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ABOUT THE COVER

This picture of an RCA PersonAlert Pocket Pager in typical operation was furnished by the courtesy of RCA Mobile Communications Systems, Meadow Lands, Pennsylvania.

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electronicscanner

news of the industry

Delta-Benco-Cascade has developed a low-cost satellite-to-earth TV receiving station for the Canadian Federal Department of Communications. Now every Canadian community can receive a high-quality network TV service through the Canadian domestic-satellite system, which is owned and operated by Telesat Canada. The Anik satellite carries the signals, which also can be received with good quality in most of the United States. Potential use of the Anik satellite for a cable-TV service was discussed recently at the Canadian Cable TV Convention in Vancouver.

The Federal Trade Commission has issued guidelines concerning the Magnuson-Moss Warranty Act, stating that any supplier issuing a full warranty cannot limit its duration, and must repair or replace a defective product under warranty within a "reasonable time", according to **Home Furnishings Daily**. Written warranties on products costing the consumer more than \$10.00 excluding tax must be designated as either full or limited. A section of the guidelines gives consumers the right to bring Federal and State court actions for any breach of warranty damages.

Sears, Roebuck and Company has introduced what Home Furnishings Daily describes as the two lowest-priced solid-state 19-inch color TV sets in the industry. The sets are priced at \$294.95 and \$329.95 in comparison to other brands retailing for \$399.00 and up. Sears is keeping its one-year parts and service warranty on all solid-state color sets, except the two 19-inch models which will have a 90-day service and one-year parts warranty.

RCA plans to introduce several innovations to the TV industry in the next few years, according to Anthony L. Conrad, company president. Improved picture quality and fidelity, automated ease of operation, higher reliability, and greater conservation of energy will be stressed, according to **Home Furnishings Daily**. RCA's new line features an electronic tuning system with a single knob.

Scanray, an X-ray baggage-inspection system developed by the ITT Electro-Optical Products Division, shows the contents of baggage on a clear, flicker-free light-amplifier tube, instead of on a shadowy TV tube. A dim light image formed by a low-intensity X-ray tube is amplified and magnified electronically to produce a clear image, and is projected on the target screen.

Citizens-band radio is no longer just a hobby business. Sales are booming, and applications for Class-D citizen radio licenses received by the FCC for the first quarter of 1975 showed a 186% increase over the same period last year, according to **Merchandising Week**. However, **Home Furnishings Daily** reports that due to increased popularity, CB radio equipment will be in short supply for the next year.

NARDA claims some appliance manufacturers that have their own service companies are charging independent service dealers more for parts than they do their own service departments, according to an article in **Home Furnishings Daily**. Jules Steinberg, NARDA executive vice-president, said the differential in price makes it possible for factory service to make a better profit as well as undersell an independent servicer.

(Continued on page 6)

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- Fast, efficient service at our conveniently located Service Centers.
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- Customized tuners are available at a cost of only \$15.95. With trade-in \$13.95. (U.S.A. only)
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IF YOU WANT TO BRANCH OUT INTO THE TV TUNER REPAIR BUSINESS,
WRITE TO THE BLOOMINGTON HEADQUARTERS ABOUT A FRANCHISE.

For More Details Circle (4) on Reply Card

(Continued from page 4)

A tuner developed by General Instrument and National Cash Register is claimed to be a major breakthrough in tuners for TV sets. According to **Home Furnishings Daily**, all functions such as contrast, tint, color, and brightness are accomplished by the tuner; the consumer merely selects the channel. The tuner is said to be competitively-priced, and is factory preset.

A bill that would require a two-year warranty on household appliances and electronic equipment is being considered by the New York State Legislature. The bill currently is being revised, due to some duplication with the Magnuson-Moss Warranty Act which became effective July 4, 1975, according to an article in **Home Furnishings Daily**.

Reaction to Perma Power's use of a video tape recording as a product-refresher course at the NEWCOM convention seemed favorable. The taped programs provided sales training at the trainee's convenience for 24 hours a day.

RCA Service Company's extended service warranties have met with some controversy, according to **Home Furnishings Daily**. The program offers retailers a 9-month in-home service contract for \$19.95 on RCA's new color TV line. Presumably, the dealer in turn would charge the consumer the suggested price of \$39.95. Frank Moch, executive director of the National Alliance of Television and Electronic Service Association, said there is nothing to stop the retailer from charging the customer \$19.95, which would sharply undercut most service contracts now offered by retailers. Moch charges this could drive independent service firms out of business if copied by other manufacturers. RCA Service Company claimed the rates for the new warranty are competitively-priced, and that it is not undercutting the remainder of the industry.

Hitachi, Ltd. has developed a "mask focusing" tube which reportedly improves brightness and contrast compared with conventional shadow-mask tubes. An article in **Home Furnishings Daily** states that the tube incorporates a black-matrix screen, electron gun, a dot-screen structure, high matrix transparency, and a large electron lens.

A subsidiary of North American Philips Corporation is in the process of acquiring the outstanding minority interest in the Magnavox Company. In 1974, North American Philips acquired 84% of the outstanding common stock of Magnavox. The Board of Directors of Magnavox have approved the proposal, which now is being submitted to Magnavox stockholders for approval.

Twelve-inch portable models continue to dominate the black-and-white TV sales market, and solid-state units are becoming more popular, reports **Merchandising Week**. Portability and low price are said to be two chief factors for the consistent demand for black-and-white sets. □

troubleshootingtips

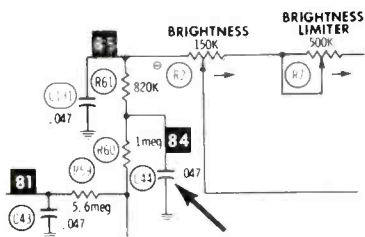
Send in your helpful tips—we pay!

Excessive brightness

RCA CTC38

(Photofact 1000-3)

During a previous repair we found an open in the burst take-off winding of the first-bandpass transformer. The break was near a lug, so we repaired the transformer and checked the IF and chroma alignment.



The complaint this time was different: the picture was too bright and couldn't be turned down. Usually, an analysis of the picture-tube voltages will pinpoint the source of the trouble as in the chroma circuit (CRT grids), or in the video (CRT cathodes). In this case, the grid DC voltages were normal, but the cathode voltages were too low, and the brightness-control adjustments could not in-

crease them enough. However, when I removed the 12GN7 video output tube as a test, the screen went completely dark. This was proof that the circuitry between the video plate and the picture tube was okay. At that point, I brought the chassis to the shop.

Control-grid bias could be made several volts positive by adjustment of the brightness control. But, instead of going several volts negative by CCW rotation (as it should), the DC voltage only reached about -.7 volts.

One end of the brightness control should have about +10 volts, and the other approximately -20 volts. **There was no negative voltage.** I checked R60, R61 and C44, and found that C44 was shorted. Installation of a new capacitor reduced the brightness to normal.

C44 was mounted on the brightness control and was easy to replace. In the future, I will test the voltages at the outside terminals of the brightness control before pulling the chassis.

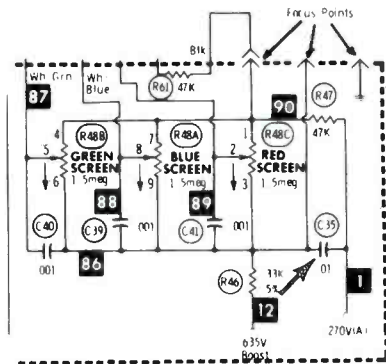
T. Schilsky
Masonville, New Jersey

Dim and variable brightness

RCA CTC55

(Photofact 1203-2)

The brightness was erratic, and usually was too dim. On the service position of the service/normal switch, the screen controls could not bring in the horizontal lines.



After a closer inspection, I noticed that R46 was overheating.

This indicated leakage in C35. I used a 1600-volt capacitor to replace C35, and also replaced R46 because overheated resistors often change value or fail later on.

The color set now worked fine with good brightness. We have found the same capacitor leaking in other models that use a similar circuit.

Mac Kellman
Brooklyn, New York

Intermittent arc and vertical

Midland Model 15-225

(Photofact 1261-1)

When the set was first turned on, the operation was normal. But after about 30 seconds, the raster lost vertical sweep, accompanied by a loud arcing noise and the odor of ozone. The HV jumped from a normal 18KV down to 4 KV when

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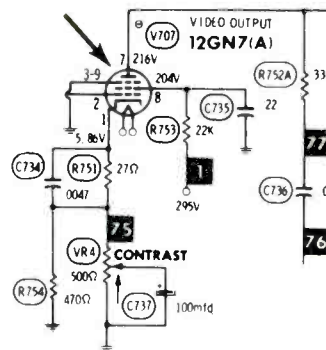
the trouble occurred. However, with the socket removed from the picture tube, there was no arc.

DC voltage tests showed that the 230 volts at the CRT cathodes fell to zero when the arc occurred, but the supply voltage did not change.

Finally, the trouble was traced to an intermittent short from plate to the grounded suppressor grid inside the 12GN7 video-output tube. (The tube checked perfect in a tube tester.) When the video plate voltage and the CRT cathode voltages became zero, the picture tube was operating with positive grids and zero cathodes, drawing enough current to kill the HV.

Why did the vertical collapse? Perhaps the change of video-plate voltage going back through the vertical-blanking network shocked the vertical into a momentary loss of oscillation. And of course, the

vertical oscillator was powered from the boost; when the HV was loaded the boost is reduced also. The

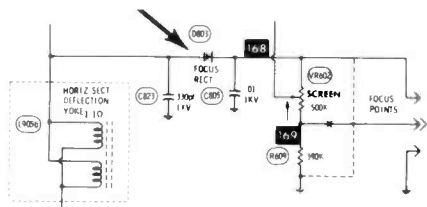


sudden change of boost and oscillator plate voltage might have killed the vertical. Anyway, replacement of the video-output tube cleared all the troubles.

Roland G. Murdock
Windsor Locks, Connecticut

Dark picture Sony SCC-08 (Photofact 1216-2)

According to the customer, his Sony color receiver had a bright, sharp picture until one night it suddenly went completely dead. He took the TV to another shop, and when he brought it back the picture was dark and snowy.



The customer watched the poor picture for several days, delaying any action because he thought the picture tube was bad. Finally, he brought the set to me for a CRT replacement.

Because I know the expense and extra work involved in a CRT replacement that proves to be unnecessary, I always make a careful examination. Two of the bridge rectifiers and the focus rectifier were new, apparently installed by the last technician.

Next, I measured the DC voltages at the picture tube. All were okay except grid #2 which had zero volts. The circuit led right to the focus

rectifier, where the anode had AC, but the cathode had no DC. Of course, I assumed the rectifier was open, and replaced it. **Still the picture was dark.**

I compared the actual wiring against the schematic and found that the previous technician had installed the focus rectifier in reversed polarity, and I had followed his wiring when trying a new one.

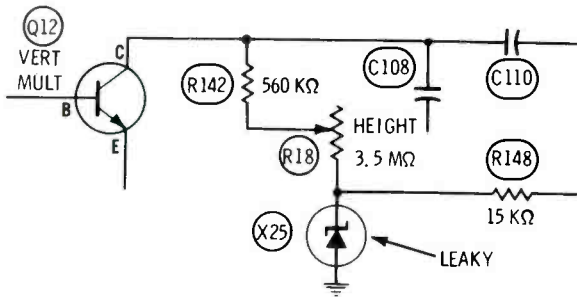
Yes, reversing the focus rectifier solved the problem and gave a bright picture.

Juan A. Reyes
New City, New York



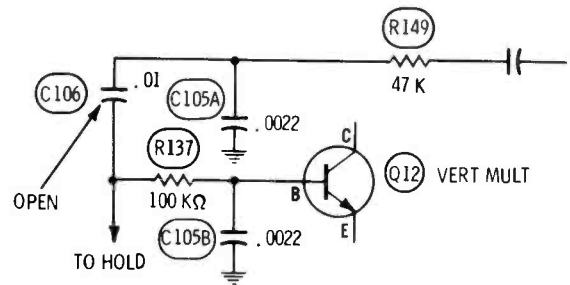
"Flat rate? Does that mean that's the way it leaves me?"

Chassis—Zenith 25CC25
PHOTOFACT—1262-3



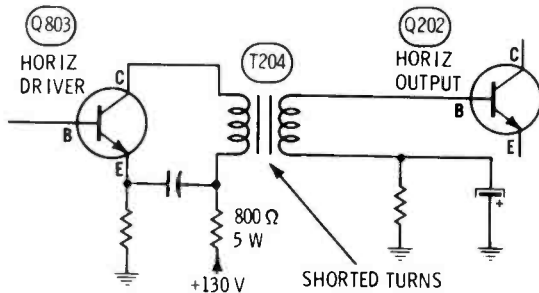
Symptom—Insufficient height
Cure—Test zener X25 for leakage by replacing it

Chassis—Zenith 25CC25
PHOTOFACT—1262-3



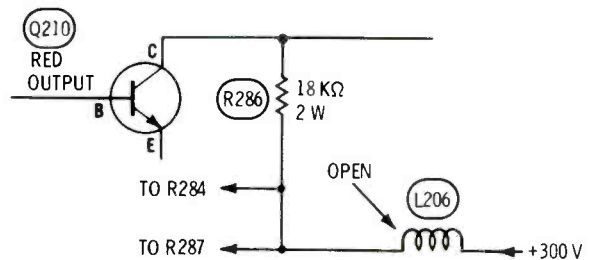
Symptom—No height
Cure—Test C106, and replace it if open

Chassis—Zenith 19EC45
PHOTOFACT—1377-3



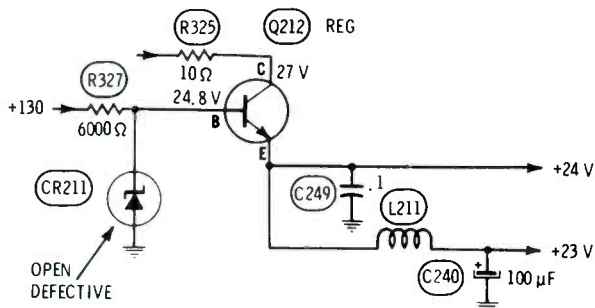
Symptom—Vertical line of foldover, horiz output transistor runs hot
Cure—Test T204 for shorted turns by replacing it

Chassis—Zenith 23DC14
PHOTOFACT—1306-3



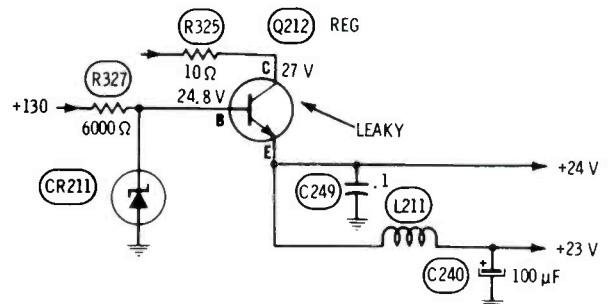
Symptom—No control of excessive brightness, perhaps intermittently
Cure—Test L206, and replace it if open or intermittently open

Chassis—Zenith 25DC56
PHOTOFACT—1312-3



Symptom—Loud hum, and white horiz bar moves upward
Cure—Test zener CR211, and replace it if open

Chassis—Zenith 25DC56
PHOTOFACT—1312-3



Symptom—120-Hz hum in picture, and flashing
Cure—Test Q212, and replace it if leaky

reader's exchange

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

Needed: Schematics for Servo Corporation pulse generator, Model 34500, and Rutherford Electronics pulse generator, Model B7B.
Ed. Hansen Jr.
P.O. Box 2064
Akron, Ohio 44309

Needed: Motor for Roberts Electronics tapeplayer, Model 1057, or address of company.
Clifford Newton
R.R. 1
Wathena, Kansas 66090

Needed: Schematic and parts list for Knight solid-state sine/square-wave generator, Model KG-688, and sweep/marker generator, Model KG-687. Will buy, or copy and return.
J. B. Pugh
3244 Tuttle Road
Leslie, Michigan 49251

Needed: Transformer T2 in Photofact 621-5 for AMC stereo AM/FM radio.
Jesse L. Butler TV
4547 Hillpine Road
Forest Park, Georgia 30050

Needed: Power transformer number 20007792 for DuMont oscilloscope, Model 304A.
A. J. Macedo
1809 Paseo Del Cajon
Pleasanton, California 94566

Needed: Schematic for Hallicrafter radio, Model TW 1000.
J. Diaz
636 Koscuisko Street
Brooklyn, New York 11221

Needed: Schematic or service information for Magnetape recording-playback amplifier, Model 710-B, made by Amplifier Corporation of America. Will buy, or copy and return.
Peter W. Meek
1788 Miller Avenue
Ann Arbor, Michigan 48103
(Continued on page 53)



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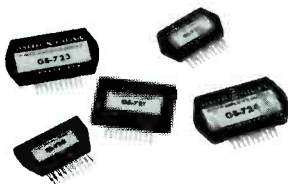
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GENERAL  **ELECTRIC**

Who's Cheating Whom?

By John Rozsa

A flurry of city, state, and national laws are being considered and enacted, governmental red-tape bureaus spring up like dandelions, and militant consumerist groups fill the news media with largely-unfounded accusations. Those pointing at our profession have one goal in common: to regulate the honesty of those of us in the electronic-service business.

Well, I fervently wish for a group that's equally fanatical in uncovering the cheats among my customers, and protecting me.

As just one example, let's consider the case of a customer we'll call John Smith, who brought his 23-inch color console to my shop and asked for a good overhaul. I repaired it, then phoned him that it was ready, and quoted the amount of the bill.

Next morning, he parked his pickup truck in front of my shop, and came in to pay cash for the repairs. His color set was running on time test, and I demonstrated the good picture. He paid cheerfully, loaded the TV, and left.

Just before closing time the same day, Mr. Smith called. "That TV you repaired is as dead as a car without a battery. There's no sound, and the screen blacked out as it did before you worked on it. Maybe it can't be fixed. Say, why don't you just refund my fifty bucks, and we'll just forget about it. My wife wants a new TV anyway."

Of course, I replied that my work is guaranteed, and I would be at his home about 9 AM the next day to check the set. He said he was

sorry to put me to all this trouble, and sounded disappointed because I refused his suggestion of a refund.

After I arrived at the Smith home, I switched on the TV and found no sound, no picture, and not even a channel light. Also, none of the tubes I could see through the ventilation holes in the back seemed to have any heater glow.

My first thought was of a loose connection at the power-input plug, but my cheater cord gave the same result. Next, I used my VOM to measure the line voltage. Aha, there was none.

I tried the 3-way lamps, and they would not light, but a ceiling light in the next room operated okay.

"There's no power in this room," I informed Mr. Smith, "I'll check your circuit-breaker panel." At this point, John showed signs of nervousness, and stumbled over his words.

Sure enough, the breaker was in the "off" position. I noticed something else, and kept it a secret: the switch was at the far left, which is beyond the position caused by an overload tripping it. Therefore, it was clear the breaker had been tripped **manually**. I reset the knob, and he followed me back to the TV set. His constant chatter seemed more subdued.

This time, the set came on with a good color picture and sound, so I packed my gear and left.

Question: Did John Smith flip off that circuit breaker in a deliberate effort to cheat me, the television service technician? Well, whether he did or not, **the customer is always right!**

HEAT IT! COOL IT!



If it pinpoints the trouble in less time and with fewer puzzling results, a simple troubleshooting method can be the best one. That's certainly true when you test components which change condition according to the temperature.

By Mort Gordon

Let me tell you about the new test instrument I have on back order. It is a combination computer, digital meter, and dual-beam scope. To use it, you just connect a few probes to the TV chassis, insert a card with the microfilmed service data, and wait a couple of seconds. LED's flash, as the computer goes through a series of tests, the scope shows the incorrect waveform and the right one for reference, while the display screen has a closeup of the section of chassis where the bad parts are, and arrows with captions point to the defective components, showing "Q307 has C/E leakage", "C516 is open", and "R909 is out of tolerance".

Of course, it will take me some time to save the \$25,000 to buy it, and perhaps a few years more before the design is out of Research and Development. In the meantime, I make do with techniques that sometimes seem to operate just as magically.

Cooling From A Can

Circuit cooler in spray cans is not new. Most of you know that a short puff of chiller can reduce the temperature of a single component by several degrees, and a long blast can frost an area to below freezing. But, you should experiment often with it, to obtain the best results. If it's intelligently used, with full knowledge of both the advantages and limitations, circuit cooler can save much diagnosis time and reduce the rate of callbacks. I don't need to lecture you about what those two factors can do to your profit-and-loss statement.

Most other sprays use a propellant to force out the desired liquid. But circuit cooler (usually Freon) is its own propellant. It works much like a refrigerator; the Freon is maintained as a liquid by pressure in the can. When sprayed out in droplets, the liquid absorbs heat from anything around it, while the lower pressure changes it to a gas. No gummy residue remains; the material is non-flammable and does not conduct electricity, and is harmless if you don't breathe too much of it.

General Tips

The technique of cooling individual parts is used most effectively with intermittent sets, whose malfunctions appear to be related to

the temperature of the chassis.

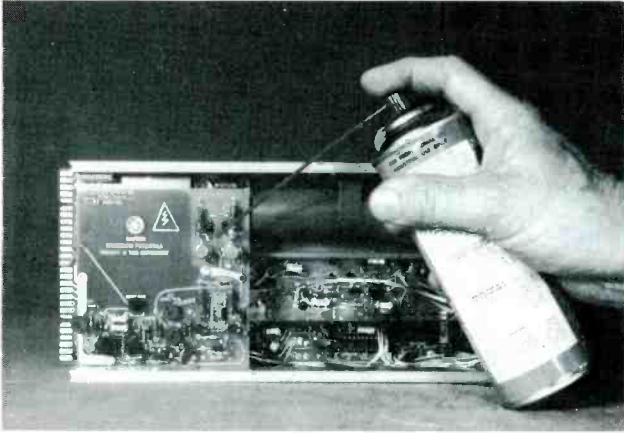
There are various symptoms that indicate a tie-in with heat. Some troubles occur at one definite temperature, but the operation is okay at higher or lower points. Others have more severe symptoms as the heat is increased.

Two points are of extreme importance: you must find the exact temperature that triggers the problem; and you must confine the cooling to only one component at a time.

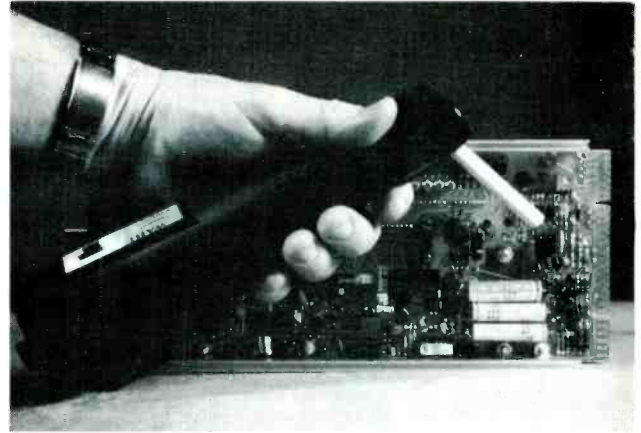
For example, suppose the problem is in the vertical sweep, perhaps a gradual change of height, a change of frequency, or stretching of the linearity at the top. First, with a heat source or by natural chassis heat, warm up the circuit until the symptom begins. Then apply the cooling spray to **one** capacitor at a time. Use the tubing that comes with the can to pinpoint the spray. When the defect disappears, heat the suspected component again and repeat the test to make certain it is the culprit before you replace the part.

Resistors are not likely to cause such symptoms. But maintain a healthy suspicion of "printed components", the packages resembling ceramic capacitors, but with several leads. These devices frequently become unstable and intermittent.

Other circuits, such as horizontal,



Use the small length of plastic tubing that comes with the pressure can to concentrate the cooling spray on only one component at a time.



