

JULY 1977 • 75 CENTS



A HARDCOURT BRACE JOVANOVIICH PUBLICATION

# ELECTRONIC TECHNICIAN/DEALER

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## EDITOR'S MEMO

### Electronics Self-Tests: You've Asked For Them, So You're Going To Get'em



■ In response to the flood of letters we received from readers requesting more Electronic Self-Tests like the one on capacitor replacement selection which we published in the May issue, beginning in August we will publish a self test in each issue.

Many of the letters we received also pointed out that the answer given for question 16 in the May self-test is incorrect. (Oh, those typographical errors that slip by!) Consequently, I am herewith repeating question 16, with the correct answer:

Q16) Which of the following statements is *not true* about the two parallel-connected electrolytic capacitors in Fig. 9?

- a) Their combined capacitance is greater than 20mfd \_\_\_\_\_
- b) The DC voltage applied across them does not exceed their individual voltage ratings \_\_\_\_\_
- c) Because their total combined internal resistance is less than that of either capacitor used separately, their total combined leakage is also greater \_\_\_\_\_
- d) If one of the capacitors opens, the total capacitance will increase \_\_\_\_\_

The correct answer to question 16—in other words, the only *untrue* statement among the four choices—is (d). The total capacitance of the two capacitors in Fig. 9 is 40mfd. If one of the capacitors opens, the total capacitance will *not* increase. Instead, it will *decrease* to the value of the remain-

ing good capacitor, or to 20mfd.

Many of the letters we received also questioned the answer we gave for question 2, which I am also repeating herewith:

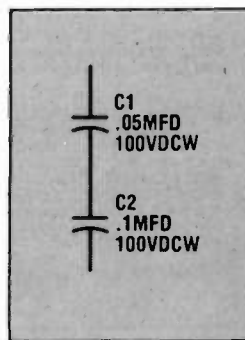
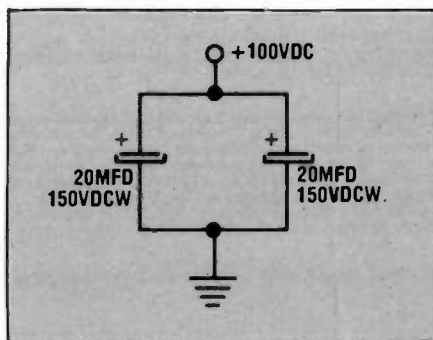
Q2) What is the maximum DC voltage which can be applied across the two capacitors in Fig. 2 without exceeding the DC voltage rating of either capacitor?

- a) 100VDC \_\_\_\_\_
- b) 200VDC \_\_\_\_\_
- c) 50VDC \_\_\_\_\_
- d) 150VDC \_\_\_\_\_

The answer given for this question in the May issue—(d)—is correct. The voltage applied across capacitors connected in series divides between them in *inverse proportion* to their individual capacitances. Consequently, because the value of capacitor C2 in Fig. 2 is *twice* that of C1, the voltage developed across C2 will be *half* that developed across C1. Therefore, to avoid exceeding the 100VDCW rating of C1, the maximum voltage which can be applied across the two capacitors without exceeding their individual voltage ratings is 100VDC (the rating of C1) plus 50VDC (half the rating of C2), or a total of 150VDC.

The same division of voltages across the two capacitors also will occur if the applied voltage is AC, because the capacitive reactance ( $X_c$ ) of C1 is twice that of C2 at any given frequency.

J.W. Phipps



# PTS THE WORLD'S LARGEST TUNER REPAIR COMPANY

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# ELECTRONIC TECHNICIAN/DEALER

JULY 1977 • VOLUME 99 NUMBER 7

**THE COVER:** An auto radio technician is pictured in his hunt for the source of 'tough dog' noise. The job should be easier because he's using a new tool from Channel Master called the "Sleuth". (see story on page 21)

## 13 Common Discrete Industrial Electronics Semiconductors—A Review—Part 2

We continue our review of common discrete semiconductors on the basis of their application in the field of industrial electronics. A TAB BOOK condensation of a book by Alfred Haas.

## 21 External Sources of Auto Radio, Tape Player and CB Noise

Here is a troubleshooting guide to common and uncommon sources for noises in mobile radio and tape player installations, plus a look at a new noise-locating tool. By Joseph J. Carr, C.E.T.

## 26 Prolonging the Life Of TV Picture Tubes

When should a brightener be installed—when should you rejuvenate—and how—and when should you recommend a new tube or new TV set? By Bernard B. Daien.

## 32 Effective Advertising For The Electronic Sales & Service Dealer—Part 2

We take a look at the factors that make up a successful advertising approach—and how to develop an effective advertising budget. By Don W. Mason.

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To top that off, the complete CB42 is hundreds of dollars below the nearest competition, and thousands below most. We've got our competition beat, and you'll beat your competition, too, by saving these six ways with this CB42 Profit Center.

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One simplified tester in a single case saves time on every test on any CB that comes in your door, including Single Sideband sets; you won't even need a scope.

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Three cables, provided with your CB42, do the entire job; audio cable, transmitter cable, and receiver cable.

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#### **\$AVE ON BENCH SPACE:**

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JULY 1977, ELECTRONIC TECHNICIAN/DEALER / 3

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No need for an external Univerter or Transverter. Vertical and horizontal matching networks are built-in.

Built-in, too, are static convergence and blue lateral assemblies in addition to a highly efficient deflection yoke for quick and accurate bench work.

Adjustable focus control is provided to focus the 800-880 if the receiver under test does not provide focus voltage.

Even incorporates a built-in speaker to check the audio of chassis being tested.

And the proper adapters are included with the 800-880 to allow servicing of virtually all Zenith TV chassis, while optional Zenith adapters are available to permit servicing 110<sup>+</sup> Zenith sets as well as other brands.

Additional adapters available from Zenith increases its versatility to over 10,000 sets from 52 manufacturers. Zenith adapters currently on your shelf can also be used.

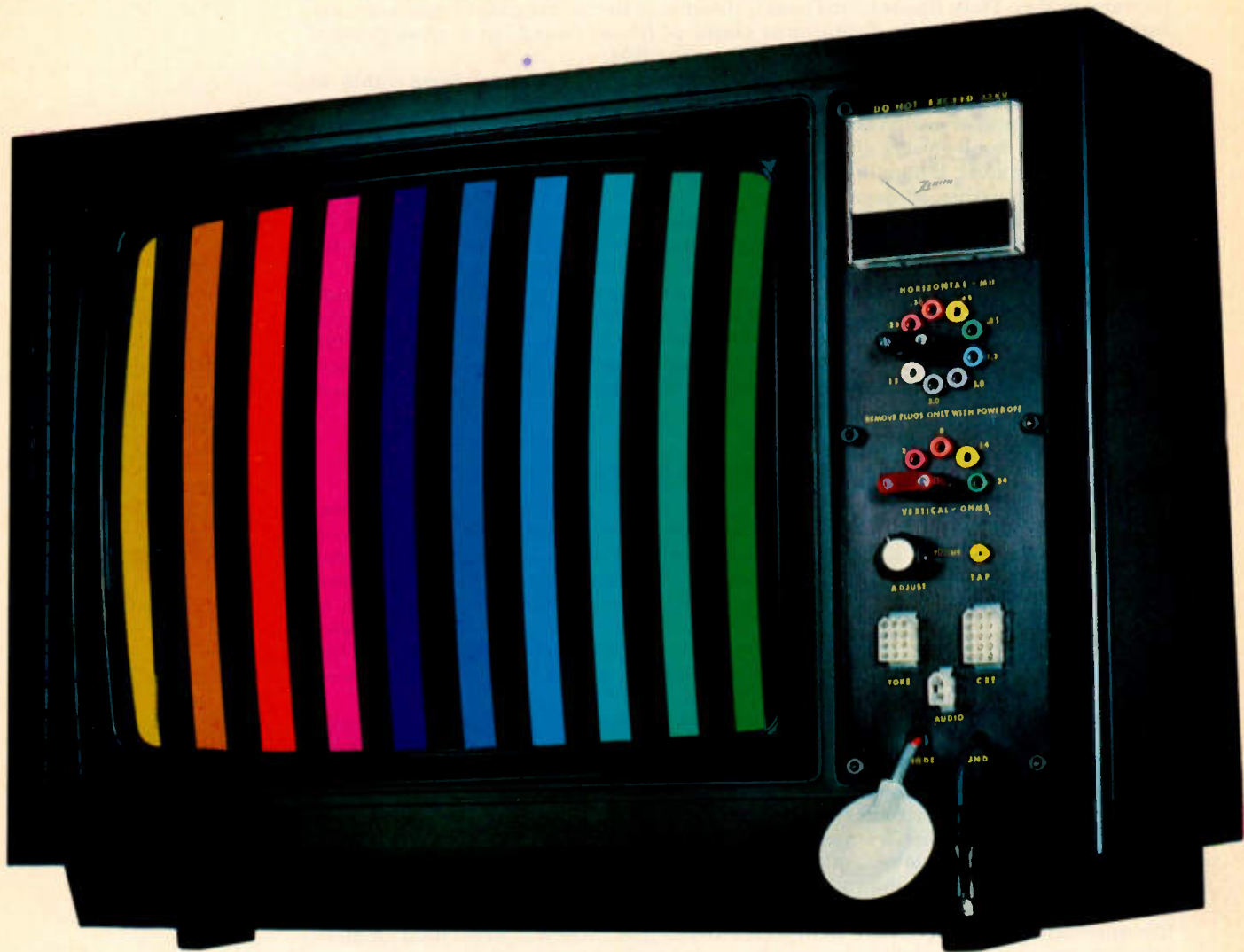
Also included is a complete up-to-date Instruction and Cross-Reference Guide with each and every unit.

Ask your Zenith distributor about this latest and most versatile of all Zenith Universal Color TV Test Rigs, the Model 800-880!

You need one...if not two or more!



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#### Adapters and Extensions

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# ZENITH

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# NEWS OF THE INDUSTRY

## Warranty Law Is In Force In Rhode Island

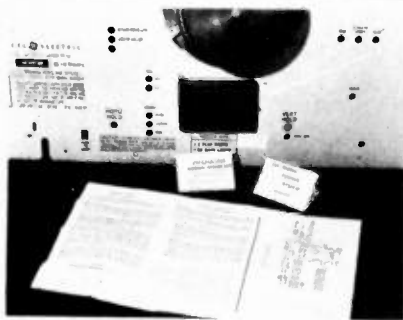
The State of Rhode Island—after a long, hard-fought contest—has a Warranty Law in force. The Rhode Island Legislature passed the bill and it was signed by Governor Garrahy in May. Thus, Rhode Island joins California as the second state to pass warranty legislation. *The Electronics Technicians Guild of Rhode Island*, in a news release, summarized the effects of the bill. Briefly it means that:

- The *manufacturer* must: 1) have service in Rhode Island, 2) furnish parts within 30 days, 3) pay the same price as a Rhode Island consumer, both for labor and parts, 4) have parts and service information available from distributors in Rhode Island, 5) have parts available for at least 4 years after the last sale of any model.

- The *servicer* must: 1) handle warranty repairs and out of warranty repairs equally, 2) complete repair within 30 days, or within ten days after receiving ordered parts, 3) charge a manufacturer the same price he would charge a Rhode Island consumer, both for labor and parts, 4) order any needed part(s) within two days of receiving the unit for repair, and notify customer, unless customer agrees otherwise.

In a statement concerning the new Warranty Law, the Guild stated that "The Rhode Island Warranty Law has given the Rhode Island servicer the opportunity at last to be fair to everyone—Manufacturer—Consumer—and even himself! What we do with the opportunity will affect not only ourselves and our customers, but many of our fellow servicers and their customers across the country. We have the law—now let's make it work!"

## "Mini-Service" Manuals To Be Packed With Each GE TV Set



General Electric has come up with an innovative 'plus' for TV servicemen. It will include a "mini-service" manual in all its new 1978 color televisions. The new mini-manuals will be located in a specially-designed enclosure on the back of each set. Access to the enclosure is by two screws on the inside of the back, meaning that only the service technician will have access to the service information.

These new mini manuals include adjustment procedures, safety information, symptom/cause troubleshooting charts, parts lists, parts ordering information, and a full-sized schematic diagram of the particular chassis. If the set has a special feature such as electronic tuning or GE's VIR color system, another complete mini manual is included on that feature.

"These new mini manuals should be a great help to service technicians since they provide the needed service information when the technician needs it most," comments "Dutch" Meyer, manager of GE's television produce service operation. "We decided on this approach after many service technicians told us that there was a real need for more detailed, more easily readable service information packed right with the set."

## 1978 Winter Consumer Electronics Show Will Be Double The Size

The 6th annual Winter Consumer Electronics Show, to be held for the first time in Las Vegas—January 5-8, 1978—will use over 250,000 square feet of exhibit space, compared to 110,000 square feet of exhibit space used in Chicago at the 1977 show. Some 375 exhibitors have already asked for space at the 1978 show.

Although the main body of the show will be staged in the Las Vegas Convention Center, an additional 160 exhibits will be available in the new Pavillion Exhibition Hall of the Las Vegas Hilton, only a minute's walk from the Convention Center.

Special events of the '78 show will be daily conferences and a New Years Champagne Gala in all exhibit areas.

Over 15,000 hotel rooms and suites have been allocated to the Winter CES. The Las Vegas Hilton, MGM Grand and Caesar's Palace will be the CES headquarter hotels.

## NESDA National Electronic Service Convention To Feature Two Training Programs

Two worthwhile training sessions are scheduled for this year's NESDA convention in Orlando, August 16 through 21. The first is a business management school that will take up the first day of convention business—and the second session is two-hour training seminar on August 21st on "Frequency Synthesizers and Phase Locked Loops (PLL): Their Applications in TV & CB Service Work."

Topics to be presented and discussed at the management session include: (1) "Everything You Need To Know About Cash Flow," (2) "The Problem With P & L's," (3) "What



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Can A Balance Sheet Show Me About Profit?", and (4) "How To Turn Warranty Contract Losses Into Profits." Fee for the day-long school is \$20.00 for NESDA & ISCET members, \$40.00 for non-members.

The two-hour technical seminar will be conducted by J.A. "Sam" Wilson, CET, NESDA/ISCET national technical training director. The seminar will be recorded on video tape for use later at service technician associations around the country. The seminar is open to all attending the convention, at no charge.

Registration for the NESDA convention and the business management school can be made by calling the NESDA office, 317-241-8160.

### Certification Program For Service Shop Managers Is Announced

The National Electronic Service Dealers Association (NESDA) has developed a certification exam and qualification program for consumer electronics service shop owners, managers and operators. It is called the Certified Service Manager (CSM) program, and involves an examination that will test the business knowledge and management skills of service managers and operators in areas such as: customer relations, advertising and promotion, record keeping, financial understanding, demographics of the service business, personnel management, product sales, safety and shop layout and design.

The first CSM exams will be given at the NESDA convention in Orlando, Florida, August 16-21. Later testing will be conducted by officials and organizations that administer the Certified Electronics Technician (CET) program. Fees for the exam have not yet been established.

### Reduced Power Consumption Is New Feature of RCA Color TV

The RCA Consumer Electronic Division has announced the development of color TV circuitry that will reduce average total energy consumption of a 19-inch diagonal color tv model to less than that of a 100-watt light bulb. The new series of XL-100 19-inch models have a chassis that operates about 24 per cent cooler than previous sets. David E. Daly, division vice president, as quoted in *Radio & Television Weekly*, said "This factor alone significantly lowers the stress on vital components in the set which should lead to improved reliability and longer life."

The new chassis use eight plug-in modules. Previous XL-100 19-inch diagonal models used 12 modules.

### Sales To Dealers Of TV & Radio Up Substantially From Last Year

Total U.S. market sales to dealers of television and radio products showed a strong increase through April of this year, the marketing services department of the Electronic Industries Association reported.

Total TV sales for this April were up 29.7 percent over last April—total radio sales for this April showed an increase of 25.3 percent over last April. TV sales for the first 17 weeks of 1977 were up 21.1 percent and total radio sales in the first 17 weeks were up 13.3 percent over last year.

The following statistical chart on sales to dealers is from the EIA.

| SALES TO DEALERS<br>APRIL 1977 vs. APRIL 1976<br>(In Units) |           |           |                   |                          |            |                   |
|---|-----------|-----------|-------------------|--------------------------|------------|-------------------|
| Product   | APRIL     |           | Percent<br>Change | 17 Weeks<br>Year To Date |            | Percent<br>Change |
|   | 1977      | 1976      |                   | 1977                     | 1976       |                   |
| B & W TV  | 355,773   | 301,196   | +18.1             | 1,630,964                | 1,452,402  | +12.3             |
| Color TV  | 577,142   | 418,133   | +38.0             | 2,584,159                | 2,029,701  | +27.3             |
| TOTAL<br>TELEVISION   | 932,915   | 719,329   | +29.7             | 4,215,123                | 3,482,103  | +21.1             |
| AM Radio  | 335,057   | 349,109   | - 4.0             | 1,721,917                | 1,432,351  | +20.2             |
| AM/FM or FM   | 1,336,249 | 853,981   | +56.5             | 5,650,020                | 4,797,992  | +17.8             |
| Auto Radio  | 962,003   | 898,620   | + 7.1             | 4,146,883                | 3,939,359  | + 5.3             |
| TOTAL<br>RADIO  | 2,633,309 | 2,101,710 | +25.3             | 11,518,820               | 10,169,702 | +13.3             |

### New National Service Manager Named at Sharp Electronics

Dewey J. Heil has joined Sharp Electronics Corporation as the national service manager. He will be responsible for directing the firm's network of 3600 independent service stations. Heil has more than 25 years of experience in the service field. He formerly was a regional service manager for Panasonic in Chicago. Prior to Panasonic, Heil worked in the service field for W.T. Grant, Montgomery Ward and RCA. ■



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## TECHNICAL LITERATURE

**A New Insulation Tester-Ohmmeter-AC Voltmeter** product bulletin is available from A. W. Sperry Instruments. The literature describes and illustrates the specifications and uses for the firm's new Meg-O-Volt instrument, which is available in two models, the 510 with a 100 megohm scale with a 2 megohm midscale, and the 520, which has a 1,000 megohm scale with a 20 megohm midscale. The pamphlet, SP-85, is available free from A. W. Sperry Instruments, Inc., 245 Marcus Blvd., Hauppauge, N.Y. 11787.

**A Merchandising Idea Book** for electronic tool displays is now available from Vaco Products. This 40-page full-color display catalog lists shelf, counter, wall and floor standing displays of tools, solderless connectors and other problem solvers. The book is available to dealers, resellers, and distributors. It contains over 140 merchandising ideas, including suggested display arrangements, product assortments, and compact shelf and counter merchandisers. In addition an entire section of the Idea Book shows the reseller how to create and organize

custom merchandisers for any showroom. Merchandise assortments include screwdriver displays, nutdriver displays, plier displays, wrench displays, fastener displays, solderless connector displays, plus a complete selection of pouched tool kits and service kits. Available free from Harmon D. Motch, Assistant Marketing Mgr., Vaco Products Company, 510 North Dearborn St., Chicago, Illinois 60610.

**A Technical and Do-It-Yourself Catalog**, from Tab Books, describes over 400 current and forthcoming books, plus 14 of the firm's Electronic Book/Kits. The 44-page catalog includes books in a wide range of subject areas from: Amateur Radio License Study Guides to Communications—2-Way, Shortwave and CB radio. Among new and forthcoming titles described are: "Build Your Own Working Robot," "Modern Electronics Math." VHF/UHF Fire, Police, Ham Scanners—Schematic Servicing Manual, and the "Electronic Musical Instrument Manual." The catalog is free from Tab Books, Blue Ridge Summit, Pa, 17214.

**A Solid State Replacement Guide For 1977** is now available from RCA. The book, SPG-202T, is intended for use by engineers, service technicians,

experimenters and others who work with solid-state devices. The new publication cross references more than 123,000 domestic and foreign solid-state devices which can be replaced with RCA SK-Series types, consisting of transistors, rectifiers, thyristors, and integrated circuits. Additional features of the guide are an index of SK-series semiconductors and accessories, significant characteristic and application information which specifies areas of operation and capability of specific RCA types, line drawings of dimensional outlines and terminal arrangements, and a listing of mounting hardware. The new guide also contains a cross reference to other competitive universal replacement devices. Available from RCA SK distributors, or from RCA Distributor and Special Products Division, P.O. Box 85, Runnemede, N.J. 08078, for \$1.50.

**CB, Automotive and Appliance Noise Filters** are described in the new selector guide from Cornell-Dubilier. Basic definitions and applications are presented plus descriptions of the complete CDE line of alternator/generator filters, co-axial feed-thrus, L-C tuned filters, appliance filters, and low pass TV filters. Also described are the firm's heavy duty rotors for

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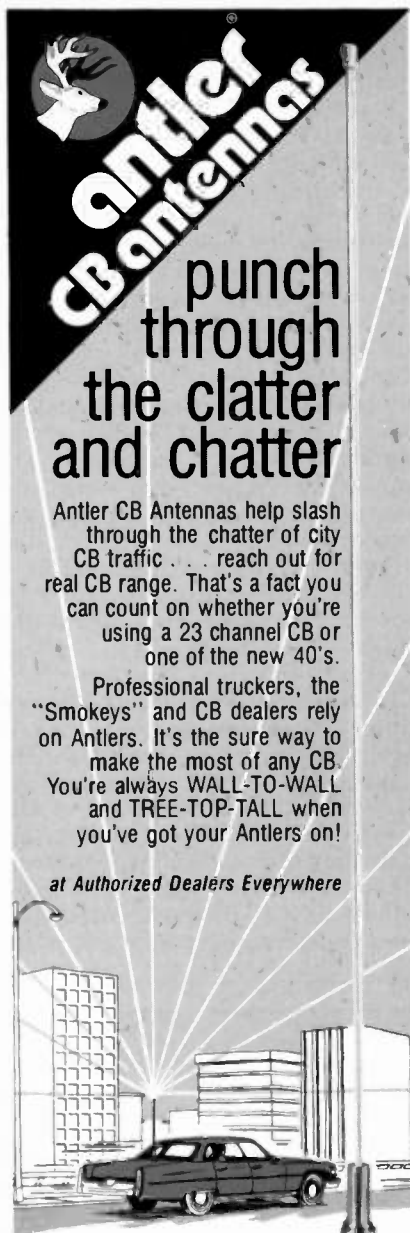
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base stations. Free from Mr. William Carlson, *Cornell-Dubilier*, 150 Avenue L, Newark, N.J. 07101.

