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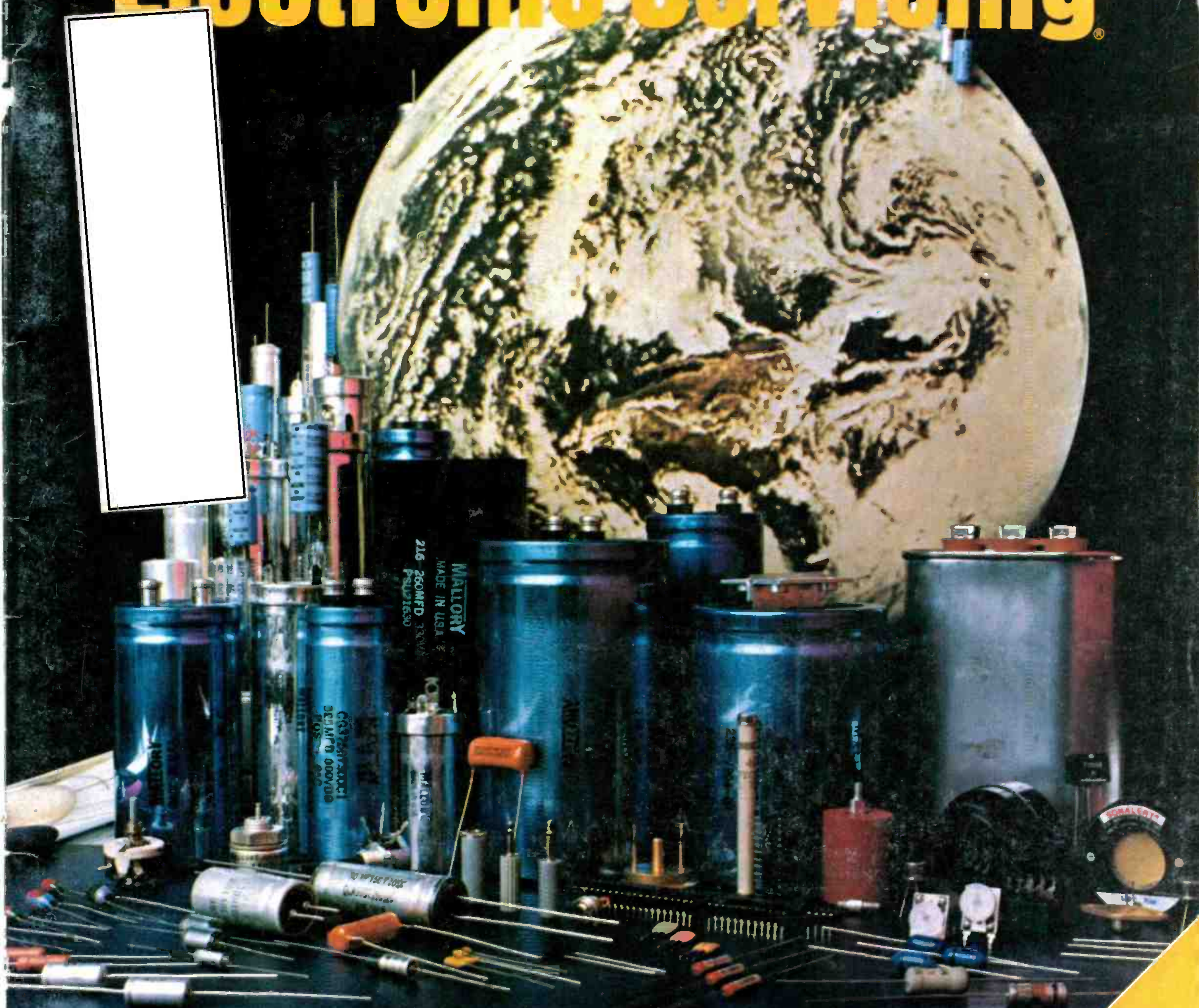

Capacitor roundup issue

AGC basics

Selecting replacement capacitors

How to locate MRO parts

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Next month in

Electronic Servicing

Industrial Maintenance

- Medical electronic equipment repair
- Industrial product test reports

Consumer Servicing

- Antenna installation and source guide
- AGC problems, part 2
- RCA chroma

For industrial maintenance and consumer servicing professionals

Electronic Servicing®

June, 1980 □
Volume 30, No. 6

Industrial MRO

Consumer Servicing

Departments

About the cover

Photograph courtesy of Mallory.

Radio Shack to offer CompuServe

Radio Shack will be the exclusive retailer of the software necessary to access the CompuServe Information Service through microcomputers such as its TRS-80, or by means of "dumb" information terminals.

Beginning in July, microcomputer users with Radio Shack's TRS-80 VIDEOTEX software package will be able to access data provided by CompuServe through its national packet switching and computer network. This is presently available in more than 230 markets on an inexpensive local-call basis.

Radio Shack has also introduced a new home and office two-way information retrieval system, the TRS-80 VIDEOTEX video information terminal to be delivered in late October. Used with any telephone and any TV receiver, it will enable users to access the CompuServe Information Service and other data bases.

Initially, the network will offer a variety of services at a low hourly rate, including: a major news wire service, electronic mail and bulletin board service; educational and financial programs; a securities information; a computer software exchange and various computer games.

CompuServe has revealed it has entered into an agreement with the *Columbus Dispatch* that will make it the first daily metropolitan newspaper available electronically. Users of the service will be able tor receive constantly updated local and international news, syndicated columns, sports and other information.

1980 Summer CES reviewed

The 1980 International Summer Consumer Electronics Show, held June 15-18 Chicago, was a sellout. About 900 exhibitors utilized nearly 550,000 square feet of exhibit space in three facilities. According to William T. Glasgow, vice president, CES, more than 60,000 attendees were expected at the show, which was sponsored and produced by the Electronic Industries Association's consumer electronics group.

The Summer CES offered a total marketplace for the consumer electronics industry and was the focal point for many company sales meetings and other industry meeting. The CES special exhibits complemented the 900 product displays including the Consumer Electronics Design and Engineering Exhibition. Also, 12 hours of retail oriented CES conferences, workshops and seminars were presented for attendees.

The show offered a wide product assortment including; audio component and compact systems; audio tape equipment, auto sound, television, video systems, including VCRs, videodiscs, video games, personal computers; radios, including CB; scanners; radar devices; telephones and answering machines; electronic calculators, electronic hand-held games, and language translators; electronic watches; security systems and accessories for all categories of consumer electronics.

VTR sales rise; color TV sales down

According to figures compiled by the marketing services department of the EIA/CEG, total US market sales to home VTR retailers increased in April and during the first 17 weeks of 1980, compared to the same periods last year. Sales to retailers of color TV receivers declined in April, and b&w TV sales also trailed.

Home VTR sales to retailers amounted to 31,426 units in April 1980, a gain of 47.3% over 21,328 units sold in April 1979. Home VTR sales to dealers in the first 17 weeks of 1980 increased to 189,550 units, up 57.1% over 120,674 units sold in the same period one year ago. April color TV sales to retailers of 514,251 units were down 17.2% from 620,781 units sold in the same month last year. Color TV sales in the first 17 weeks of 1980 reached 2,811,307 units, a decline of 5.7% from 2,980,951 units sold in the same period of 1979. Monochrome TV sales to retailers totaled 321,030 units in April 1980, down 17.4% from 388,795 units sold in April 1979. Monochrome TV sales in the first 17 weeks of 1980 were 1,593,733 units, a decrease of 12.4% from 1,818,667 units sold in the first 17 weeks last year.

Beckman chooses Criterion

Criterion Sales has been chosen as new sales representative for Beckman Instruments,' Electro-Products Group, in the areas of northern California and northern Nevada. The distribution organization will be handling the complete line of Beckman's EPG products. They include LCD and PGD displays, resistor networks, potentiometers and dials, trimmers, microcircuits and multimeters. Criterion will work in support of Wyle Distribution Group, Marshall Industries and Arrow Electronics, which are existing Beckman franchise distributors in the same area.

NESDA establishes bankcard program

A new bankcard program with a 1.6% discount has been set up for members of the National Electronic

Service Dealers Association. The 1.6% rate applies regardless of average ticket or monthly volume.

Applications are being accepted now for service, and charges will begin for completed applications August 1.

Other NESDA membership benefits include insurance programs, management and technical seminars, public relations materials, and publications throughout the year to keep members informed of important developments in business and government, and to keep members abreast of changes in technology.

For information about the bankcard or insurance programs or NESDA membership, contact NESDA, 2708 W. Berry St., Ft. Worth, TX 76109. Telephone (817) 921-9061.

NESDA/ISCET Convention highlights planned

Among the highlights of the NESDA/ISCET National Electronics Service Convention, August 18-23, at the Galt House, Louisville, KY, are a trip to the harness races, sponsored by Sony, and a riverboat cruise, sponsored by RCA Consumer Electronics, RCA Distributor and Special Products, and RCA Service Company.

Other events at the convention include the "Electronics Derby" trade show, highlighting the latest in electronics servicing products, the National Service Conference to discuss industry problems, business management and technical sessions, and a special conference for electronics and instructors.

Dinners will be sponsored by Magnavox, Zenith, the Electronics Hall of Fame and NESDA.

Sprague, PTS Electronics, General Electric and Thordarson-Meissner are sponsoring lunch events. Breakfasts will be hosted by Panasonic, GTE/Sylvania, Sharp and ISCET.

Convention to feature instructors conference

A conference for electronics instructors will be part of the NESDA/ISCET Convention, August 18-23, at the Galt House, Louisville, KY. The Instructors Conference will be held Thursday and Friday, August 21 and 22. Subjects to be discussed include: *Curriculum Development: Updating for Tomorrow: Standardized Competency Based Education;* and *The Future of Consumer Electronics Education, Problems and Solutions.*

Several major manufacturers will participate in a discussion on manufacturer's role in electronic education.

Instructors, both part time and full time, are invited to participate. Registration for the convention is $110 for the first adult family member and $90 for each additional adult, or persons may register for the Thursday and Friday Instructors Conference for $50. There are discounts for registrations prior to June 30.

For more information, contact NESDA, 2708 West Berry, Fort Worth, TX 76109. Telephone (817) 921-9061 or (817) 921-9101.

PTS announces moves, expansions

PTS Electronics has announced the expansion of their Detroit and Cincinnati operations. The new address of the Detroit servicenter is 14745 W 8-Mile Rd., Detroit, MI. Contact Dave Fuhrman, (313) 862-1783. The Cincinnati regional office and servicenter is located at 8180 Vine St., P.O. Box 16057, Cincinnati, OH 45216. Contact William Terrell, (513) 821-2298.

New PTS servicenters have been established in Charleston, SC, and Cleveland, OH. The new address of the Charleston servicenter is 3839 Rivers Ave., P.O. Box 10203, Charleston, SC 29411. Contact Steve Weaver, (803) 747-6665. The Cleveland servicenter is located at 23480 Aurora Rd., Bedford Heights, OH 44146. Contact Thomas Young, (216) 232-4528.

All distributors, service dealers and technicians in these areas are invited to visit their new PTS servicenter.

ETA announces annual meeting plans

Ron Crow, ETA director of certification, announced that the annual meeting of ETA will be held July 11-12 in Ames, IA, at the Scheman Continuing Education Center. ETA will provide a range of technical training topics, a small-business management school for dealer-technicians, certification exams and electronics instructor's conferences.

Duracell to establish new plant in Georgia

Duracell International has established a major new operation in LaGrange, GA, for the manufacture of its Duracell batteries. The new battery operation has been established in a 170,000 square-foot facility, located at 1567 Forrest Avenue. Duracell is a subsidiary of Dart Industries Inc.

The LaGrange plant is being extensively renovated, and new and existing equipment will be installed with the initial investment to be approximately $6 million. The plant modifications and equipment installation will take about six months to complete. □

letters to the editor

Letters should be addressed to
The Editor, Electronic Servicing
P.O. Box 12901
Overland Park, KS 66212.
Please include company affiliation.

To the Editor:

As a subscriber to **Electronic Servicing** and a former Sony field engineer, I read your comment in the May issue (May 1980, *Letters to the Editor*) regarding difficulty in obtaining Sony service data. I would like to assist your fine publication in obtaining this data and will bring the matter to the attention of our regional and home office service division.

Larry Stellar, sales representative
Sony Consumer Products
Denver, CO

Mr. Stellar:

Thank you. Your efforts are greatly appreciated.

To the Editor:

In the March 1979 issue of your magazine, there was an article on the features of new scopes. One of the items featured on page 30 is of interest to us and we would like to get further information about it from the manufacturer or supplier. It is the model CAG-22 digital storage device from UFI. We would appreciate your securing the address of the maker so that we can communicate with them.

James B. Sexton, president
Commercial Elevator Company
Chicago, IL

Mr. Sexton:

You may contact the UFI Corporation at the following address: 495 Embarcadero, Morro Bay, CA 93442. Telephone (805) 772-1203.

To the Editor:

We do not do any TV servicing, but your articles on industrial products interest us very much. However, no mention is ever made of where additional information on these products can be secured, i.e. manufacturers address, distributors, price class, etc. In particular, we refer to the May 1980 article on the Autotron model RPF-303 photoelectric unit. We are very much interested in obtaining further information on this product. Thank you.

Stan Nagrod, president
Albertson Communications
Mamatoneck, NY

Mr. Nagrod:

Thank you for your interest in our industrial feature articles. Please note the readers service numbers that follow each article featuring a product. Circle the number on the reader's service card, drop it in the mail, and you will receive additional product information direct from the manufacturer. The address of Autotron is: 3629 N. Vermillion, P.O. Box 595, Danville, IL 61832. Telephone (217) 446-0650. □

people in the news

Sven H. Dodington, a scientist associated with ITT, has been chosen by the Institute of Electrical and Electronics Engineers, to receive its 1980 Pioneer Award. The award recognizes Dodington's development of the electronic distance measuring equipment, currently used by the world's airliners, in most western-world military aircraft, and in more than 50,000 general-aviation airplanes.

Presented annually by the Aerospace and Electronics Systems Society of IEEE, the award is for a development that has stood the test of at least 20 years of successful service. Dodington's work began in 1945 at ITT's laboratories and was completed in 1959, when the International Civil Aviation Organization adopted DME as the world standard.

Four executives have been elected to the board of directors of the Electronic Industry Show Corporation. Elected by the exhibitors for three year terms were **Robert R. Daugherty**, president/general manager of SWIECO, Inc., **Robert G. Negele**, president of Kulka Electric, and **Bruce Anderson**, president of Sumer, Inc. **Tom Surber** of Howard W. Sams & Co. was elected by the Board to fill a vacancy created by the withdrawal of a previously selected manufacturer nominee.

Jack Roseman, former president of On-Line Systems, has been appointed president of United Computing International, a subsidiary of United Telecommunications, Inc.

Ronald Larson has been appointed plant manager of the Switchcraft manufacturing facility in Paxton, IL. Formerly, he served as marketing manager, microphone and audio connectors and assemblies.

The E. F. Johnson Company has announced the appointment of **Nicholas W. Diamond** to the position of applications engineering manager in the radio products division, marketing department. Formerly, he held positions in systems design with RCC, ADT systems and Aerotron.

Bruce Carswell, chairman of the Project With Industry National Advisory Council of EIA's Electronic Industries Foudation, was honored by the Commissioner of HEW's Rehabilitation Services Administration, for outstanding service to RSA's efforts to provide employment opportunities for disabled persons.

Martin Siskel has joined Blonder-Tongue Laboratories as manager—production control. Siskel was formerly vice presicent, manufacturing, for the Signal-Stat division of Abex.

Arthur J. Bennet has been appointed customer care assistant manager, consumer affairs division of Panasonic. Bennet joined Panasonic in 1970 as field service coordinator. Since then, he has served as customer relations specialist, product information coordinator and customer care supervisor.

Also at Panasonic, **Calvin O. Graham** has been named consumer information assistant manager, consumer affairs division. Graham joined Panasonic in 1969 as publications specialist. He has served as consumer information supervisor since 1977.

Glenn DeBella has been named general manager of Narda's Pacific Coast operation. DeBella was previously general manager, amplifiers for Avantek. □

troubleshootingtips

No sound or picture Old tube-type color TV

A friend called with a strong plea to repair his old color TV before the Sunday afternoon football game. The symptoms of no picture and no sound suggested a power supply problem, so I hurriedly packed a few rectifier tubes and filter capacitors.

At his home, I found the tube heaters and channel lights were lit. I replaced the 5U4 rectifier and confidently waited for the picture to appear. It didn't. Voltage tests revealed a B+ to find the overload. That was not successful either.

By this time, I decided to stop the shortcuts and do some genuine testing. Output acV from the power transformer was low. Also, the input acV at the primary was only about 75V. Moving upstream, I found the bi-metallic circuit breaker had 40Vac across it. Evidently an internal bad connection was producing excessive resistance and voltage drop. I did not have the correct size with me, so I quickly soldered-in a fuse to replace the breaker and was able to obtain good operation in time for the game.

Peter Burnside
Mineola, NY

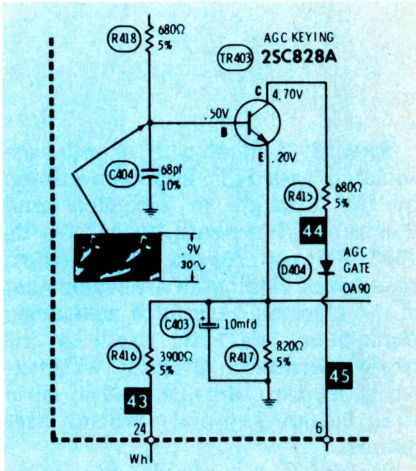
Picture pulling Panasonic CT98 (Photofact 1179-2)

Two CT98 Panasonic color TVs produced similar symptoms from the same bad capacitor in each. The first receiver had normal viewing until a very bright scene was shown. During the scene, the colors changed and the picture pulled so severely that the horizontal hold control could not correct it.

No abnormal dc voltages were measured in the receiver. The apparent connection between bright pictures and the pulling made me question the possibility of video entering the separated sync.

I sprayed coolant on individual components of the AGC and sync separator circuits. When the cold spray hit capacitor C403, the TV lost sync entirely and the color changed. Heating C403 restored normal operation. I replaced C403 and the intermittent was cured.

The second receiver exhibited a slight horizontal pulling at the lower area of the picture when any scene was bright (high contrast). This time



I wasted no time before cooling C403. Again, C403 was defective.

Although the symptoms of the two TVs were not identical, both showed horizontal pulling on similar scenes. Usually, pulling indicates a sync separator problem, but the origin can be in bad capacitors that bypass either the AGC voltages or some transistor voltage supply.

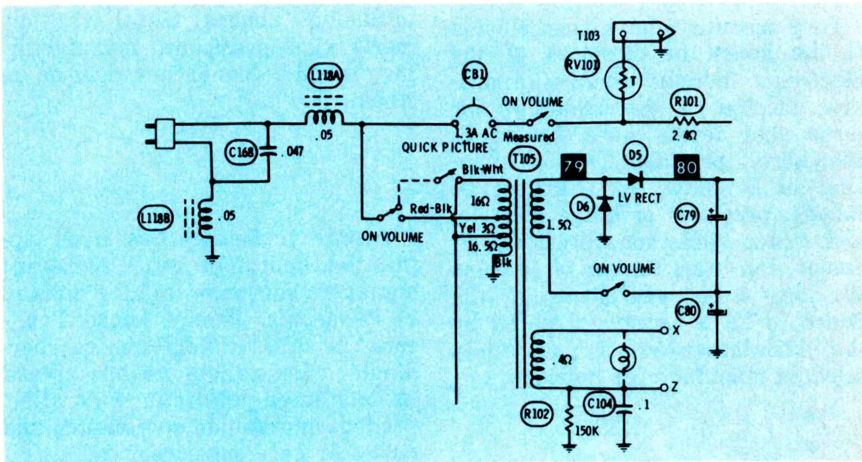
Samuel Hyman
Chicago, IL

Insufficient height General Electric UA (B&W) (Photofact 1353)

About two years ago, someone reported that replacing C215 on the deflection yoke cured a lack of height at the raster's bottom in a GE mode UA. Recently, I have had the same problem occur. The same exhaustive tests of voltages, and replacement of any suspected components revealed nothing wrong.

