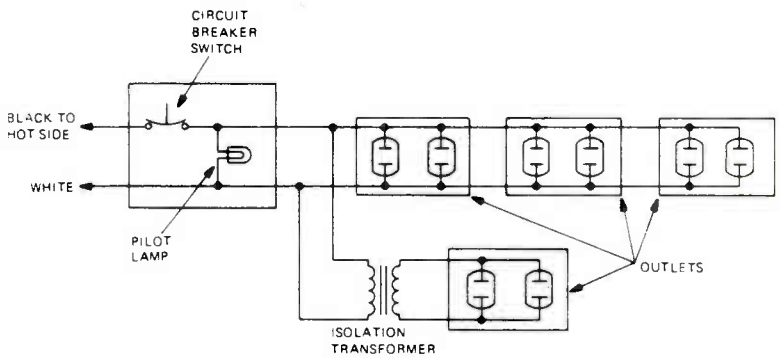


FIGURE 3.

You don't need as much equipment as you might think in order to start a television business. Start off with a few basic pieces of test equipment and add to it as your business grows. Don't waste money on elaborate but seldom-used equipment that will simply collect dust most of the time.

You can make most repairs efficiently with a good wide-band scope, high-impedance voltmeter, high-voltage tester, degaussing coil, picture tube tester, color-bar generator, signal generator, tube tester, and R/C substitution box. Although expensive, a commercial tube tester for customers will soon pay for itself many times. Fancy alignment test equipment really isn't required when you first open your shop doors. A small shop, one that averages less than 50 sets a month, probably wouldn't do one alignment a month. A $400 sweep/marker generator would be a poor investment in the infancy of a small service business.

At least two voltmeters should be in the shop, preferably one for each workbench. Also, each bench should be equipped with a set of tools and a soldering iron. A soldering gun is needed for heavy solder work.

If you plan to service car radios or car tape players, you will need a 12-volt power supply capable of at least 2 amperes. It's pretty easy to build a power supply of this type and save money. Refer to any solid-state hobby manual.

A test jig is a must for any service shop. It allows you to leave the customer's TV cabinet, picture tube, and yoke in his home. You take only the chassis to your shop. When you consider that some color TV cabinets are six feet long and weigh several hundred pounds, you can appreciate the advantages of having a test jig. By removing only the chassis from the customer's home you eliminate the possibility of causing damage to the receiver cabinet. You also eliminate the need for an extra man to carry the complete set. Scratching, burning, or marring the customer's cabinet is certainly taboo. The test jig consists of a cabinet, color picture tube, deflection yoke, convergence yoke, and extension cables to hook up the chassis. Again, time is saved. Leaving the yokes in place at the customer's home eliminates the need for purity and convergence adjustments. A good test jig can be used for many different types of chassis.

A picture tube tester, 12-inch degaussing coil, and high-voltage probe are necessities that no shop should be without.

PARTS

You can start a service business with a surprisingly small stock of parts. However, you will want to build up your stock gradually in order to reduce the number of trips or orders you must make to the parts suppliers, and so be able to give the fastest possible service.

With this small stock as a beginning, you can gradually increase the amount and variety of these parts. Keep a list of the replacement parts you use. By referring to this list, you will see what parts you use most frequently and how many of each item you should stock.

Some servicemen make the mistake of acquiring an excessively large stock. It is not wise to invest too much money in slow-moving parts. A new shop does not need to stock picture tubes, yokes or transformers. Order them as required. Increase the quantity and variety of your stock only as your service experience indicates the need for such expansion. Your local distributor can help you choose those parts that he has found to move most rapidly in your area.

Replacement parts fall into three groups: exact duplicate replacements, universal replacements, and general replacements. Exact duplicates are best because they fit both physically and electrically without any modifications. Try to get exact replacements when possible, especially when yokes or transformers are to be replaced.

Universal Parts

Universal parts are designed so that with minor physical or electrical alterations they can be used as replacements for a wide variety of radio and TV parts. For example, potentiometers come with extra-long shafts. When replacing a volume control, contrast, or brightness control in a TV receiver, once you have chosen a control with the proper electrical characteristics, you can make it fit the receiver by cutting off the shaft to the required length. Thus, the same control can be used in any receiver requiring a control that has its electrical characteristics.

General Replacement Parts

Finally, we have parts, such as tubes, transistors, diodes, resistors, and capacitors, that can be used in any receiver as long as they have the proper electrical characteristics and as long as there is room.

We include among these parts which, although not designed for the particular receiver, can be used by making some slight change in the original circuit to fit the new part characteristics. Changes of this kind are rarely necessary, because the widespread distribution of exact duplicate and universal replacement parts generally makes a direct replacement possible.

Whenever possible, tubes should be replaced with exact duplicates. It is not a good idea to install a tube of a different type from the one originally used in the set. Do so only if the original type is unobtainable. Substitutes don't always work.

Each year, more and more of the equipment serviced by electronics technicians is transistorized. Transistor manufacturers are well aware of the service technician's problem, and most have separate lines of semiconductors especially designed for replacement applications. These devices are made readily available to the serviceman through his regular parts dealer.

The most obvious way of finding a suitable substitute for a transistor or tube is to look up the type number in a substitution guide, such as the two published by Howard Sams & Company (Transistor Substitution Handbook and Tube Substitution Manual). These books are available from CONAR, at your local

distributor, or order directly from Sams at 4300 West 62nd St., Indianapolis, IN 46268.

The largest replacement lines of solid-state parts are made by RCA (SK series), International Rectifier (TR series), Motorola (HEP series), Sylvania (ECG series), General Electric (GE series), and Delco (DS series). Ask for information on them from your wholesaler.

MAKING HOUSE CALLS

The outside man plays an important part in a TV service business. In some small shops he is the backbone of the business. A good outside man must be a good customer relations man as well as a good technician. His actions should reflect a concern for the customer, honesty and technical competence. The exact amount of each will vary with each service call. A good outside man who is motivated and properly supervised can be an asset to any service shop.

It is generally assumed that extensive or time-consuming troubleshooting won't be done on service calls. If the problem can't be corrected within an hour, it's probably best to pull the chassis and work on the set back at your workbench.

TABLE 1

PARTS FOR SERVICE

Tubes

☐ 1B3	☐ 6CG3	☐ 6GM6	☐ 6KD6	☐ 17JZ8
☐ 1V2	☐ 6CG8	☐ 6GU7	☐ 6KE8	☐ 21GY5
☐ 2AV2	☐ 6CJ3	☐ 6GY6	☐ 6KM6	☐ 23Z9
☐ 3A3	☐ 6DO6	☐ 6HA5	☐ 6KN6	☐ 31LQ6
☐ 3AT2	☐ 6DW4	☐ 6HB7	☐ 6KT8	☐ 33GY7
☐ 3GK5	☐ 6EA8	☐ 6HQ5	☐ 6KZ8	☐ 38HE7
☐ 3HA5	☐ 6EH7	☐ 6HV5	☐ 6LB6	☐ 38HK7
☐ 4BZ6	☐ 6EJ7	☐ 6JC6	☐ 6LQ6	☐ 42KN6
☐ 5GH8	☐ 6FQ7	☐ 6JE6	☐ 8FQ7	
☐ 6AX4	☐ 6GF7	☐ 6JS6	☐ 12AX7	
☐ 6AY3	☐ 6GH8	☐ 6JU8	☐ 12BY7	
☐ 6BK4	☐ 6GJ7	☐ 6KA8	☐ 12GN7	

Solid State Parts

☐ SK3052	☐ SK3124	☐ SK3016	☐ SK3010	☐ SK3040
☐ SK3054	☐ SK3132	☐ SK3017	☐ SK3018	☐ SK3041
☐ SK3082	☐ ECG 155	☐ SK3066	☐ SK3021	☐ SK3042
☐ SK3103	☐ ECG 131	☐ SK3004	☐ SK3024	☐ SK3088
☐ SK3114	☐ HEP 707	☐ SK3009	☐ SK3025	☐ SK3109

Assorted thermistors
Assorted line cords
Assorted fuses
Assorted fuseable resistors
Assorted capacitors (all types)
Assorted circuit breakers

TABLE 2

Ice pick	Long 1/4" nut driver
Wire strippers	Multimeter (with current ranges)
Flashlight or troublelight	Resoldering tool
Lock jaw pliers	Soldering iron
Small screwdriver	Soldering gun
Phillips screwdriver	Solder
General screwdriver	Service mirror
6 Allen wrenches	Degaussing coil
Long-nose pliers	Assorted screws and nuts
Side-cutting pliers	Glue (quick drying)
6 adjustable end wrenches	Tuner cleaner
Keyhole saw	Alcohol
8" file	Corona dope
1/4" nut driver	Electrical tape
5/16" nut driver	Assorted batteries
3/8" nut driver	Freeze mist
Diagonal cutters	

There are certain parts that fail more often than others. These are the parts you want to have when you make house calls. Certain tools are required in order to do the work efficiently. Large, fragile or expensive test equipment should be left behind in the shop. To prevent this equipment from being lost, stolen, or damaged, don't carry it around on service calls.

