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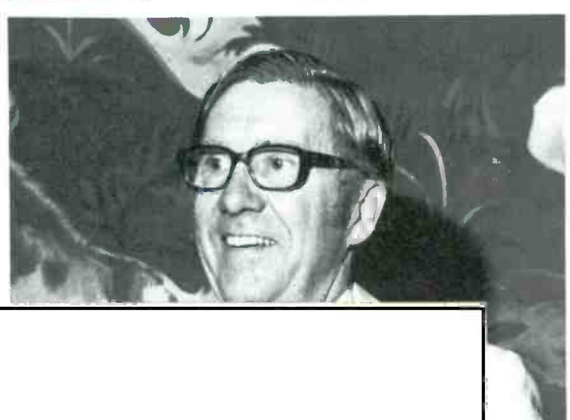

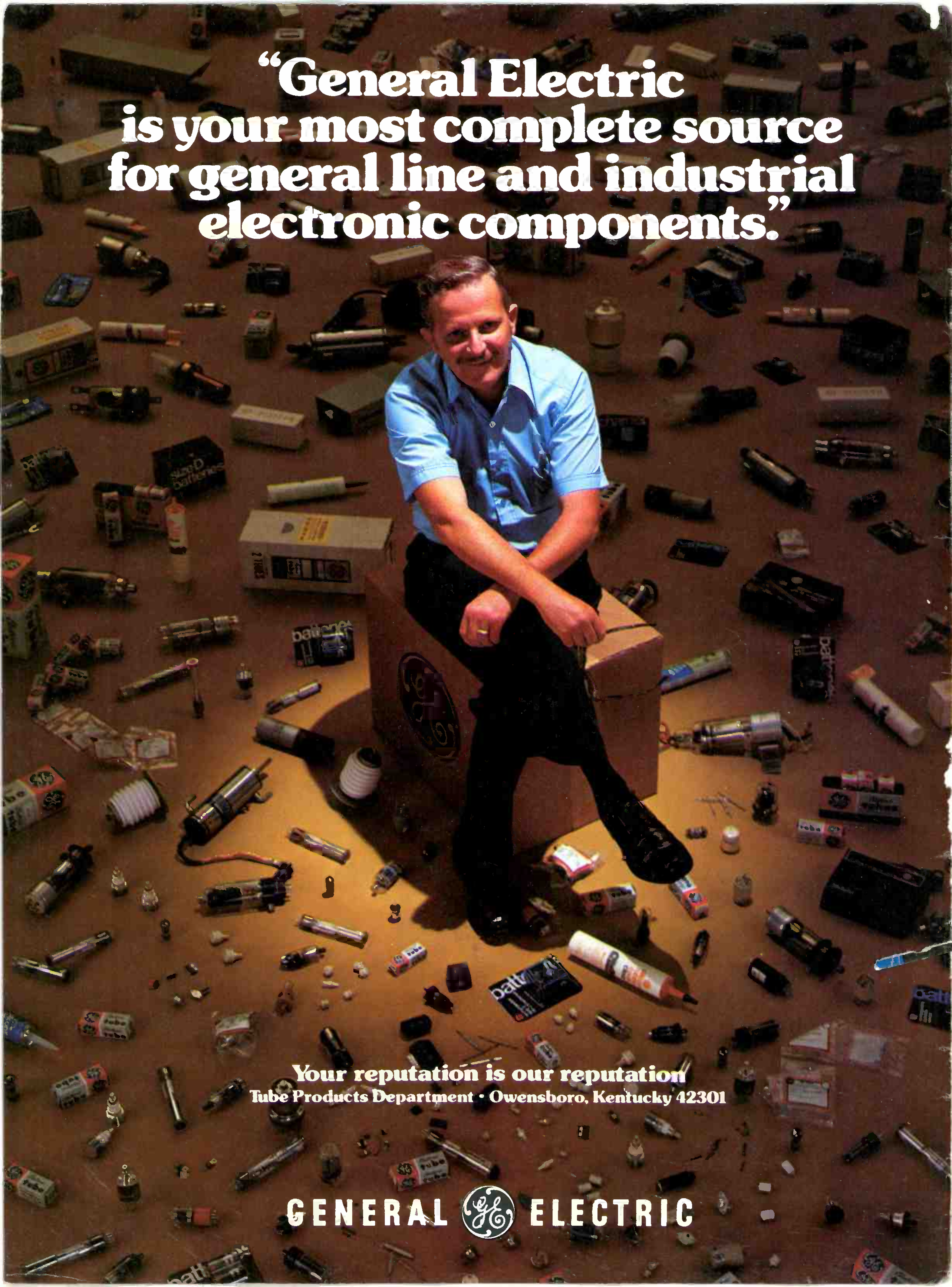
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GENERAL ELECTRIC

October, 1978 □ Volume 28, No. 10

Electronic Servicing®

Contents

About the Cover—These pictures were taken at the NESDA, ISCET, and NATESA conventions. Bob Villont is the new president of NESDA (far left); Jesse Leach became the 1978-79 ISCET chairman (lower right); new officers of NATESA were sworn in (color picture at the top); and Art Holst entertained at all three conventions, with his humorous stories and jokes (lower center).

DEPARTMENTS

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Electronic Servicing

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electronicscanner

news of the industry

Admiral's United States television business has been discontinued by Rockwell International Corporation. Admiral appliances, and television sales in Mexico and Canada, are not affected. Without prospective buyers for the division, Rockwell expects to close the Admiral plant in Harvard, Illinois, and accept an after-tax write-off of about $25 million for the fiscal year. Losses of the Admiral division since 1974 are said to total $73.7 million, while last year's losses were $19 million.

Can electrical power be stored in a magnet? Scientists believe it can be done practically and economically. Such a system would have a stadium-sized magnetic coil that is cooled to near absolute zero and buried far underground. Excess electricity generated during times of low demand would be stored in the coil by the inductor-converter process, and withdrawn later when needed. A team at the University of Wisconsin-Madison is designing a $200-million unit to store 10 gigawatts of power per hour. As stated in *Machine Design*, one important advantage is that larger units provide lower per-watt storage than do batteries or flywheels.

Magnavox is scheduled to demonstrate its videodisc system this month in New York. Probably, the demonstration is the beginning of videodisc retail sales.

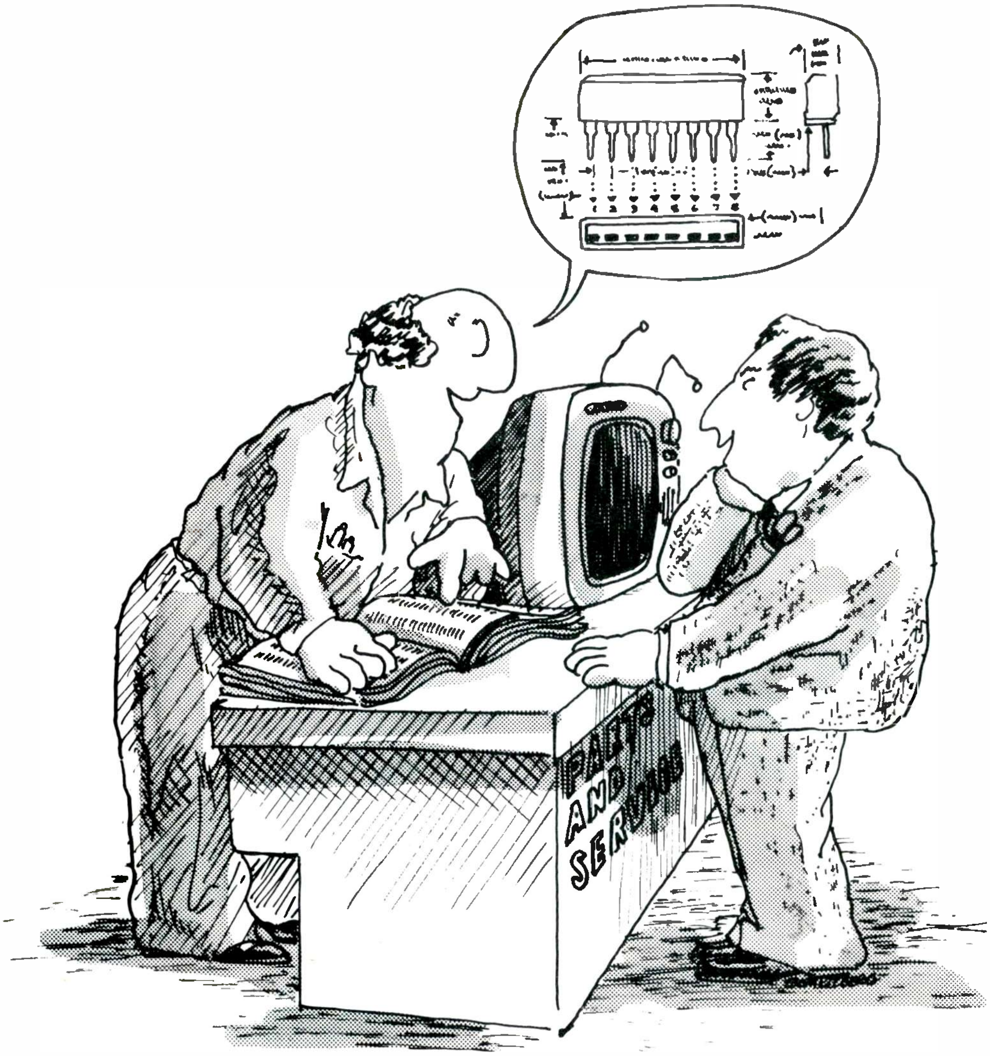
Ray Guichard has been appointed as director of Service and Consumer Affairs for the Magnavox Consumer Electronics Company. He succeeds Ray Yeranko, who retired August 31 after 44 years with the company. Guichard joined Magnavox in March of 1956, as national service manager for Magnavox's Spartan Division. He has a BS degree in electronic engineering from Tri-State University, and is a member of the Institute of Electronic Engineers, in addition to being active in several EIA committees.

Heavy-duty batteries that don't require charging or recharging are in an experimental stage. Aluminum, water and atmospheric oxygen react inside the battery to produce electricity. Aluminum hydroxide is the byproduct, and it can be processed to salvage the aluminum. A lab prototype produces 500 watts of power. Larger versions could be used to operate electric autos, according to *Electronic Design*. Operating costs are predicted to be lower than for gasoline. When the power is exhausted, conventional service stations could add water and new aluminum anode plates, allowing another 500 miles of operation.

Memory magnetic-bubble ICs having chip capacities of 254,688 bits in 224 loops are offered by Texas Instruments for $500 each. Power required is 900 milliwatts, as explained in *Electronic Design*. The 20-pin DIP dimensions are 1.2 inches square by 0.4 inch high.

Illegal copying of copyrighted cassette videotapes has become serious. Some industry sources, according to *Retailing Home Furnishings*, say the bootlegged tapes are outselling the genuine tapes. Movies such as "Patton" and "M*A*S*H" are very popular, but one source reported that 40% of his sales were X-rated or pornographic. Almost 500,000 legitimate tapes of movies are expected to be sold during 1978, along with another 450,000 pornographic tapes, and nearly as many illegal copies of "Star Wars," and other popular movies.

The Federal Trade Commission (FTC) has made its first complaint against a retailer, under the Magnuson-Moss Warranty Act. According to *Retailing Home Furnishings*, several complaints have been issued against George's Radio & Television Company, a major retailer in the Washington, D.C. area.



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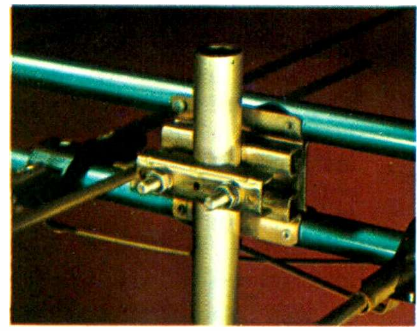

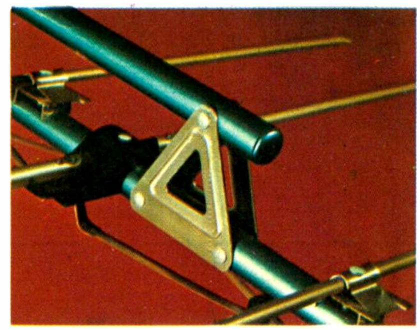

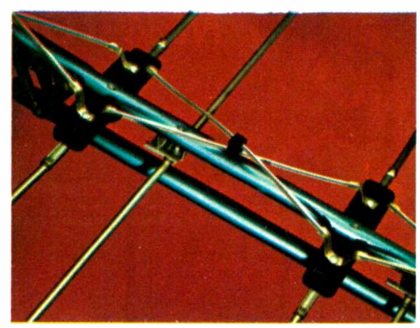

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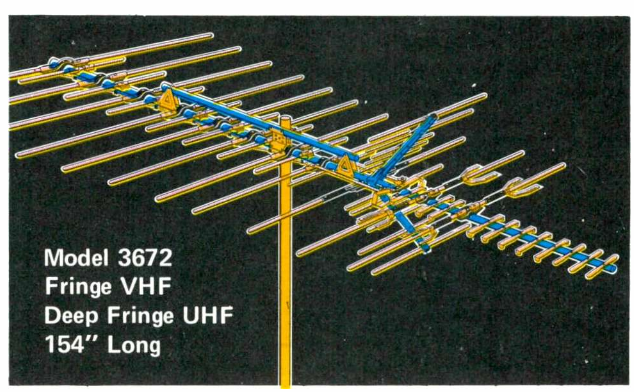
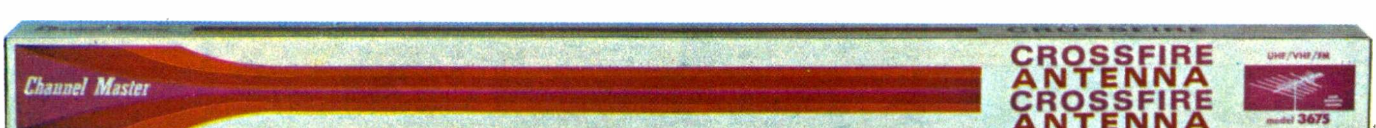




Circle (6) on Reply Card

Publisher's Note: Electronic Servicing®

New editorial director named for Electronic Servicing

Electronic Servicing features with this issue a new name on the masthead. Bill Rhodes, former editor of *Electro-Technology*, a magazine previously owned by Industrial Research, Inc., and absorbed by Dun-Donnelley Publishing Corporation, joined our staff in late August. Rhodes brings to **Electronic Servicing,** as editorial director, a broad background in RF communications, radio wave propagation and technical journalism.

Rhodes holds a MS degree in physics with an emphasis in solid-state electronics and wave propagation. His undergraduate work was in both physics and mathematics. His career, in addition to his experience in technical publishing, has encompassed virtually every facet of communications and includes the development of an all solid-state mobile broadcast system.

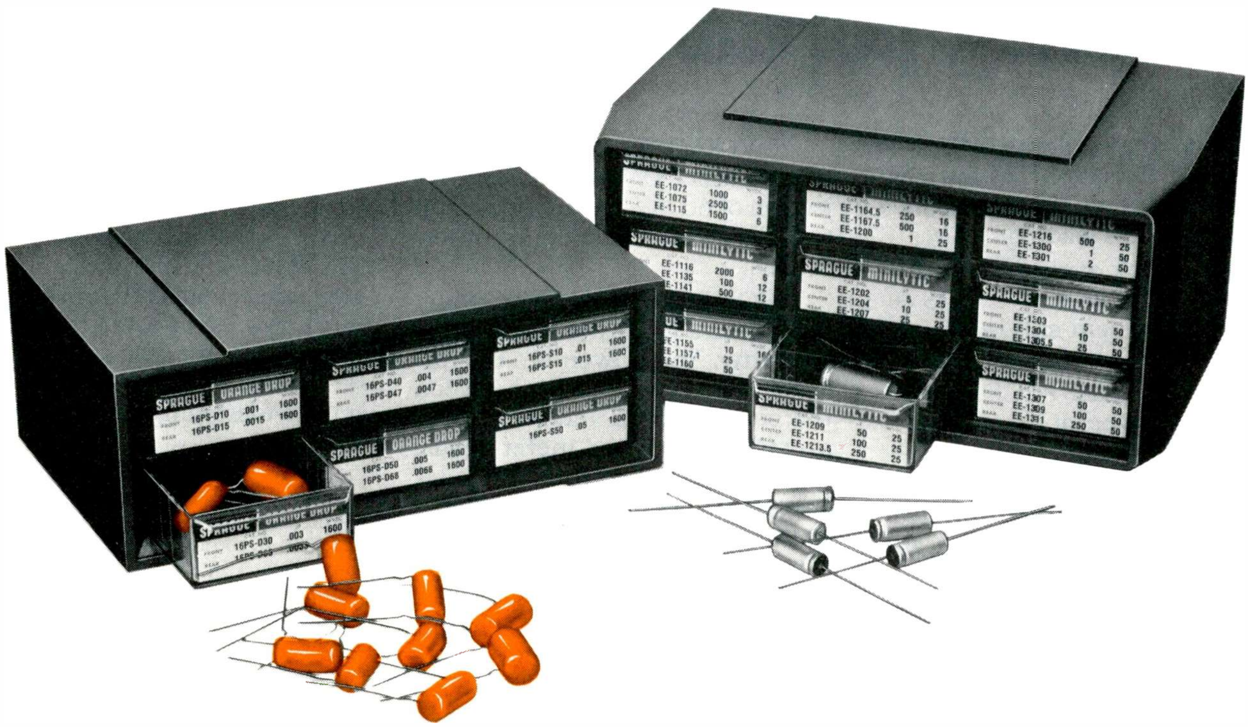
Organizations and companies that Rhodes has worked for include B&K Instruments, International Rectifier, Indiana University, Midwest Research Institute and Boeing Aircraft. Rhodes has been involved in engineering and research in various areas, including computers, minicomputers and microprocessors; the selection of servomotors and servo systems; and the evolution of recorders, oscilloscopes and counters.

In addition, he has conducted pioneering studies on the magnetic properties of ferrite materials. Rhodes also developed the first application of the LASER in the area of cryogenic research.

If Bill or Carl Babcoke, **Electronic Servicing's** Editor, can be of any help, contact them directly.

George Laughead

Reach for Sprague parts instead of running for them.



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Dipped Tubular Radial-lead Film Capacitors	KF-16	20	9	
Dipped Tubular Radial-lead Film Capacitors	KF-18	96	13	
Dipped Tubular Radial-lead Film Capacitors	KF-19	136	18	
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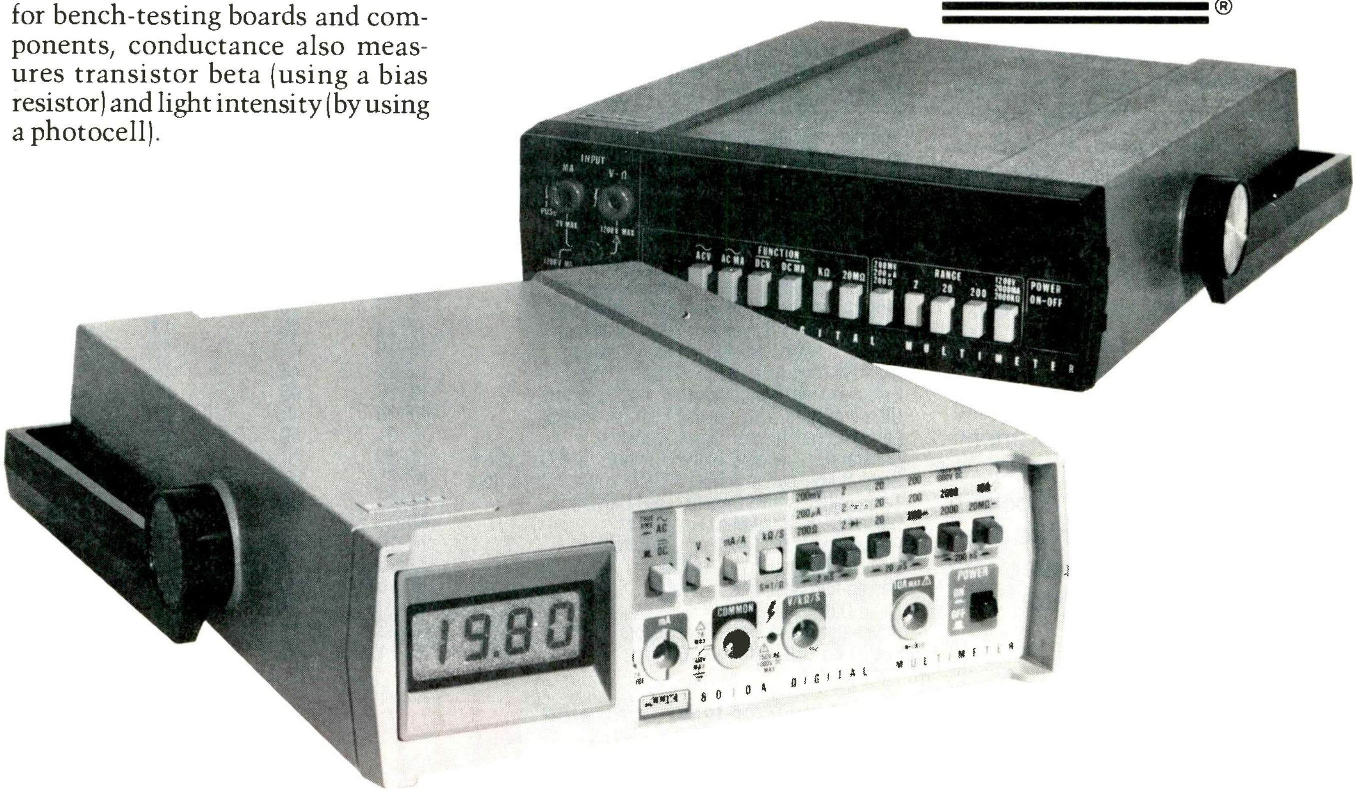

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reader's exchange

There is no charge for listing in *Reader's Exchange*, but we reserve the right to edit all copy. If you can help with a request, write direct to the reader, not to *Electronic Servicing*.

Needed: Schematic for model 811K RCA radio (has 11 tubes). *Martin's Radio & TV Service, 1101 Magnolia, Natchez, Mississippi 39120.*

For Sale: B&K-Precision 415 sweep/marker alignment generator, $325; B&K 1076 television Analyst, $150; Sencore YF33 yoke and flyback Ringer, $115; Heathkit IM-12 distortion meter, $35. All in first class condition with manual and cables. *Long's TV Service, 720 Goshen, Salt Lake City, Utah 84104.*

For Sale: B&K-Precision 415 sweep-marker generator, $320; and model 466 CRT tester rejuvenator, $120. Also, Sencore CB-42 CB analyzer, $795. Add $5 shipping each item. *Bob Begun, 1056 Fraser, Aurora, Colorado 80011.*

For Sale: Heath IM-48 audio analyzer, $45; and Heath IM-58 harmonic distortion meter, $45. Both like new, used twice with manuals and leads. Will ship COD, or send certified check and we'll pay shipping. *DuPont Electronics, Ltd., 1222 Norton, Rochester, New York 14621.*

Needed: Schematic for old Radio City Products VOM model 410. Will buy, or copy and return. *Charles R. Wells, 16029 14 Mile Road, Fraser, Michigan 48026.*

For Sale: Precision model 960 transistor and diode checker with roll chart and complete instruction, never used, in original carton, $20. *Jag's Radio & TV Service, 14 Rudolph Road, Forestville, Connecticut 06010.*

Needed: Power transformer for 1964 Philco radio-phono model M-1666, part number 32-10006-3. *C. L. Durkin, Homestead 7, Decatur, Indiana 46733.*

Needed: One horizontal/vertical board in working condition for model 4-203UW, 4-inch B&W Sony. Send price. *The TV Shop, 5820 E. 32, Tucson, Arizona 85711.*

Needed: Heath IG57A sweep/marker generator. State condition and price. *Jack Field, 531 Falcon, Miami Springs, Florida 33166.*

Needed: Acrosound output transformer, type TO-330, in good working order. *Dexter Seymour, DC Technical Laboratory, 1012 Colonial Road, Franklin Lakes, New Jersey 07417.*

For Sale: Leader LS-5 solid state electronic switch, like new, $65; EICO 950 R/C bridge capacitor tester, $40. *Richard Sanderford, 6400 Andy Drive, Raleigh, North Carolina 27610.*

For Sale or Trade: 100 TV tuners for test equipment or Riders radio manuals. *Troch's, 290 Main, Spotsweed, New Jersey 08884.*

continued on page 14

reader's exchange

continued from page 12

For Sale: Heathkit scope model 10-102, $100; Heathkit post-marker/sweep generator model IG-57A, $135; subber Mark 1V-C TV Analyst, $35; RCA stereo needs some work, $70. *Glen E. Maples, P.O. Box 503, Flippen, Georgia 30215.*

Needed: General Electric television transformer, OH1G 12493-EN 241-520, #23D230315, E1A-413-6915, EU88X1. Send condition and price. *R. J. Duba, 14475 Huron Trail, Reno, Nevada 89511.*

For Sale: B&K 1470 dual-trace triggered scope with 2 direct/X10 probes and 1 demodulator probe, $400; and Hewlett-Packard 331A distortion analyzer and AC VTVM $550. Both with original cartons and manuals. *George Echohawk, The Turntable, 723 West Broadway, Enid, Oklahoma 73701.*

Needed: Power transformer for EICO model 425 scope. *Alfred Llorens, 605 East Rock Creek Drive, Columbia, Missouri 65201.*

For Sale: EICO 666 tube tester with new 610-A adapter, manual and latest chart, $100. *Kenneth Miller, 10027 Calvin, Pittsburg, Pennsylvania 15207.*

Needed: Schematic and manuals for Allied Radio Knight kit, "Magic-eye" capacitor checker number 83Y1195 and a Jackson dynamic tube tester model 715. *Warren L. Simpson, 371 Beagle Lane, Redding, California 96001.*

Needed: New or good used output transformer for Bogen monaural high-fidelity amplifier model DB 130, series A 95. *White Electronic Service, 202 Central, Winchendon, Massachusetts 01475.*

Needed: Manuals and cables for Hickok models 288-X signal generator, 650C video generator, 532 tube tester and RCA scope WO-88A. *Kenneth Miller, 10027 Calvin, Pittsburg, Pennsylvania 15207.*

For Sale: Sam's Photofact numbers 300 through 800 with cabinets; make offer; you pay freight. *Steve's Radio & TV, 3160 East Main Sp. 116, Mesa, Arizona 85203.*

Needed: Schematic and/or manual for Tektronix 511AD scope. *B. D. Young, 102 Jumping Brook Road, Lincroft, New Jersey 07738.*

For Sale: B&K-Precision Scope model 1474 30-MHz dual trace, triggered-sweep, like new with 2 probes and instructions, $500. *C. W. Hume, 108 Hillcrest Circle, Greenville, South Carolina 29609.*

For Sale: EICO 460 Scope, 4 probes, never used, $140; Conar model 280 signal generator, never used, $30; Elenco Electronics precision crosshatch generator SG-100, never used, $25. *Randolph Wilson, Box 6, Whitelaw, Wisconsin 54247.*

Needed: Meter, complete with face plate, for Mercury VTVM model 1700A. *Earl Rivers, Sr., 333 Crimmins Avenue, Bronx, New York 10454.*

For Sale: 5867 germanium and 1300 silicon general-purpose diodes, 100% tested good and packed 100 in each ziploc bag, for $65 post paid. Also, have over 1000 integrated circuits all series, for $100 plus $5 postage. *William W. Hyatt, 473 DeSoto Drive, Miami Springs, Florida 33166.*

Needed: RCA Victor red or maroon 3-ring looseleaf binders for service data. *C. E. Sarver, 256 West 88th Street, New York, New York 10024.*

For Sale: Simpson model 488 field strength meter, $50; Sencore CR128 color and B&W CRT tester, $25; Sencore TR110A transistor tester and signal generator, $20; Hickok model 650 signal generator including vertical and horizontal drive signals, $25; EICO VTVM, model 221 without leads, $15; Precision sweep generator model E400 with crystal marker, $15; Hallicrafters S-85 all-band receiver, $25; Hickok colorbar generator, $18; EICO 955 capacitor checker, $20; Hickok model 610A alignment generator, $20; EICO model 232 VTVM, like new, factory wired and calibrated, $40. All items shipped prepaid. *Fessenden TV & Appliances, 116 North 3rd, Ozark, Missouri, 65721.*

Needed: Instruction book and set of leads for a Precision VTVM, model EV10-S. Also, would be interested in buying another, complete and in good condition. *W. Hitchcock, Tri-City TV, Sales and Service, Route 3, Birch Tree, Missouri 65438.*

Needed: Instruction book and schematic for a model 7008 Precision visual-alignment generator, for TV and FM; instruction book and adapter kit for B&K-Precision tube tester Dyna-Quik model 550; and source of parts for Candle TV sets. *Raymond J. McClellan, 961 West 8th, Santa Rosa, California 95401.*

Needed: Part number 7-55 power transformer for Bell & Howell model 34 scope. *Richard O. Greenman, 9719 Ballin David, Spring, Texas 77379.*

Needed: Stock of audio printed circuits used several years ago, made by OPCO, CRL, Sprague, etc. Also, need a cross reference for them. *Lawrence T. Anderson, Radio Activity, 3453 Balsam NE, Grand Rapids, Michigan 49505.*

Needed: Operation and service manual for Berkeley universal counter and timer model 5510. Will buy, or copy and return. *Tyler Audio Service, P.O. Box 1019, Lomita, California 90717.*

Needed: Schematic and/or operating manual for a First Dimension model FD-3000-W video game. Will pay or copy and return. *David Valencia, 7241 Tuolumne Drive, Goleta, California 93017.*

For Sale: Hickok model 517, 15-MHz dual-trace scope, brand new, $550. You pay transportation and insurance. *Clifford E. Randall, Rd. #1 Box 47, Arkport, New York 14807.*

Needed: Book about repairing volt/ohm meters. *Lawrence Gaylord, P.O. Box 1387, 336 Whittley, Avalon, California 90704.* □

troubleshooting tips

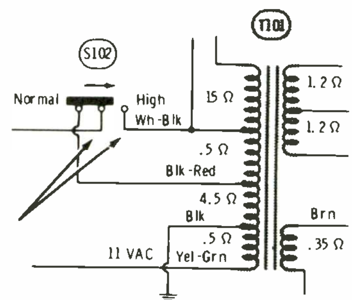
Circuit breaker trips
RCA CTC71AB
(Photofact 1552-2)

When the color TV was brought to the shop, the complaint was that the circuit breaker tripped at random times. A time test on the bench verified the problem, but there were no visible symptoms on the screen before the breaker tripped.

Of course, breakers sometimes become "weak" and trip with rated current, so we installed a new breaker of the correct type and current. At the time, we noticed the line-voltage switch was in the "high" position, and we slid it to the "normal" position to match the line voltage in our shop.

The set was powered-up for a time test, and was ignored as we worked on other sets. After about 10 minutes, we smelled something hot, and found the power transformer was almost burning.

Our first reaction was that the replacement breaker was faulty, so a 3-ampere fuse was wired in series with the breaker, and the set operated again. Well, the fuse didn't blow, but the transformer overheated. A new power-supply module made no change. In fact, with the module *removed* and the CRT socket pulled off, the transformer continued running too hot.



This called for a coffee break, while I studied the schematic for any "sneak" paths. There seemed to be no untested transformer loads, but I remembered an article in **Electronic Servicing** about a service switch causing vertical foldover. I decided to check the normal/high line-voltage switch, S102. The transformer wires at the switch were cut off, and *ohmmeter tests showed continuity between common and* **both** *lugs*, when the switch was in the normal-voltage position.