Nothing corrected the lack of height until I accidently discovered that the magnets of the centering assembly apparently had lost some magnetism. After the rings were readjusted, the picture had full height. It's possible the same ring tabs might have been moved unknowingly when the tech replaced the capacitor. Anyway, since that time I have found the same problem in three more UAs.

Robert Johnson
Raleigh, NC



Low B+ without picture Magnavox T936 (Photofact 1119-1)

Low voltage from the 36V and 18V supplies eliminated the picture and sound. First, I disconnected wires to the various loads to find any shorts or excessive loads. This raised the 36V source almost to +36V, which is not correct for a no-load condition, and indicated a problem in the power supply itself.

The diode rectifiers were tested. C79 and C80 were replaced. There was no improvement. A resistance test of the transformer's secondary winding showed a proper low value. Nothing appeared to be wrong, but the TV would not work.

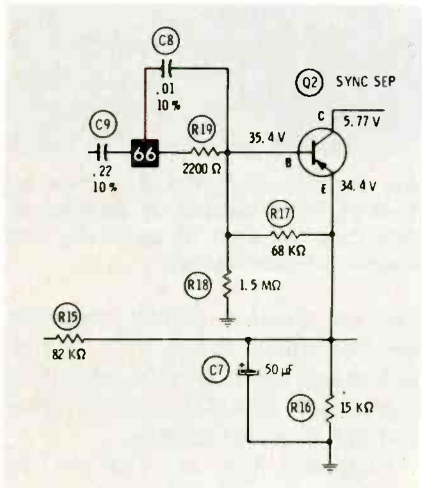
At this point, I carefully examined the schematic and decided to check the on/off switch wiring. After contentrated testing, an internal leakage was found between contacts of the on/off switch. After I pounded on the switch with a screwdriver, the picture and sound appeared.

Replacement of the multi-ganged on/off switch corrected the problem permanently.

Brad Peterson
Sparta, WI

Vertical roll and no color
Quasar/Motorola 19TS929
(Photofact 1476-1)

A slow vertical roll without color were the complaints. The vertical could be rolled up or down but would not lock; a clear case of missing sync. It is wise to work on the easy problems first, so I began checking the sync-separator and sync-inverter stages. There was no voltage at the Q2 emitter or the Q4 collector, although the supply voltage at R15 was normal.



Capacitor C7 (50μF/50V) was the immediate suspect. However, after it was removed, an ohmmeter found no leakage, and two capacitor checkers measured the correct capacitance.

When C7 was disconnected, the voltage increased to about +35V, proving C7 must be bad in some way. A variable-dc power supply was connected to C7, and it broke down into a virtual short at about 4Vdc. It's unusual for an electrolytic capacitor to have excessive leakage only at voltages higher than those produced by an ohmmeter.

A new C7 brought back solid vertical locking. An additional surprise was that the color now worked perfectly! Perhaps the sync problem had allowed the horizontal sweep to lock at the wrong phase. If so, the burst separation in the chroma channel would be upset, and this could eliminate the color.

Frank Krueger
Phoenix, AZ

Vertical problem
Zenith 19GC45Z1
(Photofact 1546-2)

The picture was locked-in solidly, but with the vertical blanking bar almost in the center of the raster. I tried adjusting the vertical centering control R718, but the range was not sufficient to center the picture. Tests around the three amplifier stages and the vertical centering control wasted much time but found nothing wrong.

Finally, I scoped the vertical sweep signal before it dawned on me that the oscillator was running at 30Hz not 60Hz! Resistance tests of the oscillator found almost double resistance in R704, which is in series with the vertical hold control. A new 120K Ω resistor allowed proper locking and centering.

Looking back at the problem, I had been so convinced the centering was at fault that I overlooked the bottom compression, the hold control position near one extreme, and the picture flickering.

Donald Hicke
San Diego, CA

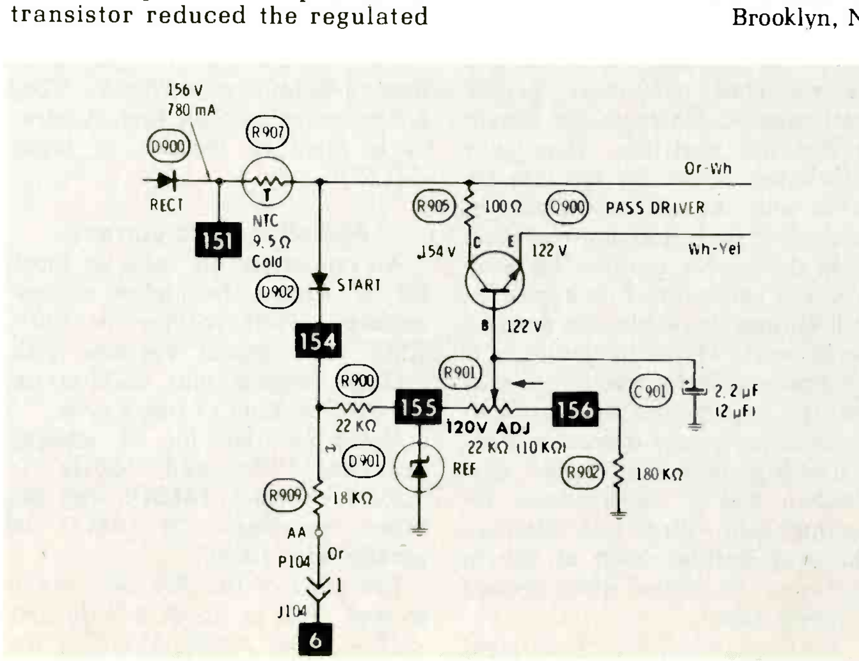
Shrinking picture
Admiral 2M10CA, 3M10C
(Photofact 1522-1)

According to the customer, the picture would shrink vertically and horizontally to postcard size after about three hours of operation. The color TV was allowed to operate, and three hours later the picture shrank in size.

During voltage tests, I found only +85V at the regulated *+120V* source. Evidently, this low voltage was causing the small picture. But the important question was the next troubleshooting step. Internal receiver heat was triggering the defect; therefore, replacing the horizontal-output transistor or other sweep components and then waiting three hours each time would waste too much time. No, *the next tests should be done without turning off the TV.*

I sprayed canned coolant on the low-voltage power supply components while the meter monitored the regulated voltage. The most sensitive to cooling was Q900, the regulator pass-drive transistor. A new Q900 solved the problem. Out-of-circuit tests with heat applied to the old transistor revealed an open circuit after the temperature reached a certain point. The open driver transistor reduced the regulated voltage. This example illustrates the large value of testing by heating and cooling suspected components.

Mac Kellman
Video Master TV
Brooklyn, NY



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, CET

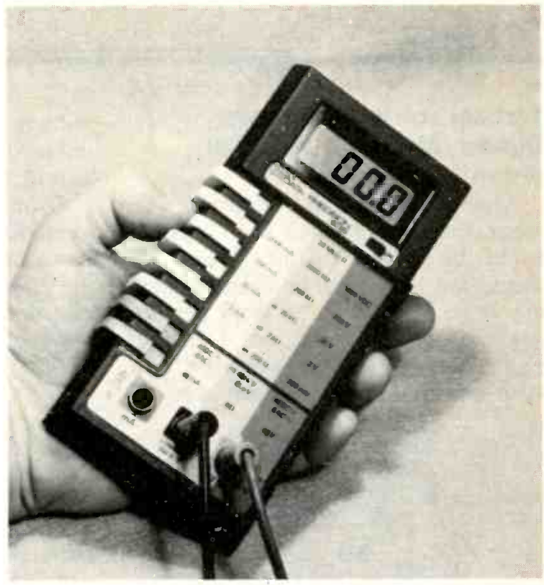


Figure 1 Data Precision model 936 has all customary 3½-digit DMM features in addition to beep tones indicating the start of continuity and continuous sounds for overvoltages.

Data Precision 936 DMM

Model 936 from **Data Precision** is the first digital multimeter having an audible indication (beep tone) to be examined in the **Electronic Servicing** lab. The model 936 is a hand-held, five-function plus beep, 29-range digital multimeter (Figure 1).

Readout and switches

All numerical measurements are displayed on 3½-digit LCD digital 7-segment readout.

Six white pushbuttons on the left edge can be pushed to select any range. When one of the white buttons is pressed, the other five are unlatched and move to the outer position. Only one can remain at the on position. Two gray pushbuttons select the function (ac or dc volts, ac or dc current, or resistance). Both gray buttons must be in the proper position for each function selection. For example, both buttons are in the out position for dc volts. The bottom button is to be pressed in for resistance tests, and the top button selects high-power or low-power operation. Panel drawings of a long button (*out* position) and a short button (*in* position) help with button selection. The gray buttons latch at the *in* positions, and release when pressed a second time.

One-hand operation of all eight buttons is the advantage of the edge locations.

Dc voltage and current

Input impedance for all five dcV ranges is 10MΩ, and accuracy is ±(0.1% of input +1 least-significant digit). Polarity, zeroing and decimal placement are automatic. Each range can display one less count than the rating. The 2Vdc range, for example, can display up to 1.999V before overrange occurs. Overrange indication shows only the most-significant digit (MSD) and the decimal. Other digits are blanked out.

Four dc-current ranges cover from 1.999mA to 1999mA. They are protected by a 2A fuse. Accuracy is rated at ±(0.5% of input +1LSD).

Ac voltage and current

Ac ranges are the same as those for dc, except the highest recommended input voltage is 700V RMS. The system operates with average sensing plus calibrations for RMS reading of sine waves.

Rated accuracy for ac voltages between 50Hz and 500Hz is ±(0.5% of input +4LSD), and the input impedance is 10MΩ in parallel with 100pF.

Lab tests of the 20V acV range showed -1dB at about 8.5kHz and -6dB at about 26kHz. Although this does not provide perfect accuracy over the audio range, it is better than many other DMMs, and it is helpful for providing comparative readings of audio voltages.

Accuracy for ac current is ±(0.75% of input +4LSD) between 50Hz and 100Hz.

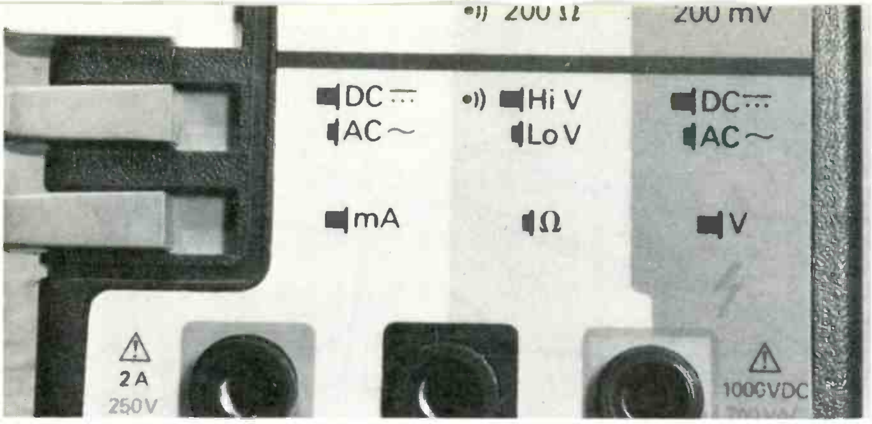
Resistance measurements

All six resistance ranges (from 200 Ω to 20MΩ) can be switched for either high-power (2.8V for open circuit) or low-power (0.25V for open circuit) operation. Although the instruction manual lists no figures for the 200 Ω low-power function (implying that such operation is impossible) this range did operate correctly in the sample meter. The high-power 2K Ω range is recommended for reading the forward resistance of transistor junctions and diodes. A test diode measured 0.67K Ω on this range.

Accuracy is rated differently for various combinations of ranges and excitation voltages. Highest accuracy of ±(0.1% of input +1LSD) is obtained on the 2K Ω to 2000K Ω ranges with high power. The 20M Ω range is rated at ±(0.3% +1LSD).

Audible tones

In addition to the accurate conventional digital readouts, model 936 also has audible sounds under certain conditions.



Various functions are selected by positions of two gray pushbuttons. Panel markings show the switch status for each function.

One important application of an audible indication is for resistance measurements, particularly those involving erratic or intermittent continuity. When any of the three lowest resistance ranges with *high power* is selected, a beep tone sounds at the start of continuity. In the sample meter, the 3500Hz tone started at maximum volume and rapidly diminished to silence in about ⅓-second.

The 200 Ω range beeped when applied suddenly to resistances up to about 5K Ω, the 2K Ω range to about 2.5K Ω, and the 20K Ω range to about 22K Ω.

Another feature of model 936 is the tone that sounds when any input voltage exceeds the voltage range. However, the sample meter performance was not in accordance with the instruction manual description. When audio was applied to the 200mV ac range, an input of 350mV or more was required to produce a sound. The tone was continuous and had the frequency of the input signal. Similarly, about 3.6Vac was required to start the tone on the 2Vac range. Higher ranges were not tested. Line voltage applied to the 20Vac range produced a constant buzz, but no buzz was obtained on the 200Vac range.

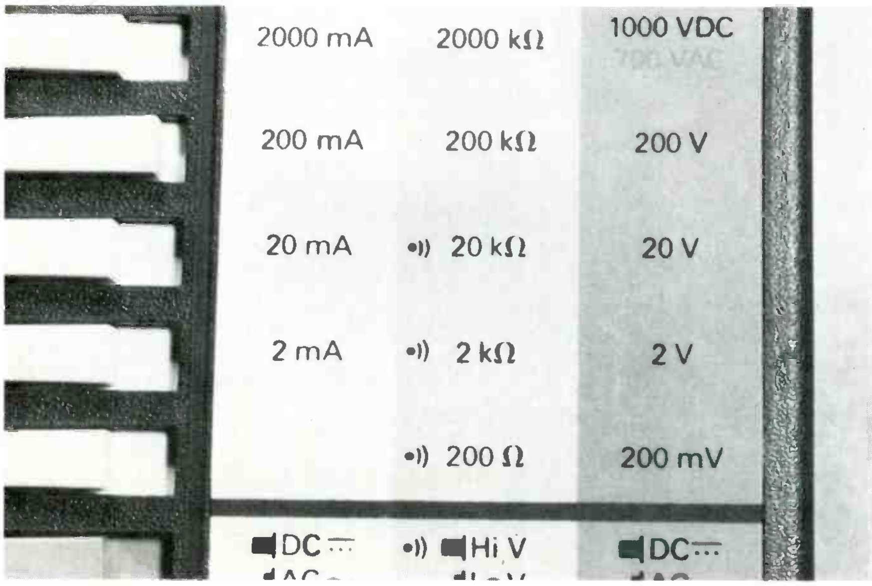
Considerable overvoltage was required for an audible indication on dcV ranges also. For example, 46V or higher was needed to generate a tone on the 20Vdc range.

General features and comments

Data Precision model 936 DMM operates for 100 to 200 hours (depending on type of battery) on one 9V battery. Model BE9 battery eliminator is available as an option for line operation.

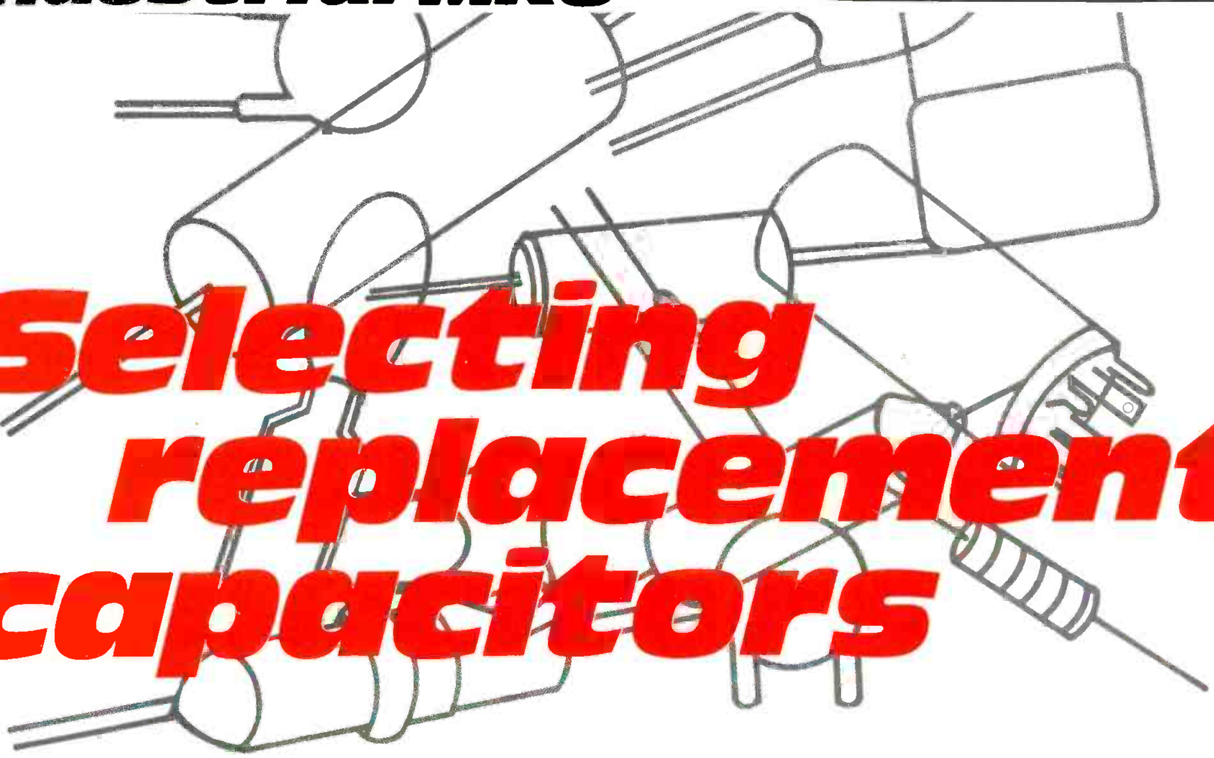
Model 936 appears to be rugged and well-built. It performed efficiently and accurately during these tests. The price is listed at $159. □

Circle (14) on Reply Card



Ranges of current, resistance and voltages are printed in three columns above the function switch instructions.

Selecting replacement capacitors



Capacitors are now available in a wide variety of types and specifications. These facts and suggestions should help technicians make the best selections of replacement capacitors.

By Carl Babcoke, CET

Installation of a new capacitor *can* degrade the performance of a critical circuit, if the replacement is selected solely for its capacitance value. For example, a high-K ceramic capacitor often produces creeping of the vertical-sweep frequency when it is substituted for a wound plastic/foil type in the vertical circuit.

Also, plastic/foil capacitors of ordinary characteristics will overheat and fail rapidly when connected across the damper diode in a transistorized horizontal-output stage or in certain points of an SCR-sweep circuit.

