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Sylvania Opens Service Centers in Cleveland and Detroit

Sylvania Service Co., Inc., has announced the opening of home entertainment electronic service centers in Cleveland, Ohio and Detroit, Michigan.

Arthur E. Kruschka, general manager of Sylvania Service Co., said the Cleveland center, headquartered at 13701 Enterprise Ave., will be managed by Albert J. Winter, and the Detroit center, located at 13101 Capital St., in Oak Park, a suburb of Detroit, will be managed by Kenneth L. Bird.

Both centers reportedly will service color and black-and-white TV and stereo and will also specialize in MATV and closed-circuit TV installations, as well as administering service contracts on Sylvania home entertainment electronic products.

FINCO Again Contributes $1000 To NEA For Membership Campaign Prizes

The FINCO Antenna Company, for the second consecutive year, has contributed $1,000 to the National Electronic Associations (NEA), for award to NEA members who have made significant contributions of time and effort in NEA's membership campaign.

This year, the $1,000 new-membership achievement fund was divided by NEA into thirteen individual prizes for award by drawing to qualified NEA members who signed up at least one new member during the year. The cash prizes ranged from $25 up to the grand prize of $500.

The grand prize winners, Hal and Elizabeth Frutschy (middle), of Medina, Ohio, are shown here receiving their $500 check from M. L. Finneburgh (far left), chairman of the board of The Finney Company, of which FINCO is an operating division, and his wife Frieda, who drew the prizes.

Industry Self-Regulation and FCC Control of CATV Included In NEA Resolutions

Proposal of a permanent committee to establish a program for self-regulation of the electronic service industry, and the recommendation that the Federal Communications Commission exercise control of CATV were included in a list of resolutions adopted by the National Electronic Association (NEA) at its annual convention in Portland, Oregon, in July.

Other regulations adopted by the NEA include: the installation of interference rejection circuits in all TV receivers, by the manufacturer, to reduce FM interference; adoption, by the Federal Trade Commission (FTC), of rules similar to those in the California consumer protection law which specify that the manufacturers of TV picture tubes must disclose to consumers which parts of the picture tube are new and which are used; the selection of New Orleans as the site for the NEA's annual convention in 1972; and the encouraging of the National Alliance of Television and Electronic Service Associations (NATESA) to hold its 1972 annual convention jointly with the NEA in New Orleans.

TV "Freezes" Display

A prototype home TV information center with which a viewer can freeze an individual picture by depressing a button was demonstrated by RCA at the National Cable TV Association convention in Washington in July, according to a report in Home Furnishings Daily.

The new information system reportedly permits a viewer to select any picture appearing on the TV screen and freeze it for closer study.

A console equipped with two screens, one for the continuing program and the other for display of a "frozen" picture, reportedly was used for the demonstration. A silicon tube stores the picture frame and displays it on command, according to the report.

Servicers' Capacity Must Increase 65 Percent By 1975, Says Motorola's Head of Video Products Planning

By 1975, consumer electronic servicers must be capable of handling 65 percent more business than handled in 1970.

Sales of color TV in 1975 will be 40 percent higher than that in 1970.

These and other favorable predictions were voiced by Charles Eissler, manager, video products planning, consumer products division, Motorola, Inc., at the 19th Annual Convention of the Texas Electronics Association (TEA), held in Austin, Texas in early August.

Noting that the Electronic Industries Association (EIA) estimates that U.S. consumer electronics sales grew some 250 percent during the past 10 years, from $2 billion annually to $5 billion annually, Eissler said that there were some 30 million color television sets in use in 1970 and he expects to see an additional 20 million units in use by the end of 1975.

Total color TV sales to the consumer, including both domestic and imported sets, could reach about 6.7 million units in 1971, for a penetration of about 54 percent of all households. By 1975, said the Motorola
PROVIDES YOU WITH A COMPLETE SERVICE FOR ALL YOUR TELEVISION TUNER REQUIREMENTS AT ONE PRICE.

VHF Or UHF Any Type $9.75.
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If you prefer we’ll customize this tuner for you. The price will be $18.25. Send in original tuner for comparison purposes to our office in INDIANAPOLIS, INDIANA.
manager, total color TV sales to the consumer should rise to 7.2 million sets, with a penetration of about 71 percent. By the end of 1975, the replacement market should account for three out of every seven color set sales, or some 40 percent of total sales, Eissler said.

Today's product mix of 60 percent portable and table color TV set sales, versus 40 percent console type, will change to 80 percent portable and table type retail sales by 1975, the Motorola manager predicted. “By 1975, the screen sizes the dealers will be selling will cover the diagonal measurements of 25V, 21V, 19V, 17V and 13V,” Eissler stated.

Monochrome television sales, both domestic and imported sets, will increase from 6 9 million units, at dealer-to-consumer level, in 1970, to 8.6 million units by 1975, according to Eissler. “And I may be conservative in that 1975 estimate, as greater growth in personal-use sets could occur if lower prices can be achieved in this product. Another two million unit sales could be added if the industry reaches the $50 level on such a monochrome TV.” Eissler told the TEA.

Eissler said that he expected sales of audio products, including console and component stereo as well as four-channel sound, to jump from 1.9 million units, distributor to dealer, to 2.8 million units by 1975, while radio sales could climb from 44.4 million to 56 million during the same period.

Eissler also predicted that four-channel sound will replace stereo instruments, except for leader-type models, within the next five years. Eissler did not estimate 1975 tape sales but said, “tape will sell at an increasingly higher rate.” He pointed out that between 1950 and 1960, only 1.5 million to 2 million tape units were sold per year, mostly reel-to-reel. But with the advent of improved packaging (magazine type) and greater availability of software, tape sales jumped to 4 million in 1966 and to 15 million units per year, mostly eight-track and cassette player/recorders, by 1970.

Eissler suggested that electronic video recording (EVR) players and similar equipment are potentially important consumer electronics products. Availability of software will determine the extent of the home application of such products, he said, adding that, initially, the industrial and educational markets will most likely be the first to be tapped.

“The history of audio tape will be repeated in video cartridge players, with the plentiful availability of pre-recorded, cassette or cartridge type software turning on the consumer,” the Motorola manager of video products planning predicted.

Blonder-Tongue Subscription TV System
Approved by FCC

FCC advance approval of the Blonder-Tongue BTVision subscription television system recently was
announced by Isaac S. Blonder, Chairman of the Board of the New Jersey electronics research and manufacturing corporation.

BTVision is a system for over-the-air transmission, reception and decoding of scrambled television signals and is compatible with the standard television broadcasting facilities. A small decoder placed in the subscriber's home unscrambles the picture for use with any television receiver. There reportedly is no interference with or reduction of existing home television reception when this system is used.

According to Mr. Blonder, the BTVision system will provide the television set owner with entertainment not previously available because of cost. New movies, feature sports events, and current Broadway plays will be offered.

The first application to the FCC to use the BTVision system has been made by Universal Subscription TV, Inc., for the Boston area. This application is in accordance with the FCC fourth Report and Order, Docket 11279, December 21, 1968, which authorizes, under certain limitations, subscription television service for markets with five or more television station assignments.

**FCC Proposes 70-Channel UHF Detent Tuner**
The Federal Communications Commission (FCC) has proposed a rule which will permit the use of a 70-channel UHF detent-type tuner, which it says is nearly comparable to VHF tuners.

The deadline for industry replies to the proposed rule was July 19. No extension of time was allowed by the FCC because it said a prompt start on design work would be necessary for compliance with the rules effective date.

At least three UHF broadcasters have opposed the FCC's proposal because they feel the proposed tuner is not comparable to those used for VHF.

**First CATV Receiver Introduced By Magnavox**
The first home television receiver designed exclusively for cable television application was introduced by Magnavox at the National Cable Television Association Convention (NCTA) in Washington D.C., in July.

Called the Magnavox "TV 101" Cable TV Terminal, the console unit reportedly offers a total of 31 channels for cable reception, as well as the standard UHF channels prescribed for all TV receivers by FCC regulations.

The set, which reportedly will be available in early 1972, is also designed to operate with a standard antenna in non-CATV applications.

The 31-channel capacity of the CATV receiver is accomplished by inserting 8 channels in the frequency gap between standard channels 6 and 7, and by adding

(Continued on page 9)
You can make more money selling the Sylvania color bright 85XR.

And Olive Oyl will look just as beautiful.

Beauty is in the eye of the beholder. And the beauty of the color bright 85XR is that its picture is in the same league as the more expensive "black surround" and "black matrix" color tubes.

Our bright phosphors make the color bright 85XR real competition for any picture tube on the market. And our simplified manufacturing process lets us sell it to you at a lower price than any "black surround" tube.

The picture will look beautiful to your customer.

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(Continued from page 7)

11 channels above channel 13. The "TV 101" had detented electronic tuning, as specified in the NCTA request to the FCC, and is double-shielded with coaxial integrity to prevent interferences from the off-the-air TV transmissions.

The price will be approximately the same as that of 25-inch color sets equipped with remote control.

Developed by Craftsman Electronics Products Division of Magnavox, the terminals will be distributed through Magnavox dealers, who will provide sales and service for this new consumer product in all areas served by CATV systems.

"The need for a special terminal for CATV subscribers has long been apparent", says Magnavox President R. H. Platt. He said that the introduction of the terminal also reinforces Magnavox's entry into the cable television systems market.

According to Mr. Platt, Magnavox regards the CATV field as one of its markets of maximum promise. He said the Company had instituted a substantial research and development program for total utilization of the Company's two-way CATV system capabilities. Short-range developments center on improving current products for cable TV distribution, while long-term projects involve the new services which he believes will develop as the wired-nation concept evolves.

The NCTA has petitioned the FCC to institute proceedings to define the specifications which a cable television receiver must meet.
Improved Serviceability: Easing the Technician’s Burden

What two manufacturers have done to improve the serviceability of their 1972 products, and the role played by electronics service associations. by J. W. Phipps

NEA Serviceability Improvement Program
The National Electronics Association (NEA) in 1968 established a special program to help manufacturers of home entertainment electronic equipment improve the serviceability of their products.

The program, administered by the chairman of an eight-member serviceability committee, involves two distinct functions:

Gathering of serviceability information from field and dissemination to manufacturer—Special serviceability survey forms are provided member technicians on which they are encouraged to list specific details about service problems they encounter which increased the “down time” of the product because of:

- chassis and/or cabinet features which significantly increases the time required for disassembly and reassembly or which reduce the accessibility of the circuitry.
- unavailability of parts and/or service literature.
- incorrect and/or inadequate labeling or identification of parts and/or controls.
- inaccuracies or omissions in service literature.

The information on the survey forms is compiled by the NEA and forwarded to the manufacturers of the sets involved. Although such information can be considered after-the-fact, it nevertheless alerts manufacturers to problem areas which can be eliminated by changes, omissions or additions to designs in the development stage.

Pre-production serviceability evaluations—Members of the NEA and other association serviceability committees perform first-hand evaluations of new chassis designs to determine how well they conform to the serviceability guidelines established by the NEA. Such evaluations are intended to help manufacturers avoid design features which detract from the serviceability of the set. To date, manufacturers which have actively participated in this part of the program include General Electric, Magnavox, Motorola, and Sylvania.

Additional information about the NEA serviceability program can be obtained by writing:
Lewis Edwards, CET
Chairman, Serviceability Committee
NEA
1309 W. Market St.
Indianapolis, Indiana 46222

Serviceability seemingly has been moved up a notch or two in the list of factors which influence the designs of new home entertainment electronic products. Preliminary analyses of 1972 chassis designs reveal that at least a few manufacturers now are placing increased importance on the ease with which their products can be serviced, if needed.

A review of the material about new chassis received by ES to date reveals only two TV designs which incorporate features that significantly improve serviceability and which have not been covered previously in ES. One is General Electric’s U-1 b-w chassis, and the other is MGA’s CS-195 19-inch color receiver. The significant serviceability features of both chassis are illustrated and described in this article, beginning on page 12.

Carry-over design features which improve serviceability but which were introduced prior to 1972 chassis and have been covered in previous issues of ES include plug-in transistors, introduced in significant quantities in Sylvania chassis, and modular design, introduced first in color TV by Motorola and adopted later, in varying degrees, by most other major manufacturers.

Manufacturer Motivation
Consumer demand for more prompt and proficient service after the sale undoubtedly has been the most influential factor in getting manufacturers to upgrade the serviceability of their products. Those manufacturers who have responded undoubtedly have done so because they realize that, today, service is an essential part of marketing.

(Continued on page 16)
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5. Lower Cost! Up to $5.50 less than other tuner companies!
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Tel. 214/753-4334
Tel. 904/389-9952

Circle 7 on literature card

October, 1971/ELECTRONIC SERVICING 11
Serviceability features of General Electric's U-1 b-w TV chassis,
some of which were included in the U-1 design as a result of suggestions from technicians, are illustrated by this series of photos.

Completely solid-state, the U-1 chassis employs 21 transistors, 16 diodes and 1 integrated circuit. Seven of the transistors are mounted in sockets, for quick substitution. These are: the audio output, horizontal oscillator, horizontal output, sync clipper, and three transistors in the vertical sweep circuitry. Also, the high-voltage rectifier, a selenium stick-type unit, is mounted in a manner which permits "snap-out" removal.

**Accessibility of all circuitry, logical grouping of circuitry according to function, and quick-disconnect-type connections and fastening devices, which make circuit board, component and module removal easy, are illustrated in this rear-view of a U-1-equipped receiver, with duplicate chassis sections shown removed in the foreground. Section on left is the low-voltage power supply; section in middle contains the signal-processing circuits; and section on right contains the vertical and horizontal sweep circuits. (Horizontal-output transformer and high-voltage rectifier are on a separate, easily removed assembly mounted above the sweep-circuits board.)**

Main chassis of U-1-equipped receivers slides back on two tracks, to completely expose all circuitry, adjustments and test points on the top and the bottom of the chassis, as shown here. Chassis is freed from normal operating position by releasing two clip-type retainers, pointed out by large, white arrows in top photo. Note that components and test points are labeled both on the top and on the bottom of the signal-processing circuit board.

(Continued on page 14)

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Serviceability of some color chassis also improved

Features which improve serviceability also have been designed into some of the new color TV chassis. An example of the significantly easier-to-service designs is MGA's CS-195 solid-state, 19-inch color receiver, the major serviceability features of which are illustrated here. MGA is a division of Mitsubishi International Corporation.

Rear views of the CS-195 receiver with back cover removed illustrates the normal operating (left) and service (right) positions of the chassis. The set is completely operable in either position. Disengaging 4 white plastic press-fit buttons permits the chassis to be swung down and folded out for servicing. Because the chassis is mounted on two rails, it also can be slid out, for improved accessibility of components on the front of the chassis. Removal of five screws releases the cabinet rear cover. The bottom of the cabinet also can be removed, to provide access to the bottom of the chassis without sliding out the chassis.

(Continued on page 14)
It's strange, but while tubes are on the way out—
tube-testers are needed more than ever. That's 
because the home electronic sets today use sophis-
ticated tubes in sophisticated circuits—and simple 
Shorts and Emission tests don't take into account 
the actual operation of the tube. Now B & K offers 
the Model 747 Dyna-Jet Solid State 100% Dynamic 
Mutual Conductance Tester—the last tube-tester you'll ever have 
to buy.

