

September, 1978 □ \$2.25

Electronic Servicing



A HOWARD W. SAM'S PUBLICATION

Programming digital counters

"Selling" fair labor rates

Betamax servo systems

Servicing 13" GE color TV



Electronic Servicing

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About the Cover—This issue features the first in a series of articles by Gill Grieshaber on General Electric's 13-inch portable color television. The cover design features the major components and systems of the AA-D chassis. (Design by Anita Blattner)

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ELECTRONIC SERVICING

electronicscanner

news of the industry

Ray Yeranko, the Magnavox Director Of Service And Consumer Affairs, retired August 31 after 44 years with the company. Ray has been active in national service organizations, and you might have met him at a NARDA, NESDA, or NATESA convention.

Robert A. (Bob) Villont of Tacoma, Washington, was elected president of NESDA and Jesse Leach became the chairman of ISCET during the combined NESDA and ISCET convention in Portland, Oregon this August. These conventions will be reported in more detail next month.

Most television prices will go up this fall. RCA has announced price increases from \$10 to \$50 above present retail prices. Suggested list prices of Zenith TVs will be increased between \$10 and \$30.

Sharp is scheduled to increase prices of its entire 1979 TV line by 3% to 5%, according to Retail Home Furnishings. Also, it is reported that Zenith will offer rebates ranging between \$40 and \$60 on all 25" consoles through September and October.

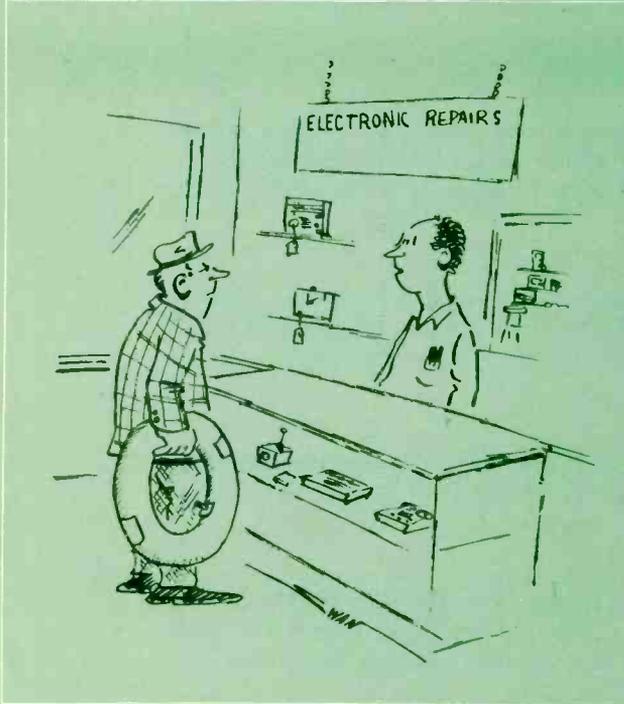
BJA Systems has developed an artist-directed electronic method of adding full color to black-and-white movie films. This was the way color was added to certain scenes of the mini-series about the life of Martin Luther King, which was viewed on TV last February. The process will be used to add color to actual black-and-white film clips of the dramatization *Ike*, to be seen later on ABC.

In the United States, there are 59 TV sets, 71 telephones, and 52 cars for every 100 Americans. In contrast, citizens of the Soviet Union have 19 TV receivers, 7 telephones and about 2 cars per 100 Russians.

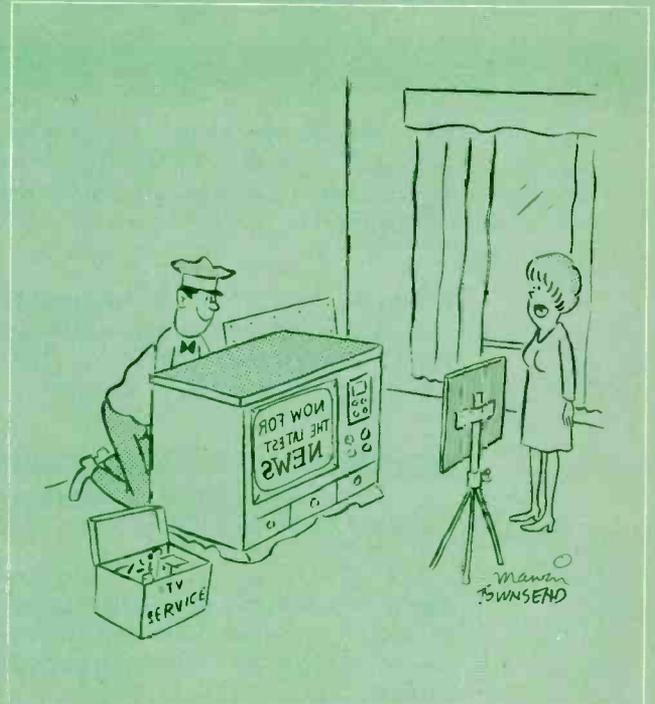
Home videotape recorder sales to dealers were 20,852 units in July, 1978, and 163,352 units in the 30 weeks of this year. Comparable figures are not available for 1977. Color TV sales in the first 30 weeks of 1978 were 5,246,482 units, an increase of 17.9% over units sold in the comparable period a year ago, according to the EIA.

Tektronix has established a nationwide distributor network for the sales and servicing of the 12 models in the Teleequipment line, including six new Teleequipment scopes. Teleequipment products are made by a Tektronix subsidiary in England, and generally sell for a lower price than similar Tektronix models. The local distributors offer warranty repair-and-calibration services.

CARTOON CORNER



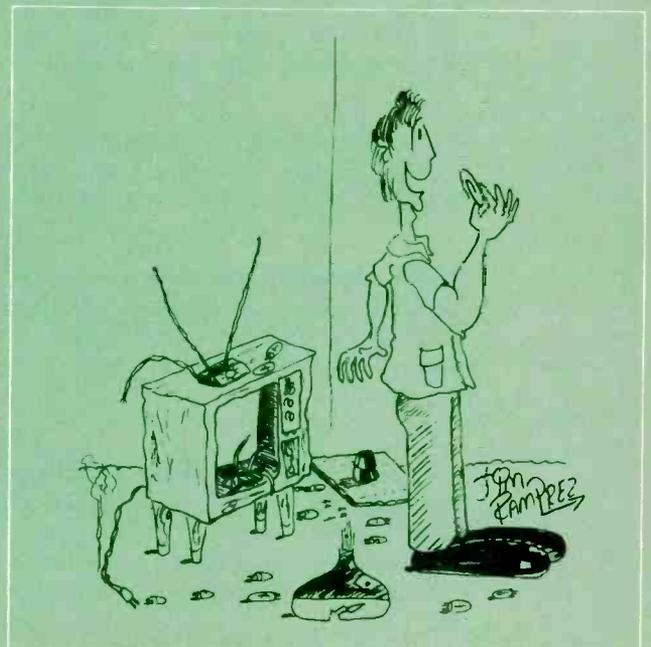
When you called about a bad tube, I naturally assumed...



It's very clear sir. But I'm afraid I have some bad news for you.



Couldn't find a 47,000 ohm resistor, but I found 47 one-thousand-ohm ones.



It's alright, honey. It was only a paperclip!

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*.

For Sale: Three hundred electronic tubes (retail value \$1596.75) for \$450. List of tubes furnished on request. City Radio & TV, 205 North Donley, Tulsa, Texas 79088.

For Sale: Hickok transistor tester model 220, \$215; RCA VTVM model WV-98C, \$65; Sencore CRT tester model CR-143, \$50; Eico tube-and-transistor tester model 667, \$110; Heath transistor tester model JT-121, \$40; Sencore SM-152 sweep and marker generator, \$240. Mario Rosignuolo, 368 South Hill Boulevard, Daly City, California 94112.

Needed: Horizontal oscillator coil (L-251) for Bradford 19-inch color TV, model 1171B22 (WTG-53421). Bradford part number EP35X2. Richard T. Baker, USS Horne CG-30, FPO San Francisco, California 96601.

Needed: FM third-IF transformer for Midwest radio (chassis RTG-16, Photofact 45-15), or used chassis for parts. Write a description. Art Glauner, 108 Carey, Deerfield, Michigan 49238.

For Sale: Eico 753 ham transceiver with power supply (VFO has been rebuilt), best offer over \$75; and Heathkit HW202 2-meter 6-channel with touch tone pad mike, \$150. Kenneth Bullard, 107 Fulton Drive, Kings Mountain, North Carolina 28086.

Needed: Schematic and parts list for B&K-Precision 120 VOM. Will buy, or copy and return. Carl W. Higgins, 2242 South 85th East Avenue, Tulsa, Oklahoma 74129.

For Sale: Kleinschmidt teletype model TT-117/FG with reperforator/transmitter, Baudot code, used but working, \$100; Tektronix type CA dual-trace plug-in unit, \$150; M.H. Research R100B plus and minus 300-volt DC power supply, \$25; Locarte 3-amp 120-volt-DC power supply (not isolated from AC line), \$20; and T-18/ARC-5 transmitter, \$20. All items plus shipping. S. Lei, P.O. Box 5312, Fargo, North Dakota 58102.

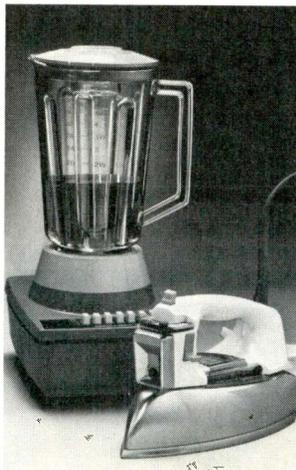
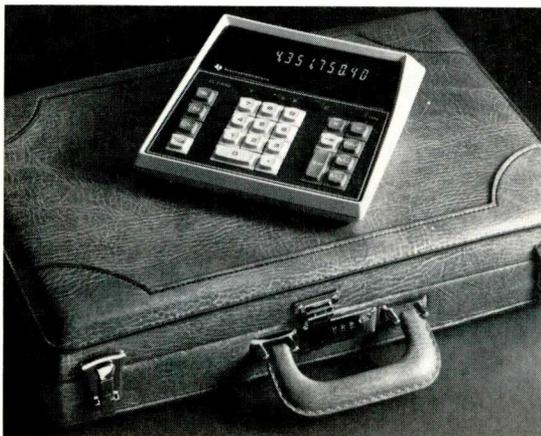
Needed: Used TV correspondence course (Bell & Howell, RCA, etc.), reasonably priced. R. Hoos, 19 Longmeadow Road, Yonkers, New York 10704.

For Sale: B&K-Precision Analyst model 1076, best offer over \$100; RCA Senior VoltOhmyst model WV98A, complete with high-voltage probe, \$75; and Simpson model 262 volt-ohm-milliammeter, \$25. William Araujo, 803 Orchard, Raynham, Massachusetts 02767.

Needed: Schematic and/or operating manual for Berkeley frequency counter "industrial" type, model 5608. Will buy, or copy and return. Dial tuning scale for 1940 Truetone console radio, 5-band, model



TOP DEAL



D-1175. State price. Schematic and/or service and operating manual for RCA scope, model 155-C. Will buy, or copy and return. Mike Nussman, 4174 Colonel Glenn Highway, Dayton, Ohio 45431

For Sale: Heathkit IO-4510 dual-trace triggered scope, one year old, lab calibrated by Heath, \$450. Heathkit IM-102 DMM, less than a year old, lab calibrated by Heath, \$200. Heathkit IG-5257 post-marker/sweep generator, lab calibrated, \$150. Heathkit IT-3121 semiconductor curve tracer, like new, \$75. Cecil F. Mott III, 222 Mobil-Land Court, Bloomington, Ill. 61701.

Needed: Adapter for model 650 B&K-Precision tube tester that allows the tube checker to test Compac-trons and other late tubes. Also, tube charts covering the testing of these tubes. Walter W. Ellett, 21040 Rainbow Drive, Cupertino, California 95014

For Sale: General Autronics K-115 RM rack-mounted scope DC-15 MHz with dual-trace plug-in; Knight KG-2000 5" scope with triggered-sweep; B&K-Precision 1077B TV Analyst; B&K 1076 TV Analyst; Heath IO-101 Vectorscope and color generator; B&K 1246 color generator; Heath RF-1 RF generator; RCA WR-36A dot-bar generator; Sencore CG-1 color-pattern generator; EICO Transistor tester model 680; EICO 261 AC VTVM and watt meter; and EICO 221 VTVM. Also "as is" for parts: RCA RF generator; and Dumont 5" scope model 248. Send self-addressed stamped envelope for information. Thomas Walls, 6360 Montgomery, Philadelphia, Pennsylvania 19151.

Needed: EICO model 685 transistor analyzer; digital multimeter for bench; dual-trace scope; signal tracer;

and B&K model 970 Analyst. Thomas Walls, 6360 Montgomery, Philadelphia, Pennsylvania 19151.

Needed: RCA service notes volumes 1923-1928, 1929-1930; Tektronix model 422 scope with manual and probes; AM/FM stereo receivers for parts. J. Allen Call, 1876 East 2990 South, Salt Lake City, Utah 84106.

Needed: Type 53, 7N7, 7F7, 7B7 and 117M7 tubes at reasonable prices. Also, want early RCA TT-5, TRK 5, 9, and 12 television sets and battery radios. Don Patterson, 636 Cambridge Road, Augusta, Georgia 30909.

For Sale: Obsolete radio tubes and Rider's Radio magazines. Have Rider's Radio manuals 8-10 and 16 without front and back covers to trade for two Rider's Radio manuals. Goodwin Radio Shop, care of Odd Fellows Nursing Home, Mattoon, Illinois 60960.

Needed: Schematic and other information for rebuilding the control panel of an army-surplus AC generator, that has a model B Briggs and Stratton engine (about 10 HP). Control panel has an AC voltmeter, a reed frequency meter, a DC ammeter, and two wire-wound rheostats, Martin Match, 21B Thorney Avenue, Huntington Station, New York 11746.

For Sale: REM Cathode-recovery unit and CRT checker, CRU-1; Leader color-bar generator model LCG-388; B&K-Precision DVM model 280 plus DR-21 Direct/100 K probe; Sencore model TC-28; and Mura VOM, all for \$685, plus shipping. Ray Duffy, Sound
continued on page 8

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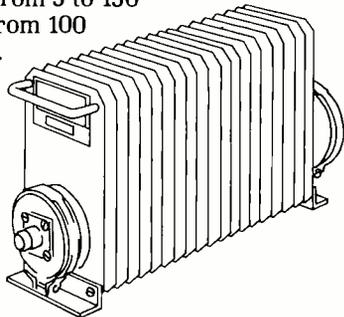
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reader's exchange

continued from page 7

Fair, 1821 NE 65th, Ft. Lauderdale, Florida 33308.

For Sale: All texts for MTI two-way radio course, without exams, unless requested, \$25, plus shipping. Charlie Perry, 1401 St. Johns Drive, El Paso, Texas 79903.

Needed: A B&K-Precision model 1077B television Analyst with cables, manual, and slides. Must be in good operating condition, and reasonably priced. Henry W. Price, 640 Cambrian Court, Sacramento, California 95825.

For Sale: EICO 369 sweep/marker generator, \$50; B&K-Precision 707 tube tester, \$60; Sencore RC-24 R/C subber, \$20; Sencore BE-156 bias supply, \$10; B&K HV Probe, \$15; B&K 1801 frequency counter, \$100; B&K 1230 color/dot bar, \$40; Simpson 432 color/dot bar, \$100; B&K 2050 RF generator, \$40; Stancor isolation transformer, \$20; EICO yoke and flyback checker, \$25; and B&K capacitor analyst, \$50, prices negotiable, you pay the freight. Terry's TV, 6738 State Route 303, Ravenna, Ohio 44266.

For Sale: Sams Photofact numbers 1 through 800. All or any one, \$1.00 each. Stuttard TV Service, 13 Tindall Drive, Clinton, New York, 13323.

Needed: Operating manual for B&K-Precision 1070 Analyzer. Bob's TV, 1822 Sun Valley Drive, Jefferson City, Missouri 65101.

For Sale: 39 copies of Electronic Servicing in like-new condition, May 1975 through July 1978. Best offer over \$39, plus postage. Will mail COD. W.F. Stroud, Box 1, Stinnett, Texas, 79083.

For Trade: One 510CTB22 color CRT for a 490BLB22 color CRT (both used); for sale, one oldie 24CP4A/TP/QP/ADP/VP/XP4 rebuilt B&W CRT, nearly new. Mike's Repair Service, M. B. Danish, P.O. Box 217, Aberdeen Proving Ground, Maryland 21005.

For Sale: Test-equipment manuals for many popular brands, such as RCA, Sencore, Hickok, B&K, Heath, H-P, Tektronix. Send self-addressed stamped envelope with your needs. Ron Jordan, 5277 Larchwood Drive, San Jose, California 95118.

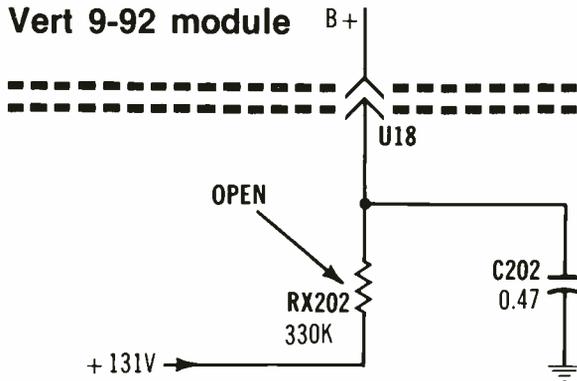
Needed: One flyback transformer TF-110 (manufacturer part number 701027-00) for Setchell Carlson TV model P66 and chassis, C106. State price. Arthur Blaha, 3855 W. 65th, Chicago, Illinois 60629.

For Sale: Garrard stereo record changer model RC120, old model but never used, in original carton, \$12; Precision multi-bias supply model 230; remote control unit model 9K1 for Fisher 400C; storage battery model BB54. Al Crispo, 159-30 90th Street, Howard Beach, New York 11414.

