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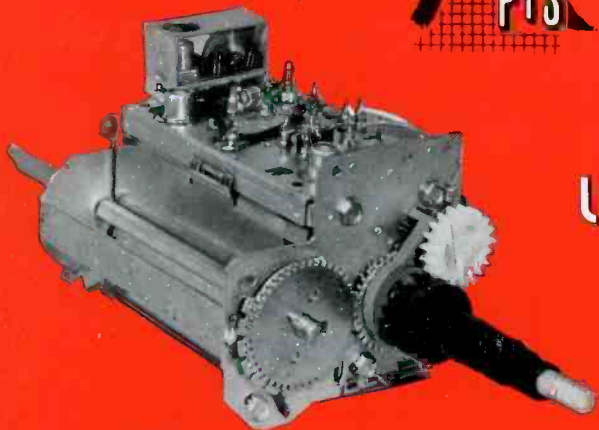
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Intro To SSB

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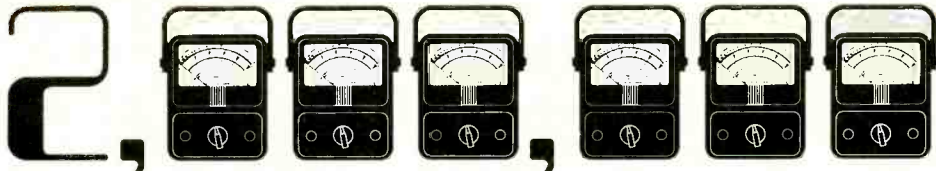
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THE COVER: The TV antenna on this month's cover is a developmental model designed by Channel Master to provide optimum reception of circularly polarized TV signals (see article on page 33). Photo courtesy of the Channel Master Division of Avnet Inc.

FEATURES

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An antenna system concept which servicers and dealers can use to solve TV reception problems in populated mountainous areas not served by conventional CATV. By James E. Kluge, Technical Editor, Winegard Company.

20 INTRO TO SSB

The whys and hows of single-sideband transmission and reception, and an introduction to servicing it. By Joseph J. Carr, ET/D Contributing Editor.

24 COPING WITH ICS

Common sense approaches to testing, replacing and stocking integrated circuits used in consumer electronics. By Bernard B. Daien, ET/D Contributing Editor.

28 ADAPTING IN-LINE TO DELTA

An adapter you can make to physically compensate for the electrical differences between the base pins of in-line and delta-type color CRTs. By Pat McGee, District Field Service Manager, GTE Sylvania.

30 HOME ENTERTAINMENT ELECTRONICS 1976

An overview of some of the color TV, VTR, CB and other consumer electronic product lines introduced recently by major manufacturers. By Joseph Zauhar, ET/D Managing Editor.

33 CP APPLIED TO TV

Although circular polarization (CP) of TV signals is still in the development stage, this new method of propagating and receiving TV signals promises an end to TV ghosting caused by reflected signals. By Harry Greenberg, Chief Engineer, Antenna & Accessories, Channel Master Division, Avnet, Inc.

34 PROFIT FROM REMOTE CONTROL

Operation and applications of Jerrold's Model TRC-12 Universal TV Remote Control system. By Lon Cantor.

TEKFAX—Admiral color TV Ch. T47K10-1A/-4A; Airline b-w TV Models GAI-11105A/B; and GAI-13145A/B; MGA color TV Model CS-195; and Zenith color TV Ch. 25FC45.

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TECHNICAL LITERATURE

SOLID STATE DEVICES

A 32-page PR Series Professional Replacement Guide is now available. Solid State Systems PR series is a full-range line of replacements for solid-state devices designed into domestic and foreign entertainment, communications, and automotive equipment. It lists transistors, diodes, rectifiers, zeners, IC's, modules, MOS/FET's, SCR's, triacs, automotive electronic ignition controls and electronic voltage regulators. The format of the guide is designed to provide functional and technical information on the devices, list applications, wiring diagrams, outline drawings and cross reference. Contact your local distributor or write *Solid State Systems*, 850 Springfield Road, Union, NJ. 07083.

SEMICONDUCTOR GUIDE

A-182 page Replacement Semiconductor Guide is now available at *General Electric* Distributors. Selective additions since the last edition of the guide reflect General Electric's commitment to help both electronic distributors and servicing technicians balance the need to meet consumer requirements yet maintain minimum inventory levels. The guide contains 65 percent more cross-references than the previous edition for both domestic and Far East equipment. The products are listed in alpha-numeric order.

ELECTRONIC TRAINING PROGRAMS

A new 40-page, four-color catalog covering independent home study courses in electronics has been introduced by Cleveland Institute of Electronics, Inc. The heart of the catalog is a 24-page section which details each of the 13 electronics training programs. Each course is outlined with course objective and listing of subjects covered. Dept. NR-05, *Cleveland Institute of Electronics, Inc.*, 1776 E. 17th Street, Cleveland, OH. 44114.

SEMICONDUCTORS

A 90-page Motorola HEP Semiconductor Cross-Reference Guide and Catalog, Supplement 1, 1975 edition is now available. It has been prepared by the Motorola HEP technical staff to include the most up-to-date cross-reference material available at the time of printing. Many new cross-reference listings have been added.

continued on page 6

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The guide may be purchased for \$.75 from Motorola HEP Distributors or writing to *Motorola Semiconductor Products Inc.*, HEP Programs, 4221 E. Raymond Street, Phoenix, AZ. 85040.

ELECTRONIC COMPONENTS

A General Electronic Catalog, presenting in condensed form, the thousands of precision electronic components which can be purchased from franchised Mallory Distributors is now available. The catalog contains many new products. Some are additions to existing line and others are completely new products. The catalog may be obtained from local Mallory Distributors or *Mallory Distributor Products Co.*, 4760 Kentucky Avenue, Indianapolis, IN. 46241.

PANEL METERS AND TEST EQUIPMENT

A new 60-page catalog No. 4400 which lists panel meters and test equipment is now available. The catalog broadens the listing by 34 percent over the previous issue No. 4300. *Simpson Electric Co.*, 853 Dundee Ave., Elgin, IL. 60120.

SEMICONDUCTORS

A 215-page Sylvania ECG Semiconductor Replacement Guide and Catalog No. ECG212F cross references 106,000 industry part numbers to the company's line of ECG semiconductors. It covers the broadest line in the industry of consumer, industrial and commercial solid-state devices for both domestic and imported products in the maintenance and repair markets. Designed as a quick reference, the guide has an extensive product directory and index. The cross-reference listings are alpha-numeric. Copies of the guide may be obtained from GTE Sylvania distributors or by mailing \$2.95 to *Sylvania Advertising Services Center*, 70 Empire Drive, West Seneca, NY. 14224.

COLOR PICTURE TUBE GUIDE

A 52 - page "Color Picture Tube Interchangeability Guide," B - 389, is designed to help the TV dealer and serviceman keep inventories at a minimum by carrying the fewest number of new tubes that can be substituted for old types. The guides is conveniently divided into two sections that can be used separately or together to locate the correct replacement tube type. The first section includes charts for each size and heater version of the 90 - degree color tubes, 19V through 25V. The charts show the evolution of the various tube types in a "family -

tree" arrangement. A simple coding system points out which types are most readily interchangeable. The second section is an alphabetical listing of all the tube types shown in the charts. This section has more detailed information and a complete list of interchangeable tubes for each type. It also provides safety tips on tube replacement procedures. G.H. Mackall, *Westinghouse Corp.*, Electronic Tube Division, Westinghouse Circle, Horseheads, NY 14845.

PROJECTOR-RECORDER BELTS AND WHEELS

A 20-page Catalog & Reference Chart listing belts and wheels, plus custom molded parts for: audio & video tape players and A/V projectors is now available. Over 650 types of belts, wheels & rubber parts for over 2000 models of over 280 makes are listed. *Projector-Recorder Belt Corp.*, 147 Whitewater St., Box 176, White-water, WI. 53190.

DIP REMOVAL TOOL

A 4-page, full-color brochure featuring the Remov-IC tool has been published. The unit is a completely portable, hand-held tool that removes soldered DIPs instantly. It prevents board discoloration, delaminating, measing and the lifting of pads. *Solder Removal Company*, 1077 East Edna Place, Covina, CA. 91724.

CB RADIO ACCESSORIES

An 8 - page, CB Radio Accessories Catalog, FR - 176, features such items as power base and mobile unit microphone dual power SWR meters, noise filters and suppressors and a specially selected assortment of microphone and antenna plugs and connectors. *GC Electronics*, Division of Hydrometals, Inc., 400 South Wyman, Rockford, IL. 61101.

OSHA VOLUNTARY COMPLIANCE GUIDE

Special problems are posed for retail store owners by the Occupational Safety and Health Act. To help store owners comply with the regulations, The Travelers Insurance Companies has prepared a guide for their insureds. The OSHA Voluntary Compliance Guide for Retail Stores is available from Traveler's agents and brokers throughout the U.S. It was prepared by the firm's engineering division. Topics included in the guide cover occupational injury and health record keeping, portable fire extinguishers, automatic sprinkler systems, exits, aisles and stairways, stock rooms, sanitation, food and drink

areas and electrical safety items. In addition to illustrations the publications contains a self - evaluation inspection guide. *The Travelers*, One Tower Square, Hartford, CT. 06115.

PROFESSIONAL AUDIO PRODUCTS

An expanded and updated catalog of professional products for broadcasting, recording, motion pictures, and sound reinforcement is now available. It lists microphones, audio components and accessories and high-fidelity phonograph cartridges. Included are specifications and individual performance profiles, as well as descriptions for installment of the products. *Shure Brothers Inc.*, 222 Hartrey Ave., Evanston, IL. 60204.

TEST ACCESSORIES

A 68-page catalog, *Electronic Test Accessories 1975*, listing accessories, usable by virtually anyone working with any electronic equipment is now available. *Pomona Electronics*, 1500 East Ninth St., Pomona, CA. 91766.

TOOLS AND MERCHANDISING AIDS

A new 16-page catalog No. SD-186 features 45 new products and merchandising aids including the Supercase, Professional and Electronic Pliers, Metric version of the popular WirePlier, a Solderless Terminal Gondola-Type merchandiser and many more. *Vaco Products Co.*, 510 N. Dearborn Street, Chicago, IL. 60610.

TEST INSTRUMENTS

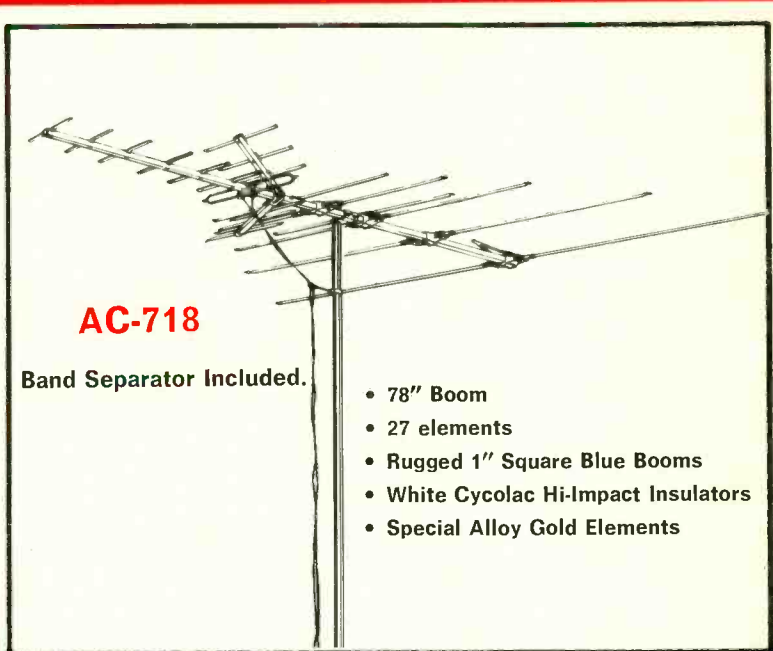
A new 32-page Catalog No. 811/16 listing assembled Frequency Counters, Oscilloscopes, Power Supplies, Meters, Generators and Strip Chart Recorders is now available. *Heath/Schlumberger Instruments*, Benton Harbor, MI. 49022.

IEEE/IHF FM RECEIVER STANDARD

A frequency modulation broadcast receiver standard developed by cooperation of the Electronics Industries Association, Institute of Electrical and Electronics Engineers, and Institute of High Fidelity has just been published. The new standard IEEE Std 185-1975/IHF 200-T, 1975 Standard Methods of Testing Frequency Modulation Broadcast Receivers, supersedes the previous IEEE and IHF documents. It provides the first up-to-date standard method for testing and comparing FM receivers that has received the endorsement from all segments of the industry. Of particular importance in the new IEEE/IHF Standard is the removal of the 6 dB ambiguity in receiver sensitivity that

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- 13 ranges: vac, vdc & ohms with 1% accuracy.
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LM-3 basic meter also available in four digits with 0.02% accuracy. Ask for LM-4.

See your local distributor!

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Replace with  Digital
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Standard Features: In Unit Quantity

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has stemmed from wide spread use of "terminated microvolts" to express input signal to a receiver, as opposed to the long-established use of "open-circuit microvolts". The problem has been overcome by expressing sensitivity in terms of available power. Copies of IEEE Std 185-175/IHF 200-T, 1975, are obtainable from the Institute of *Electrical and Electronics Engineers*, 345 East 47th Street, New York, NY. 10017. The single copy price is \$6.00.

TEST INSTRUMENTS

A 15-page Short-Form Instruments Catalog listing a highly condensed summary of the wide selection of instruments, power supplies, microwave components and computer automated test systems is now available. All major product lines are supported with comprehensive literature. *Systron-Donner Corporation*, One Systron Drive, Concord, CA. 94518.

MATV SPECIFICATION GUIDE

A MATV specification guide incorporating the latest state of the art, has been published to serve the needs of architects and specifying engineers. The guide is also expected to be useful to designers and installers of Master Antenna TV systems. Entitled "Guideline Specifications for Television Distribution Systems", the publication covers all aspects of TV distribution systems, including conventional MATV systems and CATV compatible systems. After defining the scope of the work, the specification guide covers channels to be carried; carrier-to-noise ratio and cross modulation ratios; equipment specifications; installation practices; headend tests; and system proof of performance. *Jerrold Electronics Corp.*, 200 Witmer Road, Horsham PA. 19044.

POWER SEMICONDUCTORS

A 30-page Power Semiconductor Condensed Catalog, No. 54-000 contains detailed information on the complete line of high-power transistors, rectifiers, SCR's and assemblies. Organized in an application format to allow maximum design efficiency, the fully illustrated, catalog is particularly useful to OEM purchasing and engineering personnel as well as the industrial end user. The easy-to-read catalog contains over 1500 product specifications and associated data. A complete alpha-numeric product index is provided for the convenience of the purchasing function and are indexed by parameters such as type of device, current and voltage. Semiconductor Division, *Westinghouse Electric Corporation*, Youngwood, PA. 15697. ■



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NEWS OF THE INDUSTRY

VEA Elects Woman President

Jane Hudson, Lynchburg, Virginia, was elected president of the Virginia Electronics Association during the Association's 11th Annual State Convention, held June 20-22 in Norfolk.

Earlier this year, another woman, Charlotte Norman, Hot Springs, Arkansas, was awarded the Arkansas Television Service Association's Outstanding Member of the Year award.

NESDA Estimates Indicate Decline In Number Of Service Technicians and Dealers

According to estimates by the National Electronic Service Dealers Association (NESDA), the number of technicians actively engaged in the servicing of consumer electronic products has decreased from 204,000 in January 1974 to 183,566 in January 1975, a decline of about 10 percent.

The number of consumer electronic service dealers, according to NESDA estimates, also has decreased, from 77,230 in January 1974 to 72,165 in January 1975, a decline of about 6 percent.

The NESDA estimates are based on the following numbers of service technicians and service dealers licensed and/or registered in the states listed. Using these figures, NESDA computes the average population per technician and dealer and then uses this average to compute the number of technicians and dealers nationwide.

STATE	POPULATION	DEALERS	TECHNICIANS
California	21,000,000	6,285	15,964*
Connecticut	3,200,000	1,346	2,257
Florida	7,000,000	2,851	7,241*
Indiana	5,400,000	2,071	4,855
Louisiana	3,800,000	1,220*	3,100
Massachusetts	7,000,000	2,920*	7,419
Oregon	2,200,000	800	1,250
Utah	1,160,000	370	939*
Vermont	450,000	175	389*

*NESDA estimate, not official data from state regulatory agency.

New York City Servicers Awarded State Supreme Court Injunction Against TV License Law

Members of the Metropolitan Electronic Television Service Dealers Association (METSDA) and other New York City electronic servicers have won their fight for an injunction which temporarily halts enforcement of four elements of the home entertainment electronic service regulations implemented by the New York City Department of Consumer Affairs on February 24 (page 9, April 1975 ET/D).

On May 13, about 600 METSDA members and other electronic servicers demonstrated against the regulations on the steps of the State Supreme Court in Manhattan and at the Department of Consumer Affairs and the New York City Hall. Later that day, the New York State Supreme Court issued the injunction demanded by the servicers.

The elements of the Consumer Affairs regulations which are temporarily suspended by the injunction involve those which require proof of liability insurance, posting of certain signs, specified guarantees on parts and labor, and use of specified billing forms.

Credit Card Purchases of Replacement Parts Via Phone Initiated by GE

General Electric has announced that servicers soon will be able to use their Master Charge or Bank Americard credit cards to purchase GE replacement parts ordered by phone directly from GE regional parts depots.

Under the new parts ordering system, a servicer will be able to call the GE regional parts depot in his area of the country via a toll-free number and charge his parts

NEWS.....

purchases by giving his Master Charge or Bank Americard number. This will eliminate COD charges.

In addition, GE reportedly has instituted a new computerized parts locating system which enables a regional parts depot which is out of a part to immediately order the shipment of the part from the nearest regional parts depot which has it in stock.

PBGC Announces Continuation Of Current Premium Rates For Private Pension Plan Insurance

The Federal Government's Pension Benefit Guaranty Corporation (PBGC) has announced that, until further notice, the current premium rates for insurance of the benefits of private pension plans will continue in effect for the second full plan year subsequent to the enactment of the Employee Retirement Income Security Act of 1974. These annual rates are one dollar per participant in single-employer plans and 50 cents per participant in multi-employer plans.

The PBGC presently is studying other rate formulas and expects to develop one for use at a future date. The study will include the possibility of allowing plans to elect to use any such rate formula with respect to their second full plan years.

Magnavox To Become Wholly Owned By Philips

The Board of Directors of The Magnavox Company have unanimously approved a proposal calling for a subsidiary of North American Philips Corporation to acquire the outstanding minority interest in Magnavox through a cash merger which will result in payment of \$9 per share for the outstanding Magnavox shares. Upon consummation of the merger, Magnavox will become a wholly-owned subsidiary.

In 1974, the North American Philips subsidiary acquired approximately 84 percent of the outstanding common stock of Magnavox in a tender offer at \$9 per share. In May the Board of Directors of North American Philips approved a proposal by its management to acquire the minority interest in Magnavox.

Retailer Acceptance Of Bank Credit Cards Again On Increase

Acceptance of bank credit cards by independent retailers appears to be on the increase again, although not yet back up to the level that prevailed at the beginning of 1974.

Data gathered by the continuous field survey of the National Federation of Independent Business (NFIB) in April shows that 41.6 percent of the independent retailers are accepting bank credit cards for customer purchases.

This is still below the peak acceptance found by NFIB surveys at the beginning of 1974, when it reached 45.6 percent. At the end of last year, the percentage of retailer respondents reporting bank credit card acceptance had dropped to 37.4 percent.

One possible cause of this increase is that the discount charged retailers by banks for handling credit card sales shows a perceptible decline since early last year. Of the respondents, 35.0 percent report they are discounted 3 percent. In January 1974, 85.2 percent of the retail respondents to the NFIB survey reported being discounted from 3 to 5 percent, but currently this has dropped to 73.6 percent, with the decline largely accounted for by decreases of those who formerly reported paying a 4 or 5 percent discount.

The NFIB believes that the constant efforts by independent retailers during the past several months to conserve cash by reduction of inventories and accounts receivable also has caused retailers to consider bank credit cards in a more favorable light.

Sony To Build Plant In Alabama

Sony Corporation of America, which opened its first manufacturing facility in this country in San Diego, California, in 1972, recently announced that it will begin building a second U.S. plant in Dothan, Alabama, late this fall.

The new facility will produce audio and video tapes, with production scheduled to begin in early 1977.

Sony's San Diego plant presently produces about 25,000 Trinitron color TV receivers and about 5,000 compact stereo music systems each month. ■

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RCA Tear 'n Share Headquarters,
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Distributor and Special Products Division, Cherry Hill Offices, Camden, N.J. 08101

Bringing TV Down To The Valleys

By James E. Kluge

A method of improving TV reception in hilly and mountainous areas

■ About one million homes in the U.S. are located in areas which, because of signal-weakening distances and/or signal-blocking terrain, presently do not receive TV signals of sufficient strength and quality to produce acceptable pictures. And, for the same reasons, about six million other homes are limited to reception of only one or two TV channels.

Many of these homes are located in valleys in the hilly and/or mountainous terrain adjacent to metropolitan areas such as Denver, Salt Lake City, Seattle, Cincinnati, Pittsburgh and San Francisco, to name just a few.

TV reception in the valleys and on the sides of hills and mountains in these areas is adversely affected by two principal factors: 1) blockage of direct signals by higher terrain, and 2) reflections of signals off the sides or adjacent hills or mountains. The result usually is either no reception at all or weak reception with moderate to severe ghosting.

This is tough country for TV reception and a real challenge for antenna installers. Most rules and guide lines, learned through years of experience, generally "go by the boards" in these areas. The rules are strictly "cut and try". Because TV signals ricochet much the same way a loud shout or sharp clap echoes from valley to valley, in this type of country it's not uncommon to find that the best TV signal arrives from a direction opposite to that of the TV transmitters.

So how do you get satisfactory TV reception for your customers without them having to move back to town or wait several years for a

CATV company to develop the area? The best way is to get your antenna *up* where the signal is and make it *directional* enough to select only the strongest and clearest signal and to reject all the other ghosts or reflections off nearby hills, mountains and canyon walls.

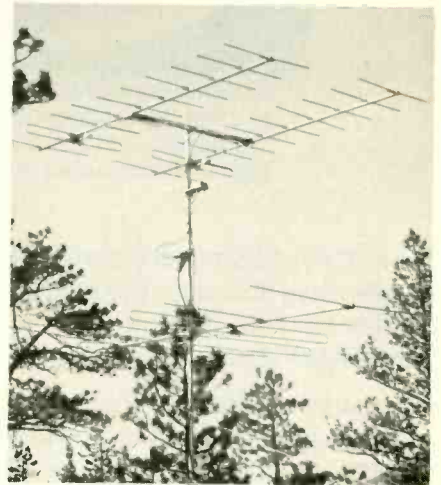
Recently, two new products to improve TV reception in mountainous areas have been announced. One is a special VHF-antenna combination which has high gain and selectivity. The other is a new type of line amplifier called a constant-level amplifier (CLA).

Amplifiers are needed to get the signal from the antenna to the TV set location. This can involve several thousand feet of coaxial cable running from a high ridge or hilltop to the valley floor below. Getting a satisfactory signal from the antenna to the TV set will require constant-level amplifiers, to preserve the signal and to keep it from dropping to a level that produces snow.

An example of an area where these two products have recently proved their usefulness is in the front range of the Rocky Mountains directly west of Denver, Colorado. For a distance of approximately 30 miles north and south of Denver, TV reception in these "hills" is sporadic. Denver has no UHF station but does have two of the major network affiliates in the VHF high-band (Channel 7-CBS and Channel 9-ABC). High-band VHF reception is particularly difficult in mountainous areas. The other three low-band channels (2, 4 and 6) do not pose as severe a problem as the high-band channels, which tend to follow a more straight-line path than do the low-band channels. (The low-band



Deep valleys like this offer little hope for acceptable TV reception unless the antenna is located high up the mountainside. Denver TV channels emanate from 20 miles beyond the mountain in the far background.



Winegard WS-1010 antenna installed on an 8000-foot hilltop overlooking a deep valley hundreds of feet below.

signals tend to follow the curvature of the earth).

The special "antenna" (Winegard Model WS-1010) is a kit consisting of one low-band antenna with two horizontally stacked high-band antennas above it. By stacking two antennas, the high-band gain increases approximately 2-3 dB and the front lobe (acceptance angle) narrows down to approximately 25 degrees. One good low-band Yagi will usually suffice since signal levels are higher and ghosting is less severe.

Once you get a good picture at the antenna, the battle has just begun. Now you have to get the signal to the TV set without allowing it to deteriorate. The three types of line commonly used to

The author is a technical editor for the Winegard Company.



WS-1010 antenna at the top of the hill in the background received all Denver channels, snow-free, from 21 miles away.



Coaxial cable which brings the signal down the hill from the remote-antenna site can be laid on the ground, as shown here.

transmit the signal down the hill are ladder line, twin lead or coaxial cable. The principal pros and cons of each are:

- *Ladder line*—This type consists of two parallel, bare conductors separated by insulating spacers. It has low loss in dry weather but its characteristics will fluctuate with changes in moisture, dirt and grime deposited on it. It must be kept off the ground and away from electrical conductors. This makes it subject to breakage by trees, snow, ice, animals and people. Being unshielded, it will pick up auto ignition and other electrical noise.

- *Twin lead*—Shielded twin lead is a better noise and spurious signal eliminator than unshielded types,



Technicians, working at 10,000 feet, ready a WS-1010 antenna for mounting on the lower mast section (next to stump.)

but shielding increases loss. Loss is more than ladder line but less than coax. Loss of unshielded is affected by moisture and deposits. Additionally, it must be kept off ground and away from conductors.

- *Coaxial cable*—This type of line has the highest cost and highest loss but offers predictable performance, consistent reliability and ease of installation. It may be laid on the ground, buried, or supported by trees, poles or fence wires. It offers ruggedness and durability in all weather and climates. Loss is only affected by extreme temperatures.

Outdoors in rural areas, coaxial cable is the only way to go. The additional expense of installing, repairing and maintaining twin



Coaxial cable may be strung between trees in wooded areas where foot or vehicular traffic might cause damage if it is laid on the ground.



In mountain country, a battery-operated portable TV set should be used to orient the antenna for the best ghost-free pictures.

lead or ladder line will probably more than offset the extra cost of using coax. This is proven by the almost exclusive use of coax in MATV and CATV systems—both indoor and outdoor.

After you've decided on coax, the problem becomes one of maintaining the integrity of the signal on the coax until it reaches the TV set. This is handled no differently than in a large MATV system except that, in this case, there are no branch lines to deal with—just a single run from the antenna to where the TV set(s) are located. This is a natural application for CLA's.

Constant-level amplifiers are designed to eliminate the usual computations associated with put-



The antenna in the foreground must "reach" over and 20 miles beyond the mountain in the background to bring Denver TV channels to residents in the valley far below near Idaho Springs, Colorado.



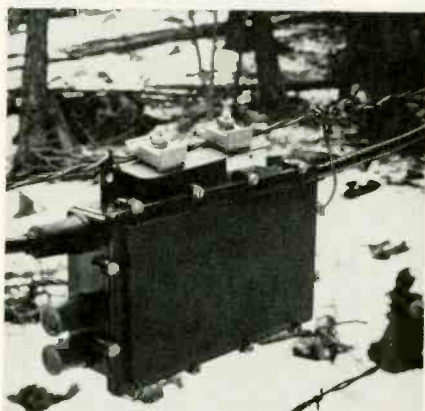
Coaxial cable replaces ladder line, which required frequent repairs and, consequently, caused TV-reception outages.

ting in line-extender amplifiers. No more loss calculations, no more tilt compensators—just get yourself a tape measure and you're on your way. One CLA, when preceded by a specified length of coaxial cable, forms a unity-gain module. In other words, the CLA is designed to compensate exactly for the nonlinear cable loss in the preceding section of coax so that the signal levels of the various TV channels at the CLA output equal the levels at the beginning of the coax cable length. This makes it possible to simply insert a CLA every so many hundred feet of cable and know that the levels will be equal and will remain constant at the output of each and every CLA in the trunkline. Thus the name *constant-level amplifiers*.

