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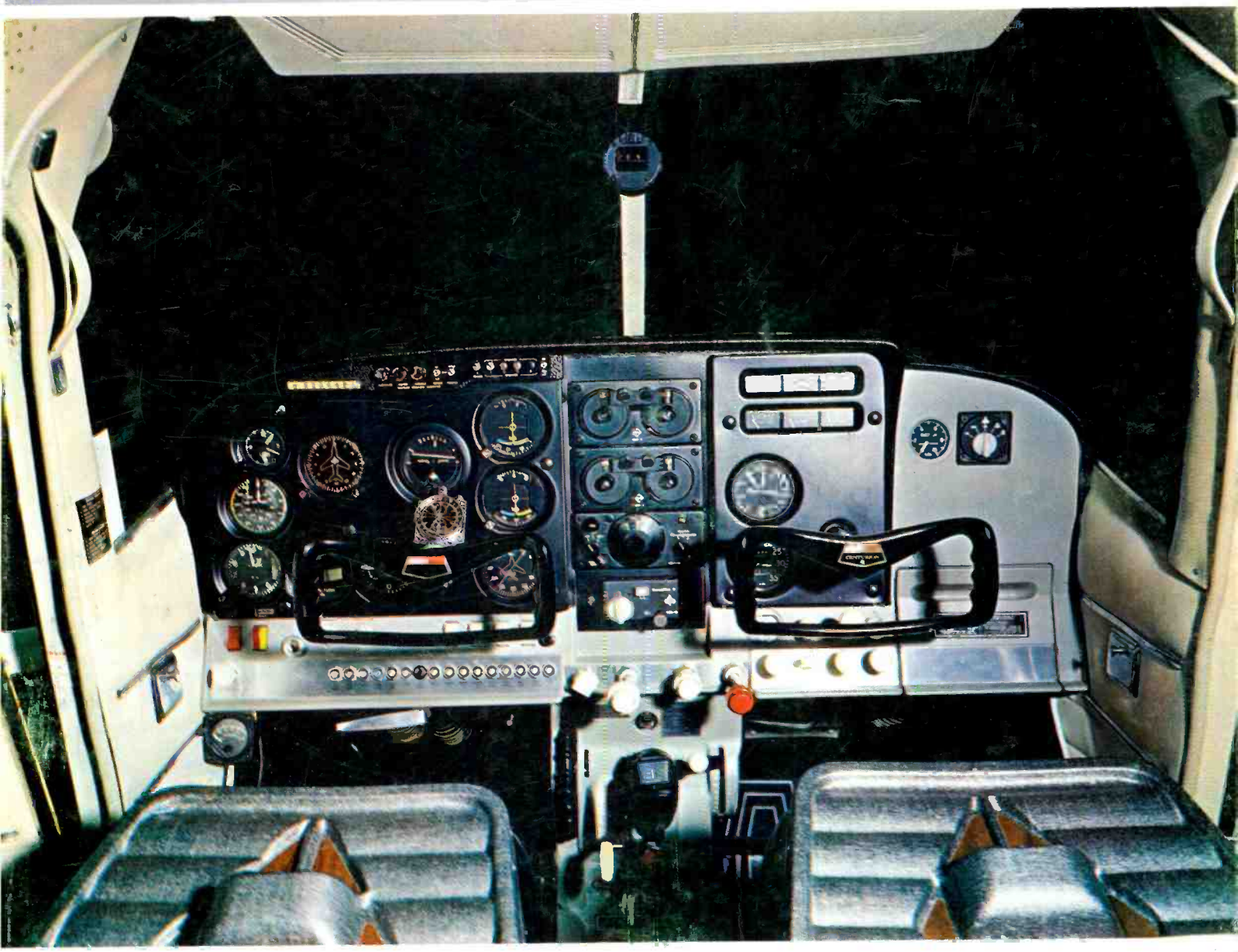
PHOTOFACT

the magazine of electronic servicing



Square-Wave Testing of Video, Y, and Color-Difference Amplifiers.

Repairing the Solid-State AM-FM Chassis

Thermistor Circuits in Industry

New Tube and Transistor Data

Permanent Repair of Chronic Tuner Trouble

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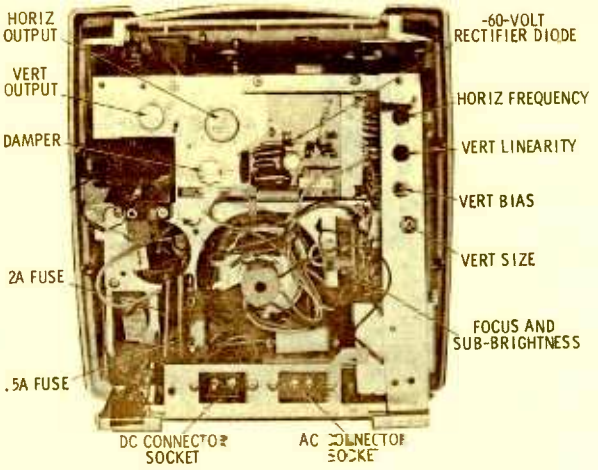
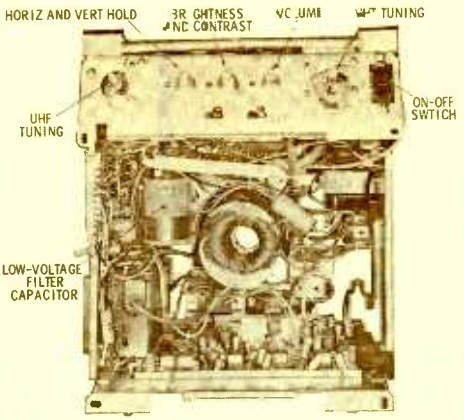
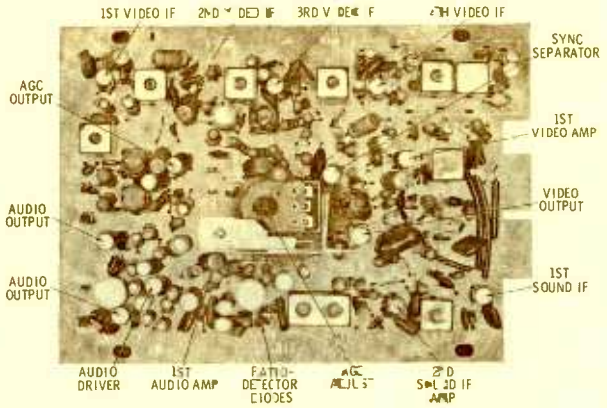
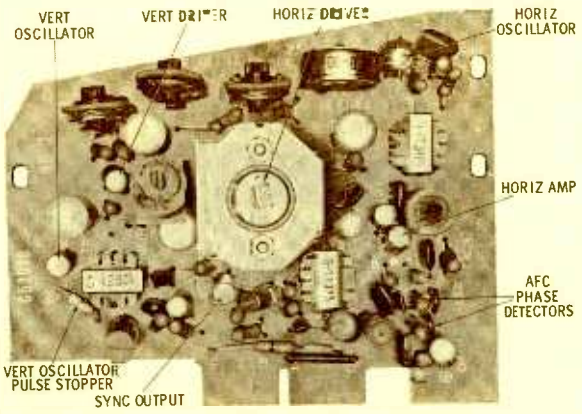
Airline









Airline Model GEN-1966B

The solid-state portable TV shown above is Montgomery Ward's new 9" b-w Japanese import. The receiver is designed to operate from either a 120-volt AC or 12-volt DC power source. DC power can be furnished either by a rechargeable, alkaline battery or by a conventional 12-volt storage battery when a special accessory cable is used.

A total of 27 transistors is used in the receiver, including three in the VHF tuner and one in the UHF tuner. Sixteen solid-state diodes are used, 6 of them as rectifiers. The only tubes used, other than the 230DB4 picture tube, are three 1DK29 diodes in the voltage-tripler, high-voltage power supply.

The −12-volt power supply is a bridge-type configuration employing four diodes. Overload protection in the 120-volt power source is provided by a 0.5-amp pigtail fuse. A 2-amp pigtail protects the 12-volt source.

The main circuit board, mounted horizontally at the bottom of the chassis, contains a four-stage picture IF; a two-stage video amplifier; a two-stage sound IF; the audio amplifier, audio driver, and push-pull audio-output stage. Also included are the sync-separator and ratio-detector circuits.

The horizontal-output, vertical-output, damper, and −60-volt-rectifier circuits are on a vertically mounted circuit board located on the right-rear of the set. Another vertically mounted circuit board on the right-rear of the set contains the sync-output, vertical-oscillator, vertical-driver, horizontal-driver, horizontal oscillator, and horizontal-amplifier circuits.

Focusing is accomplished by the selection of one of four connectors mounted on a separate board located on the right-rear of the set. The sub-brightness adjustment is located on the same board and involves the selecting of the connection to give the desired range of brightness—connection 2 provides maximum brightness range. Access to the AGC adjust is through a hole in the bottom of the cabinet.

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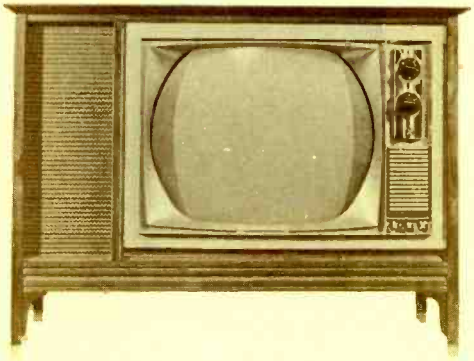
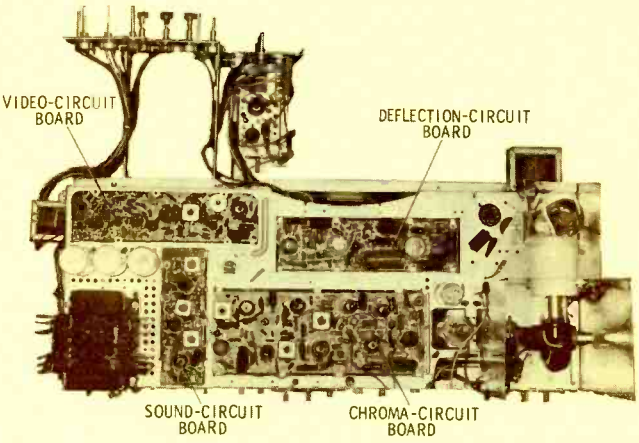
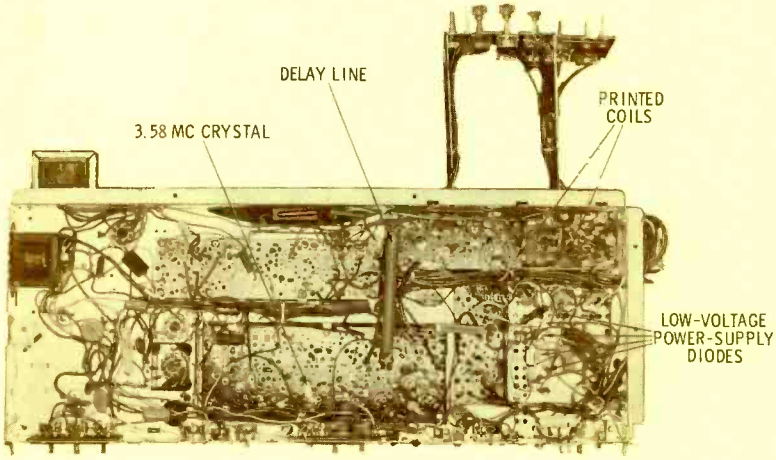
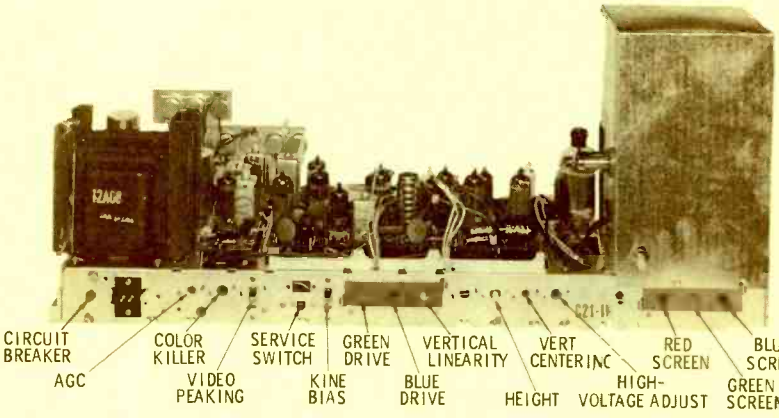
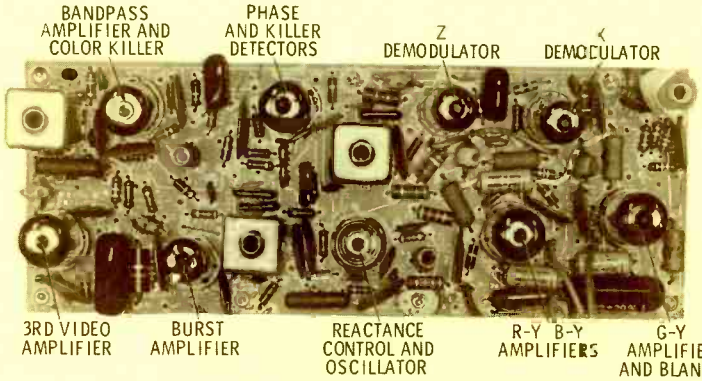










Curtis Mathes
Model 50M011
Chassis CMC21 Series

Pictured here is Curtis Mathes' new 21" color console which uses either a 21FJP22A or 21FBP22A picture tube. The video, sound, deflection, and chroma circuits are contained on four individual printed-circuit boards—a chassis layout which has become popular with color-TV manufacturers.

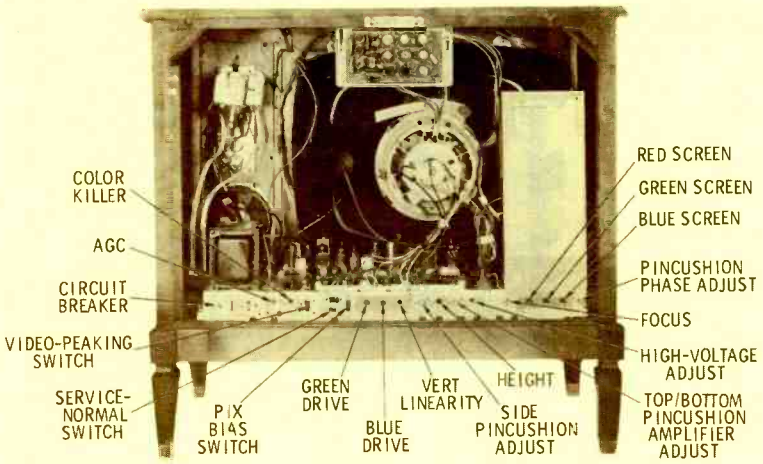
The instant-on circuit employed in this set is a departure from previous designs. A four-pole, double-throw, on-off switch places a portion of the secondary of the power transformer in series with the primary winding when the switch is in the off position, removing the secondary voltage from the rectifiers, but maintaining a lowered voltage on the filament windings. The filaments remain heated, so that when the set is turned on, the tubes conduct instantly.

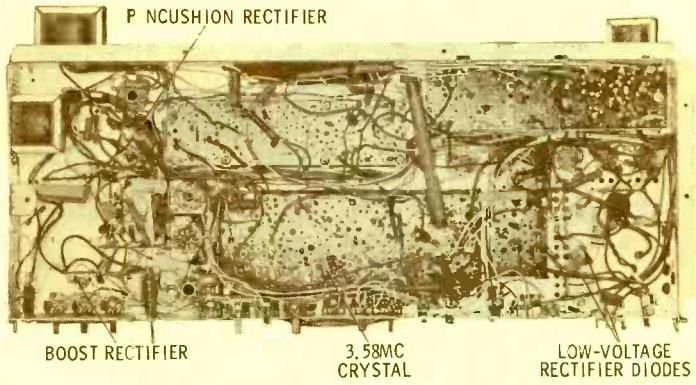
The third video IF has been changed from a 6EJ7 pentode to a 6JC6 pentode. Other tube changes involve the first and second video amplifier 6AW8A triode-pentodes which have been replaced with 6LF8 triode-pentodes. An alternate focus-rectifier circuit uses a 1V2 vacuum-tube diode in place of the selenium rectifier normally used.

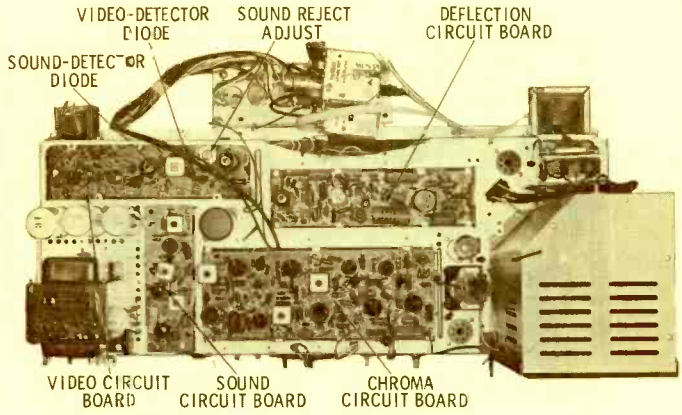
The low-voltage power supply, normally a voltage doubler, also uses an alternate in some models. The alternate is a bridge-type circuit using four silicon diodes. The model shown here uses the bridge-type circuit. Overload protection in the doubler circuit is provided by a 3-amp circuit breaker. A 2.2-amp fuse is used with the bridge rectifier.

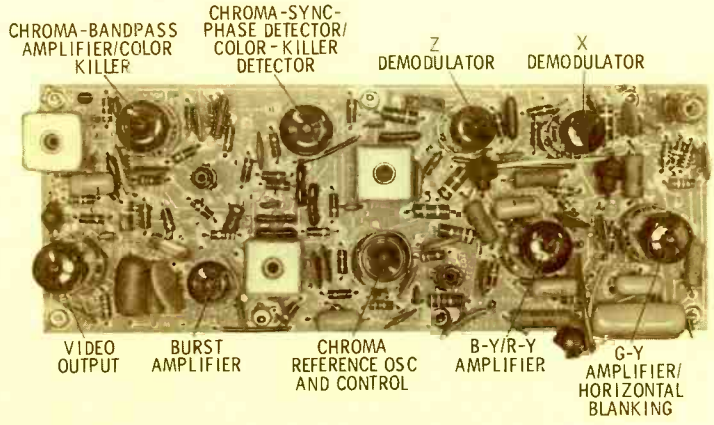
The normal service controls are located on the chassis rear apron. Customer controls, located on the right-front of the cabinet include a push-pull on/off-volume control, color, brightness, and tint controls. Also included are the horizontal-hold, vertical-hold, contrast, and tone controls which are accessible behind a pull-down panel.

Muntz









Muntz
Model 3418IP
Chassis AS-9021

The console model television shown above is Muntz's new 23" color receiver using a 23EGP22 picture tube. A total of 23 tubes and 9 semiconductors is used on the main chassis and convergence board. The basic chassis layout and circuitry do not differ drastically from the 21" color model; however, there are two new circuits in the 23" model. Added features are automatic degaussing and pincushion correction.

Two 6GH8A triode-pentodes are used in the chroma circuits; one serves the dual function of color-killer and chroma-bandpass amplifier, while the other serves the chroma-reference oscillator and chroma-reference-oscillator-control stages. A 6JU8A quadruple diode is used in the color-killer detector and chroma-sync-phase stages. Other tube types used in the chroma circuits are a 6EW6 pentode in the burst amplifier; two 6GU7 double-triodes, one serving the B-Y and R-Y amplifiers, and the other functioning as the G-Y and horizontal-blanking amplifiers; and two 6GY6 pentodes, used in the X and Z demodulators.

A full-wave voltage doubler is used in the low-voltage power supply. A reset-type circuit breaker provides B+ overload protection. The filaments are protected by a 3" fuse wire.

An NPN 24T-002 transistor is employed as the oscillator in the UHF tuner, along with a 1N82AG semiconductor diode which is used as the RF amplifier. In the VHF tuner, a 6HA5 triode is used as the RF amplifier and a 6HB7 triode-pentode performs the function of mixer/oscillator.

A single, concentric tuning control is used for UHF, VHF, and fine tuning. Three other concentric knobs, located on a panel on the right-front of the cabinet, control the contrast, brilliance, color, tint, and horizontal- and vertical-hold functions. The service controls, including the pincushion adjustments, are on the rear apron of the main chassis.

Sharp
Model 12T-Q2

Shown above is Sharp's new solid-state 12" portable. The Japanese import uses a 310ADB4 picture tube, which has a 90° deflection angle. One horizontally mounted circuit board contains most of the circuitry with the exception of the vertical drive, vertical output, horizontal output, and power circuits which are positioned on a vertically mounted circuit board located on the right side of the set.

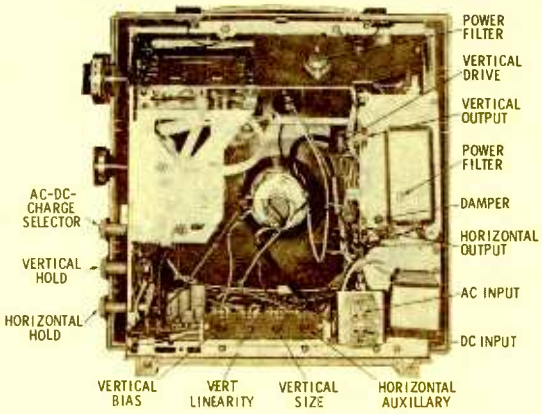
A total of 24 transistors is used on the main chassis, together with 16 solid-state diodes. The receiver is designed for operation on either AC or DC and is provided with a circuit for charging the battery from an AC power source. A three-position switch, located on the left side of the cabinet, provides selection of either AC or DC power input, or battery charge.

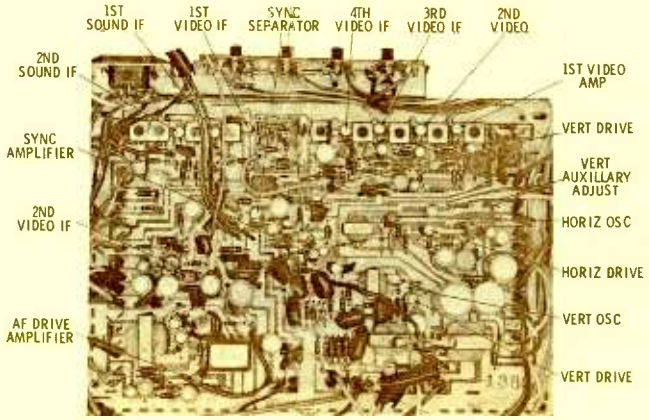
The low-voltage power supply employs a bridge-type rectifier unit and is equipped with a transistorized power filter. Overload protection is provided by a 1.6-amp fuse.

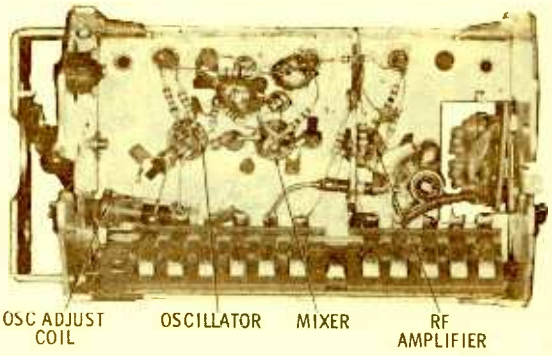
The circuit design of the receiver includes a four-stage picture IF using 2SA234 transistors, a two-stage video amplifier using 2SA350 and 2SC154A transistors, and a two-stage sound IF using two 2SA351 transistors. In the audio-amplifier stages, a 2SB75 is used as the driver amplifier and two 2SB77 transistors are used in the push-pull power amplifiers. Horizontal-circuit transistors include a 2SB370A used in the drive stage, a 2SA15 used in the oscillator, and a 2SB468 in the output stage. Three 2SB77 transistors are used in the vertical-oscillator and vertical-drive circuits. The vertical-output circuit uses as 2SB274V transistor.

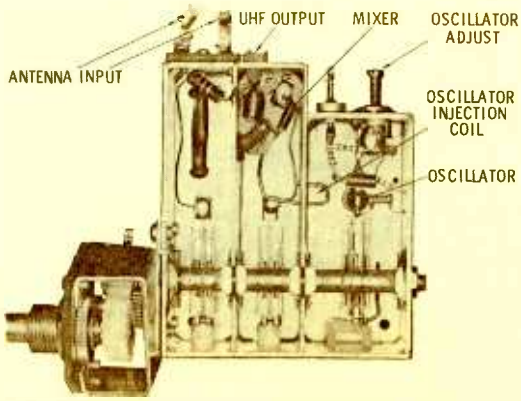
The vertical and horizontal-hold circuits are equipped with auxiliary adjustments to supplement the normal hold controls. If the picture cannot be synced by using the normal hold controls, adjust the auxiliary controls.

Separate VHF and UHF tuning controls are used. Both are mounted on the right side of the cabinet, along with the vertical-hold and horizontal-hold controls, and the power-input selector switch. The on-off/volume, contrast, and brightness controls are mounted on the top-front of the cabinet.









SEE PHOTOFACT Set 633, Folder 1

Mfr: Airline **Chassis No:** 23S31/U

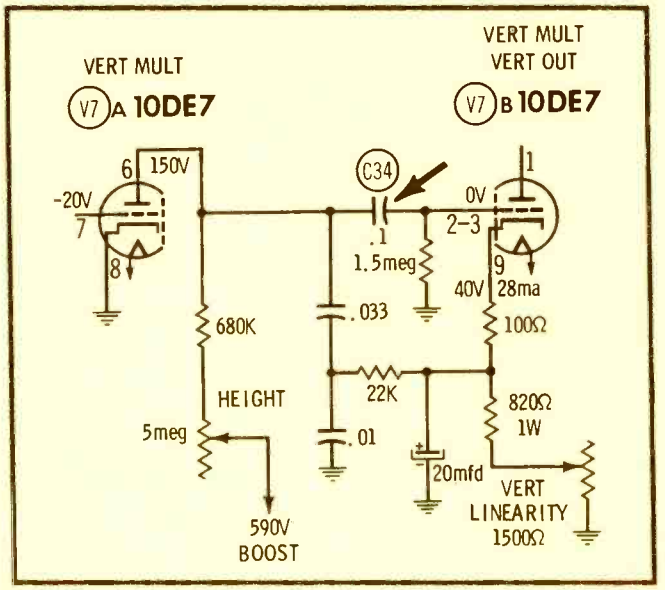
Card No: AI 23S31-1

Section Affected: Raster.

Symptoms: No vertical sweep. Horizontal sweep shows up as a straight line across face of picture tube. Positive voltage on control grid (pin 2 and 3) of vertical output V7B.

Cause: Leaky coupling capacitor in vertical oscillator-output circuit.

What To Do: Replace C34 (.1 mfd-600V).



Mfr: Airline **Chassis No:** 23S31/U

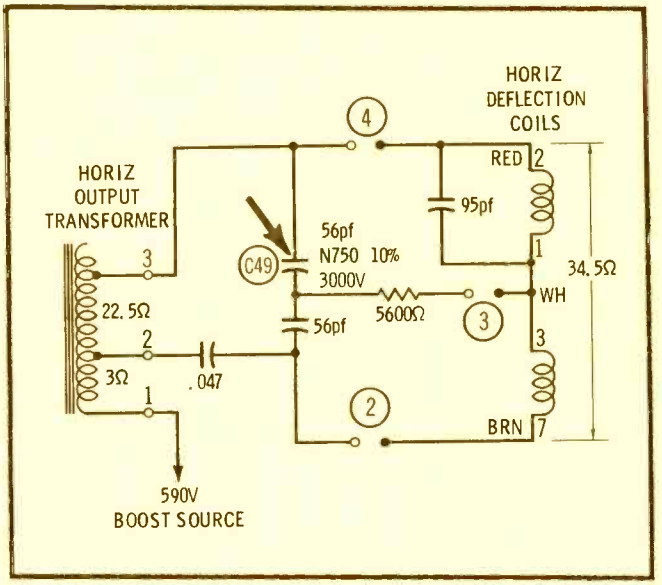
Card No: AI 23S31-2

Section Affected: Raster.

Symptoms: Wrinkles on left side of raster.

Cause: Defective capacitor in horizontal-deflection circuit.

What To Do: Replace C49 (56 pf-3KV, N750-10%).



Mfr: Airline **Chassis No:** 23S31/U

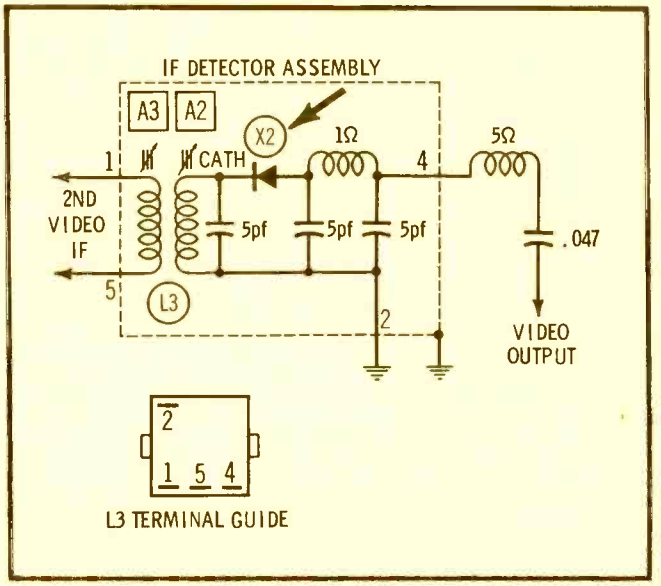
Card No: AI 23S31-3

Section Affected: Pix and sync.

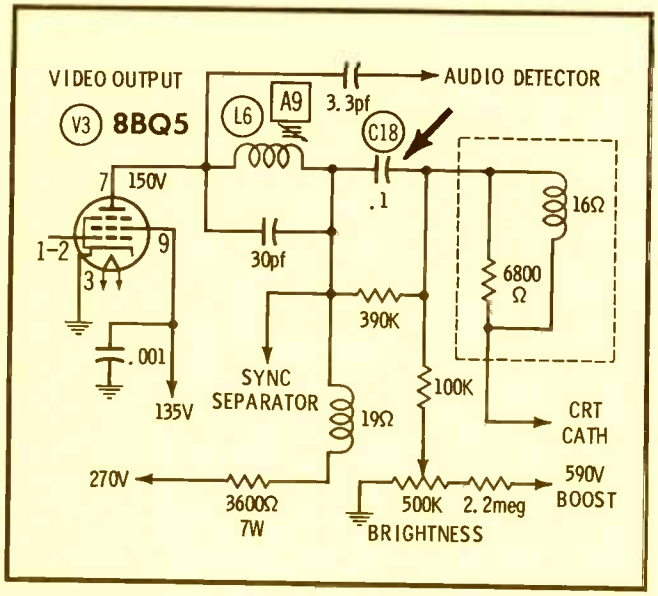
Symptoms: Poor resolution; may be accompanied by unstable sync.

Cause: Defective video-detector crystal.

What To Do: Replace video-detector diode X2.



