



# Electronic Servicing®



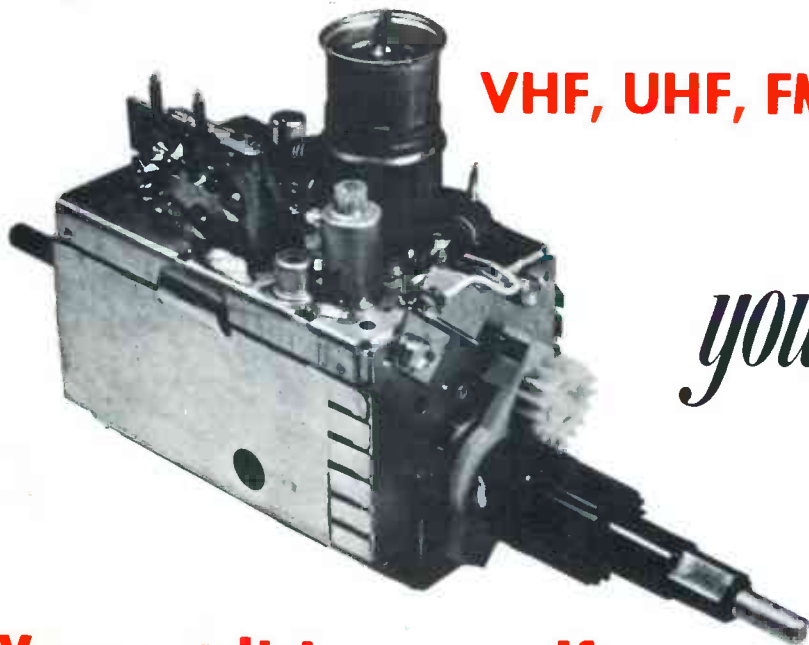
*Protect yourself in contracts*  
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**Controlling High Voltage, page 12**



# TV TUNER SERVICE



VHF, UHF, FM or IF-Subchassis...  
... All Makes

*you get...*

**Fast 8 hr. Service!**

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- Antenna Coil Replacement Guide
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Circle 1 on literature card

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# Electronic Servicing

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Robert E. Hertel, Publisher

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***and over \$1900.00 worth of tools, parts, test  
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Sometime this Fall, TECH SPRAY will ship the 1,000,000th can of BLUE STUFF. And just to say thank you for the way the Service Industry has made BLUE STUFF the Number One tuner care product, the lucky technician who purchases the 1,000,000th can will receive the FREE FORD ECONOLINE VAN loaded up with wire products from ALPHA WIRE, lamps from CHICAGO MINIATURE LAMPS, dealer service kits from CENTRALAB, service forms from

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*Circle 5 on literature card*

September, 1972/ELECTRONIC SERVICING 3

# electronic scanner

news of the industry

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**Varactor all-electronic tuning** for both VHF and UHF bands is new in the Panasonic line, according to an article in **Merchandising Week**. One of the two systems, called **Electo-Tuning**, has two controls for the slide-rule type dial. One moves the channel selector to the right, and another moves it to the left. All VHF channels and six UHF channels can be set without tools by the customer. This system appears to be a conventional type which tunes by applying a DC voltage to the varactor diodes. Panasonic's **Advanced System** seems to be unique. It has a 10-key pushbutton selector which is similar to that of pushbutton telephones, and two Nixie read-out tubes which show the channel number. Dialing the pushbuttons recalls the binary-coded channel number which is stored in a "binary memory". That code is used to signal a potentiometer to supply the correct preset voltage for the varactor diodes.

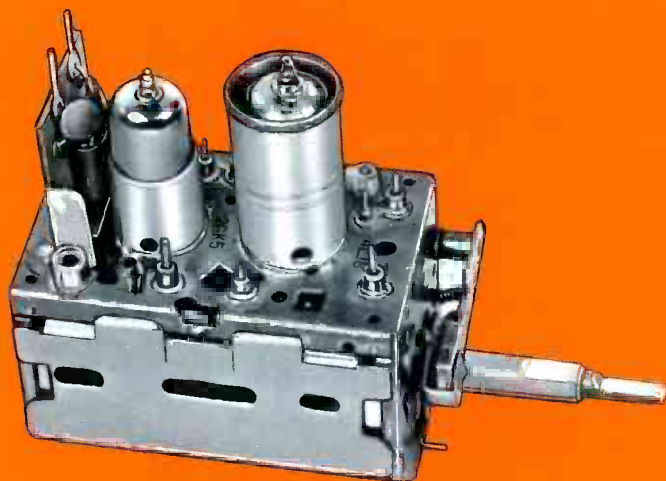
**Business licensing might become a weapon for consumer protection**, warns the **Commerce Clearing House News Bureau**. A decision in a recent New York trial court case went against a garage parking lot in its fight against a local Department of Consumer Affairs. A customer of the lot claimed he returned to find his car damaged. In turn, a garage official denied the damage had occurred there, and said that if the car had not been brought in that way, then the accident was caused by defective brakes. The city government suspended for two days the license of the garage and parking-lot operator. In the suit that followed, the court upheld the right of the city to police its licensees and protect the public. However, the court made clear that it did **not** pass on the merits of the claim by the customer for property damages, but merely on the abusive manner in which the customer was treated, and the readiness of the garage operator to disclaim responsibility without any investigation.

**Wireless communication using muon beams** has been accomplished experimentally by a government scientist, who explained the principle to a reporter for the **Wall Street Journal**. Richard C. Arnold, physicist for the Atomic Energy Commission at the National Laboratory, has sent Morse code over a distance of about 150 meters between a proton generator and a detector the size of two desk tops. The beam path included 1.5 meters of concrete. Muons are ghostly atomic particles that can pass through solid objects during their short lifetime of two microseconds before they change into electrons. Beam path distances of up to 1,000 kilometers are theoretically possible. Although this discovery has started optimistic speculation about muon generators replacing microwave communications, your editor seems to remember that a proton accelerator (atom smasher) is a huge round tunnel of several acres in size built at a cost of millions of dollars. So, I don't advise you to dump all your CB or two-way radios because they are obsolete!

**Despite the lack of standards for video tape**, **Home Furnishings Daily** reports that Sears Roebuck has sold nationally about 50 Cartrivision video-cartridge recorder/players. Admiral, Emerson and RCA are planning the addition of video tape machines to their lines by 1973. It seems likely that sales (and servicing) of these machines will be confined to a few test markets for some time to come. Expect to find information about servicing video tape machines in **Electronic Servicing** when the manufacturer's tests are completed.

*(Continued on page 6)*

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# \$975

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**PROVIDES YOU WITH A COMPLETE SERVICE FOR ALL YOUR TELEVISION TUNER REQUIREMENTS AT ONE PRICE.**

### TUNER REPAIR

VHF Or UHF Any Type \$9.75.  
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In this price all parts are included. Tubes, transistors, diodes, and nuvistors are charged at cost.

Fast efficient service at our 4 conveniently located service centers.

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	Highway 1 & 9	
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	10654 MAGNOLIA BLVD., North Hollywood, California . . . . .	TEL: 213-769-2720

Circle 6 on literature card

**National T-Day No. 3 for the CET test will be September 15, 1972.** More than 114 sites, including the editorial offices of *Electronic Servicing*, have been selected. Contact us for the site nearest to you. National Electronics Associations (NEA) is planning for these tests to be held quarterly.

**Consumer demands will increasingly focus on the service industry,** predicted Garth J. Heisig, Director of Consumer Affairs for Motorola Inc., in speaking to the Tri-State Council of TV Service Associations July 16 in Atlantic City, New Jersey. Heisig said there are estimates that within 10 years the average family will spend 15% or more of its income just to service the products it owns. This will result in a far more sophisticated service consumer. Improvement is needed, he said, in setting and maintaining realistic home-service schedules, and in notifying consumers when the schedules can't be met. Unless the service industry sets its own house in order, strict government regulation might follow. Heisig acknowledged that most service technicians do a good job, and that much of the problem is with the public image of the industry. He challenged the technicians to view their own operations from the consumer's perspective.

**An antenna 10-miles long** might be constructed by the US Navy for project Sanguine, a communications system operating at carrier frequencies below 100 Hz. According to *Electronic Distributing & Marketing*, a full-scale installation would power the antenna by a series of generators located along an insulated cable, many miles long, buried about six feet underground and with the antenna grounded at each end. An all-directional radiation pattern might require a grid pattern with as many as 20 grids in each direction, with the distance between adjacent elements varying from 4 to 10 miles. Your editor speculates that Morse code would be the only type of modulation, because the modulation always is of a lower frequency than the carrier. In this case, voice modulation appears to be impossible.

**Are vacuum tubes really doomed?** Two articles in different issues of *Radio & Television Weekly* appear to offer contradictory answers to that question. Receiving-tube sales for 1971 were only 2.7% below those of 1970. At the other extreme, most of the major manufacturers are featuring all-solid-state color and b-w models. And RCA has announced that 75% of their 1973 line of color receivers will be solid-state types. Undoubtedly, tubes someday will not be used in original equipment. But only the foolhardy would predict when that time will come.

**The Photofact-Of-The-Month (POM) Package for September** from Howard W. Sams includes a 17-page booklet called: "Consumer Electronics Service Technician SAFETY GUIDELINES". Electronic Industries Association (EIA) is supplying the booklets, and Photofact is distributing them as a service to the industry. If you would like a copy and are not on the POM mailing list, send your request to: Joe Groves, Photofact Division of Howard W. Sams, Inc., 4300 West 62nd Street, Indianapolis, Indiana, 46268. □

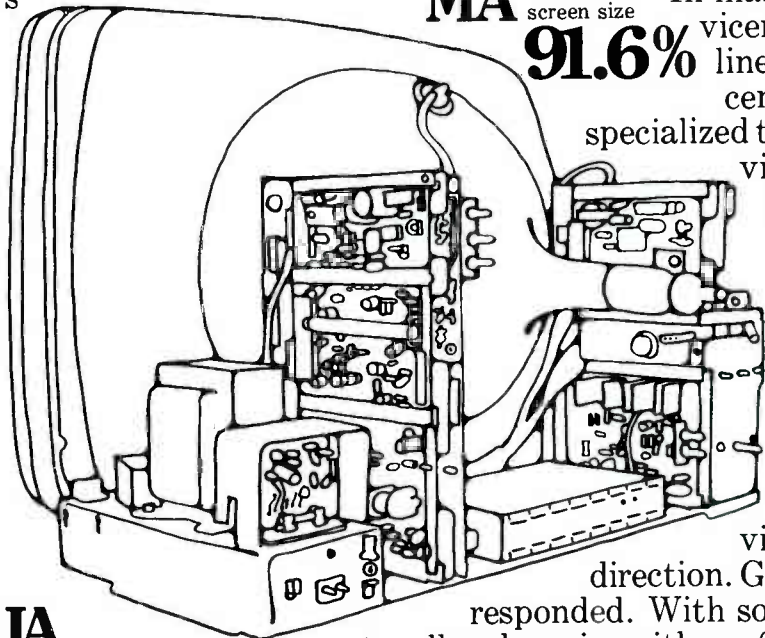


# These solid state color systems are the most serviceable we've ever built. Because independent servicers helped us design them.

Independent servicers awarded us these serviceability ratings. Proof that foresight pays. The foresight of the television service industry in developing specific serviceability guidelines and urging TV manufacturers to use them. The foresight of General Electric in working side by side with independent servicers to create 100% solid state sets that are easy to service.

GE's new solid state sets are designed for maximum accessibility. With extensive use of visual aids. And plug-in modules and components. Example: 95% of the total components in GE's new solid state modular color console models can be removed for servicing without using a soldering iron. Solid state Porta Color® II models open like a book for ease of service.

Impressed? That's only half the story. To improve local parts availability we are expanding parts distribution through independent parts distributors.



**MA** 25" diagonal screen size

**91.6%**

In many states, TV servicers use direct phone lines to regional parts centers. We provide specialized training. Our Television Service News provides advance information servicers need to more easily service GE monochrome and color models.

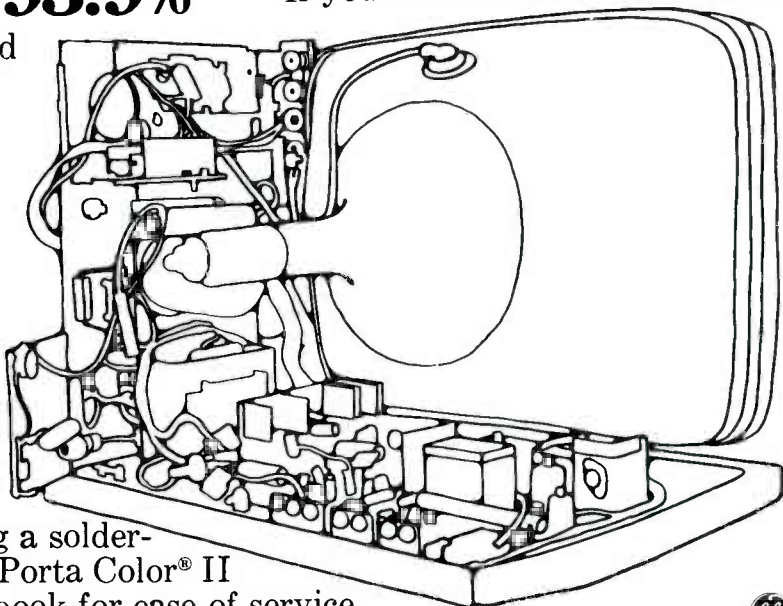
The service industry has provided foresight and direction. General Electric has responded. With solid state products to sell and service with confidence. To achieve our mutual goal of customer satisfaction.

**JA**

19" diagonal screen size

**93.9%**

If you want to know more about GE service, call collect or write "Dutch" Meyer, Television Receiver Products Department, Portsmouth, Virginia 23705. Phone (703) 484-3521.

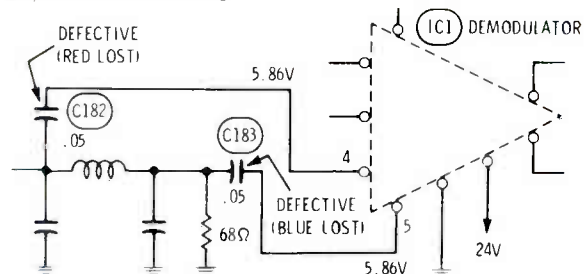


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**GENERAL  ELECTRIC**

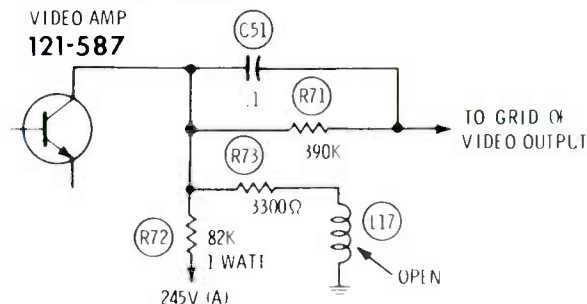
**Chassis—Zenith 14A9C50**  
**PHOTOFACT—1097-3**



**Symptom**—Loss of blue in color picture; black-and-white tracking okay; all voltages on demodulator chip are normal.

**Cure**—Check and replace C183 (.05 mfd), at pin 5 of demodulator chip (Replace C182 if red in color picture is lost)

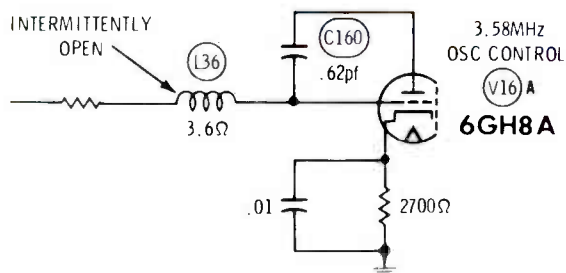
**Chassis—Zenith 14A9C50**  
**PHOTOFACT—1097-3**



**Symptom**—Brightness excessive even with brightness control and brightness range control set to minimum

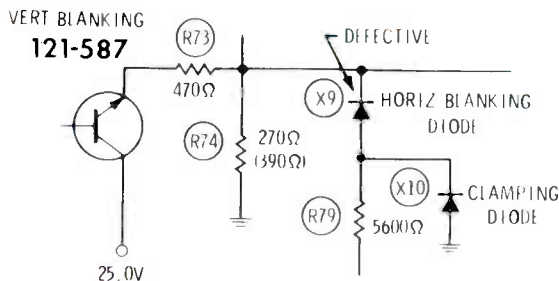
**Cure**—Check and repair or replace coil L17, if open. (If open, causes excessive voltage on collector of video amplifier transistor)

**Chassis—Zenith 14A9C50**  
**PHOTOFACT—1097-3**



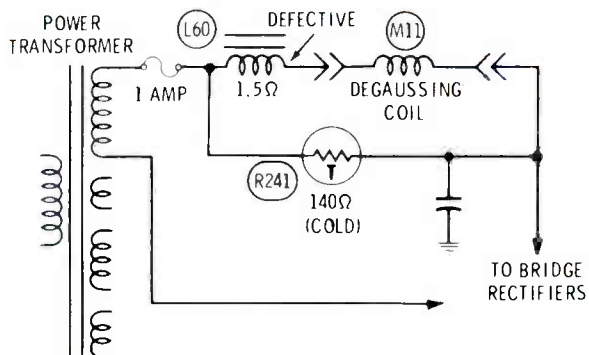
**Symptom**—Intermittent loss of color  
**Cure**—Repair or replace coil L36, in 3.58M-Hz oscillator control tube circuit. Check by temporarily shorting out with short jumper wire.

**Chassis—Zenith 4B25C19**  
**PHOTOFACT—1166-3**



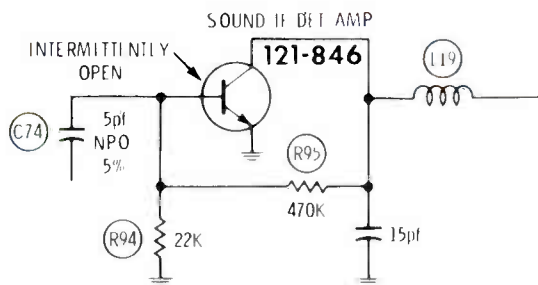
**Symptom**—Slight ringing at left edge of raster  
**Cure**—Replace horizontal blanking diode, X9

**Chassis—Zenith 14A9C50**  
**PHOTOFACT—1097-3**



**Symptom**—Weave or bend moving from top to bottom in picture  
**Cure**—Defective choke coil in series with degaussing coil, L60

**Chassis—Zenith 4B25C19**  
**PHOTOFACT—1166-3**



**Symptom**—Loss of sound after operating a few minutes  
**Cure**—Check and replace sound IF detector/amplifier (121-846)

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 **HOWARD W. SAMS & CO., INC.**  
4300 West 62nd Street, Indianapolis, Indiana 46268

ES-092

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Address \_\_\_\_\_

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Circle 8 on literature card

# editorially speaking

After working for nearly 40 years in the electronics field, I am convinced that we pay too much attention to the technical aspects, and don't give enough thought and energy to the personal-contact side of business.

Believe me, this is a radical change in my thinking, for I have always been a "nut" about electronic things, and often overlooked the personal elements. Let me share with you some of the things that have contributed to this change of emphasis.

Almost all technicians agree that our image with the public generally is a tarnished one. However, many believe that licensing laws and the activities of service associations can **force** people to accept us, and think more highly of us. This is only partially true.

Now, I believe we should all join and support the association of our choice. Even so, upgrading the technical competence of the men only restores that part of the situation to the normal state. And weeding out the incompetents and "fast buck artists" can only eliminate some negative factors. A **positive** approach also is needed.

We, the shop owners and technicians, **MUST** take personal actions which will improve our images at the local level. Assuming that this is true, what specific actions should we take?

First, we should test and analyze the **verbal** impact we have on other people. Nobody ever intends to make a poor impression, verbal or otherwise. But, sometimes we are not aware that the way we talk might "turn-off" our customers.

For example, I have known for years that the quality of my own voice was not the best; however, it

sounded fine to me. And I found that many people interpreted the things I said as being more stern or harsh than I intended. Therefore, I now make special efforts to minimize these shortcomings.

Test the effects of your voice and words by making tape recordings of conversations you have with customers. Carefully study the playback of these tapes in the quiet of your own home. Imagine that yours is the voice of a stranger. Imagine further that you are a customer who is slightly suspicious of all TV-service people because of gossip and the so-called exposes in magazines. If there is anything in your choice of words or vocal inflection that might negatively impress any customer, as you listen you'll know! Take action fast if you discover any such weaknesses.

Secondly, we should never carry a guilt complex regarding the charges we must make. Even a small doubt can make a technician unsure or cause him to over-react. Counter any such tendencies by **knowing** the cost of doing business. Some successful businesses figure a "burden" factor of three. That is, whatever the technician makes per hour must be multiplied by three to give the price-per-hour to be charged for repairs.

In any event, know your costs, and inform your technicians of it. When they are certain the charges are fair and necessary, your men can effectively reply to any negative remarks from the customers. We must be legitimate business people, then act and sound like it. Send your experiences about polishing the image of you or your business to the editor, who will share them with the other readers. □

Handwritten calculations and notes in the top right corner of the page:

$$\begin{array}{r} 200 \\ \hline 800 \end{array}$$

$$\begin{array}{r} 38 \\ 800 \overline{) 1600} \\ \underline{1500} \\ 100 \\ \underline{90} \\ 10 \end{array}$$

$$\begin{array}{r} 50 \\ 50 \\ 25 \\ \hline 440 \\ 100 \\ 400 \\ 100 \\ \hline 1165 \end{array}$$

$$\begin{array}{r} 440 \\ 38 \overline{) 1165} \\ \underline{90} \\ 265 \\ \underline{240} \\ 25 \end{array}$$

$$\begin{array}{r} 38 \text{ Labor} \\ 53 \\ \hline 91 \end{array}$$

48

2

# reader's exchange

*Needed: service information for a Delmonico Model CCTV51 combination color TV.*

**Robert E. Becker Radio & TV Service**  
208 Hazelwood Avenue  
Buffalo, New York 14215

*Needed: a yoke for a Corvette TV Model XAM1269.*

**May's Service Shop**  
413 North 15th St.  
Dade City, Florida 33525

*Needed: a schematic and service manual for a Webcor Model 210-1C tape recorder.*

**Anthony J. Wegryn**  
39 Maryknoll Drive  
Lackawanna, New York 14218

*Needed: technical data about the Ligna-Sweep Model SKV-935B made by Kay Electric Company of Pine Brook, New Jersey, and a Polylab-1 manufactured by Measurement Control Devices, Inc., Philadelphia, Pa.*

**Henry M. Leong**  
H&A Electronics, Inc.  
180 Park Row  
New York City, New York 10038

*Needed: a schematic and technical information for a model 995 Allied stereo amplifier.*

**Robert L. Piersol**  
257 Stone Quarry Road  
Monaca, Pennsylvania 15061

*Needed: a schematic and operating instructions for a model CT-1 in-circuit capacity tester manufactured many years ago by the Century Electronics Co., Mineola, New York.*

**Eugene A. James**  
4370 Louisiana Street  
San Diego, California 92104

*Needed: a schematic and other data for a Curtis Mathes Model FF500W, serial 743239.*

**Forrest Wilkinson**  
5817 North Kauffman Ave.  
Temple City, California 91780

*Needed: an overhaul for the meter of our Hickok Model 799 tube checker, and the latest tube data. We have received no answer from Hickok.*

**Wrede's Radio and TV Service**  
2054 Burnett Boulevard  
Wilmington, North Carolina 28401

(Continued on page 71)

## 5 ways to cut your cost of doing more business

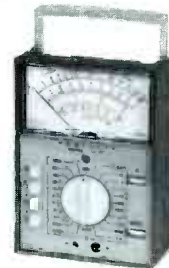
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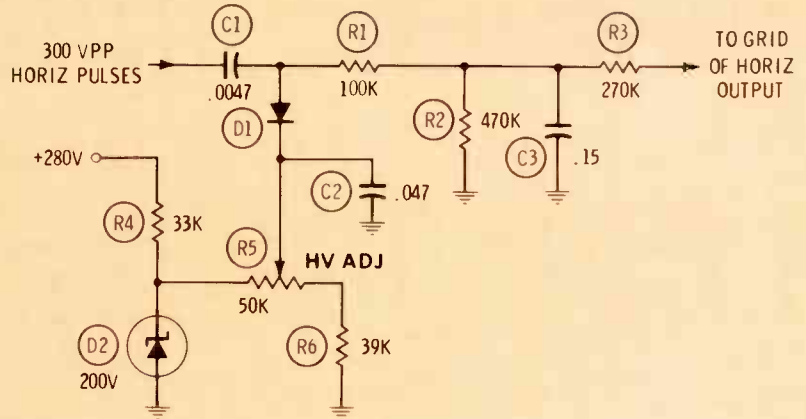
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**Fig. 1** Schematic of the high-voltage regulator used in some Magnavox color TV's. D1 rectifies horizontal pulses from the flyback transformer to vary the grid bias of the horizontal output tube according to the amplitude of the pulses. Positive DC voltage on the cathode of D1 causes the negative voltage to change more with small changes in pulse amplitude.



# Keeping HV under control part 2

by Allan Dale

Last month I described some DC high-voltage-shunt regulators used in early color receivers. Most of them used 6BK4's although other newer tubes also appeared.

But lately, not many designers specify the high-voltage-shunt regulator, perhaps because of the radiation hazard. The X-ray scare of a few years back was started by one particular type of regulator tube whose construction caused it to emit X-rays. No one wants that to happen again. So, the receivers that still use a DC-shunt regulator supplement it with a hold-down or "fail-safe" circuit to keep the anode voltage below 27 KV, even if the regulator fails.

## Grid-Bias Regulation

A grid-bias regulator circuit (see

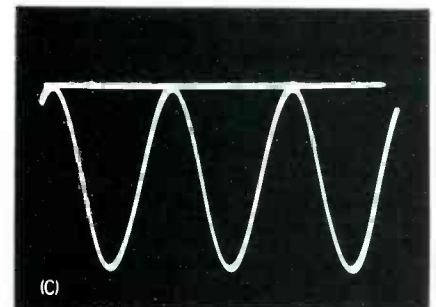
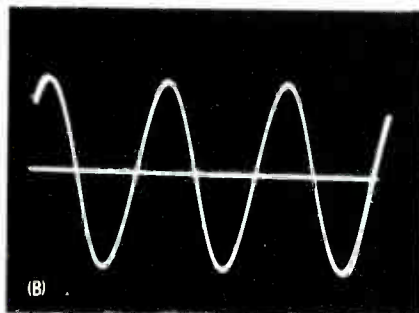
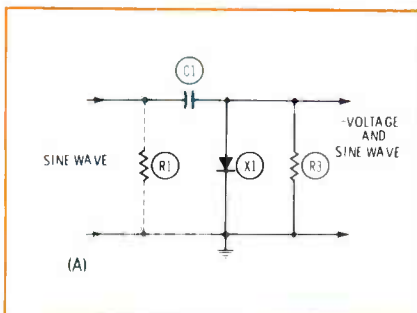
Fig. 1) operates less wastefully than a DC-shunt type because current supplying the sweep circuit is reduced in order to lower the high voltage.

Here's how the circuit of Fig. 1 operates:

- D1 rectifies horizontal pulses obtained from the horizontal-output transformer. Negative voltage from this rectification is filtered by R1 and C3 before being added to the negative voltage at the control grid of the horizontal output tube. (The negative voltage at the grid caused by rectification of the oscillator signal determines the degree of current cutoff, not the maximum plate current.)
- Increased negative voltage from D1 limits the maximum current of the output tube. This, in turn,

produces a weaker horizontal-sweep pulse and a reduced amount of DC high voltage.