**Do-it-yourself Electronic Kits** are described in the latest 96-page catalog from the Heath Company. New products introduced in the new literature include: a 3-way bookshelf speaker system, a battery monitor device for radio control modelers, 40-channel CB radios, a two-way freezer alarm and mount-anywhere touch control light switch. The new catalog is available free from *Heath Company*, Benton Harbor, Michigan, 49022.

**The New Electronics Catalog** from Mouser Electronics is now available. The 64-page catalog features a wide variety of electronic components, transformers, electronic tools, test equipment, hardware and related items. Capacitors, resistors, potentiometers, and switches are featured in a range of sizes from sub-miniature to full size. Complete with prices. Available free from *Mouser Electronics*, 11511 Woodside Avenue, Lakeside, CA 92040.

**Increased Air Time And Improved Communications** for FM two-way radio users is discussed in a new booklet from Motorola. Titled "Introducing a New Dimension in Radio Communications, the booklet discusses the advantages of using Spectrum 800 MHz Radio, a new dimension in FM two-way radio. Spectrum 800 MHz radio offers interference-free communication, through assignment by the FCC of an exclusive channel to any user who can meet the 800 MHz channel load requirements. The new booklet is available free from Barbara Bennett, *Motorola Communications Group*, Literature Distribution Center, 1301 E. Algonquin Rd., Schaumburg, IL 60196.

**Breadboarding And Test Equipment** for the professional and hobbyist is described in the 1977 catalog from Continental Specialties. The 16-page catalog features the firm's line of QT Stockets, Proto-clips, Proto-boards, logic probes, logic monitors, and introduces a new type of Experimentor sockets. The catalogs are available free from: *Continental Specialties Corporation*, 44 Kendall Street, P.O. Box 1942, New Haven, CT 06509.

**A New Antenna Reference Chart** that illustrates and outlines antennas and accessories for commercial two-way radio is now available from Antenna Incorporated. The chart describes the company's antennas for the 25-30 MHz, 30-36 MHz, 36-42 MHz, 42-50 MHz and 130-174 Hz frequency ranges, as well as the various mount-

ing configurations available. Also included are quarter wavelength antennas for the 136-512 MHz frequency range, base station antennas covering the 25-54 MHz and 130-174 MHz frequency ranges and monitor antennas. A section on antenna accessories is also included. Available free from Randall J. Friedberg, *Antenna Incorporated*, 23850 Commerce Park Road, Cleveland, Ohio 44122.

**The Latest Test Instrument Catalog—BK-78**—is now available from B&K-Precision. The new 44-page catalog features a broad range of test instruments such as oscilloscopes, frequency counters, digital and analog multimeters, audio and R-F signal generators, semiconductor testers, power supplies, and CB and TV test instruments. Included is the firm's complete line of oscilloscope and instrument probes. New products include three new frequency counters, ranging from a \$120 30MHz portable to a 520MHz counter with period measurement capability. Two new 3½ digit portable digital multimeters and two new analog VOM's are also listed. The catalog is free from *B&K-Precision*, Dynascan Corporation, 6460 West Cortland Avenue, Chicago, Illinois 60635.

**A new Recorder Care And Maintenance Catalog** is now available from the Nortronics Company. The 20-page catalog is designed to aid dealers in the merchandising of recorder maintenance products. Called the Recorder Care Catalog, the new literature is well illustrated to show self-standing displays, counter racks, supporting literature and products grouped by application on individual pages. Merchandising and selling information is carried across the top of each page; product description appears along the bottom. The catalog has been designed so that individual reprinted pages may be supplied to dealers separately for use as stuffers or handouts. Available free from *Nortronics Company, Inc.*, 8101 10th Avenue North, Minneapolis, Minnesota 55427.

**Exact Replacement Products for CB and TV Equipment** are cross-referenced in a new replacement guide from Thordarson-Meissner, Inc., The guide lists 44 flame-retardant flybacks and 14 yokes for the TV replacement market, of which 7 yokes and 19 flybacks are designed for imported TV sets. Also included is information on CB replacement parts, including 19 chokes, 16 driver transformers and 34 output/modulation transformers. The cross reference guides—for TV, TVPG 9, and for CB, CBRG 2—are available free from *Thordarson* distributors. ■



# TECH BOOK DIGEST

Condensed from a single chapter of a recently introduced TAB book,  
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## Common Discrete Industrial Electronics Semiconductors— A Review-Part 2

By Alfred Haas

### THYRISTORS AND OTHER SOLID-STATE SWITCHING DEVICES

■ The 4-layer diode is a 2-terminal semiconductor device comprised of three junctions between regions P1N1, N1P2 and P2N2. If a voltage of the polarity shown in Fig. 18 is applied to its terminals, junctions P1N1 and P2N2 are forward-connected to conduct. The central junction, N1P2, however, is reverse-connected and it blocks current. Hence, the device is nonconducting.

If now we gradually increase the applied voltage (VBO of, say, 80v), avalanche multiplication takes place, and the leakage current increases rapidly, putting the device in the high conduction region where it will stay as long as anode current I at least equals holding current  $I_0$  (Fig. 19). The device immediately will revert to its forward blocking state if I drops below  $I_0$ . VBO is called the forward breakover voltage. The left-hand reverse characteristic is similar to that of ordinary silicon rectifiers; a reverse blocking region ends with the maximum reverse voltage point where the reverse avalanche conduction region starts. Most P-N-P-N devices are designed with a peak reverse voltage capability at least equal in magnitude to the forward breakover voltage.

The flexibility of this device is greatly increased by connecting one or more of the intermediate layers N1 and/or P2 to a terminal to be used as a control elec-

trode or gate G. The 3-electrode device obtained is called a 4-layer switch, *thyristor or silicon controlled rectifier (SCR)*.

Now consider the fundamental circuit in Fig. 20. If switch I is open, there is no gate current and the device behaves like a 4-layer diode. To put it into conduction, a voltage at least equal to VBO is applied, and the characteristic BAOCDEF in Fig. 21, corresponding to the unique diagram in Fig. 19, is obtained. If now we close I to have G pass current  $I_g$ , the breakover occurs at a voltage where V1 is less than VBO, and the forward characteristic changes to OC'D'E'F' (the reverse characteristic, of course, remains unchanged). Hence, increasing  $I_g$  reduces the forward breakover voltage and shifts Point D to the left. For a given value of  $I_g$ , the forward blocking region disappears altogether, and a normal rectifier characteristic, such as indicated by the dotted line, results.

This peculiar characteristic explains the use of the thyristor as a "solid-state thyatron." Consider a supply voltage  $V_0$  between VBO and V1. With  $I_g$  equal to 0 (switch I open), the working point is H; the thyristor operates in its forward blocking region and passes but a small leakage current. If I is closed, a gate current develops, and with  $I_g$  sufficiently positive, the working point changes from H to D' and, this being a breakover point, from D' to the Branch E'F' in the high-conduction region where it settles at a point corresponding to the load current drain. If this cur-

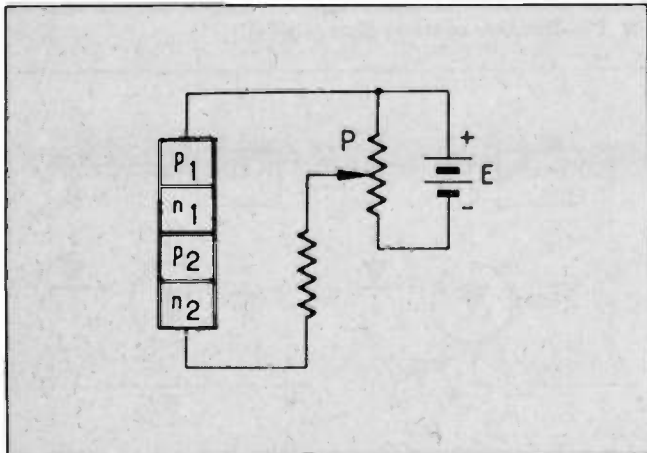


Fig. 18—Sketch showing the arrangement of the N and P regions in four-layer diode.

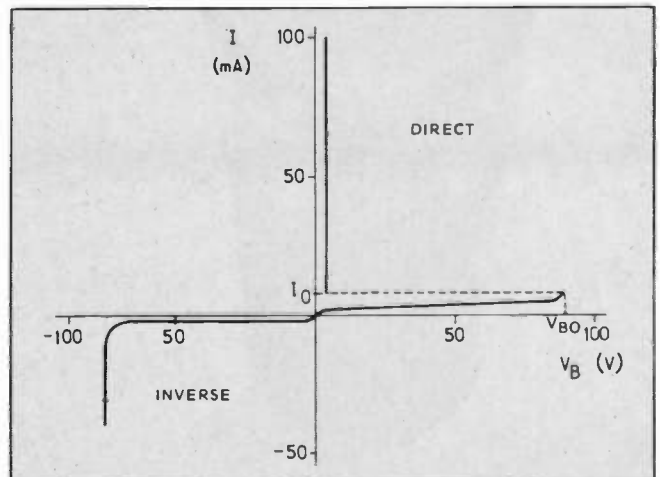


Fig. 19—Current (I) voltage ( $V_B$ ) characteristic of a 4-layer diode.

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rent exceeds the rating, the junctions overheat and the thyristor is destroyed. As heating takes time, a very short strong current transient may be better supported than a much lower continuous DC current.

Just as in a thyratron, the gate loses control once the thyristor has been fired. To return it to the blocking state, the anode current must be reduced momentarily below holding current  $I_0$  (corresponding to the ionization voltage  $V_i$  of the thyratron). In AC-fed circuits, this automatically occurs at the end of every

(From Chapter 3, "Industrial Electronics Principles & Practices," by Alfred Haas, TAB BOOKS, Copyright 1977.)

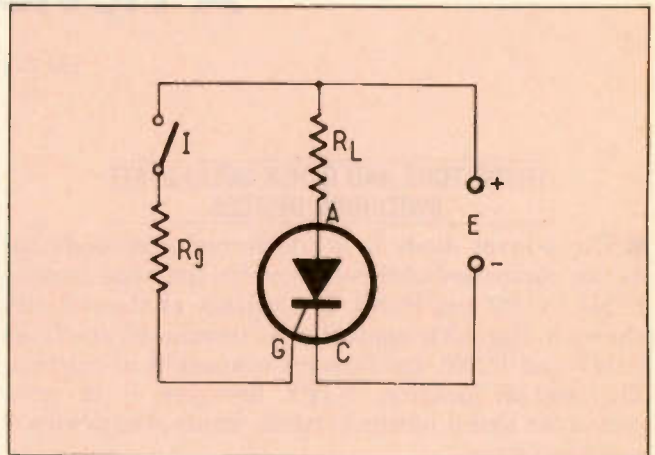


Fig. 20—Basic DC-fed thyristor circuit.

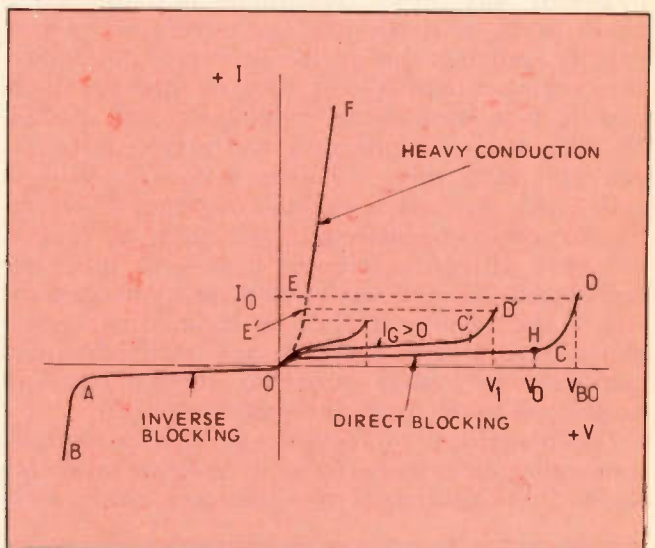


Fig. 21—Transistor switching characteristics.

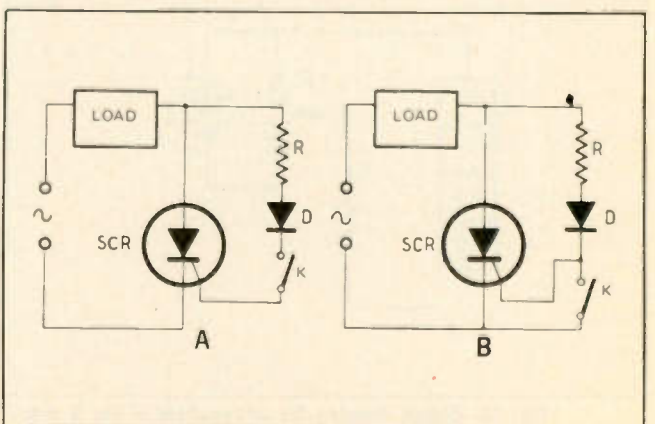


Fig. 22—Two methods of controlling an AC-fed thyristor (SCR).



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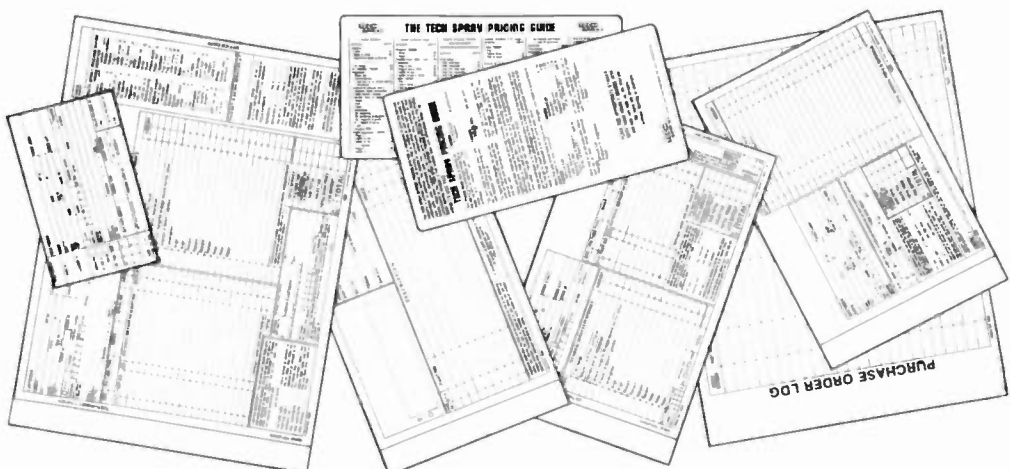
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positive half wave, and conduction resumes only at the next positive half wave if there is sufficient gate current (corresponding to the thyatron grid voltage). In DC-fed circuits, there are several ways to stop conduction: the anode current can be interrupted or the device can be shorted momentarily, or a suitably injected pulse can reduce the anode current below  $I_0$ .

Thyristors are serviceable in applications covering an extremely wide variety, their massive use in electronic controls for industry (and in appliances, too) is just starting now. Fundamental circuits for AC supply are indicated in Fig. 22. (There are commercial thyristors rated for a direct 117 or 220v mains con-

nection, so that a step-down transformer can be saved.) The thyristor is used as a static power relay to switch a series-connected load, RL. Devices designed to pass hundreds of amps while standing more than one thousand volts are marketed. Two such devices directly fed by a 480-volt (RMS) line are able to control a 300-kilowatt load!

In Fig. 22A, the thyristor is fired when switch K is closed. Gate current  $I_g$  is limited by series resistor R. The device passes current only during the positive half waves, and diode D will not inject a reverse voltage into G during the half waves of nonconduction. (This diode also can be connected between gate

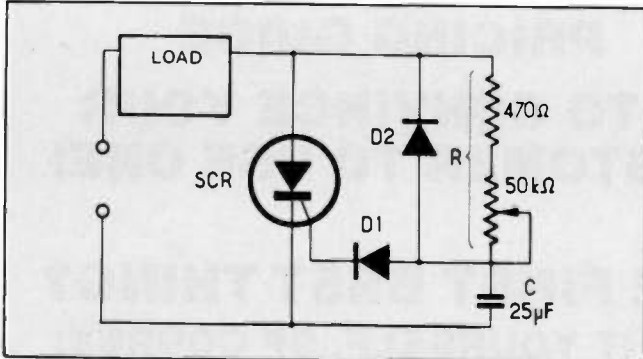


Fig. 23—Variable half-wave load current control circuit, useful as a light dimmer or motor control.

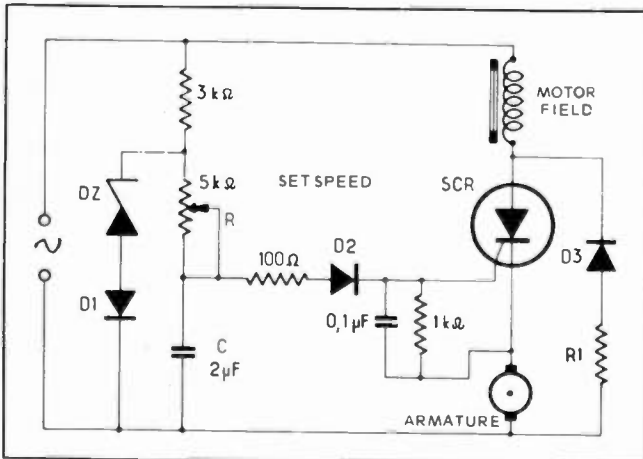


Fig. 24—Half-wave series motor speed control circuit.

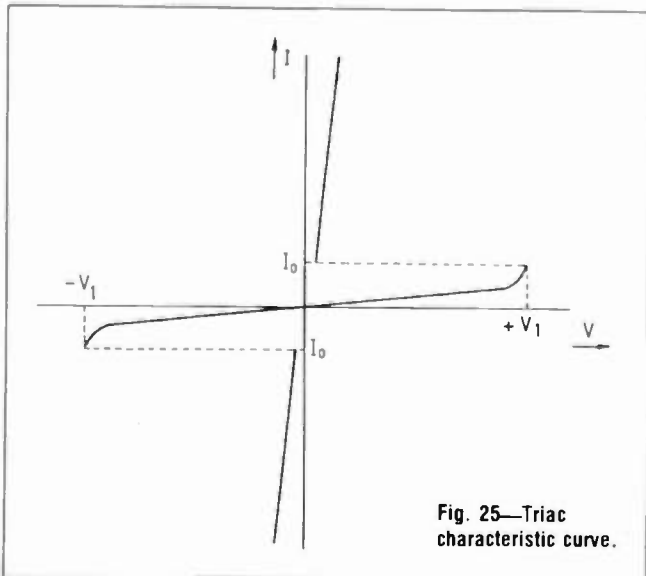


Fig. 25—Triac characteristic curve.

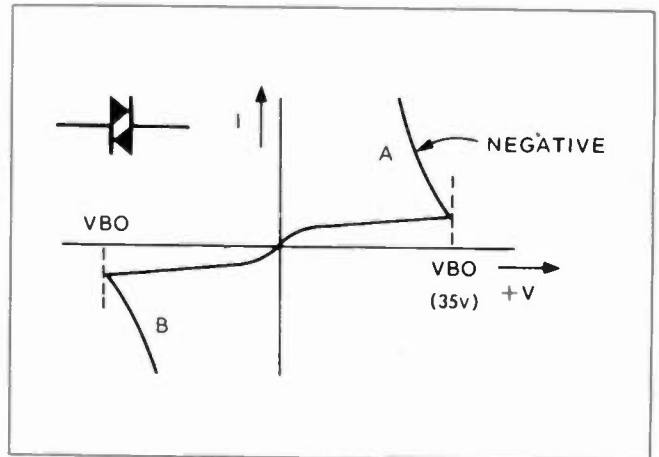


Fig. 26—Diac characteristic curve.

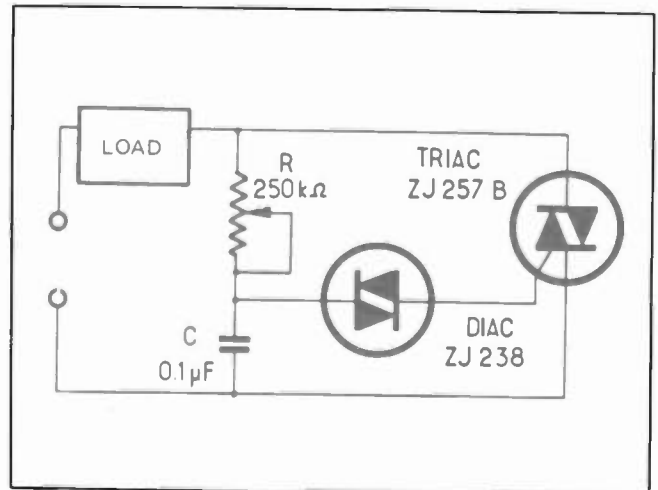


Fig. 27—Full-wave load control with phase adjustment.

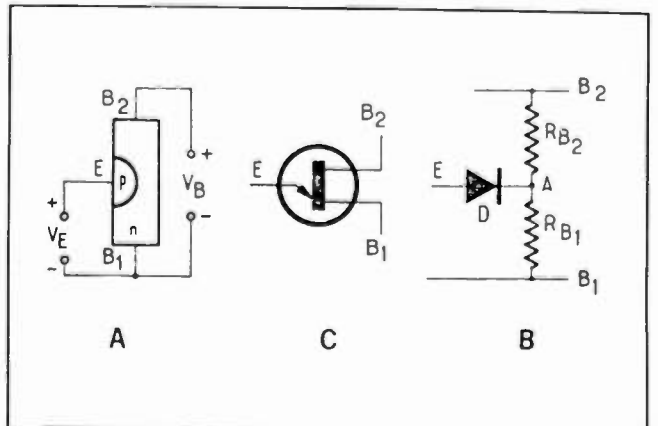


Fig. 28—Structural diagram, equivalent circuit and symbol of a unijunction transistor (UJT).



and cathode.) When K is opened, the device, already de-energized during the negative half cycles, will not strike again at the next positive half cycle. In Fig. 22B, switch K' (normally closed) ties the gate to the cathode, hence  $I_g$  equals 0, just as in Fig. 22A, with switch K open. Now K' must be open to fire the thyristor.