SEE PHOTOFACT Set 633, Folder 1



SEE PHOTOFACT Set 633, Folder 1

Mfr: Airline **Chassis No:** 23S31/U

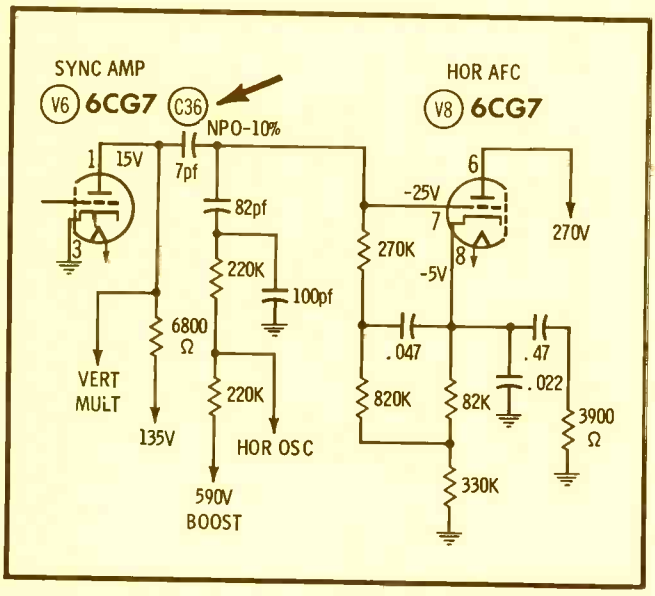
Card No: AI 23S31-4

Section Affected: Pix and sync.

Symptoms: Unstable sync. Brightness control R2 has little effect in controlling brightness.

Cause: Leaky coupling capacitor in video-output circuit.

What To Do: Replace C18 (.1 mfd-400V).



Mfr: Airline **Chassis No:** 23S31/U

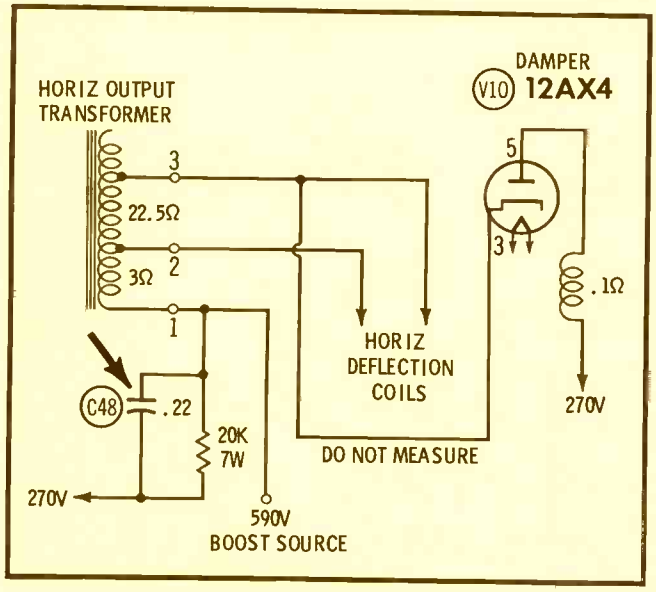
Card No: AI 23S31-5

Section Affected: Sync.

Symptoms: Pix tears; vertical sync normal.

Cause: Open differentiator capacitor.

What To Do: Replace C36 (7pf, NPO-10%).



Mfr: Airline **Chassis No:** 23S31/U

Card No: AI 23S31-6

Section Affected: Raster.

Symptoms: No high voltage. No boost B+.

Cause: Shorted capacitor in boost circuit.

What To Do: Replace C48 (.22 mfd-400V).

SEE PHOTOFACT Set 773, Folder 4

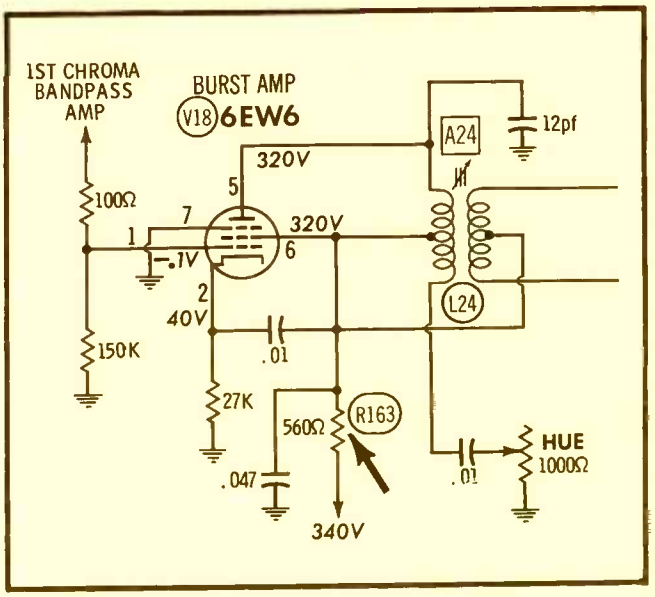
Mfr: Zenith **Chassis No:** 25MC36
Card No: ZE 25MC36-7

Section Affected: Color pix.

Symptoms: No color pix. Voltage on screen grid (pin 6) of V18, burst amplifier, is low.

Cause: Open screen-grid resistor in burst amplifier.

What To Do: Replace R163 (5.6K).



Mfr: Zenith **Chassis No:** 25MC36

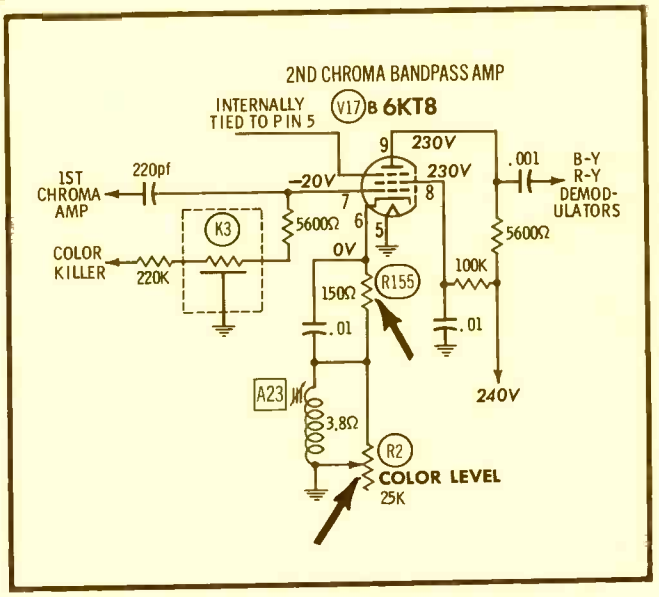
Card No: ZE 25MC36-8

Section Affected: Color pix.

Symptoms: Weak color pix and streaking.

Cause: Cathode resistor overheated and increased in value.

What To Do: Replace R155 (150 ohms) and Color Level control R2(25K). Replace 2nd Chroma Bandpass Amplifier V17.



Mfr: Zenith **Chassis No:** 25MC36

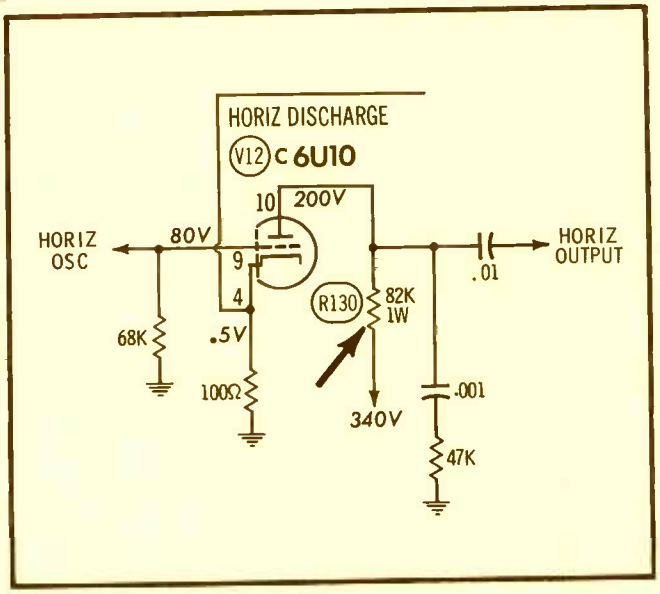
Card No: ZE 25MC36-9

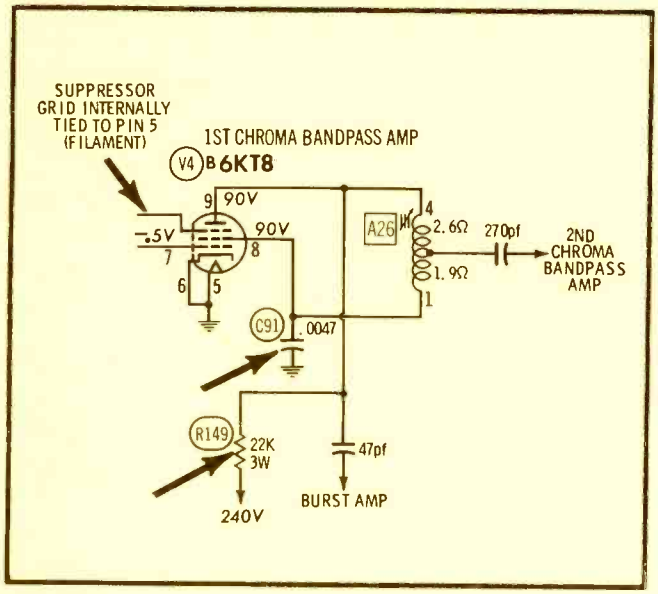
Section Affected: Raster.

Symptoms: Insufficient width after set is operated for some time. Voltage on plate (pin 10) of V12C, horizontal discharge, is low.

Cause: Defective plate-load resistor in horizontal-discharge circuit.

What To Do: Replace R130 (82K).





SEE PHOTOFACT Set 773, Folder 4

Mfr: Zenith **Chassis No:** 25MC36

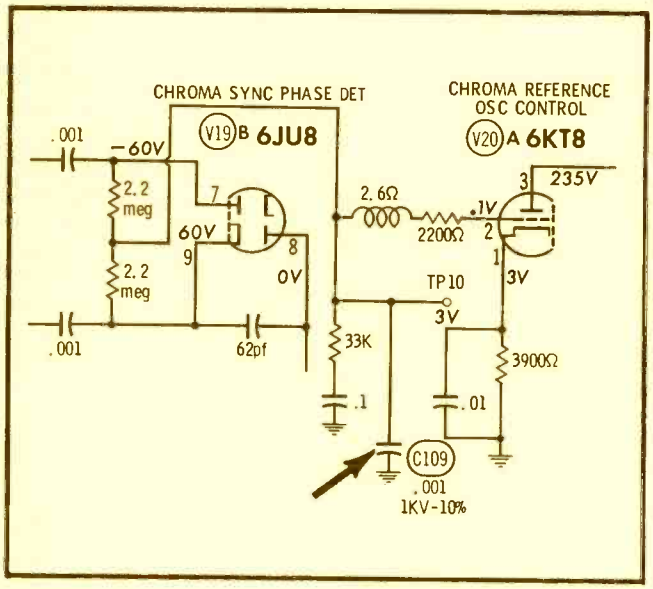
Card No: ZE 25MC36-10

Section Affected: Color pix.

Symptoms: No color pix. Voltage on screen grid (pin 8) of 1st chroma bandpass amplifier low. Screen-grid and plate-dropping resistor R149 burns. No color signal at output (plate) of V4B.

Cause: Leaky screen-grid bypass capacitor in 1st chroma bandpass amplifier circuit.

What To Do: Replace C91 (.0047 mfd) and R149 (22K-3W).



Mfr: Zenith **Chassis No:** 25MC36

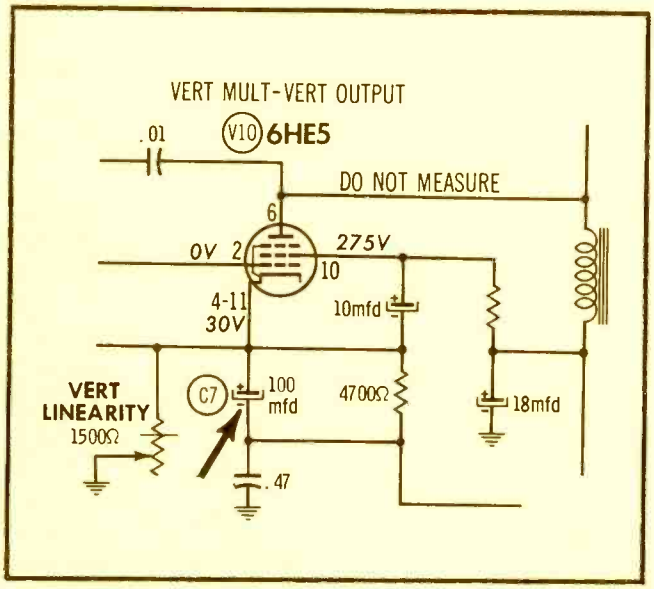
Card No: ZE 25MC36-11

Section Affected: Color sync.

Symptoms: Color pix out of sync. B-w pix normal.

Cause: Shorted capacitor in chroma reference-oscillator control circuit.

What To Do: Replace C109 (.001 mfd).



Mfr: Zenith **Chassis No:** 25MC36

Card No: ZE 25MC36-12

Section Affected: Raster.

Symptoms: Poor vertical linearity; insufficient vertical sweep.

Cause: Open cathode bypass capacitor in vertical-output circuit.

What To Do: Replace C7 (100 mfd).

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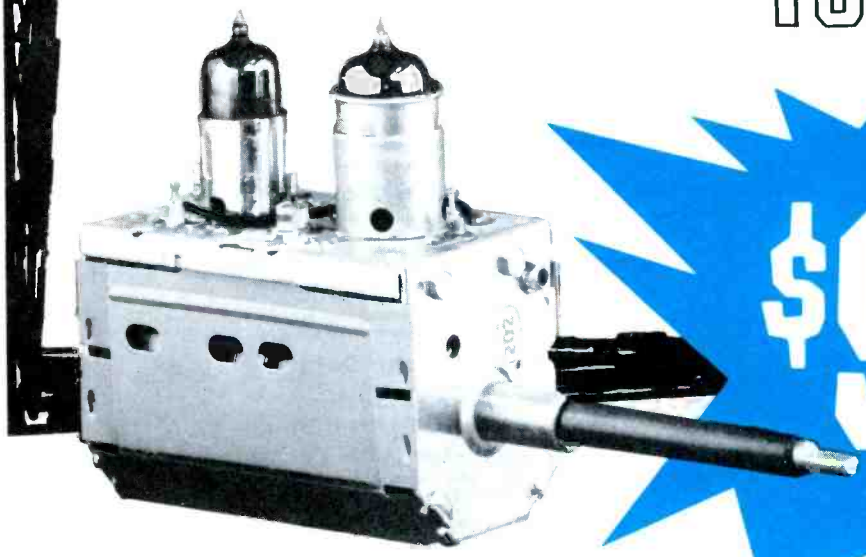

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PHOTOFACT

the magazine of electronic servicing

VOLUME 16, No. 7 JULY, 1966

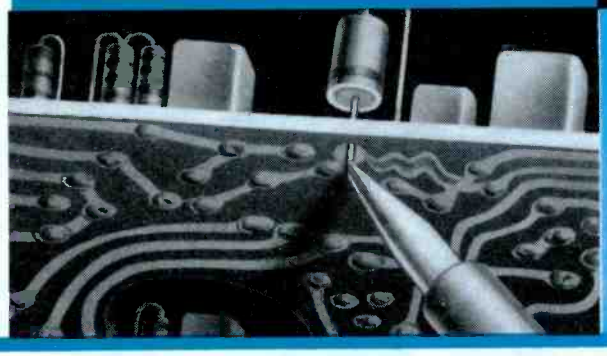
CONTENTS

About the Cover

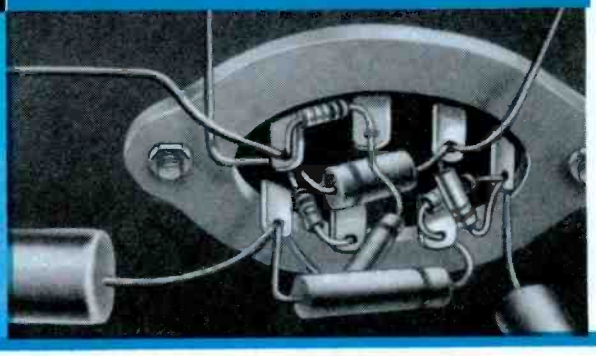
The communications and flight-control electronics equipment employed in private aircraft offers a challenging and profitable servicing market to the technician who has the skill and equipment to meet the demands of this segment of electronics. Our cover this month illustrates the variety of compact electronic gear installed in today's private plane. An article beginning on page 48 of this issue points out the potential of this servicing market and discusses methods of entering it.

Did you ever...

...lift a wire-lead component from a printed wiring board for testing ?



...test or replace a capacitor or resistor on a crowded tube socket ?



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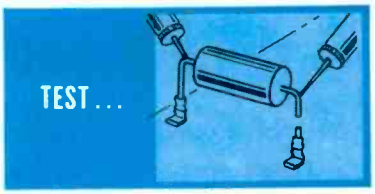

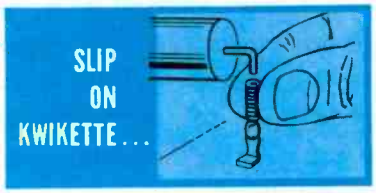

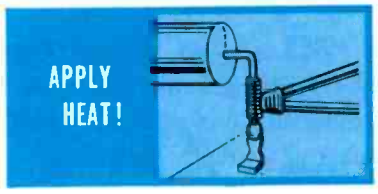

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65-6107

Circle 3 on literature card

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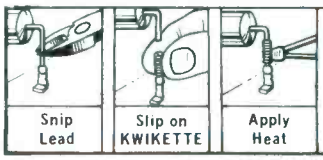
And who better than Sprague knows which values and sizes are needed in the replacement market? Sprague, the world's largest component manufacturer, has the most complete specification file on original set requirements. That's why you're always right when you work with Sprague Twist-Lok exact replacements!

GET YOUR COPY of Sprague's comprehensive Electrolytic Capacitor Replacement Manual K-107 from your Sprague Distributor.



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Circle 4 on literature card

The Electronic Scanner

news of the servicing industry

New Construction

Corning Glass Works will begin construction of a new electronic components plant at Wilmington, N.C., late in April. Manufacturing operations are expected to start at the end of the year.

The plant, located on a 58-acre site two miles east of the city, will cover 77,000 square feet, and will be devoted initially to the production of general purpose and low power resistors.

Enters International Market

The **Jerrold Corporation** has announced its first significant entry into the international market through the signing of a CATV equipment licensing agreement with **Teleng, Ltd.**

Teleng, reputed to be Britain's largest manufacturer of cable television equipment, is a subsidiary of Telefusion, Ltd., leading British TV set rental firm and operator of cable television systems. Teleng has equipped most of the largest cable TV systems throughout Europe.

Initially, Teleng will import Jerrold's Starline Series of CATV distribution equipment and accessories, to be marketed under the Teleng-Jerrold name. Later this year, the British firm will build its own version of the Jerrold equipment with special modifications for use in the United Kingdom and Europe.

Jerrold's Starline Series of solid-state, modular CATV distribution gear was hailed as a major advancement in the state-of-the-art when it was introduced last summer.

The British system of cable television, known as TV Relay, differs from CATV (Community Antenna Television) in that it includes the rental of the TV set as well as the antenna service. TV Relay systems stress better reception of local channels and the advantage of eliminating roof-top antennas.

According to Teleng Managing Director, J. R. Evans, "The United Kingdom is presently expanding its broadcast facilities, with a growing number of stations going into operation. Also, we are on the threshold of a color-television boom. These two factors make it necessary for us to expand our TV Relay facilities and add equipment capable of carrying more channels with superior color reception. We have followed the development of cable television throughout the world; in our opinion, Jerrold offers the most advanced, most reliable solid-state equipment yet designed."

In announcing the licensing agreement, Robert H. Beisswenger, president of the Jerrold Corporation, added, "Teleng is to the British Relay industry what Jerrold is to American CATV; the British firm pioneered VHF relay systems in Britain. Their manufacturing skills and facilities are excellent. We are pleased to be associated with such a firm."

The Teleng-Jerrold agreement was negotiated by Jerrold's recently formed International Division. According to Max Kraus, Director of the division, the company intends to market its CATV, master antenna TV, and high fidelity products throughout the world, with immediate emphasis on Europe, Latin America, and the Far East.

Win fabulous prizes in big Krylon® "dealer's choice" sweepstakes!

121 GIVEN AWAY

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1966 FORD MUSTANG OR **TRIP TO EUROPE FOR TWO** OR **LONE STAR BOAT, MOTOR AND TRAILER**

The sporty one with the racy lines that gives you top power and performance.

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For fishing or relaxation, here's just what the doctor ordered.

4 SECOND PRIZES
Choice of:
RCA 25" Color TV Console or Autumn Haze Mink Stole

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**All Krylon dealers are eligible.
Nothing to solve. Nothing to write about.
Good luck. (Sweepstakes close July 31, 1966)**

Here's one game of "dealer's choice" where you can't lose! Not only do you have a chance to win a big prize. In addition, you're a sure profit-winner when you sell Krylon. Krylon is far and away America's No. 1 Spray Paint—the fastest mover, the biggest money-maker...and there's no better time to order than right now when your jobber is offering this extra-profit deal. If you order now...you get 12, yet you pay for only 11 (either cans or cases).

BORDEN CHEMICAL

Your jobber salesman will be around soon. There's no purchase required, so ask him for complete details and free entry blanks. For an interesting Krylon extra-profit story, also ask him about the "1 free with 12" special.

(Sweepstakes void where prohibited by law.)

Circle 6 on literature card

Inventor Honored

Dr. Samuel Ruben, inventor of the mercury battery used in the life-saving heart pacemaker, was honored as the "Inventor of the Year for 1965."

He was given the award by the Patent, Trademark, and Copyright Institute of George Washington University, in recognition of his many achievements in the field of electronics. Dr. Lloyd H. Elliott, president of George Washington University, made the presentation at a reception held in Dr. Ruben's honor.

The mercury battery is but one of some 300 inventions patented by Dr. Ruben during a lifetime devoted to scientific research and development, but it is probably the one that gives him the greatest satisfaction.

"In one application, the use of the mercury cell in the heart pacemaker helped to save the life of a friend," he said. "The close personal involvement in this instance has meant a great deal to me."

Among other important inventions is his dry electrolytic capacitor, now found in nearly every radio and television set and in the starters of most electric motors. Production of these devices has reached more than 300 million units per year.

Expands TV Component Output

General Instrument Corporation announced that its F. W. Sickles Division, one of the country's principal manufacturers of color television deflection components, has added a new 70,000-square foot production facility in response to "an extraordinarily heavy demand from set manufacturers for color TV parts."

The new leased facility, at Ludlow, Mass. will be devoted largely to production of color deflection components and is expected to employ approximately 500 people, the announcement said. Operations began early in April.

In addition to being a major supplier of color TV deflection components, the General Instrument Division is a leading producer of UHF tuners. These tuners are manufactured at Chicopee, Mass., and in the company's Far Eastern plant in Taiwan (Formosa).

Splits Stock, Expands Plants

Admiral Corporation shareowners approved an increase in the number of authorized outstanding shares from 3 million to 9 million, while the board of directors confirmed a 2 for 1 stock split to shareowners of record date, May 31. Certificates will be mailed on or about July 1. The company also announced the approval by the board of a public offering of 300,000 shares of the split stock.

Also announced were record first quarter consolidated sales of $101,405,845, compared with $67,464,682 in 1965. Earnings after taxes were $3,667,115, or $1.46 per share on 2,514,311 shares outstanding, compared with $1,542,783, or 61 cents per share last year.

Another expansion program of the color picture tube plant in Chicago was announced at the annual meeting. When completed in July 1967, the expanded plant will have an additional capacity of 300,000 color tubes yearly.

"Our own production capability of 900,000 tubes annually combined with tubes from outside sources will provide a total availability of 1,250,000 color tubes a year," Ross D. Siragusa, chairman of the board, told shareowners.

He said the company's 151% increase in color set sales in the first quarter was made possible by the "higher than expected number of 25-inch color tubes obtained from our own plant. We are now shipping more than 1,000 tubes a day."

• *Please turn to page 63*

Square-Wave Testing of VIDEO, Y, and COLOR-DIFFERENCE AMPLIFIERS

A new technique for testing these circuits.

by Robert G. Middleton

Square-wave tests of video amplifiers provide more useful servicing data than frequency-response tests. This is true because good picture quality depends fundamentally upon the *transient* response of the amplifier. A video signal is a succession of transient voltages; some are very brief, while others have a longer duration. (See Fig. 1). For example, the transient voltage which corresponds to scanning a thin vertical line has a duration of a fraction of a microsecond. On the other hand, the transient voltage which corresponds to scanning a sunrise may have a duration of 30 microseconds, or longer. Reproduction of a thin vertical line requries video-amplifier response to an extremely short pulse. However, reproduction of the sky's background during a sunrise requires video-amplifier response to a signal voltage that changes very slowly. The first requirement can be met by simple AC coupling; but the

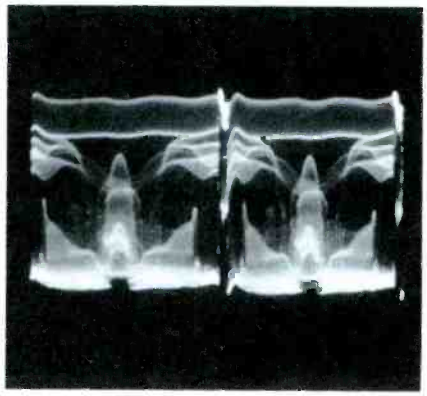


Fig. 1. A succession of transients.

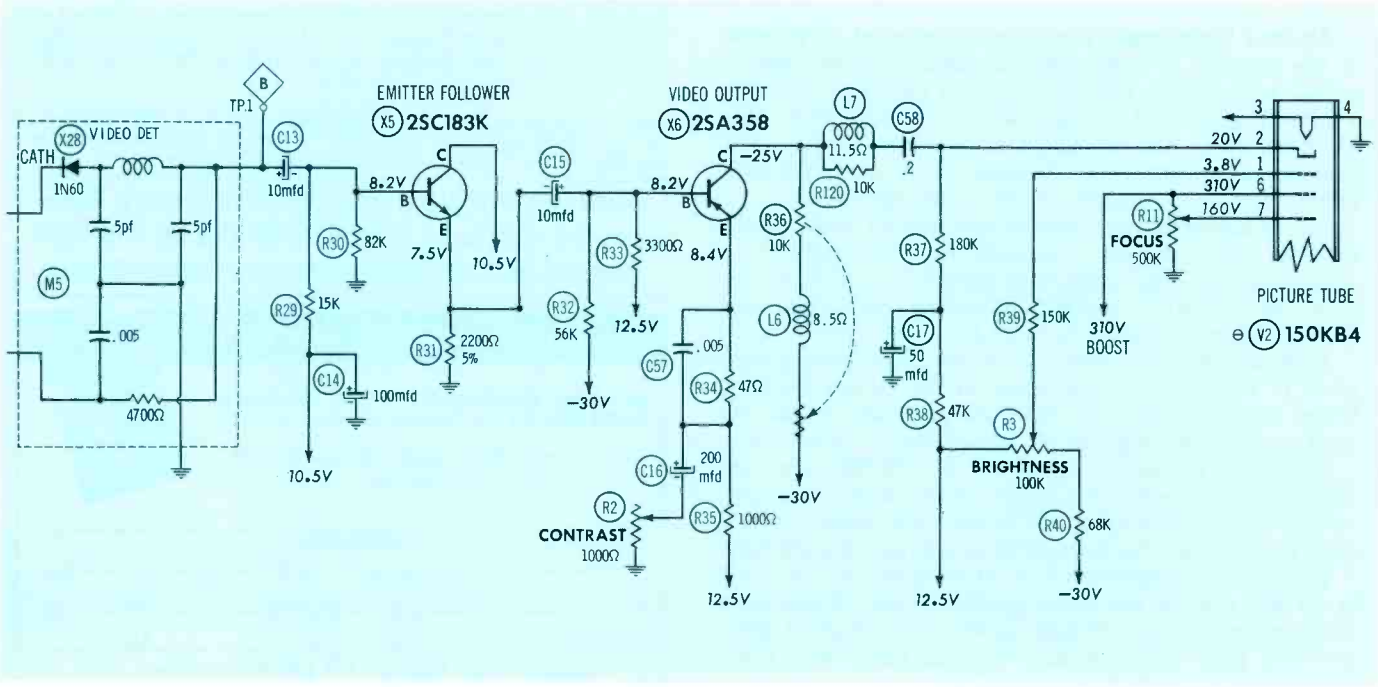


Fig. 2. Transistorized video amplifier.

second requirement can be met only by DC coupling, or AC coupling supplemented by DC restoration.

Ideal and Practical Amplifiers

An ideal amplifier would provide distortionless reproduction of a pulse that has a duration of a fraction of a microsecond and would also provide a sustained output corresponding to a prolonged DC input. The first requirement is much more difficult to achieve than the second. Practical video amplifiers represent a compromise between cost and ideal performance. The better amplifiers distort short pulses (or high-frequency square waves) much less than economy-type amplifiers. If cost were no object, video amplifiers in TV receivers could be designed like the vertical amplifiers in lab-type scopes. The distributed amplifiers utilized in high-performance scopes provide a practical reproduction of short pulses that approaches the ideal.

Trouble Analysis

Square-wave tests of video amplifiers should be of interest to bench technicians because they provide necessary clues to circuit defects that impair picture reproduction. Defects are sometimes marginal and represent cumulative drift of component values. Inductance, capacitance, and resistance values are comparatively critical in video-amplifier circuits if optimum picture quality is to be achieved. As a receiver ages, resistors tend to increase in value, or may occasionally decrease in value. Peaking coils may develop shorts between turns or layers, changing their inductance. If peaking coils are replaced, the new coil may have more or less optimum inductance. Capacitors are common troublemakers. Tolerances are cumulative, and as a receiver ages, picture quality deteriorates, although you might not be able to point to one single component and call it the culprit.

Interpretation of square-wave response is difficult for the beginner. He does not understand that low-frequency response is contributed primarily by the peaking coils. Beginners do not usually understand that all the components in a video amplifier must work together as a team to produce good square-wave response. The beginner cannot "size up" a square-wave response and state that a particular distortion is caused by an off-value or undamped peaking coil, that another distortion is caused by an open decoupling capacitor, or that still another distortion is caused by an increase in value of a load resistor. This ability to analyze scope waveforms comes only with experience and study.

Transistorized Video Amplifiers

A typical transistorized video-amplifier is shown in Fig. 2. The circuit is similar to that of a tube-type video amplifier; however, it differs in important respects. The input resistance to the base of the transistor is very low compared with the input resistance to the grid of a tube. In other words, a transistorized stage has relatively low impedance and the base draws substantial current. Hence, 10-mfd coupling capacitors are necessary —a large value by ordinary standards. Also, junction capacitances of a transistor are much greater than the interelectrode capacitances of tubes. In turn, peaking coils such as L6 have low inductance by ordinary standards—the higher junction capacitances resonate the lower-inductance coils to the same frequencies as in a tube-type video amplifier.

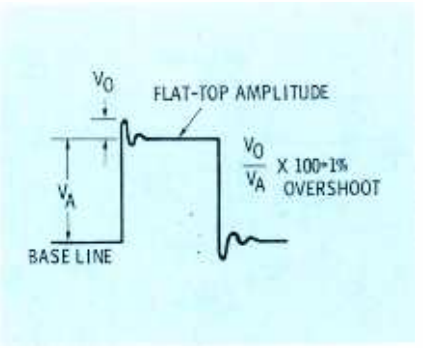


Fig. 4. Examples of square-wave ringing and overshoot.