Different types of coaxial cable require different spacings between the CLA's, but the principle is still the same. All you have to do is measure off several hundred feet of cable and install a CLA.

CLA's come in weatherproof housings and are adaptable to either pedestal mounts, for surface-laid or buried cable, and messenger wire, for overhead (aerial) cable. On pedestal mounts, the cable entering and leaving the pedestal connects to the same end of the CLA. In messenger-wire (in-line) installations, the cable enters and exits from opposite ends of the housing.

CLA's, powered by 16-28 VAC on the cable, have their own self-contained, regulated 12 VDC power supply. This way, performance is not degraded as a result



Constant-level amplifier (CLA) and coaxial cable supported by fence wire. Note the ground wire connected from the amplifier to the barbed wire, which is strung between steel fence posts.

of the AC voltage drop on the cable increasing as the distance from the power source is increased.

Most CLA's automatically compensate over the entire VHF/UHF bands for 400 feet of RG-11/U type foam cable, 280 feet of RG-6/U type foam cable, or 200 feet of RF-59/U type foam cable. If you don't need UHF, then consider a VHF-only model (CLA-221), which is designed expressly for long trunklines; it compensates for 1400 feet of RG-11/U foam or 1000 feet of RF-6/U foam cable. This lets you "cable" much further with fewer amplifiers.

Although you won't have to compute cable loss and slope, you should consider the relative economics of cable vs CLA's. That is, in some applications it may be more economical to use smaller cable and more amplifiers, while in others you might find it best to use large cable (even 0.412-diameter aluminum sheath) and

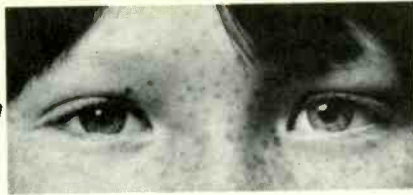
fewer amplifiers. Each installation will have to be worked out on its own merits.

At any rate, with the new antenna package and the CLA's you can produce a good TV signal where there wasn't any before. Such is the case in a mountain residential area near Evergreen, Colorado, where a group of home owners shared the cost of putting in a "mini-CATV" system. Located on the far side of a mountain from the TV transmitters, these residents couldn't even get good FM reception. Now, with a WS-1010 antenna located above them on a ridge and CLA's bringing the signal down the hill to their homes, they not only get all of the Denver TV stations but also Colorado Springs' Channels 11 and 13, which are almost 70 air miles away.

Experiences similar to this have been repeated throughout the Evergreen area. In fact, with this "mini-CATV" system, many rural areas of the nation now without satisfactory TV reception could enjoy clear, clean, sharp TV pictures.

Over the past several years, city dwellers have moved to mountain-area homes and weekend retreats in TV market areas such as Seattle, Los Angeles, Salt Lake City, Tucson, Lake of the Ozarks, Pittsburgh, Upper New York State and New England, to name just a few. These areas represent a tremendous untapped market for remote antenna sites and "miniature community antenna systems." ■

Keep your eyes on



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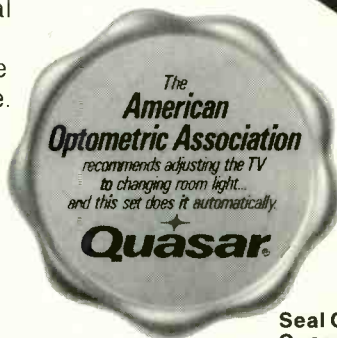
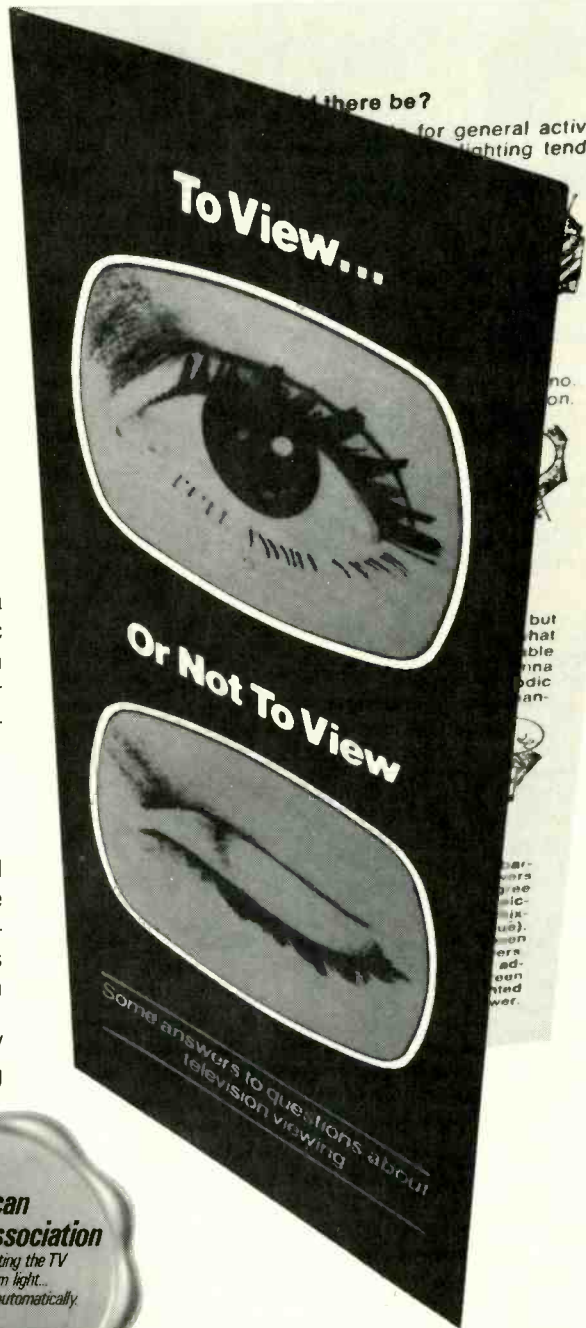
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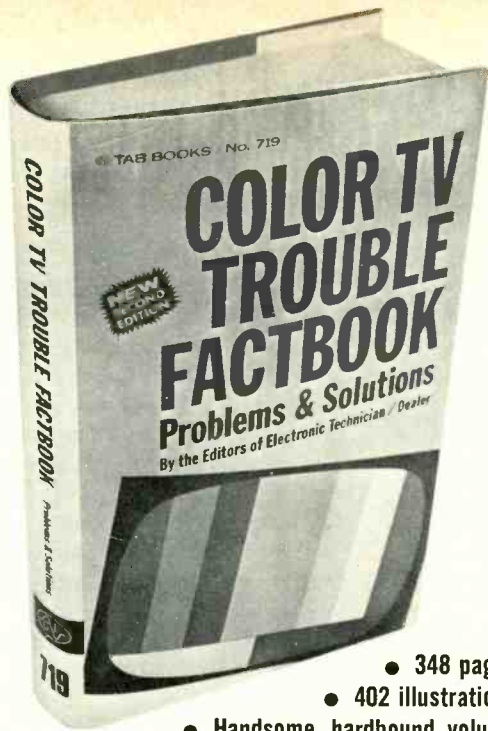
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Canadian General Electric—Chassis M663; M678; M679.

Dumont—Chassis 120957; 958

Emerson—Chassis K17; K18; K20; M20.

General Electric—Chassis CB; CD; C1; C2; G1; H; HE; H1; H3; JA; KC; KC-KD; KE; LB; L1; L2; MA; N1; N2; P; U1.

Magnavox—Chassis T38; T904 & 45; T911; T918; T919; T920; T924; T931; T933; T935; T936; T938; T939; T940; T946; T947; T950; T951; T952; T956; T957; T958; T962; T962-10; T974; T979; T989.

MGA—Chassis T50.

Motorola—Chassis 16; T921; TS908; TS-914; TS915; TS918; TS924; TS929; 18; TS929; TS931; TS934; TS938.

Olympic—Chassis CT400; CT910; CT911; CTC19; CTC20; CTC21; CTC30; CTC31.

Philco—Chassis 16M91; QT85.

Philco-Ford—Chassis 3CS90; 3CS91; 3CY-90; 3CY91; 20KT40; 20KT41; 14M91; 15M91; 16M91; 17MT80A; 18MT70; 16NT82; 16QT85; 18QT85; 18QT86; 20QT; 20QT88.

RCA—Chassis CTC17; CTC17X; CTC20; CTC21; CTC22; CTC30; CTC36; CTC38; CTC39; CTC40; CTC41; CTC42; CTC43; CTC44; CTC46; CTC47; CTC48; CTC49; CTC50; CTC51; CTC52; CTC54; CTC55; CTC59; CTC63; XL-100.

Sylvania—Chassis D01; D02; D06; D07; D08; D10; D12; D12-09-09; D12-11-06; D12-15-07; D12-20-50; D12-21-50; D14; D15; D16; E02-1, 2.

Truetone—Chassis 2DC4815.

Westinghouse—Chassis V2655; V2656; V-8001

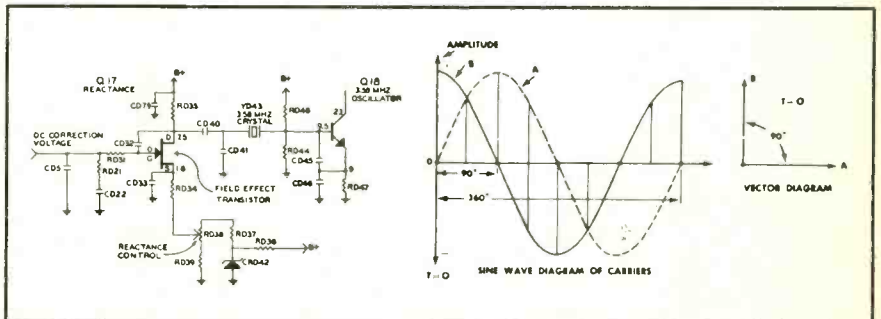
Zenith—Chassis 12A13C52; 14A9C51; 19-DC12; 19DC22; 19DC28; 25DC57; 20X138.

Twice the size of the bestselling original, this newly updated edition is a fully indexed all-in-one reference guide to color-set troubles and recommended solutions, manufacturers' service notes, and production change data—all alpha-numerically arranged by manufacturer and model. This low-cost handbook contains service tips, troubleshooting data, and special problem-solving aids for all the more popular U.S. and Canadian color TV makes and models, from A (Admiral) to Z (Zenith).

But that's not all! Included also are details concerning repetitive troubles, field-factory changes, new and unusual circuits and descriptions of how they work, special adjustment procedures and other such pertinent service information. Of particular importance are the manufacturer's production changes—this book includes a detailed accounting of such changes where they might logically affect set performance and where the technician might replace a "factory" component with an unsuitable substitute.

This book should be considered a "must" for every practicing professional TV service specialist . . . the information it contains may easily save you hours of time repairing a "tough-dog" color TV. Partial schematics, location diagrams, chassis layouts, and sketches are included as necessary to make every entry easy to understand and simple to implement in the field. To our knowledge, no other single volume contains so much easy-to-find information about so many individual models and brands of color receivers. A complete cross-reference index is provided to enable you to quickly find the specific material you need. In all, over 600 specific items are included.

The material provides instant solutions to many color TV circuit troubles, enabling you to diagnose and repair hundreds of otherwise difficult-to-solve problems. If you service color TVs, this organized file of data will pay for itself time and again. 348 pps., hundreds of schematics and diagrams. Hardbound. Publisher's list price \$8.95.



Literally hundreds of complete and partial schematics and illustrations make each of the over 600 entries in "Color TV Trouble Factbook" easy to understand.

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Intro To SSB

By Joseph J. Carr

Analysis of the principal differences between conventional AM communication systems and single sideband (SSB)

■ Single-sideband (SSB) transmitters and transceivers have almost completely replaced conventional amplitude modulated (AM) equipment in most types of communications. Amateur radio and most professional communications systems have been using SSB for years, while Citizens (Fig. 1) and high-frequency marine bands have recently begun the changeover.

As reported in the December 1974 issue of ET/D (page 34), the Federal Communications Commission (FCC) has proposed new rules which will expand Citizens Band (CB) radio from the present 23 channels to 70, and ultimately to 100 channels (see the accompanying chart). In addition, under the proposed new rules, Citizens Band radio will be converted completely, over a period of a few

years, from the present conventional AM transmission to suppressed-carrier single-sideband transmission.

WHY SSB

Single-sideband suppressed carrier (SSBSC), the correct name for this mode of communication, is a form of *amplitude modulation* in which the RF carrier and one of the sidebands are removed.

Consider, for a moment, the voltage-vs-frequency plot of an AM signal (Fig. 2) when the carrier is 100 percent modulated by an audio sine wave. Three distinct output signals are generated by this modulation process: the *carrier plus sum* and *difference* signals. Suppose, as illustrated in Fig. 2, that a 1000-KHz RF carrier is modulated by a 1-KHz audio tone. The output spectrum for this transmitter is a 1000-KHz carrier, a 1001 KHz *sum* signal and a 999-KHz *difference* signal, the latter two of which are the *upper* and *lower* sidebands, respectively.

One problem with the conventional method of AM modulation is that most of the RF output power is wasted transmitting redundant information (*two* sidebands instead of just one) and a useless carrier. Because all information transmitted in an AM signal is transmitted in *each* sideband, only *one* sideband is needed to convey the message. For a transmitter which is 100 percent modulated by a sine wave, the voltage vectors which represent the upper and lower sidebands in Fig. 2 are each at only 50 percent of the carrier voltage amplitude. Since power is proportional to the square of voltage, only $(\frac{1}{2})^2$, or $\frac{1}{4}$, of the total power is in each sideband. As a result, only *one*



Fig. 1—Example of a Citizen Band SSB base-station transceiver. Mode switch allows selection of AM, upper or lower sideband. "Clarifier" adjusts the locally generated carrier in the receiver for best recovered audio. BFO frequency is critical to within a few Hertz. (Courtesy of SBE.)

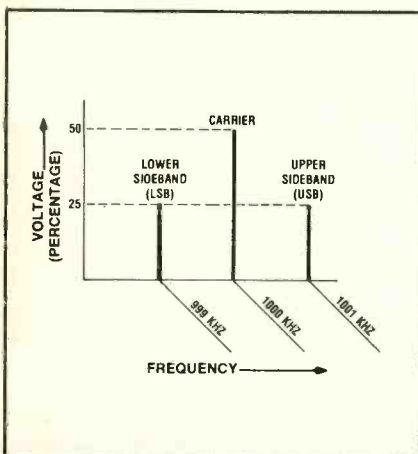


Fig. 2—Voltage-vs-frequency plot of the RF output a 1000-KHz AM transmitter 100 percent modulated by a 1-KHz sine wave.

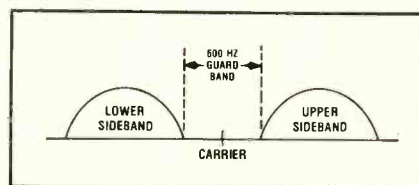


Fig. 3—The sidebands of a conventional AM-modulated RF carrier occupy about twice as much of the RF spectrum as a SSB signal.



Fig. 4—Example of a mobile SSB CB transceiver. (Courtesy of SBE.)

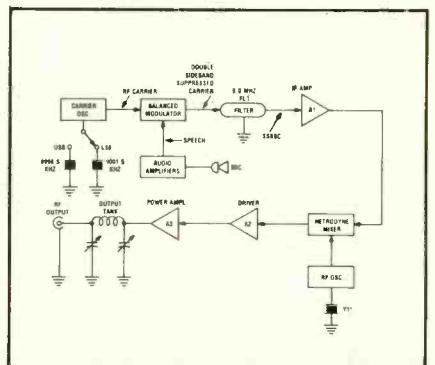


Fig. 5—Block diagram of a filter-type SSB transmitter.

fourth of the total power output is used to transmit useable information, while the other three fourths is "burned up" in the carrier and the redundant sideband.

SSB, on the other hand, concentrates all of the developed output power into one sideband (or into two if double-sideband, suppressed-carrier modulation is used).

Another advantage of SSB is the fact that carrierless SSB signals disappear when there is no audio to be transmitted. By contrast, an AM signal has a carrier which will be transmitted and can interfere with other stations even though there is no audio present.

One other advantage of SSB, and this is very important in today's crowded frequency spectrum—is that a SSB signal requires only half the bandwidth of a conventional AM signal with equivalent characteristics. (This is the basis for the claim made for some CB SSB sets that they have "effectively 46 channels" instead of the normal 23.) Voice communications systems are usually bandwidth restricted to about 300-2500 Hz. These frequencies (see Fig. 3) form sidebands spaced up to ± 2.5 KHz from the carrier. The total required spectrum for an AM transmitter, then, is twice the bandwidth of a comparably modulated single-sideband system. Because the low-frequency end of the audio passband drops off below 300 Hertz, there will be a 600 Hz guardband (2×300) between the

lower sideband (LSB) and the upper sideband (USB).

On the other hand, if receivers of adequate selectivity are used, it is possible for two SSB stations to occupy the same channel as long as one uses the upper sideband and the other the lower sideband. (Because of this stringent selectivity requirement for SSB receivers, it is necessary to use piezoelectric or mechanical filters in the IF's of SSB receivers rather than the LC tank circuits used in conventional AM receivers. Such filters have very steep skirts on their passband response curves.)

GENERATING SSB

There are two basic methods for generating a SSB signal: phasing and filtering. Because it is the most often used, only filtering will

be considered here.

Fig. 5 shows the block diagram of a typical filter-type SSB transmitter. The heart of the system is a balanced modulator, which is used to cancel the carrier when no modulation is present. A balanced modulator will produce a double sideband output only when a modulating voltage is applied to the input.

The output of the balanced modulator is fed to a filter which removes the unwanted sideband. Selection of the lower (LSB) or upper sideband (USB) is accomplished by choosing one of two separate carrier oscillator crystals, one above and the other below the RF carrier frequency (filter center frequency). In some designs, the next stage is an IF amplifier. This, in turn, is fol-

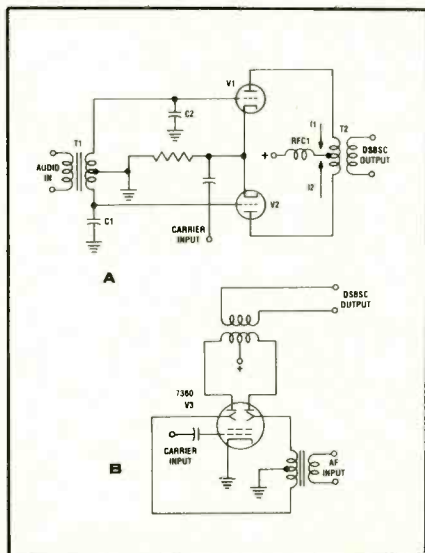


Fig. 6—Examples of older tube-equipped balanced modulator circuits. A) Triode type. B) Beam-switching type.

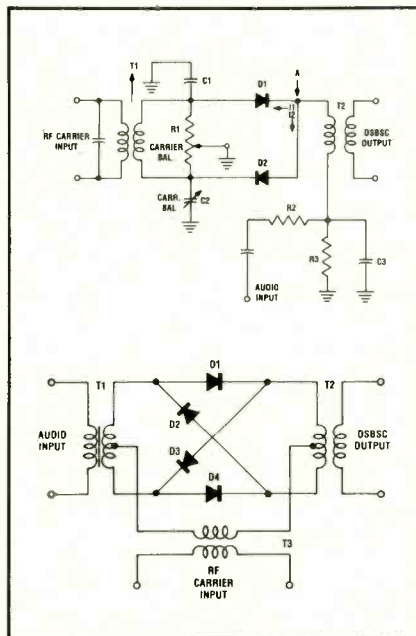


Fig. 7—Examples of semiconductor-equipped balanced modulators. A) Diode series-switching type. B) Diode ring type.



Fig. 8—Example of a SSB marine transceiver. SSB is fast replacing conventional AM in the high-frequency (2-3MHz) spectrum. (Courtesy of Ray-Jefferson.)

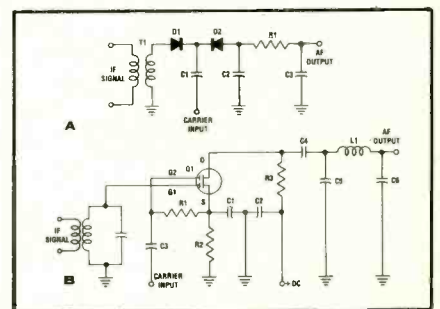


Fig. 9—Examples of SSB product detectors. A) Diode series-switching type. B) MOSFET mixer type.

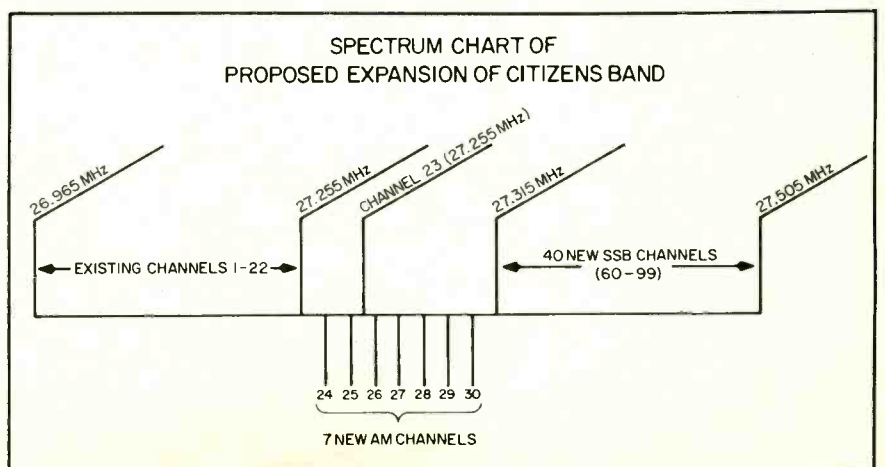




Fig. 10—Examples of a high-frequency SSB transceiver. (Courtesy of RF Communications.)

lowed by a mixer stage which converts the signal to the RF frequency of the desired channel. Following the heterodyne mixer is a chain of driver amplifiers and a linear power amplifier.

Because the modulating signal (usually audio) is added to the system back at the balanced modulator, all stages following the balanced modulator must have linear amplitude and phase characteristics. While FM and high-level modulated AM transmitters can use efficient class-C amplifiers in the final stage, SSB transmitters must use less efficient class-A, class-B, or class-AB push-pull stages.

Power output from a SSB transmitter is usually expressed as so many watts "peak envelope power" (PEP). Space limitations prevent a thorough definition of PEP here, but PEP is approximately equal to twice the DC input power to the final amplifier when the transmitter is modulated by speech with a duty cycle of 50 percent.

BALANCED MODULATORS

The balanced modulator needed to produce the DSBSC signal must have zero output when there is no audio modulating voltage. Most such circuits operate either as series or shunt "switches" driven by the audio signal.

Fig. 6A shows an older vacuum tube type of balanced modulator which uses a pair of triodes. Notice that the audio signal drives the grids *push-pull* in a common-cathode configuration. The RF carrier signal, on the other hand, drives the cathodes in *parallel* in a grounded-grid configuration. When there is no audio present, the RF flowing in the plate circuits of V1 and V2 produces equal but

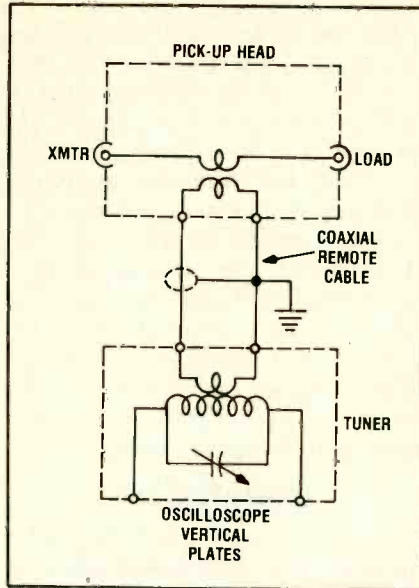


Fig. 11—RF "snifferbox" which is used to sample the output of a SSB transmitter and apply it to a scope for display of the modulation envelope.

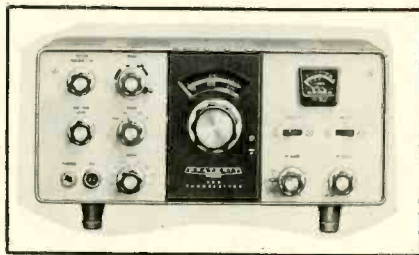


Fig. 13—Example of a multiband amateur-band SSB transceiver. Even though "hams" must pass a technically oriented examination before the FCC will issue them a license, a surprising number still depend on professional services for repair. (Courtesy of the Heath Company.)

opposite currents in the primary of transformer T2. Consequently, without a modulating signal applied, the output is zero because the currents produce mutually cancelling magnetic fields.

When the audio signal is present, the circuit becomes unbalanced. As the audio signal becomes more positive, the grid of V1 will become more positive and V2 more negative, in typical push-pull fashion. Because this increases I_1 and decreases I_2 , a changing magnetic field is produced and induces a signal in the secondary. On the negative half cycle of the audio signal the opposite situation exists and I_2 will be greater than I_1 .

Fig. 6B is another form of vacuum tube balanced modulator. It uses a special beam-switching tube called the type 7360. This tube has a single cathode and control grid structure which is com-

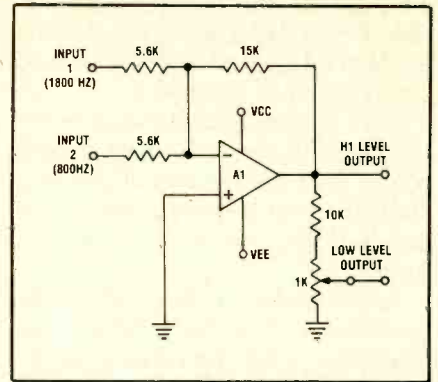


Fig. 12—Circuit for mixing together the outputs of two standard audio signal generators to produce a two-tone test oscillator for testing and adjusting SSB transmitters. The op-amp (A1) can be a low-cost 741.

mon to a pair of anodes. Electrons can be diverted to one anode or the other by applying a positive voltage to the proper deflection plate. When the deflection plates are at the same voltage, equal currents will flow in the two anodes and the same current cancellation occurs as in the previous circuit. Applying an audio signal to the deflection plates, though, switches the beam back and forth from one anode to the other at a rate established by the modulating signal. This circuit, like the one discussed previously, produces zero output when no audio is present and a DSBSC signal when there is audio.

Fig. 7A shows a simple balanced modulator which is used in some solid-state and a few vacuum tube designs. Diodes D1 and D2 are a matched pair connected so that there is no output when only the carrier is present. A positive-going audio signal will forward bias D2 and reverse bias D1, allowing current I_1 to flow. On the negative half cycle diode D1 will conduct, allowing current I_2 to flow, while D2 is cut off. Capacitor C2 and resistor R1 are used to balance the circuit under no-audio conditions. This alignment can be performed by monitoring the signal in a following stage while adjusting C2 and R1 to produce a null.

Another version of the balanced modulator is shown in Fig. 7B. This is a circuit used in some commercial equipment. One model equipped with this circuit uses an RCA type CA3019 quad-diode integrated circuit for D1-D4,

making good use of the close match and tight thermal tracking inherent in IC diodes. One version of this type of circuit is found in small metal cases (about the size of a .047 mylar-dipped capacitor) which contains four Hot Carrier type diodes and the RF transformers. Such circuits, called *double balanced mixers*, can be made into balanced modulators by the addition of an external audio transformer.

SSB RECEIVERS

Except for the use of piezoelectric or mechanical filters in the IF stages of the SSB receiver instead of LC tank circuits, the circuits between the antenna input and the detector of a SSB receiver is fundamentally the same as those in a well-designed, conventional AM receiver.

However, the simple half-wave envelope detector used in AM receivers is replaced in SSB receivers by a *product detector*, which recovers the audio by reinserting the carrier which was removed at the transmitter. This local carrier is generated by a crystal (or sometimes, variable) beat-frequency oscillator (BFO). (Some receivers use the same BFO control switch position for both CW and SSB.)