Triodes, nuvistors, tetrodes, pentodes and all other 
multi-element tubes can now be tested under AC 
operating conditions for 100% 
dynamic mutual conductance. Intermittents, low gain and other tube 
problems that would be obscured in an 
emission test, show up in this tester's 
dynamic mutual conductance tests.

A special Dynamic test has been designed into the 
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duce an unreliable reading.

Diodes, low- and high-voltage rectifiers are tested 
with proper voltages and loads to determine their 
emission capability.

And, of course, you'll still want to test for shorts, 
leakage and gassy tubes. The B & K Model 747 
makes this easy with a one-button "Shorts" test 
and a one-button grid-leakage and gas 
test. And it "quick tests" 82% of the 
tubes you'll test. And gives you 
functional pin-straighteners to fit 
any tubes you'll ever run into. 
And to help you predict a tube's 
reserve, the 747 has a built-in 
"Life" test. Filament voltage is re-
duced 10% when the "Life" test 
switch is set on.

All-in-all, the B & K Model 747 Dyna-Jet 
Tube-Tester has all the features you've wanted 
—all the features you'll ever need in a tube-tester. 
And it's small, lightweight and very good-looking.

See it at your B & K distributor, and you'll see why 
it's the last tube-tester you'll ever have to buy!

Model 747 
100% Dynamic Mutual Conductance 
Dyna-Jet Tube-Tester . . . . . . . . . . . . . . Price $249.95
Serviceability features of General Electric's U-1, b-w TV chassis

Audio module, shown here being removed, is plugged into strip-type socket on signal-processing board and contains all sound processing circuitry, with exception of input coil, volume control and output stage. A single integrated circuit on the audio module performs the functions of 4.5-MHz amplifier, quadrature-type FM detector and audio preamplifier. The only service adjustment in the sound section is the quadrature coil, which is adjusted for maximum sound.

Horizontal-output transformer/high-voltage rectifier assembly, located above the sweep-circuit section, is easily removed for replacement by disconnecting one plug, removing one screw and unsoldering 4 connections. Top photo shows complete assembly being removed. Removal of high-voltage rectifier is accomplished by opening two small doors, one at each end of selenium rectifier stack, and snapping out rectifier, as shown. Note that a diode symbol is placed on the assembly near rectifier, to point out the correct position of the rectifier.

Tuners/controls assembly, shown here, contains the VHF and UHF tuners and the slide-type volume, brightness and contrast controls. Turret-type VHF tuner is readily accessible for cleaning or adjusting, even when installed in the cabinet, as shown in top photo, or it can be removed easily and placed in position shown in the bottom photo, for access to controls. Note that the external antenna connections are located on a plastic bracket which remains attached to the tuners/controls assembly after the cabinet back is removed. Plug-type connections between assembly and chassis speed up removal and reinstallation.

Serviceability of some color chassis also improved

The IF circuit panel is shown here in the swing-out position. During normal operation, the panel is covered with metal shields, shown here removed. Normal adjustments can be made through the shields, if required. The circuitry on the IF panel, as on all panels, is "road-mapped" on both sides, for easy component and circuit identification. Note the plastic press-fit buttons, on corners of panel, which hold chassis in vertical position during normal operation.

Slide-out feature of chassis makes possible easy removal of tuners/controls assembly, shown here in service position. Both VHF and UHF tuners are detent types.

Quick-disconnect plugs, some of which are shown here, are used throughout the CS-195 receiver, to eliminate the need for soldering and resoldering of wiring for removal and installation of the circuit boards and panels which make up the chassis. Again, note the clear road mapping of circuitry and identification of components and test points.
The horizontal-output transformer unit is shown here removed. The high-voltage tripler assembly, which also can be replaced as a "package", is positioned above the flyback unit.

Speaker and AC switch unit fasteners and connections, shown in photos here, are representative of the easy access and quick-disconnect features of the U-1 chassis. Speaker is easily removed by releasing two retaining nuts and unplugging leads, as shown in top photo. Removal of push-to-operate on/off and instant-on switches, located together on assembly normally positioned above speaker (top photo), is accomplished by removing two screws and unplugging two connections (bottom). Note label, on side of receiver, which gives instructions for speaker removal.

Signal-processing circuit board of U-1 chassis, shown here, contains video IF and amplifier stages, AGC circuitry, the horizontal oscillator and buffer, and the vertical oscillator and buffer. Component adjustment and test point call-outs and circuit pattern are printed on both top and bottom of board. Note that all connections to board are plug or slip-on type; unsoldering and re-soldering are not required to remove or re-install board.

Identification of receiver model and chassis and all components, test points, voltages and adjustments obviously was given special attention during the designing of the U-1 chassis, as indicated by these photos. Serial number, model and chassis labels on cabinet back are shown in top photo. Chassis layout diagram and transistor identification data are grouped on a single large label affixed to the inside of the cabinet back, shown in the middle photo. Voltages significant to testing and the labels of controls are stamped into the metal of the power supply and sweep sections (bottom photo).
(Continued from page 10)

The Role of Service Associations
National, state and, in some cases, local electronic service associations also have played a significant role in improving the serviceability of consumer electronic products. Although it is doubtful that association efforts have had much effect in actually motivating manufacturers to improve serviceability, associations have shown interested manufacturers how to improve serviceability.

One example of the improved serviceability achieved by co-operation among service associations and a manufacturer is General Electric's new U-1 b-w TV chassis.

The serviceability committee of the Virginia Electronics Association (VEA), an affiliate of the National Alliance of Television and Electronic Service Associations (NATESA), at the request of General Electric, in October, 1970, performed an evaluation of the serviceability of a color TV chassis. The committee, using as a guide a serviceability rating system developed by the National Electronics Association (NEA), evaluated the ease with which the color chassis could be serviced, both in-home and in-shop. The chassis was awarded a serviceability rating of slightly over 80 percent, out of a possible 100 percent.

Although the serviceability of the chassis was considered by the committee to be good relative to that of other existing designs, it did recommend to the General Electric design engineers specific design changes and additions which it believed would further improve the serviceability.

An evaluation of the serviceability of the prototype U-1 b-w TV chassis was performed by the VEA committee and the chairman of the NEA serviceability committee on March 17, 1971, again at the request of General Electric, and at its TV production facility in Nansamond County, Virginia. The evaluation revealed that many of the design changes and additions suggested by the committee during the previous evaluation of the color chassis had been incorporated into the U-1 chassis design. The committee awarded the U-1 design a serviceability rating of 94.6 percent.

Parts availability and service information: Two other essential facets of serviceability

Parts availability
The formation of an expanded network of franchised independent parts distributors was announced earlier this year by General Electric. When completed, probably before the end of this year, over 250 distribution locations will have been established nationwide.

During the same period, General Electric has been testing, in select locations, new telephone ordering systems and a new credit policy, which, if adopted nationwide, will reduce telephone and shipping charges and will permit independent servicers to purchase parts without prepayment.

Also, General Electric has established a "Guaranteed Active Parts" program, which is designed to help distributors and servicers reduce and protect their investments in parts inventories. Under the terms of the program, if a distributor or servicer cannot move, within a specified time, parts recommended for inventory, General Electric will buy them back without penalty.

Service information
Direct-mail communications with every television service company who services TV receivers on a regular basis is another goal in General Electric's effort to improve the ease with which its sets can be serviced. To accomplish this, General Electric began publishing, on a quarterly basis, early this year, a publication titled "G. E. Television Service News", which provides information about parts outlets, credit policies, technical publications, training programs, new products and the location and the telephone number in his area the servicer can call for technical or other assistance. The publication is mailed on a district basis, and is available without charge to all regular servicers of TV.

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8. Tiny Town Doctor Set
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Guidelines for Troubleshooting Vertical Sweep Defects, part 2
Advanced techniques for in-shop servicing.

Several techniques which are effective for finding the sources of vertical sweep defects include: DC voltage analysis, signal injection, frequency analysis, ohmmeter tests, and waveform analysis. Although these are all independent tests, you will analyze vertical problems faster if you use as many of them as necessary during each diagnosis.

**DC Voltage Analysis**
DC voltage analysis should be performed on two levels:
First, if there is little or no vertical deflection, the DC voltages at the plates of the output and oscillator tubes should be measured.

---

Fig. 1 Complete schematic diagram of the vertical sweep system in Sears’ 528.51780 b-w chassis.
The voltage at the plate of the output tube normally should change only about 20 or 30 volts regardless of height and linearity adjustments, and not much more than that after most defects.

The voltage on the plate of the oscillator tube normally will vary more than that on the plate of the output tube. This voltage is changed substantially by height adjustments and by any defect which affects either the AC or DC voltages at the grid. Of course, neither stage will operate if the plate voltage is near zero.

Assume that the first feedback capacitor, C35, in the schematic in Fig. 1, is open. Oscillation will cease, and there will be no vertical sweep. However, no shorts or other defects are present. The DC voltages resulting from this defect are shown in Table 1.

Because the circuit is not oscillating, very little negative voltage will appear at the oscillator grid. With neither DC nor AC voltages at the grid, a large amount of plate current flows constantly. Because the value of the plate-load resistor is several megohms and a large amount of current is flowing in the plate circuit, the plate voltage drops to a very low value.

The output stage normally does not draw grid current and would not be affected by the DC voltages.

<table>
<thead>
<tr>
<th>Testpoint</th>
<th>DC voltage should be</th>
<th>DC voltage measured</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grid pin 4</td>
<td>-40</td>
<td>-.7</td>
</tr>
<tr>
<td>Plate pin 5</td>
<td>+110</td>
<td>+61</td>
</tr>
<tr>
<td>Output grid pin 1</td>
<td>-20</td>
<td>-.4</td>
</tr>
<tr>
<td>Output cathode pin 3</td>
<td>+23</td>
<td>+31.5</td>
</tr>
<tr>
<td>Output plate pin 2</td>
<td>+270</td>
<td>+265</td>
</tr>
</tbody>
</table>
in the oscillator stage, except that a part of the bias for the output stage is obtained from the grid circuit of the oscillator. When there is no oscillation, the oscillator grid is no longer negative, and no negative voltage is supplied to the grid of the output stage. With no negative voltage applied to its grid, the output tube draws more current. This increased current slightly lowers the voltage on the plate of the output tube and increases the voltage drop across the cathode resistors. The grid-to-cathode bias is now 32 volts; normal bias is between 40 and 45 volts.

Cutoff bias for the output tube is about 60 volts. This is proved by a 60-volt reading between cathode and ground when either cathode resistor is open. In circuits in which the grid resistor returns to the cathode, the value of the cathode-to-ground voltage will almost equal the plate voltage when the cathode return is open. This is not true for the circuit in Fig. 1, in which the grid returns to ground through R39 and R40. Many technicians have been misled by the voltage obtained from an open cathode circuit. An open R44 or R7 would produce the same voltages produced by an open C35, except that the cathode voltage of the output tube would be between +55 and +60 volts and the circuit might produce a slight amount of vertical deflection every few seconds, depending upon the setting of the associated controls.

Defects in the feedback components change the oscillator voltages (and the grid voltage of the output tube) because of changes in the amplitude and the shape of the signal at the oscillator grid. If it is necessary to advance excessively the height control, and thus produce a much larger voltage than normal at the plate of the oscillator tube, the defect probably is a weak output stage.

A leaky coupling capacitor, C34, in the circuit in Fig. 1, would cause the grid-to-ground negative voltage of the output tube to decrease, and the cathode-to-ground voltage to increase slightly. Proof that C34 is leaking or that the tube is gassy is obtained if there is a voltage drop across R39 and the grid side is more positive. If the grid side is more negative, the grid of the output tube is drawing current because of too much oscillator output or insufficient bias applied to the output stage.

Excessive or reduced voltage at the plate of the oscillator might indicate a defect in that particular circuit; however, it also might indicate incorrect values of AC or DC voltage at the oscillator grid.

Oscillator Grid Voltage and Frequency Analysis

The DC voltage at the grid of the oscillator tube is very critical. However, the oscillator grid voltage might differ ±50 percent from the value on the schematic and yet be normal for that one individual receiver. Although these two statements appear to be contradictory, the following information will reconcile them:

Assume that the vertical sweep circuit (Fig. 1) produces good height, linearity and locking. Next, assume that we apply, through a 22-megohm resistor (so that the time constant will not be upset), the output from a variable negative voltage supply to the grid of the oscillator tube. The more negative voltage we apply to the grid, the lower the frequency becomes, and, eventually, the picture flips up and out of lock. Then we reverse the polarity of the bias supply and apply a variable positive voltage to the grid of the oscillator tube through the same 22-megohm resistor. The decreasing negative voltage at the grid of the oscillator produces a high oscillation frequency, and the picture rolls down.

These two experiments varied the frequency by changing the amount of negative voltage stored in C38, which is also the oscillator grid voltage. The more negative the voltage, the longer the time required for the voltage to reach the point where plate current can flow and the new cycle start, and vice versa.

If you connect a VTVM or FET meter to the grid of the oscillator tube in Fig. 1 and then lock the vertical, the meter should indicate about ~40 volts. Next, if you rotate the vertical hold control so that the picture flips up out of lock (more resistance, lower frequency), the grid voltage should become more negative. If you adjust the hold control in the opposite direction until the picture rolls down (less resistance, higher frequency), the grid voltage should become less negative than when the picture was locked in. Frequency changes that occur when the hold control is varied are caused primarily by the change in time constant; the voltage stored in C38 discharges faster through a small resistor than through a larger one. A secondary factor which also affects the frequency in the same manner as a change in time constant, is the amount of DC voltage, which becomes less when the time constant is reduced.

If, at this point, you have concluded that a more negative oscillator grid voltage always causes a lower frequency, and that a less negative grid voltage always causes a higher frequency, you are slightly premature.

As an opposing example, suppose that C38 in Fig. 1 is .01 mfd, locking occurs with a grid resistance of 800K ohms, and the DC grid voltage is ~40. If you change C38 to .0082 and relock the raster, you will find that locking occurs with a grid resistance of 1 megohm, but the DC grid voltage is now ~45 volts, because of the higher resistance. The time constant and frequency are the same in each case, but the DC grid voltages are not the same.

Perform one more simple experiment. Lock the vertical, and again connect a VTVM to the oscillator grid. Now, increase the drive to the output tube by adjusting the height control (or whatever the
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control is labeled which changes the oscillator plate voltage) until the picture rolls down (higher frequency). The VTVM will indicate a higher negative voltage, and will continue to do so even after the picture is locked, even though the frequency is higher—just the reverse of the action when the grid voltage was changed by either changing the time constant or voltage leakage.

Two effects are at work in this example: The higher negative grid voltage requires a longer time to discharge; this action tries to lower the frequency. The increased pulse voltage fed to the grid of the oscillator, through C38, causes the correct negative voltage needed for normal operation to be obtained sooner. That is, the charging time for the time constant is made shorter. This increases the frequency. Although one effect attempts to lower the frequency and the other one attempts to increase the frequency, the latter effect is dominant, and a higher pulse voltage at the grid of the oscillator tube causes the circuit to oscillate at a slightly higher frequency, even though the grid is more negative.

Because defects in the positive feedback circuit change both the time constant and the amplitude of the pulse, the change in frequency is less than we might suppose.

The preceding paragraphs explain why a defect that primarily affects the height also slightly changes the frequency.

It is clear that using the negative voltage at the grid of the oscillator tube as an indicator of oscillator strength—as we correctly do with many types of oscillators—does not apply to this type of multivibrator circuit. Nor can the amount of negative voltage be used as an indicator of frequency.