It is common practice to use an emitter follower between the video detector and the video-output stage. An emitter follower gives little or no voltage gain, but it provides high current amplification. Thus, X5 in Fig. 2 develops sufficient current to drive X6 properly. Another way of stating the same fact is to note that X5 matches the output of the video detector to the input of the video-output transistor. Observe that the normal output from the video detector is 0.6 volt p-p, and normal input to X6 is also 0.6 volt p-p. There is no voltage gain in X5.

The normal square-wave response of a transistorized video amplifier is the same as that from a comparable tube-type video amplifier. However, since transistors are much more ligely to be dam-

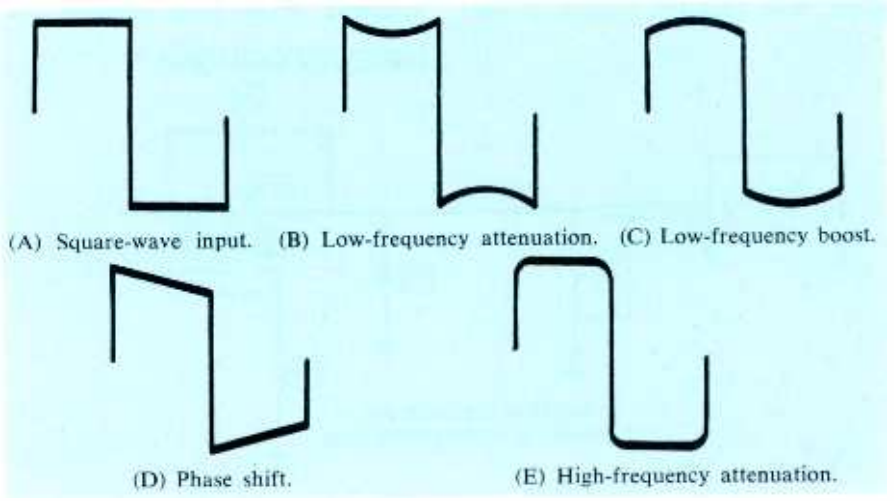


Fig. 3. Typical square-wave distortions.

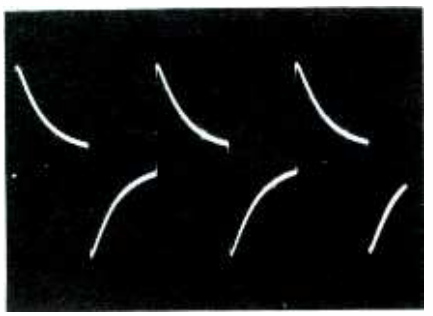


Fig. 5. Example of 60-Hz square-wave differentiation.

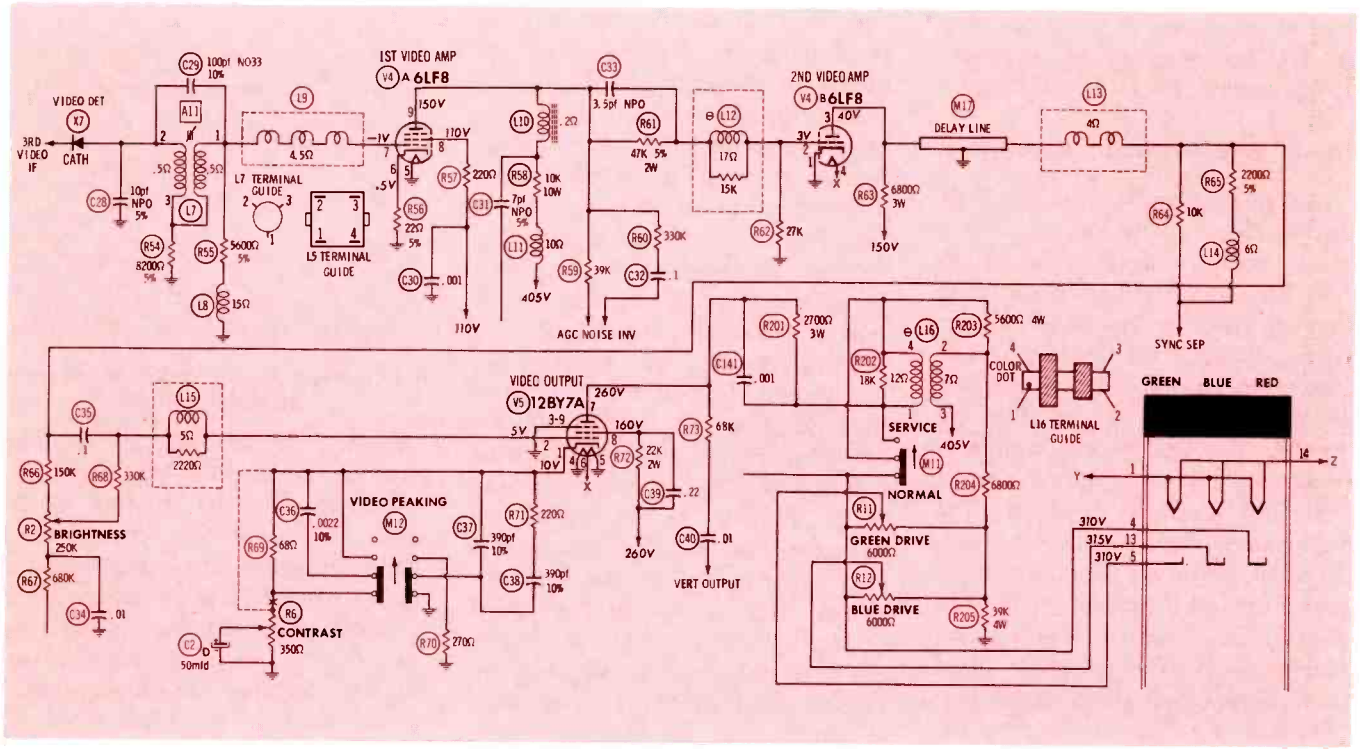


Fig. 6. Color-TV video-frequency section.

aged by overload than are tubes, always be sure to connect the ground-return lead from the generator first, and to disconnect it last. Also, avoid applying excessive drive signal to a transistorized video amplifier. Except for these technical precautions, the square-wave distortions found in transistorized video amplifiers are analyzed in the same manner as those in tube-type video amplifiers.

Square-Wave Response and Analysis

It is helpful to review briefly the "reading out" of basic square-wave distortions. Fig. 3 illustrates typical distortions and their causes. All commercial video amplifiers have more or less overshoot and ringing (Fig. 4) when tested at high square-wave frequencies. This is a design compromise employed to obtain improved rise. If the overshoot does not exceed 10%, the amplifier is considered to operate normally. Phase shift is usually accompanied by frequency distortion with the reproduced square wave displaying both tilt and curvature, as seen in Fig. 5. This is usually due to loss of capacitance in a coupling capacitor. However, a defective bypass capacitor could also be the culprit.

Fig. 6 shows the video-frequency section in a color-TV receiver. It is composed of the video-detector output circuit, the first video amplifier, second video amplifier, delay line, and video-output stage. In various references, the stage following the delay line is also called a Y amplifier. The video-amplifier circuitry used in modern color-TV receivers is more elaborate than that used in b-w receivers. The delay line slows down the video signal for approximately 1 microsecond without distortion.

In addition, the video-output response is extended to provide a linear phase characteristic, so that signals are reproduced with minimum distortion. The meaning of this will be explained in the following discussion. However, at this point, note that the output of the video detector is also the input of the first video amplifier. The amplifier is driven through the internal resistance of the video-detector diode. Therefore, to obtain the best possible square-wave test, we must disconnect the video-detector diode and replace it with a suitable resistor during the test. The diode has an effective resistance of approximately 75 ohms. Therefore, we connect the square-wave generator as shown in Fig. 7.

A low-capacity probe is used with the scope and is applied at one of the cathodes of the color picture tube. A square-wave check at a single cathode is usually sufficient. However, a complete check-out requires that the square-wave response of all three cathodes be

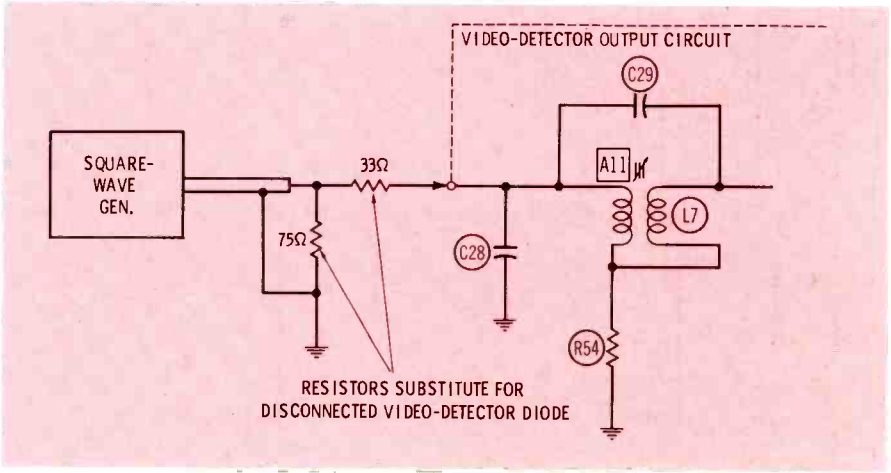


Fig. 7. Video-amplifier square-wave test.

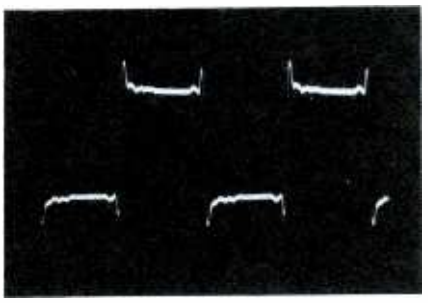


Fig. 8. Normal 100-kHz square-wave response with preshoot and overshoot.

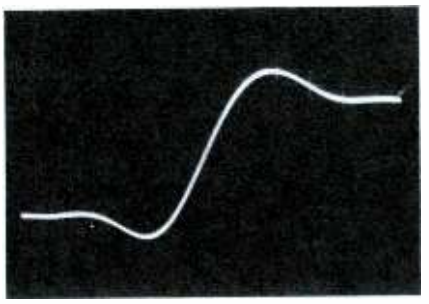


Fig. 10. Expanded leading edge.

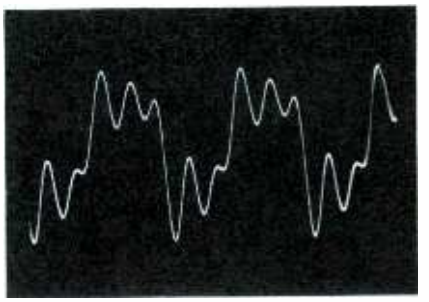


Fig. 12. Response of b-w video amp.

checked. Only the red cathode is driven directly—the signal is fed through drive controls to the green and blue cathodes. The input capacitance of the probe tends to load the cathode under test; however, this is negligible in the case of a color picture tube because the probe capacitance is only a small fraction of the total capacitance.

Normal Square-Wave Response

The normal 100-kHz square-wave response of the video section is illustrated in Fig 8. Note that both preshoot and overshoot are present. The waveform is essentially symmetrical because the video section has linear phase response. If the square-wave response should be unsymmetrical, there is either a peaking-coil defect, or L16 (Fig. 6) is defective. It is interesting to compare the response shown in Fig. 8 with the response of a good-quality b-w video section. Fig. 9 shows the 100-kHz square-wave response of a black-and-white video amplifier; overshoot and ringing are present, but preshoot is not. The waveform is unsymmetrical.

Standard tests of video amplifiers are made with a 100-kHz square wave. Of course, additional information can be obtained by testing at lower and higher square-wave frequencies. However, it is advisable to check the rise time of the reproduced 100-kHz square wave before other tests are made. Using a triggered-sweep scope, advance the sweep speed of the scope to expand the leading edge of the waveform as illustrated in Fig. 10. The rise time is 1/3 of the period at the high-frequency cutoff point. Thus, a rise time of 0.095 μsec indicates that the frequency response is -3 db at 3.5 mHz. In general, we find that the rise time of a good-quality b-w video amplifier is slightly faster than the rise time of a color video amplifier. On the other hand, we normally find that the waveform of a color video amplifier has much better symmetry.

Incidental Test Considerations

To obtain an undistorted square-wave display, interference from blanking pulses and stray fields must be eliminated. This means that you must pull the vertical-output tube and the horizontal-output-tube. Overload must also be avoided. Therefore, set the square-wave generator output for 3.5-volts p-p output, which is the normal amplitude of the video-detector output. The scope must have flat response out to at least 4 mHz, and must not introduce overshoot and ringing. Accordingly, test your scope by feeding the output from the square-wave generator directly into the vertical-input terminals. If you obtain a good square-wave display with a rise time of not less than 0.08 msec, your test equipment will be satisfactory.

It is desirable that the square-wave generator and scope have a considerably faster rise time than the video amplifier under test. Rise times affect the result, even if the test equipment is better than the amplifier. In other words, rise times combine as follows:

$$T_0 = T_1^2 + T_2^2$$

where: T_0 is the overall rise time, T_1 is the amplifier rise time, and T_2 is the equipment rise time.

If the rise time of the equipment

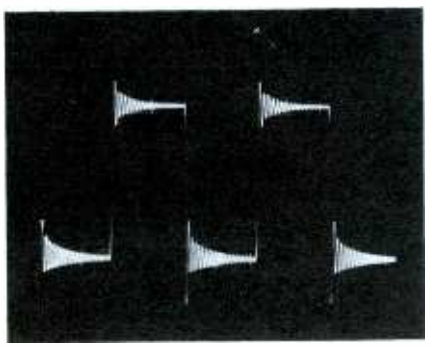


Fig. 9. 100-kHz square-wave response of a black-and-white video amplifier.

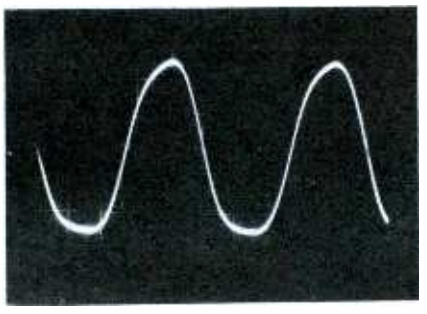


Fig. 11. Color video-amplifier response.

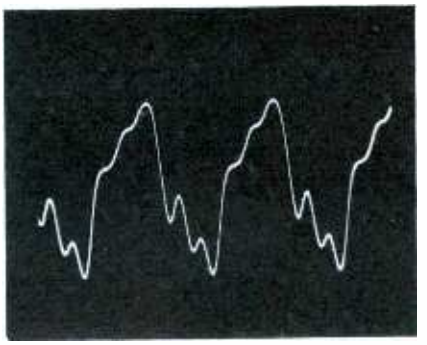


Fig. 13. Nonlinearity of amplitude.

is comparatively short, it can be neglected, and the rise time of the output waveform read directly from the scope screen. On the other hand, if T_2 is not comparatively short, you must use the formula to calculate the true rise time T_0. This is an extremely practical point that is commonly overlooked at the service bench. To save time, use a square-wave generator and scope that have a rise time of about 0.05 μsec. You can then measure T_0 without calculation because the error introduced by T_2 is negligible.

High-Frequency Test

Fig. 11 illustrates the 1-mHz square-wave response of the color video amplifier. The test frequency is now so high that most of the square-wave harmonics are suppressed, and the reproduced waveform approaches a sine wave. It is interesting to compare this waveform with the 1-mHz square-wave response of a quality b-w video amplifier. The b-w amplifier waveform in Fig. 12 displays considerable overshoot, ringing, and tilt. This difference in waveform reproduction is the result of greater bandwidth, sharper cutoff beyond −3 db, and a lack of phase linearity in the b-w video amplifier.

The appearance of amplitude nonlinearity is illustrated in Fig. 13. There are two possible causes for amplitude nonlinearity (top and bottom of waveform have different shapes). First, the applied square-wave signal may have a greater amplitude than the normal video-detector p-p output. This can be eliminated by reducing the output of the square-wave generator to the correct value. Secondly, a bias resistor in the video-amplifier circuitry may have changed value. The same symptom can be caused by a leaky cathode-bypass capacitor. If a screen-bypass capacitor is open, the reproduced square wave is distorted; system gain is reduced.

It is very easy to measure gain. For example, in Fig. 6 an input amplitude of 3.5 volts p-p should produce an output amplitude of 100 volts p-p with the contrast control set at a normal level. Check the amplitudes with a calibrated scope, transferring the probe from output to input of the video amplifier. Triggered-sweep scopes have direct-reading vertical-gain controls in terms of p-p voltage, permitting quick voltage measurement.

Color-Difference Amplifiers

Square-wave tests are also very useful in checking the response and gain of the R-Y, B-Y, and G-Y amplifiers. Fig. 14 shows a chroma amplifier and demodulator section. The output circuit of the demodu-

• *Please turn to page 60*

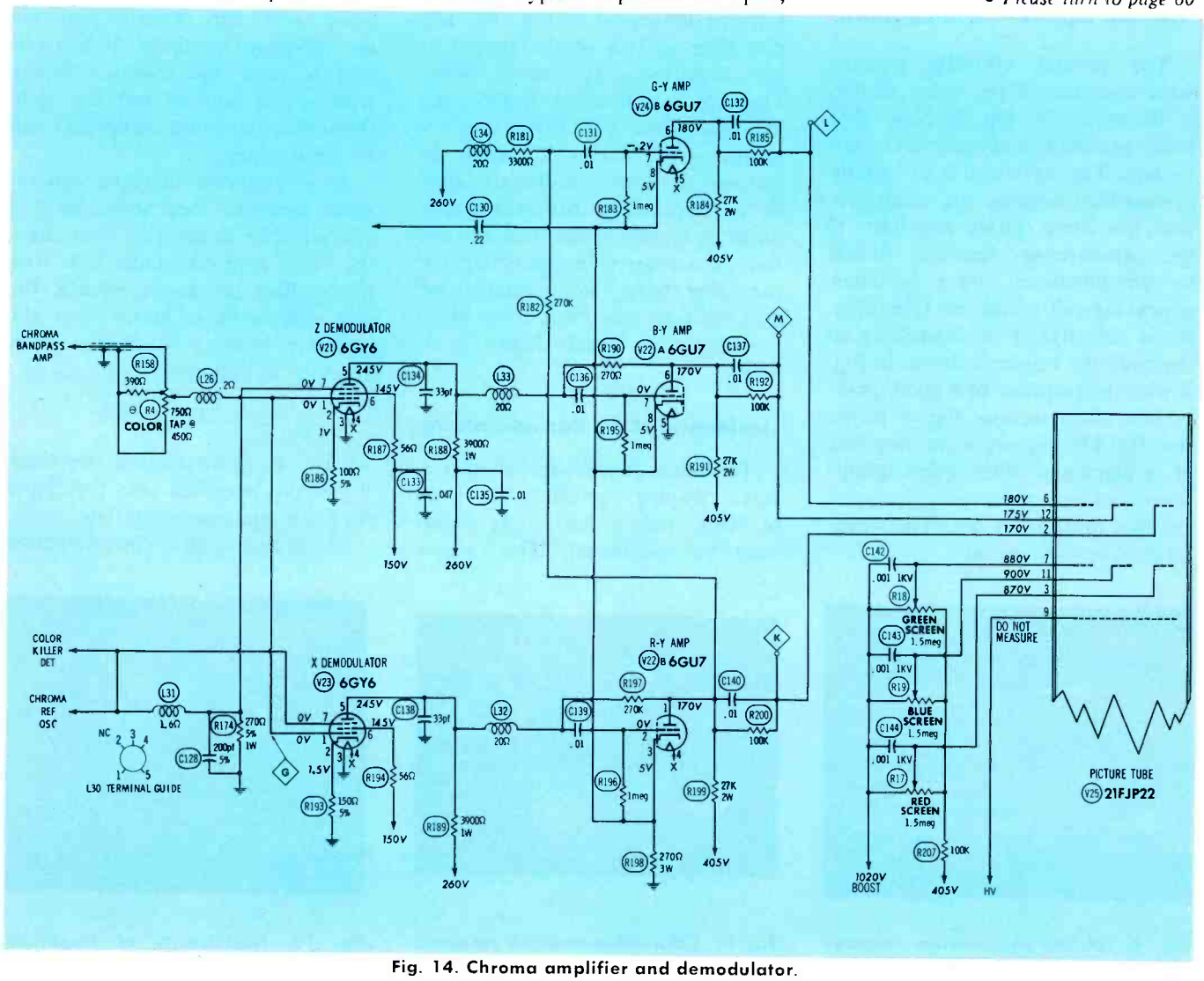
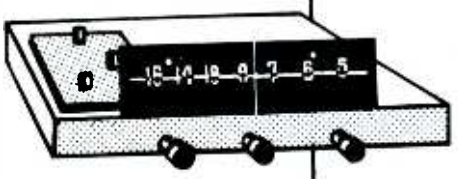


Fig. 14. Chroma amplifier and demodulator.



Repairing The SOLID-STATE AM-FM CHASSIS

Solid troubleshooting hints.

by Homer L. Davidson

You can repair a transistorized stereo chassis almost as easy as a tube chassis. Granted, the solid-state stereo chassis is a little more complicated than a pocket transistor radio. But with some previous transistor repair experience, the instruments are not difficult to repair.

One of the big differences between the solid-state and tube type chassis is the tubes themselves. You can remove the tube from its socket and check it. But most transistors have to be unsoldered before they can be checked in a transistor tester.

This eliminates the tube jockeys, and the profit and repair will be channeled to the right source, the radio and TV repairman. If you are not in the solid-state repair business, jump into it now.

Take a look at the present solid-state market. Several years ago the auto radio and portable radio went to transistors. Yesterday and today the AM-FM stereo console is in the swing of things, and during the past year several TV manufacturers have entered the solid-state TV field. Tomorrow we will see more transistors and integrated circuits used in black-and-white and color-TV receivers. The medical and industrial fields are filled with solid-state devices. With this in mind, this article was written to help enlighten the repair picture.

Circuit Description

The circuit of a solid-state AM-FM chassis is practically the same as a tube chassis. Perhaps the biggest difference is the voltage from the power supply. Most solid-state stereo units use a 60- to 70-volt power source. Therefore, lower voltage capacitors and low value resistors are used. To check these units properly we should have a good low-voltage range on our VTVM.

A superheterodyne circuit is used in both the FM and AM chassis. In most solid-state FM front ends, separate RF, oscillator, and mixer transistors are used. Some mixer stages use a crystal diode instead of a transistor device.

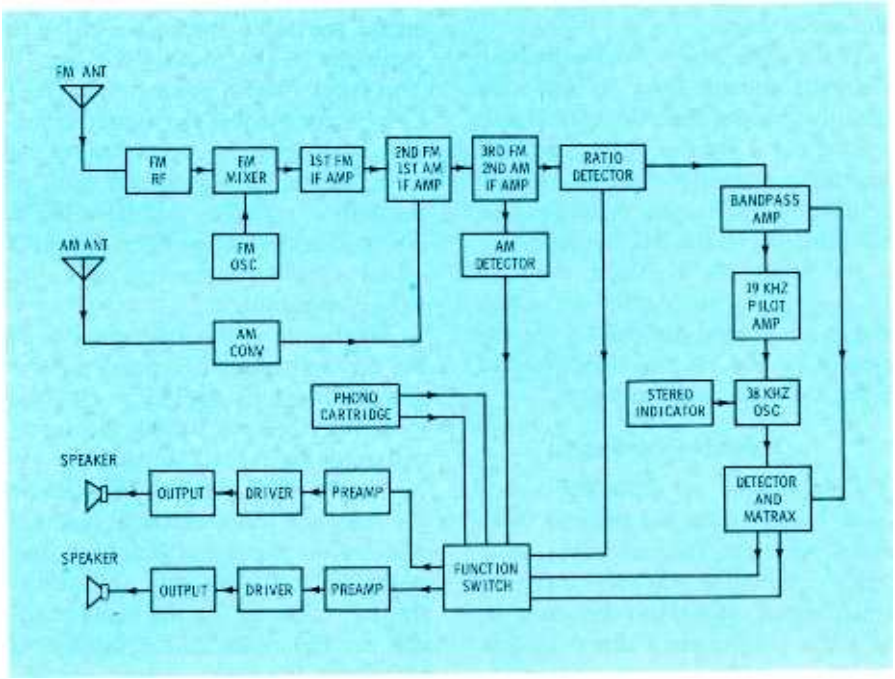


Fig. 1. Block diagram of a typical AM-FM stereo chassis.

In the lower priced solid-state AM units, front ends use only one transistor as a convertor and RF stage. The higher priced instruments have separate AM RF amplifier stages. Generally, the AM signal from the convertor stage is fed into the base circuit of the 2nd FM IF transistor amplifier.

Most AM-FM solid-state chassis have at least three FM IF stages. In the larger units there can be four FM and two AM stages of intermediate-frequency amplification. The AM IF signal is rectified by a diode detector and in the FM circuit we find a ratio detector with two diode detectors.

The detected composite signal feeds to the multiplex stages, providing the receiver is of the stereo variety. Here the 19-kHz pilot signal goes to a frequency-doubler stage and to the FM stereo indicator-lamp circuit. Again, diodes rectify the difference signal and feed it to the matrix circuit. The resulting stereo signals are then switched into the stereo amplifier circuits through the function switch.

The transistors used in the FM RF amplifier convertor stages are usually field-effect transistors. Be sure to replace them with the original manufacturer's brand or high quality equivalents. Operation of the transistors is very critical at these frequencies, and usually a front-end alignment will have to be performed after replacement.

Audio and Power Circuits

Solid-state audio stages should

not be strange to the radio-TV serviceman. They are found in PA systems, audio amplifiers, auto radios, and stereo and mono phonographs. A volume or loudness control and tone controls are usually found at the input of a solid-state amplifier. The balance control may also be located here, but the higher priced units often have one stage of amplification preceding this control. We might add that the balance control is only found in stereo units.

In the more expensive solid-state receivers, there may be three or four audio preamplifier stages. In the middle priced range we find one to two preamplifier stages and in the low priced solid-state amplifiers only one preamplifier.

Again, we may find two or three driver stages. These stages may be direct or transformer coupled to the power-output transistors which may be in series-parallel with no output transformers in the circuit.

Several speakers may be found in each output stage. Many times we find a 10-, 12-, or 15-inch speaker as the woofer. The middle range is covered with a 5-, 7-, or 8-inch speaker, with a 3½-inch PM speaker coupled through a nonpolarized capacitor to cover the highs.

The Power Supply

In the larger solid-state power supplies we find a transformer input with half-wave, full-wave, or bridge rectification. Voltages here are quite low compared to tube-type chassis, varying from 6 to 70 volts.

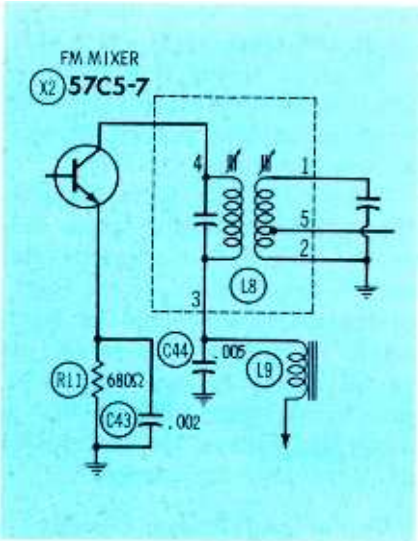


Fig. 2. Admiral 22C5 mixer circuit.

About ninety percent of power supply failures are due to shorted or open silicon diodes. Silicon diodes can easily be checked with an ohmmeter. If the resistance is high each way, the diode is open. A good silicon diode will have a reading under 60 ohms one way, and with the ohmmeter leads reversed will have a resistance of a few thousand ohms. Be sure to check for an open isolation resistor when a silicon diode is found to be shorted.

An open or dried-out filter capacitor will produce a hum or screeching noise in the solid-state amplifier, and motorboating may also result. Be sure to check for a shorted filter when a shorted silicon diode is found.

Circuit Isolation

Since there are so many stages in a solid-state radio-phono combination, and they are switched in and out by the function switch, it is fairly easy to locate a defective stage or group of stages.

For instance, if the FM doesn't work but the AM radio does, then the trouble is quickly narrowed down to the FM front end or the ratio detector. In some sets of course, there will be one stage of FM IF which is not shared by the AM radio.

If the set has one dead channel on both FM stereo and phono functions, then the trouble must be in the audio stages.

If the FM stereo works on both channels though there is one side dead on phono, then the cartridge is a good bet. Likewise, if the phono is operating properly and one channel is dead on FM stereo, then the trouble must be in the MPX section.

Referring to a block diagram (Fig. 1), we can readily see which stages are shared and which are exclusive to the various functions of a combination instrument.

Troubleshooting

Troubles in an FM-AM solid-state chassis can be isolated with signal injection, a signal tracer, or a signal generator. When using a noise signal generator, be sure to turn the gain control down as low as possible. Harmonic signal injection works well on the IF stages through the audio stages, but is not as effective in the RF and convertor stages of a solid-state receiver.

If the trouble lies in the audio or IF stages, use a noise generator and inject the signal at the base of each transistor. In the audio circuits, start at the output stage and proceed toward the volume control. Notice the gain or loudness of noise from the loudspeaker at each base connection. A loss in volume will locate the defective stage. Now check the defective stage with voltage and resistance measurements. Adjust the gain control as more stages are checked. Check the IF stages in the same manner.

To align the IF stages of the AM section, connect the AM signal generator to a small loop formed with several turns of hook-up wire and set the frequency to 455 kHz. Turn the tuning capacitor wide open, set the volume control to maximum position, and connect the VTVM to the output of the AM detector. You can now adjust each AM IF transformer for maximum reading on the meter. If one of the IF adjustments doesn't have much effect, this stage is bad. Either the IF transformer is defective or the trouble lies close to this section. Be sure to keep the signal generator output as low as possible during these adjustments.

If the signal cannot be radiated through the receiver, connect the signal generator through a .01-mfd capacitor to the base of the last IF transistor. Work toward the front end by connecting the signal generator to the base of each transistor in turn. When the signal will not go through a transistor you have located the defective stage. The 455-kHz signal should go through the convertor stage also.

Alignment or troubleshooting of the RF and oscillator stages can be accomplished by radiating with the loop described above. Set the signal generator to 1600 kHz and the radio dial to 1600. Adjust the oscillator trimmer for maximum reading. Now adjust the signal generator and radio dial to 1400 kHz and adjust the RF trimmer. In the same manner, set the radio and generator to 600 kHz. Rock the tuning capaci-

for back and forth, adjusting the slugs in the oscillator coil and the RF transformer. If the receiver has a tuning indicator in the chassis, use this instead of the VTVM.

The FM section can be checked in the same manner as the AM. Set the generator to 10.7 mHz and the tuning capacitor to a quiet part of the FM band. Connect the DC probe of the VTVM to the input of the ratio detector. Connect the signal generator through a .01-mfd capacitor and touch the base of each IF transistor.

Alignment of FM stages varies widely from set to set. It is best to refer to the appropriate PHOTOFACT Folder for alignment instructions.

Solid-State Troubles

The biggest trouble in the RF and oscillator sections of a solid-state AM-FM chassis is the transistors themselves. When stations will come in only at the lower or the higher end of the band, try changing the oscillator transistor. Many times transistors will oscillate in the RF and IF stages and the result is a squeal and muffled sound. They can also become weak and intermittent.

Shorted and open capacitors in these same circuits can stop the AM and FM signal. In an Admiral 22C5 model, a bypass capacitor opened and the FM signal was lost. This capacitor (C44) is shown in Fig. 2. Check for shorted capacitors and burned dropping resistors in the collector circuits. Remember these original voltages may be quite low to begin with.

