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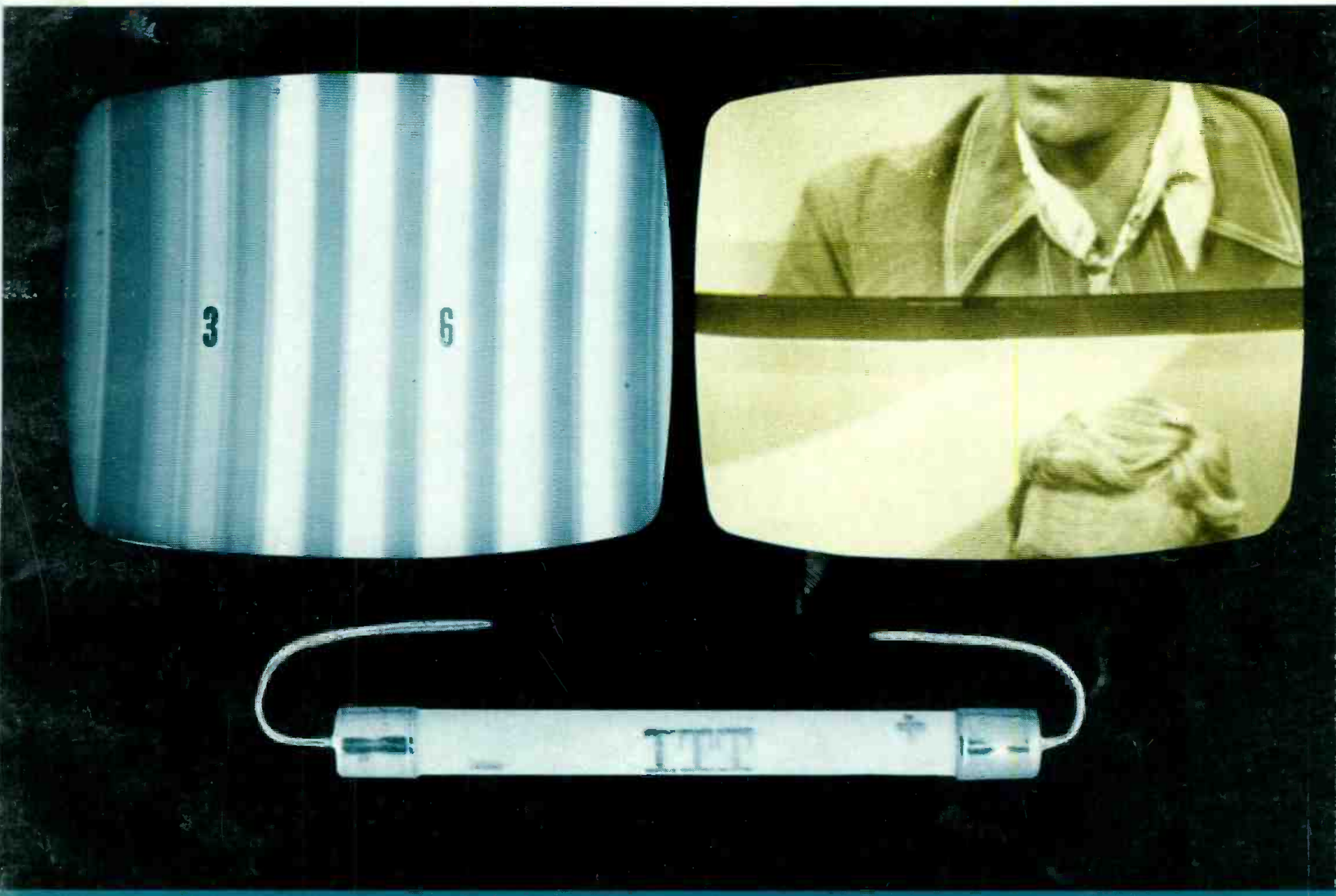
Electronic Servicing



What Color Bars Tell You, page 14

Indirect Causes of Poor Sync, page 44

Testing "High-Voltage" Semiconductor Rectifiers, page 48

Now–Just 3 RCA Hi-Lite "V" Type Color Picture Tubes Replace ~~185~~ 195 Types

Replaces 98 19″ types

- 18VABP22
- 18VACP22
- 18VADP22
- 18VAHP22
- 18VAJP22
- 18VAQP22
- 18VARP22
- 18VASP22
- 18VATP22
- 18VBAP22
- 18VBCP22
- 18VBHP22
- 19EXP22
- 19EXP22/ 19GVP22
- 19EYP22
- 19EYP22/ 19GWP22
- 19FMP22
- 19FXP22
- 19GLP22
- 19GSP22
- 19GVP22
- 19GVP22/ 19EXP22
- 19GWP22
- 19GWP22/ 19EYP22
- 19GXP22
- 19GYP22
- 19GZP22
- 19HBP22
- 19HCP22
- 19HCP22/ 19HKP22
- 19HFP22
- 19HJP22
- 19HKP22
- 19HQP22
- 19HRP22
- 19HXP22
- 19JBP22
- 19JDP22
- 19JHP22
- 19JKP22
- 19JNP22
- 19JQP22
- 19JYP22
- 19JZP22
- 19KEP22
- 19KFP22
- 490AB22
- 490ACB22
- 490ADB22
- 490AEB22
- 490AFB22
- 490AGB22
- 490AHB22
- 490AHB22A
- 490AJB22
- 490AJB22A
- 490AKB22
- 490AKP22A
- 490ALB22
- 490AMB22
- 490AMB22A
- 490ANB22
- 490ARB22
- 490ASB22
- 490ASB22A
- 490BAB22
- 490BCB22
- 490BDB22
- 490BGB22
- 490BHB22
- 490BRB22
- 490CAB22
- 490CB22
- 490CHB22
- 490CUB22
- 490DB22
- 490DB22A
- 490EB22
- 490EB22A
- 490FB22
- 490GB22
- 490HB22
- 490JB22
- 490JB22A
- 490KB22
- 490KB22A
- 490LB22
- 490MB22
- 490NB22
- 490RB22
- 490SB22
- 490TB22
- 490UB22
- 490VB22
- 490WB22
- 490XB22
- 490YB22
- 490ZB22

Replaces 22 21″ types

- 19VABP22
- 19VACP22
- 21AXP22
- 21AXP22A
- 21AXP22A/ 21AXP22
- 21CYP22
- 21CYP22A
- 21FBP22
- 21FBP22A
- 21FBP22A/ 21GUP22
- 21FJP22
- 21FJP22A
- 21FJP22A/ 21GVP22
- 21FKP22
- 21GUP22
- 21GUP22/ 21FBP22A
- 21GVP22
- 21GVP22/ 21FJP22A
- 21GXP22
- 21GYP22
- 21GZP22
- 21HAP22

Replaces 75 25″ types

- 23EGP22
- 23EGP22A
- 23VABP22
- 23VACP22
- 23VADP22
- 23VAHP22
- 23VALP22
- 23VAMP22
- 23VANP22
- 23VAQP22
- 23VARP22
- 23VASP22
- 23VATP22
- 23VAUP22
- 23VAWP22
- 23VAXP22
- 23VAYP22
- 23VAZP22
- 23VBAP22
- 23VBCP22
- 23VBDP22
- 23VBEP22
- 23VBGP22
- 23VBHP22
- 23VBJP22
- 23VBRP22
- 23VBTP22
- 25ABP22
- 25ADP22
- 25AEP22
- 25AFP22
- 25AGP22
- 25AJP22
- 25ANP22
- 25AP22
- 25AP22A
- 25AP22A/ 25XP22
- 25AQP22
- 25ASP22
- 25AWP22
- 25AXP22
- 25AZP22
- 25BAP22
- 25BCP22
- 25BDP22
- 25BFP22
- 25BGP22
- 25BHP22
- 25BJP22
- 25BMP22
- 25BP22
- 25BP22A
- 25BP22A/ 25YP22
- 25BRP22
- 25BSP22
- 25BVP22
- 25BWP22
- 25BXP22
- 25BZP22
- 25CBP22
- 25CP22
- 25CP22A
- 25FP22
- 25FP22A
- 25GP22
- 25GP22A
- 25RP22
- 25SP22
- 25VP22
- 25WP22
- 25XP22
- 25XP22/ 25AP22A
- 25YP22
- 25YP22/ 25BP22A
- 25ZP22

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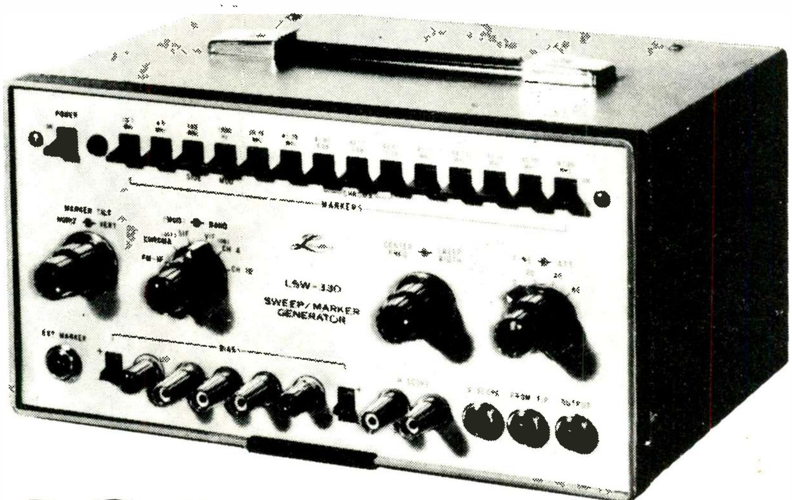

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Circle 3 on literature card

February 1972 • Volume 22, No. 2

Electronic Servicing

COLOR TV

SHOP MANAGEMENT

AUTO ELECTRONICS

TV (GENERAL)

TEST EQUIPMENT

DEPARTMENTS

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Circle 4 on literature card

electronic scanner

news of the industry

RCA closes down ServiceAmerica—The all-brand servicing operation initiated by RCA in Philadelphia in July, 1970, and later expanded to include servicing centers in San Francisco and Miami, was discontinued on Dec. 31. The reason for the closing of all centers, according to an RCA spokesman, was that "results in the three test markets do not justify the investment of money and other resources required to expand ServiceAmerica nationally."

RCA recalls AM clock radio Model RZD-422 for modification—RCA Consumer Electronics has asked owners of RCA Model RZD-422 clock radios to promptly unplug them and return them, for modification, to any RCA Consumer Electronics dealer or distributor. According to W. Thomas Collins, manager, Consumer Affairs, RCA Consumer Electronics, "An extraordinary combination of circumstances—a capacitor changing value as a result of the radio being turned on a large number of times followed by the unrelated failure of a diode—could cause this model to overheat to such an extent that a small hole may be burned in the plastic." Reportedly, this "combination of circumstances" has occurred in only three of the 27,000 units of this model produced.

The Finney Company offers $59,500 worth of its products to promote membership drives of the two national electronic service associations—Morris L. Finneburgh, Sr., E.H.F., chairman of the board of The Finney Company, Ohio based manufacturer of FINCO brand antennas, has announced that, during the period January 1, through March 31, 1972, his company will give to the first 500 approved new members of the National Alliance of Television and Electronic Service Associations (NATESA) and the first 500 approved new members of the National Electronic Associations (NEA) a gift certificate which can be redeemed, at any FINCO wholesale distributor, for $35 (dealer wholesale) worth of any FINCO MATV or outdoor antenna models. The total retail value of the 1000 gift certificates offered reportedly is $59,500. All new members reportedly will receive their gift certificates through their respective national associations, not directly from The Finney Company. For more information, write either NATESA (5908 S. Troy St., Chicago, Ill. 60629) or NEA (1309 W. Market St., Indianapolis, Ind. 46222).

Precision Tuner Service adds repair of TV IF subchassis and auto stereo and tape decks to services offered and changes name to PTS Electronics—Roland F. Nobis, president of PTS Electronics, Inc., formerly Precision Tuner Service, has announced the addition of television IF subchassis and automotive 8-track stereo and tape decks to the list of repair services offered by PTS. Recently, PTS purchased and began marketing the Colman Electronics line of tuner parts. □

SENCORE Model PS163 Triggered-Sweep Scope Price

The price listed for SENCORE'S Model PS163 triggered-sweep scope on page 41 of the Dec., 1971, issue of ELECTRONIC SERVICING is incorrect. The correct price is $595.00, including both low-capacitance probes.

Correction Of Leader Address

The address for Leader Instrument Corp. listed in the *Source Guide To Imported Consumer Electronics Products*, page 60 of the November, 1971, issue of ELECTRONIC SERVICING, is incorrect. The correct address is:

Leader Instrument Corp.
37-27 27th St.
Long Island City, N. Y. 11101

Troubleshooter Topics

If troubleshooting a particular type of circuit or section in a TV or other consumer electronic product has always seemed unusually difficult for you, let the Troubleshooter know about it and he'll discuss it in the Troubleshooter department. Send your suggestions to: Troubleshooter, ELECTRONIC SERVICING, 1014 Wyandotte Street, Kansas City, Missouri 64105.

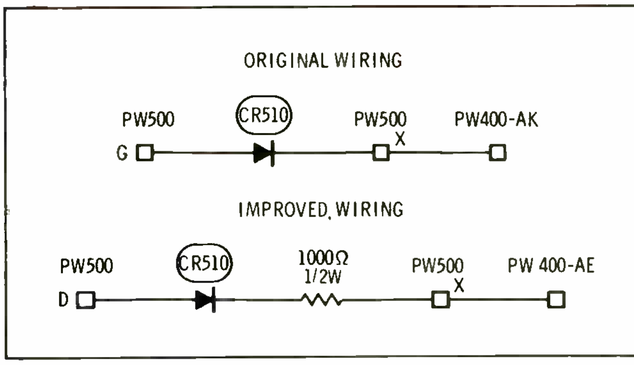
service bulletin

a digest of information from manufacturers

SCR failure prevention
RCA CTC44 color TV chassis

If SCR102 should fail in early-production chassis, change the circuit as shown in the schematic.

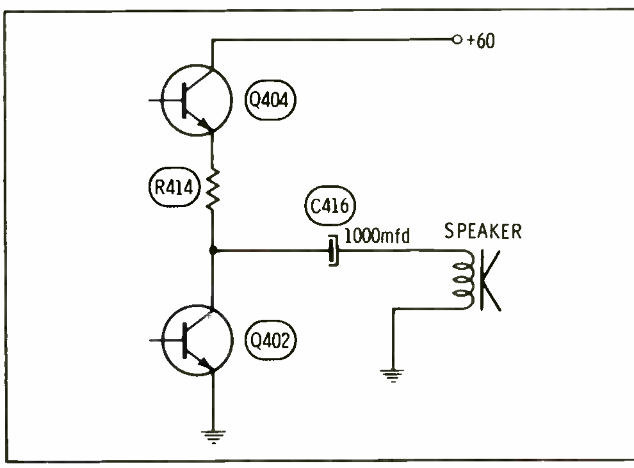
The anode lead of CR510 should be moved from point PW500-G to PW500-D. Disconnect the cathode lead of CR510, add a 1000-ohm, ½-watt



resistor in series, and reconnect the other end of the resistor to point PW500-X. Cover the diode and resistor with tubing or spaghetti. One end of the wire connecting PW500-X to the PW400 board should be changed from point PW400-AK to PW400-AE.

Failure of speaker coupling capacitor
RCA amplifiers RS252, RS253 or RS266

Defective components, such as a non-conducting Q402 or a shorted Q404, can apply excessive voltage to C416, causing it to short.



Before replacing such a shorted capacitor, disconnect it and measure the voltage between R414 and chassis ground. The voltage should be approximately one-half the value of the supply voltage.

If the voltage at R414 is incorrect, the cause should be found and corrected before a new C416 is installed. Otherwise, the replacement capacitor might be damaged.

Production changes in chroma modules
RCA CTC49, CTC46 or CTC54 color TV chassis

Two chroma modules that are identical electrically but not physically have been used in the CTC49 chassis. These modules are directly interchangeable. However, one type is correctly labelled MAC 001A, and the other is incorrectly labelled MAC 002A.

Chroma modules for the RCA CTC46 and CTC54 chassis are correctly labelled MAC 002A. These modules are **not** interchangeable with those designed for use in the CTC49.

Use the following chart to help identify these modules:

Chassis	RCA Stock No.	Module ID No.	Visual Differences
CTC49	132583	MAC 001A	two variable resistors
CTC49	132583	MAC 002A	two variable resistors
CTC46/54	134007	MAC 002A	three variable resistors

To prevent confusion, any modules with stock number 132583 which are marked MAC 002A should be relabeled MAC 001A.

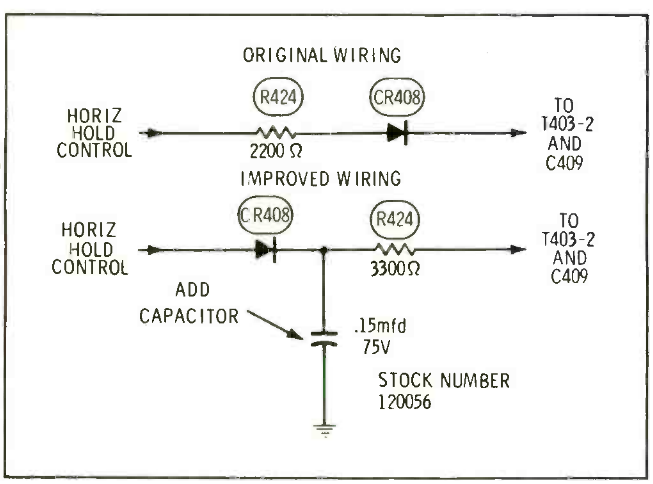
Picture overloaded on strong channels
RCA KCS186 b-w chassis

Symptoms similar to those of AGC overload can be produced by a defective video-output transistor (Q504).

Add, by means of very short leads, a neon bulb (RCA stock number 130043) between the grid of the picture tube and ground. This will minimize the possibility that picture tube arcs might destroy the replacement transistor.

Nuisance opening of the circuit breaker
RCA early production CTC46 color TV chassis

To stop opening of the circuit breaker when no overload exists, rewire the circuit around CR408



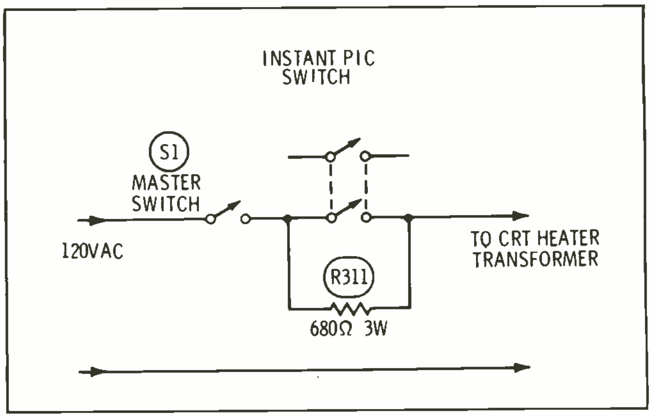
(Continued on page 8)

(Continued from page 7)

and add a .15-mfd, 75-volt capacitor, as shown in the schematic.

Drifting screen color
RCA CTC40 color TV chassis

Varying gray-scale tracking, which simulates a weak picture tube, can be caused by an open or intermittent INSTANT PIC switch.



Heater voltage of the picture tube will be either 5 volts or 6.3 volts, depending on whether the switch section that parallels R311 is open or closed (has continuity).

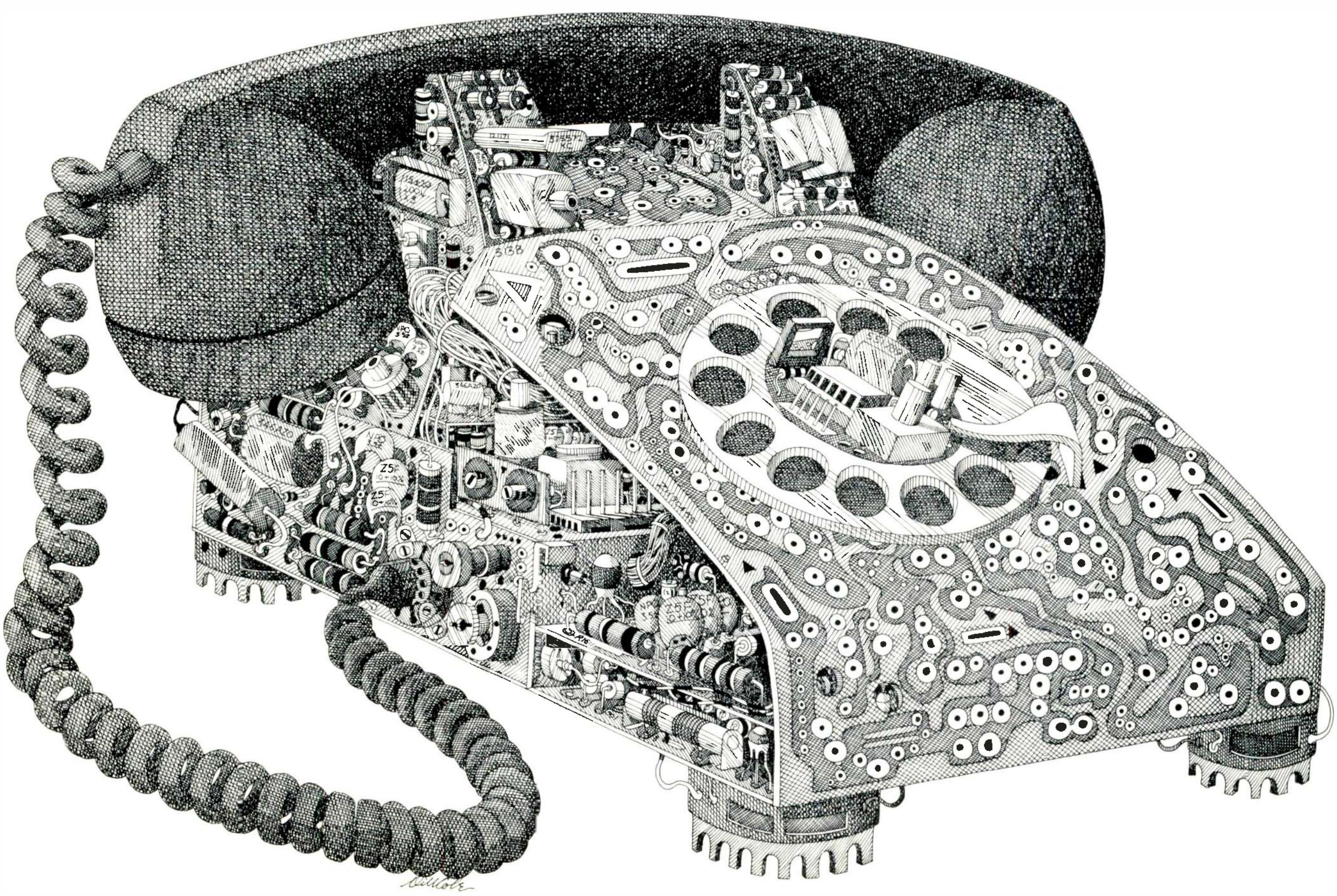
Replace the INSTANT PIC switch, if it becomes open or intermittent.

Replacement damper diodes
RCA CTC22, CTC41, CTC42 and CTC 43 color TV chassis

Single damper diodes (RCA part number 120818) will no longer be stocked by RCA Parts and Accessories. For replacement diodes, order RCA stock number 135320, which is two damper diodes with wire leads.

Parallel the two diodes by twisting and soldering together the leads (be sure that the cathodes are wired together and that the anodes are wired together). Plug one of the diodes into the fuse clip (observe the correct polarity).

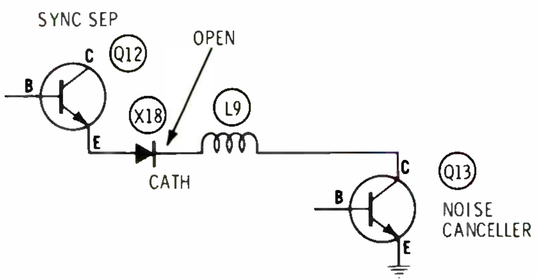
To prevent arcs, dress wires and components away from the damper diodes and their leads. □



symcure

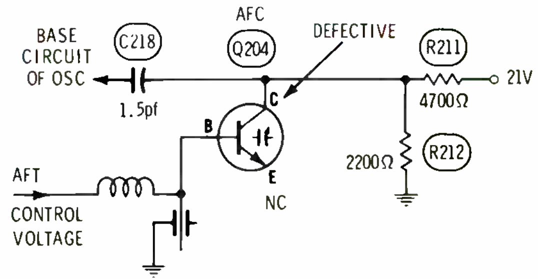
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Sylvania D10
PHOTOFACT folder—976-2



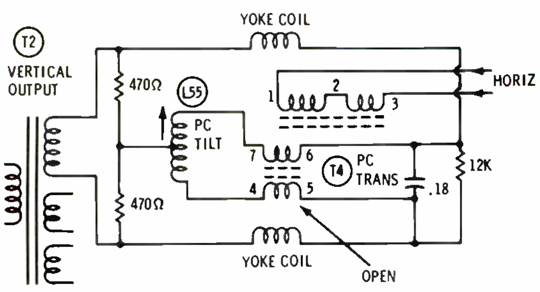
Symptom—No vertical or horizontal sync
Cure—Check diode X18, and replace, if it is open

Chassis—Sylvania D12
PHOTOFACT folder—1143-1



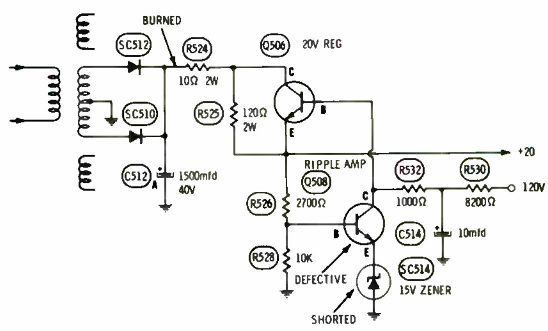
Symptom—15 horizontal bars produced on screen when AFT is on and fine tuning is adjusted
Cure—Replace Q204, which is a transistor used as a varactor diode

Chassis—Sylvania D12
PHOTOFACT folder—1143-1



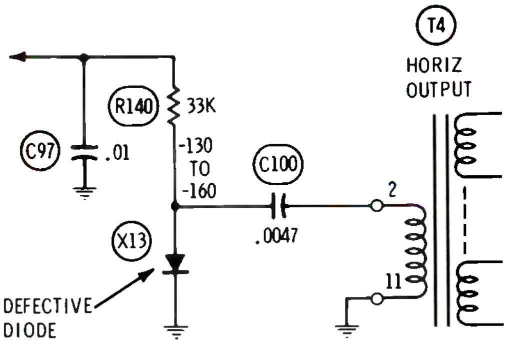
Symptom—No vertical sweep
Cure—Check for an open in T4, the pincushion transformer

Chassis—Sylvania E01
PHOTOFACT folder—1194 POM



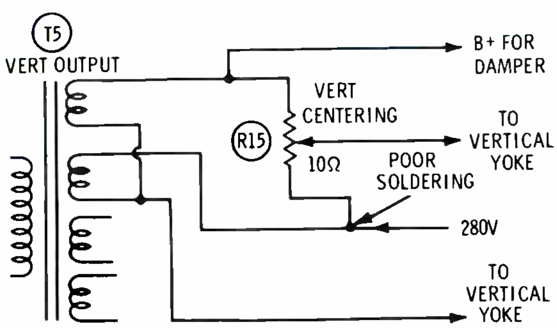
Symptom—Horizontal bending, plus hum in sound
Cure—Check and replace, if defective, Q508, SC514 and R524

Chassis—Admiral G13
PHOTOFACT folder—844-1



Symptom—Picture too bright; no control over brightness
Cure—Check and replace, if defective, the bias supply diode, X13

Chassis—Admiral K16
PHOTOFACT folder—1204-1



Symptom—Vertical centering affects the linearity
Cure—Check for poor soldering at the point where the red wire from the centering control connects to the board

(Continued on page 12)

You can make more money selling the Sylvania color bright 85XR®.

And Olive Oyl will look just as beautiful.