Experience and logic are necessary to effectively use frequency analysis in practical servicing, but such analysis can be a useful diagnostic technique.

### Waveform Analysis

Perhaps you wonder why I have not emphasized waveform analysis for servicing vertical sweep circuits. Although I do use a scope to help find the cause of vertical sweep defects, I have found that, in many instances, the waveforms only verify that a defect exists, and do not pinpoint the cause.

Most of the waveforms will be automatically wrong if the scanning frequency is wrong. Consequently, before attempting waveform analysis, always lock the vertical hold, if at all possible. If necessary, temporarily misadjust the height or linearity controls or
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Circle 9 on literature card

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change the value of the coupling capacitor connected to the grid of the oscillator, if these changes will produce vertical locking.

The waveshaping network in the plate circuit of the oscillator and the output transformer/yoke combination both are frequency sensitive, as revealed by the waveform variations in the next illustrations.

First, you must be able to distinguish between normal and abnormal waveforms. Fig. 2A shows the screen of the Sears receiver when a crosshatch pattern is tuned in and the controls are adjusted to produce the best visual height and linearity. The waveform of the voltage applied to the yoke is shown in Fig. 2B. The parts of the waveform corresponding to the top and bottom of the picture are indicated. Changes in linearity can be detected easiest by examining the two ends of the sawtooth portion of the waveform.

Compare the normal picture and yoke waveform in Fig. 2 with those in Fig. 3 (insufficient linearity and excessive height adjustments) and Fig. 4 (excessive linearity and insufficient height adjustments). A leaky coupling capacitor between the oscillator and output tubes also often causes the conditions exhibited in Fig. 4. Misadjustment of the vertical controls caused the picture and waveform shown in Fig. 4A and 4B, and substantial leakage in C34 caused the picture and waveform shown in Figs. 4C and 4D.

Operation of the vertical sweep circuit at 30 Hz caused reduced scan at the bottom of the raster, shown in Fig. 5A, and a flattened sawtooth waveform, shown in Fig. 5B. This illustrates the radical changes in waveforms produced by incorrect scanning frequency in a receiver that was normal in all other respects.

An open C3C cathode bypass electrolytic capacitor caused reduced scan at the bottom of the screen; shown in Fig. 6A, and produced the yoke voltage waveform shown in Fig. 6B. The normal 3.6-volt parabolic waveform at the cathode is changed to a 34-volt sawtooth (Fig. 6C) when capacitor C3C opens.

New Theory About Vertical Deflection

In the process of taking the preceding waveform pictures and analyzing the effects produced by various component defects, we in the ELECTRONIC SERVICING laboratory encountered some peculiar results which made us doubt the old explanation of how the sawtooth pulse, vertical yoke waveform is produced.

Traditional theory

Over the years, we have been told that a pulse of voltage is necessary to produce a sawtooth of current through the inductive reactance of the vertical yoke windings. We have been told also that a sawtooth of voltage is necessary to produce a sawtooth of current through the same vertical yoke windings. The required waveform was said to be a combination of
pulse and sawtooth, and both elements of the waveform were said to be supplied by the vertical output stage.

Such theory is very plausible, as indicated by the waveforms in the schematic in Fig. 1. The waveform at the grid of the vertical output tube and the waveform at the yoke are very similar; both have a pulse and sawtooth. It seems that the tube is merely amplifying the waveform presented to it.

Tests raised doubts

Our first serious doubt about the old theory came when we attempted to correlate the amplitude of the pulse portion of the yoke voltage waveform with the amount of vertical sweep actually produced on the screen. There was no such relationship. Although increasing the setting of the height control produced more pulse in the waveform and more sweep height on the screen, more height could also be obtained by increasing the linearity control, which did not increase the pulse.

We also wondered how any tube can have a total grid bias of only 43 volts and yet amplify, with little

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**Fig. 9** Yoke voltage waveforms (taken without changing the scope gain) when the TV screen was filled to the same degree under the conditions listed. (A) Height and linearity controls adjusted for a normal picture. (B) Linearity adjusted for minimum, height control adjusted to fill the screen. (C) Linearity adjusted for maximum, height control adjusted to fill the screen. (D) 60-Hz sine wave applied to the grid of the oscillator produces almost normal picture when height and linearity controls are properly adjusted.
Fig. 10 The pulse portion of the yoke voltage waveform (widened 5X), with different types of loading across the yoke. (A) Normal voltage pulse at the yoke. Notice the horizontal pulses "riding" on the waveform. (B) Increased ringing caused by increasing C39 from the normal .1 to .6 mfd. Most of the horizontal pulses have been bypassed. (C) This loss of normal overshoot is caused by adding a 820-ohm resistor in parallel with the yoke.

distortion, an input voltage of 145 volts PP. Of course, this is impossible—there was extreme clipping.

Fig. 7 shows the waveform produced by the cathode current of the tube. This was obtained by adding a 2-ohm resistor in series between the cathode and the cathode resistors and bypass capacitor. The pulse at the bottom has been eliminated (except for a slight undershoot, which reveals where it should be) because the tube is cut off at that point. Obviously, the pulse in the yoke is not obtained from the output tube.

With the yoke disconnected, the output waveform consists of more sawtooth than pulse, as shown in Fig. 8. Although, with the yoke disconnected, the tube was operating with an incorrect load, it did not seem likely that this change should distort the waveform as much as that indicated by Fig. 8.

A controlled experiment seemed necessary. Four conditions—three abnormal and one normal—were set up, using the Sears b-w chassis, in which the control that varies the oscillator plate voltage is called "height" and the control that varies the cathode bias of the output tube is called "linearity". The resultant waveforms were photographed and the amplitude of the sawtooth and pulse portions were measured.

Fig. 9A shows the normal yoke voltage waveform produced when both the height and the linearity controls were adjusted correctly. The scope was calibrated for 20 volts PP per division, and the graticule markings show in the pictures so you can also read the voltages. Next, the linearity control was adjusted to produce maximum resistance (more bias and less deflection), and the height control was advanced until the raster was the same size as before, although the sweep was non-linear. Fig. 9B reveals that the sawtooth portion was little changed after these adjustments, but the pulse was larger.

The linearity control then was adjusted to produce minimum resistance (less bias and more deflection) and the height control was adjusted to produce a raster with the same height as produced in the two previous test conditions. Again, the sawtooth was virtually the same amplitude, but the pulse was much smaller (see Fig. 9C).

For the last test, a 9-volt (rms) AC signal was fed to the grid of the oscillator tube through a .5-mfd capacitor. This removed the positive feedback and substituted a 60-Hz sine wave. The picture rolled slowly down the screen, because of

Fig. 11 For a test, the pulse was removed from the waveform at the grid of the vertical output tube. (A) Only a sawtooth of 40 V PP, without pulse, is present at the grid of the vertical output tube. (B) Voltage waveform at the yoke still shows some pulse.
the difference between power line and color vertical sweep frequencies. The height and linearity controls were adjusted to produce the best possible deflection — the linearity was a little spread at the top, but the deflection was nearly normal. The resultant yoke voltage waveform with very little pulse is shown in Fig. 9D.

The amount of vertical deflection and the amplitude of the sawtooth portion of the waveforms were nearly the same in all four test situations. Only the pulse amplitude and width (which indicates the speed of retrace) were changed. According to the old theory, the pulse is the part of the waveform which contributes the height and, consequently, should have remained the same. However, the preceding tests clearly reveal that the pulse does not produce the height of the raster.

Another series of tests was performed in which the controls were adjusted to produce: 1) a reduced picture with good linearity, 2) a normal-sized picture which only slightly overscanned the screen, and 3) a picture much too large, but with good linearity. In all three cases, the pulse and sawtooth amplitudes increased and decreased proportionately.

In all of these tests, the height control had the most affect on the pulse, and the linearity (bias) control had the most affect on the sawtooth. It is apparent that the purpose of the pulse at the grid of the vertical output tube is to make certain the plate current is cut off completely during retrace. Also, the quicker the current through an inductor is interrupted, the larger the "kick back" pulse.

A preliminary conclusion

Our conclusion is that the amplitude of the sawtooth portion of the waveform determines the amount of vertical deflection, regardless of linearity. Only when the deflection is linear, regardless of the size of the raster, can the amplitude of the pulse be used as a measure of height.

What causes the pulse?

If the pulse portion of the yoke voltage is not supplied by the vertical output tube, is it caused by the collapsing magnetic fields of the yoke and output transformer? In other words, is it caused by ringing? If it is caused by ringing, the circuit should respond to tuning and damping.

Fig. 10A shows a horizontally-enlarged normal vertical yoke waveform, including the bump we thought might be overshoot from ringing. A .5-mfd capacitor added in parallel with C39 and the yoke windings in Fig. 1 increased amplitude of the ringing (shown in Fig. 10B) and caused it to occur at a lower frequency, as indicated by the increased width of the pulse and the added overshoot on the right.

Addition of a 820-ohm resistor in parallel with the yoke and capacitor C39 (extra .5-mfd capacitor removed) eliminated all ringing overshoot, as shown in Fig. 10C.

These tests indicate that the large pulse is caused by ringing.

Final proof

If the old theory of vertical sweep were true, loss of the large pulse at the grid of the vertical output tube would eliminate all vertical scan. We tested this assumption.

We grounded CIRCUITRACE point 21 in Fig. 1. The pulse at the grid of the output tube disappeared (see Fig. 11A), but some pulse still remained in the waveform at the yoke, as shown in Fig. 11B. The sweep was too large for the screen, but adjustment of the height and linearity controls made the picture nearly normal, except that the short used to eliminate the pulse at the oscillator also eliminated the locking.

The preceding test, in which no pulse was applied to the grid of the vertical output tube, proved that the pulse at the yoke is not produced by the output tube.

Final conclusion

The pulse portion of the waveform at the vertical yoke windings is supplied by the collapsing fields of the inductances in the yoke and

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### Audio Systems Report

**Audio Cable and Adapter Display**

A new sales program featuring an audio cable and adapter display has been introduced by North American Electronics.

This display consists of a pegboard rack which reportedly holds a wide variety of adapters and connectors pre-packaged in clear plastic.

The Audio Cable and Adapter Program sells for $54.64.

*Circle 50 on literature card*

**Cassette Universal Motor**

The Weltron Company has introduced a new cassette replacement motor.

The 70-700 is a DC motor which reportedly operates on either 6 or 9 volts and rotates in a clockwise direction. The cassette universal motor has capabilities of 2320 RPM at 6.5 volts or 2400 RPM at 9 volts, according to the manufacturer.

The 70-700 DC motor sells for $9.10.

*Circle 51 on literature card*

**Audio Connectors**

A new line of "Q-G" ("Quick-Ground") audio connectors reportedly designed for use with professional microphones has been introduced by Switchcraft, Inc.

The connectors, called T(*)F and T(*)FL audio connectors, are designed to give professional performers full control of their microphones. The built-in, slide-type on/off switch is located so that a performer can easily find and operate it with his or her thumb.

The audio connectors are available with 3-, 4-, and 5-pin female straight cord plugs that mate with all Switchcraft "Q-G" male plugs and with microphones having similar insert arrangements and an identical number of contacts, reports the manufacturer.

No. T(*)F has a black neoprene strain relief and accepts cables up to 0.25-inch in diameter; T(*)FL has the same type of strain relief, with a larger cable opening to accommodate cables from 0.25-inch to 0.328-inch in diameter.

Specific connectors are designated by inserting the number of contacts in place of the asterisk in the part number.

Price of the T3F audio receptacle is $7.00. Other units reportedly are comparably priced.

*Circle 52 on literature card*

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antenna systems report

CB Antenna Tuner/SWR Meter
A new combination antenna tuner and SWR meter, which contains everything needed to measure and correct antenna line mismatches, has been introduced by the E. F. Johnson Company.

Called the "Antenna Mate", the unit reportedly can correct antenna line SWR's of up to 5:1 to less than 1.1:1. A built-in meter reads the standing wave ratio from 1:1 to 10:1, and also indicates the relative power output.

By correcting antenna mismatches, the "Antenna Mate" not only produces maximum transmitted signal but also improves receiver performance, according to the manufacturer. All that is required to operate the unit is to insert the coaxial line between the transceiver and antenna, using standard coaxial connectors.

Price is $29.95.

Circle 60 on literature card

Universal Stacking Kit
A new universal stacking kit which reportedly makes possible an added gain of 3 dB when used with a pair of 3-, 4-, or 5-element beams or quads has been made available by the Antenna Specialist Company.

The stacking arrangement reportedly also results in a narrowed beam path which is said to permit the operator to "zero in" on the received signal more precisely and also eliminate many interfering signals that are off the beam path.

Model M-205 has special seamless aluminum alloy support arms which take effective wind loads of up to a reported 100 m.p.h. Their
telescopic design permits them to be extended to optimum spacing, according to the manufacturer.

A phasing harness that allows matching and hookup of any pair of conventional beams or quads is supplied with the stacking kit.

Model M-205 sells for $49.95.

CATV Cable Splice

Entron, Inc., is introducing a new seized, center-conductor, coaxial cable splice offering input and output test points. The unit, which reportedly exhibits RF characteristics comparable to the cable itself, enables signal levels to be monitored throughout the cable system.

The cable splice also features a new universal seizing device. Designed for underground or aerial mounting, it is expected to help eliminate stocking and inventory problems because one unit will now fit all cable sizes.

The splice block, Model SS/U, is designed for RF coaxial transmission systems and CATV systems operating in the frequency range of 5 MHz to 230 MHz and 26 dB up to 300 MHz. The unit measures 1 1/4 inches x 3/4 inches x 3 inches and has standard 5/8-24 entry ports. It is housed in corrosion-resistant aluminum.

This new cable splice sells for $6.95.


The ideal size and shape for service calls. Handy to use. Handy to store. Handy to carry around. Lets you add to your caddy those extra tubes you sometimes wish you had.

But that's not all. The "Slim-Jim" is refillable. Fills completely to service as many as 6 to 10 sets each time.

You save by buying economy, bench-size 24-oz. cans of Tun-O-Wash, Tun-O-Foam and/or Tun-O-Brite to fill and refill the "Slim-Jim." Best of all, there are no special gadgets for transferring either. Takes just half a minute and is so simple, you're bound to wonder, "Why didn't someone think of this before?"

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1260 Ralph Avenue, Brooklyn, N.Y. 11236

Circle 13 on literature card

October, 1971/ELECTRONIC SERVICING 33
A review of the significant technological changes evident in the products displayed at the 1971 Consumer Electronics Show.

Two categories of equipment got heavy play at the 1971 Consumer Electronics Show. One was color television, the perennial cash crop of the electronics industry. The other was a newcomer: four-channel sound.

The Color TV Picture

Truly new developments in home electronics seem to be scarce this year. This also applies to developments in color TV.

Imports

The only new brand name at the show was Sanyo. Its color sets are standard sizes for imported models: 12-, 15-, and 18-inch sizes, plus the new 19-inch square-corner. A "Tint/Sensor" circuit used in Sanyo models reportedly is a true automatic tint control (ATC) system instead of pre-set controls, as in most imports.

Channel Master introduced a 25-inch set with a plug-in modular chassis which it called "Integrid". It's a hybrid, and elaborate. It sports AGC and the usual automatic stuff. The chassis appears to be similar...