Figs 9A and 9B show two forms of product detector circuits. In Fig. 9A, a series switching technique is used. Diodes D1 and D2 function as an electronic switch. When the signal from the BFO is going positive, D1 and D2 will be cut off. This prevents the IF signal from passing. On the alternate half cycle, though, the diodes will be forward biased and the signal will pass. These cyclic excursions of the impedance in the signal path produce the demodulation action. A pi-type RC filter removes the RF components.

EQUIPMENT FOR SERVICING SSB TRANSMITTERS

Most of the test equipment needed for repair and adjustment of SSB transmitters is the same as that needed for any two-way radio servicing. There are only a few, mostly low-cost, items needed. The one additional relatively expensive instrument needed is a peak-reading power meter.

It is advisable to have some means for viewing the SSB RF envelope on an oscilloscope. If you possess a highly sensitive, DC-to-30 MHz scope there is little to prevent you from using it, with suitable input attenuators, directly across the dummy load connected to the output of the SSB transmitter.

Those of us who are less well endowed can use even an old 500-KHz scope if it has provisions for convenient, direct connection to the vertical deflection plates of the CRT. Most older scopes have shortening links somewhere inside or under a rear cover which allow disconnection of the vertical amplifiers and direct connection to the vertical deflection plates. Build the RF "snifferbox" in Fig. 11 and connect it between the dummy load and the transmitter. A conductor inside the pick-up box is connected between the XMTR and LOAD coaxial connectors. A pick-up loop is placed close to the conductor so that a sample of the signal is induced into the pick-up loop. This signal is routed, via a coaxial REMOTE cable, to the tuning unit, which is near the scope.

Another alternative is to buy an SSB monitor scope, such as Heath's Model SB-610, which I have used for both CB and amateur radio repair. It is also possible to connect the scope to a receiver so that weak or off-the-air signals can be viewed.

When using a "non-monitoring" type of scope, it is necessary to apply a two-tone audio test signal to the transmitter modulator. Most authorities recommend one audio frequency in the neighborhood of 2 KHz and another just under 1 KHz (1800 and 800 Hz are popular). Fig. 12 shows a simple but effective mixer which makes it possible to use a pair of standard audio signal generators to develop the two-tone signal needed for SSB testing.

Alternatively, if you have two audio signal generators with outputs up to several volts, you can use a simple passive mixer made of potentiometers and fixed resistors. It will avoid the possibility of distortion, yet it still allows enough signal to adequately modulate the transmitter. ■

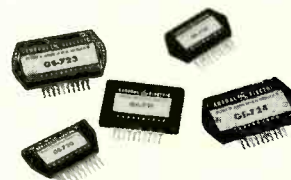
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GENERAL  ELECTRIC

Coping With ICs

By Bernard B. Daien, ET/D Contributing Editor

General troubleshooting, replacement selection, installation/removal and stocking procedures

■ Just as hand-wired, discrete circuitry gave way to printed-circuit assembly, so are printed-circuit discrete assemblies giving way to integrated circuits (ICs). The principal reasons are the same—lower manufacturing costs, elimination of human labor, and the advertising value of “something new.”

The first integrated circuits simply replaced an audio preamplifier, or some similar function, because early ICs were what we call “SSI,” (small-scale integration). As ICs were perfected, more and more devices and functions were placed on each chip, resulting first in “MSI” (medium-scale integration), and finally, what is now termed “LSI,” for, you guessed it, large-scale integration. In the computer field, this has resulted in entire computers, consisting of tens of thousands of transistors, on a half dozen chips wired together.

In the home entertainment electronics field, constant evolution has resulted in ever changing types of ICs, year after year. Now we have TV ICs called “Jungles,” each of which performs the functions of keyed AGC, AGC delay, demodulation, sync separation and audio pre-amp. You can see that any attempt to itemize each IC now in TV sets would be an exercise in

futility. The only valid approach is to consider an IC as a *function*, with an input and a desired output. This article discusses ICs from that standpoint, and also provides an IC cross-reference guide designed specifically for use by service technicians.

TROUBLESHOOTING PROCEDURES

Despite attempts to improve serviceability by service organizations and some manufacturers, ICs have moved serviceability a giant step backward. Whereas all tubes can be removed for testing, very few discrete semiconductors can, and even fewer ICs. And whereas discrete semiconductors had accessible leads for test probes, most ICs have the majority of their key connections packaged *internally*, where test leads cannot reach. Furthermore, it is a tedious, time-consuming task to unsolder most ICs.

As a result of these “characteristics” of ICs, some of the service approaches we have used for many years are no longer valid. There are no IC testers. Ohmmeter and voltmeter tests, while useful in many instances, are not able to *pinpoint* internal circuit defects in the IC.

The best approach to IC trouble diagnosis is observation of the signal input and the signal output, after first making

sure that the correct DC power supply voltages are applied to the IC. Most service shops own “service grade” scopes, but few of them are ever used by the *outside* technicians. Just as the tube tester was a standard piece of in-home test gear, so the small, 3-inch scope must now be.

To test ICs with a scope, one must know which pin on the IC is *input*, which is *output*, etc. Fortunately, some TV manufacturers are now providing schematics, stapled inside the set cabinet. Others, unfortunately, do not even label which adjustment on the tuner AFC is the discriminator, for AFC touch up.

I know that some servicers will raise their eyebrows at the thought of a technician using a scope and a schematic in the customer's house. But sets are considerably more complex than in the all-tube, black-and-white-only days. And when and if set manufacturers make *plut-in* ICs, and when and if a simple IC tester is on the market, then, and only then, will we be able to dispense with the scope and schematic.

Most schematics provide key waveforms and amplitudes. Even in their absence, experience with a scope quickly provides the servicer with insight into what to expect at each key test point, just as he learned in past years what signals and levels were to be expected in radio circuits. To view a meaningful signal, however, a signal generator that provides RF, IF, vertical and horizontal sync, video and chroma signals is needed. *All* of these signals are produced by a color-bar generator.

Most scopes come with

low-capacitance (LC) probes, which can be used for practically all service applications. If your scope is not so equipped, it would be advisable to buy such a probe, even though your scope might have a 10-megohm input resistance and low input capacitance, the shielded cable between the scope and the probe introduces enough capacitance to severely upset most circuits at TV IF and RF frequencies. In addition, a good demodulator probe is needed for RF and IF testing, because most “service” scopes are not usable above about 6 to 10 MHz. The demodulator probe converts the RF or IF to video or audio, which can be viewed on a scope.

When using a VOM for testing “live” integrated circuits, a few simple precautions will help you avoid upsetting the circuit under test. In general, it is good practice to use an isolating resistor in series with the meter test probe when testing tuned, or low-capacitance, circuits. Keep on hand a few resistors which equal the resistance of your meter at the various multiplier setting you commonly use. For example, if your meter is a 20,000-ohms-per-volt instrument and you use it on the 25-volt range, the input resistance is 500,000 ohms. A 500,000-ohm resistor in series with the test lead will act like a very effective choke. And to compensate for the error introduced by the decoupling resistor, you merely multiply the meter reading by 2.

The newer multimeters and FETVOMs have a *low-power* ohmmeter range which does not put out enough voltage to turn on, or forward bias,

a semiconductor junction. This feature permits you to take in-circuit resistance readings without semiconductor diode action causing false indications.

COMMON FAILURES

The most common IC defect is the failure of the internal connections between the chip and the pins on the package. These wires are about a thousandth of an inch in diameter, or one-fourth the thickness of a human hair. They must be welded at each end. These welds often fail after factory testing, usually at the rate of about 1 to 2 percent a month for the first few months.

Most other IC failures are caused by overheating, overvoltage, or overcurrent, often as a result of the failure of a passive component such as a coupling capacitor. There are no failures caused by "wearout," because ICs have lives in the millions of hours.

Before replacing an IC which has failed, it is advisable to make sure, with the IC out of circuit, that the proper voltages and currents are applied to its terminals. Vacuum tubes are tolerant of error; a red plate warning of overcurrent, for example. But the IC goes out in microseconds, with no noise, no flash, no warning at all.

When testing the voltages applied to an IC, remember that an incorrect voltage might be caused by an internal short in the IC or, with equal probability, it might be caused by a defect in the voltage source or by a shorted bypass or coupling capacitor. When you troubleshoot a tube-equipped circuit, you probably sometimes remove the tube to de-

termine if the fault is the tube or in the associated circuitry. The reverse procedure is true with soldered-in ICs. It is easier to open one lead of a coupling or bypass capacitor or disconnect a supply lead than it is to remove the IC.

ICs ON MODULES

As most servicers probably will agree, a module is simply a small printed-circuit board which can be easily removed. Why then should it be treated differently than any other PC board in the set simply because it is more easily removed? The only useful advantages of modules are that they permit you to delay the actual repair, and, in some cases, they help you return a set to normal operation without removing it from the home. After you replace a module, you have to either repair it later or return it to the manufacturer. All modules which can be diagnosed and repaired in the home should be so repaired, except for those of manufacturers whose in-warranty policies prohibit it. Modules which can or must be repaired in the shop can be repaired on those days when there is insufficient work. It is almost always less expensive to repair a module than to spend the time and gas (or postage) to "trade it in" for a small allowance. And after repairing a few modules, the tech will acquire the knowledge and confidence to do most of them in the home, since many of the problems are recurrent ones.

IC testing is the main troubleshooting problem with modules since discretes on them usually are easily tested. And again, removing and resoldering the IC usually

leaves the PC board in poor shape because of the heat required over a large area. For this reason it is essential to know if the IC is good or bad *before* unsoldering it. Because the IC has no signal inputs or power when the module is removed from the set, it is advisable to signal trace and diagnose *before* removing the module.

Some set manufacturers supply troubleshooting charts and/or lists of common module component failures. With these, troubleshooting modules becomes a relative easy task. It is worth the effort to obtain such troubleshooting aids from the manufacturer or his distributor. Ordinarily, I do not like the "case history" approach to servicing. I feel that it is usually better to use a systematic approach instead of trying to recall someone else's experience. However, because modules are difficult to troubleshoot on the bench, particularly without power or signal inputs applied to the module, the "case history" approach is often quicker for modules than the systematic approach to troubleshooting.

SELECTING A REPLACEMENT IC

Some ICs are peculiar to one brand of set. Some are relatively common types, but have been selected to some special specification of the set manufacturer and therefore are not directly interchangeable with the standard version of that IC.

To alleviate this situation, several of the larger set manufacturers now are improving semiconductor parts stocking for replacements. However, it should be noted that Zenith, RCA (SK Series),

International Rectifier, General Electric, and Sylvania, all have disclaimers in their cross-reference lists which state, in various terms, "...we cannot guarantee that the listed items are an exact replacement in all instances."

As a rule, non-"original" replacements for discrete transistors (bipolar) used at frequencies up through the broadcast band are relatively safe. At 40MHz (TV IF) and up, replacement with non-"original" is not very reliable. FETs and ICs are problems at any frequency. Non-"original" diodes, on the other hand, usually operate well up to UHF, but UHF mixer diodes usually must be replaced with *exact* "original equipment" replacements.

It is my opinion that you are better off buying an exact replacement IC, unless circumstances force you to do otherwise.

There is sometimes an alternative. For example, ICs for an imported brand of cassette tape recorder are difficult to get, but an entire PC board can easily be bought, and it has four ICs on it. Smart servicers buy the board, remove the ICs, and use them for replacement parts. This system, or variations of it, can be used, especially in the hi-fi field, and it can keep you going in a pinch.

It is difficult to explain these "emergency measures" on most manufacturers' in-warranty service forms. I do not know how to beat that game, and apparently neither do most other servicers. One way might be to charge the customer and let him fight the manufacturer for a refund. The customer has more muscle with the man-

ufacturer than you do, since you are "on the hook" once the work is performed and you are trying to recover your expenses. Once the customer has your bill in his hand, he is armed with the "facts," which can be presented to the appropriate consumer protection agency, if necessary. (Unfortunately, there are no service shop protection agencies to assist the servicer in obtaining payment from the set manufacturer for in-warranty work.)

At times, a direct replacement IC is not available, or not available within a reasonable time. For such occasions, the accompanying IC interchangeability list is provided. Regretfully, "it cannot be guaranteed that all items will perform exactly as the original in all applications," to quote some replacement parts cross references.

I suggest that you photocopy this list and add to it as new products are introduced by the various manufacturers.

Voltage regulator ICs are rapidly becoming standardized, and are cataloged by voltage rating. They should be no problem, regardless of the maker.

GENERAL STOCKING CONSIDERATIONS

ICs have been coming on strong the last few years, and the stocking picture has changed accordingly. Because most late-model "big name" brands of TV are equipped with ICs, stocking ICs is not only justified but essential. The price of many ICs is now down to the level of what transistors were only a few short years ago.

Determining which ICs to stock is a matter of knowing which brands of

TV IC INTERCHANGEABILITY

Chroma Amplifier

RCA SK3076	IR IC510	GE IC-6	Sylvania ECG715	Motorola C6071P
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Chroma Demodulators

RCA SK3074 (CA3076)	IR —	GE —	Sylvania ECG729	Motorola —
SK3077 (CA3072)	IC508	IC-5	ECG713	C6057P
SK3134	IC502	—	ECG705A	C6089

Chroma Amp/Demod

RCA SK3149 (CA3121)	IR —	GE —	Sylvania —	Motorola —
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Chroma Signal Processors

RCA SK3073 (CA3066)	IR —	GE —	Sylvania ECG728	Motorola —
SK3075 (CA3070)	IC509	IC-4	ECG714	C6070P
SK3167	—	—	—	C6075P
SK3170	—	—	—	C6085P

Sound IFs

RCA SK3022 (CA3014)	IR IC501	GE —	Sylvania ECG704	Motorola —
SK3023 (CA3013)	IC501	—	ECG704	—
SK3072 (CA3065)	IC507	IC-2	ECG712	C6063P

Sound IF/Limiter/Quad Detector

RCA SK3135 (CA2111)	IR IC504	GE —	Sylvania —	Motorola C6062P
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Sound IF/Limiter/FM Detector/1st AF Amp

RCA SK3101 (CA3041)	IR —	GE —	Sylvania ECG706	Motorola —
SK3102 (CA3042)	IC506	—	ECG710	—

Video IF

RCA SK3143 (CA3086)	IR —	GE —	Sylvania —	Motorola —
SK3168 (CA3075)	—	—	—	C6076P

AFC Circuits

RCA SK3070 (CA3044)	IR IC514	GE —	Sylvania ECG711	Motorola O6069G
SK3141 (CA3064)	—	—	—	C6069G

Note: RCA ICs are shown with two numbers. The SK number is the replacement type, packaged for the service trade and hobby use. The CA number is for OEM (original equipment manufacturer) use. When an OEM distributor is available, the part usually can be purchased at a savings under the CA number.

TV are sold in your particular area. In some areas, Zenith is a big seller, in others it's RCA, etc. And of course the service/dealer should handle the ICs for the sets he sells. However, for the independent servicer who services all brands, the stocking problem is more serious. An approach which helps the independent servicer is the "kit," or assortment, offered by several companies. With a kit as a starter, you have most of what you will need. You can then replace what you use, and eventually get rid of the slow moving items without large expense, since the kits are often offered as a "deal."

Some servicers are wisely taking advantage of price cuts on volume buys of ICs. They then resell ICs to other servicers who do not have the volume of business to warrant buying in quantity. The smaller-volume servicer is often willing to pay a "good price" for the convenience of being able to quickly obtain the IC locally, so everybody winds up happy and profitable.

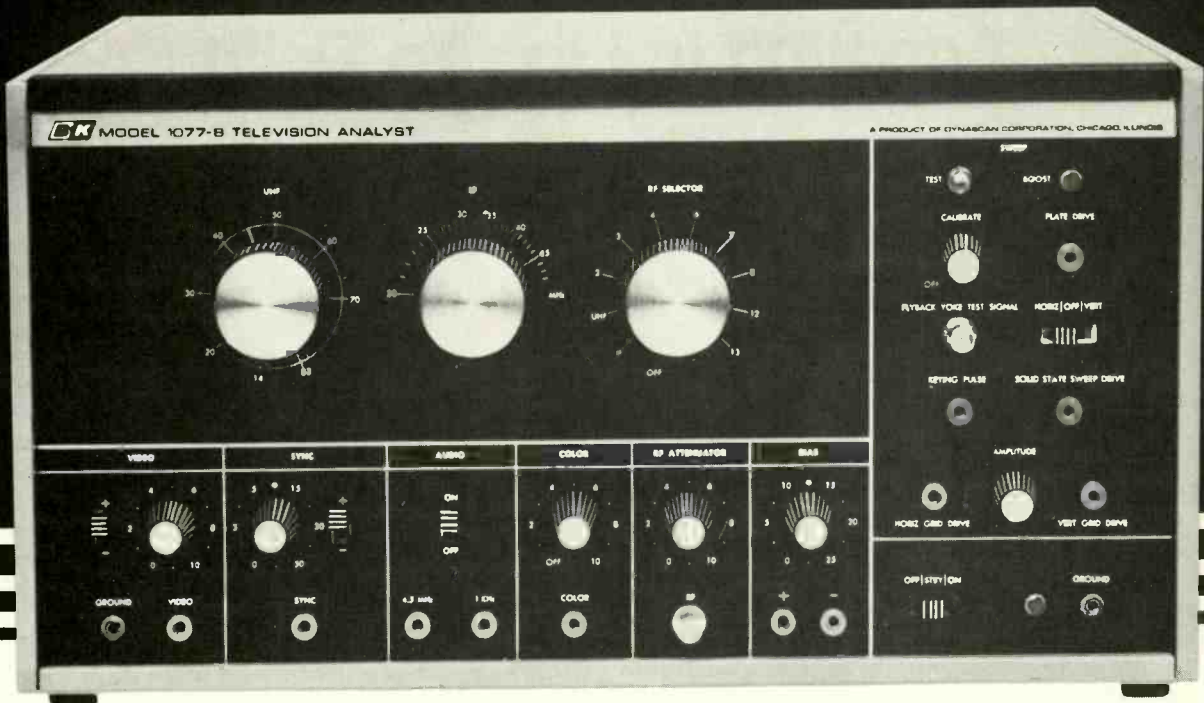
REMOVAL/INSTALLATION TECHNIQUES

Some ICs are heat sunk. If grease was used in mounting the IC, fresh heat-sink grease must be used on the replacement. Lack of grease reduces the heat conductivity, which causes overheating of the IC and premature failure.

There are now enough types of ICs in the 14- and 16-pin dual-in-line package to warrant buying a soldering iron tip designed to simultaneously unsolder all pins on the package. The only other alternatives are 1)

continued on page 41

the only prime time test pattern.



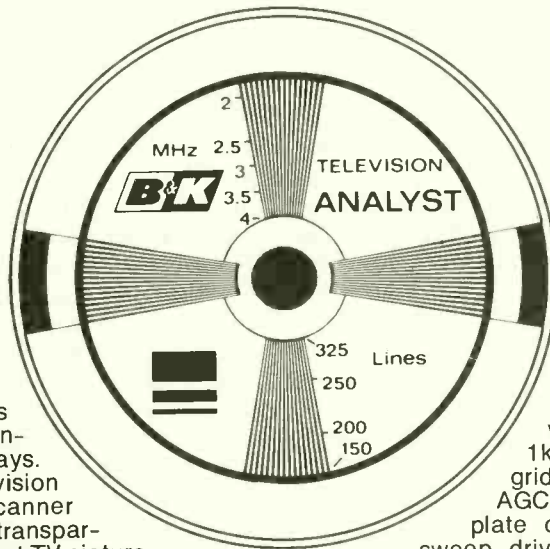
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Adapting In-Line To Delta

By Pat McGee*

An Adapter you can build and use for testing in-line color CRTs with conventional picture tube testers and color CRT test jigs

■ Although the socket of a picture tube tester or color CRT test jig originally designed only for delta-type color CRTs might *physically* fit the base of an in-line picture tube, there still will be an *electrical mismatch* because the related functions of most of the pins on the base of the in-line CRT do not correspond to the related functions of the same pins on the delta-type socket.

These differences in pin number-to-function relationships are shown in the chart in Fig. 1. For example, pin 2 of the in-line color CRT is connected to the green screen grid (G2G), whereas the same pin on a delta-type color CRT is connected to the red cathode (KR).

Also revealed in Fig. 1 is the fact that the *heater* (1 and 14) and the *focus* (9) pins of the two types of color TV picture tubes are the *same*. Because of this, a CRT tester designed originally for only delta-type tubes will light the heaters of an in-line tube, but, because the functions related to the other pins of the in-line tube are different from those on the delta type, the CRT tester will indicate *erroneously* that the in-line tube is *shorted*.

The adapter in Fig. 2, by physically compensating for these electrical differences between the base pins of in-line and delta-type color CRTs, makes it possi-

ble to test in-line color TV picture tubes with CRT testers originally designed for only delta-type picture tubes, and, in addition, makes it possible to substitute in-line color CRTs with a color TV test jig equipped with a delta-type CRT.

To build the adapter illustrated in Fig. 2:

- 1) Obtain from your local electronic parts distributor (or some other source) an in-line and a delta-type picture tube extension cable.
- 2) Cut both extension cables in two so that about 4 to 6 inches of wires remain on both the *in-line* sock and the *delta-type plug*.
- 3) Strip about ¼ inch of insulation from the loose ends of the wires connected to the socket and the plug.
- 4) Using Fig. 1 as a guide, connect each of the pin wires of the in-line socket to the pin wires related to the *same function* on the delta-type plug. (The pin holes on the in-line socket are numbered in sequence CCW from the key slot, as shown in Fig. 2, and the numbers are printed next to the pin holes on most in-line sockets. The numbers of the pins on most delta-type plugs are *not* printed on the plug; however, the number of each pin can be determined quickly by holding the plug so that the pins are pointing toward you and then counting CW from the *right* of the key.)
- 5) After soldering together all related wires, individually wrap the base area of each with electrical tape, and then, if you feel it is necessary, wrap them all together. ■

*The author is a district field service manager for GTE Sylvania.

ELEMENT	IN-LINE PIN NO.	DELTA PIN NO.
Heater	1	1
Green Screen (G2G)	2	5
Green Control Grid (G1G)	3	7
Red Cathode (KR)	4	2
Red Screen (G2R)	5	4
Red Control Grid (G1R)	6	3
Green Cathode (KG)	7	6
NO CONNECTION	8	8
FOCUS	9	9
NO CONNECTION	10	10
Blue Cathode (KB)	11	11
Blue Screen (G2B)	12	13
Blue Control Grid (G1B)	13	12
Heater	14	14

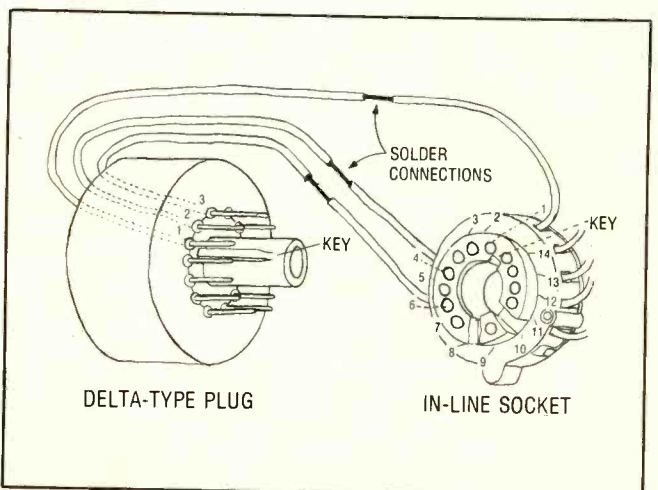


Fig. 1—Chart which lists the elements and corresponding pin numbers for in-line and delta-type color TV picture tubes.

Fig. 2—Line drawing which illustrates the construction of the in-line-to-delta adapter.

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Home Entertainment Electronics 1976

By Joseph Zauhar

■ Home entertainment electronic products for 1976 do not include many drastic changes in design.

Citizens Band radio and accessories are probably the hottest line of electronic products for the coming year. The unprecedented increase in CB product sales has attracted a number of new manufacturers into the market.

CB products are expected to double the retail sales of last year. Survey figures show that the FCC (Federal Communications Commission) applications for Class D citizen radio licenses for the first quarter of the year has increased approximately 186 percent compared to the same months last year.

Some of the new offerings feature automatic noise limiter, squelch control and built-in PA systems.

An increasing number of TV manufacturers are offering more small screen b/w and color TV sets because of increased consumer demand, but the overall number of TV models is reduced. More small screen b/w TV's which operate on AC/DC or battery are available.

Most of the major U.S. TV suppliers have announced a four to six percent price increase, and the service warranties are cut back from one year to 90-days.

Hitachi has retained the one-year labor warranty on color TV mod-

els. Other manufacturers offering a one-year service period are Toshiba, Sharp, MGA and Quasar on parts of its new line. Sanyo retained its two-year labor warranty.

Technological advances in color TV include more in-line picture tubes, more all-electronic tuning, more



A six-button electronic hand control is part of a new electronic remote control system offered by Zenith. Pressing the ZOOM button enlarges the center of the color TV picture fifty percent. Courtesy Of Zenith.

integrated circuits and energy-saving, solid-state chassis.

More of an effort will be made to boost four channel sound sales, which at present represents less than five percent of the overall retail audio product sales. Four-channel software sales are improving, with more DC-4/Quadrads and SQ matrix records now available.

Manufacturers of commercial video games will make a play for the consumer market. Magnavox, who is credited with introducing the

video games, is now offering more games with sound.

COLOR TV

Zenith-Zenith will move into the 1976 model year with a new 13-inch (diagonal) color TV set, a new electronic tuner and a ZOOM control which enlarges the picture approximately fifty percent.

The 13-inch color TV is the company's first 110 degree, in-line, small-screen receiver employing the Chromacolor negative guard band matrix color picture tube. The 13GC10 chassis will be used in the 13-inch receivers featuring a vertically constructed, modular chassis and a 25-kv high-voltage power supply. The all-solid-state chassis features Zenith's Power Sentry voltage regulating system.

A new 18-position electronic tuning package puts VHF and UHF channels on one rotary tuning knob to make channel selection easier than on previous TV sets. The VHF or UHF tuner has no moving parts or contacts to wear out. The VHF channels are preset at the factory. Six positions are provided for customer tuning of UHF channels.

An 18-position rotary mechanism selects the tuning voltages which tune the varactor tuners to the desired channels. The tuning system is used in 13 of the new TV receivers.

Another innovation in the color TV line is the Space Command 1000 with a ZOOM feature that puts an instant close-up at the viewer's finger tips. To operate, the viewer presses the ZOOM button on the remote hand unit and the TV picture is enlarged approximately 50 percent. The enlarged center of the raster is accomplished by increasing both the horizontal and vertical currents through the yoke windings. During the "ZOOM" mode, increased contrast and enhanced color levels are obtained through special circuits and the horizontal and vertical blanking pulses are substantially widened to eliminate the reflected beam during the same period. The ZOOM feature will be employed in Zenith's 19V and 25 V chassis.

All Zenith color TV sets are covered by in-warranty service labor for the first 90 days, a one-year warranty on all parts, and a two-year warranty on the picture tube.

Quasar Electronics Corp.—Quasar Electronics new product line includes 13-inch and 15-inch TV sets equipped with the new QMX-1 color TV chassis, which employs the Quintrix picture tube, first offered in Panasonic color TV sets.

The new solid-state chassis employs three circuit boards; most of the components are mounted on two boards in a slip-out design for accessibility. The third board is located on the picture tube socket. It employs four integrated circuits, virtually the entire color processing system.

Both the portable and large-screen consoles

Skyrocketing sales of CB equipment and accessories, which, in turn, have attracted more manufacturers

Roll back of most color TV labor warranties to 90 days

feature "Super Insta-Matic" color tuning and an electronic light sensor which adjusts the set to room light conditions.

The company continues to offer a limited one-year color TV in-home labor warranty on designated 19-inch (diagonal) console models. The 13-inch and 15-inch (diagonal) color TV models carry 90-day limited carry-in labor warranties.

GTE Sylvania—Introduced is an all-solid-state line of 49 color TV sets, and five home entertainment centers which are TV/stereo combinations. Forty-four of the receivers now feature GT-Matic tuning. The line includes 13-, 17-, 19-, 21- and 25-inch diagonal screen sizes. The 15-inch screen size has been discontinued.

Most of the models feature Sylvania's Dark-Lite 50 and Dark-Lite negative guard band, black matrix picture tubes, with dark

faceplates which absorb room light. Twelve models have Chroma-Line in-line picture tubes.

