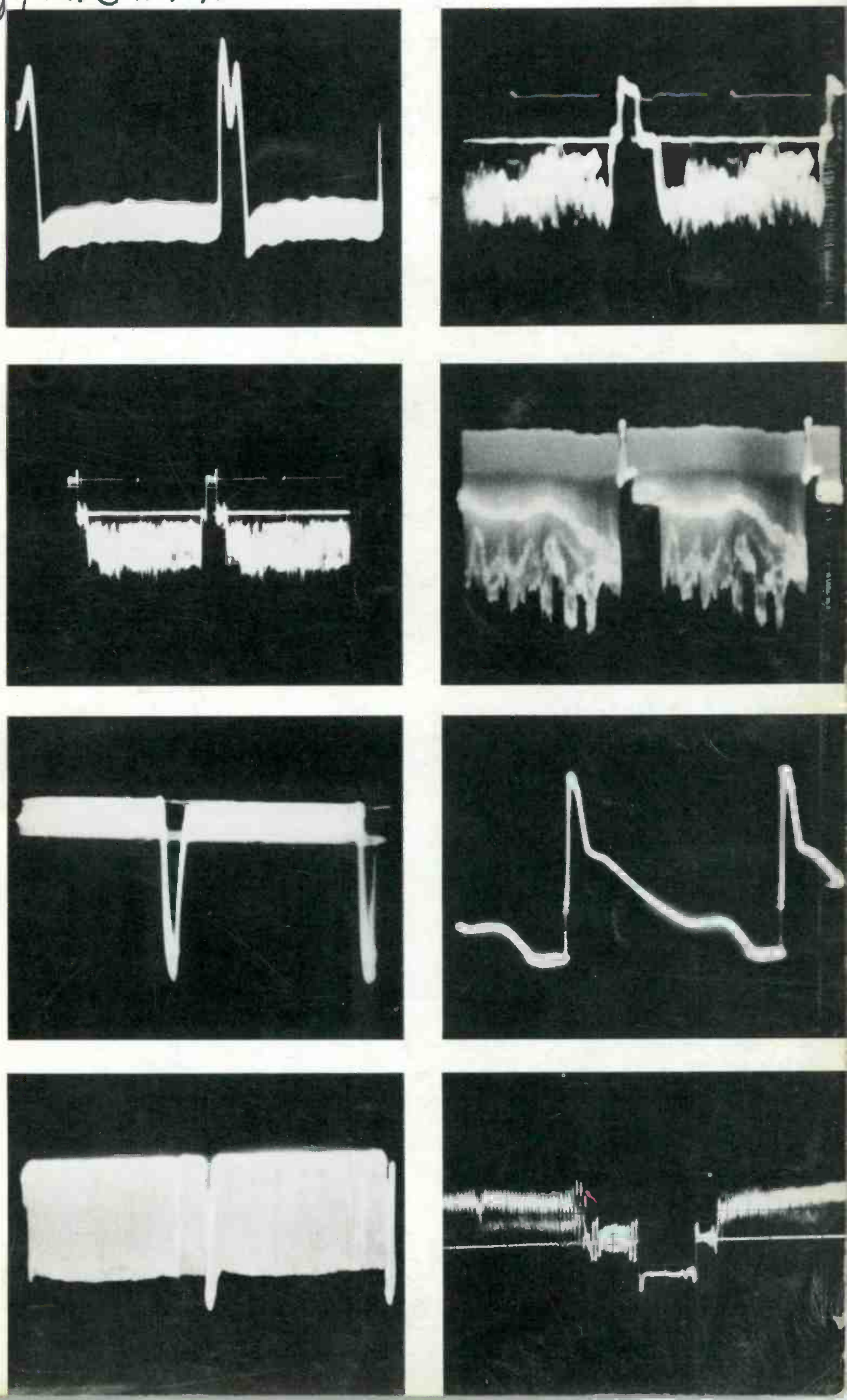
August, 1969 □ 75 cents

A HOWARD W. SAMS PUBLICATION

Electronic Servicing

Formerly PF Reporter

T.V. ALIGNMENT #12



Understanding TV Waveforms

page 30

Troubles common to many color chassis, page 48

Tracking down "no high voltage" troubles, page 16

Put your parts in order.

All it takes is genius to arrive at simplicity. This new display stand is deceiving. It's more than a display stand. It's set up to operate like a store within your store for instant servicing.

Here, within this unit, is a complete stock of all the wide range twist prongs you'll need plus micas, miniature electrolytics, ceramics, wide range tubulars and dipped paper Mylar.* The selection was based on an extensive study of all capacitors used in the replacement market. Now, with the Re-Place, you're in the capacitor replacement business. The Re-Place only takes 2′ x 5′ in space and you have all your parts in order.

Interested? Write for our new catalog on The Re-Place™ capacitor line. "The Replacers" —the most complete line of replacement capacitors in the smallest possible package.

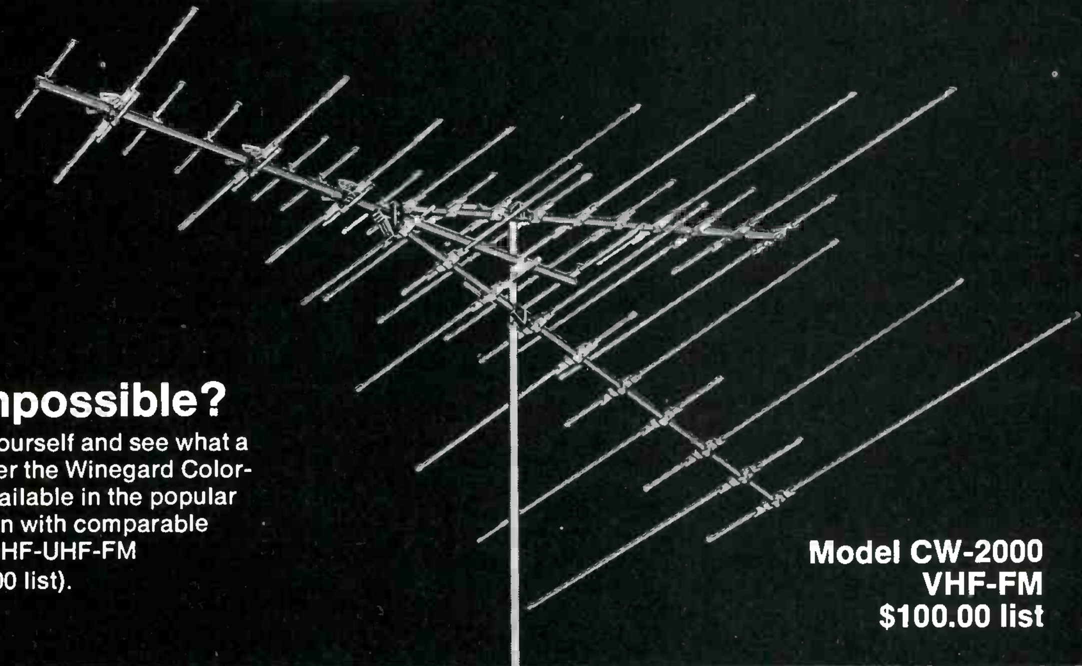
CDE CORNELL-DUBILIER

Circle 1 on literature card

*Du Pont Trademark

POWERFUL

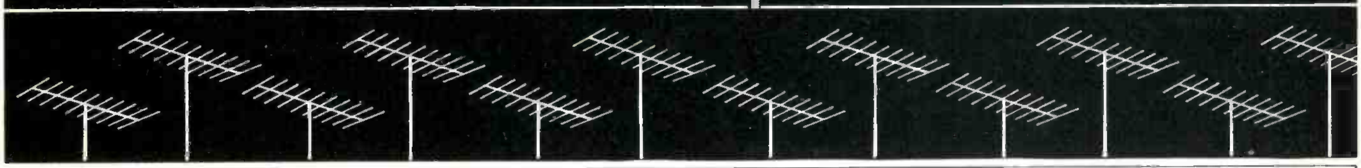
One $100 Winegard Color-Wedge equals the performance of twelve ten-element yagis!



Sound impossible?

Then try one for yourself and see what a powerful performer the Winegard Color-Wedge is. Also available in the popular 82-channel version with comparable performance on VHF-UHF-FM (CW-1000, $100.00 list).

Model CW-2000
VHF-FM
$100.00 list



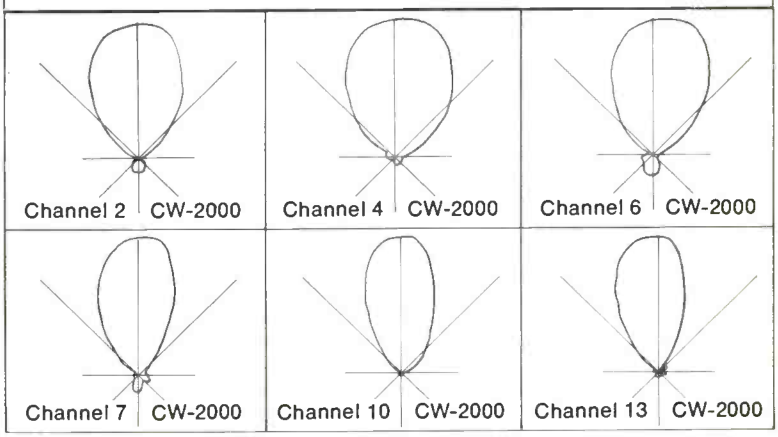
example A:

CHECK DB GAIN*

Channel	CW-2000	10-Elem. Yagi
2	7.2	7.8
4	7.2	7.6
6	7.4	8.0
7	12.2	10.8
10	11.4	11.0
13	12.0	11.5

example B:

CHECK DIRECTIVITY



example C:

CHECK FRONT-TO-BACK RATIO

CW-2000	CH. 2	CH. 4	CH. 6	CH. 7	CH. 10	CH. 13
DB	22	26	17	20	35	30

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BURLINGTON, IOWA 52601

SEE YOUR WINEGARD DISTRIBUTOR AND WRITE FOR FACT-FINDER #284

Circle 2 on literature card

August, 1969 ● Volume 19, No. 8

Electronic Servicing

Formerly PF Reporter

in this issue...

DEPARTMENTS

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Robert E. Hertel, Publisher
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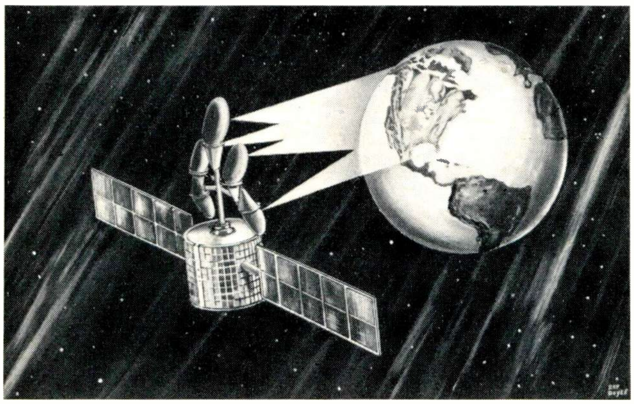
electronic scanner

news of the industry

Sylvania Designing Satellite-To-Home Antenna

An advanced antenna system for direct broadcast of television programs from an orbiting satellite to home receivers is being designed by Sylvania Electric Products Inc.

Capable of relaying four programs simultaneously, the system is expected to transmit signals strong enough to be received by modified home equipment. Presently, 97-foot diameter antennas are required for reception



of satellite television signals which are then relayed to local stations for home broadcast.

According to preliminary designs, the antenna system will include five dish-shaped reflectors, each measuring two feet in diameter. The reflectors can be steered to direct programming to specific areas—for example, time zones or regions of countries—covered by the satellite.

By transmitting communications in concentrated beams to small areas of the earth, the new system will increase the strength of the TV signals for home reception. The system will also be designed to transmit 1,000 watts of power. Present satellite systems provide coverage to one-third of the earth and transmit 10 watts of power.

A two-foot diameter antenna and a small converter, similar to the UHF units employed with earlier TV models, will be required at the home to receive the direct broadcasts.

Admiral Establishes San Antonio Sales and Service Division

Admiral Corporation—San Antonio Division has been established to handle the sales, distribution and servicing of all Admiral products in 68 counties in Texas.

C. G. Jebens has been appointed general manager of the new distributorship, which replaces the Covington Distributing Corporation.

The Admiral division will continue to operate in the present headquarters at 1819 South Flores, San Antonio, Texas.

New Deflection Technique Permits Thinner CRT

A new TV deflection technique that permits thinner picture tubes has been developed by Philco-Ford.

A prototype 13-inch b-w portable TV using the new deflection technique was displayed at the Consumer Electronic show in New York in June. The cabinet of the prototype set is only 5½ inches thick.

The new system consists of a CRT in which the electron gun is placed at an oblique angle to the front surface of the screen, instead of directly behind and in line with the center of the screen as in conventional picture tubes. This repositioning of the electron gun is made possible by the use of both vertical and horizontal **magnetic** deflection.

In a conventional deflection system, the electron beam travels in a symmetrical pyramid to the screen of the picture tube; however, using the new technique, the beam travels in an oblique pyramid and is bent forward to the screen by the fixed electrostatic field of the magnetic deflection.

The yoke employed with the new CRT is rectangular and the electron beam is elongated vertically. Two identical pieces of pressed glass, each with a flat surface, are used for the front and back of the CRT.

One prime advantage of this deflection technique over the ultra-wide angle scan technique, according to a spokesman for Philco-Ford, is that it requires much less power—the new system uses about the same amount of scan and high-voltage power as a conventional 13-inch CRT.

NAB Wants Comparable VHF and UHF Tuning

The National Association of Broadcasters (NAB) has urged the Federal Communications Commission to adopt rules which would require all new television receivers to be equipped with comparable tuning standards for both UHF and VHF frequencies.

NAB said the present manual tuning system for UHF is an "unnecessary handicap," and urged that "all possible measures" be taken to assure UHF "a full and fair opportunity to succeed."

In comments filed by Douglas A. Anello, general counsel, and John B. Summers, assistant general counsel, NAB said there should be no degradation in VHF tuning to provide easier tuning of UHF stations.

All VHF tuning now has a "lock in" device that assures correct tuning on the selected channel. On the other hand, UHF still is almost entirely controlled by manual tuning. NAB said "it is obvious that inequities have developed as to the ease of tuning which act as a deterrent to the further development of UHF television."

NAB pointed out that UHF tuners comparable to those for VHF presently are available only in the most expensive sets. Individual manufacturers, it said, are reluctant to incorporate the better UHF tuning system

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Nine-seventy-five buys you a complete tuner overhaul—including parts (except tubes or transistors)—and *absolutely no hidden charges*. All makes, color or black and white. UV combos only $15.

Guaranteed means a full *12-month* warranty against defective workmanship and parts failure due to normal usage. That's 9 months to a year better than others. And it's backed up by the only tuner repair service authorized and supervised by the world's largest tuner manufacturer—Sarkes Tarzian, Inc.

Four conveniently located service centers assure speedy in-and-out service. All tuners thoroughly cleaned, inside and out . . . needed repairs made . . . all channels aligned to factory specs, then rushed back to you. They look—and perform—like new.

Prefer a universal replacement? Sarkes Tarzian will give you a universal replacement for only $10.45. This price is the same for all models. The tuner is a new tuner designed and built specifically by Sarkes Tarzian for this purpose. It has memory fine tuning—UHF plug-in for 82 channel sets—universal mounting—hi-gain—lo-noise.

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Part #	Intermediate Frequency	AF Amp Tube	Osc. Mixer Tube	Heater
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MFT-2	41.25 mc Sound 45.75 mc Video	3GK5	5LJ8	Series 450 MA
MFT-3	41.25 mc Sound 45.75 mc Video	2GK5	5CG8	Series 600 MA

Prefer a customized replacement tuner? The price will be $18.25. Send us the original tuner for comparison purposes, also TV make, chassis and model numbers.

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EAST	547-49 TONNELE AVE., Jersey City, New Jersey	TEL: 201-792-3730
SOUTH-EAST	938 GORDON ST., S. W., Atlanta, Georgia	TEL: 404-758-2232
WEST	SARKES TARZIAN, Inc. *TUNER SERVICE DIVISION* 10654 MAGNOLIA BLVD., North Hollywood, California	TEL: 213-769-2720

WATCH FOR NEW CENTERS UNDER DEVELOPMENT

Circle 4 on literature card

since it would increase the price of sets and would "place them at a disadvantage with respect to their competitors."

Only an FCC requirement that all sets have comparable UHF and VHF tuning, NAB said, would assure manufacturers that "installation of improved UHF tuners will not jeopardize their competitive position in the market place."

TV-System Converter Developed

A converter that changes European-type (625 scanning lines and 50 fields) monochrome and color signals to the NTSC system (525 scanning lines and 60 fields) used in the U. S. and Japan has been developed by the Japan Broadcasting Corporation and the Oki Electric Company. It is possible that this type of converter will be used in the relaying of TV signals via satellite between Europe, Japan and the United States.

New Name Added to TV List

Baumritter Corp., a home furnishings manufacturer, is now marketing a 23-inch console color TV line under their Ethan Allen program. The electronic components for the color chassis are being produced by General Electric.

Initial distribution of the Baumritter color TV line will be limited to the Northeast, Southeast and Midwest until production can meet the demands of national distribution, which is projected by January, 1970.

The General Electric service organization will perform warranty servicing of the Baumritter line. TV in the new line carries a one-year warranty on all parts, a two-year warranty of the picture tube and a 90-day labor warranty.

It is expected that within six months or a year Baumritter also will introduce a line of console stereos.

Babcoke joins ES Technical staff

Carl Babcoke, author of many well-received electronics books and articles, is now a full-time technical editor on the ELECTRONIC SERVICING staff.

Carl has 36 years of experience in the electronic servicing field, and for the past 14 years has been the service manager of the Kansas City distributor branch of a major TV manufacturer. He is thoroughly familiar with both the technical and the operational aspects of consumer electronic servicing.

Beginning in the September issue and continuing each month, Carl will provide the readers of ELECTRONIC SERVICING an in-depth analysis of the operation and practical applications of both new and existing test equipment. He also will report on new developments in TV and radio circuit design and troubleshooting techniques.

Radio-TV Home Electronic Service Days In Chicago

Richard J. Daley, Mayor of Chicago, has proclaimed the period from August 15 to August 17, 1969, to be Radio-TV Home Electronic Service Days in Chicago. The proclamation was made to honor the annual convention of the National Alliance of Television and Electronic Service Associations (NATESA) which will be held in Chicago during the period designated by the proclamation.

X-Radiation Testing of Color TV

Radiological testing of both domestically produced and foreign-manufactured sets marketed in the U.S. was scheduled to begin during the last of June. The testing is to be conducted under the direction of the Radiological Health Bureau of the Health Education and Welfare Department.

The tests include measurement of the voltage and current ranges on each component capable of emitting X-radiation as a result of excessive voltage or current caused by line-voltage changes or misadjustment of consumer or service conrols; measurement of X-radiation exposure rates at accessible locations; and measurement of X-radition exposure rates using samples of replacement components that are available or recommended by the manufacturer.

Under the testing program, manufacturers have been asked to provide suitable space for the tests, and to identify chassis and models produced after October 18, 1968, the date on which the Radiation Standards Law was enacted.

Turntable Using Brushless DC Motor

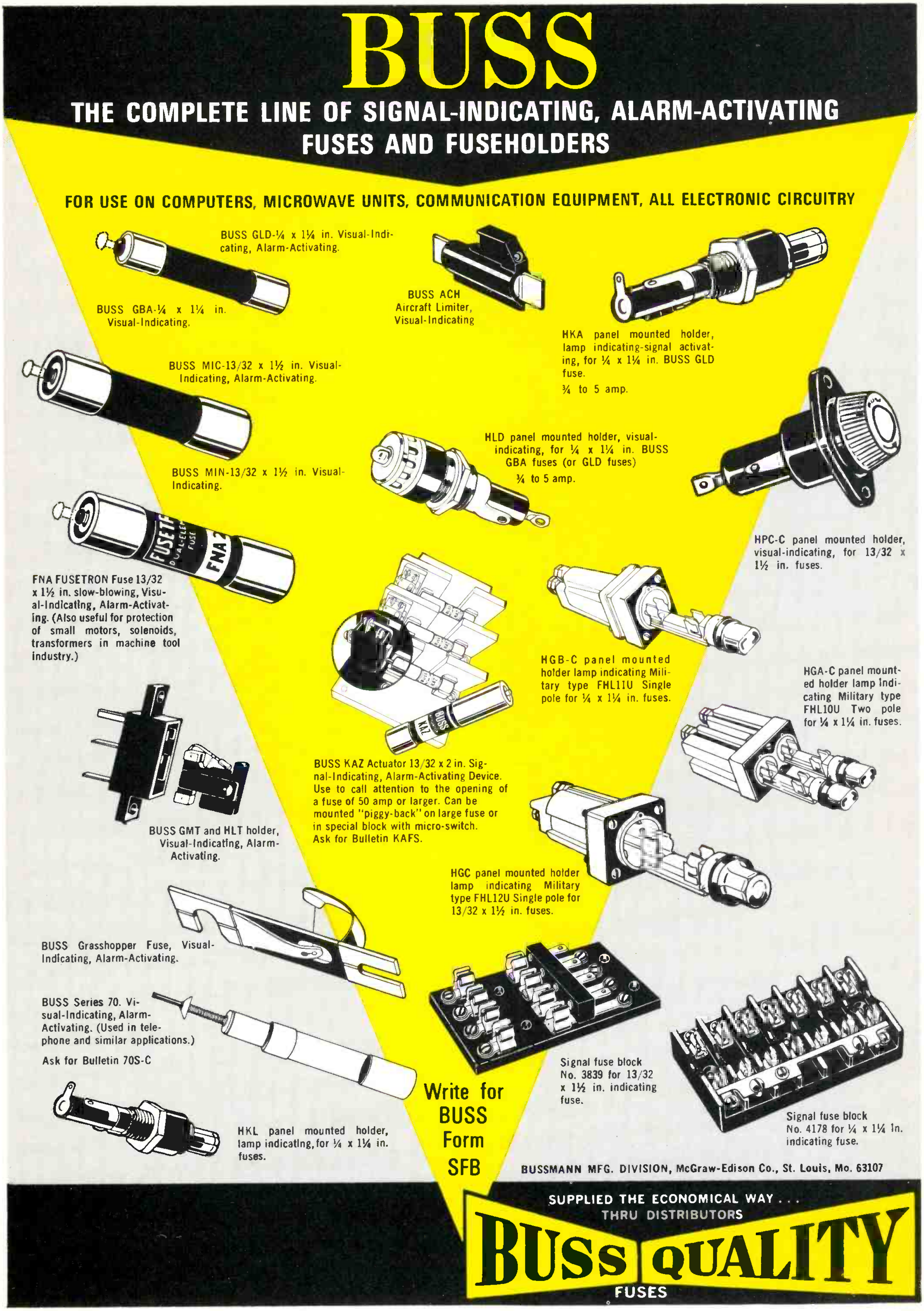
A turntable featuring a brushless DC motor that reportedly drives the turntable directly at a low speed, which eliminates vibration and, thus, reduces wow and flutter, was shown by Panasonic at the EIA Consumer Electronic Show in New York (June 15 to June 18).

The new turntable was described as "experimental" and no marketing plans were divulged.

Sylvania Announces Question and Answer Warranty Form

Sylvania Entertainment Products, an operating group of Sylvania Electric Products Inc., has announced that an easy-to-understand warranty, in question and answer form, will be included with its 1970 line of home-entertainment electronic products.

"The new warranty is presented in a single question-and-answer form, so consumers should have no difficulty understanding the terms under which Sylvania warrants its television sets, stereophonic instruments, radios, and tape recorder-players," William E. Boss, Vice President—Marketing, reported. "We appreciate that prior to this type of presentation consumers may have been confused by sometimes nebulous warranty language. This new Sylvania approach should eliminate that confusion," he added. ▲



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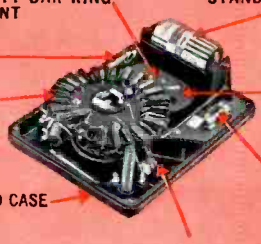


letters to the editor

Help With Magnavox Chassis

Regarding Mr. Giegerich's letter in the May '69 Troubleshooter column stating his difficulty in servicing a Magnavox T908 transistor chassis, he can do one of two things:

First, he could adjust the vertical bias to the manufacturer's specifications.

Or, second, if a really good oscilloscope is available, he should check ONE line of the video.

It is doubtful that he will be able to detect an improper voltage or waveform. The condition he describes is normally caused by a defective deflection yoke.

Glad to be of help.

T. P. Brutscher
Pittsburgh, Pa.

Polarity Is Relative

(The following letter was directed to one of our contributing authors, Robert Middleton. I think Mr. Middleton's reply to this letter provides information that will be of interest to all readers—the Editor)

Your article in the May '69 issue of ELECTRONIC SERVICING, "Servicing Solid-State TV Is Different," was excellent, but being somewhat of a newcomer to transistor circuits, it leaves me confused at one point.

Technicians are taught that NPN transistors have a positive voltage applied to the base and a negative voltage applied to the emitter, so that a forward bias exists. Your article (and Fig. 8) describes base and emitter voltages that would seem to apply only to a PNP type. An explanation of this would be greatly appreciated.

B. J. Brown
Trion, Georgia

Mr. Brown, in reply to your query concerning the bias voltage polarity for the NPN transistor depicted in Fig. 8 of my article in the May issue, you have brought up a rather tricky point. Actually, the bias polarity is correct, although it might seem to be wrong at first glance, due to the fact that the collector is grounded and the supply voltage is applied to the emitter circuit.

The tricky point that is involved here concerns the relation between negative voltages that makes one of the voltages more positive than the other. With reference to Fig. 8, the emitter voltage is -4.35 volts, and the base voltage is -4.15 volts. Note that the emitter is more negative than the base—that is, the base is more positive than the emitter. This is the required bias condition for an NPN transistor.

This is a good point that you have raised, because it also comes up in color TV; that is, when the R-Y and B-Y signals are reduced in voltage, the G-Y signal appears to increase in voltage. Actually, this apparent increase is based on a reduction in negative voltages, since the G-Y signal is formed from negative R-Y and B-Y signals.—Bob Middleton.

← *Circle 6 on literature card*

What ES is About

I wish to compliment you for your fine publication. I was very impressed by Mr. Glen Thorn's statements in regards to "Degrading to Technicians?" in your June 1969 issue. Mr. Thorn is right; we do not run "fix-it" shops. A large percentage of us handle reputable lines of merchandise, stock adequate parts, attend training sessions and keep up to date to provide our customers with professional services.

In many ways our group (that is, the specialists in our field) may be classified with doctors, which brings up another point: Many readers want articles on two way radios, industrial electronics, medical electronics, etc. Well, my answer to them is that the majority of us who read your magazine are experts in our field, and that is TV service, not the above mentioned fields. The day has come when the technological changes are so fast in this field that we must read monthly, even daily, to keep abreast. That is why a magazine such as yours is essential to us . . .

Your idea of using reader survey cards is terrific. Keep up your excellent work.

Now for my beef. We have subscribed to your magazine for some years. In the last few months our magazine didn't arrive until well past the middle of the month. Also, since the first of the year, they have arrived in such poor shape that they are almost impossible to read. I wrote before complaining about this, and you sent me replacement issues, for which I thank you. However, can't something be done so that in the future they arrive in better shape? I talked to our postmaster, and he said that by the looks of the magazines, they were on the bottom of the bundle and the bundle-tie cut them, and being on the bottom, they became rather scuffed up.

Michael E. Franzen
Amery, Wisconsin

Mr. Franzen, thank you for the encouragement.

As pointed out in our statement of purpose in the January issue, we are attempting to focus-in on all aspects of the consumer electronic servicing business. The preferences of editorial subject matter indicated by the readers of ELECTRONIC SERVICING who responded to our reader survey in the January issue will be adhered to. And the majority of those responding want technical and business management articles relating to the servicing of home entertainment electronic products—a preference you have echoed in your remarks here. However, a significant number of readers also want some coverage of auto entertainment electronic products and two-way communications. In response to the preferences voiced by our readers, ELECTRONIC SERVICING will concentrate for the most part on home entertainment electronic servicing and, to a lesser degree, on servicing auto entertainment electronic products and two-way communications equipment.

Reader response to the surveys we have been conducting, and will continue to conduct, has been, to say the least, beyond expectation. It is our hope that, with continued reader assistance such as we have enjoyed these past few months, by the end of the year we will have given our readers facts about their industry that will make their individual judgments about their businesses more accurate and more profitable—this is our goal: To make our readers' businesses more profitable.

I have received complaints from a number of readers concerning the physical condition of the magazine when they receive it. We have made a formal complaint about this matter to the U. S. Postal Department. I suggest that when a reader receives his copy of ELECTRONIC SERVICING in a mutilated condition, he should do just what you have done: Let his local postmaster know about it and inform me of the fact; I'll immediately send an undamaged copy.—the Editor

Help Needed

Can you or any of your readers furnish me with any information, or where I can obtain information, on Calex Self-Service Tube Testers? I wrote to Amityville, Long Island, New York, the address on the tester, but the letter was returned marked "moved, not forwardable."

I would like to upgrade the tester for the newer tubes. Any help will be greatly appreciated.

