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ELECTRONIC TECHNICIAN/DEALER

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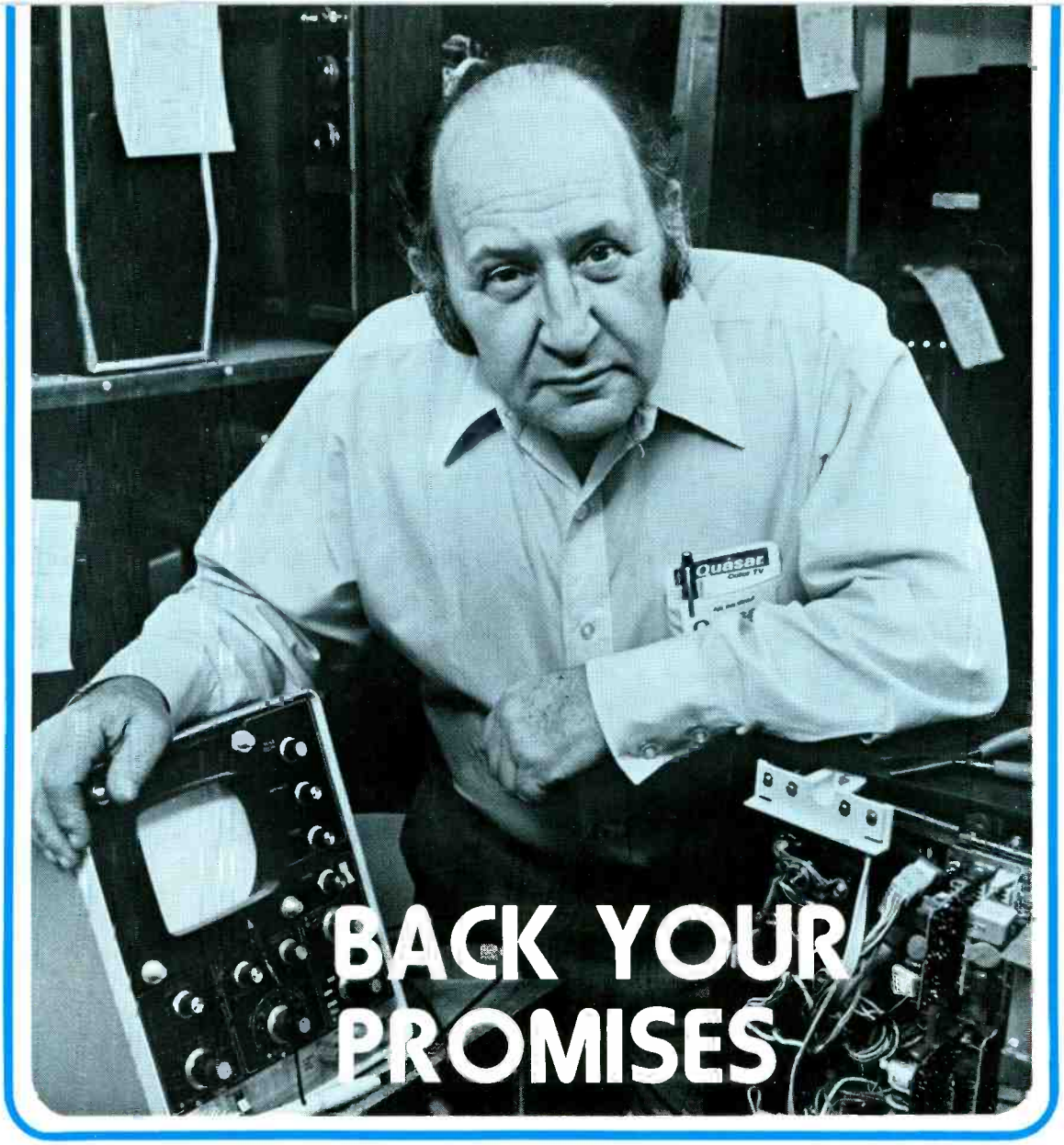
PC-76 Wrapup

CB Manufacturer/Marketer Directory

Servicing Color TV Video Amps



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ELECTRONIC TECHNICIAN/DEALER

JUNE 1976 • VOLUME 98 NUMBER 6

THE COVER: Over 9,000 dealers, distributors, and marketers of two-way radio communications equipment—primarily CB radios and accessories—passed through the gates of the Las Vegas Convention Center at the end of March to attend PC-76, the first "Personal Communications Two-Way Radio Show" in history. Despite a hotel employees strike that threatened cancellation, the show was considered "successful beyond expectations."

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NEWS OF THE INDUSTRY

TV Sales To Dealers Continue Slow But Steady Recovery Compared To 1975 Levels

Despite some faltering in the first three weeks of April, total sales of color and b/w TV to dealers as of the end of the first 16 weeks of this year (April 23) were up 14.7% and 4%, respectively, compared to total sales during the same period in 1975.

TV unit sales to dealers during the first 16 weeks of 1976 and 1975, as compiled and reported by the Electronic Industries Association (EIA), were:

	1976 *(1st 16 weeks)*	1975 *(1st 16 weeks)*	% *Change*
Color TV	1,903,397	1,660,137	+14.7
Monochrome TV	1,368,282	1,316,200	+ 4.0
Total TV	3,271,679	2,976,337	+ 9.9

Taiwan's Leading Home-Owned Electronic Manufacturer To Market Own Brand Of Consumer Electronics In U.S.

Tatung, which, according to a recent report in *Television Digest,* is Taiwan's largest locally owned manufacturer, has announced that in July it will begin marketing in the U.S. its own brand of color and b/w TV receivers and other consumer electronic products.

Tatung reportedly plans to handle its own importing and marketing through its Los Angeles based U.S. subsidiary, Tatung Company of America, and will even operate its own retail outlets, the first of which will be opened in Los Angeles in July.

MCA-Phillips Video Disk Player To Be "User Tested" in U.S. Later This Year; RCA Disc System Might Be Marketed In 12-18 Months

The MCA-Philips optical video disc player, a joint project of MCA and N.V. Philips, will be user tested in homes in the Fort Wayne, Indiana, area beginning in December.

RCA's video disc system, which differs technologically from the MCA-Philips system, is already being user tested in homes in Indianapolis and, according to RCA president Anthony Conrad, probably will be ready for marketing in the next 12-18 months.

Both systems reportedly will retail for about $500.

Meanwhile, according to a recent report in *Television Digest,* Telefunken has "temporarily suspended" manufacture of its TED video disc system in Germany because of "poor sales," which reportedly totaled only about 3,000 in the first year of marketing. The TED system is a joint venture of Telefunken and Decca.

Preliminary Agreement Reached On Sale Of Warwick To Sanyo; Justice Department To Probe Deal

The Whirlpool Corporation, which owns about 57 percent of private-label TV manufacturer Warwick Electronics Corporation, has agreed in principal to a deal under which it will sell its interest in Warwick to Sanyo Electric Company, a Japanese firm which currently markets portable TV receivers in the U.S. under its own brand name and performs private-label manufacturing for U.S. TV marketers, including Sears.

The chairman of Whirlpool, John Platts, in a 1975 interview reported on in the January issue of ET/D, stated that if the combination of continued declines in Warwick's color TV sales and increased pricing competition from Japanese TV manufacturers continued, it could force Warwick out of the TV manufacturing business. Later, in their 1975 annual report, Warwick management announced that Whirlpool was engaged in negotiations to sell its interest in Warwick, whose unprofitable TV business had caused a net loss of almost $9 million in 1975.

Under the terms of the tentative agreement, Sanyo will purchase Whirlpool's interest in Warwick's TV manufacturing business and its Forrest City, Arkansas, manufacturing facilities. The 25 percent of Warwick owned by Sears reportedly is not included in the deal, nor are Warwick's Thomas Organ subsidiary, its Niles, Illinois, warehouse/offices facility nor its two component manufacturing facilities in Mexico. However, a part of the Sanyo/Whirlpool agreement reportedly is a pledge that Sears will continue as a Sanyo/Warwick private-label TV customer.

Meanwhile, according to a report in *Television Digest,* the U.S. Department of Justice is planning to investigate the possible anti-competitive effect of the Sanyo/Whirlpool agreement.

FCC Hopes to Speed License Processing With New Box Numbers

The FCC, in an attempt to expedite the high volume of applications now being received for the various types of licenses, has announced new Gettysburg, Pa., P.O. Box numbers

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Continued from page 2

to speed up sorting and processing. They are as follows: Box 1010 for CB licenses; Box 1020 for Amateur Radio; Box 1030 for Aviation; Box 1040 for Marine; and Box 1050 for Operators permits.

53 % Of Magnavox's 1977 Color TV Line Equipped With All-Electronic Tuning

A new keyboard-addressed, 20-channel, digital-readout, all-electronic tuning system with 12 factory preset VHF channels and 8 field-adjustable channels was among the new features in the 1977 TV line previewed last month in Chicago by Magnavox.

Twenty-three, or 53%, of the 44 color TV models offered in Magnavox's initial 1977 line will be equipped with all-electronic tuning systems—11 will be equipped with the new 20-channel all-electronic tuner described previously and 12 will be equipped with Magnavox's STAR keyboard-addressed, all-electronic remote tuning system, which now provides both on-screen channel and time-of-day display.

Like the STAR tuning system, the new 20-channel all-electronic tuner is "addressed" by pressing two keys—for example, to select Channel 4, the user first presses the button labeled "0" and then "4." However, unlike the STAR system, which is frequency-dependent, the new 20-channel system is voltage dependent and therefore can be programmed so that when it is connected to a reception system which involves channel conversion, such as CATV and some MATV systems, the tuner readout will indicate the number of the "original" channel although the tuner actually is tuned to the "converted" channel—for example, if the CATV or MATV system converts Channel 27 to Channel 4, the user still presses the "2" and "7" buttons and the tuner readout indicates Channel "27" although the tuning system actually is tuned to receive Channel 4.

Another feature in Magnavox's new color TV line is a dealer-installed optional remote system for use with the new 20-channel all-electronic tuner. Installation of the optional remote—which involves the simple mounting of a sensor on the receiver's front panel and the plugging in of an "electronics box" which is about the size of a cigarette pack—reportedly can be accomplished by the dealer in about 5 minutes.

The most significant changes evident in Magnavox's 1977 b/w TV line, which are being purchased from Japan, are the dropping of 19-inch hybrid and 16-inch models. Although 12-inch hybrids presently are carried over from last year, these reportedly will be replaced later in the model year by Taiwan-built, all-solid-state 12-inch models.

New CB License Application Procedures In Effect; FCC Still In Backlog Situation

The Federal Communications Commission (FCC) in early April shipped to its field offices an initial supply of over 300,000 copies of the new temporary Class-D CB license form and since then has been encouraging manufacturers and retailers of CB equipment to make and distribute duplicate copies of the form to purchasers of CB equipment.

The temporary CB license program—initiated by the FCC in April because of the long period which new CB purchasers must wait for the FCC to process their license applications—permits the new CB'er to operate his or her CB unit for a 60-day period beginning on the date that he or she mails to the FCC an application for a permanent Class-D CB license.

According to recent reports, the FCC is presently receiving an average of 500,000 Class-D CB license applications per month, is about two weeks behind in opening mail containing CB license applications, and is taking about 7 weeks to process and mail a license once the application is opened.

PTS Electronics Opens Three New TV Tuner/Module Repair Centers

PTS Electronics, Inc., the Bloomington, Indiana, based TV tuner/module repair firm, has opened new branch service centers in Salt Lake City, Utah; Syracuse, New York; and Davenport, Iowa.

Ford & Lincoln-Mercury Dealers To Offer E. F. Johnson CB Radio Equipment

E. F. Johnson citizens-band radios and related accessories are now being offered through participating Ford and Lincoln-Mercury car dealers.

The general manager of Ford's Parts and Service Division, Philip E. Benton, Jr., in an announcement in late March, said that the E. F. Johnson equipment would be available through Ford and Lincoln-Mercury dealers after May 1, and would include three models of conventional mobile CB units, two CB radiotelephone models, a CB base station unit, a CB SSB unit, a hand-held portable CB unit and a "new special-purpose radio with private-call features," plus a line of CB accessories that includes antennas, microphones, mounting brackets, AC power supplies, battery chargers, power packs, external speakers and carrying cases.

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TECHNICAL LITERATURE

A special CB-10 Code and Lingo folder is available free from Sharp Electronics. The wallet size folder has the entire CB-10 Code, along with key words in the growing CB lingo. Write to National Sales Mgr., *Sharp Electronics Corporation,* 10 Keystone Place, Paramus, N.J. 07652.

Electronic wire and cable catalog is a 100-page guide to Belden wire, cable and cord products for electronic OEM, distributor, and installer markets, featuring expanded identification of UL-listed items, metric equivalents for all physical specifications, and a variety of new application-oriented product designs. Among new products in the catalog is a family of shielded 24-AWG UL-listed instrumentation, computer, and POS cables, plus a 5-conductor medical cable, a 75-ohm coaxial camera cable, and others. Available free from Manager, Marketing Communications, *Belden Corporation,* 2000 So. Batavia Ave., Geneva, Ill. 60134.

A Multimeter Brochure is now offered describing the Dana line of 3½ and 4½ digit multimeters, with highlights on the measurement capabilities, accuracy, noise rejection, high input impedance, wide band—width and isolated BCD output of their new 4600 digital multimeter. A color coded specification chart provides finger-tip access to characteristics and comparative information. Available free from *Dana Laboratories,* 2401 Campus Drive, Irvine, CA 92715.

The New Mail Order Catalog for Spring 1976 is available now from Heathkit. A number of new items are introduced in the latest catalog including: an R/C Glider, a CRT Tester/Rejuvenator, a Precision Power Supply, and a Digital Miles-per-gallon Monitor/Speedometer. Available from the *Heath Company*, Benton Harbor, Mich. 49022.

CB Accessories Catalog features a "cut-out-and-save" Official National CB 10-Code, along with information on the complete line of CB-Radio accessories from the Philmore Company. Available free from *Philmore Manufacturing Co., Inc.,* 40 Inip Drive, Inwood, N.Y. 11696.

A Catalog of Hard-to-Find Tools is offered now by Jensen Tools. It describes over 2,800 tools of particular interest to scientists, engineers, electronic technicians, and instrument mechanics working on fine assemblies. Included is technical data on tool selection, known as "Jensen Tool Tips." Available free from *Jensen Tools and Alloys,* 4117 No. 44th St., Phoenix, AZ 85018.

Schematic Diagrams and Service Information on specific radio and TV sets are available now at a nominal charge from Supreme Publications. The publisher says the information comes from his extensive files of factory data doing back to the 1920's. The usual charge is $2.50 with a range of from $1.50 up. Write: Supreme Publications, 1760 Balsam Road, Highland Park, Illinois 60035.

A Business Supplies Catalog, newly revised, features items for business from corrugated fiberboard files to budget-priced office furniture and accessories. Available free from *Fidelity Products Co.,* 701 Pennsylvania Avenue South, Minneapolis, Minn. 55426.

Two new product bulletins are available on sub-miniature remote microphones for use with two-way communications systems and on wired earphones for personal listening from any sound source. A complete catalog of miniature communications equipment is sent with the two new bulletins. Available free from *Unex Laboratories,* Hathorne (Danvers), Ma 01937.

A Test Equipment Catalog of 35 test instruments most used for mobile communications service is now available from the Bird Electronic Corporation. The new 12-page catalog includes technical specifications and outline drawings of the firm's Thruline directional RF wattmeters, Termaline coaxial RF loads and absorption wattmeters, as well as accessories. The MobCat 76 catalog is free from the *Bird Electronic Corporation*, 30303 Aurora Road, Cleveland (Solon), Ohio 44139.

The Electronic Market Data Book for 1976 is now available for order from the Electric Industries Association. The new edition, with figures submitted by several hundred companies, identifies possible electronic growth areas, and includes information on: consumer electronics, communications and industrial products, government products, electronic components, world trade and related information. Single copy price for EIA members is $10; for non-members, $20. Quantity rates are available. Order from *EIA Public Relations Dept., Electronic Industries Association,* 2001 Eye Street, NW, Washington, DC 20006.

A new **Catalog of Do-It-Yourself Books** has been issued by the Howard W. Sams company. It includes 80 pages that describe over 400 hard-bound and paperback books on electronics, electricity, amateur radio, audio & hi-fi, CB servicing, home repair, appliance servicing, wood finishing, upholstering, etc. Available free from *Howard W. Sams & Co.,* 4300 W. 62nd Street, Indianapolis, IN 46206.