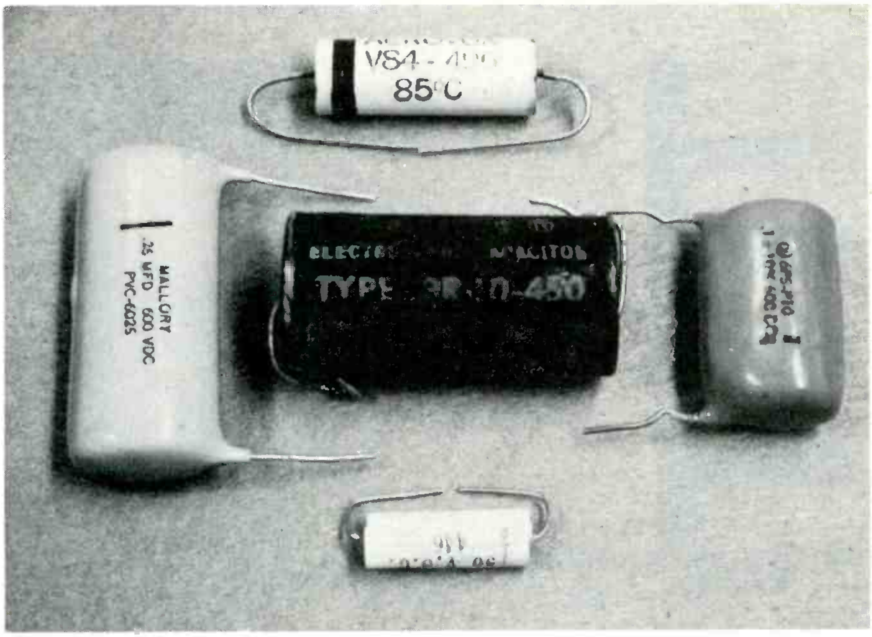
Careful selection of capacitors for critical circuits is one reason for the stable and reliable operation of modern solid-state color-TV receivers.

Important characteristics

Several characteristics are important when a technician evaluates the suitability of a replacement capacitor.

Capacitance Value—All replacement capacitors are rated by a nominal capacitance value plus a tolerance rating. Filter, bypass and most coupling capacitors require only a certain minimum value. Often the measured value can be 200% to 300% without affecting the performance. Capacitors that determine frequency should be stable and have the designated value. Capacitors used in audio-frequency tone controls and equalizers should measure no more than 10% above or below the marked values.

Microfarad and picofarad are the two capacitance units most often used in servicing. A less familiar term is nanofarad, which is midway between microfarad and picofarad.



An aluminum-oxide electrolytic filter capacitor is shown in the center of several types of wound film-foil capacitors.

Tolerance—Permissible deviation from the nominal or marked capacitance is called *tolerance,* which usually is expressed in percentage, such as ±10%.

Present availability of accurate digital-readout capacitance meters allows an electronic shop to buy quantities of broad-tolerance stable capacitors and then cull them for the few critical-value capacitors that are needed. This saves money by reducing inventory and using lower-cost components.

Insulation resistance—Dielectric strength (or insulation resistance) is the ohmmeter reading after a capacitor stops charging during a test. Present-day capacitors (with the exception of large-value filters) seldom offer problems from insulation leakage. Any good brand of plastic-film or ceramic capacitors should be suitable for all replacements, except perhaps for a few blocking or coupling applications.

ESR—(Equivalent-Series Resistance) is the sum of all capacitor losses that act as if a resistance of that value is connected in series with a theorectically perfect capacitor. These losses include dielectric leakage, resistance of leads and plates, corona, and dielectric absorption. The obsolete term *power factor* includes ESR and the dissipation factor.

All capacitors have ESR, but it is an undesirable condition. Therefore, a low-value ESR resistance is preferable.

"Q" and dissipation factor—Capacitor "Q" is the ratio of capacitative reactance to the ESR. Dissipation factor (DF) is the mathematical reciprocal of "Q." It is preferable for the "Q" to be high and the dissipation to be low.

Dielectrical absorption—After a capacitor is charged, discharged thoroughly, and then allowed to rest, a certain percentage of the charging voltage will appear slowly across the leads. This is called dielectrical absorption, and it is not desirable. Perhaps the most spectacular examples are the strong shocks possible from picture-tube anode buttons after the glass-dielectric capacitance has been shorted to remove the charge.

Dielectric constant—Permittivity (sometimes erroneously called dielectric constant) describes the additional charge a capacitor can store when dielectrics other than a vacuum are used. This is not important in selecting replacements except that dielectric material of high permittivity allows a capacitor to be smaller physically for the same capacitance. The size/value relationship sometimes is called *volumetric efficiency.*

Working voltage—Ratings of working voltage are different for dc and ac applications. The voltages marked on capacitor bodies refer to the highest *dc* voltage permitted for constant operation. This working voltage must be derated severely for abnormal temperature, humidity and acV or transients. Although the factories test new capacitors for a short time at twice the rated dc voltage, in practical service it is advisable to select a dcV rating 50% above the actual voltage. For example, a plastic-dielectric capacitor operated at 400Vdc should be rated at 600Vdc. Except for size problems, there is no penalty for using capacitors of larger working voltages.

For acV ratings, a convenient rule is to select a capacitor having a dcV rating of three times the RMS acV. A capacitor for 120V RMS should be rated at 360Vdc or higher. However, an additional safety factor must be added to capacitors connected across the power line or in power supplies. These components are subjected to transients and they should be rated much higher to provide an extra margin of safety.

Corona is another problem during ac operation. Corona has been defined as any electrically produced ionization. Horizontal-sweep pulses

Comparison of Foil Film Capacitors

	polyester (Mylar*)	poly-carbonate	poly-styrene	poly-propylene	poly-sulphone
CAP 32°F	-2.0%	-0.1%	+0.3%	+0.8%	+0.1%
CAP 185°F	+3.0%	+0.2%	-0.5%	-2.0%	-0.3%
DF 32°F	1.0%	0.3%	0.3%	0.05%	0.2%
DF 70°F	0.7%	0.24%	0.3%	0.05%	0.15%
DF 185°F	.8%	0.2%	0.05%	0.05%	0.12%
DA	.3/1.0%	.2/.5%	.02/.1%	.02/.1%	.15/.2%
WA	0.8%	0.3%	.005%	0.005%	0.22%
Coupling	YES	YES	YES	YES	YES
Bypassing	YES	YES	YES	YES	YES
Tuning	NO	YES	YES	YES	YES
Pulses	NO		NO	YES	

CAP = capitance DF = dissipation factor DA = dielectrical absorbtion WA = water absorption

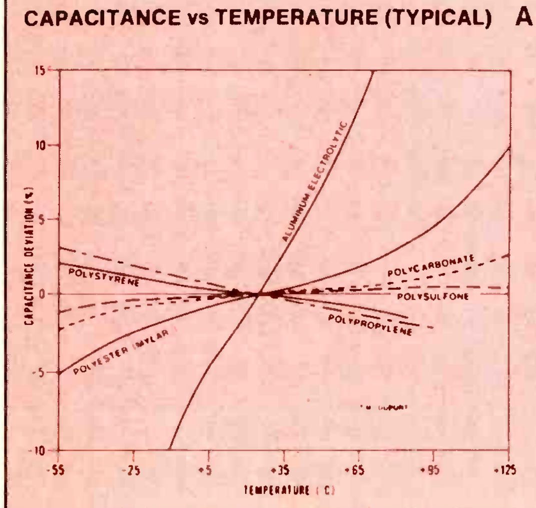
This is a comparison chart for five plastic-film capacitors, along with recommended applications.

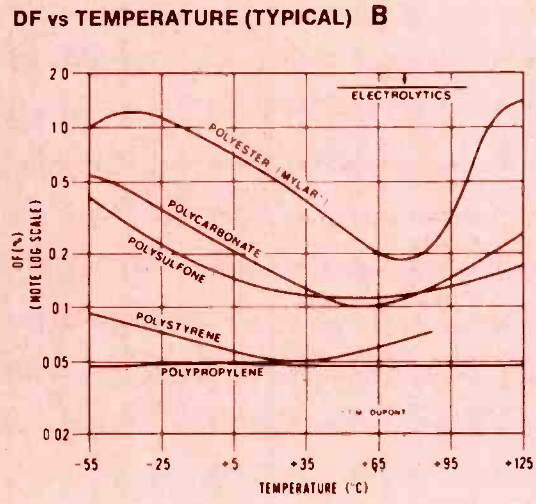
Capacitor Manufacturers*/Types

Circle appropriate number on Reader's Service card for information

Manufacturer	wound plastic	fixed ceramic	filters	fixed & variable mica	air tuning & trimmers
Capcon (15)	X	X			
Elpac (16)	X				
Erie Téch (17)		X		X	
F-Dyne (18)	X				
Industrial (19)	X				
Johanson (20)		X			
KD Components (21)		X		X	
Independent (22)	X				
ITT Jennings (23)			X		
Mallory (24)	X	X	X		
M.I.A.L. (25)	X		X		
Nytronics (26)	X	X			
Pan American (27)	X	X	X	X	X
Plessey (28)	X		X		
Plastic (29)	X				
Republic (30)		X			
Sangamo (31)			X	X	
Shigto (32)	X	X	X	X	X
Simmonds-Precision		X	X	X	X
Sprague (34)	X	X	X	X	
Standard (35)	X				
Standex (36)				X	
Tran Spectra (37)			X		
Wesco (38)	X				

*This compilation represents only those manufacturers returning material to **ES** by press time.





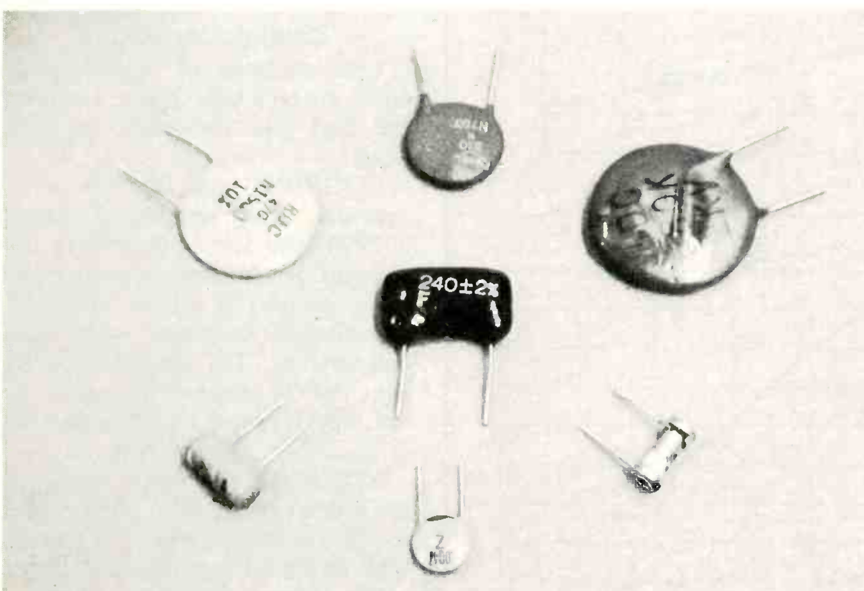
(A) A graph shows the relative temperature coefficients of six capacitors. (B) Relative dissipation factors of the six types of capacitors are shown. *Courtesy of Elpac.*

are the signal mosts likely to cause corona in TV receivers.

Dissipation factor is very important in the ac operation of capacitors. Losses from equivalent-series resistance occur only during charging or discharging of a capacitor. With ac, these losses occur *twice* for each cycle, and each results in the production of heat. Excessive heat can cause early failure of capacitors.

All capacitors have a small inductive component. Therefore, they are limited in useable frequency response. Minimum impedance of some wound-film capacitors occurs around 10MHz. Polyester-dielectric capacitors generally have a more restricted high-frequency limit than other plastic-dielectric capacitors have.

In summary, care must be used regarding the corona and ESR ratings of capacitors used in horizontal-sweep circuits. This is especially important for the capacitors used in older SCR-sweep circuits, where certain capacitors are forced to handle 15,734Hz currents of several amperes. Conventional general-replacement types might run hot before shorting. Another critical application is the use of four-lead safety capacitors in the horizontal-output stage of solid-state color TVs. For example, Sprague lists PP16-S11S as replacement for Admiral 63S102-2 and Zenith 22-7504-01. This is a four-lead polypropylene-dielectric safety capacitor that is identical to the original components.



Six types of ceramic capacitors are grouped around a dipped-mica. Mica capacitors continue to be specified where stability and dependability are factors. Ceramic capacitors offer many different specifications.

Temperature coefficient—Changes of capacitance that occur from variations of temperature are described by *temperature coefficient* ratings. However, only special temperature-compensating ceramic types have a linear change with temperature. They usually are rated in parts-per-million (PPM) for each Centigrade degree of change. Other capacitors having nonlinear variations are rated in percentage over the specified range. Other facts about temperature-caused capacitance variations are given with the various dielectrics.

Capacitor comparisons

Polyester, polycarbonate, polystyrene, polypropylene and polysulfone are the five most popular dielectric films. Polyester (Dupont Mylar) is commonly used when price is imimportant than performance. It is a good compromise. However, the other four outperform polyester.

Metallized dielectrics—Capacitors of smaller physical sizes can be manufactured from plastic film that has had a metallic layer deposited on it by an evaporative process. The layer is thinner than the metal foil it replaces.

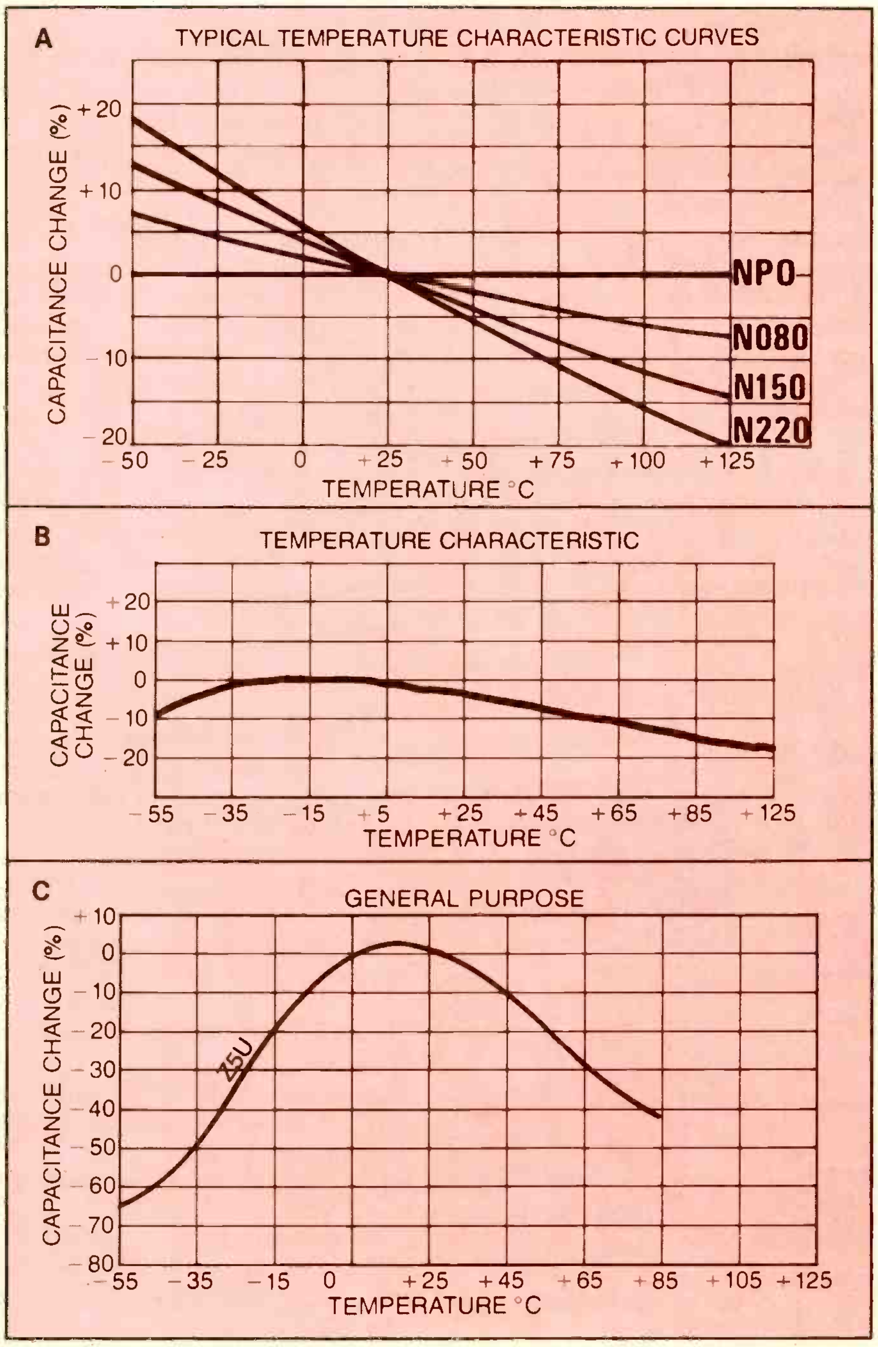
Another advantage is self-healing of some shorts. The thin metallic layer usually burns away before the film chars, eliminating the short.

Ceramic Capacitor Applications				
	Z4U Type GU	X7R Type BR	Type N Compen-sating	COG/NPO Type BP
Tuning	No	No	Yes	Yes
Coupling	No	Yes	No	Yes
Bypassing	Yes	Yes	No	Yes
Pulses	No	Yes	No	Yes

Recommended applications for the four types of ceramic capacitors are shown.

CHARTS A, B and C

These graphs below show the temperature-versus-capacitance curves of four types of ceramic capacitors. (A) NPO ceramics have virtually no capacitance change with frequency. N-types have known negative coefficients for drift corrections. (B) X7R ceramics have sufficient capacitance stability for most applications. (C) Type Z5U is unstable but allows large capacitances in small packages. *Courtesy of Republic and Erie.*



Of course, some power from the voltage source and the capacitor charge is required to burn away the metal, otherwise the short remains.

A disadvantage is the limitation of maximum capacitor current. The metallized film is thinner than metal foil, so it cannot conduct a large current without excessive heating. Perhaps that is why polystyrene usually is not metallized, since it cannot withstand heat. In summary, metallized-film types are not recommended for operation with strong current from fast-repetition pulses.

Metallizing the films does not appreciably change the basic characteristics. Therefore, metallized capacitor types are not described separately.

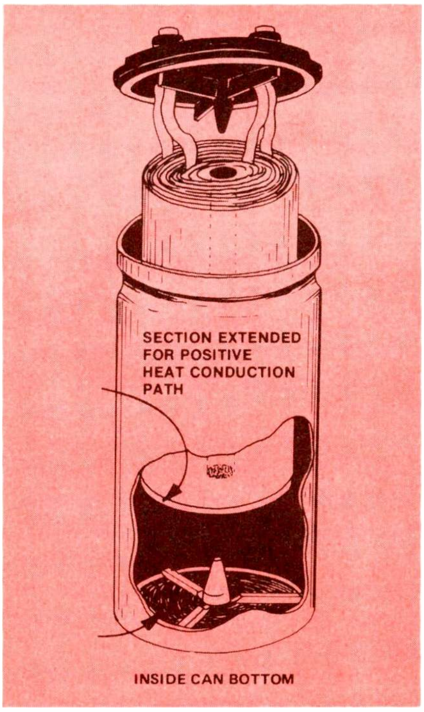
Ceramic capacitors

Characteristics of ceramic capacitors cover a wide range, including the best and the worst specifications.

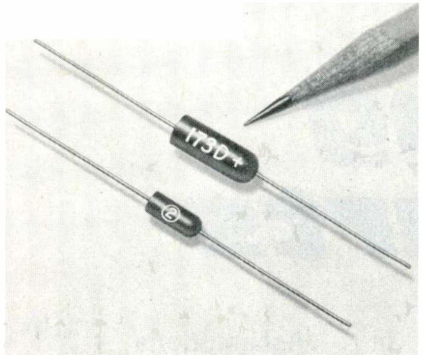
COG/NPO type BP has almost zero drift from temperature (about 30PPM) and few aging effects. The N-series of temperature-compensating capacitors is similar except the capacitance decreases with rising temperature. The negative-positive-zero (NPO) ceramic capacitors are the only successful replacement for micas.

