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ELECTRONIC TECHNICIAN/DEALER

WORLD'S LARGEST TV-RADIO SERVICE & SALES CIRCULATION

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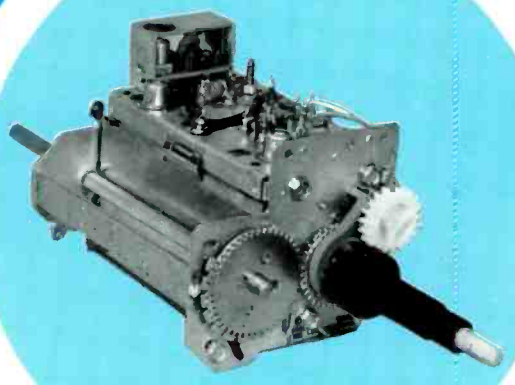

From the beginning, our goal has been to provide the best tuner service—never the cheapest. You get what you pay for in business and tuner service is no exception. The extra dollar you might pay at PTS is peanuts when you consider the added reliability and the standards of excellence we apply to every job. Thousands of PTS customers must agree or we wouldn't be the world's largest tuner service company. When you are comparing tuner service companies, price alone doesn't tell the story.

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PTS ELECTRONICS, INC.

PRECISION TUNER SERVICE

General Headquarters: P.O. Box 272, Bloomington, IN 47401

THE COMPLETE LIST OF ALL PTS SERVICE CENTERS APPEARS ON THE NEXT PAGE.

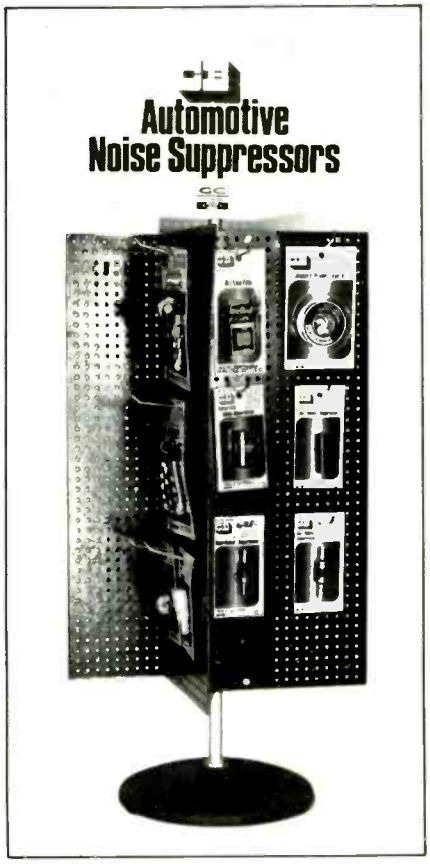
...for more details circle 102 on Reader Service Card

DEALER SHOWCASE

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

NOISE SUPPRESSOR DEALER PROGRAM 128

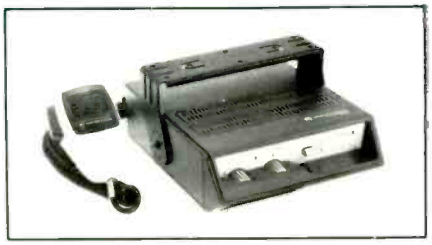
A new counter-top program that merchandises 18 different types of noise suppressors, filters and capacitors for CB and car radios is now being offered dealers by *GC Electronics*. The



products, designed to reduce or eliminate interferences with CB and car radios, are available individually, or in kits. Complete instructions for these easily-installed products are included. The program is designated Program 49-877.

TWO-WAY ALTERNATE TO CB 129

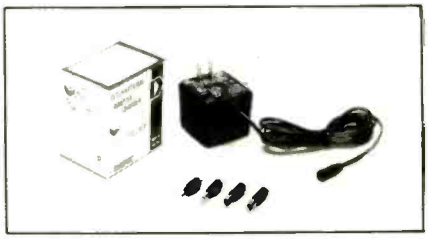
A new line of low-price FM business radios for use as mobiles or base stations has been introduced by *Motorola*. Called the Moxy line, and described as a businessman's alternate to CB, the new radios are priced between CB radios and the current FM business radios. They feature options such as digital private-line (DPL) and private-line (PL) coded squelch systems capability, an extender circuit (low band only), an external speaker, gain



antennas, a handset with hang-up cradle, inverted escutcheon and a locking mounting unit. The new Moxy radios are available in UHF, high band and low band. Power outputs range from 10 to 25 watts.

UNIVERSAL AC ADAPTERS 130

Two models of universal AC adapters for calculators, radios, tape cassettes, walkie-talkies, and other low powered battery operated products are now available from *Dynamic Instruments*. The two models, which will work from either 120 volts or 240



volts, are: the DS 690, which will power 6, 7½ and 9 volt products; and the DS 345, which will power 3 and 4½ volt products. Four interchangeable plug tips accommodate the various mechanical configurations and polarities found on the input receptacles of different products.

STEREO INTERFERENCE FILTER 131

A newly designed stereo interference filter that reduces the interference that might enter a stereo or hi-fi system through the phono or cassette input cables from CB transmissions has been introduced by *Electronic Specialists*. Designed to plug directly into the amplifier input jack, a filter in each amplifier input will greatly reduce or eliminate phono-input interference. Priced at $7.95 a pair. ■

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ELECTRONIC TECHNICIAN/DEALER

JUNE 1977 • VOLUME 99 NUMBER 6

THE COVER: A good example of the use of electronics in industry (see page 25) is the centralized electronic control system on a single panel at the new million-cubic-foot frozen storage building constructed in Duluth, Minn., by Jeno's Inc., a major packer of pizza products. In our cover photo, Frank Fisher, refrigeration supervisor at Jeno's, runs final tests on the control panel, which maintains temperatures in the building between zero and −10°F. The new building will accommodate 400,000 cases of frozen pizza and frozen hot snacks.

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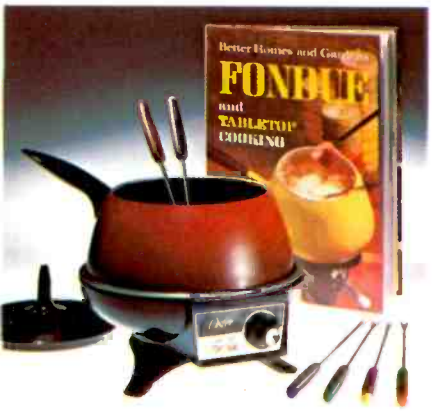

Our award catalog has never been bigger and now we've made it easier than ever to earn your choice of hundreds of great awards. Every time you specify and buy a Sylvania receiving tube or color picture tube you're earning valuable tabs. And here's how it all adds up:

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10 TABS — For all other Sylvania Color picture tube serial number labels

(You'll find the serial number labels on the upper left hand corner of every color-tube carton)

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KEEP TABS ON SYLVANIA

ET-1869

NEWS OF THE INDUSTRY

1977 Looks Good For TV And Radio Product Sales—If 1st Quarter Is Indication

Total U.S. market sales to dealers of television and radio products for the first quarter of 1977 showed an improvement over the same period of last year, according to the report from the Electronic Industries Association (EIA). Total TV sales for the 1st quarter of 1977 increased 18.8% with 3,282,208 sets sold. First quarter black-and-white TV sales of 1,272,191 sets were up 10.8% and color sales of 2,007,017 units were up 24.5%. Total first quarter radio sales to dealers increased 10.1%—non-automobile radio sales were up 13.4%—and auto radio sales increased 4.7%. Sales for the first quarter of 1977 are compared with sales for the first quarter of 1976 in the following report from EIA:

Products	1977	1976	% of Change
B & W TV	1,275,191	1,151,206	+10.8%
Color TV	2,007,017	1,611,568	+24.5%
TOTAL TELEVISION	3,282,208	2,762,774	+18.8%
AM/FM or AM or FM radio	5,700,631	5,027,252	+13.4%
Automobile Radio	3,184,880	3,040,739	+ 4.7%
TOTAL RADIO	8,885,511	8,067,992	+10.1%

Radio's Impact To Be Greater By 1985, Says NAB Report

According to a rather bullish report commissioned by the National Association of Broadcasters (NAB), radio in 1985 will be bigger, better and more profitable. In a long range study the NAB found that:

- FM stations will attract 51.7% of the total radio audience by 1985 as quadraphonic FM comes into general use.
- AM radio will provide stereo reception, possibly by 1980.
- There will be 560 million radio sets, or 2.4 per person, by 1985, compared to 401.6 million sets, or less than 2 per person, now.
- CB listening is not expected to have a major impact on radio's importance because only 1/5 of all radio listening takes place in the car.
- Satellites will be used more for interconnection of stations and networks, offering better audio quality.
- FM stations may add such services as stock market quotations, information for doctors on drug and medical developments, and commodity prices. These services would be provided through subsidiary communications authorizations such as are now used for background music.

Prices on 40-Channel CBs Dropping To Make Them As Appealing To Consumers as Existing 23-Channel Models

The large numbers of 23-channel CB transceivers still existing in the marketing pipeline are forcing manufacturers to come up with more appealing prices for their 40-channel units.

E.F. Johnson has announced a price cut on five of its 40-channel models. Four are mobiles and one is base station. The price reduction will amount to as much as $50 in some models.

According to *Electronic News*, Hy-Gain will also soon offer temporary price reductions on some 40-channel models. As quoted by *Electronic News*, Mike Fong, executive vice president, Hy-Gain, said, "There are still a million 23-channel sets out there, and you have to give customers something to focus their attention on the 40's."

Price reductions on the 40's are also in the wind for Motorola, Pathcom, Royce and Boman.

RCA Promotes Greater Use of Yellow Pages For Authorized Service Centers

According to Arnold T. Valencia, vice president, marketing programs, for RCA, authorized RCA service centers are being encouraged to make greater use of the telephone company Yellow Pages.

"We hope to substantially increase the number of RCA authorized service centers listed in the Yellow Pages from the present 1,200 to a level approaching the total 10,000 that exist nationwide," Valencia said.

Borlaug, Sylvania National Service Manager, Named NARDA Man-Of-The-Year

The man who engineered the introduction of a single, standard All Industry Warranty Form for the electronic service industry, John Borlaug, national service manager for

GTE Sylvania, has been named the *Time*/NARDA Man-of-the-Year. The award is presented annually by *Time*, the weekly news magazine, and the National Association of Retail Dealers Of America (NARDA).

As chairman of the Electronic Industries Association sub-committee on warranty, Borlaug brought about industry-wide agreement on a common warranty form.

The award was presented this spring at the NARDA national convention in Atlanta.

NESDA Convention To Include Roundtable Discussion of Electronic Service Needs

An event which was part of the 1973 NESDA convention will be reinstituted during this year's convention in Orlando, Florida.

Called the National Electronic Service Conference (NESC), the special program will occur in the middle of the convention, Saturday morning, August 20th.

Topics for this roundtable conference include: Service Requirements: 1975 through 1980 Products; Test Equipment; Technician Training (Where have all the top techs gone?); CB, Its Effect On the Service Industry; and Warranty Legislation For Electronics Products Service. Tom Thomas, CET, president of Certified Electronics, Pueblo, Colorado, will chair the event.

Number of Electronic Technicians & Firms Increase In 1977

NESDA's 1977 count of electronic service technicians and firms shows an increase in both categories over comparable 1976 figures. The number of consumer electronics firms increased by 4,526, up from 66,000 to 70,526—a 6% gain over 1976 figures. The number of technicians also increased; up 10,865 from 196,347 to 207,212; a 5% increase over 1976 totals.

The national figures were projected from statistics compiled from official state and city radio and tv license boards' records of registered businesses and technicians. The U.S. population served by the participating license boards is 58,920,000, or 27.8% of the total U.S. population.

Demographic features about the electronic service industry revealed by the compilation of figures were: 1) nearly 50% of the businesses are *owner-operated, one-man shops;* 2) nearly 75% of the businesses also engage in product sales; 3) many licensed technicians spend a majority of their time in sales/management duties; 4) a majority of the businesses hire part-time servicers to supplement their technical labor force; 5) many

businesses are operated by a servicer who holds a full-time job elsewhere; and 6) because some license fees are small ($10 in Indiana) many people carry a license rather than let it lapse even though little or no time is devoted to service work.

Japan And U.S. To Negotiate TV Import Limits

Acting in advance—and as a result of—pressure from the U.S. TV manufacturers, unions, and the Electronic Industries Association, Japanese and U.S. officials are endeavoring to come up with a negotiated agreement for a limitation on the volume of color TV imports from Japan. According to *TV Digest*, "talks in Tokyo were general—something like an extension of earlier talks between President Carter and Prime Minister Fukuda. Both sides feel there's a wide range of possibilities for settlement in the next few weeks. Further negotiations aimed at obviating need for imposition of International Trade Commission recommended 25% duty rate on color imports as protective measure for U.S. producers, could start in Washington or Tokyo soon."

"With certainty that some restrictions will be placed on color imports," *TV Digest*'s report continued, "two more Japanese companies—Mitsubishi & Toshiba—have started work on U.S. production facilities."

Electronic School Schedule For Teachers Is Announced

The schedule of the 1977 Summer Consumer Electronic Seminars for high school and vocational instructors has been announced by the Seminar sponsors, the Service committee of the EIA/Consumer Electronics Group. This year sixteen seminars, designed to help teachers update their curriculum in consumer electronic product service techniques, will be offered in 14 states.

Emphasis in the seminars will be placed on how to diagnose and repair the latest consumer electronics products including solid state circuitry. Several schools are also emphasizing CB service techniques. College credit is offered for successful completion of the session.

The fourteen states in which the seminars will be held are: Alabama, California, Colorado, Kentucky, Louisiana, Massachusetts, Michigan, Minnesota, North Carolina, Tennessee, Virginia, Washington, West Virginia, and Wisconsin. A free copy of the seminar schedule is available from: EIA/Consumer Electronics Group, 2001 Eye Street, N.W., Washington, D.C. 20006. ■

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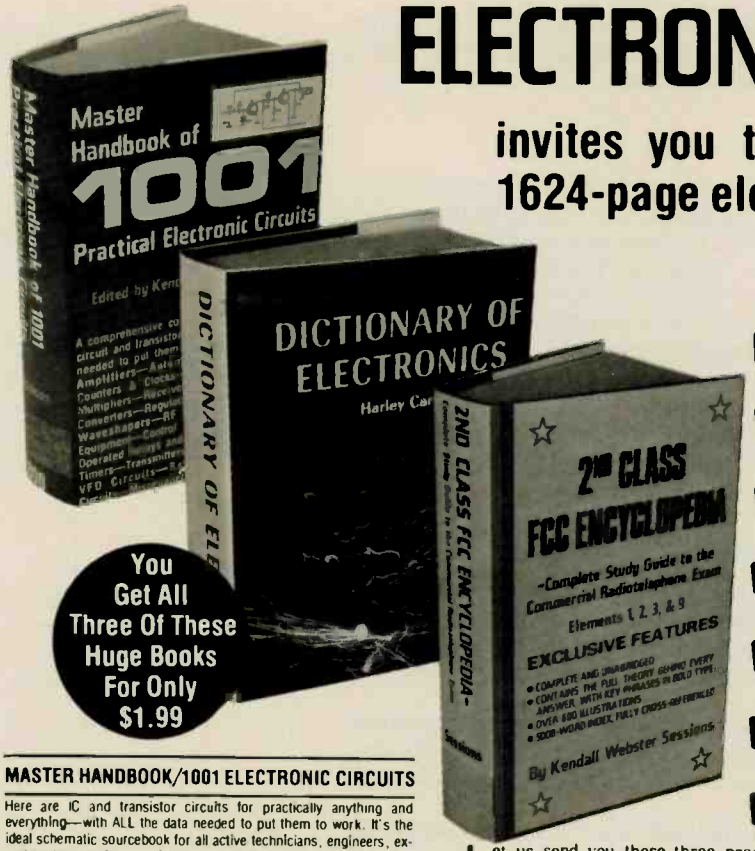

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Here are IC and transistor circuits for practically anything and everything—with ALL the data needed to put them to work. It's the ideal schematic sourcebook for all active technicians, engineers, experimenters, amateurs—for anyone who must occasionally or regularly construct or adapt electronic circuits for any purpose whatsoever. Each circuit diagram has every component carefully labeled, and every schematic is accompanied by all the info you need to construct the circuit for use in your own individual application. If there are coils to be wound, you'll find full and complete coil-winding details right there on the spot. If special parts are required, you won't have to invest a lot of time and effort before the fact, for it's all there before you in condensed captions. The circuits included are completely up-to-date, and have been designed, built, tested, reworked as necessary, and perfected. You'll find any circuit you're ever likely to need in the pages of this rich volume. Includes an ultracomplete 22-page cross-reference index so you can quickly find the circuit you need. The schematics are classified according to general application. If you're in the business of servicing/repairing commercially built electronic equipment, you're going to especially appreciate the comprehensive Appendix of IC substitutions, which includes base diagrams for most popular ICs, and gives you all the info you need to adapt the IC packages of one manufacturer to the circuit applications of another. 602 pps., over 1250 illus.

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DICTIONARY OF ELECTRONICS

This huge, quality dictionary is a handy reference that will serve most of your needs—extremely useful in whatever connection you have with electronics. Defines most all of the electronic terms you will run across in your everyday reading...from alpha particles through zoom lens...including those found in radio, TV, communications, radar, electronic instrumentation, broadcasting, industrial electronics, etc. The concise but clearly written definitions from all the various branches of electronics are of value to technicians, engineers, hobbyists, experimenters, and students. It provides full, complete and easily understandable explanations of thousands of specific electronics terms. A unique feature is the cross-indexing, whereby key words contained in the definitions (words that are defined more fully elsewhere in the book) are printed in small capitals so the user is not left in the dark by any definition. Appendices provide you with still more data—an extensive list of units and abbreviations, graphic symbols used in schematics, component color codes, db conversion tables, data on the electromagnetic spectrum, tube base diagrams, etc. 420 pps., 487 illus.

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Facts About Club Membership

- The 3 introductory books carry a publishers retail price of $33.85. They are yours for only $1.99 (plus postage and handling) with your Trial Membership.
- You will receive the Club News describing the current Selection, Alternates and other offerings, every 4 weeks (13 times a year).
- If you want the Selection, do nothing: it will be sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you simply give instructions on the reply form (and in the envelope) provided, and return it to us by the date specified. This date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and so receive an unwanted Selection, you may return it at Club expense.
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TECHNICAL LITERATURE

Replacement Batteries For Communications Equipment and portable video tape recorders and cameras are illustrated in a new catalog available from Alexander Manufacturing Company. Shown are batteries for most major hand-held two-way radios and pagers. Nickel-cadmium, alkaline, mercury and single cell batteries are described. A recently introduced line of replacement batteries for ENG video tape recorders and cameras is also described and illustrated, plus the firm's line of automatic battery chargers. A copy of the catalog, with price list, is available free from *Alexander Manufacturing Company*, Box 1645, Mason City, Iowa 50401.

Mobile Sound Equipment is outlined and illustrated in the newest catalog from Arthur Fulmer. The 12-page, color catalog contains photographs, general descriptions and specifications on more than 70 car stereo, CB and portable sound products. Included are: in-dash tape player/radio and CB/radio combinations, under-dash tape players, speakers, portables, 40-channel and 23-channel CBs, CB antennas and accessories. The catalog is free from *Arthur Fulmer*, 260 Monroe, Memphis, Tennessee 38103.

The 1977 Replacement Semiconductor Guide from General Electric is now available at GE distributors. The latest edition contains a cross reference guide to the firm's universal replacement semiconductors, including over 300 new products that allow service technicians to make one-stop selection in most cases. The new guide contains almost twice the amount of product and cross reference information than the 1976 edition, including increased application and technical data on devices and outline drawings with dimensions. Suggested user prices on all devices, accessories, and kits are included. Available for $1.50 at *GE distributors*.

A Catalog On Analog Devices, called Analog Dialogue, is now available from Analog Devices, Inc. The new volume features a variety of new product articles and applications notes on electronic devices for the measurement and control instrumentation and microcomputer-based control systems. Included in the 20-page catalog are articles on microcomputer interfaces, IC multipliers, V/F converters, true-RMS digital panel meters, and both 10-bit and 18-bit D/A converters. Applications notes deal with the use of CMOS converters as I/O devices, use of an isolation amplifier as a current-loop receiver, and how a programmable-gain multiplier helped create an ultrasonic sensor for the blind. For a free copy, write: *Analog Devices*, Inc., P.O. Box 280, Norwood, Mass. 02062.

Chlorine-free, High Temperature Wiring Duct products are covered in a new bulletin from Panduit Corp. The bulletin describes the firm's Panduct wiring duct made from a thermoplastic resin. The product described contains no chlorine, and thus will not release toxic chlorine gases if exposed to heat and flame. The literature illustrates the 34 standard, 6-ft. long sizes available. Free copies of the bulletin are available from *Panduit Corp.*, 17301 Ridgeland Ave., Tinley Park, Ill. 60477.

SSB Marine Radiotelephone products are described in a new booklet from Motorola. The literature illustrates and covers details of the Triton 55/75 synthesized radiotelephone and Triton SSB marine radiotelephone. The 55/75 marine unit is the first fully synthesized model with simplified channel identification and the SSB marine radiotelephone is said to offer the reliability of FM at distances greater than the 30-40 mile effective range of VHF-FM marine radio. Also described are the VHF-FM marine radiotelephone, the bridge-to-bridge marine radiotelephone, the VHF-FM limited coast stations, the Triton FM portable radios, and the accessories available for each unit. The booklet is free from Barbara Bennett, *Motorola Communications Group*, Literature Distribution Center, 1301 E. Algonquin Rd., Schaumburg, IL 60196.

A Security Alarm System that is said to eliminate almost 90% of installation costs in homes, apartments, farms, commercial and industrial sites is described in a new 6-page brochure from Waldom Electronics. The new security system described uses existing electrical house wiring to transmit an entry violation signal to a control center and then to various signal alarms that may be plugged into any convenient outlet. Violation sensors in the system are inconspicuous, reliable magnetic switches and the alarms include plug-in flashing lamp controls, plus indoor and outdoor horn alarms. The basic kit retails for $199.99, and the brochure is available free from *Waldom Electronics, Inc.*, 4625 West 53rd St., Chicago, Illinois 60632.

Electronic Test Accessories are catalogued and illustrated in the new 1977 catalog from Pomona Electronics ITT. New products covered in the catalog include: IC jumper cables,

black boxes, a dip remover for 14/16 pin dual-in-line IC packages, and a number of test probes, plugs, cables, and patch cords. Of course, the firm's entire line of electronic test accessories such as cable assemblies, adaptors, leads, and patch cords is covered along with a price schedule. The new catalog is available free from *ITT Pomona Electronics*, 1500 E. Ninth St., Pomona, CA 91766.

Two-way Radio And Scanner Antenna Replacements are covered in a new brochure available from Russell Industries. The new 6-page booklet describes the firm's "Rubber Duckie" line of antennas for application and connection for CB, UHF, VHF, ham, business and scanner bands. The brochure is available free from *Russell Industries, Inc.*, 3069 Lawson Boulevard, Oceanside, N. Y. 11572.

Supplies For Soldering are covered completely and illustrated in the latest catalog from Kester Solder. The new publication covers the firm's line of standard solders, flux core solders, soldering fluxes, vapor degreasing solvents and special purpose chemicals. Descriptions of more than 50 solders and related items are included, such as acid-core, resin core and flux core solders, and solid wire and bar solders. Other solder products include: Metal Mender solder, TV-Radio solder, printed circuit solder, aluminum repair solder and soldering paste flux. The catalog is available free from *Kester Solder*, 4201 Wrightwood Avenue, Chicago, Ill. 60639, attn: Mack Haraburd, vp-marketing.