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

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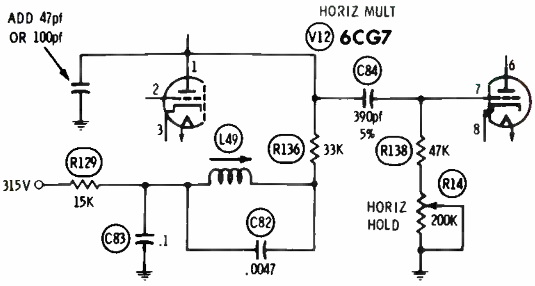
If that isn't beauty, what is?

GTE SYLVANIA

(*Continued from page 10*)

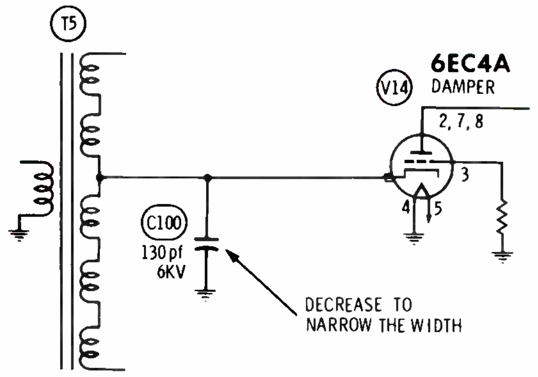
symcure

Chassis—Electrohome G3
PHOTOFACT folder—973-1



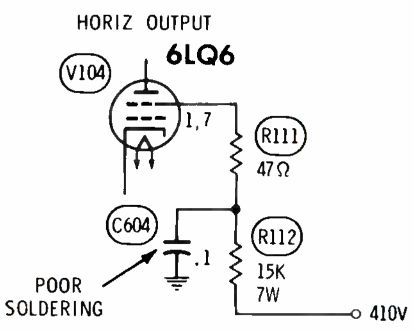
Symptom—Critical horizontal locking
Cure—If C84, R138 and R14 are good, connect a 47- or 100-pf capacitor between the plate (pin 1) of the horizontal oscillator tube and ground

Chassis—Electrohome C7
PHOTOFACT folder—1198-1



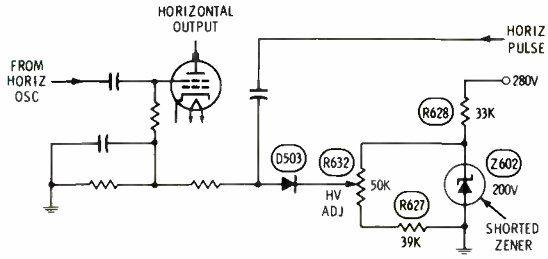
Symptom—Excessive width
Cure—Replace C100 with a 47-pf, 6KV unit

Chassis—Magnavox T951
PHOTOFACT folder—1180-1



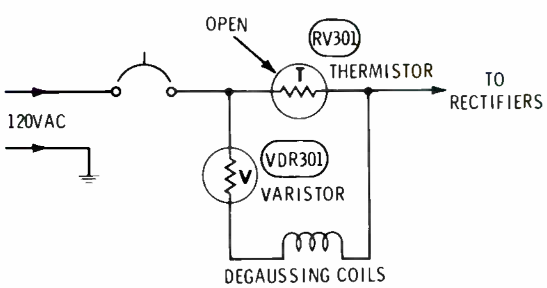
Symptom—Reduced width and decreased high voltage
Cure—Check for a poor connection at one end of C604; resolder it

Chassis—Magnavox T950
PHOTOFACT folder—1189-1



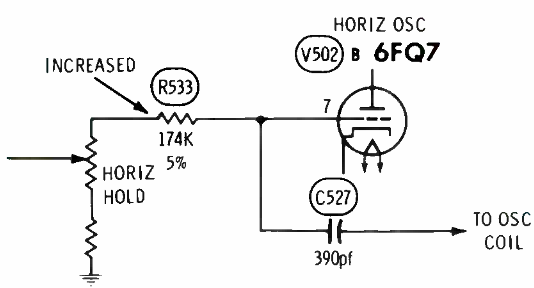
Symptom—Reduced width and decreased high voltage
Cure—Check and replace, if defective, the HV ADJ zener diode, Z602

Chassis—Magnavox T939
PHOTOFACT folder—1109-1



Symptom—Colored hum bar in raster
Cure—Check for disconnected lead on the degaussing thermistor, RV301; replace with new type

Chassis—Magnavox T951
PHOTOFACT folder—1180-1



Symptom—Horizontal sync off frequency
Cure—Check and replace, if increased in value, R533 □

Circle 12 on literature card

shoptalk

With Carl Babcoke
ES Technical Editor

What Color Bars Reveal About Hue Defects

Reproduction of natural appearing hues demands a normal b-w foundation and the correct phase, amplitude and sharpness of the individual red, blue and green color signals. By analyzing the color bars displayed on the screen of an improperly operating receiver, you can determine, in just a few tests, which of these requirements is not being fulfilled.

When a receiver is operating normally, adjustment of the tint and color saturation controls for pleasing skin colors during reception of a colorcast also automatically produces satisfactory reproduction of other hues. This is not necessarily true when chroma defects are present. In some cases, satisfactory skin color might be impossible to obtain. Or a false skin hue consisting mainly of reds might fool an unwary technician into believing all was well.

Checking Tint-Control Action

The first question to be answered by interpretation of the color bars is whether or not the tint control will adjust to the correct point.

Fig. 1 shows the color bars as they appear on the screen of a non-defective color receiver when the tint control is adjusted according to theory. The brightest red bar is the 3rd one from the left. Because this late-model receiver has 105 degrees of phase difference between the R-Y and B-Y signals, the brightest blue bar should be 6½. However, because there are no half bars, the 6th and 7th bars are equally bright. The brightest green bars cannot be seen, but the 9th and 10th bars show some green.

To compensate for changes in the phase of the burst signal from one program to another, the tint control must be able to move the color bars at least one bar to the left and one bar to the right of the correct positions.

Fig. 2 shows the color bars that are produced when the tint control is turned so that the 2nd bar is the brightest red. Notice that all the bars are moved one place to the left. This adjustment of the tint control causes slightly purple faces during colorcasts.

Adjustment of the tint control to the position that produces greenish faces moves all the bars to the right as shown in Fig. 3, in which the brightest red bar is the 4th one.

Tips About Tint Adjustment

When adjustments of the tint control cannot move the brightest red bar over the range from the 2nd to the 4th bar (or more), a technician logically would suspect a defect in, or incorrect adjustment of, the burst amplifier circuit. However, before you routinely align the burst transformer, consider carefully these tips:

- It is not necessary that correct tint be obtained at the *exact* middle setting of the tint control. More important, there are some cases where this condition is undesirable.
- Many times, the result of forcing correct tint action to occur at the exact center position of the tint control is that the bars move very little when the tint control is adjusted. This is most likely to occur in receivers in which the tint control is in series with a capacitor which tunes the burst transformer. In these receivers, align the core of the burst transformer to the position that causes maximum movement of the bars when the tint control is rotated from one end to the other. Correct tint should be obtained *somewhere* within the rotation of the control.
- If the tint control moves the color bars sideways an adequate amount (three or more bars) but faces can only be changed from slightly greenish to green or from slightly magenta to a deeper magenta, it is probably caused by poor alignment of the chroma bandpass IF's *following* the burst take-off point. Poor alignment of the video IF stages or the first chroma tuned circuit should not be suspected. Phase changes in these stages affect burst and chroma signal alike, and are not likely to cause a tint-control problem.
- The position of the brightest red bar should be used as the standard for tint adjustments because red is the dominant hue in skin color. For example, almost normal skin color can

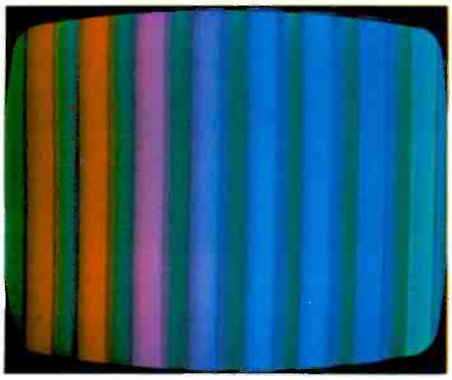


Fig. 1 Color bars displayed by a normally operating receiver which has 105-degree separation between R-Y and B-Y. Slightly excessive width has obscured the 10th bar and shows only a part of the 2nd bar. The brightest red bar is the 3rd from the left.

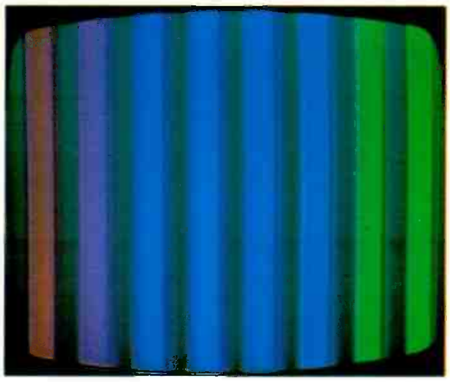


Fig. 2 Rotation of the tint control has moved the brightest red bar to the 2nd. With this tint-control setting faces would be magenta during colorcasts.

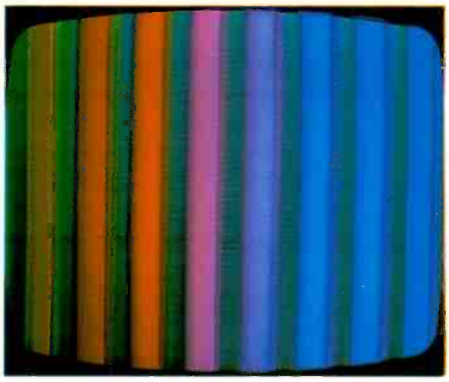


Fig. 3 The same bars after the tint control has moved the brightest red bar to the 4th. Faces would be greenish-orange during colorcasts.

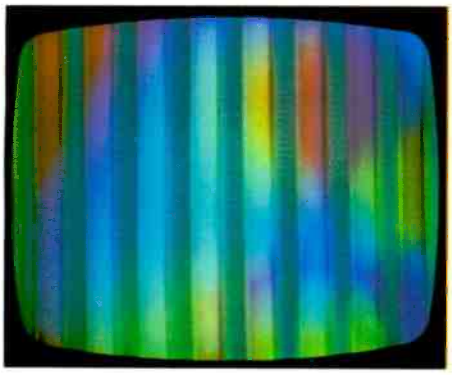


Fig. 4 Impure picture tube can cause wrong tints and weak color. Color bars become a patchwork of hues when the purity is poor. The bars near the center are nearly white (no color).

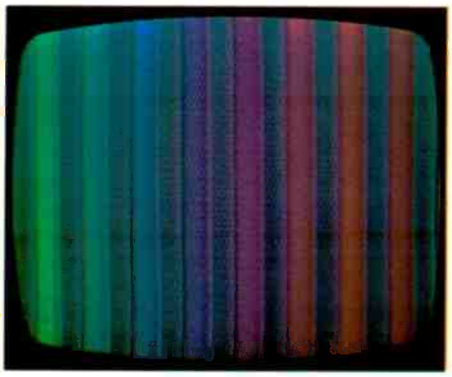


Fig. 5 Loss of B-Y eliminates the blue bars, but the background tracking is not changed. Skin hues were not affected significantly.

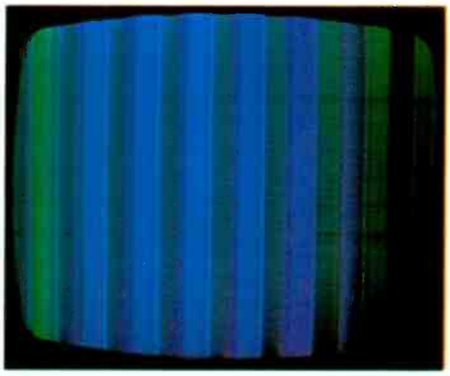


Fig. 6 Loss of R-Y eliminates the red bars without affecting the background tracking. Skin tint was impossible to attain. If R-Y is merely weak, adjustment of the tint control to produce skin hues will be very critical.

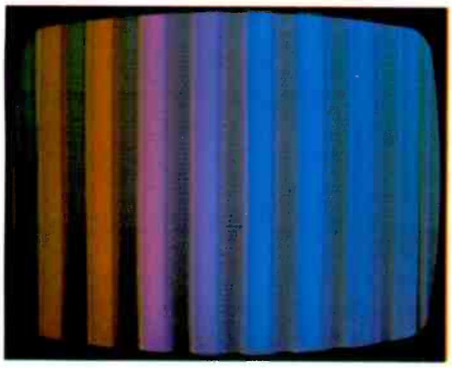


Fig. 7 Loss of G-Y is not very noticeable either on the bars, as shown here, or during colorcasts. A weak green is created by the -Y action of the other two demodulators, which remove red and blue from the raster so that some green remains.

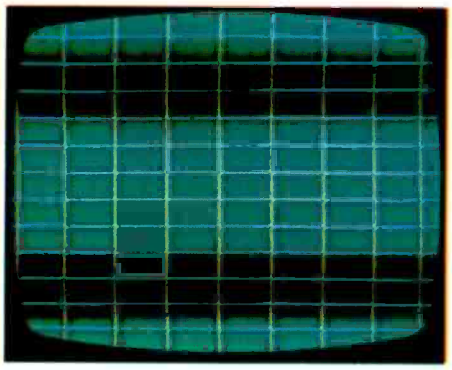


Fig. 8 120-Hz hum (two black horizontal bars) is superimposed on the crosshatch pattern. Hum from the video, such as this, does not shade the raster or change the gray-scale tracking.

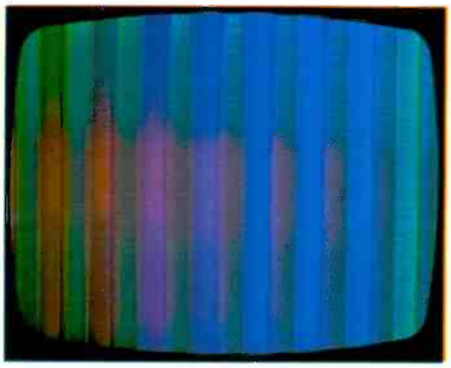


Fig. 9 Hum in the R-Y amplifier stage changes the gray-scale tracking and in the area of the hum the intensity of the colors is increased.

be produced by a receiver which has a normal R-Y signal but no B-Y or G-Y chroma signals. In such cases, the tint control masquerades as a color control; that is, the color will be brightest near the position of the tint control at which correct tint would be obtained if B-Y and G-Y were present. This mystifying symptom can be solved easily by tuning in the color bars. The red bars will move sideways in normal fashion, but there will be no blue or green bars.

- Think of the 2nd color bar as the generator equivalent of skin color. The tint control normally should vary this 2nd bar from greenish-orange to slightly magenta.
- At extreme settings of the ATC switches, some modern receivers stretch the theoretically correct 90-degree phase difference between R-Y and B-Y to as much as 150 degrees. Consequently, do not be too critical when checking the positions of the blue or green bars in these receivers. Because a pleasing skin color is the primary purpose of these ATC circuits, you should not be too critical of the positions of the other hues when the ATC is in operation.
- If all color is lost when the tint control is positioned near the point at which best hue is produced, the problem probably is a marginal setting of the killer control.

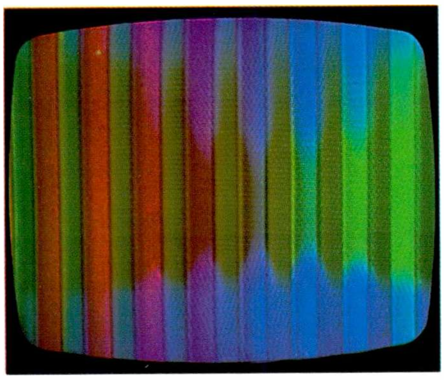


Fig. 10 Hum in the B-Y amplifier stage changes both the gray-scale tracking and the intensity of the color. Refer to the text for tips about determining which -Y stage has the hum.

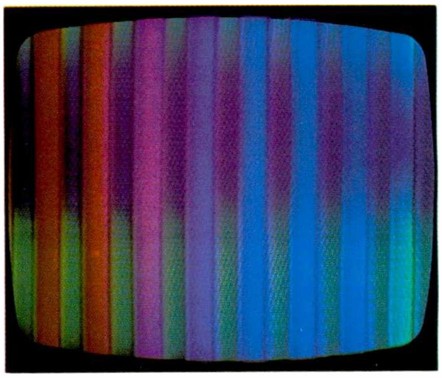


Fig. 11 Hum in the G-Y amplifier stage.

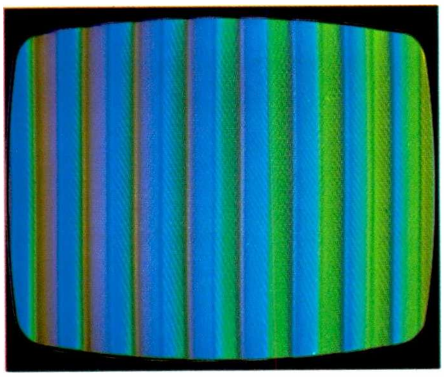


Fig. 12 Smeared colors are the result of misalignment; to produce the example shown here, the fine tuning was misadjusted. Note that the color saturation was not reduced noticeably because of ACC action. Always adjust the fine tuning to produce sound bars and beat patterns, then reverse the rotation only enough to eliminate the beat patterns.

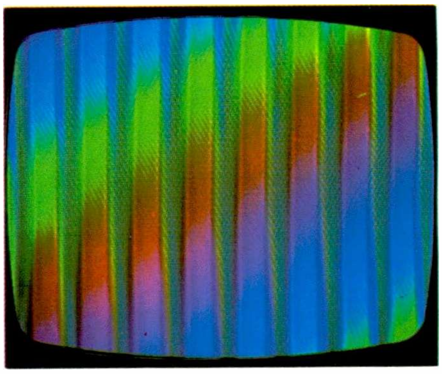


Fig. 13 Out-of-lock color is much easier to see on the bar pattern than on a colorcast. Skin color during colorcasts can be produced falsely in small areas of the picture when the color is out of lock.

Purity of The CRT Affects Tints

Tint and saturation of the color bars can be changed drastically by impurity of the color picture tube. It is futile to attempt adjustment of the tint action when the purity is very poor.

Fig. 4 shows poor purity of the red field alone, produced by turning off a degaussing coil near the CRT. The effect of this impurity on the color bars is evident in Fig. 4. The effect on a colorcast is more subtle. Such poor purity causes the skin hue to change drastically, the amount depending on its location on the CRT screen.

Notice in Fig. 4 that neither the purity nor the gray-scale tracking between the bars appears to be changed by the impurity, although we know it is.

All methods of checking for impurity are not equally effective. Impurity can be found best by viewing each color alone while the other two guns are cut off by a gun-killer switch.

The second best method is to analyze *vertically* the hue of each color bar. Receiver defects, such as poor alignment of the video IF's, change the even coloring of the bars, but the hue changes horizontally across the bars. Only poor purity can cause the bars to change hue vertically between top, middle and bottom.

The least effective method of evaluating impurity is to turn down the color control and attempt to see the effects of the impurity in the b-w picture.

Impurity which covers most of the screen area can fool an unwary technician into believing that there is weak or no color. When the beam from each gun strikes the dots of *all* three colors, there is no separation of the colors. An example of this are the bars near the center in Fig. 4, which appear to have very little color.

Gray-Scale Tracking Affects Tints

The balance of red, blue and green necessary to produce a near-perfect rendition of non-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primary hues is a very critical one. However, because the correct hues of many objects in a colorcast are seldom known, the effect of poor gray-scale tracking might go unnoticed during the reproduction of scenes with many hues. Everyone knows what natural skin color should be, and any serious deviation from the norm can be spotted easily. This is especially true of the red component, which, as mentioned previously, is the most vital for a pleasant skin color but the least important to the b-w picture.

Use the following no-instrument procedure to determine if the b-w tracking is adjusted so that enough red is produced to permit good skin color:

- Tune in a television program, turn down the color, and adjust the controls to produce a b-w picture which has moderate brightness and contrast.
- Connect a gun-killer to the CRT.
- Switch off one gun at a time, leaving on the other two. When either blue or green is missing, a large change should be seen in the screen color. Switching off red should make a distinct change, but not so much as the other two. If there is no visible change, red is weak or missing.
- Switch off all three guns, and then switch them back on one at a time. The red and blue pictures should have nearly the same brightness, but green should be brighter. If red is even slightly less bright than blue, skin color can be degraded.

Balance of The CRT Chroma Signals Affects Tint

Skin tint is composed of a large amount of red, a lesser amount of green, and some gray from the b-w picture. Any reduction in the red chroma signal makes the point at which the tint adjustment produces satisfactory skin hues very critical.

If any large decrease in red chroma occurs, good skin hue might be impossible to attain. Proof of this condition is that a point on the tint control can be found where adjustment to one side produces greenish faces, and rotation in the opposite direction produces magenta faces, but good skin color cannot be obtained between these positions.

Years ago, before Automatic Tint Control circuits became popular, there was a formula that specified the maximum P-P amplitude of the color-bar signal applied to each gun of the CRT. Because blue bars were the strongest, they were designated 100 percent. The brightest red bar should be 85 percent, and the brightest green bar about 25 percent.

This ratio could be tested by merely turning down the brightness control and watching the sequence in which the three primary colors were extinguished. First, the background between the bars disappeared, then the green bars went black, followed by the red bars. The blue bars normally could still be seen at the minimum setting of the brightness control.

This method of evaluating the relative amplitudes of the chroma signals is now riddled with exceptions. Many ATC circuits reduce the amplitude of the blue bars and shift the gray-scale tracking towards maroon. Generally, the red bars displayed by a late model color receiver should *not* be less bright than the blue bars.

The most extreme symptom produced by weak blue chroma is shown in Fig. 5, in which the blue (B-Y) bars are missing completely. Loss of blue from the b-w raster would not look the same, because the background that is between the bars would appear greenish-yellow.

Fig. 6 shows the color bars produced when R-Y is missing. Loss of red from the complete b-w raster would shift the background between the bars to cyan. This distinction is difficult to see, so use care in this part of the diagnosis.

Loss of green bars is shown in Fig. 7. The green bars are normally less bright because the brightest bar occurs during retrace. (This is one of the few weak points in color-bar analysis.) Because loss of green from the raster—which would also eliminate the green bars—changes the background between the bars to pure magenta, there should be no question about the loss of this color from the raster.

Hum Can Affect Skin Colors

Hum in a color TV receiver often produces the same symptoms as in a b-w receiver. For example, cathode-to-heater leakage in a tuner or IF tube causes hum modulation of the signal, and one rounded, horizontal bar of hum is seen superimposed on the picture. With the tuner off-channel, no hum bar is displayed on the CRT.

If hum originates in a video stage, the hum bar will be visible on the screen both on and off channel, and the appearance will be identical on both color and b-w receivers.

Transistors cannot originate hum, but power-supply hum in solid-state TV receivers is likely to be seen both with and without a signal. Such hum might appear as either one or two dark, horizontal bars. One bar indicates a hum frequency of 60 Hz, and two bars indicates 120 Hz (shown in Fig. 8).

Hum which originates in the chroma-bandpass stages will *not* exhibit black hum bars. Instead, the hum bar will be displayed in the form of a band(s) of more intense color.

The appearance of hum in the R-Y amplifier stage is shown in Fig. 9. Hum in a single -Y amplifier stage changes the b-w tracking and screen color in the shape of a hum bar. This "colored" hum bar, which will have the color of the affected -Y amplifier will be seen on the CRT screen both on and off channel.

The gain of a -Y amplifier stage also is changed by hum, which varies the grid-cathode bias. The red bars in Fig. 9 are brighter where the hum bar lightens the raster, and are missing where the raster hum bar is darker. Check this by rotating the color control.

In some cases, vertical-retrace lines of the color corresponding to the -Y amplifier in which the hum originates can be seen when the hum is intense and the brightest part of the bar reaches the bottom of the screen.

Hum bars always slowly drift *up* the screen during colorcasts, because the vertical-sweep fre-

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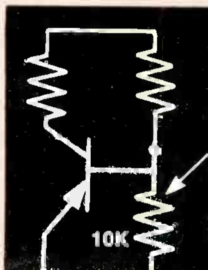
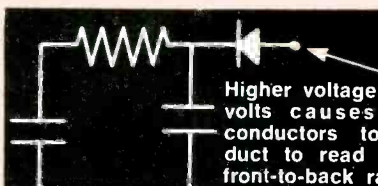


Low voltage of .08 volts prevents transistors from conducting and misreading circuit. Resistor will now read 10K as it should. Also prevents any damage to transistor.

Here is why you should have both Hi and Lo battery voltages for correct in-circuit resistance measurements in solid state circuits:



Higher voltage of 1.5 volts causes semiconductors to conduct to read proper front-to-back ratio or conductivity of transistors. Meter would not be complete without hi-ohms reading.

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quency of the color TV receiver is slower than the line frequency, to minimize beat patterns. When a color-bar signal is applied to the receiver, the hum bars will be motionless, if the generator is locked to the 60-Hz power line; if not, the bars will slowly drift up or down, depending on the exact vertical frequency provided by the individual generator.

Hum in the B-Y amplifier is shown in Fig. 10. To determine in which -Y amplifier the hum is originating, notice not only which color bars exhibit changed intensity, but also just how the background between the bars is changed. For example, in Fig. 10 the blue bars exhibit reduced intensity near the center of the screen. The background in that area is greenish orange, which is the hue produced by green and red when blue is missing. At the top and bottom of the picture, the background is nearly pure blue—not-magenta, which would be red plus blue. From these symptoms, it can be seen that the B-Y channel is the one in which the hum originates.

A similar analysis can be made of the color bars in Fig. 11. In this case, the less-intense hum is in the G-Y channel, as proved by the magenta background where the green bars are weak and the green background where the green bars are brighter.

These variations from normal tint and background color are much easier to see and analyze on an actual color picture tube than from pictures.

Gun-killing switches can aid in analyzing the source of hum. Some chroma circuits use cross-mixing of the three -Y signals. In such circuits, hum originating in one channel can be transferred, at reduced amplitude, to the others. It is simple to determine the color with the most hum by switching rapidly from one to the other.

Misalignment Can Cause Tint Problems

It is logical to assume that misalignment would reduce the sharpness of the color signal. A wide variety of unsharp, blotchy and smeared color pictures, often with sound bars or beat patterns, can be produced by an equally large variety of types of misalignment. In some extreme cases, it is impossible to adjust the tint and color controls for good skin tint.

One common type of misalignment degrades the color bars like those shown in Fig. 12. Not only do the bars appear smeared and exhibit incorrect hues, which appear as vertical lines of color along the right and left sides, but the background gray-scale tracking is affected. Even more important, there are no bright red bars.

This particular type of misalignment is easy to duplicate, for examination, because it can be produced by a normal receiver with the fine tuning misadjusted. To produce the display in Fig. 12, the fine tuning was turned, as far as possible without losing color, in the direction away from the sound bars (into the smear).

Ghosts Can Cause Tint Problems

Severe location ghosts can cause the same visual symptoms on colorcasts as those caused by misalignment. Use color bars from the generator, before condemning the receiver.

Perfect ACC Can Appear To Cause Tint Problems

To produce normal saturation of the color on the screen of older color receivers, the viewer has to adjust the fine tuning close to the sound bars. If the color is bright, the fine tuning automatically is set for sharp color.

Many of the new receivers have Automatic Chroma Control (ACC) systems which are so effective they maintain the saturation at a high level, even when the fine tuning is misadjusted enough to produce a color picture so poor it appears to have been caused by tint problems.

Also, a defective or incorrectly adjusted Automatic Fine Tuning (AFT) system can cause symptoms which can be easily mistaken for tint or alignment problems. A few seconds spent watching the color bars as you adjust the AFT, fine tuning and tint controls throughout their ranges should rapidly eliminate any doubts about the actual source of the trouble.

Out-Of-Lock Color Can Simulate Tint Problems

One of the strongest advantages of using color bars is the ease and certainty of recognizing when the color is out of lock, and the ease with which the locking can be readjusted, when that is necessary.

