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Circle (1) on Reply Card


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May, 1979 □
Volume 29, No. 5

Electronic Servicing

Departments

About the cover

Good-quality color bars are shown on the General Electric AA-D color TV screen. The smaller picture measures the overall chroma response by the chroma-sweep pattern from a Sencore VA-48 video generator. Photography by Carl Babcoke; graphic design by Linda Franzblau.

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Electronic Servicing

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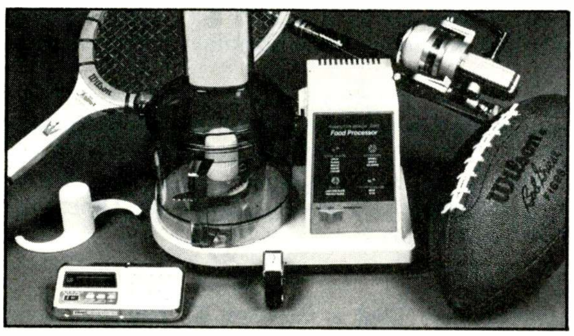

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Supertab '79 GTE SYLVANIA

SYLVANIA GTE

Circle (7) on Reply Card

Sony has introduced in Japan a Betamax with variable speed and other new features. The high-speed picture-search function allows the picture to be shown on the screen at a speed 20 times faster than normal. Other modes are still frame, frame by frame and variable slow motion. Industry rumors predict Sony later will introduce a 4-1/2 hour Beta-format machine.

Sampo Corporation of America will introduce its first 25-inch color TV consoles at the Consumer Electronics Show in June. The company plans to manufacture similar 25-inch consoles in the United States next year. Also, a combination 5-inch, ac/dc electronically-tuned color TV with cassette and AM/FM radio will be shown at CES.

Complaints against TV repairs dropped 18% in 1978 according to Arthur Startz of the Council of Better Business Bureaus, while appliance store complaints decreased 9.4%.

A potential HV-transformer defect in specific 13-inch and 17-inch Zenith color receivers will be repaired. All models L1310C, L132OW, SL1325W, L172OW, L174OW, SL1741W and L178OW that were shipped from the factory between January 1 and April 16 of 1979 are to be held in distributor's or dealer's inventory until repairs are made. Otherwise, some HV transformers might produce excessive HV momentarily.

Stereo manufacturer Capehart has filed a Chapter XI petition. Companies under Chapter XI attempt to correct an unprofitable operation while the court order shields them from creditors.

Sencore has started a new policy of giving away any replacement component not deliverable within 72 hours of order receipt. This matches the Sencore policy of a 72-hour turnaround service for test instruments serviced at the Sencore factory.

Earth graders can level a plot of ground to an accuracy of less than an inch when the scraper blade is fitted with a photoelectric receiver and a mechanism for moving the blade. A laser beam that is rotated several times per second is received at the grader which moves the blade up or down as required to center the beam on the photo cell.

One new typewriter model by Olivetti uses five microprocessors. One each for the daisy-wheel printer, the carriage, the keyboard and the display. Of course, the machine does more than merely type. A 20-character 5-by-12-dot alphanumeric readout displays one line of type for possible editing. The memory can store more words than are contained in the average one-page letter until the machine is called on to type them. Many mechanical parts are replaced by the operation of these ICs.

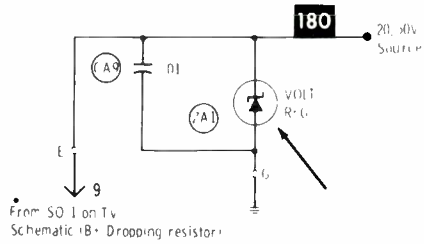
Complete controls of ac motors should become more commonplace as microprocessor equipment is added. Motor speed can be regulated digitally by a closed-loop negative-feedback action at a quarter of the cost of comparable analog components. What's more, the motor current can be checked against data stored in the ROM section, thus allowing the instantaneous and surge currents of the motor to be controlled. A 10-pole rotating magnetic disc along with a Hall-effect switch can measure the motor RPMs. Then the microprocessor converts the speed into a phase angle that controls the conduction of a triac which varies the motor power to restore the desired motor speed. Monitoring these and other operating parameters could result in a price reduction by preventing any need for an excessively large motor. In fact, vacuum cleaners and other small appliances probably will have microprocessor controls in the near future.

troubleshooting tips

No color
Magnavox T940
(Photofact 1144-1)

No color could be seen on the monochrome picture. Even with optimum adjustment of fine tuning and color controls, only a faint magenta color could be seen. A set of new chroma tubes didn't change these symptoms.

After the chassis was placed on the bench, a dc voltage analysis showed no wrong voltages. But the 3 VPP chroma IF signal that



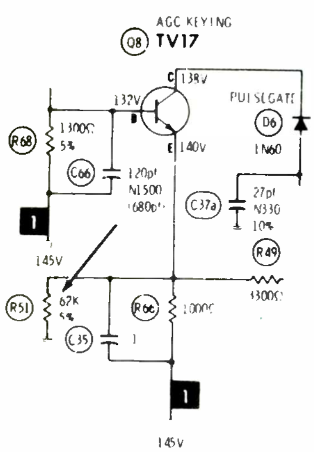
should have been at the pin 7 grid of the 6KM8 tube was about zero amplitude. Circuitrace 79 had 4 VPP, but circuitrace 80 had none.

Of course, the automatic-tint control (ATC) circuitry is placed between those two points (in sets that have ATC). A quick check in the ATC unit showed no +20-V supply. Zener diode ZA1 was shorted, and a new replacement brought back the color.

Robert Snow, Jr.
Clearwater, FL

No picture, no AGC
Philco 20ST30B
(Photofact 1241-2)

According to the original complaint, this repair should have been routine. But it became a real "dog."



The only complaint was "no picture." After our junior technician cleaned the tuner, he turned it over to me. A blank raster on channel and snow on an unused channel pointed to AGC overload. The tuner had been checked with a substitute tuner; and the AGC and IF transistors tested good both in-circuit and out-of-circuit.

A bias box applied at the IF AGC testpoint could produce a normal picture. (Incidentally, make sure the reception is good over the *usual* range of voltages. Some defective transistors apparently will work okay *for a time* with excessive AGC voltage.)

Open AGC bypass capacitors (especially electrolytics) can cause many strange symptoms. C20 was replaced, but without any change. R22 and R23 checked within tolerance out-of-circuit. After these failures, the TV was set aside for a better opportunity.

For the next attempt, I studied the schematic. Q8 acts as a variable resistor to control the rectification of diode D6. It appeared that Q8 was not conducting and no dc AGC voltage was being developed.

With a dual-trace scope, I checked to be sure the gating pulse and the video sync pulses were coincident. They were. And both had sufficient amplitude.

Perhaps, the dc bias of Q8 is wrong. Finally, I remembered the 0.02 V drop across emitter resistor R66. The emitter dc voltage was too high. According to the values of R51 and R66, there should have been about 2.3 V across B66. When R51 and R66 were disconnected, R66 checked within tolerance, but R51 read almost a MΩ instead of 62K. The 5% tolerance rating should have tipped me to its importance. And a diode or zener to stabilize the emitter voltage would have drawn my attention first to the voltage discrepancy.

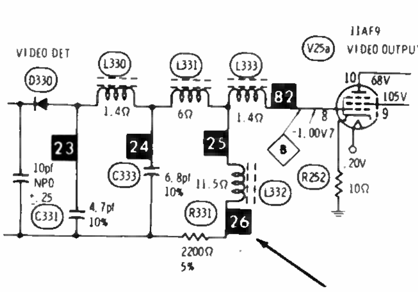
Anyway, good AGC operation was obtained after R51 was replaced.

John Coulter
Roanoke, VA

Poor picture quality
Sears Silvertone 528.5120 B&W
(Photofact 1214-3)

The picture looked as though the video had been converted to digital. It was made up of small rectangles that showed a rough outline of the picture. Little difference could be noted from constant-control adjustments. Cleaning of the tuner seemed to stop the trouble, but it soon returned.

Operation with the AGC clamped proved the AGC was not the cause. At the control grid of the 11AF9



video amplifier, some video was present but it was smeared and the dc component was almost zero.

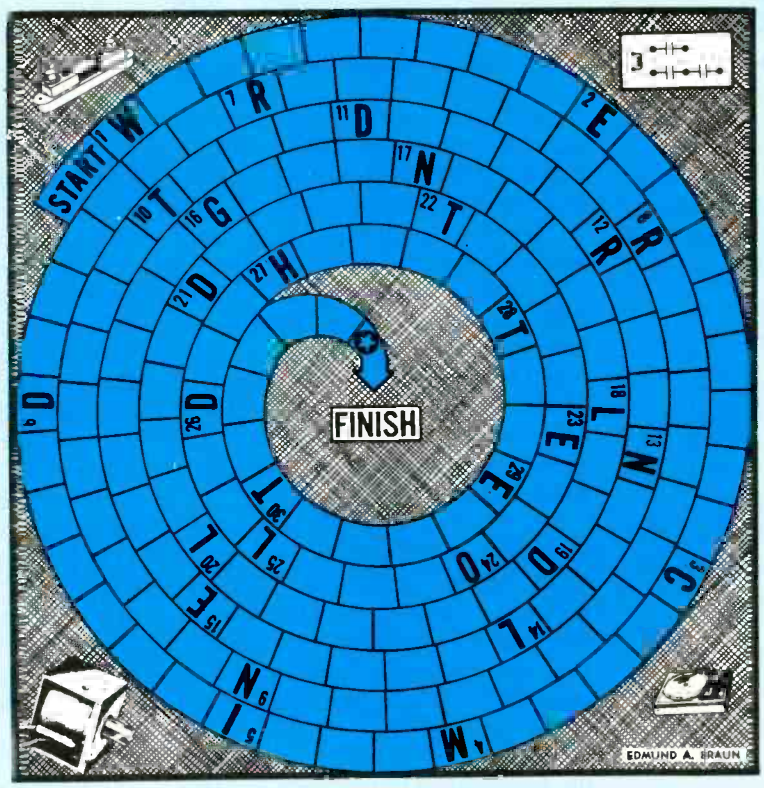
Several resistance measurements proved peaking coil L332 was open. Of course, this opened the dc path and changed the video detection. I never had seen such an effect in the picture, and expect to remember for future reference. A new peaking coil completed the repair and gave a good picture.

Bob Ellenwood
Oklahoma City, OK

Electronic Whirligig

by Edmund A. Braun

Now is the time for all good electronic technicians to get busy and have fun solving this Pinwheel Puzzle. The last letter of each word is the first letter of the next word. Each correct answer is worth 4 points; a perfect score is 120. It should prove fairly easy to get a high rating except perhaps for someone who thinks "fly back" means an insect has returned, or that "solar energy" is what a shoemaker uses to repair footwear! Pencil sharp? Ready? Then give it a whirl!



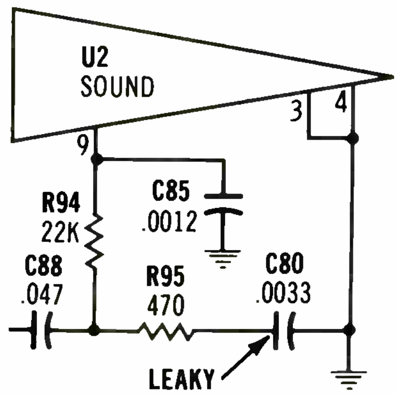
1 A type of bridge.
2 Chemical action in which heat is produced.
3 Alkaline metal used in photo tube cathodes.
4 Prefix meaning one-thousandths.
5 Pertaining to invisible rays having a penetrating heating effect.
6 Device for effecting the process of demodulation.
7 A circuit that responds in accordance to oscillation in another circuit.
8 Wireless method to guide ships and planes to their destination.
9 An integrated microelectric circuit.
10 Adjusted to resonate or operate at a specified frequency.
11 Pertaining to the photo diffusion effect; named after its discoverer.
12 Hardened secretion of some trees used in varnish; solder core; etc.
13 Miniature receiving tube having nine pins.
14 The geometrical arrangement of atoms in a crystalline material.
15 General term for encasement of a part or assembly to fit some uniform external shape.
16 Color of band on a resistor to denote vale of 5.
17 Neither negative or positive.
18 Sound with great intensity; noisy.
19 Pertaining to a 14-pin tube base.
20 Concentrated at a single point.
21 Type of electric current.
22 A two-position snap switch operated by a projecting lever.
23 Repetition of a sound by reflection of sound waves.
24 Type of tube base.
25 Power consumed by a machine or circuit in performing its function.
26 A microwave antenna usually shaped like a parabola.
27 The distance from the bottom to the top.
28 Method to capture sound for future reproduction.
29 Anything brought about by a cause.
30 Type of rectifier employed in charging batteries, etc.

For the solution turn to page 53.

symcure

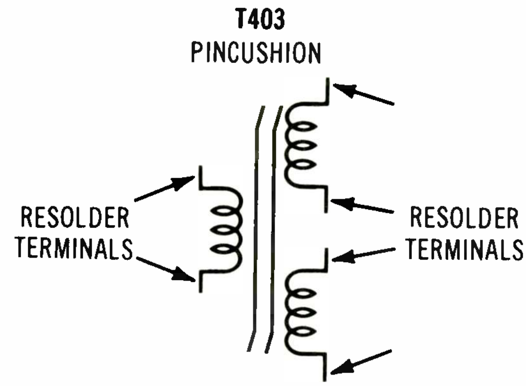
Symptoms and cures compiled from field reports of recurring troubles

Chassis—RCA CTC87
PHOTOFACT—1778-2



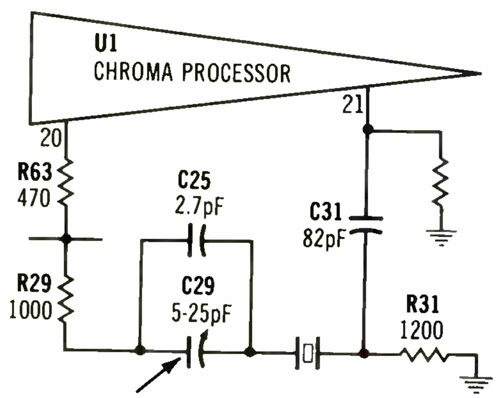
Symptom—Audio distortion
Cure—Check C80 and replace it if leaky

Chassis—RCA CTC86
PHOTOFACT—1807-2



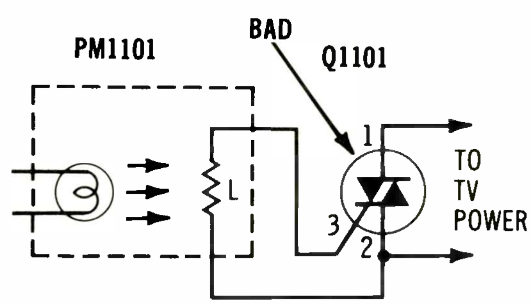
Symptom—Intermittent narrow width
Cure—Check and resolder connections of T403 pincushion transformer

Chassis—RCA CTC87
PHOTOFACT—1778-2



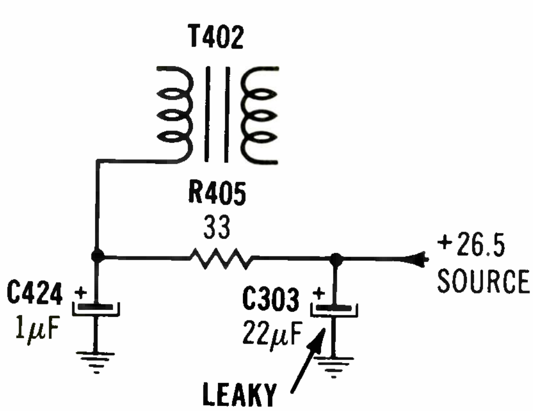
Symptom—No color—might be intermittent
Cure—Check C29 soldering and for leakage in C29

Chassis—RCA CTC90F
PHOTOFACT—1710-2



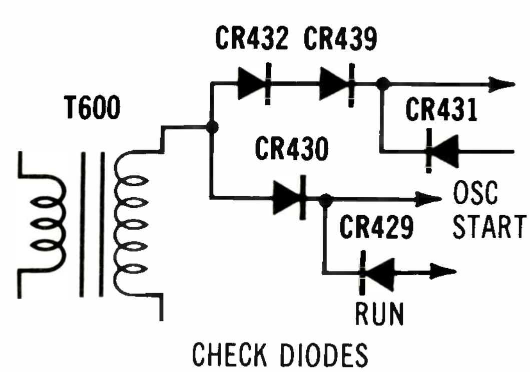
Symptom—Erratically turns itself on, and picture has distortion
Cure—Check on/off triac Q1101 and replace it if defective

Chassis—RCA CTC92
PHOTOFACT—1788-2



Symptom—Occasional failure to start-up
Cure—Check filter C303 and replace it if leaky

Chassis—RCA CTC93
PHOTOFACT—No Photofact



Symptom—No sound or picture
Cure—Check all start and run diodes and replace any that are open or shorted

reader's exchange

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

Needed: Instruction book for model 9000 Uher tape recorder. Will buy, or copy and return. *Robert DeHaan, Osceola Electronics, Marion, MI.*

Needed: Schematic and service data for RCA WO-91B scope. Also, any information about conversion of this scope to an ignition analyzer. *Paul Abelquist, 3344 Prince of Wales Court, Virginia Beach, VA 23452.*

Needed: Schematic for a Telecon 2-channel 13-transistor walkie-talkie radio (not model TMC-206). Will buy a copy. *G. M. Eckert, c/o Deray TV, 201 East Atlantic, Delray Beach, FL 33444.*

Needed: Roll chart or updating information for Hickok model 600 tube tester. *Theodore Keith, Box 139, Cherry Tree, PA 15724.*

For Sale: 840 boxed tubes including about 350 newer RCA and Sylvania tubes for $600. List furnished on request. *D&W TV, 2547 Fontana, Glenview, IL 60025.*

Needed: Service manual for model M-8 Akai reel-to-reel tape recorder. Will buy original or clear copy. *Hooks Electronics, 2639-D Lisenby, Panama City, FL 32405.*

For Sale: Model 314 Simpson analog VOM in mint condition, prepaid $180. *Marc Ditz, 1603 West Springfield, Champaign, IL 61820.*

For Sale: Photofacts from 4 to 800, $175; and 26 through 676, $60. Shipping extra. *Jack Amelar, 427 South 6th, DeKalb, IL 60115.*

Needed: Schematic, parts list and alignment procedure for model RA1150 Milovac stereo tuner. Will buy, or copy and return. *Paul Hertenstein, 13948 West 23, Golden, CO 80401.*

Needed: Used scope, prefer B&K-Precision 1432 or 1472C. Also, need power transformer 95-1935 for Zenith 29JC20 chassis. *Ed Arnold, 316 Division, Jackson, TN 38301.*

Needed: Schematic for a model 642 Jackson multimeter (has burned resistors). Will buy, or copy and return. *Clarence Hoffman, 824 Gordon, Allentown, PA 18102.*

For Sale: Utility-type watthour meter for 120V up to 30 amperes, reconditioned by GE, $20 postpaid in US *Littell, Arcanum, OH 45304.*

Needed: Schematic for a model 9T3 Pentron reel-to-reel tape recorder. *Edward Kirley, 610 Piper Drive, Madison, WI 53711.*

Needed: HV transformer part 80-113-3 for a Sears TV chassis 528.81000. Must be in good condition; advise price. *C. V. Todd, 1320 N.W. 116th, Miami, FL 33167.*

Needed: Schematic for Bosch electronic fuel-injection system model EFAW-193-S-10, and information about electronic fuel injection in VWs. *Gilbert Goodwater, Route 1, Sprague, WA 99032.*

Needed: A good electronic course (mine was destroyed), send description and price. *Logan Lawrence, Onia, AR 72663.*

For Sale or Trade: About 125 Photofacts between 400 and 800. Need Rider's 1 through 4 with index. *A-D Electronics, 108 Carey, Deerfield, MI 49238.*

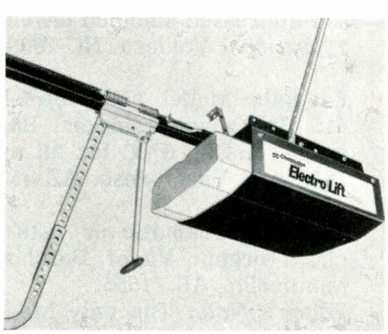
For Sale: Volumes 1 through 10 of Rider's TV manuals, also radio volume 18 plus auto radio and record-changer books. Best offer for the lot. *Allen Loeb, 414 Chestnut Lane, East Meadow, NY 11554.*

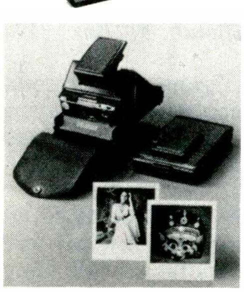
Needed: Instruction and service manual for a type 1606A General Electric RF bridge and an output-power meter type 583A. *J. A. Call, 1876 East 2990 South, Salt Lake City, UT 84106.*

For Sale: Heath IG57A sweep/marker, $135; Heath IG28 color generator; Heath IG18 audio generator, $75; and EICO 324 generator, $50. All are new. *Bill Bechtold, 7429 Frederick, Omaha, NE 68124.*

Needed: Sencore SS137 sweep-circuit analyzer with instructions, please state condition and price. *John Caputo, 271 Cadman Plaza East, G.P.O. Record Room 606, Brooklyn, NY 11201.*

Needed: Schematic and parts list for a model 3W77 and 3W78 Sharp B&W TV. It's not listed in the 1978 Photofact Index. *E. F. Carrean, Taylor Street TV, 238 Taylor, Port Townsend, WA 98368.*





Reader's exchange

Needed: Service manual with schematic for a model 516 Watterson table radio. Also, service manual and schematic for a Webcor model 12-8610 AM/FM-stereo radio. Will buy, or copy and return. *Earl Sloniker, 121 Pinion Drive, Cortez, CO 81321.*

For Sale: DuMont/DeForest model MM-200 demonstrator multimeter. List price is $134, but will sell for $72. *Domino Unlimited, P.O. Box 9309, Fort Wayne, IN 46899.*

For Sale: SX43 Hallicrafter radio; Zenith Trans-Oceanic model 315K; EICO signal generator; instructograph code with 10 tapes; and several 5FP74 picture tubes. Best offer. *Page Bledsoe, Hill Road, Route 11, Knoxville, TN 37918.*

Needed: One good used 17EQP4 or 17FCP4 picture tube for a Zenith B&W portable. *Thomson Electronics, 212 North Howard, Indianola, IA 50125.*

For Sale: The following Heath equipment: IG37 FM stereo generator, $50; IG28 color dot/bar generator, $50; IG57A post-marker/sweep generator, $75; IG18 sine/square audio generator, $40; IO-104 15-MHz triggered scope, $175. With manuals and in good shape; you pay freight. *Fred Sherwood, 23 Huntington Court, Naperville, IL 60540.*

Needed: Schematic and parts lists for an Amphenol Color Commander color-bar generator model 860. Will buy, or pay for cost of copy. *William Clark, 7401 Jewel Lane, Indianapolis, IN 46250.*

For Sale: All issues 1961-1978 of **Electronic Servicing** and Electronic Technician Dealer, about 400 older Photofacts in cabinets, about 250 tubes, miscellaneous radio and TV parts, and an RCA color TV home-study course. Write for details. *Stanley Besecker, Route 1, Box 350, Waynesboro, PA 17268.*

For Sale: Used test equipment. For details, send a self-addressed stamped envelope. *Wayne Smith, Route 1, Box 353, Valdese, NC 28690.*

For Sale: Model 1077B B&K-Precision Analyst; model 415 B&K sweep marker; B&K model 1465 triggered scope. Asking $700 for all as a package. *Slump TV, 1336 East Vine, Mesa, AZ 85704.*

Needed: Schematic or data on model 1400 Magnus chord organ. *Victor Borchardt, Route 4, Box 314, Monticello, AR 71655.*
Editor's Note: The only Magnus organs I have seen were reed organs, and the only electronic component was a motor that supplied the air pressure. Does anyone know of an electronic model?