Microelectronics lead to more multi-function products.

Clock TV/radio from Symphonic has digital timer that turns whole unit on or off unattended; picks up UHF or VHF TV on 3-inch screen, and AM or FM radio.

Futuristic home entertainment complex from Panasonic contains AM, FM stereo, 8-track stereo tape, and color television, all controlled from special console in foreground. Digital timer turns system on or off. Tiny 2-inch b-w monitor in console can be switched to any channel for preview before changing the program on large center screen. This is prototype, but suggests future designs.

Not pictured but worth mentioning: A Panasonic clock radio with world map for a face; touch a city with your finger and the time is spoken aloud in French, Spanish, Japanese, English, Italian, or German. A Panasonic "snapshot" TV that produces a photo of whatever is on the screen when you punch a button. An Akai color video recorder and camera that is portable and records on 1/4-inch magnetic tape. A portable Ampex recorder and camera that puts video and audio on 1/2-inch videotape cartridges.
The Consumer Electronics Show

The Consumer Electronics Show (CES), produced and sponsored each year by the Consumer Electronics Group of the Electronics Industries Association (EIA), is the world's largest trade show devoted exclusively to consumer electronics.

This year, nearly 300 manufacturers, importers and distributors displayed their 1972 product lines at the Show, held June 27-30 at McCormick Place in Chicago. The more than 25,000 individual products exhibited included television and television systems, radios, phonographs, audio components, tape equipment, and accessories for these types of equipment.

A record 36,160 dealers, manufacturers, distributors, manufacturers' representatives, importers, and industry and government officials viewed the new products and attended conferences about retail marketing, servicing, legislation, broadcasting and a variety of other topics related to consumer electronics.

Next year, the CES again will be held at McCormick Place in Chicago, June 11-14. Attendance is free to qualified individuals—dealers, manufacturers, manufacturers' representatives, distributors and importers of consumer electronic products. For information, write: Consumer Electronics Show, 331 Madison Ave., New York, N.Y. 10017.

to a Wells-Gardner T50.

MGA (brand name of Mitsubishi) has a modular 25-inch too, using the Wells-Gardner plug-in, slide-out chassis. It makes servicing fairly nice. Outstanding at the MGA exhibit, though, was a solid-state 19-inch color chassis. Talk about serviceable. The boards open out so both sides are accessible for testing or parts replacement. Technicians who need information or parts for MGA sets and cannot obtain them locally should write John Doble, MGA Division, Mitsubishi International Corp., 7045 North Ridgeway Avenue, Lincolnwood, Ill. 60645.

Unique to the MGA 19-inch chassis is a 25-channel, detented UHF tuner (Fig. 1). Other detented UHF tuners generally have only eight positions.

What is called automatic tint in the MGA, and most other imported sets, consists of spare controls which are pre-set for optimum color tint brightness and contrast. Some of these controls have been made more accessible so that you can adjust them without taking off the back.

JVC America has a solid-state square-19-inch chassis it calls "Quadrimatic." Some circuit boards plug in, and several IC's are used. A circuit labeled Automatic Brightness Control is merely a pre-set pot; so is the PSC (pre-set color control). Sharp Electronics, in high-end models, has ACT (automatic color tint), which is only another pre-set arrangement.

Panasonic brought a battery operated 4.5-inch color portable to the Show. The set operates on internal batteries, a car battery, or line voltage; it takes only 15 watts of power. Hitachi, Micotron (brand name of Midland International), and Toshiba displayed essentially the same line they had last year—plus some new 19-inch square-corner models.

Domestic color

Most innovations this year seemed to be in American sets. At least Motorola and RCA came through with advanced designs. Sylvania's color line is similar to what they produced last year, with the 11-inch touchbutton varactor UHF/VHF tuner in a solid-state chassis at the top of the line.

Motorola stirred curiosity with "Insta-Matic" color tuning in the new Quasar chassis. At first glance, you could mistake the one-button device for another pre-set-control gimmick. The button does switch in pre-set brightness, contrast, color, and hue controls. But there's more. Insta-Matic activates AFT plus two new automatic controls: a background circuit and a color-intensity circuit.

The background circuit does two things: 1) It turns up the red CRT gun slightly, warming the shade...
(tint, Motorola calls it) of the raster; 2) it widens the angle of color demodulation, making the chassis less sensitive to errors in flesh tone.

The background circuit operates only if a color signal is received and the Insta-Matic switch is on. The color-killer stage sends a voltage to an AND gate when color sync, or burst, is part of the received signal. The second “input” for the AND gate is the closed Insta-Matic switch. If either input is missing, the background circuit is disabled.

The automatic color-intensity circuit affects chroma gain. It is in addition to regular ACC. Fig. 2 gives some idea of how it functions. With this section of the Insta-Matic switch in the Manual position, the manual color-intensity knob sets the bias on the second color-IF amplifier. Moved to the “I-M” position, the switch applies a different bias that is proportional to chroma amplitude.

C2 feeds the chroma signal to the intensity-control amplifiers, the gain of which is set by the Automatic Intensity pot. Doubler diodes develop the proportional DC bias. Voltage from the color killer, through R8, establishes the operating level for a Zener regulator, which determines nominal bias. This closed-loop system reportedly holds color intensity steadier than can regular ACC.

New from RCA is the CTC 46 chassis and its remote-controlled cousin, the CTC 54. Construction resembles last year’s CTC 49. Accu-Circuit plug-in modules (Fig. 3) are the outstanding feature; they plug in edgewise, like computer circuit cards.

Both chassis designs are called “AccuMatic Color Chassis”. The AccuMatic feature is like AccuTint in older chassis, except that the ranges of the Color and Hue controls are narrowed. Angles in the color demodulator are broadened near flesh color, and the color temperature of the raster is “warmed” up.

Although Zenith didn’t make it to the CES, their new all-transistor 25CC55 color cassis (Fig. 4) is worth mentioning. This chassis holds five plug-in Dura-Modules and drives a 25-inch picture tube.

Five flatpack IC’s are socket-mounted and perform the following functions: sync-AGC (new), chroma demodulator, subcarrier regenerator, chroma amplifier, and sound section. A special thick-film (not monolithic), integrated-circuit package contains all horizontal sweep circuitry except the power-output section. A varactor-equipped UHF/VHF tuner assembly rounds out the latest Zenith color chassis design.

**Four-Channel Sound**

*What it is and how it is achieved*

Under various tags—quadrasonic, quadriphonic, surround sound, wraparound stereo, and others—four-channel audio certainly grabbed a lot of attention at the CES.

Originally, four-channel hi-fi was a genuine attempt to recreate the exact sound of a concert hall. During recordings, two extra microphones picked up audio that included acoustic reverberation and phase lag just as it can be heard during a performance. The effect or feeling of “being there” is called ambience.

As hawked at the CES this year, four-channel audio seems mostly a sales-promotion gimmick. For one thing, there are multiple approaches. The goal of all is enhanced sound, but not necessarily through recorded acoustic effects. Each manufacturer seems to see

---

**Fig. 2** Automatic color-intensity circuit is one of the functions brought into play by pushing Insta-Matic button. Pre-set contrast, brightness, hue, and color controls are also activated, plus a circuit that desensitizes the color demodulator to flesh color variations and adds a slight red shade to the raster.

---

**Fig. 3** AccuCircuit plug-in module cards are major design features of new RCA chassis CTC 46 and CTC 54. Five integrated circuits are used. Now-standard SCR horizontal deflection is retained in these new chassis.
four-channel sound as something different.

It always takes four speakers, and most use four amplifier channels. But program material is anybody’s guess.

Few companies have significant amounts of four-channel material out. RCA has produced nearly 100 Quad-8 tape cartridges—a two-program version of the 8-track stereo cartridge. Vanguard has done some reel-to-reel, and Ovation and Project 3 have issued a few disc recordings. No more than a half-dozen FM stations around the country have given four-channel a serious try.

The buyer of four-channel equipment faces a wait. Tape, records, or FM—none are standard yet. Equipment bought now might be obsolete before standard methods are adopted by most manufacturers. Most four-channel still seems experimental.

One version uses only two stereo channels, but with four speakers. This special Dynaco hookup and speaker placement are shown in Fig. 5. Ambience is noticeable with ordinary stereo recordings. Special production mixing enhances the surround effect for this hookup, but no major record company does it that way.

A few systems merely add delay for some frequencies before feeding them to the back speakers. This creates an all-around-you effect and some ambience, but it’s not what you hear at a live performance.

Electro-Voice devised a way to matrix (encode) four channels into two. Ordinary stereo-FM stations and stereo discs can handle this matrix signal. A decoder at the playback or receiving end converts the two-component signals back to four. Several companies at the Show offered decoders.

Many recording companies use multichannel consoles. Thus they have master tapes in multi-track format. Four-channel program material can be mixed down from 8- and 16-channel master tapes. This effectively puts the listener smack in the middle of the band or orchestra. Some listeners, especially youngsters, like that.
Fig. 6 Amplifier for four-channel audio has built-in reverb to emphasize big-hall sound. (Label "Hall Effect" does not refer to the well-known magnetic effect.) Slider controls set balance between front and rear speakers. VU meters are provided for all four channels.

Fig. 7 Ultramodern four-channel receiver by Quadracast Systems Inc., and sold by Mikado Electronics. Employs integrated circuits on plug-in modules. Can handle up to 100 watts (rms) power per channel, manufacturer claims, with special chip output amplifiers.

Fig. 8 One-control Panasonic balancing system for quad looks almost like a gyroscope. Can be added onto existing system, or is integral to some Panasonic quad-listening devices shown at CES.
Recording engineers and composers synthesize quad sound. Synthesizers such as the popular Moog (now Moog-Microsonics) supply unique bounce-around effects for four speakers. Similar qualities can be recorded from regular instruments. The sound is novel, even pleasing. Such techniques make four-channel a medium all its own—something you’ll never hear in any concert hall.

The hardware

Some companies brought new quad equipment to the Show, some displayed last year’s. I saw amplifiers and receivers, with and without decoders. Some new amplifiers include reverberation for the back channels, to stimulate big-hall ambience.

Shown in Fig. 6 is a four-channel Kenwood amplifier with decoding and reverb. The “Hall Effect” control label does not refer to true Hall effect, which is a magnetic phenomenon; this label is an offshore manufacturer’s description of the sound effect you get by lengthening echo time.

A company new to the U.S., Rolecor of America, displayed two quad amplifiers. Sanyo, a name known here, brought in a four-channel amplifier with a matrix decoder. Benjamin, maker of Mira-cord record players, offered its first receiver/amplifier.

Pictured in Fig. 7 is a Japanese-built unit which is loaded with integrated circuitry, (on plug-in modules), is equipped with digital tuning readout, and has a power capability up to 100 watts (rms) per channel. This unit, the QSI-4000, is the only receiver I know of that contains circuitry for Dorren Quadraplex, a system for multiplexing four discrete program channels on a single FM-station carrier. (Back-speaker signals go on a 76-kHz subcarrier, much like the front-speaker channels for ordinary FM stereo are put on the 38-kHz subcarrier. No station uses the system yet, but it has been tested at KIOI in San Francisco.)

The QSI-4000 also accommodates the JVC system of quad disc playback, too. The grooves of JVC-type, four-channel records contain, besides the 45-45 modulation for regular stereo, a multiplexed subcarrier that carries back-speaker modulation. Any cartridge that reaches up to 45-50 kHz can retrieve all of the modulating signal. A special demodulator recovers the two back channels.

Balancing controls for quads allow a listener to “place” himself almost anywhere in relation to the

Fig. 9 Little bright spot near front of grid (right) represents effective location of listener when balance controls are changed from center. Two controls balance the speakers and move the light. Motorola player accepts RCA-type four-channel or two-channel 8-track tapes.

Fig. 10 Tape machines are the easiest program source for quad sound. This Panasonic reel-to-reel lets you make your own four-channel recordings—two programs per tape. Four mike inputs, four input controls, four VU meters, and noise reduction system are included.
surrounding sound. The QSI receiver has a 360-degree stick-type control. It's similar to one that comes with several Panasonic quad systems, or is available for add-on.

You can see how it works in Fig. 8. It looks almost gyroscopic. The stick moves either or both of the two gimbals, which rotate the balance potentiometers.

Most quad units utilize two knobs for balancing right/left/front/rear. Motorola simplifies the task with a lighted grid in the "Quad-line" tape player (Fig. 9). The listener position, represented by a tiny lamp beneath the grid, can be moved forward or backward by one knob, from side to side with another.

Presently being the main producer of quad tape cartridges, RCA naturally has several machines to play them on. All of the RCA units play both stereo-8 and Quad-8 tapes. So do the Bell & Howell and General Electric quad units exhibited at the Show. Craig exhibited a new quad player for automobiles, and both Kenwood and Panasonic (Fig. 10) displayed elaborate four-channel reel players. Fig. 11 shows one of the first four-channel machines for recording and playing back on cassettes. It appears that some time will pass before disc records or FM radio provide much four-channel programming.

One unexpected device at the Show was a four-channel headset. The Koss "Quadrafone" (Fig. 12) reproduces "plain" stereo too. Don't expect ideal front-back separation, but the surround effect is there.

**Synthetic quad**

The ambience effect of quads can be faked. That is, your ear can be
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has lots of scope.

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Circle 14 on literature card

October, 1971/ELECTRONIC SERVICING 41
fooled into thinking it's hearing sounds from a large concert hall.

How such a unit, the Sansui "Quadphonic Synthesizer", functions is illustrated in Fig. 13.

Music develops complicated interference patterns as its waves bounce around inside the hall. A listener's ears pick up these "beat" patterns along with direct waves, giving a music hall its characteristic "sound".

The Sansui synthesizer takes ordinary two-channel stereo, phase-modulates certain frequencies, and feeds them to the rear speakers. When the mixtures of waves reach the listener's ears, they "sound" like a concert hall. The unit in no way matches any particular hall, nor can it produce the ping-pong effects of true four-channel sounds.

The Power-Rating Battle

More than usual, manufacturers and importers at this year's CES specified the power ratings of amplifiers in rms values, measured into 8-ohm loads. The Federal Trade Commission made it clear, at one seminar during the Show, that it would soon stipulate how power and frequency response are to be measured and advertised. Arguments ensued, but rms seems to be the method that will be adopted.

Ratings can fool you. One unit at the Show was advertised as a 60-watt (IHF) amplifier. Another boasted 100 watts (IPM). A third is rated at 22 watts (rms) per channel. Do you know which amplifier produces the most power?

If you guessed the 22-watt, you're right. The 60-watt (IHF) amplifier produces 7.5 watts (rms) per channel. The 100-watt (IPMP) is only a 50-watt-per-channel unit, which is less than 7 watts (rms). Consider this when you're trying to be fair with a customer who is buying an amplifier, or when you're checking power output after servicing one. Study the specs cautiously and be sure you duplicate input values and loading.
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Circle 18 on literature card

October, 1971/ELECTRONIC SERVICING 43
Let's wind up our discussions of bookkeeping and accounting with a quick review of what's been covered.

**The Fundamental Equation of Business**

Every business begins with ownership of something: the fixtures, tools, equipment required to do business. The location from which business is done (technically, you buy the right of occupancy for a stated period of time when you rent, so you own those rights while the rent is paid), and the merchandise and supplies sold or used, also are things owned. Cash in the business’s bank account is owned by the business. Likewise, any money owed to your business is 'owned' by your business.

