March, 1973 □ 75 cents

A HOWARD W. SAMS PUBLICATION

Electronic Servicing®

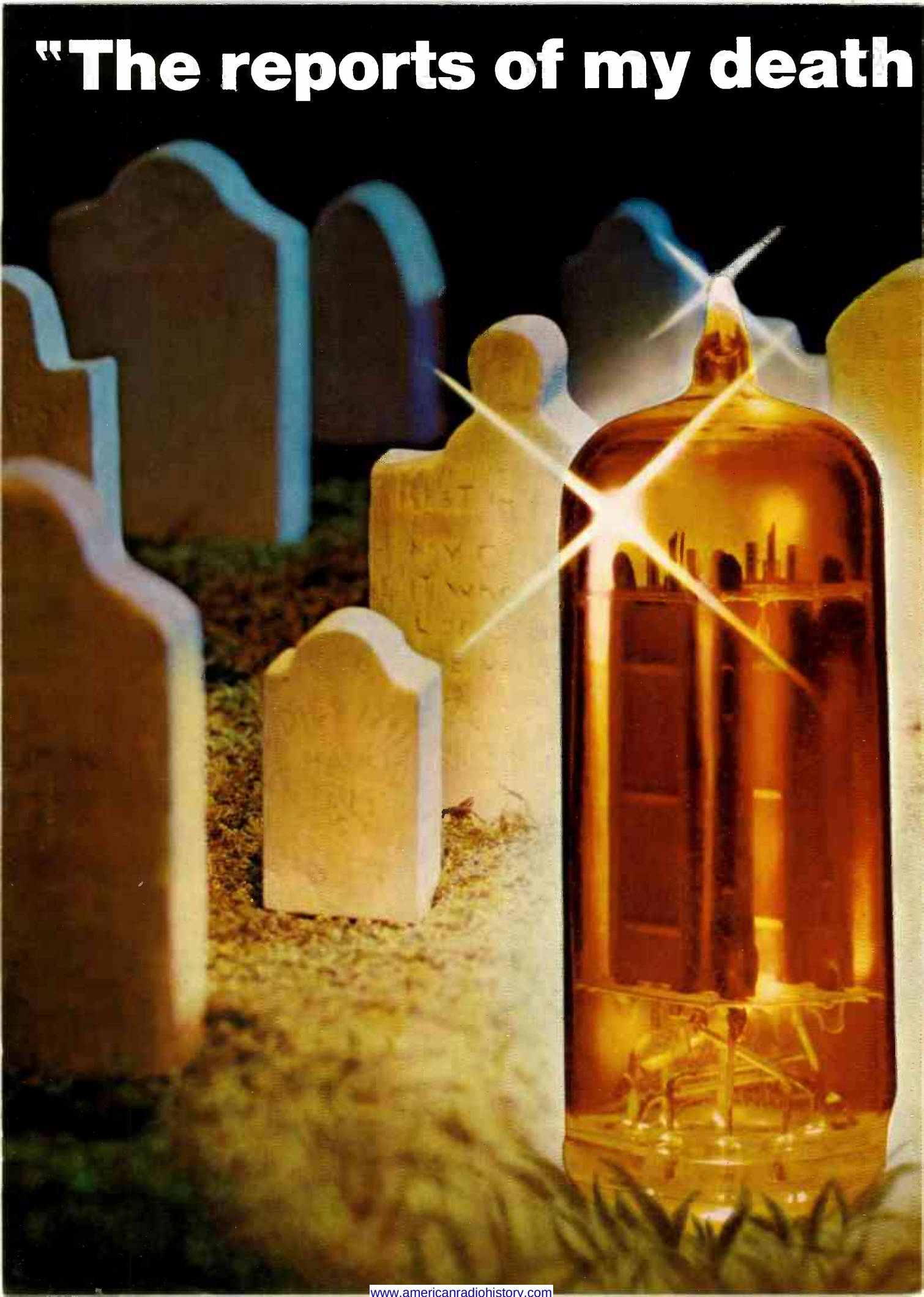
The electronics of security page 18

Finding the source of noise

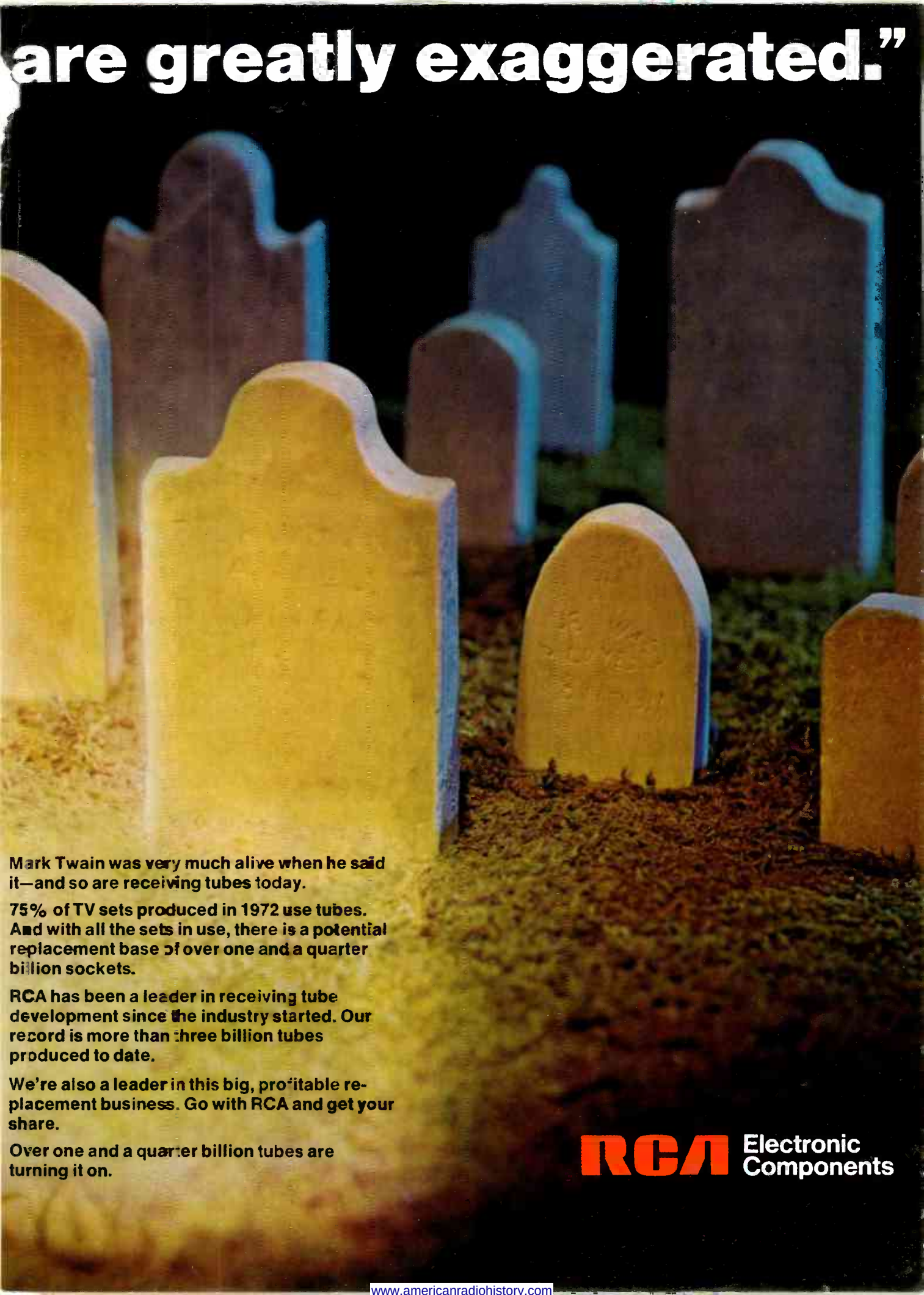
Test transistors by bias-shifting

Troubleshooting the CTC38

"The reports of my death



are greatly exaggerated."



Mark Twain was very much alive when he said it—and so are receiving tubes today.

75% of TV sets produced in 1972 use tubes. And with all the sets in use, there is a potential replacement base of over one and a quarter billion sockets.

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Over one and a quarter billion tubes are turning it on.

RCA Electronic Components

March 1973 □ Volume 23, No. 3

Electronic Servicing®

in this issue...

DEPARTMENTS

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Robert E. Hertel, Publisher

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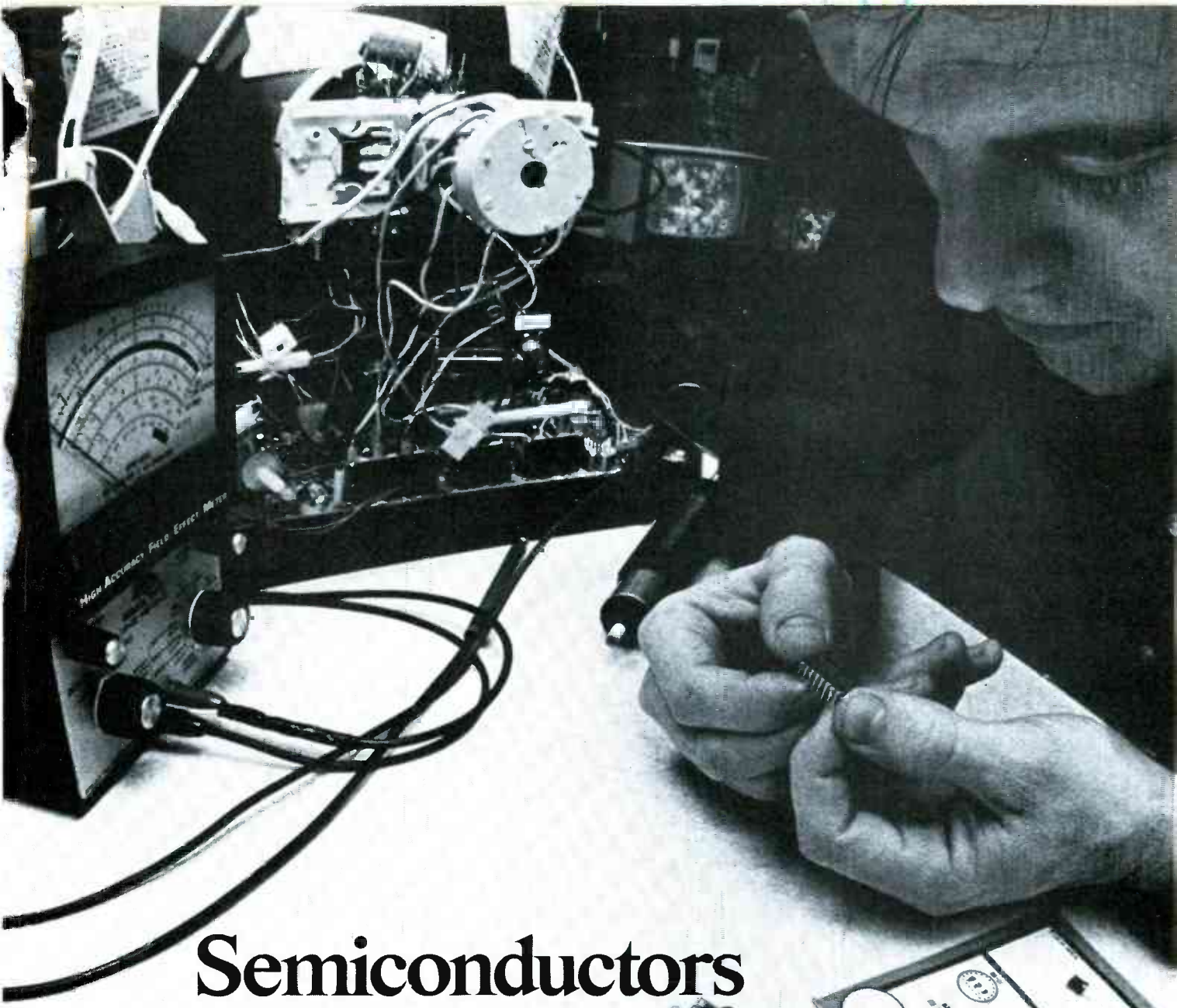

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GENERAL ELECTRIC

electronicscanner

news of the industry

The Foothill College Electronics Museum, said to be the first museum of the electronics industry, opened February 2 at Los Altos in northern California. The all-new $400,000 museum building is the result of years of work by individuals and industry leaders who wanted a display that would chronicle the evolution of commercial radio, television and other aspects of electronics.

Included in the exhibits, in what could be the world's most complete collection of early electronic equipment, are ancient radio tubes, spark transmitters, and one of the first television tubes assembled in 1923 by Philo Farnsworth. Much of the material that is on display was collected by the late Douglas M. Perlham, pioneering San Francisco peninsula radio-research expert. The foundation (including executives of the electronics industry), which Perlham formed, assisted the Foothill College in providing a permanent home for the collection.

A section of KQW, the world's first regularly-scheduled radio station, has been recreated in the museum. The broadcast facility, founded in 1909 by electrical engineer C. D. Herrold as station FN, later became a laboratory for the development of new radio techniques, and eventually was called station KQW. In 1949 it was purchased by CBS and renamed KCBS. Special exhibits, arranged by museum curator Jack Eddy, permit visitor manipulation of some early-day electronic devices. Admission is free.

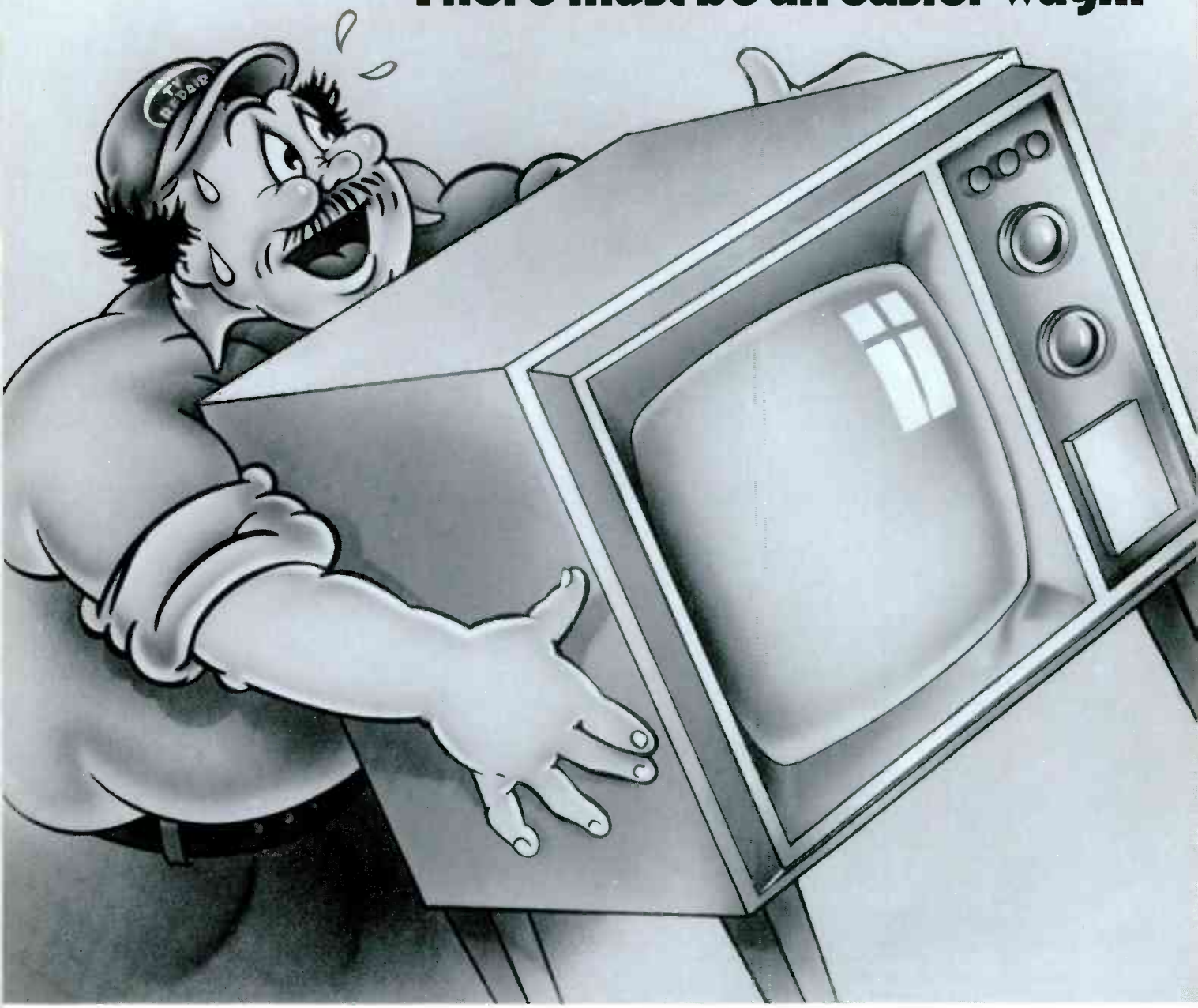
California's Bureau Of Repair Services, a part of the Department Of Consumer Affairs, **has intensified its "crackdown" on electronic servicing shops allegedly engaging in illegal activities.** Recently, the Bureau revoked the registration-to-do-business of Mrs. Marianne Petronzio, owner of Euclid Television Repair in Ontario, California. Mrs. Petronzio formerly operated Montclair TV at Montclair, also in southern California. Field representatives for the Bureau told during a hearing before the Calfornia Office Of Administrative Hearings that they had uncovered evidence of "fraud and dishonest dealings, and conduct constituting gross negligence". The investigators said unnecessary parts had been replaced, and that Mrs. Petronzio had failed to furnish proper invoices to the customers. This "evidence" was discovered by investigators running state-controlled television sets through the firm's repair facilities.

Another electronics manufacturer is quitting business. According to a recent article in **Home Furnishings Daily,** Symphonic Electronics Corporation is ceasing operation, and will sell most of its inventory to the Morse Electro Products Corporation. The Lynch Corp., sole owner of Symphonic, says that Symphonic will assemble some of the components on hand into finished instruments, then manufacturing will cease. Morse is to assume some of Symphonic's sales commitments, and the warranty on new merchandise sold. Reason for the closing is said to be significant losses over the past two years.

A transistor radio inside a ball-point pen is said by the **Wall Street Journal** to be marketed by a Japanese company. We can only hope it's a throwaway product and not one to be repaired!

(Continued on page 6)

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.

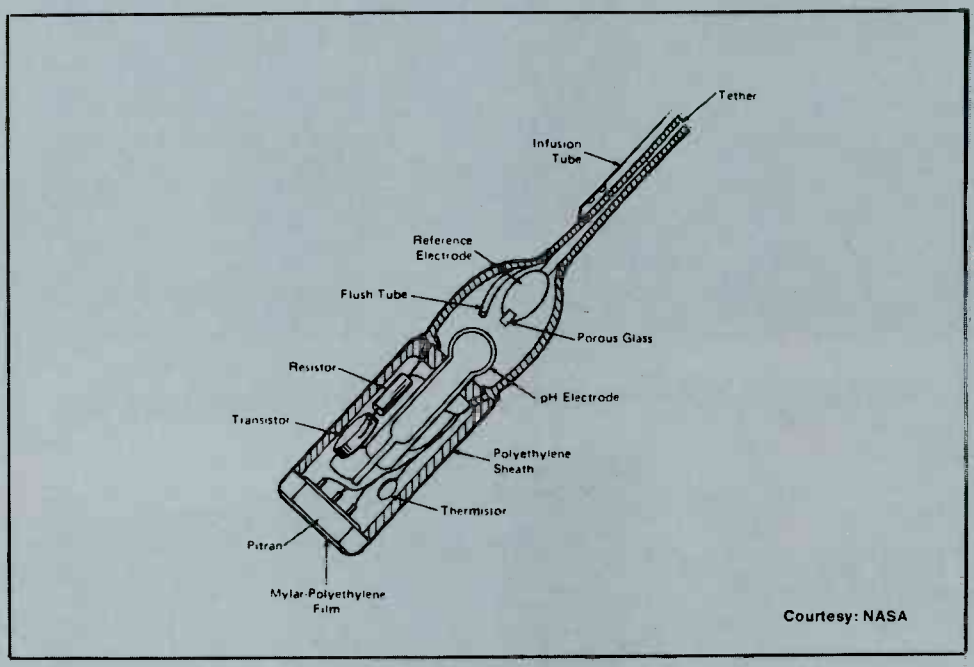
With a Chek-A-Color test jig all you have to take is the chassis. Get the picture? Sylvania Electronic Components, 100 First Avenue, Waltham, Mass. 02154

GTE SYLVANIA

An article in Radio & Television Weekly says that both RCA and General Electric are planning to introduce new color-TV picture tubes this spring. The tubes are described as having three in-line beams from one gun (similar to Trinitron?) and a slotted shadow mask. Advantages of the tubes include two inches less depth, and reduced or eliminated convergence adjustments.

Another museum is in the news. This one has been opened by the Mueller Electric Company at their general offices in Cleveland, Ohio. The origin of electric clips is traced, beginning with the curtain rod clips and men's suspender clips used by telephone men around the beginning of the century before Mueller began to manufacture test clips especially for electrical uses. Before designing their own clip insulators, Mueller used nipples intended for the feeding of orphaned lambs. Other exhibits include a lamp base from the home of Charles Brush (in 1888, this was the first American home to be wired for electric lights), an ammeter which helped distribute power to the Brush arc lamps lighting Cleveland's Public Square (a world "first" in 1879), and a 1908 DeForest radio tube. The museum was conceived by President Scott Mueller, and is based on a 60-year collection by the late Ralph S. Mueller, Sr., founder of the company.