- However, rectification by D1 of the entire amplitude of the pulses would yield an excessive amount of negative voltage which would not change enough for effective control of the grid voltage. This problem is solved by a reverse bias applied to the cathode of D1.
- An adjustable positive DC voltage is supplied to the cathode of D1 by the HV ADJUST control. So, D1 cannot conduct until the rising voltage of the pulse at the anode exceeds the DC voltage at the cathode. Therefore, a larger DC voltage at the cathode causes a smaller negative DC voltage at the anode, but one that changes

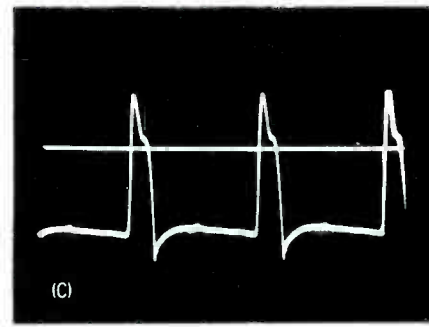
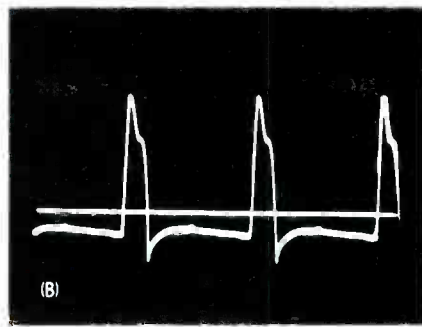
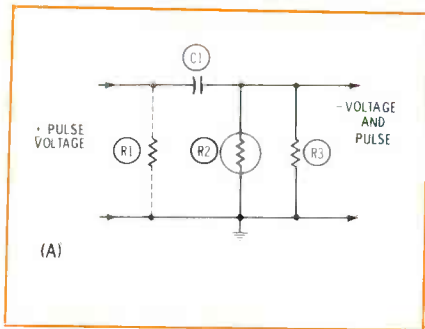


**Fig. 2** Circuit and waveforms of a shunt rectifier using a diode.

(A) Schematic of the shunt rectifier which has sine wave input.

(B) The zero-voltage line of the input sine wave is in the exact center.

(C) The zero-voltage line of the output signal is touching the positive tips of the sine wave. A DC meter reads this as a negative voltage.



**Fig. 3** The circuit of Fig. 2 modified for use as a grid-bias regulator.

**(A)** A varistor has been substituted for the diode, and the input signal consists of positive-going horizontal pulses.

**(B)** The input signal with the zero-voltage line established by use

of a DC-coupled scope. A DC meter reads this as zero volts.

**(C)** The zero-voltage line of the output signal is near the positive tips of the pulses. (With a diode, the line would touch the tips, thus producing more DC voltage.) A DC meter reads this as a negative voltage.

more when the pulse amplitude varies.

- Other variations of this circuit ground the cathode of D1 and add a fixed amount of positive voltage to the anode to partially cancel the variable negative voltage. This also makes the negative control voltage change more.

- In practice, the HV ADJUST control is set to give a specified maximum high voltage when the raster is blacked out.

When the brightness is normal, an intermediate amount of negative voltage is applied to the grid of the horizontal output tube. Decreased brightness of the picture causes stronger horizontal pulses and increased negative voltage at the grid. Increased brightness loads the sweep circuit and weakens the horizontal pulses which reduces the negative voltage at the grid and permits more plate current to power the sweep circuit.

### Troubleshooting Grid-Bias Regulators

**Failure of the diode is probably the number-one defect found in grid-bias regulators.** Some manufacturers, in attempting to reduce failures, have used series or even series-parallel diodes.

In the circuit of Fig. 1, a shorted D1 removes all the rectified negative voltage, and the positive voltage at the cathode is sent to the output grid. However, the negative voltage there is reduced only slight-

ly, because most of it is from rectification of the oscillator signal. So, the main symptom will be a loss of all regulation. You might also notice a slight compression of linearity near the extreme right edge of the picture.

In circuits where the cathode of D1 is grounded, the symptom is likely to be a total loss of regulation, but without any compression. An open D1 eliminates all regulation, but does not usually cause any other symptoms.

A narrow picture and reduced high voltage might be caused by an open R4, shorted or leaky D2, or a shorted C2. With any of those defects, the DC voltage at the grid of the horizontal output tube will measure excessively negative.

### Varistors Often Supersede Diodes

Diodes used in the shunt-rectifier of Fig. 1 are susceptible to damage by any high-voltage arc which reaches the regulator circuit. So, many manufacturers have changed the circuit slightly and substituted varistors for diodes. This has made grid-bias regulation more dependable. But notice that a **varistor cannot be used as a replacement in circuits designed for diodes: the DC voltage would be insufficient.**

Some readers questioned the simplified explanation of how varistors (VDR's) can "rectify" which was in last month's article. So, we'll review this action by using scope waveforms.

### DC From Diodes

A sine wave applied to the input of the shunt-rectifier circuit of Fig. 2A has the line showing zero voltage at the center, as pictured in the scope waveform of Fig. 2B. The positive and negative peaks average out and a DC meter reads this as zero voltage.

At the output of the rectifier circuit, the zero line (Fig. 2C) rides along the positive peaks. These are the points where the anode of the diode becomes positive and conduction occurs. This is clamping. In other words, the positive peaks are grounded through the diode.

Because all of the waveform is below the zero line, a DC meter **must** read this sine wave as a negative voltage. Of course, if the polarity of the diode is reversed, so is the polarity of the DC. All of this can be verified if you use a DC-coupled scope and a DC voltmeter.

### DC From Varistors

Suppose we replace the diode with a varistor of appropriate ratings (the circuit becomes as shown in Fig. 3A), apply a positive-going horizontal pulse to the input and analyze as before.

At the input, the zero line (see Fig. 3B) is near the base line which is between the pulses. The portions of the waveform above and below this line average, so a DC voltmeter reads zero.

A varistor decreases its internal resistance when the voltage across it is increased. However, unlike a diode, a varistor operates the same

on positive as on negative voltages; there is no polarity. Also, the resistance does not decrease so much as it does in a diode when forward biased.

Because of these varistor traits, the zero line in the signal at the output of the rectifier circuit using a varistor is located approximately as shown in Fig. 3C. A DC voltmeter applied to this signal averages the portions on both sides of the zero line and reads a moderate negative voltage. The DC voltage is less than that obtained if a diode were used, because in that event the zero line would touch the positive tips of the pulses and the entire waveform would be below the zero line, thus giving a large DC reading.

Therefore, when the signal waveform is very non-symmetrical (pulses), a varistor can "rectify" and yield a DC voltage. Notice, however, that **the polarity of the DC voltage obtained depends on the polarity of the pulse, and not of the varistor.** It follows that negative-going pulses would produce a positive DC voltage from this type of circuit.

### Varistor Replacements

Use only factory-recommended replacements for any varistors used in regulation or hold-down circuits. There are too many rat-

ings for a universal value to be successful.

### Varistor Defects

Varistors don't fail very often. But when they do, the symptoms can be strange, and many of the usual techniques ineffective.

Piecrusting or cogwheeling can be caused by a defective varistor in a grid-bias regulator circuit. In other cases, the symptom is a slight "shimmer" of the entire picture.

A fast test in many circuits is merely to disconnect the varistor. Disappearance of the symptoms indicates the varistor might be defective, and a new one of the same specifications should be substituted for the final test.

### Sweep-Pulse Regulation

Another basic kind of regulation (Fig. 4) varies the loading of the flyback pulse. If the AC load of the flyback transformer is kept constant, the DC high voltage will not change much from CRT current variations.

Again, as in the 6BK4 circuits, the grid bias of the regulator tube is determined by applying voltage from the B-boost supply to the grid and connecting the cathode to one of the B+ supplies. Less CRT current makes the B-boost voltage rise, thus reducing the bias of the

regulator tube. The lower bias permits increased plate current to load the sweep circuit and minimize the rise of high voltage which would otherwise occur.

But there is more to it than that. A constant load across the sweep circuit would probably cause heating and linearity problems. So, a pulse from the horizontal oscillator is fed to the grid of the regulator tube. Without the pulse, the bias does not allow plate current. Therefore, the regulator tube can draw loading current only from the tips of the horizontal sweep pulses. And these are the same points of the waveform during which the high-voltage rectifier conducts. Thus, a constant load is maintained across the flyback transformer, without danger of a change of linearity.

### Troubleshooting Pulse Regulation

A pulse regulator can malfunction only in three ways, such as:

- The current is insufficient to maintain regulation,
- the current is excessive causing low HV and narrow width, or
- current might flow at all times.

Insufficient regulation could be caused by a weak tube, open cathode resistor, or wrong grid bias. Normal checks should be suf-

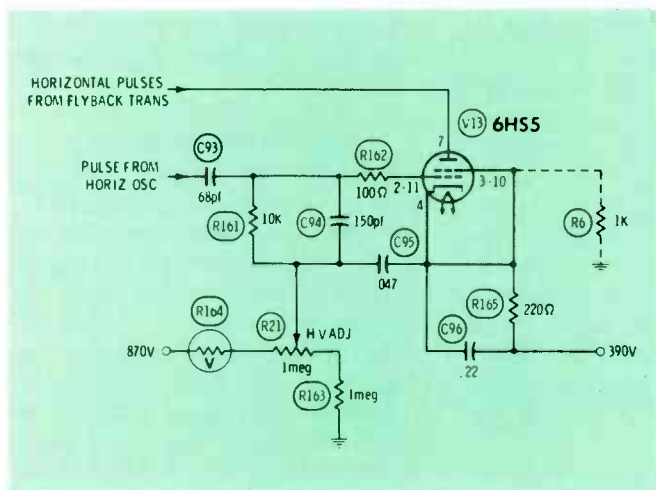


Fig. 4 Schematic of the pulse regulation circuit used in Zenith 20Y1C38 chassis.

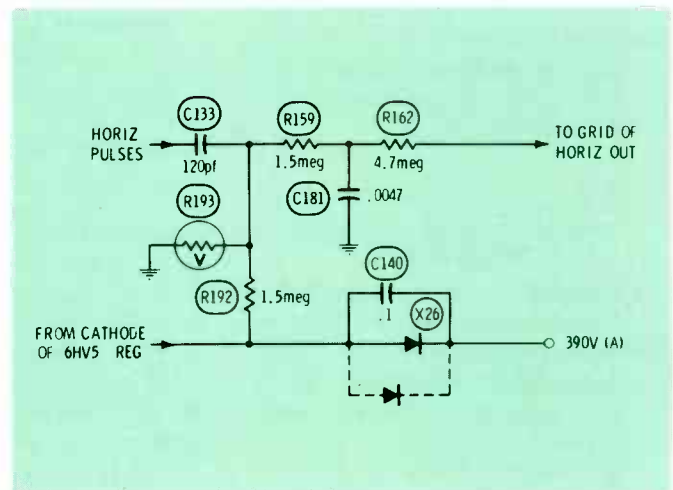
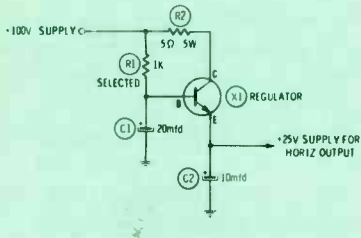


Fig. 5 Schematic of the hold-down circuit used in Zenith 14A10C19 chassis.





**Fig. 6** Schematic of the simplest regulator of the horizontal output supply voltage.

ficient to locate these troubles.

Excessive regulator current, and the low high voltage and narrow width it causes, might be caused by a shorted or gassy regulator tube, or wrong grid bias. Unplug the tube for a fast test. If the symptoms are eliminated, it is certain the regulator current is excessive.

Most of the possibilities for continuous regulator current center on C93 of Fig. 4. An open capacitor would cut off all regulator current. However, a technician might readjust the HV ADJUST control and restore some regulator current, but the linearity would suffer and the regulator tube run too hot.

At the other extreme, a leaky C93 would cause excessive regulator current. Readjustment of the HV ADJUST control might relieve the overload, but the regulation would be poor, the horizontal linearity affected and the tube would overheat.

**Be alert for regulator defects which can simulate AGC troubles,**

or give poor locking. Remember that the waveshape of the regulator current is a narrow horizontal-frequency pulse. An open B+ supply filter capacitor, to which the cathode connects, would allow large horizontal pulses to follow the B+ and enter many other circuits. Always use your scope to see what is on the B+ supply lines.

### Fail-Safe Circuits

Many of the newer receivers have "fail-safe" circuits which radically increase the negative voltage at the grid of the horizontal-output tube whenever the regulator tube fails to draw any current.

One such circuit is shown in Fig. 5, where a positive voltage is taken from the cathode of the pulse regulator tube. This positive voltage nearly equals the negative voltage produced by the varistor "rectifier" so the bias of the output tube is not disturbed so long as the regulator draws current.

If the regulator tube stops drawing cathode current, the diodes are reverse biased and open the circuit. Voltage at the cathode of the regulator dips down, possibly to zero volts. Now, the negative voltage from the VDR still gets to the grid of the output tube, but the positive voltage through R192 is missing. Therefore, the grid becomes 30 to 40 volts too negative, the picture is

narrow and blurred, and the high voltage is low.

Most strange of all, the width of the picture changes in reverse from that of normal blooming. In this case, the picture is wider when the brightness is turned higher.

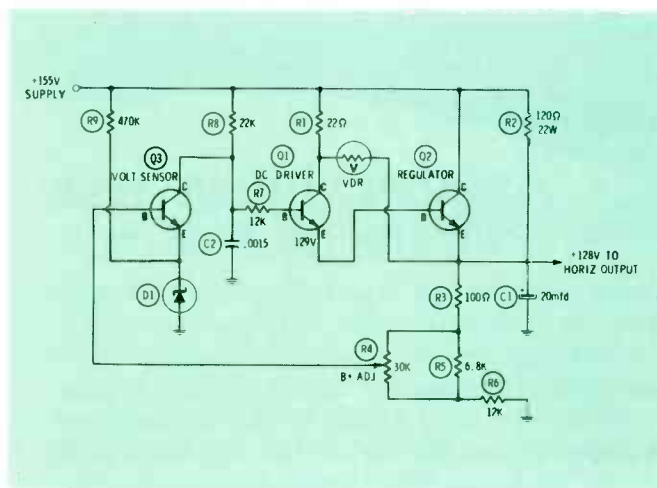
Merely short across the "fail-safe" diode, if you suspect a loss of regulator current is responsible for the narrow width and reduction of high voltage. A return to normal width is proof of the diagnosis.

### HV Regulation In Solid-State Receivers

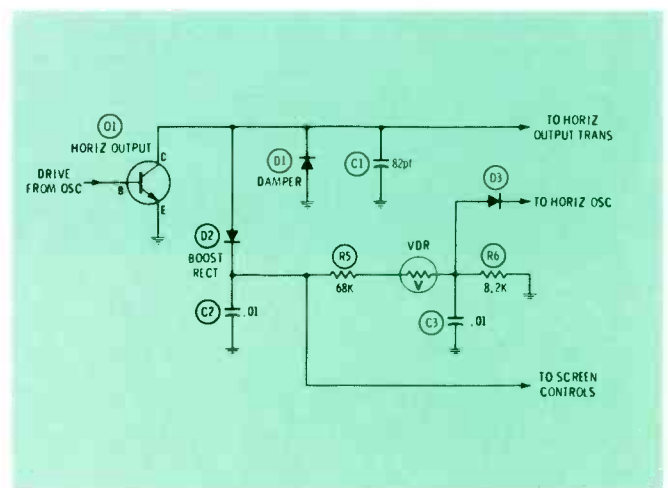
Very few color receivers directly regulate the high voltage. Many transistorized horizontal sweep circuits are series tuned, and therefore less affected by changes in the loading from CRT current compared to the large effect different loads have on the parallel-tuned tube-type sweep circuits.

However, the current supplied to the transistor horizontal output stage increases when the CRT draws more current. This makes the supply voltage decrease. So, a degree of high-voltage regulation is obtained by regulating the supply voltage.

A simple supply-voltage regulator is shown in Fig. 6. If the voltage at the emitter drops, this represents an increased bias. And the transistor decreases internal resistance in



**Fig. 7** Schematic of the regulator of supply voltage for the horizontal output stage of the Zenith 25CC55 solid-state chassis.



**Fig. 8** Voltage from the rectification of horizontal sweep pulses is used in the Sylvania EO-1 chassis to change the width of the pulses from the horizontal oscillator. This changes the sweep power.

an effort to raise the emitter voltage. Or simplify the theory and merely call it an emitter follower.

Figure 7 shows the schematic of a fairly-elaborate supply regulator used in the Zenith 25CC55 chassis. The collector-emitter circuit of Q2 acts as a variable resistor to stabilize the output voltage. A sample of the output voltage is selected by R3, R5, R6 and R4 (the B+ adjustment control) and applied to the base of Q3. Because the emitter voltage is stabilized by a zener diode, any changes in the output voltage also change the bias of Q3. Forget about Q1, which is used as an emitter follower to match the low impedance of the base circuit of Q2, when you follow the circuit action. Imagine that the collector of Q3 connects directly to the base of Q2.

Suppose a bright scene on the screen causes the +128 volts to decrease. The base of Q3 becomes less positive. This is less forward bias, so the collector voltage goes

up, and also increases the base voltage of Q2. The higher base voltage is more forward bias, Q2 decreases its collector-emitter resistance, and this raises the output supply voltage to nearly the voltage before the brighter scene. A picture of low brightness reverses all those circuit actions.

#### Pulse-Width Regulation

An unusual high-voltage regulator is diagrammed in Fig. 8. The circuit is used in the new EO1 Sylvia chassis.

Horizontal pulses from the collector of the output transistor are rectified by D2 to furnish a high B+ for the CRT screen controls. Also, part of this "boost" voltage goes through a varistor (to intensify any voltage changes) and a diode, D3, to the horizontal oscillator. This voltage determines the duration (pulse width) of the output signal from the oscillator. The wider the pulse applied to the base of Q1, the more power is supplied to the sweep circuit and the high voltage.

#### Summary

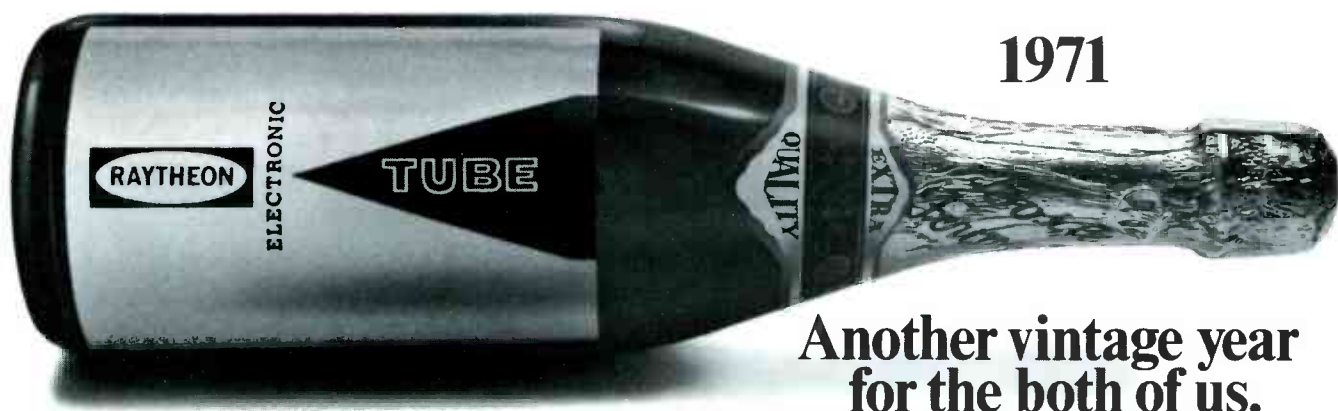
Grid-bias, power-supply, sweep-pulse and pulse-width regulators have largely replaced the 6BK4-type of HV-DC regulation. One of the problems in servicing these new circuits is in recognizing that it is a regulator. For example, a circuit that obviously changes the bias of the horizontal-output tube might be the regulator in one chassis. But it might be a hold-down or "fail-safe" circuit in another model. We hope these facts about regulators have helped to clarify some of the differences between various kinds of regulators. □

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# Protect yourself in contracts

How many contracts did you enter into last month? How many are you involved in right now? Before answering, read on.

If your business is an active one, you probably entered into **hundreds** of actual business contracts and hundreds more of non-business ones. You see, all agreements to buy or sell, each commitment to perform some act in exchange for something of value, and every exchange of one item of value for another is a legal contract. And, in most cases, the contract does not have to be written.

With this in mind, we can see that every small businessman needs to know something of the legal nature of contracts. No, not so you can be your own lawyer, or draft your own written contracts, but so you'll know how to avoid common mistakes, and when to seek expert legal advice.

## Contracts

A contract simply is a mutual obligation between two parties each of whom has a right to demand performance. Any failure to perform—called a “breach” of the contract—by one party gives the other the right to seek redress in court.

Almost every daily act of any person creates a legal relationship and obligation with another person or company. Your subscription to a newspaper is a contract. Your use of gas, water and electrical services involve contracts. Even when you pay your bus fare, a contract with the bus company is created.

## Express Versus Implied

Contracts can be **express**—that is, one where all the terms are agreed upon by the parties and are specifically set forth in detail, as in writing. Leases and insurance policies are good examples of express contracts.

Or, a contract may be **implied**—that is, it may be created by the action or behavior of the parties, or it may be created by law. Implied contracts are harder to define or typify. But usually the receipt of a benefit by one party where payment is expected by the other (that is, no gift was intended) is necessary to establish the implication of a contract. The courts treat such situations as contracts to prevent one person from gaining undeserved benefits or the other from sustaining an undeserved loss.

Contracts which are enforceable at law are called “valid” contracts. Those not enforceable are “void”. There is also a “voidable” contract: One which is valid and enforceable, but includes terms permitting one (or sometimes both) party to avoid performance of his part of the bargain. So, a voidable contract can be enforceable against one party but not the other.

## Valid Contracts

What makes a contract valid and enforceable? First, in the case of express contracts both oral or written, there must be an **intention** to create a contract. The words and actions of the parties can reveal this intention, or it can be determined by the terms of the contract.

Obligations of the contract must be assumed **voluntarily** by both parties. There must be an offer by one, and an acceptance by the other. This “meeting of the minds” results in consent.

There must be **consideration**—something of value—offered by **each** party in exchange for the performance of the other. A gratuitous promise by one party, made without any reciprocal promise by the other, is a gift and does not create a binding contract.

Parties to a contract must have the **legal capacity** to enter into it. Minors, those legally declared insane, or enemy aliens in time of war are among those who are incompetent to make contracts, or limited in their rights to do so. Some states include drug addicts, habitual drunkards and habitual spendthrifts among incompetents.

Which, incidentally, raises an important point: These discussions are necessarily general. They are from the “common law” which is the body of historic decisions and precedents going back, in some cases, six- or seven-hundred years. Statutes—laws passed by legislative bodies—may change, modify or limit common law. The general principles given here are true in



“It says, ‘Fix my hi-fi, and I’ll fix your lunch! Signed THE WIFE.’”



by Robert G. Amick

most cases, but you must know whether or not they are consistent with the statutes of your own state before acting on them.

And this brings up another point: The purpose and subject matter of a contract must be in **conformity** with the laws, public policy and morals of the place where it is made. That is, you cannot contract to violate the law, public policy or morality.

Key to the matter is **voluntary** agreement. You can't be forced or deceived into entering into a contract. To achieve a voluntary "meeting of the minds" requires a serious **offer** and an equally serious **acceptance**. The offer is a promise which, by its terms, is conditional upon being accepted. Then, if the offer is accepted, a contract results.

"I'll give you five dollars to wash my windows," is an offer. An offer must be clear, definite and specific (as this one is) so that there can be no misunderstanding or ambiguity. The offer must indicate an obvious, unquestionable intention to be bound. No joke or humorous remark (such as an offer to sell your car for a dime) is binding.

The person to whom an offer is made must be aware that it was made to him. Since a contract is a voluntary relationship, the person who makes an offer has the right to direct it to a particular person, and only that person may accept it. There is, however, a **general** offer which can be directed to a group of people—as in offers of rewards for return of lost articles, arrest and conviction of criminals or location of missing persons. The first person, who has knowledge of the offer and acts on it, accepts it, and a contract results.

Which brings up offers you make in a newspaper ad, circular, radio or TV commercial, or by a window sign. Are you bound by them? **No**. The courts have held that these are not offers to sell, but merely an invitation to the general public to visit your place of business, and to make an offer for whatever merchandise is then available. Of course, you might not want a purely legal solution when an error in your ad prices an item too low. It could be good customer relations to honor the published price. Also, check recent consumer protection laws in your community to be sure this general rule still holds.

### Ending An Offer

An offer terminates in one of several ways. It may include a specified time limit, and lapses if it isn't accepted before that time limit expires. If no time limit is specified, then the offer will expire automatically after a "reasonable" time has elapsed without acceptance. (A court might have to determine what is a "reasonable" time.) Death or insanity of either party before acceptance results in a lapse of the offer. The offerer can withdraw his offer at any time before acceptance,

unless he made it for a specific time duration.

If the person to whom an offer is made rejects it, then the offer is dead. He cannot later revive it, although the offerer can renew it. And, in a group offer, acceptance by any of those to whom it was made terminates it with respect to the others.

### Acceptance

Acceptance means compliance with the exact and precise terms of the offer. It may be the act of compliance or a promise to comply. Either way, it creates the contract. That is why it must agree exactly with the provisions of the offer. Any change in the terms of the offer which is part of the acceptance is a rejection of the original offer. This actually constitutes a counter-offer which rejects the original offer by the other party.

### Value

Consideration is necessary for a valid and enforceable contract. It is the "something of value" to be exchanged. In most circumstances, the courts insist upon its presence. In a written contract, it is set forth in fairly exact terms; while in an oral contract, it can be interpreted from the offer and the acceptance.

### Competence

What about the legal capacity to make a contract? This is one area which is undergoing substantial change right now. The law now permits 18-year-olds to vote. In several states, 18-year-olds have been emancipated in other ways.

Generally, at law, a contract made by a minor is voidable by him. He can disaffirm the contract at any time before coming of age. He must ratify it when he comes of age, or disaffirm it in his final chance to avoid

### VERBAL CONTRACT



"Five bucks extra if you can keep it until after the football season."

its terms. If he fails upon reaching maturity to disaffirm the contract, it probably will be held as if ratified by him.

The law does not intend to work hardship on the minor, nor to have him use its well-intended protection to victimize those who deal with him. Consequently, he cannot misrepresent his age; an adult trapped into a contract by such deceit might be permitted to avoid it. Moreover, a minor's contracts for necessities (food, clothing, shelter and schooling) are binding. Likewise, should a minor go to the courts to enforce a contract, he also will be bound by that contract.

While the law on other incompetents is changing slowly, some changes are being made. Those adjudged lunatic were once the main group of incompetents besides minors. Some states are now providing similar protection to addicts of drugs and alcohol, and habitual spendthrifts. But their incompetence must be declared by a court.

Since they don't wear the court findings branded on their foreheads, you'll have little protection from them. But you can have one protection: your alertness. Intoxication (by drugs or alcohol) of a contractee does not necessarily affect the validity of a contract. Before his contracts become voidable, the extent of intoxication must be such that the person doesn't know the consequences of his acts.

Performances under contracts must be legal acts in themselves. In states where gambling is illegal, a contract in which gambling is the subject matter is expressly void and unenforceable. Likewise, agreements to commit torts (civil injury to another not arising from a breach of contract) or to defraud creditors, injure good government or good public service are held to be contrary to public policy.

### Voluntary Entry

Voluntary entry into a contract has been left until now because it contains a number of special points. Certain methods of influencing you to enter into a contract destroy your right to make a free choice and therefore entitles you to relief. These are: duress, undue influence, misrepresentation, fraud and mistake.

**Duress** is the threat of force, or its use, to compel submission to another's terms. Such a contract is voidable by the victim, but will be regarded as valid until it is so disaffirmed. The victim must disaffirm when the threat is removed, or risk the determination that his failure was a waiver of his right to do so. **Undue influence** is the domination or power which a stronger-willed person exerts over a weaker one. It can be exerted by constant pressure and persuasion, or it might come about through relationships in which the parties are not on an equal footing—as guardian and ward, doctor and patient, lawyer and client. One has an advantage over the other. Again, such an agreement is valid and binding until the victim acts to avoid it, and he must act promptly to avoid the risk of delay being treated as waiver or ratification.

**Fraud** is misrepresentation of a material fact by one party, knowing it to be untrue, with the intent that the

other rely upon it and act upon it to his financial loss.

Here's an example. You're buying a delivery van and you specify air conditioning. The salesman, honestly believing the van he's showing you is air conditioned, tells you it is. You accept the van offered at the price quoted, and discover when it's delivered that it hasn't got air conditioning. That's misrepresentation, and your agreement of purchase is void.

Now, if the salesman quotes a price that includes air conditioning and knows the truck isn't air conditioned, he's committing fraud. He's intentionally misleading you; he's charging you for what you aren't getting. In fraud, the relief afforded by the courts is fairly broad, and it depends upon your needs. You can avoid the contract, you can recover your money, and you might even receive damages, too, if you've suffered any as a result of the fraud.