Hot air of about 260°F can be focussed on a small area by use of the flexible extension tube of the Thermal Spot Tester from Wahl Clipper Corporation.

AGC, sound, IF's, etc., should be checked for thermal susceptibility. Replace just one component at a time, and then test again. If you have accidentally caused a new defect, there's only one step to retrace.

It should be clear that I don't subscribe to the "shotgun" theory of troubleshooting.

Other Uses

Just before you solder any solid-state device, spray it thoroughly with freeze spray. This is good, cheap insurance against heat

damage.

Have you ever had the heat of soldering strip the insulation from plastic-covered wire? The damage will be small, if you first freeze the plastic.

Often a small crack across a circuit board will show clearly when the board is frosted by a strong application of coolant.

Precautions

To avoid the possibility of exceeding the normal operating temperature and obtaining misleading results, you should experiment

by spray cooling different components and circuits in several non-defective "normal" sets. After all, TV receivers are designed to operate only within the usual range of temperatures found in an average home.

Sometimes excessive cooling can affect the characteristics of good parts. For example, many small disc-type ceramic capacitors (not NPO or N types) seem to lose most of their capacitance when frozen. Of course, they recover just as rapidly. Capacitors used in critical circuits are not as easily affected;

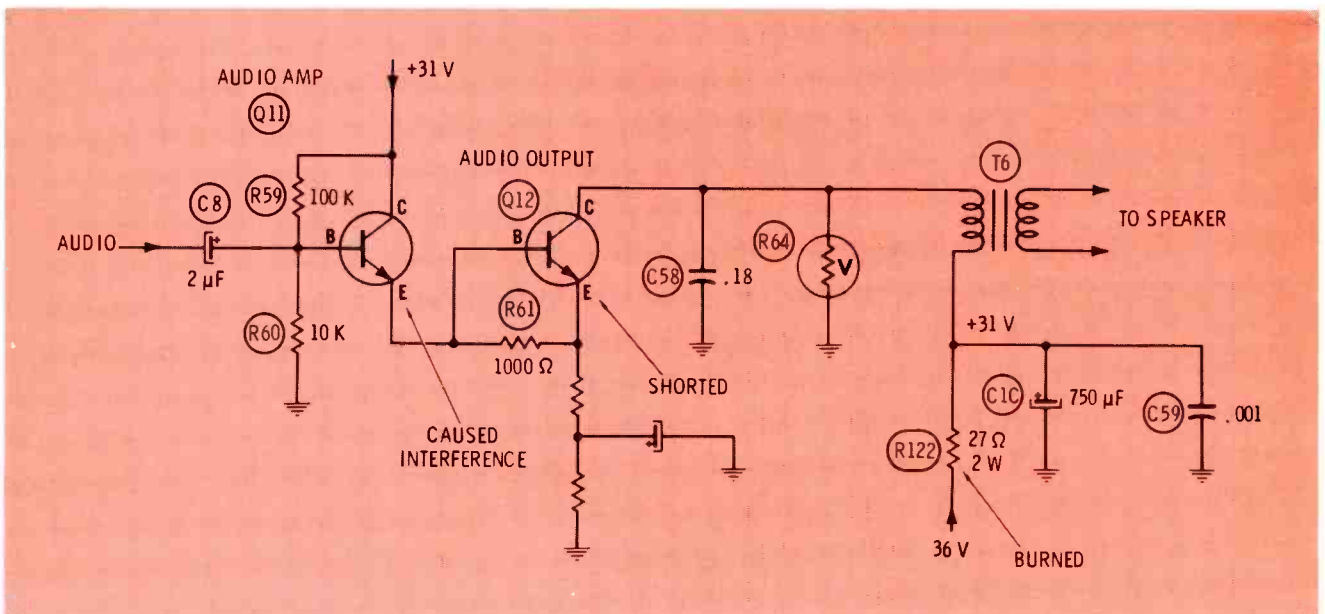


Fig. 1 The primary defect was a shorted Q12 transistor which had burned R122, changing the resistance. Also, Q11 caused a noise like interference from a brush-type motor after it became warm. Alternate warming and cooling would start and stop the symptom.

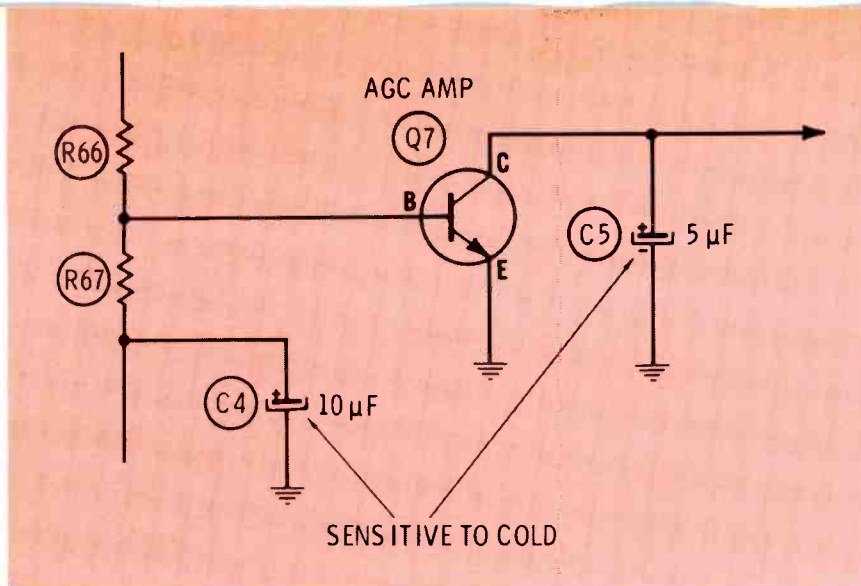


Fig. 2 Electrolytic capacitors used in the AGC circuit can be hot-and-cold troublemakers, because they are in a sensitive area.

they have better temperature coefficients.

Be alert when you cool the color output transistors in those sets which are direct coupled and have pre-CRT matrixing of color and b-w. You can see why any radical temperature change should affect the brightness, because the transistors are direct coupled to the picture tube.

As an experiment, I have placed a cheap transistor in a curve tracer and adjusted for a normal display of curves. Then I held a lighted match near the transistor and watched the amplitude of the curves decrease as the transistor became hotter. If such heat is not enough to ruin a junction, the original performance is restored when the transistor is sprayed.

So, make sure you know the normal reaction to the amount of heating and cooling you do as a test.

Of course, many problems involve rapidly-changing intermittents. In that case, it's necessary only to trigger the good/bad or bad/good condition several times by alternate heating and cooling. The exact amount of heating and cooling is not important; a good component should never show any instantaneous change.

Many Problems With A Sylvania

My struggles with the bench repair of a Sylvania A06-1 (Photofact 901-3) solid-state b-w 1967 TV

illustrate the methods. (Figure 1).

The primary complaint was a loss of sound after about 5 minutes, while the other complaints were many and varied, including unstable horizontal locking, erratic vertical rolling, and changes of vertical linearity.

Complete loss of audio was due to a shorted Q12, audio-output transistor, and the overload had overheated R122 so that it measured only 15 ohms. Replacement of transistor and resistor brought back the sound, and revealed another sound problem. Any slight flexing of the circuit board would cause the sound to cut in and out. After some time this was traced to unsoldered pins in the power plug which, among other things, connected the volume control to the audio circuit.

Now the sound had a noise similar to brush-motor noise for the

first 5 minutes of operation. As soon as the chassis heated enough for the problem to cease, I applied freeze spray to each audio transistor and capacitor. Cooling Q11 started the noise, and warming it with a soldering gun stopped it. Replacement of Q11 eliminated that trouble.

I let the TV "cook" for about an hour, and then studied the minor symptoms. At first, I thought they were all caused by ineffective filtering in the power supply. A scope test disproved that possibility.

Then I noticed a number of small imported electrolytic capacitors that have axial leads. How many have you found dried out in the AGC circuitry?

Again, selective application of freeze spray located four bad ones. Two of them, when frozen, caused a loss of contrast, loose locking, and 6 vertical 1-inch bars across the picture (Figure 2). The others caused vertical rolling and reduced height. All the problems were gone, after I replaced the electrolytics.

No Brightness

In the customer's home, this Zenith 19DC20 hybrid color receiver (Photofact 1277-3) had no brightness for about 20 minutes, but after that the performance was normal for the remainder of the evening. I found the HV was okay, and tried the set-up switch and screen controls to produce a horizontal line. These symptoms pointed to a video trouble.

Substitution of the video-processor module (9-48) and the chroma module (9-50) made no change. I started to sub the plug-in video transistors, but the test was incon-

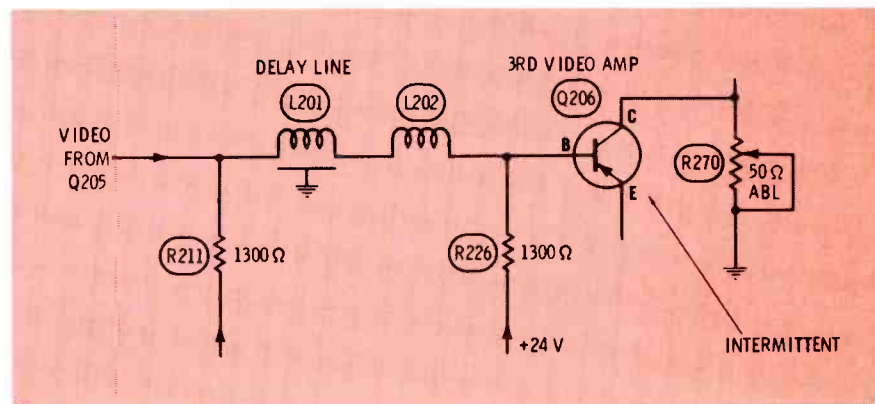


Fig. 3 This was the only intermittent audio transistor that I couldn't diagnose by the heating and cooling method.

clusive, because the brightness had clicked on by then. Freeze spray applied to the second-video transistor (Q205) gave a loss of brightness, so I replaced it, made out the bill and left.

The next day, I made a recall and brought the set to the shop. Through straightforward signal tracing with a scope, I found Q206 (Figure 3) to be intermittent. This was the "exception that proved the rule", for at no time would heat or cold make it work or prevent it from working.

Most intermittent transistors (and I've found dozens) do respond very rapidly to either heat or cold, making the test one of great value.

Magnavox Drifting Horizontal

A Magnavox hybrid b-w with a T946 chassis (Photofact 1182-3) was the next thermal example. At first, it had a multitude of symptoms, such as random bending and rolling, drifting horizontal locking and erratic contrast. All of these varied according to the heat build-up.

When the circuit board was flexed, the symptoms became worse, indicating the possibility of poor grounds. I carefully resoldered all of the ground connections, using a heavy-duty iron. That gave some success, for now the erratic symptoms were gone, leaving the drifting

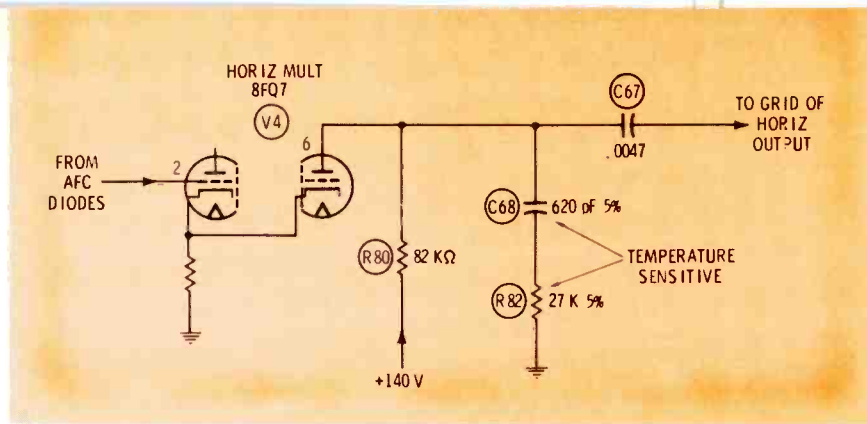


Fig. 4 When parts are mounted close together, it's difficult to avoid splattering the cooling spray on another component in addition to the one you suspect. Sometimes you can remove the part and connect it with clip leads while you heat and cool it without any possibility of affecting another component.

horizontal.

Undoubtedly, you are familiar with this situation. About every half hour, the horizontal locking is lost. After the set cools overnight, you must radically reset the hold control, and the drift begins again.

Next morning, while the set was cold, I connected my VTVM to pin 2, the grid of the horizontal oscillator tube (Figure 4). Then I varied the horizontal-hold control (core of the ringing coil) to each side of best locking. A proper voltage that was positive on one side and negative on the other proved the duo-diodes and other components of the AFC circuit were functioning correctly.

All of the horizontal-oscillator

components were grouped in one small area. I tuned in a strong channel and adjusted the hold control for zero volts at pin 2 with good locking. Then I directed the hot air from a 1,000-watt hair drier toward the oscillator area.

Immediately the meter showed an increasing error-correction voltage until locking finally was lost. The hairdrier was discarded for a can of coolant, and I squirted each component, starting with the most remote one. There was no change until I reached C68. At that instant, the meter pointer moved rapidly and the horizontal was back in lock. I repeated the test before replacing C68, which was a high-quality capacitor.

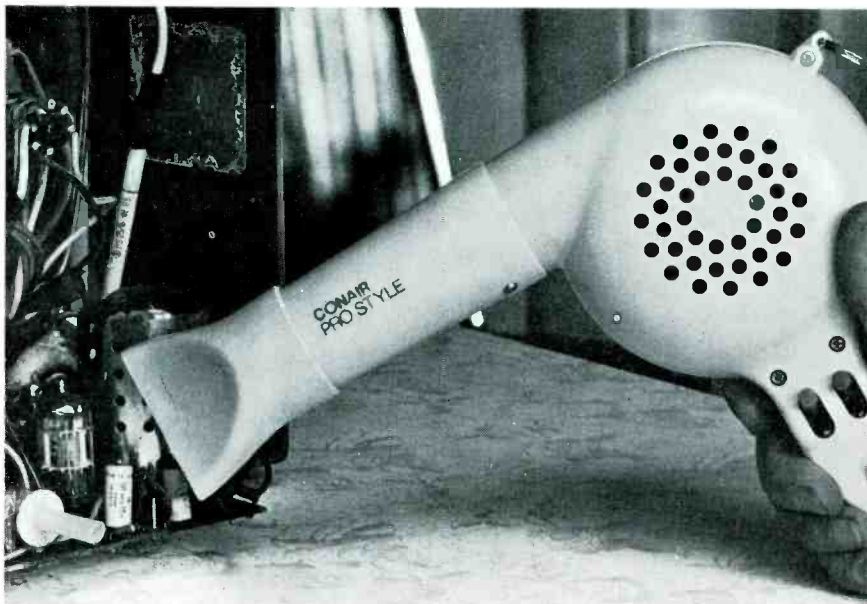
When I next tried the set, the drift remained, to my disappointment. I made a careful examination around C68 and found a small resistor, R82. Now, resistors don't often become unstable with heat, but this one tested only 15K, and after I replaced it the horizontal drift was gone.

During the testing, some of the spray had missed the mark and cooled R82 as well as C68, misleading me into replacing the wrong component.

Conclusion

All experienced technicians know that no one technique, test, or item of test equipment is invariably the best choice for every repair. Certainly, I try to select the best for each individual job.

Even so, I believe the hot-versus-cold tests are a valuable addition to the arsenal of any technician. □



A hair drier can heat a chassis very rapidly. However, it sometimes gives more heat than needed, and it warms a larger area than you might want covered.

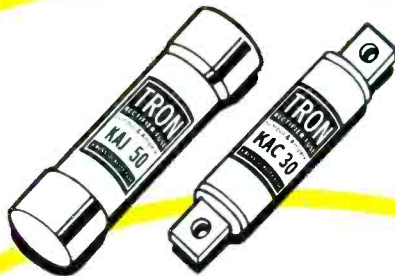
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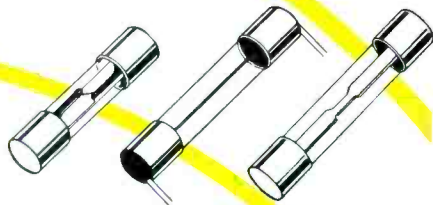
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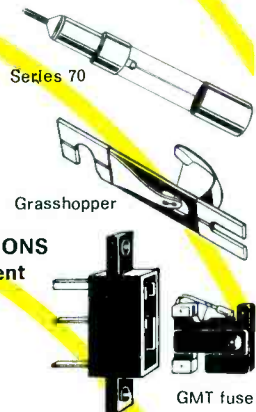
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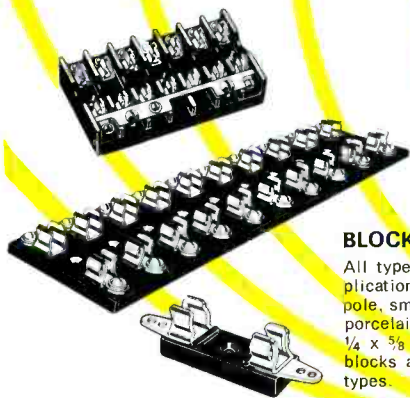


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THE QUIET WORLD OF SELECTIVE CALL

Part 2/By Marvin J. Beasley, CET



This is a Code Call small paging receiver from E. F. Johnson. It has two reed units in a two-tone-sequential circuit, a built-in ferrite antenna, and a strong clip on the back for securing in a pocket or to a belt. When the radio is called, it remains in the receive position for about 8 seconds, then it switches automatically to standby.



One of the reed assemblies is shown removed from the Code Call.

Last month, we defined "selective calling" as the operation of a two-way radio system in which each receiver is silent during transmissions on the channel until its individual tone code is broadcast. Selective calling enables the base station of a company to call any one of dozens of employees without disturbing the others. Also, several businesses can operate on the same channel, yet each one hears only its own messages.

One simple system has a short burst of an audio tone before the message. The tone activates any receiver that has a filter for that precise audio frequency, and the receiver's audio stays alive until it is manually reset.

Another system continuously broadcasts an audio tone along with the voice message. Receivers with a proper filter are made alive so long as the tone continues.

The system with more codes is the two-tone sequential. Two audio tones are generated in succession, just preceding the message, to signal the desired receiver.

Now, we present some technical details about these basic systems.

Frequency Tolerances

When technicians first begin to work with selective-calling equipment, they often are amazed at the strict tolerances of the encoding and decoding audio frequencies. For example, if the tone-controlled squelch (TCS) frequency is 100.0 Hz, then the test signal should be within $\pm .5$ Hz. That's only $\pm .5\%$; a tight specification for audio work. Most conventional audio oscillators have too much frequency drift, and are not calibrated accurately enough to serve effectively as sources of test signals.

Reed systems

The use of mechanically-resonant reeds was the first solution to the problems of inaccurate frequency, drift, and broad tuning that plagued

the early tube circuits. These reeds are a variation of the tuning forks used for centuries as standards for tuning musical instruments, and recently to time some types of electronic watches.

By proper design, the reeds can be made to have an extremely-high mechanical "Q" giving ultra-sharp tuning and good stability. An input coil near the movable part of the magnetic reed radiates a signal to the reed, causing it to vibrate when the signal frequency is the same as the resonant frequency of the reed, (see Figure 1). A similar type of output coil has a signal induced in it by the reed movement.

If the reed stages are part of a positive-feedback loop, the circuit becomes a stable oscillator for an encoder. Without a feedback path, the reed acts as a "pass" filter having a very-narrow bandwidth of approximately ± 1 Hz. The output signal is a pure sine wave.

Of course, reeds have some drawbacks. A strong blow can cause the reed to vibrate because of shock excitation, resulting in a false call.

CTCSS Encoder Circuits

Figure 2 shows the block diagram of a typical transceiver radio using Continuous Tone-Controlled-Squelch System (CTCSS). While the radio is transmitting, the TCS circuits add a low-level sine-wave tone to the voice modulation. When the radio is receiving, the tone is filtered to reduce the amplitude so it will not interfere with the message.

Some details of an actual TCS encode circuit for transmitting are shown in the signal-flow diagram of Figure 3. Q1 and Q2 form an oscillator with a frequency that's determined by the reed, RD1. The Tone Deviation control is adjusted for the desired level of the audio tone fed to Q3, where it is divided into two signals that are 180° out-of-phase. One phase of signal is

the encoder tone for transmitting, and the other phase acts as a brake to stop the motion of the decoder reed in the receiving radio more quickly.

Any high-Q device—either electronic or mechanical—requires some time after the excitation is applied before it attains maximum amplitude. Also, the signal doesn't die away immediately when the excitation is removed; it decreases in a damped wavetrain at a comparatively slow rate.

Therefore, a decoder reed would continue to vibrate after the message was over, causing an annoying condition called "squelch tail". A special circuit is used to minimize this effect.

Reed "brake"

When the Push-To-Talk (PTT) switch is closed (Figure 3), the base of Q7, the PTT gate, is shorted to its collector. The transistor saturates and effectively grounds the emitter, along with the DC voltages coming in through R7 and CR4, as well as through R2 and CR3. This initiates two separate actions. Elimination of the positive voltage at the junction of CR4, R7, and R8 forward biases Q5 so it saturates and applies a strong forward bias to Q6, the relay driver. The resulting collector current of Q6 energizes the K1 transmit/receive relay, throwing it to transmit.

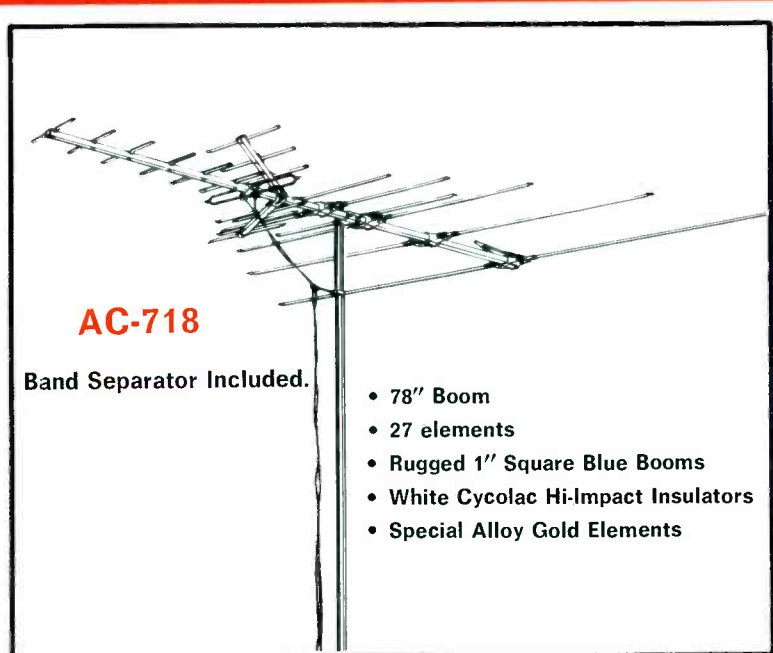
The anode of CR1 and the cathode of CR2 have a fixed positive voltage from a voltage divider. When the DC voltage at CR3 is grounded by Q7, the cathode of CR1 has nearly zero DC volts, so CR1 conducts and brings the audio tone from the collector of Q3 to the tone amplifier, where it is added to the voice message during transmit. At the same time, CR2 has zero voltage at the anode and positive at the cathode; it is reverse biased and non-conducting.

At the end of the transmitted message, the operator opens the PTT switch. But, notice carefully that the two circuits do NOT operate in reverse of the "on" sequence.