Needed: A new or good-used vertical transformer for a 17J27 Philco TV chassis. State price and air shipping charges. Jorge F. Vargas B., Apartado #9583, Guayaquil, Ecuador. □

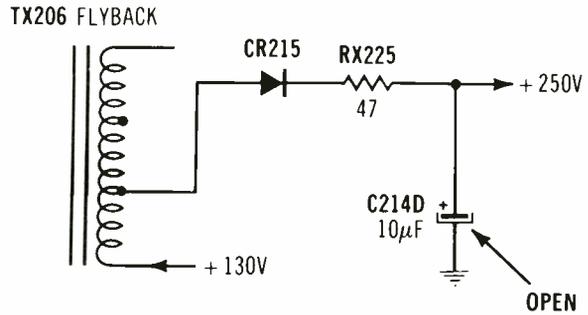
Chassis—Zenith 19HC48
PHOTOFACT—1621-2

Vert 9-92 module



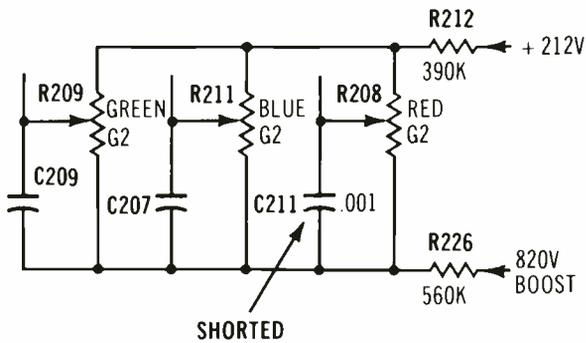
Symptom—No brightness, but HV is okay
Cure—Check resistor RX202, and replace it if open

Chassis—Zenith 23HC50
PHOTOFACT—1639-2



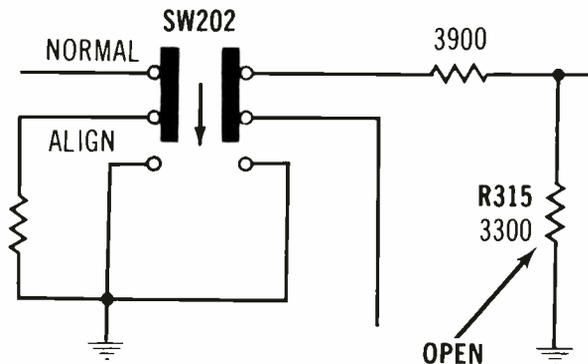
Symptom—Left third of picture is darker
Cure—Check filter CX214, and replace it if "D" section is open

Chassis—Zenith 23HC45
PHOTOFACT—1637-2



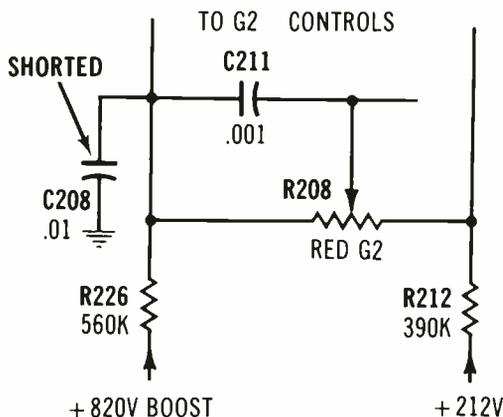
Symptom—Can't adjust proper gray scale
Cure—Check capacitor C211, and replace it if shorted

Chassis—Zenith 25EC58
PHOTOFACT—1370-2



Symptom—Color slightly smeared, and color locking is loose on weak signals
Cure—Check resistor R215, and replace it if open

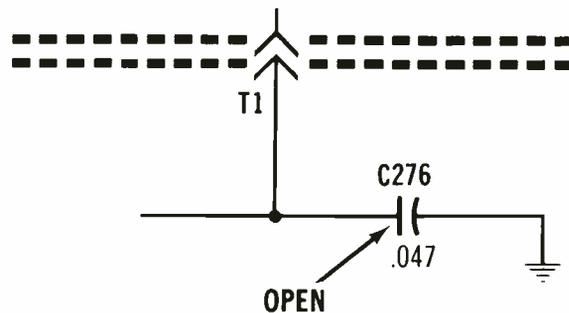
Chassis—Zenith 23HC45
PHOTOFACT—1637-2



Symptom—Picture smears at high brightness
Cure—Check capacitor C208, and replace it if shorted

Chassis—Zenith 25EC58
PHOTOFACT—1370-2

Subcarrier regenerator 9-27 module

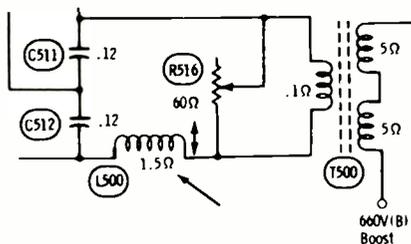


Symptom—Poor color locking
Cure—Check capacitor C276, and replace it if open

troubleshootingtips

Breaker trips; TV is dead Motorola Quasar TS929 (Photofact 1240-1)

This Motorola twice went dead and tripped the breaker. New horizontal tubes didn't help, and an examination of the horizontal-output stage showed the cathode fuse was open. A current meter connected across the open fuse read about 600 milliamperes, and there was no B-boost or high voltage.



As one test of the flyback, I disconnected the wires from terminal 6, and the boost and HV were about normal. But, after I replaced the flyback, the boost was too high (+1500 volts) and the HV was about zero. (With the old flyback, neither boost nor HV were there.)

I tried a test yoke, and the voltages were normal. Just as I was about to condemn the yoke, I noticed that the center wire of the yoke was tied into the pincushion-phase coil. With this lead disconnected (and other yoke wires replaced), the voltages were okay.

After I replaced the pincushion-phase coil and adjusted the high voltage, the performance was good.

Evidently, the PC coil shorted first, and this damaged the flyback, drawing excessive current which blew the cathode fuse.

J. M. Thurston
Fort Wayne, Indiana

Frozen tape Sony VO-1600 VTR

When the machine was brought to the shop, the tape would not move inside it. My first look found about a half cassette of tape wound around the threading ring and pinch roller.

I cleaned the machine, and inserted another cassette, which promptly jammed and ruined the tape.

A careful examination revealed a wrong alignment of the pinch roller to the capstan (they should be perfectly parallel) and deformed tape guides on the threading ring. The tape was being forced off the track.

New threading-ring assembly and a pinch roller restored the smooth tape motion. Caution: follow the factory manual closely here. The cause of the problem was a lack of proper maintenance that allowed an accumulation of dust and dirt. So, advise your customers to have their machines cleaned and lubricated, and the belts checked at least once a year, whether used or not.

Julian D. Chitta
Corpus Christi, Texas

Loss of locking Zenith 25ED58 (Photofact 1370-2)

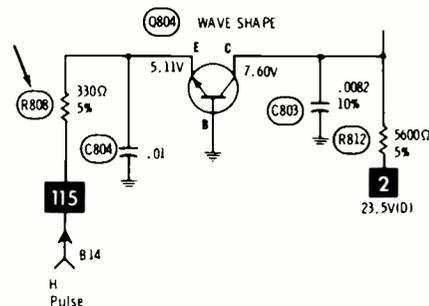
Adjustments of the vertical and horizontal hold controls couldn't lock the picture, although each would change its own scanning frequency.

First, I checked for sync pulses on the video at the A1 input of the video processor module. They were normal. Next, I checked the vertical and horizontal sync-output signals; both were okay.

When I scoped the vertical-sweep

circuit, the waveform at the base of vertical switch Q703 seemed wrong. Acting on a hunch, I adjusted the height and linearity controls for slight overscan with good linearity. Now the vertical would lock. Evidently, someone had tampered with the controls.

The horizontal locking problem was harder. Horizontal-sync pulses at terminal A1 were slightly weak, and the horizontal-sync pulses at terminal A1 were slightly weak, and the horizontal pulses at terminal B14 had more amplitude than usual.



I pulled the module and began checking all of the components. Among the last to be tested was R808, the 330-ohm resistor in the sawtooth-forming circuit. It was completely open, and a new one restored the horizontal locking.

This repair was more difficult because the symptoms pointed to a loss of both horizontal and vertical sync.

Don Hicke
San Diego, California

Editor's Note: Open R808 resistors have been reported several times, but the tip still is good.

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Circle (10) on Reply Card



Features and power circuits of GE AA chassis

Servicing GE 13" Color Portable, Part 1

By Gill Grieshaber, CET



The front panel of General Electric model 13AA9508W is uncluttered. At the top is a front-mounted speaker, below it are the detented and illuminated channel selectors, while the volume/on-off control and the "Color Monitor" indicator are at the bottom.



A neon bulb illuminates the "Color Monitor" indicator when the back-mounted switch is turned on.

Console TVs Versus Portables

None of the color receivers that were analyzed previously in the **Electronic Servicing** modular-TV series had a picture tube smaller than 19 inches. Also, most of the 19-inch information applied equally well to the 25-inch models of the same manufacturer. For several years, solid-state 17-inch and 19-inch portables usually had the same advanced features as consoles.

However, the smaller 10-inch and 13-inch color portables are becoming very popular. How different are they from the previous sizes? Do they have the high-performance circuits that give sharp stable pictures equalling those of large consoles? Or, have all refinements been stripped away by efforts of the manufacturers to reduce both size and price?

What about serviceability? In the past, smaller chassis and cabinets inevitably included inaccessible and crowded components, which sometimes were nightmares to service. Solid-state components allow reductions of chassis and circuit-board sizes. And, small-cabinet receivers make small dimensions necessary. Questions: will these reduced sizes multiply our problems, force us to buy miniature tools, and perhaps make us wish for smaller fingers to match the tiny wiring?

We can't answer those questions for other models and brands, but our coverage should answer them about the new 13-inch General Electric portable, as we examine the features, performance, and servicing of the AA-D chassis.

Features Of GE Model 13AA9508W

Several facts are given by the model number itself. The first two numbers show the picture-tube size; the following two letters indicate the chassis number; the next four numbers are the identification of this one model; and the W stands for a walnut-grained cabinet (made of high-impact plastic). Therefore, this portable has a 13-inch picture tube and an AA chassis.

Here are some important features of the AA-D GE chassis:

- one large module (plug-in circuit board) that contains most of the components;
- a color monitor system (with three transistors) which examines the red and blue signal levels and then corrects the color balance;
- Automatic Frequency Control (AFC);
- Automatic Chroma-level Control (ACC);
- DC restoration in the video;
- synchronous video demodulation;
- a transformer-isolated earphone jack;
- side pincushion correction;
- preset VHF fine tuning, and 70-detent UHF tuning; and
- a black matrix picture tube with three easy-to-converge in-line guns that illuminate vertical rectangles of color on the screen.

Many of these features and circuits will be analyzed during the series. (Not all AA chassis have the color-monitor module.)

continued on page 16

Lori Casper is typical of many youngsters who sweeten their homework by watching TV. Reduced sizes of the popular new small-screen color receivers allow them to be used in dining areas and bedrooms without crowding. Today's homes often have two, three, or four TVs.



General Electric

continued from page 14

Layout of The AA Chassis

Troubleshooting any television set is easier after you know where the boards and major components are located. Therefore, we are including several pictures that show many details of the color receiver.

Internal Service Data

Attached to the outside of the cabinet back is a black plastic box with "SERVICE INFORMATION INSIDE" stamped in raised black letters on it. Two mounting screws for the box are on the *inside* of the cabinet back. Therefore, the back must be removed *before* the service data can be obtained.

On both sides of a 34" by 10" sheet of paper (taken from the box), is printed an amazing amount of information. Here is a partial list: the normal amount of high voltage; AGC adjustment; AFC adjustment; gray-scale adjustments; APC (color locking) adjustments; safety data; two drawings explaining the convergence; locations of major components; three drawings giving the video and chroma paths on top of the module, the video paths and the B+ paths on the copper side; an 8-point test procedure to find the cause of a blown fuse; simplified drawings of the 60-Hz and the

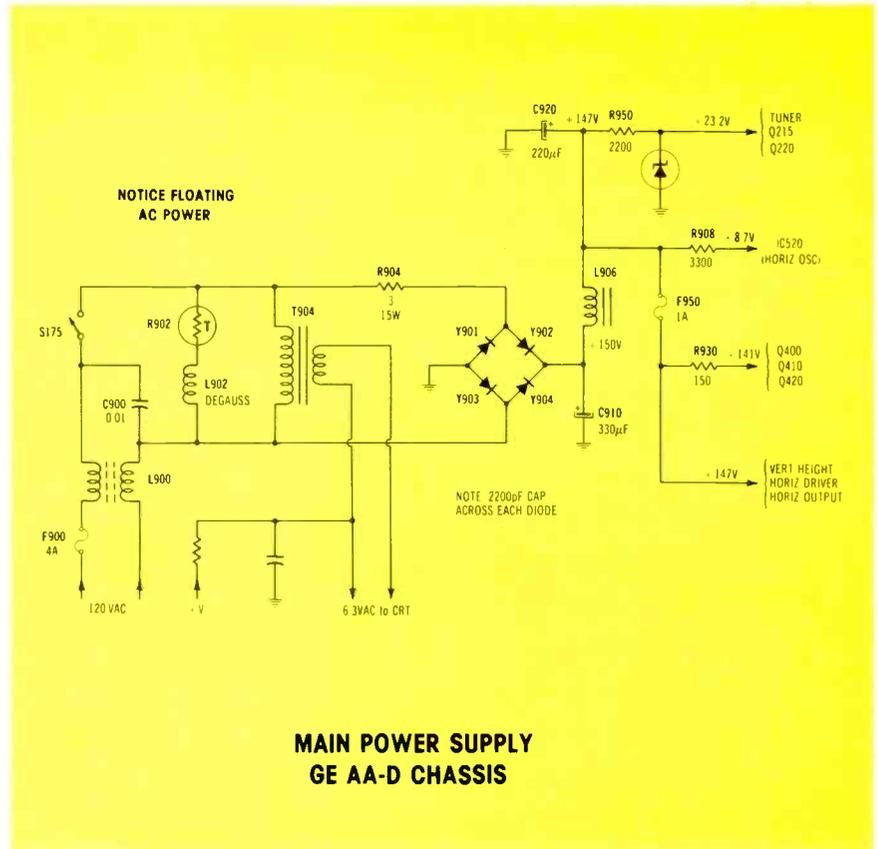


Figure 1 Two important points are shown by this power-supply schematic of the AA-chassis GE. Neither of the 120-volt power wires is grounded. Therefore, you must use precautions during servicing to avoid shock and damage. Also, to make servicing easier, the transistors and ICs that obtain DC power from each of the voltage sources are listed. Other DC voltages come from rectification of horizontal-sweep power.

15,734 Hz power supplies; a parts list of all special resistors and capacitors, transformer, diodes, transistors, ICs, and miscellaneous components (along with addresses and phone numbers for ordering

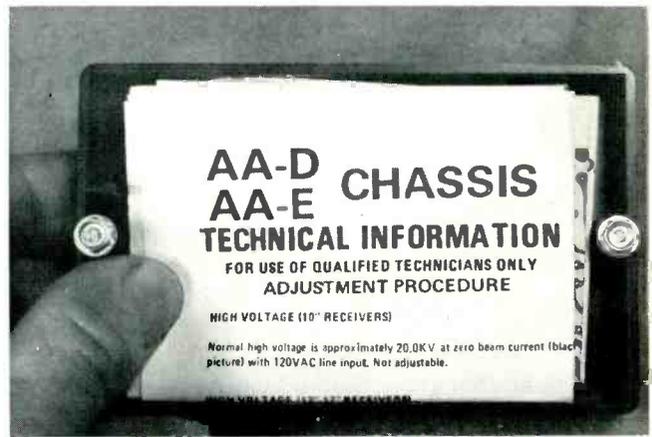
GE parts); and a complete schematic (except for tuners).

This is the valuable kind of information most needed during home service calls. Probably you'll

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Color, tint, brightness, and contrast knobs are located in front, under the picture-tube screen.



A large sheet of service information is packed in a box that's secured to the cabinet back by two screws. These screws can be taken out and the data sheet exposed only after the back is removed from the receiver.



Jerry Baumbach
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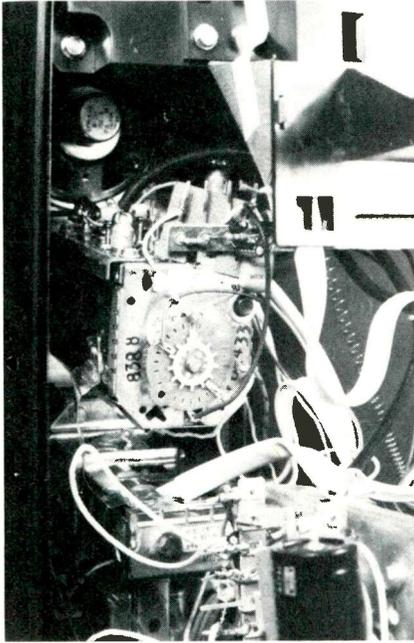
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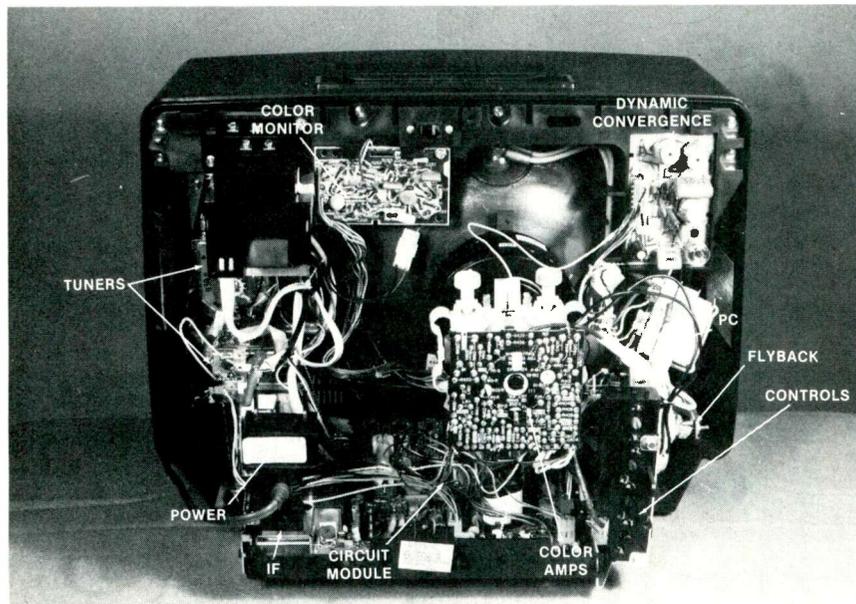
General Electric

continued from page 16

want to keep the first sheet you see. But remember, it belongs to the owner of the TV, and should be returned to the box.