Sylvania will be introducing new models in its Philco TV line in August.

Magnavox—Magnavox has expanded the use of its STAR electronic remote control tuning system, which was first introduced last year, to more models for 1976. This tuning feature is now available on four 19-inch color TV sets.

All color sets feature the negative-matrix picture tube.

A new color TV chassis, called the T991, is used with the 19-inch, in-line picture tube. The chassis is similar to the design concept of the T995 chassis and employs 10 plug-in modules. The new chassis has 168 fewer parts and 80 feet less internal wiring. Most of the modules are interchangeable with either the T995 or the T985/T986 chassis.

All new models carry a



Magnavox's 19-inch diagonal color TV console Model CF4481, will employ the new T991 chassis in conjunction with the STAR Remote Control System. Courtesy Of Magnavox.

90-day labor warranty.

Admiral—The Admiral Group of Rockwell International Corp. has introduced 10 new 25-inch console color TV sets. The line features a new solid-state, modular, AQII chassis.

The color TV line also features an Equal Ease UHF tuning system, which has click-stop positions for all 70 UHF stations.

General Electric—The "Y" color TV chassis is used in all 13-, 17- and 19-inch diagonal color TV sets. This chassis has a swing-away feature to allow access to seven modular sub-assemblies, which contain approximately 90 percent of the components on the chassis.

Three 19-inch solid-state color TV sets, called "The Townhouse Collection," are designed to provide the look of a console TV set but in a more compact size. All three are equipped with an in-line, slotted-mask, black matrix color picture tube.

Panasonic—Two color TV portables, Model CT-215, with a 12-inch diagonal screen, and Model CT-905, with a 19-inch diagonal screen, are equipped with a new chassis which employs one third less components than Panasonic's previous chassis. With fewer components, the new chassis operates more economically and reduces necessary wiring from 46 feet in the most recent chassis to only 14 feet. The new chassis is used in conjunction with the company's "Quintrix" color picture tube.

The third new color TV is a battery-powered color portable, Model CT-552, with a 4½-inch diagonal screen. The chassis employs a three-way "Sure Power"



Panasonic's Model CT-552 color TV set employs a three-way power supply system which allows it to operate on AC, built-in rechargeable batteries, or car/boat battery. Courtesy Of Panasonic.

system which allows it to operate on AC, built-in rechargeable batteries or a car/boat battery. Its maximum power consumption on AC is 22 watts.

RCA—RCA's "U-line" color TV includes a variety of screen sizes. All models feature the familiar solid-state XL-100 chassis.

A variety of 21- and 25-inch (diagonal) table and console models (some with remote control) feature the familiar CTC68X chassis.

Models with a 19-inch (diagonal) screen, including one remote-controlled TV set, feature the CTC76 chassis.

Small-screen portable color TV models (15- and 17-inch) feature the CTC72 chassis, which is designed to operate with RCA's in-line color picture tube.

B/W TV

RCA—Eleven new models of black-and-white, all-solid-state TV sets are introduced in four popular screen sizes: 9-, 12-, 16- and 19-inch.

The new KCS201 and KCS202 chassis employ three plug-in Accu-Circuit modules.

The KCS201 chassis features three-way (AC/internal battery/exter-

Fewer new color TV models and chassis with increased emphasis on small and medium size screen portables and more all-electronic tuners and in-line color CRTs

nal battery) operation and is used in the 9- and 12-inch TV sets. The internal battery pack provides up to four hours of operation.

The KCS202 chassis is in many respects similar to the KCS200 chassis, which it replaces. This chassis will be employed in 16- and 19-inch TV sets. Of particular interest is the full-wave bridge power supply which enhances voltage regulation and filtering.

Also included in the new models is a new fast-warm-up picture tube, which provides a picture within about six seconds. All models are equipped with "New Vista 100" VHF tuners that employ two MOS transistors.

Quasar Electronics Corp.—Quasar's newest 12-inch (diagonal) portable b/w TV set employs the 12TS481 chassis, which is all solid state except for the CRT. Most of the circuitry is placed on one etched circuit board. Twenty-four transistors and one integrated circuit are

employed. The chassis slides back for total access to the circuits without removing any screws. Other features include regulated power supply retrace blanking of both vertical and horizontal circuits, and 14 kv picture tube second anode voltage.

AUTO STEREO EQUIPMENT

Auto stereo manufacturers are anticipating even a greater year for the autosound industry than last year, when the industry made a 15 percent increase over previous peak sales periods.

The increases were attractive enough to attract General Electric, Sankyo Seiki and MGA into the auto stereo industry.

Motorola announced it is working on a discrete four-channel auto radio in anticipation of an early FCC ruling on discrete FM broadcasts.

It is generally agreed between auto stereo manufacturers and dealers that in-dash equipment sales will match or surpass the demand for

under-dash equipment, obviously because of the built-in security of in-dash equipment.

CB TRANSCEIVERS/SCANNERS

The surge of CB product sales not only attracted an increasing number of new manufacturers into the market, but they now include combination units.

CB radio products are now offered with built-in tape players, AM/FM/FM multiplex radios, and a CB Transceiver/Scanner such as the one offered by Bowman Astrosonix.

The unit is a 23-channel CB transceiver/scanner Model CB-750,

scanning monitor. The Bearcat Model 101 is totally synthesized, and features a re-programmable custom-integrated circuit.

In addition to receiving the Low (30-50 MHz), High (148-174 MHz), UHF (450-470 MHz) and T (470-512 MHz) bands, it will also receive the 2-meter Ham Band, and UHF frequencies from 416-450 MHz.

The unit scans 16 channels, with individual lock-out switches provided for each channel. It will receive more than 6,000 Public Service frequencies, all without crystals.

VIDEO SYSTEMS

Although there were indications that relatively low-cost video disc player systems might be introduced during model year 1976, to date only relatively high-cost tape type

Absence of relatively low-cost add-on video players

offering automatic noise limiter slide control, rotary squelch control, color-coded channel selector with lighted channel indicator, tune modulation receive beacon, positive or negative ground, pushbutton scan control and external speaker jack.

General Electric—Introduced is a tunable scanning radio called the "Searcher." The Model 7-2995 scanning radio automatically scans up to four channels on the Public Service high band as well as receiving FM and AM broadcasts. The unit can be re-tuned for reception in any part of the country.

The Electra Co.—Bearcat is said to have introduced the first five-band synthesized

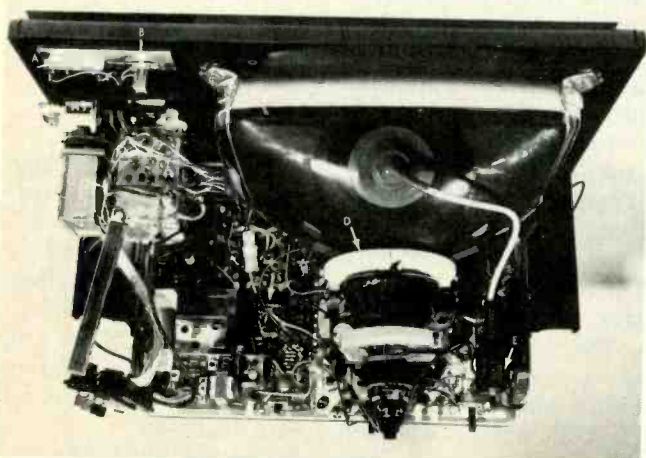
video systems are offered.

A limited market entry will be made in the fall by Sony Corp. of America. The firm's new "Betamax" home video recording system consists of a tape type player-recorder, a 19-inch Trinitron color receiver/monitor and a digital timer, all in one cabinet. The system has a retail price of \$2,295.

It can be employed to record TV programs off the air, or live pictures with a video camera accessory. The recorder accommodates a new, one-hour, half-inch video cassette.

Other possible entries in the home video player market are the video disc systems developed by

continued on page 41



Quasar Electronics Corporation's QMX-1, all-solid-state, color TV chassis is employed in the 13- and 15-inch diagonal color TV portable models. Courtesy Of Quasar Electronics.

CP Applied To TV

By Harry Greenberg*

A new ghost-reducing method of propagating and receiving TV signals

■ There recently were conducted in the Chicago area a series of on-the-air experiments of a method of propagating and receiving TV signals which, if it proves technologically and economically feasible, will significantly reduce TV ghosts caused by reflected signals.

Called *circular polarization* (CP), this method of propagating and receiving RF signals has been known for years but until now has not been applied successfully to TV broadcasting and reception.

A radiated electromagnetic wave traveling through space has two components—the magnetic and the electrostatic—which are at right angles to each other. If the *electrostatic* component is horizontal, the signal is *horizontally polarized*. If the electrostatic component is vertical, the signal is vertically polarized. The American system of TV broadcasting uses horizontal polarization.

To visualize the characteristics of a circularly polarized wave, think of the transmitting antenna as a dipole which is rotating like a propeller at a given TV frequency. The resultant circularly polarized wave radiated by the rotating antenna can be represented by a twisted ribbon in which each null equals a half wave. The amplitude of the electric field of the circularly polarized wave does not vary sinusoidally as does a conventionally radiated wave but, instead, remains constant, with rotation in either direction. However, when viewed at right angles to the direction of propagation, the circularly polarized wave appears to vary sinusoidally like a conventionally radiated wave. Consequently, an ordinary linear antenna positioned in any plane at right angles to the direction of propagation will

pick up the circularly polarized signal as if it were a conventionally radiated wave.

In actual applications, the effects of the previously visualized mechanical rotation can be provided by two crossed dipoles connected with a quarter-wave phasing harness, and the direction of twist, or rotation, can be reversed by transposing the harness connections.

As stated earlier, the principal benefit of circular polarization is the reduction of ghosting caused by reflected signals arriving slightly later than the direct signal. Although the phase of a conventional horizontally polarized wave is reversed when the wave is reflected from a surface, the reflected signal is still picked up by a horizontally polarized antenna. However, when the horizontal component of a circularly polarized wave is reflected from a surface, its *direction of rotation is reversed* (the same effect as transposing the harness between the two dipoles). Because the receiving antenna will pick up only the direction of rotation of the direct signal, the reflected signal with reverse rotation is not picked up and, thus, ghosting is eliminated or significantly reduced.

Another advantage of CP is that as long as a linear antenna is positioned at right angles to the direction of travel of the circularly polarized wave, it will pick up equal levels of signal from the wave regardless of the relative vertical or horizontal position of its elements. This characteristic will provide better reception from

properly designed indoor antennas, whether they are built into the set or are free standing. The elements of such antennas generally are not (or can not be) adjusted so that they are completely horizontal, and to the extent that they are not, a portion of the horizontally polarized signal is lost. CP will overcome this problem because, with CP, the horizontal alignment of the indoor antenna dipoles will not matter.

CP will not come cheaply to TV stations. One of the consequences of radiating a circularly polarized wave as compared to a horizontally polarized wave is that at any given location the radiated power is cut in half (reduced 3 dB). A method of compensating for this loss must be achieved. Two methods are being considered: doubling the power or increasing transmitter antenna gain. A combination of these alternatives is also possible. Whatever the solution, TV stations are faced with substantial investments in order to provide the benefits of circular polarization to the viewing public. High- and low-band transmitting antennas for CP have already been developed, and work is continuing in this field.

However, once a TV station converts to CP, the use of a CP receiving antenna will provide 3 dB more signal than an equivalent linearly polarized receiving antenna. This is true regardless of which means the station uses to compensate for the inherent power loss of CP.

Adoption of circular polarization will stimulate a whole new generation of TV receiving antennas. With these will come better reception for the viewing public and new profit potential for TV antenna installers. ■

*The author is the Chief Electronics Engineer of antennas & accessories of the Channel Master Division of Avnet, Inc.



Bars are one of many hot prospects for the TRC-12 TV remote control system.

Profit From Remote Control

A unique universal TV remote control system—how it operates and how it can mean added profit for dealers and servicers By Lon Cantor

■ Jerrold Electronics recently developed a universal TV remote control called the TRC-12, which can be attached in minutes to any TV set. It turns the set on and off, selects channels and fine tunes it.

Remote channel changing is accomplished in the TRC-12 by a varactor - diode-equipped oscillator. Because the frequency of a varactor diode oscillator can be changed by varying the bias voltage, the TRC-12 design has eliminated the need for physically rotating a

tuner shaft. Another advantage is that you can go directly from Channel 2 to Channel 10, without clicking through intermediate channels.

HOW IT OPERATES

The TRC-12 consists of two units: an *RF converter* unit, which usually is attached to the back of the TV set (Fig. 1), and a remote control channel selector unit, which is connected to the RF converter unit via a 25-foot control cord.

Fig. 2 is a block diagram of the TRC-12. The key stage is the variable

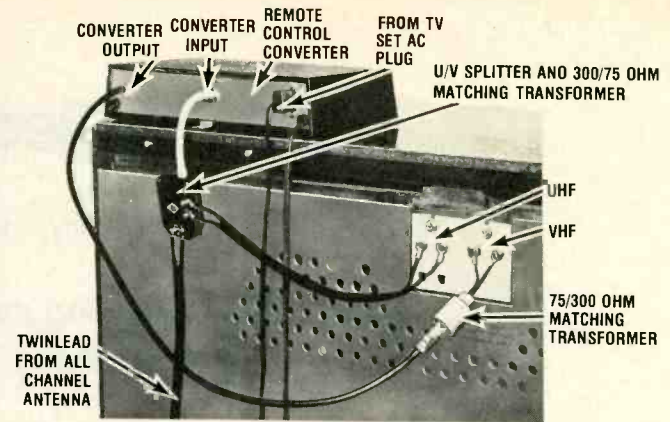


Fig. 1—How the TRC-12 RF converter output is connected to a TV receiver via a 300-to-75 ohm matching transformer. The matching transformer is not required for TV receivers equipped with a 75-ohm VHF antenna input.

oscillator, which is controlled by a varactor diode. The frequency of most TV tuner oscillators is varied by manually tuning one or more LC tank circuits. The control mechanism itself is generally a variable capacitor or a variable inductor. To give contemporary TV sets detent action, their variable oscillators are tuned by a series of contact points which select specific LC circuits. On the other hand, the frequency of an oscillator equipped with a varactor diode(s) can be varied simply by changing the bias voltage of the diode(s). Channel changing involves nothing more than sending the correct voltage to the varactor diode.

The TRC-12 remote control has a series of 12 pushbutton switches, one for each VHF channel. Each switch selects a voltage divider network which determines the precise voltage to be sent to the channel selector.

The fine tuning control makes minute, continuous changes in the varactor biasing voltage. Generally speaking, however, once the TV set fine tuning and the TRC-12 fine tuning are adjusted to the centers of their ranges, no fine tuning is required when switching

from channel to channel. And, varactor oscillators are very stable.

The power supply is in the separate converter unit, which usually is attached to the back of the TV set. A low voltage is supplied to the remote control unit via a 25-foot control cord. The remote control, in turn, sends the appropriate biasing voltage to the variable oscillator.

Because the maximum voltage carried over the control cord is 20 volts DC, at very low current, it is completely safe. There is no danger of shock, even if the family dog should bite into the control cord. The TRC-12 is listed by Underwriter Laboratory.

Incoming VHF signals are filtered, to prevent oscillator signals from being radiated out of the converter input, and then are sent to the first mixer stage. There, the incoming signals mix with the variable oscillator output, which has been sent through a buffer stage. The output of the first mixer is an intermediate frequency (IF), which goes through a filter and an amplifier stage on its way to the second mixer. There, it is mixed with the output of fixed oscillator, down converted to Channel 2 or Channel 3 (depending on which

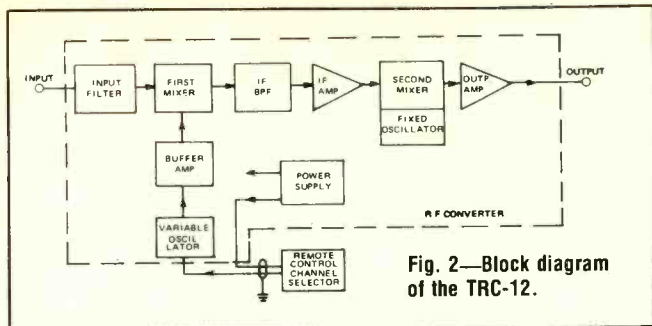


Fig. 2—Block diagram of the TRC-12.

channel is unused in the area) and sent to the output amplifier. (There are two TRC - 12 models: TRC-12-2 with Channel 2 output, and TRC-12-3 with Channel 3 output.)

The output of the converter is a strong, clean Channel 2 or Channel 3 signal, which may be sent through a matching transformer to the TV set's "VHF ANT" terminals.

The converter includes an AC convenience outlet into which can be plugged the TV set power cord. The set must be plugged into the convenience outlet if it is to be turned on and off by the remote control.

"Instant on" TV sets normally have power applied to the tube filaments at all times. However, when connected to the TRC-12, the filaments of such receivers get power only when the remote control on/off rocker-type switch is in the *on* position. Although there is a short delay until the picture comes on, this slight inconvenience is compensated for by the savings in electrical power.

HOW DEALERS AND SERVICERS CAN PROFIT FROM IT

Dealers can profit from remote controls in a variety of ways. The most obvious way to sell it is with new TV sets. A recent study showed that 44 percent of color TV set buyers want remote controls enough to be willing

to pay for them. However, the dealer often finds it difficult to sell remote controls because the one or two remote-control-equipped models he stocks are too often not the exact size, make or cabinet style the customer wants. To do a real job with remote control, the dealer would have to stock a remote version of most sets on his sales floor.

Alternatively, the dealer can use a single TRC-12 remote control with any TV on his sales floor. If he equips the output of the remote control with a clothespin-type clip, he can quickly and easily move the remote control from set to set.

One way to dramatize the TRC-12 universal remote control is to connect it at the input of the showroom MATV amplifier. Then, when a remote control channel button is pushed, every TV set on the floor changes channels simultaneously. This gives the salesman a way to get the customer's attention and sell him on the features of the remote control.

A side benefit of the TRC-12 is that it clears up certain kinds of interference. Many MATV systems are plagued by "direct pickup" ghosting. Signals are picked up by the length of twinlead between the MATV system and the TV tuner. This signal arrives at the TV tuner a few microsec-



Jerrold's TRC-12 universal TV remote control system. Unit on Top of the receiver is the RF converter, and the unit on the chair-side table is the control unit.

onds ahead of the antenna signal, resulting in a leading ghost. Because the TRC-12 remote control converts all incoming channels to an unused channel (2 or 3), there is no possibility of direct pickup interference.

Also, because aging tubes or components in some tuners produce noisy pictures, the TRC-12 often improves reception.

Its ability to clean up interference makes the remote control especially easy for technicians to sell in the home. Suppose, for example, that you have just repaired a color set in an apartment house and you notice a leading ghost. You can say something like, "Well, your TV set is back to normal, but I'd like to try to get rid of that faint outline to the left of the picture. It's called a 'ghost' and it's caused by direct pickup. I have a unique new product that gives convenience as well as eliminating interference of that type."

Then, hook up the TRC-12 and demonstrate it. Chances are that the combination of improved pictures quality and the convenience of push-

button remote control will make the customer eager to buy the remote control.

Remote controls can easily be promoted as gifts, especially for elderly and bedridden people. They are ideal for nursing and convalescence homes, as well as hotels and motels.

One excellent place to sell remote controls is in bars. TV sets in bars are usually placed up high, so customers can see them. Consequently, the bartender usually has to climb up on a stool to change channels. Some technicians have done very well simply by installing TRC-12's in bars on a 30-day free trial basis. Once the bartender gets used to the convenience of the TRC-12 remote control, he simply doesn't want to give it up. Most remote controls installed on a free basis are eventually purchased.

CONCLUSION

A product like the TRC-12 seems like a natural for consumer electronic dealers and servicers. And with a suggested list price of \$99.50 and a dealer/servicer net of \$65.00, the profit seems right too. ■

TEST INSTRUMENT REPORT



B & K Model 280 Digital Multimeter. For more information about this instrument, circle 100 on the READER SERVICE CARD.

B & K MODEL 280 DIGITAL MULTIMETER

■ The first important noticeable features of the B & K Model 280 Digital Multimeter is its compact size, easy to read large 3-digit LED readout, self-contained power supply for portability, and the fact that it is priced about the same as analog meters. The basic design features of the instrument makes it an ideal replacement for existing multimeter and FET/VOM's.

The multimeter has 22 ranges and measures DC and AC voltage, current and ohms. It has a high input impedance (10 megohms) on all voltage ranges, and a wide resistance measurement range (100 ohm full range to 10 megohms full range).

A HI/LO Ohms feature, generally not available on digital multimeters, permits making in-circuit resistance measurements at voltage levels below the threshold conduction of semiconductors.

The multimeter operates from four "C" cells or AC with option Charger/Converter. The Charger/Converter is designed for use with "C" size Ni-Cad batteries or to prolong the useful life of zinc-carbon or alkaline cells, and plugs into a jack located on the top of the instrument case. The approximate life of alkaline batteries in continued use is better than 50 hours.

To make a battery test, simply set the multimeter to the 10-volt DC range and insert the positive lead probe into the battery test terminal on

the right side of its case. Replacement of the batteries can be made by loosening the captive screw on the back cover.

Other features of the instrument include: a minus (-) indicator will be displayed on DC volts or DC current for a negative voltage or current respectively. The positive (+) sign is implied and is not displayed. Each display indicates numerals from "0" to "9" and also serves as an over range indicator by flashing all three displays when the input exceeds the value of 999. The negative test leadjack doubles as the 1 amp fuse holder. An ohms protection resistor is placed in the 100 ohm or 1000 ohm range circuit in case of accidental application to a power source. The case is constructed of an impact-resistant Cyclocac.

Specifications

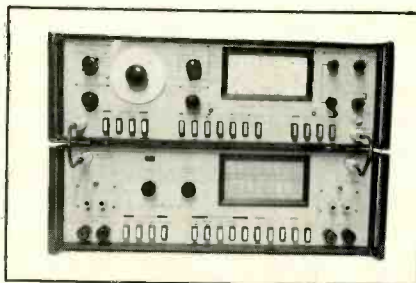
DC Voltage Ranges: \pm 0-1000 mV, 10 v, 100 v, 1000 v. **AC Voltage Ranges:** 0-1000 mV, 10 v, 100 v, 1000 v. **DC Current Ranges:** 0-1000 μ A, 10 mA, 100 mA, 1000 mA. **Resistance Ranges:** 0-100 ohms, 1000 ohm, 10 K ohms, 100 K ohms, 1000 K ohms, 10 M ohms. **Accuracy:** \pm .5 percent of reading, + .5 percent of full range, +1 LSD—1000 mV, 10 v, and 100 volt ranges. **Operating Temperature Range:** 0 degrees C to + 50 degrees C. **Setting Time:** Less than one second, typically 0.5 second.

The instrument measures 4.375 inches wide by 2 inches deep by 6.375 inches high and weighs approximately 2 lb. Price is \$99.95.

FERROGRAPH TEST SET MODEL RTS2

The Model RTS2 Test set combines, in one compact instrument, all of the measurement capabilities that are normally required for checking a wide range of audio equipment. It includes four basic test instruments: an audio oscillator, a millivoltmeter, a wow and flutter meter, and a distortion meter.

The instrument measures fre-



Ferrograph Test Set Model RTS2, top instrument, Ferrograph Auxiliary Test Unit Model ATU1, lower instrument. For more information about these instruments, circle 101 on the READER SERVICE CARD.

quency response, signal/noise ratio, distortion, cross talk, wow and flutter, drift, erasure, input sensitivity, output power, and gain.

The type of measurement is selected from a clearly labeled group of pushbuttons on the front panel of the instrument.

The BNC socket labeled OSCILLATOR, on the front panel of the instrument, is connected to the input of the equipment being tested, and the BNC socket labeled METER is connected to the output of the equipment. Both of the input and output circuits of the RTS2 are unbalanced, but with the addition of the RTS Auxiliary Unit, balanced input and outputs also are available.

The diagnostic applications of the Test Set are extended by provisions which permit the use of additional external equipment such as an oscilloscope, a wave analyzer or appropriate filters.

Specifications

Generator Section—A low distortion audio signal generator, covering the range, 15 Hz to 150 KHz within \pm 0.2 dB.

Millivoltmeter—Eleven measurement ranges from 1 mV to 100 volts, -60 dBm to +40 dBm, f.s.d., on large illuminated meter.

Wow and Flutter Meter—Measures peak weighted wow and flutter (the accepted international standard) on three ranges—0.1 percent, 0.3 percent, and 1 percent f.s.d.—and speed error on a drift range of \pm 2 per cent f.s.d.

Distortion Meter—Measures total harmonic distortion on seven ranges, extending from 100 percent to 0.1 percent f.s.d.

The RTS2 is 17- $\frac{3}{8}$ inches wide by 10 inches deep by 5- $\frac{5}{8}$ inches high, and weighs 13 pounds. Price is \$1300.

FERROGRAPH AUXILIARY TEST UNIT ATU1

The Ferrograph Auxiliary Test Unit ATU1 makes an ideal companion to the Model RTS2 Audio Test Set described previously. When employed with this test set, or other auxiliary equipment, the test unit speeds and simplifies measurements of gain, noise, frequency response, input sensitivity, output power, distortion and the parameters relating to recording equipment, such as wow and flutter, crosstalk, drift and erasure.

The self-powered ATU1 auxiliary test unit has electrically separate sections for extending the applications of audio signal generators and audio frequency millivoltmeters to include measurements on professional equipment. The oscillator and meter sections, which can be used separately or simultaneously, provides a wide

variety of loading, weighting and monitoring facilities suitable for balanced or unbalanced circuits, together with additional amplification or attenuation of the oscillator signal.

The oscillator section accepts signal from an external oscillator through a BNC coaxial connector and applies it to a circuit consisting of an amplifier, unbalance-to-balance transformer, attenuator and output switching for left/right/both-channel-driven.

The switched outputs are available at jack sockets. The output is also available prior to switching at the spring-loaded terminals. A push-button is provided for internally connecting a 600-ohm load across the output. Four push-buttons select input-to-output gains of -20, -10 and +10 dB. The output from the oscillator stage is balanced, and the normal maximum output level of +10 dBm into 600 ohms can be extended to +20 dBm by an internal adjustment.

The meter section consists of load resistors, balance-to-unbalance transformer, weighted noise filter and 1 KHz pass filter. All can be switched in or out of circuit as required. The output from the filter is fed to a BNC coaxial socket for connection to an external millivoltmeter or other measuring instrument. The output is also connected internally to an amplifier which powers the monitor speaker.

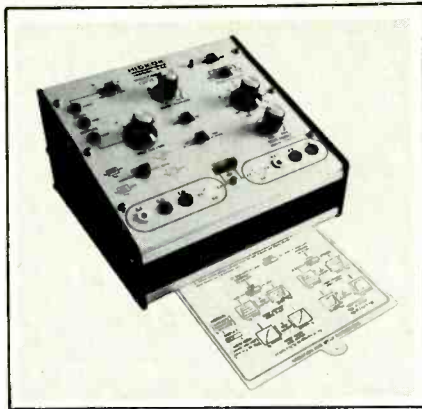
The input/output gain of the meter section is unity at 1 KHz at all control settings. The balanced maximum input is +10 dBm (30 Hz to 20 KHz) and +20 dBm (60 Hz to 20 KHz). The unbalanced input is 100 v (direct connection between input and output).

The instrument is 17- $\frac{3}{8}$ inches wide by 10 inches deep by 5- $\frac{5}{8}$ inches high and weighs 12 pounds. Price is \$550.

HICKOK MODEL 440 CURVE TRACER

Hickok's Model 440 Curve Tracer is designed with an INSTA-BETA display which dynamically tests all types of semiconductors under actual circuit conditions, in or out of circuit. This instrument can be employed with any oscilloscope that has an external horizontal input capability. It generates calibrated characteristic curves that can be accurately scaled from the screen of the scope. It tests J-FET's, MOS-FET's, diodes, Zeners, transistors, UJT's and SCR's—silicon or germanium, power or signal types.