For Sale: Model S108 Hallicrafter radio for 10 to 80 meters, needs work, $25; CDR antenna rotator and control box model TR-4, good condition, $40. *Ray Parsons, Jr., Portmouth Avenue, Stratham, NH 03885.*

Needed: One unused 6AF6 electron ray tube. Quote price, will pay in advance. *McLester Brown, 1197 North Garfield Avenue, De Land, FL 32720.*

For Sale: Model 415 B&K-Precision sweep/marker generator, used 6 times, with carton, book, probes and cables, $300 plus freight COD. *Eggleston & Young, 1902 East Harding Way, Stockton, CA 95205.*

Needed: Partial or complete GE TV models 12C07 and B, 12C108 and B, 12C09 and B, 12T3 and B, 12T4 and B. Am restoring a 1951 TV. Send description and price. *John Hulstrunk, RD 2, Box 101, Rexford, NY 12148.*

For Sale: Model 415 B&K-Precision sweep/marker generator, 6 months old, excellent condition with accessories and operating manual, $285 or best offer. Also, B&K Television Analyst in good condition, $125. *Al Crenshaw, P.O. Box 606, Rochelle, GA 31079.*

For Sale: Tuner Service UHF/VHF substituner, cost $45; and Castle Mark V Subber, cost $145. Both in excellent condition, used 3 times. Make reasonable offers. *Gerald McKouen, 534 Pacific Avenue, Lansing, MI 48910.*

Needed: Schematic for Motorola FM108M (or Photofact AR55, out-of-print). State price, or will copy and return. *C. R. Milam, 2031st Street 2nd Avenue, Nitro, WV 25143.*

For Sale: Model 1076 B&K-Precision Analyst, $175. *John Zanath, 1809 Grant, Aliquippa, PA 15001.*

Needed: New or used tube tester that will test all tubes including present types. State condition and price. *Murrays Repair, 8842 Grange Hill Road, Sauquoit, NY 13456.*

Needed: 1077B B&K-Precision Analyst in good condition. *James Mason, 3732 Effingham Place, Los Angeles, CA 90027.*

For Sale or Trade: Have Polarad spectrum analyzer model SA84T, and want a Tektronix model 465 scope in trade; you pay freight. *Andrew Kulick, 88 Standiford Avenue, Sayreville, NJ 08872.*

Needed: Schematic for OS-48/AP Navy scope; and schematic for Model A transistor curve tracer by Jud Williams. Will buy, or copy and return. *Andrew Kulick, 88 Standiford Avenue, Sayreville, NJ 08872.*

Needed: Schematic and parts list for Lago calculator model 816. Also, vertical-output transformer part A40553A for a model 8PV-47U Delmonico TV. *E. Binder, 11644 142 Avenue, Renton, WA 98055.*

For Sale: Model 466 B&K-Precision CRT tester/rejuvenator with adapters, chart and manual, new condition, $120 plus shipping. *H. B. Champion, 2108 Santa Cruz Court, Torrance, CA 90501.*

Reader's exchange

For Sale: Jackson model 710 selenium-rectifier tester, $5; Sencore PS-103 power supply, $10; Sencore TRC-4 transistor tester, $10; and P. D. model 85 transistor tester, $10. The following equipment to be sold as is, complete and with manuals but needing repairs: B&K-Precision 1076 Analyst, $60; Jackson TVG-2 sweep, $45; Hickok 288X signal and sweep generator, $45; and Lectrotech model V-7 color vectorscope, $40. *Rich Roman, 239 Matadero Avenue, Palo Alto, CA 94306.*

For Sale: CB preamplifiers for 12 Vdc, with automatic switching, valued at $34.95. Sell 8 in a lot for $6 each. *Michael Prodan, 8217 South Talman Avenue, Chicago, IL 60652.*

Sale or Trade: Hickok VTVM model 209, with 9-inch meter, $90; B&K-Precision Analyst model 1076, $150. Volume controls with switches, 50 assorted for $5. *Troch's TV, 290 Main, Spotswood, NJ 08884.*

For Sale or Trade: Bearcat 8-channel scanner; FM monitor receiver model BCU series 2. Excellent conditions. 100 out-of-print Photofacts. Best offers. *R. J. Horsley, 67 Theodore Street, Buffalo, NY 14211.*

Needed: Service information and parts for Jelco standard movie camera by Nikoncine Industrial. *Philip Davis, RR2, Box 191, New Castle, IN 47362.*

For Sale: Antique A/R range scope type 256B SN-765 for 115 V operation, manufactured by Allen B. Dumont Laboratories. *S. O. Sellers, Route 11 Box 160, Bessemer, AL 35020.*

For Sale: Heathkit IT-5230 CRT tester/rejuvenator in mint condition, $100; SO-4541 scope, $330. *Gary Utke, 1002 South Lafayette, Shawano, WI 54166.*

For Sale: Lafayette model 38-0112 tube/transistor tester with setup book, $10; Precision signal generator E-400 with manual, $25; Precision E200-C marker generator with manual, $25; 21FBP22 picture tube, new, $15; B&K-Precision 1076 TV Analyst, $50; 500-W isolation transformer with three taps, $10. *A. O. Orjias, Route 2 Box 33A, Olathe, CO 81425.*

Needed: Operating manual and alignment instructions for a Win-Tronix dynamic sweep-circuit analyzer model 820, and schematic and alignment data for Dumont TV model RA-103-D-5. Will buy, or copy and return. *Larry Brummett, 155 3rd Street, Woodland, CA 95695.*

For Sale: Model VR100 Ampex B&W videotape recorder, complete with manual, tape and cables, in good working condition, $300 postpaid. *Ron Cromer, Route 10 Oakwood Estates, Anderson, SC 29621.*

Needed: Number 2EP4 picture tube for 1959-60 Philco transistorized portable TV. *Larry Auman TV Service, Route 1, Box 368, Dover, OH 44622.* ☐

General Electric chroma

Servicing GE 13 inch color TV, part 7

Circuit analysis and troubleshooting information about the chroma stages conclude our coverage of the General Electric AA-D color-TV portable.

By Gill Grieshaber

Only one adjustment

Elimination of all alignment adjustments is the most unique feature of the chroma circuit in the General Electric AA-D chassis. A variable control for color locking is the only adjustable component in the chroma channel (except for the color and tint controls). Older tube-type color receivers often had eight or nine controls and adjustments.

Only one integrated circuit (IC), one luminance amplifier and three power transistors are used in the chroma and matrixing circuits. Arrows in Figure 1 point out the locations of many components and test points.

The color quality of this small color receiver is very good. It compares favorably with that of larger receivers.

Chroma bandpass

Input signal for the chroma bandpass (IF) stages comes from the emitter of the same Q200 that also supplies video to the video channel. Path of the chroma signal is through C360 and R360 to inductances L362, L363 and L366—which with the associated tuning and coupling capacitors make up the complete chroma-IF tuned circuits. *Not one of these inductances or capacitances is adjustable.* No-

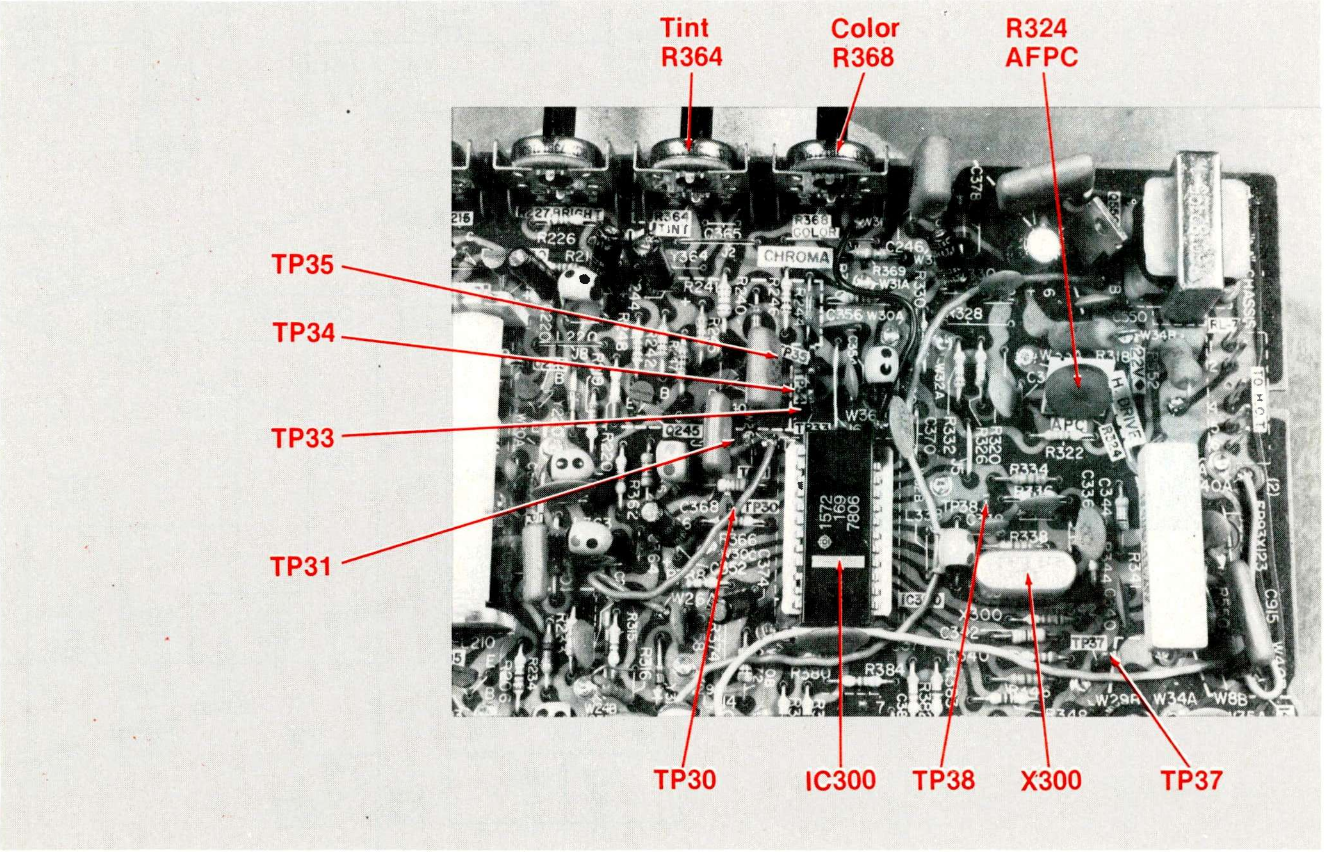


Figure 1 All major chroma-circuit components and testpoints of the General Electric AA-D chassis are available on the main module.

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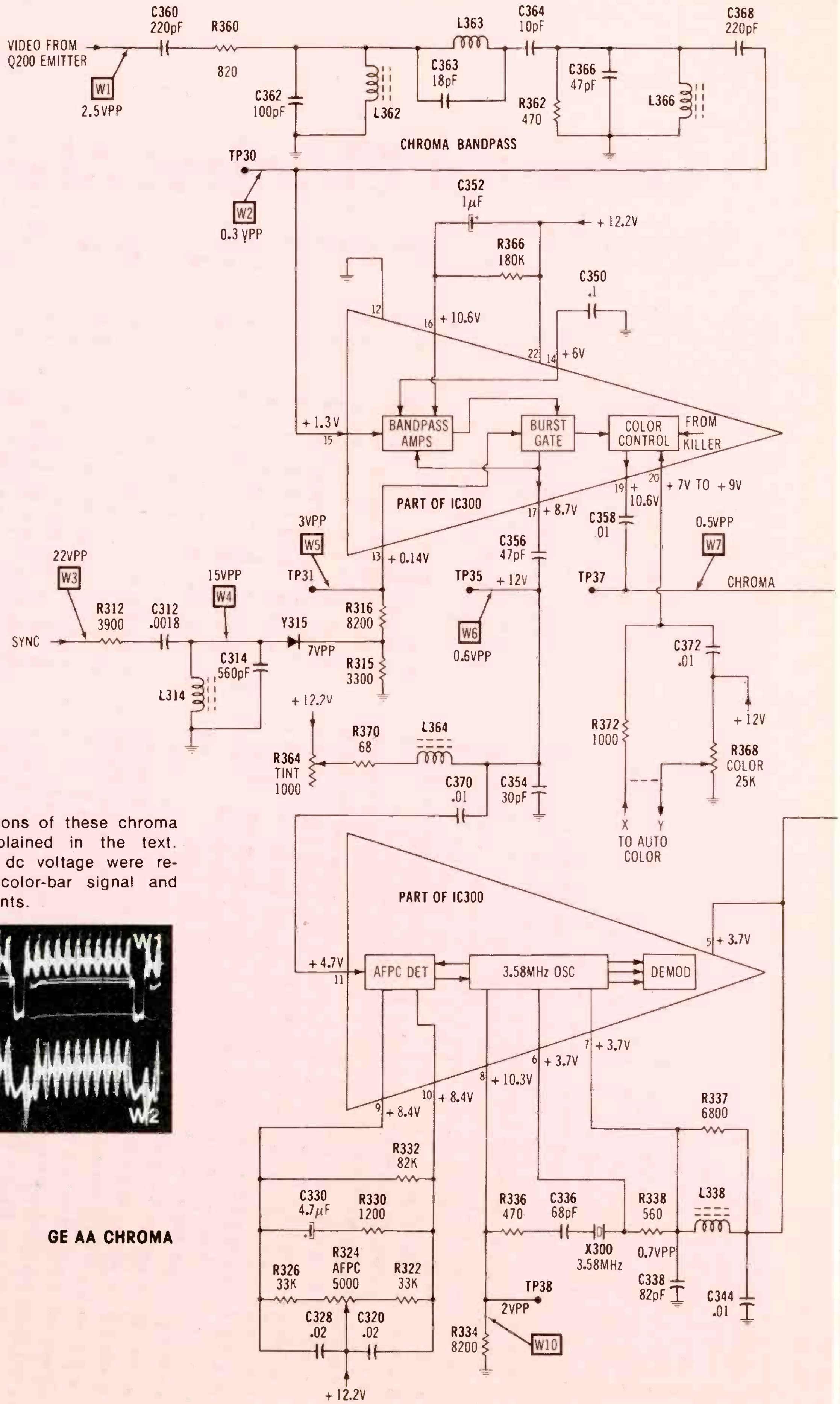
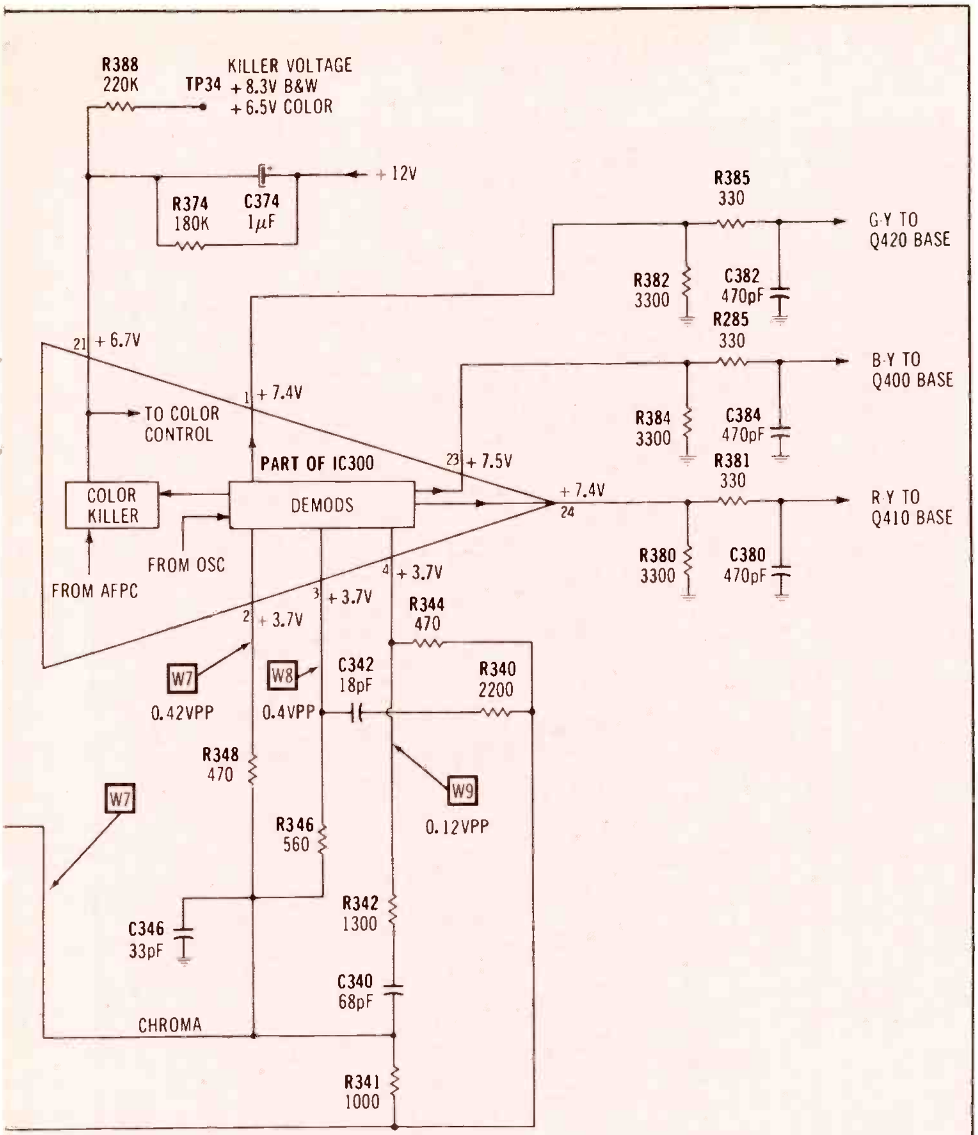
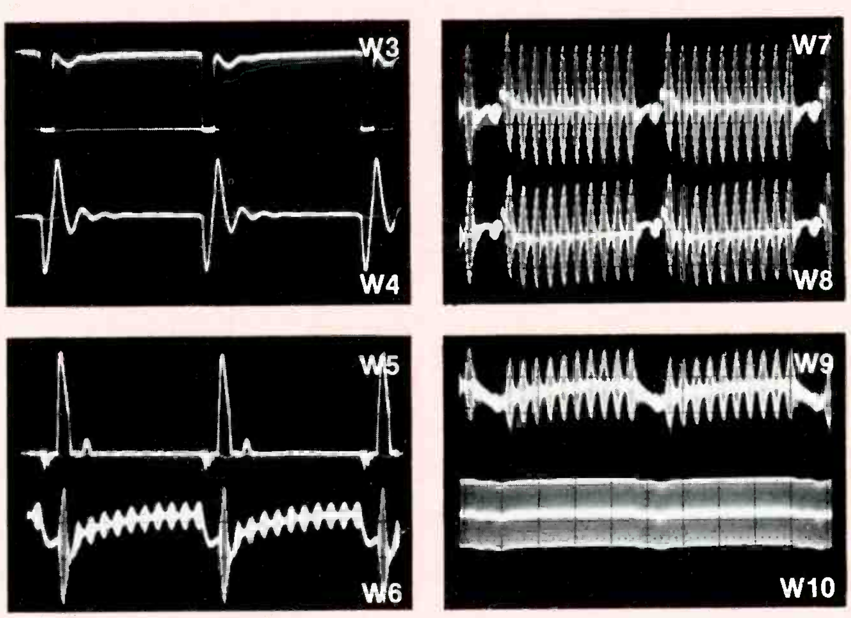


Figure 2 Operations of these chroma circuits are explained in the text. Waveforms and dc voltage were recorded with a color-bar signal and normal adjustments.

GE AA CHROMA





tice too that no amplification is provided between any of the tuned circuits, as shown at the top of the Figure 2 schematic.

All waveforms were made while a color-bar pattern (without black bars) was displayed on the picture tube. Waveform W1 shows the input video signal that has horizontal sync and blanking plus 11 bursts of 3.58-MHz chroma. After the bandwidth is restricted by the bandpass tuned circuits, the resulting waveform (W2) has only the 11 bursts of chroma which will produce 10 color bars after demodulation (one is used for color locking.)