A closer look at the switch revealed a blob of solder between the common and high terminals. With the switch in the high-voltage position, there was no problem, because the switch and solder short were in parallel. But, in the normal-voltage position, the solder blob shorted across the part of the primary winding that is between the two terminals. This gave the effect of many shorted turns, and caused excessive line current.

We considered this case to be one "for the record book," and marked on our schematic.

George Rice
Ashland, Massachusetts

National Service Conventions... A Brief Report

Benefits resulting from activities of the various service associations are not confined solely to the **members** of those organizations. Instead, **all** technicians and electronic-shop owners indirectly receive valuable help and support from the association efforts. Therefore, the editors and management of ELECTRONIC SERVICING urge you to join one or more of the service associations and assist them in improving the conditions of our industry. This condensed report of the conventions shows you some of the day-to-day activities of these organizations. Of course, conventions also have their lighter moments; and a few of those will be spotlighted. *By Carl Babcoke, Editor*

NESDA Convention

Portland, Oregon was chosen for the August 7-13 convention of the National Electronic Service Dealers Association. (NESDA).

Association business matters, including reports from officers and committees, were followed by the election of these 1978-79 new officers: Robert A. (Bob) Villont, president; Warren Baker, national

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At the Portland convention, M. L. Finneburgh gave the oath of office to these newly-elected NESDA officers (listed left to right): George Simpson, treasurer; West Correll, secretary; Warren Baker, national vice-president; and Bob Villont, president.

In a regal and colorful ceremony, M. L. Finneburgh (an honorary lifetime member of NESDA) became a knight of the Portland Royal Rosarians.

Robert A. (Bob) Villont of Tacoma, Washington was unanimously elected as the President of NESDA.

A combination of mail and in-person ballots elected Jesse Leach (of Linthicum Maryland) to the chairmanship of ISCET.

Conventions

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vice-president; West Correll, secretary; and George Simpson, treasurer. Ten regional vice-presidents also were selected.

Two business-management seminars were held. One clarified the relationship between service dealer and the law, and the other taught the skills necessary for successful selling. Technical seminars were conducted by factory representatives and J. A. "Sam" Wilson.

Six hours were given to the National Electronics Trade Show and Exposition, where products, test equipment and association information were displayed. Prizes were given away during the exposition.

Most meals were sponsored by various TV manufacturers, which also furnished after-dinner speakers.

Recognition and plaques were presented to many worthy individuals. For example, outgoing-President LeRoy Ragsdale received two awards. Two names were added to the Electronics Hall of Fame (EHF) roster. They are Enos Rice, and the late Ralph Johonnot (accepted by Ann Johonnot).

Another EHF member received a unique honor. Mr. M. L. Finneburgh was dubbed a knight by order of the Portland Royal Rosarians. During the colorful and regal ceremony, he became "Sir Morris L. Finneburgh, Sr., EHF, Knight of the Rose Tropicana."

A practical bonus for NESDA members is the new low discount rates (down to 1.1%) for those participating in the bankcard program.

Tucson, Arizona was selected as the convention site for next August. Attendance of NESDA, ISCET, OPEA, and WSEC totaled about 600.

Background

NESDA is said to be the only shop-owner association of state organizations in the electronics field. A few of the benefits to members include: Service Shop magazine; an insurance program, technical tips, reports of legislation and lobbying; and business schools.

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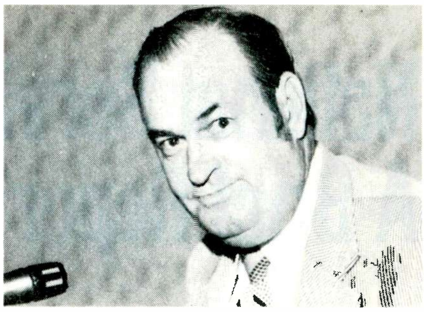
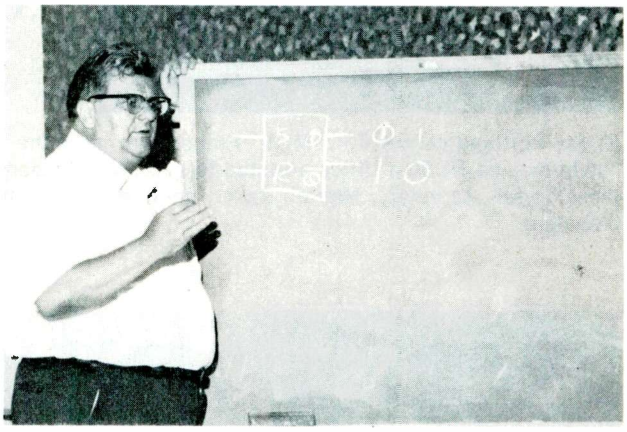


LeRoy Ragsdale, immediate past president of NESDA, received two awards at the convention.

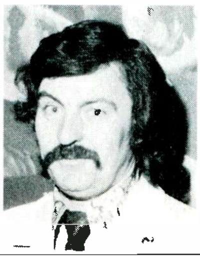
Ray Yeranko, Magnavox director of Service And Consumer Affairs, showed that he was a good sport by "playing" the harmonica with the Rudy Jarju Family at the NATESA grand banquet.

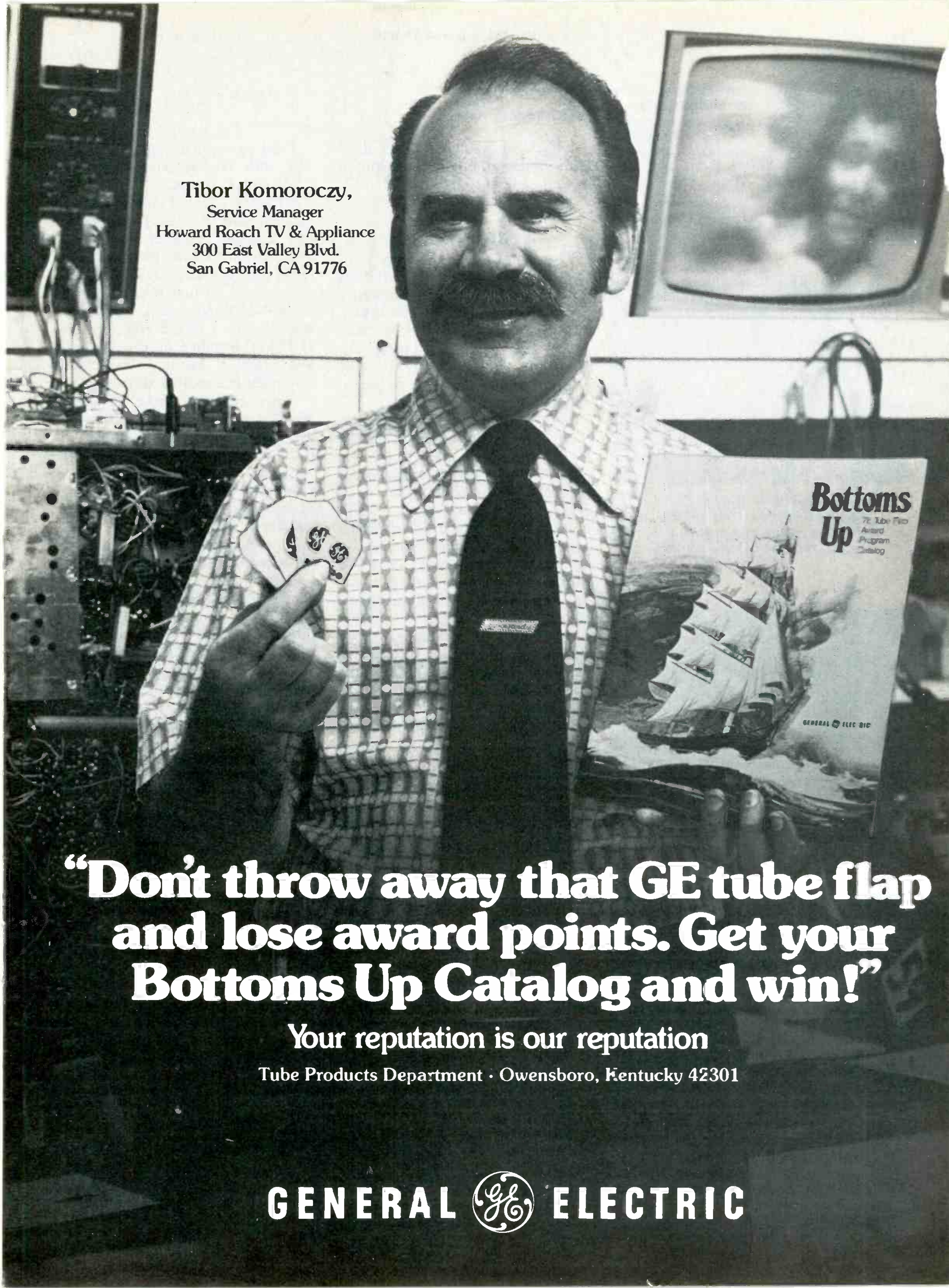
Enos Rice (CES/CET of Seattle, Washington) was inducted into the "Electronics Hall Of Fame" at the NESDA convention.



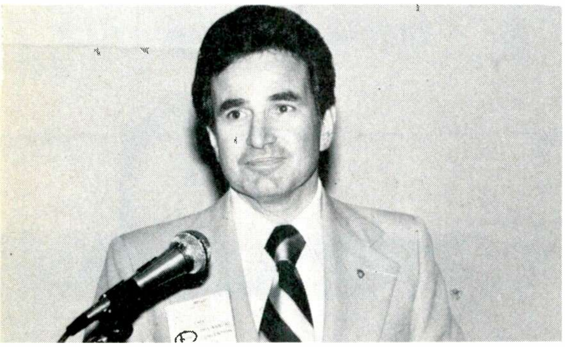
J. A. "Sam" Wilson, who writes regularly for **Electronic Servicing,** conducted the NESDA digital seminars.

From left to right, are the new NATESA 1978-79 officers: Paul F. Kelley, president; Leo Edmond Cloutier, vice-president; Richard Ebare, treasurer; Lelia Aunspaw, secretary; and Frank J. Moch, Executive Director.



Tibor Komoroczy,
Service Manager
Howard Roach TV & Appliance
300 East Valley Blvd.
San Gabriel, CA 91776
Bottoms Up
"Don't throw away that GE tube flap and lose award points. Get your Bottoms Up Catalog and win!"
Your reputation is our reputation
Tube Products Department · Owensboro, Kentucky 42301
GENERAL ELECTRIC

Carl Babcoke, editor of **Electronic Servicing** served as moderator of the NATESA Technology Overview panel, which discussed the trends and servicing of present-day electronic technology.



Miles Sterling of Garden Grove, California explained to the NATESA members the status of his lawsuit against several electronic manufacturers.

Joe Groves, manager of the Howard Sams Photofact Division, received the "Friends Of Service" 1978 award as a representative of Howard W. Sams & Co.

Humorist Art Holst, who moonlights as a referee at many National Football League games, was the star entertainer at both the NESDA and NATESA conventions. He was sponsored by RCA.

Conventions

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NESDA is located a 1715 Expo Lane, Indianapolis, Indiana 46224, and the phone number is 317/271-8160.

ISCET Convention

The International Society of Certified Electronic Technicians (ISCET) held its 1978 convention in Portland with NESDA. New ISCET officers (elected mainly by mail ballot) are: Jesse B. Leach, Jr., chairman; Forest H. Belt, vice-chairman; Leon Howland, secretary; and George Sopocko, treasurer.

ISCET is a permanent committee of NESDA. However, many of the ISCET members are strongly in favor of becoming independent of NESDA. It is said that such independence would allow ISCET to become the technical-certification agent for many other branches of electronics. Jesse Leach views his election as a mandate for autonomy. In a series of official motions, ISCET members who were present voted for close cooperation with NESDA, and for mailings to ISCET members detailing the advantages and disadvantages of independence. This vital issue is to be settled by ballot, after all members are informed.

Background

ISCET is an electronic honor society. To become a CET, each technician must meet the requirements and pass a two-part test of electronic theory and practical knowledge. All CETs of good character are offered the opportunity of joining ISCET. A charge of $20 is made for taking the CET test, and ISCET dues are $25 per year.

For more information, write to ISCET at 1715 Expo Lane, Indianapolis, Indiana 46224.

NATESA Convention

The National Association of Television & Electronic Servicers of America (NATESA) held its 28th annual convention August 24 through 27 at the Chateau Louise Resort in Dundee, Illinois (near Chicago).

Total convention registration was 438, with representation from 22 states and Australia.

Officers elected for 1978-79 include: Paul F. Kelley, president; Leo Edmond Cloutier, vice-president; Richard Ebare, treasurer; and Lelia Aunspaw, secretary. Lelia Aunspaw is the first woman elected to the NATESA council. Past-President George J. Weiss will serve as ex-officio member of the council, and Frank J. Moch & Associates continues as executive director.

Other activities were: NATESA official-business sessions; a business-practices panel, with Richard Lay as moderator; a technology overview panel, with Carl Babcoke, **Electronic Servicing** editor, acting as moderator; sponsored meals with speakers; a microwave-oven seminar; many hospitality rooms; and the Grand Banquet, with the presentation of awards and professional entertainment.

Miles Sterling reported on his litigation against some manufacturers and marketers (for alleged violation of servicer's rights to compete), and many individual NATESA members contributed to a fund for continuation of the lawsuit.

Howard W. Sams was named as the 1978 NATESA Friends of Service Award winner. Next year, the convention will return to Nordic Hills in Itasca, Illinois.

Background

Last year, NATESA changed from operation as an alliance of state and local associations to an association of individual shop owners and managers. Membership (and convention attendance) has increased since then.

NATESA has defended ethically-operating electronic businesses against unfair exposes by the media, and against some below-cost warranty practices. In addition, NATESA provides its members with extensive advice about operating at a profit.

NATESA can be contacted at 5908 South Troy Street, Chicago, Illinois 60629, or by phone at 312/476-6363. □

Horizontal sweep and high voltage

Servicing GE 13" Color TV, Part 2

By Gill Grieshaber, CET

Horizontal sweep in the General Electric AA-D chassis provides AC power for several vital DC-voltage supplies, in addition to the usual deflection and high-voltage functions. Therefore, this important knowledge about the horizontal-sweep system is necessary for efficient troubleshooting in ***any*** *stage or circuit.*

Horizontal Sweep

In the General Electric AA-D chassis, the horizontal-sweep system has several different features. These include a high-voltage rectifier assembly mounted inside the insulation of the flyback transformer, encapsulated focus resistors with a case resembling that of a HV tripler, and a horizontal oscillator without a coil of any kind. (Most oscillators have either an oscillator coil or a stabilizing coil.)

However, you will feel comfortable servicing the AA chassis, since most of the circuits are somewhat conventional.

One IC contains much of the horizontal phase-detector and oscillator stages. This oscillator IC is followed by a medium-power driver transistor, which is transformer-coupled to a power-type horizontal-output transistor.

Several low-voltage DC supplies are powered by horizontal-sweep waveforms from the output stage and the flyback. **So, if the horizontal-sweep system ever goes dead, many of the DC voltages in other circuits of the receiver will be missing.** These DC supplies were discussed last month.

Oscillator and driver components are mounted on the large module, while the flyback transformer, output transistor, focus resistors, and other large components are mounted on the upright end panel. Locations of many main parts and stages are pointed out in Figures 1 and 2.

Horizontal Oscillator and AFC

Figure 3 shows the entire horizontal-sweep system (minus only the side-pincushion and B-boost

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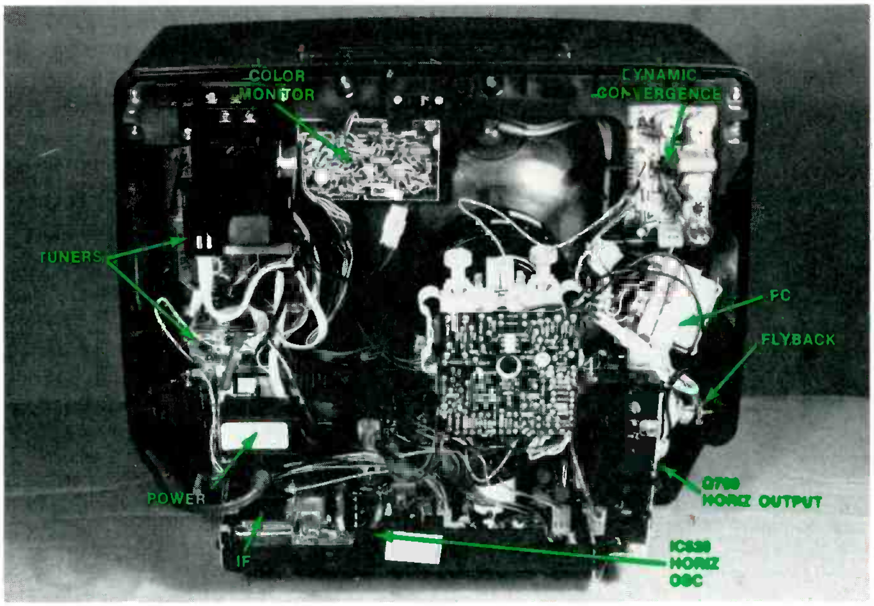

Figure 1 Locations of several horizontal-sweep components are pointed out in a General Electric AA-D portable chassis.

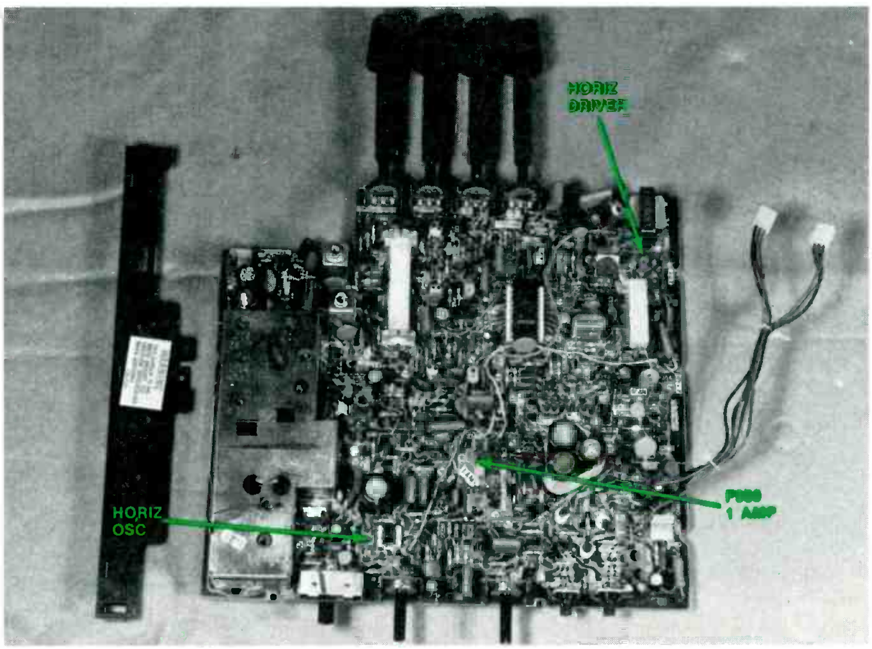

Figure 2 Many horizontal-sweep parts are mounted on the large module.

General Electric

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stages). All waveforms are in Figure 4.

Components of the horizontal oscillator are grouped in one corner of the large module (see Figure 5). One small 8-pin DIP IC (IC520) contains all transistors and diodes of the horizontal-AFC and oscillator stages.

AFC

All horizontal AFC stages must have two specific input signals: sync pulses, and sweep sawteeth. This circuit is no exception.

Negative-going horizontal sync pulses are differentiated by C510 and the input impedance of the IC, and they are filtered slightly by R517 and C516 before they enter IC520 at pin 3. (Waveforms are in Figure 4.)

Positive-going horizontal-sweep pulses (from the reference-pulses winding of the T700 flyback) are integrated into sawteeth by R519 and C518, then they are fed to IC520 pin 4.

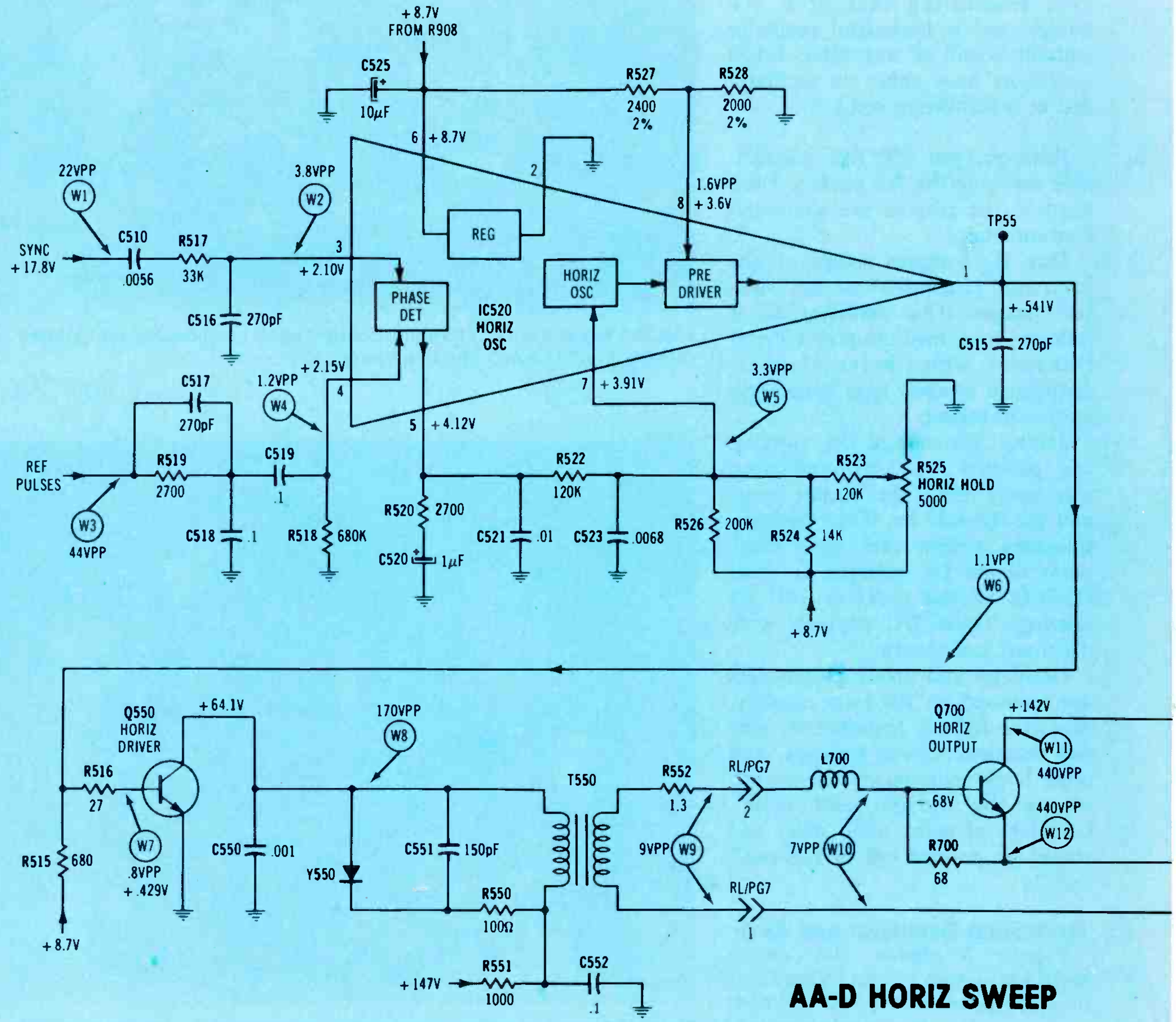
When these two signals are phase detected inside IC520, a DC error-correcting voltage is produced. This error voltage is filtered by R520/C520 and C521 (which prevent picture bending and pie-crusting) before it connects to the horizontal oscillator at pin 7. A variable-DC voltage from the horizontal-hold control also is sent through R523 to the same pin 7, to vary the horizontal frequency for proper locking.

Notice that a loss of either the sync pulses **or** *the sweep sawteeth at the IC pins will prevent all horizontal locking.*

Oscillator

The type of horizontal oscillator is not specified. We can guess only that it is some kind of multivibrator, or other time-constant type. None of the components or waveforms are available for testing.

A pre-driver stage follows the horizontal oscillator, acting as a buffer. Evidently the DC voltage at pin 8 (from voltage divider R527/R528) is critical, and necessary for correct operation of the pre-driver amplifier stage.



AA-D HORIZ SWEEP

Output of the pre-driver is made up of distorted square waves (see Figure 4) at pin 1, and the square waves go through R516 to the base of Q550, the horizontal-driver transistor.

Horizontal Driver

Q550, the medium-power horizontal driver transistor, and the interstage driver transformer (T550) are diagonally across the chassis from the oscillator IC, as shown in Figure 6.

Diode Y550 and resistor R550 prevent the driver transformer from ringing. An open diode probably would cause the driver transistor to fail, and **a shorted diode will eliminate the sweep and high voltage.**

For troubleshooting this driver stage, rely on the base and collector DC voltages and scope waveforms to locate any defects. For example, be suspicious of an open diode, if the collector waveform has excessive amplitude with ringing.

The T550 secondary drives the base/emitter junction of the horizontal-output transistor.

Output Transistor And Flyback

A single power transistor (Q700) supplies all of the deflection and high voltage. Incidentally, there are a few differences between the AA chassis for the 10-inch sets and the AA-D that's found in this 13-inch version.

In the 10-inch TVs, the emitter and low end of the driver transformer secondary are grounded. However, the AA-D chassis has the emitter and the transformer both going to an extra winding on the flyback (terminals 4 and 6). Evidently, the extra winding is required for the increased sweep and HV power.

This floating emitter changes the waveforms drastically. For example, the base, the emitter, and the collector all have very high horizontal pulses relative to the chassis. Positive pulses are found at the collector, and negative-going pulses of about the same amplitude and waveform are scoped at **both** base and emitter of the output transistor. Of course, when measured to ground, both the damper diode and the 4-wire safety capacitor have sweep waveforms at all terminals.

For fast tests, scope emitter to

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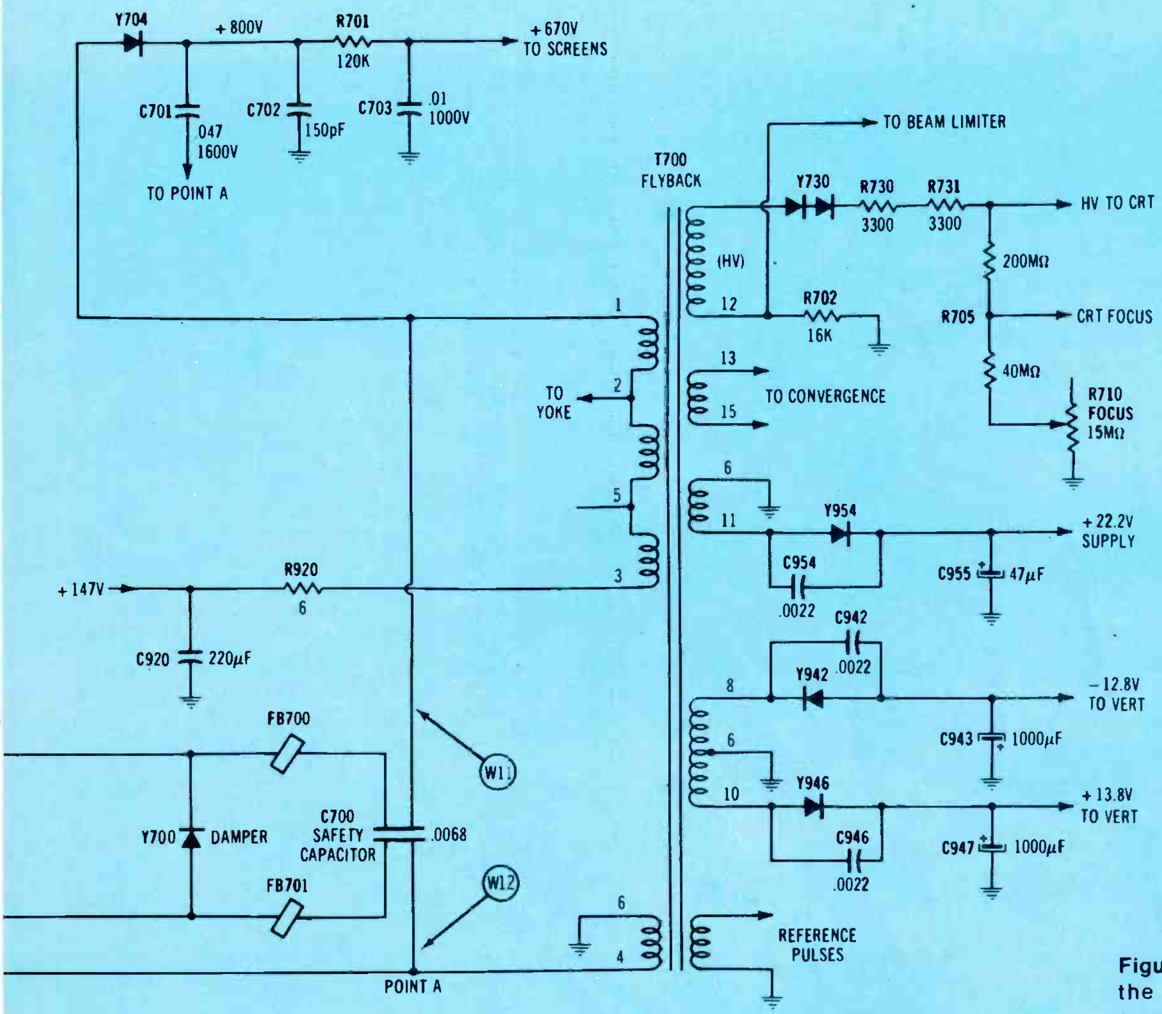

Figure 3 This schematic of the GE AA-D horizontal-sweep circuit is complete with measured DC and peak-to-peak AC voltages.

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ground and collector to ground, while noticing the waveforms. Then, if there is a question about the actual B/E drive at Q700, the scope should be connected **between** base and emitter (not to ground). Remember that your scope will have about 440 VPP between it and chassis ground, so take precautions.

Q700 base waveforms

The "normal" base-to-emitter waveform of any horizontal-output transistor defies any detailed analysis. You must accept it, merely because all correctly-operating sets have similar waveforms. But, as we have pointed out in previous articles, the B/E waveform *changes* a tremendous amount when the B/E junction opens, or if the transistor is removed from its socket.

For example, when the B/E junction of this GE AA-D chassis is open, the waveform becomes plain square waves of about 5 volts PP. Figure 7 shows both the normal waveform and the square waves present when the transistor is removed.

Flyback and DC supplies

Figure 3 also shows the many other DC power supplies that rectify horizontal waveforms.

The B-boost supply and diode Y704 operate with the full pulse amplitude from collector to emitter of Q700, because the C701 filter capacitor returns to the Q700 emitter, and not to ground.

Two opposite-polarity DC supplies provide power to the vertical-output transistors.

Probably the most important of these auxiliary supplies is the one marked +22.2 volts DC, for it splits to feed most of the IF, video, audio and chroma stages. If that supply goes dead while the others are okay, there is no sound or picture, although the high voltage is normal.

Notice the connection at pin 12, that goes to the beam-limiter circuit. Defects in this part of the circuit can cause excessive brightness or none at all. A black raster can be caused by many more defects than just a loss of high voltage!

Yoke wiring

The yoke coils are series-connected (see Figure 8). In turn, they are in series with one winding of the side-pincushion-correction transformer (T740) and the C710 yoke-coupling capacitor; then all receive sweep power between a tap of T700 and the emitter of Q700, the output transistor.