X7R type BR ceramic capacitors are much smaller than NPO capacitors of the same value. They do exhibit appreciable aging and temperature effects, but are satisfactory for most bypassing and other noncritical applications.

Z5U type GU ceramics are called



Some computer-grade electrolytic capacitors have this internal construction. *Courtesy of Sangamo.*



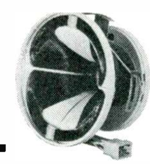
When compared to aluminum-oxide filter capacitors, tatalum dielectric types offer smaller physical sizes and longer shelf life with lower leakage. *Courtesy of Sprague.*

high K because they have maximum capacitance in a minimum space. Unfortunately, they have severe temperature coefficient and aging effects, high dissipation, and capacitance variation from applied voltages. This type never should be used in oscillators or other critical circuits. In fact, Z5U type GU should not be stocked in service shops or used for replacements. Avoid all ceramics that provide large capacitances in very small packages or those labeled *high K*. Instead use X7R type BR ceramic capacitors for all replacements (of original ceramics) except those requiring NPO or negative-temperature characteristics. This simplifies stocking and avoids problems from inferior replacements.

Comments

It is false economy to stock capacitors according to price alone. *Plastic film types* having better specs than those of polyester *cost slightly more*, but the better stability can prevent many hours of callbacks or additional troubleshooting.

Metallized-polycarbonate type can replace all wound-film types except for a few non-metallized polypropylene values needed for horizontal and pulse circuits. □



Locating MRO parts

By Bill Rhodes,
editorial director

When equipment fails in industry, quick repairs are usually necessary because downtime means idle people and loss of production. While repair parts may be expensive, the cost is usually negligible compared to production losses and delays in meeting customer deliveries. When rapid repairs are required, it is important to know how to quickly obtain the parts needed. The steps outlined below provide helpful guidelines to making this phase of repairing equipment as easy as possible.

Assumptions

As a point of reference, assume that the equipment has failed because of a solid-state device. (Other electronic, electrical, mechanical, or electro-mechanical components would serve almost as well, but solid-state devices have some special aspects that make locating an MRO part interesting.) The following steps can then be repeated for any number of parts needed.

It is important to recognize that the MRO business is essentially distributor based. However, some equipment manufacturers actively seek this MRO business because of the high potential profits and continued quality control. Consequently, for minimum downtime, several paths must be pursued simultaneously to obtain the part needed.

Document the failure

The first step is to completely describe the system that has failed. Include model and serial numbers, any date codes, and physical dimensions.

The second step is to clearly identify the failed device. Include, where possible, device type, physical packaging, vendor part number(s), and any other markings. Such markings may be date codes or special numbers that help locate replacement parts.

Of course, if the system manufacturer has provided circuit diagrams, the above steps may be simplified and more thoroughly detailed. In this case, also note the codes on the schematic provided.

Planning is the key to the CAM/RPC success. Here (left to right), Chuck Reedy, field sales manager, Lou Malnofski, inside sales manager, Cal Perlman, general manager, and Richard Murawski, marketing manager, meet to discuss business trends and customer needs.

Stocking manufacturer's literature is a crucial service to many customers.

The inside sales department is filled with activity, maintaining extensive references to solve customer data and parts needs.

Locating the part

Once the failed part has been identified, locating its replacement is straightforward, but it can be frustrating and time-consuming. To minimize downtime, pursue these parallel paths by simultaneously contacting:

1. The system manufacturer and its local office/representative/distributor.
2. The component manufacturer and its local office/rep/distributor.
3. Other local Distributors.

This may seem to be an overkill, but if parts are needed quickly, all of these resources must be used. To understand why, look at the motivations of each resource. The system manufacturer and its local sales outlets may be interested only in the OEM (manufacturing) business. In this case, an MRO inquiry may get a slow response. But, if the organization seeks the MRO business, the necessary parts may be in stock. The same argument holds for the component vendor, but the response there to MRO inquiries is typically slow. Sometimes inquiries for information are directed to a local distributor.

Consequently, contacts with local distributors may be the most successful. These sources actively seek the MRO business as their livelihood, and they can be helpful in many ways. They have vast networks of information. They know other local distributors and the lines they handle. They'll get the part, if possible, or help locate the right source, and hope that they will be called again the next time help is needed.

Alternatively, distributors have extensive cross-indexes to available components, and their principals have further data at their disposal. It may be possible to identify a substitute component and pull it off the shelf.

Both the component manufacturers and the distributors are highly competitive. Use this factor as an advantage in getting needed parts quickly.

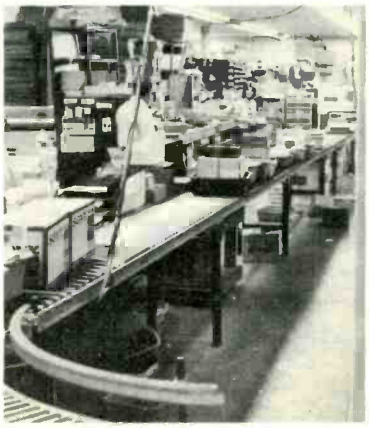
Use internal help

If a purchasing department is available, use it. Purchasing agents also have extensive resources, and they are experienced at using them. Furthermore, in a firm that manufacturers products, the purchasing department has financial clout that can get quick action, either from distributors or from system manufacturers. Also, it may be possible for purchasing to get a *sample* of the part needed, as a courtesy. This can be a quick transaction, because it bypasses the shipping and receiving departments.

Ask the purchasing department when they can give the problem some attention, and when an answer can be expected. Then, if needed, pursue with inquiries parallel to theirs, but let purchasing know, so as not to duplicate efforts and cause confusion.

Profile of an industrial distributor CAM/RPC in Pittsburgh-- 72,000 sq.ft. of stock and service

EDP supplies the answers to customer needs and order status plus data for the distributor to keep on top of market trends.



Extensive stock is maintained to serve many customers, and a service department can repair instruments or modify equipment to serve a customer's special needs.

Wrapping it up

When a source comes through with the needed part, and it is paid for, installed, and the failed system is operating again, document the service to that system, including sources that have helped. These records may prove invaluable if a breakdown should occur again.

But what if...

For solid-state devices, in particular, there is an industry idiosyncrasy that makes locating parts difficult: The use of *in-house* numbers. Some manufacturers contract with solid-state component manufacturers to mark devices with special numbers, and these are referred to as *in-house* numbers. These may be standard devices with special designations, or they may be pre-selected for certain performance characteristics. There is no way of knowing, especially on a failed device.

When encountering these in-house numbers, the best course is to buy the exact replacement, even if it turns out to be a standard device at 10 times the price. However, as a matter of routine, by pursuing the paths of information noted earlier, the identity of the device may be uncovered and a standard replacement located. This may prove important if it is difficult to obtain an in-house numbered part quickly.

Realize early in the game that difficulties may be encountered. The identity of in-house parts is closely guarded, but the competitive nature of the business makes cross-indexing infrequent but possible. Use of a substitute part may save both time and money.

Seleniums—a special case

Replacing seleniums is a special situation because of advancing technology. General Electric sold its selenium line to International Rectifier, and IR now enjoys an extensive market MRO in seleniums. As surge protectors, seleniums can be replaced, in some cases, with modern devices designated MOVs (metal oxide varistors). (For performance details, see **Electronic Servicing,** pp. 7-14, February 1980.)

If it's a selenium that has failed, use the guidelines mentioned earlier to contact selenium-device manufacturers as well a MOV sources. The distributors serving these manufacturers can be of considerable help.

If all else fails...

The MRO business has undergone recent changes because of reduced costs of components (through high volume production) and increased labor costs. As a result, some manufacturers can provide replacement systems economically competitive to the cost of servicing a failed unit. Take a look at this possibility when looking for components. If damage is extensive, and if in-house numbered parts are involved, a unit replacement may emerge as the optimum solution.

Summary

Locating replacement parts when equipment is down can be frustrating, but using all the resources available; manufacturers, distributors, reps and the purchasing department, can ease the difficulty and minimize downtime. Keep in mind that if the equipment is old and parts cannot be identified for replacement, the failed system may need to be replaced. ☐

PART 1

AGC problems in tube TVs

Typical AGC defects in tube-type color TV receivers are described in the continuing coverage of older TVs.

By Homer Davidson
Davidson Radio & TV

AGC problems in tube-equipped color TVs include these symptoms:

- Dark and unstable pictures.
- A white raster without picture but having some sound.
- Unstable flag-waving pictures with buzz in the sound.
- Low-contrast pictures.
- Erratic pulling in the picture.
- Vertical shimmy.
- Excessive snow with stations that usually are snow-free.
- A combination of several symptoms.

Although these symptoms can be produced by AGC defects, they also can originate in malfunctioning sync separators, bad tuners, IF defects or video problems.

AGC clamping tests

One popular test for AGC problems is to apply variable negative dc voltage (from a low-impedance supply) to the IF or tuner AGC line (Figure 1). If a normal picture can be obtained from any such clamping voltage, it is assumed the AGC circuit has a defect.

This test probably gives good accuracy in 80% of the cases. But it can be very misleading in the other 20%. The low impedance of the clamping supply obscures some IF defects, such as a gassy tube or a leaky bypass capacitor that reduces the TVs AGC voltage. Also, many of the older RCAs (and copies by other brands) operate with IF AGC of about +30V for weak signals and nearly zero volts for strong local station signals. Obviously, applying negative voltage will reduce the IF gain too much. If the first-IF cathode resistor value is less than 100Ω, apply a negative voltage. *But if it is between 1000Ω and 1500Ω, ground the IF AGC line.* Another danger is that apparently normal operation might be obtained by application of an atypical AGC voltage. For example, if the IF AGC of a certain model usually measures -8V when tuned to a specific station, but the receiver under test works best at -3V or -15V, then the AGC probably is normal, and the defect is elsewhere.

As with all other shortcuts, the bias-clamping test should be used selectively according to the circuit diagram. At the slightest hint that the clamping test is giving incorrect

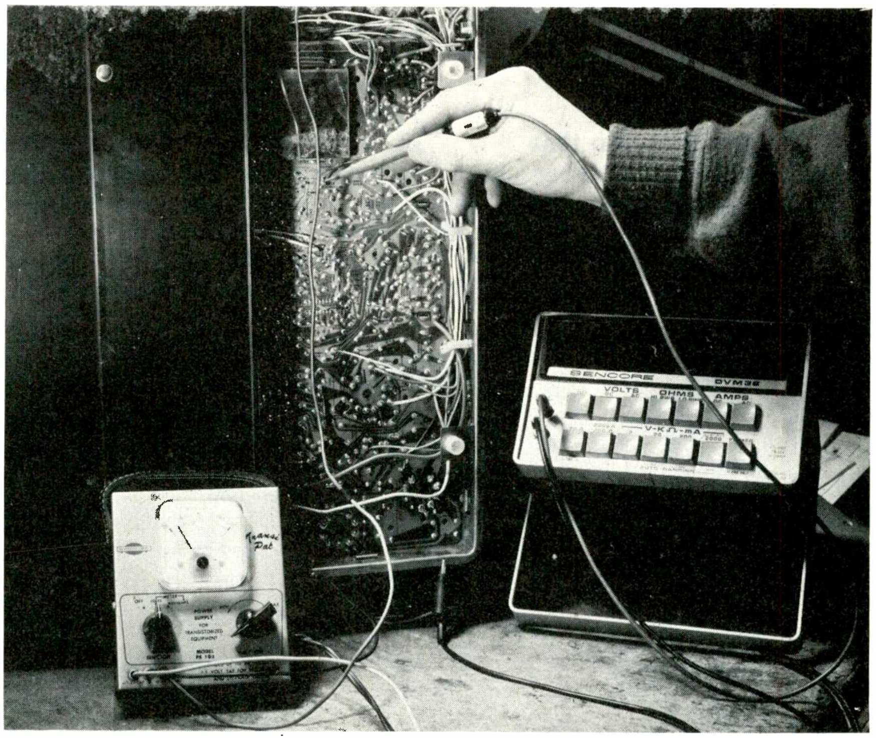


Figure 1 An external bias voltage of good regulation can be connected to the RF or IF AGC point as a partial test of AGC operation. Apply a negative voltage for tubes or a positive voltage for transistors. Any improvement of performance is an indication of an AGC problem, although the test has limitations in some circuits.

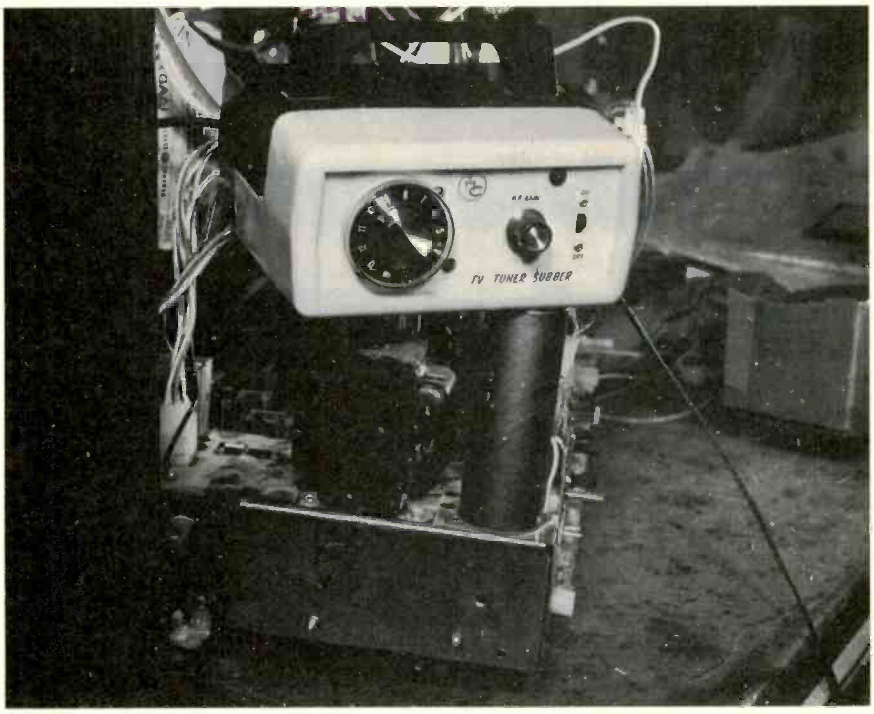


Figure 2 Some tuner defects give symptoms of AGC failures. If connecting a tuner-substitute to replace the TV tuner temporarily provides good reception, then the TV tuner is defective *or some voltage at the tuner is incorrect.*

answers, the test should be stopped. DcV and scope-waveform measurements should then be performed.

A companion article in this issue explains the operation of basic tube-powered AGC keyers. Refer to it for additional helpful information.

Tuner substitute test

The possibility that a bad tuner is producing symptoms similar to some AGC defects can be verified or disproven (within limits) by attaching the same antenna leads to a substitute tuner (Figure 2) and then plugging the IF cable into the sub-tuner. Correct operation of the usual channels indicates the old TV tuner is bad, *or some voltages that are applied to the tuner are incorrect.*

Excessive negative AGC voltage at the RF tube is a common cause of snowy pictures. When the RF tube gain is decreased by the higher AGC voltage, the mixer noise becomes more prominent.

A defect that reduces the IF AGC voltage automatically increases the tuner AGC voltage and causes the snow. An open or increased value of the resistor between B+ and the tuner AGC is another common source of snow.

Insufficient B+ voltage to the RF and mixer tubes in the tuner can produce overload symptoms similar to those caused by tuner AGC defects.

After a tuner-sub test shows a TV tuner problem, the various B+ voltages and RF AGC voltages should be checked on the old tuner. Only after these have been proved correct should the tuner be replaced or repaired.

Dark and unstable picture

Dark pictures with horizontal movements at the top were seen on the RCA CTC25 screen. The horizontal pulling would not begin until the TV had operated for two to three hours. After the problem started, adjustments of the AGC control would change—but not eliminate—the picture pulling.

Clamping tuner and IF stages with bias supplies provided some improvement, but not enough to indicate problems there. After dcV tests failed to identify the problem, a new capacitor was paralleled across C118D. The AGC problem with instability was solved.

C118D bypasses three circuits: the AGC-keyer cathode; the delay-line matching load; and the sync-separator cathode (Figure 3). The open capacitor mixed together these three signals. Video waveforms entering the sync separator probably caused the picture pulling, and

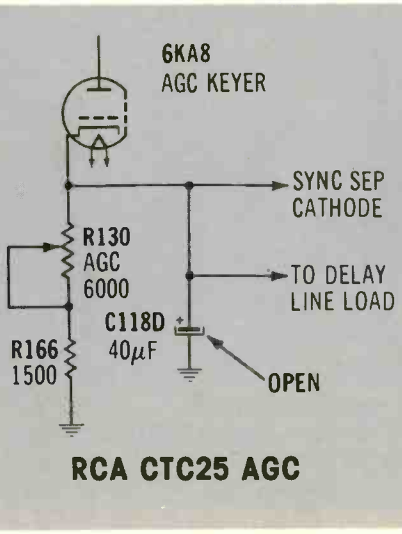


Figure 3 A typical problem in RCA CTC25 (and similar) chassis is a dark and unstable picture caused by an open or poor power factor in the electrolytic capacitor that bypasses the AGC-keyer cathode.

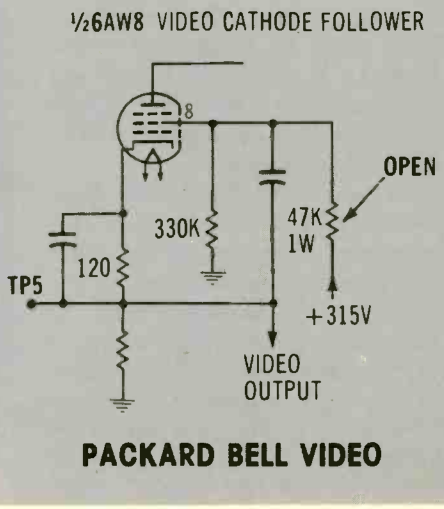


Figure 4 Video problems can imitate AGC defects. An open screen grid resistor in a Packard-Bell model CWS-502 caused a dark and intermittent picture.

the unbypassed AGC-keyer cathode produced AGC overload and a dark picture.

This capacitor has a record of causing hard-to-identify symptoms. Therefore, test it by paralleling a new one across it. Many other RCA models have the same circuit.

AGC or video

A CW5-502 Packard Bell had a dark picture with intermittent brightness. All tuner and IF tubes tested good. Waveforms were normal at video detector and the AGC tube (except the video sample). However, video amplitude at the output of the 6AW8A cathode follower was very low (Figure 4).

Dc voltage measurements at the 6AW8A showed only +12V at the pin 8 screen grid. The 47K Ω screen resistor was open, and a new one solved the dark picture problem.

The original symptoms were similar to those often associated with AGC problems, except the dark picture was not unstable. Most AGC circuits of this age take a sample of video from a video amplifier for the AGC-keyer grid.

Pulsating picture

The picture on an Admiral 12H10 chassis would flash on and off at a regular rate. Sometimes snow was seen on all TV channels. At the 6HS8 sync-AGC-noise tube, all dc voltages were changing erratically.

After several unsuccessful tests, the 20μF filter of the +140V line was found to be open. Because this capacitor was one of several in the same can, the multiple-section capacitor unit was replaced with a new one.

Although the new capacitor cured the pulsating picture, several channels were snowy. A new first-IF tube removed the snow.

The signal level is so high in the IF section that *weak* tubes do not cause snow in the picture. RF tubes or tuner problems usually are responsible. But this is a special case where a *gassy* tube with a positive voltage at the control grid will reduce the IF AGC. This forces the AGC keyer to increase the RF AGC, which is the direct cause of the snow.

AGC overload

An Admiral G-13 chassis exhibited AGC overload only on the local TV-station signal. The channel remained dark during any rotation of the AGC control, while distant signals were received normally.

Clamping the tuner RF AGC with -8V permitted a snowy picture on the local channel. A total loss of AGC was suspected.