**Mistakes** do happen. You want to buy one item and make an offer for it. The seller has two such items, and thinks you mean the other, which is the one he intends to sell. Because of this mutual mistake, there is no understanding and no meeting of the minds; therefore, no contract. Neither side can be bound by it.

There is also an "operative mistake" in which one party is induced by fraud and misrepresentation to enter into a contract without intending to do so. You sign a paper, thinking it's a receipt, and it turns out to be a contract for something else. You couldn't read it for yourself because you didn't have your glasses, and it was represented to you as a receipt. You intended to sign the receipt, but not a contract for something else. Therefore, no intent and no contract.

### Precautions

There are a couple of general cautions. You can make a bad contract—unwise or imprudent—and get

### CONTRACT OR GIFT?



"It was nice of you to repair our sets free, Mr. Gordon—and we appreciate your offer to check them every week for us."

no help from the courts so long as your consent was voluntary. Be wary. Get advice from an expert before you make any substantial commitment.

Secondly, you can't be bound to perform under a contract in which the specific goods or subject matter are destroyed before delivery. If the building you've rented burns before you take it over, the owner can't be held accountable for a breach of contract when he can't deliver it for your use. Or, if the zoning ordinance is changed before you move in, thus barring your intended use, he can't be forced to violate that ordinance because of your contract with him.

### Oral Contracts

Now, what about oral contracts? Most of the previous general rules apply to any contract. With certain exceptions, oral contracts are just as enforceable as written ones. Certainly, a complex agreement can't be committed to memory and memory can't be relied upon. Beyond that, the Uniform Commercial Code in force in practically all states, says that certain contracts must be in writing. These are the ones you need to know about:

- Any agreement which will not be performed within a year.
- Any agreement which will not be completed within a lifetime.
- Any agreement for the sale or lease of real property.
- Any contract for the sale of merchandise of substantial value.

### Summary

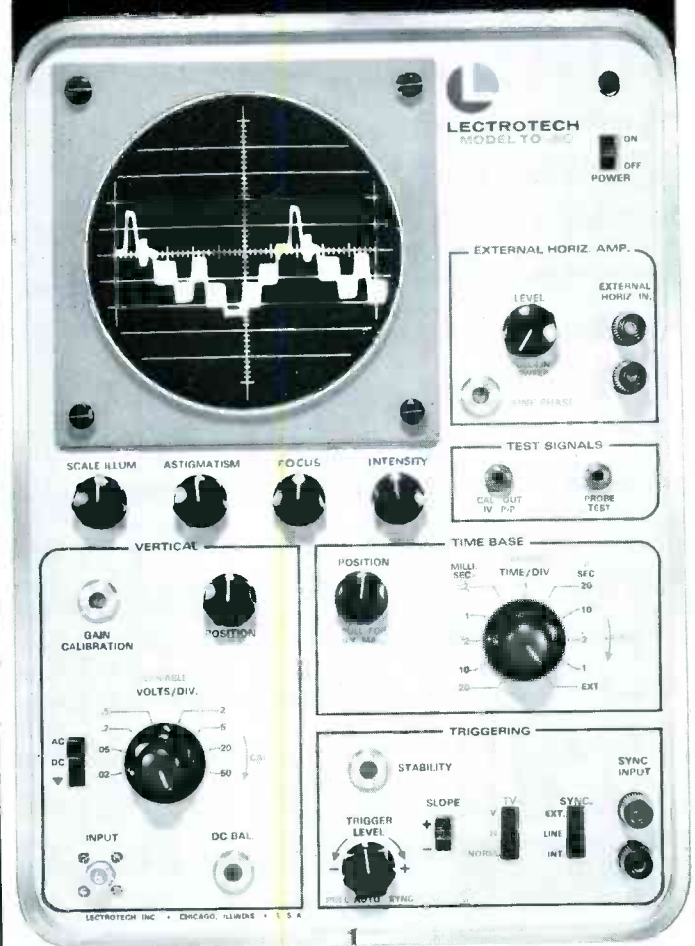
For your own protection, you should know some of the basic points of law covered here. If you contemplate any agreement or negotiations, consult an attorney. Make him aware of the special problems of your business. Be well prepared before you negotiate. Be aware of the terms and conditions you want (and those you most definitely don't want). When you're doing daily business and you must negotiate without legal advice, knowing these basics will help.

Here are some points to be sure about:

- What's being offered? On what terms? Is it valid? Is the offer still in effect? Can you get an option to keep it open? Or, will you give an option to the other party?
- Is the acceptance valid and proper?
- Are all parties legally capable of making a contract?
- Are the acts required by the agreement legal? Is the consideration of both parties present and sufficient?
- Is the agreement clear, understood by all parties, and free of the possibility of mistake?
- How is the contract to be terminated, other than by completed performance by each party? By mutual agreement? By one party only? By either? Or by the passage of a specified period of time?

One other point to remember: When you commit yourself, you're in! If you want out, consult an attorney, and do it promptly. As I've pointed out, delay might cost you the right to get out even when your legal reasons for avoidance are very good. □

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## Waveforms explain chroma demodulators part 2

by Carl Babcoke

*The editors hope you are enjoying the blend of practical-servicing information and new theory presented in this series on chroma demodulators. This concluding installment describes the two most popular demodulator circuits, and gives voltages, waveforms, and troubleshooting suggestions.*

### Grid/Suppressor Demodulation

For nearly ten years, the most popular type of chroma demodulator circuit has included a pentode tube with chroma applied to the control grid, and the 3.58-MHz carrier injected at the suppressor grid.

Figure 1 shows the schematic we used in testing this type of circuit. Tubes such as 6GY6, 6DT6 and 6HZ6 have been used in various models of color receivers. These tubes are part of a family whose largest difference from conventional pentodes is the sharp-cutoff action of the suppressor grid. Pentode tubes designed for use as RF and IF amplifiers usually require a suppressor voltage of about -40 volts to cut off the plate current. Not so with these tubes. About -5 volts is sufficient to block all plate current.

When a simulated 3.58-MHz

signal was applied to the suppressor, and no signal was fed to the grid, we expected to find clipped sine waves at the plate, similar to the ones with triode demodulators. Instead a near-perfect square wave was revealed (Fig. 2A). Evidently a negative voltage at the suppressor cuts off plate current in the normal way, but there is a limitation on how much the plate current can increase when the suppressor is positive.

We wondered how this unexpected result would affect the demodulation action, but shortly found that it had no detrimental effect. You see, the exact wave-shapes of signals at the plate are not important (except as they help us understand the action). The average plate voltage is the only signal used. After all, the AC components are filtered out before the signal reaches the picture tube.

### Normal Operation Of The Grid/Suppressor Demodulator

All of the normal typical waveforms, DC voltages, and AC voltages are shown in Fig. 2. When interpreted, they tell us the whole story.

The standard test results by which the others must be compared are those produced by a normal-

amplitude simulated 3.58-MHz signal at the suppressor, and no chroma signal at the grid (see Fig. 2A). An average plate voltage of +116 volts was measured by use of a DC voltmeter.

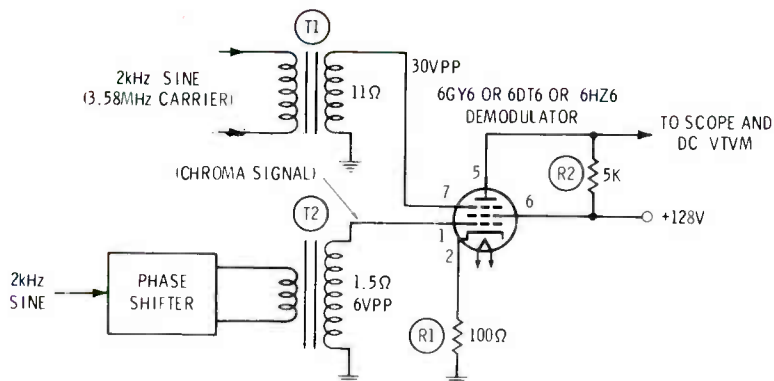
Next, according to theory, this average plate voltage should be increased or decreased by the addition of a simulated-chroma signal to the control grid. Except for the 90 degree signal which should not change the average plate voltage.

We found that in-phase signals (Fig. 2B) decreased the average plate voltage to +108 volts, apparently by elongating the lower parts of the square waves so they become pulses.

Out-of-phase signals, as shown in Fig. 2C, increased the average plate voltage to +124 volts. Notice that the bottoms of the square waves have been indented by the grid sine wave.

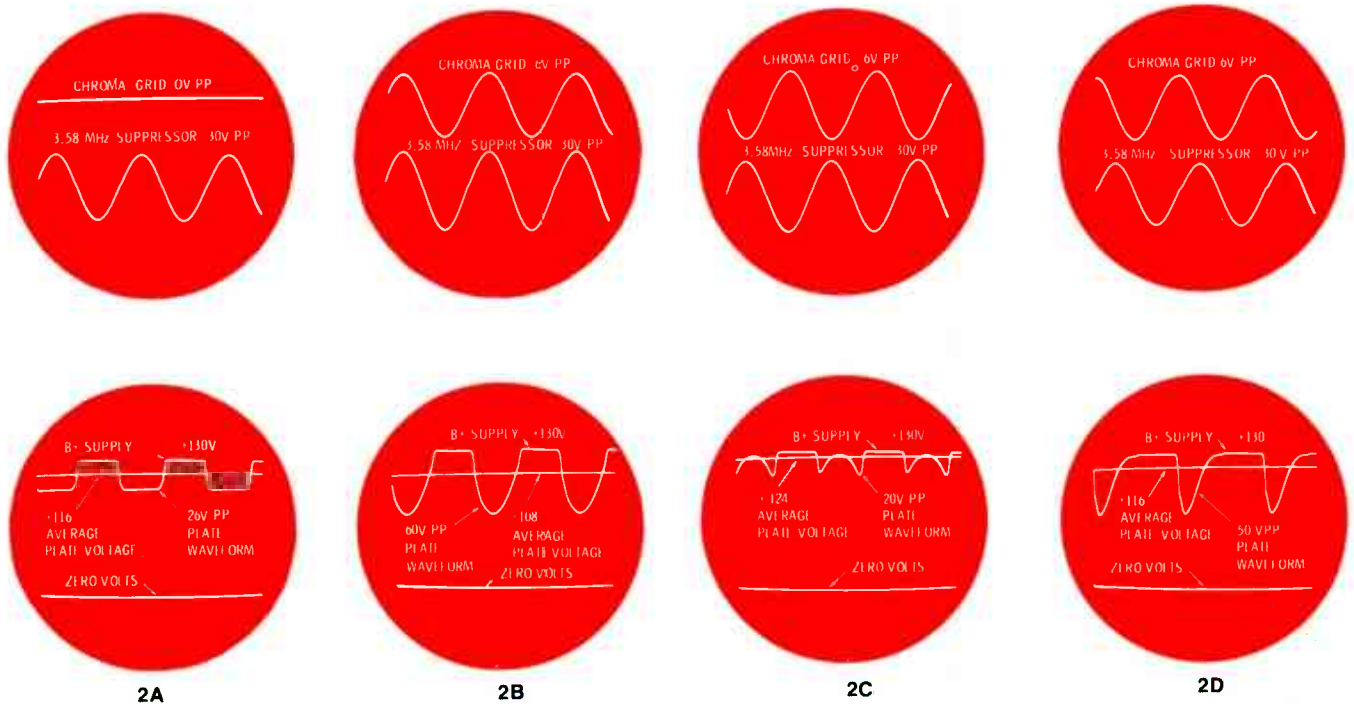
Signals of 90 degrees produced +116 volts, the same voltage as measured without any chroma signal at the grid (see Fig. 2D).

When we further analyze these results, we find the circuit performed very well all of the basic specifications for demodulators. Also, the 8 volt increase and decrease with signals of 0 degrees and 180 degrees was higher than measured with the previous circuits.



**Fig. 1** This is the circuit we used to test the grid/suppressor-grid type of chroma demodulator. Because there are no RC time-constant filters in either grid circuits, and the DC resistances are low, no DC voltages were measured at the grid or suppressor grid.



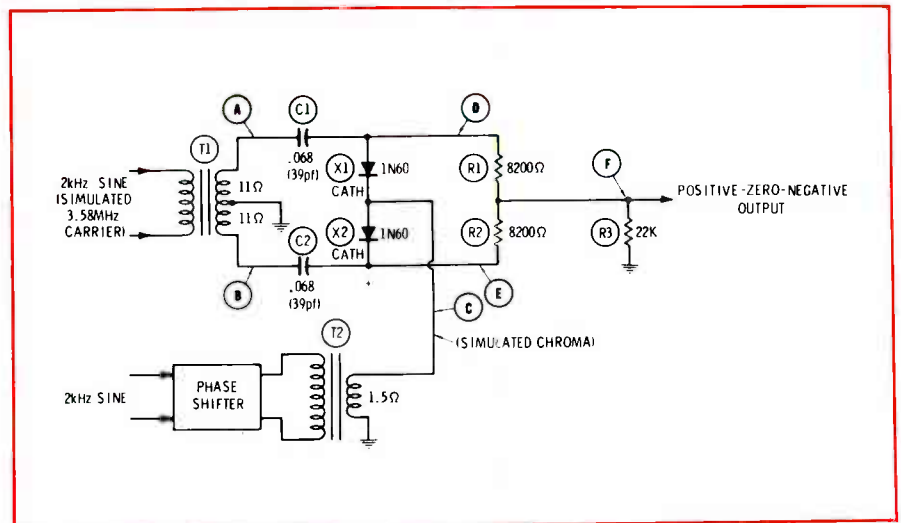


**Fig. 2** These are the waveforms and voltages when signals of various phases were applied to the grid/suppressor-grid demodulator.

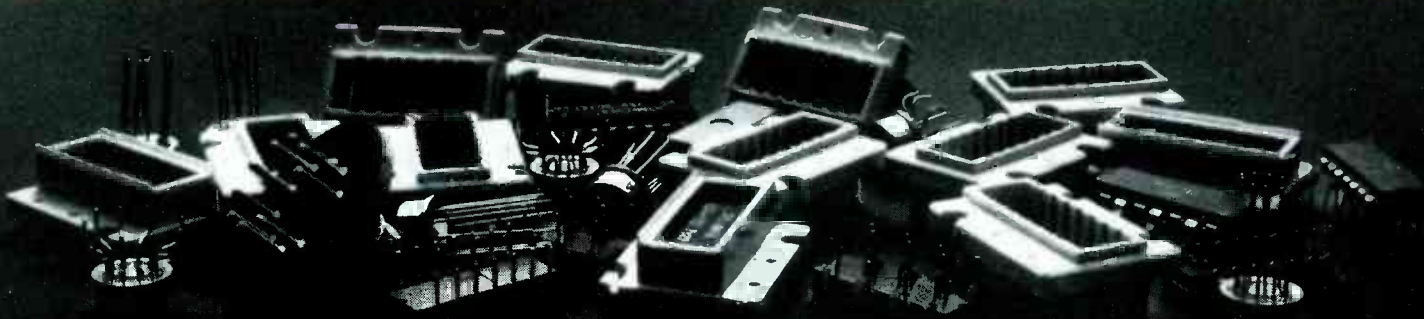
- (A)** Waveforms and voltages obtained with a normal-amplitude simulated 3.58-MHz signal, but no chroma signal.
- (B)** A strong in-phase simulated chroma signal reduced the average plate voltage by 8 volts DC.
- (C)** Out-of-phase chroma subtracted from the carrier and increased the average plate voltage by 8 volts.
- (D)** A strong 90-degree chroma signal added during ¼ cycle and subtracted during another ¼ cycle to tilt the waveform but gave the same DC plate voltage as obtained with no chroma.



**Fig. 3** DC plate voltage measured +112 volts without either chroma or carrier signals, and +118 volts with strong chroma but no carrier. Under these conditions, the demodulator is positive-going and is the reason for all-green color bars in actual receivers.



**Fig. 4** The circuit we used to test diode demodulator circuits. In some receivers, the points where the chroma and carrier signals enter the demodulator are cross-switched. However, this does not change the basic theory of operation.



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CA3071	715	MC13031	725
CA3072		MC1303P	725
CA3075	713	MC1304P	718
DM-11	723	MC1304PQ	720
DM-14	709	MC1305P	720
DM-24	718	MC1305PQ	720
DM-26	719	MC1307P	722
DM-30	721	MC1307PQ	722
EX4053	721	MC1314G	704
FF274	722	MC1328G	707
FL274	715	MC1328P	713
	712	MC1328PQ	713
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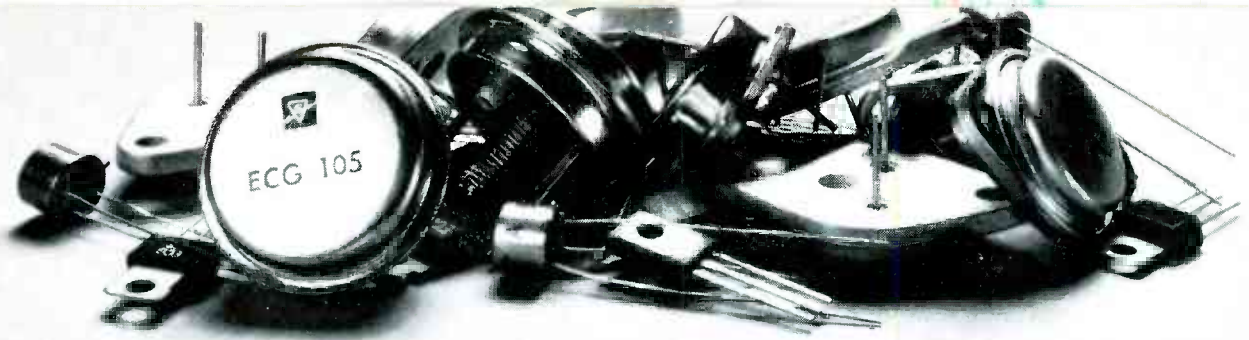
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AD149-01	121	OP 8-P	130
AD149-02	121	OP 10	179
AD149B	121	OP-11	130
AD150	121	OP-12	130
AD152	131	OP-13	185
AD155	131	OP-14	184
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indicating good efficiency. And good linearity is indicated because the increase of plate voltage equalled the decrease with the opposite phase.

Proof that the two signals of 90 degrees relative phase added for 1/4 cycle and subtracted for 1/4 cycle is found in the tilted plate waveform.

### Green Color Bars

When there is no 3.58-MHz at the color demodulators, a color bar pattern will consist of all green bars. Further, the color control will adjust the saturation, but the tint control will have no effect.

Part of the explanation for these symptoms can be found in the voltages and waveforms of Fig. 3. With no chroma or 3.58-MHz, the average plate voltage of our test demodulator was +112 volts. Then, when we applied a normally-strong chroma signal to the grid, the plate voltage rose to +118 volts. This represented a positive-going output with signal.

Before the red and blue signals reach the grids of the picture tube, they are phase inverted by the -Y amplifiers. So, the bar signals at the red and blue grids are negative-going, and this removes the red and blue from the bars.

On the other hand, green is made from samples of red and blue signals from the demodulators. Therefore, the green CRT signal is positive-going and, in the absence of red and blue, causes green bars.

The tint control does not operate because there is no phase comparison in the demodulators (only one signal). Any phase of chroma signal yields green color on the CRT screen.

### Troubleshooting the Grid/Suppressor Demodulator

A burned cathode or plate-load resistor, or a defective tube, is the most likely cause of a demodulator defect. Often the tube shorts and burns the plate load resistor so it becomes a low value. Then after the tube is checked and replaced, there is still no output from the demodulator. Check the resistors, too.

Remember that weak output from the demodulator can be

caused by either a weak chroma signal or a weak 3.58-MHz carrier. Because the sources of these signals are common to both demodulators, the weakness will affect all colors the same.

Surprisingly, the amplitudes of chroma and carrier signals can be measured accurately enough by using the AC peak-to-peak ranges of VTVM's and FET meters. The low impedances at these points permit such measurements with no disadvantage, except a slight change in tint while the probe is touching the circuit. Expect the 3.58-MHz carrier to measure between 15 and 25 volts p-p, and the chroma signal between 6 and 12 volts p-p for normal operation. Smaller readings usually indicate weak color.

### The Principles of Diode Demodulation

All three of the previously-described demodulators shared the same basic operation in which a tube was overloaded by a 3.58-

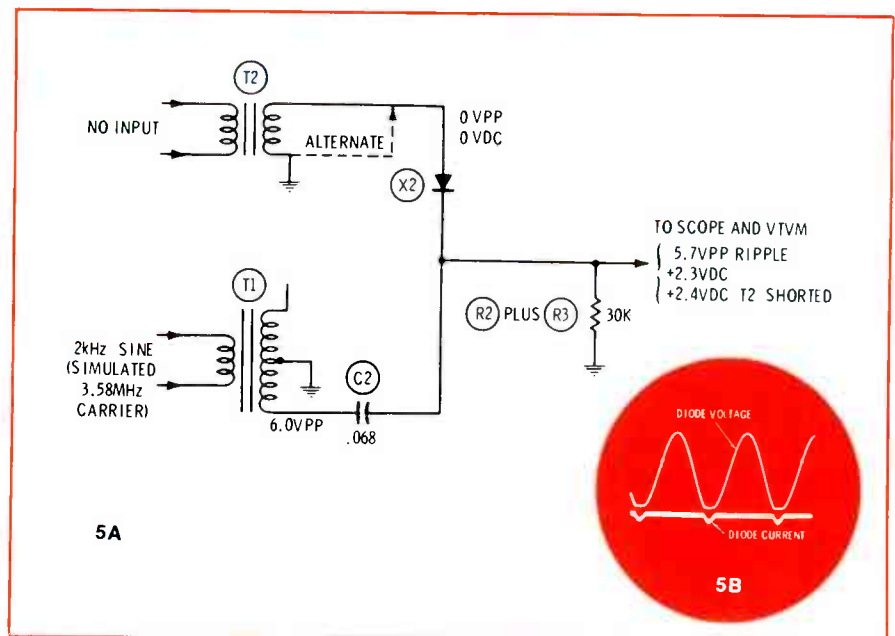
MHz carrier of strong amplitude. This gave an average plate voltage that changed when the chroma signal was added. Another similarity is that tube conduction occurred during about 40 per cent of each cycle.

Diode demodulation is completely different. It operates by peak rectification of the total vectorial voltage of the two signals. And because the rectification is peak-reading, diode conduction occurs for a very small percentage of each cycle.

The schematic of the R-Y diode demodulator used in a RCA CTC38 chassis is shown in Fig. 4. It is nearly typical, although other brands and models reverse the points where the chroma and 3.58-MHz carrier enter the circuit. None of these differences change in the slightest the basic principles of operation.

### Peak-Reading Rectifiers

Notice this first important fact about diode demodulators: Each



**Fig. 5** The circuit action is easier to understand when one-half is analyzed alone. **(A)** Partial schematic showing that the simulated 3.58-MHz signal was rectified by a shunt circuit. When there was no chroma, T2 acted only as a low-value resistor in series with X2. The output was a large sine wave whose negative tips were clamped to zero voltage. Therefore, it measured on a DC voltmeter as a positive voltage. **(B)** Dual-trace waveforms show that diode conduction occurred on the negative cycle of the sine waves, and that diode current flowed only for a short time during each cycle.

diode rectifies in the shunt peak-reading mode for one of the signals, and in the series peak-reading mode for the other.

It is helpful to examine just the action of one diode, then later add the other diode circuit in parallel. Fig. 5A shows the schematic of X2.

Assume that the secondary of T2 is shorted by a test lead to eliminate the simulated chroma signal. The circuit now is a shunt rectifier. Signal enters via C2, the peak-reading capacitor, X2 is in parallel with R2, the load resistor, and nearly the full input voltage appears at the output as ripple. The waveform across the diode and the waveform of diode current pictured in Fig. 5B. Proof that the action is peak reading is found in the short period of conduction.

### Series Rectification

Figure 6A shows the same schematic of X2, but with the chroma signal entering via T2 to the anode of X2, and with C2 grounded.

Diode current waveform and the input sine wave are pictured in Fig. 6B. Again, peak-reading action is proved by the short conduction time.

C2 is the input filter capacitor that makes the circuit peak reading. It also reduces the ripple present at the output. Figure 6C shows the normal waveform of the ripple with the secondary of T1 in series with C2, and also the sawtooth ripple (typical of power-supply rectification) that resulted when the secondary of T1 was shorted.

### Vectoral Addition Or Subtraction At The Diodes

Both signals undergo peak-reading rectification, so it is unimportant which type of rectification is dominant at any time. Rectification will be in the mode of the strongest of the two signals (usually the 3.58-MHz carrier). To each diode, only the voltage across itself produces results.

Notice that, because the two signals enter opposite ends of each

diode, phase addition appears to be reversed. When the phase of the signals at anode and cathode is 180 degrees, the voltages add. When the phase is 0 degrees, the voltages subtract. Phases in between these partially add or subtract.

Therefore, the actual AC voltage across the diode (which determines the DC output voltage) depends not only upon the amplitude of the two signals, but also upon the relative phase. But the polarity of the DC voltage obtained is determined **only** by the polarity of the diode. Each diode produces a positive or a negative voltage.

### Two Opposing Rectifiers Make Up One Demodulator

Each of the two diodes has an output DC voltage which can vary from zero to either positive or negative. Connected together (as in Fig. 4) the output voltage can range from negative, to zero, or to positive. This satisfies one basic requirement for all demodulators.

In our example, the 3.58-MHz reference carrier is applied in push-pull (180 degrees) to the two diodes operated as shunt-rectifiers. The chroma signal is applied single-ended to both diodes connected as series rectifiers. The separate output-load resistors (R1 and R2) are equal in resistance.

Under four different conditions the DC output voltage (point "F") will be zero. These conditions are:

- when both signals are missing,
- when the 3.58-MHz carrier is missing but the chroma signal is normal,
- when the chroma signal is missing but the 3.58-MHz carrier is normal, or
- when the phase between the two signals is 90 degrees.

### Missing Signals

Listings of the voltages measured in our simulated demodulator circuit are shown in Chart 1. Waveforms are not included because most were sine waves and, therefore, not very informative.

When the 3.58-MHz carrier is missing, but the chroma signal is normally strong, X1 and X2 are series peak-reading rectifiers producing a negative voltage at the

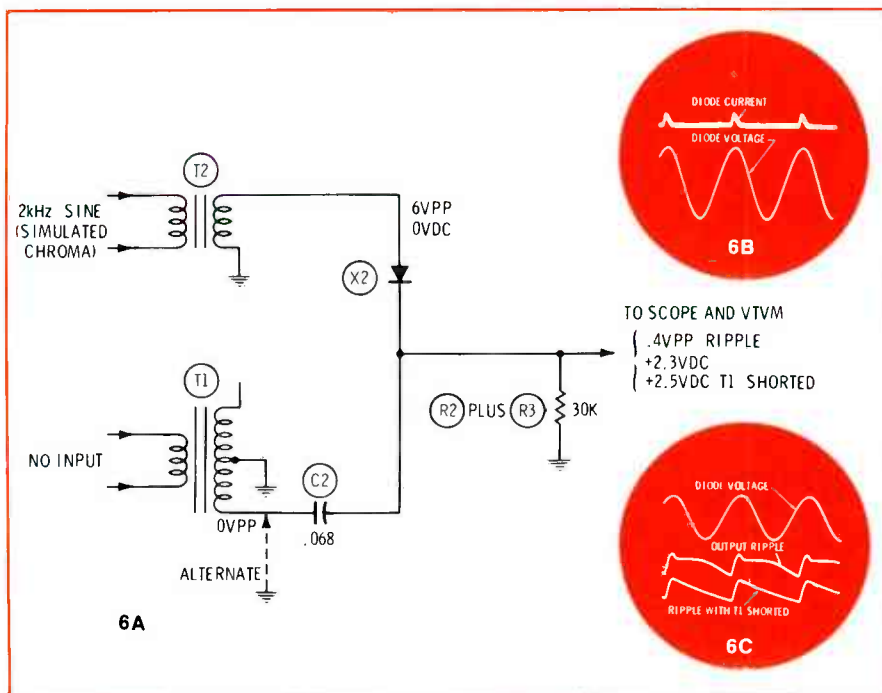
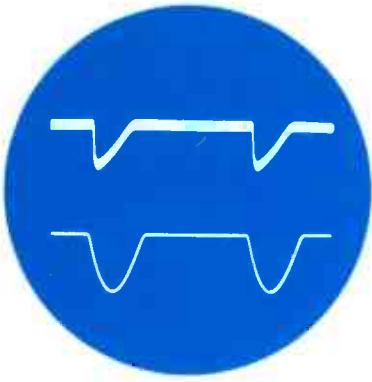


Fig. 6 To the chroma signal, X2 operates as a series peak-reading rectifier.