Safety capacitor C700 has four leads. This is designed to prevent operation of the receiver if the capacitor is cut out of the circuit, or following an open circuit of the internal foil in the capacitor.

Capacitor C700 is the main tuning capacitor for the flyback portion **of the horizontal cycle, and thus it has a major effect on the** amount of high voltage. If it opens (or is removed) the high voltage might reach 40 KV, or higher (I'm not about to remove one and test the symptoms, which have included

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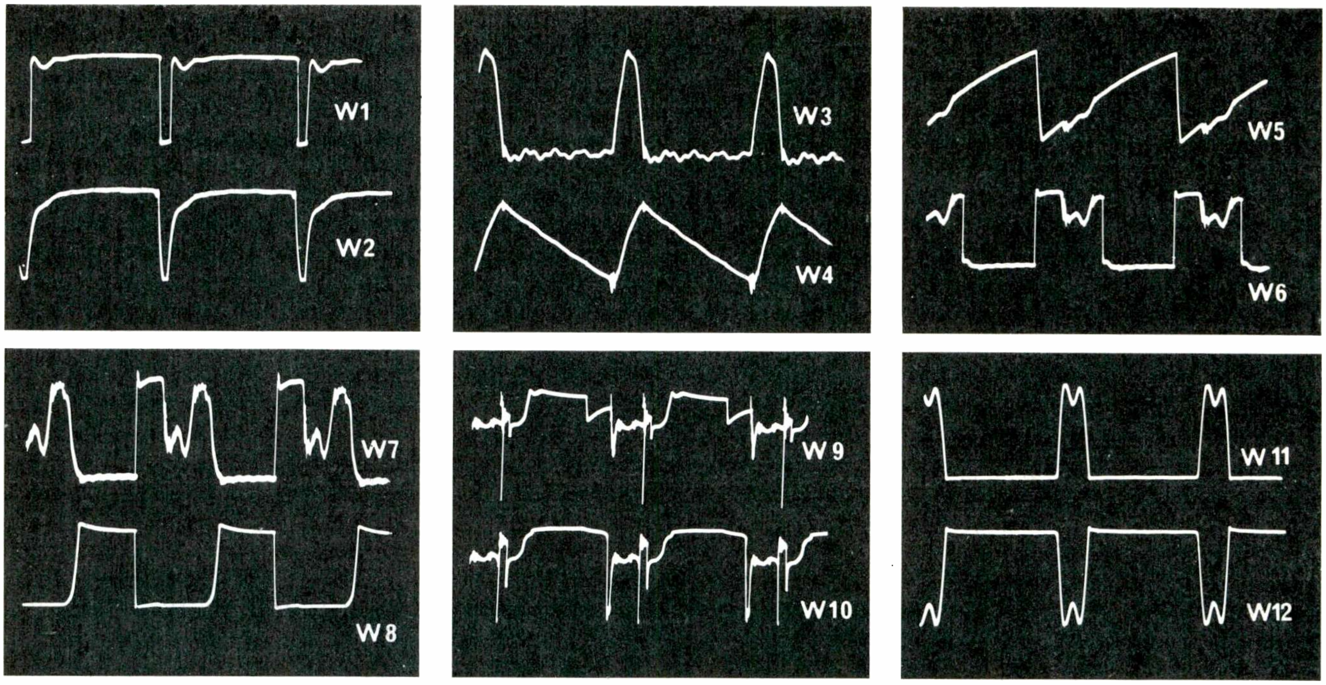

Figure 4 Numbers for these sweep waveforms correspond to those in Figure 3.

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ruined picture tubes in other brands). If replacement ever becomes necessary, use only the exact value and type of capacitor. Probably this is the most critical component in the entire receiver.

B-boost

Figure 9 details the B-boost supply and the screen grid controls for the picture tube. There is no service/normal switch, but a certain test point is grounded to establish the proper conditions for adjusting these G2 controls for best gray-scale tint.)

Troubleshooting Horizontal Sweep

Testing the AA-D chassis for sweep or HV problems is made easier by the omission of any regulator for the horizontal-sweep B+ supply. Also, no component defect, except an open C700, can cause excessive high voltage; therefore, no circuits are needed to disable the locking (or other vital function) when the high voltage is excessive. The only complication is working with the two types of power supply. One main supply operates from the 60-Hz line, while several others obtain their AC input from horizontal-sweep power. Therefore, sweep troubleshooting is slightly different, compared to other models.

There are four principal symptoms to direct you in locating the circuit or stage with the defect. They are: visible picture-tube heater glow; sound in the speaker; high voltage and raster; and a picture.

Here are some examples of that troubleshooting logic:

- Lack of sound (but picture is okay)—proves the sound circuit is bad.
- No sound, no raster, no picture, no light in heaters—hints at an AC power problem, such as an open F900 or bad AC switch, etc.
- No sound, no raster, no picture, but CRT heaters light—indicates a 60-Hz power-supply defect or a lack of horizontal sweep.
- Sound and raster are okay, but without any picture—points toward a video-amplifier problem.
- No raster or picture, but the sound is normal—a bad HV rectifier, or wrong DC voltages in video, chroma, or CRT circuits are possibilities.

Testing sequence

We have reminded you already that loss of horizontal sweep also kills sound, raster, and picture. The following test sequence is based **only** on sound and picture symptoms, because experience has shown that solid-state horizontal-sweep systems seldom cause width or linearity problems.

Follow this sequence of tests, when there is no sound and no raster:

- Examine and test both fuses. Figure 10 shows F950, which is located near the center of the main module.
- With power on, look at the neck of the picture tube for a dim glow inside all three guns. If all are lighted, the CRT heaters are okay, and AC is reaching the power supply. If not, the CRT might be burned out, or the AC is not present at the heater transformer (and probably not to the power supply).
- With the power applied, listen for the rustling noise from the stray capacitances charging with high voltage. Better yet, use a HV meter, so you'll **know** the voltage there. With enough HV, but no sound or raster, probably one of the scan-rectified B+ supplies is dead. If the high voltage is missing, it's likely the horizontal sweep is not working. First, test for the +147 volts which should be at fuse F950. Lack of DC voltage there points to a 60-Hz power-supply problem (refer to the September article).
- If the B+ is considerably lower than +147 volts, the input filter might be open, or there is excessive current drain. A B+ higher than +147 indicates the horizontal-output transistor is not drawing the proper

amount of current. Check for sufficient B/E drive at Q700, and look for an open in Q700. Use scope and DC meter for these tests. Remember that an open Q700 B/E junction causes square waves between base and emitter.

- A blown F950 and a shorted Q700 warn you to use caution. Installing a new Q700 each time you apply power can be expensive. Instead, test at reduced power by removing F950 and connecting an ordinary 100-watt incandescent light bulb across the fuse-holder terminals. Now, when you apply power, a normal TV will show a picture (perhaps small) and have sound while the bulb glows with partial brightness. In that case, remove the bulb and reinstall the fuse; the set should be okay now.
- If the bulb lights with full brilliance, some kind of overload still is there, and you have prevented a ruined Q700. Unplug both vertical-output transistor sockets, and repeat the test. Partial brightness of the bulb and a horizontal line across the screen prove the vertical circuit has a short, which must be found and repaired.
- If the overload is not in the vertical, but persists after the previous test, disconnect as many wires from the flyback as possible while keeping the primary and HV wiring intact. After each wire is

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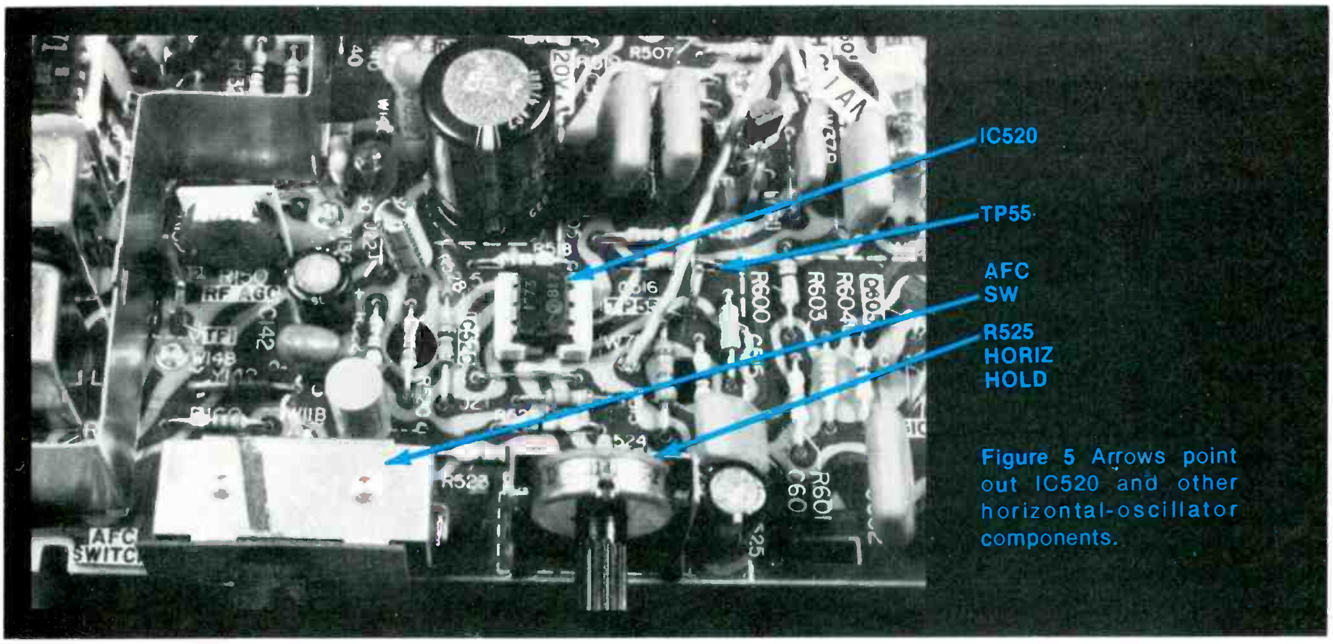

Figure 5 Arrows point out IC520 and other horizontal-oscillator components.

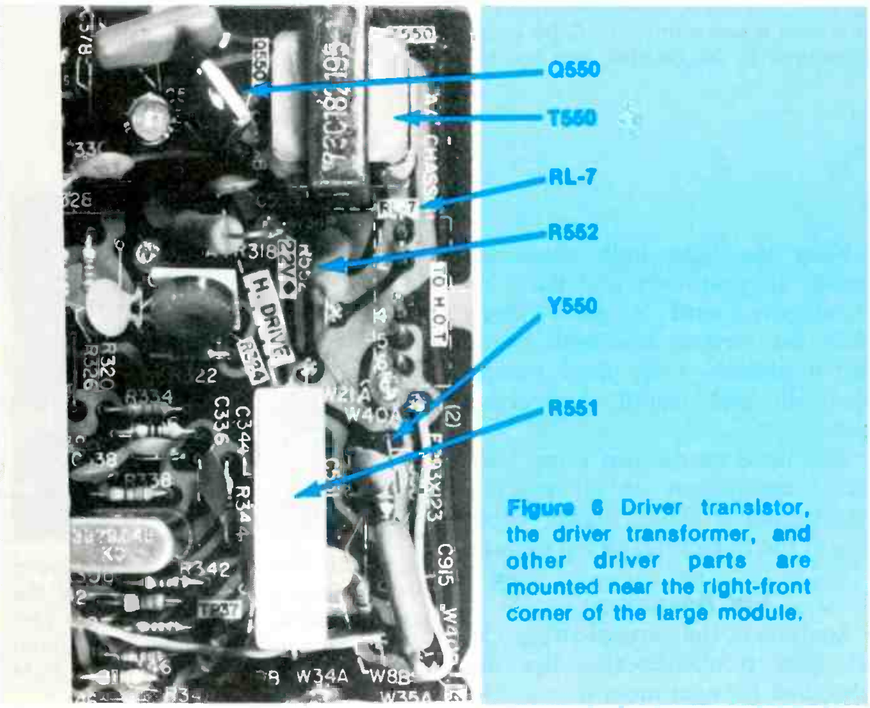

Figure 6 Driver transistor, the driver transformer, and other driver parts are mounted near the right-front corner of the large module.

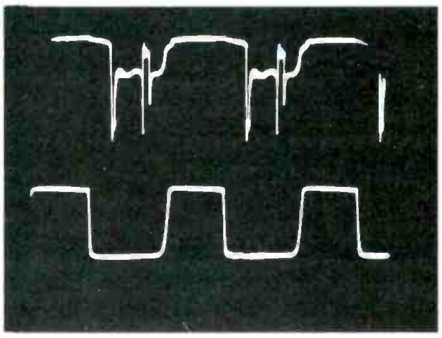

Figure 7 When the base-to-emitter junction of Q700 (horizontal output) is open, the complex waveform between base and emitter (top trace) becomes square waves (bottom trace). This is a good tip for fast troubleshooting. Remember the 440 VPP between ground and both base and emitter.

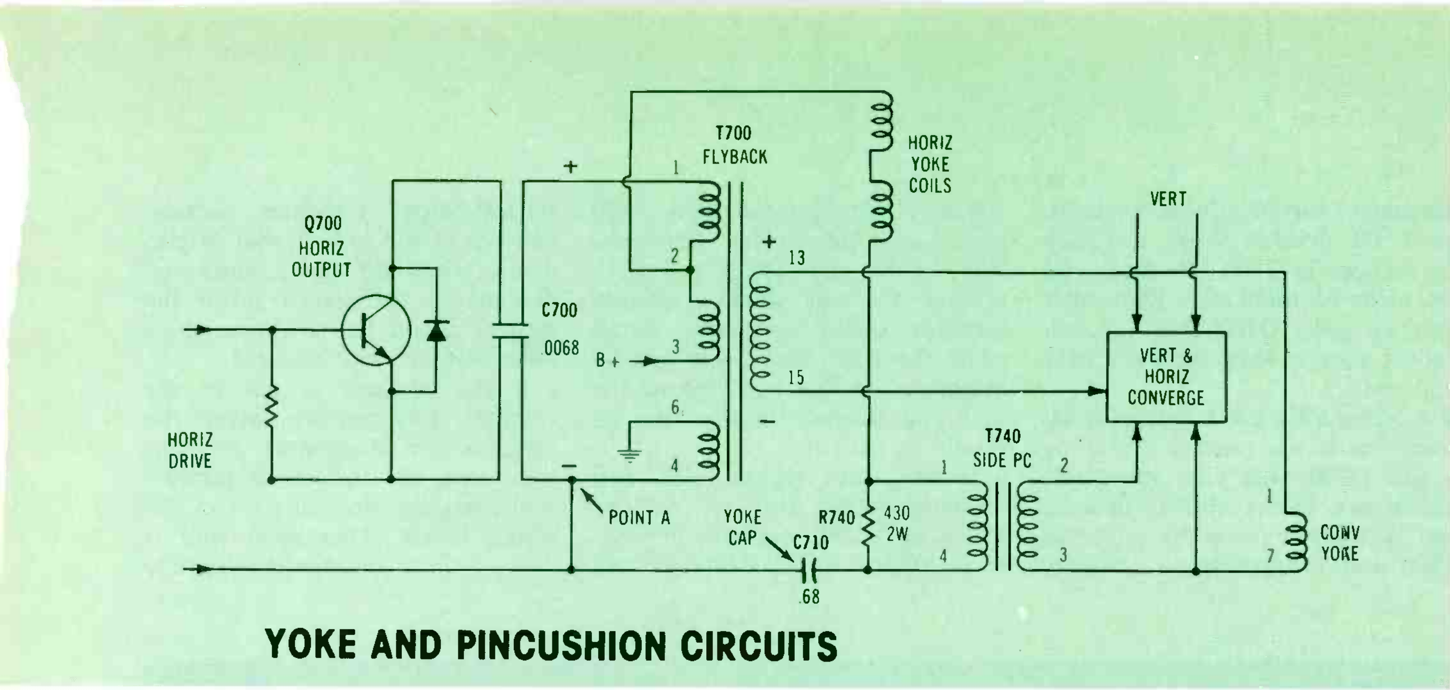

Figure 8 The horizontal-yoke wiring is clarified, along with its connection to the side-pincushion circuitry. (Chassis for 10-inch sets don't have T740, the value of C710 is larger, and the top end of the yoke connects to the cathode of the damper diode.)

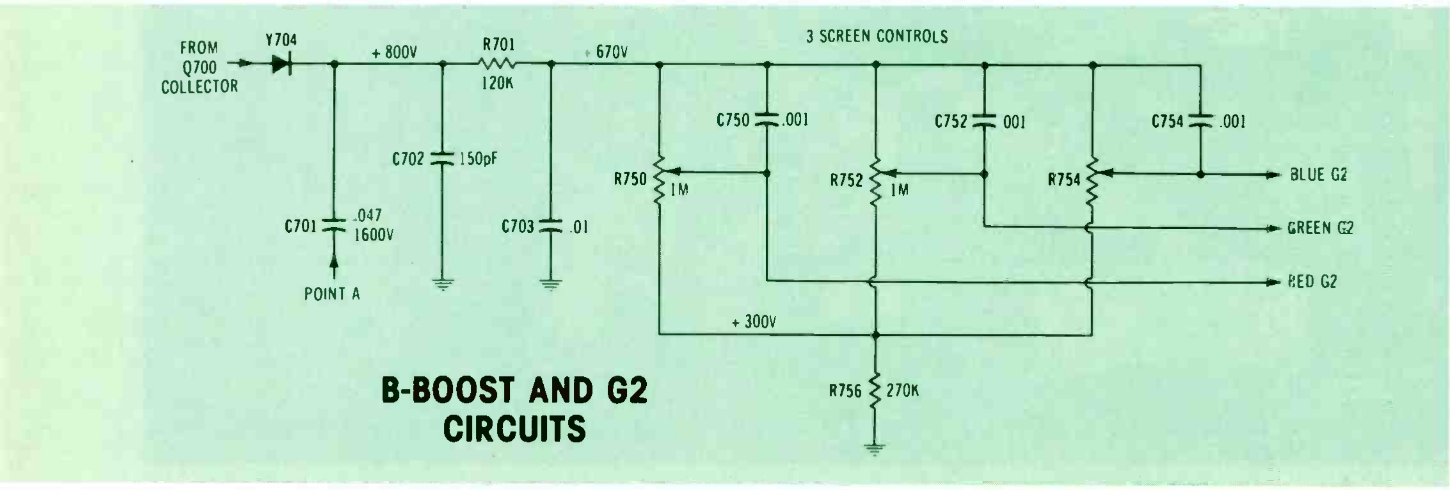

Figure 9 The total signal amplitude between collector and emitter of Q700 is rectified by the B-boost diode, because peak-reading capacitor C701 returns to the emitter, and not to ground.

General Electric

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disconnected, apply the AC power, and notice the brightness of the bulb. The last wire BEFORE the bulb went dim is the one producing the overload. Check there.

- Don't unplug the yoke to test for shorted turns, for that opens the B+ circuit. Instead, unsolder a wire somewhere in the yoke circuit, noticing if the overload is gone when the yoke continuity is open. Don't apply power for very long with the yoke open. These yokes and flybacks can be tested by ringing, but they must be disconnected completely.
- **Keep the light bulb connected** during all your tests and parts replacements, **until it glows dimly while the receiver has both sound and a picture.** Only then remove the bulb and install the correct fuse.

This list does not test every horizontal component or all possible defects, but it should locate about 95% of the horizontal-sweep defects.

For November

Analysis of the vertical-sweep circuit plus troubleshooting tips are scheduled for next month. □

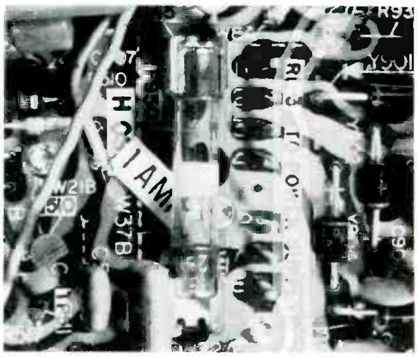

Figure 10 F950, the 1-ampere sweep fuse, is located near the center of the large module. During tests to find overloads, remove the fuse and connect a 100-watt incandescent light bulb across the fuse socket.

The Basics Of Industrial Electronics, Part 16

Programming Ripple Counters

By J. A. "Sam" Wilson, CET

Answer To Homework Problem

At the end of last month's article, I described a problem for you to solve. You were to design a ripple counter that can count to decimal 11 (binary 1011), reset to zero (binary 0000), count again to 11, reset again to zero, etc. Also, I asked you to use a 4-input NAND gate to reset the toggles, and to avoid including any NOT gates.

Figure 1 shows the finished circuit. When the count reaches 12 (binary 1100), these are the toggle states:

- flip flop toggle 1 is low; $\overline{Q}1$ is high.
- toggle 2 is low; $\overline{Q}2$ is high.
- toggle 3 is high; Q3 is high.
- toggle 4 is high; Q4 is high.

Because two inputs come from the $\overline{Q}$ outputs and the other two come from Q outputs, the 12 count brings highs to all four NAND inputs, rapidly switching the NAND output and all four preset terminals of the toggles to low state. Thus, the toggle outputs become low simultaneously for another beginning binary count of 0000. The NAND inputs then are 0011, the NAND output goes high, and the upward count can proceed again.

Notice that all reset terminals should be made high or low at the same time. That's the only certain way of resetting all of the toggles. As just one of many possible examples, if a low were to be applied only to toggle #1 when the Q output already was low, there would be no change, and the other toggles would not clear.

Reset after the last count

The correct programming of this ripple counter brings up a very important point. **Reset MUST occur when the counter first reaches the next count BEYOND the one you have selected as the last count.**

For example, suppose you misunderstood the "count to decimal 11" instruction, and instead you programmed the counter to **reset** at decimal 11 (binary 1011). When the counter reached binary 1011, the 1011 readout would be displayed as a LED blink so short your eyes could not see it. In fact, the 1011 display would be present only during the few nanoseconds necessary for the NAND output to go low and all of the toggles to go low. Visibly, the circuit would count from decimal 0 to decimal 10 and reset to zero.

That's why the short "count" that triggers any kind of change is not listed as a count. So, in Figure 1, the count can proceed as usual from zero to decimal 11 inclusive, with the instantaneous reset occurring at the beginning of what otherwise would have been the decimal 12 count.

Stopping The Count

If the circuit of Figure 1 is changed so the reset terminals all have logic 1 permanently, and the NAND output is connected to either J, or K, or J-and-K of toggle 1, the count will **STOP** at decimal 12 (binary 1100).

Probably, you remember that a J-K flip flop is made to toggle by connecting *both* J and K terminals to a constant high. Therefore, if either or both is supplied with a logic 0 signal, the flip flop freezes in the last output state. Flip flops won't change unless the input is negative-going. Without an input signal any toggle stays in the last state.

Therefore, the count of all four toggles can be frozen by stopping only the first flip flop of a ripple counter.

Other counts

By using a NAND with an input for each toggle, you can program a counter to reset or to stop at any number from decimal 0 (binary 0000) to decimal 15 (binary 1111). (Of course, a limited few numbers can be programmed without any NAND, by connecting the Q or $\overline{Q}$ output of **one** toggle to **all** reset terminals. The NAND gives more choices.)

Use the logic states shown in Table 1 to help you select the correct programming.

Experiment 1

Construct the circuit of Figure 1, and test it by noting that it counts from 0000 to 1011, resets to 0000, and counts up again.

Experiment 2

Rewire the Figure 1 circuit so it will count to 1100 (decimal 12) **and then stop at 1100 until reset.** Figure 2 gives the schematic. After being reset, the circuit should count up to 1100 again and stop there.

The reset of Figure 1 is accomplished automatically, when the count reaches the programmed number. In Figure 2, the resetting is done by a manually-operated switch.

In Figure 1, the NAND output is connected to all of the reset

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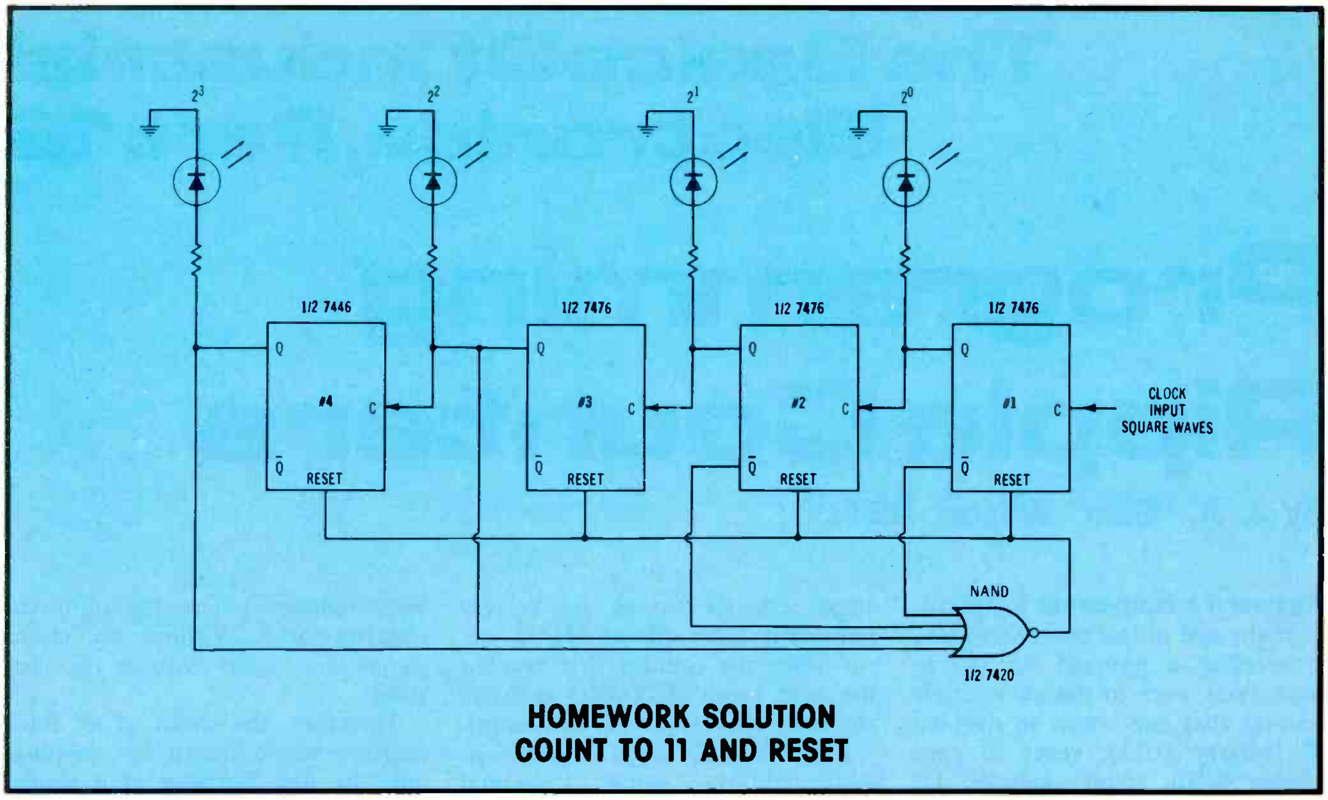

Figure 1 This circuit will begin counting at 0000 (decimal 0), and count up to display 1011 (decimal 11) before it resets to 0000 and begins counting up again. The sequence is repeated as long as the circuit has power and input signals.

Table 1 Use this handy table to help you design, program, or test these 4-digit counters.

DECIMAL	Q	$\bar{Q}$
0	0000	1111
1	0001	1110
2	0010	1101
3	0011	1100
4	0100	1011
5	0101	1010
6	0110	1001
7	0111	1000
8	1000	0111
9	1001	0110
10	1010	0101
11	1011	0100
12	1100	0011
13	1101	0010
14	1110	0001
15	1111	0000

Industrial

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terminals, while Figure 2 has the NAND output feeding only the K terminal of toggle 1. Therefore, when the 1100 count is reached, the counter is stopped, but is not reset until the manual switch is turned to logic 0.

Test the modified circuit by observing that the count proceeds up to decimal 12, where it stops. Changing the switch to the logic 0 position should reset the counter to 0000, then *after* the switch is returned to the logic 1 position, the upward count should resume until it stops at 12. Verify that these actions do occur.

Counting Down

Table 1 also shows another important fact about ripple counters. The Q column counts up from decimal zero to decimal 15, as it is read from top to bottom.

Notice that the $\bar{Q}$ column (from top to bottom) counts DOWN from decimal 15 to decimal zero.

Therefore, *the basic circuit of Figure 1 can be used to count down, if the LEDs are connected to the $\bar{Q}$ outputs* of the toggles, rather than the Q outputs.

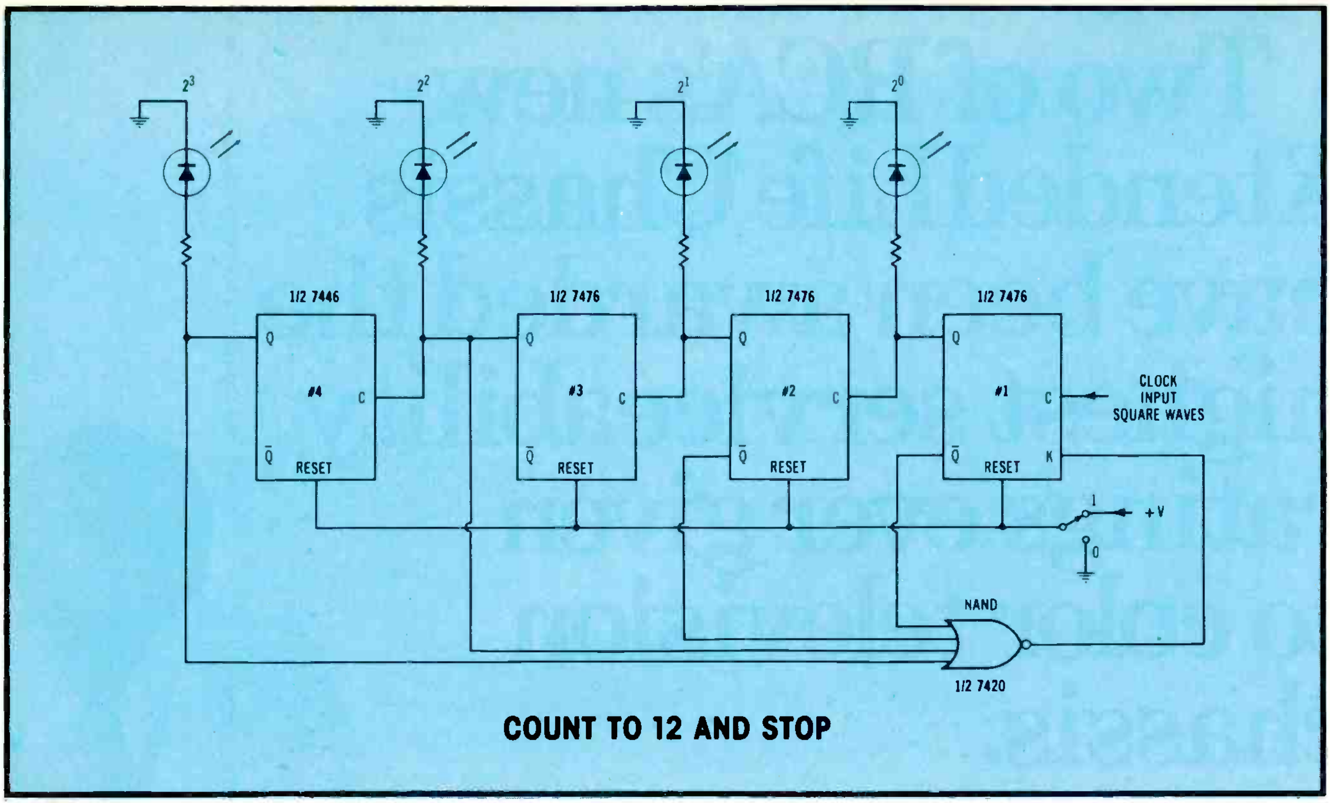

Figure 2 Rewire the Figure 1 circuit as shown here so it will count up to 12 and stop until the manual switch is turned to logic zero and back to logic 1. After the switching, the circuit again counts to 12 and stops.