The IF transformers in the FM section seldom cause any trouble, but the AM IF transformers can short between windings or become intermittent. Generally, pushing on the IF transformer terminals or putting a little pressure on the can will uncover an intermittent. Suspect an IF transformer right away if it takes several turns on the core before the signal output is changed.

In an Admiral 22C5 chassis the filtering capacitor (C5 in Fig. 3) had a leakage of 100 ohms. There was no signal on the FM or AM bands; and when the volume control was advanced, only a low audio hum coud be heard. When these filtering capacitors open, motorboating or excessive hum is often heard from the speaker.

A common complaint is weak or low volume on one channel even with the balance control set to one side. First suspect a weak or shorted transistor in the audio stages. Open or dried-out capacitors are also common offenders. Apply a noise or audio signal generator to the base of each transistor and note the gain of each stage. A weak or missing signal will show up a defective stage.

When an audio driver stage is suspected, simply short the base to the collector terminal. If the signal remains the same the transistor is most likely defective. This can be done before the transistor is removed from the circuit.

One advantage of a stereo amplifier is the fact you can compare stage-by-stage gain against the opposite channel. Use a stereo test record to check the gain and frequency response of each channel. An AC VTVM connected across the speaker terminals will indicate the gain of each channel.

The right channel of an Admiral solid-state stereo phonograph, Model Y8519, would pop, crack, and then go dead. In a few minutes the channel would be perfect and then repeat the symptoms. The trouble was an AF transistor, just ahead of the driver transistor.

In an RCA Model RS-215B solid-state phonograph, the left channel was intermittent. Then the channel would stay off for some time. At first the output transistor was suspected but it checked good. The actual trouble was an open 500-mfd capacitor between the output stage and the left speaker. See C8 in Fig. 4.

Hum in the audio amplifier may be caused by high noise or filter hum in the power supply. When the volume control is at minimum and there is hum in the speakers, this is filter hum. In the high gain amplifier stages, pickup hum can be caused by poor grounding, an open base resistor, or ungrounded volume or tone controls. A broken or cracked PC board can open up the base circuits. Start at the input stage and short a .05-mfd capacitor from base to ground at each audio stage. When the defective stage is found, take the usual voltage and resistance measurements.

The preceding tips should help "break the ice" so you can jump in and start repairing the latest solid-state instruments. Good hunting! ▲

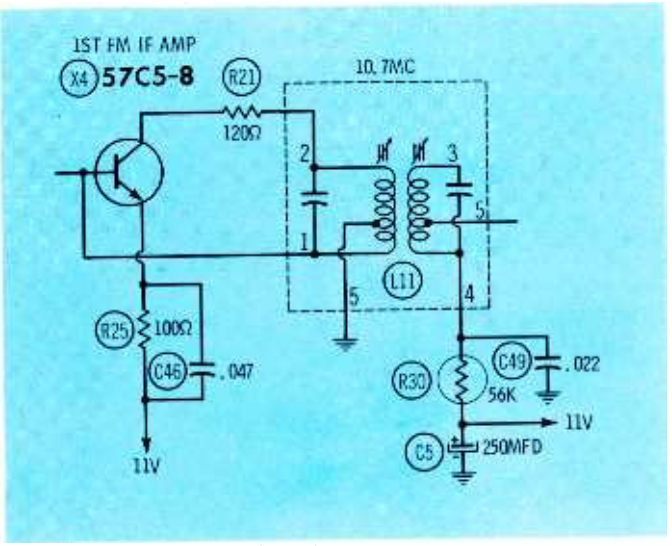


Fig. 3. Admiral 22C5 1st FM IF.

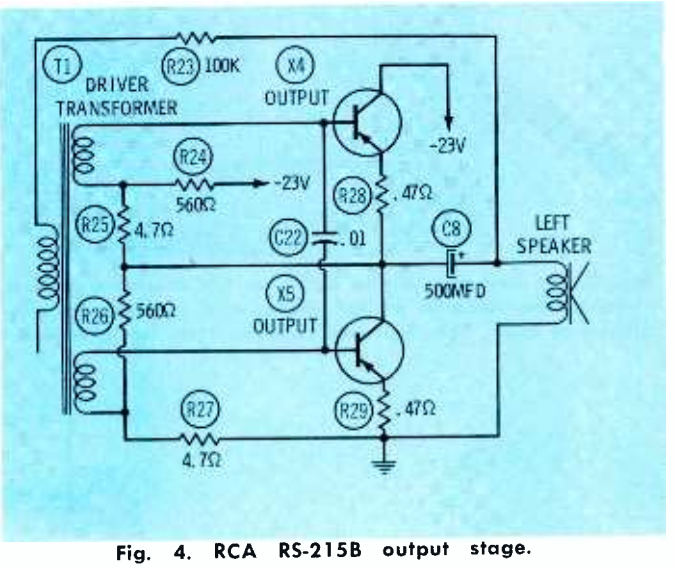


Fig. 4. RCA RS-215B output stage.

Permanent Repair Tuner Trouble

Many models of Admiral TV receivers, ranging from small portables to large consoles, used the tuner in this series of photos. The tuners, found in 1958 through 1962 models, had excellent electronic characteristics; however, they were subject to a chronic mechanical failure.

1

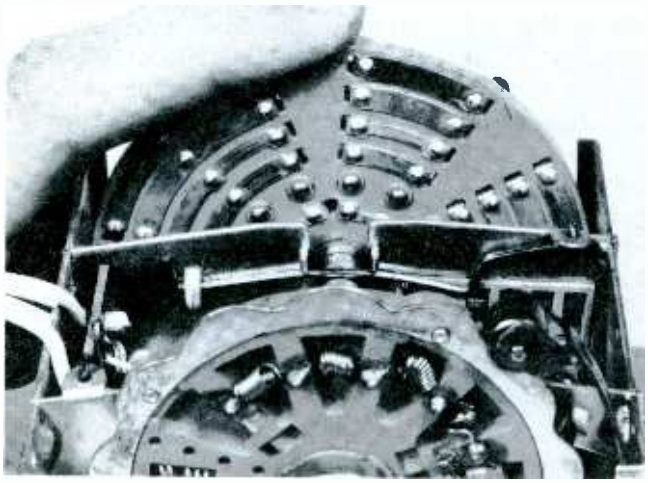


Fig. 1. Quite frequently, considerable looseness develops between the front disc and the shaft. The disc rotates slightly on the shaft preventing the disc contacts from meeting the fixed contacts. Test the disc for rotary movement.

2

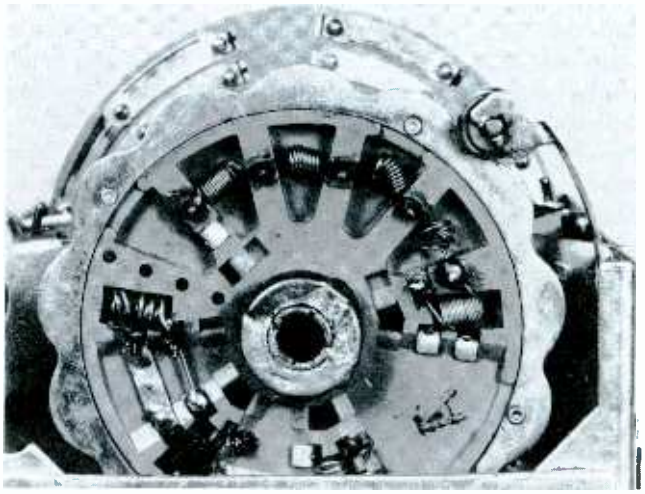


Fig. 2. Less frequently, looseness develops in the rear shaft. The looseness appears between the shaft and the odd-shaped brass washer, or between the washer and the disc. Test the rear disc for looseness.

3

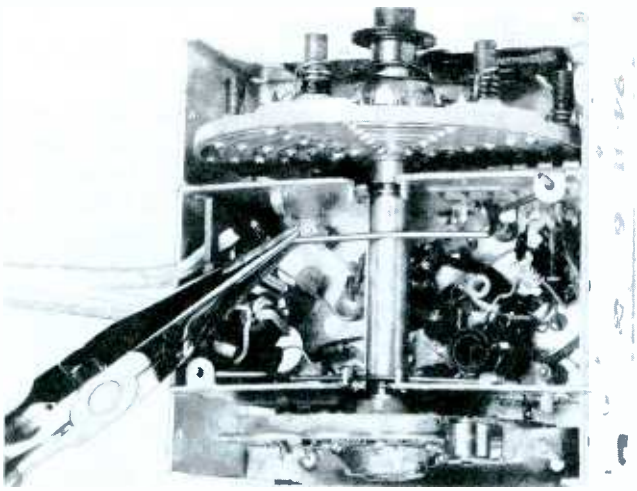
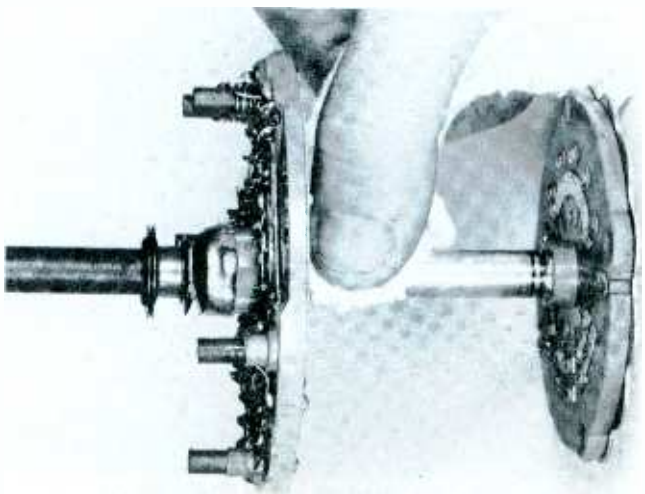


Fig. 3. The first step in the curing of the chronic condition requires the removal of the spring-wire retainers at the front and back. The disc assembly can then be lifted out.

4



# of Chronic

by Allan F. Kinckiner

5

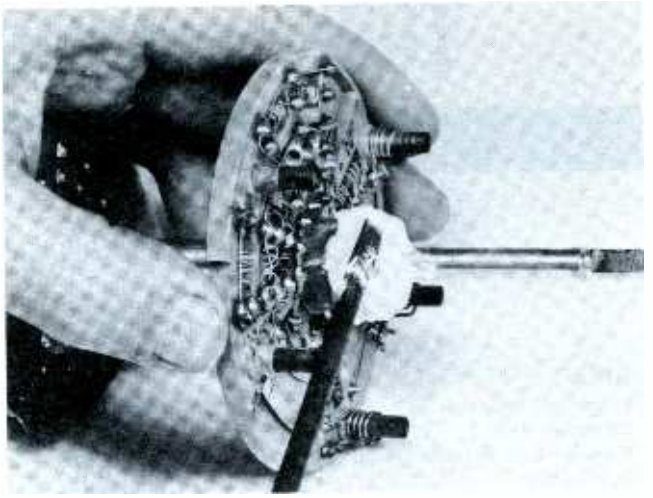


Fig. 5. A small quantity of epoxy cement should be mixed thoroughly and a fillet of it applied where the shaft passes through each disc. The mixture should have a consistency similar to a thick cream.

6

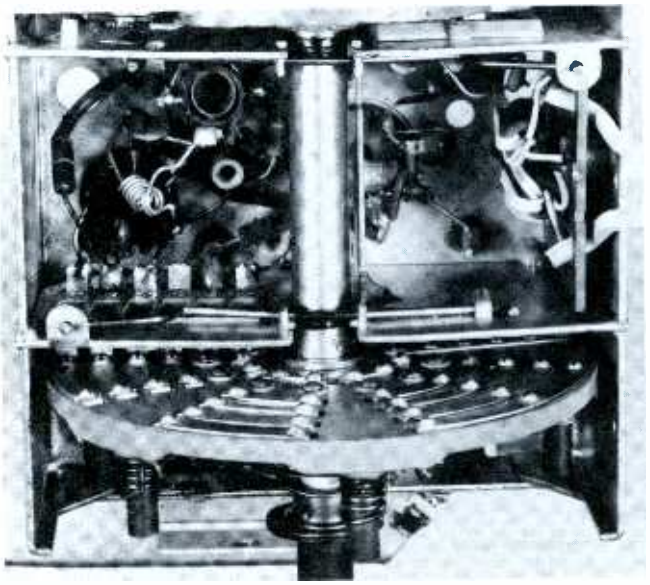


Fig. 6. After the epoxy has been applied but before it sets, the disc assembly should be returned to the tuner. The discs should be rotated individually until the outer contacts rest at dead center on the fixed contacts.

7

Fig. 4. All grease, oil, or lubricant should be dissolved and wiped away from the shaft near the discs and from the discs near the shaft. Lighter fluid and alcohol are efficient solvents for this purpose.

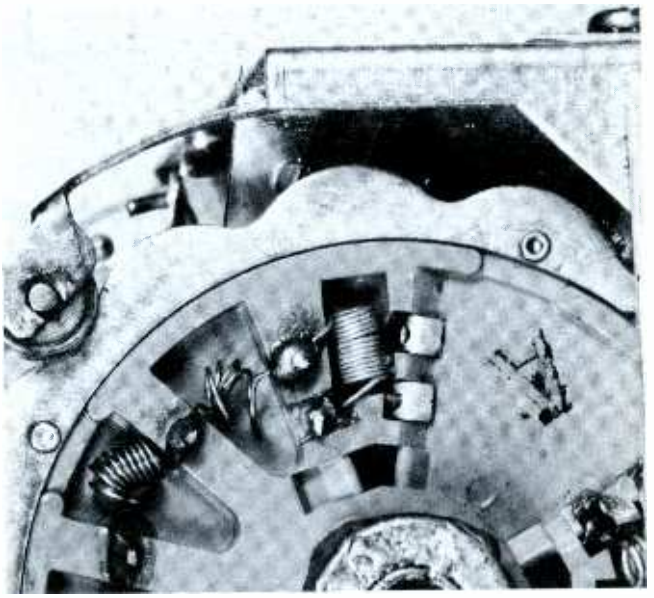


Fig. 7. If the assembly has shifted slightly, the detent spring can be moved slightly or the spring contour can be changed. The long arc of the spring can be changed to rotate the assembly; bend the ends to maintain correct pressure.

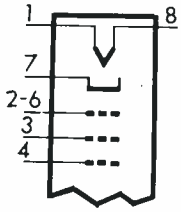
Conclusion

The sequence of steps shown here is necessary if a positive and permanent repair is to be attained. If any one step is neglected, the cure is likely to be short-lived. Permanency of the repair is attested by some dozens of cases, some dating back several years.

TUBE and TRANSISTOR DATA

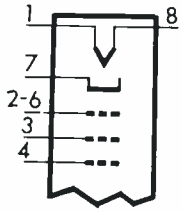
CATHODE-RAY TUBES

9TP4
Protection—filled rim
Deflection—110°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—50V



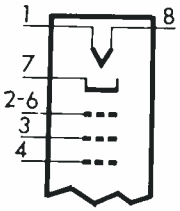
8HR

19EJP4
Protection—tension band
Deflection—114°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—30V



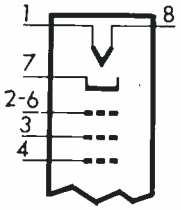
8HR

12BTP4
Protection—filled rim
Deflection—110°
Filament—12.6V @ 0.15A (11 sec)
Grid 2—50V



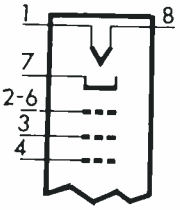
8HR

21GBP4
Protection—tension band
Deflection—114°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—50V



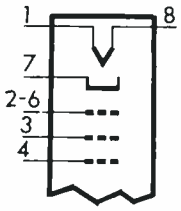
8HR

12BUP4
Protection—tension band
Deflection—110°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—50V



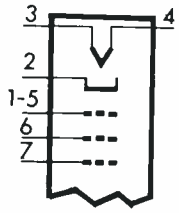
8HR

23FHP4
Protection—tension band
Deflection—110°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—50V



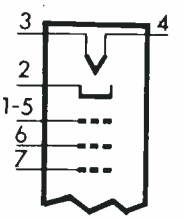
8HR

12BVP4
Protection—tension band
Deflection—110°
Filament—12.6V @ 0.075A (11 sec)
Grid 2—50V
Neck Diam.—0.787″



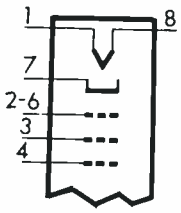
7GR

11RP4
Protection—tension band
Deflection—104°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—140V
Neck Diam.—0.787″



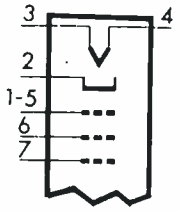
7GR

16BWP4
Protection—tension band
Deflection—114°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—300V



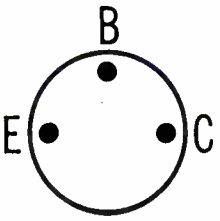
8HR

16CFP4
Protection—tension band
Deflection—104°
Filament—6.3V @ 0.45A (11 sec)
Grid 2—140V
Neck Diam.—0.787″

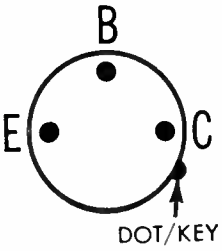


7GR

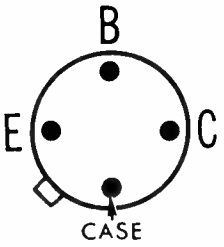
2SA102
RF Amplifier
PNP—Germanium



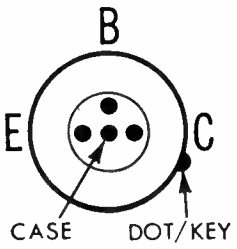
2SA142
RF Amplifier
PNP—Germanium



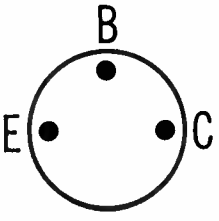
2SA161
VHF Amplifier
PNP—Germanium



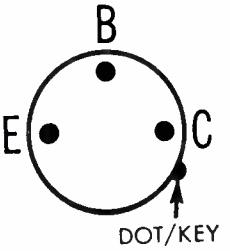
2SA435
VHF Amplifier
PNP—Germanium



2SB22
Audio Amplifier
PNP—Germanium



2SB33
Audio Amplifier
PNP—Germanium



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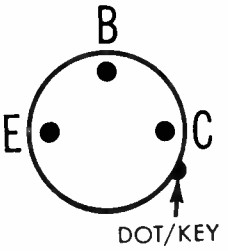
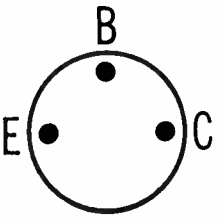
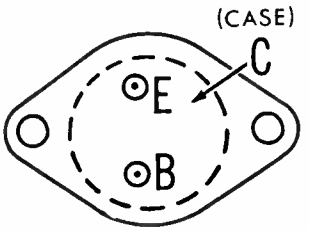


2SB77B
Audio Amplifier
PNP—Germanium



2SB126
Vertical Output
PNP—Germanium



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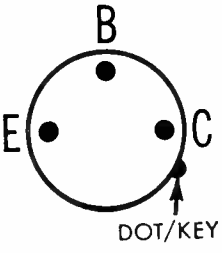
Audio Amplifier
PNP—Germanium



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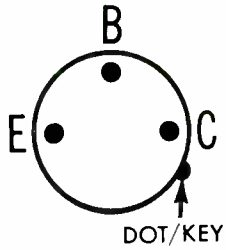

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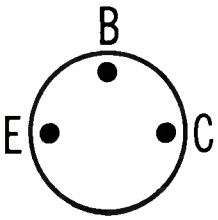
PNP—Germanium



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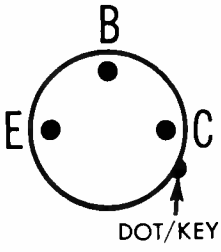
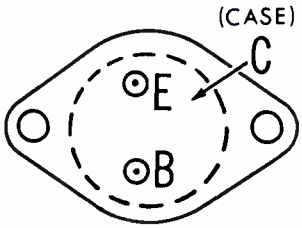
PNP—Germanium



2SB216
Vertical Output
PNP—Germanium



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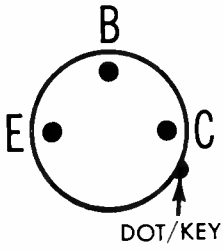

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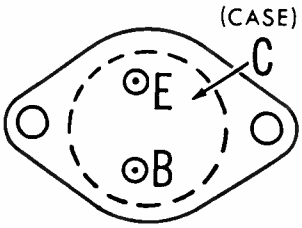
Horizontal Output
PNP—Silicon



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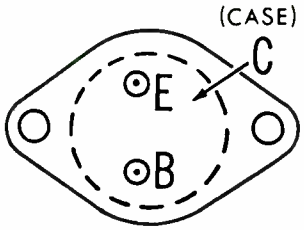
Horizontal Output
PNP—Germanium



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RF Amplifier
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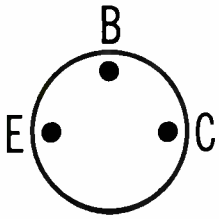

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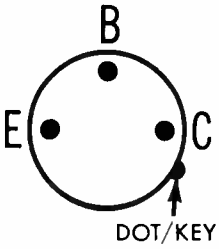

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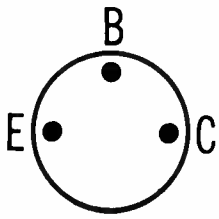
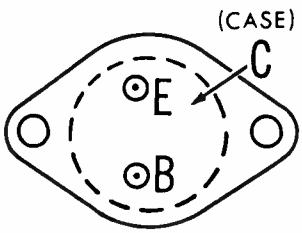
Audio Amplifier
PNP—Germanium



2SB424
Vertical Output
PNP—Germanium



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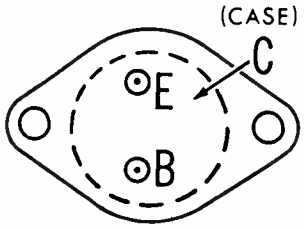
Audio Amplifier
PNP—Germanium



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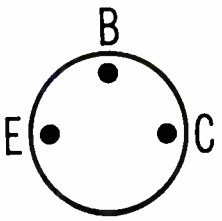

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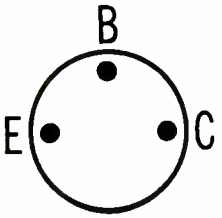
Audio Amplifier
PNP—Germanium



2SC50
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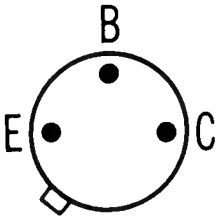
NPN—Silicon



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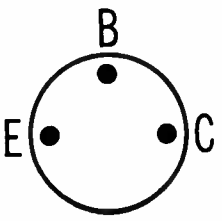

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Video Amplifier
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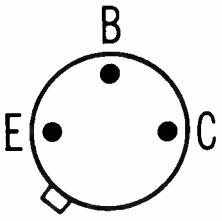
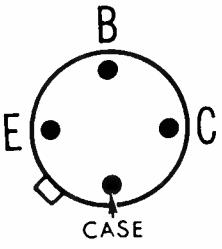


2SC70
Video Output
NPN—Silicon



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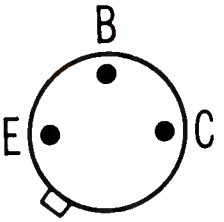
Horizontal Driver
NPN—Germanium



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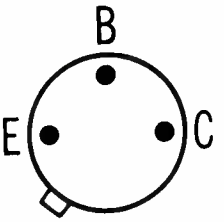
Vertical Output
PNP—Germanium



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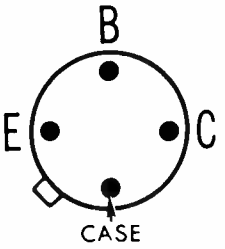
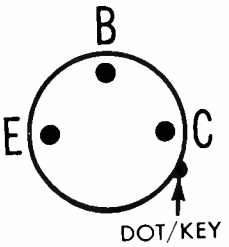
Audio Amplifier
PNP—Germanium



2SD33
Audio Amplifier
NPN—Germanium



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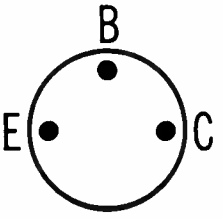
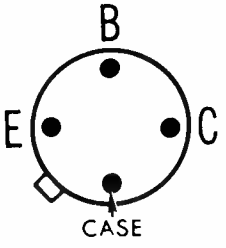
PNP—Germanium



2SD100
Horizontal Driver
NPN—Germanium



LASER TV SYSTEM

A laboratory-developed laser television camera, capable of reproducing subjects shot in total darkness, has been demonstrated by the *Perkin-Elmer Corp.*, a company which has pioneered many developments in laser technology. The laser TV camera was developed from the company's work in optical scanning and laser illumination.

The word laser is an acronym for Light Amplification by the Stimulated Emission of Radiation—light that is highly coherent, bright, pure and monochromatic. First demonstrated in 1961, the laser has opened the scientific door to a broad area of uses for this light source.

In the present *Perkin-Elmer* system the light beam from a CW (continuous wave) laser is deflected by a pair of rotating mirrors so as to completely scan the object in a series of adjacent lines once every sixtieth of a second. The energy reflected from the target is sensed by a photomultiplier and used to intensity modulate the cathode ray tube in a television monitor whose electron beam is scanning in synchronism with the laser beam.

The laser used in the demonstration model (Figs. 1 and 2) is a helium-neon unit with approximately 15mw output in a one-milliradian beam at 6,328 angstroms (one angstrom equals a wavelength of light 10^{-8} cm long). The beam from this laser is reflected off a folding mirror to the line scanner. This scanner consists of a 16-sided, 1½″ diameter, polygon prism mounted on the rotor of the scanner motor. This motor, driven from a 2-kc, solid-state power oscillator, drives the line scanner at approximately 60,000 rpm (60,000/60 × 16 = 16,000 scans per second). Following the line scanner the beam strikes the 24-sided frame scanner running at 150 rpm (150/60 × 24 = 60 frames per second). The beam reflected off the frame scanner continues on toward the target. In combination, the line and frame scanners cause the target to be scanned at rates similar to commercial television (15,750 lines/sec; 60 frames (sec). The one-milliradian beam results in resolution similar to that of commercial television.

A portion of the laser energy reflected from the target is detected by an 11-stage photomultiplier with an S-20 photocathode. A 90-angstrom spectral filter located in front of the photocathode rejects 99% of the background light to prevent saturation from background lighting. Following the photomultiplier, a preamplifier with a gain of 26 db and bandwidth of 5 mc raises the signal to a level sufficient to drive the video amplifier of a commercial television set and intensity modulate the trace on the picture tube.

The deflector circuits in the television monitor are synchronized with the scanning laser beam by means of photocells placed in the scanning beams. The line-sync cell is located between the line and frame scanners so that it is illuminated by the line scanner at the beginning of each scan line. The frame-sync cell is located beyond the frame scanner so that it is illuminated by the scanning beam at the beginning of each frame. The output of the line-sync cell is amplified and shaped in the line-sync amplifier which generates 20-volt pulses to synchronize the horizontal-deflection circuit in the television monitor. The output of the frame-sync cell is amplified and shaped in the frame-sync amplifier resulting in 20-volt pulses which are used to trigger the vertical deflection circuits of the television monitor.

The laser transmitter-receiver is shown in Fig. 1 with side cover removed; the TV monitor at left shows a test grid on picture tube. The beam from the helium-neon laser (lower left in instrument case) is directed via mirrors through a rectangular window below lens of light receiver at upper right. The present unit weighs approximately 60 pounds and measures 8″ x 30″ x 18″. Use of miniaturized components could readily reduce its weight to about 25 lb. and its size to about 8″ x 10″ x 18″. ▲

Fig. 1. First laser TV camera.

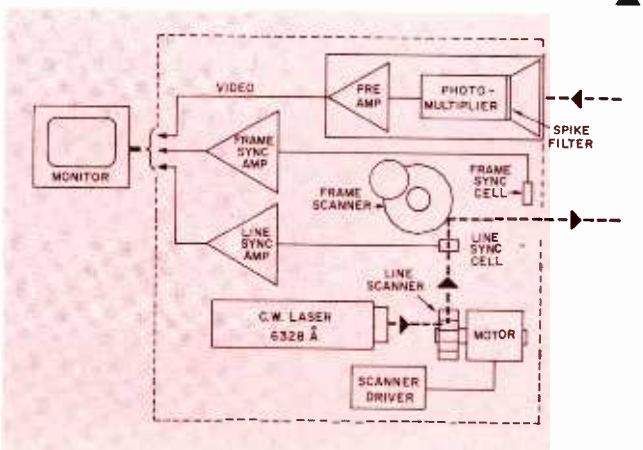


Fig. 2. Laser TV block diagram.

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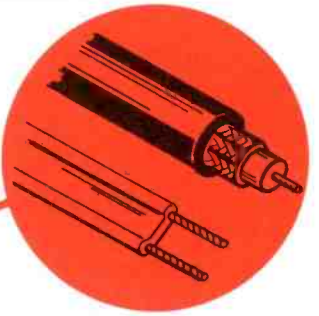
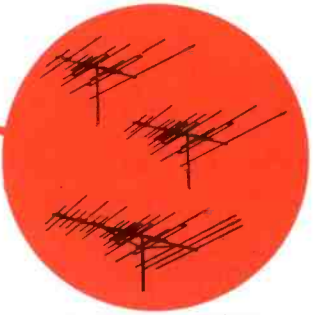
HERE ARE JUST A FEW OF THE MANY USES...

A. Distribution Systems

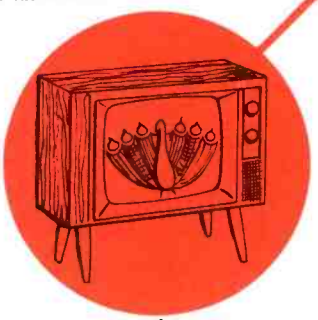


D. Transmission Lines

B. Antenna Installations



E. Antenna Comparisons



C. Color Insurance

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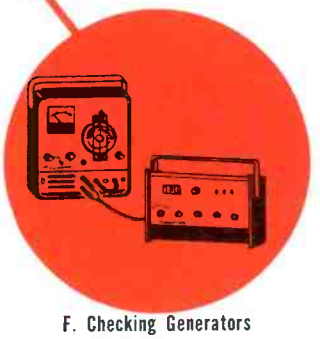

F. Checking Generators

A. INSTALLING AND CHECKING OUT DISTRIBUTION SYSTEMS

Qualify for this multimillion dollar business in hotel, motel, and hospital installations.

B. INSTALLING UHF, VHF, AND FM ANTENNAS

Cut down installation time and pay for the FS134 in a short time on critical UHF as well as VHF and FM antennas.

C. COLOR INSURANCE

Be sure the signal is adequate on each channel for proper color TV operation.

D. CHECK TRANSMISSION LINES

For the first time read actual db loss in either 75 or 300 ohm transmission lines.

E. COMPARE ANTENNAS

For actual db gain; see which is best for each location, both VHF and UHF. Also excellent for orienting "dishpans" for translator use at the high end of UHF band.

F. CHECK ANY GENERATOR OUTPUT

For correct frequency and output all the way up to a tenth of a volt RMS. What a time saver when you want to know if your generator is putting out.

PLUS: LOCALIZE NOISE AND INTERFERENCE

Find noise source fast; pick quiet locations for antenna installations or orient antenna away from noise when possible.

These are only a few uses of this UHF-FM-VHF accurately microvolt calabrated field strength meter. You can start paying for the FS134 tomorrow in the time saved today — if you see your Sencore distributor now. Why not pick up the phone and ask him to show you the new FS134?

