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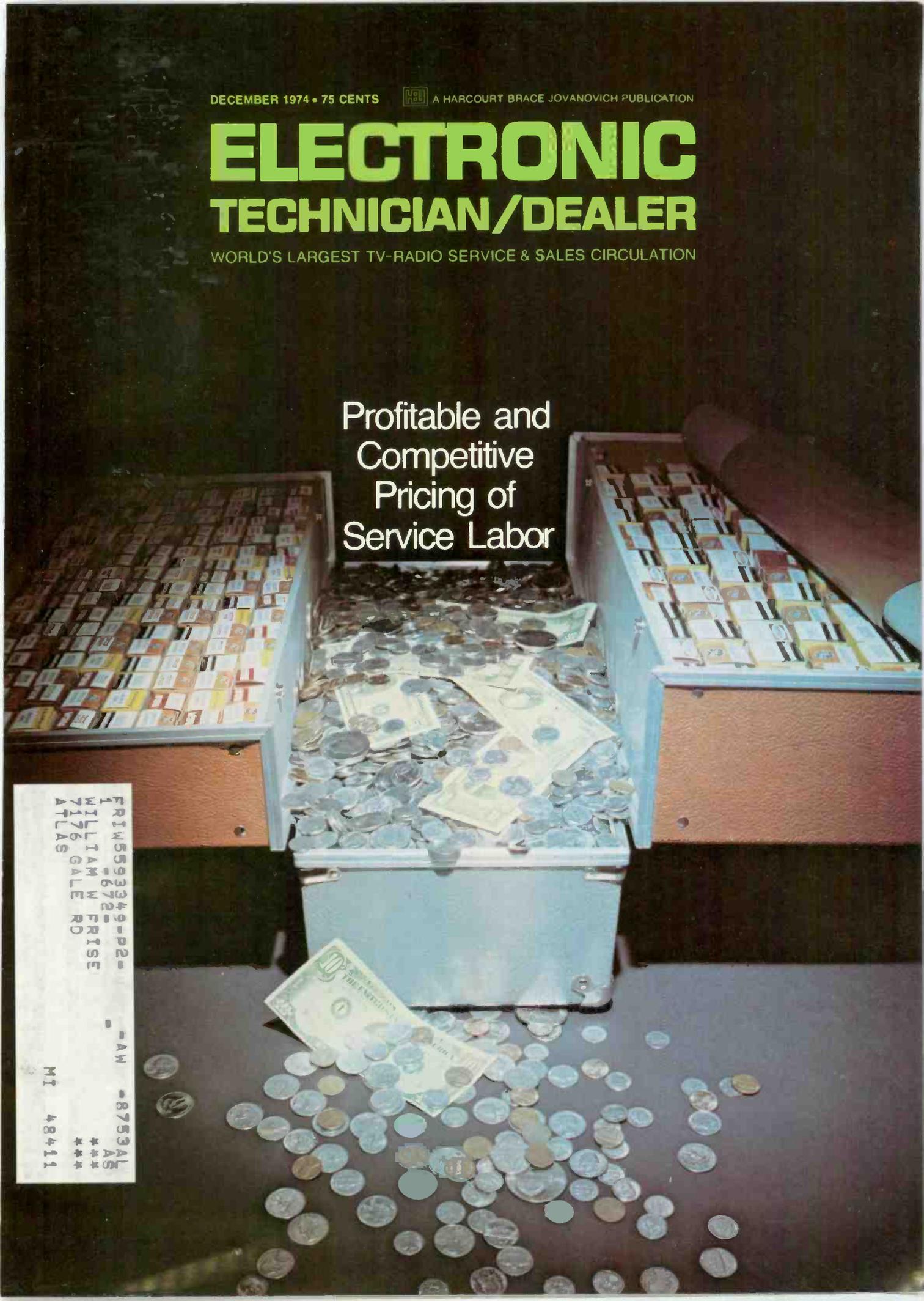
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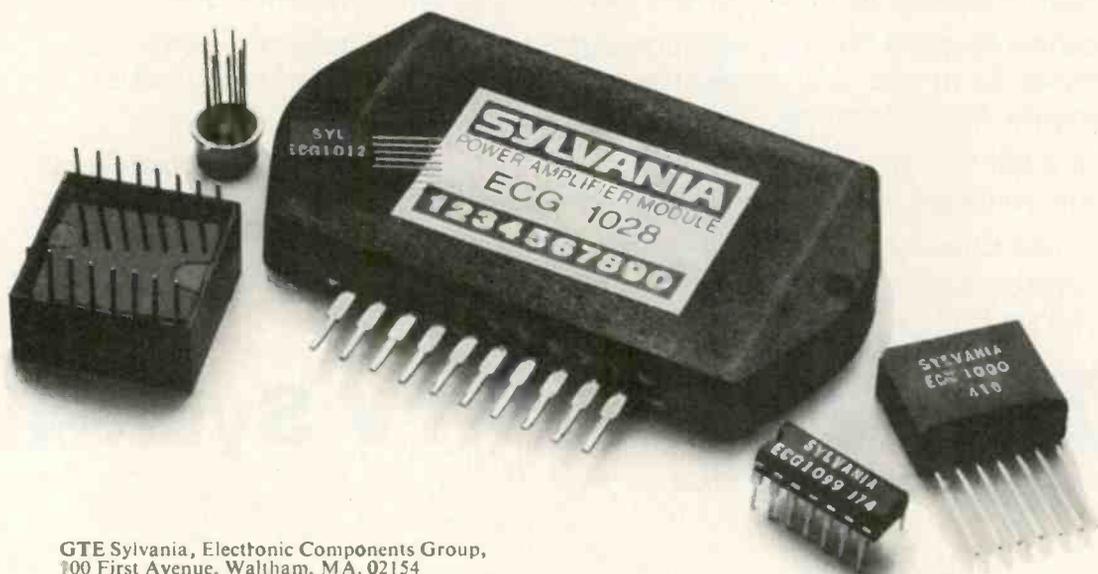
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TEKFAX—Special 10-year Index, plus schematics for Sony Model KV-1730R, Sylvania Ch. A22-1, and Zenith Chs. 12CB12X, ZX and 19FC46.

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COMING NEXT MONTH IN ET/D:

- Testing Transistors In and Out of Circuit
- Digital Frequency Counters for Servicing
- Troubleshooting Horizontal & High-Voltage Circuits
- Pricing Home Service Calls
- New in Color TV for 1975—Part 5

Plus the ET/D Annual Subject Reference Index

EDITOR'S MEMO



During the past year, there has been a major shakeout of home entertainment electronics manufacturers. The two most recent developments are the purchase by GTE Sylvania of the Philco home entertainment product line, and the acquisition of control of Magnavox by Dutch-owned North American Philips. Earlier in the year, Admiral was bought by Rockwell International, the home entertainment product line of Motorola was bought by Matsushita (Panasonic), Teledyne Packard Bell discontinued production of home entertainment electronic products, and RCA announced that in 1975 it would phase out its home audio product line.

As a result of these and other mergers, sales and dropouts of TV manufacturers during the past five years, by the middle of the coming year about 90 percent of the TV receivers being sold in this country will be produced and marketed by only nine manufacturers—Admiral, General Electric, Magnavox, Panasonic, RCA, Sears (Warwick), Sony, Sylvania and Zenith—of which only six are domestically owned and controlled (Admiral, General Electric, RCA, Sears, Sylvania and Zenith). And about 45 percent of the domestic color TV market will be shared by RCA and Zenith, if these two manufacturers are able to retain at least their present shares of this market.

Many of the same economic and market factors which contributed to the recent shakeout of TV manufacturers also have forced the surviving manufacturers to cut back on the number of chassis in their 1975 TV lines.

This combination of fewer TV manufacturers and fewer new TV chassis should be beneficial to servicers. Fewer makes and types of chassis hopefully will mean less proliferation of parts and modules and, consequently, an easing of servicers' inventory, service

continued on page 6

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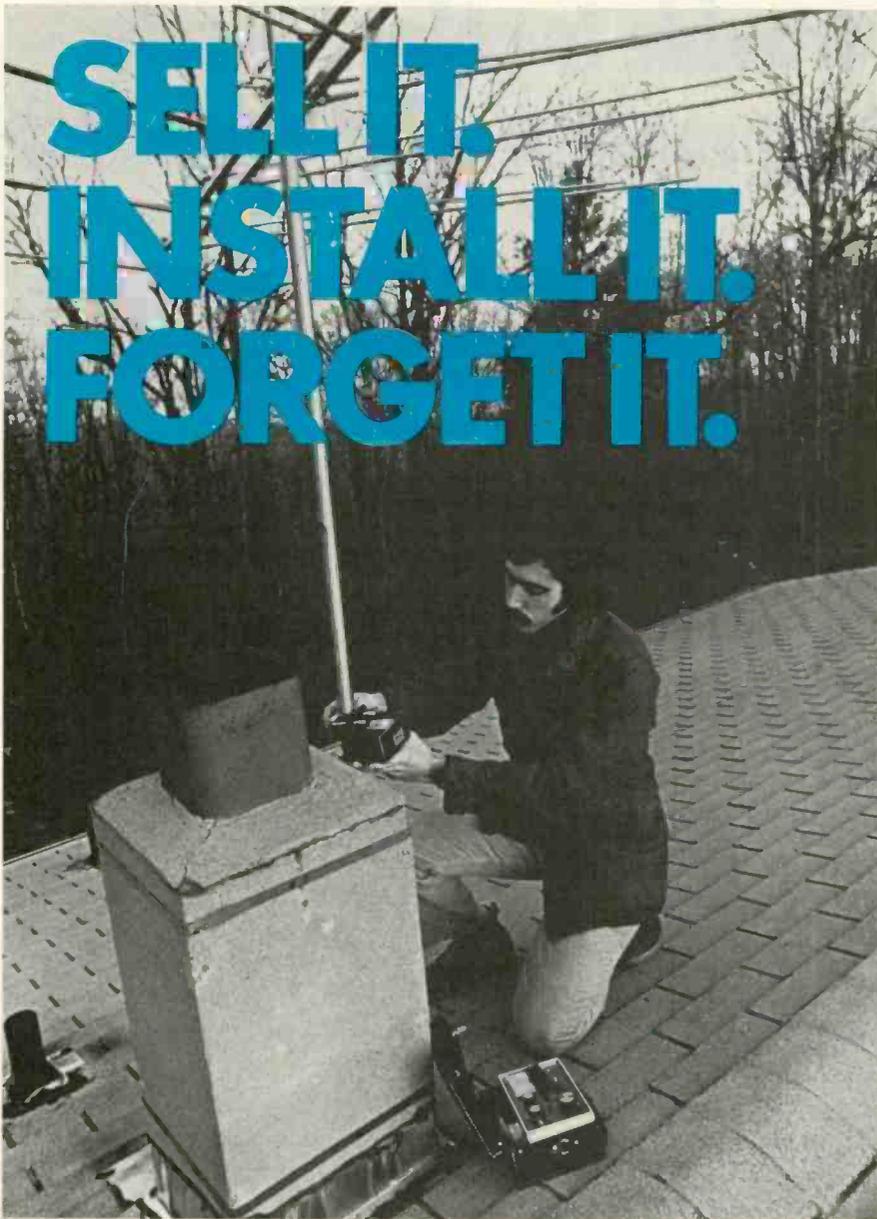
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.033 @ 400	$\pm 5\%$.500 x .750	PP4-S33S	.022 @ 800	$\pm 3\%$.600 x 1.300	PP8-S22S
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For cross-reference information on close-tolerance polypropylene and polycarbonate film capacitors, showing original part numbers with correct Sprague replacements, ask your Sprague distributor for Cross-Reference Guide C-873, or write to: Sprague Products Company, 65 Marshall Street, North Adams, Mass. 01247.



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What makes Horizon so reliable? Solid-state, trouble-free circuitry. Four-way lightning and surge protection. Temperature compensation for all-weather reliability, and two individual amplifier circuits—one for Ch. 2-6 and the other for Ch. 7-13.

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And these are the reasons that made the Horizon one of the fastest and best sellers ever, and once it's sold, forget it. B-T has the industry's broadest line of home and MATV TV signal amplifiers—indoors and outdoors. Available from Blonder-Tongue distributors.

For solutions to your reception problems write:
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One Jake Brown Rd., Old Bridge, N.J. 08857.



BLONDER TONGUE

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EDITOR'S MEMO ...

continued from page 4

literature, and parts procurement problems. It also should make it easier for servicers to keep abreast of new technology.

Whether or not these recent developments will help ease servicers' warranty-related problems is difficult to tell at this time. However, it is possible that the combination of less competition plus the economic pressures of declining sales and increased costs will encourage TV manufacturers to cut back the length of their labor warranty periods. If this happens, it will not completely solve the servicer's problem of unrealistic warranty service labor rates, but it will make it a less significant problem by putting ailing TV receivers in independent servicers' hands on a nonwarranty, profit-producing basis sooner.

Although the present inflationary, depressed economy is creating the same problems for consumer electronic servicers as it is for everyone else, some of the problems faced by servicers should be offset by an increase in the demand for out-of-warranty service as more and more people are forced to repair what they have now instead of replacing it. This continuing decline in the demand for new home entertainment electronic products is a mixed blessing for servicers who are also retailers; however, it should prove to be both a short- and long-term blessing for nonretailing servicers because it is slowing the rate at which existing tube and hybrid TV receivers are being replaced by new all-solid-state, modular types. This, in turn, should slow the rate at which profits from tubes sales have been declining.

How well consumer electronic servicers will fare in 1975 will depend, in part, on how well the economy as a whole fares; however, as the new year begins, it seems that independent electronic servicers just might have an edge over other types of businesses. If so, we've earned it. ■

J. W. Phipps

Comments from our readers are always welcome. Address your letters to:

J. W. Phipps, Editor
Electronic Technician/Dealer
1 East First Street
Duluth, Minnesota 55802

ELECTRONIC ASSOCIATION DIGEST

Information about the activities of national, state and local associations of electronic servicers, dealers and manufacturers. Material for publication in this department should be addressed to: Service Association Digest, ET/D, 1 East First St., Duluth, Minn. 55802.

NARDA to Offer Three Schools of Service Management in 1975

The National Appliance & Radio-Electronics Dealers Association, a division of NARDA Inc., has announced that in 1975 three NARDA Schools of Service Management will be held on different dates and in different locations throughout the country, to make it more convenient and less costly for more servicers to attend.

The three Schools of Service Management will cover the same subjects, but with different speakers and instructors.

The dates and locations of the three schools are:

- January 26-28—University of San Francisco
- February 9-11—Hilton Airport Hotel, Philadelphia
- February 23-25—University of Notre Dame, South Bend, Indiana

Each school will open on a Sunday afternoon with an open "bull session," followed by an evening seminar which explores the subject of "how to make a profit from service."

Seminars on Monday include topics such as: "How Do I Keep My Technicians From Goofing Off?," "What Can My Financial Statements Tell Me?," "How Can I Stay In the Warranty Business When I Can't Get Paid Fairly?," "How Do I Keep A Proper Inventory?" Topics on Tuesday include: "What Should I Be Charging For Service?," "How Do I Get My Share Of The Service Contract Pie?," "Help! I'm Drowning In Paperwork!" "How Do I Get My Call Takers To Do A Better Job?," "Am I Getting Routed and Dispatched To The Poorhouse?," and "Good Grief, What's Next?"

The registration fee for NARDA members is \$125, including lodging, meals, tuition and materials. The fee for non-members is \$185. Additional information about the schools can be obtained by writing or calling NARDA, 318 W. Randolph St., Chicago, Ill. 60606, phone (312) 726-5583.

EIA Approves EIA/AEM Merger

The membership of the Electronic Industries Association (EIA), at the Association's 50th annual convention in Beverly Hills, California, in October, voted final approval of the merger of EIA and the Association of Electronic Manufacturers (AEM).

AEM had already approved the merger in September. The EIA action cleared the way for formal consummation of the merger at the AEM National Convention in Miami on November 14.

Effective January 1, 1975, members of AEM automatically will become members of the Distributor Products Division of EIA, increasing EIA membership by about 100 companies.

EIA is the only national trade association representing the full spectrum of manufacturers in the electronics industry. ■

What will you look for in your next service scope?



Heath's 4510 has the performance and features you need to tackle just about any service job.

A good service scope should be more than just a visual voltmeter. It should have the performance necessary to troubleshoot today's sensitive circuits. Our 4510 has DC-15 MHz bandwidth, 1 mV/cm sensitivity, time base sweep to 100 ns/cm and complete dual trace capability. And many features that other manufacturers don't provide at anywhere near the price.

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NEWS OF THE INDUSTRY

GTE Sylvania Buys Philco-Ford Home Entertainment Products

GTE Sylvania has acquired the Philco name and distribution rights for home entertainment products manufactured by the Home Products Division of Philco-Ford.

On November 1, GTE Sylvania began distributing Philco color and black-and-white TV receivers and stereo consoles to established Philco distributors and dealers in the U.S. and Canada.

Philco-Ford will continue to assemble television and stereo consoles and supply them to GTE Sylvania until April 30, 1975, after which Philco-Ford will terminate such manufacture, and GTE Sylvania will begin producing all home entertainment products bearing the Philco trademark.

Service, parts and warranty obligations will be fulfilled initially by Philco-Ford but subsequently will be assumed by GTE Sylvania.

The purchase relates only to Philco home entertainment products sold domestically and in Canada, and does not involve Philco-Ford's line of home refrigerators and freezers, its Telesound operations, or its auto products, including radios, air conditioner components and electronic controls. All of these will continue to be manufactured, marketed and serviced by Philco-Ford.

Sales of Philco home entertainment products to dealers and distributors are being handled by a GTE Sylvania sales organization which operates independently of Sylvania's field sales organization.

Color TV Sales to Dealers Off 21.7% in September, Down 9.3% for First Nine Months of 1974

Sales of color TV to dealers in September were 21.7 percent below the volume sold during the same month in 1973, according to the Marketing Services Department of the Electronic Industries Association (EIA).

Total color TV sales to dealers during the first nine months of this year were 9.3 percent below total sales during the same period last year.

Total U.S. Market sales to dealers of all categories of consumer entertainment electronic products during the first nine months of 1974 and 1973 are shown below. (Source: EIA Marketing Services Dept.)

	FIRST 3 QUARTERS YEAR TO DATE		% CHANGE
	1974	1973	
Television			
Monochrome	4,373,967	4,913,973	-11.0
Color	5,803,006	6,396,487	-9.3
TOTAL TELEVISION	10,176,973	11,310,460	-10.0
Radio			
AM	8,690,337	12,102,592	-28.2
FM	14,459,316	13,294,576	+8.8
TOTAL	23,149,653	25,397,168	-8.9
AUTOMOBILE	7,679,967	9,440,955	-18.7
TOTAL RADIO	30,829,620	34,838,123	-11.5
Phonograph			
Portable & Table*	2,957,648	4,123,259	-28.3
Console	568,303	598,300	-5.0
TOTAL PHONOGRAPH	3,525,951	4,721,559	-25.3

*Includes compact and component systems.

Number of Employed TV Technicians to Decline Says MIT Study

By 1980, the number of employed TV technicians will have declined from the estimated 137,000 employed in 1970 to about 126,000, according to the recently reported findings of a study conducted by the Massachusetts Institute of Technology (MIT) and financed by the National Science Foundation.

The report, published this summer by MIT's Center for Policy Alternatives, and

titled *The Productivity of Servicing Consumer Durable Products*, says that the decline in employed TV technicians will be attributable to advances in technology which reduce the incidence of need for service and improve the ease with which TV receivers can be repaired.

Philips Buys Control of Magnavox

North American Philips Development Corporation, a subsidiary of Philips, the giant Dutch electronics firm, has purchased controlling interest in Magnavox.

FTC Issues Rule Covering Audio Amplifier Power Output Ratings

The Federal Trade Commission (FTC) has announced the adoption of a Trade Regulation Rule which establishes standard methods by which all manufacturers must evaluate and advertise the power output, power band (power frequency response) and distortion characteristics of home entertainment audio amplifiers which exceed 2 watts per channel or 2 watts total output power.

The Rule, which has been under consideration by the FTC for over ten years, became effective November 4 of this year.

The Rule stipulates that whenever the power output, power band (power frequency response) or distortion characteristics are stated either directly or indirectly, in connection with the advertising, sales or offering for sale of a sound power amplification device "the following disclosures must be made clearly, conspicuously and more prominently than any other representations or disclosures":

(a) The manufacturer's rated minimum sine wave continuous average power output, in watts, per channel (if the equipment is designed to amplify two or more channels simultaneously)

(i) For each load impedance required to be disclosed in paragraph (b) of this section, when measured with resistive load or loads equal to such (nominal) load impedance or impedances, and

(ii) Measured with all associated channels fully driven to rated per channel power;

(b) The load impedance or impedances, in ohms, for which the manufacturer designs the equipment to be used by the consumer;

(c) The manufacturer's rated power band or power frequency response, in Hertz (Hz), for each rated power output required to be disclosed in paragraph (a) (i) of this section; and

(d) The manufacturer's rated percentage of maximum total harmonic distortion at any power level from 250 mw to the rated power output, for each such rated power output and its corresponding rated power band or power frequency response.

The rule also stipulates that the following conditions must be adhered to during testing required to establish power output ratings and related characteristics:

(a) The power line voltage shall be 120 volts AC (230 volts when the equipment is made for foreign sale or use, unless a different nameplate rating is permanently affixed to the product by the manufacturer in which event the latter figure would control), RMS, using a sinusoidal wave containing less than 2 percent total harmonic content. In the case of equipment designed for battery operation only, tests shall be made with the battery power supply for which the particular equipment is designed and such test voltage must be disclosed under the required disclosures of Section 2 of this Rule. If capable of both AC and DC battery operation, testing shall be with AC line operation:

(b) The AC power line frequency for domestic equipment shall be 60 Hz, and 50 Hz for equipment made for foreign sale or use;

(c) The amplifier shall be preconditioned by simultaneously operating all channels at one-third of rated power output for one hour using a sinusoidal wave at a frequency of 1000 Hz;

(d) The preconditioning and testing shall be in still air and an ambient temperature of at least 77°F (25°C);

(e) Rated power shall be obtainable at all frequencies within the rated power band without exceeding the rated maximum percentage of total harmonic distortion after input signals at said frequencies have been continuously applied at full rated power for not less than five (5) minutes at the amplifier's auxiliary input, or if not provided, at the phono input.

(f) At all times during warm-up and testing, tone, loudness-contour and other controls shall be preset for the flattest response. ■

TECHNICAL LITERATURE

Solid-State Databooks

The SSD-200B seven-volume, 4300-page set of 1974 Databooks is now available on RCA's complete commercial line of linear integrated circuits, discrete MOS devices, COS/MOS digital integrated circuits, power transistors, thyristors, rectifiers, RF and microwave devices, hybrid circuits, and high-reliability ICs and discrete de-

vices. The SSD-200B series contains complete technical data sheets and application notes on all commercial types in the RCA inventory as of January 1, 1974. The seven volumes contain data on 1664 basic types, many of which are available in various packages and lead configurations. This number includes 434 new commercial types introduced during 1973. The books may be obtained individually or in seven volume sets. The Databooks may be ordered by individual volume for \$2.00 each or the seven-volume set for \$14.00. RCA Solid-State Division, Box 3200, Somerville, NJ. 08876.

Serviceman/Technician Catalog

A 48-page, illustrated, discount mail-order catalog is now available. This catalog has been specifically designed as a quick reference ordering guide for use by radio/TV servicemen and other electronic technicians. Included are tools, service and repair kits, tubes, test equipment, phono cartridges and needles, speakers and microphones, antennas, components and many other servicing aids of various major manufacturers. All products are shown with their prices. Fordham Radio Supply Co., 558 Morris Ave., Bronx, NY. 10451.

Test Equipment

A 6-page, condensed catalog featuring a broad line of electronic test and measuring instruments for laboratories, industry, schools and radio/TV servicing is now available. The catalog features the most popular units in a line of over 100 electronic kits and factory assembled instruments. Eico Electronic Instrument Co., Inc., 283 Malta St., Brooklyn, NY. 11207.

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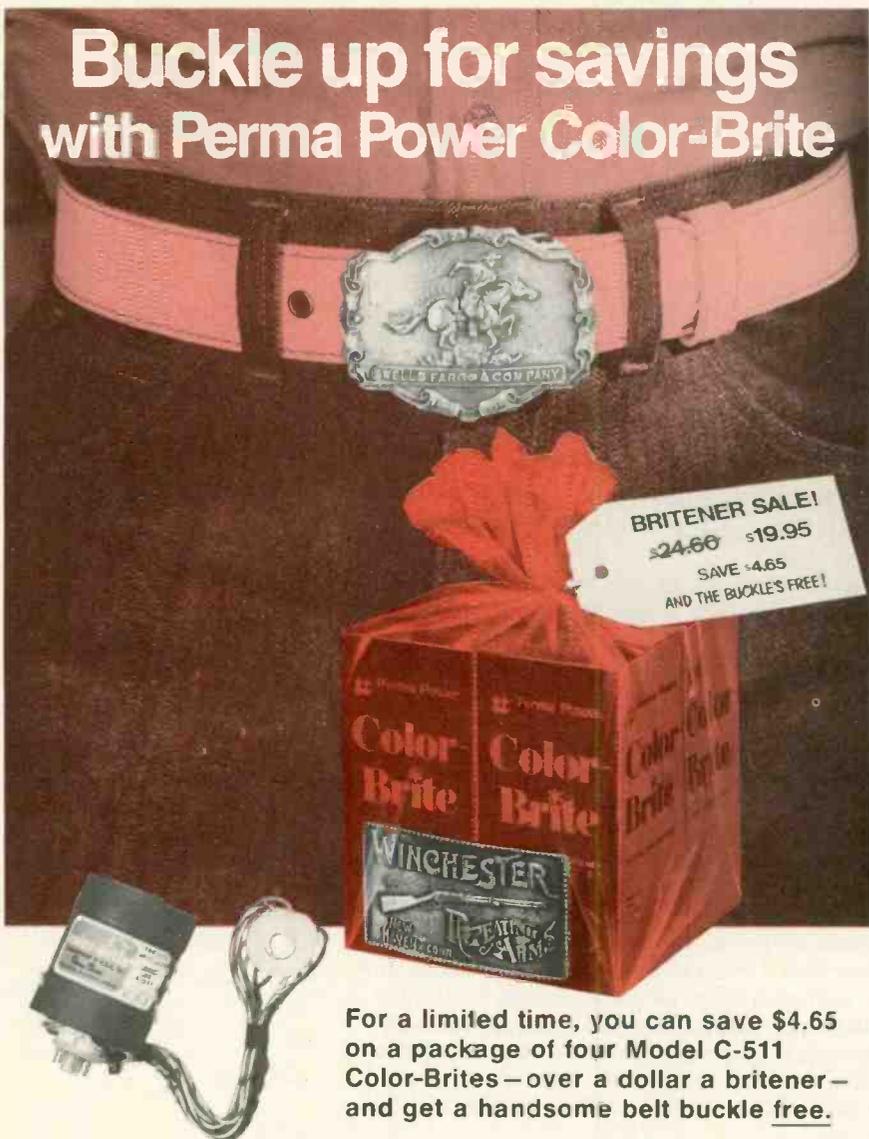
Color TV Test Jig

Information on Sylvania's CK1500X CHEK-A-COLOR and RIG-A-JIG CK1900X color test jigs and the entire line of test equipment accessories may be obtained from the Marketing Dept., GTE Sylvania, 100 First Ave., Waltham, Mass. 02154

Electronic Products

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Profitable and Competitive Pricing of Service Labor

By J. W. Phipps

How to compute the hourly service labor rate you must charge to realize the profit you desire

■ Profitable pricing is, simply stated, a matter of selling a product or service for more than it cost you to buy it or produce it. To determine at what price you must sell a product or service to realize a specific profit, you first must determine what it cost you to produce and sell it, or buy it and resell it. For this reason, *accurate cost accounting* is an essential part of profitable pricing.

Most electronic servicing businesses have two separate but interdependent profit-producing functions:

- *The production and sale of service labor*
- *The purchase and resale of replacement parts (including tubes and semiconductors)*

Ideally, for the purposes of cost accounting, pricing and profit computation, these two profit-producing functions should be treated as completely separate profit centers, or operations.

However, because of the inherent *interdependency* of these two profit-producing functions, many of the costs of operating an electronic servicing business are *shared by both* and cannot be accurately apportioned between the two. To do so would require a cost accounting system so complex and time consuming that it would be self-defeating.