Conventional solid-state tuners are located above the power-supply section.



Arrows point to the major components and systems of the AA-chassis General Electric 13" color-TV receiver. Any of the four modules can be removed.

Power Supplies

Although power supplies usually are not very interesting, we recommend that you read this next explanation. As you will discover, there are several points that are extremely important for efficient (and safe) troubleshooting.

Hot chassis

The polarized AC-line plug of the transformerless power supply in Figure 1 is no protection against electrical shocks to you, or against damage to your test equipment. That's because *neither* side of the incoming AC power is grounded. Instead, one corner of the bridge rectifier is grounded.

About 60 volts RMS or about 60 VDC can be measured from chassis ground to an earth ground, regardless of how the AC plug is inserted into a power outlet.

Now, most items of test equipment are isolated from the power line, and they represent no large threat. That is, except for an infernal third AC wire added at the command of our government. This so-called safety ground wire is connected to a power-line ground at one end and to the metal outer case of your test equipment at the other end. Just imagine the sparks,

smoke, and damage that will occur, when the *metal* case of your OSHA-safe test equipment touches the common ground of chassis AA (or any other hot-chassis TV)! Of course, all external TV parts are safe to touch.

To eliminate the hazard, you should connect a 120V-to-120V isolation transformer between the power source and any transformerless TV chassis. This warning applies to both shop and home service.

60-Hz power

Figure 1 shows a schematic of all the AA-chassis B+ voltage sources that operate from the power-line 60-Hz voltage. The +147 volts (which is not regulated) feeds both the driver and output transistors, while the horizontal-oscillator IC obtains power through R908 from the same +147 volts. Therefore, the horizontal-sweep circuit operates normally when the +147 volts is present. This point is important, since **other low B+ voltage supplies come from rectification of flyback horizontal pulses.**

15,734-Hz power

A simplified schematic in Figure 2 shows the seven B+ and B-voltage supplies that are obtained by rectification of horizontal-sweep pulses. Detailed explanations will be given as part of the horizontal-sweep coverage later.

For troubleshooting, remember this: any defect which eliminates the flyback horizontal pulses also stops (by eliminating the DC voltages) the functions of all transistors and ICs listed in Figure 2.

Fast-recovery diodes

Also, remember to use only the proper fast-recovery type of diodes to replace any of the scan rectifiers in Figure 2.

Conventional 60-Hz power supply diodes probably will fail rapidly, if used to replace a scan rectifier.

Comments

Preliminary watching of the 13AA9508W portable General Electric color TV indicates good performance with stable locking and adequate picture size.

Although the compact construction does not allow every component to be in the open and perfectly

continued on page 20

RCA guarantees every SK you buy. 100% perfect or we'll replace it.

Industrial

continued from page 21

or K (or J and K together) is switched to logic 0, the flip flop remains in the high condition, and the clock signal has no effect.

- If the SET terminal is switched to logic 0, the flip flop will go to a high condition ($Q = 1$). It will

remain in the high condition so long as the SET terminal has a logic 0.

- If the RESET terminal is switched to logic 0, the flip flop will go to a low condition, and remain there until the RESET terminal is changed to a logic 1.

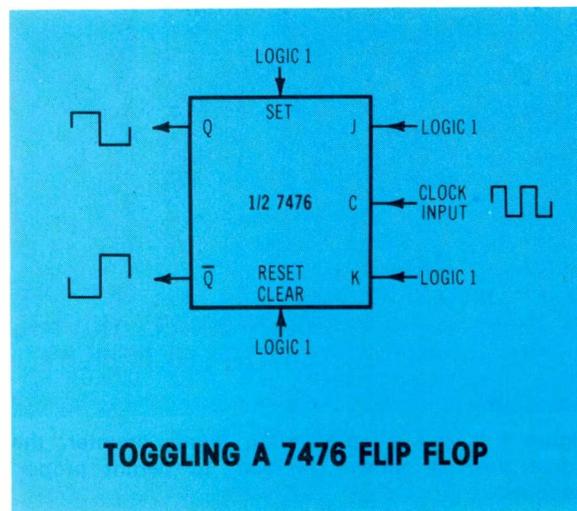


Figure 2 Flip flops in 7476 ICs will toggle when wired with these signals and logic levels.

Troubleshooting Question #1

A 7476 toggled flip flop is in the high condition, but the input clock signal has no effect. Which of these terminals might be wired wrong: J; K; SET; or RESET?

Experiment #1

In the circuit of Figure 1, connect all of the SET terminals to logic level 0 (ground or common).

All of the LEDs should be on (high), because the flip flops are in the high condition. Verify that the

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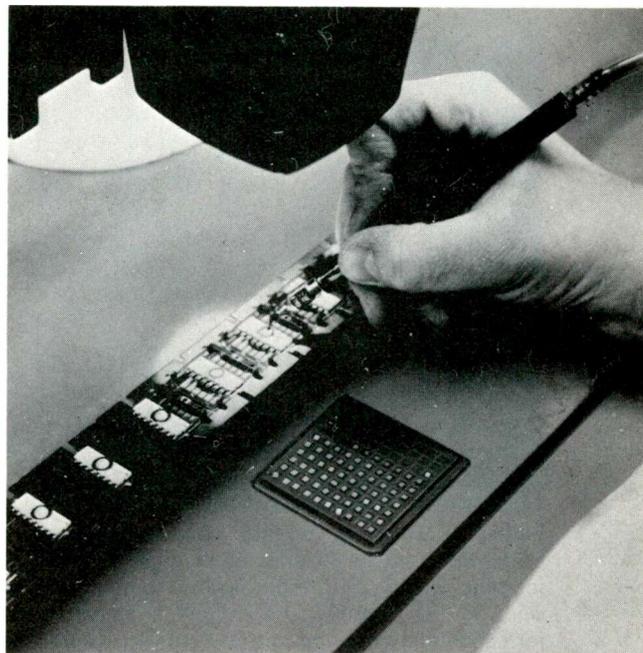
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LEDs are lighted.

Restore the circuit to the original condition for counting.

Experiment #2

Also in the circuit of Figure 1, wire all of the RESET terminals to logic level 0. The flip flops now should be in a low condition, with **none** of the LEDs lighted. Verify the LED conditions, then restore the circuit to the previous counting condition.

Experiment #3

In the circuit of Figure 1, change the wiring **ONLY** of the first flip flop K terminal as shown in Figure 3.

Try the switch in both positions and notice what happens to the count. With the switch at the "A" position (a high at the K terminal), the counter should operate normally.

When the switch is changed to the "B" position (a low at the K

terminal), **all of the flip flops stop counting!**

Important Note: With ripple counters, all of the flip flops can be prevented from counting, if counting of the **first** one is stopped. The second flip flop can't change until the Q terminal of the first flip flop goes from logic 1 to logic 0. Of course, this applies to the downstream flip flops as well.

Programming Ripple Counters

Until this time, the binary counters operated continuously, counting from zero up to 15 and then starting at zero again and counting to 15 again, and so on, as long as the power was applied. (The four binary numbers have values of 8, 4, 2, and 1, so 15 is the limit with four flip flops.)

However, by applying some of the basic theory we have learned, we can force the circuit of Figure 1 to count to any number between 1 and 15 before starting over.

Suppose we want the counter to operate to the seven count (0111) and then start over at zero (0000). **It's done by arranging the count of eight (1000) to trigger a RESET of all flip flops.**

Troubleshooting Question #2

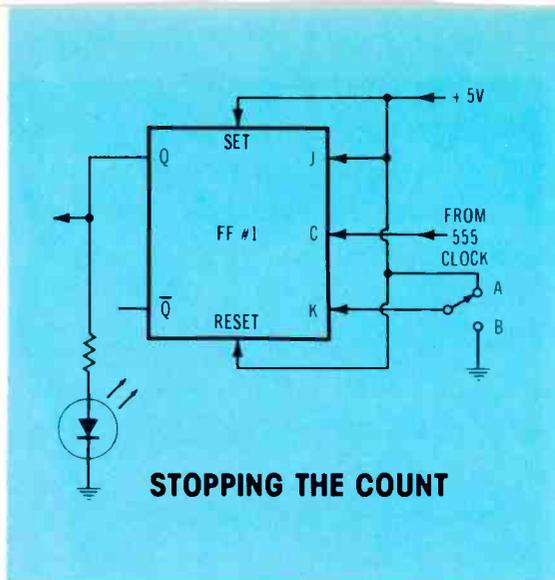
What logic levels are at the Q terminals in Figure 1, when the counter is displaying the number 8?

Programming A Seven Count

The method shown here to program four toggles to count to 7 and then begin again at zero is not the most simple or the least expensive, but it always will work! Later on, I will show you some other methods.

Remember that a display of zero (logic 0000) can be obtained **at any**

continued on page 24



STOPPING THE COUNT

Figure 3 Toggling counts can be stopped by switching J, K, or J—and—K to logic 0. When the toggling stops, the logic levels remain as they were. In this example, the K input is switched to A for sequential counting and to B for a frozen count.

TABLE 1
LOGIC LEVELS FOR THE CIRCUIT OF FIGURE 4

DECIMAL NUMBER	Q OUTPUT (ALSO LED DISPLAY) $2^3 2^2 2^1 2^0$	\bar{Q} OUTPUT	INPUT TO NAND	NAND OUTPUT
0	0 0 0 0	1 1 1 1	0 1 1 1	1
1	0 0 0 1	1 1 1 0	0 1 1 0	1
2	0 0 1 0	1 1 0 1	0 1 0 1	1
3	0 0 1 1	1 1 0 0	0 1 0 0	1
4	0 1 0 0	1 0 1 1	0 0 1 1	1
5	0 1 0 1	1 0 1 0	0 0 1 0	1
6	0 1 1 0	1 0 0 1	0 0 0 1	1
7	0 1 1 1	1 0 0 0	0 0 0 0	1
8	1 0 0 0	0 1 1 1	1 1 1 1	0

Industrial

continued from page 23

time by delivering a logic 0 simultaneously to **ALL** of the flip flop RESET terminals. Also, a NAND gate has a logic 0 output, when **all** of the inputs have a logic 1.

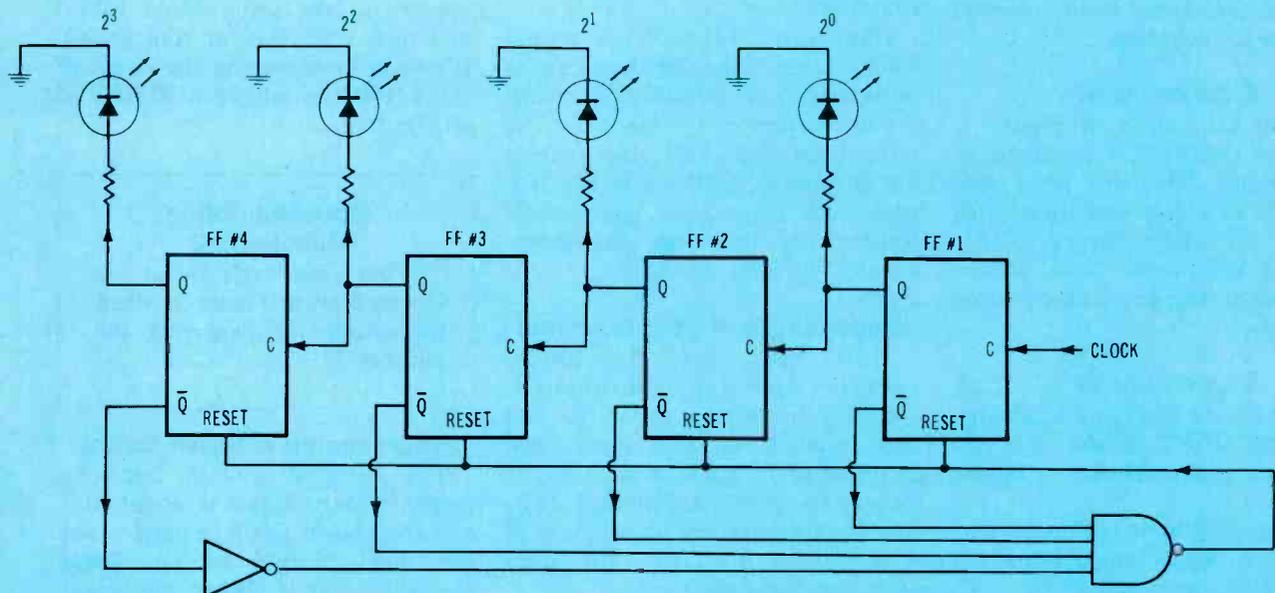
Combining these two statements points to a possible solution (see Figure 4). When the count is 8, the

Q terminals have logic 1000. And, you know from Troubleshooting Question #2 that the Q logic levels are 0111. Therefore, the required four input highs for the NAND can be obtained from the Q outputs of FF#1, FF#2, and FF#3 plus the **inverted** Q output of FF#4.

When the counter advances one count beyond 7, the LEDs normally would light to show an 8 (1000 at

the LEDs). But, at the 8 count, all four NAND inputs are high (1111), so the NAND output delivers a low to all of the RESET terminals. This clears the 4 flip flops to low outputs (0000) almost instantaneously—so rapidly in fact, that the LED readout does not show a 1000 readout for number 8.

Since the flip flops have been stopped at low outputs by the



COUNTING ZERO TO SEVEN

Figure 4 Addition of a 4-input NAND to control the RESET state allows the circuit to count to 7, reset to zero, count to 7 again, etc. When all of the NAND inputs are high at the count of 8, the output of the NAND at the RESET terminals goes low, thus resetting all 4 binary digits to 0.

RESET low, the counting can't begin until the RESET terminal is brought high. The NAND inputs (for the 0000 zero count) are 0111; therefore, the NAND immediately changes to a high output, and the zero count is brought step by step up to seven, where on the next count it is reset back to zero.

This description covers slightly more than one complete counting cycle, and the cycles continue until the power is removed.

Table 1 shows the logic levels in the Figure 3 circuit, proving that only the eight count has a low output from the NAND, which is necessary to reset the counting back to zero.

Also, notice that the Q output column counts *down* from 15 to 8, while the Q output (and LEDs) count up from 0 to 7. The same circuit could be used for a 15-to-8 countdown, if the LEDs were connected to the Q outputs.

Simplifying the circuit

In Figure 4, a minor change can eliminate the inverter (NOT gate). We know that the Q output digital level is always opposite the level at the Q output, and vice versa. Therefore, we can wire the fourth NAND input direct to the Q output of FF#4, instead of to the Q output through an inverter (see Figure 5). In other words, the internal inverter of the flip flop is used instead of the external one.

Incidentally, there's an easy way of changing the wiring slightly so the NAND is not needed for counting to 7 and resetting. However, there's a serious limitation. Can you figure it out before next month?

Troubleshooting Question #3

Suppose you are testing the circuit of Figure 5, but instead of resetting after the 7 count, it counts to 15 before resetting. Which is likely to be the cause of the malfunction: (1) a defective flip flop; (2) an incorrect clock signal; or (3) a defective NAND?

Experiment #4

When a counter is not functioning
continued on page 27

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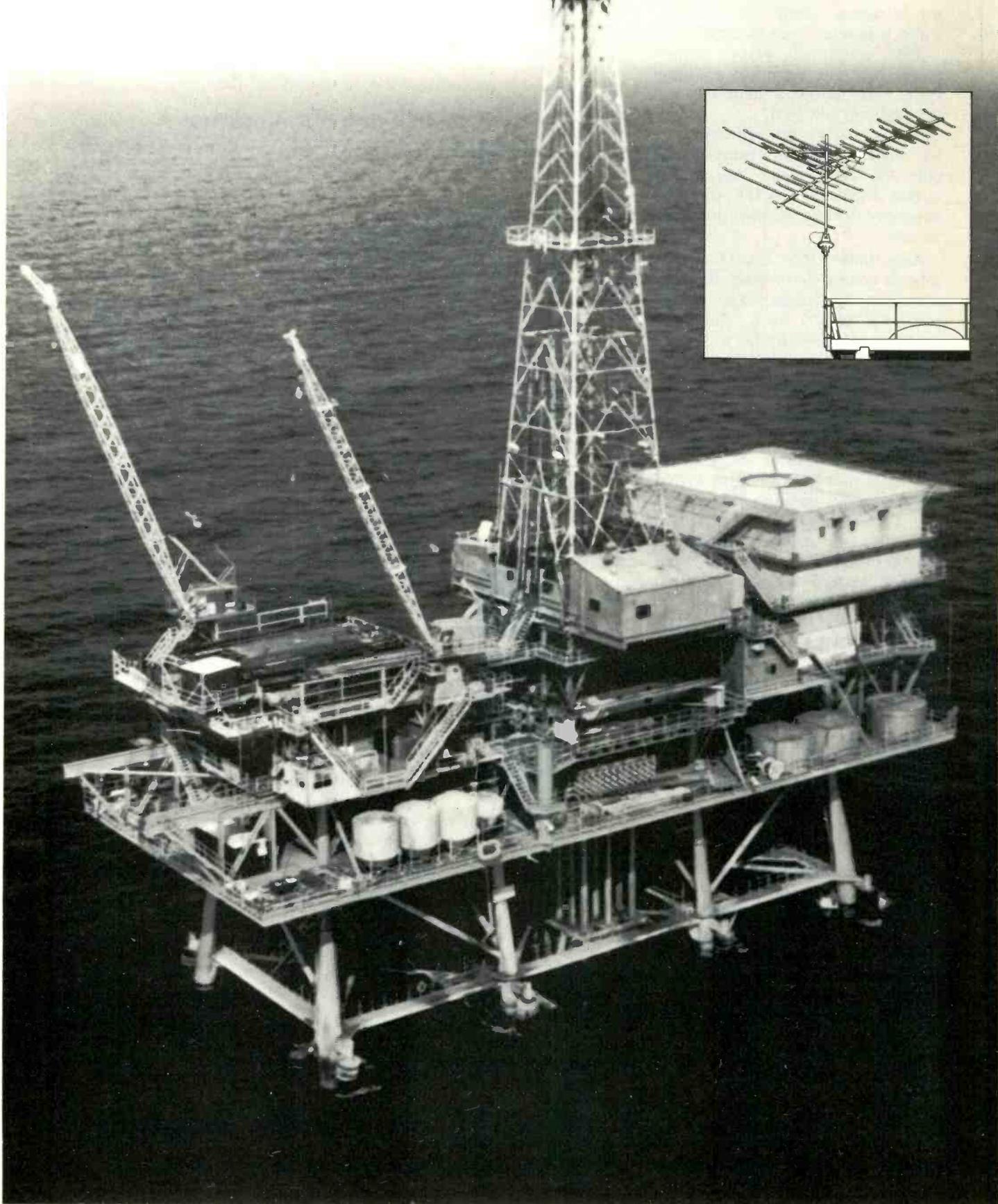
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Far out in the Gulf, drilling and construction oil rigs stand like giant metal mushrooms. Crews of workers spend many days on the platforms, isolated by distance and weather from the mainland. Even with well equipped recreation rooms that include pool tables and regular movie showings, they depend on television sports and news for relaxation and information.