William Marshall
Box 394
New Haven, W. Va. 25265

Perhaps the members of your staff or some of your readers could give me some assistance.

I need information as to where I can get up to date roll charts for a Superior Tube Tester, Model TV11. It was made by Superior Instruments Company in New York, N. Y., who have gone out of business.

Thanks in advance for any help your staff and/or your readers may be able to give me.

Gerald R. McComb
Rock River Road, R.D. #2
Ovid, New York 14521

If any reader might help, I am looking for Volume I of "Transistors and Circuit Troubleshooting" prepared for GE by Basic Systems, 800 Third Avenue, New York, N. Y. This is part of a three-volume set and I need it to complete my set. If anyone has any information as to where this might be available and what it might cost, please let me know.

John A. McGregor
Addison TELE-SERVICE Center
P. O . Box 45
Addison, Illinois 60101

Ire at (Hz)

I have been reading this (Hz) thing for a long time, holding my ire, trying to become accustomed to it, but it is impossible.

This (Hz) is the most superfluous, noncontending preposition that I have encountered in many years. To me, as a technician, this appears to be anything, oh yes, anything to glorify some marble-headed college professor who is so happy with himself for making us accept his fumble.

I do not wish to see it in print anymore.

A. O. Kopplin
Kirkland, Washington

Atwater Kent Info

On page nine of the January 1969 issue of "Electronic Servicing", you asked help for Mr. Sam McCrea in obtaining the battery hookup for an Atwater Kent Model 60 radio.

I think Mr. McCrea is mistaken about the model, since the model 60 was an all-electric set put out in the early 1930's, using 3-224A tubes as RF amplifiers, a 227 detector, 2-245 power tubes, and a 280 rectifier. I believe that the "20" series of 1926 or 1927, which used 3-226 RF amplifier tubes, a 227 detector, and a 171A power tube, is the last battery-operated radio put out by Atwater Kent.

Information might be obtainable from Mr. John F. Rider, who published an annual book on sets with service notes, diagrams, etc., in the later 20's and the 30's. Supreme Publications might have information, also, and I may be able to locate a friend who had the Atwater Kent manuals and several of the Rider books at one time.

Supreme Publications
1760 Balsam Rd.
Highland Park, Ill.

Div. of Hayden Book Co.
Rider Publishing, Inc.
116 West 14th St.
New York, N.Y. 10011

Thanks for trying to help your readers. Although I have been out of the radio service business for a number of years, I still enjoy reading "Electronic Servicing" every month.

G. R. Mann
902 S. Elm Blvd.
Champaign, Ill.

More On Atwater Kent

A request for a schematic or wiring diagram for an Atwater Kent Model 60 appeared in the Letters to the Editor column in the January 1969 issue.

A drawing for a Model 60-C, 3rd. Type, Serial 5,670,001 to 5,684,000, showing the tube types and some capacitor and resistor values is listed in the 1926-1938 Radio Diagrams, Supreme Publications compiled by M . H. Britman. The set uses a power transformer with a No. 80 rectifier. The index shows this drawing as 60, 60C.

I would be happy to be of assistance to Mr. McCrea if this drawing would help him and I believe I have plenty of the tubes used in this set. They have been used but are in good condition.

Al Huf
Waukegan, Ill.

Old Issues Available

I would like to inform your readers I have back isues of PF REPORTER from the 1950's to 1960's plus many issues of electronic magazines that have ceased publication.

Donald Schultz
Box 722
Patchogue, N.Y. ▲

ELECTRONIC SERVICING . . .
the country's only magazine devoted 100% to the *ELECTRONIC SERVICING* industry . . .

Dale's service bench

by Allan Dale

REALLY Understanding TV Alignment

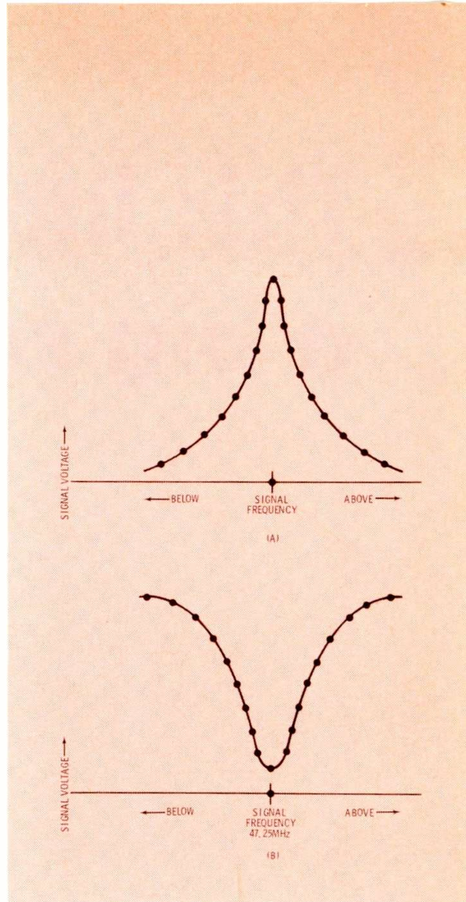


Fig. 1 Graph of meter readings as tuned circuit is adjusted to, through and past resonance with applied signal frequency. Curve at B is tuning response of a trap.

Facts and tips that will "clear up" your concept of response curves, traps, markers and other details associated with alignment.

An awful lot of sets that need alignment don't get it. When I ask technicians why, they often tell me sets "don't really need alignment." Since I know better, I keep pressing the issue.

What I find out, eventually, is that not many technicians truly understand how to do a good alignment job. The thing they seem to lack most is a feeling for exactly what alignment is. That's understandable. There aren't many good explanations around. If you're not completely comfortable with alignment, read this explanation of it. You may see it in a new light.

Nature of a Tuned Circuit

Start by examining the mechanics of getting a single tuned circuit on its correct frequency.

You have to feed it a signal of the right frequency, and you do that with an RF signal generator. Second, you need something to indicate what's happening as you tune. Most practical is a meter. If there's a diode detector following a tuned circuit in a receiver, its output is a good test point. Or, an RF probe with a DC voltmeter can be connected just after the tuned circuit.

Next consider what's happening when you tune the adjustable slug in a tuned circuit. If the coil is considerably off tune, the meter reading keeps rising as you keep turning the slug. Sooner or later, if you keep turning, the meter reading goes through a peak and then starts dropping again. The reading may eventually fall all the way to zero. With a sharply tuned coil (high Q), all this can happen within three or four turns of the slug.

Fig. 1A is a graph plotted from the different voltages you read as you turn a slug from below the input-signal frequency to above it. Remember that the circuit is resonant at every point you turn it through. You only get the voltage peak as you finally tune it to **resonance** at the frequency of the **signal being fed to it.** At that point, the tuned circuit passes **the most** of the applied signal along to the meter.

Then consider what happens when a tuned circuit is connected to function as a signal trap. The purpose is to reject some particular frequency. Suppose it's designed to reject 47.25 MHz. It does that only when it's resonant at that frequency. To tune it, you feed in a signal—from the RF generator—at 47.25 MHz. And, you put an indicating meter somewhere after the trap circuit.

The results of tuning the circuit are graphed in Fig. 1B. If the resonant frequency of the circuit is not near 47.25 MHz, the meter reads fairly high because the signal isn't being trapped. As you tune the circuit closer and closer to the right frequency, the meter reading goes downward. Finally, you tune past the signal frequency, and the meter starts upward again. At the dip, the

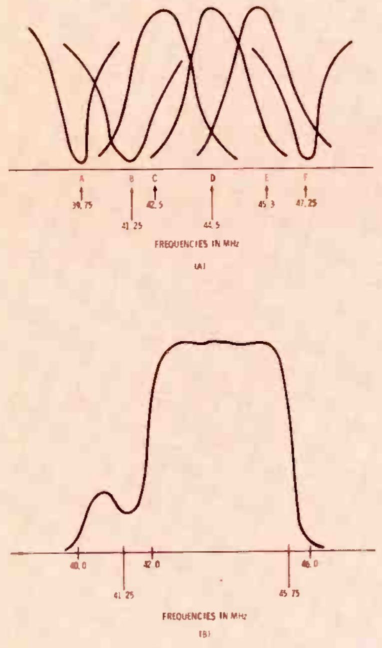


Fig. 2. Group of individual voltage-response curves (A), when combined, make up overall response curve (B). Shows voltage indications at every frequency within the band of signals to which a television IF section responds.

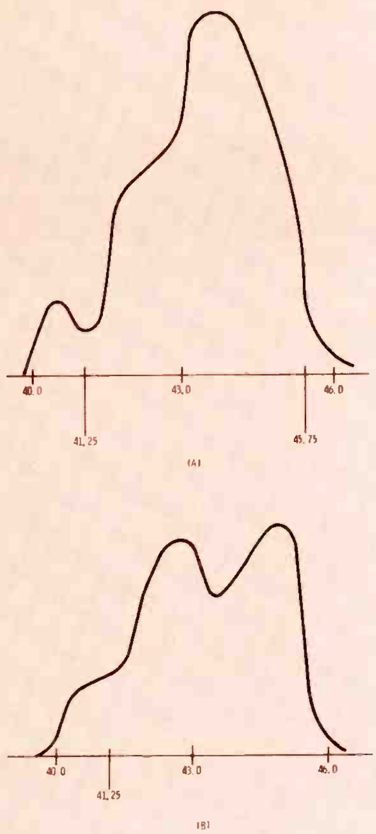


Fig. 3. Oddly shaped response curves indicate trouble in tuned circuits of IF strip. (A) Coil usually peaked at 42.5 MHz has shifted to about 44 MHz, and adds to response of coil already peaked at 44.5, creating exaggerated peak. (B) Trap normally at 41.25 MHz has shifted to about 43.5 MHz; eliminates the dip needed at 41.25 MHz, and introduces unwanted dip slightly above 43.0 MHz.

tuned circuit traps out 47.25 MHz very efficiently.

Traps and Coils Together

The IF strip of a telivision set contains several tuned circuits. Each one, taken alone, is simply a peaking circuit or a trap. Each one responds sharply to the frequency it is tuned to. Their response graphs look very like the graphs in Fig. 1.

But, response curves are not tuning curves. They are voltage responses of a tuned circuit, plotted as the frequency of an applied signal shifts from below the resonant frequency, through it and on above it. Keep this fact in mind for the next few paragraphs.

Now, imagine several of these peak and trap response curves, at different frequencies. side by side. Fig. 2A shows what this looks like. A, B, and F are traps; their frequencies are listed. The other three are peaked at their own operating frequencies.

When all these response curves are combined mathematically, they produce an overall frequency-response curve like that in Fig. 2B. This is the signal-voltage response graph of a whole IF strip—with all its coils and traps—if all the frequencies from 39 to 47 MHz were fed to it one at a time. The peak curves add to each other, and the traps at the edges steepen the skirts of the overall curve.

There is a way to look at an entire response curve like that instantaneously, and keep it visible so you can study it. You do it with a sweep generator and oscilloscope. The generator sweeps the input signal back and forth across the whole wide band of frequencies the IF section is expected to pass. The oscilloscope, synchronized with the sweep generator, measures the output signal voltage from the tuned-circuit group, at each finite frequency, and plots them all side by side on the scope screen. It does this over and over so fast (60 times per second) that you see only the outline of all those different voltage responses. That line is called a **sweep response curve** of the IF strip.

Imagine what might happen to the overall response curve if one of the individual response curves is weak. There will obviously be a sag at that point. An individual response that's a little too strong could make a hump in the overall curve.

Suppose one coil becomes mistuned—a common happening. The effect of its response is then added to the overall response curve in the wrong place. It might cause too much response at some point if another coil were already "peaking up" that part of the curve. Or, it might cancel some of the effect of one of the traps.

The effect would alter the overall curve. An example is shown in Fig. 3A. The 42.5-MHz coil (Fig. 2A) has become mistuned to about 44 MHz. It leaves response low in the

43-MHz region and overpeaked near 44 MHz.

A trap could cause the trouble, too. Suppose the 41.25-MHz trap were mistuned to somewhere near the center of the curve. A badly misplaced dip (Fig. 3B) would occur in the curve, because the trap would actually be "fighting" the responses of the coils. Any misshapen curve like these indicates a need for alignment.

Markers

From the curve generated by a sweep generator and scope, you can't always tell at what frequency the skirts of a response curve begin or end. For that, you need markers. Generators are available now that put several key fixed-frequency markers on the curve at the same time. You can do them one at a time with any **accurate,** unmodulated RF signal generator.

The relationship between markers and the sweep curve is probably the most misunderstood factor in TV alignment. Technicians—and many books—usually say a marker is at such-and-such place on the curve. Instead, it's better to think of the curve as being in such-and-such relationship to the marker.

An example will illustrate what I mean. Fig. 4 shows an ordinary television-IF response curve. The little squiggle on the curve is a marker. A technician referring to this marker commonly says the 45.75-MHz marker is at the half-way point on the upper skirt. **That's wrong.** It's more accurate to say the half-way point of the upper skirt of the response curve falls at 45.75 MHz.

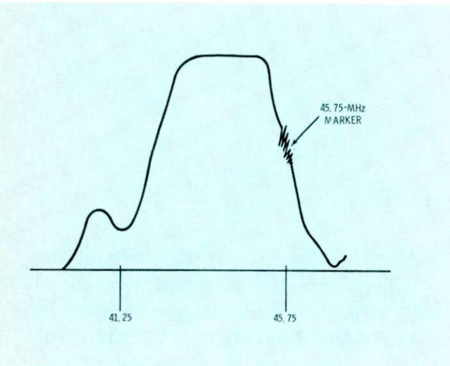


Fig. 4. The 45.75-MHz marker falls right above the 45.75-MHz position on the base line of this hand-drawn curve. You can imagine the same for markers put on response curve by a generator.

Sometimes this concept is hard to get across. Figs. 5A and 5B are two simple curves that further illustrate this idea. A 42.17-MHz marker, for example, can never be anywhere except at 42.17 MHz. In Fig. 5A it is shown "half-way up the curve" (by usual phraseology). The truth is, **the curve** is situated so that **its** lower skirt falls on the 42.17 marker. Proof of this is obvious when the 41.25-MHz coil is mistuned to change the skirt position —as in Fig. 5B. **The marker is in the same place as before.** However, the **curve shape** has changed so that the bottom of its down-frequency skirt is at the 42.17-MHz marker.

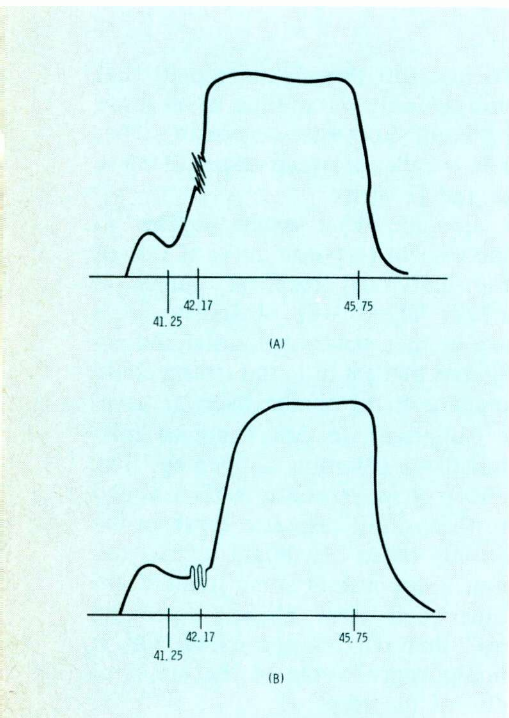


Fig. 5. More proof that markers are not what you "move" in sweep alignment: you move the curve or reshape it until peaks, dips, and skirts coincide with the markers they are supposed to.

Always remember this relationship. This way of thinking will do more to help you "clean up" a bad alignment job than any other advice or hint. You simply must remember that you can't shift a marker. You can only shift or reshape the reponse curve to suit the marker. This one point seems to befuddle more technicians than any other.

Timesaver Tips

There are a few little things that bug some technicians when they're getting a set ready to align.

Keep your equipment connected, warmed up, and ready. Every shop that operates efficiently does this. Use a rollabout cart or the shelf over your bench. But don't waste time making all those connections every time you have a set to align.

One common problem results from poor grounding. The resulting response curve never looks like it's supposed to. Put a couple of extra clip leads (heavy ones) between the TV chassis and the ground terminals of the generator and the scope. Another problem that arises frequently is overloading. Always start with your scope set for about 2 or 3 volts peak to peak. Then turn up the sweep generator only enough to put a trace on the scope. Do that and you'll never get the distortion that occurs with overload.

Also, be sure to use the bias clamp voltage. This gives you a standard AGC level. The manufacturer's alignment sheet tells you how much bias to apply. Sometimes two or three points must have bias. They're all important, so don't skip one.

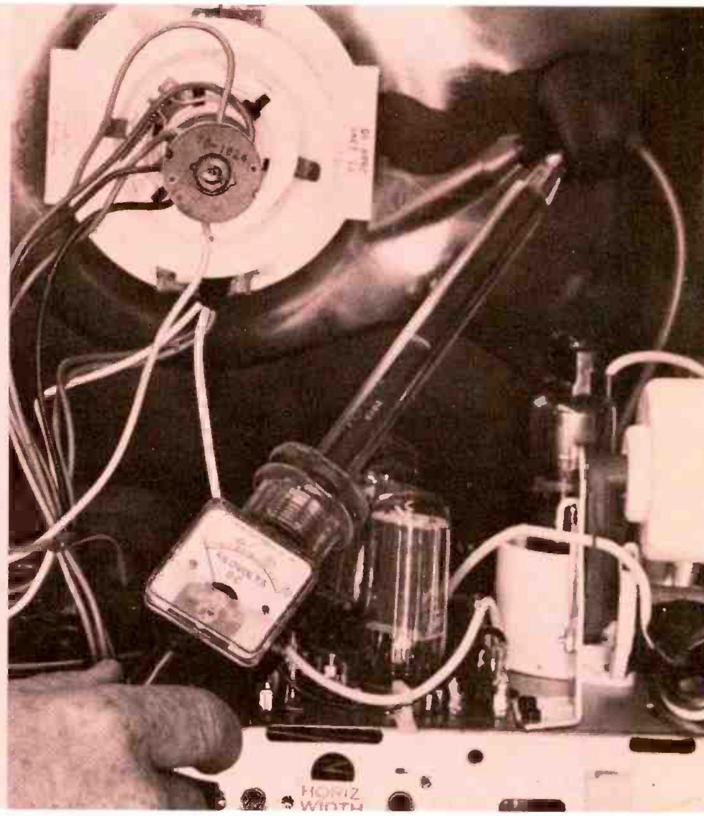
You can easily warp the alignment curve with a marker that's too strong. Mix the marker through some kind of a resistive pad that cuts the marker signal down. Or, just turn down the output knob on the marker generator. Best: use a a post-injection marker setup.

Kill the horizontal sweep during alignment. One simple way is to open the boost circuit fuse. Another way is to pull the horizontal output tube out of its socket. Never simply pull off the horizontal output tube cap, because you'll overload the screen circuit. Load the B+ line down with a 2500-ohm, 25-watt resistor while the sweep is disabled. The manufacturere usually tells where to connect this load.

Look Forward To . . .

some help with something that is catching the interest of quite a few technicians nowadays. In my next column, I tell how to get the most out of a triggered-sweep oscilloscope in ordinary TV troubleshooting. Even if you don't have a triggered scope, you'll understand more about all scopes after you read some of the hints and tips I have for you. And if your shop is one of the several that own this time-saving instrument, you'll discover ways to make it even handier than you thought it was. ▲

Zeroing in on the causes of "no high voltage"



A logical system for isolating the defects that commonly kill high voltage.

by Wayne Lemons

The symptom is no high voltage. What should you do first? Check all the tubes in the horizontal and high-voltage section? Substitute tubes or transistors? Hook up a sweep-circuit analyzer? If you do any of the above first, you probably are taking longer than is necessary to find the cause of the trouble symptom.

Testing tubes or transistors may isolate the trouble in other circuitry, but such a technique may be misleading in the horizontal or high-voltage section. Why? Because no shop tester submits a tube or transistor to anywhere near the stress or conditions encountered in horizontal output or high-voltage circuits.

Substitute tubes or transistors? Possibly, but which ones? Substituting tubes or parts at random can hardly be called a scientific procedure. In addition to taking a lot of time, there is a very real risk of temporarily healing the defective part in the circuit, which may lead you to believe you have cured the trouble only to find yourself with a callback. So blanket substitution normally is neither efficient, practical, gratifying nor economical.

Using special test equipment is fine; however, most special equipment is not intended for preliminary diagnosis, but rather for those troubles that don't respond to ordinary techniques.

There is no point moving in an entire infantry brigade to neutralize a lone sniper in a tree, at least until a scouting party determines whether or not the sniper is an advance man of an all-out invasion.

To make fast work of any TV service problem, especially the "no-high-voltage" one, you need a mode of operation that is as systematically organized as a Brinks holdup.

Any problem will eventually succumb to more than one plan of attack, and the good technician, like the good general, varies his plan as conditions warrant so he can reach the objective the quickest and best way.

The plans of attack suggested here are useful on any tube set, black and white or color.

Using the Senses

No technician worth his salt should overlook shortcuts to trouble analysis. Sight and smell are two shortcuts: the cherry red plate, smoke, unusual odor, too much melted wax, arc trails on components or chassis, broken parts, etc.

An overheated (cherry red plate) horizontal amplifier tube, for example, in a black-and-white set almost always means a lack of drive signal from the horizontal oscillator. It can mean this in a color set, but it can also mean an excessive load on the horizontal-sweep or high-voltage circuit—for instance, a shorted damper tube or boost capac-

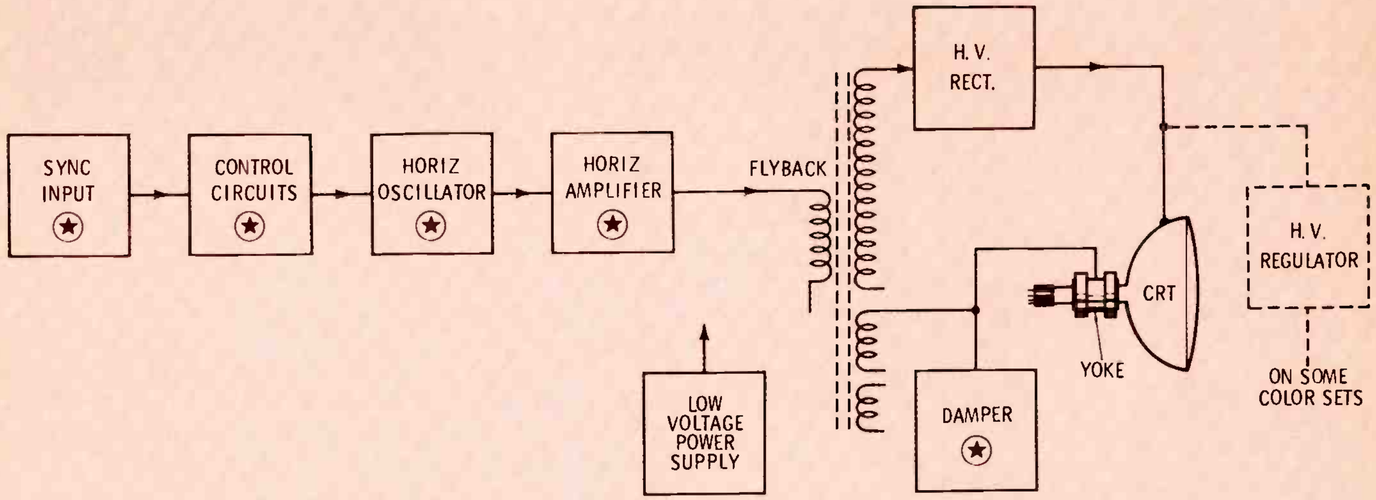


Fig. 1 Block diagram of the TV stages in which common defects can reduce or completely kill the high voltage.

itor. It goes without saying that if the plate of a tube in a TV set is glowing cherry red, you first should find the reason for it.

Pinning Down the Trouble

If the senses don't find the source of the trouble, then it is time to mount a reconnaissance mission on one flank to flush out the enemy. You have to know which part of the circuit has trouble, and if you can prove that the enemy is or is not in one section, you will have the information needed to deploy the mop-up squads.

Fig. 1 is a block diagram of circuits where the enemy may be concealed. It is essential for a good commander to determine as quickly as possible where the battleground is going to be. Here is the technique:

1. Though you don't often find it included in books or magazine articles, it is no secret that just about every technician uses a screwdriver in the manner shown in Fig. 2 to check the amount of arc at the high-voltage rectifier plate cap. You should know how blue and how long the arc should be; experience will teach you this. Once the arc is struck, you should be able to pull it out to one-half inch or more on a black-and-white set and more than three-quarters of an inch on most color sets.

(For the beginning technician: Be sure you don't ground the blade of the screwdriver to the chassis or you could damage the sweep circuit, and be sure you are holding only the insulated part of the screwdriver.)

2. If there is little or no arc from the cap, turn off the TV set and remove the cap connector from the tube, as in Fig. 3.
3. Turn the set on and again check the arc, this time from the plate cap to the screwdriver blade. Again, be sure the screwdriver blade is not near ground.

(**Note:** The reason for steps 2 and 3 above is to remove any excessive load that may be on the high-voltage circuit, such as a defective high-voltage rectifier tube or CRT, or in the case of a color set, a load caused by high-voltage regulator trouble or an improperly biased color CRT.)

4. If the arc is okay when the plate cap is pulled, the trouble is in the rectifier, regulator (in color sets) or CRT.

(**Note:** The best way to check the high-voltage rectifier is to substitute a new tube. Unless there is an open filament in the tube, a tube tester almost is of no use at all for testing a high-voltage tube.)

To check the shunt regulator tube and associated circuitry in a color set, remove the plate cap of the regulator and insulate it away from the chassis. Then again turn the set on and see if the high voltage increases to the unregulated value (around 30 kv).

The best way to check the CRT is to remove the high-voltage anode lead and see if the high voltage returns to normal. Another quick check of an operating color set is to remove the socket connection from the base of the picture tube; if bias problems are causing the tube to load down the high voltage, pulling the socket will restore the high voltage. However, do not overlook the fact that the trouble may not be caused by improper bias, but rather by some internal fault in the anode section of the CRT. If that is the case, removing the base socket will have no effect on the high voltage. (**Special Caution:** Fig. 3 shows what can happen when you remove the plate cap from the high-voltage rectifier of a color set. Since all the load is removed, the high-voltage pulse increases above the normal level, and the arc can leap over a long path to ground or some terminal on the flyback transformer. Turn the set off quickly if this occurs, or you may damage the flyback or other nearby components.)

5. At this point, if the arc is still too small at the rectifier cap, you may want to move back to the horizontal amplifier plate and check for the normal arc there. This, of course, is a much smaller arc, but if it is there and there is little or none at the rectifier cap, the trouble is probably a defective high-voltage winding on the flyback. (Newer black-and-white sets cannot be checked from the top side of the chassis because most use single-ended horizontal amplifier tubes.)
6. One point that sometimes is overlooked by technicians is that if there is no arc at a particular plate cap, it is permissible to check the DC voltage on the cap. This gives you a point at which you can check for both the amount of B+ and the continuity between B+ and these two points. The B+ should measure near the rated voltage. (Both the high-voltage and the horizontal-output plates normally have boosted B+; with no arc at either plate, there obviously is no boost voltage fed to the points, but the damper cathode feeds B+ to these plates.)
7. If B+ is okay, look for trouble in the stages indicated by a star in Fig. 1. Obviously, there are still too many stages in which to check individual parts, so more reconnaissance is needed to further localize the defect.

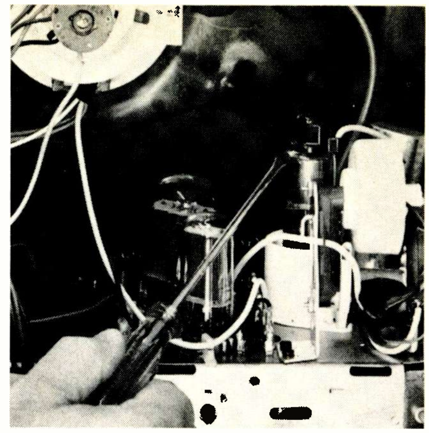


Fig. 2 If a suitable arc can be drawn from the plate cap of the high-voltage rectifier, the horizontal oscillator and output tubes, flyback transformer, damper circuit and B+ are probably okay.