Despite the fact that some of the shared costs cannot be accurately apportioned between the two profit functions, there are four factors which still make it possible to treat them as completely separate profit centers for the purposes of pricing and profit analysis:

1) *About 90 percent or more of the seemingly shared costs would nor-*

mally be incurred by the business even if it did not purchase and resell replacement parts. Consequently, all of these costs realistically can be charged against the cost of producing and selling service labor.

2) *The amount the business pays for replacement parts has no direct bearing on the cost of producing and selling service labor, and, consequently, the total amount can be charged to the function of purchasing and reselling replacement parts.*

3) *The amount of gross receipts (income) received from the sale of service labor has no direct bearing on the function of purchasing and reselling replacement parts.*

4) *The amount of gross receipts received from the resale of replacement parts has no direct bearing on the function of producing and selling service labor.*

Thus, all cost involved in the operation of the business, except the amount the business pays for replacement parts, can be charged against the service labor profit center. The *only* cost to be charged against the replacement parts profit center is the amount the business pays for replacement parts. (The only exception to these guidelines is the total payroll costs for a parts man, if one is employed specifically for this function, in which case his salary and fringe benefits also would be charged to the replacement parts profit center.)

A hypothetical example of how an electronic service business is operated as two separate profit centers and how this concept applies to profitable and competitive pricing of service labor is described in the following paragraphs.

COMPUTING TOTAL SERVICE LABOR COSTS

Assume that you are the owner/manager of Main Street TV in Populartown, U.S.A. You employ four full-time technicians and a secretary/bookkeeper who, with your part-time assistance, also serves as a call-taker and billing clerk.

Most of your time is spent managing the business and "chasing" parts, although you occasionally do return to the service bench when one of your bench technicians needs help or is absent from work.

You are now in the process of determining whether or not your present hourly service labor rate is sufficient to provide you the profit you desire from your business during the next twelve months. You anticipate that inflation will *increase* your total cost of doing business by about *10 percent* and, if you do not readjust your hourly service labor rate, your profit will *decrease* correspondingly.

The first step you have taken is to list all of your costs of doing business during the previous 12-month period. (You obtained them from the comprehensive accounting system established for you by your accountant, and maintained by you and your bookkeeper.) To each expense you have added the amount that you know or anticipate that it will increase. The resultant list is shown in Table 1. Note that these costs total \$93,784, including the salary you will pay yourself.

Before you will be able to realize any profit from the sale of service labor, you will have to sell *more* than \$93,784 worth of service labor manhours.

BUILDING IN THE PROFIT

There are at least five widely accepted methods, or formulas, which can be used to determine the amount of profit you should reasonably expect from your business. They are:

- Turnover of working capital
- Ratio of profits to tangible net worth
- Turnover of tangible net worth
- Turnover of inventory
- Net profit to net sales.

Because your working capital, inventory and total investment in Main Street TV are still relatively

TABLE 1

COSTS OF PRODUCING SERVICE LABOR	
TECHNICIAN WAGES & PAYROLL EXPENSES	
Technician Wages	\$44,720
Employer Social Security Contribution	1,230
Employer Unemployment Contribution	895
Employer Life & Medical Insurance Contribution	1,200
Employer Pension Contribution	474
	\$48,519
GENERAL AND ADMINISTRATIVE EXPENSES	
Secretary/Bookkeeper Wages	\$ 8,320
Employer Social Security Contribution	229
Employer Unemployment Contribution	166
Employer Life & Medical Insurance Contribution	300
Employer Pension Contribution	100
Building Lease	3,600
Utilities (including heating & air conditioning)	1,500
Telephone	500
Office Equipment Depreciation	100
Office Supplies	600
Advertising Expenses	1,000
Legal/Auditor Fees	400
Insurance (All other than employee)	800
Taxes (all other than Fed. & State income tax withholding)	800
Interest & Bank Charges	800
Misc. (Assoc. dues, subscriptions, license fees, etc.)	300
	\$19,515
OPERATING EXPENSES	
Owner's Salary	\$18,000
Social Security Contribution	990
Unemployment Contribution	360
Life & Medical Insurance Premiums	400
Pension Premium	300
Vehicle Operating & Maintenance Expenses	1,800
Vehicle Depreciation	2,400
Shop Equipment Depreciation	1,000
Expendable Items, Shop (cleaners, solder, tape, etc.)	400
Service Literature	100
	\$25,750
TOTAL SERVICE LABOR BUSINESS COSTS	\$93,784

TABLE 2

ANNUAL SERVICE LABOR RECEIPTS REQUIRED FOR DESIRED PROFIT	
1) TOTAL SERVICE LABOR COSTS (TABLE 1)	\$93,784
2) DESIRED PROFIT EQUALS 20% GROSS SERVICE LABOR INCOME	
3) TOTAL SERVICE LABOR COSTS (TABLE 1) = DESIRED PROFIT, or	
4	
$\frac{\$93,784}{4} = \$23,446$	
4) DESIRED PROFIT + TOTAL SERVICE LABOR COSTS = REQUIRED ANNUAL GROSS SERVICE LABOR INCOME, or	
$\$23,446 + \$93,784 = \$117,230$	

small compared to the volume of business you do, you feel that using the first four methods of computing your profit expectations would produce an amount substantially less than the realistic profit potential of your business. For this reason, you have chosen the net-profit-to-net-sales method, and, after analyzing the profits produced by businesses

comparable to yours, you have decided that 20 percent of net sales is a realistic profit margin for your business.

As stated previously, to break even, your net receipts from the sale of service labor must equal your total business costs, which are \$93,784. To compute what your total service labor net receipts must be to

realize a 20 percent net profit, you divide your total business costs by 4 (this figure is used only for 20 percent, other percentages of profit would require a different figure), and you then add the answer to your total business costs, as shown in Table 2. The sum of these two figures (\$117,230) is the total receipts you must receive from the sale of service labor to recover your business costs plus realize a 20 percent margin of profit during the upcoming 12-month period.

COMPUTING THE BILLABLE MANHOURS

Your next step is to determine how many service labor manhours you will have available which can be billed *directly* to customers to produce the \$117,230 net receipts you must receive to recover expenses and realize your 20 percent profit.

As shown in Table 3, each of your four technicians receives pay for 40 hours per week. Multiplying the 40 hours per week by the 52 weeks in a year produces 2080 hours per year per technician. Multiplying this figure by the number of technicians (4) indicates that your shop produces a total of 8320 manhours per year.

However, all of these 8320 manhours will *not* be available for *direct* billing to customers. The 2 weeks of paid vacation and the 5 paid holidays you give each technician during the year are nonproductive time which must be deducted from the 8320 manhours for which you pay. Deducting the total of 480 manhours lost to vacations and holidays leaves a total of 7840 manhours of on-the-job time.

Although your four technicians will be on the job a total of 7840 manhours, a percentage of this time will be lost to activities such as coffee breaks and training time, the manhours for which, again, cannot be billed *directly* to customers. Based on previous experience, you decide that you can continue to hold such lost time to no more than 20 percent of the total manhours your technicians are available for work. (The percentage of total manhours of on-the-job time which actually can be billed directly to customers

is called *labor recovery rate*. A labor recovery rate of 80 percent is considered good for a service-type business.)

Multiplying the total manhours your technicians are on the job (7840) by the anticipated 80 percent labor recovery rate tells you that you will have a total of 6272 manhours which *can* be billed *directly* to customers during the 12-month period.

COMPUTING THE HOURLY SERVICE LABOR RATE NEEDED TO PRODUCE THE SERVICE LABOR RECEIPTS REQUIRED FOR EXPENSES AND PROFIT

At this point, you have determined two principle factors:

- To recover business costs and realize a 20 percent profit on net service labor sales, you must receive \$117,230 from service labor sales during the 12-month period
- You will have 6272 service labor manhours available for *direct* billing to customers

As shown in Table 4, dividing the total service labor receipts required (\$117,230) by the number of billable manhours available (6272) tells you that the hourly service labor rate you must charge to recover all business costs plus realize the desired profit is \$18.70.

This hourly service labor rate is *not* the *absolute minimum* you can charge and still realize the desired overall profit. It merely serves as a *reference*, or standard, against which you can apply other variable factors which affect your service labor pricing. These other factors include: 1) profit realized from the sales of replacement parts, 2) competition, and 3) unanticipated business costs.

BUILDING IN PROFIT FROM REPLACEMENT PARTS SALES

At this point, you have computed the hourly service labor rate needed to recover the costs involved in your service labor profit center plus a 20 percent profit.

Now you are ready to determine how much net profit you can reasonably expect from your replacement parts profit center during the upcoming 12-month period, and how much this net profit will permit

TABLE 3

SERVICE LABOR MANHOURS AVAILABLE FOR DIRECT BILLING TO CUSTOMERS	
TOTAL SERVICE LABOR HOURS PER YEAR PER TECHNICIAN	2080 Hrs.
NUMBER OF FULL-TIME TECHNICIANS	× 4
TOTAL SERVICE LABOR MANHOURS PER YEAR	8320 Hrs.
MANHOURS DEDUCTED FOR PAID VACATIONS & HOLIDAYS	
Vacations (2 wks. per year per technician)	320 Hrs.
Holidays (5 days per year per technician)	160 Hrs.
TOTAL	480 Hrs.
Service Labor Manhours Per Year	8320 Hrs.
Service Labor Manhours Deducted for Vacations & Holidays	— 480 Hrs.
TOTAL Manhours Technicians on Job	7840 Hrs.
LABOR Recovery Rate (80%)	× .80
TOTAL SALEABLE MANHOURS	6272 Hrs.

TABLE 4

SERVICE LABOR HOURLY RATE REQUIRED	
SERVICE LABOR INCOME REQUIRED (TABLE 2)	\$117,230
TOTAL SALEABLE MANHOURS (TABLE 3)	6272 Hrs.
$\frac{\$117,230}{6272 \text{ Hrs.}} = \18.70 per Hr.	

you to *reduce* your hourly service labor rate, if competition or any other factor forces you to do so, and still realize an effective *overall net* profit of 20 percent of service labor receipts from your business.

During the previous 12-month period your net sales of replacement parts totaled \$20,000. Your costs of these replacement parts were \$10,000, producing a net profit of \$10,000. You anticipate the same volume and profit during the upcoming 12-month period.

If your competition will permit you to charge the \$18.70 hourly service labor rate you computed previously, the \$10,000 net profit from your replacement parts profit center can be added to the net profit you will realize from your service labor center.

COMPUTING THE ABSOLUTE MINIMUM HOURLY SERVICE LABOR RATE NEEDED TO PRODUCE THE MINIMUM PROFIT YOU DESIRE

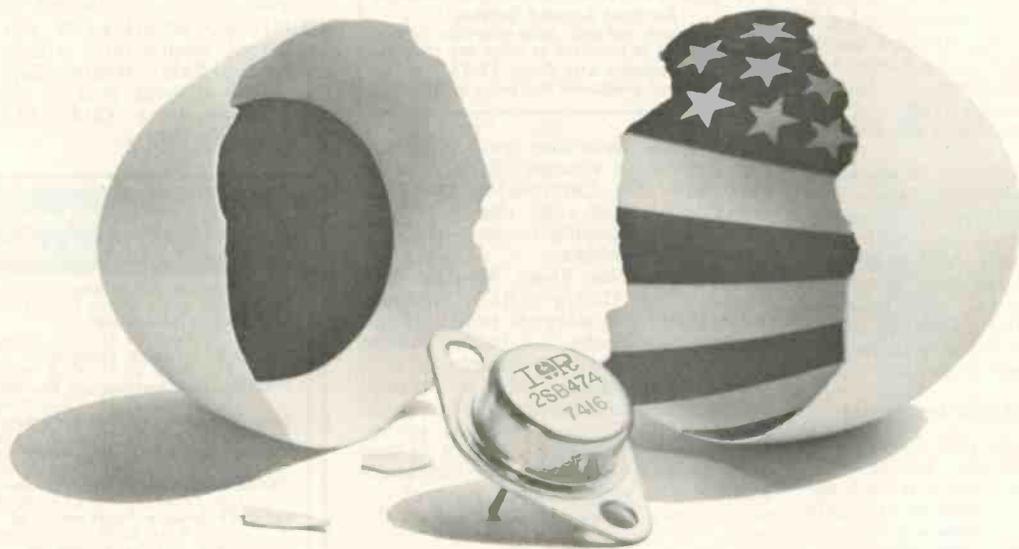
As determined previously, the *minimum* annual net profit you desire from your business is an *amount equal to* 20 percent of net service labor receipts. If you can realize *all* of this profit from your service labor profit center, all of the net profit you realize from your parts replacement profit center can be considered a "bonus."

However, if competitive factors in your market area will not permit you to charge the \$18.70 hourly service labor rate needed to realize *all* of your desired minimum annual net profit from your service labor profit center, a percentage of it will have to come from the replacement parts profit center. In effect, you will have to use a percentage of the net profit realized from replacement parts sales to offset the amount of service labor receipts lost as a result of having to reduce your hourly service labor rate. The *maximum* percentage that service labor receipts (and, therefore, your hourly service labor rate) can be reduced is an amount equal to the *total net profit* you realize from replacement parts.

The \$10,000 net profit you anticipate from sales of replacement parts is 8.5 percent of the total service labor receipts of \$117,230 you need to recover business costs and realize a profit of 20 percent from service labor. Therefore, the *most* you can reduce your hourly service labor rate and still realize the desired minimum total net profit is 8.5 percent of \$18.70, or \$1.60. Your *absolute minimum hourly service labor rate* is \$18.70 minus \$1.60, or \$17.10. ■

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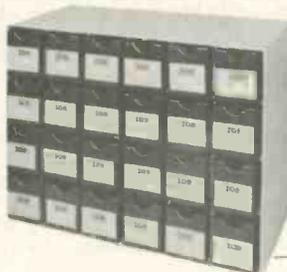


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2SB367A	2SC403A	2SC633A	2SC829B
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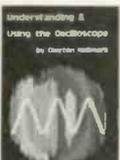
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Sync circuits and the Chroma Amplifier and Demodulator circuits.

Low Voltage Power Supply

The type of power supply used in the 1M30 color TV chassis is a Voltage Regulated Transformer (VRT) System. Regulation of the supply voltages is accomplished by the power transformer.

Because of the physical construction and magnetic design of the transformer, square wave voltages of

fixed amplitudes are provided by the outputs of its secondary windings. It is operated in saturation and is tuned to the line resonance by the oil-filled capacitor, C122, shown in Fig. 2. When an input line voltage of 100 to 135 v AC is applied to its primary winding, the output voltage at the secondary winding is clipped on the tips of each alternation, forming a square wave of fixed amplitude. Fluctuations in line voltages cause an inverse clipping action,

and the peak-to-peak output voltage of the square wave remains at a constant amplitude. This square-wave output is then applied to the rectifier circuits and line voltage changes of ± 10 percent are isolated from the B+ supply lines, providing voltage regulation.

Two full-wave bridge rectifiers are used to provide B+ source voltages of +25 v, +75 v, +130 v and +250 v which are all constant because of the regulated AC input supply voltages.

vertical countdown system is used in the 1M30 color TV chassis. This system eliminates the *vertical hold* control and the *horizontal hold* control is preset at the factory.

The countdown circuit employs horizontal signal obtained from the horizontal processor (Fig. 3) IC801 and counts down the horizontal signal frequency to the vertical scan rate. Negative-going pulses at the vertical sweep rate are obtained from the output of IC800 (Fig. 4). These pulses are used to drive the predriver stage (Fig. 5) (Q600) and to initiate the saw-forming action of capacitor C600,

Horizontal and Vertical Countdown Circuit

A new horizontal and

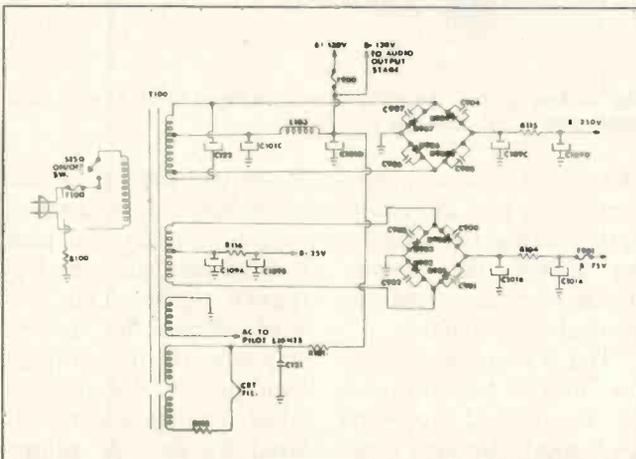


Fig. 2—Schematic diagram of the power supply used in the 1M30 color TV chassis, employing a Voltage Regulated Transformer System. Courtesy of Admiral.

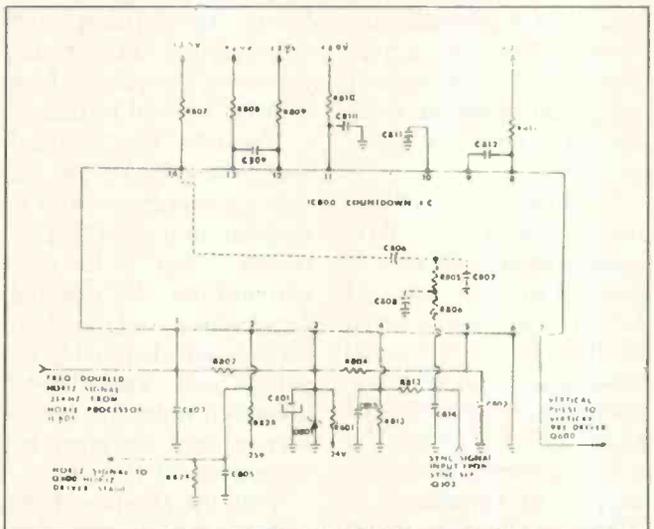


Fig. 4—The countdown circuit IC800 takes the place of a vertical oscillator circuit and because the vertical signal is derived from the fixed frequency horizontal signal, no vertical hold control is required. Courtesy of Admiral.

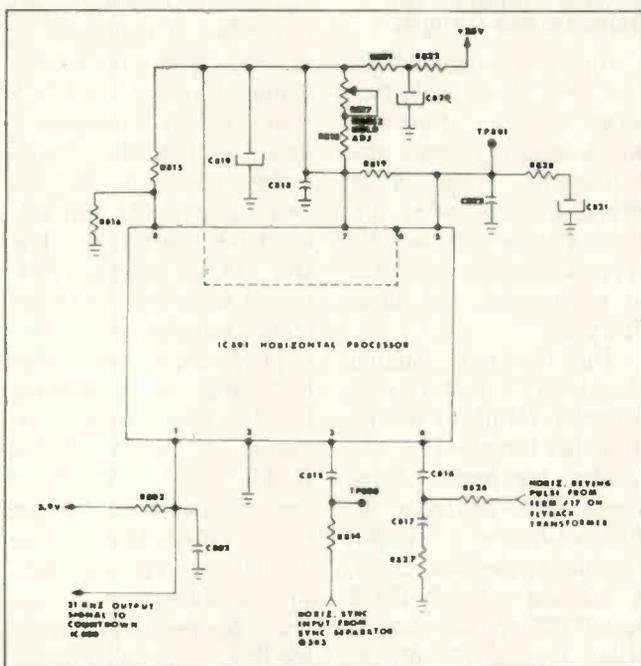


Fig. 3—Horizontal Processor integrated circuit IC801. Courtesy of Admiral.

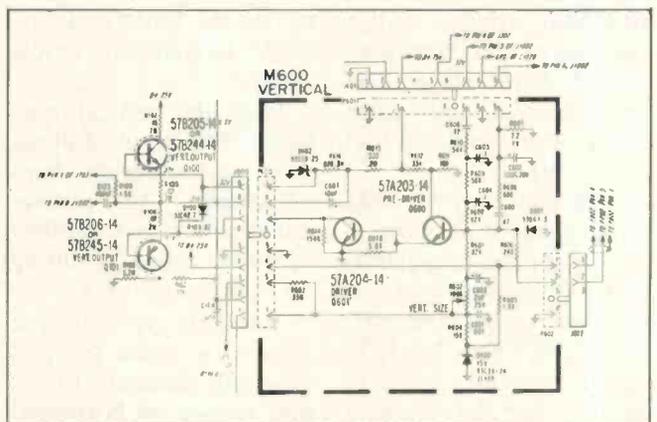


Fig. 5—The vertical predriver stages are contained in the M600 Vertical Module. Courtesy of Admiral.

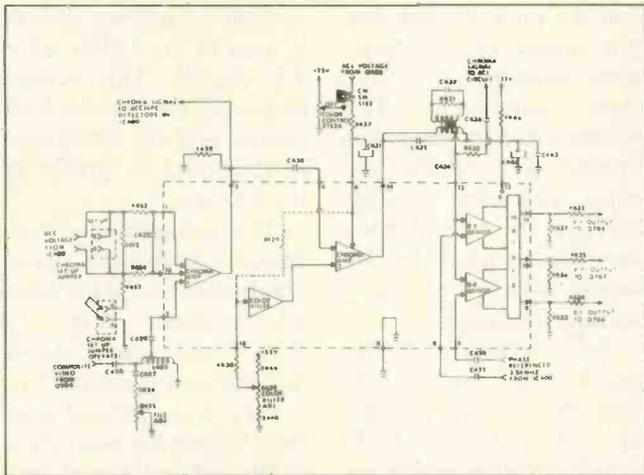


Fig. 6—Chroma Amplifier and Demodulator integrated circuit IC401 and associated circuits. Courtesy of Admiral.

which changes the pulse-like waveform into a saw-tooth waveform. Integrated Circuit IC800 takes the place of a vertical oscillator circuit and because the vertical signal is derived from the fixed frequency horizontal signal, no vertical hold control is necessary.

Frequency doubled horizontal signal (31 KHz negative-going pulses) is coupled to Terminal 1 of IC800. The output signal of IC801, the horizontal processor circuit, is a frequency doubled horizontal signal (31 KHz negative-going pulses) which is coupled to Terminal 1 of IC800. A flip-flop circuit contained in IC800 divides this signal by two and then couples the signal to output Terminal 2 of IC800, which is tied to the base of Q800, the horizontal driver stage. The frequency of this pulse signal is at the horizontal sweep rate.

The incoming 31 KHz pulse signal at Terminal 1 also is applied to a counter string consisting of ten flip-flop circuits contained in IC800. The 31 KHz signal is then "counted down" to the vertical sweep rate. Negative-going pulses at the vertical

frequency rate can now be obtained at Terminal 7 of IC800. This derived signal is then applied to the vertical predriver stage (Q600) where saw-forming and amplification takes place, providing the pulse which initiates vertical retrace.

Vertical sync signal (negative-going) from the sync separator transistor is coupled into IC800 Terminals 4 and 14 for synchronization. All external components relating to these terminals provide dividing and waveshaping networks, which are necessary to meet the input requirements of IC800.

With the absence of the vertical sync signal (no signal condition) vertical retrace (in time sequence with the leading edge of the output pulse) is started on the horizontal line "541" to maintain vertical sweep.

With the vertical sync signal being out-of-phase (this occurs during channel change), the counter initiates retrace regardless of correct count (as during no signal condition).

When the vertical sync signal is in phase (normal viewing), the counter initiates retrace on horizontal line "525." This will provide a vertically locked-in



Fig. 7—Rear view of the 4M10 chassis employed in an Admiral table model color TV set. Courtesy of Admiral.

picture. If adverse conditions exist, such as vertical sync missing the equalizing pulses, the counter initiates retrace from the vertical sync signal.

The B+ supply voltage for IC800 (at Terminal 3) is supplied from the 24 v source through resistor R801 and regulated by zener diode D801.

Chroma Amplifier and Demodulator Circuits

A plug-in integrated circuit (Fig. 6) IC401, performs three functions which include chroma amplification, color killer operation, and color difference demodulation. Six chroma circuits are used to accomplish the three functions.

The previous similar chassis M25 used two integrated circuits to accomplish the functions.

The composite video signal received from the Video/Chroma Buffer Amplifier transistor, Q204, is coupled through C428 and C429 to the chroma input terminal 2 of the Chroma Processor module. Components L405, C447,

R426 and the tilt adjustment, R425, form a tuned circuit to select and pass only chroma and high frequency signals. This network shapes the chroma response of the chroma band-pass information which can be slightly altered by the tilt adjustment. The chroma signal received from Terminal 2, is then applied to the input of the Chroma Amplifier No. 1 contained in IC401. The Automatic Color Control (ACC) connected to Terminals 1 and 16 of IC401, determines the gain of the chroma amplifier and color killer detection. The DC ACC voltage (obtained from the ACC detector contained in IC400) is applied and established in balance and magnitude by the input circuit consisting of R454, R453, R452 and C432. When the chroma set-up jumper connector is placed across Terminals "AA" the chroma circuits are in the operate position. Now resistor R452 is included in the circuit, establishing the proper amount of divider

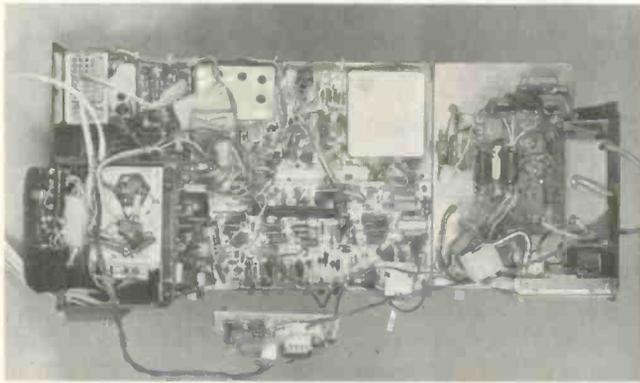


Fig. 8—Top view of Admiral's 4M10 color TV chassis showing module location and component layout. *Courtesy of Admiral.*

resistance to ground on the ACC lines for quiescent operation. When the set-up jumper is placed in the *set-up* position, across Terminals "BB," R452 is not included in the circuit and both ACC lines are tied together for proper adjustment of the ACC control (associated with the ACC detector contained in IC400).

The operation of the color killer circuit is controlled by ACC action. When a monochrome transmission is received, the ACC command causes an increase of DC voltage at the color killer input (Terminal 15), which is obtained by an increase of DC voltage from Chroma Amplifier No. 1, contained in IC401. This action causes a DC shut-down in voltages from the color killer to Chroma Amplifier No. 2, contained in the IC. Resistors R440, R439 (*color killer* adjustment) and R446 form a DC voltage divider to provide the threshold bias to the color killer stage. Resistor R429 provides killer tracking when the various settings of the color controls are changed, stabilizing the color killer operation.

Capacitor C430, couples the amplified chroma signal from Chroma Amplifier No. 1 to Chroma

Amplifier No. 2. A sample of the chroma signal also is obtained from Terminal 3 and applied to the ACC and Automatic Phase Control (APC) circuits contained in IC400.

The bias voltage applied at Terminal 6 of the IC, controls the gain of Chroma Amplifier No. 2 and the overall color intensity. Two independent control bias supplies are used. When the Color Master switch is in the *off* position, the main color control acting as a DC voltage divider is switched into the control line. When this takes place, the *preset color* control and Automatic Chroma Level (ACL) circuits are disconnected from the control line. When the Color Master switch is in the *on* position, the main color control is disconnected and the ACL voltage is connected to the control line. The *preset color* control settings establish the quiescent operating voltage of the ACL output. Variations in the transmitted color signal intensity, are compensated for by the ACL circuit, altering the gain of the Chroma Amplifier No. 2. The amplified chroma signal from this stage is then coupled to the input of the R-Y and B-Y demodulators through a tuned cir-

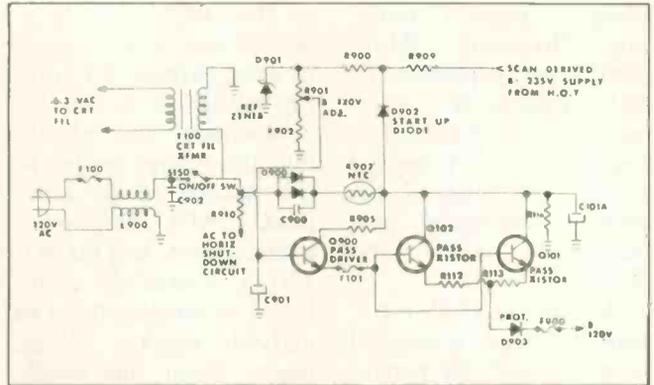


Fig. 9—Schematic diagram of the low voltage power supply employed in Admiral's M10 color TV chassis. *Courtesy of Admiral.*

cuit consisting of L406, R431, C437, C435 and C434. Chroma signal used for amplitude sampling is coupled to the input of the ACL circuit through R438 and C436.