Getting and keeping good, watchable pictures means overcoming two major problems: distance from tv transmitters—as much as 150 miles or more—and the ravages of salt spray and gale winds on antennas.



**Clifton Giroir, Winegard Dealer
Associated with Houma Avionics.**

Houma Avionics and Winegard dealer Clifton "Pookie" Giroir (Antenna Service Company), have become specialists in tv antenna

installations on oil rigs, both drilling and production types. Giroir's early efforts on jobs contracted by Houma Avionics, were as a "troubleshooter" for antenna installations which were not working properly.

As he states it, "We replaced unsatisfactory equipment with complete Winegard systems, from antenna to the tv outlets. While models vary by distance from shore and specific installation problems, we use Chromstar antennas, Chromstar high gain—low noise preamplifiers, and other Winegard electronic components. This may include a distribution amplifier, cartridge filters, and up to 8 or 10 outlets. With drilling rigs, the antenna is mounted on the derrick crown, 150-200 feet high. On production rigs, the antenna is mounted on the communications tower, with cable run to the crew's home base platform.

We prefer Winegard products for these oil rig installations. Winegard has everything we need in their line, components are compatible and reliable. The antennas are anodized and very ruggedly constructed."

Giroir, in working with Houma Avionics, has developed many techniques for dealing with unusual installations, particularly in assuring longer life for oil rig antennas which face destructive conditions constantly. He adds to his knowledge by attending Winegard technical seminars, and by tackling, for Houma Avionics, the very toughest oil rig antenna installation problems in the Gulf of Mexico.

Industrial

continued from page 25

ing properly, it's often easier to locate the problem by stepping the counter **slowly** one digit at a time while a logic probe measures the various highs and lows. However, the contact bounce of conventional switches sometimes obscures the results by adding extra unwanted pulses.

To obtain single logic changes, a bounceless switch (Figure 6) replaces the clock signal.

Follow this method of advancing the counter manually:

- Construct the bounceless switch of Figure 6.
- Use a logic probe to verify the high and low outputs obtained when the switch is operated.
- If your probe can identify glitches, then verify that the output has no glitches.
- In Figure 5, disconnect the clock signal from the FF#1 clock input, and connect the output of the bounceless switch to the clock input.
- Operate the bounceless switch slowly to step the counter. Observe that the count changes when the bounceless switch output goes from logic 1 to logic 0, as is typical of TTL devices. (Use your logic probe to determine when the high-to-low transition takes place.)
- Open the output circuit of the NAND, and connect the RESET leads to a permanent high (the +5-volt supply). This eliminates the resetting after the 7 count, and the counter will count to 15, and then repeat. Beginning with zero count, step the counter with the bounceless switch and notice that the NAND output is high until the count reaches 8. At that point, the NAND output should go low. This is normal operation. (If you were troubleshooting a defective counter, any wrong responses would indicate a bad NAND, or improper inputs to the NAND. Check the inputs with the logic probe.)
- Reconnect the counter for the zero-through-7 count.
- Use the squarewave output of the 555 timer circuit to operate the counter at about one count-change per second, and observe the count. It should count up to 7, reset to 0 count, and then count up to 7, etc.

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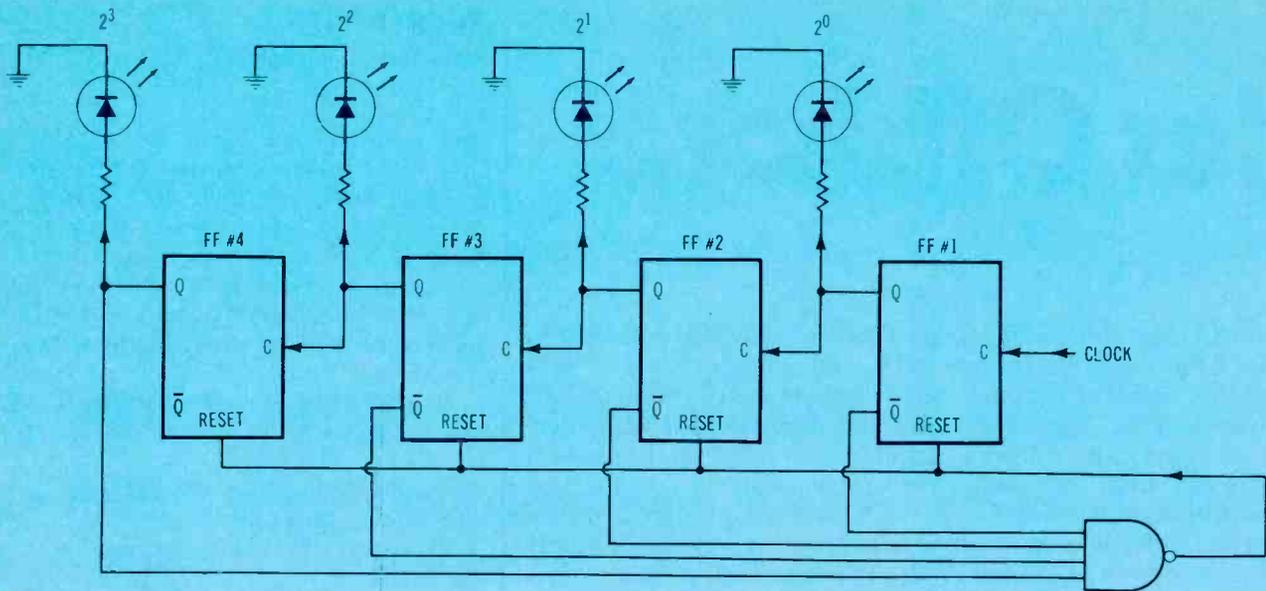


Figure 5 The NOT gate of Figure 4 can be eliminated by taking the NAND input from the Q output of FF#4, rather than from the Q output through the NOT.

Industrial

continued from page 27

Experiment #5

Design a way to wire the counter so it counts from 0 decimal (0000 binary) up to 11 decimal (1011) before resetting.

Don't use any NOT gates (inverters), but include the 4-input NAND gate, in the same general way as Figure 5.

Next Month

The answer to Experiment #5 will be given first next month, followed

by additional notes about programming counters both up and down. Finally, a digital readout for the counter will be described.

Answers To The Troubleshooting Questions

Question #1 Probably the SET terminal is wired to a logic 0 instead of the proper logic 1, causing the toggled flip flop to be stuck in the high condition. Less likely is the possibility that the J and/or K terminals might have a logic 0, and assuming that the flip flop happened to have a high when first energized. It's not likely the RESET is wrong.

Question #2 The Q logic levels always are opposite to those of the \bar{Q} outputs. An 8-count at the LEDs and the Q outputs is 1000; therefore, it is 0111 at the Q outputs.

Question #3 The most likely cause of the counter continuing to 15, rather than resetting after 7, is a defective NAND gate. If one of the flip flops is defective, the circuit could *not* count to 15. Also, the clock signal must be okay, else the counter could not count at all (or, the 0-to-15 count would not be normal). Of course, there is a remote possibility that one of the Q outputs is defective, or not reaching the NAND. □

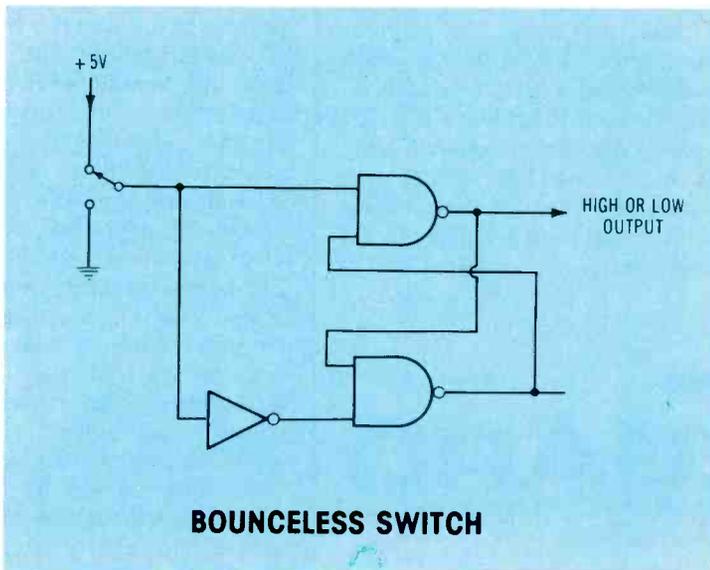


Figure 6 Build this bounceless switch (actually a D-latch) to advance the counting circuit manually.

Servicing Betamax Videotape Recorders

Basics Of VTR Servos

PART 5

By Harry Kybett



Servo systems are included in VTRs to control the rotating speed and position of heads and capstans. Here are the facts behind the circuits.

Head Phase

Videotapes **could** be recorded without any speed control equipment except a synchronous motor to drive the heads. However, the results would be totally unsatisfactory, because the vertical sync would be placed at a different point of the track each time the motor was started.

As shown in Figure 1, the vertical sync **MUST** be recorded at the same precise spot on each and every track.

Although a synchronous motor is forced by its design to run at the proper multiple of the 60-Hz line frequency, one more condition is

needed: the location (phase) of the head must be known and controlled.

Therefore, all videotape recorders have some kind of a **servo** system to control **BOTH** the speed and phase (position) of the heads during recording and playback.

Servos

In general, a servo system controls the position (phase) and the rotation speed (frequency) of some piece of machinery. Common examples are auto pilots in airplanes and the adjustable stabilizer fins of ships. Servos not only command the

continued on page 30

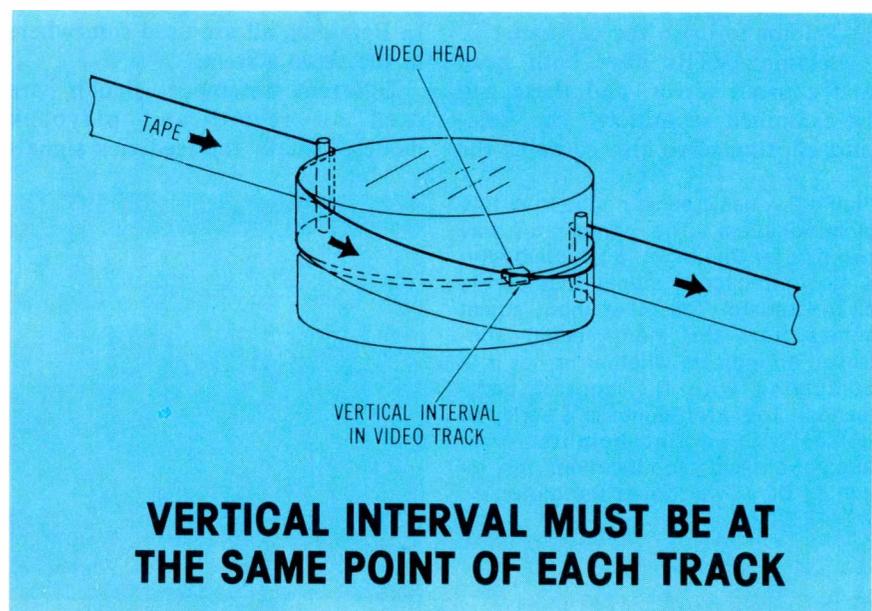


Figure 1 Each vertical-sync interval must be placed *precisely* near the end of each slanted track, so that head switching follows the vertical sync in the unused part of the vertical interval. This drawing has several errors, but it conveys the right idea.

Betamax

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equipment to do the operation that's wanted, but they also check to see that those commands are carried out.

Basically, servos are simple circuits, and the main differences between the various types are the specific input and output signals.

VTR servos

Servos in videotape recorders must perform these three functions:

- Speed of the heads and the capstan must be controlled very accurately at all times.

- During recording, the speed is determined by the sync in the composite video, and the phase is controlled so the vertical interval of each vertical field is placed at the desired specific point of each one-field slant track.

- For playback, the servo must know where each slant track is located, then according to the control information recorded on the tape, it controls the head speed and phase, bringing the head to the proper place on the track at the right time.

All VTRs have a head servo, but do not always have a capstan servo. Simple VTRs drive the capstan at constant speed with a belt from a synchronous motor. The better machines supply a servo-controlled DC motor to drive the capstan.

Betamax VTRs have both head and capstan servos, and these will be examined separately. The Betamax capstan servo also contains the

speed-sense circuits, the muting circuits, and the internal vertical-drive reference generator. These will be explained later, before the final section about servicing.

Basic Servos

A servo system has two input signals and one output signal that's used to control one of the input signals. (You TV techs will notice similarities to phase detectors that permit the frequency-control and phase-locking of chroma and horizontal oscillators. All of these, including the servo, are examples of phase-locked loops where the standard and variable frequencies are the same.)

One input is a sensing feedback signal from the motor (this signal varies in step with the motor speed and phase), and the other is a fixed (reference) signal. These two signals are compared for frequency and phase, as shown in Figure 2.

Any phase difference between the two input signals changes the error-correction output signal, which is filtered and amplified before it is applied to the motor where it controls the speed.

These feedback, reference input, and error signals can be DC levels, pulses, square waves, or sine waves. In Betamax, all are used somewhere in the servo system.

Different reference signals are used for record and playback modes. Usually the feedback signals

from the motor sensor remain the same.

Pulse servo

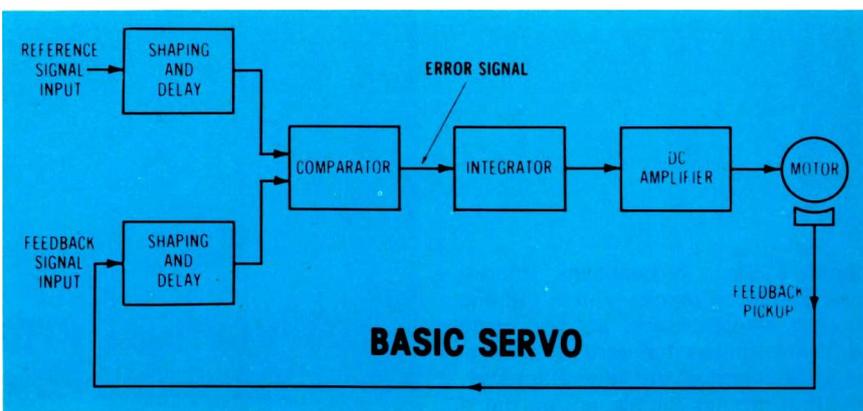
One type of VTR servo has pulses at both inputs. However, the waveforms are changed before they are compared. The reference pulse triggers a multivibrator (see Figure 3), and its output square wave is integrated into a curved ramp (saw-tooth).

The sensor-feedback pulse triggers a one-shot, which produces a narrow output pulse. This pulse is caused to "sample" the ramp at the comparator. Output of the comparator is a series of pulses whose height vary in the shape of the ramp. These pulses are integrated and amplified before they control the motor speed.

Figure 4 shows a simple method of sampling. The transistor can amplify **only** when the base has forward bias from the ramp and the collector has positive pulses. Output from the emitter is a series of pulses having widths equal to that of the sampling pulses, and a voltage level equal to that of the input ramp at the time of sampling.

Here's how it works. If the motor runs slow, the sampling pulses will arrive later at the comparator, when the ramp has increased to a higher voltage. Therefore, the integrated output pulses have a higher DC average voltage, which forces the motor to rotate faster. Of

Figure 2 A basic servo might have this block diagram. The comparator has two inputs. One input is supplied with a stable-frequency signal that serves as a standard. The other input signal comes from the motor being controlled (to indicate whether or not it is complying with the control commands). The error signal is a series of pulses with varying heights. After integration and amplification, the resulting DC power drives the motor.



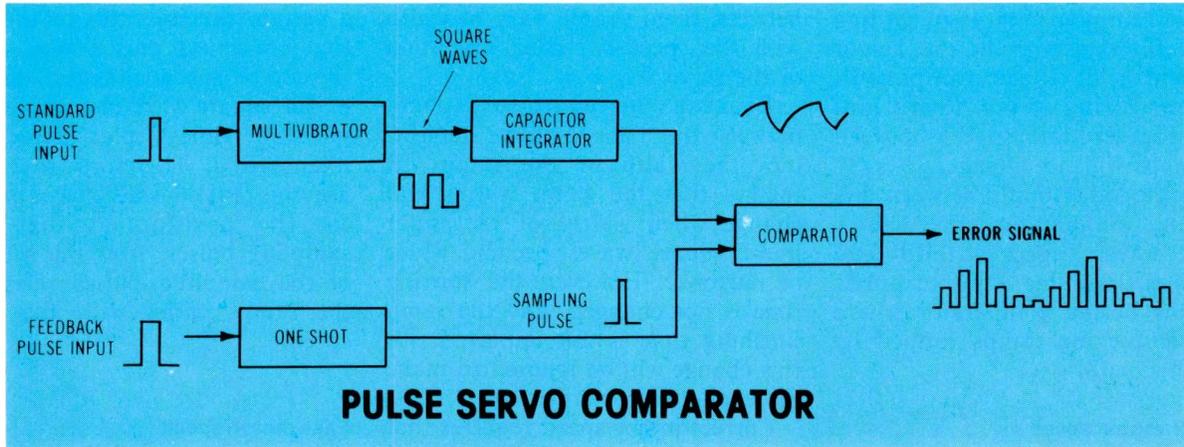


Figure 3 One type of servo has pulses at both inputs, but the reference pulses are changed to square waves, and then to rounded ramps before they are applied to the comparator. The tips of the error signal trace the shape of the ramp.

course, these actions are reversed if the motor speed is too fast.

