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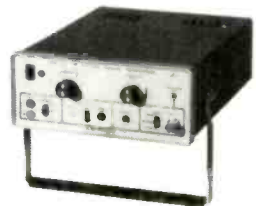
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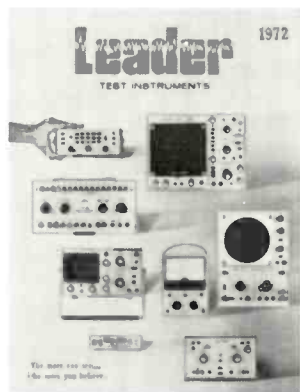
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# Electronic Servicing®

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# electronic scanner

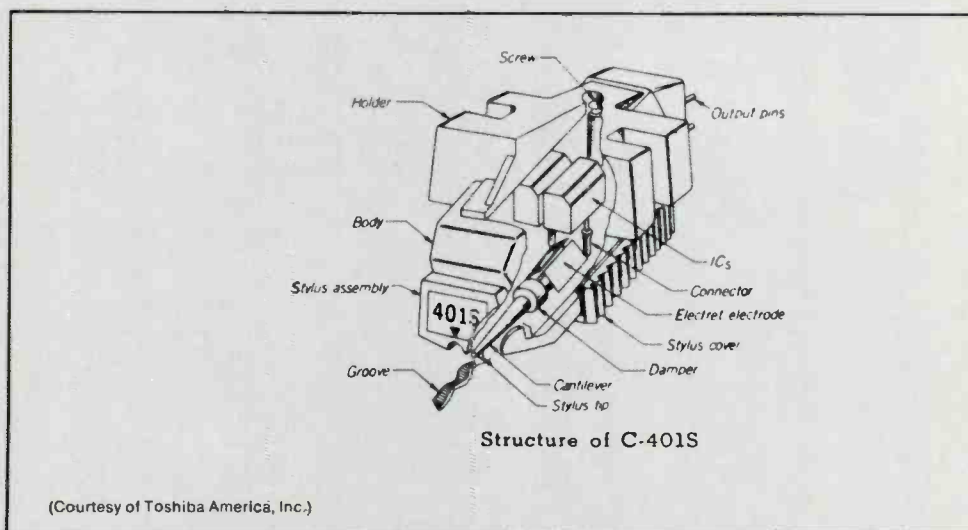
news of the industry

Gas ranges manufactured by the Caloric Corporation are to have an electric ignition system, according to a recent article in *Home Furnishings Daily*. Each burner has a 1.5-watt electric element which ignites the gas within 2 seconds of turn-on. These ignition coils glow continuously but don't produce as much heat as the conventional pilot light. Some previous attempts to develop electric ignition failed because the coils in time became brittle. According to Caloric, they have solved the problem by using coils made of a material called Kanthal.

Jerrold Electronics Corporation currently is running both basic and advanced schools for MATV. These are technical meetings, and there is no charge for attendance. For further details, write to: Training Director, Jerrold Electronics, P.O. Box "A", 401 Walnut Street, Philadelphia, Pa., 19105.

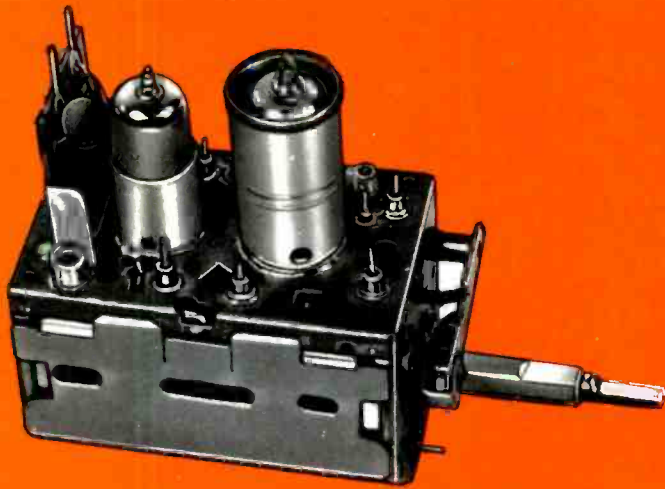
Ceramic cookware utensils now can grill or brown foods cooked in a microwave oven. Previously, one of the serious limitations of the system of cooking foods in microwave ovens has been the difficulty in browning, grilling, searing or frying foods. Some ovens have included conventional electric elements for these purposes. The Atherton Division of Litton Industries, according to *Home Furnishings Daily*, is now taking orders on a steak grill and a skillet, called Micro-Browners, for browning food at the same time it is cooked from inside-out by microwaves. These utensils sell for \$19.95 each, and are made of specially-designed ceramic material that heats when exposed to the microwave field.

A condenser-type phonograph cartridge which uses an electret for a voltage source has just been introduced by Toshiba America, Inc. The low-mass of the cantilever arm of the stylus is one plate of the condenser (capacitor), and built-in IC's amplify the tiny signals at the source. The manufacturer claims a dynamic range of 100 dB, and a frequency response up to 35,000 Hz for the C-401S cartridge with a SZ200 matching equalizer.



(Continued on page 6)





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In this price all parts are included, tubes, transistors, diodes, and nuvistors are charged at cost.

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**WATCH US GROW**

For More Details Circle (6) on Reply Card

Just as this issue was going to press with an article called "Be A 'Good Guy' And Brighten Your Image", the editor noticed an article in the *Wall Street Journal* entitled "Corporate 'Good Guys' Get To Tell Their Side Of Consumer Story". Senator Frank Moss (D., Utah), who is chairman of a Senate Consumer sub-committee, a few months ago wrote to the largest companies and invited them to detail their voluntary efforts to help consumers. The 181 replies from corporation executives, who are harassed by consumer activists and unappreciated by both the press and the public, fill a 466-page Senate document. It seems that TV servicemen are not the only ones who have received a bad press.

The sounds of Big Ben's chimes mark the hour and half-hour near London Bridge at Lake Havasu City, Arizona. Big Ben has rung out the hours to Londoners since 1858, and now by means of special audio tapes is adding atmosphere for the enjoyment of tourists visiting the transplanted bridge. Equipment and tapes were supplied by Tape-Athon Corporation of Inglewood, California, and the music system was engineered and installed by Hollywood Sound Systems.



(Courtesy of Tape-Athon Corp.)

Color TV has been introduced in Italy, according to *Radio & Television Weekly*, but not without much technical and political dissent. The Olympic games from Munich were broadcast in Italy using both the French SECAM and the West German PAL systems. Proponents of the two systems are battling for control of the Italian market. In addition, leaders of the minority political party are against the start of any kind of color broadcasting because they say the money is needed for better schools and hospitals.

A thin-panel TV display was demonstrated by Zenith engineers at a recent Institute of Electrical and Electronic Engineers (IEEE) conference, as reported in *Home Furnishings Daily*. The experimental "picture tube" was a Burroughs Self-Scan panel using the gas-discharge principle, and showed only a portion of the TV picture. Dr. Robert Adler, Zenith vice president of research, is quoted as saying: "The Zenith thin-panel display is the first matrix device to produce a TV picture of sufficient quality to warrant comparison with a CRT."



# Introducing the expensive digital multimeter that doesn't cost a lot.

The B&K Precision Model 281. A solid-state, lab-quality portable instrument that measures AC/DC voltage, current and resistance.

The state-of-the-art Model 281 shows readings on a large, clear, 2½-digit numeric display. It also has positive over-range and reverse-polarity indication. There's no need to switch leads. You can reverse polarity at the flick of a switch.

Model 281 readings are faster and more accurate than analog-type meters. Unlike hard-to-see needle indicators, you can read the large, illuminated numerals—including the decimal point—from a distance.

Featured are 26 ranges: five DC voltage, 100mV to 1000V, with 1% accuracy and 10 megohms input impedance; five AC voltage, 100mV to 1000V RMS, five DC current, 100μ A to 1A; five AC current, 100μ A to 1A; and six resistance, 10 ohms to 10 megohms.

With built-in protection, the 281 can't be harmed by overload. And for safety's sake, it has a three-line AC grounded cord.

Everything about the 281 says expensive—except the price.

Call your B&K distributor.

Or write Dynascan Corporation.

Very good equipment  
at a very good price. **B&K**

# \$169<sup>95</sup>

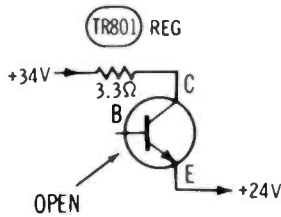


Product of Dynascan Corporation, 1801 West Belle Plaine Avenue, Chicago, Illinois 60613

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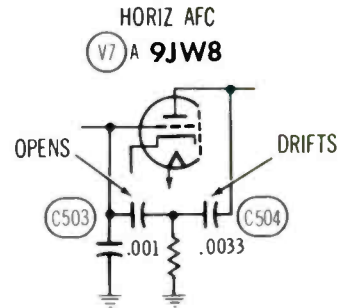
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**Chassis—Panasonic Models CT-601, CT-602 and CT-603**  
**PHOTOFACT—1211-2**



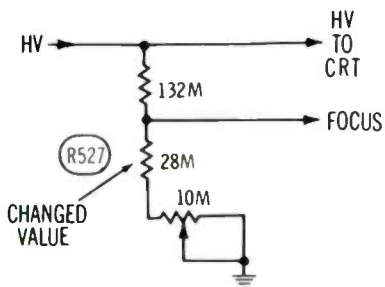
**Symptom—No sound and no raster**  
**Cure—Check TR801 regulator transistor, and replace if open**

**Chassis—Panasonic CT-98**  
**PHOTOFACT—1179-2**



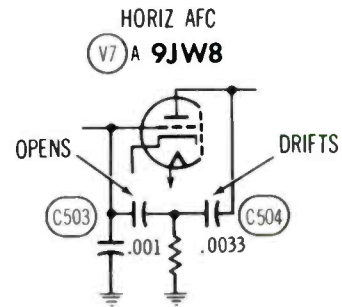
**Symptom—Horizontal frequency drifts with heating**  
**Cure—Replace C504 (.0033)**

**Chassis—Panasonic Models CT-95, CT-97 and CT-98**  
**PHOTOFACT—1115-1, 1153-2 and 1179-2**



**Symptom—Poor focus**  
**Cure—Check R527 and replace, if it is out of tolerance**

**Chassis—Panasonic CT-98**  
**PHOTOFACT—1179-2**



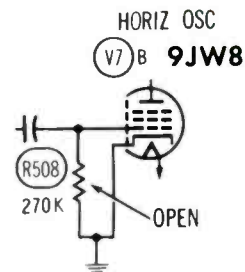
**Symptom—Intermittent horizontal locking**  
**Cure—Replace C503 (.001), if it is open intermittently**

**Chassis—Panasonic CT-97**  
**PHOTOFACT—1153-2**



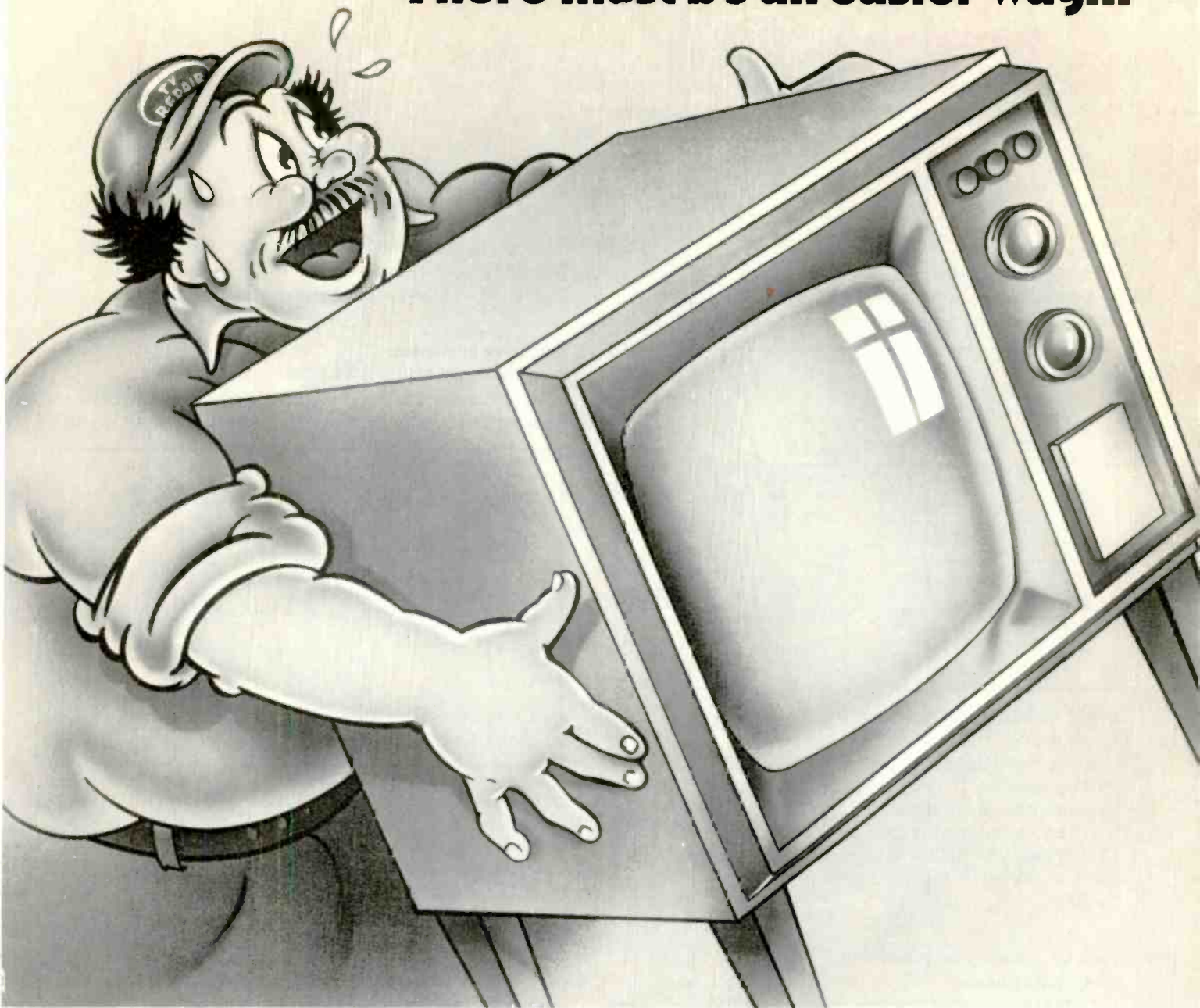
**Symptom—Vertical rolls for several minutes when turned on**  
**Cure—Replace the 6EJ7 3rd video IF amplifier tube**

**Chassis—Panasonic CT-98**  
**PHOTOFACT—1179-2**



**Symptom—No high voltage, horiz output tube overheats**  
**Cure—Replace R508 (270K), if it is open or increased in value**

# There must be an easier way...



## There is: Sylvania's Chek-A-Color test jig.

TV servicemen were never meant to be movingmen.

But, that was before antique, modern and French Provincial units that included hi-fi, tape decks and record players were built around a large-screen color TV set.

Getting those units to the shop can be a big job.

That's why we developed our two Chek-A-Color test jig units. One, our full-house model, gives everything you need to test a chassis. The other is a basic unit that practically lets you design your own test jig.

All you have to take back to the shop is the electronic guts of the TV monsters.

Regardless of the size of the original picture, Chek-A-Color lets you see it on a benchtop 14-inch



(diagonal) screen. It adapts to both high and low focus voltage sets and a full line of adapters lets you test over 5,000 different models.

A front-panel switch controls a yoke programming system that gives you a range of impedances and/or deflection voltages to closely match both tube and solid-state systems.

For actual testing, a convenient meter lets you measure anode voltage and a speaker lets you check sound performance.

Since Chek-A-Color handles tube, hybrid and solid-state chassis, there won't be many complete cabinets to lug.

With a Chek-A-Color test jig all you have to take is the chassis. Get the picture? Sylvania Electronic Components,

lets you see it on a benchtop 14-inch

**GTE SYLVANIA**

100 First Avenue, Waltham, Mass. 02154



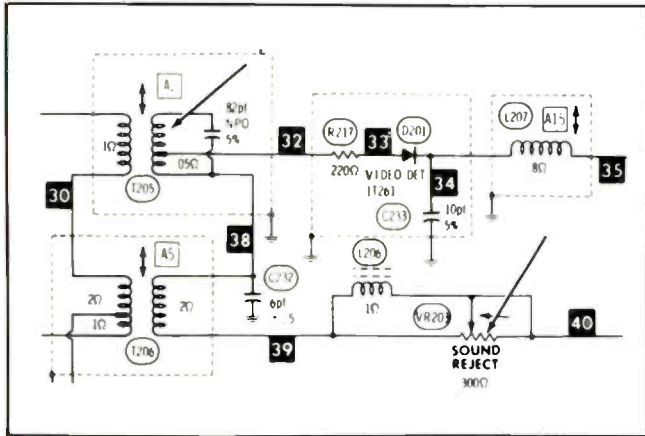
# service bulletin

a digest of information from manufacturers

## Video-IF oscillation

### Sony Model KV-1210U

Symptoms of ringing or black horizontal bars during strong-signal reception with the Sony KV-1210U



might be caused by an open sound-reject potentiometer, VR-203.

For a fast diagnosis, parallel VR-203 with a 330-ohm carbon resistor. If a normal picture results, it is certain the control is open, and should be replaced.

After the control is replaced, align the sound trap (T205) and VR-203 for minimum signal when a modulated 41.25-MHz marker signal is fed to the input of the IF's.

## Pads for mounting the yoke

### RCA CTC59 Chassis

In these models, the housing of the deflection yoke is attached to the picture tube by four adhesive mounting pads.

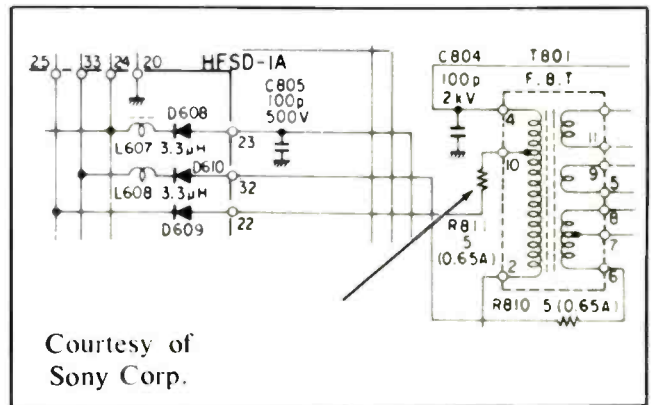
Replace these pads with new ones, if removal of the housing becomes necessary.

The RCA stock number for the pads is 135645.

## Excessive brightness

### Sony Model KV-1710 and KV-1720

Symptoms of high brightness and vertical retrace lines when the brightness control has little effect might



Courtesy of  
Sony Corp.

be caused by an open 5-ohm fusible resistor (R811).

This resistor protects D609 and the +170 supply, and it is mounted on the flyback transformer.

First, check the resistor with an ohmmeter. If a normal reading of 5 ohms is obtained, suspect the picture tube. To check the picture tube, disconnect the cathode leads of the picture tube at terminals 34, 35 and 36 on the SC board. If the picture is still bright, the picture tube is defective.