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Circle 8 on literature card

Is your SCOPE good enough for Color TV

Check your color equipment.

by William H. Artzberger, Jr.

Did you ever try to make a measurement with a piece of test equipment you weren't sure of? Is the trouble with the circuit or with the test equipment? After a few rounds of this, you feel like you are spinning in orbit futilely.

When you are hunting an elusive signal in a television receiver, the oscilloscope is the most important test instrument on your rack. Even though your present

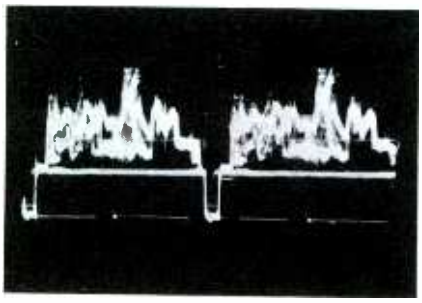

Fig. 1. Monochrome signal at 7875 Hz.

scope has served you well during the black-and-white television days, it may not be designed to do the job in color. The color signal contains an entirely new band of frequencies which are much higher than those used in black and white.

A primary requirement of a good color scope is that it have a flat frequency response to at least 3.58

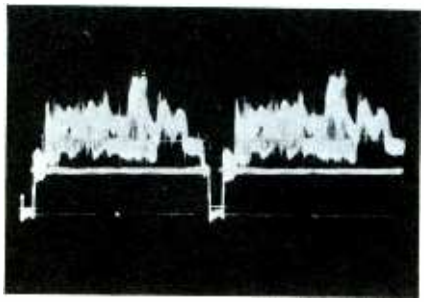

Fig. 2. A color signal at 7875 Hz.

mHz, preferably higher. A reason for this is that the composite color video signal contains a color sync burst composed of 8 or 9 cycles of a sine-wave signal at 3.579545 mHz. This burst is located on the back-porch interval of each horizontal sync pulse. Fig. 1 shows a monochrome signal at the horizontal sweep frequency. The scope sweep rate is 7875 Hz to show two horizontal cycles. Shown in comparison is a chroma signal (Fig. 2). Note the color sync burst on the back porch, and observe that the waveform contains finer video content. This indicates the presence of color information.

A scope not able to pass this band of frequencies will deceive the operator into believing that a color signal is absent in the receiver. Fig. 3 is a display taken from an older scope that had been used for years in servicing b-w receivers. The same color signal as in Fig. 2 has been fed to it. Notice the complete absence of a color sync burst, the rounding of the horizontal sync pulse, and poor video content. This scope is useless as a color instrument in its present condition.

Another feature that is desirable, though not absolutely necessary, is that the scope have great horizontal gain. If you are able to expand the display, a closer examination of the composite signal can be made. Many times a superfluous signal, which would be overlooked when the signal is crowded, can be detected in an expanded display. Figs. 4 and 5, respectively, show an expanded horizontal sync pulse (including a color sync burst) and an expanded vertical signal. Some scopes have a pre-set switch for the vertical and horizontal sweep rates. This is a time-saving feature.

Television broadcast stations use a multiburst signal to check their equipment. The signal consists of a white bar and six sine-wave bursts. The first burst following the bar is .5 mHz. Then, 1.5, 2.0, 3.0, 3.58, and 4.2 mHz follow in order. Fig. 6 is a scope picture of a multiburst signal. Note that all bursts have the same amplitude. This indicates the scope has the same re-

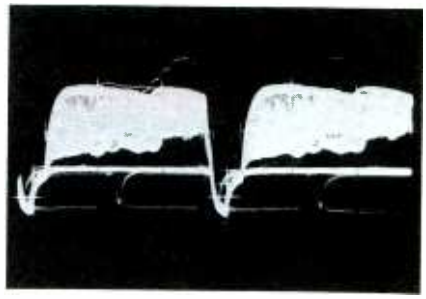

Fig. 3. Color signal on older scope.

sponse at each frequency and will be excellent for color television tests. In some cities, this signal is aired during transmitter test periods.

Good vertical linearity is a very important feature of your scope. You may want to know if there is

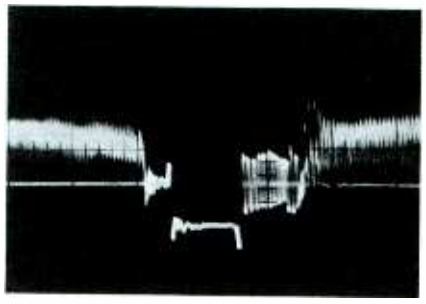

Fig. 4. Expanded horizontal pulse.

This part speaks for the whole radio.

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To the listener, the speaker is the most important part of the radio. Reason enough that it be of the highest quality and reliability. And when it says Delco on the box you can be certain you've got it: genuine OEM quality.

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Delco Radio, Division of General Motors, Kokomo, Indiana.

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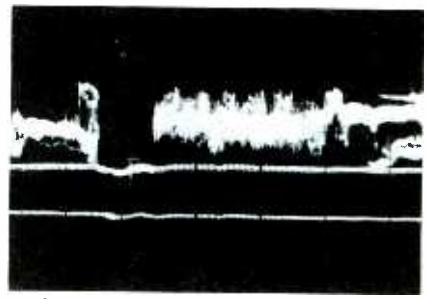


Fig. 5. Expanded vertical pulse.

sync compression in an amplifier circuit, or whether there is video compression. Unless your scope has a very linear vertical sweep, you may be misled. In the synchronizing circuits, your scope again becomes a most valuable asset. Square-tipped pulses are much easier to trace than rounded and blurred smears.

When aligning the receiver IF strip, remember that the color receiver's IF stages are much broader tuned than b-w stages. This is another reason why it is necessary to have a wide-band scope.

What can you do about "Ol' Cyclops," the scope that's been like a third eye to you for these past years? All is not lost—try writing to the manufacturer of the instrument. Some have kits or will offer suggestions for wide-banding their products. Or, if you have the time, you can attempt some modifications on your own. An additional wide-band vertical amplifier will spark it up in some cases, and some work on the horizontal circuit will help the width. In the event you decide to purchase a new color scope, look the field over carefully. You can buy excellent kits for less than $100, or you can spend more than $1000 for a deluxe laboratory scope. Suit yourself, but unless you have a wide-band scope when checking color television circuits, you'll have a hard time finding that pot of gold at the end of the rainbow. ▲

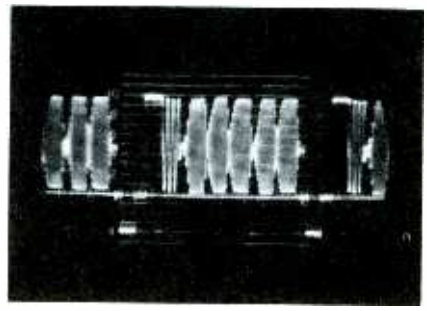


Fig. 6. The multiburst signal.

First UHF/VHF/FM 2-83 antenna that really works in fringe areas

New Winegard Chroma-Tel CT-100

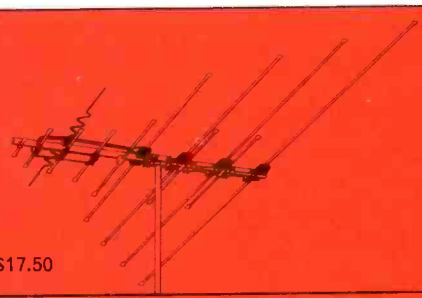
NEW! Model CT-100 $52.50

Wingard's sensational new CT-100 Chroma-Tel has 29 elements in all. And they're all working to provide the finest all-band reception (UHF-VHF-FM) even in difficult fringe areas.

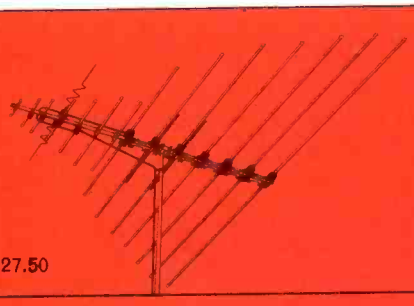
In addition to those 29 elements, the CT-100 incorporates a unique matching network that guarantees maximum signal transfer to the downlead—and on all channels 2-83 plus FM. Gives sharpest color and black & white reception.

And like all Chroma-Tels, it has Winegard's exclusive Chroma-Lens Director System (intermixes both VHF and UHF directors on the same linear plane without sacrificing performance) . . . and our Impedance Correlators (special phasing wires that automatically increase the impedance of Chroma-Tel's elements to 300 ohms).

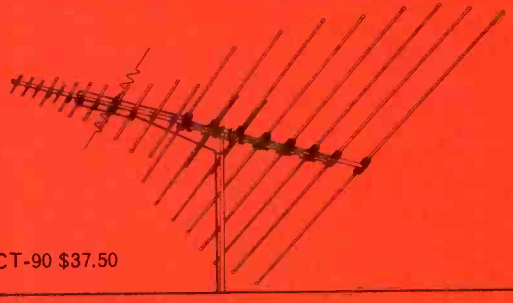
That's Winegard's new CT-100 Chroma-Tel. Bigger and better. But not too big. The full-line of Winegard Chroma-Tels still offers half the bulk; half the wind loading; half the truck space; and half the weight of all other all-band antennas—and at much lower prices. No wonder Winegard Chroma-Tels (now 4 models) are the hottest performing, hottest selling all-band antennas on the market! Better call your Winegard distributor or write for Chroma-Tel Fact Finder 242.



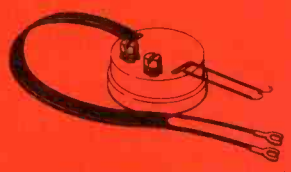
Model CT-40 $17.50



Model CT-80 $27.50



Model CT-90 $37.50



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Circle 11 on literature card

Fig. 1. Thermistors can be very small.

Thermistor Circuits in Industry

Odd uses for resistive elements.

by William Nelson

Many precision and semi-precision measurements, control, and compensation problems in industry are being solved using thermistor circuits. These thermally-sensitive resistors are small, simple, stable, rugged, and have improved sensitivity. Such qualities make them useful for a wide variety of industrial applications.

The word *thermistor* stands for "thermal resistor." This term applies to devices with a positive or negative temperature coefficient of resistance. Thermistors having a negative coefficient are the most widely used; therefore, this discussion is confined to these types.

Actually, thermistors do only one thing—change their electrical resistance when changes in temperature occur. They are small, ranging from tiny beads, pictured in Fig. 1, to washers about 1 in. diameter and ½ in. thick.

Temperature Measurement

A precision thermistor connected in one leg of a Wheatstone bridge circuit affords a very accurate temperature-indicating system. The overall accuracy of such a circuit, shown in Fig. 2, is usually limited only by the accuracy of the meter or other readout device.

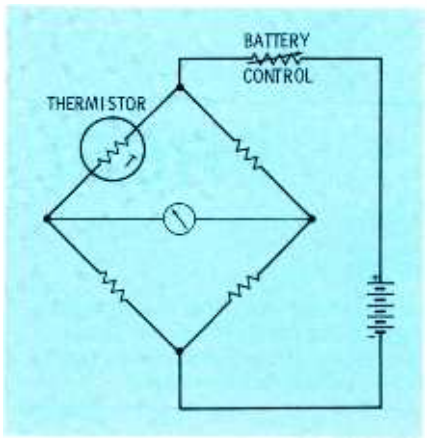

Fig. 2. Circuit for temp. measurement.

Any particular application may call for the temperature measurement of a number of systems from one central location. This is possible using thermistors and a selector switch connected as in Fig. 3. In this arrangement, lead length from the thermistor to the bridge circuit is not critical because changes in resistance are rapid for small changes in temperature.

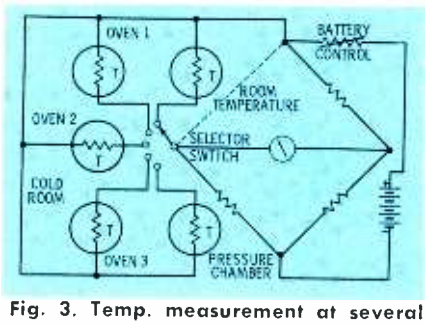

Fig. 3. Temp. measurement at several remote locations.

Differential Thermometer

A very accurate method of measuring temperature difference or a temperature differential is by use of the circuit in Fig. 4. Two thermistors are connected in the Wheatstone bridge circuit for this purpose.

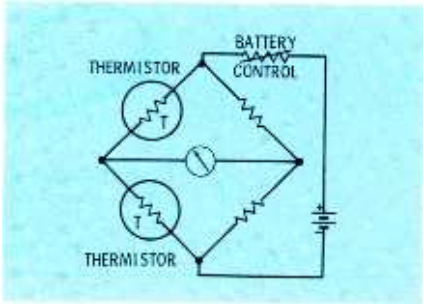

Fig. 4. Differential thermometer.

One typical use for this circuit is in measuring the heat loss in a complex piping network. Thermistors can be placed at different points and the difference between point temperature and the original temperature can be monitored at a convenient location.

Another application is measuring air temperature at different elevations with reference to ground temperature. A circuit like the one in Fig. 5 is useful to obtain temperature inversion data or information for other meteorlogical studies.

Temperature Control

Since the resistance of a thermistor at any temperature is known, thermistor controllers can be designed in which the set-point temperature can be set accurately and directly without reference to external indicators.

The thermistor forms one leg of an AC bridge as in Fig. 6, while a variable resistor, calibrated in temperature, forms another leg. When the variable resistance is set to a desired temperature, bridge unbalance occurs. This unbalance is fed into a high-gain amplifier which actuates a relay to provide a source

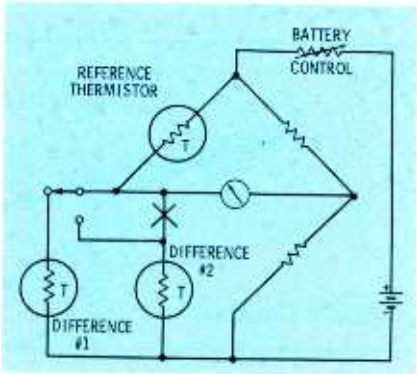

Fig. 5. Air temp. vs ground temp.

successful service shop beats rising costs with B&K television analyst

"As every serviceman knows, major TV repairs represent an increasingly large part of the service business and the average time per repair has increased"...

says Willard Horne of Horne Radio and Television in Evanston, Illinois.

After more than 25 successful years in the service business, twenty of them in the same location, Mr. Horne can be considered an authority on how to keep a business profitable. Mr. Horne says, "In order to be successful, our 3-man shop has to be competitive on the large jobs as well as the small ones. With the increase in bench time that we were experiencing and the limitations on what we could charge, there was a reduction of profit that had to be stopped. Then we bought a B&K Model 1076 Television Analyst."

"Now our customers get the same extra-value service on the big repairs and the small ones," said Mr. Horne. "We use the Television Analyst for troubleshooting a wide variety of complaints, particularly for those that require touch-up alignment, location of IF overloads and color convergence. We are more competitive now that we use the B&K Television Analyst because we spend far less time on the jobs that used to be dogs, with benefits both to the shop and our customers."

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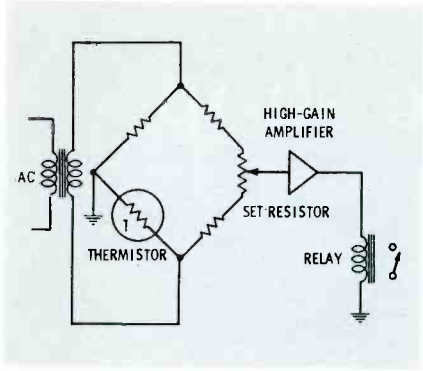


Fig. 6. Temperature-controlled relay.

of heat or cold as required to return the temperature to the desired value.

Master-Slave Control

In certain industrial processes there is often a need to control one temperature with respect to another. An example is a dipping or soaking process in which a piece of material

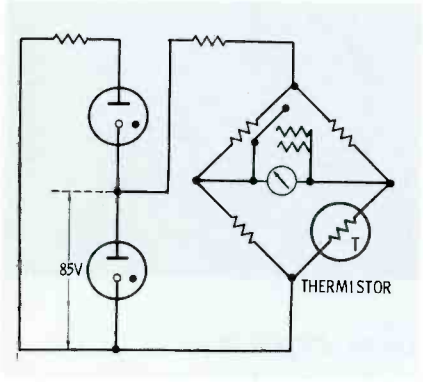


Fig. 8. Thermistor vacuum gauge.

goes from one bath to another for curing, cleaning, or aging.

The first bath acts as a master, with a precision thermistor indicating bath temperature. The second both is a slave and also uses a thermistor for temperature indication. When these thermistors are connected in the controller bridge in Fig. 7, the slave bath can be maintained at the same temperature, or at one slightly higher or lower than the master temperature. This control of the master bath temperature can be accomplished using the direct settable controller of Fig. 6. This

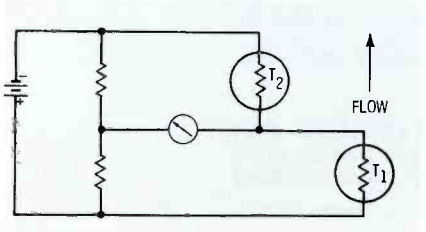


Fig. 9. Liquid/gas flow measurement.

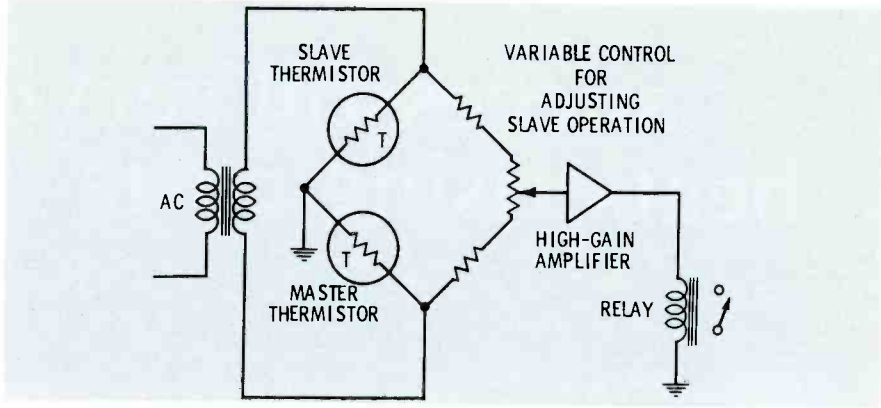


Fig. 7. Slave controlled by master.

system of master-slave controllers can be operated in as many baths as desired.

Flow Measurement

When current is passed through the thermistor, the I^2R loss results in self-heating of the thermistor. Consequently, the temperature of the thermistor will increase until it reaches a state of equilibrium. This characteristic of the thermistor may be utilized for measurement of a vacuum system. The principle illustrated in Fig. 8 uses a thermistor as the sensitive element which is fused into the vacuum system being measured. In this arrangement, the thermistor is incorporated in a bridge circuit fed by a stabilized voltage. Any unbalance in the bridge is caused by changes in pressure which affect changes in the heat transfer from the thermistor. This bridge unbalance results in a change in bridge current flowing through a microammeter.

Also based on the principle of heat transfer, the thermistor can be connected as in Fig. 9 to measure flow of liquids or gases. There are two thermistors in this circuit. One thermistor is subject to the fluid flow, while the second is placed in the fluid but not exposed to the flow. Since the second thermistor dissipates heat less rapidly than the first, current flows through the galvanometer of the bridge circuit because of bridge unbalance. The temperature equilibrium of the measuring thermistor is then determined by the rate of flow of the fluid.

Liquid-Level Control

Since the heat dissipation of a thermistor changes with a changing environment, it can be used as the sensing element of a circuit which will indicate and control changes in the level in liquid containers such as oil baths, enameling baths, and gas tanks.

The circuit in Fig. 10 is used specifically for controlling the level of a lacquer bath which has a temperature of 30°C. Here, the thermistor is mounted in the liquid just below the surface. It forms part of a bridge circuit, the bridge voltage of which controls a thyratron. So long as the thermistor is immersed in the liquid, its temperature will remain low; the bridge elements are such that a grid voltage of −2.3

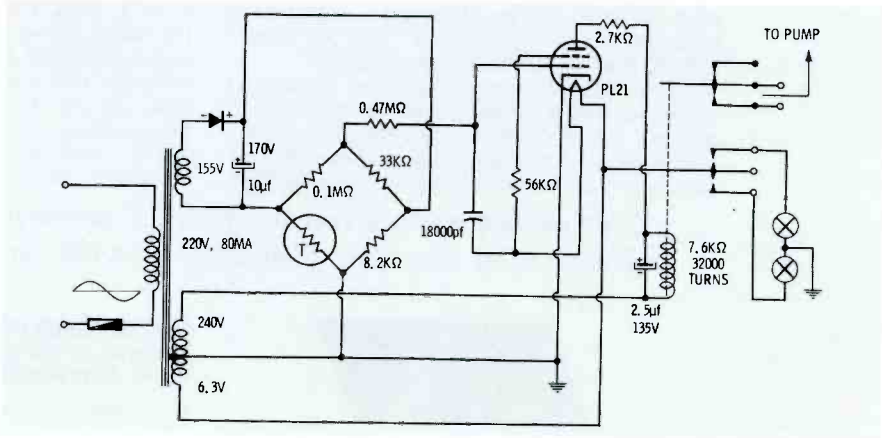
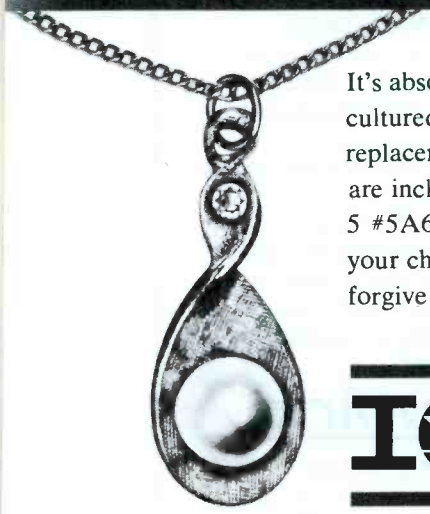


Fig. 10. Liquid level control.



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volts will be applied to the thyratron. This grid voltage is sufficient to keep the thyratron extinguished.

If the level of the liquid falls below a desired point, the thermistor is no longer submerged; its temperature will rise, resulting in a decrease in resistance. This resistance change will alter the grid voltage to −2 volts; the thyratron will ignite and activate a relay which starts a pump to restore the level of the liquid.

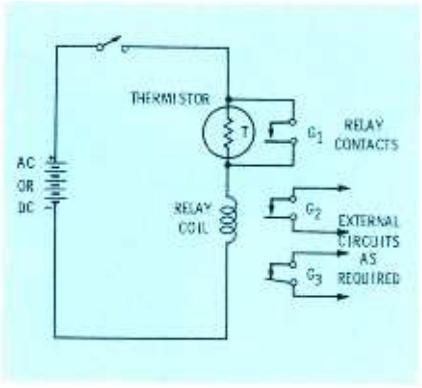

Fig. 11. A time-delay circuit.

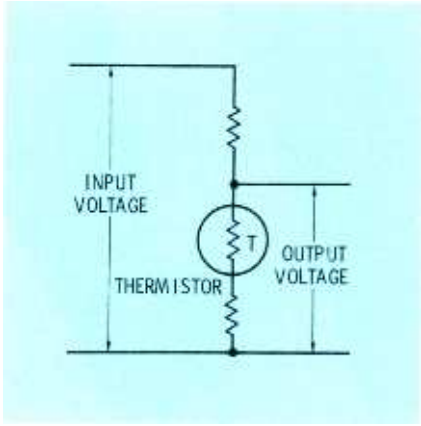

Fig. 12. Voltage regulator circuit.

Time-Delay Devices

Because of their voltage-current characteristic, which depends upon thermal inertia, thermistors can function in time-delay circuits. Time-delay cycles may be varied from a fraction of a second to several minutes by using an appropriate thermistor in a suitable circuit.

Fig. 11 illustrates one such time-delay circuit. When the circuit is energized by closing the switch, the initial current flow is limited by the cold resistance of the thermistor. As current continues to flow, however, self-heating of the thermistor occurs and the resistance decreases. As self-heating continues, the resistance is further reduced until a value of current is reached which causes the relays to operate.

The delay characteristics of the thermistor may be modified by changes in ambient temperature. The result is a shortening of the delay periods when the cooling period is insufficient to allow the unit to reach equilibrium with ambient temperature. To avoid this delay change, a set of relay contacts shunts the thermistor when the relay is actuated. This increases the reliability of the delay-circuit operation and thus permits the thermistor to cool and be ready for re-use.

Voltage Regulation

A thermistor is used in the circuit of Fig. 12 to stabilize output voltage, where this voltage varies over a wide range. A selected value of resistance is placed in series with the thermistor; the combined resistances are then used as a shunt which will regulate and maintain the voltage across the combination practically independent of current.

This principle of voltage regulation using thermistors can be applied either to AC or DC power supplies. Because of the thermal in-

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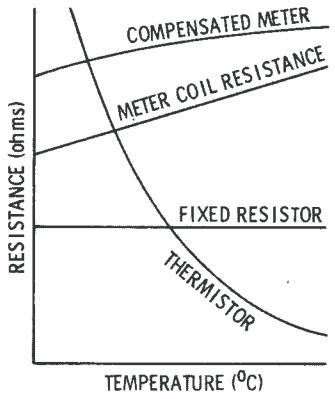

Fig. 13. Meter compensation curves.

ertia of the thermistors, however, only slow current variations will be compensated, and the circuit will not control current surges.

Meter Compensation

The coil resistance of a meter movement changes with varying temperature; hence, the meter accuracy is temperature - dependent. Using the thermistor's property of having a high negative temperature coefficient of resistance, the coil of the meter movement can be compensated so that the total resistance due to temperature is essentially constant; the curves shown in Fig. 13 illustrate this compensation.

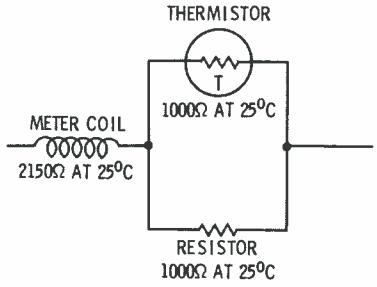

Fig. 14. Meter compensation circuit.

Using thermistor compensation, the meter movement can be used over a wide range of temperatures with minimum error in the meter indication. See Fig. 14.

There is an increase in the total resistance using this compensating network, which will cause a decrease in meter sensitivity. In many instances, however, the original meter resistance is obtained by use of a series resistor which can be reduced in value or eliminated by incorporating it with the compensating network. This will result in increased accuracy of the meter movement without decreasing meter sensitivity. ▲

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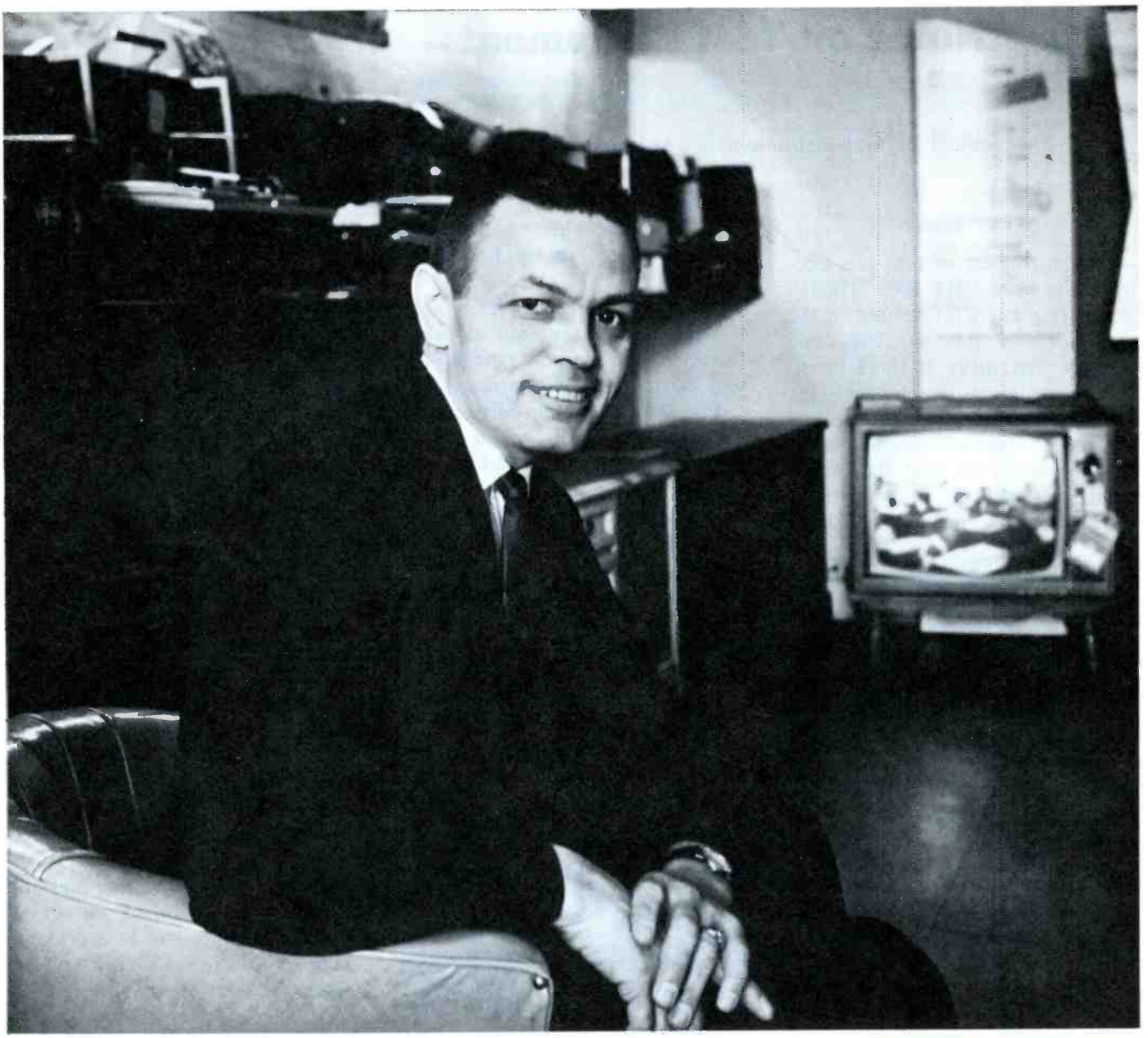

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Notes on Test Equipment

by T. T. Jones

analysis of test instruments . . . operation . . . applications

CRT Tester

The instrument in Fig. 1 is Lectrotech's new CRT-100. Though there are many CRT testers on the market today, this one has some features that make it stand apart.

The cable has a plug-and-jack arrangement where it enters the instrument. This will certainly make repairs easier. Not that the instrument isn't rugged, because it is. But repairs are inevitable if your

Fig. 1. New Portable CRT tester.

CRT tester gets the workout that most do.

There is only one socket cable, with the color sockets attached. The black-and-white sockets are on the adaptor shown beside the instrument.

The circuits are completely solid state and use a substantial safety factor in their current ratings. The unit carries a 1-year warranty.

Fig. 2A shows the circuit used for measuring leakage and shorts. Note the meter in the grid 1- to-cathode circuit. This test is quite sensitive and measures leakage currents as little as 10 microamps. Leakage from grid 1 to grid 3 is measured in the same manner. Heater-to-cathode shorts are not as critical, and the neon bulb test is satisfactory.

Fig. 2B shows the quality circuit. With the quality button up, R2 is set for zero with a color tube, or to a calibrated level with a b-w tube. The meter reads in microamps. When the quality switch is depressed, the meter is shunted by R4, and the –45V bias is removed. The meter now reads in the milliamp range. It is calibrated from 1 to 10, for convenience in determining whether the guns of a color tube will track, and also is calibrated with a green and red good-bad scale.