New Do-It-Yourself Electronic Kits are described, illustrated, and priced in the newest catalog from the Heath Company. Among the new products featured are: a 3-band UHF/VHF scanner, a matching stereo tuner and amplifier, a five-function aircraft clock timer and a programmable home heating control which is said to save up to 10% on home heating bills. The catalog also describes nearly 400 other electronic kits including automotive and marine accessories, amateur radio equipment, test instruments, learn-at-home electronics courses, stereo equipment and color TV's. The catalog is free from *Heath Company*, Dept. 350-13, Benton Harbor, Michigan 49022.

A Guide To Frequency Counter Use is the subject of a new technical publication available now from Hewlett-Packard. Written for the technician and repairman, the new 8-page booklet covers the application of frequency counters below 1.3 GHz, but omits detailed technical design discussions of counters. Instead, it zeros in on how to get the signal into the counter, how to interpret the answer, and how to keep from destroying the counter. It is well illustrated with typical counter hookups, and includes examples, two conversion charts and a list of references. The technical note, "Straight Talk on Frequency Counters in Communications Applications," is available free from: Inquiries Manager, *Hewlett-Packard Company*, 1501 Page Mill Road, Palo Alto, CA 94304.

The 1977 Edition Of A Solder Selector Guide is now available from Multicore Solders. It is a reference guide to the firm's line of solders, fluxes and chemicals. In six pages, the brochure describes the basic features of each category of products and lists in tables all products within the category. The tables include such information as: characteristics; formulations; uses; variations; alloys where applicable; MIL and government approvals; and ordering data. Also included are full color photographs of 12 visually identifiable soldering problems that are the most frequent causes of poor joint quality and rejects. The brochure is free from *Multicore Solders*, Westbury, N.Y. 11590. ■

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Simply rotate the CB42 and CB selectors through all 40 channels and read "percent off center frequency" on the direct-reading digital meter (.005% FCC maximum deviation) in less than two minutes for all 40 channels.

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

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Why get a screwdriver in the back from the guy next to you, when you can substitute for that annoying speaker howl? Just plug the built-in, non-grounded speaker sub cable into the transceiver and quietly monitor the audio output on the meter.

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The CB42 takes less than one-third the bench space of other equipment. You can even take it to the field with you, for on-the-spot mobile checks, since it is also 12 Volt battery powered.

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ZENITH

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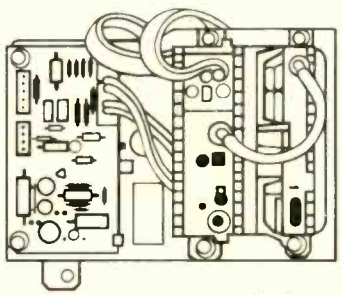
Color Sentry. Now from our smallest to our biggest set.

When we created Color Sentry, we knew it was more than a remarkable improvement in the color picture. We knew it was the basis of a remarkable retail sales story. "Color Sentry," salesmen could say, "controls the color picture, corrects the color picture, thirty times a second. Automatically." Now that sales story is going to be even more effective. Because now Color Sentry comes in selected models of every size in our line. So if someone wants a little 13-inch diagonal set for the bedroom, you can sell them Color Sentry. The same for our 17, 19, 23 and 25-inch diagonal sets. Now Color Sentry is going to have broader appeal—to make Zenith color sales even easier.

The Matisse, Model J1320W. Beautiful simulated Walnut finish.



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The Zenith Electronic Video Guard Tuning system is the most advanced, most dependable tuning system in our history. Ordinary mechanical tuners have contact points inside that get dirty and corrode. And so they cause more service calls than any other part of the set. You can get snow, flashing or worse. But our electronic tuner has no contact points inside to cause problems. Electronic tuning has made Zenith color sets even more dependable. And now we've added it to more sets—more than any other brand. In fact, it is now in 89% of our line. So you'll have even more chances to close a sale.

Remote control with Zoom — only Zenith has it.

NORMAL PICTURE

ZOOM PICTURE

There's nothing else like it. A TV remote control that does more than turn the set on and off. More than change channels — in both directions. More than raise and lower the volume. Zenith's Space Command with Zoom lets you push a button and get an instant close-up of the action. All from across the room. It's the most dramatic demonstration the industry has seen in years. And it's just one more reason so many people won't settle for anything less than a Zenith.

Zenith's fine furniture styling gets even finer.

When you already have the best-looking line of color consoles, what more can you do? We consulted with leading furniture designers. We checked with furniture makers. And we spotted a new trend in furniture fashion. So we created a new group of consoles with more refined, distinguished lines. One with more elegant and subtle detailing. One with a lighter, more delicate look. Many with fine wood and veneers. The result is a line that's elegant, simple and rich from top to bottom. A line designed for increased sales.

The Raeburn, Model J2542E. Classic Transitional-styled credenza with genuine Oak veneers on top and ends. Decorative front of simulated woods in matching finish. Entire cabinet beautifully finished in Antique Oak color.

The Gypsy, Model J123W. Richly grained simulated Walnut finish. Shown with detachable sunshield.

More black and whites. And more to them.

To help you sell more black and white sets, we've made them even more appealing. We've restyled the new 12-inch diagonal models to give them a sleek, contemporary look. But most important, every Zenith black and white TV — and only Zenith — has these three top performance features: Power Transformer (for longer life), 3-Stage I.F. Amplification (for a stronger signal and less interference) and Perma-Set VHF Fine Tuning (so you don't have to fine-tune every time you change channels). There are new sets in 9, 16, 19 and 22-inch diagonal models, too. And new contemporary and Mediterranean consoles. In short, our new black and whites give you more models with more styling and more features. So you can sell more.

The Zenith television line for '78 is going to be too hot not to handle — with more of everything it takes to close a sale. Including the famous Zenith quality. And who could ask for more than that?

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The quality goes in before the name goes on.®

ZENITH

78

The new Mini-Wedge. And more.

The Mini-Wedge, Model J587W. Beautifully simulated grained Walnut finish.

Now there's a Wedge for every budget.

We've just increased your Wedge sales opportunities. Considerably. Because now we have a new Mini-Wedge. It's new in styling – but it's in the same rakish, contemporary tradition of the Wedge itself. And it's also great in performance – the Mini-Wedge has a big, full-throated sound you just have to hear. But it's a lot less in price than the big Wedge. And that should mean a lot more in sales. Because now you have two ways to sell the Wedge mystique – when you sell the Wedge. And when you sell the Mini-Wedge.

The Model J584W. Handsome simulated grained Walnut finish.

More 584 value. For no more.

Our 584 has been called the best modular stereo value on the market. So how could we make it better? First, we added a closed dust cover. And we added bigger speakers. Then we reduced the price. No kidding. New features at a new, low price. And you'll find these same values in many other new models – all with added features and lower prices for the biggest values ever.

THE
Dartmoor,
Model J902P.
Charming country-
style console with
simulated grained Pecan finish.

Beautiful music that's beautiful looking.

To a console stereo buyer, nothing's more important than styling. So that's the first place we added more to Zenith consoles. We consulted the leading furniture designers. We scanned the furniture industry trends. We assigned craftsmen and cabinetmakers to sculpt and re-sculpt their ideas. And the result was nine new Zenith console stereo models that are going to look right at home in the finest homes. The lines match the finest furniture. The details are subtle and elegant. The rich finishes glow. Inside, we designed a sleek new control deck that integrates both the tape and tuner/amplifier controls in one panel. And we offer a choice of play or play/record tape systems in selected models. In short, we've made Zenith console stereos a lot more. And a lot easier to sell.

New Wedge advances. With no advance in price.

The new Wedge is greater than ever—with lots of new features—but we've left the price alone. We've added a new, low filter. We've put in a 3-position speaker switch. We've changed from a ceramic to a magnetic cartridge. We've included a microphone with the built-in tape recording system. We've introduced a new, high performance tuner/amplifier. And we've introduced a 4-pole motor in the changer. Yes, the new Wedge is a lot more to sell. And it's a lot easier to sell. Because the one thing we haven't added to is the price.

The Wedge,
Model JR596W.
Richly grained
simulated
Walnut finish.

Now there's a Billboard that wakes you up.

The
Billboard
Model J465W. Smart
simulated grained Walnut
finish with jet-black trim.

We found a simple way to give you more clock radio sales—we've come up with one that's a lot more visible in your store. It's called the Billboard. And with good reason. The digital read-out panel across the top looks like a Twenty-First Century, electronic billboard. Unique in design and beautifully styled, it should sell like snowshovels in Buffalo. The Billboard is only the latest in the Zenith line of Power Reserve clock radios. The time keeps going (for up to four hours) even if the power doesn't.

The Zenith audio line for '78 is going to be too hot not to handle. It offers more features, more value and more products. Plus the famous Zenith quality. And you can't ask for more than that.

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GE's Solid-State Vertical Sweep System

By J. W. Phipps

An overview of the theory of operation of a vertical sweep system whose basic design is representative of the vertical sweep systems employed in most GE all-solid-state monochrome and color TV chassis, plus a listing of associated common trouble symptoms, their most probable causes, and procedures for isolating them.

■ Shown in Figs. 1, 2 and 3A/B are the three functional sections which comprise the vertical sweep system employed in GE's 1975 model-year XA all-solid-state monochrome TV chassis. These three sections are: the vertical oscillator (Fig. 1), a differential amplifier (Fig. 2), and the vertical driver/output section (Figs. 3A/B).

This vertical sweep system, with minor variations, is employed in most GE all-solid-state monochrome and color TV chassis, including the JA/QA, QA/QB, YA/YC and MB/MC color chassis and the XB monochrome chassis.

THEORY OF OPERATION

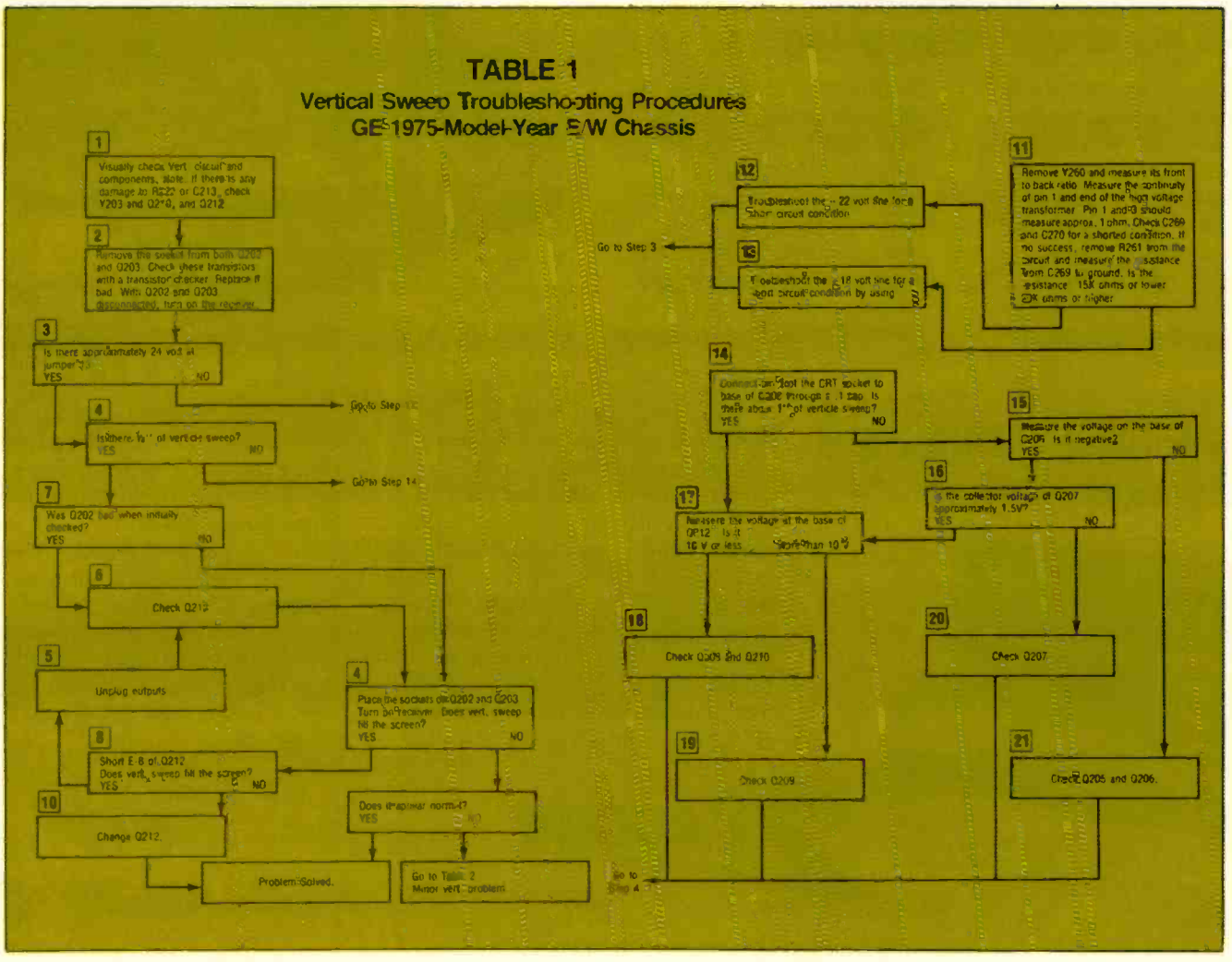
Vertical Oscillator/Sawtooth Generator

The vertical oscillator section of the XA chassis (Fig. 1) consists of a free-running complementary relation oscillator (Q205, Q206) and a sawtooth generator stage (Q207, called 'VERTICAL DISCHARGE' in Fig. 1).

Vertical oscillator transistors Q205 and Q206 are connected in a configuration which functions like a silicon controlled rectifier (SCR). The emitter of Q206 corresponds to the SCR's cathode, the base of Q205 corresponds to the SCR's gate, and the emitter of Q205 corresponds to the SCR's anode.

Conduction of this SCR-like device is initiated by application of a forward bias across the emitter-base junction of PNP transistor Q205.

Free-running mode—In the absence of a negative-going vertical sync pulse (free-running mode),



the base-emitter junction of Q205 is forward biased whenever the positive charge on C205 exceeds the positive voltage drop across R215. (R215 is part of a voltage divider network tied to the +20 and +22 VDC sources.) Q205 then conducts and its collector current, which flows 'up' forward biases Q206. The resultant conduction of Q206 increases the forward-bias on the base-emitter junction of Q205, causing it to conduct even more.

Once the combination of Q205 and Q206 begins conduction, C205 begins discharging through ground and back 'up' through the conducting transistors and R215. Consequently, the positive charge on the 'top' side of C205 rapidly decreases to a level which no longer forward biases the base-emitter junction of Q205. Both transistors then cease conduction and the 'top' side of C205 begins recharging to the positive level which, again, will forward bias Q205 and start the conducting sequence over.

The length of time it takes C205 to recharge to the level which again forward biases Q205 is dependent on the setting of VERT HOLD control R211, which varies the time constant of C205's charging circuit.

Synced mode—Each time the base of sync inverter Q204 receives a positive 60-Hz sync pulse from the sync separator stage, the resultant current through the collector circuit of Q204 decreases the voltage at the 'bottom' end of R209, thereby developing a negative-going 20-volt PP pulse which, in turn, 'develops' a lower-amplitude negative-going pulse across R215, the 'top' of which is tied to the base of Q205. This reduction of the positive potential on the base of Q205, in conjunction with the higher positive potential on the 'top' of C205, forward biases the base-emitter junction of Q205, thereby starting the 'oscillating cycle' of Q205/Q206.

Because the frequency *and*

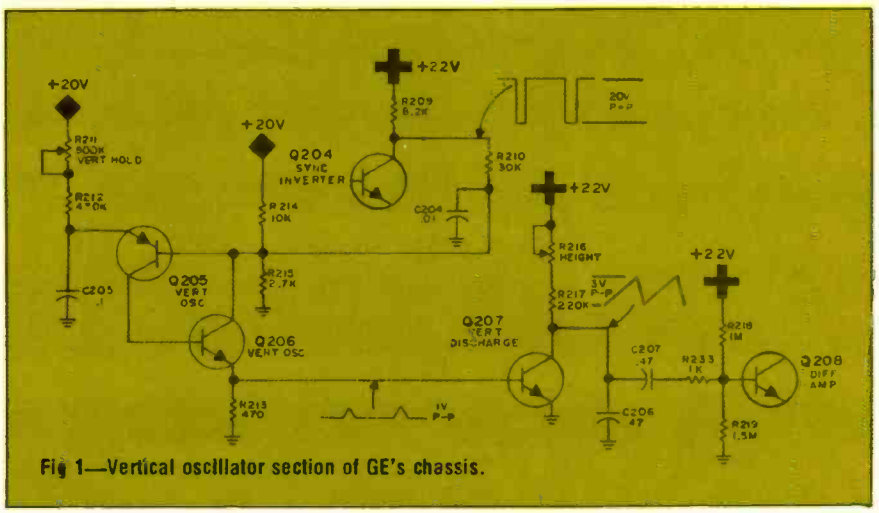


Fig 1—Vertical oscillator section of GE's chassis.

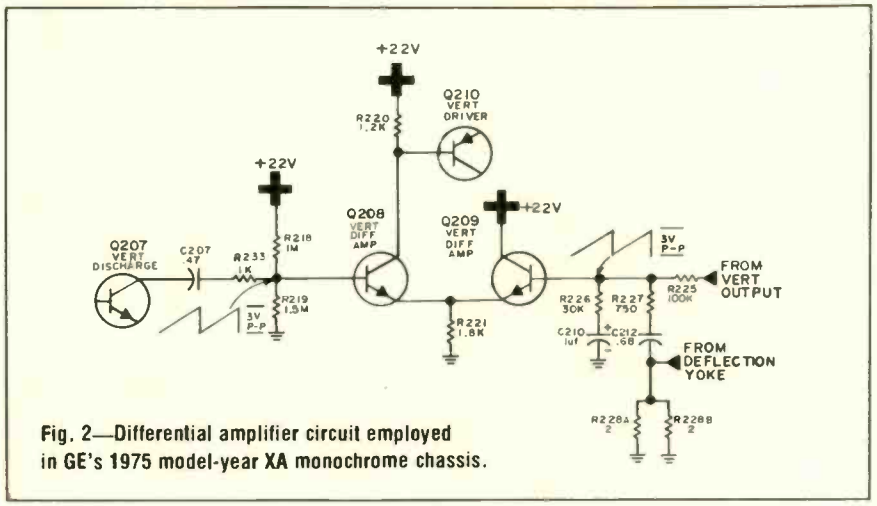


Fig. 2—Differential amplifier circuit employed in GE's 1975 model-year XA monochrome chassis.

phase of the negative-going pulse applied to the base of Q205 correspond to the frequency *and* phase of the broadcast vertical sync pulse, the 'start-up time' of the receiver's vertical oscillator corresponds to the leading edge of the vertical sync pulse—which means that the output of the oscillator is *in phase* with the received vertical sync pulse. Thus, if the free-running frequency of the oscillator (determined by the setting of VERT HOLD control R211) is relatively close to the vertical sync rate of 60 HZ, a vertically stable picture should be displayed on the receiver's screen.

Each time Q205/Q206 conducts, a positive-going 1-volt PP pulse is produced across R213, the emitter resistor of Q206. This pulse, in turn, forward biases Q207, the vertical discharge (or sawtooth generator) transistor.

Conduction of Q207 creates a discharge path for the positive charge normally present on the 'top' side of C206 when Q207 is not conducting.

When Q207 ceases conduction, the voltage on the 'top' side of C206 again begins recharging toward the value of the +22-volt source, through resistor R217 and the HEIGHT control, R216. The positive amplitude to which C206 recharges is dependent on the setting of R216, which, along with R217, determines the time con-

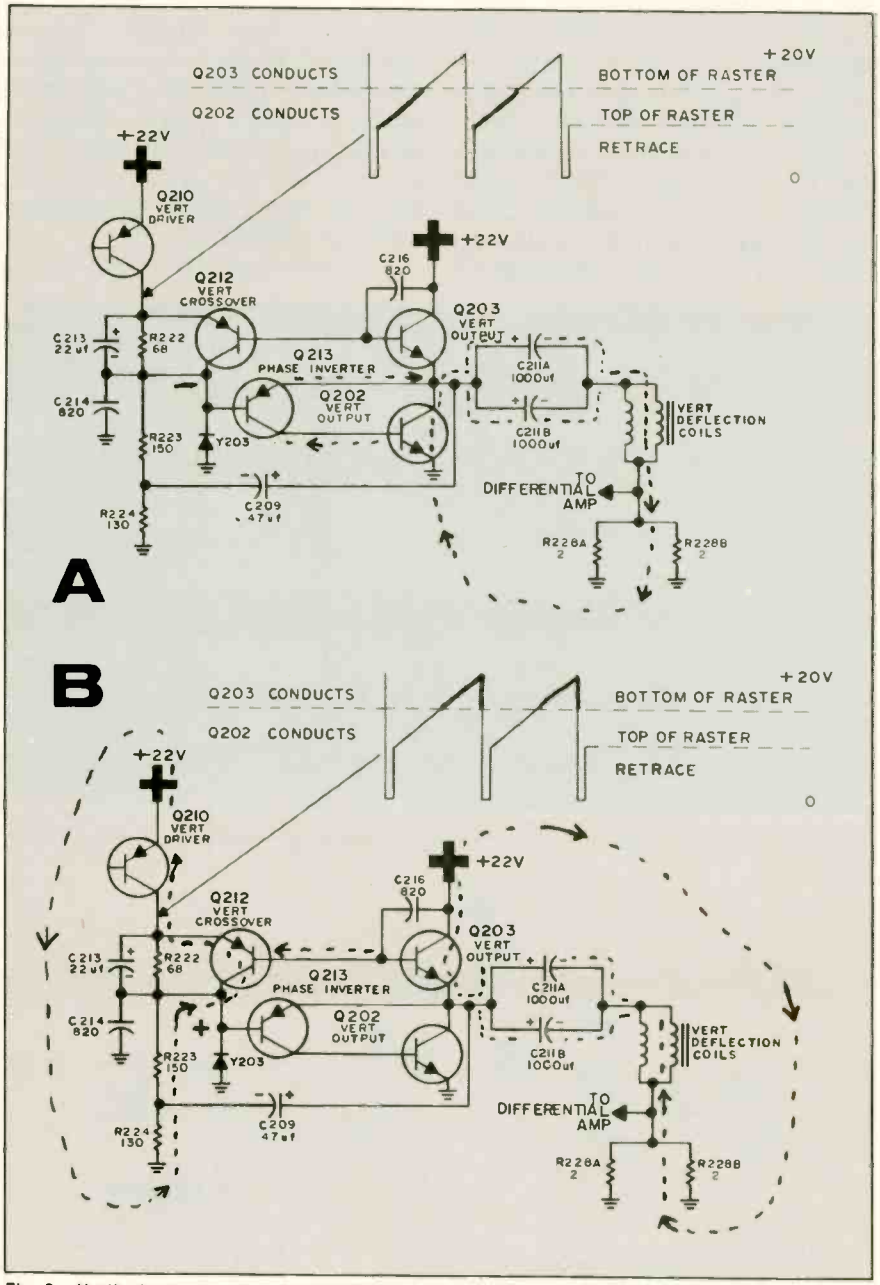


Fig. 3—Vertical output section of GE's 1975 model-year XA monochrome TV chassis. A) Current flow during bottom half of scan. B) Current flow during top half of scan.

stant of C206's charge circuit. Consequently, the setting of R216 determines the peak-to-peak amplitude of the sawtooth waveform produced by the charge/discharge of C206 and—because the amplitude of this sawtooth ultimately determines the amplitude of the current through the vertical windings of the yoke—the setting of R216 thus controls the *heights* of the raster.