A 3.58 MHz reference signal obtained from IC400 also is applied to the demodulator circuits. The two input signals are out-of-phase with each other to provide approximately a nominal 105-degree demodulation angle with the Color Master switch in the *off* position. When the switch is placed in the *on* position, the angle widens to approximately 120 degrees. Capacitors C425 and C426 provide the reference input coupling.

With the presence of 3.58 MHz and chroma signals at the demodulators, color difference signals are produced and applied to the matrix stage. Then the two demodulated signals are mixed in proper mathematical relationship to derive the G-Y color difference signal.

The matrix circuit output provides all three (R-Y, G-Y and B-Y) color difference signals which are then coupled to the base element of each RGB output stage.

M10 COLOR TV CHASSIS

The M10 solid-state color TV chassis (Fig. 7)

is used with 17- and 19-inch (measured diagonally) screen size TV sets. The picture tube employs a precision close spaced, in-line gun structure, including a precision static toroid deflection yoke which is permanently bonded to the neck of the picture tube. This design eliminates the dynamic convergence and most of the purity and static convergence adjustments required in the field because they are made during the manufacturing process.

Most of the circuitry is contained in satellite modules (Fig. 8) to simplify servicing if required.

Power Supply Circuit

The power supply used in the M10 color TV chassis employs a half-wave rectifier circuit (Fig. 8) with the low side of the AC line connected to chassis ground. A series B+ regulator circuit is used to compensate for line voltage and load current fluctuations. Three transistors are used; two of which act as series pass stages, and one as a pass driver stage. The complete regulator circuit is referenced to zener diode, D901. Rectification of the B+ voltage is performed by D900 and bypassed by capacitor C900 for transient protection and to

prevent spurious radiation. Resistors R116, R907 and capacitor C101A provide B+ filtering. The unregulated B+ supply voltage is applied to the collectors of the parallel connected pass transistors Q101 and Q102.

Scan derived 235 v B+ supply voltage is applied to the cathode of reverse biased diode D901 through resistor R900 and R909. A DC voltage divider network consisting of resistors R901 and R902, adjusts and sets the operating point of Q900, and in turn the entire regulation circuit.

The unregulated supply voltage is placed across the 120 v B+ load resistors R112, R113, and pass transistors Q101 and Q102. The voltage drop of the transistors vary with line voltage variations to provide a constant 120 v supply voltage at the output terminals. The regulated output line voltage is equal to the base voltage of Q900, minus the forward bias voltage drops of D903 and Q900, and the base-emitter junctions of Q101 and Q102.

As voltage fluctuations attempt to occur, they are not detected at the regulator output terminal because the regulator circuit is referenced to the constant reference voltage, provided by zener diode D901. A constant voltage is maintained for variations of ± 10 percent of the 120 v AC line voltage.

When the TV receiver is turned on, there is no scan derived 235 v B+ source for the biasing of D901. This bias voltage must now be provided by the start-up diode D902. The unregulated rectified supply voltage received from the AC line is connected

to the anode of D902. Since there is an absence of scan derived B+ supply voltage on its cathode, it conducts and applies this unregulated supply to the cathode of the zener diode D901. Regulating action begins, and the B+ 120 v source is established, developing the scan derived supply voltage again. When this supply voltage is present, the cathode voltage of D902, exceeds the anode voltage and the diode cuts off completing its function. The scan derived supply voltage then maintains reverse bias on the zener diode until the set is turned off.

Some of the AC line voltage is coupled to the horizontal shut-down circuit to meet its input requirements and this coupling is provided by R910. The picture tube filament transformer T100, drops the 120 v AC line voltage to 6.3 v AC.

The *high voltage adjustment* control is eliminated in this chassis, because the adjustment of the 120 v B+ control will affect the high voltage setting. To prevent false triggering of the horizontal shut down circuit, the 120 v B+ adjustment should be ad-

justed to read 120 v DC, when measuring the voltage of the line.

High Voltage Shutdown Circuit

The M10 color TV chassis employs a high voltage shutdown circuit (Fig. 10) for component protection if the horizontal or high voltage section malfunctions. Excessive horizontal drive signal, high voltage, or B+ regulator failure can damage chassis components. In some cases, the customer may not detect the malfunction because the sound and picture may appear normal.

This circuit acts as a combination protection and warning system. The horizontal pulse amplitude present at the high voltage transformer is sampled and if there is an excessive amount of horizontal drive or high voltage we will have pulsating audio and a flashing raster. A negative-going horizontal pulse is obtained from the horizontal output transformer, coupled through C114 and R111 to the cathode of zener diode D804. Diode D108 provides negative tip clamping and keeps the negative peak voltage at .6

v below ground potential.

If a malfunction occurs, the pulse amplitude is allowed to increase in the positive direction, driving the 27 v zener diode into breakdown, and then applies the signal to the gate element of SCR Q805 causing it to fire. The horizontal oscillator is then turned off, by grounding the base of Q801 through diode D805 and the SCR. When the oscillator is turned off, there will be no current flow in the pre-driver, driver or the horizontal output stages.

A 50 mfd, capacitor C817, is initially charged to approximately 24 v, because of the voltage drop through one diode. When Q805 fires, its anode voltage drops and the base of Q801 is grounded as mentioned earlier. The 24 v supply voltage drops to zero because it is a scan derived power supply. Capacitor C817 discharges through resistors R829 and R828 and the conducting SCR. An AC voltage from the high side of the AC line is injected through R910 to the junction of R829 and R828. The peak value of the AC voltage at this point is 3.6 v. When capacitor C817 discharges to 3.6 v, the anode voltage will drop to zero on the negative peaks of the AC voltage. This occurs approximately one second after the SCR fires. When the anode voltage drops to zero, the SCR turns off and the horizontal oscillator functions again. If the problem still exists, the SCR fires again and the cycle repeats itself.

The pulsating scan provided B+ voltage to the audio circuits will produce a "putt" sound from the audio circuits at the once-per-second rate. ■

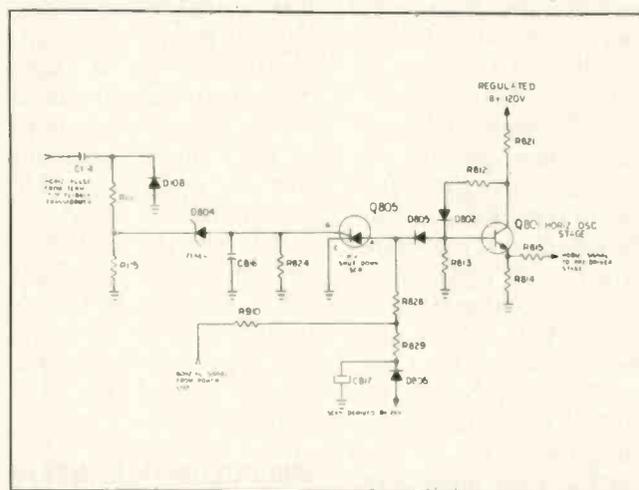


Fig. 10—Schematic diagram of the High Voltage Shutdown circuit. Courtesy of Admiral.

Solving Sync Problems in Solid State TV

By Joseph Zauhar

Sync and AGC circuits are closely related, making isolation of the defective stage difficult if we don't have a thorough understanding of all associated circuits

■ Troubleshooting for the loss of sync can be difficult, because it can be caused from problems in almost any part of the TV receiver. We often find sync instability caused by outside interference, antenna system, signal overload and AGC circuit problems. To locate and isolate the problem we should have a thorough understanding of the composition of the sync pulse, the circuits involved as it passes through the TV receiver, especially the operation of the sync amplifiers, clippers or separators, and noise canceling circuits.

As you probably know, the purpose of the sync pulse is to synchronize the TV receiver's scanning rates to the scan frequency of the TV camera. If the synchronizing is correct, we will have a "locked in" stable picture. If it is not synchronized we will receive a picture that rolls, tears, "piecrusts" or has

"Christmas tree" effects. These sync pulses are received with the video information from the transmitter at about a 25 to 30 percent higher level. It is this higher sync pulse level that enables separation of the sync pulses from the video information. If we don't separate the video information, changing video signals will cause the picture to lose sync.

Sync Pulse Construction

The vertical and horizontal scans are synchronized by two sets of sync pulses, one at the vertical rate, and the other at the horizontal rate. The vertical and horizontal oscillators are usually adjusted to operate at a slightly lower frequency than their normal scanning rate. As the sync pulse is applied to the oscillator, it is "locked-in" to the proper frequency.

During the vertical retrace time

the horizontal oscillator has to be kept from running off frequency, so the horizontal rate pulses are superimposed on the vertical blanking and sync pulse. Without these pulses we would have "bending" or "flag-waving" near the top of the TV screen.

To accomplish proper interlace equalizing pulses are inserted in the vertical blanking interval which maintain the exact starting time for the horizontal oscillator. Shown in Fig. 1 is a composite drawing of the sync waveform. An integrator circuit is employed to select the proper time for the vertical oscillator to start, because all of the pulses during the vertical blanking time are the same amplitude. The equalizing pulses are too short to allow enough time for the integrator to develop a charge with sufficient amplitude to trigger the vertical oscillator. To allow the integrator enough time to

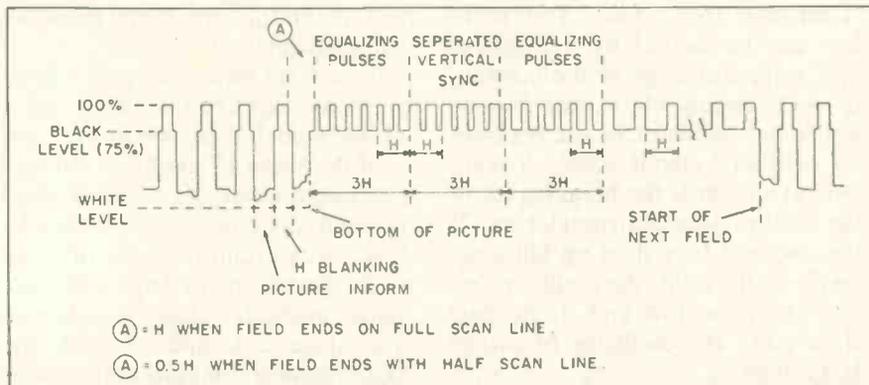


Fig. 1—Shown in the composite drawing is a sync waveform with the sync pulse structure varying on odd and even scan fields. Equalizing pulses and the serrated vertical sync pulse maintain proper horizontal oscillator frequency during vertical blanking and sync time.

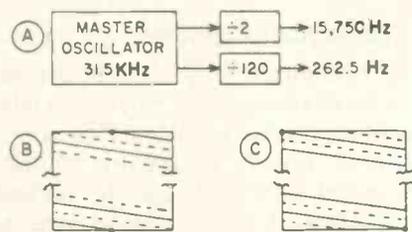


Fig. 2—(A) The illustration shows the exact odd-line relationship between the vertical and horizontal rates as maintained by divider circuits from a common oscillator. The odd ratio between the rates causes the scan to end on a half line on one field and a full line on the next field. (B) The beginning and ending points of the field preceding or following the half line field.

charge, the vertical sync pulse is serrated, forming pulses about twice as wide as the equalizing pulses. As the proper level is reached at the integrator output, the vertical oscillator will start to conduct.

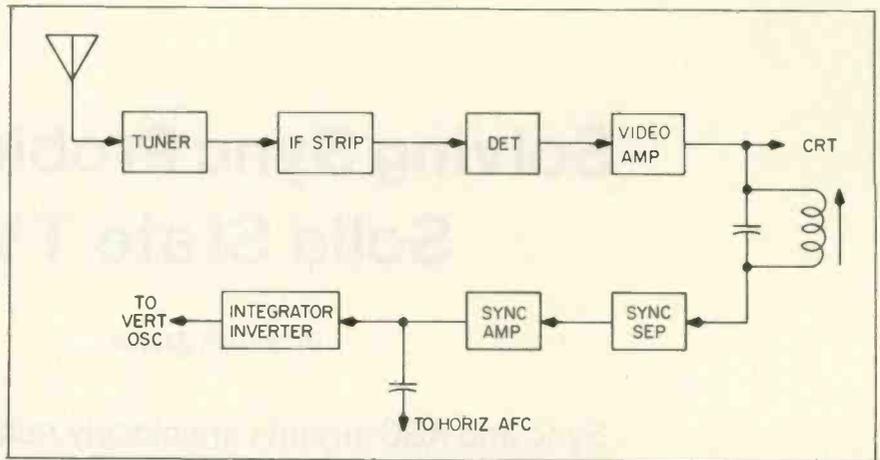
To maintain an odd-line relationship between the vertical and horizontal scans to allow interlace the sync pulses are developed from a common oscillator with divider circuits feeding separate sweep oscillators as shown in Fig. 2. Because the relationship for 60 Hz scan is odd (525 horizontal lines per frame) every other field is the same length; alternating between 262 and 263 scan lines. Each frame is composed of two interlaced fields.

Sync Circuit Functions

- 1) Removes the video information and black level pedestals leaving only the sync pulses.
- 2) Amplifies the sync pulses for good picture stability.
- 3) Clips the sync pulses to a uniform amplitude and removes the noise or interference pulses. These circuits are called sync clippers or limiters.
- 4) Shaping of the horizontal sync pulses into sharp blips for the operation of the horizontal phase detector circuit and to control the horizontal oscillator frequency.
- 5) Forming of the vertical pulses with sufficient amplitude to trigger and lock-in the vertical sweep oscillator. The RC differentiating and integrating filters perform this function.
- 6) Develop the correct sync pulse polarity which is needed to trigger the sweep oscillators or AFC control system.

Sync Circuit Problems

- A complete loss of vertical sync or weak vertical hold "lock-in" ability is a common problem. This symptom is usually caused by the absence of vertical sync at the vertical oscillator, if the horizontal sync is normal. With this symptom we would most likely find the sync separator stage or the vertical sync amplifier stage at fault.
- If we encounter a problem of poor interlace, as mentioned earlier, the timing sequence which regulates the odd-line relationship between



Block diagram of the sync flow through most TV receivers. The sync separator removes all the video information from the composite signal and only the horizontal and vertical sync pulses remain.

the horizontal and vertical scan rates provides interlace. If the ratio at the transmitting station is normal, one of the triggering circuits in the chassis is likely at fault.

Basically, the integrator circuit is the only circuit which determines this ratio. If the time constant of the integrator circuit changes, equalizing pulses may change the integrator and trigger the vertical oscillator prematurely. Substitution of the integrator unit is usually the best method of isolating a problem of this type. Check all circuits after the sync take-off circuit output stage or any of its associated feedback networks.

- A complete loss of vertical and horizontal sync usually is caused by defective components in a common sync handling stage or AGC circuit.
- Loss of horizontal sync is another common problem. Horizontal sync problems produce symptoms of squealing, squегging, horizontal pulling or bending in the picture and "Christmas tree" effect. This problem can be caused by a defective sync separator stage or the horizontal AFC circuit which precedes the horizontal oscillator or the horizontal oscillator circuit itself. A common symptom is the breaking up of the picture into horizontal bars. If the diagonal bars slant up hill diagonally to the right, the oscillator frequency is too low and if the bars slant down the oscillator frequency is too high.

Troubleshooting Sync Circuits

Obtain the manufacturer's service

literature which provides information on the service adjustments, circuit voltages and the oscilloscope waveforms for the sync pulse shapes and amplitudes. If this information is not available the technician must rely on experience and information obtained from measurements of normal similar circuits or operating characteristics and voltages found in a transistor manual.

When troubleshooting the sync circuits we must remember the sync and AGC circuits are very closely related and a sync circuit malfunction may resemble an AGC problem and vice versa.

Perform the normal set-up adjustments on the TV set and if the adjustment of the contrast and AGC controls do not provide a normal picture, then what may appear as a sync problem may actually be a fault in the signal stages of the chassis, prior to the sync take-off point, or an AGC circuit malfunction. Any overloaded amplifier circuit will tend to clip the sync signal from the video information.

If we don't have sync pulses present at the input to the sync separator we would then check back toward the video IF amplifier circuits.

A major cause of preceding stage overload conditions is a defective AGC circuit, allowing one or more of the amplifiers to have excessive signal applied. Also, a defective sync stage can interact with the AGC circuit so that preceding stages are overloaded.

If a sync problem is suspected it is a good practice to "clamp" the

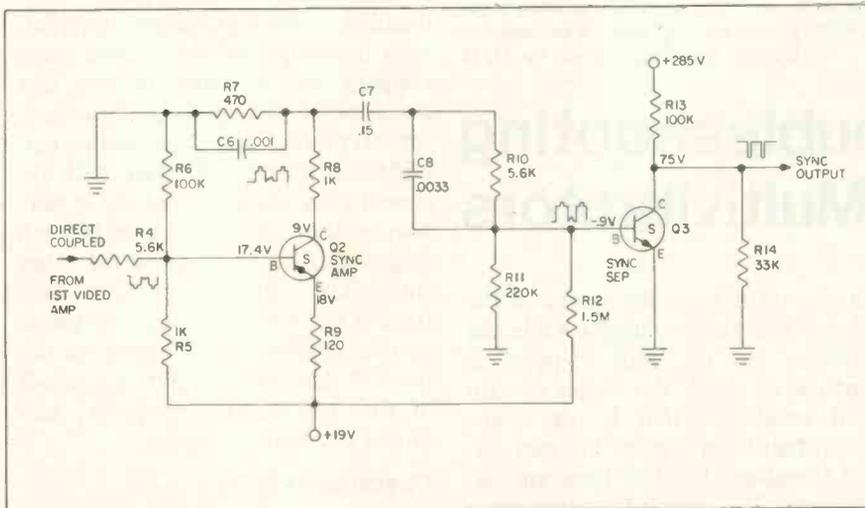


Fig. 3—Schematic diagram of the sync amplifier and sync separator stage.

AGC line with a filtered power supply that is adjustable between about 0 and 22 v DC. When applying a bias voltage to transistor circuits check the manufacturer's schematic for proper AGC voltage and polarity, to prevent injury to the transistors. Then set your bias supply close to this voltage before making any connection to the circuit.

Using the oscilloscope, start by checking the waveforms at the input to the sync separator circuit, to determine the condition of the composite signal and whether both of the sync pulses are present. It is easier to start troubleshooting at this stage rather than, for example, the sync amplifier and then try to determine if the amplitude of the sync pulses are sufficient.

If the input signal to the sync amplifier is normal, with the sync pulse riding clearly above the video information by 20 to 30 percent, the sync stages are likely at fault.

Sync Amplifier and Sync Separator Circuit

The sync amplifier circuit shown in Fig. 3 is a class A amplifier which receives video signal for the video amplifier stage, then inverts and amplifies the signal. The positive-going output signal from the sync amplifier transistor Q2, is applied to the base of the sync separator transistor Q3 and the bias voltage is applied through resistor R12. The large video signal received from the output of Q2 and then applied to the base of Q3 is of sufficient amplitude to drive the transistor, causing it to

draw considerable current because of the base-emitter action of rectification, which in turn causes the base to go negative. When the base is negative, only the most positive-going part of the signal will cause current to flow in the collector circuit and only the sync signals are amplified leaving the video signal unchanged. The collector of the sync amplifier transistor Q2 has a complete positive-going video signal and the output of Q3 will have negative-going sync pulses.

We will find that the collector voltage of Q3 is higher than expected in a solid-state circuit because this particular circuit is used in a hybrid chassis driving a circuit employing a tube. If the circuit is used in an all-solid-state chassis the collector voltage would be approximately 20 to 30 v.

Troubleshooting Sync Amplifier and Sync Separator Circuits

The sync amplifier transistor Q2 is a PNP transistor requiring a negative bias voltage between the base and emitter. It is biased by the +19 v supply voltage and the collector circuit of the video amplifier is direct coupled to its base. The video amplifier's collector circuit with a maximum voltage of 15 or 16 v would mean that Q2 would have excessive negative bias (+16 from +19 v would be a negative 3 v) so a 1K resistor, R5, connected to the 19 v source increases the voltage to the proper amount, along with the bleeder action of R6 from the base to ground.

If we observe the waveform at the output of Q2, we will have a gain of five times at the junction of R7 and R8, as compared to the video signal at the base. The signal now will be positive-going and is coupled through C7 to the shaping circuit consisting of C8 and R10. If we observe the waveform at the base of Q3, we will have a positive-going signal and at the collector we will have strong negative-going sync pulses and no video signal.

After you have isolated the problem with the scope to one of these stages, you should then make DC voltage checks to find the defective component.

Circuit Problem Symptoms

If the signal at the collector of Q2 is weak and not inverted from the base signal we would likely find the transistor defective or resistor R9 or R5 open.

If the signal at the collector of Q2 is distorted the likely cause would be a defective transistor. First, check the bias voltage between the base and emitter of the transistor; it should be approximately 0.6 v. Next, check the voltage drop across R9 and calculate the transistor current drawn. The current usually is about 4 to 7 ma if the circuit is otherwise functioning normally.

If the signal is normal at the collector of Q2 and weak at the base of Q3, capacitor C7 would likely be open. If this capacitor or any part of the circuit is open, the video signal will not be present at the base of Q3, the DC bias voltage on Q3 will be positive between base and emitter. In normal operation, the sync signal will cause "reverse" bias on the NPN transistor Q3. Without input signal, the collector voltage on Q3 will be lower than normal because of additional collector current flow.

If the signal is normal at the base of Q3, and little or no output signal at the collector, we would most likely find the transistor defective or resistor R13 open.

When replacing transistor Q2, a general-purpose silicon type will perform well in most cases. If we replace Q3, make sure it can withstand a collector to emitter voltage (V_{ce}) of at least 90 v. ■

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

Troubleshooting Solid-State Multivibrators

■ This article deals with multivibrators, those circuits that generate rectangular wave shapes that vary according to the design of the circuit. There are three types of multivibrators: the bistable, monostable and astable. The bistable multivibrator is so called because it has two stable conditions of operation and requires an external input or trigger pulse in order to change from one state to the other. The monostable multivibrator gets its name from the fact that it has one stable state of operation and a temporary state of operation. When triggered by an external input, it switches to the temporary state for a predetermined amount of time and then shifts back to its stable condition. The astable or free-running multivibrator is similar to the sine-wave oscillator. The astable multivibrator requires no input and continually switches from one state of operation to the other.

ASTABLE MULTIVIBRATORS

The term *astable multivibrator* refers to multivibrator circuits that can function in either of two temporarily stable conditions and are capable of rapidly switching from one temporarily stable condition to the other. The astable multivibrator is frequently referred to as a free-running multivibrator. It is basically an oscillator consisting of two stages coupled so that the input signal to each

stage is taken from the output of the other. One stage conducts while the other is cut off until a point is reached at which the stages reverse their condition; that is, the stage which had been conducting cuts off, and the stage that had been cut off, conducts. The circuit is free running due to regenerative feedback, and the frequency of operation is determined primarily by its coupling circuit constants.

The frequency of the multivibrator can be controlled by changing the value of the time constants in the coupling circuits, if a large change in frequency is desired. If a small change in frequency is desired, the frequency can be controlled by changing the base-to-emitter voltage. Many multivibrators use separate power supplies for the base and collector elements.

The output waveform of the astable multivibrator is commonly a square wave. A square-wave output results when the time constants of the coupling circuits are made equal. It is not always necessary, however, that the time constants be made equal. For example, if an unsymmetrical pulse output waveform is desired, the time constants of the coupling circuits are purposely made unequal.

The free-running (astable) multivibrator circuit is normally used to produce a square-wave output for

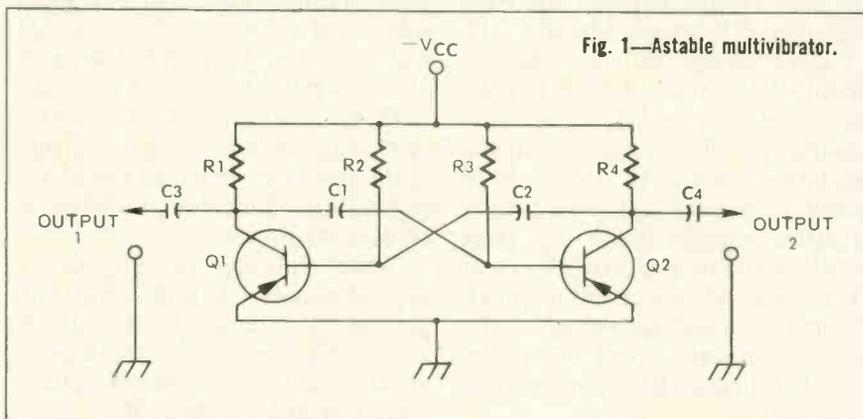
use as a trigger or timing pulse in electronic equipment. The circuit is fundamentally a two-stage, RC-coupled, common-emitter amplifier, with the output of the second stage coupled to the input of the first stage. Since the signal in the collector circuit of a common-emitter amplifier is reversed in phase with respect to the input to the base, a portion of the collector output of each stage is fed to the base of the other stage. The output signal from each stage is fed back in the proper phase to reinforce the input signal on the base of the other stage. As a result of this regenerative feedback, sustained oscillations occur.

Operation (Fig. 1)

The multivibrator circuit shown in the schematic is a balanced (symmetrical) circuit, since each RC-coupled stage is identical to the other. However, in spite of the use of close-tolerance components, there will always be minor differences in circuit resistances and in junction resistances within the transistors themselves. As a result of this inherent imbalance, the initial collector current, resulting from the forward-bias conditions set up by the emitter-base junction resistances and bias resistors R2 and R3, is different for each transistor. The immediate effect produced by regenerative action between the coupled stages is that one transistor conducts while the other is cut off.

Assume that initially more collector current flows through Q1 than through Q2. As the collector current of Q1 increases, the voltage at the collector of Q1 decreases with respect to its emitter, or ground. In other words, the collector of Q1 becomes less negative and, in effect "outputs" a positive-going pulse, which is coupled through C1 to the base of Q2. The positive-going pulse at the base of Q2 makes the base positive with respect to its emitter and, as a result, Q2 approaches cut-off. The collector current of Q2 decreases because of the reverse-bias action, and the voltage at the collector of Q2 increases and approaches the supply voltage. The collector of

(From Chapter 6, *TROUBLESHOOTING SOLID-STATE WAVE GENERATING & SHAPING CIRCUITS*, by Ben Gaddis, TAB BOOKS, Copyright 1973. A review of the complete book follows this article.)



Q2 becomes more negative and this, in effect, acts as a negative-going pulse, which is coupled through C2 to the base of Q1. The negative-going pulse at the base of Q1 places the base negative with respect to its emitter, and the collector current of Q1 is further increased because of the forward-bias action. This regenerative process continues until Q1 is driven into saturation and Q2 is cut off.

A better understanding of the operation can be achieved by referring to Fig. 2. Assume that Q1 is conducting and has just reached saturation. When Q1 is at saturation, its collector current no longer increases but instead becomes a constant value between times t_0 and t_1 . There is no further change in collector voltage to be coupled through C1 to the base of Q2. The voltage at the base of Q1 is only a few tenths of a volt negative, and C2 quickly charges through the low resistance of R4 to a potential which is approximately equal to the supply voltage. Since the collector voltage at Q1 is at nearly ground potential, C1 starts discharging at a rate which is equal to the C1-R3 time constant. As C1 discharges, the voltage at the base of Q2 becomes less and less positive until a point is reached where reverse bias is no longer applied and Q2 is able to conduct, as shown in the Q2 base waveform at the end of period t_1 .

When the base of Q2 returns to a forward-bias condition, Q2 begins to conduct and its collector current begins to flow through load resistor R4. As the collector voltage at Q2 drops at time t_1 , a positive-going voltage is coupled through C2 to the base of Q1, applying reverse bias. Transistor Q1 is driven to cutoff, and the collector voltage of Q1 rises. This rise, coupled through C1, will drive Q2 into harder conduction. The voltage at Q1 is approximately equal to the supply voltage. Capacitor C1 quickly recharges through the low resistance of R1 to a potential which is approximately equal to the supply voltage. Since the collector voltage at Q2 is at nearly ground potential, C2 starts discharging at a rate which is equal to the R2-C2 time constant.

As C2 discharges, the voltage at the base of Q1 becomes less and less positive until a point is reached where reverse bias is no longer applied, and Q1 is able to conduct.

When the base of Q1 begins to conduct, collector current begins to increase through load resistor R1. As the voltage drops at the collector of Q1, positive-going voltage is coupled through C1 to the base of Q2 to initiate another cycle of operation.

For each half cycle of operation, whenever a changeover of the multivibrator takes place, one of two actions occurs: In one case, C1 recharges (through load resistor R1 and the base-emitter junction of Q2) to the value of the supply voltage while C2 discharges through the series circuit consisting of Q2, the voltage source, and R2. In the other case, C2 recharges (through load resistor R4 and the base-emitter junction of Q1) to the value of the supply voltage while C1 discharges through the series circuit consisting of Q1, the voltage source, and R3.