Gain, transconductance, breakdown voltage, leakage, saturation voltage and zener breakdown are a few of the parameters that the instrument is capable of measuring. From the actual characteristic curves obtained on the screen of the oscilloscope it can be employed to identify, evaluate, classify and match solid state devices—



Hickok Model 440 Curve Tracer. For more information about this instrument circle 102 on the READER SERVICE CARD.

find substitutes or troubleshoot defective modules.

The INSTA-BETA feature eliminates the guesswork when making transistor Beta and FET parameter calculations. In the transistor mode, it displays a single, full range IC/IB curve from which AC and DC Beta can be instantly determined without interpolation. Also this curve displays the entire transfer curve including Vp or pinch-off voltage, IDSS or full-on current, and active portion for easy calibration of Gm.

A handy pull-out card is contained in the instrument cabinet providing condensed set-up and operation instructions. With this feature the instructions stay with the instrument for quick reference when needed.

The controls are logically arranged on the front panel using color coding and fast set-up marks where applicable.

The connections from the curve tracer to the transistor under test can be made with the test leads provided, or the transistor can be placed into the plug-in replaceable sockets containing gold contacts and Teflon body. The socket is mainly intended for use with most small signal transistors, FET's and some diodes. Each side of the tester contains three color-coded banana jacks and one test socket. This dual capability is especially useful when comparing good and bad devices or when attempting to match transistors.

In normal semiconductor testing, a variable STEPS/FAMILY control provides characteristic curve displays with up to ten steps per family (steps of base current for transistors and steps of gate voltage for FET's). A HORIZ V/DIV control changes the horizontal sensitivity without requiring scope recalibration. It is preferable for the external horizontal amplifier of the scope to have a variable gain adjustment capable of calibrating the horizontal amplifier to 1 V/DIV sensitivity. This sensitivity is especially useful for measurements in the semiconduc-

tor threshold or turn-on region. A tapered SWEEP VOLTAGE control provides easier sweep voltage settings at low voltages. Dual mode versatility is provided by a NORMAL display or INSTA-BETA display slide switch. When the switch is moved to the right or DISPLAY, a plot of collector current versus base current at a specific collector voltage is displayed. When checking field-effect transistors, a plot of drain current versus gate voltage is displayed. From this curve you can determine transconductance (GM), a drain current with VGS-O (IDSS) and pinch-off voltage (VP) in a short time.

Specifications Collector Supply

Voltage: Continuously variable from 0 to 100 volts peak
Current: Up to 100 mA peak with automatic current limiting at approximately 13 X the setting of the VERT mA/DIV switch e.g. current limiting occurs at approximately 13 mA when the VERT mA/DIV switch is set to 1 mA/DIV.

Base-Gate Generator

Steps: Variable from 1 to approximately 10 steps per family of curves.
Current: 11 ranges from 1 μ A/STEP to 2 mA/STEP, accurate within ± 5 percent.
Polarity: Same as collector sweep; inverted in V/STEP position.
INSTA-BETA/INSTA-GM: In the XSTR mode it provides instantaneous plot of Ic versus Ib; at fixed Vce (set by SWEEP VOLTAGE); in FET mode, provides instantaneous plot of Id versus vG, at fixed Vds (set by SWEEP VOLTAGE.)

Calibration

Vertical: 0.5, 1, 2.5, 10 mA per division ± 5 percent with scope set to 0.1 V/DIV
Horizontal: 1, 5, 10 volts per division ± 5 percent with scope calibrated to 1 V/DIV.

Size and Weight

The instrument measures 4- $\frac{5}{8}$ inches by 8- $\frac{1}{4}$ inches wide by 7- $\frac{1}{2}$ inches deep and weighs 4- $\frac{1}{2}$ lbs. Price is \$165.

WESTON MODEL 660 VOM

The Weston Model 660 VOM is a portable self-contained analog multimeter which is designed for bench, laboratory and field applications.

It is housed in a shock resistant polycarbonate thermoplastic case which provides "drop-proofed" protection against accidental drops from heights of up to five feet. Precision metal film, wire wound, and carbon film resistors of ± 1 percent tolerance

continued on page 38

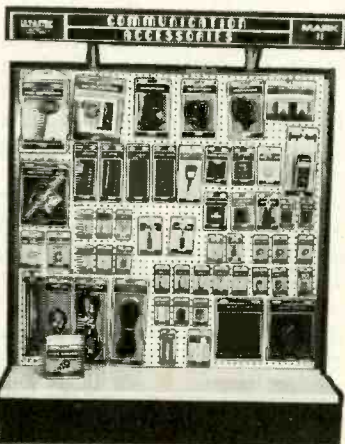
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Two tin cans and a string were fine for kids playing. And, they didn't require much in the way of merchandising, either.

CB Communications today is serious business, a valuable tool to the professional driver, a convenience to the leisure traveler. Both represent a market of great potential. The key, of course, is through proper merchandising.

ULTRATEC'S COMMUNICATIONS ACCESSORIES MARK II CENTER presents 248 accessories of proven high turn, attractively packaged and displayed for maximum impulse sales. Ideal for truck stops, marinas, indeed any location frequented by the professional or holiday traveler.



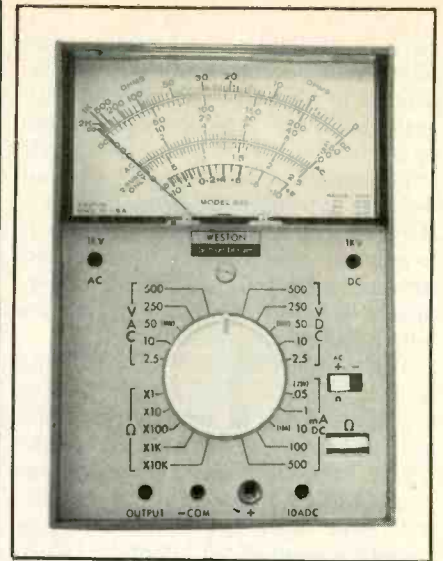
This free-standing display will do the selling with minimal inventory or clerical effort on your part. Offering most attractive profit margins the MARK II is instantly available for a very modest initial investment.

Your business card or letterhead will bring full details and service by one of our factory representatives.

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by WORKMAN ELECTRONIC PRODUCTS, INC.
PO Box 3828 Sarasota, Fla. 33578 / PO Box 5218 Redwood City, Calif. 94063

...for more details circle 135 on Reader Service Card



Weston Model 660 VOM. For more information about this instrument, circle 103 on the READER SERVICE CARD.

are employed in the circuitry. The components are mounted on two parallel circuit boards that plug together to form an assembly with no soldering required to assemble. The four-inch scale meter is a taut band suspension, self-shielded core magnet microammeter and is diode protected. Separate scales are provided for the 2.5 volt AC range, the balance of the AC ranges, the DC ranges, decibels and ohms. The ohms scale range from 0 to 2 K, has a 20-ohms center value for more accurate readings with good resolution.

A single knob, and two banana jacks marked + and - COM are provided for quick range selection and simple operation. Separate jacks are provided for the 10 amp DC, output, the kilovolt AC and kilovolt DC ranges.

A two-amp fuse located in the + test leadjack, protects the meters circuitry and can quickly be changed from the front panel of the instrument without disassembly.

Specifications

Accuracy: 2 percent DC (1.5 percent on 50 μ a range) 3 percent

Sensitivity: 20,000 ohms/volt DC, 5,000 ohms/volt on AC Ranges

DC Millivolts 0 to 250, DC volts 0 to 2.5, 10, 50, 250, 500, 1000

VAC Output 0 to 2.5, 10, 50, 250 DC

Microamps 0 to 50 DC *Milliamps* 0 to 1, 10, 100, 500 DC *Amps* 0 to 10 Ohms

RX1 (0-2K) *RX10* (0-20K) *RX 100* (0-200K) *RX1000* (0-2M) *RX10K* (0-20M)

dB Scales (1mw on 600 ohm line) - 10 to +10/ +2 to +22, +16 to +36/, +30 to 50/, +36 to +56.

Size and Weight

The instrument measures 7 inches high by 5 inches wide by 2-1/4 inches deep and weighs less than 2 lbs (battery included). ■

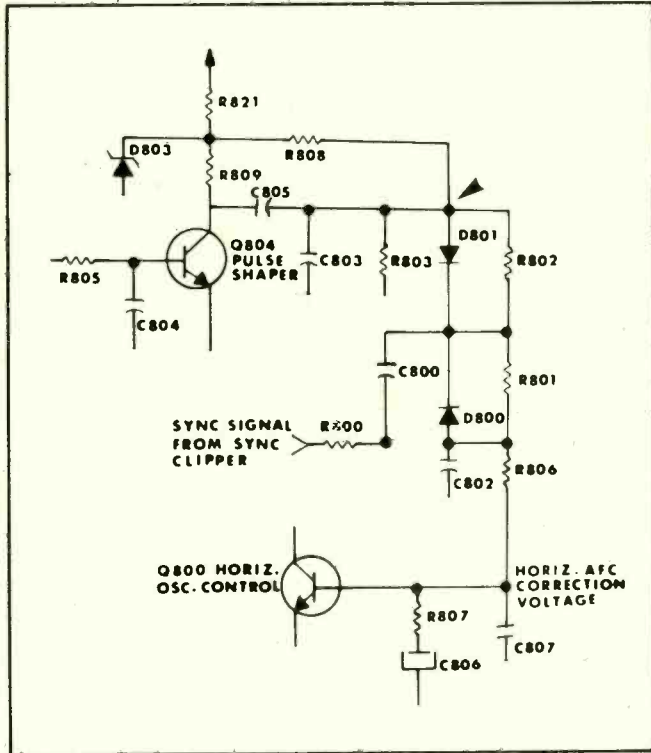
TECHNICAL DIGEST

ADMIRAL

Color TV Chassis M10—Revised Horizontal Hold Adjustment

This new procedure differs from the original adjustment found in the M10 service manual, S1349, primarily in the "point" that is to be temporarily grounded during the adjustment. This procedure will insure a better setting of the Horizontal Hold Control.

1) Check the horizontal hold *pull-in* and *locking* by switching from station to station. If at first the picture has



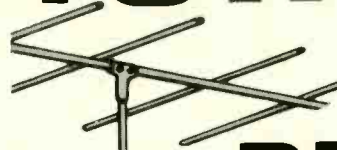
several slanted bars and takes several seconds to *lock in*, it requires adjustment. 2) The *Horizontal Hold* adjustment is available at the back of the cabinet. A limited range of horizontal frequency is available without removing the cabinet back. If this is inadequate, proceed to step 3. 3) Remove the cabinet back. Attach a short clip-on jumper from the junction of R803 and D801 as shown in illustration (in the middle of the chassis, behind the *green bias* control) to chassis ground, the T800 horizontal shield can. 4) This connection should aggravate the out of sync condition; the slanted lines should change angle or increase in number. 5) Bend the tabs of the horizontal oscillator coil top shield and pull the adjustment rod out slightly to permit full rotation. 6) Slowly turn the adjustment rod to produce a picture that is as close to stationary as possible. 7) Remove the temporary jumper installed in step 3. 8) Push the horizontal oscillator adjustment rod back in to its original position and bend the tabs down to hold it in place.

Servicing Modular Color TV Chassis

The MOD I kit (98A150-1) contains all of the modules required to service the M20 chassis. It can also be used to service the 3M20 chassis if you add to it the A8912-2 Signal Processor and A8916-2 Chroma modules.

The MOD II kit (98A150-2) contains all of the modules required to service the M25 chassis. It can also be used to

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service the M24 chassis by adding the following modules:

- A8919-2 or -4IF Module
- A8926-2 Power Supply Module
- A8927-2 Convergence Module
- A8931-1 4.5 MHz Amplifier Module

To service the M30 chassis, add the following modules to the MOD II kit:

- A8919-2 or -4IF Module
- A8926-3 Power Supply Module
- A8927-3 Convergence Module
- A8929-1 Pulse Processor Module
- A8931-1 4.5 MHz Amplifier Module

To service the 1M30 chassis, add the following modules to the MOD II kit:

- A8919-4 IF Module
- A8926-3 Power Supply Module
- A8927-3 Convergence Module
- A8931-1 4.5 MHz Amplifier Module
- A8932-1 Vertical Module
- A8933-1 Horizontal Module
- A8934-1 Chroma Module

To cover all of the above chassis you would need one each of the following items:

- 98A150-1 MOD I Kit (M20, 3M20)
- 98A150-2 MOD II Kit (M24, 25, 30; 1M30)
- A8912-2 Signal Processor Module (3M20)
- A8916-2 Chroma Module (3M20)
- A8919-4 IF Module (M24, 25, 30; 1M30)
- A8926-2 Power Supply Module (M24)
- A8926-3 Power Supply Module (M30, 1M30)
- A8927-2 Convergence Module (M24)

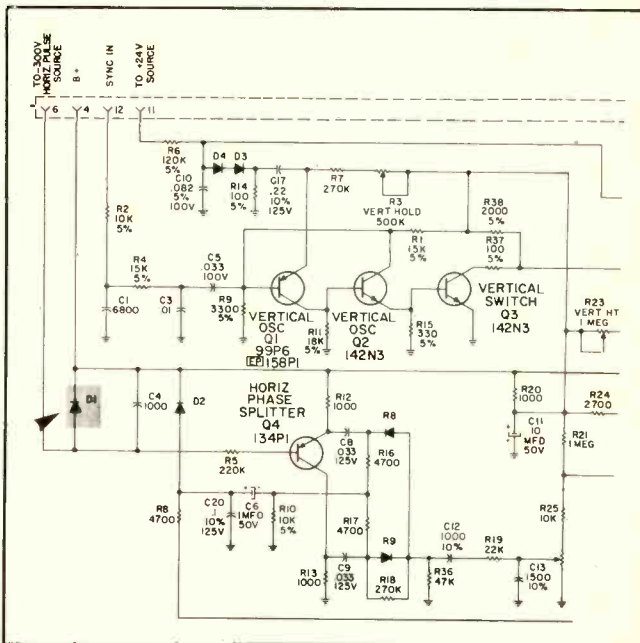
- A8927-3 Convergence Module (M30, 1M30)
- A8929-1 Pulse Processor Module (M30)
- A8931-1 4.5 MHz Amplifier Module (M24, 25, 30; 1M30)
- A8932-1 Vertical Module (1M30)
- A8933-1 Horizontal Module (1M30)
- A8934-1 Chroma Module (1M30)

All of the above items are available through your Admiral distributor.

MAGNAVOX

Color TV Chassis T995—No High Voltage

A symptom of "no high voltage" because of a defective horizontal output transistor can be the fault of a shorted diode, D1, on the Vertical module. When D1 shorts, it



places a low impedance path to ground on the flyback transformer. The resultant increased horizontal output current destroys the Horizontal Output transistor, Q1, and thus the high voltage is lost. Replacing the Horizontal Output transistor will not solve the problem since the replacement transistor will also be destroyed. To avoid this problem, check D1 with an ohmmeter whenever replacing Q1.

Color TV Chassis T995—Brightness Change After Turn-On

Some of these chassis may exhibit a condition of continual brightness increase during the first ten minutes after initial turn-on. This symptom can be corrected by replacing the Videoematic Switch Module Part No. 703654-1 with a 70364-2 version. The 703654-2 Videoematic Switch Module contains a thermistor circuit which prevents the brightness drift.

MAGNAVOX

Star Tuning Assembly—Routine Checks For Replacements

If a replacement STAR Tuning Assembly does not operate properly, check the following items before assuming that the replacement assembly is defective: 1) Test/Normal Switch—should be in the Normal position. If not, the raster will rapidly flash on and off. 2) Remote On/Off Switch—should be in the On position. If not, the STAR will not respond to the transmitter. 3) Band II and Band III Adjustments—if these are misadjusted, the STAR will not tune correctly. Refer to the T995 Service Manual for ad-

NOT EVERYONE NEEDS A TV PREAMPLIFIER, BUT WHEN THEY DO, THEY NEED ONE WHICH GIVES RESULTS.

Q-bit Corporation's PA-0530 VHF/UHF preamplifier is such a performer. It displays low noise, flat response, is built to commercial standards and is easily serviceable. Q-bit Corporation knows what is required of preamps, because we build them for CATV tower service and the military market too.

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justment procedures. 4) Character Drive and Vertical Frequency Adjustments—if these are misadjusted, the channel number readout may be too bright or too dim or of unsatisfactory height. Refer to the T995 Service Manual for adjustment procedures.

Eight-track tape Player Model VE16—Failure To Change Programs Properly

The tape player may fail to change programs properly because of a tight plunger in the Head Step Solenoid. This problem was caused on some solenoids by winding the solenoid coil too tightly. The solution is to replace the solenoid. The solenoid plunger need not be replaced. Although some service manuals list three parts comprising the solenoid, the complete solenoid assembly (excluding the plunger) is available under Part No. 76110160.

Star TV Systems — Slight Audio Feedthrough

A slight amount of audio feedthrough is normal on STAR sets when Muting is engaged. The feedthrough level remains constant, regardless of where the volume was set when Muting was engaged. When Volume Up is activated, Muting is automatically disengaged. ■

HOME ENTERTAINMENT

continued from page 32

Philips-MCA and RCA.

The two video disc systems do not provide recording capability. They are player-only systems, which are used with pre-recorded software.

The discs used in the Philips and RCA systems are similar, and have the appearance of phonograph records, but are played in a different manner.

The Philips-MCA player scans the inserted disc with a focused light beam and a low-powered laser sensor which picks up the images.

A pick-up arm and diamond- or -sapphire stylus which rides in the video disc's circular grooves, similar to a phonograph needle, is used in the RCA system. ■

COPING WITH ICS

continued from page 26

to cut all pins and then unsolder the stubs one at a time, which often renders the IC unusable even if it turns out to be good, or 2) you can attempt to unsolder a couple of adjacent pins, prying up the IC a bit at a time. The last method usually makes a mess out of the PC board, and is very time consuming. Because time is costly, the proper unsoldering tool pays for itself in a few jobs.

Solder "suckers" are fairly slow, but are often the only way to go on the

odd ICs with unusual pin arrangements. There are several types of solder suckers on the market, and all work reasonably well.

Despite care, the PC board pattern might still come loose, since PC board quality is variable and heating tends to do bad things to old, dried up boards. If this happens, try PC board lacquer, which usually does a good job of resealing the pattern to the board. In a pinch, nail polish, Duco cement or speaker cone cement will work. ■

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**A Full Range, 5-Function, 4½
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\$295.00

Model 245 is the smallest, lightest, and most accurate 4½ digit portable DMM you can buy.

It's rugged. Dependable. Precise.

Model 245 measures DC and AC current, DC and AC volts, and resistance with .005% resolution and a basic accuracy of ±.05%.

It features a bright .33" display, autopolarity, auto-decimal positioning, rechargeable battery or line operation, fused probes, carrying case and one year warranty.

**A Full Range, 5-Function, 3½
Digit Multimeter.**



\$189.00

Competitively priced to its analog equivalent, the Model 134 is 5 to 10 times more accurate and it is convenient, readable and free from operator error.

Model 134 measures DC volts, AC volts, DC current, AC current and resistance with a basic accuracy of ±0.2% through a total of 22 range scales.

It features auto-decimal positioning, autopolarity, 100% overranging, and a full ½ inch, bright, easy-to-read display, fused probes and one year warranty.

Contact Data Precision or the Data Precision representative nearest you. Data Precision Corporation Audubon Road Wakefield, MA 01880, Phone (617) 246-1600

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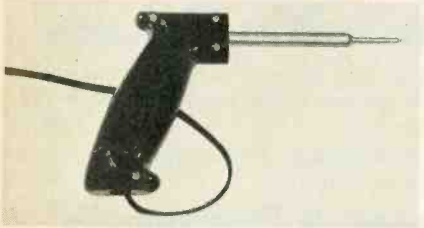
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NEW PRODUCTS

SOLDERING GUN

136

Wall - Lenk Manufacturing Co., has announced production of an economy model, lightweight, pistol grip solder-

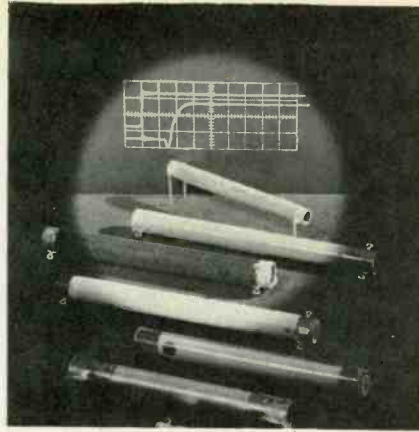


ing gun. The Lenk Model 2116 is an ultra - light, 30 watt gun wired to operate off 120 volt, either AC or DC, UL listed. It has a nylon handle that stays cool even after hours of use and is balanced for convenience and comfort. The long - life heating element reaches the operating temperature in a matter of seconds.

TV DELAY LINES

137

A new series of replacement TV delay lines has been introduced by Bell Industries/J.W. Miller Division. The



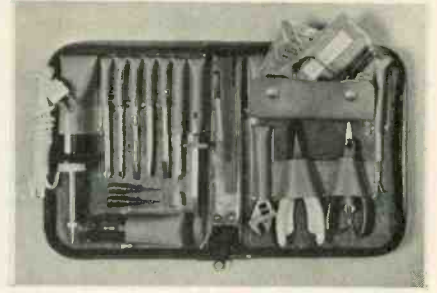
series consists of 15 delay lines that are designed as replacements for more than 500 OEM popular part numbers used by virtually all trade names. The delay lines are available nationwide from local distributors.

ELECTRONIC TOOL KIT

138

Jensen Tools and Alloys has developed a new 24 - piece compact - sized kit of electronic tools. Designated the JTK-6, the kit is ideal for engineers, scientists, technicians, students or executives. The kit includes seven - sizes of screwdrivers, an adjustable wrench, two pairs of pliers, wire stripper, knife, two alignment tools, stainless rule,

hex - key set, scissors, two flexible files, burnisher, miniature soldering iron, solder aid, coil of solder, and de-



soldering braid. The padded zipper case measures approximately 6 by 9 by 1 3/4 inches inside. The price is \$49.

BATTERY TESTER

139

A new battery tester that tests the most popular battery types has been announced by RCA Electronic Instruments. The Model WT - 537A Battery Tester provides an accurate test, under typical load conditions, and is well suited for use in service shops and many stores that sell batteries. The large color - coded meter scale indicates the battery condition at a glance and is specially marked to indicate the levels at which rechargeable batteries should be recharged. A separate color -



Rapid Rebate

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A Free Raytheon 6GH8A Receiving Tube

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Raytheon RE - the only broad line of semiconductors that gives you all of these:

- individual packaging with replacement cross references printed on the bag
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Plus a Rapid Rebate

Offer expires October 15, 1975. Good at participating distributors, or send proof of purchase to: Raytheon Company, DPO, 4th Ave., Burlington MA 01803

ET-8

...for more details circle 133 on Reader Service Card



orange plastic case that is 5½ inches by 3¾ inches by 2 inches. Price is \$18.75.

CATHODE RECOVERY UNIT/CRT TESTER 140

REM Electronics Instruments has introduced a new Cathode Recovery Unit and CRT Tester which is said to

coded meter scale is provided for testing mercury batteries. A single knob function switch provides the following test ranges for standard carbon - zinc and alkaline type batteries: 1.5, 3, 6, 9, 15 and 22.5 volts. Ranges for mercury batteries are 1.4, 5.6 and 8.4 volts. A special feature of the tester is the convenient "BULB TEST." With this function, since it is actually a "continuity" tester, not only flashlight, pilot light, automobile and standard AC electric bulbs can be tested, but it can also be used to test fuses, switches, and circuit wiring. The unit has a rugged, texture - finish, high - impact,



be superior to old style CRT rejuvenators. The Cathode Recover System provides a modification of the 'curing' process used to complete the processing of new picture tubes. It will reportedly improve brightness, focus,

and gray - scale tracking on most picture tubes with low emission, extending the life of a treated tube from 12 to 18 months. The testing function of the unit differs from other testers on the market, providing the TV service technician with extremely accurate test results.

TUBE TESTER 141

A new portable tube tester from Hickok Electrical Instrument Co. has exclusive opens test for all elements plus shorts, H-K and grid leakage



tests, as well as basic emission test under rated load. The Model 230 tube tester incorporates features previ-



New 2½ digit Heathkit DMM - only \$79⁹⁵

The new Heathkit IM-1212 Digital Multimeter is the DMM you've been looking for... it's easy to read, has built-in calibration standards, service bench styling, easy assembly...and it's low cost. Four overlapping AC and DC voltage and current ranges and five resistance ranges make operation fast and easy. Accuracy is very good for a meter in this price range: 1% on DC volts, 1½% on AC volts and AC/DC current, and 2% on resistance. Full scale ranges are: DCV, 2, 20, 200, 1000V; ACV, 2, 20, 200, 700V rms (25 Hz to 10 kHz); DC current, 2, 20, 200, 2000 mA; AC current, 2, 20, 200, 2000 mA (25 Hz to 10 kHz); Resistance, 200, 2k, 20k, 200k, 2000k ohms. Lighted panel indicators show overrange, positive and negative DC voltages and current. All solid-state design uses IC circuitry for clear, non-blinking display with readout update every 16 msec. and automatic decimal positioning. Overload protected. 120/240 VAC. Also available assembled for only \$125*.

See the complete line of Heathkit instruments in your FREE Heathkit catalog.



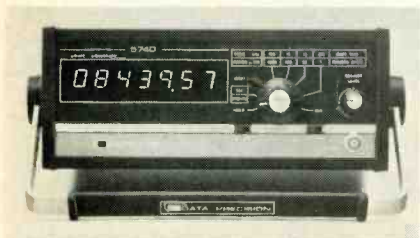
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TE-326	

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ously unavailable in small, lightweight, portable tube testers including: true test for opens and shorts, any combination of elements may be locked out, directly metered H-K leakage test with $2\mu\text{a}$ sensitivity, and a $50\mu\text{a}$ meter. The instruments design offers lifetime serviceability, using standard components mounted on a plated - through glass - epoxy PC board. The data book, which may be retained in the cover or removed for easy reference, contains all the old and new tubes including Nuvistors, Novars, Magnovals and the new 10 and 12 pin compactrons. Update sheets will be available.

MULTIFUNCTION COUNTER 142

A 7 - digit, 100 MHz Counter/Timer is designed by *Data Precision* to measure frequency, period, period aver-

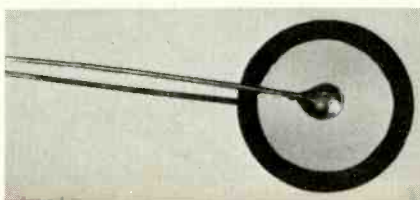


age, elapsed time and total events. The Counter Model 5740 features an easy - to - read LED display and a full range of options including remote start/stop for time and events, a 50 ohm input termination addition, BCD interface and logic control to extend its use from a bench instrument to a systems component. It measures frequency from 5 Hz to 100 MHz; single period (sine wave) time from 1 microsecond to 0.2 sec.; period average with 1 nanosecond resolution to 99,999.99 microseconds; event counting (totalizing) from 0 to 9,999,999; and time interval measurement covering 0 to 9,999,999 sec. Sensitivity is mV from 5 Hz to 20 MHz, rising

linearly to a high frequency sensitivity of 50 mV rms at 100 MHz. In addition to automatic decimal placement and low component count for MTBF, the instrument incorporates an adjustable trigger level front panel control which allows odd wave forms to be measured and, in conjunction with a 20/1 attenuator, its measurement ability is extended to + 250 volts. Input impedance is 1 Megohm in parallel with 25 pf. A special feature of this instrument is its ability to resolve and count random pulses. Price is \$295.

THERMISTORS 143

Oneida Electronic Mfg., Inc., has announced the addition of several popular new thermistors to its line.



The latest to be added is thermistor No. GB - 205, a fast response, instant on degaussing thermistor for use in most late model sets. Other additions include exact replacements for RCA and other major brands.

MOBILE ANTENNA MOUNT 144

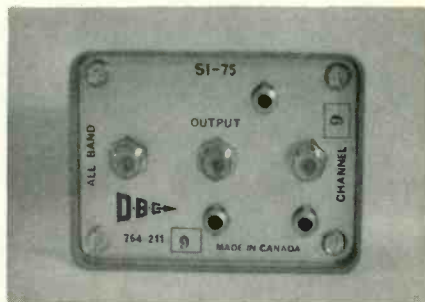
Larsen Electronics introduced a new permanent magnet mount for mobile antennas. The mount is available in five different models to accommodate all popular types of mobile antennas including Motorola, GE, DB Products, Antenna Specialists and Larsen models. The unit comes complete with 12 feet of RG58/AU coax and plug all attached. All that is needed to be operational is to screw the antenna to the base, place the base with its magnets on the vehicle roof, fender, trunk or



any other convenient spot and run the attached coax to the equipment. The magnet used in the mount is guaranteed permanent and to stay in place on the vehicle for any highway speed.