Tubes will probably cost you more than any of the other equipment that you carry in your caddy. It takes time to build up a well-stocked tube caddy. You can start out stocked pretty well with the tubes listed in Table 1. Keep a current tube price chart in your caddy. You should be able to purchase this stock of tubes from your wholesaler for less than $100. One of each will do for the time being. When you use one, put two in the next time you buy parts. Don't take tubes from the shop stock unless it's an emergency. After you've serviced a few sets you'll find out which tubes are popular and which to stock the most of.

With the influx of hybrids and solid-state sets, you should also carry a few transistors on service calls. Those in Table 1 should be helpful.

You don't want to be bogged down with too much equipment on a service call but you want to take enough. In the beginning I could carry everything I needed in my tube caddy, but over the years I have had to start carrying a small tool box also. Table 2 lists the items I carry in my tool box. The degaussing coil fits in my tube caddy.

Be prepared. Before you leave the shop you should know where you are going. Call and obtain directions if necessary, and if you might be late, always call the customer and explain. If you have a clerk or receptionist, let them handle scheduling, routes and courtesy calls. Spend the time required to carefully study each call you are going to make. Look over the customer's complaint, and, if at all possible, obtain a schematic of the set and diagnose the probable trouble. Always try to have the schematic if you aren't familiar with the set. The complete Sams photofact is quite helpful. Parts are pointed out so you can find them quickly.

There is a parts list and the schematic includes voltages and waveforms. Note the tubes most likely to be needed for each repair and make sure you have them in your box.

A cheaper method of obtaining service information is to buy the all-in-one TV schematic/service manuals for both color and black-and-white receivers published by the Tab Book Company located at Blue Ridge Summit, Pennsylvania 17214. These books are sold in most electronic supply houses.

CUSTOMER RELATIONS

How you treat the customer and how you act on a service call is just as important as the repair, if not more so. You want to leave a very positive and cordial impression. The customer generally associates these qualities with an honest and proficient repairman.

Being courteous means simply that you should do everything you possibly can to help the customer. Remember, you are selling service and the customer is the one who is buying it. Some customers appear to make unreasonable demands like, "But it was a much clearer picture before you fixed it," or "Could you look at this radio while you're here?," etc. To the first demand, make certain that everything is as it should be and then hook up your color generator (even on a monochrome set!) and show her that your "precise test equipment" is producing the best possible picture. To the second demand, if you have time, take a quick look at whatever else needs fixing. If it's simple, fix it. On the other hand, if you have to disassemble something or if more than a visual look is required, schedule another service call or take it with you for repair.

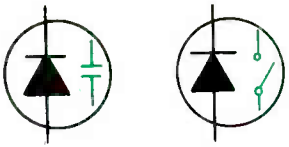
Always be sure to protect the customer's furniture (including the TV cabinet!) and the rug or floor behind the set where you work with a large protector cloth. They do not take up much room and will impress the customer with your thoughtfulness and careful work habits. Don't mix business with pleasure. When you have completed a repair, make up the bill, get your payment and leave.

SERVICE CALL TROUBLESHOOTING HINTS

Here are ten of the most popular troubles.

1. **Bad line cord.**
2. **Bad on/off switch (carry on/off switches, cut shaft as required for correct length).**
3. **Bad tubes (mostly horizontal output).**
4. **Open fuses.**
5. **Bad circuit breaker.**
6. **Dirty tuner (intermittent on some channels).**
7. **Poor purity or convergence.**
8. **Controls misadjusted.**
9. **Bad power supply rectifier (fuse blows quickly or circuit breaker kicks quickly).**
10. **Bad electrolytic (power supply or vertical section.)**

electronic TUNING



One of the most recent innovations in television tuners is the development of the electronic tuner. This tuner is generally smaller and more reliable than the switch-type tuner. Switch-type tuners malfunction because the switch contacts fail to make a good contact because they become dirty and with use the contacts lose their tension. These problems are reduced in the electronic tuner; electronic tuners should require little or no maintenance during the life of the TV receiver.

The electronic tuner has been made possible by two special diodes. Before studying complete electronic tuners, let's briefly review diodes and then study the two special diodes used in these tuners.

SPECIAL DIODES

The two special diodes you will encounter in electronic tuners are the varactor diode and the PIN diode. The varactor diode is used as a variable capacitor and the PIN diode is used as a switch.

The diodes we are concerned about are made by forming a junction between n-type and p-type silicon. At the junction, some of the electrons in the n-type material will move across the junction and fill holes in the p-type material. This will leave a hole in the n-type material. The electrons on the p-side of the junction will build up a negative charge so that no additional electrons can cross the junction. At the same time, the holes that will occur on the n-side of the junction will produce a positive charge so that additional holes will not move across from the p-side of the junction. At the junction we have a space charge due to the movement of the electrons across the junction into the p-type material and to the holes appearing on the n-side of the junction. On both sides of the junction we have what is called a depletion area, an area that does not have any majority carriers. You will remember that in n-type silicon, the electrons are the majority carriers and in the p-type silicon, holes are the majority carriers.

Now let's compare the junction diode with a capacitor. A capacitor is simply two metal plates separated by a dielectric. If we place a negative charge on one plate and