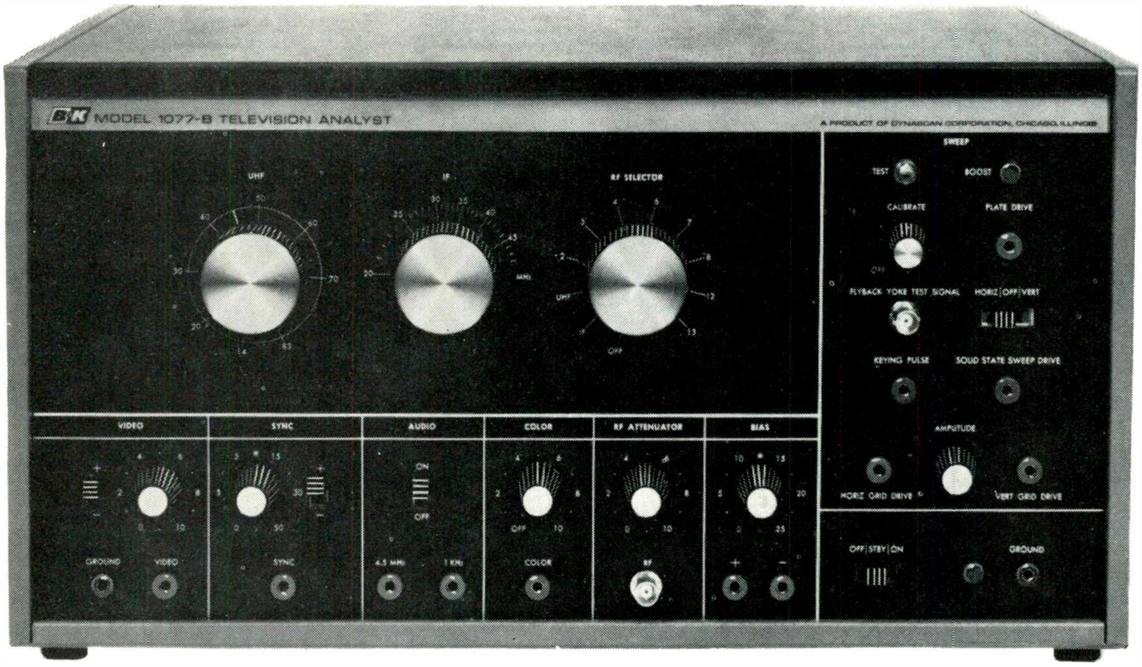
Fig. 13 shows the color-bar pattern which is produced when the color is out-of-lock by only 1 "stripe" (the more stripes, the larger the frequency error). If an area of skin color were located anywhere along the orange part of the stripe, the tint would appear to be nearly normal; however, skin hue at any other location would be some gruesome combination of green and blue.

Summary

Color-bar generators of the keyed-rainbow type are in almost universal use among color TV technicians, because color-bar, dot and crosshatch patterns can tell them more in less time than can any other instrument.

Visible characteristics of the color-bar display can indicate: demodulator phasing; the approximate amplitude of each red, blue, and green signal at the CRT; the tint control range; and color locking. Only in cases involving setup characteristics—such as gray-scale tracking or purity—is it necessary to use b-w or color broadcast programs as a supplement to the color-bar analysis.

No TV receiver can compensate for the differences of the color broadcast signals which produce weather instrument meters which are pale green when viewed by one color camera and light pink when produced by a second camera. Analysis of the color bars displayed on the screen of the receiver can quickly reveal a gross unbalance of red, blue or green in a color camera at the TV studio—a condition which the set owner might be trying to eliminate by repeatedly readjusting the tint control. Conversely, if the trouble symptom is produced by a receiver defect, analysis of the color-bar generator pattern also will quickly and positively reveal this fact. □



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The Cash Budget:

A Forecast of Your Business' Cash Input, Output and Balance

You have a big cash outlay coming up—a business insurance premium, a new service truck or a much-needed (and expensive) piece of test equipment.

Where's the money coming from? A good business manager will have a plan. He'll anticipate the upcoming need and plan for it.

We've already made the point, and often, that good management begins with good records. And, we've already discussed how your record system functions as a historical document: the record of what's happened.

Now, let's look at it as a key to the future. That's where the budgeting, or financial forecasting, comes in.

A cash budget is your plan for what's coming up, financially, and how you'll handle it. Forecasting is the main tool in financial management. In the narrow sense, it predicts your cash position month-by-month, to help you plan for your needs in advance.

The broader objective of cash planning comes into play when it is geared with growth planning, to set down the monthly growth goal (in terms of cash position) to give you a clear statement of those goals. By recording the actual performance, as well as the predicted performance, you have a direct measure of your achievement of these goals.

Call it a 'budget' and your cash plan immediately takes on a bad image. That name conjures up memories of living in a money squeeze, of wrangles at home about how much to spend on clothing for the kids, or jokes about "never-enough-left-to-live-on."

Nevertheless, budget it is.

Major Objectives of Financial Management

Good financial management has three major objectives:

- It aims to use assets in a way which produces the highest possible return on their investment.
- It aims to evaluate the need for new assets, and help obtain the funds required for them.
- It aims at proper management of these funds—obtaining them, repaying them (if borrowed) and making them work at a profit.

Notice that every one of these objectives involves *planning*, which is a predictive, or forecasting, activity.

What A Cash Budget Can Do For You

Using a cash budget, or financial forecast, to predict your cash position helps you foresee your needs for additional money, as mentioned. You can foresee how much you'll need, for how long, and how you'll repay it. And, you can predict *when* you're going to need it. A forecast can also help you plan your financing for high-cost periods, for special seasonal needs, or for improvements and expansion. It can also help you take advantage of money-saving, or money-making opportunities, like using cash discounts, or buying in bigger quantities to get better price breaks, or moving into new service activities which promise good profits.

Unplanned, these moves can only be made "if and when money is available." With planning *you* decide when these moves should be made, and work out a plan to be ready on time.

Elements of a Cash Budget

A simple Cash Budget form is shown in Fig. 1. It begins with the entry of your expected Cash Balance at the beginning of the month. Initially, this is obtained from your present Cash Balance minus whatever you'll have to spend before the planning period begins.

Cash receipts

Items 1 through 5 give you the total cash you expect to have as each month of the budget period

	Initials	Date
Prepared By		
Approved By		

CASH BUDGET

Item	January Budgeted	January Actual	February Budgeted	February Actual	March Budgeted	March Actual
1. Expected Cash Balance at Beginning of Month						
Expected Cash Receipts:						
2. Cash Sales						
3. Collections on Receivables*						
4. Other Income						
5. Total Cash for Month						
Expected Cash Payments:						
6. Parts and Supplies						
7. Disbursed on Payables						
8. Payroll						
9. Administrative Expense						
10. Other Cash Payments						
11. Total Cash Payments						
12. Cash Balance at End of Month (Item 5 less Item 11)						
13. Desired Cash Balance to Maintain (for Comparison with Item 12)						
*If appropriate to your operation						

Fig. 1 A typical short-term Cash Budget

(Continued from page 23)

begins. They're estimates, based on your past records and your plans for growth.

Cash payments

Likewise, Items 6 through 11 build up your estimate of what your expenses will be during the same period. Some of these can be determined relatively accurately—tax bills, insurance premiums, your accounts payable and, sometimes, your payroll expense. Others will be estimates, again, based on your records and your plans.

Cash balance

The difference between Total Cash and Total Payments gives you your Cash Balance at month's end. Item 13 is simply a statement of what you want your Cash Balance to be, and is included on the form for comparison purposes. How all these elements are combined is traced in the block diagram in Fig. 2.

How much of a Cash Balance should you maintain? That's up to your judgment of your business, its cash needs and the margin of safety that "feels right" to you. In retail businesses, a Cash Balance equal to so many days' sales is used as a guideline. In service businesses, the formula is usually based on the average daily expense for so many days. You may want to have a month's expenses on hand, or six weeks' expenses. Whatever your choice, it's largely a matter of experience and partly a matter of your plans and the forecast itself. Don't overlook the "special" factors. A new business that isn't breaking even needs more than a going concern, to cover the anticipated losses during startup. So does an "old, run-down" business that you've taken over.

Fundamental Guidelines To Follow When Building Your Cash Budget

These suggestions may help you build your first cash budget:

Be realistic, and a little conservative. Set sensible, attainable goals. Accept the fact that you can't achieve everything in the first budget period, and be satisfied with signs of progress at first. Although you're working with estimates, try to make them accurate. Posting actual figures alongside your budgeted figures helps. The form allows for this.

Be systematic. To make up your anticipated expenses, use your records and your payments calendar. First, list all your known and predictable expenses coming up during the budget period. List the date and the amount needed. Then estimate and list the variable expenses that are expected.

Be flexible. The forecast is, after all, a plan. Plans can, and do, go astray. Avoid this as much as possible by playing it cagey with your estimates—understate your income a bit, overstate your expenses a bit, and allow a little for emergencies. If you've done a good job with your forecast, small deviations won't hurt you; and part of your planning should be directed toward having the means to withstand the big ones. Revise your budget if you see it going too far astray. And be ready to revise your idea of how much your Cash Balance should be.

Start with what you can handle. While larger businesses do their budgeting for a year at a time, and often have extended forecasts of three, five and even seven or ten years, your first effort might be for just three months. Or, if you're in a tight squeeze when you begin, you might make your initial budget for as long as you think it will take to get out of trouble. Eventually, you may want to take on budgets of six months to a year, but not until you've mastered the method.

Once you've got your forecast working, you'll see the spots at which decisions have to be made. When your Cash Balance falls too low, you'll have to decide whether or not you need extra funds, or can shorten up on plans and expenses. If you go for the funds, lenders will appreciate your ability to tell them how much you'll need, for how long, and how you plan to repay it. Good managers don't have too much trouble with lenders or loans.

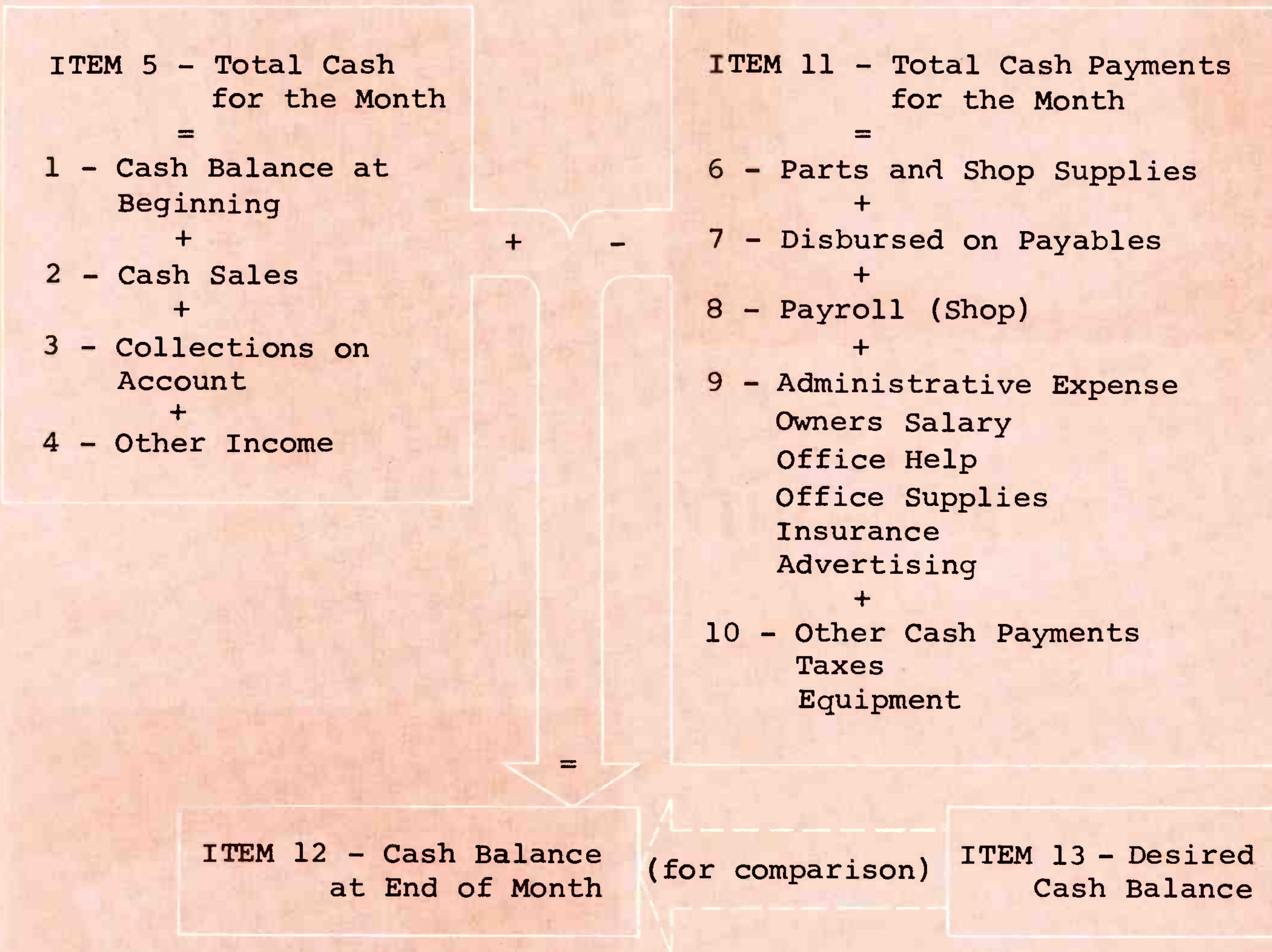
Keep Your Excess Cash Working For You, But Keep It Available

When your Cash Balance is running high, you can use the excess. In fact, you should use it. It's money not working if it's just lying around. Big firms frequently use excess cash to make money on short term investments. You can do the same, although on a smaller scale. Transfer your excess to a passbook savings account, to draw interest. Left there, it represents an invested reserve which is quickly available in emergencies, or to avoid the need for borrowing when a bigger cash need develops.

Excess cash can also be used for purchases you've deferred for lack of funds, to lay the financial groundwork for improvement or expansion, or

(Continued on page 26)

Fig. 2 Block diagram illustrating the elements of a Cash Budget.



reduce present obligations. Just make sure, from your forecast, that it's not money you'll need later, when a high-cost period comes along.

Special Sections You Might Need

That is all there really is to budgeting, but a few refinements might help you. It's possible that certain periods—often long ones of a year or so—will call for special planning. When you get ready for a major expansion, a big modernization and improvement program, or when you're in difficulties, as mentioned before, your forecast might become much more detailed, calling for closer study of your income prospects or your expense prospects. Your forecast may take on special sections to set forth the special expense you must plan for. For example, if you're working your way out of difficulty, you may want under your expenses, a special section called "Debt Retirement". If there are many creditors, you might even list each by name, to give further control to your plan for repaying them.

If you're expanding, modernizing and improving, your special heading could be "Plant and Equipment," to budget the outlay your program calls for.

Either way, that plan is your roadmap. It can also be a positive help—convincing lenders of your loanworthiness, or buying the time you need to pay off your creditors.

A workable forecast demands data from a good set of books. And, without the guidance of your cash forecast planning is no more than daydreaming. The bedrock question of any plan is "How will I pay for it?"

If your company books are the accurate, unbroken biography of your business—its history, if you please, then your forecast is its destiny. □

bookreview

How To Troubleshoot A TV Receiver (Revised Third Edition)
Author: J. Richard Johnson
Publisher: Hayden Book Co., Inc., New York
Size: 5¾ x 9 inches, 154 pages
Price: Softcover, $4.50

This text presents practical information about the preparatory and preliminary aspects of troubleshooting plus detailed discussions and listings of the tools, test equipment, replacement parts and accessories required to efficiently service b-w TV—all of which subject areas are ignored or treated only superficially by most other authors. The information presented in this book should be particularly useful to beginning technicians.

Contents: Getting The Most Out Of TV Service Data—TV Receiver Sections—Tools, Equipment And Accessories—Preliminary Observations And Checks: The Troubleshooting Approach—Use Of Test Patterns And Crosshatch Patterns In Troubleshooting—Controls And Their Adjustment—Tubes And Solid-State Devices—The Dead Receiver—Interpreting Raster Or Picture Distortion—Sound Troubles—Physical Aspects Of TV Troubleshooting.

How To Use Color TV Test Instruments
(No. 577)
Author: Robert L. Goodman
Publisher: TAB Books, Blue Ridge Summit, Pa.
Size: 5⅜ x 8½ inches, 256 pages.
Prices: Softcover, $4.95; hardcover, $7.95.

Although the title infers that this text covers only text instruments designed specifically for servicing color TV, instruments which have other primary applications also are included. A more appropriate title would be, "How To Use Test Instruments To Service Color TV."

Included in the text, in almost equal proportions, are: analysis of test equipment features and characteristics; general information about the applications of generic types of test instruments as well as what the author considers representative models of each type; specific troubleshooting techniques; IF and chroma alignment techniques; theory of operation of test-instrument and color TV circuitry; and a brief discussion of what the designs and features of future test instruments and TV's will be.

Contents: The Color Bench Scope—Color-Bar Generator Uses—TV Alignment Considerations—Basic Alignment Techniques—Color TV Alignment—Using Your Vectorscope—The TV Analyst—Sine, Square-Wave Generator—Semiconductor Curve Tracer—Miscellaneous Test Gear. □

by Joseph J. Carr/ES Auto Electronics Editor

Bendix 1972 Stereo FM Auto Radio

An analysis of the most unique circuitry—how it operates and how it should be serviced.

The new breed of car radios, especially the O.E.M. units supplied to the car makers, is the equal of most high-priced home stereo FM systems. In fact, some of the new car radios cost more than many home systems. It isn't impossible to spend up to half a kilobuck for an automotive electronic entertainment system. The Bendix stereo FM radio for the 1972 Ford cars is a good example of this new breed.

With the introduction of Philco-Ford into the stereo FM auto-radio market, the Bendix line is somewhat slimmer than it has been in previous years. Bendix has, however, managed to hang in there with a highly advanced product.

Many home FM systems cannot brag of some of the goodies used in the '72 Bendix. For example: dual-gate MOSFET transistors in the FM RF amplifier and mixer stages, crystal filters to replace the conventional IF transformers, IC FM IF amplifier, IC FM detector, and a new type of IC stereo decoder (not to be confused with the Motorola-type IC decoder used in certain other brands).

An IC preamplifier is used in the audio section. This IC is actually a dual operational amplifier, which contains the preamplifier stages for both channels.

The power rating of the audio amplifier stages is the only area where the Bendix radio has less than a typical home hi-fi- unit. The Bendix radio produces only a few watts of power, which is typical of car-radio power levels. Home systems with similar FM sections are now boasting upwards of 200 watts of audio power.

The Front End

The RF amplifier and Mixer stages of the FM portion are shown in Fig. 1. These stages use type 3N201 dual-gate MOSFETs. Both stages, even the RF amplifier, use the "common source" configuration instead of the "common gate" circuit popular in other designs.

Tuning is accomplished by the standard permeability tuning mechanism (PTM) used in car radios for years.

Bias is applied to the MOSFETs in two ways. One bias method sets the source slightly above DC ground by connecting a resistor between the source and ground. This is similar to cathode bias in vacuum tubes. A positive voltage applied to each gate of both transistors via resistor networks slightly modifies the bias.

In Q1, the RF amplifier stage, gate 2 (G2) is bypassed to ground as far as the signal is concerned. In the mixer stage, on the other hand, G2 is used as the injection point for the local oscillator signal. Because MOSFETs are high-impedance, voltage-operated devices, the tap usually found on the primary of the FM IF input transformer isn't necessary.

FETs have been accepted by modern designers for several reasons: Because they accept a wider range of input signal voltages without overloading, they provide better performance where cross- or inter-modulation is a problem. In this respect, they are equal to or better than the triode vacuum tubes used in the FM designs of a few years ago.

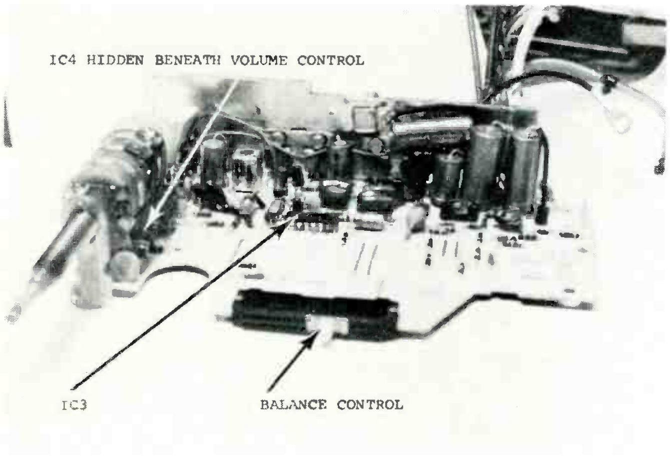
Solid-state FM circuits in older models traded off the vacuum tube's freedom from nonlinearity for the advantages that solid-state can offer. Although bipolar-equipped receiver front-ends were small, compact, generated little heat and consumed absurdly small amounts of electrical power, they exhibited poorer large-signal performance than tube-equipped front-ends. With MOSFETs, we can have the best of both worlds.

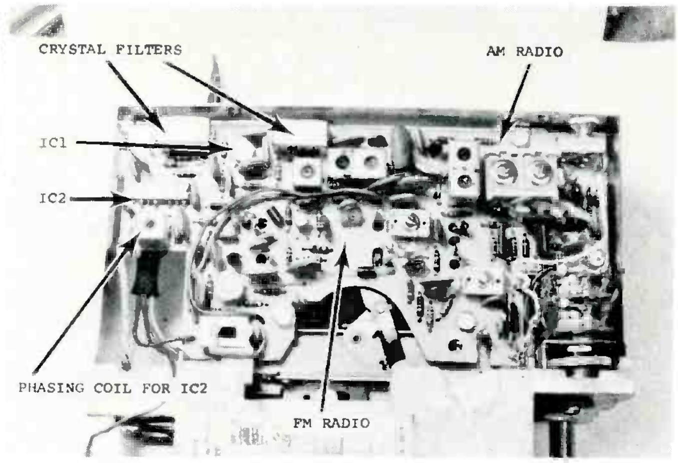
Until recently, however, this was also a trade-off of sorts. Early MOSFET's were delicate. A little static from your body or tools often destroyed the MOSFET. In those days, MOSFETs were packed with either a metal "jump ring" or a piece of lead foil shorting all of the leads together. The idea was to remove the metal foil or jump ring *after* the MOSFET was installed in the chassis. The guy that designed that system probably never had to replace a part inside a crowded TV or FM tuner. If he had, it is doubtful that he would have suggested reaching down inside the tuner with a big, chunky pair of diagonal side-cutters, to snip the ring.

Finally, RCA came up with the idea of using internal Zener diodes to protect the delicate MOSFET. Fig. 2 shows how these diodes are connected. Any high-voltage static charge applied between a gate and any other element is shunted around the gate insulation by the diodes.

The FM IF Amplifier

Moving up to the FM IF amplifier stage, we find an integrated circuit performing as the active





Circuitry of Bendix's new AM/FM Stereo FM auto radio is contained on two subassemblies: (Left) Multiplex/audio/power supply subassembly. (Right) AM and FM RF and IF subassembly.

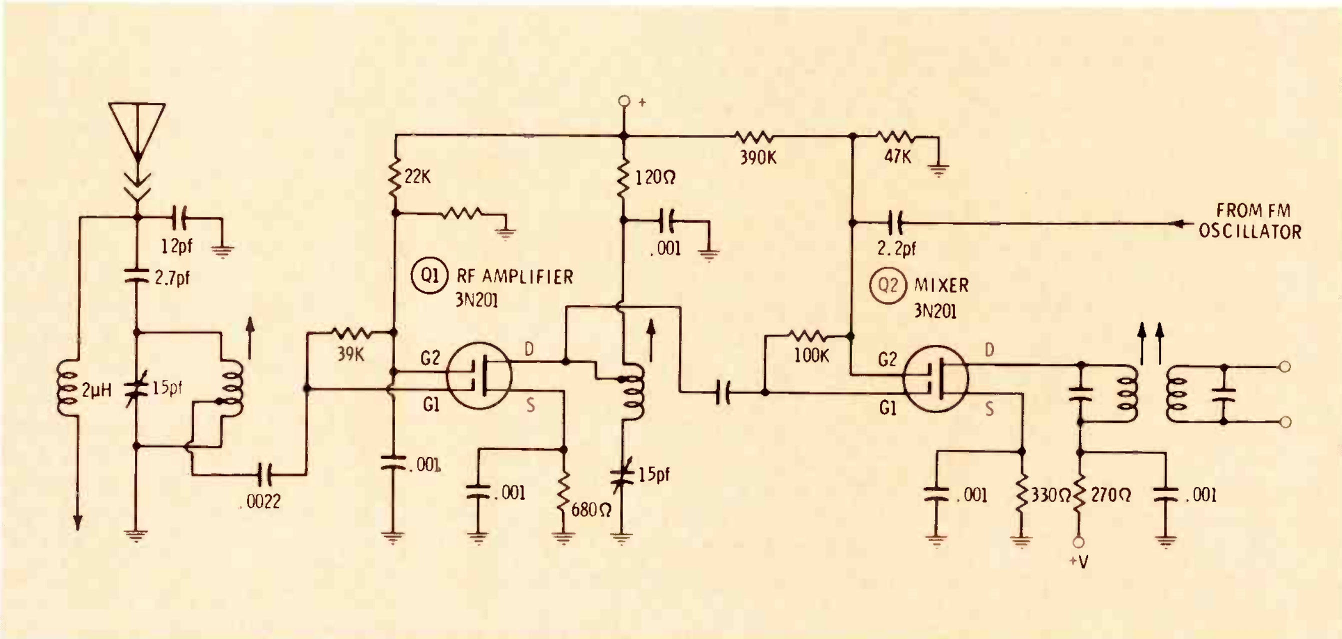


Fig. 1 Schematic diagram of the "front end" of Bendix's new stereo FM auto radio. Note the use of dual-gate MOSFET's.

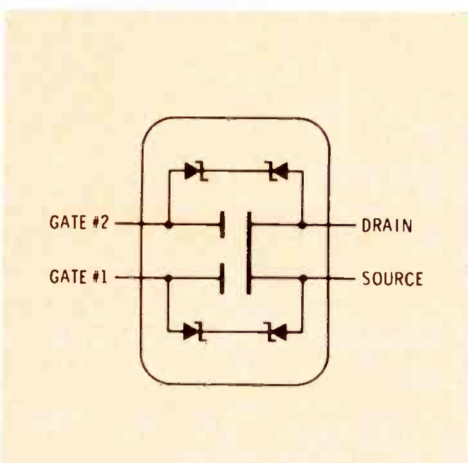


Fig. 2 Built-in Zener diodes protect new MOSFET's from static charges which frequently destroyed previous designs of MOSFET's.

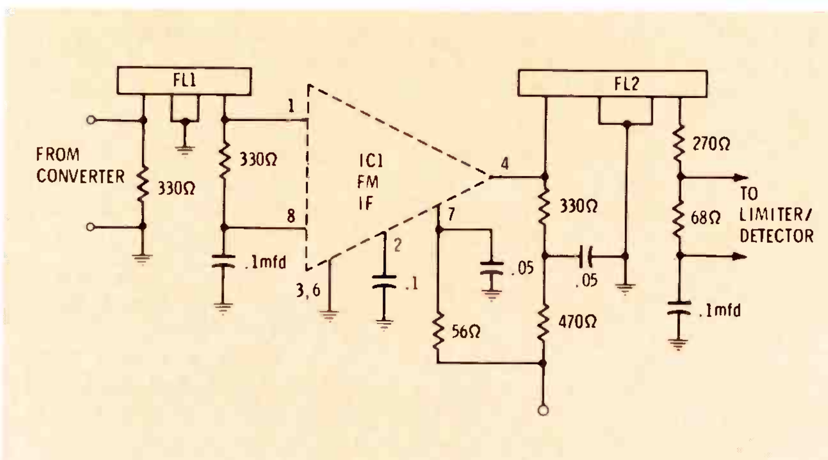


Fig. 3 Ceramic filters provide input and output coupling in IC-equipped FM IF amplifier section of Bendix's 1972 auto radio.