From NASA comes another benefit of our space program: a sensor capsule designed to be retained inside a stomach for extended periods. As shown in the drawing, the sensor is a capsule which includes a Pitran pressure transducer, a thermistor for recording temperature and a PH electrode for measuring gastric acidity. It does not interfere with normal digestion. The capsule is about 7mm in diameter and 3.2cm long. It is connected by means of three polyethylene tubes which enclose the seven wires, permit infusing the alkaline solution, and allow flushing of the bulb. □



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FLORIDA	1505 CYPRESS ST., Tampa, Florida 33606	TEL: 813-253-0324
GEORGIA	938 GORDON ST., S.W., Atlanta, Georgia 30310	TEL: 404-758-2232
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	817 N. PENNSYLVANIA ST., Indianapolis, Ind. 46204	TEL: 317-632-3493
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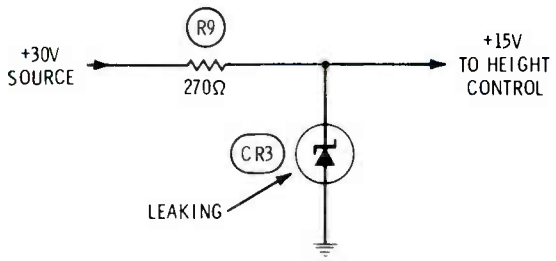
WATCH US GROW

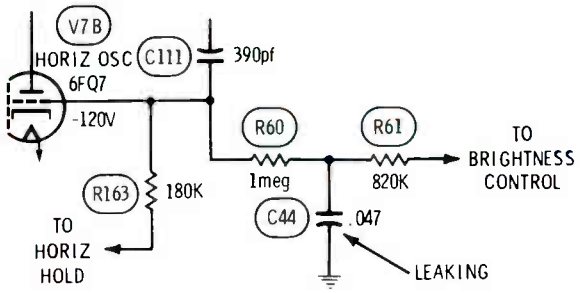
For More Details Circle (3) on Reply Card

Chassis—RCA CTC46
PHOTOFACT—1243-2



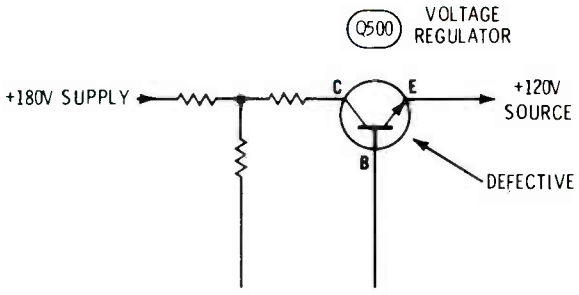
Symptom—Insufficient height
Cure—Replace CR3, if it is leaking

Chassis—RCA CTC38
PHOTOFACT—1000-3



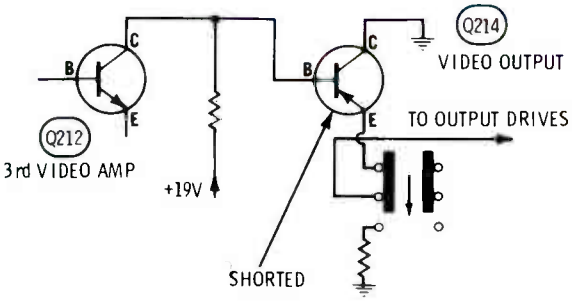
Symptom—Varying brightness and horizontal locking
Cure—Check C44, and replace if it is leaking

Chassis—Sylvania EO1
PHOTOFACT—1251-3



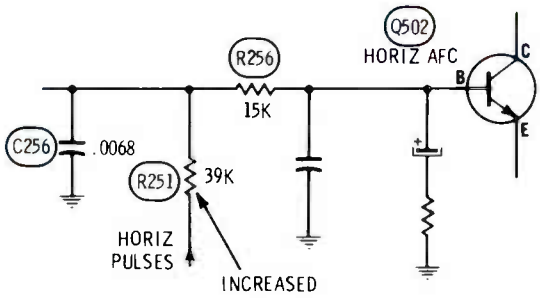
Symptom—At low brightness level, the picture flickers
Cure—Check Q500 regulator transistor, and replace if erratic

Chassis—Sylvania EO1
PHOTOFACT—1251-3



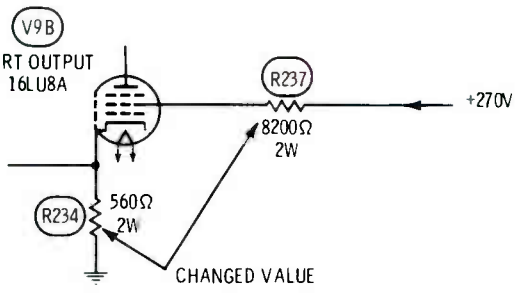
Symptom—Excessive brightness, and control has no effect
Cure—Check Q214 for C/E short, and replace if defective

Chassis—General Electric C-2/L-2
PHOTOFACT—1231-2



Symptom—Weak or no horizontal locking
Cure—Check R251, and replace if it has increased in value

Chassis—General Electric C-2/L-2
PHOTOFACT—1231-2



Symptom—Insufficient height or poor linearity following 16LU8 tube replacement
Cure—Check R234 and R237, and replace them if they have changed value

Introducing the expensive curve tracer that doesn't cost a lot.

The B&K Model 501A.

It's a lab-quality instrument that provides fast analysis of all semiconductors including J-FET's, MOS-FET's, signal and power bipolar transistors, SCR's, UJT's and diodes.

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The 501A won't burn out either the semiconductors or itself.

With all these features, you'd think the 501A was an expensive curve tracer. But look at the price.

For complete technical data, call your B&K distributor. Or write Dynascan Corporation.

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

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reader's exchange

Needed: *GE's ETR2208 Profitable Service Management Course.*

Borden c/o Flicktronix
1362 Prospect Avenue
Bronx, New York 10459

Needed: *One meter dc movement 0-200 microamperes part number 93991 for RCA Master Voltohmyst Type WV-87A.*

Dean Lefford
484 Fair Oak Street
Salamanca, New York 14779

Needed: *Schematic for an old Dumont scope model 274A.*

John J. Campbell
C/F Enterprises
248 Ferry Street
Newark, New Jersey 07105

Needed: *The complete address of the manufacturer of a sound-activated color lite box. The label has No. 001161-Westek-Santa Ana, California.*

L. E. Moore
Moore's – TV
516-7th Avenue, South
Lewistown, Montana 59457

Needed: *Schematic and operating instructions for a Precision sweep generator type E-400.*

Edgar I. Castro
Box 995
Arecibo, Puerto Rico 00612

Needed: *A tape head for an Audiomatic tape recorder model A-700.*

Interwest Color Television Service
274 North 100 West
Provo, Utah 84601

Needed: *Suggestions about service charges and contracts for repairing TV sets for hotels and motels.*

Angelo Cali
240 Culver Parkway
Rochester, New York 14609

For Sale: *Tubes I purchased between 1940 and 1950 for older radios and phonos. All are new and in original cartons.*

Middleton Electric
1502 West Windsor Street
Tucson, Arizona 85705

Needed: *Manual and schematic for Model 702 Radio City Products Company signal generator. Will pay for manual or will copy and return.*

AEC Howard Adams USN Ret.
209 West Shadywood Drive
Midwest City, Oklahoma 73110

Needed: *Fine tuning knob for Sony TV model No. 8-301W.*

Nick Karamanian
12 Dante Avenue
Belmont, Massachusetts 02178

Needed: *Schematics and other service data for Philco radios; Models 38-7 and 39-7. Will gladly pay reasonable expenses.*

Herbert Naugle
1792 Finch Court
Hayward, California 94545

Needed: *Schematic and operating instructions for a Triplett Sweep Generator model No. 3435 (0-240MC).*

R. Wilson
KELO-AM-FM-TV
Sioux Falls, South Dakota 57104

Needed: *Schematic for a Realistic STA-30 Stereo-Tuner-Amplifier.*

Ed Denham
Upson Co. Area Voc.-Tech. School
P.O. Box 1089
Thomaston, Georgia 30286

Needed: *Transformer T13 No. HB-201 for Decca AM-FM radio model DR-344.*

Lee E. Collier
Lee's Radio
804 Farmer Street
Cleveland, Mississippi 38732

Needed: *Schematic for a Seco Model 79 Super Meter*

Ralph Bland, Sr.
900 Bonaparte Avenue
Baltimore, Maryland 21218

Needed: *A power transformer for a Heath CT-1 in-circuit capacitor checker.*

Merlin Preuss
Route 1
Weyauwega, Wisconsin 54983

Needed: *Schematic and operating instructions for Triplett model 3440 scope.*

Frederick S. Heim
Box 203B High Hall
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Lock Haven, Pennsylvania 17745 □

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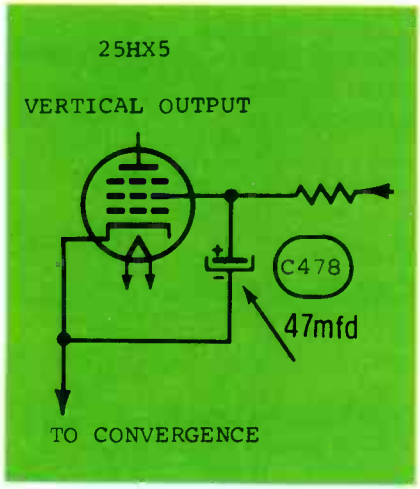
For More Details Circle (4) on Reply Card

troubleshooting tips

Send in **your** helpful tips—we pay!



Chassis—Panasonic CT25
Symptoms—Poor vertical convergence following breakage of 25HX5 tube.
Troubleshooting—These vertical-output tubes are mounted horizontally, and this combined with the heat sometimes causes glass breakage at the base of the tube. After the tube is replaced, the vertical convergence might be very poor.

Check C478, because often it is damaged by the tube failure. The same DC voltage measured at each end of the capacitor proves it is leaking or shorted.

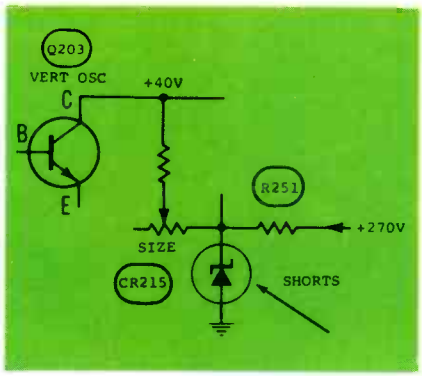
Gene Tucker
Edgewood, Texas

Chassis—RCA CTC48
Symptoms—narrow raster, excessive high voltage causing the HV-disable circuit to eliminate horizontal locking.
Troubleshooting—Grounding TP-2 to defeat the disable circuit produced even more high voltage and arcing inside the CRT. First, the trace diode, CR401, and the yoke-to-ground continuity were tested, without results. C407 was disconnected to lower the high voltage, then the high voltage was measured while varying the HV-adjust control. This gave some variation of the high voltage, which directed suspicion away from the high-voltage regulator circuit.

Next, a clip lead was used to ground the anode of SCR101. A scope showed nearly the correct waveshape and frequency at the anode of SCR102. This indicated the retrace circuit was okay.

I knew that an open in R122 could cause excessive high voltage, so I grounded terminal DC of the high-voltage tripler assembly. No change. Finally, in desperation I replaced the tripler, reset the high voltage and all operations were perfect. Evidently, the tripler was open inside at terminal DC.

Roger D. Redden
Beaver, West Virginia



Chassis—Zenith 23DC14
Symptoms—Intermittent vertical collapse to a four-inch picture.
Troubleshooting—Vertical linearity and size controls couldn't restore the height. Both the vertical-oscillator transistor and output tube checked good.

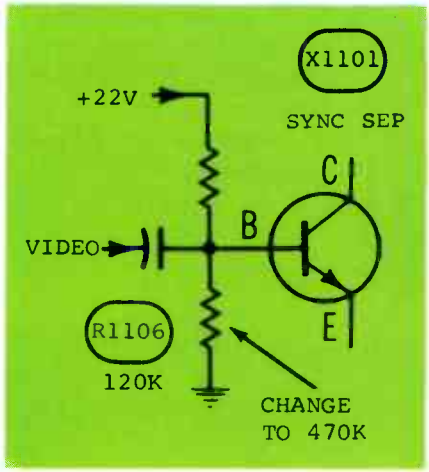
When reduction of height occurred, the collector voltage of Q203 oscillator went down. Further testing showed that the normal +150 volts at the junction of R251 and the height control was at that time about +50 volts.

Leakage of zener CR215 was suspected, but it checked okay on an ohmmeter. When it was disconnected, the voltage rose to nearly 200 volts, and the intermittent height was cured. A new zener stopped the intermittent.

M. E. Cer Janic
Seneca Falls, New York

Chassis—Any FM receivers using the uA703 IC.
Symptoms—Defective IC.
Troubleshooting—These IC's run warm in the circuit, so we have been using metal-cased replacements such as the Sylvania ECG703A (A denotes the metal-cased version). The metal dissipates the heat faster, and we have not had a "comeback" since making this change.

Joseph Rotello, Jr.
Tucson, Arizona



Chassis—JVC (Catalina) Model 7408
Symptoms—Intermittent vertical jitter.
Troubleshooting—DC voltages in the vertical circuit checked okay. A scope showed the vertical sync pulses were compressed at the output of the sync separator when the jitter occurred. Additional scope tests showed the sync pulses also were compressed at the base of X1101 sync separator. X1101 transistor checked normal.

It seemed likely the DC forward bias was not sufficient to overcome the negative voltage produced by rectification of the video, so I raised the bias by increasing the value of R1106 from 120K to 470K. Stubborn cases might require a change up to 560K. There has been no vertical jitter since this modification.

Marvin L. Nethery
Vernon, Texas □

Which color TV needs fewest repairs?

TV servicemen say Zenith.

Here are the questions and answers from a 175-city survey of independent TV service shops.

QUESTION: "In general, of the brands you are familiar with, which one would you say requires the fewest repairs?"

ANSWERS:	**Zenith**	**30%**
	Brand A	11%
	Brand B	9%
	Brand C	5%
	Brand D	4%
	Brand E	3%
	Brand F	2%
	Brand G	2%
	Brand H	2%
	Brand I	1%
	Other Brands	3%
	About Equal	21%
	Don't Know	11%

QUESTION: "In general, of the brands you are familiar with, which one would you say is easiest to repair?"

ANSWERS:	**Zenith**	**34%**
	Brand A	25%
	Brand B	11%
	Brand D	5%
	Brand F	4%
	Brand E	4%
	Brand C	3%
	Brand I	1%
	Other Brands	3%
	About Equal	18%
	Don't Know	1%

QUESTION: "If you were buying a new color TV set for yourself today, which brand would you buy?"

ANSWERS:	**Zenith**	**35%**
	Brand A	21%
	Brand B	12%
	Brand D	7%
	Brand E	5%
	Brand C	4%
	Brand F	4%
	Brand G	3%
	Brand H	1%
	Brand I	1%
	Other Brands	6%
	Don't Know	9%

NOTE: Answers total more than 100% because some servicemen named more than one brand.

How the survey was made.

One of the best-known research firms in America conducted this study of independent TV servicemen's attitudes toward brands of color television. Telephone interviews were conducted with TV servicemen themselves in April, 1972, in 175 cities from coast to coast. To eliminate the factor of loyalty to a single brand, the study included only shops which serviced more than one brand of TV.

We want to hear from you.

We're proud of our record of building dependable, quality products.

But if it should ever happen that a Zenith product doesn't live up to your expectations—or if you would like additional details of the servicemen's survey—we want to hear from you. Write to the Vice President, Consumer Affairs, Zenith Radio Corporation, 1900 N. Austin Ave., Chicago, Ill. 60639. We'll give your request our personal attention.

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ZENITH®

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For More Details Circle (5) on Reply Card

Color TV Center of Santa Rosa, California actively advertises and promotes sales, but also happily accepts warranty and other service.

Better to push service or sales?

By Kenneth R. MacDonald

Some interesting food-for-thought from the managers of two competing stores.

Competition has been called "the life blood of American business". For some, competition has meant bankruptcy; for many others it has brought growth and profits.

Competition in Santa Rosa, California has produced more business for each of two thriving TV-radio shops, although they operate under opposite approaches to service.

Fortier's, owned by Will Monroe who claims "service is my real stock in trade", aggressively promotes the service end of the business.

The other, Color TV Center owned by Jim Van Blaricom, puts its service department on an equal basis with sales, but refuses to specifically seek service work.

Color TV Center

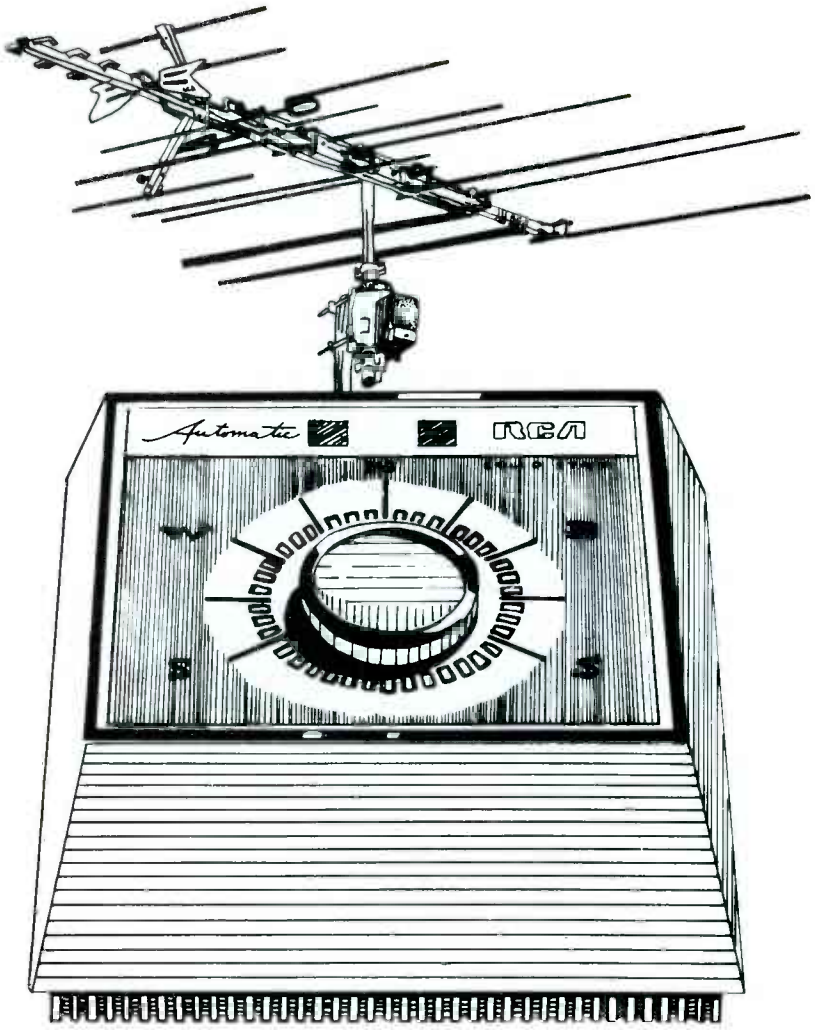
"We have plenty of service work to do," Van Blaricom reports, "with warranty work and over-the-transom jobs that come in from the best and least-expensive advertising there is: word of mouth."

Van Blaricom's store is the warranty center of Santa Rosa for five major brands, so about half the service jobs involve warranty.

Only an occasional job is serviced by Van Blaricom, a qualified technician. "Jim prefers to be out in the store selling," explains service manager George McCleary. "Sometimes, when we get in as many as 20 TV sets at one time from the area's Sony distributors, I get to wishing Jim wasn't boss and I could put him to work servicing."

McCleary has two service trainees, and a part-time technician in the shop, as well as one outside man who averages eight to ten service calls a day.

In addition to servicing TV sets, McCleary and his crew handle all types



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RCA

Parts and Accessories, Deptford, New Jersey 08096

of sound equipment. He and Van Blaricom agree "the sales end has really jumped on the audio bandwagon".

They have converted a section of the store into an audio center, handling a dozen different brands. It is operated by Jim Van Blaricom, Jr., son of the owner.

"The audio market is growing rapidly," McCleary believes, "but, the bulk of our shop service work remains TV sets, and about 95 per cent of our outside calls are on color TV."

In most instances, the shop can get a unit in and out within two days. Even if a part not on hand must be ordered, it usually can be obtained within a week. Word has spread throughout the community of this rapid service.

"Also," McCleary adds, "we are willing to tackle a lot of off-brands and foreign-made sets that many other shops just refuse to touch. Actually, solid-state technology is making sets much easier to service in spite of increasing makes and models. The modular components systems have proved a real boon to the service business. It's a lot easier to replace a plug-in module that has a defective part than to try and track down a bad circuit in an old tube set."

Speedy servicing is accomplished at Color TV Center by what McCleary describes as his "assembly line" shop operations.

"When a set comes in, one man cleans the chassis and checks the tubes. If he cannot immediately pinpoint the problem, another man steps in. As always, two heads are much better than one. Then, I make a final check of each set, and handle most of the inside color-TV work."

One reason his staff can tackle an old Hallicrafter or Capehart is a stack of schematics for TV sets dating back to earliest 1950 models.

Fortier's

In contrast, Will Monroe, who manages Fortier's, is not a service technician, but he contends "service is really all we sell. Anybody can merchandise a TV set, but what we also sell is the service behind the set."

Monroe offers a full warranty covering both parts and labor on all he sells, from home entertainment centers to transistor radios. He does this by adding a small markup to the **retail** prices.

"In this store," Monroe contends, we sell quality and service, not price."

Monroe supervises a service schedule worked by one inside man and two outside men, and offers a full 90-day warranty for both parts and labor on all repairs.

He estimates that 75 per cent of his shop work is on TV sets, about evenly divided between color and b-w. Monroe also is expanding his audio sales line to go after the youth market.

"Young people," Monroe is convinced, "are not watching TV so much anymore. There is a growing trend among TV buyers toward more portables and fewer consoles, and we have switched the emphasis."

Where previously Monroe devoted two-thirds of his TV floor space to consoles, that two-thirds now is allotted to table models and portables.

Monroe has a follow-up method that produces additional sales. Within a week after a sale, he personally calls the customer to thank him and to inquire about the performance of the product. Two weeks later, the customer gets a "satisfaction report" card to be filled out and returned to Fortier's.

Six months later, another card is sent to the customer, asking about operation, servicing, or whether the customer might have any questions. Just before the end of the one year Fortier warranty, he again contacts the customer. This time he is offered a one-year service contract, covering all parts and labor, for $94.50. This contract is renewable until the machine is nine years old.

Monroe believes that these follow-ups are extremely important in assuring customer satisfaction with the product, and in bringing repeat business.

Which Emphasis?

The managers of both businesses believe their approach is the best one. Perhaps the truth is that either sales or service can be emphasized, and the business prosper, if the people work hard and efficiently to make it happen! □

Fortier's, also of Santa Rosa, sells merchandise, but their emphasis is on after-the-sale service, including contracts.

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RAYTHEON

The electronics of security

By Joseph J. Carr, CET

"Things that go bump in the night" can be coped with, if they trip the alarm of a security system during their prowling. This article explains the circuits of typical detection and control units.

With frightening regularity, our law-enforcement officials report sharp increases in most categories of criminal activity. The ever-spreading circles of theft and sabotage now even include small towns and farms.