The waveforms shown in Fig. 2 are for a symmetrical multivibrator, and the output taken from the collector of either transistor is a square wave. The waveforms shown in Fig. 3 are for an unsymmetrical multivibrator, and the output waveforms have unequal time durations. The general circuit operation is identical to that of the symmetrical multivibrator; however, charge and discharge times are different since different RC values are used.

Troubleshooting

The first step in troubleshooting any of the multivibrator circuits is waveform analysis. The output of the circuit should be observed with a scope and the quality of the output waveform noted. Checking the waveform at various points in the circuit is also helpful for locating defective components.

An open circuit, short circuit, or overbiased condition, as well as a

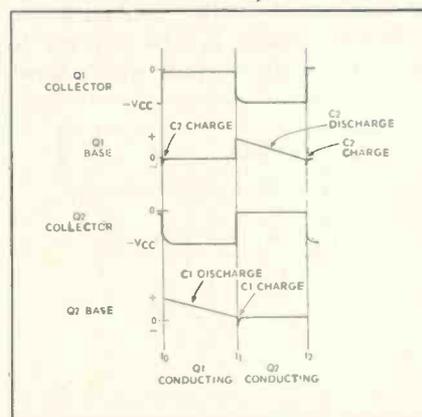


Fig. 2—Waveforms produced by symmetrical astable multivibrator.

defective transistor, can cause lack of output. The transistor voltages should be checked against the prescribed values. With the astable circuit in the nonoscillating condition, a check of the voltages at the collector of each transistor will reveal whether load resistor R1 or R4 is open. If either resistor is open, there will be no collector voltage on the associated transistor. Also, the other transistor will conduct heavily because of the reduced bias and its collector voltage will be low. If this happens, the collector resistor might burn out.

If coupling capacitor C1 or C2 is leaky or shorted, the collector resistor of one transistor will be shunted across the base resistor of the other transistor, and the fixed bias on the base of the transistor to which the defective capacitor is connected will be increased. If the increase in bias is sufficient, the transistor will be rendered inoperative. Sometimes an unsymmetrical output will occur. Also, if coupling capacitor C1 or C2 is open, or if R3 or R4 is open, the circuit will be rendered inoperative. If output capacitor C3 or C4 is open, the circuit will operate at a slightly different frequency because of load changes, but no output will be observed.

The critical components governing the frequency and pulse width of the multivibrator are those in the coupling circuits. Any change in the components governing the RC discharge time constant will directly affect both the frequency and the pulse width. A change in value of coupling capacitor, C1 or C2, or in the base resistance, R2 or R3, will have the

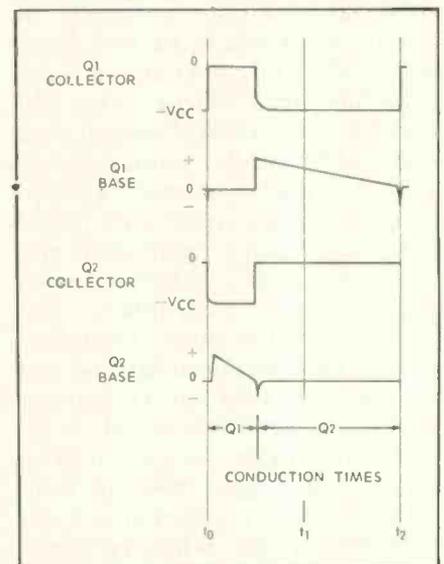


Fig. 3—Waveforms produced by unsymmetrical astable multivibrator.

greatest effect. Although a change in the value of collector resistor R1 or R4 will affect the frequency and the pulse width, it will have a greater effect on the output amplitude of the waveform.

A variation in the collector voltage may cause some frequency drift. In practical circuits where the multivibrator is unsynchronized and free-running, adjustments are usually provided to adjust the collector voltage or the base resistance. In this manner, the circuit can be set to the correct frequency and pulse width, and can be compensated for the difference in transistor characteristics when a replacement is made.

If output coupling capacitor C3 or C4 is leaky or shorted, the voltage divider action which can occur through the base resistance of the next stage might reduce the amplitude of the output waveform and cause the multivibrator to operate at a higher frequency. This is true because the discharge time in the base circuit is dependent on the amount of change in the voltage applied to the base circuit capacitor.

BISTABLE MULTIVIBRATORS

The term *bistable multivibrator* refers to multivibrator circuits that can function in either of two stable states, and are capable of switching rapidly from one stable state to the other upon the application of a trigger pulse. In the strict sense of the word, the bistable multivibrator is *not* an oscillator. It is a circuit having two conditions of stable operation and requiring *two* input triggers to complete a *single* cycle. The bistable multivibrator is initially at rest in either one of its two stable states; when triggered by an input pulse, the circuit switches to the other stable state, where it remains until triggered by another pulse. Because there is a sudden reversal, or "flop-ping," from one stable state to the other, the bistable multivibrator is frequently called a *flip-flop circuit*.

The bistable multivibrator produces an output pulse, commonly called a gate, which has fast rise and fall times and a flat top. To generate this type of waveform, the circuit requires one trigger pulse for turn-on and another trigger pulse for turn-off, generating a step function for each input trigger. When the trigger pulses are of constant frequency and are applied at long time intervals,

the gates generated are wide. On the other hand, when the trigger pulses are of constant frequency and are applied at short time intervals, the gates generated are narrow. In all cases, however, *two* input trigger pulses are required to complete *one* cycle of operation, resulting in an output gate frequency *half* that of the input trigger frequency. The rectangular output of the bistable multivibrator can be either positive or negative in polarity. Each gate is formed by the combination of positive and negative step functions produced by triggering the flip-flop.

The basic flip-flop produces a square or rectangular wave output for use as gating or timing signals in radar, computer, and communications equipment. It is often used for relay control functions and a variety of similar applications. This type of multivibrator has two stable states in which one transistor is normally conducting while the other transistor is normally held cut off, each one functioning for only a half cycle when triggered. Feedback from the collector of one transistor to the base of the other is similar to that of the astable circuit. Because two separate input triggers are required to complete one cycle of operation, the output gate frequency of the flip-flop multivibrator is half the input trigger frequency. The output gate length is determined by the time interval between the turn-on and turn-off triggers. Output signals are taken from the collector of either or both transistors in the common-emitter circuit configuration.

Operation (Fig. 4)

In Fig. 4, two transistors are shown connected in a basic flip-flop multivibrator circuit. Transistors Q1 and Q2 are identical PNP types used in a common-emitter configuration.

When voltage is first applied to the circuit, the current which flows

in each collector load resistor, R5 and R6, is determined by the effective resistance offered by Q1 and Q2 for a given value of base bias voltage. As in the astable circuit, in spite of the use of close tolerance components, there are always minor differences in internal resistance within the transistors. As a result of this inherent imbalance, the initial collector current for each transistor is different, and the immediate effect produced by regenerative action between the coupled stages is that one transistor conducts while the other is cut off.

Waveforms for this circuit are shown in Fig. 5. Assume that Q1 has been initially turned on and is conducting heavily in a saturated state, while Q2 remains cut off. Thus the circuit is resting in one of its two stable states as discussed above. The initial turn-on period is represented by time interval t_0 to t_1 on the waveform diagram, while the steady-state conducting condition of Q1 is represented by time interval t_1 to t_2 . Therefore, the output at the collector of Q1 is at its most positive excursion, while the output at the collector of Q2 is at its most negative excursion. Since there is no internal time constant circuit provided to permit the nonconducting transistor to be automatically raised above cutoff, the circuit remains in this stable condition until a positive turn-off trigger is applied to Q1.

At time t_2 the positive turn-off trigger is applied to the base of Q1 via input 2 and Q1 is instantaneously driven toward cutoff. Collector current flow through Q1 decreases, and heavy collector current flow through Q2 develops a positive-going output voltage across R6, which is also applied through R4 and C4, to reverse-bias the base of Q1. This additional reverse bias quickly causes Q1 collector current to cease, and the collector voltage rises quickly toward the supply value, producing a negative-going output through C5. At the same time, this negative-going collector voltage is fed back through R3 and C3 to the base of Q2 as a forward bias. This continuous feedback action of reverse bias on Q1 and forward bias on Q2 continues until the collector voltage on Q2 bottoms. The circuit now rests in its second stable state between t_2 and t_3 , with Q1 cut off while Q2 conducts heavily. The

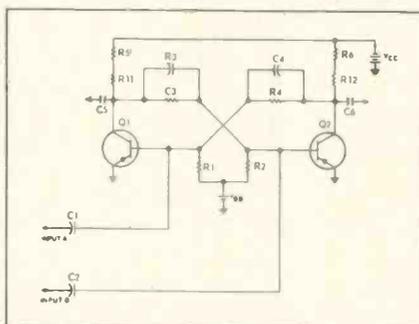


Fig. 4—Basic two-input flip-flop (bistable) multivibrator.

switching action is speeded up by C3 and C4 which allow the instantaneous changes to be immediately applied to the associated base element to produce the steep leading and trailing edges of the waveform. The circuit remains in this condition until another turn-on trigger of positive polarity is applied.

At time t_3 the positive turn-on trigger via input 1 is applied to C2 and the base of Q2, which is already forward-biased and heavily conducting. The instantaneous positive bias produced by the input signal cancels the existing forward bias and reverse-biases Q2, drastically reducing collector current flow. As the collector current of Q2 ceases, the collector voltage of Q2 rises towards that of the supply and produces a negative-going output signal. Meanwhile, this negative output voltage is also fed back to the base of Q1 through feedback resistor R4 (which is bypassed by C4). The instantaneous negative swing through C4 quickly drives the base of Q1 in a forward-biased direction, and causes Q1 to conduct. As Q1 conducts, an output voltage of positive-going polarity is developed across R5, and is fed back through R3 (bypassed by C3) to the base of Q2, driving it still further towards cutoff. Finally, Q2 is held cut off, while Q1 once again conducts heavily near saturation. This is the starting condition and the other stable operating point during time t_3 to t_4 .

Examination of the waveforms reveals that the length of the output gates is determined by the time interval between the turn-on and turn-off triggers. If the frequency of the turn-off trigger is *decreased*, the time interval between the triggers will *increase*. Also, the gate length will *decrease* if the turn-off trigger frequency is *increased*. The bistable multivibrator provides a positive or negative output gate in response to a timing input trigger pulse, with the gate being terminated by a turn-off trigger pulse.

If a single, constant-frequency trigger is used for both the turn-on and turn-off functions, the circuit produces a symmetrical square wave output, with a frequency half that of the trigger frequency. A single pulse can be used for triggering because either the leading or the trailing edge of the trigger can be used. When conducting, and the leading edge is

applied, a positive trigger operates to reverse-bias the conducting transistor, while the feedback causes the nonconducting transistor to be turned on. Conversely, if the trailing edge of the trigger pulse is applied to the nonconducting transistor, it produces a forward-biased condition and starts the transistor conducting, while feedback from the transistor produces a reverse bias to stop the first transistor from operating. This action is true as long as the trigger is a sharp pulse of short duration. If of long duration, an unsymmetrical output will be produced.

In the symmetrical input bistable multivibrator, negative trigger pulses of sufficient amplitude can also be used to initiate the switching action between Q1 and Q2. When the negative pulse is applied simultaneously to the base of the transistors, there will be no effect on the operation of the conducting transistor. However, the collector current on the transistor that is cut off will be increased, causing the collector voltage to decrease. The decrease in collector voltage, when coupled to the base of the nonconducting transistor, drives this transistor into full conduction. In turn, feedback through this newly turned on transistor biases off the originally conducting transistor.

Although it is true that either negative or positive input trigger pulses can cause the switching action to occur, triggering with positive pulses is preferred. If the transistor that is cut off is biased with a highly positive

potential, a high-amplitude negative pulse is required to drive it into conduction, and only the most negative portion of the pulse has any effect. On the other hand, a low-amplitude positive pulse applied to the conducting transistor immediately drives this transistor into cutoff, causing a relatively instantaneous switching action.

Troubleshooting

With no output present, the input trigger should be checked with a scope to determine whether it is being applied to the circuit, and whether it is of the proper amplitude and polarity. Lack of an input trigger at the base of Q1 or Q2 can be due to an open input coupling capacitor, C1 or C2, or to failure of the external input trigger source. If the input signal does not appear on the base side of the capacitor, use an in-circuit capacitance checker to check C1 or C2 for proper capacitance or an open circuit.

Failure of the base bias or collector bias supply will disrupt operation of the circuit as would an open feedback circuit. Use an electronic voltmeter to check the base bias, collector, and supply voltages. Normal voltage indications on these elements also indicates that neither R1 nor R2 is open; and likewise R3 and R4. If either C3 or C4 is shorted, the circuit will still operate as a direct-coupled unit and operation will be somewhat slowed up, but an output will still be obtained. If normal signals appear on the collectors but not at the output, C5 or C6 is probably open. An in-circuit capacitance checker may be used to verify their values and to check for an open or a short.

A reduction of output is usually caused by low collector voltage, improper bias, or a defective transistor. A change in the resistance of the associated collector load resistor (R5 or R6) will also affect the output amplitude. A leaky or shorted output coupling capacitor, C5 or C6, will form a voltage divider with the input resistor of the following stage. If the input resistor of the following stage is returned to ground or to a bias supply, the collector voltage on either Q1 or Q2 will be changed and operation of the following stage will be upset by the change in voltage on its base. In addition, this might possibly cause additional collector cur-

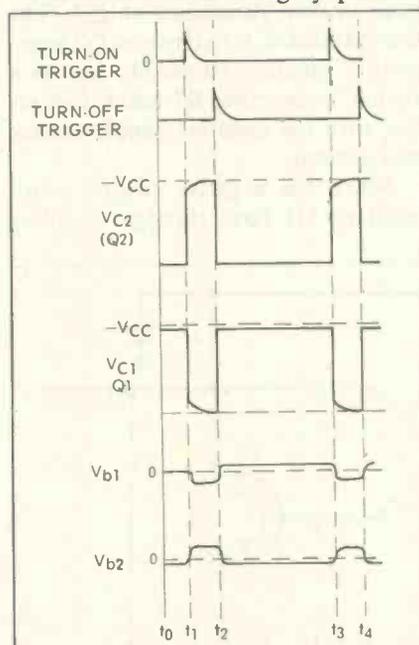


Fig. 5—Waveforms produced by bistable multivibrator.

rent flow through one of the collector resistors (R5 or R6) and may cause one to burn out.

The basic flip-flop has no parts governing the frequency or width of the output gate signal. These are governed by the input triggers applied to the circuit. Therefore, any change in the output gate frequency or width is a direct result of improper operation of the turn-on or turn-off trigger generating circuits.

MONOSTABLE MULTIVIBRATORS (ONE-SHOTS)

The *monostable multivibrator* has only *one* fixed or stable state. The other, operational, state is determined by an RC time constant network. Initially, the monostable circuit is triggered into action similar to the bistable circuit. Once triggered, the change of state occurs and the formerly conducting transistor is cut off, while the other transistor conducts. This state continues until the RC network is discharged sufficiently to trigger the nonconducting transistor on again and restore the initial state of operation which existed before the trigger was applied. The monostable circuit can usually be easily recognized by the base biasing connection of the normally conducting transistor. It usually consists of a voltage divider connected to the supply which holds the transistor forward biased until cut off by the action of the trigger pulse, whereas the other type of multivibrators have symmetrical feedback networks.

Because of the single stable state of operation, this circuit is also known as a *one-shot*, *single-swing*, or *single-shot* multivibrator. Because of the time constant switching action, the circuit needs only one trigger per output waveform, and

operates at the same frequency as the input trigger, instead of half the trigger frequency as in other multivibrators.

The basic one-shot (Fig. 6) is used to provide a gating function in computers, electronic control, or communications equipment. The basic one-shot is a triggered circuit, which requires a trigger pulse to initiate action. Once the trigger pulse initiates the action, the circuit uses its own power to complete the operation. Either the stable state of cutoff or saturation is used. Normally, one transistor is operated saturated while the other is at cutoff. When the circuit is triggered by an external pulse, the operating point is moved from the initial stable region to the static operating region. The time constant of the circuit elements holds the operating point in the static region for a short period of time, the operating point then moving back to the original stable state.

Operation (Fig. 6)

In the stable condition, Q2 conducts heavily while Q1 is cut off. This action occurs initially because of the large negative forward bias placed on the base of Q2 by R2, which is connected back to the negative supply. On application of power, Q2 quickly saturates and develops a positive-going output across R4, which is fed back through R3 to the base of Q1, holding Q1 at cutoff. During the *on* period of Q2, C1 charges through R1 and the low base-emitter resistance of Q2. The low saturation resistance of Q2 base-emitter junction effectively acts as a switch, connecting R1 and C1 in series with the negative supply source and ground.

When the negative trigger is applied to Q1 base through coupling

capacitor C2 (time t_1 in Fig. 7), Q1 is instantly driven into conduction by this forward bias. The flow of Q1 collector current produces a positive-going voltage across R1, which is applied through feedback capacitor C1 as a positive reverse bias to cut off Q2. As the collector current of Q2 reduces, the voltage across collector resistor R4 rises toward that of the negative collector supply, and an increasing forward bias is fed back to the base of Q1 through feedback resistor R3. Transistor Q2 is cut off and Q1 is turned on.

Operation is now reversed and the output from Q2 is a negative voltage during time t_1 to t_2 . Since C1 is positively charged, when disconnected from ground by Q2 being driven into cutoff, C1 holds the base of Q2 highly positive until it discharges. The discharge path is through the low collector-emitter saturation resistance of Q1, and ground on one side, and through R2 to the negative supply on the other side. The discharge is shown by the typical RC discharge curve on the trailing edge of the V_{b2} waveform at time t_1 to t_2 . Transistor Q2 remains cut off until the base voltage drops to zero and the base of Q2 goes slightly negative at time t_2 .

Now Q2 immediately starts to conduct, and the flow of collector current through R4 produces a positive-going voltage, which is applied through feedback resistor R3 to drive Q1 in a reverse-biased direction and stop conduction through

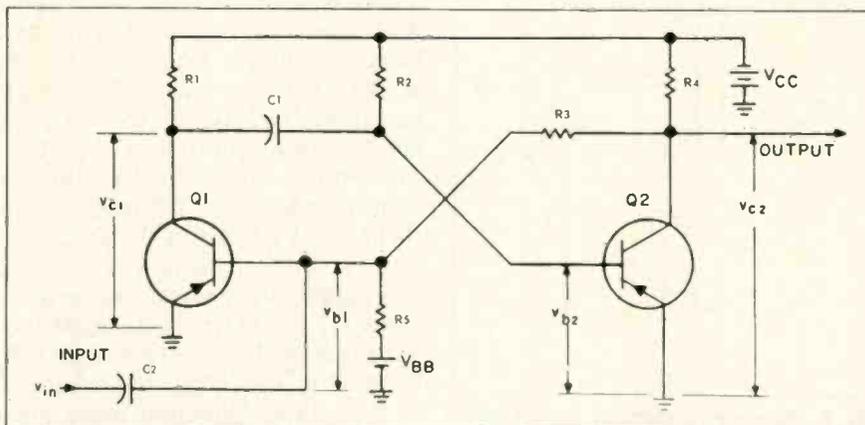


Fig. 6—One-shot multivibrator.

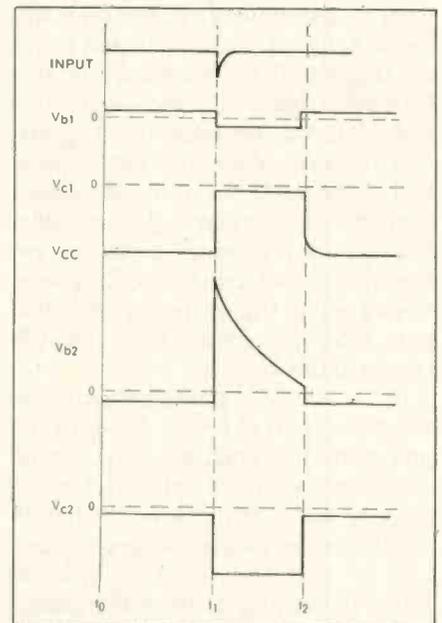


Fig. 7—Waveforms produced by one-shot multivibrator.

Q1. This regenerative feedback action occurs quickly, and the output of Q2 is a positive rectangular voltage. The quiescent state of operation continues until the next trigger occurs.

Troubleshooting

If bias resistor R2 value increases with age or if it opens, the base of Q2 will tend to float in a zero-biased condition, the collector of Q2 will rise to the supply value, and a continuous output with no switching action will occur. The same indication will also occur if R3 is open, since Q1 will be biased beyond cutoff and the trigger will not be large enough to initiate action. At the very best, an attempt to switch may be noticed, with the circuit reverting back to the cutoff condition when the trigger ceases. Such action is best observed with a scope.

Should R5 open, both Q1 and Q2 will conduct, with a continuous positive output from Q2. On the other hand, if Q1 is stopped from conducting by a short across R5, Q2 will continue to operate alone, also producing a continuous positive output. Because of the few resistors in the circuit, a quick check with an ohmmeter will determine if they are satisfactory.

Should C1 open, no feedback can be applied from the collector of Q1 to the base of Q2 and switching will not occur. Again, Q2 will rest in a conducting position with a positive output near zero. If C1 becomes shorted, R1 and R2 will be paralleled and a higher forward bias will be applied to Q2 base, holding it in conduction and preventing operation.

Low collector voltage, improper bias, or defective transistors can cause a low output voltage. A change in resistance of R4 will also affect the output amplitude. Use a scope to check the output waveform and determine where the reduced amplitude exists. Then check for the proper bias and collector voltages in that portion of the circuit. If normal voltages are present and the collector resistor is within tolerance, but a low output amplitude still exists, it can only be because of reduced collector current. Replace the doubtful transistor.

While the frequency is governed by the input trigger, the length of time the circuit operates before flip-

ping back to the initial stable condition is determined by the circuit time constant governed by the charge and discharge of C1 through R2, and also R1. If the value of C1, R1, or R2 changes, or the saturation resistance of Q2 changes, a different pulse width may be expected. Observation of the output pulse on a scope will show any change in width. Measure the values and if these parts appear satisfactory, replace Q2 with a known good transistor. Should a noticeable delay in switching occur after the circuit has been operating properly, first check all parts values; if satisfactory, replace the transistor with a good one.

TECH BOOK REVIEW

Title: Troubleshooting Solid-State Wave-Generating and Shaping Circuits (TAB BOOK No. 653)

Author: Ben Gaddis

Price: \$7.95 hardbound; \$4.95 paperback

Published: January 1974

Size: 192 pages, 78 illustrations

Everything technicians need to know about troubleshooting wave-generating and wave-shaping circuits is right here in one handy volume. Theory and operation of just about any kind of oscillator or signal source one can name are clearly and concisely explained. Armstrong, Colpitts, Hartley, Clapp, RC, Weinbridge, etc.—the list reads like a “Who’s Who” of signal sources. Equally complete coverage of the theory of wave-shaping modulation, demodulation, and frequency-conversion circuits is provided. This book is literally jam-packed with circuits and theory.

But circuits and theory are only half the story when it comes to troubleshooting. It’s one thing to know how a circuit works but quite another to know what to do when it doesn’t. Circuit-sleuth Ben Gaddis shows how to detect the clues with instruments, piece them together (using theory and deduction), and track down the errant part! When checking out wave generators and modifiers, the reader is interested in two quantities: amplitude and frequency. Amplitude is measured with a voltmeter—no instruction is needed in that. Thus, the text starts right out with a description of frequency-measuring devices and how to use them. Counters, wavemeters, frequency meters, dippers, and scopes

are covered in a way that’s like having a lab instructor present. All the basic wave-generating circuits are detailed, transistor by transistor, resistor by resistor, capacitor by capacitor. How to track trouble down quickly and efficiently to a specific circuit, then to a specific part is shown. The second half of the book (wave-shaping circuits) kicks off with a review and explanation of RC and RL differentiators and integrators, serving as a lead-in to advanced discussions of detectors, discriminators, mixers, and converters. ■

CONTENTS: Frequency Measurement — Using the Scope — Lissajous Patterns — Frequency-Counters — Wavemeters — Grid-dip Meter — Heterodyne Frequency Meter — IC Oscillators — RC Oscillators — Wein Bridge — Crystal Oscillators — Blocking Multivibrators — Pulse Shapers — Differentiators — Integrators — AM Detectors — FM Detectors — Video Detectors — Mixers and Frequency Converters — Modulators — Limiters and Clampers — Double-diode Limiters — Biased Limiters, Clippers, Clampers. ■

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The Expansion of Citizens Band

By Skip Meuron

Additional channels and conversion to single-sideband emission promise dealers and servicers increased income from an already booming market

■ The Federal Communications Commission (FCC) recently has proposed new rules which, if adopted, 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 (SSB) transmission.

The proposed new rules initially will establish seven new AM channels between 27.23 MHz and 27.31 MHz (excluding the space now occupied by Channel 23 at 27.255 MHz), plus 40 new suppressed-carrier SSB (upper sideband only) channels spaced 5 KHz apart between 27.315 MHz and 27.505 MHz. These new SSB channels will be designated 60-99.

The new rules further provide that, a few years after the rules are adopted, the present AM and lower sideband SSB transmission will be abolished and the associated 30 AM channels will be divided into 60 SSB (upper sideband) channels spaced 5 KHz apart.

The additional channels and the SSB method of transmission will provide better utilization of the radio spectrum and will eliminate the increasing congestion on the present 23 channels.

HOW THE PROPOSED NEW RULES WILL AFFECT SERVICERS

Technician Licensing

It is doubtful that the present FCC rules covering the licensing of electronic technicians who service communications equipment will be affected by the proposed new rules.

Existing FCC rules permit unlicensed technicians to service CB equipment under the supervision of a technician with a First Class or Second Class Radiotelephone Operator license. An unlicensed technician can service a CB transceiver when it is *not* connected to a radiating antenna. However, before it is operated in the transmit mode while connected to a radiating antenna, the transceiver must be checked out by a licensed technician.

Fig. 1—Test setup for measuring SSB transmitter frequency.

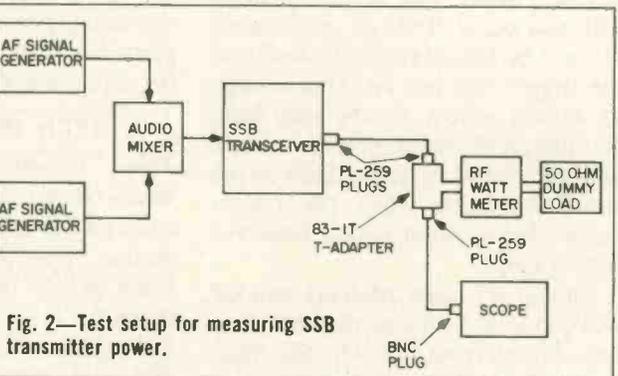
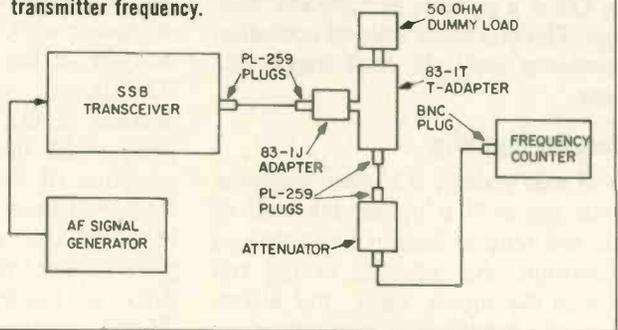


Fig. 2—Test setup for measuring SSB transmitter power.

Techniques and Test Equipment

Those now servicing or planning to service AM and AM/SSB transceivers will have to acquire knowledge about SSB and the additional test equipment required for servicing it.

Along with the addition of new channels, a new type of CB transceiver will emerge as a result of the proposed new rules. Of the 47 new channels, only seven will be available for AM transmission; the other 40 will be reserved for suppressed-carrier single-sideband (SSB) transmission (upper sideband only). Existing CB transceivers will *not* be operable on the 40 new SSB-only channels.

The most popular basic type of CB transceiver currently on the market is operable on all of the existing 23 CB channels. It is equipped with a frequency synthesizer which, typically, employs 14 crystals. The other basic type, operable on fewer channels, requires installation of a pair of crystals (one for transmit, one for receive) for each channel.

When the FCC adds Channels 24 through 30 for AM or AM/LSB/USB use, it is anticipated that adapters will be available for expanding the capability of 23-channel transceivers to 30 channels, if the FCC approves the use of adapters. Transceivers that do not employ a frequency synthesizer can be made operable on any or all of the seven new AM channels by simply installing appropriate crystals.