This tuned (but not amplified) chroma-IF signal is coupled through C368 to the pin-15 input of IC300 and the internal chroma amplifiers. A variable dc voltage from the color control is sent to pin 20 where it regulates the IF gain. After amplification, the chroma-IF signal emerges at pin 19.

The chroma signal from pin 19 goes through resistor/capacitor networks (that change the phase and determine the amplitude) to pins 2, 3 and 4 (see waveforms W7, W8 and W9) and the three demodulators.

Burst separation

Extraction of the burst from the chroma-IF signal is accomplished by pulse gating. However, horizontal-sweep pulses are *not* used for gating.

Negative-going sync pulses (W3 from the sync separator) are coupled through R312 and C312 to the L314/C314 ringing circuit (see W4). The tuned-circuit "Q" is not high, and only about four cycles of sine wave are formed from each pulse. Because the pulses are negative-going, the first peak of the ringing is negative, but this is reverse bias to diode Y315 and so it is blocked. Instead the first *positive* peak of W4 passes through Y315, creating the positive pulses of W5.

In the dual-trace W3 and W4 waveforms, however, notice that the ringing first-positive peak occurs *after* the sync pulse. Therefore, the W5 positive-going gating pulse is delayed in phase so that it reaches IC300 pin 13 at the same time

General Electric

(phase) as the burst appears.

This gating provides 3.58-MHz burst at pin 17. After phase shifting by the C354/L364/R370/R364 network of the tint circuit, the burst signal goest hrough C370 to pin 11 and the AFPC detector.

Color oscillator and AFPC

Pins 6, 7 and 8 of IC300 are used for the 3.58-MHz crystal oscillator. Pin 8 also connects to TP38 and has carrier waveform W10. There are no frequency adjustments in that part of the circuit. Instead, the R/C network at pins 9 and 10 of the AFPC circuit determines the free-running 3.58-MHz color oscillator frequency.

Color locking—The simple AFPC sequence for color-locking is as follows:

- Ground TP34 (deactivates the color killer) and TP35 (eliminates the burst) with short jumpters. Better yet, short TP34, TP33 and TP35 together with alligator clips (no wires). TP33 is ground, and the three test points are close together in a line.
- Adjust the AFPC control (R324) for zero beat of the color in the picture (colors should be upright and drifting slowly to either side).
- Remove the grounds from the test points. That's all.

Color killer—No adjustment is provided for the color killer, although the dc voltage at TP34 does increase with monochrome or no-signal operation. Perhaps the keying by processed sync pulses rather than by horizontal-sweep pulses might be responsible for the good killer action.

Older killer circuits could distinguish easily between normal burst and none (color versus monochrome), thus producing dependable killer action with a station signal. But without an input signal, the circuits gave erratic results from false burst (noise tuned by the burst transformer). With the GE system, a lack of video eliminates the keying pulses. Without pulses, there can be no false burst. Also, the absence of a burst transformer prevents borderline killer operation from high-frequency video harmonics that in older sets would ring the burst transformer and simulate burst.

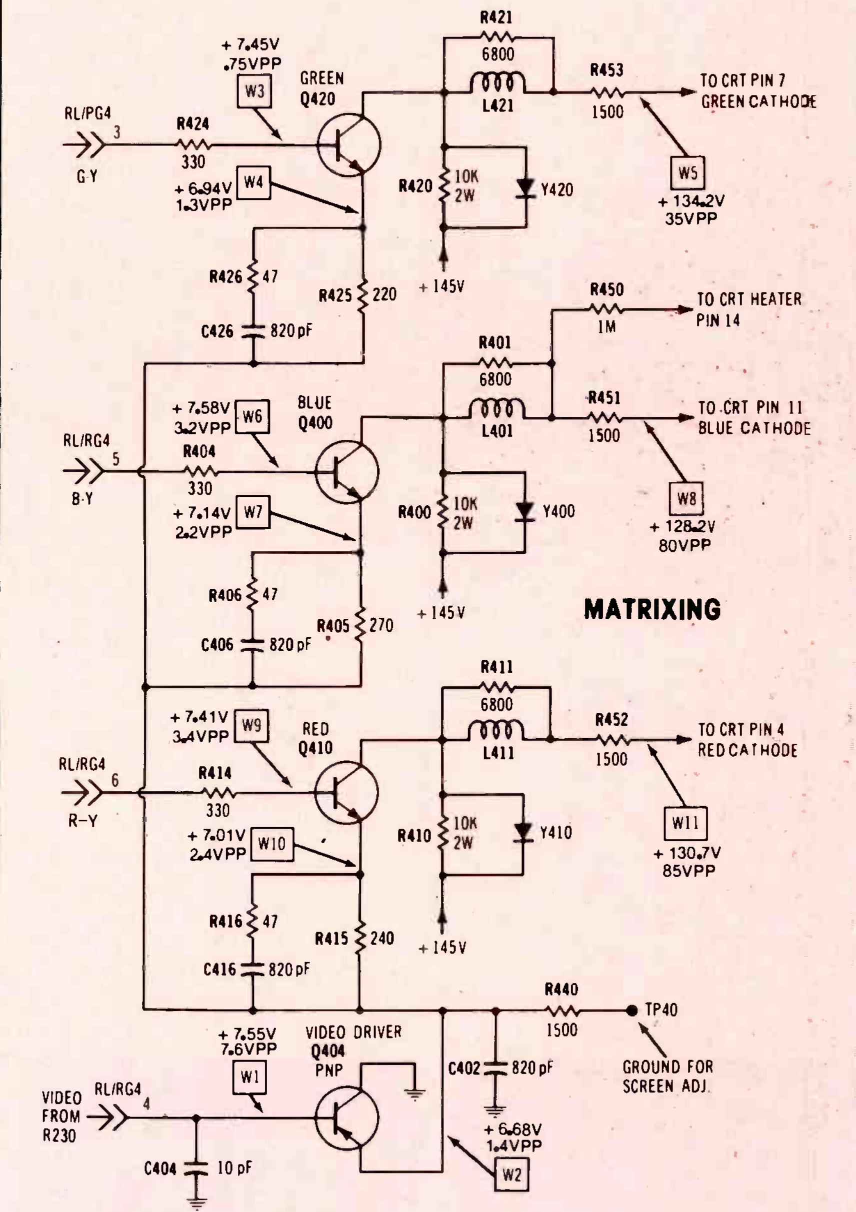


Figure 3 Matrixing of the luminance and the proper -Y color signal is accomplished in each of the three power transistors that are located on the CRT-socket module. The pure color signals that result are sent to the three picture-tube cathodes after amplification.

Demodulation

Two basic signals always are necessary for chroma demodulation. One is the chroma IF signal which reaches the three demodulators by way of pins 2, 3 and 4.

The other necessity is a source of 3.58-MHz continuous-carrier signal for each demodulator. This is obtained inside IC300 from the crystal oscillator.

Of course, each demodulator must have the correct phase difference between those two input signals. In the AA-D chassis, the phase shift is accomplished by fixed components; there are no adjustments.

From the demodulators come three -Y signals. G-Y exits at pin 1, B-Y at pin 23 and R-Y from pin 24. RC filters (R383/C382, R285/C384 and R381/C380) remove the unwanted ripple at the demodulator outputs.

From those three pins, the signals go through a cable to the module which includes the picture-tube socket and eventually reaching the bases of the power color-output transistors that drive the picture-tube cathodes (see the schematic in Figure 3).

Matrixing

Matrixing of the -Y chroma signals with the Y video signals takes place inside the three power-output transistors. This matrixing was described in the February issue. The dc and ac-signal voltages for monochrome generator operation were listed and many waveforms were shown.

The same matrixing schematic is printed again in Figure 3, but the voltages are different from the previous listing because the signal now is a color-bar pattern without black luminance bars between the color bars. Corresponding waveforms are presented in Figure 4.

An amplified *and inverted* replica of the base -Y signal emerges at each collector. Luminance entering at each emitter also is amplified, but it is not inverted. Therefore, a mixture of both input signals appears at the collector of each output transistor.

Also, the emitter-follower principle produces some amplitude of the

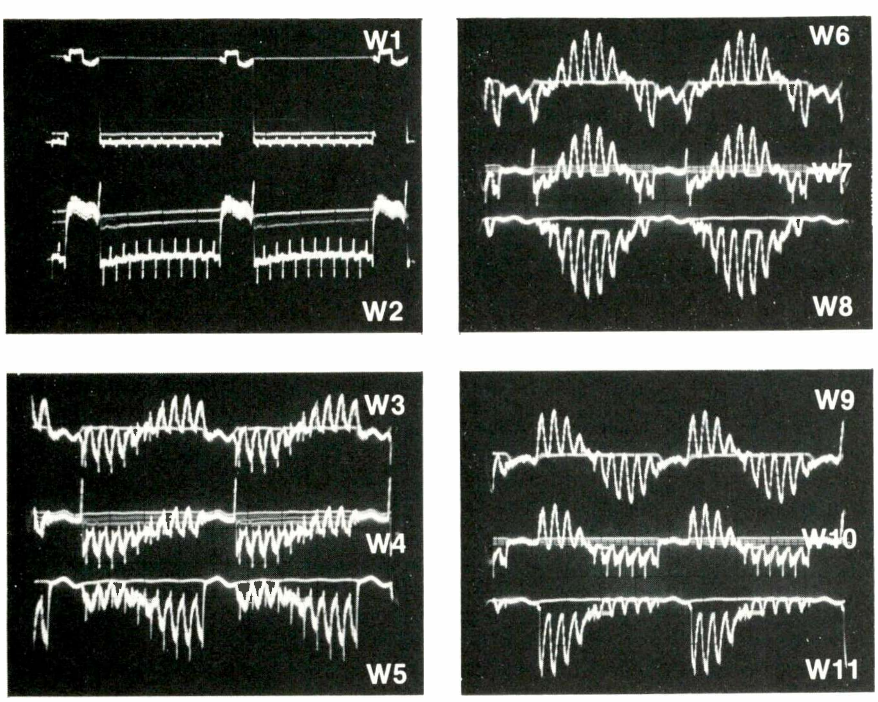


Figure 4 These are the waveforms recorded in the matrixing circuits of Figure 3 when a color-bar pattern was tuned in and the usual color and tint adjustments had been made.

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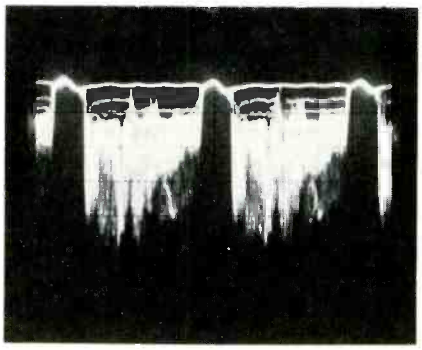
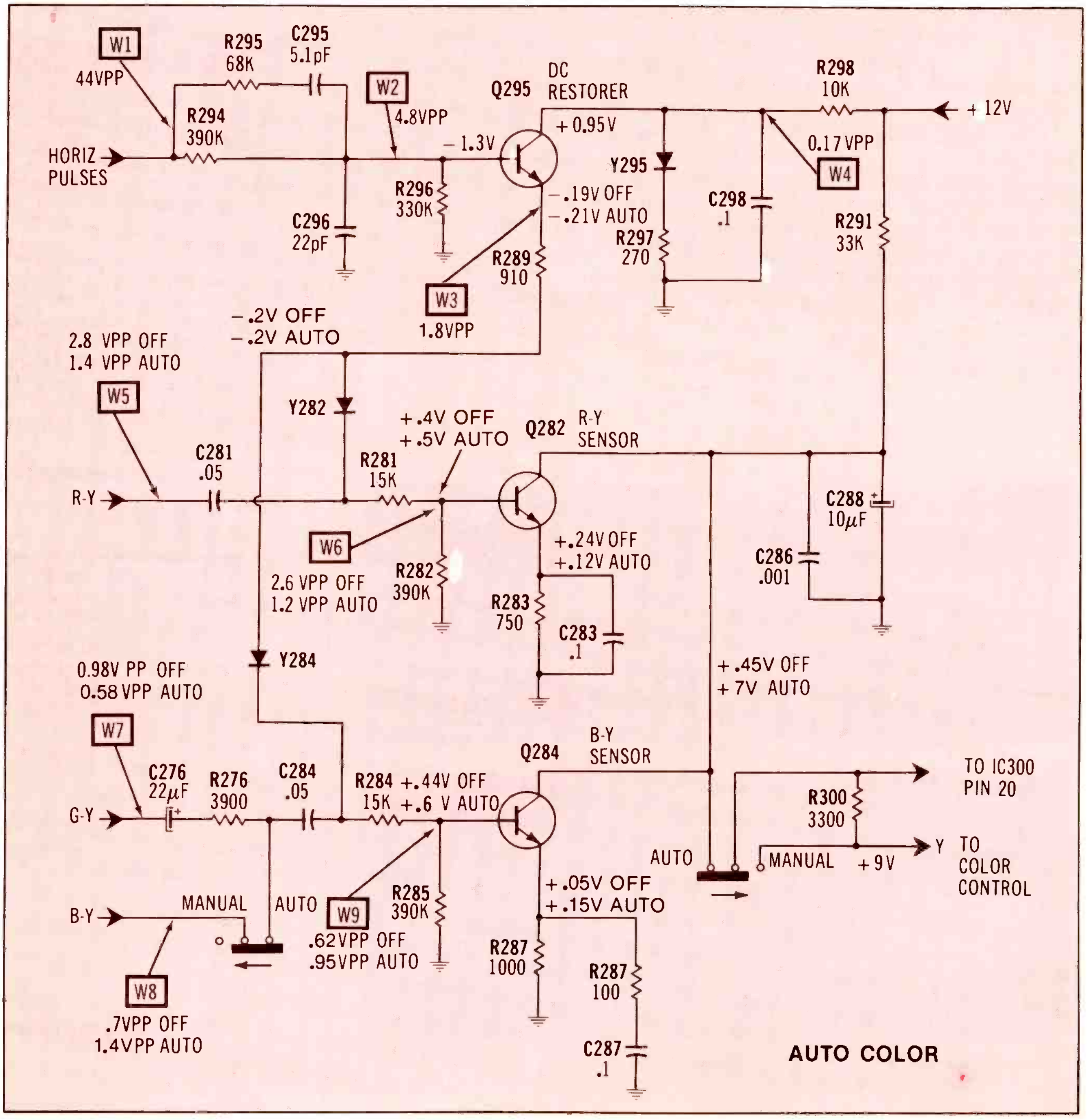


Figure 5 This color waveform at the collector of Q410 (the red output transistor) has little resemblence to a conventional positive going composite waveform. The burst and other 3.88 MHz components have been trapped out, and both vertical and horizontal blanking pulses have been added.

base signal (-Y chroma) at the unbypassed emitter. And the B/E current again mixes the two input signals so some of the emitter waveform appears at each unbypassed base. This should be understood, else it might be confusing to discover the mixture during waveform analysis.

A generator color-bar signal is recommended highly for any kind of troubleshooting in the chroma or



matrixing circuits, and these Figure 4 waveforms should be valuable as approximate standards. Minor differences might be obtained from other generators. Also, the height of the blanking will vary according to the brightness-control setting.

There are some precautions if a conventional broadcast signal is used during analysis. Waveforms of the demodulated -Y signals vary constantly and without any recognizable patterns. Only the maximum amplitude provides any help at all. Even the luminance video signals have been changed greatly. Burst and other 3.58-MHz components are removed by a trap and the usual peaking. Both vertical and horizontal blanking have been added. Figure 5 shows the waveform at the collector of Q410, the red output transistor. It has little resemblance to a conventional positive-going composite waveform.

Auto-Color Monitor

Some versions of the AA-D General Electric chassis include an extra module for the Auto-Color Monitor feature. Figure 6 shows the entire schematic. The module is mounted at the top of the cabinet beside the antenna terminals.

Stated simply, the purpose of the Auto-Color circuit is to monitor the amplitude of the demodulated chroma and reduce the amplitude if it becomes excessive. It's a type of automatic chroma-level control.

Transistors Q282 and Q284 act as variable shunt resistors which change the dc voltage that is between the color control and pin 20 of IC300. A lower dc control voltage reduces the chroma IF gain.

Q295 acts as a dc restorer by supplying a small amount of dc voltage to the bases of Q282 and Q284 (through diodes) when gated by the horizontal pulses at the base. Diode Y295 and resistor R297 (at the Q295 collector) limit the dc voltage at the collector to about +1 V. Therefore, the maximum emitter dc voltage during conduction is slightly less than +1 V. This pulse dc voltage is sent through R289 and diodes Y282 and Y284 to the bases of Q282 and Q284.

R-Y from the demodulator is brought to the base of Q282 through C281 and R281. When amplitude of the R-Y is strong, this signal is rectified by diode Y282, producing positive dc voltage that forces Q282 to draw considerable C/E current which reduces the collector voltage (and along with it the color-control voltage). Therefore, stronger R-Y levels decrease the chroma IF amplitude and eventually also reduce the visible color on the picture tube screen.

During horizontal blanking times when there is no chroma signal, and the Y282 cathode voltage drops near zero, positive voltage from the Q295 emitter biases-on diode Y282 so the positive voltage reaches the Q282 base where it determines the dc operating point. (see Figure 7).

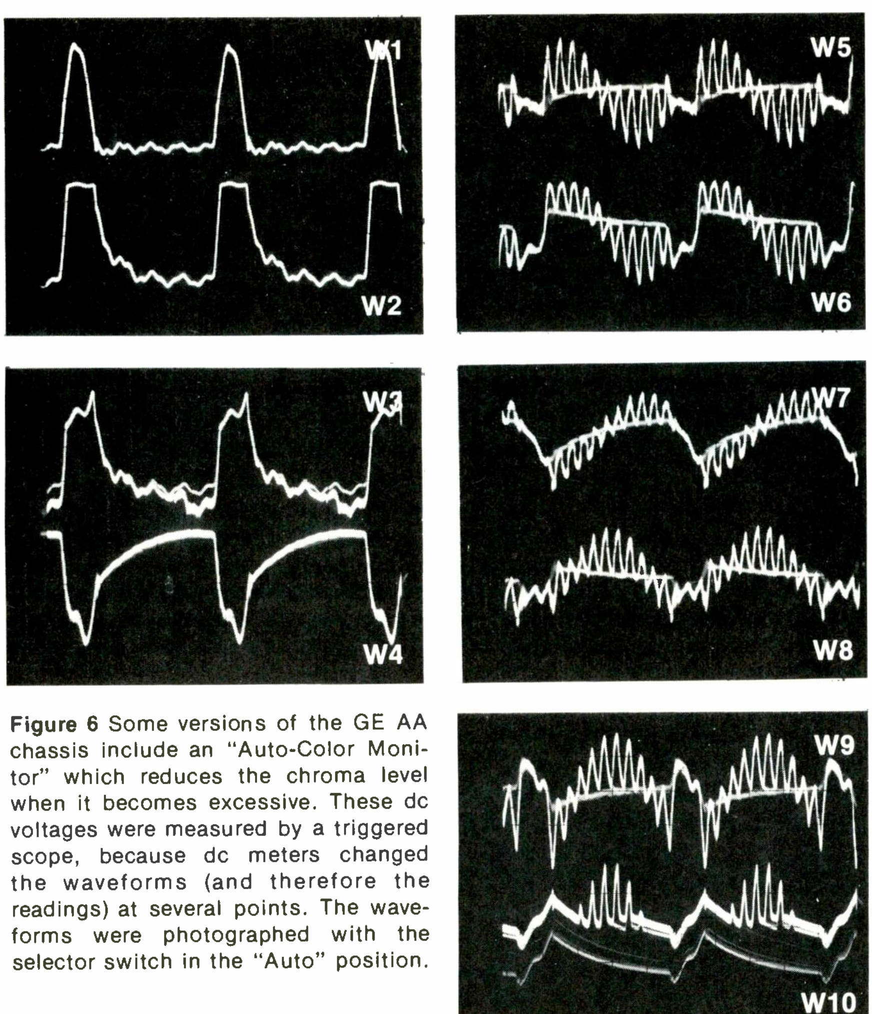


Figure 6 Some versions of the GE AA chassis include an "Auto-Color Monitor" which reduces the chroma level when it becomes excessive. These dc voltages were measured by a triggered scope, because dc meters changed the waveforms (and therefore the readings) at several points. The waveforms were photographed with the selector switch in the "Auto" position.

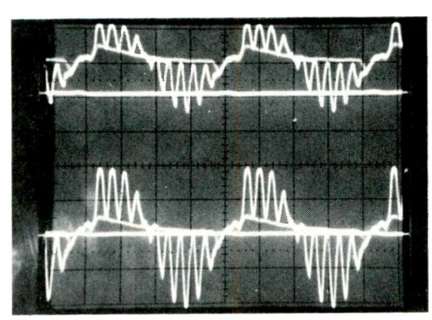


Figure 7 These two traces show the change of dc level with the Q295 restorer operating normally and with it disabled. Top trace was recorded at the Q282 base during normal operation. The zero-voltage line is near the most-negative tips of the waveforms, indicating the presence of positive dc (+0.5 V). For the bottom trace, the base of Q295 was shorted to ground, thus removing the dc restoration. The zero line now is near the center, and the scope measured a near-zero amount of dc.

General Electric

Similar operation occurs in the Q284 stage, except both B-Y and some G-Y are applied to the base.

Therefore, if all three -Y signals (or any one or combination) have an excessive amplitude above the design level, the Q282 and Q284 collector currents reduce the collector voltage. For automatic operation, the collector voltage mainly comes from the color control through the manual/automatic switch. When the dc voltage is reduced, it decreases the gain of chroma IF stages inside IC300.

Color control of this type does not depend on burst level, but rather operates from total amplitude of the chroma.