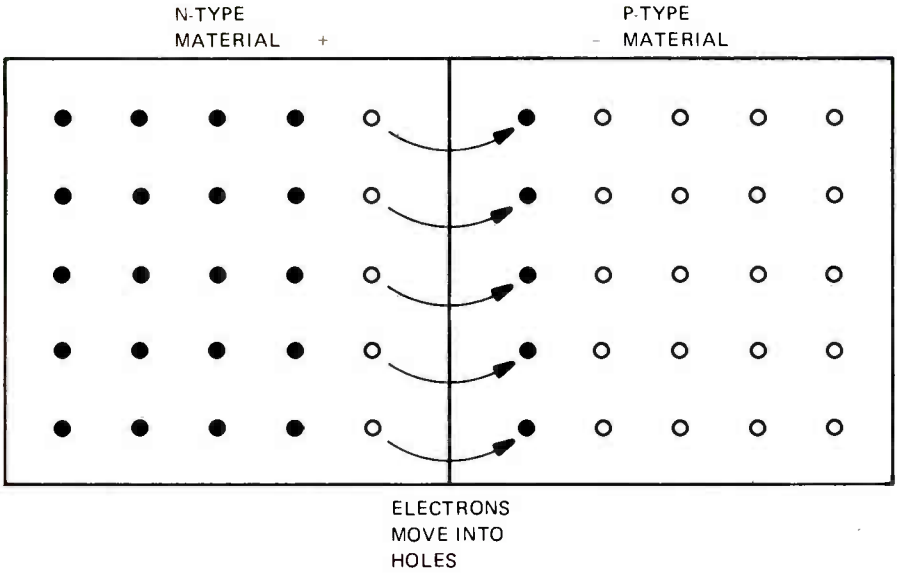


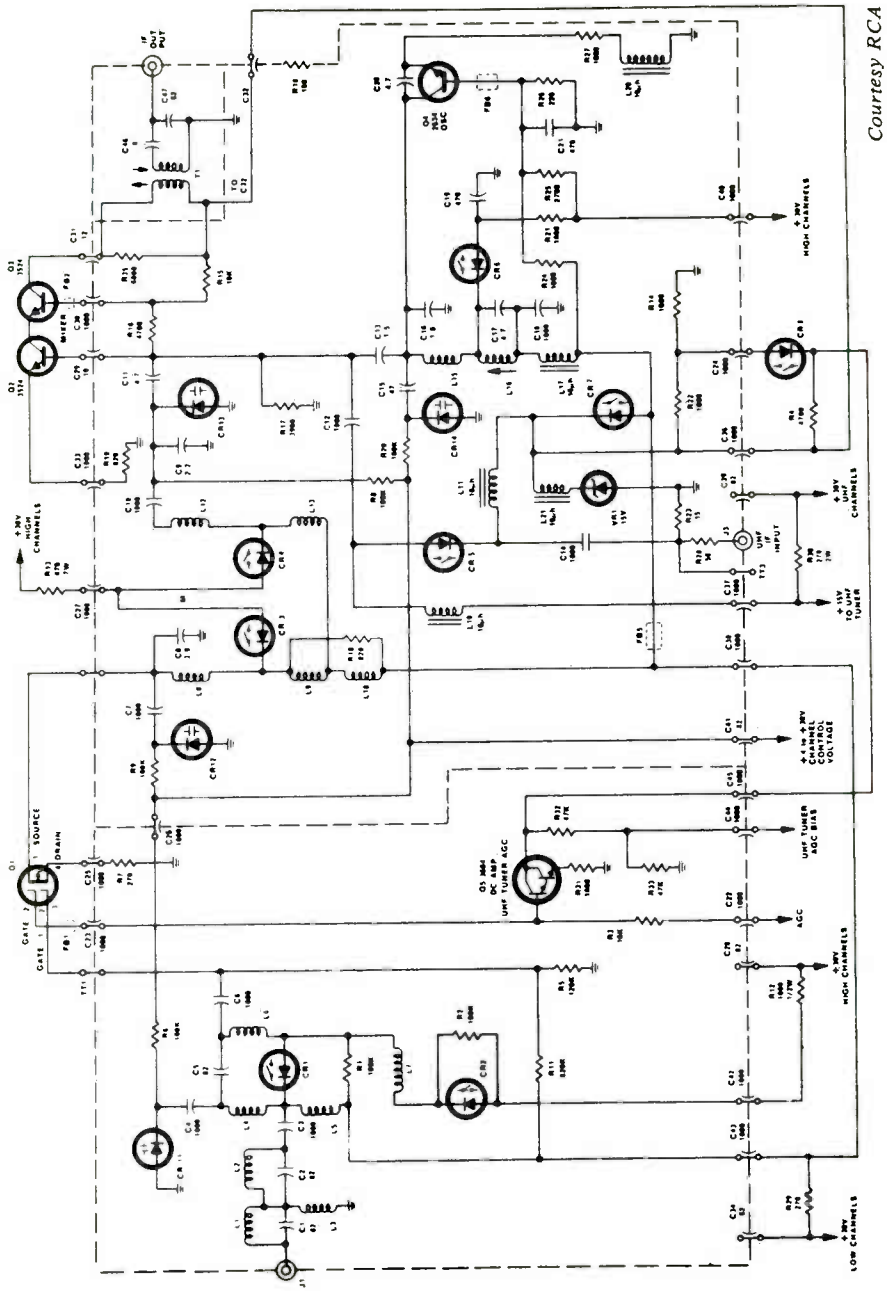
FIGURE 1. DISTRIBUTION OF CARRIERS IN A JUNCTION DIODE.

a positive charge on the other, we'll simply have a surplus of electrons on one plate and a shortage of electrons on the other; in other words, a positive and a negative charge. The two charges are separated by the dielectric. We have exactly the same thing at the junction of a diode. The electrons in the n-type material represent a negative charge and the holes in the p-type material represent a positive charge. They are separated by the depletion area which, in effect, is the dielectric.

The capacity of the junction diode can be varied by placing a reverse bias across the junction. For example, if we have an electron pattern similar to that shown in Figure 1 we'll have a certain capacity. Now if we put a reverse bias across the junction and begin to increase it, the positive voltage applied to the n-type material will repel holes away from the junction. At the same time, the negative voltage applied to the p-type material will drive electrons further from the junction. This will have the effect of widening the dielectric and reducing the capacity. The more you increase the reverse bias across the junction, the smaller the capacity of the diode.

Varactor diodes are simply diodes that have been specially doped to take advantage of this characteristic of the junction diode. These capacitors are used to tune the tuner from channel to channel. PIN diodes are diodes that have been doped specially for use as the switch. With a reverse bias across the junction, they exhibit a very high resistance, but with a forward bias across the junction, the resistance of the diode drops to a low value.

Now that we have reviewed some fundamentals of the operation of the junction diode and explained the characteristics of these two special diodes, let's look at a typical electronic tuner.



Courtesy RCA

FIGURE 2. VHF TUNER USING ELECTRONIC TUNING.

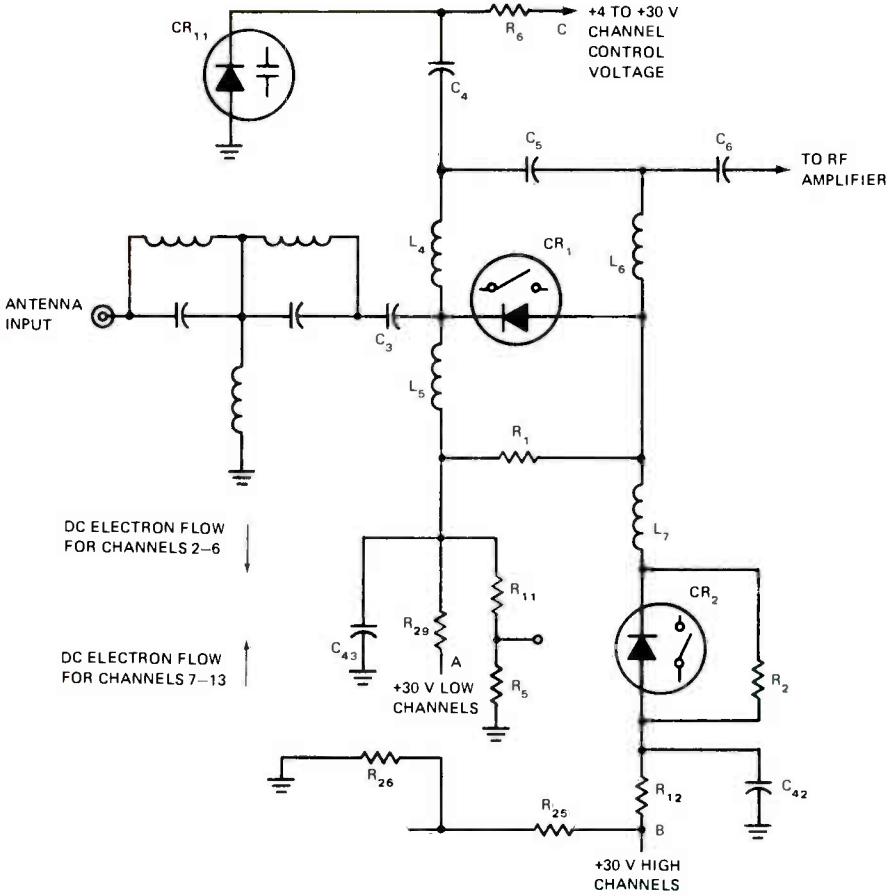


FIGURE 3. (A) INPUT CIRCUIT OF RCA KRK 155 TUNER. (B) EQUIVALENT RESONANT CIRCUIT FOR CHANNELS 2-6.

VHF TUNER

Figure 2 is a schematic diagram of a vhf tuner using electronic tuning. The diode symbols tell you whether the diode is used as a switch or as the capacitor. For example, in the top left of the diagram you will notice the diode CR_{11}. Notice that inside the circle drawn around the diode symbol, you see a small capacitor symbol. This diode is part of the electronic tuning. CR_1 has a switch symbol inside the circle around the diode. This is part of the switching arrangement used to switch the tuner from the low vhf channels to the high vhf channels.

The rf amplifier in the tuner is a dual gate MOSFET. The input circuit is tuned electronically by CR_{11} and the switching for the high and low channels is accomplished by CR_1 and CR_2. The output of the rf stage is tuned by CR_{12} and the input to the mixer is tuned by CR_{13}. CR_3 and CR_4 are switching diodes used to switch the rf output and mixer input from the low vhf channels to the high

channels. The oscillator, Q_4, is tuned by CR_{14}. Switching in the oscillator circuit is accomplished by CR_6.