(A) Partial schematic shows that C2 is the peak-reading filter capacitor, and is in series with the low-resistance winding of T1. The output consisted of positive DC voltages with a small amplitude of ripple.

(B) Dual-trace waveforms show the input sine wave and the diode conduction which occurred for a short time at each positive tip.

(C) The waveform of the ripple at the output was changed from the normal sawtooth by the impedance of the T1 winding in series with the capacitor.



**Fig. 7** The harmonic content of the diode current is reduced by the low-value anti-radiation resistors. The vertical leading edges of the top waveform indicate a high harmonic content without the resistor. Fewer harmonics are shown by the more-rounded lower waveform, after addition of the resistor.

anode of X1 which is exactly equal to the positive voltage at the cathode of X2. After joining through R1 and R2, a near-zero voltage should be measured at the output, point "F".

In the same way, a missing chroma signal combined with a strong 3.58-MHz carrier operates the diodes as shunt peak-reading rectifiers which also yield equal positive and negative voltages at the same diodes, and a near-zero output voltage.

Although these voltage readings can be helpful in troubleshooting, or in explaining the circuit operation, they cannot alone show when one of the signals is missing.

### Voltages With Various Phases

Assume that the signals across diode X2 in Fig. 4 are in-phase. This is vectorial subtraction, the diode has less AC voltage across it, and the DC voltage at point "E" will be less positive than it was without a chroma signal.

Just the reverse is true at X1, because the phase of the signals at cathode and anode of X1 are out-of-phase and so vectorially add to a higher voltage across X1. A more negative voltage appears at point "D".

At this time, the output voltage is not zero because of the unbalanced voltages at points "E" and "D". Instead, the DC output voltage is negative at point "F".

When the phase of the chroma signal is reversed, a decreased neg-

ative voltage is produced at point "D" and a correspondingly increased positive voltage is produced at point "E". Now the output voltage measures positive DC at point "F".

But when the phase of the chroma signal is 90 degrees, the two signals add partially at both X1 and X2. There is a higher negative voltage at point "D" and an equally higher positive voltage at point "E". Therefore, the output voltage at point "F" is zero.

All other phase relationships between the two signals must fall between the in-phase and out-of-phase example. This fulfills all of the specifications necessary for good demodulation.

### Troubleshooting Diode Demodulators

For faster troubleshooting, first eliminate one of the two signals and check to see if the DC voltages at the two diodes are **equal** and **opposite**. Usually the chroma is eliminated by use of the color control; this is the easiest method.

In some circuits, the entire demodulator is floated above ground. For example, all the grounds of Fig. 4 might be connected together and tied to a positive voltage to furnish transistor or tube bias for the following -Y amplifiers.

Use this sequence of tests:

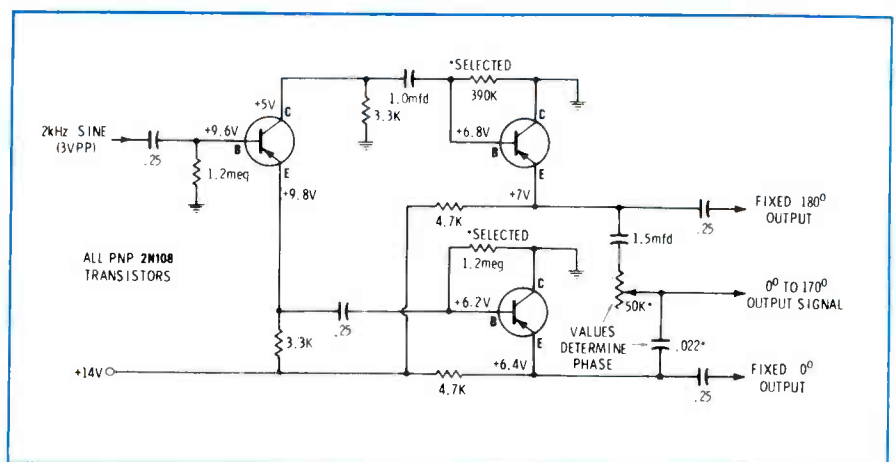
- Tune in a color bar pattern, and attempt to obtain normal saturation

and tint. (In some models, a color signal is necessary before the 3.58-MHz carrier can be generated.)

- Completely turn down the color control.
- Measure the DC voltages at the points corresponding to "D", "E" and "F". Use chassis ground or floating ground, whichever applies.
- Normal voltages should be around -3 to -6 at point "D", the same positive voltage (within 10%) at point "E", and only a few tenths of a volt at point "F".

If voltages within normal tolerances are obtained, the demodulator should have normal operation when supplied with chroma of the correct relative phase. Defects will cause one of these conditions:

- If all three voltages are near zero, the 3.58-MHz carrier is missing.
- A negative voltage at "F" which is about 3/4 of the negative voltage at "D" indicates either R2 or X2 is open. (If the circuit does not have R3, the readings will be the same.) A higher-than-normal positive voltage at "E" shows that X2 is normal, but R2 is open.
- A positive voltage at "F", which is about 3/4 the positive voltage at "E", indicates either R1 or X1 is open. (Again, if R3 is not used, the two voltages should be the same.) A higher-than-normal negative voltage at "D" shows that X1 is normal, but R1 is open.
- A normal negative reading at



**Fig. 8** This is the schematic of a phase-shifting circuit we built to test (at phases other than zero and 180 degrees) the performance of various demodulators.

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point "D", 1/2 of that reading at "F" and zero voltage at "E" indicates X2 is shorted, or C2 is open or shorted.

- A normal positive reading at "E", 1/2 of that reading at "F" and zero voltage at "D" indicates X1 is shorted, or C1 is open or shorted.
- If the negative voltage at "D" is slightly low, the voltage at "F" is slightly positive, and the positive voltage at "E" is normal, C1 might be leaky or partially open, or X1 might be leaky.
- If the positive voltage at point "E" is slightly low, point "F" is slightly negative, and "D" is normally negative, C2 might be leaky or partially open, or X2 might be leaky.
- Low and either equal or unequal voltages at both "E" and "D" indicate a defect in T1 or the preceding 3.58-MHz circuit. Also, such a defect should affect all the demodulators in the same way.
- Normal and equal DC voltages at points "D" and "E", but a positive or negative voltage at "F" indicates R1 and R2 are not equal in resistance. There is also a possibility that a defect in the circuit following "F" might affect this voltage. Disconnect the following circuit to find out.

Any demodulator which successfully passes these tests should have normal output when supplied with enough chroma signal, the phase between the chroma and carrier is correct.

### Scope Analysis

A fast check with a scope can determine if the two signals are present at the diodes, and if there is demodulated output. However, the results are not so definite and accurate as the conclusions reached by analysis of the voltage and ohmmeter tests.

### Open Diodes

An open diode produces an output signal swinging either positive or negative (depending on which diode is open) but not to both polarities. This could cause the affected color bars on the screen to be too dark or too bright, and give poor color rendition.

### Shorted Diodes

Shorted diodes also destroy the ability of the demodulator to swing both positive and negative. But more important, this is a permanent partial short on both signals. The result is both weak color and poor color reproduction.

### Anti-Radiation Resistors

Most actual diode demodulator circuits have one or more added low-value resistors whose function is to reduce radiation of the 3.58-MHz signals. Such radiation can cause serious interferences on Channel 6.

Undoubtedly, these resistors reduce the interference, but we submit that they do so, not so much by reducing the efficiency of radiation, as by reducing the harmonic content of the signal.

Partial proof of that statement can be found in the waveforms of Fig. 7. The upper waveform, whose sharp leading edges indicated a high harmonic content, is the current of the diode without an anti-radiation resistor. Far less harmonics are shown by the more rounded lower waveform, which is the diode current after the resistor was added. Fewer harmonics means less radiated interference.

### Circuits We Used To Shift The Phase

The home-brew circuit we used to provide the various phases for these demodulator measurements might be of interest to you. It is shown in Fig. 8. An audio oscillator was used as source of the sine waves. First stage of the phase-shifter is a phase inverter, followed by two emitter-followers (to give low impedances). Then the two signals of opposite phase were combined through a small capacitor (selected for the frequency used) from one channel and a variable resistor from the other. A capacitor value of about .1 could be used for 60 Hz operation, for example. Output of the phase-shifter should be lightly loaded for best operation.

We judged the 90-degree phases by the position of the sine waves on the screen of our scope; 90 degrees was halfway between 0 degrees and 180 degrees. □



# "DEAD" Damper Operated

While gathering data for an article about horizontal sweep in color TV's, we noticed a puzzling and unexpected symptom: a damper tube continued to operate after the heater voltage was reduced to zero.

Now, a valid simulation of weak emission can be obtained by operating a non-defective tube at reduced heater voltage. During this particular simulation, a 6-volt heater transformer (supplied with power by a variable-voltage transformer) was used to furnish various heater voltages to a 6AU4 damper tube.

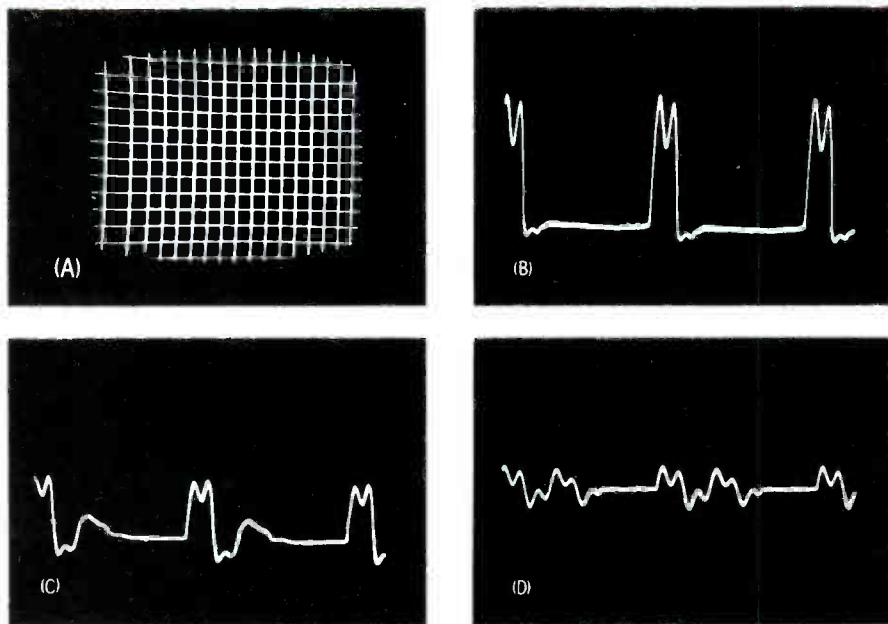
When the heater voltage was eliminated suddenly, the linearity expanded near the left edge of the picture, then the picture narrowed, darkened and disappeared. This is the normal sequence when the heater voltage of a damper tube is lost.

However, when the heater volt-

age was reduced **very slowly**, the linearity expanded near the left edge of the picture in the usual way, but then the sequence of symptoms stopped. Heater voltages from 3.2 volts AC down to zero volts produced no further changes. No light could be seen from the heater or the cathode. However, the metal of the plate showed a dim red glow.

To prove that this unusual symptom was not caused by leakage, gas, or some other defect in this individual tube, we substituted two other new damper tubes. The results were identical when the heater voltage was reduced very slowly.

My explanation for this unorthodox behavior is that the decreasing heater voltage caused increased plate-to-cathode resistance which, in turn, produced more heat at about the same rate as the decrease of heat from the heater element. What is your explanation?



**Fig. 1** Crosshatch and yoke waveforms produced by a weak damper tube. **(A)** This crosshatch pattern was produced by the "dead" damper tube. **(B)** A moderately-weak damper tube gave this waveform. Fig. 1A is the crosshatch pattern obtained at the same time. **(C)** When the heater voltage was changed rapidly from normal to zero, this waveform appeared immediately after the raster disappeared. **(D)** Several seconds after the raster disappeared, the waveform was reduced to nearly zero, and all traces of damper action were missing.

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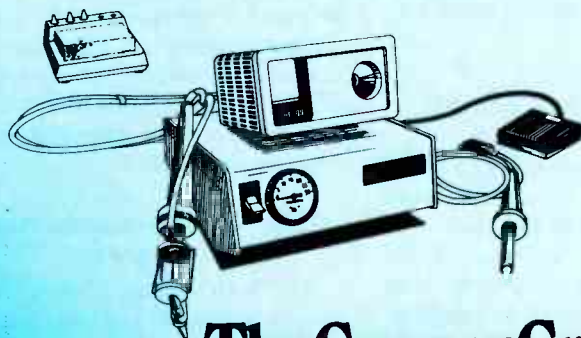
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# POST-SCRIPT FOR TEST JIGS

by Carl Babcoke

In the April issue of *Electronic Servicing*, we neglected to describe the color test jigs of a prominent manufacturer, Pix-O-Scope, Inc. In addition, we have discovered that certain combinations of chassis and jigs distort the horizontal sweep waveforms and change the high voltage and B-boost voltage. Thus, this postscript is presented.

## Double-Tipped Horizontal Pulses

Horizontal-blanking waveforms at all three grids of the color picture tube showed an abnormal double tip (Fig. 1A), when we checked an Admiral 25D6 chassis on one of the RCA color test jigs.

Also, the horizontal sweep waveform (Fig. 1B) had a prominent second tip, the B-boost voltage was low and the high voltage too high.

These wrong voltages and waveforms were the results of a mismatch between the test jig and that particular chassis. But, notice that the mismatch was **not** wrong impedances of the yoke coils, but of **tuning** the horizontal sweep circuit.

## Where Are The Tuning Capacitors?

Most tube-type horizontal-sweep circuits in color receivers use some variation of the yoke wiring shown in Fig. 2. The 100 Pf capacitor is not in question: it is there to prevent wavy horizontal-scanning lines on the left edge of the screen. Most important, in this case, are the two 560 Pf capacitors. They tune the combined inductance of the flyback transformer and the yoke.

The possibility of wrong tuning occurs because the two capacitors might be located inside the yoke

cover in some models of receivers, but in others are located inside the chassis. If there are capacitors in the test jig and also in the chassis under test, the total capacitance will be too high. This combination will cause reduced high voltage, excessive B-boost voltage, and a wider picture.

On the other hand, if neither the yoke nor chassis has these capacitors, tuning of the circuit is by stray capacity. The result is excessive high voltage, reduced B-boost voltage, a narrower picture, and the wrong waveforms of Fig. 1.

Exact circuit functions of the yoke-tuning capacitors were given in Fig. 2 on page 37 of the November, 1971 issue of *ELECTRONIC SERVICING*, and will not be repeated here.

## Effects Of Various Tuning Capacitances

Figure 3 shows several waveforms and voltages obtained by testing the effects of different values of capacitances paralleled across the yoke coils. The receiver was adjusted for a picture with normal brightness and contrast. Larger values of capacitance increased the width. A capacitance of 360 Pf gave about one inch more width than was obtained without any capacitance.

## Theory and Practical Results Agree

DC high voltage is developed by rectification of the positive-going tip of the horizontal-sweep pulse. The smaller the yoke-tuning capacitance, the higher is the pulse voltage developed by collapse of the yoke's magnetic field, and the greater the high voltage.

But, notice that a smaller yoke-tuning capacitance **reduces** the B-boost voltage. This unexpected

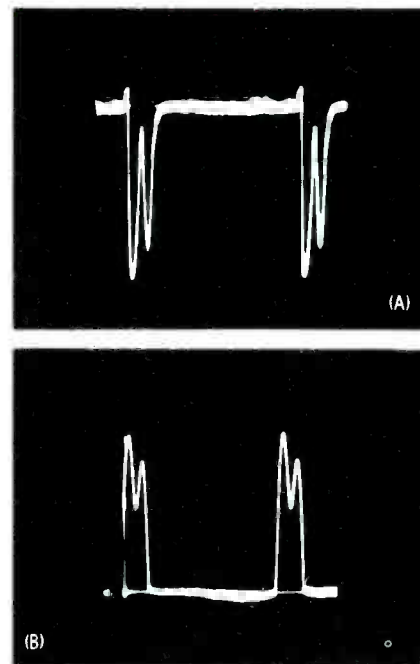


Fig. 1 These unusual waveforms were produced by a "tuning" mismatch of a chassis and test jig.

(A) Horizontal blanking pulse at the grid of the CRT when the color control was at minimum has nearly two separate tips.

(B) Horizontal sweep waveform shows an excessive amount of second tip.

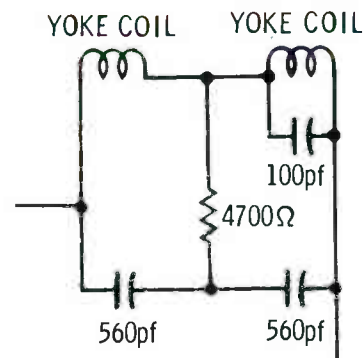
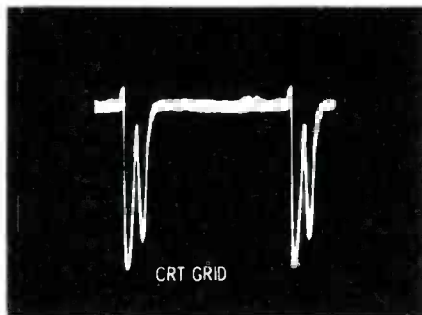
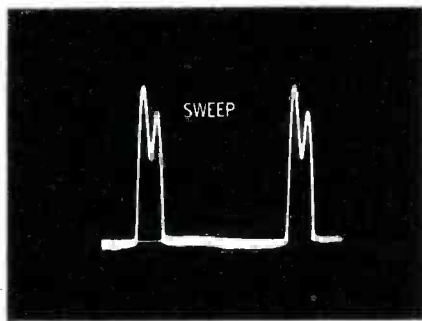
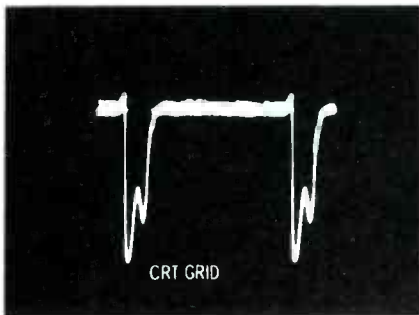
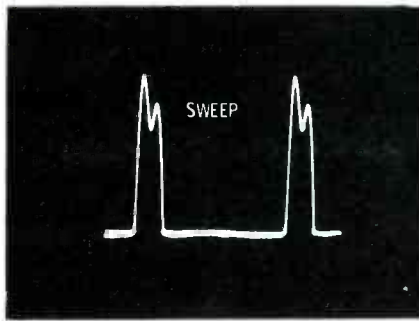


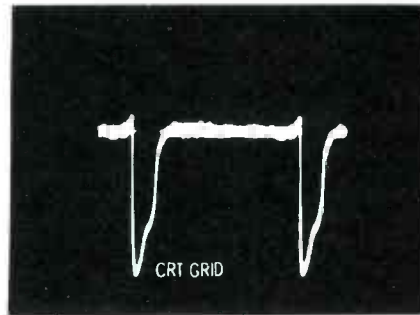
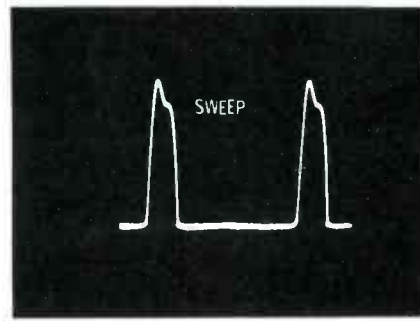
Fig. 2 Yoke circuit showing the 100 Pf (anti-ringing) capacitance and the two 560-PF yoke-tuning capacitances. If both chassis and yoke have tuning capacitances, the B-boost voltage will be too high and the HV will be too low. If neither the chassis nor the yoke contains the capacitances, the B-boost voltage will be too low and the HV will be too high.



(A) yoke capacitance 0 PF  
high voltage 25 KV  
B-boost voltage +745  
regulator current .65 ma



(B) yoke capacitance 100 Pf  
high voltage 23.5 KV  
B-boost voltage +750  
regulator current .85 ma



(C) yoke capacitance 360 Pf  
high voltage 21 KV  
B-boost voltage +760  
regulator current 1.2 ma

**Fig. 3** Above are the voltages and waveforms obtained when the total capacitance across the yoke was as listed. No adjustments were changed during these measurements.

#### CHART I

yoke capacitance	high voltage	B-boost	regulator current
0	25.0 KV	+745	.9 ma
100	24.5 KV	+770	.9 ma
360	24.0 KV	+795	.9 ma

**Chart 1** Measurements obtained when the yoke capacitance was varied and the regulator current adjusted to the same value each time.

### Pix-O-Scope Portable Color Test Jigs Models P-I, P-II and P-III

**Cabinet:** Cabinet is of durable shock-resistant plastic with a compartment for storage of cables, a handle for carrying, and eye-bolts for mounting by hanging.

**Picture Tube:** A 15-inch color picture tube is furnished. It has a laminated faceplate, an implosion-protection band, and is a grounded-focus type.

**Focus:** The test tube requires no voltage from the chassis for correct focus. Measure the focus voltage (if provided) from the chassis under test using a high-voltage meter.

**High-voltage meter:** All models (except some kits) have an internally-connected multiplier and meter to read high voltages up to 35 KV.

**Center convergence:** All components necessary for purity and center convergence are mounted on the picture tube.

**Dynamic convergence:** No provision is made for dynamic convergence. Pix-O-Scope believes this is not essential, and its inclusion would limit the number of sets with which the jig could be used.

**Yoke matching:** "P" models include yokes that match most tube-type sweep circuits; "PT" models match transistorized receivers. In addition, the Adapt-O-Scope enables full horizontal and vertical sweeps with tube chassis having different impedances or models not equipped with an eight-pin socket. Price of the adapter is \$10.95.

**Accessory cables, loads and plugs:** Included with the jig are a high-voltage lead, ground wire and picture-tube base extension cable.

**Size and weight:** The cabinet is small because of the 15-inch tube, and the weight is less than 30 lbs.

**Additional features:** The standard Model P-I includes the picture tube and high-voltage meter for \$149.95. Deluxe Model P-II has all the features of the P-I plus a switch to change the meter to current reading for adjustment of efficiency coils; the price is \$199.95. Super Deluxe Model P-III has all the features of the other models plus a built-in volt-ohm-meter and color-bar generator; the price is \$369.95.

Kits also are available. PK-I without the tube and meter sells for \$69.95. PK-II with the 2-way meter but without the tube sells for \$149.95. PK-III without the tube and generator sells for \$199.95.



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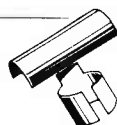
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result is obtained because the B-boost voltage depends on rectification of what would be (if not clipped by the rectification) the negative-going tip of the huge sine wave caused by ringing during retrace time.

In other words, high voltage and B-boost voltages are rectified during different parts of the sweep waveform. Therefore, they change in opposite directions when the value of the yoke-tuning capacitors is changed. This effect is an important exception to the rule-of-thumb that says the B-boost and high voltage must vary together.

Voltages obtained when the regulator current was adjusted to the same value each time the yoke-tuning capacitance was changed are shown in Chart 1. Notice that the high voltage did not change so much as did the B-boost voltage.

**Retrace Lines**

Occasionally, when no capacitor was paralleling the yoke coils, we could see vertical lines in the picture. These lines were part of the horizontal retrace made visible by the loss of horizontal blanking from the valley between the two tips of the waveform (see Fig. 1A.).

A broad and fuzzy vertical white line could be seen occasionally. During other scenes, three separate, narrow and sharp, red, blue and green vertical lines were visible.

If any such unusual vertical lines show during operation of a chassis on a test jig, check to see if the horizontal blanking pulse has two tips.

**Don't Make Some Final Adjustment When Using A Test Jig**

The advantages of using color test jigs far outweigh the disadvantages. However, you should observe this precaution; don't judge horizontal sweep waveforms or make final high-voltage or horizontal-efficiency adjustments when the chassis is connected to a test jig. At least, not unless you are certain the yoke inductance and yoke-tuning capacitance are matched correctly.



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by John Rogerson  
Technical Director, MATV  
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*The editors sincerely believe that many dealers and technicians are missing some profitable opportunities, if they fail to sell MATV systems. So, we want to inspire you to action, and also to give you the information needed to take advantage of those dollar-green opportunities. To help you even more, we intend to feature in coming issues the "nuts-and-bolts" details of how to install antennas and MATV components.*

## Designing The Head End

The first step in designing the head end is selecting the proper antenna, or antenna array, because the strength of signals received at the antenna determine what amplifier and other signal-processing components should be used.

### Antenna Selection

You must determine the number of channels, which bands they occupy, and the directions from which their signals approach the receiving site.

If all the channels are received from the same direction, and the signal strengths are approximately the same, a broadband antenna, as shown in Fig. 1, might be used.

But, if one channel is much stronger than the others, single-channel yagis (Fig. 2) will be required. Separate VHF and UHF antennas might be desirable, if the UHF signal (see Fig. 3) arrives from a different direction. Or a single TV station that is located in another direction might necessitate the addition of a single-channel antenna to a broadband system (see Fig. 4 for the diagram).

In all cases, at least 1000 microvolts of signal for each channel must be provided by the antenna installation. If the signal from one channel is too weak, stack the antennas of that channel to strengthen the signal. This is preferable to using a pre-amplifier, since stacking usually delivers a more pure signal to the system.

Use a **field strength meter** to measure the exact signal levels of each channel; don't guess.

### Location Of The Antenna Is Important

In weak-signal areas, location of the antenna for best results is often critical. For example, antennas only 75 feet apart can produce entirely different signal strengths.

Height of the antenna also makes a big difference in the amount of signal. Although signals usually are stronger at greater heights, this is not always true. So you should test to find the strongest signal.

When the signal strength is weak, a small increase in the microvolt reading makes a larger increase in the dB measurement (which more nearly follows the visible results). Use a portable TV to aid in determining where and how the best results are obtained.