First, Q7 opens, restoring the positive voltage at CR3, and applying a greater positive voltage to the cathode of CR1 and the anode of CR2 than the fixed positive voltage that is present at the anode of CR1 and the cathode of CR2. CR1 is

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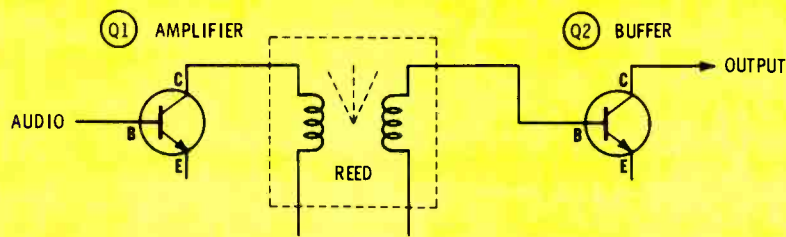


Fig. 1 A vibrating reed (similar to a tuning fork) is driven by a coil and an amplifier. The output signal is a pure sine wave, which is taken from another separate coil. Selectivity and stability both are excellent.

reverse biased, becomes an open circuit, and prevents the tone at the collector of Q3 from reaching the tone amplifier.

On the other hand, CR2 is forward biased, becomes a near short circuit and passes the tone from the emitter of Q3 to the tone amplifier. When the diode paths are switched, the phase of the audio tone supplied to Q4, the tone amplifier, changes by 180°. This reversal of phase at the radio receiving the message opposes the vibration of the decoder reed. It acts as a damper, or brake, to stop the vibration quite rapidly, and the removal of the reed output signal activates the squelch to mute the receiver before the transmitter carrier leaves the air.

One thing still is missing: the carrier of the transmitter must continue for a fraction of a second after the conduction paths of CR1

and CR2 have been reversed (to prevent squelch tail). That is the purpose of R6 and C6. When Q7 is conducting during a transmission, the anode of CR4 measures about +1 volt; therefore, R6 and C6 have nearly 11 volts DC across them, with the end of R6 toward the base of Q5 being negative relative to the B+ supply. Of course, C6 becomes charged, and when Q7 becomes non-conductive, and the current coming through R7 attempts to raise the voltage at CR4, the voltage charge stored in C6 opposes this change. Q5 and Q6 are kept conducting and the relay in transmit position for about 150 milliseconds before C6 discharges enough to cutoff Q5 and switch the circuits to receive. Diodes CR3 and CR4 isolate the phase-reversal and burst-delay functions so the reversal occurs quickly, and the delay more slowly.

CTCSS Decoder Circuits

The signal-flow schematic of Figure 4 shows one kind of decoder circuit.

Active filter

A sample of the receiver audio is brought into the decoder section through a filter (L1, C1, and C2) to remove any RF. The next stage is an "active filter", although it might not seem so at first. An active filter is one that does the work of an RCL tuned filter, but uses only capacitors, resistors, and an amplifying device. Negative feedback flattens the curve up to the desired shoulder, and gives sharper roll-off above that point.

Here's how this low-pass filter works: Q1 and Q2 are connected as a Darlington pair, giving very-high input impedance and low output impedance. Think of them as a single emitter follower, to simplify the concept.

R1, R2, R3, C4, C5, and C6 form a type of RC low-pass filter, but there are some important reasons for the exact wiring. Let's consider three "if" situations, such as:

- If C4 and C5 returned to ground rather than the emitter of Q2, the circuit would be a conventional RC low-pass filter, giving 18 dB per octave roll-off at extreme high frequencies. However, the shoulder of the curve would be so gradual that the filter would be nearly

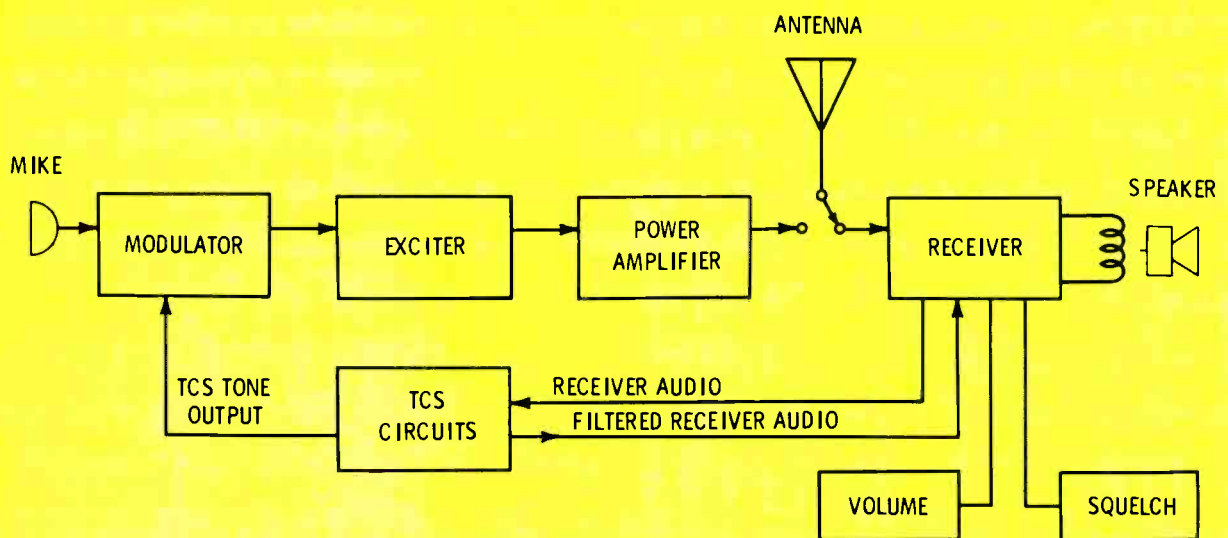


Fig. 2 A low-amplitude audio sine-wave signal is added to the voice modulation all the time during transmissions of the CTCSS systems. Receiver audio is filtered to minimize the audibility of the tone during receiving.

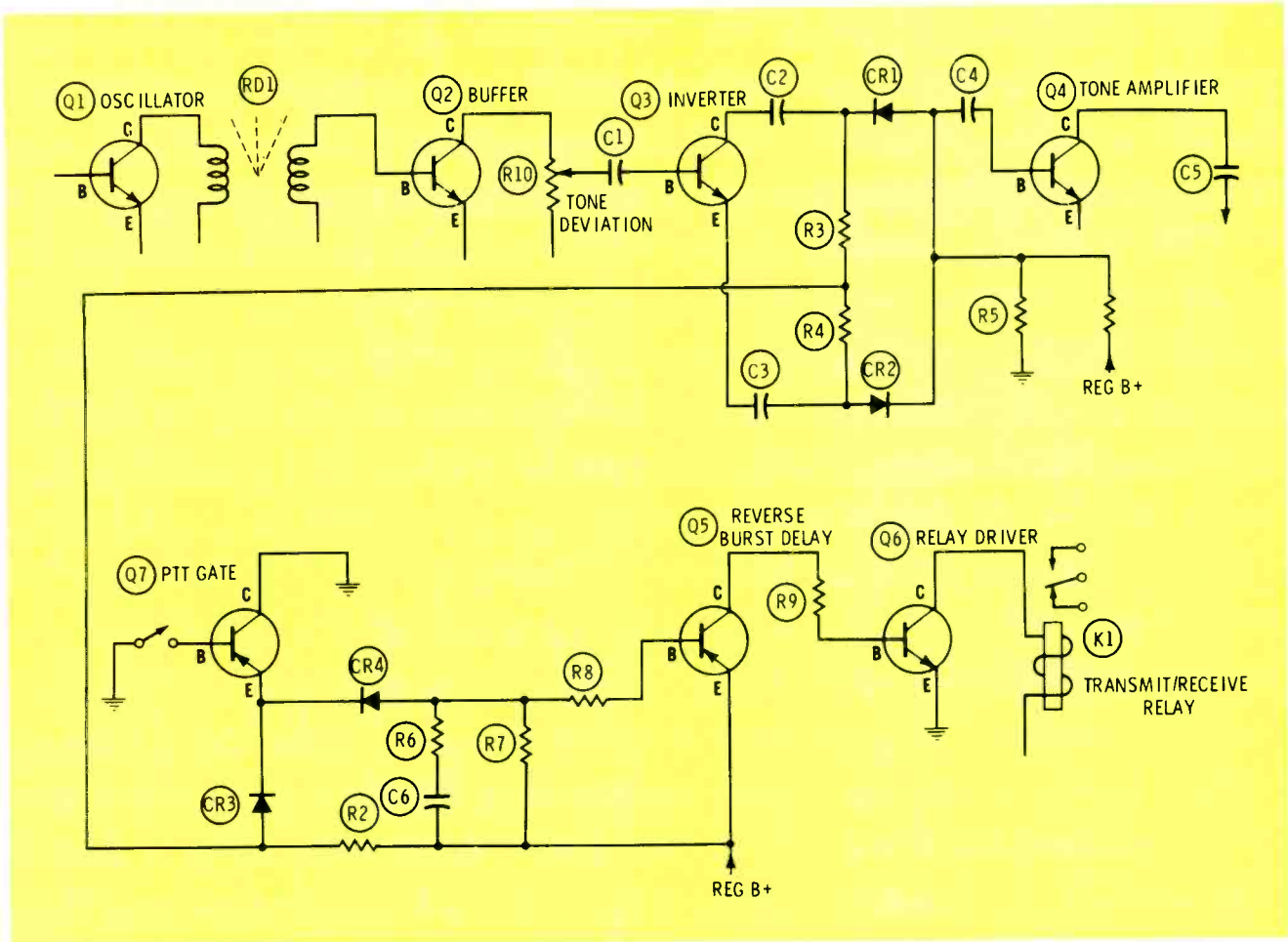


Fig. 3 To prevent "squelch tail" in receivers, the phase of the reed signal during transmission is reversed just 150 milliseconds before the carrier switches off. This is comparable to shifting the gears of an auto into reverse for a time to slow it down rapidly.

useless for the application;

- If C4 and C5 were disconnected (leaving C6), the roll-off would never exceed 6 dB per octave, and the shoulder of the curve would be rounded;

- If C4, C5, and C6 all were connected to Q2's emitter (C6 now goes to ground), there would be almost **no** filtering action! In an emitter follower, the same amplitude and waveshape appears at both the base and emitter. Therefore, the capacitors would be connected with both ends to virtually the **same** signal. Components wired that way act as though they were disconnected.

With those basic concepts in mind, let's go through the sequence. The beginning of the roll-off is when R1, R2, R3 and C6 attenuate the frequency. For frequencies below that point, the same amplitude appears at C3 and the base of Q1, so C4 and C5 do

nothing.

Any attenuation by C6 causes a voltage difference between C3 and the emitter of Q2. Now, C4 and C5 have a signal voltage across them, and they, too, add a bit of attenuation.

The net result is a frequency curve that is flat up to about 200 Hz, then has a fairly-sharp shoulder with an attenuation of 18 dB per octave above the shoulder.

The reason for the filter is to eliminate any possibility of static, whistles, or voice frequencies falsely opening the squelch when the station has not been called.

Reed and gate drivers

The filtered audio signal from Q2 is amplified by Q3 and Q4, raising the level to that required to drive the resonant reed, RD1. Diode CR1 protects the reed assembly, by clipping any excessive level.

Selectivity is so sharp that the

tone must be within about 1 Hz for it to vibrate the reed. When the reed vibrates, a signal goes to Q5, a buffer provided to prevent excessive loading of the reed.

CR2 and Q6 detector circuit changes the AC signal from Q5 into a DC voltage, that is amplified by Q7 and Q8 and operates the squelch-gate circuit.

When the microphone is removed from its hanger, diode CR3 is forward biased, reducing the positive voltage at the collector of Q6. This in turn causes Q7 and Q8 to conduct and turn off the squelch, allowing the audio to be heard for the purpose of monitoring the channel to make sure it is clear before transmitting.

Active-Filter CTCSS

Development of high-stability components and solid-state devices (with less heat than tubes) has made possible all-electronic CTCSS

systems. One imperative is that the electronic system must be compatible in operation with the reed system, for many two-way systems will have a mixture of the two types.

Most of the circuitry is similar in the two systems. But the resonant reed assembly is replaced by a precision RC filter plus the amplifiers to make it function either as a filter or as a stable oscillator.

Ideally, the tone should not vary more than $\pm .5$ Hz between -30 degrees Centigrade and +60 degrees Centigrade. Only during the past two years have the electronic systems become more reliable than the reeds. Evidence of the small tolerance and the high quality of some parts is found in the following excerpt from a factory manual:

"The tone board assembly consists of precision components selected and matched at the factory. Do not attempt to replace individual components in the field; in the event of a malfunction, order and install a new plug-in module."

An electronic circuit can replace a resonant-reed assembly (Figure 5). The precision frequency-determining network (inside dotted lines) is a bridged-T rejection filter.

In a bridged-T filter, the signal

travels through two paralleled RC "T" filters; one is a high-pass type and the other is a low-pass kind. Each filter alone would cause a gentle falling curve at the desired frequency. However, each also gives a phase shift (high pass = leading phase, low pass = lagging phase). At the frequency where the total phase difference between the filters approaches 180° , cancellation takes place, almost eliminating the signal.

If such a filter is placed in the negative-feedback path of an amplifier, the curve resulting is a sharp peak resembling a single high-Q tuned circuit.

One kind of plug-in network (picture in Figure 6) has each resistor made up from two precision resistors in series. Of course, factory matching can produce ultra-accurate resistance values. But in addition, the use of different types of resistors seems to indicate a compensation for ambient heat.

Another basic type of plug-in module, that's field-adjustable for exact frequency, is shown in Figure 7. It has two IC's, several transistors, a level control, and a tuning control.

It is predicted that electronic systems eventually will supersede the reed types.

Two-Tone Sequential Systems

Some applications require more codes and a lower percentage of false calls than is possible with just a single tone. The most-simple and widely-used system is a natural evolution that has two tones of the proper sequence and duration. (See Figure 8.)

When the first tone is received, tone-1 detector is activated, providing an input to the coincidence detector and the timing switch. The timing switch turns on the tone-2 detector for a short period of time. If the second correct tone is received during that time, another signal from tone-2 detector to the coincidence detector causes the call indicator to be activated. However, if the first tone is received, but the second has the wrong frequency or is not there at the proper time, the circuits reset and wait for the first tone again.

Many variations of the actual circuit are found, but the final results are the same. As explained last month, once a two-tone system is activated it remains on until manually or automatically squelched.

Electronic, not reed

The two sequential tones usually

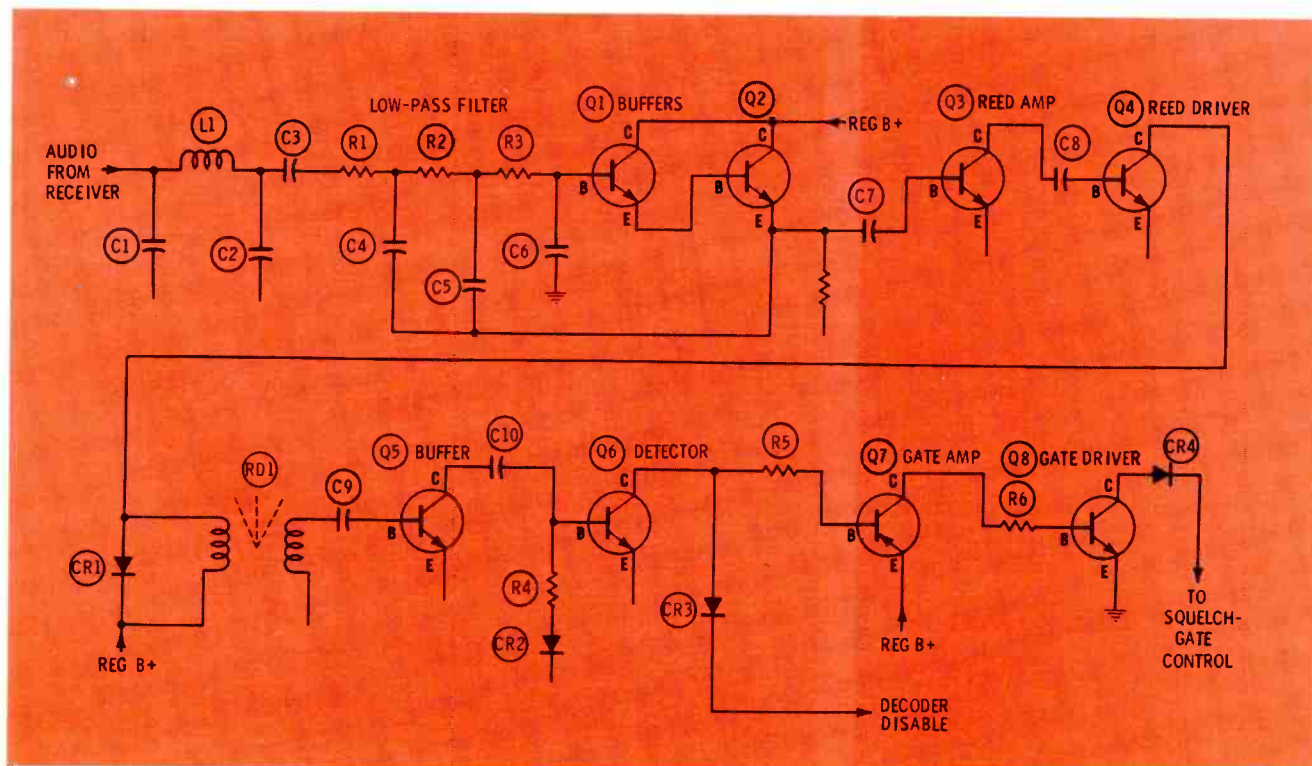


Fig. 4 The low-pass filter section and the buffers comprise an active filter, giving a sharp cutoff curve. Grounding CR3 cancels the disable so an operator can be certain the channel is clear before he transmits.

Your VTVM is obsolete!

This may sound like a harsh claim, but it's true. Thousands of TV technicians are using instruments designed in the 1950's to trouble-shoot circuits designed in the 1970's.

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Now you need an instrument to look at the voltages at each pin of an IC with sufficient accuracy and resolution to determine proper IC operation.

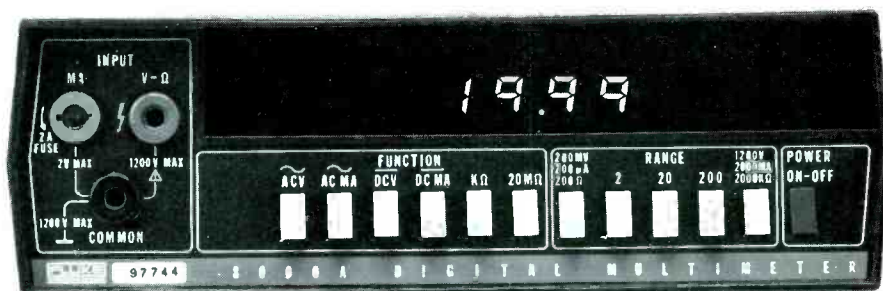
For example, a reading of "around 2.8 volts" is no longer sufficient. You must be able to distinguish between 2.80 and 2.82 volts.

You need a test instrument that gives you 0.1 ohm resolution so you can reliably measure resistance of switch contacts, circuit breakers, and low value resistors.

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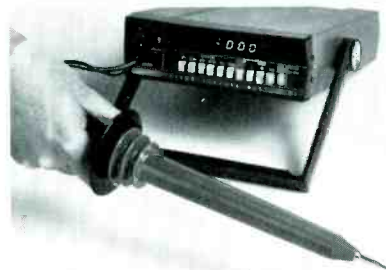
Unlike other DMM's the 8000A has fast response time—3 readings a second. And the bright, digital readout means that no interpolation is necessary.

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are generated electronically. A double-reed encoder system would be cumbersome and costly by comparison. Precision networks often are selected by pushbutton switches for the desired code, then the "start" button is operated. The circuitry automatically generates the proper tones in the sequential order that's required.

In the constant search for greater accuracy, several companies have introduced digitally-synthesized code generators. The heart of such an encoder is a single master oscillator of extremely-high stability.

Servicing Selective Call

Troubleshooting selective-call equipment comes in all degrees of complexity. But, just to keep it simple, we'll divide the repairs into two categories.

Field servicing

Much of the servicing done in the field, away from the bench and accurate test equipment, is by substitution and logic.

In a reed system, the first suspect is the reed. In transceivers that have identical reeds for transmit and receive, just swap the reeds and see if the trouble follows the reeds. That is, if the original trouble was with the encoding during transmission, swapping the reeds would make the transmissions okay, but the receiver decoding defective.

If the transmit and receive reeds are different, borrow a reed from another unit of the same model and substitute it for the suspected one.

A quick-and-dirty test of a reed is to hold it between thumb and finger while you feed an audio signal to it. An ordinary audio generator is satisfactory as a source. Vary the frequency until you feel a vibration of the reed, reduce the input level and retune until you have found the precise spot where vibration is greatest. Try a known-good reed and compare the results with the suspect.

Often it's not necessary to employ a more-precise test. Generally, reed problems fall into one of two

categories: off frequency; or insensitive. The symptom of loss of sensitivity is that the reed needs excessive drive to function at all, or it fails to respond regardless of drive.

Electronic systems usually have plug-in networks, which can be substituted easily as a test. Poor temperature stability might result in a failure to operate either in hot or cold weather.

Shop servicing

Accurate and stable equipment to check frequencies is a necessity for servicing on the bench.

A digital frequency counter would seem to be the ideal choice. However, there are problems. Some counters, that are especially designed to count away up in the megahertz, can't seem to count audio tones; or they do so only with critical adjustments and spurious readouts. Also, many counters require from one second to 10 seconds for an accurate reading at low audio frequencies.

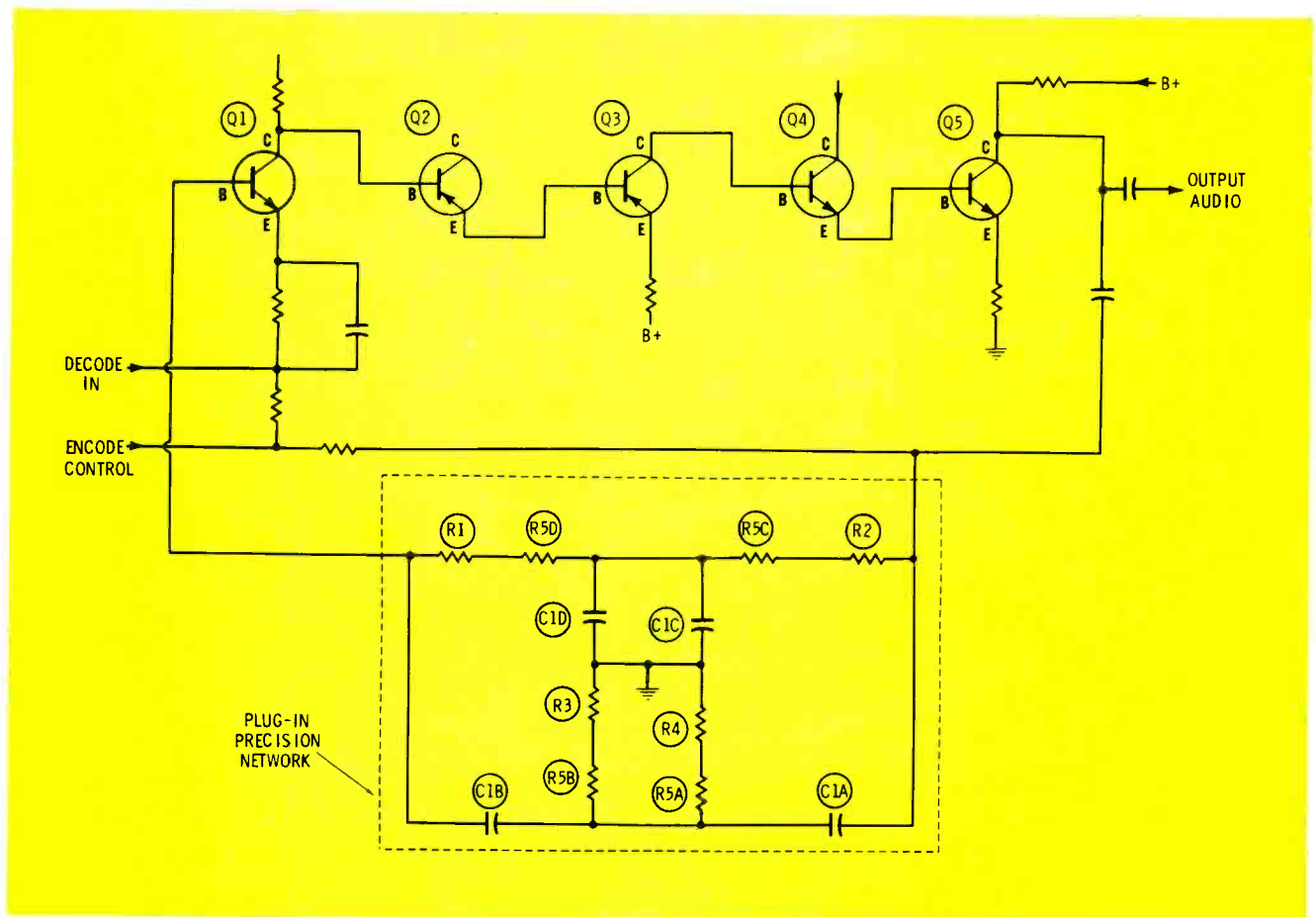


Fig. 5 Inside the dotted lines is shown the precision bridged-T network that cancels one frequency. When connected in a negative-feedback path (as here), it gives a sharp resonant curve that's useful as a filter or as an oscillator.