Operation on the 40 new SSB-only channels (60-99) will require an entirely new type of transceiver. They are already being designed. And, some of them will be unique in that they will employ a PLL (phase locked loop) and a single crystal instead of a conventional frequency synthesizer or a pair of crystals per channel. Some will be operable in the USB mode on Channels 1 through 30 as well as Channels 60 through 99.

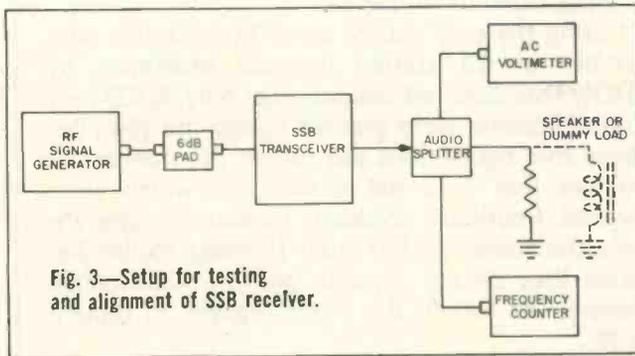
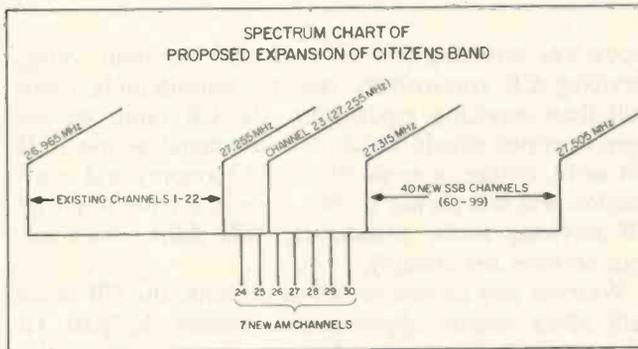


Fig. 3—Setup for testing and alignment of SSB receiver.



Existing AM/SSB transceivers can be operated in the AM mode when measuring carrier frequencies. However, because SSB-only transceivers do not emit a carrier, measurement of frequencies requires unbalancing or bypassing the balanced modulator so that the carrier frequency signal will be present at the transmitter output. Since this method requires "tampering" with the internal circuitry, more time is required to measure the frequency of a suppressed-carrier transmitter. An easier method is to modulate the transmitter with a 1000-Hz tone and measure the frequency of the resulting upper sideband with a frequency meter or counter and deducting 1000 Hz from the measurement figure, using the setup shown in Fig. 1.

In addition to a frequency meter or counter accurate to at least ± 0.0005 percent, a wide-band oscilloscope (up to 30-MHz vertical response) will be required for observing the modulation envelope when measuring peak envelope power (PEP) output and adjusting the automatic level control while the transmitter is being modulated simultaneously by two tones (400 Hz and 1800 Hz). This means that two audio signal generators also will be required. The setup is shown in Fig. 2.

Since the 40 new SSB-only channels (Channels 60-99) are spaced only 5 KHz apart, new receivers will have to be extremely selective. Transmitter frequency tolerance is to be 0.002 percent under the proposed new rules. But it will actually have to be better, because even small frequency errors will result in unintelligible recovered audio at the receiver.

Receiver servicing will be different too. You can feed into the receiver an unmodulated RF signal at a frequency 1000 Hz above the carrier frequency, to obtain a sideband signal for alignment and signal tracing purposes, using the setup shown in Fig. 3. By tuning the RF signal generator from 300 Hz to 3000 Hz higher than

the suppressed carrier frequency, you can measure the frequency response and bandwidth of the receiver. The frequency of the RF signal generator must be very accurate and extremely stable. For this purpose, a frequency synthesizer, such as the communications monitors made by Cushman and Singer, is recommended.

In addition to a very accurate frequency measuring instrument, a wide-band scope and two accurately calibrated audio signal generators, you also will need 50-ohm dummy loads and conventional multimeters. Also, very useful as a time saver is a peak-reading RF wattmeter, such as the Bird 4311, which indicates PEP on a meter scale.

HOW THE PROPOSED NEW RULES WILL AFFECT DEALERS

The proposed ban on the use of AM within a few years should not alarm dealers, existing CB'ers and those now buying current-generation equipment. The same thing happened in the marine radio field. When the FCC changed the marine rules to require the use of only SSB on marine frequencies between 2 MHz and 24 MHz, the Commission set a five-year cut-off date on the use of AM (January 1, 1977).

Obviously, dealers also will participate in the present and future CB radio boom. According to records kept by *CB Magazine*, there are approximately 14,000 retail CB outlets. They include thousands of independent dealers and parts distributors plus retail chains such as Lafayette, Penney, Radio Shack, Sears and Wards. It has been rumored that even Macy's will soon be handling CB radios, because most buyers fall into the "consumer" category. Handling CB equipment is a natural for TV, hi-fi, auto radio and auto tape equipment dealers.

TYPE ACCEPTANCE

Since all CB transceivers of existing and future types sold or first installed after November 22, 1974 must be FCC type-accepted in order to be licensed, CB equipment service technicians should be aware of the rules concerning type-acceptance. Modification of a type-accepted transmitter can result in automatic loss of type-acceptance unless the modification is classed by the FCC as a "permissive" one approved by the equipment manufacturer. Transmitter components may be replaced only with factory furnished or factory approved components.

Detailed information about type-acceptance rules can be found in an up-to-date edition of Part 2, FCC Rules and Regulations, and information about CB technical standards can be found in Part 95 of the rules. Copies of these rules can be obtained from the Government Printing Office, Washington, D.C. 20402.

CONCLUSION

Precision is the name of the game when servicing SSB equipment, as many in the marine radio business have learned. Servicing is a lot easier when there is a carrier signal. But, when there is no carrier signal except at the input of the balanced modulator in the trans-

THE CB SERVICING MARKET

In spite of the almost unbelievable congestion on the existing 23 CB channels, thousands of new CB'ers are going on the air each month, and the need for servicing keeps increasing. The lid will really be off when the proposed 47 new channels (24-30 and 60-99) are added.

As of June 30, 1974, there were 928,642 licensed CB stations. Based on an estimated average of 4.2 transceivers per licensee, it is probable that there are more than 4 million licensed CB transceivers in use. It is believed that there are equal-

ly as many, if not more, that are being operated illegally, without a license.

During the year ending June 30, 1974, the total number of CB station licenses increased by 95,630. This does **not** indicate that only 95,630 new station licenses were granted during the year, because this figure does **not** reflect the number of licenses that were **not** renewed or which were revoked. Countless licensees continue to operate their transceivers after their licenses expire because they do not want to pay the \$20 license renewal fee (which the FCC proposes to reduce to \$6).

mitter and a locally-generated carrier re-inserted at the receiver detector, an intimate understanding of SSB and more precise servicing techniques are required.

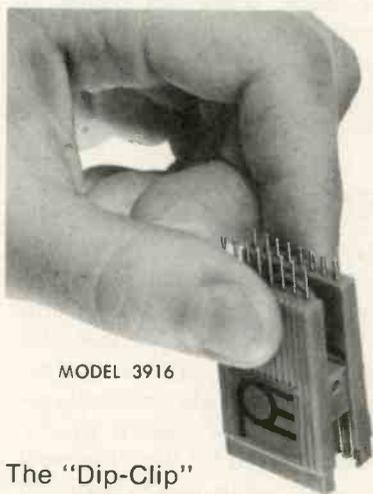
When new-generation CB equipment will become available depends on how soon the FCC acts. It is anticipated that the FCC will act during the first half of 1975. For the present and for several years, there will be a great demand for current-generation CB equipment.

It is expected that many more TV service establishments will expand into the CB service business because of the significant increase in the use of CB equipment.

Recently, IBM increased its New York City rates for

typewriter servicing from \$16 to \$23 per hour. Since servicing CB transceivers requires considerably more skill than servicing typewriters, the CB radio service shop operator should be able to command as much, if not more, except in areas where the economy and competition will not permit it. But once you have acquired CB servicing skills, particularly SSB skills, don't sell your services too cheaply.

Whether you service or sell or do both, the CB radio field offers unique opportunities. During the past 16 years, the CB industry has become almost as big as the entire electronics industry was at the start of World War II, and in half the time. Every citizen is a prospective CB equipment buyer and service customer. ■

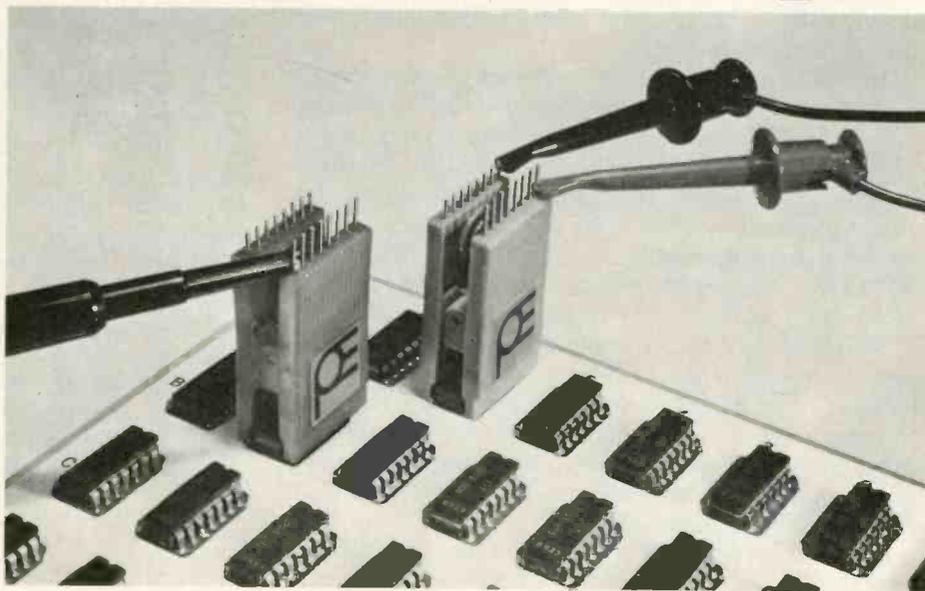


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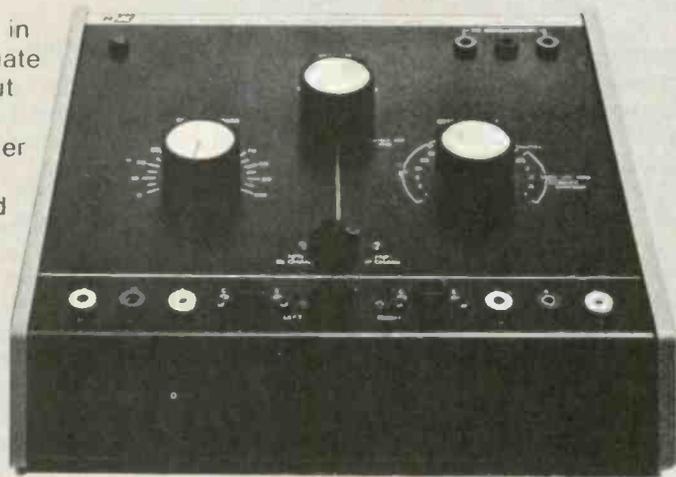
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TEST INSTRUMENT REPORT

HEWLETT PACKARD MODEL 5381A FREQUENCY COUNTER



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■ The Model 5381A is an AC-operated, direct-counting, digital-readout frequency counter with a range of 10 Hz to 80 MHz.

Display Type

The digital readout is provided by seven light-emitting diodes (LED's), each of which has seven segments.

Input Impedance

Input to the counter is through a BNC connector on the lower right of the front panel. The input impedance is 1 megohm shunted by less than 50 pf of capacitance.

Sensitivity and Input Levels

Maximum sensitivity is 25mv (rms sine wave) from 30 Hz to 20 MHz, with a nominal overall sensitivity of 50 mv (rms sine wave) throughout the usable frequency range of 10 Hz to 80 MHz.

A three-position ATTENUATOR switch on the front panel reduces the sensitivity of the counter by factors of 10 and 100. Maximum sensitivity and an optimum ratio of signal to noise are provided in the X1 position of the ATTENUATOR switch. Maximum recommended input levels with the ATTENUATOR switch in the X1 position are 200 volts (DC plus peak AC) from DC to 40 Hz, 250 volts rms from 40 Hz to 100 KHz, .25 microvolt per hertz from 100 KHz to 5 MHz, and 5 volts rms for signals over 5 MHz.

The X10 and X100 positions of the ATTENUATOR switch reduce the sensitivity by factors of 10 and 100, respectively. Maximum recommended input levels in the X10 and X100 positions are 200 volts (DC plus peak

AC) from DC to 40 Hz, 250 volts rms from 40 Hz to 1 MHz, .025 microvolt per hertz from 1 MHz to 50 MHz, and 5 volts rms from 50 MHz to 80 MHz.

If the amplitude of the signal to be measured is unknown, or if noise causes an unstable display, the ATTENUATOR switch should be set initially to the X100 position and then reduced to X10 or X1, if necessary, to obtain a stable readout.

Time Base

The internal time base of the Model 5381A is equipped with an unheated, 1-MHz crystal which has an aging rate of less than .3 parts per million per month (ppm/month) and is accurate to within ± 10 ppm over a temperature range of 32 degrees F to 104 degrees F.

A BNC jack labeled EXT IN and a two-position switch labeled EXT/INT on the back of the Model 5381A permit use of an external oscillator in place of the internal time base of the counter. Externally generated time base frequencies from 10 KHz to 2 MHz at levels not exceeding 25 volts rms can be accommodated by the counter.

Gate Times and Resolution

The length of time the counter takes to make a measurement is manually selected by a three-position switch, labeled GATE TIME, on the front panel of the instrument. (The gate time effectively establishes the range of frequencies which can be measured and displayed by the counter.) In the .1s position of the GATE TIME switch, the counter "accumulates" hertz (cycles) for .1 second and, at the end of this period, displays the accumulated count in terms of "tens" of MHz plus decimal fractions of MHz up to 5 places to the right of the decimal point. (The decimal point is automatically shifted and displayed when the GATE TIME switch is repositioned.) This provides a measurement resolution to within at least

10 Hz of any frequency between 10 Hz and 80 MHz. For example, a frequency of 79.99999 MHz would be indicated as 79.99999 MHz.

In the 1s position of the GATE TIME switch, the counter accumulates hertz for 1 second and then displays the count in terms of up to thousands of KHz plus decimal fractions of KHz up to three places to the right of the decimal point. For example, 5555.555 KHz would be displayed as 5555.555. This is a resolution of 1Hz.

In the 10s position of the GATE TIME switch, the counter accumulates hertz for 10 seconds and then displays the count in terms of up to hundreds of thousands of hertz plus decimal fractions of a hertz one place to the right of the decimal. This is a resolution of .1 Hz.

If the number of hertz accumulated during the time period of a particular position of the GATE TIME switch exceeds the readout capability of the instrument in that position, a dot on the upper left of the display lights, indicating the *overflow* condition. The GATE TIME switch then should be moved to the next *faster* position (for example, from the 10s to the 1s position).

Accuracy

The accuracy of the readout is ± 1 count \pm the accuracy of the time base oscillator.

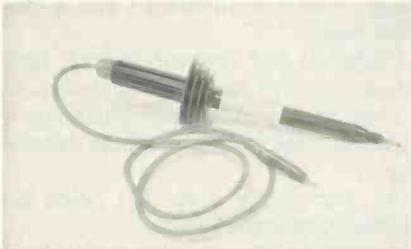
Size and Weight

The Model 5381A is a compact 3.5 inches high by 6.25 inches wide by 9.75 inches deep and weighs only 4.75 pounds.

The frequency range, accuracy and price (\$249.00) of Hewlett Packard's Model 5381A Frequency Counter should make it particularly appealing to electronic technicians who service Class D CB and low-band VHF commercial two-way communications equipment. Technicians who do not service communications equipment should find it useful for servicing and calibrating other test instruments as

well as a variety of industrial electronic servicing applications.

TRIPLETT HIGH-VOLTAGE PROBE



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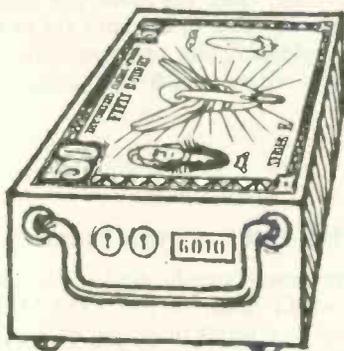
A new high-voltage probe, Model 79-70, for measurement of DC voltages up to 30 kv, recently was announced by the Triplet Corporation.

The probe is designed for use with Triplet Models 630, 630A and 631 VOM's and Triplet's new Model 615 Maintenance Tester. When these instruments are used with the 79-70 probe, their function switches are rotated to the 3VDC position. The measured voltage is read on the 0-300 DC scale and then is multiplied by 100.

Although the 79-70 probe is equipped with an insulated handle and cord, a spring-loaded hook on the point of the probe eliminates the need for holding the probe against the voltage source during the measurement. This safety feature permits you to connect the probe to the voltage source *before* power is applied to the equipment, and then, after power is applied, you can make a hands-off measurement.

The price of the Model 79-70 high-voltage probe is \$22.80. ■

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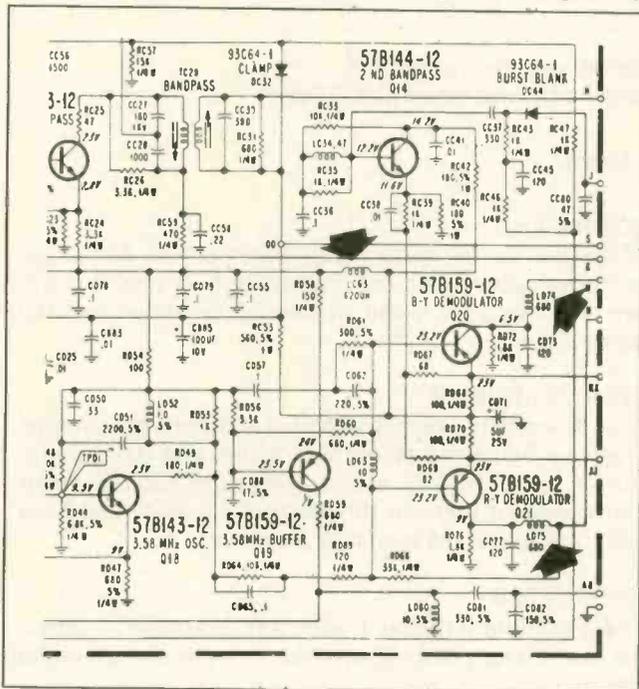
The material used in this section is selected from information supplied through the cooperation of the respective manufacturers or their agencies.

ADMIRAL

Color TV Chassis K10—No Color

A problem of no color can possibly be caused by an open coil, LC63 (620 mh). If this coil is open, we will not have voltage at the collector of the 2nd Bandpass transistor, Q14. Replace the defective coil with Part No. 73A55-48.

If we lack some colors in the TV picture, it possibly



can be caused by an open coil LD74 or LD75 (680 mh). With LD74 open, blue will be missing; with LD75 open, red will be missing. Replace the open coil with Part No. 73A55-17.

GENERAL ELECTRIC

Color TV Chassis "C"—High Voltage "Ticking/Sizzling" Sounds

The "ticking/sizzling" sounds that are sometimes heard in the high voltage cage area of the "C" chassis are caused by static build-ups and discharges. The condition is not detrimental or an indication of a fault existing in the TV set. There have, however, been some customer complaints about these sounds. The following recommended procedure should be used to reduce and, in most cases, eliminate the noise.

Step 1—Measure the high voltage at minimum brightness and contrast. If it is high, adjust to correct level (with minimum illumination of screen) as follows: Sets with a focus rectifier should be set to maximum 26.0 kv. Sets with a focus divider resistor should be set to maximum 25.0 kv. If the high voltage cannot be adjusted as described, check the high voltage circuitry for a component failure (possibly the hold down diode). If this step does not correct the "ticking" problem, continue to the next step.

Step 2—Reduce the high voltage to the minimum setting (i.e., turn the *high voltage adjust* pot completely counter-clockwise). Turn the brightness and contrast controls through their complete range from minimum to maximum to insure that there is no picture deterioration caused by lowering the high voltage. If picture deterioration exists, increase the high voltage until it is eliminated and a customer acceptable picture exists.

Step 3—With the *brightness* and *contrast* controls both set at maximum, increase the *brightness limit* control (i.e., clockwise direction) until picture tube spot blooming is seen. Reduce the brightness limit setting until the blooming is no longer evident.

Step 4—Remove and discard the strap that holds the 3DS3 tube in place during shipment.

If these steps fail to eliminate the problem in stubborn cases, the following items should be checked and/or corrected as indicated.

Disconnect the anode cap from the picture tube and inspect for corona/arcing damage. If the anode cap shows damage or deterioration, replace with a new cap. This may occur especially on sets that have been in use for a long time.

Wipe lightly around the anode connection of the picture tube with a soft cloth and distilled water to remove any contaminants. Clean the anode cap in the same manner. Allow sufficient time for complete drying of the anode cap and anode connection area on the picture tube before reconnecting the anode and applying power to the set.

Replace the high voltage rectifier with a brand new 3DS3 insuring that the tube is clean and has not been previously used.

Before installing the plate cap on the 3DS3, fill the plate cap with "Insulgrease" (EP90X9).

Remove and discard the duct seal (gray putty material) from the pins of the high voltage rectifier socket.

Replace the black cap on the high voltage cup with the new clear cap (EP60X16). Some sets produced in the last quarter of 1973 already have the new cap and it is not necessary to complete this step.

Inspect the 3DS3 socket connections insuring that no pigtails exist and that all connections are smooth and round. Inspect the cup area to insure no foreign material (such as solder balls or splashes, etc.) are in the cup.

Install new duct seal (EP90X24) in the high voltage cup so that the duct seal covers all of the pins in the cup completely and does not come in contact with the cover.

On sets that have focus dividers, excessive spark gap lead length protruding through the terminal board may cause arcing. Cut the leads on the backside of the board so that they are flush with the board. Resolder the connections to produce a smooth round solder joint.

On sets with a focus divider, clean the spark gap with a clean, soft cloth to remove any dust or oil built up in the gap (Note: Do not use sandpaper, files or other abrasives since they will leave sharp edges which will encourage spark gap breakdown).

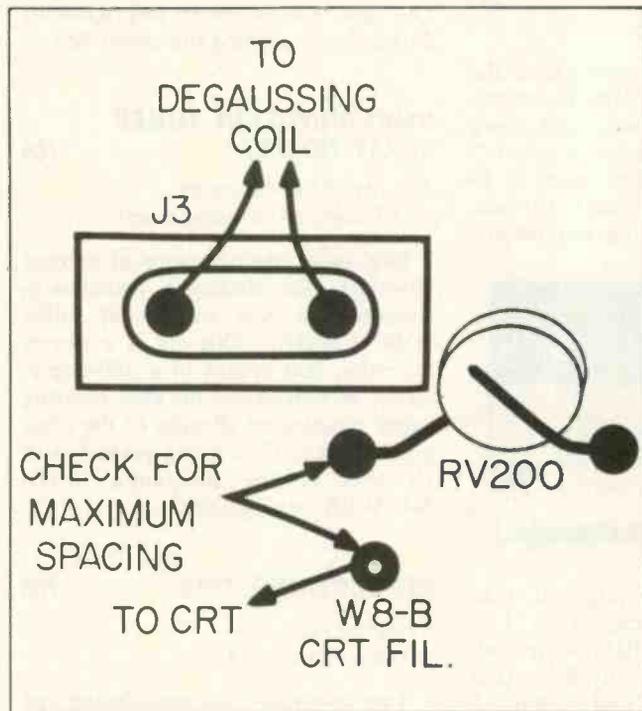
MAGNAVOX

Color TV Chassis T981/T982/T987—Power Supply Diode Failures

Failure of one or more power supply diodes, and possibly the CRT filament, might occur in the T981, T982, and T987 color TV chassis as a result of arcing in the picture tube. The voltage pulse produced by the arc travels down one of the CRT filament leads to point W8B on the Scan board. If this lead is positioned too close to thermistor RV200, the pulse will be transferred to the thermistor and to the power supply diodes. Should any of these diodes

have to be replaced, check the position of the filament lead to be sure it is dressed as far away from RV200 as possible. An inspection of the filament lead dress should be made on all T981, T982, and T987 chassis during routine service.

The power supply diodes might also be destroyed if the T981 or T982 chassis is connected directly to earth ground. Neither of these chassis is equipped with isolating power transformer. The AC line voltage is connected directly to a bridge rectifier, and the circuit arrangement causes the



chassis to measure approximately 70 v AC above earth ground, regardless of the polarity of the AC plug. If the chassis is connected to earth ground (such as through the ground lead of a VTVM using a three-wire AC cord), one or more of the diodes in the bridge circuit will be destroyed instantly. This problem can occur in any radio or TV set which has one side of the AC line connected to the chassis. Therefore, an isolation transformer should always be used when servicing this type chassis.

Color TV Chassis T995—Module Removal

The Horizontal module and the Retrace/Screen module are each held in place by a nylon mounting post fastened to the module with a 1/4 inch hex screw.

The nylon post snaps into a hole in the chassis to secure the module. The modules should be removed by pushing the post out of the chassis hole, not by removing the screw on the module. Replacement modules are supplied with nylon mounting posts attached to the module. ■

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NEW PRODUCTS

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

RF SIGNAL GENERATOR 700

Solid-state compact unit provides three types of outputs

Dynascan Corp. has introduced the B&K Model 2050 RF Signal Generator. The unit is all-solid-state, compact, and is ideal for numerous applications in the audio, radio and TV service field. The many applications include AM receiver alignment, marker source for TV sweep alignment; RF amplifier gain tests and signal tracing. The generator provides three types of outputs: RF, 400 Hz modulated RF, and externally modulated RF with an accuracy of 1.5 percent of dial setting. Combination HIGH-LOW switch, plus continuously variable RF output control which provides 20 dB of signal change. The power supply is zener-regulated; FETs are used in the RF and audio oscillator stages—ensuring



greater stability and maximum linearity of modulated signals. Most of the components are mounted on a single PC board, and the isolated RF circuit assures maximum protection against external voltage sources. Other features include a multicolored, large 4½ inch dial with positive anti-backlash drive; sturdy case with convenient carry handle; 3-wire, grounded AC line cord. The generator measures 7½ inches by 6½ inches by 9¾ inches deep. Price is \$107.

TV TUNER CLEANER/ LUBRICATING KIT 701

Corrects noisy VHF turret-type TV tuners

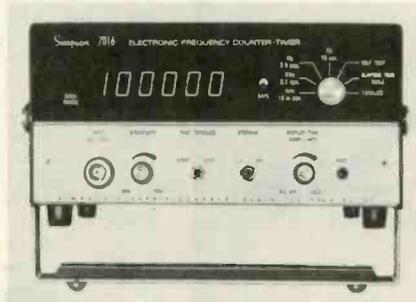
The Tube Products Department—General Electric Co., is offering independent service dealers an inexpensive kit designed to help solve the problem of noisy VHF turret-type television tuners. The kit includes ten foam pads and a bottle of cleaning/lubricating jelly. Simply remove the tuner cover

and affix the foam pad on the inside of the tuner cover where the pad will lightly wipe all tuner contacts when revolved. Apply a light coating of jelly and replace the tuner cover. The kit sells for \$3.75.

FREQUENCY COUNTER/TIMER 702

Features bright planar readout

Simpson Electric Co. announces the availability of Model 7016 Electronic Frequency Counter-Timer. The counter-timer has a frequency range of 5 Hz to 50 MHz with gate times of 10 msec (0.1 KHz resolution), 0.1 sec, 1.0 sec and 10 sec (0.1 Hz resolution).

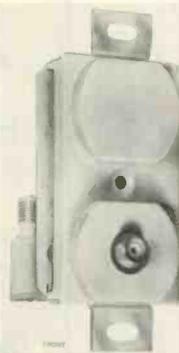


It has a total display range of 1 to 1,999,999, and an accuracy of ± 1 count. This compact, lightweight unit measures 4 inches high by 8.5 inches wide by 8 inches deep and weighs 6.5 lb. A new .55-inch, bright planar readout can be read from a distance of several feet. Display storage is selectable by means of a front panel switch. The sample rate is continuously adjustable from 2 readings per second to hold.