Experiment 3

Wire the Figure 3 circuit. But, before you apply power to it, determine at which decimal number the counter will reset to decimal zero.

Check your answer at the end of this article, then verify the operation by watching the circuit count.

Troubleshooting Question 1

Answer the following questions about the circuit of Figure 4:

(1) Does the circuit count up or down?

(2) Is the counter designed to stop at a certain number, or start again at 0000 after a certain number is displayed?

(3) If it resets after a certain number is displayed, what is that number?

Experiment 4

Construct the circuit of Figure 4, and verify the answers to Troubleshooting Question 1.

Don't disconnect the wiring, for the counter is part of the next experiment.

Decoders And Readouts

All counters operate by binary numbers (highs and lows in combination), but such numbers are not convenient for many uses.

Decoders can be used to translate the binary count into some desirable decimal-number count. The type of decoder that's used most often incorporates a 7-segment decoder which controls the individual bars of a 7-segment display (LEDs or liquid crystal).

The block diagram of Figure 5 shows a decoder with a display. Toggled flip flops (such as those in Figure 1, except programmed to count only between decimal 0 to 9) furnish the four input signals to the decoder. From the decoder, seven output lines control which of the 7 readout segments are activated.

Figure 6 shows how decimal numbers from zero to nine are formed by combining segments of the display.

Typical Decoder And Readout

The wiring diagram for a 7447 decoder and a typical 7-segment LED readout is shown in Figure 7. The inputs marked 1, 2, 4, and 8 are to be connected to the same numbers at the top of Figure 4.

Output terminals of the decoder are identified with lower-case numbers, and the corresponding segments of the display are given the same numbers. The resistors are required to limit the current to a safe value.

When the output terminal of the decoder goes low, the corresponding readout segment lights. All of the LED anodes are paralleled and wired to +5 volts.

Test the readout by momentarily grounding the "lamp test" terminal. All 7 segments should light, forming the number 8. If any fails to light, the wiring is wrong, or one of the devices is defective.

Experiment 5

Wire the circuit of Figure 7, and connect it to the Figure 4 counter. **Note:** it is not necessary to disconnect the LEDs.

When power is applied, the total circuit should count from decimal 0 to decimal 6, then reset to 0 and count to 6 again, etc.

Answer to Experiment 3

As it is wired, the circuit of Figure 3 should count down from decimal 15, then reset instantly

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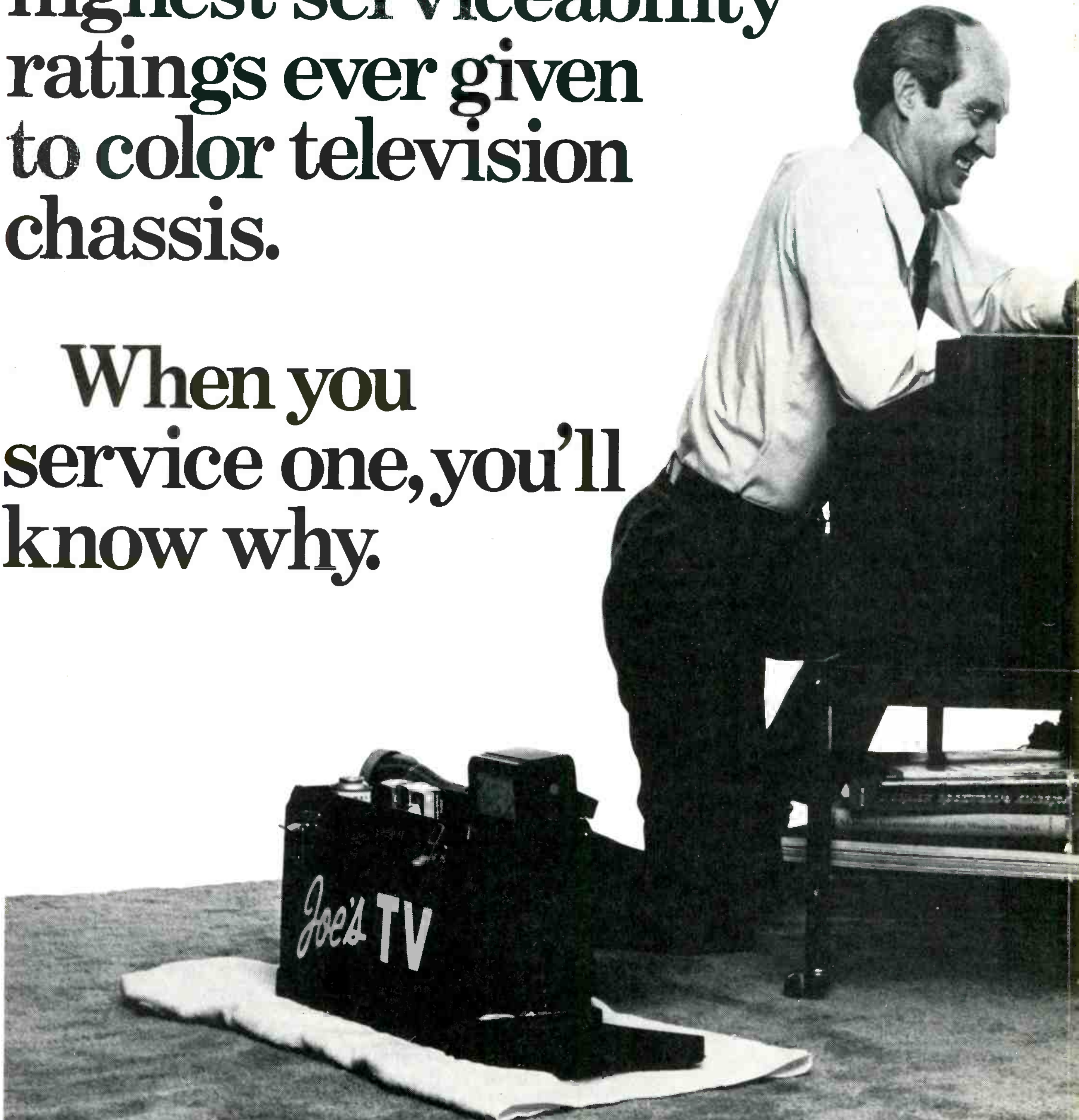
Two of RCA's new XtendedLife Chassis have been awarded the highest serviceability ratings ever given to color television chassis.

When you service one, you'll know why.



Sooner or later, every television set requires service by a professional. So RCA designed two new XtendedLife Chassis to make servicing easier for any professional service technician. These new chassis are easily accessible and clearly marked.

To prove it, we invited NESDA/ISCET (the International Society of Certified Electronics Technicians) to send a team to inspect and evaluate our new CTC88AC and CTC93D chassis. And they gave them the highest serviceability ratings of any color television chassis they have ever tested.

RCA CTC88AC chassis	93.90%
RCA CTC93D chassis	91.92%

Two new RCA color chassis receive "excellent" ratings—highest in NESDA/ISCET history.

Here are a few of the reasons:

☐ *The wire pattern* is printed on both sides of the circuit board, making it easy to trace out individual circuits.

☐ *Schematic symbols* identify each component on the board.

☐ *All power supply source voltages and key pulse voltages* are identified.

☐ *All key test points* are marked on the chassis, with their functions on the Cabinet Layout Chart.

☐ *An Active Device Location Guide* in the cabinet reduces the need for service books or diagrams.

☐ *The chassis slides back* for better accessibility in normal field servicing.

These new chassis earned their high ratings from some of the toughest judges around—professional, independent service technicians. And when the testing was done, and scores were in, here's what the leader of the ISCET team had to say:

"The scores are important, and they are very good; but of greater importance is the result of RCA's efforts in making sets easier to service, which will earn the recommendation of thousands of technicians who will be working with these chassis for years to come." —Dean R. Mock, Chairman, NESDA/ISCET Serviceability Committee.

RCA

RCA is making television better and better.

Circle (15) on Reply Card

Industrial

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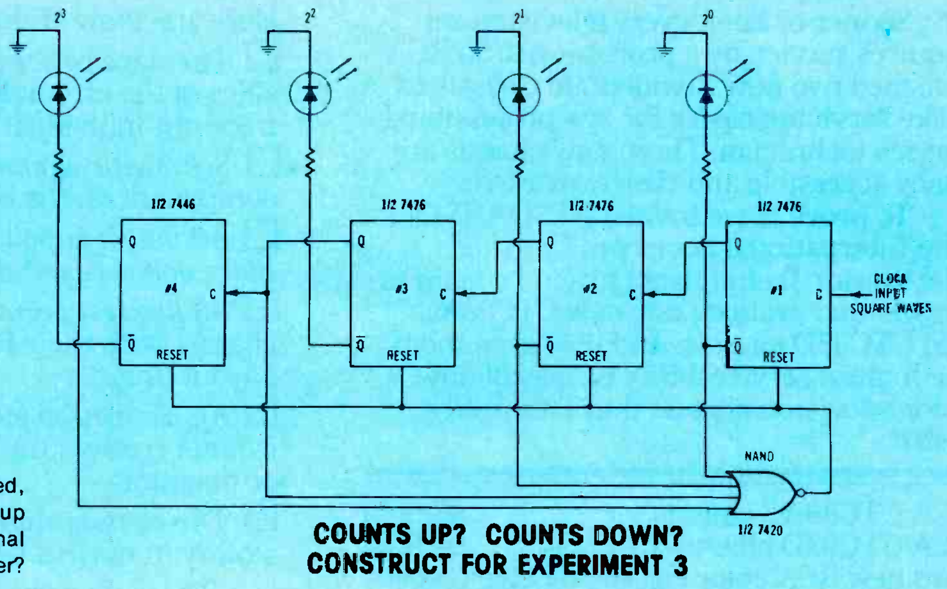

Figure 3 As it is programmed, should this circuit count up or count down? What decimal number will reset the counter?

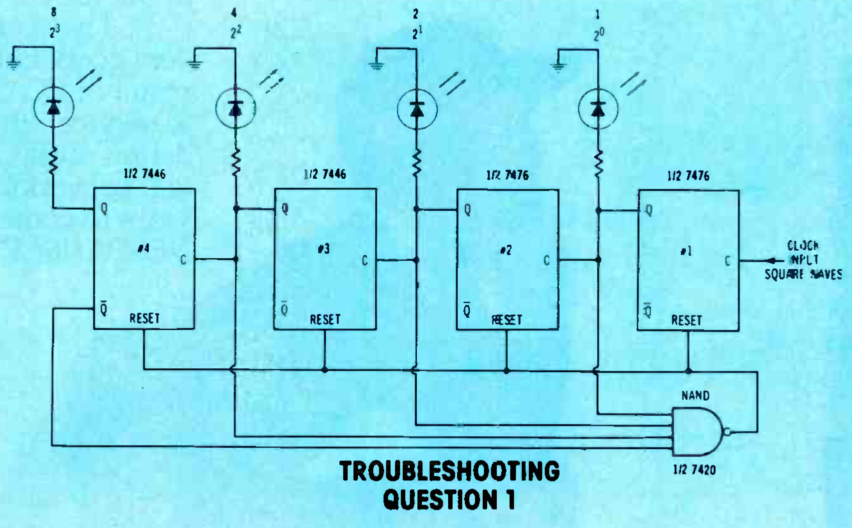

Figure 4 Use the diagram to answer three troubleshooting questions.

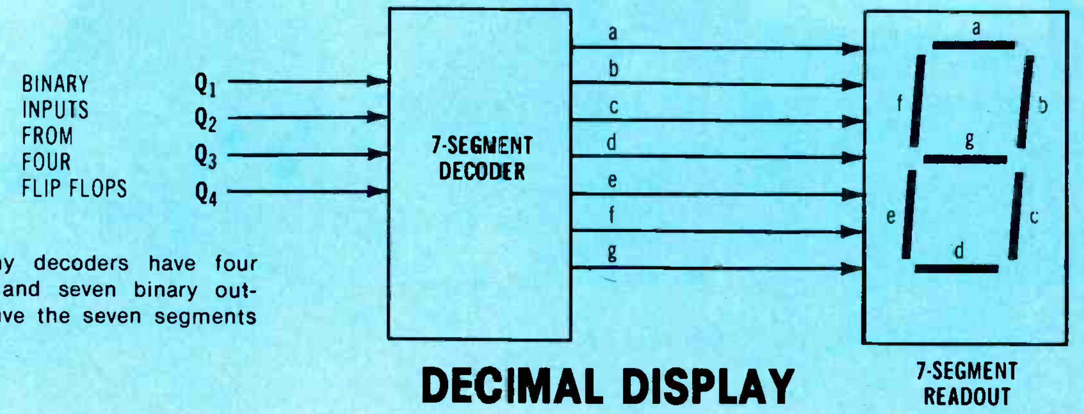

Figure 5 Many decoders have four binary inputs and seven binary outputs which drive the seven segments of a display.

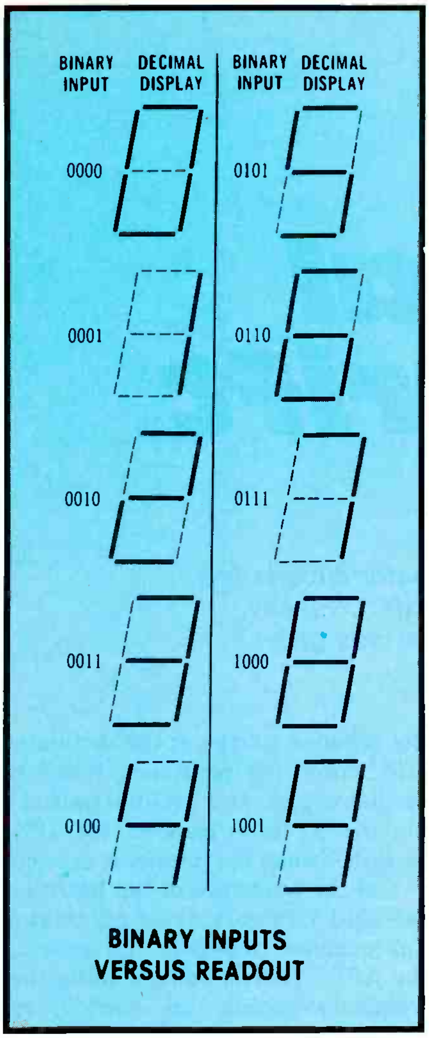

Figure 6 Readout segments can be lighted to form simulations of all decimal numbers from 0 to 9.

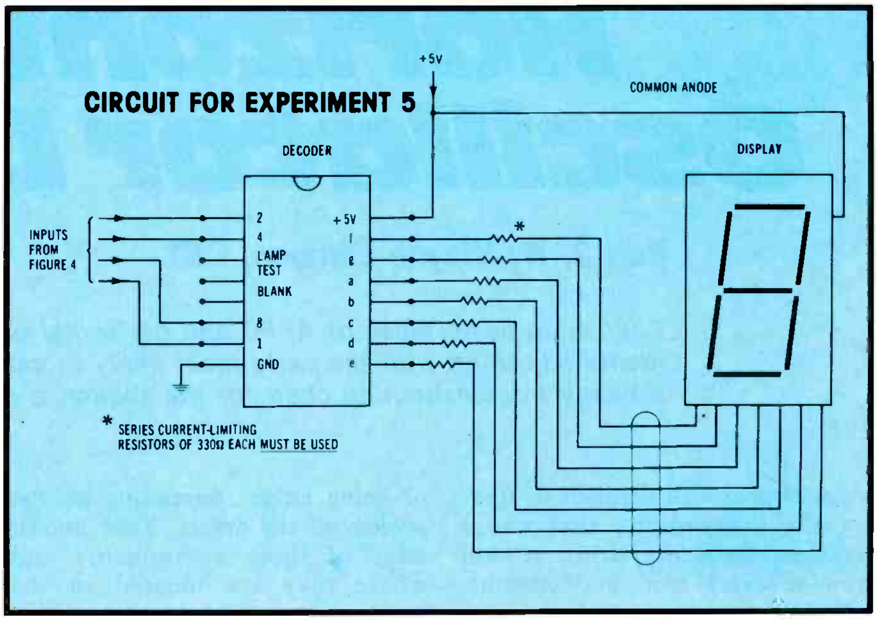

Figure 7 Wire this decoder and display system to the counting circuit of Figure 4.

when the count reaches binary 1100.

Figure 8 shows that, starting at decimal 15, only three counts occur before 1100. They are: 1111 (decimal 15); 1110 (decimal 14); and 1101 (decimal 13). The next down count is 1100 (decimal 12), and the counter will reset to decimal 15 before the 1100 binary readout can be seen.

Answers To Troubleshooting Question 1

(1) The circuit will count up, because the LEDs are connected to the Q-output terminals of the toggles.

(2) The counter is designed to reset to 0000, when the count reaches the programmed number. Notice that the NAND output goes to all four reset terminals.

(3) Reset will occur when the binary number 0111 (decimal 7) is reached. Thus the highest number that can be displayed is binary 0110 (decimal 6). □

DECIMAL	Q	$\bar{Q}$	NAND	NAND OUTPUT
0	0000	1111	1000	1
1	0001	1110	1001	1
2	0010	1101	1010	1
3	0011	1100	1011	1
4	0100	1011	1100	1
5	0101	1010	1101	1
6	0110	1001	1110	1
7	0111	1000	1111	0

LAST COUNT DISPLAYED

RESETS COUNTER TO 0000

COUNT FOR FIGURE 4

Figure 8 These are the binary counts for the circuit of Figure 3.

Curing Horizontal Oscillator Drift

Part 3, By Wayne Lemons, CET

Four more basic types of AFPC and horizontal oscillator circuits are identified, along with the parts most likely to cause drift. Finally, a handy troubleshooting chart for the sequence of tests is given.

Continuing with methods of finding the components that cause horizontal-frequency drift, we will examine several more basic circuits.

Perhaps you are wondering why so much space is being devoted to identifying the type of horizontal oscillator. That kind of thing usually is confined to courses and textbooks. Well, it's because *you can save much time* and be more certain the trouble is cured.

Each basic type of oscillator has only a few different parts that can cause horizontal drift or a radical out-of-frequency condition. Often, the same components are capable of doing either, depending on the severity of the defect. Your knowledge of these components and where they are located in the various circuits can make your troubleshooting much easier.

Cathode-Coupled Blocking Oscillator

In Figure 1, the usual AFPC duodiode circuit produces an error-correcting DC voltage, which is amplified by the "horizontal control" tube, and goes from that plate through the 2.2M resistor to the time-constant capacitor, C1, where it controls the frequency by varying the negative voltage at the oscillator grid. Also, the resistance between oscillator grid and ground (including the R1 82K resistor, the 10K resistor—when the jumper is opened—and the resistance of the horizontal-hold control) determines the approximate frequency. Of course, the AFPC control voltage shifts the frequency slightly, as needed, to provide solid horizontal locking.

Type of oscillator

A high negative bias is measured at the oscillator grid, and the L1 oscillator coil is tapped but not

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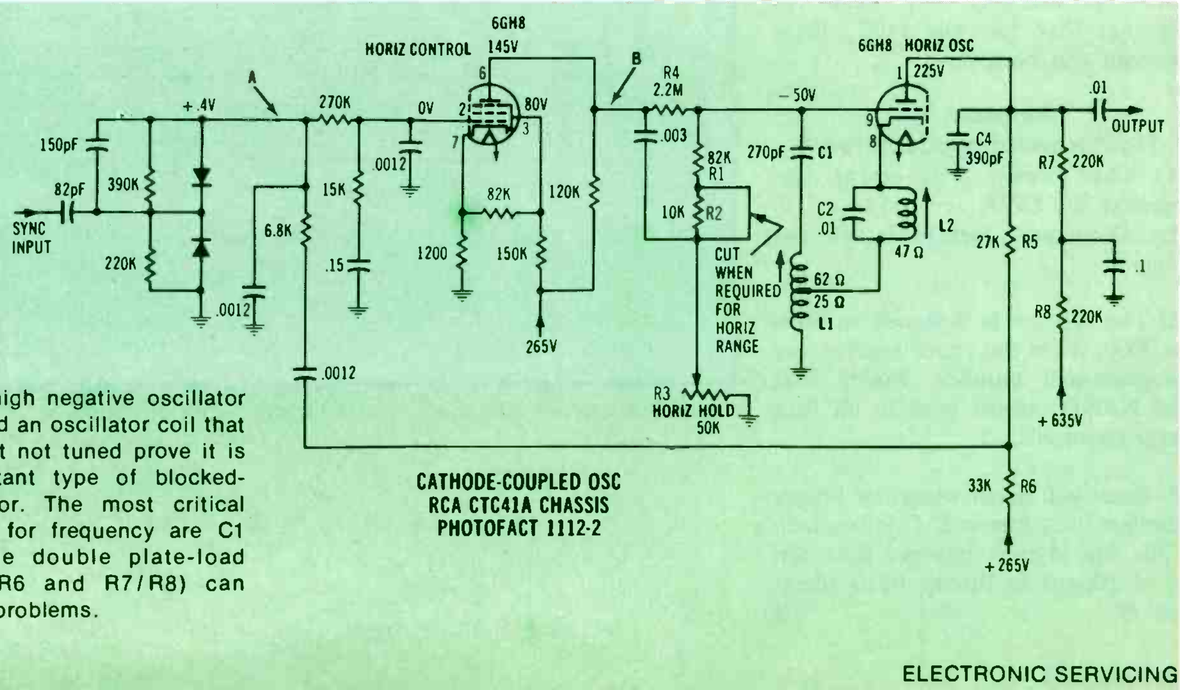
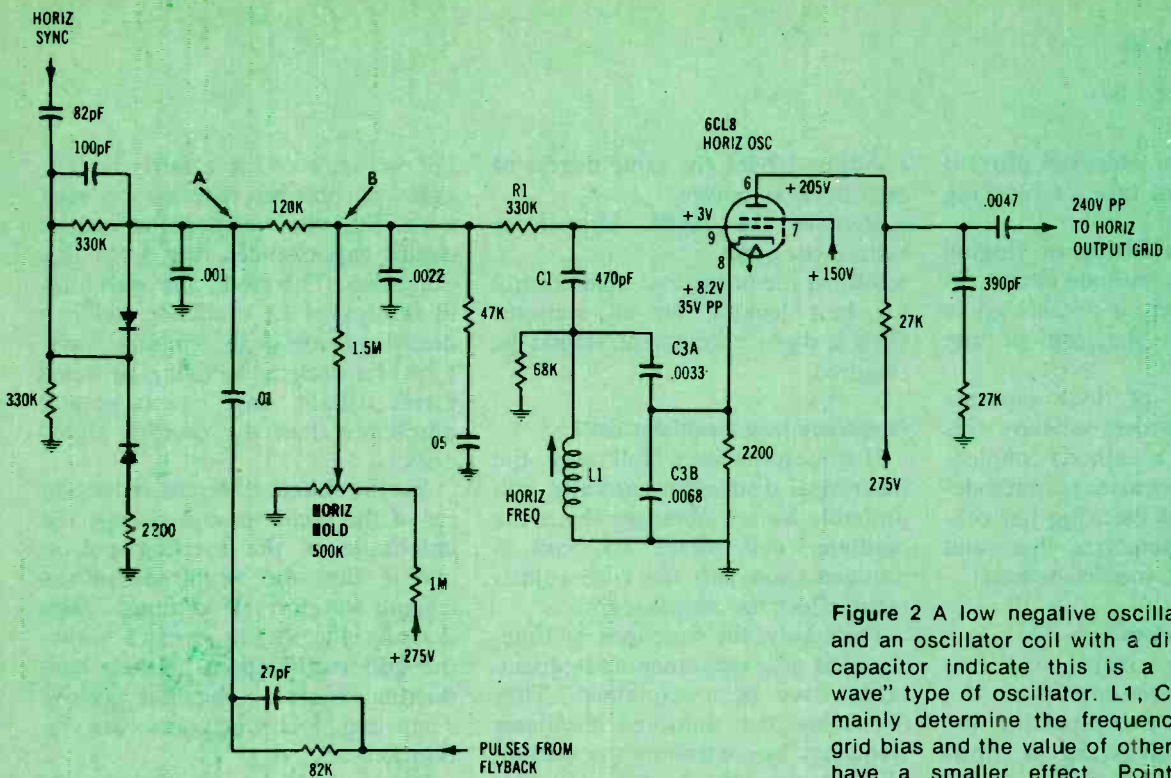


Figure 1 A high negative oscillator grid bias, and an oscillator coil that is tapped but not tuned prove it is a time-constant type of blocked-grid oscillator. The most critical components for frequency are C1 and R1. The double plate-load paths (R5/R6 and R7/R8) can cause extra problems.



SYLVANIA D05-14
PHOTOFACT 1051-2

Figure 2 A low negative oscillator grid bias and an oscillator coil with a dividing tuning capacitor indicate this is a tuned "sine-wave" type of oscillator. L1, C3A, and C3B mainly determine the frequency, while the grid bias and the value of other components have a smaller effect. Point A can be shorted to ground to test for oscillator drift separate from the phase diodes.

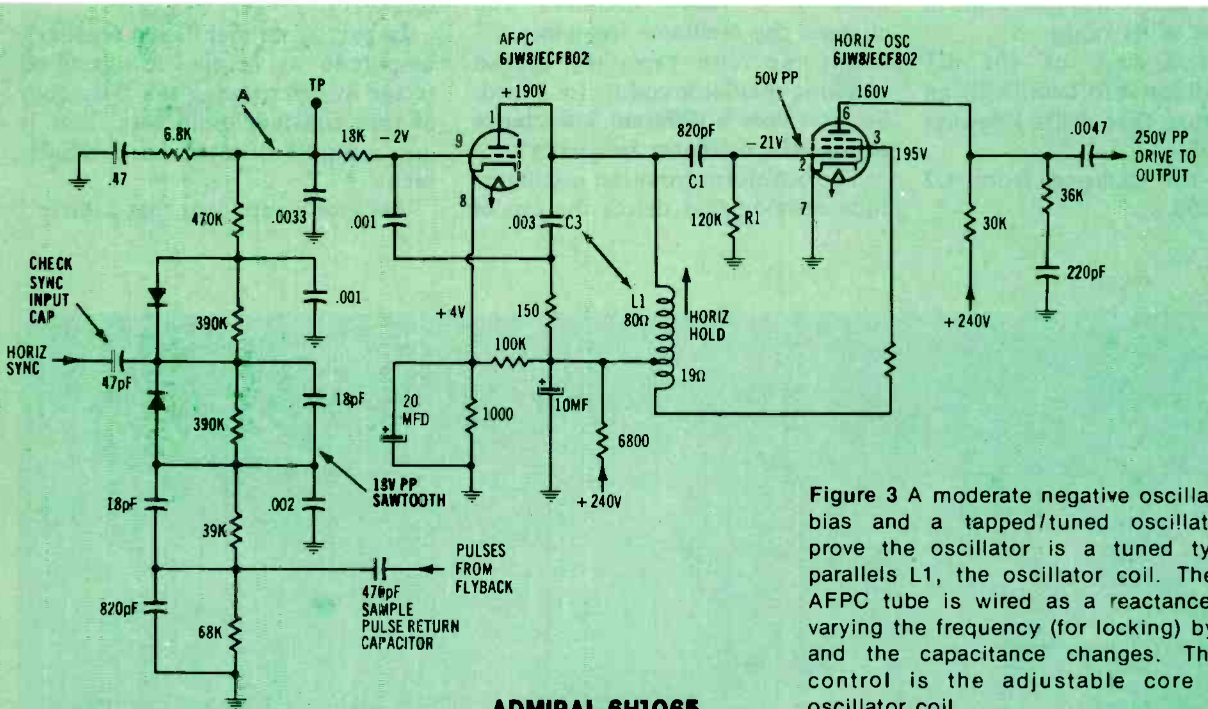


Figure 3 A moderate negative oscillator grid bias and a tapped/tuned oscillator coil prove the oscillator is a tuned type. C3 parallels L1, the oscillator coil. The triode AFPC tube is wired as a reactance stage, varying the frequency (for locking) by phase and the capacitance changes. The hold control is the adjustable core of the oscillator coil.

ADMIRAL 6H1065
PHOTOFACT 1113-1

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tuned. These characteristics prove it is a time-constant type of blocking oscillator.

The tuned stabilizing or ringing coil (L2) is in the cathode circuit. In this case, however, it doesn't go to ground, but to the tap of the oscillator coil.

If we add all of these separate designations together, we have this jawbreaker: It's a cathode-coupled-feedback, time-constant, cathode-stabilized type of blocking horizontal oscillator. Memorize that, and use it to impress your customers!

Adjustment procedure

Because this circuit has two frequency adjustments plus the ringing coil, we are repeating the sequence of adjusting a non-defective circuit.

The method is as follows:

- Connect a short jumper wire across the L2 stabilizing coil.
- Defeat the sync, or ground either point A or the pin 2 grid of the oscillator-control tube.
- Preset the horizontal-hold control to the center of its range.
- Adjust the core of the L1 oscillator coil for zero beat, with an upright picture that drifts sideways slowly.
- Remove the jumper from L2 stabilizing coil.
- Adjust L2 for the same degree of zero beat, as before.
- Remove the AFPC jumper or restore the sync.
- Adjust the horizontal-hold control for best locking on all stations. Only a slight adjustment should be required.

Frequency from oscillator coil?

If you have been following the theoretical discussion carefully, you probably have a question about the oscillator coil. Since the coil is untuned, how can the core adjustment affect the frequency?

Previously, the functions of time-constant grid resistance and capacitance have been explained. They determine the unlocked oscillator frequency by controlling the amount of time the grid is cut off. This also explains how a DC voltage from the AFPC can vary the frequency (it changes the negative grid voltage).

And, you probably already know about the reason the core adjustment of a **tuned** oscillator coil changes the oscillator frequency.

But, we have explained that a blocking oscillator coil is not tuned. So, **how does a different inductance change the oscillator frequency?**

The waveform from the oscillator-tube cathode that drives the tap of the oscillator coil is a fairly narrow pulse of positive current for each cycle. But, the coil and the various circuit capacitances ring from this excitation. Therefore, the waveform at the top of L1 oscillator coil is a decaying wave trail (ringing waveform) for each cycle. (Ringing waveforms usually have much greater amplitude than the exciting signal does.)

Simply stated, different inductances of the oscillator coil change the amplitude of the exciting pulses; and in turn the amplitude of the ringing waveform is changed. Incidentally, the ringing doesn't bother the grid rectification, because conduction occurs on the first positive ring, and following ones are ignored.

There we have it! Tuning the core of the oscillator coil changes the inductance, and the inductance changes the positive-feedback amplitude. Then, the amplitude variation changes the time-constant discharge time to change the oscillator frequency.

In part 2, we mentioned feedback amplitude as being the disguised factor in determining the frequency of time-constant oscillators. This is one example of a planned adjustment.