Because of the very low control current ( $I_g$ ), a thyristor can be controlled by a low-power switch such as a sensitive relay or a contact-closing thermometer, or a static control resistive transducer (photoconductor, thermistor) can be used as well.

The circuits described are on-off controls. In AC-fed

thyristor circuits, a stepless variation of controlled power, however, is easily obtained by displacing the thyristor firing point along the time axis during the positive half cycle (de-energizing takes place anyway toward the end of that half cycle). By delaying the firing point, a smaller portion of the half wave is used and less power is delivered to the load. This allows for controlling the speed of an electric motor or dimming a light. The simple stepless half wave power control in Fig. 23 is typical for such applications. At the beginning of the positive half wave, capacitor C charges through variable resistor R, and the thyristor anode voltage rises simultaneously. After a time

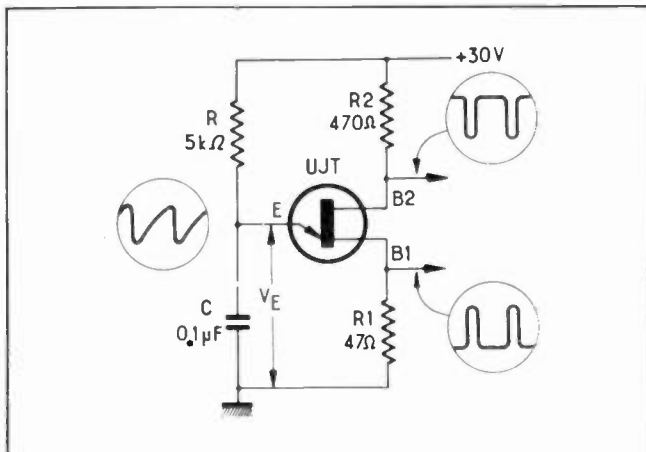


Fig. 29—UJT relaxation oscillator circuit.

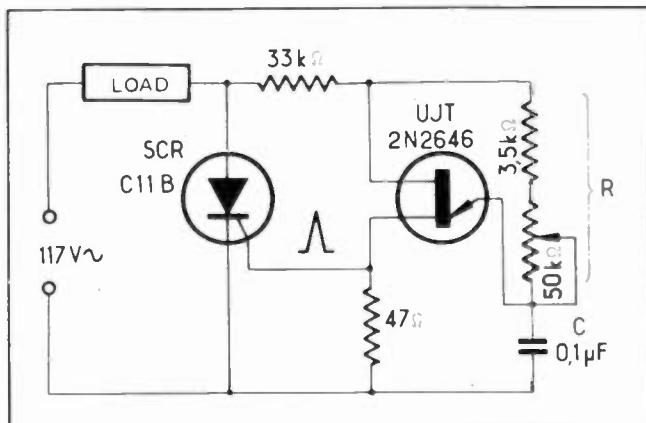


Fig. 30—Thyristor control using a unijunction transistor.

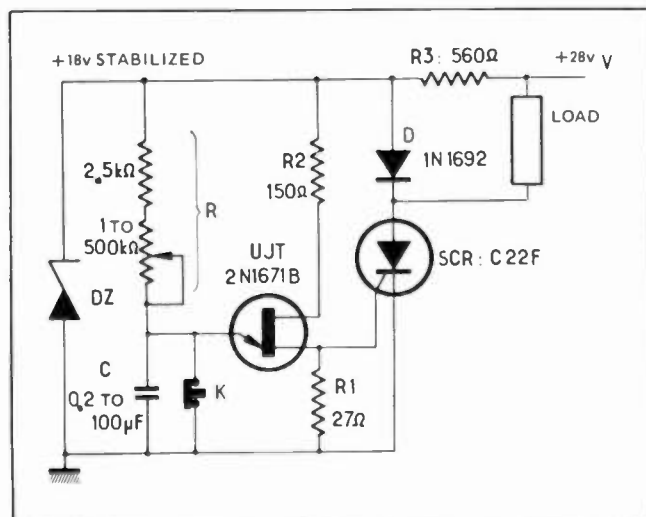


Fig. 31—Timer circuit using a UJT-controlled thyristor.

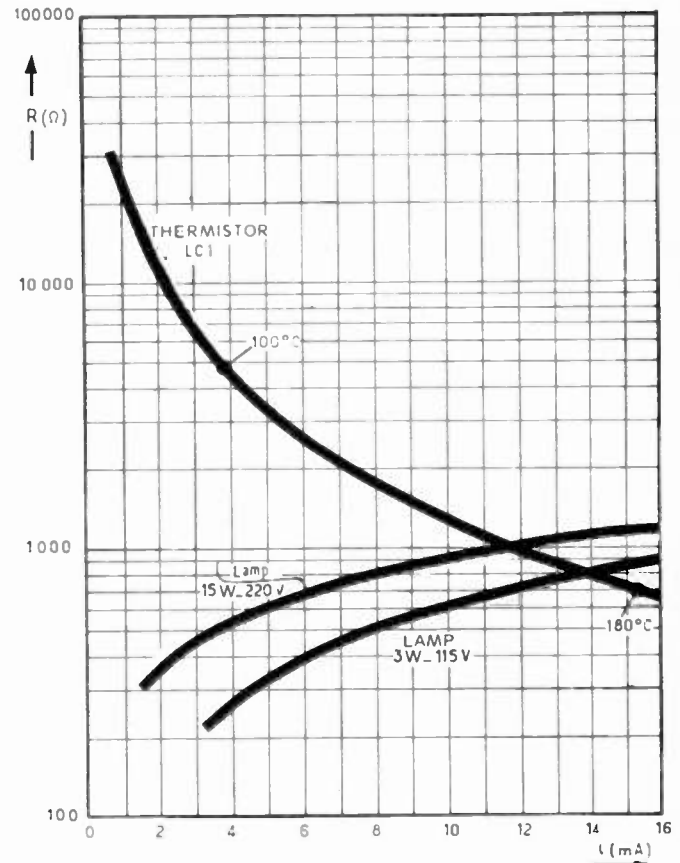


Fig. 32—Resistance variation in terms of current for a thermistor and two small-power lamps.

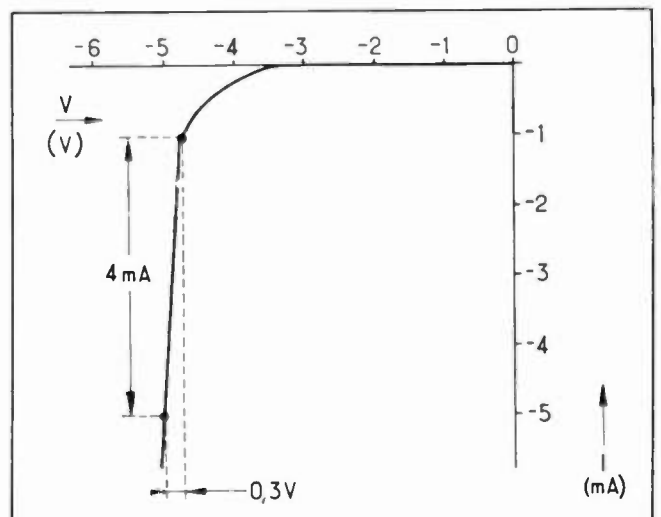


Fig. 33—Curve showing the steep reverse characteristics of a zener diode.

delay, mainly depending on time constant  $RC$ , a current flows through diode  $D1$  into the gate and fires the device. The thyristor conducts up to about the end of the half cycle. The  $50K$  variable resistor allows for a phase shift of nearly  $180$  degrees, making for a gradual control of rectified power from about zero to full power. During the negative half cycle,  $C$  charges in the opposite direction and blocks the thyristor at the beginning of the next positive half cycle.

The universal motor-speed drive in Fig. 24 is just another application of this principle. Universal or AC-DC motors are used in applications requiring high torque during starting and at low speeds (the armature and field are series-connected). In the present circuit, thyristor SCR is inserted between them, allowing half-wave operation. The degree of power

rectified and the motor speed depend on the SCR firing angle during the positive half cycle as formerly, and is a function of time constant  $RC$ . Variable resistor  $R$  allows for speed adjustment. Voltage across  $RC$  is stabilized by zener diode  $DZ$  during positive half-cycles (diode  $D1$ ) to avoid the effect of mains fluctuations on the speed setting.

Stabilization of the preset speed is obtained by applying the counter-electromotive force developed across the rotating armature to capacitor  $C$  with a polarity opposing that of the charging current. Thus, motor acceleration has the same effect as a reduction in charging current and results in a slightly smaller amount of power delivery by the SCR, which slows down the motor. During the blocking state of the SCR, the field coil is fed through  $D3$  and  $R1$ . (Though

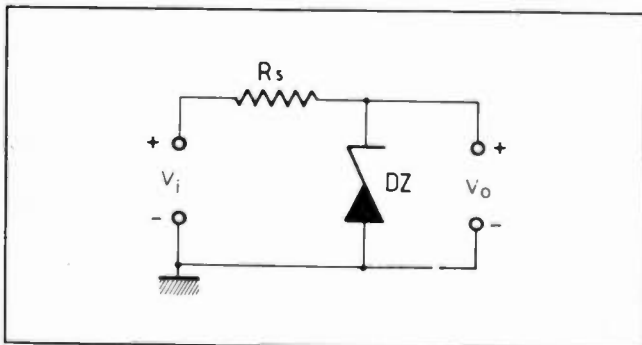


Fig. 34—Zener diode used as a voltage stabilizer.

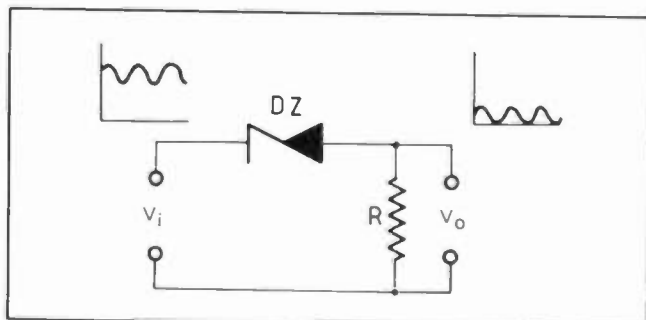


Fig. 35—This zener circuit exaggerates voltage fluctuations and can be used to provide a convenient error signal.

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the universal motor is reversible by crossing armature or field connections, this stabilization principle works only for one direction of rotation.)

### Photothyristors

If a small glass window is fitted in the opaque SCR casing to let an external light impinge upon the light-sensitive junction, a photothyristor or light-activated silicon controlled rectifier (LASCR) results. Such a device can be triggered by a light ray as well as by an electric signal. An LASCR can replace a photoelectric transducer followed by a thyatron or a thyristor. While LASCRs are sensitive to visible light, their peak sensitivity is well within the infrared region of the radiation spectrum. If its rating is inadequate for energizing a power device, an LASCR can be used to drive a higher-power SCR.

### Triacs

The thyristor is a half-wave device; for full-wave control, two such devices are connected back-to-back. The Triac (General Electric), a full-wave switch with but one control gate, behaves as two back-to-back connected thyristors. This 3-terminal device with electrodes T1, T2 and G is triggered by a positive or negative control current flowing between G and T1. Its characteristic, shown in Fig. 25 is the now familiar thyristor characteristic symmetrically displayed in the first and third quadrants. This bidirectionality allows for considerable simplification of AC control circuits.

### Oiacs

Another component, the Diac (General Electric) or bidirectional diode, has been developed as a full-wave control device. Its characteristic (Fig. 26), displaying the same symmetry as that of the Triac, shows that up to a threshold voltage of VBO of some 35v positive as well as negative, the device is blocked and passes only a negligible residual current. Then, the breakover takes place at both polarities, and the current greatly increases while the voltage drop actually decreases, indicating a negative-resistance region (A and B). A variable full-wave load control, using a Triac triggered by a Diac, is shown in Fig. 27. Just as in the half-wave counterpart (Fig. 23) of this circuit, the firing angle is varied by a gate voltage phase-shift determined by RC. As soon as the rising slope of the positive as well as the negative half-cycle reaches breakover voltage threshold VBO, the Diac sharply begins conducting and transmits to the gate a steep voltage that immediately fires the Triac.

### THE UNIJUNCTION TRANSISTOR

The little world of semiconductors definitely is rather complicated, for here comes the unijunction transistor (UJT), still another 3-terminal semiconductor device exhibiting very different characteristics. As shown in Fig. 28A, an UJT is made up of a tiny N-type silicon bar with electrodes called base-one (B1) and base-two (B2). Also, there is a small P-type region called the emitter (E), arranged in the center of the bar. The UJT symbol is shown in Fig. 28C and Fig. 28B is its equivalent circuit, composed of voltage divider RB1 and RB2. Midpoint A is connected to diode D.

B1 is common to input and output circuits. Positive voltages are applied to E and B2. As long as VA, the potential at Point A, is lower than emitter voltage VE, the diode is blocked, and the emitter current IE is 0. This condition makes for a comparatively high value of RB1 of, say, 4,600 ohms. If VA is greater than VE, the diode begins conducting, a current passes from E to B1, and RB1 decreases. If IE is 50 ma, RB1 should be 40 ohms. The main UJT applications is as a relaxation oscillator, especially for thyristor triggering.

The fundamental UJT relaxation oscillator circuit diagram appears in Fig. 29. Capacitor C charges through resistor R, and VE rises gradually. When VE equals VA, the junction begins conducting, the resistance of RB2 decreases, and C rapidly discharges through base-one resistor B1. At the end of the discharge, VE increases again, and a new relaxation cycle sets in. The waveforms on the electrodes are indicated on the diagram—an approximate sawtooth wave on E and pulses of opposite polarity on B1 and B2. The repetition frequency depends on time constant RC. This circuit is used as a trigger pulse generator, as a timer and as a time base (sawtooth linearization provided). It can be synchronized by injecting negative pulses into E.

A simple AC-fed thyristor control triggered by a UJT is shown in Fig. 30. Capacitor C charges through variable resistor R and fires the UJT which delivers a triggering pulse to the SCR gate. The pulse strikes the SCR, switching it to conduction until the end of the half wave. Thus, RC sets the firing angle of the SCR and the power delivered to the load.

Slightly modified and DC-fed, this circuit becomes a timer featuring fair accuracy. (Fig. 31.) Pressing normally-closed push-button K removes the short across capacitor C and allows C to start charging. After a time delay, depending on time constant RC, the UJT fires and triggers the SCR. All of the supply voltage (except for the low voltage drop across the SCR) is then applied to the load. Diode D and series resistor R3 deliver a holding current (IO) to the SCR to make sure it stays in the conducting state should the load be disconnected. The delay-determining charging voltage is stabilized by zener diode DZ.

### NONLINEAR DEVICES

A conventional ("linear") resistor is defined by Ohm's law as a device in which R equals E over I. This means that should E or I vary, the E over I ratio will always remain constant and equal R. A device is called "nonlinear" if its resistance varies in terms of applied voltage, current drain or any other parameter. (Photoconductors in which the resistance varies with illumination can be considered nonlinear resistors, too.) These devices are extremely useful in regulation and control systems, either for voltage or current stabilization, or rather to exaggerate their variation in order to provide a healthy-amplitude error signal for control purposes.

A cheap and easy to use positive-t.c. component is the ordinary metallic-filament lamp. The R over I characteristic curves plotted in Fig. 32 represent two lamp types. The resistance of such a lamp varies from about 200 ohms at a cold start to some 1,500 ohms when hot. There is no point in heating the filament to

the normal operating temperature, for the curved segment at the very beginning where nonlinearity is highest is preferred. Low-voltage and high-power lamps present high thermal inertia (and thus slow action) because of the mass of the comparatively thick filament.

### Thermistors

Thermistors are nonlinear resistors composed of sintered metallic oxides; they feature a negative comparatively high t.c. of about 4 percent per degree C according to composition. The characteristic of a typical 100,000-ohm thermistor (the rated value is for a 20-degree C or a 68 degree F ambient) is plotted on the same R over I diagram in Fig 32. (Notice the logarithmic ordinate.) This device yields a resistance variation exceeding 100:1, a "honey" for control purposes. Thermistors are available with rated resistances of from a couple of ohms to about 0.2 meg, and they are marketed as discs, rods and tiny pinhead-size pearls for low time constants (some seconds). This component can be heated by a current (Joule effect) as well as by heat radiation of conduction (temperature transducers). There are indirectly heated thermistors composed of the sintered pearl surrounded by a tiny insulated heater winding. Positive-t.c. thermistors are available, too.

### Varistors

The varistor or *Thyrite* (General Electric trade

name) is another nonlinear component; its resistance rapidly decreases when the applied voltage increases. This property makes it useful for overvoltage protection, and Thyrites, made of sintered oxides, make economic high-power lightning-arrestors. Low-power varistors are inverse-parallel connected diodes. Both devices have similar characteristics, including two forward conduction segments in the first and third quadrants; one diode conducts for each polarity.

The nonlinear devices examined above are not polarized; therefore, they are serviceable with AC and DC. Semiconductor, vacuum and gas diodes are highly nonlinear devices; they pass current in the forward direction, but very poorly or even not at all in the reverse (blocking) direction.

On the blocking side, the vacuum tube is best, for there is no possibility for a reverse current. Silicon is nearly as good, especially if the voltage applied is low compared to the rated peak inverse voltage. Germanium has a slightly higher reverse current, and selenium has appreciably more. However, all types are satisfactory if they are chosen in terms of the rectifying characteristics required.

### Zeners

The zener diode is a silicon diode featuring a particular reverse characteristic as shown in Fig. 33. (It is this branch that is used for voltage regulation. Notice the forward conduction is the same as that of any other silicon diode.) For low voltages, the reverse current practically is zero. Then suddenly, for a voltage exceeding a threshold, called zener voltage (about -5v on the diagram), the current increases rapidly (a voltage increase of 0.3v corresponds to a current increase of as much as 4 ma), making for a differential resistance of  $dV$  over  $dI$  equals 75 ohms, and sufficient series resistance must be provided to limit the current to a safe value.

With a series resistor  $R_s$ , the Zener diode (DZ) forms a voltage stabilizer (Fig. 34). This actually is an attenuator coil. If  $R_s$  is 7,500 ohms, with a differential resistance of 75 ohms for DZ, input voltage fluctuations will be reduced to one one-hundredth of the original amplitude. Permuting  $R_s$  and DZ results in a circuit that exaggerates the input fluctuations and thus yields a fair-amplitude error signal (Fig. 35). The resistor is of low value here in regard to the differential resistance. Thus, a constant voltage drop, preferably only slightly lower than the input voltage, develops across DZ, leaving mainly the fluctuating component across the output. For control purposes, it is necessary only to amplify this component and reinject it into the input.

Zener diodes are made for stabilizing voltages up to 100, but devices designed for zener voltages of 5 to 6 feature the lowest differential resistance and a practically zero temperature coefficient and are, therefore, preferred. For voltages between 65 and 150, gas regulator tubes (glow lamps) are used. Nowadays, Zener diodes have superseded glow lamps as regulators in most applications, but glow-type indicators, of course, will survive as long as gallium arsenide injection diodes are not mass-produced. ■

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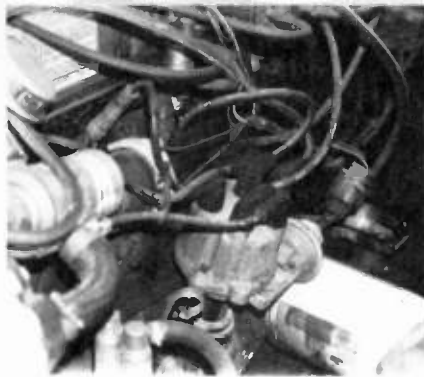


Fig. 1A—The Ignition system forms the most powerful source of RFI/EMI in auto electronics. Early "wireless" pioneers, in fact, used a Model T Ford spark coil coupled to an antenna as a radio transmitter.

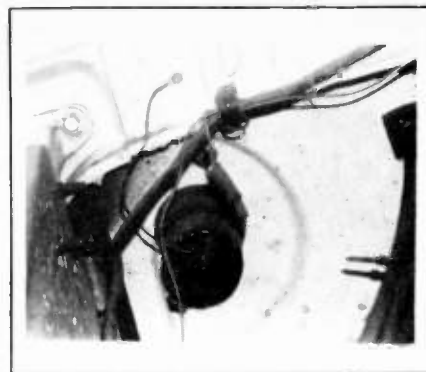


Fig. 1B—Often overlooked by the inexperienced servicer are small DC electric motors such as this one used in the automobile heater system.

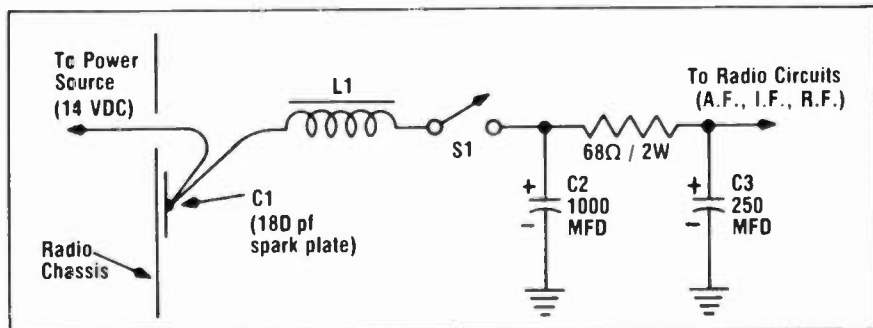


Fig. 2—Typical car radio power supplies have several noise suppression features such as L1, C1, and C2. Capacitor C3 is usually used for audio, I.D., and R.F. stage decoupling.

## External Sources of Auto Radio, Tape Player and CB Noise

Common and uncommon causes of noise and how to cure them, plus a look at a servicing aid which is particularly useful for tracking down otherwise hard-to-find noise sources.

By Joseph J. Carr, C.E.T.

■ The first step in troubleshooting auto radio or CB noise is to attempt to identify the *types* of noise. Is it ignition noise? Is it alternator noise? Or is it the 'sloshy sounding' ticking of gas gauge noise? (Do not make the mistake of assuming that only one type of noise is present; many noise sources can create more than one type of noise in the radio)

The most common types of noises and their most probable sources, along with the recommended cures are shown in Table I. Be aware, though, that many car manufacturers have their own recommendations. A call to the

local dealership, or auto manufacturer's service representative often can be helpful. Also, let me point out that a bypass capacitor on the ignition coil works fine for those vehicles equipped with traditional Kettering coil/breaker-point ignition systems, but it can be totally ineffective on modern solid-state systems.