### Factors Affecting Good Reception

Here are some common recep-

tion problems and the general solutions made by choosing appropriate antennas:

- **Ghosting** (pickup of reflected signals causing multiple images) can be minimized by using antennas with high front-to-back ratios and sharp directivity. In severe cases, stacking the antennas will enhance these qualities and further reduce the ghosts.
- **Co-channel interference** caused by two stations in different cities transmitting on the same frequency also can be minimized by the use of antennas having high front-to-back ratios.
- **Adjacent-channel interference** is caused by a strong signal on one channel overriding a weak signal on an adjacent channel of the same band. Often this produces a "herring-bone effect" that can be eliminated or minimized by using a more powerful yagi (or stacked yagis) for the weak channel, and by using attenuators to reduce the picture- and sound-carrier strengths of the interfering channel.
- **Power-line interference** is caused by radiation of noise from a nearby power line to the receiving antenna. Locate the antenna as far away from the power lines as possible. Use 75-ohm cable and baluns to prevent the down-lead from picking up the noise. Also, proper grounding of the system will help minimize the noise problems.
- **UHF reception** generally requires the use of a UHF antenna having higher gain than those used for VHF because of the higher line losses at UHF frequencies. Stacking of antennas or a UHF pre-amplifier can be used when needed.
- **FM reception** often can be received satisfactorily on the VHF antenna, if it is a broadband type. But, if the FM stations are not in the same direction as the TV stations, or if the FM signals are much stronger (or weaker) than



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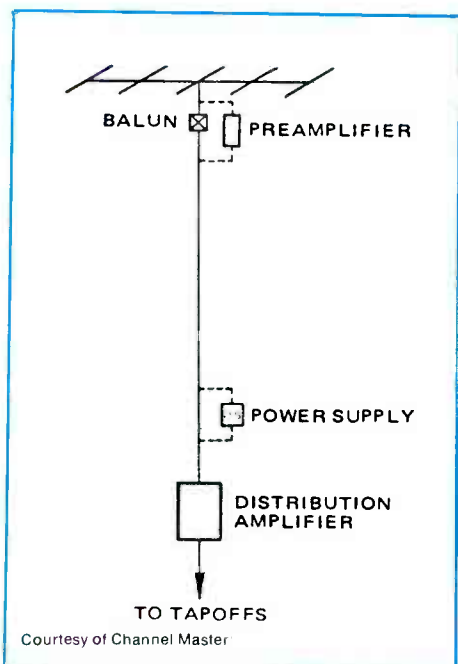
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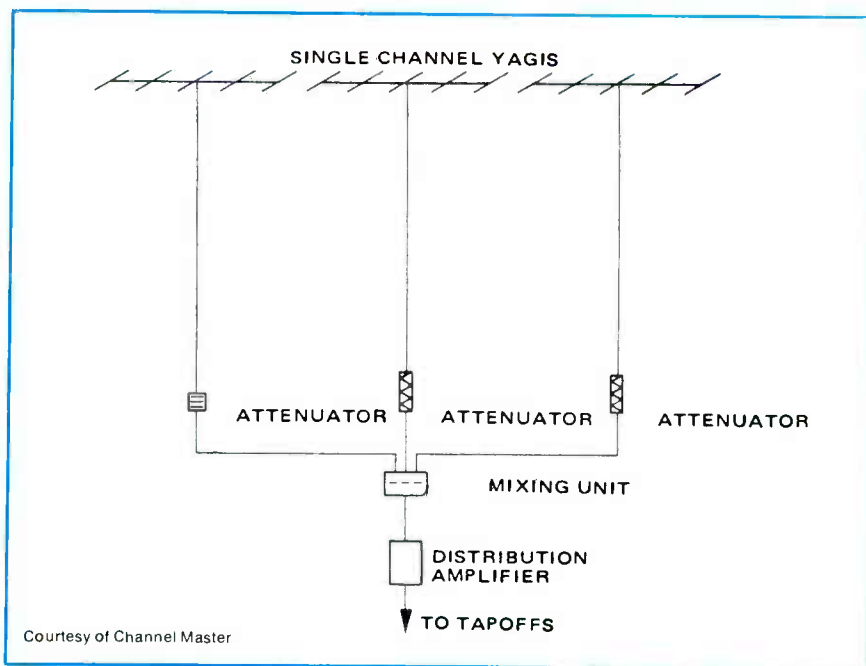
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September, 1972/ELECTRONIC SERVICING 41



**Fig. 1** Diagram of a simple VHF broadband antenna system with all channels received from the same direction.



**Fig. 2** Diagram of a VHF single-channel antenna system with yagis for signals received from different directions.

the TV signals, then a separate FM antenna should be used. Also, a separate FM antenna should be provided when each of the TV channels is received on a separate single-channel antenna.

### Equalizing Signal Levels At The Amplifier Input

For good-quality reception, the signal level of each channel should be approximately equal at the input of the distribution amplifier. Otherwise, one channel might have insufficient signal and another might have an excessive signal which would overload the amplifier or TV receiver.

Signal levels can be equalized by attenuating the stronger signals (Fig. 2), or by amplifying the weaker signals. Or, by a combination of both methods. In strong-signal areas, attenuation of the stronger signals down to the level of the weaker ones is a more economical method. Either variable- or fixed-attenuation pads can be used to attenuate signals from separate antennas. Stacking of antennas or the use of a pre-amplifier is recommended for signals below zero dB.

### Signal-Processing And Mixing Equipment

Equipment used for signal processing consists of mixers, filters and traps. Where broadband antennas are used, and signals are not received at the same level, it might be necessary to use a mixing unit or units in reverse to separate the individual signal needing processing. Also, interfering signals can be filtered out or trapped, and the desired signals can be adjusted to the required level by use of variable or fixed attenuators.

In systems where single-channel antennas are used with broadband amplifiers, you might have to combine signals from each antenna by use of a mixing unit placed at the input of the distribution amplifier.

### Signal Levels At The Distribution Amplifier

After the antennas have been selected and installed, and the signal levels of each channel equalized, then the signal level intended for the distribution amplifier should be measured. From this level and the level needed by the distribution system (explained last month), you can select the distribution amplifier

necessary for the system.

### Choosing An Amplifier

These are the four main considerations to observe when you select a distribution amplifier:

- the frequencies and number of channels to be received,
- the total losses of the distributing system (cable, splitter and tapoff losses),
- level of the signals at the input of the amplifier, and
- the maximum output signal the amplifier can deliver without overloading.

If there is no problem with adjacent channels which might interact, a broadband amplifier should be sufficient.

However, if several adjacent channels are to be received, each channel must be filtered separately. Strip (single channel) amplifiers usually are required for this purpose.

Broadband amplifiers are available for VHF bands only, VHF and FM, UHF bands only, or for all bands, VHF, FM and UHF.

### Single-channel amplifiers

Single-channel amplifiers are

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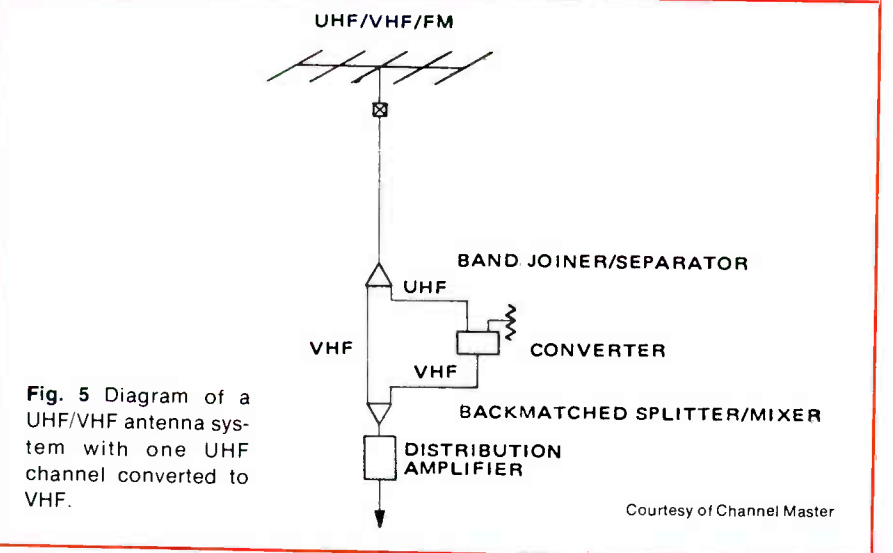
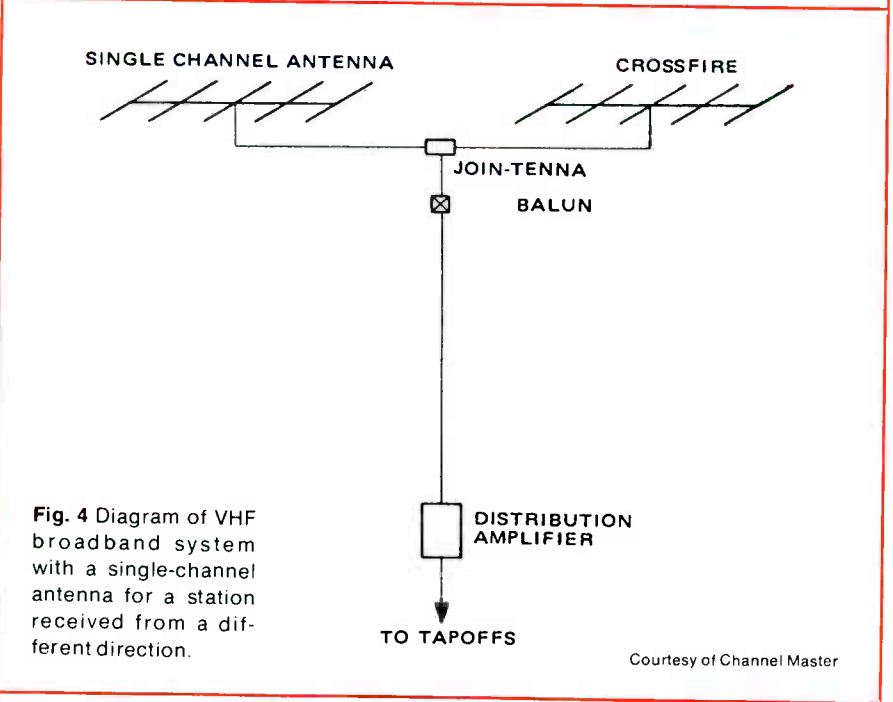
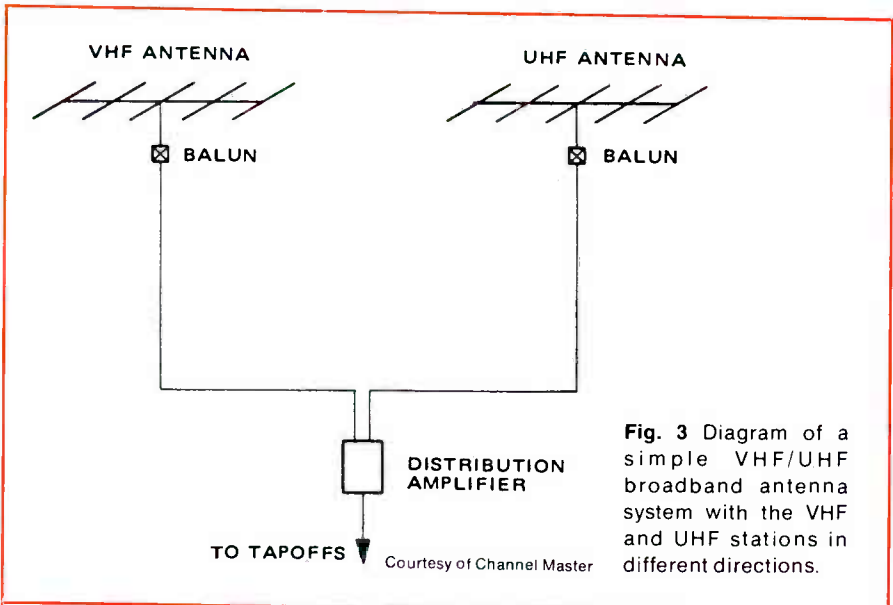
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useful for amplifying each individual channel while filtering or rejecting all other channels. This helps avoid cross-modulation and inter-modulation interferences.

There are two basic types of single-channel amplifiers: those with AGC, and those with manual control of gain. The one with AGC should be used for channels where fading occurs.

Because single-channel amplifiers offer so many advantages, they are preferred over broadband types.

**Conversion of UHF channels**

Conversion of a UHF channel to VHF sometimes is desirable in cases where the losses of a long cable run would be excessive, or where one of the TV receivers does not have UHF capability.

Figure 5 shows how the converter should be added to a broadband antenna system.

**Gain of the distribution amplifier**

Gain is the amount the amplifier will increase the input signal. An amplifier rated at 50 dB increases the signal delivered to it by 50 dB. But the **output** signal of a 50 dB amplifier will be 50 dB only if the input signal is 0 dBmV (1,000 microvolts).

If the signal at the input of the amplifier is only 250 microvolts (-12 dBmV), the output signal would be 50 minus 12, or 38 dBmV. At the other extreme, an input of 10,000 microvolts (20 dBmV) would require an output of 70 dBmV, which is beyond the power-handling capability of the amplifier and would thereof, cause overload.

The input signal in dBmV, plus the gain of the amplifier in dB, equals the output signal in dBmV.

**Output capability**

Output capability of the amplifier is the amount of signal it can

handle without producing cross modulation or sync clipping in the receivers obtaining a signal from it. All amplifiers have this limitation regardless of whether one common output stage supplies all channels or whether there is an individual output stage for each channel.

Depending on the design of the amplifier, the output capability can be stated as a total figure for all bands, or it might be given as a figure for individual bands. It is important to know which way the amplifier is rated.

### Cross-Modulation Interference

Broadband amplifiers are susceptible to cross modulation because the input signal is the total of all the channels, which can add easily to a voltage that overloads the input stage. Cross modulation is caused by non-linearity, and the effect is to add the modulation of the strongest station to the modulation of all the other channels.

For example, a case of severe cross modulation would appear as weak pictures with vertical bars between which drift slowly back or

forth across the picture of all the weaker channels.

Less severe cases of overload might show only the vertical bars which drift sideways. This is often called "windshield wiper".

Borderline examples of overload can make the picture look grainy or have some herringbone. This kind is difficult to spot with any certainty.

It is always the strongest signal being received that causes the cross modulation. Reduction of the level of this one carrier might clear up the interference, or traps and filters (see Fig. 6) might be required to eliminate the overload.

### Overload Distortion

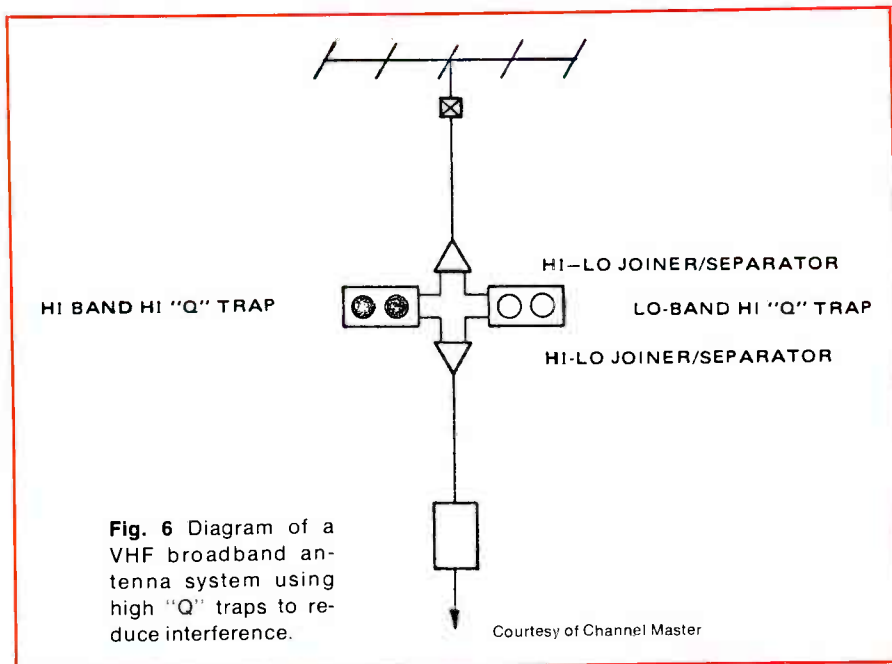
Overload of amplifiers is of importance only when the amplifier is single channel. That is because broad-band amplifiers become afflicted with cross modulation long before the amplifier overload point is reached.

The type of overload we are concerned about causes clipping of

the signal, and results in white compression and sync clipping in receivers. Moderate overload causes an effect like sound bars, with dark horizontal lines which move with the volume of the audio. Extreme overload might cause a loss of vertical or horizontal locking in the receiver.

Most amplifiers have built-in attenuators, gain controls and tilt controls that permit adjusting the input signal to values not causing overload. Attenuators are pads giving a fixed loss of signal; gain controls are adjustable for precise signal reduction; and tilt controls affect the signal output by shifting the gain at one end of the band relative to the other. For example: higher frequencies suffer the greatest loss in the lines, and the tilt controls permit boosting the channel-13 side of the VHF band.

Because the amplifiers, cable and other components normally lose some efficiency over a period of time, it is recommended that you select an amplifier with at least 6 dB gain than the amount barely necessary to compensate for the losses of the system.



### Summary—By the Editor

Although MATV installations can be huge and involve hundreds of receivers, most installations are comparatively simple ones with a single antenna and two to four tapoffs. The principles of design given in this series of articles should guide you in making plans and layouts. □

# A servicer's view of medical electronics

By: Joseph J. Carr, C.E.T.

Modern medical teams are assisted by a bewildering array of sophisticated equipment. The emergency rooms of even moderate-sized hospitals offer life-saving services that were only dreams a short decade ago. And, **electronic equipment** is responsible for most of these badly-needed improvements.

## Equipment To Help Heart Patients

Take the care of cardiac patients as an example of these radical improvements. Once, if the patient's heart went into ventricular fibrillation, there was only a slight hope for his survival. The twin problems were rapid detection of the condition, and an effective treatment.

### ECG monitor

Today an ElectroCardioGraph (ECG) monitor instantly signals the staff if any of the deadly arrhythmia conditions appear. Outwardly, an ECG monitor appears to be related to a TV-service oscilloscope. As you can see in the block diagram of Fig. 1, an ECG is very specialized.

Conductive paste is spread on the patient's skin and the electrodes attached to various points of the body. Most ECG machines have pushbutton-operated switches to select which of several possible voltage drops is used for monitoring. The medical slang term for the voltage drops is "leads", which does not refer to the wires. One common connection of the electrodes is the "Eindhoven Triangle" consisting of electrodes placed on both arms and on the left leg.

Electrical signals produced by the commands of the body to the heart muscles are picked up by the electrodes. By comparison with the tiny amount of voltage at these electrodes, a tape head or a magnetic phono cartridge is a powerhouse! Approximately 1 microvolt of signal is expected, as evidenced by the 1-mV square-wave standard calibration voltage.

And this tiny voltage is mixed with several volts of 60 Hz hum picked up capacitively by the body of the patient from the power wiring of the room. To eliminate this undesired hum signal, differential

amplifiers are used to balance-out any signal common to all electrodes.

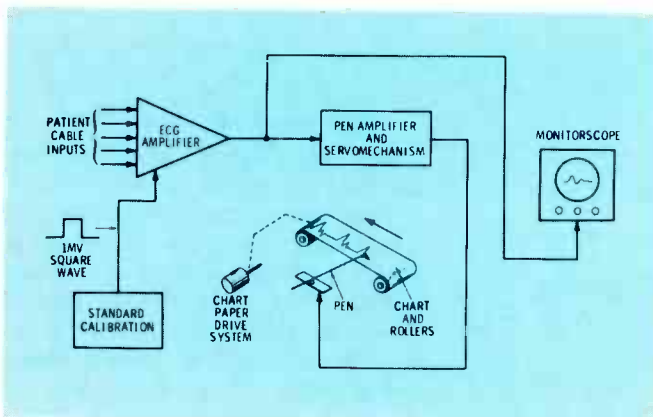
The sweep speed of the scope readout is very slow. Where a good service-type scope might zip up to a sweep of 1 MHz, an ECG requires about a second. Also, the persistence of the phosphors and the color are both different. The phosphor persistence is usually a slow P7 type and is yellow (sometimes a vivid purple). Most of one sweep can be seen by the lighted dot and its "tail".

### Strip-chart recorder

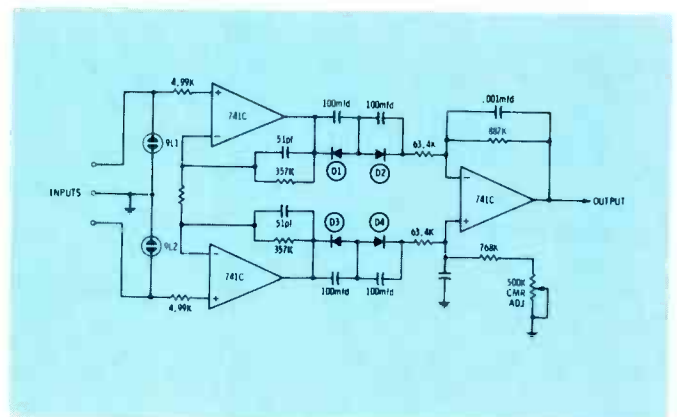
When permanent records of the characteristic heart patterns are desired, the scope readout is replaced, or augmented, by a machine which writes the waveform by use of an ink-pen on a moving strip of paper. An amplifier powers the lateral motion of the pen. The pen mechanism is delicate and susceptible to damage. Much of the service on these machines will be on such mechanical components.

### General Electric ECG

A partial schematic of the ECG amplifier made by the Medical Sys-



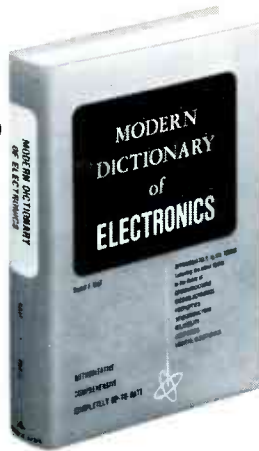
**Fig. 1** Block diagram of a basic ECG machine. Voltages from the body of the patient are amplified and then viewed on a special scope screen. Or the waveform is recorded permanently on a roll-paper chart by an ink pen driven laterally by a pen amplifier. The waveform is recorded by photoelectric means in other models.



Courtesy of General Electric, Medical Systems Division

**Fig. 2** This is a partial schematic of the op-amps in a General Electric ECG machine.

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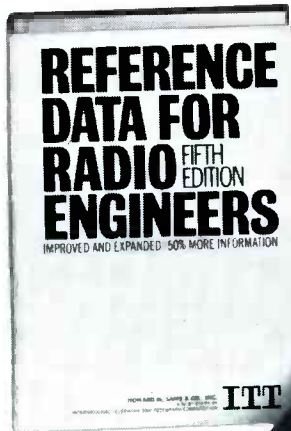


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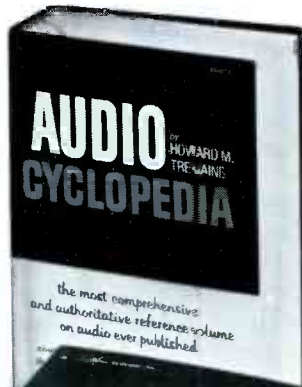
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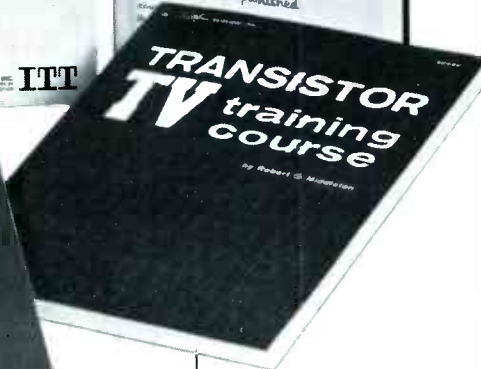
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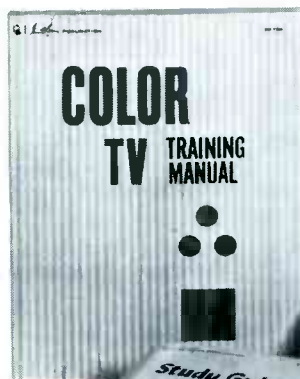
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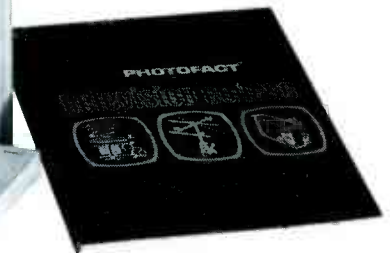
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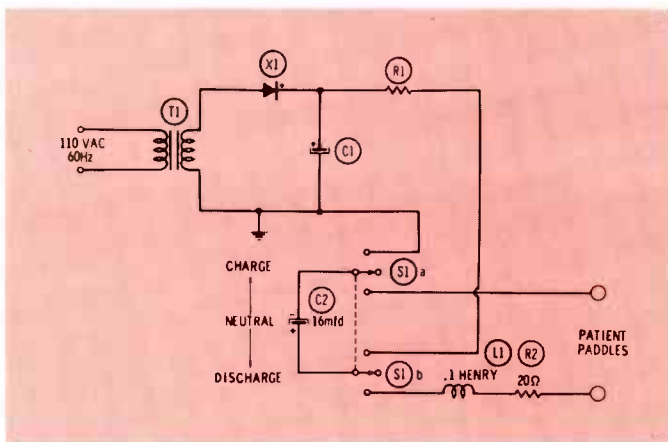


Fig. 3 A simple capacitor-discharge defibrillator circuit.

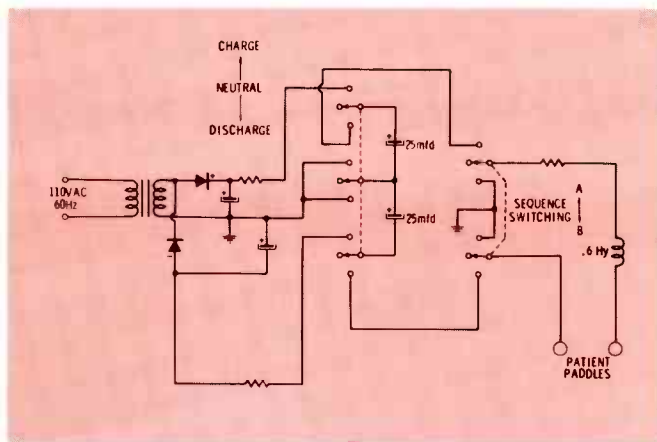


Fig. 4 A more-recent defibrillator charges two capacitors for an alternate-polarity discharge.

tems Division of General Electric is shown in Fig. 2. Operational-amplifier IC's are connected differentially to drive a single-ended '741 output stage. The "diff-amp" connection is necessary to balance out 60 Hz hum and other extraneous noises. External noise applies equal voltages (relative to ground) to each input, and they cancel in the second stage. This ability to reject such noise signals is called "common-mode rejection ratio" (CMRR) and is expressed in decibels.

Incidentally, an operational amplifier (op-amp), such as the type '741s used in this GE amplifier, is a fine building block for designing circuits. The textbook definition of an op-amp is an amplifier with infinite input impedance, zero output impedance, and infinite open-loop gain. In practice, these parameters might typically be 500,000 ohms input impedance, an output impedance of less than 150 ohms and an open-loop (no external feedback) voltage gain of 100,000. With these ratings, the op-amp can be given nearly any desired gain and frequency response by manipulating the circuitry and values of the components of the external-feedback loop.

Versions of the op-amp used in ECG amplifiers have a bandwidth from DC to about 200 Hz.

#### De-fibrillators

A de-fibrillator is the device often used on TV medical shows dramatically to shock back to life patients who otherwise would have

died. Essentially, a de-fibrillator is little more than the discharge of a capacitor. Of course, the voltage and current must be tightly controlled for effectiveness and for safety of the patient.

Ventricular fibrillation is a rapid, but shallow, beating of the heart. Under this condition, the heart can't pump sufficient blood to meet the needs of the victim, and death can result. An electric shock of the necessary voltage and current sometimes can jolt the heart back into its normal rhythm. The electric shock is applied to the patient through paddles that are held against the body.

Figure 3 is the schematic of a simple de-fibrillator. A diode rectifies the 60 Hz AC voltage from the transformer, C1 filters the DC voltage, R1 limits the charging rate

of the capacitor, S1 selects the modes of operation, and C2 is the capacitor whose charge shocks the heart. When C2 is switched to the "discharge" position the voltage stored in it is connected to the paddles. After each discharge, the switch must be returned to the "charge" position to restore the voltage in C2.

In a slightly more sophisticated de-fibrillator (Fig. 4), two capacitors are charged by separate rectifiers and a second switch for selecting the polarity of voltage and the instant of discharge is provided. Another variation, shown in Fig. 5, adds another RCL circuit to change the waveshape of the pulse. Waveforms of the three types of de-fibrillators are shown in Fig. 6.

Many late-model de-fibrillators have features not found in the less-

## Getting Started In Servicing Medical-Electronic Equipment

It is both profitable and interesting to repair medical-electronic equipment. Granted, that the schematics do not appear in Photofact, but they can be obtained from the manufacturer.

The first step is to contact the local hospitals and doctor's offices and inform them that you are ready and able to make repairs. Without a local source of such repairs, they usually must ship the equipment back to the manufacturer. This is awkward and time consuming. Many doctors and hospitals would

welcome a local repair facility.

If they give you the green light, get a list of all the equipment, including the brand name, model number and the name and address of the manufacturer. Then write to the manufacturer and arrange to obtain schematics and service data before the need arises.

A large percentage of the work will be mechanical problems, such as broken cables or electrodes, or perhaps loose knobs. But even electronic repairs are not difficult when you have a schematic.