8. Turn off the power to the set. Pull the damper tube (unless it is in the same envelope with the horizontal amplifier tube; in this case skip ahead to step 9.) Turn the set on. Check to see if the high voltage now comes on or if there is at least a noticeable increase in the arc at the rectifier plate cap. If pulling the damper tube restores the high voltage (maybe even a narrow raster), the trouble is probably caused by an excessive load on the damper circuit. The trouble may be the damper tube itself, a shorted capacitor (C2 in Fig. 5), or a shorted "matching" capacitor across the damper tube (C1 in Fig. 5). Another possible cause is an internal short between the vertical and horizontal coils in the deflection yoke, or between their leads. In some circuits, the deflection yoke is connected as shown in dotted form in Fig. 5; in this case, a shorted yoke coupling capacitor (C3) will kill the high voltage.
9. If the set uses a combination horizontal amplifier and damper tube, turn off the set, pull the tube and with an ohmmeter measure at the chassis tube socket between the damper plate and cathode pins. If the ohmmeter reading is less than 100K, find out why. Only a very few sets have been built that normally

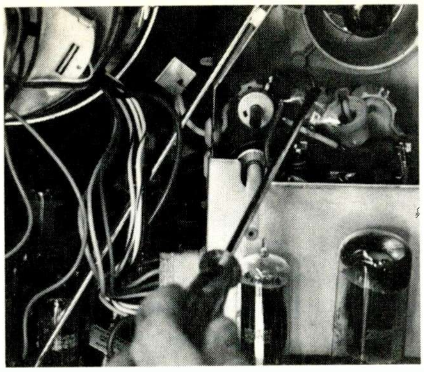


Fig. 3 Checking the arc with the high-voltage rectifier plate cap of a color TV removed can cause damage if the arc is sustained more than three or four seconds. Note in this photo that the high-voltage pulse of this color set is not only arcing to the screwdriver but also from the screwdriver to a terminal on the flyback. If the screwdriver is removed, the arc will still flash over to terminals or chassis points over an inch away, unless the sweep circuit is defective.

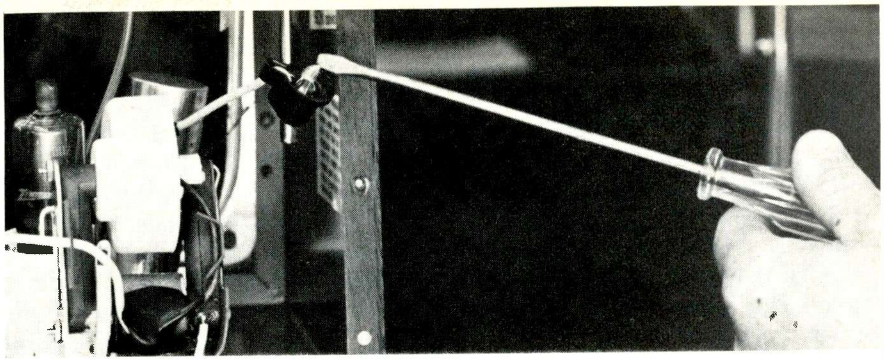


Fig. 4 Removing the rectifier plate cap and again drawing an arc to determine whether the trouble is before or after the high-voltage rectifier tube. (Although the screwdriver blade here appears to be touching the metal cabinet, it actually is more than an inch away.)

have less than about 100K between B+ and boost (to which the plate and cathode of the damper tube are connected through low resistance). If there is a low resistance between the damper plate and cathode, and if the set has a plug-in yoke connection, pull the yoke plug while monitoring the ohmmeter reading to determine whether the yoke or its circuit is causing the trouble.

(**Note:** Step 9 can be used with any set regardless of the type of damper tube used, and is sometimes preferred over the more dynamic method of pulling the damper tube, turning the set on and seeing what is flushed out.)

Excessive Loads

At one time, flyback transformer checkers were quite popular. They lost much of their popularity when technicians found that they are not always dependable (for the same reason that tube checkers are not practical for checking tubes in circuits).

Visible signs of "waxing" or burning are fairly dependable signs of flyback failure, although waxing can be caused by an excessive load.

Perhaps the best method of isolating flyback failure is to prove beyond reasonable doubt that nothing else is wrong. This you do by following the plan of attack already suggested, plus these additional checks:

Shorted turns in the yoke can cause the high voltage to drop. In many circuits, disconnecting the horizontal yoke winding from the flyback is all that is necessary to bring back the high voltage if the yoke winding is shorted. In other circuits you need to do more. Disconnect the horizontal yoke winding and connect another yoke winding in its place. This substitute yoke does not need to have the exact impedance of the original, nor does it need to be positioned on the picture tube. The purpose of it is to return the flyback circuit to near its normal load condition so you can determine whether or not the high voltage comes back up to normal level.

Other sources of excessive load can reduce drastically the high volt-

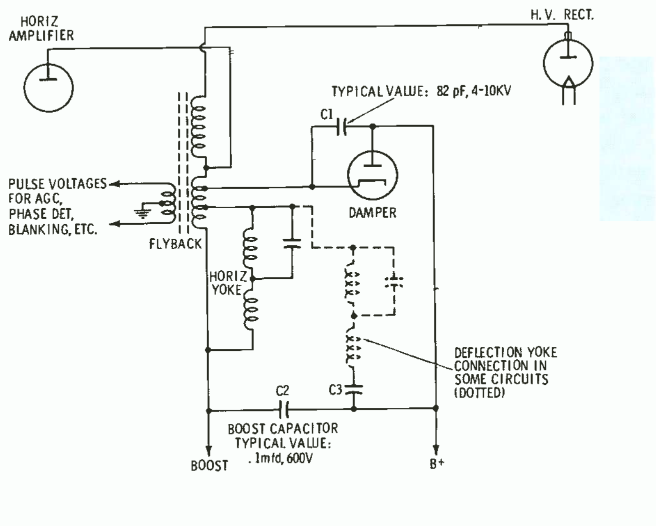


Fig. 5 Simplified schematic diagram of a common flyback circuit.

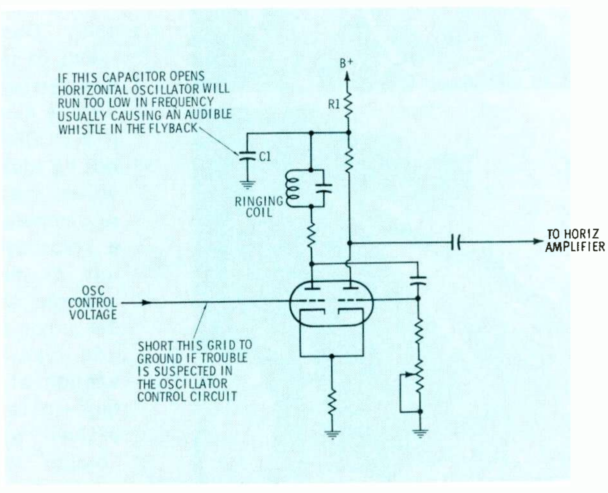


Fig. 6 Simplified schematic diagram of a horizontal multivibrator circuit which employs a decoupling network, R1 and C1, in the plate circuit. If C1 opens, the oscillator frequency will be reduced,and an audible whistle in the flyback probably will be heard.

age. If the set uses a width coil and it develops shorted turns, the flyback circuit will be overloaded. Temporarily disconnect the width coil to determine whether it is part of the problem. In many cases, a shorted coupling capacitor between the flyback and a circuit it is feeding—such as AGC, convergence, etc.—can be the cause of reduced high voltage. Disconnect any possible excessive load and check the high voltage.

Failure in Horizontal Oscillator or Control Circuits

If either the horizontal oscillator or control circuits cause a loss of high voltage, you almost always can be sure that the horizontal output tube has overheated, except in those chassis which have automatic protection for the horizontal output tube.

The low-pitched whistle produced when some sets are first turned on indicates that the protection circuit is working (others have less audible methods). The lower pitched whistle may also be caused by an opening decoupling capacitor (usually an electrolytic) in the horizontal oscillator. Fig. 6 shows the type of circuit that can be affected in this manner. If C1 opens, the oscillator sections share another mutual impedance, R1, in addition to the common-cathode resistor. This slows down the oscillator to the point that no high voltage is generated by the flyback.

It sometimes is easy to overlook the horizontal oscillator control circuit as a possible cause of missing high voltage. But if trouble develops in this circuit, the horizontal oscillator may be stopped completely or the frequency may be changed drastically.

The multivibrator circuits of Fig. 6, which fortunately is the most common oscillator circuit, is easy to check for control-circuit troubles. Put a tube-socket adaptor under the tube, determine which grid is controlled, ground that grid and, if the high voltage returns, you have isolated the trouble to the oscillator control circuit. (The controlled grid is the one to which the DC control voltage is fed. In Fig. 6, it is the grid of the tube section on the left.)

Defective diodes usually do not cause the oscillator frequency to drift far enough to result in a loss of high voltage, but don't overlook the possibility. For example, in one set, high voltage and a raster were present when the set was off channel, but the high voltage disappeared when the tuner was turned to an active channel. The trouble was the horizontal control diodes.

The most common control-circuit trouble is a leaky coupling capacitor, which causes either a high positive or high negative voltage on the grid of the horizontal oscillator, resulting in too high or too low of an oscillator frequency, or completely stops the oscillator.

Most oscillator circuits use some form of DC control voltage. Usually the control voltage is near zero when the oscillator is at the correct frequency; however, sometimes the voltage on the control grid may run several volts positive or negative. In this case, measuring the DC control voltage and comparing it with the schematic is probably the best way to tell if there are control circuit troubles. If the voltage is within 25% or so of the specified voltage, the control circuit is probably okay.

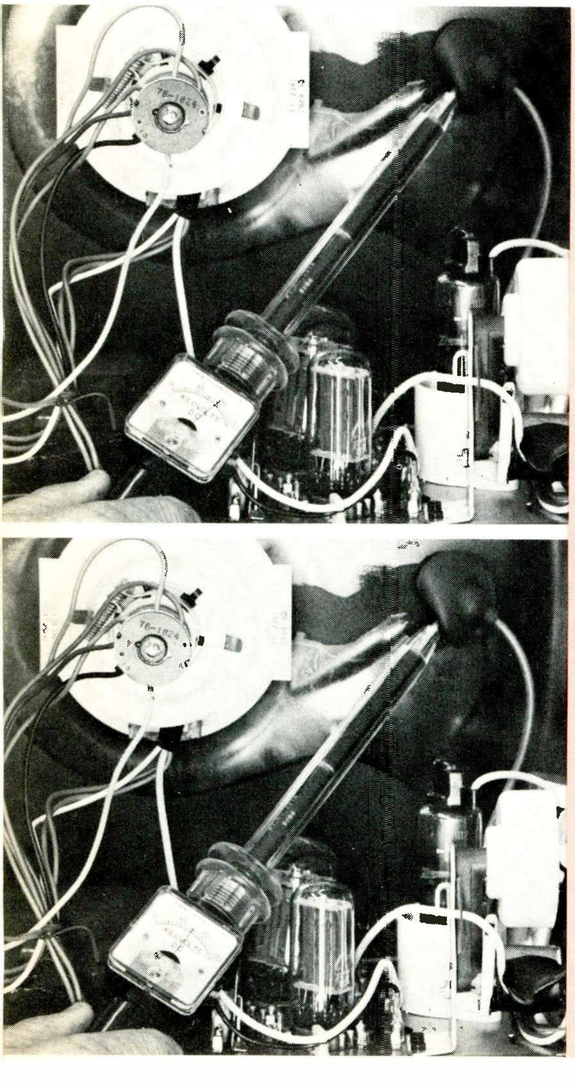


Fig. 7 These two photos show the different high-voltage readings obtained on a b-w set with (A) the brightness control turned down all the way and (B) with the brightness control turned up full. Note that the voltage changes from about 18 KV to about 15KV. This variation is a result of the varying load presented to the high-voltage circuit by the CRT. A b-w CRT normally can not be biased to the point where the raster blooms or disappears. However, in a color set, a circuit defect or misadjustment of controls can produce on the color CRT a positive grid bias which creates enough of a load on the high-voltage circuitry to either extinguish or "bloom" the raster.

Conclusion

Every TV chassis has its own idiosyncrasies, and it's impossible in an article of this length (even though it's quite long) to cover anywhere near all of the possible causes of horizontal-sweep or high-voltage trouble. Our purpose here has been both to show you a plan of attack and, hopefully, how you can prepare your own plan as you go along. Like a game of chess, the combinations keep the game interesting and keep the combatants on their toes, and as one of my fellow technicians said one time, "There is one thing you can say about a TV problem, it has all the patience in the world; it can watch you work yourself into frustration and never offer a helping hand." This means that it is up to you to flush out the enemy so you can get your sights trained on him. ▲

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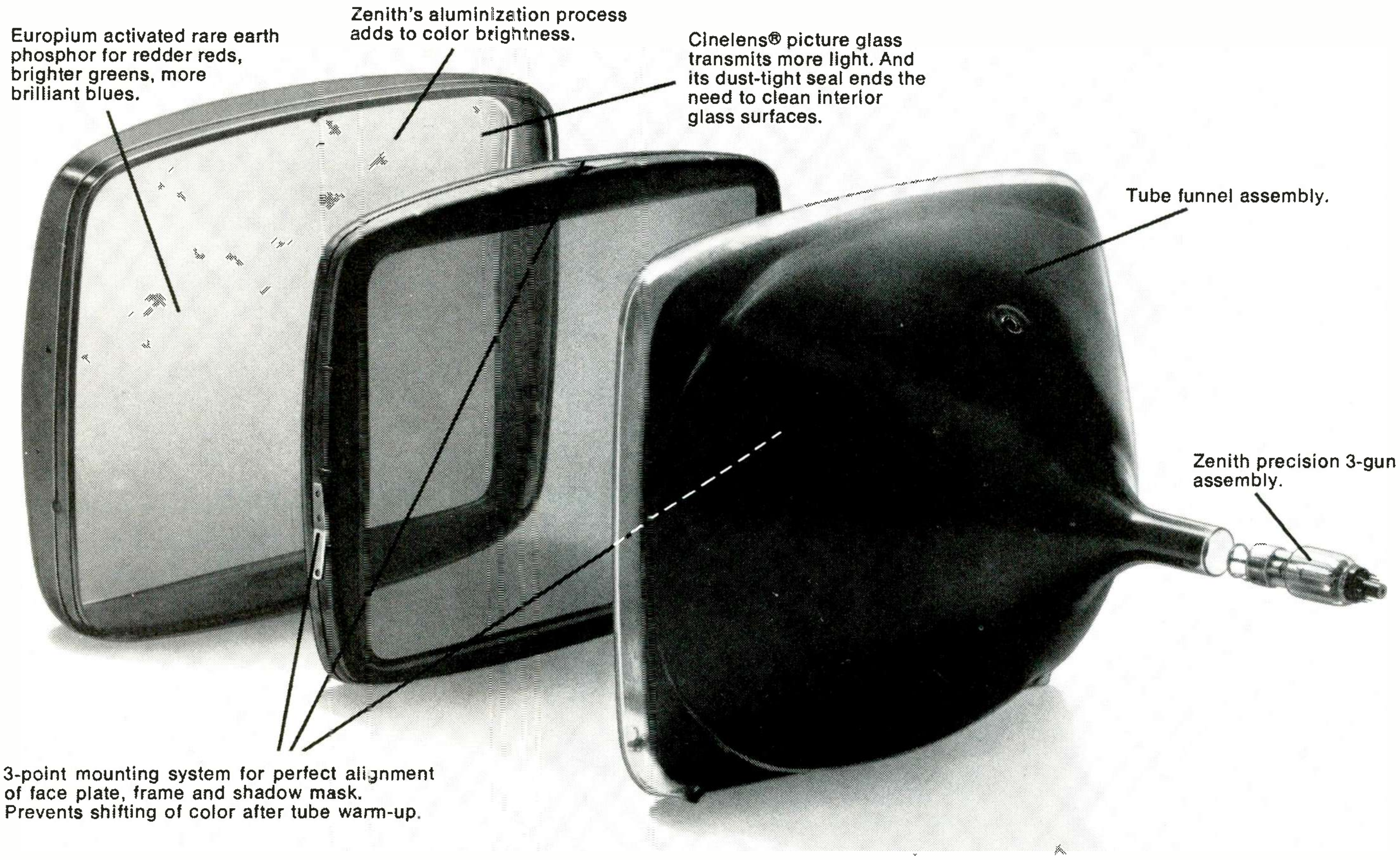

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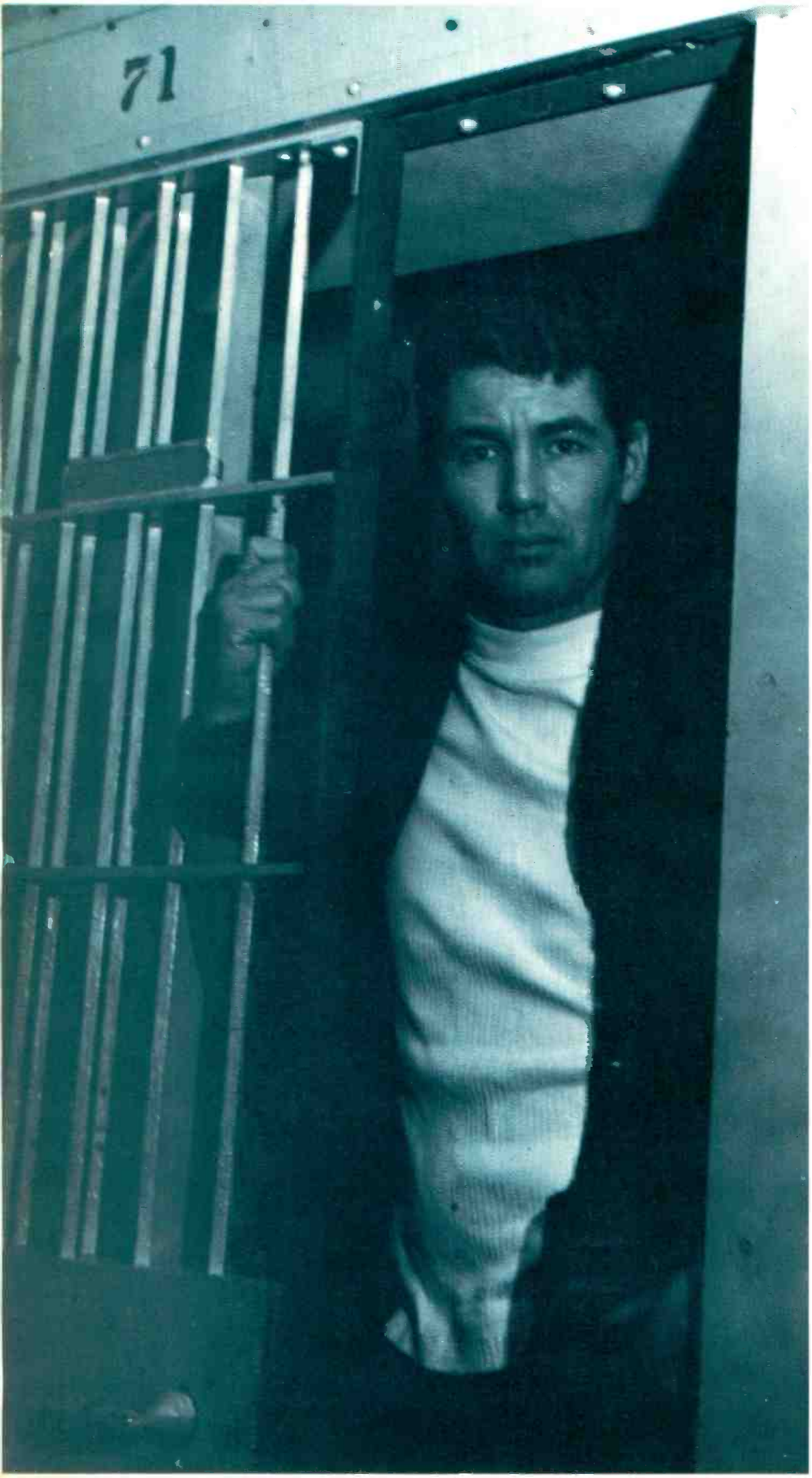

by John Mac Isaac #78904*

A man who knows the business tells how to lessen the chances of armed robbery and if it should occur, what you should and should not do.

All the guns around me now are in the hands of prison guards, but for fifteen years the guns were in my hands. Guns were my life and **your shop** was my business—I was a professional bandit, and among the places I robbed over the years I can count more than thirty electronic service shops.

Why Armed Robbery

Armed robbery is the least subtle of all crimes. It is harsh, violent, and often deadly. It also is one of the most widespread. According to FBI statistics, holdups occur in this country at a rate of more than one every minute and a half, twenty-four hours a day. Armed robbery owes its popularity to the fact that it is swift, direct, and requires a minimum of tools. It attracts criminals of every type because it seems, at first glance, to be the easiest way to pick up a quick buck.

Why Your Shop is Popular

Electronics service people owe their popularity among armed robbers to the fact that most dealers and servicemen are not prepared to deal with a robbery and have not taken steps that make their shop unattractive to armed bandits. It's the sort of thing that always happens to the other guy, to the man who runs the jewelry store down the block or the savings and loan office two streets over. It's always one of them—until the fellow with the gun walks into your place.

Aside from complacency on the part of victims, there are a couple of other attractive features that

*In preparing the following article for ELECTRONIC SERVICING, Mr. John Mac Isaac—himself a convicted robber—was able to consult more than twenty other armed robbers now serving time in the State Prison of Southern Michigan. He is intimately familiar with many areas of crime. An account of his hilarious and wildly improbable adventures beyond the law can be found in his book, **Half the Fun Was Getting There**, to be published in October by Prentice-Hall.

for armed robbery?

make service shops rate high in a bandit's "case" book. Many of them are located in areas where pedestrian traffic is fairly heavy and where a man in a hurry can lose himself quickly. And because they are seldom heavily staffed, one man with one gun usually can handle the job himself (or so he thinks).

An Example

The last job I pulled, for instance, was in an electronics service shop in suburban Detroit. It was eight in the morning, and the owner and one technician had just opened the shop office when I entered. I was dressed in a neat, conservative business suit—about as far as I could get from the Dillinger stereotype or the comic strip bandit with his collar turned up around his ears. People were hustling by on the walk outside, and horns were sounding in the street. A very ordinary morning, and a very unlikely atmosphere for violence.

It seemed so unlikely, in fact, that when I showed the owner and the other man my gun, they couldn't believe I was serious. They actually smiled at me. It finally registered, though, when I cocked the hammer back. I always carried an old .45 army revolver, which was the ugliest, most intimidating weapon I could get my hands on. It even made me nervous, and I was behind it. From the front, it looked more like a howitzer than a hand gun.

The two men were so terrified when they caught on to what was happening that I almost felt like putting the gun away and telling them everything was all right. But it behooves a bandit to stay in character, so I forced the owner to open the safe and put the cash in a paper bag. In this instance I settled for a little better than $300 dollars—plus a solid-state TV set that was too handy to be left behind in good conscience. Not so spectacular as a jewelry store or a savings and loan association heist, perhaps, but exactly just the sort of job an average robber counts on to make his living. And I didn't have to worry about hidden alarms, protection services and store personnel who were on guard against people in my line of work.

A professional like me might pull off such a robbery once or twice a week—and there are plenty of us doing it. There are also an increasing number of freelancers getting into the business, especially young people. Delinquents and drop-outs. In most urban areas across the country, in fact, there are so many newcomers looking for the fast dollar of an armed robbery that many shops have been forced to relocate or go out of business. These amateurs can't take your money as smoothly and skillfully as a true pro, but you still stand an immediate financial loss and such unwelcome fringe benefits as frightened (and lost) customers, increased insurance rates and reduced credit. Maybe even worse.

How You Should React

Chances of a robbery occurring in your shop are good enough that you and your employees should know how to behave during the course of one—or what to do until the gunman leaves. If you're smart, you do exactly what you're told. You hold up your hands or allow them to be tied or prostrate yourself on the floor or march into the stockroom and bury yourself beneath a pile of modular components according to the whims of your robber. You do your best to be calm and helpful. Hysteria or balkiness is an invitation to shooting. And **nothing** in the shop is worth that.

When you find yourself at the wrong end of a gun, the best course of action is summed up in the stock phrase delivered by many oldtime robbers, "Don't nobody get excited and nobody gets hurt!" Never indulge in heroics on the assumption that you are facing one of those nuts with a squirtgun so dear to the hearts of newspapermen. If the robber is a professional, he is quite prepared to shoot you—even though he would rather not. And if he's an amateur, he may shoot **everyone** in the place out of sheer panic, himself included.

There are exactly two things for you to do during a robbery: concentrate on staying alive, and get a good description for the police. **After** the bandit has left is the time to begin screaming bloody murder and peeking out the door for license plate numbers.

How to Lessen the Chances of Armed Robbery

Your main interest, however, must be in **preventing** a robbery before it occurs. There is no magic formula to give you absolute assurance, but by taking the proper precautions you can put the odds very much in your favor.

Your most basic safeguard is to maintain close security on major cash transactions. Discussing such matters or displaying large amounts of cash in front of customers is a good way of advertising yourself to the wrong people. Most bandits are initially attracted to their victims by hearing second hand that they are ripe for a robbery. Thieves know there is **some** money on the premises at all times—don't add to that lure by offering the certainty of a nice fat score.

As a matter of routine, you should caution all employees not to discuss cash movements with anyone. Never take cash deposits to the bank at the same time two weeks in a row. Try, in fact, not to have **any** predictable pattern in your banking habits.

Most holdups occur at closing time. That's when the maximum amount of cash is on hand and there is less apt to be customers to complicate things. It is also one of the times during the day when there is likely to be only one person on the premises—since many shop owners have a habit of dismissing their employees and closing up by themselves.

Any shop presents a far less tempting prospect for robbery when everyone leaves at the same time. And it's a wise precaution to close as soon as possible after the last customer has left. It's also a wise idea to keep a wary eye on that last customer—armed robbers frequently enter a shop shortly before closing time and wait until the last minute before striking.

The two other most vulnerable times during the day are in the morning (especially where the owner is in the habit of arriving early and opening up by himself) and at lunch hour when there is a minimum of personnel about.

Early hour bandits are known in the profession as "morning glories," and their approach is as effective as it is simple and direct. They linger near the shop until the owner arrives; when he opens the door they push right in with him and force him to hand over the cash. The best weed killer for morning glories is for all employees to arrive at approximately the same time. When owners or service managers **must** arrive early, they should look into the possibility of timing their arrival to coincide with the passing of a police patrol.

Noontime robberies can best be prevented by staggering the lunch hours of employees so that no more than necessary will be gone at one time. Of course, there are apt to be many times during the day when the number of on-hand personnel is reduced by service calls, but this is not such a predictable factor and not the sort of thing robbers depend on.

Physical layout is an important consideration in a store's vulnerability to robbery. Side and rear entrances, for example, should be locked, or at least easily visible when not in actual use. Safes and cash boxes should not be located near a door. Robbers like nothing better than a situation where they need only step inside the door, clean out the cash and slip away before others in the building are even aware that anything is wrong.

Another important consideration is proper lighting. Typically, service and display areas are well lighted. Money handling areas, however, are quite often tucked away in an obscure corner. This gives a bandit the sort of edge he is looking for. He knows there is less chance of a passerby seeing what is taking place. Adequate lighting and street visibility is not only good business—it is good security.

If you have an alarm system (and, with the increasing risks of robbery, more stores and shops than ever before are beginning to use them—especially in view of the fact that installation costs in some area are offset by reduced insurance rates), it would be a good idea to have someone from the police robbery detail take a look at it. Chances are he can show you at least one loophole in it.

I once robbed a TV service and sales store in Dallas that had an excellent alarm system designed to trigger a remote alarm with a protection agency. Unfortunately, the buttons were mounted under counters and none of the employees dared reach for them, correctly assuming that I would either realize what they were doing or think they were going for a gun. The buttons, of course, should have been on the floor.

Another basic encouragement to armed robbers in some localities is inadequate police protection. This is something you should not accept passively. Get together with other area businessmen and lean on city officials and police authorities to route more patrol cars through your neighborhood. Even a slight increase in police surveillance can cut your risks tremendously since thieves are very sensitive about being interrupted in the middle of a job. If enough of you squawk loud enough, the police will give you the protection you are supposed to be getting.

Conclusion

Your overall protection against robbery can be no more effective than your **awareness** of the problem and your willingness to **take precautions.** And bear in mind that what may seem a small detail to you—the placing of a light, for instance, or the location of your cash—can be an extremely important consideration to a bandit. He is risking from twenty years to life imprisonment every time he pulls a job, and he can't afford to ignore anything that might trip him up.

With any number of stores to choose from, people in my former business will always choose the one that is most lax in security—the one that is going to involve the least risk.

By giving just a little time and attention to these details you can rate yourself as a very bad risk for armed robbers—and a very good one for your insurance company. ▲

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Circle 13 on literature card

FCC bureau chief discusses TV interference

The Federal Communications Commission (FCC) processes each year approximately 30,000 complaints about various types of TV and radio interference. Although the FCC does not employ enough people to permit it to find the causes and cures relating to each individual complaint, it does provide assistance through appropriate form letters that clarify the reasons for the interference and offer general suggestions of cures.

At the spring 1969 meeting of the Electronic Industries Association (EIA) Service Committee, Curtis B. Plummer, Chief of the Engineering Bureau of the FCC, discussed the FCC's policy in handling complaints about interference to TV reception. During that discussion, Mr. Plummer made the following three points:

1. TV sets could be designed to have no interference problems but it would increase the cost. Since less that 1% of all TV receivers will ever be affected by interference, it is best for all manufacturers to design sets as they do and make modifications on only those sets located where interference occurs—with the additional cost borne by the users in the special-case areas.

2. Situations can change in any location and such changes may cause interference to develop. An FM station may start in the area, or increase power. Also, land-mobile, amateur, CB or additional TV stations may come on the air or increase power and create a problem. Faulty antennas, antenna booster amplifiers, lead-in and television tuners and IF sections can also cause interference problems.