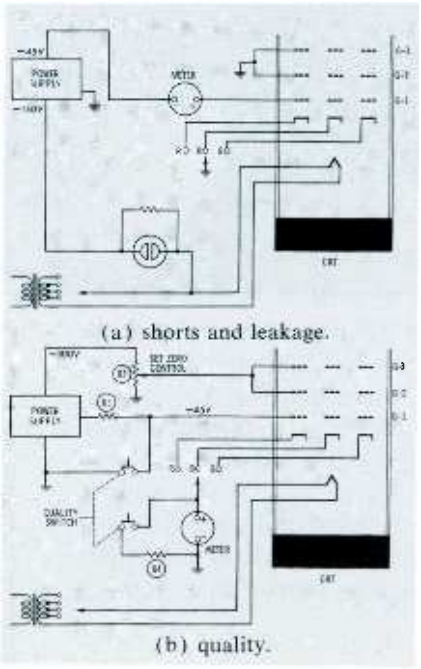

Fig. 2. Shorts and quality circuits.

The CRT-100 is housed in a black leatherette-covered wood case, with steel corner protectors and rubber feet.

For further information, circle 55 on literature card.

Lectrotech CRT–100 Specifications

CRT's tested:
All presently manufactured TV types—both color and black-and-white.

Tests performed:
Interelectrode shorts; emission; cutoff voltage; life test.

Corrective functions:
Three levels of cathode rejuvenation, removes cathode-to-grid 1 shorts.

Size: (HWD)
4¾" x 11" x 11½".

Weight:
8½ lbs.

Power requirements:
117 VAC, 60 Hz, 15 watts.

Price:
$89.50.

Sweep-Circuit Analyzer

Having trouble with sweep circuits? Most of us do; 75% of the tough dogs are in these circuits.

You have sound, but a blank screen. You've checked the tubes, and the low-voltage supply. You've checked the drive on the horizontal-output tube. Now what?

Get our your SENCORE SS 137. This unit checks everything in sweep circuits including the technician. (If he can't find the trouble with this instrument, then he needs repairs.) I'll hedge a little, and admit you'll need standard test equipment to pinpoint bad resistors and such, but the SS 137 isolates the stage, and the working area.

A list of some tests which can be made appears in the specification box. Once the operator is familiar with the output signals and meas-

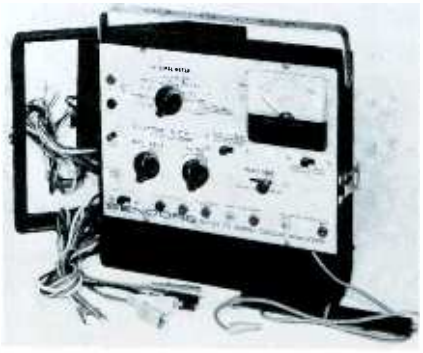

Fig. 3. Makes fast sweep tests.

Zowie! Here's big news for "Mister Right"—the independent service dealer who carries Sylvania tubes.

Every time you order Sylvania picture or receiving tubes from a participating distributor, you receive Sylvania Means Business (SMB)-Mister Right dealer certificates. They're redeemable for an exciting selection of gifts. For yourself, your family, your home.

You get certificates for your purchases of receiving tubes and every SILVER SCREEN 85®, *color bright 85*™ or COLOR SCREEN 85 picture tube.

So you're a winner in two ways: big profits and top-quality prizes. Sylvania Means Business.

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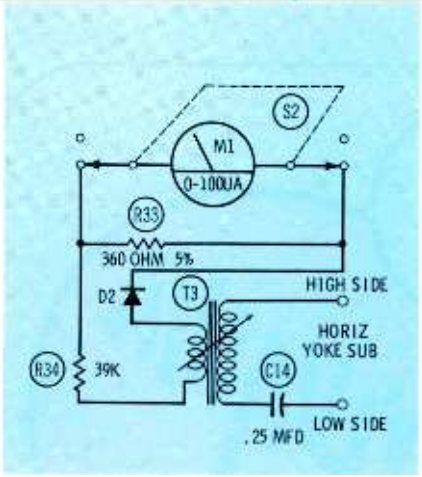


Fig. 5. Yoke and flyback tester.

urements available, he can probably find other applications.

The schematic in Fig. 4 does not show the meter circuits. The DC voltages are measured on a standard voltmeter circuit, with 10,000 ohms-per-volt sensitivity. The peak-to-peak voltages are measured on a VTVM, which uses a full-wave rectifier feeding a cathode follower.

The vertical oscillator (Fig. 4) consists of the two triode sections of V2 operating as amplifiers. The input signal is tapped off the secondary of the power transformer through R2. The signal is partially shaped by C10 and R28, and further shaped into a sawtooth by C9, and the primary of T2. The signal level is controlled by R31, and the output level is monitored by the meter section on the 300-volt p-p scale.

The vertical yoke drive signal is taken directly from a winding on the power transformer, with R1 in the circuit to limit current if the leads are accidentally shorted together.

Vertical transformer drive is taken from the secondary of the power transformer, unrectified. Even though this unit has a floating ground, and the output is coupled through C16, be careful with this output. The voltage present is 700 volts p-p, and you can get a severe shock from this lead.

The horizontal oscillator consists of a blocking oscillator in the first section of V2, coupled through C12 to the grid of the second section of V2. Frequency is controlled by R26 in the network at the bottom of T2 secondary. The wave is shaped by C9 and C8.

The horizontal-yoke substitute (Fig. 5) serves two functions, first as a check of the yoke itself by substitution, and also as a check of the flyback by measuring the output amplitude. The inductance of this coil is adjustable from 5 to 40 millihenries by a front-panel control. A small secondary on the coil picks off some energy and feeds it to the meter, through rectifier D2. The meter is calibrated in degrees of deflection angle.

The instrument is housed in the standard SENCORE portable carrying case. The mechanical construction is quite rugged, and the meter is fairly well damped. Further damping can be accomplished by leaving the meter on the 300-ma scale during transportation.

The case has a large mirror mounted in the cover, for viewing the screen during adjustments.

On that set we were testing at the beginning, we substituted the SS 137 horizontal oscillator, and the raster lit up right away. After testing through the oscillator in the set, we found a part way off value. The stage was providing drive, but was so far off frequency that the flyback would not operate. ▲

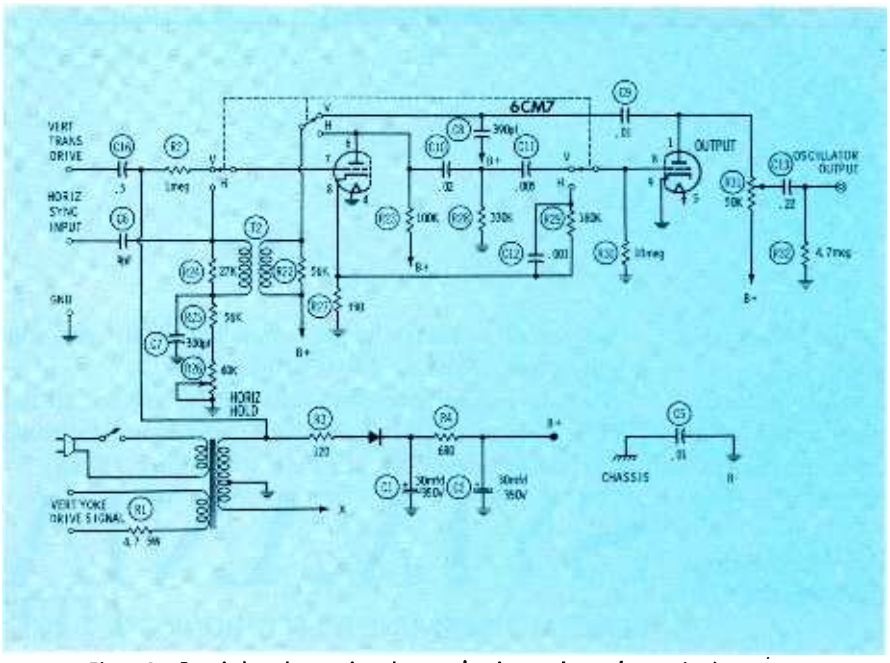


Fig. 4. Partial schematic shows horizontal and vertical stages.

SS 137 Specifications

Outputs Available:

Horizontal oscillator; modified sawtooth 0-300V P-P frequency variable around 15,-750 Hz. Can be externally synchronzied.

Vertical oscillator; sawtooth 0-280 V P-P fixed frequency 60 Hz.

Vertical yoke; sinewave 18.5 V P-P, 60 Hz.

Vertical transformer; sine wave 700 V P-P, 60 Hz.

Meter Ranges:

0-3, 300 ma DC

0-3, 300, 1000, 10K, 30K volts DC

0-300, 1000 volts P-P

50°, 70°, 90°, 110°, and color for flyback transformer check.

Internal monitor of horizontal and vertical oscillators 0-300 volts P-P.

Dynamic Tests:

Horizontal and vertical-oscillator signal.

Horizontal yoke substitute.

Flyback output check, both deflection angle and high voltage.

Vertical-transformer drive signal.

Vertical-yoke drive signal.

Horizontal sync.

Power Requirements:

110-120 VAC, 60 Hz, 15 watts.

Size (HWD):

9½" x 10" x 4".

Weight:

10 pounds.

Price:

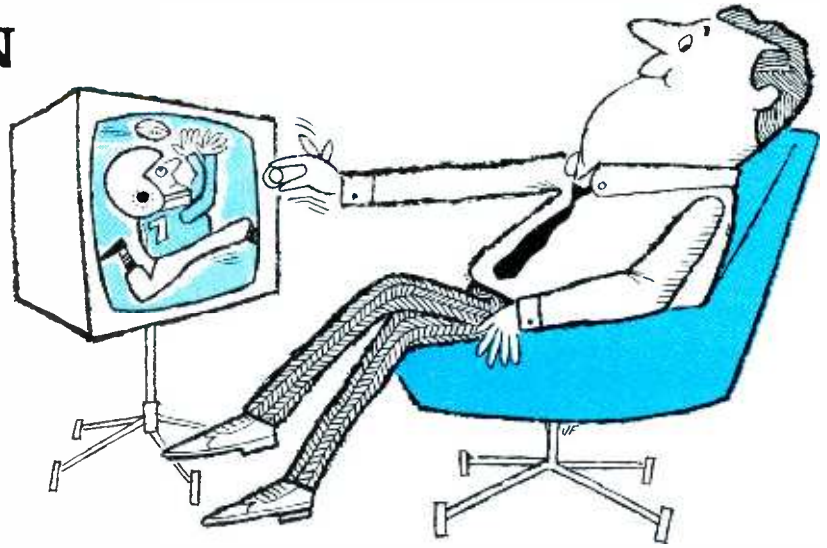
$79.50.

For further information, circle 56 on literature card.

GET SUPERIOR 82-CHANNEL COLOR TV RECEPTION WITH

NEW BELDEN 8290

SHIELDED PERMOHM* LEAD-IN



Until the introduction of Belden 8290 Shielded Permohm TV lead-in cable, there were serious limitations in the effectiveness of the various lead-in cables available, whether twin lead or coaxial.

Here Robert E. Sharp, electronic engineer of the Belden Manufacturing Company, discusses the problems and the reasons why Belden 8290 Shielded Permohm is the all-purpose answer for 82-channel and color TV reception.

Q. *What problems have been experienced in using twin lead cables other than 8290?*

A. Most installers have found out that using flat ribbon or tubular 300 ohm line for UHF and color installations is unsatisfactory. When these lines encounter dirt, rain, snow, salt, smog, fog, or industrial deposits, the impedance drops abruptly, the attenuation soars and the picture is lost.

To overcome this problem, Belden developed its 8285 Permohm line which encapsulates the flat twin lead in a low loss cellular polyethylene jacket. This keeps all of the surface deposits out of the critical signal areas—regardless of weather conditions.

Although this was a major improvement, there still remained the problem of electrical interference signals from automotive ignition systems, reflected TV signals and extreme electrical radiation which could be picked up by the lead-in to create ghosts and static lines in the picture.

Q. *Then, is this why many people recommend coaxial cable as TV lead-in?*

A. Yes. Because of the incorporation of a shield, coaxial cable has an advantage over unshielded twin lead.

Q. *Then, why isn't coaxial the total answer?*

A. Coaxial cable has much higher db losses per hundred feet than twin lead. Although the shield in coaxial cable does reduce lead-in pick-up of interference signals, it is not as effective as a 100% Beldfoil* shield.

Another way to put this is that 8290 delivers approximately 50% of the antenna signal through 100 feet of transmission line at UHF while coaxial cable can deliver only 15% to 20%, frequently not enough for a good picture. Even at VHF, the higher losses of a coaxial cable may be intolerable, depending on the signal strength and the length of the lead-in.

The following chart spells this out conclusively. We have compared RG 59/U Coax to the new Belden 8290 Shielded Permohm. All 300 ohm twin leads, under ideal weather conditions, have db losses similar to 8290.

CHANNEL	MC	db LOSS/100' 8290	db LOSS/100' COAX (RG 59 Type)
2	57	1.7	2.8
6	85	2.1	3.5
7	177	3.2	5.2
13	213	3.5	5.9
14	473	5.4	9.2
47	671	6.6	11.0
83	887	7.7	13.5

Capacitance: 8290—7.8 mmf/ft. between conductors
Coax—21 mmf/ft.
Velocity of Propagation: 8290—69.8%
Coax—65.9%

Q. *Won't the use of matching transformers improve the efficiency of a coaxial cable system?*

A. No! The efficiency is further reduced. Tests show that a pair of matching transformers typically contribute an additional loss of two db, or 20% over the band of frequency for which they are designed to operate. Incidentally, transformer losses are not considered in the chart.

Q. *How does 8290 Shielded Permohm overcome the limitations of other lead-ins?*

A. 8290 is a twin lead with impedance, capacitance, velocity of propagation and db losses which closely resemble the encapsulated Permohm twin lead so that a strong signal is delivered to the picture tube. At the same time, 8290 has a 100% Beldfoil shield which prevents line pick-up of spurious interference signals. In short, 8290 combines the better features of twin lead and coaxial cable into one lead-in.

Q. *What about cost?*

A. In most cases, 8290 is less expensive than coax since matching transformers are not required. The length of the lead-in is also a factor in the price difference. The cost of coaxial cable installations can vary tremendously, depending upon the type and quality of matching transformers used. If UHF reception is desired, very high priced transformers are required.

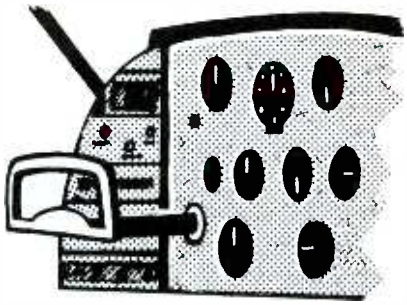
Q. *Is 8290 Shielded Permohm easy to install?*

A. Yes! Very! It can be stripped and prepared for termination in a manner similar to 300 ohm line without the use of expensive connectors. It also can be taped to masts, gutters or downspouts, thus reducing the use of standoffs. There is no need to twist 8290 as the shield eliminates interference problems. It is available from your Belden electronic distributor in 50, 75, and 100 foot lengths, already prepared for installation, or 500' spools. 8-11-5

Belden

BELDEN MANUFACTURING COMPANY
P. O. Box 5070-A • Chicago, Ill. 60680
*Belden Trademark Reg. U.S. Pat. Off.

Circle 20 on literature card



The AIRCRAFT ELECTRONICS SERVICING MARKET

A new source of income.

By Forest H. Belt

In 1965, there were 85,000 private and executive aircraft registered with the Federal Aviation Agency. By conservative estimate, over 90% of these aircraft are equipped with one or more radio navigation and/or communication devices. All these are potential customers for sales and service of aircraft radio equipment. With more than 800 VOR or "omni" stations in operation and at least 400 more planned, it is merely a matter of time until virtually all planes will have to be equipped with this basic navigation aid. Since they will all have to be serviced, this represents a large market, and the field is expanding every year.

As our standard of living keeps rising, more and more people are finding they can afford to buy and fly their own airplanes. Someone will have to service the electronic equipment on these aircraft, and it could be you. In 1965, there were only 350 FAA (Federal Aviation Agency) certified radio repair shops, while there were 8814 registered airports. A periodic check of the Airman's Information Manual will tell you that new airports are opening all the time. It's obvious, then, there is a shortage of aircraft-electronics repair facilities at present and the need for them grows every day.

Table 1. Federal Aviation Agency Regional Offices

Federal Building, New York International Airport, Jamaica, N.Y. 11430
P. O. Box 1689, Forth Worth, Texas 76101
P. O. Box 20636, Atlanta, Georgia 30320
4825 Troost Avenue, Kansas City, Missouri 64110
P. O. Box 90007, Airport Station, Los Angeles, California 90009
632 Sixth Avenue, Anchorage, Alaska 99501

There are as many ways to enter the aircraft electronics field as you have ideas. Of course, step one is to get the business. One good start is to send a letter to the flying clubs in your area, introducing yourself and outlining the services you can provide. Get acquainted with your local FAA flight service station (FSS) and leave them a supply of your cards to give to pilots who need service. Run a regular ad in the yellow pages of your telephone book. It doesn't hurt to take up flying yourself. It's fun and gives you a chance to get acquainted with some of the local pilots. If your area has more than one airport, see if the operators will let you erect a poster or some form of advertisement in the pilots' lounge at each of them. Try to arrange some form of advertising anywhere pilots are likely to congregate. If you do put up posters, make them attractive and interesting, and change them every couple months. As in your regular servicing business, your best advertisements will be recommendations by pleased customers.

Technicians work on aircraft radios in new shop at Joliet, Illinois airport.

Where

The ideal location for your shop is of course at the airport itself. If your present shop is at a distant location, this can cause some difficulties. To have both necessarily involves duplication of test equipment and parts inventory, plus the added overhead of maintaining two shops. A shop at the airport has the advantage of being convenient to your customers as well as enabling you to provide immediate service—very important to itinerant flyers. Installations of new or used equipment are nearly impossible to handle from a downtown shop.

If it is impractical for you to open a shop at the airport, it is usually possible to make some sort of arrangement with the airport operator to contact you when his hangar or line personnel encounter an aircraft with faulty electronics equipment. You can then dispatch a serviceman to either repair the set or remove it and bring it into the shop for repair.

What

In addition to the tools and test instruments needed to service the

STEP UP

TO WIDER RANGES GREATER ACCURACY

TRIPLETT

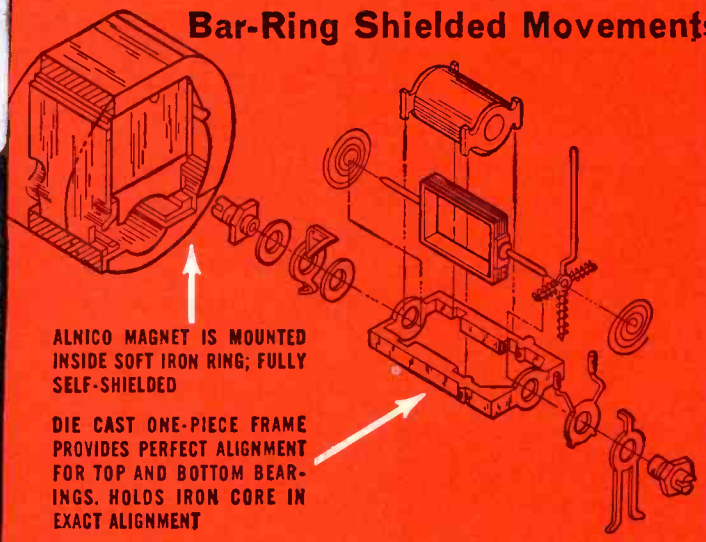
Model 630-NA

VOLT-OHM-MILLIAMMETER

PRICE $85.00

EXCLUSIVE PATENTED

Bar-Ring Shielded Movements



ALNICO MAGNET IS MOUNTED INSIDE SOFT IRON RING; FULLY SELF-SHIELDED

DIE CAST ONE-PIECE FRAME PROVIDES PERFECT ALIGNMENT FOR TOP AND BOTTOM BEARINGS. HOLDS IRON CORE IN EXACT ALIGNMENT

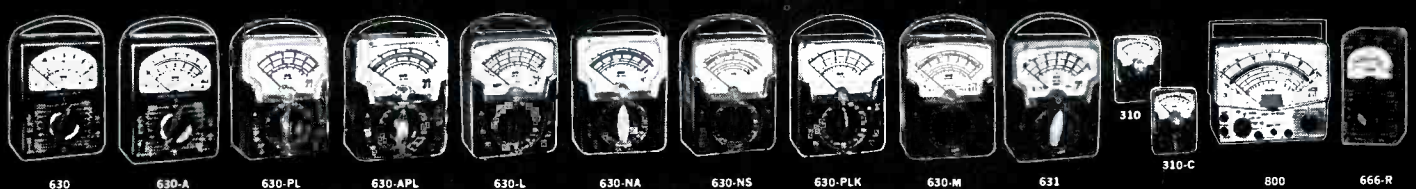
FACTS MAKE FEATURES:

1. **70 RANGES**—nearly double those of conventional testers. Unbreakable window. Mirror Scale.
2. **HIGHEST ACCURACY**—1½% DC to 1200 volts, 3% AC to 1200 volts; mirror scale and knife-edge pointer to eliminate parallax.
3. **FREQUENCY COMPENSATED**—Flat from 20 CPS to 100,000 CPS; varies from ¾ to 1¼ DB at 500,000 CPS. Temperature compensated. Meter protection against overloads.

THE TRIPLETT ELECTRICAL INSTRUMENT COMPANY, BLUFFTON, OHIO

Uses Unlimited:

FIELD ENGINEERS ■ APPLICATION ENGINEERS ■ ELECTRICAL, RADIO, TV, AND APPLIANCE SERVICEMEN ■ ELECTRICAL CONTRACTORS ■ FACTORY MAINTENANCE MEN ■ INDUSTRIAL ELECTRONIC MAINTENANCE TECHNICIANS ■ HOME OWNERS, HOBBYISTS



THE WORLD'S MOST COMPLETE LINE OF V-O-M'S. AVAILABLE FROM YOUR TRIPLETT DISTRIBUTOR'S STOCK

Circle 23 on literature card

Table 2. Manufacturers of Aircraft Electronics Equipment

Aircraft Radio Corp., Boonton, N.J.
Avionics Division, National Aeronautical Corp., Ft. Washington, Pa.
Bayside Electronics, Inc., 1598 Lindbergh St., Stockton, Calif.
Brittain Industries, Inc., 12027 So. Prairie Ave., Hawthorne, Calif.
Collins Radio Company, Dallas, Texas
Control Position Indicator, 1800 Westlake North, Seattle, Wash.
Dayton Aviation Radio, Dayton, Ohio
Kett Avionics, Inc., 920 Santa Monica Blvd., Santa Monica, Calif.
King Radio Corporation, Olathe, Kansas
Lightcraft Avionics, P.O. Box 621, Arcadia, Calif.
Mitchell Industries, Inc., P.O. Box 610, Mineral Wells, Texas
Motorola, 4545 Augusta Blvd., Chicago, Ill.
Regency Avionics, 7900 Pendleton Pike, Indianapolis, Ind.
Tactair Incorporated, Bridgeport, Pa.

many-channeled VHF AM transceivers, you will need facilities to handle VHF Omnirange (VOR) receivers, instrument landing system (ILS) equipment, distance-measuring equipment (DME), automatic direction finders (ADF), autopilots, and possibly radar. This will include—in addition to shop instruments you already have:

1. An output-calibrated signal generator for 5 mc through 470 mc
2. Omni-signal generator
3. Glide-slope generator
4. ILS-signal generator
5. Frequency meters to cover at least the ranges from 108 to 136 mc
6. DME test set.

It is best to have your shop FAA certificated as considerable of the work you will be asked to do requires this certification. Details of how to obtain this certification can be obtained from your regional office of the FAA. A list of these offices and their addresses is in Table 1. Mechanical work of installation must be done by an FAA certified mechanic, and you'll want to make arrangements with the nearest airframe repair shop.

Sales

In setting up a sales orgnization, the same general rules hold true as for your present operation. If your shop is on the airport, you can set up displays of your various lines of radio equipment. (Some makers of aircraft radio and navigational equipment are listed in Table 2.)

If your shop is located elsewhere, it may be necessary to arrange for a display and work space somewhere in the hangar where planes are serviced. Work out an arrangement with dealers in new and used aircraft to refer prospective buyers to you for purchase of their radio and navigation equipment. Giving them a small commission on equipment sold to customers referred by them is usually attractive for both of you.

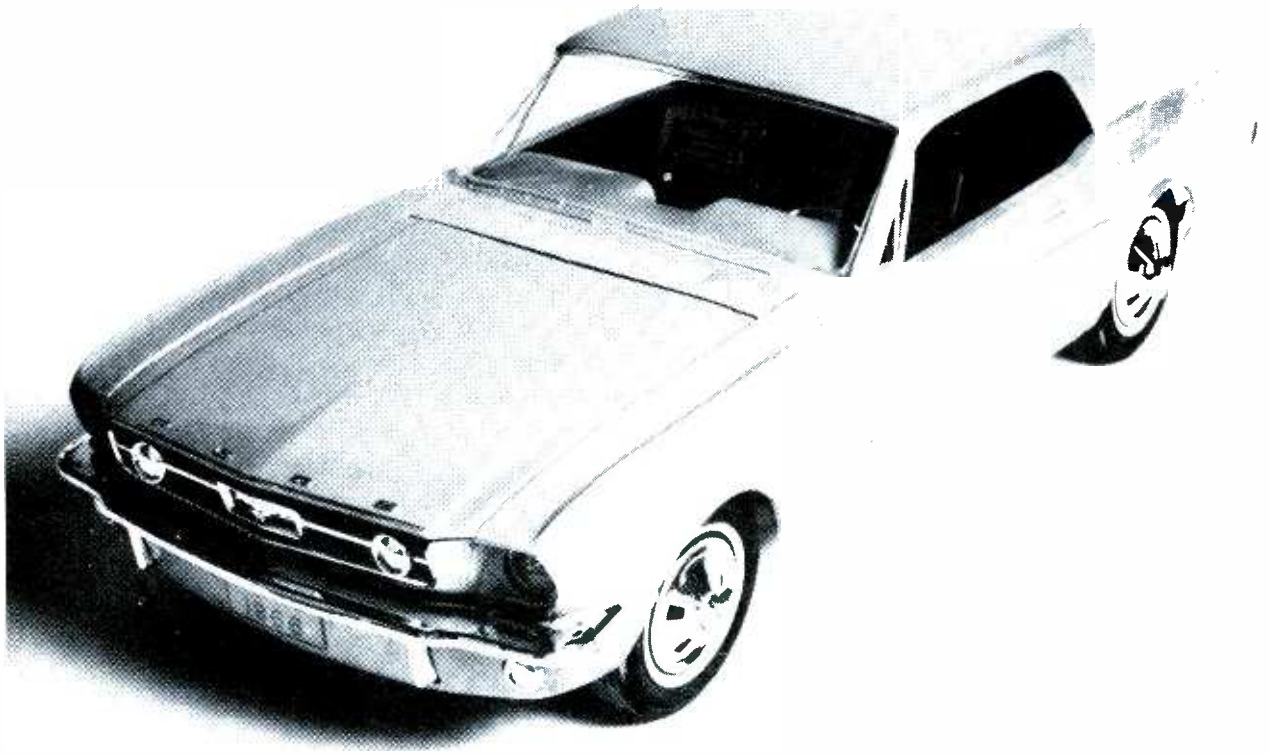
Conclusion

The opportunity is awaiting you. The number of private and corporate aircraft goes up every month. Every time a new plane is sold, its buyer is a prospect for your services. With a little effort, you can add another profitable facet to your servicing business. ▲

Parts room in aircraft electronics shop gives an idea of extent of inventory.

WOULD YOU BELIEVE YOU'LL GET A FORD MUSTANG IF YOU BUY PHILCO TUBES?

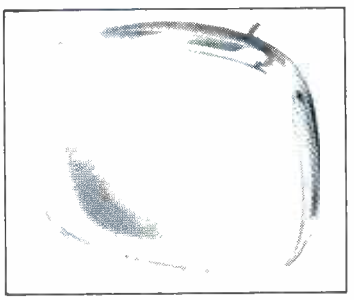
HOW ABOUT A TOY MUSTANG FOR YOUR KIDS?

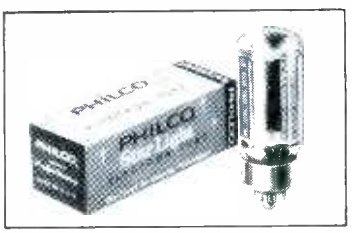


You'd better believe the one about the model Ford Mustang. To get one free, all you have to do is buy 4 Philco Star Bright Picture tubes or 100 Philco Star Light Receiving tubes. Or any other combination, since one picture tube is worth 25 receiving tubes.

The Mustang is a 16-inch scale model of the real McCoy. Complete with battery-operated motor and lots of sporty extras. Your kids will put it through the paces. And you might, too.

And the Mustang will be a breeze to get, because you know





that Philco tubes stand for the finest quality. Philco Star Bright 20/20 Picture tubes and Star Light Receiving tubes are built to the most demanding specifications. So they assure you of complete customer satisfaction.

And, speaking of satisfaction, you can really make your kids happy. So be the first dad on the block to get them this sleek model Mustang. And why not give your Philco distributor a call while you're at it?

Would you believe he has as many as 65 other premiums that you can get?

PHILCO®

A SUBSIDIARY OF *Ford Motor Company*

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INVESTMENT TAX CREDIT ON EQUIPMENT

by Ralph H. Butz—If you are involved in purchasing decisions, here are some economic facts to remember.

The 1962 business tax law, authorizing business firms to deduct from their tax liability a certain percentage of the cost of new or used equipment purchases, has benefited the Treasury Department as much as the businesses that purchased equipment for replacement or expansion.

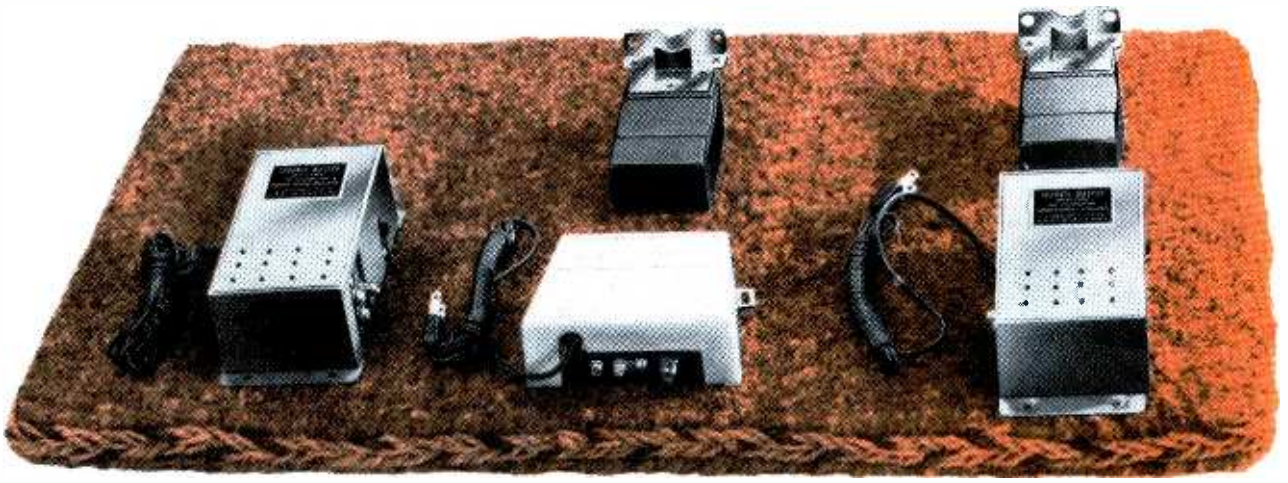
The expansion of small businesses, since investment tax credit has become an allowable deduction, reflects a reversal of the trend that prevailed before the new tax law became effective. A recent survey in one state (Pennsylvania) by the National Federation of Independent Businesses, indicated that the average net profit of small manufacturers was $20,000 per year. At a tax rate of 30%, this indicates an average tax bill of $6,000. If each of these businesses had qualified for the investment tax credit of 7% on $25,000 equipment purchases, each would have been entitled to $1,750 tax credit.