Note also that the ignition system is not the only cause of spark-like noises. Figures 1A and 1B show some sources, such as the automobile's ignition system and numerous small DC motors. Often overlooked, incidentally, are the blower motors in the heating/air

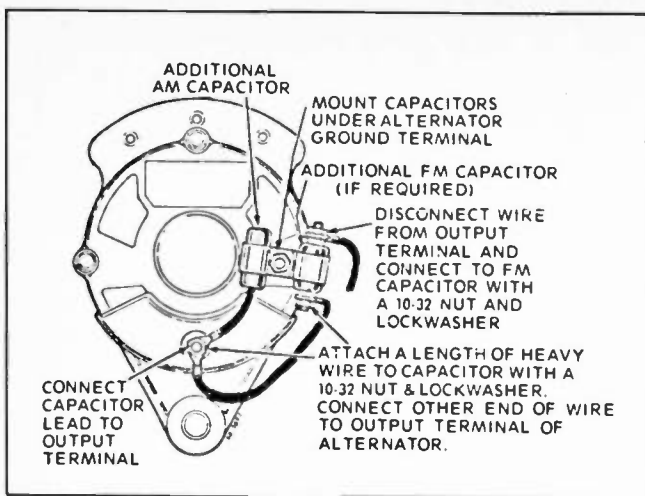


Fig. 4—Capacitors are connected to the output terminals of an alternator for noise filtering. (Courtesy Motorola.)

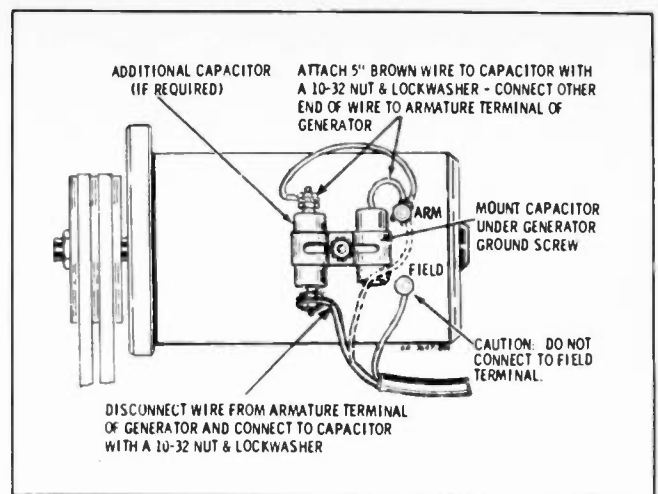


Fig. 5—Capacitors are connected to the field terminal on a generator to eliminate noise. (Courtesy Motorola.)

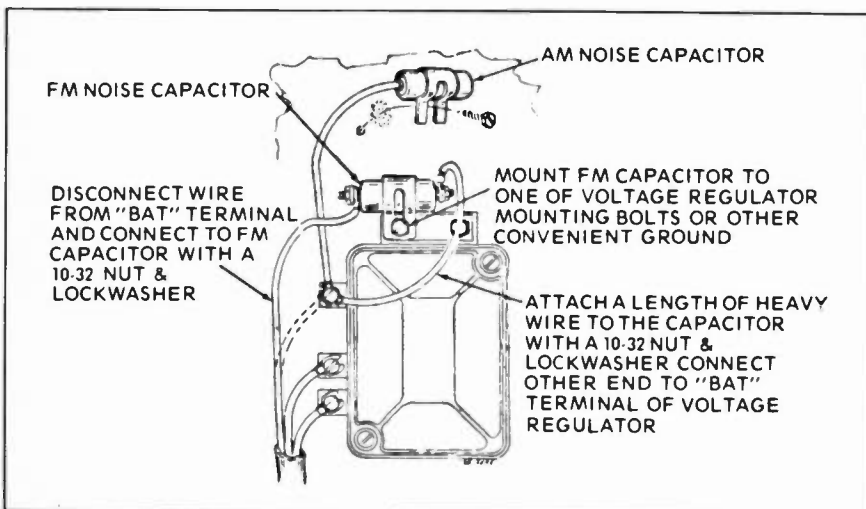


Fig. 6—Noise-filtering capacitors are connected to the voltage regulator. (Courtesy Motorola.)

conditioning system.

### DEFECTS IN THE RADIO

It is also wise to realize that radio defects can create noise problems. Typical *internal* causes of noise in automotive broadcast receivers and tape players were discussed in an article titled 'Noise Sources In Auto Electronics' in the January 1977 issue of ET/D. The most common of these internal noise-generating defects are failure of the noise suppression components in the power-input circuit of the radio (for example, a shorted L1 or open C1 or C2 in Fig. 2) and incorrect positioning of the antenna-input choke so that it is parallel to the power input ('A') lead of the radio, which causes any noise pulses on the A-lead to be coupled directly into the input of the receiver.

To find out if a defect in the radio is the cause of the noise, the substitution method can be used. It is best if the same make and model of

radio can be used, but any model will do. Connect the new set in place of the old, and check to see if the noise is still present. Remember, though, because the substitution radio will probably not mount in the same way as the original, there might be some noise present. So look, instead, for a *reduction* in the noise level.

### ANTENNA & RADIO GROUNDING

Do not overlook the grounding connections for the antenna and the radio as possible sources of noise. The antenna should be checked by substituting it with a known good antenna. Do not actually mount the substitution antenna to the vehicle, but be sure to ground the base of the test antenna against the car body. You can usually reach some chrome trim or other conductive surface from inside the car while making the test.

When checking the ground connections, never depend totally on

readings from your ohmmeter. They can be highly misleading. Like the tube tester, if it says "bad", then it is bad; but if it says "good", then it may still be bad. In the case of the radio antenna, an ohmmeter may say that the outer shield of the antenna cable is open, in which case you believe it—and replace the antenna. But, if the ohmmeter reads some low resistance, then believe it only after you have made the substitution test.

Similarly—to the DC power supply—a radio chassis may look grounded. But to RF, it actually might be a relatively high impedance.

Modern automobiles frequently use a clay-like anti-rattle compound between the dashboard and the firewall. If the dashboard and firewall make up the ground return for the radio, noise will be the result.

The solution is to connect a heavy conductor between the radio chassis and the firewall. Use battery braid or the outer conductor of a heavy grade of coaxial cable (RG/8, RG/11, etc.).

The problem of noise caused by poor chassis grounding has been compounded in recent years by the use of lock-type mounting brackets and anti-theft consoles over the transmission hump. Many less experienced installers—and that frequently includes some in the industry—will use the coaxial cable's outer shield as the ground return. The radio has a ground wire, and it should be used. If the copper connectors on these brackets are in good shape, little problem should result from their use. Just



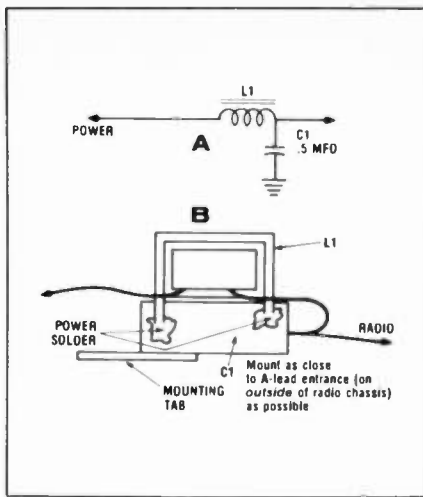


Fig. 7—A diagram of the L-section filter circuit (A) that will take the alternator whine out of radios and tape players in cars. DC resistance of the choke must be very low. The filter is installed as shown in part B.



Fig. 8—Insulated mounting hangers for the tailpipe, coupled with a length close to resonance at 27 MHz in many cases, forms a situation made for the re-radiation of motor noise.

make sure the ground wire goes directly to the firewall (or, at least, to a major dash brace).

#### NOISE VIA ANTENNA OR POWER LINE

Once the antenna, radio and chassis grounding connections have been eliminated as possible sources of noise, the next consideration is whether the noise is entering via the antenna or the power line.

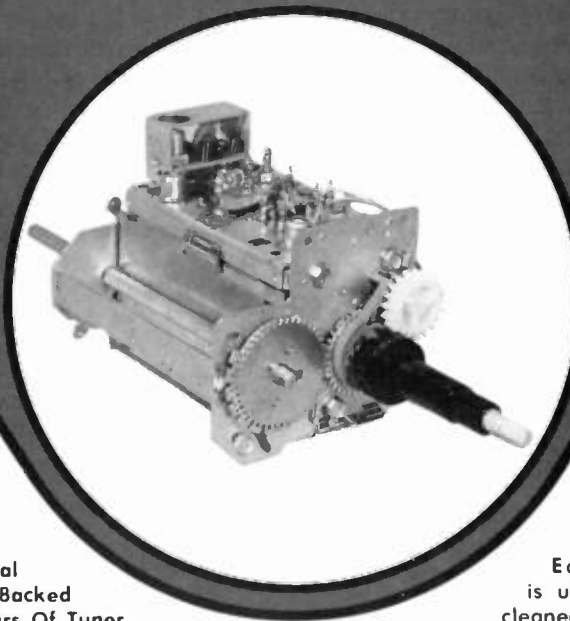
This is done by disconnecting the antenna and noting whether or not the noise level is reduced. Some technicians erroneously believe that the *type* of noise will tell you where it gets into the set. Ignition noise can enter the set by either route, and the corrective action for each is different.

Antenna-born noise, for example, is most likely caused by inadequate shielding action of the hood, body panels, or it might be caused by re-radiation of RF noise from the tailpipe.

Noise that enters via the power

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line, on the other hand, may be caused by incorrect dress of the power cable itself or by *induction from another cable*. Once you realize just what this can mean, you will understand why one old timer in auto electronics claims that "once the most probable causes are eliminated, finding the source of the motor noise is a lot like trying to nail ice cream to a wall."

Also determine whether or not the car has been recently serviced, or has been in an accident. The extensive use of fiberglass and plastic components to repair the damage and an antenna ground that was not reconnected can cause all sorts of problems.

The author recalls a Corvette Sting Ray (with all fiber-glass body) that had recently been to the body shop for left rear quarter panel repairs. The bodyman had

neglected to reconnect the ground connection between the base of the antenna and the tail pipe. The result was tremendous motor noise.

#### AFTER THE TUNE-UP

Another possible cause of radio noise is that which is encountered after an improper ignition tune-up. For this reason, it is wise to find out from the customer if the car has had a tune-up recently. In most cases, just the mere mention of 'tune-up' will prompt the customer to remember that the noise appeared right after the tune-up.

In most noise cases related to a recent tune-up, you probably will discover that the mechanic improperly substituted straight wire for the carbon 'radio-TV' wire specified by the manufacturer. An ohmmeter check will reveal this rapidly. First check the wire from

the coil to the distributor, because it is typically easier to reach and remove. If the ohmmeter check indicates a short instead of several K-ohms, refer the customer back to his auto mechanic for correction of the noise by installation of proper coil and spark plug wires.

It is equally as important to determine if the car has *not* been tuned up in the last 25,000 miles. If the car seems to be running roughly, this is probably the case. The carbon wire used in the ignition system probably has deteriorated to a point where it arcs internally. This will, of course, create RFI/EMI in the radio.

Besides rough idling of the engine, the best telltale sign of a bad ignition cable set is a "pop-pop-pop" sound made by just having one open-circuited spark plug. If you have ever seen the fire parade

### TROUBLESHOOTING CHART FOR AUTO RADIO NOISE

| Sound Made  | Cause                               | Cure   | Comments  |
|---|-------------------------------------|--|---|
| Popping static at regular rate, varies with engine speed                          | Ignition system                     | Check condition of Radio-TV high voltage wire. Bypass capacitor (0.5- $\mu$ F) from ignition coil's battery terminal to ground | Also check antenna and radio chassis grounding  |
| High pitched, raucous howl which varies with engine speed                         | Generator                           | Bypass armature terminal to ground with 0.5- $\mu$ F. DO NOT bypass field wire. The correct wire is the heavy cable            | Only found in older American-made cars and some current foreign cars  |
| High pitched whistle, varies with engine speed. More "pure" than generator noise  | Alternator                          | Check manufacturer's service manuals and bulletins. Install L-section filter (1) in radio power lead                           |   |
| Flutter at low engine RPM and when receiver set to low volume                     | Breaker points                      | Bypass battery terminal of ignition coil with 1000- $\mu$ F capacitor (i.e. Motorola AK300)                                    | May also indicate that vehicle needs, or just had, a tune-up. The cause seems to be too wide a gap across breaker points. |
| "Frying Eggs" Sound   | Voltage regulator (non-solid-state) | Bypass the input and output terminals to ground through 0.1-mfd capacitors   | Also may indicate a faulty regulator  |
| Popping at irregular rate. Does not vary with engine speed. Sounds like sloshing. | gas gauge sending unit              | Bypass lead-in wire as close to the tank as possible with 0.5-mfd capacitor  | Usually accessible through the trunk. Some car makers also have a repair kit for this problem                             |
| Popping sound when brake is pressed   | Brake light switch                  | Bypass across the switch, or from light wire to ground with 0.5-mfd capacitor  |   |
| Horn Noise  | Horn                                | 0.5-mfd capacitor across horn terminals  |   |
| Electrical motor whine, usually does not vary much with engine RPM                | Motors (see Fig. 2B)                | 0.5-mfd capacitor across motor winding terminals   |   |

NOTES:  
 (1) See Automotive Electronics Servicing Guide, Sams No. 20927  
 (2) Use only automotive bypass capacitors. For FM radios and CB sets the author recommends coaxial bypass capacitors

Table 1—A source chart of motor noise, caused by lack of shielding, inductive pickup from nearby wires, or re-radiation from tailpipes, decorative chrome strips, or cable harness.



of a multicylinder engine on the mechanic's oscilloscope when this was the problem, you will recall seeing the amplitude of the pulse from the offending plug swing upward completely off the screen.

Other sources of noise in a car's ignition system are the alternator or generator and the voltage regulator. The whine and other noises produced by these ignition system components can be reduced and sometimes eliminated by the installation of bypass capacitors or an L-section filter. In Fig. 4, a bypass capacitor has been installed on an alternator, and in Fig. 5, on a generator. In the case of the alternator, it is wise to consult the car maker's suggestions for capacitor value to be used. With the wrong capacitor, you could resonate the circuit. In Fig. 6, a capacitor has been installed on

Here's an example. A few years ago I was troubleshooting a CB installation that had a tremendous amount of 'motor' noise. My boss and I spent several hours trying to find the problem, and frankly admitted defeat by mid-afternoon. To ease the ache in my back caused by bending over the automobile engine for what seemed like hours, I leaned against the side of the car—and the noise stopped.

Inspection revealed that a decorative chrome strip was loose, and its few remaining fasteners were badly corroded. To add insult to injury, the strip was exactly 104 inches long, or about a quarter wavelength at the 27-MHZ CB spectrum. The chrome strip was picking up the noise, and re-radiating it because of the resonant length.

Inductive and capacitive pick-

DC grounded, because of rust or the type of fittings used. To cure this type of noise-radiating problem, it is necessary to ground the tailpipe to the frame at intervals that are short, relative to a quarter wavelength of 27 MHz, (i.e., less than 5 feet).

#### A NEW NOISE-SEEKING TOOL

A new device that is probably the first service tool designed especially for tracking down sources of motor noise has been developed by Channel Master. It is Model 5270 RF Noise Detector, also called the "Sleuth". Shown in Fig. 9, I call it the "magic wand."

The Sleuth, which costs only \$16.95, is approximately 25 inches long and about 1 inch in diameter. It has a 17 foot coaxial cable fitted with the standard connector (PL-259) used in most CB antenna systems. You can also make an adaptor, which I feel Channel Master should develop as an accessory, to go from PL-259 to a Motorola auto radio plug. I made this adaptor in the shop by using a short piece of RG/59U coaxial cable. The PL-259 was connected to one end and the Motorola plug to the other. The PL-259 was then connected to the PL-259 on the Sleuth's cable through a double-ended female barrel adaptor, which is also called a 'through-wall' if it's over 3 inches long.

Don't bother trying to mount a PL-259 or any related type of connector on one end of a conventional car radio antenna cable, even though it may seem to be an appealing way to go. Auto antenna cable is hollow (for low capacitance), and will not easily mate with the PL-259. This is why I used a piece of coax.

The Sleuth is then connected to the antenna jack of the radio in the vehicle, or to a test radio. If the radio is a CB set, *do not key the transmitter*, or some damage to the Sleuth could result.

When the Sleuth, which is a directional RF detector, comes in close contact with the offending noise source, it lets the operator know through the test radio's speaker. The device will pinpoint noise sources wherever they are on the vehicle, even re-radiation sources, such as the emergency brake cable, a cable bundle, or the

*continued on page 44*



Fig. 9—A new service tool called the Channel Master "Sleuth" (Model 5270) helps pinpoint tough dog noise source.

a voltage regulator to filter out noise. And in Fig. 7, an L-section filter has been used on an alternator. The choke may be almost any car radio input choke that has a DC resistance low enough to prevent excessive voltage drops.

#### INDUCTIVE AND CAPACITIVE PICKUP

At this point we have covered all of those problems that have traditionally caused most auto electronics noise problems. Those which remain can be unprofitable—and are often very difficult to find.

up, coupled with re-radiation, cause some of the most difficult-to-find motor-noise problems. Noise suppression is usually a simple matter of rerouting a wire, shielding something, or adding a ground wire. Fig. 8 shows a very common source of re-radiation: the exhaust pipe. It is a conductor, and hangs from insulated supports. Furthermore, it often has a length that is a quarter- or half-wavelength of 27-MHZ, so it may not act grounded, even though it is attached to the engine block. Besides, many tailpipes are not even



# Prolonging the life of TV Picture Tubes

When and how it should be attempted

By Bernard B. Daien

■ With the exception of open tube base connections, which often can be permanently repaired by applying the tip of a hot soldering iron to the related pin, the best approach to most defective TV picture tubes is to recommend either replacement of the picture tube with a new or rebuilt one or, if the receiver is more than 6-8 years old, purchase of a new receiver.

## Nonrepairable Defects

Some picture tube defects are absolutely nonrepairable. These include a burned phosphor screen, a loose or warped shadow mask, a gassy condition, and an internally open gun element whose ends have shifted out of position enough to preclude 'welding' with the element closing provision with which some of the CRT tester/rejuvena-

tors available are equipped.

When these defects are encountered, the only two options you can recommend to the set owner are: 1) replacement of the picture tube or 2) replacement of the entire receiver.

## Repairable Or Temporarily Restorable Defects

On the other hand, some types of picture tube defects often can be repaired or the technician can temporarily lessen the effects of the defect so that the operating life of the tube is prolonged for at least a few months. These possibly repairable or temporarily 'restorable' defects are:

- **Low emission**—This condition is not always 'repairable' but, depending on the degree to which emission is reduced, it frequently can be temporarily restored to a usable level by use of a brightener (Fig. 1) or by one of two types of rejuvenation (Fig 2): 'cooking' or 'arcing'. (These methods of rejuvenation and their recommended applications are described in detail later in this article.)

- **Heater-To-Cathode Shorts**—The effect of this defect (Fig. 3) frequently can be eliminated by installation of an isolation transformer, which electrically isolates the heater, and therefore the cathode, from ground.

- **Cathode-To-Control Grid and Control Grid-To-Screen Grid Shorts**—These defects occasionally can be eliminated by the shorts-clearing provision (Fig. 4) built into most CRT tester/rejuvenators.

- **Internally Open Gun Elements**—If the two ends of an internally open gun element are partially or intermittently touching, the break sometimes can be 'rewelded' by use of the element closing (or shorts removing) feature with which some CRT tester/rejuvenators are equipped.

- **Open External Connections To Gun Elements**—As noted previously, these defects frequently can be cured by application of a hot soldering iron tip to the related tube pin.

## Get The Set Owner's Approval

Attempts at temporary restora-

tion of emission by the rejuvenation process, and opening shorts or closing open elements with the 'shorts clearing' provision of a CRT tester/rejuvenator usually involve a risk of damaging the picture tube in a manner that will make it completely inoperative and, consequently, worthless except as a trade-in dud for a replacement tube. For this reason, *before* attempting these procedures it is advisable to explain the inherent risk to the set owner and *then let him or her decide whether or not the procedure should be attempted.*

### Is The CRT Covered by A Warranty?

There is also one other very important factor which should be considered *before* any repair or restoration procedure is attempted: *Determine whether or not the picture tube is still under warranty—even if the CRT obviously is not the original.* (All new replacement CRTs and most rebuilds have warranties which range from 90 days up to 3 years or more.) The best procedure is to ask the set owner if he or she has a copy of the original sales invoice and/or the new-set warranty—or at least ask the owner how old the set is.

### Candidates For CRT 'Restoration'

CRT's with low emission in sets that are 6 or more years old are prime candidates for restoration. In such sets the PC boards are probably dried out, the tuner probably is worn, and you almost always find several other failing components.

Although replacing only the CRT usually will not restore a 6-8 year-old set to top operating condition, most customers expect this from the large bill which they must pay for CRT replacement. When the need for the other repairs crops up, the customer is dissatisfied. The alternative is a complete overhaul, which is usually not worth the money, compared to the purchase price of a new set.