The 60-Hz, 3-volt PP sawtooth produced on the collector of Q207 is coupled to the base of differential amplifier Q208 through an RC waveshaping network consisting of C207, R233 and R219.

Differential Amplifier

duction of Q209. An increase in the emitter-collector current of Q209 increases the positive voltage developed at the 'top' of R221, which, in turn, reduces the forward bias on the emitter-base junction of Q208, decreasing its conduction. (Conversely, a decrease in the emitter-collector current of Q209 increases the conduction of Q208.)

Emitter-collector current through Q209 is controlled by a 'composite' positive-going sawtooth developed on its base by 'negative' feedback pulses from two sources in the vertical output section: the collector of vertical output transistor Q203, and the 'top' of two parallel resistors connected between ground and the 'bottom' of the vertical deflection windings of the yoke.

TABLE 2

Vertical Sweep-Related Trouble Symptoms And Most Probable Defects Associated With Each

OFF FREQ.	NO SWEEP, OSC.	NO SWEEP, AMP.	INSUFFICIENT SWEEP	JITTER	LINEARITY	OVERSWEEP UNDERSWEEP	FOLDOVER, TOP	FOLDOVER BOTTOM	OUTPUT TRANSISTOR RUNS HOT	BOUNCE	DUNCE CAPPING	TOP COMPRESSION	BOTTOM COMPRESSION	HORIZ. STREAMS IN PICTURE	HUM BAR ON HIGH CHAN.
R211 R212 R214 R215 C205	R213 R214 R215	R220 R221	R221	R206	R226 R225 C207 C210 C313	R216 R228 C206	R233 R224 C209 Q203 Q210 Q213	R218 R219 C216 Q203 Q210 Q213	R222 R223 R224	R225	R225 R226 R227 C210 Q212	R226 C211 C212	C207 C208 C211	R227 C208	C215 C216

The purpose of the differential amplifier (Q208 and Q209 in Fig. 2) is to insure *linearity* of the vertical sweep.

Fixed bias for the emitter-base junction of Q208, the 'left' half of the differential amplifier, is established by voltage divider R218/R219 and emitter resistor R221. (Note that R221 is 'shared' by both halves of the amplifier.)

The positive-going, 3-volt PP sawtooth coupled to the base of Q208 from the vertical discharge stage forward biases Q208 into conduction, decreasing the voltage at the 'bottom' of R220. The resultant negative-going pulse is applied to the base of PNP vertical driver Q210, which, in turn, inverts it and applies it to the vertical output stages, as will be described later in this article.

Because emitter resistor R221 is shared by both Q208 and Q209, the bias on the base-emmiter junction of Q208—and therefore the level of conduction of Q208—is also controlled by the level of conduction of Q209. An increase in the emitter-collector current of Q209 increases the positive voltage developed at the 'top' of R221, which, in turn, reduces the forward bias on the emitter-base junction of Q208, decreasing its conduction. (Conversely, a decrease in the emitter-collector current of Q209 increases the conduction of Q208.)

Any difference in the shape and/or amplitude of this 'composite' pulse and the shape and amplitude of corresponding points on the sawtooth applied to the base of Q208 is representative of nonlinearity-producing distortion introduced into the sweep system by the oscillator output, the vertical output stages and/or the yoke. (The feedback voltage from the vertical output stages is developed across R225 and is indicative of differences in the gain of the two output stages. The feedback sawtooth voltage from the yoke is developed across parallel resistors R228A/B by the yoke current and is representative of the oscillator output sawtooth and any distortion in it caused by the output section, including the yoke.)

As a worse-case example of how the differential amplifier eliminates distortion which otherwise would cause noticeable nonlinearity in the raster, assume that a slight *positive-going* 'bulge' appears in the normally linear slope portion of the sawtooth applied to the base of Q208 by the sawtooth generator. This distortion causes a momentarily abnormal increase in the conduction of Q208, which, in turn is reflected on through the output section and, via the feedback system, back to the base of Q209. The positive-going bulge in the sawtooth on the base of Q209 increases the conduction of this half of the differential amplifier, which in turn increases the positive voltage on the 'top' of the emitter resistor R221. Thus, the abnormal *positive-going increase* in the *base* voltage of Q208—which caused an abnormal increase in the forward bias applied across the base-emitter junction of Q208—has now been offset by a proportional *positive-going increase* in the voltage on its *emitter*, which decreases the instantaneous value of forward bias to a 'normal' level. Consequently, the effect of the bulge in the sawtooth on the base of Q208 is cancelled out of the pulse produced in its collector circuit.

Vertical Output Section

A simplified schematic of the output section of the GE vertical sweep system is shown in Figs. 3A and B.

Output transistors Q202 and Q203 are connected in a quasi-complementary configuration—which means that they operate push-pull, Class-B. Q202 conducts on the least positive half of the input signal (corresponding to the top half of the raster) and Q203 conducts on the most positive half (bottom half of the raster).

Because Q202 and Q203 are the same type of transistor (NPN), push-pull operation requires that their inputs be 180 degrees out of phase with each other. This provision is met by Q213, which inverts the phase of the input to Q202 by 180 degrees (compared to the input of Q203).

Forward biasing base-emitter current for Q203 is furnished by the conduction of Q212, and forward biasing base-emitter current for Q202 is provided by the conduction of Q213.

The point on the input signal at

continued on page 47

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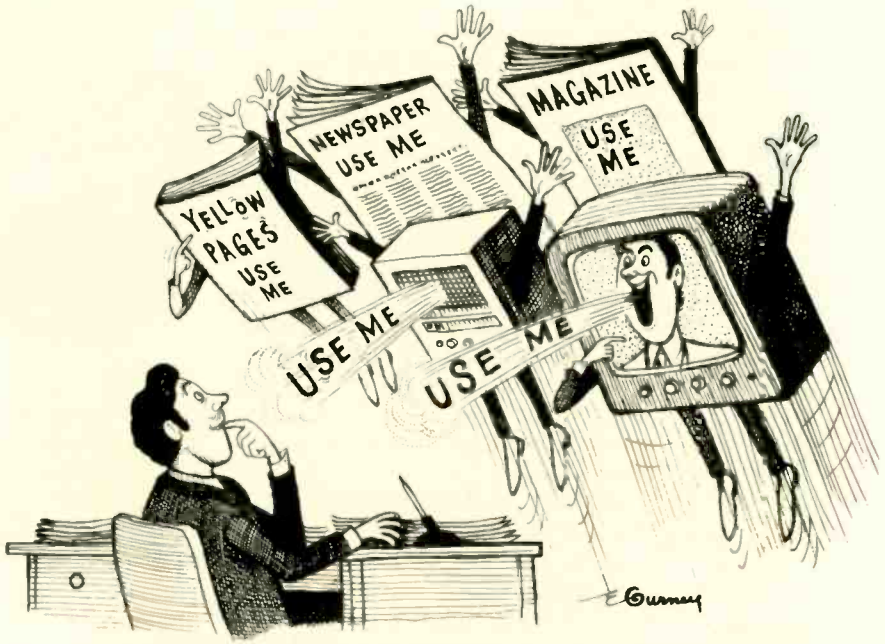


A guide to the many advertising methods available—when and how to use them—and how much to spend

By Don W. Mason

■ If you operate the one and only electronic sales and/or service shop in you town—and you have built a reputation for quality service at a reasonable price—advertising may not be one of your major concerns. But add one competitor for the TV sales and service business in your community, and you've got good reason to consider some kind of advertising 'program'.

In today's competitive marketplace, it really isn't a question of whether or not to advertise. It is more a matter of "which of the many types of advertising available should I use?"—"How much should I spend?"—and "What should I say?"

When you display merchandise for sale in your front window or the showroom or at the service counter, it's true that you are advertising. And when one of your customers tells her friends about the wonderful service you offer, that's advertising of the most valuable kind. And when you hang up the sign outside your shop, that's advertising, too.

But, even though word-of-mouth and point-of-sale advertising efforts do produce results, those results are slow in coming, and to a degree, unpredictable. What is needed—if advertising's goal of increased sales is to be realized—is a faster, more predictable, more encompassing means of motivation. So let's first examine the different kinds of advertising that are available.

THE LOCAL NEWSPAPER

Newspapers are the retailer's primary medium because, daily or weekly, they reach the greatest, predetermined number of consumers. You can be sure, also, that a newspapers readers are three or four times the announced circulation because almost every copy is seen by several readers.

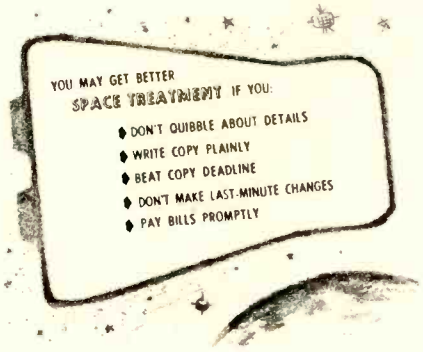
Anyone who subscribes to a daily or weekly newspaper does so to keep up on the news in their community and the shopping information of interest to them. As with any of the printed advertising media, a newspaper ad has more retention value than, for example, a one-minute spot on the local radio or television station, or a billboard, or even the sign at the front of your shop. Your newspaper ad will stay around a consumers house for at least a day and sometimes a week. And, as mentioned, more than one member of the household usually reads the paper each time.

When considering the daily or weekly newspaper for your ad-

Some of the information and artwork for this series has been provided by the Small Business Administration and by Cunningham & Walsh, Inc.

vertising, you should compare the areas covered by its circulation with the market area you want to cover with your products and services. This is especially true if you are located in a relatively large city.

If the bulk of your business is drawn from only a small portion of the area covered by the paper, you will be paying a premium for advertising that does no good. Depending on the size of the city you are located in, and the market area you serve, you might do well to consider using limited-circulation 'neighborhood' or 'shopping papers' for your advertising. But be sure to check the reader interest in these smaller papers. In some areas, well-edited neighborhood papers are read with great interest, but in others they are thrown away or regarded as a nuisance.



Newspaper Contract Rates

If you have been advertising in the local newspaper on a somewhat sporadic basis—whenever the ad salesman twists your arm hard enough, or when you've got a little extra money—you should look into the possibility of 'contract rates'. By using only one newspaper and by following a prearranged advertising schedule, you will probably find it possible to buy regular advertising at a preferred, or lower, rate. This could save you money, allow you to increase the size of your ad, or give you extra dollars to invest in some other form of advertising.

Positioning of Your Newspaper Ad

Getting a good spot for your ad is desirable, but not always possible. Only rarely can you get a guarantee for a specific location, but you can usually arrange to have your ad appear on a certain page or in a given section. Occasionally, you may find your ad at the bottom of the page or next to an ad of your major competitor. It's important, therefore, to depend more on layout, design, and copy than to rely on a specific location. Always try to design your ad so that it won't be lost in the maze of an advertising page. Usually, your newspaper's advertising department will be well equipped to aid you in layout, design, and copy preparation.

Here are some hints that may help you get better space treatment for your newspaper advertising:

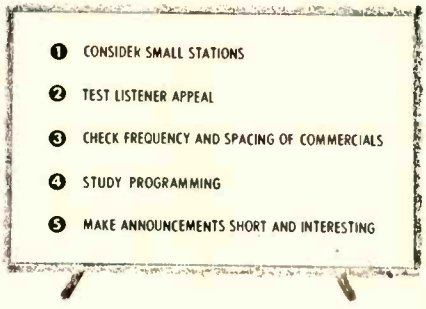
- Don't quibble about insignificant details
- Write or type your copy plainly and without mistakes
- Hand in your copy well before publication deadlines
- Don't ask for last-minute changes—except in rare emergencies
- Pay your bill promptly. (Frequently, newspapers offer a discount for immediate payment of the bill.)

Classified Newspaper Ads

Up to now, in our discussion of newspaper advertising, we've referred to 'display' advertising, i.e., ads appearing on the regular news pages. The classified advertising section of the newspaper should also be considered as a possibility for the average electronic sales and/or service operation, for the following reasons:

- Because classified ads are less expensive than display ads, generally, they can provide an advertising means for service shops with extremely limited advertising budgets.
- Many newspapers include in their classified section a separately designated area for just 'service' agencies—businesses which provide servicing of everything from appliance repair to woodworking. Readers get into the habit of referring to that section when they are in need of service.
- The classified section is an ideal place to announce the close-out of discontinued lines and used items, such as rebuilt TVs.

GUIDES TO RADIO/TV ADVERTISING:



RADIO & TV ADVERTISING

In that the existence of radio and television broadcasting stations provides us with the reason for being in the electronic sales and service business, it might seem natural to include them in a program of advertising. That would be an invalid reason, however.

Before you buy radio or TV advertising, consider several factors just as you would in newspaper advertising. It is possible to buy coverage that does you no good. For example, if you buy time from a broadcasting company that has an effective range of 100 miles in every direction, you are charged a rate calculated on the entire broadcast range—even though your own trade area may extend only 10 miles in any direction from your business location.

Again, the answer here is an analysis on your part of how wide an area you wish to cover in your sales and service efforts. If you are located in a city up to, say, 100,000 in population, it is likely you pro-

vide service in all parts of the city. Thus, radio, and even television, advertising could be a worthwhile investment in terms of increased sales volume. On the other hand, if you are located in a city of 500,000 or more population, your radio and TV advertising dollars would be spent on a lot of people you would never be able to serve. That is, unless you are serving the whole city with a fleet of service vehicles and a staff of technicians.

Some Guidelines To Radio & TV Advertising

The advertising sales office and program department of most radio and TV stations will provide much help in the preparation of your broadcast advertising copy, and we'll pass along some ideas on the subject later in this article. However, here are some broad guides to more effective radio and TV advertising:

- If you are located in a smaller town (10,000-25,000 population), radio advertising can be worthwhile because of lower rates and greater ease at reaching the targeted audience.
- Where possible, choose the station projecting the strongest listener appeal. If several stations are available, test all of them over a period of time to determine if their usual programs are the kind your potential customers would find appealing. For instance, if you are directing your advertising to the teenage crowd (for radio & stereo service & sales), you wouldn't select a station that plays symphonic music most of the time. Or, you wouldn't choose a hard rock station, exclusively, for promoting TV sales and service, as you'd miss most of the grown-up sales prospects.
- Check the number of commercials that are broadcast on the different stations. Just as you don't want your newspaper ad to get lost on a page, you don't want your radio-TV announcements crowded in with scores of others, maybe back-to-back. Find out if announcements are run together or are separated by interesting program material that will hold audi-

continued on page 24

ence attention.

- Study a station's programming schedule. Try to get time just before, just after, or in the middle of a program having strong listener, or viewer, interest, such as sports events and news programs. Television advertising in these periods and the prime evening viewing hours, however, will probably be priced far beyond the average service dealers budget.
- Make your announcements short and interesting. Prices and values should be featured in spot announcements. If you decide to use prestige and institutional advertising, sponsored programming is better.

HANDBILLS AND DIRECT MAIL

The use of handbills and direct mail in advertising, in some ways, fits the needs of the average electronic sales and service business better than other methods. The cost is generally lower and can be controlled, and there is a greater opportunity to pinpoint specifically the desired market coverage.

Handbills

The handbill was at one time the most used medium in retail advertising. It is still an important tool for many small retail and service businesses and the most economical means of small-volume advertising, if well handled. Handbill advertising is more readily controlled than other forms of promotion because it is distributed directly by the business doing the advertising, and it is usually cheap to produce—by mimeograph, multilith, or silk screen printing. (Whichever method is used, the handbill must be neat, legible, and attractive or the advantage is lost.) The hand-bills can be distributed over the specific area that is expected to give the greatest return, and they can also be passed out in the shop or laid out on counters for customers. Another technique is to insert them in packages and monthly bills.

Remember, though, that handbills can be costly and worthless if not properly distributed. The people you hire to distribute them must be trustworthy, or else you are apt to find your message in the nearest creek or garbage dump.

Also to be considered is community reaction to handbills. Some people resent finding unsolicitated materials on their porch or in their mailbox.

Direct Mail Advertising

Direct mail advertising has many of the advantages of handbills, and it is also a bit more dignified and personal because it can be directed to an individual customer.

Direct mail is more selective than newspaper, radio-TV, or handbills. To insure adequate but controlled coverage, use a selective mailing list compiled from your own business records, or from various sources in the community, such as telephone and city directories. In most medium cities there is also a least one mailing service (often associated with a printer) that maintains an up-to-date list and address labels of city and rural residents.

Direct mail is somewhat more expensive than handbill advertising, mainly because of the postage, but it will give you greater latitude because:

1. You can say more.
2. You can try novel ideas on selected clients.
3. You have a better chance to get across your business "personality."
4. You can use a more personal approach and appeal.
5. It can be used as an effective follow-up on past customers.

ADVERTISING IN THE YELLOW PAGES

In one way, "Yellow Page" advertising should have appeared at the beginning of our list of advertising methods because it usually is the very first kind of advertising that is offered to a beginning retail business. And at least a listing in the Yellow Pages, and preferably an ad, is especially worthwhile for the electronic service shop because usually the first thing people head for when their television set fails is the telephone directory.

However, in comparison to the newspaper, TV, radio, handbills and direct mail, telephone directory advertising offers a 'long-term' advertising message. It remains in homes and offices for an entire year. For this same reason, however, a good deal of thought and care should go into the preparation of the Yellow Page ad.

The information you include in your directory ad should be information that will, to your knowledge remain valid for the life of the directory, or for at least one year.

Aim for a strong Yellow Pages ad, one that leaps from the page and distinguishes you from your competition. Be precise, but give all the facts about your business that prospects for your services will want to know. You should include all basic information about your operation—the location, brands you service and/or sell, if you do warranty service, which kinds of electronic products you service and/or sell, hours of operation, and your policy on house calls.

Also, be sure to explore some of the advertising options the Yellow Pages has to offer. By advertising under different headings, for example, you can promote different products and services. For example, you could have one listing under Television & Radio Dealers, one under Television & Radio Service, and still another under Radio Communication Equipment & Systems, if you handle sales and service for CB and other two-way radio equipment.

Here, again, the Yellow Page advertising representative is usually equipped and ready to help you in the preparation of your ad with artwork and copy ideas.

NEXT MONTH...

We'll examine typical advertising budgets for electronics sales & service dealers—offer ideas for effective advertising copy—and outline the qualities required and effects realized from a good advertising program. ■

Common Discrete Industrial Electronics Semiconductors—A Review—Part 1

By Alfred Haas

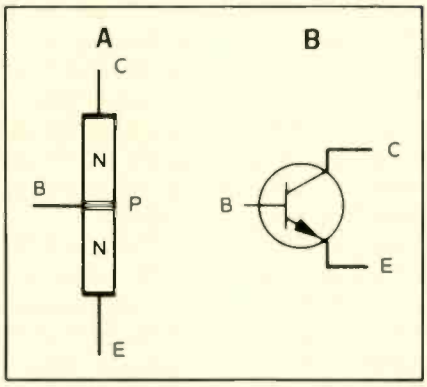


Fig. 1—Structural diagram and schematic symbol of an NPN transistor.

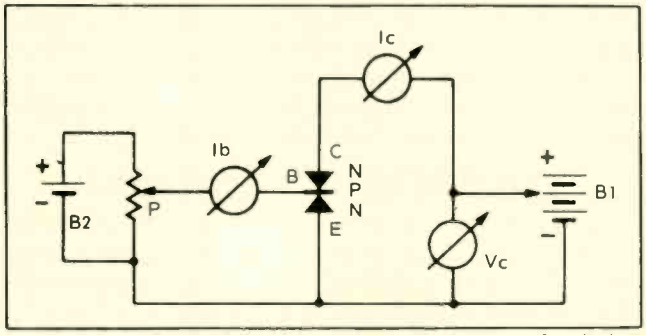


Fig. 2—A transistor behaves like two opposing diodes.

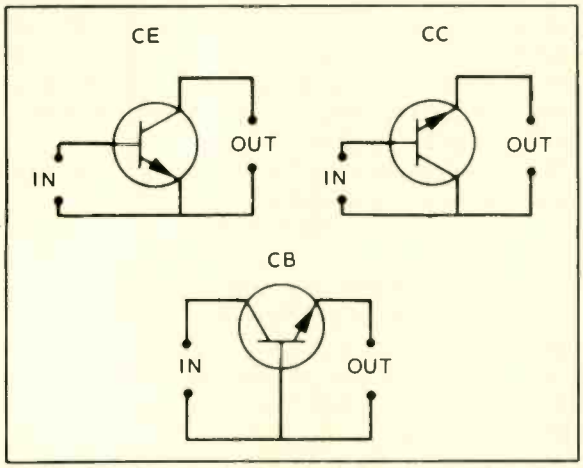


Fig. 3—Schematics of the three basic transistor configurations.

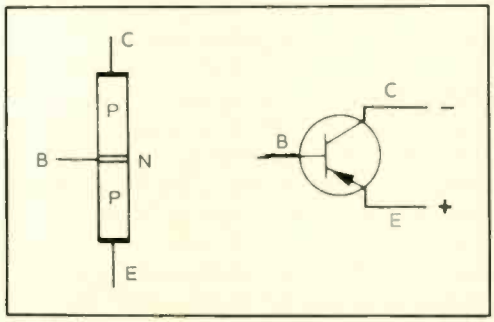


Fig. 4—Structural diagram and schematic symbol of a PNP transistor.

■ The discrete semiconductors commonly employed in *industrial* electronic applications are basically the same as those employed in other electronic applications. These include bipolar transistors, field-effect transistors, thyristors (SCRs, LASCRs and Triacs), discs, UJTs, and zener diodes.

The fundamentals of these devices are reviewed from an industrial electronics viewpoint in the following paragraphs.

BIPOLAR TRANSISTOR FUNDAMENTALS

A transistor (NPN-type junction) is shown cut lengthwise in Fig. 1A, while Fig. 1B indicates the corresponding symbol. The tiny semiconductor bar, generally made of germanium or silicon, is shown much enlarged here. By introducing an impurity such as arsenic, antimony or phosphorus, the nonconducting pure semiconductor can be made conducting by (negative) electrons. In the center of the bar has been arranged a small P region of positive hold conduction, the holes being vacancies left by the departure of electrons.

The electrodes placed at the ends of the bar are called emitter (E) and collector (C), and the center electrode is the base (B). The name and symbol of the base are reminiscent of the early transistors where two point contacts (cat whiskers) touched a semiconductor chip used as a base.

Because of its two junctions NP and PN, this transistor behaves just like two opposing diodes with a common cathode, B (Fig. 2). With E grounded, let us apply positive potentials to B and C and look at the meter scales to see what happens. If B were unconnected, collector current Ic would be zero whatever the polarity of collector battery B1, for if one of the diodes were conducting, the other would be reverse biased and block any current. For the polarity shown, the upper diode (BC) is cutoff. If now we made B positive regarding E by means of potentiometer P, shunting battery B2, the lower diode (EB) is thereby biased to conduct and will pass the electrons provided by emitter E (hence, its name), and since the base region is made extremely thin by design, the electrons attracted by the positive collector potential will easily traverse the base to penetrate the collector region. The collector thus absorbs practically from 95 to 99 percent of the emitter current, with only 1 to 5 percent of it taken by the base.

Each of its three electrodes can be made the common input-output electrode as deemed convenient,

(From Chapter 3, "Industrial Electronics Principles & Practices," by Alfred Haas, TAB BOOKS, Copyright 1977. A review of the complete book follows this article.)