A Pocket Reference Guide Of Electronic Symbols is available now that includes more than 500 most frequently used symbols representing electronics components. The shirt-pocket-sized guide groups the symbols into 19 alphabetically listed classifications. It includes a 2-page feature that shows conversion factors and constants, Ohm's Law Formulas, resonant frequency, impedance decibel table and color code. It's available for 50 cents from the *Cleveland Institute of Electronics, Inc.,* Dept. J-103H, 1776 East 17th Street, Cleveland, Ohio 44114.

The ABC's of Ceramic Capacitors is a new educational brochure from Sprague that describes the various types of ceramic capacitors which are available, shows the construction of the most popular types and discusses their applications. Included in the new booklet is a chart, explaining the various characteristic codes used by the industry and formalized in specifications of the Electronic Industries Association. It's available free from: Technical Literatures Service, *Sprague Products Company,* Marshall Street, North Adams, Mass. 01247.

Microwave Components and Equipment, test instruments and specialized components are included in a new 40-page catalog from Lectronic. The new catalog, Sales Bulletin #104, lists: waveguide, flanges, ferrite isolators & circulators, microwave horns, coaxial & waveguide switches, coaxial terminations, fixed & variable coaxial attenuators and others. Available free from *Lectronic Research Laboratories,* Inc., Atlantic & Ferry Avenues, Camden, N.J. 08104.

Electrolytic Motor Starting Capacitors: Their Construction and Application, a booklet from Mallory, is now available in a revised edition. The 16-page booklet features the history, assembly, diminsions, applications, limitations, selection, and use of electrolytic motor starting capacitors available from Mallory, and used in motor and appliance applications. It's free from *Mallory Capacitor Company,* 3029 East Washington Street, Indianapolis, Indiana 46206.■

When you install a B-T Booster outside, you get a lot of new boosters inside.

The service technician's job is a tough one. Customers are always grumbling about the high cost of TV service calls. And they complain about poor reception—even when it's aimost impossible to get a good signal.

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The VAULTER, for example, is the number one outdoor booster today in the B-T line... *and* in the entire industry. This ultra-high performance, all-channel amplifier offers the ideal combination of lowest possible noise figure (4.6dB, VHF; 7.0dB, UHF) and high gain (15dB). While it can't make unusable, snowy pictures perfect, it *can* reduce fading, loss of color, overcome cable loss and reduce lead-in cable noise. It can even feed more than one TV set from the same antenna in fringe reception areas. It has separate U/V inputs and a coax output. Finally, it's specially designed for lightning prone areas.

The B-T line consists of 5 all-channel models (including the popular VOYAGER); 5 VHF models and 4 UHF boosters (the ABLE-U2bis a favorite).

See your B-T distributor for details. And see why you can count on boosters inside, when you install B-T Boosters outside. Blonder-Tongue Laboratories, Inc., One Jake Brown Road, Old Bridge, N.J. 08857.

25 BLONDER-TONGUE

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PC-76 Wrap-up

Highlights Of The Personal 2-Way Communications Show Held In Las Vegas

By Don Mason, ET/D Managing Editor

■ "Successful beyond expectations, even in the face of unexpected difficulties" would be one good way to describe PC-76—the Personal Communications Two-Way Radio Show—that was staged in Las Vegas at the end of March. Despite a strike of musicians and hotel employees that threatened cancellation of the show and finally forced last-minute relocation of the show from the Hilton Hotel to the Las Vegas Convention Center, over 9,000 distributers, dealers, and CB enthusiasts showed up to view the more than 220 exhibits.

NEW BUT NOT REVOLUTIONARY PRODUCTS IN ABUNDANCE

Because of the delay by the FCC until later this year in the proposed expansion of channels in the 27 MHz CB band, nothing revolutionary in the way of expanded-channel CB equipment was introduced at the show. There were plenty of new and interesting products on display, though, ranging all the way from bumper stickers, T-shirts and road maps for CB enthusiasts to the very latest in complete CB communications systems. The main concentration, of course, was on CB base and mobile transceivers, with over 80 marketers and/or manufacturers represented. Most base and mobile units had 23-channel coverage, either crystal controlled or synthesized, some featuring the newer Phase Lock Loop (PLL) design. Prices of mobiles ranged all the way from Tran Sonics MCB-909 at $49.95 to a unit from Standard at $766. Base station prices ranged from $69.96 for a unit from Kustom Kreations to the Browning base station for $750. Many of the higher priced mobiles and base stations were SSB.

CB Antennas were everywhere at the show with every type of mount conceivable—roof mount,

gutter mount, trunk mount, trunk lip mount, and several new electric disappearing CB antennas. Prices ranged all the way from $5.45 to $373. Also in rich array were scanners—from $29.95 to $207.95—speakers, converters, microphones, weather radios and a whole bevy of CB test equipment.

HOW PC-76 WAS DEVELOPED

PC-76 was the first national trade show devoted exclusively to two-way radio products and accessories. It was the brainchild of a number of communications industry leaders who, in 1973, when the CB boom got underway, saw the need for a single, vertically-integrated trade show which would be an annual showcase for not only citizens radio, but also for amateur and marine equipment, scanning monitors, antennas, and related equipment and accessories.

As described by John Sodolski, staff vice president of the Communications Division, Electronic Industries Association (EIA), sponsors of the show, "There was a growing feeling in the industry that personal communications was a new and special marketplace which deserved the type of focused attention provided by an industry trade show. Preliminary planning for the show—which became PC-76—began in 1974, and reached the final decision point in mid-1975. The result, PC-76, far exceeded the expectations of those involved in the early concepts of the show. I believe all of us agree," Sodolski concluded, "that PC-76 will be the first of a long line of successful and growing annual Personal Communications Two-Way Radio Shows." In fact, with the success of PC-76 under their belt, the EIA has announced that next year's show, PC-77, will be twice the size of this years show, both in space to be used and the number of exhibits. It will be staged on February 15, 16 and 17, 1977, at the Las Vegas Convention Center.

THE SHOW IS BIG SUCCESS

That PC-76 lived up to—and beyond—expectations was echoed time and again by spokesmen for those companies who exhibited products at the show. Ted Donhauser, national CB sales manager for Modar Electronics, a subsidiary of Motorola, Inc., told ET/D that "It was an exciting thing to see—a trade show with so many people wanting to buy in the midst of that fairyland called Las Vegas. It boggled the mind. We consider it a very successful show." And Jim Hart, vice president of marketing for the Breaker Corporation, said, "It was a good order-writing show for us and it certainly aided our visibility in the marketplace. Considering the problems with the strike, it was tremendous."

Even those companies currently in a 'back order' status because of the booming demand for CB products found PC-76 a worthwhile venture. "We were not looking for new distributors or new orders because of the shortage situation," Larry Eugene, advertising manager for the Cobra division of the Dynascan Corporation, said, "but it gave a lot of people an opportunity to talk to us about Cobra, even though we couldn't take them on. There were a lot of people who wanted to handle our servicing or to become Cobra dealers, so we were able to tell them in person

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Baton Rouge, La. 70821

For Faster Service, call
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what the situation was. PC-76, for us, became a medium of communication," Eugene concluded, "which is what a trade show is all about."

SHOW IS FELT TO HAVE IMPACT ON GOVERNMENT

Although a hoped-for announcement by the FCC of plans for CB channel expansion did not materialize before or during the Las Vegas show, those attending were assured by an FCC spokesman that the number of CB channels would be expanded both in the present band, and perhaps in other bands. Charles Higganbotham, chief of the Safety and Special Radio Service Bureau of the FCC, told those attending a seminar during the show that "The timetable for channel expansion calls for an FCC decision by this July, with an effective date next January." "We're on your side," he assured the group, "and today the FCC is interested in furthering CB rather than considering it a step-child as in the past. CB now is seen as an important radio service and is getting the time and attention it deserves."

The success of the show was credited with having an impact on government, specifically the FCC, by Ed Walsh, manager of the Communications Equipment division of the Craig Corporation. "I think PC-76 probably had greater impact on government than on the industry because of the difficulties that arose at the last minute regarding the channel allocations. The show demonstrated, in fact, that we are now an industry. And the proof that we are a full-fledged industry and an important market area," Walsh said, "has a lot to do with the intensity with which the FCC is approaching the needs and problems associated with the CB service. Even though the impact of the show was somewhat blunted by the lack of new channel information—in terms of showing new products and new ideas—nonetheless, the show will have a "clock function," or a "timing point" for the industry for years to come."

Several of the major electronics manufacturers who have recently entered the CB marketplace with new lines of CB radios were represented at PC-76—among them Motorola and RCA. Dennis Burke, manager of Autosound & Specialty Products Merchandising for RCA said, "We were very pleased with PC-76. We displayed the products we now have FCC type acceptance on and held back some things we did not. Other companies took other paths—but that's fine," he said, "if that's the way they run their show. We've got other things we'll introduce as the year goes by—but we just wanted to concentrate on what we're shipping right now. There's such a nebulous situation now concerning the FCC position," he continued, "that there's no point in trying to second-guess it. We're just going to take it on a day-to-day basis with the knowledge we can react very, very quickly whenever necessary. We were pleased with the response at the show. We got a lot of attention and it's nice to see that type of enthusiasm in today's economy."

NEED FOR SERVICE SUPPORT IS RECOGNIZED

Most of the emphasis at the show naturally was on CB sales, in line with the expansionary mood of the whole industry during this boom period. There were a few voices heard, however, saying "Don't forget adequate service back-up!" Among them was the voice of Dave Bradley, marketing manager for the E.F. Johnson Company. He addressed a PC-76 seminar on "Installation and Service in a Regulated Market," a subject that should be of interest to most ET/D readers.

Bradley outlined four important factors to consider for anyone planning to set up a CB service facility, especially if it's to be a factory-warranty service center:

* The *Product Source*—Does the manufacturer turn out a product that you would want to service?
* *Parts Availability* — How much time would it take to fill out a normal parts order? What is his average back-order percentage? Does he offer special methods for high priority or emergency orders on a 24-hour basis?
* *Technical Training*—Any company that manufactures a product that must be serviced must recognize the necessity for providing those who service the product with the knowledge necessary to complete the talk in a profitable manner. (Toward this end, E.F. Johnson is presently conducting product-familiarization seminars in major cities throughout the country and also is offering resident courses in CB and land mobile communications servicing at its new training facility in Waseca, Minnesota.)

continued on page 46

Material in this article is condensed from a single chapter of a recently introduced TAB book, by permission of TAB BOOKS, Blue Ridge Summit, Pa. 17214

Servicing Solid-State Color TV Video Amplifiers

By Wayne Lemons

Circuit analysis and general troubleshooting procedures

■ The block diagram in Fig. 1 illustrates how the luminance signal is processed in the video amplifier section of a typical solid-state color TV receiver. The direction of the video detector diode shows that the video output from it will be positive-going. The 1st video is an emitter follower; there is no phase reversal and no amplification, but it does provide a low-impedance feed to the sync and chroma amplifier circuits and prevents them from loading the detector stage. The 2nd video is emitter-fed, and though there is no phase reversal, there is considerable amplification. The 3rd video is a base-fed (common-emitter) amplifier which amplifies the signal and reverses its phase.

The 4th video amplifier, another emitter follower, does not reverse the signal phase, and though it does not amplify the signal (voltage-wise), it does increase power and provides impedance matching to the final video output transistor.

The output transistor amplifies the signal and reverses its phase so that there is a positive-going signal at the cathodes of the CRT, which is the polarity of video that must reach the cathode(s) of any CRT. If in tracing through the circuits you find what appears to be a negative-going signal at the cathodes, you have made some mistake in assigning polarities somewhere along the line. If, however, the signal should be fed to the grid(s) of the CRT, the signal polarity must be negative-going.

The above is true for all sets built for American color or black-and-white TV reception because the higher the signal amplitude, the darker the detail in the picture. The vertical blanking bar amplitude is in the "black" region. Thus it takes a positive signal on the cathode or a negative signal on the grid to reduce the CRT brightness and produce black detail in the picture. The sync signals, that part of the composite video above the "shoulder" of the blanking bar, are said to be in the "blacker than black" region.

(From Chapter 11, How To Solve Solid-State Circuit Troubles, *by Wayne Lemons, copyright 1976, TAB BOOKS. A review of the complete book follows this article.)*

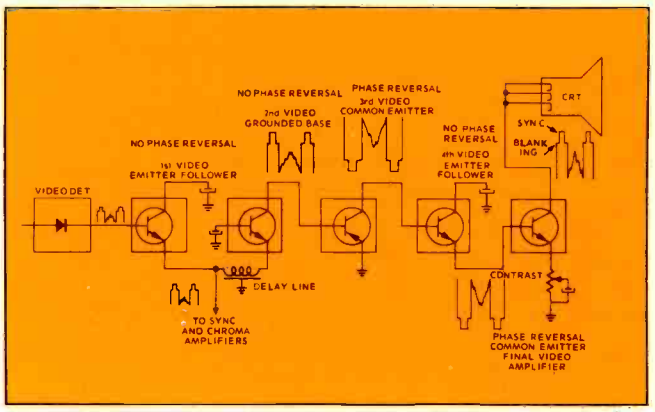


Fig. 1—Simplified block diagram of a five-stage color TV video amplifier section.

FIRST VIDEO AMPLIFIER

The 1st video amplifier stage, a schematic diagram of which is shown in Fig. 2, is biased class A; that is, in normal operation, collector current flows even when no input signal is applied. Bias is provided through R1, R3, L2 and L3 from the 21-volt supply line to the base of the NPN transistor. Bias is also supplied by the output of the video detector diode via L1 and L2 primary.

The 4.5-MHz trap prevents a 920-KHz beat from appearing in the color picture. Peaking coils L3, L4, and L5 shape the output response of the amplifier. Resistors R4 and R7 broaden the peaking coil action to provide a wider response and also prevent "ringing."

Two output signals are taken from this amplifier. The emitter output, which is not amplified but is decoupled by the transistor from the detector circuit, feeds the chroma IF circuits as well as the AGC in this particular arrangement. The video and sync outputs are amplified and reversed in phase in the collector circuit.

A delay line is used in the video amplifiers of all color sets. This "slows down" the "black and white" video to allow time for the color signals to pass through the chroma IF amplifiers, which results in the monochrome and color signals being in "register" when they arrive at the CRT.

Troubleshooting The CRT

An oscilloscope can be used to follow the signal through this circuit. The oscilloscope should have good frequency response or at least "known" frequency response and should be used with a low-capacitance probe, to prevent undue loading of the circuit while testing. The polarity of the signal coming in will generally be positive-going; however, some sets will have a negative-going signal into the 1st video. Whatever the polarity into the base, the polarity at the emitter will be the same. The amplitude at the emitter will be about the same as the input at the base or slightly less. The polarity of the signal at the collector will be opposite that going into the base: normally, however, the amplitude of the signal at the collector should be at least 10 times that at the base.

Trouble Symptoms

Little or No Gain: Defective transistor. Before replacing transistor, check emitter voltage to ground. Typical current for this stage is about 5 to 10 mA. Use Ohm's law to

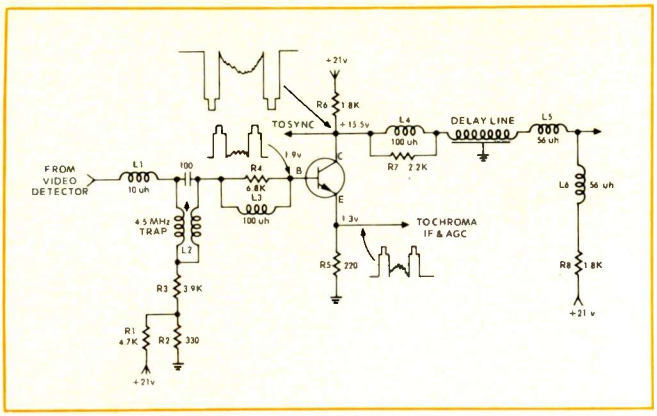


Fig. 2—Schematic diagram of the 1st video amplifier stage of the video amplifier section shown in Fig. 1.

determine if transistor current is within the expected range. If voltage is low across emitter resistor (R5), check transistor bias between base and emitter. Bias should be between about 0.5 and 0.7 volt. If bias seems close to correct, check to make sure that collector voltage is near normal; if it is high, the transistor is probably defective.

If bias voltage is low, check R1. If bias voltage is high, check for open R2. Another cause for high bias voltage could be a defective AGC circuit, allowing more than normal signal level to arrive at the video detector. *Fuzzy Picture Caused By Poor High Frequency Response:* May be caused by open L3 or L4. Temporarily short across these coils with a short jumper; if picture quality improves, replace coil. *Ringing In Picture Due to Excessive High Frequency Response:* May be caused by open R4 or R7. Again short across with a short jumper; if picture improves, place another resistor of the correct value across the coil.