Single-input servo

One circuit that does not require two input signals to the servo is shown in Figure 5A. A multitoothed wheel and a pickup coil inside the motor produces a near-sinewave wheel and a pickup coil inside the motor produces a near-sinewave having a repetition frequency that varies in step with the motor speed. The average frequency depends on the model of the machine, and might be any between 180 Hz and 10 KHz.

This circuit is called a "frequency generator" or FG type. The sine waves from the FG coil are amplified excessively until the resulting overload changes them into square-waves, which then are divided into two paths. One generates and shapes the reference sawteeth, while the other path supplies pulses for the comparator.

During the following explanation, remember that one-shots are triggered by negative-going edges of the input signals. After triggering, the output is "high" and remains

"high" for a fixed period of time—determined by a time constant—before the output reverts to zero or "low." Then, the output stays "low" until the one-shot is triggered again.

Refer to the waveform drawings in Figure 5B as this servo is explained. Each falling edge of the line 1 square waves triggers the first one-shot, which generates the Time-1 output pulses of line 2. In turn, each falling edge of the line 2 pulses triggers the second one-shot, producing the wider Time-2 pulses of line 3. **Important note:** neither of these two one-shot pulses vary in width as the servo regulates the motor speed. However, the spaces between the Time-1 and Time-2 pulses will change.

The line 3 pulses are inverted
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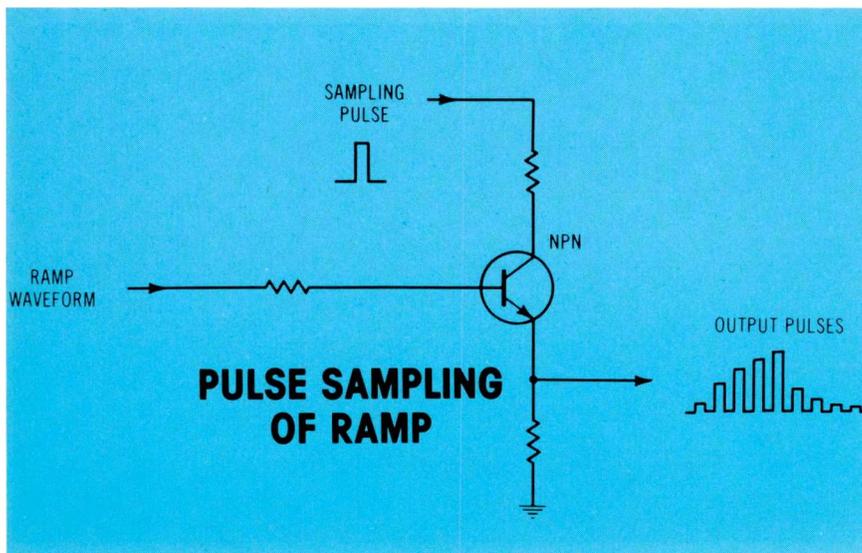


Figure 4 Here is one kind of sampling circuit. The transistor can't amplify until the collector has a positive-going pulse and the base has a positive-going ramp signal. The output waveform shows the shape of the base signal by the pulse heights.

Betamax

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and then integrated to form the positive ramps of line 4. According to the facts just given, the height and width of these ramps will change during servo operation, while the zero-line spaces between the ramps will not change.

For the other path between FG coil and comparator, the line 1 square waves trigger a third one-shot, and those line-5 output pulses are sent to the comparator where they sample the ramps formed by the other path.

Correct motor speed

Notice that the leading edges of the Time-1 pulses of line 2 coincide with the leading edge of the line-5 sampling pulses, because both are triggered by the negative-going falling edges of the same line-1 input square waves. This coincidence of edges does not change. Also, it has been stated that the width of the Time-1 and Time-2

pulses never vary, but the spaces between them should vary in width with the speed-adjusting operation of the servo.

Because the width of spaces **between** the Time-2 pulses determines the width of the ramps, it follows that the ramp widths will change when widths of the input line-1 square waves become wider or narrower. However, the starting time is not changed, and the ramp finishing time is not important, so this change will be ignored to make the explanation simpler.

Correct motor speed requires that the time of the first (point X) and second (point Y) falling edges of the line-1 square waves occur at the same point (X and Y) on two successive ramps (as shown in Figure 5B). With those conditions, the integrated error signal has a constant DC voltage, and the motor speed is not changed.

This is possible **ONLY** when the

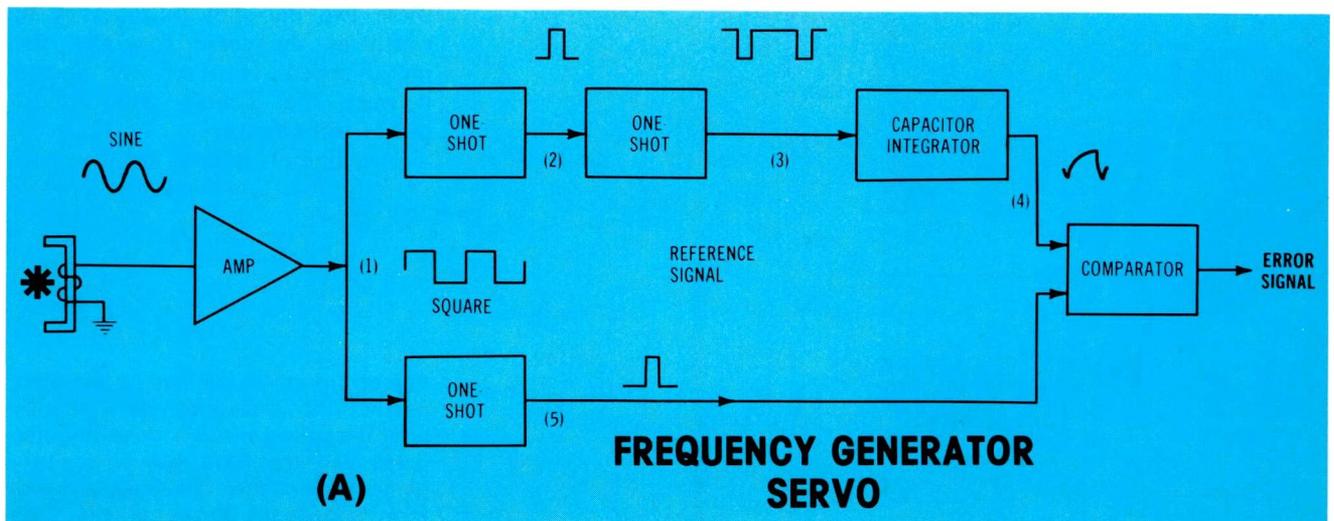
time of one line-1 square wave has a certain precise ratio to the total time of Time-1 plus Time-2. When the motor speed changes, the time of one square wave changes in step, but the Time-1 plus Time-2 remains fixed. Therefore, the ramps are the "standard" of comparison for the position of the line-5 sampling pulses. And the positions of the sampling pulses relative to the ramps varies with the motor speed.

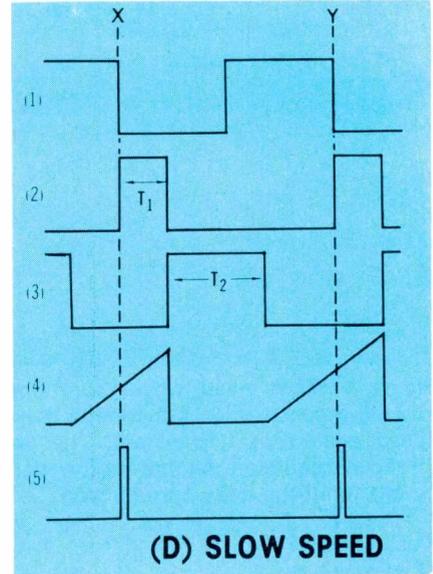
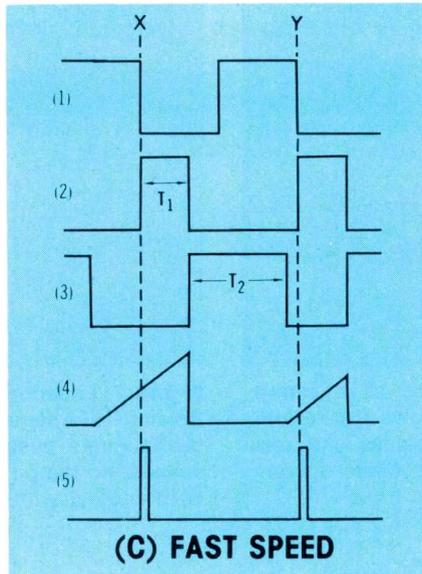
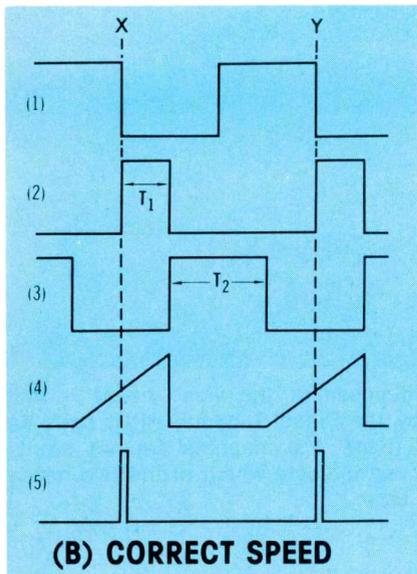
Fast motor speed

Suppose the motor begins to run faster than the design speed. The line-1 input square waves are narrowed (more cycles per second). In Figure 5C, assume that the motor speeds up after the **first** falling edge of the line-1 square waves (at X). The first line-5 sampling pulse arrives at the center

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Figure 5 A "frequency-generator" servo holds the motor at one precise speed, according to the time constants of the two one-shot multivibrators. (A) This is the block diagram of a FG servo. (B) When the motor is running at the correct speed, these are the waveforms and phase of the signals shown on the diagram. (C) A faster motor speed narrows the square waves, and the pulse samples the ramp at a point of lower voltage, to reduce the motor speed. (D) If the motor runs too slow, the square waves become wider, and the pulse samples the ramp later at a point having higher voltage. After integration and amplification of the error signal, the DC power that's applied to the motor is increased, thus speeding up the rotation.





SPECIAL REPORT:
Jack Darr, Service Editor of
Radio-Electronics writes:
Oneida's Nu-Color Picture Tube
Restorer 'Lives up to its name'

This device is designed to restore color to old picture tubes with one or more weak guns.

I had a trade-in Wards TV, with a picture tube so bad it had to be seen to be believed. The blue gun read almost normal emission; the green gun would come up to the bottom end of the BAD sector on the meter; and the red gun just barely wiggled the needle.

The Nu-Color model 90A is a plug-in device that is inserted between the picture tube and socket, like a brightener. However, it is not a brightener, at least in the usual sense of the word. Between its plug and socket is a little box with three color-coded slide controls, one for each color.

Starting with all controls at the OFF position, I plugged the Nu-Color in and turned the set on. As expected, the raster was a bright blue. I adjusted the controls of the Nu-Color and came up with a good-looking color-bar pattern. Twiddling the grey scale and the Nu-Color controls gave an excellent color picture. Reds saturated normally, with the color control all the way up and all other things looked very good! This device lives up to its claims and its name; it certainly did "restore the color" to this old dog.

As Oneida is careful to explain, the Nu-Color is not intended as a "cure-all" for color troubles, but it will help correct problems due to unbalanced picture-tube emission. The device can be installed and adjusted in the home with very little trouble.

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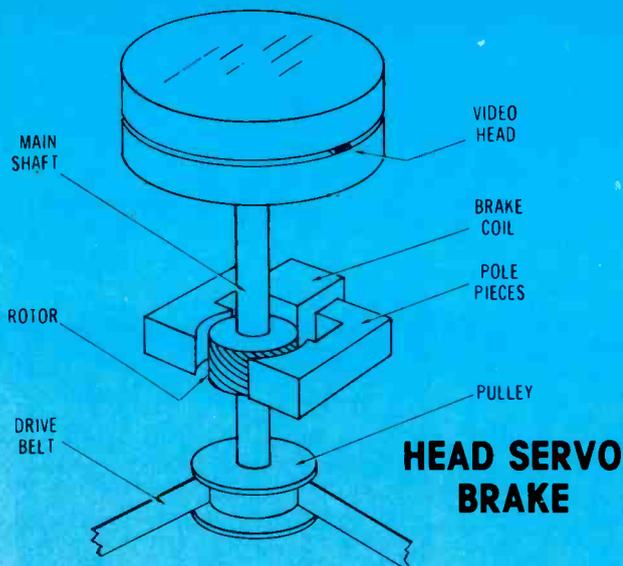


Figure 6 Many head wheels are operated at a slightly excessive speed, then a magnetic brake slows the rotation speed and keeps it constant. The pole pieces and rotor strongly resemble a simple motor, but this brake operates by changing the eddy-current drag.

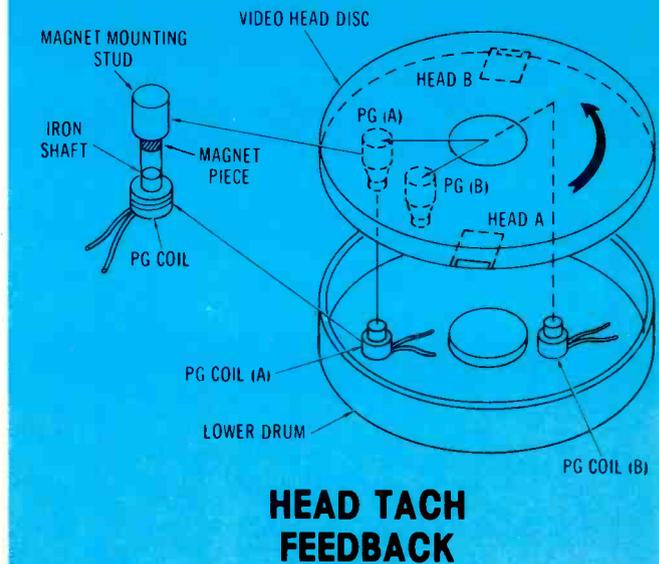


Figure 7 Location and speed of the video heads in the Betamax are sensed by the Pulse Generator (PG) coils as the magnets pass by them. The magnets are not evenly spaced, so the pulses can indicate which of the two heads is in contact with the tape.

Betamax

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of the first line-4 ramp (as it should when the speed is correct).

However, the next falling edge (Y) and sampling pulse occur during an earlier (lower voltage) time of the second ramp. So, after sampling, the error voltage has a lower DC value, which reduces the motor speed.

Slow motor speed

When the motor runs slower, the square waves of line 1 become wider. Assuming that the motor speed is correct at the first falling edge of the square waves (X in Figure 5D), the slower motor speed moves the next sampling pulse (Y of line 5) to the right. Thus, this pulse arrives during a *higher ramp voltage*, and the integrated error voltage has a higher DC value, which speeds up the motor.

Sensitive motor control

With the single-input type of servo, the speed correction occurs very rapidly after slight changes of speed. Therefore, large speed errors don't occur.

Head Servo

In most small VTRs, the head is NOT directly driven by a motor.

Instead, it is belt-driven about 1% too fast by the main AC motor, then is slowed to the correct speed by a variable magnetic brake. Any speed variations are corrected by a change of brake current from the servo.

These magnetic brakes have the appearance of squirrel-cage motors, as shown in Figure 6. The head-servo circuit provides the proper amount of DC current to slow the shaft and head speed to the correct value. When the head speed is too low, the servo decreases the DC current. And the servo increases the current when needed to slow down the head rotation.

All consumer cassette VTRs have this type of head servo, although some smaller portables use a DC motor to rotate the heads.

Feedback (that describes the head position) comes to the servo circuit from the "head tach" or "PG" coils. These coils are mounted in the non-moving lower drum (Figure 7), where magnets on the rotating head drum pass near the coils, thus inducing pulses.

These PG magnets are placed 180° apart in most VTRs; but in the Betamax, they are offset as shown in Figure 7.

Pulses from the PG coils provide the 30-Hz head-switching signal for playback, and the offset magnets allow the heads to be identified for chroma-phase switching.

Also, pulses from the PG coils are used *during recording* as the feedback signal, while the reference is the vertical sync of the incoming video. *For playback*, the PG pulses again are the feedback signal, and the reference is the signals previously recorded on the tape control track.

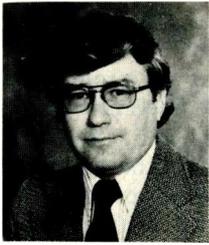
Capstan Servo

When a capstan servo is included in a VTR, a DC motor provides a belt drive, or direct drive, to the capstan; a magnetic brake is not used. **The DC drive to the motor is the output signal from the servo.**

In the dual-speed Betamax, a capstan servo is essential to provide a smooth speed change without mechanical complications, and also to maintain good control of the tape motion at the low speed.

Next Month

This information has been general in nature. Therefore, specific Betamax servo circuits will be explained next month. □



Painless service prices

Service management seminar, part 9

Now that you have calculated accurate and fair service rates, how do you convince Mrs. Customer? By Dick Glass, CET

Don't Defend Unfair Pricing

If your service rates ARE unfair, you *should* feel guilty as you collect for them.

For example, suppose you made out a bill for six or seven expensive components, a major diagnosis charge, parts installation fees, and other charges totalling \$225. But, in truth you had installed nothing but one 27-cent AC plug! You didn't even remove the back to check for intermittent joints, weak tubes, or a needed vertical adjustment.

Because parts were charged for, but not installed, and the customer was deceived into believing work had been done, when it was not, the repair bill was "unfair." Also, you committed several crimes, such as theft, deception, and fraud. You **are** guilty, and should feel guilty. What's more, your guilt will reflect on the entire servicing fraternity.

Well, most of us agree that such a repair and pricing would be totally and completely unfair. Next, we'll go to the other extreme.

Super-Fair Pricing

In contrast to the bad example, imagine you repaired one routine defect, inspected the chassis for borderline problems, touched-up a couple of adjustments, and air-checked for two hours before charging the customer your usual "minor" labor fee. Let's say the total bill was between \$20 and \$40, although we all know there is no agreement about a specific charge.

If that repair charge has been calculated to reflect your proper costs of performing the service (as all of your charges should be), is the total charge fair? Should you feel guilty when presenting the bill?