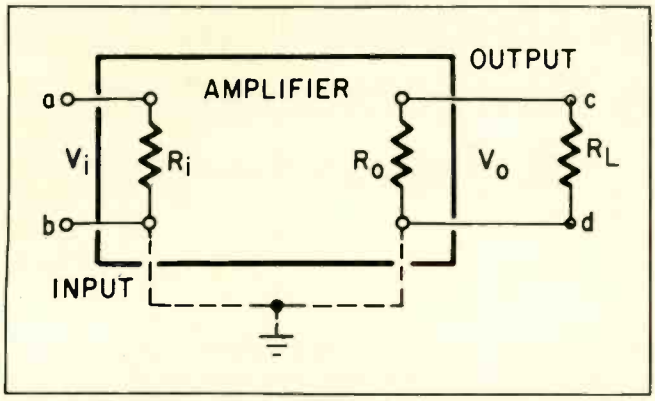


Fig. 5—This diagram illustrates the main parameters of an amplifier.

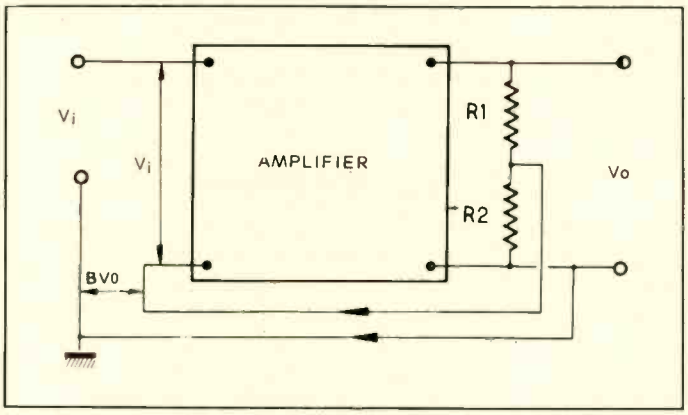


Fig. 6—Amplifier with an inverse voltage feedback loop.

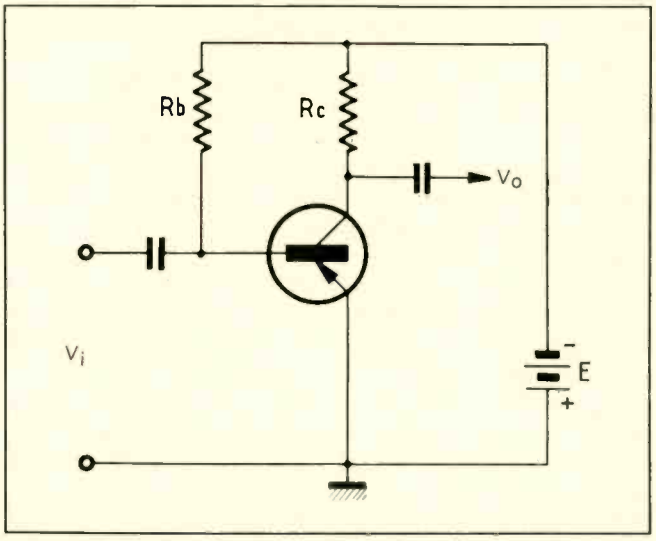


Fig. 7—Basic common-emitter (CE) transistor amplifier circuit.

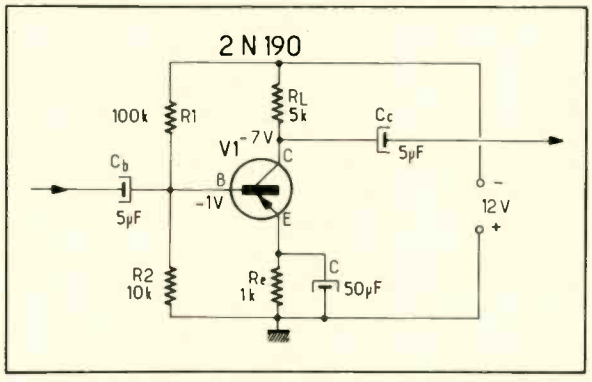


Fig. 8—CE amplifier with thermal stabilization.

resulting in the three basic configurations—common emitter (CE), common collector (CC) and common base (CB) diagrammed in Fig. 3. Most amplifying transistors are CE-connected, yielding an input-output current gain of 20 and more.

The transistor input resistance is lower than its output resistance, making for high voltage and power gains. The voltage gain of the CC configuration is a little less than one, but there actually is current and power gain; this connection is used as a stepdown impedance converter, especially for low input impedance CE amplifier transistors. The CB connection offers no current gain because of its low input and high output resistances; a voltage or power gain is possible. This configuration is principally used in high-frequency oscillators.

On the other hand, if instead of the N-type bar with a P region, we take a P-type bar with an N region, we get a PNP transistor complementary to the former NPN type (Fig. 4). With similar characteristics provided, the PNP transistor behaves exactly as the NPN type does, except for the fact that the polarities of all voltage sources used are reversed. This singular property, which has no counterpart in electron tube technology, based on electron rather than hole conduction, allows for interesting possibilities in circuit design, since it offers additional flexibility.

TRANSISTOR AMPLIFIER FUNDAMENTALS

To begin with, consider the "black box" labeled amplifier (Fig. 5) presenting two input posts a, b and two output posts c, d. (Posts b and d are conveniently tied together and grounded whenever possible.) Applying an input voltage or signal Vi at the input results in an output voltage Vo at the amplifier output. Both voltages are of similar waveform, but their amplitude and phase may differ. (Control amplifiers generally do not require the perfect linearity characteristic sported by hi-fi equipment, especially so if they are pulse operated.)

If Vo is greater than Vi, there is voltage amplification, and the actual gain is:

$$G = Vo/Vi$$

Though less evident, there may still be amplification if Vo is less than Vi. Suppose the black box input resistance, Ri, is 1 meg and load RL is 100 ohms; Vi is 100v and Vo is 10v. While the voltage gain of 0.1 actually is a loss, the input and output powers, respectively, are

$$Pi = Vi^2/Ri = 0.01w$$

and

$$Po = Vo^2/RL = 1w$$

Hence, there is a power gain of:

$$Po/Pi = 100$$

Similarly, a current gain of 1,000 is obtained.

Power amplifiers (one stage often will do) provide the power necessary to energize motors, electromagnets and other kinds of loads. A voltage or current driver amplifier generally is required to sufficiently amplify the low-level signal for controlling a power amplifier. The gain required determines the number of driver amplifier stages needed.

The transmitted frequency band is another fundamental amplifier characteristic. In industrial elec-

tronics, mostly low and very low frequencies are used, and 100 kHz can be considered as an upper limit. (This does not include special HF gear not "interfacing" with conventional control equipment.)

On the other hand, phase distortion-free amplification of signal frequencies lower than 60 Hz is not easy, for the use of RC-coupled AC amplifiers may lead to excessive time delay and instability. There are so-called DC amplifiers (i.e., amplifiers for slowly varying voltages or currents.) that are either direct-coupled or chopper amplifiers.

Inverse Feedback

Consider the black-box type of amplifier in Fig. 6. It produces an output voltage, Vo, upon applying an input voltage Vi. By means of output-fed voltage divider R1, R2, a portion (β) of Vo is reinjected into the output ("feedback") in a way to oppose the initial signal Vs (inverse feedback). Without any feedback, the amplifier gain was:

$$G = Vo/Vi$$

Amplifier input Vi is identical with signal input Vs. By injecting feedback voltage βVo, in series with Vi, the overall gain reduces to:

$$Go = Vo/Vs = Vo/(Vi - \beta Vo.)$$

Hence:

$$Go = G/(1-\beta G)$$

Assuming the factor β G is far greater than unity, this reduces to 1 divided by β. This means that the overall gain of that amplifier practically depends on:

$$\beta = R_2/(R_1 + _2)$$

and is independent of its original gain G. Supply voltage variations, aging and other factors do not influence Go. Using a high feedback factor, the apparently varying device becomes a stable and accurate amplification standard, at the price, however, of a somewhat lower gain.

The collector current (Ic) of a transistor is controlled by its emitter-base current (Ieb). This makes for a low input resistance—a few hundreds to some thousands of ohms. The preceding stage has to match this load. If it is a similar transistor stage, its output resistance is comparatively high, 50,000 ohms, for instance. There evidently is a problem.

On the other hand, the emitter-base junction of resistance re is common to base and collector circuits. This results in an internal feedback between input and output, greatly complicating the calculation of transistor circuitry. A number of equivalent quadripoles describe transistor operation in a given set of conditions.

The simplest possible transistor amplifier is presented in Fig. 7. A PNP transistor is CE-connected; for an NPN, reverse the supply battery as well as the polarity of the electrolytic capacitors. The base is biased to the same polarity as the collector by series resistor Rb. To obtain a base bias current of 0.1 ma from a 6v battery, Rb is 60K. (Regarding Rb, re is negligibly small.) The output voltage develops across collector Rc. Coupling capacitors are provided to avoid shorting out the electrode voltages.

This simple biasing method is seldom used. Transistors are marked with some allowance on the current amplification factor β, so that Rb should be matched to the transistor used. Still more important,

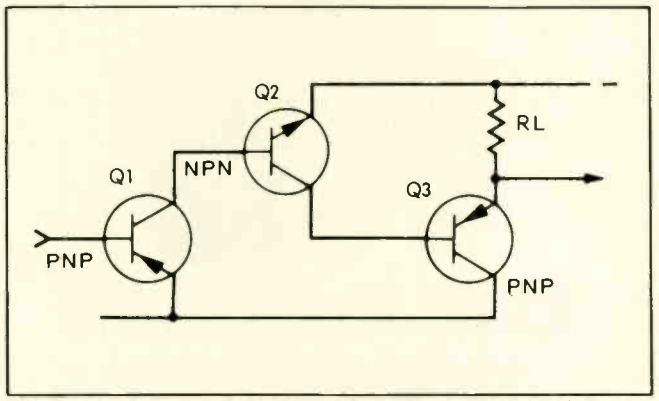


Fig. 9—Direct-coupled 3-stage amplifier using complementary transistors. Only one passive component is used (RL).

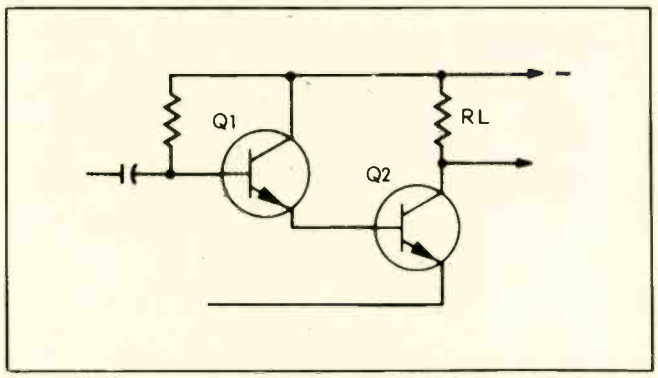


Fig. 10—Schematic of a Darlington-connected current amplifier.

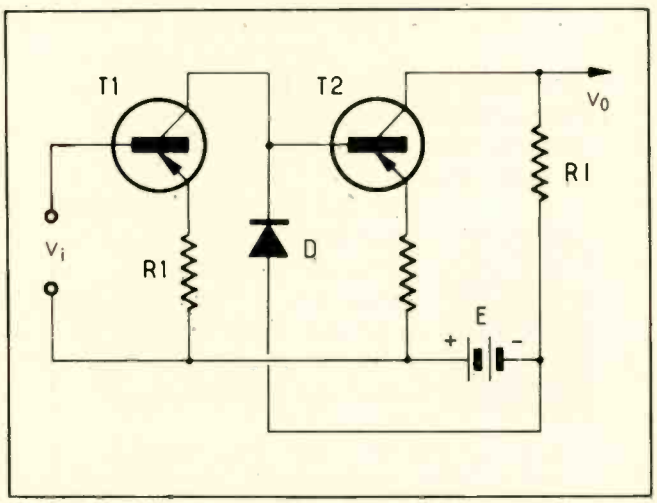


Fig. 11—Direct-coupled transistor amplifier with improved thermal compensation.

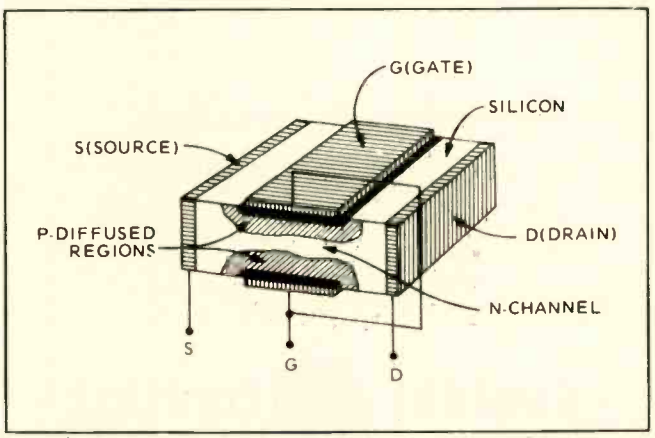


Fig. 12—Structural diagram of a junction-type field-effect transistor.

the internal transistor resistances are largely temperature-variable and may lead to thermal runaway and eventually to destruction of the device. Consequently, it is necessary to choose a bias method that compensates for thermal effects. In the amplifier stage in Fig. 8, an excessive base current is provided by voltage divider R1R2, and an opposing bias is developed by emitter resistor Re, bypassed by a suitable capacitor (C) to avoid a loss of AC signal components. This circuit yields a gain of about 172; a high load impedance, however, is required to make use of it.

To get a higher gain, a number of stages of this type can be cascaded. Taking advantage of the peculiar proprieties of transistors, the 3-stage amplifier using complementary transistors in Fig. 9 uses the fewest possible passive components (only one resistor and no capacitor) and thus is a natural for microelectronics. The base currents of Q2 and Q3 equal the collector current of the preceding transistor, and the overall current gain equals the product of the individual gains of the transistors used. The voltage gain of this amplifier is given by the product of the mutual conductance of Q1 the current gain of Q2 and Q3 and the value of RL.

While a power tube is driven by a voltage amplifier, power transistors require a current amplifier drive. The so-called Darlington connection is frequently used for this purpose. As shown in Fig. 10, CC stage Q1 directly drives, from the emitter, the base of CE-connected output stage Q2. The overall current gain, again, equals the product of the current gains of Q1 and Q2, while the voltage gain of Q2 makes up the entire voltage gain. The input resistance is that of Q2 multiplied by the current gain of Q1, an increase to be welcomed.

Unlike a tube, the transistor will directly (transformerless) drive a low-impedance load (several ohms).

THERMAL COMPENSATION OF DE-COUPLED TRANSISTOR AMPLIFIERS

Because of the low supply voltages involved, generally between 1.5 and 24v, direct-coupled amplifiers are easier to design with transistors than with tubes. But on the other hand, the effects of thermal variations in transistors (more pronounced in germanium than in silicon) may well add and lead to a thermal runaway unknown in tube circuits. Therefore, it is determined first if the thermal effects tend to accumulate or cancel. Thermistors and reverse-biased diodes, in which the resistance varies with temperature, are often used to compensate for thermal effects.

The two direct-coupled CE amplifier stages in Fig. 11 feature a built-in thermal compensation tendency, for an increase of T1 collector current results in a lower collector-emitter voltage of the same transistor, thereby lowering the base-emitter voltage of T2, counteracting the increase in its collector current. Diode D, used as load for T1, still improves this compensation by its negative temperature coefficient.

FIELD-EFFECT TRANSISTOR FUNDAMENTALS

We know that tubes are voltage-controlled and transistors are current-operated. This is true for con-

ventional, so-called bipolar transistors, but not for unipolar or field-effect transistors (FET).

JFETs

A junction-type FET is composed of an N-type silicon chip with electrodes on the two opposite ends, called source S and drain D. On the central part of this chip, P-type regions are diffused into the upper and lower sides; metallic contacts are made and tied together to make up the gate (G) electrode (Fig. 12). If the drain-source resistance of the device is connected across battery B1 through resistor RL (Fig. 13), there appears (proper polarity provided) a depletion region extending more toward the center of the chip with an increasingly higher negative gate potential referred to source. The result is a "pinch" of the drain-source current, due to the electrostatic gate field. The gate, therefore, acts to control current in a way somewhat similar to the grid control of an electron tube, though the operating principles are entirely different.

The likeness is even more disconcerting when examining the drain current in terms of the drain-source voltage (LD over VDS) characteristic for a set of gate potentials UG; these curves (Fig. 14) are reminiscent of the Ia Va characteristics of a pentode. The gate forms, with the chip material, a reverse-biased PN junction, and the input impedance of the FET is at least as great as that of a pentode tube. For a number of models, manufacturers specify a typical leakage current of 1 na (one nanoampere, of 10^{-9} ampere)! Therefore, FETs are a natural for various circuits requiring a very high input impedance, far exceeding the possibilities of conventional semiconductor devices. Remember, however, that this junction is nothing more than a reverse-biased silicon diode, and that it is serviceable only at low levels.

MOSFETs

The MOSFET gate acts by its electrostatic field through the dielectric on the space between the two N regions; its control action is strongest with the thinnest dielectric film, and a comparatively small potential difference may be enough to puncture this layer, resulting in device destruction. Particular measures, therefore, are to be taken to protect the MOSFET against any voltage transients and static charges a junction FET will stand. Thanks to this dielectric, the MOSFET input resistance is even higher than that of the junction FET—from 1012 to 1015 ohms against about 1010 ohms, this leakage actually is that of the insulated feedthroughs of the sealed casing. This dielectric layer between the gate electrode and the semiconductor material is depicted in the MOSFET symbol.

If the MOSFET is connected like the FET in Fig. 13, an N channel (called an inversion channel) forms between S and D so that a current can pass. The thickness of the inversion layer, and also the charge carrier concentration, can be controlled by the gate potential. Actually, characteristics such as shown in Fig. 15 are obtained. While there still is a similarity to pentode curves, the rising segment is less steep than that of FETs.

If the P-type slice is suitably doped, a conduction channel already forms for UG equals 0. Then, it is

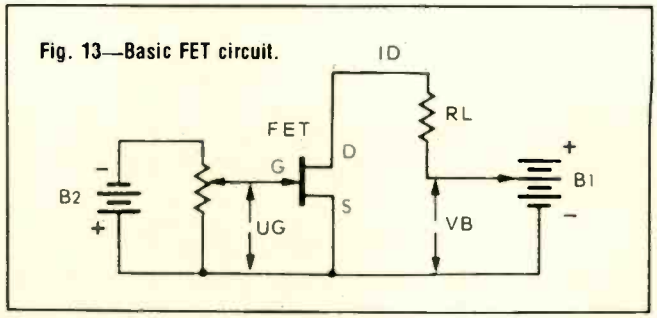


Fig. 13—Basic FET circuit.

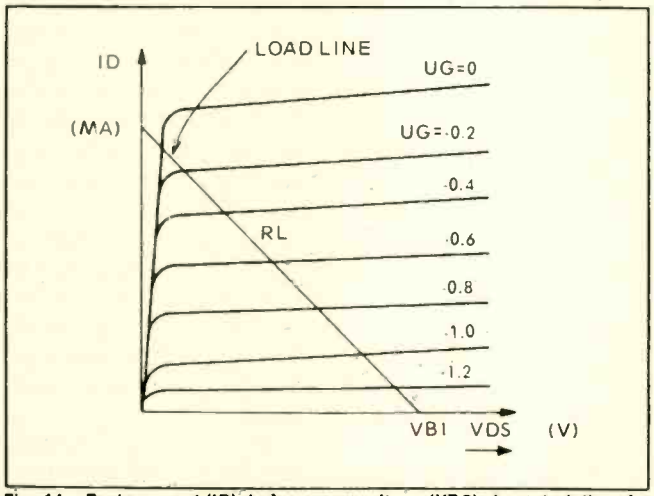


Fig. 14—Drain current (ID) drain-source voltage (VDS) characteristics of a typical FET for various gate voltages.

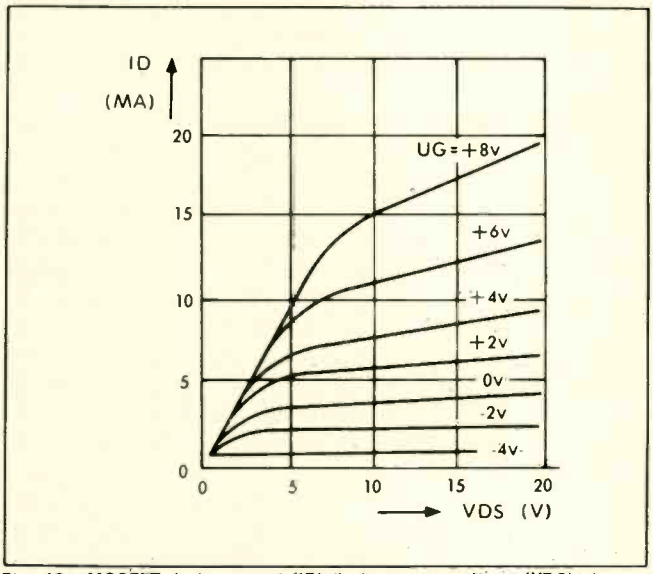


Fig. 15—MOSFET drain current (ID) drain-source voltage (VDS) characteristic.

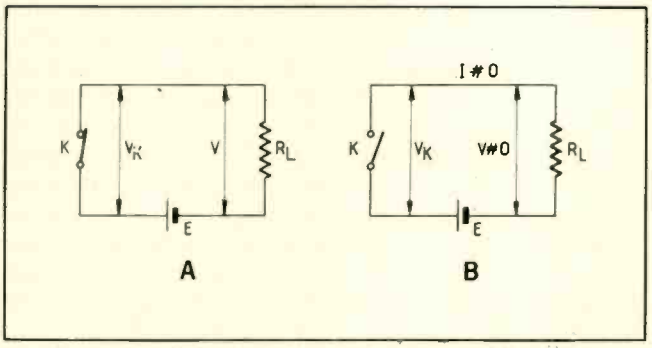


Fig. 16—With any switching device, there are two possible states.

necessary to make UG negative for ID cutoff. (This is the case in Fig. 15.) MOSFETS with gate and drain voltages of the same polarity are said to be enrichment types, while depletion types require opposite G and D polarities for ID cutoff. Besides our N-channel type, there are P-channel devices, too; they are just complementary. FETs being symmetrical by design, S and D can be inverted.

SWITCHING BEHAVIOR OF THE TRANSISTOR

Another important consideration is the rated power dissipation limit specified by the transistor manufacturer, shown traced on the characteristic. To the right of the dotted line, the power dissipated within the device would be excessive, leading to exaggerated heating and eventually destruction. Notice that N and P are situated within the permitted region where the transistor can operate indefinitely; but passing from N to P or from P to N, the operating point crosses the interdicted region inside the parabola. This is harmless if done quickly enough to avoid heating effects. Therefore, the transistor has to be fed a control signal of sufficient amplitude to sweep base current Ib at least from 2.5 ma to 0; furthermore, a steep-slope switching wave (preferably a square wave) must be used to achieve a rapid crossing of the dangerous region.

Transistors generally are more stressed during switching than in their steady state. Where large capacitors are used in the circuit, potentially a dangerous current transient appears, and when a high inductance is disconnected, it may produce a voltage spike leading to junction breakdown. Vacuum tubes are less vulnerable to damage from such transients.

Before a slowly-varying control voltage can be applied to a switch circuit, it must be transformed into a steep-front wave for well-defined switching conditions. This is done by the Schmitt trigger, that yields a square-wave output for any input waveform of at least 4.5v of amplitude. This step voltage is transmitted to output transistor T3, by zener diode D, which is conductive only for inverse voltages overcoming some voltage threshold, the so-called zener voltage. This signal is transmitted to T3 only when the zener is in the conducting state; thus, there is no need to care for residual current in T2 when it is nonconducting.

For on-off control of relays and other power devices, thyratrons and thyristors may be more convenient to use, especially for all but very low power applications.