Ringing can also be caused by an open ground wire to the delay line. Usually this is an external break and can be repaired rather easily. If break is not obvious, temporarily replace delay line to see if symptom is cured. *Low Collector Voltage* (May be accompanied by a picture which is "milky"): Increase in value of collector load resistor (R6). Also can be caused by excessive transistor bias or by low supply voltage. Note that in this circuit the collector is fed through two different 1.8K resistors (R6 and R8). Depending on the remainder of the circuit, one of these resistors opening may not cause a sufficient change in collector voltage to make diagnosis easy using DC measurements. If either resistor opens, though, there will be a marked change in the response of the circuit. For example, if R8 should open, it may cause ringing of the circuit due to an improper termination resistance for the delay line.

The circuit is direct-coupled to the next stage in most color sets. This means that any change of significance in the collector voltage will be reflected as a rather drastic change in bias on the following stage. Depending upon the number of stages following, this change in bias may cause either the screen brightness to go up or down. This is why, if a set comes in with either insufficient or excessive brightness, before readjusting brightness limit controls, you should thoroughly check the video circuits. (Later in this article we cover a complete direct-coupled video circuit and give you hints for troubleshooting the overall circuit.)

EMITTER-FOLLOWER TYPE OF FIRST VIDEO AMPLIFIER

The emitter-follower type of 1st video amplifier configuration, shown in Fig. 3, is an excellent circuit for transforming impedance and in the process, gaining power (though no voltage gain) for feeding a succeeding circuit. The input impedance of this amplifier is high, being roughly equivalent to the size of the emitter resistor times the transistor beta. For example, a transistor with a beta of 75 would have an input impedance of about 75,000 ohms. Since the resistive load on the detector circuit is about 4.7k ohms, the 75K-ohm input impedance imposes almost no load on the detector circuit. However, the voltage gain will be about 95 percent of that on the base. Because the signal is transferred from a circuit with 75K-ohm impedance to a circuit with 1K or less of impedance, we have a power gain (due to current gain). For example, 1 volt across 75K results in a current flow of just .0133 mA, but .95 volt across 1K results in a current flow of .95 mA, a current gain of about 71 times.

The principal advantage of this circuit is that current is supplied to the following transistor stage for driving it, as well as current to sync and other circuits, with little or no effect on the detector circuit at all.

Capacitor C2 is the "collector ground" capacitor, which prevents any degeneration in the collector circuit from transferring all the available power gain to the emitter. The base bias is provided through resistor R3, with a bleeder to ground via R2. This "hard" bias (low resistance) circuit establishes the bias at a fixed level which is relatively unaffected by external influence. The transistor bias then is the sum of this fixed bias plus the bias developed across the 4.7K resistor, R1, by the signal through D1. Peaking coils L1 and L2 compensate the amplifier and improve the high-frequency response, but, because they have a low DC resistance, they have almost no effect on the DC bias voltages.

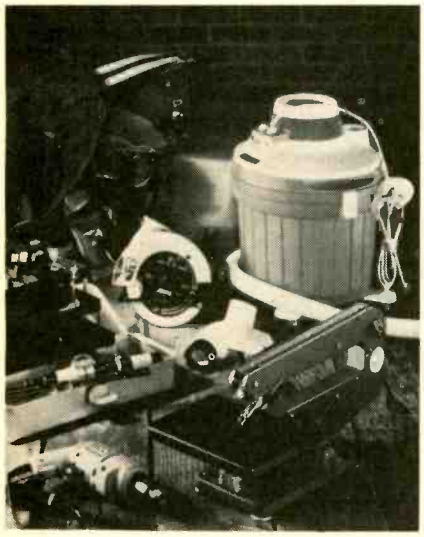
The current flow through the transistor is limited by both R4 and R5 so that even a shorted transistor, or a transistor with saturated bias, can have a maximum current flow of only 10 mA (assuming a 20-volt DC supply).

Troubleshooting The Circuit

This circuit should offer little difficulty during troubleshooting. Measuring the DC voltages alone should help you find almost any trouble, such as a shorted transistor, open transistor, lack of DC bias, etc. The bias for this silicon NPN transistor should be around 0.5 volt positive from base to emitter.

A trouble that could occur and not affect the DC voltages would be an open collector bypass, C2. With C2 open, there would be some tendency for feedback at higher frequencies due to the internal capacitance of the transistor. Such feedback would reduce the high-frequency gain of the stage and perhaps cause a degraded picture and a possible loss of the chroma signal. At the least, it would weaken







the chroma signal. The actual result of an open C2 will vary with transistors, and you may sometimes find that the circuit appears to work almost as well without C2 as with it.

When checking this circuit with an oscilloscope, see that the video output signal at the emitter is almost exactly the same size, shape and polarity as the signal at the base of the transistor; if not, carefully check the amplifier circuit. One problem that can cause an unusual condition that can vary from circuit to circuit, and even from signal to signal, is an open R1 or L2. Neither of these components is likely to open due to circuit currents, but they can open due to physical stress, or they could be open due to an incorrect connection by a technician either at the factory or because of earlier servicing.

DIRECT-COUPLED VIDEO AMPLIFIERS

Although Fig. 4 is a simplified circuit, it should help to explain how almost any direct-coupled video amplifier works.

Starting at the input of the amplifier at the emitter of Q2, the 2nd video amplifier, the signal is amplified to the collector. Then it goes through the RC network, C2-R6, to the base of Q3, then to the base of Q4, and finally to the emitter of Q4, which is connected to the base of Q5.

To show how a DC change affects this circuit, let's suppose there's a positive-going bias at the emitter of Q2. The positive bias on an NPN emitter is the same as a negative bias of the same amount on the base (assuming the base cannot vary), and this reduces the collector current of Q2. With less current through R4, the voltage on the collector (to ground) goes more positive. The added positive voltage is transferred to the base of Q3, which is a PNP transistor. A positive increase at Q3 causes a decrease in its collector current, meaning less voltage drop across R11. With less drop across R11, the voltage (to ground) on the collector of Q3 will be *less* positive, and since this voltage is direct-coupled to the base of Q4, it will result in reduced current through Q4. With less current through R12, there will be a less positive voltage on the emitter of Q4.

The feedback line sends the less-positive voltage at the Q4 emitter back through a resistance network to the emitter of Q2, where the voltage is positive-going. This results in a degenerative, or self-regulating, feedback so that any decrease in current in Q2 results in a feedback voltage that tries to increase the current in Q2. If this were unity feedback—that is, if it completely cancelled any change in Q2 current—there could be no amplification. Consequently, the feedback

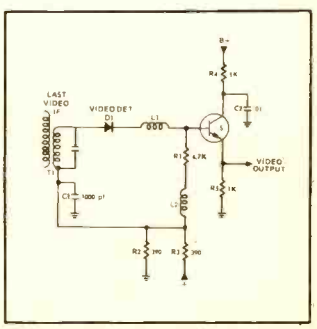


Fig. 3—Simplified schematic diagram of an emitter-follower type of 1st video amplifier which might be used in place of that in Fig. 2.

circuit must be selected by the designer to allow the most compensation without undue loss of gain. This circuit could be stripped of video and only allow a DC change to be reflected, but another use of this circuit is shown here. The video signal is fed back by the same circuit and tends to correct for "tilts" in the amplifier response, but a "side" peaking circuit can be adjusted to bypass more or less of the higher-frequency video signals. If more higher frequencies are bypassed, there will be less inverse feedback at high frequencies and consequently more gain at those frequencies. Adding high-frequency gain results in "peaking" of the fine detail of the picture. Sometimes this peaking is desirable, especially if the picture sent out has some loss of detail. It is also desirable in weak-signal fringe areas to "de-peak" the picture to reduce "snow," or noise.

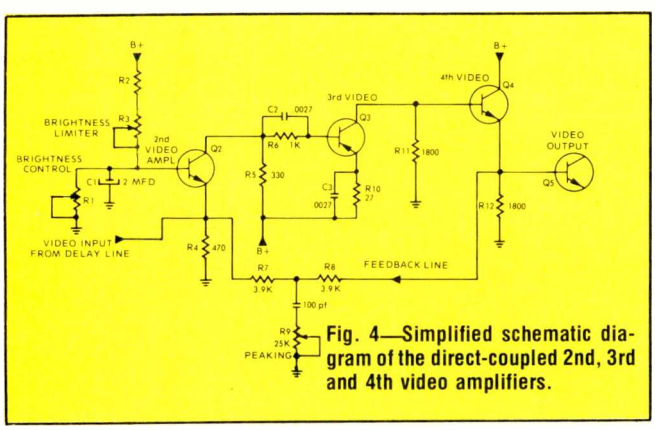


Fig. 4—Simplified schematic diagram of the direct-coupled 2nd, 3rd and 4th video amplifiers.

Capacitors C2 and C3 both have the effect of improving the high-frequency response of the amplifiers. This does not mean that the amplifier has more high-frequency than low-frequency gain; it is simply a method of counteracting the natural loss of high-frequency gain caused by residual capacitance in the circuit due to internal transistor capacitance and stray capacitance around the parts.

The brightness control circuit varies the bias on the base of the 2nd video amplifier, and since this bias will reflect through the whole chain to the picture tube, any change of bias here controls the DC on the cathode(s) of the picture tube and consequently the brightness. A brightness "limiter" is in reality a designer's tool for setting the bias of the stage so that the brightness control will vary the CRT brightness in accordance with the specifications for a particular CRT.

The brightness control and brightness limiter could be in the cathode circuit of this transistor or in other video stages so that it would control bias. Or the brightness control could be in one bias-regulating circuit and the brightness limiter in another.

Sometimes a transistor is added in the brightness limiter circuit to detect a change in picture tube load and/or high voltage and automatically shift the bias on the video amplifier to compensate for these conditions.

Troubleshooting The Circuit

When troubleshooting

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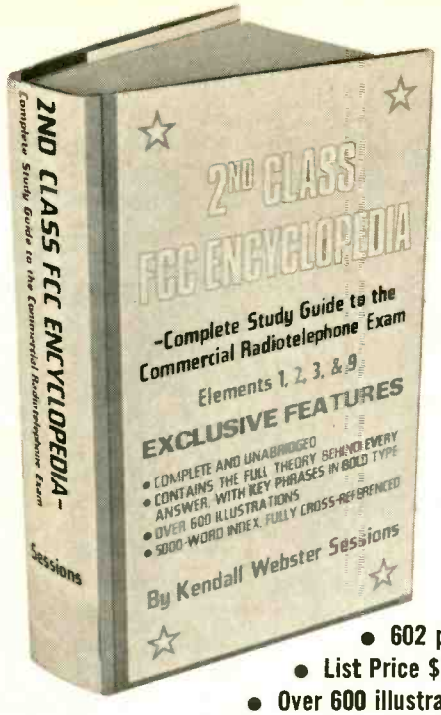

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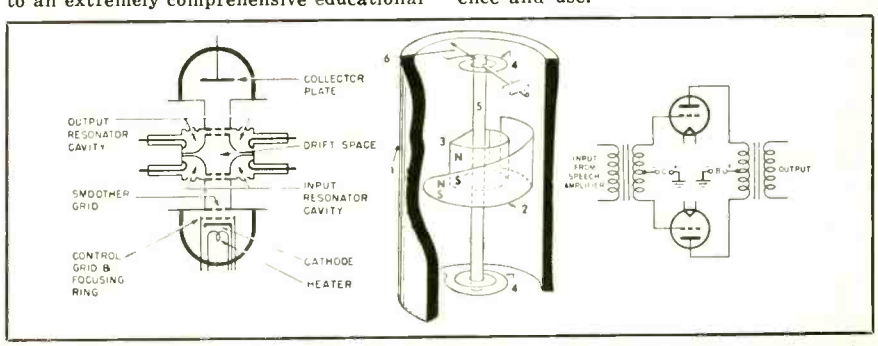

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any direct-coupled circuit do not be overwhelmed by all the "wrong" voltages in the circuit. You must concentrate instead on how the circuit works and what can be expected from it when trouble occurs in any specific stage. The best place to start is at the beginning, since any change in bias at the beginning of the chain will produce the most reaction at the other end.

The collector and emitter voltages on the stages are important measuring points, more so perhaps in most cases than the base-to-emitter bias since this cannot be established at any "exact" optimum point—it may be 0.4, 0.45, 0.5, 0.55, etc., for the correct operating point, depending upon the transistor itself. But the current through R4, for example, as indicated by the voltage across R4 should be nearly correct, and if it isn't, you need to find out why. If the voltage is high, it could be caused by a shorted transistor or by a high bias, which in this case could be caused by misadjustment of either the brightness limiter or the brightness control or both.

If the voltage across R4 is correct, chances are that the voltage at the collector of Q2 will be correct.

In this particular circuit, a reduction in current in any transistor results in a reduction of current all along the line. (It must be pointed out that not all circuits work like this.) With this situation you can quickly check any succeeding stages, starting with any transistor simply by zero-biasing that transistor (shorting between the base and the emitter).

If, for example, you short the base-to-emitter of Q2, the voltage drop across R5 should drop to zero, across R10 to zero, across R11 to zero, across R12 to zero, showing zero current flow through all the transistors. If, for example, you short the base-to-emitter of Q3, the current for Q4 will also drop to zero, but because of the feedback circuit, the current through Q2 will increase because it is trying to compensate for the low current of Q4.

When you encounter trouble in a circuit such as this, and you are convinced the trouble is not caused by someone else having made an incorrect adjustment, you should check the transistors by measuring DC voltages on each transistor and then zero-biasing the transistor to see if there is a change—if there is none, the transistor is defective. Do not try to check transistors in the circuit with an ohmmeter—the direct coupling will almost surely cause an erroneous conclusion. Instead, temporarily disconnect either the collector or emitter from the circuit and then make the regular ohmmeter check, and if there is any doubt about the validity of the test, disconnect two terminals of the selected transistor from the circuit and remeasure either with an ohmmeter or with a transistor tester, or better still, tack in a substitute transistor.

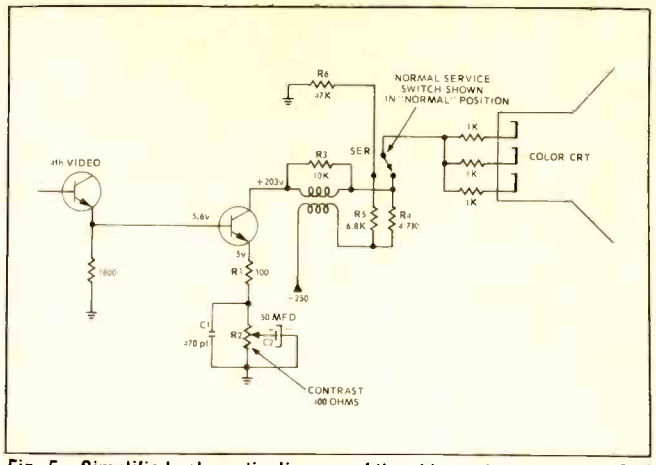

Fig. 5—Simplified schematic diagram of the video output stage and CRT cathode drive circuit.

VIDEO OUTPUT STAGE

The video output transistor, shown in Fig. 5, has to be a different type transistor than the ones preceding it. The main difference is that it must be able to operate with a high collector voltage—in this circuit, around 200 volts. The reason the high collector voltage is essential is that the color CRT must have more than a 100-volt swing in voltage to drive it between full brightness and cutoff; a transistor with only 20 volts on the collector to start with cannot produce such a change. Thus, when a video transistor is found defective, you should always use an exact replacement if you are not *absolutely* sure that the replacement you wish to use will perform properly.

The contrast control varies the amount of gain but not the bias on the output transistor. If the bias was varied, the brightness of the CRT would vary with a change in the contrast setting. Instead, the contrast control varies the amount of signal bypassed around itself. With the center arm of the control at ground there is low gain from the video amplifier, but there is full gain with the center arm at the junction of the contrast control and the 100-ohm emitter resistor. The 470-pF capacitor, C1, provides a high-frequency bypass which tends to sharpen pictures set for low contrast and maintains a "visual balance" for all contrast control settings.

Troubleshooting The Circuit

If varying the contrast control does not affect the contrast, check for an open C2 (50-mfd electrolytic). The size of this component varies with different circuits, but almost any value of 5 mfd or more when shunted across a defective capacitor will make a significant difference in the gain, or the contrast. Replace the capacitor with one of similar capacitance, though usually any larger size that is no more than twice the size of the original will be satisfactory.