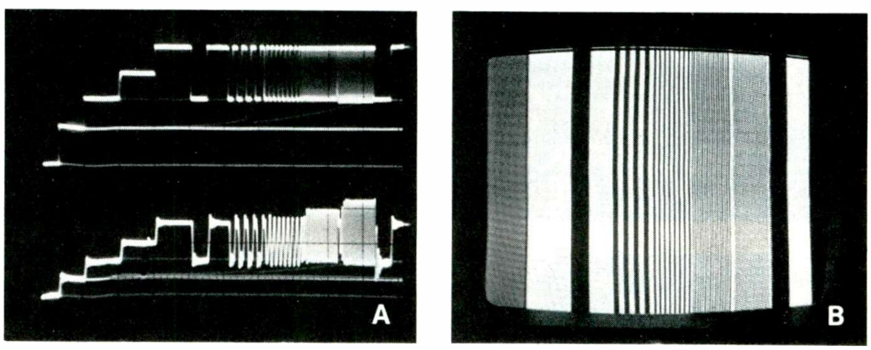


Figure 8 Bandwidth of the GE AA chassis was good. (A) The bar-sweep pattern direct from the Sencore VA-48 Video Analyzer is shown by the top scope pattern. Bursts are at 75 kHz, 151 kHz, 3.02 MHz and 3.56 MHz. Bottom trace is the same pattern after it has traveled in the TV from antenna to video TP-3. Some high-frequency boost is noted. (B) However, the pattern viewed on the picture-tube screen showed excellent flat response. Evidently the video peaking had reduced the high frequencies and provided level response over the required bandwidth.

Meter loading—A strange series of readings were observed when the dc voltages of the Auto-Color circuit were being measured. Now, it's not unusual for digital dc meters to give varying readings when pulses are mixed with the dc voltages. But this problem gave wrong readings also with a VTVM. After much crosschecking it was discovered that both digital and VTVM meters gave erroneous readings at certain points in the Auto-Color circuit.

Therefore, the dc voltages in Figure 6 were measured by a triggered scope, which proved to be the most accurate for this particular circuit. More details will be given in a later article.

Chroma troubleshooting

IC300 plugs into a socket, and it can be replaced easily whenever a question arises. There are no practical field tests for ICs. So, verify that the supply voltage is correct and that dc voltages at the important pins are within tolerance. Then if the proper input signal is present but the symptoms and output

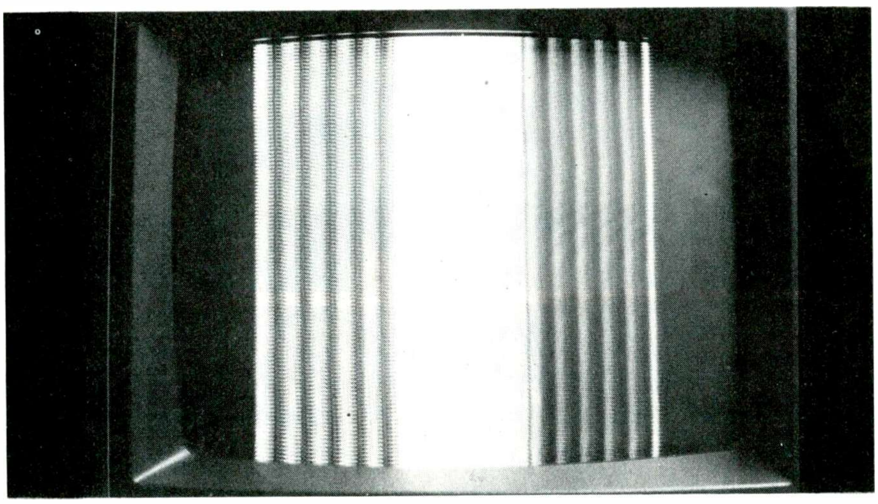


Figure 9 A similar generator test using the Sencore chroma-bar sweep showed the AA choma response to be very good from antenna to picture tube.

waveforms indicate a defective IC, remove IC300 and substitute a new one as a test.

All four of the matrixing transistors are soldered to the CRT-base module. Therefore, they should be given an in-circuit good/bad check and dc-voltage analysis before removal for out-of-circuit tests or replacement.

Probably the best diagnostic tool is a good scope. Next best is a digital multimeter for accurate dc voltage tests.

Defects in demodulators or color power amplifiers often affect the brightness. Sometimes just one color signal has the wrong brightness or amplitude. Occasionally, all three can be affected. Check the dc voltages when such symptoms are noticed.

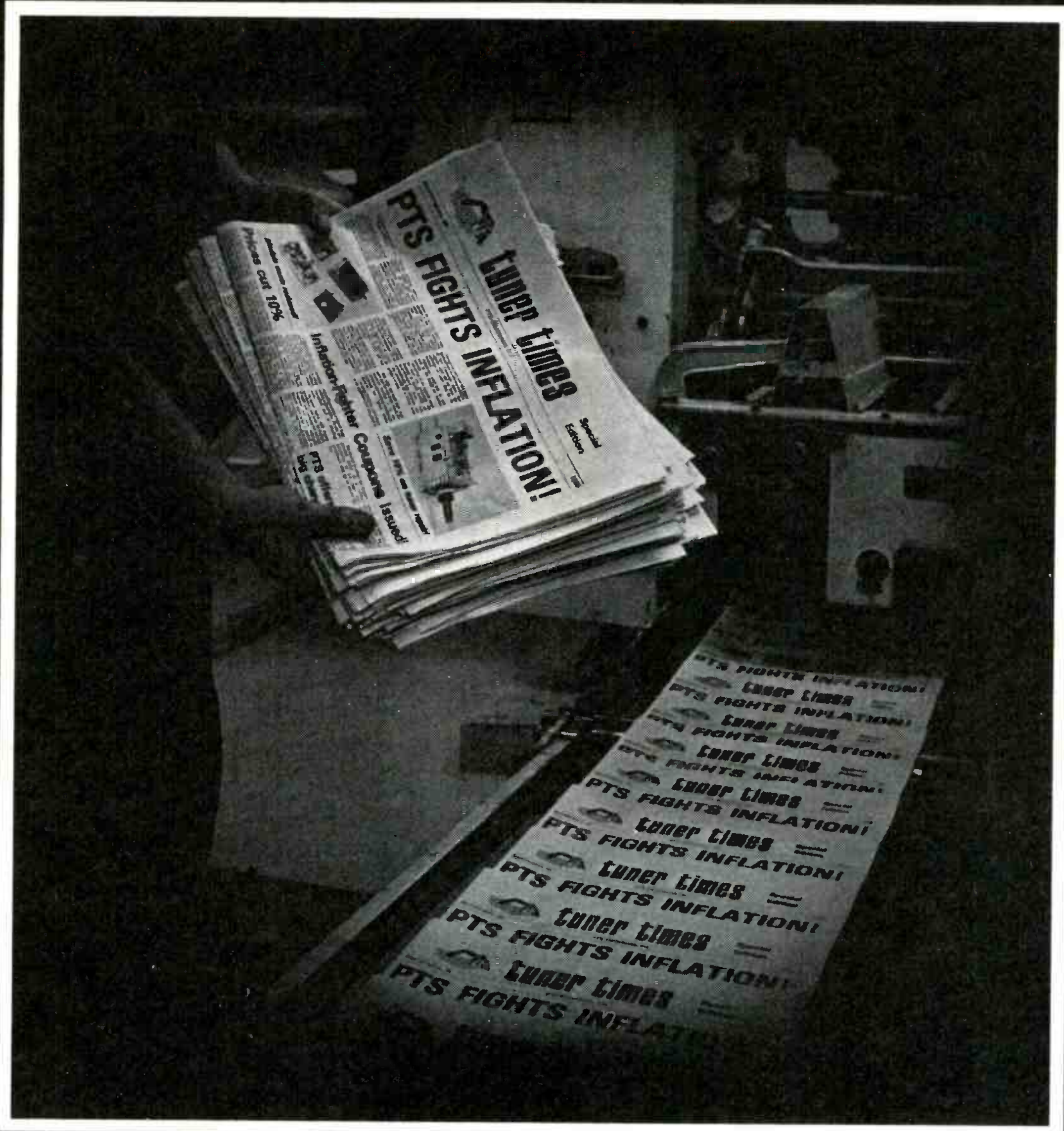
For intermittent or obscure troubles that are not found by these tests, the entire large module can be replaced. Of course, the matrixing power transistors are on the CRT-socket module, so the general location of the defect must be known.

Color performance

Overall response from the VHF antenna terminals to the first-video stage was checked visually by the "bar-sweep" pattern from a Sencore VA-48 Video Analyzer. The excellent results on the face of the picture tube are shown in Figure 8. Chroma response from the antenna terminals to the picture tube is shown in Figure 9. Even without adjustable chroma-IF tuning, the response was very good.

These pictures of IF and chroma response are included to serve as a standard so a technician can know for certain if the picture quality of a set is satisfactory after repairs. ☐

Hot off the press!



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people in the news

R. W. King has been appointed vice president of marketing for PTS Electronics of Bloomington, IN. King has more than 20 years experience in the electronics field including a position as national sales manager for PTS since 1976.

Other promotions include Murl Reeves who advanced from PTS regional manager and supervisor of the PTS-Springfield Servicenter to become regional vice president. John Rollison formerly was a regional manager, and now also becomes a regional vice president. All announcements were made by Roland Nobis, president of PTS Electronics.

Oscar A. Goedecke III has been honored with an award as the outstanding 1978 salesman in the Oklahoma City sales office of RCA Distributor and Special Products Division.

Frank Quement of Quement Electronics in San Jose, CA, recently received a plaque from John McLernon, Western regional manager for RCA Distributor and Special Products Division, in honor of the distributor's 40 years of service to the electronics industry.

The Electronic Industries Association (EIA) recently presented the EIA Medal of Honor to Robert C. Sprague, Sr., of the Sprague Electric Company. The presentation was made by Senator Edward M. Kennedy at the dinner during EIA's spring conference. Almost 300 companies belong to EIA.

Norm Schneider has been awarded the second annual James B. Lansing (JBL) "Rock" for outstanding sales and dealer-service performances during the last year. Technical Systems Reps, Schneider's company, is based in Chamblee, GA, and serves the southeastern states.

Wayne Etter has been promoted to president and chief executive officer of the Mallory Components Group. Etter was elected a corporate vice president in 1969, and has served as vice president of the components group since 1975.

The Audio Engineering Society has awarded a fellowship to Bernhard W. Jakobs, director of engineering for Shure Brothers, for his outstanding contributions to the design and measurement of phono cartridges. Jakobs is considered to be one of the world's foremost authorities on phono cartridge design and has written a number of papers on the subject.

Altec Lansing has appointed Charles "Chuck" Harper as vice president of consumer sales for Altec Lansing International. Harper is a 20-year veteran of the audio industry.

Murray Feigenbaum, president of LogiMetrics, has announced the appointment of two executives. Jerome Deutsch, who has been vice president of engineering, now is vice president of marketing. Melvyn Radner has joined LogiMetrics as vice president of engineering.

Robert C. Brockman has been named sales-service manager for Phelps Dodge Communications Company. Brockman has had extensive training and experience in military electronics.

Mrs. H. A. Williams, owner and manager of the H. A. Williams Company of Columbus, Indiana, recently was awarded a plaque as the PTS Electronics Distributor of the Month. Richard W. King, PTS vice president of marketing, made the presentation. (Courtesy of PTS)

Power supply problems in Admiral M10

The M10 chassis has been employed in many Admiral 13-inch through 19-inch portable color-TV receivers and also in some Montgomery Ward and K-Mart versions.

by Homer L. Davidson

About 90% of the service problems in the Admiral M10 chassis are caused by the power supplies, although some failures also occur around the flyback area.

Typical symptoms of power-supply defects include the following:

- a single pulsating horizontal line;
- narrow picture;
- hum in picture and sound;
- no picture and no sound; and
- an intermittent raster that flashes on and off at a regular rate.

Essential information

Several general facts must be known before any efficient troubleshooting can be done in any circuit of the Admiral M10.

Only *one* dc voltage source comes from rectification of ac line voltage. This supply voltage is regulated to approximately +120 V by a driver transistor and two paralleled power transistors in a series-pass circuit.

Power from the +120-V supply is used to operate the entire horizontal-sweep circuit, including the oscillator, pre-driver, driver and output transistors.

All other stages receive power obtained by rectification of horizontal-sweep pulses. The amount of high voltage and its regulation are direct results of the exact value of the +120 V and its regulation.

Therefore, if the +120-V supply has zero dc voltage, all dc voltages are eliminated in all circuits.

If the +120-V supply increases significantly above the nominal value, all dc voltages (including the HV) will be too high.

It's clear, then, that defects in power supplies of this type can cause all of the conventional symptoms of insufficient dc voltage (small picture perhaps with hum) in addition to new ones caused by excessive power-supply voltages.

Diagnostic difficulties are increased by the "high-voltage shutdown circuit." A protective safety circuit (described later) monitors the sweep amplitude. If the pulse voltage rises above the desired level, the safety circuit kills the horizontal oscillator. No damage is done to the horizontal-output transistor (which merely idles without drive). However, the loss of horizontal sweep eliminates all of the low-voltage supplies except the line-rectified +120 V and the picture-tube ac heater voltage.

After a shutdown has reduced the B+ below a certain low voltage, the protective action is cancelled, allowing the B+ to rise which triggers another shutdown. So, the result often is a continuous alternation between picture and a loss of raster. These symptoms can be confused with defects in the horizontal-sweep system. Therefore, every technician should be familiar with the tests and methods of locating the source of all problems, regardless of any similarity of symptoms.

Main power supply

A simplified schematic of the M10 Admiral main power supply is shown in Figure 1. One side of the incoming 120-V ac power is grounded to the chassis. Therefore, an isolation transformer should be used for the TV power whenever the back is removed. Several other tips are included with the description of circuit operation that follows.

A single silicon diode (D900) rectifies the line voltage. D900 and first filter capacitor C101A operate as a peak-reading circuit that (when loaded) produces about +160-Vdc with moderate 60-Hz ripple. D900 is rated at 3 A, but it runs a little warm; therefore, no diode of lesser value should be substituted. Figure 2 shows the location of D900 and other components on the M900 power-supply board, which is mounted behind the antenna terminals. An open in D900 or R907 stops both sound and picture. A leaky or shorted D900 blows the F100 4-A line fuse.

R907 has a negative-temperature coefficient and a resistance at room temperature of about 10 Ω. When power first is applied, the ac current heats R907, forcing it to decrease in resistance. The lower resistance reduces the heating, and a point of balance is reached where R907 remains at a low resistance (below 1 Ω) so long as power is applied. This is a good way to reduce the starting current surge (which without R907 would be huge) without producing an excessive voltage drop after the current surge has moderated.

Also, R907 has the dubious distinction of being the only power-supply resistor that has caused many problems. It runs quite warm even under normal conditions. A blue-colored resistor that sometimes failed prematurely was used in early production. The correct replacement is black and it carries the 61C49-6 part number. Some of

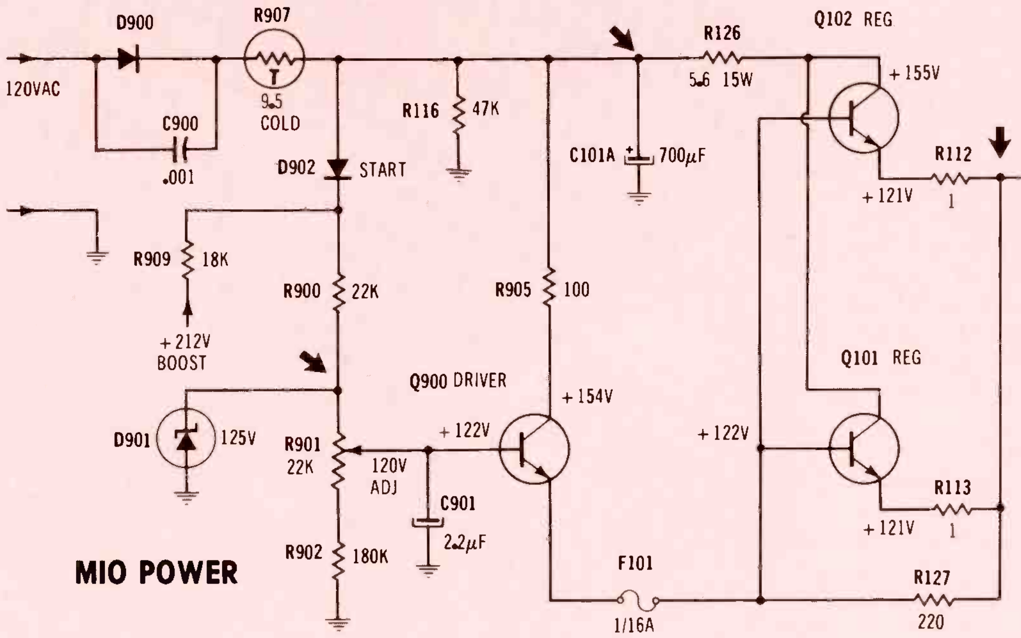


Figure 1 Voltage from the +120-V supply of the Admiral M10 chassis is used only by the horizontal-sweep circuit. Other low-voltage dc sources are powered by rectification of horizontal pulses. Therefore, the exact voltage from this regulated supply determines the dc voltages for the entire TV receiver (including the high voltage).

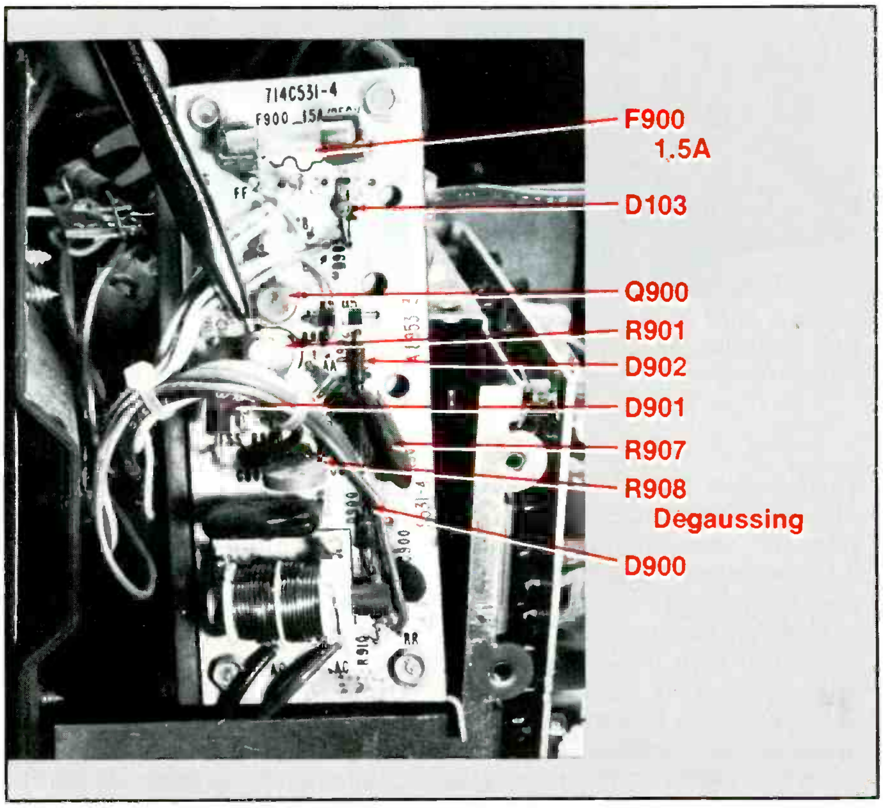
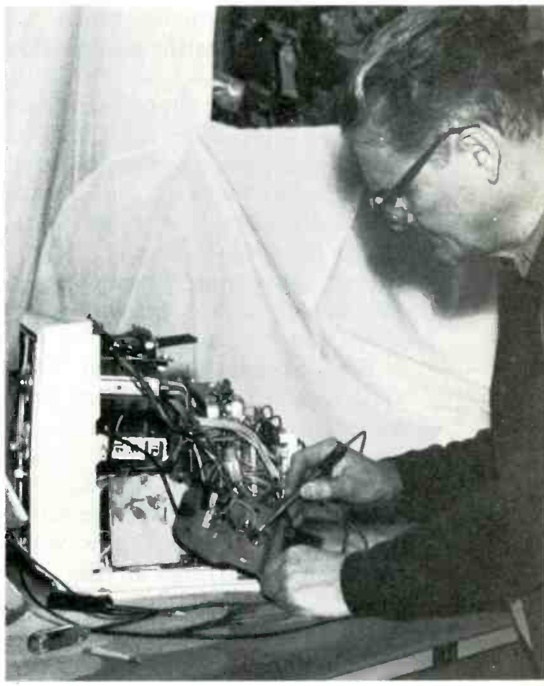


Figure 2 A pencil points to the +120-V adjustment (R901), and arrows show the locations of other important power-supply components on the M900 module.



A TV technician checks the dc voltages at one of the series-pass voltage-regulator power transistors.

these thermistors fail by burning open. Others crack from the heat and break into pieces.

Figure 3 pictures the three fuses and other components that can be used as convenient testpoints. They are accessible without requiring the removal of any boards or panels. F900 and the top edge of M900 board are visible behind the antenna-terminals panel. Two filter cans are mounted in front of F100.

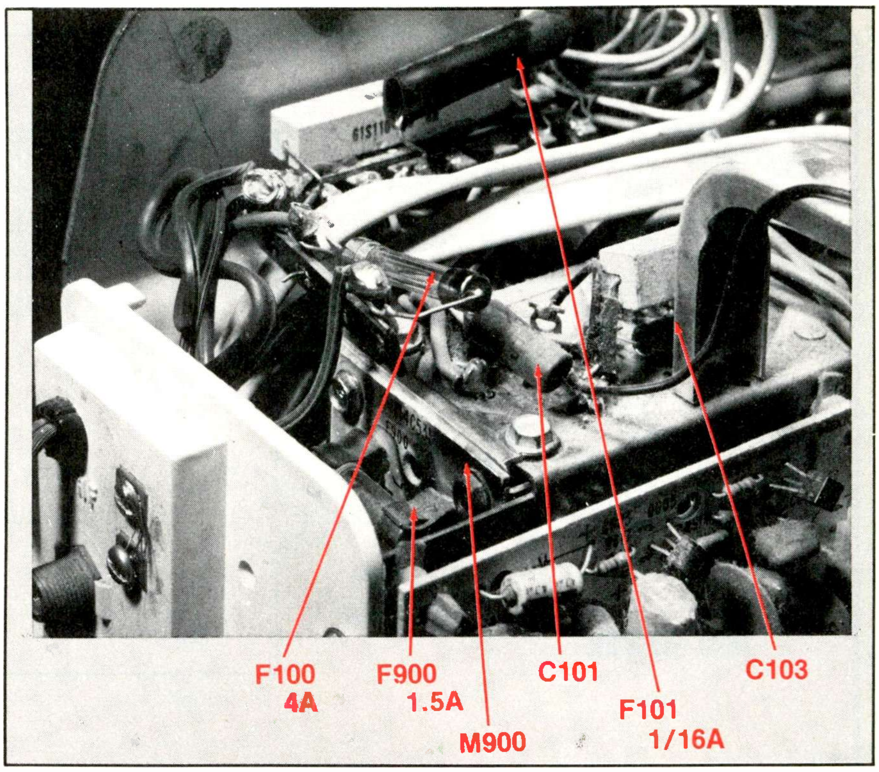


Figure 3 Three fuses are accessible without removing any shields or modules. F100 is the ac-line fuse, F900 is the main +120-V fuse and F101 protects parts of the regulator circuit.