CRT restoration, on the other hand, is relatively inexpensive, and permits the repairs needed elsewhere in the set to be per-

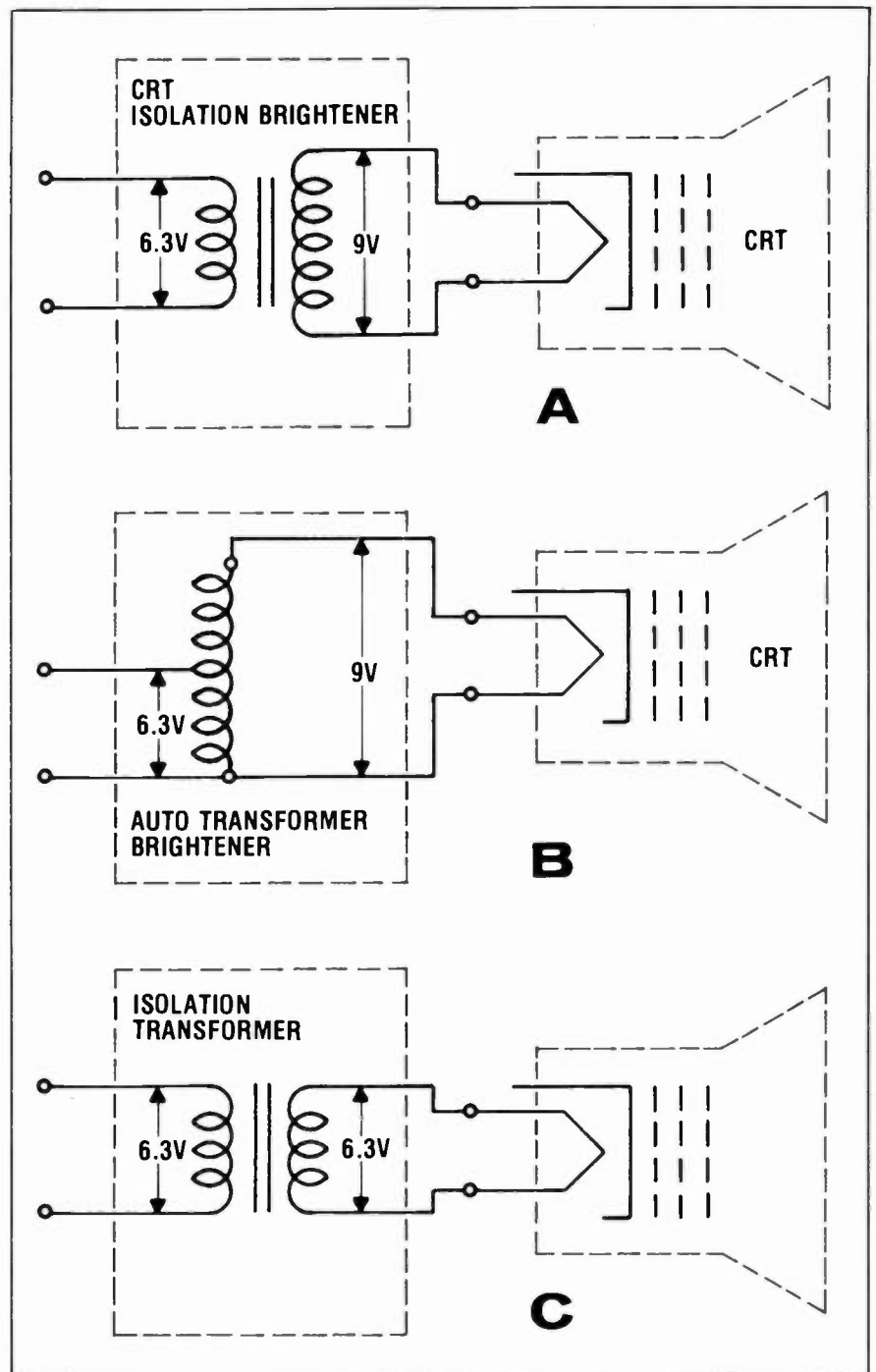


Fig. 1—A) Isolation brightener, which provides both CRT filament boost and isolation of the filament from ground, for use with CRTs with reduced emission and heater-to-cathode short. B) Autotransformer-type brightener, which provides only CRT filament boost and no isolation. C) Isolation-type transformer, which provides only CRT filament isolation and no boost.

formed for a modest total bill, giving the customer another year in which to prepare for the purchase of a new set.

Many of the latest model sets are not suitable for CRT restoration by means of a booster, since the picture tube heater may be powered by the horizontal sweep source (15,750 Hz). Present designs of boosters do not function

well in these circuits. For example, certain models of Philco Sets use the 60-hz power line for instant-on preheating of the CRT filament when the on/off switch is in the 'off' position (Fig. 5). However, when the set is turned on, the *horizontal sweep source* powers the CRT filament with a non-sinusoidal 15,750-Hz waveform. Boosters do not even light up the CRT under



these conditions. Since the home-call technician usually does not carry a full schematic file, he has no way of knowing what CRT filament-power circuitry is utilized in the set, and may assume that the newly-installed booster is defective.

Further compounding the home-call technicians problems is the fact that a number of different filament voltage and base pin configurations are employed by b/w CRTs, and some have series filament connections while others employ parallel connections.

It is therefore advisable that the home-call technician check the CRT data in a tube manual before selecting and installing a CRT booster, just as he uses such data to set up tube checkers and determine tube interchangeability.

Many of the sets made in the mid-1960s and earlier, are equipped with pix tubes which respond well to boosters, or to 'cooking'. Cooking consists of running the filament at higher than nor-

mal temperature under carefully controlled procedures, and is described later in this article. Cooking brings more electrons from the interior of the cathode to the surface, thus increasing emission. Newer tube types do not respond to this procedure as frequently, because of a different manufacturing technology.

The new CRTs respond to the third method, which consists of a variation of "arcing" to the surface of the cathode. This removes the top surface of the cathode emitting material, exposing fresh emitting material beneath. Under certain conditions, a non-emitting layer can form on the surface of the cathode, acting very much like an insulator. Arcing, unlike the previously-described methods, has greater risk and, if carried too far, can actually reduce emission by destroying the relatively thin emitting layer on the cathode. However, it is used in many of the commercial CRT tester/rejuvenators in use today.

To sum up: older sets respond best to boosters, cooking, or both. Newer sets do not respond as well, or at all, to boosters and cooking, and may need arcing, with greater risk and less chance of success.

### Recommended Restoration Procedures

There should be no guesswork involved in the restoration of a CRT. The tube should be first tested in your CRT tester in the conventional manner. If the tester indicates that the CRT has a heater-to-cathode short, install an isolation brightener (Fig. 1). Some CRT brighteners have a switch which permits selection of either isolation only or both isolation and filament boost. Such isolation boosters are larger, heavier, and cost more.

If the CRT fails to reach "Cutoff," or has low emission at its rated filament voltage, turn the filament voltage up 20% (i.e., 7.5 volts for a 6.3 volt tube), wait a full minute, and retest. If the tube now reads good, it will work with a booster. The booster is a quick and profitable sale, and the customer is satisfied with having avoided the expense of a picture tube replacement.

Some purists insist that the CRT must also "track" on all three guns of a color tube. If you think a bit, you will recall that tracking determines the amount of color shift that occurs when the brightness changes. A tube that is otherwise satisfactory may not track perfectly from full brightness down to cutoff (black). If poor tracking is due to a weak gun, then the weak gun's color will drop off at higher levels, causing a loss of that color at these levels. Obviously, this is not satisfactory. On the other hand, if the three guns have satisfactory emission, then the drives and screens can be set to give a good picture at both normal and bright viewing levels, and the mistracking will occur only at low brightness levels. If you recall your color TV theory, the human eye does not perceive color at low brightness. (Thus, you do not see colors when driving at night.) The customer will not see the mistracking near cutoff. I have had

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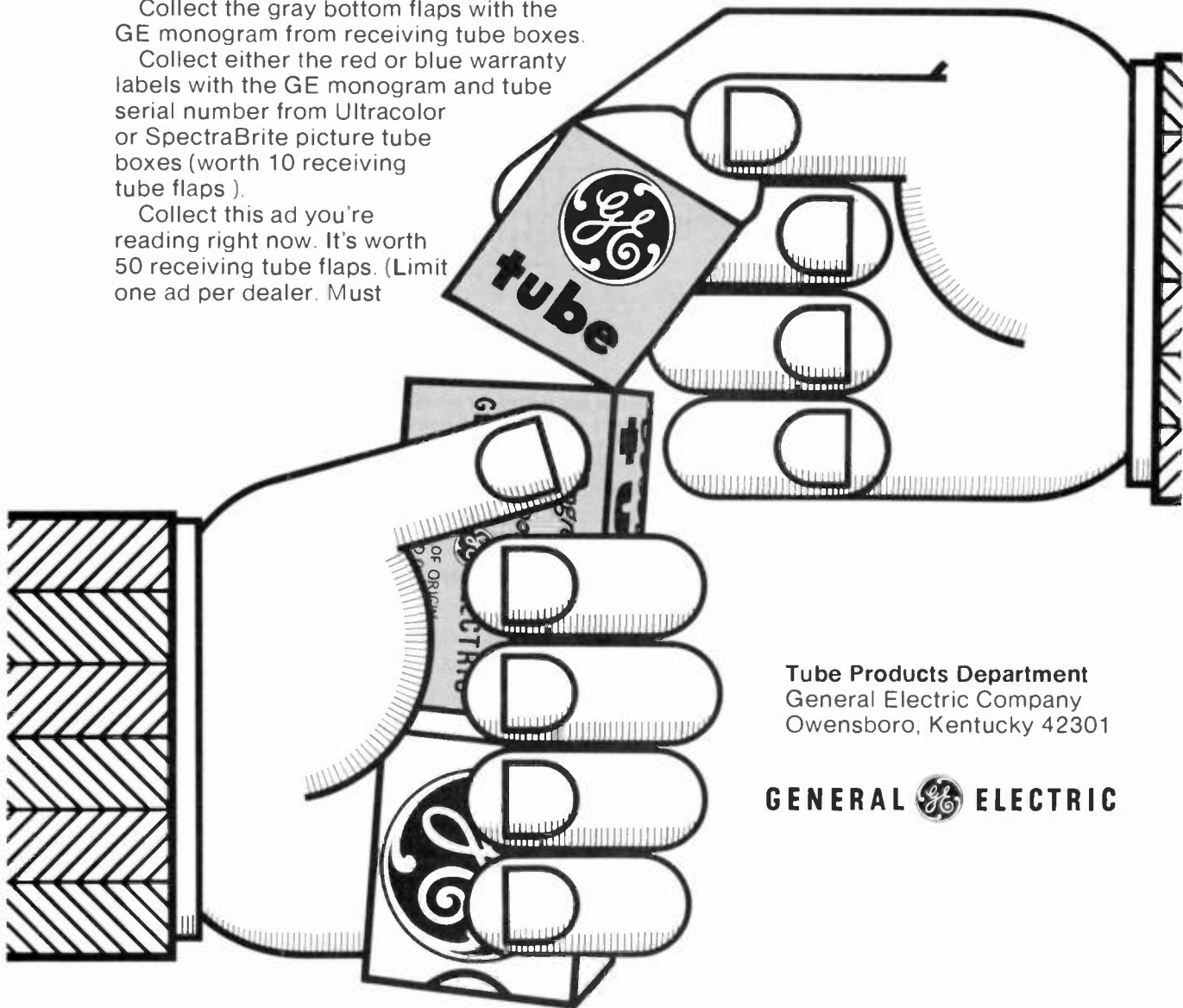
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**GENERAL  ELECTRIC**

complete customer satisfaction under such circumstances, and do not hesitate to recommend that you set up tracking to give a good white raster at medium to high brightness levels, then turn to an active channel and view the picture. You usually will find that it is quite satisfactory. *Tracking alone is therefore not a good reason for replacing a CRT which has otherwise been restored.*

If raising the filament voltage 20% does not result in the picture tube passing the emission test, 'cooking' is in order. As mentioned previously, before you attempt cooking, or more drastic methods, you should obtain the *set owners* permission, after explaining that there is a certain element of risk involved. He may prefer to view a green screen rather than risk having no TV set at all.

Following is a procedure that minimizes the risk and maximizes the results: With your CRT tester hooked up and set for rated filament voltage, wait a full minute, then raise the filament voltage 50%—i.e., about 10 volts for a 6.3 volt tube. (If you apply the 10 volts immediately, the surge current to the cold filament may burn it out.) After one minute, drop the filament voltage back to rated voltage for a full minute, then retest the tube, looking especially for shorts which may result from heat warping the gun elements, or from breakdown of the insulation between heater and cathode. Watch the emission on each gun carefully for a minute or so. It should stabilize in the 'good' region. If it continues to drift downward, even very slowly, the emission of the tube will not hold up. At this point, raise the filament voltage 20% to see if a booster will work now that the filament has been cooked. If the emission reading holds *steady*, a booster (or, as it commonly is called, a 'brightener') will probably provide satisfactory emission.

If the combination of cooking and a booster do *not* produce sufficient emission, you must use the rejuvenator in your CRT tester, which is usually the arcing type. (Some testers use the cooking method, and of course, we have already considered that, but trying

once more may do some good.) If your tester uses the arcing method (which results in a small blue flash in the CRT neck when the 'rejuvenate' button is pressed), what follows is for you.

Remember, we said that arcing holds greater risk than boosters or cooking. CRT tester/rejuvenators using arcing usually have a switch which permits "Low" or "High", or else have three positions corresponding to 'low', 'medium' and 'high' strength. These switches determine the amount and duration of the high voltage applied between cathode and control grid, and must be used in sequence, starting with the lowest strength. (During this arcing, higher than normal voltage usually is also

applied to the CRT filament.)

If the CRT responds to the lowest strength, repeat again at that strength. If the emission of the tube is improved, see if it will work satisfactorily with a booster, using the method previously described. If so, *stop*.

If some improvement is noted with two attempts on 'low' on a three-position tester/rejuvenator, but the results are not satisfactory with a booster, go to position two. If position two does not result in a "good" reading, even with a booster, *stop!* Position three usually destroys whatever emission the tube has, and should be avoided. On two-position rejuvenators, the high level should also be avoided for the same reason.

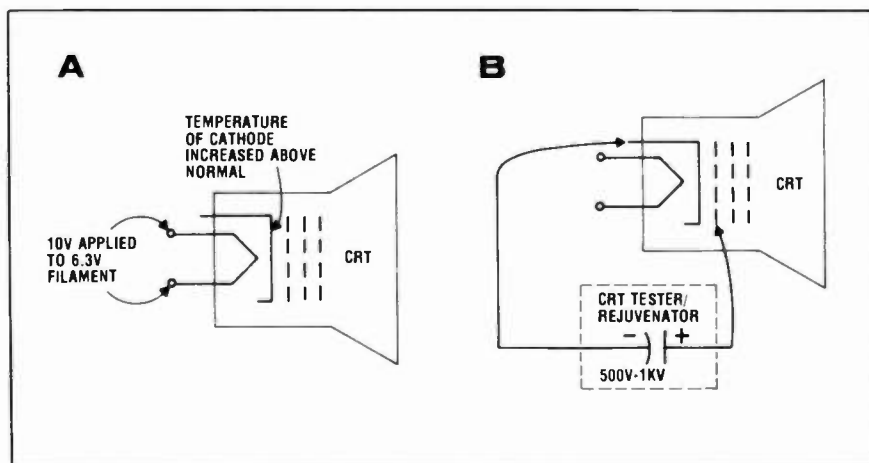


Fig. 2—Illustration of two methods of rejuvenation: A) 'Cooking', in which a higher-than-normal filament voltage heats the cathode to a level that 'boils' emission-reducing oxide coating off the cathode. B) 'Arcing', in which a high potential (typically 500V-1KV) is applied momentarily between the cathode and the control grid, and the resultant arc 'pulls' the emission-reducing oxide from the surface of the cathode, thereby exposing more of the emission-producing material beneath it.

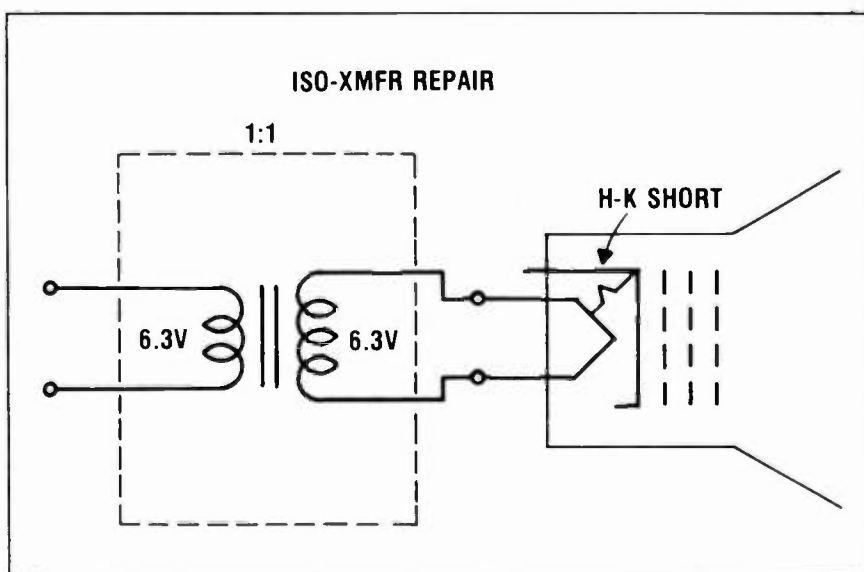


Fig. 3—Illustration of the use of an isolation transformer to 'cure' heater-to-cathode short in CRT.



*Never arc a good gun!* Confine arcing to guns which definitely need 'strong medicine'. If only the red gun is weak, then arc the red gun only. Repeated arcing on position, two on a three-position machine, should also be avoided.

Retest the CRT after rejuvenation, again waiting a full minute. As before, there must be no indication of fall off in either the cut-off or emission indications. If the readings stabilize in the "good" region, the tube will perform satisfactorily. Again, if rejuvenation results in improvement, but a booster is required to bring it into the good region, use a booster.

To recap: Do not guess. Use a CRT tester. Retest after each step. Do your procedures in the described sequences.

### What You Can Expect

Based on my own experience with older sets which had not been previously restored, 50% of those with poor emission responded to boosters and cooking. Sets which already had boosters on the CRT (or which had previously been restored by other means) did not respond satisfactorily to any method. Another 10% with heater-cathode shorts, or low emission, were restored with isolation boosters and/or with arcing.

On newer sets, the ratio was not as good, since boosters could not be used on many models. Further, the newer CRTs did not respond well

to cooking. Arcing on low power did result in dramatic improvement of some tubes. Many of the CRTs tentatively diagnosed as defective, actually were good, the trouble being in one of the DC-coupled circuits associated with the CRT input.

One question often asked is, "How long will a CRT remain good after restoration?" Of those with which a booster alone restored emission, cut-off, or a heater-to-cathode short, 75% of the CRTs restored were still operating satisfactorily a year later. Of the CRTs that were cooked, only 60% were still performing satisfactorily a year later. Of the CRTs that needed cooking plus a booster,

50% operated satisfactorily for a year. Of the CRTs that needed arcing, 35% operated normally for a year. Only 10% of the sets that needed arcing plus a booster, were still good a year later.

Thus, it can be seen that the more drastic method of restoration required, the shorter the life of the restored tube.

### The Economics Of Restoration

If a grade 1 rebuilt CRT runs about \$125 installed, for the most popular types, and is warranted for two years, we will assume the tube will last for four years, at a yearly cost of about \$31. Restoration, including a booster, runs about \$31, and should last a year if done properly. Therefore, the cost to the customer per year of operation is the same.

As far as the shop is concerned, the sale of booster and the time charges incurred in rejuvenation provide extra income. Remember, the technician should have a CRT tester with him on service calls anyway. The extra money provided by this use of the tester therefore does not require additional test gear. There is no sure fire way to detect a bad CRT without a tester. I have seen CRTs that looked like classic cases of CRT failure, but were caused by leaky solid-state focus rectifiers, leaky high-voltage rectifiers, gassy rectifier tubes, etc. As long as you have a CRT tester/rejuvenator, use it to make extra income.

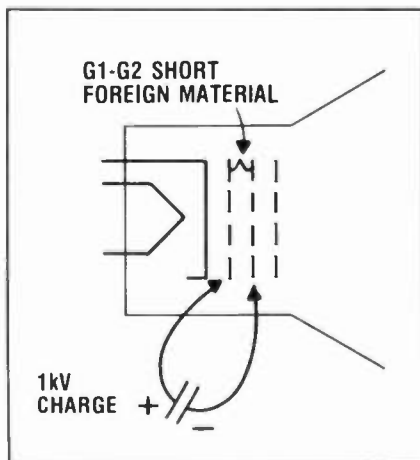


Fig. 4—Illustration of the basic principle of operation of the shorts-removing provision with which most CRT tester/rejuvenators are equipped.

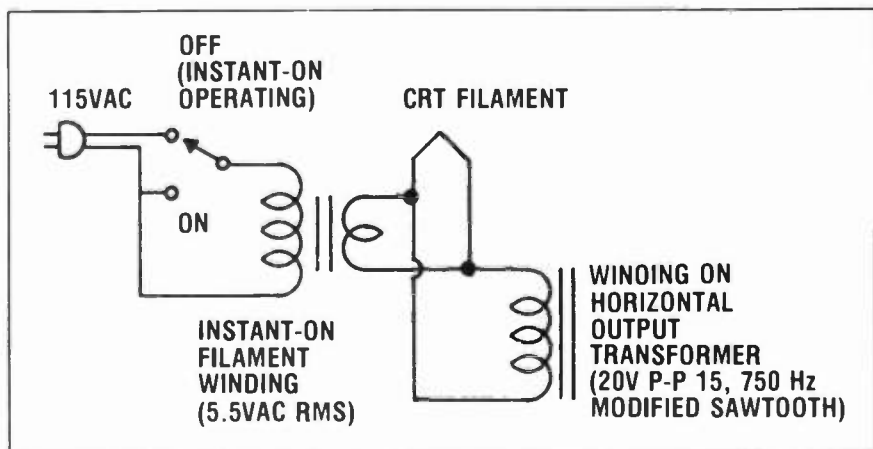


Fig. 5—Simplified schematic diagram of CRT 'dual' filament supply circuit employed in Philco TV chassis. In 'on' position of set's on/off switch CRT filament is powered by 15,750-Hz modified sawtooth from horizontal sweep system. In 'off' position instant-on winding supplies 60-Hz sinewave to keep CRT filament warm, for 'instant' raster when set is switched on. Instant-on winding is shorted out in the 'on' position, to prevent the winding from acting as a choke and limiting filament current from the 15,750-Hz source. CRT brightener will not function in sets equipped with this and similarly powered CRT filaments.

### Cautions Repeated

Even though your CRT tester has a built-in rejuvenator, resist the temptation to use it until you have determined first if the tube responds to gentler treatment ...i.e., boosters or cooking. Once you have arced the tube, there is no going back to other methods.

If you have a favorite tester, by all means use it, in the order described. The 'results' data presented in this article is the summation of carefully kept records, on many CRTs, over a two-year period. Only original equipment CRTs, or 'standard brand' grade-1 rebuilds, were tested, since others were of unknown quality to begin with. ■



## Effective Advertising For The Electronic Sales & Service Dealer —Part Two

The factors that make up a successful advertising approach—and how to develop an effective advertising budget.