3. Most problems can be cured at the TV by inserting a trap at the antenna terminals or tuner input. Generally, fixed-tuned traps are most effective, but adjustable traps may afford a better solution in some cases. In other cases, two filters may be required, or a tray may be required, ahead of an antenna booster.

The charts shown here provide the attenuation characteristics in decibels of a representative list of available commercial filters as measured by FCC laboratories. ▲

HIGH-PASS FILTERS FOR REJECTION OF OUT-OF-BAND SIGNALS

Filter	14 MHz	21 MHz	27 MHz	30 MHz	41 MHz	44 MHz	47 MHz	50 MHz	52 MHz	54 MHz	60 MHz	66 MHz	76 MHz	82 MHz
Drake TV-300-HP	81	63	53	48	45	54	57	60	38	3.5	1.5	0.8	0.0	0.7
Finco 3013	51	40	36	35	58	50	36	33	17	3.5	0.5	0.5	0.5	0.5
JFD HP 50	62	51	42	38	20	15	9	4	3	1	0.5	0.5	0.5	0.5
Lafayette 99-4021	60	44	36	30	22	21	27	7	1	0.5	0.25	0.5	0.5	0.5
Miller 6167	15	5	15	17	22	22	16	14	12	10	6	2	4.5	1.5
Miller 6168	23	28	38	25	8	6	4	3	3	3	3	3	3	2.5
Radio Shack 15-582	35	26	19	16	7	5	3	1.5	1.5	1.5	1.5	1.5	1.5	1.5
Winegard TR-316	73	73	59	51	25	16	8	1.5	0.5	0.5	0.0	0.0	0.0	0.5

FILTERS FOR REJECTION OF FM BAND SIGNALS

Filter	Chan. 2 Video 55.25 MHz	Chan. 3 Video 61.25 MHz	Chan. 4 Video 67.25 MHz	Chan. 5 Video 77.25 MHz	Chan. 6 Video 83.25 MHz	Chan. 6 Color 86.83 MHz	Chan. 6 Sound 87.75 MHz	FM 88.5 MHz	FM 93.1 MHz	TV 170 MHz	TV 180 MHz	TV 190 MHz	TV 200 MHz	TV 216 MHz
Drake 300 FMS	3	3.6	3.8	2.0	1.5	2.1	1.6	8	18	3.6	2.5	2.4	1.5	0.2
Drake 300 FMT	0	0	0.1	0.6	2.4	10	13.5	16	18	0.4	0.6	0.8	0.4	1
Finco 3006	1.8	2	2.4	4	7	14	14.6	15	17	4.2	3.5	2.8	2.2	3.4
Jerrold 1435A-FM	0	0	0	1	3.4	10	13	26	23	0.4	0.4	0.4	0.4	0.4
JFD TR-FM	0	0	0	1	3.4	10	13	26	23	0.4	0.4	0.4	0.4	0.4
Meissner 15-7513A	0	0.1	0.4	2	5	20	24	32	28	8.4	15	15	15	15
Miller 6146	7	10	11.5	14	18	20.4	21	21	21	0	0	0	0	0
Mosley WT-78	0	0.4	1.2	4	7.4	11.4	13	21.6	24.6	0	0	0	0	0
Superex FM Reject	2.6	4.2	6.2	10.4	17	18	18	18	19	6.5	6.5	6.8	6.5	6.3

book review

Waveform Measurements: Rufus P Turner, Hayden Book Company, Inc., 116 West Fourteenth Street, New York, N. Y. 10011; 86 pages, 5⅜"x8¼", paperbound $2.95.

A practical approach to waveform measurements, bringing the various methods into one reterence book. Both oscilloscope waveshape and individual harmonic analysis measurements are detailed, with many illustrations of typical equipment connections shown. Mathematics and abstract theories are held to a minimum, with only enough included to clarify the instrumentation.

The chapter headings are: Characteristics of Waveforms, Simple Observation of Waveform, Quantitative Measurement of Waveform, Measurement of Total Distortion, and Measurement of Modulated Waves.

Working With Semiconductors: Albert C. W. Saunders, TAB Books, Blue Ridge Summit, Pa.; book number 501, 224 pages, 185 illustrations in 15 chapters; hardbound, $7.95; paperbound, $4.95.

The book starts with simple solid-state diodes explained with a minimum of chemistry, and proceeds logically through basic transistor characteristics and methods of testing them, transistor and tube similarities and differences, biasing and stabilizing circuits, typical amplifiers, oscillators and many other circuits. The actions of varactor and tunnel diodes, field-effect transistors, unijunction transistors, and zener diodes are explained along with typical circuits and applications.

While many diagrams, with exact parts values, are shown in full, the accent is on how these solid-state components actually work in the various basic circuits. ▲

Sets in Use 1960-1968

A recent report by the Consumer Products Division of the Electronic Industries Association (EIA) lists the following numbers (millions of units) of consumer entertainment electronic products in use during the years indicated.

Year	Auto Radios	Home Radios	Total Radios	Television Receivers Monochrome	Television Receivers Color	Phonographs
1960	40	116	156	56.9	.2	34.0
1961	41	127	168	59.5	.4	35.7
1962	43	140	183	61.9	.8	37.0
1963	45	151	196	64.0	1.6	39.0
1964	47	161	208	65.8	3.0	42.0
1965	55	172	227	66.4	5.0	45.0
1966	64	188	252	66.1	9.7	48.0
1967	73	195	268	65.5	14.6	51.0
1968	74	216	290	64.5	20.1	53.8

Toward a Better Understanding of

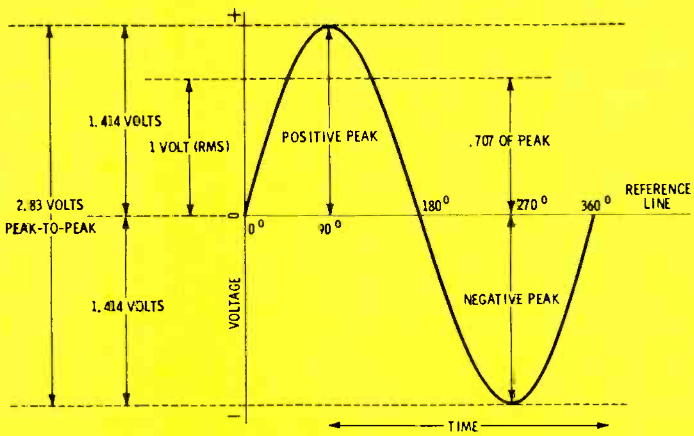


Fig. 1 Fundamental sine wave.

TABLE 1—VOLTAGE RELATIONSHIPS

PEAK-TO-PEAK VOLTAGE = 2 × PEAK VOLTAGE
PEAK VOLTAGE = 0.5 × PEAK-TO-PEAK VOLTAGE
RMS VOLTAGE = 0.707 × PEAK VOLTAGE
PEAK VOLTAGE = 1.414 × RMS VOLTAGE
PEAK-TO-PEAK VOLTAGE = 2.828 × RMS VOLTAGE

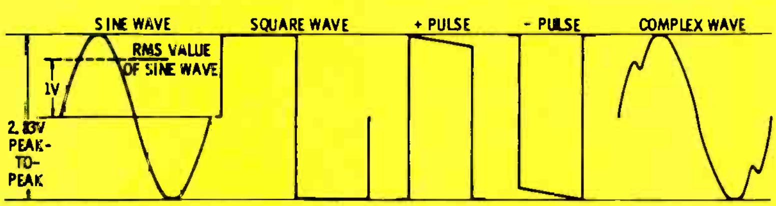


Fig. 2 Five waveforms that have the same peak-to-peak voltage.

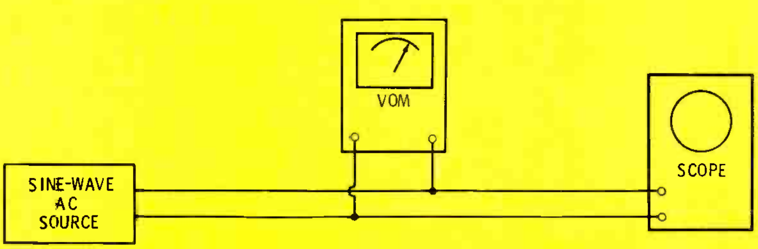


Fig. 3 A basic method for making a scope calibration.

A review of the basic characteristics of waveforms and how circuit defects distort them.

We will find that there is much more circuit-action information contained in TV waveforms than is ordinarily supposed. At the risk of rehashing well-known facts, let us consider the principles of waveform analysis systematically, and start at the beginning. Basically, there are two fundamental waveforms, from which all others can be built up (or broken down into):

1. The sine wave.
2. The exponential wave.

Sine-Wave Characteristics

A sine wave has a certain amplitude, or peak-to-peak voltage, that can be measured on the scope screen. The peak-to-peak voltage of a sine wave is related to its peak voltage and to its rms voltage as depicted in Fig. 1. These relations are true only for a sine wave—for example, the peak-to-peak voltage of a sync pulse has a different relation to its peak voltage and to its rms voltage, as will be explained subsequently. In the case of a sine wave, we can use the equations shown in Table 1.

Most TV troubleshooting procedures are based on peak-to-peak voltages. However, rms voltages come into use during scope calibration procedures. Nearly all VOM's read in terms of rms volts; therefore, if we use a VOM as a calibration reference, we must multiply the meter scale reading by 2.83 to find the corresponding peak-to-peak voltage. Of course, if we use a VTVM calibration reference (or TVOM) that reads in terms of peak-to-peak volts, no conversion factor is employed.

After the scope has been calibrated in terms of peak-to-peak volts per inch of deflection, we can easily measure the peak-to-peak voltage of any complex waveform. For example, each of the wave-

TV Waveforms

by Robert G. Middleton

forms shown in Fig. 2 has an amplitude of 2.83 peak-to-peak volts.

Fig. 3 shows a basic method for calibrating a scope; if the scope has a built-in calibrating circuit, an external AC voltage source is not required. Simplified scopes may provide a sine-wave calibrating voltage, while elaborate scopes usually provide a square-wave calibrating voltage. The end result is the same, in any case. In most cases, the calibrating voltage has an amplitude of 1 volt peak-to-peak. Beginning technicians often ask why a VOM is calibrated in terms of rms volts; this is because the meter is a general-purpose instrument, used by electricians as well as TV technicians. Electricians always work with sine-wave voltages, and with rms values. The reason is that an rms voltage develops the same amount of heat or power in a load as an equal value of DC voltage.

Since a sine wave is a symmetrical waveform, its positive-peak voltage is equal to its negative-peak voltage, as seen in Fig. 4. This is just another way of saying that the **average value** of a sine wave is zero over a complete cycle.

A pictorial review of the effects of scope-control settings is shown in Fig. 5. If the horizontal trace originally is centered on the screen, a sine wave will be displayed, as depicted in Fig. 4, with its zero-volt axis centered on the screen. This is an important point to be observed, since an AC scope always displays a waveform in this manner; the zero-volt axis will always cut through the waveform at its average-voltage level. We will return to this consideration at a later point.

A sine wave also has a certain frequency, measured in Hz, KHz, or MHz. The beginning technician should note Fig. 6, which shows how more cycles are displayed when the frequency is increased, and vice versa (provided the horizontal deflection rate is constant). Note the

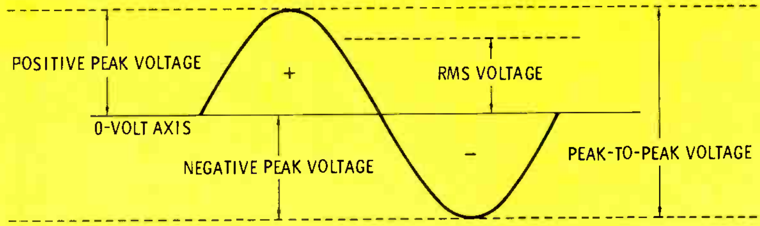


Fig. 4 A sine wave has equal positive and negative peak voltages.

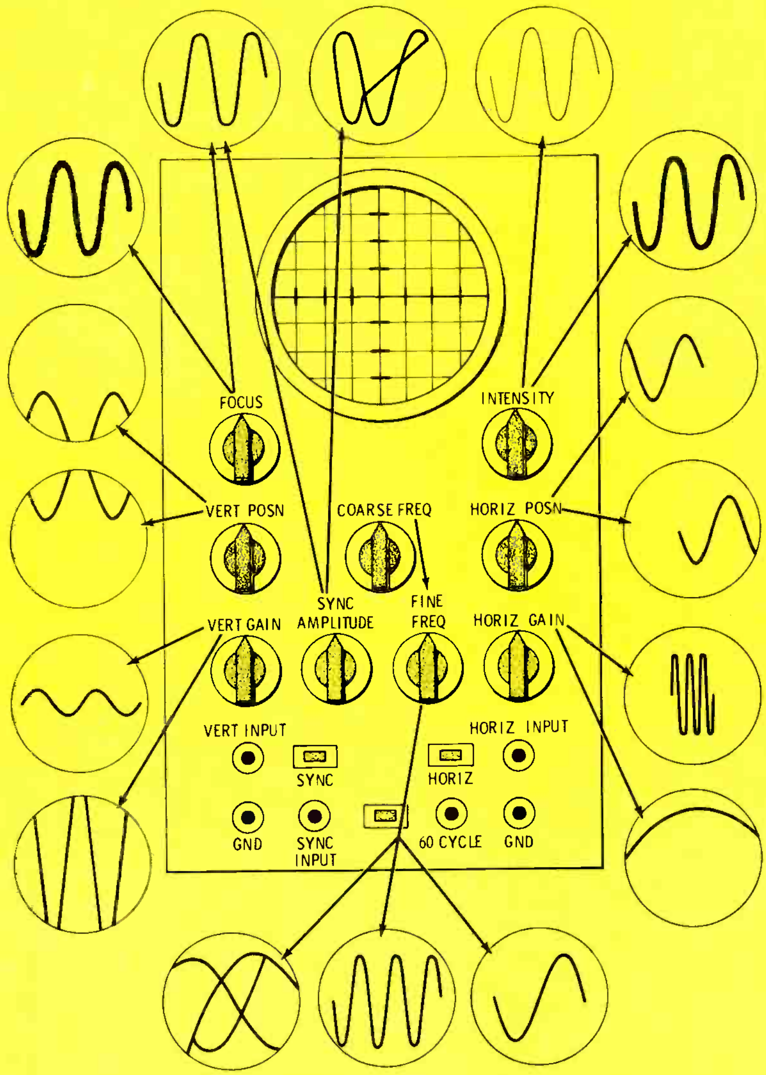


Fig. 5 Effects of scope control settings.

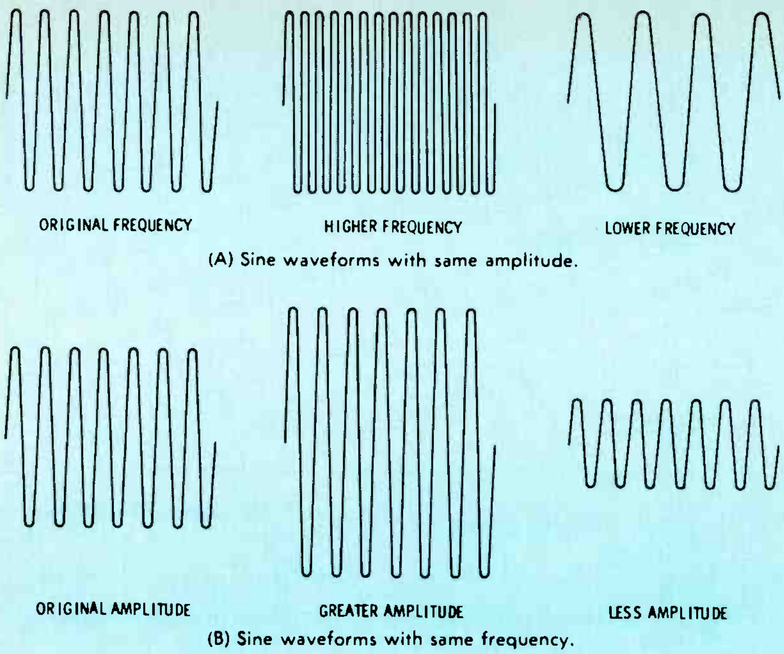


Fig. 6 Distinction between amplitude and frequency.

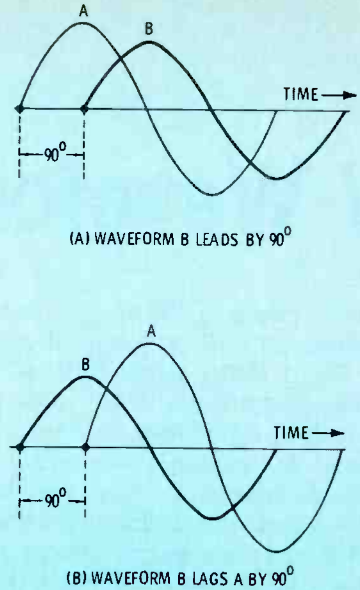


Fig. 7 Illustration of phase relationship.

distinction between amplitude and frequency in a scope display. Frequency can be measured only roughly with a service-type scope. If a lab-type scope is used, frequency can be measured with high accuracy. If we use an audio oscillator or a signal generator to "sweep" a service-type scope, the frequency of a waveform can be accurately measured. Details of this procedure will be explained subsequently.

Another basic sine-wave characteristic is its phase with respect to its source voltage (or load voltage). The meaning of phase lead and phase lag is depicted in Fig. 7. Even a simple scope can be used to measure phase relations, although the sine-wave patterns shown in Fig. 7 cannot be employed unless the scope is supplemented by an electronic switch. In practical work, TV technitians generally use square waves instead of sine waves to check phase relations, because the procedure is thereby simplified. Phase angles seldom need to be measured, because a TV receiver will indicate phase errors in its image on the picture-tube screen. For example, if there is a phase error in the chroma section, a color-TV receiver will display poor "color fit."

Fig. 8 A pulse waveform has unequal positive and negative peak voltages.

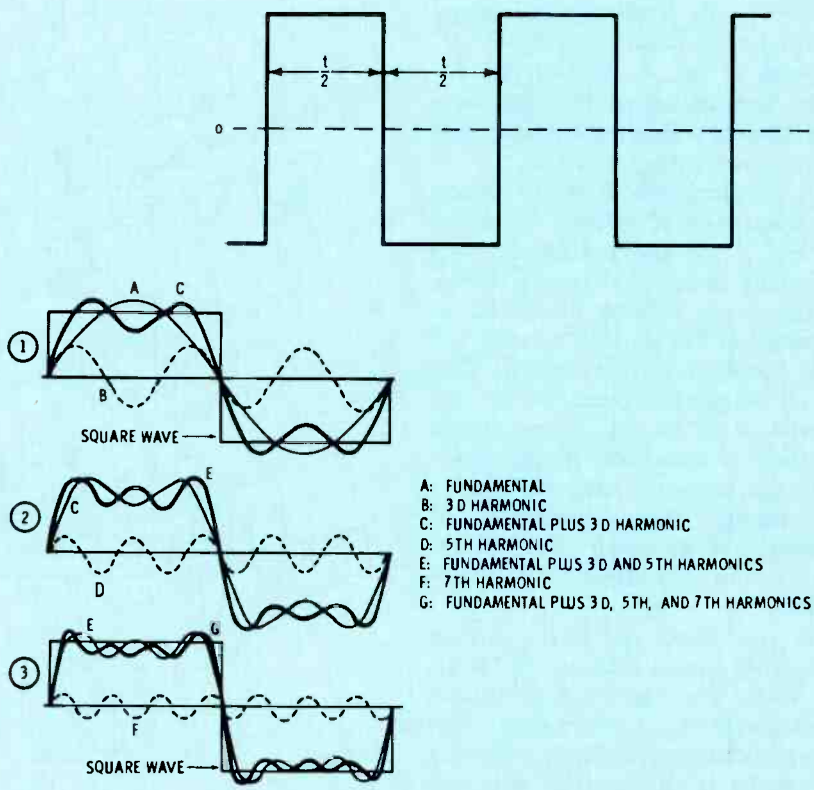
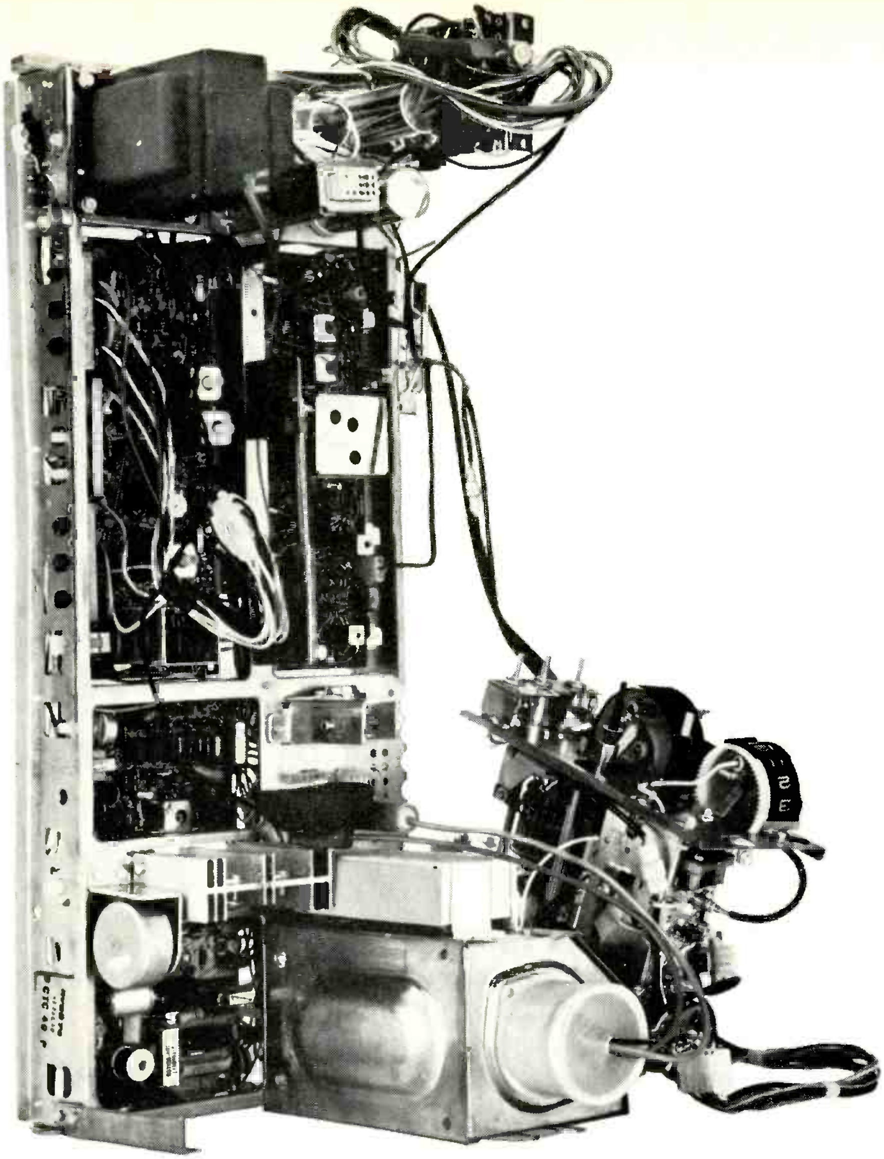


Fig. 9 Harmonic conception of square wave.



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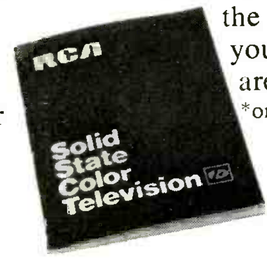

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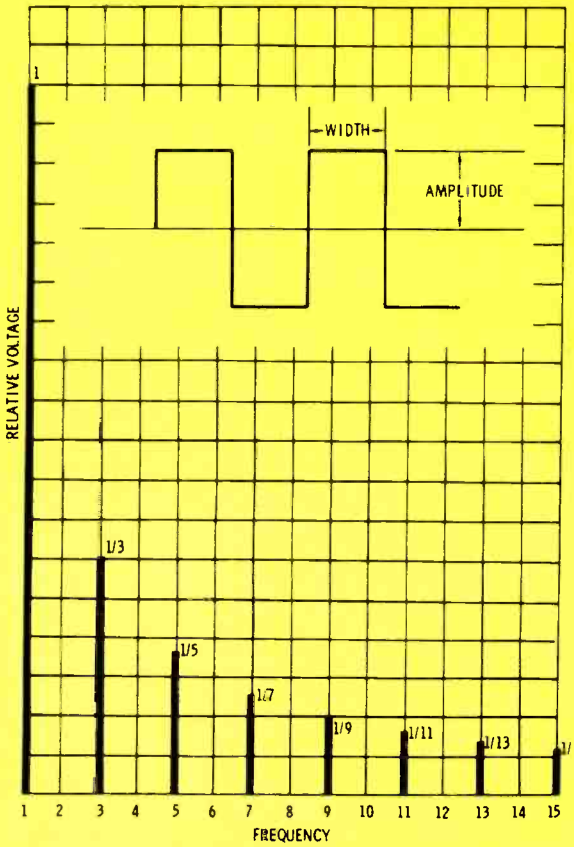
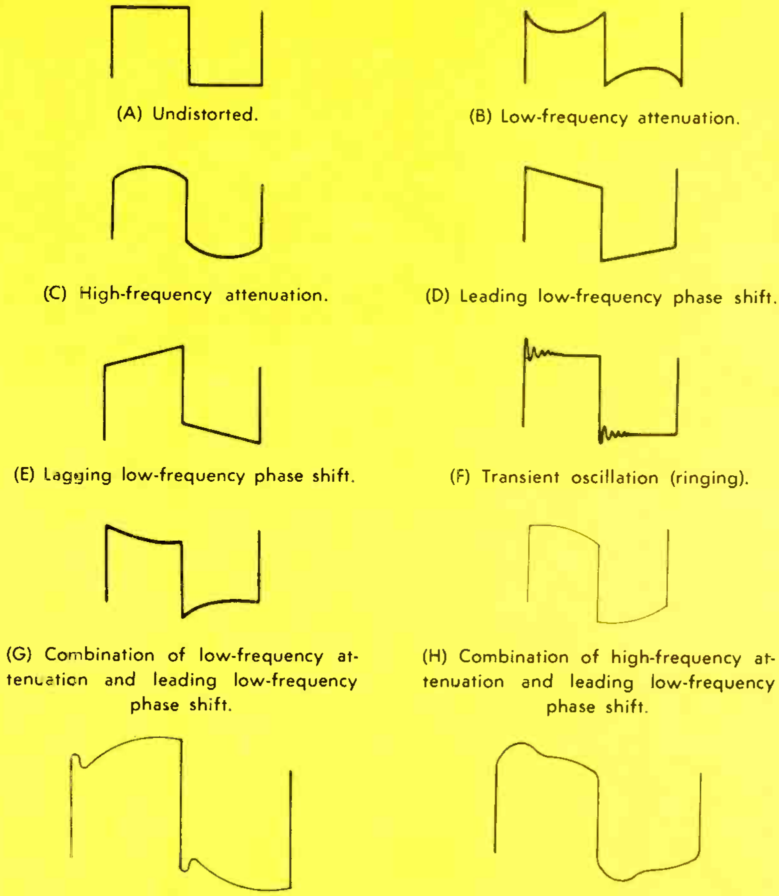


Fig. 10 An ideal square wave and the relative voltages of its harmonics.



(A) Undistorted.

(B) Low-frequency attenuation.

(C) High-frequency attenuation.

(D) Leading low-frequency phase shift.

(E) Lagging low-frequency phase shift.

(F) Transient oscillation (ringing).

(G) Combination of low-frequency attenuation and leading low-frequency phase shift.

(H) Combination of high-frequency attenuation and leading low-frequency phase shift.

(I) Combination of F, followed by E.

(J) Combination of G, followed by H.

Fig. 11 Key square-wave reproductions.