Regulation

Q101 and Q102 are large power transistors which are paralleled to increase the total current-carrying capability. They regulate by having a fixed dc voltage at the bases so that variations of the +120 volts at the emitters is a change of transistor bias. For example, an increase of the +120-V supply voltage decreases the bias the same as a decrease of base voltage does when the emitter voltage is fixed. Therefore, the transistor passes less current which decreases the emitter (load) voltage. A decrease of emitter voltage is an increase of forward bias that produces more C/E current and raises the emitter (load) voltage.

There is little voltage variation at the paralleled bases of Q101 and Q102 in normal operation. However, this base voltage can be *adjusted* to select the exact voltage that's needed for the +120-V supply. Supplying this stable but adjustable voltage is the job of Q900 and its components.

Both stages (Q900 and Q101/Q102) are emitter followers (where the control signal enters at the base, and the output signal is taken from the emitter). Therefore, the Q101/Q102 emitter voltage (+120-V supply) "follows" any voltage variation occurring at the Q900 base. For example, an increase of Q900 base voltage in turn increases the nominal voltage of the +120-V supply.

Zener diode D901 regulates the dc voltage at the top end of R901 (the adjustment control). This gives the required stability of voltage.

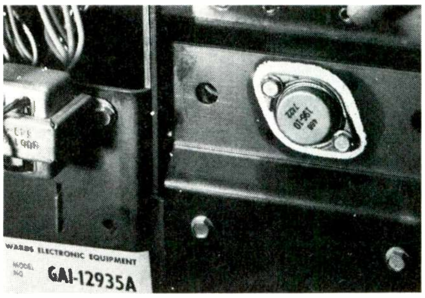


Figure 4 Q102 is mounted on a heat sink that also functions as an end panel. It's easy to remove for tests.

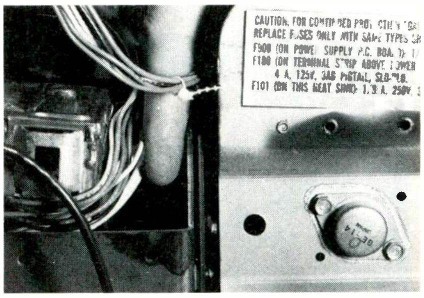


Figure 5 Q101, the other power transistor in the +120-V regulator, is mounted in a hard-to-reach position on the front side of a metal panel.

Then control R901 is adjusted for whatever Q900 base voltage provides the correct output from the +120-V supply (which determines the high voltage).

Moderate failures have been experienced with power transistors Q101 and Q102. Q102 is easily accessible, since it is mounted on a heatsink that doubles as a side panel (see Figure 4). However, Q101 is buried so deep that the TV chassis might have to be removed from the cabinet, or the low-voltage power cage could require unhooking from the chassis before this transistor can be replaced. The finger in Figure 5 points to where Q101 is hiding. (Two different versions of the M10 chassis are shown in Figure 4 and Figure 5.)

Because Q101 is not very accessible, it's best to test it last after Q102. Unplug Q102 and power the chassis to determine whether or not the problem remains. If it does, Q102 probably is good, but Q101 is a suspect so it should be removed for testing.

Voltage for R901 and the base of Q900 comes from one or the other of two sources: through D902 and

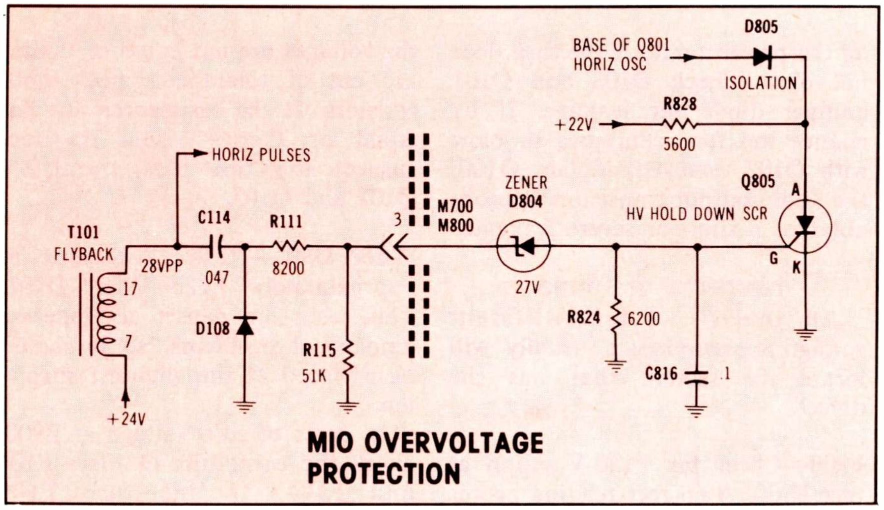


Figure 6 The overvoltage protection circuit of the Admiral M10 monitors the amplitude of horizontal pulses. If the amplitude becomes excessive, SCR Q805 is activated, and the SCR conduction kills the horizontal oscillation. After the dc voltage drops, the SCR releases and allows the oscillator to operate again. Therefore, a constant overvoltage allows a picture to be seen briefly about once per second.

R900 from the +160-V source; or through R909 and R900 from the +212-V supply. This peculiar double source is needed for the "high-voltage shutdown" circuit.

High-voltage protection

Figure 6 has a simplified schematic of the high-voltage shutdown circuit, which kills the horizontal-oscillator operation whenever the horizontal pulses from one flyback winding exceeds a certain level.

C114 and diode D108 form a shunt-type peak-reading rectifier circuit. The output has a mixture of dc voltage and ac pulses. The amplitude of these voltages is reduced by R111 and R115 before the combination reaches zener diode D804, which has a 27-V rating. Any signal amplitude exceeding +27 V is passed to the gate of SCR Q805. When the Q805 base signal exceeds about +0.8 V, the SCR is triggered into conduction between its anode and cathode.

The Q805 anode is connected to the base of the horizontal-oscillator transistor (Q801) through diode D805. During normal operation, D805 is reverse-biased by the +22 V at its cathode (from Q805 anode), and the oscillator operation is not affected.

Whenever SCR Q805 is triggered by excessive flyback pulses, the anode/cathode path through Q805 becomes a virtual short circuit. Now D805 is forward biased by the small positive voltage at the anode (from the oscillator) and nearly zero at the cathode (from the SCR). Therefore, this near short (through D805 and the SCR) eliminates the Q801 oscillation.

Without horizontal oscillation, there are no pulses from the flyback, and the high voltage and raster both disappear. Of course, the pulses to C114 and D108 are gone also, and the gate of SCR Q805 no longer has any positive voltage. However, Q805 continues to conduct (and kill the oscillator) until its anode voltage)from the 22-V supply) drops below the latching point. Then the Q805 anode voltage rises and reverse biases D805, which becomes an open circuit allowing the oscillator to start up.

When SCR Q805 stops conducting, the horizontal oscillator and the entire sweep circuit begins to operate again. If the +120-V supply and the pulses at flyback pin 17 are normal, the set continues to operate. However, if the pulses at pin 17 have excessive amplitude (from any defect), the SCR conducts again and kills the horizontal sweep.

The time delay for the B+ to drop sufficiently produces a raster that flashes on about once every second, assuming the defect remains. This is a symptom that's unique to those sets with a similar shutdown circuit.

D902 is essential

If D902 is omitted or is open, nothing in the receiver will have power at turn-on except for the CRT heaters and the +160-V supply. No voltage comes from the +120-V supply because the Q900 base obtains its voltage from the +212-V supply which is not working since it is produced by rectification of horizontal pulses that are missing because the sweep can't operate without the +120-V supply. So, it's a standoff. Other low-voltage supplies have no voltages since they too operate from pulses.

But with D902 in place, some of the +170 V goes through D902 and R900 to the top of R901 control. The Q900 base has normal voltage, the regulation works, and the +120-V supply operates the horizontal, which in turn powers the other B+ supplies. As the +212-V supply climbs toward its maximum, it raises the voltage at the junction of D902, R909 and R900 to a point higher than the +160 V at the anode of D902. Therefore, D902 is reverse biased and becomes an open circuit. Base voltage for Q900 now comes from the +212-V supply. This is normal operation.

Insufficient width

A narrow picture or one that is compressed on the right might be caused either by the horizontal sweep or the low-voltage power supply. First, check for +120-V at F900. If the voltage is within tolerance and it can be varied with R901, the power supply probably is okay, and the horizontal sweep must be suspected. However, if the voltage can't be adjusted up to above +120 V, the power supply might have a problem.

Narrow width can be caused in the power supply by R907, zener D901 or driver Q900. Be certain R907 does not have excessive voltage drop across it. R907 customarily operates at a very warm temperature and cannot tolerate any more wattage. Visually check these components for cracks, dis-

Admiral M10

coloration from heat and other damage.

A defective D901 zener voltage regulator that has excessive leakage can reduce the width by causing the +120-V supply to be low. If D901 measures less than +100 V and it's running warm, then replace it.

Leakage in driver transistor Q900 can narrow the width, also. Check the base and emitter voltages. If they are too low and the R901 control doesn't seem to work properly, replace Q900.

Defective R126 resistors have caused a few cases of insufficient width. If it runs too warm and has a cracked case, replace it.

When the regulated +120-V supply measures between +40 and +80 V, suspect filter C101A. Incidentally, a 100 μF capacitor paralleled across C101A will not help enough, even if C101A is completely open. Use a larger value, but do not connect or disconnect with the power on.

Loud hum

Excessive sound or picture hum usually is caused by an open C101A. This can be verified by scoping the waveform. The previous remarks about C101A apply here also.

Fuses blow

When the 4-A line fuse F100 keeps blowing, suspect a serious overload in the low-voltage power supply. Check rectifier D900 first, perhaps after it is removed from the circuit. If R907 operates too hot and has a cracked case, a short in C101A is a possibility. Of course, a shorted degaussing coil or a grounded wire to the coil will blow F100 also.

If the F101 1/16-A fuse continues to blow, shorts in Q101 and Q102 are likely. Replace them also whenever a doubt exists that they might be shorting under load but testing okay.

Excessive current that continually blows the 1.5-A fuse F900 probably is produced by a defect in the horizontal-output stage. Remove the Q103 output transistor and turn on the power again. If the fuse does not blow, check Q103 and D101 damper diode for leakage. If by chance the fuse continues to blow with Q103 removed, replace Q100, the audio-output transistor. It probably has a short or severe leakage.

No raster or sound

An analysis of four different voltage measurements usually will locate the section that has the defect.

F900—Check for +120-V supply at fuse F900. A correct reading proves the low voltage and regulator are okay, and probably the trouble is in the horizontal sweep. The line fuse (F100) must be working if any voltage is present at F900. A zero reading suggests a serious problem in the low-voltage or regulator circuits.

C101A—Check for the presence of at least +155 V at C101A. A zero reading or low voltage points toward a low-voltage defect (D900, R907 or C101A).

Emitter current—Measure the voltage drop across emitter resistors R112 and R113. Usually these range between 0.3 V and 0.6 V. If the voltages are not equal or if they are out of tolerance, check both resistors. If the resistances are not equal or there's visual damage, suspect the two pass transistors Q101 and Q102.

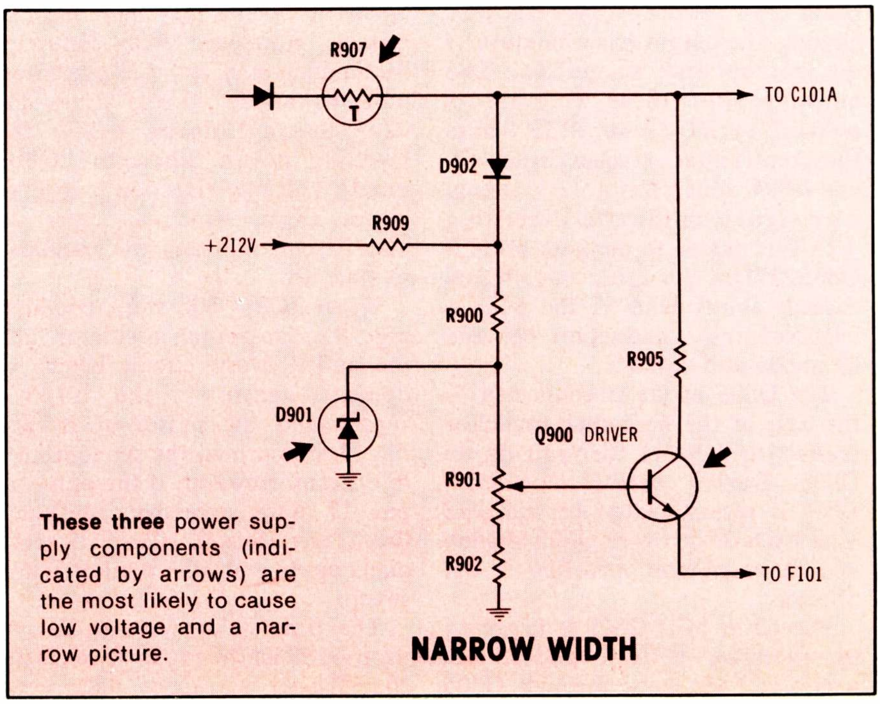
Zener D901—Verify a reading of approximately +125 V at D901. This zener has caused a moderate amount of problems, so it should be replaced at the slightest suspicion.

In cases of zero voltage at F900, check the continuity of fuses F100 and F101. If line fuse F100 continues to blow instantly, remove F900 to disconnect the load of the horizontal sweep. Suspect the power-supply components if F100 blows without the sweep load.

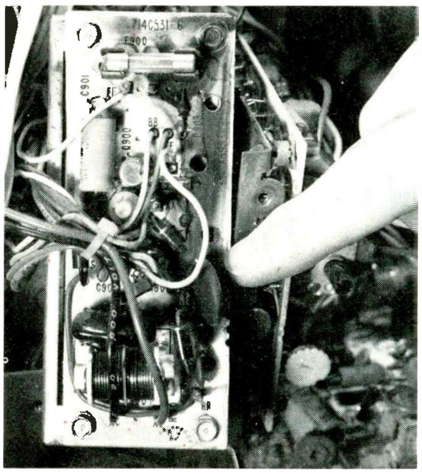
A lack of proper voltage at F101 (or at the bases of Q101 and Q102) directs the suspicion to Q900, which has failed in many cases. In fact, it's not unusual to find a leaky Q101 and an open Q900 in the same chassis. Sometimes Q900 checked okay after removal, but apparently broke down under the in-circuit load.

Intermittent raster

Usually a raster that flashes on and off at about a one-second rate

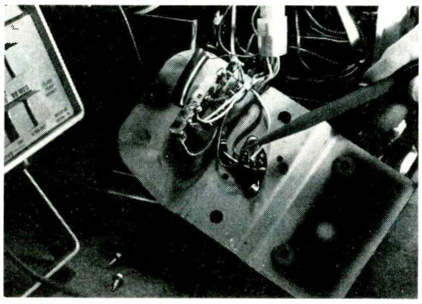


These three power supply components (indicated by arrows) are the most likely to cause low voltage and a narrow picture.



Smoked areas above R907 (negative TC surge resistor) show that R907 has been severely overloaded or has burned up.

indicates the shutdown circuit is being triggered. But the next question is whether the cause is excessive power-supply voltage or a horizontal defect that produces too



The combination heat-sink/side-panel can be removed from the chassis for convenience during voltage and resistance tests of transistor Q102.

much HV and sweep-pulse amplitude.

Remove F900 and check the power-supply end for dc voltage. If it is below +125 V, the low-voltage supply and regulation is okay, and the shutdown triggering must be caused by the sweep. Of course, if the +120-V source measures above +150 V, the regulator circuit requires repairs.

Try to measure the high voltage, although it will be varying. If it seems to be high, then check or replace the capacitors that parallel the damper diode. A decrease of capacitance produces excessive high voltage.

In an emergency, the gate of shutdown SCR Q805 can be grounded to provide constant operation. But use great care, for a HV or 40 kV to 50 kV can damage the picture tube and other components. This disabling of the shutdown function is not recommended except in cases where it is believed the HV is not excessive.

Comments

These explanations of circuit operation and the discussions of test methods for the various sections plus tips about recurrent parts failures should enable bench technicians to identify all defects in the Admiral M10 low-voltage and shutdown circuits. □

Flip flop memories

Many digital memory systems are built around flip flops, because flip flops easily can produce high and low digital states when needed, and then hold them indefinitely until changed by the programming. Several improved memories that use flip flops are described.

by Jack Webster

A typical microprocessor includes these subsystems: input and output devices; arithmetic-logic unit (ALU); control and timing-clock circuits; and two kinds of memory.

Each of these essential sections will be examined in detail. Then the interactions between individual sections in the microprocessor IC will be studied during the last parts of the series.

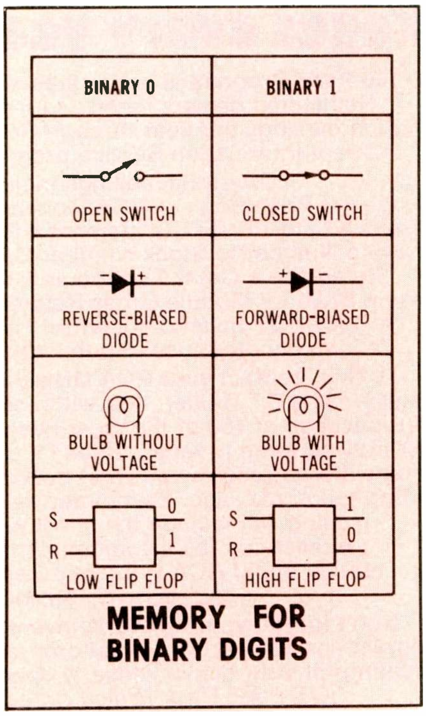


Figure 1 Memories can be constructed around any device which can attain and sustain alternate on and off conditions. Of course, flip flops are more compatible with digital circuits than the others are.

Memories use binary

Binary numbers in various combinations make up the language of microprocessors and computers. A single binary number (0 or 1) is called a *bit* (Binary digIT). Instructions to a microprocessor are groups of bits which are called *words*.

Memorizing a bit

Any device that has only two stable states can be used as a memory. Each of the examples in Figure 1 has been used to some degree in computers. When such a device attains and sustains a desired digital state, that bit is said to be "memorized."

Of the logic gates that are compatible with microprocessors, the most simple memory is the D latch of Figure 2. The output state is determined by the input data, and it's displayed by the LED.

A high input causes the flip flop to go high, thereby remembering a logic 1. Similarly, a low input forces the flip flop to remember a 0.

The Figure 2 circuit, however, has two disadvantages when used as a memory. When the flip flop is in the low condition, a transient noise pulse at the D terminal might switch the output to high momentarily. Also, the states are not stable unless the input bit stays at the D terminal. Otherwise, the flip flop will change when the input is removed (because inversion in the NOT resets the latch).

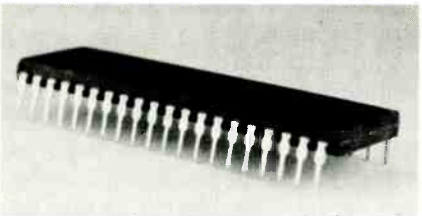
An improved memory

Figure 3 shows an improved memory flip flop (or latch). The quiescent inputs to a NOR flip flop (when it's not being switched) are two logic zeros. A logic 1 applied to the S terminal switches the flip flop to high. This state is stable, and the high remains even after the logic 1 at the S terminal is removed. A logic 1 applied to the R terminal then switches the flip flop output to a low condition. The flip flop remains low after the R terminal is pulled low; this too is a stable condition.

The NOR type of flip flop must *not* have highs at both S and R inputs simultaneously—a requirement which is fulfilled by two AND gates and the NOT that inverts the state at the A input of the bottom AND gate.

Because of the NOT gate, the A inputs of both ANDs always will have opposite logic states. The B inputs are tied together and are connected to the "write" input.

AND gates require highs (logic ones) at both inputs before the output can go high. Therefore, when the write input has a logic 1 and the data input has a digital signal, *one* of the two AND gates will have a high output. A high from AND 1 activates the S terminal, causing a high condition of the flip flop. A high from AND 2 activates the R terminal, switching



Type **8080** microprocessor has a 40-pin DIP case, and it includes flip flop memories.

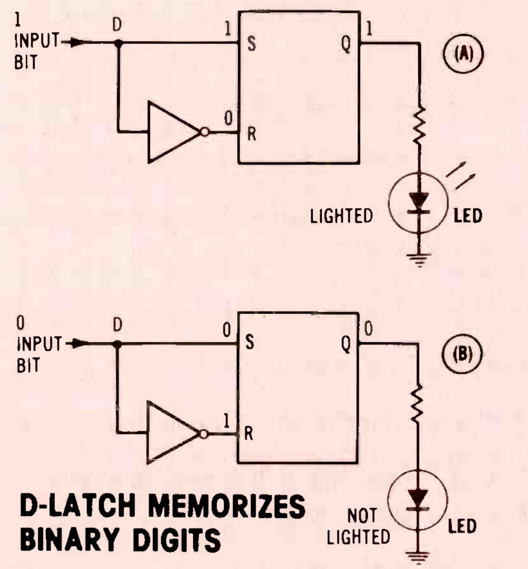


Figure 2 A D-latch output follows the state of the input signal. However, it cannot maintain the last digital state after the input signal is removed.

the flip flop to the low condition, as described before.