Figure 3 shows the input circuit of the tuner. When the tuner is set to receive the low TV channels, Channels 2 through 6, a positive voltage of 30 volts is applied to terminal A, and terminal B is at ground potential. This places a reverse bias on CR_1 and CR_2 so the diodes do not conduct; in other words, the switches are open. When the tuner is set for the high vhf channels, Channels 7 through 13, a positive voltage of 30 volts is placed on terminal B and terminal A is at ground potential. This forward-biases the diodes so that they conduct and have a very low resistance. On both the low vhf channels and the high vhf channels, the various channels are tuned in by varying the voltage applied to terminal C from +4 to +30 volts.

Figure 4(A) is a simplified diagram of the input tuning circuit when a tuner is set to the low vhf channels. Figure 4(B) is a simplified diagram when the tuner is set for the high vhf channels. Notice that in the low-band position, the input signal is fed through C_3 to a parallel tuning network. One branch of the network consists of L_5 and C_{43}, which are connected in series to ground. The other branch consists of L_4, C_5, L_6, L_7, R_2, and C_{42}, all connected in series and to ground. They are tuned by CR_{11} which is connected in series with C_4 to the junction of L_4 and C_5. The different voltages applied to CR_{11} change the capacity and hence select the desired station.

Now look at Figure 4(B) and see how the conducting diodes which act as closed switches have rearranged the circuit. Now the signal comes in through C_3 to several parallel branches. You have L_5 in series with C_{43} as one series circuit, L_7 in series with C_{42} as another circuit, and finally the combination of L_4 and L_6. L_4 and L_6

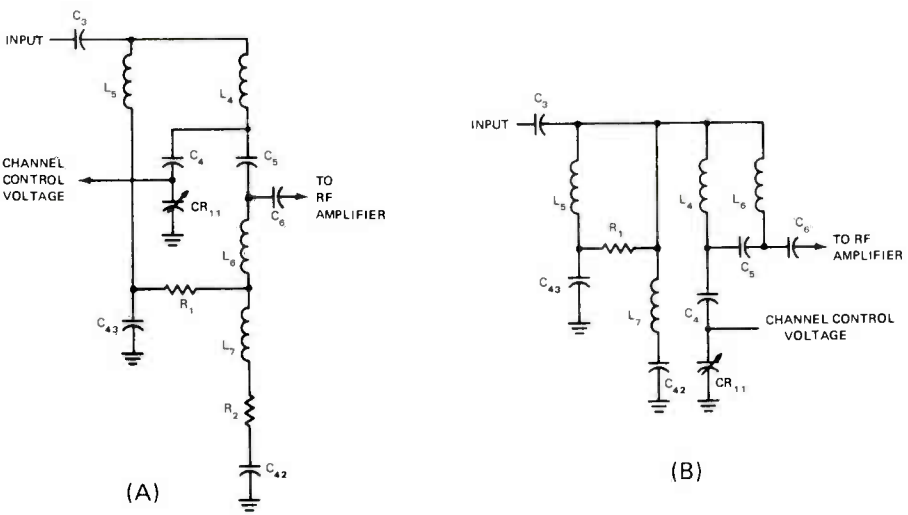


FIGURE 4. EQUIVALENT CIRCUIT OF RCA KRK 155 VHF TUNER. (A) CHANNELS 2-6. (B) CHANNELS 7-13.

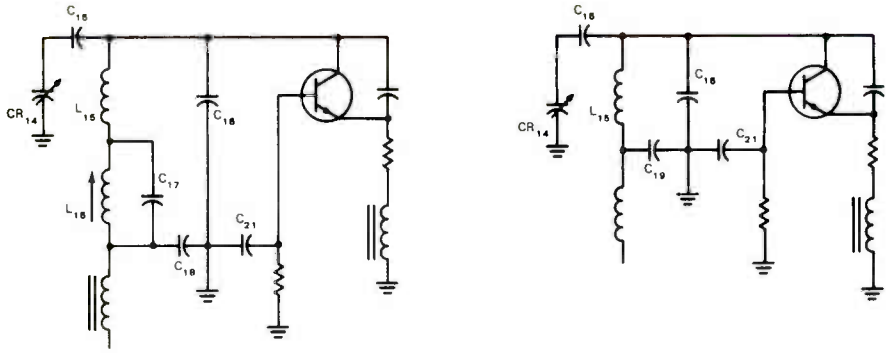


FIGURE 5. THE OSCILLATOR EQUIVALENT TANK CIRCUITS FOR RCA KRK 155 VHF TUNER. (A) CHANNELS 2-6. (B) CHANNELS 7-13.

are connected in parallel because C_5 acts as a low reactance. The parallel combination is in turn connected in series with C_4 and C_{11}. The multiple parallel paths reduce the total inductance in the circuit so it is tuned to a higher frequency.

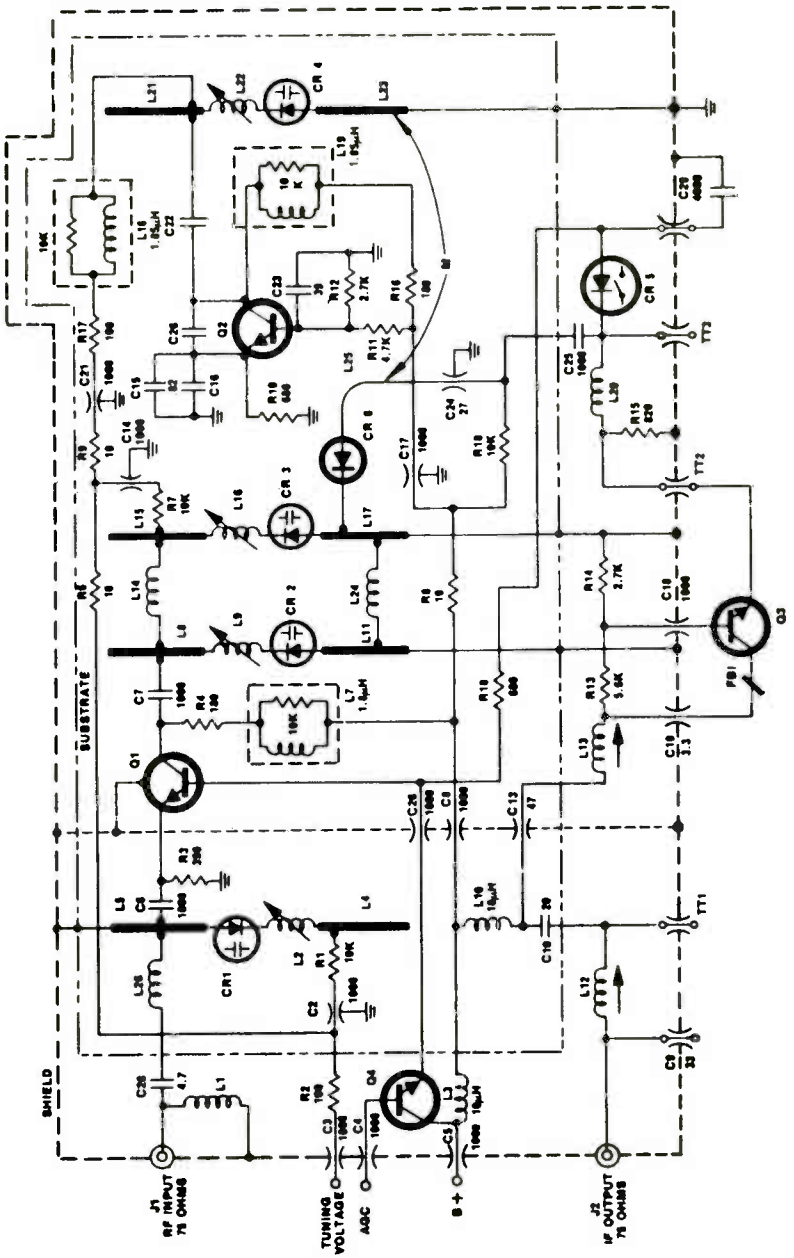
The switching in the oscillator circuit is somewhat simpler. The simplified circuit is shown in Figure 5. In the low channel position, CR_6 is reverse-biased so that it acts like an open switch. In this case, the inductance in the oscillator circuit is made up of L_{15} and L_{16}. The channels are selected by varying the voltage applied to CR_{14}, which acts as a variable capacitor. When a high-band vhf station is selected, CR_6 is forward-biased so that L_{16} is shorted out of the circuit. The inductance in the tuned circuit is now made up entirely of L_{15} and the oscillator is tuned from Channel 7 to Channel 13 by varying the voltage applied to CR_{14}.