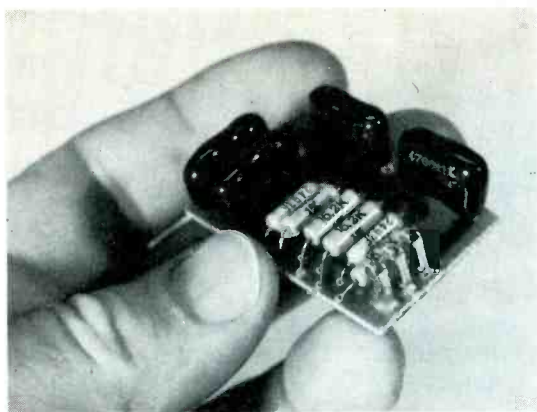


Fig. 6 Resistance values of this plug-in bridged-T filter have been trimmed at the factory by using two in series for each.

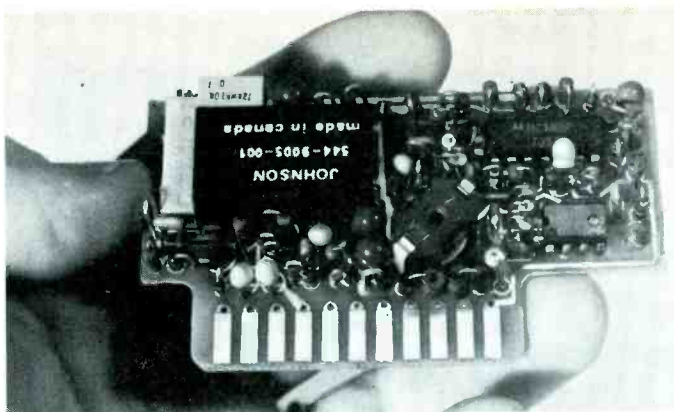


Fig. 7 One electronic substitute for a reed unit can be adjusted for the desired frequency.

One solution is to obtain a counter that reads time periods. For example, a 100 Hz tone has a time period of 10,000 microseconds. So, 100.2 Hz would be 9980 microseconds, or 99.8 Hz would be 10,020 microseconds. The instruction book for the counter will detail the recommended method of period measurements.

A digitally-synthesized audio generator has the required accuracy, but supplies only one frequency at a time. A single tone is of little help in checking a two-tone sequential system, where the tones must have the proper duration and sequence. The ideal solution is a specialized two-tone sequential generator sold by Singer, Cushman, or Motorola. The dual tones are selected by dials, and the timing and duration also are controllable.

Installation Tips

Add-on units sometimes present special problems. RF from the transmitter or ignition noise riding in on the battery line might affect the proper operation of the encoder. Such problems are minimized when the encoder can be placed inside the transceiver, permitting short leads.

Some add-on units have adequate A+ filtering; but many do not. If needed, an LC filter similar to those used with tape players can be installed.

RF elimination is done at the input to the modulator in the transceiver. Slip a ferrite bead over the center conductor of the shielded cable coming from the encoder, and

bypass it with a capacitor to a common point. Modulators are sensitive to noise and RF, so precautions are necessary. In fact, complaints of noisy communications following the installation of a TCS unit usually are caused by extraneous signals fed to the modulator.

Fortunately, two-tone-sequential add-on decoders present few difficulties. That's because there are no changes to the internal circuits; instead, the speaker line is opened until the audio tones unlock the decoder, thus allowing the audio to reach the speaker. Some units also signal by honking the car or truck horn or blinking the lights.

Comments

More than 50% of the transceiver radios sold now have tone-con-

trolled squelch, and perhaps 10% have alert decoders of some type. As the channels become more crowded, TCS operation is the only way to shut out everyone else using your channel.

Troubleshooting tone squelch circuits is not essentially different from that in other electronic products. A little study of the purpose and operation of the specialized circuits will suggest techniques and shortcuts.

Although equipment to generate or measure audio frequencies accurately is certainly a money and time saver, it is possible to operate with conventional audio equipment while you are getting started in the business. It's not difficult to become a competent "Old Pro" in this profitable field. □

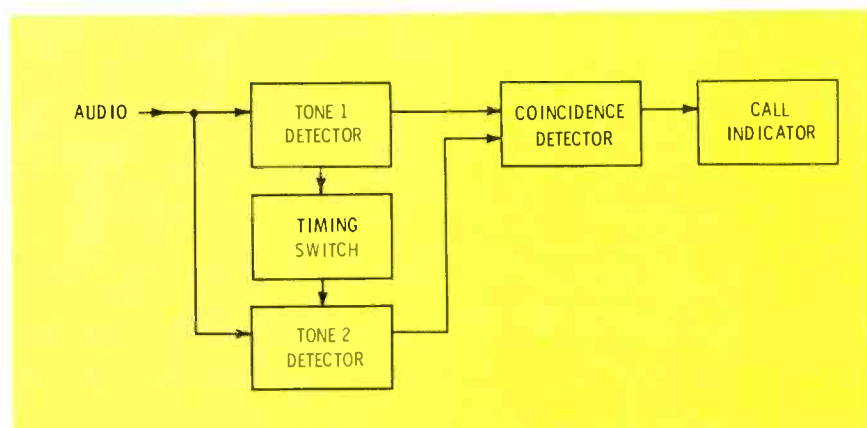


Fig. 8 In the two-tone-sequential system, the first correct tone activates the tone-1 detector, which sends signals to the coincidence detector and the timing switch. The timing switch turns on the tone-2 detector for a short time. A second correct tone causes the tone-2 detector to signal the coincidence detector, and when it has both signals, it turns on the call indicator. If the second tone is wrong in any way, the circuit resets itself to standby.

More favorite repairs

By Ron Meyer, CET

Following the popular acceptance of his favorite repairs in the January, 1975 *Electronic Servicing*, Ron Meyer again relates the details of other television repairs that stick in his memory.

No Raster

Symptoms

There was no high voltage at the picture tube, although all the tubes of the Admiral H4-1A b-w TV receiver (Photofact 909-1) seemed to have lighted heaters. When I checked the horizontal-sweep tubes, the oscillator was okay, and the 33GY7A output tube tested very weak. The plate of a new output tube soon glowed red, and I rapidly turned off the power to prevent ruining the replacement.

Diagnosis

Because the heaters were in series, it was not practical to

protect the new output tube from damage by removing it from the chassis during tests of the oscillator circuit. The old tube was ruined already, and too weak to draw excessive current, so I replaced it temporarily.

Incidentally, if you do remove the output tube (in parallel-heater circuits permitting such operation), don't expect any **DC voltage** at the grid pin. Without the grid/cathode "diode", there can be no rectification, and thus no negative grid voltage.

A quick series of DC voltage measurements at the socket of the 8LT8 horizontal oscillator showed a normal screen-grid voltage, but all other voltages (grid, cathode, and plate) were too low (Figure 1). Replacement of the tube produced insignificant changes of voltages.

The +40 plate voltage seemed the most promising symptom, even after making allowances for the reduced voltage source from the

B-boost supply (which would go down to about +120 when the sweep was missing). More data was needed, because a defect in grid, cathode, or plate circuit **could** account for the low plate voltage.

A grid problem, producing a less-negative voltage, certainly would reduce the plate voltage, but it also would raise the cathode voltage. Those symptoms didn't fit. Leakage from cathode to ground could account for the voltage readings. However, careful ohmmeter measurements proved the cathode resistor and both capacitors were well within tolerance. Only the plate circuit and its supply voltage remained as suspects.

Plate voltage for the oscillator tube came through R63 and R60 from the B-boost supply, which then measured about +115 volts. The voltage drop across R60 was about 50% more than across R63. This indicated that R63 and R60 probably were correct in value, because the chances are very slim that both would increase or decrease the same. These symptoms indicated excessive plate current, but the other tube voltages proved otherwise.

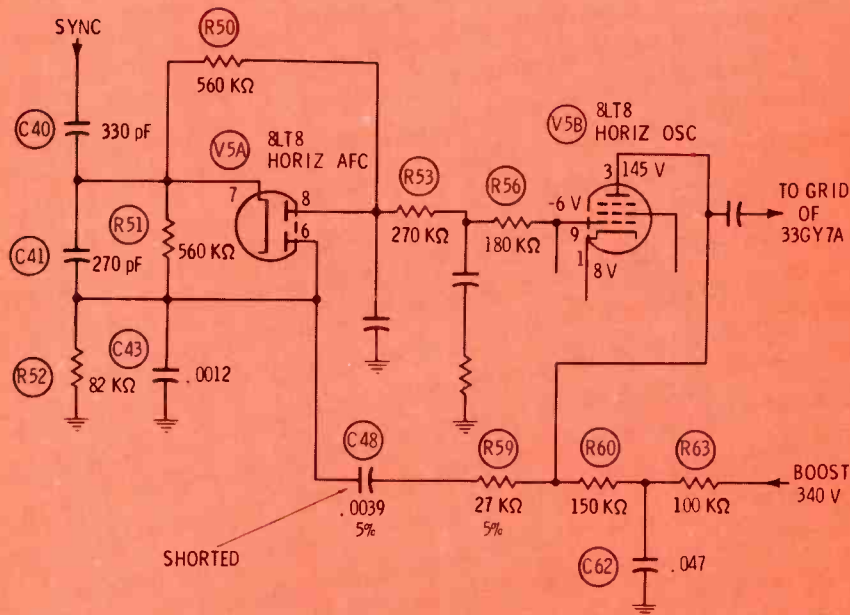


Fig. 1 The horizontal AFC schematic of the Admiral H4-1A b-w TV chassis is different from most, but sync and a sawtooth from the horizontal oscillator or deflection still are necessary for proper locking.

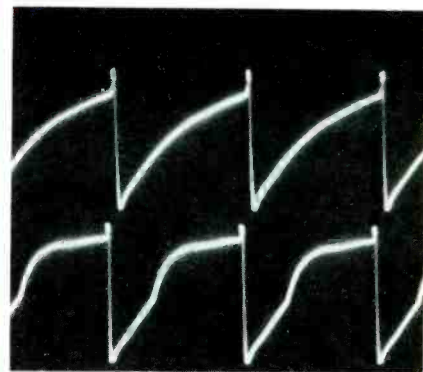


Fig. 2 Trace at the top is the correct waveform at the grid of the vertical oscillator of the RCA CTC30 chassis following repairs. At the bottom is the distorted waveshape when leakage inside the service/normal switch caused vertical and AGC problems.

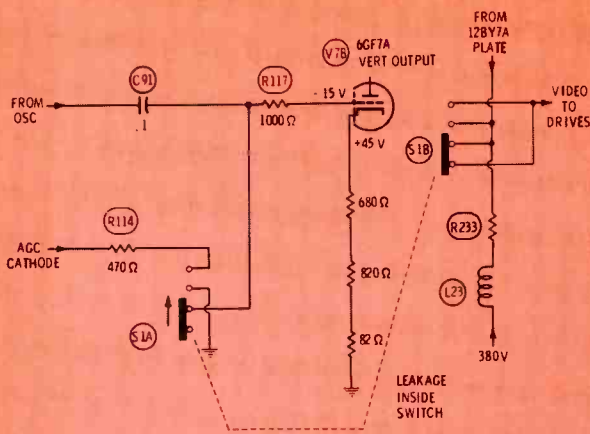


Fig. 3 This partial schematic of the RCA CTC30 shows how AGC, vertical, and video signals became mixed together.

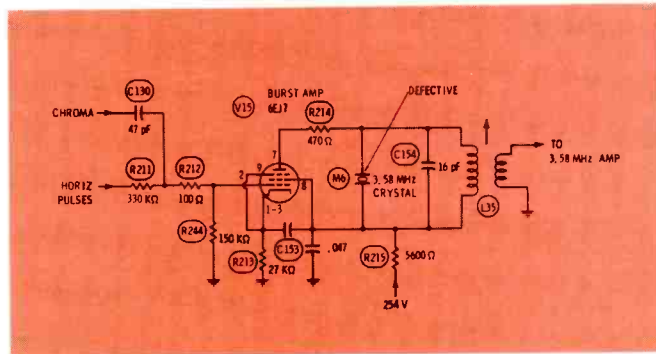


Fig. 4 A 3.58-MHz crystal that wouldn't ring when hit by the envelope of burst eliminated the color in an 18CC30 Zenith receiver.

Then I noticed R59 and C48 that feed some of the oscillator output back to the horizontal AFC diodes. A VTVM should read the same DC voltage at both ends of R59 in a normal circuit, but in this case, R59 had a large voltage drop. There was no place for the voltage to go, except through C48, and I was not surprised to find C48 measuring a low resistance. Replacement with a new polystyrene-type brought back the drive to the output grid, and a new output tube completed the repair.

Comments

Since that repair, I have found at least three more of these capacitors shorted or leaky.

Insufficient Height And Instability

Symptoms

The picture from the RCA CTC30 chassis (Photofact 926-2) was pulled up from the bottom, the linearity was spread at the top, the hold control was almost to one end, and locking was so loose that the picture flipped occasionally. In addition, there was a look of overload or AGC trouble.

Diagnosis

A new 6GF7A vertical tube and adjustment of the height and linearity controls did nothing to improve the height or locking.

Quickly, I made a few DC voltage readings and checked a couple of waveforms. Control grid of the output section was +120 and

the cathode nearly +150 volts. These readings suggested an open cathode resistor or a defective tube, but neither was the case.

At the grid (pin 9) of the vertical-oscillator tube the waveform was distorted (Figure 2). The waveform and the hold control against one end convinced me that the problem was in the positive-feedback loop between the plate of the output tube and the grid of the oscillator. Unfortunately, I tested or replaced all the capacitors and resistors in the loop, finding nothing wrong.

The solution came accidentally after I moved the service/normal switch to the "purity" position and noticed that the height and linearity were almost perfect. I knew the switch had three functions (Figure 3): connecting or disconnecting the cathodes of the picture tube to the plate of 12BY7A video output tube; grounding the vertical-output grid in the "service" position to provide a single horizontal line; and grounding R114 (in the cathode circuit of the AGC keyer) to produce excessive AGC, giving a blank raster. Prompted by a hunch, I disconnected the wire going from the switch to R114 and slid the switch back to the "normal" position. Immediately, the vertical spread to full size, and the supposed AGC problem disappeared.

Out of curiosity, I checked the R114 end of the wire, finding +275 volts and video waveforms. Installation of a new switch solved all

the problems.

No Color

Symptoms

No color could be obtained on the Zenith (18CC27 chassis, Photofact 1225-3), although the b-w was excellent and the fine tuning would adjust normally into the sound bars.

Diagnosis

One of my trustworthy methods, when there's a loss of color, is to check for **both** the chroma signal and the 3.58-MHz carrier at each demodulator. These signals are of equal importance; demodulation is impossible without both.

In this case, there was sufficient chroma at pin 2 of the demodulator IC, but no 3.58-MHz signals at pins 4 and 5. Working back through the circuit towards the burst amplifier, the signal was similar to weak burst, instead of the continuous carrier that was required.

Figure 4 shows the circuit of the burst amplifier, which is slightly different from most. The large cathode resistance cuts off all plate current, except when the horizontal pulses appear at the grid to temporarily bias-on the tube, allowing the burst to be amplified and appear at the plate. That much is conventional.

But the unusual feature is the connection of the 3.58-MHz crystal in parallel with the output tuned circuit (L35 and C154). Burst is supposed to shock excite the crystal,

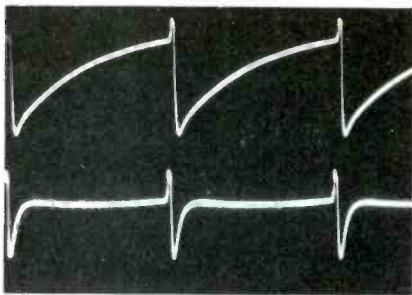


Fig. 5 The wrong waveform at the grid of the vertical oscillator in a Magnavox T952 alerted the technician to the possibility of a defect in the positive-feedback network between the plate of the output and the grid of the oscillator. At the top, the correct waveform is shown for comparison.

which then continues to ring mechanically until the next envelope of burst again strikes it. In this case, the burst was there (proving that most of the components were okay), but it didn't produce a continuous carrier by ringing. All signs pointed toward the crystal, and a new one brought back the color.

Insufficient Vertical

Symptoms

The vertical sweep was compressed at the bottom and expanded at the top of the picture on the Magnavox (T952 chassis covered in Photofact 1293-1). Also, the hold control was at the end of its rotation, because the circuit was trying to run slow.

Many, many parts defects can cause these same symptoms, so it is necessary to look at some waveforms, and analyze the DC voltage before you know where to concentrate the search.

Diagnosis

One of the first tests should prove or disprove any leakage of the coupling capacitor at the grid of the output tube, or any other problem that reduces the bias of the output tube. This time, the bias was slightly out of the normal range, but just enough to indicate that it was the **result** of a defect, and not the cause of the difficulty.

Next, the waveform at the grid of

the oscillator must be analyzed. Figure 5, bottom trace shows the incorrect waveform at the oscillator grid. This seemed to indicate a problem in the positive-feedback loop between the oscillator grid and the plate of the output tube (Figure 6). Starting at the grid, I traced back a part at a time, but found no discrepancies until I reached C173. Both ends of C173 had the same waveform: pulses with a sawtooth between each pair (see Figure 7).

There should be a different waveform at each end of C173; therefore, it seemed likely that the capacitor was shorted. I was not surprised to find a low resistance, during an ohmmeter test.

Comments

The Magnavox method of printing the parts identification numbers on the foil side of the board helped in locating the components. I could go from the Photofact schematic to the circuit board, without pausing to find the parts on a pictorial.

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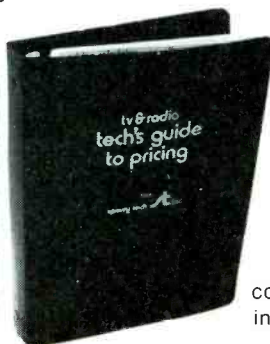


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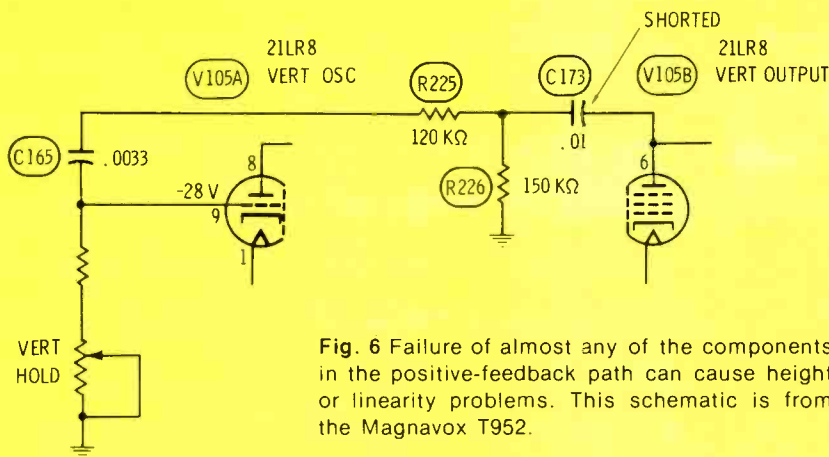


Fig. 6 Failure of almost any of the components in the positive-feedback path can cause height or linearity problems. This schematic is from the Magnavox T952.

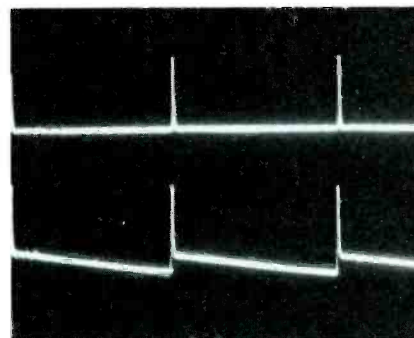


Fig. 7 C173 shown in Figure 6 should have the waveform shown by the bottom trace at the output plate end, and the top waveform of pulses at the left end. When C173 was shorted the same waveform (bottom one) appeared at both ends.

Snow In The Picture

Symptoms

All active channels, even those with strong signals, had more than the normal amount of snow. A technician previously had installed a new tuner in this RCA CTC30 chassis, but it hadn't helped, according to the customer.

Diagnosis

A technician friend of mine once sent in a tuner for overhaul three times because of excessive snow. After much agony he found the cause on the main chassis, not in the tuner. So, I don't often get fooled, because now I know that snow is **not necessarily** a tuner defect.

To be completely frank about the subject, it's true that sharp, grainy snow usually results from insufficient RF signal reaching the input to the mixer stage in the tuner. And that points the finger of suspicion squarely at the RF stage, antenna, or balun and high-pass filter.

Any RF stage needs the proper supply voltage and the correct bias, so a couple of DC-voltage measurements usually tells the story.

The voltage at the 6CW4 end of the plate-supply resistor was +265 volts. That's too high, indicating either the voltage was failing to reach the tube, or the resistor was shorted. Although a shorted resistor, when there's no sign of overheating, is a rarity, I checked it anyway. It was okay.

It's difficult to reach the plate pin at the RF tube socket to test for voltage there. So, before wasting any time, I measured the RF AGC voltage at the green wire to the tuner. It was -10 volts; much too negative. Quickly, I grounded the AGC terminal, and found the snow had disappeared, and the plate voltage had dropped to a normal +80 volts.

All of this was proof that the basic defect was in the AGC voltage, not in the tuner. The next step was to pinpoint the bad component.

Almost all AGC circuits for tubes feed some B+ into the RF AGC. The purpose is to delay the application of any negative AGC voltage until the station signal strength is very strong, when the gain reduction is necessary to prevent mixer overload. That way, there is no gain reduction for weak signals, preventing excessive snow.

You might wonder what happens to this positive voltage, and what effect it has on the RF tube. Some old sets used a diode to clip any positive voltage from the RF AGC, leaving only any negative. But, this receiver, and many others, operates the RF tube with no cathode bias, and lets the grid act as a diode to eliminate the weak-signal positive voltage. That's the reason for the high-value plate-supply resistor; it reduces the plate voltage when the bias is low, preventing excessive wattage dissipation in the tube. Of

course, the grid at most only runs a few tenths of a volt in the positive direction.

Photofact 1000-3 for the RCA CTC38 showed the RF AGC circuit as in Figure 8. Because I know high-value composition resistors tend to increase in resistance as they age, I started to check all of them. All were okay, until I searched for R104. It was missing! The result was too much snow, the same as if the resistor had increased to 10M, or more.