ANTENNA SYSTEM DIRECTIONAL COUPLER TAPS 703

Compatible with 30-channel two-way antenna systems

Jerold Electronics has developed a new series of directional coupler flush-mounted tap-offs for use in internal TV distribution systems. The new DFT series is recommended for use with either an MATV head-end or a CATV feed. They are compatible with 30-channel, two-way service systems. Five values of uniform tap isolation are available: 7 dB, 13 dB, 19 dB, 25 dB, and 31 dB. Directionality is 16 dB, 5 to 300 MHz. Minimum isolation between outlets is 30 dB (twice tap isolation plus 16 dB directionality). The



7-dB isolation DFT passes 5 to 300 MHz, and the 13, 19, 25 and 31 dB units handle 5 to 806 MHz, with directionality of 10 dB minimum through the UHF band. Insertion losses of the DFT's range from 0.5 dB to 1.7 dB, 5 to 300 MHz, and 0.7 dB to 1.0 dB, 470 to 890 MHz. Tight shielding is achieved by means of a sealed, die-cast enclosure with F connectors. The unit will mount in any standard 2-inch-depth, single-gang outlet box.

OMNI-DIRECTION TUNER SPRAY NOZZLE 704

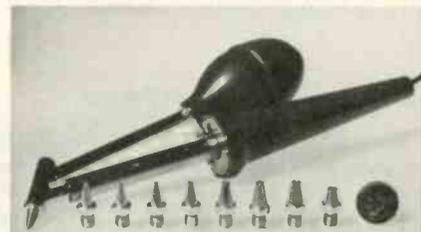
Assures better cleaning on all sides of the component

Tech Spray, manufacturer of aerosol chemicals for electronic technicians, announces a new service aid called "OMNI-SPRA." This aid is a nozzle extension that sprays in a 360-degree circle, as well as out the end, assuring better cleaning of all sides of the component. The aid is being packed with all cans of the company's BLUE SHOWER product line.

DESOLDERING TIPS 705

Designed for miniature components

Two new small size desoldering tips for removing miniature components have been introduced by Enterprise Development Corp. The tips—with an I.D. of .025 and .031—brings the total number of tips available to eight, for use with its Model 510 Endeco pencil style desoldering iron. All eight are included with the firm's desoldering



kits. Tips also fit the new desoldering head that quickly converts any Endeco soldering iron into a desoldering tool. Tip sizes range from .025 to .090, with the .063 standard.

FLAMEPROOF FILM RESISTORS 706

Can be used as general-purpose replacements

Flameproof film resistors are now available from RCA Parts and Accessories Division. These resistors won't flame or short under the most severe overloads. While they are designed for use as "exact replacements" in RCA instru-

3 temperature ranges



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Ask your local distributor or write...

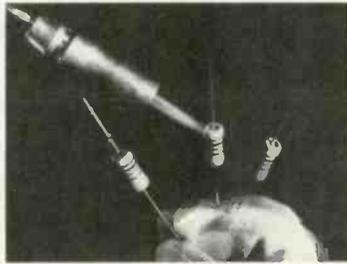
**Weller-Xcelite
Electronics Division**



The Cooper Group

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APEX, NORTH CAROLINA 27502

ments, they can also be used as general-purpose replacements in consumer instruments of any make. To assure their use by service technicians, they are marked by a star, as "safety" parts in RCA service data. The resistors

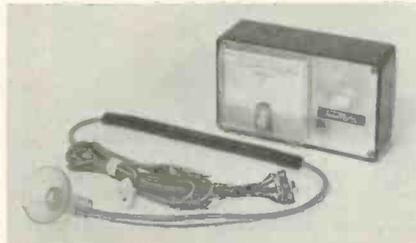


have a 2-percent tolerance and are available in 1/2-watt, 1-watt, and 2-watt ratings. There are 61 standard resistance values, ranging from 10 ohms through one Megohm, in each wattage rating.

TEST RIG HIGH-VOLTAGE METER 707

*Designed for add-on
to any TV test rig*

The Model HVM 3900 ADD-A-METER from Telematic is designed for add-on to any TV test rig. The self-contained unit can be mounted anywhere, to provide continuous monitoring of the picture tube second anode voltage of the chassis under test, without additional connections. Features of the high-voltage meter are: a 3 1/2-inch precision meter with self-shielded movement and jewel pivot bearings,



a full scale reading of 35 kv, and an accuracy of 2 percent. The multiplier assembly is a calibrated high-voltage resistor and a grounding assembly, which insures precise, accurate operation of the meter. The meter is completely assembled with hardware for mounting at any convenient location up to 36 inches from the test rig.

ANTENNAS 708

*The UHF director train
features diamond-shaped elements*

The UHF gain of Channel Master's "Quantum" antenna series has been increased up to 3 dB by the development of a UHF director train feature

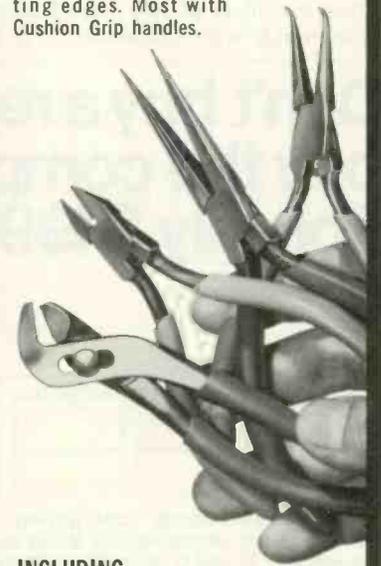
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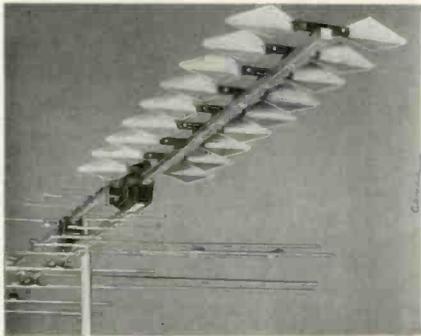
The Cooper Group

ORCHARD PARK, N. Y. 14127

NEW PRODUCTS...

continued from preceding page

ing diamond-shaped elements. The design is standard on all UHF/VHF "Quantum" models. The directors are mounted side-by-side in co-linear fashion,



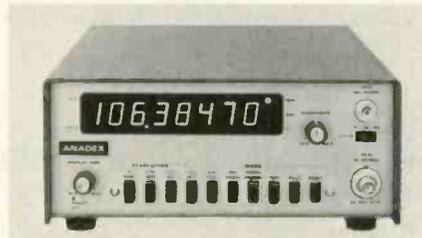
and provide high gain and directivity across the entire UHF band without the necessity of pre-tuning for specific bandwidths or "peaking" for specific channels. The diamond shape of the director lowers the element's inductance without changing its capacitance, resulting in improved bandwidth. Positioning the diamonds side-by-side creates a broad aperture and an extremely narrow beam width, creating the affect of two yagis mounted side by side with a common feed. The

antenna rejects interference from side and rear by combining high gain with very high directivity and narrow beam width. There are seven VHF/FM models and eight UHF/VHF/FM models.

COMMUNICATIONS COUNTER

Eight-digit display with units 709 annunciators and overflow indication

Anadex Instruments, Inc., introduces the Anadex Model CF-710 Communications Counter. The instrument features a 1 GHz measurement capability at 30 mv RMS sensitivity over the temperature range of 0° C to 50° C. Packaged in a rugged case with a carrying handle on the side, the counter has an 8-digit, .55 inch high Sperry



display with units annunciators and overflow indication. Function modes are selected by front panel pushbutton controls. Plug-in IC's are used

throughout the chassis. The counter features phase lock multipliers of X100 and X1000 for input frequencies from 50 Hz to 10 KHz. Resolution of 0.001 Hz on frequency inputs and up to 10 KHz is provided by these multipliers. Front panel pushbutton controls permit selection of the multiplication factors and resolution desired. Price is \$920.

TRUCK INTERIOR SHELF/BIN UNITS

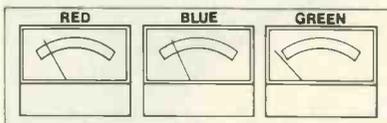
710

Constructed of 20-gauge steel with 600-lb. shelf-load capacity

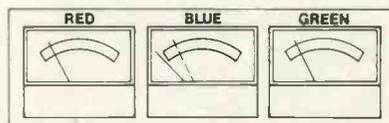
These Kole Compact Truck Interior Shelf and Bin Units, offered by Kole Enterprises, Inc., are designed for easy access and conservation of valuable space—anyone can custom fit any van to fit whatever their needs are. Avail-



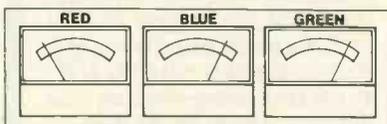
Don't buy a rejuvenator... buy the complete picture-tube service system! For only \$199*.



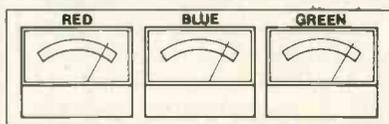
1. Leakage and Shorts Tests/Repairs: Meters indicate simultaneously shorts or leakage in R, B, and G guns. Here, Green gun is defective.



2. Easy Intermittent Tests: Simultaneous monitoring of three guns quickly detects intermittent gun, eliminates time-wasting guesswork. Blue gun, above, is intermittent.



3. Emission/Tracking: Simultaneous emission readings give you instant check on ratios between guns. Here, Red-gun emission is not acceptable.



4. Rejuvenation: Rejuvenate picture tubes 5 ways with the WT-333A depending on tube's condition. Meters, above, show Red gun has been restored.

*Optional Price



When you buy the 3-meter RCA WT-333A, you get *both* an accurate picture-tube tester *and* a rejuvenator. The WT-333A performs *all* the vital tests and repairs you need to service nearly 2000 picture-tube types.

Get all of these servicing essentials at RCA's sensible price — only \$199*. Buy the WT-333A from one of the more than 1000 authorized RCA distributors worldwide. Or, write to RCA, Harrison, N.J. 07029.

Remember, only RCA makes both picture tubes and a picture-tube tester. Ours has to be good!

RCA Electronic Instruments

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

able in two popular sizes—three- and four-foot units—they can be arranged the way they are needed. The units are constructed of 20-gauge steel with 600-lb. shelf capacity. Features include: 1-inch increment holes for shelf adjustment; shelves trimmed and folded for greater strength and safety; shelves can be adjusted and slanted up to 3 inches and have special locking nuts that won't vibrate loose.

POWER METER

711

Provides a perfect match and stops power loss

Two all new matcher-reflected power meters are added to the line of accessory products of Gold Line Connector,



Inc. The GLC 1087 (shown in picture) is a 500 watt, 13-78 MHz unit and the GLC 1088 has a rating of 1000 watts and 144-220 MHz. Both matchers eliminate the need for an SWR Bridge. They both stay in line for a perfect match and stop power loss. By simply inserting the unit between the transmitter and antenna lead-in and adjusting the tuning knobs to the lowest meter reading, a perfect match results and power loss is eliminated. The price of the Model GLC 1087 is \$28.95 and the GLC 1088 is \$33.95.

TUNER LUBRICANT/CLEANER

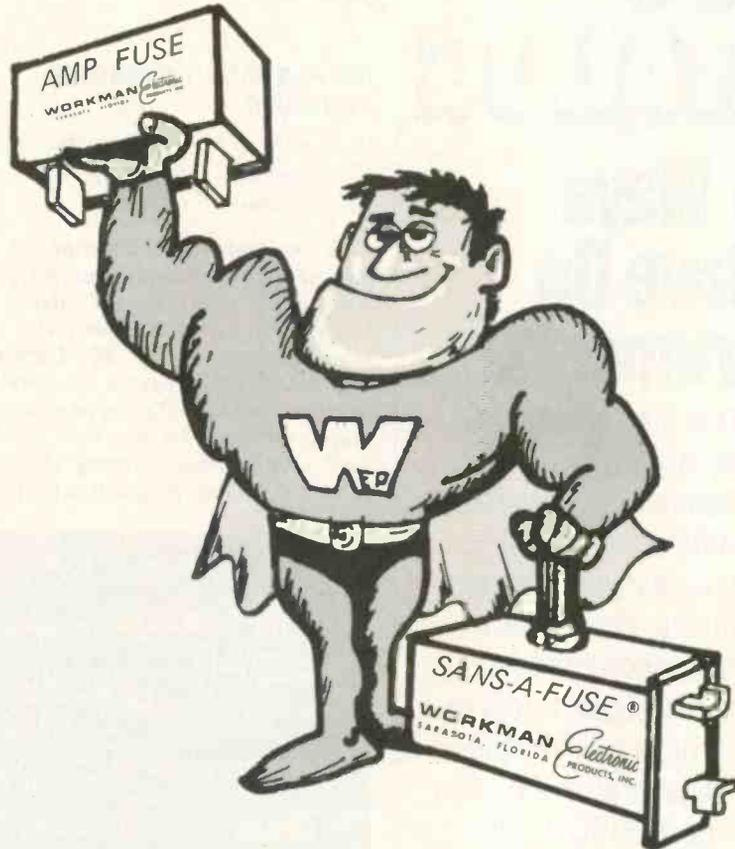
Provides continuous cleaning, polishing and lubricates tuner contacts 712

PTS Electronics, Inc., announced a new product—PTS No. 108, GREEN GIANT TUNER FOAM. The foam provides continuous cleaning, polishing and lubricating of the tuner contacts. It is safe for all plastics and will not cause drift or detuning when sprayed only on the contacts. Available



from all PTS locations. ■

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DEALER SHOWCASE

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

CB PARTS/ACCESSORIES PROGRAM

713

Over sixty different products displayed on a self-service merchandiser

A comprehensive selection of CB and Amateur radio replacement parts, accessories and "step-up" items are offered in a new CB Accessories Program introduced by GC Electronics. Merchandising Program No. 49-810 features over 60 different products displayed on a self-service, 4 ft. by 4 ft. floor merchandiser. Among the items featured in the program are power



base and mobile unit microphones, dual power SWR meters, noise filters and suppressors and a specially selected assortment of microphone and antenna plugs and connectors. Also available is a colorful CB Accessories catalog that illustrates and describes the entire GC Citizens Band equipment line.

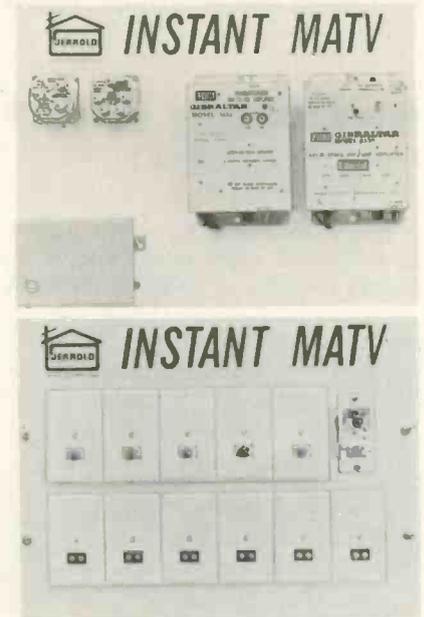
MATV SYSTEM DISPLAY

714

Helps distributors and dealers explain instant MATV

As an aid to merchandising their newly developed Instant MATV, Jerrold Electronics has developed a compact portable display. Mounted on one display board are a choice of head-end amplifiers—a 4330 all-channel Gibraltar, a 3455 Gibraltar for VHF areas, and a TAC-81 all-channel amplifier for small systems. Two splitters, a model 1597 4-way splitter and a model

1596A 2-way splitter, are mounted on the display. The other plexiglass display board holds 12 Jerrold OMNI-TAP tap-offs, completely wired with attenuators simulating cable losses. The dealer or distributor salesman who uses the display can easily connect it to any good antenna and TV



set for a simple Instant MATV demonstration. He can show the prospect that picture quality at any OMNI-TAP and the end of the MATV feeder line is equal to pictures obtained from one set connected directly to the antenna. He can also show the effect of varying the isolation of the OMNI-TAPs which are screwdriver adjustable from 12 to 25 dB isolation. Jerrold Instant MATV makes available a selection of factory pre-engineered MATV systems that require no customer calculations.

VHF HIGH BAND MONITOR/RECEIVER

715

Automatically locks in on emergency broadcasts

Channel Master has introduced the Model 6258, VHF/High Band Monitor and Receiver. It is a hand-held, four-channel scanner that automatically searches for and locks in on emergency broadcasts. The crystal-controlled unit is designed to receive frequencies used by fire and rescue workers. It can be set to bypass unwanted channels, or locked into a single preferred channel. Channel selection may be manual or automatic. A squelch control quiets unwanted background noise as the receiver scans for signals. Other features include indicator lights for each channel, a belt clip for hands-free carrying, an AC adapter jack, and a charging jack. The scan-

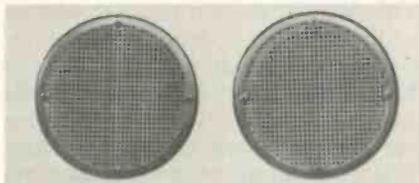


ner operates on four penlight cells, and an AC recharger/adapter is available. The audio output is 300 milliwatts; frequency range is 150-170 MHz. The unit measures 6 inches by 2¾ inches by 1½ inches. Price is \$119.95.

STEREO SPEAKER SET 716

Especially suitable for flush-mount installation

An economy model stereo speaker set is introduced by RCA to sell at a moderate price, making it especially suitable for low-cost installations.



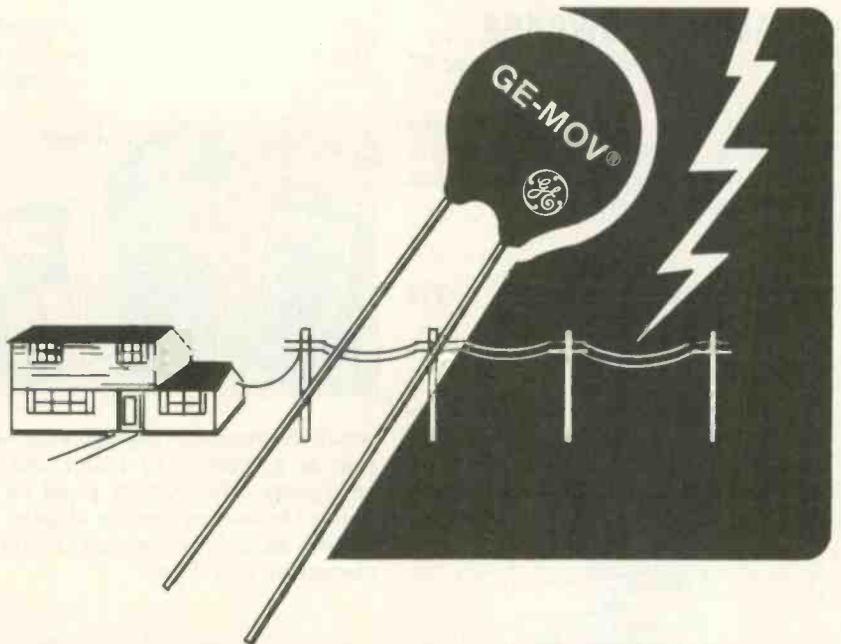
These speakers are especially suitable for flush-mount installation in confined areas such as in cars, trucks, recreational vehicles and boats, as well as in walls or ceilings of homes. The stereo speaker set, Model 12R403, includes 20 feet of speaker wire, all necessary mounting hardware, and simplified installation instructions. Technical specifications are: 6½-inch grill, 5-inch speaker with 3-oz. ceramic magnet and 7600-gauss flux density, 8-ohm voice coil. The speaker is rated for 10 watts music maximum input. Price is \$7.50.

DIGITAL CLOCK 717

Changeable messages promote electronic servicing

The Tube Products Department—General Electric Co. is currently offering independent service dealers a digital clock, promoting the "Four Seasons of Electronic Servicing." One of a variety of items available in GE's new Business Aids Catalog, the clock features

continued on page 48



NOW! Protect against Transient Voltage Damage to TV, Stereo and Home Appliances with GE-MOV[®] Metal Oxide Varistors.

TV Set manufacturers know that many component failures are caused by voltage transients: lightning, voltage spikes and power surges. Now you can do something about it . . . economically.

Insert easy to install GE-MOV metal oxide varistors in component circuits and prevent damage from transient voltage once and for all. The varistor absorbs the dangerous transient and dissipates it as heat. The cost is low. The installation fast and easy. It's like offering your customers an insurance package . . . and it's an opportunity to make a profit!

Our GE-MOV program is ready and waiting. For all the facts about this addition to General Electric's growing replacement semiconductor line, see your authorized distributor.



TUBE PRODUCTS DEPARTMENT
GENERAL ELECTRIC COMPANY
OWENSBORO, KENTUCKY 42301

GENERAL  ELECTRIC

DEALER SHOWCASE . . .

continued from page 47

four full color, changeable messages promoting the servicing of color television, stereo sets and portable radios throughout the year.

NEEDLE MERCHANDISER 718

A totally self-contained selling unit

A new phonograph needle merchandiser, the NEEDLE FINDER, has been introduced by EV•GAME. The merchandiser requires only one square



foot of counter space and incorporates the simplest to use system for needle identification. Actual size and color photographs of the 77 fastest selling needles are printed on durable plastic pages, tabbed for easy reference and mounted on the merchandiser with a three-ring binder. The photographs are taken in a manner that gives the needles a third dimension appearance, and are grouped by physical characteristics which enable the user to quickly locate his needle. The unit is a complete merchandiser—colorful, compact, pilferproof and a totally self-contained merchandiser. Two programs are available—the 69-130 which consists of 69 types totaling 130 diamond needles, and the 77-347 with 77 types totaling 347 diamond needles. Both programs include many extras such as spring loaded needle drawers and storage bin, eye-catching mobile, window banner and catalog.

CONSUMER PRODUCT DISPLAYS

Features raised molded platforms and backdrops which frames the merchandise 719

Channel Master is offering dealers a variety of new, full color counter displays for its Emergency Broadcast Scanner, Telephone Answering System, and Walkie Talkies. All three units feature raised molded platforms and backdrops which dramatically "set

up" and frame the actual merchandise. The Scanner display attracts shoppers' attention with a flashing red beacon



which dramatically highlights its function as a receiver of police and fire emergency calls. A copy panel on the Phone Answering System display advertises its unique one-year instant replacement guarantee.

HEADPHONES 720

Contains a 2 1/2 inch driver in each ear piece

Panasonic has added the Model EAH-23 headphones to its popular priced line, offering features as lightweight, adjustable head bands, and ear pads which are removable for clean-



ing. The stereo headphone set contains a 2 1/2 inch driver in each ear piece for complete stereo sound reproduction. It also features separate volume controls for convenient adjustment to individual tastes. The frequency response is 20 to 20,000 Hz. Price is \$34.95.

NEEDLE AND CARTRIDGE DISPLAY 721

Displays 150 needles and 30 cartridges in standard packages

Pageant/N.A. Miller Industries introduced a merchandising display that can accommodate both phonograph needles and cartridges. It stores either 200 needles or 150 needles and 30 cartridges in standard industry packaging. Constructed of masonite and sheet metal, the merchandiser measures 16 inches by 16 inches by 10 inches. Being compact, it is ideal for

counter-top merchandising where space is at a premium. A lock, on the hinged rear panel opening, prevents pilferage. The front and rear panels of the merchandiser identify 28 of the most popular needles sold today. Life-size illustrations make it easy for consumers to match needle styles, saving considerable time for sales personnel.

CD-4 DEMODULATOR 722

Can be used with any four-channel receiver

The Marantz Co., Inc., announces the addition of the Model CD-400 Demodulator for playing of CD-4 discrete discs. It features a Phase-Lock-Loop for the 30-KHz subcarrier, and Automatic Noise Reduction System circuitry. Also included is a complete



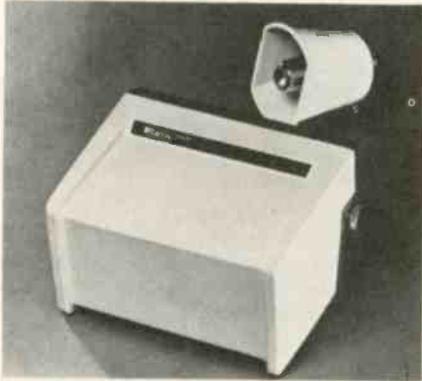
set of auxiliary four-channel inputs and a front-panel AUX pushswitch. This feature provides the user with an additional input selection for his four-channel equipment. Of importance to high fidelity listening is that the unit has its own built-in RIAA equalization network, obviating the need to drastically roll off the phono frequency response of the amplifier used with it. The demodulator can be used with any four-channel receiver. The price is \$99.95.

MOTION DETECTION SYSTEM 723

Detects motion at ranges of up to 100 ft.

A complete alarm system featuring reliable detection of moving intruders at ranges up to 100 feet has been announced by Mountain West Alarm. Volume coverage can provide floor-to-ceiling and wall-to-wall protection. For many applications the Model R4, Microwave Intrusion System can provide protection with no added equipment as it detects motion over a large area. Local alarm is provided with a distinctive yodel type electronic siren which can be heard a block away. In addition, the system provides means for connecting other detectors from doors, windows, floor mats, fire detectors, and panic switches to the same alarm. Alarm relay outputs are available for connecting the system to telephone

dialers, direct wire alarms, and audible signals. The 10.525 GHz microwave motion detection system covers a 30° angle over ranges adjustable from 0 to 100 feet. Moving intruders are detected with solid-state digital circuits that eliminate false alarms caused by random vibrations, air motion, telephone bells, etc. The system is simple to install and can be placed on a shelf or mounted permanently.



The unit is powered from AC line or 12 v DC and switches to 12 volt battery for emergency power. The unit measures 9 inches wide by 6 inches high by 7 inches deep. Price is \$369.