And yet, there's quite a few things the homeowner or businessman can do to protect his property and his life.

A rather impractical method was described by a now-reformed burglar. While appearing on a national-TV talk show, he was asked about the most frightening incident that happened to him during his nocturnal career. The ex-burglar recalled the time he was climbing in through a first-floor window, using for illumination a dim pencil-type flashlight. When he was halfway inside the window, his light was reflected by a pair of cat's eyes. Now, seeing cat's eyes is normally of little concern to a burglar. In this case, however, the eyes were nine inches apart! These folks kept more than a cute little kitty; their pet was a real live black panther!

Of course, few people can either control or afford to feed such a pet. Even large dogs, although they are cheaper, can cause problems and sometimes not protect effectively. Only electronic systems offer practical solutions for making homes and offices secure.

Types Of Systems

In the January issue of ELECTRONIC SERVICING, the basics of security by use of electronic equipment was described. We learned that:

- Centralized protection systems tie the sensors into a master switchboard watched over by armed guards on the premises.
- Remote alarms signal their reports to watchmen, such as police or private guards, at some distant, remote point.
- Local alarm systems respond by flashing lights, or by sounding bells, buzzers, sirens or howlers in the vicinity of the protected property.

Transducers for use in all of the basic systems are available to sound warnings of danger from intruders, excess heat, smoke, or water. Of these, intruder alarms are the first we shall consider.

Closed-Loop Systems

In closed-loop intruder-detection systems, the alarm is triggered by interruption of a current path. Figure 1 shows a basic system I designed and installed for a shop where I once worked.

The control element is a Silicon-Controlled-Rectifier (SCR) having current and voltage ratings high enough to carry the current and withstand the voltage transients of the alarm bell. If alarm devices requiring heavier currents or voltage are required, the SCR can be used to power a relay, which turns on the alarm.

When the protection loop is intact (has continuity), current from the B+ supply maintains a heavy forward bias at the base of transistor Q1. This saturates Q1 so its collector voltage is nearly zero. The collector of Q1 drives the gate of SCR1; therefore, the SCR at this time has no gate voltage, the anode doesn't conduct, and the bell is silent.

When an intruder interrupts the protection loop, Q1 loses its bias and turns off. The collector voltage rises, placing a forward bias on the SCR gate, causing the SCR to conduct, and to ring the alarm bell.

After they are triggered, SCR's remain conductive, even with no voltage at the gate, so long as a minimum anode current flows. Therefore, if the alarm device has continuous continuity, the SCR will remain triggered even after the gate voltage returns to zero. Buzzers or bells having internal breaker switches will not keep the SCR in conduction in this circuit. Where latching is desired, use the alternate circuit with a relay. A normally-closed switch is provided to reset the cycle of operation.

A loop-defeat switch inactivates the protection loop so that authorized persons can enter or leave. This switch is usually of the key-operated variety and located outside an entrance or exit door as required.

Open-Loop Systems

An open-loop version (Figure 2) of the previously-described SCR circuit reverses the polarity of the transistor. Closing any one of the alarm switches applies forward bias to Q1, which in turn biases-on the SCR. The advantage of open-loop operation is that no current is drawn until there is an alarm.

Open-Loop Automotive

Closing any of the door, trunk, or hood switches (Figure 3) activates K1 relay which applies battery voltage to the car horn. In addition, relay contacts 1A close to parallel the intruder switches. This keeps the relay closed and the horn sounding until the reset switch is activated or the battery runs down, whichever occurs first, even after the original alarm signal has been switched off. Such a circuit is called self-latching, and it can be used also in security systems for homes and shops.

More expensive variations use the relay to supply power to a louder, more distinctive signal such as a siren of ear-splitting volume. One type of siren is shown in Figure 4.

Beam-Of-Light Systems

Beam-of-light security systems have been used nearly as long as wired/relay types. The block diagram (Figure 5) is very simple, and the actual wiring is not much more so. Sometimes the transmitter is a light bulb with a lens, and the receiver is a lens, photoelectric cell, and a relay to send power to the alarm. Normally, the contacts of the relay are closed while the beam is received, and then open to sound the alarm when the beam is broken.

Only one mirror is shown in the illustration, but several mirrors can be

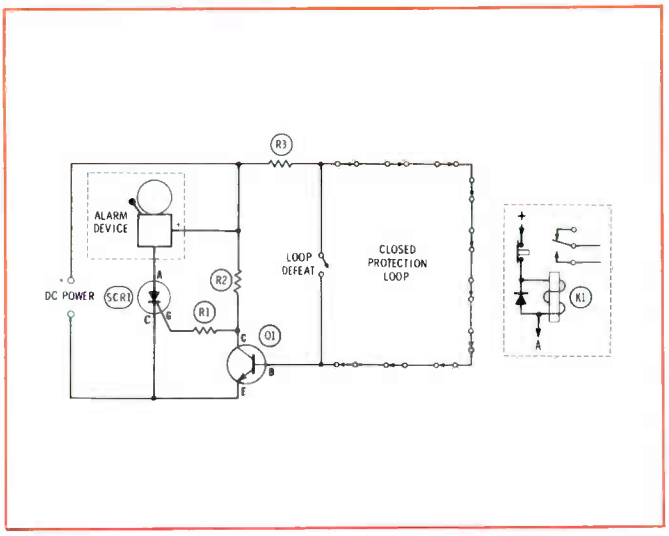

Fig. 1 One type of closed-loop alarm system uses a SCR to activate the bell, or other alarm device. A very small amount of Q1 current flows at all times.

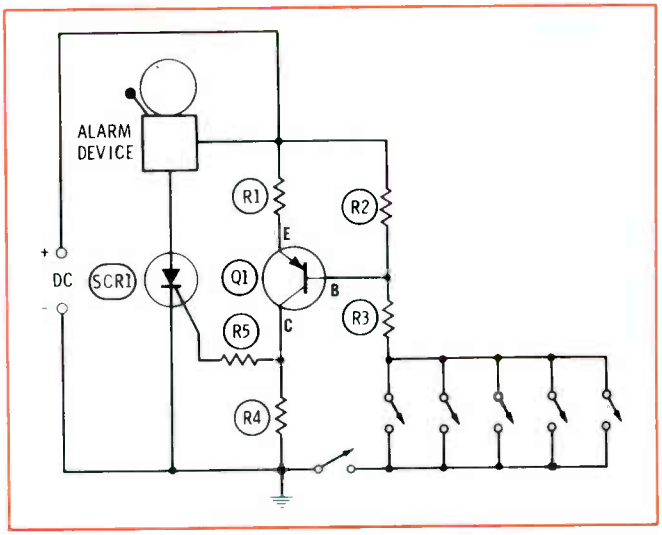

Fig. 2 A SCR also can be used as the alarm control in open-loop circuits. No current flows until one of the point-of-entry switches closes.

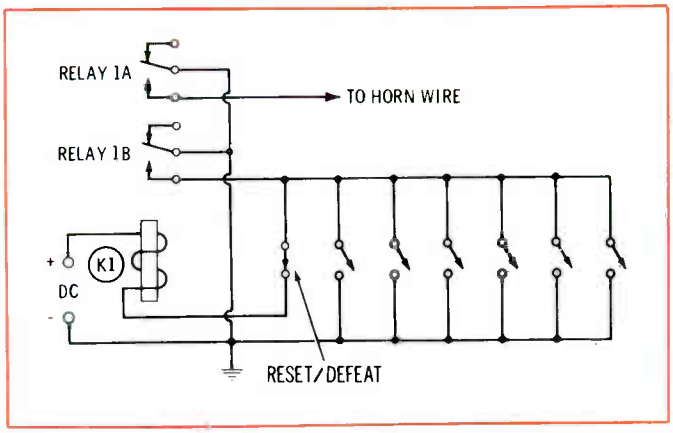

Fig. 3 A simple system for autos uses a relay having a 12-volt coil in a self-latching open-loop circuit. No current flows until an alarm is sounded.

Courtesy of Mallory Distributor Products Co.

Fig. 4 This siren is rated at 120 volts, but similar ones can be installed on cars and trucks. When one of these sounds an alarm, people really listen!

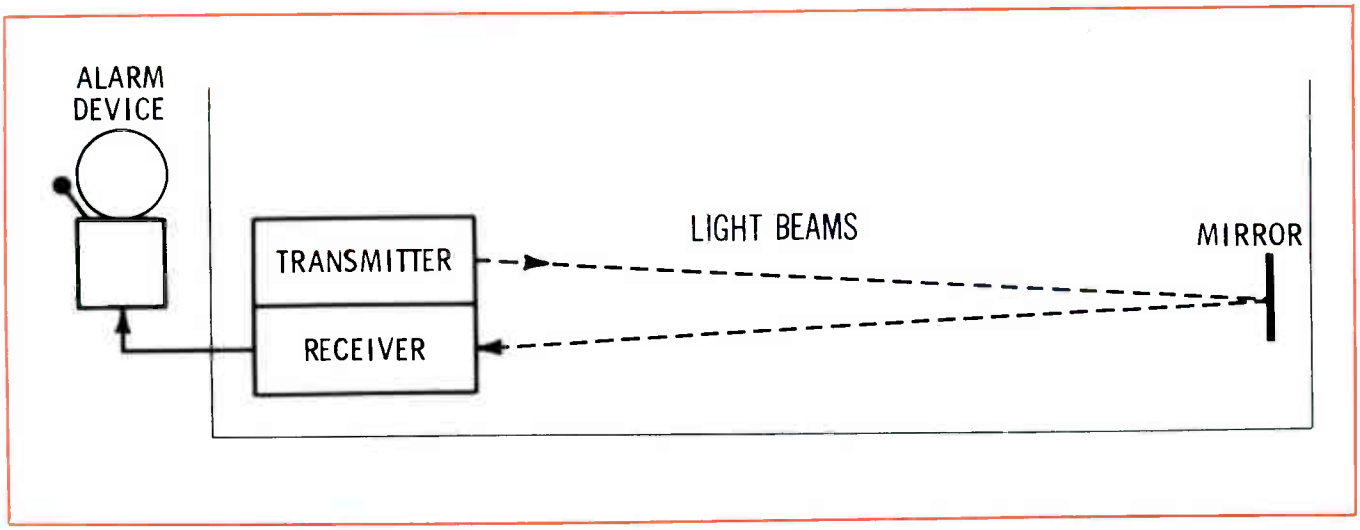

Fig. 5 Infrared-light beams have been used for years. Transmitter and receiver don't require mounting together, as shown, but can be separated by any reasonable distance.

used if required to protect an odd-shaped area. The principle of operation is the same whether the light source and the receiver are opposite one another, or whether many mirrors and beam paths are used. Of course, the more mirrors, the harder it is to align them correctly.

White light seldom is used because the beam could be seen by the intruder who would be warned, or who might easily defeat it. Also room lights or daylight might give false alarms.

One partial solution is to use filters on the light source to block all wavelengths except infrared, which is invisible to the eye. That method works well except against a resourceful burglar who might locate the receiving lens and shine a flashlight into it while he safely moved through the infrared beam path. The cell would not be able to detect the change of light, for there is much infrared in incandescent light. Another possible problem with infrared is the interference from furnaces or other heated objects which emit large amounts of infrared.

A better solution for several of the problems (at the expense of greater complexity) is to use audio modulation of the infrared beam. At the receiver, the modulation is the part of the signal that keeps the relay closed, so the flashlight trick wouldn't work. A steady beam would affect the system in the same way as a loss of the beam.

Body Heat Detector

Another application of infrared energy is a sensor that detects the heat of a human body when it is in motion.

Weaknesses Of Wired And Infrared Systems

Assuming that a burglar can locate the parts of a security system, there

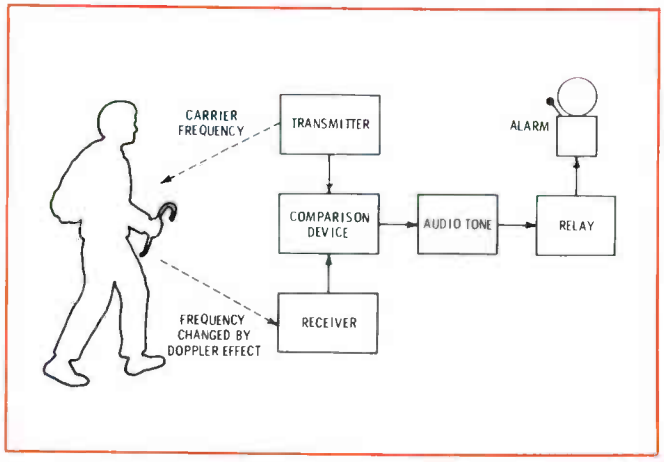

Fig. 6 Radar (Doppler effect) alarms are very effective for detecting movement.

Courtesy of Mallory Distributor Products Co.

Fig. 7 One brand of motion detector houses both the transmitting and receiving transducers and circuitry in one cabinet.

Courtesy of General Electric

Fig. 8 Two General Electric closed-circuit TV cameras are shown watching the Flying Tiger warehouse.

Courtesy of General Electric

Fig. 9 Eight General Electric video monitors are used to check security and work-load operations in the Flying Tiger warehouse.

are many ways he can make it ineffective. If a door switch is the normally-open type, he merely cuts the connecting wire. Or, he might use a clip lead (having a miniature alligator clip on each end) to jumper a normally-closed switch or window tape. Infrared beams can be defeated by special lights and mirrors, or simply by the burglar crawling under or jumping over the beam.

Harder to defeat are the more elaborate (and expensive) systems using ultrasonic or RF frequencies and circuits that take advantage of the Doppler effect.

Doppler Effect

Briefly stated, the Doppler effect is the apparent compressing or stretching of the waves of a signal because of the relative motion between the source and the receiver. A classic example is the definite reduction of the pitch of a train whistle just as the engine passes the hearer. Another more modern (perhaps infernal) application is that calibrated Doppler effect known as police radar. In speed radar, the audio beat-note between the original carrier and the echo (whose frequency has been changed by movement of the car) is measured accurately and calibrated in miles-per-hour.

Doppler-Type Motion Detectors

Motion detectors which use the Doppler audio beat-note to trigger an alarm circuit (Figure 6) are difficult to circumvent. When properly installed, and provided with an emergency battery supply (in case the burglar cuts the AC power line), there is more chance of false alarms than failure to signal an intrusion.

Curtains blowing in a breeze, or rats (not the human variety) on the prowl are some of the things that might give false alarms.

A typical commercial unit, the Mallory Crime-Alert, is shown in Figure 7.

Selecting the best frequency

Ultrasonic frequencies are used when detection is desired only in one room. Frequencies of several megahertz can penetrate for a short distance beyond the walls for roof and window protection. Gigahertz carriers can be focussed by directional antennas to cover only specific areas, if desired.

These are general guides; check the ratings of specific models for more accurate specifications.

Audio Monitors

An audio monitor is similar to the first stages of a public-address system. A sensitive microphone feeds a high-gain preamplifier. The audio monitors incorporate a sensitivity control, signal detector and a relay. In practice, the sensitivity control is adjusted so normal sounds don't trigger the relay, but louder noises do.

Video Monitors

The most simple video monitor is a closed-circuit video camera connected to a monitor or to a TV receiver. Usually, a person must watch the monitor and decide what action to take. There are new gadgets, however, that signal for any increase or decrease of brightness of the monitor screen.

Elaborate video systems might include multiple cameras, each with a monitor. Or, there might be just a few monitors that can be switched to any one of several cameras. And, some of these cameras might be special-purpose types, such as infrared-sensitive or of high-sensitivity for use in dimly-lighted areas.

Parts of the security installation for the warehouses of the Flying Tiger Line (air-freight carriers) are shown in Figures 8 and 9. The cameras are in environmental housings, and have facilities for remote pan/tilt control.

Many luxury apartments feature closed-circuit video for security and privacy. For example, a receptionist or guard might be stationed with a bank of monitors which are connected to cameras in the lobby, corridors and elevators.

Another application is to have a video camera watching outside the locked entrance door, and with the video modulating a carrier which is piped on an unused channel throughout the MATV system to all the apartments. A person desiring admittance would ring the apartment bell, then the tenant would look at his TV receiver for identification of the

(Continued on page 50)

Ease the pain of taxes

Taxes are said to be one of the two inevitable things. These suggestions should help you at tax time.

By Robert G. Amick

Most of us greet the annual (or quarterly) tax time with bad humor and much grumbling. Although there might be a slight amount of comfort in ranting and raving, it helps even more to view this periodic invasion of your pocketbook as a challenge rather than a battle. Call it an opportunity, instead of a hopeless situation.

After all, Uncle Sam makes an art of taxing us. Therefore, there must be an art of being taxed.

Choices Under Law

Although your fair share (and mine, too) of taxes are calculated under rules fixed by law, there are many choices about the method of figuring certain factors. Even the calendar gives us choices.

The art of being taxed is in paying your share, but not a penny more. It's legal, and it's ethical.

Short-Form Return

Consider the form 1040-A, the so-called "short form" brought back again this year. Completing it takes less work than the longer form, requires almost no records, and can be whipped out in minutes. If your income is all from wages under withholding and you can't be bothered with forms and laws, this is the one for you. But, be prepared to pay—perhaps a steep price—for this small saving of time and thought. **Choosing something which is to your disadvantage is legal; and the tax people will gladly accept your money!**

Those Valuable Records

All businessmen keep records. There are many reasons why they must do so. Whether you keep them yourself or hire them done, they cost money. But, there are a number of indirect compensations, in addition to the important financial one of helping you keep your tax bill as low as possible.

Now, your study of the tax rules should not be for the purpose of making you into a tax expert. What you're after is a fair knowledge of the alternatives you have, and a basic understanding of the rules.

Choices

Some of the choices you have are fairly simple, such as to delay paying certain bills until the next year. Or, perhaps to put off making certain expenditures until they offer the best tax break. The calendar can be your friend.

Other choices are more difficult. What outlays can be amortized, or which depreciation method should you use? Remember that some choices bind you to the chosen method for all items of the affected group, while others can be applied to only one item. Some methods can't be changed later without approval of the IRS.

Receive Sound Advice

Very important to the art of being taxed, is to know what questions to ask, and of whom to ask them. Don't look on this as a kind of multiple-choice exam. There can be severe penalties for mistakes.

You need tax help for two reasons:

- to avoid committing yourself to a method that is advantageous only for a year or two; and
- to reduce the chance of having your choice disallowed.

Remember, if your choice is disallowed and you must pay a higher amount, you'll be charged interest. No one wants to be taxed twice.

One Helpful Book

One government publication, called "Tax Guide For Small Business, 19XX Edition" can be extremely helpful to you. A new one is printed each year with tax changes, additions and deletions. Last year the price was 75c.

Unfortunately, it reads at times like a law book. But, with the help of a dictionary, you can understand it.

With ideas you can get from the book, you can ask better questions of your tax adviser or the IRS people.

The IRS employees **DO** want to help you. They'll answer your questions, check your arithmetic, or show you how to figure a complicated element. And they'll send refunds if you add wrong and inflate your tax. But, they will not choose your method of figuring any elements where there is a choice. They won't let you underpay, but they might let you overpay. □

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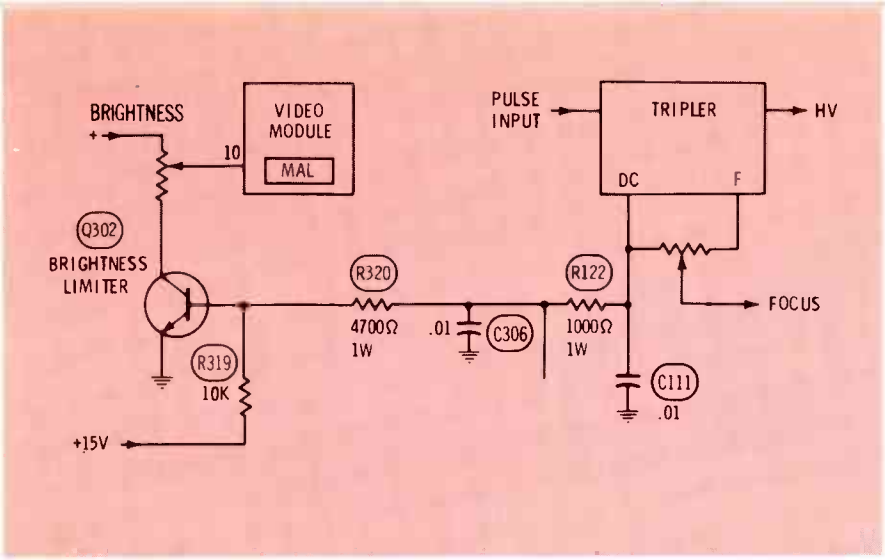


Fig. 1 Partial schematic of the ABL circuit of the RCA CTC48. The normal positive saturation bias for Q302 is cancelled at high brightness by a negative voltage from the high-voltage circuit.

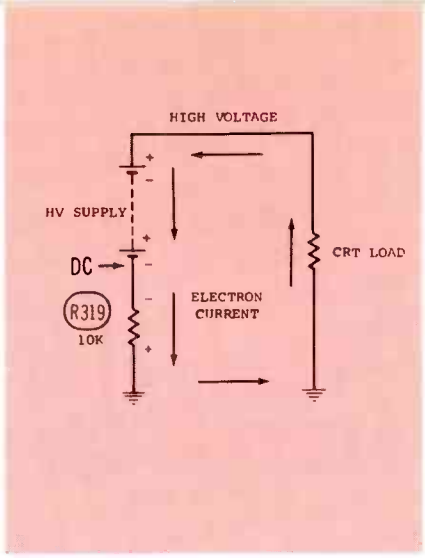


Fig. 2 Visualize the high-voltage supply as a battery, and the reason for the negative voltage drop across the 10K resistor is clear.

Brightness changed the height!

By John S. Hanson

Follow the tests and symptoms, and see if you can find the defective component before the technician does.

The brightness control varied the brightness as it should. But, it also drastically changed the vertical height. It was a real technician's nightmare!

Specifically, the picture had full vertical size when the brightness was dim. Then, as the brightness was increased gradually, the height shrunk until at maximum brightness only a horizontal line remained. That was the only symptom. Color and b-w appeared to be normal.

The receiver was a fairly-new RCA color receiver using a CTC48 solid-state chassis, one of the XL-100 series.

Armed with a schematic, VTVM and scope, I began searching for the cause of this peculiar symptom. My first suspicion was about the brightness-limiter circuit. Now, I don't know why I started there, except defects in that circuit can cause some unpredictable symptoms.