Almost everyone answers "Yes" to the first and "No" to the second question. You NEVER have reason to feel guilty about charging a fair price for good service. Neither should you feel guilty about raising

your service rates, if your efficiency is average or better, and those higher prices are essential for permitting you to provide the good-quality service your customers demand.

(Editor's Note: Dick Glass operates a consulting and accounting service for electronic businesses, and this gives him access to actual first-hand information about typical prices, profits, and costs of doing business. He reports that probably thousands of you are "giving away" your labor because you are afraid of customer displeasure if you increase your rates to a profitable level. If this is true of you and your business, we strongly recommend that you study again the previous eight installments, and then take

the actions needed for your financial improvement.)

Ordeal Of Presenting The Bill

Even when they KNOW their charges are perfectly fair, it's true that many (perhaps most) service technicians and dealers feel anxiety about presenting each bill. They know the customer will not (and cannot) appreciate the technical expertise required to overcome the problems. Also, they suspect each customer is well-acquainted with the many exposés and accusations leveled in our direction. In fact, **most customers seem to believe every service job is another ripoff**, such as the bad example described at the beginning.

Yes, the task of collecting fair service charges often is a distasteful one!

Heart Of The Problem

If you have done everything recommended in this series, including the calculation of service rates based on actual costs plus a reasonable profit, you should **know** without any question that *your rates are fair*.

Therefore, your most imperative need is to *convince* the set-owning customers that your rates ARE fair. Unfortunately, this important area has been ignored by our industry. We desperately need **methods** and **aids** to help with this acute problem. The following 6-step plan will detail some valuable methods.

Create Better Attitude And Image

Preventing customer complaints about pricing involves many items, such as: belief by your entire organization that the rates ARE fair; the professional appearance of your employees, shop, and office; showing customers some of the electronic complexities; effective

continued on page 36

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Reg. No. — Clerk	ACCOUNT FORWARDED	
1	4 RESIST.	4 00
2		
3	2 CAPS	2 00
4		
5	Service Fee	20 00
6		
7		
8	TOTAL	26.00
9		
10		
11		
12	Pd 26	
13		
14		
15		
Your account stated to date. If error is found return at once.		

Figure 1 Small, cheap, and simple are words that describe these "feed-store" service forms. However, such inexpensive forms invite doubt and questions about your pricing. In the long view, they can cost much more than the detailed forms.

Service management

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estimating practices, detailed and attractive invoices; an "outside authority" pricing system; well-lettered pricing signs in the shop; and a positive attitude reflected by everyone on your staff.

Step 1—Calculate fair rates

Use the methods given in previous articles to calculate the return you need on the money and goods invested in the business, and to calculate the salary you and your employees should have. Don't use **prices** from any outside source as a guide. If you do, you'll destroy the immense value of **KNOWING** without any doubts or questions what prices are fair.

We can't overstate the absolute necessity of this step. **Calculate** your proper rates **before** you begin to do the other steps.

Step 2—Believe in your rates

You can't believe your rates are fair unless you have calculated them. In addition, you must know that your shop is not inefficient, unlucky, or undercapitalized, and does not have excessive expenses or poorly-trained employees.

To acquire this knowledge, you must compare your operation against others in the same field. It's likely you are doing an outstanding job of managing an efficient busi-

ness in an industry where that is difficult to do. One way to find out is to join one of the national service associations, talk to other shop managers, and attend several management schools.

Only after you know (both intellectually and emotionally) that your service rates are fair to both you and your customers, should you try to convince your employees of these truths.

Call a meeting (on company time) and explain the relationship between your prices and their wages. If necessary, reveal the cost percentages. Prove to the employees that there is no magic way of making money; it must come from the prices charged to customers.

Remember: the attitudes of your employees will show through them to the customers. Therefore, unless both you and your employees believe in the fairness of the rates, the other aids for preventing pricing complaints can't be totally successful.

Step 3—Professional appearance

Perhaps we all suffer somewhat from the delusion that the value of our technical expertise is obvious, thus entitling us to perform service work in dirty, smelly bib-overalls without any adverse effect on the amount we can collect without re-

sentment. Not true!

If you dress as a professional should; if you look like an educated person who attended a technical school; if you radiate the assurance of competence; and if you don't act sheepish about the charges, then the customers will pay your rates without question.

On the other hand, if you seem apprehensive when presenting the bill, and if your clothing appears to be from a rummage sale, it's likely your customer will not be satisfied with the price, even if it is so low that you are losing money.

You can test the value of a good appearance without much cost or trouble. Try wearing a new shirt with tie, a blazer, shined clean shoes, and the latest kind of slacks. Make sure you have a fresh haircut and are well-groomed. Paint or clean up your truck, and make certain the signs are readable and attractive. At first, your regular customers might tease you about a possible new girl friend, but when they learn your improved professional appearance is not a one-day event, you will hear less complaining about prices.

Step 4—Reveal technical complexity

Customers are vaguely aware that electronic equipment is mysterious and complex, but a few unobtrusive demonstrations will prove to them that you are performing service work which few people can do.

It's not necessary to lecture in electronic slang, or to do anything obvious. Just let them *see* you use some of your fancy equipment, especially those devices that look as though they came out of *Star Wars*.

Of course, it's easier to make a home service call without taking in a tube checker, a dot-bar generator, a digital meter, or a module caddy. But, if you want to earn **maximum** respect for your knowledge, haul such items of equipment into each home, and **operate** them.

Once I knew a shop-owner/technician who usually entered homes during calls with only a universal handle and a few screwdriver/nut-driver blades hidden in his hip pocket. I've often wondered what his customers thought about a technician who **apparently** started a

TECH.	TECHNICAL SERVICES PERFORMED	AMOUNT
	Trip Charge	
	Return Trip or Pick-up Charge	
	Delivery and/or Installation	
	Service Charge for mileage beyond normal radius	
	Analysis or Bench Diagnosis	
	Convergence	
	Align	
	Align	
	Replace	
	Replace	

Figure 2 The Tech Service form by Tech Spray is printed in blue and yellow. It has many categories for analysis, adjustments, and parts replacements that are rated in "units". The total labor is determined by the units multiplied by the hourly rate.

(Courtesy of Tech Spray, Inc.)

service call without *any* tools or equipment. Of course, he had the usual equipment in the truck; but first impressions are important.

In the shop, let your customers see you *from a distance* as you use those mysterious space-age gadgets on their machines. After the repairs are finished, you can elevate your technical image by making a casual remark, such as, "Your flyback checked fine on the sweep-circuit tester." Or, "My video analyzer proves your TV needs a complete IF alignment." Who would question modern science or the value of equipment which provides a precise diagnosis?

Contrast that customer's reaction with another who watched a "technician" use one worn-out screwdriver to pound on the insides of his TV, in the midst of a cluttered bench without any visible test equipment. You can bet the second customer is going to be suspicious

of ANY price he is charged!

Step 5—Invoices and pricing systems

Experience indicates that about half of the nation's 50,000 service businesses could increase their dollar incomes about 20%, while reducing pricing complaints by about 50%. How? By throwing away all of their cheap unimpressive service tickets, and buying new professional invoices.

An adequate service invoice should tell the essential details of each repair, and break it down into functions. All parts used should be itemized and priced separately.

I believe that a detailed and attractive service-invoice form will be more important to you in making a profit than the repair job itself! It gives the impression of having nothing to hide, and this can ease the natural skepticism of many customers.

Examine the "feed store" billing

form in Figure 1, and contrast it with the excellent forms by Tech-Spray and Sperry-Tech. We have shown as much of these forms as possible in Figures 2 and 3.

When listed on the "feed store" form, *even the most complicated and expensive repair job appears to be minor* (and thus overpriced).

The larger 8½" by 11¾" forms seem to be excessively bulky and complicated, compared to the 3¼" by 5¼" "feed store" type. But they are worth much more than the small amount of extra trouble and expense. First, they reduce customer complaints, because each component or each labor procedure is detailed. It's difficult to argue against detailed facts, and customers will visualize extensive service operations because of the many listings. This brings the listings into balance with the **reality** of the work done.

continued on page 38

SOLID-STATE REPLACEMENTS FOR TV HV RECTIFIER TUBES

AVAILABLE FROM STOCK FROM YOUR DISTRIBUTOR



Replace vacuum and gas rectifier tubes with thoroughly proved (in use for over 8 years) solid-state, silicon rectifier Solid-Tubes.® They meet or exceed standard tube ratings. Only 6 replace 37 vacuum tubes. Off shelf distributor delivery.

You'll make more money because there's a bigger profit and your customer will get: no more filament burn out (They're perfect replacements when the HV filament transformer burns out.) Constant output. Long life; reliable and dependable. No warm up. No heat. Replacements available for all tubes.

SOLID-STATE TUBE CROSS REFERENCE LIST

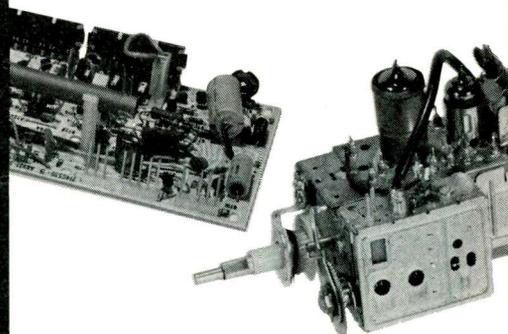
EDI	SYLVANIA	GENERAL ELECTRIC	ZENITH	RCA
R-3A3	ECG-508	GESS-3A3	S-3A3	SK3756
R-3AT2	ECG-509	GESS-3AT2	S3AT2	SK3757
R-3DS3	ECG-514	—	—	SK3761
R-3DB3	ECG-510	GESS-3DB3	S-3DB3	SK3758
R-2AV2	ECG-511	GESS-2AV2	—	SK3759
R-DW4	ECG-512	GESS-6DW4	—	SK3760
R-3DR3	ECG-514	GESS-3DS3	—	SK3761

Send For Complete Information Kit

edi electronic devices
21 Gray Oaks Ave., Yonkers, N.Y. 10710
(914) 965-4400, TWX 710 560-0021

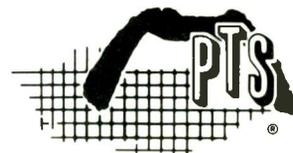
Circle (17) on Reply Card

TUNERS • MODULES



The next time you need a tuner repaired or module rebuilt:

- Remember **FAST SERVICE**
- Remember **PROFESSIONAL QUALITY**
- Remember **ONE-YEAR LIMITED WARRANTY**
- Remember **PTS ELECTRONICS**



PTS ELECTRONICS, INC.

SEE THE YELLOW PAGES FOR THE PTS SERVICENTER LOCATION NEAREST YOU

Circle (18) on Reply Card

Service management

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Any reduction of callbacks and rework jobs from complaints helps you to make more profit with less work.

Of course, you should have your shop logo, business name, complete address, and phone number **printed** on the forms. This information is cheaper to add with a rubber stamp. Unfortunately, it also looks cheap.

One more thing: **Don't delay in obtaining new service forms.** After you are convinced that new forms would help your business, you might be tempted to wait until the old forms are used up. **Don't do it!** Throw out the old ones the same day the new forms are received.

Outside-authority pricing systems

Both Tech-Spray and Sperry-Tech offer excellent incremental-pricing systems that reduce complaints by listing average times for specific service functions. You then determine the price per hour for *your* shop. These systems increase your customer's confidence in your charges by listing repair times

according to a third person (outside authority). This minimizes any suspicions that you might be making up the times or prices from guesswork or whims.

These systems will be described later in detail.

Step 6—Price and policy signs

Take a few moments, while you are alone in your shop, and look at the signs in the reception area. Most shops have one or more signs that list the various prices to be expected for certain common types of repair jobs. Look at these signs as though you have never seen them before.

Are they dirty, faded, or cracked from age? Are they little more than some barely-readable lists that you scribbled with a marker pen? Originally, were they professionally lettered, but have had some of the prices marked over until they now are an eyesore?

If your signs are in any of these deplorable conditions, have new attractive ones made. And do it *now*. **Customers don't want to see**

any evidence of price increases, even though they are painfully aware of inflation.

Also, hastily-drawn amateur signs, or professional ones with crude price changes lead the customers to think you have guessed at fair prices.

Attractive signs without changes or corrections help convince your customers that the prices were carefully selected and *calculated*; that they were *established* some time ago; that they fit a *routine* pattern after having been tried and proved; and therefore are not subject to question or debate.

Electronic repairs are not bought every week, and customers can't be expected to know whether they are getting a bargain, or being ripped off. But routine prices help to quiet many doubts. After all, **prices that are paid routinely by many others just can't be very wrong.**

Summary

The following is a summary of the suggestions given here for minimizing customer complaints about high prices:

- Establish your service charges (after you have reduced waste and increased the efficiency) by using a system which you know is fair to you and to your customers.
- Convince yourself and your employees that your prices are a bargain.
- Dress as though you are a well-paid professional. Improve your truck and shop in the same way.
- Reveal to your customers *some* of the technical space-age equipment and advanced knowledge you must have for today's service work.
- Use large and detailed professional service invoices (the best you can find).
- Take away most of the customer's pricing fears by having prominently-displayed attractive signs. Don't botch any price changes, but have them appear as old as the sign itself.

Display this condensed set of pricing suggestions near your desk, where you can see it every day, and remind you of actions you should take. □

TECHNICAL DESCRIPTION	TECH	CHARGES	CODE	AMOUNT
1 Outside Service				
<input type="checkbox"/> TRIP				
<input type="checkbox"/> RETURN TRIP				
<input type="checkbox"/> DELIVERY & REINSTALL				
<input type="checkbox"/> MILEAGE				
2 Preliminary Diagnosis				
<input type="checkbox"/> 1ST <input type="checkbox"/> 2ND				
2A Antenna—MATV				
<input type="checkbox"/> MINOR <input type="checkbox"/> MAJOR				
3 Remove & Replace				
<input type="checkbox"/> CABINET <input type="checkbox"/> MAIN CHASSIS				
<input type="checkbox"/> TUNER <input type="checkbox"/> SUB ASSEMBLIES				
4 Precision Adjustments				
<input type="checkbox"/> AFPC <input type="checkbox"/> BIAS—AUDIO <input type="checkbox"/> SPEED REG				
<input type="checkbox"/> AFT <input type="checkbox"/> BIAS—RECORD <input type="checkbox"/> TORQUE				
<input type="checkbox"/> CONVERGENCE <input type="checkbox"/> TONE ARM <input type="checkbox"/> HEADS				
<input type="checkbox"/> L V RECT <input type="checkbox"/> CYCLING—REJ <input type="checkbox"/>				

Figure 3 A condensed version of the Sperry Tech pricing method is included in the blue-and-pink service forms used by Sperry TV. Detailed labor functions are rated in tenths of an hour, totalled at the end, and then multiplied by the per-hour rate.

(Courtesy of Sperry Tech, Inc.)



Charged Versus Uncharged Capacitors

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:

J. A. "Sam" Wilson
c/o Electronic Servicing
P.O. Box 12901
Overland Park, Kansas 66212

Capacitor Question Revisited

One of the readers who disagreed with some of the things I wrote recently about capacitors is Larry Reid, who lives in California. Specifically, he objected to my answer for question 3 of the quiz in the February 1978 issue of **Electronic Servicing**.

The circuit is printed again in Figure 1. My answer under the stated conditions was and is: 100 VDC is present at the output. An electrostatic meter (which draws no current from the circuit) will show a steady 100 volts.

However, **capacitances in real-life circuits don't remain uncharged very long**. That's where Reid went wrong. Just as soon as current (even from the load of a VTVM) is drawn from the output, the capacitor begins to accept a charge, and the output voltage drops. The time constant of the circuit determines how fast the DC voltage drops. And, notice that the *conditions* of Figure 1 have changed now, because *the capacitor no longer is*

totally uncharged.

To prove his contention that uncharged capacitors don't pass DC voltage, Reid sent me a 1.5-volt battery wired in series with a 220-picofarad capacitor (Figure 2). He said the capacitance was reduced to compensate for the lower voltage, and that his VTVM measured zero voltage at the output.

Actually, the capacitance value has nothing to do with the principle, but a larger capacitor value would have given a short pulse of DC voltage, thus showing him the transient nature of the action.

Mathematical proof

The time constant of any resistance-capacitance circuit can be calculated easily from the formula: **Time equals the resistance** (in ohms) **multiplied by the capacitance** (in farads). Assuming that a VTVM having an input resistance of 11 megohms was used, the time constant is: $T = 11 \times 10^6 \times 220 \times 10^{-12}$

$$T = 0.00242 \text{ seconds}$$

continued on page 40

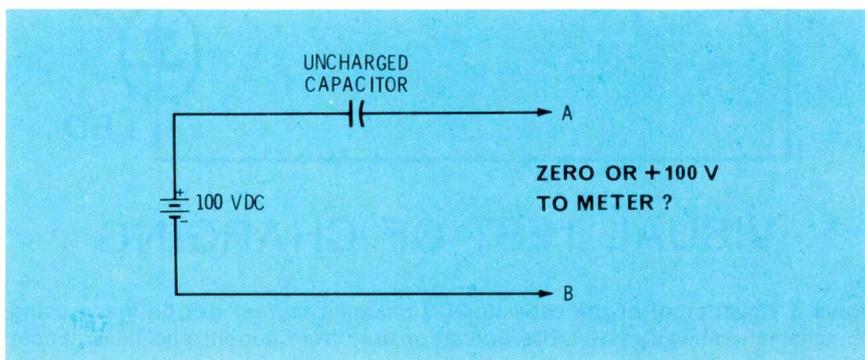


Figure 1 What is the voltage between terminals A and B? This is the question that has aroused some controversy.