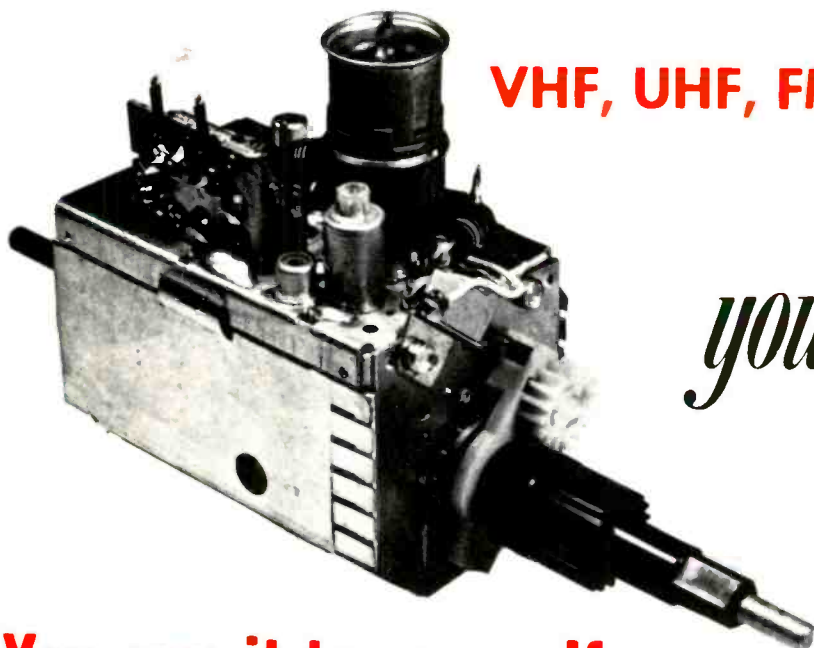
Don't operate the picture tube at such a high brightness level for very long, otherwise it might be damaged by the excessive internal heat.

## Got a Troubleshooting Tip?

If you've recently run across an unusual trouble symptom and have determined what caused it, why not pass the info on to the other readers of ELECTRONIC SERVICING. You'll not only be saving other service technicians valuable troubleshooting time, you'll also be making a little extra change for yourself. Send a thorough description of the trouble symptom and the solution along with a brief discussion of your troubleshooting technique to:

**Troubleshooting Tip, ELECTRONIC SERVICING**  
1014 Wyandotte Street, Kansas City, Missouri 64105

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UV-COMBO	<b>\$16.95</b>
IF-MODULE	<b>\$12.50</b>

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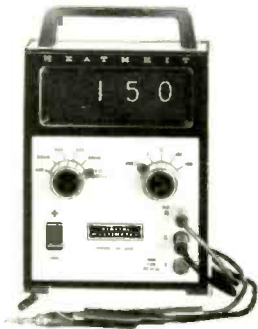
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## reader's exchange

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.

**Needed:** A "Combo" tuner VHF-UHF, Sears part number T95-44, for a Silverton Chassis number 528-33500.

Jasper Mazar  
10 Brook Ave., R.D. 4  
Binghamton, N.Y. 13901

**Needed:** Power transformer for a Delmonico, Model E.M.U. 932. The transformer has no part number but has markings STN.

Philip Bonsignora  
3217 Pelham Ave.  
Baltimore, Maryland 21213

**Needed:** Schematic & calibration data for a Pyramid capacitor-resistor analyzer, Model CRA-2.

Larry Janzen  
Minilab  
P.O. Box 163  
Neosho Rapids, Kansas 66864

**Needed:** Schematic or a service manual for an antique "Freshman" table radio, about 1923. The serial number is 152771, it was manufactured in Chicago, by B.R.C.

Stephen A. Elosh, Jr.  
231 Gladstone  
Campbell, Ohio 44405

**Needed:** Operating manual for the Hickok, Model 188X signal generator.

John Rudiak  
1360 Well Road  
Somerville, N.J. 08876

**Needed:** Schematic and operating instructions for a Doss-D150, transistorized flyback yoke tester.

George Suzuki  
4545 Aliikoa St.  
Honolulu, Hawaii 96821

**Needed:** Schematic and technical information for the dynamic transistor tester developed by Hy-Tronix Instrument, Model 900.

Rudy's TV  
6002 Libbey  
Houston, Texas 77018



**Needed:** Schematic of a power supply to furnish both +50 and -50 volts at 3 amperes, and +29 volts well isolated from the other voltages.

R. L. Wesely  
585 F St.  
Lebanon, Oregon 97355

**Needed:** Schematic and operating manual for Eico, Model 677 tube tester.

A. Bochichio  
45 Andrews St.  
Staten Island, New York 10305

**Needed:** Suggestions for restoring vertical sweep in a Magnavox T935 chassis. All the resistors have been checked and all capacitors replaced.

Jasper D. Grant  
280 Leslie St.  
Newark, N.J.

**Needed:** To help underprivileged kids in high school electronics courses: scopes; color test jigs, and miscellaneous components. Write to me for details.

Charles Primerano  
3509 Rogero Rd.  
Jacksonville, Florida 32211

**Needed:** Service information on Lafayette communications receiver, Model HA-600A.

Jimmie Briggs  
Route 2  
Happy, Texas 79042

**Needed:** C-40 adapter for a Model 350 or 400 Cathode Rejuvenator Tester; a schematic and operating manual for a Philco Dynamic Mutual Conductance Tube Tester, Model 9100.

Steve Hermanson  
102 South St.  
Lebanon, Illinois 62254

**Needed:** Up to date tube testing data for a Precision Tube Tester, Model 660 and adapter Model G-140.

Robert Ralston  
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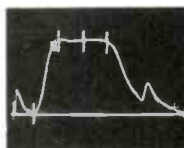
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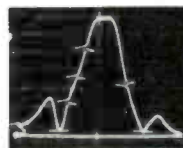
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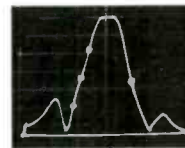
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December, 1972/ELECTRONIC SERVICING 13

# SERVICE ASSOCIATIONS

At the joint NEA/NATESA convention in New Orleans, Morris L. Finneburgh, Sr. offered to take a leave of absence from his company duties to help the merger. This offer has been made official in an announcement from his company. "The Finney Antenna Company is highly honored by the unanimous election of its senior officer—M. L. Finneburgh, Sr., E.H.F.—as Moderator-Chairman of the all-important NATESA/NEA Merger Committees. The Finney Antenna Company Board of Directors—recognizing

that the future security of independent TV service is seriously involved—has taken the following action: 'Morris L. Finneburgh, Sr., E.H.F. has been temporarily relieved of certain important company administrative responsibilities in order to invest his maximum time, efforts and guidance in behalf of the TV service industry merger project.' The Finney Antenna Company knows no ethically better way of continuing to earn the respect, confidence and patronage of our industry."

Members of the NATESA/NEA Merger Committee present at the September meeting were: (back row, left to right) Clifford Shaw, Gerald Hall, Paul Dontje, Edward Gorman, George Weiss and Emmett Hughes; (front row, left to right) Charles Couch, Leroy Ragsdale, M. L. Finneburgh, Sr., Norris Browne, and Virgil Gaither.



## NEA/NATESA MERGER

A giant step towards merger of NATESA and NEA was taken at a meeting September 29th and 30th by the Joint Merger Committee. The committee, under the chairmanship of Morris L. Finneburgh, Sr., tentatively selected the name National Electronic Service Dealer Association (NESDA).

By unanimous agreement, Frank Moch (NATESA) and Richard Glass (NEA) would be elected to the positions of Executive Vice-Presidents for the new association. A sub-committee at a later time will

present an outline of their specific duties. It was suggested that Frank Moch assume the responsibilities of public relations, governmental contacts and publicity, and Richard Glass would be in charge of internal and administrative affairs.

The next joint meeting will be held in Denver, Colorado the first week of December, 1972. At that meeting, the question must be answered about an early ratification of the merger or waiting until the August, 1973 convention in Kansas City.





Fred Martin, who teaches salesmanship at the Omaha Technical College, is shown lecturing at one of the five Business Management sessions. All the sessions were well-attended.

### NESA FALL CONVENTION

Members of the Nebraska Electronic Service Association (NESA) met in their fall convention October 6th, 7th and 8th at the New Paxton Hotel in Omaha, Nebraska. Five sessions of a Business Management School were held; Carl Babcoke, Managing Editor of ELECTRONIC SERVICING presented a three-hour technical seminar; Ron Crow gave a report on the ISCET program and gave the CET test to several

technicians; and the keynote address was by Phillip Dahlen, editor of Electronic-Technician Dealer.

A total of 208 persons attended some part of the activities. Twenty-six distributors and manufacturers furnished exhibits for the trade show. Bob Royce, regional vice-president, made most of the arrangements.



# The anatomy of a sweep failure

By John S. Hanson

*A step-by-step account of how a professional TV technician followed the rules of good servicing and repaired an unexpected failure in his own color receiver.*

One Saturday evening as I watched the antics of Archie Bunker, the circuit breaker in my portable color set went "snap" and the picture disappeared. When I reset the breaker, sound and picture came back, but left again about 15 minutes later. There seemed little point in trying the breaker again, obviously I was faced with a TV malfunction.

I had been wanting to try some of the techniques presented in the RCA No. 8 and No. 9 workshop programs, which are about trouble-

shooting the RCA XL-100 solid-state receivers. So my momentary disgust at the prospect of an evening without television faded into an interest in trying some new troubleshooting. I brought into the living room some of my test equipment, a schematic, and a power cable.

## Testing The SCR Circuits

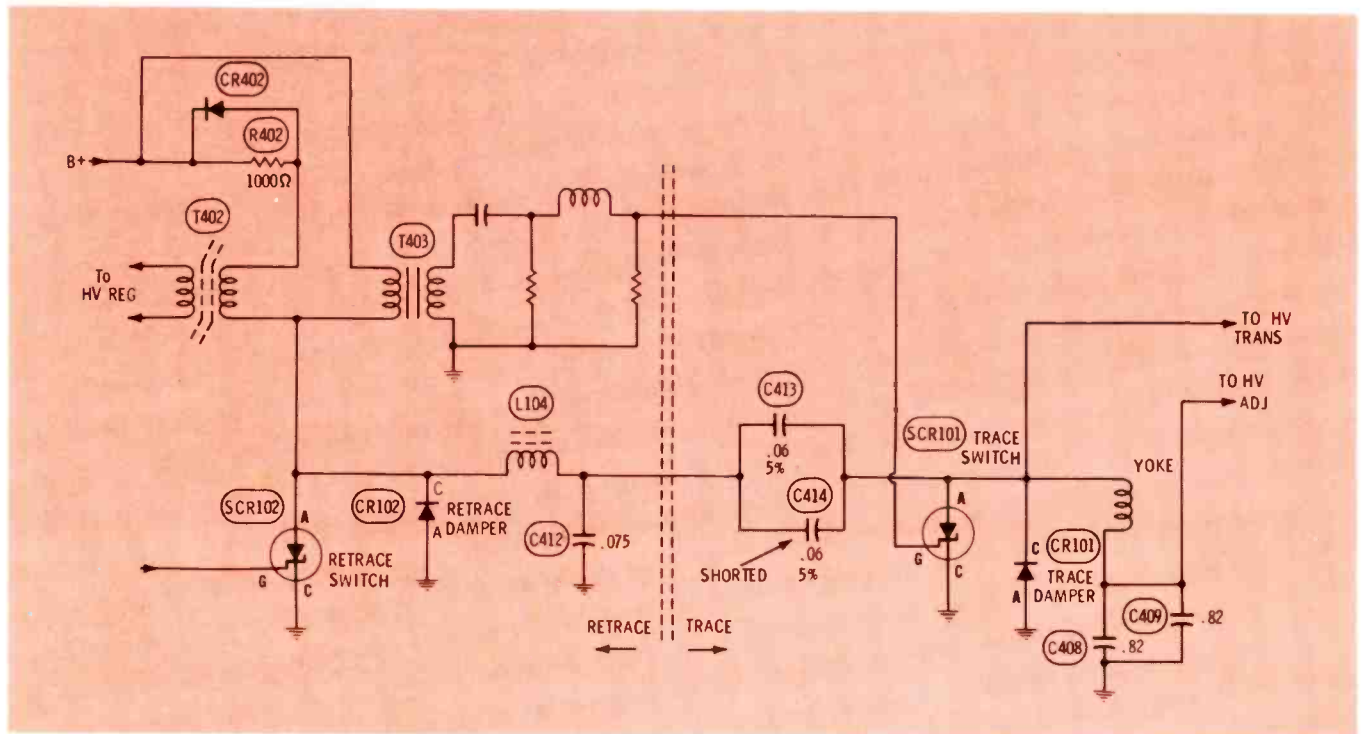
My receiver is an 18-inch portable using RCA's CTC49XA chassis. A simplified schematic of the horizontal sweep circuit is shown in Fig. 1. This is a modified version of the pioneering CTC40 horizontal circuit.

First, I measured the resistance to ground from the anode (case) of each SCR. Retrace SCR102 read about 20K ohms and trace SCR101 measured about 4K ohms; both readings were within tolerance. I

reset the breaker which promptly clicked-off again. Rapidly turning off the power switch, I measured between the anodes of the two SCR's, and was rewarded with a low-resistance reading. Only the commutating capacitor (C413 and C414 in parallel in this model) is connected between these two points, so it is the only component that could give such a reading if it shorted. Removing both capacitors, I found C414 (.06 mfd 5 percent) was shorted.

Luckily, I had an exact replacement capacitor in my parts kit, and quickly installed the new one. The picture came on and I settled back to watch, but this time I left off the back, just in case more repairs were needed.

After a few commercials, I realized the width was excessive, and the side-pincushion correction



**Fig. 1** This is the basic horizontal sweep circuit of the RCA CTC49XA chassis. Deflection is by ringing the retrace circuit at its high resonant frequency and ringing the trace circuit at a lower resonant frequency. This avoids harmful switching transients and the circuit operates at a low impedance so the yoke and high-voltage transformer can be driven in parallel.

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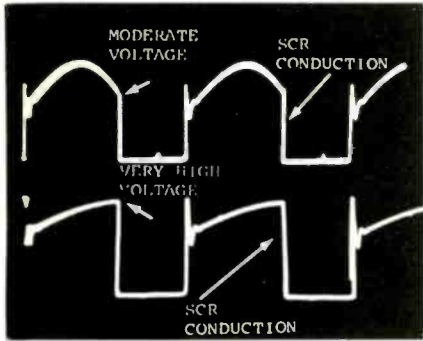
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**Fig. 2** Normal waveform at SCR102 (retrace) is the one above, and below is the wrong waveform found when the high-voltage regulator was inoperative. Normal ringing frequency of the charging circuit is about 12,000 Hz, while the wrong frequency was about 7800 Hz.

wasn't working. Previous to this failure, the picture had been perfect in convergence and pincushion correction. In fact, I recently demonstrated the excellent setup to a friendly competitor.

At that point, I decided some waveform analysis was needed, and started with the low-capacitance probe applied to the anodes of the SCR's. The pulse at SCR101 (trace) was okay, just the normal

sharp spike of approximately the correct 500 volt p-p amplitude.

But at the anode of the retrace SCR, the waveform was abnormal (see Fig. 2). Instead of a rounded top, it ascended more like a sawtooth or ramp. This is the type of waveform produced by too long a time constant.

When I tried to adjust the high voltage, R411 (schematic in Fig. 3) had no effect. Also, the side-pincushion adjustment was inoperative.

### Normal High-Voltage Regulation

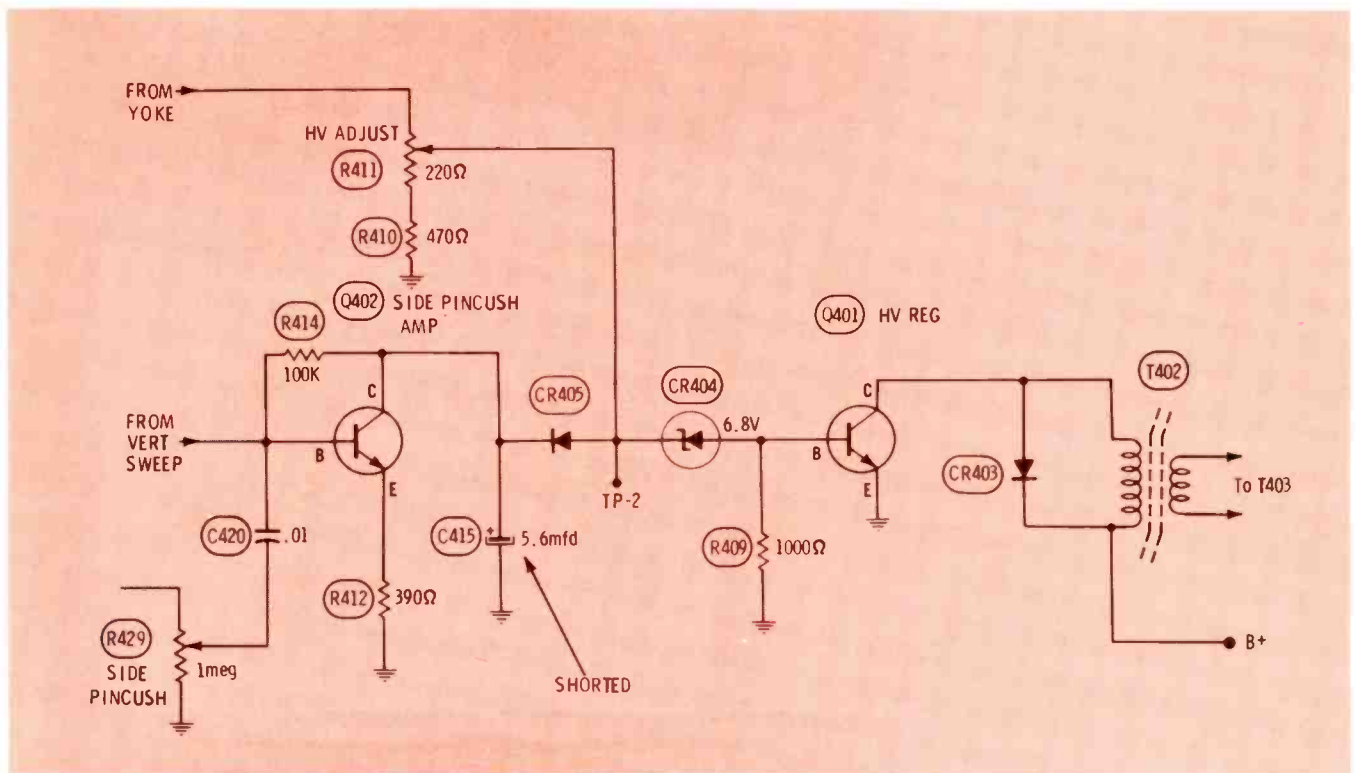
A short review of the design goals and normal operation of the high voltage regulation should be helpful at this point.

The amplitude of voltage at the anode of SCR102 in the retrace circuit at the time retrace SCR102 conducts determines the amount of high voltage and the width of the picture. This is done by ringing the charging circuit so the voltage ar-

rising through T402 and T403 windings in parallel reaches a maximum and then starts down to a lower voltage before SCR102 conducts. The amount of voltage needed at any particular time is supplied by the control circuit which changes the inductance of T402 (Fig. 1) to vary the resonant point of the charging circuit. When the SCR conducts, the charge in C413 and C414 is available to power the trace part of the circuit.

The higher this voltage is at the time SCR102 conducts, the wider the scan and the greater the high voltage. Also, the reverse is true when the voltage is reduced.

T402 is a saturable reactor whose inductance decreases when the current through its control winding is increased. Minimum control current drawn by the HV regulator transistor, Q401, during times of maximum brightness, produces a large inductance in the winding of T402 (see the schematic in Fig. 3) which is in parallel with



**Fig. 3** The side-pincushion-correction waveform is added at TP-2 to the waveform from the cold end of the horizontal yoke winding. Both signals normally affect the width and high voltage, but at different points of the picture.



the winding of T403. Therefore, this large combined inductance is tuned by C412, C413 and C414 to a low frequency of about 10,000 Hz, as shown in the lower waveform of Fig. 4. The moderately-high voltage present when the SCR conducts maintains the normal high voltage even with the extra load of maximum picture-tube current.