Brightness Limiting

The older color receivers using 6BK4 high-voltage regulator circuits bloom and lose high voltage when the picture tube draws more than a certain amount of current, usually about 1.4 milliamperes. So, in addition to regulation, the circuit also protected the picture tube from excessive current which might damage it.

However, in solid-state circuits, the decrease of high voltage from additional CRT current is gradual, and there's sufficient voltage remaining to damage the picture tube if the current is excessive. Something is needed to protect the CRT against these dangerous overcurrents, usually stated as 1.6 milliamperes or more. In the CTC48 chassis, that protection is the automatic-brightness-limiter (ABL) circuit. Here's how it works.

Q302, the ABL transistor shown in Figure 1, normally is biased to saturation by the positive base voltage through R319 from the +15-volt supply. The collector/emitter junction becomes a virtual short circuit and grounds one end of the brightness control. This permits normal manual control of picture brightness.

But there is also a source of variable-negative (reverse) bias coming through R320 and R122 from terminal DC of the tripler assembly. The negative voltage varies with picture tube current. The more current, the more negative voltage because of the voltage drops across R122, R320 and R319.

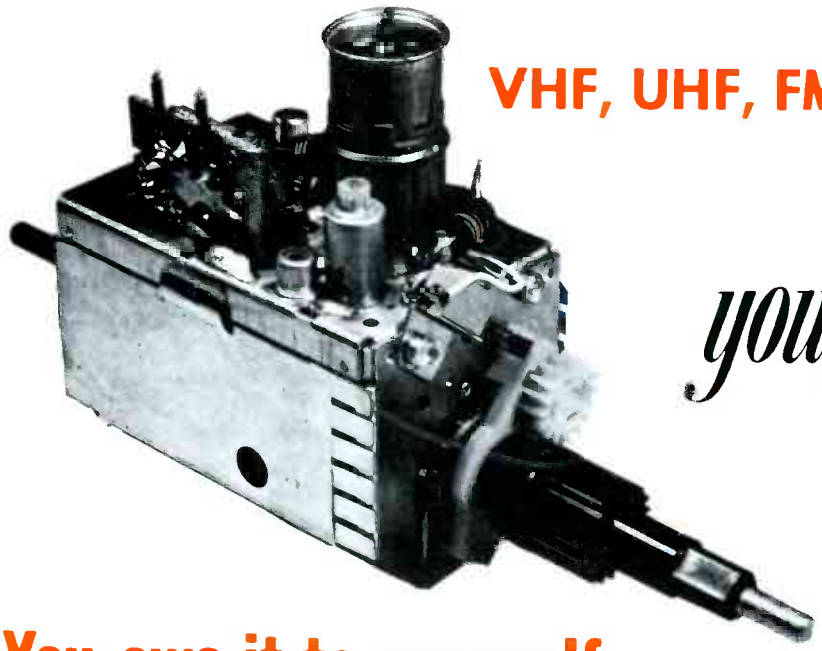
Perhaps you wonder how a negative voltage could be obtained from the positive high-voltage supply.

Look at it this way: visualize R319 connected from terminal DC to ground (see Figure 2). Terminal DC is the low side of the rectifier circuit. When the picture tube has brightness, the resulting electron current flows from terminal DC through the 10K resistor to ground. The excess of electrons at the top end of R319 makes it measure negative. Remember that a larger value resistor would cause a higher voltage drop. Of course, in the complete circuit, terminal DC returns through resistors R122, R320 and R319 to the 15-volt supply.

Now, look at Figure 1 again and imagine that Q302 has been removed from the circuit. Without any picture tube current, no negative voltage is produced at terminal DC. The voltage at the terminal where the base of Q302 belongs is now +15 volts. When the negative voltage at terminal DC rises with the brightness level, the voltage at the base is reduced until, at a CRT current of 1.5 milliamperes, the negative voltage equals the positive and the base voltage becomes zero.

Of course, the base of Q302 normally is in the circuit preventing the base voltage from rising above about +.7 volt. But this little exercise proves the base voltage will go to zero when the picture tube draws 1.5 mills or more.

TV TUNER SERVICE



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A zero base voltage of Q302 stops the conduction of Q302, thus increasing the positive voltage from the brightness control. This reduces the brightness below the point which endangers the picture tube.

The resistance values are chosen so that the brightness is not affected until the CRT current becomes excessive, then the video voltages change the CRT bias to reduce the brightness of the picture.

Troubleshooting the ABL circuit

Two simple tests are usually enough to prove the effect (or lack of effect) of Q302 on the brightness. First, ground the collector. There should be no change of brightness. Any brightness increase proves Q302 is not conducting sufficiently.

Next, ground the base of Q302. Normally, the picture should darken. If the brightness doesn't decrease, Q302 might have a collector/emitter short.

In this case, grounding the collector made no change. But, grounding the base decreased the brightness. Diagnosis: the ABL action is normal, and not the source of the variable height.

ABL and height

At this point, I changed my attention to the vertical sweep circuit (Figure 3), then measured the 15-volt supply and the voltage applied to the height control. No change of the 15 volts occurred at any brightness, but the voltage at the junction of R609 and the height control fell nearly to zero at high brightness. I immediately knew this was important, but didn't see what defect was indicated. It seemed advisable to take a coffee break and think about the symptoms and measurements.

The negative ABL voltage is the only one in the entire machine that changes enough between low and high brightness to be of any consequence. Could there be any wiring connection between the ABL and the vertical? The coffee was forgotten, as I rushed back to the schematic.

After some searching, I found a connection (Figure 4) between the vertical sweep and the ABL at point "B" of PW600. A small sample of the negative voltage from terminal DC of the tripler is channeled through R122 and thermistor RT601 to the height control. Apparently, this is to reduce the height slightly at high brightness where a small reduction of the high voltage would otherwise increase the height.

Hurriedly, I measured the DC voltage at point "B", and found it increased to nearly -200 volts at high brightness. According to ohms law, the voltage should not exceed about -20 volts, so the reading was away out of tolerance.

When I grounded the junction of R122 and R320 (also called point "B"), the height didn't change with the brightness.

Although I didn't realize it at the time, the preceding tests had bracketed the source of the trouble. Grounding the collector and base of Q302 proved the effect of the transistor on the video circuit was normal. And, grounding point "B" to eliminate the changing of height proved the circuit was good back to the tripler.

The only component between those two points was R320. It measured infinity, after it was removed for out-of-circuit testing. Replacing it with the correct type cured the changing of height by the brightness.

Analyzing After The Fact

After the repair was finished, it was clear that the excessively-high negative voltage produced by the open resistor R320 was cancelling (through RT601) most of the positive voltage at the height control. To the vertical sweep, the action was the same as greatly increasing the value of the height control.

This type of problem, resulting from a rare cross-circuit interconnection because of a defective component, underlines the necessity of carefully analyzing the symptoms to reduce the testing time. □

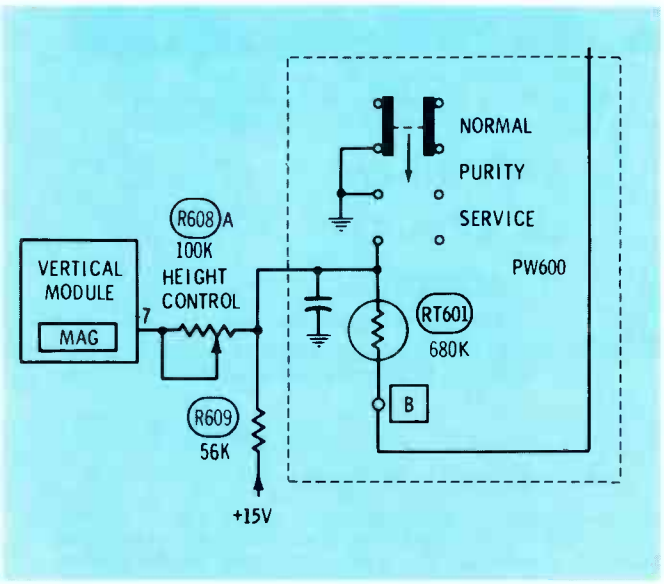


Fig. 3 At high brightness, the DC voltage at the junction of R609 and the height control fell to nearly zero.

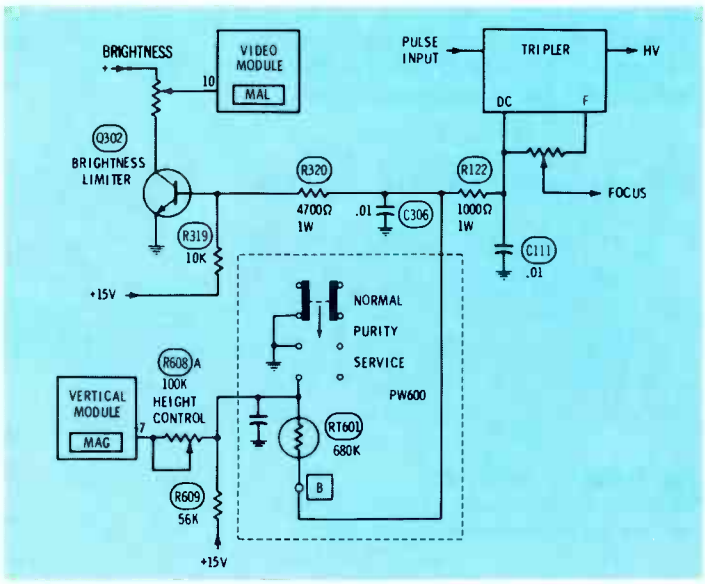


Fig. 4 This combination schematic shows the one connection between the ABL and the vertical-sweep circuits. When R320 opened, the excessively-high negative voltage from R122 was channeled through RT601 and reduced the voltage available to the height control.

Finding the source of noise spots and lines

By Robert L. Goodman

All too often those flashing dots and lines originate from arcs inside the receiver, not from outside interference.

It's easy to look at a TV picture speckled with small black dots, or with vertical lines made of tiny flashes of light and correctly say that it's caused by "interference". But, the question is whether the interference is coming from inside or outside the TV receiver. That's not always easy to answer.

First Analysis

As the first step of analysis, weaken the signal from the station, preferably until some snow can be seen mixed with the picture. If the interference is reduced the same amount as the station signal, it's likely the interference is coming from the neighborhood or some other point outside of the receiver.

On the other hand, a stronger interference when the picture is weaker indicates a defect in the receiver. Some types of noise seem to show more plainly when the set is locked to a station. Others appear to need a carrier to "ride" on.

Of course, if you remove the antenna to eliminate all stations and the interference remains, it's certain the trouble is in the receiver.

Where Should We Look?

The appearance of the interference coming from the chassis often indicates its frequency. In turn, the frequency suggests the circuit hiding the defect. For example, horizontal bands of noise (or dark horizontal bars) have a frequency equal to or higher than that of the 60-Hz vertical scanning rate. Such bars or bands might indicate the vertical sweep or the power supply as a source of the problem.

Vertical bars or lines have a repetition frequency equal to or higher than that of the horizontal-sweep circuit. Vertical lines, when they are motionless, nearly always prove the trouble is in the horizontal-sweep or high-voltage circuits.

Vertical Bars Of Noise

Six vertical bars made up of noise streaks, as shown in Figure 1, nearly obscured the picture. Strength of the bars changed with the picture brightness.

This multiple vertical-bar pattern typically is caused by the ringing waveform that is found between the large horizontal pulses of the sweep waveform. The job is to find out why they are bothering the picture.

Experiences in the past have shown similar bars to have been produced by a defective part in the horizontal-sweep circuit, electrically near the high-voltage rectifier tube.

An arc across R35 (Figure 2) was the cause of these vertical bars. A typical failure is for R35 to be burned or open. R35 might appear to be okay, or it might be swelled from heat. In other cases, the resistor has been so hot it melted a hole through the insulating cup around the HV-rectifier socket.

Sometimes the arc is so severe it causes an intermittent loss of horizontal or vertical locking. The picture produced by a similar problem is shown in Figure 3. In other cases, the receiver must be operated for several minutes before the arcing begins.

Remove the resistor

Both the troubleshooting and the repair can consist of the same step: short across the R35 resistor. If the test shows it to be the source of the arc, remove it and replace it with a

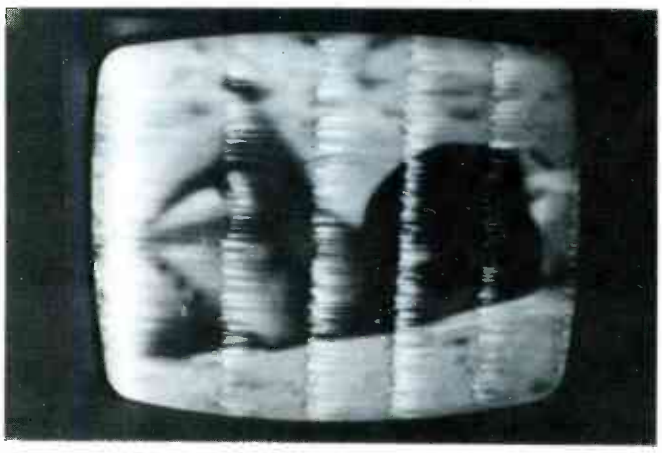


Fig. 1 Vertical bars of noise were caused by arcs across a resistor in series with the high voltage to the picture tube in an older Zenith color TV.

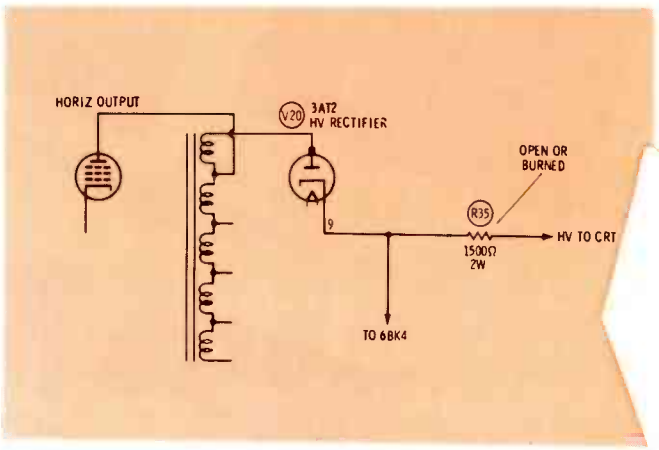


Fig. 2 This partial schematic shows R35, the anti-radiation resistor in Zeniths. These resistors often burn or arc to cause the noise patterns of Figures 1 and 3. Replace a bad resistor with a wire.

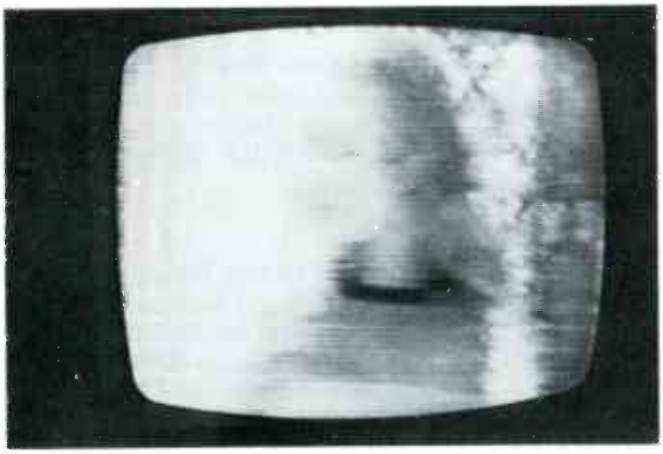


Fig. 3 Another type of noise pattern produced by an arc across R35 of Figure 2.

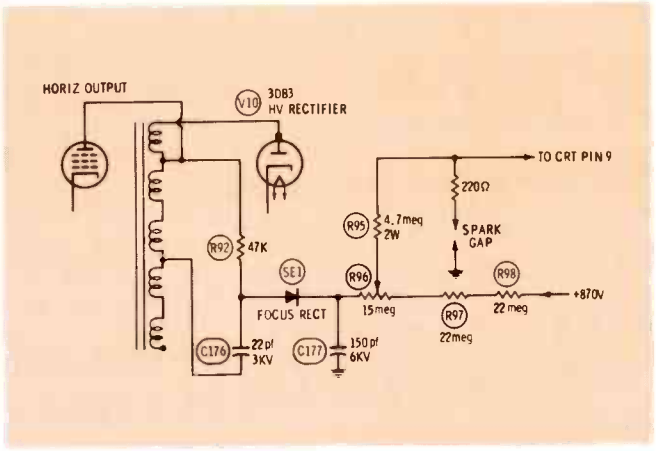


Fig. 4 Several components that might cause arcing are shown here. These include the focus rectifier, the focus control, the focus spark gap and the two 22-megohm bleeder resistors.

Fig. 5 Horizontal bands where the focus is different were caused by a defective focus-rectifier diode, SE1 in Figure 4.

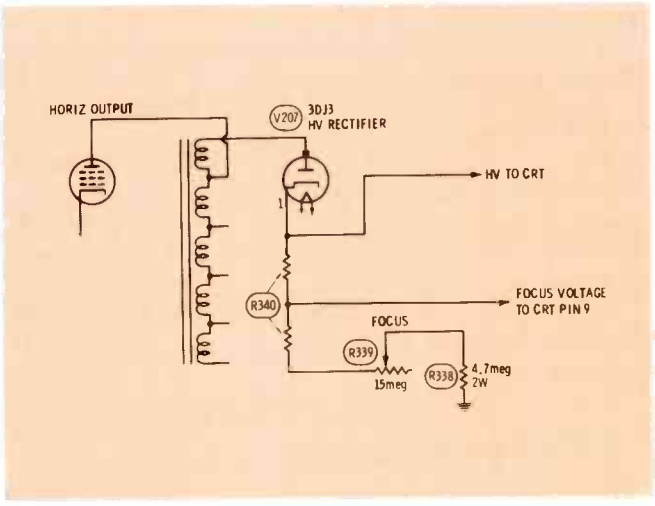


Fig. 6 High-ohmmage focus-bleeder resistors, such as R340, are prone to opens and arcs.

piece of buss wire. Some sets were built without the resistor, so it's a safe repair.

Symptoms Of Bad Focus Rectifiers

Defective "long-stick" focus rectifiers can cause various symptoms. If one partially opens, the focus voltage will be low, and the picture blurred. Or, one might short, reducing the high voltage, and perhaps burning up some of the sweep components. In-between defects might cause intermittent focus or arcing.

In one receiver (schematic in Figure 4), the picture was blurred so the scanning lines could not be seen, and there were many horizontal bars (Figure 5). I listened carefully around the high-voltage cage and the flyback transformer, but could hear no arcs. Prompted more by feelings than by facts, I replaced the focus rectifier. The bars were gone and the scanning lines were sharp.

Another receiver of the same model had varying focus, and several inch-wide vertical lines in the picture. Faint sounds of arcing near the focus rectifier plus the jaggedness of the scanning lines convinced me that the focus rectifier should be replaced. That cured the problem.

If you find the focus diode shorted, always replace R92 (47K/3 watt) resistor (Figure 4) because the overload may have changed its value.

Other sources of arcing are the focus spark gap and the two 22-megohm bleeder resistors. Also, the focus control, R96, can cause a blurred picture having streaks. Don't try to clean the control, just replace it.

Arcs In Divider Resistors

In some focus circuits, the focus voltage is obtained from a specially-built voltage-divider resistor, such as R340 in Figure 6. Internal arcs can cause an out-of-focus picture with many horizontal streaks (Figure 7).

Arcs Around The CRT

The small base sockets used with rectangular picture tubes can cause their share of noise specks and flashes. These arcs occur most often in areas where the humidity is high, and they can be intermittent.

Pin 9, the focus pin, is the most likely offender. Pull off the CRT socket and look for a greenish corrosion inside. If there is a small amount of corrosion, thoroughly clean the tube pin and the socket connection. But, if the plastic is burned, or has a large amount of corrosion, you should replace the entire socket and wiring assembly. This green corrosion can cause horizontal bands where the scanning lines are blurred, and other bands where they are sharp.

One arc that might be very difficult to locate can develop under the plastic pin-alignment cap that fits over the pins. It's not likely you can see the arc, but you might be able to hear it. Remove the pin cap and inspect it. If it shows signs of arcing or corrosion, exchange it by removing one from a dud tube.

The horizontal streaks of Figure 8 were caused by an arc under the plastic pin cap.

Arcs In Tripler

Small dots in a random pattern on the CRT screen (Figure 9) are a common result of defects in tripler or quadrupler HV-rectifier assemblies. Occasionally, arcing can be heard from the box. I use a stethoscope for listening to such sounds. One symptom is that the number and intensity of the dots of noise increase with brightness. Replacement is the only sure cure.

Miscellaneous Arcs

Arcs can occur inside capacitors, resistors, tubes, transformers and solid-state devices. Some examples have been given already.

In one case, involving a Zenith color receiver, the height was not sufficient to fill the screen, the height was erratic, and the vertical locking was intermittent. The erratic height seemed to point away from the high voltage and towards the vertical sweep circuit.

Tests or replacements of most of the capacitors and resistors in the vertical-sweep circuit found none bad. Finally, while I was pressing the stethoscope hard against the core of the vertical output transformer, I heard arcing. Replacement of the transformer cured all the symptoms.

Ground straps and springs around the picture tube are a possible source of arcs that disturb the picture, when they are not grounded properly. Ground each one separately by using a clip lead to find the ungrounded one.

Loose module plug-in connections also can cause white flashes or black erratic streaks across the picture.

Capacitors inside the yoke housing, or ceramic capacitors across the flyback transformer or damper can cause various kinds of arcs. Some of these will occur only at a certain temperature. Temporary replacement of any suspected ones is the most reliable test.

Starting The Arc

One of the problems of finding the source of arcs is that many of them are highly intermittent. Here are some suggestions for prodding them into action.

Use an autoformer to increase the AC line voltage. The higher power supply voltages often trigger the defect.

Misadjust the high-voltage control to produce more high voltage. Caution: don't run the machine too long this way.

Darken the room and visually try to locate the arc.

Alternately warm the ceramic capacitors, then cool them with freeze spray. Some capacitors act up only when the temperature is a certain reading. Don't heat or cool too much or you might overshoot the mark.

Many arcs generate ozone. Let the characteristic odor guide you to the arc.

If you don't have a stethoscope to locate arcs by listening, make a temporary one from a piece of rubber hose or a rolled-up piece of cardboard. The rubber hose helps insulate you against shocks. Don't get too near the high voltage; it jumps!

When all else fails, and the arc can

Fig. 7 Arcs across R340 shown in Figure 6 caused these horizontal streaks.