Another component that indirect-

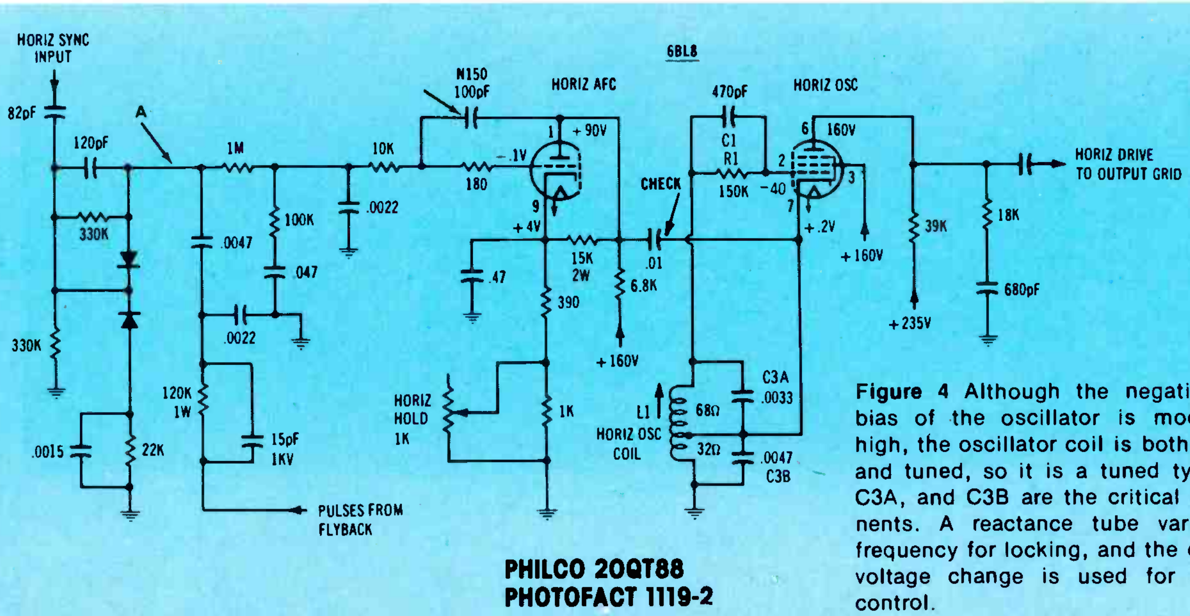

Figure 4 Although the negative grid bias of the oscillator is moderately high, the oscillator coil is both tapped and tuned, so it is a tuned type. L1, C3A, and C3B are the critical components. A reactance tube varies the frequency for locking, and the cathode voltage change is used for a hold control.

ly affects the signal amplitude is C4, which bypasses the oscillator plate, forming the sawteeth which are needed to drive the output tube. An open C4 forces the oscillator far out of frequency.

Troubleshooting

A few shortcuts for finding the cause of wrong horizontal frequency are possible. However, if these don't find the bad part right away, it's better to use the entire procedure.

For example, suppose the oscillator is badly out of frequency (perhaps 10 or 12 diagonal bars). First, ground the pin 2 grid of the 6GH8. If the frequency is noticeably better, perhaps the duo-diode portion of the AFPC is bad. If the frequency change is small, measure the pin 6 plate of the 6GH8 control tube. A DC voltage within 10% of the schematic value is an indication that the AFPC circuit is okay, and the defect is in the oscillator.

Before wasting much time, it's wise to jumper the L2 stabilizing coil. Any frequency improvement points to a defective or misadjusted stabilizing circuit.

If these two fast tests indicate an oscillator defect, then it's usually safe to start *detailed* tests in the oscillator circuit.

Peculiar problems

Open filter capacitors can produce hard-to-analyze symptoms. Make a practice of using your scope to check for abnormal waveforms (including horizontal pulses where weak hum should be) at each filter. Then, correct any such power-supply problems **before** wasting excessive time testing the horizontal-oscillator circuit.

Other weird symptoms come from defects that greatly increase the amplitude of the sawteeth supplied to the duo-dides. Perhaps the frequency might drift excessively, and drop out of lock with a tearing action. *Especially check the resistors bringing in pulses or sawteeth.*

Plate resistors of the oscillator often are responsible for other obscure problems. The circuit of Figure 1 has two separate B+ paths to the oscillator plate. Resistors R5 and R6 provide sufficient voltage from the +265-volt supply to start the oscillation. (Lower values would give higher DC voltage, but would distort the drive to the output tube.) Then, after the boost voltage comes up, more voltage is brought to the plate through R7 and R8.

Generally, a drastic decrease in any of the four resistors brings the possibility of instability or a compressed raster at the right edge. If any of the four resistors increase in value, the drive to the output grid is reduced, causing excessive current in the horizontal-output tube.

Also, R5 and R6 form a voltage

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Horizontal Drift

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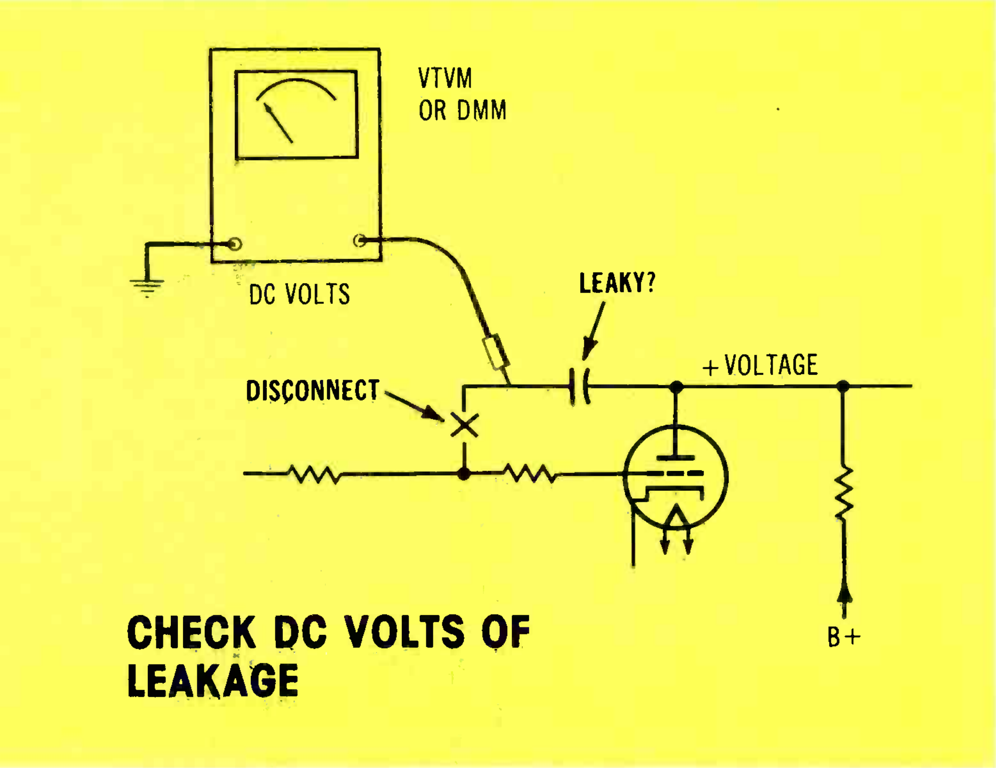

Figure 5 A frequent cause of drift (where resistance tubes are used) is the plate-to-grid capacitor. The slightest leakage causes drift or wrong horizontal frequencies. Test these capacitors with the power turned on, as shown here. For example, with an 11-megohm meter impedance, a leakage of 11 megohms would produce a capacitor voltage reading just half of that at the plate. The slightest voltage reading indicates excessive leakage, and the capacitor should be replaced.

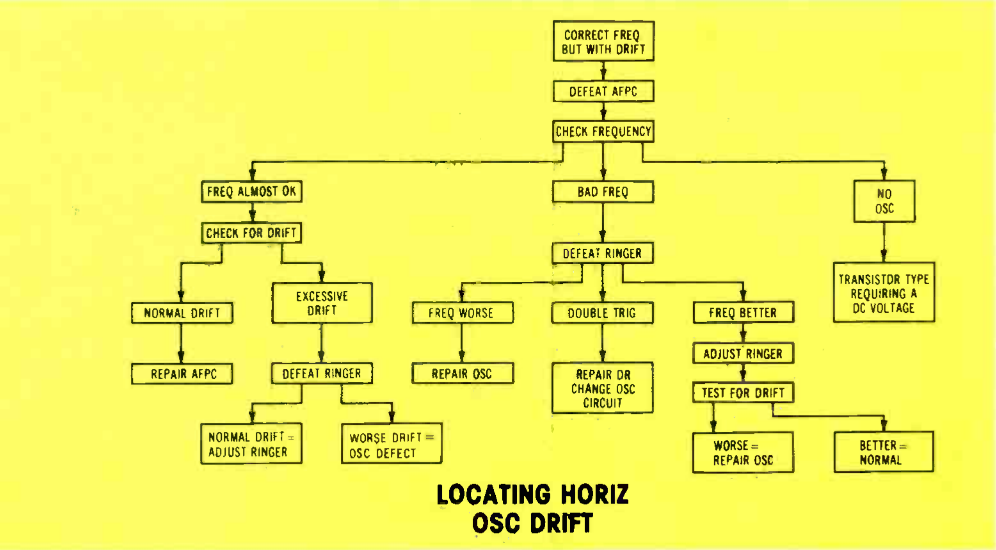

Chart 1 Here is a handy chart to guide you in locating the causes of horizontal-oscillator frequency drift.

divider to reduce the amplitude of sawteeth applied to the duo-diodes. As explained before, any excessive amplitude of these sawteeth can overload the AFPC circuit, causing loose locking, and other erratic symptoms.

Hot and cold tests

Components that cause drift often can be identified by alternate heating and cooling of each *individual* component. Or, the general area can be heated moderately by an incandescent bulb, then canned coolant should be sprayed through the small tubing to *one* part at a time. Almost all of these components can change the frequency slightly when heated. You should suspect those which react excessively to temperature variations.

Check the specs of any capacitors in the oscillator circuit. Don't replace a mica type with anything else, and don't use a plain ceramic to replace a negative-temperature coefficient type.

Note: Observe one precaution with these hot/cold tests. These components are moderately sensitive to heat changes, so don't overdo it. **Don't apply excessive heat, and don't cool them too much.**

Tuned Oscillator

Our first example of a tuned oscillator is diagrammed in Figure 2. The L1 oscillator coil is not tapped, but the paralleling capacitance is in two capacitors, C3A and C3B. Feedback from the oscillator-tube cathode produces the oscillation.

Notice that the grid bias is only -5.2 volts (+8.2V at cathode minus +3V at the grid). The tuned oscillator coil and the low grid bias prove it is a tuned sinewave type. At least, the oscillator coil has a near sine waveform. However, the output at the plate is a kind of pulse that's filtered to a rounded sawtooth-plus-pulse.

There is no control tube. Instead, the output from the AFPC diodes goes through two resistors to the oscillator grid. The horizontal-hold control varies the positive voltage at the oscillator grid.

Here is the simpler adjustment procedure:

- Ground the grid of the sync separator, and pre-set the hold control to the mechanical center of the rotation.
- Adjust the core of the oscillator coil for zero bead.
- Remove the sync-separator ground, and slightly adjust the hold control, if necessary, for best horizontal locking.

In this circuit, the only components likely to change the horizontal frequency drastically are the grid capacitor (C1), the oscillator coil, and the two tuning capacitors (C3A and C3B). Other components and the exact grid bias can have only minor effects on the frequency.

Reactance Tube

Other models include a reactance tube, which can change the frequency slightly to maintain good locking. See Figure 3.

The L1 oscillator coil is tapped, and the feedback signal comes from the screen grid, which functions as a plate.

It's not easy to see how L1 is tuned by C3, until you notice that the resistor from the bottom end of C3 to the coil tap has a value of only 150 ohms. So, for purposes of oscillation, the top winding of the oscillator coil is paralleled by the .003 microfarad capacitor.

The reactance-tube operation is very similar to those found formerly in color-oscillator circuits. The frequency is changed by a combination of phase shift and capacitance variation.

No leakage at all can be tolerated in the .001 grid capacitor. Test it as shown in Figure 4 by disconnecting the grid end and using a VTVM, FET meter, or digital DC voltmeter. Any reading above a volt or two indicates excessive leakage, and a new capacitor should be installed.

Troubleshooting Chart

Chart 1 shows the basic steps for efficient troubleshooting of those horizontal-oscillator/AFPC circuits that have duo-diodes with an error-correcting DC output voltage centered around zero volts, and followed by a time-constant oscillator with a stabilizing coil.

Most of the steps were explained in these articles, and they should be largely self-explanatory.

Comments

If all facts and tips about horizontal oscillators and methods of locking them were ever compiled in one publication, it's likely the book would be as large as a dictionary. This is not practical.

Therefore, we have tried to give you some of the landmarks to look for, in hopes you can adapt these methods to similar circuits. □

Calculating Sales Profits

Service Management Seminar, Part 10

By Dick Glass, CET

How can you *figure sales expenses and profits separately from your service department costs and profits? This article tells how.*

Service Losses?

A retailer recently told me that he was considering closing his electronic-repair department. However, he intended to continue his present sales of furniture, appliances, and TV receivers. The reason: his sales operation was profitable, but last year he lost $10,000 in his service shop. So, he knew that drastic changes were necessary or he couldn't continue to suffer such a financial drain on his business.

As we analyze the wisdom of his decision, we need to consider several important questions, such as these:

- Did his service operation *actually* lose $10,000?
- If his service did lose that much money, was one important factor the below-cost labor rates he established in an effort to attract more customers for his sales operation?
- Did the service technicians regularly make deliveries of appliances, TVs, and furniture for the sales department, but without proper credit?
- Did the technicians repair the floor-stock TVs without charge, or perform warranty repairs for below-cost prices?

Business Evolution

One business owner started with a small electronic repair shop, where nothing but parts and labor were sold. With gradual growth through the years, the operation expanded by stocking small radios, toasters, and other small appliances. Later, one or more full lines of TV receivers, stereos, refrigerators, and automatic washers were added.

Finally, a business that started as "all service" developed into one that is "mostly sales." Both sales and service were handled in one building. For accounting purposes, the owner lumped all income (from sales, parts, and labor) together and subtracted the total expenses. Therefore, this owner finds it impossible to even estimate the individual profits from sales and service.

Probably the owner justifies his lack of itemized profits and expenses by thinking that he is doing the best possible. Knowing about individual profits—he rationalizes—would not increase them. After all, he's selling merchandise at competitive prices. Service labor is priced below the point where his customers might rebel. He prices parts at the manufacturer's suggested-list price. Warranty work is done for whatever each manufacturer agrees to pay. **What more can he do?**

Most store managers, when faced with this question, try to increase the efficiency in making repairs, and to expand the volume of parts and merchandise sales.

What's Wrong?

Here are some things this typical dealer is doing wrong.

Parts prices

Probably his shop is selling component parts at too little markup. Fewer parts are being required per repair, thus increasing the overhead. A 50% (or larger) gross profit from parts is not out of line, at this time. In fact, it might be mandatory, if you expect to make *any* profit.

Labor rates

If you base your labor rates on those being charged by others in your area, you probably are losing money. It's likely your competitor is basing his rates on yours! *Perhaps all of you are losing money.*

Instead, you need to calculate your profit or loss from labor, and adjust your rates until they bring in the return you need to stay in business.

Merchandise sales costs

The most common mistake of sales/service firms is wrong allocation of some TV, stereo, and appliance sales costs.

Usually, the service technicians are required to help deliver the large merchandise after delivery, to uncrate it, and to check the performance. Also, they often answer phoned questions about performance of new sets. In some organizations, the technicians are expected to attend sales seminars, learn the features of each product, and even sell it at times.

Sometimes trade-in machines are

PROFIT & LOSS STATEMENT
(combined operation)
DICK'S TV SALES AND SERVICE

	"C" COMBINED	"S" SERVICE	"P" PRODUCT SALES
TOTAL SALES			
Merchandise	100,000	10,000	90,000
Parts	40,000	40,000	0
Labor	60,000	60,000	0
	$200,000	$110,000	$90,000
COST OF SALES			
Merchandise sales	100,000	10,000	90,000
Direct merch. cost	80,000	8,000	72,000
Merch. gross profit	20,000	2,000	18,000
Parts sales	40,000	40,000	0
Parts costs	20,000	18,000	2,000
Parts gross profit	20,000	22,000	(2,000)
Labor sales	60,000	60,000	0
Labor wage costs	40,000	30,000	10,000
Labor gross profit	20,000	30,000	(10,000)
Total Direct Costs	140,000	56,000	84,000
GROSS PROFIT	$60,000	$54,000	$ 6,000
OVERHEAD EXPENSES			
Advertising	5,000	1,000	4,000
Insurance	4,000	1,000	3,000
Truck expenses	7,000	4,000	3,000
Utilities	3,000	1,000	2,000
Clerical salary	8,000	4,000	4,000
Other expenses	25,000	12,500	12,500
Total Overhead Expenses	52,000	23,500	28,500
NET PROFIT	$8,000	$30,500	$(22,500) loss

repaired by the service crew. In the worst cases, the service department receives no credit for labor and parts used on trade-ins, while the *income* from trade-in sales is listed under "merchandise sold."

Many sales/service stores fail to credit the service department for any of these expenses made to help the sales department. At best, only a fraction of the actual costs are charged against sales. The result is a constant showing of poor service productivity, and a large loss on paper. Of course, this is demoralizing to the technicians, and contributes to low wages for them.

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Service Management

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A Solution

Even if you are resigned to the poor performance of your business, you would do well to take a realistic look at the **relative** profitability of each segment of your business. Product sales, parts, and service labor must be examined separately.

Parts profit

The industry average of profit from parts sales is between 40% and 60%. If your gross parts profit is found to be 34% (for example), this might influence you to change your parts-pricing formula.

Service profit

If you properly credit your service department for work done to help the sales branch, and then separate service expenses and income from that of parts sales and product sales, you just might find to your surprise that your service department is doing very well.

Service supports sales

Some sales/service firms deliberately operate their service department at a loss in the belief that this will enhance their image and allow considerably more profit from merchandise sales. Usually, this is a false premise.

If your philosophy is to offer cheap service and recover the lost profit from increased sales, you should calculate what this "sales incentive" is costing you. Perhaps it's worthwhile as a sales-promotion expense, but it is an unknown one, in most cases.

For example, assume that you figured your service rates (as explained previously), and found them to be 25% low. Therefore, they produced a service loss of $10,000 last year. But, your "gut feeling" tells you that the "cheap-service" incentive brought in an extra $50,000 in sales. These extra product sales produced a gross margin of $10,000. **Therefore, the increased sales gross profit just cancelled the gross service loss.**

Was this a smart decision? Probably not, when the net profit figures are in. But, knowing the true figures can help you plan for the future.

Next, we'll show you how to calculate the profits separately.

Dividing The P&L

Figure 1 shows a typical profit-and-loss statement (P&L) showing the income and expenses for a firm which sells merchandise and also operates a service department. Column "C" gives listings in the usual way, with all income and expenses combined. Column "S" shows only the income and expense items applying directly or indirectly to the service department, while figures for the product sales are given in the "P" column. Notice that the "S" and "P" columns together total the same as the "C" column.

This P&L might be similar in dollars to that of a large firm for a month, or for a year with a small store. Of course, P&Ls for a year permit better accuracy in separating sales and service figures.

Combined figures are okay

According to the combined "C" column, the business doesn't appear to have any serious problems. Merchandise gross profit is 20%, parts are being sold at 100% markup (50% discount from list), and the 60% figure for direct-labor costs is not excessive since it includes some unlisted repairs of trade-in sets and deliveries of new merchandise.

However, by separating the two departments and allocating the costs accurately, we find this hypothetical business actually lost $22,500 in its sales department, and the service shop produced a profit of $30,500.

Of course, the example has been exaggerated to make the point, but it might not be far from reality with some stores.

Allocations

When you construct your own split P&L, you might want to follow these allocations:

- We attributed $10,000 of sales to the service department, since the techs made 10% of the total sales while on service calls. So, 10% of the merchandise cost ($8,000) was charged against the service department.
- 10% of the total parts cost was charged to sales, because many parts were used in repairing trade-in sets for resale—a large part of this store's sales business.
- About 25% of total technician's time was charged to sales, because of trade-in repairs, delivery of sales merchandise, and other jobs in support of the sales effort.
- Overhead expenses were allocated according to the percentage incurred by each department. For example, advertising usually is 100% for product sales, but the service department was assumed to have benefited. Therefore, 20% of advertising cost was listed against service. Insurance covers sales merchandise primarily. But, the trucks were used more for service than for sales deliveries; thus, a large proportion was charged to service. You must decide these percentages for your own firm.

Conclusions

If you were the owner of Dick's TV, and only used a combined P&L, you might be satisfied with the $8,000 profit for the period. However, if you split the P&L and recognize the real costs and profits for each department, you probably would consider strong actions to improve the results.

For one thing, the margin for product sales is too small. While improving on the 20% gross profit for new merchandise might be difficult, the sales of used machines often bring in 25% or more.

The 50% direct-labor cost versus labor-sales percentage is too high for most service businesses, even allowing for the $10,000 in labor costs listed against the sales department. **Probably the service rates should be raised.**

Other items are not so easy to decide. There are many trade-offs and considerations to be taken into account *before* you take any drastic actions, such as the elimination of either the sales or the service.

However, the beginning of any intelligent decision should begin, as we have done here, by listing all of the known facts.

Next Seminar

Instructions about pricing component parts—profitably—will be given next month. □

Sam Wilson's Technical Notebook

By J. A. "Sam" Wilson, CET

Your comments or questions are welcome. Please give us permission to quote from your letters. Write to Sam at:

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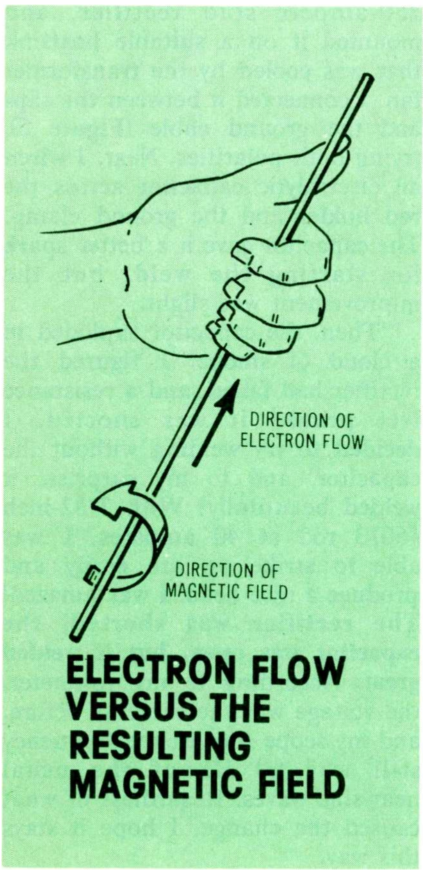

More Magnetic Memory

In a previous article, I showed how coils could be wound around ferrite cores, and the device used as a magnetic memory. This information is an extension of the same principle.

Any motion of electrons through a conductor ALWAYS produces a magnetic field at right angles to the conductor. No exceptions ever have been found for the rule. Even in cases where the electron flow is not confined to a conductor (such as an electron stream in a cathode-ray tube), there is an accompanying magnetic field.

The direction of any magnetic field is defined as the direction that a "unit" north pole would move, if placed in that field. Of course, a unit north pole is an imaginary north magnetic pole without an accompanying south magnetic pole.

Left-hand rule

Direction of the magnetic field around an electron current flow can be determined by the "left-hand" rule. Imagine that you are grasping the wire with your left hand (see Figure 1), with your thumb pointing in the direction of electron flow. Then, your fingers are pointing in the direction of the magnetic field.

Magnetizing a core

Figure 2 shows electron current flowing in a single wire that passes through the center of a ferrite core. If the electron current has enough amperage, the core will become magnetized, and the flux will be in the direction shown by the arrows on the core. This flux remains, even after the current flow stops.

Figure 1 The "left-hand" rule shows the direction of magnetic field produced by this direction of electron current flow.

By definition, if the core has a magnetic flux, a logic 1 level has been memorized. On the other hand, the lack of any magnetic flux indicates a logic 0 level. Those are the only two conditions permitted with this simple system.

In Figure 3, a second wire is threaded through the core. It will be used to determine the logic state of the flux.

Reading the flux

Suppose the core flux of Figure 3 has been established previously by an electron current pulse flowing from A to B. A second pulse, also from A to B, will not change or affect the flux stored in the core, but an equal pulse from B to A will eliminate the core flux. When the flux is cancelled, the resulting **change of flux** will induce a voltage in the wire between C and D.

Now, notice that inducing a voltage in a wire doesn't necessarily mean that current MUST flow. If wire C-D is part of a closed circuit (that is, has continuity external to the wire), *current will flow.* If an open circuit is across the C-D wire, *no current will flow.* These simple facts are important for understanding how only one core can be operated in a memory system having many thousands of cores. This will be explained later.

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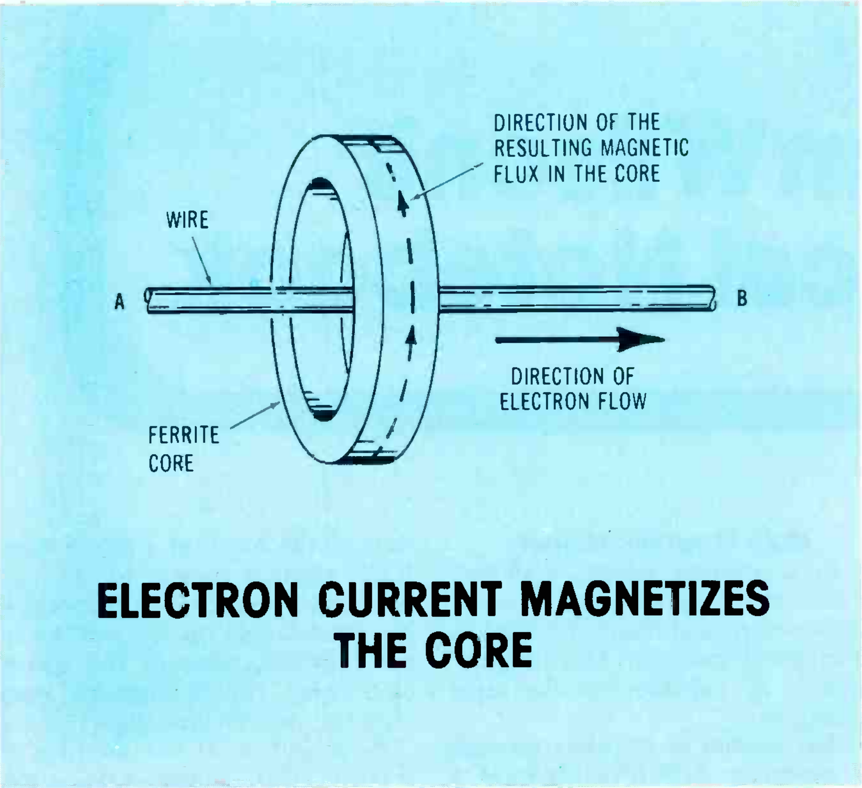
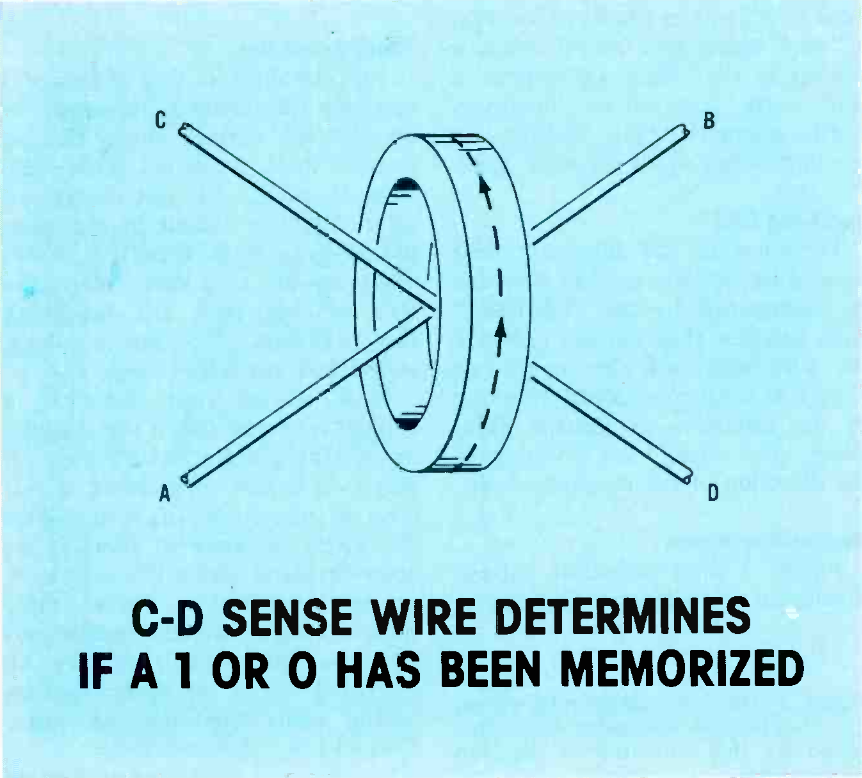


Figure 2 Electron current in a wire through a ferrite core produces a flux in the core of the same direction as the previous "left-hand" rule. Sufficient current magnetizes the core.

Figure 3 Addition of a second wire through the core provides a method of determining if the core originally was in the logic 1 or the logic 0 condition.



Refreshing the state

The simple memory described in a previous article had three conventional coils on one core. The first two coils performed the same functions as wires A-B and C-D in Figure 3. A third coil was added to re-establish the core flux, when it was eliminated by the sensing current.

In the same way, a third wire is added to the core, as shown in Figure 4. Wire E-F is used to **refresh** the memory. In other words, it re-establishes the original flux.

I'm not finished with my discussion of applied magnetics. The principles of magnetic memory will be extended in a future issue.

Welding Problem

In a recent letter, Mr. Earl Swallow writes, "Some years ago, I bought a Craftsman AC welder (40 amps to 230 amps), but never was happy with it. With 3/32-inch #6013 30-80 ampere rod and #308 stainless 60-90 amp, it took a long time to strike an arc, and I had a lot of trouble holding it. Using a higher amperage might burn holes in the material.

"Recently, I bought a 100-volt 250-ampere stud rectifier, and mounted it on a suitable heatsink that was cooled by the transformer fan. I connected it between the taps and the ground cable (Figure 5), trying both polarities. Next, I wired an electrolytic capacitor across the rod holder and the ground clamp. The capacitor gave it a better spark for starting the weld, but the improvement was slight.

"Then, the capacitor exploded in a cloud of smoke. I figured the rectifier had failed, and a resistance test proved it was shorted. I decided to try welding without the capacitor, and to my surprise, it welded beautifully! With 3/32-inch #6013 rod at 40 amperes, I was able to strike an arc easily and produce a nice bead. I was amazed! **The rectifier was shorted, the capacitor was open, but it welded great.** According to my voltmeter, the voltage was the same as before, and my scope showed the frequency still was 60 Hz of the usual near-sine waves. Regardless of what caused the change, I hope it stays this way.