Operation with a black raster reverses these conditions. Control current through T402 is at maximum, and this decreases the inductance of the winding paralleling that of T403. The smaller total inductance is tuned by C412, C413 and C414 to about 13,000 Hz. Therefore, as shown in the upper waveform of Fig. 4, ringing has proceeded farther and there is a much lower voltage available when the SCR102 conducts. Lower voltage means less high voltage and narrower width which cancels the effects of the lighter picture tube load. Of course, operation at normal brightness produces conditions in between these extremes with a ringing sine-wave frequency of about 12,000 Hz (shown in the upper waveform of Fig. 2).

When decreased picture tube current or increased line voltage produces more width, the horizontal sweep current through the yoke also increases. This larger current causes more amplitude of the parabolic voltage (lower waveform of Fig. 5) dropped across C408 and C409 (see Fig. 1). This voltage is reduced and regulated by the action of zener CR404, and the remainder (upper waveform of Fig. 5) is applied to the base of Q401, the HV regulator transistor. Q401 has no forward bias except this signal. Therefore, it can conduct only during the positive-going tips when collector current is needed to determine the inductance of T402. CR403 is added in parallel with T402 to damp any ringing of that winding, and current from the damping conduction adds to that of Q401 to increase the efficiency of the HV and width regulation.

#### Pincushion correction

In the RCA CTC49 chassis,

side-pincushion correction is inserted into the high-voltage regulation. Most of the other SCR-sweep circuits don't have this tie-in. And, instead of narrowing the picture at the top and bottom to remove the pincushioned effect at the right and left edges, the CTC49 widens the picture in the center.

Q402 (Fig. 3) amplifies a filtered vertical sweep waveform and applies it through CR405 to the same zener (CR404) used in the high-voltage regulator. This increases the amount of width and HV when the vertical sweep is near the center of its scan. Obviously, some high-voltage regulator defects also eliminate the side-pincushion correction. And both circuits affect the width.

#### Finding The Source Of The Wrong Retrace Waveform

According to the theory of operation, the abnormal waveform at the anode of SCR102 (lower waveform of Fig. 2) indicates the charging circuit is ringing at about 7800 Hz. This is such a low frequency it suggests T402 might have zero control current or have an open winding.

The scope showed no signal at the base of Q401, the HV-regulator transistor. Moving the probe to the other end of CR404 (TP-2), I could find no waveform there, either. Without these waveforms, there can be no HV regulation.

Because both the HV-regulator and pincushion-correction circuits affect the width, and both signals should appear at TP-2, I decided to separate them at that point for testing. When CR405 was disconnected, a normal HV-regulator waveform was obtained at TP-2. And when I tried it, the HV Adjust control changed the high voltage.

Next, I suspected the pincushion-amplifier transistor, Q402, might be defective, but it was okay.

Just a few ohmmeter measurements later, I found C415 was shorted. The value of C415 can't be too large, else there will be in-

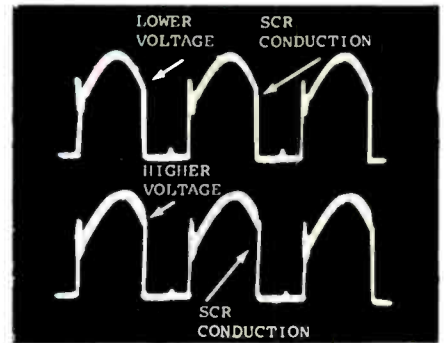


Fig. 4 The top waveform is normal for operation with the brightness turned down. Frequency of the charging-circuit ringing is about 13,000 Hz, so the voltage is fairly low when SCR102 conducts. Likewise, the lower waveform is normal for high-brightness operation when the frequency of the charging circuit is about 10,000 Hz. This gives a fairly high SCR voltage to maintain good high voltage under the heavy drain of the picture-tube current.

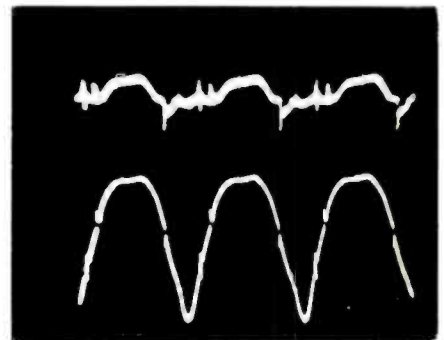


Fig. 5 Normal waveform at the base of the regulator transistor (Q401) is shown at the top. The bottom waveform is the normal 6 volts p-p at TP-2.

sufficient side-pincushion correction. After measuring two or three 4-mfd capacitors, I found one of about 5 mfd. I installed it, reset the side-pincushion control for straight vertical lines at the extreme left and right edges of the picture, turned the brightness down and adjusted R411 for 26.5 kilovolts, and the picture looked fine again.

#### A Happy Ending

Why had there been two separate parts failures? Perhaps C415 shorted first and the resulting excessive width escaped my attention until the overload found a weakness in C414 and shorted it also.

My color receiver was operating excellently again, but I had missed the news and had to settle for watching the late, late show. □

# Troubleshooting tips for flybacks and other defective components

by Morris Moses

*A high-voltage transformer in flames is a spectacular sight, but not all component failures in the horizontal sweep/high-voltage circuit provide dramatic evidence. One of the following methods of testing is sure to spot those other bad parts.*

Component failures in the horizontal-sweep/high voltage circuits are so common we might think the job of finding them would become a dull routine. That's not true, because there are defects which can cause many different symptoms. It's not surprising, then, to learn that more than one type of test is necessary to find all of the bad components.

To start, let's assume there is no raster because there is no high voltage, and this has been proved by use of a high-voltage probe and meter connected to the anode button of the CRT and to ground. A visual inspection of the flyback and the horizontal sweep tubes should be done first.

## Visual Tests

My best advice is to look, look and look even more. Use a magnifying glass if your vision is less than 20/20, and examine carefully all areas where flyback or high-voltage troubles can lurk.

Here are some specific defects to watch out for:

- A burned spot on a flyback winding. (Usually proves it is defective.)
- Broken leads at a lug of the flyback. (Often can be repaired.)
- An excessive amount of wax underneath the winding of the flyback. (Many flybacks drip some wax; learn from the ones still working how much is normal.)
- A pinhole in the insulation of the single-turn HV-rectifier filament winding permitting an arc to the transformer frame or to ground. (Often this can be repaired by installing a new wire.)
- A path of carbon across the socket of the HV rectifier tube. (Repair by installing a new socket.)
- Cracked glass or a white getter-

area inside a tube. (Replace the tube.)

- A blue glow inside the plate. (Replace the tube, it's gassy.)
- A red area on the plate of the tube. (Usually not a defective tube, but indicates trouble elsewhere.) It's surprising how many troubles can be found by watching for these symptoms.

## Testing By Tube Replacement

Checking horizontal-sweep tubes by use of a tube tester is not altogether satisfactory. The DC and AC voltages in any type of tube tester can't be as high as those encountered in the receiver. Therefore, many arcs, slight leakages, borderline weak emissions or tendencies toward gas will not be found by that method. Replacement with a known-good tube often is the only satisfactory solution.

Even the replacement of tubes must be planned with some care, for such common conditions as double-troubles can give false results. For example, suppose the original trouble was an open horizontal oscillator coil. This kills the

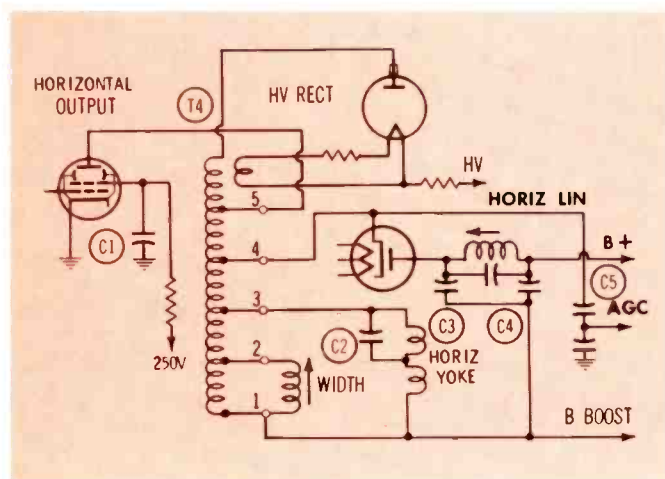


Fig. 1 This schematic is typical of many b-w horizontal-sweep and high-voltage circuits.

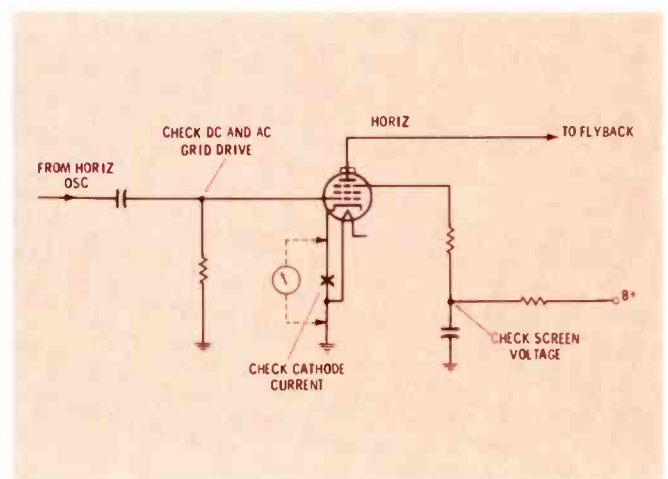


Fig. 2 Open the cathode circuit, then check the cathode current, DC and AC grid voltages, and the screen-grid voltage to obtain some helpful readings.



oscillation; and loss of drive to the output tube is the original trouble (the only one). But it never stops there. No customer ever turns off the receiver soon enough to avoid damage. In fact, many of them continue running the set all evening so they can follow the programs by the sound alone!

Of course, after the horizontal sweep has operated for a time without oscillator drive, the output tube (and probably the damper) has been weakened or ruined. Then regardless of which tube-replacement method you use (one by one or all at once), there is a possibility you'll ruin one or more of your new tubes before deciding that tubes are not the main problem.

My own answer to this dilemma is to replace the tubes one by one, but also to monitor some sweep voltage and keep a sharp watch for visual symptoms. Two DC voltages give us the most information for this test. One is the B-boost voltage, and the other is the screen voltage of the horizontal output tube. Analysis by the screen voltage was given in the May, 1972 issue of *ELECTRONIC SERVICING*, starting on page 57, and will not be repeated here.

An alternate method is to install all new sweep and high-voltage tubes at the same time, and watch carefully for red plates during the first minute of operation. If the new tubes restored normal operation, re-install the old tubes one at a time until there is no raster. The last tube replaced will be the bad one. Unless, of course, there's two!

### Diagnosis In The Shop

Previously, I mentioned monitoring a DC voltage while changing tubes. If the B-boost in Fig. 1 measured +350 when a bad tube was used and the voltage shot up to +800 when a new tube was installed and given time to heat, there is no doubt about the need for the new tube. But there are many more cases in which the B-boost voltage helps diagnosis.

For example, when the receiver was turned on from a cold start, the

B-boost started at zero and at the end of a minute was only 200 volts. **Diagnosis:** The damper tube is weak. Or, the B-boost came up to +350 after 45 seconds of operation, and the plate of the output tube had a red glow. A loss of oscillator drive, bad flyback, shorted boost capacitor (C3 or C4), or other defects which load the output stage could be the culprit. Then, if you disconnected the horizontal yoke coils, and the B-boost went to +1000 volts, it is certain the yoke has shorted turns.

### Checking horizontal drive and plate current

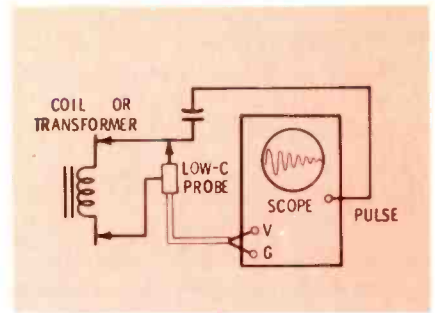
Any horizontal-output tube will draw an excessive amount of plate current if the horizontal drive from the oscillator is missing or reduced in amplitude. The schematics usually show a typical DC voltage for the control grid. This voltage is produced by rectification of the AC signal from the oscillator by the grid-cathode circuit of the output tube. So, remember the output tube must be in the socket, have a complete circuit through the cathode to ground, and the tube must be capable of drawing grid current before this voltage can be generated.

In most cases, the DC reading is an accurate indication of the amount of AC signal there. But this can be misleading where leakages (through capacitors, for example) can increase or decrease the DC voltage without materially affecting the AC drive from the oscillator.

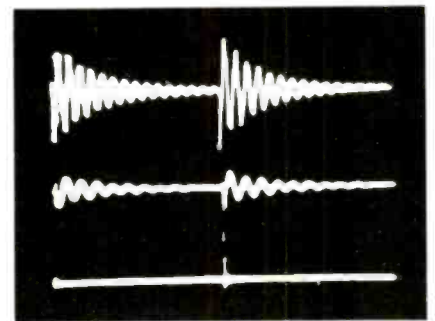
Anyway you look at it, a low DC reading there means trouble and excessive plate current.

After you have checked (and corrected, if needed) the control-grid drive, it is recommended that you break the cathode circuit of the output tube and install a milliammeter between the cathode and ground as shown in Fig. 2. Be careful that you don't also open the heater ground circuit; often the two are grounded at the same spot.

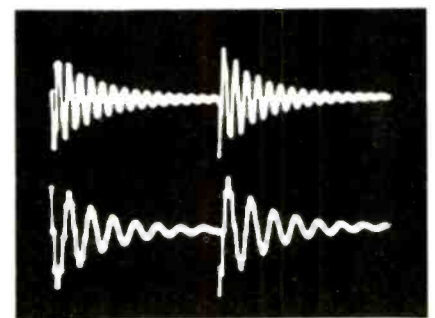
If normal cathode current for that model should not exceed 220 mills, but the meter shows 350, don't operate the chassis very long



**Fig. 3** Circuit used to check inductances by the ringing method. The test frequency and the value of the series capacitor are critical for best results.



**Fig. 4** Waveforms obtained by ringing a flyback transformer.  
**(top)** Normal waveform when the inductance has no shorted turns.  
**(center)** Reduced amplitude when several turns are shorted.  
**(bottom)** Nothing but the ringing pulse shows when many turns are shorted.



**Fig. 5** Waveforms obtained by ringing with and without the yoke in the sweep circuit.  
**(top)** Normal waveform of the entire horizontal sweep circuit, when the capacitor is connected to the plate cap of the output tube.  
**(bottom)** Normal waveform (without changing the test conditions) when the yoke was disconnected. Ringing occurs at a lower frequency.



at a time because the tubes can be damaged. Such a reading indicates a large overload in the plate circuit of the output tube. Remove the plate cap of the HV-rectifier tube. Reduction of the cathode current to normal indicates the rectifier tube is gassy or shorted, or there is an excessive load on the DC output of the high voltage.

**Using the cathode current as an indicator shows when the overload has been eliminated**, even when the temporary test you used to reduce the current also eliminated the HV or the raster.

When you have to dig deeper for the defect, monitor the cathode current as you disconnect parallel loads, such as focus coils or pin-cushion transformers in color sets, or width coils in b-w chassis. The circuit which reduces the plate current when you disconnect it undoubtedly is the one producing the overload. If you have opened all the circuits that load the flyback and the cathode current is still high, it is likely the flyback has shorted turns.

#### Checking the flyback

It's good technique to test the easy things first. With flybacks, that means to try ohmmeter readings first. An open winding is easy to spot because most modern flybacks measure continuity between all lugs (except pulse windings on some color sets).

Checking for shorted turns is more difficult. Of course, if the HV-tertiary winding is supposed to be 600 ohms and measures 80, there's no doubt about that reading!

#### Ringing tests using your scope

Figure 3 shows how to check any inductance by ringing it with a pulse from the deflection circuit of your scope. Some scopes have a terminal on the back panel for this purpose. Or you can open your scope and add a terminal and a wire to the best point.

Two conditions are critical in a ringing test. The frequency must be nearly optimum for the inductance, or the ringing will continue too long or die away too soon for an accurate test. (When you use your scope

for the pulse, you select the frequency by adjusting the coarse and fine horizontal-frequency knobs.)

In addition, the value of the capacitance between the source of pulses and the inductance is critical. Values between 100 and 200 pf usually work best with components which are part of horizontal sweep circuits.

The results of ringing tests can be quite accurate, but only if another identical but normal inductance is available for a comparison. Select a frequency and a capacitance value that give ringing similar to that in the upper waveform of Fig. 4. Then test the suspected inductance.

The waveform in Fig. 4 is probably ideal for ringing tests. When a few turns of the inductance are shorted, both the amplitude and the number of cycles before it decays to zero are reduced, as shown in the center waveform. The bottom waveform shows the results of many shorted turns.

#### Ring the entire sweep system

Because there are so many separate inductances in any horizontal sweep circuit, it is faster to do a preliminary ringing test of the entire system. If the results are normal, the whole circuit is certain to have no shorted inductances. Then check the individual inductances, if the test shows a heavy load.

Just connect the capacitor between the source of the pulse and the plate cap of the output tube (and ground the scope to the receiver chassis, of course).

A normal ringing waveform is shown at the top of Fig. 5. When the yoke coil is disconnected, the ringing operates at a much lower frequency, as shown by the wider sine waves in the lower waveform.

Square waves from an audio generator can be used also for ringing tests. The advantage is the better accuracy with which the frequency can be reset each time.

#### Installing A New Flyback

My advice is to obtain an exact replacement flyback. This is particularly important with color TV's because of the many extra pulse windings and other differences.

Sometimes, as with some Zenith parts, the original-replacement flyback comes with many of the smaller components already mounted and wired. This saves considerable time.

One situation we technicians don't like to talk about, is the possibility of incorrectly wiring the replacement transformer. There are several methods of avoiding this problem. I always make a sketch which includes the color code and terminal numbers plus extra notes like: "Don't forget to install the rubber grommet on the 6JE6 plate lead". Another tip is to clip the old wires leaving about 1/4 inch of insulation at the terminals of the old transformer. This gives an extra check of the color codes. Also, it's better to strip the insulation and make a new end on the wire before soldering.

Speaking of soldering, sharp points of solder or tips of the wires can draw arcs, so make sure the ends of the wires are down against the lugs and the solder flows on smoothly.

Dress all wiring around the transformer very carefully. Use any of the original clips or ties to hold it in place. It's easier to prevent future arcs and callbacks than to repair them later.

#### Adjusting The Sweep Circuit

Most color TV's have two adjustments in the horizontal sweep circuit: a high-voltage adjust control and an efficiency coil. These two adjustments affect each other and, therefore, should be adjusted alternately several times. Check the service data for the method for each model.

Remember that a loss of high-voltage regulation might have been the cause of the flyback failure, because this permits excessive high voltage and width during times the screen is dark. The only way to be certain the high-voltage regulation is operating normally is to adjust it and test it.