The method of supplying B+ to the oscillator collector of Figure 2 is interesting. On the low vhf channels, it is fed through R_{29}, L_{17}, L_{16}, and L_{15}. On the high vhf channels, it is fed through R_{12}, CR_2, CR_1, L_{17}, L_{16}, and L_{15}. When the tuner is in the uhf position, neither the low channel or high channel switching potentials will be energized, so there will be no oscillator voltage.

The cascode mixer on vhf receives its collector voltage through CR_7. On uhf, B+ is supplied to the collector from the 30 volt uhf terminal to R_{30}, L_{19}, CR_5, and L_{11} over to the i-f transformer T_1. Voltage must be supplied to the mixer because the mixer is used as an i-f amplifier on uhf.

THE UHF TUNER

The schematic diagram of the electronically tuned uhf tuner is shown in Figure 6. Notice that this tuner has an rf stage. Q_1 is the rf amplifier and is connected in the common-base circuit. The input circuit is tuned by CR_1 and the output of the rf amplifier is tuned by CR_2. The input of the mixer is tuned by CR_3 and the oscillator is tuned by CR_4.



Courtesy RCA

FIGURE 6. UHF TUNER USING ELECTRONIC TUNING.

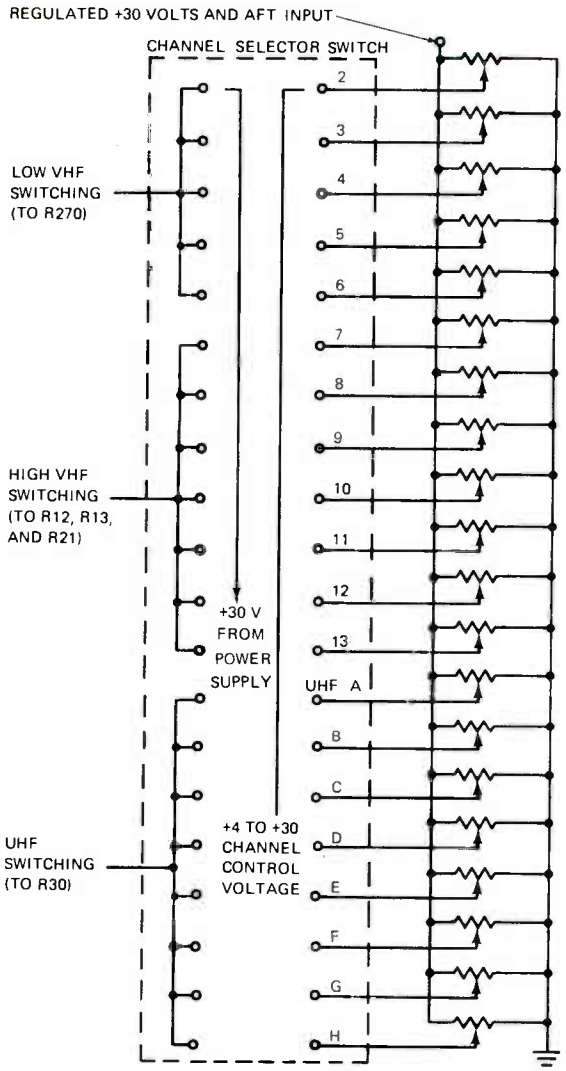


FIGURE 7. ARRANGEMENT FOR CHANNEL SELECTION OF ELECTRONIC TUNERS.

As we pointed out earlier, the i-f signal from the uhf tuner is fed to the mixer in the vhf tuner rather than to the rf stage as in most cases. To make up for the loss in gain by not feeding the signal to the vhf rf amplifier, the signal is fed from CR_6, the uhf mixer, through C_{25} and L_{20} to the emitter of Q_3. Q_3 is an i-f amplifier and the amplified signal is fed through L_{13}, C_{10}, and L_{10} to the i-f output terminal.

The only switching diode in the tuner is CR_5. This diode is used to apply the amplified agc voltage to the base of the rf amplifier Q_1 and to the emitter of the i-f amplifier Q_3.

The switching arrangements used to apply the various control and tuning voltages is shown in Figure 7. Notice that the +30 volts is applied through the switching arrangement to R_{270} in the vhf channel positions 2 through 6. In the high-band vhf switching, the +30 volts control voltage is fed to the junction of R_{12}, R_{13}, and R_{21}.

As the tuner is set to each channel, the potentiometer used to adjust the control voltage is set until the channel is tuned in correctly. There are twelve separate potentiometers used for the twelve vhf channels 2 through 13, and one is set for each channel. When you switch to uhf, the control voltage is applied through the switching mechanism to R_{30}. As you tune to the eight channels, labeled A through H on the diagram, the potentiometer is set for each station. With this type of tuner, the maximum number of uhf stations that can be received is eight.

We mentioned earlier that one of the advantages of the electronic tuner is that you don't have the switching problems that you have with the switch-type tuner. Of course, to select channels, you have to have a switch, but this switch is usually less complicated and easier to repair. In addition, if pushbutton-type switching is used, you don't have to go through so many switch positions to change from channel to channel. For example, if you are watching Channel 4 and want to go to 9 with a rotary switch tuner, you have to tune through Channels 5, 6, 7, 8, and finally to 9. With a pushbutton electronic tuner set to Channel 4, you simply press the Channel 9 button and you have Channel 9. Thus there is no wear and tear on the other switches used to select the channels in between.

At the present time, electronic tuners are widely used on TV receivers manufactured in Europe, but are used only on the top-of-the-line TV sets manufactured in the United States and Canada. The electronic tuner is more expensive, but the chances are that its cost will come down in time and it will be more widely used because of its convenience.

Reader Exchange

FOR SALE: NRI digital computer Model 832. Needs minor work and parts. Also, miscellaneous electronic parts and schematics. Asking $325, postage and handling included. Contact Leonard Peltier, 644 Isbister Street, Winnipeg, Manitoba R2Y-1R1, Canada.

FOR SALE: Conar oscilloscope, Model 250, excellent condition including all accessory probes. $70 plus express charges for shipping. Contact W. J. Burns, 4466 Casa Grande Circle, #45, Cypress, California 90630.

FOR SALE: EICO six- and twelve-volt battery eliminator, charger, like new, $60. Lafayette VTVM with high-voltage probe, good condition, $30. Conar TVOM, good condition, $20. All equipment sent express collect. Contact Raymond D. Berry, 2622 Roger Williams Drive, Irving, Texas 75061.

FOR SALE: Complete service shop. All-new Sencore and B&K equipment. Complete set of Sams. Parts stock. Ready to be moved to your location. Contact Vanguard Electronics, 11435 Big Lake Road, Davisburg, Michigan 48019.

The Hugo Gernsback Award

Once again NRI will cooperate with RADIO-ELECTRONICS Magazine in making an annual scholarship award of $125 to a deserving student currently enrolled in NRI. The award will be applied toward furthering the selected student's education in electronics. NRI is one of eight home-study schools chosen to perpetuate the scholarship established by RADIO-ELECTRONICS in memoriam to Hugo Gernsback, its founder and a notable pioneer in electronics. In addition, through the generosity of RCA Electronic Components, there will be an award for the second most deserving student from each of the schools, an RCA Service Special VOM.

If you wish to nominate a student for this award (and you may certainly nominate yourself), send a letter outlining the reasons for your choice to:

Gernsback Award
National Radio Institute
3939 Wisconsin Avenue
Washington, D.C. 20016

Entries must be postmarked not later than March 31, 1975, in order to be considered. A panel of judges chosen by NRI will select the winner, and their decision will be final. (Sorry, previous winners of the Gernsback Award do not qualify for the 1975 awards.)

Written notification will be sent to the winner and announced in the September/October issue of the Journal.

Reader Exchange

FOR SALE: Conar Model 250 5-inch wide-band scope with four accessory probes, $90. Conar Model 280 signal generator, $20. Conar Model 211 VTVM with high-voltage probe, $20. Isolation transformer, 1:1 ratio, $15. All equipment in excellent condition. Will sell separately or as a package for $125 plus shipping charges. Contact Fred W. Keylor, 821 Court Street, Auburn, Maine 04210.

FOR SALE: Model 460 EICO oscilloscope, $100 plus postage. Model 601 Triplett FET VOM with leather case and probes, $90 plus postage. Both items of equipment are in excellent working condition and fully calibrated. Contact Edward M. Agnelli, 20-43 127 Street, College Point, New York.