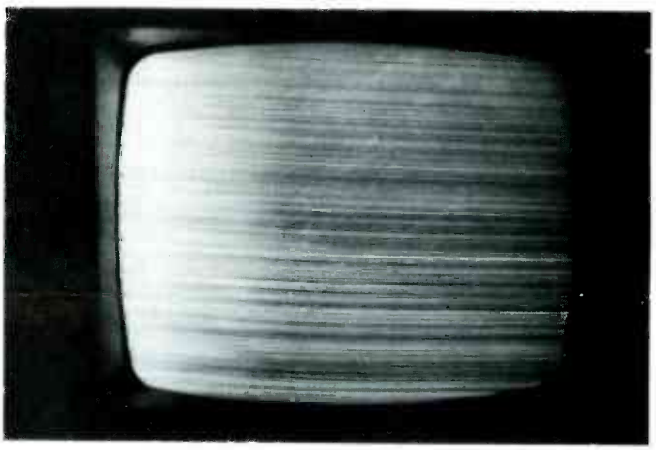


Fig. 8 These violent horizontal noise streaks originated in an arc under the plastic locating-pin cap on the base of the CRT.

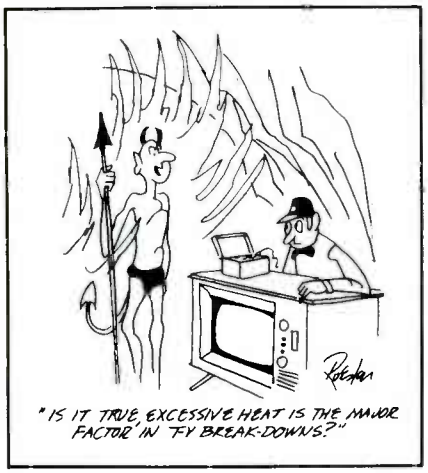
Fig. 9 Random pattern small dots of noise might be produced by defects inside HV tripler or quadrupler rectifiers.

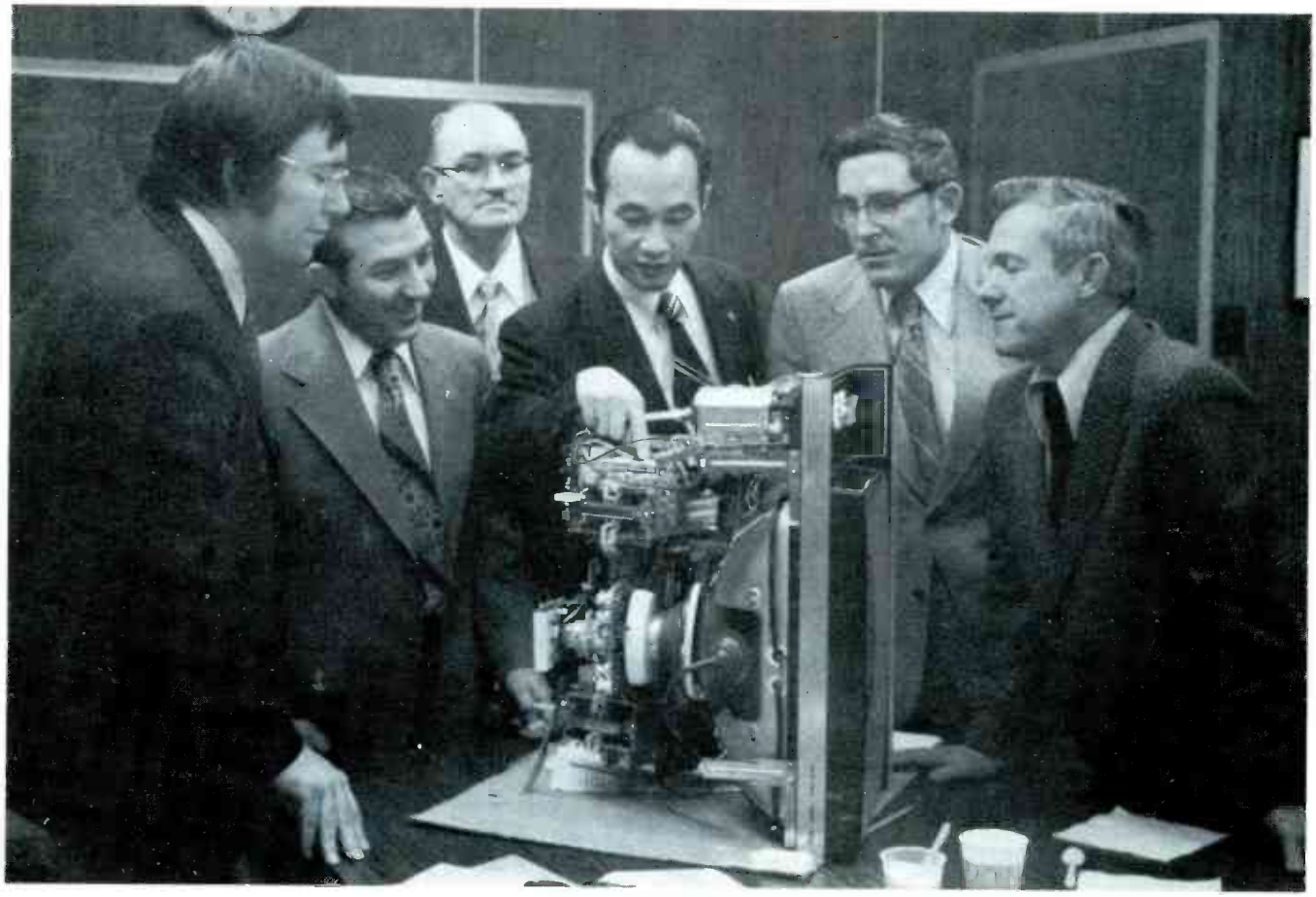
be heard in the sound, disconnect components of the high-voltage system that you suspect, but which kill the high voltage when they are removed. The sounds of the arc heard in the speaker tell you whether or not disconnecting the component stopped the arc.

Most Likely Sources Of Arcs

Here is a list of the circuits and physical locations where arcs are most likely to occur:

- inside the high-voltage rectifier tube;
- a poor connection at the plate of the HV-rectifier tube;
- inside a HV tripler or quadrupler unit;
- inside a flyback transformer;
- from filament leads or socket of the HV-rectifier tube to chassis;
- a broken weld inside the plate cap of a 6BK4-type regulator tube;
- inside a HV regulator tube, damper tube, or output tube;
- across a burned or open resistor in series with the high voltage;
- inside focus rectifiers, focus controls, or bleeder resistors;
- inside horizontal-centering controls;
- across the windings of pincushion-correction transformers;
- across the windings of a vertical-output transformer;
- poor ground for the CRT strap;
- at the CRT socket pin No. 9;
- across spark gaps, perhaps inside the CRT socket;
- from the CRT anode to aquadag because of moisture and dust; or
- inside ceramic capacitors in the HV or horizontal sweep circuit. □





CET's and Panasonic employees examine a Panasonic Model CT-701 color TV during a serviceability inspection. Left to right are shown: Ron Palluth, CET, Poughkeepsie, New York; Dominick Favuzza, Panasonic national service division; Ernest Shannon, CET, Woodside, Delaware; Dale Ishii, Panasonic; John McPherson, CET, Grafton, Virginia; and Lew Edwards, CET, Trenton, New Jersey. Not shown is the committee chairman, Warren Baker, CET, Albany, New York.

News from the

SERVICE ASSOCIATIONS

A Panasonic Model CT-701 color TV receiver (chassis ET-A-1) is the center of attention during an in-plant inspection by a team of CET's before it was given a Serviceability Rating of 94.6 per cent. This was the first serviceability inspection of the new program in which the manufacturer requests an inspection, then ISCET selects a team from their permanent national serviceability committee to perform it.

Before some changes (improved access to service controls, and better identification of parts) were made by Panasonic, the same model was given a rating of 89.8 per cent by a similar team of NEA and NATESA technicians. This shows the value of the serviceability inspections.

Spokesmen for the 400-member Florida Electronics Service Association, Inc. have taken the story of the legitimate shops to the newspapers, with very beneficial results. The Friday, December 29 issue of the Florida Times-Union of Jacksonville contained more than half a page, including two large photographs, of information about the activities of FESA in cooperating with the state shop owner licensing law and local consumer affairs organizations to solve conflict between customers and electronic service shops. In addition to spotlighting the work of the FESA members in attempting to clean up the industry, several suggestions were given to the public about the best ways of selecting a competent service organization. □

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shoptalk

Test transistors by bias-shifting

by Wayne Lemons

Here are the "brass tacks" of bias-shift testing of in-circuit transistors to speed your solid-state servicing.

I have been repairing transistorized circuits, lots of them, for more than a dozen years. But, I still get stumped occasionally. When that happens, I find it helps to go back to one of the basics about transistors. In the action of a circuit, a transistor is merely a variable resistor. After all, the word tran/sistor comes from the words "transfer" and resistor".

Current Versus Voltage

Although transistors are often spoken of as being "current" devices, those currents result in voltage drops. These voltage drops are the ones used more often than the currents in testing transistorized circuits. Almost invariably, there will be a resistor in either the collector or emitter circuit that can be used to show the collector/emitter current by the voltage drop across it, as shown in Fig. 1.

By the use of nothing more complicated than Ohm's law, we can calculate the collector/emitter DC resistance. For example in Figure 1A, the 5-volt drop across the 5K collector resistance indicates a current of 1 milliampere. Then, because the transistor has 6 volts at 1 mill, its resistance is 6K-ohms. In similar manner, the drop across the transistor is also 6 volts in Figure 1B, but the current is higher, so the resistance is found to be 3K. The 4 volts drop across the 1K emitter resistance in Figure 1C indicates a current of 4 milliamperes. And the 4 mills divided into the 8 volts drop of the transistor equals 2K-ohms.

Current Depends On Heat And Bias

Collector/emitter current is determined primarily by the DC bias between base and emitter. Although it's true the hotter the base/emitter junction, the less voltage is required to produce the same collector current.

When the base/emitter bias is zero, or very low, the collector/emitter path has a very-high resistance, similar to a switch in the off position. Therefore, if the voltage across the transistor is the same as it would be with the transistor removed from the circuit (Figure 2), the transistor is either open or cut-off by lack of forward bias.

An excessively-high bias reduces the collector/emitter resistance to just a few ohms. Therefore, readings of nearly zero volts across the transistor (Figure 3) indicate the transistor is shorted, or is saturated by too much forward bias. These preceding statements assume that the resistors are not shorted or off-tolerance.

However, seldom are transistors designed to operate under such extreme conditions in the kind of equipment we work on. Usually, the transistor is biased so the output resistance is of some intermediate value.

A Simple Test Is Needed

If our voltage test across the transistor indicates an abnormal condition, we need a simple, fairly-accurate test to determine whether the bias or the transistor is at fault. That test we call

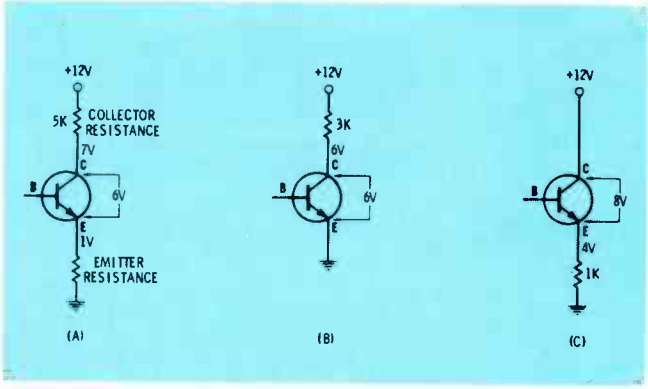

Fig. 1 One of these three DC current paths usually is used in circuits using small transistors. In some cases, the collector resistor will be a decoupling resistor, instead of a load resistor. According to Ohm's law, the transistor resistance is 6K in (A), 3K in (B) and 2K in (C).

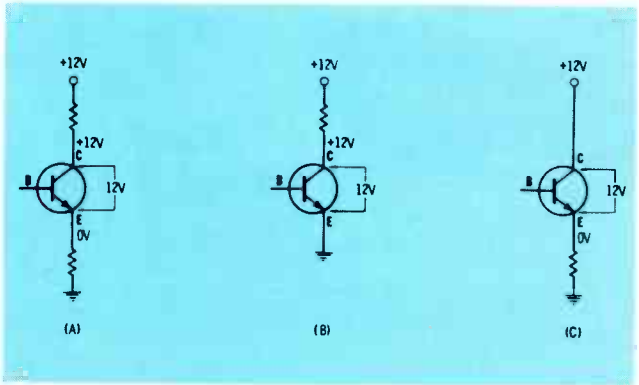

Fig. 2 In each case, the transistor is an open circuit. Is the transistor open, or is the bias insufficient?

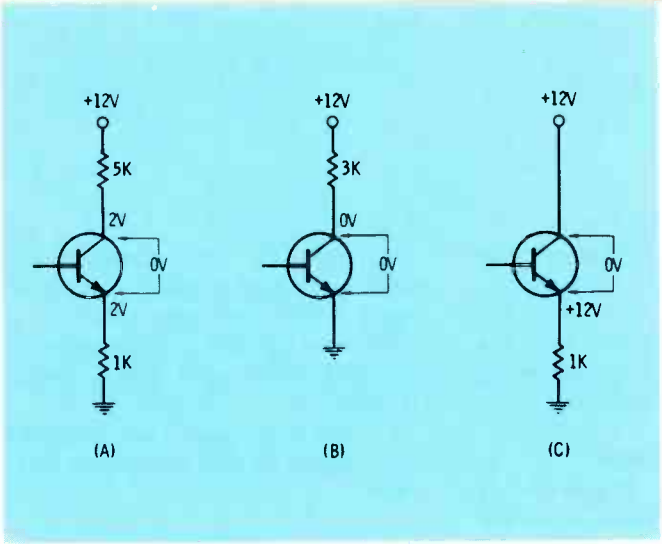

Fig. 3 Now the transistors are a near short circuit. Are they shorted, or is the forward bias excessive?

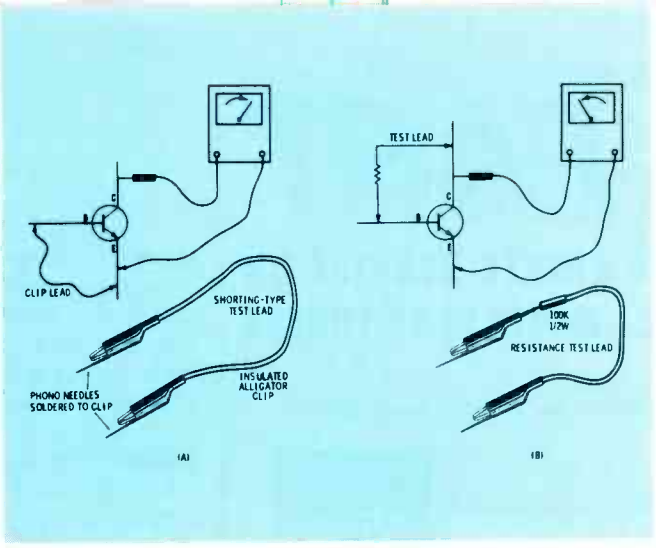

Fig. 4 Make up these two test leads, and you're ready for bias-shift testing.

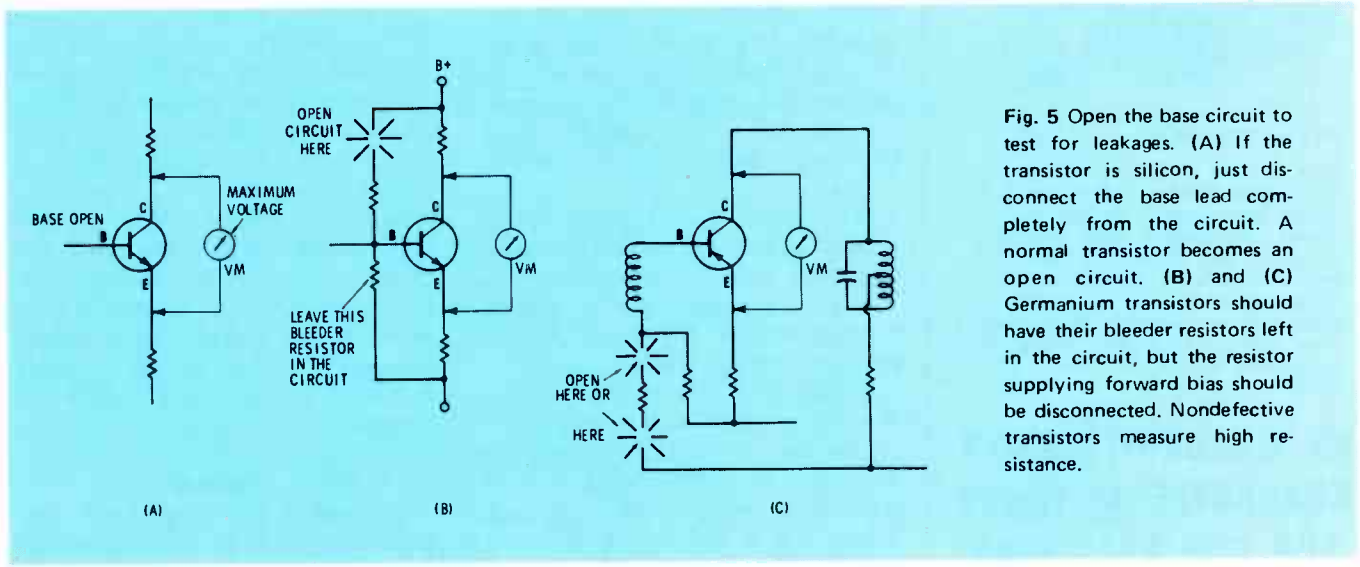

Fig. 5 Open the base circuit to test for leakages. (A) If the transistor is silicon, just disconnect the base lead completely from the circuit. A normal transistor becomes an open circuit. (B) and (C) Germanium transistors should have their bleeder resistors left in the circuit, but the resistor supplying forward bias should be disconnected. Nondefective transistors measure high resistance.

the **bias-shift method**.

No, this method is not new. But, we believe these suggestions will be helpful to you as additions to any you might be using now.

Equipment And Methods

The bias-shift method compels the transistor to change its operation, or show by not changing that it is defective.

Assume the circuit conditions of Figure 2. Obviously, the transistor has no collector/emitter current. Now, we could measure the base/emitter bias, but to obtain any satisfactory kind of accuracy, we would need to know the material of the transistor (germanium about .2 volt or silicon about .7 volt) and then make allowances for the junction temperature. Add to that the requirement for a vast amount of experience in analyzing these bias voltages.

The fast, easy way is to change the bias and notice the results, if any, on the collector/emitter voltage.

Figure 4 shows all the equipment needed: two modified clip leads and a VTVM or FET meter.

The test lead without the resistor is used to short the base to the emitter, thus eliminating the bias. This should turn off the transistor causing a collector/emitter reading equal to the supply voltage. If the voltage drop remains low, the transistor is shorted.

That's half the test. Use the test lead with the resistor for the next check. When the test lead is attached from the collector to the emitter, the forward bias should be increased, and the collector/emitter voltage reading should decrease. If the voltage remains high, the transistor is defective.

Of course, a 100K resistor will change the bias more in some circuits than in others. But even a limited amount of experience will enable you to judge the results.

Leakage Tests

If the transistor is a silicon type, you can check for collector/emitter and collector/base leakage by merely disconnecting the base lead from the circuit (Figure 5A). This can be done in some cases by unsoldering the base wire, or by cutting across the copper foil if that is easier. In either event, no component (even a capacitor) can be left connected.

A normal silicon transistor will show

maximum voltage drop from collector to emitter, because the internal leakage is not sufficient to provide any bias. The lower the voltage drop, the more serious is the leakage, indicating the transistor should be replaced.

Leakage of germanium types

Collector/base leakage of germanium-type transistors is usually enough that a transistor will have moderate conduction when the base is disconnected from all components of the circuit.

For that reason, a slightly different leakage test must be used for germaniums. As shown in Figures 5B and 5C, disconnect the resistor that supplies the forward bias, but leave intact the other resistor which eventually connects to the emitter return.

If the circuit doesn't have a bleeder resistor, add a 6.8K resistor from base to emitter for the duration of the test.

A good transistor will be without forward bias at this point, so the collector/emitter voltage should be very high. Leakage reduces the voltage in proportion to its seriousness.

Note that this type of test will not work for germanium output power transistors, which have such high leakage that a base/emitter resistance of only a few ohms would be required to cut off the current.

Precautions About Bias-Shift Testing

All in-circuit tests, bias shift included, give inconclusive results in a few circuits. For example, if the collector resistance is very high, the addition of the 100K resistor reduces the collector voltage by the voltage-divider principle. Check for this possibility by measuring the collector/emitter voltage while you temporarily attach the 100K resistor from collector to emitter. If this test gives the same reduction of collector/emitter voltage as the base/emitter test, the loading is at fault, and the test will not give an accurate answer.

In other words, connecting the 100K resistor from collector to base of a good circuit should reduce the collector/emitter voltage more than connecting it from collector to emitter.

Although the 100K resistor was selected to give a good average of results when used with small transistors, that size will produce virtually no change when used with a power transistor.

A much lower value, such as 1000 ohms, should be used with power transistors.

Saturation Or Cutoff Circuits

The transistors in some circuits, such as noise cancellers, are normally biased at saturation. Others, such as those used as burst keyers or as oscillators, are at cutoff for most of each cycle. Nevertheless, the bias-shift method usually will prove whether or not the transistor can respond to a change of forward bias. In a simple test, that's all we need to know.

In video-amplifier stages, particularly in color sets, a bias shift also causes a change of picture brightness. Of course, you must be able to see a raster. If so, a change of brightness indicates a change of the transistor resistance, and the meter test is not required.

Warning

Be careful that you don't accidentally short between collector and base, or use the direct test lead for that step. Although it's true most of the circuits have enough resistance to limit the resulting current to safe levels inside that particular transistor, in some direct-coupled circuits (video, for example) the radical change of voltage might be passed on to a power stage which might be damaged by the overvoltage.

Also remember that you are using the receiver voltages to make these bias-shift tests. Make sure the supply voltages are correct.

Summary

In most circuits, transistors are biased so their collector/emitter resistance is some intermediate value. A non-defective transistor will permit bias-shift testing both higher and lower in voltage between the collector and emitter. If the bias-shifting doesn't change the transistor resistance in either one or both directions, the transistor must be defective. □

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For More Details Circle (11) on Reply Card

Living with snow from cable reception

By Bruce Anderson

Little-known, but very real, causes of snow in cable systems and receivers are explained, and some solutions are proposed.