If the high-voltage regulation is working okay and the cathode current of the output tube is within tolerance, there's a very good chance there will be no callbacks on that repair. □

# TO A PRO, TIME IS MONEY

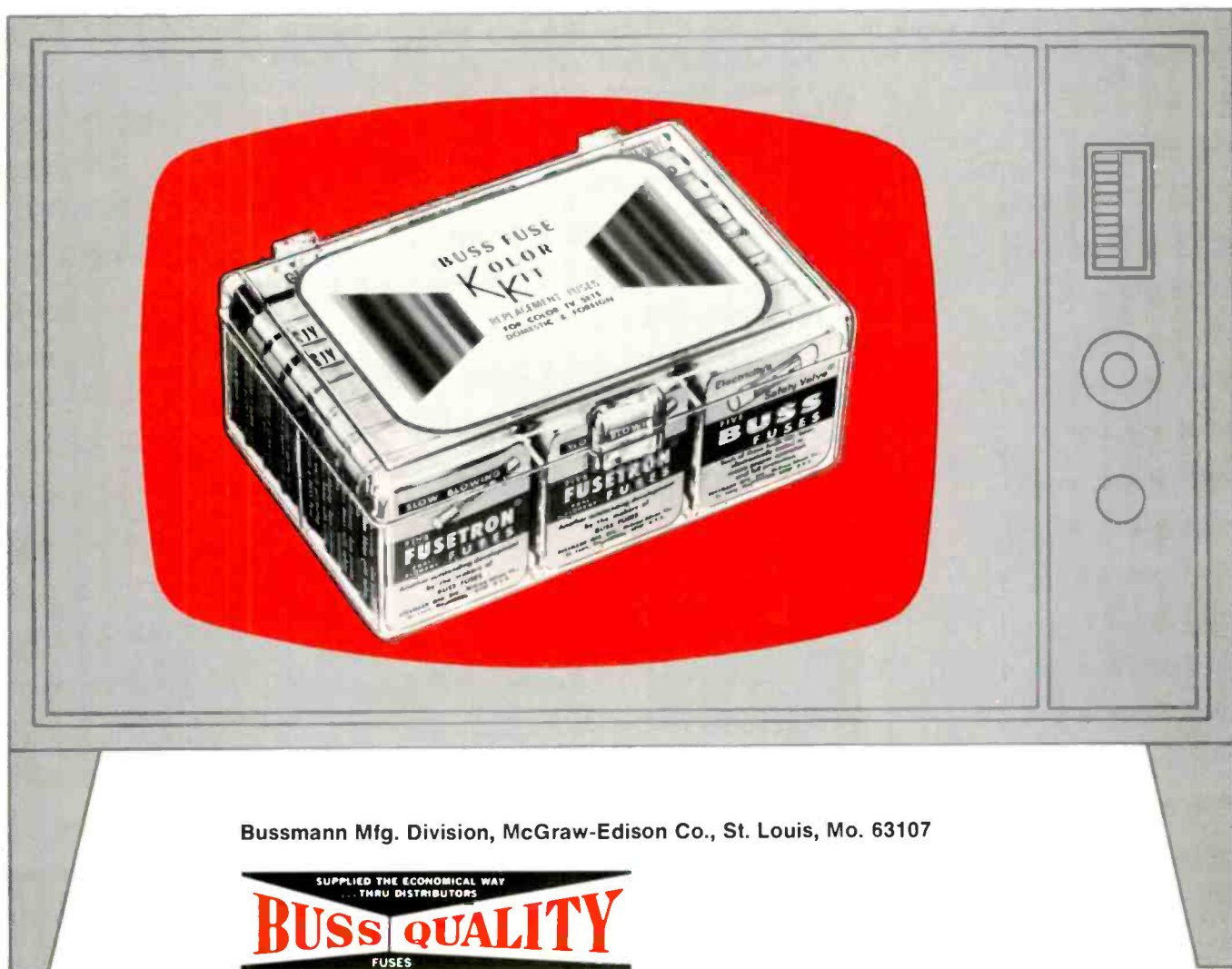
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# Find horizontal sweep defects by SIGNAL-SUBBING

By Forest H. Belt

*The second step in troubleshooting is to find which stage of a basic circuit hides a defect. Signal-Subbing helps you locate this stage—fast!*

Troubleshooting any type of horizontal deflection system in a TV receiver is loaded with difficulties. One reason for this unhappy state of affairs is that sweep circuits contain one or more "closed loops" (see Fig. 1). A defect in any link of a loop upsets the rest of it, making it hard to know where to start checking.

Perhaps you have your own pet way of curing that kind of trouble. My method starts by opening the loop. Then I check the stages by signal-substitution just as if they were a series of amplifiers.

## Signal-Subbing In The Output Stage

Suppose there is no high voltage or raster. Open the flyback/output-tube loop by removing the cap from

the horizontal output tube and connecting an external horizontal-output signal to the cap. I use the plate drive from my B&K model 1076 TV Analyst for this step. If the high voltage doesn't return, suspect the flyback transformer, boost capacitor, damper tube or yoke. Disconnect the Analyst and reconnect the plate cap.

Disconnect the yoke and see if the high voltage returns or if the boost voltage rises to a value higher than normal. If so, the yoke is shorted.

Check the B-boost voltage. If it is equal to or higher than the B-plus supply, chances are the damper tube is okay.

However, if the high voltage returns when you use the drive from the Analyst, the trouble is in the horizontal oscillator, or in the grid, cathode or screen circuit of the output tube.

Next, inject a grid-drive signal at the grid of the output tube. A raster and the return of high voltage proves the problem is in the horizontal oscillator stage or in the coupling to the grid.

## Signal-Subbing The Oscillator

One way to service the oscillator is to break the positive feedback loop and treat the stage as an amplifier. Inject a grid-drive signal at the output, in the middle (if there are two stages), and at the input of the oscillator. By noticing which points give high voltage and which do not, you can find the stage with the defect.

Or, if the problem involves horizontal locking, you can substitute the grid-drive signal for either the horizontal sync or the sample of sweep from the flyback to see if the AFC is controlling the frequency. And because the output of the AFC stage is DC voltage, you can use a variable DC supply, varying the voltage to see the effect on the frequency.

These are the condensed procedures in signal-subbing horizontal deflection in tube-type television sets.

## Signal-Subbing In Transistor Output Stages

Unfortunately, when I tried using these methods with my model

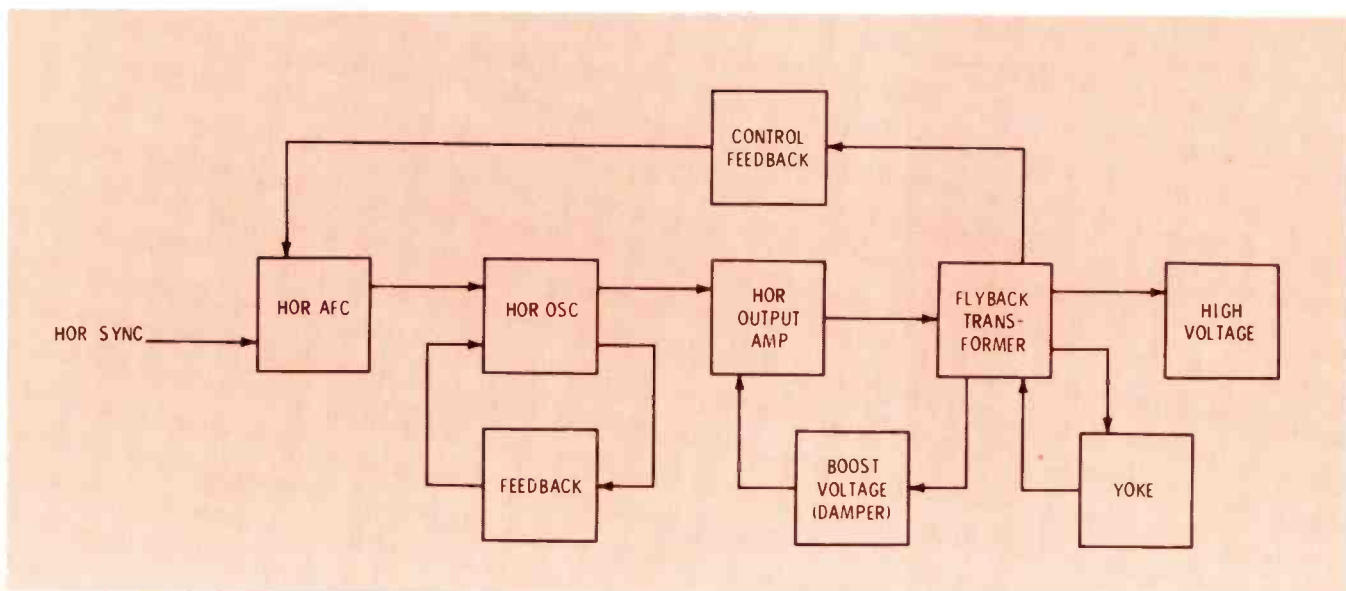
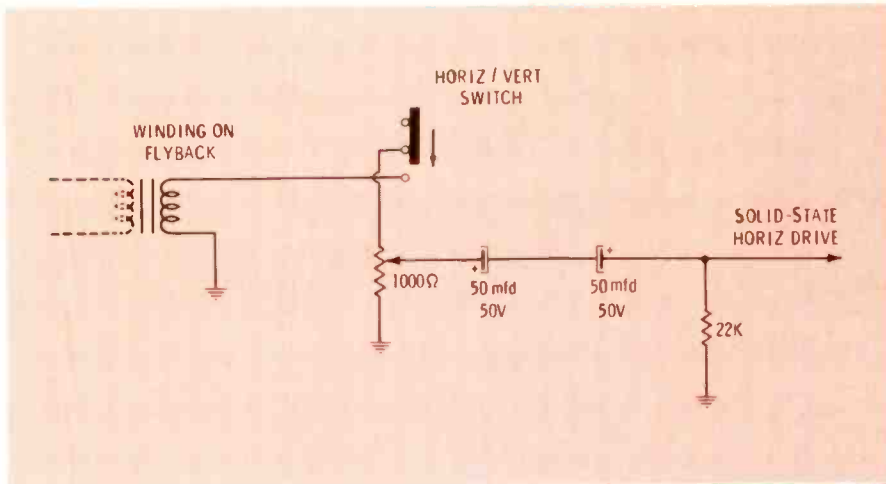
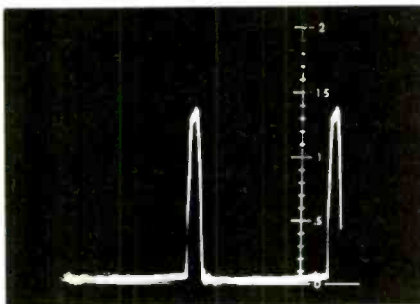


Fig. 1 Horizontal sweep section actually contains several closed loops. Best way to check is by opening them and substituting signal at appropriate points.

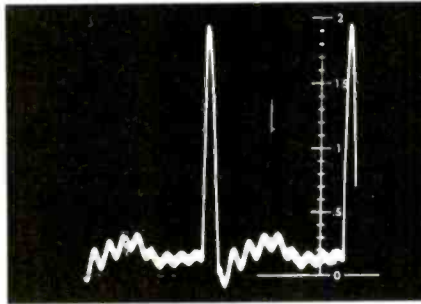




**Fig. 2** Low-impedance circuitry in the B&K model 1077B supplies a signal that can drive solid-state sweep stages in transistor TV sets.

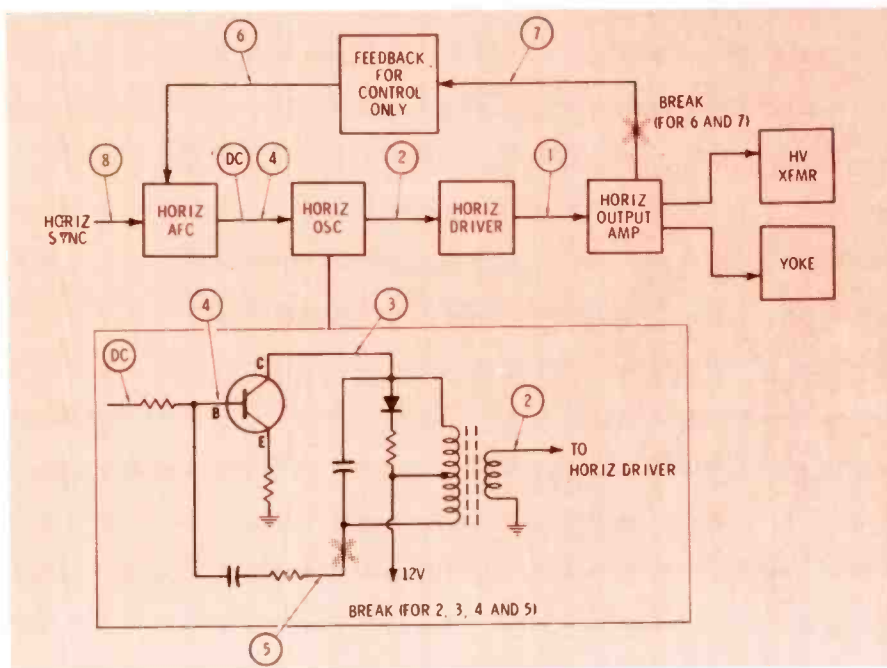


(A)



(B)

**Fig. 3** These sweep waveforms are supplied by the B&K model 1077B. "A" is for solid-state substitution; "B" is for tubes.



**Fig. 4** Signal-substitution sequence in a typical transistorized monochrome television receiver. Oscillator is a closed-loop circuit within the section, and is tested accordingly.



**Fig. 5** Inductance-test jack and knobs on model 1077B for checking yoke and transformer when substitution won't work.

1076 Analyst and solid-state sets, I found it wouldn't work. I had to update my equipment. Now I have the new B&K model 1077B Analyst. It has a Solid-State Sweep Drive jack. Figure 2 shows the circuit used to drive transistorized horizontal sweep stages. The signal comes from the same flyback that supplies deflection for the flying-spot scanner. Impedance is low, back-to-back electrolytics are used as couplers, and a potentiometer is provided for amplitude adjustments.

Waveforms of the pulses for use with solid-state and with tubes are shown in Fig. 3.

The block diagram of Fig. 4 shows the horizontal-sweep section of a transistorized monochrome TV. Numbered points show where to use signal substitution to isolate troubles.

There's one important difference between most transistor horizontal sweep systems and their tube counterparts: The yoke is driven directly from the output transistor. Horizontal-output transformers supply a stepped-up signal for high-voltage rectification, and pulses of lower amplitudes for other purposes.

The only feedback loop is for the control of horizontal frequency. Pulses from the output stage are fed back to the horizontal AFC circuit.

More detail of the horizontal oscillator is shown in the inset. The numbers correspond with the same numbers on the main block diagram. Positive feedback to sustain

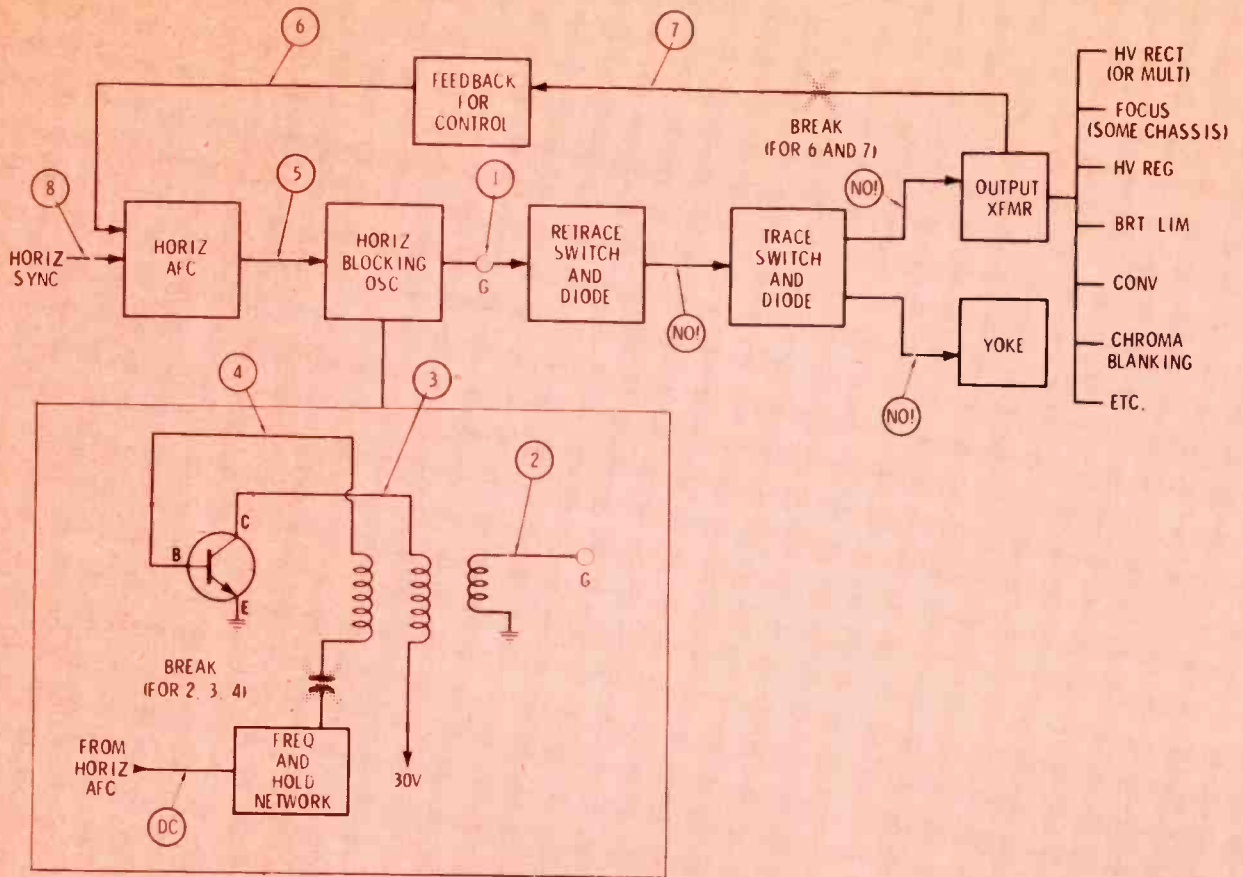


Fig. 6 Horizontal sweep system unique to RCA color chassis CTC40 and CTC44. Uses silicon-controlled rectifier switching, with diodes to keep sweep currents in right paths.

oscillation comes from the lower end of the collector transformer winding back to the base through a capacitor and a resistor.

To inject the drive signal into the oscillator, break the feedback circuit, as shown. Injection at point 2 checks out the driver and the stages that follow. A signal subbed at point 3 tells whether or not the transformer is okay.

If the drive signal applied to point 4 produces high voltage and a raster, the oscillator transistor must be normal. And if the signal comes through when applied to point 5, the feedback capacitor and resistor are okay.

Testpoint DC is the place to apply a variable DC voltage from the Bias-DC outlet on the Analyst to check how well the oscillator frequency can be controlled, if locking is the problem.

Points 6 and 7 are for checking the AFC feedback loop. Pulses injected here will not permit hori-

zontal locking unless you use the RF test pattern from the generator applied to the antenna terminals of the set.

The 1077B solid-state sweep drive works fine for points 1, 2, 3, 4 and 5. Also at points 3, 4 and 5 if you turn down the amplitude at bit. Use the Keying Pulse for points 6 and 7.

### Testing The High-Voltage Transformer

One question I've heard from technicians who try these methods of subbing is how you can directly drive the high-voltage transformer with the Analyst. The answer is: **you don't**. There just isn't enough power to drive both the yoke and high-voltage transformer. It's only practical to inject the horizontal-drive signal at the base of the output stage. However, inductance tests can be made with the Flyback Yoke Test Signal (see Fig. 5).

### Testing SCR-Sweep Circuits

You can use the 1077B Analyst in testing the horizontal oscillator of RCA TV's which use two SCR's for horizontal deflection. But don't hook the Analyst into the anode circuits of the SCR's, or it's likely the back-to-back electrolytics inside the Analyst will explode from overload! Later, I'll tell you a better way of servicing that portion of the circuit.

The block diagram of the horizontal sweep circuits of the RCA CTC40 and CTC44 is in Fig. 6. Both the retrace and trace sections include a SCR and a diode: all four are used for switching.

The inset of the schematic shows how the blocking oscillator can be opened up for testing by injection of horizontal pulses. In this case, you start by injecting the pulses at point "G" (see Fig. 7A) which is connected to the gate of the retrace SCR. If the raster and high-voltage

appear, the horizontal oscillator is dead.