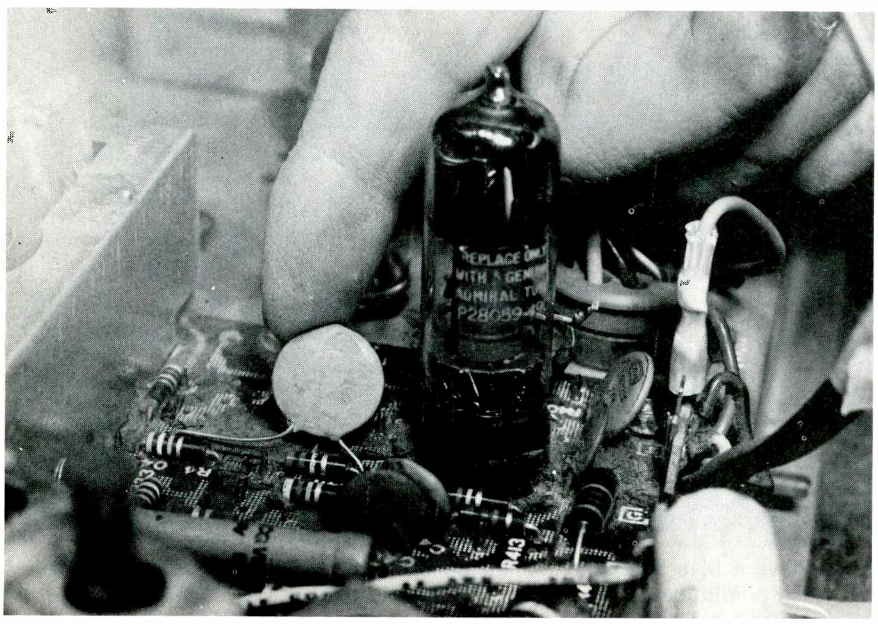


Figure 5 Failure of all AGC action and a dark overloaded picture resulted from a leaky C416 ceramic capacitor in an Admiral G13 chassis. C416 couples horizontal pulses to the AGC-keyer plate.

Video waveform at the pin 3 grid of the 6HS8 AGC during the AGC clamping appeared to be normal. However, dc-voltage tests showed more than +800V at the plate where about -21V is normal for on-station operation. Only the boost and flyback circuits have such high dc voltages. C416 (Figure 5) is part of a capacitive voltage divider that reduces the amplitude and couples damper horizontal pulses to the AGC-keyer plate. C416 was disconnected, and it measured 15K Ω. A new one was installed to restore good AGC action.

Critical AGC adjustment

Only one point on the AGC-control rotation provided a normal picture. The adjustment was so critical that small movements of the fine-tuning would change the picture from dark to white.

Clamping the IF AGC is difficult in the RCA CTC38 because of the transistor that controls the first-IF-emitter dc voltage. The RF AGC was clamped instead. This made the adjustment of the AGC control less critical, and indicated an AGC problem.

Dc voltages and waveforms of the AGC keyer were about average. All bypass and coupling capacitors were paralleled without bringing any improvement. The AGC control (R9) and other resistors were measured. All appeared to be within tolerance.

When resistance measurements were extended to include resistors on both sides of the AGC control, an incorrect reading of 35K Ω was measured between ground and the R59 end of the AGC control. C43 was located there, and it measured 35K Ω after it was removed for testing. Installation of a new .047μF capacitor cured the critical AGC-control adjustment.

A unique circuit—The CTC38 partial schematic in Figure 6 shows several unusual circuit features. An elaborate video coupling network is located between V1A and V1B. The values shown are for late-production chassis. Early-production values sometimes caused a black ringing line around the right side of objects in the picture. Compare the two schematics if an early chassis

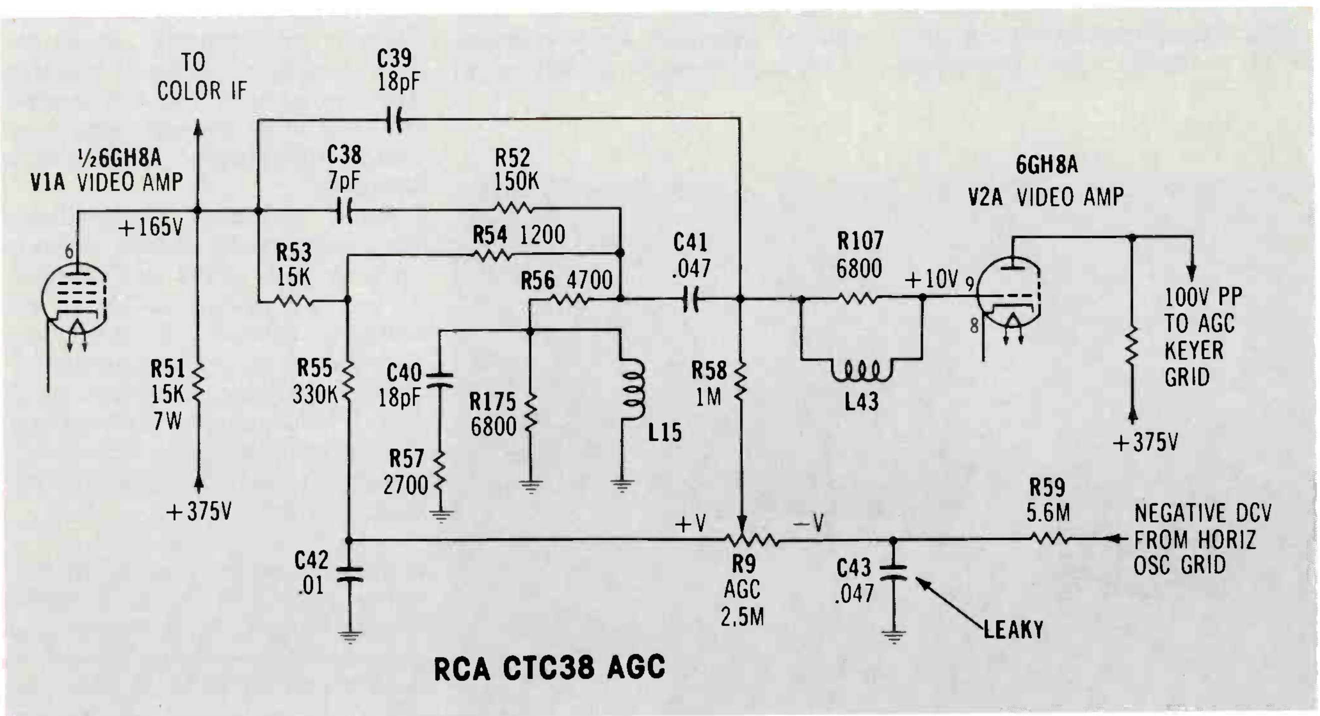


Figure 6 The RCA CTC38 AGC keyer does not have a bias adjustment. Instead, the AGC control varies the V2A video amplifier grid bias. In turn, this changes the video amplitude at V2A plate. This plate signal drives the AGC-keyer grid. Therefore, the symptoms of AGC failure are different from other TVs. If the positive voltage at the R55 end of the AGC control is missing, the AGC action increases thus giving low contrast. If the negative voltage at the R59 end of the AGC control is missing, the reduced AGC action causes a dark and perhaps overloaded picture. A special method for setting the AGC control is detailed in the text.

AGC Problems

is to be modified to remove the ringing. Leakage in either C39 or C41 can cause AGC overload.

Notice that the left end of the AGC control has a bypassed positive voltage applied to it from the V1A plate circuit. The circuit is direct coupled from the video detector to the V1A plate circuit. Therefore, this positive voltage varies with the station signal, giving dc-restoration action for automatic black level. At the other end of the AGC control is a negative dc voltage, which for convenience is taken through R59 from negative voltage at the horizontal-oscillator control grid. Because of negative at one end and positive at the other, the bias of V2A can be varied over a large range. These bias variations change the gain of triode V2A, and this controlled video level is fed to the AGC keyer (which does not have the customary bias control).

Because the video level to the AGC keyer is varied instead of the bias, adjustments of the AGC control change the picture contrast, but *do not black-out the picture as the AGC control is rotated clockwise.* This is an important difference, because it is not practical to turn up the AGC control until overload occurs and then reverse the rotation slightly.

The only accurate method of setting the AGC control is to scope the V2A plate signal and adjust R9 for 100VPP at the plate. If a VTVM is used, adjust for about 90VPP. Then finish by adjusting the RF AGC for minimum snow.

For troubleshooting purposes, remember that a higher positive voltage at the grid of V2A darkens the picture with higher contrast and, if carried to an extreme, overloads the video signal. This can occur if a defect reduces the negative voltage at the R59 end of the AGC control. In the other direction, a lower positive grid voltage at V2A reduces the contrast. Any decrease of the positive voltage at the R55 end of the AGC control will do this.

Comments

Some video defects or bad tuners can imitate AGC problems. Therefore, several simple tests should be employed to determine if the problem is in the AGC or not. These tests include using a test tuner, clamping the AGC voltage, and trying the performance both on and off an active channel.

After the easy tests have revealed all they can, they should be stopped, and more accurate measurements with scope, dc voltmeter, and ohmmeter then should be started. Study the schematic for methods of tailoring these tests to the exact circuit and its peculiarities.

Next month will bring more case histories and comments about AGC-test methods. □

Updated tube-AGC basics

AGC problems in tube-operated TVs can be analyzed faster and more accurately by technicians who follow these suggestions.

By Carl Babcoke, CET

Automatic-gain control (AGC) circuits operate to reduce the gains of RF and IF tubes when the incoming TV signal increases in level. There are several major advantages provided by AGC action. When working properly, AGC supplies the video detector with IF signals of relatively constant amplitude for all active channels. The contrast is the same for all stations, and adjustments of brightness or contrast seldom are required.

A more important reason for including AGC is to prevent overload of the receiver *while providing the best signal-to-noise ratio for TV carriers of many signal strengths.* Overload of strong signals or excessive snow represents two extremes of operation, and they often identify the type of defect.

Gains of RF and IF tubes always are reduced by increased cut-off bias. Negative dc voltage from the AGC is applied to the control grid of each first-IF tube, and the negative voltage is increased as the signal level becomes stronger. Negative bias for the second-IF tube (in three-IF TVs) is a more-positive cathode voltage (grid dcV held constant). This change of cathode voltage comes from the first-IF tube which amplifies both the signal and the dc AGC.

AGC keyer operation

Basic AGC keying operation is shown in Figure 1. A triode tube is operated as a grid-controlled rectifier. When the grid-to-cathode voltage is zero, the tube acts as a tube diode between plate and cathode. As the grid becomes more negative than the cathode (although both usually are positive relative to ground), the plate-cathode resistance is increased. This decreases the rectification efficiency which decreases the negative voltage generated at the plat. Therefore, the grid-to-cathode instantaneous bias determines the amount of negative plate voltage (which is processed before it reduces the gain of RF and IF tubes).

Three input signals—one for each tube element—are required for proper operation in a keyed AGC system.

Cathode voltage of the AGC keying tube remains constant during operation, although most circuits provide a control that adjusts the dcV. A higher voltage increases contrast, and a lower voltage decreases the RF/IF gain and contrast. The control also compensates for differences between individual receivers. It is the only adjustment in most tube AGC circuits.

Positive-going composite video (with its dcV level) is applied to the control grid. Tube bias is the instantaneous voltage between grid (with dc and video) and the cathode. Increased negative bias (higher cathode dcV or lower grid voltage) decreases the negative plate voltage and allows higher RF and IF gain. Lower negative bias (higher grid voltage or higher cathode voltage) increases the plate's negative voltage, reducing the RF/IF gain.

The plate requires large-amplitude positive-going horizontal-sweep pulses brought through a coupling capacitor. When grid and cathode have identical voltages (zero bias), the grid has little action, and the plate/cathode diode produces maximum negative dcV. This type of rectification sometimes is called shunt, but actually it is a clamping circuit. The positive tip of the waveform is clamped to the cathode voltage, and the entire waveform is negative compared to the cathode.

Figure 2 waveforms show that the positive-going sync pulses in the grid video signal *must* in-phase with the positive-going horizontal pulses. If these plate pulses are missing, or have very different phase from that of the sync pulses, rectification will be eliminated or reduced, and strong signals will be overloaded. This explains why many TVs have buzz in the sound and show signs of picture overload when the horizontal is not locked. Any defect that changes the pulse phase by a large amount will interfere with AGC operation. However, phase defects are rare.

Those pulses at the plate produce keyed AGC. No AGC action can occur unless a pulse is there, and the video level does not affect the AGC. Another advantage is that noise pulses cannot fool the AGC unless they occur during sync-pulse time.

Two AGC paths

Because the plate's negative voltage is produced by clamping, the full pulse amplitude appears at the plate. These pulses must be removed by R/C filters. Otherwise, the picture will pull, and the vertical lock might be unstable. In Figure 1, R2 is the filter resistor, which often has several hundred peak volts across it. If the resistor arcs internally, further deterioration soon follows, and eventually the resistance is very low. Low resistance in R2 can cause AGC overload by reducing the pulse amplitude. If the filtering capacitor C2 opens, ex-

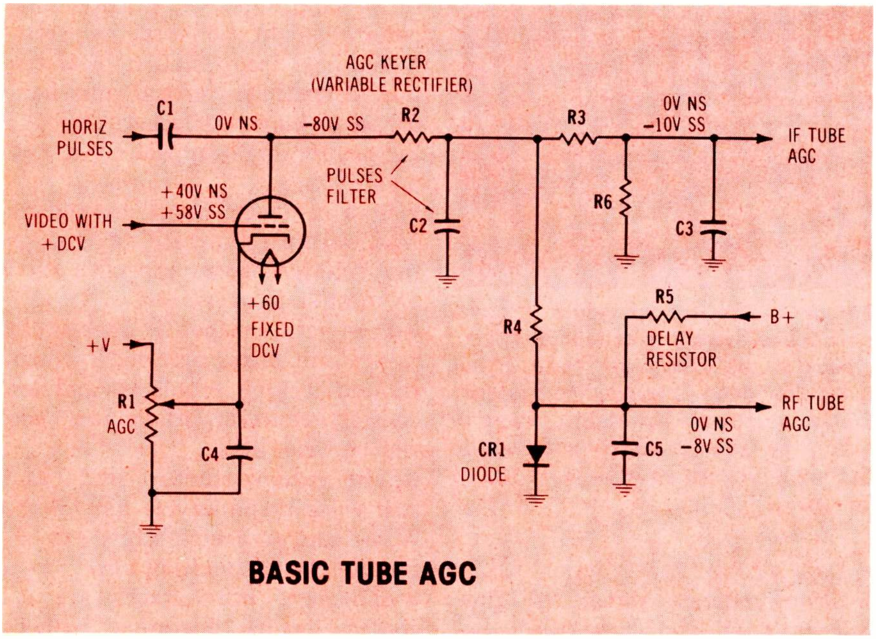


Figure 1 Only essential components are shown. Other AGC keyers use a pentode tube and additional parts. Operation only during the horizontal-retrace time is made possible by applying the plate voltage in pulses. No AGC action is possible except when a pulse tip is at the plate. A waveform-clamping action rectifies these pulses to produce negative dcV. Zero-bias voltage between grid and cathode permits full rectification of maximum negative voltage. Negative bias at the control grid reduces the amount of rectification (and the negative dcV). This negative voltage is filtered and applied to RF and IF tubes to decrease the gain when the station signal is strong. AGC for the IF is reduced by a simple linear voltage divider. AGC for the tuner is cancelled partially by a positive voltage so the RF tube receives negative gain-reduction bias only during reception of very strong TV signals. These two AGC paths work independently, but both are necessary for proper operation. Positive-going pulses are applied through a coupling capacitor to the plate, and the control grid is supplied with positive-going composite video that has a dcV level.

cessive pulse amplitude can reach the controlled stages causing loss of interlace, shimmy, or critical vertical locking.

Following the R2/C2 pulse filter, the negative-voltage AGC signal divides into two branches, one to the IFs and the other to the tuner RF amplifier.

Two paths are necessary because RF AGC gain reduction should occur *only* with strong TV signals. Without any antenna signal reaching the tuner, both RF and IF amplifiers should have maximum gain. With a moderate-strength signal, *any* gain reduction in the RF stage will increase the picture snow. Without a strong signal from the RF stage, mixer noise (snow) becomes a problem. No RF gain reduction should be applied until the increasing signal level approaches the mixer overload point. All gain reduction below that level should occur in the IFs, thus preventing overload of the third IF tube and the first video amplifier.

These requirements are satisfied in the IF AGC by a linear voltage divider (R3 and R6) that allocates to the IFs a fixed percentage of the negative voltage coming from the keyer plate.

Operation of the RF gain-reduction voltage is more complex because it should not operate at low-to-moderate signal levels. This voltage delay is accomplished by starting with too much negative voltage (all the keyer plate voltage) and cancelling it with a fixed positive voltage over most of the AGC range.

When a TV station signal is weak, the low negative voltage from the keyer plate is overpowered by the fixed positive voltage from R5. Without some clamping device, this would supply a high positive dc voltage to the RF tube. The positive voltage is clipped by diode action. Some TVs add a diode, as shown in Figure 1, from tuner AGC source to ground. Others have a Nuvistor RF amplifier with no cathode resistor, so *the grid and cathode act as a diode* to remove all positive voltage.

If the signal strength is gradually increased, the IF negative AGC voltage rises smoothly in step with the larger input signal. However, until the signal is very strong, the AGC voltage at the RF grid remains zero. With further signal increase, the RF AGC voltage becomes negative in a steep curve. In other words, the RF AGC remains zero until the signal level almost reaches the mixer-overload point. Stronger signals do not change the IF AGC voltage but rapidly increase the negative RF AGC voltage.

A defect in either IF or RF branch allows the other branch to continue functioning. Even when it is crippled, the AGC circuit tries to control the gain with the other branch. However, the results are not good enough.

Suppose a shorted C3 removes the AGC voltage from the IF tube. The video detector signal increases and the keyer plate becomes more negative. This supplies a large negative voltage to the RF tube, biasing it to cut-off. The only signal passing through does so through the stray and internal-tube capacitances. Therefore, the picture has excessive snow from the mixer stage and also low contrast.

If only part of the IF AGC voltage is eliminated, the performance might be nearly normal except for noticeable snow on stations of moderate signal strength. A fast test is to ground the RF AGC point. Overload could occur on a signal of high strength. But with lower-strength carriers, the snow should disappear. This proves the RF stage has insufficient gain that is produced by excessive AGC voltage. One common cause is an open or increased value in R5. Check it first.

If grounding the RF AGC point makes no difference in the snow, it's probable that the tuner is defective or the first-IF tube is gassy.

Servicing tips

These tips apply to most tube-type color TVs:

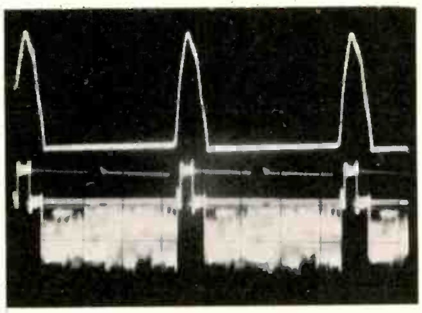


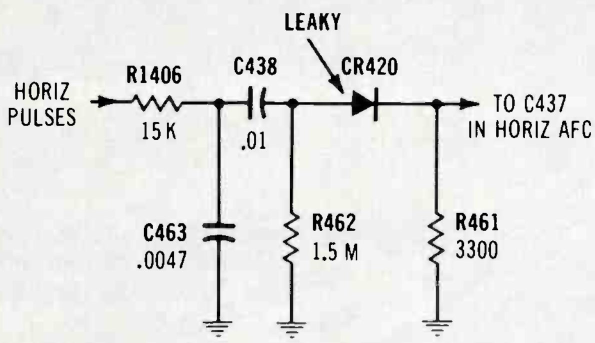
Figure 2 The top waveform shows typical positive-going horizontal-sweep pulses at the AGC-keyer plate. Positive-going video is applied to the grid (bottom dual-trace waveform), where it makes possible plate-cathode rectification which generates a negative voltage.