CAUTION: Too large a capacitance may cause a "lagging" effect when the contrast is changed, resulting in a momentary change in brightness and contrast which will then return to normal when the capacitor has had time to charge or discharge.

If the CRT brightness is high, and varying the contrast control causes a change in brightness, suspect a shorted capacitor C2. If brightness is high and adjustment of the brightness control or the shorting of the base-to-emitter of the video output stage has no effect on brightness, this might be caused by a shorted video output transistor. If brightness is low and the same tests produce no effect, it may be because

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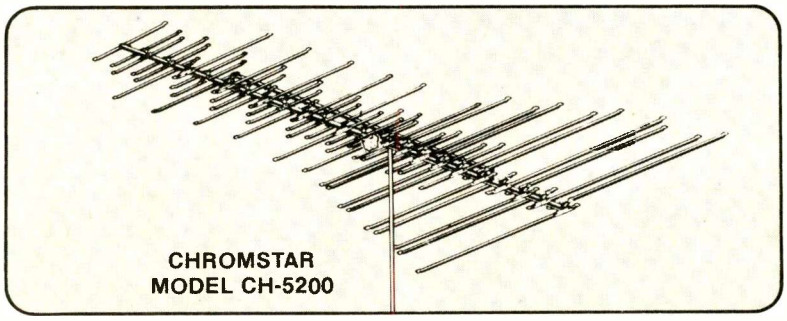

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of an open video transistor.

Disconnect the transistor from the circuit and make DC tests if an in-circuit test is inconclusive.

A "milky" or washed out appearance of the picture might be caused by an increase in value of the 4.7K resistor, R4. An increased value here would increase the brightness, but often this may have been compensated for either by the customer or by another technician resetting the brightness limiter.

Ringing in the circuit (outlines around sharp edges of detail in the picture) could be caused by an open R3, or could be caused if someone inadvertently connected C1 from the emitter to ground rather than across the contrast control.

A NORMAL-SERVICE switch is shown in this circuit since one is often used in color video amplifier output stages. The purpose of the switch is to establish a brightness level for the CRT which is not affected by the brightness control. Thus, when the switch is turned to the "SERVICE" position a fixed DC bias is applied to the cathodes of the CRT and the video circuit is removed. This brightness level is close to the low brightness position that would be established with the brightness control near minimum when the switch is in the "NORMAL" position.

Although this switch is intended primarily as a set up convenience, it makes an excellent quick check for video amplifier troubles that affect brightness. Turn the switch to "SERVICE" and if the normal set-up procedures produce the correct brightness level, you can be almost sure that the brightness problem is caused by the video amplifier(s). If, however, you cannot establish the correct set-up brightness, you know the brightness problem is almost surely elsewhere, such as in the CRT grid bias circuit or the screen voltage circuits, etc. Make a habit of using this switch not only for set-up, but also for a quick check for biasing problems in the video amplifier or picture tube.■

TECH BOOK REVIEW

TITLE: *How To Solve Solid-State Circuit Troubles* (TAB BOOK No. 624)
AUTHOR: Wayne Lemons
PUBLISHER: TAB BOOKS, Blue Ridge Summit, Pa. 17214
SIZE: 304 pages, 161 illustrations
PRICE: $8.95 hardbound, $5.95 softbound

Written by one of the electronic servicing industry's most experienced electronic technician/educator/authors, this comprehensive reference source provides practical, technician-oriented circuit analyses and easy-to-follow, step-by-step descriptions of proven-effective procedures for troubleshooting more than 90 percent of the circuits in modern, solid-state home and auto entertainment electronic products—including those in b/w and color TV receivers; AM, FM and stereo FM radio receivers; tape player/recorders; and phonographs—all amply supplemented with uncluttered, easy-to-read circuit diagrams.

Following an introduction to general techniques for testing semiconductor diodes and bipolar and field-effect transistors in and out of circuit, the text is divided into 18 chapters, each of which is devoted to one functional category of circuits. Included in each chapter is complete information about the theory of operation, troubleshooting and typical failure modes and related trouble symptoms of representative circuits in that particular functional category—a time-saving, confusion-avoiding manner of presentation which eliminates the need for referencing back and forth among the various chapters.

Immediately following each circuit analysis are detailed guidelines for quickly localizing and isolating typical defects in that particular circuit—and the most frequently encountered trouble symptoms and their causes are included for many of the 161 different circuits covered in this reference source.

This text just as accurately could have been titled "The Technician's Dictionary Of Consumer Electronic Solid-State Circuits & Troubleshooting Procedures."

CONTENTS: General Servicing Procedures — RF Amplifiers — Oscillators — Converters — Mixers — Automatic Fine Tuning — IF Amplifiers — AM Detectors & AGC — FM Detectors — Stereo Multiplex — Video Amplifiers — Sync Separators & Amplifiers — Noise Inverters, Clippers, Gates & AGC — Vertical Deflection — Horizontal Oscillators, Drivers & Output Stages — Special Color TV Circuits — Audio Amplifiers — DC Power Supplies — Tape Recorder Oscillators. ■

Audio Output Defects In Car Radios

Analyses of the most frequently encountered failures in yesterday's and today's designs

By Joseph J. Carr

■ Up until four or five years ago, auto radio and tape player audio output stages were low-efficiency, single-ended, class-A circuits that generated more heat than audio power. Newer radios use more efficient stages, allowing use of smaller power transistors, and are generally more complex than previous designs.

THE PNP CLASS-A DESIGN

Fig. 1 shows a "composite" version of the "classic" solid-state audio amplifier. Although no specific brand is represented by this circuit, it is most similar to that used in pre-module Delco designs.

With no signal applied, there is a potential of approximately 1.3 VDC on the collector of power output transistor Q3. On the positive half of an input sine wave, Q1 conducts harder, causing a higher current to flow in its collector. This causes a larger voltage drop across R4 and, in turn, a lower voltage at point "A." Because the voltage at point "A" also is the bias for transistor Q2, the reduction in voltage at point "A" turns off Q2 and its collector current drops causing the voltage at point "B" to increase. This, in turn, reduces the emitter-base bias applied to the power transistor, Q3, thereby reducing output power.

Exactly the opposite circuit action occurs on the negative half of the input cycle.

One characteristic of class-A amplifiers is that collector current flows over the entire 360° of the input waveform and also when no signal is being processed. This causes the tremendous heat build-up associated with class-A designs. Delco has traditionally used large, finned heat sinks to dissipate this heat.

There are several common faults associated with the class-A circuit, especially those using the PNP germanium type power transistor. One of these is shorting of the emitter-collector junction of the output transistor. Delco uses their own DS-501 and DS-503 types, while Motorola uses transistors in the 2N176 class. When these transistors become shorted, a high current will flow through the emitter-collector circuit, and this almost always blows the fuse resistor, R6. Open driver (Q2) and pre-driver (Q1) transistors also are frequently found in the circuits represented by Fig. 1. These will cause zero and excessive collector currents, respectively. Collector voltage, incidentally, is the key to determining collector current, and thereby aids immensely in audio stage troubleshooting.

In some older Delco radio mod-

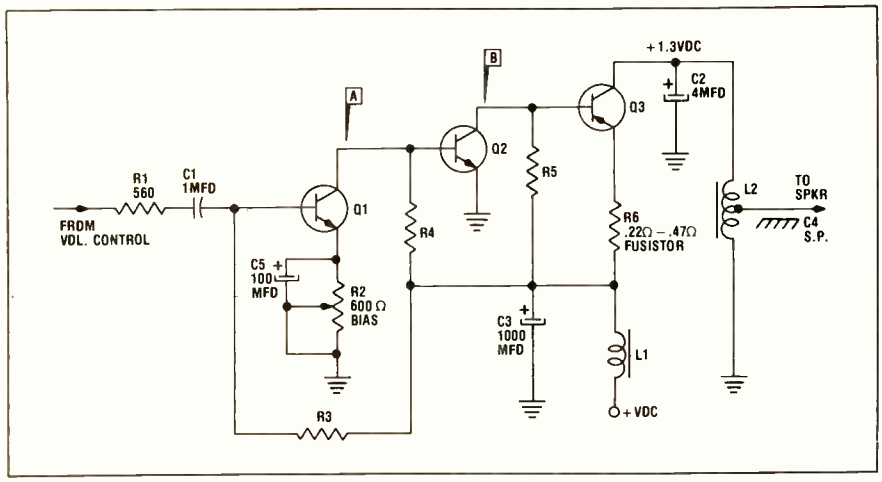

Fig. 1—Classic PNP Class-A power amplifier used in auto radios since the early '60s. Transistor Q3 is usually a germanium type such as the Delco DS-501 or DS-503 or the Motorola 2N176.

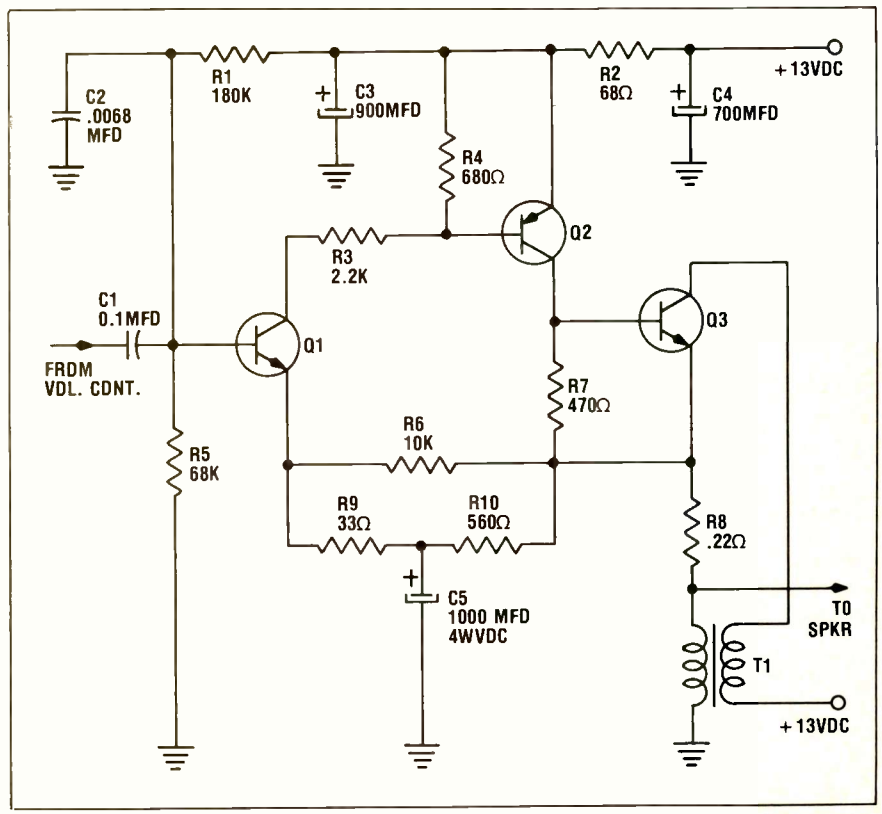

Fig. 2—Bendix version of the NPN silicon Class-A power amplifier. Similar circuitry also is used by Philco (now Aeronutronics-Ford) and others. Transistor Q3 is usually a P-66 plastic power transistor.

els, the resistor represented by R2 in Fig. 1 is a 600-ohm potentiometer (it became a fixed resistor in later versions) and these open occasionally. If an "original" part is available, use it. If a suitable pot cannot be located, use a resistor substitution box (or a handful of half-watt carbon resistors) to determine which value of resistance between 0 and 600 ohms yields a Q3 collector voltage of about +1.3 VDC. The correct value of R2 usually is between 270 and 470 ohms, with 330 ohms and 390 ohms being most common. If after Q3 or R2 replacement it is found that the radio is still distorted and the +1.3 VDC is unattainable, check the output matching inductor L2 to see if it is shorted. Burned output chokes are rare, but they are not unknown.

BENDIX NPN CLASS-A DESIGN

A more recent design of class-A circuit, which uses an NPN power transistor in a plastic case, is shown in Fig. 2. The plastic encased power transistor, Q3, which is the principal distinguishing feature of this circuit, is a 2N5294 class in later models, but in 1967 versions it is a type which looks like a "blue pill on a topless TO-3 base." In 1968 and later models, Bendix used transistors such as the 2N5294, which is a plastic type and is tab mounted on the "topless" TO-3 base in some models and directly to a heat sink in others.

The most frequent faults involving this transistor seem to cause low volume (or no output at all) and a very low A-lead current. When you first turn on a radio with this type of defect, there will be a brief flicker of A-lead current as the power supply capacitors charge, then the "A"-lead current will settle down to a couple

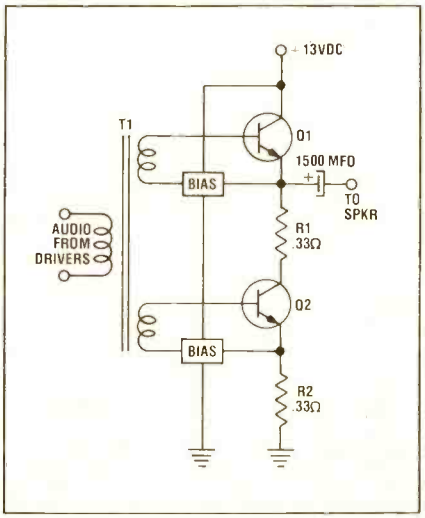

Fig. 3—Totem-pole push-pull power amplifier uses identical power transistors driven by a special transformer with two secondaries which drive the bases out of phase.

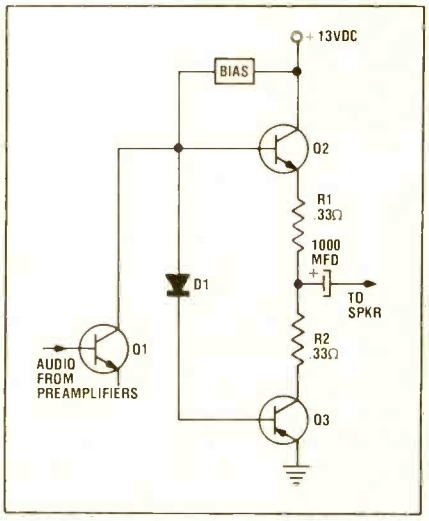

Fig. 4—Complementary symmetry push-pull power amplifier depends upon the "opposite" characteristics of matched PNP and NPN power transistors.

hundred milliamperes.

The main failure mode of these output transistors is an open base-emitter junction, which can be quickly pinpointed by measuring the base voltage. It normally should be between 1.5-3.5 VDC. When the base-emitter junction opens, the voltage increases to over 8 VDC. When ordering replacements for this transistor from the universal semiconductor lines, examine the basing and case outlines in the replacement catalog and compare them with the original. Some of the replacement types are physically different and are difficult to properly mount in some Bendix models.

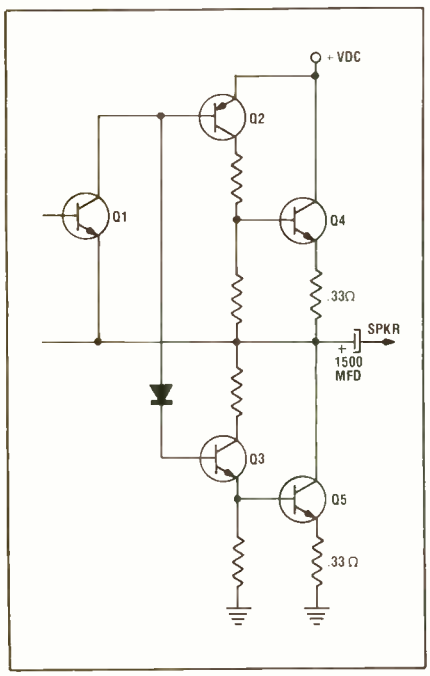

Fig. 5—Quasi-complementary amplifier uses identical matched output transistors but has complementary drivers. These lower power transistors are sometimes easier to source out in low-power complementary pairs.

To reduce the incidence of power-transistor failure, use either a TO-3 or TO-66 type. Philco radios of the 1967-1968 era were often drilled (on the front escutcheon) to accept a TO-66 power transistor, while most Bendix types will accept a TO-3 replacement on either the escutcheon or rear apron. If the TO-3 can be installed, use a 2N3055 type (or its equivalent from a replacement semiconductor line). The 2N3055 is a very common type and can be obtained from some mail order electronic suppliers for less than a dollar. If a TO-66 must be used, select the appropriate type from one of the replacement lines, but first check the base-emitter pin spacing. The TO-66 type offered by ECG will fit satisfactorily.