In its closed state, a good switch offers a negligible voltage drop Vk so that voltage V across load RL differs the least possible from supply voltage E (Fig. 16A). In its open state, the circuit current (I) has to be zero for V to be zero, (Fig. 16B). In electronic controls, transistors and other semiconductor devices are used whenever possible, instead of relays, because static switches do not wear out and, therefore, require very little maintenance; and then, static devices may accommodate extremely high switching speeds such as required by computer techniques, while moving-contact devices have a limited operating speed by nature.

But while moving-contact devices have perfect switching characteristics, transistors are not such good switches. In the heavily conducting state (switch closed), there is a residual voltage Vk of some tenth of a volt, and in the cutoff state (open switch), there is a low, though not negligible, residual current. Furthermore, this current is temperature-dependent, especially in germanium transistors where the residual collector current increases about twofold for a temperature increase of 10 degrees C, or 18 degrees F. Silicon transistors and integrated circuits, however, offer low residual currents and reduced thermal variations thereof.

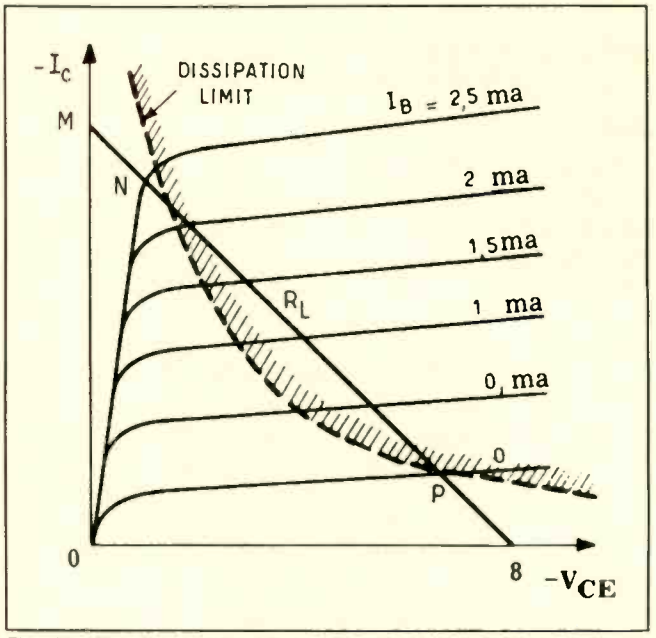


Fig. 17—The diagonal load line shows the best switching points of a transistor. The dashed line defines the dissipation limit.

To understand the switching behavior of a transistor, consider its Ic equal to the f (Vce) characteristic shown in Fig. 17, where MQ represents the load line for definite operating conditions. Points M and Q define the "ideal" switch. At M, Vce (or voltage drop Vk) is zero, and at Q, Ic is 0. The actual operating points N (conduction) and P (nonconduction) have to come as close as possible to M and Q, respectively, for acceptable switch characteristics.

In part 2, next month, we'll complete Chapter 3, which covers Thyristors, the Unijunction Transistors, and Nonlinear Devices such as thermistors, varistors and zeners.

TECH BOOK REVIEW

Title: *Industrial Electronics: Principles & Practice* (TAB BOOK No. 583)
Author: Alfred Haas
Publisher: TAB BOOKS, Blue Ridge Summit, Pa. 17214
Size: 416 pages, 380 illustrations
Price: $8.95 hardbound; $5.95 paperback

This is a comprehensive text on the electronic systems used in modern control and processing applications, including information on all the up-to-date, sophisticated solid-state digital techniques.

The books content provides an in-depth treatment of modern industrial control, processing and monitor-

continued on page 45

TV OEM Replacement Parts Source Directory–Part 2

The completion of an alphabetical, geographical listing of the major TV set manufacturers, headquarters, and all of their authorized OEM replacement parts distributors.

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Understanding characteristic impedance of TV transmission lines

By James E. Kluge*

■ CATV and MATV systems are almost exclusively interconnected with 75-ohm coaxial cable. The function of the coax cable is to transmit signal voltages from the antenna to the TV set.

The '75-ohm' designation refers to its *characteristic impedance*, which corresponds to an imaginary 75-ohm resistance at RF frequencies.

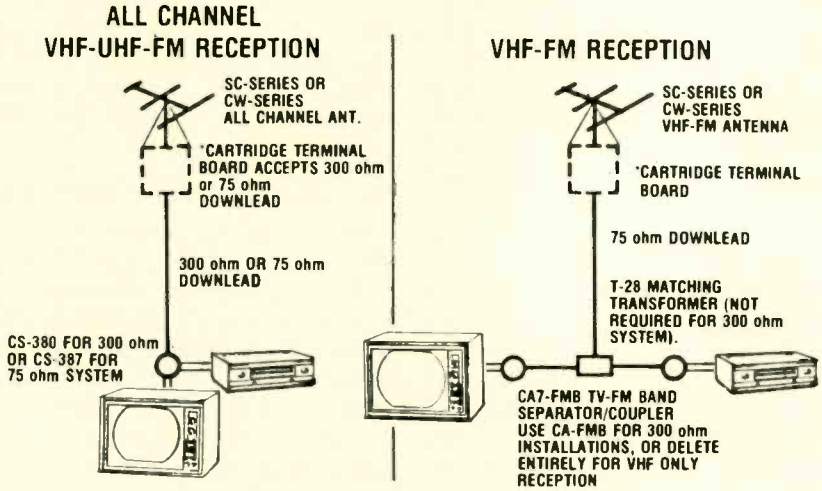
In a typical system, the cable interconnects numerous 75-ohm amplifiers, filters, equalizers, splitters and/or taps, inserted between the antenna and the TV set (Fig. 1). These devices, either active or passive, require an input and an output impedance that is also nominally 75 ohms. When this condition is met, the interconnected system is considered 'properly matched'.

Matching assures that maximum RF power is transferred from the source (antenna) to the load (TV set), and that VSWR is unity, and picture reproduction, as delivered from the antenna, is clear and sharp.

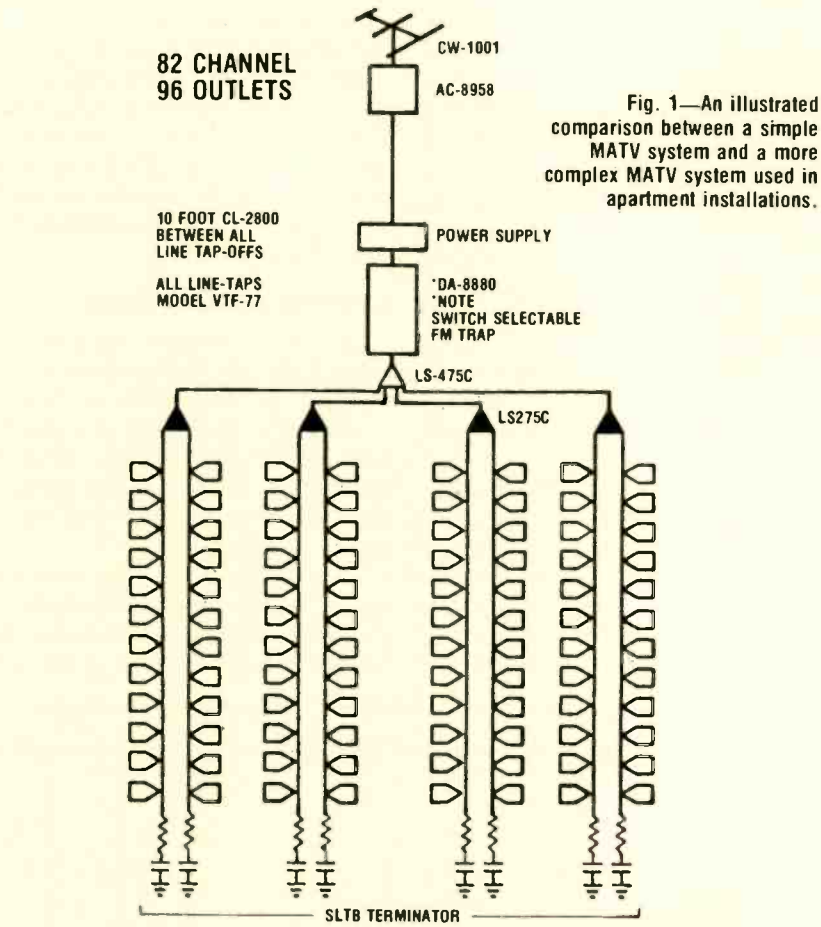
'Characteristic Impedance' Defined

The *characteristic impedance* of a transmission line is the ratio of the applied voltage to the steady-state current which flows when the line is terminated in a pure resistance that is equal to the characteristic impedance value of the cable. It also is defined as that value of pure resistance which, when connected to the output terminals of the transmission line, makes the cable appear infinitely long. In other words, no signal is reflected back up the cable toward the source.

Effects of characteristic impedance are meaningful only when a line is more than a wavelength long; i.e., at RF frequencies and reasonable line lengths of several feet. At power line frequencies the line simply behaves like two copper conductors; at RF, it behaves



A relatively simple MATV system.



A more complex MATV system for apartments.

Fig. 1—An illustrated comparison between a simple MATV system and a more complex MATV system used in apartment installations.

The author is a technical editor for the Winegard company

like a complex network. At 60 Hz, for example, one wavelength is about 3100 *miles* long—while at TV Channel 14, it is merely a little over 2 feet.

Coaxial Cable

Although it involves an electrical parameter, the characteristic impedance of a coaxial cable is determined by the physical geometry of the cables cross section. The surfaces of the two conductors form two plates of a capacitor with the dielectric material between them. The geometry of the conductors and the dielectric constant of the material determines the capacitance of the cable.

In addition, the inner conductor of the cable also acts as a one-turn *inductor* linked by flux lines that are created by current flowing through the conductor. Thus, the geometry of the conductors determines the self-inductance of the cable.

The distributed capacitance along a typical coaxial line is commonly expressed in picofarads per foot—and the distributed inductance is expressed in microhenries per foot. For example, a 75-ohm coaxial line insulated with solid polyethylene typically has a capacitance of 21 pF/ft., (17 pF/ft for foam) and an inductance of approximately 0.1 μH/ft.

The capacitance in a coaxial cable increases as: 1) the diameter of the inner conductor increases, 2) the diameter of the outer shield decreases, and/or, 3) the dielectric constant (or capacitivity) of the insulating material between them increases.

Like capacitance, the inductance is also a function of the diameters, but from a practical standpoint, it is not affected by the constant of the dielectric material. The permeability of the insulating space (or dielectric material) is, for all practical purposes, equal to that of air.

Transmission Lines

Transmission lines for television and MATV signals are commonly one of two types; 1) a 300-ohm, balanced two-wire line (flat twin lead), or 2) a 75-ohm, unbalanced coaxial cable in various sizes. The most commonly used coax types for MATV, in order of popularity and increasing size, are: RG-59/U, RG-6/U, and RG-11/U.

The Equivalent Circuit Of Coax Line

The equivalent circuit for a coaxial transmission line (Fig. 2) consists of series inductance (L) and shunt capacitance (C), both of which are virtually constant with frequency. In the line there is also series resistance (R), which is inherent in copper conductors, and some shunt conductance (G), representing the dielectric loss of the imperfect dielectric material which insulates the two conductors. Both R and G, which increase with frequency, contribute to TV signal attenuation on the line.

Series inductance and shunt capacitance determine the value of the transmission line's characteristic impedance, Z_o. An increase in shunt capacitance decreases Z_o, while an increase in series inductance increases Z_o.

Inductance And Capacitance

Series inductance in a coaxial cable is *directly* proportional to the ratio of the diameters of the two conductors, D/d (Fig. 3). As the ratio D/d gets larger, so does the spacing(s) between the conductors, causing an increase in the series inductance.

Shunt capacitance in a coaxial cable is inversely proportional to the ratio D/d. As the ratio gets larger, so does the spacing(s) which, in turn, decreases the shunt capacitance.

Calculating Characteristic Impedance

The mathematical expression for characteristic impedance is:

$$Z_o = \sqrt{L/C}$$

Note that Z_o is a function of the ratio of inductance to capacitance, L/C, and is not affected by frequency. Because both L and C are affected by the ratio D/d, Z_o is principally determined by that ratio also.

Coaxial-cable inductance and capacitance may be calculated from the following expressions:

$L = 0.140\ \mu r \log (D/d$ in μH/ft.)
($\mu r = 1$ for permeability of most dielectric materials)

$C = \dfrac{7.36 \varepsilon r}{\log (D/d)}$ in pF/ft.

where εr = dielectric constant of insulating material relative to that of vacuum.

Dividing the expression for L by that of C and taking the square root yields:

$$Z_o = \sqrt{L/C} = \frac{138 \log (D/d)}{\sqrt{\varepsilon r}} \text{ in ohms}$$

Dielectric Material

As we have seen, the characteristic impedance of a cable or connector is determined by the size and spacing of the conductors and, to a lesser degree, by the relative dielectric constant of the insulating material separating them. The dielectric or insulating material may be air, or it may be either solid or cellular (foam) material. Polyethylene is used almost exclusively as the dielectric material in flexible transmission lines, such as twinlead and coaxial cable. It has a relative dielectric constant (εr) of 2.3.

Dielectric Constants

The term 'dielectric constant' re-

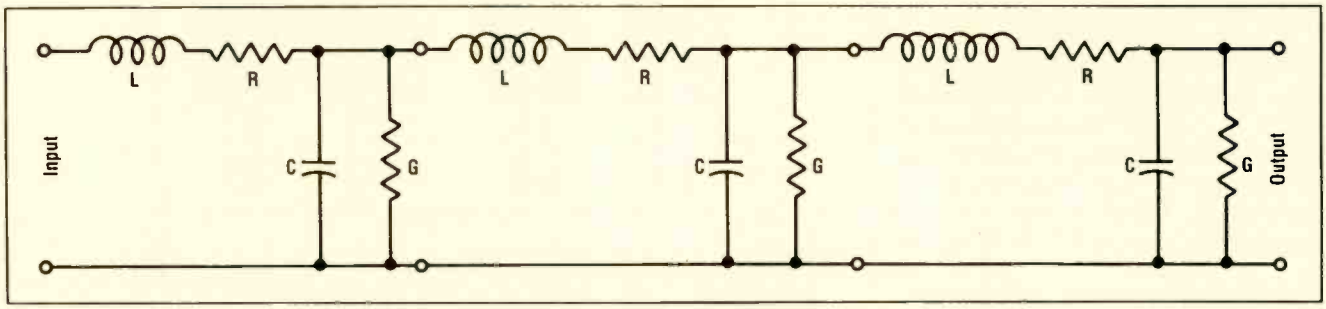


Fig. 2—A simple schematic drawing of an equivalent circuit of an antenna transmission line.

fers to the ratio of the capacitance of a capacitor with the given dielectric to the capacitance of a capacitor having air for its dielectric but otherwise identical to the first capacitor.

Vacuum, or dry air, has a relative dielectric constant of unity ($\varepsilon r = 1$). Other dielectric materials, such as solid polystyrene, polyethylene, or Teflon, have dielectric constants relative to vacuum of 2.6, 2.3 and 2.1, respectively. Frequently the space between conductors consists of foamed polyethylene (i.e., air cells in the material). The air cells reduce the relative dielectric constant to some value nearer to that of air, Simply replacing solid polyethylene with foam and keeping the geometry the same reduces the shunt capacitance by about 30 percent and increases the characteristic impedance by about 20 percent. Foamed or cellular polyethylene dielectric also is commonly employed to reduce dielectric loss, because air has a lower dielectric loss than that experienced with polyethylene.

Some larger, semi-rigid aluminum-sheath cables employ polystyrene discs to support the center conductor and enable the cable's dielectric constant to closely approach a dielectric constant of air. This construction not only reduces the size of the cable for a given characteristic impedance, but also significantly reduces dielectric loss.

Loss and Attenuation

Transmitted energy is lost in a transmission line through: 1) the resistance in the conductors, and 2), the dielectric loss representing the electrical work done by the voltage stressing the dielectric material.

Signal voltage along the line is attenuated by the preceding two factors, as well as by the combined shunt capacitive reactance and series inductive reactance. Attenuation is commonly expressed in dB per 100 ft. of line, and it increases with frequency.

Skin effect, which also increases with frequency, results in an increasing voltage drop along the conductors. Dielectric loss behaves like a high shunt resistance across the shunt capacitance. Skin effect and dielectric loss generate heat, which establishes the power rating of a cable. Because these losses increase with frequency, the cable power rating must be derated as the frequency increases. However, with MATV signals, negligible power is dissipated.

Variables and Their Effect

As the conductors come closer together, the capacitance between them increases; this lowers the characteristic impedance and increases signal attenuation. Likewise, an increase in the dielectric constant of the insulating material increases the shunt capacitance and lowers the characteristic impedance.

If we were to vary the dielectric material in a coaxial cable of fixed dimensions to effect a change in characteristic impedance, we would find that an air dielectric would provide the highest value of characteristic impedance and lowest loss. Foam polyethylene would be next, and solid polyethylene would offer the smallest Z_o and the highest loss.

If we were to vary only the conductor spacing in the coaxial cable, we would find that the largest conductor separation would provide the largest characteristic impedance.

Thus, the characteristic impedance of a coaxial cable is altered by: 1) changing the size of the inner conductor, 2) changing the dielectric material composition, or 3) the inner diameter of the shield.

For example, let us consider the three larger coaxial cables shown in Table I—75-ohm RG-11/U, with solid polyethylene; 75-ohm RG-11/U with cellular polyethylene; and 50-ohm RG-213/U with solid polyethylene. All have an outside diameter of 0.405 inches and an inside shield diameter of 0.285. The sizes of the center conductors of these cables are: #18 AWG, #14 AWG, and #13 AWG, respectively. Because the second cable uses cellular-polyethylene dielectric, the capacitance and loss will normally be less than the first cable.

Since both cables are 75 ohms, a *larger* center conductor (#14 AWG

continued on page 46

Table I

Type Cable	Z_o Ohms	Jacket O.D.	Shield I.D.	Dielectric Material	Center Conductor	100 MHz Attenuation dB/100 ft.	Capacitance pF/ft.
1. RG-11/U	75	0.405	0.285	Solid Polyethylene	#18 AWG	2.0	20.5
2. RG-11/U	75	0.405	0.285	Cellular Polyethylene	#14 AWG	1.5	17.3
3. RG-213/U	50	0.405	0.285	Solid Polyethylene	#13 AWG	2.0	30.8
4. RG-59/U	75	0.242	0.146	Solid Polyethylene	#22 AWG	3.4	21.0
5. RG-59/U	75	0.242	0.146	Cellular Polyethylene	#20 AWG	2.6	17.3
6. RG-6A/U	75	.0332	,.0185	Solid Polyethylene	#21 AWG	2.9	20.5
7. RG-6/U	75	0.270	0.185	Cellular Polyethylene	#18 AWG	2.1	17.3

Table I—Specifications Chart of Coaxial Cables For TV Transmission Lines.

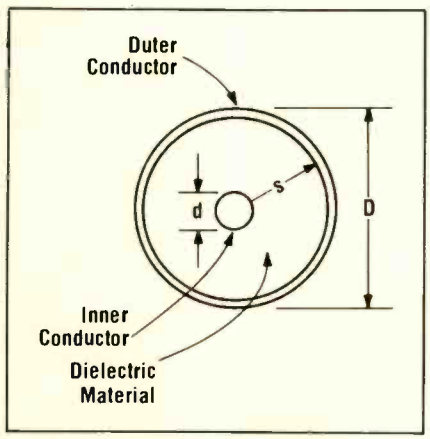


Fig. 3—Drawing of the cross-section of a typical coaxial cable.

Fig. 1—For more information about this test instrument, circle 127 on the Reader Service Card in this issue.

Data Precision's Model 1455 DMM

■ The Model 1455 is an AC/DC-powered 4-½ digit multimeter which is capable of performing the following measurements:

- DC volts, from 100 μV to 1000 V, in four manually-selected ranges (1, 10, 100, 1000)
- AC volts, from 100 μV to 500V (RMS), in four manually-selected ranges (1, 10, 100, 500)
- Current, both AC and DC, from 1μA to 2A, in four manually-selected ranges (1, 10, 100, 1000)
- Resistance, from 100 milliohms to 20 megohms, in five manually-selected ranges (1, 10, 100, 1000, 10meg).

The 0.5-inch-high, 4-½ digit display of the 1455 is equipped with 7-segment plasma planar readouts. Display-related operating features of the 1455 include:

- Automatic positioning of the decimal point by the range swith
- Automatic polarity indication (both '+' and '−'indicators are provided)
- Overrange indication (when the quantity being measured exceeds the 100% overrange capability of the selected range, all digits are blanked and only the decimal point and polarity indicators remain illuminated).

The Model 1455 may be operated either from AC or from its own built-in rechargeable battery pack, which, when fully recharged, provides a minimum of 6 hours of in-spec operation. The 1455's built-in battery recharger functions continuously when the removable power cord of the 1455 is plugged into an AC source, even when the FUNCTION switch is in the 'OFF' position. (Recharging of the built-in *NiCad* battery pack from a fully discharged to a fully-charged condition requires 12 hours of continuous charge.) The 1455 is automatically powered by its battery pack whenever the line cord is not plugged into an AC source.

The 1455 can be AC-powered from either 105-125VAC or 210-250VAC. Selection of either of these two AC power ranges is accomplished by an internally-mounted switch.

The Model 1455 is 3.5 inches high, 8.5 inches wide, and 7.25 inches deep. (A built-in handle, which also functions as a variable-tilt stand, increases the overall width to 9.75 inches and adds 2 inches to the overall depth when in the carrying position, or to the overall height when in the stand position.)

Price of Data Precision's Model 1455 DMM—including a pair of test probes, a detachable line cord, a set of *NiCad* batteries, and a comprehensive instruction manual—is $355. (A 30-KV high voltage probe, Model V-50, is available on an optional basis for $25.)■

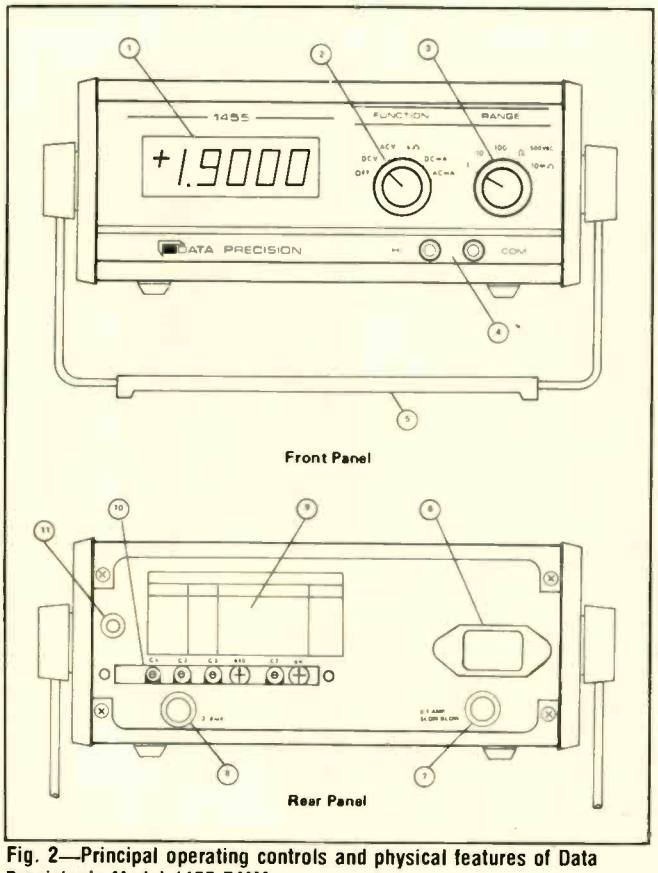


Fig. 2—Principal operating controls and physical features of Data Precision's Model 1455 DMM.