Most businesses also owe something from time to time. Short-term debts, like money owed for supplies purchased, to be paid at the end of the month, or long-term debts like mortgages on buildings and equipment.

What you own are called your ASSETS. What you owe are called your LIABILITIES. Taken together, these two factors determine the value of your business — its NET WORTH, your PROPRIETORSHIP. The simple equation based on Assets, Liabilities and Net

![Fundamental Equations of Accounting](image)

**Fig. 2** Mike’s TV-Electronics Balance Sheet October 1, 1970

<table>
<thead>
<tr>
<th>ASSETS</th>
<th>LIABILITIES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cash $1,109.60</td>
<td>Accounts Payable</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>C E M Supply Company 112.00</td>
</tr>
<tr>
<td>Springville Hospital 134.00</td>
<td>Martin Supply Company 54.30</td>
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<td>Total Liabilities 975.60</td>
</tr>
<tr>
<td>Total Assets 5,800.60</td>
<td><strong>PROPRIETORSHIP</strong></td>
</tr>
<tr>
<td></td>
<td>Mike Farad, Capital 4,825.00</td>
</tr>
<tr>
<td></td>
<td>Total Liab. and Prop.$5,800.60</td>
</tr>
</tbody>
</table>
Worth, or Proprietorship, is shown in Fig. 1.

**The Balance Sheet: End Product of the Bookkeeping System**

That equation is the major premise of bookkeeping and accounting. In practice it is expressed as a Balance Sheet, as shown in Fig. 2.

The Balance Sheet shows Assets to the left, Liabilities and Proprietorship to the right.

**Assets**

Assets begin with Cash (on hand, and in the bank account) and money owed (Accounts Receivable) to the business. Then the other items owned are listed, at their current book value. (Their beginning cost, less the amount of their value used up—called Depreciation.)

**Liabilities**

Liabilities begin with Accounts Payable—the money you owe that must be paid at the end of the month or soon thereafter. Then come the special items and long-term debts: Taxes Payable and Mortgages Payable.

**Proprietorship**

Finally, to satisfy the equation, comes proprietorship—the share of the business belonging to the owner, free and clear of all claims of his creditors. Determining Proprietorship follows upon establishing the other two items.

The Balance Sheet is the first, and basic document, of any business's books. Everything else follows upon it, because all the other records in a bookkeeping, or accounting, system feed information back to the Balance Sheet. That means that all the changes that result from doing business can be carried back to the Balance Sheet—and they are, each time the books are closed and summaries prepared.

When a new business is born, its birth-certificate is a Balance Sheet.
**Bookkeeping—What and Why**

All businesses exist to trade merchandise or service for money. That's giving and receiving value—and every such exchange of value is a business transaction.

From its birth, a business with a serious records system records each transaction faithfully and accurately. Its books become a complete history of its life as a business. One Balance Sheet follows another as the books are summarized periodically, to show the growth of the business or its shrinking; its success or its failure.

That's all Bookkeeping is—the recording of transactions in their proper form, to reflect the moment-to-moment changes taking place as one business transaction follows another. A bookkeeping system will be "tailored" to a specific business, to record its particular types of transactions in the most useful form, but it will be very much like every other system, in outline.

**Recording Business Transactions—The Place and Sequence**

A major characteristic of bookkeeping systems is **orderliness**. From Immediate Record back to the Balance Sheet and other summaries and reports, the flow proceeds as in Fig. 3.

**Immediate records**

Each entry begins with a piece of business paper—a check, a receipt, an invoice or bill, a sales ticket, a check stub or a deposit slip. These are the immediate records of the transaction. They are made **at the time** of the transaction.

**Journals**

These papers trigger the entries in a Journal, which is a **book of original entry**. That is, the Journal is the first place a transaction is entered. There may be one Journal for each class of transaction—as in large businesses. There may be only one or two, in smaller business—or even one Journal combining many journals into one book (a Combination Journal) of several columns.

The original entries are classified in the Journals. There's a Cash Journal for cash transactions; a Sales Journal for sales on account; a Purchases Journal for purchases of parts on account for resale, and a General Journal to record miscellaneous transactions.

In a Combination Journal, the four Journals mentioned may be combined in one book, on an eight-column page, with two columns serving each of the four journals each get two columns—one for Debits and one for Credits.

**Ledger Accounts**

From the Journal, or Journals, the transactions are transferred to the Ledger Accounts concerned. This transferring is called **posting**. An Account is simply a record of a single class of transaction. There are Accounts for each category in the Balance Sheet—Assets, Liabilities and Proprierty. There are also Accounts for Income and for Expenses. You'll have **Asset Accounts** consisting of Cash, Receivables, Equipment, Parts & Supplies—each class of item owned. You'll have Liability Accounts for each class of debt, and each creditor.

The advantages of such Account classifications are apparent—you have, in one Account record, information on who and how much you owe; who owes you,
and how much; what you spend on a specific group of items. If you just wrote them down in a book, as they were transacted, you'd have to go through and sift them out when you needed information on one creditor or one bill owed you.

**Debits and Credits—Give and Take**

The two aspects of bookkeeping that cause more trouble than any other are the relationship and selection of Debits and Credits.

Naturally, transactions are two-way streets. You take in something and you give up something. If you're selling, you take in money and give up merchandise or service. If you're buying, you give up money and get merchandise or service in return.

Going back to the Balance Sheet, you can see immediately that either of these transactions causes one of the Balance Sheet items to increase and another to decrease. Every transaction has these two parts. Double-Entry Bookkeeping is called that because it records both parts. Only by doing so is the continuing effect on the Balance Sheet accurately reflected.

There is no definition of Debit or Credit I can give you. There is just one fixed rule I can offer: In any given transaction one will mean increase and the other will mean decrease.

How you tell which means which is determined from the Balance Sheet, and the custom of putting Debits on the left and Credits on the right in the Ledger Account Form (T-Account), shown in Fig. 5.

Assets are on the left-hand side of the Balance Sheet. Therefore, by accepted accounting custom, their increases are shown on the left-hand side of the account sheet (same-side-increase rule). Hence, an Asset Account increase is shown as a Debit. An Asset Account decrease must, therefore, be shown as a Credit.

On the Balance Sheet the right-hand side are Liabilities and Proprietorship. Under the same-side-increase rule Liabilities and Proprietorship Account increases are shown as Credits, and their decreases as Debits. Fig. 6 helps to clarify this.

That takes us through the Balance Sheet part of the problem. There is another basic business document—the Income and Expense Summary (or Operating Statement). Here, Debit and Credit mean decrease and increase, respectively. Not because they suddenly abandon the rule, however. The rule still holds true, for this reason:

Income is defined as the result of a transaction which increases an Asset and Increases Proprietorship. Expense is defined as the result of a transaction which reduces proprietorship, either by reducing an Asset or Increasing a Liability. As a result, these two items bear on Proprietorship—they're actually almost a part of it—so that the rule is satisfied.

The Bookkeeping Equation is subject to all the algebraic rules. Subtracting equal amounts from both sides, or adding equal amounts to both sides leaves Proprietorship unchanged. And, this operation also shows you why Debit and Credit can't mean the same thing on both sides of the Balance Sheet. Try it this way: you pay a bill that's due; you reduce Accounts Payable. Both reductions can't be Debits, or the Equation-Balance Sheet would go wild.
Balance Sheet and Operating Statement: Two Key Reports Which Summarize The Effects of Your Business Transactions

The Balance Sheet and Operating Statement are the two key reports you get from your bookkeeper after the closing of the books each month, quarter or year. The Balance Sheet shows you the condition of your business at a given date. The Operating Statement shows you what you've taken in and what you've spent.

Each can tell you something: Whether you're gaining or losing ground, whether sales or expenses explain the change, what your debt picture is and how you stand on operating capital. They can tell you what's happening, but not always why.

Part of any manager's job is to keep in touch with his business environment. To read his Balance Sheet with an eye to what's happening around him. To read his newspaper and other indicators of economic trends with an eye to his Balance Sheet. That's an important way to get the "why" of what your books alert you to look for. More than that, it's a good way to learn what upcoming changes might give you a chance to promote more business.

Bookkeeping—Not Necessarily Easy, But Necessary

Bookkeeping isn't a snap, it takes time and care. It will cost you to have someone else do it for you—although it probably will be money well-spent, freeing you to do what you get paid for doing. It'll cost you some late nights, if you do it yourself. Either way, it has to be done.

The U.S. Small Business administration says that next to lack of adequate capital and lack of knowledge of the business, the most common cause of small business failure is failure to keep sound, adequate records.

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Fig. 6 Showing how T-Account entries derive from the Balance Sheet.

**BALANCE SHEET**

<table>
<thead>
<tr>
<th>Assets</th>
<th>Liabilities</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>cash</em></td>
<td>Accounts Payable</td>
</tr>
<tr>
<td>Equipment</td>
<td>Notes Payable</td>
</tr>
<tr>
<td>Merchandise</td>
<td>Mortgages Payable</td>
</tr>
<tr>
<td>Accounts Receivable</td>
<td>Proprietorship</td>
</tr>
<tr>
<td>Supplies</td>
<td>Any Liability or Proprietorship Account</td>
</tr>
</tbody>
</table>

Any Asset Account

Debit Side: Shows Increases by Debit Entries
Credit Side: Shows Decreases by Credit Entries

Normally Shows a Debit Balance when Closed

(Total Debit Balances Equal Total Credit Balances)

Occasional question about each, plus quarterly and annual tax reports to two or three levels of the government, you can average sifting through such a notebook at least once or twice a week. This adds up to a lot of wasted time.

And, if your only record of work you’ve done and haven’t been paid for is in that notebook, an attempt to be systematic about collections costs time too.

Finally, there have been small businesses which might have been helped when trouble first developed, except that lack of records kept anybody from knowing exactly what was wrong and, consequently, what help was needed.

Not too long ago, I heard of a promising small business that failed because of lack of working capital. The lack was brought about by an ambitious re-equipping and refixturing program—all paid for in cash.

The owner actually owned his new equipment and fixtures and could have borrowed money on them. But not a banker in town would risk much on him when it developed that he couldn’t produce a Financial Statement (our old friend, the Balance Sheet). The man had $13,000 in new equipment and couldn’t pay his rent. The new equipment might have brought him new business, but he couldn’t afford to wait until it came in.

Records would have helped him, if he’d had them and had paid attention to them. He’d have known how much he had to hold back for operating expenses and how much might be needed to meet some big items due fairly soon. Most of all, he could have presented a reasonable case to the bankers.

One of the greatest effects a solid set of records gives you in the inclination to be systematic and businesslike in other things, as well. Systematic filing, recording, and other businesslike practices seem just naturally to follow.
FM alignment with and without sweep

One of the persistent fears that prevents some technicians from realizing the most from FM radio servicing is alignophobia. This is characterized by a fear of touching tuned circuits above 2 MHz or so.

FM alignment admittedly is more complex than, say, aligning an AM table model radio. On the other hand, even the simplest black-and-white TV alignment is much more complex than FM radio.

Sweep alignment is considered to be the best method for aligning an FM receiver. Although we will shortly be getting into a more simplified method involving non-swept techniques, we'll begin examining the characteristics of FM modulation and sweep alignment methods.

Frequency modulation (FM) differs from amplitude modulation in, shall we say, the direction of the modulation.

**AM**

In amplitude modulation, the audio information is superimposed on a radio carrier wave. This relationship is shown in Fig. 1. (The waveform shown in C can be viewed on an oscilloscope by connecting the output of an AM signal generator through a diode demodulator probe to the vertical input of the scope.) All that is necessary for proper AM demodulation at the receiver end is a simple solid-state diode detector.

**FM**

In an FM transmitter, on the other hand, angular modulation is used. There are actually two types of modulation commonly called FM. One is “pure” FM while the other is actually phase modulation.

**Terminology—deviation and swing**

In any given FM modulator, an audio signal of one polarity will cause the carrier frequency to increase while the opposite polarity causes the frequency to decrease. Many technicians become bogged down at this point with unfamiliar terminology and false impressions. One point is confusion over the sweep width and deviation. The distinction between frequency deviation and swing is illustrated in Fig. 2.

The amount of frequency shift, usually measured in KHz from the center frequency to either extremity, is called deviation.

The entire width of the modulated signal, from its lowest extremity to the highest, is called the frequency swing. The meaning of this term is synonymous with the sweep width of an FM generator.

Another term, modulation index, often is used in connection with frequency modulation. It is defined as the ratio between total deviation and the modulating frequency. Because an FM broadcast station can transmit audio signals up to 15 KHz, the maximum attainable modulation index value is 5 (75 KHz deviation/15 KHz modulating frequency).

Some technicians believe that deviation and frequency swing are determined by the frequency of the modulating signal. This is true for AM. In pure FM, however, deviation and frequency swing are determined by the relative level, or amplitude, of the modulating signal. The term “100 percent frequency modulation” is actually an arbitrary standard established by the FCC, who have determined that 75 KHz deviation will be 100 percent.

**Phase modulation**

To prevent confusion, it might be well to explain a thing or two about a related form of angular modulation, phase modulation (PM). It is the type of modulation used in the so-called VHF-FM two-way radio transmitters.

PM deviation is directly related to the modulating frequency. The process of phase modulation produces a rising curve which increases 6 dB per octave over the range of modulating frequencies. Because of this, it is necessary to de-emphasize the higher audio frequencies.

---

Fig. 1 Elements of amplitude modulation. A) Unmodulated carrier. B) Modulating signal. C) Amplitude modulated carrier. All of these can be viewed on a scope.
The deviation vs modulating frequency differences between FM and PM are shown in Fig. 2B.

**FM fidelity**

Frequency modulation is well known for its high-fidelity sound. This is attributable to the wide range of audio frequencies allowed FM broadcasters by the FCC. An FM station is allowed to transmit audio frequencies up to 15 KHz while most AM stations are restricted to no more than 5 KHz. Some hi-fi buffs might be more than a little upset if they knew that FM is actually rather lo-fi. Those upper audio frequencies must be increased, or as mentioned earlier, pre-emphasized, before being applied to the modulator in the transmitter. To compensate for this pre-emphasis, the receiver must be equipped with a 75-microsecond (RC time constant) de-emphasis network.

The purpose of sweep alignment is to insure that the bandwidth of the receiver is wide enough to provide sufficient amplification of all the transmitted intelligence. An FM receiver that has too narrow a bandwidth will significantly distort the received signal. On the other hand, a bandwidth that is too wide will produce an annoyingly high noise level.

What constitutes proper receiver bandwidth seems to be a matter of controversy. Many technicians, including the author, have traditionally aligned FM receivers to produce a 150-KHz bandpass. However, at least one authority claims that it should be wide enough to admit the eighth significant harmonic produced by an index 5 modulating frequency, which is 240 KHz on monaural stations and 318 KHz on stereo stations. Because there is contradiction about this point, and because an electronic technician is a professional who is responsible for his own work, I leave it to you to determine which bandwidth to use.