HAM NEWS

By Ted Beach K4MKX

Among the many things that I keep myself busy with during these long winter nights are several ham projects. It seems that there are always at least two going on at the same time, and somehow or other they all get stopped at various points. I guess lots of people work this way, but I find it very frustrating.

For instance, at the present time I am in the process of troubleshooting my 2-meter mobile rig for an intermittent audio problem, I am working on an omnidirectional horizontally polarized 6-meter antenna design, and am in the process of writing a series of three articles on designing and building home-brew gear. For these present tasks, my work on the 2-meter synthesizer has been temporarily halted.

Oh well, I've only been working on this one for slightly over two years, so what the heck. Anyway, I would have put this particular project on the shelf for want of some exotic CMOS IC's that I haven't been able to buy surplus yet. But boy, when I put these in I will be able to run the synthesizer on D cells, so perhaps the wait will be worth it. At any rate, I have everything down on paper and when the time comes I'll be able to get back into the groove quickly (I hope!).

The reason I'm working on a 6-meter antenna is because of the very recent acquisition of an elderly (but not much used) Lafayette 6-meter AM transceiver. I haven't had enough nerve to connect the SWR meter in the feedline to the 4BTV vertical (10 through 40 meters!!) which I am using at present, but I'll bet it would read about 15 to 1. I made a couple of local contacts on 50.4 MHz the first time out, so some of the 20 watts input must be getting to the antenna.

I also heard some sideband signals down around 50.1 MHz, but since the rig is an AM unit only, I couldn't do much with them at first. Then I thought perhaps I could use the SPOT function with the transmitter VFO to insert a carrier. Fine—as long as the guy I was listening to was two miles away. Stations coming in from Maryland (DX for me) were completely wiped out with the SPOT signal.

Then, quite by accident, I discovered that if I tuned the VFO about 1 MHz higher than the receiver frequency, there was also a weak SPOT signal. This was just what I needed to copy those weak "DX" sideband stations. The only problem now is that they won't talk to me while I have all that carrier in there. At any rate, the AM guys on 50.4 are a nice bunch and I guess I'll have to content myself with talking to them and listening to the SSB group for the time being—but *next* year . . .

Before we get on with listing the people heard from since last time, we are very proud to relate that we have a new ham on the staff here. On December 17, 1974 Jim Davis of our instruction staff received his Novice ticket. Welcome to hamdom, WN3YQR!

Jim, like myself, has a Ranger and at his QTH he is "antenna bound" as am I. At the present time he is trying to get a windowsill whip loaded up on 40 meters and has had to postpone further operating until he finishes building an SWR bridge.

Interestingly enough, the day after Jim got his call I found out that one of our Amateur Course students here in Washington had been issued WN3YQS dated December 6. How about that coincidence?

One other item before we go on to the new Hams. Talk about the Postal Service—or my messy desk, for that matter. The other day I returned to my desk and found a letter from WA9QGN smack in the middle of my current work. Lloyd's letter was dated *June 29, 1974*. Where that letter has been since June 29, I have no idea, but anyway, welcome aboard, Lloyd! He asked in his letter if there was an NRI "net," and I'm sorry to say the answer is no. A couple of years ago we tried to stir up some interest in such a net, but nothing came of it, Lloyd. Sorry about that.

Now, on to those we have heard from since last time. As usual, those listed first are students or graduates of one of our Amateur Radio courses, while those listed last are from the ranks of other courses.

Bill	WN2YGN	N	Newburgh NY
Bill	WN2YLS	N	Oyster Bay NY
Dave	K3DIJ	A*	Washington DC
John	WA3TNT	G	Summit Hill PA
Ron	WN3YQS	N	Washington DC
Frank	WN4KPN	N	Oneco FL
Merlin	WB4UEJ	G	Princeton KY
Leon	WN5NLR	N	Longview TX
John	WN7AKK	N	Beaverton OR
Marion	WN8SHN	N	Van Wert OH
Jerry	WB2UIF	—	Searingtown NY
Rob	VE1AFM	A	Hubbards N.S.
Ariel	WP4ECA	N	Ponce PR

* Just upgraded — congratulations!

K3DIJ is a graduate of our Advanced Amateur course and as a graduation present got his Advanced license! Dave says his code speed (like mine) isn't quite up to the 20 wpm needed for Extra, so he'll have to cool it for a bit. Dave is a traveling man whose home QTH is California but he also holds HK3DIJ and LU6ADE calls for when he is out of the country, using his SBE34. In his Washington apartment Dave uses a HW7 into a mobile whip stuck out of a window. He says he has yet to hear K4MKX, "probably because you operate as infrequently as I do." Right you are, Dave, but I'll be listening for K3DIJ.

WN5NLR got his license back in August and says the NRI course was very helpful in paving the way. Leon is now working as hard as possible to get that General ticket. Best of luck, OM, and hope to hear you soon.

In addition to his Novice ticket, WP4ECA also has a First Radiotelephone license as a result of his Communications Course studies. Nice going, Ariel, and with those qualifications you should have General real soon. At the present time Ariel is operating with a HW16 feeding an inverted vee antenna—what bands he did not say.

The VE1AFM operates all bands 160 through 2 except 6 meters (my latest band!) from his Canadian hideaway. The only reason he isn't on 6 meters is that his receiver died and hasn't been fixed. On 2 meters Rob uses a Marconi DT45 which puts out about 30 watts FM. On the low bands he uses a HW101, DX60B and a home-brew QRP rig (40 meters CW). Rob is a traffic hound and says he does a little DXing but loves to jsut rag-chew. Presently, he is building an 80-meter CW rig with a 6L6 driving a pair of 807's "just because I like to build things." Rob's wife is also a ham and her call is VE1AYS. Very nice. In closing his very interesting letter, he asked if I would be interested in a device he had designed that gives an instant alert of band openings on 6 and 10 meters. The answer is "yes," and I'd be delighted to pass the information on to our readers and fellow amateurs, Rob. Send it on in!

In closing this time, I want everyone to give serious thought to the proposed changes to Part 97 of the FCC Rules in Docket 20282. I'm quite sure you have all heard and read about the rather drastic licensing restructures proposed so I won't say anything further myself except that I feel we should all give the docket studied attention as to its merits and demerits as regards the *entire amateur fraternity* and not just an initial "gut reaction." I have mulled over the entire thing and am in the process of submitting three separate comments (with the required 14 copies of each) prior to the June deadline. I would suggest that all of you take the time to do the same—express your own feelings to the FCC after you have given the matter careful thought.

See you next time!

Very 73—Ted—K4MKX

Reader Exchange

FOR SALE: Lost interest. Hammarlund HQ-180A receiver, like new, with extension speaker, phones, and manual (new value, $500). Large RCA caddy filled with assorted tubes. EICO signal tracer Model 147A complete with manual. EICO capacitor and resistor checker, Model 950B, complete with manual. Simpson current meter. $225 takes all. Will not ship. Contact John Fitzpatrick, 178 West Orange Street, Brentwood, New York 11717.

WANTED: Have partial library of Sams Auto Radio Repair manuals (Nos.1-86) and would like to complete the set. Will buy or trade Sams AR No.87 to date. Contact Ronald Kesterke, RFD 1, 578 East Third Street, Dallas City, Illinois 62330.

Job Ops

ANNOUNCER NEEDED: Radio station WPRW in Manassas, Virginia, needs a part-time announcer with a First Phone for weekend shifts. Prefer some experience, but might accept a beginner. Saturday shift 6 p.m. to midnight, Sunday shift 3 p.m. to 11 p.m. If interested, contact Randy Lee, Program Director, before 2 p.m. on weekdays at (703) 368-3108 or (202) 591-9327.

NRI HONORS PROGRAMS AWARDS

In the tradition of NRI's pursuit of excellence in training, the following graduates who earned NRI electronics diplomas in November and December also earned unusual recognition under the NRI Honors Program. On the basis of their grades, these graduates distinguished themselves by earning the right to honors listed below and to the appropriate Certificate of Distinction in addition to their regular NRI Diploma. This distinction is made part of their permanent NRI records.