- Loss of all AGC action on a weak-to-moderate signal will produce a dark and overloaded picture. With a very strong signal, probably only a white raster can be seen (video detector high-negative dcV eliminates all first-video gain). However, normal heavy snow should be seen on any channel not having a signal.
- Excessive AGC gain reduction in the IFs along with no tuner AGC often overloads the tuner on strong local channels. A grainy beat pattern might be seen by cross-modulation from another local station. Sometimes vertical and horizontal locking is affected, although the picture might appear to be normal.
- Loss of IF AGC, or normal IF AGC with excessive RF AGC negative voltage, causes excessive snow on most stations.
- Low gain in the IF stages can cause both mixer overload (with or without locking problems) and low contrast. However, off-channel snow will be weak also.
- The video-detector diode and first video amplifier are part of the AGC loop, so their defects can affect the AGC operation also.
- Schematic dc voltages are recorded during operation without any input signal. *All* these AGC voltages will be different during tests with normal signals.
- Failure to measure the AGC keyer cathode dc voltage is a common troubleshooting mistake. *This voltage is equal in importance to the grid dc and waveform.* Also, check for proper amplitude of pulses at the plate. ☐

symcure

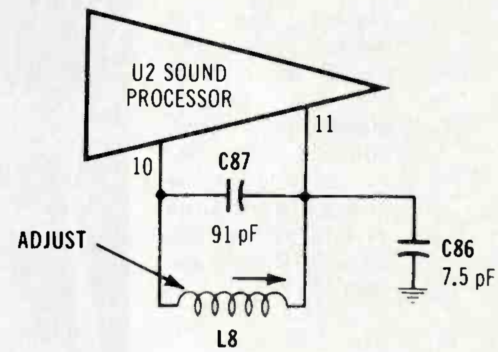
Symptoms and cures compiled from field reports of recurring troubles

Chassis—RCA CTC93
PHOTOFACT—1810-2



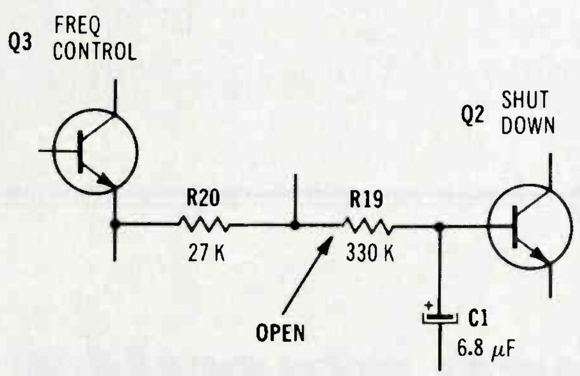
Symptom—Wrong horizontal frequency
Cure—Test diode CR420 and replace it if leaky

Chassis—RCA CTC88
PHOTOFACT—1787-1



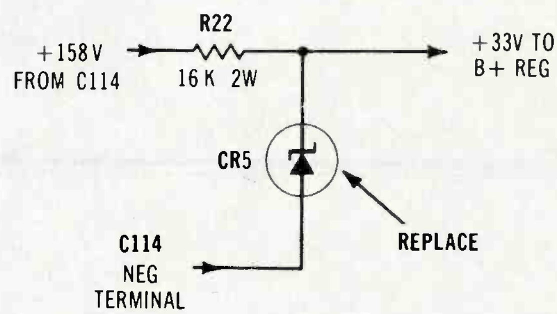
Symptom—TV sound is distorted
Cure—Adjust L8 quad coil for best sound

Chassis—RCA CTC88
PHOTOFACT—1787-1



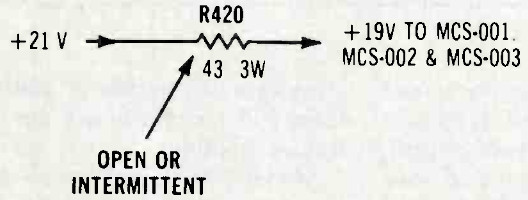
Symptom—Short blast of sound followed by shut-down
Cure—Check R19 in B+ regulator, and replace it if open

Chassis—RCA CTC87
PHOTOFACT—1778-2



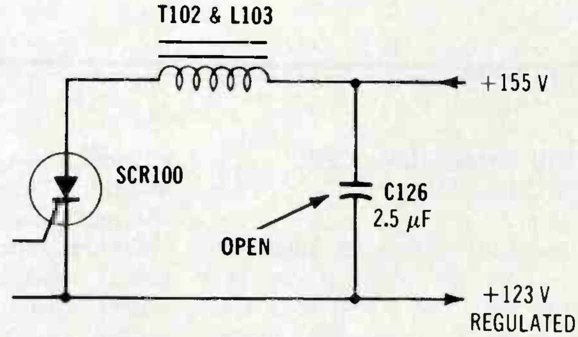
Symptom—Short period of audio followed by shut-down
Cure—Check dcV at CR5 in B+ regulator, and replace CR5 if the voltage is not 33V

Chassis—RCA CTC92
PHOTOFACT—1788-2



Symptom—Erratic tuner or station selection
Cure—Check R420, and replace it if open or intermittent

Chassis—RCA CTC99
PHOTOFACT—1895-1



Symptom—Shutdown giving no sound or picture
Cure—Check C126, and replace it if open or shorted

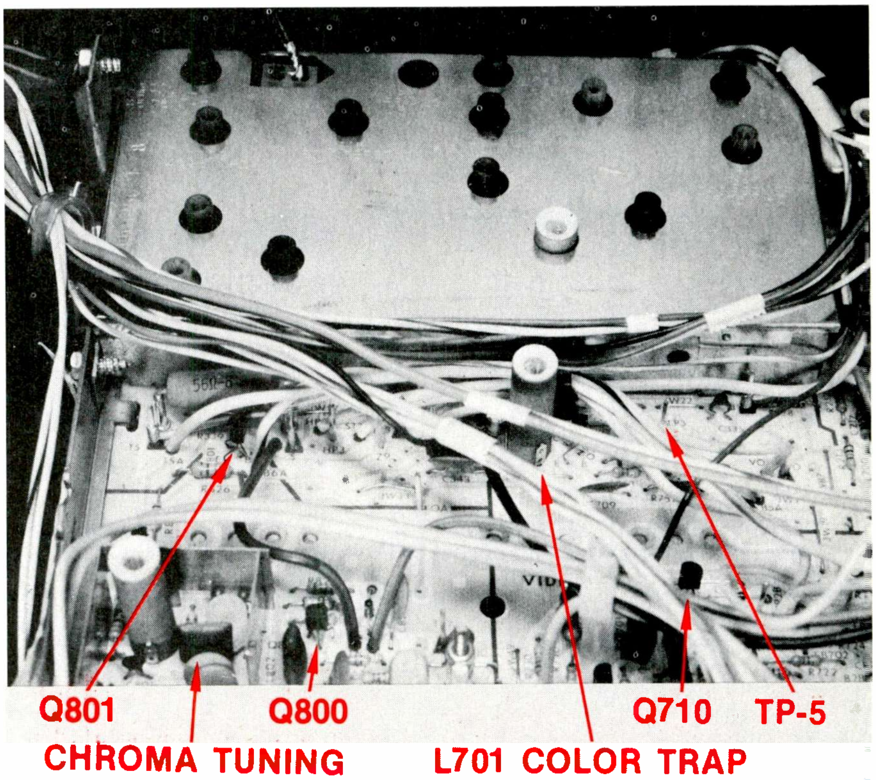


Figure 1 The gray rectangle near the top is the shield of the IFs. Arrows identify other components and test-points of luminance and chrominance circuits in the RCA CTC99 (Photofact 1895-1).

RCA luminance circuits

Luminance (video) stages include circuits for brightness, contrast, sharpness, color trapping, dc restoration and voltage amplification. Therefore, trouble symptoms can range from loss of raster to a blurred picture. Luminance circuit operations, voltages and waveforms are examined.

By Gill Grieshaber, CET
Gill's Color TV

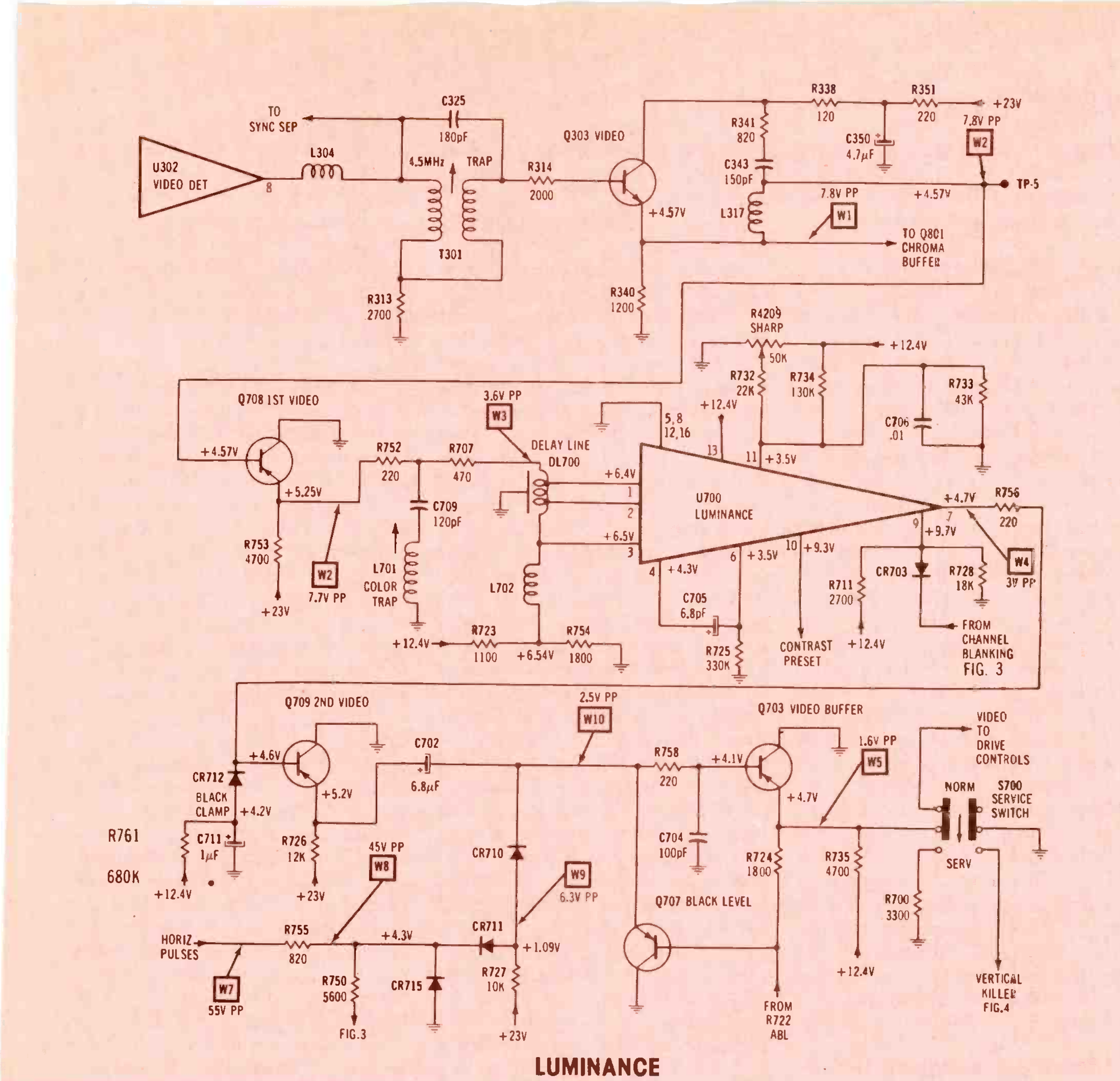
Luminance stages in solid-state color TVs do more than just amplify the video signal to a level that properly drives the picture tube. Many other essential functions are performed in these video stages.

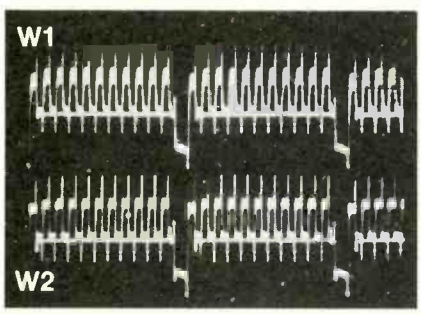
In the RCA CTC99 luminance channel, these variable controls and additional functions are included: contrast control; brightness control; sharpness control; vertical and horizontal blanking; channel blanking during each tuner search; normal/service switching; delay-line time delay; black-level clamping; and automatic brightness limiting.

Clearly, the chances are good that defects will produce baffling symptoms. Examples of actual voltages and waveforms are needed for troubleshooting.

Model 240 Hickok video generator was chosen for the signal source, because the color bars have black bars between them. The same color-bar pattern can be used for both video and chroma waveforms.

All waveforms and dc voltages were recorded when a properly





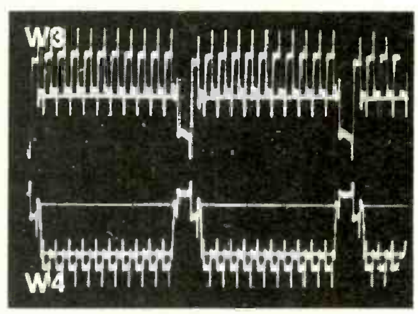
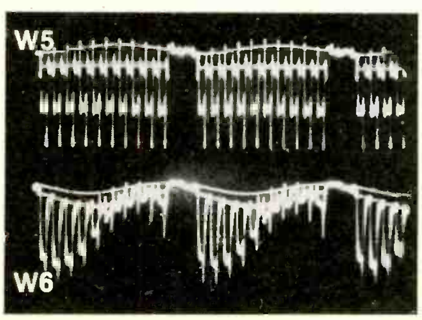
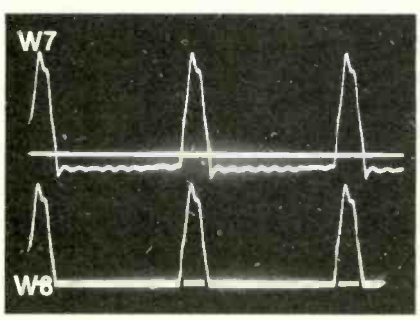
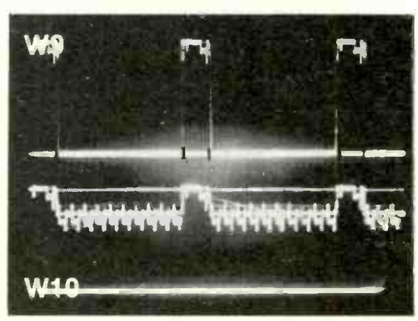


Figure 2 These are the circuits and waveforms of the luminance section from the video detector to the service/normal switch.







adjusted color-bar pattern was on the screen. They show typical operation, but are different from those in other service data.

Luminance and chroma separation

Video detection takes place in integrated circuit U302, which is located inside the IF shielded enclosure (Figure 1) along with 4.5MHz trap T301 and Q303 video-peaker transistor.

Separation of video and chroma occurs at the Q303 emitter (schematic in Figure 2). Composite video containing chroma is channeled directly from the Q303 emitter to chroma buffer transistor Q801. Video for the luminance channel also comes from the same point, but travels through a high-frequency-attenuation filter (L317, C343 and R341) to TP-5 and the base of Q708 first video emitter follower. This filter reduces the chroma amplitude by about one-half.

From TP-5, the filtered luminance signal goes through emitter-follower Q708, which provides isolation and impedance matching. Output of Q708 at the emitter has the chroma frequencies removed by trap L701 and matching resistors R752 and R707. From R707, the chroma-less video is sent to the tapped delay line DL700 and pins 1, 2 and 3 of U700 luminance IC.

Video processing in U700

Picture sharpness is adjusted by variation of the dc voltage at U700 pin 11. The sharpest picture was obtained at the minimum voltage setting of about +1.3V. A reading of +8.5 was maximum, and it provided minimum sharpness.

Contrast is controlled by the positive dc voltage at pin 10 of IC U700. Reducing the voltage increases the contrast (video gain).

Pin 9 of U700 is used to inject vertical and horizontal blanking into the video (Figure 3). The dc voltage there is increased to silence the sound and darken the picture during channel changes.

Amplified and controlled video exits from U700 at pin 7, and it is sent through R756 to the base of Q709, another emitter follower.

Blanking—Figure 3 shows the schematic and waveforms of the sweep samples and the resulting blanking at pin 9 of U700.

All three kinds of blanking (vertical, horizontal and brightness during tuning) are accomplished by variation of the dc voltage at pin 9. *A higher pin 9 positive voltage blanks the picture brightness.* Notice that the *sweep pulses do not travel to pin 9.* Instead, the positive peaks switch CR703 from conducting to non-conducting state. When CR703 conducts, R713 parallels R728, reducing the pin-9 voltage. When a reverse-bias signal prevents R703 from conducting, the pin-9 voltage increases to a value (+10.7V) determined by the R711/R728 voltage divider. The higher voltage blanks the brightness. *Average* voltage at pin 9 during normal vertical and horizontal blanking measures +9.7V.

Q710 acts as an electronic switch. When the channel-change dc voltage from the tuner-control circuit decreases during channel selection, the Q710 base becomes less positive than its emitter. Because it is a PNP transistor, this is forward bias that biases Q710 into saturation, conducting to the collector most of the +12.4V supply.

The Q710 high-positive collector voltage forward biases CR713 and CR709 into conduction which applies about +12V to the CR703 cathode. CR703 is reverse biased, and its open circuit blocks all current flow to load resistor R713. Without the R713 load, the CR703 anode voltage rises (along with pin 9 voltage) to blank the brightness. (A voltage from the tuner control to the sound circuit silences the audio. The Figure 3 operation does not affect the sound.)

Vertical sweep through R721 is applied to the CR709 anode. Positive peaks of the vertical waveform pass through CR709 and continue on to the cathode of CR703. However, the positive pulse is reverse bias for CR703, and conduction does not occur. The open CR703 allows the pin 9 voltage to rise and blank the brightness.

Horizontal pulses from R750 operate these diode switches in the same way. Positive-going horizontal-sweep pulses pass through the forward biased CR708 and reach the cathode of CR703. Again, this is reverse bias that prevents CR703 from conducting. Pin 9 voltage rises and blanks the brightness.

A beneficial side effect of the diode switching is that any ringing or tilting of the waveform is removed. Therefore, the blanking pulses are clean with flat tips.

Second and third video

Additional control and processing of the video is accomplished in the Q709 and Q703 stages (Figure 2).

CR712, C711 and R761 at the base of Q709 form a white clipper or clamp that conducts on the *whitest* peaks of the video. Evidently, the purpose is to limit negative excursions of the signal. Grounding the cathode of CR712 made no noticeable difference in the visible picture, but a scope showed the white spikes no longer were clipped.

Coupling capacitor C702 at Q709 cathode removes the dc level as it passes the video signal to the Q703 base and the other circuits there. Horizontal pulses enter at R755 (Figure 3) and are used for additional broad-pulse horizontal blanking. CR715 clips the negative portion of the pulses, leaving pulses of positive voltage (Waveform W8 in Figure 2). These pulses must pass through CR711 and CR710 on their way to the Q703 base. However, the polarity of CR711 is wrong; positive voltage cannot enter at the cathode. This is another example where removing a load simulates a pulse.