**Sweep Alignment**

A typical sweep alignment setup for FM is shown in Fig. 3. The sweep generator simulates the signal from an FM broadcast station. The marker generator provides small pips which help determine the frequency at a particular point on the response curve traced out by the oscilloscope. The marker and the sweep outputs are fed into an adder. This device combines all of the required signals into one composite that can be fed into the FM receiver. Direct connection, without the adder, can cause interaction between sweep and markers which can

---

**Fig. 2** A) The graph here illustrates the frequency components of a single FM channel. The total bandwidth is 200 KHz, 50 KHz of which is divided into two 25K-Hz guard bands, one situated at each extremity of the channel. The amplitude and polarity of the modulating signal causes the frequency to shift either above or below the center, or carrier, frequency; this is called deviation, and is limited to no more than 75 KHz above or below the center frequency. The total amount that the modulating signal can shift the frequency is 150 KHz. The frequency of the modulating signal determines the rate at which the frequency of the transmitted signal is shifted. Ideally, the amplitude of the transmitted signal remains relatively constant. The percentage of FM modulation, usually called the modulation index, is determined by the ratio of the maximum deviation and the modulating frequency which produced it. For example, if a deviation of 75 KHz is produced by a 15KHz modulating signal, the modulation index is 5, or 100 percent—the deviation and the modulating frequencies used in this example are the maximums allowed by the FCC. B) This graph illustrates the fact that in phase modulation, which is an indirect form of frequency modulation, the higher frequencies of the modulating signal are purposely de-emphasized prior to application to the modulator. This is because the amount of frequency modulation produced by the lower modulating frequencies is not proportional to that produced by the higher frequencies; the lower the frequency, the disproportionately lower the modulation. The main advantage of the various phase-modulation systems over conventional FM systems is that a crystal-controlled oscillator can be used in the master oscillator. This eliminates the need for the separate crystal-controlled frequency control system required to maintain acceptable frequency accuracy in conventional FM systems.
distort the response curve. Many test equipment manufacturers now offer sweep, marker and adder functions in one cabinet. Many of these instruments also include bias supplies and other functions that are needed by TV men. All this means a lot less effort, less bench clutter and more usable bench space.

**IF**

The alignment instructions for most FM receivers and/or tuners usually will tell you where the adder output is to be injected. Success will be more sure if these instructions are followed to the letter.

If such instructions are not given, however, you can connect the output wire from the generator or adder to a short piece of insulated hook-up wire. This "gimmick" is then dropped inside the slug of the 1st FM IF transformer. If this transformer has screwdriver slots instead of hex-holes in the slugs, the added output can be connected to

---

**Fig. 3** Typical setups for performing sweep alignment of an FM receiver. See text for detailed procedure.

**Fig. 4** Simplified block diagram of a typical FM receiver (Motorola Model FM991).
the base or grid of the FM mixer. The hot side of the adder’s output cable should be connected to the injection point via a capacitor of .001-.005mfd.

Most instructions also specify the generator settings. These typically read: 10.7 MHz, 22.5 KHz sweep width, 400 Hz modulation.

A simplified block diagram of an FM receiver is shown in Fig. 4. Connect a zero-center, high-impedance voltmeter to point A. (Most ordinary shop VTVM’s can be made zero center by readjusting the zero control.) With proper signal applied to the input point, as described previously, adjust the secondary of the detector transformer for zero volts. The meter will read a positive voltage on one side of the correct transformer setting and a negative voltage on the other side.

Next, connect the meter across the speaker of the receiver. Peak all other IF tuned circuits to produce a response curve similar to that in Fig. 5.

**Tuner**

To align the front end, it is necessary to apply a proper signal to the antenna terminals of the set. The signal, preferably, should have a frequency that corresponds to one of the calibration points on the tuning dial.

After injecting the proper signal, zero the receiver oscillator by carefully turning the associated trimmer capacitor (occasionally a slug-tuned coil is used) until the voltage at point A (Fig. 4) is again zero.

Next, peak the RF amplifier and antenna tuning adjustments for maximum output. Monitor the response curve on the scope during this process. The markers will help you determine whether or not the response is correct at the significant frequencies. It is best to sacrifice a little gain to produce a correctly shaped response curve.

**Non-Swept Alignment**

Although sweep alignment is considered the most accurate way to align an FM set, it isn’t the only way. An unmodulated signal generator, if properly used, can provide a signal good enough for acceptable alignment under certain conditions.

Equipment for non-swept alignment is wide and varied. In general, however, all of it can be broken down into two categories: First, you will need some sort of level indicator. A good shop VTVM generally will suffice. Also, you will need a stable signal source. This can be either a good grade of tunable service-type signal generator (AM modulation, if any, must be switched off) or a crystal-controlled marker oscillator.

There are only a few requirements which the signal source must meet:

- One is that it have decent short term stability. Another is that it be reasonably accurate. A third requirement is that it have low leakage and a good attenuator. (Many of the so-called service grade generators exhibit enough leakage, even under maximum attenuation, to cause overload problems during alignment.)

- The author built a fairly decent alignment oscillator using commercially available oscillator and buffer kits. These are inexpensive and, when housed in a double-shielded aluminum enclosure produce low residual RF radiation.

- I chose two crystals for my portable FM alignment oscillator: 10.7 MHz and 9 MHz. The 10.7-MHz crystal is, of course, used to align the FM IF amplifiers. The 9-MHz crystal was chosen because it has harmonics at 90 MHz, 99 MHz, and 108 MHz, which can be used for checking an FM receiver’s calibration and tracking at both extremities and the middle of the band. No provision was made for modulation because this signal generator was intended exclusively for FM alignment and servicing.

- Many sets require some sort of dummy antenna between the signal generator and the injection point. This is especially true of automotive FM and FM Stereo receivers. A dummy antenna which can be used with most types of car radio is shown in Fig. 6. It can be built inside of a standard Motorola-type car radio antenna plug. Other types might require a different type of dummy antenna. Be sure to consult either the appropriate PHOTOFACT or the manufacturer’s service manual.

The test setup shown in Fig. 7 will produce satisfactory alignment of most types of FM receivers. Connect the output of a 10.7-MHz generator (6.5-MHz for some European car radios) either to the input of the FM mixer or, via a gimmick, as described earlier, to the 1st IF transformer. (Do not connect the generator cable directly to the transformer because the cable capacitance will de-tune the set.) Connect a high-impedance DC voltmeter to a point that corresponds to point Z in Fig. 8. Adjust the secondary of the detector transformer to null (zero voltage). Here a zero-center VTVM will be convenient. As in sweep alignment, the voltage will swing positive and negative on either side of the correct adjustment.
There are two major factors which, if overlooked, can make identification of the “null” point difficult. One is overloading of the IF amplifier chain, which, in some sets, is caused by AGC action. Identification of the null points also can be difficult because the visual effect of the tuning adjustments will be very small in relation to the total meter reading.

The AGC system can be disabled in many FM sets. In fact, in many cases, the manufacturers instructions call for the FM AGC to be disabled.

The only way to eliminate simple overload problems associated with alignment is to select more attenuation in the signal generator. Most instructions state that the best signal level is the point slightly above the level that “quiets” the FM receiver. As the tuned circuits are peaked up, it might be necessary to periodically readjust the attenuator to that point.

**IF alignment**

To peak the IF transformers, connect the meter to the point that corresponds to Z in Fig. 8. An alternate point might be the input of the limiter stage, which will require a low-capacitance detector probe. At either test point, the reading will be maximum when the IF transformers are properly adjusted.

When using the detector probe at the limiter input, however, you will find that adjusting the limiter output tuning will not produce an indication on the meter. Consequently, to peak the limiter output, connect the meter to either side of the detector transformer secondary. Be sure to use only a high-impedance voltmeter equipped with detector probe.

During IF transformer peaking, the signal source may be left connected in the same manner as it was in the previous step. Again, be sure that the generator output level is maintained just above the receiver’s quieting point, to prevent overload.

Do not attempt to use a broadcast station signal as a source. It is very difficult to find a station that presents this optimum signal level with any degree of reliability. Also to be considered is that “capture effect” and the inherent rejection of weak signals by FM receivers will raise havoc with attempts at on-the-air alignment.

Also, do not attempt to use your ears as a level detector. Added to the objections listed previously is the annoying broadness of FM tuned circuits. This broadness is a result of the 75-KHz maximum deviation. Also, the receiver can break out of quieting at both extremes of the tuning slug adjustments while the quieted range can cover several complete turns. This explains the futility of aligning by ear.

Work from the detector end of the chain towards the tuner. Ad-
just first the secondaries then the primaries of each transformer. When you have completed the sequence, start again and repeak for optimum results. This repeaking is required on many sets because the transformers have substantial interaction.

Tuner alignment

The alignment of the tuner section of the FM set is similar to that used in sweep alignment. However, many of the signal sources that were usable at 10.7 MHz are useless at 100 MHz.

Some RF generators use harmonics to supply signals over 30 or 40 MHz. Unfortunately, this leads to problems. A frequency error, for example, at 10.7 MHz might be acceptable. At the tenth harmonic, however, that error will be ten times as bad. Instability also will be ten times as bad. Therefore, a signal generator that had reasonable short-term stability at 10.7 MHz will be unacceptable at 100 MHz.

As an alternative signal source, I use the 9-MHz crystal oscillator described earlier. Another alternative is to use the second harmonic of a crystal controlled TV alignment marker generator. The 2nd harmonic of the 44-MHz marker, for example, is 88 MHz. The harmonics of other markers provided other required frequencies further up the FM band. Again, as with the IF stages, continually adjust the attenuator in the generator to just above the receiver quieting level.

The tuner of an FM receiver is especially sensitive to changes of stray inductance and capacitance. To combat this problem, be sure to use a rather long non-metallic alignment tool. Also, be sure not to move any leads, resistors, capacitors, or coils inside the tuner. Although it might be a great temptation to move a disc ceramic capacitor to get to a tuning adjustment, it can very easily upset prior adjustments. Therefore, make sure all adjustments and test points are accessible before beginning alignment.

Proceed very slowly when adjusting the tuned circuits in an FM set; you might miss the peak setting of the adjustment.

It is worth noting, at this point, that most trimmers used in FM tuners pass through their entire capacitance range in just 180 degrees of rotation, although they will rotate a full 360 degrees. This will produce a double peak that can be very confusing.

Fig. 9 Quadrature detector circuits, such as this one, used in Delco AM/FM stereo radio Model 02GFP1, require an alignment procedure which is different than that used with receivers equipped with conventional detectors. See text for detailed procedure.
Another standard FM alignment procedure is to leave all metal covers in place during alignment. It is quite possible for these covers, which admittedly are difficult to work through, to completely change the tuning of the front end.

Quadrature techniques

The methods detailed previously have been predicated on the assumption that the set uses either a discriminator or ratio detector. For most sets, these techniques will easily help a technician through an alignment job. Some recent sets, however, do not use either of these types of detector. They are using what is known as the quadrature detector.

In most sets employing quadrature detection, the demodulation, limiting and final IF amplifier functions are combined inside one integrated-circuit chip. This chip can be either a 14-lead dual in-line IC pack or a multi-lead version of the old TO-5 transistor case. In any event, quadrature detectors require an entirely different alignment problem.

The circuit in Fig. 9 is the quadrature detector circuit used in the 1970 Delco AM/FM Stereo radio model 02GFPI (installed in Pontiac Grand PRIX). The alignment procedure for this radio is different than that for conventional detectors. One apparent difference is the necessity for using an RF demodulator probe as a peak indicator. Delco recommends the RCA WG301 demodulator probe be connected to a high-impedance VTVM.

A 10.7-MHz unmodulated signal is injected into the set at the base of the mixer transistor. On the Delco set, it is necessary to use a dummy antenna consisting of a .0047-mfd capacitor in series with a 270-ohm resistor.

The RF probe is connected to point M in Fig. 9. Adjust the transformers between the first two stages for maximum amplitude.

First, to adjust the phase transformer in the quadrature detector, remove the RF probe from the VTVM. Switch the meter to "AC Volts", then connect it directly across the speaker terminals. The 10.7-MHz signal is injected directly into the antenna circuit of the receiver. Reduce the output of the generator until background noise begins to overcome quieting. As the phase transformer is adjusted through its entire range, you will notice there are two peaks in the background noise. The proper adjustment point is the null between those two peaks. It will be very close to midway between the peaks.

Although the author prefers to use a genuine FM sweep generator for FM alignment, non-swept methods do have their proper use. After replacing a transistor or FM tuning component, for example, it is generally only necessary to peak the affected components using the above techniques. About the only place we use non-swept techniques for a complete alignment is when it is on a low-cost, low-quality set whose performance will not be compromised by such an alignment.

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Circle 22 on literature card
Test equipment report

FM Multiplex Signal Generator

The Model LSG-230, an FM multiplex generator, which reportedly provides RF and IF markers and multiplex signal output, has been introduced by Leader Instruments.

The LSG-230 has a 3-volt output at approximately 19 KHz, with an adjustable frequency range of 75 to 110 MHz; separation is over 30 dB, 50 to 15,000 Hz, according to the manufacturer.

Test functions include resistance from 0 to 200 megohms, in 4 ranges; capacitance from 0 to 0.2 mfd, in two ranges; and decibels from -20 to +58 db, in 5 ranges.

The multimeter reportedly has a band suspension meter movement, overload protection, and is pocket-size.

The 51-100 sells for $30.88.

Circle 71 on literature card

Portable Digital Frequency Counter

A new portable digital frequency counter, Model 1250, with a frequency range of 5 Hz to 32 MHz, has been introduced by Weston Instruments.

Specifications of the 1250 are:

Frequency Coverage—5 Hz to 32 MHz

Ranges—10 KHz (10 second gate); 100 KHz (1 second gate); 1 MHz (10 millisecond gate); 32 MHz (1 millisecond gate)

Accuracy—±1 count ± time base stability

The new unit not only checks separation and balance in FM receivers and tuners but also reportedly serves as a sweepmarker for 10.75 MHz FM and IF alignments.

The LSG-230 is 10½ inches x 7 inches x 11 inches, and weighs 13½ pounds. It features a 115- to 230-volt dual power supply and a 300-ohm or 75-ohm (open) cable.

The price is $175.00.

Circle 70 on literature card

Multimeter

A multimeter, designated Model 51-100 which features 100,000-ohm-per-volt DC and 10,000-ohm-per-volt AC sensitivity has been introduced by Weltron Co.

The 51-100 has a low DC voltage range of 0.3 volt, which is used for testing semiconductor circuits.

Time Base Stability—±10 PPM/10 degrees (C) to 40 degrees (C), Ref. temperature of 25 degrees

Circle 70 on literature card

Order parts, tubes, and accessories from your nearest Magnavox Parts Center

The Magnavox Company
FORT WAYNE, INDIANA, 46804

Circle 23 on literature card
Operating Temperature—10 to 40 degrees (C)
Input Impedance—1 megohm
Input Sensitivity—250 mV rms
(max. 50 volts rms or DC)
Power Required—115 volts or 230 volts, 50 or 60 Hz (approx. 10 watts)
Size—7 inches x 3 inches x 7.9 inches
Weight—4 pounds.
Model 1250 sells for $395.00.
Circle 72 on literature card

Solid-State Field-Strength Meter
A new portable solid-state field-strength meter, capable of measuring the signal levels of UHF, VHF and FM channels, plus mid-band and super-band CATV channels, has been introduced by Jerrold Electronics.

Channel separation reportedly is wide for ease of tuning, with picture and sound carriers marked, including mid-band and super-band carriers.

Accuracy of the Model 747 is ±1.75 dB, 50 to 260 MHz; and ±3 dB, 470 to 890 MHz, over a temperature range from 20 degrees (F) to 100 degrees (F). The unit provides simultaneous readings in microvolts and dBmV, with a range from 10 µV (−30 dBmV) to 1.0 volts (+60 dBmV), according to the manufacturer.