TWO-WAY CB RECEIVER

Features double-conversion, output for extension speaker and a tone control **724**

The Model CAM-89, CB Base Station Receiver introduced by Dynascan Corp., is all-solid-state, offering maximum legal power output, and includes a number of important features. Among these is the exclusive Cobra "DynaMike" gain control, which provides even more "talkpower" during



transmission than its predecessor Model CAM-88. In addition, it includes delta tune, to permit pulling in even slightly off-frequency transmissions with clarity; separate illuminated meters for modulation percentage and signal strength indications; switchable automatic noise limiting; RF gain control; and PA capability. The receiver also features double-conversion, output for extension speaker, and a tone control. The unit measures 5¾ inches high by 13¾ inches wide by 12¾ inches deep. Price is \$240. ■

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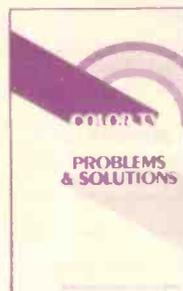
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GROUP
268

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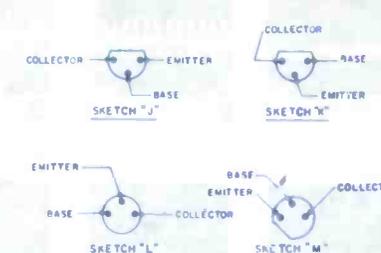
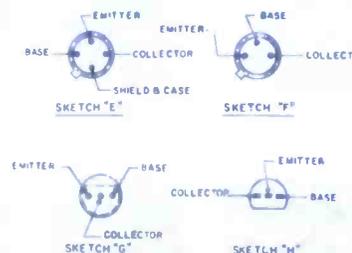
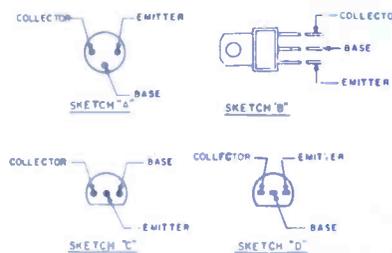
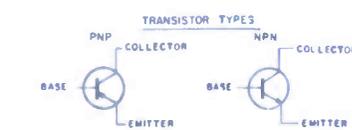
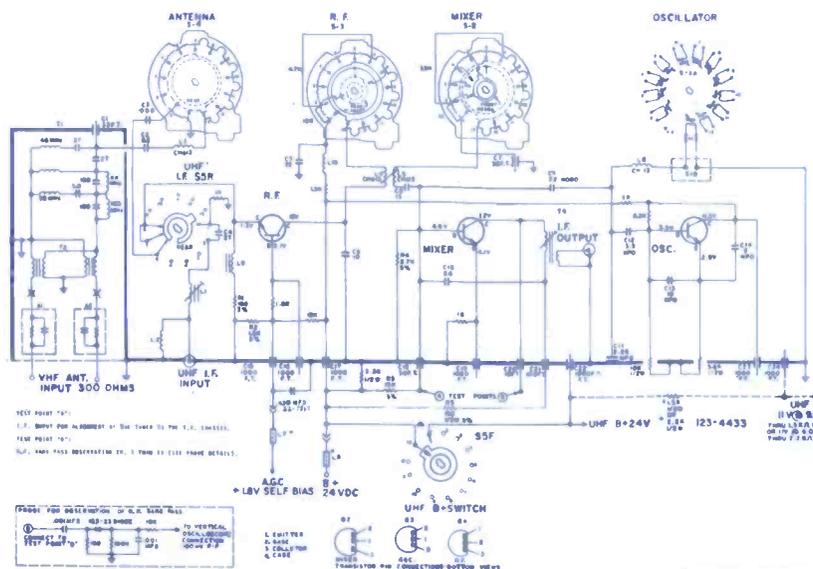
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TR3			TV17-9386A	860
T3K3-1A, T3K3-1B			TV21-9367A	1102
T3K4-1A, T3K4-1B			TV21-9643A	1094
T7H2-1A, T9H1-1A				
T9K3-1A, 1B			CURTIS MATHES	
T10H1-1AX			Chassis:	
T11K10-1A			TV-17, 17-1	1057
T15K10			TV-19-1	937
T22H4-1AX				
T28K3			DELCO	
T41K10, TK2K10			Model:	
Model:			985694 Auto Radio	833
ID4	883			
ID11	890		DUMONT	
ID13-2	883		Chassis:	
ID42-2	883		120689	891
ID61-1	903		120708	876
ID412-2	903		120712	876
ID611-1, 2, 3, 4	928		120725	891
ID760-1	928		120780	876
ID761-1	890		120783	962
ID1160-5	890		120783	962
ID1161-5	890		120804A, B	1071
IG310-1	956			
IG311-1	956			

SCHEMATIC NO.		SCHEMATIC NO.		SCHEMATIC NO.		SCHEMATIC NO.		SCHEMATIC NO.		SCHEMATIC NO.		SCHEMATIC NO.		SCHEMATIC NO.	
Z9P10	1248	M618	1030	MGA		PENNY, J. C.		RCA SALES CORP.		6152	995	B05-1, 2, 3	973	V-2490 Series	1014
35P01/35P02	1177	M638	1171	Model:		Model:		Model:		6154	995	B06-1, 2, 3	960	V-2496 Series	1023
T2L2-1A	1451	M649	1101	CM-250A, 51A, 52A	1512	1315	1320	KRK105/112, KRK112 with 96209	856	6155	995	B06-1, 2, 3, 4, 5	1108	V-2498 Series	1029
T2R2-1A	1374	M685	1123	CS-165	1520	1316A-89	1286	KRK105/KRK66 Series	856	6156	995	B09-1, 2	1122	V-2528-3 Radio	846
T8K3-1B	1442	M687	1112	CS-197	1516			RFG35 Radio	863	6157	995	B10-1, 2	1209	V-2652-2	1092
T10K10-1D, C	1336	N-1	1307					RP-215-C1 Record Player	848	6164	1000	B10-7, 12	1450	V-2655-2, 3, 4-7-8-13	1058
T25H4-1A	1446							Chassis:		7110	1486	B10-14, 17	1486	V-2655-1, 2	1121
FIRESTONE		HEATH		MOTOROLA		PHILCO-FORD		CTC16, X	885	7111	1026	B10-19	1529	V-2659 Series	1143
Chassis:		Model:		Chassis:		Model:		CTC17X	952	7114	1026	B12-1, -1	1247	V-2660	1162
12-129-94U	918	AA-21 Stereo Amp	829	TS-454	931	NT-600 Radio	867	CTC19	984	7120	1038	B13-1	1350	V-2664 Series	1157
		GR-53	839	TS-458	1107	Q1054	1113	CTC20	1032	7121	1038	B14-1	1321	V-8001	1213
GENERAL ELECTRIC		HOFFMAN		TS-460 Series	1089	Chassis:		CTC22 Series	1040	7122	1026	B15-1, 2	1455		
Chassis:		Chassis:		TS-461	1047	N1052	935	CTC25	1026	7128	1026	D01-1, -2	925	ZENITH	
AA	889	913-000366, 386	1166	TS-465	1258	N1200	932	CTC27X Series	1261	7131	1098	D01-1, -2, -8	1043	Model:	
AB	963			TS-467	1424	N1204	932	CTC28 Series	1136	7151	1098	D03, 3	987	40 Radio	857
AC	1164	KORTING		TS-584-05, -H	913	3CR40/41	1475	CTC31 Series	1144	7152	1098	D05	1024	Chassis:	
AD	1148	Model:		TS-586	904	3CS45	1542	CTC35 Series	1132	7154	1098	D06-1, -2	1091	1Y21B55	1139
AE	832	MT2233, 2243 Tape Recorder	865	TS-587	919	3CS45	1542	CTC38 Series	1237	7155	1098	D07-1, -2	1115	6KT5028 Radio	857
A-1	1191	MT3643/3633 Stereo Tape Recorder Constellation	853	TS-588	964	3CY80	1480	CTC39XAA	1319	7156	1098	D08-2	1154	8Y4B36	1145
A-2	1370			TS-589	899	3CY91	1463	CTC40	1219	7157	1098	D09-1, -2, -4	1150	12A8C14	1302
BA	1447	MAGNAVOX		TS-589	899	4B117/4B118	1500	CTC41	1314	7158	1098	D11-1, -2	1190	12A10C15	1360
C-1	1353	Chassis:		TS-592	1149	4CS71	1507	CTC43	1308	81401, 411, 421	1167	D12-20, 21	1343	12A16, M, S, Z, MZ, SZ	1360
C-2/L-2	1376	40 Series	849	TS-594	1031	4CS73	1537	CTC44 Series	1368	Chassis:		D13-2	1243	12B14C50	1441
CB	953	43 Series	835	TS-596	957	4CY90	1525	CTC46 Series	1373	456.61580	955	D14-3, 4	1301	12B15, 12B9C16	1437
DA	861	45 Series	882	TS-597	1021	14G20	855	CTC47 Series	1278	456.61581	955	D15-3, 5	1382	12CB12X	1414
DB	930	47 Series	1062	TS-599	1298	14N30	871	CTC48 Series	1444	456.70120	967	D16-2	1338	12CB12X, ZX	1559
DC	990	48 Series	912	TS-611	1196	14N50	862	CTC49	1342	456.70121	967	D17-1, 2	1413	1M30T20	977
DD	1075	49 Series	901	TS-612A	1203	15G20	905	CTC50 Series	1381	528.61580	955	D18-1, 2, 3	1423	13A12	1325
D1	1214	T907 Series	981	TS-613	1232	15J25	1007	CTC51, 52	1436	528.61581	955	D19-1, 2, 3	1388	13M15	923
D2	1345	T908 Series	993	TS-908C-02 to D-02	924	15M91	898	CTC53 Series	1487	528.70120	967	D19-10	1034	13X15	1034
ETV	1046	T910 Series	985	TS-912A	819	15N30	914	CTC54	1440	528.70121	967	E01-1, 2, 11, 12	1322	13Y12	1086
ETV-1A	1265	T911 Series	1088	TS-914A-00 to A-07	951	15N50	921	CTC55 Series	1378	528.70122	967	E02-1, 2	1453	13Y16, Z	1246
FY	866	T914 Series	954	TS-921 Series	1142	16J27	980	CTC59 Series	1408	528.71150	1133	E05	1484	13Z12, 13Z12S	1228
G-1	1156	T915 Series	1181	TS-924B, C	1225	16JT26, A	96E	CTC60 Series	1466	528.72280	1114	E06-1	1521	13Z13	1187
H-1	1173	T916 Series	1140	TS-929	1363	16N35	971	KCS136M	1008	528.72281	1114	E09-1, E10-1	1557	14A9C29	1309
H-2	1236	T917 Series	1186	TS-930 Series	1260	16NT82	1017	KCS136M Series	1161	528.72282	1114	406-3 Stereo	859	14A10C29	1308
H-3	1318	T919 Series	1012	TS-931	1517	16QT85	1017	KCS136X	879	528.72500	1160	577, 1, 2	851	14B36	1334
H-4	1406	T920 Series	1103	TS-934 (Late prod.)	1296	17C21, A, V, AV	1099	KCS142	834	529.61580	955	584-1 thru 7	933	14B38Z, 39Z	1355
HB	1011	T921 Series	1059	TS-938	1395	17J25, 27A	1084	KCS143F	906	529.61581	955	585-1, 2, 4, 5	922	14CC14Z	1418
HD/H4	1470	T922 Series	1079	TS-938 (Additional Information)	1419	17J28	1096	KCS144E	998	529.70120	967	14DC15, 16	1449	14L20	842
JA	1432	T923 Series	1076	TTS-587	919	17KT50	1017	KCS147A, B	786	562.10096	972	14L25	838	14M20	893
KC	1037	T924 Series	1135	VTS-587	919	17N35	1049	KCS148	927	564.10000	972	14M21	1054	14M22	876
KD	1141	T925 Series	1135	MUNTZ		17NT45	1078	KCS149AA, AB, AD	942	564.10003	972	14M23	876	14M27	916
KE	1474	T926 Series	1111	Chassis:		18CT24	1305	KCS151A	917	564.10000	988	14M32	934	14M33	934
KE-II/EB	1474	T927 Series	1158	T68A14	940	18J32	1151	KCS152A	915	564.10003	988	14N22	1001	14N26	956
L-T2	1469	T928 Series	1311	T68A15	940	18L33	1130	KCS153	959	564.10002	988	14N27	1080	14N28	1010
MA	1528	T929 Series	1200	T68H28	947	18L43	1137	KCS154A, B	948	564.10003	988	14N29	969	14N29Z	1067
MJA	1412	T930 Series	1200	OLYMPIC		18NT45	1125	KCS155	966	564.10004	988	14N31	986	14X21	1039
N-1	1412	T931 Series	1224	Model:		18Q785/18MT70	1118	KCS156	1019	564.10005	988	14Y21Z	1168	14Y33	1163
N-2	1357	T932 Series	1200	3P70	1430	19FT60B	1277	KCS157 Series	1116			14Z21, 14Z21Z	1252	14Z37	1216
N-3	1195	T933 Series	1283	6P28, 6P29, 6P30	992	19HT15	1250	KCS158 Series	1119	SONORA		14Z38, 14Z43	1240	15M22	908
P-1	1485	T934 Series	1283	9P44, 45, 46	1275	19K T40B	1242	KCS161	1022	563P197	852	15Y6C15	1174	UNITED SCIENTIFIC LABS	
QB	1550	T935 Series	1285	9P54	1275	19K T50/50B	1207	KCS162	1028	563P197	852	16EB12X, ZX	1548	Model:	
R-1	1485	T936 Series	1341	9P94 Series	1379	19L21	1233	KCS163 Series	1065	S64K236M	989	16N24	1006	Contact 23 CB Transceiver	986
R-2	1435	T937 Series	1341	CT-910	1064	19P22	1226	KCS164	1050	S65P198	1060	16N24	1006	VOICE OF MUSIC	
R-2 (Late prod.)	1539	T938	1206	9P56, 57, 58	1095	19P22	1226	KCS165 Series	1104	Chassis:		725 Tape Recorder	850	WESTERN AUTO	
SA	911	T939	1271	9P59, 60	1090	19Q785R	1197	KCS168 Series	1175	1194-194	869	Model:		4DC7260A Tape Recorder	840
SB	939	T940	1254	9P90/9P91	1245	20HT70	1332	KCS169 Series	1192	SONY		WESTINGHOUSE		Model:	
SC	1018	T941	1344	Chassis:		20HT71	1332	KCS170 Series	1192	Model:		H-883N29 Radio	846	Chassis:	
S-2	1155	T942	1349	CTC-19/21 Series	1077	20P22	1299	KCS171 Series	1198	KV-1500	1547	Chassis:		V-2444-1, 2, 3, 9, 10	837
S-3	1393	T943	1349	CTC-31	1231	20Q74	1358	KCS172 Series	1385	KV-1722	1501	V-2474-1, 2, 3, 6, 7	875	V-2474-1, 2, 3, 6, 7	846
TA	881	T944 (Late prod.)	1364	CTC-1940	1218	20Q75	1372	KCS173 Series	1180	KV-1730R	1561	V-2475-1, 4	900	V-2475-1, 4	900
TB	1004	T946 (Late prod.)	1359	CTC-400	1255	20R27	1276	KCS174 Series	1182	KV-5000	1545	V-2476-1, 4	900	V-2476-1, 4	900
TC	1048	T947	1458	NDP	1013	20S230AV	1422	KCS175 Series	1204	SYLVANIA		V-2483-1	907	V-2483-1	907
T-5	1257	T948	1297	NEC	1365	20S32/A	1293	KCS176 Series	1269	Model:		V-2495-11	1053	V-2495-11	961
T-6	1544	T949	1310	PACKARD BELL		20T33	1287	KCS177 Series	1251	6122	1009	V-2496 Series	986	V-2496 Series	986
UB	1534	T950	1328	Model:		20T33	1287	KCS178 Series	1270	6150	995	V-2487 Series	1002	V-2487 Series	1002
U-1	1398	T951	1323	MSJ-202	1134	20V35	1253	KCS179 Series	1340	6151	995				
U1/UA	1459	T952	1433	MSJ-204	1134	21HT15	1434	KCS183	1331						
VB	979	T953	1377	Chassis:		21K T41	1367	KCS184A	1315						
V-2	1263	T954	1407	88-16	877	21L23A	1439	KCS185	1339						
W-1	1478	T955	1407	88-18C	941	21ST31V	1438	KCS186	1404						
YA	1556	T956	1392	88-19	970	21ST90, 91	1437	KCS187	1482						
9SF	1464	T957 Series	1407	98C15	1083	22LT45/R	1401	KCS188	1410						
10HE	1511	T958	1420	98C17	1131	22QT79	1396	KCS191	1472						
10QA	1506	T959	1420	PANASONIC				RC-1216 Radio	863						
12SE/15SE/S3	1473	T960	1425	Model:				RS-206-A Record Changer	868						



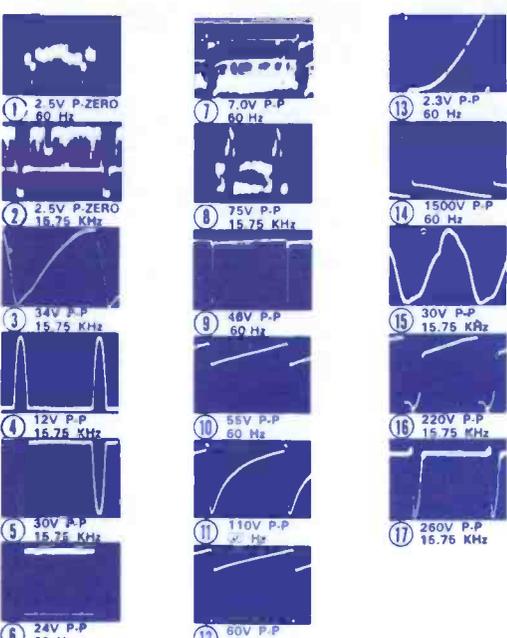
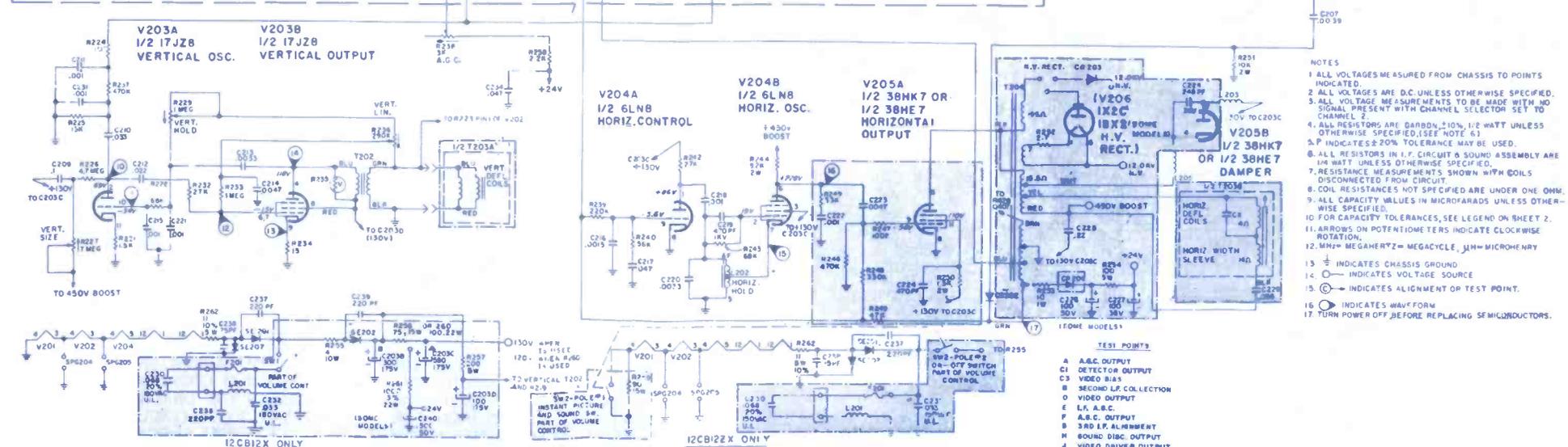
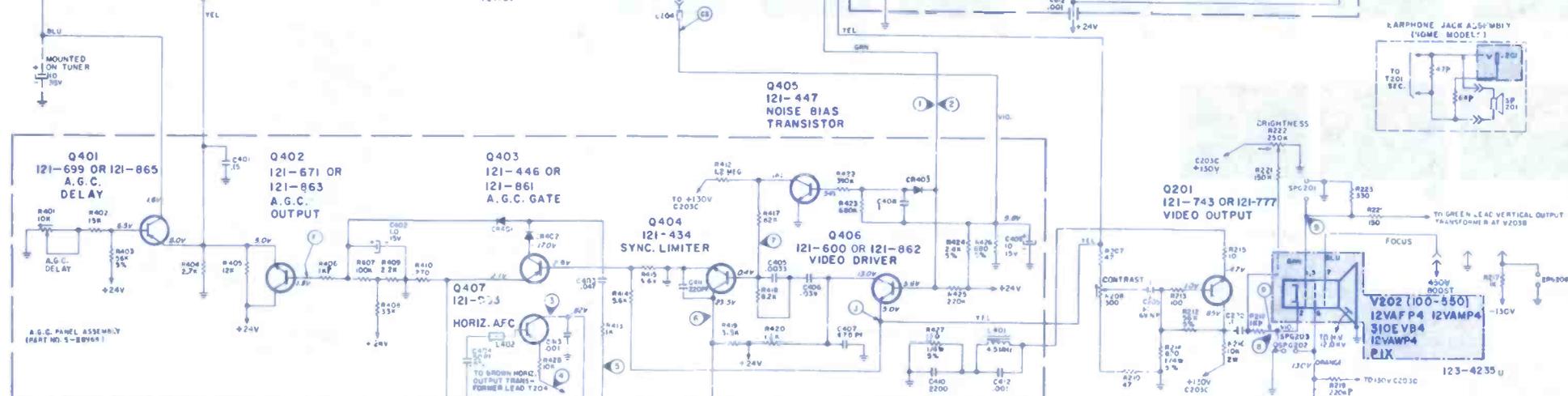
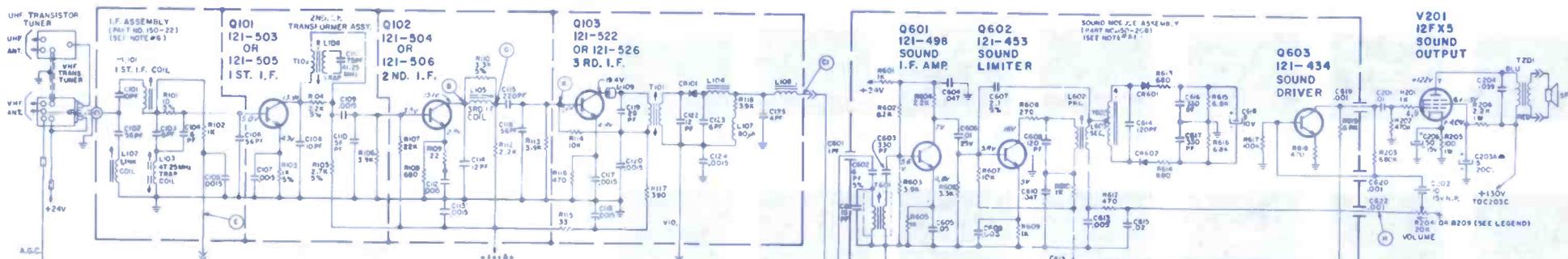
TEST POINT #1
UHF INPUT FOR SUBSTITUTION BY THE USER TO THE UHF ANTENNA
TEST POINT #2
UHF ANTENNA INPUT FOR SUBSTITUTION BY THE USER TO THE UHF ANTENNA



- NOTES:
1. ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED.
2. ALL VOLTAGES ARE DC UNLESS OTHERWISE SPECIFIED.
3. ALL RESISTORS ARE 1% TOLERANCE UNLESS OTHERWISE SPECIFIED.
4. ALL CAPACITORS ARE 5% TOLERANCE UNLESS OTHERWISE SPECIFIED.
5. ALL CAPACITORS ARE MICROFARADS UNLESS OTHERWISE SPECIFIED.
6. ALL CAPACITORS ARE MICROFARADS UNLESS OTHERWISE SPECIFIED.
7. ALL CAPACITORS ARE MICROFARADS UNLESS OTHERWISE SPECIFIED.
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11. ALL CAPACITORS ARE MICROFARADS UNLESS OTHERWISE SPECIFIED.
12. ALL CAPACITORS ARE MICROFARADS UNLESS OTHERWISE SPECIFIED.

SYMBOL DESCRIPTION ZENITH PART NO.

- C203—A-5µf electro cap 200v
- B-300µf electro cap 175v
- C-550µf electro cap 175v
- R208—300n contrast control
- R209—20K volume control
- R227—7M vert size control
- R229—1M vert hold control
- R235—voltage dependent resistor
- R236—290K vert lin control
- R238—3K AGC control
- R401—10K AGC delay control
- L103—47.25MHz trap coil
- L104—41.25MHz trap part of T102
- L202—horiz hold
- T201—audio output xformer
- T202—vert output xformer
- T204—horiz sweep xformer, use with CR203
- T602—ratio detect winding assembly
- F201—fuse 1.8a 3 AG pigtail



- NOTES:
1. ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED.
2. ALL VOLTAGES ARE DC UNLESS OTHERWISE SPECIFIED.
3. ALL VOLTAGE MEASUREMENTS TO BE MADE WITH NO SIGNAL PRESENT WITH CHANNEL SELECTOR SET TO CHANNEL 2.
4. ALL RESISTORS ARE CARBON, 1%, 1/4 WATT UNLESS OTHERWISE SPECIFIED (SEE NOTE #1).
5. P. INDICATES ±20% TOLERANCE MAY BE USED.
6. ALL RESISTORS IN I.F. CIRCUIT & SOUND ASSEMBLY ARE DISCONNECTED FROM CIRCUIT.
7. RESISTANCE MEASUREMENTS SHOWN WITH COILS DISCONNECTED FROM CIRCUIT.
8. COIL RESISTANCES NOT SPECIFIED ARE UNDER ONE OHM.
9. ALL CAPACITY VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
10. FOR CAPACITY TOLERANCES, SEE LEGEND ON SHEET 2.
11. ARROWS ON POTENTIOMETERS INDICATE CLOCKWISE ROTATION.
12. MHz= MEGAHERTZ= MEGACYCLE, µM= MICROHENRY
13. ⊕ INDICATES CHASSIS GROUND
14. ⊖ INDICATES VOLTAGE SOURCE
15. ⊙ INDICATES ALIGNMENT OR TEST POINT.
16. ⊕ INDICATES WAVE FORM
17. TURN POWER OFF BEFORE REPLACING SEMICONDUCTORS.

- TEST POINTS
A A.G.C. OUTPUT
C1 DETECTOR OUTPUT
C3 VIDEO BIAS
B SECOND I.F. COLLECTION
D VIDEO OUTPUT
E L.F. A.G.C.
F A.G.C. OUTPUT
G 3RD I.F. ALUMINUM
H SOUND DISC. OUTPUT
J VIDEO DRIVER OUTPUT
K 3RD I.F. BASE