WITH HIGHEST HONORS

Stanley L. Bunch, Washburn, TN
Richard P. Campbell, Grandview, MO
Robert Davis, Williston, ND
Thomas A. Heath, Lincoln, NE
Paul E. Hedrick, FPO, Seattle
James P. Jamison, Potomac, MD
Gregory Kapela, Columbus, OH
Dennis G. Major, APO, New York
Robert Mireault, Sutton, PQ, Canada
Robert C. Schorb, Satellite Beach, FL
Billy D. Seay, York, NE
Edwin L. Seay, Beaver Dam, VA

WITH HIGH HONORS

Richard E. Albury, Fort Lauderdale, FL
Robert D. Barber, Leesburg, VA
Richard J. Bechard, Leesburg, FL
Daniel E. Bittleston, Round Lake Park, IL
Edward K. Bresney, Plattsburgh, NY
Ray L. Burnham, Port Arthur, TX
Clarence E. Carnahan, Hendersonville, TN
John E. Cerisano, Vienna, VA
Dennis F. Chapman, Portland, OR
Joseph B. Chritz, Freeland, MI
Richard Cicalese, Philadelphia, PA
Lynn P. Condoluci, Albion, NY
Alan G. Cordes, Grants Pass, OR
Rudolph Correa, Dallas, TX
George H. Cox, Janesville, WI
Charles E. Crotty, Jr., Seabrook, NH
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Robert C. Edwards, Sr., Carmel, NY
Ben W. Fagen, Pittsford, NY
Ben W. Fagen, Pittsford, NY
Claude T. Fariss, Bedford, VA
Thomas A. Fox, Elizabeth City, NC
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Yaakov Gorlin, Flushing, NY
John R. Hardwick, Gower, MO
Everett J. Harrington, Lockport, NY
John R. Harrington, Peru, NY
Kenneth L. Heinzen, Miami, FL
Ronald Hibler, Houston, TX
Eugene A. Irwin, Malcom, IA
Richard D. Johnson, Bainbridge, GA
Carl A. Jones, Jr., Marianna, FL
Charles V. Jones, Highland, IN
Charles A. Keever, FPO, San Francisco
Margie Kirby, Chestertown, MD
Barry N. Kobashigawa, Kekaha, HI
Donald Koke, West Chicago, IL
Herbert H. Kunz, Haysville, KS
James R. Lampley, Oak Ridge, TN
Julian LeBlanc, Toronto, ON, Canada
Eduardo P. Lever, Guadalajara, JAL, Mexico
Malcolm E. Lilly, Lowell, MA
William A. McCartney, Cambridge, OH
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John F. Williams, New Canaan, CT
Robert L. Wilson, Orlando, FL
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Vincent A. Banis, Fleetwood, PA
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Edward A. Brannan, Canal Zone
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Thomas D. Brooks, Jr., New Orleans, LA
L. B. Broussard, Crowley, LA
James L. Brown, Huntsville, AL
Leroy A. Brown, Washington, DC
Jack W. Buckley, Jr., Bay City, MI
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George W. Dye, Harrison, OH
Robert A. Fase, Grand Rapids, MI
Thomas G. Fitzpatrick, Pensacola, FL
Thomas J. Francis, Sterling Heights, MI
Bruce Gemmill, Trimont, MN
Earl George, Prattville, AL
Wilbert M. George, Schiller Park, IL
Larry R. Gibbs, Atlanta, TX
Joseph H. Goodwin, Kansas City, KS
Edward Gordon, Denver, CO
Alfred R. Haines, Monroe, MI
Phillip D. Hale, Columbus, IN
Dale C. Hall, Bettendorf, IA
Thomas O. Halliday, Upland, CA
Everett L. Harrison, Jr., Camarillo, CA
Richard C. Helgeland, Bothell, WA
Bobby D. Hill, West Germany
Walter W. Hortman, Oglethorpe, GA
Dennis J. Hotmar, Waterloo, WI
Patrick J. Jablonski, Washington, DC
Kelvin M. Kaneoka, Honolulu, HI
Joseph P. Kaschak, Pittston, PA
James L. Keeley, Huachuca City, AZ
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David Laukat, Oklahoma City, OK
Roland F. Lavoie, Jr., Dover, NJ
John C. Leaf, Olney, IL
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Aloysius L. Mussari, Broomall, PA
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SOUTHEASTERN MASSACHUSETTS CHAPTER meets 8 p.m., last Wednesday of each month at the home of Chairman Daniel DeJesus, 12 Brookview St., Fairhaven, Mass. 02719.

SPRINGFIELD (MASSACHUSETTS) CHAPTER meets at 7 p.m. on the second Saturday of each month at the home of Chairman Art Byron.

TORONTO CHAPTER meets at McGraw-Hill CEC, 330 Progress Ave., Scarborough, Ontario, Canada. Chairman Branko Lebar. For information contact Stewart J. Kenmuir (416) 293-1911.

SPRINGFIELD, MASSACHUSETTS CHAPTER TROUBLESHOOTS COLOR TV

At the November meeting, immediately after business was taken care of, the members went to work on the Zenith color TV which is owned by our chapter.

There was no raster and the high-voltage rectifier heated until it glowed. The trouble was located as a poor connection in the cap of the tube. Some progress was made towards the convergence of the color. We had replaced the CRT and therefore had to reconverge the whole set.

At the December meeting Tom Nolan, Executive Secretary of the NRI Alumni Association, attended the chapter for his annual visit. Tom gave us a very interesting talk on oscilloscope waveforms and also demonstrated the new NRI Model 255 solid-state oscilloscope. He also went into great detail concerning oscilloscope probes and their uses.

The chapter always looks forward to Tom's visits, which are always special occasions.

NRI AA OFFICERS

Thomas Schnader.....	President
Richard G. Moore.....	Vice President
Homer Chaney.....	Vice President
Angelo J. Colombo...	Vice President
William D. Harris.....	Vice President
Tom Nolan.....	Exec. Secretary

Alumni News

PITTSBURGH CHAPTER ELECTS NEW OFFICERS

At the December 5 meeting we held election of officers. The following officers were elected. George McElwain, Chairman; Thomas D. Schnader, Vice Chairman; Gerald F. Genellie, Treasurer; Joseph M. Burnelis, Secretary; and James L. Wheeler, John L. Benoit and William J. Lundy, Directors. Along with this Journal you will see a photograph of our new officers.

New officers of the Pittsburgh Chapter. Front row (l. to r.): James L. Wheeler, John L. Benoit, and William J. Lundy, Directors. Back row: Joseph M. Burnelis, Secretary; Gerard F. Genellie, Treasurer; Tom D. Schnader, Vice Chairman; and George McElwain, Chairman.

After the meeting the chapter held its annual party, which was complete with refreshments and a good time was had by all.

At the January meeting we had a talk by Tom Schnader on how to check purity. Tom showed us how to get purity in a color TV set using a bar and dot generator in conjunction with a degaussing coil. It was a simple method and Tom claims it to be faster than the regular method once it has been understood.

NORTH JERSEY CHAPTER STUDIES TV FAULTS

At the December meeting two GE TV's were brought in and worked on by Al Mould and Robert Podinomi and Harry Ala.

One of the GE's, a black and white model, had a bad filter and an intermittent filament voltage which was traced to the cathode-ray tube.

After working on the other GE, which was a color TV receiver, it was found that it was impossible to get good color because of the weak picture tube.

At this meeting Mr. Edmand Palladino was admitted to the chapter as a new member. Congratulations Ed and welcome to the chapter.

SE MASSACHUSETTS CHAPTER HEARS TALK BY LOCAL TV ENGINEER REPAIRMAN

At the November meeting, Carl Merrill gave a talk on capacitor troubles and their effects on color television.

Mr. Merrill went into capacitor troubles in great detail, including explanations of the oscilloscope displays. The equipments he happened to be using were a Leader LBO-511 oscilloscope, an Eico 460 wide-band oscilloscope, an Eico 1140 series parallel RC combination box, a B&K precision 282 digital voltmeter, and a color tube test jig.

At the coming January meeting Mr. Merrill has been invited back to continue into color television capacitor troubles in the i-f and AGC circuits. The chapter really appreciates these types of programs and is looking forward to more of the same.

DETROIT CHAPTER BRAVES SNOW FOR MEETING

Even though there was plenty of snow, our regular members were at our December meeting.

For the last two meetings John Nagy has been bringing his 16-millimeter sound projector and has displayed several interesting movies each evening. It sure peps the meetings up having the films and if any of the other chapters discover some good interesting films, please let our chapter in on it. We are having a little trouble getting films that the chapter can afford.

At the last meeting we had a new member join—his name is Wilson Crane and we welcome him with open arms.