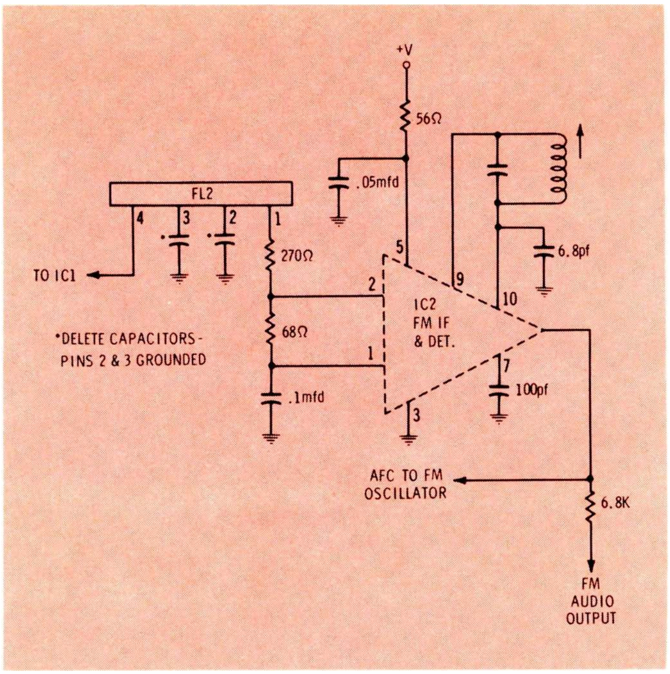


Fig. 4 IC shown here, used in Bendix's new stereo FM auto radio, performs the functions of amplifier, limiter and quadrature detector.

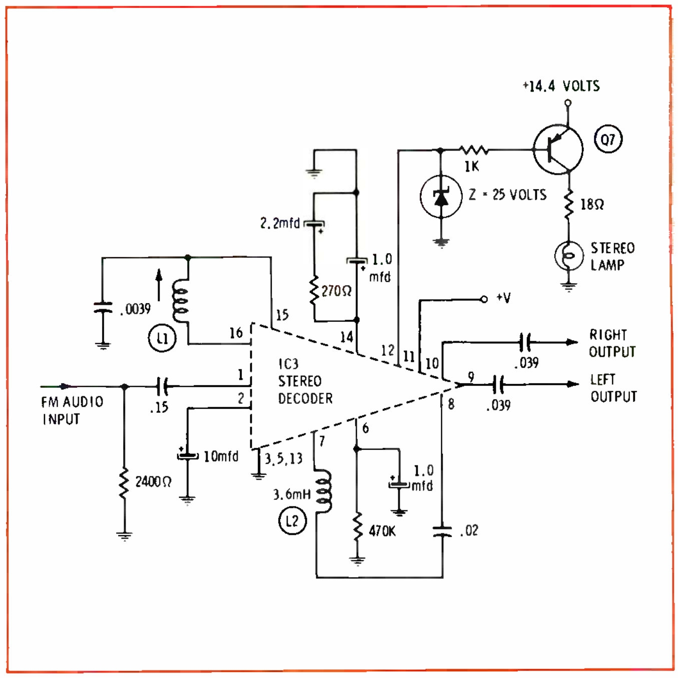


Fig. 5 IC-equipped stereo decoder circuitry of new Bendix radio is simpler than previous IC designs. Note that only one adjustment is required—L1.

element. Fig. 3 shows this stage.

Input and output coupling to this stage is accomplished by ceramic filters. There are no IF transformers to become misaligned. As is usual with most ceramic-filter IF strips, the filter can be replaced only with one which has the exact characteristics of the original. The characteristics are indicated by a color coding system. When ordering, simply add, in parenthesis immediately after the part number, the name of the color needed to obtain the correct filter.

These new filters look a bit small at first. In earlier home sets which used ceramic filters, the filter occupied several cubic inches of space. The new filters, however, are the result of advances in ceramic technology—fall-out from the space program we are told—which permits a significant reduction of size. In fact, the new filters might be mistaken for square capacitors, unless you read the label.

To troubleshoot a stage such as that in Fig. 3, you can take at least two approaches. One is to measure the DC voltages present at each pin of the DC and compare them with those in the service literature. Another technique is to use an oscilloscope to compare input and output signal levels (there should be some gain).

In some cases, it might be necessary to use both techniques. Some ICs, notably the UA703 type used by Motorola, can produce near-normal DC voltages, yet fail to even pass, much less amplify, a signal.

A word of warning, admittedly often repeated: Be extra careful with your tools and instrument probes when working around linear IC's. One slip and you might destroy the IC. Do not be misled by some manufacturers who will tell you that it is almost impossible to destroy an IC by accidentally shorting its elements. It is true that certain "digital-type" IC's are almost immune from the effects of sloppy techniques. These are primarily those digital ICs that are in the RTL family. The reason for their immunity is that there are resistors connected internally to each IC lead. These resistors limit the current to safe values as long as the voltage is kept within certain levels. Linear ICs are quite different. Get messy working around them and you will wind up replacing an expensive chip.

The FM Detector

The second IC in the '72 Bendix stereo FM radio is the FM detector, IC2, shown in Fig. 4. Notice the LC-tuned circuit connected between pins 9 and 10 of the IC. Also notice that it is not a regular ratio detector or discriminator transformer. Bendix, like Delco in previous years, is using a quadrature detector. The purpose of the tuned circuit is to provide a 90-degree phase shift to a sample of the 10.7M-Hz signal. The phase-shifted signal then is recombined with the main signal in a synchronous detector circuit (also within the IC).

Integrated circuits such as IC2 function as a gain package (up to 80 dB, or a gain of 10,000), limiter and detector, all inside one chip.

The Stereo Decoder

The stereo decoder IC in this radio is unlike anything used previously. There have been other IC decoders used in previous models of various manufacturers. However, all of these decoder circuits were based on one of the several versions of the Motorola IC.

The Bendix radio appears to be using a version of the RCA SK3078 IC. Fig. 5 shows the external circuitry used by Bendix. With only one adjustable coil, it is simpler than most circuits using the Motorola IC.

Fig. 6 is a block diagram of the inside functions of this IC. The composite input signal is fed to a preamplifier and balanced phase-splitter stage. The purpose of this stage is to produce two identical signals that are 180 degrees out of phase. The two signals then are fed to three other circuits: a primary phase-lock detector, a pilot-signal detector and an L-R detector.

The primary phase-lock detector is used to drive a voltage-controlled oscillator (VCO), which operates at approximately 76 KHz (4 x 19 KHz). This oscillator is locked to the pilot signal when the radio is tuned to a stereo station. The output of the 76K-Hz VCO is fed to a series of three "J-K" flip-flops, each of which divides its input signal by two. The output of the first flip-flop, therefore, is 38 KHz. This signal drives two more flip-flops and the stereo L-R detector.

Fig. 6 shows some signal designations that might be unfamiliar to you. Notice that each flip-flop output, and the corresponding detector stage input, is labeled either "C", "$\overline{C}$" or some other code combination. This digital code is read: "C" and "not-C". Because digital electronics involves only two states—i.e., on and off—digital electronic designers label the states "1" and "O", or "Q" and "$\overline{Q}$", and so forth. Don't let these codes confuse you. They simply indicate a push-pull output. In other words, when an output ("C", for example) is in the "1" state, the other ("$\overline{C}$") will be in the "O" state. When the flip-flop flips, the reverse is true. The two outputs are, simply said, 180 degrees out of phase. Because digital, or two-state, circuitry fits so well into the binary logic system, the terminology is likely to stick.

The AM IF Circuitry

A new type of AM IF transformer circuit used in the new Bendix radios is shown in Fig. 7. It is actually composed of two separate cans. The first can, or "primary No. 1", is a series-tuned circuit which is resonant at 262.5 KHz. This is connected to "primary No. 2", inside the second can. The secondary of this second can is a typical parallel-tuned, tapped-impedance circuit. Although new and unique in American radios, this type of configuration has been used in European radios for a number of years.

The Audio Section

Operational amplifier

The operational amplifier audio

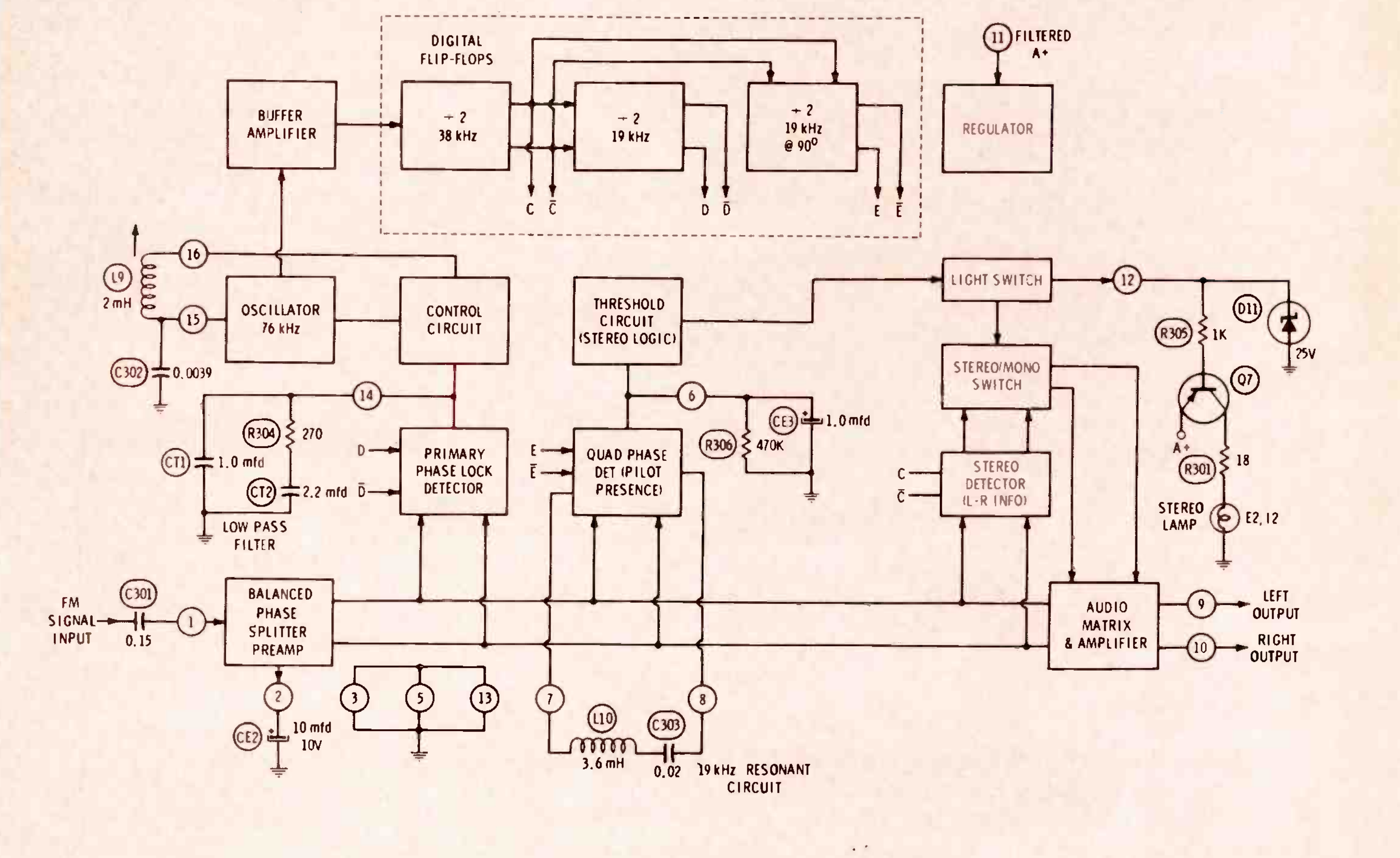


Fig. 6 Block diagram of the internal circuitry of the stereo decoder IC used in Bendix's new auto radio. See text for detailed explanation.

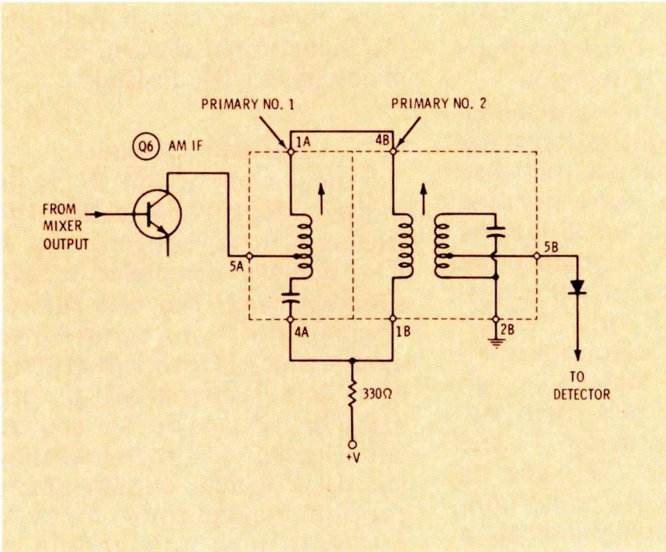


Fig. 7 Circuit diagram of new "dual-can" AM IF amplifier transformer and associated circuitry used in Bendix 1972 radio design.

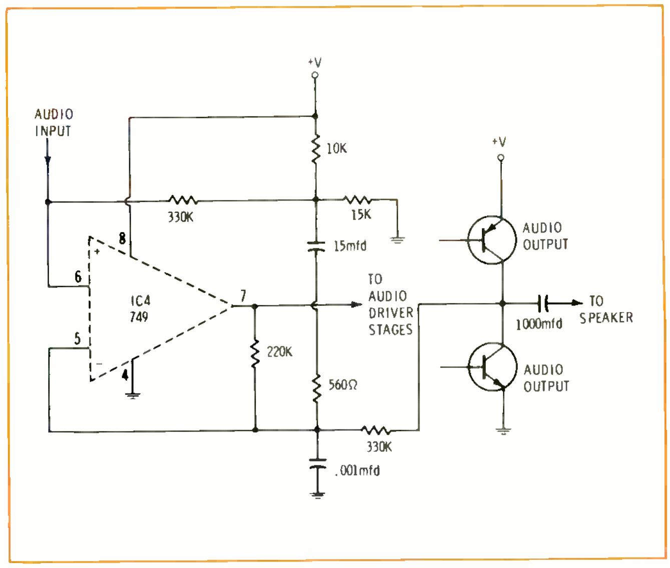


Fig. 8 IC operational amplifier functions as a predriver audio amplifier in new Bendix radio. See text for details.

stage is shown in Fig. 8. An operational amplifier actually is a DC amplifier which usually has a high input impedance, a high output impedance and very high open-loop (no feedback) gain. By adjusting an external feedback network, both the gain and the frequency response of the stage can be varied.

The particular operational amplifier used by Bendix has both positive and negative inputs. The negative input is an inverting input, while the positive is noninverting. Any signal put into a negative (inverting) input comes out 180 degrees out of phase. Bendix, however, uses the positive (noninverting) input for audio. The output, therefore, is in phase with the input. Negative feedback is accomplished by connecting a 220K-ohm resistor between pins 5 and 7.

Driver stages

As shown in Fig. 9, the output from the operational amplifier is direct-coupled to the driver-output stages. These stages could be properly called a "complementary-complementary" circuit. Such a circuit can be identified by the fact that both the drivers and the actual power-output stages are in complementary symmetry. This configuration is relatively new to car-radio design. Most circuits, up until now, have been either conventional complementary or transformer-driven "totem-pole" configurations.

The 5K-ohm bias potentiometer can be used to set the operating conditions of the total circuit. It is advisable to check the adjustment of this pot whenever transistors or any other bias-affecting parts are changed. There are several methods that can be used to determine when the adjustment is normal.

One method is to monitor the current drawn by the stage, while adjusting the pot. The emitter current from the power supply should be in the 40 to 60 milliampere range under zero-signal conditions (volume control turned down completely). This is also known as the "idling", or quiescent current.

Another useful method of adjusting the pot is to measure the voltage between ground and the junction of the two collectors (Fig. 9). This voltage, under zero-signal conditions, should be equal to exactly one-half of the supply voltage, measured between ground and the emitter of Q15.

The third method is to monitor the output with an oscilloscope, while adjusting the pot. Apply a sine-wave signal to the volume control (or feed a sine-wave modulated RF signal into the antenna jack). Adjust the 5K-ohm pot until one peak of the sine wave exhibits clipping. Back off the adjustment until all signs of clipping disappear.

Although all three methods will produce the proper adjustment, the author believes that the two DC methods are more reliable and more sensitive to impending trouble which could destroy both of the output transistors. The correct operating point is easier to spot using the DC methods. You can also see when you are beginning to approach the correct operating point. This allows you to slow down before you pass the point and the circuit enters a region of higher-current operation. Using the scope method, you must go past the proper point, to see clipping.

The Power Supply

All of this fancy circuitry needs a well-filtered, well-regulated power supply. The old days of a choke and a couple of high-value electrolytics are gone.

The Bendix power supply is shown in Fig. 10. Q18 and Q19 are regulator transistors. Q20 and Zener diode D9 are used as a cut-off circuit, to kill the radio if the supply voltage drops below 8 volts.

Although possibly not designed specifically for noise suppression, this type of power supply is more immune to negative-going noise pulses entering via the power lead. This is because the

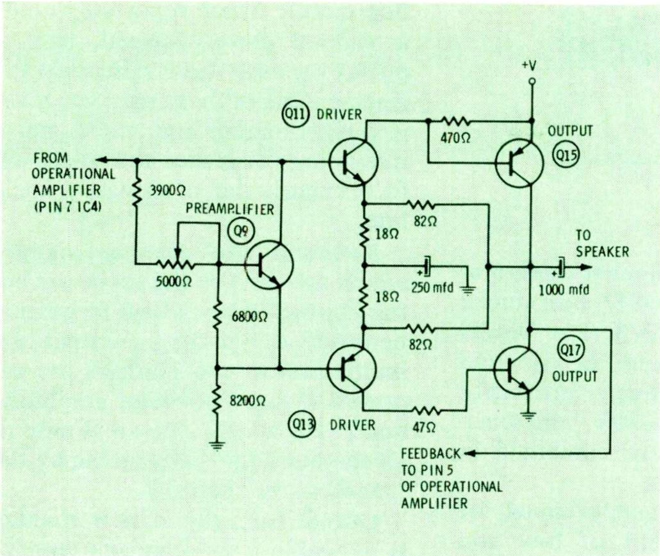


Fig. 9 Preamplifier/driver/audio-output circuitry used in Bendix 1972 radio design is relatively new to auto radio.

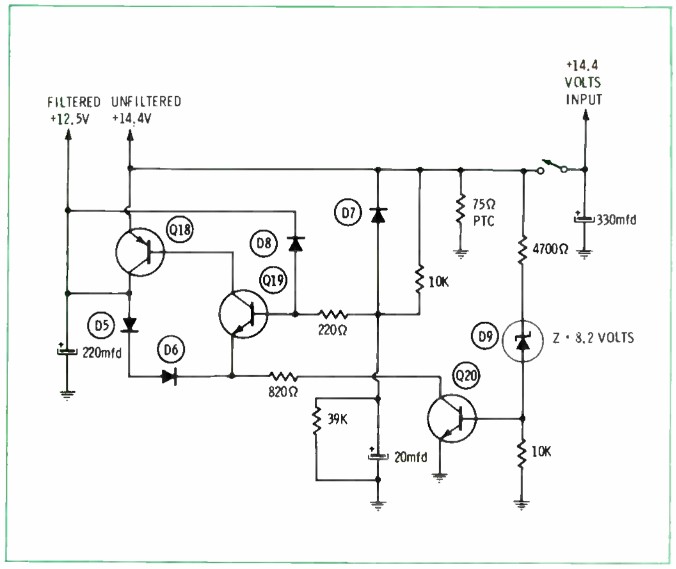


Fig. 10 Schematic diagram of well-regulated power supply of new Bendix stereo FM radio design.

negative-going pulses subtract from the positive battery voltage. This will momentarily cut off the radio or, if time constants are too long, at least reduce it's output for the duration of the pulse. This occurs too fast to be noticed by the listener. (Technicians familiar with communications equipment might recognize this as a relocated version of the IF noise-blanker principle. Although not as effective as a true blanker circuit, it should help somewhat.)

Alignment

Bendix recommends using a digital frequency counter (DFC) to align the 76K-Hz, voltage-controlled oscillator (VCO), in the decoder section (Fig. 6), in it's free-running (unlocked) state.

For those who do not have access to a DFC, it is possible to align the VCO circuit using a well-calibrated audio-signal generator and a scope. Connect the output of the generator to the horizontal input of the scope. The 76K-Hz signal from the radio is fed to the vertical input of the scope. Set the frequency of the generator to either 19 KHz, 38 KHz, or 76 KHz. Adjust the 76K-Hz oscillator coil until the appropriate Lissajous pattern locks in on the screen of the scope.

Because this is a locking oscillator, it isn't necessary to be accurate down to the last Hertz when making this initial adjustment. If you can get the free-running frequency within plus or minus 50 Hz, the locking circuitry will "pull" the VCO to 76 KHz. It, however, is true that the radio will perform over a wider range of conditions if the free-running VCO is accurately adjusted.

If you do not have an extremely accurate audio oscillator but do have one of the better FM Stereo generators, you can still perform this prealignment without rushing out to buy a new AF generator (which can cost upwards of 300 dollars). Most of the better stereo generators use a 19K-Hz crystal to generate the pilot signal. Most also feed this signal to a separate output jack, or through the composite output jack when the output selector switch is set correctly. It probably will be more accurate than any of the low-priced audio generators.

The remaining circuits in the FM portion of the radio are aligned using normal FM alignment techniques. For correct alignment of a quadrature detector, use an FM signal generator capable of 125K-Hz deviation (250K-Hz sweep width). Connect a scope probe to pin 8 of IC2. With the scope controls adjusted properly, you will see the standard "S" curve. Adjust the phasing coil for best linearity between the two peaks of the "S" curve.

Another way to adjust the phasing coil is to use an unmodulated, but very stable, signal. For safety's sake, apply a 108M-Hz signal to the antenna jack instead of applying a 10.7M-Hz signal to the input of the first IC, but remember that these IC's are extremely sensitive to accidental shorts. The use of a "gimmick" coupled into an IF transformer isn't a good idea on this radio. The mixer transformer uses slots instead of hex holes, and the crystal filter has a sealed case. It is safer to use the VHF signal.

If you don't have a high-quality VHF signal generator with the relatively high stability required for this operation, you can build a 9M-Hz crystal oscillator for this purpose. The harmonics of 9 MHz are 90, 99, and 108 MHz—exactly the frequencies needed. Use either a digital IC or a diode "harmonic-enhancer" circuit. (Circuits for suitable high-harmonic-content oscillators can be found in *RTL Cookbook*, by Donald Lancaster, published by Howard W. Sams.) The particular IC used might have to be specially hand-selected, but they are relatively cheap.

When you use this method to adjust the phasing coil, you will notice a quiet null between two noisy peaks at some point throughout the range of the phasing coil's slug. Set the slug at the point that is precisely the bottom of that null.

(Continued on page 36)

Although this method isn't as good as the Bendix-recommended FM Generator method, it will do in a pinch. In fact, you might not be able to notice any difference, once you become skilled at locating the dead center of the null.

As a subjective indication of how well the radio is aligned, try looking for distortion on the center-tuned position of a station. These quadrature detector circuits behave much like conventional FM detectors: They produce less distortion on a station's sidebands than in the center, if the coil is not aligned properly.

All types of FM detectors also can cause the AFC locking characteristics to change when they are out of adjustment. Check to see if the tuning is too broad, or if the AFC seems to lock only when the station is almost tuned in. On a properly aligned radio, the station should "jump" into the passband as you approach it on the dial, and "jump out" just as easily as you tune past it. □

test equipment report

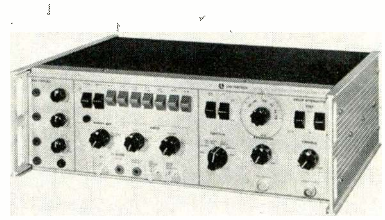
Sweep/Marker Alignment Generator

Lectrotech recently introduced Sweeper Marker Generator Model SMG-39. Functions of IF and chroma-IF sweep, multiple markers, marker-adder, and bias-voltage supplies are combined in this generator.

The swept-frequency signal for video IF alignment of b-w and color receivers is said to cover the 40-MHz IF band. For VSM type alignment of the chroma channel in color receivers, a crystal-controlled carrier is amplitude modulated by swept video.

Marker signals do not travel through the receiver, but are combined in the generator with the curve produced by the receiver. Then the composite waveform is sent to the scope. This method is sometimes called "post injection" of markers, and is employed reportedly to prevent overload or distortion of the curve when strong markers are desired.

Pre-marker signals of the heterodyne type are created by the swept-frequency IF signal ringing the quartz marker crystals. Marker crystals of 39.75 MHz, 41.25 MHz, 41.67 MHz, 42.17 MHz, 42.67 MHz, 45.75 MHz and 47.25 MHz can be selected by switches. Any combination from none to all crystals can be switched on. Provision is made for another crystal, of the frequency needed by the user, to



be plugged into the spare socket. All crystals that are in use are paralleled. These markers perform a double duty by supplying also the needed chroma frequencies.

Signals obtained from ringing of the marker crystals trigger a flip-flop circuit which reportedly emits a pair of closely-spaced, narrow pulses for each wavetrain of crystal ringing. One of these narrow pulses is positive-going and one is negative-going. Together the visual effect is nearly that of a single vertical line.

Because the marker signals which are seen on the scope are not the "birdie" type of beat-frequency heterodyne, but are the output of a multivibrator, the markers are reported to have constant amplitude and pulse width. The amplitude of all the markers is adjustable by the "marker size" control.

Output from the marker channel is available from a banana plug located on the front panel. When this signal is connected to the external intensity modulation input of a scope, the marker positions are brighter than the curve.

The pulse markers can be displayed either vertically or horizontally on the curve, or as bright dots, if the intensity markers are used.

The internal amplifiers are said to have approximately unity gain, so scope measurement of the peak-to-peak amplitude of the curve can be made.

A Variable Frequency Oscillator (VFO) is included which has a calibrated dial scale. The "birdie" type of marker from this signal can be seen on the curve, and can be adjusted to any IF frequency. This signal can be used as a variable marker, or it can be amplitude modulated by a 1000 Hz audio tone for trap adjustments.

Also provided are crystal controlled 4.5 MHz unmodulated and 10.7 MHz sweep with marker signals for TV sound IF and FM IF alignment.

Included are one pad for connection to the mixer-grid test point in the tuner, and a combined roll-off filter and demodulator probe.

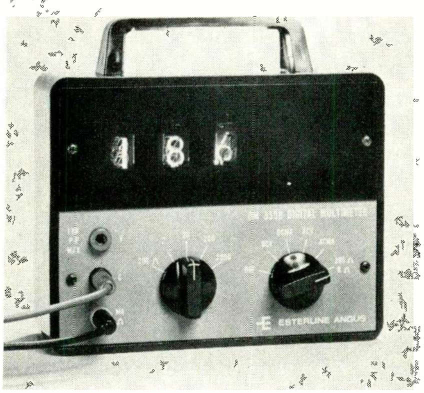
Price of the Sweeper Marker Generator Model SMG-39 is $339.50.

Circle 50 on literature card

Digital Multimeter

A new digital multimeter which reportedly features twenty-one switch-selectable ranges—eight AC voltage and current ranges, eight DC voltage and current ranges and five resistance ranges—has been introduced by Esterline Angus.

The multimeter features measurements of 10 mV and 10μA steps on the lowest voltage and current ranges according to the manufacturer. Other features in-



clude: solid-state silicon transistors, diodes and integrated circuits, linear readings, accuracy of 1 percent with a 10 percent over-range on all scales and a non-blinking panel display.

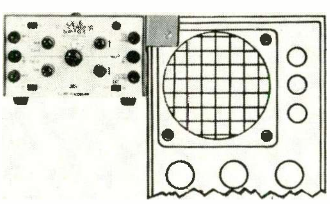
The digital multimeter measures 5¼ inches x 6⅞ inches x 2⅜ inches, weighs 2½ pounds and sells for $195.50.

Circle 51 on literature card

Solid-State Electronic Switch

Leader Instruments has announced a new transistorized electronic switch, which reportedly enables a single-trace oscilloscope to operate with a dual trace.

Model LS-5 electronic switch is said to have four switching frequencies: 1.5, 5, 30 and 50 KHz. The triggered-output signal facilitates stable locking of the scope.



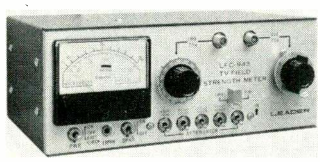
AC or DC operation is switch-selected, with frequency response up to 300 KHz for DC operation, and from 2 Hz to 300 KHz for AC operation, according to the manufacturer. Vertical sensitivity is 0.05 V/cm, and the input impedance is 1 megohm paralleled by 40 pf. Individual positioning and wide-range gain controls are provided for each channel. The Electronic Switch operates from an internal supply powered by regular line voltage.

The LS-5 electronic switch measures 3⅛ inches x 5¼ inches x 4 inches, weighs 3 pounds, and sells for $69.95.