When no positive pulse is at the cathode of CR715, positive voltage flows through R727, CR711 (which is forward biased), and R755 to ground. The instantaneous dc voltage at the anode of CR711 is almost zero. During the time each positive pulse is at the cathode, CR711 is open, which allows the R727 positive voltage to pass through CR710 and reach the Q703 base. In other words, a short is removed to *allow* 6.5V positive dc pulses at the anodes of CR711 and CR710. These pulses of dc voltage are narrow, so the average as measured by a meter is only slightly higher than +1Vdc. This explanation is proven by dc waveforms W7, W8, W9 and W10.

The W9 blanking pulses after

they reach the Q703 base are sufficiently wide to blank the color burst, leaving just 10 bar patterns (W5).

Video from Q703's emitter is sent to the S700 normal/service switch for distribution to the video-drive controls or to a dummy load.

Brightness transistor—Q707 is called a black-level transistor. It appears to function only as a voltage-controlled resistance that varies the Q703 base voltage to change the brightness.

A higher positive voltage from R722 (brightness control and ABL circuits) is reduced forward bias for PNP Q707, which increases its C/E resistance between Q703 base and ground. This is less forward bias for Q703 (another PNP) and its emitter voltage increases to darken the picture. When a brighter picture is desired, the brightness control decreases the Q707 and Q703 base voltages in an action just reversed from the previous explanation.

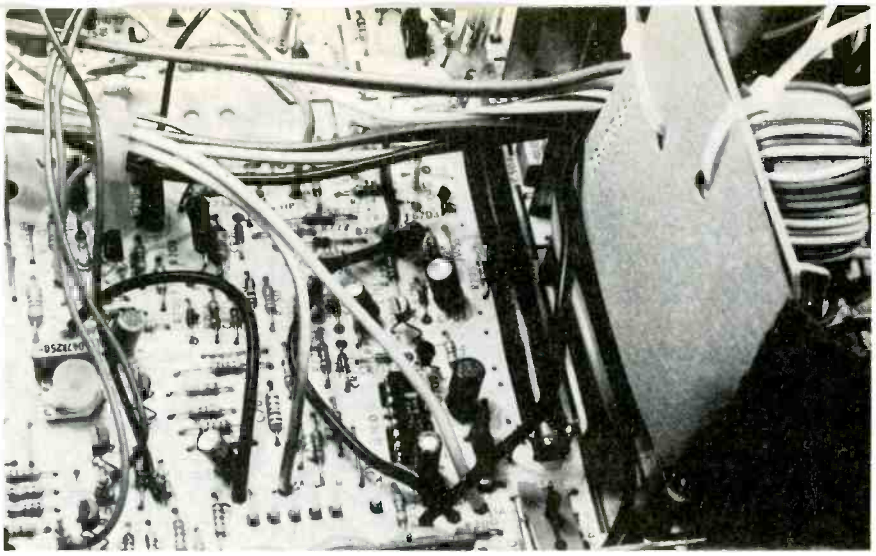
The Q707 base voltage is changed also by the automatic brightness-limiting circuit when the picture-tube current exceeds a certain amount.

Service switch—Normal/service switch S700 does three functions with only two sets of contacts. Figure 2 shows the video switching. In the normal position, video from the Q703 emitter goes through the contacts to the drive controls and the matrixing transistors. A dummy

TABLE 1 **U700 DC VOLTAGES**

pin 1	+6.5V
pin 2	+6.5V
pin 3	+6.52V
pin 4	+4.3V
pin 5	00.0V
pin 6	+3.55V
pin 7	+4.6V
pin 8	00.0V
pin 9	+9.7V
pin 10	+9.2V
pin 11	+3.5V
pin 12	00.0V
pin 13	+12.4V
pin 14	00.0V
pin 15	00.0V
pin 16	00.0V

These dc voltages were measured at the U700 luminance-IC pins during typical operation on a color-bar pattern.



IC700, diodes and transistors of the luminance circuit are located to the left of the delay line (the long black object on the right).

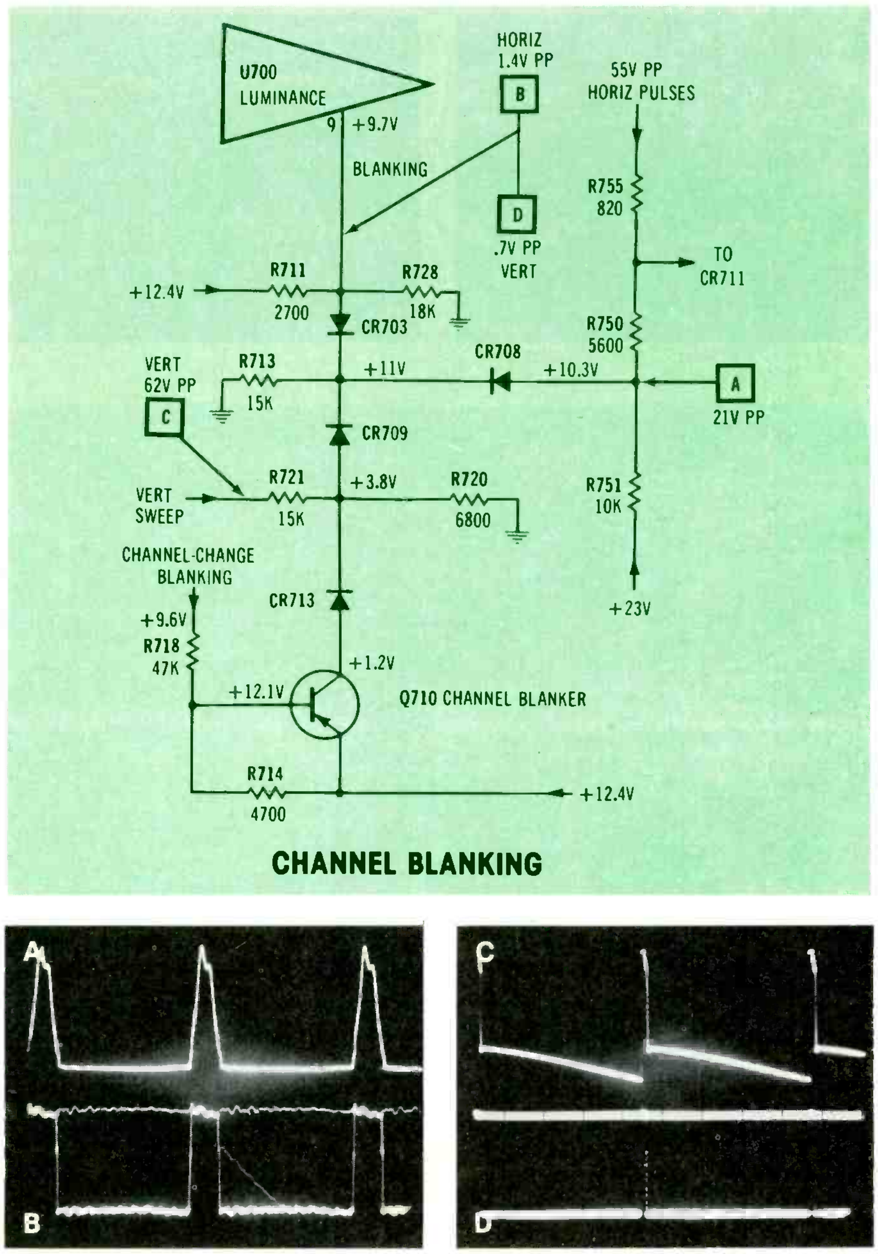


Figure 3 Three kinds of blanking are applied to U700 pin 9. Horizontal pulses enter at R755, vertical sweep enters at R721, and picture blanking during tuner operation between channels is applied through R718, Q710 and CR713. During any blanking, pin 9 increases to +10.7V.

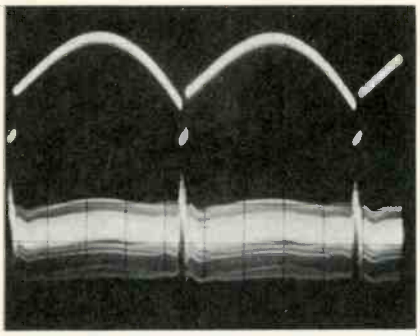
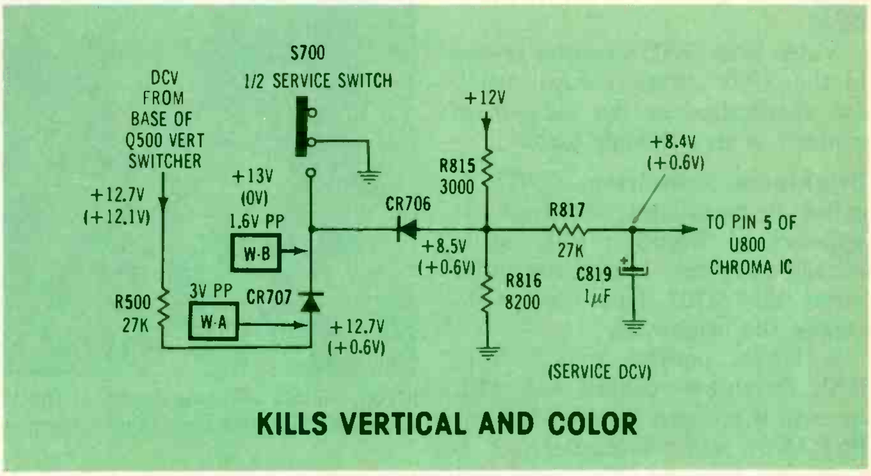
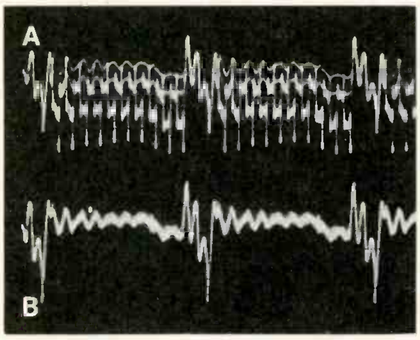


Figure 4 One set of S700 contacts grounds CR707 and CR706 cathodes to eliminate vertical sweep and color when S700 is pulled out to the service position. Dc voltages in parenthesis were measured in the service position. Others are typical of normal operation with a color signal.

Luminance





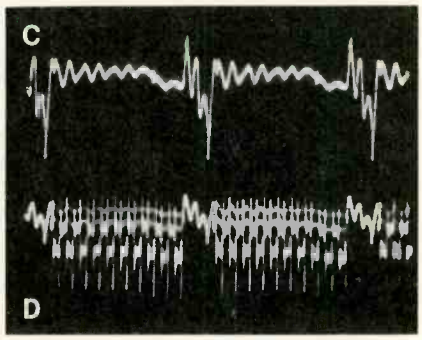
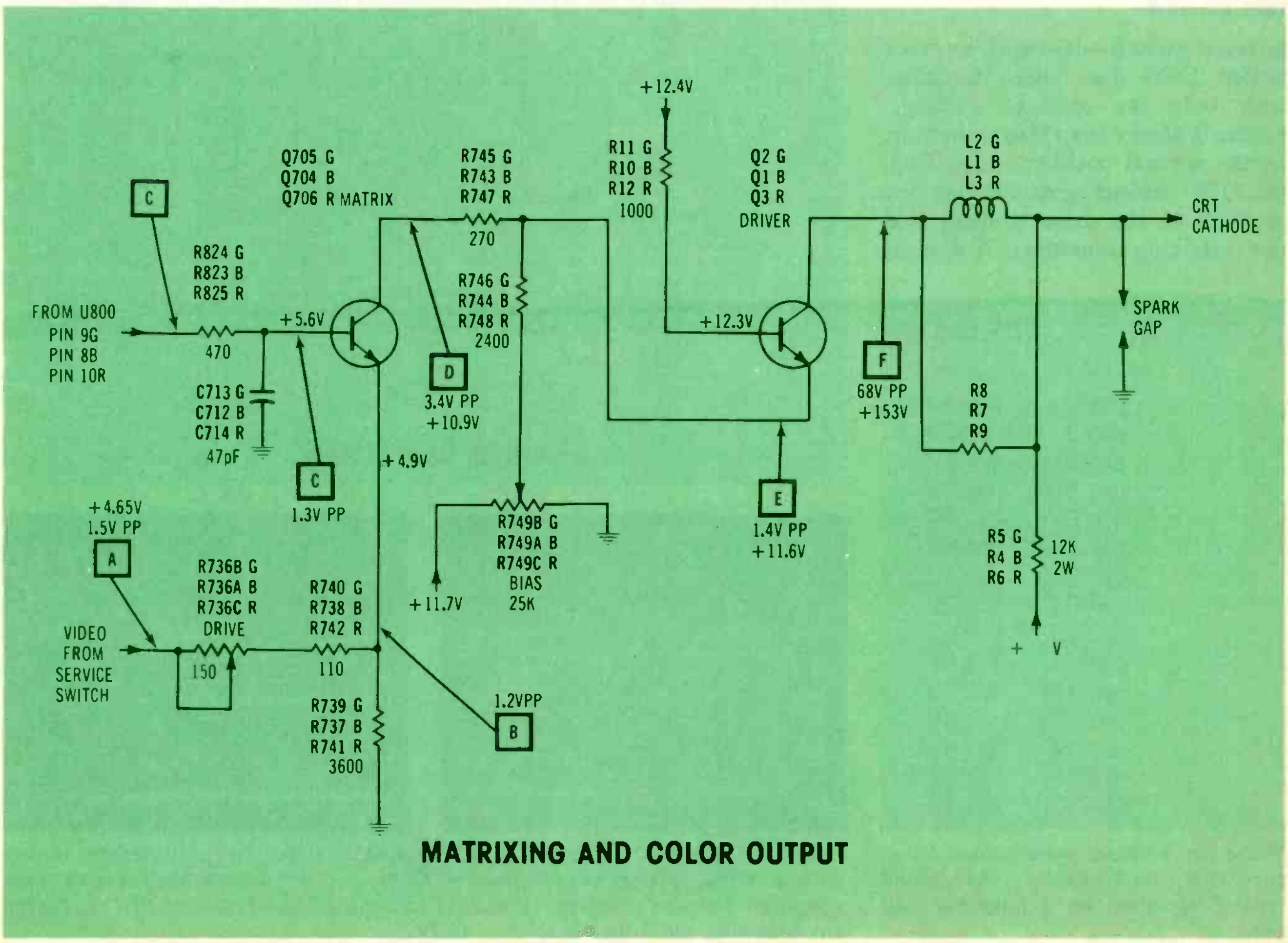


Figure 5 These voltages and waveforms were measured in the green color output circuit when the signal was color bars but with the color control turned down. Component numbers for all three identical red, blue and green channels are shown. Chroma-Y signals are applied to the matrixing transistor bases, and luminance video is applied to all three emitters. Matrixing occurs inside these three matrix transistors.



load (R700) is connected to the Q703 emitter, and the video is disconnected from the drive controls in the service position. This provides a dc level at the picture-tube cathodes that is not affected by the video or any brightness adjustments.

Figure 4 shows the circuit that eliminates color and vertical sweep, thus establishing proper conditions for CRT screen-voltage adjustments. Although some vertical and horizontal waveforms are present, they are only incidental.

With the switch in the normal position (as shown), the vertical-elimination circuit at the left and the chroma-killing circuitry on the right appear to be connected together. Positive voltage from the vertical can pass through CR707, but CR706 is reverse-biased so the voltage cannot pass through it. In the same way, the positive voltage from R815 can pass through CR706, but is blocked by CR707. Neither circuit affects the other.

However, when S700 shorts the cathodes of CR707 and CR706 to ground in the service position, CR707 conducts dc current from R500 to ground. Q500 base voltage is reduced sufficiently to stop vertical oscillation. After S700 is pulled-out, the vertical sweep becomes smaller and finally stops after one last bounce. This eliminates all vertical sweep so the CRT brightness is concentrated into one horizontal line.

Also, positive voltage from R815 now can pass through CR706, which reduces the normal voltage at the junction of R815 and R816 to about +0.6V. This dc voltage is filtered (R817 and C819) and delivered to U800 chroma IC pin 5 where it kills the color signal during S700 operation in the service position. A voltage at pin 5 of about +8V is necessary for normal color. This voltage should be measured first when the luminance is normal but there is no color on the screen.

Matrixing and color outputs

Matrixing of the luminance and demodulated chrominance signals in the CTC99 is accomplished by applying a R-Y, B-Y or G-Y signal to the base *and an amplitude-adjusted luminance signal to the emitter* of each small-size matrixing transistor. Of course, the true transistor bias is the sum of both signals, so the collector output signal of each matrixing transistor is a true red, blue or green signal that is applied to the emitter of a power transistor for amplification and delivery to the appropriate picture-tube cathode.

One of the three matrixing/output channels (identical except for signals) is shown in Figure 5. Identification call-outs are shown for all three channels.

Although a color-bar pattern was used, the color control was turned down. Therefore, the waveforms show only the luminance signals.

11.7V power supply

Chroma and luminance circuits show a +11.7V supply. As shown in Figure 6, it is slightly different because the base voltage of Q701 is not regulated by a zener diode but by connection to the regulated +12.4V supply. A shorted Q701 will apply about +20V to the U700 and U800 ICs, perhaps causing damage. This supply voltage should be measured before a new IC is installed.

Another power-supply problem

During power-supply troubleshooting explanations, the effects of an open C126 were not investigated. C126 is the 2.5µF 1kV capacitor that is connected between the +123V regulated and the +155V supplies.

An open C126 (in a CTC99 that otherwise is normal) produces shut-down. When operated at 35V line voltage and with +23V applied to TP-13 (as described previously), the Figure 7 waveforms were obtained. Although the Q100-collector pulses had about half amplitude, the most significant symptom was the distorted waveform at the anode of SCR100. (A shorted C126 activates the shut-down because the voltage at the 123V supply is too high.)

Next month

Circuit operation of the CTC99 chroma channel will be examined. In addition, troubleshooting procedures for luminance and chrominance channels will be proposed. ☐

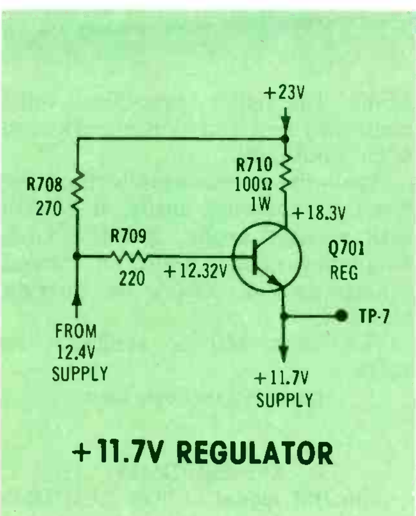


Figure 6 The +11.7V supply for luminance and chrominance circuits comes from this dcV regulator, but it is controlled by the voltage of the +12.4V supply.