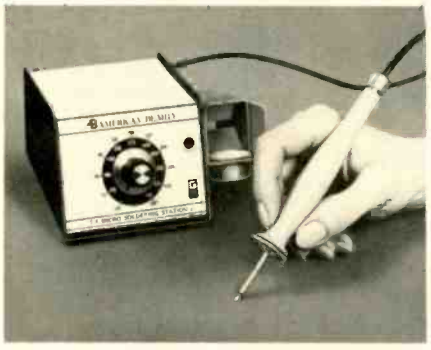
Fig. Item	Name	Description/Function
1	Display	4 Decimal digits and MSD "1"; range-selected decimal point display; automatic polarity (+ and –) indication. 7-segment plasma planar display units.
2	Function	Rotary 6-position switch. Selects one of 5 measuring functions and OFF.
3	Range	Rotary 5-position switch. Selects one of four full-scale ranges for voltage or current measurements, or one of five full-scale ranges for resistance measurements. Decimal point location is located by same selection.
4	Inputs HI and COM	Receptacles for probe terminals. COM designation for reference lead of DC measurements. HI Input polarity with respect to COM input is displayed automatically.
5	Handle/Support	Carrying handle; also sued as tilt-up support for bench use.
6	Line cord receptacle	For 110 or 220 VAC inputs. (Source selection switch internally mounted.)
7	Fuse; 1/10 Slow Blow	Power-protect fuse; protects against effects of excessive drain by a malfunctioning instrument.
8	Fuse 2A	Input-protect fuse; protects instrument circuits against excessive current (>2A) inputs. When in DCmA or ACmA functions.
9	Calibration Table	Callbration Instructions Procedural Sequence
10	Adjustments	6 calibrating adjustments for range scales.
11	Test Point	To check battery charge

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.

SOLDERING STATION 132

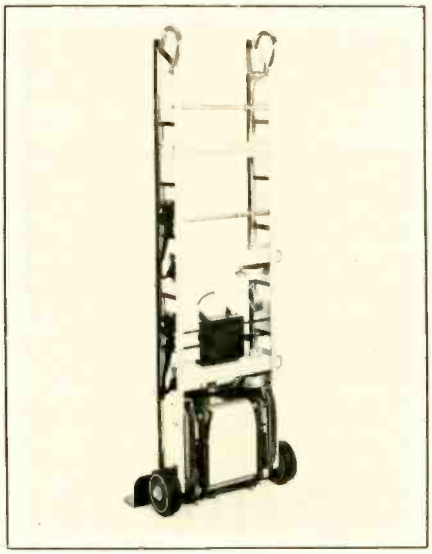
A new soldering station that features stepless dialing through a temperature range of 175° to 910° is now available from *American Beauty*. Solid-state circuitry in the new station maintains the desired temperature, with a dial that indicates both Fahrenheit and Celsius. Work is protected from voltage-leak damage by grounded, low-voltage, line-isolating



transformer and grounded soldering tip. The handpiece of the iron is lightweight with a four-foot super-flexible, oil-resistant cord. Heating element is built into the soldering tip, close to the point, which is pure iron and pretinned. Two replacement tips are available: needle point and chisel. Both may be filed to special shapes by the user to fit the job.

POWERED HAND TRUCK 133

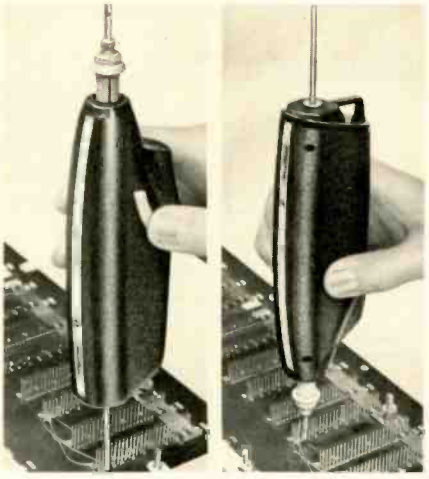
A new powered hand truck, called Manhandler Supreme, has been introduced by *Escalera, Inc.* The new unit



features a 20% weight reduction with no decrease in payload and a provision to change climbing speed for various loads. It is said to be designed so that one person can move heavy, bulky items up and down stairs with safety and efficiency. Aluminum portable steps are used to load or unload delivery vehicles, saving the installation and cost of a power lift gate. The rechargeable battery power source and lifting mechanism are self-contained within a basic aluminum hand truck. The new device is available with a capacity of 700 or 1200 pounds and comes complete with battery and automatic chargers.

WIRE-WRAPPING TOOL 134

A new double-ended wire wrapping and unwrapping tool has been introduced by *Vector Electronic*. Called Model P160-9, the new device has a wire-wrapping bit on one end and an unwrapping bit on the other end for fast, single-tool wrapped-wire terminations. It can be used with a power tool or manually, and is said to make



gas-tight terminations on 0.025 inch square posts, using 26 to 30 AWG wire. To remove a wire, the tool is simply turned end for end. The wrapping bit has an 0.070 inch radius which allows wire termination of 0.025 inch square posts on 0.100 inch centers. A bit depth of 0.56 inches permits three wrap levels. The unwrapping bit has a spring-loaded sleeve that retains and ejects the wire after removal, preventing loose wire from falling into the interconnections. The manual version is priced at $18.40, and the power tool sells for $45.68.

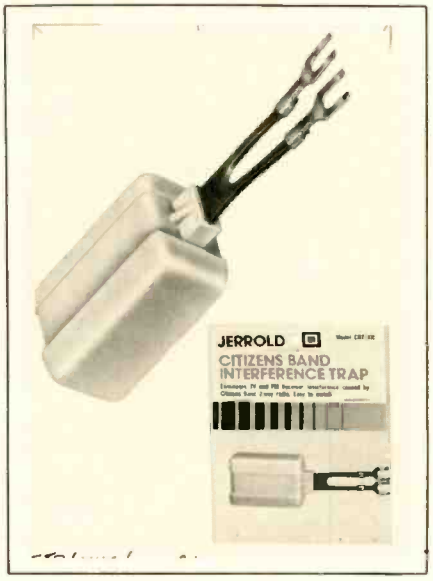
MEGOHM INSULATION TESTER 135

A new combination megohm insulation tester-ohmmeter-AC voltmeter is now available from *Sperry Instruments*. Called the Meg-O-Volt, the new instrument is available in two models, the 510, featuring a 100 megohm scale with a 2 megohm

midscale, and the 520, which has a 1,000 megohm scale with a 20 megohm midscale. Both models have Rx1 and Rx100 resistance scales, as well as a 0-300 AC voltage scale. They feature keyboard push-button controls, threaded test leads, and a shock-resistant plastic housing. Powered by 8 AA batteries, the meter is portable. It develops a 500 VDC test voltage for insulation testing.

CB & FM TRAPS 136

A new trap that can be added to the antenna terminals of any TV set to filter out CB interference has been introduced by *Jerrold Electronics*. Designated CBT-300, the new trap filters out all CB frequencies (26.99 MHz to 27.3 MHz) from the TV tuner input. The CBT-300 reduces CB signals arriving at the tuner to about 10% (−20dB) of the strength at antenna terminals. Also introduced by Jerrold is the model RFT-300, a tunable FM trap that can be tuned to attenuate



FORDHAM BEST BUYS

B+K PRECISION OSCILLOSCOPES

Dual-Trace 5"-15MHz Triggered Sweep

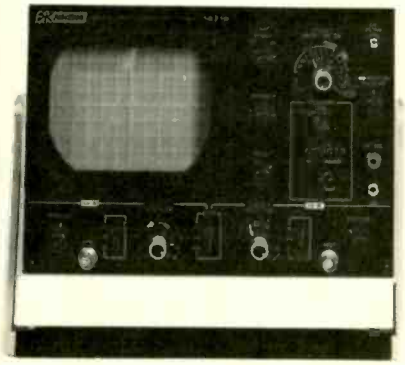
■ 24nSEC rise time permits display of high-speed square wave pulses ■ Dual trace display ■ Individual vertical sensitivity and positioning controls ■ Large 8 x 10cm rectangular viewing area ■ Front-panel Vectorscope operation with matched-sensitivity inputs ■ 19 calibrated sweep ranges ■ Intensity modulation (Z-axis) input for time or frequency markers ■ Internal calibration source ■ 100% solid state (except CRT) ■ Compact, lightweight and rugged ■ Protective carrying case and accessory probes optional

Model 1472C

3"-5MHz Solid State Oscilloscope

■ High sensitivity ■ CB modulation monitor ■ Ultra compact and lightweight (weighs only 8½ lbs); goes anywhere ■ Vertical sensitivity 10mV/division ■ New high brightness CRT and smoked-glass graticule ■ Can be externally triggered ■ Protective carrying case and accessory probes optional

Model 1403A



Dual-Trace 5"-10MHz Triggered Sweep

■ Usable deflection to 15MHz ■ 35nSEC rise time permits accurate display of high-speed square wave pulses ■ Large 8 x 10cm rectangular viewing area ■ Front-panel Vectorscope operation with matched-sensitivity inputs ■ TTL compatible intensity modulation (Z-axis) input for time or frequency markers and character displays ■ Internal calibration source ■ 100% solid state (except CRT) ■ Compact, light-weight and rugged ■ Protective carrying case and accessory probes optional

Model 1471B

Dual-Trace 5"-30 MHz Triggered Scope

■ 11.7 nS rise time ■ 30 MHz dual trace operation ■ Internal signal delay line ■ 21 position sweep switch ■ Intensity modulation compatible for 5V p-p ■ Illuminated graticule ■ Internal 0.5 V p-p ±1% calibration source ■ 100% solid state (except CRT ■ X-Y Vectorscope capability ■ High performance/cost ratio ■ Protective carrying case and accessory probes optional

Model 1474

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any FM signal (88 to 108 MHz), or any industrial radio station frequency. Both models are priced at $4.75.

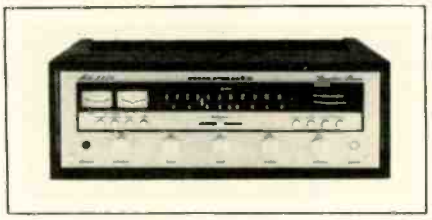
LONG-RANGE DETECTION SYSTEM 137

A new electric eye detection system for use at long range, indoor and outdoor, is available now from *Mountain West Alarm*. The device has been designed to protect buildings having long interior or exterior spans. If the

beam is interrupted on the unit for as little as 50 milliseconds, an output relay triggers the alarm, sounder or dialer. It automatically resets 1 to 2 seconds after the alarm. Standby batteries guarantee operation for up to 10 hours in case of power failure. It comes with beam source, receiver, rechargeable batteries, one transformer, and installation instructions. Priced at $349.

AM/FM STEREO RECEIVERS 138

A new line of AM/FM stereo receivers that feature a dual gate MOSFET front end for sensitivity and selectivity has been introduced by *Marantz*. The three models in the line produce 26 watts, 38 watts and 52 watts, respectively, minimum continuous power per channel, with both channels driven, covering a power band of 20 Hz



to 20,000 Hz. The 26 watt model is rated at no more than 0.2% total harmonic distortion with an 8 ohm load, and the 38 watt and 52 watt models are rated at no more than 0.1% total harmonic distortion. All three are equipped with zone detented tone controls for variation of bass, mid-range and treble frequencies for tone enhancement. A phase lock loop multiplex demodulator produces stereo separation with lower harmonic distortion and maximum noise rejection.

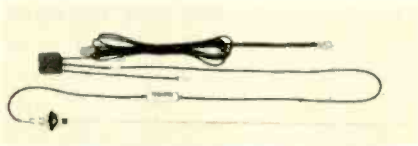
LOW-VOLTAGE SOLDERING STATION 139

A new low-voltage miniature solder station designed for soldering components which are sensitive to heat, voltage and current has been introduced by *Weller-Xcelite*. The new product features a "closed loop" system with a grounded tip and automatic control of maximum tip temperature. The unit is complete with a choice of 650° or 750° F lightweight pencil-type iron with a "freeze-proof" tip assembly, a quick connect/disconnect receptacle for attaching either iron, an on/of switch and red indicator light, receptacle and sponge, non-heat

sinking pencil holder, and three-wire non-burning cord. The power unit operates from line voltage with a step-down transformer. A 1/64 inch conical tip is provided, and seven other types and sizes are available.

CB/AM/FM DISGUISE ANTENNA 140

A new cowl-mounted CB-AM-FM disguise antenna for 40 channels is now available from *Antenna Incorporated*. Called the Model 11004, the new antenna is identical in appearance to most standard replacement



AM-FM receiving antennas, and is pretuned at the factory for a standing wave ratio of 1.5:1 or less across all 40 channels. Model 11004 includes an in-line coaxial cable connector for easy installation, and 18 feet of low loss RG-58/U coaxial cable.

LOW-DISTORTION OSCILLATOR KIT 141

A new low-distortion oscillator for audio testing is now avialable in kit form and already-wired from the *Heath Company*. In kit form, the instrument is designated IG-1272, and fully-assembled, SG-1272. The new oscillator features a low-distortion sine wave output over a frequency range from less than 5 Hz to 100 kHz. It has both pushbutton and variable-frequency operation, and a flat output across the entire frequency range. Attenuation accuracy is ± 0.2 dB. Hum and noise are rated at 0.01% or less. The kit form is priced at $129.95 and the assembled oscillator at $190.

IND. SEMICONDUCTORS

continued from page 30

ing applications, including many of the latest innovations brought about by advances in solid-state electronics technology.

The book begins with a look at how electronics is used in various industrial applications, and then proceeds to describe the various types of transducers used to con-

vert the physical qualities into electrical signals which can be measured or monitored. This leads to a thorough discussion of system components—the "building blocks" used to put together any system.

The reader will learn about the methods and devices used to automatically inspect, sort, and count, and about digital process control techniques that have been developed to "tell" machines how to perform repetitive operations. The book also provides in-depth coverage of electronic heating, welding and machining devices, plus ultrasonic cleaning, liquid processing, and laser applications. Electronic safety devices are covered, too, along with the power conversion and control equipment used between sensitive transducers and amplifiers, and the circuits that control the operation of heavy machine-type equipment.

CONTENTS: Industrial Electronics: Purpose & Means—Transducers—System Building Blocks—Automatic Inspection, Sorting & Counting—Digital Process Control—Electronic Heating, Welding & Machining—Electronic Safety Devices—Power Conversion & Control ■

CHAR. IMPEDANCE

continued from page 39

compared to #18 AWG) is used in the second cable to reduce the space between conductors and restore the capacitance from 20.5 to 17.3 pF/ft to maintain the 75-ohm characteristic impedance. Because of the larger center conductor, the inductance has also been reduced. This results in cable No. 2 having a smaller capacitance, smaller inductance, lower loss and higher current-carrying capability, or lower voltage drop, than cable No. 1.

Cable No. 3 is the same as cable No. 1, except that it uses a still larger center conductor, #13 AWG, to decrease the inductance and increase the power rating and the capacitance. This reduces the characteristic impedance from 75 to 50 ohms and maintains the signal attenuation at about 2.0 dB/100 ft. Cable No. 2, on the other hand, employs cellular polyethylene, and thus has a loss of only 1.5 dB/100 ft. at 100 MHz.

75-OHM Coax For MATV

Generally speaking, 75-ohm cable has lower loss and attenuation, while 50-ohm cable has a higher power-handling capability. For this reason, MATV/CATV applications use 75-ohm cable because runs are long and loss is critical. On the other hand, two-way radio or broadcasting systems use 50-ohm cable because it must handle large amounts of RF power.

Considering only 75-ohm MATV/CATV cable, there are three common sizes of flexible coaxial cable, and three sizes of semi-rigid aluminum sheath cable. In *increasing* size, they are RG-59/U, RG-6/U, RG-11/U, in the flexible, and 0.412, 0.500 and 0.750 O.D. in the semi-rigid aluminum sheath.

The primary reason for using a larger cable is the lower power loss and attenuation. In applications where line amplifiers and antenna preamps must be remotely powered, a larger center conductor might be necessary to avoid an excessive DC voltage drop. If the center conductor diameter is increased to accommodate higher current and the characteristic impedance and the dielectric material remains the same, the shield inside diameter then must increase to maintain the same D/d. This results in a larger overall-size cable having a smaller power loss and less signal attenuation.

If all system components are nominally 75-ohms input and output, the cable used to interconnect them, for proper matching, should be 75 ohms.

So—how does one know the nominal characteristic impedance of a coaxial cable? Actually, there is no easy way to measure it. You can't just look at it and tell, and you can't measure it with an ohmmeter as you would discrete resistors. If you can carefully mea-

sure the conductor diameters and determine the type of dielectric, you can calculate the Z_o. Or, if you have suitable instruments, you can measure the VSWR with several known loads and, thus, approximate the Z_o. But the best advice we can give is to buy cable made, marked and specified by a well-known, reputable cable manufacturer.

Don't Shop For Bargains

Because of the many manufacturing variations, don't buy surplus, unmarked 'bargain' cable for TV. Manufacturing variations affect characteristic impedance and signal loss, and may result in standing waves at certain frequencies. So buy only cable made expressly for VHF/UHF-TV.

Look for manufacturers who sweep-test their MATV/CATV cable. Such tests offer you the highest assurance of uniform quality and characteristic impedance, and thus, virtually eliminate potential cable problems. Trouble-shooting and call-backs on problems caused by 'cheap' cable will cost many times more than the savings realized from a 'bargain'. ■

VERTICAL SWEEP

continued from page 19

which the conduction of one output transistor ceases and the conduction of the other begins is controlled by vertical crossover transistor Q212 and the RC combination of R222 and C213.

Input to the vertical output section is from the collector of Class-A driver transistor Q210, which effectively acts as a linearly varying resistance between the +22-volt source on its emitter and the voltage divider connected to its collector (R224, R223 and R222).

During the *bottom* half of vertical scan, the following circuit actions occur in the output section:

- Q210 is approaching maximum conduction and the resultant current through divider R224/R223/R222 has developed a sufficiently positive voltage on the 'top' of R222 (the emitter of PNP Q212) to forward bias the emitter-base junction of Q212, causing it to conduct.
- Conduction of Q212 shorts across R222, increasing the positive voltage applied to the base of

PNP Q213, keeping it in cutoff and prevents the conduction of Q202.

• Simultaneously, the base-emitter current of Q212 turns on Q203, whose emitter-collector current flows through the vertical deflection coils in the direction shown in Fig. 3A. This causes the CRT beam to scan from the center of the screen to the bottom and, in the process, charges capacitors C211A/B to the polarity indicated in Fig. 3A.

When the conduction of Q210 reaches its maximum level and abruptly decreases (*'BOTTOM OF RASTER'*) in the waveform in Figs. 3A and B), the following circuit actions occur:

• The positive voltage on the 'top' of R222 (the emitter of Q212) abruptly decreases to a level which no longer provides forward biasing of the emitter-base junction of Q212 and, consequently, Q212 ceases conduction.

• As a result of the cut off of the emitter-base current of Q212, Q203 also abruptly ceases conduction and the magnetic field of the deflection coils collapses, deflecting the CRT beam to the top of the screen (retrace).

• Simultaneously, as a result of the abrupt cut off of Q210, the positive voltage across the R224/R223/R222 divider suddenly decreases, effectively creating a negative-going pulse at the 'top' of R223. This forward biases the base-emitter junction of PNP Q213, causing it to conduct.

• The resultant current in the collector-emitter junction of Q213 creates sufficient base-emitter current in Q202 to turn it on. (The positive charges previously built up on the '+' sides of capacitors C211A/B and C209 during the bottom-scan sequence provides the collector-base junction reverse bias necessary for the forward conduction of Q202.)

• Conduction of Q202 provides a discharge path for capacitors C211A/B, which, as shown in Fig. 3B, is from the '-' plate of the capacitors to ground through the vertical deflection coils and R228A/B, and 'up' from ground through the emitter-collector junction of Q202 to the '+' plates of the capacitors. The resultant yoke current, which produces scan of

the top half of the CRT screen, flows in a direction opposite to that which produced scan of the bottom half of the screen.

The conduction of Q210 begins linearly increasing again at the end of retrace ('TOP OF RASTER' in Figs. 3A and B). Consequently, the voltage developed across divider R224/R223/R222 also begins increasing, toward a level of +20 volts. At a scan time corresponding to a point near the center of the raster (dotted line in the waveform in Figs. 3A and B) the voltage developed at the 'top' of R222 becomes sufficiently positive to once again forward bias the base-emitter of Q212. The resultant conduction of Q212 starts a repeat of the previously described sequence of circuit actions.

TROUBLES & TROUBLESHOOTING PROCEDURES

Trouble symptoms related to abnormal operation of the XA vertical sweep system (and of variations of it employed in other chassis) fall into the following two general categories and related subcategories:

Sync-Related Symptoms

From a troubleshooting viewpoint, sync-related trouble symptoms can be divided into the following two subcategories:

Vertical and horizontal sync both missing or erratic—In such cases the cause is usually in one of the stages preceding the point where the horizontal and vertical sync are removed from the composite video signal and routed separately to their respective sweep systems. In the XA chassis, this point is the base of the sync inverter (Q204 in Fig. 1).

Only vertical sync missing or erratic (horizontal sync normal)—When only vertical sync is affected, the source of the defect usually is in either the 'vertical' portion of the sync separator circuit or the frequency-determining components of the vertical oscillator. In the XA type of vertical sweep system, the most probable causes of missing or erratic sync are: R208, Q204, R209, R210 (all of which are shown in Fig.1, except R08, which is in the base circuit of Q204), or the following frequency-affecting components in the oscillator circuit (Fig. 1): R211, R212, R214, R215 and C205.

Height-and Vertical Linearity-Related Symptoms

The three general subcategories into which most height- and/or linearity-related trouble symptoms fall are: no vertical sweep (only horizontal line on screen), insufficient height, and nonlinearity.

Because of the interdependent operation of the vertical oscillator, differential amplifier and vertical output section, any one of these functional sections can cause any of the preceding three subcategories of symptoms.