Circle 52 on literature card

TV Field-Strength Meter

Leader Instruments has just announced the TV Field Strength Meter Model LFC-943. This meter is said to be battery powered, solid-state and portable for use in CATV and MATV applications.



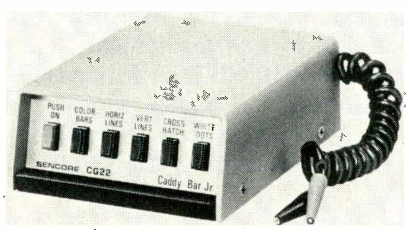
Other features include: a combination microvolt/dB meter scale, decade attenuator, earphone jack, and a neck strap.

Price of Model LFC-943 is $375.00.

Circle 53 on literature card

Color Generator

The new CG22 Caddy Bar Jr. color generator has been introduced by Sencore, Inc.



The Caddy Bar Jr. reportedly has the same circuit board as Sencore's Color King, and generates standard, RCA-licensed color bars, horizontal lines, vertical lines, crosshatch and white dots which are pushbutton selected. Battery-operated, solid-state circuitry assures instant-on action and solid stability of patterns, according to the manufacturer.

Other features reportedly include a built-in pre-heater for cir-

(Continued on page 38)

(Continued from page 37)

cuits that need warming if they were left in the cold, a retractable cord, and an automatic shut-off.

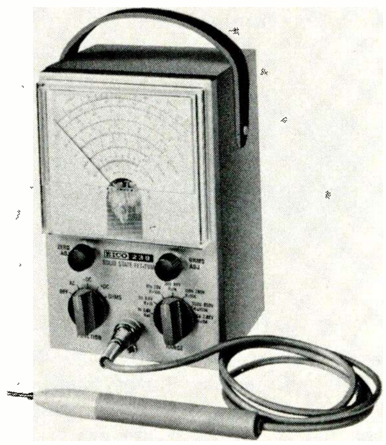
The Caddy Bar Jr. measures 2 inches x 4 inches x 6 inches and sells for $89.00.

Circle 54 on literature card

FET-TVM

A new battery-operated, solid-state FET-TVM meter, reportedly intended for use in testing both semi-conductor and vacuum-tube electronic circuits, has been announced by Eico.

Some of the features include: input resistance of 11 megohms on



DC voltage ranges; seven ranges of AC rms and DC voltages from 1 to 1000 volts full-scale on a 4½-inch meter; seven ranges of AC peak-to-peak voltages from 2.8 to 2800 volts full-scale; seven resistance ranges to measure from 0.2 ohm to 1000 megohms.

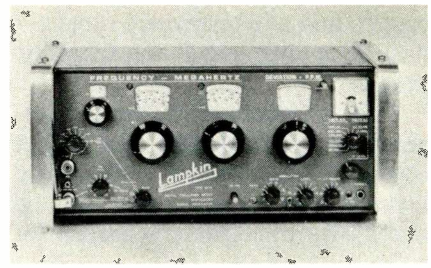
Model 239 FET-TVM measures 8½ inches x 5 inches x 5 inches. The kit version sells for $39.95, and the wired meter for $59.95.

Circle 55 on literature card

Digital Frequency Meter/Synthesizer/Signal Generator

New, from Lampkin Laboratories, is the Digital Frequency Meter/Synthesizer/Signal Generator Model 107A. This instrument is reportedly intended for testing applications in the mobile radio field.

As a heterodyne frequency meter, the Model 107A is said to measure the carrier frequencies of nearby transmitters or of signals picked up on a receiver with an



accuracy of 1 part in one million. The coverage of FCC-assigned frequencies is continuous from 10 KHz to above 500 MHz, according to the manufacturer.

When used as a synthesizer, the generator reportedly supplies, in steps of 100 Hz, any frequency from 1000 Hz to 9999.9 Hz.

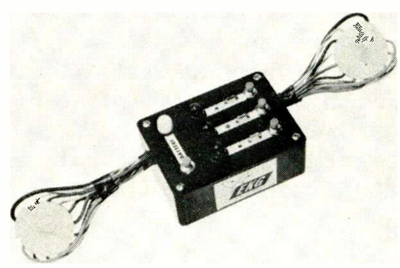
Amplitude- or frequency-modulated signals reportedly are generated on fundamental frequencies up to 10 MHz and on harmonics of the directly-calibrated dial up to 500 MHz. Frequency stability is said to be 1 part in 1 million.

Model 107A sells for $2150.00.

Circle 56 on literature card

Tester For Lifespan of Color Picture Tubes

EKU, Incorporated has announced a new test instrument, Model EKG, which is reported by the manufacturer to predict, with an accuracy exceeding 98 percent, whether or not a rejuvenated color picture tube will last for six months.



The test unit plugs in between the color tube and any CRT tester/rejuvenator. It is said the tester has no meters to be read and no dials to adjust, and an indication of the operating life can be obtained in 60 seconds.

Price of Model EKG is $39.95. □

Circle 57 on literature card

For more information about above products use reader service card

audio systems report

Stereo Headphones

A new stereo headphone with an extra-long, coiled, extension cord has been introduced by RMS electronics.

Model HP-4 reportedly has a frequency response of 35 to 17,000

Hz, impedance of 8 ohms, and an input power up to 0.5 watts.

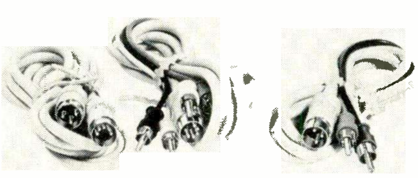
The headphones have vinyl ear cushions and adjustable vinyl head bands, according to the manufacturer.

Model HP-4 sells for $9.95.

Circle 60 on literature card

Plugs and Cables For European Phonographs

Three types of adapters with plugs and cable, which reportedly connect many brands of European phonographs to domestic com-



ponents, have been announced by the Weltron Company. All three types are said to be compatible with Norelco, Telefunken and many other European makes.

Shown on the left is Model W-HOS-4 which has a 5-pin plug and a 3-pin plug. In the center is Model W-HOS-1 which has a 5-pin DIN-type European plug and four separate RCA-type male plugs. Model W-HOS-2 which has a 3-pin DIN-type European plug and two separate RCA-type male plugs is shown on the right.

The price of each adapter assembly is approximately $4.50.

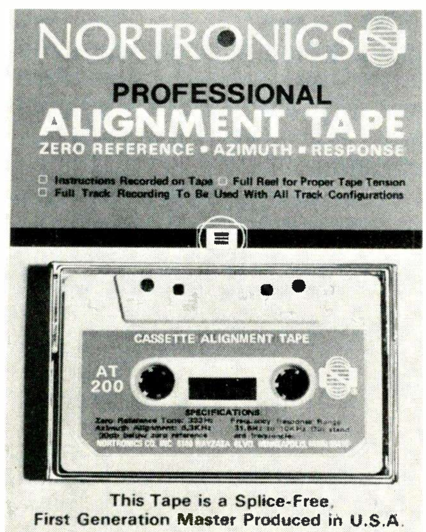
Circle 61 on literature card

Cassette Alignment Tape

A new professional cassette alignment tape, which reportedly uses a full reel of tape to ensure proper tape tension, has been introduced by Nortronics Co., Inc.

Specifications include: 30-second zero-reference tone at 333 Hz ±5 percent; a 60-second, 6.3 KHz tone, 20 dB below zero reference for azimuth alignment; and a series of 10-second tones ranging from 3.15 Hz to 10 KHz for measuring frequency response.

Model AT-200 reportedly has a



speed accuracy of ±0.01 percent at 1⅞ IPS (4.75 mm), frequency accuracy of ±0.05 percent, tone level accuracy of ±1.2 dB and less than 0.6 percent distortion.

The model AT-200 sells for $21.00. □

Circle 62 on literature card

For more information about above products use reader service card

Circle 22 on literature card

Displaced TV Troubles

Defects which occur where they are not supposed to—at least, not where we think they are supposed to. by Bruce Anderson

All objects which require service have an IPIO (inherent perversity of inanimate objects) factor, which is roughly proportional to the square of the number of components which make up the object. For example, if twelve screws hold a TV chassis in a cabinet, it is four times as likely that one of them will be dropped into an inaccessible crevice as it would be if only six screws were used.

Murphy's Law applies to the preceding situation in the following manner: 1) If a screw is to be dropped into the chassis and cannot be recovered without removing the chassis, it is twice as likely to happen when the chassis is being installed as when it is being removed. 2) A dropped screw will always make the optimum trade-off between inaccessibility and maximum damage, if not recovered.

Because a color television receiver has more parts than any product the general public uses regularly, the IPIO factor of it is astronomically high. Couple this with the fact that Murphy's Law was discovered by an electronics engineer and it is no surprise that our fraternity is the most affected.

When Murphy's Law is not operating, sync problems are in the sync circuits, black rasters are caused by loss of high voltage, interference bars are the result of received interference, etc. However, when The Law is in effect, the causes of all these symptoms move to new spots.

Some of these "displaced" troubles will be examined in this article.

Vertical Bounce

The Law usually doesn't apply anymore to this one, because the cause is becoming widely known; but it will do for a starter.

The symptom

Reception is normal, except that about every 17 seconds the raster just starts to flip upward. It rises perhaps half an inch, jitters for a second or so, and then returns to normal.

The cause

Because practically all stations broadcast the color-standard sync pulses, the usual vertical frequency is 59.94 Hz. This is .06 Hz lower than the power-line frequency, or a frequency difference of 1 cycle in about 17 seconds. If the power supply of the receiver has excessive 60-Hz ripple, the vertical oscillator will tend to synchronize with the ripple at those times when the most positive part of the ripple just precedes the sync pulses. (When the ripple pulse follows the sync pulse, the oscillator will have been triggered before the ripple gets there and will not be affected.)

If the receiver uses a full-wave rectifier in the power supply, the ripple frequency is 120 Hz, and the tendency to bounce would occur at roughly eight-second intervals. However, if one side of the full-wave rectifier is open, the ripple frequency will be reduced to 60 Hz and, consequently, could cause vertical bounce. In such cases, connecting another filter in parallel with the existing one will apparently cure the trouble, until the original filter is disconnected. Therefore, always check the diodes of a full-wave rectifier before assuming that a filter capacitor is at fault.

Half-wave rectifiers normally have a 60-Hz ripple. If the symptom appears in a receiver which has a half-wave rectifier, it is logical to suspect the filter capacitor.

If a voltage doubler is used, failure of a filter capacitor normally will reduce the B+ to the point that other symptoms will be more noticeable.

Purity

The symptom

The job ticket says "Picture is lousy." When you get to the home, you have to agree. Obviously, the trouble is loss of purity. So, you

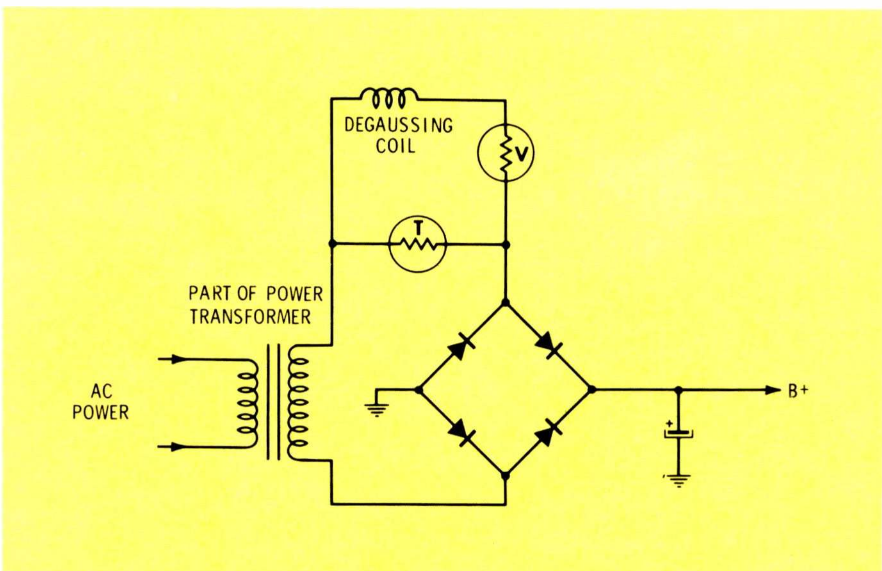


Fig. 1 Typical automatic-degaussing circuit.

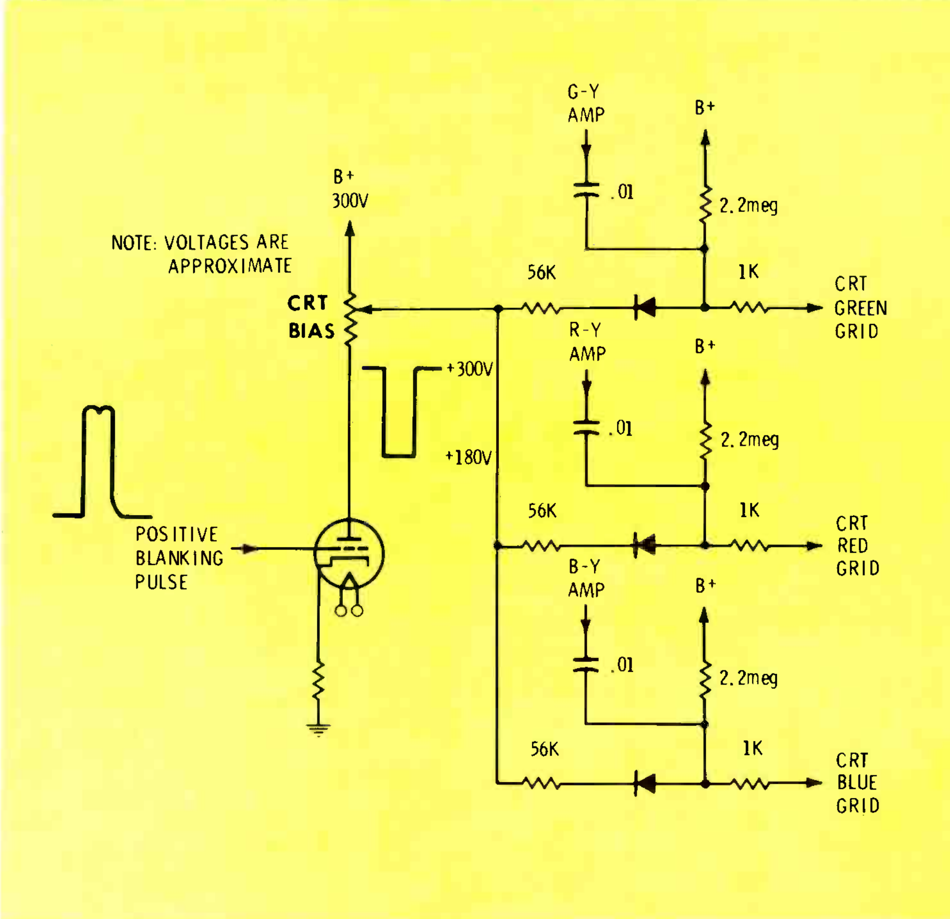


Fig. 2 CRT grid clamping circuit, typical of that employed in 1967-71 RCA color TV chassis.

get out the mirror, set up the purity, and touch up the convergence. Fifteen minutes later, everything looks great. (The set was on when you arrived, so there was no need to let it warm up). You put the back cover in place, turn on the TV again, and whip out your pencil, to write the bill. As the raster comes on, you smile a little sheepishly as you put the pencil back in your pocket—the picture is "lousy" again.

You get the back off again, and this time you *really* degauss the instrument. No need to go further —the picture is good. You put the back on; turn the set on; whip out your pencil; put your pencil back in your pocket—the picture is "lousy" again. Where do you go from here?

The cause

This problem could be caused by a loose shadow mask in the picture tube, in which case the solution is to replace the picture tube. But, before changing the picture tube, it is wise to check the diodes in the power supply.

Many receivers use an automatic degaussing coil which is activated at turn-on by a circuit similar to the one shown in Fig. 1. At the moment of turn-on, the resistance of the temperature-sensitive resistor (thermistor) is high and the resistance of the voltage-sensitive resistor (varistor) is low, causing AC to pass through the degaussing coils on its way from the transformer to the bridge rectifier. In a few seconds, the thermistor begins to warm, causing its resistance to decrease. This allows some current to be shunted around the degaussing coils and the varistor, lowering the voltage drop across the varistor. The lowered varistor voltage causes the resistance of the varistor to increase, again increasing the current and temperature of the thermistor. The action is regenerative, and in a few seconds nearly all the current is passing through the thermistor.

If one of the rectifier diodes opens, the bridge becomes a half-wave rectifier instead of full wave and the current through the degaussing coil changes from AC to pulsating DC, which *magnetizes* the CRT at turn-on instead of demagnetizing it.

Purple People

The symptom

The set is a relatively new RCA, and the lady who calls in insists that the service call be made in the morning.

When you arrive, she explains that a couple of nights ago the picture turned green, but that her husband "fiddled around with the knobs on the back until he thought it was okay." Unfortunately, there is now very little green in the picture, although the black-and-white picture looks good when the color control is turned to minimum.

There are two questions involved here. First, "Why the request for a morning call?" Second, "What's wrong?"

The cause

The answer to the first question is simple. She wants the set fixed before her husband gets home, so that he won't notice, hopefully, and have his ego deflated.

The key to this problem is the fact that you found out about the attempted "fix." Fig. 2 illustrates the circuitry involved. During retrace time, the CRT grid voltages are reset to their correct levels by a pulse applied through the clamping diodes. If one of these diodes shorts, the bias on that particular grid swings toward B+, and the raster color becomes predominantly the color of the grid which has the shorted diode. In this example, it is the clamping diode of the green CRT grid which is shorted.

Our fictitious "hero of the house" thought he had fixed the set when he reduced the setting of the green-screen control and restored the raster to gray. What he didn't realize was that, by reducing the screen voltage of the green gun to nearly zero, he also had reduced the "gain" of

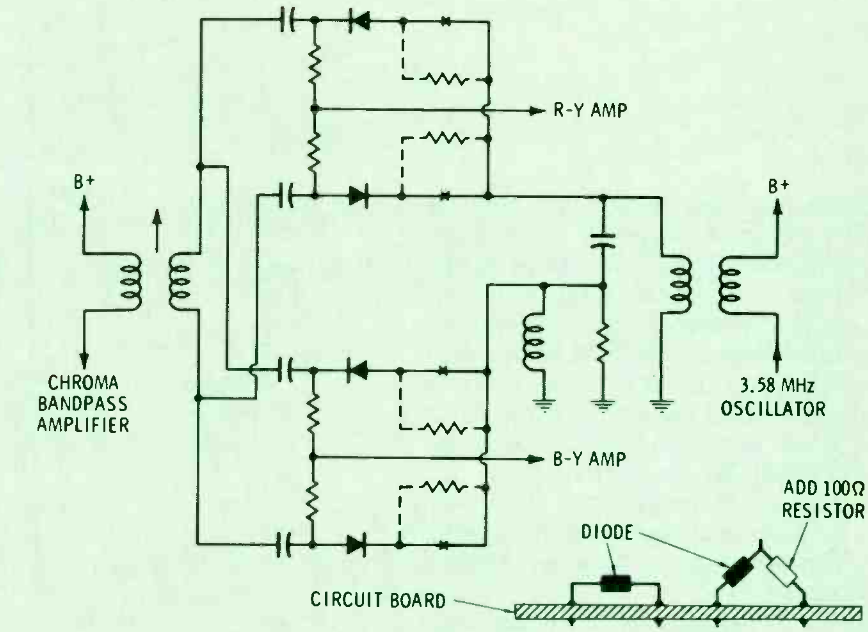


Fig. 3 Dotted lines show how resistors are added to prevent diode radiation.

the green gun to the point that it could not reproduce green signals. Naturally, with no greens available, flesh tones shift towards the bluish-red axis, and purple people are produced on the screen.

There are some other things which could have caused this trouble—a defective CRT, a defective coupling capacitor between the G-Y amplifier and the CRT grid, plus other similar defects which vary from chassis to chassis. The diode can be checked easily with an ohmmeter, and, even if a replacement diode is not immediately available, it is probably easier to go get one than it is to pull the chassis, take it to the shop, fix it and return it. After all, the diode weighs about forty pounds less than the chassis.

Christmas in August

The symptom

It's a beautiful Tuesday morning and you are feeling great after taking a "stretched weekend" for a little fishing. When you get to the bench, there is a chassis sitting there that wasn't there before. It was pulled yesterday by one of the home-call men, and the tag says, "No horizontal sync."

When you get the set fired up, you decide that "no sync" is something of an understatement. The raster is making "Christmas trees," and the squeals coming out of the flyback are loud enough for even an old timer like you to hear. By carefully adjusting the hold control and the sine-wave coil, you can get the picture to sync momentarily, but it flops back into a Christmas tree at the slightest provocation. After checking the tubes "one more time," trying a new AFC diode pack, and replacing a couple of your favorite capacitors in the oscillator circuit, you get the feeling that you are going to resort to shotgunning this dog. Then you turn off your hands and put your brain in gear, which leads you to the simple solution.

The cause

This type of problem points up a very important servicing technique which all of us are prone to omit. In short: "Get all the symptoms before attempting to locate the trouble." The home-call man should have caught it and added the comment on the shop ticket. Since he did not, it was very easy to overlook in the shop.

The stroke of genius which led us to the very obvious symptom didn't come until sometime later, but *finally* we connected a speaker to the receiver and there it was—a lot of hum. When the open filter capacitor was located and replaced, the hum cleared, and so did the horizontal problems.

Jail Bars

The symptom

The service call looks routine on this set. The complaint is no raster, which turns out to be an open high-voltage rectifier. You change it, measure the high voltage and find that the shunt regulator is on its last legs, so you change it, too.

Then you discover some faint vertical stripes of color in the raster. These are a lot more noticeable when the color control is turned to minimum, but you can see them, although just barely, when all the controls are set to their normal positions.

At this point, the owner tells you that he has always had this problem—the set is three or four years old—but the dealer he got if from couldn't seem to fix it. The set hasn't given him any other trouble, just a tube now and then, and he really isn't too upset about the bars. Nevertheless, he would like to have it fixed, if it won't cost too much.

Since you are no fool, you can see that you have a prospective lifetime customer—if you can get rid of those bars. On the other hand, you are in for a lot of grief if you take the job and cannot produce results. Fortunately, you remember hearing about this symptom somewhere—maybe in a bull session after an Association meeting.

The cause

This symptom was fairly common when diode demodulators first came in vogue, but design improvements have made it a relatively rare trouble symptom in more recent models.

The problem is spurious radiation from the demodulator diodes themselves. There are two ways to get rid of the bars—either replace the diodes or do a little circuit changing.

The first solution isn't recommended, because many new diodes will produce the same problem, and the problem can develop after they have been in use for a short time. (This is one of the reasons why the problem used to crop up.)

To make a permanent fix, lift the ends of the two diodes in each demodulator which are connected together and connect a 100-ohm resistor in series with each. This usually will solve the problem.

When installing the resistors, keep the leads as short as possible, but be careful not to get too much heat on the diode leads. The value of the resistors is not particularly critical, and while 100 ohms is sufficient, two or three times this value won't hurt anything.

Summary

The cases discussed here are all relatively uncommon, although they can, and do, occur in many different makes and models of color receivers. No doubt, many technicians have come across all of them at one time or another. However, all of them might be new to a few of the luckier members of the profession who have been servicing consumer electronic products for less than a day or two.

In any case, there is a lesson to be learned from these examples: Too often, the technician neglects to observe all the symptoms before arriving at a conclusion. This might not cause problems 90 percent of the time, but it can make things awfully difficult the other 10 percent. By listening to the customer, it often is possible to pick up a valuable clue which can save an hour of troubleshooting time. Taking the time to connect a speaker to the receiver when it is on the bench takes only a minute and might save thirty times that much. Insisting that home-call men write down *all* of the symptoms also helps. □

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Indirect Causes of Unstable Vertical Sync

by Wayne Lemons

Not all sync troubles occur in sync circuits. And it is those that don't which prove the most difficult to diagnose.

Defective Electrolytics

Most of us know that sync problems, especially vertical sync problems, often accompany a defective AGC circuit. If the AGC voltage is marginal, intermittent picture instability is common, sometimes occurring only during commercials. For example, if the sync pulses are compressed by some overloaded circuit prior to the sync clippers, the sync clippers continue clipping, but, instead of producing only sync pulses, they start clipping the top part of the video. As a result, both video and sync pulses are applied to the oscillator circuits, producing erratic locking.

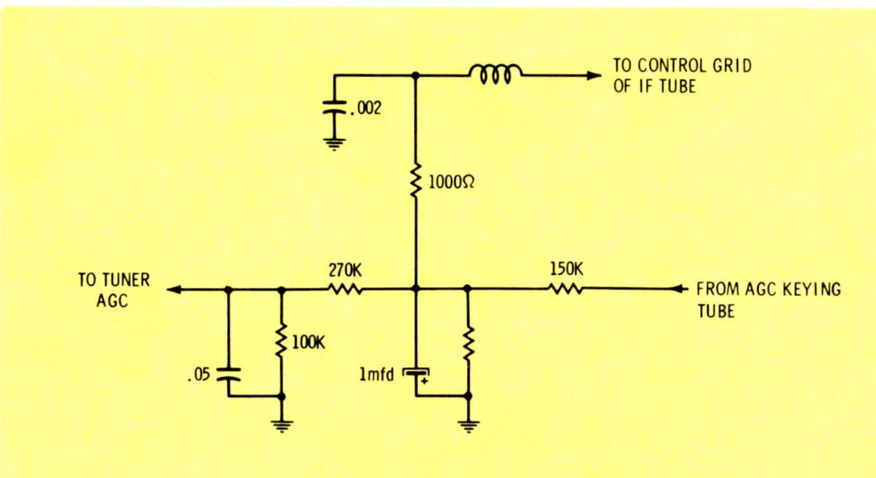

Fig. 1 A typical tube AGC circuit which uses an electrolytic. If the electrolytic opens, loss of vertical sync will result.

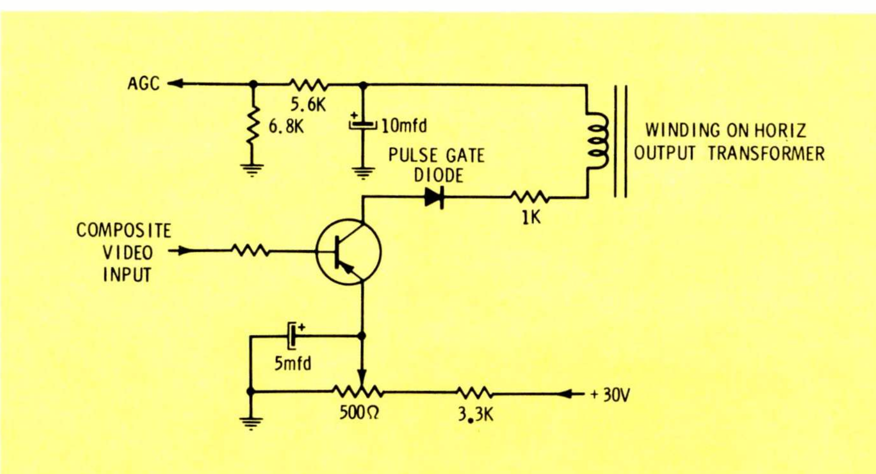

Fig. 2 A transistor AGC circuit. Tube or transistor AGC circuits can develop symptoms that effect only the sync, without changing the average level of AGC voltage.

AGC bypass

But the *amount* of AGC voltage is not always what triggers the sync malfunction. It is possible for the average AGC voltage to be correct and still interfere with the vertical sync. This happens if the AGC bypass capacitor opens. Such a defect often seems to be overlooked, even though it is a common one, especially if the bypass is an electrolytic.

A typical tube-type AGC circuit using a 1m-fd electrolytic as the low-frequency bypass is shown in Fig. 1. If this capacitor opens, the vertical sync pulses increase the AGC voltage each time the pulse occurs, and thereby reduce the gain of the set at a vertical rate. This will cause weakening of the pulses reaching the vertical oscillator through the sync clipper, and so rolling or cirtical and unstable vertical lock is inevitable. The horizontal sync usually is not seriously affected, because of the paper bypass capacitors in the circuit. The solution—a new capacitor.

To test the old capacitor, bridge another capacitor across it, and if the picture stabilizes, you have found the trouble. The substitute capacitor for testing can be up to 10 times larger, but the actual replacement should be the same size as the original.