We had twelve members present at the last meeting and at the next meeting we are going to learn how to use the oscilloscope as we have all found that it is the most useful instrument in servicing but quite a few members still do not understand it.

FLINT–SAGINAW MICHIGAN CHAPTER GOING STRONG

At the November meeting Dennis Besser brought in a B&K analyst that he had just purchased and demonstrated a few problems that it is possible to check out in a TV set. As it is a new instrument, he is learning how to use it along with the chapter. Andy Jobbagy gave a demonstration on how to check high voltage in color TV sets and how to set the color killer.

At our second November meeting the Alumni members were invited to the Sencore Instrument Seminar in Davidson, Michigan. Bearnie Holden, the distributor, furnished the dinner and refreshments. Those members who did not attend will never know how much they missed.

Members of the Flint-Saginaw Valley Chapter at their meeting in January. Members have just finished talking into the radio WAMM microphone.

At the January meeting the chapter elected new officers and Mr. Jobbagy gave a lecture on voltage doublers in low-voltage supplies, condensers in vertical and horizontal oscillator circuits, and how you can be fooled so easily by overlooking the testing of the various condensers in these circuits. Also, a discussion of color killers was given by Steve Avetta, who gave some pointers on tuners and what to look for and how to repair them.

The chapter gained a new member, Roger D. Donaven. Welcome to the chapter, Roger. Roger is a student of NRI and he joined the Saginaw Valley Chapter after three months as a student. He found that this was very helpful while taking his course with NRI.

The following members were elected officers of the chapter. Chairman, Larry McMasters; Vice Chairman, Donald L. Stewart; Secretary, Steve Avetta; Treasurer, Andrew Jobbagy; Good-Will Ambassador, Shigeru Higa; Educational Director, Henry Hubbard; Entertainment, Roger D. Donaven; Photographer, Dennis Besser; Membership Committee, Frederick Malik, Larry Myers, Cash Laferty, and Robert Newman. The chapter telephone is 694-6773.

Personal Glimpses

It is not every day that one can celebrate the twenty-fifth anniversary of one's First-Class Radiotelephone license, but such was the case with William H. Wilson in December of 1974.

William Homer Wilson

William, who has devoted a lifetime to the electronics field, has worked as a two-way radiocommunications technician for the last 23 years. He is a graduate of five radio-electronics schools, including NRI's TV-Radio Servicing course (1966) in which he achieved excellent grades. In addition, he is a member of NRI's Alumni Association and the Society of Broadcast Engineers.

During his long career, William has worked as broadcast technician and engineer for stations WSSV, KORA, WCOH, and WGAA. In 1952 he left broadcasting for a more rewarding job with the Georgia Kraft Company in Douglasville, Georgia, where he specializes in two-way radiocommunications. Georgia Kraft maintains 270 mobile radio units and eight base stations in Georgia and Alabama.

Says William, "I feel real proud to be a part of NRI. I think your school is tops in the radio field." Thank you, William. Congratulations, and we think you're tops in your field, too.

THE "ANYWHERE" HI-FI SPEAKER SYSTEM

The Poly-Planars . . . speakers of totally new design that give your imagination the go-ahead! As small as 13/16" in thickness, their uses are practically unlimited. The world's first speaker to provide truly superlative sound no matter where you put it—under tables, in a wall or ceiling, in your car or boat, inside or outside, even under water. Use it as is or cover it, baffle it, enclose it. Go ahead—do your thing with several of these speakers that invite imagination.

The original . . .

This is the one that started it all. Hi-fi enthusiasts and just plain people have taken this to heart, amazed that so much **good** sound can come from such a speaker.

SPECIFICATIONS

Power capacity: 20 watts peak. **Frequency range:** 40 to 20,000 Hz. **Input impedance:** 8 ohms. **Sensitivity:** 85 db/m for 1 watt electrical input. **Operating temperature range:** −20°F to +175°F. **Net weight:** 19 ounces. **Voice coil diameter:** 1 inch. **Magnet weight:** 4.8 ounces. Indox frame and acoustic panel, expanded polystyrene. **Humidity:** up to 100 percent. Impervious to water immersion. **Size:** 1-7/16" w by 11-3/4" d by 14-11/16" l.

Stock No.200SK
Weight 2 pounds
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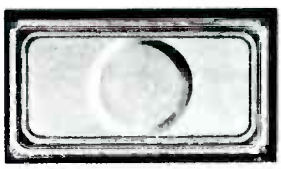

The P-5 is the smallest (4½" by 8½") and the thinnest (13/16") of all the Poly-Planar speakers. It is ideally suited for installations in automobiles, boats, and other areas where space is limited.

SPECIFICATIONS

Power capability: 5 watts peak. **Frequency range:** 60 Hz to 20 kHz. **Sensitivity:** 80 db/m for 1 watt electrical input. **Input impedance:** 8 ohms.

Stock No.5SK
Weight 1 pound
Parcel Post Insured
$5.95

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SPECIFICATIONS

Speaker type: electromagnetic movement. **Power capability:** 10 watts rma, 20 watts peak. **Frequency range:** 40 Hz to 20,000 Hz. **Input impedance:** 8 ohms. **Sensitivity:** 90 db/m for 1 watt input. **Operating temperature range:** −20°F to +175°F. **Construction:** planar type, expanded polystyrene panel, polystyrene frame. **Magnet:** ceramic, indox. **Voice coil:** ¾". **Speaker size and shape:** round, 8 inches diameter. **Overall depth:** 1.05 inches. **Weight:** 11 ounces.

Stock No.8SK
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20.01- 25.00	1.05	3 50		
25.01- 30.00	1.50	4,00		
30.01- 35.00	2.05	4.50		
35.01- 40.00	2.65	4.75		
40.01- 50.00	3.00	5.00		
50.01- 60.00	4.15	5.50		
60.01- 70.00	5.50	6.00	6.40	4.50
70.01- 80.00	7.00	6.50	8.00	5.00
80.01- 90.00	8.00	7.75	10.10	5.00
90.01-100.00	9.00	8.75	12.60	5.25
100.01-110.00	10.00	9.75	14.80	5.50
110.01-120.00	11.00	10.75	16.20	6.00
120.01-130.00	12.00	11.75	17.60	6.50
130.01-140.00	13.00	12.75	19.40	7.00
140.01-150.00	14.00	13.75	21.60	7.50
150.01-160.00	15.00	14.75	23.20	8.00
160.01-170.00	16.00	15.75	24.80	8.50
170.01-180.00	17.00	16.75	26.20	9.00
180.01-200.00	18.00	17.00	27.90	10.00
200.01-220.00	20.00	18.50	29.80	11.00
220.01-240.00	22.00	20.00	32.40	12.00
240.01-260.00	24.00	22.00	35.20	13.00
260.01-280.00	26.00	24.00	38.20	14.50
280.01-300.00	30.00	24.50	41.20	15.50
300.01-320.00	32.00	25.50	44.20	17.00
320.01-340.00	35.00	27.00	47.80	18.00
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PRINT FULL NAME ..... Age .....

HOME ADDRESS ..... CITY ..... STATE ..... ZIP CODE .....

HOME PHONE ..... HOW LONG AT THIS ADDRESS .....

( ) OWN HOME ( ) RENT ..... RENT OR MORTGAGE PAYMENTS $ ..... PER. MO.

WIFE'S NAME ..... MARITAL STATUS ( ) MARRIED ( ) SINGLE

NUMBER OF DEPENDENT CHILDREN .....

PREVIOUS ADDRESS ..... HOW LONG? .....

B ➔ WHERE DO YOU WORK?

YOUR EMPLOYER ..... POSITION ..... MONTHLY INCOME $

EMPLOYER'S ADDRESS ..... HOW MANY YEARS ON PRESENT JOB?

Street ..... City ..... State .....

PREVIOUS EMPLOYER ..... HOW LONG?

Name ..... Address .....

WIFE'S EMPLOYER ..... MONTHLY INCOME $

Name ..... Address .....

C ➔ WHERE DO YOU TRADE?

BANK ACCOUNT WITH ..... ( ) CHECKING

Street ..... City ..... State ..... ( ) SAVINGS

CREDIT ACCOUNT WITH ..... ( ) LOAN

Street ..... City ..... State .....

CREDIT ACCOUNT WITH ..... TOTAL OF ALL MONTHLY PAYMENTS INCLUDING CAR $

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