#### Oscillator subbing

Inject the solid-state drive pulses at the collector of the oscillator transistor, and then at the base. Lack of high voltage tells you which circuit is dead. If both points produce high voltage, break the positive feedback path at the capacitor which is between the oscillator transformer and the hold control network. Try injecting the drive at either end of the capacitor.

Horizontal locking can be tested using the variable-DC-voltage method by connecting the supply to point "DC".

#### Testing the SCR's

However, if the horizontal-drive pulses applied to point "G" did not give high voltage and sweep, test the SCR's.

Remove two screws from each SCR (Fig. 7B) then use a fingernail to lift them away from the mica washer and the socket. Caution: mark the SCR's or remove them one at a time, because they are not interchangeable (one is rated for more current).

In nearly every case, an ohmmeter test will be sufficient. The gate-to-cathode resistance should be low, about 300 ohms for those in CTC40 chassis, or less for the CTC44 version. There's no diode action; resistance is nearly the same regardless of polarity. The anode-to-cathode resistance should be very high (say above 10 megohms) with either polarity.

#### Types of defects

Defects in the SCR sections can be classified into two types: the ones that trip the circuit breakers, and the ones that do not.

A dead oscillator merely stops all SCR and diode conduction, and they feel cold relative to the normal slight warmth.

#### The breaker trips

Suppose the breaker keeps tripping when reset. Turn off the set, and connect a jumper lead from the anode of the trace SCR101 (Fig. 9B) to chassis. This prevents the trace section from operating. Reset the breaker and apply the power. If the breaker trips again, the over-

*(Continued on page 46)*

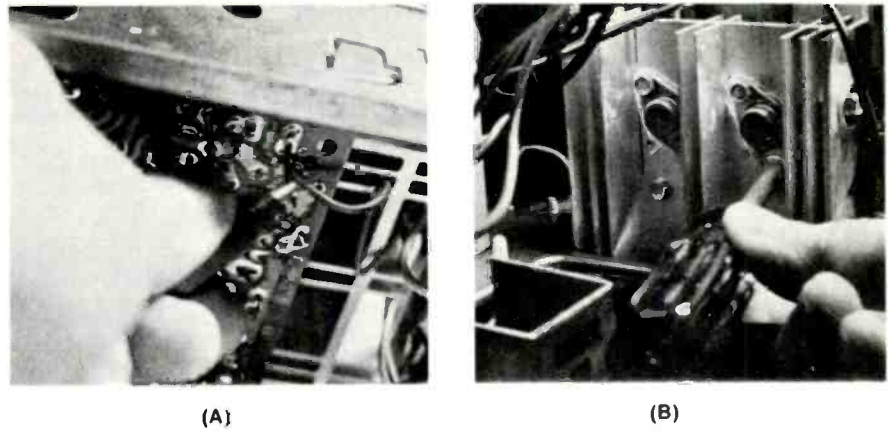


Fig. 7 (A) Test point "G" for substituting sweep trigger. (B) Two screws hold each SCR in its socket.

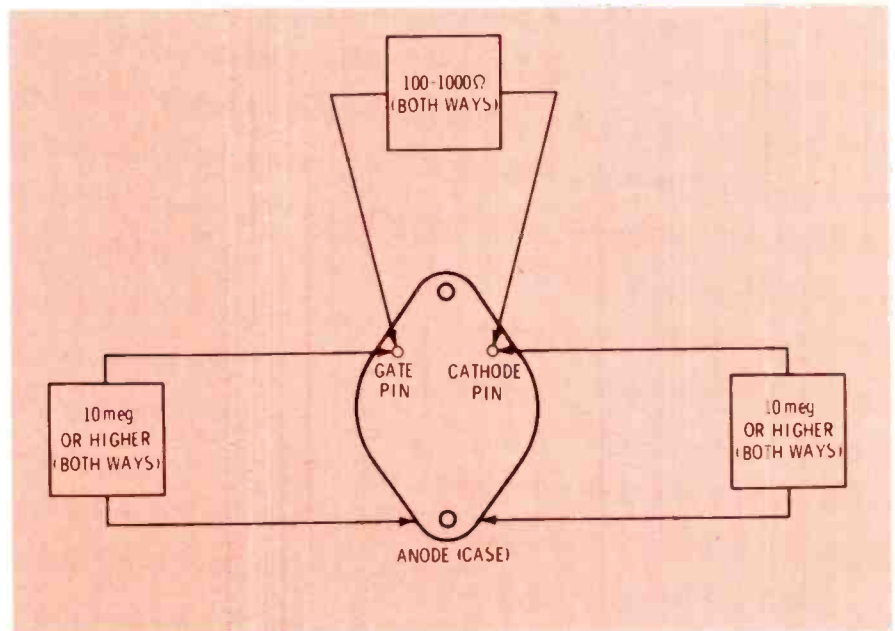


Fig. 8 Method of checking SCR's with an ohmmeter.

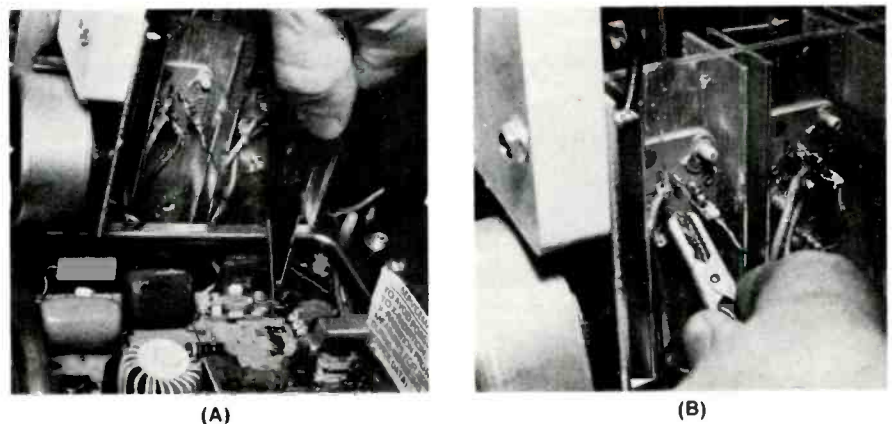


Fig. 9 Some of the tests to make if substitute trigger doesn't start SCR sweep working. (A) Test diodes. (B) Ground anode of trace switch SCR to isolate cause of overload that trips circuit breaker.



# CHECKS... Do The Benefits Exceed The Dangers?

*You know the advantages of using checks. Now learn the dangers and precautions.*

Checks help make doing business easier, safer and faster. Instead of taking in or paying out cash in the normal course of business, you receive or pay out checks. You don't need to keep large sums of cash on hand, nor must you make a trip to the bank before paying a bill. But where there is money, or a negotiable substitute for money, the crooks will not be far behind.

## Crooks Are Versatile

In the days before banking became widespread, robbers and burglars preyed on couriers who carried cash between businesses. Use of checks and credit exchanges have reduced that hazard. But crime is an inventive man's business, and we find the highwayman has been replaced by the forger, bad-check artist and "paperhanger."

So, although there are so many advantages to using checks, you should know the hazards, and how to protect yourself from losses.

## Properly Draw Up Your Checks

A sample of a properly-drawn check is shown in Fig. 1. Notice that it contains all of the legal requirements: date, payee, drawee, amount to be paid, and the signature of the maker. Also, the payee is **named**, not just mentioned as "Bearer". The amount to be paid is given **both** in figures and words. Since this check is handwritten, the words and figures are carefully placed to eliminate any spaces that could be used to alter the amount. Notice that insertion of a word and a number could "kite" your carelessly-drawn check from \$20 to \$120 or \$200.

You must be sure you have enough credit in your

account to cover all your checks. A check drawn against a bank where you don't have an account is a "No Account" (NA) check. One drawn against a bank where you do have funds, but not enough to cover the amount of the check, makes it a "Not Sufficient Funds" (NSF) check. Both NSF and NA checks are grounds for prosecution in most areas of the nation. The law, recognizing the crucial importance of credit, protects the trustworthiness and collectibility of checks.

## Endorsements

Figure 2 illustrates "Blank", "Restrictive" and "Full" (or "Special") endorsements. It's handy to know what each does and means.

A Blank endorsement actually turns the check into one that can be used by anybody possessing it, just like a check made to "Bearer". The danger here is that—after the first endorsement—it can be passed without further endorsements, making prosecution of a bad check very difficult. Minimize the danger when accepting a third-party check by requiring an endorsement by the one presenting it to you.

Remember the old riddle about the check that was passed several times from one person to another before it was found to be worthless? The riddle asked for a mathematical solution as to who lost. Legally, the last person who holds the check—the fellow who presents it to a bank for payment—is the loser.

## Holders In Due Course

This last man of the chain is called a "holder in due course" and he has special protection under the law, with the right to collect from the prior endorsers, the payee, or the maker. If the original check was legal, nothing takes precedent over his right.

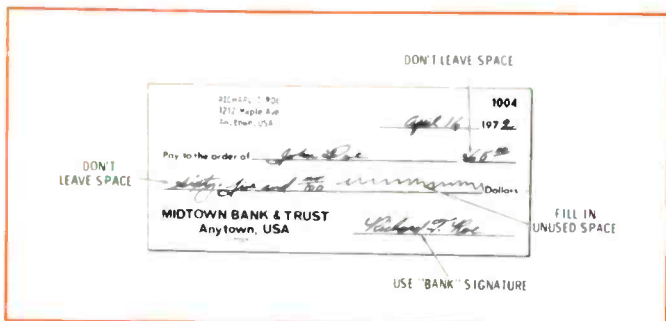


Fig. 1 Details of a properly-drawn check.

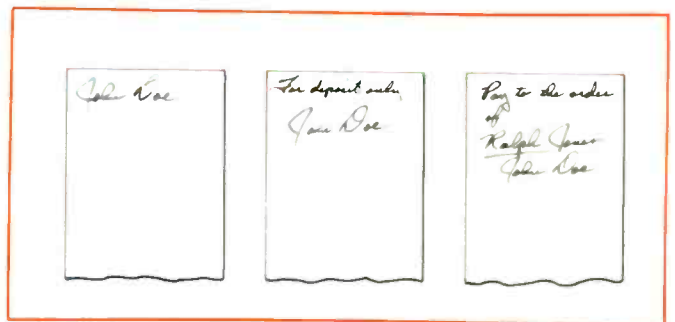


Fig. 2 Three examples of common forms of indorsement (on the back of the check). From left to right, Blank Endorsement, Restrictive Endorsement and Full (special) Endorsement.



By Robert G. Amick

Obviously, any lack of intervening endorsements reduces the number of people against whom you can take action. The cost of recovery of a small-amount check is much too high to be practical. Prevention is the best solution to the problem.

### Restrictive Endorsements

A safety device you should use is the Restrictive Endorsement which restricts further negotiations of the check. When you endorse a check "For Deposit", your bank, but no other, will accept it.

### Full Endorsements

Full Endorsements make transfer of a check specific, but allows it continued negotiability. This helps in questions about whether or not payment was actually made, but doesn't make any easier the tracing of a bad check.

### How To Avoid Trouble

**Don't compete with your neighborhood bank for the check-cashing business!** Especially when cashing requests come from pleasant-appearing strangers with plausible stories of "emergencies". Occasionally, one of your customers, or someone who's known to you, will have a real need and ask for help after banking hours. If you have a "No Checks Cashed" rule, this could be a worthwhile exception. But, be careful of the others.

It's likely you'll receive a few NSF checks from your regular service customers, even when the amounts are small. Most will be from people who try to race the check to the bank and will cause you few problems. The dangers from real crooks occur when you get into higher-ticket rentals or sales. Also, you're more vulnerable when doing walk-in business, because there are no hints about the permanence of the home location.

Your best protection, when cashing checks, is to explain that you do very little cash business, and keep only a small amount of petty cash. That lets you out of any request over (say) \$10 or \$15.

What kind of checks should you look out for? **Every check!** Even paychecks are not necessarily what they seem. Rolling drunks on payday isn't profitable for the crook just because of the cash. The thief usually gets—in addition to the victim's check—many identification cards with samples of signatures.

### Avoid Counter and Universal Checks

Cashing two forms of checks definitely is out:

### Tips for safer check cashing

- Don't cash any check showing alteration.
- Don't cash any check written in pencil.
- Don't cash checks for juveniles.
- Don't cash bank-counter checks, or universal checks.
- Don't cash checks signed with rubber stamps, unless you know all the people involved.
- Don't cash checks for strangers unless they have positive identification from local references.
- Make the person presenting the check indorse it in your sight (even if it is already signed) and compare the signature against those on other identifications.
- Don't cash "third-party" checks unless all persons are known to you.
- Don't cash checks on out-of-town banks or businesses unless you are certain the companies and checks are valid.
- Don't be too embarrassed to ask questions about any check details that bother you. It is, after all, **your** money, and you are being asked to confer a favor.
- Call the bank (if within banking hours), give your business name, the account number from the check that is in question, and the amount of the check. The bank will tell you whether or not there is sufficient money in the account to cover the check.
- Immediately deposit into your bank all the checks you receive.

**Counter Checks and Universal Check Blanks.** Counter checks are intended for use inside a bank by a person who has an account but didn't bring his own check book. Unfortunately, these forms are available to anyone who walks into the lobby of the bank. The Universal check has a space for the name of the bank to be written in. Neither type of check can be handled by high-speed automatic check-sorters. They won't be accepted for transfer by clearing houses, and many banks will not honor them, even at the bank counter. Refuse to cash any of these checks.

### Avoid Post-Dated Checks

Although post-dated checks are not illegal, the bank won't accept one, or it may not place a "hold" on the amount until the date on the check. This gives the customer time to get his deposit in before the check is due. Unfortunately for you, it also gives him time to close his account and move away.

### Be Alert For "Kriters"

Check "kriters" alter the amount on the check. The successful ones change the spelled-out amount, because most banks give priority to this over any amount



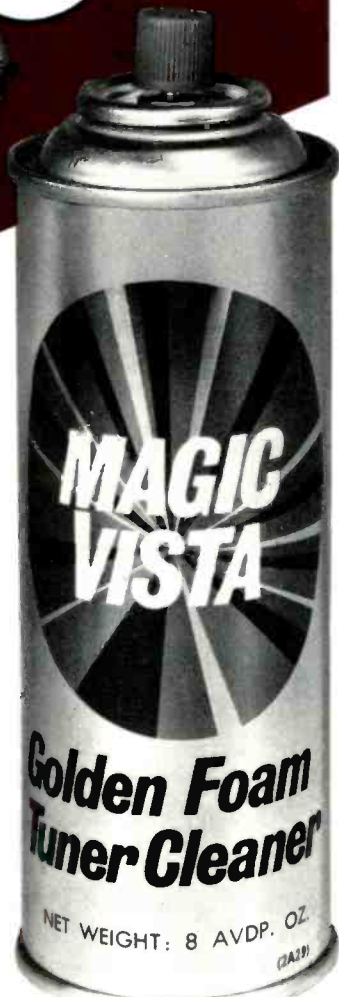
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For More Details Circle (12) on Reply Card

in figures. If one of your checks is altered in this way, you legally are responsible for the **original** amount of the check. On the other hand, if you cash a "kited" check, you lose any amount in excess of the original.

### Watch For Forgeries

Forgers work on the signature, or on the endorsement. The mugger who rolls a drunk also commits forgery if he endorses and cashes the check. That's why you can't trust even legitimate payroll checks. Sometimes whole blocks of payroll checks are stolen by burglars, who then cash as many of them as possible before moving out of town.

Ordinarily, an incomplete negotiable instrument (unsigned or incompleting check) doesn't become legally valid when filled out by a thief. But it makes a lot of trouble, and you just might be stuck for the amount.

A few versatile, imaginative criminal groups even print their own checks—on nonexistent banks or companies—and their own identification. And, I heard of one creative loner who cashed his valid paycheck at the bank, and then went to a neighborhood grocery store where he cashed the voucher half of the same check!

### There's Danger Both Ways

By now, you're aware of many ways you can lose money at both ends of the check business: either by accepting checks from others, or by issuing them yourself.

Employ a few simple precautions to make things more difficult for those who try to misuse your checks. Here's some examples:

- Make out your checks so alteration is difficult. Better yet, use a check protector;
- Don't pre-sign your checks;
- Use a different signature for banking uses than for letters or legal matters;
- Keep your checkbook and bank records locked up;
- Endorse your checks "For Deposit Only" when sending them to your bank by someone else; and
- Verify the amount of each cancelled check returned with your bank statement against the amount on your check stub or book to determine whether or not it has been "kited".

### Summary

All things considered, it is safer to use checks than cash. But you must use many precautions to avoid losses.

Although the law is all on your side, conviction of a "kiter" or forger doesn't automatically restore your money. Prevention is always better than any cure. □



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# Let's zap a few transistors. . . .it's fun!

By Bruce Anderson

*Good Advice in reverse about the care and feeding of solid-state components.*

When the first transistors appeared nearly twenty years ago, it wasn't much of a trick to blow out a handful of them in the course of normal servicing. Those early transistors were point-contact devices, and were extremely sensitive to overcurrent and overvoltage, heat, and lead stress.

Nowadays, zapping a transistor is more of a chore. The voltage and current ratings are higher, heat dissipation is greater, and tolerance to transients is better. Yes, transistors are plainly more rugged than they were a generation ago. And yet, the enterprising repairman (not to be confused with technicians) still can ruin a fair number of transistors by following the suggestions offered here.

## Zapping By Soldering

Unsoldering and resoldering transistors is an excellent way to ruin them, so this should be done at every opportunity. After all, in-circuit transistor testers have been known to be inaccurate in certain rare instances, so it's pointless to use one of them. Right? Better to unlimber the trusty old soldering iron and yank out that pesky transistor. Then if it's bad, half the job will already be done!

For killing these new, tougher transistors, a large-wattage iron definitely is called for. If a 150-watt iron is used, it usually is possible to heat the transistor leads enough from the top of the board to melt the solder underneath. This way, it isn't necessary to turn the chassis upside down to unsolder. Of course, there's no way to solder in the new one from the top, but wor-

ry about that later on.

For those who insist on unsoldering from the copper side of the board, we suggest this little time-saver. Hold the iron on the transistor lead while you locate the device on the opposite of the board. Then, when you finally get hold of the correct lead the solder already will be melted along with the copper-foil junction.

The soldering iron itself shouldn't be overlooked, also, for it can add significantly to the number of transistors that can be zapped. As noted before, it should be plenty large. (This makes it more useful for separating the copper foil from the circuit board—an added benefit.) If it is equipped with a three-contact plug, cut off the ground connection. This will prove that you are not intimidated by Underwriters Laboratories, the National Safety Council, National Bureau of Fire Underwriters, and other cautious types. It will also keep any stray electrical leakage between the heating element and the tip from blowing a fuse or tripping a circuit breaker. As added advantages, removing the ground connector will allow the iron to be plugged in either way, a time-saver, and the tingle you feel when touching the tip is an assurance that the iron is energized.

This electrically "hot" iron is much more effective if the chassis to be serviced is connected to AC power. Especially when the chassis is a "hot" type, the AC from the tip of the iron can produce high currents in any transistors which are touched. It may not zap every one, but then, nothing is perfect. To help compensate for the transistors that survive, an occasional low-voltage capacitor can be destroyed.

## Zapping By Signal Injection

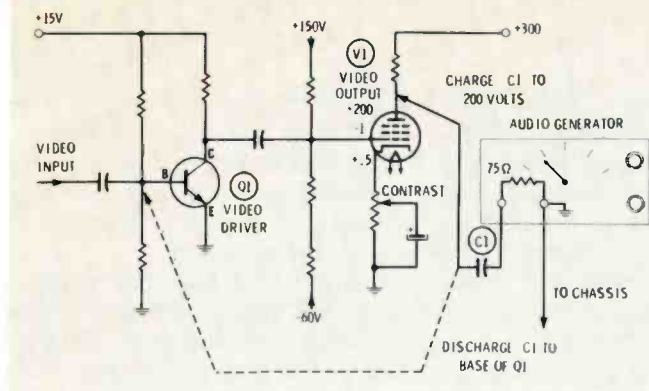
Signal injection and signal tracing are probably equally good ways of troubleshooting. With proper attention to detail, a fair number of transistors can be destroyed with either technique.