Technical notebook

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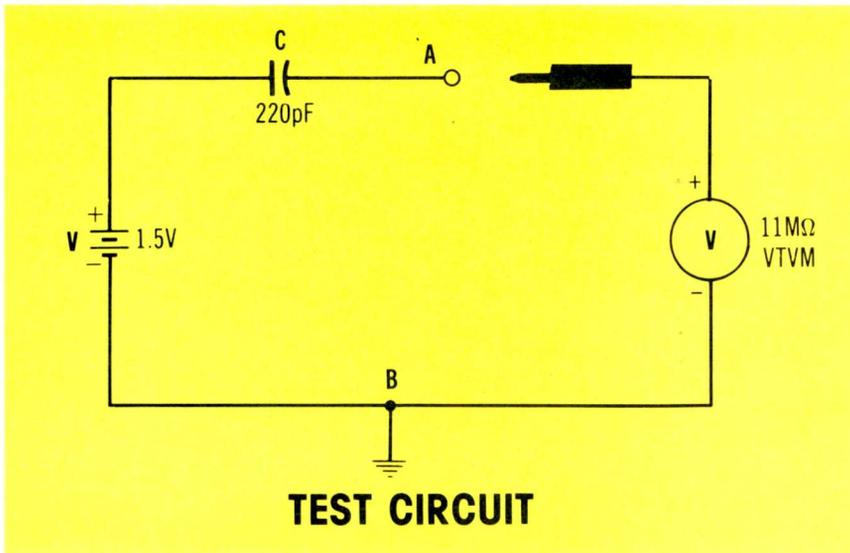


Figure 2 One doubting reader sent in this battery and capacitor, saying he couldn't measure any DC voltage with his VTVM. A larger capacitor would have provided a DC voltage pulse of sufficient duration to be read on his meter.

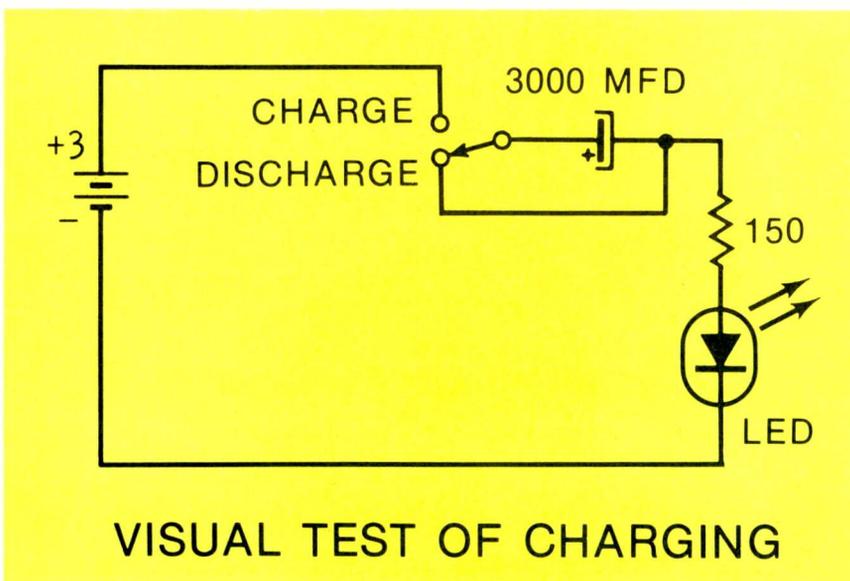


Figure 3 Visual proof of the capacitor DC charging current can be made using the schematic shown here. LEDs operate mainly from current and have almost instantaneous response.

That's the time required for the charge in the 220 pF capacitor to reach 63.2% of the supply voltage. Any voltage across the capacitor must be subtracted from the supply voltage to give the output voltage. So, at turn-on, the capacitor has zero voltage across it, leaving the full 1.5 supply volts at the output.

After one time constant of 0.00242 seconds, the capacitor has 0.948 volts, and the output voltage is 0.552 volts.

After two time constants totalling 0.00484 seconds, the capacitor has 0.599 volts and the output is 0.349 volts.

A capacitor is considered to be fully charged after 5 time constants. In other words, after about 12 milliseconds (0.0121 second), the capacitor charge is 1.5 volts, and the output measures zero volts.

A VTVM DC voltmeter will show **zero** volts across the output of Figure 2, because the short pulse of voltage decays to zero volts **before** the pointer can move up from the resting position. A DC scope, or other fast voltmeter, can show the short pulse, but your eyes will have difficulty following it.

Of course, the capacitor charging can be slowed by increasing the Figure 2 capacitor value, allowing a VTVM or FET meter to follow the changing output voltage.

For example, I first tried a 150 microfarad electrolytic, but stopped the count after several minutes, when the output voltage remained above 1.5 volts. Another capacitor (marked 10 microfarads) required about 80 seconds before the VTVM reading dropped to the 1-time-constant voltage of about +0.95 volts on the 1.5-volt range. Also, a 0.1 capacitor dropped to the same voltage in about 1 second. (Digital meters are not suitable for tracking these large voltage changes.)

Or, you can do an interesting (but uncalibrated) visual experiment using an LED as the indicator, since it has instantaneous response. Wire the circuit of Figure 3, which includes a convenient way of discharging the capacitor. The LED flash, when it's switched to charge position, begins with full intensity and rapidly dims over a period of two to three seconds (depending on the individual components). The capacitance must be very large, because the LED has a low resistance.

Passes current when charged?

Reid also wrote, "In your explanation of why we should read (the battery voltage) between points A and B, you state that a capacitor passes current until it becomes charged. Not so....no current can pass **until** the capacitor becomes charged."

Probably the preceding information has convinced Reid already. In addition, I could refer him to the textbook charge and discharge curves of voltage and current with capacitors. Instead, let's consider the schematic of Figure 4. If the capacitor actually is charged already (as Reid evidently believes), its voltage **MUST** equal the battery voltage, but have the opposite polarity. Therefore, the voltages will cancel, leaving zero volts between points A and B. So, if a resistor is connected from A to B, no current can flow.

As we found from the information and experiments just given, capacitor current **DOES** flow strongest when the capacitor is uncharged, and it diminishes according to the time constant. Perhaps I should explain that a VTVM connected between A and B of Figure 2 actually is reading the capacitor **current** by measuring the **voltage** drop across the internal resistance of the VTVM. Please study the schematic.

Thanks

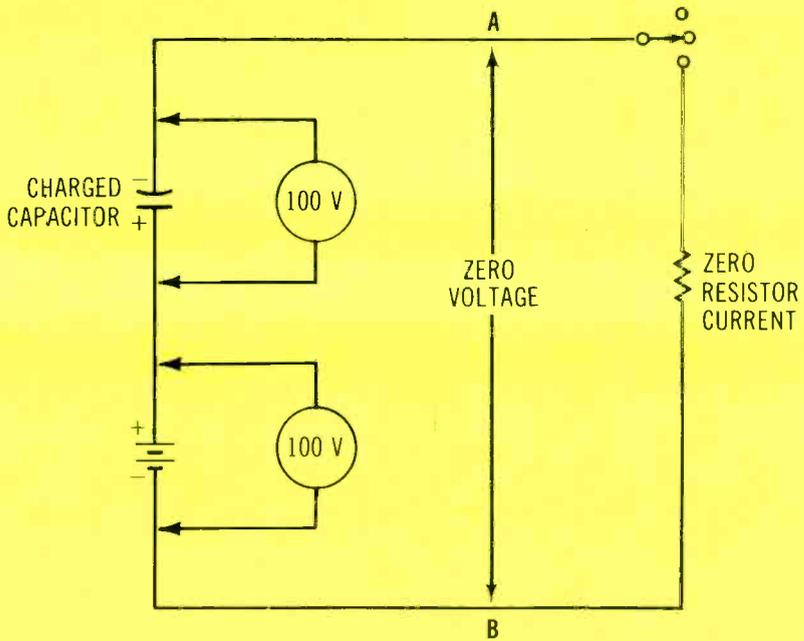
Mr. Reid, thanks very much for the questions and taking time to write.

Incidentally, a number of technicians objected to the previous quote because I said the "current flows through the capacitor." Their point is well taken, if you define current as being a flow of *electrons*. However, I don't define current that way, so my model is not in jeopardy.

Question About A Practice Question

Allen Daubendiek of Beatrice, Nebraska, sent in a query about a question in one of my CET Practice Tests. The question is repeated here.

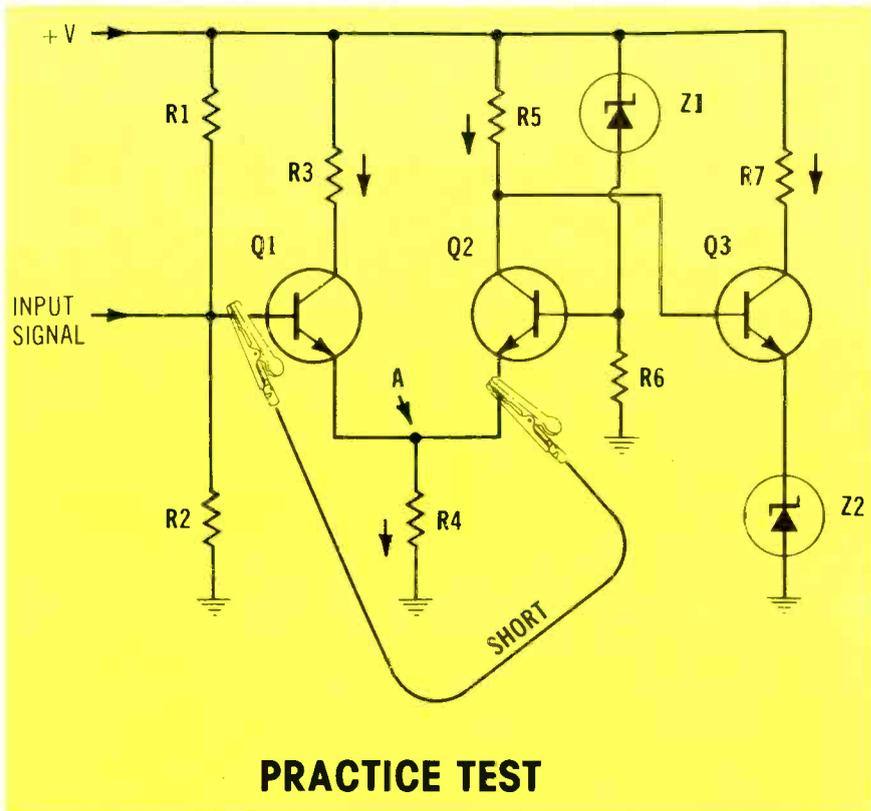
Question: In the circuit of Figure 5, which of the following would most likely occur when the base of Q1 is shorted to the emitter of Q2?
continued on page 42



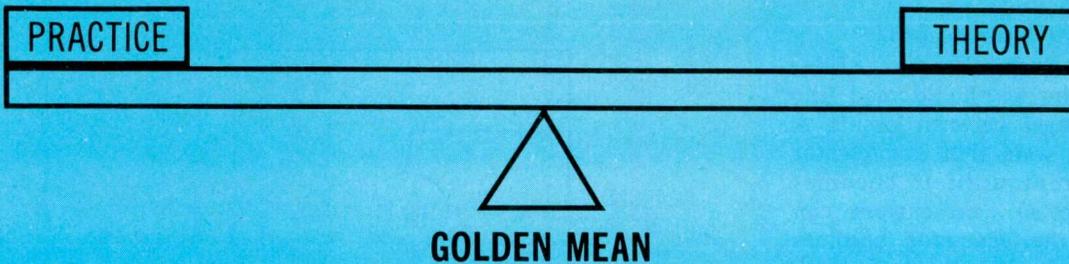
CHARGED COUPLING CAPACITOR HAS NO OUTPUT VOLTAGE OR CURRENT

Figure 4 In answer to another dissenting opinion, it's true a **charged** capacitor has full supply voltage across it. Therefore, a charged capacitor in Figure 1 or Figure 2 would give this equivalent circuit, which would not ever allow any output current or voltage. Perhaps the reader was confused by voltage and current that can be drawn (discharged) from the two leads of a capacitor after it has been charged.

Figure 5 What actions occur when the base of Q1 is shorted to the emitter of Q2? Arrows show "conventional" flow of current.



PRACTICE TEST



WHERE ARE YOU ON THE "GOLDEN MEAN?"

Figure 6 Aristotle's "Golden Mean" applies to technicians, who also operate most efficiently when they have equal amounts of theory and practice. Where do you rate yourself?

Technical notebook

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(1) Transistor Q2 would be destroyed. (2) Very heavy collector current would flow in Q3. (3) The collector of Q2 would become less positive. (4) Transistor Q1 would be cut off.

The answer in the Practice Test is given as (2). That answer is wrong! The correct answer is (4).

Mr. Daubendiek correctly reasoned the following circuit action:

- Since the emitter of Q1 is connected to the emitter of Q2, shorting the base of Q1 to the emitter of Q2 is the same as shorting the base of Q1 to its own emitter—the forward bias is eliminated, along with the Q1 C/E current.

- This reduces the current in resistor R, thus decreasing the emitter voltage.

- Reduced Q2 emitter voltage increases the forward bias, the same as a more-positive base. Therefore, Q2 conducts more C/E current.

- Increased conduction by Q2 reduces its collector voltage, and with it the Q3 base voltage of Q3.

- Less positive voltage at the base of Q3 decreases the Q3 C/E current.

Daubendiek has an excellent grasp of bipolar-transistor theory. There is an important point to be made here. Mistakes sometimes creep into printed material, even after the many times it is proofread. Therefore, if you don't agree with some fact (and you have not overlooked an important point), then *please* write to me about it!

I'll be glad to exchange information with you. But there's one exception. I don't respond to sarcastic or insulting letters. Your letters have been very professional, and I thank you.

Where's The Resistance

A pleasant letter from Robert Saunders, electronics instructor at the James Whitcomb Riley High School in South Bend, Indiana, says in part, "You refer quite often to the **resistance** of a capacitor or inductor." He goes on to say that the internal opposition to current flow is called **reactance**.

Of course, Saunders is correct. However, in a quick search of the articles, I couldn't find any such reference. I would appreciate you telling me the issue and page number of any examples.

Practical components have DC resistances, such as the leakages in capacitors. Could that have been the way the word was used?

Editor's Note: In my past hobby of designing elaborate audio amplifiers, I made extensive use of a capacitor's equivalent resistance. Of course, a capacitor's equivalent resistance to AC is the "capacitive reactance," but it is measured or stated in ohms versus frequency. Perhaps during the editing, I regressed to this short cut. In any event, please show us some examples, and we will make corrections if the wrong term was used.

The "Golden Mean"

You will remember from your

study of Greek history and mythology that Aristotle was obsessed with the idea of finding the greatest "virtue." His approach to the greatest virtue was called the "Golden Mean," which is always halfway between extremes.

Practical applications

By considering **theory** and **applications** as opposite ends of the extreme, Aristotle probably would say that a good (virtuous) technician practices the Golden Mean. As shown in Figure 6, equal portions of theory and practice are required to achieve a balance.

Aristotle's philosophy certainly has much to recommend it. A man who has knowledge of nothing but theory, *without* any practical applications, tends to be useless, according to his value to employer and customers.

Once, long ago, I knew a genius in electronics who was stumped by a vacuum-tube voltmeter (VTVM) which would not measure resistance. This brain had disassembled the VTVM in a vain effort to find the trouble. He spent two whole days analyzing the circuit, but failed to find any bad parts.

However, someone else had cannibalized the unit by taking out the ohmmeter battery! This theory man was so obsessed with the problem that he actually redesigned the VTVM so it worked better, but he never could make the ohmmeter function operate.

At the other extreme is a person who has all practical-application experience and knowledge, but



MAGNETIC POLES IN WELDING ROD

Figure 7 Another reader offers his theory explaining the multiple poles measured in a magnetized welding rod.

doesn't know any theory. Such a person also is worthless. I have known of anti-theory technicians (?) who butchered new circuits in disastrous attempts at repairing them. Their practical experience did not (and could not) prepare them for repairs of any new receivers.

I once saw a technician installing an antenna in Akron, Ohio. He formerly had worked for a friend of mine, so I knew him slightly. As we talked, I told him about a class I was teaching. "I don't go for all that theory stuff," he said. "The class wouldn't help me."

I watched in amazement as he worked. He laid the twin-lead wire (coming from the VHF antenna) flat against the roof, taped it along several feet of drain pipe, and finally brought it through a window. My knowledge of transmission lines told me that the moisture on the line from rain or snow would give a poor picture.

Sure enough, within three weeks another team arrived to rework the installation, particularly the location and securing of the twin-lead. Apparently, this made the customer satisfied with the picture, because no other work was done on the antenna for several years.

Unfortunately, the anti-theory guy probably didn't get any feedback report to tell him of his mistake.

Tests

When I wrote the CET tests, I constantly was faced with this problem of the Golden Mean between theory and practice. The association officials and I felt each technician should know *both* before he could be certified. Although I arranged the tests very closely for half theory and half practical experience, the first versions of the

tests were criticized for being oriented to theory.

To prove or disprove the complaints, we gave the same tests to some college professors, and compared their grades with those of an equal number of practicing electronic technicians. **The technicians made higher scores on the tests**, indicating that the professors, who undoubtedly were much stronger in theory, could not answer the practical questions.

Of course, the test will please only those who have equal strengths in both theory and practice. All others will think the tests are unbalanced.

Look again at Figure 6, and mark an arrow on the drawing where you would rate yourself at this time. Then, consider whether you should take action to increase either your practical or theoretical knowledge to bring you nearer the "Golden Mean."

Letters Delayed In Moving

If you sent me a letter, but have not received an answer, please forgive me. I have been moving, and my packing was done by a young man who works for me part time. I made the mistake of telling him to pack everything in boxes, and then left for several hours. When I came back, he was just folding my model of the Hindenburg, and placing it in the last box. All of my correspondence is somewhere in those boxes.

So, if you haven't received an answer, please write again. That will be quicker than waiting until the many boxes are unpacked.

Magnetic Pole Mystery

In the March issue of **Electronic Servicing**, I described the unsuccessful attempts of my students to magnetize a 3-foot length of steel

welding rod so there is a north pole at one end, a south pole at the other end, but no extra poles in between. When they used a compass to check the results, there were many NN and SS poles in between, as shown in Figure 7.

In a letter, Edward Marceau Jr., gave his reply. The pertinent parts are quoted here.

"The answer is basically simple. As you probably learned long ago in physics class, a steel bar is made up of an endless array of individual magnets (molecules) that are lined up north and south. Also, if you have ever done the experiment with iron filings sprinkled on a piece of paper, and a magnet held underneath, then you know that there are magnetic lines present.

"Now, back to the welding rod. (Why this type instead of iron?) The rod does have continuous field lines from end to end, but because of the weak magnetic field present, and the low sensitivity of your compass, you cannot detect the **outer** field lines. Instead, you are seeing the inner field lines which have + and - nodes just like standing waves in an antenna.