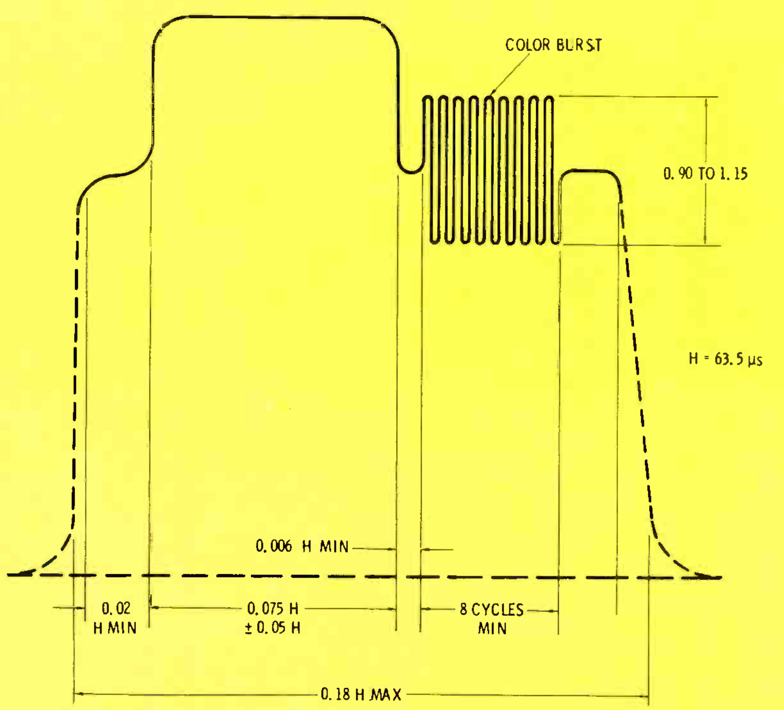
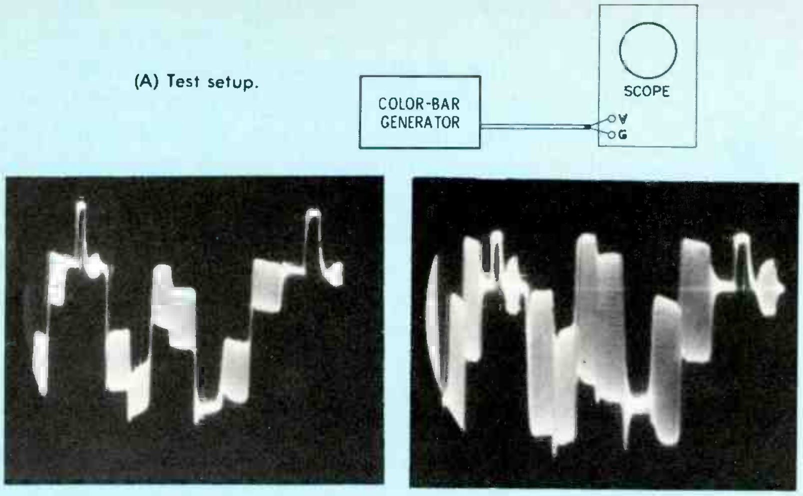


Fig. 12 Horizontal sync pulse and color burst.

Square-Wave and Pulse Characteristics

A square wave is a special type of a pulse waveform in which the period (or elapsed time) of the positive excursion is equal to that of the negative excursion. In a pulse waveform, the positive peak voltage is not equal to the negative peak voltage, as evidenced in Fig. 8. The zero-volt axis (scope beam-resting level) divides the waveform into its positive-peak and negative-peak excursions. Note that the average value of the pulse waveform is zero—its positive area is equal to its negative area. Of course, the peak-to-peak voltage of a pulse is equal to the sum of its positive peak and negative peak voltages. After a scope has been calibrated for measurement of peak-to-peak voltages, the same calibration holds true for measurement of peak voltages.

It follows that the average value of a square wave is zero, as depicted in Fig. 9A. A square wave is not a fundamental waveform, because it can be built up from sine waves,



(B) Display on narrow-band scope. (C) Display on wideband scope.

Fig. 13 Comparison of wide-band and narrow-band scopes.

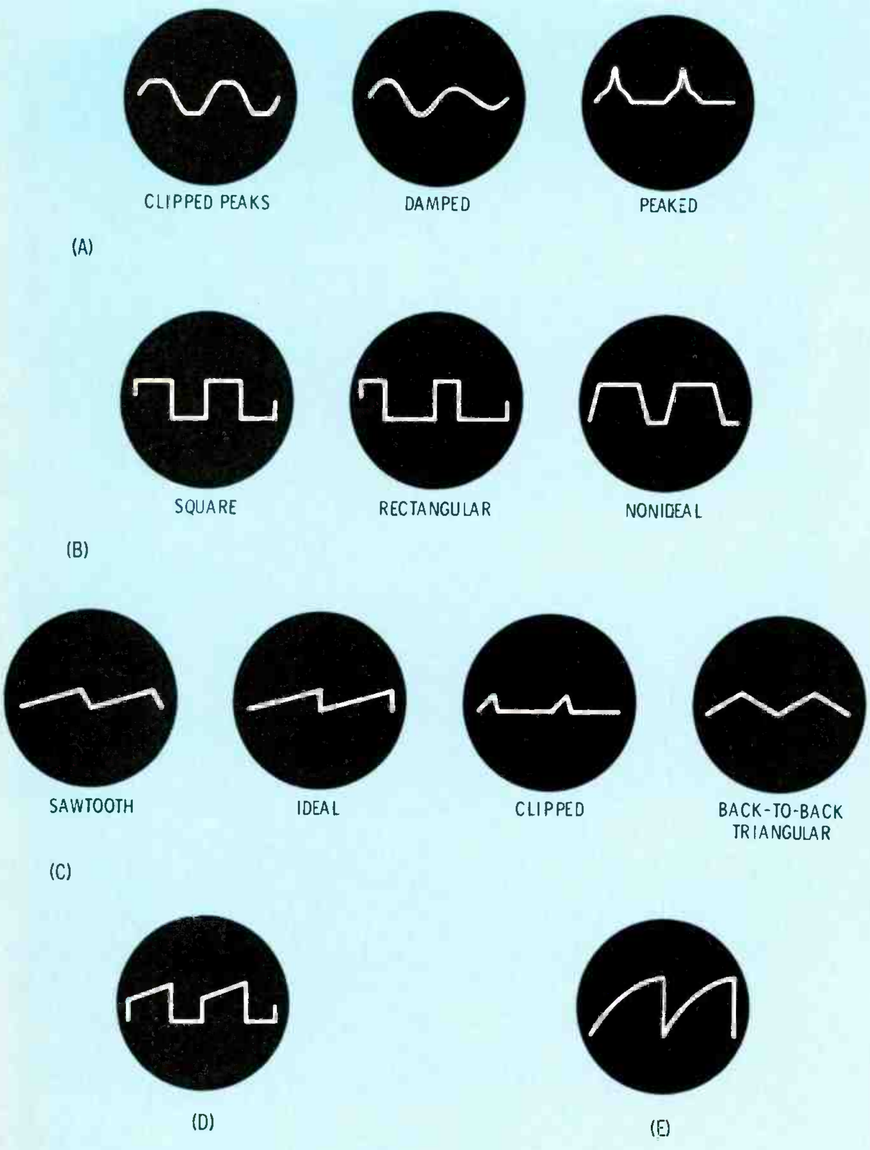


Fig. 14 Basic waveforms.

as shown in Fig. 9B. These sine waves are harmonically related, and have the relative amplitudes shown in Fig. 10. These facts are of considerable importance in practical troubleshooting procedures, because analysis of distorted pulse or square waveforms will provide clues concerning circuit defects. For example, some of the most basic distortions and their causes are shown in Fig. 11.

A horizontal sync pulse consists of a pulse called a sync tip superimposed on a wider pulse called a blanking pedestal; in a color signal, a sine wave called the color burst is superimpised on the back porch of the pedestal, as depicted in Fig. 12. This is an example of a combined pulse and sine-wave waveform. If this waveform passes through a narrow-band circuit, such as the vertical amplifier of a narrow-band scope, its high-frequency components are attenuated and the waveform becomes distorted as seen in Fig. 13. We will also find that a narrow-band circuit increases the rise time (explained later) of a pulse waveform; if the rise time is excessive, the waveform becomes noticeably distorted.

Exponential Waveform Characteristics

A familiar exponential wave (E) appears among the basic waveforms illustrated in Fig. 14. In various situations, complex waveforms are analyzed to best advantage as combinations of exponential waves. For example, it is much easier to evaluate a sync-pulse waveform in terms of exponential waves than in terms of sine waves. Fig. 15 shows a series RC circuit energized by DC voltage through an on and short-circuit switch. Voltage eR is called a differentiated waveform, and voltage eC is called an integrated waveform.

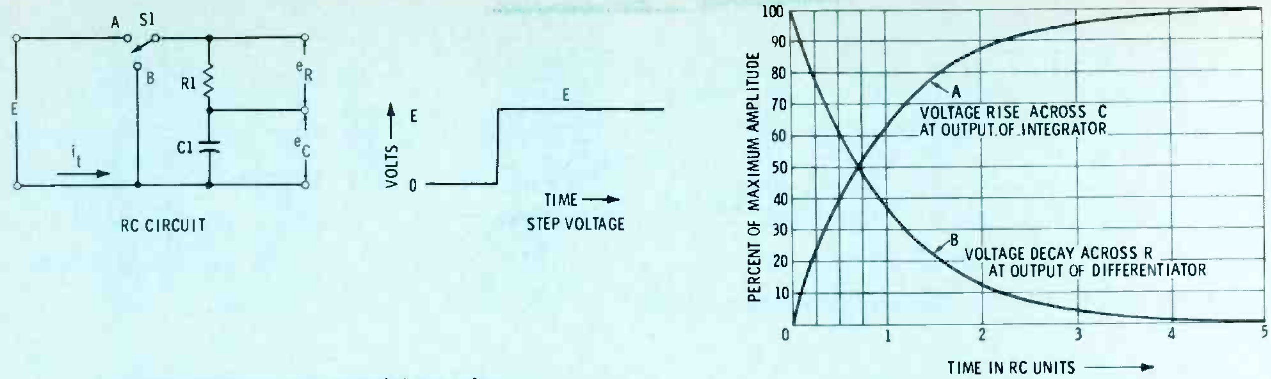


Fig. 15 Basic exponential waveforms.

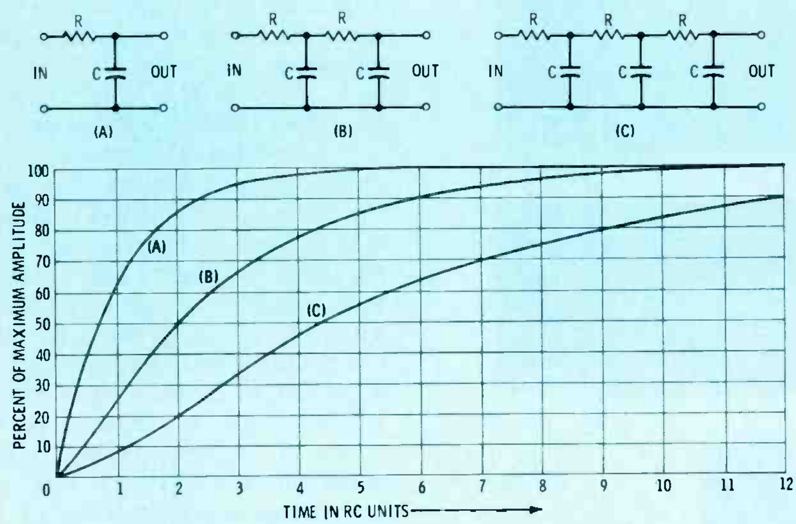


Fig. 16 Universal time-constant chart for one-section, two-section, and three-section integrator circuits.

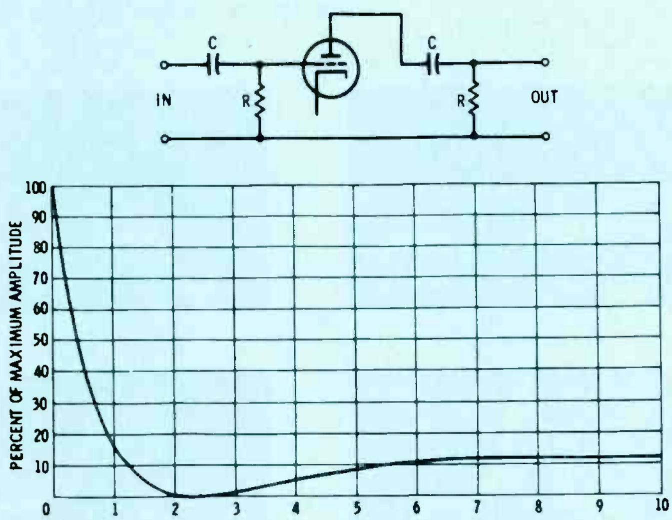


Fig. 17 Universal time-constant chart for RC-coupled amplifier with two RC sections.

The time constant of the circuit in seconds (or fractions of a second) is equal to the product of R and C, given respectively in ohms and farads. Any series circuit has the same transient response, as shown in the universal RC time-constant chart in Fig. 15C.

In TV circuits, vertical sync pulses are often integrated by means of two-section or three-section RC circuits, as shown in Fig. 16. The output waveforms in Figs. 16 B and C are also exponential waveforms, but they are combination waveforms that are built up from more than one basic exponential wave. All symmetrical two-section or three-section integrators have the same transient response, as shown in the universal RC time-constant chart in Fig. 16. In an RC-coupled sync amplifier, a pulse (unsymmetrical square wave) may be differentiated through a two-section differentiating circuit, as shown in Fig. 17. Note that the output waveform differs from that produced by a single-section differentiator in that the waveform undershoots its quiescent level. Peak undershoot occurs at about 2.5 time constants. All symmetrical circuits of this type produce the same waveshape.

Another type of RC circuitry found in some TV sync systems consists of two differentiating circuits connected in cascade, as shown in Fig. 18. Tube isolation is not present in this case, and the second section loads the first section. In turn, the combination of exponential waveforms is somewhat different; sharper differentiation and less undershoot are the result. All symmetrical RC circuits of this type produce the same waveshape. Next, we will find that waveforms such as depicted in Figs. 15, 16, 17, and

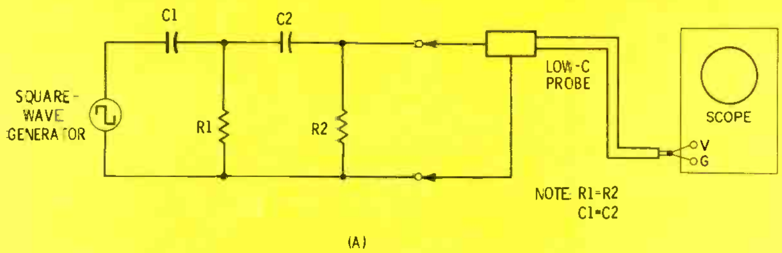


Fig. 18 The basic symmetrical cascaded differentiating circuit.

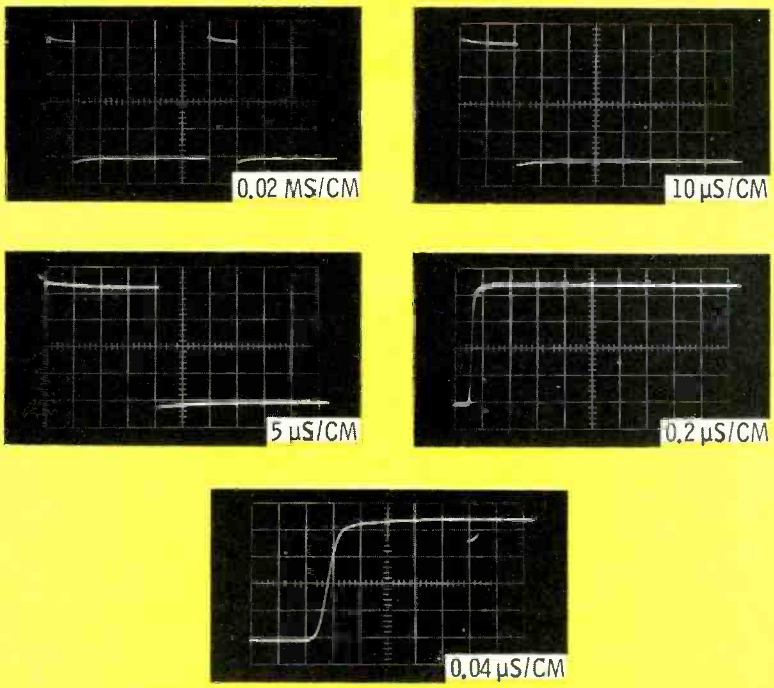


Fig. 19 Expansion of a 20-microsecond pulse with increasing sweep speed.

18 have a basic characteristic called "rise time" (or fall time) that can be measured with a lab-type scope. This category of waveform analysis is not pracical with a simple service-type scope.

Rise Time of a Pulse or Square Wave

Sync pulses and other rectangular waveforms observed in TV circuits are not ideal, in that they have sloping sides. Waveforms with perfectly vertical sides exist only in theory. The slope of actual pulses is called rise time. We will find that rise time is related to circuit bandwidth. When a pulse is expanded on the screen of a triggered-sweep scope, as shown in Fig. 19, the rise time can be measured in terms of the calibrated time-base control setting. The difference between an ideal pulse and a practical pulse is shown in Fig. 20. Rise time (T) is measured between the points indicating 10% and 90% of maximum amplitude; this measurement standard eliminates corner effects, which are

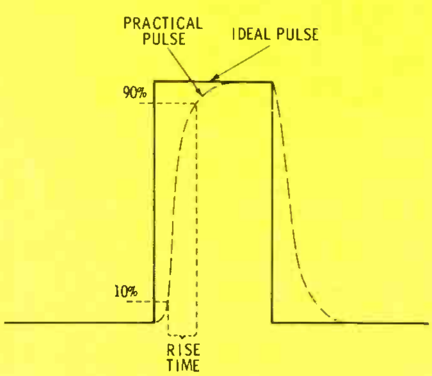
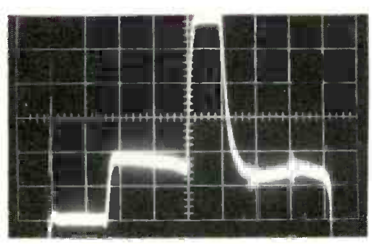
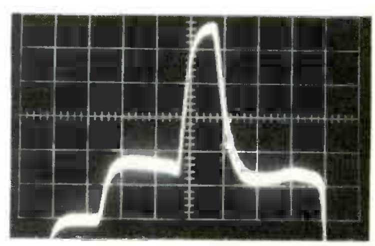


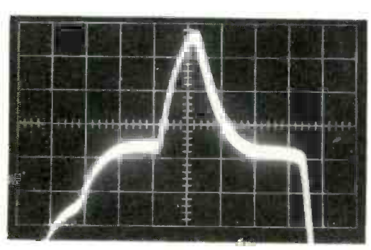
Fig. 20 Practical versus ideal pulse, showing rise time.



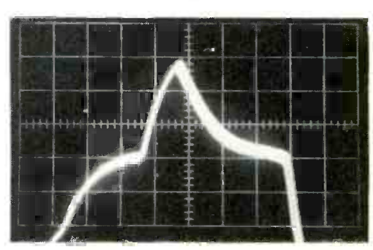
(A) Normal.



(B) Slight distortion.



(C) Medium distortion.



(D) Heavy distortion.

Fig. 21 Progressive "feathering" of the horizontal sync pulse.

produced chiefly by circuit actions that are not closely associated with rise time. Cornering, however, is an important aspect of waveform analysis.

As an example of the use of rise time in circuit analysis, the bandwidth of a video amplifier, Y amplifier or bandpass amplifier is related to its pulse (or squarewave) rise time by the following equation:

$$T = \frac{1}{3\,fc}$$

where T is the rise time, and fc is the cutoff frequency.

Although the rise time of a pulse cannot be accurately measured with a service-type scope, the effect of subnormal bandwidth is sometimes clearly evident, as seen in Fig. 21. This is called "feathering" of the horizontal sync pulse, and is caused by decreased circuit bandwidth—e.g., by a plate-load resistor that has increased considerably in value. The effect of increased load resistance in a conventional RC-coupled stage is depicted in Fig. 22. In tuned amplifiers, the circuit alignment affects bandwidth and rise time. Fig. 23 illustrates the normal output waveform from a bandpass amplifier, using a keyed-rainbow

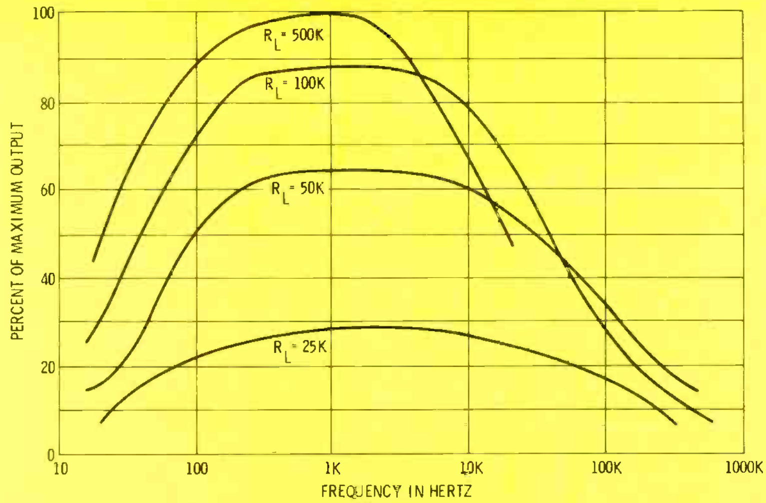


Fig. 22 Frequency response versus plate-load resistance for an RC-coupled stage.

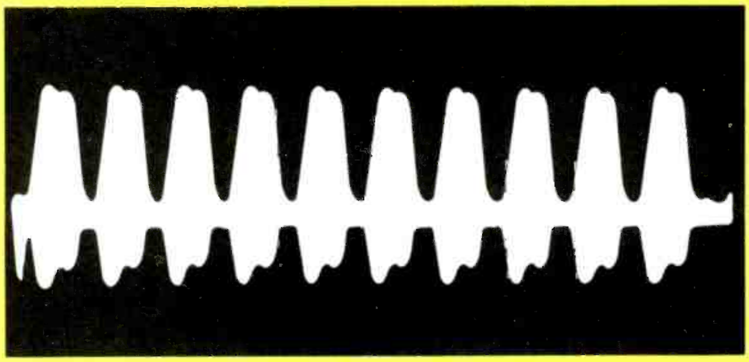
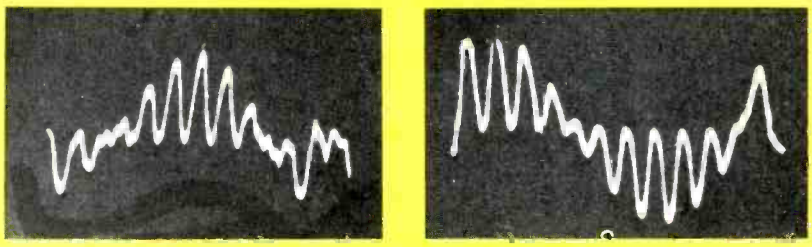


Fig. 23 Bandpass-amplifier output waveform has sloping sides and rounded corners.



(A) R — Y waveform.

(B) B — Y waveform.

Fig. 24 Actual waveforms.

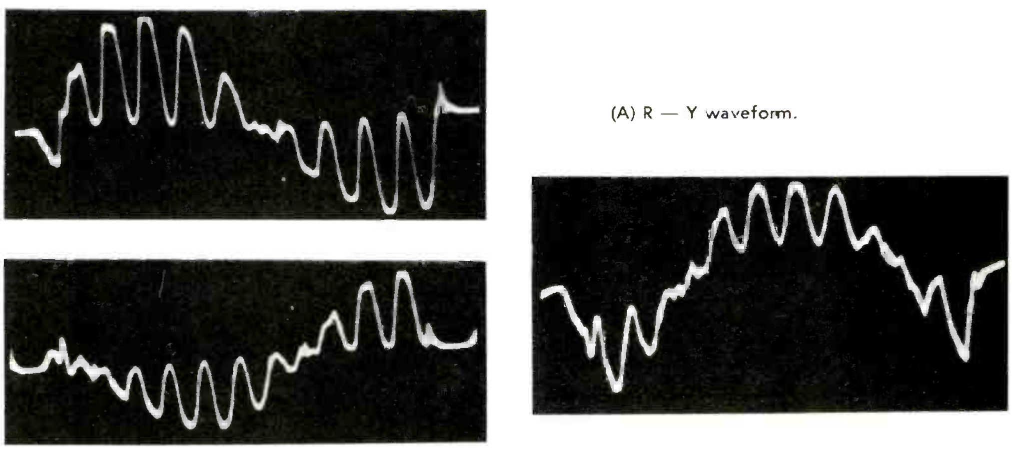


Fig. 25 The B-Y channel has subnormal bandwidth.

(A) R — Y waveform.

(B) G — Y waveform.

(C) B — Y waveform.

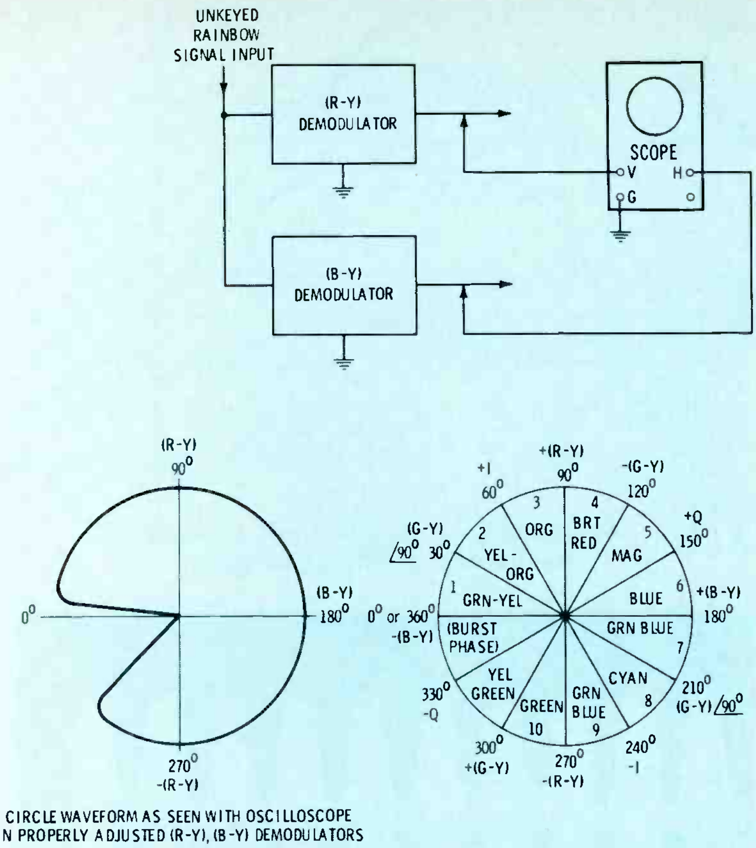


Fig. 26 Basic vectorscope connections and normal vectorgram.

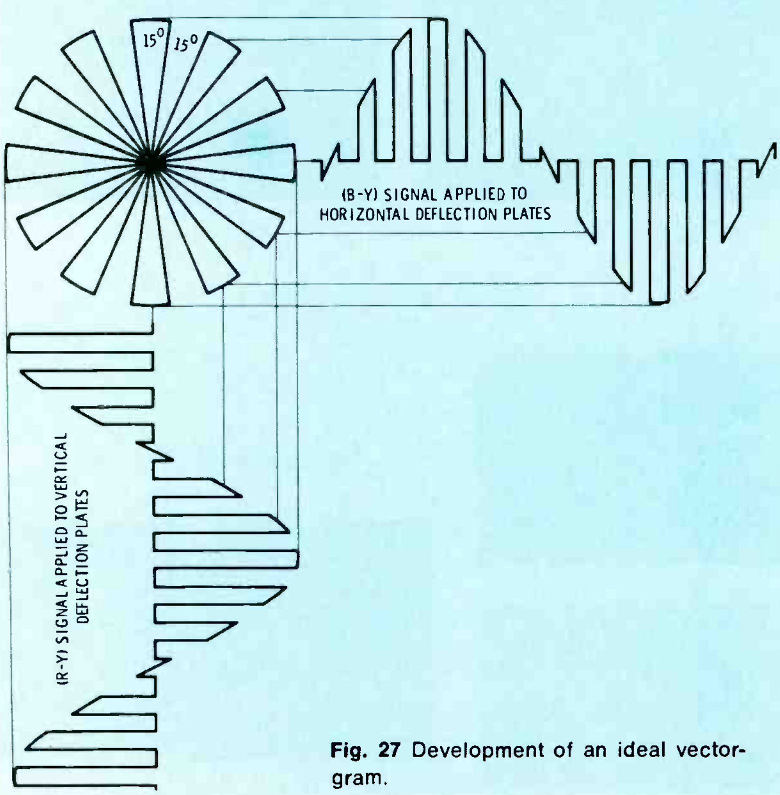


Fig. 27 Development of an ideal vectorgram.

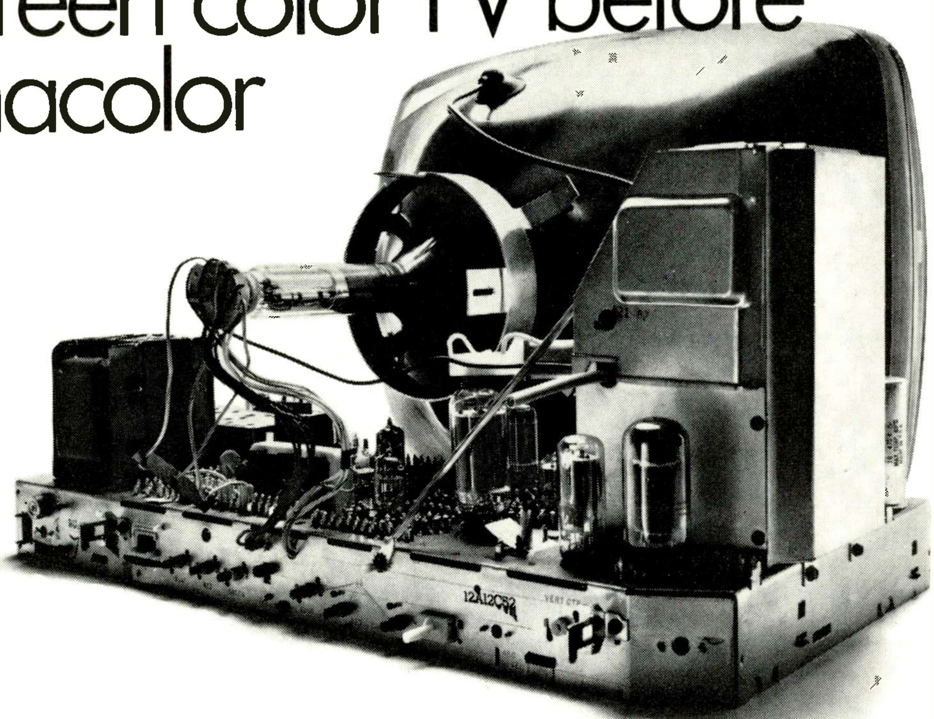
signal. If the bandwidth is too narrow, the sides of the pulses have less slope, or the rise time increases.