In the early days of TV, one of the common problems was receiver noise in the picture. The slang term for it was "snow". Problems of snow gradually were solved at the manufacturing level by better tuners and better antennas. At the same time the stations increased their Effective Radiated Power (ERP).

Why, then, should we need to consider snow at this late date?

The snow problem has been creeping back for the following reasons:

- Color receivers are inherently more susceptible to noise and snow problems because their bandwidth must be wider than that of b-w sets. Also, colored snow is much more visible than the b-w variety.
- More programs are received from UHF stations, with all the added problems of higher losses in the antenna lead-in and tuners with less gain and more snow compared to VHF.
- Customers are not intrigued by the miracle of obtaining a picture, regardless of quality, and are demanding better reception.
- The proliferation of MATV and CATV systems involving miles of cable and scores of amplifiers introduces potential problems of snow, cross-modulation, sync compression and overload.

As technicians, we have the obli-

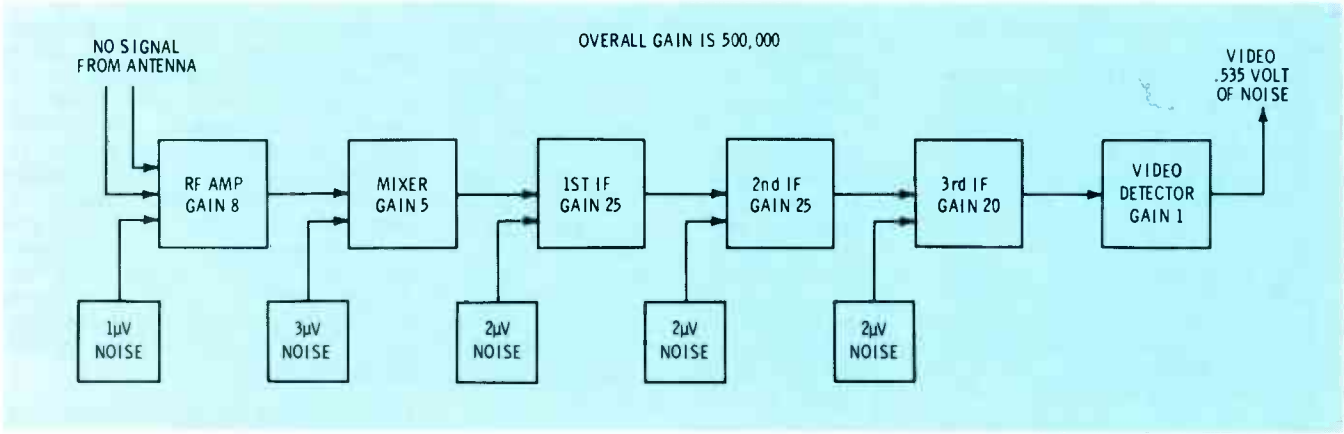


Fig. 1 Without any input signal, a typical tube-equipped TV receiver has a video-detector signal consisting only of snow (noise). The blocks labeled "noise" represent the equivalent noise of the stage.

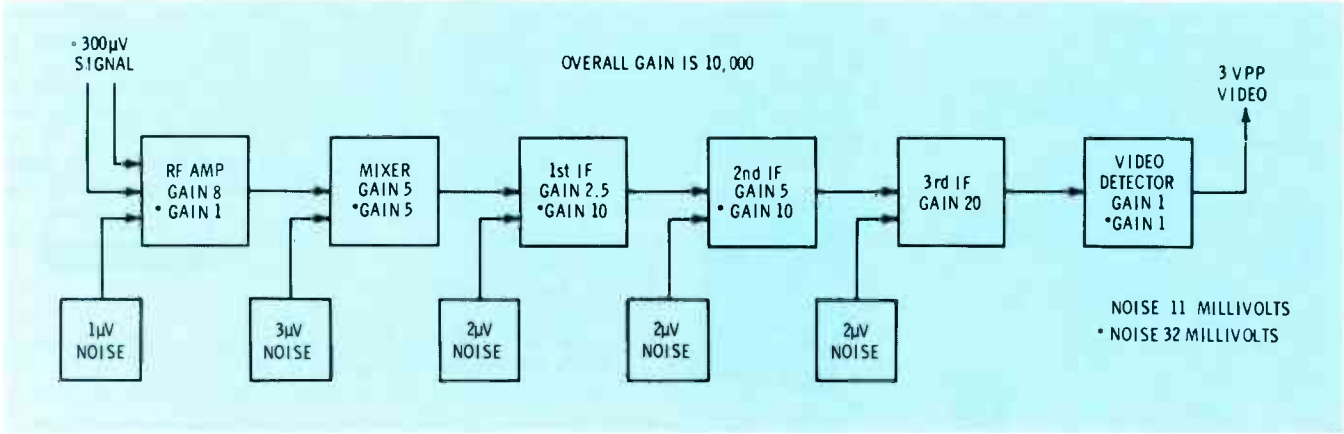


Fig. 2 Snow is minimized if the RF amplifier operates at full gain, and AGC controls the gain of the IF's. More snow is produced when both RF and IF stages operate at reduced gain.

bookreview

Kwik-Fix TV Service Manual
Author: Forest H. Belt
Publisher: TAB Books, Blue Ridge Summit, Pennsylvania
Size: 5-5/8 X 8-3/4 inches, 384 pages.
Price: Paperback $5.95; hardcover $8.95.

The Kwik-Fix system supplies methods needed to repair color TV receivers in short order. Each Kwik-Fix section contains a circuit description, signal flow analysis, station or signal control effects, DC voltage charts (both normal and abnormal) and waveforms – all condensed into easy-to-use, step-by-step trouble-shooting charts that will solve almost any TV trouble in Kwik-Fix time. Color circuits covered include chroma, video, demodulation, sync and AGC, vertical and horizontal oscillators, multivibrators, and output amplifiers; vertical and horizontal blanking; dynamic convergence; high-voltage regulation, focus, video and sound IFs, quadrature detectors, and audio sections. **Contents:** Chroma and Video-Chroma Detection and Demodulation – Sync and AGC – Vertical and Horizontal Sweep – High Voltage – IF and Sound.

Transistor Radio Servicing Course
Author: Wayne Lemons
Publisher: Howard W. Sams & Co., Inc., Indianapolis, Indiana
Size: 8-1/2 X 11 inches, 192 pages.
Price: $6.95 softbound ($8.35 in Canada).

The objective of the book is to bring the beginner to a professional level in servicing transistor radios. At the beginning is a discussion of the basic principles of radio and progresses to an analysis of components. Then a study of the radio receiver by stages is presented. All aspects of operation and servicing of both AM and FM receivers are covered in numerous diagrams. The use of test equipment, how to troubleshoot, and how to remove and replace circuit components are thoroughly explained. Questions, answers, and explanations of answers for each chapter offer supplementary instructional value. □

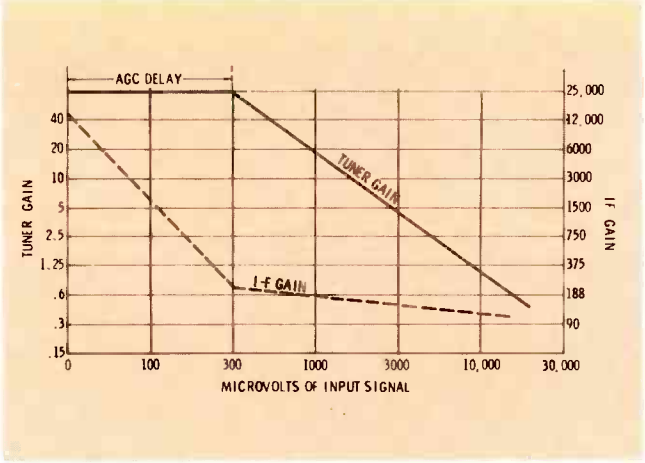


Fig. 3 The best compromise between minimum snow and freedom from overload of the mixer stage is obtained when the RF and IF gains are controlled as shown here.

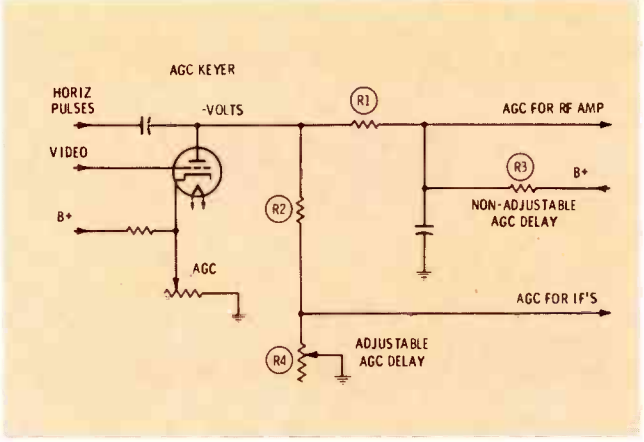


Fig. 4 In most AGC circuits, reducing the AGC to the IF stages increases the AGC to the RF stage. Best reduction of snow on weak signals often can be obtained by tailoring the value of R4 to the largest value not causing overload or sync clipping.

gation to our customers to insure that their receivers perform correctly. In addition, we have a second, more difficult one, of not wasting our time and the client's money trying to improve a picture when it is not possible. To fulfill both these obligations, modern technicians must know the inside facts about television snow.

Characteristics Of TV Snow

One common misconception is that a snowy picture is caused by low gain of the tuner or the picture IF's. In reality, such insufficient gain would only reduce the contrast. If the receiver hasn't enough output to drive the picture tube, there will be less snow, not more. The origin of the wrong idea probably comes from the true fact that a weak RF amplifier tube produces a snowy picture. But this is a special case; the snow results, not from insufficient overall gain, but from the wrong **distribution** of the gain between the RF and IF amplifiers.

Video amplifiers and the picture tube contribute only a negligible amount of snow, so their operation will be ignored.

Receiver gain versus noise

Manufacturers usually design their receivers so about 30 microvolts of input signal at the antenna terminals will produce the desired output from the video detector (say 3 volts p-p). This is an overall gain of 100,000. To provide some reserve to accommodate tube aging and other slow reductions of gain, the maximum gain is usually designed to be about 500,000. This is called the "no-signal" gain.

Even with the antenna removed and the terminals of the receiver shorted together, there is considerable signal at the detector, and noticeable snow on the raster. Obviously, this signal originates in the receiver, and it can be represented symbolically as a noise signal injected into each stage, as shown in Figure 1.

Because the RF amplifier is the first tube, the signal-to-noise ratio of this stage is the most critical of all. That's the reason the lowest noise equivalent has been designed for the RF amplifier. Notice that the mixer is the noisiest of all. It's the nature of mixers to be noisy.

There is a long story connected with the .535 volt p-p detector voltage. I'll spare you the mathematics, but the computation involves allowances for the random nature of noise.

Because the output from the RF amplifier is amplified by all of the remaining stages, it produces .5 volt of the total .535 detector volts. Contrast this with the output noise of only 40 microvolts supplied by the third IF amplifier stage.

Signal-to-noise ratio (SNR)

In actual television reception, the amplitude of the noise present is not nearly so important as the ratio of the signal to the noise. Most viewers are said to find the SNR acceptable if the signal is 100 times greater than the noise. However, a so-called "perfect" picture requires a SNR of 300.

The block diagram of Figure 2 shows the gain and signal figures for the same 300-microvolt input signal, and with the same overall gain of 10,000. The differences are in the gain per stage and the signal-to-noise ratio. Gain figures at the top are those when the RF amplifier had full gain, and the IF gain was reduced; the output video had 11 millivolts of noise. Gain figures marked * are those with the gain of the RF amplifier reduced, and the IF amplifiers operating with partial gain. The video output signal had 32 millivolts of noise; nearly three times the noise of the other AGC condition.

A Trade-Off: Snow Versus Overload

The preceding discussion proves that a less-snowy picture would be obtained if the RF-amplifier stage operated always with maximum gain. Unfortunately, in the areas having strong signals this is impossible because the mixer stage overloads. Overload causes intermodulation and cross-modulation distortion and cannot be tolerated.

Therefore, gain reduction of the RF stage MUST occur when the amplitude of the station signal exceeds a certain point. Where the designing engineer must tip-toe a narrow line is in deciding at which signal strength this AGC-controlled gain reduction should begin.

Figure 3 shows the best compromise between minimum snow and safety from overload at different signal levels. Of course, the chart is just for information; it's not expected you would measure everything.

The AGC delay mentioned on the chart is not a time delay, but a delay of application of the AGC voltage to the tuner until after the IF AGC has reached the practical limit of the gain reduction, and until there is danger of overloading the mixer stage of the tuner.

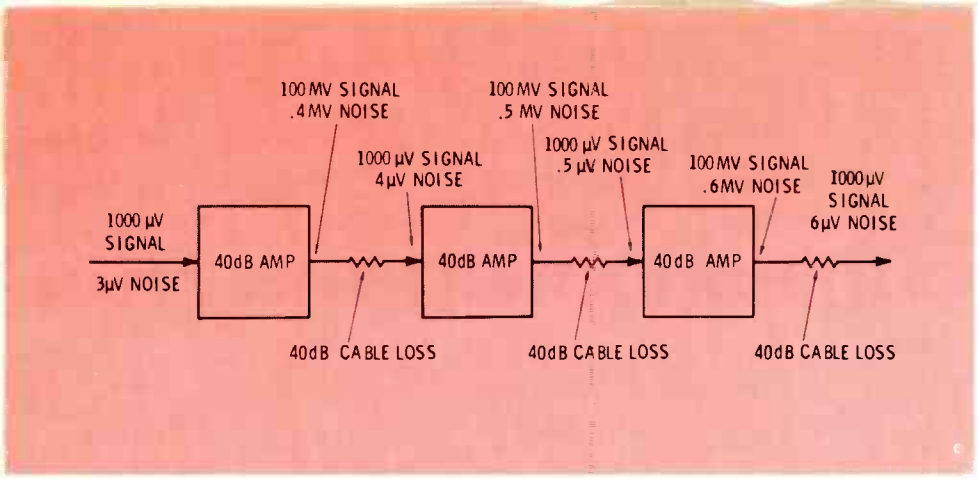


Fig. 5 An illustration of how snow can increase in a CATV system even though the signal never drops below 1000 microvolts, which is considered to be the ideal signal strength.

Reducing The Snow

For several reasons, receivers with tube-equipped tuner and IF stages are less susceptible to overload. Therefore, most have only one AGC control. An adjustable AGC delay control is included in the example of Figure 4, although tube sets just have a fixed resistor.

Strangely enough, varying the value of R4 (the AGC delay control) doesn't change the negative voltage applied to the IF's, but changes the RF AGC voltage! Seems ridiculous, because the control and R2 obviously function as a voltage divider to reduce the IF AGC voltage. Both statements are true.

Think of it this way: the AGC system changes the negative voltage at the plate of the AGC keyer tube in an attempt to maintain a constant video level at the video detector. If the AGC voltage to the IF's is reduced by adjustment of R4, more negative voltage is generated at the plate of the keyer. Therefore, the positive voltage coming through R3 is more than cancelled, and the AGC for the RF tube becomes more negative, reducing the gain. **The AGC voltages to the IF and RF stages have been changed, but the overall gain is the same.**

It should be clear now why a defect (such as a gassy 1st-IF tube) that reduces the AGC voltage to the IF's often produces a snowy picture as the main symptom. It explains also why some controls that vary the IF AGC voltage in solid-state receivers are called "noise" controls.

Manufacturers must design for average signal-strength conditions. This is understandable. However, in your area all the stations might be very strong. Or they might all be very weak. In the latter case, a modification increasing the AGC to the IF's might reduce the snow. If the receiver has tubes, just use a resistor-substitution box to find the largest value that paralleled across R4 of Figure 4 produces a minimum amount of snow. Solid-state circuits, because of the many variations, require more individual study to determine the best way to reduce the RF AGC .

Overload

A moderate overload from excessive signal will produce a grainy-looking picture which easily might be mistaken for snow. Although experience will help us determine at a glance whether the signal is too weak or too strong, the best proof is to try a variable attenuator between the antenna lead-in and the receiver.

Stations And Snow

Before this point, we have assumed that the signal at the station was without noise (snow). In practice, no station signal is ever completely free of noise, because video cameras, VTR's and film chains contribute a certain amount of noise. It is unlikely that the signal-to-noise ratio at the transmitting antenna will ever exceed 50 dB (316:1 voltage ratio). Stated another way, a transmitter emitting 100 kilowatts of video power will at the same time be transmitting about one watt of noise.

CATV and Snow

Cable TV can add snow in two ways: because of too little signal; or from the total snow produced by the many amplifiers.

Signal attenuation

In free space, TV signal voltages obey the inverse square law. That is, a signal at twice the distance from the transmitter is only one-fourth as strong. In contrast, the lowest-loss coax attenuates a Channel-13 signal to one-half the voltage every 600 feet. Of course, the losses at lower frequencies are much less.

Because of the high losses in cable, it is necessary to boost the signal with amplifiers at frequent intervals. This leads to another problem: Each time the signal is amplified, a small amount of noise is added (Figure 5). Even though each amplifier has low noise, the total snow added by twenty or thirty amplifiers can be considerable.

Often there is no longer any "comfortable margin" in the SNR to allow for any receiver noise. Increasing the signal output from the cable system can do little to help the situation, and it might make it worse.

Recognizing Cable Noise

A signal-strength meter is not suitable for determinimg the amount of snow in a cable system. Although this sounds like heresy, it does NOT imply that a field-strength meter is not necessary. A meter will tell when there is sufficient signal; it cannot measure the amount of noise present.

Monitor receiver

A small portable receiver, usually black-and-white, often is used for testing cable systems. Unfortunately, the results can be very misleading. Any picture looks more snow-free on a small screen, and also appears less snowy in b-w than in color. A signal which looks slightly snowy on the small screen of a test receiver might appear **very** snowy on a 25-inch color set.

Obviously, no one is going to drag a large-screen color receiver about the countryside to check signals for snow. There are two easier ways.

One way is to check with the neighbors. Quality of the pictures in the same one-block area should be the same.

Secondly, "normalize" the b-w set you use for checking signal quality. This isn't difficult: simply add an attenuator between the antenna terminals and the tuner of the portable receiver. The reduced signal will make the picture equal in visual snow to that of large-screen color sets. □

Troubleshooting the *RCA*

By Bob Jones

Save your servicing time by first understanding how each suspected circuit operates, then use logical reasoning before making tests with instruments.

The era when hybrid-type color receivers dominated the sales figures is drawing rapidly to a close. Soon the majority of sets will have all-solid-state chassis.

But there are millions of these transistor/tube hybrids which for many years will require repairs. To help you efficiently service these sets, we are going to discuss some unusual or recurrent troubles of the RCA CTC38 chassis (the CTC39 is the same with automatic tint circuitry added). One reason we selected this model is that it has been sold in large quantities for nearly five years. In fact, there's a possibility it might be number 1 in total sales volume.

Of course, many of these methods of troubleshooting the CTC38 also can be applied to other models.

SYMPTOM: Contrast Changes With Warmup

When the set was first turned on, the contrast was normal, and the horizontal locked okay. Gradually, the picture contrast increased, but without any large change of brightness. Then, perhaps 30 minutes later, the picture began to bend and finally lost horizontal locking.

Notice that these symptoms are not the traditional ones caused by defects in the AGC or video circuits. AGC troubles, which in other sets increase the contrast, also darken the picture. Video defects can affect the contrast, but ordinarily they change the brightness and picture sharpness more than is the case here.

Background information

Most AGC circuits vary the grid/cathode bias of the AGC-keying tube to set the desired amount of AGC gain reduction. But, as shown in Figure 1, the bias of the 2nd video-amplifier tube is varied in the CTC38. Two separate actions take place. One increases the brightness, but without changing the contrast, while the other decreases the brightness and increases

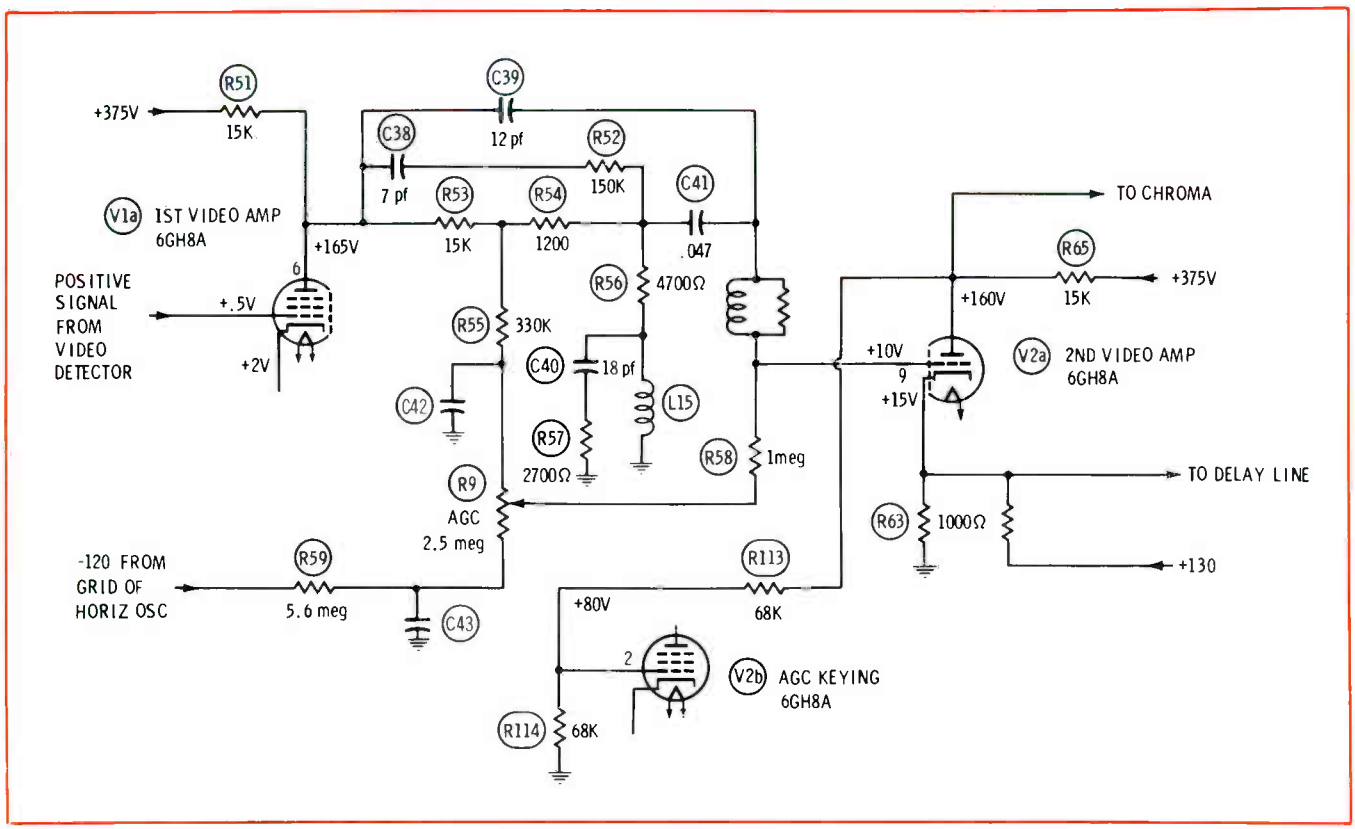


Fig. 1 A partial schematic of the 1st and 2nd video amplifier stages of the RCA CTC38 chassis.