If the circuit in Fig. 2 produces weak audio but A-lead current drain is close to normal, check capacitor C5. It is a black plastic electrolytic mounted upright on the PCB. It might be either a single-or dual-section type, depending upon the make and model of radio. (The second section, if used, is a lower value capacitor and is used to decouple the AGC feedback line.) Although you can replace C5 with almost any electrolytic of appropriate value, space and mounting considerations make an original part the most convenient. Whenever service is performed on radios which use the circuit in Fig. 2, examine C5 for cracks or evidence of electrolyte leakage on the outside case. Both visual defects are sure indications of impending failure.

TOTEM POLE DESIGNS

This class of audio output circuit uses a special interstage coupling

transformer represented by T1 in Fig. 3. Such transformers have two secondary windings which are identical but isolated from each other. The secondary windings also are connected in opposite polarities so that one output transistor base will be positive while the other swings negative, producing push-pull action.

Transistors Q1 and Q2 in Fig. 3 are identical types and might be matched pairs, although this is not always the case.

Totem pole power amplifiers are found most commonly in Japanese auto entertainment electronic equipment. In such sets, the values of resistors R1 and R2 are between 0.1 and 1.0 ohms, and might even be several carbon resistors tied together in parallel. Suspected power amplifier problems can often be quickly confirmed by examining these resistors for signs of burning. Also, measure the DC potentials at the collectors of Q1 and Q2. In a normally operating stage with the volume turned all the way down, the voltage on the collector of Q2 will be approximately half of that on the collector of Q1. Shorts or opens in either transistor will affect these DC voltages and their relationship to each other. Even when you do not know the exact voltages to expect, this 2:1 relationship can be of use in troubleshooting.

Whenever Q1 or Q2 is found to be shorted, it might be wise to also check for a short in transformer T1. In some cases, T1 shorts and the excessive current burns out of the transistors. If so, the new replacements will suffer the same fate as soon as power is applied. Occasionally, the secondary winding of T1 will open and the output of the radio will become distorted.

The power amplifiers of many imported car radios and tape players are equipped with marginally rated transistors. Consequently, it is absolutely essential that silicone heat transfer grease be used when the replacements are installed and that the manufacturer's heat sinking efforts be either duplicated or improved. Many of these transistors are in TO-5 or smaller cases (a standard small-signal transistor case popular in Japan is often seen) but have a 500-mA or 1-amp collector current rating. Do not replace these transistors with preamplifier type transistors.

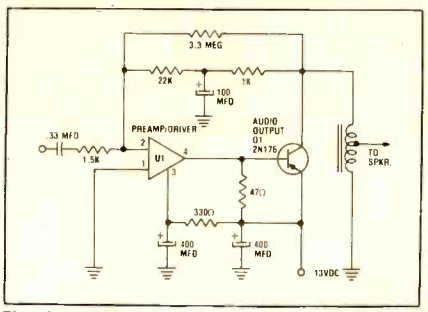

Fig. 6—Motorola audio stage used in VW and other European cars has an IC as the preamp. Design has been around since the late '60s.

COMPLEMENTARY-SYMMETRY DESIGNS

Although popular in home entertainment electronics for many years, complementary symmetry amplifiers have been widely used in auto electronics only during the past five years. Fig. 4 shows a simplified version of this style of circuit. Transistors Q2 and Q3 have identical electrical characteristics but are of opposite polarity—Q2 is NPN and Q3 is PNP. Such transistors are called "complementary pairs."

Troubleshooting of these circuits is similar to that of totem pole amplifiers, but it is necessary to identify which transistor is which. Fortunately, some manufacturers of auto electronic equipment use color-coded, plastic-case transistors—usually black for the NPN and green or red for PNP type. However, because not all are so coded, you should be extremely careful when servicing such receivers. Take time to look up the numbers in either the manufacturer's service manual, the appropriate Sams AR-Series manual or a replacement semiconductor guide.

The fundamental operating principle of complementary amplifiers is dependent on Q2 and Q3 being of the opposite type, but matched. The bases are fed in parallel. When the input signal at the bases swings positive, transistor Q2 is turned on and Q3 is turned off. Negative going signals have the opposite effect, turning on Q3 and turning off Q2.

QUASI/COMPLEMENTARY DESIGNS

The final class of amplifier circuit which we shall consider is the quasi-complementary circuit of Fig. 5. In this circuit the output transistors are identical types—usually, but not necessarily, NPN. This eliminates the problem of finding matched and complementary high-power transistors. The drivers, however, are complementary, but it is usually easier to find matched complementary low-and medium-power transistors.

IC-FED DESIGNS

In the early days of solid-state audio, all preamplifiers consisted of discrete transistors and other components mounted on a printed-circuit board. Since the mid- and late-'60s, however, many manufacturers (including the two largest O.E.M. suppliers) have used either integrated circuits (ICs) or potted modules in their audio preamplifier and driver circuits. Delco, for example, makes audio preamplifier/drivers which are potted inside a plastic case with solder tabs along one edge for mounting to the printed-circuit board. The first of these was the DM-8, followed by the DM-28 and now the DM-29. Philco uses a similar concept, but their casing material is ceramic.

Some car radio manufacturers use "genuine" integrated circuits in the audio preamplifiers. An example is shown in Fig. 6. This is one version of a circuit used in Motorola car radio models manufactured for use in Volkswagen and other European cars. IC U1 occasionally will short out or become open, and this affects the output transistor. If U1 shorts, it will drive Q1 into hard conduction, making Q1 appear shorted because of the amount of A-lead current it draws. Diagnosis is easily performed by using an alligator clip lead or a pair of thin, long-nosed pliers to short across the base-emitter of Q1 while observing the A-lead current. If the transistor is not internally shorted, this will remove forward bias and reduce A-current to almost zero. If, on the other hand, the transistor is shorted, the A-current either will remain the same or will increase slightly.

A resistor substitution box connected between Q1 base and ground will help you determine if U1 is open. Start at a high value and reduce it until A-lead current begins to increase.■

Troubleshooting CB Squelch & RF/IF Stages

By David Norman

Typical defects and guidelines for isolating them

SQUELCH

■ The purpose of a squelch circuit is to quiet the receiver when no intelligence-bearing signal is being received. This is accomplished by biasing off one of the audio amplifier stages when no signal is present.

Theory Of Operation

Fig. 1 is a simplified functional diagram of the receiver portion of a CB transceiver. (The circuit design in Fig. 1 is hypothetical and is intended only to illustrate the fundamental principal of squelch operation.)

Transistor Q5 in Fig. 1 is the 1st audio amplifier. Detected audio is applied to the base of Q5 via volume control VR1 and coupling capacitor C8.

Transistor Q4 in Fig. 1 is the squelch amplifier. Note that the collector of Q4 is connected to the emitter of the 1st audio amplifier (Q5) via resistor R13.

With no signal being received, squelch control VR2, which establishes the forward bias threshold of Q4, is adjusted so that squelch amplifier Q4 is cut off. With no current flow through Q4, the voltage on its collector increases to a positive value established by the voltage rating of Zener diode D5. A portion of this *positive* voltage is dropped across R14 in the emitter circuit of *NPN* transistor Q5, reverse biasing it. Consequently, with no signal being received, 1st audio amplifier transistor Q5 is cut off, quieting the receiver.

When a signal is received, a sample of it is rectified by AGC detector D4 and the resultant negative-going voltage is applied to the base of AGC amplifier Q3, reducing its conduction. As the current through Q3 decreases, the voltage on its collector swings more positive. In turn, the voltage across squelch control VR2 also swings more positive, turning on the NPN squelch amplifier transistor, Q4. Conduction by Q4 lowers the positive voltage on its collector, which, in turn, decreases the positive voltage at the top of R14, eliminating the reverse bias applied to the emitter of the 1st audio amplifier, Q5, permitting it to conduct and amplify the detected audio signal applied to its base.

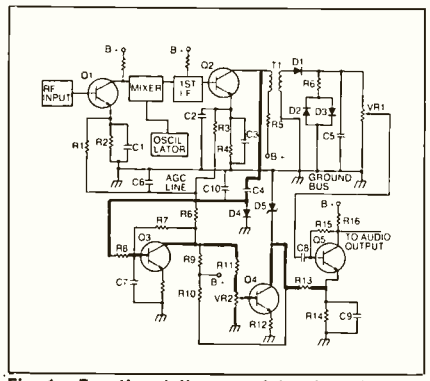

Fig. 1—Functional diagram of the simplified circuitry of a hypothetical CB transceiver. Bold lines show path of "signal" used to develop AGC voltage and indirectly control the squelch circuit. Transistor Q3 is the AGC amplifier and transistor Q4 is the squelch control amplifier.

When atmospheric or manmade electrical interference is at a constant low level and there are no skip signals, most modern squelch circuits are relatively effective. Many of them will open cleanly at received signal levels well under one microvolt. When used in conjunction with one of the better noise blanking circuits, some of the squelch circuits will handle noise levels with peaks up to several microvolts and still open only on "intelligence-bearing" signals.

However, in most areas, the unit has to deal with noise peaks of several dozen microvolts which fluctuate wildly. In addition, skip signals look the same to the signal-sensing circuits as do weak local transmissions. Under these conditions, to prevent the squelch from randomly opening and closing, the control must be set to a level which will quiet the receiver at all signal levels below the amplitude of the noise or skip peaks. However, when this setting is used, weak intelligence-bearing signals also are squelched. This is why many operators—myself included—usually leave the squelch open and reduce the volume to a low level in hopes that they will be able to pick the desired signals out of the noise.

Amplitude modulation (AM) receivers respond to noise peaks. Most frequency modulation (FM) receivers have "noise-operated" squelch circuits and are relatively immune, but not totally, to noise peaks.

Troubleshooting Procedures

Squelch problems usually can be pinpointed quickly by either applying or removing bias from each related transistor until proper operation is restored. Unless you just like to unsolder and resolder parts, this is the best method of tracing squelch problems.

For example, say that the 1st audio amplifier has voltages on the collector, base and emitter of 10VDC, 2VDC, and 4VDC, respectively. If this is an NPN transistor, you don't have to be a genius to see that the transistor is biased well beyond cutoff. If you use a resistor to "bleed off" some of the emitter voltage, and the transistor is not defective, the amplifier will begin to function properly. *A word of caution:* Always start with a high value of bleeder resistor. A dead short or near short from the emitter to its common point or ground might let the transistor draw excessive current which will destroy

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it. An alternative method is to open the circuit from the switching transistor. (For the sake of this discussion, we are assuming that the squelch operates by emitter biasing of the audio amp. Some units use base biasing to accomplish the same thing. A little study of the circuit and the voltages present will tell you which way voltages need to go to restore operation.)

If the audio transistor can be "artificially" biased on, then move back to the next test point—the squelch amplifier transistor itself. If biasing fails to restore operation, the audio output transistor is either defective or no signal is being applied to it. If the unit has a built-in meter, a strong input signal will cause the meter to deflect if the circuits preceding the audio amp are working as they should. On units with no "S-meter," you can monitor for proper receiver operation by measuring the AGC voltage. If AGC voltage or the meter shows little or no fluctuation as input levels are varied, you have a receiver RF or IF problem.

If the audio transistor can be

turned on, determine which way the bias on the squelch switching transistor must go to turn on the audio amp. Then use the same bias technique on it. Most squelch problems are caused by either a defective switching or squelch amplifier transistor, or by malfunction of the squelch control pot. If the reference end of the pot—usually tied to ground or chassis common—is open, the squelch usually stays closed even on strong signals.

In some CB units, one transistor performs both the squelch amplifying and switching function, as is the case in Fig. 1. Whether the switching and amplifying functions are combined or not, the operation is basically the same.

Squelch delay, or the time that the squelch stays open after a signal is no longer present, is controlled by the RC constants of the particular circuit. As a rule, squelch systems which open cleanly or not at all are more effective than those which open and close gradually.

In summary, squelch problems can usually be found quickly by systematically checking voltages at the points mentioned. Confirmation before replacement is as simple as either adding or subtracting voltages to restore operation. An adjustable 0 to 10-VDC supply in series with a resistor will serve quite well when voltages need to be increased. Don't be afraid to clip leads or make neat cuts in a circuit board; solder is much cheaper than time. At times, such isolation without removing components is the only economical out that you have. Don't forget about it. As a rule, less circuit board damage is caused by neat cuts than by removing a handful of components which were good before you applied soldering gun heat to them.

A well-tinned iron will easily form shiny bridges across your cuts, if you take the time to scrape the copper foil clean. Reinforcement can be added by soldering a small bare wire across the smaller cuts and a piece of tinned copper braid across larger gaps.

RF/IF STAGES

Most transistorized receivers use Class-A common-emitter amplifiers in the RF and IF stages. For all intents and purposes, the only difference between these stages and the audio stages is the frequency involved and the type of coupling. Of course, there are a few relatively unusual designs, but even these are not all that complicated.

One of the variances from the usual is the use of field-effect transistors (FETs) as either the RF input amplifier or the first mixer. To simplify understanding of FET's just think of an N-channel FET—which is the most commonly used type—as an NPN bipolar transistor which needs no forward base bias to turn it on.

Another device used in some units—in Lafayette units, for example—is the diode mixer (Fig. 2). The advantages of the diode mixer are simplicity, low cost and a low noise figure. The disadvantages are relatively high conversion *losses* and a propensity to "wear out."

Another design becoming quite popular is the integrated circuit IF amplifier. The IC provides the

gain necessary to overcome the losses inherent in "brute-force" mechanical or ceramic IF filters. Besides gain figures higher than most transistors, IC's are often designed with the additional bonus of having other circuits, such as squelch amplifiers, built into the same package.

If a unit has low sensitivity or weak audio output, the problem is probably in the IF or RF stages. Touching a finger to the input (usually base) of the audio stages will induce a distinct hum if the audio circuits are okay.

Not every unit that seems to have low sensitivity actually has. In many cases, the unit will respond to a signal of one microvolt or less, yet the audio output at full volume is so low that it can barely be measured on a scope.

On the other hand, a unit might exhibit a similar "low-volume" symptom but plenty of "noise" will be present in the speaker when the squelch is opened. The differences between the two cases described are significant.

As a general—but not absolute—rule, front end (RF input) problems cause loss of sensitivity and yet normal or near normal squelch-open noise is heard at the speaker.

IF problems make the unit much quieter with actual sensitivity still high; the problem is that any signal under 30 μV or so is too weak to be heard above room noise. In both instances, S-meter readings will be subnormal.

There are almost as many different methods of receiver troubleshooting as there are technicians. Let's look at a couple of short cuts.

Fig. 3 shows a very simple device that you can build and use to uncover dead stages. (Actually, the capacitor could be left out for many applications, but it prevents you from destroying a component by applying the wrong DC potential to it. Some transistors and miniature transformers are completely unforgiving.) To use the device in Fig. 3, attach the clip end to a point where you know a signal exists (in RF stages, try the center pin of the coax connector) and touch the probe end to first one element of a stage and then another until a noticeable change in receiver output is heard. If the change is downward, you are probably only loading a normally functioning stage. You are looking for an *increase* in volume level.

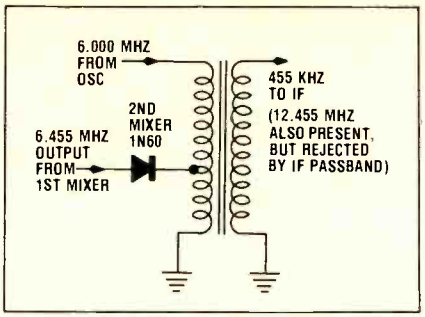

Fig. 2—Example of diode-equipped mixer circuit used in some CB transceivers.

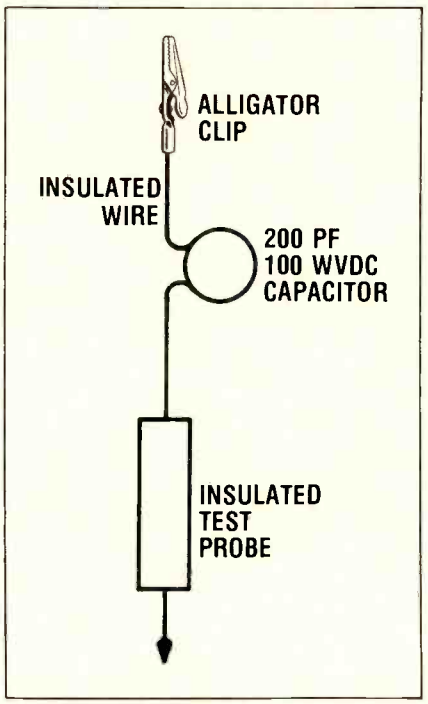

Fig. 3—Simple, do-it-yourself signal-injection probe. Usage is explained in the text.