Vectorgram Analysis

Normal output waveforms from the R-Y and B-Y sections are illustrated in Fig. 24, using a keyed-rainbow signal. Note that the rise time is comparatively slow. Next, let us consider a trouble situation in which the bandwidth of the B-Y section is subnormal. This has the effect of partially integrating the B-Y waveform, as seen in Fig. 25. That is, the baseline of the B-Y waveform is no longer reasonably straight, but has considerable curvature. This is our clue to the defective circuit, and we look for a defect in the B-Y section that could cause subnormal bandwidth. The basic vectorgram is obtained with the test setup shown in Fig. 26. Let us consider some of the details that are involved.

If a keyed-rainbow signal is employed (as is usually the case), the vectorgram displays sectors, or "petals", as shown in the idealized diagram of Fig. 27. However, since in practice the pulses have sloping sides and rounded tops, the petals are shaped as shown in Fig. 28 (the 11th and 12th pulses are blanked out). If the bandwidth of the band-pass amplifier is subnormal, the pulses will increase in width and, in turn, the "petals" will increase in width. Curvature in the **sides** of the "petals" is due to different R-Y and B-Y waveforms, as illustrated in Fig. 29. This is an extensive subject in waveform analysis which cannot be covered in this article. The best method of evaluation is to compare the curvature wtih that in a vectorgram produced by a receiver which is known to be in good operating condition.

Zenith's new CHROMACOLOR outcolors...outbrightens...outdetails... and outperforms...every giant-screen color TV before Chromacolor



...and it's the easiest to service!

Zenith Chromacolor is a revolutionary new color television system... featuring a revolutionary new patented color picture tube... pioneered and developed by Zenith.

Five important engineering advances make Zenith Chromacolor the most dependable color TV ever made. And by far the easiest to service.

New Chromacolor Picture Tube uses Zenith's patented black-surround screen and fully illuminates every color dot—for a color picture that's more than 100% brighter, with truer colors, sharper detail, and greater contrast than any giant-screen color TV before Chromacolor.

New Titan Color Chassis combines Handcrafted dependability with solid-state performance. All transistors are either plug-in or part of a plug-in assembly. All test points are flagged or coded for easy identification.

New RGB Color Circuitry is more sophisticated and highly refined—for higher color fidelity. And alignment is simplified for setup and servicing.

New Color Commander Control. Now! *One control* simultaneously adjusts contrast, color level and brightness in proper balance to provide the most pleasing picture for any light conditions in the room! This easy viewer adjustment means fewer false service calls to remedy maladjustments.

Exclusive Chromatic Brain introduces TV's first integrated circuit in a color demodulator . . . for the purest reds, greens, and blues. 100% of the color demodulator circuitry is in the easily accessible plug-in Dura-Module.

Take a good look at new Zenith Chromacolor. Designed with both you and your customer in mind. The best giant-screen color picture! The easiest to service!

ZENITH®

The quality goes in before the name goes on

Circle 17 on literature card

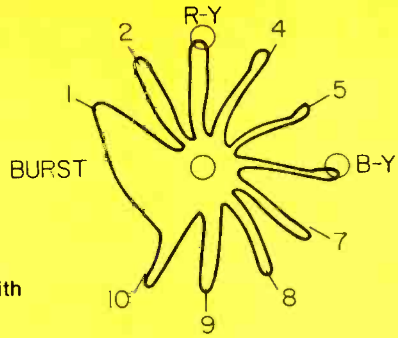


Fig. 28 Normal vectorgram for a Zenith receiver.

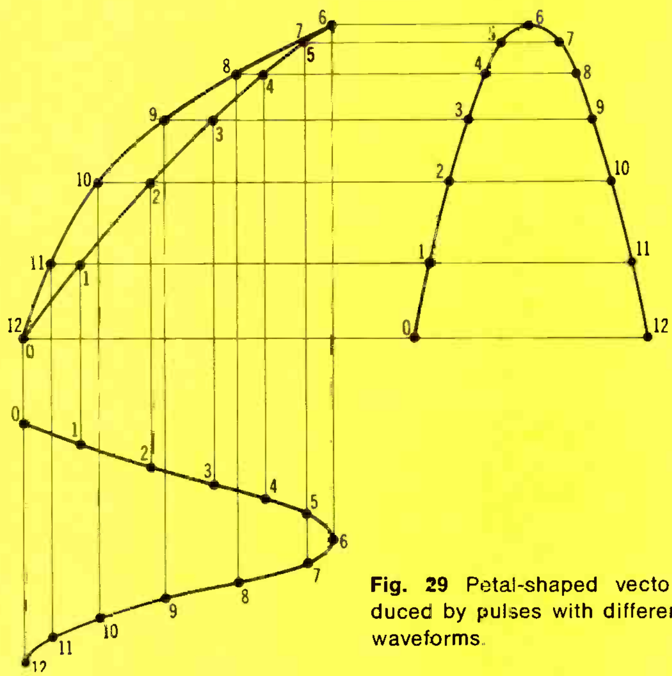


Fig. 29 Petal-shaped vectorgram produced by pulses with differently shaped waveforms.

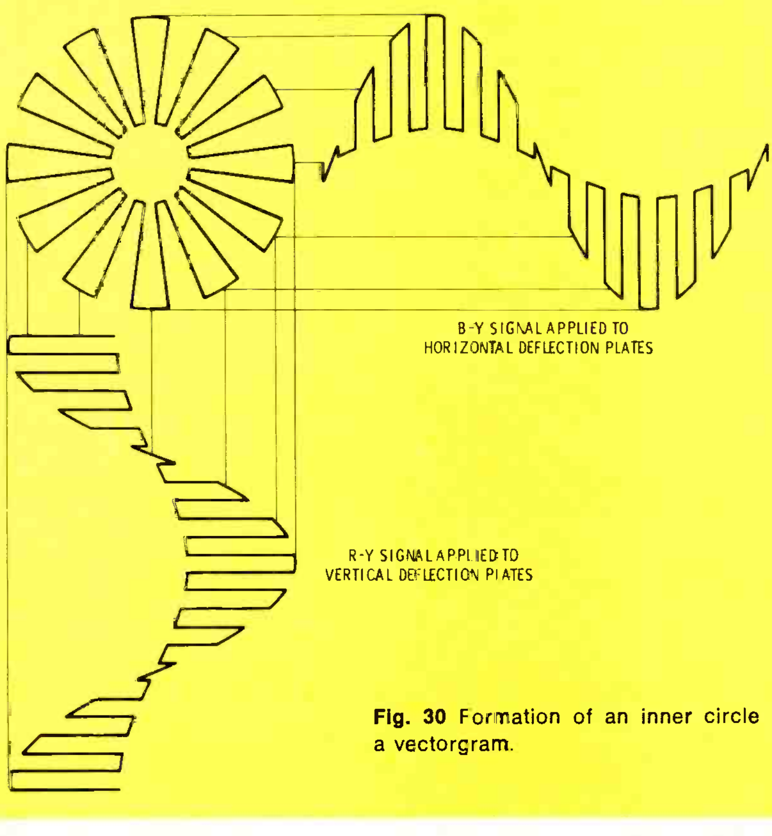


Fig. 30 Formation of an inner circle in a vectorgram.

We have noted that petal width is associated with the bandwidth of the bandpass amplifier. Next, let us consider the relation of chroma-demodulator bandwidth to vectorgram proportions. Observe in Fig. 28 that the vectorgram has an "inner circle". This inner pattern is associated with baseline curvature in the R-Y and B-Y waveforms, as depicted in Fig. 30. In other words, we evaluate chroma-demodulator bandwidth on the basis of the **inner pattern** of a vectorgram. The diameter of the inner circle shown in Fig. 28 is normal; if the chroma demodulators have subnormal bandwidth, this diameter will increase accordingly. Some basic points to keep in mind are as follows:

1. An inner circle is formed in a vectorgram only if the R-Y and B-Y channels have the same bandwidth.
2. If the R-Y channel has less bandwidth than the B-Y channel, an inner vertical ellipse is formed.
3. If the B-Y channel has less bandwidth than the R-Y channel, an inner horizontal ellipse is formed.

Conclusion

This article has presented some of the more basic characteristics of TV waveforms, and some of the defective circuit actions that cause waveform distortion. Additional evaluation procedures and methods of TV circuit testing with scopes will be explained in the next article. Apprentice technicians are advised to actually operate scopes along with reading about waveform analysis and test procedures. Practical experience is indispensable in scope work, as in any other area of TV troubleshooting. ▲

bookreview

FM From Antenna To Audio: Leonard Feldman, Howard W. Sams & Co., Inc., Indianapolis, Indiana 46201; book number 20723, 159 pages 5⅜"x 8½", paperbound $3.95.

The hi-fidelity and noise-free qualities, and the reduction of co-channel and adjacent-channel interference in FM are discussed in the first two chapters. Transmitter principles and circuits are also detailed.

Old and new FM circuits plus a typical receiver from antenna through the "front end", the IF's and limiters, to the FM detector and audio stages are presented in the remaining seven chapters.

Using Scopes In Color TV: Robert G. Middleton, Howard W. Sams & Co., Inc., Indianapolis, Indiana 46201; book number 20718, 160 pages 5⅜" x 8½", paperbound $3.95.

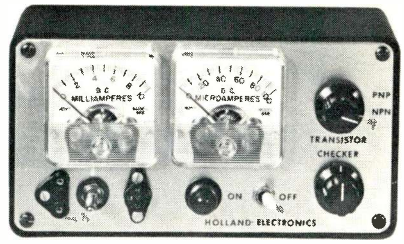
An oscilloscope and a color-bar generator are the essential items of equipment for chroma analysis. This book starts with narrow-band, wide-band and lab scopes, the circuits which determine wide or narrow bandwidth, the measurements each type can do, and the various probes to be used.

The circuits and output signals of the various types of color-bar generators are shown and analyzed. Waveforms inside the generators are also pictured, and suggestions for locking the dividers are given.

Three chapters are devoted to the correct waveforms in various parts of the chroma circuit, and what the wrong waveforms mean. The last chapter deals with the vectorgrams of both keyed-rainbow and NTSC color-bar displays. Apparently, the book is intended for color TV receiver technicians and electronic school students. ▲

testequipment

notes on analysis of test instruments, their operation and applications



Portable Transistor Tester

The small, battery-operated transistor tester shown here provides base and collector current readings that enable the technician to check both standard and power transistors for shorts, opens, gain and type (PNP or NPN).

Model TT285 transistor Tester is equipped with two 1⅝-inch square ammeters, one with a range from 0 to 100 microamps for measuring base current and the other with a range from 0 to 10 milliamps for measuring collector current.

The transistor to be tested is plugged into either the standard- or power-transistor socket, and the two-position front panel control labeled PNP/NPN is switched to the position that provides a positive-going indication on the meters. This action indicates to the technician the type of transistor that is being tested. A potentiometer, located on the lower right of the faceplate and part of a voltage divider network, is rotated to vary the current in the base circuit of the transistor. Both meters are watched as the potentiometer is rotated. If a short or open exists, the milliammeter will indicate either excessive or no collector current, respectively.

To measure the Beta, or gain, of the transistor, the values of collector and base current are noted for various settings of the potentiometer, and the gain is calculated using these readings.

The unit, manufactured by Holland Electronics, Inc., requires no test leads or other external equipment. Self-contained in a plastic case, the tester can be carried in a tube caddy. Power is obtained from two 1.5-volt "penlite" batteries. Price is $65.00, without batteries.

Circle 45 on literature card

Decade Amplifier

The Syntelex Model SDA-100 solid-state decade amplifier is listed as having these specifications: voltage gain (selected by switch) of X100, X10, X1, X.1, X.01 with a frequency response from 10 Hz to 1MHz; input impedance of 1.11 megohms; a maximum input level of 100 volts rms; output impedance of 100 ohms; a maximum output level of 10 volts peak-to-peak; and an equivalent input noise figure of 50 microvolts.

A field-effect transistor (FET) is used to provide high input impedance, with silicon transistors used in other stages. The amplifier is 6" x 3½" x 2" and has shielding and an internal battery.

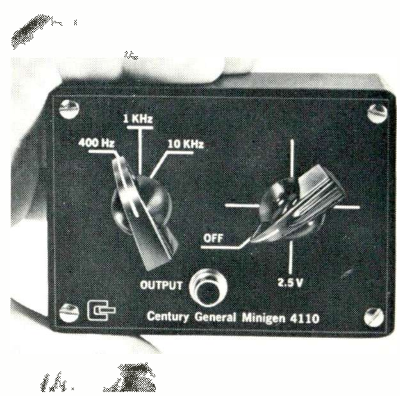
Model SDA-100 decade amplifier permits you to use your own VOM or VTVM to read AC signals in the millivolts range for measurements in stereo, communications, telemetry, oceanography or other systems. Or use it as an external preamp with your oscilloscope to observe waveforms of only a few millivolts.

Model SDA-100 is priced at $34.95, and the model SDA-100A, with an internal detector to give DC output voltage for a VTVM, is $36.50.

Circle 46 on literature card

Solid-State Audio Generator

Century General Corporation has announced the MINIGEN Model 4110 pocket-sized, solid-state audio generator. This unit measures 2⅞" x 4" x 1⅝", and weighs 7½ ounces, with the battery. Output frequencies are 400Hz, 1KHz and 10KHz, with the output level continuously adjustable from 0 to 2.5 volts. The 10-KHz tone can be changed internally to 5KHz, if desired.

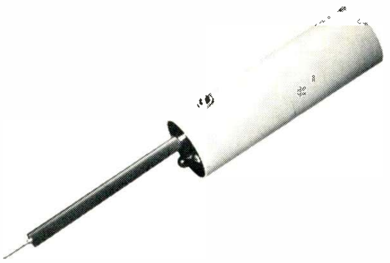


The audio generator is priced at $14.95, complete with probe and standard 9-volt transistor battery.

Circle 47 on literature card

Signal Injector Kit

Model KG-644 Knight-Kit is a



portable, self-contained solid-state generator whose output signal is rich in harmonics for use in signal-injection testing of audio, IF and RF circuits. The housing has a battery test light, a push-to-operate switch and an insulated probe.

The Knight-Kit Model KG-644 Signal Injector is priced at $4.95, complete with four penlight batteries.

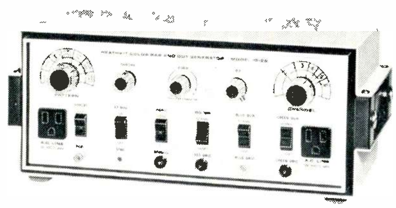
Circle 48 on literature card

Color Bar-Pattern Generator

The newest addition to the Heath Company line of test equipment is the Heathkit Model IG-28, a solid-state generator of clear raster, dots, crosshatch lines, gray shading bars, keyed rainbow bars, vertical lines and horizontal lines for the adjustment of color television.

Computer-type circuitry using eight integrated circuits provides 15 flip-flops to count down from a master crystal oscillator for the various frequencies. This is said to eliminate flicker, bounce and jitter without need for any divider adjustments.

Front panel controls include: pattern and display switches, variable tuning for channels 2 through 6, variable plus and minus video output, two AC outlets, sound carrier

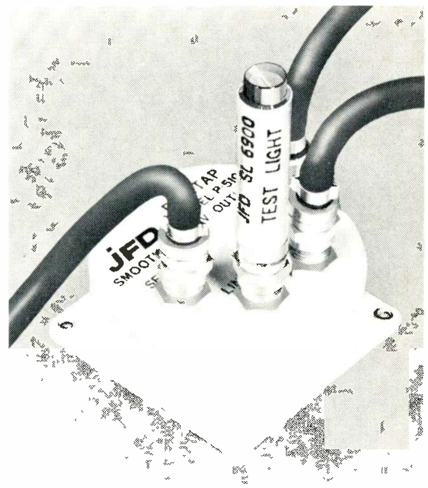


switch, and CRT grid-shorting switches. The 3x3/9x9 display switch selects normal numbers of dots, bars, crosshatch lines, vertical and horizontal lines in the 9x9 position, or just three dots, bars or lines in the 3x3 position.

Price of the IG-28 kit is $79.95, and the Model IGW-28 (factory-wired and tested) is priced at $114.95.

Circle 49 on literature card

Green Light Tester For MATV Service



JFD Electronics has announced a rapid tester for the +17 VDC which should be present in an MATV system. The model SL-6900 "Green Light" tester plugs into the system's F-59 fittings and lights up green if the circuit is normal at that point. There is no loss of TV signals during the test.

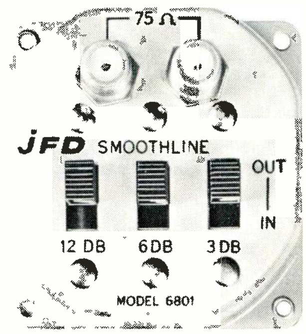
The SL-6900 tester lists for $6.25. ▲

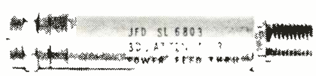
Circle 50 on literature card

antenna systems report

75-Ohm Attenuators

JFD has introduced several fixed and variable 75-ohm attenuators designed specifically for MATV applications, and are for both UHF and VHF. Also, they pass AC and DC power for cable-powering uses.





Model SL-6801 is adjustable with three heavy duty slide-switches from 0 to 21 dB in 3 dB steps. Model SL-6803 gives a fixed 3 dB attenuation, Model SL-6806 gives 6 dB, Model SL-6812 gices 12 dB and SL-6820 gives 20 dB.

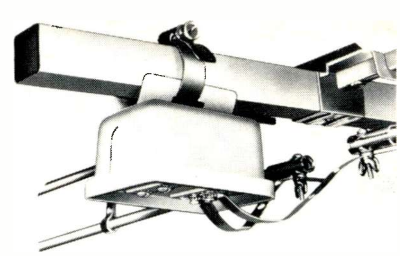
SL-6801 lists for $22.50, while the fixed attenuators list for $5.95 each.

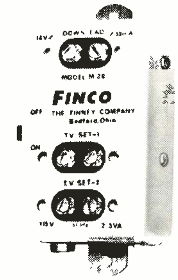
Circle 51 on literature card

Boom Mounted TV Preamplifier

The FINCO solid-state VHF-TV/FM boom-mounted preamplifiers are available in three models; M-10 and M-11 have two 300-ohm outputs, while M-12 has a single 75-ohm output. Three silicon transistors are used in the circuit designed to minimize overloading on strong signals. The gain on both high and low TV bands is said to be 10 times, or 20 dB. A FINCO M-522 trap may be used between antenna and preamplifier to reduce strong local signals to a more usable level.

A die-cast housing, aluminum base plate and a stainless steel mounting clamp combine to make the unit corrosion resistant. The power supply, which can be mounted inside the home wherever convenient, supplies power to the preamplifier through the signal lead-in wire.



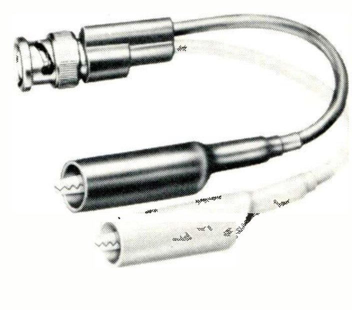


Model M-10 is priced at $49.95, Model M-11 at $52.50 and Model M-12 at $57.50.

Circle 52 on literature card

Coax to Clip Lead Adapter

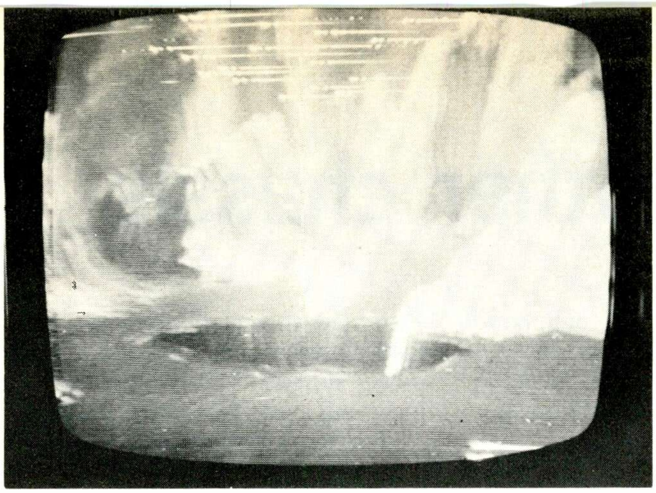
New to the Pomona Electronics line are two "Breakout" models to convert standard coaxial cable with a BNC receptacle into a test cable equipped with test leads. Model 2885 is for BNC plug to alligator clips, and model 2886 is from BNC plug to minigator clips.



These items complete a series of 10 models with BNC, TNC, UHF and type "N" receptacles or BNC plugs to either alligator or minigator clip leads.

The net price of models 2885 or 2886 is $4.50 each. ▲

Circle 53 on literature card



Interference caused by poor ground connection between chassis and CRT of portable color chassis.

INTERFERENCE . . . A neighborhood project

A group of home owners turns super-sleuth to track down the source of TV interference.

by David Mark

Every home owner in a two-block area complained to the local power and light company that the power lines were causing interference on the screens of their television sets. The interference on the screen of one of the home-owners' sets is shown here.

The interference began about 4:15 each evening and usually lasted until about 9:30—the period of "prime listening time."

A new power-line transformer recently had been installed in the area, and everyone concerned suspected that it was the source of the interference. To save face, the power and light company removed the transformer and installed another one. The interference continued.

The Great Search

Instead of calling a TV technician to help isolate the source of the interference, the men of the area decided to tackle the job themselves.

One home-owner suggested that they turn off the power to each house, one at a time, while monitoring the TV sets in the homes with power still on.

Cunning Pays Off

When the power to the Jones' house was turned off, the interference disappeared from the TV sets in the other homes in the area. The power to Jones' house was turned on again and the interference returned—the source had been localized.

The Jones Receive Guests

Immediately, the Jones' home became the center of "operation noise elimination." Many ideas were voiced concerning the probable source of the interference—the furnace motor, the air conditioner, the flourescent lights and various electrical appliances. All of these items were turned off, but the interference continued. The time was 9:25, and if the previous pattern of interference was repeated, the interference would disappear in five or ten minutes—the search continued with increased fervor.

Thirsty Little Boy Is Clue

No one noticed little Tommy Jones leaving his bedroom to get a drink of water and then returning to his bed to go to sleep for the night—that is, not until it was noticed that the interference had disappeared at about the same time Tommy had left his bedroom to get a drink.

Suspect Cornered

A search of Tommy's bedroom for possible sources of interference turned up only the 14-inch portable color receiver, which Tommy had been watching prior to the time he went to get a drink. When questioned, Tommy stated he had turned the set off before leaving his bedroom to get a drink—circumstantial evidence pointed to the color portable.

Suspicions Confirmed

Dr. Jones brought the set into our shop for a checkup. We found a poor ground connection between the color chassis and the CRT assembly.

The manufacturer was not at fault in this case; Dr. Jones at one time had attempted to repair the set himself and in the process had broken the grounding bond.

Problem Solved

Installation of a shielded cable between chassis, tuner and CRT assembly cured the interference. ▲

Same trouble...another chassis

The similarity of earlier color chassis permits a technician to relate the cause of a particular trouble symptom in one chassis to the same trouble symptom in another. The trouble-shooting techniques and troubles discussed in this article actually occurred in an RCA CTC16 color chassis, but the same techniques, trouble symptoms and associated defects also pertain to the many other chassis of similar or identical design.

by David Held

In early color receivers, many different manufacturers used designs and component layout plans that are very similar—even identical in many instances. Most of the color receivers were fashioned after the RCA color chassis. Although other manufacturers replaced several tubes with different types, the circuit operation remained the same. Because of this, the problems described in this article are common to several makes and models. In fact, the same trouble may appear in another make or model of chassis.

Troubles in Low-Voltage Circuits

One of the most common troubles found in the RCA CTC16 color chassis is the on/off switch. The symptoms are no sound and no picture. Even the dial light remains dark. In most cases, either the interlock, the power cord, or the on/off switch is at fault.

No Picture, No Sound, No Raster

If the dial light comes on and there is still no sound and picture, the problem could be a defective circuit breaker. Sometimes the damper or horizontal output tube will "flash over," causing the circuit breaker to kick out. Resetting the circuit breaker usually restores normal operation.

In some cases, however, the circuit breaker may trip again after being reset; if this happens, suspect a shorted silicon diode or an overload condition in the low-voltage power supply. If the circuit breaker kicks out after **several** seconds, the trouble is probably in the horizontal output and flyback circuits. Watch the horizontal output tube and see if the plate element becomes cherry red. If it does, the circuit breaker will trip again. This probably is caused by either a defective horizontal output tube, insufficient grid drive to this tube, or an overload in the high-voltage section.

The circuit breaker itself may be defective. If so, replace it with one that has a current rating identical to that of the original. Do not replace it with a unit that has a larger current rating. Remember that the circuit breaker takes the place of a fuse; if it is replaced with one having a larger current rating, the low- and high-voltage circuits are not properly protected. This can, and has, resulted in expensive damage to the low-voltage power and flyback transformers. Burned switch

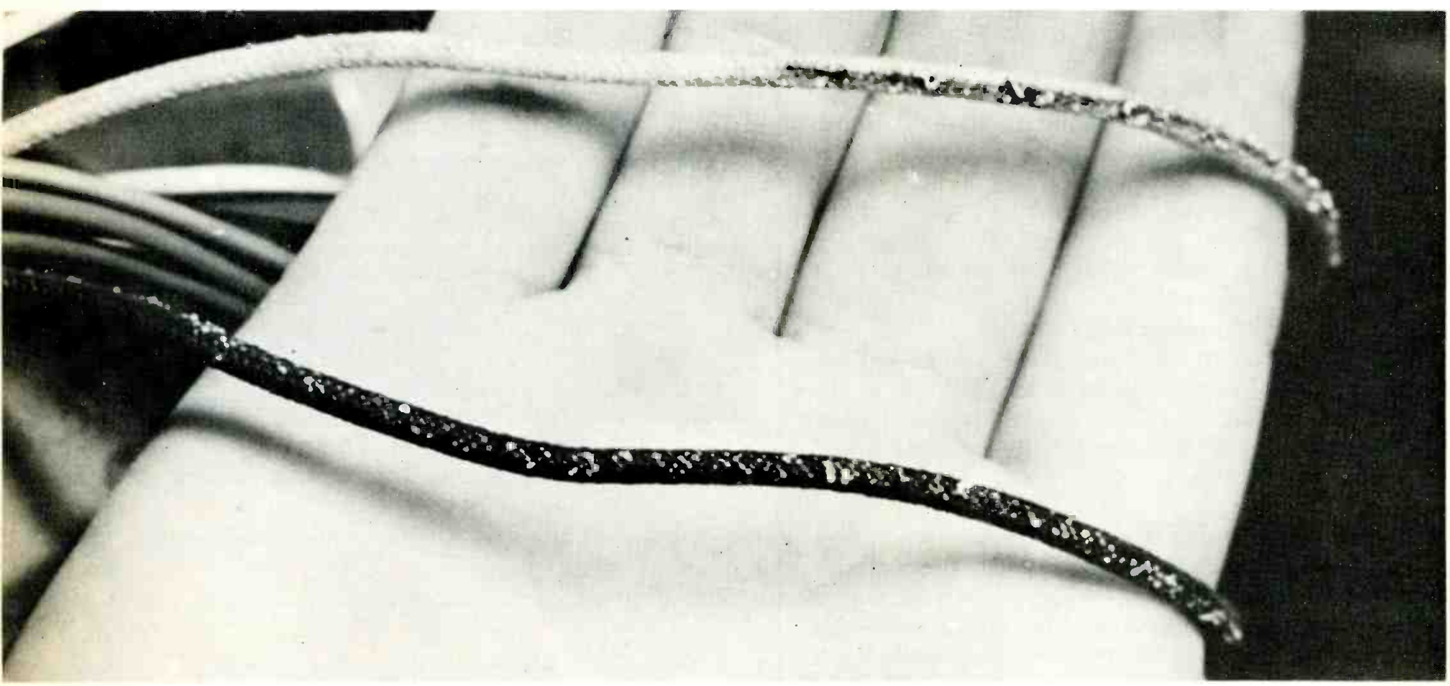


Fig. 1 This photo shows the results of a stuck circuit breaker. Notice the beads of solder on these AC leads, which were connected to the on/off switch. The wire was coated with solder, and when an excessive amount of current passed through them, the solder popped out through the insulation—a visual indication of the source of the overload. In this case, the power transformer was also "cooked."