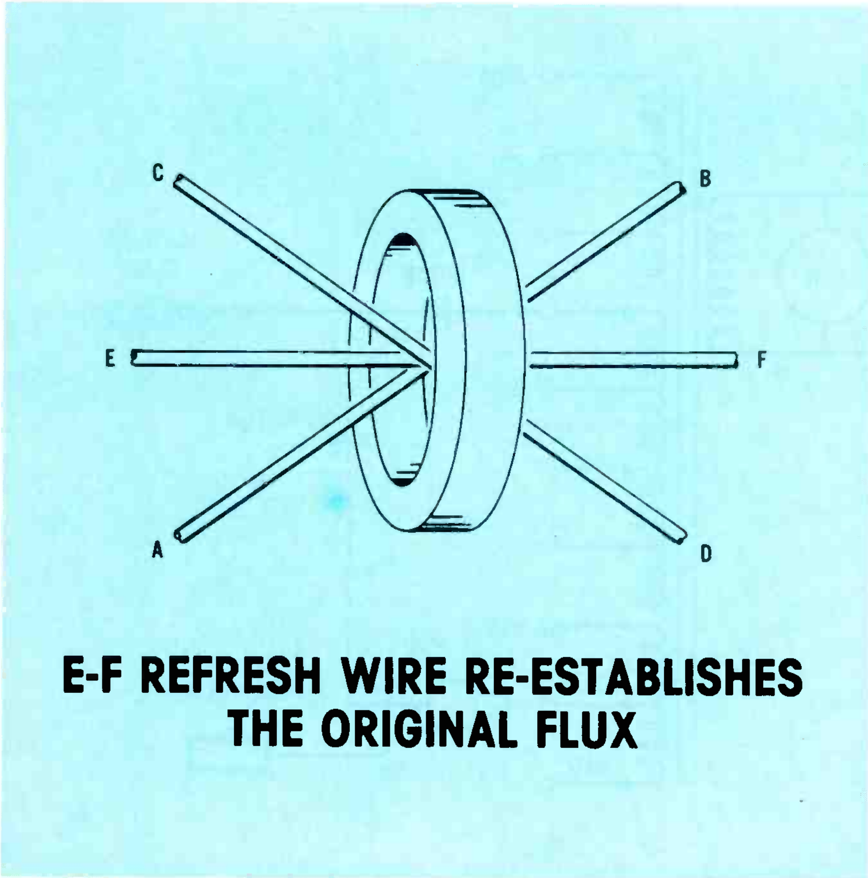


Figure 4 Read-out of the core's condition reverses a logic 1 to a logic 0 state. Therefore, a third wire carries current to re-establish the former logic 1 state, following a logic 1 read-out (and cancellation). This is called "refreshing" the stored logic state.

"But, I am puzzled. What caused the improvement? Have you any ideas?"

Mr. Swallow, I doubt that I can solve this completely. But, by studying long hours, attending many classes, interviewing technicians, and working for years in electronics, I now have arrived at the point where I am qualified to **guess.** So, here goes.

Probably the electrolytic capacitor exploded because you accidentally reversed the polarity of voltage across it when experimenting with the diode. Next, the diode was destroyed because the shorted capacitor connected the diode ACROSS the secondary winding of the transformer.

Part of the welding improvement might be caused by current now flowing during both peaks of the AC voltage. (The rectifier allowed current to flow for only one-half cycle. The capacitor increased the DC voltage slightly, but was much too small in capacitance—compared to the arc resistance—to make the rectification true peak-reading.)

I can't even guess what happened to make it better now (with a shorted series diode) than it was originally. Perhaps the overload caused shorted turns in one winding of the transformer, thus changing the turns ratio and the output AC voltage. Or, perhaps the shorted diode added a slight amount of DC resistance that *helped the performance at this one set of conditions*, by limiting the current.

Those are my guesses, and I'll open the discussion to include you readers.

More "In Situ"

An "in situ" method of measuring just one of several interconnected resistors was described last March. These in situ measurements are made without disconnecting the component or the wires in a circuit.

With the series parallel arrangement of Figure 6, the ohmmeter connected across R1 will give a wrong reading, until the meter voltage across R2 is bucked out by an external voltage applied across

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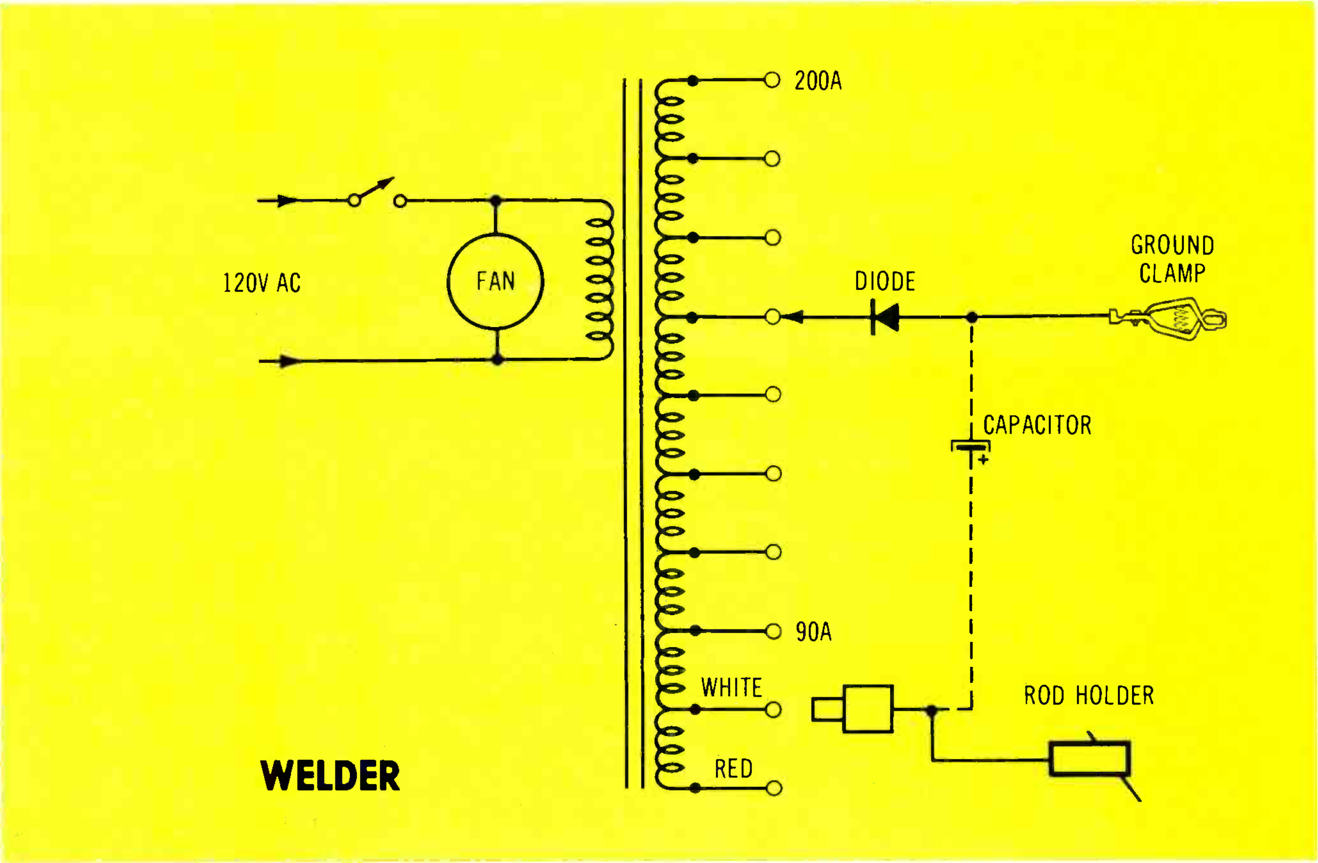

Figure 5 This welder schematic shows the modifications made by a reader.

Technical Notebook

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R3. **When the same voltage is applied to BOTH ends of R2, the circuit behaves as though R2 is open.** This gives the effect of disconnecting R3. Therefore, the ohmmeter reads the resistance of R1 alone.

It is necessary to observe a few conditions to make the test accurate and fast. A center-zero meter range allows the balance to be checked by one meter, and without re-connecting any leads. Many VTVMs can be operated this way, by adjusting the "zero balance" control to place the zero reading (without any voltage input) at the *center* of the voltage calibrations. Negative voltages read to the left, and positive voltages read to the right of the center zero. The power supply must have an adjustable output voltage, and have regulation over the whole output range. Select the most-likely ohmmeter range at the beginning, since changing ranges requires a new zero balance.

After the equipment is connected as shown in Figure 6, vary the power-supply voltage in whichever direction moves the meter pointer nearer the zero mark. When the DC voltmeter reads a **practical** zero, you stop varying the power-supply voltage, and then read the ohmmeter. The ohmmeter will measure only R1, the reading doesn't require any correction or mathematics, and the accuracy will be as good as that of the ohmmeter and the zero-center DC voltmeter.

In most cases, a precise zero-voltage reading is not necessary. This would waste too much time. A 10% deviation from perfect zero can cause no more than a 10% resistance error. Of course, many resistors are rated at ±20%, and ohmmeters often have errors of 5% or more. The method is not proposed as one giving accuracy to three decimal places. Rather, it is a quick test that can give in-situ readings of "sufficient" accuracy.

Alternate method

The popularity of inexpensive hand-held calculators makes possible a combination measurement and calculation of the Figure 6 R1 resistance.

First, the in-circuit resistance of R1 paralleled by R2 and R3 in series is measured. Then, the ohmmeter reading is placed in this simple equation:

$$R1 = \frac{\text{ohmmeter reading times } (R2 + R3)}{(R2 + R3) \text{ minus ohmmeter reading}}$$

For example, in Figure 7, the rated values are: R1 is 270 ohms, R2 is 680 ohms, and R3 is 330 ohms. The ohmmeter reading across R1 is 210 ohms. Is R1 within tolerance?

Using the previous formula, these are the three additional steps:

$$R2 + R3 = 680 + 330 = 1010 \text{ ohms}$$

therefore,

$$R1 = \frac{210 \times 1010}{1010 - 210}$$

$$R1 = 265 \text{ ohms}$$

Since R1 is rated at 270 ohms, this is an accuracy of about -2%, which is better than required (in most circuits).

Notice also, that actual wrong

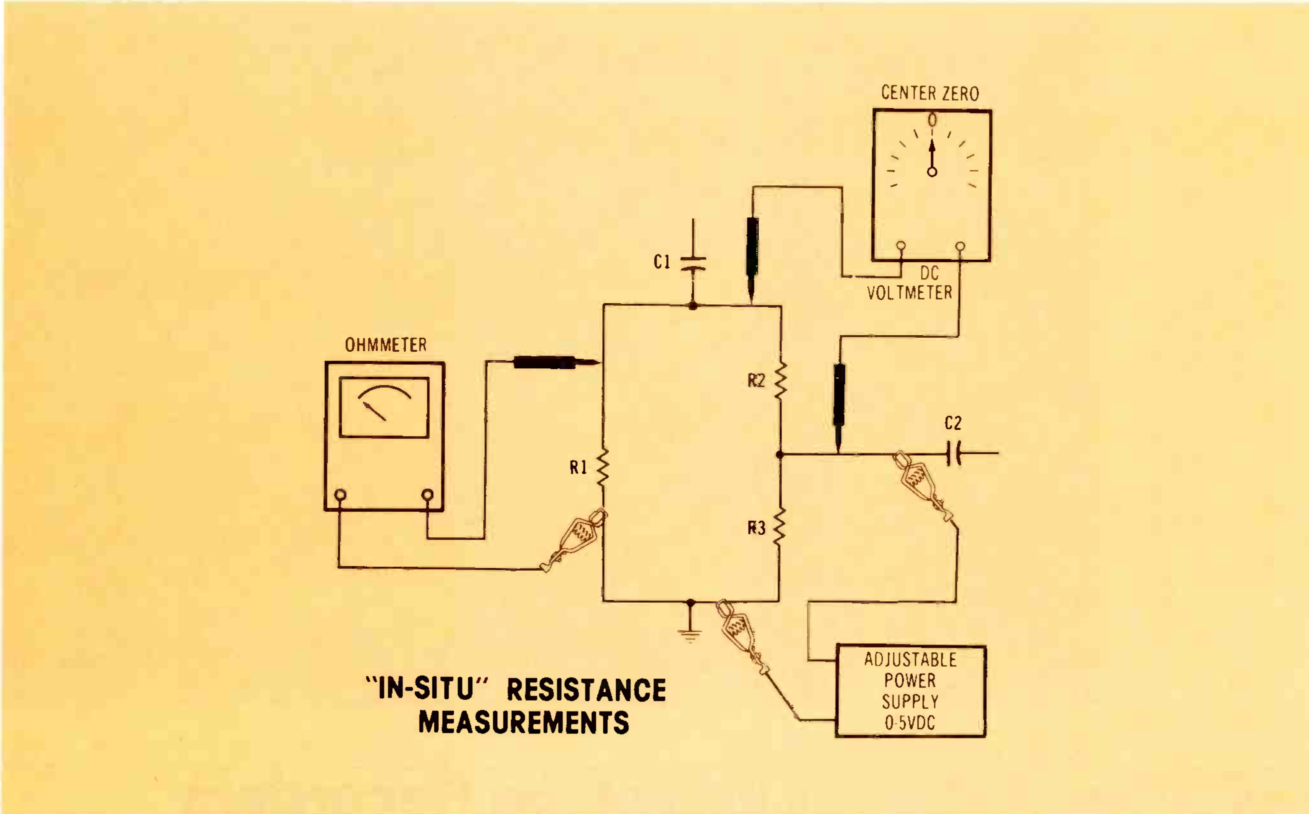


Figure 6 Here is the method of connecting the equipment to measure R1 in situ (in-circuit), when R2 and R3 in series are paralleled. The power-supply voltage is increased from zero until the center-zero DC meter reads zero volts across R2. With the same voltage at each end of R2, the effect is an open in R2; thus, opening the R2/R3 path.

resistances of R2 or R3 will make the answer wrong. So, in a way, the method checks all three resistors.

Derivation of the equation

For those of you who enjoy a bit of math, here is the way the formula for finding the resistance of R1 was evolved. The resistance measured by the ohmmeter is called Rx, and the formula becomes:

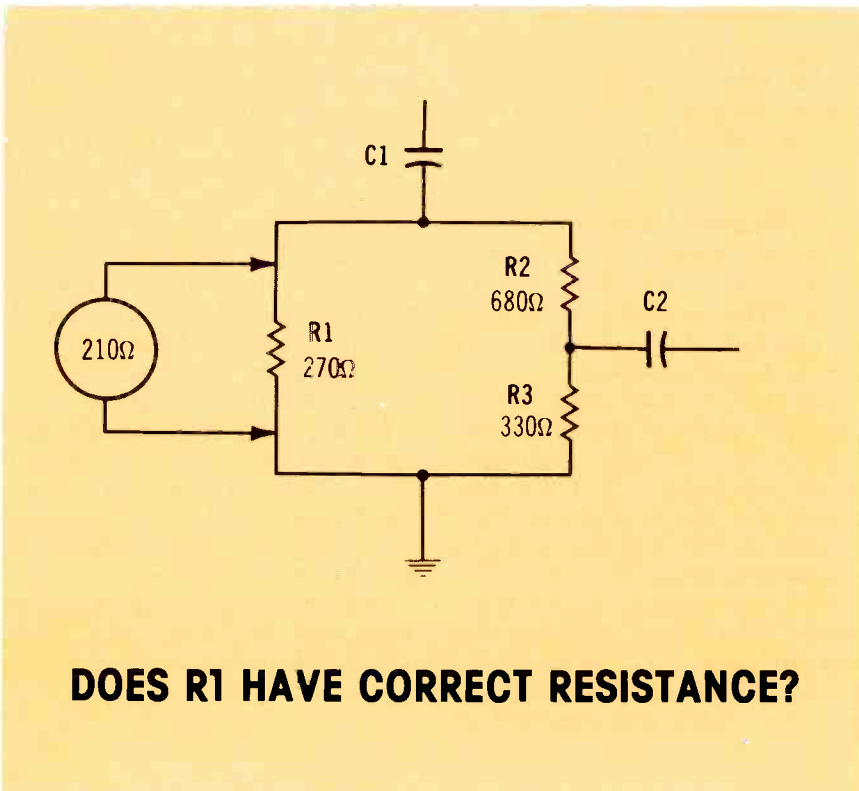
$$Rx = \frac{R1\ (R2 + R3)}{R1 + R2 + R3}$$

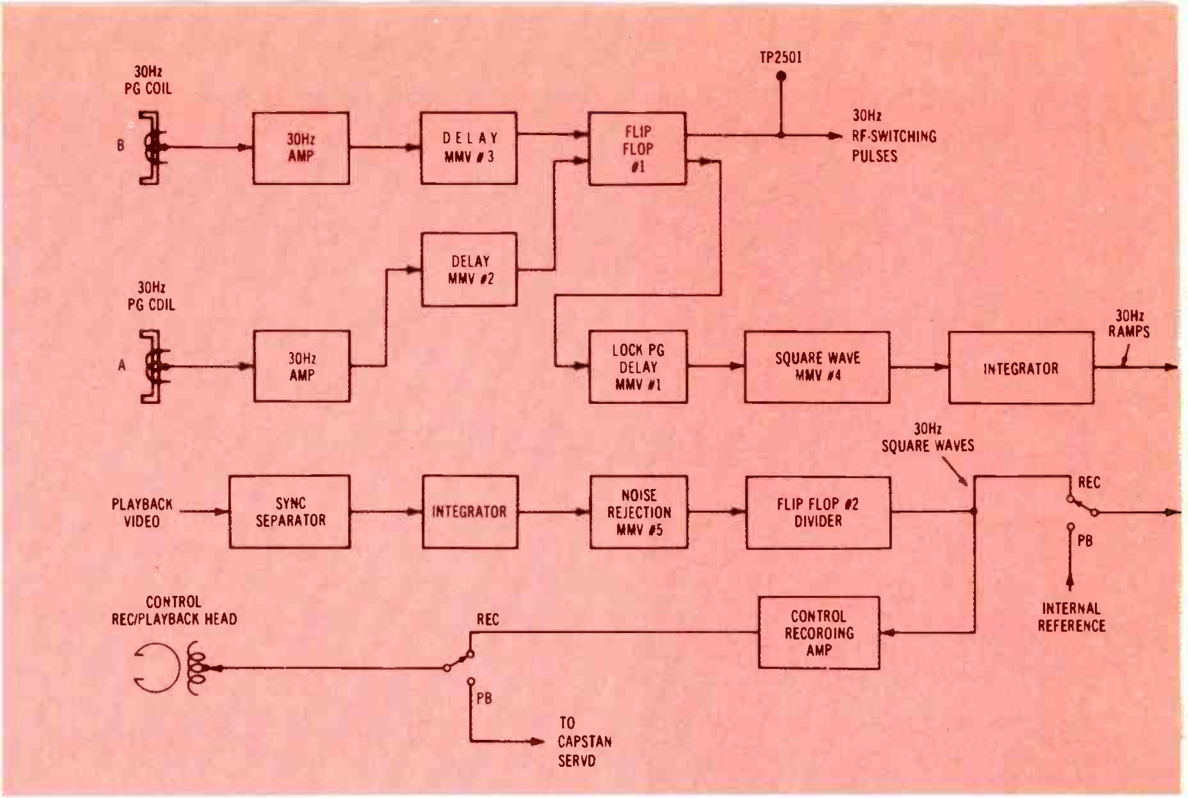
Then, the equation is solved for R1, which produces:

$$R1 = \frac{Rx\ (R2 + R3)}{(R2 + R3) - Rx}$$

This is the same as the first formula given for solving Figure 7. Notice that the same technique can be used to check the ohmmeter reading for any series-parallel arrangement of resistances. ☐

Figure 7 Given these conditions, does R1 have the correct rated resistance?





Servicing Betamax Videotape Recorders

PART 6 Betamax Servo Circuits

By Harry Kybett

Details of the Betamax head phase, capstan speed, capstan phase, speed sensing, and muting circuits are explained.

Betamax Head Servo

General principles and typical circuits of servos were discussed last month. This article gives specific information about the Betamax head and capstan servos.

Although it does control both speed and phase of the head-wheel rotation, the Betamax head-servo system (see Figure 1) is not very complicated. Much of the circuitry is inside the ICs, and thus can't be explained in detail.

All servos must have two input signals. One is the standard (or reference) signal. The frequency of this signal does not change during operation (either good or bad) of the machine. The other signal often is called "feedback," although it's not like negative or positive feedback in amplifiers. Instead, the feedback information reveals whether or not the device being controlled is obeying the control commands.

Reference

For recording, the reference signal is the vertical interval, which is extracted from the incoming video. It is processed to minimize noise, then divided down to 30-Hz.

During playback, the reference signal is produced by the internal vertical-drive circuit (to be described later). The 30-Hz square waves are locked to the 60-Hz line for stability.

In both cases, the 30-Hz square waves are processed into pulses before they are sent to the sampling gate.

Feedback

The feedback signal for both recording and playback consists of processed pulses from the A head pulse-generator coil in the head wheel. Part of the processing is to make symmetrical 50% duty cycle square waves out of the pulses. Then, integration changes the square waves to rounded ramps that are needed for the sampling.

Sampling

During both recording and playback, ramps are applied to the feedback input of the sampling gate, and pulses are applied to the reference input.

From the sampling gate comes a signal of pulses that vary in height according to any difference between the reference signal and the true motor speed. After integration in the "hold" capacitor, the signal is a DC voltage which is amplified and then used to power the brake coil of the head drum.

Any deviation from perfect syn-

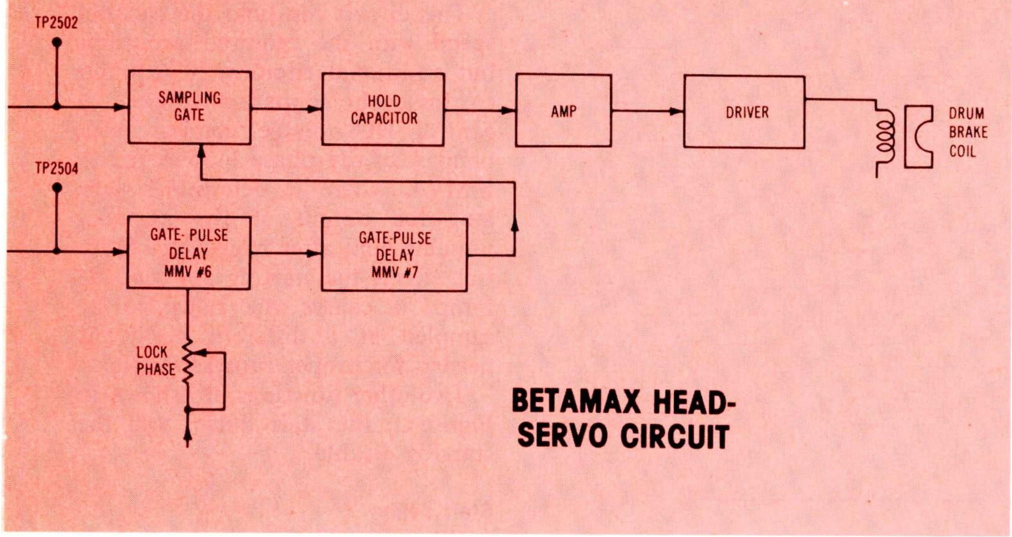


Figure 1 Operation of the Betamax head-servo circuit is shown only by a block diagram, because much of the circuitry is inside various ICs. A DC ramp processed from the PG signal is sampled by a pulse from the frequency-reference signal. DC voltage from the sampling operates an eddy-current brake that reduces the speed of the head rotation, as needed for correct speed and head phase.

chronism between the standard and the feedback signal from the head-drive motor causes the brake to be actuated to slow down or speed up the head drum, as needed for correct head phase.

(The abbreviation "MMV" in the Figure 1 block diagram stands for Monostable-MultiVibrator, or a one-shot.)

Most of the major circuit functions occur inside the ICs, and thus are not accessible for testing or for obtaining waveforms. Although these hidden operations do limit knowledge of the circuit, the system is economical of components and provides good reliability. Test points are provided, and the voltages or waveforms there are shown in the service manual to help during repairs.

Betamax Capstan Servo

The capstan-servo system in the Betamax is more complex than those usually found in small VTRs, because separate circuits (or "loops") are furnished to control phase and speed separately.

Stated simply, the speed loop provides the main drive for the motor, and it is fine-tuned by the DC output of the phase loop. Both loops are shown in the block diagram of Figure 2.

Pulses from the frequency-generator (FG) coils in the capstan motor are the feedback signal for both loops. These pulses are amplified sufficiently to change them into square waves.

Capstan-speed loop

Because the speed loop has major responsibility for establishing the correct capstan speed, it will be described first (see Figure 3).

(This loop is similar to the single-input servo described last month. To refresh your memory, we'll give a brief summary of the operation. The signal from the motor frequency generator (FG) coil is split into two branches. One produces a narrow **pulse** for each cycle of the FG signal, while the other branch manufactures a **ramp** that varies in position with changes of motor speed. These two processed signals are fed to the *sampling* circuit, which has an error-correcting signal at the output. This error signal is filtered, amplified, and finally used to operate the motor at a speed determined by the speed loop.)

In the Betamax capstan-speed loop (Figure 3), the input FG signal has an approximate sine waveshape, and is amplified excessively to form square waves. This square-wave signal is sent to three points: the phase loop; the start-delay one-shot (MMV6); and the speed loop.

Negative-going falling edges of the square waves trigger one-shot MMV5, and it emits narrow *pulses* to the comparator. *This is the reference input.*

Also, the square waves trigger two cascaded one-shots (MMV3 and MMV4) which establish a type of square-cornered signal having a fixed time duration (non-varying waveform width) at the output of MMV4. The square-cornered waveform is integrated by C605 to form a rounded *ramp, which is the feedback input to the comparator* (sampler) mentioned before. The comparator now has both necessary inputs.

Each recording time must have a different ramp. C605 alone is the integrator capacitance for one hour. A larger value is needed for the 2-hour speed. Positive voltage comes from the speed sense circuit, and it biases Q603 into saturation. The Q603 low C/E resistance effectively grounds C606, which now is in parallel with C605, thus changing the slope of the ramp.

DC pulses at the output of the comparator are filtered by C607, amplified, and used to drive the DC capstan motor. Any variation from the correct speed moves the ramp sideways relative to the fixed pulses, causing the pulses to sample each ramp at a different DC level. This produces a different average DC voltage at the comparator output,

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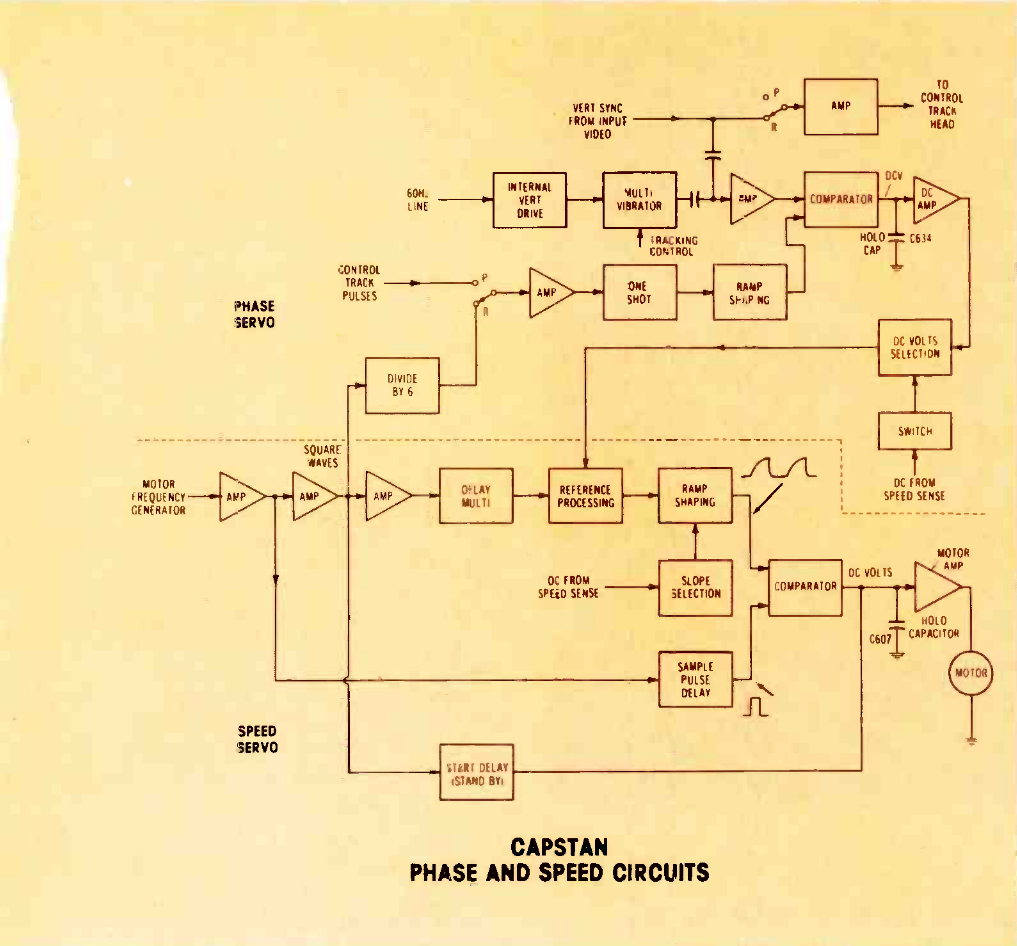
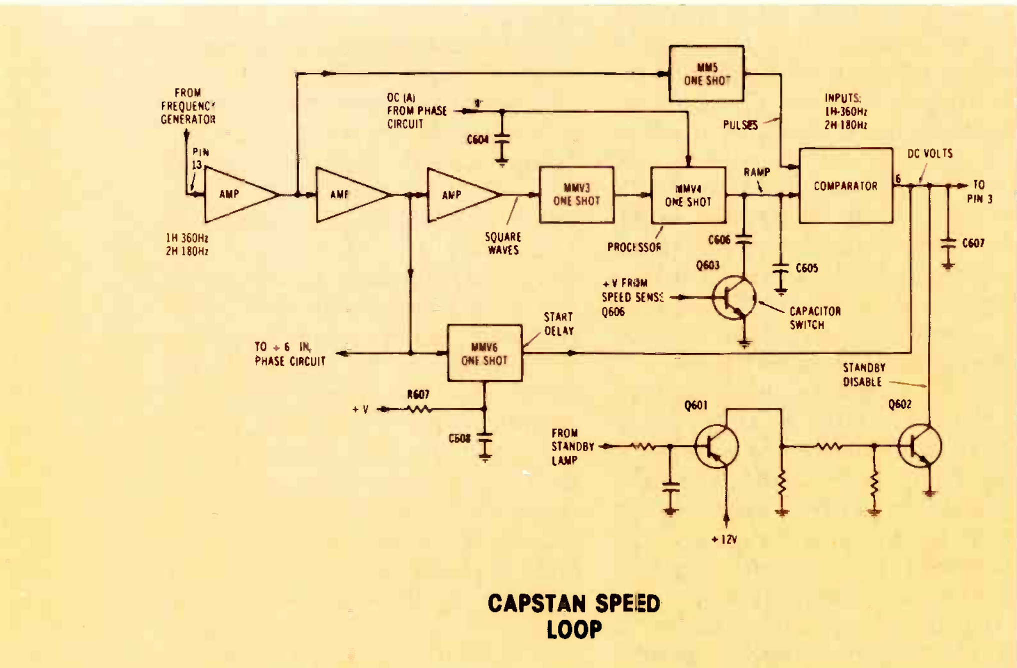


Figure 2 The Betamax capstan servo system is in two parts: the speed servo; and the phase servo. These are explained in the next two figures.

Figure 3 In the Betamax capstan-speed loop, a single signal from the motor frequency-generator coils is processed into a feedback ramp that changes position according to motor speed, and into a reference fixed pulse that samples the DC ramp. The resulting DC voltage from the sampling eventually drives the DC capstan motor. Two ramp-forming capacitances are required for two-speed operation. This loop operates at 360 Hz for 1-H, or at 180 Hz for 2-H speed, and a DC voltage from the capstan-phase servo varies the triggering of MMV4, thus changing the position of the sampling ramp, and controlling the phase of rotation.



Betamax

continued from page 55

and thus changes the motor voltage and speed until it is correct.