By Don W. Mason

■ There are a number of different avenues by which the average electronic sales and service shop owner can get his advertising message to the people he wants to serve. The media available includes: daily and weekly newspapers, neighborhood shopping newspapers, radio and television stations, direct mail and handbills, billboards, and the Yellow Pages of the local telephone directory.

The task of selecting the right advertising method for your particular operation is, as pointed out

in the first part of this series last month, simply a matter of determining who and where your present and potential customers are, and then picking the advertising method that gets your sales message to the largest number of these customers at the lowest cost.

The size of the community in which you operate is a major factor in media selection.

For example, if you are located in a small to medium size town, you probably cover the whole community and surrounding area with your products and/or service.

In this case, the local newspaper and the local radio station will probably give you good advertising coverage with little waste.

On the other hand, if you are located in a section of a large city, it is likely that you provide product and service coverage to only part of the city. If this is the case you could be wasting your money to advertise in the city newspapers, or on radio or television because you'd be buying too many readers or listeners and viewers who could not conveniently use your services, or buy your products. In this situation, more effective use can be made of a community shopper or direct mail. These will allow pinpoint advertising coverage of potential customers who can conveniently get to your shop.

To further pin down this matter of media selection on the basis of the location of your business, remember these observations from the Small Business Administration (SBA):

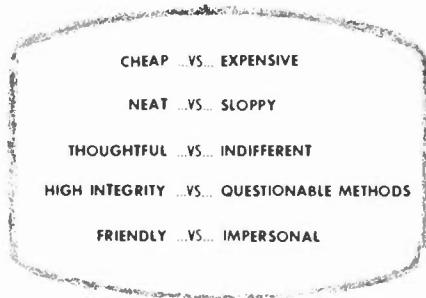
- The average independent retail business draws customers from not more than a quarter of a mile.
- The average chain store draws customers from not more than three quarters of a mile.
- The average shopping center draws customers from as far away as four miles.

Of course, if you do home service calls and use a mobile service van you can extend your customer coverage according to how much equipment you have and how large a staff you employ.

Finally, on this matter of media selection, here are the questions you should ask yourself about present and prospective customers if you want to avoid the purchase of *waste* advertising coverage:

- Who are your customers or potential customers?
- What income groups are they in?
- Why do they buy, or use your services? (On price or quality? By word of mouth, or through advertising?)
- How do they buy your products or service? (Do they prefer carry-in service, or home calls? How often do they use your services, or buy your products?)
- Where do they live?
- Are your present customers sat-

## THE IMAGE OF A BUSINESS



ified with your products and services?

Let's examine that last question about customer satisfaction.

What your present customers, and the community in general, think about you and your operation is an important fact to consider in the development of your advertising approach. It is the image your business presents to the community and your customers.

Depending on a lot of factors such as the inside and outside appearance of your shop—its location—your appearance and that of your employees—your treatment of customers—and the quality of your service, your business "image" can be:

- "Cheap" or "expensive"
- "Neat" or "sloppy"
- "Thoughtful" or "indifferent", and
- "Warm and friendly" or "cold and impersonal."

Your business image is created by how you operate. Advertising is the method by which you reinforce that image with your present and future customers. When you've correctly discerned your "business image", you should include that image in your approach to advertising.

### WHAT TO ADVERTISE?

Your 'business image' must certainly be a part of your advertising message. But there is a lot more—and, again, you must ask yourself some questions, such as:

- Should I advertise products and/or service? (This one is easy if you run a service-only operation)
- (If sales and service) Should I always feature a price-cut (or sales) come-on?
- (If service only) Should I feature "fast" service, or "high quality" service?

- Should I advertise myself and my employees?

The answers to these and other questions about what to advertise depend on exactly what kind of operation you have. In other words, think about your business and determine its good points.

*In what ways is it unique or outstanding?* Do you specialize in a certain type of electronic service that no one else in your area offers? Do you sell and service a certain name brand product exclusively in your area? Do you offer radio-dispatched home repair service?

*What are its strengths?* Have you and/or your employees spent many years in electronic service work? Do you have an unusually convenient location? Are your 'open-for-business' long than others? Do you employ all state-licensed servicemen? Are they C.E.T.'s?

*What do you have to offer that the competition can't or doesn't duplicate?* Do you have diagnostic equipment that your competition doesn't have? Do you offer a speedy drive-in service with plenty of free parking? Do you have a special demonstration show-room for the electronic products you sell and service?

There are a lot of other questions your can ask about your business, but the idea is to determine all your strong points—and



as a popular song that's long-gone states—"Accentuate the positive, and eliminate the negative" in your advertising. Above all, don't copy the advertising of your competitors. Don't be afraid to be different.

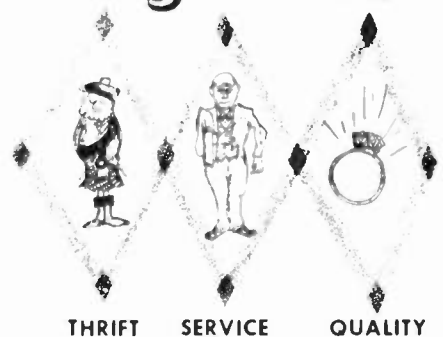
Also remember—in advertising, say only one thing at a time. Choose the major point you want to make, and make it as effectively as you can. In other words, if the story you've chosen to tell is worth the telling, don't dilute it by mix-

ing in a second or third one at the same time. If you try to feature everything in the same ad, you'll end up by featuring nothing.

### Name Brands and Product Advertising

You can give your advertising dollar a running start by featuring nationally advertised brands in your ads, whether you're advertising product or service. Manufacturers spend millions of dollars to advertise their products. By using these brand names and symbols in your own promotion, you can associate your firm with this national advertising and reap the benefits of the drawing power of

### 3 BASIC APPEALS



household names, and the holding power of what the public regards as quality products or services.

Obviously, honesty is necessary in using brand names in your advertising. If you don't sell or service a particular brand don't say so in your ads. But if you do sell and/or service on a regular basis certain brand name products, and especially if you are an authorized sales dealer or service station for one or more brands, include that information in every ad.

### Something About Advertising Appeals

In trying to decide what to include in your advertising copy, a little bit of the psychology of advertising might be helpful.

To understand the job your advertising will have to do, you must look beyond material features or the obvious and search out the intangible appeals that cause people to buy your products and/or services.

People don't buy things—they buy goods that satisfy their wants. Every product or service that is marketable has some benefit that the potential customer must see and want before you can ring up a



sale. In other words, "people buy want-satisfaction".

For example, a *toothpaste maker* uses these appeals in his advertising: "It helps to remove dingy film"—"It penetrates crevices"—"It washes away food particles"—and "It cleans and beautifies the teeth."

And a *motor oil refiner* uses these appeals: "It gives a motor pep and power"—"It provides a quicker get-away"—"It saves up to 15 percent in gas and oil"—and "It frees sticky valves and rings."

### Things People Want

People's wants are fairly standard. Most will react to one or another of the following appeals:

- Convenience or comfort
- Love or friendship
- Desire for security
- Social approval or status
- Life, health, and well being
- Profit, savings, or economy
- Stylishness

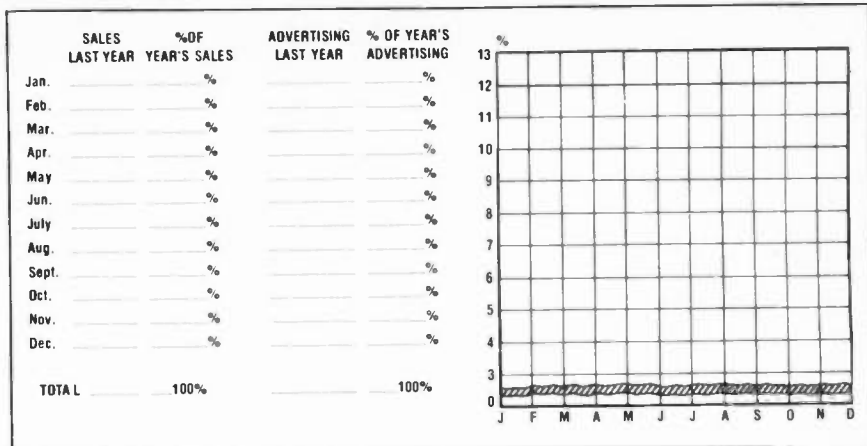
And these may be further simplified to the 3 Basic Appeals: *Thrift* (bargain appeal); *Service* (convenience appeal); and *Quality* (snob appeal).

Interpret your products or services in terms of these appeals. As you advertise, some appeals will get better results than others. Stick with these and reject the weaker ones. In deciding on appeals, remember that women (1) generally read, see and hear advertising more than men, (2) buy approximately 80 percent of the necessities, and (3) greatly influence all other purchases. Only at the lowest income levels do men assert greater influence than women.

### HOW TO BUDGET YOUR ADVERTISING DOLLARS

Promotion (or advertising) is a part of your operating expense, and it should be budgeted just as other operating expenses are. In order to avoid overspending or underspending, set up an advertising budget that can be used as an effective policy guide.

First, include the expense of advertising in your markup calculations. Secondly, put a definite amount into your operating budget to cover the cost of promotion. Then, use the national average of advertising percent of net sales for appliance and radio-TV



dealers, which is 2.45%, and adjust it to your local situation. (A little comparison with friendly, successful competitors might be helpful, if available.)

Make provisions in your budget for: 1) the time or duration of your advertising program, 2) the size, type, and layout of the ads you intend to use, and 3) the media you plan to use.

Finally, check your budget periodically to be sure that your policy is getting results and that your estimated expenses were realistic. A convenient method of matching results with expenses is the chart shown in Fig. 1.

Using this chart, record your sales figures for last year month-by-month. Then figure the percentage for each month by dividing the year's sales into the month's sales. Record those percentages on the chart.

Now, decide what your sales goals for this year should be. Good yardsticks for figuring sales goals are: 1) increased population, income, employment, etc. in your community; 2) new or expanded departments or services in your shop; 3) changes in prices; 4) what competitors are doing; 5) stock on hand; and 6) increased selling and advertising efforts.

Now, on the chart, record the dollar amount month-for-month that you spent on advertising. Then figure the percentage figure by dividing your total advertising amount for the years into each month's figure. Record the advertising percentage on the chart.

To get a visual record of how well your last year's advertising matched sales opportunities, make a simple graph as shown in Fig. 1. Plot in each month's percentages for sales with a dot on the

graph. Connect the dots with a black line.

Now do the same with your advertising percentages. Connect your advertising dots with a red pencil to make the comparison stand out. If your sales and advertising lines don't run fairly close together, you are probably missing selling opportunities. Something is probably wrong with the 'mix' of your advertising media, or in verbal and visual advertising methods. Also, your advertising could be appearing too early or too late to do the best selling job. In other words, your timing may be off.

### DOES ADVERTISING PAY ITS WAY?

If the advertising you have already used does not pay its way, something is either wrong with what you are saying or where you're saying it. Effective advertising, properly placed, should pay you dividends—in the form of greater sales volume, in proportion to the amount of money you spend on it.

Remember these two guidelines:

(1). Your additional dollars of sales volume should total enough to pay for the advertising and the merchandise, operating expense, and net profit on your sales.

(2). The amount of money you plan to put into advertising should be based on the business objective you hope to achieve, the type of business you have (whether it's service only, or service & sales), and the advertising medium you decide is the most economical for reaching your particular goals effectively.

### The Holding Power of Advertising

The question always comes

up—"Why should I advertise? I'm happy with the volume of business I have now."

"Now" is the key word in the answer to that question. *Now* is all right—but how about tomorrow? No business can stand still for long. It must do better or it will do worse. It must grow or it will diminish. It must attract new customers because the market itself is in a constant state of flux. Consumer tastes and loyalties change, people are continually moving into or away from a trade area. An older generation dies or retires and a younger one takes its place.

Stop advertising and, in other ways, promoting your business and see what happens.

The National Retail Merchants Association estimates that the average store would have to go out of business in 3 or 4 years if it did no advertising because the average store loses between 20 and 25 percent of its customers each year, and these must be replaced just to maintain the status quo. This means that if you have 1,200 customers, you must add one customer a day to replace the one you lose.

#### THINGS TO REMEMBER ABOUT ADVERTISING

The two main objectives of advertising for any business—large or small—local or national are to draw in new customers—and to help hold old ones.

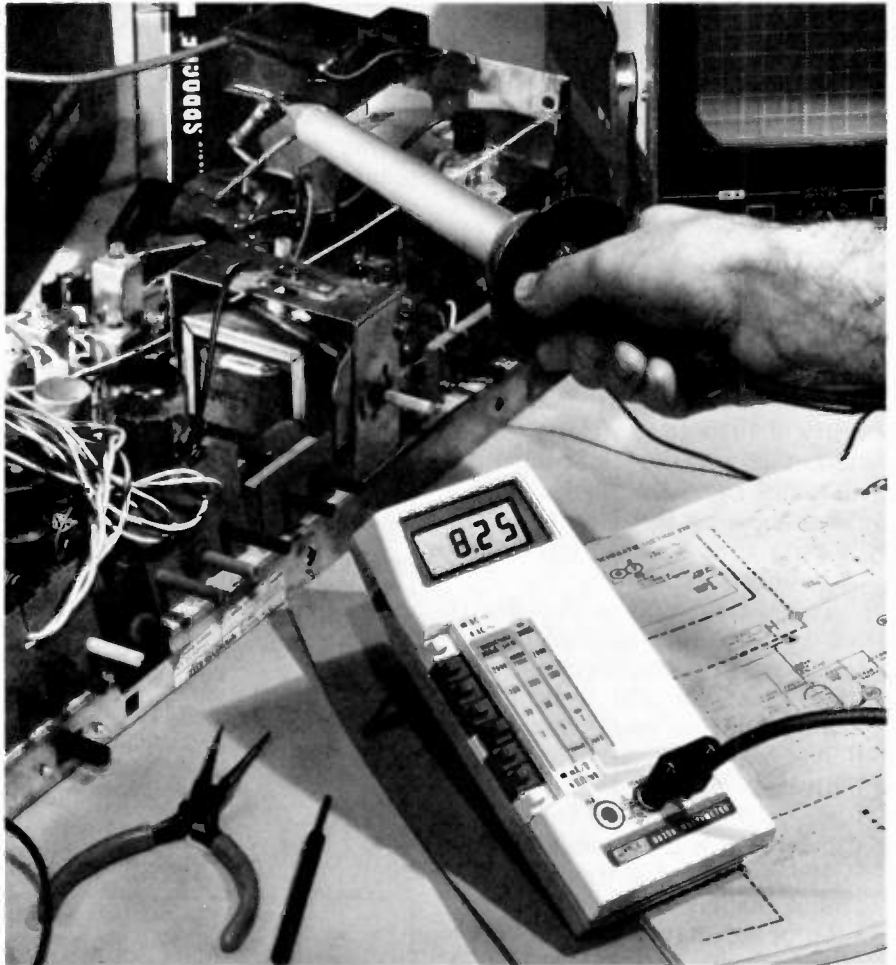
Remember that advertising can:

- Identify a business with the goods and services it offers.
- Build confidence in a business.
- Create good will for the business.
- Increase sales and speed turn-over.
- Reduce your expense by spreading them over a larger volume.

And remember that advertising cannot:

- Make a business prosper if that business offers only a poor product or an inferior kind of service.
- Lead to sales if the prospects which it brings in are ignored or poorly treated.
- Create traffic overnight, or increase sales with a single ad. (Too many small businesses use a touch-and-go advertising policy).
- Build confidence in the business if the advertising is untruthful or misleading. ■

# How do you really use a multimeter?



Usually at your bench, in the shop, shared with others. And, if it's a Fluke multimeter, you use it with confidence.

Now you can carry that same bench precision on the job. Introducing the new Fluke 8020A DMM for only \$169.\*

This rugged beauty packs more field-valuable features than any other DMM available, at any price. And that means field versatility when you need it most.

The 8020A has six resistance ranges, including a 20 megohm range for those special high-resistance TV components. Plus, you can measure focus dividers, pcb and capacitor leakage clear up to 10,000 megohms with the new conductance function. And conductance allows you to measure transistor beta—unique

with the 8020A.

Ever damaged your meter in the fly-back circuit? Rest easy. The 8020A is MOV-protected to 6000V against hidden spikes and transients.

Your 8020A comes with a full-year warranty, with worldwide service backup. Regardless of what happens to it, we'll fix it inexpensively and quickly, making the 8020A a truly cost-effective investment.

Call (800) 426-0361, toll free. Give us your chargecard number for immediate delivery. Or, we'll tell you the location of the closest Fluke office or distributor. (Buy ten 8020As for only \$1521!\*)

\*U.S. price only.

**Command Performance: Demand the Fluke 8020A.**

1807-7007

**FLUKE**®

...for more details circle 113 on Reader Service Card

# TEST INSTRUMENT REPORT



## DIGITAL FREQ COUNTER

■ Simpson Electric Company's Model 710 digital frequency counter has a measurement capability of 10Hz to 60MHz, a resolution of 1Hz in the 'Hz' range and 1KHz in the 'MHz' range, and a rated accuracy of +1 count (+ the 10 ppm time base accuracy), yet costs only \$150.

The Model 710 is equipped with a 6-digit, .35-inch-high LED readout, a pushbutton-selectable low-pass input filter (which eliminates error-producing noise), a standard BNC-type input connector, and a built-in bench stand.

Sampling times of the Model 710 are 5 times per second in the 'MHz' range and .5 times per second in the 'Hz' range.

Dimensions of the new frequency counter are 2 inches by 5.6 inches by 4.6 inches.

Optional accessories available for the Model 710 include a 4-foot shielded input cable, a 50-ohm dummy load, an adapter for 12 VDC operation from a vehicle cigarette lighter receptacle, standard and low-capacitance probes, and a carrying case.

For more information about this test instrument circle No. 148 on the Reader Service Card in this issue.

## BATTERY-POWERED SEMICONDUCTOR TESTER

Sencore recently announced a portable, battery-powered version of its 'Super Cricket' type of semiconductor tester.

This latest addition to Sencore's line of ease-of-use-oriented semiconductor testers is designated the TF46 Portable 'Super Crick-

et' and features a provision which automatically turns off the instrument after twenty minutes of continuous operation, to extend battery life.

The TF46 also can be powered from AC via an AC-to-DC power adapter (Model PA202), which is available for \$9.95. The adapter automatically bypasses the power-off-after-twenty-minute feature of the TF46, so that during bench use the user will not have to bother with turning the instrument back on every twenty minutes.

Testing capabilities of the TF46 include in-and-out-of-circuit good/bad testing of bipolar and field-effect transistors (FETs) and semiconductor diodes, plus out-of-circuit direct measurement of bipolar transistor beta and leakage, FET transconductance (in microhms, and leakage (ICBO of bipolars, and IGSS and IDSS of FETs). In addition, the TF46 also provides identification of transistor polarity (NPN or PNP for bipolars, and N- or P- channel for FETs), plus element identification.

Six definitively-labeled push-buttons provide function selection, and transistor polarity and element identification are accomplished by a 12-position rotary switch.



Price of the TF46 Super Cricket is \$195.

For more information about this test instrument circle No. 149 on the Reader Service Card in this issue.

## PORTABLE FET VOM

The VIZ Test Instruments

Group of VIZ Manufacturing Co. has introduced a new analog-type FET VOM that is especially useful in servicing solid-state equipment.

The new portable electronic VOM operates either on AC or on self-contained batteries. It is equipped with a FET (field-effect transistor) differential-amplifier circuit for accurate measurement of AC and DC current from 0.005 milliamperes (5 microamperes) to 1.5 amperes in nine ranges.



Called the VoltOhmyst Model WV-543A, the new FET VOM features a 'low-power' resistance function which limits both voltage and power supplied to solid-state devices under test. Thus, because semiconductor junctions in the circuit do not conduct, resistances in-circuit can be accurately measured. An ohms/polarity indicating meter is provided on the front panel as well as an ohms-polarity switch for convenient circuit testing.

The new electronic VOM also features auto-polarity on all DC voltage and current ranges. Regardless of the actual polarity, all readings are upscale, with polarity shown on a separate front-panel meter.

The new VOM features a 10-megohm input impedance; overload protection of the FET circuit and the meter movement; a large, easy-to-read color-coded meter scale; a 100° arc mirrored scale, to prevent parallax-caused errors in readout; pushbutton function switches combined with a 24-position detent-type range selector switch; a shielded probe and case; and decibel measurement from -50 dB to +56 dB with a standard 0 dB reference of 1mW into 600Ω.

The VoltOhmyst V comes com-



plete with one AC/DC ohms probe, one set of test leads with banana plugs, and an AC adapter. Power in the resistance-measuring mode is derived from eight 1.5 V "AA" cells and one 1.5 V "C" cell (batteries are not supplied). The price is \$150.

For more information about this test instrument circle No. 150 on the Reader Service Card in this issue.

#### WIDEBAND TEST INSTRUMENT PROBE

A new wideband instrument probe has been announced by B&K-Precision. The new probe, Model PR-37, is designed for use with oscilloscopes and frequency counters in applications through 100 MHz.

The PR-37 is a slim-body probe of lightweight construction. A three-position switch selects 10:1 or direct modes, or a reference position that grounds the tip through a 9 megohm resistor.