"What is needed is a Hall-Effect Magnetometer. It's a sensitive device for detecting magnetic fields, and one can be built from plans in the 1977 issue of *Popular Electronics Experimenters Handbook*, pages 48-51."

Dear Mr. Marceau:

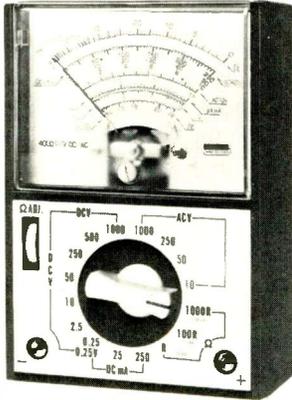
I want to thank you for taking the time to write. You must have spent appreciable time thinking about the problem.

At this time, I'm not going to agree or disagree with what you say. Perhaps other readers will want to comment. Let's hope so. I'll discuss the subject again in a later issue. □

test equipment report

Multimeter

EICO Electronic Instrument Company has added a multimeter to its Truvohm line.



Model 4A4 is a 4000 ohms/volt general-purpose instrument with 17 ranges. The meter measures up to 1000 VDC and VAC, up to 250 mA DC and up to 2 megohms resistance.

It features a recessed selector switch and a 3-inch meter with mirror-back scale all contained within a high-impact plastic case.

Suggested price is \$17.95.

Circle (54) on Reply Card

Power Supply

Circuit-testing capability is featured on the Supplyst power supply from **VIZ Test Instruments Group**.



Model WP-707 provides two outputs independently adjustable to

0.1V in five switched ranges from 0-25V. The full-load output current is 0-2A over the entire voltage range. Load regulation is better than 0.075% over the full operating range; line regulation is better than 0.05% at full output voltage and current when the input voltage is 105-130VAC.

The unit has current-limiting overload and short-circuit protection; each output has its own LED to indicate an overload, and its own reset button.

Circle (55) on Reply Card

Logic Probe

The IT-7410/ST-7410 Logic Probes by **Heath** are designed for in-circuit testing of TTL and CMOS integrated circuits.

Features include switch selection of threshold levels and a memory circuit.



The probes are said to provide true logic level detection at high frequencies (not AC-coupled) and detect pulses as short as 10 nS.

Power for the probe is drawn from the circuit under test via two spring-loaded, insulated clips, and a ground lead is provided for high frequency operation.

Circle (56) on Reply Card

Multi-tester

Universal Enterprise's DM100 digital multi-tester features auto-

matic zeroing, automatic polarity indication, .4-inch LED display, 3½-digit resolution, over-range indication, 10-megohm input impedance, fuse protection, battery test mode and 25 ranges.



Available accessories include a tilt stand carrying case, an AC adapter/battery charger, nickel-cadmium batteries, and a variety of test leads, probes, adapters, and connectors.

Circle (57) on Reply Card

RFI-Shielded DMM

Dynascan has announced a **B&K Precision** lab digital multimeter. Model 2830 is a 3½ digit AC-powered unit that also can be used in the field with the optional battery pack and features a high-efficiency LED display with 0.43-inch high digits.

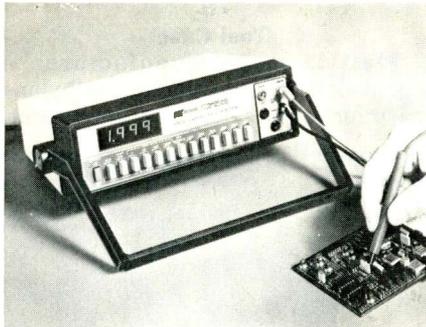
It has a basic DC accuracy of 0.5% and autozeroing, auto polarity and 100% overrange on all ranges. It is shielded to stay accurate when used in RF fields, including operation near business band, broadcast, CB and amateur radio transmitters.

All ranges and functions are pushbutton selectable and a built-in 10-amp current shunt permits the

measurement of current up to 19.99 amperes (with overrange), without the need for an external plug-in shunt.

Voltage measurement capability extends to 1,000 VDC or 750 VAC or up to 40,000 volts with the optional PR-28 probe.

The unit is available with a 10-ohm range, capable of 0.01-ohm resolution. The unit offers a total of seven ohms ranges for measurements spanning from 0.01 ohm to 20 megohms.



Selectable high-/low-power ohms permits in-circuit resistance measurements without forward-biasing semiconductor junctions, and allowing high/low selection on four ohms ranges. All voltage ranges are protected to a minimum of +1,000 VDC or DC + AC peak.

The combination tilt stand/handle permits the 2830 to be viewed from four angles. For field use, available options include the LC-50 carrying case and BP-30 battery pack.

The BP-30 permits 8 hours of continuous use from one overnight recharging and can be done while the unit is being used.

Recommended list price is \$235.

Circle (58) on Reply Card

Portable Scope

Tektronix had added a battery-operated, rugged, lightweight, portable scope to its Teletest line.

The D34, a dual-trace, 15-MHz oscilloscope with a single time base, has major applications in minicomputer and peripheral servicing, μ Ps trouble-shooting, and video and communications equipment servicing.

TV triggering allows automatic lock on to the TV frame at sweep

speeds below 0.1 mS/div, and to TV line at higher sweep speeds.

The scope also can be powered up for calibration when open and will operate up to 4 hours on internal rechargeable batteries or can be connected to AC line.

Suggested list price is \$1220.

Circle (59) on Reply Card

Frequency Counter

Radio Shack offers the Micronta Digital Frequency Counter 22-351 for use in making frequency measurements in audio, RF, video, ultrasonic and digital applications.



The counter has a 0.6-inch, 6-digit LED display with lead zero blanking. Frequency resolution is 100 Hz throughout the 100 Hz to 45 MHz range, and is protected against input overvoltage.

Circle (60) on Reply Card

Features of these products were supplied by the manufacturers, and are listed at no charge to them. If you want factory bulletins, circle the corresponding number on the Reply Card, affix a stamp, list the required information, and mail the card.

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123	.79	183	3.63	233	.74	306	2.80
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Moisture Repellent

Chemtronics' industrial-grade DPL spray displaces moisture in electrical and electronic circuitry.



The spray eliminates moisture-induced short circuits and leaves a coating on the equipment that protects against rust and corrosion outdoors for six months to a year, and indoors for well over a year.

Two-way radio repair personnel rely on moisture repellents for restoring proper component values in mobile units which have become wet during severe weather. DPL also will help waterlogged engines get going by spraying damp wiring, spark plugs, coils, distributors, etc.

Circle (61) on Reply Card

De-soldering Braid

Wik-It Electronics offers an expanded line of de-soldering braid.



Featured is the Tinned Braid and the Tiger Stripe and Copper Braid.

The Tiger Stripe combines equal strands of copper and tin to provide good performance plus the ability to see the solder flow into the braid. A new size, .075-inch, is now available.

Wik-It de-soldering braid is ultrasonically cleaned and manufactured with water-white pure non-conductive rosin.

Circle (62) on Reply Card

VCR Maintenance Kit

A videocassette recorder maintenance kit for VCR heads is offered by the recorder-care division of **Nortronics**.

Model QM-95 kit contains products required to keep delicate video heads free of dust, dirt and the accumulated tape-oxide debris that can cause snowy pictures and possibly damage pre-recorded tapes. Products included in the kit include QM-103 spray tape head cleaner; a



special anti-static dust cloth; a quantity of QM-505 cellular-foam swabs; and a special screwdriver for removing headcover screws of Betamax, JVC and other videocassette recorders.

Circle (63) on Reply Card

Interference Handbook

Sony's RF Interference Handbook gives detailed directions for correcting 25 different forms of RF interference.

Covered in the book are remedies

for everything from common sources of RF interference, such as CB radios and commercial broadcasting stations, to new forms, such as home video games, semiconductor "hash" and electric motors and ignition systems.

Corrective actions for each type of RF interference are outlined in separate sections devoted exclusively to one particular interference form.

The handbook is available for \$5.

Circle (64) on Reply Card

Tool Case

Platt Luggage manufactures a compact, lightweight polyethylene case for tools, parts and equipment.



Besides being dent, shatter and scuff proof, the single unit construction features a double wall, molded locks, handle and hinge. A molded pallet to hold a large selection of tools is included.

Circle (65) on Reply Card

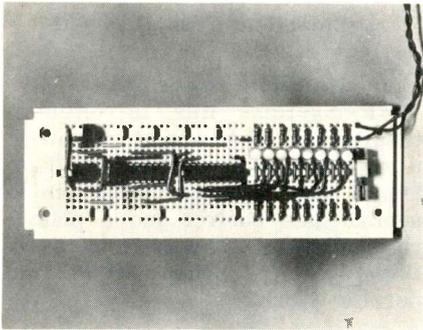
Experimenter Sockets

Continental Specialties Corporation Experimenter sockets are designed for electronics, from industrial training programs to beginners' self-instruction.

DIP (dual inline package) ICs (integrated circuits) plug into the face of the breadboard, where each lead is held in a conductive spring clip which acts as a terminal and connects a group of five adjoining

holes.

Components can be interconnected through the use of individual terminals directly, or through the use of jumpers between terminals.



No soldering is required as ordinary solid hookup wire works as jumpers. Most electronic components, resistors, capacitors, diodes, and transistors can plug directly in, and components may be removed from the circuit by hand, without tools.

CSC sockets are available in five models, priced from \$4.00 to \$10.95 per unit.

Circle (66) on Reply Card

Parts Directory

The 1978-79 Tuner Replacement Guide & Parts Directory from PTS Electronics has 182 pages of technical information about TV tuners and modules, tuner blow-ups, diagrams and comprehensive descriptions of PTS products and services.

The catalog contains sections on module repair, a list of all modules rebuilt and exchanged, a module cross-reference guide, troubleshooting information, a section about PTS test instruments, PTS tools and chemicals, and a list of exact tuner replacements by manufacturer.

The catalog is available through each of the 43 PTS company-owned service centers located in major metropolitan areas.

Circle (67) on Reply Card

Ratchet Screwdriver Sets

Xcelite has packaged two offset ratchet screwdriver sets for assembly and repair involving Allen hex, Phillips and slotted screws.

The 19-piece No. XL-70 includes

12 hex socket screw bits, Nos. 1 and 2 Phillips, a reversible ratchet arm, a spinner/extension, and a hex/square adapter bit. It is packaged in a molded plastic bench case.

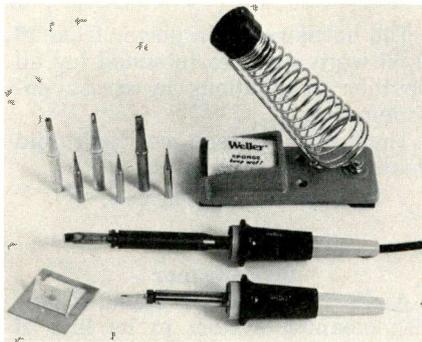
The No. XL-75 set includes the same size slotted and Phillips screw bits and ratchet arm. It is packaged in a molded plastic tool kit pouch.

Circle (68) on Reply Card

Industrial Irons

The Weller W and WP industrial soldering iron series feature multi-purpose operational use with interchangeable tips.

The W60 and W100 controlled output irons offer a wide assortment of screwdriver-style tips with selection of automatic temperatures of 600°, 700°, and 800°.



Both are available in 2- and 3-wire cord models.

Circle (69) on Reply Card

Microphone Holder

Oneida has introduced a self-adhesive mike holder for attaching mikes to any surface. For metal surfaces the magnetic back will hold; for non-magnetic surfaces the self-adhesive back holds. The holder will accommodate all standard microphones.

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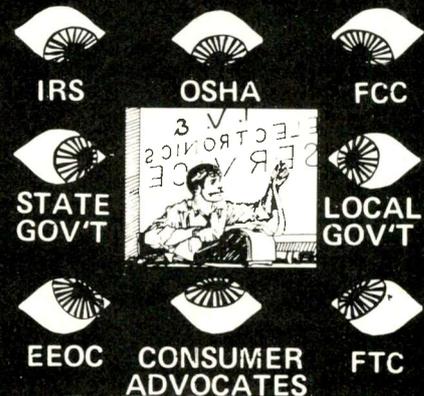
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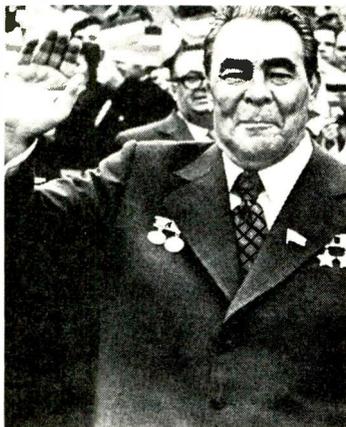
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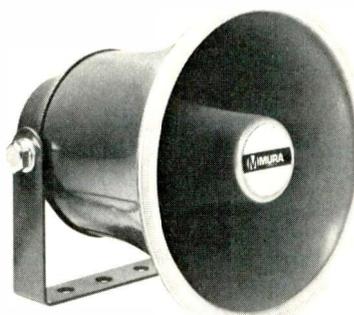
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PA Horns

Mura has introduced a new line of all weather-resistant high power PA horns for emergency vehicle and marine use.



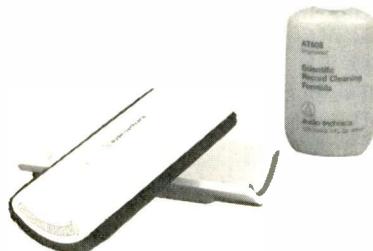
The horns range in power from 10 to 60 watts and are intended for all weather applications in stress environments.

They have passed sea salt and weather resistance tests.

Circle (71) on Reply Card

Disc Cleaner

Audio-Technica has added a new disc cleaning system to its line of record care products.



AT6012 Sonic Broom is a hand-held disc cleaner used with AT608 Record Care Formula, an antistatic

cleaning solution.

The cleaning pad is curved to insure the proper amount of cleaning surface contacts the record. The handle houses a reservoir of the formula which dispenses the proper amount of fluid to moisten the pad.

Circle (72) on Reply Card

Hand-Held Power Mike

JMR Systems has introduced "Clear-1" model 40 miniature power microphone for CB radios. The electret-type condenser mike has a variable gain control and a pistol-grip shape that allow it to be used at the steering wheel while the operator is driving.



A Velcro pad is furnished instead of a hanger to attach the mike to any handy surface when it's not in use.

Suggested retail price is \$44.95.

Circle (73) on Reply Card

Portable Sound System

A portable voice reinforcement system, the Perma Power Voice Carrier (model S-230) is available from Perma Power Electronics.

The S-230 offers a six-speaker sound column; 35-watt, solid-state amplifier; and professional dynamic cardioid microphone. An adjustable microphone stand is included.

The system is powered by 10 D-size flashlight batteries, which provide up to 200 hours of operation. A 120V AC adapter is available.

Circle (74) on Reply Card

Features of these products were supplied by the manufacturers, and are listed at no charge to them. If you want factory bulletins, circle the corresponding number on the Reply Card, affix a stamp, list the required information, and mail the card.

75. Dynascan—The 48-page BK-79 test instrument catalog features scopes, frequency counters, digital and analog multimeters, function and RF signal generators, capacitance meter, digital probe, semiconductor testers, power supplies, and two-way radio and television test instruments.

76. Mountain West Alarm Supply Company—A 72-page catalog on burglar and fire alarm products. Featured are magnetic door switches, control and bell systems, radar, ultrasonic and infrared detectors.

77. Atlas Sound—A 2-page bulletin providing a concise guide to two series of professional omnipurpose indoor/outdoor music loudspeakers. Also included is a wide range of the firm's microphone boom models and accessories.

78. Etco Electronics—A 16-page Surplus Electronics catalog featuring parts, components, test equipment, educational, industrial and consumer equipment acquired from leading manufacturers.

79. Leader Instruments—A 12-page booklet describing scopes, audio system analyzers, multimeters, frequency counters, color bar generators, and other general purpose instruments and accessories.

80. Parker Publishing—Catalog of new electronics titles of interest to technicians and engineers contains a wide range of titles including books on digital test equipment, reading schematic diagrams, troubleshooting and home electrical repairs.

82. Acoustic Research—"Truth in Listening," a 14-page catalog, defines the characteristics of accurate sound reproduction and describes the expanded AR hi-fi speaker line. Complete specifications, including DIN measurements, are provided for all seven speakers.

83. Electronic Devices—A miniature catalog shows the line of silicon-rectifier bridges, diodes, high-voltage rectifiers, TV high-voltage diodes.

86. Litton—The complete line of Kester standard solders, flux core solders, soldering fluxes, and vapor

degreasing solvents are covered in a new 12-page catalog. Descriptions of more than 50 solders and related items are included.

88. Heathkit—Nearly 400 electronic products in kit form are listed in the latest catalog. Among new products featured in the catalog are a three-band UHF/VHF scanner, a matching stereo tuner and amplifier, a five-function aircraft clock timer, and a programmable home-heating control for saving on home-heating expenses. The catalog also describes automotive and marine accessories, amateur radio equipment, test instruments, learn-at-home electronics courses, stereo equipment, and color TVs.

89. TRW Semiconductors—Included in the revised RF Transistors and Hybrids Product Selection Guide is the complete line of RF transistors and hybrids. The 16-page booklet (Number 503) contains complete data for TRW's microwave, VHF, UHF, linear and mobile-radio product lines. It also has package design diagrams and a frequency index for all devices.

90. AP Products—Limited quantities of number 7701 Applications Notes are available. It is a reprint of the article "A 555 Tester" which appeared in two electronic publications.

91. Hewlett-Packard—A new technical note describes how to use a frequency counter. Written for the technician, this eight-page note discusses how to get the signal into the counter, how to interpret the answer, and how to keep from destroying the counter. It also includes examples, two conversion charts and a list of references.

96. Mountain West Alarm—The burglar and fire alarm catalog features the complete product line, and alarm-application information on system design, installation procedures, and connection diagrams.

97. Norcom Electronics—"The Ultimate in Antenna Tuning Systems," describes isolated-circuit antenna tuners for CB mobile and base radio operation. The brochure illustrates and describes the features and operation of the firm's "Iso-Tune", "Back Talk", and "Ultra-Tune" antenna tuners. □

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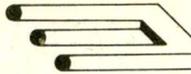
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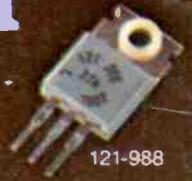
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