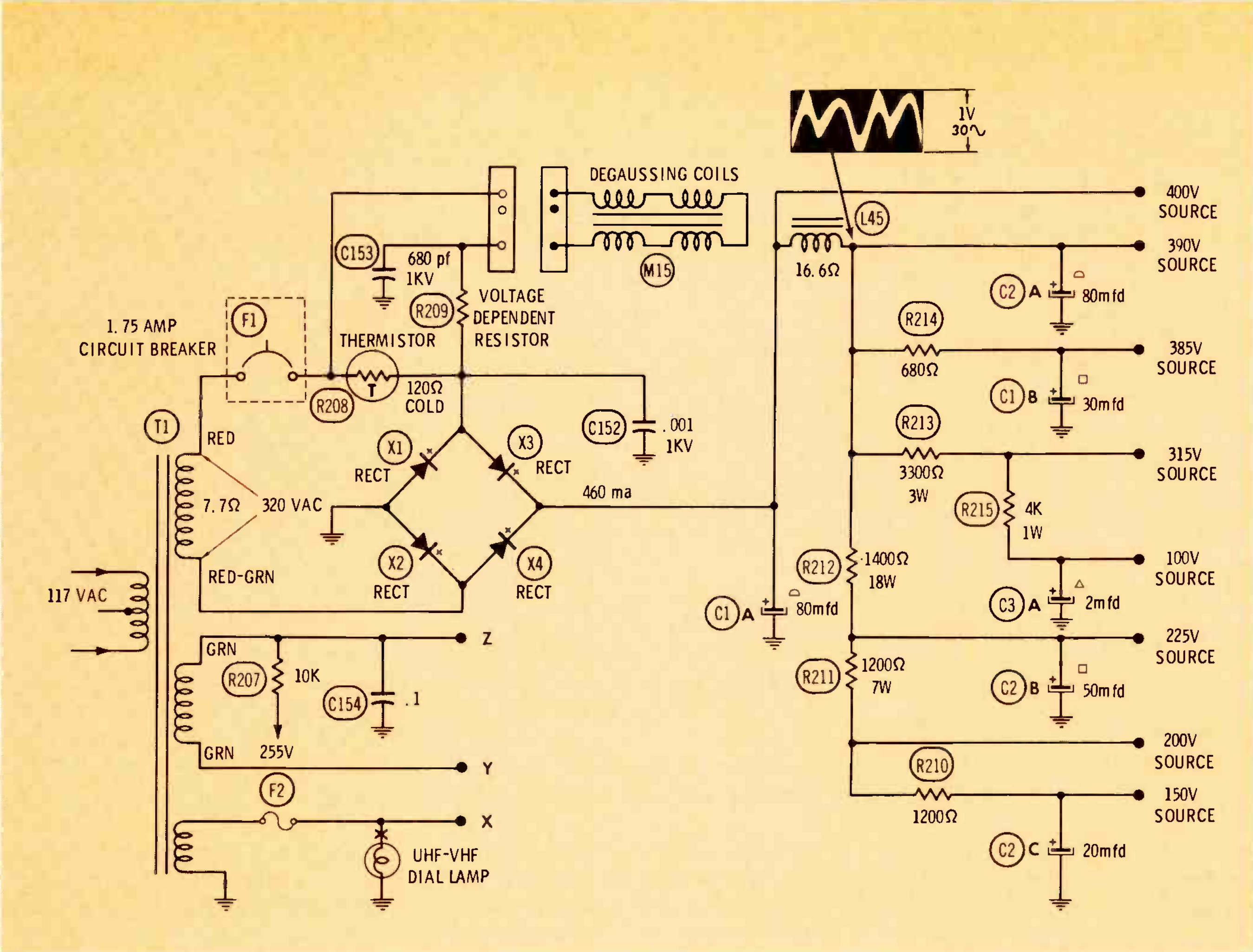


Fig. 2 Shorted or open diodes and a defective C1A are prime causes of hum in the sound and raster of the RCA CTC16 chassis.

wires (Fig. 1) and popped-out solder are often the results of a stuck circuit breaker.

Most troubles in the low-voltage power supply are caused by shorted silicon diodes and filter capacitors. In the RCA CTC16 chassis, four silicon diodes are used in a bridge-type circuit with an electrolytic capacitor and choke input filter network (Fig. 2). If trouble develops, first check for a shorted or open silicon diode by removing from the circuit board one end of each diode and measuring the front-to-back resistance ratio of each. The shorted diode will read under two ohms in both directions. A good diode will read around ten ohms in one direction and no resistance when the ohmmeter leads are reversed. An open diode, of course, will read infinity in both directions. In some cases, both a shorted and an open silicon diode will be found in the same circuit. When one diode of a full-wave or bridge rectifier is found shorted, check the other diodes, too.

Excessive hum in the sound or a dark section in the raster usually indicate a defective low-voltage filter network. In some cases, the trouble symptom may resemble one caused by a sync or AGC defect. In the RCA CTC16 chassis, suspect electrolytic capacitor C1A (Fig. 2).

One quick method to check for improper filtering in the low-voltage power supply is with a scope. The correct filter waveform should be a fairly straight horizontal white line. If there is excessively large humps, or ripple, in the waveform, bridge the suspected filter capacitor with

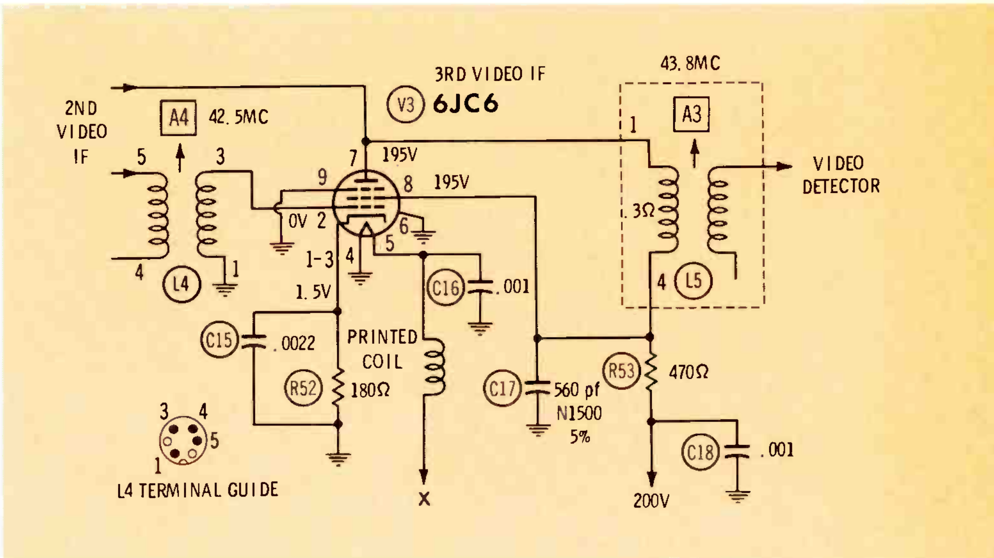


Fig. 3 When the 3rd video IF amplifier shorts, it also usually destroys the plate-load resistor, R53.

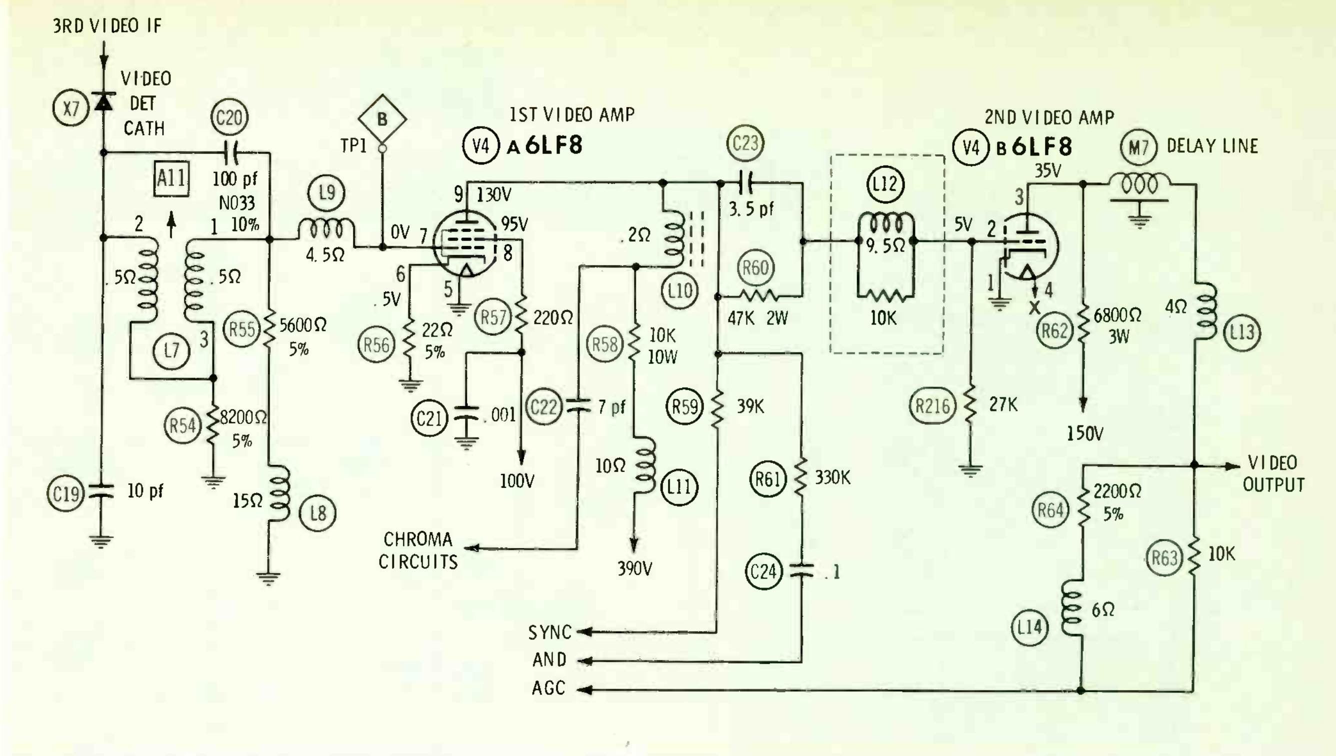


Fig. 4 Check L8, L13 and L14 and their associated solder connections when the trouble symptom is a smeared or blurred picture.

one that is known to be good. The horizontal line on the scope should straighten out and the TV picture should be restored to normal. Always replace the whole filter can, even though only one capacitor is defective.

Another source of low-voltage power-supply trouble in the RCA CTC16 chassis is defective high-wattage, voltage-dropping resistors. Check resistor R212 in Fig. 2 for bad connections and burned connection wires. This resistor has been known to break open physically. Either replace this wirewound resistor or remove and resolder it to the terminal board.

Troubles in RF, IF and Video Circuits

No Picture, No Sound, Normal Raster

Most troubles in the RF, IF and video circuits are caused by defective tubes. One common condition is a shorted 6EJ7 tube, which burns out R53 (Fig. 3), a 470-ohm decoupling resistor in the plate circuit of the third video IF.

Smeared and blurred picture troubles generally are caused by defects in the video amplifier circuits (Fig. 4). First, check, L8, L13 and L14 for open windings. These peaking coils have a habit of opening, which produces wavy lines or a smeared picture. Also, check for broken connections at the terminal wire connection of these coils. In many cases, the coil winding is drawn tight against the wire terminals and, when moved, will break off easily.

Intermittent Contrast

A defect that commonly causes intermittenty varying contrast is capacitor C2D, in the cathode circuit of the third video amplifier (Fig. 5). This electrolytic capacitor becomes intermittent and when moved, will cause the contrast of the color picture to decrease. Make a routine check by pushing on the terminal connection of C2D; sometimes, just by moving the electrolytic can, the contrast can be made to change. If so, replace the complete filter can.

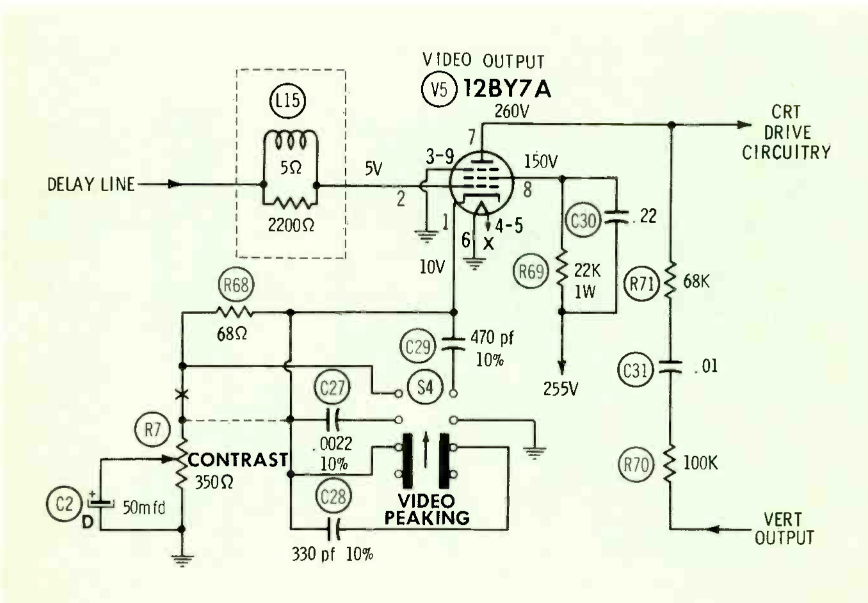


Fig. 5 A defect in capacitor C2D, in the cathode circuit of the 3rd video IF, has caused intermittently changing contrast in the CTC16 chassis.

Sound Problems

Sound problems usually can be solved by testing and/or substituting

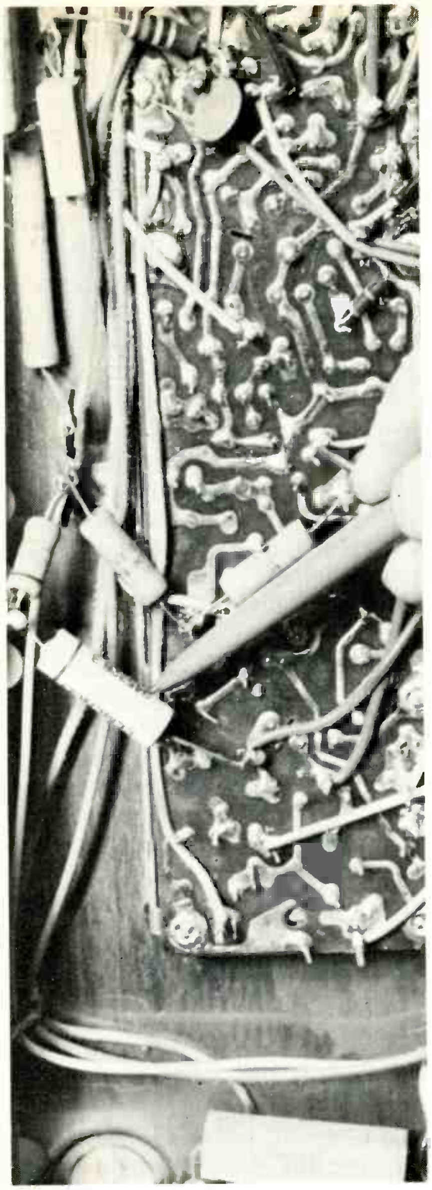


Fig. 7 Vertical feedback capacitor C71, pointed out here, has a long history of failure in the CTC16 chassis. When leaky or shorted, this capacitor reduces the vertical sweep to a horizontal white line.

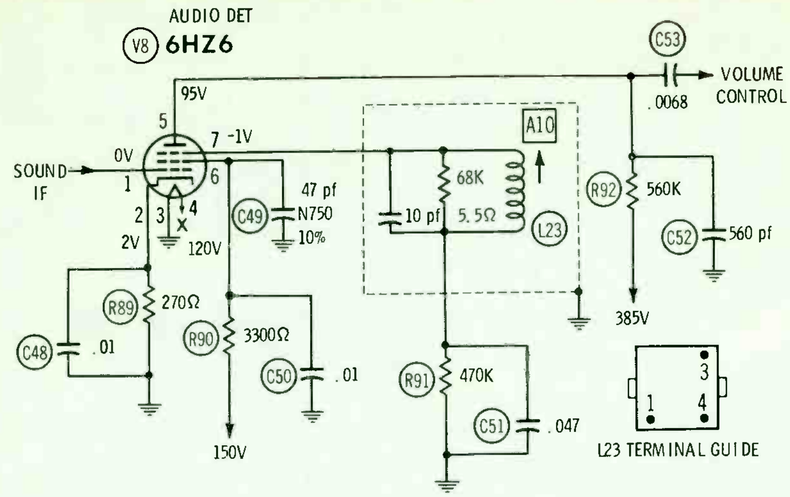


Fig. 6 A defective or misadjusted L23 or poor solder connections have caused distorted and intermittent sound, respectively, in the RCA CTC16 chassis.

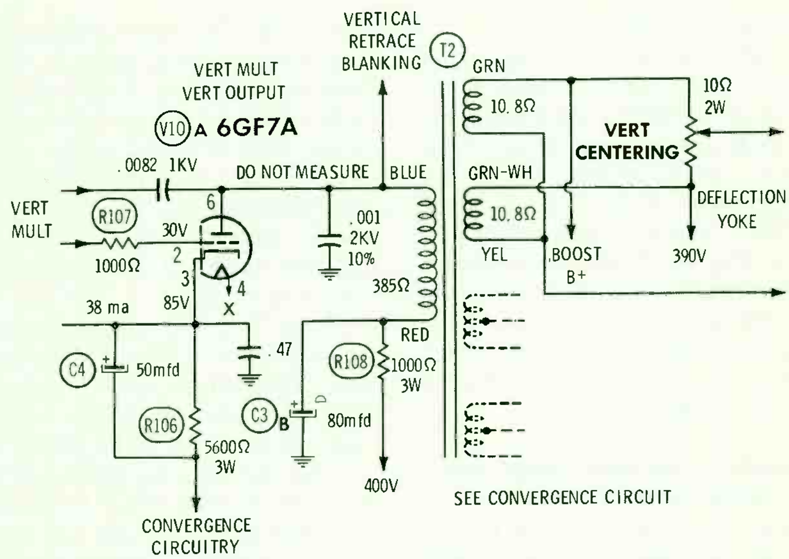


Fig. 8 C4 and R108 commonly cause insufficient height in CTC16 chassis.

the sound tubes. If the color chassis is over three or four years old, the sound detector transformer, (L23, Fig. 6) should be readjusted. Many times, mushy and distorted sound can be cured by adjusting L23. It is difficult to completely align the sound section during a house call; instead, tune in a weak fringe-area TV station and adjust L23 for clear and maximum reception.

Many cases of intermittent sound in the RCA CTC16 chassis have been caused by a poorly soldered joint at terminal 3 of L23 (Fig. 6). Unsolder L23 from the circuit board and remove the metal shield. Resolder all wiring connections, then reassemble and realign the sound detector transformer. Check the solder connections by twisting the transformer can.

Troubles in the Vertical Circuits

A large percentage of all vertical problems involve either insufficient height, rolling picture or a horizontal white line. Ninety percent of these vertical troubles in the CTC16 chassis are caused by a defective vertical oscillator and output tube (6GF7). In many cases, it may be necessary to try several tubes in order to restore correct vertical height and linearity.

Reduction of the vertical sweep in the CTC16 to a horizontal white line can also be caused by a defect in vertical feedback capacitor C71 (Figs. 7 and 9). This capacitor has been known to be either leaky or shorted.

Intermittent vertical troubles may be caused by poor soldered connections around the socket of the vertical oscillator/output tube. In one particular chassis, when the tube was moved in the socket, the TV picture would collapse into a horizontal line. At the same time, the heater of the tube would go black. The trouble was a cracked wiring connection to the heater. Also, check for a poor ground connection to the heater of

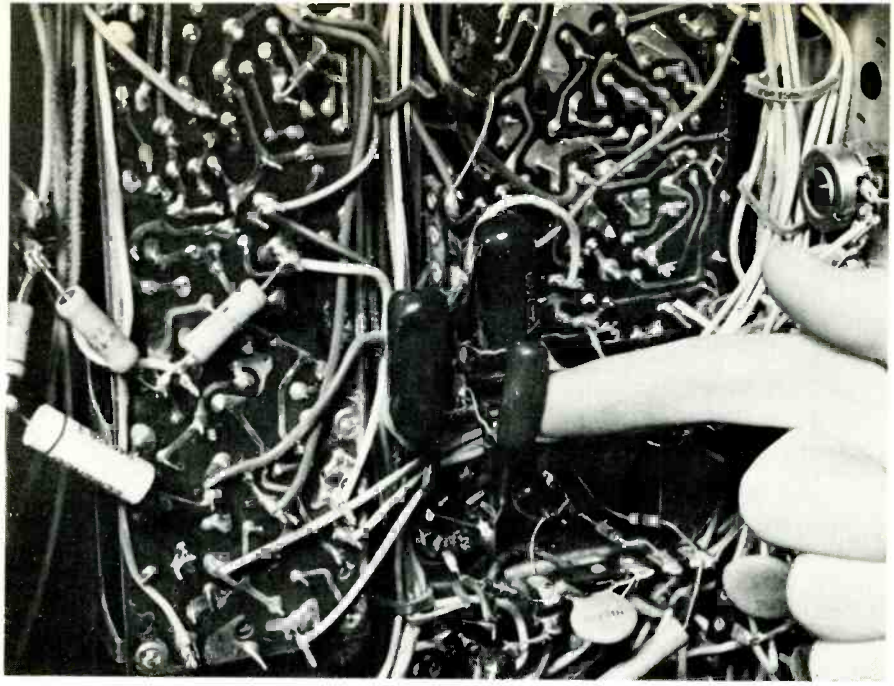


Fig. 10 C143, a .056-mfd capacitor in the horizontal efficiency coil circuit, is a prime source of overload in the high-voltage section.

the vertical oscillator tube.

Insufficient height of the raster of the CTC16 can be caused by C4 in Fig. 8, a 50-mfd electrolytic capacitor in the cathode circuit of the vertical output section. A change in resistance of R127 and R128 also have caused vertical height problems (Fig. 9). These two resistors are located in the cathode circuit of the vertical output tube and serve as snivet suppressors. Also, check R108 (Fig. 8) for an increase in value or an open condition.

Trouble in the Horizontal and High-Voltage Circuits

Measure the high-voltage on the CRT if "no raster" is the trouble symptom. This voltage should be adjusted to 25KV. If, after replacing the horizontal output, high-voltage and damper tubes, there is still no high-voltage, remove the cap of the high-voltage regulator. (Be sure the power cord is pulled before removing this cap.) With the regulator circuit disconnected, the high voltage should increase to 33KV. If it does not, the trouble is **not** in the shunt-regulator circuit.

Don't forget to adjust the high-voltage control. When the horizontal and high-voltage circuits are normal, this control should vary the high-voltage from 20 to 28KV.

Also, measure the horizontal output tube current, either by inserting a current socket in the tube socket or by inserting a current meter between the cathode (pin 3) and chassis ground. Use the "500 MA" scale of the meter. The current meter should read somewhere between 190 to 220 ma. If the current exceeds this range, check for insufficient drive voltage on pin 2 of the horizontal output tube. The drive voltage should be around –55 to –60 volts. If the drive voltage is low, check further into the horizontal oscillator circuits. It is adviseable to double-check the drive voltage with a scope; a 190-volt sawtooth waveform should be seen at the control grid terminal.

If the drive voltage is normal, check for an overload in the flyback circuits. A prime suspect is capacitor C143, a .056-mfd unit in the horizontal efficiency coil circuit (Fig. 10). This capacitor has broken down in several color chassis.

Also, always check the condition of the boost rectifier by measuring the boost voltage. This rectifier cannot be checked with resistance measurements and, if suspected, should be replaced. Be sure to observe correct polarity when reinstalling this component.

The cause of reduced high-voltage sometimes is located in the voltage-regulator circuit. If the high-voltage increases to, or above, normal after the cap of the regulator tube is removed, suspect the voltage-regulator circuits. A leaky capacitor (C141) between the cathode and grid terminals of the voltage regulator tube will reduce the high-voltage output to as low as 10KV.

Also, in a case of extreme arc-over of the high voltage, the cause of the trouble is probably in the voltage-regulator circuit. Check the high-voltage adjustment and be sure

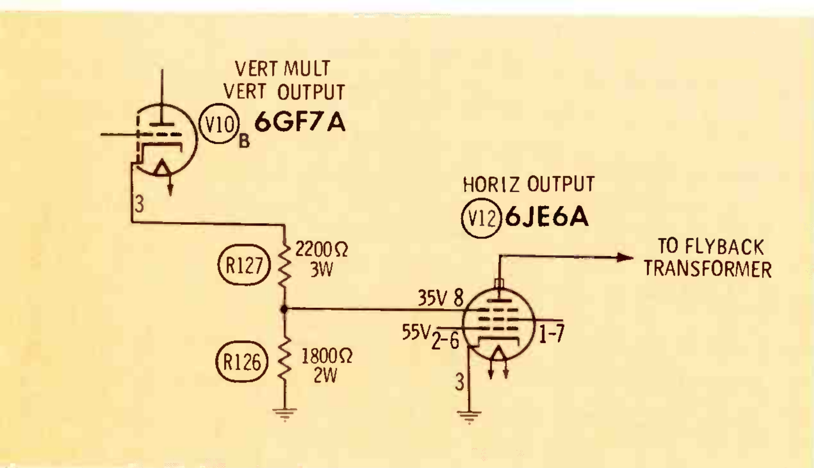


Fig. 9 A change in the values of resistors R127 and R128 cause vertical height problems.

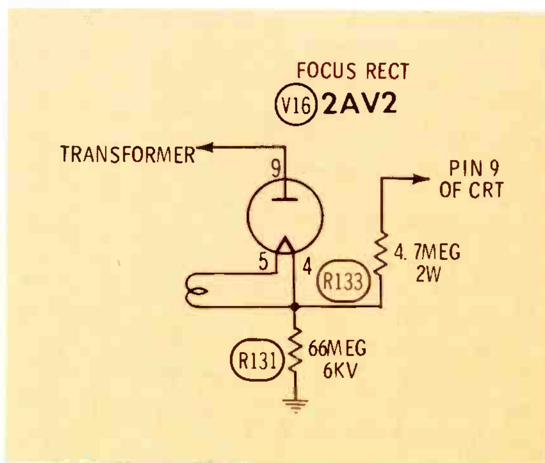


Fig. 11 An increase in the value of R131 or R133 will produce poor focus.

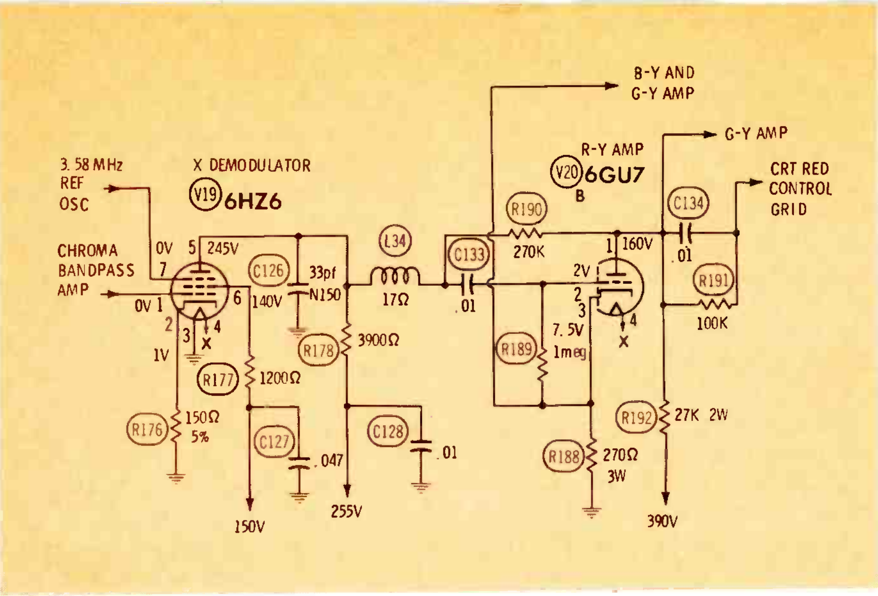


Fig. 12 A leaky coupling capacitor (C133) between demodulator and color difference amplifier and over-heated plate-load resistors (R192) can cause a missing color and intermittent color, respectively.

that 25KV is being applied to the anode terminal of the CRT. If the high voltage cannot be turned down, resistor R136 probably is at fault. This resistor will open, placing 33KV on the picture tube.

Poor Focus Problems

If you are confronted with poor focus, begin by replacing the 2AV2 focus tube (Fig. 11). If the high-voltage is too low, the CRT will never focus properly. Adjust the high voltage on the CRT to 25KV and then adjust the focus coil. Measure the voltage at the focus output lead that goes to the CRT socket; the focus voltage should vary between 3.5 and 5KV as the focus coil is adjusted. It is possible that the focus slug will be found frozen. When this condition exists, either the plastic adjustment control is broken or the coil terminals are torn loose. Do not waste time repairing a frozen focus coil—replace it.

Many times, poor focus will result when the screen grid controls are turned up too high. This causes excessive blooming in the picture. Position the normal-service switch to the service position and turn each screen control completely clockwise. Then turn up the red screen until a thin red line appears. Do likewise with the green and then the blue screen control. Recheck possible blooming in the b-w picture by turning the brightness control completely clockwise. Readjust the focus control for clean scanning lines on the CRT.