For example, if you connect the device to the base of the RF amplifier and no change is noted, then try the collector. If operation is drastically improved, you have definite reason to suspect that transistor. (In this example, a common-emitter configuration is assumed.)

If the RF transistor seems to be functioning normally, proceed on toward the speaker, but not into circuits which are not designed to process the frequency of the signal source to which your probe is connected. (A 27-MHz signal applied to a 455-KHz IF stage can give you some funny, and meaningless, responses.)

The probe in Fig. 3 can be attached to a 455-KHz source and used in the IF sections, but many technicians prefer to begin at the detector and proceed back toward the first (or only) mixer with a scope while feeding a 27-MHz signal to the RF input.

The "quickie" methods become easier with practice, and any technique which can allow you to pinpoint a problem in a minute or so is worth learning. There will be enough times when it's a matter of rooting slowly from one hard-to-get-to-point to another. Save it for when you really need it.

There are three circuits to suspect anytime sensitivity is below normal: RF input amplifiers, IC IF amplifiers, and diode mixers.

If drastically reduced sensitivity is really the problem, suspect the RF amplifier. If the receiver is able to respond to a weak signal, but volume is low, check to see if the unit has either a mixer diode or an IC in the IF section. If so, substitute the mixer diode and either bridge across the IC or check the voltages on it. Bridging can be done even if you have no table of normal voltages. You should be able to locate input and output by carefully examining the circuit board.

If you are servicing one of the units which uses a mixer diode, go ahead and replace it. The little germanium diodes are cheap and, as mentioned before, these diodes tend to "age." If the change improves receiver performance, bill the customer for it. If not, it was a good bet anyway.

So far we have only discussed failure of solid-state devices. Transformers, capacitors, resistors, "cold" solder joints or broken wires can also give you fits. Even so, about 90% of the receiver problems that you will face are caused by failure of one solid-state device or another.

There are other minor symptoms which point out failures of other components, but they are often very subtle. Every technician should learn to look for cold solder joints or broken leads. Wiggling components and watching the other side of the board is one of the best ways. Gentle probing with a nonconductive tool is another.

At the low power levels in CB receiver sections, resistor and capacitor failures are uncommon

continued on page 45

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91 North McKinley
Greenwood, IN 46142
(317) 888-7265
Brand: *American*

Audiovox Corp.
150 Marcus Blvd.
Hauppauge, NY 11787
(516) 213-7750
Brand: *Audiovox*

Automatic Radio
Two Main St.
Melrose, MA 02176
(617) 321-2300
Brand: *Automatic Radio*

B & B Import-Export, Inc.
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Brand: *Alaron*

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Gardena, CA 90248
(213) 532-0254
Brand: *Beltek*

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Enterprise Co., U.S.A.
7037 Hayvenhurst Ave.
Van Nuys, CA 91406
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Brand: *Bohsei*

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(213) 869-4041
Brand: *Astro-Line, Boman*

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(603) 524-5454
Brand: *Browning*

Cobra Communications Products Group, Dynascan Corp.
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Chicago, IL 60613
(312) 327-7270
Brand: *Cobra*

Commando Communications Corp.
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(615) 756-8981
Brand: *Commando*

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(312) 564-2012
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Brand: *Metro Sound*

Midland International Corp., Communication Div.
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(816) 474-5080
Brand: *Midland, Medallion*

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(312) 451-1000

Communications Div.
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Schaumburg, IL 60172
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Melrose, MA 02176
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Brand: *National*

Nuvox Electronics Corp.
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Brand: *Nuvox*

PAL Electronics Co.
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2962 West Weldon
Phoenix, AZ 85017
(602) 264-0214
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(714) 746-2666
Brand: *Palomar*

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Oceanside, CA 92054
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256 Oak Tree Rd.
Tappan, NY 10983
(914) 359-5050
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Brooklyn, NY 11207
(212) 649-8000
Brand: *Sonar*

Sparkomatic Corp.
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Brand: *Sparkomatic*

Standard Communications Corp.
108 West Victoria
Carson, CA 90746
(213) 532-5300
Brand: *Standard*

Superscope, Inc.
Automotive Products Div.
20525 Nordhoff St.
Chatsworth, CA 91311
(213) 998-9333
Brand: *Superscope, Marantz*

Surveyor Manufacturing Corp.
29245 Stephenson Highway
Madison Heights, MI 48071
(313) 544-9110
Brand: *Surveyor*

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4825 North Scott St., Suite 214
Schiller Park, IL 60176
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Brand: *Challenger*

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(317) 842-0280
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Brand: *Tenna*

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Paramus, NJ 07652
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Unimetrics, Inc.
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Syosset, NY 11791
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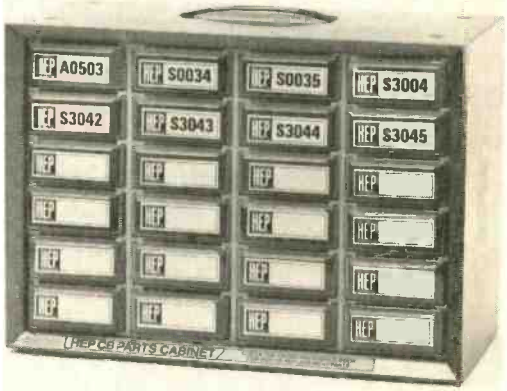

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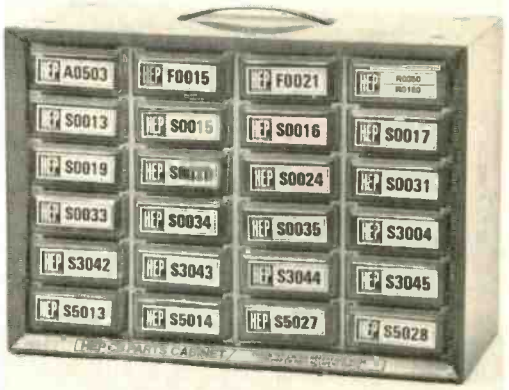

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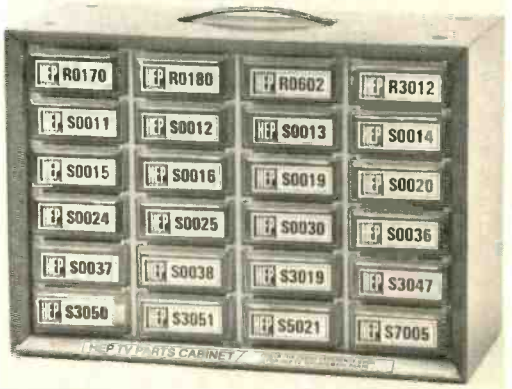

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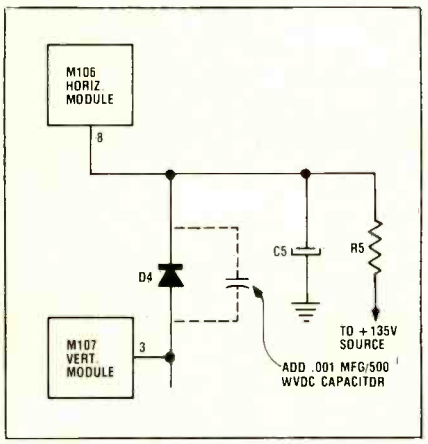
TECHNICAL DIGEST

The material used in this section is selected from information supplied through the cooperation of the respective manufacturers or their agencies.

CHASSIS: Magnavox T995

TROUBLE SYMPTOM: A white stripe which extends down from the top of the screen about three inches and curves to the left. This video interference occurs only under certain weak signal conditions.



CAUSE: Radiation from diode D4, which is electrically connected between Pin 3 of the M107 vertical module and Pin 8 of the M106 horizontal module. (The physical location of D4 is on the copper side of the "mother" printed-circuit board, near the lower right side of the chassis.) To eliminate this radiation or the possibility of it occurring, add a .001-mfd, 500 WVDC capacitor (Magnavox Part No. 250551-1029) across D4. Place the capacitor as close to the printed-circuit board as possible, but avoid shorting out the adjacent copper bands on the board.

CHASSIS: Magnavox T985/986/991/995/998

TROUBLE SYMPTOM: AM, FM or CB interference in sound.

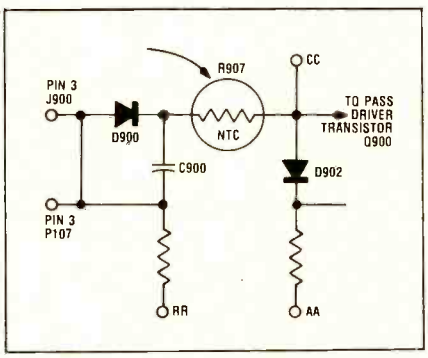
CAUSE: Interfering signal feeds through sound module. In other than STAR-equipped models, this problem can be cured by replacing the 703727-1 two-chip or 703639-1 one-chip sound modules with a new one-chip sound module (Magnavox Part No. 703760-1). The new 703760-1 should not be used in STAR-equipped models because of excessive audio feedthrough at minimum volume settings. If the new 703760-1 sound module is not readily available, the 703727-1 and 703639-1 modules can be modified to reduce or eliminate interference in the following manner:

703727-1 two-chip module–
A) Add a .001-mfd capacitor across R5.
B) Add a 2.2-K resistor in series with C9.

703639-1 one-chip module–
A) Cut the copper between Pin 10 of the module and C10. Add a 2.2-K resistor from Pin 10 to C10. This places the 2.2-K resistor in series with Pin 10 and the junction of IC1, Pin 1 and C10.
B) Add a .001-mfd, 100 WVDC capacitor between Pin 3 of the IC and ground.
C) Cut the copper between Pin 3 of the IC and the junction of Pin 8 of the module and C11 and add a 2.2-K resistor across the cut.

CHASSIS: Admiral M10 Series

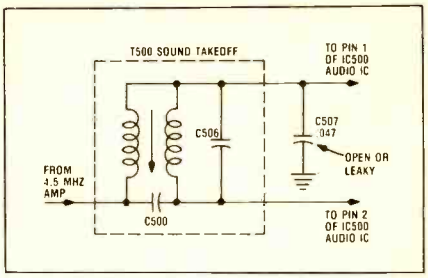
TROUBLE SYMPTOM: No raster or sound.



CAUSE: Open NTC resistor R907 on the M900 power supply board. Two versions of this resistor were used in production runs of this chassis series: both were assigned Admiral Part No. 61C49-6, but the color of one version is aqua (bluish) and that of the other is black. The aqua-colored version has a higher than normal failure rate. Admiral has requested that when any M10 series chassis is serviced, the color of resistor R907 be checked and if an aqua version is found, it be replaced with a new black version of this resistor (Admiral Part No. 61C49-7).

CHASSIS: Admiral M10 Series

TROUBLE SYMPTOM: Hissing or static type noise in sound which is not changed by varying the volume control setting.



CAUSE: Open or leaky capacitor C507, which is connected to Pin 1 of the audio IC, IC500.

CHASSIS: Magnavox T960/966

TROUBLE SYMPTOM: Horizontal sync instability during warmup of the receiver.

CAUSE: Slow stabilization of the horizontal oscillator, which might be cured by replacing the following resistors with the carbon film types indicated and the following capacitors with the mica types indicated:

T960 Chassis–
A) Replace the 47-K R608 with a 47-K carbon film type (Magnavox Part No. 230212-4735).
B) Replace the 180-K R607 with a 180-K carbon film type (Magnavox Part No. 230212-1845).
C) Replace the 470-pF C606 with a 470-pF mica type (Magnavox Part No. 250702-4715).

T966 Chassis–
A) Replace the 240-K R155 with a 240-K carbon film type (Magnavox Part No. 230212-2445).
B) Replace the 470-pF C130 with a 470-pF mica type (Magnavox Part No. 250702-4715).

CHASSIS: Magnavox T998

TROUBLE SYMPTOM: Beat and hash interference in the picture

CAUSE: RF interference, which can be cured by the following modifications on the IF module:

A) Remove C16 from the component side of the module board and place it between Pin 16 and ground on the copper side of the board.
B) Add a .001-mfd capacitor (Magnavox Part No. 250551-1020) between Pin 16 and 17 of IC1 on the copper side of the board.■

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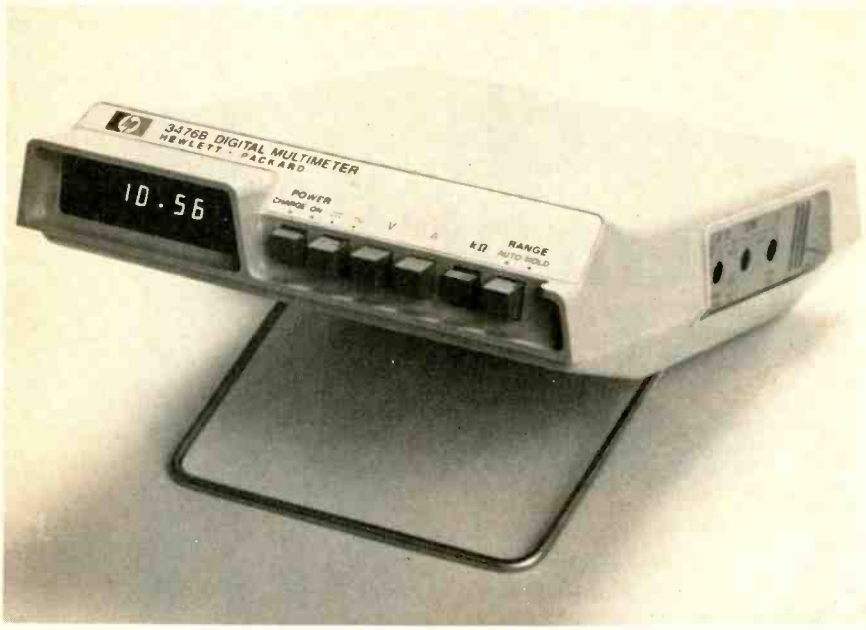


AUTORANGING DMM

Hewlett-Packard recently introduced a 3½ digit, five-function, fully autoranging digital multimeter, the line-powered version of which, Model 3476A, is priced at only $225 and the AC/DC-powered version of which, Model 3476B, is priced at $275.

The automatic range switching (autoranging) feature, combined with two other "automatic" features—automatic polarity switching and automatic zeroing—make the 3476 virtually a hands-off instrument once you have selected the measurement mode.

The *DC volts* measuring capability of the 3476 extends from .0001 volt (100 microvolts) to 1000 volts; the *AC volts* measuring capability extends from .0033 volt to 700 volts RMS; the *DC current* measuring capability extends from .0001 amp (100 microamps) to 1.1 amp; the *AC current* measuring capability extends from .0033 amp to 1.1 amp; and the *resistance* measuring capability covers the range from .001 K ohm (1 ohm) to 11,000 K ohms (11 megs).

The typical accuracy of the 3476 for DC voltage measurements is .5% and the accuracy for DC current measurements is 1.0%. The AC voltage and current measuring accuracy of the 3476 varies with frequency and measurement range but generally extends from + (1.5% of reading +4 digits) over the frequency range of 45Hz-2KHz, to + (18% of reading + 10 digits) over the frequency range of 5KHz to 10KHz. The resistance measuring accuracy of the 3476 extends from about 0.4% to 0.6%, depending on the range, and the open circuit voltage in the resistance measuring mode is less than 4 volts.

The input resistance of the 3476 in the AC and DC voltage measuring modes is 10 megohms on all ranges, and the input capacitance in the AC voltage measuring mode is less than 30pF. The input of the 3476 is internally protected up to 1100 volts peak on all DC and AC voltage measuring ranges.

In the DC and AC current measuring modes the input is protected by a 1.5-amp fuse, and in the resistance measuring mode the input is protected by a fuse rated at 250 volts RMS. The fuses are conveniently accessible behind a cover plate on the side of the 3476; when the cover plate is slid back, the fuses pop out.

The LED-equipped readout of the 3476 gives all voltage readings in volts, all resistance readings in kilohms and all current readings in amperes. If the value being measured exceeds the measuring capability of the 3476, the overrange condition is conspicuously indicated by the appearance of horizontal bars on the readout.

A black, slightly recessed background and orange numerals make the readout highly visible in any ambient lighting condition.