Since the hybrid chassis offers easier opportunities for zapping, here is a good place to practice. Figure 1 illustrates the basic principle. A reasonable way to start checking a no-video problem is by injecting a square wave at the plate of the final video amplifier. A blocking capacitor is necessary to prevent the plate voltage from damaging the generator and the capacitance has to be fairly high to pass a low-frequency square wave. So, the result is a 1-mfd capacitor charged to about 200 volts from the plate voltage. Now, what better way to discharge it than through the base/emitter junction of Q1, a transistor video amplifier? Just remove the capacitor from the plate and touch it to the base. The peak current might reach several amperes, but only for a very short time. If the transistor happens to survive, don't waste any more time trying to blow it—pick an easier one.

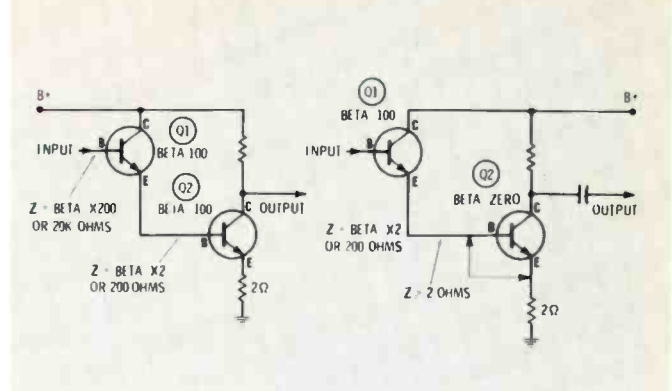
After the technique has been practiced awhile, it can be adapted to all-transistor circuitry. Simply charge the blocking capacitor from the highest-available collector voltage and discharge it through a base circuit.

## Zapping With Meters

It's a little difficult to damage transistors with a scope or VTVM probe, unless you use an oversize alligator clip. This will allow simultaneous connection to the base and the collector; or perhaps to a B+ terminal and a transistor lead.



**Fig. 1** Charge the blocking capacitor which is between generator and tube to a high voltage then discharge it by next injecting a signal at the base of a transistor. This method is guaranteed to zap any small transistor.



**Fig. 2** Removing the forward bias of Q2 by shorting between base and emitter also decreases the impedance of the base circuit of Q1. The resulting excessive base current might successfully zap the base-emitter junction of Q1.

On the other hand, a "cheapie" VOM can wreck a transistor if you use it properly. First, connect the 1000-ohms-per-volt meter to the collector and check the DC voltage. Next, decide to check for AC signal at the collector, so switch to the "output" function of the meter and scale down to the lowest range, say 1 volt. This charges the blocking capacitor of the meter. Then, without discharging the capacitor, connect the meter to the base of the transistor. The discharge current equals the voltage across the capacitor divided by the resistance of the meter and junction, which is a little more than 1000 ohms total. This allows an instantaneous current of 10 milliamperes, enough to damage some transistors. If the device happens to be a MOSFET, and this jolt is applied to the gate, chances are good that the device is ruined.

**Zapping With In-Circuit Tests**

As mentioned before, there are a lot of good in-circuit transistor testers available, but of course, these are for "scientists." Any true "screwdriver and pliers" serviceman knows that fancy test equipment is unnecessary, so he simply shorts together the base and emitter of the transistor. This turns off the device, and the collector voltage will rise to B+ if the transistor is not leaky or shorted.

Usually, this technique will not damage the transistor. So to do

maximum damage, use a test lead with large alligator clips, preferably one you have stepped on a few times, and don't bother to turn off the instrument while making the connections. It is surprising how many times it's possible to get the base of the transistor connected to B+ or to the collector. The blow-outs score is nearly 100 percent.

Even if the transistor under test survives the previous routine, it's possible in some circuits to zap the one next to it. The circuit in Figure 2 shows how it can be done. As a general rule, the base impedance of a transistor is approximately equal to the value of the emitter resistor times the DC beta of the transistor.

In the example, the base impedance of Q2 is about 200 ohms, and this is effectively the emitter resistance of Q1. Consequently, the normal base impedance of Q1 is beta times 200, or 20K ohms. But, when the base of Q2 is shorted to its emitter, the base impedance of Q1 drops to only 200 ohms. It is very likely the base current of Q1 will be increased well above the rating of the transistor, causing it to overheat and self-destruct. (Mission Possible!)

**Special Zapping Tricks For TV's**

Because of the high voltages and pulsed circuits in a television receiver, transistor zapping is a lot easier in TV's than it is in audio equipment, especially if one takes full advantage of his opportunities.

One simple trick is to remove any defective spark gaps—and simply leave them out. Many of the spark gaps look a lot like small disc capacitors, so a capacitor can be used to replace a defective spark gap and hardly anyone will notice the difference. Of course, the capacitor will not protect the circuit, and sooner or later a transistor or two will be destroyed by a simple arc in the high-voltage system or the CRT.

Replacing the original spark gap with a capacitor is doubly ingenious. First, there is a delayed action, because the transistor might not blow for days, weeks, or maybe even months. Second, whoever replaces the transistor probably won't notice that the spark gap has been replaced by a capacitor. Therefore, the actual cause of the trouble will not be suspected, and will continue to zap. To get maximum "mileage" out of this little swap, avoid servicing the receiver after the first time. Chances are, you won't be asked anyway.

Less subtle is the trick of replacing a CRT socket which has built-in spark gaps with one which does not. If a technician happens to service the instrument the next time, he is likely to notice the change and correct it.

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ly stops doing some of the good things it had been doing before. Although this is a good way to zap transistors, it is recommended that you stifle the urge to draw those pretty arcs of high voltage until the receiver is in the shop and safely away from the inquisitive eyes of the set owner.

Leaving out grounding straps and wires between various units of the chassis is another little trick which will zap an occasional transistor. Many of these grounding conductors are used to prevent hum or to reduce stray pick-up of pulses from the horizontal-output system. But some of them serve to insure very-low-resistance current paths for the energy contained in arcs. Since it is difficult to tell which is which, eliminate all the conductors you can. In addition to killing a few transistors, you also can degrade the performance of the set.

The SCR horizontal-deflection system introduced by RCA a few years ago (and now in use in some other makes of receivers) offers some unique opportunities for zapping. The system requires a yoke having very low impedance, which makes it a cinch for you to blow the SCR's (and the diodes that go with them) by connecting to the high-impedance yoke of a wrong test jig. And if the clips which hold the diodes are too tight, spread them a little with a screwdriver; the arc which results is sure to zap at least one of the devices. As a matter of fact, just about any intermittent connection in the yoke or flyback-transformer circuits can damage one or more of the devices, so do a sloppy solder job, or operate the sweep with a couple of unsoldered connections.

## Zapping New Transistors

If it has been difficult to achieve the daily quota of zapped transistors, don't overlook the possibility of shooting a couple of the new ones. The tips which follow are not guaranteed always to work, but they will help the dedicated zapper.

Slip-over heat sinks make attractive decorations for the shop, so

neatly line them up over the bench. If you should decide to put some of them back on the transistors, avoid using heat-sink compound—it's messy, and also makes the heat sinks get warmer!

Don't take heat-sink compound with you on service calls. There is usually some left over around the edges of any bolted-down transistors you might replace in the home, and this can be wiped up daintily with a finger and reused on the replacement. If there just isn't any compound at all on the old one, make a note to bring some on the call-back, which should be about a week later.

If there is a high-wattage resistor conveniently near a transistor, leave a little extra lead length on the replacement so that it can be snuggled close to the source of heat. This added warmth, we suspect, makes the transistor feel "wanted and loved". Thus it will surely respond by conducting much more current than it would if it were cold.

Some fussy technicians have formed the habit of always grasping with pliers the lead to be soldered. The idea is that the pliers will serve as a heat sink to conduct away the heat of soldering. A true transistor-killer knows that the pliers get in the way, so he holds the body of the transistor or perhaps one of the other leads. He may get the idea that a high percentage of new transistors are defective; but on this he is either wrong or modest. He should take the credit; his own efforts are wiping them out.

## Confession

Just to keep the record straight, our personal preference is to make money servicing television. We also like to help our customers, and we like to go to sleep at night with the feeling that we have treated each of these customers honestly, efficiently, and professionally. Accordingly, **our policy is against zapping transistors.** All my previous suggestions were made "tongue-in-cheek". Invert them 180 degrees if you will extend the lifespan of all solid-state components. □

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# RF devices used in medical electronics



By Joseph J. Carr

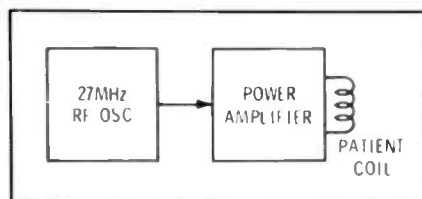
*Diathermy and Electrocautery equipment used by medical teams feature circuits that will seem familiar to anyone who has studied radio transmitters. Only the strict requirements for dependable operation and patient safety make them unique.*

For many years, the medical profession has been using radio-frequency (RF) energy in the treatment of patients. Electrocautery instruments cut and cauterize tissues, while diathermy heats by RF induction. These machines are of incalculable value to doctors and surgeons. But they can and do cause interference with broadcast services.

Just ask any Citizens-Band or amateur radio operator what a diathermy machine can do to his reception. It's likely his answer will be unprintable! Remote model-control and Class-D CB services must share the 11-meter band with diathermy equipment which is noted for causing interference that seems out of all proportion to the small amount of energy actually radiated.

## Diathermy Machines

A block diagram typical of modern diathermy machines is shown in Fig. 1. You transmitter buffs will recognize it as the old-fashioned "master oscillator/power amplifier" (MOPA) type of circuit. The 27-MHz oscillator usually is crystal controlled, and the "antenna" is a coil inside the patient's heating pad. RF currents heat liquids in the tissues during typical usage.



**Fig. 1** This block diagram of a simple-type of diathermy machine is similar to a MOPA transmitting station.

In many cases, an unfiltered DC voltage is supplied to the final or output stage. Some early-designed machines actually fed raw high-voltage AC to the plate circuit of the final amplifier. It is the unfiltered DC or raw AC in the final amplifier that accounts for the raucous, buzzing sounds radiated on the 11-meter band by medical and



Photo courtesy of the Liebel-Flarsheim Division of the Ritter Company, Rochester, NY

Typical of electrocautery machines is this Bovie unit.

industrial diathermy induction-heating equipment.

## Electro Surgery

RF-powered machines enabling surgeons to perform electrocautery and electrocautery ("stops bleeding") are variously called "electrocautery machine", "electrosurgical apparatus" or "Bovie's". Actually, the word "Bovie" is a proprietary brand name for any such apparatus manufactured by the Liebel-Flarsheim Division of the Ritter Company. Because Bovie machines were so prominent in the pioneering days of the 1920's, many medical people mistakenly call all electrocautery machines by the generic term of "Bovie".

Surprisingly, many of the basic spark-gap principles are still used in modern electrocautery equipment. One of the less-desirable characteristics of any spark-gap transmitter is that it generates many harmonics, plus other signals not harmonically related, in addition to the fundamental frequency (itself a broad signal because of some FM action plus jagged modulation). Although, the circuitry is ostensibly shielded, the high level of Electromagnetic Interference



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(EMI) around nearly any hospital is evidence of the difficulties in controlling such unwanted radiation.

Occasionally signals from the diathermy or electrocautery equipment will enter ECG or EEG machines and cause an interference on the scopes or strip paper read-out that is descriptively called "baseline grass" or "baseline artifacts". If you are called on to eliminate such interference, it's wise to check against the use of diathermy and electrocautery machines.

The partial schematic of Fig. 2 is from a Philips Medical Electronics Company Model ES3 electro-surgical apparatus. The high voltage which arcs across the points of the spark gap is raw AC from a step-up power transformer. Spark-gap current also passes through the primary of the RF-oscillation coil, L2A. A tuned circuit, consisting of L2B and the three paralleled .001 capacitors, forces the spark-gap current to flow in resonance with it. Matching to the electrodes used for cutting human tissues is by the step-up coil, L3. The amplitude of the cutting voltage is determined by selection of a tap on L2B.

A good example of things that cause confusion between medical men and electronics men also is found in Fig. 2: differences of jargon. Notice the lead going to the patient plate that is called "indifferent electrode". To electronics men, such a label is meaningless. Medically, it means an inactive connection; which is far from correct! The wire lead connects to an "electrode" consisting of several square feet of metal fabric on which the patient is placed while on the operating table. Such a large area is necessary to spread or dissipate the current. If a bony part of the body (such as an elbow) presses too hard and significantly reduces the resistivity at that one

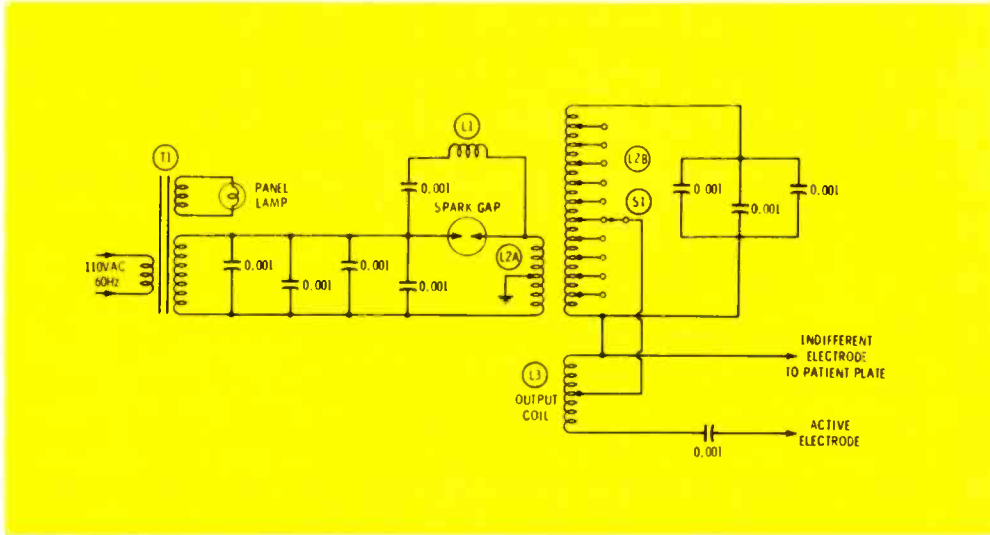


Fig. 2 Spark-gap oscillators still are being used in electrocautery equipment. This circuit is from the Philips Medical Systems, Inc. Model ES3.

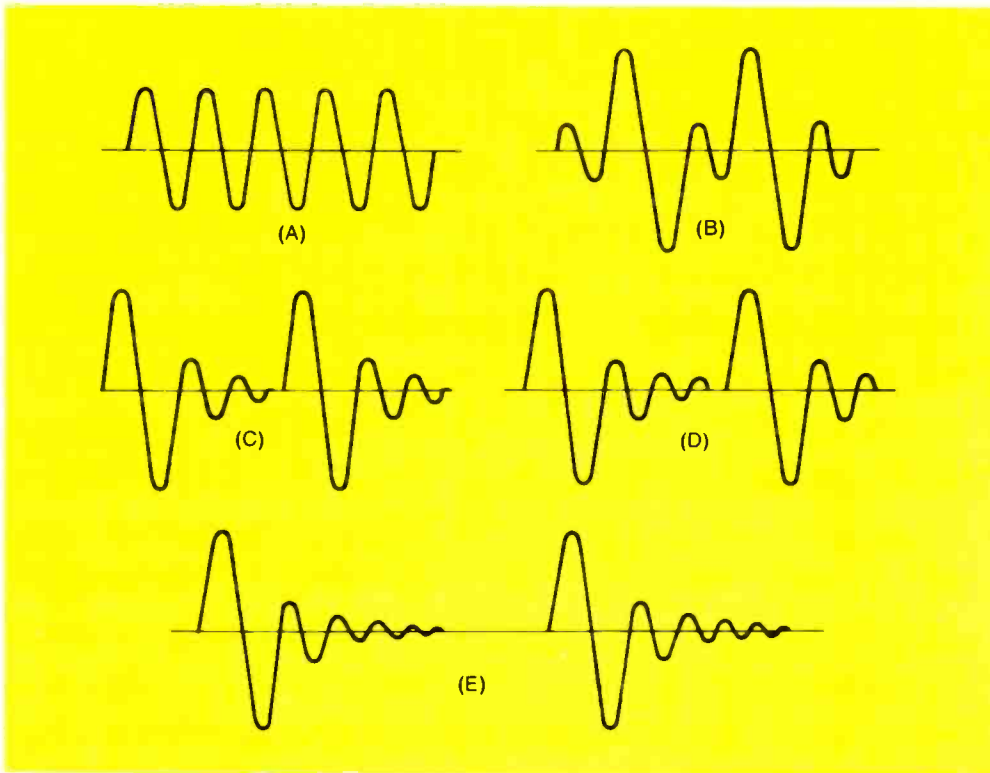


Fig. 3 Waveforms available from the Bovie brand of electrocautery machine. (A) A near-sine wave gives maximum cutting and minimum hemastasis. (B) Cutting with moderate hemastasis. (C and D) Cutting with increased hemastasis. (E) Minimum cutting with maximum coagulating and fulgurating effects.



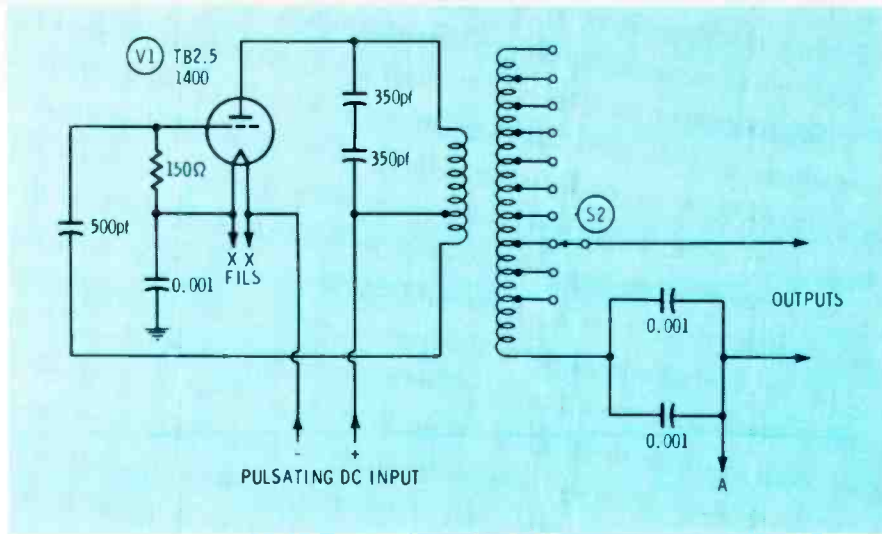


Fig. 4 Circuit of the vacuum-tube oscillator in the Philips Model ES3 electrocautery machine.