These important functions are illustrated in Figure 4. Both the data and write inputs of Figure 4A have highs. Therefore, AND 1 has highs at both inputs, and the output consequently goes high which places that high at the S input of the flip flop, forcing it to produce a high output. At the same time, AND 2 has a low input from the NOT and a high input from the write terminal. These conditions produce a low AND 2 output.

The data input of Figure 4B has a low while the write input has a high. Therefore, AND 1 has one high input and one low input which produces a low output. At the same time, AND 2 has highs at both inputs (the NOT has inverted the data-input low to a high), so its output becomes high which switches the flip flop R input (and the flip flop output) to low.

A low at the write input prevents either AND from producing an output high. In turn, this condition stops the flip flop from changing to a different logic state. In other words, *a low at the write terminal freezes the flip flop memory.*

Reading the memory

The Figure 3 circuit would be more flexible and useful if the output state could be "read" or observed at any designated time. For example, suppose 10 of these memories are operating but only the output of the fifth one is to be

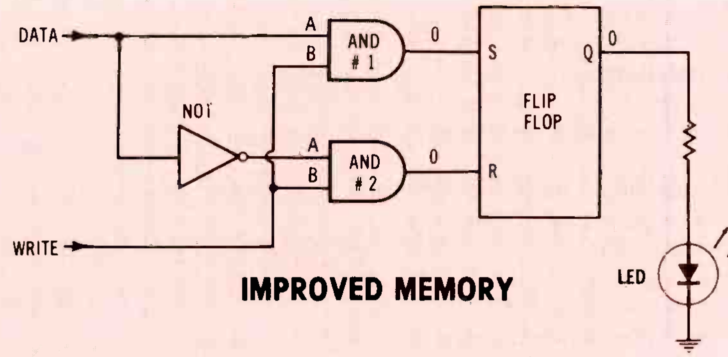
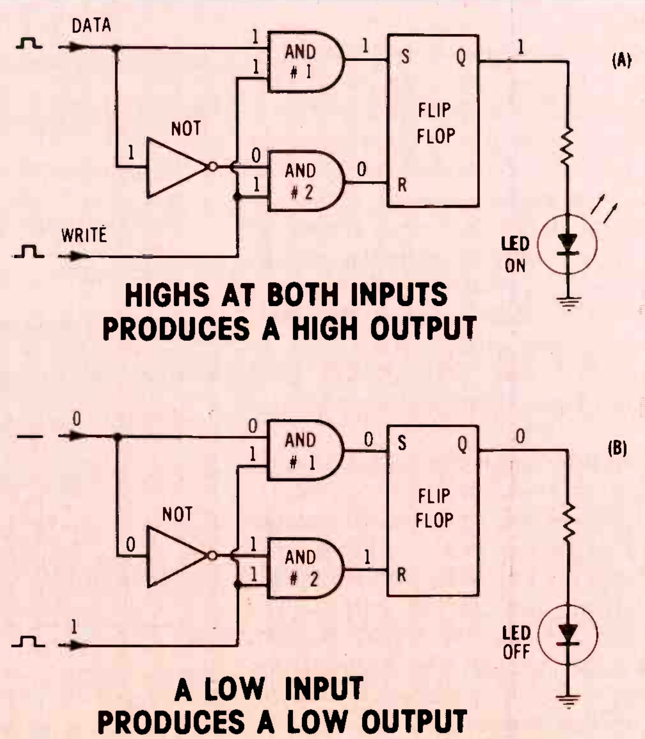


Figure 3 An improved memory allows the last state of the flip flop to be retained after the data signal is gone. The AND gates also prevent any change of flip flop output state unless the "write" input has a high.

Figure 4 Two of Figure 3's four possible input conditions are illustrated. (A) A high at both inputs produces a high at the output LED. (B) A high at the write input and a low at the data input produces a low at the output LED. If the write input has a low, H freezes the memory and the flip flop output state cannot change, regardless of the state at the data input.



delivered somewhere at a certain time.

Addition of AND gate 3 (Figure 5) allows the flip flop output state to be observed *only* when desired. If the flip flop Q output is high and then a high is applied to the "read" input, AND 3 produces an output high which lights the LED. When the read input has a logic 0, the AND 3 cannot have a high output and the LED doesn't light.

Basics of memory

These are the basic requirements for digital memories:

- The digital circuit must have only two stable states which can be sustained indefinitely;
- Data can be stored (memorized) only after a command to "write;" and
- The stored data must be displayed by command from the proper "read" signal.

Types of memories

After the data has been entered into the flip flop memory by application of a logic 1 to the write terminal, the data logic state is maintained without any more actions being required. The data remains unchanged so long as supply-voltage power is delivered to the gates and the flip flop. This type is called a *static* memory.

Some memories require constant refreshment to maintain the data. They are called *dynamic* memories.

If the data is lost when the power is turned off, it's called a *volatile* memory. A *non-volatile* memory retains the data through any number of power on/off cycles.

A few examples should help clarify these terms and concepts.

Dynamic memory—A dynamic memory model is shown in Figure 6. A positive input pulse charges the capacitor which retains the charge for a time to produce a logic 1 digital level at the output. The stored information would be lost, however, without the recirculation circuit which periodically replenishes the charge.

Of course, remember this is only a simple model of a dynamic memory. Real memories are not constructed this way, although the charge in a capacitor has been used as a memory in some commercial equipment.

Data latch—Figure 7 gives the pinout for a type 7475 data latch; and the truth table in Table 1 applies to each of the D-type flip flops in the IC. The top row (first under the line) shows that when the data input (D) has a low when the gate (write) terminal has a high, then the Q output develops a low. (Of course, the $\overline{Q}$ output state always is opposite to that of the Q output.)

Row number 2 shows that a logic 1 at the data-input terminal (D) produces a logic 1 at the Q terminal when the G (gate) input is high. And the bottom row shows that when the gate (G) input is low, the Q output will not change regardless of a high or a low at the data (D) input.

The data latch is useful for holding a number on display. For example, a frequency counter works by actually counting the number of cycles that occur during a precise time period. The number at the end of the count needs to be displayed while the next count is going on. A data latch with the gate (write) pulled low freezes the data (count

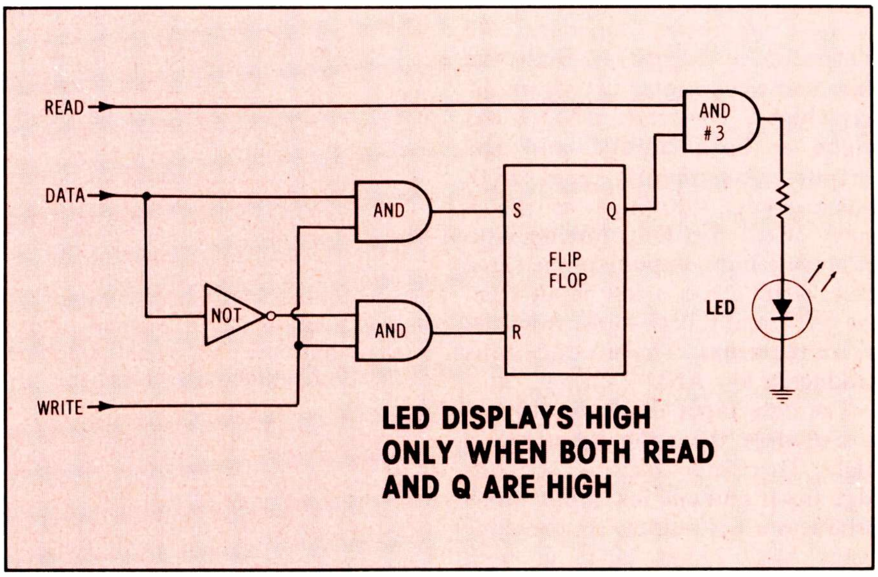


Figure 5 Addition of a third AND and a "read" input allows the flip flop to change state (as in Figure 4), but with the LED showing a high only when both the read input and the flip flop Q output have highs. A low at the read input allows data to be stored, but without any readout of the state of the bit.

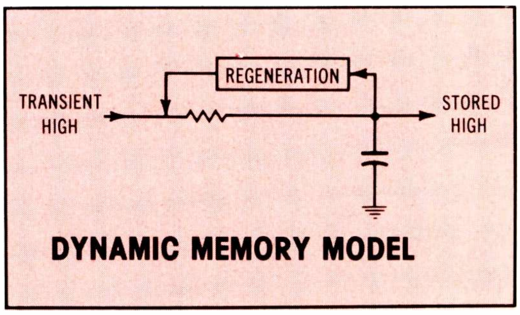


Figure 6 Digital dynamic memories (which require periodic refreshing) are not constructed as shown here. But the diagram shows how a stored high leaks away unless it is continually refreshed by the regeneration circuit.

INPUTS		OUTPUTS	
D	G	Q	$\overline{Q}$
0	1	0	1
1	1	1	0
X	0	Qo	$\overline{Qo}$

DATA LATCH TRUTH TABLE

Table 1 This is the truth table for each data latch of Figure 7.

in this case) until a high is applied to the gate when an updated count is needed.

A frequency-counter block diagram is shown in Figure 8. Of course, additional 7-segment displays are required for counts of more than nine.

Data latches are used often in IC memory arrays. A typical array might have 16 rows of D flip flops with four in each row (for 64 flip flops). When a bit of information is to be stored or retrieved, one of the 64 flip flops must be located.

The method of locating one certain flip flop is similar to that used with many maps. It's done by specifying a column and a row. Newville in Figure 9 is located at B3.

Integrated-circuit memory

Figure 10 is a block diagram of an IC memory that's similar to those in microprocessors. There are 32 horizontal *rows* and 32 vertical *columns*, making a total of 1024 locations for the storing of data.

Some of the terms might be unfamiliar. For example, the symbol $R/\overline{W}$ means "read, but do not write." The symbol CE stands for "chip enable," and the terminal must be activated with a logic low before information can be brought into or out of the memory.

Access to the *row* that has a certain memory cell is obtained by application of the proper binary number to terminals A0 through A4. Similarly, the correct *column* is located by applying a binary number of terminals A5 through A9.

For example, to locate a memory cell that is in the fifth row and first column, the logic levels of Table 2 must be applied. At the same time these logic levels are applied to the address terminals, it's also necessary to apply the proper signal to

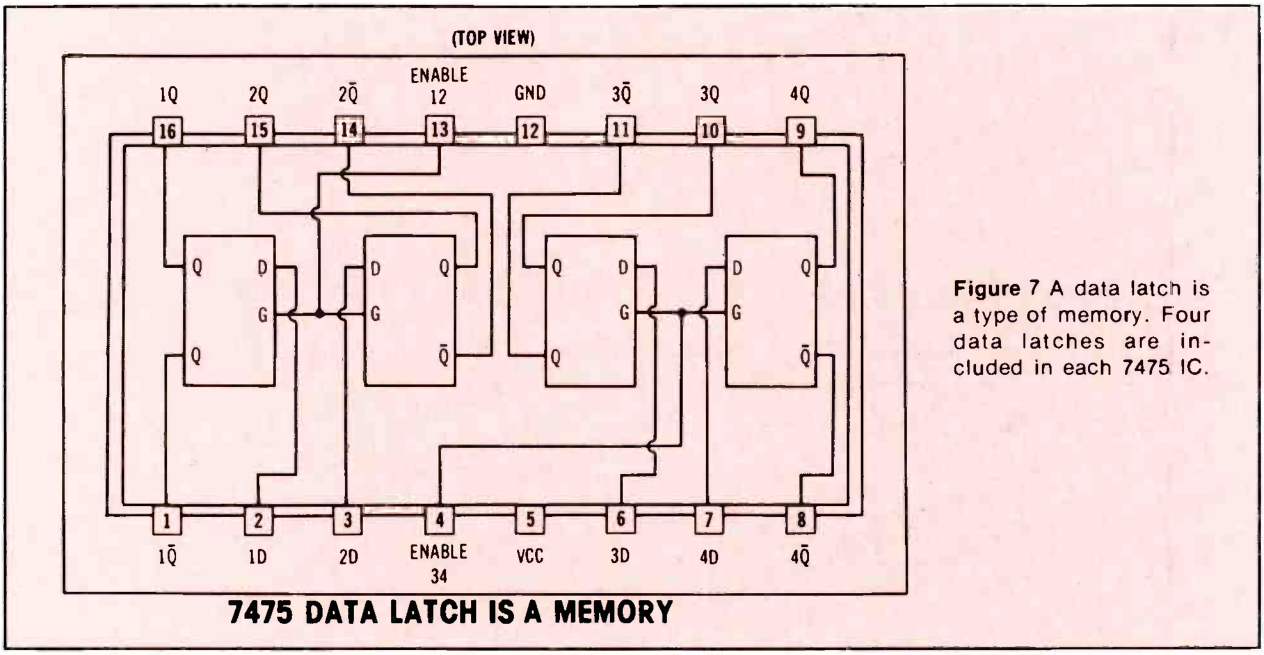


Figure 7 A data latch is a type of memory. Four data latches are included in each 7475 IC.

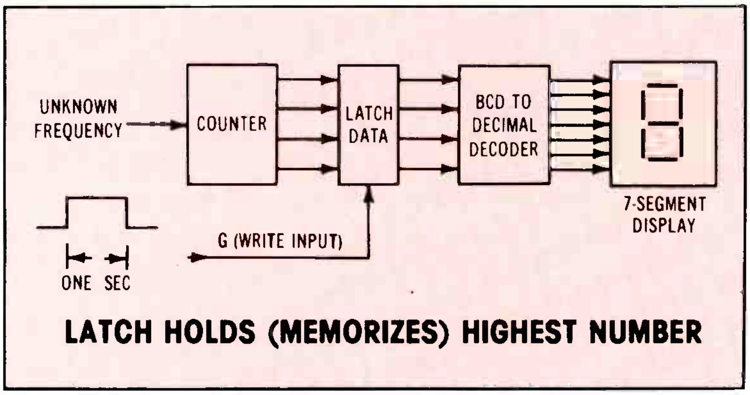


Figure 8 A latch holds a digital number, and it can be used in a frequency counter to display only the final tally.

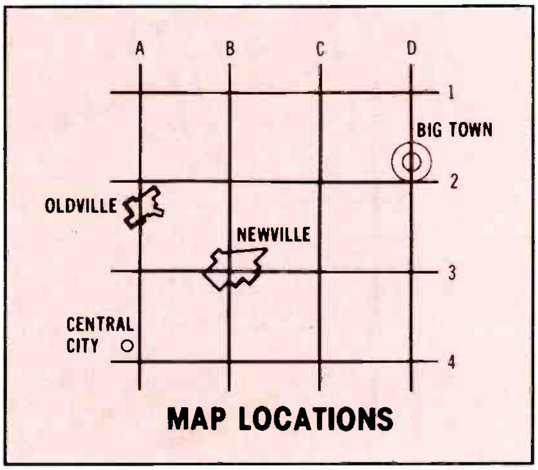


Figure 9 Locations of digital bits are accounted for by a system similar to that used with maps. Vertical lines equal digital columns and horizontal map lines are equivalent to digital rows.

Flip flop memories

the chip enable (CE) terminal. Or, if information is being retrieved, the read-but-not-write terminal also must be activated.

The truth table of Table 3 is supplied by National Semiconductor for the Figure 10 memory. It allows information to be inserted or retrieved from the memory.

First row of the truth table shows that the IC is inoperative when the $\overline{CE}$ has a logic 1 (high) applied. The second row indicates logic 0 will be stored in the memory when $\overline{CE}$, R/$\overline{W}$ and D(in) all are at logic 0. The specific cell where the logic 0 is stored is selected by terminals A0 through A9. The D(out) terminal is for output logic, so signals are not applied to it. However, D(out) will have a logic level 0 output at this time.

The truth table third row specifies that when $\overline{CE}$ and R/$\overline{W}$ are at logic 0 and D(in) is at logic 1, a logic 1 is stored in the cell which has been selected by terminals A0 through A9.

Fourth row of the truth table shows that the stored data can be retrieved by making the $\overline{CE}$ terminal low and the R/$\overline{W}$ terminal high. The data appears at the D(out) terminal. As before, the terminals A0 through A9 must be programmed to select the specific cell from where the stored information is to be retrieved.

Microprocessor memory

Memory blocks in microprocessors are similar to the one described. However, a special coded signal is used to locate a memory cell. □

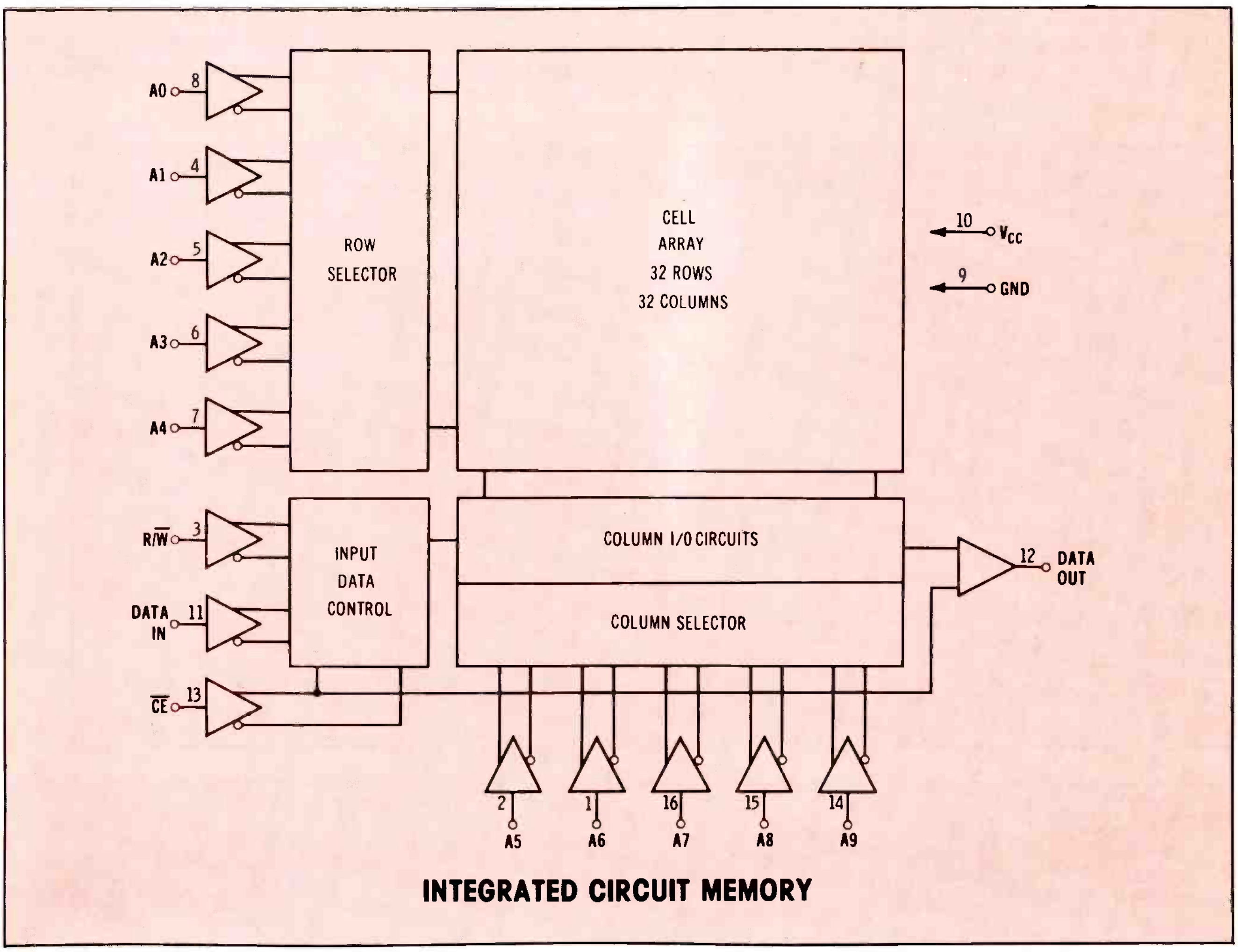


Figure 10 A block diagram of an integrated circuit memory shows the access points to the rows and columns.

ROW	LOGIC LEVEL	COLUMN	LOGIC LEVEL
A0	0	A5	0
A1	0	A6	0
A2	1	A7	0
A3	0	A8	0
A4	1	A9	1

LOCATING A MEMORY CELL

Table 2 To locate a memory cell in the fifth row and the first column, these logic levels must be applied to the Figure 10 memory.

CE	R/W	D(in)	D(out)	MODE
H	X	X	OPEN	NO SELECTION
L	L	L	L	WRITE 0
L	L	H	H	WRITE 1
L	H	X	D(out)	READ

MEMORY TRUTH TABLE

Table 3 These logic levels are required to move information into and out of the Figure 10 memory.

Sam Wilson's Technical Notebook

By J. A. "Sam" Wilson, CET

Wire with infinite capacitance

In the February, 1979, *Technical Notebook,* a strange capacitor was described and discussed. Part of the information is repeated here.

The capacitance of a capacitor is given by the equation:

$$C = k \left(\frac{NA}{d}\right)$$

where

k = the dielectric constant
N = the number of plates
A = the area of the facing plates
d = the distance between the plates.

A capacitor can be constructed from two pieces of conductive material that are separated by a non-conductor. Therefore, two pieces of wire in a straight line have a capacitance between the adjacent ends. As the ends are brought closer together, the distance decreases and the capacitance increases. The formula proves that action, since it includes a fraction with the distance as the denominator. When a denominator is made smaller, the fraction has a larger value. And if the denominator finally becomes zero, the value of the fraction becomes infinity.

Therefore, the statement was made that the straight piece of wire in Figure 1 should have infinite capacitance since the distance between plates is zero. That was the conclusion given in the February issue.

A large quantity of mail was received about the wire-capacitance statement. Not all of the letters can be answered personally or included in this article. About half of the letters treated the statement as a joke, and the writers gave humorous suggestions for using the "capacitance" in various filters and for tuning far-out circuits.

Other letter writers opposed the idea of the wire having infinite capacitance. Strangely enough, not one mentioned that the wire violated the definition of a capacitor (given in an earlier issue)!