To give you a better concept of what the autoranging, autopolarity and autozeroing features of the 3476 mean in terms of convenience and time and motion savings, following is a step-by-step description of how the 3476 is used to measure DC voltages: 1) the POWER button is pushed in; 2) the AC/DC pushbutton is placed in the "DC" position; 3) the RANGE pushbutton is placed in the "AUTO" position; 4) the V (volts) pushbutton is pressed in; and 5) the two test leads are plugged into their appropriate jacks on the side of the 3476—hereafter, without again touching the operating controls of the 3476, you can measure all positive and negative DC voltages in the range from .0001 volt to 1000 volts—all you have to do is move the test leads from one circuit point or element to another—the autoranging, autopolarity and autozeroing features of the 3476 automatically switch its DC voltage measuring circuit to the appropriate range and polarity. If you wish to lock the 3476 on the range used for the particular voltage then being measured (the 3476's DC and AC voltage measuring capability is divided into five automatically selected ranges), you merely place the RANGE pushbutton in the "HOLD" position. (This range holding feature also functions during current and resistance measurements.)

Both versions of the 3476 are surprisingly compact and light. They are only 2.3 inches high by 6.6 inches wide by 8.1 inches long. The AC-line operated version, Model 3476A, weighs a mere 1 lb., 9 oz., and the AC/DC-operated version, Model 3476B, weighs but 2 lbs., 2 oz.

The four rechargeable Nickel Cadmium (Sub C size) batteries of the "B" version provide about 8 hours of continuous operating time and can be fully recharged in about 14 hours with the instrument turned off or trickle charged over a longer period with the instrument on.

Other features of both versions of the 3476 include a high-impact-resistant polycarbonate case and a three-position stand, or bail.

Accessories available on an optional basis for the 3476 include a 10KHz-700MHz RF probe ($87), a test lead kit ($5), a soft carrying case ($20) and a "composite" kit which contains test leads and soft carrying case ($25).

...for more details circle 161 on Reader Service Card

TRANSISTOR/FET TESTER

Sencore, Inc., has introduced a battery-powered, pocket-size version of their "Cricket" series of transistor/FET testers.

Called the Model TF40 Pocket Cricket, the new instrument performs "good/bad" gain and quantitative leakage tests of bipolar and field-effect transistors, both in and out of circuit, and provides identification of the "polarity" of the device as well as identification of the device's leads.

To perform the good/bad gain test, the three-position, slide-type function switch on the lower right front of the Model TF40 is placed in the "GAIN" position and the three color-coded test leads are connected in a random manner to the three elements of the device being tested. The 12-position TEST switch, on the center front of the instrument, then is rotated until a position is found in which a chirping sound is produced and the pointer of the meter moves to the "GOOD" portion of the scale. If the combination of a chirping sound and a "GOOD" meter indication is not produced on any position of the TEST switch, the transistor or FET is defective.

(The preceding "gain" test actually establishes whether or not the bipolar transistor or FET is capable of amplifying and inverting the Pocket Cricket's built-in test signal—two functions which any "good" device should be able to perform.)

Once it is established that the device has "good gain," the polarity of the device is indicated by which half of the TEST switch produced the "good" indication—if it is the half labeled "N," the device is either an NPN bipolar transistor or N-channel FET, and if it is the half labeled "P," the device is a PNP bipolar or P-channel FET.

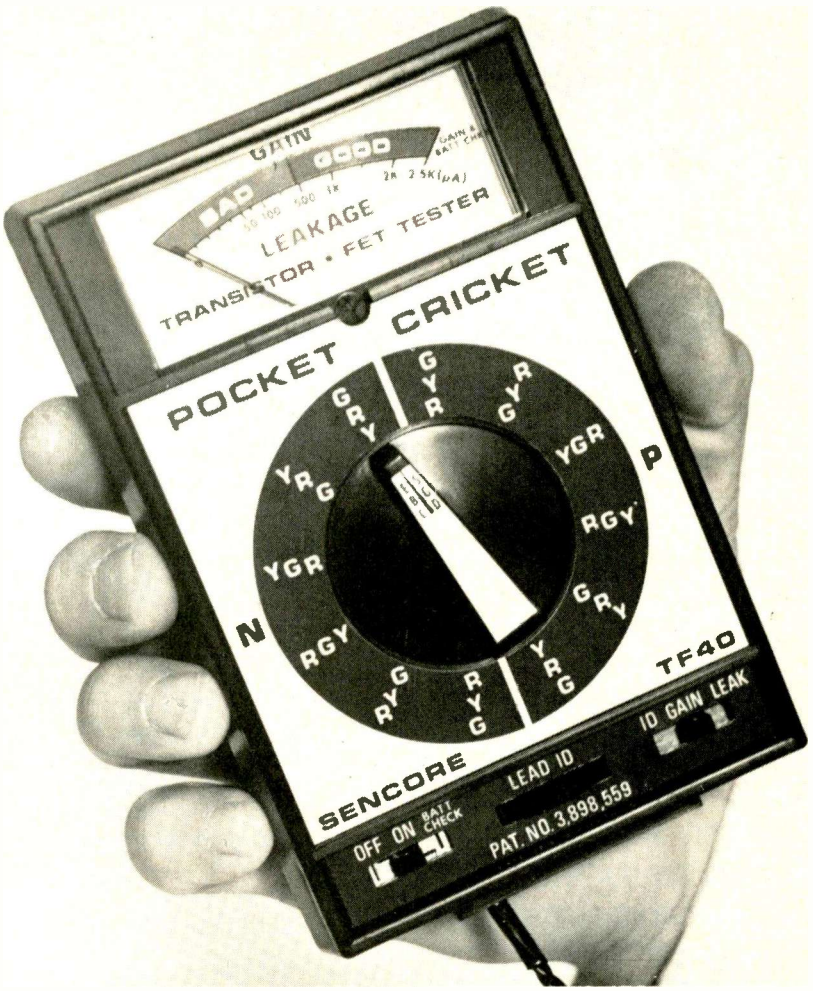
Identification of the device's leads is accomplished by placing the function switch in the "ID" position and adjusting the LEAD ID thumwheel to a position in which only *one* position of the TEST switch provides a good gain indication. (Normally, two positions of the TEST switch are capable of producing a "good gain" indication for any particular normally functioning device, with the two positions determined by the manner in which the test leads are connected to the device.) Once a single "good gain" position of the TEST switch is established, the device's leads can be physically identified by matching the element-to-test lead color code of that TEST switch position to the corresponding color-coded test leads connected to the device's elements.

When the function switch of the Pocket Cricket is placed in the "LEAK" position, the leakage between elements of the bipolar or FET can be read directly from the "LEAKAGE" scale of the meter.

The condition of the Pocket Cricket's battery can be quickly checked by placing the OFF/ON/BATT CHECK switch in the "BATT CHECK" position; if the battery charge is still sufficient to produce accurate tests and measurements, the meter pointer will swing to the "GOOD" portion of the scale.

The price of the Model TF40 Pocket Cricket, complete with test leads and a cassette training tape which explains the operation and applications of the unit, is $98. ■

...for more details circle 162 on Reader Service Card



FEATURES UPCOMING IN THE JULY ISSUE

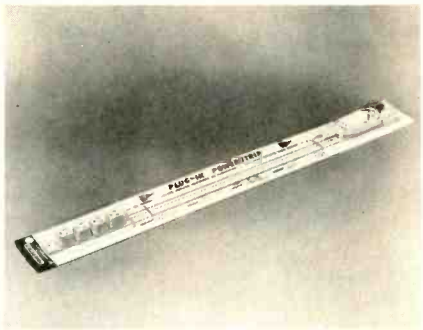
- NEWCOM '76 Wrapup
- "Non-audio" Sources Of Car Radio Distortion
- Troubleshooting Sync Separator/Noise Limiters
- CB Theft Prevention: A Viable Market For Dealers

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.

FLEXIBLE OUTLET SYSTEM 131

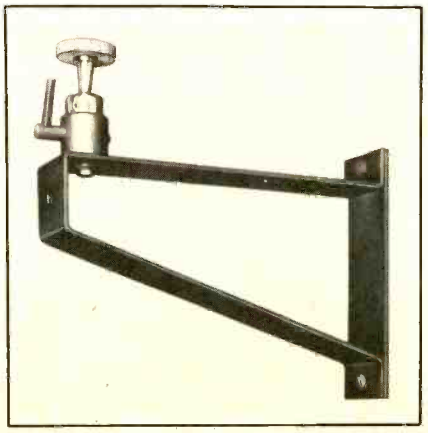
A new UL-listed flexible plug-in electrical outlet system now available from *ITE Imperial* permits hook-up to four AC lines along its 3-foot length. The new system, which is carded for mass merchandising, is designed for residential, commercial, institutional, industrial and office installations.



Rated at 20 amperes and 125 AC and designed for use in dry locations, the new system is made from urea plastic and is polarized for proper insertion. Each system contains a three-foot section of power line, a feed-in line cord, end caps and four 3-wire receptacles that twist in easily at any point along the strip.

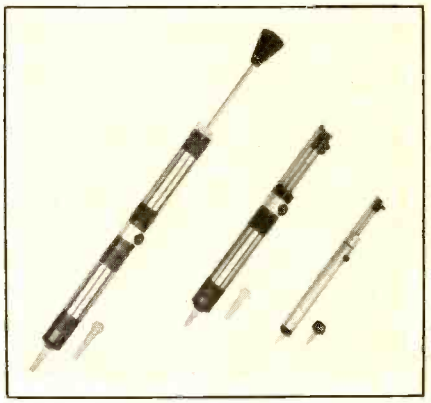
CCTV CAMERA MOUNT 132

A new wall mount for closed circuit TV cameras has been introduced by *Jerrold Electronics*. Primarily designed for indoor use, the camera mount features a universal swivel head which permits 360 degree swing and tilt of up to 90 degrees. The TVM-3 mount is 7 inches high, protrudes from the wall 10 inches, and is said to be ideal for holding CCTV cameras for surveillance, security and other applications where fixed cameras are required. The swivel head can be set to any angle and then locked securely into place. It lists for $39.90.



DESOLDERING VACUUM TOOL 133

Three models of a new self-contained vacuum tool for desoldering on PC boards or terminal strips are now available from *Consell*. They are of all-metal construction except for the



Teflon tip. The Maxi is for heavy production work, the Mini is for work in restricted spaces and the Mini-Mini is for PCB repair and rework. Priced from $9 to $14.

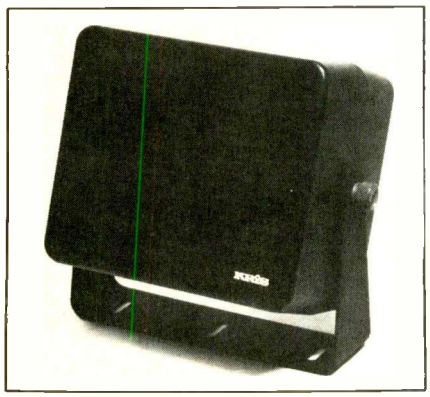
CONTACT CLEANER 134

A new contact cleaner for computer heads, meter registers, alarm and signal systems, receivers and transmitters and other sensitive electronic/electrical equipment is now available from *CRC Chemicals USA*. According to the manufacturer, the new cleaner penetrates and drives out light contaminants—dust, lint, atmospher-

ic oils, moisture and fingerprint oils—leaving no residue and without harming plastics, elastomers, painted or varnished base materials. They say that in-place cleaning with the new cleaner takes the place of vapor degreasing and ultra sonic cleaning. Comes in one, six and sixteen ounce aerosol cans.

MOBILE EXTENSION SPEAKER 135

A new mobile extension speaker which is specifically designed for voice range audio reproduction in citizens band radio, marine radio and other land mobile services is available now from *Kris, Inc.* The new Model 417-500



speaker features a molded ABS plastic case, 3-½ inch speaker with ceramic magnet and moisture resistant case, a gimbal mounting bracket, and molded cable with 3.5 mm phone plug. Power handling capabilities are a full 3 watts of audio. Priced at $12.95.

AUTOMATIC AMPLIFIER SWITCH 136

A new switch, called Amplifier Power-Off, that automatically turns an amplifier off when the record changer shuts down is now available from *GC Electronics*. The device features a special switch for automatic or manual operation, solid-state cir-

cuitry, and a 6-foot polarized cord to eliminate power line interference. The amplifier and changer plug into sockets on the back of the new switch, which operates off any 115 V-AC outlet. It can be used with either foreign or domestic units.

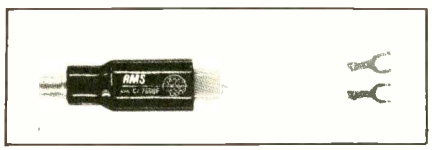
VLF RECEIVER 137

A new VLF receiver is available from the *Spectracom Corporation* with a 60 Hz comparator option that continuously monitors power line phase drift with respect to the NBS standard frequency transmitted by station WWVB. Resolution of the phase measurement is ± degree (about 5 micro-

seconds), and analog readout is provided by an accessory 0-1 ma meter or strip chart recorder. The receiver provides outputs at 0.1, 1, 5 and 10 MHz that are phase locked to WWVB. Local oscillators, frequency counters and frequency standards may be calibrated at these four frequencies using the phase comparator. Receiver price is $1300. Delivery from stock to 60 days.

HIGH PASS CB INTERFERENCE FILTER 138

New high pass filters designed to knock out CB and ham radio interference on TV have been introduced by



RMS Electronics. They also cut-off interfering frequencies below 50 MHz resulting from two-way radio, x-ray, industrial plant equipment, and auto ignition noise.

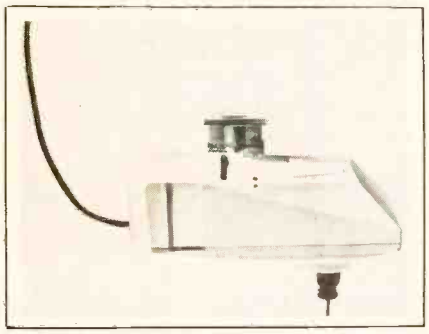
RFI-SUPPRESSING CONDUCTORS AND CABLES 139

Power conductors and cables that provide RFI suppression of more than 100 dB at undesired frequencies have been introduced by *Capcon, Inc.* Unwanted RFI energy (noise) of frequencies up to 45 GHz is absorbed and dissipated by a lossy medium surrounding the central conductor. The new conductors are available in standard current ratings of 1, 5, 10, 25, 50 and 100 amperes, and in standard voltage ratings of 125, 250, 440, or 550 volts AC or DC. Standard AC operating frequencies are 25, 50, 60, 400 or 1000 Hz.

Operating temperatures ranging from minus 55 to plus 250 degrees Centigrade are obtainable.

ANTENNA PRE-AMPS 140

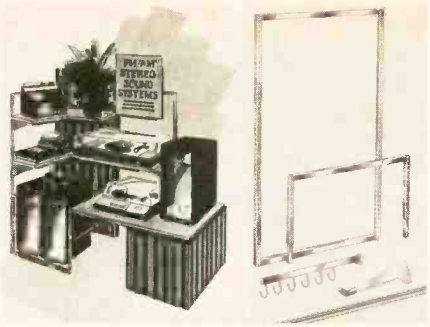
A new line of antenna pre-amps for VHF only, UHF only, and VHF-UHF in 300 Ohm or 75 ohm models is now



available from *ACA*. The new line works with both B/W or color, features a universal mount for any antenna, and all pre-amps have high input capability, low noise and high gain. The output capability goes up to 1,250,000 MV or 62 DB.

EQUIPMENT DISPLAY SYSTEM 141

A lightweight, flexible display system for merchandising stereo and



other entertainment equipment has been introduced by *Garcy Corporation*. There are two basic components of the system—a full frame, 50 in. high by 30 in. wide, and a half frame, 18 in. high and 30 in. wide. Both are made of 1 inch square cold rolled steel .050 wall tubing, and are slotted on two opposite sides with ½ in. slots, 1 in. on center, and finished in chrome or off-white baked enamel. All that is needed for assembly is a mallet.

CRYSTAL-LESS SCANNER 142

A new ten-channel AC/DC scanner receiver that digitally derives some 16,000 different radio frequencies, without the use of crystals, has been introduced by *SBE, Inc.* It's called Opti/Scan because of an optical card reader that programs the device's memory. With a pre-programmed card inserted, the unit will scan ten channels. Frequencies can be changed simply by inserting a different pre-programmed card. The scanner covers all frequencies within the public service, land mobile, marine, or business-industrial FM bands (30-50)

MHz, 150-170 MHz, 450-470 MHz, and 490-510 MHz). Antennas that cover all bands—LO, HI, UHF—are included with the unit, which measures 7¾ in. wide x 10 in. deep x 2½ in. high.