SINGLE CHANNEL SIGNAL INJECTORS 145

Delta - Benco - Cascade Inc., has introduced Signal Injectors which are designed specifically to inject a single channel into an "All Band" down lead. Both 300 - and 75 - ohm versions are available for home or professional in-



stallations. The design of this unit provides low insertion loss of the injected signal and employs a band reject filter in the all - band side to reduce ghosts and double images on the injected channel. Two versions are available: A 300 - ohm model, SI - 300 with "No Strip" terminals, and a 75 - ohm model, SI - 75 with matching 'F' connectors. Both models are in rugged die - cast housings and are supplied with right angle brackets and metal clamps. Price is \$8.35.

TRIGGERED SWEEP OSCILLOSCOPE 146

Dynascan's B&K Precision Division has expanded its line of oscilloscopes, with a new dual-trace Model 1472 featuring 15 MHz bandwidth. Its features include: Automatic selection of chopped or alternate mode of display and automatic selection of TV line and

Pocket-Size Slide-Switch Resistance Substitution Unit

- Eleven million step range
- 1% Accuracy resistors
- Rugged construction
- Only \$58

Featuring a very broad range of resistance steps, this aluminum-housed unit is unique in its small size. Half-watt, 1% resistors provide a range from 1 to 11,111,110 ohms, in one-ohm steps. Designed with three binding posts—one to ground case. Available from stock.



Phipps & Bird, P.O. Box 27324, Richmond, Va. 23261 (804) 264-2858

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frame sync, which can also be used as a low-pass filter for triggering. The trace is automatically chopped at all sweep times of 1 microsecond cm and slower to avoid flickering; at all faster speeds, the sweep is alternated; high stability of waveform presentations—sweeps remain at rest until triggered by signal being observed, assuring synchronization; fully adjustable trigger threshold allows desired portion of waveform to be used for triggering; nominal 15 MHz bandwidth, with usable 30 MHz bandwidth; 11 sensitivity ranges and 19 sweep ranges; 24 nsec risetime; bright blue phosphor CRT, with variable graticule scale illumination. The instrument measures 9¾ inches by 14½ inches by 7¾ inches. Net weight is 19.5 lbs. Price is \$599.

CIRCUIT BOARD EXTRACTOR 147

Branem Industries, Inc., has introduced a vinyl coated printed circuit board extractor which provides excep-



tional gripping power to insert or remove boards from tight fitting connectors. The vinyl coating protects the boards from damage and eliminates any chance of electrical shock hazards. It can be used on boards with components placed close to the outside edges as it grips only ¼ - inch of the board.

FUNCTION GENERATOR 148

Heath Company is offering a new function generator combining wide frequency range, compact size and reliability. The instrument generates sine, square or triangle waveforms from 0.1 Hz to 1 MHz. A short-circuit-

proof output amplifier supplies a 10 - volt peak - to - peak signal into a 50 - ohm load. A calibrated step attenuator adjusts from 0 to 50 dB (10 v p-p to 30 mv p-p) in 10 dB steps. The variable attenuator control provides up to 20 dB additional attenuation for each step for a total of 70 dB with an accuracy of -1 dB. The frequency accuracy is + 3%. The triangle waveform non-



linearity is 5% maximum with waveform symmetry within 10%. Square wave rise and fall times are 100 nsec. maximum. Selection of 105/130 or 210/260 VAC. Kit version, IG - 1271 is \$99.95; assembled version, SG - 1271 is \$140.

SEMICONDUCTOR KIT 149

A kit of 24 entertainment semicon-



ductors is now available from *General Electric* which will enable electronic technicians to service some 75 percent of the most popular Japanese-made TV sets, eight-track tape players, home and auto radios, stereos and CB rigs now being sold in this country. The kit devices will cross over 25,000 JEDEC numbers, covering the most often needed devices for the repair of consumer electronics equipment made by Sony, Hitachi, Panasonic, Toshiba and other Far East firms. The kit designated K934, contains 40 universal semiconductors in a 24 drawer parts cabinet with a carrying handle.

VOM 150

A new drop-proof, burnout-proof and super-safe Model 60 VOM is being

Swap 75 GE flaps for one book S&H Green Stamps. Offer ends November 30.

TAKE GE and Award Yourself!

BOTTOMS

marketed in a versatile kit form by *Triplett Corp.* The instrument is particularly valuable for measuring AC

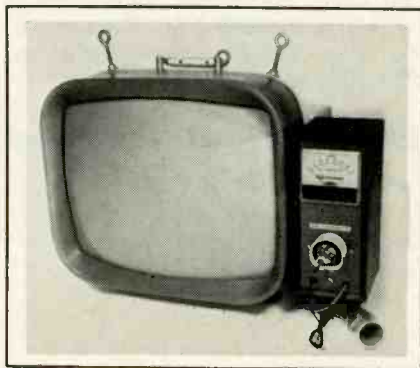


amperes and to isolate one conductor of a two-conductor cable. the battery-operated, 28-range, general purpose test instrument is a new concept in

VOM design. The tester case protects the unit against accidental drops up to five feet and has a non-slip "finger-tread" finish for handling ease. It is easily serviced, and has an external access, to the sealed battery compartment. The instrument is designed for the safety of the user to prevent explosive arcs under misuse conditions in circuits up to 1000 volts. It is completely insulated and comes with newly designed, 48-inch long safety leads, plus a single selector switch to minimize error. Price is \$150.

COLOR TV TEST JIG REGULATOR 151

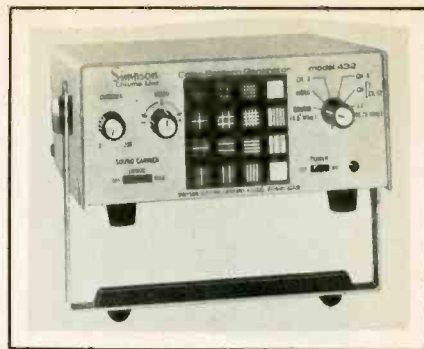
GTE Sylvania Incorporated has introduced a solid-state regulator that will adapt most existing test equipment for safe servicing of color TV receivers rated to 35,000 volts. The *Chek-A-Color High Voltage Regulator*, designated Model CK200, is supplied fully assembled and tested. It connects quickly and easily—without



modification to most test jigs currently in use. A 15-watt varistor and all solid-state 15-watt thick film divider network comprise a specially designed circuit that provides regulated 22 kv to the jig cathode ray tube from a receiver anode voltage range of 22 to 35 kv. The regulator protects against test jig CRT X-radiation exceeding Federal Standards, providing installation instructions are carefully observed. Power dissipation reserve protects jig and receiver from excess voltage.

COLOR PATTERN-GENERATOR 152

A compact, all solid-state generator for color TV servicing called the *Chroma-Line Model 432* is available from *Simpson Electric Co.* It provides 16 patterns through the use of a unique 4 x 4 pushbutton selector matrix, located on the front panel. The generator incorporates the latest digital large-scale integration (LSI) technology for maximized color-pattern stability and reliability. It provides a total of five channel outputs: three VHF channels and two



UHF channels. Channels 3 and 4 are fully crystal controlled. Channel 7 and UHF channels 23 and 52 are L-C controlled. Two additional crystal-controlled outputs include the 45.75 MHz picture IF and 4.5 MHz sound IF. The sound IF is available both as an unmodulated carrier and as a modulated carrier with a 1000 Hz audio signal. Additional features include a composite video output, vertical and horizontal sync outputs, a built-in cable storage compartment, 75-ohm coax and 300-ohm impedance matching transformer outputs, and red, blue and green gun killers. Price is \$179.

CONTACT CLEANER 153

LPS Research Laboratories, has introduced a new *Instant Contact Cleaner*. It is a solvent degreaser and penetrates the most minute crevices to remove oil, grease, dirt and any foreign material from electrical and



precision equipment. It will not harm plastics, rubber, fabrics or metals and is completely anti-static and leaves no residue. Being di-electric it can be used while the electrical equipment is in use. The handy two-ounce size can fits into any tool maintenance kit.

TRANSISTOR/DIODE TESTER 154

A new *Transistor/Diode Tester Model 688* is introduced by *Eico*. The tester is connected to your oscilloscope and then simply touch the terminals of the semiconductor with the probes. The oscilloscope waveform indicates the semiconductors condition at a glance. Switch the selector of the instrument for "in" or "out" of circuit testing to assure that the correct amount of current is applied to the semiconductor under test. The tester checks all diodes and transistors (ex-

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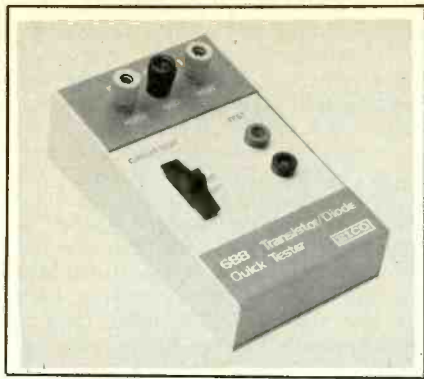
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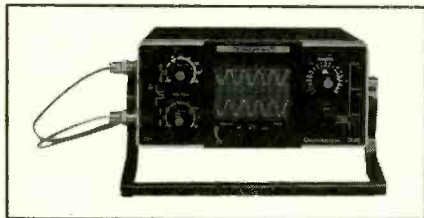
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cept MOS FETS). Other features include: Five-Way binding posts for interconnection between the tester and scope; jacks for rapid batch testing without probes. Available in both easy-to build kit form for \$14.95 and factory assembled for \$22.95.

OSCILLOSCOPE 155

Tektronix, Inc., announces the 10-MHz, dual-trace Telequipment Model D32 Oscilloscope. It offers 10-MHz bandwidth, vertical sensitivity ranging from 10 mV/div to 5V/div in nine

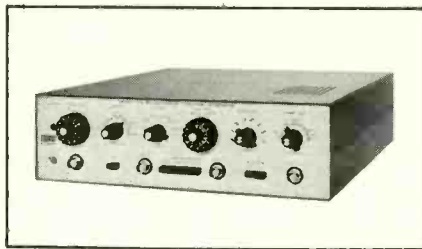


calibrated steps, (19 sweep speeds from 500 ns/div to 500 ms/div, extended to 100 ns/div with a X 5 magnifier). Other features include flexible triggering, automatic selection of chopped or alternate modes (depending on sweep speed setting). Its 8 x 10 division CRT (0.7 cm per division) covers nearly one third of the front panel. It offers a choice of battery or AC line operation with up to four hours continuous operation when working from its six rechargeable "D" cell batteries. The instrument measures 4 inches high by 9 inches wide by 11 inches deep. Price is \$995.

PULSE/SWEEP/FUNCTION GENERATOR 156

Dana Exact Electronics, Inc. has announced a new Model 516, 11 MHz Function Generator. The instrument features a frequency range of 0.001 Hz to 11 MHz, offering sine, square, triangle, ramp and pulse waveforms at 20 volts p-p open circuit, 10 volts p-p into 50 ohms. A 20 Hz to 20 KHz range is provided for audio use and sweeping the entire audio range. The frequency can be controlled manually by a frequency multiplier having ten turn

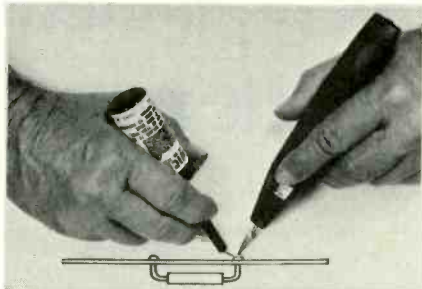
type resolution, externally through a VCF (Voltage Controlled Frequency) input, or with an internal sweep generator, over a ratio of 1000:1 (three



decades). It contains unique trigger circuitry which allows the main generator to be gated or triggered manually, externally or by the ramp generator. The ramp generator can also be triggered both manually and externally. A sync output provision, variable DC offset control, external offset capability, and 80 dB of attenuation in 10 dB steps with 20 dB variable attenuation. The unit measures 12.5 inches by 3.5 inches by 13.5 inches. It is priced at \$695.

DE-SOLDERING TOOL 157

Two new tools that permit fast, efficient de-soldering of pot, post, hole, or flag connections is being manufactured by Tech-Tool Industries, Inc. Called Tech-Wick, the tools permit placing of their wick on the connection

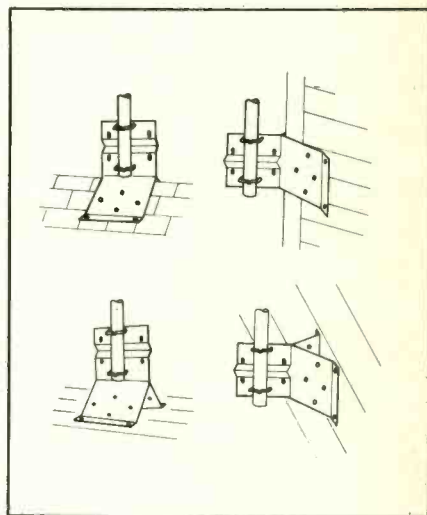


to be de-soldered with accuracy, thus making it ideal for working in tight places. The design of the tool's shank eliminates wick sag and bending,

making possible firm application to the solder connection. The Model S-16 contains approximately 10 feet of 65 strands of 34 gauge, pure copper wire having an overall wick O.D. of .064 inch. The Model R-20 contains approximately 20 feet of 105 strands of 40 gauge wire with an overall wick O.D. of .040 inch, the wicks in both of which are treated with non-corrosive, non-conductive resin. Prices for the Model S-16 and R-20 are \$2.75 and \$3.25.

ANTENNA MOUNT 158

Introduced by South River is the Model PM-105 multi-purpose TV/



FM/CB Antenna Mount. It is suitable for mounting antennas on peak or flat roofs and may also be mounted on the wall or corner of the house. When mounted on the roof, it will support a five foot mast mounted antenna without guying. The unit is welded into a one-piece constructed unit of heavy gauge embossed steel for extra strength and rigidity. It is fabricated of hot-dip galvanized steel for added anti-rust protection. The mount will accommodate masts up to 1 1/4 inch O.D. and is shipped factory pre-assembled for quick mounting.

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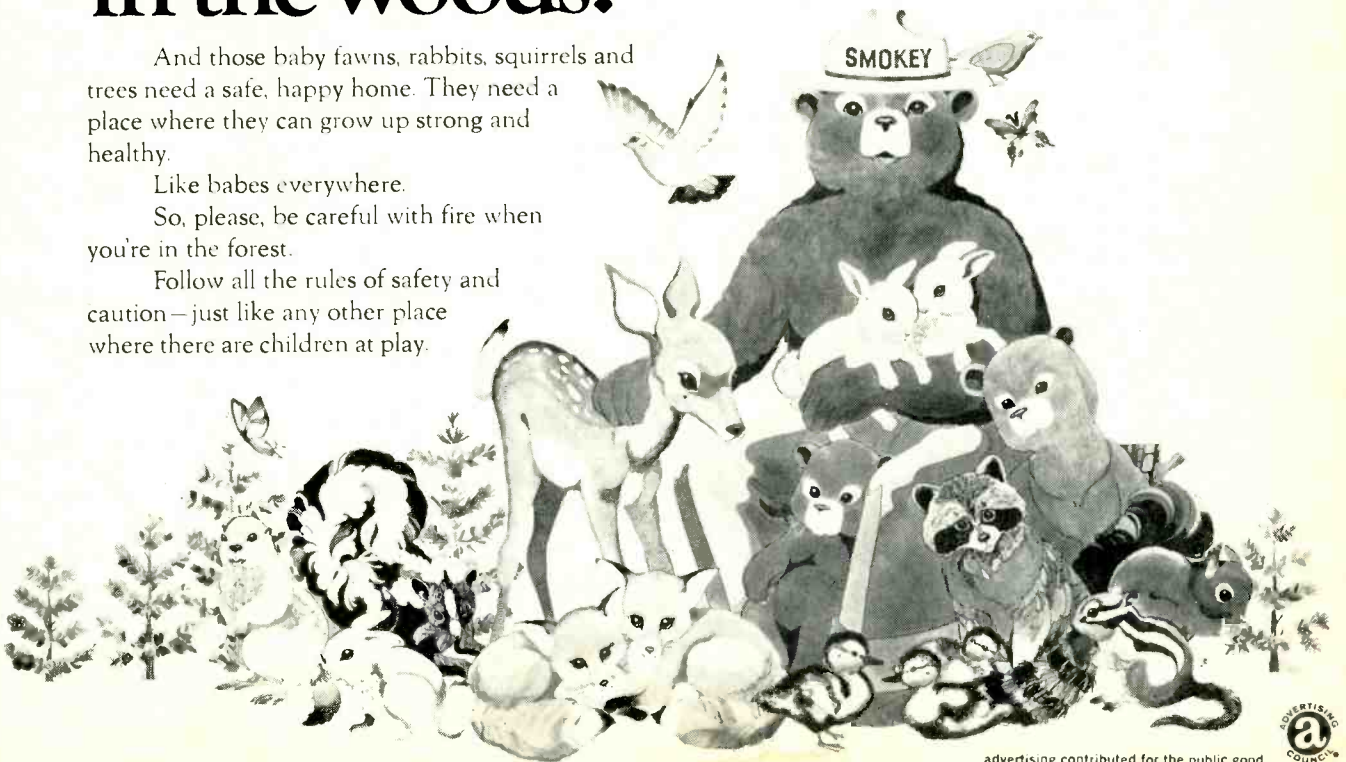
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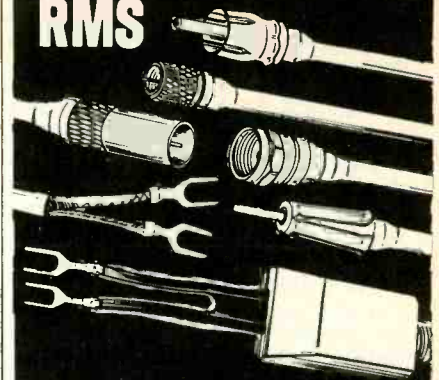
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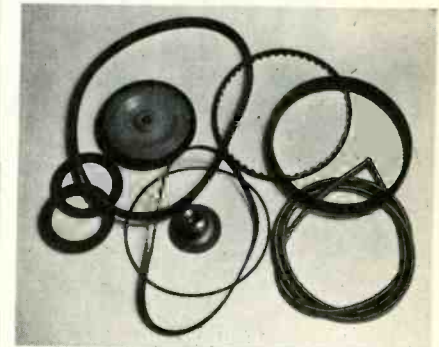
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MGA
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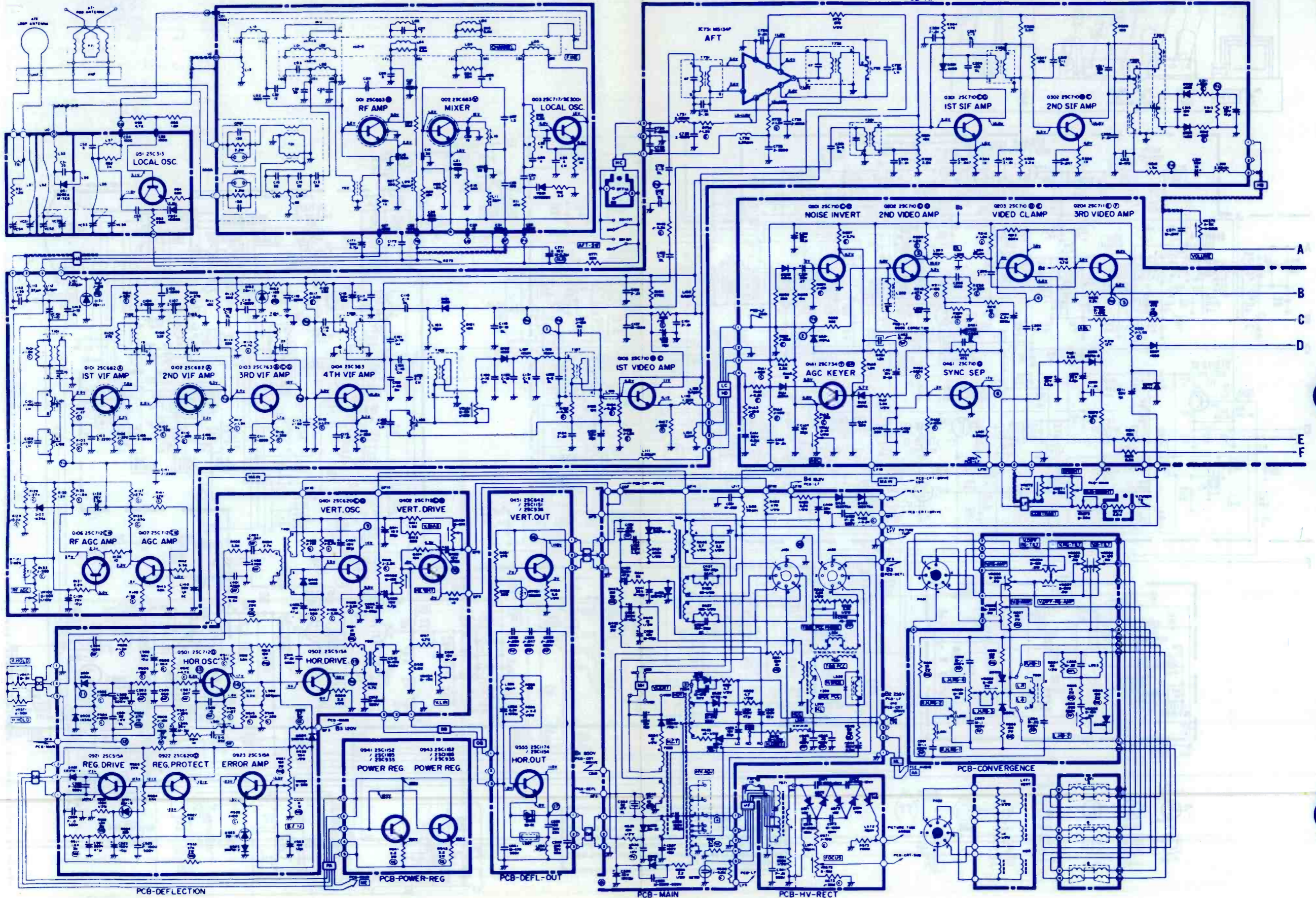
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COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR 5 NEW SETS

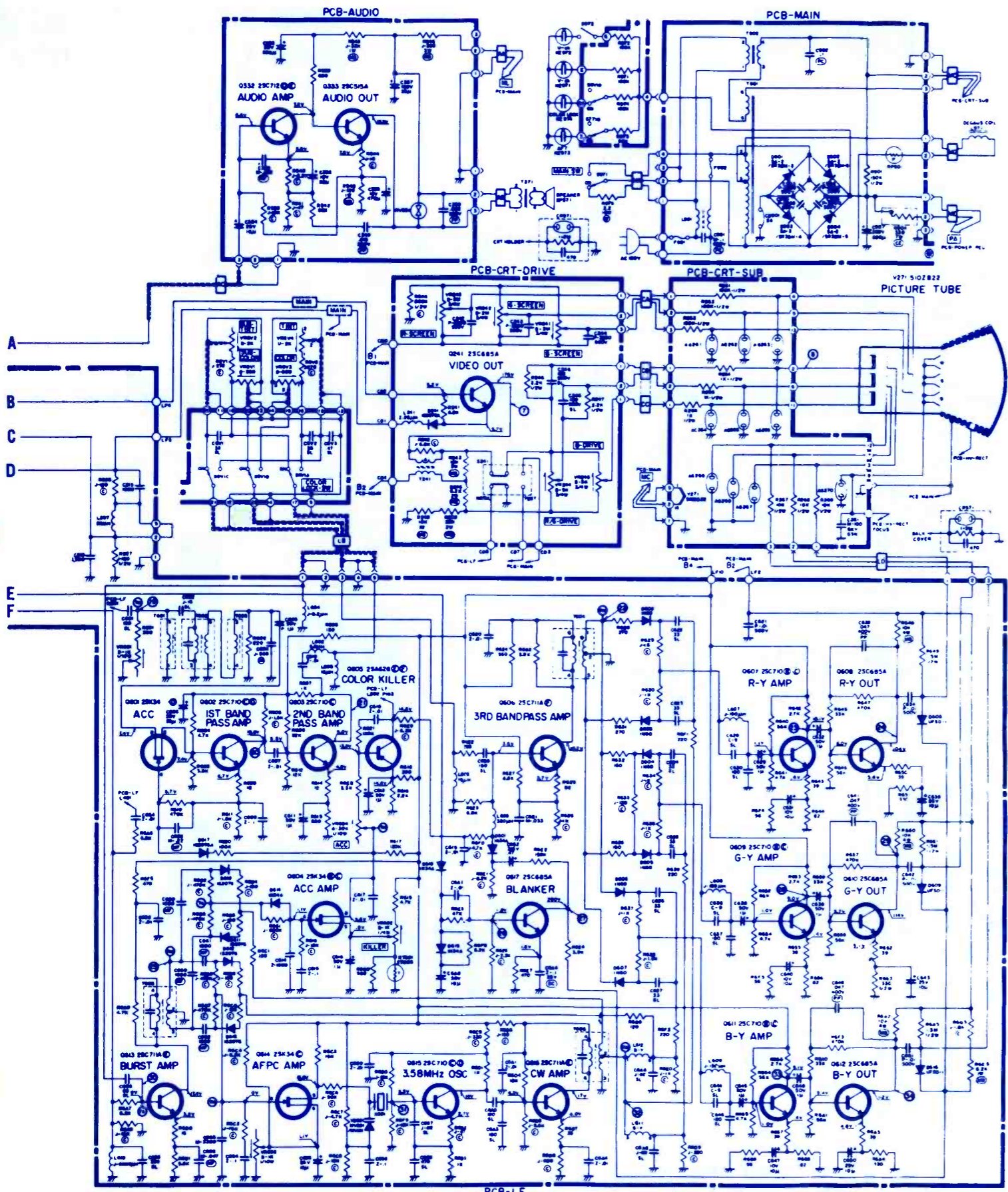
SYMBOL	DESCRIPTION	MGA PART NO.
T301	— sound IF	327P02002
T371	— audio output	352P01402
T401	— vert osc	328P00302
T431	— vert output	329C01901
T501	— horiz drive	336P00503
T533	— HCT	409B00401
T534	— HOT	336B00202
T571	— flyback	334P05802

T601	— chroma takeoff	349P03301
T604	— chroma output	349P03601
T605	— chroma burst	349P03701
T901	— power	350P03501
L471	— deflect yoke	330P02903
VR271	— double B- 30K brite	122C15001
VR272	— double C- 1K contrast	122C15002
VR372	— STD A- 5K vol UL	120C13104
VR471	— double B-2K vert hold	122C15001

VR571	— double A- 50K horiz hold	122C15002
VR572	— double B- 15M focus	129P00401
VR603	— semifixed B- 1K, 1/10w color	129D02503
VR6V1	— twist B- 500 ohm sub-color	121C03001
VR6V2	— slide B- 500 ohm color	129C01901
VR6V3	— E - 2K sub-tint	121C03507
VR6V4	— slide U- 2K tint	129C01908
CB901	— circuit breaker 2.0a	287C00202
F571	— fuse 1a	283D01801



MGA
Color TV Model
CS-195



NOTE 1:

- The unit of resistance "ohm" entirely omitted. Accordingly, K=1000 ohms, M=1000K ohms.
- The wattage of resistor, not specifically designated, is 1/4 watt.
- Resistors, not specifically designated, are: Fixed Composition resistors (Solid type)
- The marks of resistors are as follows:
 (C) : Fixed carbon film resistor.
 (CE) : Cemented resistor.
 (F) : Fusible resistor.
 (HS) : Fixed composition resistor, hermetic shield
 (HT) : Fixed carbon resistor (type HT)
 (MA) : Metal oxide film resistor (type A)
 (MB) : Metal oxide film resistor (type B)
 (W) : Wire wound resistor.
- The tolerance of resistor value, not specifically designated, is: ±10%, J=±5% M=±20%
- The unit of capacitance, not specifically designated, is:
 a) μF, for numbers less than 1
 b) PF, for numbers more than 1
- Capacitors, not specifically designated are: Ceramic capacitors except electrolytic capacitors.
- The marks of capacitors are as follows:
 (CELL) : Cellulose film capacitor
 (M) : Mica film capacitor
 (MP) : Polyester film capacitor
 (MPP) : Metalized polyester film capacitor

- (MP) : Fixed metalized paper capacitor
 - (PA) : Paper capacitor (type A)
 - (PC) : Paper capacitor (type C)
 - (PP) : Polypropylene film capacitor
 - (PS) : Polystyrene film capacitor
 - (ST) : Styrol capacitor
 - (E) : Electrolytic capacitor
- Mark a ● ● indicate 1 block capacitor respectively.