CTC38 chassis

the contrast. Here's what happens.

Assume that adjustment of the AGC control makes the grid of V2A (the 2nd video-amplifier tube) more positive. The DC cathode voltage rises slightly (it's part of a voltage divider so it doesn't change much), which increases the picture brightness. But the video there changes very little because the circuit is a cathode follower. At the plate, the DC voltage goes down, but the amplitude of the negative-going video (used for AGC, not for the picture) increases as the result of the decreased grid bias.

Secondly, the plate signal of V2A is coupled to the grid of V2B (the AGC-keyer tube), where the grid voltage is decreased both by the lower DC plate

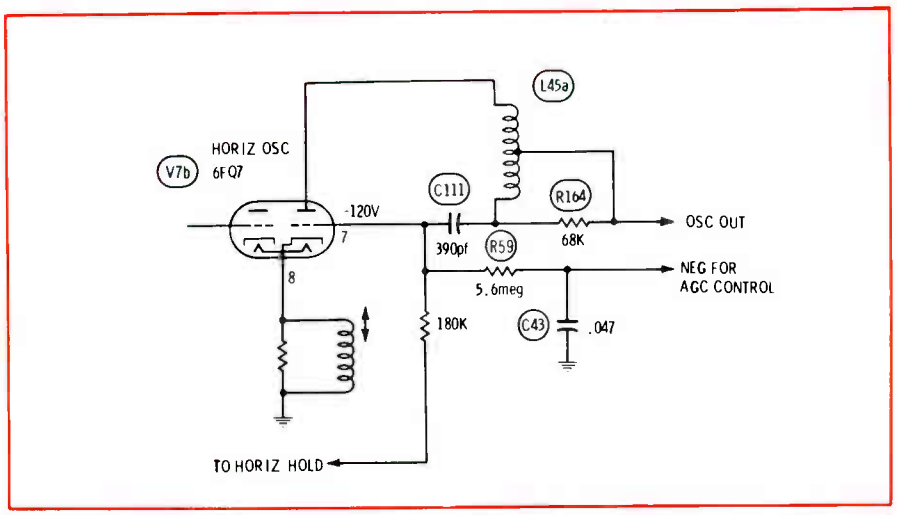


Fig. 3 Negative DC voltage for the AGC control is obtained from the grid circuit of the horizontal oscillator tube in the CTC38.

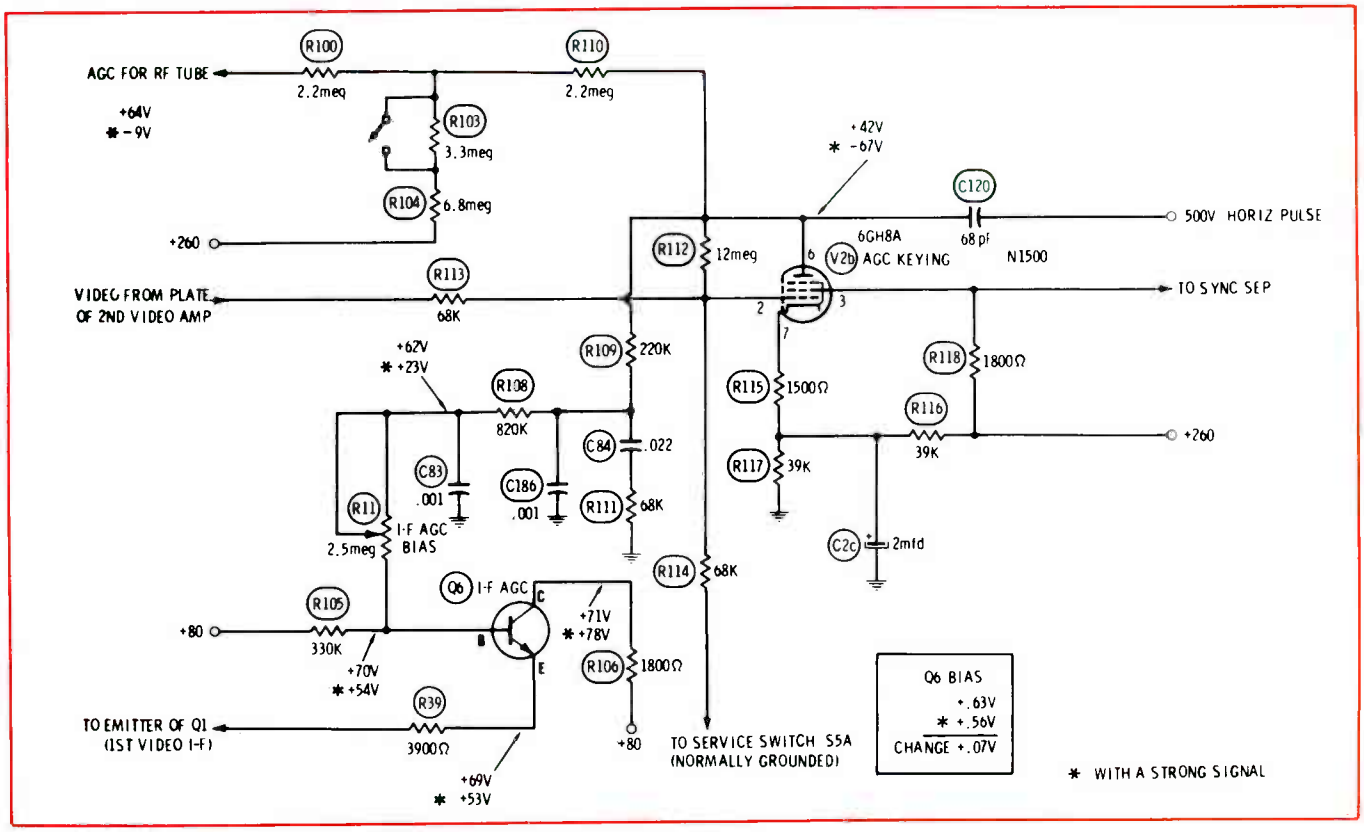


Fig. 2 Both a tube and a transistor are used in the CTC38 AGC system. Q6 is used to match the high impedance of the tube-type AGC keyer to the low impedance of the transistorized IF circuit.

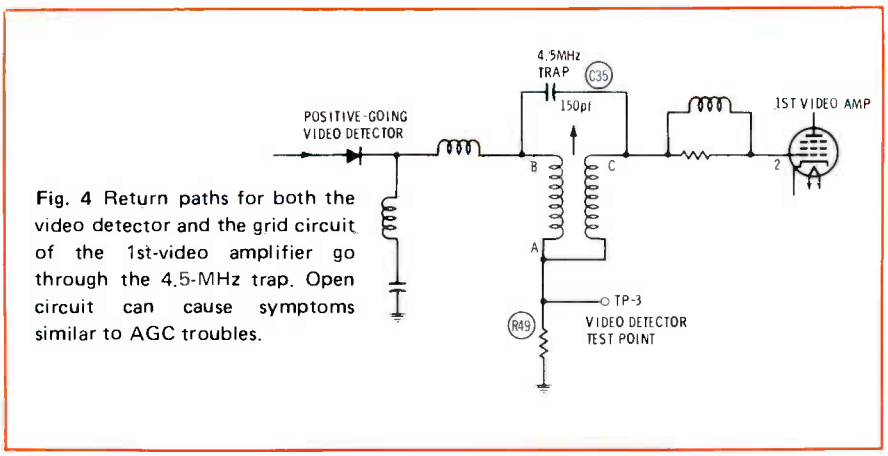


Fig. 4 Return paths for both the video detector and the grid circuit of the 1st-video amplifier go through the 4.5-MHz trap. Open circuit can cause symptoms similar to AGC troubles.

voltage and the larger negative-going video signal (Figure 2). This reduction of grid voltage decreases the amount of AGC, which in turn increases the detector video signal, the negative-going signal at the plate of V1A, and the contrast of the picture. Also, the portion of the less-positive V1A plate voltage that is coupled to the grid of V2A swings the grid down nearer the original DC voltage. The net result of all this closed-loop activity is increased contrast with very little change of brightness.

Adjusting the CTC38 AGC

Because of the different visual symptoms obtained by adjustment of the AGC control in the CTC38, and because IF transistors are more difficult to control by AGC, as well as being more prone to overload than tubes are, RCA has specified an unusual method of adjusting the AGC.

Connect the low-capacitance probe of a calibrated scope to the plate (pin 1) of V2A, tune in a strong station signal, and adjust the AGC control for 100 volts p-p. That's all. However, if you make allowances for the loading effect, you also can use the AC p-p function of a VTVM or FET-meter. Adjust the AGC control for about a 90-volt reading on the meter.

Troubleshooting contrast changes

We now have the specialized information necessary to find the cause of the increasing contrast. The first step is to determine whether the drifting condition originates in the AGC, the IF section, or in the video-amplifier stages. Because these stages constitute a closed loop, the loop must be broken and the two halves tested separately.

Conventional negative-voltage AGC is applied to the Nuvistor RF tube, while an emitter follower (Q6 of Figure 2) functions as an impedance-matching interface between the AGC-keying tube and the transistorized IF system.

Never apply a substitute AGC voltage directly to the emitter of Q1, the 1st-IF transistor, because a voltage change of only about .05 volts out of the approximately +40 volts there can vary the gain of the transistor from maximum to nearly cutoff. Connecting to the other side of R39 at the emitter of Q6 is slightly better, but is not recommended because of the possibility that damaging currents might flow through Q6 at certain bias voltages.

The best point to connect the AGC-clamping voltage obtained from an external bias supply is the base of Q6. It's not necessary to disconnect anything. Voltages of +54 to +56 usually are about right, although it's recommended you vary the voltage to that giving 3 volts p-p of signal at the video detector. Also, ground the RF AGC voltage at the tuner.

Immediately after turning on the receiver, connect the AGC bias supply and adjust it for a normal-contrast picture as soon as a raster is obtained. Also, measure the p-p video signals at the video detector, the plate of V1A, the plate of V2A, and the cathode of V2A. It's best to write down these voltages.

Then run the chassis on a time test for 30 minutes or so. Measure the temporary AGC bias both at the beginning and ending of the test period to make sure it has not changed and given a false symptom.

If there is no change of contrast during the clamping test, it's certain the AGC system is faulty. Test it by retaining the clamping while you heat-cycle the set and notice any change of the AC or DC voltages around the AGC keyer and Q6.

On the other hand, if the contrast changes when the AGC is clamped, the AGC is okay, and the finger of suspicion must point toward the video IF's or the video stages. This is the time to use those p-p readings recorded earlier. An increase of video waveform amplitude at the video detector indicates a defect in the IF's. A steady amplitude at the grid and an increased amplitude of signal at the plate of a stage brackets the problem between those two points.

Typical parts failures

The parts most likely to cause a gradual increase of contrast are C39 and C41 (Figure 1), if they are leaky, or a gassy V2A. It's recommended you replace both capacitors at the same time, because leakage tests often are not sensitive enough to provide positive proof.

Symptoms of changing contrast identical to those previously described can be caused by defects of the parts that supply negative voltage (borrowed from the grid of the horizontal oscillator) to one end of the AGC control (see Figure 3). Check for a leaky C43 or an R59 that has increased in value.

SYMPTOM: Critical AGC Adjustment

Adjustment of the AGC control brought in a station with normal contrast and locking. However, the range of adjustment was very narrow; overload or insufficient contrast resulted from almost microscopic movements of the control. Also, if the performance was right for one channel, the next station selected would have contrast or locking problems. An AGC defect was the first suspect.

Clamping the AGC

Clamping the AGC as described previously didn't help the stability of the signal. Adjustments of the AGC-clamping voltage were very critical and gave a "rubbery" response with overshoot.

This test cleared the AGC of suspicion, so the next logical step was to trace the video-detector and video-amplifier stages using a scope. At the input of the 4.5-MHz trap (terminal "B" in Figure 4), the video waveform was nearly normal. But the amplitude of the waveform was greatly attenuated at the grid of the 1st-video amplifier tube.

An open in the trap at terminal "C" was found during subsequent testing with an ohmmeter.

If you wonder why the picture quality was not degraded enough to become a prime symptom, the video was coupled through the 150-pf capacitor (C35 which parallels the trap) into the infinite impedance of the open grid circuit. The grid circuit was left floating, and this contributed to the erratic response to AGC-control adjustments and changes of signal strength.

SYMPTOM: Noisy Sound

When the AFT was switched on, the sound had a raspy quality and some sync buzz. Manual adjustments of the fine tuning made in either direction from the correct fine-tuning point eliminated the symptoms and gave good reception.

Background information

Quadrature-grid sound detectors of this type (Figure 5) appear to operate in one of three possible modes. When the 4.5-MHz signal at the control grid of the 6HZ6 is very strong, the operation is typical of quad detectors. The sound is good with virtually no buzz, noise or distortion.

If the sound-IF signal is only moderate in amplitude, the stage self-oscillates, and the IF signal (acting as sync) locks the frequency of the oscillation. Volume of the detected sound is the same as if the sound-IF signal were very strong, because the oscillation **becomes** the signal, and its amplitude is nearly constant. This gives very good limiting, but occasional buzzes or rasps might be heard if the signal is slightly weak.

When the amplitude of the sound-IF signal is too weak to lock the oscillation, large amounts of noise, buzz and a peculiar swishing noise can be heard. This kind of sound quality is not acceptable.

Next, remember that the amplitude of the sound-IF signal normally is at a minimum in this model when the color is correctly tuned. The 41.25-MHz sound trap at the input of the 1st-video IF stage is included for that purpose.

At this point, many technicians might leap to the conclusion that the weak sound **must** be caused by poor alignment of the video-IF stages. That's just not the case! Unless the adjustments have been "diddled" beyond belief, and there is AGC overload, poor video-IF alignment (in-

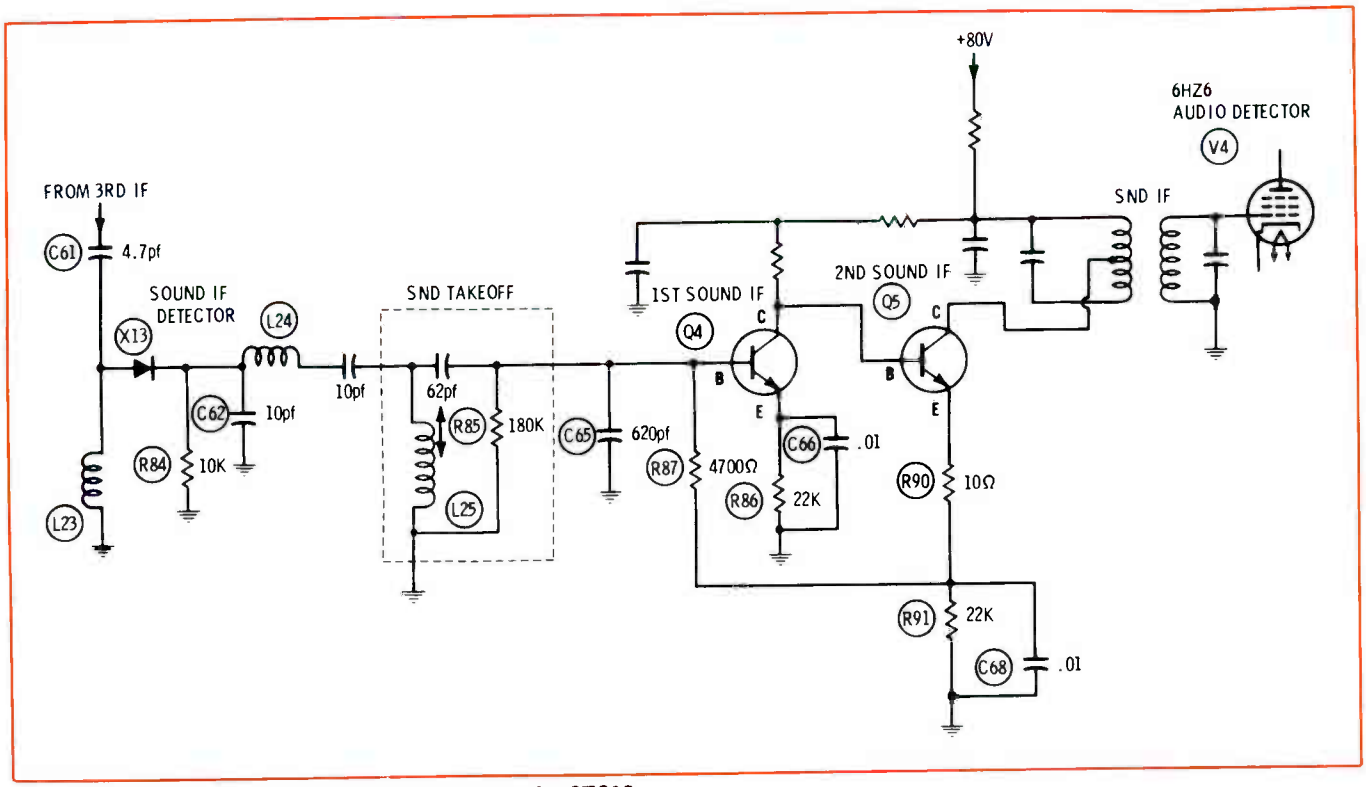


Fig. 5 A partial schematic of the sound circuit of the RCA CTC38.
A weak signal at the control grid of the 6HZ6 causes noisy sound, but not weak volume.

cluding traps) will not cause such a sound problem. Additionally, the sharp, normal color without beat patterns was evidence the video-IF alignment was okay.

Conclusion

Misalignment of the sound IF transformers, or a defect which reduces the gain in those stages would cause the symptoms.

Testing the sound IF's

DC voltage analysis should always be the first step of troubleshooting sound-IF stages. In this case, the emitter voltage of Q5 was too high (also the base voltage of Q4), and the emitter voltage of Q4 was zero indicating an open element in Q4, 1st sound-IF transistor.

Other defective components, such as an open L23 or L24 RF chokes, or defective X13 diodes, also can make a very-accurate adjustment of the fine tuning necessary in order to obtain good sound quality.

SYMPTOM: Excessive Color And Poor Locking

The color saturation was excessive and the color sometimes jumped out of lock when the tint control was adjusted to one end of its rotation. Both the b-w picture quality and the gray-scale tracking were okay.

Background information

The CTC38 chassis uses a sync-injection-locked color oscillator in which the burst (see Figure 6) of about 90-volts p-p is injected through the quartz crystal into the grid circuit of the oscillator. One side-effect of this injection is an increase of the negative grid voltage. Typical voltages are -3.5 without any signal output from the burst amplifier, -5 volts with off-channel snow, to about -7 volts with burst of normal amplitude. What's more, this voltage changes with any variation of the burst amplitude, and is used, therefore, to control the ACC and color killer circuits.

Killer control operation

Operation of the color-killer circuit is easy to understand, if we visualize the killer transistor, Q8, as a variable resistor which changes the DC output of one of the two voltage dividers. The first voltage divider (R207 and R206) reduces the -80 volts (borrowed from the grid circuit of the horizontal blanker tube) by a factor of about 10-to-1. R205 and the collector/emitter resistance of Q8 make up the second voltage divider. The ACC voltage is the sum of fixed negative voltage and the variable positive voltage.

When an increased negative voltage caused by increased amplitude of burst at the grid of the oscillator is applied to the emitter of Q8 (NPN), the effect is the same as a more-positive voltage at the base. That is, the collector/emitter resistance decreases, thus reducing the positive source of the ACC voltage.

This makes the ACC voltage more negative and it reduces the gain of the color-bandpass tube. Also, the amplitude of the burst is reduced because it too is obtained from the output of transformer L30. Less burst amplitude reduces the amount of negative voltage at the grid of the oscillator, thus bringing the ACC action around the closed loop back to the starting point.

Typical ACC voltages range from +5 volts with no signal or a b-w program, to about zero for weak color burst, or as high as -7 volts when a strong color-bar pattern is used. From this wide range of ACC voltages, you can correctly assume that the ACC, when normally operating, is quite effective in maintaining a constant amplitude of burst. Color saturation is also maintained at a constant level when the stations keep the same ratio of burst-to-chroma level.

On the other hand, any defects that abnormally affect the amplitude of the burst will change the color saturation in the opposite way.

Troubleshooting color saturation and burst

To find the source of problems of color saturation and burst amplitude, you should use a color-bar pattern and a scope.

In this case, the scope measurements revealed an abnormally-strong color-bar waveform at the top of the color control, but a very-low amplitude of chroma signal at the grid of the burst keyer, V16. Because both of these signals come from the same tapped-secondary winding of L30, the problem had to originate somewhere between L30 and the grid of V16. A very weak signal was found at both ends of C141, so a defect in L30 seemed likely. It was no surprise to find by use of an ohmmeter that the secondary winding was open at terminal "E".

Of course, a loss of the positive-going keying pulses at the grid of the burst-amplifier tube, a defective resistor or capacitor at the cathode of the burst tube, a dead burst-amplifier tube, or shorted turns in L34 all could have produced the same symptoms by eliminating the burst before it arrived at the oscillator.