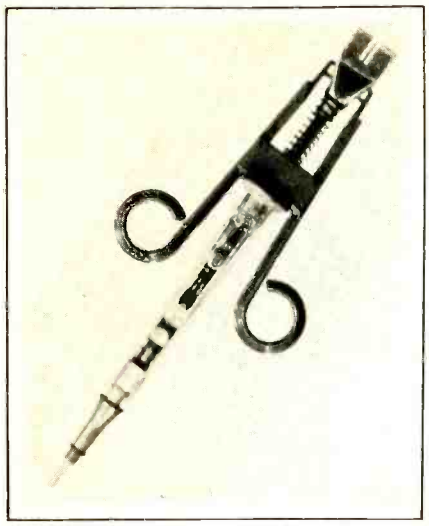
CB/SCANNER REPAIR KITS 143

Two new semiconductor repair kits for most popular brands of CB and scanner radios have been introduced by General Electric. The new kits supplement the basic K-935 kit introduced last fall for repair of CB and other Far East built consumer electronics. Included with the kits is a 12-

page cross reference parts guide. Each kit provides 16 types with a quantity of 36 or 37 items. Parts are filed in a 24-drawer storage cabinet with pull-out drawers which can be used on the workbench. The new kits are available at GE distributors.

EXTRACTOR FOR IC'S 144

A new method of removing 14 and 16 pin DIP integrated circuits that have been soldered to printed circuit boards is provided by a new DIP extractor from *Edsyn, Inc.* The new de-



vice features a precision width, high mass heating head for maximum pin contact and heat transfer. All of the IC pins are heated uniformly so the IC may be quickly removed the instant the solder becomes molten. The manufacturer says heat damage to the board is minimal. After the holes are desoldered, a new component may be directly soldered in place. The extractor includes heat-resistant plastic forceps and stainless steel tongs which grip the IC for fast removal.

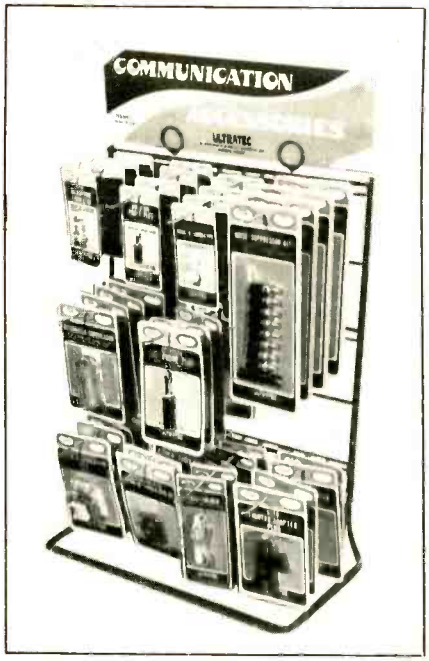
ELECTRICAL CLEANING KIT 145

A complete kit for the cleaning and preserving of small, precision electrical and electronic parts such as contact pins, switch gears, relays and other avionic components has been introduced by *CARE Laboratories, Inc.* The kit includes cleaning and corrosion

preventive compounds in aerosol cans, disposable plastic gloves, wiping towels, metal polish, brush, eraser and abrasive pad. The cleaning and preserving compounds were developed in conjunction with Naval Air Force maintenance engineers, and according to the manufacturer, will not harm rubber, plastic or other synthetic materials.

CB ACCESSORIES DISPLAY BOARD 146

A point-of-purchase display board of fast-moving CB accessories for counter-top use is now being offered by *Workman Electronic Products, Inc.* The display assortment is one of the top ten movers from the firm's Mark II CB Accessory line: including magnetic mike holder, auto stereo noise suppressor kit, alternator noise suppressor, solderless cable connector, phone plug, 4-pin female mike plug, inline fuse holder, 90° noise suppressor kit,



and auto adapter plug with fuse. Dealer net price for the one-package dealer assortment and display board is $134.50.

UHF/VHF AMPLIFIER 147

A new UHF-VHF-FM amplifier for MATV markets, designed for both 75 and 300 ohm input on 4 sets, has been

introduced by *AVA Electronics Corporation*. The device features a bandwidth of 50-900 MHz and has an output capability up to 30 dB. The power source is a 117V AC-60 Hz isolated transformer. The model features built-in lightning protection. It lists for $37.95.

TROUBLESHOOTING CB

continued from page 32

enough to drive you up a wall when they do occur. Resistor failure or change is best pinpointed by

voltage or resistance checks. The same applies to shorted capacitors. Open capacitors can usually be found by bridging across them with the device in Fig. 3.

The real problem causer is the transformer. In high-Q devices such as IF transformers, a single shorted turn can make a lot of difference. Your best tipoff of this condition is a lack of response to a little judicious diddling. (Or by the same token, a tuning peak several turns from normal.)

If you find a broken slug in a transformer, either replace the transformer or the slug. Then start retuning. After you have retuned the unit as well as you can, start looking for the reason why the unit received poorly in the first place.

Open transformers are usually somewhat easier to locate than are shorted ones, but not always. You may have to try your capacitor bridge across each in turn. Your only advantage is that transformer coupling is almost always better than capacitive coupling. So if you get an increase in receiver output across a transformer by bridging it with a capacitor, you probably have found a bad one. What can make transformer problems worse is that most of them have tiny capacitors inside them, and the heat necessary to remove the transformer might either "cure" an open internal connection or a "defective" capacitor.

Another common "dead" receiver problem is really caused by a power supply failure: loss of regulated B+ (used in almost all CB's), which usually causes total receiver failure. There are degrees of voltage loss, and a really strong signal (100,000 μV or more) may seep on through and fool you, but only until you check a few voltages.

One other problem that you might encounter (I've only seen a couple) is a defective IF filter. Scope checks and bridging are the best ways to locate the problem. Locating a replacement might also be a problem—especially one for older, discontinued units.■

PC '76 WRAP-UP

continued from page 11

its new training facility in Waseca, Minnesota.)

* *Back-up Service*—Situations will exist where service backlog on a local basis reaches proportions which cannot be handled by the dealer. And inevitably you'll run into the 'dog' radio which cannot be profitably serviced on a local basis. In these cases a factory repair facility becomes a definite 'plus.'

Bradley then proceeded to describe what a typical CB service shop should include in the way of space, parts inventory and test equipment, and what the approximate capital outlay would be. He emphasized that he was describing an "average" shop that would do some factory warranty, or authorized, service. He said shop space required would be about 150 square feet per service bench, and parts inventory for each manufacturer's products serviced would be $500, plus from $500 to $1000 for parts common to all manufacturers, such as resistors, transistors, and capacitors.

The test equipment Bradley recommended for a minimum shop set-up included:

* A good quality signal generator that is frequency stable after warmup and has a calibrated output. Cost = $1,000
* Audio generator. Cost = $100
* Oscilloscope Cost = $400
* Frequency counter Cost = $200
* Meters Cost = $150
* Power Meters & Load Cost = $150
* Power Supply Cost = $50
* Miscellaneous Cost = $50

Equipment Cost for Minimum setup = $2100

CB SERVICING IS DIFFERENT

In his seminar presentation, Bradley pointed out the various factors that set the servicing of CB and other two-way radio apart from the servicing of home enter-

tainment electronic products such as TV, radio and stereo. These differences, Bradley said, were:

* *The regulation by government*—By FCC regulation, no internal adjustments may be made to two-way radios unless done by, or signed off by, a holder of at least a 2nd Class FCC license. This rule applies to the owner of the set, or the consumer, as well as it does to the service shop, which, Bradley pointed out, is contrary to a popular myth that's going around.
* *CB must be considered as a total system*—This includes an antenna system, properly installed and tuned, a power source, antenna leads, a ground plane, *and* other stations.
* *Environmental effects*—Two-way radio is affected by a poor ground, unprofessional user installation, vibration, and temperature extremes.

"Anyone planning to service CB equipment," Bradley said, "should expect to run into at least two types of customer—the *hobby-oriented person*, who with his new-found hobby, will be perfectly happy to waste your time seeking advice, relaying opinions, and in general, 'BS'ing. (Bradley didn't say it but we would guess that this hobbyist would be a good prospect for accessories and newer units that upgrade his present equipment)—and the *self-styled expert*, who feels he needs to be involved in the servicing. Many shops have taken care of this type of customer," Bradley continued, "by placing a limited amount of test equipment in a store front location so that the customer can see the initial checks and probable diagnosis made on his radio before he leaves his radio at the shop for repair."

Although Bradley didn't describe a third type of CB service customer, we think there is one. And he, or she, is either now, or soon will be, representative of the majority. This customer does not know, and doesn't want to know, a single thing about the technical side of two-way communication. This customer simply wants to talk to someone else in another car, a truck, his home, or someone else's home, and he wants his communications equipment in working order. He will probably be your best customer, your easiest customer to deal with, and your most profitable customer.

That brings us, finally, to the principal point which we think we learned from our attendance at PC-76. This is that CB radio, two-way communication, or "personal communications"—whatever you want to call it—is here to stay. It's a bonafide business, a big business already, and destined to get a lot bigger. It's not a "hoola-hoop fad" that will disappear after the boom. It's already a very definite part of 'life in America.' And, regardless of today's heady atmosphere of short supply and big demand and the cries of "sell it," two-way radio communication equipment does, and always will, require professional installation and servicing. That's where you, the professional electronic technician or sales and service dealer, come in—if you want to. ■

CLASSIFIED

RATES: 35¢ per word: 45¢ per word Bold Face Type. Add $3.00 if you wish Box Number. Minimum $10.00 charge. Classified Display Rate billed $40.00 per inch, 1 inch minimum.

Business Opportunities

TV SHOPS: Repair and update master antenna systems with new patented method, under my technical assistance by telephone; or qualify for my telephone assistance to solve your "Tough Dog" TV repairs that waste bench space. Send resume and credit references: Melvin Cohen, Television Broadcast Engineer, May Company Building, 3651 Prospect Avenue, Riviera Beach, Fla. 33404. Enclose 13¢ addressed envelope. Be patient for my reply. 6/76

REBUILD PICTURE TUBES: Save 50 to 75% by rebuilding your own picture tubes. You can purchase a plant from us to rebuild from one to 50 tubes per day with one week of schooling and follow up instructions in your plant. Factory Outlet, 951 E. Hudson St., Columbus, OH 43211, 614-263-0645.TF

TV Sales and Service in same location 15 years. Nets over $25,000. Retiring. Including truck, equipment, & inventory 25,000. A. Bolin, 6361 Balsam Lake, San Diego, CA 92119. 6/76

ADVERTISING PACKAGE FOR TV service shops. Inexpensive eye catching ads contain personal message from you-build customer confidence. Keeps your name before the public weekly. PROVEN RESULTS. Thirty ads with instructions. $19.95. Sample $1.00 refundable. TV TIPS, 430 South Jefferson, Lebanon, Mo. 65536. 10-76

TV Repair Shop on Wheels franchise available. We supply 1½ ton step van, fully equipped. Low investment. Excellent income. Technicians must have at least 5 years field and 2 years formal training. Write to M.R.S. Electronics, 1616 Hinckley Road, Orlando, FL 32808. 6/76

BUSINESS FOR SALE. T.V. Sales & Service. Zenith Franchise. For more information contact Harold Schumaker, Box 265, Whittmore, Iowa 50590. 6/76

SURPRISE! SURPRISE! Digital Piano Tuning Device tunes **ALL** musical instruments Accurately! Perfectly! Inexpensively! Tuner Construction—Piano Tuning Instruction **PLAN SET** Complete $12.98 Airmailed Postpaid! Moonlighting quickly repays $40 electronics investment!! **GREEN BANK SCIENTIFIC,** Box 100W, Green Bank, WV 24944. TF

TV Business For Sale. South Florida. Zenith-RCA. Unlimited potential for right party. Write Sam, 1195 NE 134th St., N. Miami, Fl. 33161. 7/76

MOVING? BE SURE TO LET US KNOW YOUR NEW ADDRESS.

TV SHOPS: Repair and update MATV systems with new patented method. $200.00 day possible. Send resume and credit references: Melvin Cohen, Television Broadcast Engineer, May Company Building, 3651 Prospect Avenue, Riviera Beach, Fla. 33404. 9/76

FOR SALE - Television business established 21 yrs., $100,000 potential, store with 6 room house, 50' basement and attic, second television shop in finished 20' x 20' garage, paneled, heat, electric, property all zoned business 60' x 135' in beautiful suburbia surroundings, retiring, asking $48,000. Cash needed $16,000. Burke's T.V., 2312 Newbridge Road, Bellmore, L.I., N.Y. 11710. 516-785-9127. 6/76

Construction Plans

JAPANESE TRANSISTORS - All Transistors Original Factory Made. Free Catalog. West Pacific Electronics, P.O. Box 3879, Torrence, Ca., 90510. 12/76

Convert black/white TV to Color: experience not neccessary. $3.00 (refundable). Tayo Paul, 980 Greene Ave., Brooklyn, NY 11221. 7/76

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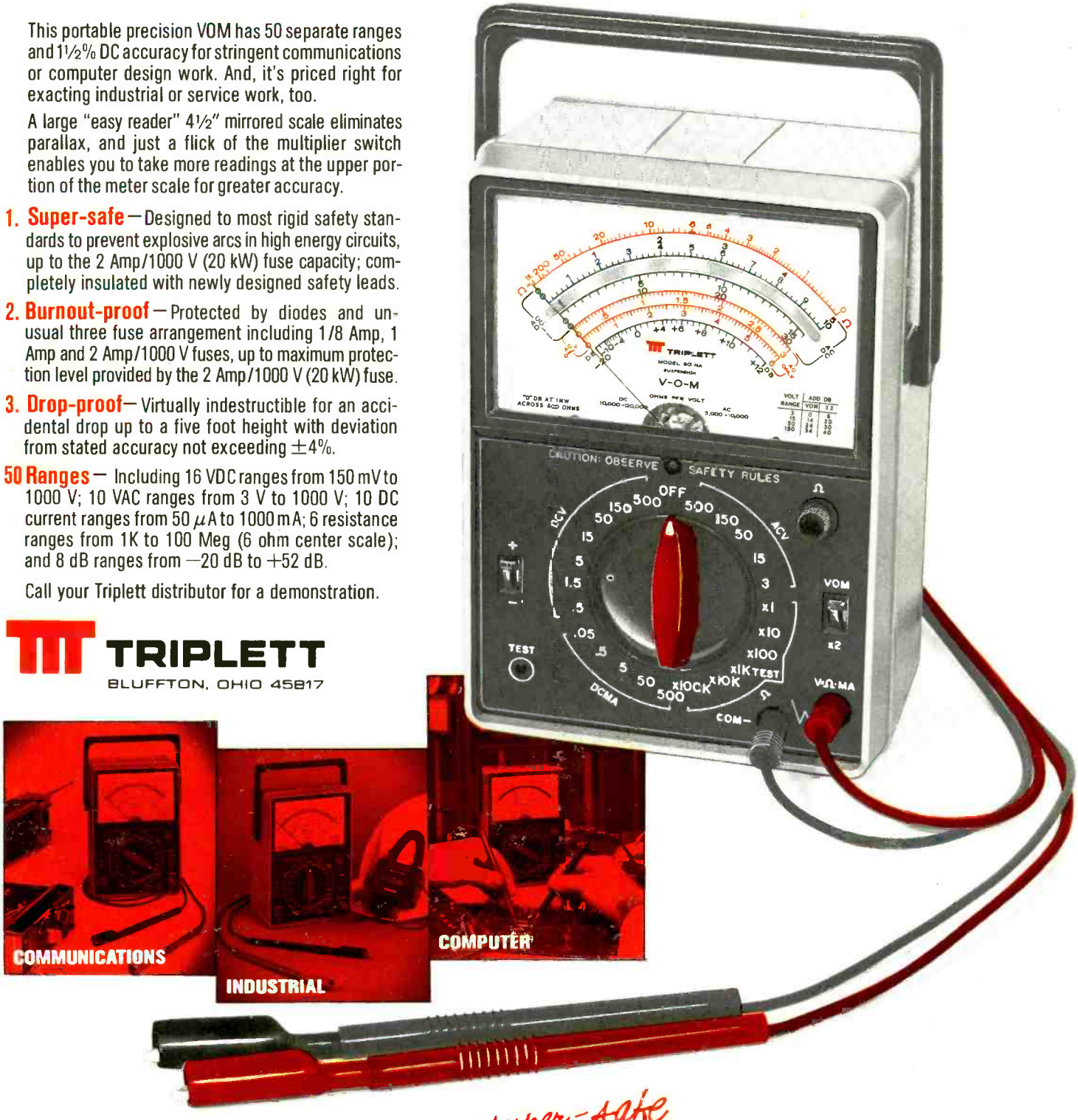

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