Make a visual check of the focus pin on the CRT socket. This tube pin may become corroded and be eaten away or broken inside the CRT socket. Remove the fiber piece at the rear of the CRT socket and check for either a broken wire or broken focus pin terminal.

Also, check resistors R131 and R133 (Fig. 11). These high-megohm resistors can increase in value, resulting in poor focus.

A defective color CRT will not focus sharply. Test the CRT on a good picture tube tester, or substitute it with a color-test jig.

Troubles in the Color Circuitry

If a color set produces no color, replace the chroma reference oscillator control tube. If this does not restore color, then replace the color burst and chroma bandpass amplifier tube. Make sure the color killer control is turned completely down before beginning tube substitution.

Weak color problems may be caused by defective color-circuit tubes, poor color alignment, or a weak 3.58-MHz crystal.

Generally, a very low negative grid voltage on pin two of the chroma reference oscillator tube indicates a weak crystal. Remove the old crystal and install a new one. It is surprising how the color picture can be pepped up by a new crystal.

Defects that can cause intermittent color are possible throughout the circuitry on the color-circuit board. Check all connections on color transformers and coils for poor contacts. Poorly soldered connections from component to circuit board cause the majority of intermittent color conditions. Try to isolate the intermittent section by waveforms analysis in the color circuits.

When large bars of color (rainbow pattern) begin to float through the picture, change the 3.58-MHz oscillator, burst and phase-detector tubes. In weak, or fringe, areas, the large color bars often will be seen just before the color picture is tuned in with the fine-tuning control. Replacing the 3.58-MHz oscillator tube will cure this problem. A touch-up of the AFPC and color alignment usually will improve the color picture. (Before attempting any alignment, be sure no circuit defects exist.)

Replace the X demodulator and R-Y amplifier if there is no red in the color picture. Also check for a

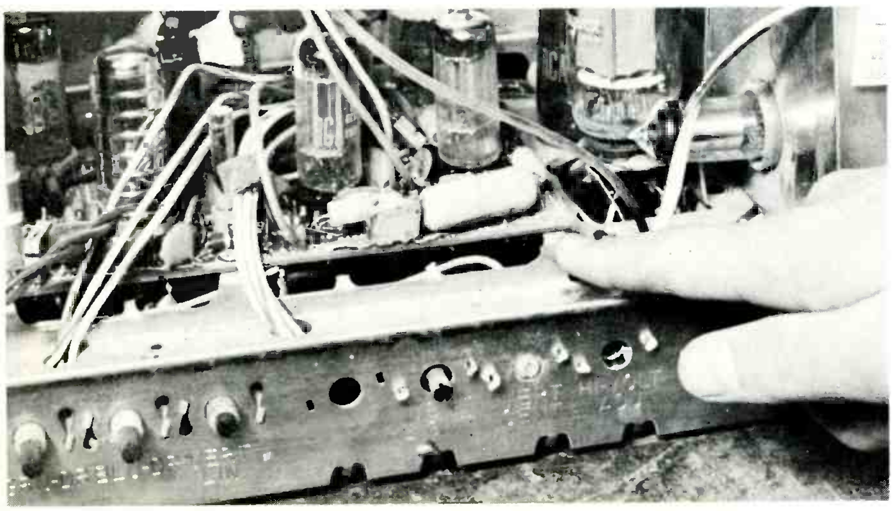


Fig. 13 Poor ground connections on chroma and video circuit boards can cause hard-to-solve trouble symptoms.

leaky coupling capacitor (C133 in Fig. 12) between the X demodulator and R-Y amplifier. In the CTC-16 chassis, when one coupling capacitor between demodulator and -Y amplifier becomes leaky, replace all three capacitors. Other troubles that commonly cause a "missing color" symptom are a burned or cracked resistor in the cathode circuit and a defective plate resistor in the demodulator circuits.

If the problem of intermittent red and poor black-and-white picture develops, check the soldered terminals of the two-watt plate-load resistors (such as R192 in Fig. 12); these resistors have a tendency to run quite warm and can melt the solder at circuit-board connections. Remove the resistor, check for correct resistance, and retin the resistor terminals. Clean around the circuit board connections before resoldering the resistor into position. Also, for missing or intermittent red, check C134 (Fig. 12).

Another source to look into if there is a poor color and b-w picture is improper ground connections on the chroma circuit board (Fig. 13). After several years of use, this board has been known to cause a lot of trouble. It is best to resolder every ground connection on this board. Don't just heat up the ground connection; place new solder into the circuit-board eyelet connection. Also, resolder the ground connections on the video amplifier circuit board. These two circuit boards always should be resoldered before the color chassis leaves the shop.

A defective CRT can produce one or more missing colors. Generally, the red gun is the first to become defective in these color picture tubes. All three color guns should have close readings within the green scale on a CRT tester. Poor b-w pictures can be caused by one or two weak guns in the color CRT.

CRT defects that cause intermittent and flashing pictures can be confirmed by **gently** tapping the end of the CRT with a screwdriver. Always test the suspected color picture tube with a good CRT tube tester or, preferably, by substituting it with a color test jig.

CONCLUSION

Since many of the earlier color receivers have very similar circuitry, the problem areas discussed here also apply to them. In some chassis the circuitry is the same, except that different tube numbers are used.

Many TV service technicians use a file card system to record all color troubles, while others circle and mark the trouble spot or component on the schematic diagram. Later, when they are confronted with an identical trouble symptom on a similar chassis, they refer back to the "case-history" file system or schematic. The time spent maintaining such a reference system can be repaid many times over by time saved in the future. ▲

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troubleshooter

Tripping Circuit Breaker Caused By Defective Horizontal Oscillator

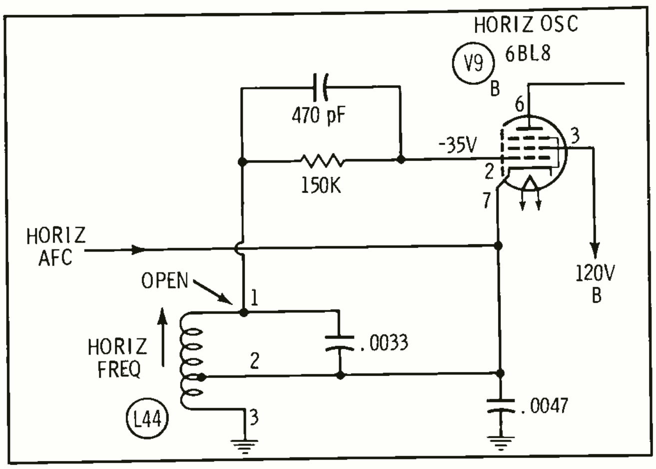
The circuit breaker in a Sylvania D06 color chassis opened after the set operated for approximately 30 seconds.

Monitoring the cathode current of the horizontal output tube revealed that it increased to over 500 ma., at which time the circuit breaker would open. Normally, this indicates a short in the horizontal output circuitry, but not in this case.

All tubes in the horizontal and high-voltage sections checked normal.

When the plate lead to the horizontal output tube was removed, the cathode current dropped to 30 ma. A check with the scope revealed that there was no drive signal on the grid of this tube.

The voltage at the plate of the horizontal oscillator



was slightly above normal. The voltage at the cathode of this stage was 200 volts instead of the normal .23 volt.

All capacitors and resistors in the cathode-grid circuit of the horizontal oscillator were checked, but none were found defective.

A check of the continuity of the horizontal frequency coil finally isolated the cause of the trouble: the reading from the middle tap of the coil to ground was normal, but the reading from the top of the coil to the grid indicated an open (normally reads 150K ohms). When the coil was removed from the board and examined, it was discovered that there was an open connection on the lug on the coil form. Resoldering this connection and replacing the coil restored the set to normal operation.

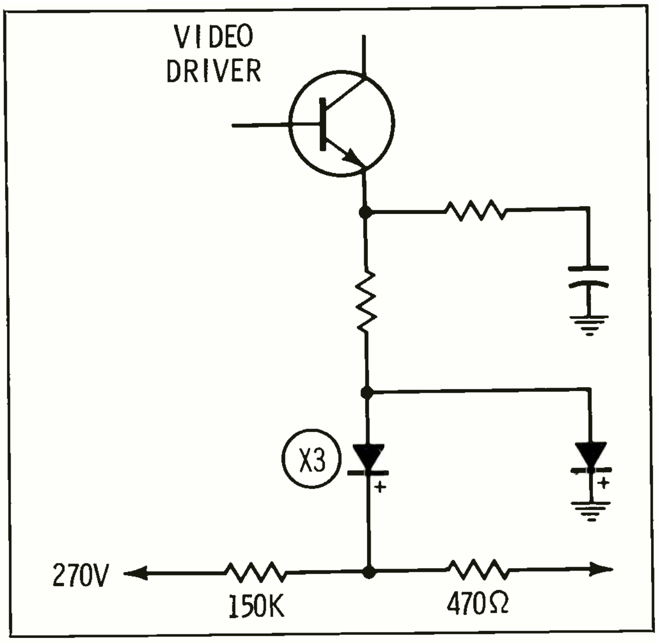
Cy Ezer

Broxville, N. Y.

Mr. Ezer, your troubleshooting technique in this case was excellent and illustrates well the application of logic—without which the servicing of any electronic device is nothing more than a combination of educated guessing and a dependence on lady luck.

Irregular Line and Difference In Contrast

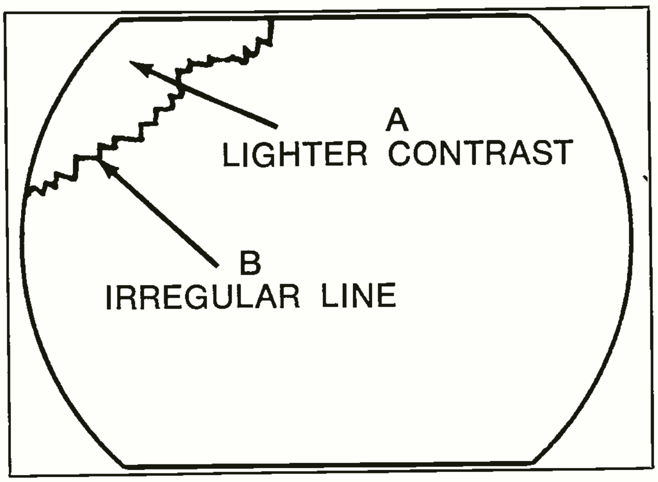
A Zenith 15Y6C15 color chassis displayed a dark, irregular line across the upper left portion of the



screen (illustrated here). The level of contrast in the area labeled "A" was several shades lighter than that of the rest of the screen. An otherwise normal picture—both b-w and color—was displayed.

After the set operated for a short period, the irregular line retreated toward the upper left corner of the screen and in about 15 minutes had disappeared.

The cause of this symptom was finally isolated to a poor connection between diode X3 and the 150-K ohm



and 470-ohm resistors in the emitter circuit of the video driver transistor. Resoldering the connection eliminated the trouble symptoms. (The poor connection was probably the result of a rosin joint, because the symptom always disappeared as the set warmed up.)

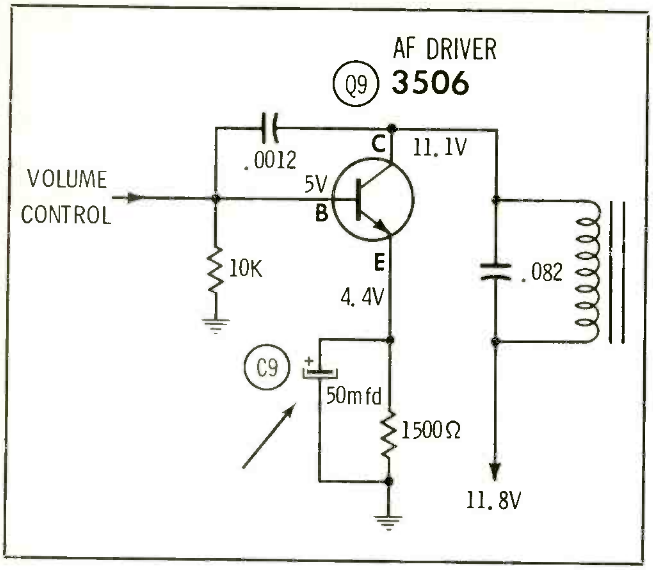
Frank Kolde, Jr.

Anderson, Ind.

Reduced Sound

The audio output of an RCA KCS 157A solid-state

TV chassis was reduced to about half the normal level. All voltages in the transistorized audio section were normal. Signal tracing revealed that the output of the



audio driver stage was below normal. Component checks in this stage isolated the trouble to an open bypass capacitor (C9) in the emitter circuit of the audio driver. Total troubleshooting time: 15 minutes.

LONNIE E. HOLDER

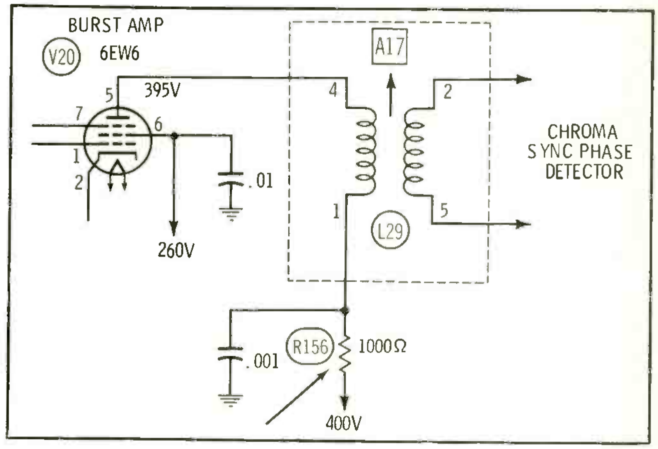
Edwards, CA

With C9 open, emitter degeneration reduced the gain of the audio driver stage. Troubles such as this are particularly difficult to uncover in transistor stages because of the minute voltage deviations involved. Leaky or shorted emitter bypass capacitors are easier to isolate because they usually increase the forward bias of the transistor and produce a noticeable drop in collector voltage.

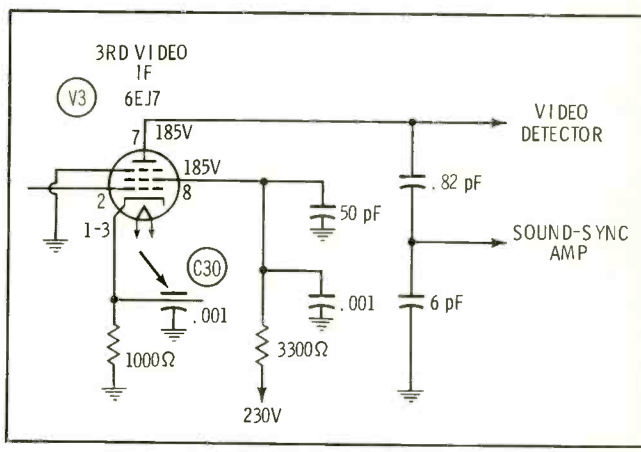
Obviously, Mr. Holder has a good grasp of solid-state circuits and associated troubleshooting techniques, as evidenced by the time it took him to diagnose and isolate the trouble.

Increased Resistance and a Bad Feed-Through

A General Electric CA color chassis displayed weak color and a complete loss of color sync. While attempting to perform a color sync alignment, I discovered



that adjustment of L29 had little or no effect. A check with the scope revealed that there was burst present on the grid of the burst amplifier, but none on the plate. Using a VTVM, I discovered that the voltage



on the plate of the burst amplifier was below tolerance. Resistance checks uncovered the fact that the value of R156, in the plate supply circuit of the burst amplifier, had increased. The set was restored to normal operation after R156 was replaced and the color sync realigned.

A Zenith 20Z1C37 color chassis displayed a raster but no picture and produced no sound. Probing with a plastic tool in the IF section produced intermittent sound and picture. The 3rd IF stage seemed to be the most sensitive. Further examination confirmed that C30, a feed-through capacitor, was defective.

WILLIS CODDINGTON

Eudora, Ark. ▲

product report

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

Tape Head Cleaner For Casettes

A new head cleaner designed specifically to meet the critical needs of casette tape recorders has been introduced by Chemtronics Inc. It can also be used for conventional reel-to-reel tape recorders.

The new aerosol is said to preserve tapes and improve fidelity by removing all dirt, film and oxide that accumulates on tape recorder heads.

A six-inch extender tube enables the technician to direct a jet stream of cleaner into hard-to-reach areas.

Tape Head Cleaner is non-toxic, non-flammable and non-conductive.

It is guaranteed by the manufacturer to be safe for all tapes and will not mar the finish of any casette or reel-to-reel tape recorder. It can be sprayed safely on running tape without affecting the operation of the recorder. According to the manufacturer, the cleaner contains no abrasives to cause tape head wear, and no wiping with a cloth is required. Tape Head Cleaner washes away dirt and oxides and then dries away thoroughly, leaving no trace of any residue.

Model THC-6 Tape Head Cleaner is sold in a 6-oz. spray can and is priced at $1.95.

Circle 54 on literature card

Wireless Alarm System

Selectron Products, Inc. has announced the development of a closed-loop, solid-state, wireless

alarm system. The unit operates in the freqeuncy range of 265MHz to 285MHz.

This alarm system can be triggered by a pocket-size personal transmitter. Pressing the button on the transmitter triggers an alarm.

A variety of accessories are available for Selectron systems, including fire detectors, automatic phone dialers to notify police and firemen, and extra sirens or alarm bells.

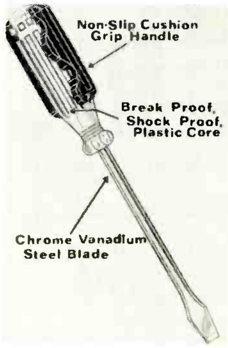
The unit operates on normal line voltage; when normal power fails, the system automatically switches to built-in battery operation.

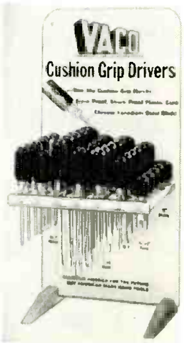
The basic system sells for $199.50.

Circle 55 on literature card

Cushion-Grip Screw Drivers

Vaco Products Co. introduces a new line of 20 different cushion-grip screw drivers in all popular sizes of round, square and stubby styles for regular screws, plus No. 1 and No. 2 Phillips drivers for cross-slot screws. The extra-large handle has a rubber covering permanently locked with double tongue-and-groove construction to a shock-proof, break-proof plastic core, and on the end, a smooth





plastic dome. Prices range from $1.10 to $2.50, and $5.24 for a set of four matched drivers in a plastic pouch.

Circle 56 on literature card

Inventory System

APSCO introduces its Fill n' File system consisting of a reusable see-thru plastic dome permanently secured to a heavy-duty index card with a sliding card insert. The part can be inventoried with the file card and records all in one self-contained unit.

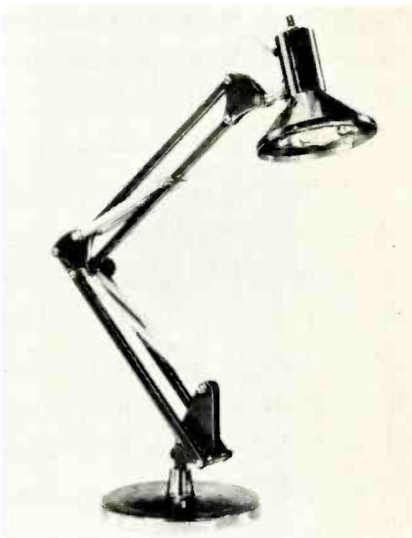
Fill n' File record/inventory cards are available in a wide range of standard sizes. Also, special sizes for specific requirements are available if needed.

Fill n' File cards are 16½ cents each in quantities of 100, and 10 cents each in quantities over 1000.

Circle 57 on literature card

High Intensity Lamps for Office or Home

The 1969 High Intensity Lamps



Tube Types Used Most In 1968

The 41 tube types listed here account for nearly 50% of the more than 98 million tubes used in 1968, according to a recent General Electric report of the estimated usage of over 650 types of tubes.

Percentage of Tubes Used	Tube Type
4%	6FQ7/6CG7
3%	6CJ3/6CL3/6DW4B, 6JE6B
2%	6GH8A, 6EA8
1.5%	3A3/3AW3/3B2, 6BK4B, 6DQ6B/6GW6, 5U4GB/5AS4A
1%	6AQ5A/6HG5, 6JS6B, 12AX7/ECC83, 6BZ6, 50C5,
	6CB6A/6CF6, 6BQ7A/6BZ7, 12AU7A/ECC82, 1G3GT/1B3GT, 35W4, 6U8A/6KD8/5KD8, 12AT7/ECC81
.5%	6CG8A, 6AU6A, 6AX4GTB, 6GF7A, 6AW8A, 12BY7A/12BV7/12DQ7, 6EM7/6EA7, 6GU7, 8FQ7/8CG7, 3AT2, 6SN7GTB, 12BA6, 12BE6, 6EW6, 6BQ5/EL84, 6GY6/6GX6, 6AY3B/6BS3A, 6AV6, 1V2, 6JC6

introduced by Swing-O-Lite, Inc. are designed for versatile installment in any setting. Both Model No. 800, "T-Bar", and Model No. 900, the "All-Angle Mobile", extend 24 inches and come with wall or permanent mounting, C-clamp or weighted base for desk or table top. They have a 40S11 bulb guaranteed to last 500 hours with 200 watts illumination, a cool-aid shade to dissipate heat and provide ample light area, a heavy chrome base with black vinyl finish, die-cast swivel and base, and springs with unidirectional mobility.

Depending on type of mount, model No. 800 costs $18.50-$20.00; Model No. 900 costs $19.50-$21.00.

Circle 58 on literature card

CCTV Surveillance System

A self-contained—all-in-one box — CCTV surveillance system has been announced by Packard Bell.

Designated GTS-1, it comes complete with PB-911 camera, a Packard Bell TV receiver with 90-inch tube, wall (or ceiling) camera mount, 50 feet of RG 59/U cable with a 75-ohm matching transformer on one end and a UHF plug with reducing adapter on the other, and an easy-to-follow installation and operating booklet.

The camera is fully automatic and weighs 6 lbs. It measures 5½ inches x 3 inches x 11 inches and costs $475.00. ▲

Circle 59 on literature card

For More Information on Products Use ES's Handy Reply Card

catalogs literature

ANTENNAS

100. *Antenna Specialists Co.*—5 catalogs, each covering the line of A/S antennas used by a particular market. Catalog No. HM1001 lists information for amateur radio bands; catalog No. AV3010 covers aviation antennas for general communications, navigation and marker beacon applications; citizens two-way radio antennas and accessories are listed in catalog No. CB-1001-C; Marine applications are included in catalog No. MAR-2000; and catalog No. MON-1003A covers moniter antennas for emergency and industrial frequencies.

AUDIO

101. *Robins Industries Corp.* — Catalog No. C6905 covers Robins' complete line of casettes and casette and cartridge accessories.

BUSINESS

102. *M M Business Forms Corp.* —Samples and brochure describing the complete line of M M business forms specifically designed for consumer electronic service shops.

COMPONENTS

103. *International Rectifier* — Components catalog has information on integrated circuits, heat exchangers, photo cells, transistors, rectifiers, capacitors, zeners, etc.
104. *Kings Electronics* — 274 RF coaxial connectors are listed in Kings' TNC Connector Catalog for engineer and buyer, including complete cable assembly and crimping data.
105. *J. W. Miller Co.*—196-page catalog No. 170 covers coil replacement for color and b-w TV sets and home and car radios. It also features a 120-page cross reference section.
106. *Switchcraft* — 8-page catalog S-312 describes mountings, switching capacity, operating characteristics and construction of Switchcraft's line of lever-type switches.

SERVICE AIDS

107. *Bay Products* — Illustrated 48-page reference manual covers Bay's complete line of "Shop Furniture and Steel Shelving."
108. *GC Electronics* — Aerosol chemical brochure details use of aerosol units in electronics.
109. *Robins Industries Corp.* — Details of Robins' new phono and tape-recording accessories are included in catalog TP6905.

SPECIAL EQUIPMENT

110. *Alco*—Machined aluminum anodized knobs (standard series, concentric, spinner, skirted, and knurled models) are listed in Alco's 8-page ALCOKNOB catalog.
111. *Electrovert* — 4-page data sheet, Bulletin No. 1002, describes and illustrates the features of Electro-Duct plastic wiring duct.
112. *International Telephone and Telegraph (ITT)* — 64-page catalog No. GC-10 of electrical wires and cables describes materials, construction and applications of a wide range of wires and cables.
113. *Russell Industries* — Catalog describes and lists aluminum anodized control knobs for military and commercial applications.

TECHNICAL PUBLICATIONS

114. *Howard W. Sams*—Literature describes popular and informative publications on radio and TV servicing, communication, audio, hi-fi and industrial electronics, including 1969 catalog of technical books on every phase of electronics.*

*Check "Index to Advertisers" for additional information. ▲

photofact bulletin

PHOTOFACT BULLETIN lists new PHOTOFACT coverage issued during the last month for new TV chassis. This is another way ELECTRONIC SERVICING brings you the very latest facts you need to keep fully informed between regular issues of PHOTOFACT Index Supplements issued in March, June, and September. PHOTOFACT folders are available through your local parts distributor.

ADMIRAL

Chassis 4H12, 4H1270-2, 4H1273-1/-4/-8/-9, 14H1279-1, 14H1282-1 1049-1
Remote Control Receiver 11A9N, Transmitter S376AN 1049-1-A

BRADFORD

CMAT-55426 1047-1

ELECTROHOME

Chassis C5 1044-1

EMERSON

Chassis 120908A/909A, B/910A/912A/913A, B/933A, B/936A 1048-1

MAGNAVOX

Chassis T937-03-AA, T937-04-AA 1049-2

MOTOROLA

Chassis 9TS-460A/B, D9TS-460A/B, E9TS-460B, F9TS-460B, Y9TS-460A/B, YD9TS-460A/B, YE9TS-460B, YF9TS-460B 1044-2
Chassis C20TS-/F20TS-/Y22TS-/22TS-592 1048-2

PACKARD BELL

MQ-123 1046-1

PHILCO-FORD

S3804WA (Ch. 19S32) 1045-1

SEARS SILVERTONE

Chassis 528. 70520/521/522/523 1044-3

SYLVANIA

Chassis D12-1 thru D12-8 .. 1045-2
Remote Control used with Chassis D12-3/-5/-6/-7 .... 1045-2-A
Chassis B10-1, B10-2 1047-2

TOSHIBA

T4 (Ch. TAT-2003) 1046-2
C2A, C3A (Ch. TAC-3310) 1048-3

TRUETONE

MEA3755A-76 (2DC3755) 1046-3

LOOKING FOR ACCURACY?

STOP RIGHT HERE!

Take a close look at a revolutionary new multimeter. The Sencore Field Effect Meter. This beautifully styled FE meter virtually obsoletes all VTVMs and VOMs. Why? Exclusive FET circuitry. A totally new concept in multimeter design that prevents circuit loading. Interested? Here's more. The FE16's 15 megohm input impedance on DC and 10 megohm on AC is 750 times less loading than a standard 20,000 ohm/volt VOM, 50% less loading than a standard VTVM on DC volts and 10 times less loading on AC volts. Here's a real package of dynamite that means accuracy. FET ACCURACY that's 1.5% on DC, 3% on AC. (An unbelievable ½% full scale accuracy on 1 VDC.)

Want more? Look a little closer. An exclusive true zero center scale starting at ± .5V DC, DC current ranges from 100μA to 1-amp, complete meter and circuit overload protection, mirror back scale, built-in battery check, rugged vinyl clad all steel case, and . . . . that's it. If you still want a closer look, you'll have to buy it. *Remember the name FIELD EFFECT METER.* Only Sencore makes them. Your Distributor has them in stock at $84.50—less than the cost of a good VOM or VTVM.

SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Circle 31 on literature card

advertisers' index

How do you "install" confidence when you install an RCA color picture tube?

The surest way to compliment a customer is to agree with his opinion. This is pretty easy to do when it comes to deciding which brand of replacement color picture tube to install in his set.

Here both set owner and service technician agree—and by a wide margin—on RCA! And for one very good reason: RCA's reputation...for experience, quality, and proven performance...over the years. More years than anyone else in the business.

Place your confidence in the company that perfected the color TV system in use today. Introduced more technical innovations than any other company. Stays on top of the state-of-the-art not just in technology, but in tube sizes as well.

Whether it's an all-new RCA HI-LITE or the popular priced quality rebuilt RCA Colorama—when you recommend RCA—you'll not only flatter your customer, you'll also be protecting your own hard-earned service reputation. That's because RCA picture tubes are designed to protect the biggest reputation in the COLOR TV industry.

RCA Electronic Components, Harrison, N.J.

RCA

Introducing a Complete Line of Littelfuse Quality Circuit Breakers

Actual Size
1¾" x 13⁄16" x ½"

Exact replacement from factory to you

Designed for the protection of television receiver circuits, the Littelfuse Manual Reset Circuit Breaker is also ideally suited as a current overload protector for model railroads and power operated toy transformers, hair dryers, small household appliances, home workshop power tools, office machines, small fractional horsepower motors and all types of electronic or electrical control wiring.

LITTELFUSE DES PLAINES, ILLINOIS

Circle 32 on literature card