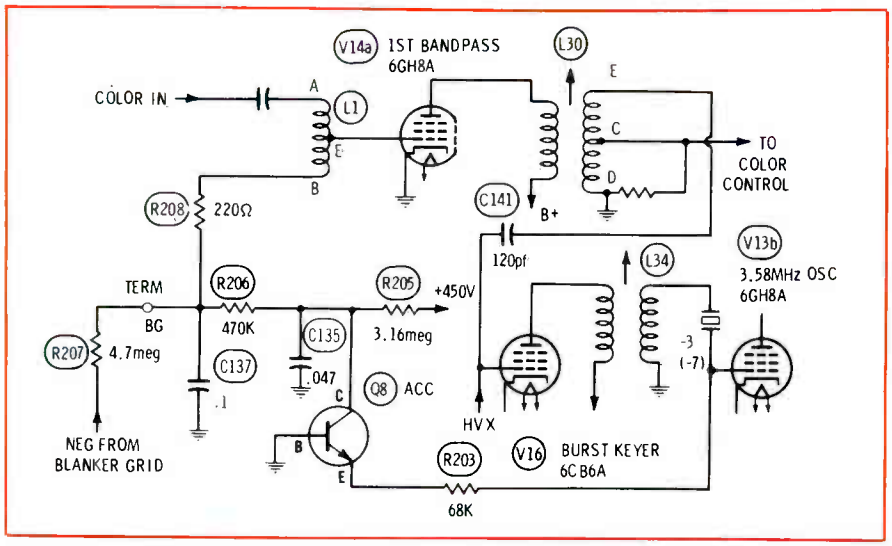


Fig. 6 A partial schematic of the CTC38 chroma circuit showing the closed-loop ACC path. Some defects affect both color saturation and locking, while others might cause locking or saturation problems.

Other symptoms and cures

Excessive color saturation, but with normal color locking will be produced if:

- R208, R207 or Q8 opens;
- C137 shorts; or
- R203 opens.

On the other hand, insufficient color gain will be the symptom if:

- R206, R205 or C137 opens, or
- Q8 shorts between collector and emitter.

SUMMARY

As you probably have guessed by now, I am strongly in favor of understanding the functions of most of the unique circuits in each color receiver I service. Next, I notice and analyze all of the symptoms before making any instrument tests. This method usually takes me to the general area where the problem originates, and it is necessary to make only a few measurements to pinpoint the bad part.

Remember the words of that great Supertech who said: "Son, they're never dogs, if you can fix them!" □

(Continued from page 21)

visitor before activating the buzzer to unlock the door.

Multiple-Function Systems

Most security systems incorporate more than a perimeter loop, a radar motion-detector, or an infrared light beam. In fact, often all three basic types are used in one installation. Each type has advantages as well as disadvantages. Therefore, the individual security system should be tailored for the needs of the location.

In addition, it is a simple matter to add sensors to detect excessive heat, low temperatures, smoke, water or high humidity. The value of the security installation is greatly enhanced at low extra cost by the addition of the sensors to detect fire and other damage.

Sensors Alert People

With the possible exception of automatic-sprinkler systems for fire control, the sensors of a security system have one ultimate aim: to alert a person or persons that an emergency is happening.

The bell or siren of a simple perimeter-type intruder alarm sounds to frighten the burglar, of course. But, even more important the alarm is intended to alert citizens or policemen who are in the vicinity that an illegal entry is being attempted.

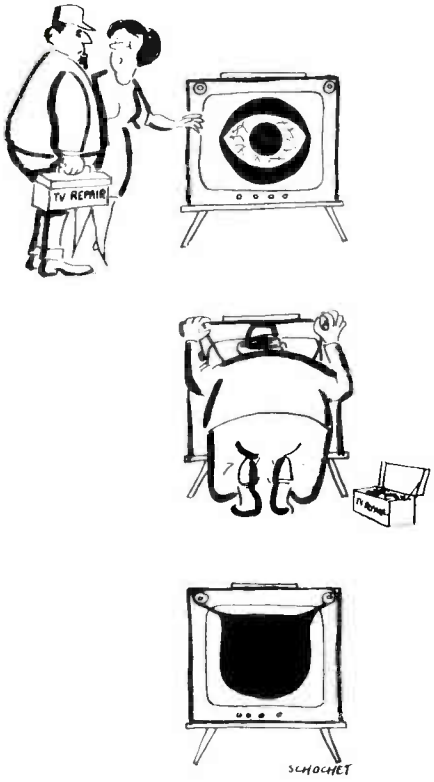
Whether the alarm signal is silent at the point of entry and indicates at a local guard point, a remote switchboard, or automatically dials the phone number which is used for emergencies, it must be interpreted and acted upon by people. Even more so, must a video-monitor picture be analyzed.

In Future Issues

YOU are the primary contact that your customers have with the electronics industry. It's only natural they should turn to you when shopping for a security system.

The installation and repair of security systems belongs to our field, and we should NOT permit others to take it by default, by our inaction.

To help you prepare for this extra business, we intend to present future articles dealing with the nitty-gritty of actual installations. Look for them. □



catalogs literature

Circle appropriate number on Service Card.

100. RCA Parts and Accessories – is distributing a 12-page brochure illustrating the various cables and adapters used with the RCA Industry Compatible Test Jig (ICTJ) Program. RCA Color TV Test Jigs can be used to service color TV sets of 41 manufacturers. An RCA ICTJ cross reference chart listing all the cables included in the program by description and numerical order is supplied with the brochure.

101. Sprague Products Company – has released a 52-page Semiconductor Replacement Manual K-500. Containing over 30,000 OEM part numbers listed alpha-numerically which can be replaced by Sprague's new line of 82 popular semiconductor devices, the manual also includes performance characteristics, outline drawings and pertinent parameters for the entire Sprague line.

102. Winegard Company – has released a newly-revised consumer products catalog No. CP-2. The 24 pages contain illustrations and descriptions of more than 230 products. Included among the products are TV and FM antennas, preamplifiers, couplers, band separators, and wire.

103. Winegard Company – No. 109 is a 36-page commercial products catalog. Illustrations, descriptions and specifications for over 250 products are presented. Some products listed are Ultra-Plex strip amplifiers, power panels, splitters, drop taps, line amplifiers, and tilt compensators. Commercial systems equipment for MATV, CCTV, ITV, ETC, CATV, NATV, and Sub-Channel are also covered.

104. Channel Master—has published a 1973 antenna-systems product guide. The 48-page book provides data on VHF/UHF/FM antennas, kits, mounting hardware, wire, chemicals, masting, rotators, amplifiers, and converters. Some MATV antennas are also included.

105. Channel Master – offers a MATV Systems Planning Manual which explains the principles of such a system. Ten sections cover theory, definitions of MATV terms, and the fundamentals of planning and installing systems of different sizes. Required equipment is illustrated and explained. Charts and drawings showing typical systems are included.

106. Nortronics Company, Inc. – has available the 2nd Edition of their Design Digest for Digital Magnetic Recording Heads. It contains over forty pages of technical and applications information, and is illustrated with photographs, diagrams, tables, graphs and circuit diagrams. Also, the product section is supported by full specifications and mechanical drawings showing dimensions in both inches and millimeters.

107. Howard W. Sams & Co., Inc. – has released their 1973 Technical and Scientific Book Catalog which describes over 400 popular hardbound and paperback books. Electronics, electricity, amateur radio, audio & hi-fi, mathematics, plus Audel do-it-yourself books on appliances, mechanical power, and sheet metal are among the many topics covered. The authors who are experts and professionals write in easy-to-understand language and use understandable show-how photographs and drawings. □

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Pull enough to bring in those distant stations—those hard-to-get channels—pull enough to feed more than one set! Try Winegard's CW-980 Color-Wedge VHF-UHF-FM model, with its optional antenna-mounted solid state preamplifier, for the ultimate in TV reception.

Or, for strong-signal areas, try one of Winegard's smaller models. They offer the same high quality, the same protective gold finish, the same two-year replacement policy. If the Winegard name is on the box, you can be confident it's an antenna with real "pull"—and that's the name of the game!

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Specially designed SENSAR solid-state antenna for boats & recreational vehicles—extra strong construction.

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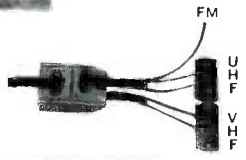
CC-282 COUPLER
All-Channel non-amplified couplers to connect two sets to one antenna.

HA-130

Winegard's new "Hideaway" Travel antenna for trailers, boats, campers, folds like an umbrella for travel!



CS-380 BAND SEPARATOR
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WINEGARD
TELEVISION SYSTEMS

For More Details Circle (27) on Reply Card

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.

AC-Current Leakage Adapter

Product: AC-current leakage adapter model 60-413 by the Triplett Corporation.

Features: The adapter has two test leads and one short ground lead attached. It plugs into the Triplett Laboratory and General Service FET volt-ohm-milliammeter, model 801. Model 60-413 permits measurements of often-undetected small amounts of leakage current between patient-connected instruments in hospitals and geriatric centers. It can also measure leakage current of commercial appliances.

Specifications: The Model 60-413 adapter, in 8 ranges, measures from 10 microamperes full scale to 30 microamperes full scale. Resolution is .2 microamperes on the lowest VOM range. Accuracy is ±4% of full scale. Frequency response is within ±1.0 dB. Input impedance: medical, 500 ohms test load; commercial appliance, 1500 ohms test load.

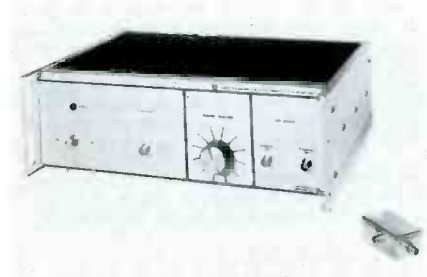
Price: The AC-current leakage adapter model 60-413 sells for $30.00.

For More Details Circle (38) on Reply Card

Sweep Generator

Product: Model SMG-12 by Lectrotech, Inc.

Features: The SMG-12 is used in conjunction with the Lectrotech SMG-39 or other equivalent generator. The combination of the two instruments permits the technician to check alignment on each of the VHF TV channels. Also supplied as part of the alignment package is the Model SMG/UHF balanced detector. This device permits alignment checks on each of the UHF channels from 14 through 83. The SMG-12 sweep generator is supplied with all necessary cables and probes.



Price: The SMG-12 with SMG/UHF and cables is priced at $249.50.

For More Details Circle (39) on Reply Card

Portable Multimeter

Product: Model 4442 Digital Multimeter by Weston Instruments, Inc.

Features: The Weston model 4442, a battery-operated 3-1/2 digit instrument of .05% accuracy, is designed specifically for field use. It has solid-stated LED readouts designed for the unit, and a dual-slope high-impedance bipolar A/D converter for accuracy and long-term stability. Also, there is a single MOS LSI plug-in chip for all of the logic circuitry, auto-polarity, automatic blanking of unused digits to conserve battery life, overload protection with spare fuses, and a custom-molded high-impact plastic case. A self-contained rechargeable battery-pack provides up to 12 hours of continuous operation. Four nickel-cadmium "C" cells and a battery charger are provided.

Specifications: Twenty ranges cover 200 mv (100 microamperes resolution) to 1000 volts AC/DC, 200 ohms (0.1 ohm resolution) to 20 megohms, plus AC and DC current.

Size and Weight: The size of No. 4442 is 2.25 inches X 5.45 inches X 7 inches, and the weight is less than 2-1/2 pounds.

Price: Model 4442 sells for $325.00, which includes probes, batteries, fuses, case and AC-line converter.

For More Details Circle (40) on Reply Card

Frequency Counter

Product: Model 5725A Frequency Counter by the Ballantine Laboratories, Inc.

Features: Model 5725A is a direct-reading five-digit (KHz and MHz) instrument which offers an input sensitivity of 75 millivolts RMS to 40 MHz and 120 mv to over 80 MHz. This high input sensitivity minimizes the need for conditioning low-level signals. The counter features totalizing which is accomplished in the Count Mode with front-panel pushbuttons providing Start, Stop and Reset functions; 1-Hz resolution for signals in the MHz ranges; a crystal-controlled 1-MHz reference source with an aging rate of less than 2 ppm per month; a self-checking capability by use of the clock output. It is rack-mountable and packaged in a high-impact case. In systems use, it can be installed and utilized as a panel frequency meter. The low 10-watt power requirement permits its use from car batteries or other DC sources with inverter.

Size and Weight: Model 5725A measures 8 X 3-1/4 X 7-3/8 inches and weighs 4 pounds.

Price: Frequency Counter No. 5725A is priced at $325.00. □

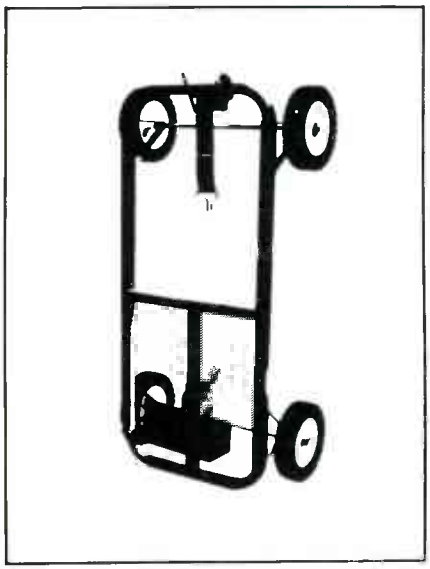
For More Details Circle (41) on Reply Card

productreport

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

Appliance Dolly

Product: Tele-Caster TV Dolly, Model TC-1 by The Finney Co.



Features: An automotive-type lifting jack makes it possible for one man to move heavy TV sets, appliances, desks and files. The operator places the jack plate under one end of the object, raises it with the jack until it clears the floor, secures it with the nylon strap, and wheels the object like a wheel barrow or dolly. The TC-1 can also "walk" up and down stairs, can be used to tip a TV set or appliance upside down in order to work on the bottom, and can remain attached to the TV set or other object while in the service vehicle. The square tubular frame is padded with 3/8-inch thick foam tape on contact areas, and has large 8-inch steel wheels with rubber tires and ball bearings. The unit is shipped assembled except for the wheels.
Price: The TC-1 sells for $89.50.

For More Details Circle (42) on Reply Card

Intrusion and Fire Alarm System

Product: Model Y-2000-A burglar and fire alarm system by Idea Systems, Inc.

Features: The self-contained Y-2000-A has a speaker horn, solid-state control center, 2 heavy-duty 6-volt batteries, and a security shunt lock (on/off) with two keys. A package of mounting hardware, a door or window decal, 150 feet of black and yellow conductor wire, an instruction sheet and a guarantee are all included with the system. Additional switches or sensors are available, with two of each included in the package. When a burglary is attempted, the magnetic closure contacts are latched, sounding the alarm siren. The special circuit for fire detection sounds the siren if the temperature exceeds sensor limits of 135 degrees F. The alarm easily can be tested by pushing a button which activates the system.
Price: Model Y-2000-A sells for $99.00. □

For More Details Circle (43) on Reply Card

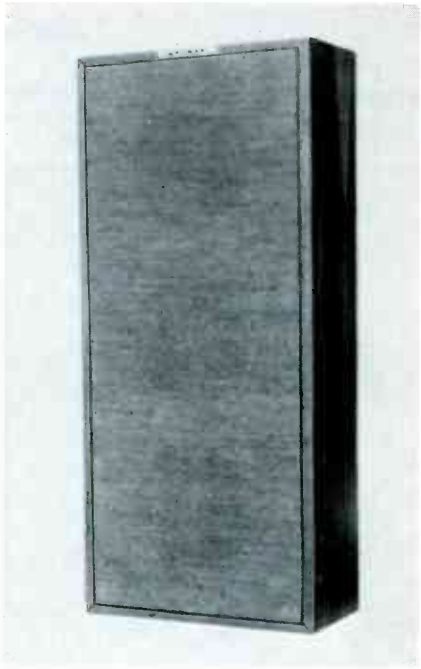
audio systems report

Sound Column Speakers

Product: Models No. 10/150 and No. 10/151 by American Geloso Electronics.

Features: Pictured is sound column No. 10/150. Both models, No. 10/150 and No. 10/151, have cabinets handcrafted in oil-walnut veneer finish and are suited for sound reinforcement applications in auditoriums, churches, and schools. The directional sound dispersion pattern allows for hi-fi sound reinforcement for music reproduction, and intelligibility in speech range. These sound columns are supplied with wall and mounting brackets and have provisions for plug-in line-transformer modules.

Specifications: Model 10/150 has 120-degree horizontal and 40-degree vertical radiation, frequency response of 80 to 15,000 Hz, and power handling of 24 watts with peaks of 40 watts. Model 10/151 has 120-degree horizontal and 30-degree vertical, frequency response of 60 to 18,000 Hz, and power handling of 40 watts with peaks of 80 watts.



Size and Weight: The dimensions of Model 10/150 are 24 inches X 10-1/2 inches X 5-1/4 inches and its weight is 15 pounds. Model 10/151 measures 47 inches X 10-1/2 inches X 5-1/4 inches and weighs 34 pounds.

For More Details Circle (44) on Reply Card

Paging Speakers

Product: Models FID-8 and FID-T talk-back speakers by University Sound.

Features: The FID-8 is a reflex-horn speaker of standard 8-ohm impedance. Although the FID-T is similar to the FID-8, it includes a built-in 70V and 25V line transformer with six screwdriver-selectable wattage taps. The FID horns are round and exponentially flared to reduce undesirable reflections within the horn. They are built from non-resonant, virtually shatterproof material. A clear shield over the input terminals and wattage selector (FID—T) is recessed in the driver housing and locks the input cable into place. Both speakers are rated at 15 watts RMS, are full range having a frequency response from 260 Hz to 14.5 KHz, and were designed for lowest distortion. □

For More Details Circle (45) on Reply Card

photofact bulletin

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

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1007A32 (WTG-91900) 1301-1

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MIDLAND
15-129B 1300-1
15-112C 1301-2
15-010 1304-1
Chassis T974-06/-07/-11/-12/-13/-15/ -16/-20-BA/-DA 1305-1

PANASONIC
TR-003, TR-003C, TP-180C, TY-180P 1303-1

PENNCREST
2889 (685-2889) 1302-3

RCA
Chassis CTC48A/B/H/J/P/R/T/U 1300-2
Chassis CTC54B 1301-3
AR092W (Ch. KCS189A/B) 1302-2

SEARS
564.40050100/101/102 1303-2

WARDS AIRLINE
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GAI-12643A 1303-3
GAI-12863A/B 1305-2

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

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

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UNUSUAL SURPLUS electronics and parts catalog, thousands of items. $1. ETCO, Dept. ES, Box 741, Montreal, Canada. 2-73-10-t

PICTURE TUBE & FLYBACK HIGH VOLTAGE TESTER ONLY $1.98 SCHEK TV WAND CO. 8101 Schrider St., Silver Spring, Maryland 20910. 2-73-6t

B&K 1077B analyst $225.00. Completely checked out. Jerry Vondruska, C.E.T., 2921 E. 16th St. F.O.B. Nat'l. City, Calif. 92050. Work (714)282-7623. 3-73-1t

FOR SALE: WINDSOR C.R.T. Rebuilding Equipment with extra C.R.T. Champion glass machine and diffusion pump. $1,250.00 Gaspard's TV, 4359 N. Foster Dr. Baton Rouge, La. 70805. 3-73-1t

FOR SALE: Picture tube rebuilding equipment complete. Eastern C.R.T., 73 Selden Blvd., Centereach, N.Y. 11720. 3-73-1t

FOR SALE: Television—Radio Service material, diagrams, manuals, 50-pound carton, only $14.95, postpaid. BEITMAN, 409 East Chalmers, Champaign, Ill. 61820. 3-73-1t

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Model 801
$210

1. Lower power ohms — 8 ranges with 35 mV power source and 1 ohm center scale.
2. High sensitivity —5 mV AC full scale at 10 megohm input impedance; 50 mV DC at 11 megohm input resistance.
3. Simplified scale — 8" meter with only 4 arcs for all 73 ranges.

It offers 73 measurement ranges including 8 low-power resistance ranges that apply only 35 mV to the device under test . . . does not activate or damage solid-state components. With full-scale readings as low as 50 mV DC and 5 mV AC, 5 μA DC and 100 Ohms (1 Ohm center-scale) — plus a 10 megohm input impedance on the AC scales and 11 megohm input resistance on DC — Triplett's Model 801 V-O-M is ideally suited to in-circuit testing. When you add 2% DC and 3% AC accuracy on the voltage ranges (current: 3% DC and 4% AC) and a 25 μA suspension-type meter with a nearly 7½" scale length, there's no doubt that the Model 801 has no equal among analog V-O-M's in terms of sensitivity and versatility. And there's an optional Leakage Adapter ($30) that measures leakage currents as low as 1 μA.

See the remarkable Model 801 V-O-M — priced at $210 — at your Triplett distributor. For more information—or for a free demonstration—call him or your Triplett sales representative right away. Triplett Corporation, Bluffton, Ohio 45817.

TRIPLETT

The World's most complete line of V-O-M's . . . choose the one that's just right for you

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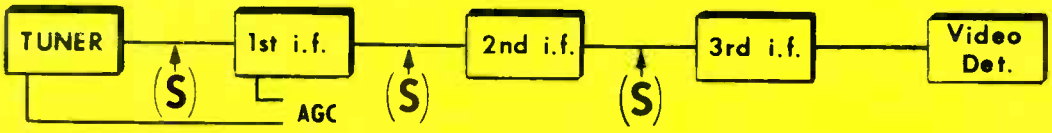
The all NEW

TV TUNER SUBBER™

Mark IV

Latest, all solid state version of the sensational signal circuit analyzing timesaver originated by Castle.

Invaluable for locating the break in the tuner and i.f. signal chain or analyzing agc system defects in tube TV receivers . . . essential for speedy location of signal circuit defects in modular IC, solid state and hybrid TV receivers.



Subber Mk. IV permits injection of substitute 40MHz signal at points (S) in signal amplifier chain. Permits signal injection after the agc controlled stages to simplify testing for agc defects.

- Works with any 40MHz receiver . . . color or black and white . . . solid state, tube or hybrid.
- High level, low impedance output furnishes signal usable at input of final i.f. stage.
- Special output circuit works equally well into first i.f. input of late model, link coupled systems and older, low "C" bandpass coupled systems.
- Antenna input and i.f. output electrically isolated; no "hot" chassis hazards.
- No need to disconnect supply leads from suspected tuner being tested. Substitutes the VHF tuner and tests the UHF tuner.
- Tunes all 12 VHF channels, has preset (memory) fine tuning on all channels.
- Higher overall gain than previous models with wide range gain reduction control of 60db.
- Completely self contained and battery operated, uses popular batteries available everywhere. Simple battery replacement; battery compartment in rear of custom molded case.
- Reduced current consumption extends battery life to as much as double that of previous models. Bright LED indicator warns when unit is ON.
- Use on the bench or in the home . . . anywhere.
- Comes complete with extension cables, batteries and instructions.

TV TUNER SUBBER™ Mark IV net $45.95

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

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