AGC filters in transistor sets

Almost all transistor circuits have electrolytics in the AGC circuits, and sometimes more than one. Check these when the complaint is instability. One kind of transistor AGC circuit is shown in Fig. 2.

B+ line filter

Open electrolytics in other circuits, not just in sync or AGC circuits, can cause sync trouble. In some circuits, an open electrolytic in a B+ line might allow a spurious "pip" to ride along the line and insert itself into another circuit.

Video screen bypasses

Open electrolytics in video circuits, especially screen bypass capacitors, can make sync slippers out of the video stages so that the sync is reduced in the composite signal reaching the sync clippers. In some of the old RCA color sets, a 2m-fd capacitor in the 1st video amplifier circuit typically develops a poor power factor, causing loss of most of the vertical sync. Fig. 3 shows a partial schematic of this RCA circuit.

Vertical cathode

Sometimes electrolytics in the vertical oscillator/amplifier circuits produce what might seem like unlikely causes of unstable sync. For example, one particular set has an electrolytic in the cathode circuit of the vertical amplifier which is paralleled by a 0.47m-fd paper capacitor. If this electrolytic opens, the height is reduced. The inexperienced technician then adjusts the height and linearity controls to fill out the raster, but the higher voltages necessary to get additional height cause the vertical lock to be weakened. The same happens in other sets; if you adjust the height and linearity for too much overscan (too large a picture), the vertical lock becomes critical.

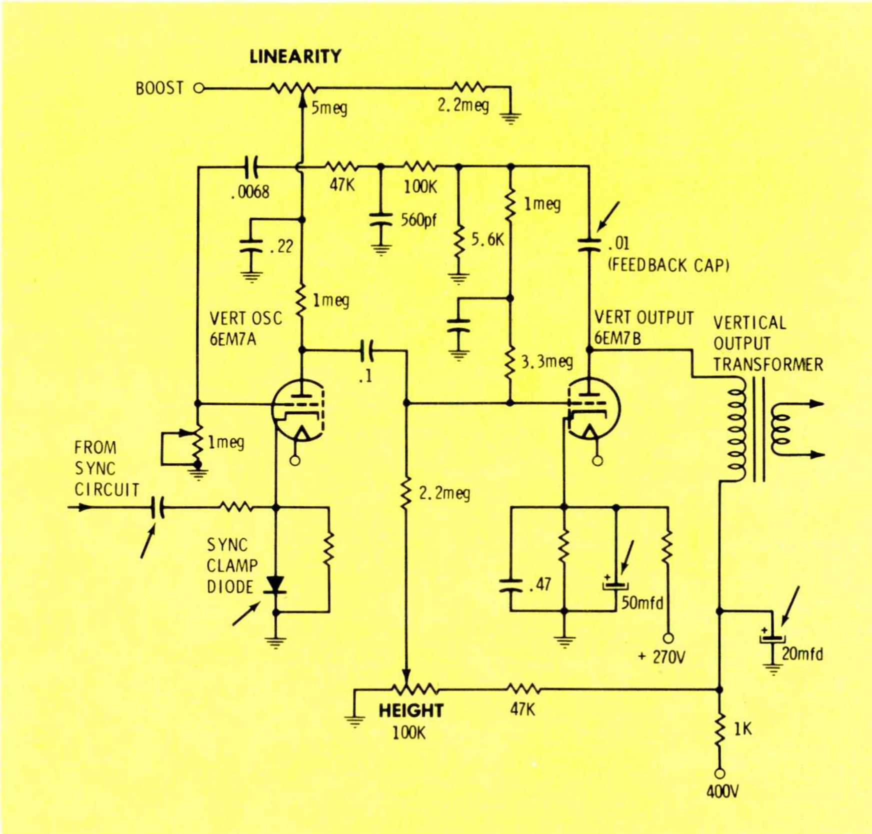

Fig. 4 Arrows point to areas which might cause vertical sync instability without a related sweep defect.

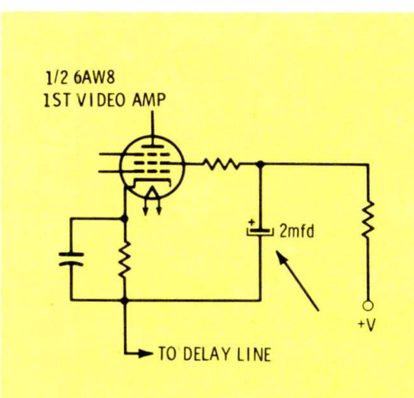

Fig. 3 Vertical locking problems can be the result of defective electrolytics in video amplifiers.

Vertical feedback

Some vertical-oscillator/amplifier circuits will not lock tightly unless the height and linearity are adjusted for less than a whole picture. This happens when the AGC bypass capacitor is open. It also can occur if the feedback capacitor (Fig. 4) is breaking down. In this later case, when the controls are adjusted for inadequate scan, the pulses at the amplifier plate are lower, so the capacitor might not arc internally.

Defects In Oscillator/Amplifier

If lock-in occurs only when the picture is of insufficient height, the trouble probably is inadequate amplitude of the sync pulse arriving at the oscillator or pulse breakdown in the oscillator/amplifier circuit itself.

Fig. 4 is a representative composite oscillator/amplifier circuit showing possible trouble spots which might cause the sync to lock only when the picture has less than normal scan.

Defective Diodes

Detector

Another cause of sync problems is a defective detector diode (Fig. 5). The diode, because of an internal defect, becomes a clipper of large signals. Because the sync signals have the highest amplitude, they are eliminated before they arrive at the sync clippers. Then, as any other time when a

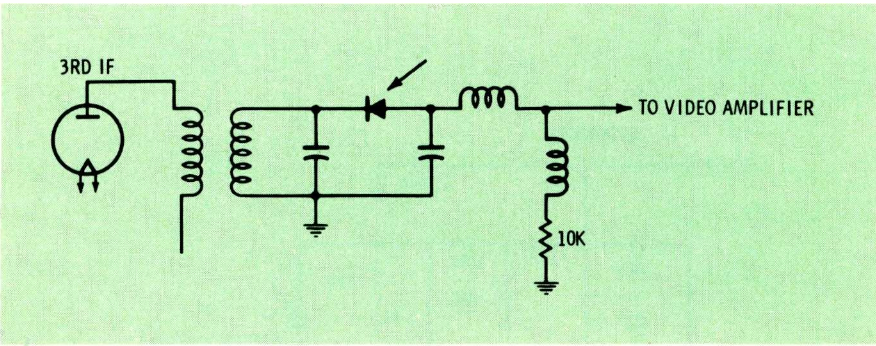

Fig. 5 A defective diode can cause sync and/or AGC defects.

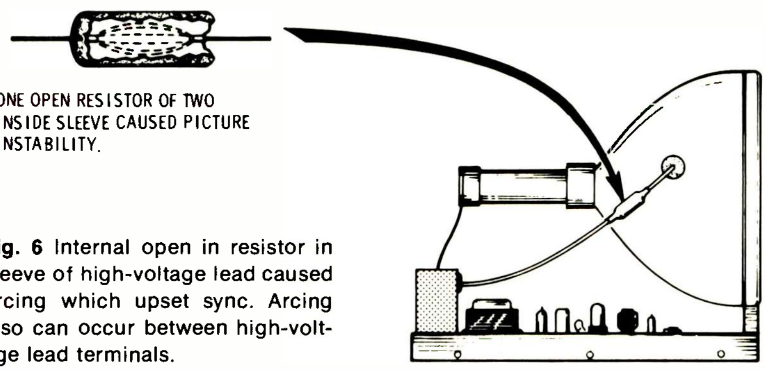

Fig. 6 Internal open in resistor in sleeve of high-voltage lead caused arcing which upset sync. Arcing also can occur between high-voltage lead terminals.

defect compresses the signal, the sync clippers still try to work on the top 20 percent or so of the signal; however, without sync pulses there, they simply inject clipped picture information into the vertical and horizontal oscillators. This causes the picture to tear, bend, lean, roll and jump. A detector diode that is clipping and causing instability normally will exhibit a significant amount of reverse leakage, but don't depend on it. Substitution is the best test; disconnect the original at one end and temporarily tack in a new one.

Oscillator clamp diode

Another diode that can cause sync stability problems is the clamp diode (Fig. 4) in the cathode of some vertical-oscillator circuits. If the diode shorts, there will be no vertical sync. If the diode opens, the main symptom will be insufficient height.

Don't overlook checking any electrolytic or diode when you have an obscure sync proplem. You can't predict what trouble might occur when a seemingly unrelated circuit component becomes defective.

High-Voltage Arcing

Another cause of sync instability is arcing in the high-voltage circuits. Severe arcing is no problem because it is usually visible or audible.

Slight arcing is something else. It can be invisible and/or inaudible, on the chassis or CRT, and yet be quite sufficient to cause unstable sync.

Fortunately, there is another telltale sign of arcing. If you look at the picture closely, you will see many small streaks flicking across the screen, usually at random but occassionally in bands. (Those which occur in bands are more likely to be caused by an outside power-line interference instead of internal arcing.)

The real problem is finding where the arc is occurring and how to restore the circuit to normal operating condition. You might be able to do this by putting the set in a dark place and carefully inspecting around the high-voltage circuit for telltale glows. Substituting a portion of the high-voltage circuit—such as supplying the CRT voltage from another set—also might isolate the problem.

The source of arcing which occurred in one portable set is shown in Fig. 6. A series resistor, one of two in series inside a sleeve in the high-voltage lead, was open. The high voltage was still reaching the CRT and lighting the raster, but it was reaching it by way of an arc inside one of the resistors. The arc was radiating RF noise, which was being picked up by the set and making the picture unstable.

When checking sets for this sort of trouble, make sure that the arcing is not in another set you have turned on in your shop. An arcing set can radiate a disturbing signal to all its neighbors, and, on occasion, the set causing the problem might not show picture instability.

Before you diagnose the trouble as internal arcing in any particular set, check another set in the same location. If there is evidence of arcing in the picture of the second set, turn off the first set to see if it disappears. If it doesn't, the interference is eminating from some other source, and not from the set you're servicing.

Conclusion

The above might not be all the reasons why a picture can become unstable and the set might not have sync circuit troubles, but these are some that you might forget when faced with unusually hard-to-solve stability problems that seem to defy logic. □

Spots trouble fast-tells where it is

This Master Chro-Bar/Signalyst is the most advanced color-bar generator ever developed by RCA

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- RCA's exclusive color-bar marker identifies the third, sixth, and ninth color bars... aids in AFPC alignment and setting the tint control in over-scanned sets.
- Pushbuttons provide color bars, dots, lines, crosshatch, and blank (white, no noise) raster patterns with provision for selecting three or ten horizontal and/or vertical lines with middle of pattern electrically centered.
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RCA Electronic Components

Circle 27 on literature card

troubleshooter

Testing "High-Voltage" semiconductor

■ Semiconductor rectifiers designed for applications involving voltages higher than the typical range of ratings of single-junction silicon or selenium rectifiers typically are made up of several silicon or selenium diode junctions connected in series and sealed inside a single assembly. Because the assembly is sealed, the junctions cannot be tested individually. Consequently, they must be tested as a whole unit, the characteristics of which, in many ways, are significantly different from those of the single units of which it is made.

These differences and how they affect various test methods are analyzed in the following paragraphs and illustrations.

General Information About "High-Voltage" Solid-State Rectifiers

Silicon junctions draw virtually no current when a forward-bias voltage of less than about .4 to .6 volt is applied. This means that, in a rectifier assembly containing 10 silicon junctions in series, an ohmmeter with a battery voltage of above 6 volts will be required to produce a reading. Most VTVM's and FET meters use a 1.5-volt battery to produce ohmmeter voltage, and would produce a reading which indicated an open when used to measure a nondefective silicon rectifier.

Selenium rectifiers composed of only one diode junction are seldom used, because of the inherent low voltage rating of such a unit. The resistance of a reverse-biased selenium junction is lower (increased leakage) than that of a reverse-biased silicon. However, increased leakage often can be an advantage in a series-connected rectifier assembly, because high leakage across one selenium junction in a series assembly will cause less voltage drop across it, which probably will prevent a complete failure of that one junction.

The following sums up the basic information technicians need to know about testing "higher-voltage" rectifier assemblies:

- Ohmmeter readings are of little value, except if a dead short or very high leakage exists.
- Many nondefective selenium rectifiers will exhibit a 5-to-1 reverse-to-forward resistance ratio, but, because both readings probably will be in the hundreds-of-megohms range, relatively small but significant variations from normal will be hard to detect.
- Nondefective focus or high-voltage tripler or quadrupler rectifiers will produce an open reading on most ohmmeters.

Boosted-Boost Rectifiers

Because boosted-boost rectifiers contain several selenium junctions, they cannot be accurately tested with an ohmmeter, except for shorts. One new typical unit measured 120 megohms forward resistance and 700 megohms reversed resistance. Such readings are of no practical value for determining the true condition of the unit.

Boosted-boost circuits nor-

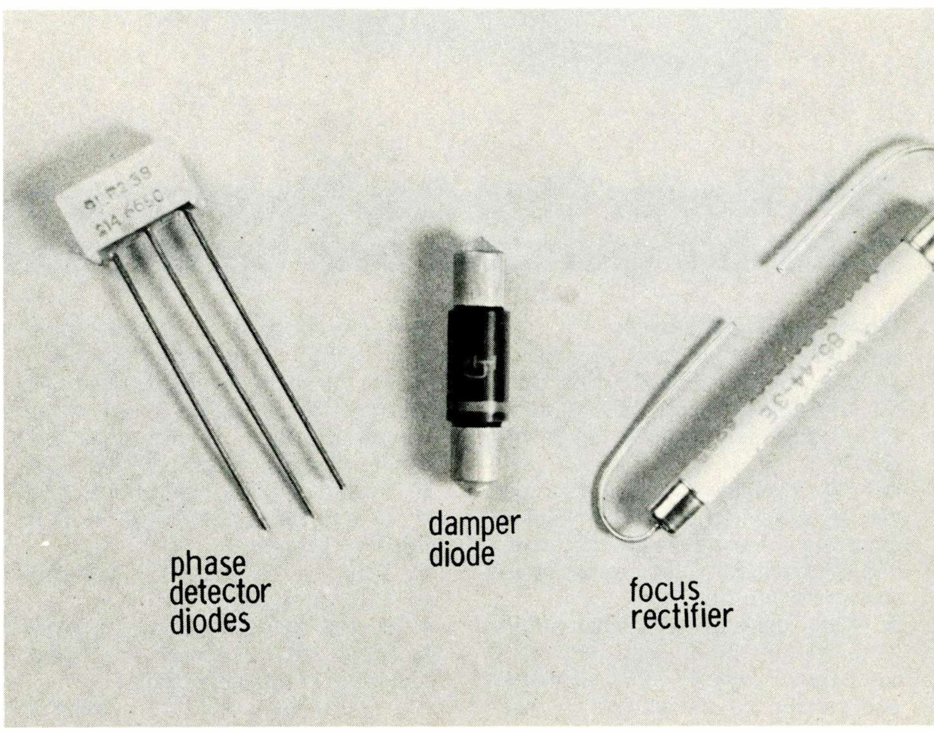


Fig. 1 Examples of "high-voltage" rectifier assemblies and a phase detector duo-diode.

rectifiers

mally are required to furnish about 300 to 350 volts DC. Consequently, do *NOT* use a conventional power-supply silicon rectifier as a replacement for the selenium type.

One method of testing "higher-voltage" selenium rectifiers is illustrated in Fig. 2. This method provides a reliable indication of the amount of leakage which exists across the rectifier during reverse-bias conditions. The higher the leakage, the lower the resistance and, consequently, the lower the voltage across the rectifier.

Forward-bias test

When a typical boosted-boost rectifier was forward biased—anode connected to the 1 megohm resistor in Fig. 2, and cathode grounded—the resistance across the selenium junction was reduced to an amount which developed only about 11 volts. When similar rectifiers with known amounts of leakage were connected in the same manner into the circuit of Fig. 2, the amount of leakage in each case caused a reduction of the voltage across the rectifier, as indicated by the VTVM, but the various reductions were not significant nor consistent enough to provide a definite indication of a specific amount of leakage. For this reason, the forward-bias test should be limited to determining whether or not the device is conducting when forward biased. Proper forward conduction of most selenium devices of this type is indicated by a voltage reading of *15 volts or less* across it.

Reverse-bias test

The reverse-bias test—anode grounded and cathode con-

Table 1

Results of Tests of Boosted-Boost Rectifiers Using Test Setup In Fig. 2.

Known Reverse-Bias Leakage (In megohms)	Voltages Across Rectifiers
open rectifier	259V
5.6	220V
3.3	204V
1.8	174V
1.0	140V

Table 2

Results of Tests of Boosted-Boost Rectifiers Using Test Setup in Fig. 3, With 110 Volts AC (RMS) Applied.

Known Leakage (In megohms)	Voltages Across Capacitor
open rectifier	153V
5.6	150V
1.8	148V
1.0	146V
.560	136V
.330	125V

Table 3

Results of Tests of Focus Rectifiers Using Test Setup in Fig. 3, With 110 Volts AC (RMS) Applied.

Known Leakage (In megohms)	Voltages Across Capacitor
open rectifier	98V
5.6	85V
3.3	81V
1.8	75V

Table 4

Results of Tests of Duo-Diode Phase Detector Diodes Using Test Setup in Fig. 3, With 6.3 Volts AC (RMS) Applied.

Known Leakage (In megohms)	Voltages Across Capacitor
open rectifier	8.6V
5.6	8.4V
1.8	8.2V
1.0	8.0V
.1	5.0V

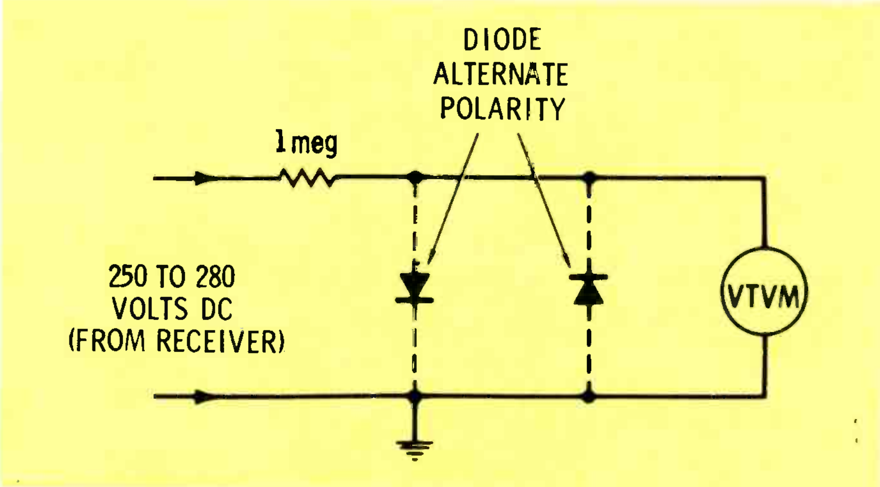


Fig. 2 Schematic diagram of a setup for testing "high-voltage" rectifiers by the high-voltage-ohmmeter method.

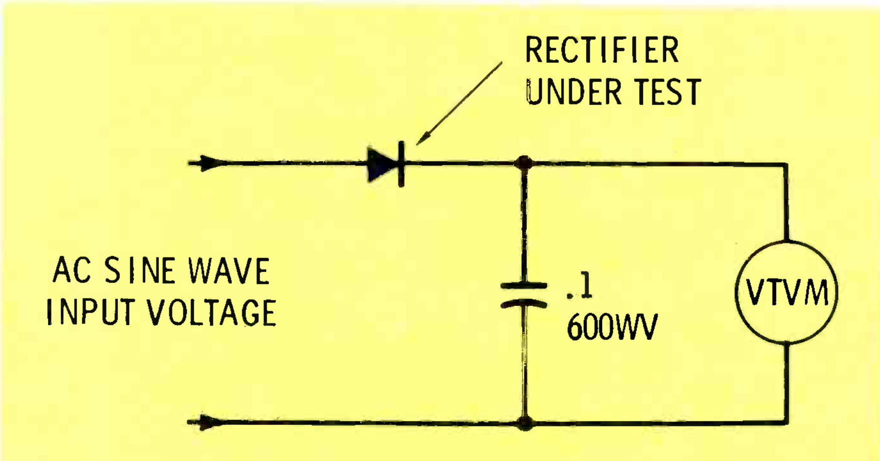


Fig. 3 Schematic diagram of setup for testing rectifiers by the rectified-voltage method. The input voltage should be selected to match the rating of the rectifier. Leakage through the rectifier reduces the output voltage. The higher the output voltage, the better the rectifier.

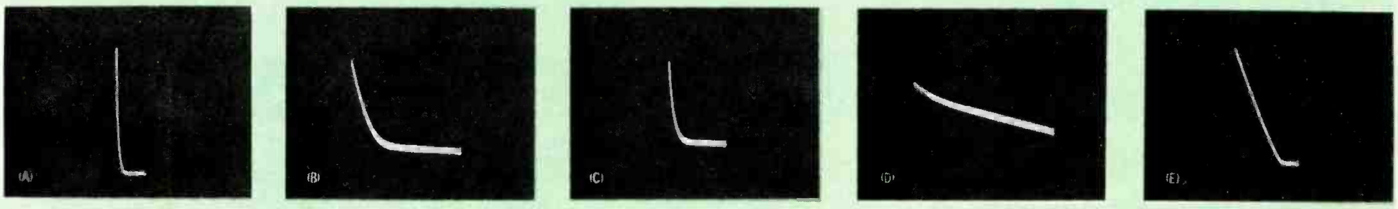


Fig. 4 Various waveforms of rectifiers tested on the Jud Williams Transistor Curve Tracer. **A)** For comparison, the waveform of a nondefective silicon power-supply diode. **B)** Series resistance is indicated by the slope of the vertical line in this waveform produced by a normal boosted-boost rectifier. **C)** This waveform of a damper diode required a high "VOLTAGE" control setting on the curve tracer. **D)** Because the 80 volts from the curve tracer was not enough to overcome the barrier potential of this focus rectifier there is no "corner" produced in the curve. **E)** The waveform of a nondefective selenium horizontal-phase-detector double diode reveals some series resistance.

nected to the 1 meg-ohm resistor in Fig. 2—is used to determine the amount of leakage across the selenium when it normally is cut off. The leakage again is indicated by the amount of voltage across the device—the higher the voltage, the lower the leakage. Table 1 lists the amounts of known leakage in seleniums tested by this method in the ES lab and the respective voltages measured across each.

Related tests in the ES lab revealed that, for a boosted-boost selenium to produce a voltage within 10 percent of the normal level required of a typical boosted-boost circuit, the reverse-bias resistance of the selenium should not be below about 1.8 megohms, which, in the test setup in Fig. 2, is indicated by a VTVM reading of about 174 volts. A voltage lower than this indicates excessive reverse-bias leakage, and the selenium should be replaced.

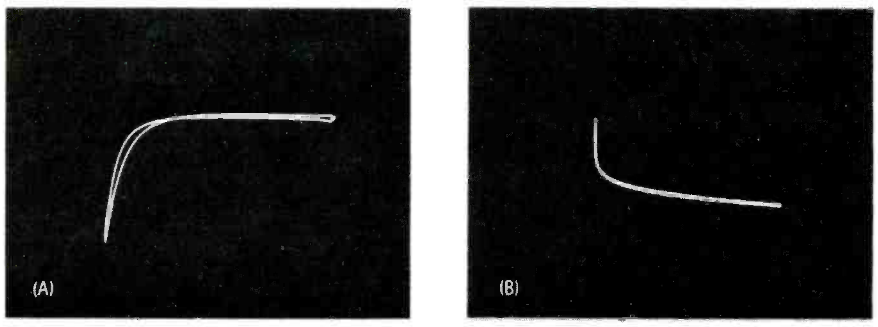


Fig. 5 Most of the high-voltage rectifiers tested were not supplied enough voltage by the Eico 443 curve tracer to produce meaningful curves. **A)** Peak-inverse-voltage curve of the boosted-boost rectifier appears similar to that of power-supply diodes, except the avalanche point (on the left) does not have a sharp corner. **B)** Nearly 6 volts of forward voltage drop was measured during this test of the damper diode. A power-supply diode measures about .7 volt.

Rectification Test of Boosted-Boost Rectifiers

Another, and perhaps more realistic, method of testing selenium boosted-boost rectifiers is illustrated in Fig. 3. In this test, the device is used to rectify a known amount of voltage, the value of which should always be more than the amount required across the junction to cause it to conduct.

Because the solid-state rectifiers used in "higher-voltage" applications are low-current devices, the size of the capacitor used to make the test setup in Fig. 3 peak-reading should be as small as possible.

Table 2 shows the results obtained when seleniums with known leakages were tested using the setup in Fig. 3, with 110 volts AC (RMS) applied.

Testing Damper Diodes

The forward and reverse resistances of a typical solid-state damper diode, measured with an ohmmeter, were 600K ohms and 300 megohms, respectively. Because of these inherently high normal junction resistances, ohmmeter tests of solid-state damper diodes usually will be inconclusive, except in cases in which a short or near-short exists across the diode junction.

Testing the typical damper diode with the test setup in Fig. 2 produced a voltage drop of 2.2 volts across the diode in the forward-biased condition, and, with the diode reverse-biased, the indicated leakage was almost identical to that produced by the nondefective boosted-boost diode. If the voltage across the damper diode in the forward-biased condition exceeds 10 volts, the diode should be replaced.

The voltages produced when the damper diode was tested with the dynamic test setup in Fig. 3 were, again, almost identical to those produced by the nondefective boosted-boost diode. However, because the damper diode normally is required to handle more power than is the boosted-boost diode, it should be replaced if the VTVM reading corresponds to a reverse resistance of about 2 to 3 megohms or less.

Testing Rectifiers Used in Focus And High-Voltage Circuits

Rectifiers used in the focus and high-voltage circuitry of TV receivers should produce an open indication (infinite resistance) on a VTVM or FET VOM, if not defective.

The leakage and rectifier tests used to check boosted-boost and damper diodes also can be applied to focus and high-voltage rectifiers. However, less leakage can be tolerated in the latter types.

The voltage dropped across a typical forward-biased focus rectifier was 75 volts, measured using the test setup in Fig. 2. The voltage measured across other typical focus rectifiers with known amounts of leakage and with 110 volts AC (RMS) applied and a .1-mfd filter capacitor connected, to duplicate the test setup in Fig. 3, are listed in Table 3. From these tests, it is apparent that a reverse resistance reading of between 5 and 10 megohms across the diode is the minimum acceptable.

Duo-Diode Phase Detectors

Selenium duo-diode assemblies which typically are used as phase detectors in horizontal oscillator-control circuits are not "high-voltage" devices. However, it is better to test them in the rectifier circuit shown in Fig. 3 than to depend upon ohmmeter tests alone. It is possible for ohmmeter readings to indicate a severe unbalance between the two sections, and yet a rectifier test will indicate that they are almost identical.

The preceding was true of the several samples we measured. Section 1 of one such unit indicated a forward resistance of 3.3K ohms on the X100 scale, 14K ohms on the X1000 scale, and a reversed resistance of 500 megohms on the X1M scale of a VTVM. The other section of the same unit indicated a forward resistance of 2.7K ohms on the X100 scale, 11K ohms on the X1000 scale, and a reversed resistance of 300 megohms on the X1M scale of the VTVM. Yet, a simulated rectifier test indicated that the two sections were identical.

Table 4 lists the DC voltages dropped across typical forward-biased duo-diodes with known amounts of leakage, which also are listed. These voltages were obtained by testing the duo-diodes in the test setup in Fig. 3, with 6.3 volts AC (RMS) applied. The results indicate that the minimum duo-diode reverse resistance which can be tolerated in most horizontal oscillator-control circuits is about 1 megohm, which, as shown in Table 4, corresponds to a voltage drop of about 5.6 volts across the duo-diode.

Testing High-Voltage Rectifiers With A Curve Tracer

We attempted to test with a curve tracer the high-voltage rectifiers and the phase diodes described previously. However, the results were not conclusive and the leakage tests not sensitive enough.

Fig. 4 shows the waveforms produced, after much knob twiddling, by the various rectifiers tested on the Jud Williams Model A transistor-curve tracer.

Most of the rectifiers required more voltage than was available from the Eico Model 443 curve tracer. Fig. 5 shows two of the test results, which approached that produced by normal diodes.