Most of the rebuttals followed this line of reasoning: When the two ends of the wire are brought together, there no longer is any air dielectric. Therefore, the dielectric constant becomes zero.

Several of the formulas were similar to this one:

$$C = 0\left(\frac{NA}{0}\right) = \frac{0}{0} = 0$$

Those who proposed such solutions appeared to be comfortable with the idea that "zero divided by zero equals zero." Frankly, I don't believe that is true. Readers who have had calculus training will recognize that the denominator of the equation is decreasing more rapidly than is the numerator (k x N x A). Also, the case of k=0 and d=0 is undefined.

To avoid these difficulties and to allow a valid calculation, a new start should be made with the condition that k x N x A = 1. (Certainly, it's reasonable to assume that a set of values exists where this is true.)

The only variable remaining is the distance (d) between the ends of the two pieces of wire. Notice, however, that the wires do *not*

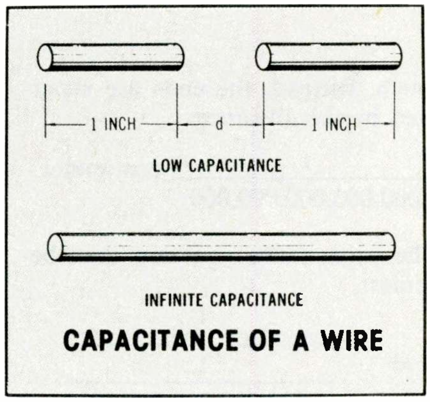


Figure 1 Two pieces of wire (A) have capacitance between them. The ultimate in minimum distance between the plates occurs when a single piece of wire is used (B). Therefore, the wire should have infinite capacitance, according to a statement in the February *Technical Notebook.*

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

Technical notebook

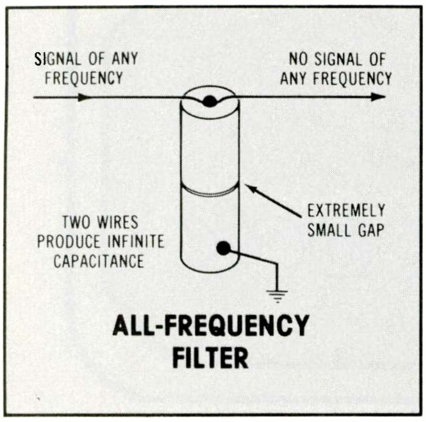


Figure 2 A capacitor of infinite capacitance should eliminate all frequencies.

touch. Instead, the ends are separated by this distance:

$$\frac{1}{1,000,000,000,000,000} \text{ centimeter}$$

The capacitance equation then becomes:

$$C = \frac{1}{\dfrac{1}{1,000,000,000,000,000}}$$

The answer is:
C = 1,000,000,000,000,000 Farads.

That would have to be the great-grandfather of all capacitors!

One reader suggested that the reactance (which is 1 divided by the quantity 2 times Pi times f times c) of such a large capacitance would be zero ohms at all frequencies. Therefore, he proposed a use for the capacitor as a filter which would remove all frequencies (see Figure 2).

Some who wrote letters about the infinite-capacitance wire thought the idea wasn't intended to be taken seriously. No comment. But, it does arouse some healthy interest in capacitance, doesn't it?

Stacks of letters

A mountain of mail (or at least a small mound) has accumulated, and each letter will be answered as soon as possible. Some of the interesting subjects are discussed in these articles. Send written permission if you want your name mentioned in connection with any subjects suggested in the future.

Mu metal

A reader of Woodhaven, NY asks these three questions about magnetism:

- What is Mu metal, how does it work and what are some applications?
- Is it possible to shield magnetic flux?
- How permanent are the "permanent" magnets used in speakers and other magnetic components?

The first two questions are closely related. Mu metal is a special metal which offers low opposition to magnetic flux. In other words, it has high permeability, and that makes it useful for magnetic shielding, as shown in Figure 3. However, notice that the flux lines are not eliminated, but rather are shunted around the object being shielded.

Such Mu-metal shields are used to reduce magnetic pickup of hum by microphone transformers, tape playback heads and the CRTs in scopes.

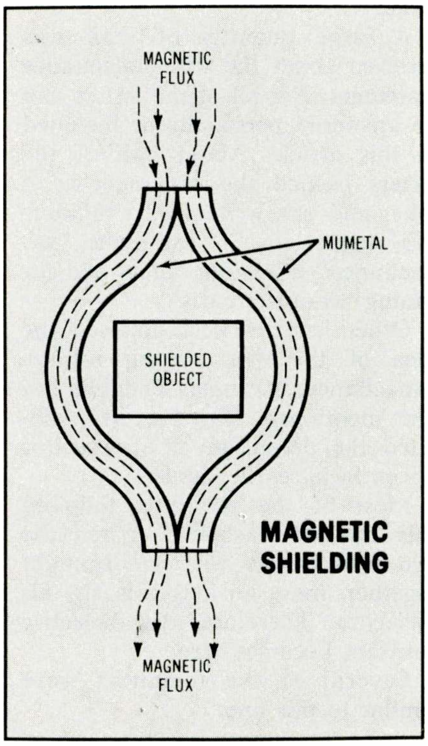


Figure 3 A Mu-metal shield forces the flux lines that normally would travel through an object to detour *around* the object. Therefore, the effect is to eliminate the flux lines that are within the shield.

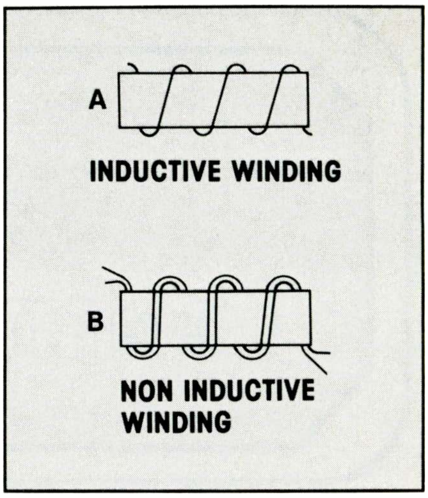


Figure 4 The secondary cable of an arc welder acted as a series inductance that limited the welding current when it was wound in inductive fashion (A) around the cable brackets. (B) After it was rewound in a non-inductive way, the welder operated normally.

No figures are readily available about any weakening of permanent-magnet strength with aging. If the flux does diminish, it must be a minor amount, for it's certain the magnets outlast the cones.

Spin versus magnetism

A question about the theory of magnetism was sent in by William J. McEvoy of Oxnard, CA. He wanted to know if the lines of magnetic flux of a magnetic field are produced by alignment of the electrons spinning around the atom.

Well, it's not quite that simple. If it were, a piece of wood could be magnetized. All non-magnetic materials have spinning electrons.

If clockwise spins are called positive and counter-clockwise spins are called negative, then most materials have an equal number of positive and negative spins. Therefore, no net magnetic field is associated with each atom.

Only certain materials (such as iron) have uncompensated spins. In other words, there are more spins of one direction than there are spins in the opposite direction. Therefore, the atom has a net field in one direction. When the fields of these atoms are aligned, a magnet is produced.

Practical application of theory

Joseph Knotek of Racine, WI described an unusual problem with an arc welder. He told about an electrician who extended a welding cable to more than 200 ft. After testing the performance, he coiled the cable. A few days later, another worker reported that the welder would not work properly. Joseph reasoned correctly that the coiling of the cable had created an inductance which limited the current. After the cable was rewound as shown in Figure 4, the welder worked with normal power.

At the end of the letter, he stated, "Basic theory is needed and should be used along with practical applications in troubleshooting."

Recovery time

A reader who lives in Oak Forest, IL asked for the derivation of diode shunt capacitance versus recovery time, as relating to a subject in the July, 1978, issue.

Company publications are valuable sources of information. The data about diode-recovery time, for example, came from a Motorola publication entitled *Silicon Zener Diode and Rectifier Handbook.*

A counter that skips?

In a letter from Mt. Olive, NC, a reader comments that he enjoys reading *Technical Notebook* and mentions an error that has been corrected already. Then he asked, "How can I program a counter to skip one number while it continues to count?"

It's difficult to imagine a practical use for such a counter. Anyway, the problem is presented to all readers. Design a counter that displays a count of 0, 1, 2, 3, 4, 5, 7, 8, 9 and resets back to zero after the display of 9. Notice that number 6 is omitted.

This is a contest, and the *first* one to send such a design will be presented with a copy of *Industrial Electronics And Control,* a SRA publication written by J. A. "Sam" Wilson. Another prize will be awarded to the first reader who sends a practical application for such a counter.

An ac problem

A reader who lives in Flagler, CO has written, "Enjoying your *Technical Notebook* in **Electronic Servicing,** but my question deals with an item in your Howard Sams book *Study Guide For Associate CET Exams.* Forgive any of my mistakes, for I am a beginner in electronics."

Question 12 and Figure 8-28 have been modified slightly to fit the magazine requirements. This is the way the question was stated:

> In the circuit of Figure 5, both V1 and V2 measure 10 V. Therefore, the generator voltage (e) is:
> (a) 20 V
> (b) 10 V
> (c) 7.07 V
> (d) impossible to determine from the information given
>
> The book gave (d) as the correct answer.

Continuing from the letter, the reader had the impression from previous studies that the generator voltage could be found by use of the following formula.

$$EG = \sqrt{ER^2 + EL^2}$$

This is a case where some of the original material was deleted during editing, but the question was not changed. Notice that the generator voltage is labeled "E" on the drawing, but the question calls for "e."

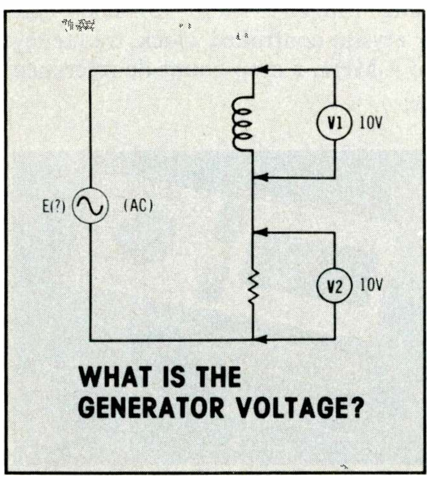


Figure 5 When part of the text was omitted from a book, the answer to the problem (accompanying this schematic) was ambiguous.

One point that was *supposed* to be brought out by the question is that lower case letters are used for instantaneous values, and capital letters are used for RMS and average values.

The equation the reader quoted would provide the RMS value, so he was correct if he wanted the RMS voltage. However, the information is not sufficient for the instantaneous voltage to be calculated.

Although the question is not one of the better ones in the book, it becomes useless when separated from the discussion about symbolism.

Incidentally, the letters V and v are used for voltage now, and not E and e.

Ultrasonic welding

From Astoria, NY came a letter from a reader who asks for help with ultrasonic or percussion welding.

He makes synthetic emeralds in his spare time and needs the welder to fasten on the cover of a platinum cylinder that's to be used in a high-pressure high-temperature autoclave. The cover is 0.013-inch thick, and he can weld most of it with a small oxy-acetylene torch and leaving open a small portion for filling with an acid. He can't use flame on the rest because the acid fumes out.

Figure 6 is a rough drawing of the cylinder. If any reader can help, please write to Sam Wilson, in care of the magazine. □

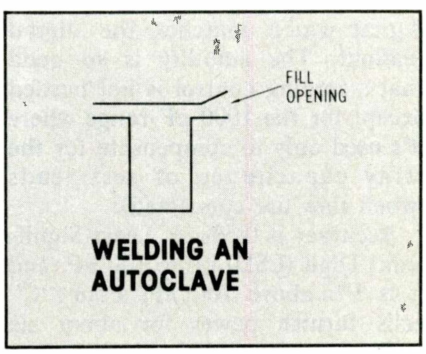


Figure 6 How can a reader weld the opening remaining at the top of this cylinder which is to be used in an autoclave?

Reports from the test lab

Each report about an item of electronic test equipment is based on examination and operation of the device in the **ELECTRONIC SERVICING** laboratory. Personal observations about the performance, and details of new and useful features are spotlighted along with tips about using the equipment for best results.

By Carl Babcoke

"Connect a capacitor of unknown value to an instrument, turn on the power, and rotate the selector switch to higher ranges until the overrange indication changes to a direct digital readout of capacitance." Most measurements can be that simple when the instrument is a model 820 Capacitance Meter from B&K-Precision. Stable and highly accurate readings are obtained within a fraction of a second, except for very large capacitance values that require more time.

Features

Model 820 B&K-Precision Capacitance Meter (Figure 1) has a 4-digit LED readout with a decimal that moves according to the setting of the range switch. The 10 range-switch positions allow measurements of capacitances between 0.1 pF and 999,000 µF.

Most of the internal circuitry is digital which matches the digital readout. The stability is so good that a zeroing control is not needed except for the 1000-pF range where it's used only to compensate for the stray capacitance of test leads (when they are connected).

Accuracy is 0.5% ± Least-Significant Digit (LSD) up to 100 µF, and it is 1% above 100 µF. Four "C" cells furnish power for about six hours of continuous operation. Provisions are made for NiCad cells and an external charger as an extra-cost option. A carrying case is available also. The meter is about 6-½"x4-½"x2-½."

All measurements are direct reading in pF, nF, µF and mF. A handy conversion chart is printed on the back of the case. The overrange indication appears as four horizontal dashes at the bottom of the display.

Tests by charge and discharge

Model 820 measures the amount of *time* required to charge the tested capacitance to a certain dc voltage when a constant current is applied. This is a time-constant action that permits larger capacitances to charge more slowly than smaller ones do. Linearity is achieved by arranging a different maximum charging time for each range so each test is completed in far less than one time constant.

Ten decaded ranges (Figure 2) are required to allow measurements over such a huge span of capacitances. They are handled by a single counting and display system and a proper selection of these four conditions:

- one of the five clock frequencies;
- one of the three discharge frequencies;
- one of the two stop-count charging voltages; and
- one of the four constant currents used for capacitor charging.

For example, the smallest-capacitance range (999.9 pF full scale) has a crystal-controlled clock frequency of 4 MHz, a stop-count dc reference

Figure 1 Measuring capacitances with the B&K-Precision model 820 can be this simple. Accuracy of most ranges is 0.5% ±1 digit.

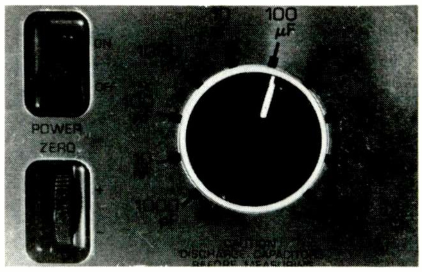


Figure 2 Ten decaded ranges measure between 0.1 pF and 999.9 mF. Maximum reading of all ranges is one less than the markings. For example, the 100 µF range reads from 00.01 µF to 99.99 µF. Overrange occurs above that value. The edgewise-mounted knob for zeroing is at the left below; it is used only for the 1000-pF range.

of 2.5 V, and a constant current of 1 µA. No measurement in this range requires more than 2.5 mS to complete. The 999.9 mF (.9999 F or 999,900 µF) range has a clock frequency of 400 Hz, a charging voltage of 0.5 Vdc, and a constant current of 20 mA. About 25 s are required for a full-scale reading of this highest range.

Shorted capacitors cause an overrange indication on all 10 ranges, and an open capacitor usually measures only a few picofarads on the most sensitive range. No leakage test is provided.

Operating tips

Operation of model 820 is extremely uncomplicated and requires very little interpretation of the readings. However, these next tips should answer some questions and perhaps save time for the user.

Figure 3 shows proper adjustment of the "zero" control. This control affects only the 1000-pF range, and should not be adjusted when other ranges are in use. The control can compensate for up to 20 pF of stray capacitance when test leads are used with the 1000-pF range.

Two facts should be kept in mind. First, the control is a multi-turn type requiring several revolutions to produce much change of reading. Second, no negative count (below zero) is possible. With no capacitor connected, therefore, rotate the knob in an upward direction (toward the + sign) until the 1000-pF range shows some reading. Then rotate the knob in

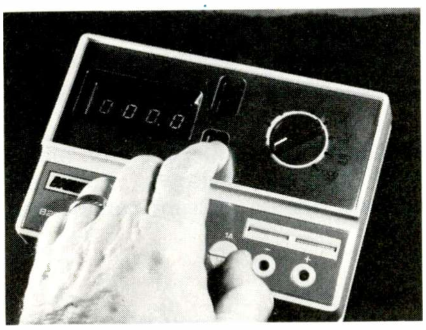


Figure 3 For the zeroing adjustment, select the 1000-pF range and rotate the zero knob until the readout goes from 000.2 to 000.1 and barely to 000.0.

the opposite direction until the reading alternates between 000.1 and 000.0. If extreme accuracy is required, this adjustment should be done with the test leads lying in approximately the proper position, but not connected to the capacitor that's to be tested. Of course, if test leads are not needed, they should be removed and the zeroing performed again before any capacitors are plugged into the slots (see Figure 3).

Polarity of the test leads does not need to be observed with paper, film, ceramic or mica types, but only with electrolytics.

The jacks for the test leads are in parallel with the spring-loaded metal plates in the two slots which are just above the jacks (Figure 4).

To the left of the jacks is a holder for a 1-A fuse that protects the meter against chassis voltages or charged capacitors.

Do *not* connect a charged capacitor to the meter; always discharge each one before a test is made.

Capacitor leakage

Only one condition will produce a noticeable difference in capacitance reading when the range switch is turned from one position to another: **leakage across the capacitance.**

Capacitors with low leakage show the same capacitance when checked on two or three consecutive ranges, except for the inevitable rounding off of the least-significant digit. For example, a low-leakage 0.1 μF capacitor gave these three readings:

- 99.42 nF on the 100 nF range;
- 99.0 nF on the 1000 nF range; and
- 0.099 μF on the 10 μF range.

If the three readings had been overrange, 108.0 and 0.100 respectively, a moderate amount of leakage would be suspected. Or a severe leakage would be likely if the readings had shown overrange, overrange, and 0.210.

In other words, moderate leakage produces a *higher* reading, while severe leakage often causes overrange indications.

Although the model 820 instruction booklet does not mention any tests for leakage, such leakage should be expected when the readings of two ranges are not in agreement.

In-circuit tests—Model 820 is not recommended for in-circuit tests because of errors from circuit resistances. However, practical tests uncovered many cases where measurements were possible in high-impedance circuits at the cost of reduced accuracy. If several ranges show widely different readings, the lowest reading probably has the least error. And an approximate reading is better than none, so long as the operator realizes the reading is not totally accurate.

Comments

Model 820 B&K-Precision Capacitance Meter performed all measurements perfectly. During the testing of many types of capacitances, the capacitors in a substitution box were checked. Some were slightly higher than the marked values; other checked slightly lower. Also, the measurements proved that the sub box added about 20 pF of stray capacitance to the values indicated by the dial of the sub box.

Electrolytic capacitors up to 3,000 μF were tested. Many of them were much higher in capacitance than their ratings. Of course, this is typical of electrolytics.

Model 820 is an excellent instrument which should be a valuable addition for any work bench where capacitances need measuring. □

For factory bulletins, circle (1) on the Reply Card

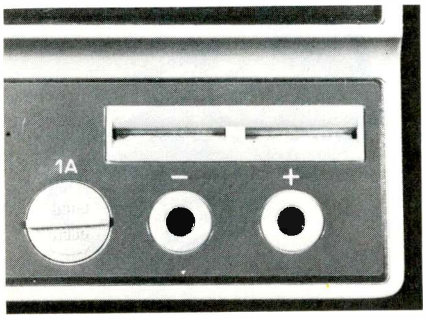


Figure 4 Metal plates behind the slots are paralleled with the two banana jacks. Capacitors with leads can be plugged into the slots, while electrolytics and others large capacitors should be connected by test leads to the banana jacks. Never test a charged capacitor, although the fuse is provided to minimize any damage to the meter.

pF is picofarad	1,000 pF = 1 nF
nF is nanofarad	1,000 nF = 1 μF
μF is microfarad	1,000 μF = 1 mF
mF is millifarad	1,000 mF = 1 F
F is farad	

CONVERSIONS

pF reading ÷ 1,000 = nF	F reading X 1,000 = mF
nF reading ÷ 1,000 = μF	mF reading X 1,000 = μF
μF reading ÷ 1,000 = mF	μF reading X 1,000 = nF
mF reading ÷ 1,000 = F	nF reading X 1,000 = pF

pF reading ÷ 1,000,000 = μF
μF reading X 1,000,000 = pF

Table 1 Many technicians are not very familiar with the term "nanofarad" (nF) which is midway between microfarad and picofarad. Use this table to convert nF to either μF or pF.

test equipment report

Digital capacitance meter

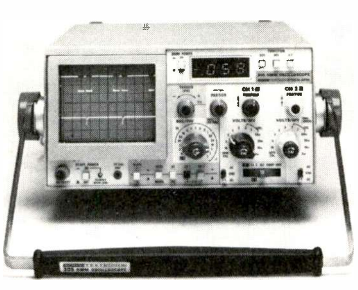
Data Precision has introduced model 938, a digital capacitance meter for testing capacitances between 0.1 pF and 1,999 µF in eight ranges. A basic accuracy of ±0.1% and a 3-½ digit LCD readout are features of the instrument that operates up to 200 hours from a single 9-V alkaline battery. Measurements are based on a dc time-constant principle. The zero adjust can compensate for up to 20 pF of stray capacitance during tests.

Model 938 sells for $149 with battery, spare fuse, clip leads and instruction manual.

Circle (20) on Reply Card

Scope with DMM

A weight of only 10 pounds including an internal battery pack is one important feature for portable field-servicing applications of the



Tektronix dual-trace 5-MHz triggered scope combined with an autoranging 3-function digital multimeter. Operating power can be from ac, dc or internal battery.

Model 305 sells for $1725.

Circle (21) on Reply Card

Isolation transformer

B&K-Precision has introduced model TR-110 Isopak isolation transformer which prevents the dangers of electrical shock and component damage during the testing of transformerless equipment. Both isolated and direct voltage outlets are supplied.