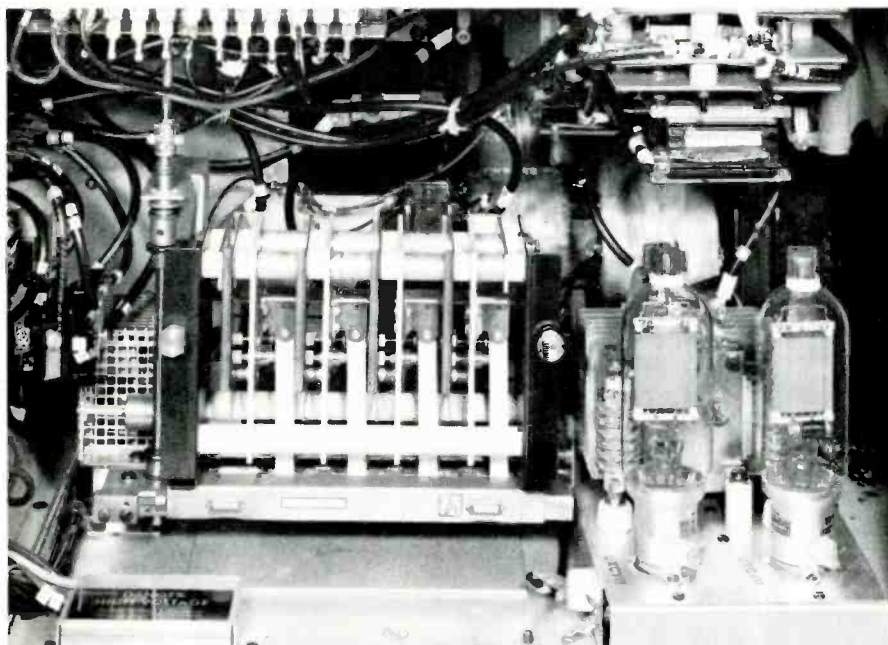


Photo courtesy of the Liebel-Flarsheim Division of the Ritter Company, Rochester, NY

Fig. 5 An interior view of the Bovie electrocautery machine.

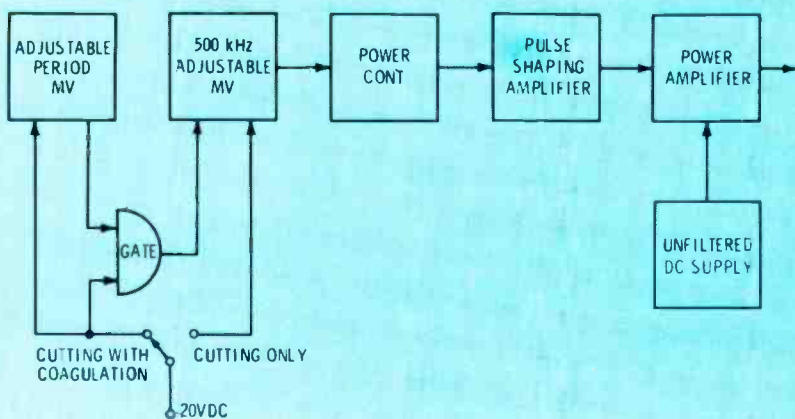


Fig. 6 This block diagram is of the solid-state model Bovie.

point, a painful burn could develop there.

Of course, two electrodes are required, and you might reasonably expect the cutting electrode to be just opposite in characteristics from the "indifferent" one (and it is). The small cutting electrode has a point which concentrates all of the RF energy at one tiny area, resulting in a combination of cutting and burning (cauterizing) of the tissues. This ability to cauterize and thus control bleeding is one of the major advantages of electrocautery over the scalpel.

The ratio of the degree of cutting versus the amount of burning is determined largely by the wave-shape of the RF current. Some of the waveshapes available from a Bovie are pictured by the drawings of Fig. 3. Generally speaking, a pure sine wave produces more cutting and less hemostasis ("stop bleeding"), while a pulsed signal which is allowed to ring causes more hemostasis and fulguration (deliberate destruction of tissues) and less cutting.

### Tube-Powered Electrocautery Machines

Waveforms with pulses and sine waves indicate that there must be means other than spark gaps for generating the RF current for electrocautery uses. Most modern electrocautery units use vacuum tubes, or tubes plus a spark gap.

Figure 4 shows the Hartley-type self-excited oscillator used in the Philips Model ES3 electrocautery machine. Low RF frequencies of under 1 MHz are necessary to minimize general heating of the tissues. Notice that the power for this stage is unfiltered pulsating DC voltage. Energy from a spark gap can be mixed with a signal from the tube to produce the variety of current waveforms needed by the surgeon.

An inside view of Ritter Company's Bovie electrocautery unit (Fig. 5) shows the push-pull oscillator tubes and the massive switch. Sizes of these components should give us an appreciation of the large powers involved.

### Accessories

One important accessory for use with electrosurgical machines is the footswitch. These switches are called "explosion proof", but are in reality "arc proof" because the equipment is usually used in operating rooms which also contain raw oxygen and explosive gases used for anesthesia. It is imperative that the gas-proof integrity of these switches be maintained at all times.

### A Solid-State Bovie

Solid-state components have invaded the medical field, although many tube-powered units also are being sold. The block diagram (see Fig. 6) of a Ritter Bovie using transistors starts with a 500-KHz multivibrator whose output is fed to a number of potentiometers that control output power by reducing the drive to the power amplifiers. The final power amplifier (and only that stage) is supplied with unfiltered pulsating DC voltage.

A gating circuit (shown in Fig. 7) modifies the signal from the 500-KHz oscillator so ringing can occur after the oscillator is cutoff, whenever coagulation is required.

Switch-selected timing resistors control the amount of time the astable multivibrator conducts so the output of the 500-KHz oscillator is in pulses or bursts of energy.

A partial schematic of the power amplifier stage in the solid-state Bovie is shown in Fig. 8. Two transistors are paralleled in a unique circuit that has a special combination input-output transformer, diodes to stabilize the bias, and zener diodes to clip any transient voltages that might damage the transistors.

### Patient Safety

Safety for both the patient and the operating-room personnel is of paramount importance in medical electronics. The equipment manufacturers take great pains to design safety into the units. Any repair work must maintain this safety.

Safety precautions are grouped into three basic areas: electrical, mechanical, and the prevention of

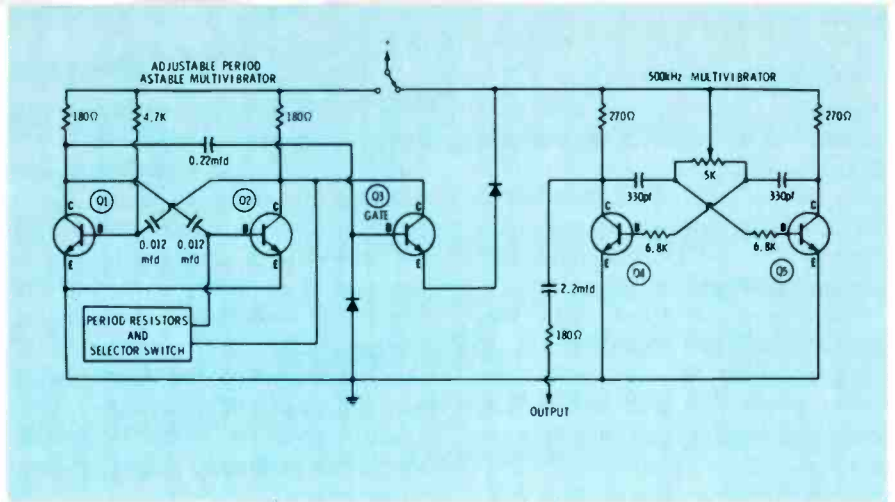


Fig. 7 Schematic of the 500-KHz and adjustable-period multivibrators used in the solid-state Bovie.

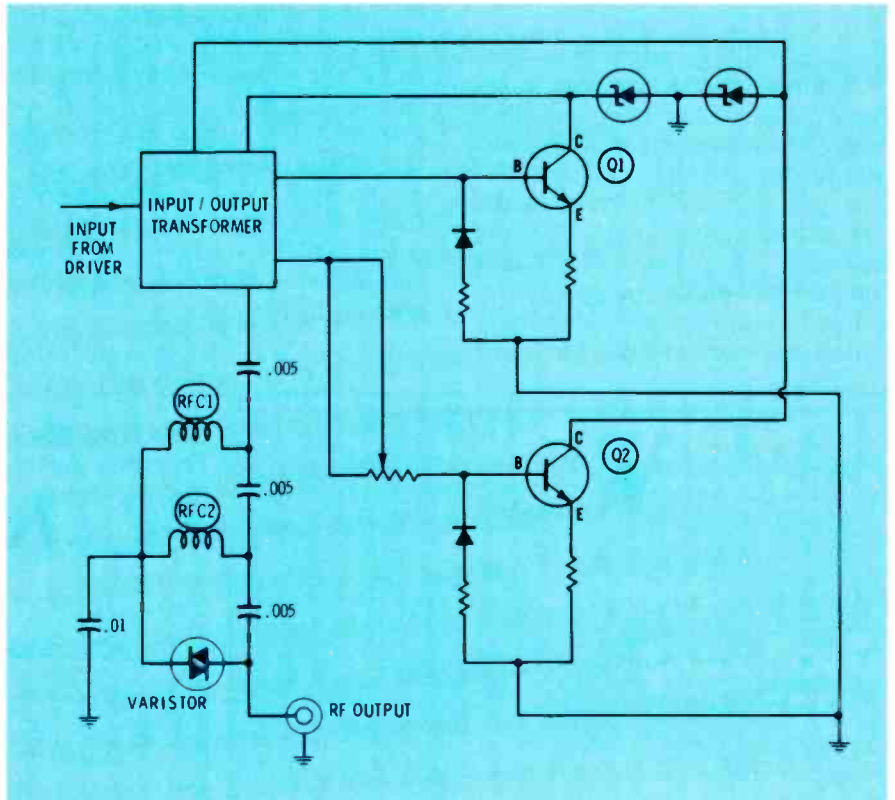
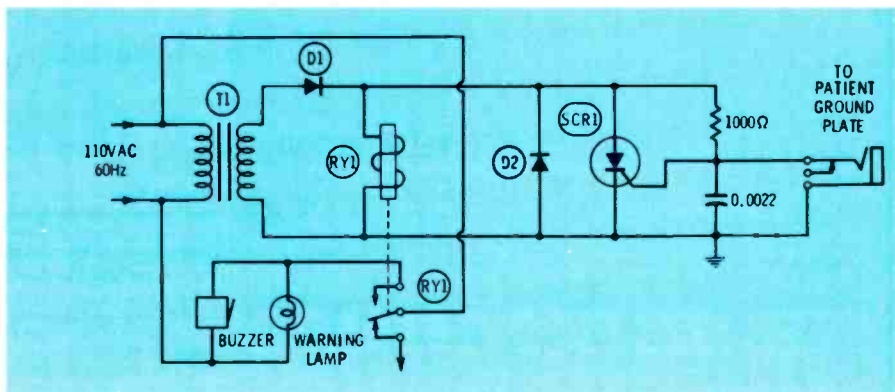


Fig. 8 Schematic of the final RF power amplifier of the solid-state Bovie.



(Courtesy of the Ritter Company)

Fig. 9 This open-ground protector circuit removes power to the Bovie if the ground circuit becomes open.



explosions. Mechanical safety is seldom the concern of electronics men. But the prevention of explosions is so important that most electrocautery equipment is marked clearly "Do not use in the presence of explosive gases".

Sometimes electronic and mechanical safety procedures must work together. For example, the power plugs that pull out all too easily, or make intermittent contact, so that critically-needed machine (perhaps a monitor or a defibrillator) is out of service just when it is needed most. Only the highest type of servicing craftsmanship can be permitted.

### Ground Currents

A minor ground loop that might cause only a faint buzz in a hi-fi amplifier could cause a killing current to flow through a patient. Before you dash off to refer to the "lethal currents level" in some electrical safety book which says 200 or 300 milliamperes are required to kill, remember that those figures are correct only for intact

skin touching both conductors. In surgery, however, the electrical condition is vastly more critical because the patient's body might be opened by surgical incision or by means of a catheter placed in the vein of an arm. It is the **current density** through the **heart** that is the danger. A current as low as 20 microamperes at the heart might kill the patient. Voltages that couldn't even be felt by the operating room personnel might be fatal to the patient.

In the solid-state Bovie, there is a circuit (Fig. 9) that disconnects the AC power to the equipment if the ground lead is broken. The SCR normally is biased "off" because the ground wire shorts out the forward bias at the gate. If the ground wire opens, the current through the 1000 ohm resistor biases the SCR "on" and it removes the voltage from the relay coil, cutting off the voltage to the Bovie and applying it to a buzzer and a warning light.

By the way, some operating

room people have been known, incredible as it may seem, to disconnect the buzzer because it kept sounding!

### The Future Of Electronics In Medicine

Data about symptoms and readings from many types of patient monitors now can be stored in computers. In fact, there are rumors that computers might be used to give tentative diagnosis.

It seems more than likely that the most helpful of future machines used in medicine will be electronic in nature. Therefore, more repairs to these instruments must be done by electronic technicians and less by doctors or medical aides.

The repair of electronic medical equipment appears to be a very needed and promising field for any of you who would want to enter it. But we must emphasize: Prepare **thoroughly** for this type of work. Remember that human lives can depend on the quality of your workmanship. □

## NEW EICO TR-410 Solid-State Triggered Sweep 10MHz Oscilloscope

\$379.<sup>95</sup>

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Use as Vectorscope for Color TV Servicing ■ 3 calibration voltages (2, 5 and 10) ■ Quick connect BNC connector at Vertical Input ■ Front panel adjustable Horizontal and Vertical DC Balance Controls ■ Vertical and Horizontal selection of AC or DC modes of amplification ■ Sweep synchronized Gate Output ■ Flat faced CRT ■ Z Axis input ■ Rear panel astigmatism control ■ Edge lit calibrated screen ■ Operates on a standard 120 volt, a low 100 volt or a 220-230 volt line.

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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.

Substitutes the VHF tuner and tests the UHF tuner. Provides signal to simplify testing of tuner, i.f. system and AGC system. Comes complete with extension cables and instructions.

TV TUNER SUBBER MK. II net \$31.95 Contact your distributor.

Include \$1.50 shipping and handling on prepaid mail orders: we will ship C.O.D.



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For More Details Circle (17) on Reply Card

For More Details Circle (16) on Reply Card



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Can you name the 32 Personalities and 16 United Way Services



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# Some answers from the june survey

Thousands of you sent back the survey cards which were included in the June issue of *ELECTRONIC SERVICING*. These survey results are presented in appreciation of your help.

## A Profile Of Full-Time Technicians

**Shop Owners**—total years in business  
18% have been in business less than 2 years  
15% have been in business 2 but less than 5 years  
8% have been in business 5 but less than 10 years  
59% have been in business 10 or more years

**Technician Employees**—years worked for present employer  
47% have been employed for less than 2 years  
31% have been employed 2 but less than 5 years  
10% have been employed 6 but less than 9 years  
12% have been employed 10 or more years

**Wages of Experienced Owner-Benchmen**  
5% earned \$2.00 or less per hour  
15% earned \$2.01 to \$3.00 per hour  
30% earned \$3.01 to \$4.00 per hour  
50% earned more than \$4.00 per hour

**Wages of Experienced Benchmen**  
4% earned \$2.00 or less per hour  
13% earned \$2.01 to \$3.00 per hour  
24% earned \$3.01 to \$4.00 per hour  
59% earned more than \$4.00 per hour

**Wages Of Experienced Owner-Outsidemen**  
5% earned \$2.00 or less per hour  
19% earned \$2.01 to \$3.00 per hour  
39% earned \$3.01 to \$4.00 per hour  
37% earned more than \$4.00 per hour

**Wages of Experienced Outsidemen**  
3% earned \$2.00 or less per hour  
18% earned \$2.01 to \$3.00 per hour  
31% earned \$3.01 to \$4.00 per hour  
48% earned more than \$4.00 per hour

**Wages of Trainees**  
54% earned \$2.00 or less per hour  
35% earned \$2.01 to \$3.00 per hour  
8% earned \$3.01 to \$4.00 per hour  
3% earned more than \$4.00 per hour

## A Profile Of Full-Time Shops

**Full-Time Employees**  
79% of the shops had 2 or less outsiders  
78% of the shops had 2 or less benchmen

**Number Of Service Trucks**  
77% operated 1 truck  
21% operated 2 to 5 trucks  
2% operated 5 to 10 trucks  
1% operated more than 10 trucks

**Estimates and Service Contracts**  
37% of the shops offered free estimates  
21% of the shops offered contracts on TV's

## Opinions Of Owners And Managers About Regulation and Service Associations

26% wanted no regulation  
24% favored regulation by local government  
21% favored controls by national government  
29% favored certification controls by associations  
37% actually belonged to some service association

## Sources of Gross Shop Income

50% obtained from service labor (estimated)  
35% obtained from parts sales (estimated)  
15% obtained from retail sales (estimated)

## Method Of Pricing Replacement Parts

39% figured cost plus 50%  
29% figured cost plus 51% to 75%  
26% figured cost plus 76% to 100%  
6% figured cost plus over 100%

## Percentage Of Shops Selling Merchandise

52% sold TV receivers  
51% sold stereo machines  
11% sold communications equipment  
72% sold antennas

## Gross Shop Income According To Products Repaired

50% obtained from repairing color receivers (est)  
30% obtained from repairing b-w receivers (est)  
12% obtained from repairing stereo receivers (est)  
8% obtained from repairing car radios (est)

## Charges For Bench Labor

40% charged \$9.00 or less per hour  
34% charged \$9.01 to \$12.00 per hour  
16% charged \$12.01 to \$14.00 per hour  
10% charged over \$14.00 per hour

## Charges For B-W TV Service Call (1st 30 minutes)

52% charged \$8.00 or less per call  
24% charged \$8.01 to \$10.00 per call  
14% charged \$10.01 to \$12.00 per call  
10% charged over \$12.00 per call

## Charges For Color TV Service Call (1st 30 minutes)

22% charged \$8.00 or less  
28% charged \$8.01 to \$10.00  
22% charged \$10.01 to \$12.00  
28% charged over \$12.00

## Charges for Setup Of Color TV (1st 30 minutes)

20% charged \$8.00 or less  
24% charged \$8.01 to \$10.00  
28% charged \$10.01 to \$12.00  
28% charged over \$12.00

## Charges For Stereo Service Call (1st 30 minutes)

36% charged \$8.00 or less  
30% charged \$8.01 to \$10.00  
16% charged \$10.01 to \$12.00  
18% charged over \$12.00



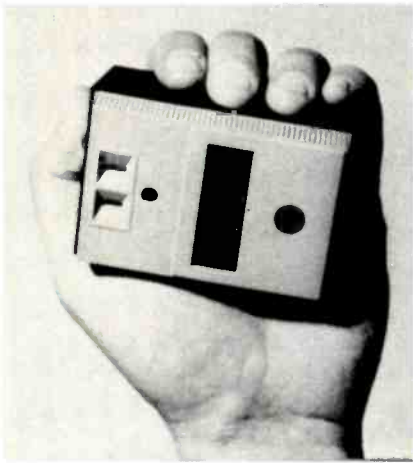
# productreport

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

## Power Line Monitor

**Product:** Model EP-110 voltage monitor by Logitek, Inc.

**Features:** When electric companies reduce electricity due to power shortages, the Model EP-110 automatically prevents damage to



household appliances. When line voltage drops below 100 volts, it automatically disconnects equipment from the line. When power returns to normal, it automatically reconnects equipment. A built-in time delay prevents short duration line drops from disconnecting and restarting equipment.

**Price:** Model EP-110 sells for \$19.95.

For More Details Circle (46) on Reply Card

## Auto Burglar Alarm

**Product:** "Auto Alarm" by Metra Electronics Corp.

**Features:** The new alarm is contained in a small plastic case with an on/off switch integral with the case, and can be easily concealed behind the dashboard. The auto alarm senses any current change in the car's electrical system such as the dome light turning on when a door is opened, opening lighted glove compartments, trunks, etc.

After a 6-to-8 second delay, the alarm triggers, blowing the car's horn in pulsating blasts. An optional siren may be connected to the alarm system instead, along with an optional parking-light flasher. It



can be connected with a single wire connection to the horn button switch wire and a wire to ground.