Projecting these figures on a national scale, the loss to the U.S. Treasury appears to be about $313 million. However, because of added equipment and resulting expansion, some 1,400,000 workers were added to payrolls, paying new taxes totaling about $450 million. The net result was a profit of approximately $137 million for the Treasury.

Some businessmen complain that the formula to compute tax credits is too complicated. As a result, some equipment buyers have not taken

• *Please turn to page 54*

Small homes are saying "Yes" to big MATV business.



Walk right in with one of our 5 brand-new Channel Master MATV Amplifiers*

(They're priced fantastically low).

The color explosion has given birth to a gigantic new market. One that's left the door to multi-set homes wide open for big business opportunities.

When a family buys a color set, they don't throw the old black-and-white console away. They keep it. Chances are they also own a portable and even an FM set or hi-fi.

All this means one thing: Every one in your neighborhood who has, or buys, a color set becomes a hot prospect for the unique room-to-room flexibility offered by a Master Antenna Home System.

Here's where you cash in with our big line of Channel Master MATV amplifiers. They let you accommodate the **exact** need. For instance: Our new solid state VHF/FM Color Amplifier (Model 7035) provides 15 db across the entire band, flat color response, 1.5 volt output capability, plus a 75 ohm or 300 ohm input or output. It could be perfect for a home with a number of outlets in a weak to medium signal area.

Or the situation may call for one of our two new 75 ohm coaxial boosters: the single transistor Telstar VHF/FM (Model 0043); or the 2-transistor Twinstar VHF for areas with overload problems (Model 0041). Both models provide especially high gain (15 db) and low noise figures—and are the **only** coaxial amplifiers with both a 75 ohm and 300 ohm output.

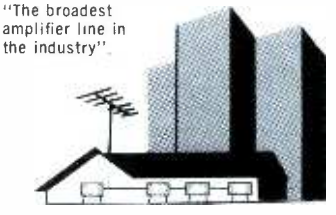
Motels and garden apartments? Use our new outstanding 30 db VHF/FM Color Tandem Amps (Models 7041, 7043). Consists of mast-mounted pre-amps of models 0041 and 0043 cascaded with Model 7035 (contains power supply for pre-amps).

We have other amplifiers, including several for medium and large commercial systems. But the important thing is our flexibility. You're backed by the broadest MATV amplifier line in the business.

Like we said: The welcome mat is out. What are you waiting for?

Write for the facts!

* MODEL	GAIN	NOISE FIGURE		MAXIMUM INPUT SIGNAL IN MICROVOLTS		OUTPUT CAPABILITIES		LIST PRICE
		LOW BAND	HIGH BAND	LOW BAND	HIGH BAND	LOW BAND	HIGH BAND	
7035 Color Amp	15 db	2.5	5.4	300,000 total		1.5v total		Only $34.95
0043 Telstar	15 db	2.2	3.0	15,000	30,000	100,000	135,000	Only $34.95
7043 Color Tandem	30 db	2.2	3.0	15,000	30,000	1.5v total		Only $64.95
0041 Twinstar	15 db	2.5	3.7	150,000	190,000	850,000	600,000	Only $44.95
7041 Color Tandem	30 db	2.5	3.7	60,000	100,000	1.5v total		Only $74.95



CHANNEL MASTER

ELLENVILLE, NEW YORK

Circle 26 on literature card

Tax Credits

(Continued from page 52)

advantage of credits to which they were entitled. The base upon which the 7% tax credit is computed depends upon the useful life of purchased equipment. There is no tax credit on purchased equipment with a useful life of less than 4 years.

Equipment with a useful life of 4 to 6 years is subject to the 7% tax credit on 33⅓ percent of cost; cost includes both freight and installation of equipment. Assuming that equipment with a projected useful life of 4 to 6 years costs $9,000, the tax credit is figured on $3,000, or ⅓ of $9,000, and the tax credit amounts to $210. Equipment with an estimated useful life of 6 to 8 years qualifies for the 7% tax credit on 66⅔ percent of cost. A firm purchases a truck for $6,000 intending to use it for 7 years. Here the 7% tax credit is computed on $4,000, or ⅔ of the $6,000 paid, yielding $280 tax credit. Equipment with a useful life of more than 8 years qualifies for the tax credit on 100 percent of cost.

Do the same rules apply on purchases of new, used or rebuilt equipment? Yes, with the exception that the tax credit on used equipment is limited to purchases up to but not exceeding $50,000. Rebuilt equipment is classified as used equipment. No limit has been set on the amount of new equipment that may qualify for tax credit.

Assuming that your tax liability on business income is $9,000, and that you paid $20,000 for equipment qualifying for the 7% tax credit, you would deduct the $1,400 credit by attaching Form 3468 to your income-tax report.

The investment tax credit you may deduct in one year is limited by the amount of your tax liability. Obviously, it is not possible to deduct more tax credit than the total tax liability as shown on your tax report. Assuming that you file a tax report showing $10,000 tax due on business income, and you have investment tax credits totaling $11,000, the excess credit of $1,000 is carried forward to be deducted the following year. If there is no profit the following year, the credit may be carried forward up to five years from the year the credit was due.

The regulations also state that if you report income-tax liability in excess of $25,000, you are permitted to deduct only $25,000 tax credit, plus 25 percent of the income tax liability that exceeds $25,000. If your report shows $49,000 tax due on business income, the tax credit you may deduct is limited to $25,000, plus 25 percent of $24,000, resulting in an allowable deduction of $31,000.

It is also important to know the rule regarding recapture of tax credits, and how this rule is applied. Assuming that a piece of equipment was purchased for $20,000 and that the 7% tax credit was claimed on the basis of useful life of more than 8 years, if the equipment was then sold after having been in use less than 4 years, the tax credit would be disallowed. You would be required to add $1,400 to your tax payment on the report submitted after the equipment was sold.

If you used the equipment only 7 years before it was sold, the recapture rule provides that you must recompute the tax credit. Based on a useful life of 6 to 8 years, the tax credit would be computed on ⅔ of the original cost, reducing the tax credit from $1,400 to $933.34. The difference, $466.66, is added to your tax liability in the year it was sold.

Investment tax credit for a partnership is divided among the partners according to the percentage of profit each partner receives from the business. For example, Brown and Jones operate a business as partners, and their partnership agreement specifies that Brown, the active partner, is to receive 70 percent of the business profits, while Jones is to receive 30 percent. Since each partner is required to file a report on his income from the business, the 70-30 ratio applies to the tax credit on equipment purchased for the business. The partnership business earns a profit of $20,000 for the year, $14,000 for Brown and $6,000 for Jones. The tax credit on equipment purchased totals $2,000. Therefore, Brown is entitled to deduct $1,400 from his income tax, while Jones can take credit for $600. ▲

When you use your CRT Commander, everyone wants to watch

Compact and only 7½ lbs, the CRT Commander has a built-in high impedance voltmeter (so you don't have to carry a VTVM). Price: $89.95.

Sometimes that's the price you pay for using a professional-looking piece of equipment. And there's something about Amphenol's new tester-rejuvenator that attracts attention.

We think the CRT Commander deserves your attention, too. Here are three reasons why:

1. **It tests more tubes than other models.** The CRT Commander has 11 steps of filament voltage plus extra taps for future releases. There's not much chance of its becoming obsolete.
2. **It tests both b/w and color**—and does it the way NCTA recommends. Testing with the CRT Commander is fast and easy. Five permanently-fixed adaptors do the work of seven.
3. **If a tube will rejuvenate,** the CRT Commander will do it—even where others fail. As recommended, it treats each gun separately in color CRT.

Compare Amphenol's CRT Commander to any other tester-rejuvenator on the market. If you want more information, see your Amphenol salesman. Or write to Dan O'Connell, Market Manager for Service Products, 2875 South 25th Avenue, Broadview, Illinois 60153.

AMPHENOL

Circle 30 on literature card

Don't Change That Picture Tube

Symptoms can be misleading.

by Jack Darr

The phone rang. Picking it up, I said in my best Dale Carnegie voice, "Honest John's Radio-TV, Good morringggg!" As I wiped the syrup off the mouthpiece, I could hear a babble at the other end that sounded like the 20-meter ham band on Wednesday night. I finally identified a familiar voice in the confusion and got him calmed down enough to use only one word at a time. It was my very best dealer-type friend, who was, to put it mildly, in a big flap.

"What would you do if the screen all of a sudden turned green?" he asked.

"Well, if it were my own set, I'd probably think it was a bad picture tube and burst into tears," I said. I heard him gulp. "Cheer up, though, there are several other things that can cause the same symptoms. Did you check the green-amplifier tube?"

"It ain't got any!" he said.

"Oh, yes it has," I insisted.

"No, it ain't." he said, forgetting grammar in his excitement. "I looked. Nothing but an R-Y and a B-Y tube!"

"What kind of a set *is* this?" I asked. He told me, and things became a little clearer. It was a new model with high-level color demods, driving the picture tube directly. The green came from both plates of the two color-demod tubes, so it wasn't labeled. Then he added, "It's a new set. I just sold it last month to Mrs. Quibble!"

"Oh!" I said. "You poor fellow!" She was a nice lady, a lovely lady, but one of the most extremely particular souls in town. (Also one of his best customers!) Everything had to be just right, or you heard from her; loudly, directly, and with no misunderstanding. He'd been working to sell her a color set for a year or more, and finally did after repeated assurances that color sets gave no more trouble than b-w. And now this. No wonder the poor fellow was excited. "Where is it?" I asked.

"I brought it to the store," he said. "I thought it would be easier to work on here."

"Right." I agreed, "Now, cheer up. I'll be right over and we'll see what's happened. In the meantime, you replace those two 6JH8's by the high-voltage cage. Change both of 'em, just to make sure." I hung up, grabbed the CRT checker, and lit out. This sounded like an emergency, and I wished I had a siren.

I got to his store, and there it was—a big, beautiful console with a rectangular 25″ tube. It was turned off, and he was standing there looking at it. "Hi," I said. "Did you change those tubes?"

He nodded, wiping away a tear.

"Did it help?"

He gulped, and shook his head sadly, lip quivering. "I patted him on the back. "There, old man. Buck up. Things are never as bad as they seem. It's always darkest just before dawn. Stiff upper lip." I turned off the stream of platitudes, and he laid down the electric carving knife he'd been thinking of hitting me with. We went to look at the set.

I plugged in the cheater, and turned it on. Hmm. No mirror, as usual, so I pulled an old trade-in console TV around so that I could see the screen in the safety glass behind the color set. Everything looked normal, and sure enough, it came on with a nice color picture. Cartoons, since this was Saturday morning. Finding a channel with an old movie, I switched to it, so that we could see color contamination a bit better. Looked fine so far. I raised an eyebrow at him. He shook his head. "Just wait. It'll show up in a minute," he said dejectedly.

He was right. In about 5 minutes, bright green streaks started running

through the picture. In a few more minutes, the whole screen was very green, with the flashing still going on. In other words, all of the classic symptoms of a hot-short in the green heater-cathode circuit. "Doesn't do a bit of good to turn the green screen down, either," he said. "Tried that already."

So, I tried it, with no success. However, something looked peculiar. This *did* look like a heater-cathode short in the green gun, so I unbuttoned the CRT checker to find out. Then I made an astonishing discovery. I couldn't check this tube; not until I made an adapter to fit the small base! Oh, well, there I sat.

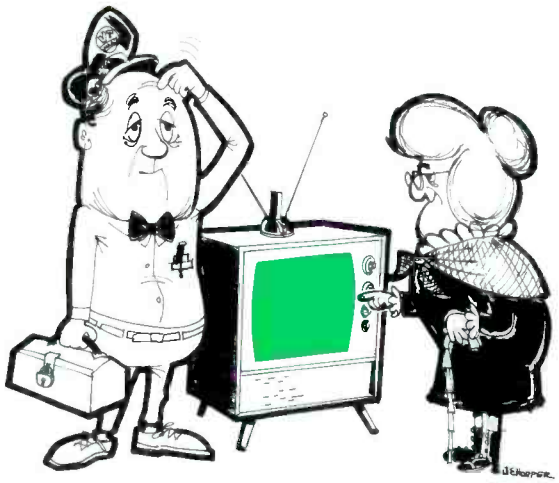
Let's see. I sat down on the case of the CRT checker and tapped the neck of the picture tube over the green gun with a fingertip. Nothing. I rapped it a little harder. Still nothing happened. Hmm. I touched the CRT socket, and he screamed as if I'd touched him with the high-voltage lead. I looked up, and there it was—a perfect picture!

Perching on the CRT checker case again, I started experimenting. By moving the CRT socket, I could make the picture turn green or come on in a perfect b-w! Ignoring dealer-type friend, who was dancing and babbling happily in front of the set, I started experimenting. Ah, ha! By moving the wires to the green gun, I could make the picture cut in and out on that color. Hmm. Bad contact. I turned it off, and pulled the socket. The pins looked OK, but I scraped 'em anyhow, and put the socket back. Hmm. Same thing. Now I found that pulling the green-gun control-grid wire caused the trouble; the screen and cathode were OK.

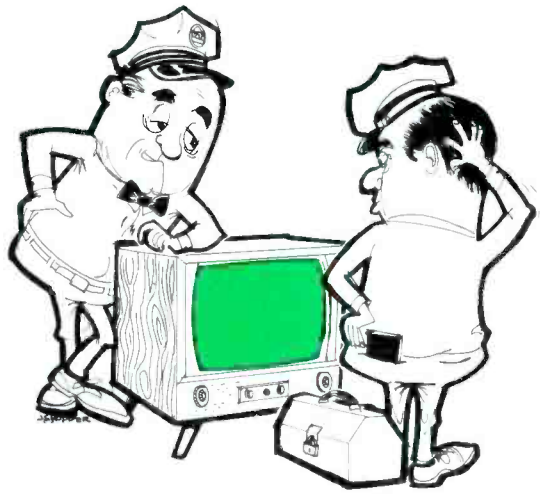
I pulled the socket and looked. Riveted together, of course. We got a drill from the appliance department, and set the CRT checker case up on edge behind the cabinet. (It was turning out to be a very useful instrument after all; now it was a portable bench.) Holding the socket down firmly, we carefully drilled out the tiny rivets holding the socket cover to the socket. He started to pull the cover off, and I grabbed his hand. "Wait one!" I said ."Take it easy. I did that once, and then spent an hour trying to get all of the little 'dinguses' back in the right slots!" So, we lifted it off very cautiously, while he held the wires down. As soon as the cover came off, we saw it.

The wire to the green-control grid was broken, right at the contact! It had come adrift, and been sitting there making contact, until the neck of the tube warmed up enough to make things expand! Then, it would 'make and break', and eventually open up entirely letting the green gun go to a zero-bias condition. His face lit up like a Christmas tree.

We couldn't find an old socket with the right size contact to replace it. So, we held the old one in place and made a good butt-joint on it. That is, *I* held it and he sol-



I wouldn't complain sonny but it does clash with my orange rocker.



You say it's been this way since St. Pat's Day?

dered it. (I always get the best part of the job.) Sucking my burnt fingertip, I slipped the green wire carefully back into its slot, and replaced the back cover. I put his fingertip on it, and told him to hold it there until I got back.

I went to the shop and hunted for a pair of very small bolts to replace the rivets. Finding just what I needed in a jar of gadgets saved up from replacing phono catridges, I went back, and we bolted the cover back on the socket, dropping the miniature nuts only three times. Then, we slid the socket gently back on the tube, crossed our fingers, and turned it on.

Victory! A beautiful picture. We reset the screens that had been upset while we were checking, and waited. A half hour later, we decided that we had won this one, and went out for a cup of coffee. When we came back, it was still looking fine, so I departed.

The moral of this story is "Don't jump the gun! Especially if the gun happens to be one of the three in a color picture tube." Although the symptoms *were* exactly the same as those of a hot short between heater and cathode in the green gun, they turned out to be something else. So, *don't* order a new picture tube until you've checked out *all* of the other 'possibles.' (Serious note: Distributors tell me that an amazingly high percentage of 'defective picture tubes' that come in are still in perfect shape. This was going on back in the black-and-white days, and it's worse now. So, look before you leap —to conclusions.

*Author's note: This is a true story, and the set was a Zenith 25-MC36, (*PHOTOFACT *Folder 773-4) with a 25GP22 picture tube and no G-Y amplifier. Green comes off at a couple of the paralleled plates of the 6JH8 sheet-beam demodulator tubes; other plates provide red and blue.*

Book Review

Communications Electronics Circuits: J. J. DeFrance; Holt, Rinehart and Winston, New York, 1966; 548 pages, 6″ × 9″, cloth, $9.50.

This book presents a detailed analysis of each of the principal circuits used in RF applications. Circuits are grouped according to purpose, such as RF voltage and power amplifiers, oscillators, modulators, and detectors. Complete chapters are devoted to combined circuits in transmitters and receivers. Frequency modulation is treated separately, as are transmission lines and antennas. Special chapters are given to resonant and coupled circuits, and to special transmitters.

Each circuit described is developed by mathematical analysis, and most circuits now in use are discussed. At the conclusion of each chapter are several pages of test questions and design problems. Their solutions require considerable review of each circuit and problem covered by the book.

This is a text on the subject and can be used as a handbook of RF design. The use of mathematics, extending to integration, is extensive, but does not preclude use of the volume without it. ▲

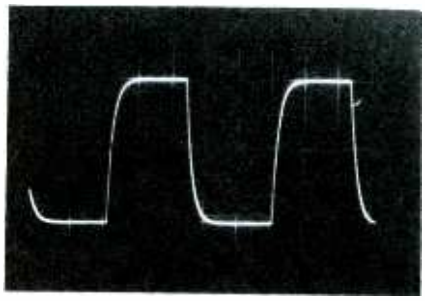
STORM WARNING

Snow on the ground
Is pretty to see,

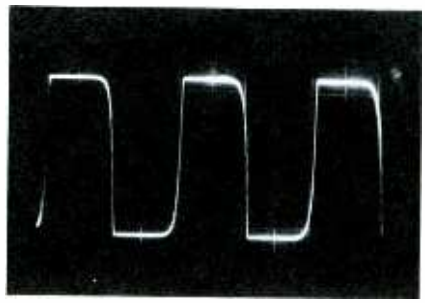
But snow's woe to me
When it's on a T.V.!

—*by Phyllis Barlow*

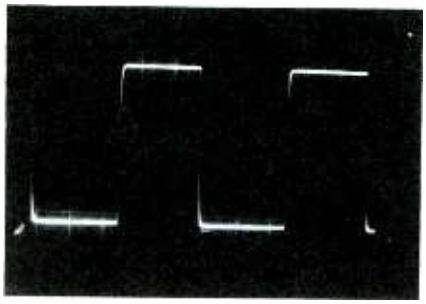
(Continued from page 20)



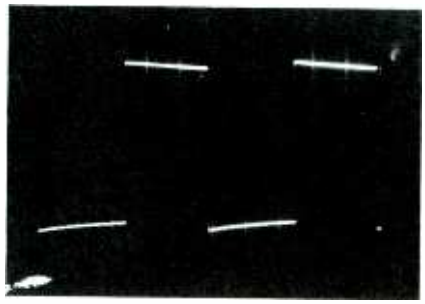
100 kHz



50 kHz



10 kHz



1 kHz

Fig. 15. Normal response of B-Y channel.

lator is the input circuit for the color-difference amplifier. Therefore, we apply the square-wave signal at the color control. The scope is connected to a grid of the color picture tube through a low-capacitance probe. In this example, you will need to pull the horizontal-oscillator tube to eliminate interference in the square-wave pattern.

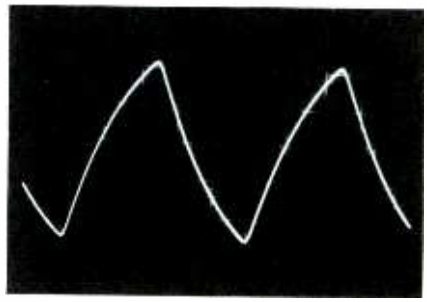


Fig. 16. Distortion caused by an open coupling capacitor to grid of CRT.

A color-difference circuit has much less bandwidth than a video amplifier. Therefore, use a lower square-wave frequency. Fig. 15 shows the B-Y channel response to square waves ranging from 1 kHz to 100 kHz. If C137, in Fig. 14, is open, a 100-kHz square wave will be distorted as shown in Fig. 16. The gain of a chroma channel is measured in the same manner as video amplifiers. In Fig. 14, an input square-wave amplitude of 10 volts p-p normally provides an output of 260 volts p-p through the B-Y channel. If the gain is low and the reproduced square wave distorted, an open screen-bypass capacitor could be suspected. Of course, resistors may have changed in value, although this is less likely than capacitor defects.

The rise time of a chroma channel is much slower than the rise time of a video amplifier. Thus, chroma channels have normal bandwidths in the range from 0.5 to 1.5 mHz. This results in proportionally slower rise times. When trouble occurs, the defective stage can be localized by moving the signal-injection point from the color control to the grid of an individual color-difference amplifier tube.

Conclusion

This review has covered the practical information necessary to make informative square-wave tests in video-frequency circuits. The best way to become familiar with this technique is to check out a normally-operating receiver. Triggered-sweep scopes appear formidable to the beginner, but they are easy to use after practice. ▲

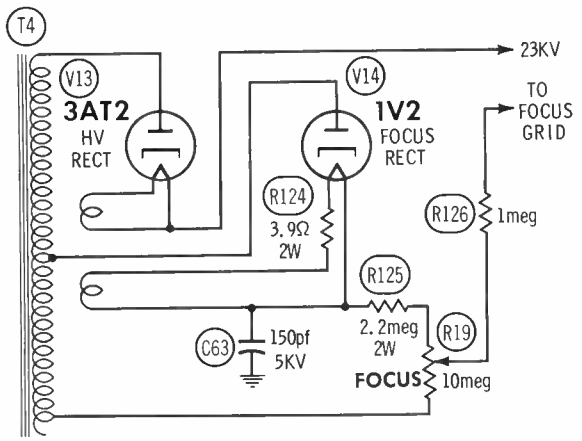
Color Countermeasures

Symptoms and Tips from Actual Shop Experience

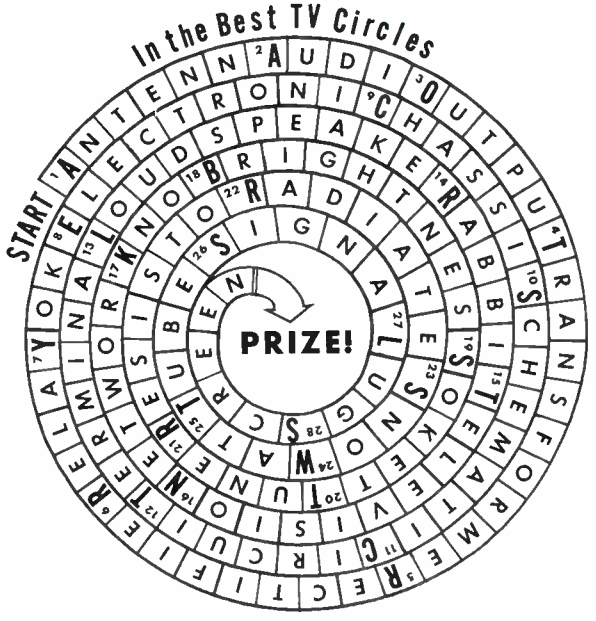
Chassis: Zenith All Chassis

Symptoms: Raster breaks up into large white blobs with no focus and video.

Tip: Replace V14. Check C63 Focus Filter.



Solution to June Puzzle



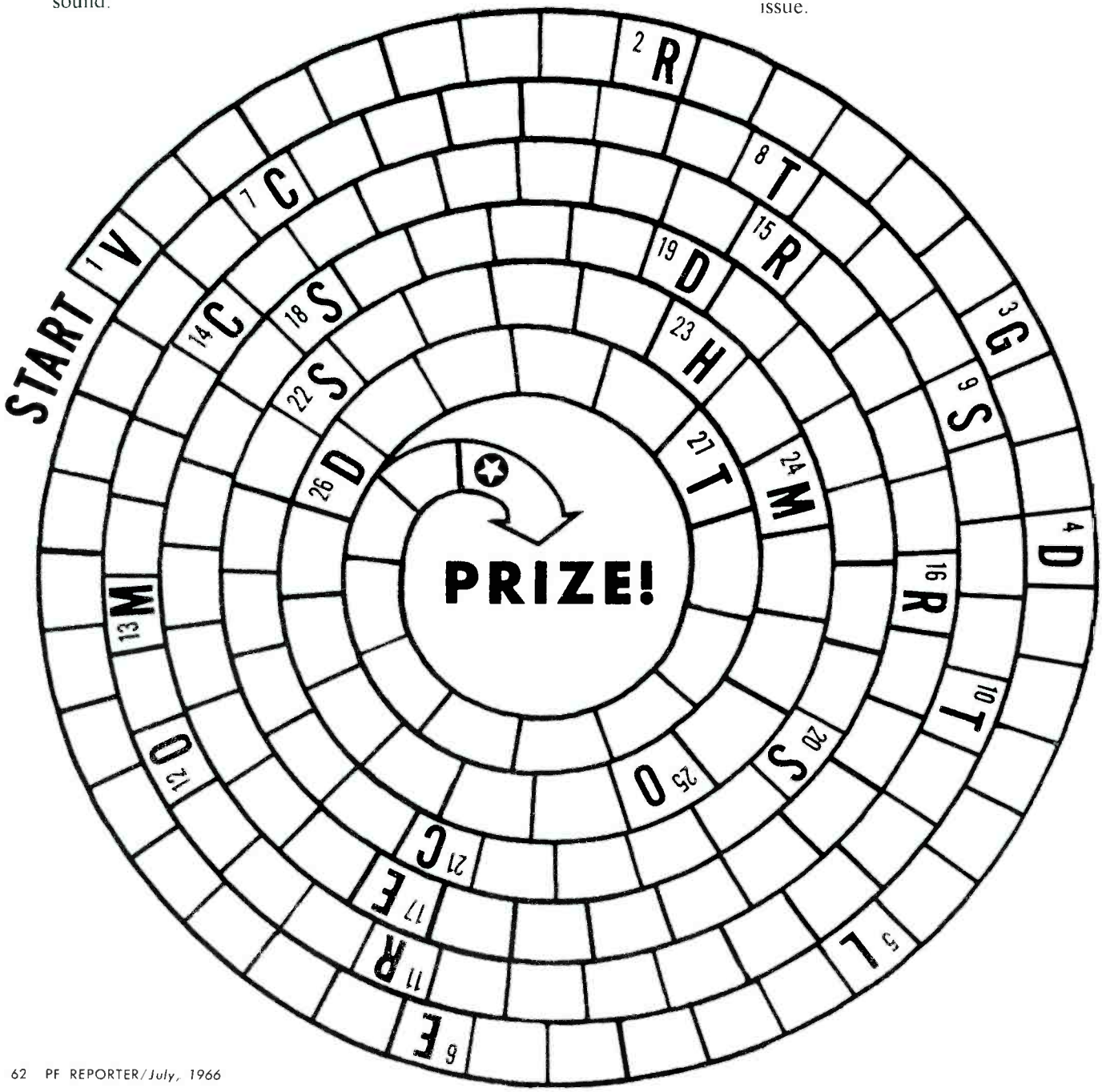
PFR Puzzler

Circling An Electronic Circuit

Here's a puzzle that's guaranteed to have you going around in circles! The last letter of each word is the first letter of the next word. Get them all correct and you'll be entitled to a Surprise Prize! Miss only one or two and you'll earn a Consolation Award. We know you know the answers but can you think of 'em before you get that see-sick feeling? Blow your whistle GO!

1 Instrument for measuring electronic force.
2 Vertical-hold adjustment may correct this.
3 Control electrode of an electron tube.
4 Unit of loudness or volume of sound.
5 Escaping electrical current.
6 Attraction developed by a current of electricity.
7 Difference in adjacent parts of picture.
8 Examination or checks.
9 A low- or small-resistance circuit.
10 Nonvacuum device which controls an electron current.
11 Ancestor of television.
12 Unit of electrical resistance.
13 Sounds having rhythm and melody.
14 Capable of transmitting electricity.
15 Image produced on cathode-ray tube of receiving set.
16 Opposition to the flow of electric current.
17 Terminals of electric source.
18 Defense or protection against interference.
19 Changes from the regular sound.
20 Atmospherics.
21 Narrow bands of frequency for TV transmission.
22 Device for controlling current.
23 Buzz or a drone.
24 Prefix: 1,000,000th part of a specified unit.
25 Add too much to a circuit.
26 A type of electric current.
27 A skilled expert.

Solution and prize list in August issue.



Scanner

(Continued from page 15)

Mr. Siragusa also told shareowners $1,000,000 is being invested to double the capacity of the Shelbyville, Indiana, cabinet plant. This expansion program will be completed next January.

Canadian Admiral Corporation is building an addition in Port Credit, Ontario, to expand production of color television sets. The Galesburg appliance manufacturing facility will have a new engineering-research building to permit enlargement of the engineering staff.

A new plant will be built shortly on a 20-acre plot in Sun Prairie, Wisconsin — 85 miles from Admiral's major consumer electronics center at Harvard, Illinois. Electronic components produced in Sun Prairie will be used in color television sets at Harvard.

The Admiral official said that as a result of the critical labor shortage in the Harvard area black-and-white TV set production will be shifted shortly to Dixon, Illinois, permitting the Harvard facility to manufacture color TV sets exclusively. When the move is completed in the second quarter, Harvard will have an annual production capacity of approximately 1,200,000 color receivers.

Mr. Siragusa said the industry estimates it will market more color TV sets in 1966 alone than were sold in all previous years combined. Marketing officials have predicted that industry color sales probably will surpass the total dollar volume of all other home entertainment products this year — including black-and-white TV, phonographs, radios and tape recorders.

Admiral's government electronics division has a $42,000,000 backlog, Mr. Siragusa disclosed, largest since the Korean War and four times higher than at the beginning of 1965.

Acquires 60,000 Feet

The nation wide upsurge in sales of outdoor antennas to meet the growing market of color TV sets and the new UHF stations has resulted in a record breaking year for **RMS Electronics, Inc.,** President Sidney Pariser announced.

According to Arthur A. Fink, vice-president of sales, "orders for RMS Antennas have increased our present production requirements to the point where our plant facilities have been greatly overburdened. The tremendous acceptance of our new VHF/UHF single-line antennas compels us to increase our production facilities to a much greater area to meet this expanded volume of orders."

Sidney Pariser, RMS president, stated, "with color TV here, more antennas are being sold than in the past two years. We decided to expand our production and manufacturing facilities with the acquisition of the additional 60,000 sq. ft. of new space adjacent to our current plant. This expansion affords us the opportunity to continue the development and the manufacture of new indoor and outdoor antennas, antenna accessories, and intercoms to meet the present and the future needs of our growing industry."