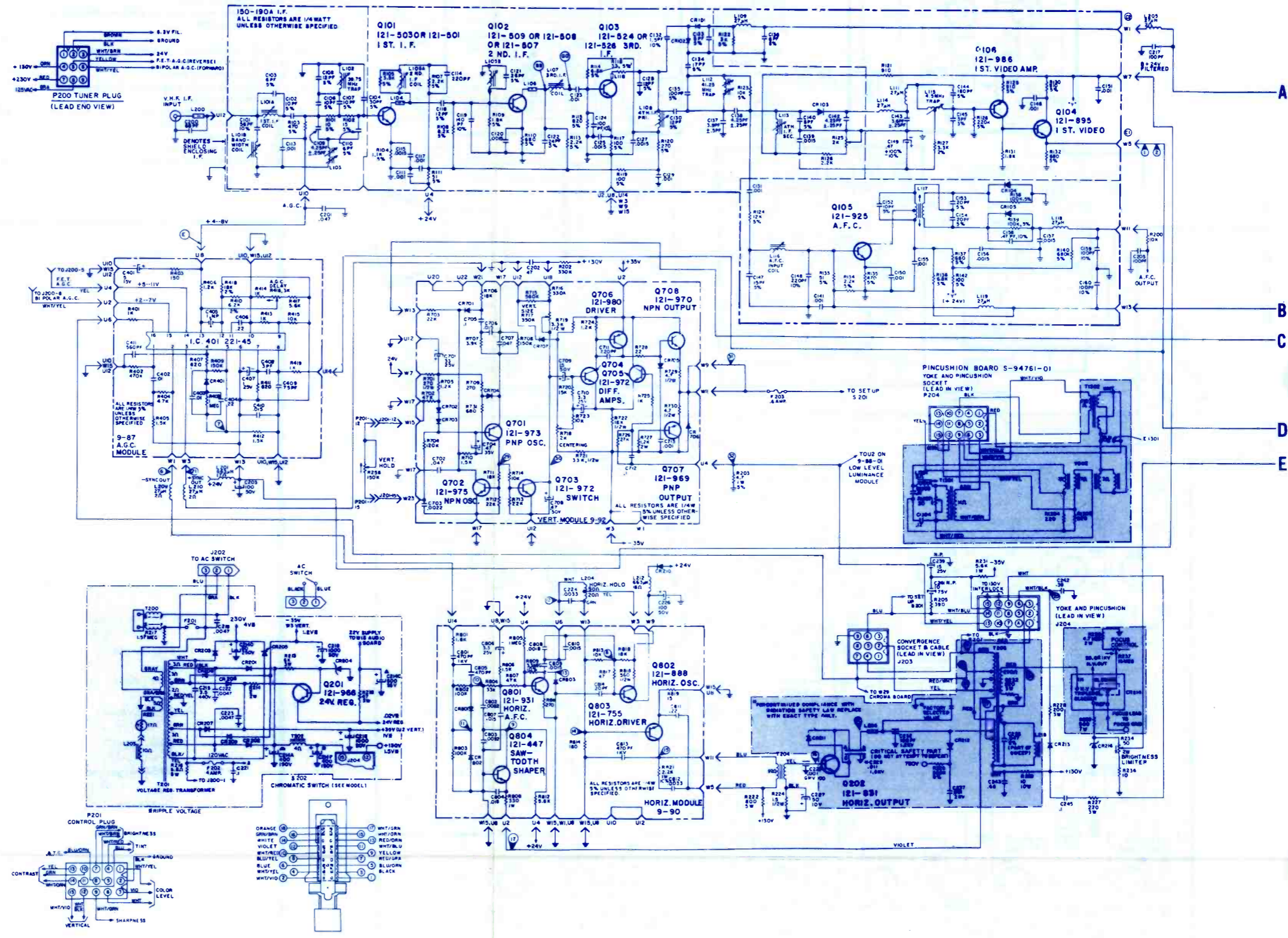
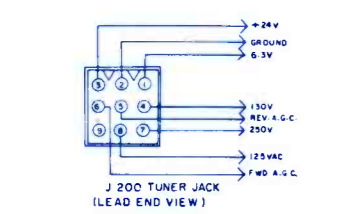
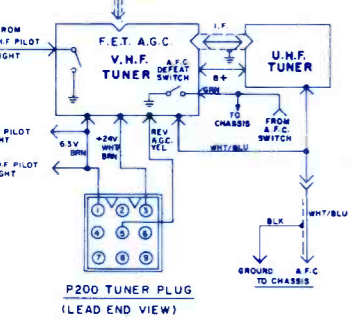
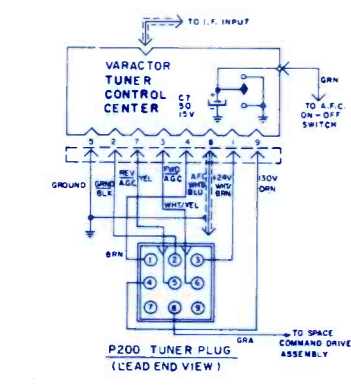
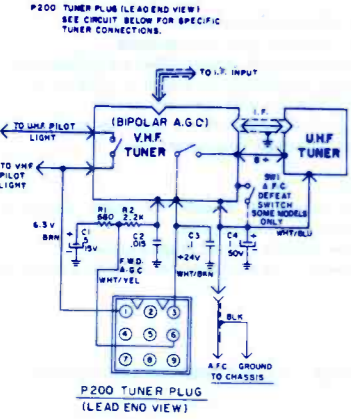
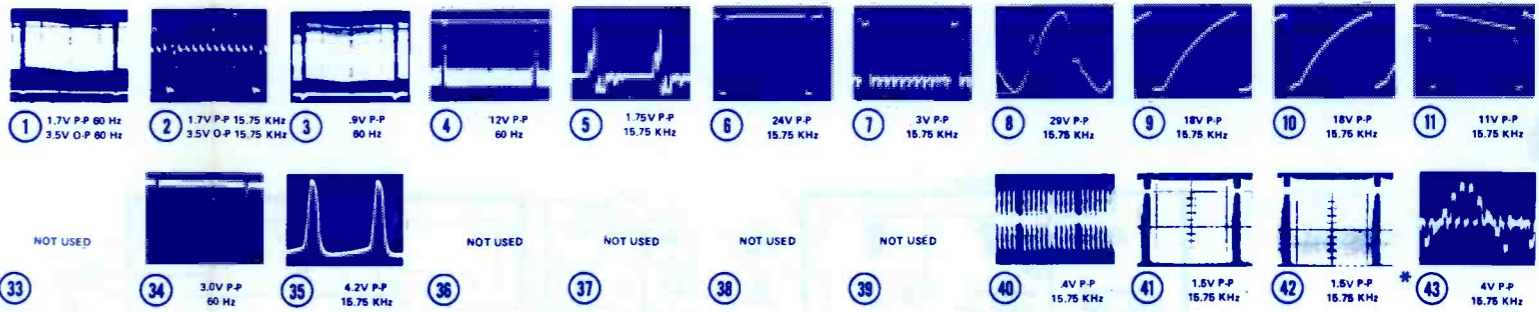
- The DC work voltage of capacitor, not specifically designated is:
 a) 400V for paper capacitors
 b) 50V for other kinds of capacitors
- The tolerance of capacitor value, not specifically designated, except the electrolytic capacitor is: ±10% J=±5% M=±20%
 P=+100% C=±.25PF D=±.5PF F=±1PF
- Ceramic capacitors with the marks RH, UJ, SL etc. are temperature compensating types.

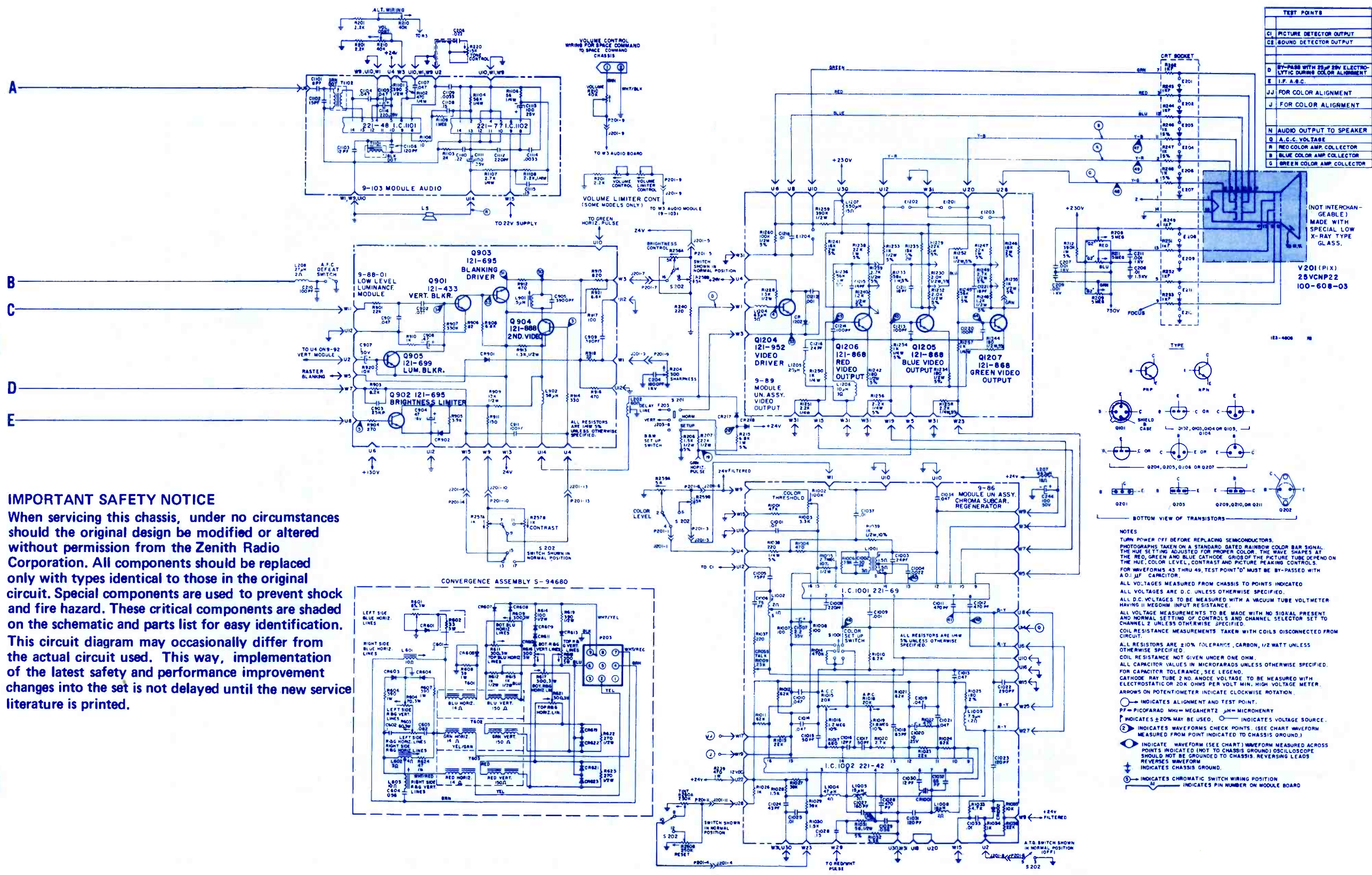
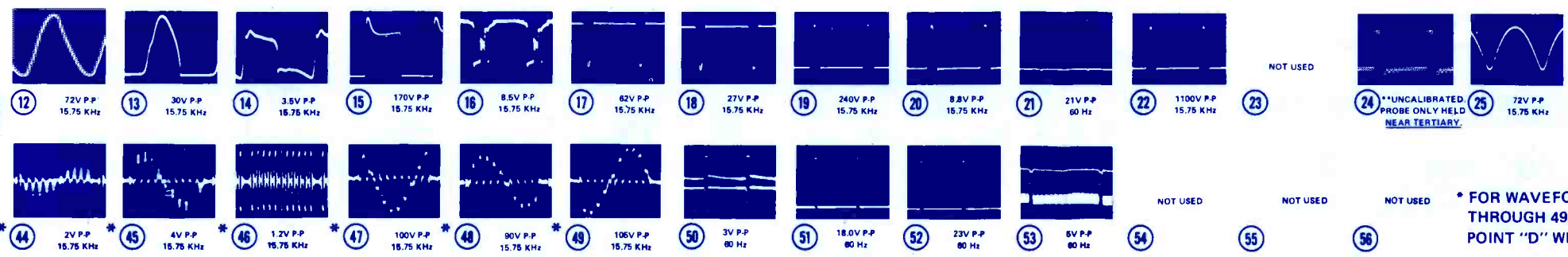
NOTE 2:

- DC voltages are measured from points indicated to the circuit ground with a VTVM.
 Line voltage at 120V AC on sign supplied.
- Waveforms are taken with control for a normal picture.

SPECIFICATIONS

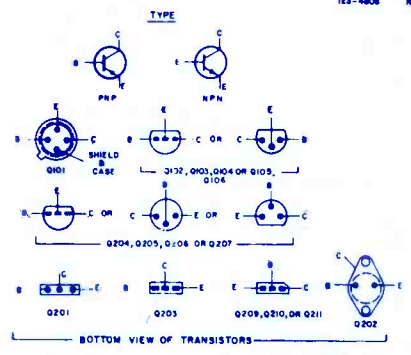
Power Input	-----	AC 120V 60 Hz
Power Consumption	---	160 W
Channels	-----	VHF ch 2 ~ ch 13 UHF ch14 ~ ch 83
Antenna	-----	VHF Dipole Antenna, balanced 300 Ω UHF Loop Antenna, balanced 300 Ω
Intermediate Frequency	-----	Video 45.75 MHz Sound 41.25 MHz
Audio Output	-----	2W
Speaker	-----	4" Round Type
Picture Tube	-----	510ZB22A 19" 90° Deflection Shell-bond Type
Semiconductor		
Integrated Circuit	-----	1
Transistors	-----	50
Diodes	-----	68
Thermistors	-----	3
Posistor	-----	1
Varistor	-----	1
Cabinet Dimensions	-----	25 1/4"(W) x 21 1/2"(D) x 19 3/16"(H)
Weight	-----	78.7 lbs.





IMPORTANT SAFETY NOTICE
When servicing this chassis, under no circumstances should the original design be modified or altered without permission from the Zenith Radio Corporation. All components should be replaced only with types identical to those in the original circuit. Special components are used to prevent shock and fire hazard. These critical components are shaded on the schematic and parts list for easy identification. This circuit diagram may occasionally differ from the actual circuit used. This way, implementation of the latest safety and performance improvement changes into the set is not delayed until the new service literature is printed.

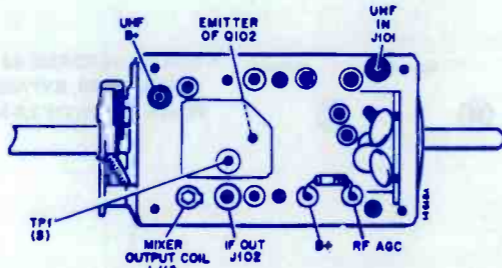
TEST POINTS	
CI	PICTURE DETECTOR OUTPUT
CE	SOUND DETECTOR OUTPUT
D	BY-PASS WITH 50PF 50V ELECTROLYTIC DURING COLOR ALIGNMENT
E	I.F. A.F.C.
JJ	FOR COLOR ALIGNMENT
J	FOR COLOR ALIGNMENT
N	AUDIO OUTPUT TO SPEAKER
Q	A.C.C. VOLTAGE
R	RED COLOR AMP. COLLECTOR
B	BLUE COLOR AMP. COLLECTOR
G	GREEN COLOR AMP. COLLECTOR



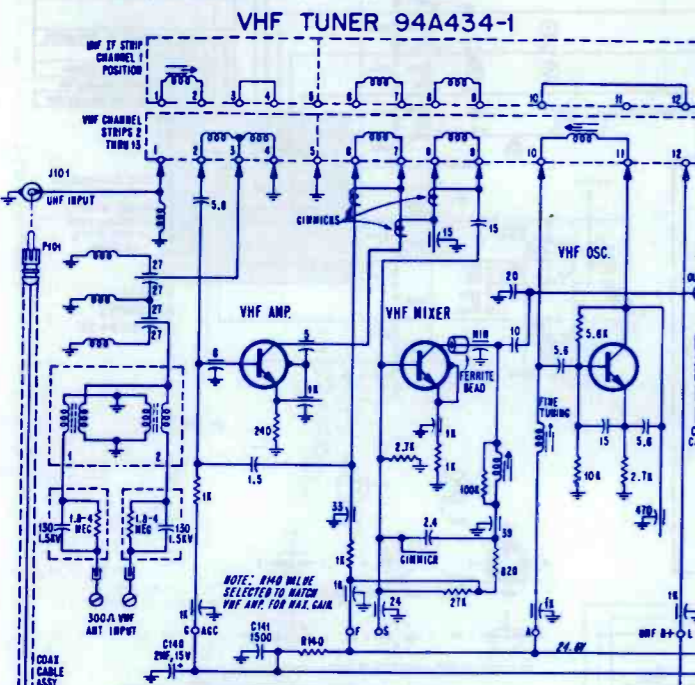
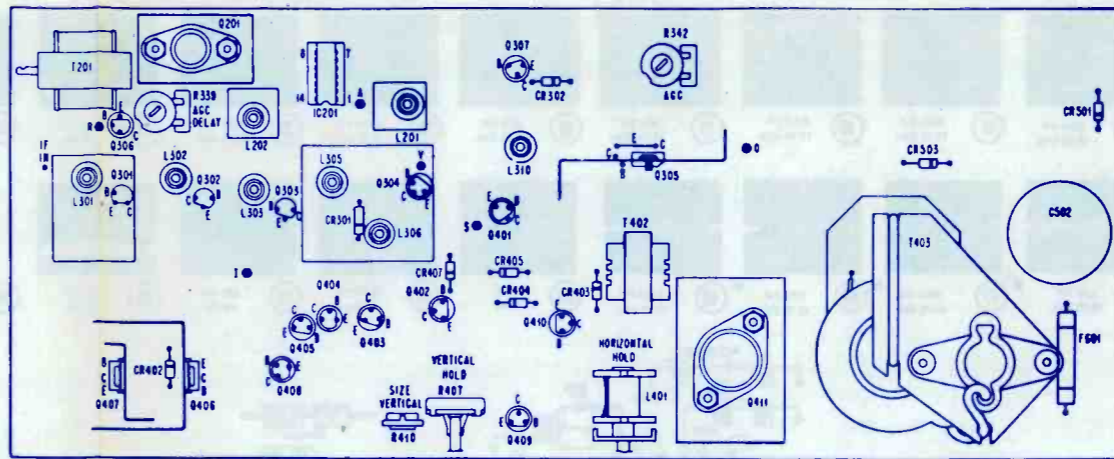
NOTES
TURN POWER OFF BEFORE REPLACING SEMICONDUCTORS. PHOTOGRAPHS TAKEN ON A STANDARD GATED RAINBOW COLOR BAR SIGNAL. THE HUE SETTING ADJUSTED FOR PROPER COLOR. THE WAVE SHAPES AT THE RED, GREEN AND BLUE CATHODE GRIDS OF THE PICTURE TUBE DEPEND ON THE HUE, COLOR LEVEL, CONTRAST AND PICTURE PEAKING CONTROLS. FOR WAVEFORMS 43 THRU 49, TEST POINT "D" MUST BE BY-PASSED WITH A 0.1 μF CAPACITOR.
ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED
ALL VOLTAGES ARE D.C. UNLESS OTHERWISE SPECIFIED.
ALL D.C. VOLTAGES TO BE MEASURED WITH A VACUUM TUBE VOLTMETER HAVING 11 MEGOHM INPUT RESISTANCE.
ALL VOLTAGE MEASUREMENTS TO BE MADE WITH NO SIGNAL PRESENT AND NORMAL SETTING OF CONTROLS AND CHANNEL SELECTOR SET TO CHANNEL 2 UNLESS OTHERWISE SPECIFIED.
COIL RESISTANCE MEASUREMENTS TAKEN WITH COILS DISCONNECTED FROM CIRCUIT.
ALL RESISTORS ARE 5% TOLERANCE, CARBON, 1/2 WATT UNLESS OTHERWISE SPECIFIED.
COIL RESISTANCE NOT GIVEN UNDER ONE OHM.
COIL CAPACITOR VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
FOR CAPACITOR TOLERANCE, SEE LEGEND.
CATHODE RAY TUBE 2 NO. ANODE VOLTAGE TO BE MEASURED WITH ELECTROSTATIC 20K OHMS PER VOLT MIN. HIGH VOLTAGE METER.
ARROWS ON POTENTIOMETER INDICATE CLOCKWISE ROTATION.
○ INDICATES ALIGNMENT AND TEST POINT.
PF = PICOFARAD MH = MEGAHERTZ μH = MICROHENRY
⊕ INDICATES ±20% MAY BE USED. ○ INDICATES VOLTAGE SOURCE.
② INDICATES WAVEFORMS CHECK POINTS. (SEE CHART WAVEFORM MEASURED FROM POINT INDICATED TO CHASSIS GROUND.)
◇ INDICATE WAVEFORM (SEE CHART) WAVEFORM MEASURED ACROSS POINTS INDICATED (NOT TO CHASSIS GROUND) OSCILLOSCOPE SHOULD NOT BE GROUND TO CHASSIS. REVERSING LEADS REVERSES WAVEFORM.
⊕ INDICATES CHASSIS GROUND.
⊕ INDICATES CHROMATIC SWITCH WIRING POSITION
⊕ INDICATES PIN NUMBER ON MODULE BOARD

SYMBOL DESCRIPTION AIRLINE PART NO.

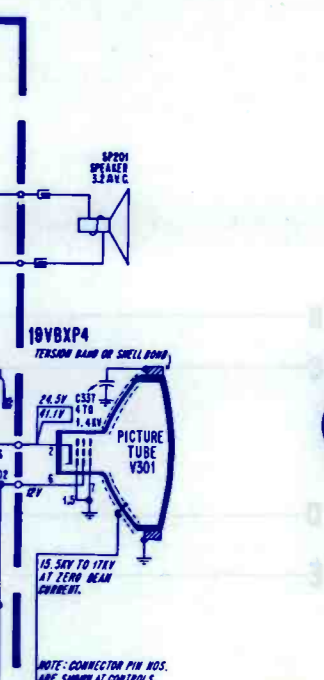
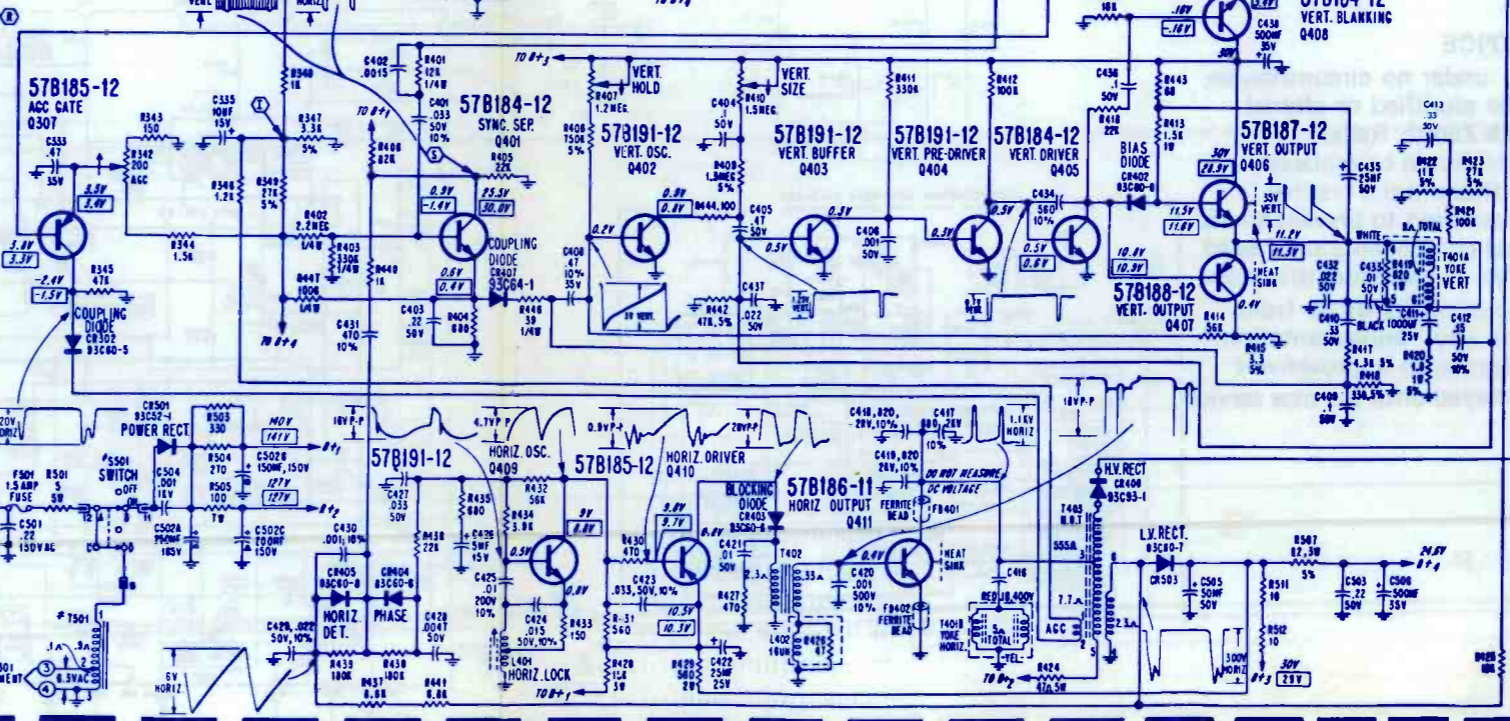
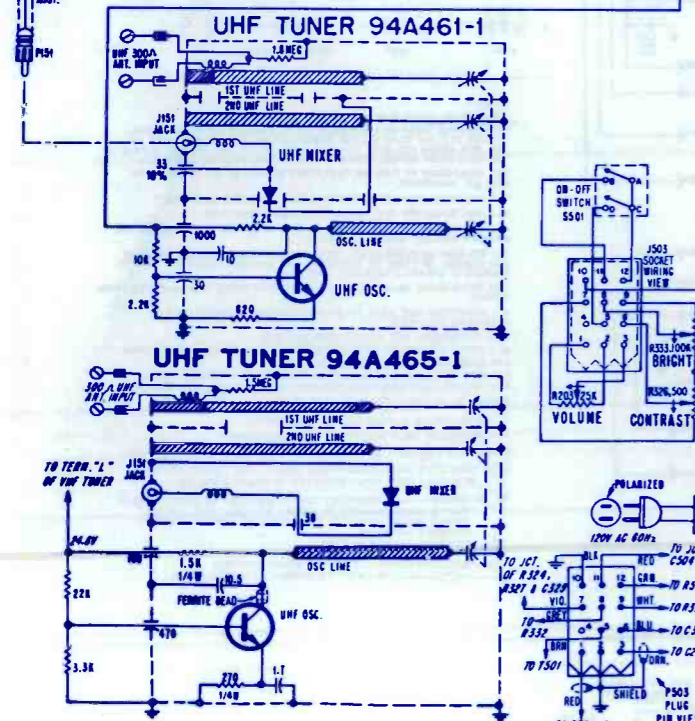
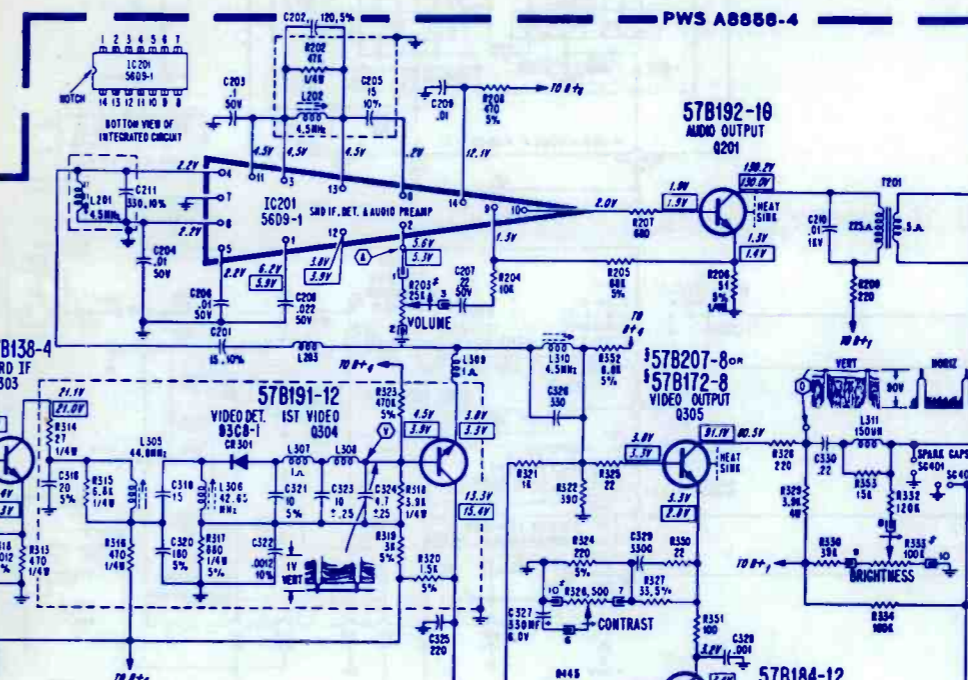
C502A, B, — 250mf/165v, 150mf/150v, 200mf/150v,	
C — electro	67A30-11
R203 — 25K, volume	75A167-9
R326 — 500 ohm, contrast	75A167-5
R333 — 100K, brite	75A167-4
R339 — 400 ohm, AGC delay	75A101-50
R342 — 200 ohm, AGC	75A101-49
R407 — 1.5M vert hold	75A191-1
R410 — 1.5M vert size	75A101-11
L201 — coil 4.5MHz, sound IF	72A317-7
L310 — coil, sound take-off	72A317-1
L401 — coil, horiz osc lock	94A480-1
T201 — xformer, audio output assm.	700A1035-5
T401A, B — yoke, deflect	750A1089-15
T402 — xformer, horiz drive	79A167-1
T403 — xformer, horiz output	79A166-1
T501 — autotformer, CRT filament	80A117-2
F501 — fuse, 1.5a	31801-5
77A221-2 — switch, on-off w/pushbutton	77A221-2
tuner, VHF, GAI-13145A	94A433-1
tuner, VHF, GAI-13145B	94A34-1



Top View of VHF Tuner (94A434-1) Showing Test Point and Alignment Locations



SAFETY NOTICE
 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. REPLACEMENT PARTS MUST BE IDENTICAL TO THOSE USED IN THE ORIGINAL CIRCUIT. SERVICE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY.