The inconclusive results of the tests made using the two curve tracers should not be interpreted as criticism of these instruments,

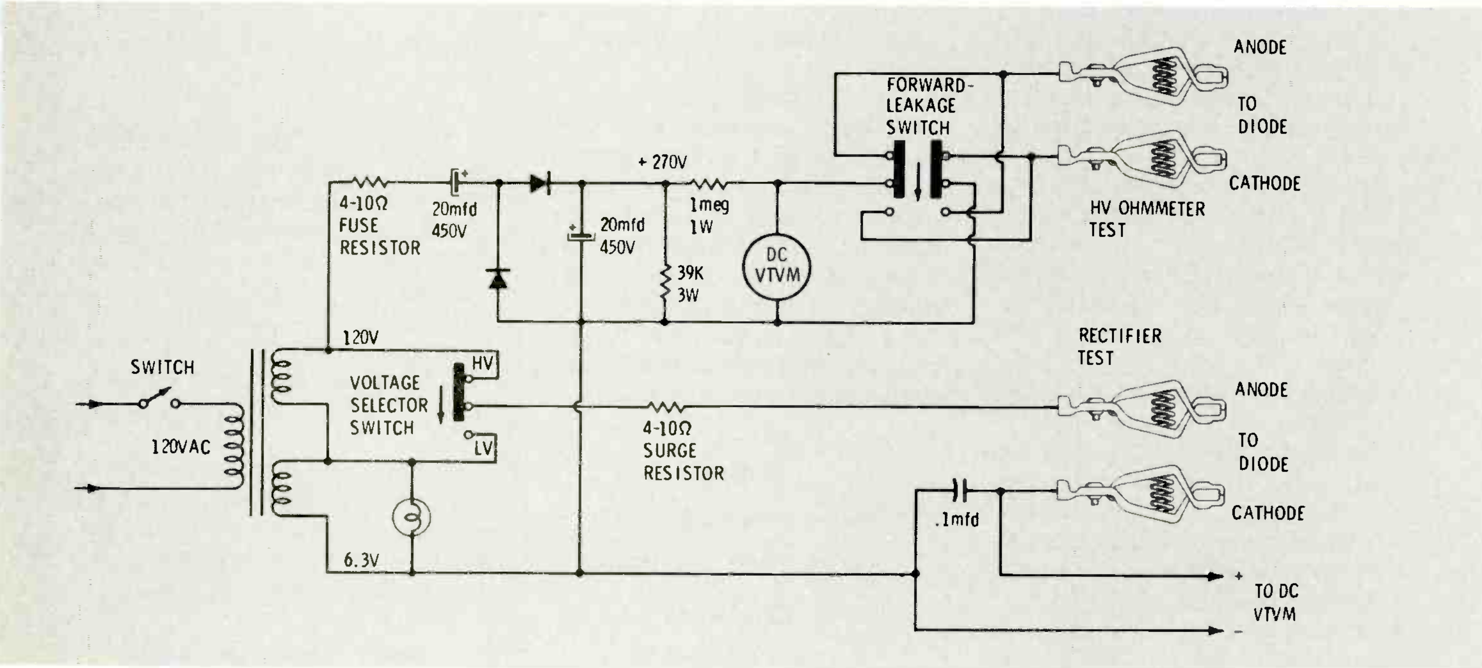


Fig. 6 Schematic of a test jig you can build to test high-voltage rectifiers by both the high-voltage-ohmmeter and rectified-voltage methods.

because neither was designed to test these specialized types of rectifiers.

A Test Jig For High-Voltage Rectifiers

A test jig which permits high-voltage-ohmmeter and rectifier-voltage tests with a minimum of lead juggling is diagrammed in Fig. 6.

To use the test jig to test rectifiers by the high-voltage-ohmmeter method:

- Attach the VTVM or FET meter terminals on the test jig. Select the first DC range above 280 volts.
- Turn on the power switch of the test jig.
- Connect the rectifier to be tested to the color-coded, insulated clips.
- Measure the voltage at both positions of the "forward-leakage" switch.
- Low or zero voltage on both positions indicates the rectifier is leaking or shorted.
- Full power-supply voltage on both positions indicates the rectifier is open.
- A higher-than-normal voltage reading during the "forward" test indicates excessive internal resistance in the rectifier.
- A lower-than-normal voltage reading during the "leakage" test indicates excessive leakage. The readings which prove the rectifier to be defective depend on the type of rectifier and the circuit in which it is used. Refer to preceding parts of this article for suggested guidelines to follow.

To use the test jig to test diodes and rectifier assemblies by the rectified-voltage method:

- Connect the VTVM and diode rectifier leads to the proper color-coded clips. Be sure the correct polarity is observed.
- Select the HV or LV position of the voltage-selector switch, according to the type of rectifier. Normal power-supply diodes and phase-detector diode assemblies should be tested on the LV position.
- Select the appropriate DC voltage scale on the VTVM, according to the position of the voltage-selector switch.
- Turn on the power switch of the test jig.
- Read the positive DC voltage obtained, and interpret the condition of the rectifier assembly or diode by your experience and the suggestions given earlier in this article.

Conclusion

Although an ohmmeter measurement of the forward and leakage resistances of power-supply diodes is satisfactory, such a simple measurement is of little value for testing high-voltage rectifier assemblies.

We suggest you try the previously listed methods of testing such unique components. ☐

antenna systems report

Antennas For Long-Distance UHF Reception

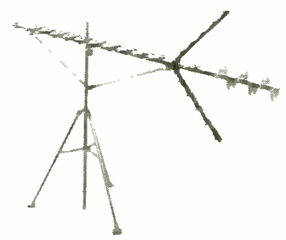
RMS Electronics, Inc., announces the three new "Star-Track" VHF-UHF-FM antennas reportedly designed for long-distance UHF reception.

Model SK-1919 features 8 UHF disc directors, 1 driven element, a reflector array of 10 elements, and 19 VHF elements to provide a reception range of up to 175 miles on VHF channels 2 to 13, and up to 100 miles on UHF channels 14 to 83, according to the manufacturer.

Model SK-1919 sells for $77.95.

Another antenna, Model SK-1916, reportedly has 5 UHF disc directors, 1 driven element, 10 reflector array elements, and 19 VHF elements which provides reception up to 175 miles for VHF channels 2 to 13, and 50 miles for UHF channels 14 to 83.

The Model SK-1916 sells for $71.95.



Model SK-719 (shown here), used to extend the UHF reception range in metropolitan areas, has 8 UHF disc directors, 1 driven element, 10 reflector array elements, and 7 VHF elements, according to the manufacturer. The reception range reportedly is up to 100 miles for UHF channels, and 50 miles for VHF channels 2-13.

Model SK-719 sells for $50.95.

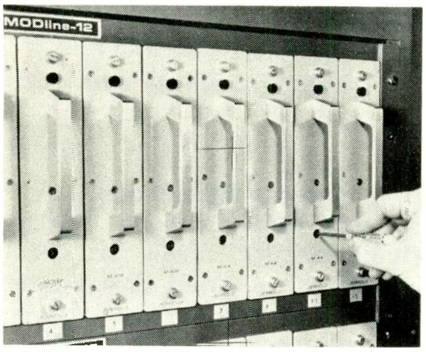
A Model SP-332 VHF/UHF splitter reportedly is included with each "Star-Track" antenna.

Circle 70 on literature card

MATV Distribution System

Jerrold Electronics announces a new modular-amplifier MATV distribution system with a solid-state headend unit, consisting of amplifier modules in a rack mounting enclosure.

Each enclosure, when filled with eight modules, reportedly will distribute the FM band and seven non-adjacent VHF-TV channels.



The enclosure contains a combined output filter and either a single or combined input filter, according to the manufacturer. The channel selector filters are said to be included in the rack rather than in the amplifier modules. Consequently, each amplifier unit reportedly can be made the equivalent of any other, and one module serves as a spare for any in the system.

The MODline 12 requires no tuning, matching or wiring, according to the manufacturer.

Circle 71 on literature card

Mobile Antenna

A new mobile antenna, Model M-410, with a power-handling safety factor of 40-to-1 has been announced by The Antenna Specialists Co.

Model M-410 reportedly utilizes an industrial-type loading coil twice the size and weight of a

(Continued on page 54)

Circle 30 on literature card

Circle 31 on literature card

(Continued from page 53)
conventional CB type, and a stainless-steel whip coated by a new copper-and-nickel process known as "Supercon".

Installation is said to be simple, as the 17-foot cable is connected at the factory.

The M-410 sells for $29.95.

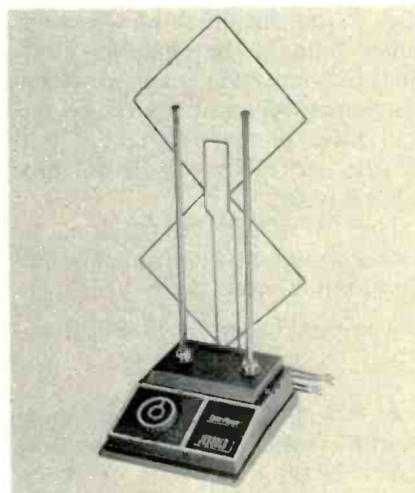
Circle 72 on literature card

Antenna Color Phaser

A new indoor antenna utilizing a color-phasing circuit has been developed by Jerrold Electronics.

The Color Phaser Model JIN-5 reportedly provides UHF, VHF and FM reception.

UHF signals are received on a double-diamond UHF element, and its height is said to provide extra UHF signal "capture area". VHF and FM signals reportedly are received on corrosion-resistant, telescoping elements.



Model JIN-5 sells for $14.95.

Circle 73 on literature card

Antenna Mast Clamp

Just introduced by Becker & Fuhrman is the TENNA-CLAMP, which is intended to be used as a temporary or semi-permanent replacement for a rotor when the rotor must be removed for repairs.

Horizontal brackets are located on the side reportedly to permit insertion of the stub-mast of the antenna so repairs can be made conveniently to the antenna.

Price of the TENNA-CLAMP is $19.50. □

Circle 74 on literature card

photofact™ bulletin

PHOTOFACT BULLETIN lists new PHOTOFACT coverage issued during the last month for new TV chassis.

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EMERSON
Chassis 11H5, 12H5, 14H5, 16H5 1222-1

GENERAL ELECTRIC
Chassis N-2 1219-1
Chassis R-1 1220-2
Chassis W-1 1221-1
Chassis H-4 1223-2

HITACHI
IU-54 1223-3

MGA
BS-130 1222-2

OLYMPIC
9P94 1219-2
6P71 1221-2

PENNCREST
2871, 2871A, 2887, 2887A 1218-1
2855, 2855A, 2861, 2862, 2863 1221-3
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SONY
KV-1220U (Ch. SCC-10-A, SCC-A04-AA, SCC-A04-CA) 1218-3
KV-9000U (Ch. SCC-B-01-AA/-BA/-DA) 1222-3

TRUETONE
MIC3916B-17, MIC3918C-27, MIC3919B-17 (2DC3916B/18C/19B) ... 1224-3

WARDS AIRLINE
GCI-17321A/21B/41A/41B/51A/51B, GCI-17421A/41A/51A .... 1220-3 □

Heath's IB-101 digital frequency counter— operation and service applications

by Joseph J. Carr

■ One reason why more service technicians are not familiar with digital-frequency counters (DFC) is that, until recently a DFC cost, at the very least, something in the low kilobuck range. The Heath Company has changed all of that with the introduction of their Model IB-101 digital frequency counter. It is priced under $200.

I recently purchased an IB-101, in kit form. Total assembly time, including calibration, was a little less than six hours.

How It Measures Up To Specs

Accuracy

I took my IB-101 to a commercial two-way radio shop for comparison with some high-priced, exotic equipment. Using a Measurements Model 80 signal generator as a source and a Motorola SN1075 DFC (a $3500.00 instrument), we checked the accuracy of the Heath IB-101. The Heath unit tracked with the Motorola, right down to the last digit. On this last digit, there was more "bobble" on the Heath than on the Motorola. (The last digit on all DFC's switches back and forth between two adjacent digits. This is called "bobble".)

Frequency response

Heath claims that the IB-101 requires an input of only 240 millivolts (240,000 microvolts) for proper triggering. The unit in our possession exceeded this specification; it triggered properly down to 75 millivolts. Although the spec sheet calls for a 15-MHz upper limit on the IB-101, the unit tested triggered nicely to almost 22 MHz before becoming erratic. A few hundred KHz higher and it reset to zero and refused to count.

Other Frequency Counters Reported On In ES

The characteristics and features of the following frequency counters have been reported in the indicated issues of ES:

Weston, Model 1250—
Oct., 1971, page 59
Simpson, Model 2726—
June, 1971, page 38
Cushman, Model CE-40—
Aug., 1971, page 45

General Theory of Operation of DFC's

Extensive discussion of DFC circuit operation is more or less irrelevant in an article primarily about the operation of and the uses a technician can make of an instrument such as the IB-101. For those who are interested in the general theory of circuit operation of this and other counters, we can offer at least two sources of good reading. One is the IB-101 assembly manual (available for $2.00 from Heath). Another excellent source of digital circuit information is *RTL Cookbook*, by Donald Lancaster (Howard W. Sams, Catalog No. 20715).

How The IB-101 Functions

Fig. 1 is a simplified block diagram of the IB-101. The input signal is amplified by an FET stage, then passed on to a Schmitt trigger. The purpose of the Schmitt trigger is to convert the input waveforms to a square-wave output. From the trigger, the square waves pass to a five-decade counting and display section.

This arrangement, however, can count only the total number of cycles, not the frequency, or number of cycles per *second.* To make valid frequency measurements, it is necessary to reference the count to a time base. To accomplish this, an AND gate is used to turn on the counter for a precise period of time. In the "Hertz" position, the period is 1 second; in the "kiloHertz" position, .001 second is used. The time base is a crystal-controlled, 1M-Hz oscillator which drives a chain of IC decade dividers. Each of these divides the frequency by a factor of ten so that output frequencies of 100 KHz, 10 KHz, 1 KHz, 100 Hz, 10 Hz, and 1 Hz are obtained. The 1K-Hz and 1-Hz frequencies supply the required .001- and 1-second gating periods.

Operating The IB-101

Frequency counting

To count a frequency less than 99,999 Hz, simply connect the IB-101 test cable to the circuit being checked. Wait for the counter to clear, count and display.

Frequencies from 100 KHz to 15 MHz are measured in a two-step procedure. First, set the counter to the KHz mode and note the reading. Push the range switch to Hz, wait for the display to change, then add the figures now displayed to those previously indicated in the KHz mode. For example, a marine transmitter with a 2182K-Hz crystal might read:

(In KHz position) 02182
(In Hz position) 82035
02182035 =
2182.035 KHz, or 35 Hz high.

The upper frequency limit of the IB-101 specified by the manufacturer is 15 MHz. However, this is not the highest frequency that can be measured with the IB-101, if other equipment is available. Some of the techniques also permit measurement of the frequency of a received distant station.

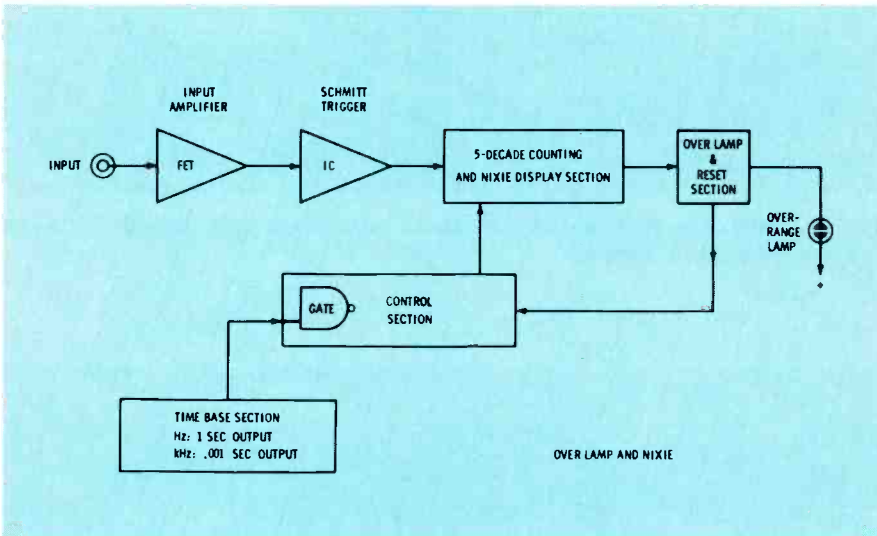


Fig. 1 Simplified block diagram of Heath's IB-101 digital-frequency counter (DFC).

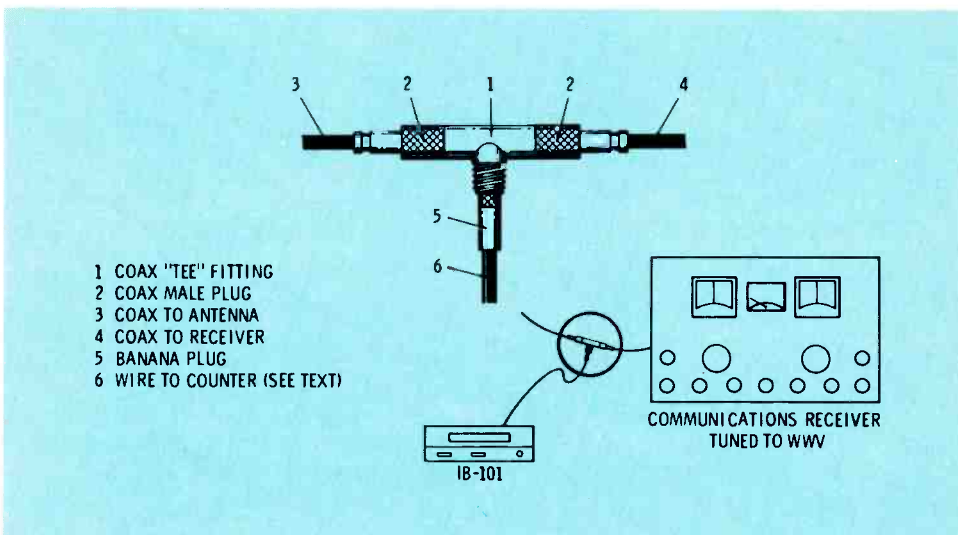


Fig. 2 Equipment connections for calibrating the time-base oscillator of the IB-101 by zero beating its output against a signal from WWV. The receiver used should be equipped with an S-meter. See text for procedure.

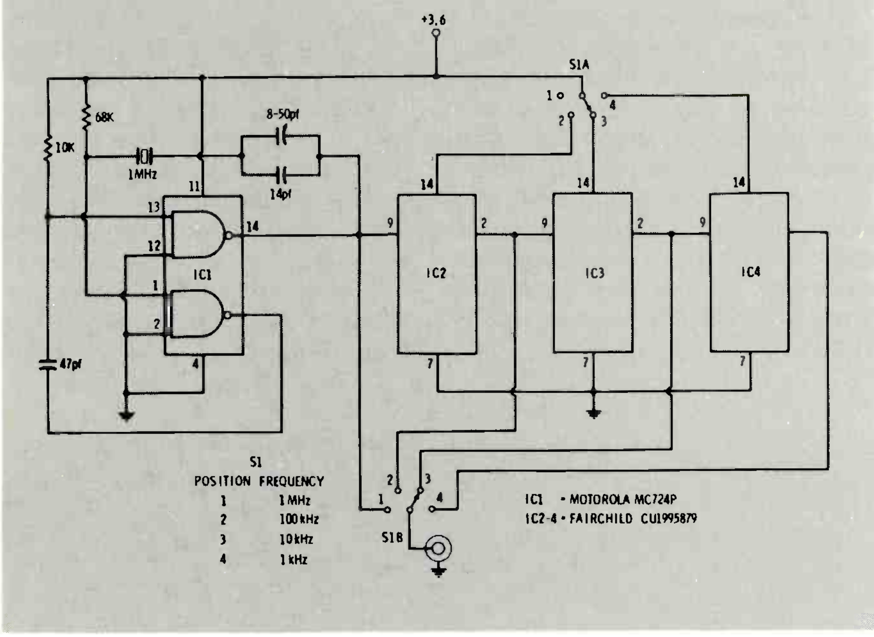


Fig. 3 Circuitry of an extremely accurate crystal calibrator. Application of the calibrator is explained in detail in the text.

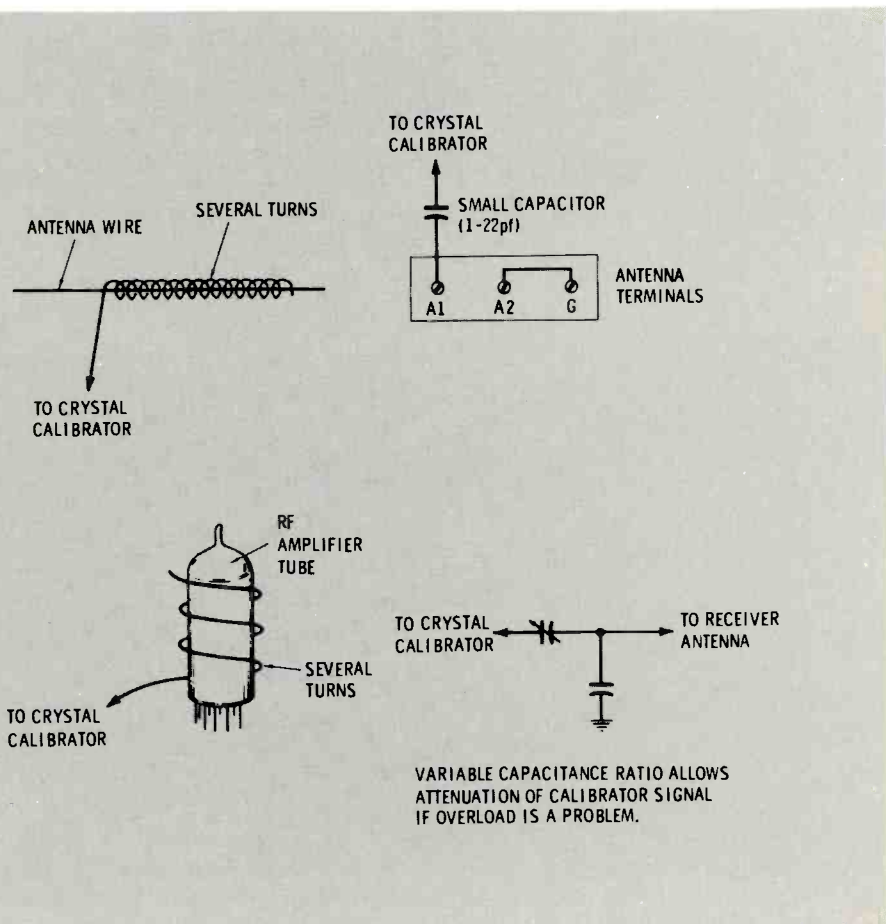


Fig. 4 Shown here are several methods for connecting the crystal calibrator to a receiver.

Calibration of the IB-101

To calibrate the IB-101, zero beat the 1M-Hz time-base oscillator in the IB-101 against a WWV signal received by a receiver equipped with an S-meter. Use the highest WWV frequency that produces a strong signal in your area. Couple signals from the IB-101 time-base oscillator, by way of a piece of wire, to the antenna circuit of the receiver, as shown in Fig. 2. An audio note from the receiver's speaker or a pair of headphones will indicate when the frequencies of the two signals are getting closer together. For the final adjustment, wait for the interval when WWV modulation ceases. Zero the oscillator trimmer by watching the receiver's S-meter sway back and forth slower and slower as the pitch of the beat note decreases. When the time base is exactly on the right frequency, the S-meter will cease moving.

A high-accuracy crystal calibrator circuit is shown in Fig. 3. It can produce markers up to at least 50 MHz. This particular circuit, incidentally, is a near duplicate of the first part of the IB-101 time-base chain. If an accurate crystal is obtained and is operated inside a crystal oven, this circuit not only will be highly accurate but also can provide an extremely high degree of stability. The variable capacitor, shown in Fig. 3, should be a rotary shaft tuning type rather than a trimmer, for closest adjustment of frequency. It also should be coupled to the operating knob via a reduction gear assembly, such as those made by National Radio and other manufacturers. This will make zeroing against WWV easier.

Fig. 4 shows several ways to couple a crystal calibrator to a receiver.

When using a calibrator with the IB-101, it is necessary to locate on a receiver the signal being measured. Be sure you are on the correct signal and not an image frequency. A hypothetical receiver dial calibrated for a portion of the 27M-Hz Citizens' Band is shown in Fig. 5. The calibrator, set to the 1M-Hz position, is used to set the receiver dial pointer right on the 27M-Hz mark.

If the signal of interest falls at point "A", use the 1M-Hz position of the calibrator to produce a beat note. Connect the input cable of the IB-101 across the speaker terminals of the receiver and add the frequency displayed to 27.000000 MHz. For example, if the counter reads 133 Hz, the frequency of the transmitter is 27,000,000 plus 133 Hz, or 27.000133 MHz.

If the signal being measured falls on the low side of the marker, it will be necessary to subtract the counter reading from the frequency of the known calibration point.

In the event that the signal of interest falls at point "B", use the same procedure, but have the calibrator set to produce a 100-KHz output. In this case, a 133-Hz reading would indicate a frequency of 27,100,000 plus 133 Hz, or 27.100133 MHz.

It might be necessary to use the 10K-Hz position of the calibrator for points close to the middle of any specific 100K-Hz point. Even at 27.085 MHz, for example, we are 15 KHz from the nearest check point (27.1). This might be too far away because of the narrower IF and AF bandwidths. A typical measurement at 27.085 MHz will use the 10K-Hz calibrator to identify both the 27.08 and 27.09 points on the dial. Unfortunately, there is a strong possibility of error when the signal is close to midway between 10K-Hz points. Let's take as an example a frequency of 27.085133 MHz. The 10K-Hz markers will produce two close beat notes: 5133 Hz and 4867 Hz. In such a case, it will be necessary to use a filter network in the line between the receiver output and the DFC input to sharply attenuate the signals above 5000 Hz. Should 25K-Hz, 50K-Hz, 2.5K-Hz, 5K-Hz, etc., markers be desired, they can be produced by connecting, to the appropriate calibrator output, either or both sections of an IC called a "dual J-K flip-flop". (A J-K flip-flop is a digital IC that can divide the input signal by two.)

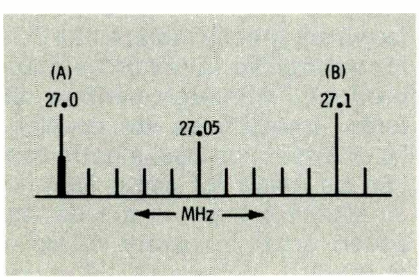


Fig. 5 Calibrated dial of a hypothetical receiver calibrated for a portion of the 27-MHz Citizens' Band.

The transfer-oscillator technique is another method of measuring frequencies above the IB-101 limit. This is illustrated in Fig. 6.

A transfer oscillator is merely a stable signal generator. If specifically called a "transfer oscillator", it probably will have a high-ratio vernier dial, a high output voltage and a distorted output waveform so that it will be rich in harmonics. However, any signal generator that can be zero beated against the signal being measured, either directly or via harmonics, can function as a transfer oscillator.

For ease of arithmetic, I prefer using the tenth harmonic. For example, suppose you want to measure the frequency of a 42.0M-Hz signal generator. Tune the transfer oscillator to 4200 KHz. Then, find the beat note between the 42.0M-Hz generator and the tenth harmonic of the 4200K-Hz signal by using a receiver which has an appropriate frequency range. Zero beat the transfer oscillator against the 42.0M-Hz signal. In the "KHz" position, the counter should read 04201; in the "Hz" position, the counter should read 01234. Adding the two readings as illustrated earlier, you will find that the signal generator is producing a signal that is the tenth harmonic of 4201.234 KHz, or, stated in MHz, 42.01234 MHz—a little over 1.2 KHz high.

An extension of the crystal marker idea is to use a high-frequency marker and a heterodyne unit with a wide bandpass. The setup is shown in Fig. 7. A 30-MHz crystal will allow you to measure those frequencies that are at 30 MHz plus and minus the upper frequency limit of the counter. A 15M-Hz counter, such as the IB-101, will measure frequencies between 15 MHz and 45 MHz when heterodyned against that 30M-Hz marker. Care must be taken to determine whether the signal being checked is on the high side or the low side of the heterodyne crystal. Amateur radio operators have been known to use a 140M-Hz oscillator to measure frequencies in their 2-meter band (144-148 MHz). This is an example of extending the useful range of the counter to almost ten times its normal range. For the service technician, this technique will allow checking, for example, the accuracy of the shop FM signal generator (with modulation off, of course). A 100M-Hz crystal will do in this case.