A resistor was installed, and performance on all channels tested, to complete this job.

No Color, Later No Horiz Sync

Symptoms

Before the first repair, the symptom was "no color". Later it changed to loose horizontal locking.

Diagnosis

During the first repair of the Zenith 17EC45 chassis for a complaint of no-color, I replaced the 9-86 chroma module. The color promptly came in, so I notified the customer, who picked up the receiver.

Two days later the same receiver appeared on my counter, but the disgusted customer reported large stripes on the screen.

This time a 9-90 horizontal module brought back the horizontal locking. It was unusual for two modules to fail so near the same time. Nagging doubts arose in my

mind.

The original 9-86 chroma module was still in the shop, so I retrieved it and tried it in the chassis. All color characteristics were perfect, and my jarring the chassis and modules showed no tendency for an intermittent.

Was there a possibility of some tie-in between the two problems? I referred to Photofact and found one common bond between the chroma and color-locking circuits. The burst-keying pulses for the chroma, and the pulses that are filtered and used for sync comparison in the horizontal, both came from opposite polarities of the same winding of the flyback (see Figure 9).

I traced the pulse paths on both modules, finding no problems on the original chroma module, but R808, the first part I checked on the 9-90 horizontal module, measured 150K. That's a little out of tolerance, when the value should be 330 ohms!

After mulling over the facts for some time, I believe this was the sequence:

- first, R808 burned and became a low-value resistance;
- this reduced the horizontal pulses from the flyback so much that the burst separator malfunctioned, activating the color killer, and stopping the color;
- the new chroma module was just enough different that it operated

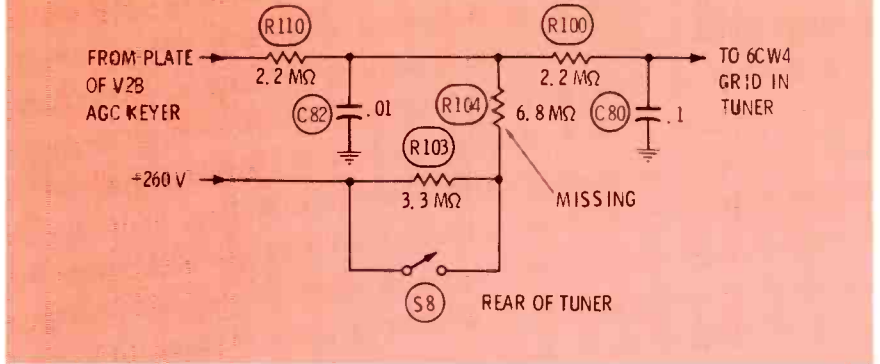


Fig. 8 An open or missing R104 can cause snow in the picture of the RCA CTC38 (or any similar circuit with a resistor from B+ to RF AGC).

with the minimum horizontal-pulse amplitude;

- about this time the resistance of R808 changed again, becoming nearly open;
- now, there was no extra load on the pulse winding, and the chroma was okay with either original or new chroma modules, but the open resistor eliminated one of the signals necessary for horizontal AFC, making locking impossible.

Since that first R808 failure, I have found three more. So, now I merely replace it with a 1-watt high-quality resistor, and have had no repeats.

Incidentally, it's not too unusual for resistors to go down in value when overloaded, and later to open

or become higher resistance. That's one good reason to replace resistors which show signs of overheating, even when the resistance at the moment remains within tolerance. There's too much possibility of a delayed failure.

Summary

These selected case histories illustrate some of my basic troubleshooting principles. First study the symptoms and listen to the customer; next make an educated guess where the defect might be, and finally select the test instrument most likely to find the bad part or condition in the least amount of time, but with the greatest accuracy. □

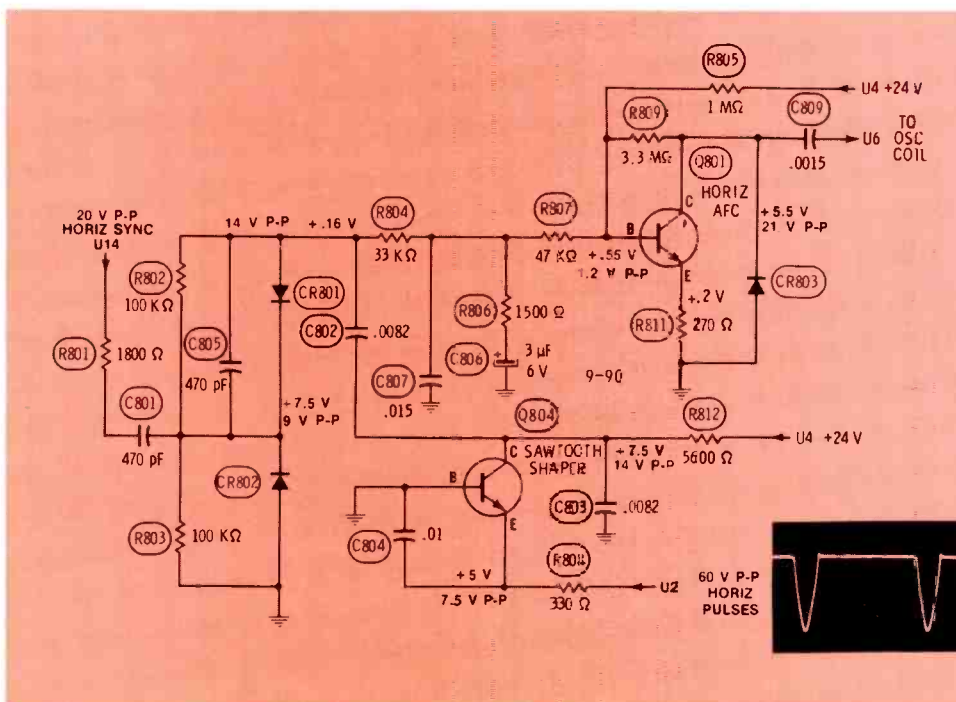


Fig. 9 F808 might eliminate either the color or the horizontal locking, depending on whether the value is too high or too low (Zenith 17EC45 chassis, also 19EC45, 17FC45 and 19FC45).

SERVICING MODULAR COLOR

, Part 7



By Charles D. Simmons

Many solid-state color receivers regulate the main DC supply by using a series transistor to vary the voltage drop. Others have a saturable-type power transformer which regulates all the AC voltages coming from it. Some models of Quasar use an unusual bridge rectifier with SCR's replacing two ordinary diodes. Regulation is accomplished by varying the turn-on time of the SCR's.

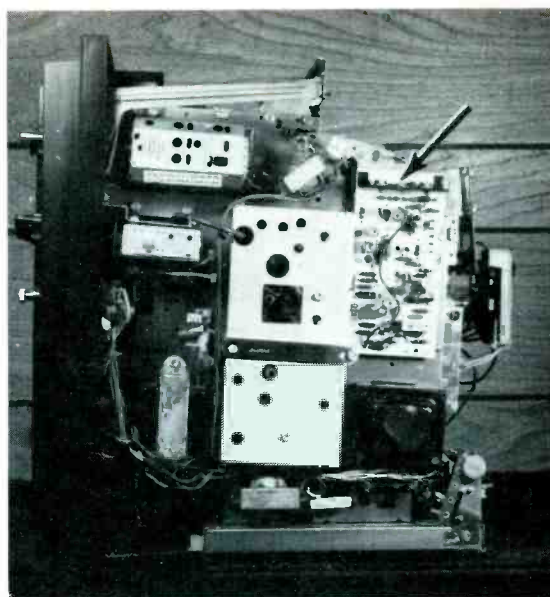


Fig. 1 An arrow points to the "ZC" power-supply module on a Quasar E19TS-941 chassis. The large black choke (L803, just below) plays an important part in the regulation.

The length of time the bridge rectifiers conduct is varied automatically to regulate the +80-volt main DC power supply in the "ZC" panel used in the Quasar color receiver E19TS-941 chassis (Figure 1). Increased drain or decreased line voltage will reduce the DC voltage, so the circuitry compensates by lengthening the conduction time of the rectifiers, raising the voltage to nearly the original value. Of course, if the +80-volt supply rises for any reason, the rectifier conduction time is shortened to decrease the supply voltage.

Although the basic concept is simple enough, additional circuits are necessary for proper start up, for overvoltage protection, and for synchronizing the regulator with the 120-Hz ripple.

Therefore, the operation is much easier to understand if we start with some fundamentals, and add a step at a time.

The Basic Bridge

Do you remember the old synchronous vibrators in car radios? Only a transformer and vibrator were necessary to produce DC. There was no rectifier. The vibrator simultaneously switched the primary and secondary polarities so the output voltage always had the same polarity.

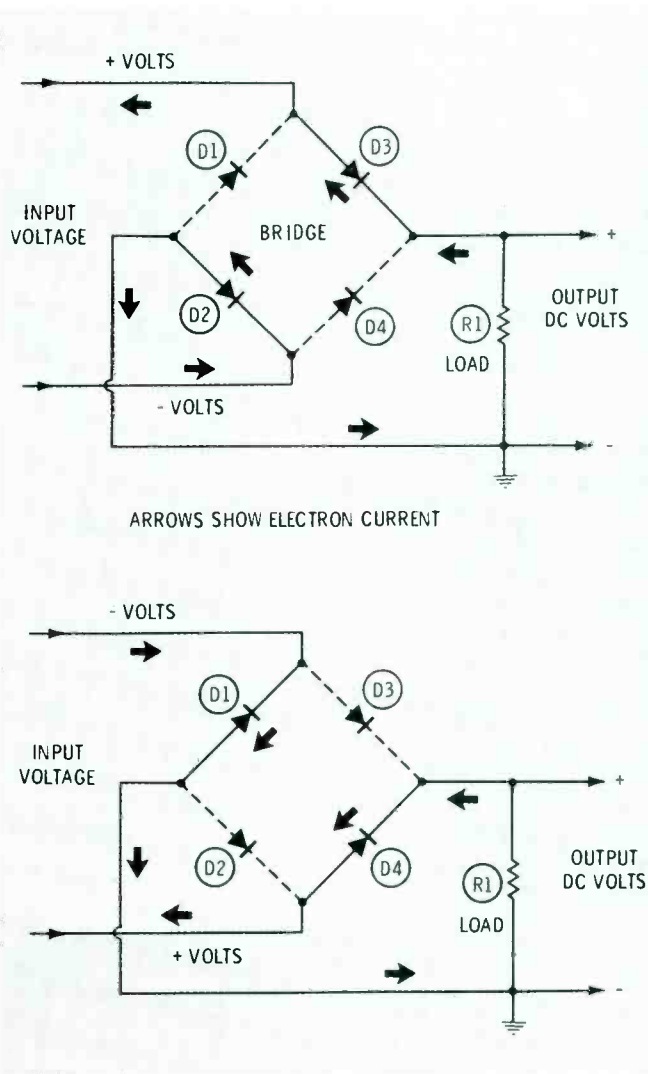
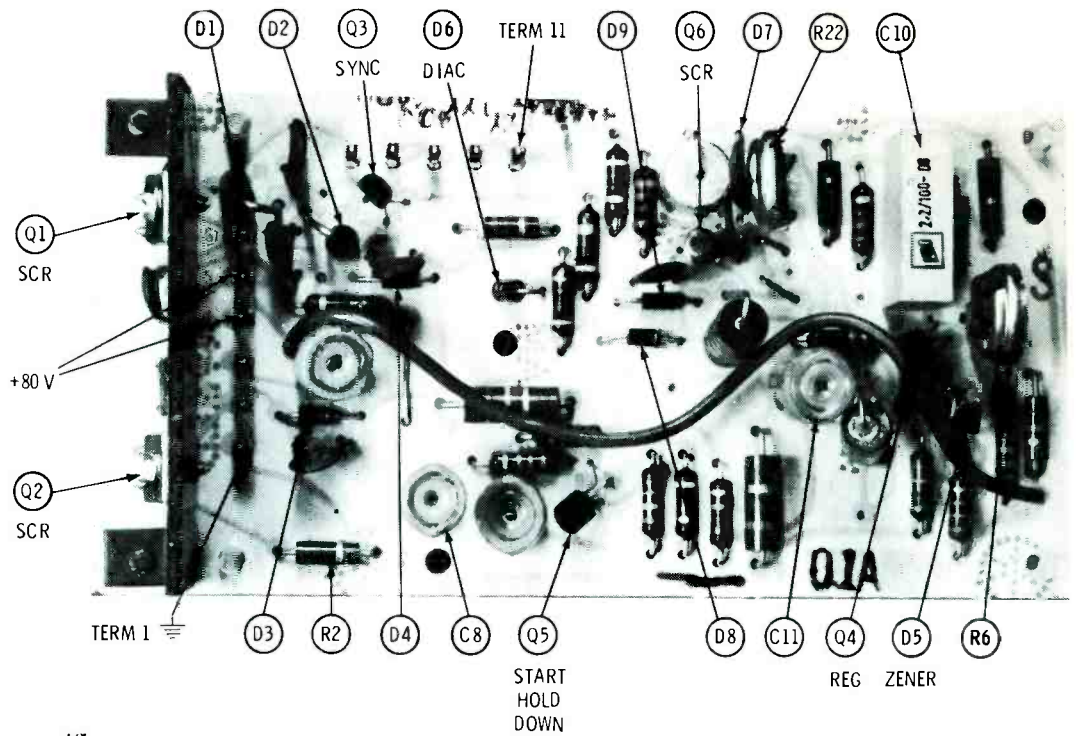


Fig. 2 In a bridge-rectifier circuit the polarity of the incoming AC signal causes the diodes to switch automatically so the input lead that's negative always is grounded, and the lead that is positive always connects to the B+ end of the load. Drawing at the top shows the electron current, and which diodes conduct, when the positive comes to D1 and D3; while the lower schematic gives the current and diode conduction when the positive is at D2 and D4. In all circuits, a diode conducts when the anode is positive relative to the cathode, or when the cathode is negative relative to the anode. When those polarities are reversed, a diode becomes an open circuit.



Locations of major components are pointed out on the "ZC" power-supply panel.

A 4-diode bridge rectifier essentially does the same thing. According to the input voltage, two diodes alternately connect one side of the input voltage to ground (minus) or to B+, while the other pair connects the other side of the input voltage to B+ or to ground (Figure 2). Therefore, the polarity of the output voltage does not change.

Always think of a diode as a voltage-controlled switch. When the anode is .6 volt or more positive relative to the cathode, the diode is a virtual short circuit. In other words, it conducts. But when the anode is negative relative to the cathode, the diode is an open circuit. **There are only two conditions: open or conducting.** Addition of an input filter capacitor makes the circuit peak-reading and shortens the conduction time, but this does not change the switching action or the current paths.

SCR's

SCR is an acronym for Silicon Controlled Rectifier. By strict English, it means the silicon is controlled, and that's not the intent. The true meaning is a diode rectifier made of silicon material, and also that the diode is controlled by something. Control is possible because of an element called a "gate", which operates in a regenerative-type action to allow total conduction or none. It's virtually impossible to make an SCR con-

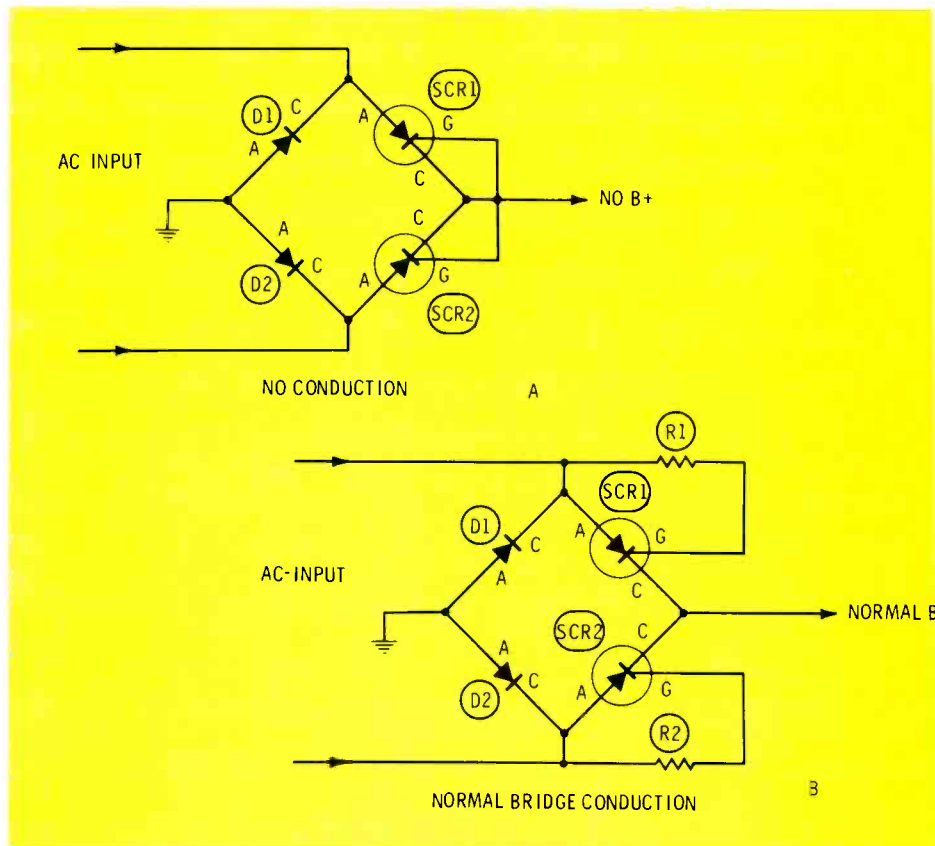


Fig. 3 SCR's can replace two bridge diodes, when it's desired to control the time that conduction starts. (A) When the gate/cathode voltage is zero or insufficient, an SCR will not conduct regardless of the anode voltage. Therefore, this bridge cannot conduct or rectify. (B) If a resistor makes the gate positive when the anode is positive, an SCR behaves exactly like an ordinary diode. This version of a bridge produces normal rectification.

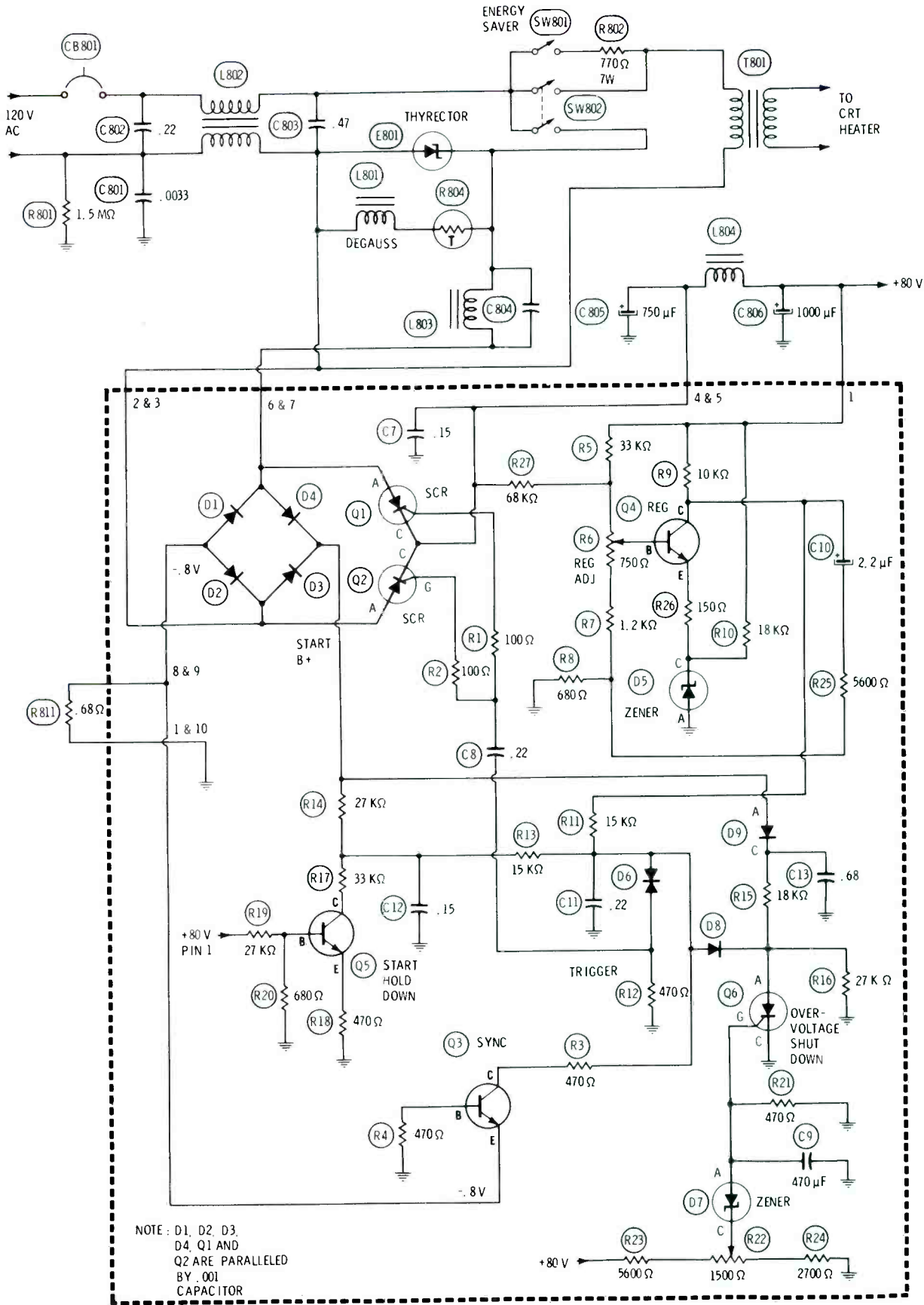


Fig. 4 This is a complete schematic of the "ZC" regulated power-supply panel of the Quasar E19TS-941 color chassis.

duct partially, even when you try to do so.

Notice in the following explanation that the voltage and polarity of **both** anode and gate must be correct before conduction can occur.

SCR conduction does NOT occur:

- when the anode is zero or negative relative to the cathode; and
- when the gate is negative, zero, or insufficiently positive relative to the cathode. **Either condition prevents conduction.**

Normal SCR conduction DOES occur:

- when the anode is positive relative to the cathode; and
- when the gate is about .8 volt or more positive relative to the cathode. **Both conditions must exist before conduction can occur.**

Especially remember this one additional statement:

- after conduction has begun, it continues until the anode becomes negative relative to the cathode (loses "latching" current), **even if the gate becomes negative in the meantime.**

SCR's can be triggered into conduction either by AC or DC gate voltages. Anode current can be supplied by positive DC voltages, or during the positive peak of AC voltages. This is the difference between SCR's and triacs: after triggering, triacs conduct equally well on positive or negative DC supplies, or on both peaks of AC voltages.

Now we are ready to see how SCR's can be used to control the conduction time of a bridge rectifier.

A Bridge With Two SCR's

Figure 3 shows two bridge-rectifier circuits. Each has two conventional diodes and two SCR's. In (A) conduction cannot occur because the gates are shorted to the cathodes of SCR1 and SCR2. Normal rectifier bridge action occurs in (B) because R1 and R2 drive the corresponding gate positive when its anode becomes positive. These are approximately the two conditions for control of the DC voltage.

Although somewhat simplified, this is the basic theory of the

Quasar regulating bridge rectifier: both SCR's are without gate voltage (therefore, non-conducting) until a certain point of the input AC voltage is reached (the point determined by another part of the regulator circuit), then a positive-going pulse is fed to **both** gates. The SCR with positive voltage at the anode conducts, and continues to conduct until the anode becomes negative, even though the pulse has ended long ago.

The other SCR with negative voltage at the anode does not conduct with this pulse, but waits until the polarity of the input voltage reverses and it is triggered by the **next** pulse. **Both SCR's receive each pulse, but only one conducts at a time.**

Therefore, the triggering pulses must have a repetition rate equal to the total conduction rate of the rectifiers. In other words, both the ripple and the pulses are 120 Hz.