**Price:** The alarm has two model designations, type MBA-335 for AMC, Chrysler and GM cars sells for \$18.95 and MBA-335R for Ford-made cars and foreign cars that do not have a horn relay sells for \$20.95.

For More Details Circle (47) on Reply Card

## Circuit Breaker/Fuse Combination Caddy

**Product:** Model 094076 "2 in 1" caddy by Littelfuse, Inc.

**Features:** The fuses and circuit breakers are designed to safeguard electronic circuits in such applications as black and white and color TV, high fidelity stereo equipment, AM and FM radios, audio amplifiers, motor controls, electronic business machines, digital and ana-



log test instruments, vending machines and others. The caddy is housed in a sturdy plastic box with transparent top. Amperages of the circuit breakers in the caddy are: 2, 2.75, 3, 3.5, 4, 4.5, 5 and 7 amps. There are five each of the following fuses in the caddy: 3AG1, 2 amp; 2AG Slo-Blo 2, 3 amp; 3AG Pigtail 1 amp; and 3AG Slo-Blo Pigtail 2 amp.

**Price:** The Model 094076 caddy sells for \$23.00.

For More Details Circle (48) on Reply Card

## Tool Kit

**Product:** JTK-90 tool kit by Jensen Tools and Alloys

**Features:** The kit includes more than 60 precision tools. The tools are securely packaged in an attache case which features hardwood construction, black Marvelon cover-



ing, and solid brass hardware. Most of the tools are mounted on a removable tool pallet in the cover of the case. Remaining tools are located in the bottom of the case, and there is also room for spare parts and special tools. A pocket for instruction manuals is located behind the tool pallet.

**Price:** The JTK-90 is furnished with a Triplet No. 310 VOM and is priced at less than \$225.00. Without the tester, the kit sells for \$175.00.

For More Details Circle (49) on Reply 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





# DIAL & CODER

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For More Details Circle (19) on Reply Card

### Signal-Subbing

(Continued from page 27)

load is in the retrace portion, because that's where the DC power is applied.

If the breaker holds with the jumper in place, it means the overload happens only during the sweep operation. Remove the jumper. Unplug the yoke (but don't operate very long this way to avoid damage). If the breaker holds, the yoke is shorted. If the breaker trips, plug in the yoke and disconnect the output transformer. An abnormally-heavy load on the

transformer is indicated, if the breaker holds now. Connect the transformer, but in turn, disconnect each load on it. Gassy high-voltage rectifier tubes are common in the CTC40.

### Summary

It has been necessary to skim lightly over many of these tests. Each one of us must practice until we get the "feel" of what results to expect from injection of sweep-pulses into the many variations of horizontal circuits. After you get the hang of it, you'll wonder how you ever serviced without these methods. □

## catalogs literature

**100. Alco Electronic Products, Inc.**—A new 12-page Condensed Catalog lists and illustrates the Alco family of front panel electronic components. Six major categories of product lines are described in this Catalog which include: Miniature toggles, push buttons, printed circuits, slides, paddles, proximity, keyboards, etc; high quality aluminum and plastic knobs with set-screws; unusual isolation relays combining relay transformer and contacts in one small package: neon and incandescent, seven-segment, single plane readouts, with logic and other accessories; lamps and indicator assemblies, both incandescent and neon; ceramic terminal strips of various configurations.

**101. Electronic Devices, Inc.**—is offering a new, 6-page catalog on its line of standard and fast recovery silicon rectifiers for industrial, commercial and military applications. The new catalog devotes individual pages to ratings and electrical characteristics as well as dimensional drawings of case styles for EDI bridges, high-voltage axial lead rectifier cartridges,

high-voltage rectifier assemblies and miniature axial lead rectifiers.

**102. Brookstone Co.**—The firm's new 1973 edition contains hundreds of useful products rarely sold by industrial distributors or found in stores. The collection includes hard-to-find hand tools and small power tools used by woodworkers, metalworkers, machinists, technicians, designers, production, maintenance and service personnel.

**103. Dremel Manufacturing Co.**—has introduced a two-page data sheet featuring its new do-it-yourself burglarly prevention kit for home and office consisting of a "Theft-Guard" electric engraver and burglar warning window stickers. Helpful instructions are given on how to burglar-proof home and office valuables such as TV sets, radios, stereo sound equipment, sports gear, cameras, business machines, typewriters and any item attractive to burglars, by using the engraver. The user engraves his driver's license number on all items of value be it metal, plastic, glass, leather or wood. □

# 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.

## Dual-Trace Triggered Sweep Oscilloscope

**Product:** Model 1470 by B&K, Dynascan Corp.

**Features:** Applications include: viewing simultaneously two waveforms that are frequency or phase-



related, such as in digital circuitry; checking frequency dividers; checking differential amplifiers for balance; relay testing and sequencing; measuring amplifier phase shift. The 1470 offers DC to 10 MHz bandwidth, 10 mV/cm sensitivity, maximum sweep of .2 microseconds/cm, and fully automatic and triggered sweep. It permits dual display of waveforms in 6 modes: Channel 1, Channel 2, Chopped (for low-frequency waveforms), Alternate, Add and Channel 2 Invert. In the first 2 modes, only one input signal will be displayed. In the alternate mode, Channel 1 and 2 inputs are displayed on alternate sweeps—the two traces appearing as simultaneous waveforms. Operation is from 105-125 VAC, 50-60 Hz, and is available for 117/234 VAC.

**Size:** 9 inches x 10 inches x 17 inches.

**Price:** The 1470 requires two probes, the PR-20, a combination 10:1/DIRECT probe with spring-

loaded clip-on tip for \$19.95 and the PR-16, which is similar to the PR-20, but does not have the clip-

on feature, at \$14.95. Model 1470 sells for \$499.95.

For More Details Circle (35) on Reply Card

## Audio Level Meter

**Product:** MINI-VU portable level meter by Edison Electronics.

**Features:** The MINI-VU is designed for use as a utility level meter in checking audio distribution systems, remote lines, and in other similar applications. A selector switch provides for bridging either balanced or unbalanced audio circuits. With an 11-position selector switch that provides level ranges from -60VU to +40VU, the MINI-VU becomes an extremely versatile test instrument. A self-contained mercury cell that minimizes battery deterioration when the unit is not in operation, provides the power.

**Price:** The MINI-VU sells for \$145.00.



For More Details Circle (36) on Reply Card

(Continued on page 48)

Send your own Photo-Tip to the editor. Yes, we pay.

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- Eliminates "Down Time" on special and foreign belts.
- No need to stock replacement belts; makes any size in minutes.
- No molds or complicated vulcanizing processes to follow.
- No special skill required, cutting guide, cutting tools and adhesive all included.
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- ORK-1 Round Rubber Drive Belt Kit** ..... \$19.95
- ORK-2 Flat and Square Rubber Drive Belt Kit** ..... \$19.95
- ORK-3 "O" Ring Kit** ..... \$19.95

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Now make economical repairs that were never before possible. Extremely economical, up to 132 bonds per tube.

**NEW INSTA-WELD®**  
only \$2.00 per 2-gram tube

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MEADVILLE, PENNA. 16335

For More Details Circle (21) on Reply Card

## AC Leakage Current Tester

**Product:** Model 301 by Sotcher Measurement.

**Features:** The Model 301 allows anyone to quickly identify an electrical defect in 120V equipment before it can become a safety or fire hazard. Meets OSHA requirements by detecting any leakage from 0.5 milliamp up to a dead short and displaying the GO/NO GO condition on dependable neon lamps. Other features: accurate simulation of normal body impedance, built-in calibration standard, ground wire continuity check, in-



dependent high and low current solid-state circuits, and no batteries to change. The tester comes complete with detailed instructions and a shock proof test pad.

**Price:** Model 301 sells for \$150.00.

For More Details Circle (37) on Reply Card

## FET Tester

**Product:** IT-121 by Heath Co.

**Features:** The IT-121 checks transistors, diodes, FET's, SCR's, triacs, and unijunction transistors in or out of circuit. Five current ranges measure leakage as low as 1μA and collector currents as high as 1 A. Gain (DC Beta), transconductance (GM), and leakage values are read directly on large meter face, has color-coded pushbutton range selection, battery tested circuit, and handy 3-foot leads.

**Price:** The IT-121 sells for \$49.95.



For More Details Circle (38) on Reply Card

## 25-MHz Bandwidth Oscilloscope

**Product:** Model D66 by Tektronix, Inc.

**Features:** Sweep rates are from 2 s/div to 100 ns/div (20 ns/div with 5X magnifier). X-Y measurement capability, 5 percent accuracy and 14-ns risetime. Deflection factors extend to 10 mV/cm at full bandwidth, to 1 mV/cm at 15 MHz.

**Size and Weight:** 9 1/2 inches x 8 1/4 inches x 14 1/2 inches and weighs 25 1/2 pounds.

**Price:** The D66 sells for \$795.00.

For More Details Circle (39) on Reply Card

signal is accurate to ±1 percent. Signal separation is rated at 50 dB with output voltage at 0 to 3V rms continuously variable. It is easy to operate, compact and complete with a handy tilt stand.



**Size and Weight:** 8 inches x 12 inches x 3 1/2 inches; 5.5 lbs.

**Price:** Model LSG-231 sells for \$229.95.

For More Details Circle (40) on Reply Card

## FM Multiplex Stereo Generator

**Product:** Model LSG-231 by Leader Instruments Corp.

**Features:** The LSG-231 has a pilot signal frequency of 19 KHz with ±2 Hz accuracy. The 1 KHz audio

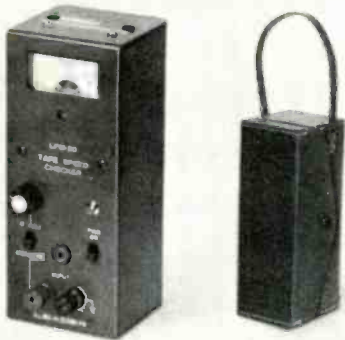


# audio systems report

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

## Tape Speed Checker

Product: LFM-30 by Leader Instruments Corp.



**Features:** This new instrument will check tape recorder speeds at 1, 2, 3, 4, 5, 6, 7, 8, and 9 KHz frequencies with one stipulation: recorder output frequency must be a multiple of 1 KHz. The unit has a test range of -3 percent to +3 percent with an input level of 100MV rms. Input impedance is 150 K ohms. It is offered with a standard test tape at 4 KHz and a leather-like carrying case.

**Size and Weight:** 11 inches x 1 inches x 1 1/2 inches: 2 pounds.

**Price:** The LFM-30 sells for \$129.95.

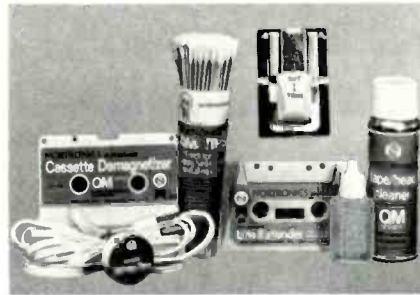
For More Details Circle (41) on Reply Card

## Cassette Recorder/Player Maintenance Kit

Product: QM-1 Cassette Maintenance Kit by Nortronics Co., Inc.

**Features:** The kit is used for the cleaning, maintenance and demagnetization of cassette recorders and players through an effective personal-preventive maintenance program any machine owner can perform. The new kit contains six QM-Series accessories which are suited for routine cleaning and maintenance of heads, capstan,

pressure rollers and tape guides. A cassette head demagnetizer is included for degaussing heads. A professional splicer and supply of bleed-free Mylar Splicing Tape are included to facilitate editing and repair of .150 inch tapes.



**Specifications:** The kit includes: 3 oz. can of QM-103 Spray Cleaner; QM-141 Cassette Life Extender with 1 1/4 oz. bottle of Tape Head Cleaner; QM-240 Cassette Head Demagnetizer; QM-340 Splicer for 1/8 inch tape; QM-501 inch roll, Mylar Splicing Tape and QM-502 6-inch soft cotton M-Tips.

**Price:** The maintenance kit sells for \$26.90.

For More Details Circle (42) on Reply Card

## Speaker Protector

Product: Model R47001 by Robins Industries Corp.



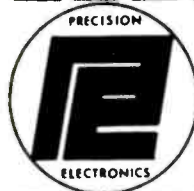
**Features:** It has solid-state circuitry and is self contained, requiring neither batteries nor line current. The protector automatically limits out-

(Continued on page 50)

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## A LITTLE SQUIRT stops all the noise.

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Also available in bottles, and the new silicone—"Silitron."



Product of  
**QUIETROLE**  
COMPANY

Spartanburg, South Carolina

For More Details Circle (24) on Reply Card

### Audio Systems

(Continued from page 49)

put of the stereo hi-fi amplifier without impairing tone quality. Limiting is achieved by a compressing action, which can be pre-set to defy excessive levels. Controlling the levels and equalizing

them can even produce a background music effect.  
**Price:** The R47001 speaker protector sells for \$29.50.

For More Details Circle (43) on Reply Card

### Transparent Stereophones

**Product:** PRO-B VI by Superex Electronics Corp.

**Features:** The heart of the unit is its woofer with controlled acoustic suspension and carefully matched new ceramic tweeter that takes the response past the limit of hearing. The PRO-B VI features a new "Clip-Cord" consisting of a fifteen foot coil cord and a three foot straight section at the headphones. Attached to the straight section is a clothing clip that permits the pull of the coil cord to be absorbed at the belt or shirt pocket, while insuring easy movement with minimal weight or head pull.

**Price:** Model PRO-B VI sells for \$60.00.



For More Details Circle (44) on Reply Card

### Four-Channel Tape Player

**Product:** Model 12R800 by RCA Parts and Accessories.

**Features:** The Q-8 sound is created by the simultaneous playback of four separate sound tracks through four separate speakers. Designed to play both Q-8 and stereo 8 tapes, the 12R800 features eight solid-state integrated circuits and delivers over 32 watts of peak power stereo sound.



For More Details Circle (45) on Reply Card

## Tired of hand-me-down copies of ELECTRONIC SERVICING?

Fourth page of a five-page article missing by the time you get to read ELECTRONIC SERVICING? Schematic diagram missing? Then you need a subscription of your own! Priced right and packed with profitable information each month! Use the convenient order form inside the back cover of this issue! P.S. If that's missing, too, send us a note with your name and address—we'll contact you with full details!

# antenna 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.

## All-Channel Four-Set Coupler

**Product:** Model MF-84 TV/FM coupler by Jerrold Electronics Corp.

**Features:** The MF-84 coupler is recommended for splitting signals so that four TV sets can be attached to a single outdoor antenna. Low loss and high isolation between sets make it good for color TV. The MF-84 passes all frequencies between 54 MHz (Channel 2) and 890 MHz (Channel 83). Insertion loss is only 7 dB and isolation



between sets is at least 15 dB. It can be mounted along a baseboard, to the back of a TV set, in the basement or the attic. Weather resistant, it can even be mounted outdoors on the mast or outside a window.

**Price:** The MF-84 sells for \$5.90.

For More Details Circle (50) on Reply Card

## Broadband Amplifier

**Product:** PAM-300 series amplifier by American Electronic Laboratories, Inc.

**Features:** The amplifier is solid state with a high-dynamic range

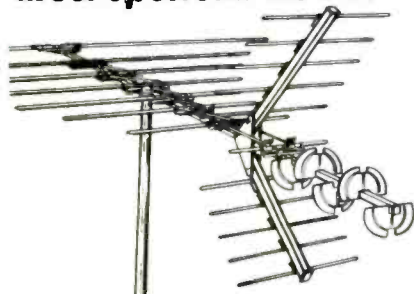
covering the entire 30 to 300 MHz VHF band. The PAM-300 is useful for telemetry, ECM, monopulse, communications receiver applications, as well as in multicouplers and other frequency-distortion systems, including critical surveillance systems.



**Specifications:** The noise figure is 5.5 dB with an output of up to +10 dBm at 1 dB compression. Gain is 24 dB while gain variation is only  $\pm 0.5$  dB. For two -20 dBm input signals, the second-order intermodulation products are -40 dB and the third-order intermodulation products are -65 dB.

(Continued on page 52)

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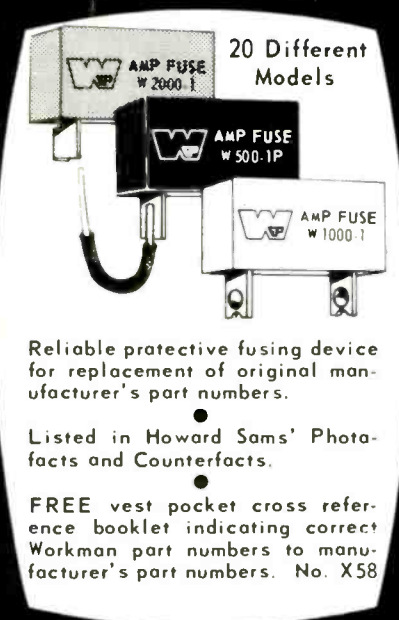
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## Antenna Systems

(Continued from page 51)

Size: 1 3/8 inches x 1 3/4 inches x 6 inches, including connectors and mounting flange.

Price: The PAM-300 series sells for \$350.00.

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## Color TV Antenna

Product: "Quantum" high-gain antenna by Channel Master.

Features: The "Quantum" improves reception by blocking out electrical interference. In cases where interference comes from the front or side, the "Quantum" will deliver a 10 dB improvement in signal-to-noise ratio. This is equivalent to a 10 dB increase in antenna gain, and will bring about the same picture improvement as 10 dB additional forward gain. The "Quantum" reaches 35 dB. Transmission line noise pickup is eliminated by the use of coaxial line. There are 15 "Quantum" models, designed for all reception areas and conditions, from metropolitan to the deepest fringe areas. Seven models cover VHF and FM; eight models also receive UHF, using a tunable antenna that can be adjusted for peak performance on any selected range of channels.

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## Yagi Antenna

Product: Model ASP-760 by The Antenna Specialists Co.

Features: Forward gain is 10 dB and the front-to-back ratio is in excess of 15 dB across the entire band. A weatherproof gamma match delivers a VSWR of less than 1.5:1. All radiating and parasitic elements are welded to the boom, and all elements are gold irridite-treated for exceptional resistance to corrosion. The unit is furnished with a solid cast aluminum mounting clamp for installation in either horizontal or vertical polarization, plus 2 feet of RG8A/U cable with male-type "N" connectors.

Price: The ASP-760 sells for \$71.50.

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## Solid-State Electronic Projects

Author: Charles D. Rakes  
 Publisher: Howard W. Sams & Co., Inc., Indianapolis, Indiana  
 Size: 5 1/2 inches x 8 1/2 inches, 128 pages  
 Price: Softcover, \$3.95.

This book has been written to encourage hobbyists, students, and technicians to take advantage of the new and surplus solid-state components being sold and build some solid-state electronic projects. The book's projects are useful, educational, and serve to demonstrate the operation of a number of semiconductor devices. The book is easy to understand and is supported by numerous schematic and pictorial diagrams. In addition, all of the projects discussed have been previously built, tested, and debugged.

**Contents:** Basic Burglar Alarm Systems—Solid-State Alarm Circuits—Solid-State Alarm Sounders—Metal Locators—Electronic Music, Noise, And Sound Effect Circuits

## Questions & Answers About Color TV

Author: Leo G. Sands  
 Publisher: Howard W. Sams & Co., Inc., Indianapolis, Indiana  
 Size: 5 1/2 inches x 8 1/2 inches, 96 pages  
 Price: Softcover, \$3.95.

The information contained in this book is presented as answers to the most often asked questions about color television. This book does not attempt to cover color television receivers from A to Z. This would involve a much more technical discussion than this book was intended for. It is intended, however, to enlighten anyone with some background in electronics about the most important aspects of color television. The first part of the book concerns theory and operation. Part two covers installation procedures and problems. The third part discusses color-television servicing. The concluding part tells how to make simple modifications of and additions to receivers to improve and extend their capabilities.

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