A complete set of accessories is supplied with the PR-37, including a spring-loaded retractable tip-cover, insulating tip, BNC tip

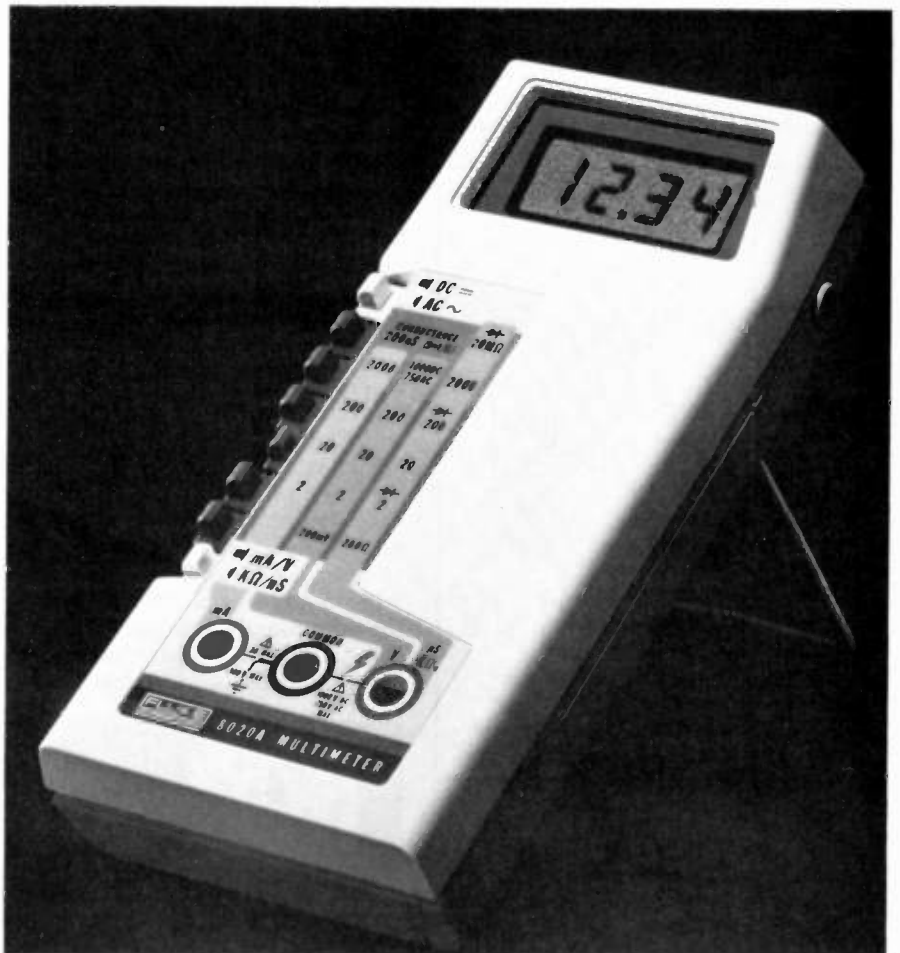


adapter, IC tip and an insulated compensation capacitor adjustment tool. The insulating tip is designed for probing dense solid-state circuitry with no danger of shorting nearby components.

For interface with test points or output jacks, the BNC adapter converts the probe tip into a push-on BNC connector. The IC tip guides the probe contact onto any pin of a standard DIP, making it almost impossible to short two pins of an IC. The PR-37 and accessories, in a convenient zippered vinyl case, is priced at \$40.

For more information about this test instrument circle No. 151 on the Reader Service Card in this issue. ■

# The reasons for giving up analog.



The best reason is accuracy of 0.25% dc. The 8020A digital multimeter has it, and that's *ten times* better than most analog meters!

And we guarantee that accuracy for a full year, plus we've calibrated your 8020A with equipment that's NBS traceable. A tradition with Fluke.

But you're also buying performance. Like high/low power ohms and *conductance*—the missing function on other multimeters. Ten megohm input resistance on both ac and dc. Plus more, for only \$169.\*

The tougher your job gets, the more you need resolution, and the 8020A offers a full 2000 counts. The large 3½-digit liquid crystal display is readable

anywhere. Inexpensive 9V battery power means continuous operation for up to 200 hours.

The new 8020A is especially suited for TV service. Measure transistor voltages within 10 millivolts, even when they float as high as 20V. With the 200Ω range, you also can measure circuit breaker resistances within 0.1Ω. Try that with analog.

Get your hands on an 8020A today: Call (800) 426-0361, toll free. Give us your chargecard number for immediate shipment. Or, we'll tell you the location of your local Fluke office or distributor. (Buy a ten-pack of 8020As for only \$1521\* and save \$169!)

\*U.S. price only.

## Fluke 8020A DMM for TV Service: \$169.

1807-7008



...for more details circle 114 on Reader Service Card

JULY 1977, ELECTRONIC TECHNICIAN/DEALER / 37

## DEALER SHOWCASE

Descriptions and specifications of the products included in this department are provided by the manufacturers. For additional information, circle the corresponding numbers on the Reader Service Card in this issue.

### CB MICROPHONE CONNECTORS 131

A new point-of purchase merchandiser featuring a dealer stock of Eltratec CB microphone connectors is now being marketed by *Workman*. Designated Model WD491, the wire counter display offers 14 different



types of connectors that cover 95% of the CB transceivers on the market today. A cross-reference feature permits counter sales personnel to select the proper connector by CB model number. Each WD491 display includes 90 individually packaged mike connectors. The display included a colorful header sign.

### COMPUTER-CONTROLLED CB 132

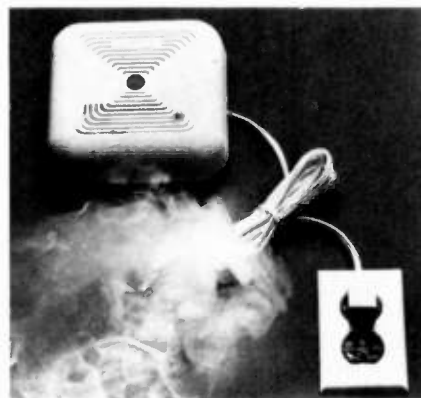
A new 40-channel single sideband/AM mobile CB radio and base station that are controlled by two microcomputers has been announced by



*Texas Instruments*. Designated model SM-172 for the mobile radio and SB-173 for the base station, the new radios feature operating controls located on a small, lightweight handset, with memory-stored, push-button selective calling. The handset control head comprises a keyboard for digital control; five-digit LED display for quick data response on channel and SSB mode selection; signal strength and standing wave ratio (SWR); a microphone and rocker switches for squelch, channel select, volume control, and push-to-talk. One microcomputer is in the control head; the other microcomputer controls the transceiver by reacting to commands from the control head. Suggested retail price for the mobile radio will be \$325 and \$375 for the base station.

### HOME SMOKE ALARMS 133

A new AC-powered home smoke alarm featuring a nine-foot cordset has been introduced by *General Electric*. Called the Home Sentry, the new smoke alarm monitors surrounding air 24 hours a day. When combustion particles, small enough to be barely visible, reach the vicinity of the alarm system, the system is activated and triggers the alarm. The new alarm, of the dual chamber ionization type, features a signal indicator light which shows that the unit is energized and



working. The alarm system can be checked by pushing a test-fire drill button that simulates smoke. The new corded model features a plug retainer, which fastens under the electrical outlet plat screw to help prevent accidental unplugging. Suggested retail value for the corded alarm is \$39.95.

### VOICE REINFORCEMENT SYSTEM 134

A new voice reinforcement system that offers sound column audio penetration in a completely portable version is being introduced by *Perma Power*. Called the Model S-230, the new system features a 35 watt solid state amplifier, a professional dynam-



ic cardioid microphone, and a six loudspeaker sound column. It is said that it will cover audiences up to 3,000. To use, the speaker simply opens the carrying case, plugs the components together and positions them where they are wanted, and starts to talk. No electrical plug-in is necessary because the amplifier is powered by 10 D-size flashlight batteries. However, a 120 VAC adapter is available if desired. The sound column of the S-230 uses six high efficiency 5-inch loudspeakers, positioned in a frequency tapered sound column. Amplifier is rated at 35-watts output and is of transistor and IC design. Inputs are provided for microphone, phonograph, tuner, or tape recorder, with outputs for 4 to 16 ohm speakers. Priced at \$349.50.

### HOME & OFFICE INTERCOM SYSTEM 135

A new wireless, two-station intercom system that requires no installation for use in home and office has been introduced by *GC Electronics*. This lightweight, portable system permits 2-station communication between 20 feet and  $\frac{3}{4}$  of a mile. A single control regulates the volume and the "on" light. A lock button allows for dictation or continuous monitoring of children's playroom. An automatic squelch and factory pre-set frequency are additional features. Single units may be added on later. The system

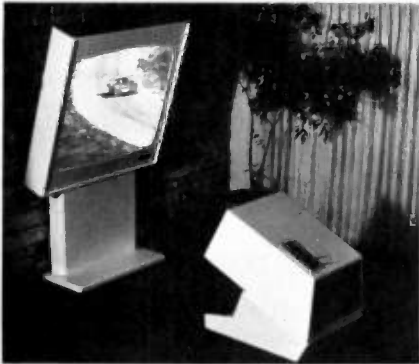


(30-6025) has a four transistor circuit, 150 mW output, 2½ inch dynamic speaker and operates on a standard 180 KHz frequency.

**GIANT SCREEN VIDEO PROJECTION**

136

A new version of large screen projection TV for home use has been introduced by the Amtron Video Corporation. Called the Epic 100, the new unit utilizes a direct beam, as opposed to mirror reflection, and is said to produce a bright, crisp, clear image. The Epic 100 features a 51 inch diagonal



screen, is modular solid-state, and receives both VHF and UHF broadcasts. It is adaptable, without modification, for cable and closed circuit TV, video tape cassettes or discs, video games and features an optional remote control unit. Contemporary cabinet styling is available in ivory or coffee finish.

**AEROSOL FIRE EXTINGUISHER**

137

A new fire extinguisher in an aerosol can that's ideal for small fires involving oil, wood, electricity or gasoline has been introduced by Mountain West Alarm. Designated A-20, the new aerosol power carbon dioxide spray is not a conductor of electricity and will not damage cloth, varnish or paint outside the fire area. Each can weighs 1½ pounds and is priced at \$3.50.



# Don't let size and price get in the way of digital.



The new 8020A, at only \$169,\* packs a lot of capability for a small, lightweight (13-oz.) digital multimeter.

Carry it in your pocket, or your parts caddy. Anywhere. But it's in your hand that you'll appreciate the 8020A's performance, reliability and ease of operation.

And the 8020A is as simple to repair as it is to operate. Fix it yourself if you like, with all 47 parts available at Fluke service centers worldwide. But for the first year, don't worry—our solid guarantee covers it.

The 8020A's usefulness is extensive—use it with our 80K-40 high voltage

probe, for example—a good match. With accuracy of ±1% at 25 kV, it's just right for precise CRT measurements.

And for a limited time, buy both the 8020A and the 80K-40 for only \$199,\* and save \$20 off the price of individual units.

Clip the special coupon below and rush to your local Fluke office or distributor. Call (800) 426-0361, toll free. We'll tell you the closest office. Or, give us your chargecard number and we'll ship both today!

\*Price and offer good in U.S. only.



## SAVE \$20

off the list prices of the 80K-40 probe and the 8020A DMM by presenting this coupon to your local Fluke office or distributor. Price and offer good in U.S. only; coupon expires October 31, 1977.

1807-7009



...for more details circle 115 on Reader Service Card



## NEW PRODUCTS

Descriptions and specifications of the products included in this department are provided by the manufacturers. For additional information, circle the corresponding numbers on the Reader Service Card in this issue.

### UHF BROADBAND AMPLIFIER 152

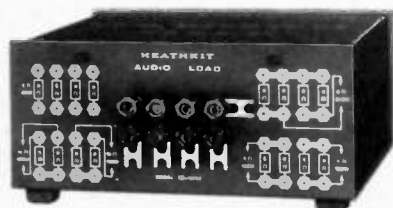
A new UHF broadband MATV amplifier that delivers an output of 50dBmV on each of 5 UHF channels at 0.5% cross modulation is now available from the *Winegard Company*. Designated Model DA-4300, the new amplifier features a high gain of



+32dB that can overcome higher systems losses by taking weak signals and building them up to a usable picture level. The DA-4300 has a 20dB variable gain control that allows the installer to reduce the gain in areas where there's a stronger signal than is needed, preventing cross modulation. The amplifier has a noise figure of 10dB avg., including UHF translator frequencies. It lists at \$119.00.

### AUDIO LOAD KIT 153

A new audio load kit for service technicians, manufacturers and audiophiles is available now from the *Heath Company*. Designated Model ID-5252, the new product provides audio loads of 2, 4, 8, 16, or 32 ohms for amplifier testing according to manufacturer's specifications and the IHFM. A series of five-way binding posts allow it to handle up to 240 watts mono or four 60 watt inputs, both into 8 ohms. In addition to the various resistor values, there are jacks for connecting a voltmeter, oscilloscope or other instrument at the load in use. The ID-5252 includes four 3-foot No. 12 gauge leads with spade lugs. Priced at \$44.95.

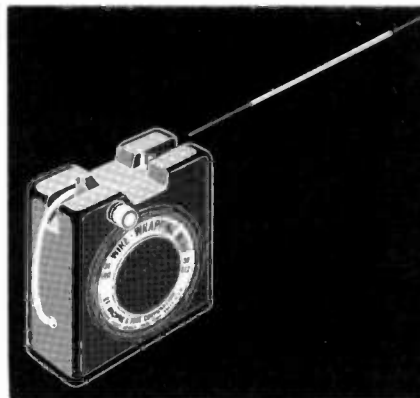


### SERVICE & ASSEMBLY BENCHES 154

A new series of benches designed to permit selection of optional features for electronic assembly, testing, service, and lab work has been introduced by *Advance Engineering Systems*. The series starts with a stable, vibration-free bench in 30 or 36 inch depth and 30 or 34 inch height. From this basic bench, it is possible to add an instrument shelf and electrical circuits at up to 9 optional locations. Bench top is covered with non-glare, white thermosetting plastic. They are available in 4, 5, 6, and 8 foot lengths, and priced at \$89.00 for the basic bench.

### WIRE DISPENSER 155

A new wire dispenser that has cutting and stripping capability is now available from the *O.K. Machine & Tool Corp.* When the wire is drawn out

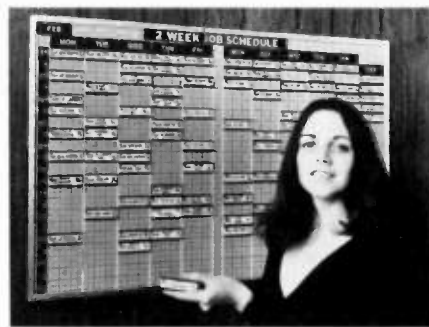


to the required length, a built-in plunger cuts the length free from the roll and a gentle pull through a stripping blade removes the insulation. Repeating the procedure strips insulation from the other end. The new WD Series dispenser includes a 50 foot roll of AWG 30 top industrial quality, silver plated copper wire. Insulation comes in blue, white, yellow or red.

### JOB SCHEDULE BOARD 156

A new 2-week magnetic job scheduling board has been introduced by *Methods Research*. The new scheduling board makes the time schedule for

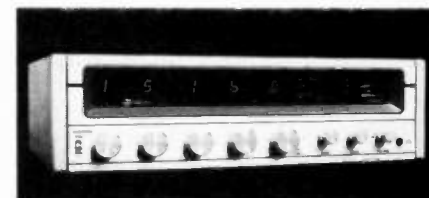
each job visible to all persons involved, showing job description, job number, and day and time job will run. The light grey, lithographed gridded boards come in two sizes, 2 foot by 3



foot and 4 foot by 3 foot. They come equipped with colored acetate tape for making lines and headings printed with month, day and hour. Each board features magnetic cardholders with card inserts in 5 colors.

### COMMUNICATIONS RECEIVER 157

A new all-wave, synthesized communications receiver covering the entire frequency range of 50 KHz to 29.7 MHz has been introduced by *McKay Dymek Company*. Designated Model DR-22, the new digital readout receiver features high sensitivity coupled with wide dynamic range and high selectivity. It is said to receive weak stations in the crowded high and medium frequency bands where overload, intermodulation and cross modulation can cause reception difficulties. It is equipped with switch selectable 4 or 8 KHz band width ceramic filters. The DR-22 has a digital phase



locked loop tuning system for tuning in AM broadcast stations, international short wave, ham radio and CB. AC power consumed is 30 watts. It is priced at \$995.

### SEMICONDUCTOR REPLACEMENTS 158

A number of solid-state devices have been added to the ECG semiconductor line from *GTE Sylvania*. The new types include: ECG172A, and NPN silicon darlington amplifier for audio pre-amp and switching applications; ECG322 thru 326, a series of silicon transistors for use in CB, audio, and industrial equipment; ECG426, an assortment of metric hardware found in imported entertainment equipment;



"I personally read the service 'report cards' returned by customers. Their comments keep our technicians conscientious."



"We designed a classroom into our service center to help our people keep abreast of new technical developments."



"We think physicians have an easier job than we do. They treat the same old body all the time. Our patient keeps changing."

# "Over 60% of our sales is repeat business. Most people mention good service as the reason they came back."

Charles Marling, Ed Marling's TV, Topeka, Kansas 66603

"We believe that it's better to lose money on a customer who honestly believes he's right than to insist he's wrong and save a couple of bucks. If you lose that customer, you lose his family and friends too. We bend over backwards to make sure our customers are satisfied..." says Charles Marling, President of Ed Marling's stores.

### Ed Marling started in 1936.

Marling's service center covers over 15,000 sq. ft.; ten times larger than the original facility. Bill Weidner, supervisor of the service operation will retire soon. He began working for Ed Marling, Charles' father, in 1936 when they specialized in radio/phonograph repair. Bill has played a major role in planning the efficient new service center using his long years of experience to good advantage.



The nerve center of the service operation is the radio dispatch desk. Mrs. Rita Halderman talks with Service Manager Bill Weidner before relaying a call to one of 18 radio-equipped trucks.

Ed Marling's Stores, Inc., is a multi-million dollar business. The new service center, located in a former warehouse, serves four Marling retail stores—three in Topeka and one in Lawrence.

It's equipped to provide service on all electronic and appliance products, ranging from microwave ovens and refrigerators to lawn mowers and TV's.

And even though Marling's doesn't sell "fish-finders," their service expertise on fish-finders has earned a "word-of-mouth" reputation among fishermen as far away as Texas.

Eighteen RCA radio-equipped vehicles average a total of 135 service calls a day. About 43,000 in-home calls a year provide

service on TV's and "appliances" to customers within a radius of 45 miles.

**A team effort is the key to Marling's success.** After completion of their new building, Bill Weidner prepared rough floor plan layouts. From there, Electronics Service Manager Roy Bassett and Asst. Service Manager Everett Alfrey developed the final plans for the major appliance service area and the customer service counter. Assisting them, individual technicians provided input describing their needs for work space in several areas including television, white goods, and mower repair. They also had to consider the needs of the parts department, storage areas for new and used merchandise, water facilities, gas, electricity, and antenna systems.

The efficient shop is divided into well lighted, mirror lined U-shaped work spaces.

The office and reception area was added to the front of the revamped structure, with the parts department placed between the customer desk and the service area, making parts readily available to both customers and technicians. Parts manager Tom Waters designed his own department layout which maintains an inventory of \$175,000 in parts.

**Special listening room for sound problems.** A small room next to the service area is used to handle especially troublesome audio problems in any sound system or television. It is equipped with four large speaker enclosures. An acoustic tile ceiling and carpeted floor provide optimum listening conditions for quadrasonic work.

The mower repair shop is located at the far end of the building because of the noise level. For his convenience, the mower specialist maintains his own parts supply there.

### Busy but efficient dispatch desk.

The dispatch desk maintains two-way radio contact with the 18 service vehicles on Marling's own radio frequency so "traffic" is never a problem. Each driver is listed on the master call-board where service requests are clipped and relayed by radio as soon as possible. Nearby is the "Service Schedule" blackboard. It lists product category and the day service is expected to be available. This enables the office staff to tell customers when they can expect service.

**Customers know the charges prior to actual service calls.**

Marling's customers are informed in advance about all costs to avoid surprises. The service ticket is designed for itemized estimates of parts and labor with space for the final charges. Basic data on the form includes whether the unit was picked up, brought in or serviced in the home, where the set was purchased, and warranty information with model and serial numbers.

After service is completed the customer gets an "Electronic Service and Parts Warranty" form explaining the 30-day labor and 90-day parts Marling guarantee. Service records are kept in an active file for two and one half years, then transferred to inactive files for five years, and finally to a microfilm file for up to 12 years.

**"Report Cards" keep courtesy at the top of the class.**

Marling's customers receive a post card asking them to rate Marling's on telephone courtesy, promptness of service, quality and neatness of work, delivery service and the attitude and appearance of the serviceman.

Maintaining customer satisfaction in neatness, courtesy, etc. is only part of the continuing training program. Bill Weidner also keeps his team of technicians well-informed. Bill says, "With a variety of brands and product categories being handled our people are going to school constantly."

The "school room" is outfitted with forty desk-chairs Bill bought at a school board auction. There is also a slide projector and movie projector for training films.

Every first and third Tuesday of the month, Marling techs attend different product category training sessions. Bill says, "Just to keep up with the pace of technology is a challenge. And if we're going to provide the kind of service that brings people back, we're going to have to keep up with that pace."

# RCA

Consumer Electronics Division  
600 N. Sherman Drive  
Indianapolis, IN 46201

## Better Service Through Better Communications.

...for more details circle 121 on Reader Service Card

ECG 501A, a selenium tripler for TV sets; ECG 601 and 604 varistors used in a variety of imported equipment; ECG 973 thru 976, a series of linear integrated circuits for use in communications equipment; and ECG 1161 thru 1167, linear integrated circuits for CB radios and TV sets.

### INDOOR CB BASE STATION ANTENNA

159

A new CB base station antenna that doesn't require roof, window or balcony mounting has been introduced by *New-Tronics*. Designated the Hustler HP-27, the antenna is contained in a decorative housing, and installs instantly between any floor and ceiling like any pole lamp. Tuning of the



HP-27 is accomplished by adjustment of two free sliding tuning sleeves. One setting covers all channels and no tools are required. SWR at resonance is adjustable to 1.1:1 or better. For 40 channel operation, SWR averages well below 2:1. The new antenna, complete with 17 foot coax cable and factory installed connectors, lists for \$42.95.

### DIGITAL FREQUENCY COUNTER

160

A new digital frequency counter designed to indicate the frequency of any signal from 5 kHz to 40 MHz with a level of 50 microvolts or more has been developed by *Siltronix*. Called the



model FC-1, the new counter features one-half inch high easy-to-read light emitting diodes (LED) numbers and a two-position sensitivity switch for hard-to-read signals. A two-crystal controlled time-based switch provides resolution to either + .1 kHz or + 1 KHz. The FC-1 is powered from 117 AC or a 12-volt battery. Priced at

\$169.95 with parts and labor under warranty for six months.