The 747 has a single input for the entire spectrum and single-knob tuning. The dial lights operate from separate C cell batteries; the meter itself operates from four miniature 9-volt batteries.

Model 747 sells for $450.00.
Circle 73 on literature card

Tape-Head and Guide Gauge
A new gauge which reportedly permits users of cassette drives to accurately position guides, heads and pinch rollers has been introduced by Information Terminals Corp.

The gauge locates the tape path in a cassette drive with reference to the mid-point dimensions of all cassettes meeting ANSI, ECMA and audio standards, according to the manufacturer. It is placed in the drive in the same manner a cassette is inserted, and the machine then is set to the "play" mode. A separate reference block, machined to the width of a cassette tape, is placed on the gauge to provide an accurate reference for positioning drive components.

The tool-steel gage reportedly is machined to a tolerance of ±0.0001 inch for measurements, and has graduation marks which indicate head insertion distance.

The M-300 sells for $80.00. ▲
Circle 74 on literature card

NOW...ONE PERMA-POWER BRITENER SOLVES BOTH KINDS OF COLOR TV PICTURE PROBLEMS...

NEW COLOR BRITE HAS BOTH...

ISOLATION AND BOOST!

This efficient new Britener corrects for cathode-to-filament shorts causing loss of black and white video drive...isolates the short, restores the black and white information necessary for color picture quality.

When needed later, sliding the boost switch raises electron emission, restores full contrast and sharpness to fading picture.

Model C-503 for round tubes
Model C-513 for rectangular tubes
Dealer Net $7.75

Circle 24 on literature card

ELECTRONIC SERVICING
is your magazine!

If you would like to see an article about a particular subject directly related to servicing consumer or communications electronic products, send us your suggestion.

We value your comments and criticism.—Ed.
This General Electric solid state television received a 94.6% serviceability rating.

With the help of independent servicers, we designed General Electric's new 19" (diag meas) black and white solid state set to service like a tube set. It has a plug-in chassis that includes 21 transistors, 16 diodes and an integrated circuit module. And it was given a 94.6% serviceability rating by an independent service panel.

This is just one of the things we're doing to make General Electric television products as easy to service as possible. Our warranty policy now provides for prepaid transportation on in-warranty parts. We are also testing direct telephone lines to regional parts centers. To improve local parts availability, we are expanding parts distribution through independent parts distributors.

General Electric's television products aren't perfect yet. But we're getting closer. For additional information about GE service, call collect or write "Dutch" Meyer, Television Receiver Products Department, Portsmouth, Virginia. Telephone: (703) 484-3521.

Nobody's perfect.
Picture tube discontinued
General Electric b-w portable TV receivers

General Electric states that they will not produce any more 20AHP4 b-w picture tubes. Type 19VBNP4 replaces the discontinued tube and is reported to have a higher anode voltage rating than the older type tube.

Hum bars (silicon-diode type)
RCA CTC52

Hum bars of the type sometimes caused by radiation from the silicon diodes used in power supplies might originate in the CTC52 neon channel indicator bulbs and be noticeable during reception of weak signals.

In early production chassis, AC was applied to the bulbs (both anodes lighted in the bulb); later-production chassis operate the bulbs from the 280-volt DC supply (one anode lighted, one dark).

Test for bulb radiation by disconnecting the supply voltage at switch S4101, terminal 2 (RCA numbers). Absence of the bars when the supply voltage is disconnected indicates the bulb is the source. Reconnect the supply voltage and add a 680-pf ceramic (use short leads) from terminal 2 of the switch to ground.

If the radiated bars are still present, rewire the circuit so the bulbs operate from the 280-volt supply, as shown in the associated schematic.

Sound IC failures
RCA KCS176A

Repeated failures of the sound IC can occur in the KCS176A chassis because of a spark discharge from rug static attracted to the volume control knob and shaft when a customer turns off the machine.

Replace the volume control and switch with a unit which has an RCA stock number 128153. Be sure the shaft is nylon and not metal.

Disconnect and discard the resistor or capacitor which grounded the case of the original volume control, and add a wire from the case of the new control to ground. Also, scrape off any metallic coating from the rear side of the knob, and install a piece of insulating “fishpaper” around the shaft between the volume control and the escutcheon.

Nuisance fuse failures
Magnavox T940/T951

Because heavy heater supply current flows through F3 (20 ampere, 32-volt slow-blow type), any increase in contact resistance between the fuse and the fuse clips produces heat which can cause premature failure of the fuse when there actually is no overload.

Apply silicone grease (the kind used on power transistors) to the ferrules of the fuse before inserting it in the clips. Do not bend the clips to tighten the contact; this might destroy the resiliency of the clips.

Fuses F3 and F1 (5 ampere, 125-volt slow-blow, used in series with the primary of the power transformer) are both mounted in a dual fuse holder on the side of the chassis near the power supply.

Failure of the audio output tube, caused by arcs
RCA CTC38 and CTC39

The focus lead between picture tube and chassis should be tied or taped to the picture tube heater wires, to prevent the insulation on the wire from touching the audio output tube. Heat from the audio output tube might cause deterioration of the insulation on the focus wire, thus causing arcs which can crack the glass of the tube.

Examine the focus wire lead dress of each CTC38 and CTC39 chassis you service and correct it, if necessary.
Arcing between pins of the pincushion tube socket
Magnavox T931/T933

Dust and moisture might cause arcing between socket pins 5 and 6 of the pincushion amplifier tube, V506 (V12, Photofact 984-1).

Scrape away carbonized particles or damaged parts of the board between the two pins. Move C571 out of the way and remove all the solder from pin 6. Cut the copper wiring near the center of the socket, as shown in drawing (A), heat the copper and peel it away between pin 6 and the cut point. Add a buss wire from pin 1 to pin 6, as shown in drawing (B), being careful to provide maximum spacing between the wire and pin 5. Return the capacitor to the original position.

Intermittent or no vertical sweep
Coronado TV2-6617 or TV2-6618

No vertical sweep when the receiver is first turned on or intermittent loss of vertical height at any time often can be corrected by replacement of V7 (6JQ6), the vertical output tube, and C57 (.0033, 1.6KV). Test C57 by disconnecting one end and checking for presence of DC. Restoration of vertical sweep when C57 is disconnected also indicates the capacitor is shorted.

Also, test R99 and R98, for changes of values. (Parts identification numbers used here are from Photofact 997-2.)

Color saturation produced in "on" position of AccuMatic control not the same as that in "off" position
RCA CTC46

Control R4204A, part of a dual control whose inner shaft is the customer tint control, provides a means of adjusting the color saturation so that the level produced in the "on" position of the AccuMatic control is the same as that produced in the "off" position.

R4204A should be re-adjusted if module MAC is replaced or if for any other reason the color saturation is not the same in both positions of the AccuMatic control.

The procedure: tune in a color program; turn the AccuMatic control to the "off" position; rotate the customer-operated color-level control to the minimum position (extreme counterclockwise); adjust R9 (on module MAC) to the point where color just disappears; adjust the customer-operated color-level control to produce a normal picture; turn the AccuMatic control to the "on" position; adjust R4204A to the point where no change of color saturation is evident when the Accumatic control is switched from "on" to "off".

(R4204A can be adjusted by removing the tint-control knob and using an Xcelite TW-140 or General Cement GC9308 control to rotate it.)

Discolored fuses
Delco electronics products

The engineering department at Delco Electronics states that reliability of the fuse resistors used in their products is not degraded because of any discoloration which might appear on the outer surfaces.

Do not replace a fuse resistor unless an ohmmeter check reveals that it is open or out of tolerance. The red covering of the .68-ohm fuse resistor often turns black, then later turns white after continuous usage.
Practical TV Tuner Servicing

by Carl Babcoke

Contact Cleaning

The switch contacts of VHF tuners should be cleaned periodically, as preventive maintenance.

Most switch contacts in tuners are silver plated, and silver does tarnish—as any housewife who owns a set of sterling silver knows very well. Lubrication slows the oxidation process, but the contacts eventually turn black, except for a narrow track where the wiping action of the rotor contact has swept a path. Clean contacts are shown in Fig. 1.

An easy test for corroded contacts is to rock gently the channel selector shaft up, down, sideways, and in a rotary direction while watching the picture for intermittent white flashes, loss of color, snow, or changes in contrast. Other loose connections can imitate these symptoms, but they do not occur as often as dirty tuner contacts.

Methods of cleaning corroded contacts can be classified into one of the following categories.

The soak-everthing-in-sight approach

A technician holds the nozzle of a spray can of tuner cleaner to each crevice of the tuner and sprays until liquid gushes from every crack in the shields. This same technician later mutters uncomplimentary remarks about TV and tuner manufacturers as he makes several callbacks for intermittent reception and drifting fine tuning. Finally, when he opens up the tuner, he finds most of the pastic parts have turned to jelly.

Think the preceding is far-fetched? Tuner repair stations report some tuners sent to them for repair are in just such a state.

If you must use this shortcut method, be selective. Don’t spray neutralizing capacitors, variable capacitors, or other such components. Spray only the switch contacts.

Use a brand of spray cleaner which will not damage plastic or detune circuitry.

The combined selective spray and lubrication technique

For quick cleaning, remove the tuner shields and apply a safe brand of spray cleaner to the switch contacts.

But for more permanence, with a lintless rag remove most of the cleaner you have just sprayed. Then if the cleaner also contains a lubricant, again spray a small amount of cleaner on each contact. If the cleaner does not contain lubricant, apply a separate spray- or grease-type lubricant. Replace all shields.

The separate degreasing and lubrication technique

With a short-bristled brush, apply a liquid degreaser (chlorothene or other liquid specifically recom-

mended for this method) to the contacts, tube sockets, neutralizing capacitor or any other component which is flooded with sprayed liquids or exhibits signs of corrosion. Clean vigorously until all the corrosion, old lubricant and cleaner have been wiped away. Don’t turn the channel selector during this part of the operation, if it can be avoided, because damage by scratching is possible when there is no lubrication on the contacts.

Then, directly apply a good lubricant—either spray or bulk—to the stator and rotor contacts. Do not apply an excessive amount, or it will pile up on coils and capacitors.

Pads soaked in cleaner/lubricant, for mounting inside the bottom shield in turret (or “strip”) type tuners, can be purchased at electronic parts distributors. The pad lubricates the strip contact during every revolution of the channel selector.
Neutralization of the RF Amplifier

During the past few years, many VHF tuners have used triode tubes in the RF amplifier stage. Although triodes have low noise (snow) they present oscillation problems because part of the RF signal is fed back from plate to grid via the internal inter-electrode capacitance. To counteract this tendency to oscillation, neutralizing circuits are used. Such circuits feed back to the grid a signal that is 180 degrees out of phase but equal in amplitude to the signal normally applied to the grid. When a sufficient degenerative signal is applied to the grid, the effect of the triode grid-plate capacitance is cancelled out and the tendency to oscillate is eliminated. However, because the amount of degenerative signal required is so critical, a variable capacitor, or a fixed capacitor and a "gimmick" in parallel for adjustment, is provided (see Fig. 2).

If the RF amplifier tube is replaced with a tube in which the internal capacitance is different, the tuner will require re-neutralizing.

Neutralizing capacitors which have been filled with tuner spray or other liquids must be thoroughly cleaned and degreased before neutralization is attempted.

To neutralize an RF tube, the gain of the tube first must be reduced to zero, and the tube must remain in the socket.

To satisfy both of these conditions, unsolder or disconnect only the resistor through which voltage is applied to the plate of the RF tube, or apply sufficient negative bias to the AGC line of the RF tube to completely cut off the tube. This voltage should be -15 volts or more.

With the RF tube cut off, the neutralizing capacitor is adjusted to produce minimum high-band station signal (preferably channel 8, 9 or 10) and maximum snow.

Clamping the IF AGC bias produces a more stable reaction to the adjustment.

Most neutralizing capacitors should be adjusted with a non-metallic tool; if not, the adjustment will change when the tool is withdrawn.

Symptoms which indicate that neutralization is needed

One common symptom indicating the need for neutralization is erratic, sharp-edged, black bars on one or more high-band channels (7 through 13). These bars might become either worse or better, if one side only of the antenna lead-in is connected.

Another more subtle symptom is automatic fine tuning action which is normal on the low-band channels, but incorrect on some of the high-band stations. Incorrect orientation of the antenna or misalignment of the RF stage can cause the same effect, but the need for neu-

Fig. 3 A fine tuning coil used in older RCA tuners. The tip of the plunger contains inserts of powdered iron. Often the iron inserts fall out or break and either jam the movement or cause inadequate fine-tuning action. Buy a new coil and cross-switch the two cores. This eliminates the need for adjusting each channel screw or replacement of the coil.

Fig. 4 One type of feedthrough capacitors used in tuners. The two white bands are ceramic insulation; the flange in the center is soldered to the chassis of the tuner. Avoid solder splatters.

Fig. 5 When it is necessary to cut a wire, but the diagonal cutters won't reach, use a two-pronged soldering aid to break the wire by bending it back and forth.
Switch-Type All-Tube Tuner

**KRK22 Tuner**

The **KRK22** tuner used in an RCA CTC5 chassis is a “switch” type and employs a 6BQ7 RF amplifier tube in a “cascode” circuit which requires no neutralization.

**Oscillator Frequency Problems**

The frequency of the oscillator in the tuner is critical even for **B-w** reception. For good color reception, the frequency is ultra-critical. If the frequency is slightly low, sound bars and beat patterns will be produced; if the frequency is too high, a smeared **B-w** picture and weak or no color will be produced.

A method of adjusting the oscillator frequency is included in all TV tuners. Usually oscillator frequency is adjusted by the fine tuning control, or the fine tuning plus **AFT**. One type of fine-tuning coil is shown in **Fig. 3**.

**Causes of incorrect oscillator frequency**

Incorrect oscillator adjustment can be caused by both mechanical and electronic defects. **Slipping** cans, belts or gears are the most frequent mechanical defects.

Electronic defects can produce either rapid or gradual misadjustment of the oscillator frequency. Rapid frequency changes are usually caused by corroded switch contacts, loose connections or capacitors which open intermittently. Slow frequency changes can be caused by tubes, resistors which change with heat, tuner spray on coils and capacitors or, capacitors which have incorrect temperature compensation or which leak when heated.

Whatever the cause, a rapid increase of oscillator frequency can cause complete loss of color, but it might not change the **B-w** sharpness enough to produce a conclusive symptom. Such an intermittent, can easily be diagnosed incorrectly as a defect in the chroma channel.

The oscillator frequency is considered correct, if the fine tuning control varies the picture quality.
Turret-Type Tuner

The tuner used in Silvertone chassis 456/528, 51780 is a turret type with plug-in strips.

The two strip contacts on the left have been cleaned; the three on the right are still corroded. Use a cloth and a degreasing liquid to clean such contacts.

Stator contacts before and after cleaning. Several strips have been removed to provide access. Upper—dirty; lower—clean.

Remove several coil strips to make room for “live” testing. Strips are coded with numbers and colored dots. Capacitors C220 and C221 are the most critical components in the oscillator circuit.