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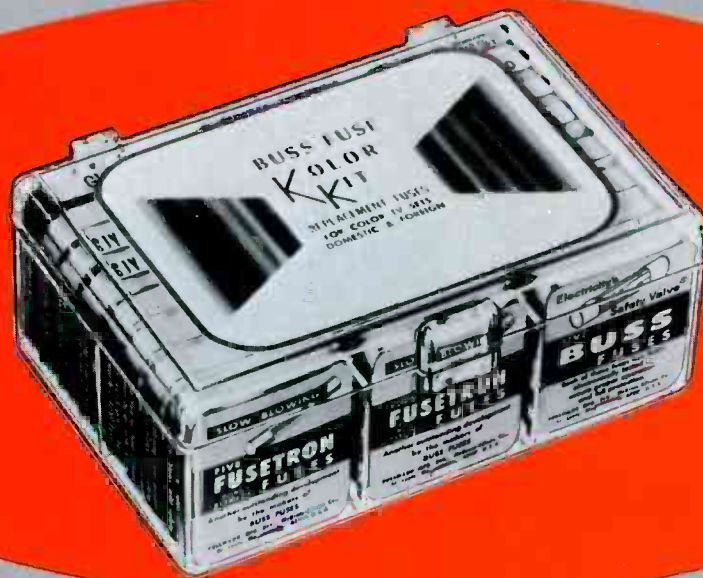
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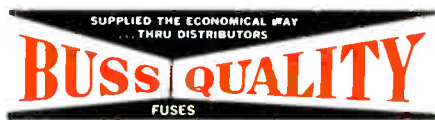
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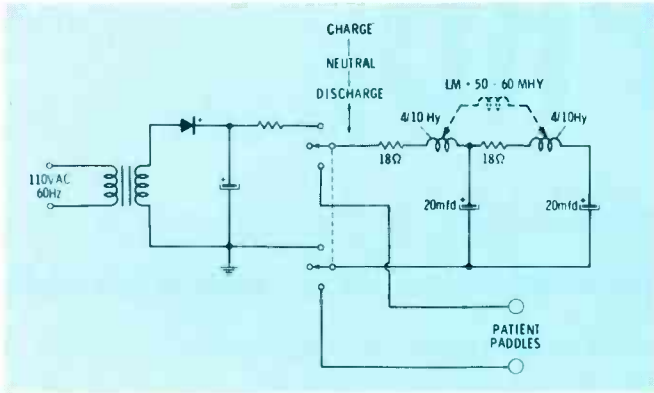


Fig. 5 An extra RCL circuit produces a second voltage tip in this defibrillator.



Courtesy of General Electric, Medical Electronics Division

One type of cardiograph and pulse-rate monitor

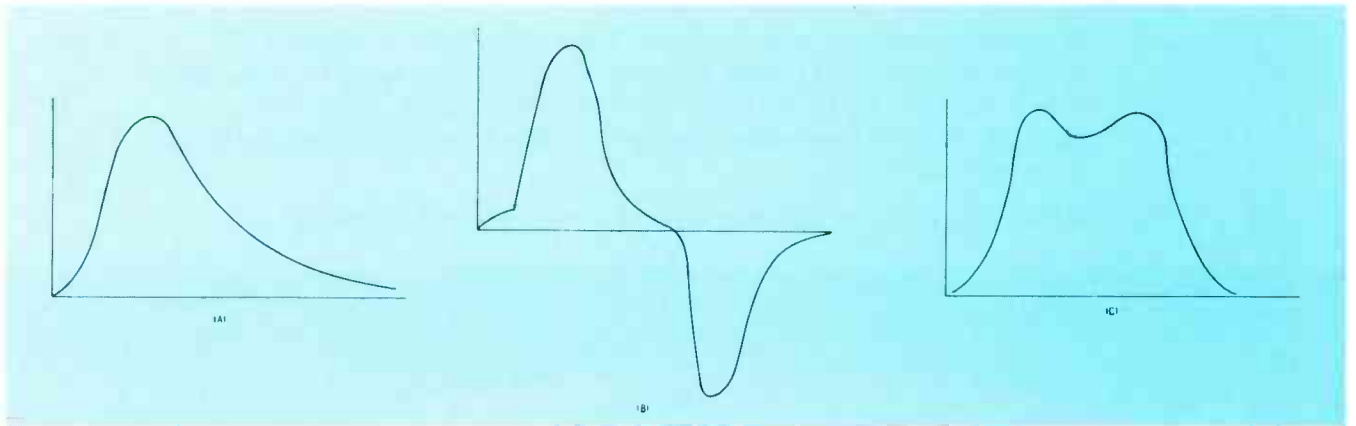
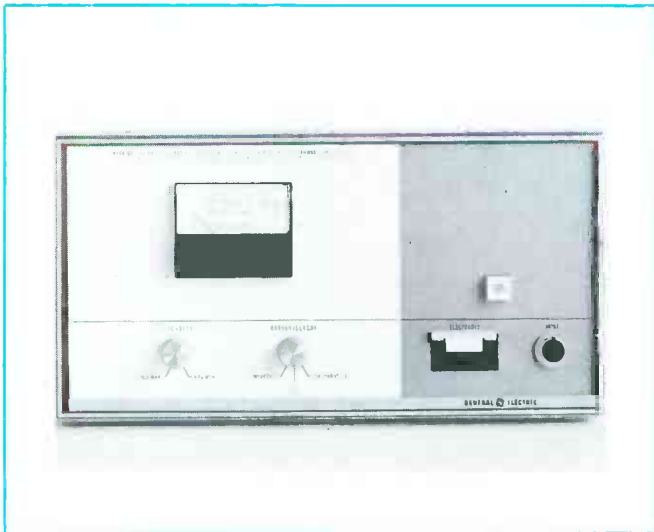


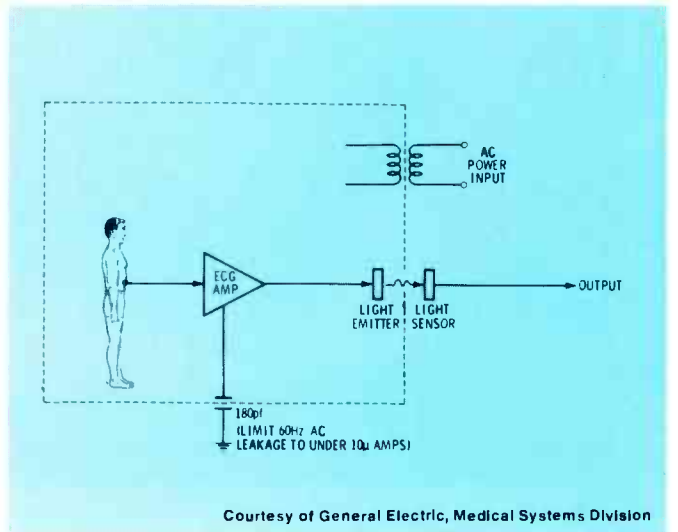
Fig. 6 Waveforms produced by various defibrillators. (A) Waveform from the simple circuit of Fig. 3 is a simple pulse. (B) Waveform from the circuit of Fig. 4 shows first a positive then a negative

pulse discharge. (C) Circuit of Fig. 5 has a broadened pulse because of the coupling between the inductances of the RCL circuits.



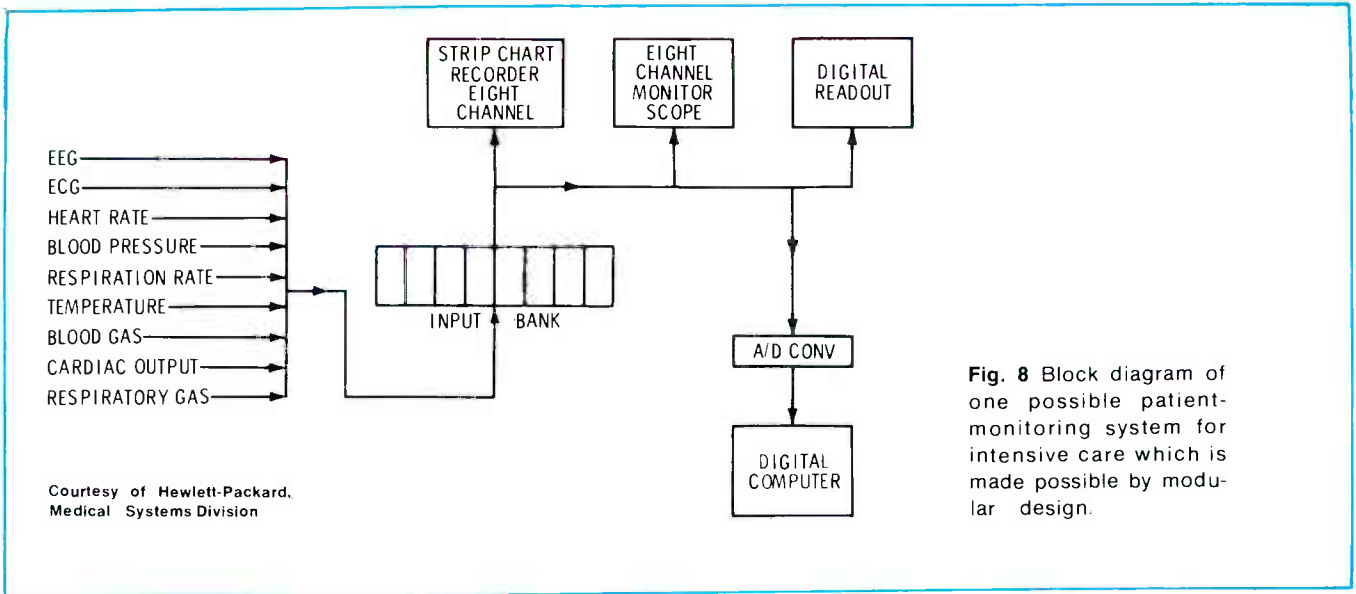
Courtesy of General Electric, Medical Electronics Division

This is a synchronous defibrillator that only discharges during the part of the cardiac cycle having the best chance of restarting the heart action, and the least chance of harm to the patient.



Courtesy of General Electric, Medical Systems Division

Fig. 7 To isolate the patient from possible shock by the line voltage, the General Electric ECG system uses photoelectric coupling between the ECG machine and any additional equipment. In addition, the capacitance between the line voltage source and the chassis of the ECG is held to less than 180 Pf.



Courtesy of Hewlett-Packard, Medical Systems Division

Fig. 8 Block diagram of one possible patient-monitoring system for intensive care which is made possible by modular design.

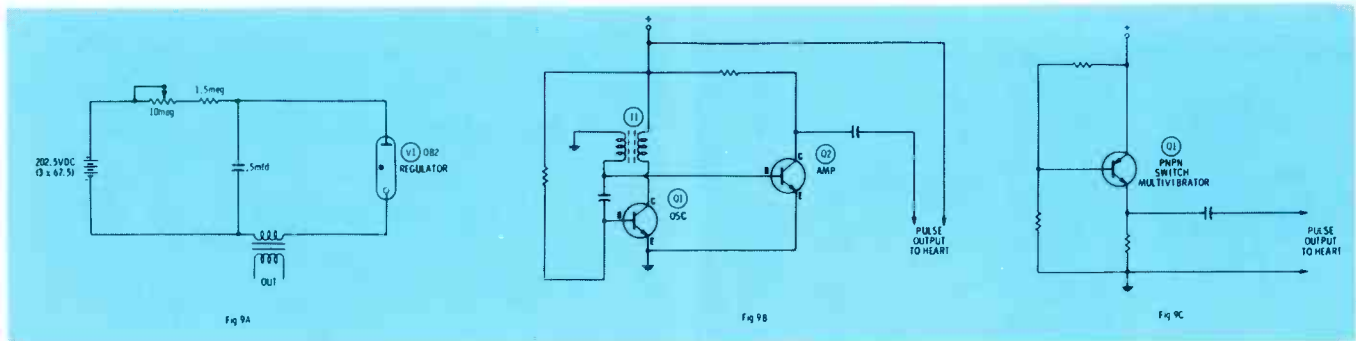


Fig. 9 Pacemaker units supply a voltage pulse which initiates the heart beat. All use some variation of relaxation or blocking oscillators. (A) This pacemaker circuit obviously is not to be operated inside the patient's body. The gas-discharge tube is used in a relaxation-oscillator circuit, which is similar to that of a neon-bulb

oscillator. (B) Two transistors are used as blocking oscillator and amplifier/isolation stages in this newer miniature pacemaker. (C) A PNP semiconductor switch is used as a multivibrator in this modern pacemaker circuit.

costly types just described. One is a watt-second meter. Because the same capacitor always is used, a watt-second meter only needs to be a simple DC voltmeter connected across the capacitor. The scale is calibrated accurately in watt-seconds instead of volts. Some de-fibrillators have a synchronizer circuit that allows the capacitor to be discharged only during a specific period of the heart-beat wave-shape. In other machines, it is possible to select the width, amplitude and repetition rate of the discharge pulses.

### Safety Of The Patient

Patient safety is of primary concern in the design, operation and maintenance of the electronic

equipment used in the medical profession. Consider that a current of less than 15 microamps, when certain catheters to the heart are in place, can cause the death of a patient. If you work on medical electronic equipment, you must make every effort to maintain the safety features originally built into the device.

One way of preventing accidental shock to a patient is to isolate him as completely as possible from the equipment. In the General Electric system (Fig. 7) this is done by connecting the ECG amplifier to the rest of the system through a photoelectric-coupling arrangement. Stray capacitance to the chassis is held to less than 180 pf,

so any 60 Hz leakage current would be less than 10 microamps.

This tiny and relatively non-dangerous current is grounded through the third wire of the power cable. If the third wire should break, or be defeated by one of those infernal dime-store adapters, this current might be passed through the patient's body. Don't ever replace a three-wire plug with a two-wire type. Have the doctor or hospital get an electrician to install a three-wire socket before you connect your machines.

Some installations have redundant grounding so the loss of one ground will not affect the patient. In other cases, a ground-fault indicator or interrupter (GFI) device is

used which either sounds an alarm or turns off the equipment when excessive leakage currents flow.

### Patient Monitoring Systems

The block diagram of a sophisticated patient-monitoring system, such as offered by the medical electronics division of Hewlett-Packard, is shown in Fig. 8. Inputs are received from a wide variety of transducers and measuring devices that are connected to the patient. These transducers might be simple electrodes, as used with an ECG, or they might be more complex. One example is a piston-operated pressure sensor that is inserted into a vein either by a catheter or a hypodermic needle. An-

other transducer might be a complete electronic subassembly such as an electro-chemical blood analyzer.

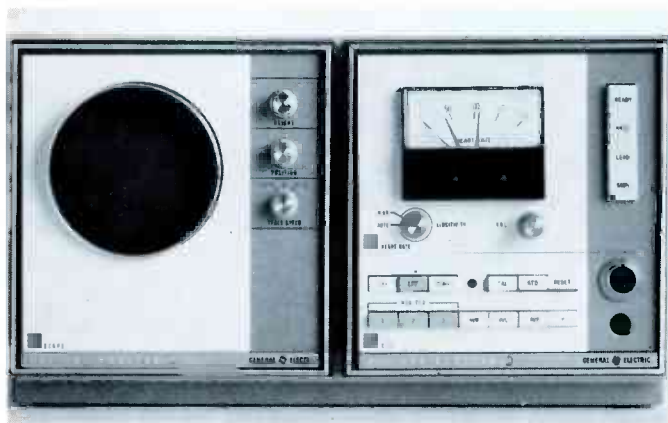
This data is fed to the inputs of the patient-monitoring system. Here the signals are refined and conditioned for final display. Readouts can be by a strip-chart recorder, a multitrace scope, or even numerical-readout tubes such as those used on digital meters. Or the data might also be fed to an analog-to-digital convertor so it can be processed by computer. The exact form taken by any specific monitoring system will undoubtedly be different from that in Fig. 8. This is possible because custom tailoring of the installation by component

modularization.

In many cases, the patient-monitoring system will give a dual readout. A portable readout is often located near the patient's bed, with another readout unit at the central station for the nurses. Banks of these readouts at the central station can be very impressive!

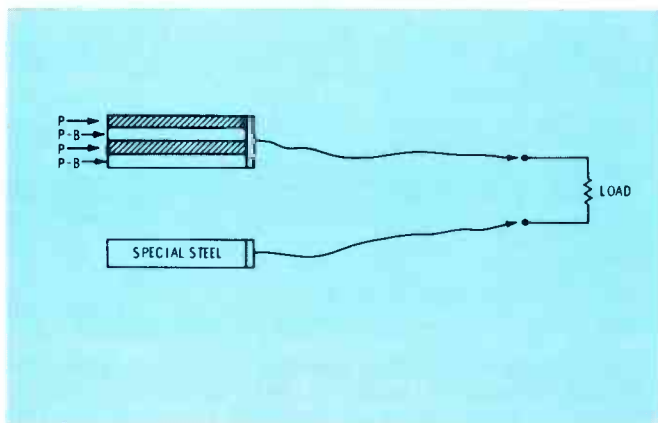
### The Pacemaker

The human heart has a built-in biological "digital clock" that tells it when to beat. If this function is impaired, an external substitute must be used. Such devices are called "pacemakers", and some of them are so small they can be surgically implanted and left unattended for long periods of time.

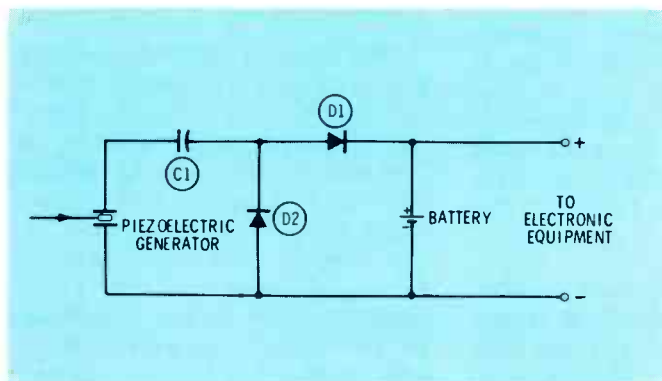


Courtesy of General Electric, Medical Electronics Division

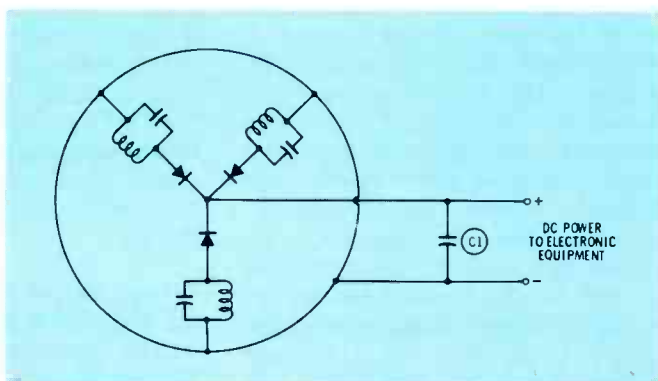
**Typical bedside** use of a heartbeat monitor with scope waveform readout



**Fig. 10** One type of biogalvanic battery uses platinum, platinum-black and steel for plates and body fluids for the electrolyte. This type can be surgically implanted.



**Fig. 11** When body movement is used to move a piezoelectric element, electricity is generated. This voltage is increased by a voltage-doubler and used to charge a battery. This type, also, is implanted.



**Fig. 12** This is an implanted circuit which receives RF energy from outside the body and rectifies it to make DC which powers the pacemaker. A low operating frequency must be used because of the attenuation from the tissues. However, a problem arises because such low frequencies require tuning coils that are fairly large in physical size.

The type of pacemaker shown in Fig. 9A, however, would have to be used externally. The tubes and battery bank are hardly small or light. But the ones in Figs. 9B and 9C are solid state and miniaturized. These pacemakers can be implanted subcutaneously by a surgeon.

All of the pacemakers emit voltage pulses of approximately the repetition rate of normal heartbeats.

#### Power supplies for pacemakers

Power supplies for the cardiac pacemaker, and other types of electronic equipment, are a real problem. Some of the circuits require only microwatts of power; others need much more.

One of the alternatives open to the designer is to use a disposable battery. Another is to construct an internal biogalvanic battery. Piezoelectric energy and RF induction also have been tried.

Giant strides have been made in the manufacture of better and smaller batteries. Unfortunately, even these new types of batteries go dead every two or three years when used with a pacemaker and require replacement. When replacement is done surgically, it is more serious than slipping a new battery in a portable radio.

One approach to solving the voltage supply problem is the biogalvanic battery. In this method, the patient is his own battery. Electrodes of platinum, platinum-black, and steel form the plates of the battery (Fig. 10), and the body fluids are the electrolyte.

One authority has suggested that the E. coli bacteria in the digestive tract and the oxygen in the aorta (artery leaving the heart) be used as opposite poles of a long-lasting biochemical fuel cell.

Piezoelectricity has been used experimentally to provide power for some implanted circuits. Some rhythmical movement of the body flexes the piezoelectric element, and the voltage produced (see Fig. 11) is rectified by a voltage doubler and used to charge a battery.

Another method, reportedly developed experimentally by the Bulova Watch Company, used the motion of the diaphragm to rewind continuously the mainspring of a mechanism similar to that of a self-winding watch. The power stored in the spring caused tiny hammers to strike a ceramic piezoelectric element, and the voltage from it was used to charge either a capacitor or a battery.

One last experimental type of power supply, illustrated in Fig. 12, uses RF induction to supply power for charging a capacitor or for battery charging. Unfortunately for practicality, the attenuation of radio-frequency energy increases very sharply with frequency. The practical limit for implanted devices is about 2MHz, a frequency where the size of the coils becomes a significant factor.

The phenomena of attenuation becomes so pronounced above

about 20 MHz that it changes to heating. In fact, this is the basis for another entire medical sub-field which includes diathermy, diathermy, and electrocautery. Hopefully, we will bring you information on these related electronic fields at a later date.

#### Advice To Servicers

If your firm is engaged in servicing medical electronic equipment, you should be careful about being obtrusive in doctor's offices or hospitals. A good TV technician tries to avoid upsetting the customer's home or routine as much as possible. In an Intensive Care or Coronary Care Unit, this ideal becomes less of a courtesy to the customer and more of a necessity.

Arrange, if possible, for any defective equipment to be removed from the ICU or CCU before you arrive. Thus, you can service it at leisure in a maintenance area, and not have to intrude into a medical area. □

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Circle 25 on literature card

September, 1972/ELECTRONIC SERVICING 53

# It had to be the tuner!

By Wayne Lemons

*Sometimes the part we "know" as the defective one is not the source of the problem.*

## No High-Band Stations

The reception on channel 3 was good, except the sound might have been a trifle weak. But, there was nothing on either channel 10 or channel 27; no picture, no sound, and no snow. The receiver was an Admiral with a H12 or 1H12 color chassis, which is covered in Photofact 876-1. The diagnosis seemed easy: The tuner was bad.

Unfortunately, the tuner had just made its second round trip to a dependable tuner-repair facility. And the second time, the tuner technician included a note saying that the trouble must be in the chassis, for there was absolutely nothing wrong with the tuner.

At that point, I was called in to consult on the job. I accepted, for it should be easy work, and fun to prove that tuner techs are human enough to make an occasional mistake.

## An Easy Repair?

However, the solution of the

problem was not to be all that easy. First, I asked if the shop had a substitute tuner. They didn't. Then I grounded the AGC, as a fast check of that circuit, but still only channel 3 had a picture.

A positive test was needed, perhaps one by substitution. There was also a normally-operating chassis in the shop. It had the same type of plug for the IF cable used by the Admiral. By placing both chassis close together, and leaving the power wiring to the tuners undisturbed, we could cross-switch the IF cables of the two tuners.

When the other tuner was supplying the IF cable of the Admiral, all three channels were received. But when the Admiral tuner was connected to the IF cable of the other chassis, only channel 3 could be seen on the alternate receiver.

## "This Has To Be The Tuner"

To myself I said, This has to be the tuner; the test proves it. Luckily, I didn't say it aloud. Yet an uncertainty nagged at the back of my mind. The tuner company had been so sure the tuner was okay. But what trouble in the chassis would allow reception only on the low-VHF band? Certainly, it could not be the antenna, the AGC, or

the IF stages. On the other hand, we had not changed the B+ and heater supplies when we cross-switched the tuner outputs.

I asked the shop technician about the voltages in the tuner, and he replied that they changed very little between high- and low-band operation.

## Make Your Own Measurements

However, in my 30 years of servicing, I have learned (often the hard way) not to depend on the word of anyone else about basic measurements. So I decided to check the tuner voltages for myself.

This tuner is a turret type, and I removed several coil strips to allow access to the tube socket pins. DC voltages of the RF tube were normal, but the plate voltage of the oscillator tube was low. Perhaps the voltage was low because the meter probe was loading or detuning the circuit. But wait a minute! Surely, there should be more than +16 volts.

I looked at the schematic of the power supply (Fig. 1) and found that the mixer voltages were obtained direct from the +140 volt source, but the plate voltage for both VHF and UHF oscillators came from R204, a 4700 ohm resistor. The voltages at the ends of R204 were +28 and +16, and this

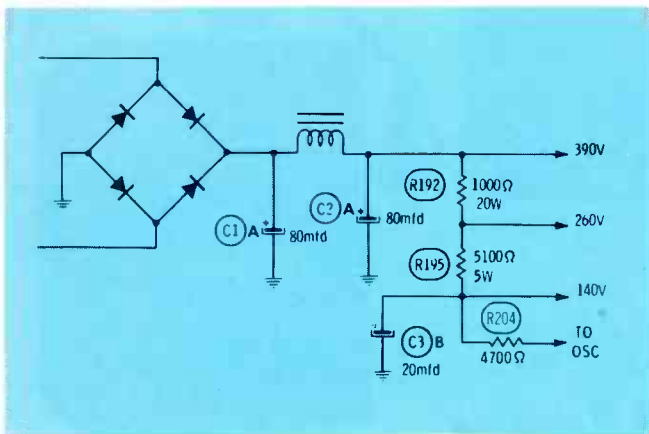


Fig. 1 Schematic of the power supply of the Admiral H12 or 1H12 color TV chassis (Photofact 876-1) shows the +140 source and the supply for the oscillator.

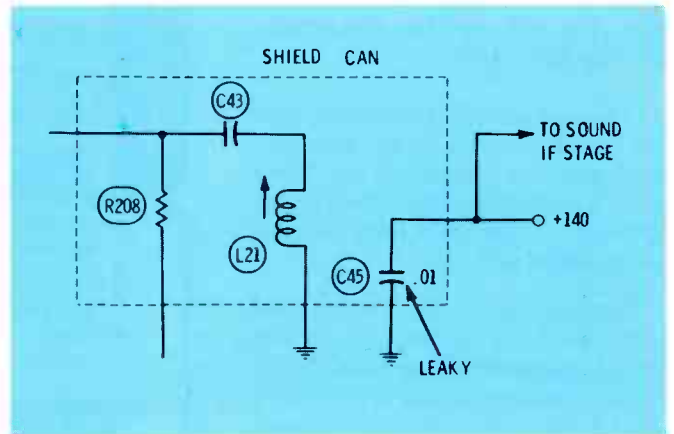


Fig. 2 This partial schematic of the sound take-off circuit includes a bypass capacitor (for the +140 line) that is hidden inside the shield.