Consequently, to facilitate isolation of the cause of height- and/or linearity-related trouble symptoms, GE has developed and recommends the use of the logical troubleshooting sequence outlined in Table 1. Additionally, as a supplemental aid to the procedures in Table 1, GE also has prepared a cross-reference of common vertical sweep-related trouble symptoms and their most likely causes in the XA chassis. This cross-reference is reproduced in Table 2. ■

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TV SALES & SERVICE business in growing community in Colorado. Requires $8,000 cash down and assumption of low interest loan. Send inquiries to ELECTRONIC TECHNICIAN/DEALER, Box 108, 1 East First St., Duluth, MN 55802. 6/77

TV Picture tube rebuilding operation, includes four position, automatic oven. Only one going in area. $12,000. Building available. Details: 2333 Compton, St. Louis, MO 63104. 6/77

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RIDERS MANUALS WANTED. Volumes I, II, III, IV and V or I-V in one volume. Please send price and condition. C. Kirsten, 1659 Kenwood Ave., Alexandria, VA 22302. 7/77

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REPLACEMENT COLOR YOKES-DEALERS ONLY. Zenith 95-2501-2532-2638-2667-S89633 etc. $16.95. Magnavox 361380-1 $18.95 etc. Sylvania, G.E. etc. $14.95 to $19.95. Request for price list on your letterhead. David Sims Enterprises, Inc., 665 Jerricho Turnpike, Huntington Station, N.Y. 11746. TF

LINEAR AMPLIFIER for C.B., 2-meter, walkie-talkie. Tiny Solid-State Portable Unit produces 100 Watt PEP from Milliwatts and can be inserted inside existing unit. Build for about $20. Send $5.00 for plans to: J. Martin Peter, P. O. Box 07071, Milwaukee, WI 53207. 7/77

SEEKING ORIGINAL JAPANESE TRANSISTORS, IC, FET AND DIODES FOR CB REPAIR USE? Write or call for our list and compare prices. Fuji-Svea Enterprise, Dept. ET, P.O. Box 40325, Cincinnati, OH 45240. (513) 874-0220. 7/77

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ELECTRONIC TECHNICIAN/DEALER

TEKFAX

COMPLETE MANUFACTURER'S CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS

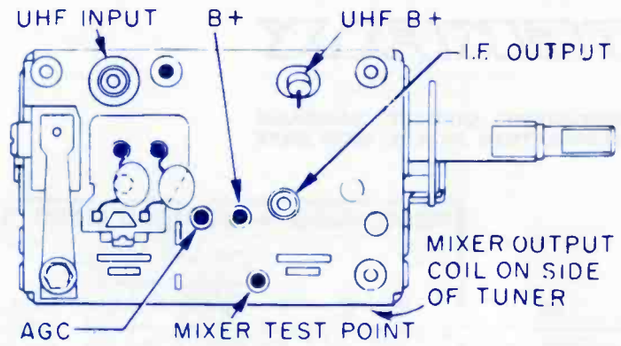
GROUP 298

	SCHEMATIC NO.		SCHEMATIC NO.
ADMIRAL ..... Color TV Chassis 3M45/7M45	1697	GTE SYLVANIA ..... Color TV Chassis E21-9, -10	1698
AIRLINE ..... B/W TV Chassis T1N3	1696	ZENITH ..... Color TV Chassis 19HC46	1699
GTE SYLVANIA ..... B/W TV Chassis A16-7	1700		

1696

AIRLINE
B/W TV Chassis
T1N3

JUNE • 1977



VHF TUNER (Oak) 94A611-1

MODEL CHART			
MODEL	CHASSIS	VHF TUNER	UHF TUNER
GAI-13107A	T3N3-4A	94A611-1	94A712-1
GAI-13137A	T3N3-4B	94A611-1	94A712-1
GAI-13147A	T1N3-4B	94A611-1	94A712-1

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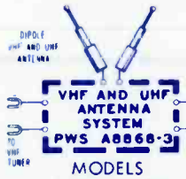
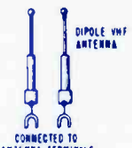
THE DESIGN OF THIS RECEIVER CONTAINS MANY CIRCUITS AND COMPONENTS INCLUDED SPECIFICALLY FOR SAFETY PURPOSES. FOR CONTINUED PROTECTION, NO CHANGES SHOULD BE MADE TO THE ORIGINAL DESIGN AND COMPONENTS SHOWN IN SHADED AREAS ON THE SCHEMATIC SHOULD BE REPLACED WITH EXACT FACTORY REPLACEMENT PARTS. THE USE OF UNAUTHORIZED SUBSTITUTE PARTS MAY CREATE A SHOCK, FIRE, OR OTHER HAZARD. SERVICE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY.

RELIABILITY AND PERFORMANCE

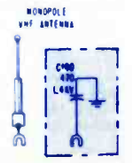
FOR CONTINUED RELIABILITY AND PERFORMANCE, EXACT FACTORY REPLACEMENTS ARE RECOMMENDED FOR ALL OTHER PARTS REPLACED. IF A SUBSTITUTE MUST BE USED, BE SURE ITS QUALITY AND SPECIFICATIONS ARE IDENTICAL TO THE ORIGINAL PART.



MODELS GAI-13147A



MODELS GAI-13137A



MODELS GAI-13107A

SCHEMATIC NOTES
(UNLESS OTHERWISE INDICATED)

RESISTOR VALUES IN OHMS=5%, 1/4W

CAPACITOR VALUES OF 1.0W AND HIGHER ARE IN M. LESS THAN 1.0W IN UF. 20%.

COILS RESISTANCE VALUES LESS THAN 1 OHM NOT SHOWN.

COMPONENT NOT MOUNTED ON PRINTED CIRCUIT BOARD.

COMMON GROUND (B-).

RESISTORS MAY BE REMOVED AT FACTORY FOR PROPER V301 FILAMENT VOLTAGE.

WARNINGS

USE ISOLATION TRANSFORMER WHEN SERVICING WITH CABINET BACK REMOVED.

WHEN SERVICING, USE EXACT REPLACEMENT PARTS. SEE "SAFETY CRITICAL COMPONENTS" NOTICE.

ALSO PERFORM ALL SAFETY CHECKS SPECIFIED UNDER "IMPORTANT PRODUCT SAFETY INFORMATION" IN SERVICE MANUAL.

TRANSISTOR CAUTIONS

TO AVOID TRANSISTOR DAMAGE DO NOT ARC 2ND ANODE LEAD OF PICTURE TUBE TO GROUND. DISCHARGE THROUGH 10K RESISTOR. DO NOT TURN SET ON WITH TRANSISTORS, PICTURE TUBE, OR LEADS REMOVED OR UNSOLDERED. BE CAREFUL NOT TO ACCIDENTALLY SHORT BETWEEN COMPONENT TERMINALS OR TO COMMON GROUND. MAKE CONTINUITY AND RESISTANCE MEASUREMENTS WITH A VTVM, FIELD EFFECT METER, OR OTHER HIGH INPUT IMPEDANCE METER. DO NOT USE A VOLT-OHM-METER HAVING LESS THAN 100K OHMS/VOLT FOR RESISTANCE MEASUREMENTS.

VOLTAGE & WAVEFORM INFORMATION

DC VOLTAGES TAKEN WITH TVTM, WITH RESPECT TO COMMON GROUND (B-). DC VOLTAGES, WAVEFORMS AND P-P VOLTAGES TAKEN WITH 120V AC INPUT. VOLTAGES SHOWN IN BLOCKS TAKEN WITH TV SIGNAL. OTHER VOLTAGES TAKEN WITH VHF ANTENNA TERMINALS SHORTED, CHANNEL SELECTOR SET ON UNUSED VHF CHANNEL, VOLUME CONTROL MINIMUM, BRIGHTNESS AND VIDEO CONTRAST CONTROLS MAXIMUM. ALL OTHER CONTROLS IN NORMAL OPERATING POSITION. ON-SIGNAL VOLTAGES AND WAVEFORMS TAKEN WITH TRANSMITTED, NOISE FREE SIGNAL PRODUCING 2.8 TO 3.5 VOLTS AGC AT TEST POINT (B). VIDEO CONTRAST AND BRIGHTNESS CONTROLS AT MAXIMUM. ALL WAVEFORMS TAKEN WITH WIDE-BAND OSCILLOSCOPE.

AGC DELAY ADJUSTMENT

DO NOT DISTURB FACTORY SETTING OF AGC DELAY CONTROL. IF AGC DELAY ADJUSTMENT IS REQUIRED, REFER TO SERVICE MANUAL. IF NECESSARY TO DISTURB FACTORY SETTING OF AGC DELAY CONTROL, MARK ROTOR POSITION SO CONTROL CAN BE RETURNED TO ITS EXACT ORIGINAL SETTING.

1697

ADMIRAL
Color TV Chassis
3M45/7M45

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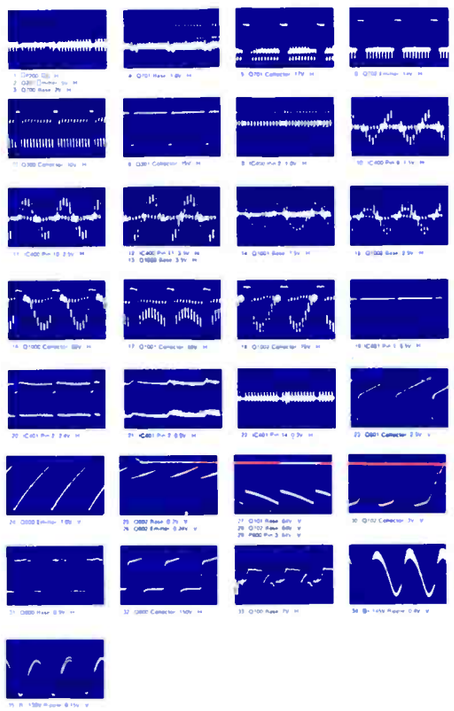
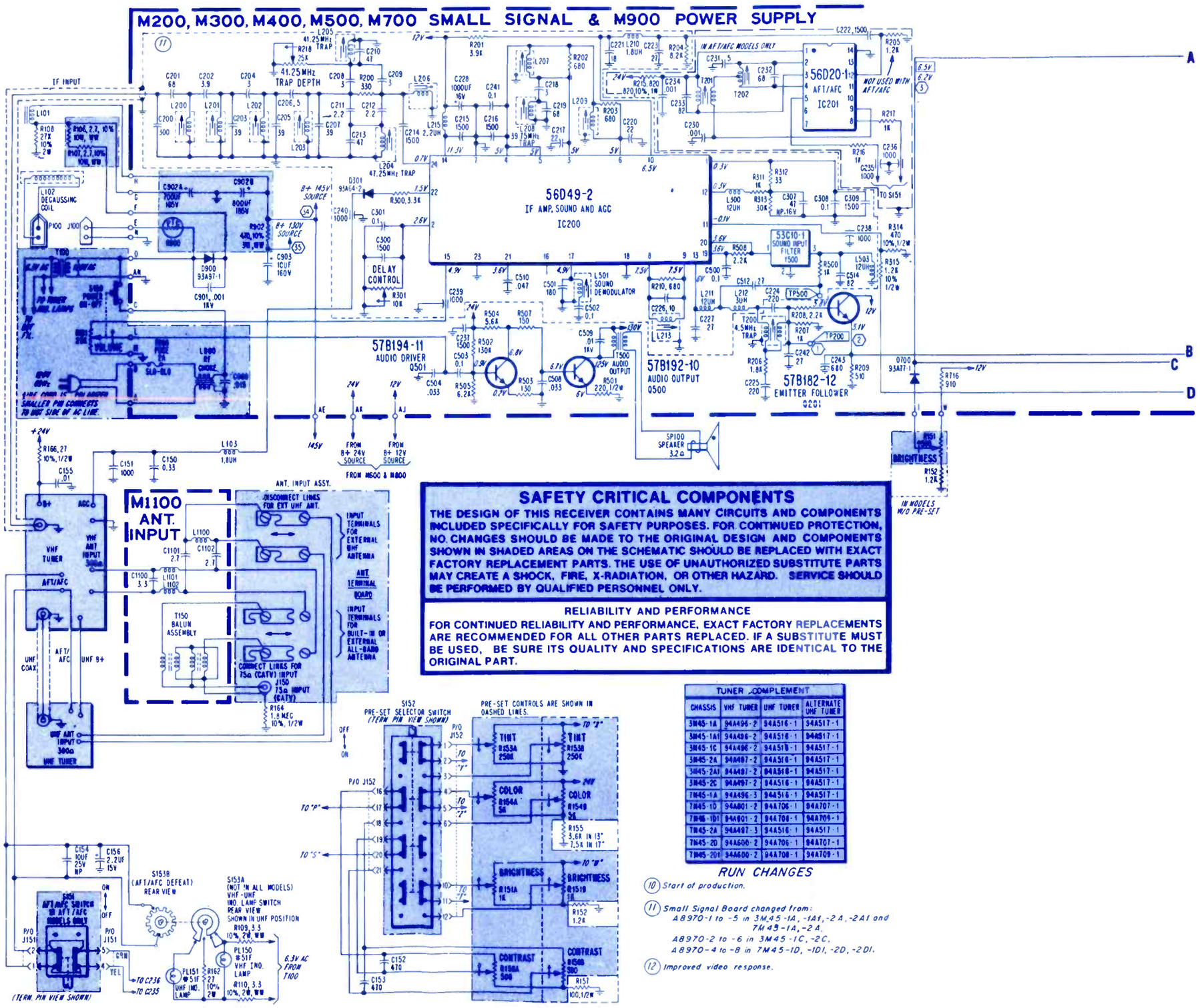
ELECTRONIC TECHNICIAN/DEALER TEKFAX

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR 5 NEW SETS



M200, M300, M400, M500, M700 SMALL SIGNAL & M900 POWER SUPPLY



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RELIABILITY AND PERFORMANCE

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TUNER COMPLEMENT

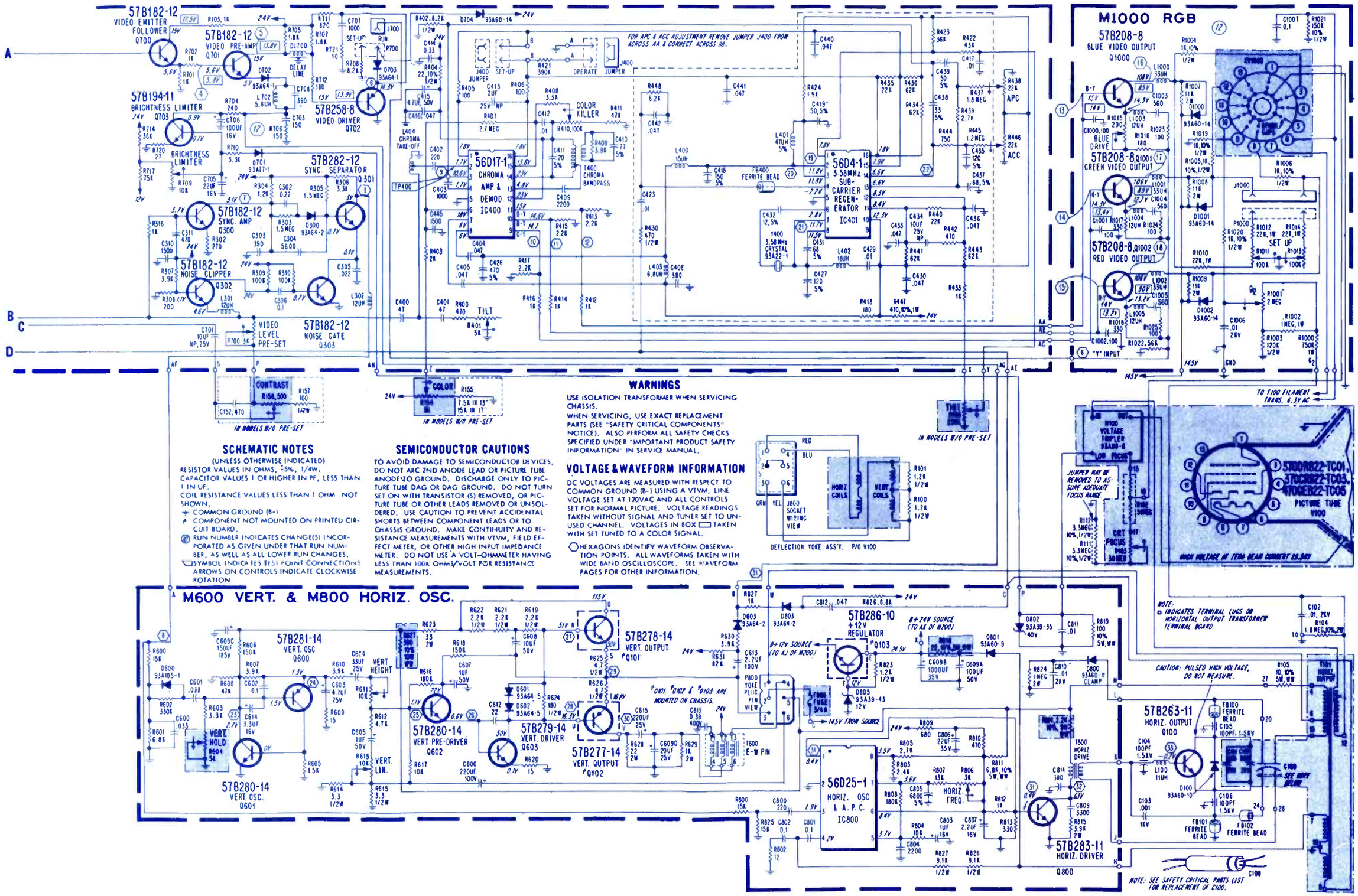
CHASSIS	VHF TUNER	UHF TUNER	ALTERNATE UHF TUNER
3M45-1A	94A496-2	94A516-1	94A517-1
3M45-1A1	94A496-2	94A516-1	94A517-1
3M45-1C	94A496-2	94A516-1	94A517-1
3M45-2A	94A497-2	94A516-1	94A517-1
3M45-2A1	94A497-2	94A516-1	94A517-1
3M45-2C	94A497-2	94A516-1	94A517-1
7M45-1A	94A496-3	94A516-1	94A517-1
7M45-1D	94A801-2	94A706-1	94A707-1
7M45-1D1	94A801-2	94A706-1	94A709-1
7M45-2A	94A497-3	94A516-1	94A517-1
7M45-2D	94A800-2	94A706-1	94A707-1
7M45-2D1	94A800-2	94A706-1	94A709-1

RUN CHANGES

(10) Start of production.

(11) Small Signal Board changed from:
A8970-1 to -5 in 3M45-1A, -1A1, -2A, -2A1 and 7M45-1A, -2A.
A8970-2 to -6 in 3M45-1C, -2C.
A8970-4 to -8 in 7M45-1D, -1D1, -2D, -2D1.

(12) Improved video response.



WARNINGS

USE ISOLATION TRANSFORMER WHEN SERVICING CHASSIS.
WHEN SERVICING, USE EXACT REPLACEMENT PARTS (SEE "SAFETY CRITICAL COMPONENTS" NOTICE). ALSO PERFORM ALL SAFETY CHECKS SPECIFIED UNDER "IMPORTANT PRODUCT SAFETY INFORMATION" IN SERVICE MANUAL.

SCHEMATIC NOTES

(UNLESS OTHERWISE INDICATED)
RESISTOR VALUES IN OHMS, ±5%, 1/4W.
CAPACITOR VALUES 1 OR HIGHER IN PF, LESS THAN 1 IN UF.
COIL RESISTANCE VALUES LESS THAN 1 OHM NOT SHOWN.
⏚ COMMON GROUND (B-)
P COMPONENT NOT MOUNTED ON PRINTED CIRCUIT BOARD.
(#) RUN NUMBER INDICATES CHANGE(S) INCORPORATED AS GIVEN UNDER THAT RUN NUMBER, AS WELL AS ALL LOWER RUN CHANGES.
SYMBOL INDICATES TEST POINT CONNECTIONS ARROWS ON CONTROLS INDICATE CLOCKWISE ROTATION

SEMICONDUCTOR CAUTIONS

TO AVOID DAMAGE TO SEMICONDUCTOR DEVICES, DO NOT ARC 2ND ANODE LEAD OR PICTURE TUBE ANODE TO GROUND. DISCHARGE ONLY TO PICTURE TUBE DAG OR DAG GROUND. DO NOT TURN SET ON WITH TRANSISTOR (S) REMOVED, OR PICTURE TUBE OR OTHER LEADS REMOVED OR UNSOLDERED. USE CAUTION TO PREVENT ACCIDENTAL SHORTS BETWEEN COMPONENT LEADS OR TO CHASSIS GROUND. MAKE CONTINUITY AND RESISTANCE MEASUREMENTS WITH VTVM, FIELD EFFECT METER, OR OTHER HIGH INPUT IMPEDANCE METER. DO NOT USE A VOLT-OHMMETER HAVING LESS THAN 100K OHMS/VOLT FOR RESISTANCE MEASUREMENTS.

VOLTAGE & WAVEFORM INFORMATION

DC VOLTAGES ARE MEASURED WITH RESPECT TO COMMON GROUND (B-) USING A VTVM, LINE VOLTAGE SET AT 120VAC AND ALL CONTROLS SET FOR NORMAL PICTURE. VOLTAGE READINGS TAKEN WITHOUT SIGNAL AND TUNER SET TO UNUSED CHANNEL. VOLTAGES IN BOX ▭ TAKEN WITH SET TUNED TO A COLOR SIGNAL.

⬡ HEXAGONS IDENTIFY WAVEFORM OBSERVATION POINTS. ALL WAVEFORMS TAKEN WITH WIDE BAND OSCILLOSCOPE. SEE WAVEFORM PAGES FOR OTHER INFORMATION.