Using the IB-101 in the Service Shop

Test-equipment calibration

Calibration of shop test equipment is an ideal use for the IB-101. Most stereo generators have a 19K-Hz output. The DFC will tell you whether your pilot signal is actually within the plus or minus 2-Hz frequency tolerance specified by the FCC for FM stereo broadcasters. If an inaccuracy exists, it will cause serious degradation of the separation of any receiver aligned by the generator.

Your standard AM Mod/Unmod signal generator also can be calibrated with the IB-101, directly up to 15 MHz, and indirectly above it. My own sine-/square-wave audio generator was so close to being exactly on the indicated frequencies, that I actually did a double-take to reread the counter and the dial of the AF generator.

The DFC might also be the answer when performing the sometimes ticklish alignment procedure used to set up certain color-bar generators.

On the car-radio bench

Another area of use for the IB-101 is the car-radio bench. Tune a radio to approximately

1000 KHz. Set the input signal generator (unmodulated) to 1000 KHz, using the DFC. Check the frequency of the signal at key test points in the receiver, as shown in Fig. 8, until either an incorrect frequency or "00000" appears on the DFC readout. At the output of the RF amplifier, for example, you should find a 1000K-Hz signal. If not, that stage is not functioning. On the emitter of the converter, you should find a 1262.5K-Hz signal, except on certain older or imported sets and most current table models, which use a 455K- or 460K-Hz IF. In those sets, the signal on the emitter of the converter will be 1455 or 1460 KHz. In the IF amplifier, a 262.5K-Hz signal should be indicated.

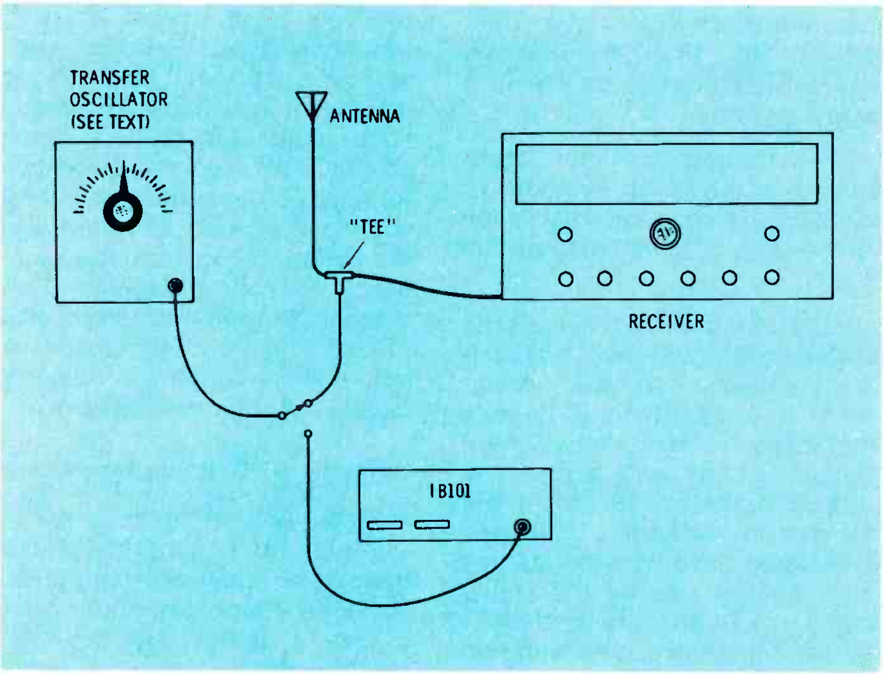


Fig. 6 Equipment connections for using the transfer-oscillator method of measuring frequencies above the range of the IB-101.

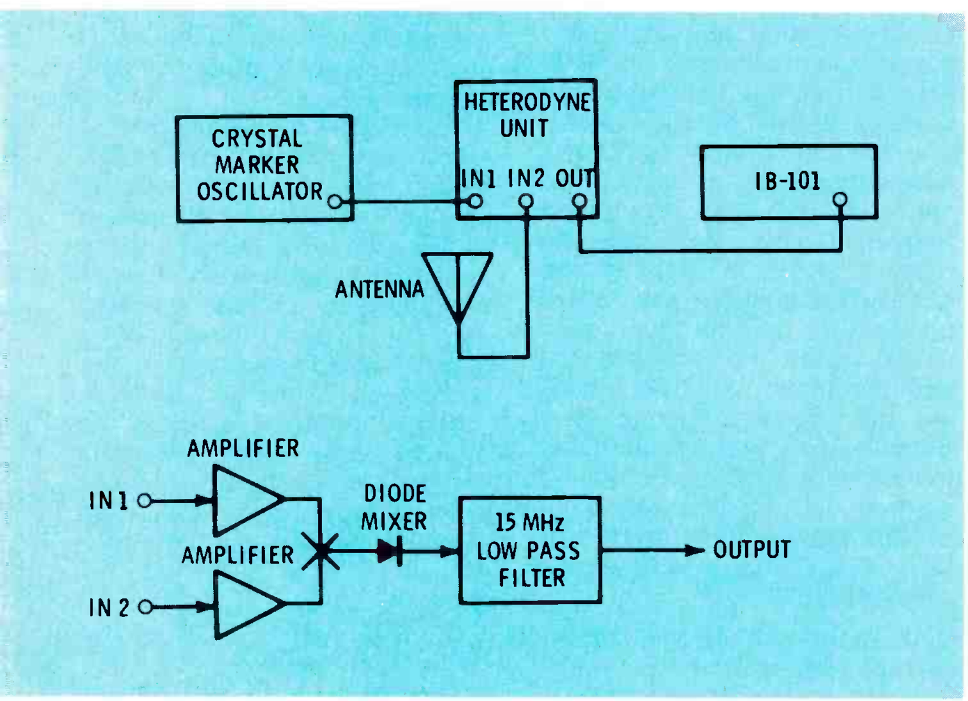


Fig. 7 Setup for using a high-frequency marker and a hetrodyne unit to measure frequencies above the range of the IB-101.

An open capacitor in the converter stage of a radio is one example of a defect that can be found quickly with a DFC. (See Fig. 9.) The usual check for proper oscillator operation is to measure the DC voltage drop across the emitter resistor while tuning from one end of the band to the other. The conduction of the transistor, as reflected by the emitter voltage, should change drastically from one end of the band to the other. If either the emitter bypass or one of those small capacitors, including the trimmer, should open, the oscillator might continue operating, but at the wrong frequency. In a superhet circuit, this usually will kill the output of the radio just as surely as if the stage were completely dead. When the normal frequency of the oscillator is 1262.5 KHz (radio tuned to 1000 KHz), the small capacitors will cause the frequency to shift upwards a few hundred KHz. Loss of the emitter-bypass capacitance usually will cause the oscillator to operate on a frequency in excess of 2000 KHz. For some reason, 2548 KHz seems to be popular with older Bendix VW radios, which use a certain black tubular .0082-mfd or .01-mfd bypass capacitor at this point. This is a relatively difficult problem to solve, unless a DFC is used.

Tape player/recorder applications

Another new use for a DFC is to set the speed of eight-track and cassette tape players. Fisher Radio and several other manufacturers specify the use of a DFC for setting the speed of their tape products. Although various different frequencies are specified by different sources, a good case can be made for using 1000 Hz. At 1000 Hz there is a 1-percent speed error for every 10 Hz of frequency difference. For example, a reading of 1010 Hz indicates it is 1.5 percent slow.

Should the player and tape

produce enough hiss to trigger the counter, it would be desirable to insert an audio filter into the input of the counter.

There is at least one other use of the IB-101 that the tape-recorder technician can make. Recently, the author had to repair a relatively expensive reel-to-reel recorder. The complaint was "poor record". Extensive checks in both playback and record modes revealed nothing wrong in the audio amplifiers. The tape head checked out alright, as did pressure pads and pressure-pad carriage tension. A scope check showed that the AC bias was slightly low. The trouble was uncovered when we checked the bias-oscillator frequency with the IB-101. It was closer to 120 KHz than to the normal 40-50 KHz specified in the manual. The defect proved to be an open capacitor in the bias-oscillator circuit.

Electronic organ servicing

In many areas of the country, well-paying electronic organ servicing goes begging, for lack of someone to do the work.

A standard method of tuning a musical instrument, including electronic organs, is to compare the pitch of the note produced by any given key with the pitch of a standard such as a tuning fork, electronic pitch reference, etc. Proper tune is established by monitoring the slow beat note between the organ and the standard.

Unfortunately, many competent electronics technicians cannot hear those beats clearly enough. They are of a very low frequency, much like wow on a record player. Also, most musically trained people are not electronic technicians. Therefore, it might be conceivable in many areas that two men are needed to serve the electronic organ customer—a tuner and a technician. Using the IB-101, the technician can take over both functions more easily than can an organ tuner without an electronics background.

Conclusion

The preceding uses are but a few of those to which I have successfully applied the Heath IB-101 digital-frequency counter during the past few months. The time I've already saved using a DFC has more than justified the purchase of it for our shop. In my opinion, the Heath IB-101—or any other DFC of comparable design and price—should be seriously considered by shops whose volume of business warrants investment in time-saving test instruments. □

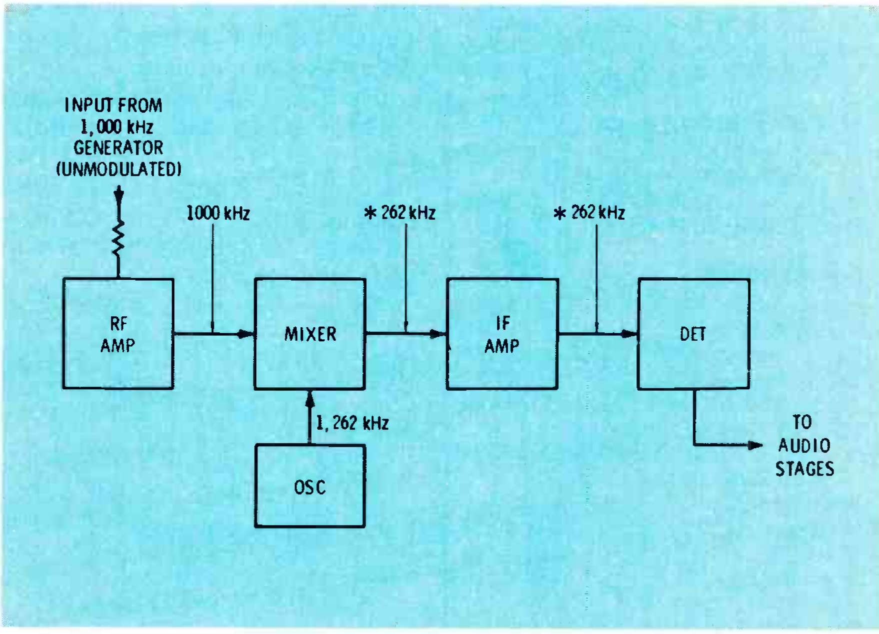


Fig. 8 "Signal tracing" in a radio by measuring the frequencies of the signals at key test points, as shown here, is an example of how a DFC can be applied to conventional troubleshooting techniques. Frequencies shown here are for an auto radio.

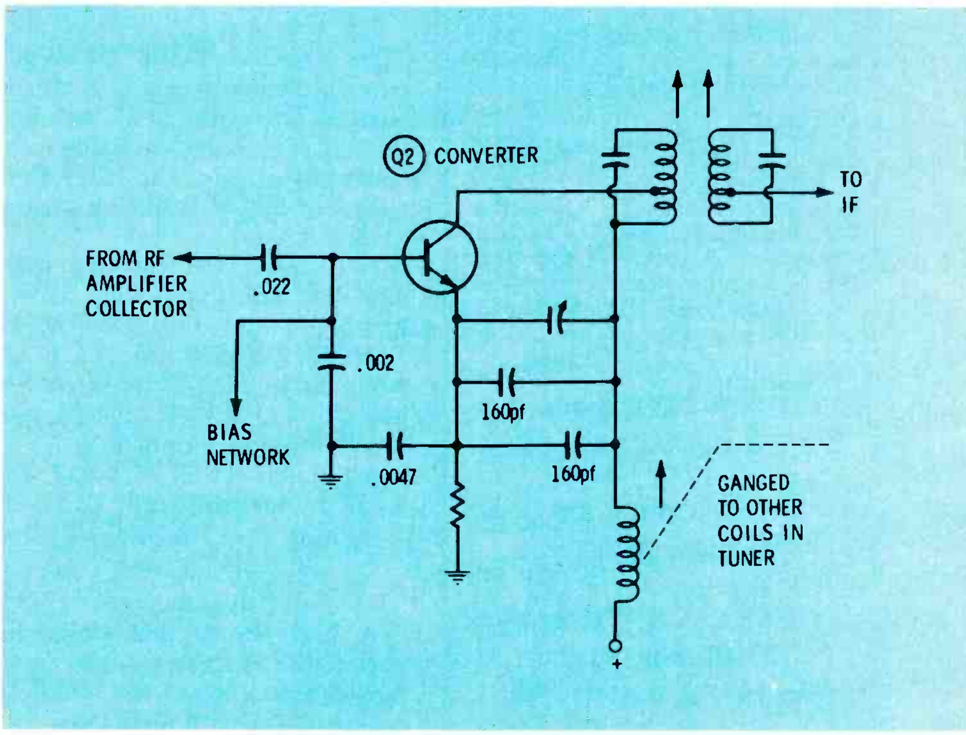


Fig. 9 Circuit diagram of a typical converter stage in an auto radio.

product report

for further information on any of the following items, circle the associated number on the reader service card.

Transfer Tuner Spray Kit

The new "Slim-Jim" transfer tuner-spray kit, which reportedly can fit in a technicians shirt pocket, during service calls, has been introduced by Chemtronics.

The "Slim-Jim" refills in "piggy-back" fashion from bench-size cans of TUN-O-WASH, TUN-O-BRITE and TUN-O-FOAM. Each refill reportedly can service 6 to 10 tuners, depending on how corroded the tuners are.

To transfer the contents from a bench-size can to the "Slim Jim", remove the spray heads, insert the stem of the "Slim Jim" can into the larger can and press down for about 30 seconds. The "Slim Jim" container can be refilled again and again.

Reportedly there are three standard kits, each consisting of two bench-size TUN-O-WASH (Kit 1), TUN-O-WASH and TUN-O-BRITE (Kit 2) or TUN-O-WASH and TUN-O-FOAM (Kit 3) with two "Slim Jim" size cans.

Kit 1 sells for $6.98, Kit 2 sells for $8.24, and Kit 3 sells for $8.24.

Circle 80 on literature card

Heat Gun

A new hot-air tool which reportedly delivers in seconds an air flow temperature at the nozzle of approximately 750-degrees to 800-degrees Fahrenheit has been introduced by Ungar.

Air stream width at the nozzle is 3/8 inch. Two baffle reflectors, 3/4 inch long and 1½ inches long are included for solder sleeve and shrink tubing applications, according to the manufacturer.

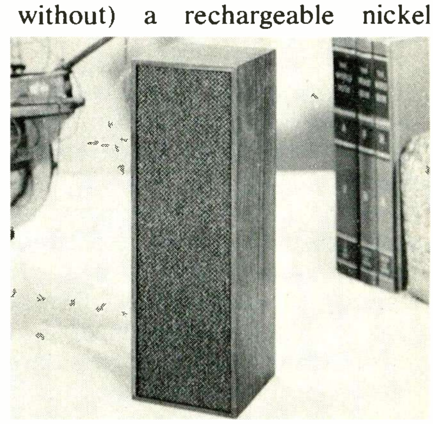
Model 6955 can be used hand-held, or it can be placed on a table or workbench without the need for an auxiliary stand or holder. Equipped with an on-off switch at the trigger position, and a hot-or-cold air-selector switch, the heat gun can cool and dry as well as heat.

Model 6955 is rated at 250 watts, 120 volts AC, weighs 18 ounces and sells for $39.95.

Circle 81 on literature card

Automatic Intrusion Alarm

New, from James Electronics, is the Ultrasonic Intrusion Detector, Deluxe Model C-7525. This model operates on power from a wall receptacle, but is reported to be internally wired for (but supplied without) a rechargeable nickel cadmium battery which can function for 10 hours following a power failure.



Auxiliary terminals reportedly are provided for heat/fire, smoke, water or door/window entry detectors.

The cabinet has wood-grain finish and is said to resemble a small stereo speaker. Dimensions are 3¾ inches x 11 inches x 3⅞ inches.

Price of the Untrasonic Intrusion Detector Model C-7525 is $119.50, including a Model C-7510 horn.

Circle 82 on literature card

Component Kits

Eight new service kits, reportedly designed to provide immediate access to a wide assortment of components, have been introduced by Centralab.

The new kits are: Kit-10F, Fastatch II Controls; -20W, Miniature Wirewound Controls; -30T, Miniature Trimmer Controls; -50A, Axial Lead Electrolytics; -55P, PC Lead Electrolytics; -60D, General Purpose Capacitors; -70H, High-Voltage Capacitors; and -100P, Packaged Electronic Circuits.

Each kit is housed in a steel frame cabinet with 15 plastic drawers. The cabinets are portable, and can be stacked in groups or wall-mounted, according to the manufacturer. The cabinets measure 10 inches x 8 inches x 6¼ inches.

The components are arranged in drawers by value, type and size; each drawer is pre-labeled.

Included in the three control kits (Kit-10F, -20W, -30T) is the latest edition of Howard W. Sams, Replacement Control Guide. ☐

Circle 83 on literature card

For more information about above products use reader service card

advertisers' index

Circle 34 on literature card

The MARKETPLACE

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

Advertising Rates in the Classified Section are:

- 25 cents per word (minimum $3.00)
- "Blind" ads $2.00 additional
- All letters capitalized— 35 cents per word

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

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

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

EQUIPMENT WANTED

Wanted: Used B&K and Sencore TV Test Equipment, Analyst, Scope Etc. Reasonable. Joe Wegner, POB 262, Glendale, Calif. 91209.

FOR SALE

For Sale—Perfect condition—Jerrold field strength meter, Model 720 B. $125.00, Prepaid. Send check to, Electronic Maintenance Co., 172-24 Jamaica Ave., Jamaica, N.Y. 11432. 2-72-1t

For Sale—Radio, TV, Atenna and MATV Service Shop. Profitable and busy in South Central East coast, Florida. Fully and well equipped with current instruments. Selling because of physical problems. Reasonable price. Dept. 500 Electronic Servicing, 1014 Wyandotte St., Kansas City, Mo. 64105. 2-72-1t

TV — RADIO — INDUSTRIAL TUBES — BRAND NEW — DATING BACK 1925 to 1965. GEORGE SCALZO, 1721-86th STREET, BROOKLYN, NEW YORK 11214. 2-72-1t

catalogs literature

ANTENNAS

100. *Vikoa, Inc.* — is making available a 64-page, illustrated catalog covering their line of wire and cables and IDS-MATV equipment. Hardware, accessories, connectors and fittings and an index also are included.

101. *Jerrold Electronics Corp.*—Catalog S, titled "Systems and Products for TV Distribution," lists specifications of this manufacturer's complete line of antenna distribution products, including antennas and accessories, head-end equipment, distribution equipment and components, and installation aids.

AUDIO

102. *Arista Enterprises, Inc.*—announces their 58-page needle and cartridge catalog. The needle cross reference reportedly has up-to-date cross references of all major needle marketers, in addition to cross reference sections of phonograph manufacturers' needle and cartridge numbers.

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

104. *GC Electronics*—announces catalog No. FR-135-W, containing an updated line of rubber drives and belts, phono and recorder drive wheels and pulleys, pinch rollers, round rubber belts, etc. The catalog also contains a cross-reference section, with replacement part numbers for equipment made by 194 manufacturers.

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

AUTO ELECTRONICS

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

BATTERIES

107. *General Electric Co.*—has made available two new brochures (GEA-9232, GEA-9612) describing their line of standard rechargeable nickel-cadmium batteries and the new high-temperature GOLD TOP rechargeable battery.

CABLE

108. *Columbia Electronic Cables*—has published a 92-page wire, cable, and cord-set catalog No. CEC-MC-571 which includes technical data concerning comparison charts of different types of insulating materials, copper wire specifications, estimating charts, and ampere ratings.

CAPACITORS

109. *Cornell-Dubilier Electronics*—has issued an 80-page cross-reference, 1972 catalog for location of single, dual, triple, and quadruple section replacement electrolytics.

COILS

110. *J. W. Miller Co.* — announces a new 92-page radio and TV replacement coil cross reference guide for known domestic and foreign color and black and white TV sets, home and car radios. Over 22,000 replacement coils for 327 manufacturers names reportedly are listed.

COMPONENTS

111. *Arco/LDP div. of Loral Corp.* — has published a new cross-reference guide and price book for its miniature aluminum electrolytic capacitors. The four-page publication includes specifications for the Arco/LDP line of Miniature Arcolytics, cross-references them by part number with similar products of other capacitor manufacturers.

112. *Essex International, Inc.*—announces their 24-page SC-5 RBM Standard Controls Catalog listing over 450 electrical/electronic relays and contactors.

113. *GTE Sylvania* — 50-page brochure which reportedly describes characteristics of over 900 television picture tubes. Plus data on interchangeability information and tips on installation and handling of TV picture tubes.

114. *Loral Distributor Products*—has made available a 24-page electrolytic capacitor replacement guide. The catalog features replacement products by the original manufacturers part number.

115. *P. R. Mallory & Co., Inc.*—introduces a 64-page general catalog containing approximately 10,000 items. Included in the catalog are batteries, capacitors, controls, resistors, semiconductors, switchers, and timers plus security systems, cassette recorders and cassette recording tapes.

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

117. *RCA Distributor Products*—introduces a 72-page "SK Series Top-Of-The-Line

Replacement Guide" (SPG-202L) which cross-references over 20,000 semiconductor device numbers. In addition a Solid State Quick Selection Replacement Chart (1L1367) listing 79 entertainment SK-Series devices is included.

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

119. *Semitronics Corp.* — has a new, revised "Transistor Rectifier, and Diode Interchangeability Guide" containing a list of over 100 basic types of semiconductors that can be used as substitutes for over 12,000 types.

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

121. *Stancor Products*—pocket-size, 108-page "Stancor Color and Monochrome Television Parts Replacement Guide" provides the TV technician with transformer and deflection component part-to-part cross reference replacement data for over 14,000 original parts.

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

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

124. *GTE Sylvania, Inc.* — has published an interchangeability guide listing 191 commonly used color TV picture tubes which can be replaced with 19 GTE Sylvania Color Bright 85® types.

KITS

125. *Heath Co.*—announces their 1972 Heathkit catalog, reportedly featuring over 350 kit projects. Projects for the home, the car, and workshop are included.

MISCELLANEOUS

126. *Alco Electronic Products, Inc.*—an 8-page catalog describing handcrafted, machined aluminum, control knobs.

127. *Allied Radio Shack's*—new 132-page, 1972 Electronic Parts & Accessories catalog reportedly lists thousands of hard-to-find electronic items. Exclusive Allied, Realistic, and Radio Shack brand products are listed, as well as the complete line of Knight-Kit and Science Fair Kits.

SEMICONDUCTORS

128. *GTE Sylvania, Inc.* — announces a revised semiconductor guide which reportedly gives replacement information for more than 41,000 solid-state devices. The 73-page catalog, ECG 212D, provides characteristics and outline drawings of the 124 components in the Sylvania ECG semiconductor line.

129. *Motorola* — announces release of the new HEP HMA-07 semiconductor cross-reference guide and catalog. Replacements are reportedly listed for over 30,000 semiconductor device numbers. A product catalog plus 168 new hobby, dealer and industrial M.R.O. devices are also included.

SERVICE AIDS

130. *Kester Solder* — has released an 8-page brochure presenting the company's full line of soldering products. Presented are: "44" resin core solder, acid-core solder, solid-wire, bar solder, TV-radio solder, and Metal Mender.

131. *Chemtronics*—announces a new 12-page, 1971-1972 catalog of products, including: tuner sprays, circuit coolers, insulating sprays, contact and control sprays, lubricants, tape head and record cleaners/accessories, cartridge tape head cleaners and conditioners, electronic glues and cements, solder, and spray paints.

SPECIAL EQUIPMENT

132. *M. P. Odell Co.*—introduces a new 12-page booklet, "The Whys and Hows of Cleaning Electronic Equipment." Reviewed are some of the effects of dirt and air pollution on electronic equipment.

TV ACCESSORIES

133. *Telematic* — introduces a 14-page catalog featuring CRT brighteners and reference charts, a complete line of test jig accessories and a cross reference of color set manufacturers to Telematic Adapters and convergence loads.

TECHNICAL PUBLICATIONS

134. *Howard W. Sams & Co., Inc.* — literature describes

popular and informative publications on radio and television servicing, communications, audio, hi-fi industrial electronics, including their 1971 catalog of technical books about every phase of electronics.

135. *Sencore, Inc.* — Speed Aligner Workshop Manual, Form No. 576P, provides 20 pages of detailed, step-by-step procedures for operation and application of Sencore Model SM158 Speed Aligner sweep-marker generator.

136. *Sylvania Electric Products, Inc., Sylvania Electronic Components Div.* — has published the 14th edition of their technical manual, which includes mechanical and electrical ratings for receiving tubes, television picture tubes and solid-state devices.

137. *Tab Books* — has released their Spring, 1971 catalog describing over 170 current and forthcoming books. The 20-page catalog covers: schematic/servicing manuals, broadcasting; basic technology; CATV; electric motors; electronic engineering; computer technology; reference; television, radio and electronics servicing; audio and hi-fi stereo; hobby and experiment; amateur radio; test instruments; appliance repair, and transistor technology.

TEST EQUIPMENT

138. *Dynascan Corp.* — announces a new 24-page 2-color catalog of B&K Precision Test Equipment. A total of 21 instruments are reportedly presented; from a Mutual Conductance Tube Tester to a new DC to 10 MHz Triggered Sweep Oscilloscope.

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

140. *Hickok*—has published a 4-page brochure, "Hickok Oscilloscopes," which contains descriptions, specifications and prices for Models 5000A and 5002A oscilloscopes.

141. *Information Terminals* — has introduced a new brochure featuring the M-100 Tension Monitor, the M-200 Torque Tester and the M-300 Head and Guide Gage.

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

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

144. *Mercury Electronics Corp.* —14-page catalog provides technical specifications and prices of this manufacturers' line of Mercury and Jackson test equipment, self-service tube testers, testers, test equipment kits and indoor TV antennas.

145. *Special Instruments & Machinery Co.* — introduces a 6-page catalog listing product line of resistance, capacitance, dissipation factor and inductance bridges; resistance, capacitance and inductance decades; measuring standards, DC and AC potentiometers and calibration systems; instrument transformers and calibration systems for instrument transformers; and of DC and AC null indicators.

146. *Tektronix, Inc.* — has announced a 4-page brochure describing the 54 Series oscilloscope manufactured by Tektronix English subsidiary, Telequipment.

147. *Triplett Corp.* — announces a 6-page, two-color brochure featuring four new portable, battery-operated, FET Volt-Ohm-Milliameters and accessories.

148. *Triplett Corp.* — announces a 2-page, 2-color data sheet for Model 6028, a 2¾ digit VOM. Data sheet gives DC volts, AC volts, ohms AC and DC current ranges plus construction information, price and accessories.

149. *Tucker Electronics Co.*— features a catalog listing their new and reconditioned electronic test equipment. Their inventory reportedly includes over 10,000 pieces of equipment manufactured by over 250 different companies.

TOOLS

150. *Chapman Manufacturing Co.* — offers a pamphlet containing their line of tools and tool kits. Kit No. 6320, the Midget Ratchet is featured along with other available tool kits.

151. *Ideal Industries* — introduces a 2-page, 4-color brochure announcing their new Heat Gun. Performance characteristics applications, operating features, specifications and ordering information reportedly are included.

152. *Janel, Inc.* — announces a three-color catalog on precision hand tools used primarily in miniature and micro-miniature electronic assembly and production applications.

153. *Jensen Tools and Alloys*— has announced a new catalog No. 470, "Tools for Electronic Assembly and Precision Mechanics." The 72-page handbook-size catalog contains over 1,700 individually available items.

154. *Xcelite, Inc.* — Bulletin N770 describes this company's three new socket wrench and ratchet screwdriver sets. ☐

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