Twin-lead connects the antenna terminals on the cabinet back to the two tuner input prongs, which are also feedthrough capacitors for isolation of the antenna circuit from the “hot” chassis. The balun coil is mounted next to the feedthroughs; the coils and capacitors below it are the high-pass filter assembly.
Hybrid Switch-Type Tuner

KRK144A hybrid tuner used in late-model RCA color receivers. The balun coil is mounted, with the antenna terminal strips, on the cabinet back. The tuner is very small, but accessibility is good.

Two cascaded mixer transistors are mounted on feedthrough capacitors.

Shielded box at rear of the tuner contains the input plug for the shielded cable from the balun coils, and the traps and high-pass filters.

Stator switch wiping contacts can cause loss of all stations, if they become bent. Older models were prone to intermittents caused by loose rivets. The cure is to solder them to the switch.

The RF grid coils are conventional and can be "knifed" during sweep alignment. The RF plate and mixer-grid coils are "printed" on the board and cannot be adjusted.
The tuner defect which is most likely to be the cause of total loss of color is incorrect oscillator frequency. Misalignment of the antenna or RF tuned circuits might weaken the color, but it cannot completely eliminate the color. Overload would cause clipping of the vertical and horizontal sync pulses before it would affect the burst or the chroma signal.

**Snow and AGC**

Snow is visual "white noise" which is normally caused by thermal agitation in the tubes in the tuner. The mixer stage contributes the most snow, the RF stage next, and the video IF's practically none. A mixer defect might increase the amount of snow, but this is rare; most cases of excessive snow originate in the RF stage.

It is impossible to separate RF stage snow from that caused by incorrect AGC action. Application of excessive AGC voltage to the RF stage reduces the input to the mixer. This degrades the signal-to-noise ratio, and snow is produced. At the other extreme, insufficient RF AGC voltage might permit overload of the mixer. Such overload causes problems such as reduced contrast, unstable sync, grainy picture with beat patterns, and a blurred picture with weak color.

In locations where the signal strength is not too high, a simple test for tube-equipped RF stages is to ground the AGC at the tuner. Any decrease in the amount of snow is proof the tuner AGC is too high. An AGC circuit defect which increases the negative AGC voltage to the tuner—such as an increase in the resistor from tuner AGC to B+—will cause extra snow. Any AGC defect which reduces the AGC voltage applied to the video IF's will increase the snow.

The test involving grounding of the AGC at the tuner also can be used for RF stages which use a MOSFET transistor. An AGC voltage of more than -2 volts is almost certain to cause snow. On the other hand, zero AGC voltage does not provide maximum RF gain, because an AGC voltage of around +5 is necessary for highest gain.

The forward bias of RF transistors is very critical. AGC voltage that is excessive will reduce the gain as much, or more, than a voltage which is too low. Grounding the AGC source at the tuner will not work as a test for snow in transistorized AGC stages.

**Feedthrough Capacitors**

More feedthrough capacitors are used in tuners than in any other TV circuit. Because the feedthrough capacitor effectively functions like many series RF chokes bypassed by many capacitors, bypassing at high frequencies is better than if separate components were used. Also, the assembly acts as a tie point for some of the wiring.

Feedthrough capacitors manufactured several years ago were relatively fragile and could be cracked easily by rough probing. Today's feedthroughs (see Fig. 4) are more durable, but are still occasionally victims of solder splatters.

One tuner-repair specialist advises that we should not unsolder all the wires from feedthrough capacitors when wire removal is necessary. Instead, cut the wire close to the rod and then restrip the wire and solder it near or over the old solder. This technique minimizes shorts and cracked ceramics by eliminating the stresses usually placed on the capacitor when attempts are made to remove wired connections.

**Tools For Tuner Servicing**

Tools for tuner repairs must be small because the working space is restricted and large tools cannot be inserted into many areas. Tiny diagonal-cutters, long-nose pliers and soldering irons are essential. However, for many jobs of holding or bending, a two-pronged soldering aid and picks are more useful. For example, whenever the small diagonal pliers can't be inserted to cut off a wire, use the soldering aid to bend rapidly the wire from side-to-side until it breaks, as shown in Fig. 5. Then the soldering aid can be used to hold the new wire or lead in place while it is soldered.

Magnifiers and small, high-intensity lamps help make those hidden corners accessible.

A large, high-heat iron should be available, for soldering shields and brackets.

Generally, very few special tools are necessary other than the ones that should be found in any shop which does acceptable repair of circuit boards.

**Alignment**

In most cases, re-alignment of the tuner will not be necessary following repairs—if the following precautions are observed:

- Don't move parts or wires, unless there is no alternative. That peculiarly-shaped, one-inch piece of wire just might be a trimming inductance.
- Keep the leads of replacement parts SHORT. This is particularly important in UHF tuners, in which long leads can detune.
ANTENNAS
100. *Antenna Specialists Company*—announces a transmitter accessories catalog. The catalog includes a series of circulators, isolators, hybrid couplers, circulation terminations and harmonic filters.

101. *RMS Electronics, Inc.*—has made available a 27-page catalog of their 1971 line of antennas, replacement antenna rods for TV sets and portable radios, color tube brighteners, replacement picture tube sockets, antenna hardware and kits, splitters, transformers, tap-offs, and many more.*

102. *Russell Industries* — announces the availability of a complete line of telescoping antenna rods with swivel bases and sliding adapters for rods to disappear. This line is used for walkie-talkie and all portable radio applications.

AUDIO
103. *Altec Lansing*—introduces a 12-page brochure for information on sound systems in the sports and entertainment field, stadiums, automobile speedways, hotels, restaurants and other public entertainment facilities.

104. *Bell P/A Products Corp.* — new 6-page catalog gives detailed specifications and descriptions of the company’s broad line of commercial sound components and special purpose sound system products.

105. *Jensen Manufacturing Div.*—has issued an 8-page catalog, No. 1090-E, which describes applications of 167 individual speaker models. Special automotive, communications, intercom and weathermaster speakers, plus a complete line of electronic musical instrument loudspeakers are featured.

106. *Nortronics Co., Inc.* — has released a new Tape Head Replacement Guide which contains tape head replacements for over 2,800 domestic and foreign recorder models, a cross-reference to both model and head part numbers for reel-to-reel and cartridge recorders.

AUTO ELECTRONICS
107. *Littelfuse, Inc.* — has released a new 32-page, 1971 automotive replacement fuse guide for passenger autos, sports cars, trucks, and taxi cabs. Fuse descriptions and circuits they protect are included.*

108. *Electrovert, Inc.* has announced a 16-page brochure describing their line of wire/cable harnessing, wire/cable marking and wire/cable accessory products. The differences and application advantages of each of the products is explained.

109. *Sprague Products Co.*—announces a 40-page manual which lists original part numbers for each manufacturer, followed by ratings, recommended Sprague capacitor replacements, and list prices. More than 2,500 electrolytic capacitors are included.*

CABLE HARDWARE
110. *Electrovert, Inc.*—has announced a 16-page brochure describing their line of wire/cable harnessing, wire/cable marking and wire/cable accessory products. The differences and application advantages of each of the products is explained.

111. *Sprague Products Co.*—has made available a 20-page catalog of service replacement capacitors containing information and rating charts for electrolytic, paper/film, filters, ceramic, mica and AC capacitors.

COMPONENTS
110. *Aerovox Corp.*—has made available a 20-page catalog of service replacement capacitors containing information and rating charts for electrolytic, paper/film, filters, ceramic, mica and AC capacitors.

111. *General Electric Tube Department* — has released a new 52-page Semiconductor Almanac, No. ETRM-4311F. The almanac contains approximately 20,000 cross references from JEDEC, or OEM part numbers to GE parts numbers for universal replacement semiconductors, selenium rectifiers for color TV, dual diodes, and quartz crystals.*

112. *Motorola, Inc.* — has made available a 1971 HEP cross reference guide catalog, which lists replacements for over 31,000 different semiconductor device type numbers available through authorized HEP suppliers.

113. *Precision Tuner Service* — announces a new tuner parts catalog, including a cross reference list of antenna coils and shafts for all makes of tuners.*

114. *RCA Distributor Products*—introduces a 72-page "SK Series Top-Of-The-Line Replacement Guide" (SPG-202L) which cross-references over 20,000 semiconductor device numbers. In addition a Solid State Quick Selection Replacement Chart (1L1367) listing 79 entertainment SK-Series devices is included. Price of this catalog is $.35.*

115. *RCA Solid-State Division* has made available a new 28-page catalog describing the selection of RCA thyristors (triacs and SCR’s), rectifiers, and diacs. Data for each type of device is arranged by series and in order of ascending current.*

116. *RCA/Solid-State Division* — announces a revised edition of the Power Transistor Directory, which reflects new product programs, as well as new product data. All product matrices have been updated to include the latest commercial types as well as preliminary data on developmental types, including RCA power transistors, both silicon and germanium. The Index of Types has been expanded to include DT types as well as JEDEC (2N-Series) types and RCA 40-K series types. Copies are $.40.*

117. *Sprague Products Co.*—has announced a 40-page man-
ual which lists original part numbers for each manufacturer, followed by ratings, recommended Sprague capacitor replacements, and list prices. More than 2,500 electrolytic capacitors are included. 

118. Sylvania Electric Products, Inc. — a 73-page guide which provides replacement considerations, specifications and drawings of Sylvania semiconductor devices plus a listing of over 35,000 JEDEC types and manufacturers' part numbers. Copies are $1.00.*

119. Workman Electronic Products, Inc. — has released a 32-page, pocket-size cross reference listing for color TV controls. 105 Workman part numbers are listed in numerical order with specifications and illustrations of the part.*

SERVICE AIDS

120. Chemtronics, Inc. — has published a 6-page, 4-color, folder describing TUN-O-Brite chemical spray. Application uses are included.

TECHNICAL PUBLICATIONS

121. Chemtronics, Inc. — has published a pocket-sized booklet describing typical thermal intermittent and how Super Frost Aid aerosol coolant will locate them. A step-by-step service procedure is outlined.

122. Howard W. Sams & Co., Inc. — literature describes popular and informative publications on radio and television servicing, communications, audio, hi-fi industrial electronics, including their 1971 catalog of technical books about every phase of electronics.*

TEST EQUIPMENT

123. B & K Mfg. Div., Dynascan Corp. — is making available an illustrated, 24-page 2-color Catalog BK-71, featuring B & K test equipment, with charts, patterns and full descriptive details and specifications included.*

124. Eico — has released a 32-page, 1971 catalog which features 12 new products in their test equipment line, plus a 7-page listing of authorized Eico dealers.*

125. Hickok Electrical Instrument Co. — the 1971 Product Selection Guide covers all current product lines including digital multimeters, oscilloscopes and digital measuring systems, as well as tube and transistor testers, data collection terminals, and card and industrial readers.

126. Leader Instruments Corp. — announces the 1971 Catalog of Leader Test Equipment. Test equipment included is the LBO-301 portable triggered-sweep oscilloscope, LSW-330 new solid-state post injection sweep/marker generator, and the LCG-384 miniature, solid-state battery operated color-bar generator.

127. Lectrotech, Inc. — announces the 1972 catalog, "Precision Test Instruments for the Professional Technician". It contains specifications and prices on sweep marker generators, oscilloscopes, vectorscopes, color bar generators and other test equipment.

128. Pomona Electronics — has published a 60-page, 1971 catalog of electronic test accessories which contains more than 450 individual products, including 47 new items.

TOOLS

129. Xcelite, Inc. — announces their New Bulletin/Price List 671L, describing a series of magnetic nutdrivers said to eliminate lost motion and fumbling when driving hex screws and bolts or starting nuts in close quarters and hard-to-reach places.*

*Check "Index to Advertisers" for additional information.
The MARKETPLACE

This classified section is available to electronic technicians and owners or managers of service shops who have for sale surplus supplies and equipment or who are seeking employment or recruiting employees.

Advertising Rates in the Classified Section are:
- 25 cents per word (minimum $3.00)
- "Blind" ads $2.00 additional
- All letters capitalized—35 cents per word

Each ad insertion must be accompanied by a check for the full cost of the ad.

Deadline for acceptance is 30 days prior to the date of the issue in which the ad is to be published.

This classified section is not open to the regular paid product advertising of manufacturers.

EQUIPMENT FOR SALE

CRT color champion and oven, near new, $100.00 takes all. Rebuild your own picture tubes. Acme TV, 1735 North Wells, Reno, Nevada 89502. 10-71-11

19" Portable GE TV sets, VHF-UHF perfect and near new shape. Any amount. $55.00 each. Acme TV, 1735 North Wells, Reno, Nevada 89502. 10-71-11

Limited quantity 12" FR tubes. 88.50. Cressman, 327 N. Prospect St., Washington, New Jersey, 07882. 10-71-11

Flameless Heat Guns—Used Surplus. Great for electronic Tech & Hobbyist. 5 amp—200 F. 14 amp. 700 F. 17 amp. 1000 F. New prices from $49.00 to $59.00. Your choice—$12.00 ea. We also offer Calibration & Repair Services on all types of electronic test equip. Large supply of new and used test equip. Intraxon Inc., 300 N. Broadway, Fresno, Calif. 93701. 10-71-11

EQUIPMENT WANTED

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Wanted: Westinghouse grill style Q25366 used with Westinghouse glove model KAA 40. Frank Szewaczek, Mullen, Neb. 69152. 10-71-11

HELP WANTED

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Covers PHOTOFAC Set Numbers 1146 thru 1199 and Specialized Values AR-87 thru AR-105, CB-31 thru CB-35, MHF-8 thru MHF-17, TR-72 thru TR-85, TSM-119 thru TSM-127 Released.

JANUARY—SEPTEMBER 1971

This Supplement is your Index to new models covered by PHOTOFAC since December 1970. For model coverage prior to this date see the 1970 PHOTOFAC Annual Index. Use this Supplement with the Annual Index together to have your complete Index to PHOTOFAC coverage of over 87,000 models.
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Now—Just 3 RCA Hi-Lite "V" Type Color Picture Tubes Replace 185 Types

Replaces 92 types

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Here's the way to save yourself time, give your customers faster service and improve your profit. Stock these three RCA Hi-Lite color picture tubes and have immediate replacements for the fastest moving industry types – 185 of them.

RCA Hi-Lite types are all new, made to OEM specifications and contain the newest RCA manufacturing technology, including Perma-Chrome and the latest X-ray attenuating glass. It adds up to a big plus for you. Order these three RCA Hi-Lite tubes, and other types you may need, from your RCA Distributor. He also has the complete RCA Interchangeability Guide, available free of charge.

RCA Electronic Components | Harrison, N.J. 07029
Littelfuse TV set circuit breakers are the safe, reliable, money saving short-circuit-problem-solvers... 17 available models—exact replacements—cover the entire range of domestic television sets.

Littelfuse circuit breakers are available from your distributor—singly or in bulk.

Super-simple in operation—the sensitive breaker flips open under current overloads protecting the circuitry. Reset by merely pressing the red reset plunge. A built-in "trip free" feature of Littelfuse breakers prevents forced closing when dangerous overload currents are present.

Nothing's more reliable than a Littelfuse circuit breaker. Thermal-responsive Littelfuse breakers are dual operated bi-metallic devices providing temperature compensation over a wide range of ambient temperature variation. Molded phenolic construction eliminates warping and distortion of the base, maintaining exact factory set calibrations. The unit is completely enclosed to protect critical moving parts from dirt and other foreign matter.

Any TV set you're likely to service will take Littelfuse circuit breakers.

They'll flip for safety.

You'll flip for satisfaction.