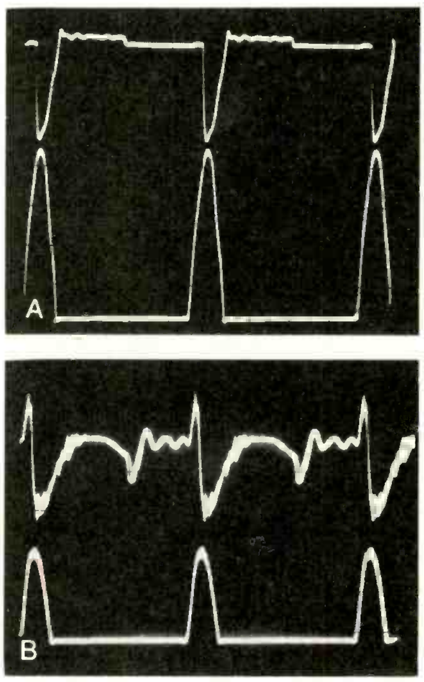
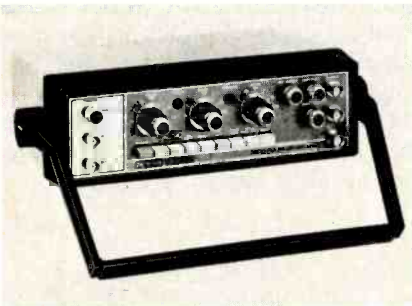


Figure 7 An open C126 in the regulated +123V supply causes immediate shut-down and the wrong waveshapes. (A) These are the correct waveforms at SCR100 anode (top trace) and Q100 collector (lower trace). (B) During operation with an open C126 and low-voltage operation, the incorrect SCR100 anode waveform is shown by the top trace. The Q100 collector waveshape was reduced in amplitude (lower trace) but was not distorted.

test equipment report

5MHz pulse generator

The model 3300 digital pulse generator from **B&K-Precision** offers a frequency range of 5MHz to 1Hz and a pulse width range of 100nS to 1-second. Four separate outputs are



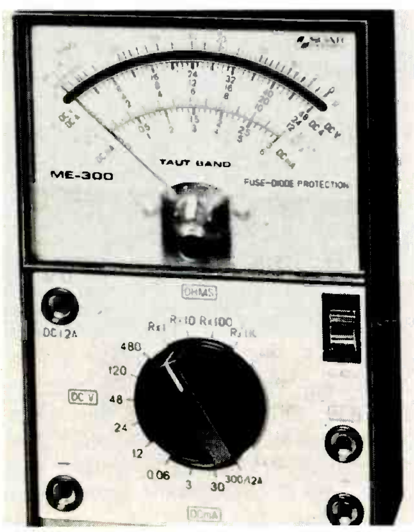
available. The unit is contained in a compact case with a combination tiltstand/carrying handle. A 48-page operation and applications manual is included.

The 3300 is available at local distributors at a user price of $325.

Circle (39) on Reply Card

Analog multimeter

The drop-proof battery-operated ME-300 analog multimeter from **Soar** has a dc sensitivity of 30,000Ω/V and an ac sensitivity of 10,000Ω/V. Features include centerscale readings of 6-, 12- and 24V, a wide-scale meter deflection angle of 95°, a mir-



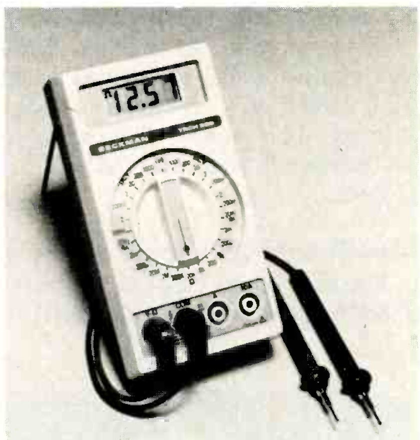
rored scale for easy reading, five function modes and high accuracy and stability. The unit has a voltage measurement range to 480Vdc and 480 Vac, a current measurement range to 12A dc and 6A ac, and a resistance measurement range to 3MΩ. It is powered by two 1.5V AA batteries and has an accuracy of ±4% ac and ±3% dc. The meter movement and the PC board are protected against burnout by diodes, a fuse and a fusable link.

The ME-300 sells for $38.

Circle (40) on Reply Card

3½-digit multimeter

The TECH 300 multimeter from **Beckman** features 10A current ranges, a built-in continuity indicator, typical 2000-hours battery life, complete internal RF shielding, and 0.1% basic dc accuracy with 22MΩ input resistance. The instrument measures both ac voltage and current in true RMS for accurate measurement of non-sinusoidal wave-



forms. The unit's Insta-Ohms quick continuity test function checks electrical continuity.

Available accessories include two types of carrying cases, a 50kVdc high voltage probe, 200MHz radio frequency probe, 150A ac current clamp and a 1000A ac current clamp.

The Tech 330 is available for $200.

Circle (41) on Reply Card

3½-digit DMM

The **DSI** model LC5000 LCD DMM provides a high Vdc accuracy of 0.1% and four measuring ranges, combined with low current-drain and minimal calibration. It features a 0.5-inch high, 7-segment LCD that is legible at a distance and under bright ambient light conditions. The LC5000 push-button controls select five RMS ac and five dc voltage ranges, five dc current ranges, and six resistance ranges. It also pro-

vides automatic polarity (plus/minus) indication.

The LC5000 is available for $169.95.

Circle (42) on Reply Card

Logic monitor

The **Global Specialties** model LM-3 logic monitor is a 40-channel state-indicating logic test instrument that offers triggerable latching modes and selectable logic thresholds. It permits simultaneous monitoring of up to 40 logic points selected by the user. Its three operating modes permit it to follow data, latch on the first trigger only or latch on the first trigger and update with succeeding triggers. A manual pushbutton latch is also provided. All 40 data channels and the trigger input channel share the same user-selected threshold. All present a constant high input impedance of 0.5mΩ + 6pF regardless of threshold. All offer 5MHz speed, and are capable of capturing 100nS events.

Circle (43) on Reply Card

Clamp-on amp/volt/ohm meter

Universal Enterprise's MCP3 clamp-on amp/volt/ohm meter locks in the measurement reading with a meter locking button. The MCP3's jaw width capacity is 1 1/8-inches. Other features include fuse protected ohm circuit, three color coded front panel and scale plate for easy readability, and a one year warranty.

The MCP3 comes complete with carrying case, test leads, batteries and an instruction manual at a suggested price of $54.95.

Circle (44) on Reply Card □

productreport

RH/temperature meter

Direct and accurate measurements of both relative humidity and temperature are provided from **Extech's** handheld model 5500 digital RH/temperature meter. By using the aspirated wet and dry bulb principle, the model 5500 does not have the contamination error associated with solid-state RH sensors. The unit has two precision matched sensors with an output processed to

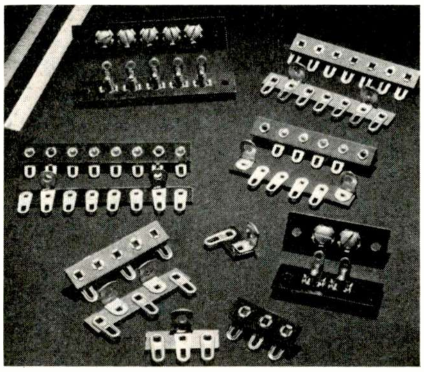
display % RH to a resolution of 0.1% RH over the range 10% to 100%. With a flick of the switch the unit will directly display the dry bulb temperature. Use of a separate temperature probe converts the unit to an accurate digital thermometer reading temperatures from 0-300°F. Both °F and °C versions are available. The meter is powered by five AA 1.5 volt disposable or rechargeable batteries.

The price of the 5500 meter is $349.

Circle (45) on Reply Card

Terminal strips

Two types of terminal strips, standard and screw types, available from **Waldom Electronics.** The standard type terminal strips TS series are fabricated from X-grade Bakelite, 1/16-inch thick, 3/8-inch wide. Square barreled construction prevents twisting and slippage. End terminals are spaced 3/16-inch from end of strip. All terminal strips are furnished with lug holes spaced 3/8-inch center to center. Two through nine position standard terminal strips are available. The screw-type terminal strips BTS series are made

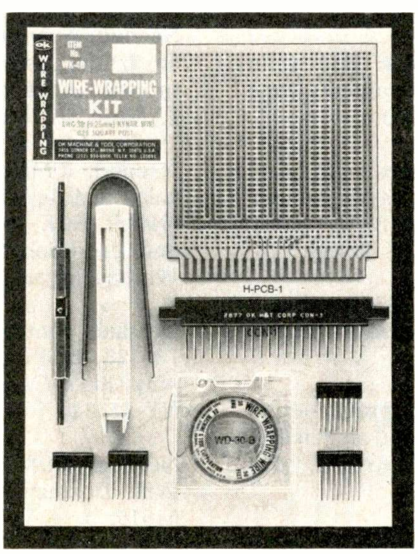


of Bakelite. Terminals are hot-tinned dipped for easy soldering. All are 5/8-inch wide, with .136 diameter mounting holes, 1/16-inch thick, 7/16-inch spacing between screws; 7/16-inch from end screw to mounting hole. Two through seven position terminal strips are available.

Circle (46) on Reply Card

Wire-wrapping kit

The WK-4B kit from **OK Machine and Tool** includes a universal PC board, an edge connector with wire-wrapping terminals, two industrial quality 14-pin wire-wrapping DIP sockets, two 16-pin sockets, a DIP inserter, a DIP extractor, a wire dispenser complete with 50-feet of

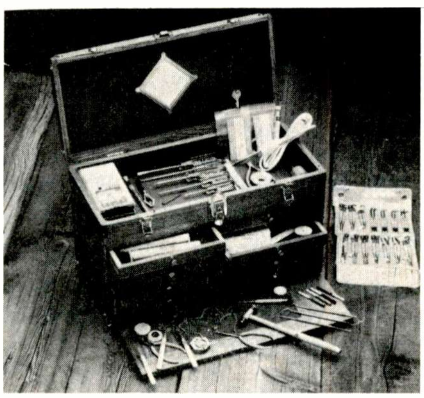


wire, and a wire wrapping and unwrapping too.

The tool model WSU-30 is a combination tool that wraps and unwraps 30 AWG wire on .025 square pins, plus strip 30 AWG wire using a built-in stripper. The board features glass-coated epoxy laminate construction with solder-coated 1-ounce copper pads. The corresponding edge connector features 22/22 contacts on standard .156-inch spacing. Both types of sockets have gold-plated terminals and UL recognized thermoplastic bodies. The INS-1416 inserter features one-hand operation and a built-in pin straightener, while the EX-1 is a simple all-metal extractor. The WD-30B dispenser features a cutting and stripping mechanism to prepare the wire for wire-wrapping or soldering. The wire is industrial-quality kynar insulated silver-plated solid copper.

The WK-4B kit is priced at $25.99.

Circle (47) on Reply Card



Repair kit

Jensen Tools has developed the JTK-96 tool kit, which contains more than 180 fine tools in a 7-drawer oak chest. The kit is available with or without an optional digital multimeter.

Circle (48) on Reply Card

Picture-tube rebuilding

An updated vertical sealing machine and other equipment from **Lakeside Industries** enables anyone to rebuild television picture tubes. This semi-automatic machinery is said to allow the rebuilding of as many as five picture tubes per hour. Lakeside provides the necessary small amount of training needed. □

Circle (49) on Reply Card

reader's exchange

There is no charge for a listing in *Readers Exchange* for items "Needed," but we reserve the right to select and edit all copy. Due to the limited amount of space for this department, "Needed" listings must contain no more than *three* items. If you can help with a request write directly to the reader, not to **Electronic Servicing.** "For Sale" listings will be charged for an included in the regular classified section of **Electronic Servicing.** Please consult that section for price and ordering instructions.

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Needed: IF circuit board for M6 General Electric. *John Russin, 222 Suncrest St., Pittsburgh, PA 15210.*

Needed: Power transformer for EICO model 460 scope. Will buy complete or partial scope with good transformer. Need probes for B&K-Precision model 1431 scope also. *James Burgess, Rt. 13 Box 304, Cullman, AL 35055.*

Needed: Schematic and service data for a Capehart AM/FM/MPX stereo receiver, 8-track player recorder, BSR turntable model SKTR400/17AA. All mail must be first class. *Howard Quinton, Northrop Corp. Box 747, A.P.O. NY 09616.*

Needed: Tuning gear for Atwater Kent model 60; and cheap 20UP4, 19UBXP4, 21VAQP22. *Osceola Electronics, 226 S. M66 Hwy., Marion, MI 49665.*

Needed: Used electronics related study courses, communications, avionics, FCC, microprocessors. *John Sepello, RR1, Kirkville, NY 13082.*

Needed: Manual and schematic for a Supreme signal generator model 666 and a manual with illustrated parts breakdown for a Woolensak tape recorder model T1515-4. *Charles Small, 19 Crown Rd., Westford, MA 01886.*

Needed: Heath IM-58 distortion meter with manual, in good working order. *Bob Kramer, 919 Grove St., Aurora, IL 60505.*

Needed: 610 adapter for B&K-Precision 550 tube tester. Will pay for schematic or layout drawing. *Dave Brower, 236 Welsh St., Camden, SC 29020.*

Needed: One 510HRB22-TC03 color picture tube used in Mitsuba 19-inch TV. Prefer new, but will consider rebuilt or used. State price and condition. *Larry Sobelman, 7290 Forrest St., Hollywood, FL 33024.*

Needed: S meter part number 082-000280 for Hallicrafters SX-100 short-wave radio. *Lenwood Williams, Box 326, Brunswick, NC 28424.*

Needed: B&K-Precision or similar equipment—tube tester, CRT tester, capacitance meter and schematic for Supro guitar amp #S6422TR. *Ed Arnold, 316 Division, Jackson, TN 38301.*

Needed: Howard W. Sams *TV Servicing Made Easy*, volumes 1 and 2; T2121 audio output transformer for DB-115 David Bogan amplifier. *Lee Randolph, 710 Morton St. NW, Washington, DC 20010.*

Needed: Schematic and/or service manual for Knight Kit Safari I CB transceiver base reference number 22 3809 702018 704 and Strober-Carlson FM radio model 1121, Series 12 (Sams photofact #10, out-of-print). Will pay for copy, or will copy and return. *David Doroh, 2129 Patricia Pl., Manhattan, KS 66502.*

Needed: Sams MHF-23. Will buy or copy and return. *Charles Trainor, 618 Van Alstyne Rd., Webster, NY 14580.*

Needed: 5AQP1 CRT for Hewlett-Packard scope model 130A. Weak one OK, so long as it is not gassy. Any reasonable price paid. *Harry G. Campbell, Box 28011, San Antonio, TX 78228.*

Needed: Any information on Superior Instruments tube tester model 82A. *Vernon Lawver, RR1, Rockton, IL 61072.*

Needed: Complete set of Rider Manuals and any other early 1900 service literature and catalogs. Also need early vacuum tubes such as 27, 227, 45 and 80's. *Bill Springer, 923 Nelda, Houston, TX 77088.*

Needed: instruction manual for model A Jud Williams curve tracer for transistors. Will buy or copy and return. *Andrew Kulick, 88 Standiford Ave., Sayreville, NJ 08872.*

Needed: Complete set of Rider's Radio Manuals with indexes. Will buy complete set or single volumes to make a complete set. Please include price and condition in first letter. *Frank Ingrassia, 15467 Montery Ln., Kerman, CA 93630.*

Needed: New or used audio interstage transformer for old radio primary about 200 , secondary center-tapped about 25,000 impedance. *Lewis Frodge, 41 E. Main St., Mt. Sterling, KY 40353.*

Needed: 10MHz or better triggered scope with probes; color test jig with adapters; tube tester; digital multimeter; B&K-Precision transistor tester. State price and condition. *Walter Young, 26 Zophar Mills Rd., Wading River, NY 11792.*

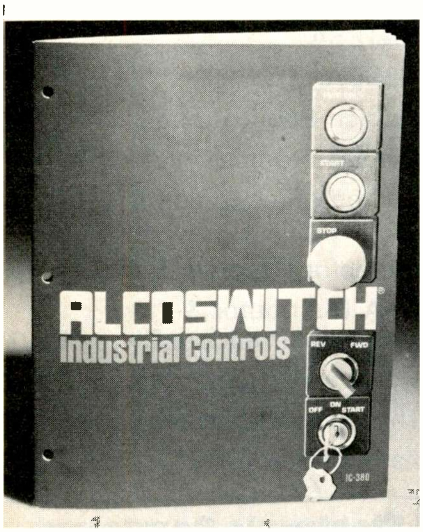
Needed: Emerson power transformer part number 730138, 135P21 or 8316619. State price, will pay shipping. *Joe's TV Service, 242 Starke Ave., East Meadow, NY 11554.*

Needed: B&K-Precision Analyst 1077B, State price. *Wm. Duxbury, RR5 Box 232, Black River Falls, WI 54615.*

Needed: UHF channel 54 strip for Zenith "O" model 175-352 Gold Video Guard tuner. *Paul Capito, 637 W 21st, Erie, PA 16502.* ☐

catalogs literature

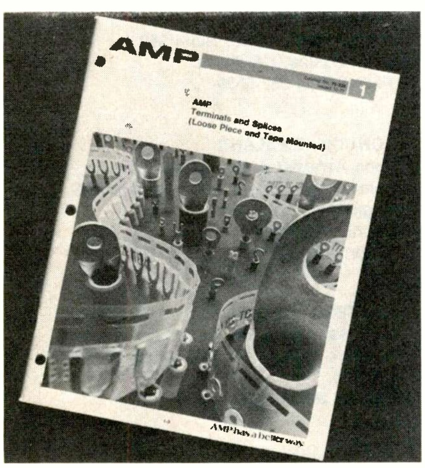
A 20-page catalog (No. IC-380) from **AlcoSwitch** describes miniature and standard size oil-tight pushbuttons, mushrooms, selectors, keylocks and illuminated controls and pilot lights. The Alco series 2000 miniature controls fit a 7/8-



inch diameter panel hole, and the standard size series 6000 controls fit a 1 3/16-inch panel hole. Cam-operated rotary switches up to 32A are included. Current prices for all items are also listed.

Circle (50) on Reply Card

A 124-page catalog (No. 75-338) from **AMP Incorporated** contains complete descriptions and specifica-



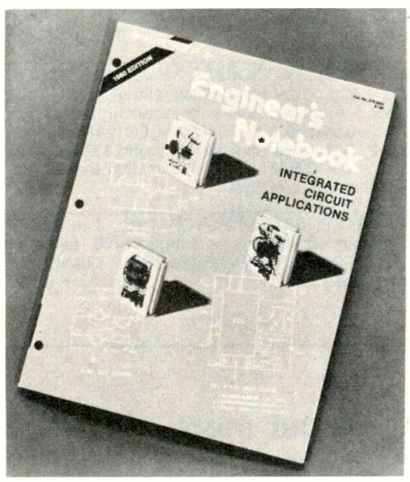
tions for more than 1200 solderless terminals and splices. All terminals and splices are cataloged by wire size (26 AWG through 600 MCM) and tongue type. In addition, each wire size and tongue type listed shows the complete family of preinsulated and uninsulated terminals.

Circle (51) on Reply Card

A 16-page *Instant Storage Catalog 801* for those responsible for storage planning is offered by **Bernard Franklin Company.** The illustrated catalog features types of storage equipment to use, and more than 90% of the standard stocked user sizes inventoried for a 72-hour shipment. Included is steel shelving, pallet racking, storage-retrieval and mezzanine systems, lockers, gondolas, benching and shop equipment.

Circle (52) on Reply Card

The *Archer Engineer's Notebook* from **Radio Shack** contains 128 pages of circuitry, with applications included for most of the integrated circuits sold by Radio Shack. Prob-



lem-solving circuits are described, and tips and techniques for beginners are included in the introduction that precedes each section.

Circle (53) on Reply Card

Global Specialties has published its *Instruments for Testing and Design* catalog. The catalog features the company's line of solderless breadboards, logic probes, electronic test instruments, cases and hardware.

Circle (54) on Reply Card ☐

Circle (60) on Reply Card

Circle (61) on Reply Card

the marketplace

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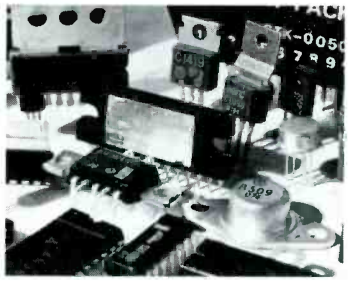

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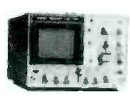

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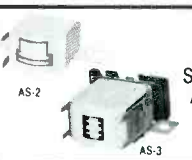

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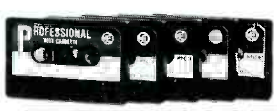

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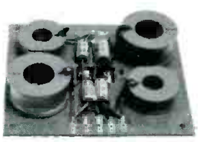

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