The isolated voltage is adjustable in nine steps from 90 to 140 Vac. This permits changing the voltage to the specified value when the voltage source is high or low, and permits testing of intermittents that are voltage sensitive.

Power rating of TR-110 is 350 VA for continuous operation or 500 VA for intermittent use. Price of model TR-110 is $75.

Circle (22) on Reply Card

Digital-readout power supply

Adjustable and regulated dc power for testing TV, stereo, radio, microprocessor and security equipment is available from model DG-1 Digital Power Supply by **PTS Electronics**.

The output voltage is adjustable to 30 V, and it is monitored by the 3-digit LED digital readout which is accurate to 0.5% and has a resolution of 0.1 V.

Circle (23) on Reply Card

Testing probe

The CVP model 33-133 multitester from **Workman Electronic Products** tests for continuity, voltage and polarity.

The CVP multitester checks for floating grounds, capacity, leakage, fuses, ac line voltages and determines ac neutrals. The compact size of the probe makes it ideal for checking circuit boards.

The CVP multitester is solid-state equipped and it operates on three size-N batteries. User price is $9.95.

Circle (24) on Reply Card

Small VOM

Mura has introduced budget-priced model NH-63 multitester. Sensitivity is 20 k Ω /V for dc and 1 Ω /V for ac voltages. Four dB ranges, two dc current ranges and

three resistance ranges are included. A mirrored scale and protection from meter overload are additional features.

Model NH-63 is priced at $25.50.

Circle (25) on Reply Card

Logical analysis kit

Continental Specialties Corporation's LTC-2 high speed logical analysis kit consists of a high speed (10 ns) LP-3 logic probe, DP-1 digital pulse and DM-1 clip-on logic monitor, plus an assortment of accessories and documentation, all housed in a custom-molded carrying case.

The LP-3 logic probe has .5 meg input impedance and can catch pulses as brief as 10 ns. The DP-1 digital pulser has either single pulses or 100-Hz pulse train. The LM-1 logic monitor clips onto any standard 14-pin or 16-pin DIP IC.

The suggested retail price of the kit is $235.

Circle (26) on Reply Card

LED-readout DMM

Model DM100 digital multimeter from **Universal Enterprises** has 3-½ digit resolution with a display of 0.5-inch LEDs. Zeroing, polarity and overrange indication are automatic, the five basic functions have a total of 25 ranges plus a battery-test switch. Accuracy for dc volts is between ±0.1% and ±0.5% depending on the range.

Price of model DM100 is $99.95. Optional accessories include an ac adapter/battery charger, NiCad rechargeable batteries, and many test leads and probes.

Circle (27) on Reply Card

Rugged VOM

The taut-band movement of the meter is said to be able to withstand shocks up to 50 Gs in the **Soar** model ME-221 VOM. Other features include a mirrored scale, ac and dc measurements to 1000 V, dc current measurements to 250 mA and resistances up to 500 Ω. Two 1.5-V AA batteries provide ohmmeter power.

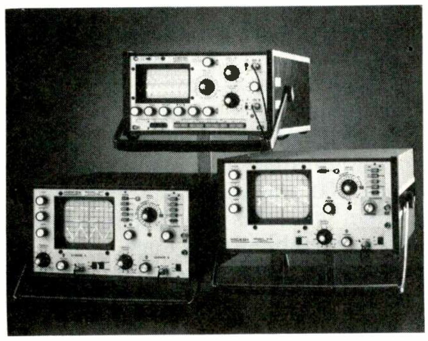
Price of model ME-221 is $30.

Circle (28) on Reply Card

Scopes

Hickok Electrical Instruments offers three low-priced scope models with automatic triggering, color-coded front panels and grouped controls for easy set up.

Hickok model 532 is a dual-trace 30 MHz scope with 11.7 ns risetime, 30 MHz vertical bandwidth and a built-in delay line for viewing the leading edge of fast-risetime pulses.



It has a full time 4x expansion that allows any portion of a pulse train up to 40 full divisions long to be viewed without the use of a multiplier. Price is $995 with probes.

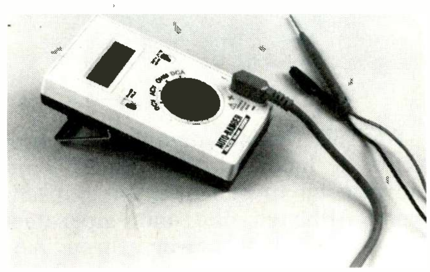
Model 517 is a dual-trace 15 MHz scope with 5 mV/cm sensitivity and response up to 30 MHz. It's priced at $695 including probes.

The model 515 offers most of these features in a $495 (including probe) single-trace version.

Circle (29) on Reply Card

Autoranging DVM

A portable auto-ranging digital multimeter announced by **Alco Electronic Products** features minimal controls and a 3½ digit LCD readout for measurement of dc or ac (RMS) voltage, dc current and ohms, with full auto-ranging. Model



2000A also has auto-zeroing overload protection and auto-polarity sensing. Also included are overrange and low battery indication, tilt stand and custom test lead.

Circle (30) on Reply Card

Logic probe

The **B&K-Precision** logic probe is capable of measurements from DC to 50 MHz. The probe, model DP-50, is a multifamily device that is compatible with TTL, DTL, RTL, HTL, CMOS, MOS and High-Noise Immunity Logic (HiNIL). □

Circle (31) on Reply Card

productreport

Transistor manual

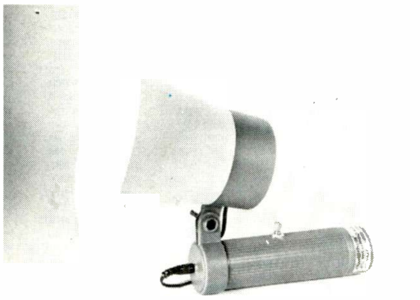
Howard W. Sams has introduced a 9th edition of the *Transistor Specifications Manual* which provides the electrical and physical parameters for more than 19,000 bipolar transistors. Manufacturers of the transistors are listed also.

The 288-page manual sells for $8.95.

Circle (32) on Reply Card

Small megaphone

A Mini-Megaphone (catalog 47-801) is available from **Robins Industries**. Features include a



weight of 14 ounces, automatic-level control, solid-state circuitry and an adjustable horn angle. Four penlight batteries supply power for up to eight hours of intermittent use.

List price is $43.

Circle (33) on Reply Card

Professional sound system

Modern sound control and enhancement are available for either portable or permanent installations in the **Shure** model 700 Pro Master power console which includes two

200-W solid-state amplifiers. Other features include two 10-band graphic equalizers, LED peak volume indicators and a power supply for condenser mics.

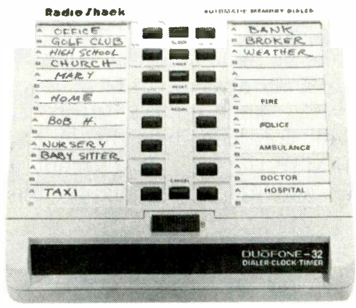
Model 701 speaker systems are recommended for use with the model 700 amplifier. The bass-reflex cabinet contains a 15-inch woofer and a variable-angle horn.

One model 700 power console and two model 701 speaker systems sell for $1980.

Circle (34) on Reply Card

Automatic dialer

Emergency or frequently called phone numbers can be programmed into the **Radio Shack** DuoFone-32 Automatic Memory Dialer which uses microprocessor technology. The machine can store up to 32 different phone numbers that do not exceed 14 digits each. The push of one button can dial long distance or a "dial 9 for outside" number.



An LED readout digital clock and timer is included. The timer can indicate up to one hour of elapsed time. Although the unit operates from 120-V line power, three AA cells prevent loss of stored numbers from power failures.

It sells for $99.95.

Circle (35) on Reply Card

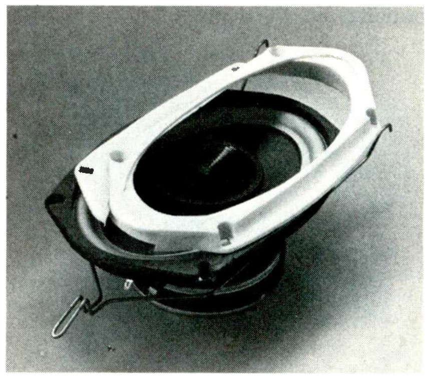
Replacement guide

More than 950 solid-state replacement devices that are cross-indexed to about 153,000 domestic and foreign types are listed in the SPG202X 339-page *SK Solid State Replacement Guide* that sells for $1.50 from **RCA**. A dual numbering system lists both the SK stock numbers and the ECG stock numbers. Information is included about the RCA line of replacement transistors, rectifiers, thryristors, ICs and HV triplers.

Circle (36) on Reply Card

Speaker-size adapter

Many new autos have speaker openings for 4" x 10" speakers, which are not always available for replacement. **East Coast Enterprises**



offers a plastic adapter that allows a standard 6" x 9" speaker to be installed. A spring is included for snap-in mounting of the speaker.

Circle (37) on Reply Card

Desk-top file

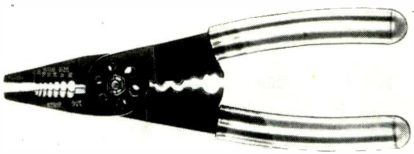
A desk organizer from **Kole** has six pockets arranged in a rising sequence for temporary storage of important papers. It is constructed of corrugated fiberboard with a woodgrained finish.

Circle (38) on Reply Card

Cutting & stripping tool

Model PL-15 tool from **Jonard Industries** cuts and strips insulated wire of gauges between 10 and 22. In addition, it crimps connecting lugs and cuts bolts up to 10-24.

The 8-inch crimper is $8.90.



Circle (39) on Reply Card

Servicing guide

Workbench Guide To Practical Solid-State Electronics provides practical information about the building, testing and repairing of many specific items of solid-state equipment.

The 238-page book sells for $12.95 from **Parker Publishing**.

Circle (40) on Reply Card

Soldering iron & solder

A combined soldering iron and solder applicator is the "Hot Rod" system that's available from **Michael Anthony & Company**. The refillable magazine and solder-feeding mechanism allows one-hand soldering.

Included with the system are the 60-W soldering iron, a beveled tip, refillable magazine with 60/40 solder, a safety stand and instructions. It sells for $19.95 postpaid.

Circle (41) on Reply Card

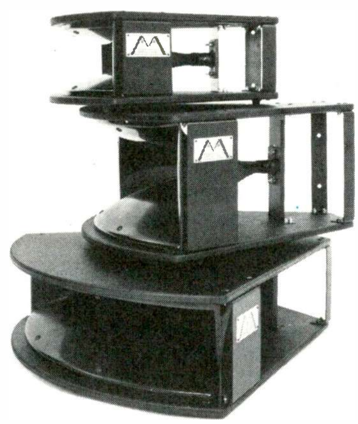
Solderless terminals

Various sizes of solderless terminals that fold over to cover the wire and eliminate possible shorts from stranded-wire ends are available from **Waldom Electronics**.

Circle (42) on Reply Card

Radial horns

Ashford Audio Products has introduced its new line of professional fiberglass radial horns which produce crisp sound reproduction and minimize unwanted resonances and sound coloration, including the ringing tones often produced by metallic horns.



Circle (43) on Reply Card

Replacement baluns

A card with seven replacement baluns including one extra of the two fastest-selling types is a **PTS Electronics** product.

Price of each card is $9.75 net.

Circle (44) on Reply Card

Anti-static brush

The Microniser, a hand-held record cleaner by **Metrosound Audio Products,** contains about one million very-fine carbon fibers which are conductive to reduce static charge from the surface of the record and brush away harmful deposits at the same time.

Circle (45) on Reply Card

Test cassettes

Five test tapes for cassette servicing are available from **ORA Electronics**. Model PTC-1 has a -10 dB 330-Hz tone for playback level reference; model PTC-2 has a 0 dB 1000-Hz tone for measurement of signal-to-noise ratio and for a high-level reference; model PTC-3 has a 0 dB 3000-Hz tone for measurement of speed drift; wow and flutter; model PTC-4 has a -10 dB 6.3-KHz full track tone for tape head azimuth and phase alignments; and

PTC-5 has six different tones from 100 Hz to 10 KHz for frequency response measurements.

Retail prices of all except PTC-5 are $18.95. PTC-5 retails for $19.95.

Circle (46) on Reply Card

Stereo headset

Mura Corporation has designed model HV-100, a hi-velocity stereo headset which uses a thin mylar diaphragm to provide response from 30 Hz to 15 khz. Each earphone has a volume control, and the 10-foot cord has a stereo/mono switch.

Suggested list for Mura's HV-100 is $22.95.

Circle (47) on Reply Card

High-bias audiotape

Memorex introduces the High-Bias audiocassette line that replaces the chromium-dioxide line, and features an advanced ferrite crystal-oxide formulation that provides improved sound reproduction when used at the high-bias setting.

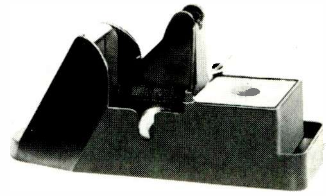
Advantages of the new cassette are said to be excellent recording performance at high frequencies, low noise and increased maximum output level. Suggested retail prices are $4.39 (C-60) and $5.99 (C-90).

Memorex will continue to offer its MRX_3 cassette line.

Circle (48) on Reply Card

Soldering station

A soldering-iron holder which also serves as a compact soldering station is offered by **EDSYN.** "Idle-Rest" model TL194 General Purpose Holder has a tool cradle designed for most soldering irons. It is made



of bakelite to maintain the exterior at a temperature that's safe for skin contact. A heat shield and ventilating grill helps keep the heat concentrated at the tip area. The holder is not prone to tipping, and it can be fastened down to a bench top if desired.

Space is provided for desoldering wicks and solder (included), a storage tray for parts or iron tips, and a large sponge for cleaning tips. The sponge may be removed if desired to obtain additional storage room.

Circle (49) on Reply Card

Replacement semiconductors

PTS Electronics offers individually-packaged replacement transistors, SCRs, diodes, rectifiers, zeners and other semiconductor components for TV, audio and general servicing.

Circle (50) on Reply Card

Teledapter

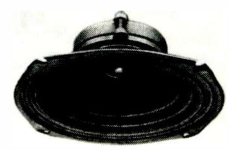
Model TE-100 from **Rhoades National** plugs into the earphone jack of TV receivers. It has matrix circuitry to give simulated stereo sound that's connected to two inputs of a stereo amplifier. An internal transformer provides isolation, minimizing hum and the possibility of shorts or shocks.

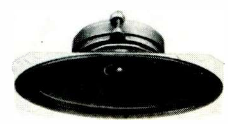
Model TE-100 retails for $16.95.

Circle (51) on Reply Card

Speakers

For replacement use in sound systems and aircraft radios, **Quam-Nichols** has introduced a line of five speakers. All are rated at 3.2 Ω





impedance, provide good voice clarity, are flame retardant and hold up well under unfavorable conditions of altitude and temperature.

Circle (52) on Reply Card

CB Antenna Mount

Three CB antenna mounts have been added to **GC Electronics'** CB accessories line.

A bumper mount (18-1065), for whip antennas with standard 3/8-24 thread base comes with set screws and allen wrench. It adjusts to any angle, for vertical installation.

A multi-mount is available for both 3/8-inch snap-in base-loaded antennas (18-1044) and 3/8-24 threaded whip antennas (18-1043).

All mounts are chrome-plated, heavy-duty steel for complete weatherproofing. Instructions are included.

Circle (53) on Reply Card

Locking pliers

Either curved or straight jaws are available in the Klein-Lok locking pliers from **Klein Tools.** Rotation of a knurled nut adjusts the 10-inch pliers for various sizes of materials and the desired amount of pressure.

Circle (54) on Reply Card □

catalogs literature

Pomona—The largest Pomona test-accessory catalog (100 pages) shows new socket adapters, test leads, plugs, probes and jacks, in addition to a continuing extensive line of accessories illustrated by pictures.

Circle (55) on Reply Card

NATTS—National Association of Trade and Technical Schools (NATTS) offers a guide listing about 500 accredited schools including 107 that specialize in electronics. The NATTS *Handbook of Trade and Technical Careers and Training* has 48 pages compiled by the accrediting commission.

Circle (56) on Reply Card

Jensen Tools—More than 2000 hard-to-find tools are described in the Jensen catalog. These include test equipment, soldering devices, micro-tools, tools and tool kits.

Circle (57) on Reply Card

Dunlap—A 372-page catalog describing industrial electronics components gives descriptions and specifications of 500 product categories from 79 manufacturers. Details for obtaining the catalog will be sent.

Circle (58) on Reply Card

Akai—The complete line of Akai stereo components is illustrated in the 56-page color catalog. Included are cassette, 8-track and reel-to-reel tape recorders, turntables, stereo receivers, amplifiers and speakers.

Circle (59) on Reply Card

Relay Specialties—A new 1979 16-page short-form catalog describes timers, counters, switching devices and controls in hundreds of models.

Circle (60) on Reply Card

Biddle Company—Sixty-nine different measuring instruments for industrial operations are covered in the 12-page 2-color catalog. Tests include insulation resistance, power factor and many more.

Circle (61) on Reply Card

Optima—Price sheets for tubes, phono needles and cartridges, ICs and transistors, cables and connectors, speakers and modules are available. Many items have special discounts. New tubes in cartons are priced at 72% off of list, and quantities receive more discount.

Circle (62) on Reply Card

Blonder-Tongue—The complete line of signal-distribution devices for MATV, CATV, audio/video and home antenna uses is described in a new catalog.

Circle (63) on Reply Card

Quam-Nichols—Engineering and architectural specifications for Quam intercomm and outdoor-communications speakers, ceiling baffles and line-matching transformers are provided in a new spec sheet.

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Essex—A 70-page catalog illustrates and describes many items of electronic hardware, including jacks and plugs, instrument cases, clips, grommets, machine nuts and screws, rivets, tools and tool cases.

Circle (65) on Reply Card

New England Business Service publishes a 56-page full-color catalog 7539 listing more than 250 business forms and related products. These include service orders and repair tags.

Circle (66) on Reply Card

A. W. Sperry Instruments has available MES-100 short-form catalog containing detailed specifications about multitesters and voltmeters.

Circle (67) on Reply Card

Continental Resources offers a 64-page catalog of more than 1000 items of rental test equipment.

Circle (68) on Reply Card

Dunlap Electronics describes 500 product categories of 79 manufacturers in a 372-page catalog. ☐

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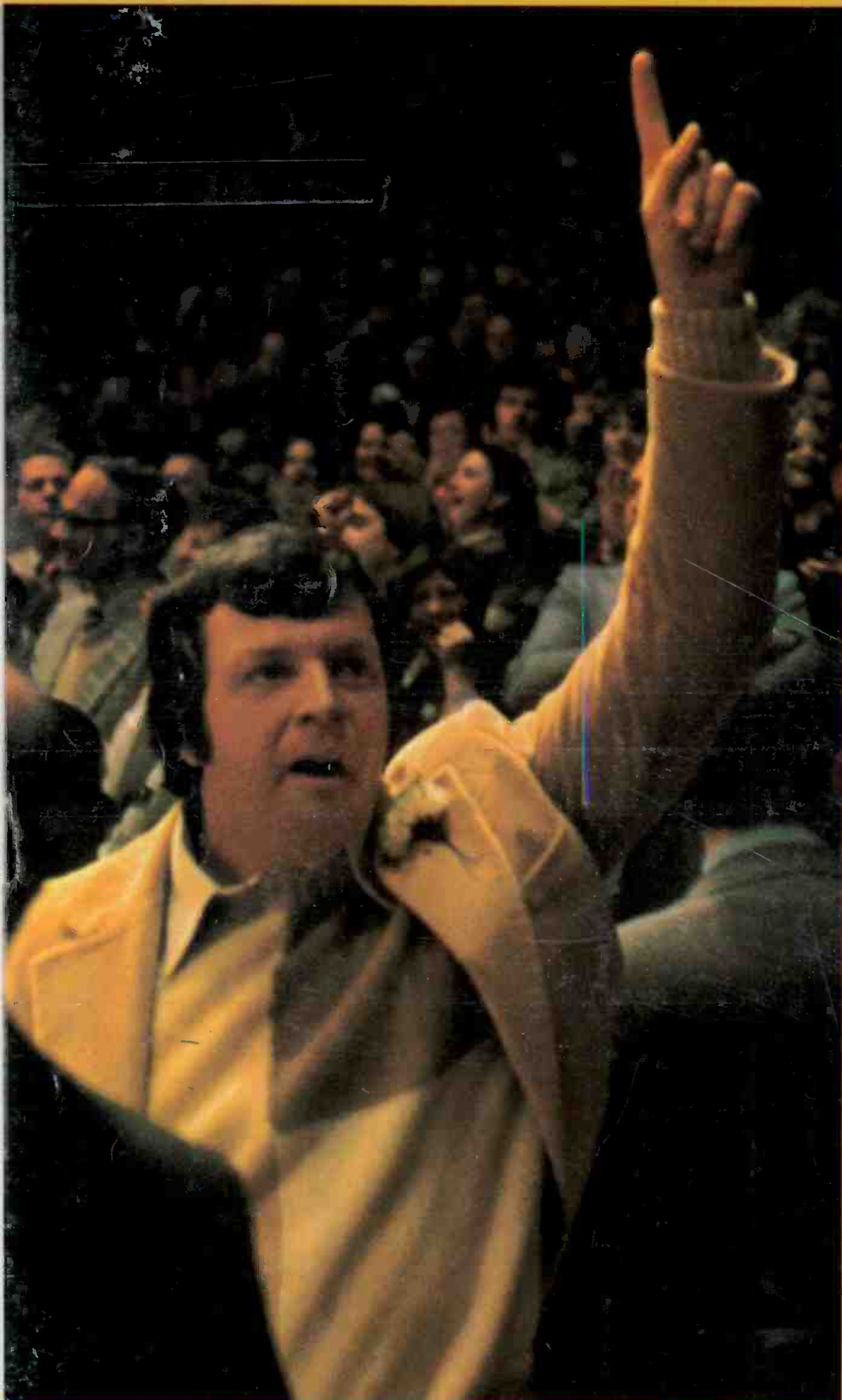

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