This circuit can hold the capstan **speed** with the required accuracy, but additional circuitry is required to lock the capstan **phase.** A control DC voltage coming from point A of the phase loop is fed to MMV4, where it determines how long the output of the one-shot remains high after triggering. Since this affects the starting point of the ramp, it causes the ramp to be sampled at a different point, as needed for proper capstan phase.

Two other functions are shown in Figure 3: the start delay; and the standby disable.

Start delay

When power first is applied to the VTR, the capstan motor is not rotating, and no FG waveforms reach the speed loop. Therefore, C608 charges and forces the output of the one-shot MMV6 to go high. This high is connected to the output of the comparator, and it temporarily increases the DC voltage fed to the motor above normal, and thus bringing the motor up to speed more rapidly.

As the motor approaches the correct speed, the FG frequency is high enough to discharge the capacitor below the threshold point, which prevents the output of the one-shot going high. So, the start delay becomes inactive, and remains that way until next time the machine is started.

Standby disable

If the machine is turned on, but is in the standby mode, a DC voltage from the standby lamp is applied to the base of Q601. This saturates Q601, which in turn applies a large forward bias to Q602, causing a low C/E resistance. Because the collector of Q602 is wired to the comparator output, the low C/E resistance shorts out the error voltage, and eliminates the motor DC voltage, thus preventing the motor from running during standby operation (such as cassette loading or unloading).

Phase loop

The capstan-phase loop operates

during both record and play modes, but the inputs are different for each (see Figure 4).

For recording, the vertical interval from the input video signal is integrated into a pulse that's used as the *reference* signal.

The FG square wave from the speed loop is divided in frequency by 6; and, after timing and shaping by an amplifier and a one-shot, it is integrated into a rounded ramp which is the *feedback* signal for the comparator.

Time constant of the one-shot is about 22 milliseconds, so during operation in the 1-hour mode, it ignores alternate 60-Hz differentiated square waves from the X6 divider. Therefore, the output of the one-shot (and the ramp at the comparator) always is 30 Hz, regardless of the mode.

DC pulses at the comparator output are filtered, amplified, and then applied to the speed loop for fine control of the phase. However, different control voltages are needed at the speed loop for the 1-H and 2-H modes. Electronic switching selects whether the control voltage goes through the 1-H or the 2-H adjustment pot to the speed-servo circuit. DC voltages from the speed-sensing circuit bias-on either Q28 or Q30, and the active one of these transistors in turn applies saturation bias to either Q27 or Q29. When Q27 is biased to saturation, the control voltage passes through the emitter-to-collector path and to the 1-H control. When Q29 has saturation bais, the control voltage passes through it and to the 2-H control.

Therefore, the error-correcting DC voltage is sent to the reference generator (MMV6) in the speed servo circuit, where it produces the correct phase of the capstan.

Internal Vertical-Drive Circuit

Simply stated, the internal vertical-drive circuit (Figure 5) is a 300-Hz multivibrator oscillator, with a frequency that's controlled by the frequency of the incoming power line voltage. An unusual feature is that it works equally well with a 50-Hz line frequency.

Q36 and Q37 are the transistors for the 300-Hz oscillator. Q35 amplifies the output of Q36, and it drives the divide-by-ten circuit, producing 30-Hz square waves for the servo reference source.

Sampling

Pulse sampling of a sawtooth voltage yields a DC voltage that controls the 300-Hz frequency. A 60-Hz pulse and a 300-Hz sawtooth must be formed.

A sample of the line voltage is clipped, amplified, and differentiated. Positive-going pulses produced by differentiation of the square waves come from the Q40 collector, and they are direct coupled to the base of Q39. Therefore, Q39 can conduct through collector resistor R697 ONLY when these positive pulses are at the base. *These are the reference pulses needed for sampling.* Next the sampling sawteeth must be formed.

A signal from the collector of Q37 is coupled to the Q38 base. Across R697, the Q38 collector resistor, square waves normally would be formed. But, C647 integrates them into rounded sawteeth. *These comprise the feedback sawtooth waveform needed for sampling.*

Notice carefully that both Q38 and Q39 share the same collector resistor, R697.

Present at the Q39 collector are 300-Hz DC sawteeth (from the Q38 operation), but Q39 can conduct ONLY during the 60-Hz positive pulses at its base. Therefore, sampling of the sawteeth occurs during every **fifth** sawtooth (every sixth sawtooth, for 50-Hz line voltage).

When a transistor is biased to saturation (by excessive forward bias), there is less than 0.1 volt drop between collector and emitter. **During each of the 60-Hz** (50-Hz in other countries) **pulses, the DC level of the collector sawtooth** (at that one time, only) **is conducted to the Q39 emitter, where it charges C648 to a certain DC voltage.** After amplification in the Darlington-connected Q41 and Q42, the DC voltage is applied to Q37 and Q36 through the base resistors. Any

continued on page 58

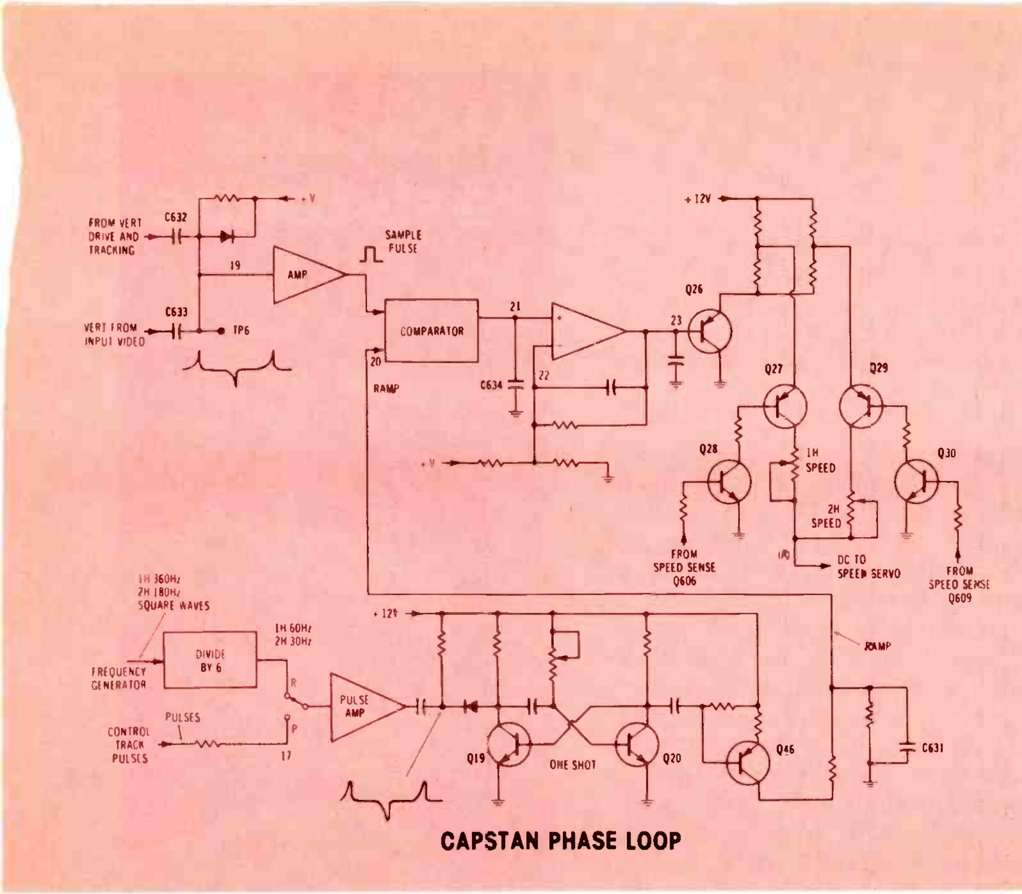


Figure 4 Pulse sampling of a DC ramp also is used in the Betamax capstan-phase loop. Operation always occurs at 30 Hz. DC voltage from the sampler/comparator goes through either the 1-H or the 2-H speed controls (switched by Q27/Q28 or Q29/Q30) to the speed-servo circuit of Figure 3, where it controls the capstan phase.

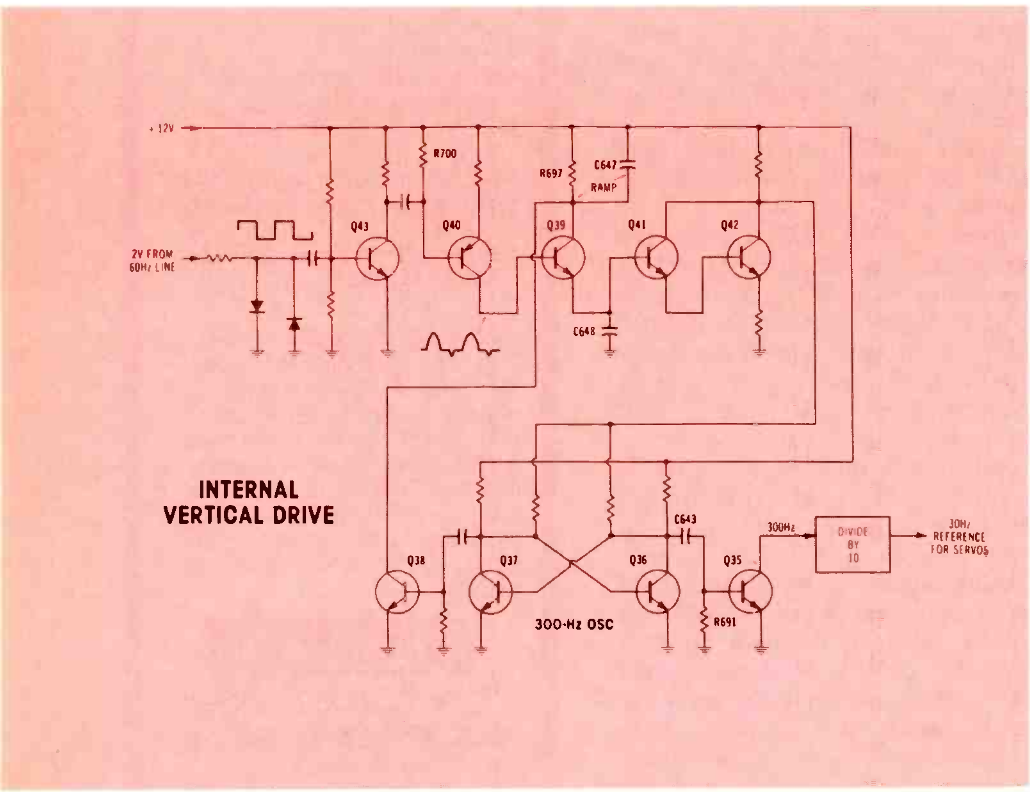


Figure 5 For the Betamax internal vertical-drive signal, a 300-Hz oscillator is frequency-stabilized by the 60-Hz line, and the output is divided to produce 30-Hz square waves for use by the servos.

Betamax

continued from page 57

variation of this DC voltage changes the oscillator frequency.

If the 300-Hz oscillator frequency changes for any reason, pulse sampling of the sawtooth occurs at another point on the DC ramp. Thus a different DC voltage is stored in C648, and in turn this restores the correct frequency at the oscillator.

The 30-Hz square waves at the output of the vertical drive circuit are used in the servos, and for other switching operations.

Speed Sensing

Suppose a tape has some sections that were recorded at the 1-hour speed, and others recorded at the 2-hour speed. The peculiar patterns obtained by attempted playback at the wrong speed would be very confusing. So, circuitry is included to switch the playback speed to match the recording speed. A speed-select on the front panel determines the speed during recording, and the playback speed is selected automatically.

For playback, the repetition rate of the control-track pulses is sensed, and the speed is adjusted from this rate (see Figure 6). When power first is applied, the circuit automatically is in the 1-hour (fast speed) mode. If a 2-hour section is played, the control-track pulses will be 60 Hz, rather than the correct 30 Hz. This causes the 2-H detector (Q15, Q16, and Q17) to develop an output pulse, which flips the speed-memory circuit and mutes the audio and video signals. The speed-memory flip flop changes output state, thus making the required changes in the speed servos and switching the video and audio equalizers. The mute eliminates both audio and video until the tape speed has settled. The control-track pulses now are at 30 Hz, and the circuit rests, with the flip flop in the 2-hour mode.

If the tape has a 1-hour section following a 2-H section, the control-track pulses will be 15 Hz, while the machine is still in the 2-H mode. This low frequency trips the 1-H detector circuit, which flips the memory flip flop back to the 1-H speed and activates the mutes temporarily.

If the 2-H tape is removed (or if blank tape is played following a 2-H recorded section), there will be no control-track pulses, and the circuit automatically selects the 1-H mode.

A complete circuit description can be found in the Betamax manual, but this brief description should give a general idea of the operation.

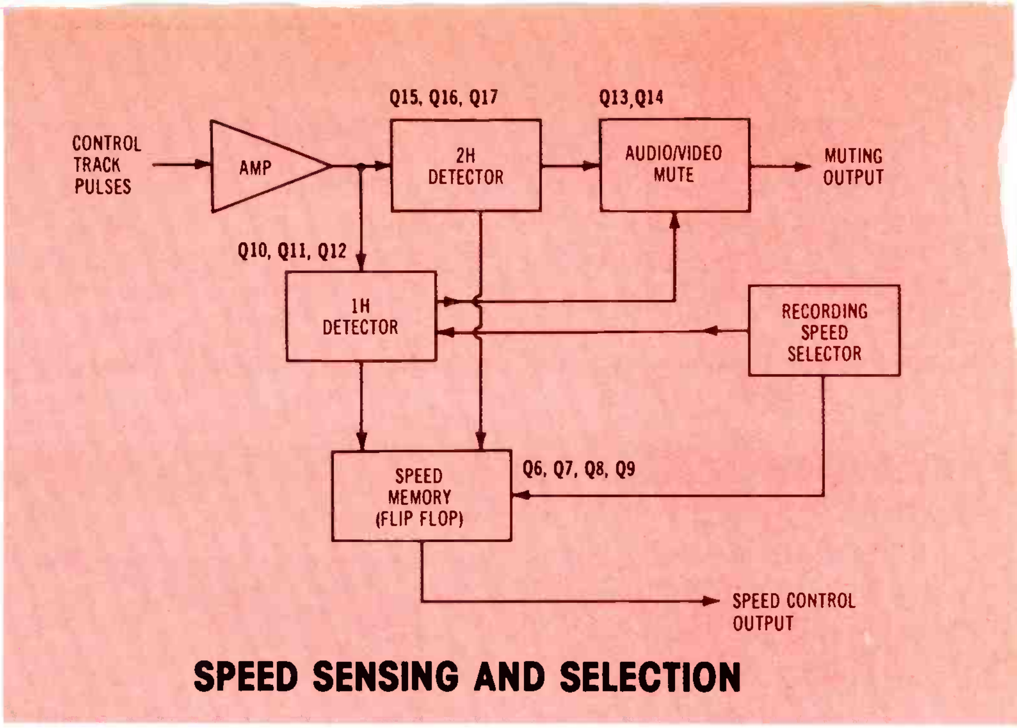


Figure 6 During Betamax playback, the control-track pulse frequency is monitored to provide automatic selection of the correct speed during playback, according to whichever speed was used during recording.

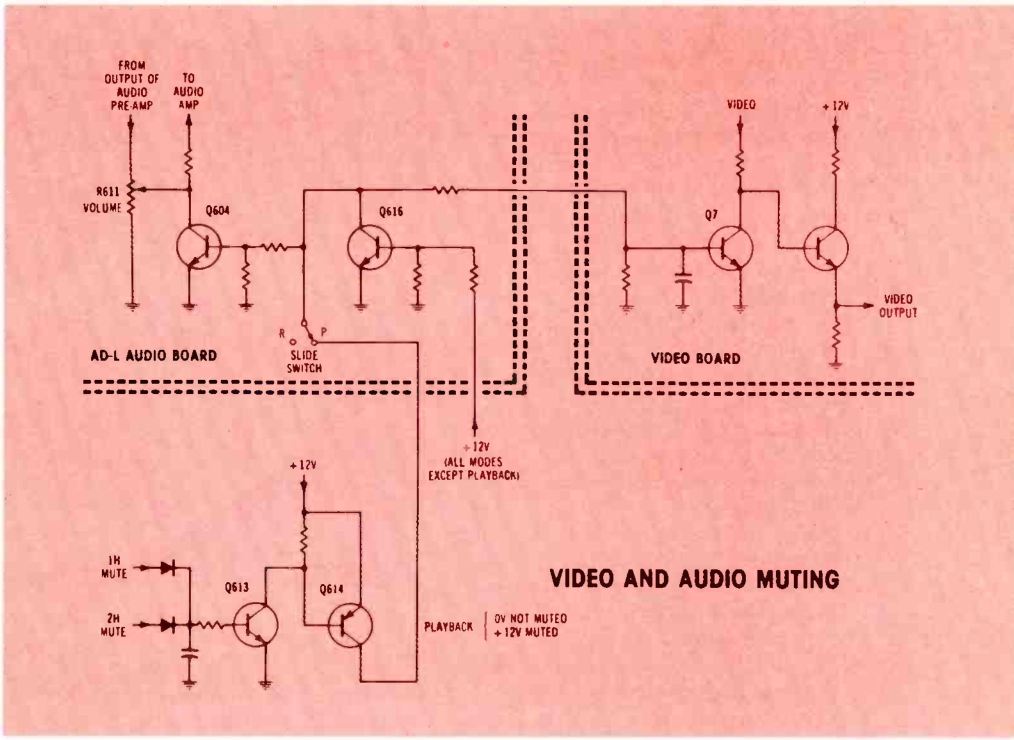


Figure 7 Audio and video muting in the Betamax is arranged so it can occur only during the playback. Even then, these signals are muted only following turn-on or a speed change.

Muting

Several seconds are required for the tape speed to stabilize, following turn-on or a speed change. The varying sound and picture symptoms during each settling period are eliminated by the muting signals.

In Figure 7, Q613 and Q614 are DC amplifiers that control the two muting transistors, Q604 and Q7. A positive pulse from the 1-H speed-sensing circuit comes through one of the isolation diodes and reaches the base of Q613 (a positive pulse from the 2-H circuit goes through the other diode to the base). Q613 is biased into conduction, and this in turn produces a saturation bias at the base of Q614. Full conduction of Q614 brings +12 volts to the record/play muting switch, and in the play position, the +12 volts reaches the muting "rail."

The pulse of +12 volts at the muting rail charges the base capacitor of Q7, and also provides saturation bias to both Q604 and Q7. These transistors short out their respective audio and video signals, causing muting of both.

Following each speed-change pulse, the capacitor holds sufficient voltage charge to maintain the transistors in a saturated condition (with video and sound muted) for about 3 seconds, which should be long enough for the tape to reach normal speed. Thus, after 3 seconds the playback picture and sound both are restored.

Notice that Q616 receives saturation bias during all operating modes except playback. The saturation bias forces Q616 to ground out any positive voltage at the muting rail, so muting can't occur except during playback. This allows Electronic-to-Electronic (EE) monitoring for all other functions, and permits muting during playback.

Troubleshooting

Servo problems can be seen as periodic sequences of good and bad pictures. Therefore, they are entirely different from other difficulties in the luminance or chroma circuits.

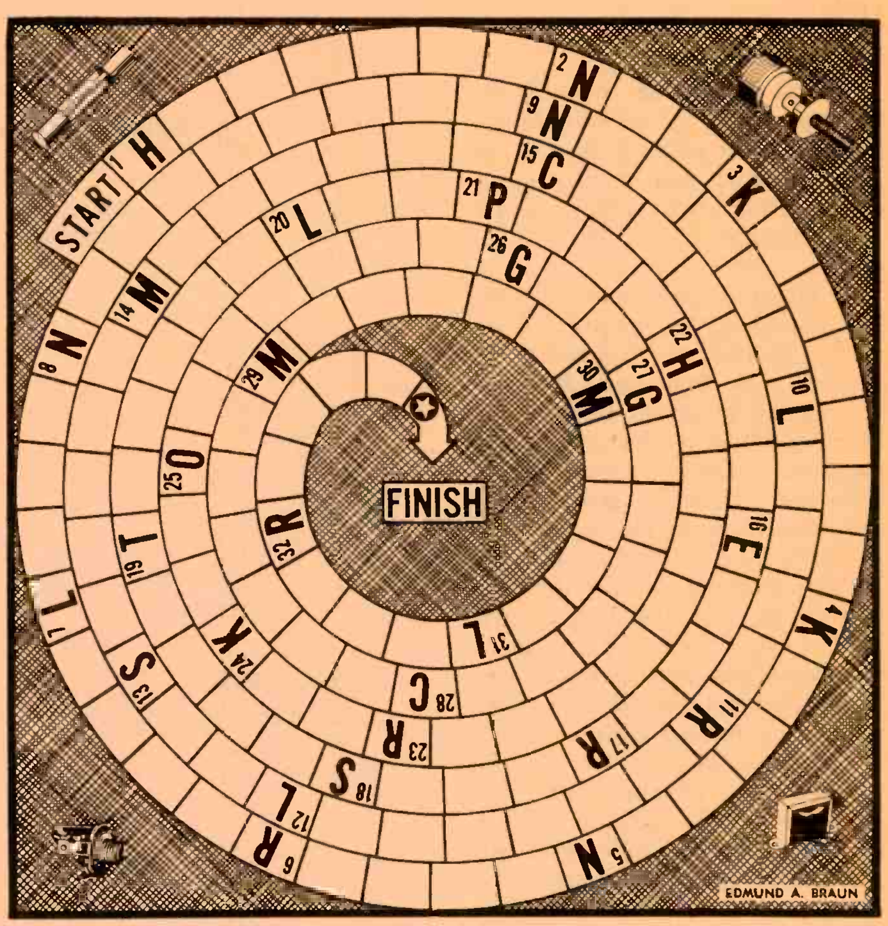
Other troubleshooting information will be presented at the end of this series.

Next month the subject will be mechanical and system controls. □

BRAIN STRAIN?

by Edmund A. Braun.

Even though you know ElectronicS from E through S, this Pinwheel Puzzle is guaranteed to have you going around in circles! The last letter of each word is the first letter of the next word. Each correct answer is worth 4 points; a perfect score is 128. It shouldn't be difficult to get a high rating except perhaps for someone who thinks "tint" is a temporary home for campers, or that "wrench" is a farm in the west! So take your pencil and this puzzle in hand and start going around together. Ready? Then (BANG!) GO!



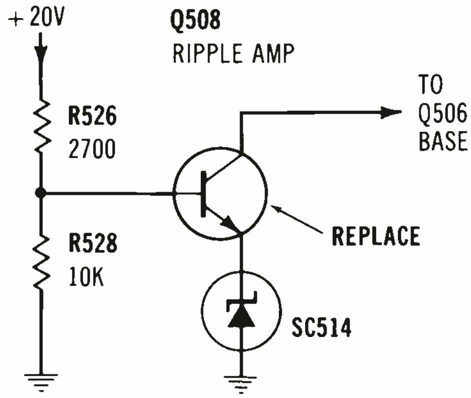
1 Distortion seen as blurred images.
2 A notch.
3 Voltage developed across an inductance by sudden collapse of a magnetic field when current through inductance is cut off.
4 Also called a double or a Thomson bridge.
5 Abstract mathematical symbol for expressing quantity.
6 Pertaining to the price the public pays for an item.
7 Unit of visible radiation on surface 1' square located 1' from source of 1 candlepower.
8 Process of directing an airplane or ship toward its destination.
9. Relatively very small.
10 Instrument that automatically scans certain quantities in a controlled process and records readings for the future.
11 Change in the direction of transmission or polarity.
12 Devices soldered or crimped to end of wire to provide an eye or fork for placing under head of a binding screw.
13 A cgs electrostatic unit of resistance.
14 Term describing something used to assist human memory.
15 Packaged recording tape used in its container.
16 Hypothetical medium that pervades all space.
17 Pertaining to upward or downward movement of a TV picture.
18 Type of holder.
19 Pertaining to a relay actuated by heating effect of current flow.
20 General term for an artificial source of light.
21 Tool driven against a surface to produce a hole.
22 Instrument for measuring the specific gravity of a liquid.
23 Vertical frame on which equipment, relays, etc., are mounted.
24 Prefix denoting 1000 in metric units.
25 In terms of printed wiring, the inverted shelf of plating formed when conductor material is selectively removed from under the plating.
26 To mechanically couple two or more components together to permit operation from a single knob.
27 Early term for current resulting from chemical action.
28 A hard, metallic chemical element resistant to corrosion.
29 The smallest quantity possible or permissable.
30 Pertaining to an 11 pin base or socket for a CRT.
31 Device for transforming incoherent light of various frequencies of vibration into a narrow, intense beam of coherent light.
32 A long-distance, low-frequency navigational system.

Any attempt to peek at the solution on page 66 will be considered shrewd, smart, canny, adept, wily, astute, and clever; especially if you don't know an answer.

symcure

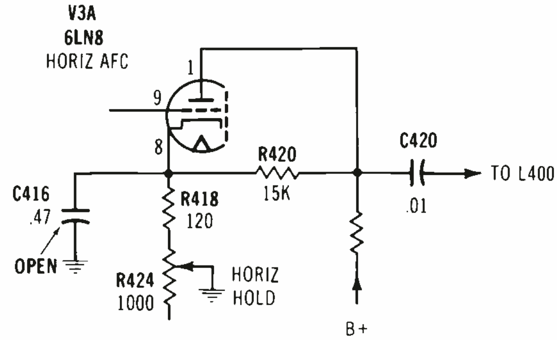
Symptoms and cures compiled from field reports of recurring troubles

Chassis—Sylvania E01
PHOTOFACT—1251-3



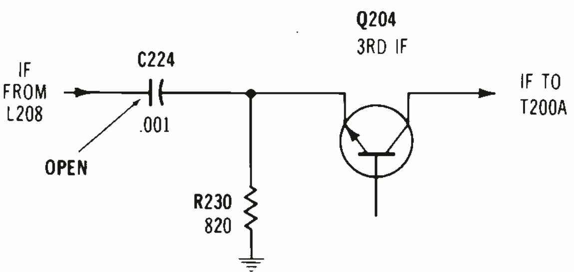
Symptom—Horizontal bending
Cure—Replace hum amplifier Q508, and check performance

Chassis—Sylvania D14
PHOTOFACT—1168-3



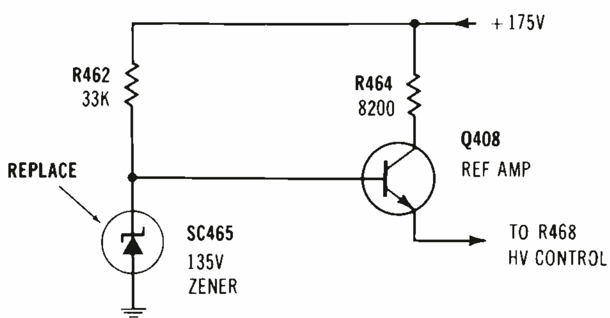
Symptom—Weave in picture, like bad filter
Cure—Check bypass C416, and replace it if open section is open

Chassis—Sylvania D14
PHOTOFACT—1168-3



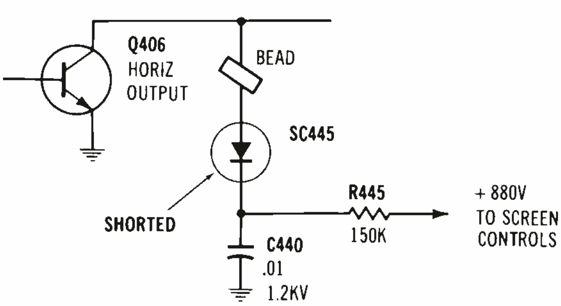
Symptom—No picture, acts like bad AGC
Cure—Check coupling capacitor C224, and replace it if open

Chassis—Sylvania EO4
PHOTOFACT—1425-3



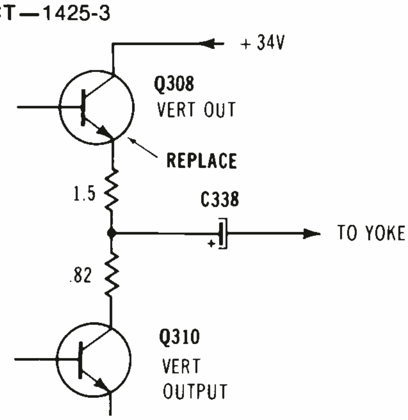
Symptom—Snow only on the right edge of the picture
Cure—As a test, replace SC465 zener, and check performance

Chassis—**Sylvania E03**
PHOTOFACT—**1414-3**



Symptom—Low brightness, looks like bad CRT
Cure—Check SC445 boost rectifier, and replace it if shorted

Chassis—Sylvania E04
PHOTOFACT—1425-3



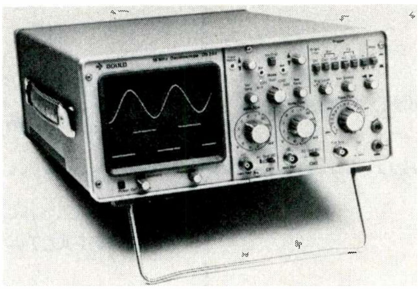
Symptom—On UHF, a bar of interference is at top of the picture
Cure—As a test, replace Q308 vertical output, and check performance

test equipment report

15-MHz Dual-Trace Scope

A compact, portable, 15-MHz dual-trace/X-Y scope, model OS255, has been added to the line of **Gould Instruments Division.**

The OS255 uses 8- x 10-cm rectangular CRT, 2 mV/cm vertical sensitivity over the full bandwidth, and time-base speeds to 500 nanoseconds, plus a 5X-Expand button. In the TV mode, an active sync separator automatically selects line or field triggering according to the time base chosen.



Additional features of the OS255 are: the sum-and-difference displays; switched X-Y displays; a 1-volt, 1-kHz square wave calibrate output; a 4-volt positive ramp output; and a 1-volt Z-mod input, useful in handling logic-analyzer outputs.

Price for the Gould OS255 scope is $795, including probes.

Circle (35) on Reply Card

Dual-Trace Miniscope

Model MS-215 from **Non-Linear Systems** is a dual-trace, 15-MHz scope that is battery or line operated, and weighs only three pounds. Chopped and alternate dual-trace sweep modes are included, as well as provisions for internal and external sync. The time-base controls provide 21 settings from 0.1 microseconds-per-division to 0.5 seconds-per-division. There are 12 vertical gain settings for each channel, providing a range from 0.01 to 50 volts-per-division.

Size is 2.9"x6.4"x8".

The MS-215 is furnished with two input cables, battery charger and rechargeable batteries.

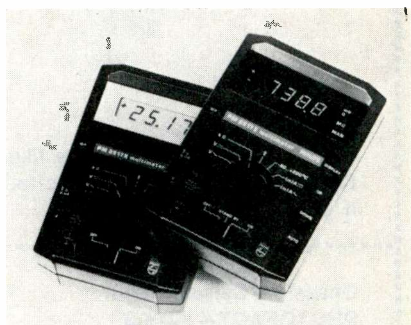
Options include a leather carrying case with neck strap and belt loop, for hands-free operation, and a 10-to-1 10-Megohm probe.

Price of MS-215 scope is $395.

Circle (36) on Reply Card

Four-digit Multimeters

Two new model PM2517 multimeters with four-digit readouts and .01% resolution have been introduced by **Philips Test & Measuring Instruments**.



These multimeters are available with a choice of LED or LCD readouts, and have both manual and automatic ranging. They also provide true-RMS measurements for AC signals, are protected against overloading on all ranges, and have a current range up to 10 amperes.

With an optional probe the Philips PM2517 multimeter can measure temperature from -60 degrees C to +200 degrees C. Another option, the data hold, permits measurement data to be frozen.