1698
GTE SYLVANIA
Color TV Chassis
E21-9, -10

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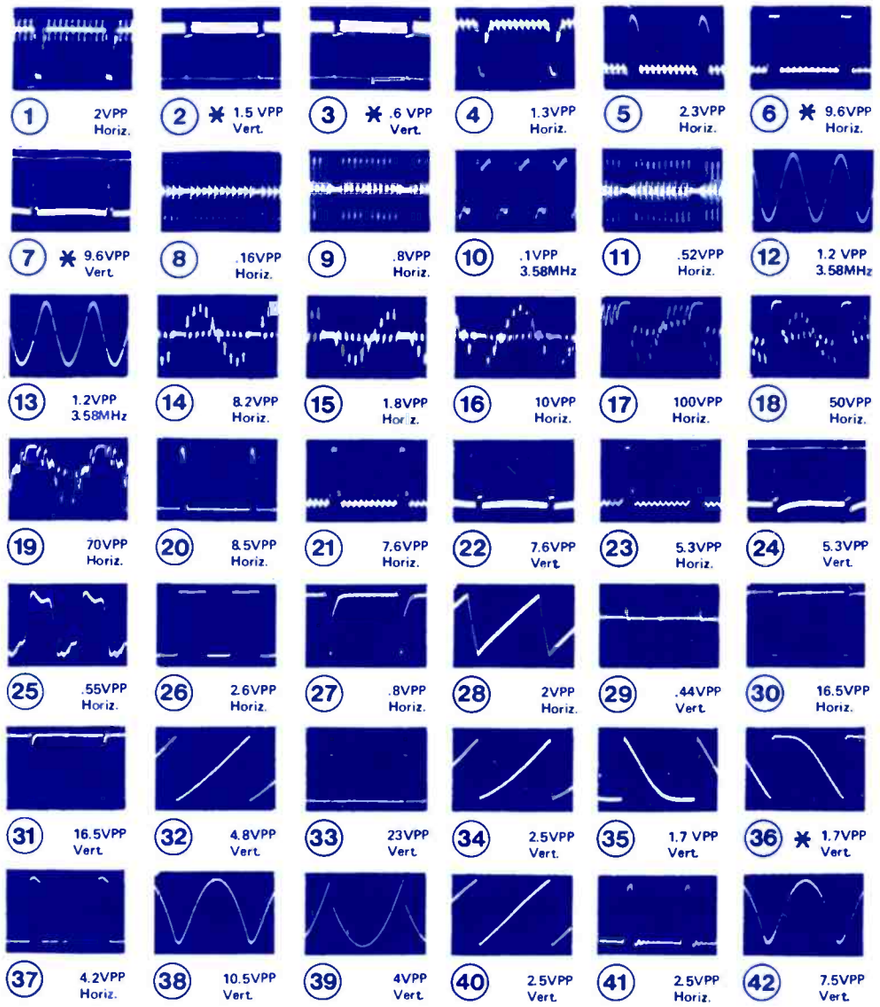
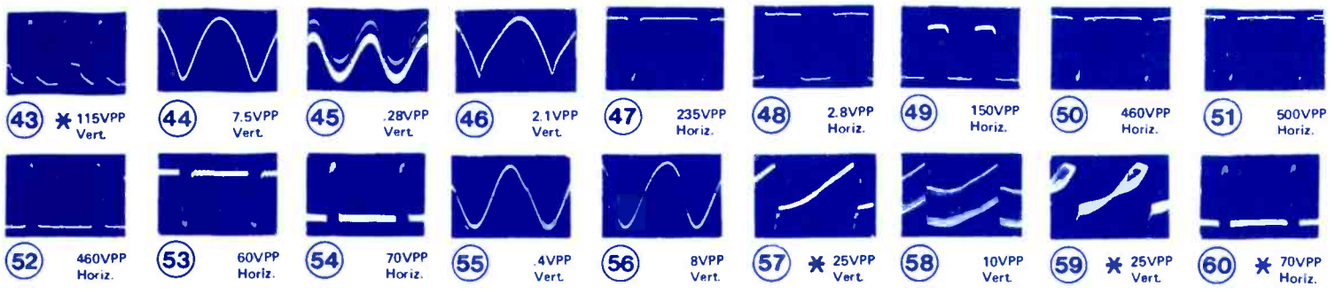
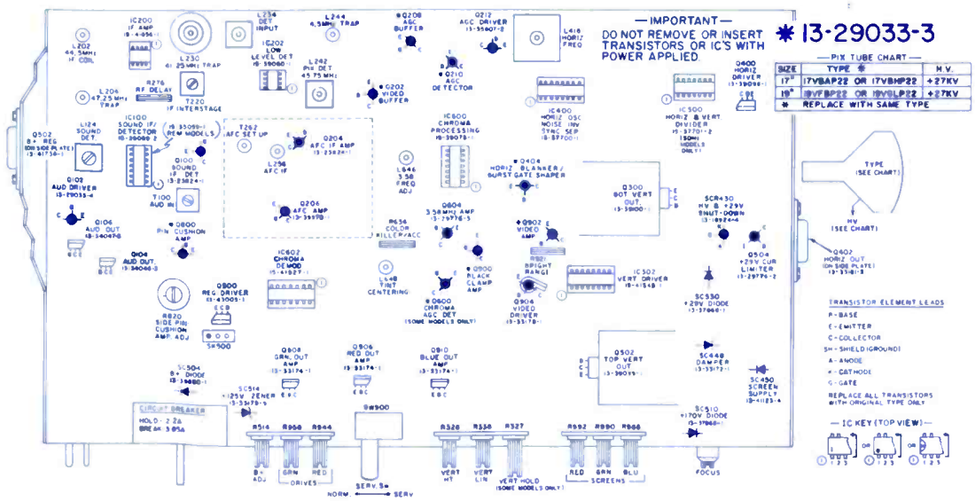
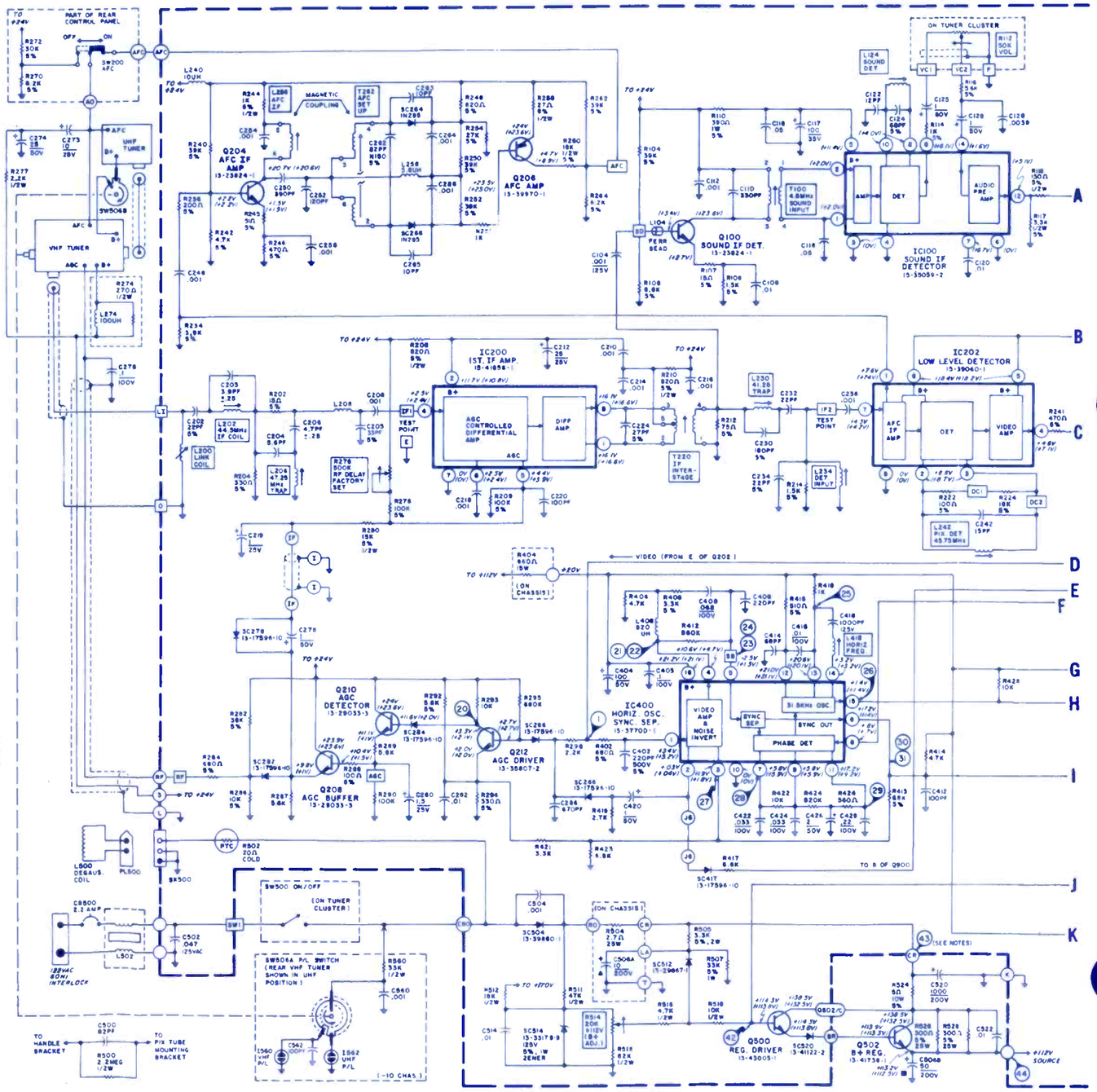
JUNE • 1977

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS









GTE SYLVANIA
Color TV Chassis
E21-9, -10

61 ✱ 1.5VPP Vert.

62 ✱ 6.4VPP Vert.

— TRANSISTOR BASINGS —
(✱ INDICATES ALTERNATE BASINGS)

✱13-23824-1
✱13-29033-3,4
✱13-29776-1,-3
✱13-35807-1,-2
✱13-39970-1

✱13-23824-1

✱13-18824-4

✱13-33178-1

✱13-33174-1
13-39099-1
13-39146-1

13-33181-3
13-33188-2
13-41738-1

METAL SURFACE
13-39099-1
13-39100-1

13-34048-3
13-34047-3
13-39074-1
13-43005-1

— IC KEY (TOP VIEW) —

NOTE:
ARROWS DESIGNATING POINTS NOT CONNECTED - POINT IN THE DIRECTION OF THE COMPONENT OR TIE POINT WHERE THEY ARE TO BE CONNECTED.
EXAMPLE:

✱✱ NOTE:
SOME 19" CAB. MODELS USE 19VGLP22. CAN BE REPLACED WITH SAME TYPE OR 19VFBP22.

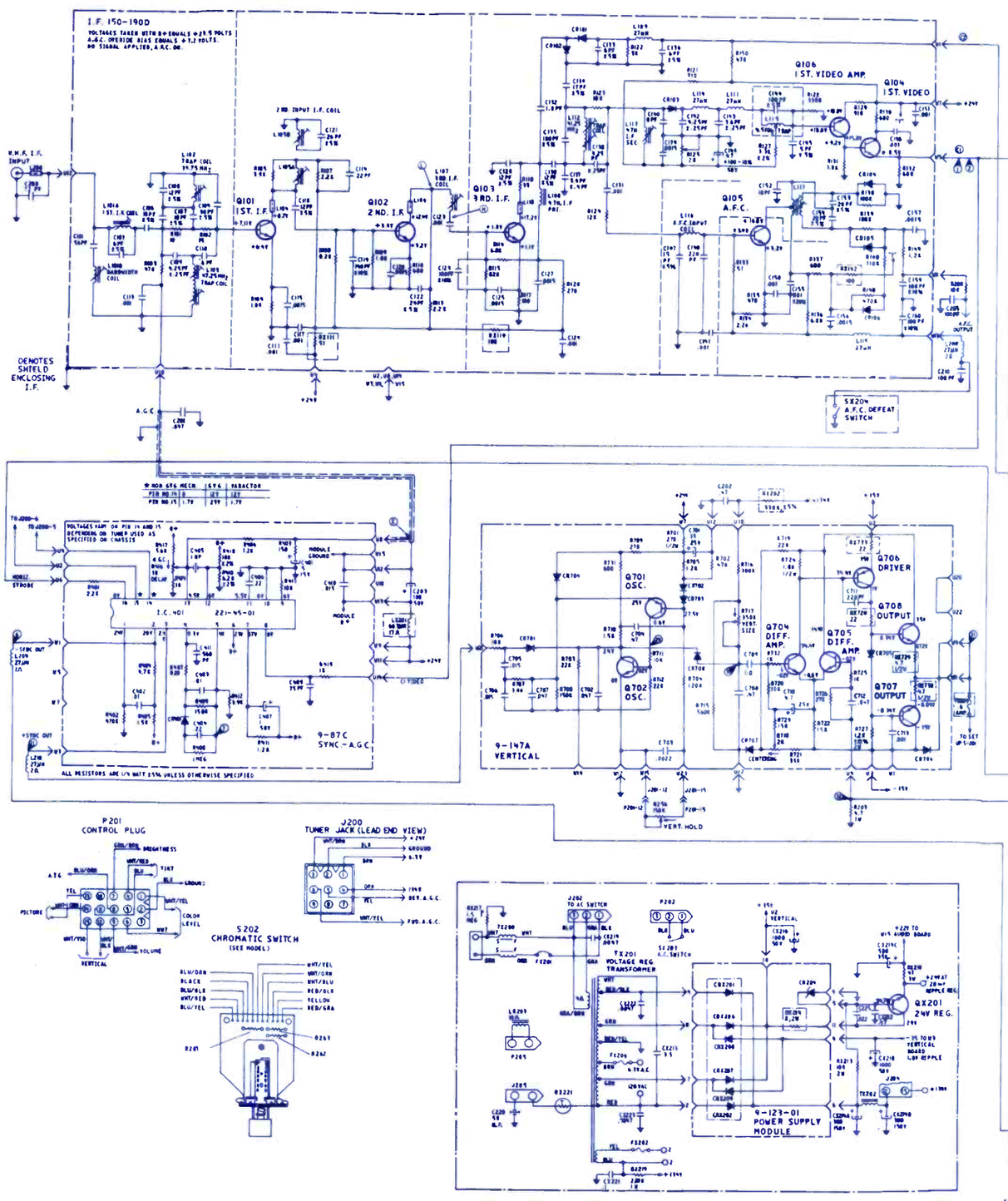
1699

ZENITH
Color TV Chassis
19HC46

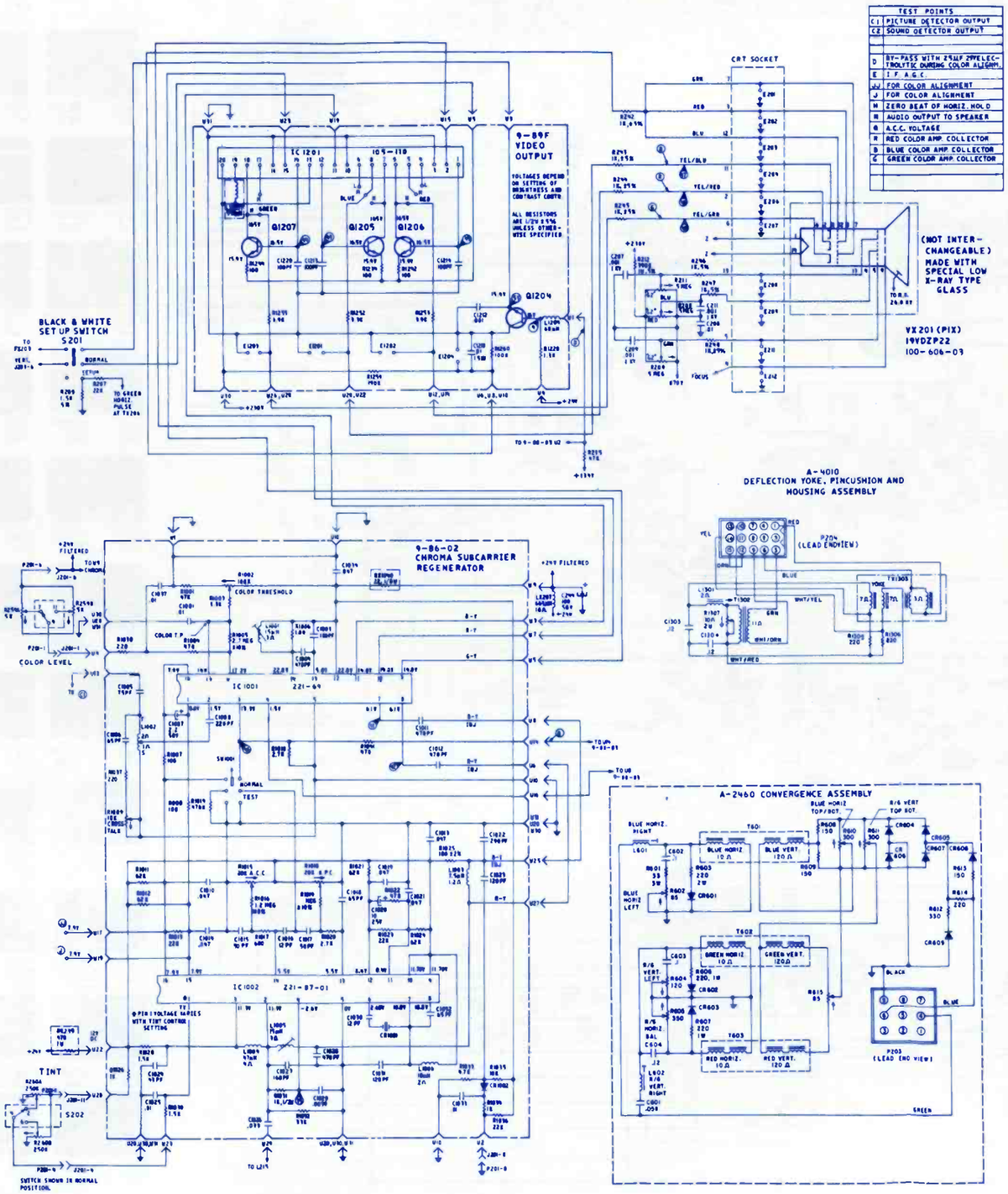
JUNE • 1977

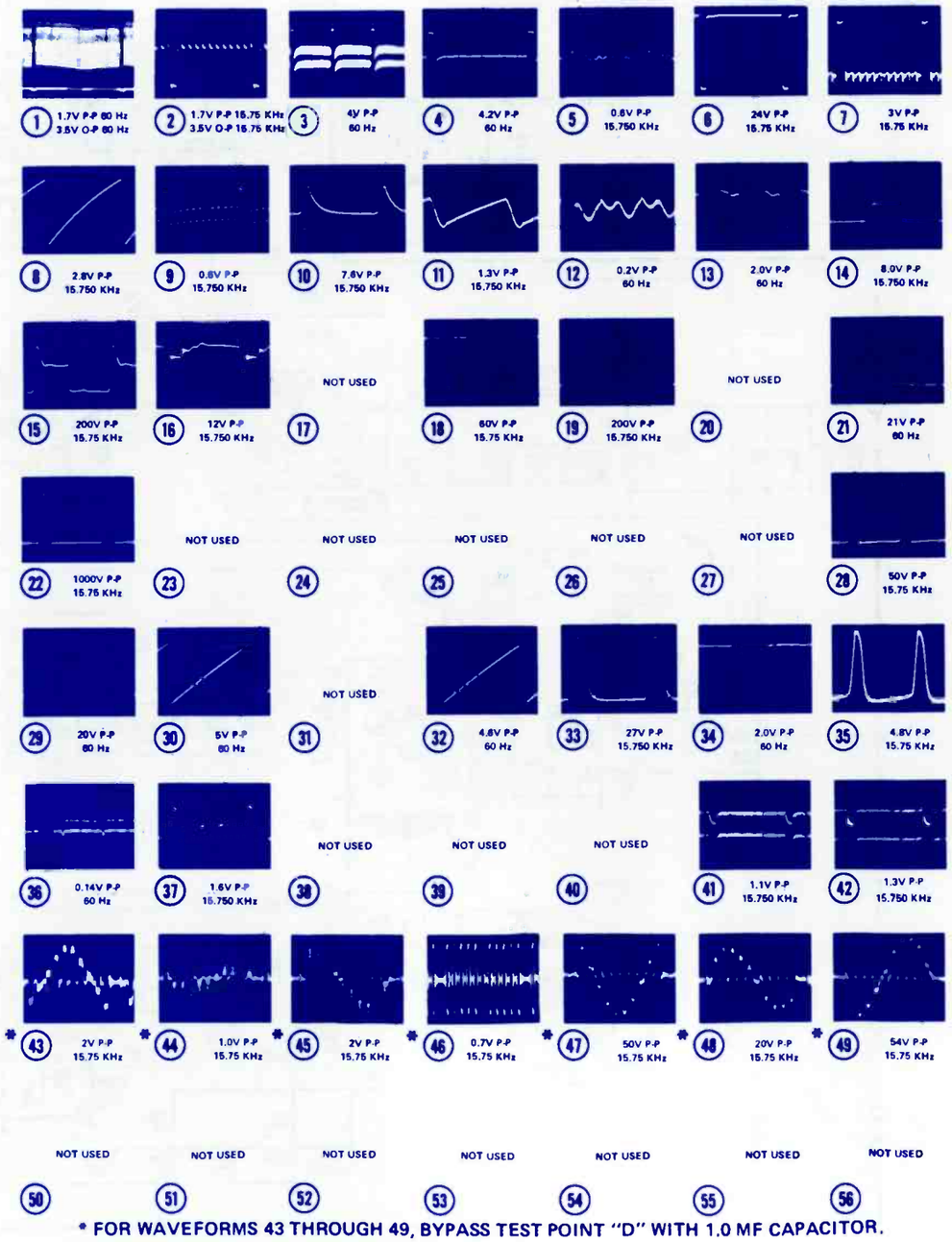
ELECTRONIC TECHNICIAN/DEALER TEKFAX

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS



ZENITH
Color TV Chassis
19HC46





* FOR WAVEFORMS 43 THROUGH 49, BYPASS TEST POINT "D" WITH 1.0 MF CAPACITOR.

1700
GTE SYLVANIA
B/W TV Chassis
A16-7

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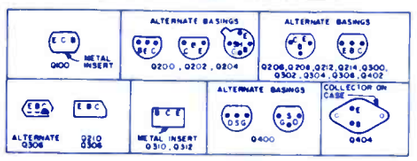
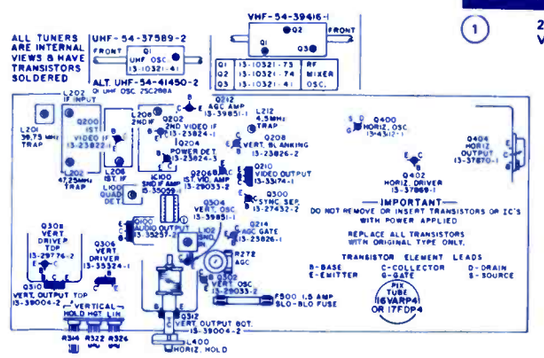
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS

BOTTOM VIEW-TRANSISTOR BASINGS



CHASSIS TRANSISTOR LAYOUT



ICIOO VOLTAGE CHART

PIN NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC CHIP INSERTED	+1.8V (+1.8V)	+1.8V (+1.8V)	0V (0V)	0V (0V)	+11.7V (+11.7V)	+.03V (+.03V)	+6.4V (+7.3V)	+5.8V (+6.2V)	+8.2V (+8.2V)	+4.2V (+4.2V)	N.C. (N.C.)	+3.9V (+3.9V)	N.C. (N.C.)	+1.5V (+1.5V)
IC CHIP REMOVED	0V (0V)	0V (0V)	0V (0V)	0V (0V)	+28V (MEG.8V)	0V (0V)	0V (0V)	0V (0V)	0V (0V)	0V (0V)	N.C.	0V (0V)	N.C.	0V (0V)

NOTES:
1. ALL CAPACITORS ARE IN MFD, 500V UNLESS OTHERWISE SPECIFIED
2. ALL RESISTOR ARE 1/4 WATT, 10% UNLESS OTHERWISE SPECIFIED
3. ARROWS ON CONTROLS INDICATE DIRECTION OF CLOCKWISE ROTATION
4. SQUARE WIRE PINS [X] ARE TEST POINTS AND WIRE WRAP CONNECTIONS.
5. SCHEMATIC SYMBOLS (V) ARE TEST POINTS.

NOTE
ARROWS DESIGNATING POINTS NOT CONNECTED - POINT IN THE DIRECTION OF THE COMPONENT OR TIE POINT WHERE THEY ARE TO BE CONNECTED.
EXAMPLE:

(1) 2 VPP Vert.
(2) 60 VPP Vert.
(3) 4.2 VPP Horiz.
(4) 1.8 VPP Vert.
(5) 3.5 VPP Vert.
(6) 46 VPP Vert.
(7) 46 VPP Horiz.
(8) .7 VPP Vert.
(9) 1.7 VPP Vert.
(10) 8.5 VPP Vert.
(11) 37 VPP Vert.
(12) 25 VPP Vert.
(13) 25 VPP Vert.
(14) 22 VPP Vert.
(15) 24 VPP Vert.
(16) 26 VPP Horiz.
(17) 15 VPP Horiz.
(18) 5 VPP Horiz.
(19) 6.2 VPP Horiz.
(20) 150 VPP Horiz.
(21) 8 VPP Horiz.
(22) Depends on amount of coupling Horiz.
(23) 3.4 VPP Vert.
(24) .2 VPP Vert.
(25) 20 VPP Vert.
(26) 9 VPP Vert.
(27) 24 VPP Horiz.

Suddenly, you're the most versatile shop in town.

With this little 25-pound test jig, you can adapt to over 10,000 color sets, 59 different brands. Delta 70° and 90° tube, hybrid, transistor, SCR sweep. Anode voltages to 30kV and more. Regular 4.5kV and 7.1kV focus voltages.

And our new optional In-Line Test Kit lets you handle more than 100 precision in-line chassis, including RCA, Magnavox, Admiral and Sears. (We're the first test-jig manufacturer to offer a kit like this.)

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CK3000 comes to you fully assembled, pretested and ready to use. Just plug it in, and you're in business. See it now, at your Sylvania distributor.

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GTE SYLVANIA

How to tell a Super-VOM from just the everyday garden-variety Brand X.

ONLY THE SUPER-VOM (Triplett's New 60) HAS ALL THESE FEATURES:

X'TRA RUGGED CONSTRUCTION
(For an accidental drop up to a five-foot height)

BUILT-IN "CONFIDENCE-TEST"
for periodic meter reassurance checks after overload/drops.

OVERLOAD PROTECTED
(All ranges; 3-fuse arrangement including diodes and 2 Amp/1000 V protection fuse)

SINGLE-RANGE SELECTOR SWITCH
(Most VOM's have 2 or more. Single switch minimizes range selection errors)

SAFETY DESIGNED FOR YOU
(Completely insulated; new Safety Leads; prevents explosive arcs from high energy circuits up to 20 KW)

48" SAFETY ENGINEERED TEST LEADS
(Especially designed recessed safety connectors and heavily insulated alligator clips)

ONLY 2 RECESSED INPUT JACKS
(Makes lead changes unnecessary—Some VOM's have as many as seven)

DETENTED HANDLE POSITION

$99

Nobody else offers these features in a VOM at any price. So for only $99, the Model 60 is the safest, most versatile, most honestly priced quality VOM you can buy. And, for just $7 more, you can have the Model 60-A that has 1½% DC accuracy, plus a mirrored scale.

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