Choke Input

One more component is vitally important. Without it the DC voltage would be too high for the TV receiver, and the variation of conduction time would not provide effective regulation. It is choke L803 shown in the complete schematic of Figure 4. In the schematic, the symbol is similar to that for a noise-filter RF choke. Don't let that mislead you, this component is built somewhat like a filter choke, with a large inductance, and a wide air gap in the core to prevent saturation.

Laminated-core chokes often are used to control the speed of fan motors; and other chokes (called ballasts) limit the current in fluorescent lights. In both cases, the control operates by introducing a lagging phase shift. The inductance in series, acting as a low-pass filter, delays the phase of the output voltage by as much as 90°. If the applied input voltage to a choke is changed rapidly enough, relative to the inductance, it's possible that the output voltage will not have sufficient time to reach the maximum voltage. As you can see, this is a type of voltage control.

One point to keep in mind regarding the Quasar power-supply circuit is that the power choke, L803, does **not** change the phase of

the voltage unless bridge current is being drawn. But after bridge current starts, and all the time during the current, the phase of the input voltage to the bridge is delayed by about 90°. More about this later.

Generating Gate Pulses

Gating pulses for the SCR's are generated by the solid-state equivalent of the old neon-bulb oscillator. As shown in Figure 5, R11 and C11 form a time-constant circuit. By definition, Time (in seconds) equals the Capacitance (in farads) times the Resistance (in ohms). Also, a time-constant network produces a voltage charge in the capacitance equal to 63.8% of the supply voltage after 1 time constant, and about 99% after 5 time constants.

In this case, the component that discharges the capacitance, so the charging cycle can start over again is called a "diac", which is similar to reversed-polarity zener diodes wired in series. Regardless of the polarity of the applied voltage, one diode section is always forward biased, while the other is reverse biased, but will conduct in the zener mode if a certain voltage is exceeded.

In the circuit, therefore, C11 starts to charge up to a higher voltage, which eventually would equal the applied voltage if not stopped. But the same voltage also is across the diac, D6, and when the voltage reaches the zener point, the diac suddenly conducts, discharging C11 through R12. The voltage drop across R12 is the pulse waveform used to trigger-on the SCR's in the bridge.

Figure 6 shows the waveforms at the diac and R12 during normal operation of the complete power supply.

Timing The Gate Pulses

The time necessary for a time-constant capacitor to become charged to a specific DC voltage depends on three factors:

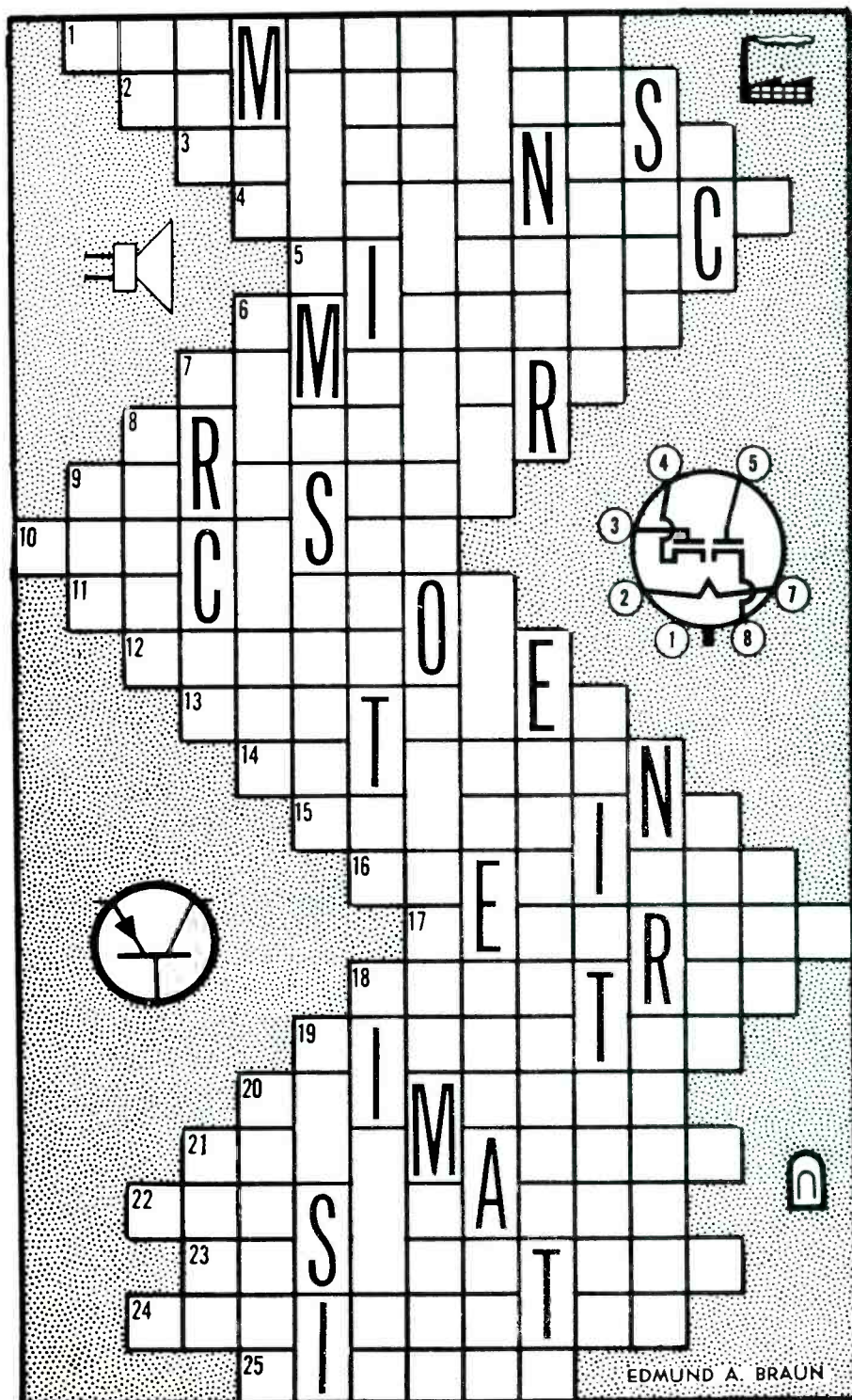
- the series resistance;
- the value of the capacitance; and
- the amount of the supply voltage.

In theory, therefore, R11, C11, or the supply voltage to R11 could be varied to make the diac fire sooner or later (reach critical voltage more quickly or more slowly). But in

YOU KNOW WATT?

by Edmund A. Braun

Sure you know what about Electronics, so have fun solving this Just-Across-Word Puzzle! Each word is connected to the word above and below by one or more letters although only one is usually shown as a clue. Each correct answer is worth 4 points; a perfect score is 100. It should prove easy to get a high rating except perhaps for someone who is sure that "Autosyn" is advertising on a car, or that "dielectric" refers to execution in a special chair! So sharpen your pencil, put on your thinking cap, and GO!



1. Part of #7 to which the motor coils are connected.
2. Pertaining to materials such as bismuth, antimony, and arsenic.
3. Visual perception of more or less light.
4. To unplug an electrical device or appliance.
5. Pertaining to a mirror which allows all light frequencies to pass except for the color which mirror is designed to reflect.
6. Waves radiated into space by a transmitter.
7. The rotating part of a motor or generator.
8. Device that protects circuits against lightning.
9. A material for grinding, polishing, or cleaning.
10. Horizontal, or X axis on a chart or graph.
11. Single-anode pool tube able to maintain a continuous cathode spot.
12. High-voltage, high capacity transmission line with a limited number of large-capacity connections between loads and point of transmission.
13. Device used to secure a conductor or other object to the structure supporting it.
14. Large doughnut-shaped accelerator which produces artificial beta radiation.
15. Process of converting electrical energy to stored chemical energy.
16. Of or pertaining to chemistry, or its forces, processes, etc.
17. A type of semi-conductor crystal.
18. A 4-electrode negative-resistance vacuum tube used in oscillator circuits.
19. Semi-conductor device for switching and storage circuits.
20. Attaching solderless terminals to conductors.
21. Color picture tube using a single electron gun.
22. Formation of maxima and minima by superposition of two sets of interference fringes from light or two different wavelengths.
23. Degree of reproduction of detail in a televised scene.
24. Perpendicular to the direction of gravity.
25. Precious metal more conductive than copper.

Now, wet your thumb and turn to Page 46.

EDMUND A. BRAUN

practical circuits, it's easier to vary the supply voltage by using a transistor amplifier.

As you can see in Figure 4, the emitter voltage of Q4 regulator transistor is clamped by zener regulator D5, and current to keep D5 within the proper zener range is supplied by R10. Base voltage comes from the +80-volt supply, and is adjusted by R6, which is used to determine the exact supply voltage.

With the emitter clamped, and the base voltage varying with the supply voltage, any change of supply voltage changes the forward bias, which in turn changes the collector voltage of Q4. There's inversion in the transistor, so an increase of supply voltage causes a less-positive collector. Some of the collector voltage goes through R11 to the diac where a less-positive voltage increases the time necessary for C11 to charge enough to fire the diac.

Therefore, any increase of the +80-volt supply voltage indirectly makes the diac fire later in the cycle of the line voltage, and this permits less time for the current to flow through choke L803, thus reducing the maximum amplitude of voltage applied to the bridge rectifiers and decreasing the +80-volt supply voltage. Of course, a decrease of supply voltage, for any reason, produces an opposite chain of events resulting in an increase of voltage.

Synchronizing The Pulses

Although the circuit just described can regulate the DC output voltage somewhat by changing the point of the input line voltage where SCR conduction begins, it needs to be timed or synchronized against an unvarying standard, otherwise bridge conduction might not occur at the same equivalent point on the positive and negative peaks. Refer to the waveforms of Figure 7.

Look at it this way: pulses from the diac determine when bridge

conductions **start**, but the **cessation** of conduction **always** happens when the anode of the SCR swings negative relative to the cathode. So, a separate sync circuit senses when bridge conduction-current ceases, and only then starts the charging of the time-constant capacitor at that specific point of the cycle.

Current flow of the bridge is monitored by connecting the anodes of D1 and D2 (which in most bridges are grounded) through R811 and then to ground. The voltage drop across R811 is pro-

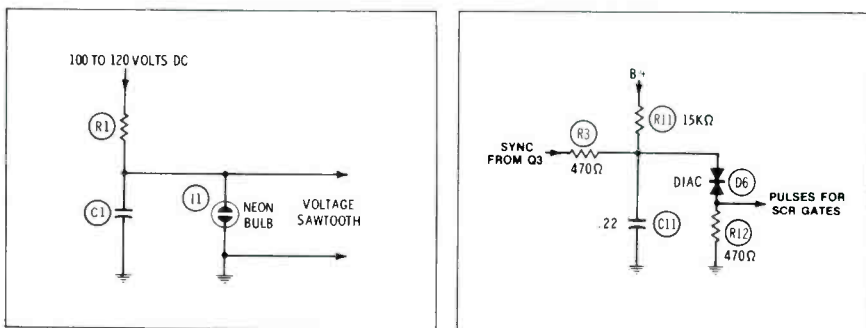


Fig. 5 There is a great similarity between the old neon-bulb oscillator and the diac circuit. At left, C1 starts to charge through R1, until the ionization point of the neon is reached. Then the neon conducts and reduces the voltage of the capacitor. The charge builds up again, followed by conduction of the neon bulb. Waveform across the capacitor and bulb is a series of sawteeth. If a resistor is added from the low side of the bulb to ground, positive-going pulses will be developed by the bulb current. In the Quasar circuit at the right, C11 begins to charge through R11, and continues until the voltage reaches the zener point of D6, then D6 conducts, bleeding part of the voltage from C11, and forming narrow pulses across R12. The waveform across C11 would be sawteeth, except the Q3 sync circuit drains all the charge from C11 between cycles. See the text for more data.

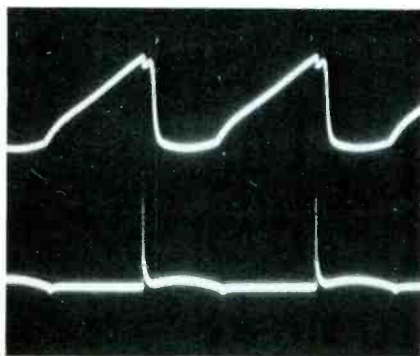


Fig. 6 Top trace is the 33-volt p-p waveform at the top of the diac, and the lower trace shows the narrow pulses at the R12 end. The pulses are 120 Hz and about 8-volts p-p. The flat area at the bottom of the upper waveform is zero voltage formed by the drain of Q3, as explained in the text.

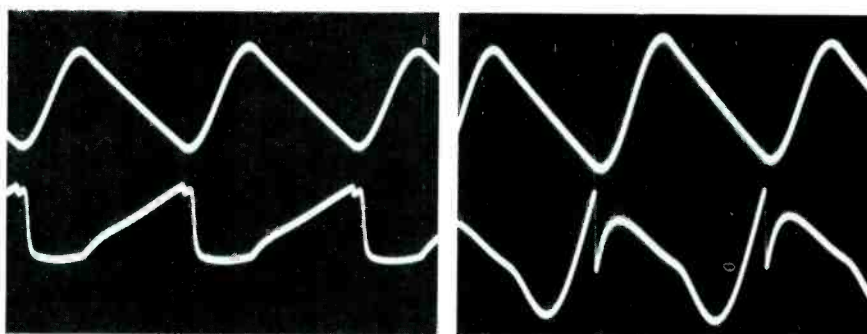


Fig. 7 Waveforms of the picture at left are normal ones; the top trace shows the 7.5-volt p-p 120-Hz ripple when the B+ was +78 volts, and the lower waveform is the one at the top of the diac. The start of conduction is shown by the notch at the tip, and the flat area at the bottom shows where the Q3 "sync" transistor keeps the voltage bled until bridge conduction starts, and C11 is allowed to start charging. In the right picture, the top waveform is the ripple when the base and emitter of Q3 are shorted together, raising the supply voltage to nearly +84. The trace at bottom is the 5-volt C11 waveform when Q3 is not conducting.

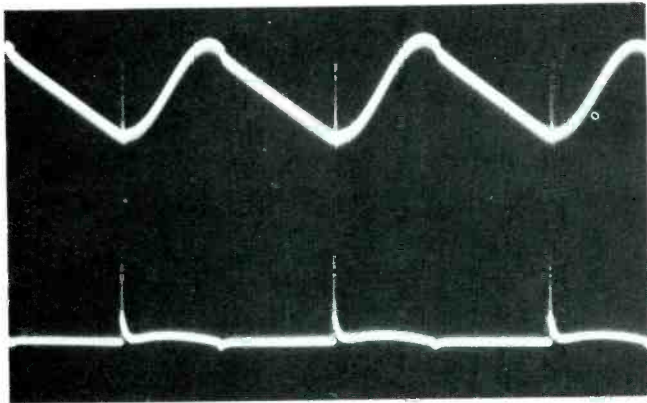
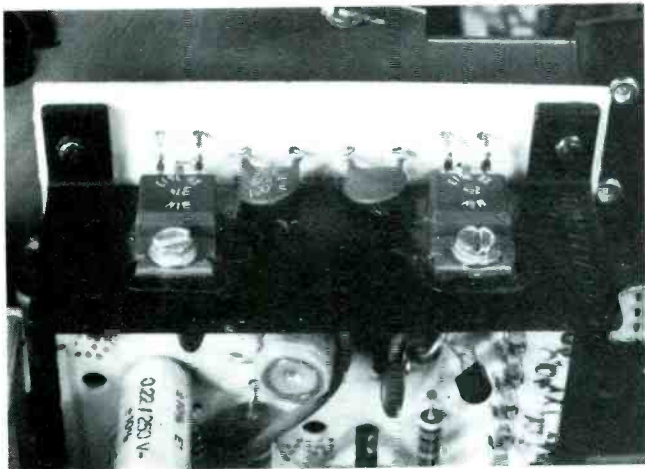


Fig. 8 Top waveform is at the gate of one SCR. Amplitude is about 8-volts p-p, and most of the B+ ripple appears there, also. In between the large sawteeth can be seen the narrow trigger pulses that start bridge rectification. Trace at the bottom is the trigger pulse at R12. Also, there is a small negative notch showing when conduction ceases.



This is how the two SCR's appear on their heat sink in the receiver.

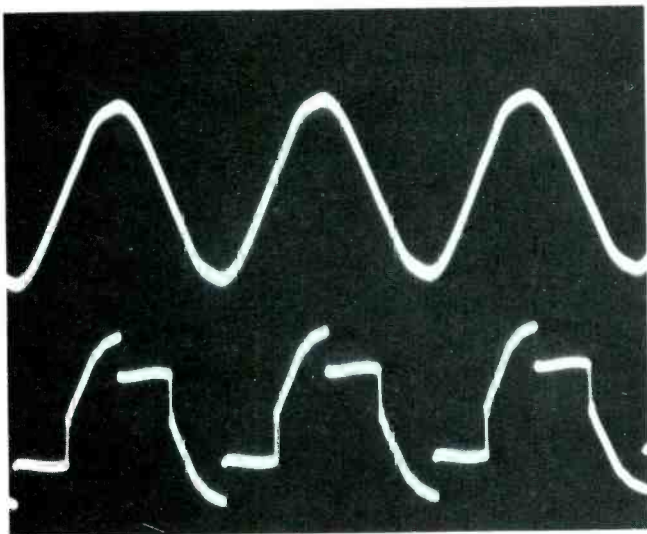
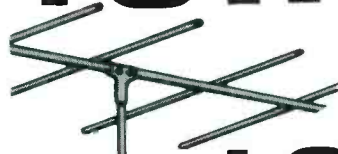


Fig. 9 At the top is the waveform of input line voltage, and below is the strange waveform following the power choke, L803. When the bridge conducts, the choke delays the phase by almost 90°, but does not change it when there is no bridge current.

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duced by the bridge current, and the waveform is a portion of the negative-going peak of a sine wave. This negative peak is applied to the emitter of Q3, the NPN-polarity sync transistor, where it acts as a part-time forward bias. The negative tip produces maximum forward bias, forcing Q3 at that time to conduct strongly and bleed the remaining voltage from C11, thus preventing the start of any charging of C11 before the bridge current stops.

Perhaps it would help to explain that diac conduction does not completely discharge C11, but conduction stops when between 10 and 20 volts remain. Q3 finishes bleeding the voltage and does not permit a new charging cycle to start until the bridge current ceases.

Did you notice that the synchronization is **not** accomplished by injecting a pulse to trigger an oscillator slightly ahead of time, as is true of vertical-sweep oscillators?

Triggering The SCR's

If you know how to interpret them, the waveforms of Figure 8

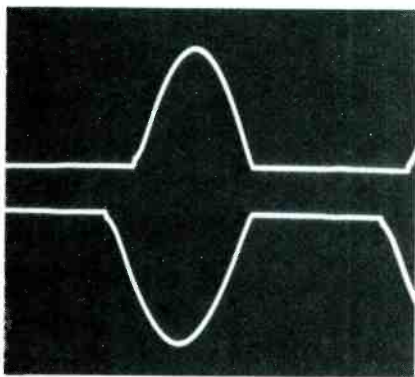


Fig. 10 Bridge current at R811 shows best the effect of regulation. The top waveform has been inverted in the scope to make comparison easier. When the regulator is reducing the voltage, the pulse (top trace) is narrower (shorter conduction time) and has smaller amplitude (current). But when the supply is working harder to increase the voltage, the conduction time is longer (wider pulse) and has more current (larger amplitude). The duty cycle of the bridge is about 40% when reducing the voltage and about 50% when increasing it.

reveal several conditions. The bottom trace is the 8-volt p-p waveform at the junction of R12, C8 (coupling capacitor to the SCR's), and the diac. Current of the diac makes the narrow positive-going pulses which mark the SCR triggering and the **start** of the bridge current. The smaller negative-going pulses in between the others are a by-product of the ending of the bridge current; therefore, these do not move sideways as the regulation operates. In other words, the SCR or bridge conduction occurs during the time between those two sets of pulses.

Now, look at the upper trace, which is the 7-volt p-p waveform at the gate of one of the SCR's, and notice evidence of those same kinds of pulses that are superimposed on the ripple sawteeth. Conduction starts with the diac pulse and the current increases steadily (raising the voltage) until just before time for the current to stop. At that point, the rate of increase levels off, followed by the small notch where the current ceases completely.

Waveform of the B+ ripple at the cathodes of the SCR's is nearly identical to that just pictured at the gates. The reason is that the gate/cathode junction of an SCR tests as though it were two diodes of reversed polarity connected in parallel. In other words, a resistance test seems to show a forward-biased diode junction regardless of

the polarity of the applied voltage.

If you are familiar with the normal waveforms of the ripple from conventional power supplies, you already have wondered about the gradually-rising edges of the sawteeth. That's because of the power choke, L803, which slows down any sudden increase of current.

Waveforms Explain The Regulation

What waveform would you expect at the input of the bridge rectifiers following the power choke L803? Rounded sine wave, sawtooth, or what? My guess was a rounded sine wave, but I was completely wrong! The top trace of Figure 9 shows the 340-volt p-p (120-volts RMS) power-line voltage coming in to the TV, while the jagged mess at the bottom is the waveform at the input of the bridge (terminals 2 and 6 of the panel). Both signals have the same peak-to-peak voltage. Study them for a time, remembering that the zero-voltage line of a sine wave runs horizontally through the exact center.

Let's examine that lower waveform, the one at the bridge. First, start at the zero line. There is no bridge current then, so the voltage rises unhindered until it approximately reaches the tip of the positive peak. At that point, the diac pulse triggers the SCR, and the anode is positive, therefore

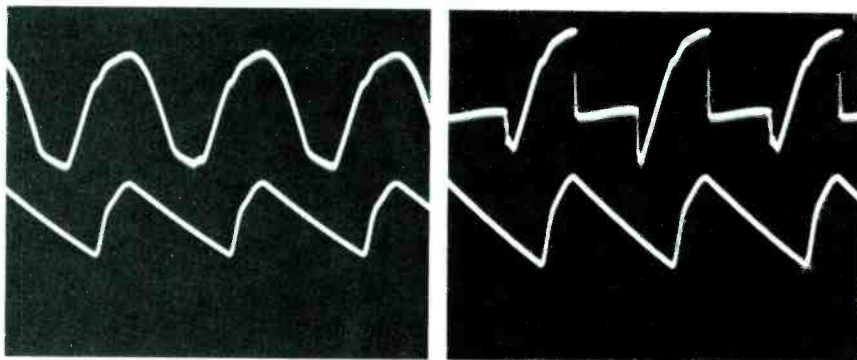


Fig. 11 Diode D9 in Figure 4 accepts the DC voltage from one bridge (D1, D2, D3, and D4) and adds to it the voltage obtained from rectifying the ripple of the bridge voltage, making a total of about +150 volts used to reverse bias D8 so the shut-down circuit doesn't interfere with the diac operation. Waveforms at left are the anode of D9 (top) and the cathode (bottom trace) when the SCR's are not conducting. The lower waveform in the right picture is at the cathode of D9 during normal operation, while the top waveform is at the anode. Probably the jagged waveform is from L803, conducted through D4.

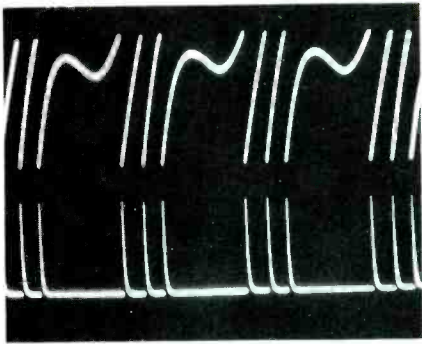


Fig. 12 These unusual waveforms appeared at the diac when the SCR's were prevented from conducting.

conduction starts. (In a conventional power supply, current starts before the tip of the positive peak and continues to the tip before being cutoff.) When bridge conduction begins, the heavy load through L803 causes about a 90° voltage lag. The output of L803 is connected through the conducting SCR to the +80-volt supply; **however the voltage from L803 is reduced to what it was a quarter cycle (90°) before.** That's the sharp fall to the shelf at about the 50% amplitude point. Now, the voltage from L803 to the bridge rises slightly, bringing the +80-volt supply up with it, as the bridge draws current.