### PULSATING CLEANER & DEGREASER

161

A new device that provides pulsations for aerosol cleaners and degreasers is being introduced by *Chemtronics, Inc.* Called the *Vibra-Jet*, the new product works on the principle of the "venturi effect" which creates a pressure differential in an aerosol spray, producing a pulsating solvent jet. When connected to an aerosol cleaner or degreaser, the pulsating action provides the mechanical force necessary to dislodge hard-to-remove contaminants. It is claimed that the device will remove dirt from horizontal surfaces, increase solvent penetration of surface pores and remove con-



taminants not normally removed by the cleaners themselves. Comes complete with a 26 inch flexible polyurethane hose and 12 inch probe for reaching inaccessible areas. The new device is being offered with the purchase of two cans of the firm's product, *Tun-o-Wash*.

### FORTY-CHANNEL RF GENERATOR

162

A new RF generator designed for 40-channel CB transceiver service is now available from *Hickok*. Designated Model 256, the new generator offers 5-band frequency tuning, covering channels 1 to 40. Frequencies of 100 kHz through 16 MHz are covered on the other four bands to provide all IF requirements including 455 kHz



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| 2SD 235    | 4 pcs  | ZSC 1239 | 3 pcs |
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|-------------|---------|---------|---------|---------|---------|---------|----------|----------|----------|----------|------|-----------|------|
| ZSA 495     | 70      | ZSB 463 | 150     | ZSC 517 | 3.95    | ZSC 777 | 3.50     | ZSC 1061 | 1.40     | ZSC 1678 | 2.25 | TA 7062P  | 1.90 |
| ZSA 562     | 59      | ZSB 471 | 160     | ZSC 535 | 70      | ZSC 778 | 3.60     | ZSC 1096 | 1.00     | ZSC 1679 | 4.25 | TA 7205P  | 3.90 |
| ZSA 568     | 59      | ZSB 474 | 120     | ZSC 536 | 59      | ZSC 781 | 2.65     | ZSC 1166 | 59       | ZSC 1684 | 59   | BA 511    | 3.40 |
| ZSA 628     | 59      | ZSB 492 | 100     | ZSC 562 | 2.15    | ZSC 784 | 59       | ZSC 1173 | 90       | ZSC 1728 | 2.00 | BA 521    | 3.70 |
| ZSA 634     | 90      | ZSB 499 | 100     | ZSC 567 | 2.15    | ZSC 785 | 70       | ZSC 1175 | 90       | ZSC 1760 | 2.00 |           |      |
| ZSA 640     | 59      | ZSB 500 | 100     | ZSC 568 | 59      | ZSC 789 | 1.00     | ZSC 1189 | 1.40     | ZSC 1816 | 4.25 |           |      |
| ZSA 643     | 70      | ZSB 501 | 100     | ZSC 569 | 59      | ZSC 793 | 2.80     | ZSC 1213 | 70       | ZSC 1908 | 59   |           |      |
| ZSA 683     | 70      | ZSB 502 | 100     | ZSC 570 | 59      | ZSC 799 | 3.60     | ZSC 1226 | 1.00     | ZSC 1909 | 4.40 |           |      |
| ZSA 719     | 70      | ZSB 503 | 100     | ZSC 571 | 59      | ZSC 802 | 3.60     | ZSC 1237 | 4.25     | ZSC 1957 | 1.20 |           |      |
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| ZSA 721     | 70      | ZSB 505 | 100     | ZSC 573 | 59      | ZSC 828 | 59       | ZSC 1306 | 4.40     | ZSD 77   | 1.00 |           |      |
| ZSA 733     | 59      | ZSB 506 | 100     | ZSC 574 | 59      | ZSC 829 | 59       | ZSC 1307 | 4.90     | ZSD 142  | 2.00 |           |      |
| ZSB 54      | 59      | ZSB 507 | 100     | ZSC 575 | 59      | ZSC 838 | 59       | ZSC 1317 | 59       | ZSD 180  | 2.50 |           |      |
| ZSB 75      | 59      | ZSB 508 | 100     | ZSC 576 | 59      | ZSC 839 | 59       | ZSC 1318 | 59       | ZSD 187  | 66   |           |      |
| ZSB 77      | 59      | ZSB 509 | 100     | ZSC 577 | 59      | ZSC 900 | 59       | ZSC 1330 | 1.50     | ZSD 188  | 3.00 |           |      |
| ZSB 186     | 59      | ZSB 510 | 100     | ZSC 578 | 59      | ZSC 930 | 59       | ZSC 1359 | 1.40     | ZSD 277  | 59   |           |      |
| ZSB 324     | 70      | ZSB 511 | 100     | ZSC 579 | 59      | ZSC 945 | 59       | ZSC 1377 | 4.90     | ZSD 325  | 1.00 |           |      |
| ZSB 337     | 160     | ZSB 512 | 100     | ZSC 580 | 59      | ZSC 945 | 59       | ZSC 1449 | 1.00     | ZSD 313  | 1.10 |           |      |
| ZSB 367     | 150     | ZSB 513 | 100     | ZSC 581 | 59      | ZSC 945 | 59       | ZSC 1475 | 1.40     | ZSD 325  | 1.10 |           |      |
| ZSB 368     | 2.15    | ZSB 514 | 160     | ZSC 582 | 1.50    | ZSC 945 | 59       | ZSC 1674 | 1.55     | ZSD 360  | 1.20 |           |      |
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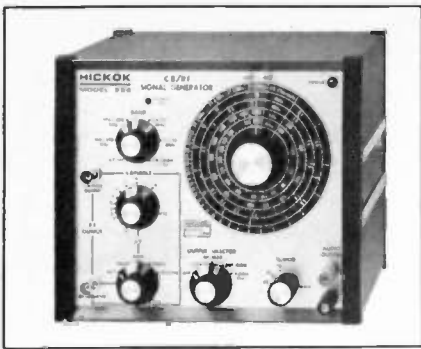
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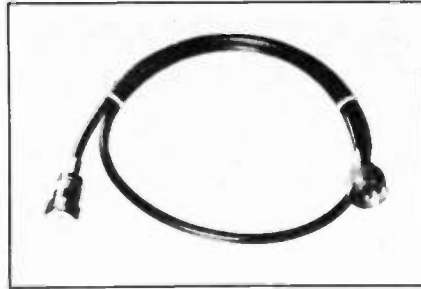


and 10.7 MHz. Frequency selection is accomplished by connecting the counter output jack to a frequency counter for continuous monitoring. A calibrated/attenuated output control provides RF signal output of 100,000  $\mu$ V down to less than 1  $\mu$ V for receiver sensitivity checks. The attenuated output is variable in 20 dB steps and by a 20 dB continuously-variable control calibrated in microvolts. Internal modulation at a frequency of 1 kHz is variable from 0 to 100%, calibrated at 30%. Provision is also made for use of external modulation at frequencies from 20 Hz to 10 kHz through front-panel out/in jacks. Priced at \$199.

#### COAX EXTENSION CORD 163

A new extension cord that extends coax cable without having to use a

double female cable splice, is available now from *Gold Line*. The new cord features a plug on one end and a receptacle on the other end. It is furnished in lengths of 5 feet (MF585), 12 feet (MF812), 20 feet (MF820), and 50 feet (MF5850).



#### FIELD STRENGTH ANALYST 164

A new test instrument that combines the features of an all channel field strength meter and a TV tuner analyst has been introduced by *PTS Electronics, Inc.* Designated Model 5001, the new instrument, when used as a Field Strength Meter, is tunable to all UHF and VHF channels and has a three-position attenuator switch which allows signal measurement from 0 to 100,000 microvolts. The meter scale is calibrated in microvolts and dB's, and the analyst portion can be used to substitute the VHF and

## TUNER SUB \$19.95

Since all tuner subs that we know of are modified TV Tuners, we decided to market an excellent performing yet very low cost sub for the technician who has to get all he can for his money...a "Poor Boy's Sub" for only \$19.95.

This was not an easy task since cabinets, knobs and controls would push the price far above \$19.95...We searched for a tuner that needed no cabinet and no controls...one that the tech could scrounge the knobs from most any old TV...

It took over two years but we finally found it. The gain is excellent...Battery drain is very low (only 18 mils). It's self biasing so there is no R.F. gain control to fiddle with...It works equally well on tube or transistor sets...b/w or color...and is as easy to use as starting a fight with your wife (well, almost). All you need do is hook the set's IF cable to the "Poor Boy" and view the picture...That's it...no set up controls to confuse you.

We compared the "Poor Boy" with other subs costing over twice the price and found it to work just as well on all the comparison tests we made...and often a lot easier to use...Even though instructions aren't needed...you get those too.

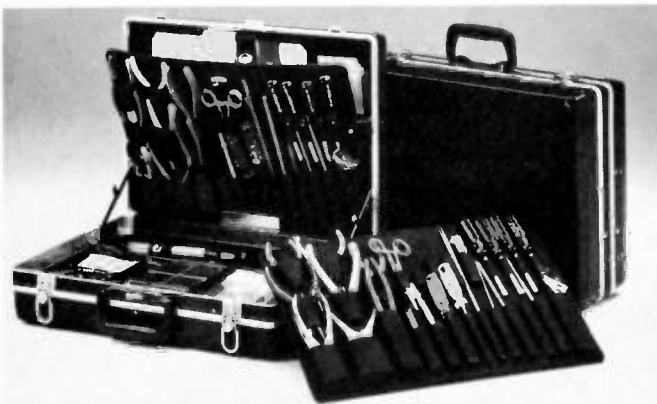
The "Poor Boy" is small enough to easily hold in one hand...no wires or controls dangling around. It comes completely wired and tested including batteries and ready to use. Send a check for only \$19.95, and we even pay the shipping (how about that?) or we will ship COD.

Try it for 10 days...If not completely satisfied...return for full refund.

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Platt also has rugged hardware. Like an aluminum rim for extra strength. Steel core handles. And tough brass locks.

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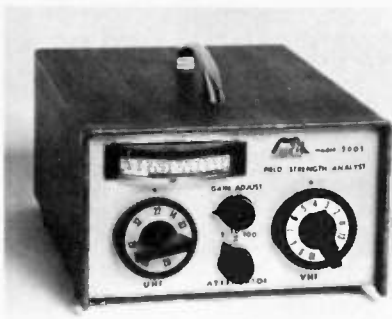
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UHF and/or any combination of the two for any 41 MHz television receiver. It can also be used to check the IF and AGC stages of a TV receiver. Powered by either AC or DC, the Model 5001 has a 300 ohm input for standard home installations and a 75 ohm input for maintaining and installing CATV and MATV systems.

**POLYETHYLENE TOOL CASE 165**

A new blow-molded tool case that is dent-proof, shatter-proof, and scuff-proof is now available from *Platt Luggage*. Designated Model 615T, the new case is compact and lightweight and



designed for tools, parts and equipment. Constructed of polyethylene, the case features single unit construction with a strong double wall, molded locks, handle and hinge. It comes with a molded pallet to hold a large selection of tools, weighs 3¼ pounds, and is guaranteed for five years. Priced at \$30.50.

**CORDLESS SOLDERING GUN 166**

A new heavy-duty cordless soldering gun with automatic feed has been



introduced by the *Wahl Clipper Corporation*. Called the Iso-Tip gun, the new tool is said to have the power reserve and versatility to solder everything from #12 electronic connections to micro circuitry. It contains a built-in refillable .062 solder spool and self-feeding mechanism that operates by fully depressing the trigger. If the self-feeding feature is not needed, another model of the Iso-Tip gun is available without the self-feed. A plug-in battery charger is standard equipment with the gun and will recharge the unit overnight. Each charge will make up to 400 electronic joints. The tip comes up to 700° within 5 to 10 seconds.

**HAND-SIZE VOM 167**

A new hand-size VOM with a -50° to +300° F temperature range has been introduced by the *Triplet Corporation*. Called model 390, the new meter features five AC/DC voltage ranges from 0-1200 Volts, four DC milliamp ranges from .6-600 mA and four ohm ranges from 10k to 10 megohms. Two direct reading temperature scales from -50° F to +150° F and +50° F to +300° F are included along with a temperature probe. The bare probe is used for surface temperature measurements and an aluminum shield is used to protect the probe from damage

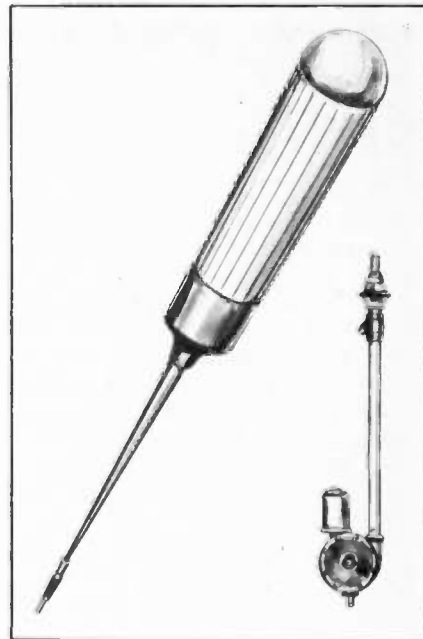


when taking air temperature readings, or when the probe is stored in the meter case. Included with the meter is the leather carrying case, temperature probe, VOM leads, a clamp-on AC ammeter, and a plug-in line separator for current readings on standard line cords. Priced at \$120.

**NESTING CB/AM/FM ANTENNA WITH SIGNAL LAMP 168**

A new automatic, motor driven CB/AM/FM mobile antenna that features a nesting function and a transmit-actuated neon lamp that glows when in use, has been introduced

by *EV Game, Inc.* Called the Breaker Beam, the new antenna retracts in the housing when vehicle ignition is turned off. The transmit-actuated neon lamp glows whenever the user



keys the microphone. The antenna extends to a 40 inch length, has an above center loading coil situated on the 4th section of its 5-unit mast. It has an extremely low SWR. Breaker Beam sells for \$79.

**EXTERNAL NOISE**

*continued from page 25*

various rods and linkages that pass through the vehicle's fire-wall.

After using the Sleuth for several months, I concluded that it was a valuable tool for troubleshooting the less obvious motor noise problems. The new device isn't really necessary for the standard, uncomplicated noise problems. but that one *unstandard* problem that keeps you working all day for too little money will more than justify the Sleuth's relatively low cost. In fact, the cost is so low that I would place it on the list of necessary tools and equipment for the auto electronics shop—right along with the drill, VOM and portable soldering iron.

Once the auto radio noise is found, with whatever means, suppression will depend on the source of the noise. In most re-radiation cases, grounding or redressing will be the cure. Bypass capacitors in most cases are almost ineffective, even when the re-radiation is from a wire or cable-bundle. ■

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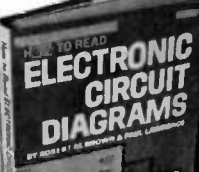
754-238 p.—Practical CB Radio Troubleshooting and Repair (\$8.95)

841-238 p.—Build Your Own Working Robot (\$8.95)

919-434 p.—Color-TV Trouble Factbook—Problems & Solutions (\$9.95)



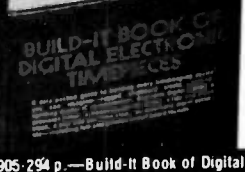
785-294 p.—Microprocessor/Microprogramming Handbook (\$9.95)



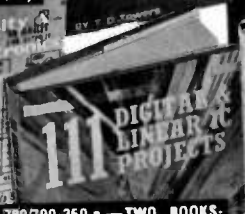
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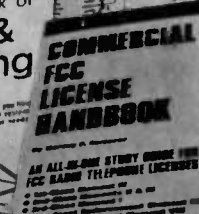


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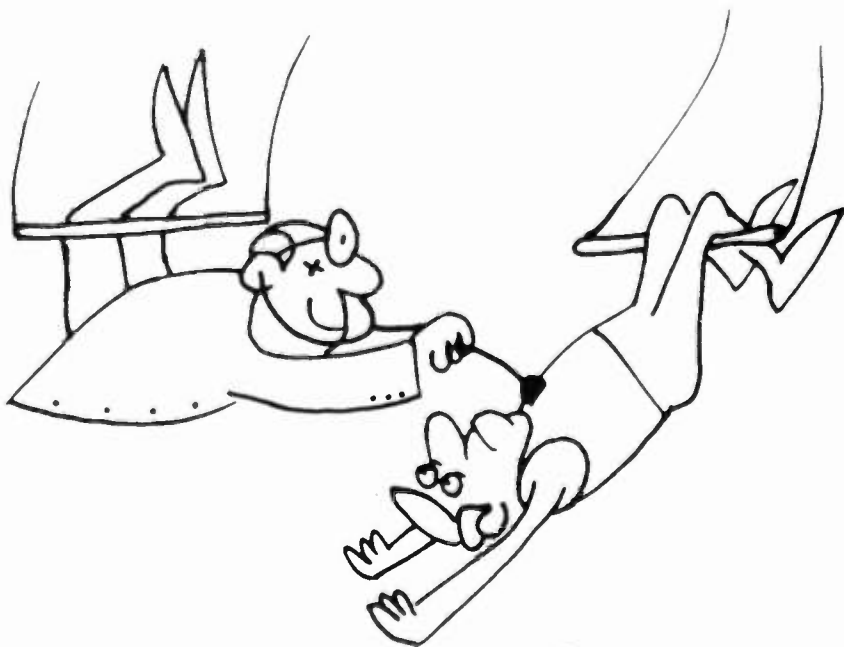
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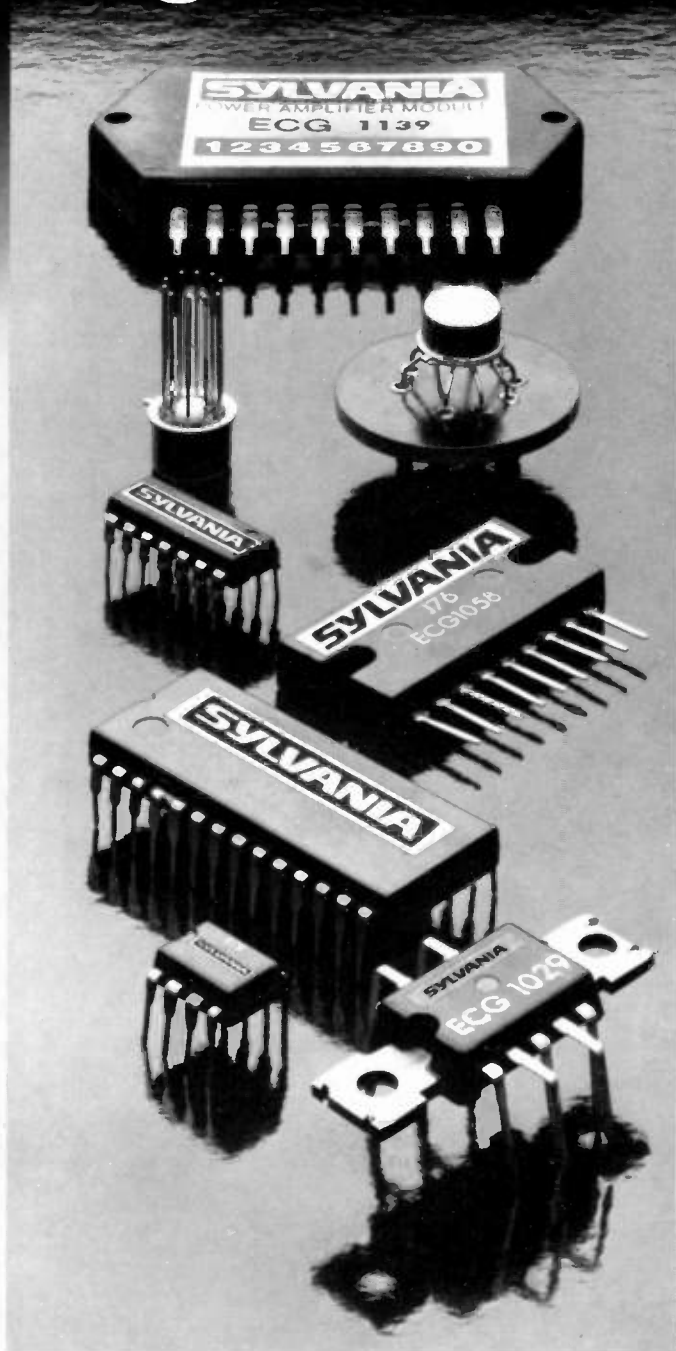
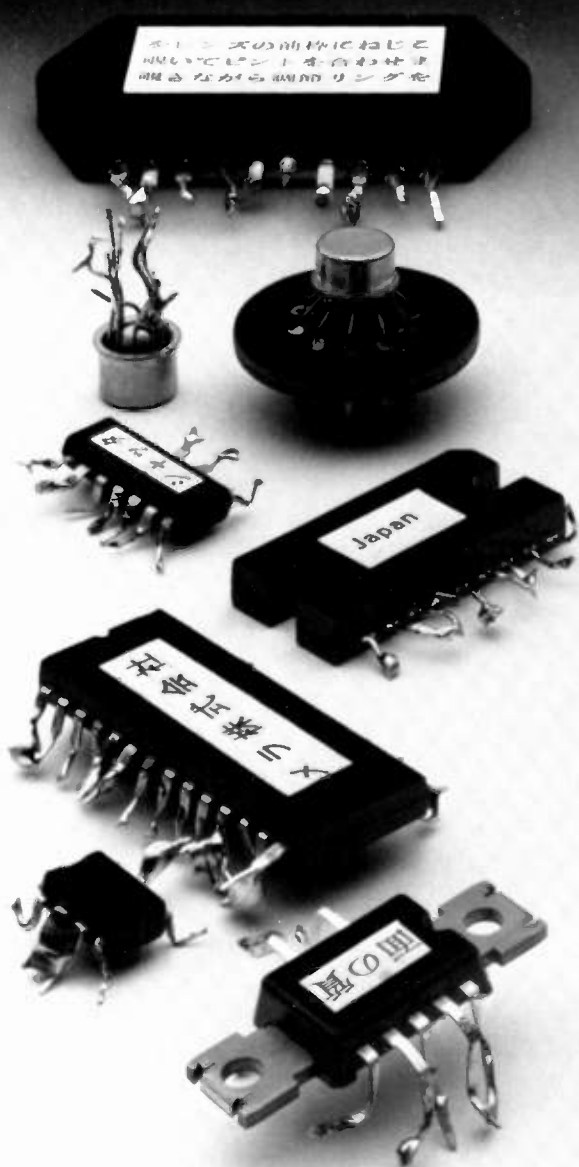
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