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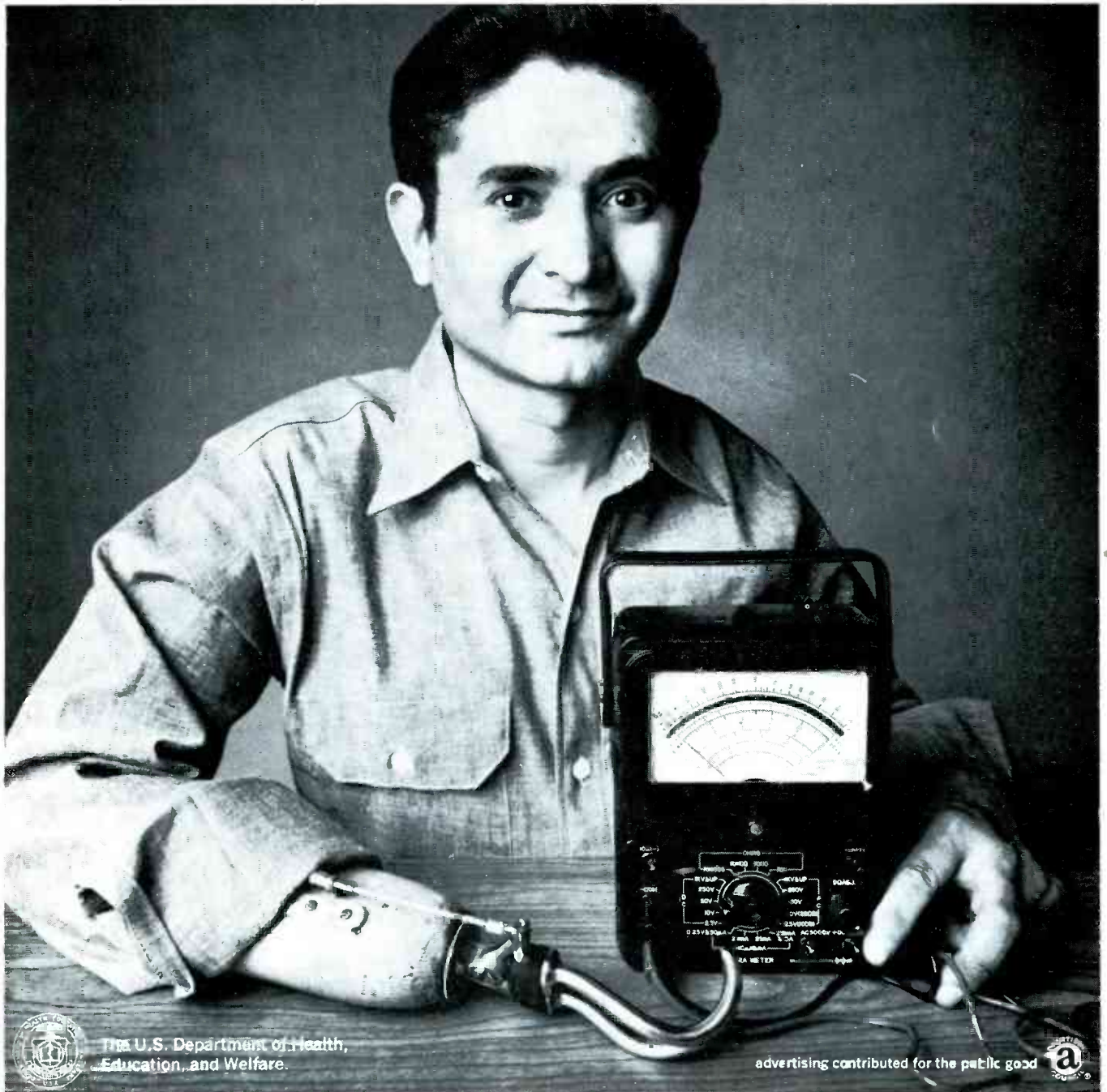
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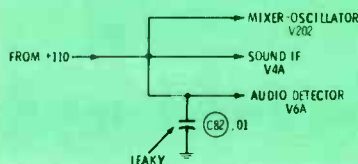
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GLOBE-UNION INC.

Circle 27 on literature card

Chassis—Admiral 4H12  
PHOTOFACT—1049-1



Symptom—All high-band channels dead  
Cure—Check and replace leaky capacitor C82

Fig. 3 One of the Sycmures for January, 1970 described the same symptoms and cure for a different production run (Admiral 4H12 in Photofact 1049-1) receiver. Nearly-identical chassis often develop similar defects; check tips for them, also.

indicated that the source of the problem was in the +140 volt supply. With such a low plate voltage, oscillation was possible on the low band, but not on higher channels.

### That Wasn't The End

Now, the story could stop right here, except that finding the cause of the low +140 voltage wasn't as easy as you might believe.

R195, a 5100-ohm 5-watt resistor, is the dropping resistor for the +140 volt supply. If it increased in resistance, the +140 volts would go down, and this would explain the symptoms. I touched the resistor and blistered my finger from the intense heat. Hot resistors are usually okay. To be certain, I measured it and found it to be within tolerance.

An excessive load also would reduce the voltage. Perhaps C38 was leaky. And it did test about 1100 ohms in-circuit. But after I disconnected the three wires from the terminal, one of the wires measured 1100 ohms to ground. The others, and C38, showed no serious leakage.

Following the wire that showed leakage, we traced it to the circuit board near the sound-IF section. Evidently, the sound-IF tube also received voltage from the +140 source, and this interconnection might explain the secondary symptom of weak sound volume.

According to the schematic, a .01 mfd capacitor (C45 in Fig. 2) bypassed the +140 volt line. But when we examined the board, we could not see any such capacitor.

Finally, we found one +140-volt wire going up inside a shield can. Could the capacitor be hidden inside the can?

I clipped the wire while the set was adjusted to channel 10. "Looks okay now" I said. They had to turn down the volume before they could hear me.

**Editors note:** The preceding true story illustrates the need for service tips of all kinds, both the short Sycmure types as well as the kinds that depend on logical reasoning coupled with a knowledge of circuit theory. You see, this trouble was reported in Sycmure in the January, 1970 issue. If any of the technicians involved in this repair had filed and referred to that Sycmure, he might have avoided extra work. On the other hand, the diagnostic methods used were very good. Actually, both types of information are important and valuable. □

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reader chuckles

Fuses were blowing repeatedly in the old RCA b-w TV, chassis KCS111C. Replacement of all the horizontal and high-voltage tubes did not help.

But, a close visual inspection showed that an insect had strayed into the high-voltage cage where electrocution had ended its career. The body of the insect formed a carbon path from one of the terminals of the flyback to chassis.

Removal of the insect corpse restored operation of the TV to normal. This is one case where the bugs *literally* had to be gotten out of the equipment!

Klaus Halm  
East Point, Georgia

Send in your true anecdote or short, amusing troubleshooting story to share with our readers. We reserve the right to edit and print all contributions to this column.



# catalogs literature

Circle appropriate number on Reader Service Card.

## ANTENNAS

**100. Antenna Specialists Co.**—announces a new amateur radio catalog with an expanded line of two meter, six meter, and three-quarter meter amateur base and mobile antennas.

**101. Blonder-Tongue, Inc.**—announces a booklet presenting the basic facts necessary to understand MATV systems. A Glossary of Terms is included for further understanding.

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

**103. Union Metal Manufacturing Co.**—announces a new 8-page catalog that illustrates self-supporting antenna poles up to 250 feet in height, design information for 25 foot through 200 foot poles, pole accessories, foundation specifications and erection information.

## AUDIO

**104. Atlas Sound**—introduces an 8-page color brochure of loudspeakers, paging and intercom speakers, projector horns and drivers, mobile and industrial communications units, hi-fi and sound columns. Included are 100 individual models of loudspeakers and accessories.

**105. GC Electronics**—an updated line of exact replacement rubber drives and belts is detailed in the new Walsco cross-reference catalog. Included are a variety of phono and recorder drive wheels and pulleys, pinch rollers, round rubber belts, square cross-section rubber belts, spring belts and fabric drive belts, felt pressure pads, phono mounting "E" and "C" clips in an assortment kit, motor mounting grommets, changer

switchers, and a kit of assorted phono drives and belts.

**106. Mellotone, Inc.**—introduces a new catalog featuring CHANGE-A-GRILLE self-stick acoustic fabric for speaker grilles. Swatches of six basic patterns are attached to the catalog showing fabric styles and colors.

**107. Nortronics**—a new publication, "Recording Equipment Maintenance Manual" describes factors that make regular maintenance important. Also, product-by-product catalog section on QM-SERIES accessories.

**108. Shure Brothers**—has published a new catalog describing their line of microphone and circuitry products for broadcasting, recording, motion pictures, and professional sound reinforcement. Included are illustrations and technical specifications.

**109. Switchcraft, Inc.**—introduces a 28-page catalog listing its line of phone jacks and plugs, switches, connectors, adapters, and molded cable assemblies. Each part is listed by number and the page on which it is found.

## CCTV

**110. GBC Closed Circuit TV Corp.**—announces a new 20-page catalog, which illustrates and describes all of the components necessary to a complete video communications system. The catalog illustrates monitors ranging from 5-inch units to a 20-inch solid-state unit.

## CAPACITORS

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

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

## COMPONENTS

**113. Essex International, Inc.**—the new 64-page Color and Monoch-

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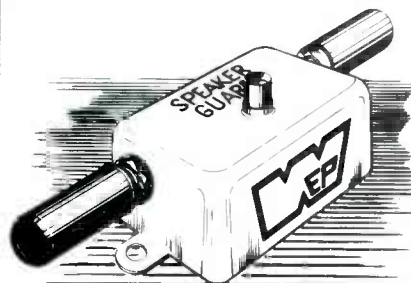
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rome Television Parts Replacement Guide lists over 500 Stancor transformer and deflection components for 200 television manufacturers. A reported 14,000 replacements for original parts are available.

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

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

**116. Workman Electronic Products, Inc.**—has released a 68-page 1972 catalog of replacement components for radio and television. Included are resistors, fusing devices, circuit breakers, sockets, convergence controls, electronic chemicals, audio cables, adapters for hi-fi and cassette type recorders battery holders and prototype kit components.

### CONTROLS & SWITCHES

**117. Centralab Dist. Products**—introduces a chart which covers all Fastach II rotary and push-pull action line switches. Diagrams are illustrated for each switch plus photographs for quick reference guide to replacement push-pull line switches.

### FUSES

**118. Littelfuse, Inc.**—announces a 56-page product catalog featuring mechanical and electrical specifications of all types of glass and ceramic tube fuses, fuseholders, fuse clips and blocks, automatic and manual reset circuit breakers, heavy and medium duty relays, alarm buzzers, and momentary action switches.

### KITS

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

### MARINE ELECTRONICS

**120. Raytheon Co.**—introduces the

Webster antennas and seven new antennas designed for use with standard and single sideband marine radio-telephone and citizens band radios. The Webster antennas for VHF/FM radio are offered in 3 dB, 6 dB, and 9 dB models.

### SECURITY ELECTRONICS

**121. Mountain West Alarm Supply Co.**—a 64-page catalog describes and offers over 350 intrusion and fire alarm products. Six-pages of Application Notes for alarm equipment also is included.

### SEMICONDUCTORS

**122. Electronic Devices, Inc.**—announces a 4-page catalog on solid-state replacement and renewal parts for color TV receivers including solid-tubes, cartridges and multipliers. Solid-state solid-tube high-voltage rectifiers, focus rectifiers and damper diodes, silicon and selenium focus cartridges, diagrams showing dimensional drawings and socket connections for solid-tube solid-state replacements of vacuum tubes with maximum ratings for pulse rectifier service is also included.

**123. GTE Sylvania**—has published a 12-page supplement, designated ECG 212D-2, cross referenced with more than 7,100 industrial part numbers with the Sylvania types which replace them.

**124. International Rectifier Corp.**—announces the new 64-page "Semiconductor Cross Reference and Transistor Data Book," with over 35,000 listings, including 10,000 types not previously shown. Types included are transistors, diodes, zeners, capacitors, rectifiers, and SCRs. A removable wall chart and new products bulletin are also included.

**125. Motorola, Inc.**—announces the 1972 Motorola HEP Semiconductor Cross-Reference Guide and Catalog, featuring approximately 38,000 semiconductor devices to HEP replacements. Included are 1N, 2N, 3N, JEDEC, manufacturers' regular and special "house" numbers and many international devices, with particular emphasis on Japanese types.

**126. North American Electronics**—announces a new catalog supplement (N-72) describing 70 new

products. Included are miscellaneous accessories as a universal AC adapter and a low-cost auto burglar alarm, audio cables and adapters, DIN cables, speakers and accessories, and a selection of 13 semiconductors.

**127. RCA Distributor Products**—introduces a 96-page "SK Series Top-Of-The-Line Replacement Guide" (SPG-202M) which cross-references over 46,000 semiconductor device numbers. In addition a Solid-State Quick Selection Replacement Chart (1L1367A) listing entertainment SK-Series devices is included.

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

#### SERVICE AIDS

**129. Castle Television Tuner Service, Inc.**—literature describing the Castle TV Tuner Subber—solid-state, portable unit for field service of color or black and white TV receivers.

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

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

#### SHOP EQUIPMENT

**132. Kole Enterprises, Inc.**—announces a 36-page color catalog which includes 31 sizes of corrugated stock/parts bins, flat and vertical storage bins, transfer and magazine files and shipping cartons.

#### SOLID-STATE

**133. Electronic Devices, Inc.**—offers a replacement guide on tubes and parts replaced by the EDI solid-state replacement components for color TV.

**134. International Rectifier**—64-page volume, JD-451, has been revised and lists information on diodes, zeners, capacitors, rectifiers and SCR's. There are a reported 4000 new transistor listings. Specifications, characteristics, tables and wall charts are also included.

#### TECHNICAL PUBLICATIONS

**135. Howard W. Sams & Co., Inc.**—announces publication of a new 96-page 1972 Technical and

Scientific Book Catalog. Described are over 800 hardbound and softbound books which cover "do-it-yourself" titles from the Audel Division, amateur radio publications, audio visual materials, instructor's guides and student workbooks. Titles range from "ABC's of Air Conditioning" to Writer's and Editor's Technical Stylebook."

**136. Sencore, Inc.**—Speed Aligner Workshop Manual, Form No. 576P, provides 20 pages of de-

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have the needle,  
there's no point  
in looking for it.**

We're a prime manufacturer of phonograph needles and cartridges. So we're always ahead in needle knowledge. That's why your E-V/Game distributor always has just the right replacement needle you want. Factory sealed. Attractively packaged. And priced right.

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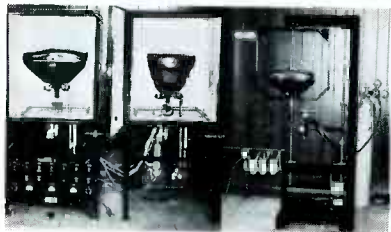
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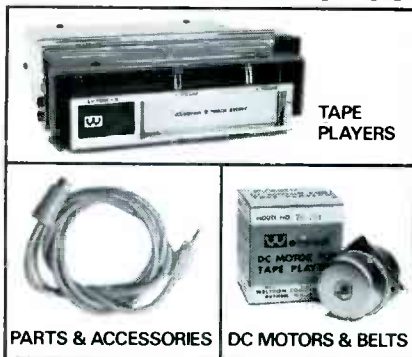
Profit? Imagine building four color tubes per day and if you sold these tubes for \$60.00 each. Total income \$240.00. Total cost \$26.40. Net profit \$213.60. Multiply this figure by five days per week. Your profit \$1,068.00 per week. Cut this figure in half! Build and sell only two color tubes per day. Your profit \$534.00 per week. Facts are facts, figures do not lie.

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Circle 33 on literature card

tailed, step-by-step procedures for operation and application for Senecore Model SM 158 Speed Aligner sweepmarker generator.

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

**138. Tab Books**—has released their Spring 1972 catalog describing over 170 current and forthcoming books. The 20-page catalog covers: schematic/servicing manuals; broadcasting; basic technology; CATV; electric motors; computer technology; reference; television, radio and electronics servicing; audio and hi-fi stereo; hobby and experiment; amateur radio; test instruments; appliance repair, and transistor technology.

### TEST EQUIPMENT

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

**140. Eico**—has released a 32-page, 1972 catalog which features 12 new products in their test equipment line, plus a 7-page listing of authorized Eico dealers.

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

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

**143. Leader Instruments Corp.**—announces the 1972 Catalog of Leader Test Equipment. Test equipment included is the LBO-301 portable triggered-sweep oscilloscope, LSW-300 new solid-state post injection sweep/marker generator, and the LCG-384 miniportable, solid-state battery operated color-bar generator.

**144. Lectrotech, Inc.**—announces

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

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

**146. Pomona Electronics**—announces their new 60-page 1972 general catalog of electronic test accessories. The catalog provides illustrations and complete engineering information on all products, including dimension drawings, schematics, specifications, features, and operating ranges.

**147. Signal Analysis Ind. Corp.**—announces a 4-page bulletin describing their Model SAI-42 real time digital correlation and probability analyzer. Computational and averaging flexibility, increased dynamic range, increased time resolution, and dial-in capability are among features described with illustrations of the instrument controls.

**148. Speco Components Specialists, Inc.**—announces their 43-page, 1972 catalog of VOM multimeters and meters for TV technicians. Individual features and specifications for each instrument are included.

**147. Tektronix, Inc.**—introduces a 76-page "New Products" catalog. Products listed are: automated test systems, computer display terminals, machine control products, and TV test instruments and monitors.

**150. Testline Instruments**—has issued a brochure for their new Model 101 Curve Tracer for checking transistors in-and out-of-circuit. All features, specifications, applications and warranty information are included.

**151. Triplett Corp.**—a 4-page, illustrated, 2-color brochure featuring a new battery-operated, portable Model 603 FET VOM has been

introduced. Application data and specifications are included.

**152. Triplett Corp.**—announces a 2-page, 2-color date sheet for Model 6028, a 2 $\frac{3}{4}$  digit VOM. Data sheet gives DC volts, AC volts, ohms AC and DC current ranges plus construction information price and accessories.

## TOOLS

**153. Brookstone Co.**—announces a new 48-page, 1972 catalog which includes 185 new, unusual and useful hard-to-find tools, plus hundreds of other versatile hand tools and small power tools.

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

**155. Plato Products, Inc.**—introduces a 28-page, 2-color soldering tip catalog, No. 0372. Illustrated with dimensioned drawings to facilitate accurate selection, the new catalog features tips to fit leading brands and models of soldering irons.

**156. Upson Tools, Inc.**—Catalog No. 72 contains many new service kits and metric tools. The complete line of 4-in-1 tools offers 16 combinations of double-ended screwdrivers and a variety of nutdrivers.

**157. Vaco Products Co.**—has issued a 12-page price schedule for all Vaco tools. Stock number, description, and list price on each item is given.

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

## TRANSFORMERS/COILS

**159. Essex Controls Division**—new Stancor Transformer Catalog No. 207 lists over 1,900 standard transformers for design engineers. Full technical data, mounting dimensions, photographs and other specifications on the line of audio transformers, power transformers, chokes and inductors are included. A complete listing of all Stancor sales offices and stocking warehouses is included.

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

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

## TUNER REPAIR

**162. PTS Electronics, Inc.**—62-page catalog with over 600 exact-replacement tuners listed under their original manufacturer number for ease of exchange. A replacement guide for antenna coils and shafts is also provided.


## TV ACCESSORIES

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

# GET COMPLETE DETAILS

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MATCHING TRANSFORMER, SPLITTER AND DIRECTIONAL TAPS IN BOTH MINIATURE AND STANDARD SIZES, HYBRID AND DIRECTIONAL WALLPLATES, LIGHTNING GROUNDING ARRESTERS

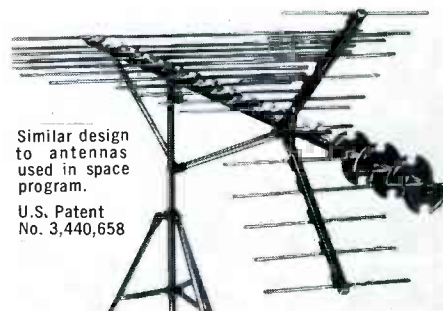
Cases are epoxy covered cadmium plated steel • Circuits embedded in polyurethane foam, encased in epoxy resin • High degree directivity prevents unwanted reflected signals. • Shockproof • Waterproof

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Similar design to antennas used in space program.

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- Maximum construction for long installation life!
- Exclusive Reynolds Aluminum COLORWELD durable baked enamel Gold finish!
- Includes RMS SP-332 VHF/UHF Splitter for economical single down-lead installation!

Model	RANGE OF RECEPTION	
	VHF	UHF
SK-716	Up to 50 miles	Up to 50 miles
SK-719	Up to 50 miles	Up to 100 miles
SK-1117	Up to 125 miles	Up to 75 miles
SK-1519	Up to 150 miles	Up to 100 miles
SK-1916	Up to 175 miles	Up to 50 miles
SK-1919	Up to 175 miles	Up to 100 miles

Write for Catalog Profit Details!—

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VHF . . . only \$9.50	B-W or COLOR
UHF . . . only \$8.50	Tube or
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STEREO LOCK MOUNTS

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# phototip

Exchange

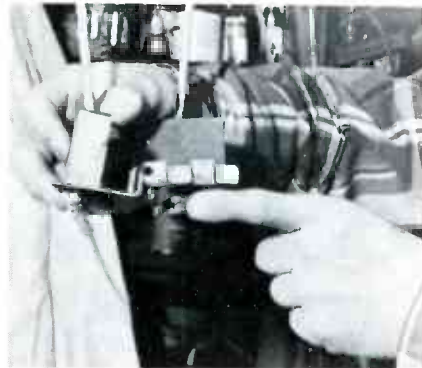
Hanger for Record Player

Submitted by: Russel Libke,  
Michigan City, Indiana

The pictures show a hanger system built by reader Libke to suspend record players or record changers during repairs or adjustments. These hangers are easy to make from inexpensive materials, and they do a good job of keeping the mechanism accessible.

Details of the construction are shown in the top picture. To build a hanger, you make three saw cuts in one side of a square piece of sheet metal, then bend up the cut ends, making two shorter than the others. (The frame of the player goes in the slot between the bent ends.) Fasten with wood screws the metal to the bottom of a piece of 1" x 2" lumber. Drill a hole through the wood from top to bottom, and insert a piece of woven clothes line held by a knot at the bottom of the hanger. Make two of the hangers, one for each side of the machine.

A record player is shown in the bottom picture swung by the hangers.



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Yes, they do. But not in the same proportion.

Business contributes about 15% of the total voluntary support received by colleges.

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

## CHANNEL MASTER

6144A, 6145A ..... 1262-1

## JVC

2450, 2451, 2460, 2462 ..... 1264-1

## MIDLAND

15-225 ..... 1261-1

15-228 ..... 1263-1

## PANASONIC

TR-489R, TY-703P ..... 1265-1

## RCA

Chassis KCS188A (1973 Prod),  
KCS188B ..... 1261-2

## SANYO

90T41 ..... 1263-2

## SEARS SILVERTONE

528.43140021 thru 40039/46012  
thru 46035, 528.43150021 thru  
50039/56012  
thru 56035, 528.43160021 thru  
60039/66012  
thru 66035, 528.43170021 thru  
70039/76012  
thru 76035, 528.43220006 thru  
20028/60002  
thru 60019, 528.43266005  
thru 66019 ..... 1263-3  
Remote Control Receiver  
528.43146003, Transmitter 90-928 ..... 1263-3-A

## SINGER

HE-8001 ..... 1264-2

## SYLVANIA

Chassis D16-3/-4/-5/-6/-7/-9 ..... 1264-3  
Remote Control used with Chassis  
D16-6 ..... 1264-3-A  
Remote Control used with Chassis  
D16-3 ..... 1264-3-B □

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from



Signal Tracer  
TIS-2

**\$19<sup>75</sup>**  
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The SPECO TIS-2 is a Radio Frequency and Audio Frequency Signal Tracer and Signal Injector Probe, self contained as a compact, easy handling, all-purpose service tool. Designed specifically for solid state circuits, the TIS-2 is not a high voltage probe and can be used only in circuits of 25v or less.

The TIS-2 features a volume control for AF or RF Signal level and comes complete with crystal ear-phone and ground lead. This exceptionally well engineered service tool is a must for all service technicians. Engineered with the service technician in mind, the TIS-2 will eliminate 90% of the time normally necessary to trouble shoot transistor radios, amplifiers, etc. Service now becomes profitable. Time is money.

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Circle 37 on literature card

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## The Cooper Group

CRESCENT · LUFKIN · WELLER

Circle 39 on literature card



15677

# test equipment report

Features and/or specifications listed are obtained from manufacturers reports. For more information about any product listed, circle the associated number on the reader service card in this issue.



## Frequency Counter Kit

**Product:** Model IB-1102 by Heath Co.

**Features:** Eight cold-cathode display tubes, an overrange lamp, gate lamp and two range indicator lamps provide an easy-to-read display. A pre-built temperature compensated crystal oscillator "clock" assures overall accuracy. The 8-digit readout allows the resolution (down to 1 Hz) to be read without switching the time base. The unit employs

plug-in IC's and circuit boards to speed assembly and service.

**Specifications:** Sensitivity of 50 mV to 100 MHz and 125 mV above and accepts inputs up to 120 volts RMS from 1 Hz to 150 Hz, 50 volts at 40 MHz, and 3 volts at 120 MHz without damage to the instrument. The counter can be wired for either 120 or 240 VAC operation.

**Price:** The IB-1102 sells for \$349.95.

*Circle 50 on literature card*

## Five-Inch Oscilloscope

**Product:** LBO-505 dual channel/dual trace, solid-state oscilloscope by Leader Instruments Corp.

**Features:** Checks for simultaneous arrival of fly-back pulse and color burst signals for proper burst amplifier operations; measuring low level color signals for stage-by-stage color set troubleshooting; checking delay lines and stereo separation are among features. Continuous scale illumination with front panel control and offers triggered and automatic sweep with

AC or DC coupling.

**Specifications:** Bandwidth is rated at 15 MHz with separate or simultaneous display in the sweep mode



of channels 1 and 2; alternating, chopped, algebraically added, vector (X-Y). It has a triggered sweep range that extends from 1 microsecond/cm to 0.5 sec/cm calibrated in 15 steps. Magnification is 10X, with a maximum speed of 100 nanoseconds/cm. Vertical sensitivity is rated at 10Mv p-p/cm. The new instrument also features input impedance at 1 megohm shunted by 40 pfd. Rise time in the vertical amplifier is 35 nanoseconds.

**Size and Weight:** 7 3/8 inches x 9 7/8 inches x 15 inches and weighs 17 pounds.

**Price:** The LBO-505 sells for \$559.95 and comes complete with 2 direct, low capacity probes; 2 terminal adapters and 1 set of test leads.

*Circle 51 on literature card*

## Counter-Timer

**Product:** Autometronic 5500A by Ballantine Laboratories, Inc.

**Features:** Model 5500A automatically computes the dimensions of the measurement and the position of the decimal point, and immediately displays the result on the numeric readout. "Read Only Memory" (ROM) enables time and frequency measurements with the desired resolution to be made without operator adjustments. The ten operating modes are: Count; Frequency; Period; Positive Pulse Width; Negative Pulse Width; Period Average; Ratio A/NB; Time A to B; Time Interval and Remote Programming. The automatic feature is applicable on all of the operating modes. Resolution is selectable in 4, 5, 6 or 7 digits.

**Specifications:** Operating temperature is 0 degrees Centigrade to 50 degrees Centigrade; power requirements are 115 or 230 volts  $\pm$  10 percent, 48 to 400 Hz, 25 watts. The time base is automatically selected for maximum resolution.

**Size and Weight:** Model 5500A measures 3 1/2 inches x 8 3/8 inches x 12 1/2 inches and weighs 7 pounds.

**Price:** Model 5500A sells for \$650.00 in its basic six-digit display package. A full package with a 7-digit display, printer output and remote programming option is priced at \$835.00. □

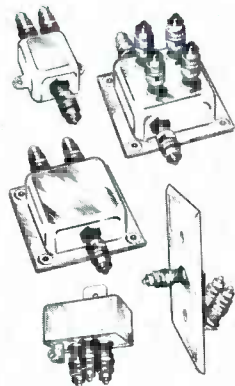
*Circle 52 on literature card*



# productreport

Features and/or specifications listed are obtained from manufacturers' reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

## MATV-CATV Products



**Product:** Multi-family dwelling (MATV) and cable installation (CATV) products by Workman Electronic Products, Inc.

**Features:** Housings are cadmium plated steel covered with circuits embedded in polyurethane foam and encased in epoxy resin. This prevents rotation of fittings and makes the product waterproof and shockproof.

**Specifications:** Included in the line are: matching transformers, two and four way splitters in standard and miniature sizes, directional taps in standard and miniature sizes, multi-directional taps, directional wall plates and lightning arrester blocks with and without splitters.

**Price:** No price available.

Circle 60 on literature card

## Aerosol Cleaner

**Product:** ZAP-IT-LIGHT by Tech Spray, Inc.

**Features:** Removes water from metal, rubber, or plastic surfaces; can be welded, soldered, or painted over, it is greaseless, contains no silicones, provides lubrication and

penetrating action and will not attract dust. ZAP-IT-LIGHT resists salt spray, acid fumes, sulfur dioxide and hydrogen chloride. It can be removed with any solvent or degreaser.

**Size:** Sixteen ounce aerosol cans with free extensions are available.

**Price:** ZAP-IT-LIGHT sells for \$1.41.

Circle 61 on literature card



## Storage Bins

**Product:** "Kolor Koded Kole Bins" by Kole Enterprises, Inc.

**Features:** Boxes are made of heavy duty corrugated boards and carries an index panel on the side and front for content identification. The bins come in 5 shades, green, blue, red, orange and brown.

**Specifications:** Sizes are 12 inches deep by 2 inches, 4 inches, 6 inches, and 8 inches wide; and, 18 inches deep by 4 inches and 6 inches wide.