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

GROUP
276

SCHEMATIC NO.

SCHEMATIC NO.

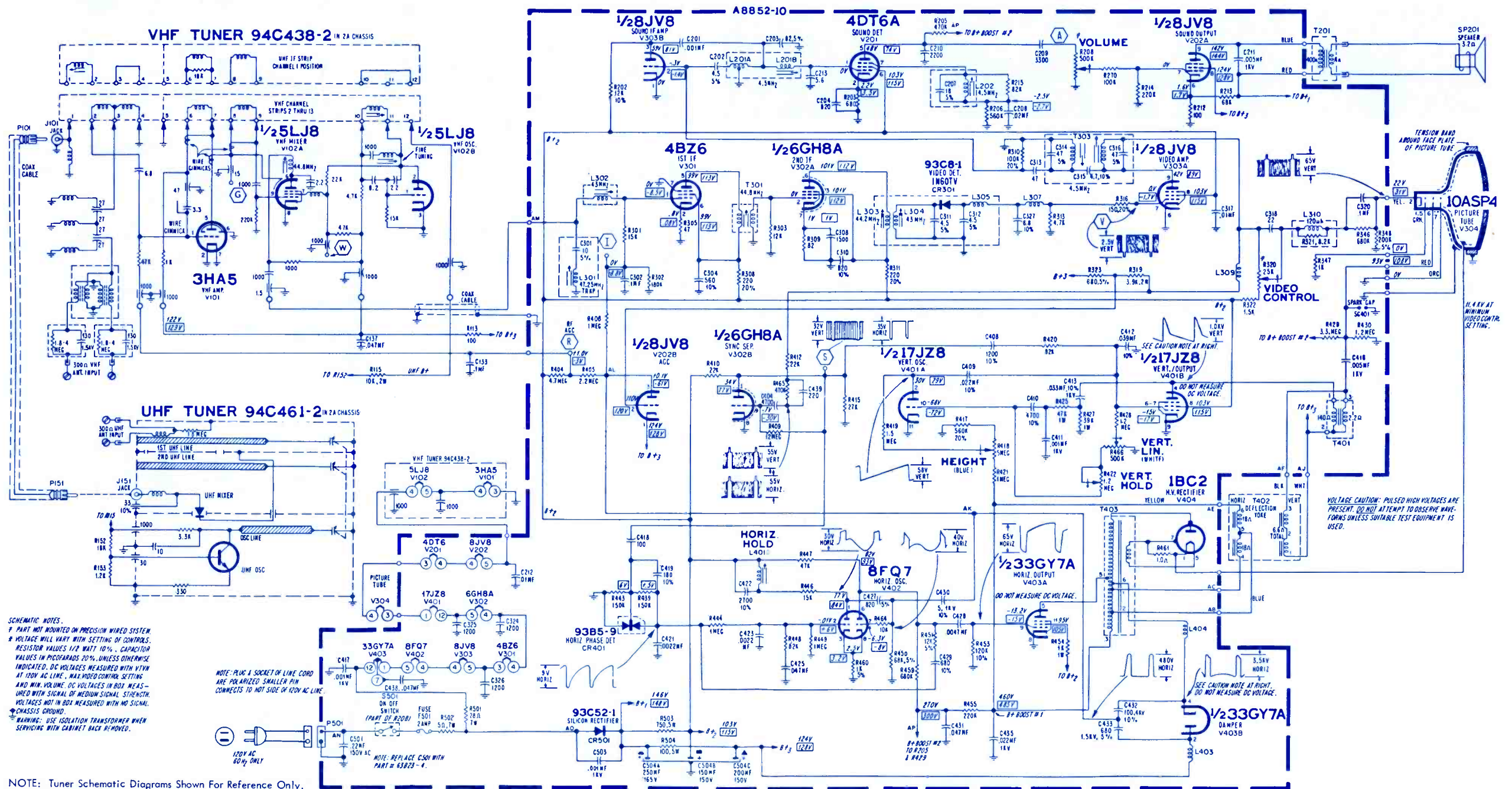
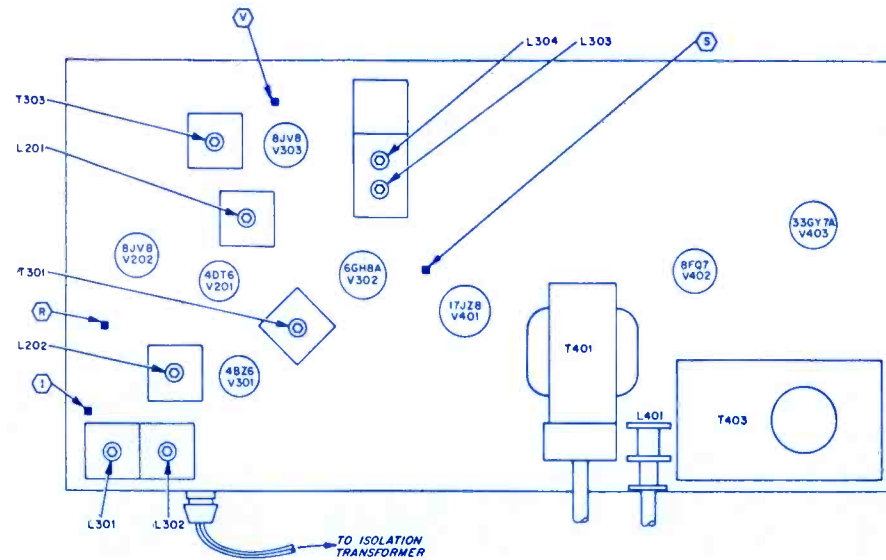
ADMIRAL1599
Color TV Chassis T47K10-1A/4A

MGA1600
Color TV Model CS-195

AIRLINE1598
TV Model GAI-11105A/B

ZENITH1601
Color TV Chassis 25FC45

AIRLINE1602
TV Model GAI-13145A/B



SCHEMATIC NOTES:
* PART NOT MOUNTED ON PRECISION WIRED SYSTEM.
VOLTAGE WILL VARY WITH SETTING OF CONTROLS.
RESISTOR VALUES 1% TOLERANCE UNLESS OTHERWISE INDICATED. DC VOLTAGES MEASURED WITH VTVM AT 120V AC LINE, MAX. MFD CONTROL SETTING AND MIN. VOLUME. DC VOLTAGES IN BOX MEASURED WITH SIGNAL OF MEDIUM STRENGTH. VOLTAGES NOT IN BOX MEASURED WITH NO SIGNAL. CHASSIS GROUND.
WARNING: USE ISOLATION TRANSFORMER WHEN SERVICING WITH CABINET BACK REMOVED.

NOTE: PLUG A SOCKET OF LINE CORD ARE POLARIZED SMALLER PIN CONNECTS TO HOT SIDE OF LINE AC LINE.
NOTE: REPLACE CS01 WITH PART # 63823-4.

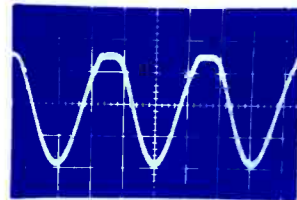
VOLTAGE CAUTION: PULSED HIGH VOLTAGES ARE PRESENT. DO NOT ATTEMPT TO OBSERVE WAVEFORMS UNLESS SUITABLE TEST EQUIPMENT IS USED.

NOTE: Tuner Schematic Diagrams Shown For Reference Only. See Parts List For Service Replaceable Parts.

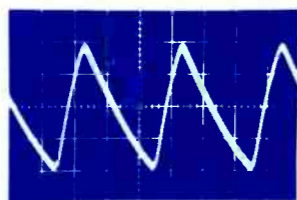
SYMBOL DESCRIPTION ADMIRAL PART NO.

RA82	— 2K AG delay	75A101-31
RA83	— 2K AGC control	75A101-31
RC64	— 10K color kill control	75A101-18
RD38	— 400 ohm, react control	75A101-35
RE54	— vert size control, triple cont	75A95-18
RE55	— vert hold triple cont	75A95-18
RE56	— vert line cont, 300K triple cont	75A95-18
RF76	— blue screen triple cont	75A95-17
RF77	— green screen triple cont	75A95-17
RF78	— red screen	75A95-17
RH28	— control brite	75A198-4
RH29	— 350 ohm contrast control	75A198-3
RH34	— 500 ohm side tint control	75A198-2
RH39	— 500 ohm color control	75A198-2
RH42	— 50K vol on/off control T47K10-4A	75A140-31
RH42	— 50K vol on/off control T47K10-1A	75A140-30
RH149	— 30M focus control	75A108-8
RH150A, B	— bleeder focus control	61A71-1

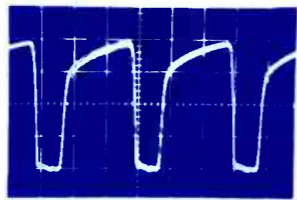
CH10A	— 300mf, 350v electro	67A15-415
CH10B	— 300mf, 350v electro	67A15-415
CH10C	— 80mf, 350v electro	67A15-415
CH10D	— 10mf, 350v electro	67A15-415
CH14A, B	— 2000mfd, 40v electro	67A15-413
DLH43	— delay line	72A217-3
LC16	— chroma input coil	72A329-1
LD74, 75	— 689µh, 3.58MHz SR trap	73A55-17
LF24	— horiz hold control	94A351-1
MH57	— deflect yoke	94A571-2
TB20	— ratio xformer	72A318-1
TC14	— burst xformer	72A325-3
TC29	— bandpass xformer	72A327-1
TH2	— line choke	73A31-16
TH4	— power xformer	80A108-14
TH18	— horiz output xformer	79A169-3
TH44	— audio output xformer	79A141-4
TH73	— vert output xformer	79A165-1
MH140	— tripler voltage tuner VHF	93A91-1 94A383-4



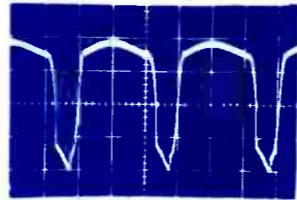
1. Horiz. Osc. V3B, Pin 2, 38V P-P, H



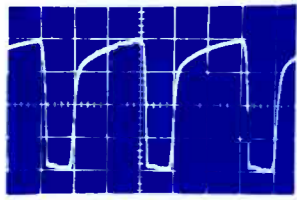
2. Horiz. Osc. Control V3A, Pin 8, 1V P-P, H



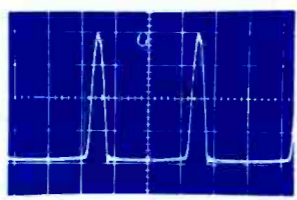
3. Horiz. Osc. V3B, Pin 6, 240V P-P, H



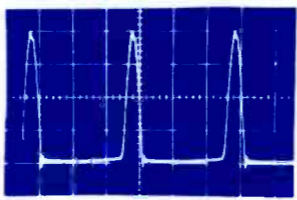
4. Horiz. Osc. V3B, Pin 3, 64V P-P, H



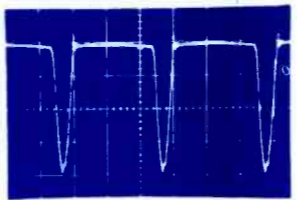
5. Horiz. Output V6, Pin 5, 220V P-P, H



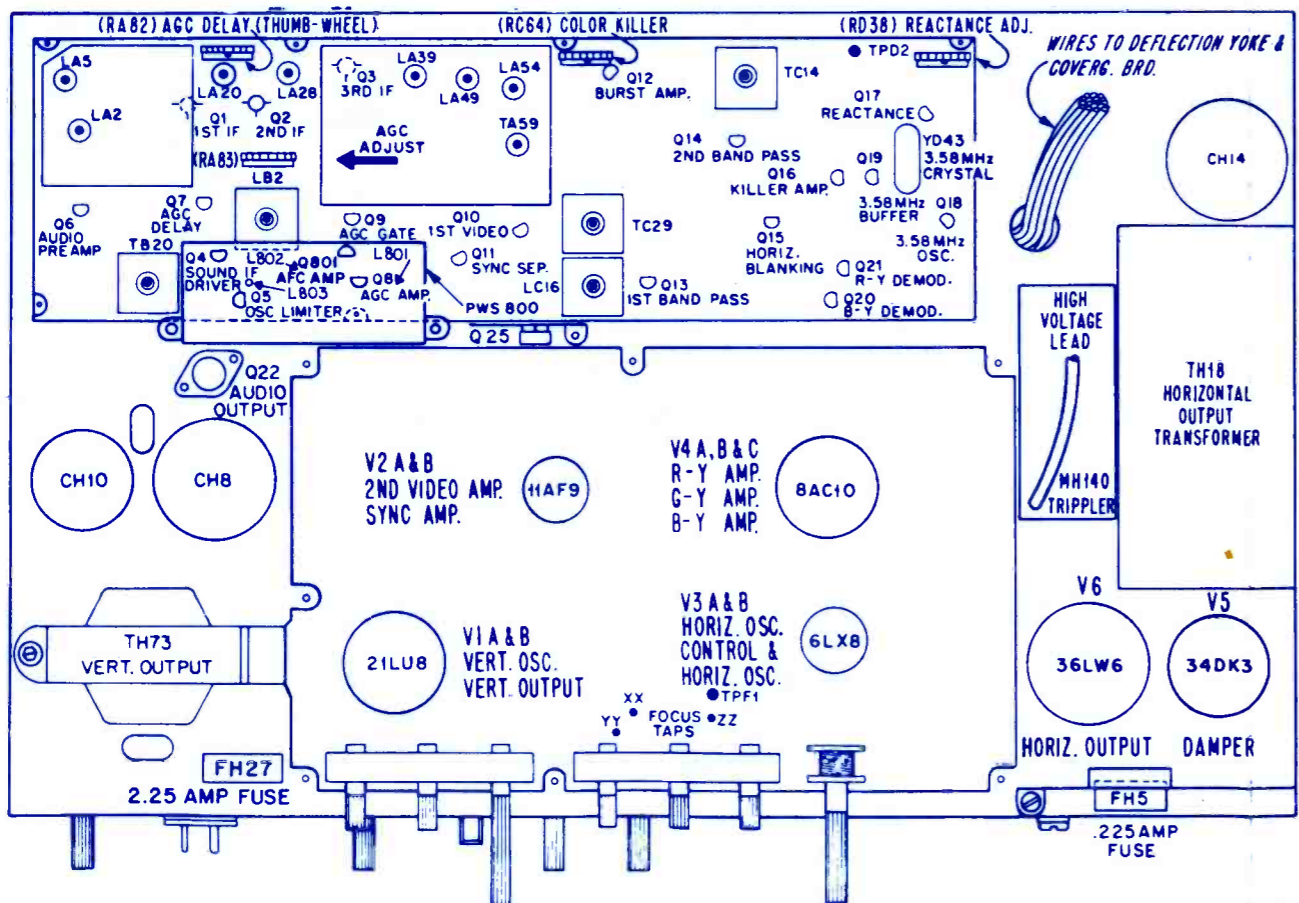
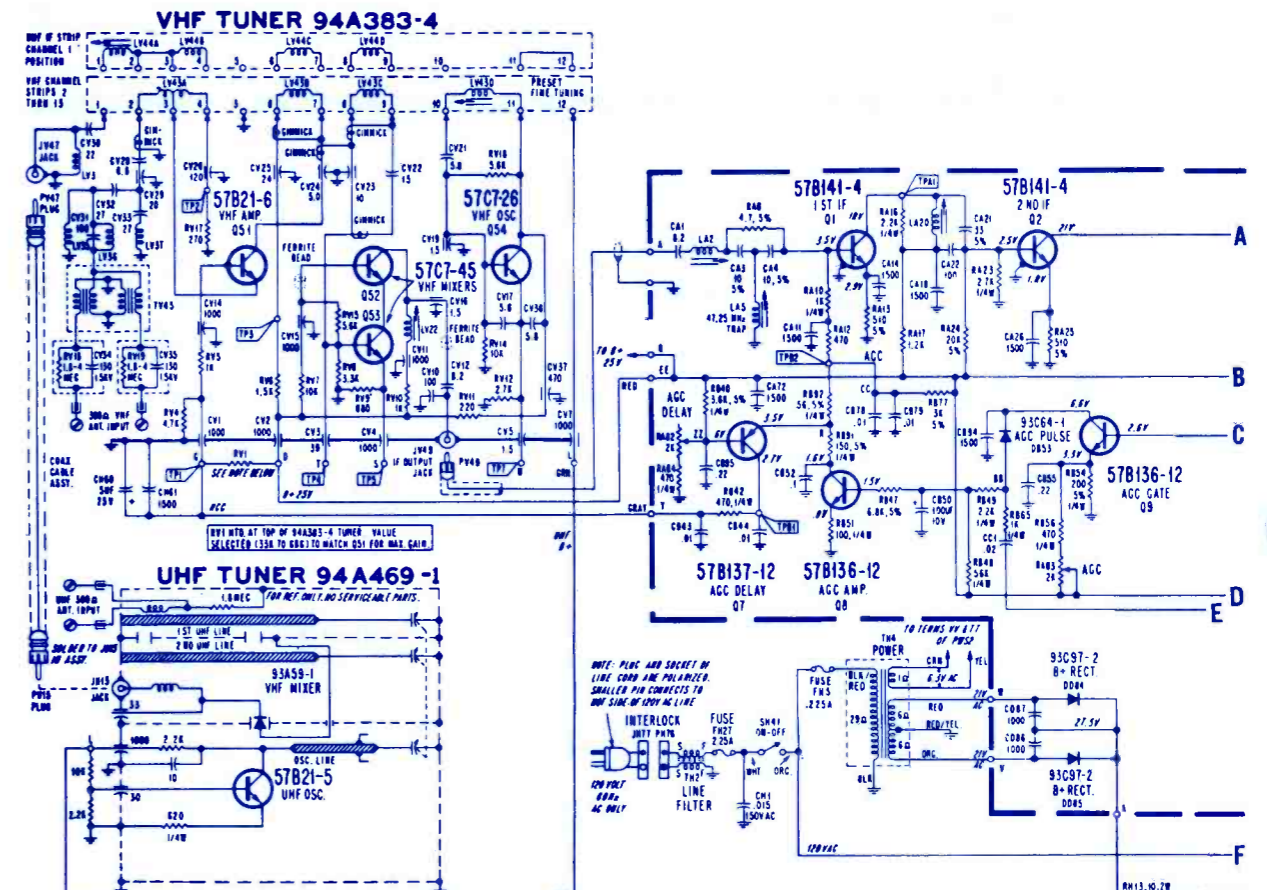
6. Horiz. Output Trans., Pin 27, 290V P-P, H



7. Horiz. Output Trans., Pin 2, 32V, H



8. Horiz. Output Trans., Pin 1, 10-15V, H



TOP ILLUSTRATION OF CHASSIS

T47K10-1A INSTANT ON CKT

NOTES: UNLESS OTHERWISE SPECIFIED, RESISTANCE VALUES ARE IN OHMS, 10M, 100K, 1M, 100µF, CAPACITANCE VALUES 1 OR HIGHER ARE IN µF. CAPACITANCE VALUES LESS THAN 1 ARE IN nF, INDUCTANCE VALUES ARE IN µH. — INDICATES CHASSIS GROUND. H INDICATES CYCLES PER SECOND. DC INDICATES ARE MEASURED WITH VTVM PLACED BETWEEN POINTS INDICATED A CHASSIS GROUND. LINE VOLTAGE SET AT 100V AC & ALL COMPONENTS SET FOR NORMAL PICTURE UNLESS OTHERWISE INDICATED. VOLTAGE READINGS ARE TAKEN WITHOUT SIGNAL, WITH VHF TUNER SET AT UNUSED CHANNEL. VOLTAGES SHOWN IN BRACKETS () ARE MEASURED WITH RECEIVER TUNED TO A COLOR SIGNAL.

WARNING: CHASSIS IS CONNECTED DIRECTLY TO ONE SIDE OF AC POWER LINE. USE AN ISOLATION TRANSFORMER WHEN SERVICING TO AVOID THE POSSIBILITY OF ACCIDENTAL ELECTRICAL SHOCK & DAMAGE TO TEST EQUIPMENT.

TRANSISTOR CAUTION: TO AVOID DAMAGE TO TRANSISTORS, DO NOT OPERATE CHASSIS WITH PICTURE TUBE DISCONNECTED FROM CHASSIS GROUND. DO NOT TURN SET ON WITH TRANSISTOR TEST TUNGSTEN OR LEADS. REPAIR OR DISCONNECT. DO NOT AC AND AUDIO LEAD TO CHASSIS GROUND. DISCONNECT AND REMOVE BOLT TO PICTURE TUBE OR AC GROUNDING. USE CAUTION TO PREVENT ACCIDENTAL SHORTS. REMOVE COMPONENTS FROM CHASSIS GROUND. DO NOT APPLY EXCESSIVE HEAT TO TRANSISTOR LEADS. DO NOT USE AN ORDINARY BURNER FOR RESISTANCE MEASUREMENT, USE VTVM OR OHM RANGE OR HIGHER.

Ⓢ BUN NUMBER INDICATES CHANGE(S) INCORPORATED AS GIVEN UNDER THAT BUN NUMBER, AS WELL AS ALL LOWER BUN CHANGES.

Ⓢ STOPS IN RECTANGLES INDICATE TEST POINT CONNECTIONS.

Ⓢ HEADINGS IDENTIFY WAVEFORM OBSERVATION LOCATIONS. CONDITIONS FOR TAKING WAVEFORM MEASUREMENTS ARE GIVEN WITH WAVEFORM PHOTOGRAPHS.

PLAIN CHANGES:

⑩ START OF PRODUCTION

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A new 310-Type 3. Made to take a fall.

The rugged new "drop-resistant," hand size Triplet Model 310, Type 3 is priced at just \$49.

The latest addition to the rugged Triplet 310, general purpose, multi-range V-O-M family—the Model 310, Type 3—has impressive new features. Its case and clear front are made of high impact-resistant plastic.

The low Ohms range Rx1 has been fused to protect against damaging overloads. These two improvements should eliminate over half of all repair requirements resulting from field use damage.

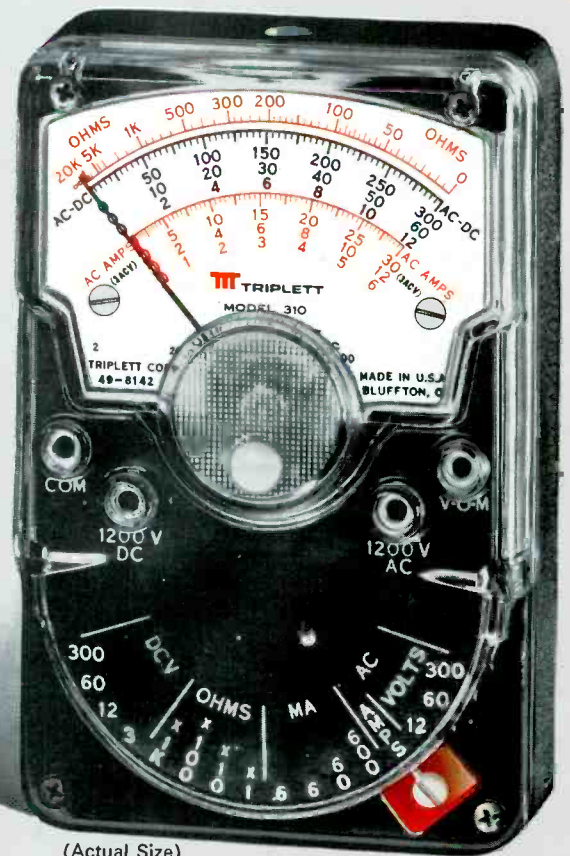
But that's not all. The case of the new Triplet 310, Type 3 sports an elegant new non-slip "finger-tread" surface finish. The meter movement brackets and pointer feature a new rugged design as well as newly designed lead jacks and Model 10 jack. Added to this, the front range and tester dial markings are changed to read easier when used with Triplet's Model 10 Clamp-on-Ammeter.

Outstanding features:

1. Drop-resistant, hand size V-O-M with high impact thermoplastic case.
2. 20,000 Ohms per Volt DC and 5,000 Ohms per Volt AC; diode overload protection with fused Rx1 Ohms range.

3. Single range switch; direct reading AC Amp range to facilitate clamp-on AC Ammeter usage.

The durable new 310, Type 3, self-shielded for checking in strong magnetic fields, is an extra-rugged, high-torque, bar-ring instrument with spring back jewels. An interchangeable test prod fits into the top of the tester, making it a common probe and freeing one hand. All this for only \$49.



(Actual Size)

For more information or a free demonstration, call your Triplet distributor or sales representative. For the name of the representative nearest you, dial toll free (800) 645-9200. New York State, call collect (516) 294-0990. Triplet Corporation, Bluffton, Ohio 45817.

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