But when the input voltage to the bridge drops below the +80-volt point, bridge current suddenly ceases. Now watch this carefully! When the current stops, the 90° phase lag is cancelled, and the voltage instantaneously drops to the same point as the input AC to the choke. That voltage at this time is zero. So, the right end of the shelf drops rapidly to zero, and then begins the normal sine wave path to the negative peak of the sine wave. At that point, the other SCR is triggered, and the entire action is repeated.

Although the DC voltage obtained is about the same as from a bridge input of about 55-volts RMS, the advantage is that the characteristic of the L803 inductance (to resist any rapid increase of voltage through it) allows the output voltage from the bridge to rise to a higher level whenever the bridge-conduction time is extended.

Of course, full line voltage never is reached, because the inductance is sufficient to prevent so much rise of voltage in the length of time between the periods of bridge conduction.

Proof Of Variable Conduction Time

Several waveforms observed while the line voltage was changed showed some variations, but the differences were hardly enough to notice if the waveforms were reduced in size before printing.

Finally I found one waveform that could show clearly any differences of conduction times: the waveform of bridge-rectifier current that is developed across R811 (Figure 10). Two separate exposures were made on film. The top trace I inverted in the scope so it would make an easier comparison with the other. This top waveform was made during high line voltage and a black raster; the regulator was decreasing the DC supply voltage by drawing current for less than a quarter cycle.

The lower trace shows increased current for a longer period of time (wider pulse) when the line voltage was low, the raster brightness high, and the regulator was trying to increase back to normal the sagging B+ voltage.

Start-Up Circuit

Again referring to Figure 4, the DC voltage for the regulator transistor and the diac comes from the +80-volt supply—the same one that's regulated by those components. Without some kind of a special start-up circuit, there could be no diac conduction when the receiver is first turned on. Therefore, the SCR's would not operate, no +80 volts could be produced, and the receiver would have no sound and no picture.

What's more, the start-up circuit should be disabled after the regulated 80-volt supply is operating. The disabling functions are handled by D3, D4, Q5, and associated components.

Here's the sequence:

- the power is turned on;
- D1, D2, D3, and D4 comprise a conventional diode bridge, feeding

unfiltered positive DC through R13 and R14 to the diac;

- the diac conducts, making unsynchronized trigger pulses for the SCR's, which conduct, along with D1 and D2, to feed the +80-volt supply;

- operation now is normal, except for some uncontrolled DC voltage coming in through R14 and R13;

- a sample of the 80-volt supply, through R19 and R20, biases Q5 to saturation, which grounds R17, reducing the voltage applied through R13 to the diac so it does not interfere with the regulation; and

- the sequence is over, the start-up action is disabled, and regulation is normal.

One more function is needed: automatic shutdown in case of overvoltage of the +80-volt supply.

Overvoltage Protection

Failure of the Q4 part of the regulator probably could increase the +80-volt power source enough to create an X-ray hazard from the extra high voltage developed. That's bad enough, but consider the results of shorted turns in L803, or a shorted C804, which parallels L803. Full line voltage would be applied to the bridge, without any regulating action. Voltage of the power supply would skyrocket to about +140 volts for a short time until the horizontal-output transistor and probably other transistors and parts destroyed themselves, followed by the click of the circuit breaker. Not a pretty picture, but that's why an extra SCR, Q6, and the other components are added. They completely eliminate all voltage in the power supply, if it ever increases above +100 volts.

Incidentally, some people have thought both D8 and D9 functioned as isolation diodes. Well, D8 does, but D9 is a rectifier, as we shall see.

The strange waveforms at D9 (see Figure 11) are another surprise. Without the SCR's, the waveform at the anode of D9 is nearly a series of sine waves with B+, instead of the parabolic forms expected. With the whole circuit in correct operation, the anode waveform resembles shark's fins, probably from

(Continued on page 41)

productreport

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Rechargeable Batteries

Rechargeable nickel-cadmium batteries in D, C, AA, and heavy-duty D sizes are available individually or in 2-battery blister packages from Mallory.



A 2-battery package of D or C batteries retails for \$5.38; size AA in a 2-battery package is \$4.78.

Three charging devices also are offered. One model designed for D, C, and AA size batteries is retail-priced at \$10.99. For industrial and specialized uses, 48-battery charging units are available in one model for D- and one for C-size batteries. They cost \$175.00 each.

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High Voltage Resistor

Oneida Electronic Manufacturing has introduced a 205-megohm high-voltage resistor, CR-205. The component is said to be an exact replacement for Silvertone Part 61-103-9 and Warwick Part 61-103-1B.

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IC Project Kits

Seven electronic projects featuring IC circuit designs, drilled and etched PC boards, and step-by-step instructions have been introduced by Eico Electronic Instrument.

The "build-it-yourself" kits include: SCA adaptor, ESP tester, decision maker, stereo amplifier, stereo pre-amplifier, electronic combination lock, and universal power amplifier.

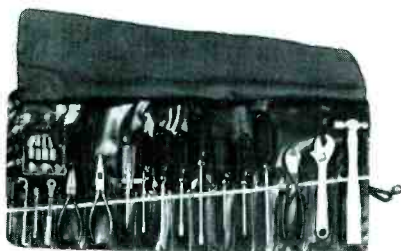
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Copper Tool Kit

Developed by Jensen Tools and Alloys, the JTK-85 kit contains tools of beryllium copper that are non-sparking, non-magnetic, and corrosion-resistant.

Reportedly the beryllium-copper alloy is nearly as hard as steel, and superior to bronzes or brasses. The alloy does not require constant re-grinding as plastic, fiber, or bone tools do.

Kit JTK-85 contains 3 pair of pliers, 9 screwdrivers, an 8-piece socket set with ratchet and extension, adjustable wrench, awl, and ball-pein hammer.



The \$169.00 tool kit comes in a heavy-duty canvas roll pouch with 17 pockets.

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Motion Detector

For protection against burglars or intruders, the Ultrason Motion Detector uses an ultrasonic signal to sense any motion in the protected area. To prevent the intruder from identifying the detector and disconnecting it, no alarm sounds at the detector. Instead, the detector broadcasts a signal by carrier current (sometimes called wired wireless) through the power wiring of the house to the remote satellite alarm. Both units plug into wall outlets; no other wiring is needed.

When activated, the satellite alarm emits a shrill, pulsating shriek for 5 minutes, then resets. A room lamp plugged into the unit lights when the alarm sounds.

Another feature made possible by the carrier-current operation, is that the satellite could be plugged into a wall outlet in a neighbor's home. The

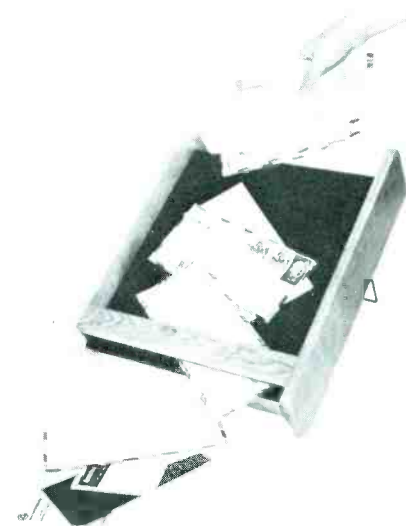
limitation is that the two homes must receive electricity from the same utility pole transformer.

Satellites are offered by Master Lock in three loudness levels, and for indoor or outdoor use.

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Letter-Bomb Detector

Successfully tested and used by Federal, State, and Municipal governments, police departments, and large



corporations, the \$695.00 L3 Letar-Gard from Mountain West Alarm detects letter bombs.

As mail slides down an inclined ramp of the detector, it passes through a weak electronic field. Presence of any metallic material, foil, or electrical circuit that distorts the field is detected by a sensitive electronic circuit that triggers an audio alarm, which sounds until manually reset. The weak electronic field cannot trigger any bomb. Calibrated sensitivity adjustment can be set to pass letters with a paper clip.

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Cordless Drills

Black and Decker has introduced a line of cordless drills which have the power packs required for continuous operation. The drills are available in



1/4-inch and 3/8-inch chuck sizes in five models, including reversing units.

SPANISH BATTERIES

By Mort Gordon

A one-hour fast charge is featured on 3 models; a 16-hour charge cycle is standard on the other 2 units. With the one-hour fast charge, additional energy packs can be purchased to keep the unit in almost continuous operation. The replaceable energy pack feature offers flexibility not possible with conventional electric drills.

The drills are priced between \$60.00 and \$110.00.

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Chemical Light

For use as an emergency flare, a signal light, or viewing light, the Cyalume lightstick generates light without heat or flame for 3 full hours of working light, plus an additional 8 to 10 hours as a marker light. The self-contained plastic tube contains two sealed liquids. By bending the tube, the chemicals mix, producing a yellow-green light.

Cigar-sized, the lightstick is convenient to carry and store, and reportedly will not corrode or break. The light is not confined to a narrow beam, but shines in all directions.

Cyalume is a product of **Central Dynamics, Inc.**

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Temperature-Controlled Soldering Station

The Ungarmatic soldering station from **Ungar** has modular, thread-in, temperature-controlled heaters, and the idling temperature is controlled by a closed-loop, non-magnetic device. Nine plug-type tips of different shapes are available, and there is a choice of 600°F, 700°F or 800°F temperatures.



Power is obtained through a 3-wire grounded, polarized plug, but the heater operates from 24 volts. A large tip-cleaning sponge is mounted on the power supply. When not in use, the iron rests in a stainless-steel cage. □

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**Ideas for articles?
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Sometimes, I tire of being snow-bound in the winter, and spend a few sunny weeks in the semi-tropical city of Miami, Florida.

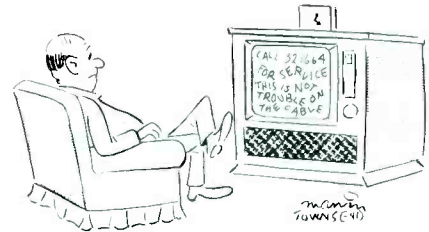
In recent years, many refugees from Castro's Cuban paradise have flooded Miami and changed it into a bi-lingual city. Spanish is spoken almost exclusively in some sections, and the employees of most business establishments must have a working knowledge of both languages. Naturally, much of the radio programming is entirely in Spanish.

I was shopping in my favorite discount store one day and noticed that a clerk (who had a Spanish accent) was having trouble with the complaint of a nice, gray-haired, little old lady. Unobtrusively, I moved over where I could overhear the conversation.

It seems the little old lady (a newly-arrived retiree in Miami) had

come in the store the previous week and purchased a battery for her transistor radio. Obliging, the clerk had installed the battery for her, and the pleased customer had paid and left. This time she was complaining bitterly that she had wanted an American battery for her radio. She objected to the "Spanish" radio battery because now all the programs were in Spanish, and the radio never did that back in Ohio!

Like a devout coward, I slowly walked away, leaving the poor clerk to his fate. After all, I was on vacation! □



(Continued from page 39)

the L803 waveform. In any event, D9 rectifies that signal, and the .68 capacitor at the cathode makes the circuit peak-reading, producing about +150 volts DC with a ripple of 32-volts p-p. Such a high DC supply seems to be necessary to reverse bias D8 under all conditions, preventing false shutdowns.

R15 and R16 form a voltage divider to stabilize the voltage and act as an isolation when Q6 conducts. The cathode of D8 is more positive than its anode; therefore it is an open circuit, which does not disturb the diac function.

But assume a defect that raises the supply voltage above +100 volts. Voltage from the regulated supply, pre-determined by the setting of R22, exceeds the zener point of D7. The zener (D7) conducts positive voltage to R21, C9 filter, and the gate of SCR (Q6) causing Q6 to conduct, and grounding the cathode of D8. At this time, D8 is forward biased, and conducts in turn, grounding the diac (through D8 and Q6). Of course, this eliminates the SCR trigger pulses, so the +80-volt supply is shut down; the voltage becomes zero, and it remains there until the receiver is turned off and back on.

If the overvoltage condition remains, the protection circuit shuts off the power again. But if the overvoltage was temporary, and now all is normal, the power stays on.

Another Surprise

While I had the gates of the two rectifier SCR's shorted to their own cathodes to make sure the power actually stopped, and to check out the start-up voltages, I noticed the waveforms of Figure 12 at the diac. Evidently it was some kind of a parasitic oscillation, for it changed drastically with different line voltages. I can't explain it, but just present it as a fact.

How Well Does It Regulate?

Tests with different line voltages and brightness levels proved the circuit produced good regulation. Brightness changes from black raster to near-blooming reduced the +80-volt supply by about 1%. An 8% increase or decrease of input line voltage changed the supply voltage by about 2%.

This is good performance, and no noticeable change of picture size or brightness could be seen when the line voltage was changed from 100 volts to 130 volts. □

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audio systems report

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Rack-Mountable Power Amplifier

The Shure Model SR105A power amplifier provides either 200 watts RMS direct-coupled to a 4-ohm load, or 150 watts RMS transformer-coupled to a 70-volt line. Model SR105B is similar, but only permits direct coupling of the speakers.

Internal circuitry protects against damage from open or shorted output loads, and the amplifiers are said to be capable of operation at full power up to an ambient temperature of 108°F without derating. Frequency response is rated at ±1.5 dB from 20 Hz to 20 kHz, and distortion reportedly is low.

Model SR105A is priced at \$348.00, and Model SR105B is \$321.00.

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Sound Lectern

According to the manufacturer, Model L251/P sound lectern provides uniform sound coverage wherever speech reinforcement is needed. Featuring a built-in solid-state 25-watt amplifier with an acoustic equalizer,



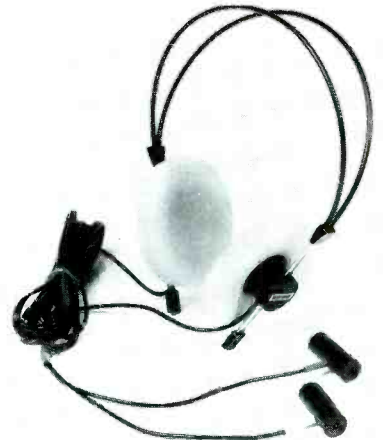
and a unidirectional dynamic microphone, the Paso unit provides crisp voice reproduction while minimizing reverberation and acoustic feedback.

An adjustable reading light, and a second microphone input for audience participation is provided.

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Lightweight Stereo Headphones

The high-velocity open-air type stereo headphones from Uher of America weigh only 2.2 ounces with an 8-foot cable. Available with a phone plug, 2- or 5-pin plugs, the unit costs \$49.95.



Featuring a frequency response of 20-20,000 Hz, the headphones employ a directional high-velocity principle that lets the user hear outside sounds reportedly with no loss in stereo reception.

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Line-Matching Transformers

Models A95U and A95UF are new additions to Shure Brothers A95 series of line transformers, which are designed to solve most microphone line-matching problems.

With the transformers, you can wire a low-impedance microphone to a high-impedance amplifier or vice-versa by matching impedances. This type of connection usually solves problems of excessive high-frequency loss and objectionable hum pickup when long lengths of microphone cable are necessary at high impedances.

A95U has a male professional 3-pin audio connector at one end (A95UF has a female connector) and an Amphenol MC1M-type connector at the other end. Both models are supplied with phone-jack and phone-plug adapters. With these connector variations, it's possible to meet virtually all line-transforming situations.

Model A95U is priced at \$15.45; Model A95UF is \$17.55.

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Pushbutton Car Radios

Two in-dash car radios, one an AM/FM unit and the other an AM/FM/FM-stereo unit, have been introduced by RCA. Compactly-designed, the units are equipped with 4-position adjustable shafts for installation in

most domestic and foreign cars. An under-dash mounting bracket is included for use when in-dash installation is not practical.

Both models feature 5 quick-set pushbuttons (3 for FM and 2 for AM), a manual tuning knob, illuminated station dial, and full-range tone control. The FM-stereo radio also has a balance control, LO/DX switch to help eliminate interference from strong local stations, and a stereo program indicator light.

Each unit reportedly delivers up to 9 watts of peak audio power output (per channel for the stereo unit) into

4 ohms, and is suitable for either 4 or 8 ohm speaker loads.

Model 12R606 AM/FM is priced at \$74.95; the AM/FM/FM-stereo Model



12R607 is \$104.95. Both units are equipped with push-in harness connectors which require no soldering.

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High Frequency Speaker

Designed to be used with Vocal Master VA300-S or VA301-S speaker columns, Model VA305-HF high-fre-



quency speaker reportedly extends the frequency range of the columns to 18,000 Hz.

The accessory speaker from Shure uses twin horn-loaded, high-frequency dome drivers and an integral 5-kHz crossover network.

Provided with the \$119.50 unit are a heavy duty cable, mounting hardware, and template.

For More Details Circle (64) on Reply Card

Mobile PA Amplifier

The Realistic MPA-10 solid-state 10-watt mobile public-address amplifier is designed for 12-volt operation in cars, boats, or anywhere an AC power source is not available.

The \$39.95 unit from Radio Shack features separate microphone and auxiliary input jacks for connecting a tuner, ceramic phono, or tape player to the amplifier with pushbutton selection for paging over music.

According to the manufacturer, response is 200 Hz to 10,000 Hz at full power, and the power rating is 10



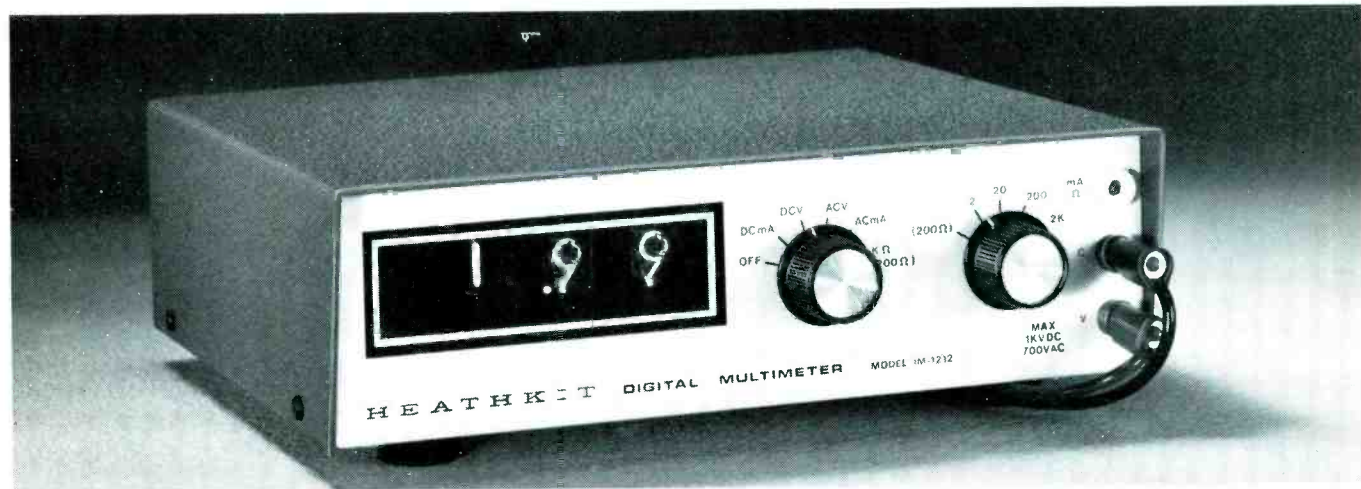
watts RMS at 8 ohms. MPA-10 comes complete with microphone and mounting hardware. □

For More Details Circle (65) on Reply Card

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New 2½ digit Heathkit DMM-only \$79⁹⁵

The new Heathkit IM-1212 Digital Multimeter is the DMM you've been looking for... it's easy to read, has built-in calibration standards, service bench styling, easy assembly...and it's low cost. Four overlapping AC and DC voltage and current ranges and five resistance ranges make operation fast and easy. Accuracy is very good for a meter in this price range: 1% on DC volts, 1½% on AC volts and AC/DC current, and 2% on resistance. Full scale ranges are: DCV, 2, 20, 200, 1000V; ACV, 2, 20, 200, 700V rms (25 Hz to 10 kHz); DC current, 2, 20, 200, 2000 mA; AC current, 2, 20, 200, 2000 mA (25 Hz to 10 kHz); Resistance, 200, 2k, 20k, 200k, 2000k ohms. Lighted panel indicators show overrange, positive and negative DC voltages and current. All solid-state design uses IC circuitry for clear, non-blinking display with readout update every 16 msec. and automatic decimal positioning. Overload protected. 120/240 VAC. Also available assembled for only \$125*.

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For More Details Circle (18) on Reply Card

test equipment report

These features supplied by the manufacturers are listed at no-charge to them as a service to our readers. If you want factory bulletins, circle the corresponding number on the Reply Card and mail it to us.

Six-Digit Frequency Counter

Ballantine Laboratories has introduced a six-digit compact frequency counter that is direct counting to beyond 512 MHz, and full resolution reportedly is obtained twice as fast as similar counters. The portable Model 5755A can be operated from an AC line or an 11- to 18-volt battery.



Frequency measurements are referenced to an internal time base which can be derived either from the instrument's built-in 1-MHz crystal clock or from an external clock. The front panel frequency switch selects the time base gate time to provide three ranges of frequency and resolution.

Designed with input overload protection, the instrument sells for \$745.00.

For More Details Circle (66) on Reply Card



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AMP SPECIAL INDUSTRIES

Division of AMP Products Corporation Valley Forge, Pa

For More Details Circle (19) on Reply Card

Auto-Ranging Multimeter

Systron-Donner has introduced a high-precision 20,000-count auto-ranging multimeter. Model 7224 includes an Accu-Ohm resistance-measuring circuit that gives the convenience of 2-wire resistance measurements with accuracies reportedly equivalent to those of 4-wire systems.



The unit has a 20-ohm range for resistance measurements to 0.001 ohm resolution. Readout features a large in-line/in-phase display with 1/2-inch high numerals, and includes automatic polarity, decimal point, and annunciator.

DC accuracy is specified as 0.02% for 90 days. DC volts and resistance are standard. Accessories include current shunts, high-voltage probe, protective snap-off cover, and leather carrying case or rack mount. Options include true RMS, AC averaging, DC/DC ratio and BCD output.

Price of Model 7224 is \$699.00.

For More Details Circle (67) on Reply Card

CB Service Monitor

A multi-purpose Citizens Band servicing instrument, the **Zodiac U-2** can be used as a RF signal generator, watt meter, modulation meter, SWR meter and field-strength meter.

The battery-operated monitor has a frequency synthesizer that generates 210 frequencies, 5 KHz apart, within the range of 26.49 MHz to 30.11 MHz. This includes the existing and proposed CB channel frequencies.

Measurements can be made of sensitivity, bandwidth, adjacent-channel selectivity, power output up to 5 watts, and modulation up to 100%.

Price of the U-2 CB monitor is less than \$1000.

For More Details Circle (68) on Reply Card

Solid-State Curve Tracer

Hickok's Model 440 curve tracer, with Insta-Beta display, safely tests all types of semiconductors under actual conditions, in- or out-of-circuit. The unit can be used to test, identify, classify, find substitutes, and match solid-state devices.

Used with any scope having external horizontal input, the unit

generates calibrated characteristic curves that can be accurately scaled right from the screen.

Insta-Beta helps take the guesswork out of transistor Beta and FET parameter calculations. In transistor mode, Insta-Beta displays a single, full-range collector/base current curve that lets you find AC and DC Beta instantly, without interpolation.

In FET mode, Insta-Beta displays the entire transfer curve including pinch-off voltage, full-on current, and active portion for easy calibration of Gm.