**Price:** Prices start at \$.16.

Circle 62 on literature card

(Continued on page 68)

# Don't let this familiar face fool you.



## Messenger 123A is all new inside.

We've taken our most popular 23-channel CB two-way radio and given it completely new circuitry! New ceramic filter for great selectivity. New acoustically isolated speaker for clearer sound. And more. All for a suggested price of \$149.95.

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Businesses like yours gave over \$340,000,000 to higher education last year.

It was good business to do so. Half of all college graduates who seek work go into business. The more graduates there are, and the better educated they are, the more college serves the business community.

Your money was vital to colleges. It relieved financial pressures, made planning more flexible, and contributed to the kind of basic and applied research that puts new knowledge and technology at the service of industry.

So that colleges can continue to help you, give to the college of your choice now. For information on ways to do it, please write on your letterhead to Council for Financial Aid to Education, Inc., 6 East 45th Street, New York, N.Y. 10017. Ask for the free booklet, "How Corporations Can Aid Colleges and Universities."



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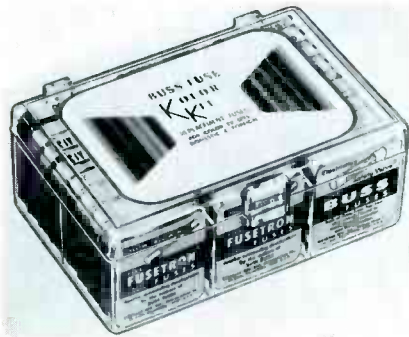


(Continued from page 67)

### Replacement Fuse Kits

**Product:** Kolor Kit fuse replacement kits by Bussmann Mfg.

**Features:** Kits are designed to provide fuse replacement in domestic



sets—RCA, Zenith, Magnavox, Motorola, GE, Philco and others—

as well as foreign makes like, Sony, Panasonic, Mitsubishi, Toshiba, Sanyo and others. Each kit is packaged in a plastic box, the inside lid gives the contents plus a list of both domestic and foreign color TV's using the fuses.

**Specifications:** The Kolor Kit is available in two sizes, No. 140 contains 120 fuses of 14 different types; No. 240, the Deluxe Kolor Kit contains 240 fuses of 32 different types, plus two pair of insulated twin clips and two pair of regular twin clips for paralleling blown fuses. Kit No. 240 also may be used as an all-purpose kit for servicing stereos, amplifiers, tape recorders, and other electronic equipment.

**Price:** No price available.

Circle 63 on literature card

### Voltage Sensors

**Product:** Single channel and dual channel voltage sensors by Mag-Con Engineering Co.

**Features:** Low-drain DC voltage sensors protect direct current equipment from over and under voltage occurrences, and are frequently used in battery charging equipment and stand-by power systems. Set points are adjustable by multi-turn controls.

**Specifications:** Single channel models energize a relay when DC input exceeds preset value. The dual channel model operates the same but provides two preset sensing values and two relays.

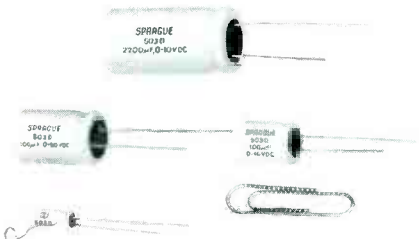
**Price:** The single channel sells for \$35.00 and the dual channel sells for \$49.50.

Circle 65 on literature card

### Electrolytic Capacitor

**Product:** Type 503D Verti-Lytic® Capacitor by Sprague Products Co.

**Features:** Type 503D can be used for couplings, decoupling, bypass, and filtering circuits in "personal" radio receivers, automobile receivers, portable tape recorders, and similar high density applications. The capacitors are sealed in metal cases with thermoplastic insulating sleeves.



**Specifications:** Capacitance stability is +20 percent, -15 percent maximum change, after high-temperature testing. They operate over a temperature range of -25 degrees Centigrade to +85 degrees Centigrade. The Verti-Lytics® are available in 14 case sizes with lengths up to 1.614 inches and diameters up to 0.708 inches. The capacitors are furnished as polar units from 6.3 to 63 WVDC.

**Price:** No price available.

Circle 64 on literature card

**For more details about products in this issue use free readers service card in the back of this issue.**

### Transistor Curve Generator

**Product:** Model TCG-1 by Caringella Electronics, Inc.

**Features:** Displays NPN and PNP transistors, FET's, MOSFET's and dual-gate MOSFET's, diodes, zener diodes, tunnel diodes, and other devices. Direct transistor "Beta" readout is provided on the front panel base-drive control; NPN and PNP transistors can be tested consecutively without changing controls or switches; vertical and horizontal channels of the oscilloscope are calibrated simultaneously for accurate readings.

**Specifications:** Model TCG-1 provides a  $\pm 10$ -volt sawtooth, operating at a frequency of 550 Hz; a regulated power supply, utilizing a  $\pm 15$ -volt IC regulator, and a solid-state LED panel indicator light. Power requirement is 5 watts at 105 to 125 volts AC, 60 Hz.

**Size:** Model TCG-1 measures 6



inches x 4 1/2 inches x 2 1/2 inches and features a brushed aluminum front panel and black-anodized aluminum cover.

**Price:** The kit form sells for \$79.95, factory wired and tested units sell for \$99.95.

Circle 66 on literature card

### Contact Cleaner

**Product:** Chemical, fluorocarbon solvent cleaner

**Manufacturer:** LPS Research Laboratories, Inc.

**Function and/or Application:** Cleaning agent for electrical, electromechanical and precision equipment

**Features:** LPS Contact Cleaner is used for cleaning: electric motors, relays and switches; tape and tape heads; printed circuits; tuners; precision instruments; bearings, liquid oxygen systems

and many others. The cleaner is non-toxic, non-flammable, non-explosive, non-conductive and leaves no residue.

**Specifications:** LPS Contact Cleaner is available in 7 ounce and 16 ounce aerosol cans, and is available in one, five and fifty-five gallon containers.

**Price:** The 7 ounce aerosol sells for \$1.98 and the 16 ounce aerosol for \$3.75.

Circle 67 on literature card

(Continued on page 69)

## Electronic Thermometer

**Product:** Model 8600 Electronic Thermometer by James Electronics, Inc.

**Features:** Model 8600 measures temperatures at three different locations that can be from inches to a thousand feet from the push-button direct-reading meter. Temperature readings are from -20 degrees Fahrenheit to +122 degrees Fahrenheit. The temperature sensing probes are connected to the instrument by a flexible two-wire weatherproof cord that can be extended to hundreds of feet.

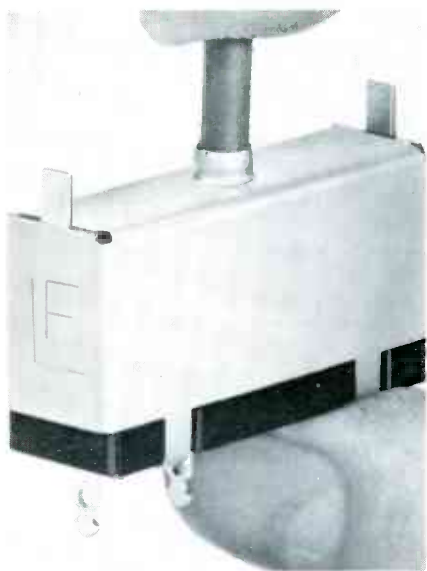
**Price:** Model 8600 sells for \$39.95.

Circle 68 on literature card

## Circuit Breakers

**Product:** 815 series manual-reset circuit breakers by Littelfuse, Inc.

**Features:** The breakers use a fire-retardant, self-extinguishing SE-O rated insulating base material and is 180-second arc resistant with current capacities up to 4.14 amperes at 125 VAC. The new breakers, designed for the protection of color and black and white television receiver circuits, are also suited as a current overload sentry for electronic organs, test instruments, audio amplifiers and other consumer and industrial electronic equipment.



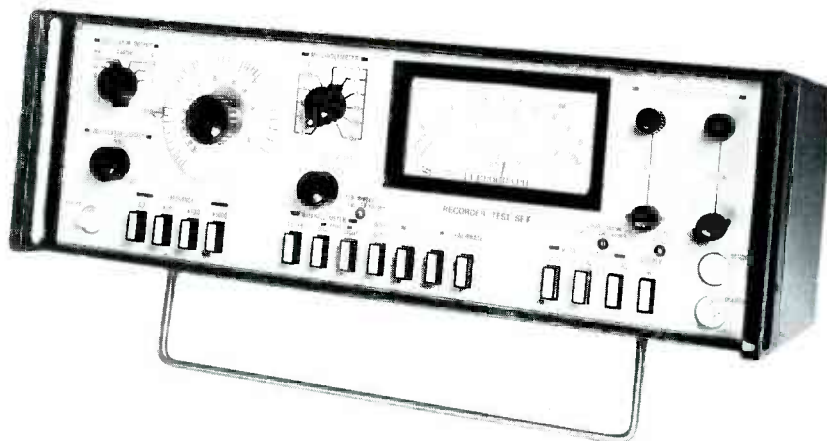
**Specifications:** Hold-current ratings of 0.65 through 0.1 amperes are for 15 ampere, short-circuit current. The 27/32 inch high, 0.175 inch diameter red reset button is also molded of SE-O type material.

**Price:** The 815 Series circuit breaker sells for \$1.40. □

Circle 69 on literature card

# audio systems report

Features and/or specifications listed are obtained from manufacturers reports. For more information about any product listed, circle the associated number on the reader service card in this issue.



## Recorder Test Set

**Product:** RTS-1 ferrograph recorder test set

**Manufacturer:** Elpa Marketing Ind., Inc.

**Function and/or Application:** Applicable to magnetic recorders, disc reproducers, dictating machines, tele cine and film apparatus and audio amplifiers.

**Features:** The RTS-1 consists of four sections: variable frequency audio generator, millivolt meter with associated attenuator, wow and flutter unit and total harmonic distortion measuring unit. Independent access to the inputs and outputs of the various sec-

tions insure the flexibility for general purpose work. The interconnecting of these sections in the correct sequence for any particular test, or for calibration checks is carried out by labelled push buttons. Two leads are necessary from the test set to the equipment under test.

**Specifications:** The unit measures 17 3/8 inches x 10 inches x 5 5/8 inches and weighs 13 pounds. A portable carrying case and rack mounting provisions are available.

**Price:** The RTS-1 sells for \$1200.

Circle 70 on literature card

## Phone Jack Coupler

**Product:** "Tini-Jax" No. 356PI by Switchcraft, Inc.

**Features:** Provides interconnection between tape recorders/players, amplifiers, speakers, tuners, turntables and other audio equipment with two miniature phone terminations or in-line coupling audio cables having similar type terminations. The "Tini-Jax" is housed in a nickel plated brass body.

**Price:** "Tini-Jax" sells for \$2.25

Circle 71 on literature card

## Cassette Head Cleaner

**Product:** QM-140 by Nortronics Co., Inc.

**Features:** The cleaner is designed to remove accumulated dirt and oxide from the magnetic heads in cassette machines, preventing spacing losses and protecting pre-recorded tapes. A non-abrasive 9 foot length belt removes built-up contaminants without damaging the head surface.

**Price:** The QM-140 sells for \$2.90.

Circle 72 on literature card

(Continued from page 69)

### Lectern Sound System

**Product:** Portable Speech Director II by Argos Products Co.

**Features:** Solid-state amplifier, sound column speaker system, and effective in sound coverage in any room with audiences up to 500 persons and more are among features. The Speech Director II is self-contained, and includes a built-in four-speaker sound column speaker system. The microphone is dynamic cardioid that permits three-way operation. Optional accessory high intensity lamp is also offered to light up the lectern's reading table.

**Specifications:** The Speech Director II operates on 110 VAC or the



single self-contained 12 volt battery.

**Weight:** 23 pounds.

**Price:** The Speech Director II sells for \$249.95.

Circle 73 on literature card

### Reflex Sound Projector

**Product:** Model CJ-46 reflex horn, less driver

**Manufacturer:** Atlas Sound

**Function:** The speaker horn provides wide-angle sound projection.

**Features:** The construction is of weatherproof fiberglass, and is recommended for use outdoors. Equipped with an adjustable mounting bracket.



**Specifications:** The dispersion angle horizontally is 120 degrees, and vertically is 60 degrees. Length of the air column is 4½ feet. Low-frequency cutoff is 115 Hz. Outside dimensions are 23 inches x 13 inches x 17 inches.

**Price:** The Model CJ-46 sound projector unit, less driver, sells for \$63.00.

Circle 74 on literature card

### Got A Troubleshooting Tip?

If you've recently run across an unusual trouble symptom, send a thorough description of it and the solution to:

Troubleshooting Tip,  
Electronic Servicing  
1014 Wyandotte St.  
Kansas City, Mo. 64105

### Stereo Replacement Head

**Manufacturer:** Workman Electronic Products, Inc.

**Features:** Replacement heads for almost 90 per cent of all eight-track heads. A cross reference guide is included with display package and lists almost 400 different sets.

Circle 75 on literature card

### Diamond Stylus

**Product:** Quadrasonic sound diamond-stylus needle by Duotone Co.

**Features:** The new needle was designed expressly for quadrasonic sound and is compatible with stereo and mono. The new quad stylus requires two separate diamond polishing laps.

**Price:** The diamond needle sells for \$9.95.

Circle 76 on literature card

### Cassette Cabinet

**Product:** Models CC-12 and CC-24 by E. S. Johnson Co., Inc.

**Features:** The cabinet has an acrylic dust cover and side plates of black high impact styrene with wood grain styrene inserts. The CC-12 holds 12 cassettes and the CC-24 holds 24.

**Size:** 8 7/8 inches wide x 3 7/8 inches high x 7 1/2 inches deep for the CC-12 and 17 inches wide x 3 7/8 inches high x 7 1/2 inches deep for the CC-24.

**Price:** Model CC-12 sells for \$9.95 and the CC-24 for \$16.95.

Circle 77 on literature card

### Cassettes

**Product:** KROM<sub>2</sub> chromium-dioxide cassettes

**Manufacturer:** TDK Electronics Corp.

**Function and/or Application:** Cassettes for recorders designed to match characteristics of chromium dioxide tape

**Features:** KROM-<sup>2</sup> cassettes reportedly establish performance standards with respect to frequency response, signal-to-noise ratio, distortion and output uniformity.

**Specifications:** High frequency output in the range between 10 KHz and 15 KHz is about 9dB higher than ferric oxide cassettes. Signal-to-noise ratio is improved by 3 dB. The cassettes are available in two lengths.

**Price:** The C-60KR sells for \$2.99 and the C-90KR sells for \$3.99.

Circle 78 on literature card

### TV Audio Transmission Radio

**Product:** Model RP-8220 by Sanyo Electric, Inc.

**Features:** The RP-8220 is a portable radio which receives TV audio transmissions almost any place where a TV set may not be practical. Output jacks are provided for tape recording the audio portion of TV shows. An electronic timer, the Memoriode, electronically and automatically shuts off the radio at a preselected time. The Stereocast adapter is a small electronic device that can be plugged into all Sanyo AM/FM radios to receive, decode and amplify FM stereo broadcasts through stereo headphones.



**Price:** The RP-8220 sells for \$84.95. □

Circle 79 on literature card

(Continued from page 11)

*Needed: a 6-VDC to 12-VDC power converter to operate a 12-volt tape player in a Volkswagen.*

Lloyd's Radio & TV Service  
Morford Street  
McMinnville, Tennessee 37110

*Needed: a schematic or service data for a 1970 Zenith Model A4515-13, chassis 14A9C50 color TV.*

Joe Chan  
2683 E. 24th Avenue  
Vancouver 12 B. C. Canada

*Needed: information about the old Templetone Radio Mfg. Co., of New London, Connecticut. Does the Radio Manufacturers Association still exist?*

Mel Straus  
1234 Claiborne Drive  
Walnut Creek, California 94598

*For Sale: Old issues of PF Reporter and ELECTRONIC SERVICING for sale for \$1.00 per year. Only about 8 issues of the past 16 years are missing.*

E. L. Smith  
Smith TV & Radio Service  
325 North Main  
Herculaneum, Missouri 63048

**Technical advice wanted:** *When the brightness control of this Zenith Chassis 14A10C29 color TV is turned down, or the switch is turned to "service", there is strong arcing from the base of the high-voltage rectifier to chassis. The high voltage measures only 15KV.*

Ponciano Svevado  
23 Moss Street  
San Francisco, California 94103

**Editor's note:** My guess is that the high-voltage regulation is not operating correctly and the high voltage is excessive. Perhaps a wrong or defective HV-probe is giving a low reading.

**Technical advice wanted:** *Three different color receivers have had diagonal green lines across the screen. The lines are not very bright and cannot be seen at a distance.*

William Tracy  
N. Caribou Road  
Detour, Michigan 49725

**Editor's note:** This might be a case of poor tracking of the b-w screen color. There is more green in a normal raster than red or blue, so vertical retrace is more likely to be green. Try tracking such sets with the screen controls adjusted lower and the CRT bias or brightness control higher. □

Need a not-available schematic? Need an obsolete part? Have an unusual service problem and want help? Send information and full mailing address to ELECTRONIC SERVICING. Other ES readers should send replies with their offer of help direct to the writer. We reserve the right to edit and print all letters sent to this column. Let us help one another.

## bookreview

### TV, Radio & Hi-Fi Hints & Kinks

Author: John J. Schultz  
Publisher: TAB Books, Blue Ridge Summit, Pennsylvania  
Size: 5 5/8 x 8 3/4 inches, 256 pages  
Price: Softcover \$4.95; hardcover \$7.95.

Here are over 150 accessory construction modification and customizing ideas for TV, radio, hi-fi, CB and shortwave hobbyists. The author tells how to connect single and multiple accessory speakers, how to properly phase speakers, outdoor and auto installations, how to add remote controls to TVs, radios, hi-fi systems, and tape recorders and many other helpful hints.

**Contents:** Tools, Test Equipment & Wiring—Remote Speakers & Headphones—Sound-Activated Light Displays—Remote Controls & Timers—Microphones—FM & TV Antennas—Long-Distance AM & Shortwave Antennas—Two-Radio Systems—Tape Recorders & Phonographs—Hi-Fi Amplifier Accessories—Equipment Care & Repair—Interference Control & Suppression—Home Video Recorders.

### ABC's Of Electronics

Author: Farl J. Waters  
Publisher: Howard W. Sams & Co., Inc., Indianapolis, Indiana  
Size: 5 1/2 x 8 1/2 inches, 160 pages  
Price: Softcover \$3.95.

Analysis of the principles of electricity, functions of atoms and electrons, magnetism, and solid-state physics is detailed in this new edition. Electrical resistance, capacitance, inductance, alternating currents, circuit impedances, electromagnetic radiation, vacuum tubes, transistors, integrated circuits, radio wave production and propagations, and the various electromechanical devices are covered in the individual chapters. Each chapter concludes with a number of review questions. The appendices also contain reference data on electronic standards, mathematical formulas, and color codes of resistors and capacitors.

### Change of Address

To receive Electronic Servicing at your new address, send an address label from a recent issue and your new address to:

Electronic Servicing, Circulation Dept.  
1014 Wyandotte St., Kansas City, Mo. 64105

**YEATS dollies**

**FURNITURE PADS** \$3.50 each

**ROLLS UP & DOWN STAIRS**

**YEATS Model No. 5 \$66.50**

FREE-illustrated brochure

Yeats Appliance Dolly Sales Inc.  
1307W. Fond du Lac Ave.  
Milwaukee, Wisconsin 53205

Circle 40 on literature card

**FREE CATALOG**

**HARD-TO-FIND PRECISION TOOLS**

Lists more than 1700 items—pliers, tweezers, wire strippers, vacuum systems, relay tools, optical equipment, tool kits and cases. Also includes four pages of useful "Tool Tips" to aid in tool selection.

**JENSEN TOOLS**  
4117 N. 44th Street, Phoenix, Ariz. 85018

Circle 41 on literature card

**Got A Troubleshooting Tip?**

If you've recently run across an unusual trouble symptom, send a thorough description of it and the solution to:

Troubleshooting Tip,  
Electronic Servicing  
1014 Wyandotte St.  
Kansas City, Mo. 64105

# Your Heart Fund Fights

Heart Attack  
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**mountain west alarm**  
4215 n. 16th st., phoenix, az. 85016

Circle 42 on literature card

## The MARKETPLACE

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

### Advertising Rates in the Classified Section are:

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

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

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

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

Use your Scope (any model, no rewiring) to Test Transistors Incircuit. Simple instructions \$1.00. Shek Technical Services, 8101 Schrider St. Silver Spring, Maryland 20910. 9-72-6t

### FOR SALE

FOR SALE—14 pcs. of test equipment with manuals. All the equipment is less than a year old. The first \$900.00 takes all. Send self-addressed envelope for list. Daniel Seidler, 5827 S. Campbell Ave., Chicago, Ill. 60629. 9-72-2t

TV & RADIO TUBES 36c EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92105. 9-72-6t

For Sale—TV shop in Central Florida on busy highway near Disneyworld. 4 room house, 28 x 36' shop, few fruit trees, fish pond, country living. Elderly owner retiring. P. Adams R. 1. Box 48. Davenport, Florida. 33837. 9-72-1t

### WANTED

WANTED—Electronic Service Technician. TV Audio Expert. Capable of handling all phases of shop work. For Aspen, Colorado. Heart of Colorado ski, fishing and hunting area. Charles H. Littlejohn, 10672 West Alameda, Lakewood, Colorado 80226. 9-72-2t

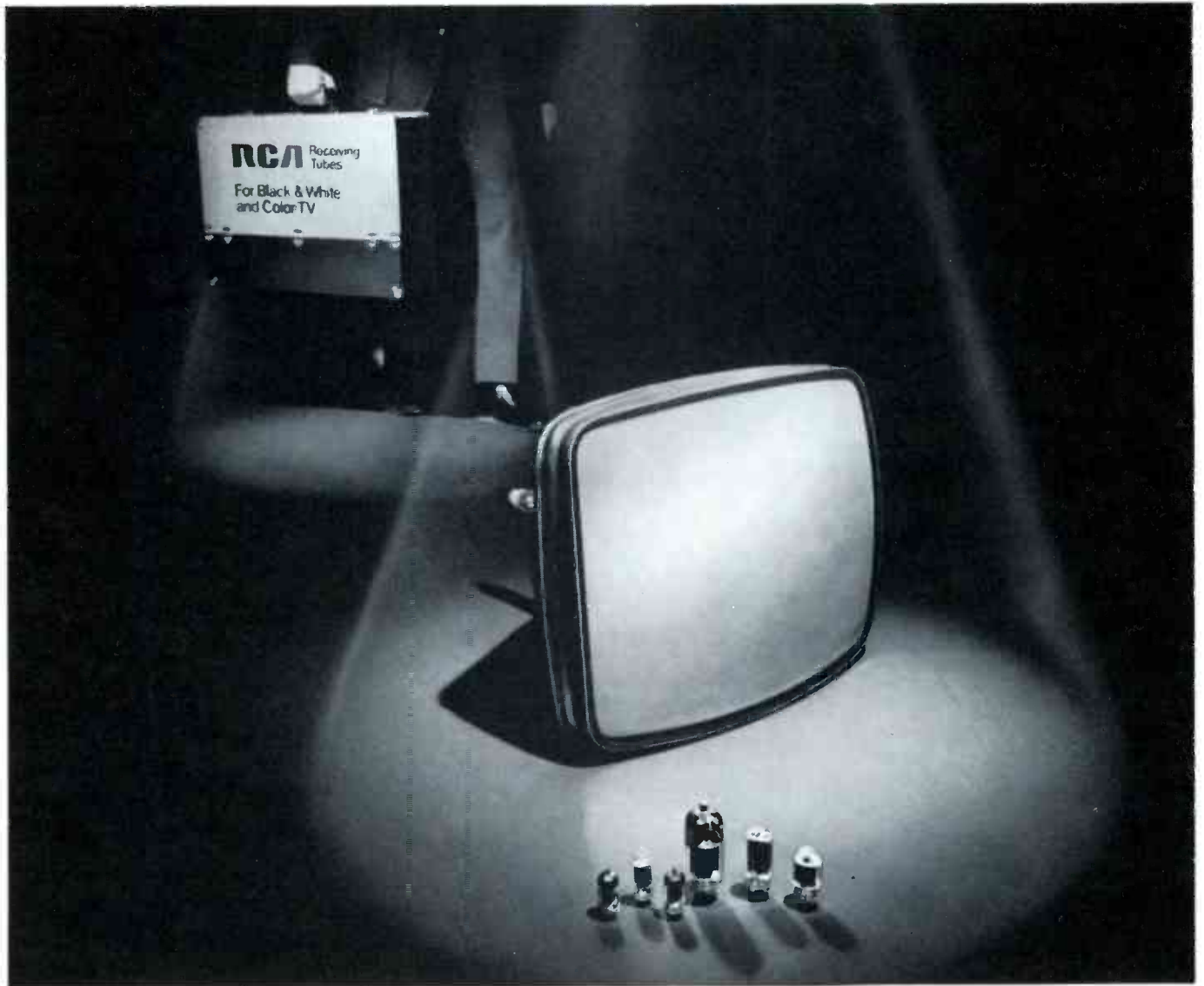
WANTED—Color picture tube rebuilding equipment. Telephone 716-684-2856. 9-72-2t

Wanted to Buy—Good used Picture Tube rebuilding Unit. Barnhart Radio & Electric, Bloomdale, Ohio 44817. 9-72-1t

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# Performers



## RCA tubes and the service technician

A color TV set is probably the most intricate piece of equipment in the average home. And you're the expert who services it. But even an expert needs performance-proven components to back up his technical skills, components like RCA receiving and picture tubes. After all, RCA is a pioneer in TV tube design and has been in the forefront of new tube development since the start of the industry.

Just consider the fact that 6 of the TOP 10 types\* of receiving tubes used in color TV were designed by RCA: 6DW4B, 6GF7A, 6FQ7/6CG7,

6GH8A, 6JC6A and 6LQ6/6JE6C. And as part of its constant efforts to improve tube performance, RCA introduced the Pre-coated Cathode to reduce arcing and the Dark Heater to prolong tube life.

RCA picture tubes are also designed with performance in mind. RCA PERMA-CHROME offers locked-in color purity and RCA MATRIX provides the sharpest, brightest color pictures in RCA history. With RCA picture tubes you can offer your customers a choice of the finest tubes in the industry... all-new HI-LITE produced to rigid OEM specifications, popular-priced COLORAMA produced to RCA's high re-manufacturing standards... and SILVERAMA for black/white replacements.

RCA tube performance is solid. Our record to date is more than three billion receiving tubes and twenty million color picture tubes. See your RCA tube distributor for the broadest possible tube type coverage and offer your customers your own expert service and performance-proven RCA tubes.

Two top performers, you and RCA tubes.

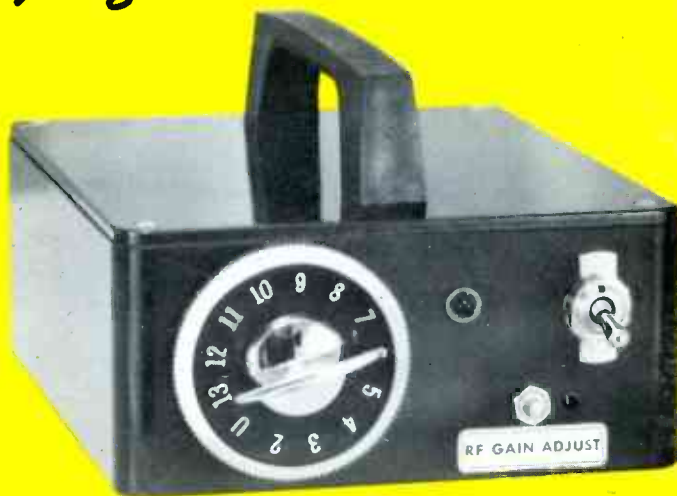
RCA | Electronic Components I  
Harrison, N.J. 07029

\*Based upon available EIA statistics.

# RCA

*Pioneering again.....Castle presents a sensational NEW Timesaver for the Professional TV Service Technician..... Speed Testing by signal substitution. A new, simplified approach to signal circuit analyzing.....*

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Completely self contained and battery operated; Mk. II, all solid state, improved version of original "subber." Uses L.E.D. indicator, has higher gain with wide range control affording more than 40db of gain reduction. Use on the bench or in the home . . . anywhere.

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*" . . . received only Ch. 5, and not good. Used the new Castle TV Tuner Subber and got all channels . . . original tuner removed for service!"*

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