Toll-line Teaching

Development of an electronic "blackboard-by-wire" teaching system that transmits voice communications and handwriting over telephone lines for long-distance illustrated lectures was announced by **General Telephone & Electronics Corporation.**

Leslie H. Warner, president of GT&E, said the new integrated system, developed by the Sylvania Electric Products subsidiary, "provides high-quality visual display of handwriting, diagrams, formulas, equations, and other graphics on a television monitor within the classroom, thereby supplying a most important educational aid which is a convenient, economical supplement to educational TV."

In addition to the added dimension of two-way voice communications between the instructor and his remotely located students, the blackboard-by-wire system offers transmission costs lower than those for ETV. For example, an expenditure of approximately $3,500 would be required for a one-hour closed-circuit TV transmission with audio between Los Angeles and New York City, in comparison with about $700 for a similar transmission via the blackboard-by-wire system.

During the course of the conference, the system was demonstrated to business representatives and the press through transmission of an illustrated "classroom lecture" to the headquarters of General Telephone Company of Pennsylvania in Erie, Pa. The voice and graphic signals were returned instantaneously to a receiver unit in the New York Hilton Hotel, completing a round trip of approximately 640 miles.

E. J. Vigneron, vice president and general manager of Sylvania's Commercial Electronics Division, said the system will enable distinguished scholars and leaders in various fields to transmit illustrated lectures to students at up to six remote locations throughout the country. Any number of TV monitors can be utilized for display purposes at each reception site.

While speaking from his classroom, office, or home, the instructor illustrates his remarks on an electronic writing unit on the system's transmitting console, Mr. Vigneron said, and the handwriting is transmitted over telephone circuits in the form of voice-frequency electrical tones to the TV monitors at each remote location.

In addition to the TV monitor and loudspeaker at each classroom reception point, the system includes equipment which allows the students to ask questions and discuss ideas with the instructor. A light-indicator panel on the instructor's desk-type transmitting console signals him when a student wishes to interject a question or comment.

As the instructor talks, he uses an electronic pen on the eight-by-six inch writing surface of the transmitting console. The electrical tones generated by the unit are decoded by the system at the reception points and electronically "etched" on a storage tube.

A TV camera in the equipment unit then transmits the image from the storage tube to the screen on the TV sets where it is displayed in a fashion similar to the conventional school blackboard — a white image on a black background. The image remains on the TV screen until the instructor pushes an "erase" button on his console, which clears the "blackboard" instantly for further use.

Mr. Vigneron said the system will undergo extensive field tests this summer and will be placed in production next September at the division's manufacturing facility in Bedford, Mass. Equipment for the basic system is expected to cost approximately $5,000, he stated.

Home Video Tape

RCA disclosed that the company has built prototypes of a home television tape recorder-player "that we believe can outperform any such devices on the market today," according to President Robert W. Sarnoff.

Such tape recorders, President Sarnoff said, must be able to record and play back color as well as black-and-white TV programs. He continued:

"The type of instrument on which we are working would not only record programs off the air, but it would also enable consumers to buy or rent color video tapes of other special program material, just as they now buy original cast albums and other special musical recordings. Coupled with a small television camera, it would enable the user to make his home video tape recordings to play back on the TV set." ▲

The Troubleshooter

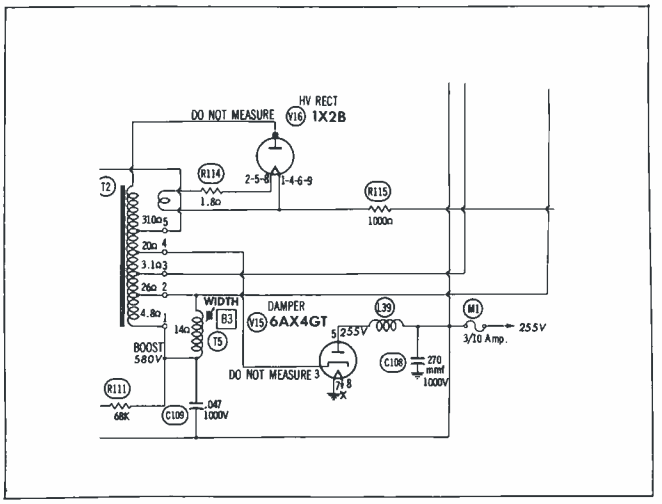
answers your servicing problems

High Voltage Problem

I have an RCA TV chassis KCS98A (covered in PHOTOFACT Folder 347-14) which keeps blowing high-voltage rectifiers. I have performed resistance and voltage checks of the horizontal output and damper circuits, but have found nothing abnormal. Fuse M1 in the damper plate circuit has not blown. I removed R114 to lower filament voltage on the high-voltage rectifier but this has not helped.

WILBERT GAHLER

Janesville, Minn.



Removing R114 would increase filament voltage rather than lower it, and could burn the filament out, or result in increased conduction of the tube to the point of reducing its lifetime. Replace R114 with a resistor of 1.8 ohms. Also, check for other defects in the high-voltage-filament circuit which could cause an increase in filament voltage.

One other possible cause of the trouble could be excessive drive in the horizontal sweep circuits. Perform a horizontal sweep circuit adjustment in accordance with PHOTOFACT *instructions.*

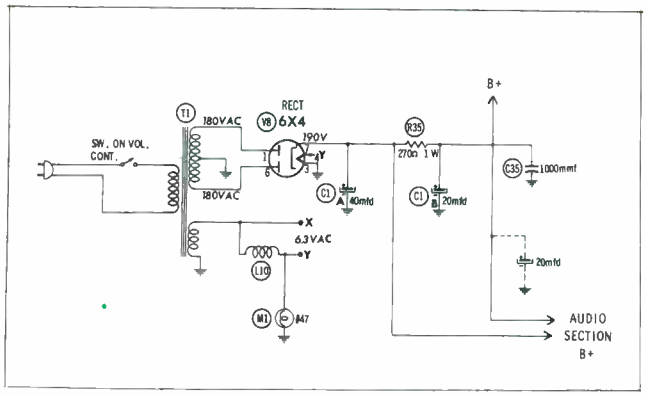
Burned Out Power Transformers

When the original power transformer in a Monitoradio Model MR-10 (PHOTOFACT Folder 366-6) burned out, the power-supply electrolytics, the 270-ohm resistor, and the 6X4 rectifier were replaced before a replacement transformer was installed by another serviceman. However, the replacement transformer has now burned out. Is it possible that the replacement transformer was defective or could some other component, previously overlooked, be the cause of the trouble?

When I checked the PHOTOFACT replacement transformer data I found that the Thordarson replacement part number (22R28) was incorrect. Could you supply me with the correct replacement part number?

J. W. MICHALSKI

St. Louis, Mo.



Stancor transformer P-8359, Thordarson transformer 22R94, and Triad transformer R-22A are correct replacements. Thanks for bringing this error to our attention. When installing the replacement transformer, cut and tape the 160-volt secondary leads, the 6.3-volt AC (.6 amp) leads, and the center-tap of the 6.3-volt AC center-tapped filament windings. These transformer leads are not needed in this installation.

It is possible that the replacement transformer used previously was defective, incorrectly installed, or was an incorrect replacement. However, it is just as possible that a defective component in the B+ line is the cause of the overload that is burning the transformers out.

After installing the new transformer and before applying power to the receiver, perform a resistance check of the B+ line. A visual check should also be made, looking for burned resistors or other evidence of a shorted capacitor or a shorted IF or output transformer. If these checks fail to turn up the faulty component, connect a milliammeter (set to a high range) in series with the power-supply output and apply power to the set. Monitoring the current drain on the power supply, start disconnecting individual branches of the B+ line. The current should drop a little as each branch is disconnected; when the faulty branch is disconnected, the current will decrease drastically. When the faulty branch is found, check or substitute every component that could provide an overload if defective—shorted or leaky capacitors, winding to core shorts in IF and audio transformers, etc. After the trouble has been found and remedied, install a slo-blo fuse between the center tap of the transformer and ground to provide power-supply overload protection.

AGC Filter Fault

Failing to locate the trouble causing vertical jitter in an Emerson TV (PHOTOFACT Folder 702-1), I took the advice of a friend who had a similar experience with another Emerson model, and replaced C3, the 2-mfd electrolytic in the AGC circuit. This cured the vertical jitter.

What is the purpose of C3 and how can a trouble of this type be traced with a scope or voltmeter?

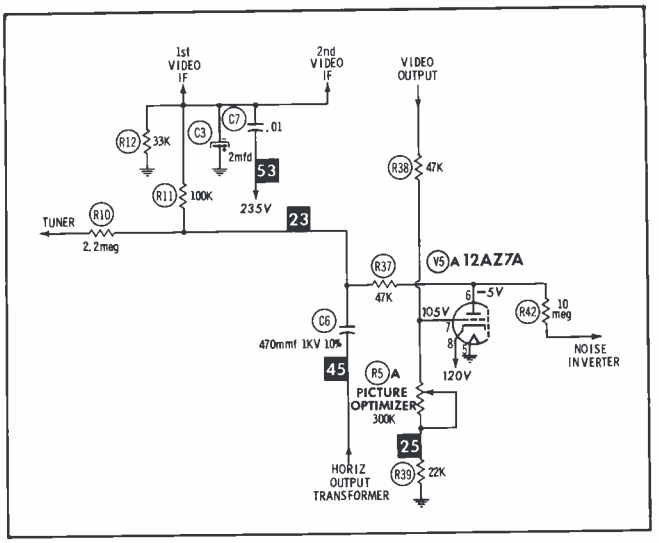
J. E. HILL

Muskogee, Okla.

Capacitor C3 and resistor R12 form an RC filter whose purpose is to remove the keyer-tube plate-pulse present at the junction of R10 and R11. R12 performs the additional function of developing the AGC bias voltage applied to the first and second video IF stages. If C3 opens (or partially opens), the filtering action is eliminated or reduced, and results in the presence of an unwanted signal

Circle 41 on literature card

Circle 40 on literature card



on the AGC lines, varying at the horizontal and vertical sync rates. (Theoretically, the keying tube should not respond to the vertical sync pulses, since it is controlled by the much shorter horizontal sync pulses; however, in actuality, it can reproduce degenerated versions of the vertical sync pulses).

The unwanted signal present on the AGC lines effectively subtracts from the normal video signal, reducing the height of the horizontal sync pulses and canceling a part of the vertical sync pulses. The result of this action can affect the picture in various ways, depending in part on the particular design of the AGC filter and distribution circuits. Vertical jitter resulted in this case.

Localizing an AGC trouble of this type normally begins with an analysis of the composite video signal at the plate of the video-output stage, keeping in mind the effect the trouble has on the picture. If the composite waveform is distorted in any way that would suggest possible AGC trouble, clamp the AGC by applying a bias voltage (−30 to −40 volts in most cases) to the plate of the keying tube. If the picture returns to normal, it can be assumed that the keying circuit is at fault; however, if the trouble persists, the AGC circuits cannot be ruled out completely. A faulty filter or distribution-circuit component could be attenuating or dissipating the clamping voltage.

Since clamping the AGC in the case under discussion would produce a normal picture (provided the bias source is equipped with a capacitor across the output leads to short the keying pulses to ground and disable the keying-tube action), the AGC line would not ordinarily be suspected. However, in this particular case, the distortion that was probably present in the composite-video signal would indicate that unwanted pulses were getting into the waveform at some point in the video section. It would be advisable to check the AGC line in this instance. This is accomplished by clamping the individual branches of the AGC line with a lower bias voltage than that applied to the plate of the keying tube—usually −6 to −9 volts.

When the application of a low clamping bias to a particular branch produces a normal picture, the trouble must exist within that branch. Scope the faulty branch after removing the clamping voltage from it. In this case the scope would be applied to the junction of R11, R12, and C3. If an AC signal is present, it can be assumed that either R12 or C3 is faulty.

The April and August '65 and May '66 issues of PF REPORTER *contain useful information about AGC troubleshooting and AGC filter and distribution troubles.*

Product Report

For further information on any of the following items, circle the associated number on the Catalog & Literature Card.

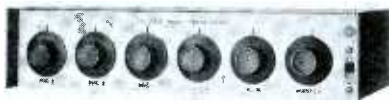
DC Power Supply

(60)

A DC power supply specifically designed for testing of two-way radio equipment is manufactured by the **Lapp Company Inc.** The Model 73 Power Supply features 6-12 and 24 V.D.C. outputs at 30 and 20 amps respectively, continuous duty rating.

The power supply output voltage is adjustable from zero to 18 and 36 volts, in two ranges. Voltage and current are read on 3 inch D'Arsnoval type panel meters.

Input voltage is 117v AC 50/60 cycles. Price is $239.00.



Microphone Mixer

(61)

This new microphone mixer is called the Model M68 and is the first to be manufactured by **Shure.** It has been designed to meet the requirements of commercial public-address use as well as the needs of series-minded tape recording enthusiasts. The unit has inputs to accommodate up to four dynamic microphones — either high or low impedance.

Each input is equipped with a switch for impedance selection. No auxiliary transformers are needed. In addition to the four microphone inputs, one auxiliary high-level input is provided to accept a tape recorder, AM-FM tuner, or phono-cartridge preamplifier. Individual volume controls for each of the five inputs are provided, as well as a master volume control to control gain of all inputs simultaneously.

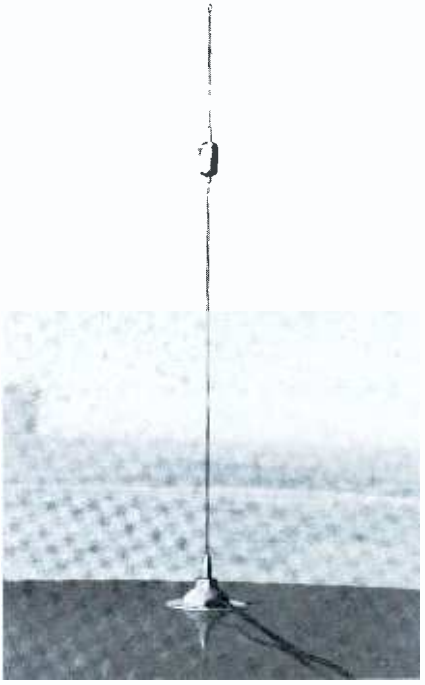
The mixer has two outputs. One provides high- or low-impedance output for connection to the microphone input of an amplifier or tape recorder. Desired impedance is selected by a switch. The second is an auxiliary high-impedance, high-level output designed primarily to feed a power amplifier requiring .5- to 2-volts drive.

Another feature of the versatile unit is a jack provided on the rear panel to supply 28 volts DC for accessories such as a phono preamplifier for ceramic or magnetic phono cartridges. The jack can also be used as a power input in conjunction with a battery power-supply accessory. The mixer is 11-5/16" × 2-5/8" × 5-3/16" and is priced at $125.00.

Floor Merchandiser

(62)

"Soldering Center" is an appropriate name for the **Weller Electric** floor merchandiser. This compact unit effectively displays the company's line of soldering guns, irons, kits, and accessories.



CB Antenna

(63)

A new mobile antenna for Citizens Band using an **Alnico** magnet in the base has been announced by **Hy-Gain Electronics.** The permanent magnet in the base permits installation of the antenna on any car, truck, tractor or other vehicle. There are no holes to drill, no special tools required—simply hook up the feedline which is furnished with the antenna to any CB transceiver, place the antenna on the roof-top, trunk deck, or on any other metal surface of any vehicle, and you're ready to communicate on all 23 channels. Tests have proven the magnet in the base mount will hold the antenna securely in place, even at speeds of over 80 MPH. Easily moved from vehicle to vehicle, the "Magna-Topper" employs top loading design. It uses a durable stainless steel whip section, equipped with a loading coil and adjustable tuning rod. Of special significance is the base plate which forms a capacitance connection to the vehicle body, thus electrically establishing ground-plane performance. Overall height of the antenna is 29". It is furnished complete, ready to install, with 16' of coaxial cable and PL-259 connector. Price is $14.95.

De-soldering Attachment

(64)

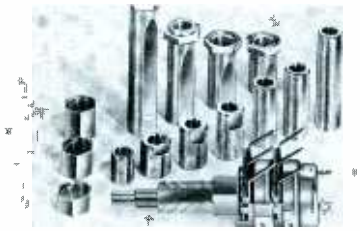
A new de-soldering attachment for the Imperial ine of soldering irons has been introduced by **Ungar Electric Tools.** The #6825 de-soldering tool can be used on

either the 25-, 30-, 40, or 60-watt heat cartridges.

When threaded onto any of these heat cartridges, the tool will help speed and simplify printed-circuit repair. No tinning of the tip is necessary since the desoldering tool has a special ungarized coating that resists solder.

The tool is designed for easy operation with one hand, leaving the operator's other hand free to remove components. On plastic-coated printed-circuit boards, the desoldering tool melts through the plastic, and melts and removes solder all in one operation.

A stainles steel check valve is provided in the back of the desoldering tool to prevent molten solder from being drawn up into the rubber aspirator bulb. After each desoldering operation, molten solder in the collector is discharged into a metal waste receptacle by simply depressing the rubber bulb.



Added Bushings

(65)

With the addition of 36 special bushings and 6 shoulder spacers, **Centralab's** Fastatch II exact replacement controls can now be used in servicing all auto radios. With these new parts, even the most unusual auto radio control can be exactly matched. The Fastatch II system provides the possibility of over 9 billion control combinations with exact shaft lengths, exact shaft end, exact mounting hardware and exact resistance and taper.

Solid-State CB Transceiver

(66)

This solid-state, 23-channel, frequency-synthesized Citizens-band transceiver delivers 5 watts of input power with 100% modulation. Designated Plus 23, the new **Pace Communications** unit features a full-size signal-strength meter which indicates the strength of the incoming signal in "S" units. The lighted 1½", edgewise scale is factory calibrated to read S-9 at 100 μv.

The design utilizes 22 silicon transistors, installed on glassfiber circuit boards which are lifetime-guaranteed. An MOS field-effect transistor in a double-conversion design is employed in the receiver section. Other design features include a heavy-noise-clipping switch for extended range or high-noise areas, and an external public-address jack with front-panel control.

The transceiver measures 6¾" × 2⅜" × 8⅜" and is housed in a vinyl-covered alumnum case, equipped with a "Snap Rak" mobile mount. Snap-in power leads permit easy changeover from mobile (12-volt DC) power to home (115-volt AC) use. A one-year replacement warranty covers all parts. Price of the unit, with all 23 channels included, is $199.00.

High-Voltage Capacitor Kit

(67)

A new high-voltage color TV replacement DP capacitor kit, featuring Elmenco dip mylar-paper capacitors, includes the ten most popular replacement values as specified in leading national-brand and private-brand color sets. Specially featured is an oil-impregnated, ceramic-cased, mylar-paper capacitor rated at 2000-VDCW for maximum reliability in AC circuitry.

All of the dip mylar-paper capacitors in the **Arco Electronics** kit are rated at 1600VDCW to meet critical color circuit requirements. They are rated at exact original equipment capacitance values to assure proper operation. The capacitors are moisture proof for maximum reliability, and are easy to install, being up to 50% smaller than comparable types.

The #30 kit is housed in a partitioned plastic box and is priced at $14.20.

Circle 46 on literature card

INDEX TO ADVERTISERS

JULY, 1966

FREE Catalog and Literature Service

**Check "Index to Advertisers" for further information from these companies.*

Please allow 60 to 90 days for delivery.

ANTENNAS & ACCESSORIES

80. *ALLIANCE* — Colorful 4-page brochure describing in detail all the features of *Tenna-Rotors.*
81. *AMPHENOL CORPORATION* — New 28-page catalog aids selection of RF connectors and coaxial cable. Specifications are detailed for nearly 1400 items.*
82. *ANTENNACRAFT* — Four-color catalog sheet about the new *"Big-Shot-8"* VHF-UHF-FM antenna designed for city and suburban use.
83. *BLONDER-TONGUE* — New products catalog, featuring all channel UHF-VHF-FM amplifiers, couplers, converters, etc.
84. *EASY-UP, INC.* — Brochure about television *Towerette* and accessories.
85. *FINNEY* — Form 20-353 about the *Finco-Axial* 75 ohm antenna system for UHF-VHF and FM.*
86. *JFD* — New 1966 dealer catalog covering complete line of log-periodic outdoor antennas, indoor antennas, rotators, converters, amplifiers, masting, splitter-couplers/combiners, matching transformers, lightning arrestors, antenna mounts, and hardware.
87. *WINEGARD* — Interesting and colorful brochure about the RS 230 and RS 275 *Super Red Head* antenna preamplifier.*
88. *ZENITH* — Information bulletin on antennas, rotors, batteries, tubes, power converters, record changers, picture tubes, wire, and cable.*

AUDIO & HI-FI

89. *ADMIRAL* — Folders describing line of equipment; includes black-and-white TV, color TV, radio, and stereo hi-fi.
90. *ATLAS SOUND* — Catalog 566-67 illustrates and describes many new models of public address loudspeakers, microphone stands and accessories for commercial sound applications.*
91. *BENJAMIN* — Product literature on *Miracord* 40A, 40H and 50H automanual turntables and associated accessories. Product literature on stereo 200 and stereo 200/FM compact systems.
92. *CLEVELAND ELECTRONICS INC.* — 3 multi-color flyer sheets describing *Babe* reverberation kit, *Cathedral-Sonic* self-contained reverberation kit, and *Cletron* TV camera components.
93. *JENSEN* — Multicolored 24-page catalog No. 165-L featuring speakers and headphones. Also, 22-page catalog No. 6801 supplying phono-cartridge list and cross-reference.
94. *OAKTRON* — "The Blueprint to Better Sound," an 8-page catalog of loudspeakers and baffles giving detailed specifications and list prices.
95. *OXFORD TRANSDUCER* — 4-page catalog describing three lines of phonographs, tape recorders, and consoles.
96. *SONOTONE* — New spec sheet SAH-107 about new Dynamic Cardioid mikes.
97. *SWITCHCRAFT* — New Product Bulletin No. 160 describes 6 new accessory adaptor cables.
98. *TURNER* — Bulletin 1060 describes the *Jet Star 777* cardioid dynamic nite club mike.
99. *WATERS CONLEY CO., INC.* — Colorful brochure describes the full line of *Phonola* tape machines and phonographs.

COMMUNICATIONS

100. *KRECKMAN* — Catalog #68 describes a full line of communications antennas and accessories.
101. *MOSLEY ELECTRONICS* — Catalog covering complete 1966 line of Citizens-band equipment.
102. *NOVA* — Catalog sheets describe the *Hallmark SS*, a new modular design solid state CB radio, also the *Banner 85* AM and CB radio. All specs are included.
103. *PEARCE-SIMPSON* — Specification brochure on IB-301 business-band radio, *Companion II & III, Escort II, Director, Guardian 23,* and *Sentry* CB units. Also a booklet: Modern Two-Way Communications.
104. *POLYTRONICS LABORATORIES, INC.* — Catalogs on CB transceivers and walkie-talkies, AM business-band Handie-talkies FM transceivers and RF power boosters.

COMPONENTS

105. *BUSSMANN* — 24-page catalog giving detailed information on the complete line of *BUSS* and *FUSETRON* Small Dimension fuses and fuseholders — the ones most used for protecting electronic equipment. Ask for BUSS Bulletin SFB.*
106. *CENTRALAB* — Form 42-D379D is a replacement guide for *Fastach® II* line of Auto Radio controls. Form 42-D365-1 is a complete guide and cross-reference to Centralab PEC's.
107. *CLAROSTAT* — Offers the complete 1966 distributor catalog.
108. *CORNELL-DUBILIER* — 112-page reference catalog about Twistprong Electrolytic capacitors.
109. *G.C. ELECTRONICS* — Complete full-line catalog FR 67, over 300 pages of the comprehensive GC product line plus form FR-15G, a complete TV knob cross-reference, and FR-16-G TV antenna cross-reference.
110. *J. W. MILLER* — New 1966 coil catalog and replacement guide.*
111. *QUAM-NICHOLS* — General catalog listing P.A., sound systems, Hi-fi, automotive and Radio & TV replacement speakers.*
112. *TRIAD* — Replacement guide for radios, tape recorders, CB, and home music systems. Spec sheet on 3 new color TV yokes.
113. *WORKMAN* — New coil cross-reference catalog #103 lists all manufacturers part numbers to Workman. Covers AM, FM, and TV receivers.*

SERVICE AIDS

114. *CASTLE* — How to get fast overhaul service on all makes and models of television tuners is described in leaflet. Shipping instructions, labels, and tags are also included.*
115. *CBC INDUSTRIES* — New literature on outlet boxes including circuit breaker and SCR types.
116. *CLEVELAND INSTITUTE OF ELECTRONICS* — New pocket-sized, plastic "Electronics Data Guide" of formulas and tables, including frequency and wavelength, db formulas and table, antenna lengths, and color code.*
117. *ELECTRONIC CHEMICAL* — Brochure of aerosol chemicals for controls, tuners, and tape heads.*
118. *INJECTORALL* — New 1966 catalog of electronic chemicals.
119. *MASTRA — TNT Totemaster* — a new tube caddy and tool box.
120. *PRECISION TUNER* — Literature supplying information on complete low-cost repair and alignment service for any TV tuner.
121. *RAWN* — Instruction bulletin on how to make knobs in minutes with *Plas-T-Pair.*
122. *WALDOM* — Brochure on new *TES CON-ECTS* snap-on test lead terminations.
123. *YEATS* — The new "back-saving" appliance dolly Model 7 is featured in a four-page booklet describing featherweight aluminum construction.

SPECIAL EQUIPMENT

124. *ANDREA RADIO* — Brochures about the *Custom Color* receivers and a new 9-inch all transistor TV.
125. *PERMA-POWER* — New catalog LCG-680 describes *Electro-Lift* garage door opener.
126. *SOUND SENTINEL* — Information on a new security alarm.
127. *TENATRONICS* — Form 4-66-T describes an auto radio with built-in reverberator.

TECHNICAL PUBLICATIONS

128. *CLEVELAND INSTITUTE OF ELECTRONICS* — Free illustrated brochure describing electronics slide rule and four-lesson instruction course and grading service.*
129. *HOWARD W. SAMS* — Literature describing popular and informative publications on radio and TV servicing, communications, audio, hi-fi, and industrial electronics, including special new 1966 catalog of technical books on every phase of electronics.*
130. *RCA* — New 1966 electronics career book describing courses in all phases of electronics.*

TEST EQUIPMENT

131. *B & K* —New 1966 catalog featuring test equipment for color TV, auto radio, and transistor radio servicing, including tube testers designed for testing latest receiving tube types.*
132. *EICO* — 1966 short-form catalog is 48-pages long. Describes a complete line of test instruments, CB and ham equipment, hi-fi components, and miscellaneous electronic equipment.
133. *HICKOK* — New flyer detailing selected items of service test equipment.*
134. *JACKSON* — New catalog of "Service Engineered" test equipment.
135. *MERCURY* — All new test-equipment catalog featuring time saving "Service-Man" equipment, and brochure on a new color bar generator.
136. *SECO* — Form SS 200 about the new model 240 SCR analyzer and model 260 transistor tester.*
137. *SENCORE* — Latest 4-color catalog plus other information on new developments in the *Econoline* series of test equipment.*
138. *SIMPSON* — Flyer giving specifications of Model 604 Multicorder for measuring and recording volts, amps, milliamps, and microamps.*
139. *TRIPLETT* — All new catalog 49-T covering the full line of VOM's, VTVM's Tube & transistor analyzers, signal generators, and featuring the new laboratory accurate, overload-protected VOM model 630-APLK.*

TOOLS

140. *BERNS* — Data on unique 3-in-1 picture-tube repair tools, on Audio Pin-Plug Crimper that enables technician to make soderless plug and ground connections also for color and other picture tubes. Model AV-2 for RCA type pnono plugs, along with C rings for shielded braided wire ground connections and LC-3 for 5/32" pin diameter.
141. *CHANNELLOCK* — New catalog #66 covering complete line of tools and featuring an expanded line of Little Champ precision pliers.
142. *ENTERPRISE DEVELOPMENT*—Time-saving techniques in brochure from Endeco demonstrate improved desoldering and re-soldering techniques for speeding and simplifying operations on PC boards.
143. *VACO* — New 4-page catalog on Vaco's line of Professional Pliers and wrenches.

TUBES & TRANSISTORS

144. *WORKMAN* — Transistor cross-reference for use with *Miracle Five* transistor line that replaces 2,977 entertainment-type transistors.*

Are you offering today's color?

RCA Hi-Lite color picture tubes bring OEM quality to your replacement tube customers

Odds are that when you're called to replace a customer's color picture tube and you replace it with an RCA Hi-Lite, you're giving him a better product than he had when his set was new.

That's because RCA Hi-Lite picture tubes are RCA's best... the same quality... the same tubes... that go into today's original equipment sets. RCA Hi-Lites are all-new... glass, gun, the works! And incorporate the continued advancements in picture tube technology achieved by the world's leading color picture tube manufacturer. So you literally "up-date" your customer's color set when you install one.

Here's picture brightness and color fidelity at its finest, available for the service trade in 19-inch and 25-inch rectangular and 21-inch round tube types.

How about you? Are you offering your customers today's color?

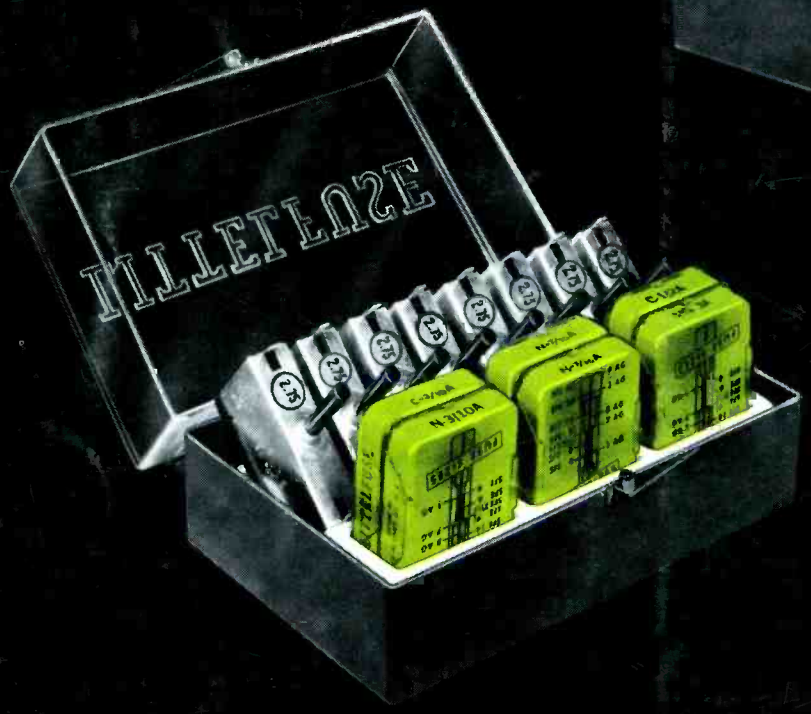
RCA Electronic Components and Devices, Harrison, N.J.

The Most Trusted Name in Electronics

CIRCUIT BREAKER CADDIES

CADDY #094077

10 circuit breakers, trip ratings: 2.25, 2.5, 2.75, 3, 3.25, 4, 4.5, 5, 6, and 7 amps.



CADDY #094076

8 circuit breakers, trip ratings: 2.25, 2.75, 3, 3.25, 4, 4.5, 5, and 7 amps.

30 Popular Fuses: 5 each — N 3/10, N 7/10, N 1, C 3/10, C 1/2, C 3-1/2.

Circuit breakers and fuses at your finger tips for instant servicing in field and shop. For color and black/white TV sets.

LITTELFUSE DES PLAINES, ILLINOIS

Circle 54 on literature card