In normal semiconductor testing, a variable step control provides characteristic curve displays from 1 to 10 steps per family. A horizontal V/DIV control changes horizontal sensitivity without requiring scope recalibration.



The \$165.00 test instrument includes a pull-out card with reference information for calibration, set-up, and operation.

For More Details Circle (69) on Reply Card

Portable Digital Multimeter

Included in the IM-2202 portable digital multimeter from **Heath** are 4 rechargeable nickel-cadmium batteries and a built-in charging circuit. Up to 8 hours of continuous operation can be obtained from each charge.



The \$179.95 unit features 26 ranges and a large 3 1/2-digit display, which includes automatic polarity indication and decimal point placement.

For More Details Circle (70) on Reply Card

bookreview

Know Your Oscilloscope

Author: Paul C. Smith (Revised by Robert G. Middleton)

Publisher: Howard W. Sams & Co., Inc. 4300 West 62nd Street, Indianapolis, Indiana 46268

Size: 168 pages, book number 21102

Price: \$4.95 paperback

In this updated Third Edition of a popular handbook, the authors have provided a wealth of information about typical internal circuits of oscilloscopes, in addition to describing many of the jobs that scopes do best. The practical data ranges from facts about the cathode-ray tube to transistorized sweep systems, including the four-layer diode used as a sawtooth generator. A chapter on amplifiers discusses frequency response, push-pull and DC amplifiers, and writing speed. Voltage calibration, intensity modulation, and phasing controls are covered in the special-features section. Other topics covered include accessories such as probes and external voltage calibrators, how to check oscilloscope performance and make simple adjustment of DC balance controls, and specific applications of the scope such as amplifier testing with square waves and sweep signals, radio and TV alignment, and signal tracing. The approach of the text is from a technical viewpoint, but is easy to understand.

Color TV Case Histories Illustrated

Author: Robert L. Goodman

Publisher: TAB Books, Blue Ridge Summit, Pennsylvania 17214

Size: 238 pages, 219 illustrations, book number 746

Price: \$8.95 hardbound, \$5.95 paperback

Goodman has condensed hours of TV troubleshooting time into a practical, easy-to-use handbook of TV troubles and cures. The text contains screen photos, schematics of individual stages, and abbreviated theory of operation that shows how specific malfunctions result from various circuit problems and component failures. Goodman has grouped chapter entries according to symptom classification. To use, simply turn to the section covering the appropriate general symptom, then look for the screen photo resembling the trouble. Diagrams, test-point voltages, and ideal waveforms are shown where applicable. A separate chapter lists a variety of symptoms unrelated to video, such as no sound or weak sound, distorted audio, no remote operation, buzzing, and audio squeals. The Appendix includes detailed theory of operation, schematics, and troubleshooting information on Zenith remote control transmitters and receivers. □

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antenna systems report

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VHF/UHF Preamp

The \$42.00 broadband VHF/UHF preamplifier from **Q-bit Corporation** has a flat 15-dB gain from channel 2 through 83. Model PA-0530 uses an integrated circuit amplifier stage, yielding a 4-dB noise figure. The unit has a 300-ohm input and 75-ohm output.

For More Details Circle (71) on Reply Card

RF Modulator

UHF Associates have developed a small-sized modulator that transforms the signal from any video source into an RF signal tunable over TV channels 2 through 6. The unit meets all FCC regulations for RF devices used with MATV, CATV, and RF-distribution systems. RFM-26 features RF and video gain controls.

For More Details Circle (72) on Reply Card

Push-Pull Internal Distribution Amplifier

For use in MATV systems with up to 35-channel capability, Model IDA-45 push-pull internal distribution amplifier is adaptable to 2-way communications systems as required for a CATV/MATV interface amplifier.

Gain is said to be 45 dB over a range of 50 to 300 MHz, enabling the amplifier to handle mid-band and super-band channels, as well as VHF channels. Push-pull output circuitry reportedly cancels second harmonic distortion.

The noise figure is 8 dB, and response is flat within ± 0.4 dB. Manual gain-control range is 15 dB.



The versatile \$438.00 unit from **Jerrold Electronics** offers plug-in and accessory modules.

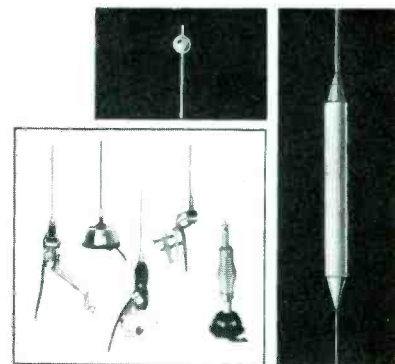
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Center-Loaded CB Antennas

"Range Riders", a new line of center-loaded CB antennas from the **Antenna Specialists Company**, feature special tuning tips for adjustment without cut-and-try antenna trimming.

The "static ball" tuning tip acts electrically as a capacity hat, and can be moved up and down on the active element to achieve resonance. Once the desired setting is found, the static ball can be secured in position with an Allen wrench (supplied with the antenna).

A completely-waterproof center-loaded coil assembly is featured. The coil is pressure-molded into a single, rugged shaft which resists shock and vibration.



Mounting options include dual-mirror types for heavy-duty trucks, and a Quick Grip mount for permanent no-holes installation on passenger cars. All models come complete with coaxial line and connectors, plus phasing harnesses when required.

For More Details Circle (74) on Reply Card

Mobile Antenna Mount

A mobile antenna mount for 3/8-inch (one-side) fitting features lower roof-hugging appearance, quick installation, more positive braid and center conductor fastening, and fewer parts for simplified installation.

The JM mount from **Larsen Electronics** accommodates any mobile antenna in the HF or VHF range that adapts to a 5/16-inch by 24 stud, which includes most quarter-wave and gain-type mobile antennas. □

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photofactTMbulletin

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

ADMIRAL

Chassis T46K10-5A 1502-1
Chassis 1M30, 1M3008-5, 1M3012-5,
1M3013-1, 1M3014-1 1505-1

BRADFORD

1071A33/B33, 1071E44/F44 1498-3
1171C35, 1171F45 1504-2

BROADMOOR

2119W 1501-1

CURTIS MATHES

Chassis C-53, CMC-53 1498-1

GENERAL ELECTRIC

Chassis 25MB-75 1500-1
Chassis 25MC 1501-2

HITACHI

Chassis SX 1501-3
CU-110 (Ch. CQX) 1502-2
CT-972 (Ch. NP3SX) 1507-1

JC PENNEY

2118 (855-2259) 1505-2
2001 (855-0055), 2017 (855-0063) 1506-1

PANASONIC

Chassis T204A 1497-1
Chassis ETA-12 1499-1
CT-772 1505-3

PHILCO-FORD

Chassis 5CS45, 5CS45-C 1499-2

SEARS

528.42000400, 528.42001400 1498-2
564.41991301/1302/1303 1498-3
564.41700400/401/402,
564.41720400/401/402 1506-2
564.50392400 1507-2

SONY

Chassis SCC-63A-A/-B/-C/-D 1503-1

SPECTRICON

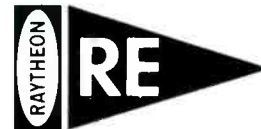
B12H175 1500-2

SYLVANIA

Chassis E09-1/-3 1497-2
Chassis E11-1/-3/-4 1503-2

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Chassis TAC-9330, TAC-9340 1500-3



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catalogs literature

Circle appropriate number on Reader Service Card.

100. RCA—offers a pocket-sized manual featuring the RCA line of car-stereo products. Illustrations, features and benefits, and technical specifications of car-stereo players, speakers and accessories are described.

101. Cleveland Institute of Electronics—makes available a booklet entitled **How You Can Get Your FCC License**. Answering the where, when, how, and why questions for obtaining an FCC license, the booklet covers basic requirements, and gives typical questions on the exam.

102. Kester Solder—covering the Kester line of solders, flux-core solders, and soldering fluxes, the 8-page catalog describes more than 50 solders and related items.

103. Advance Schools, Inc.—has published a 6-page pamphlet describing its radio and TV service course. Course topics and career opportunities are discussed briefly.

104. Data Technology Corporation—the brochure describes and illustrates Model 21, a palm-sized 3-1/2-digit multimeter that measures capacitance, AC volts, DC volts, and resistance. The \$269.00 model is designed for field or bench operation.

105. Xcelite—bulletin 274 gives specifications and prices on a variety of new metric hand tools and sets from Xcelite.

106. Jersey Specialty Company—has issued a catalog featuring its line of wire and cable products. Included are illustrations and descriptions of coaxial cable, rotor wires, parallel cord, and speaker wire.

107. International Rectifier—the Maintenance, Repair, and Operations catalog lists replacement components for industrial electronics equipment including germanium, silicon and selenium rectifiers, zener diodes, bridges, SCR's, protective devices and semiconductor

fuses, switches and relays. Charts give complete specifications including voltage range, current rating, case style, and price information.

108. GC Electronics—has published a Service Technician and Industrial Catalog which contains descriptions and illustrations of nearly 2,000 items. The catalog, FR-75, covers the entire GC product line, including chemicals, alignment tools, printed circuit aids, technical aids, universal replacement parts and components, and electronic hardware.

109. General Electric—offers a variety of professionally-prepared display advertisements to service dealers. The four camera-ready ads stress "any make and model" service capability, and require only the dealer's name, address, and phone number before placement.

110. SGL Waber Electric—is distributing catalog No. 100 which features over 250 electrical power outlet strips, and 21 wheeled utility carts.

111. Electronic Devices—describes silicon rectifiers such as bridges, axial lead, high-voltage packs, cartridges, Solid-Tube®, and other special device rectifiers. The short-form catalog contains 12 pages of electrical characteristics, dimensional drawings, and photos of the complete product line of rectifiers.

112. Fordham Radio Supply Company—this discount mail-order catalog includes tools, service and repair kits, tubes, test equipment, phono cartridges and needles, speakers and microphones, antennas, components and many other servicing aids of major manufacturers. The catalog is illustrated and products are shown with discounted prices.

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servicebulletin

a digest of information from manufacturers

Module Contact Cleaning Precautions Magnavox T979/989 TV Chassis

These chassis contain plastic module sockets used for such modules as the sound detector, audio output, video output, etc. Do **not** attempt to clean the module sockets. **No cleaner or solvent should be applied to these sockets** because the plastic material will be chemically attacked.

If intermittent contact is suspected, clean the edge contacts on the module as follows: Wipe the edge contacts clean using a cloth dampened with Magnavox contact-cleaner/lubricant (171378-1). Wait awhile to allow the solvent portion of the spray to evaporate; the lubricant part will remain on the contacts. Insert the module into its socket. Do **not** spray the contact-cleaner/lubricant into the module socket.

Failures Of Power Supply Diode General Electric KE Chassis

Whenever a CR109 or CR110 power-supply diode failure occurs, check to see if there is a 1000pF capacitor across the diode. Early production did not use these capacitors.

If there are no capacitors in these locations, add an EP18X81 (1000pF, 1KV) capacitor across the replacement diode (part number EP57X4) to provide added protection against voltage surges which might result in future diode failures.

Certain diodes operating without the added capacitor can develop "switching transients" which appear as a narrow black or gray horizontal bar, floating up the screen.

Improved Reliability Of Horizontal Sweep Circuit Philco-Ford 21ST90, 21ST90T, 21ST91, 21ST91P, 22ST80, and 22ST81 Chassis

When a problem occurs in the horizontal sweep circuit, check for failure of resistor R159 (100K ohms), located on the deflection panel between the junction of lug M125 and resistor R158.

Replace resistor R159 with a 390K 1/2W resistor. Do **not** replace with a 100K-ohm resistor. If any of these chassis are brought into the shop for service, resistor R159 **must** be inspected, and if found to be 100K it **must** be changed to 390K ohm as preventive maintenance to reduce future call backs.

After replacement, check the high-voltage setting and reset for 26.5KV at 120 VAC line with zero beam current (minimum brightness). **Under no circumstances** should the horizontal bias control (VR100A) be left in its maximum high-voltage setting position. □

Rem's New Superstar Is Loaded With Super Features.



Still Way Ahead of the Game

Rem's forged ahead again! This time, with the full REM CRT RECOVERY SYSTEM in a small, lightweight (6 lbs.), compact unit.

Five years and a few thousand units ago, Rem originated the "new generation" RECOVERY SYSTEM with the CRU-IA. It startled the industry and caused the "big boys" to take a close, hard look at their suddenly out-dated CRT Rejuvenator/Checkers.

Now, take a close, hard look at Rem's brand new CRU-II. Unequaled performance and a pocket-sized price tag puts the CRU-II far in advance of any Tester/Restorer on the market today.

Fully-Automatic Recovery System

Rem's exclusive feedback control system brings picture tube restoration into the Computer Age. The AUTO-RECOVERY® SYSTEM

in the CRU-II varies the timed recovery cycle according to the exact requirements of the gun being recovered.

Feedback from each gun determines recovery time. This new, unique circuitry allows each gun to receive the optimum current necessary to its recovery.

Beam Current Checking

Rem originated Beam Current Checking. With this superior checking capability, the CRU-II allows accurate testing of color CRT's. What you see on the meter is what you'll see on the screen. Compare that feature with other checkers!

Safe and Secure

The REM RECOVERY SYSTEM all but eliminates the danger of cathode damage. The CRU-II makes it practical for the technician to offer CRT restoration as a standard service procedure.

No Generation Gap

The CRU-II is the forerunner of an even newer generation of CRT Tester/Restorers. Until now, this type of restoration process and innovative beam current checking were available only in units priced from \$262. to \$399.

Not Just Another Pretty Face

The CRU-II looks like the real pro it is. Great looks and performance to match. Every feature was designed for ease of operation. Switches and buttons were placed where they fall-to-hand, eliminating much of the confusion technicians face when working with other units.

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SERVICE ASSOCIATIONS

VEA Convention / By Carl Babcoke

This month the report on the activities of service associations will be about the Virginia Electronics Association's 11th annual state convention held at Norfolk, Virginia June 20, 21, and 22. Your editor had the privilege of attending, and will attend other state conventions as time permits.

First on the agenda was a Service-Management Seminar conducted by John Gooley, Manager of the NARDA Service Division. Later the Association Board met, and the evening was spent pleasantly in the Hospitality Room.

Following breakfast on Saturday morning, W. S. (Bob) Harrison, Chairman of the '75 Convention Committee (and editor of the excellent publication, VEA Reporter) was the keynote speaker. Bob reviewed the 20-year history of VEA. The history of VEA, he said, can be broken into two segments. "The first ten years provided us with the vehicle. The second ten years got it rolling in the right direction. What is needed from the present is the fuel to propel the vehicle more rapidly forward and upward over obstacles...we look back with pleasure, and we look back with pride, but, as an association which values progress, we know that we can't afford to look back too often." Although the organization has grown, and now has nine local affiliates, one goal of statewide trade-standards and licensing remains far from enactment. Other programs (such as business insurance,

discounted Master Charge, and group insurance) have been very successful and profitable for the members.

Profitip\$ and an associational business meeting, including elections, occupied the remainder of the morning, while CET tests and the Electronics Trade Show were held that afternoon.

These officers were elected: Jane Hudson, President; Carl B. Rae, Jr., 1st Vice President; Chuck Mitchell, 2nd Vice President; Sid Allgood, 3rd Vice President; Leonard Cowherd, Recording Secretary; Charles Porter, Secretary General; Frank Moss, Treasurer; and John McPherson, National Representative.

To our knowledge, this is the first time a woman has been selected for the presidency of a state association. Jane Hudson is the widow of Tom Hudson, a former Secretary General of NATESA, and has been very active in VEA work for many years.

Following a delicious and bountiful Hawaiian Luau buffet dinner, awards were given to various associational members, and recognition made of the visiting VIP's, including Charles Couch, president of NESDA. The first part of the evening's entertainment consisted of South Sea Island music and dances, including hula, sword, and fire dances under the direction of Louis Hahn. Perhaps the high point of hilarity was attempts of the "wahines" to teach some of the men and women guests how to do a few of the motions. Dancing to old standards completed the evening. Aloha! □



John Gooley, manager of the NARDA Service Division, was honored by Bob Harrison for his help in presenting a Service-Management seminar.



These technicians are just a few of the ones taking the CET test.

Jane Hudson, shown here in lei and Hawaiian dress at the Luau, was elected President of the Virginia Electronics Association.



On the lighter side of the convention was the South Sea Island entertainment and Hawaiian music.



Needed: Power transformer for Milovac 8-track record-playback deck, Model SC-300.

Hemco Electronics
1346 Norton Street
Burton, Michigan 48529

Needed: Power transformer T608, part number 80B-61-1, for 1958 Admiral hi-fi amplifier, chassis 6D3B or 6D3C.

Elmer L. Mosley
1609 Pine Street
Kenova, West Virginia 25530

Needed: Vertical-output board for Symphonic TV, Model AC30 or TPS5050.

C&M TV Service
75 Varnum Avenue
Dracut, Massachusetts 01826

Needed: Old-type VT-67 tube by Hytron.

John Lucero
4220 East 69th Place
Commerce City, Colorado 80022

Needed: One spindle, one turntable mat, and one cartridge for Lesamatic changer, Model CD-3/31.

J. H. Soules
Route 1, Clay Road Box 462
Trussville, Alabama 35173

Needed: Transformer for Muntz black/white TV, Model TP0040.

Powers TV Service
327 Adams Street
Camden, Arkansas 71701

For Sale: One copy each of **Radio Physics Course, Second Edition**, copyright 1932, by Alfred A. Ghirardi; **Modern Radio Servicing, First Edition**, copyright 1935, by Alfred A. Ghirardi; **Mathematics for Electricians and Radiomen**, copyright 1942, by Nelson M. Cooke. Each hardback copy is clothbound and in good condition.

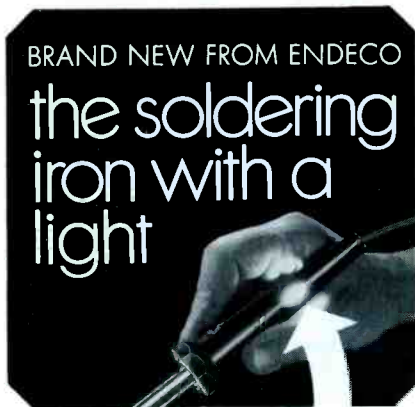
Addison S. Cooke
1520 N.W. 30th Street
Gainesville, Florida 32605

Needed: Schematic for a Grebe broadcast band radio (150-3000M) Type CR-9, that uses an Armstrong circuit patented in 1914.

E. N. Sanford
212 Ashley Road
Boonville, Missouri 65233

Needed: Schematic for Sears Silvertone radio, Model 1965. Will copy and return.

Sid Creacey
1358 Turquoise Avenue
Mentone, California 92359



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ELECTRONIC 8 digit calculator: 25 keys, (\$33.00) refundable: durable, Tayo Paul, 980 Greene Avenue, Brooklyn, NY. 11221. 7-75-3t

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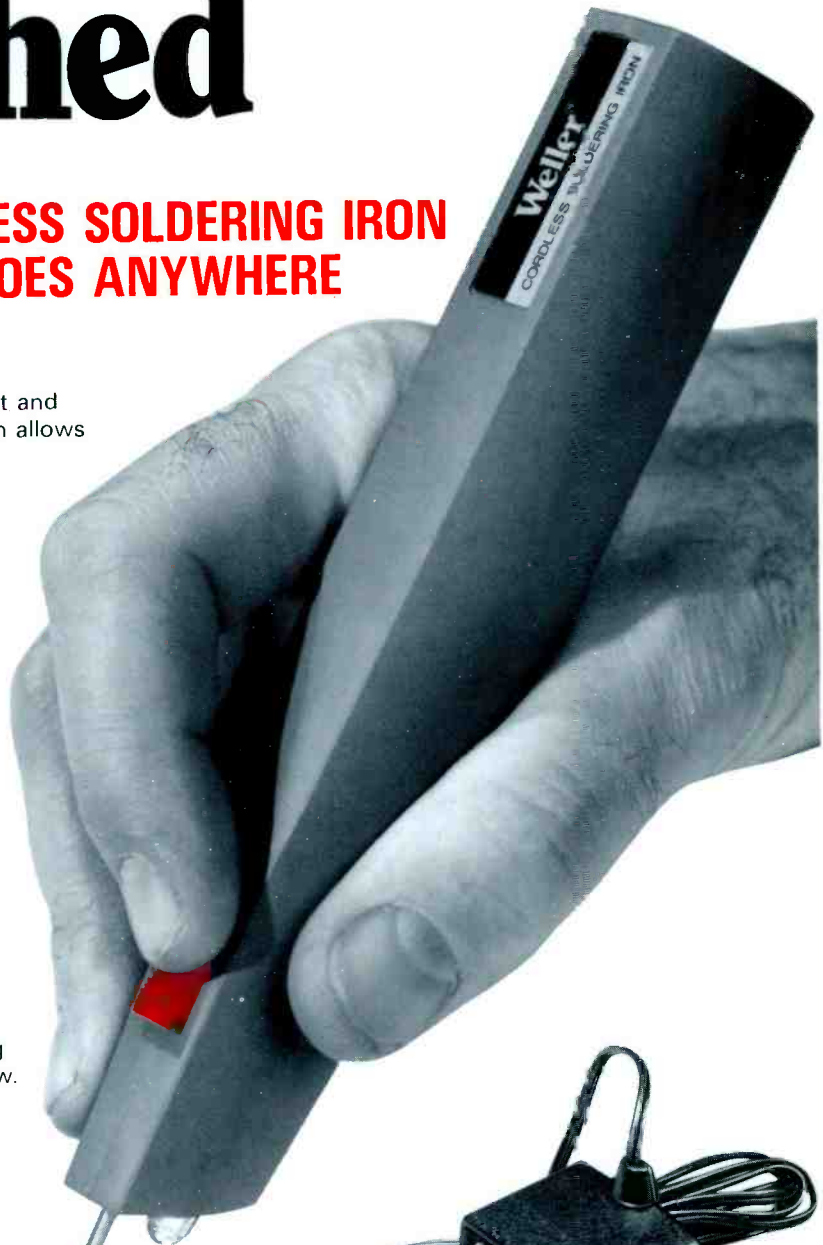
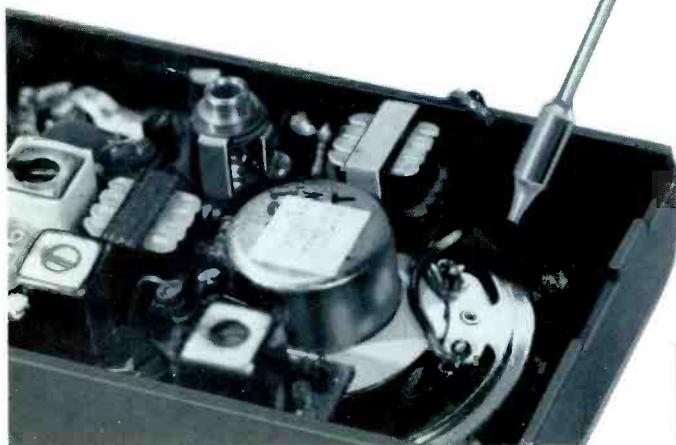
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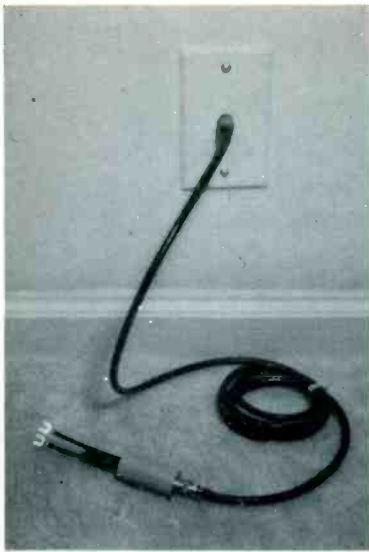
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