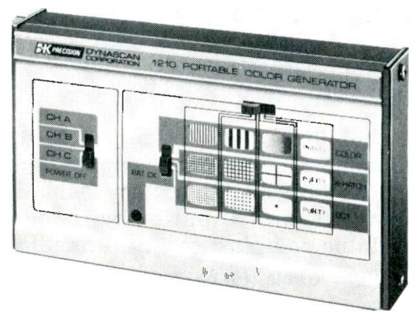
These multimeters run on four standard 1.5 V dry cells for 200 to 300 hours. Rechargeable batteries or an external line adapter also can be accommodated.

The Philips PM2517 multimeter sells for $295. The optional temperature probe, PM9248, is priced at $80.

Circle (37) on Reply Card

Color Pattern Generator

B&K-Precision offers model 1210 portable IC color pattern generator which has 10 stable patterns, including those required for static and dynamic convergence of any color TV. Other patterns include crosshatch, gated and ungated rainbow, and purity. Video, color and sync signals are synchronized to a crystal-controlled master oscillator for stable, jitter-free patterns. A color-level control is included.



Five different output channels can be selected. A front panel battery-check indicator lamp shows when the battery should be replaced.

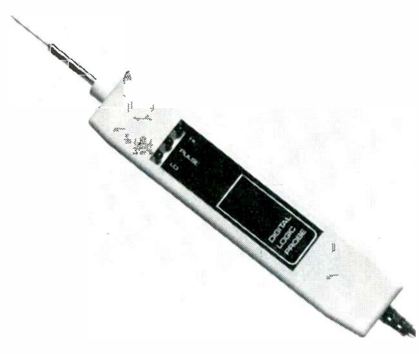
Price of model 1210 is $97.50.

Circle (38) on Reply Card

Probe Kit

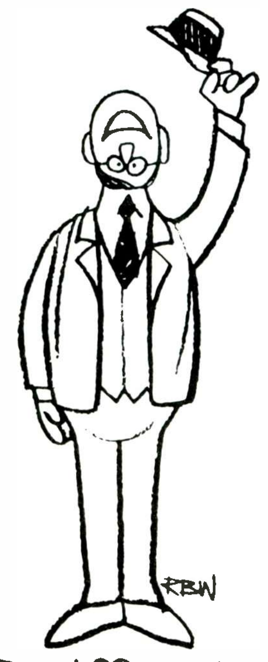
Continental Specialties Corporation introduces the LPK-1 logic probe kit which sells for $19.95.

The new probe features: separately-driven high, low and pulse indicator LEDs; .3-Megohm input impedance; input overload protection; pulse stretching and indication for pulses as fast as 300 nanoseconds; and reverse-voltage protection.



Complete assembly instructions are included, as well as an owner's manual describing operation of the probe. ☐

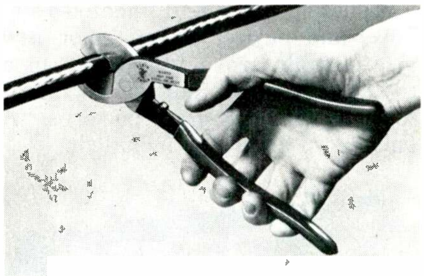
Circle (39) on Reply Card



productreport

High-leverage Cable Cutter

Klein Tools announces a handy cable cutter. High-leverage design of the 63050 gives it amazing cutting capability for its size. It's only 9½



inches long, but will cut up to 4/0 aluminum or 2/0 soft copper communication cable, battery cable or heavy rope. Supplied with comfortable red plastic-dipped handles.

Circle (40) on Reply Card

Video Camera

A lightweight modular video camera, designed for use with all existing videotape and videocassette systems now on the market, has been introduced by **Akai America.**

The new model VC-8300 camera is a high resolution, monochrome video camera of modular design. The basic camera includes a 16mm lens, attached to the unit by a universal C-mount, permitting the user to utilize a variety of lenses. An 8:1 zoom lens (11.5 to 90mm) is offered by Akai as an option.

An optical viewfinder is included with the basic VC-8300, but the camera's modular design permits changing to an electronic viewfinder if desired.

Weighing only 1.75 pounds, the camera is said to be the lightest unit available in the U.S. It carries a suggested retail price of $393.

Circle (53) on Reply Card

Powered Breadboard Kit

Continental Specialties Corporation offers model PB-203A solderless breadboard as the model 203-AK Proto Board Kit.

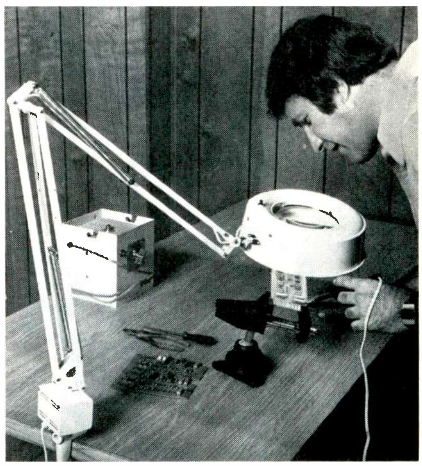
The three on-board voltage supplies deliver 5 VDC (with 1% regulation at 1 amp) and separately-adjustable plus and minus 15 VDC at ½ ampere. All parts are furnished, and assembly is easy.

Price of model 203-AK kit is $99.95.

Circle (41) on Reply Card

Magnifier lamp

A 3-dioptor magnifier with a circular 22-watt fluorescent lamp is offered by **Dremel Manufacturing Company**, a division of Emerson Electric. Tension adjustments are provided at all pivot points on the 45-inch reach, 360-degrees rotatable pivot arms.



Suggested retail price of the Dremelite model 1320 is $79.95.

Circle (42) on Reply Card

Aerosol Dust Remover

Projector Recorder Belt has introduced Dust-Away for removing dust, lint or other foreign particles from any delicate surface.

Dust-Away is a safe, nontoxic, nonflammable aerosol gas and includes an extension tube for hard-to-reach places. About 21 to 25 minutes of one-second blasts can be expected per container.

The cost is $1.55 per 10-ounce can.

Circle (43) on Reply Card

Thread-locking Adhesive

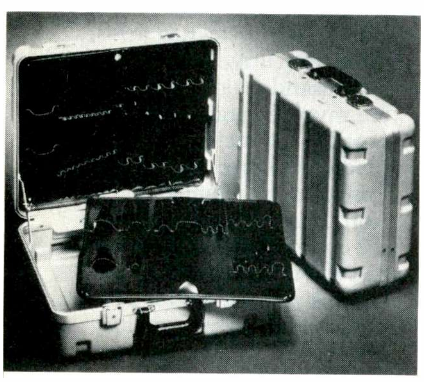
Master Bond has introduced a versatile single-component polymer adhesive called GP14, for thread locking, bonding and sealing metal

fasteners and rigid assemblies of all types. It cures readily at room temperature, only in contact with metal surfaces, and has low shrinkage upon cure.

Circle (44) on Reply Card

Field Tool Case

A new two-pallet tool case designed by **Jensen Tools and Alloys** for the traveling field engineer is made of high-density but lightweight polyethylene. The permanent gray color won't fade, chip or rub-off.



Other features include a full-length piano hinge, a tongue-and-groove aluminum closure, chrome-plated latches, a leatherette handle, two removable tool pallets, document pouch and two keys. Inside dimensions of the case are 17¾" x 14½" x 6¼".

The case sells for $110 in single quantities.

Circle (45) on Reply Card

Tool Organizer

This **Platt** pallet is molded of tough urethane and holds a large selection of small tools. It is made in one piece, without stitches, seams, flaps, or rivets. The organizer has a five-year guarantee.

Circle (46) on Reply Card

Circuit Board Protective Coating

Multicore Solders has introduced PC-52, a protective coating for application to PC Boards after soldering. This coating will protect the circuit and soldered joints from finger acids, atmospheric oxidation and extreme humidity.

Multicore PC 52 is applied by spraying or brushing. It easily can be soldered through, should modifications or repairs be necessary at a later date.

Circle (47) on Reply Card

High Voltage Multipliers

Thordarson Meissner offers a complete new line of high-voltage multipliers for service repairs. All of the items are exact replacements that previously were said to be available only from original equipment manufacturers. There are 21 catalog numbers in this Tech-Mate line. Each high-voltage multiplier package contains clear technical information.

Circle (48) on Reply Card

Catalog Tool Case

Platt's catalog tool case is a new way to carry and store large numbers of tools and parts conveniently. Inside the case with the molded pallet are three sections for Platt's tool pallets and a 3-level tool and parts tray.

Circle (49) on Reply Card □

Solution to:

BRAIN STRAIN?

1 HalatioN	17 RollS
2 NicK	18 SockeT
3 KickbacK	19 ThermaL
4 KelviN	20 LamP
5 NumbeR	21 PuncH
6 RetaiL	22 HydrometeR
7 LumeN	23 RacK
8 NavigatioN	24 KilO
9 NominaL	25 OverhanG
10 LoggeR	26 GanG
11 ReversaL	27 GalvaniC
12 LugS	28 ChromiuM
13 StatohM	29 MinimuM
14 MnemoniC	30 MagnaL
15 CassettE	31 LaseR
16 EtheR	32 Radux

Your rating:

Start with 128 points and deduct 4 points for any part you may not have answered correctly.

60 - 72 Passable.
76 - 84 Prime.
88 - 96 Proficient.
100 - 124 Super-duper
128 PERFECT! You've been awarded our First Annual Imaginary Trophy!

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Phone: 502-0656

audio systems

Private Intercom

Intercom master stations of the new IP Series by **Bogen** lock out eavesdroppers and interruptions for complete master-to-master privacy. Each can answer hands-free when called by another master, and can have a separate line to its own remote station for a secretary or assistant.

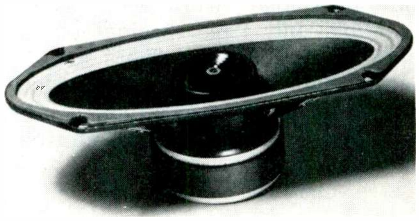
Lighted LEDs indicate to all other masters when the main talk path is busy.

The IP Series has two master models. IP-11 allows up to 11 masters, or 10 masters where each has a dedicated remote. The IP-6 allows up to six masters in a system, or five masters and their dedicated remotes. They can be wired into a public address system for paging.

Circle (50) on Reply Card

20-Ounce Magnet Speakers

Acoustic Fiber Sound Systems (AFS) now offers its popular 4 x 10 and 5¼-inch coaxial speakers with 20-ounce magnets.



The 4 X 10 model 8072 speakers are for installation behind the back seat on the rear deck, and the 5¼-inch model 8272 round size is among the most popular for mounting in the front door of a car, truck, van or recreational vehicle. Both are rated at 30-watts.

Circle (51) on Reply Card

catalogs literature

70. GTE Sylvania—ECG212H-2, the 20-page supplement to the 1978 Sylvania ECG Semiconductor Master Replacement Guide, supersedes one published earlier this year and contains information on 31 new ECG devices. Approximately 3,500 industry part numbers also have been added to the cross-reference section, and separate listings give recommended changes in ECG replacements and deletions from the line. The Sylvania ECG line contains more than 2,000 solid-state devices, which are cross-referenced to more than 142,000 foreign and domestic part numbers.

71. Heath—A 96-page catalog describing the latest in electronic kits is now available from the Heath Company. Product categories for the kit builder include: amateur radio; color television; high-fidelity components; test instruments; digital clocks; weather instruments; personal-computer systems; auto, marine and aircraft accessories; and other products for home improvement and family entertainment.

72. Kole Enterprises—An 84-page color catalog incorporates "Manufacturer-to-User" quantity discounts on sorting, filing, retrieval systems and mailing/shipping cartons and supplies.

74. Radio Shack—A new 1979, 176-page catalog includes 112 full-color pages describing the latest in electronic items, parts and accessories.

77. Vaco—SD-268, a new merchandising-idea catalog is available from Vaco Products. It contains full-color illustrations and descriptions of Vaco's merchandising displays for screwdrivers, nutdrivers, pliers, wrenches, measuring tapes, fasteners and solderless terminals. In addition, the SD-268 catalog contains a full description of Vaco's expanded line of super cases, the new super tool set, empty tool cases and several pouched tool kits.

advertisers' index

themarketplace

Advertising rates in the Classified Section are 35 cents per word, each insertion, and must be accompanied by cash to insure publication.

Each initial or abbreviation counts a full word.

Minimum classified charge $3.00.

For ads on which replies are sent to us for forwarding (blind ads), there is an additional charge of $3.00 per insertion to cover department number, processing of replies, and mailing costs.

Classified columns are not open to advertising of any products regularly produced by manufacturers unless used and no longer owned by the manufacturer or a distributor.

For Sale

REPLACEMENT COLOR YOKES-DEALERS ONLY. Zenith 95-2501-2532-2638-2667-S-89633 etc. 16.95, Magnavox 361380-1 18.95, Sylvania, GE etc. 14.95 to 19.95. Request for price list on your Letterhead. David Sims Enterprises, Inc., 665 Jericho Turnpike, Huntington Station, N.Y. 11746. 12-76-tf

TV & RADIO TUBES 36c EA!! Free color catalog. Cornell, 4221 University, San Diego, California 92105. 8-76-tf

ELECTRONIC SURPLUS, CLOSEOUTS, LIQUIDATIONS! Parts, equipment stereo, industrial, educational. Amazing values! Fascinating items unavailable in stores or catalogs anywhere. Unusual FREE catalog. ETCO-011, Box 762, Plattsburgh, N.Y. 12901. 6-78-tf

MOVING TO FLORIDA? TV SERVICE AND RENTAL BUSINESS FOR SALE ON FLORIDA'S WEST COAST. DOING $40,000-$50,000 PER YEAR. ALL REASONABLE OFFERS CONSIDERED, ALSO BUILDING AVAILABLE. CONTACT: MR. SOTHERN, 1-813-535-2026 AFTER 7 PM OR WRITE: 1834 SUNRISE BLVD., CLEARWATER, FLORIDA 33520. 9-78-tf

TUBES-RECEIVING, Industrial and Semiconductors Factory Boxed. Free price sheet including TV, Radio and audio parts list. Low, low prices. Transleteronic, Inc., 1365 39th St., Brooklyn, New York 11218. Telephone: (212) 633-2800. Toll free: 800-221-5802. 5-78-12t

TUNER SUB, $19.95, wired, tested, complete with batteries and ready to use on tube or transistor sets. Tunes all VHF channels. This unit is without knobs or cabinet but very compact with no wires or controls dangling. Easy to use, simply connect set's coax to sub and view picture (instructions provided). Only $19.95 and we pay shipping or will ship C.O.D. ($1.85 C.O.D. charge). Phone Toll Free 1-800-433-7124. MASTER CHARGE and VISA accepted. This is not a gimmick. If not COMPLETELY satisfied, return within 10 days for full refund. TEXAS TUNER SUPPLY, 4210 N.E. 28th Street, Fort Worth, Texas 76117. 10-78-3t

SEEKING ORIGINAL JAPANESE TRANSISTORS, IC'S, FET AND DIODES FOR CB, TV AND STEREO REPAIR? See our full page ad in this issue for listing of parts and prices. Write or call TOLL FREE for our complete list and compare prices. FUJI-SVEA ENTERPRISE, Dept. ES, P.O. Box 40325, Cincinnati, OH 45240. Nationwide: (800) 543-1607. Ohio: (800) 582-1630. 8-78-4t

For Sale (Cont.)

COMPLETE COLOR B/W PICTURE TUBE Rebuilding Equipment, never used. Phone (212) 387-2744. 616 Grand St., Brooklyn, N.Y. 11211. 10-78-2t

ELECTRONIC TECHNICIAN/DEALER 1966-1978, PF Reporter/Electronic Servicing 1965-1978. $35 each or best offer, plus freight. Moraga TV, 1480 Moraga Rd., Moraga, CA 94556. 10-78-2t

R.C.A. T.V. & STEREO Sales & Service. Well established 70K Gross & Growing Northern California Retirement Community. Electronic Servicing, Dept. 518, P.O. Box 12901, Overland Park, KS 66212. 8-78-3t

GOING OUT OF BUSINESS: Sams Photofacts #1 through #1200 in the cabinets, for only $900. You pay shipping. (201) 887-0750. 10-78-1t

TUNER CLEANING PADS. Stick-on backing foam not lubricated. TRIAL PACKAGE 5/$1.25 Postpaid. TUNCO, DEPT. A, P.O. BOX 4381, SCOTTSBURG, IN 47170. 10-78-1t

EQUIPMENT AND STOCK for a Radio & Television Repair Shop, $2500. Will accept best offer. Contact Mrs. Robert Relue, 505 E. Second St., Defiance, Ohio 43512. 10-78-1t

TV AND APPLIANCE BUSINESS for sale. RCA, Whirlpool, Roper and Amana dealer. Established and grossing $100,000 in a friendly, progressive town in northern part of Indiana. Owner made enough to retire. Electronic Servicing, Dept. 519, P.O. Box 12901, Overland Park, KS 66212. 10-78-1t

BOSTON'S MOST REPUTABLE service shop. Four complete benches—servicing stereo and TV. Gross of $80,000. Asking $20,000. Test equipment and stock alone worth this. Call 617-566-8358 Days. 10-78-1t

Help Wanted

ELECTRONIC TECHNICIANS—MOTOROLA, leader in two-way radio communication, presently has openings throughout the U.S. for technicians and supervisors experienced in the installation and maintenance of communications systems (two-way, paging, microwave and CCTV). If interested in good salary and excellent fringe benefits send your resume and geographical preference to: BOB CLENDENIN, MOTOROLA, COMMUNICATIONS & ELECTRONICS, INC., 1821 N. Office Square, Room 200C, Schaumburg, IL 60196. Equal employment opportunity/affirmative action employer. 7-78-3t

EARNINGS OVER $20,000 YEARLY to top outside technicians. Qualifications: 15 years experience, absolute honesty, non-drinker, non-smoker. Benefits: group hospital plan, paid vacations, reimbursement for moving, excellent area to raise families, outdoor sports paradise. Send resume to American Television, 1032 South State, Orem, Utah 84057. 10-78-4t

ELECTRONIC TECHNICIANS—MOTOROLA, leader in two-way radio communication, presently has openings throughout the U.S. for technicians and supervisors experienced in the installation and maintenance of communications systems (two-way, paging, microwave and CCTV). If interested in good salary and excellent fringe benefits send your resume and geographical preference to: BOB CLENDENIN, MOTOROLA, COMMUNICATIONS & ELECTRONICS, INC., 1821 N. Office Square, Room 200C, Schaumburg, IL 60196. Equal employment opportunity/affirmative action employer. 10-78-3t

TUNER TECHNICIAN NEEDED to live in Dallas, Texas. $7.00 per hour starting wage. Call toll free 1-800-433-7124. 10-78-2t

Professionals Accredited

PROFESSIONAL BACHELOR DEGREE...earned with 4 or more years of Electronic Business Management, Sales, or Servicing Experience. For FREE information write: EBERT PROFESSIONALS INSTITUTE, Box 1651, Dept. R., Columbia, Missouri 62501. 5-78-6t

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NO WAITING! Ads in by Wednesday airmailed Friday. Results possible by Monday! Just 20 cents a word! Receive next 5 issues $2. Subscribe 24 issues $7.50, get one ad free! "Electronics Trader" ad sheets, Box 73-ES, Folly Beach, SC 29439. 10-78-1t

Education-Instruction

REPAIR TV TUNERS—High Earnings. Complete Course Details, 12 Repair Tricks, Many Plans, Two Lessons, all for $2. Refundable. Frank Bocek, Box 3236 Enterprise, Redding, Calif. 96001. 8-76-tf

ADD $12 TO $25 AN HOUR to your business income by installing and servicing CB transceivers and antennas. To find out how you can cash in on this additional income, call us toll free at 1-800-654-6785 and ask for details on Section 2 and 3 of our repair course, or write: CB Radio Repair Course, 531 N. Ann Arbor, Dept. ES-098, Oklahoma City, OK 73127. 9-78-3t

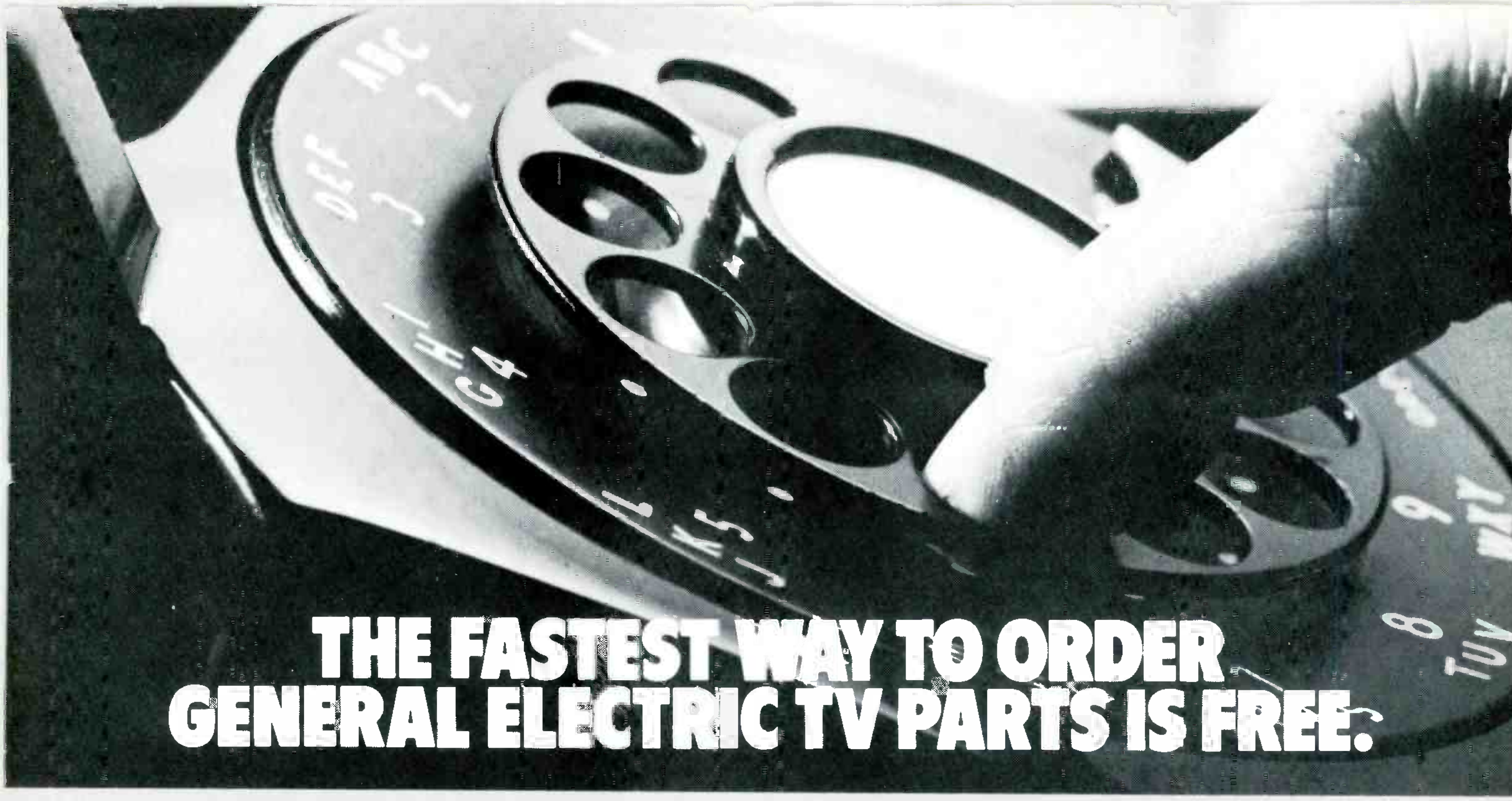
Business Opportunity

MECHANICALLY INCLINED INDIVIDUALS—BUILD ELECTRONIC DEVICES IN YOUR HOME. GET STARTED IN YOUR SPARE TIME. $300 TO $600/WK POSSIBLE. EXPERIENCE NOT NECESSARY. WRITE FOR FREE LITERATURE. ELECTRONIC DEVELOPMENT LAB., BOX 1535A, PINELLAS PARK, FLA., 33565. 8-78-tf

TV SHOPS: Increased profits with **NO INCREASED** overhead. Patented system. Send $2.00. P.O. Box 809, Boynton Beach, Fla. 33435. 10-78-eom

C. B. SERVICES—Make extra income doing **LEGAL, HIGH PROFIT, HIGH DEMAND** modification. Works on all radios. "How to do it" Information packet, $9.50 Ppd. Larsen Electronics, P.O. Box 82152, Okla. City, Okla. 73148. 10-78-3t

TV SALES AND SERVICE, shopping center, suburb near San Francisco Bay, seven years. Completely equipped including late Dodge van. Excellent growth potential. Owner retiring. $18,000 buys lease and all. Principals only, no shoppers please. Mornings (415) 376-3796. 10-78-2t



General Electric has the magic number. A toll-free hotline connecting you directly with the GE Parts Center in most all areas. And the simple key to using it is charging your order to VISA, Master Charge or an approved GE Open Credit Account.

That's one way we're making your business easier. But it's not the only way. We're continuing to increase stocks throughout our national computer-linked parts distribution system. And striving to fill orders faster than ever before.

To make GE Performance Television even easier to service, we're packing a new Mini Manual into the back of every color set. It gives you the right schematic diagram, parts list, symptom repair information and safety features for the set you're working on. Which makes your job a lot easier.

For our list of toll-free numbers and everything you need to order GE TV parts fast fill out and send in the coupon below. **It's our business to make your business easier.**

ES-78

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Please send the following:
- ☐ Brochure covering GE toll-free ordering numbers.
- ☐ Listing of Parts Distributors.
- ☐ Master Charge and VISA information.
- ☐ GE Open Credit Account information.

Name ____________________

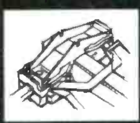
Service Company ____________________

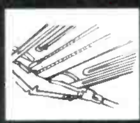
Address ____________________

City ____________ State ____________ Zip ____________

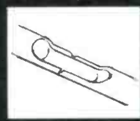
GENERAL ELECTRIC

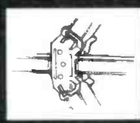
Zenith's full line of antennas, featuring CHROMATENNA II T.M. with 18 ways you can count on for optimum picture quality!

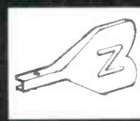

Transmission Line Termination bleeds off static charges thru antenna system ground. Terminal stub improves front to back ratio on lower channels.


Aluminum Construction of all key metal parts works to eliminate rusting—provides long life. **Golden-Color Alodine Finish** is conductive—helps improve electrical performance!

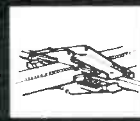

High-Impact Plastic Insulators double-lock each element to the boom for extra bracing and durability.

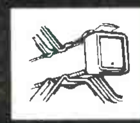

FM Block reduces FM gain up to 12dB. Remove to receive full FM gain.

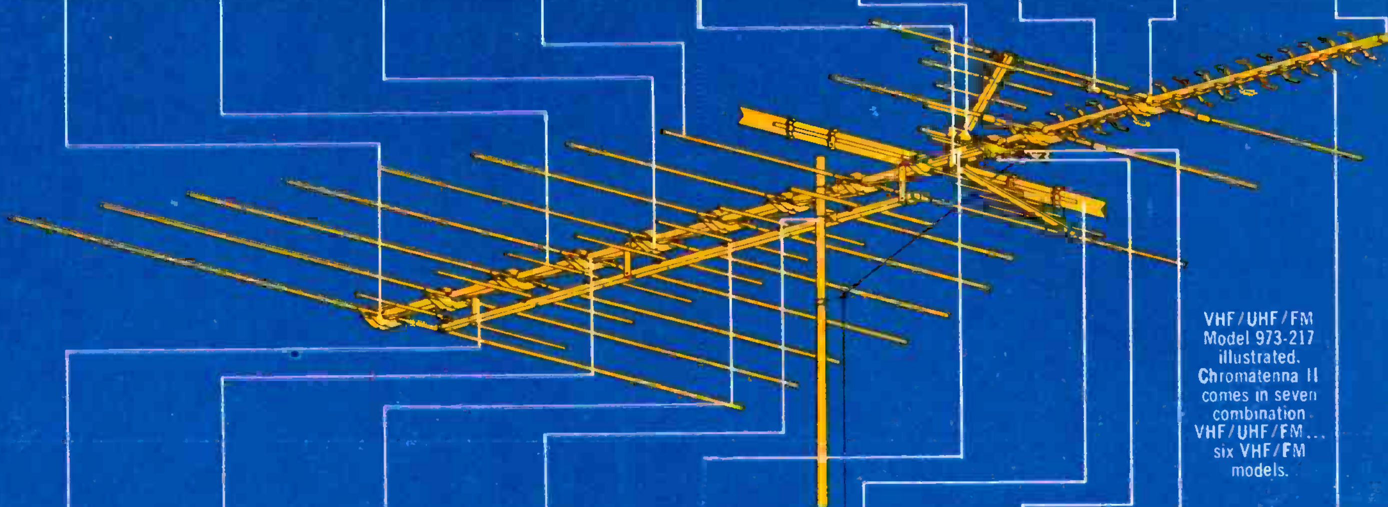

Corner Reflector Bracket improved with larger tabs. (Combination models only.)


Zenith Dipole on UHF. (Combination models only.)

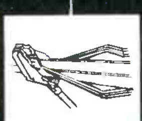

VHF Colinear Directors provide extra signal boost on both low and high band VHF.

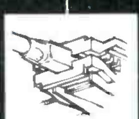

Loading Straps—metal plates close to first VHF element insulators provide compensation for Lo and High band by tuning the first driven element with extra capacity.

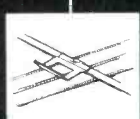

Rugged 1" Square Boom provides extra strength compared to many round-type booms.

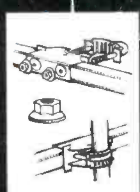


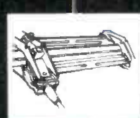
VHF/UHF/FM Model 973-217 illustrated. Chromatenna II comes in seven combination VHF/UHF/FM... six VHF/FM models.


Wide-Spaced, Heavy-Duty Feed Lines help prevent shorting from heavy build-ups of snow or ice.

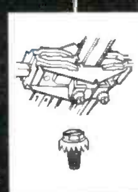

Sleeved Elements of heavy-duty construction afford extra bracing and protection.


Hi-Bracket with angled ends for added strength.

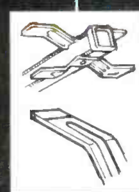

U-Bolt Mounting provides a larger clamping area; larger locking nut with teeth an integral part assures a more rugged U-BOLT arrangement.


Dual Isolator Bars insure no loss of UHF to VHF signal transfer. (Combination models only.)


Proximity Spaced Signal Balancer (Z elements) provides automatic taper control of periodic driver, improves impedance matching and signal leveling on both Lo and High band channels. Improves Channel 7 pattern.


Electrically Matched Terminals With Stainless Steel Screws eliminate mismatch... protect against rusting, and provide positive electrical contact with improved no-strip stainless steel serrated washers for the take off terminals.


Strain Relief Insulator accommodates either 300-OHM twin-lead, Foam lead or Coax download.


Optional Break-away UHF Wing Directors provide maximum gain of standard UHF channels with optional coverage of Hi UHF channels and translator frequencies when broken off. (Combination models only.)

Zenith has quality do-it-yourself antenna kits—UHF only, VHF YAGI and Stereo FM antennas as well as a complete line of reception aid equipment.

ZENITH

The quality goes in before the name goes on®

Zenith Radio Corporation / Service, Parts & Accessories Division / 11000 Seymour Avenue / Franklin Park, Illinois 60131

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