1560

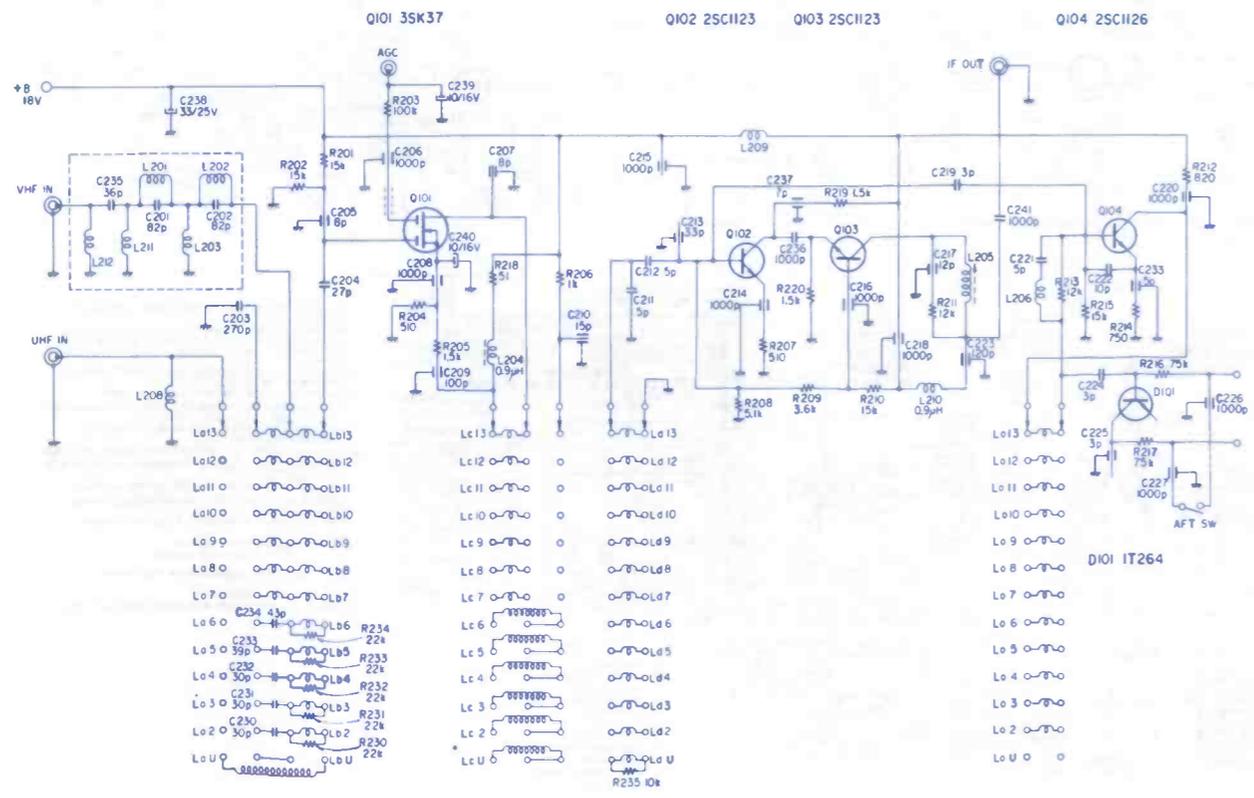
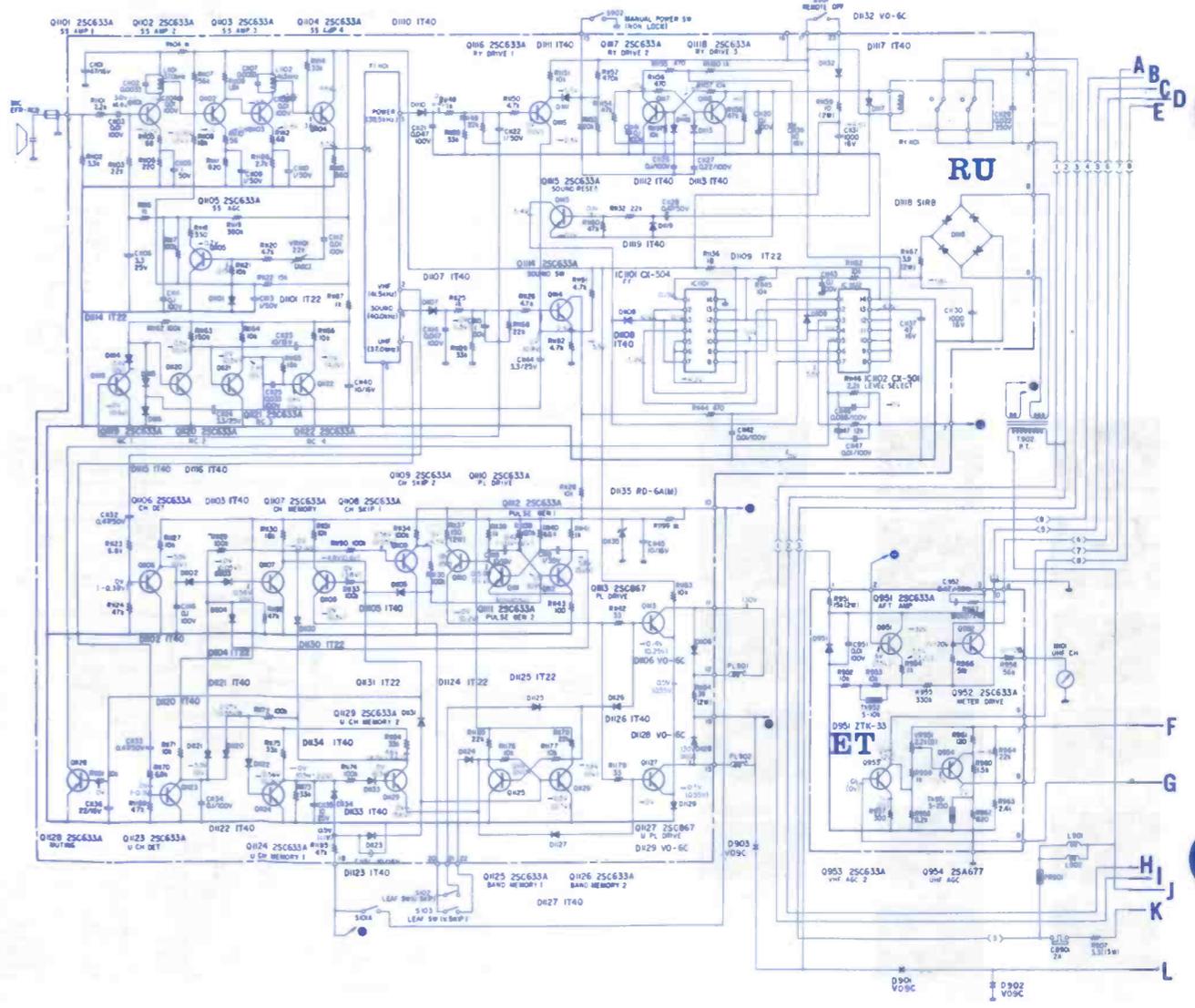
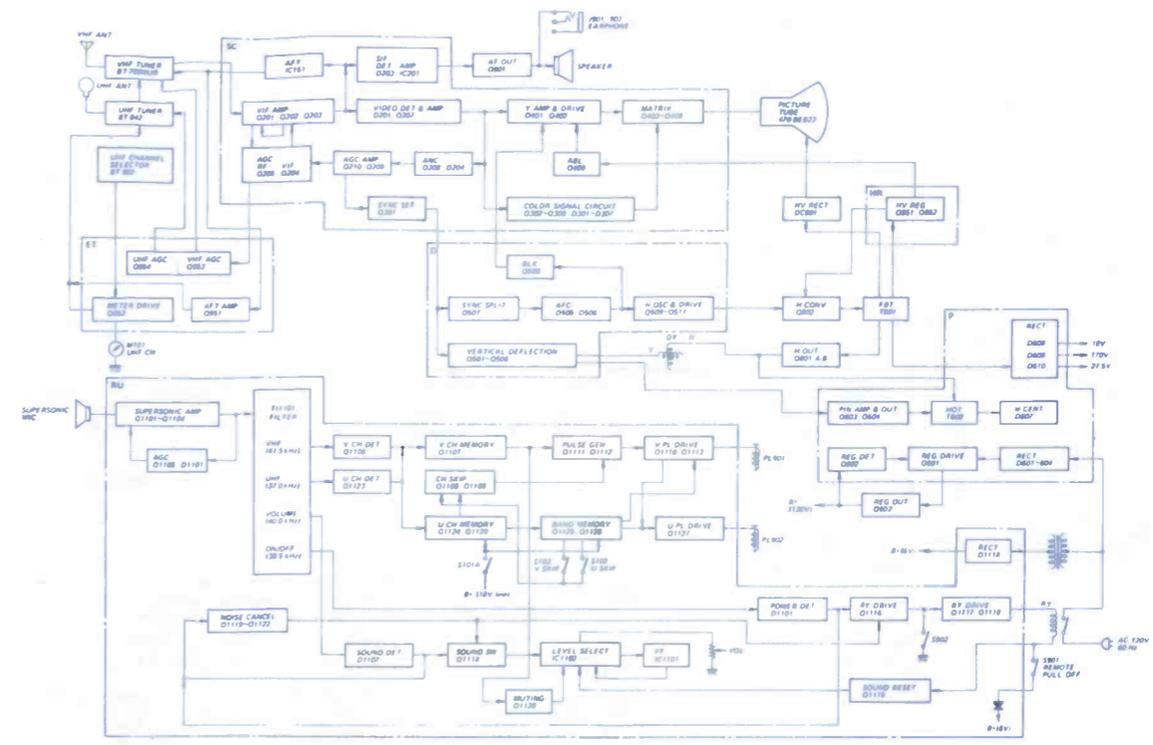
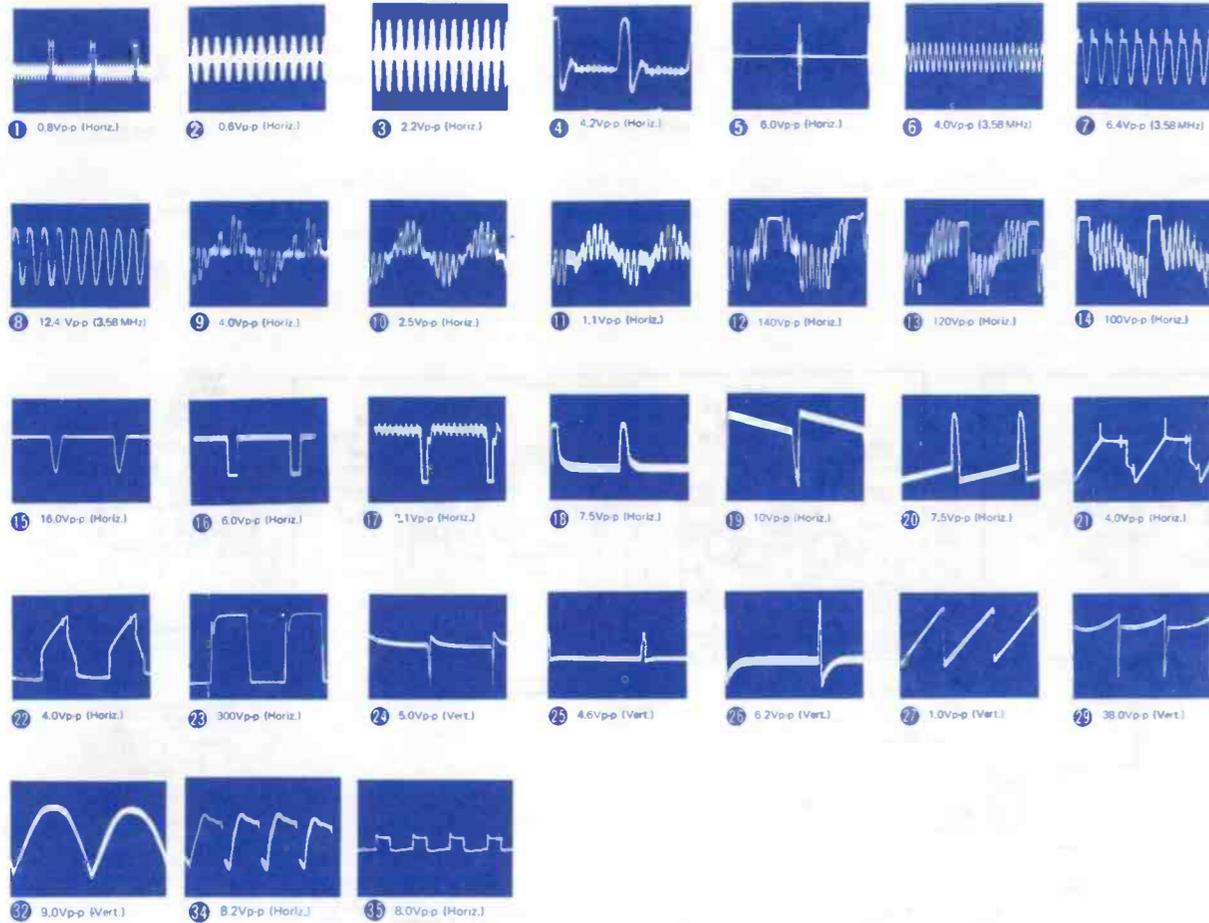
SONY

Color TV Model KV-1730R

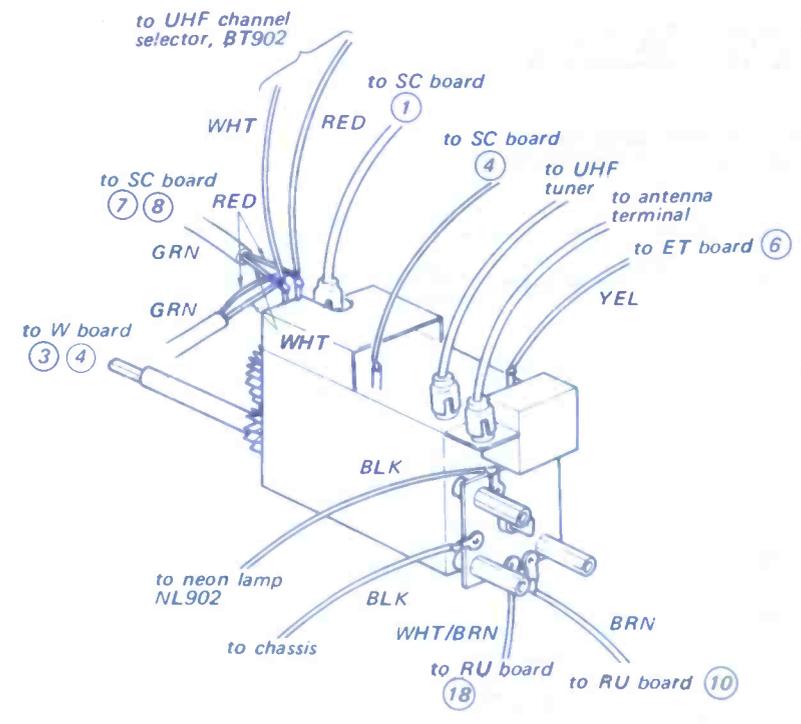
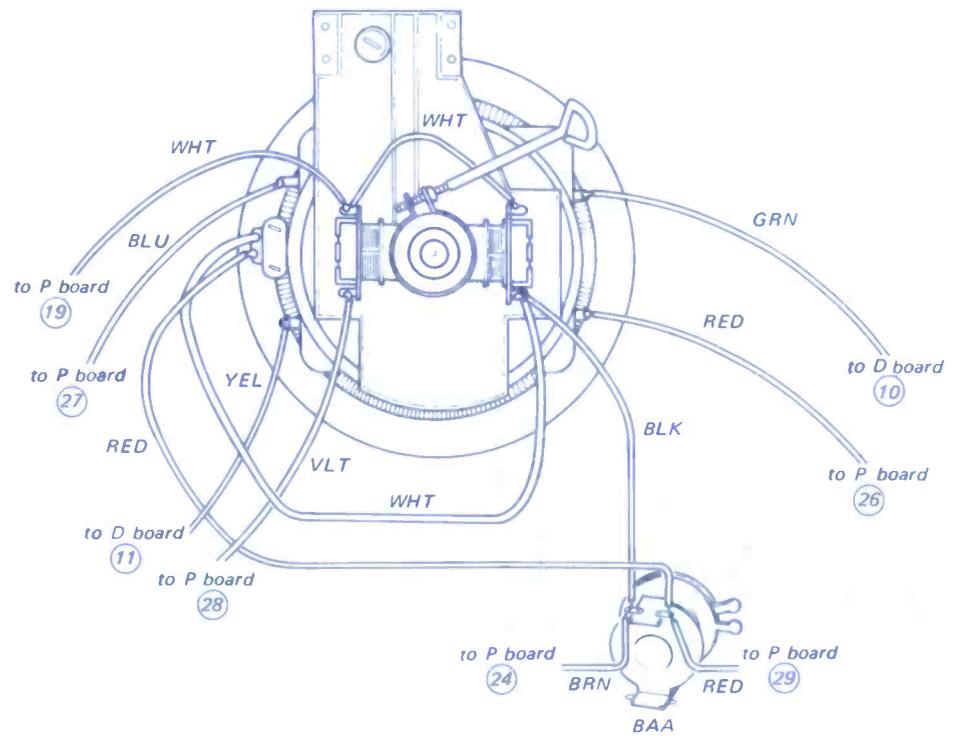
ELECTRONIC TECHNICIAN/DEALER **TEKFAK**

DECEMBER • 1974

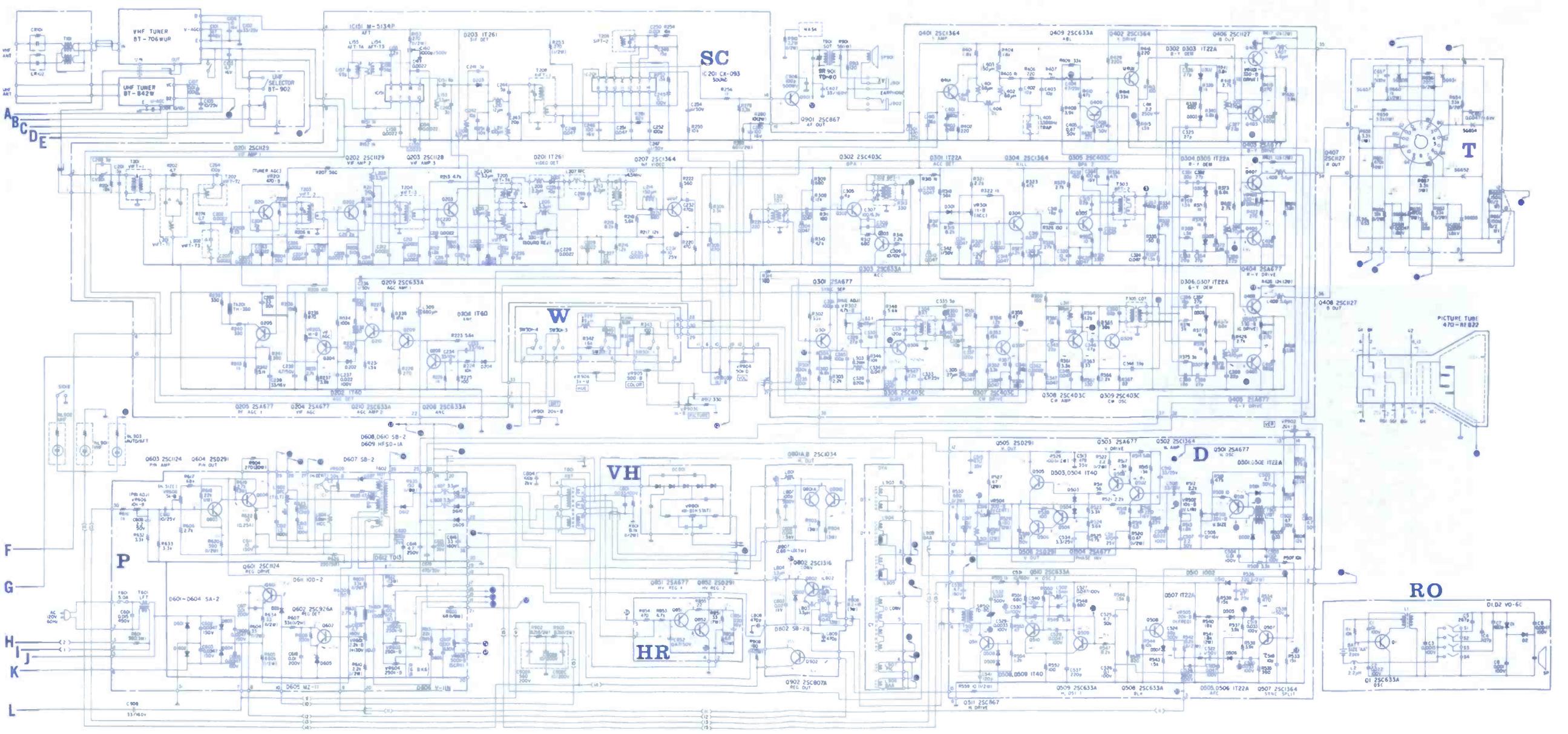
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 4 NEW SETS

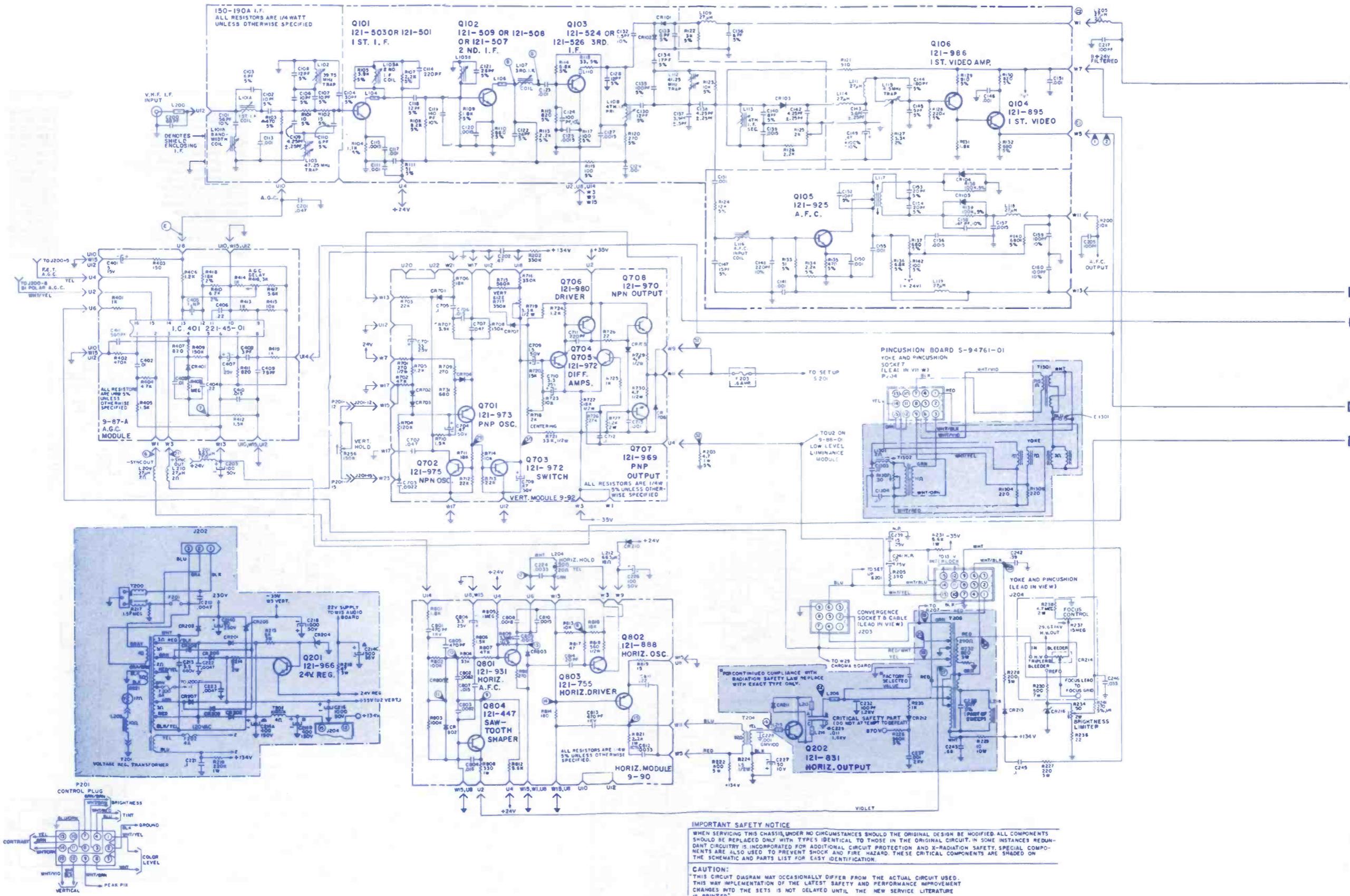


SONY
Color TV Model
KV-1730R



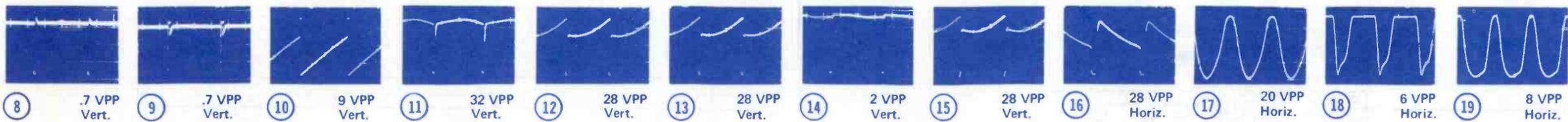
SYMBOL	DESCRIPTION	SONY PART NO.
L604	coil, horiz centering	1-459-056-00
L903	deflect yoke	1-451-069-63
T304	x-former, burst amp	1-405-372-00
T501	x-former, vertical osc	1-435-008-00
T502	x-former, horiz drive	1-437-028-00
T602	x-former, horlz output	1-439-078-00
T801	x-former assembly, flyback	1-439-120-13
T901	x-former, sound output	1-427-307-00
T902	x-former, power	1-442-020-00
VR902	20-k-B, vertical	1-222-388-00
VR903	1-k-B, picture	1-222-383-00
VR904	50-k-D volume	1-224-124-00
VR905	500-B color	1-222-386-00
VR906	3-k-U hue	1-222-387-00
VR951	2.2-k-B UHF AGC	1-222-785-00
VR1101	22-k-B SS AGC	1-222-786-00
CB901	circuit breaker	1-515-144-31
F601	fuse 5a	1-532-214-00





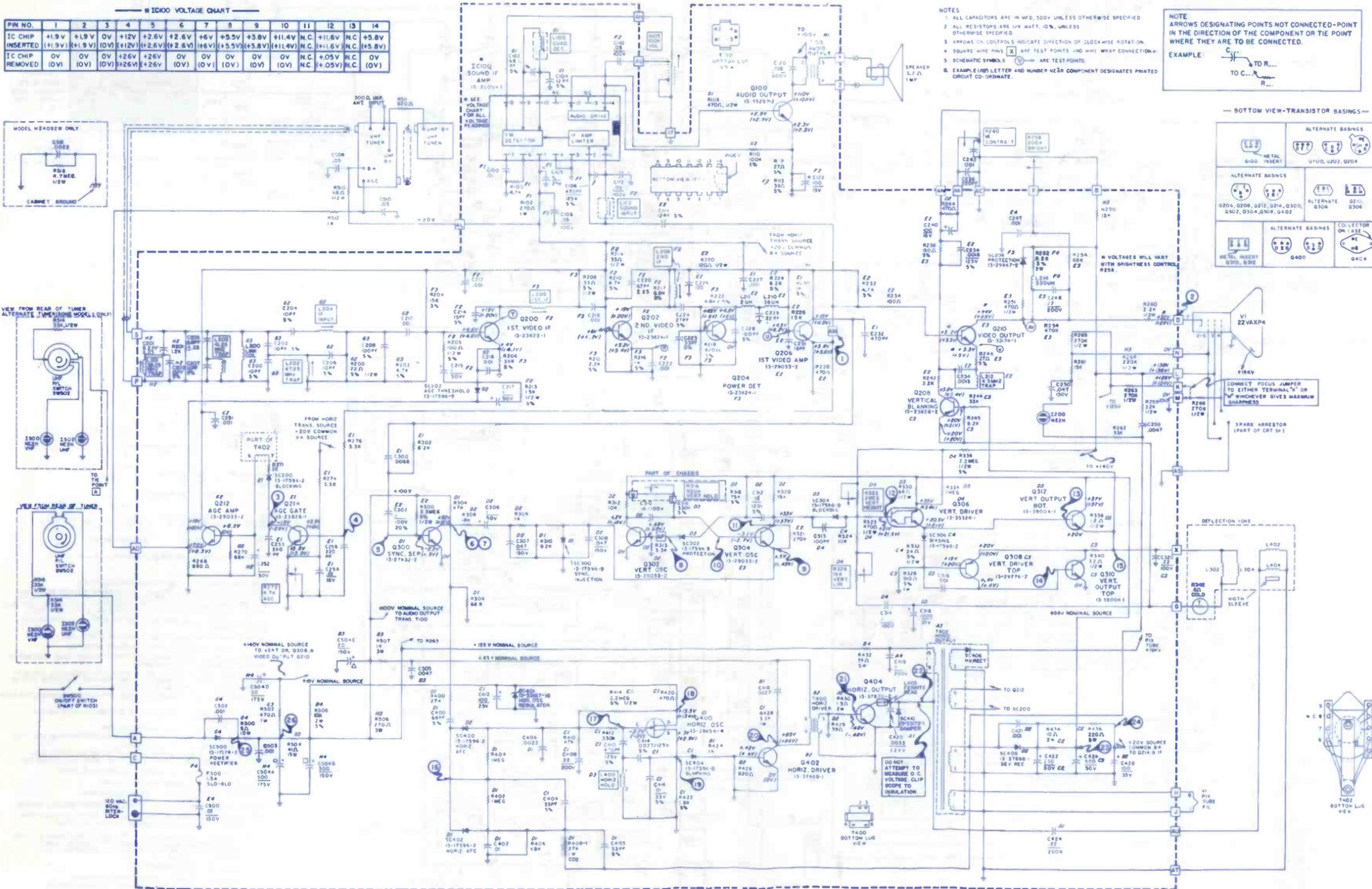
IMPORTANT SAFETY NOTICE
 WHEN SERVICING THIS CHASSIS UNDER NO CIRCUMSTANCES SHOULD THE ORIGINAL DESIGN BE MODIFIED. ALL COMPONENTS SHOULD BE REPLACED ONLY WITH TYPES IDENTICAL TO THOSE IN THE ORIGINAL CIRCUIT. IN SOME INSTANCES REDUNDANT CIRCUITRY IS INCORPORATED FOR ADDITIONAL CIRCUIT PROTECTION AND X-RADIATION SAFETY. SPECIAL COMPONENTS ARE ALSO USED TO PREVENT SHOCK AND FIRE HAZARD. THESE CRITICAL COMPONENTS ARE SHADED ON THE SCHEMATIC AND PARTS LIST FOR EASY IDENTIFICATION.

CAUTION:
 THIS CIRCUIT DIAGRAM MAY OCCASIONALLY DIFFER FROM THE ACTUAL CIRCUIT USED. THIS WAY IMPLEMENTATION OF THE LATEST SAFETY AND PERFORMANCE IMPROVEMENT CHANGES INTO THE SETS IS NOT DELAYED UNTIL THE NEW SERVICE LITERATURE IS PRINTED.



— H IC100 VOLTAGE CHART —

PIN NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC CHIP INSERTED	+1.9V (+1.9V)	+1.9V (+1.9V)	OV (OV)	+12V (+12V)	+2.6V (+2.6V)	+2.6V (+2.6V)	+6V (+6V)	+5.5V (+5.5V)	+3.8V (+3.8V)	+11.4V (+11.4V)	N.C. (N.C.)	+11.6V (+11.6V)	N.C. (+5.8V)	+5.8V (+5.8V)
IC CHIP REMOVED	OV (OV)	OV (OV)	OV (OV)	+26V (+26V)	+26V (+26V)	OV (OV)	OV (OV)	OV (OV)	OV (OV)	OV (OV)	N.C. (N.C.)	+0.5V (+0.5V)	N.C. (OV)	OV (OV)



NOTES

1. ALL CAPACITORS ARE IN MFD, 500V UNLESS OTHERWISE SPECIFIED.
2. ALL RESISTORS ARE 1/4 WATT, 10%, UNLESS OTHERWISE SPECIFIED.
3. ARROWS ON CAPACITORS INDICATE DIRECTION OF CLOCKWISE ROTATION.
4. SQUARE WAVE PINS ARE TEST POINTS AND HAVE WIRE CONNECTIONS.
5. SCHEMATIC SYMBOLS ARE TEST POINTS.
6. EXAMPLE: (PIN LETTER AND NUMBER NEAR COMPONENT DESIGNATES PRINTED CIRCUIT CO-ORDINATE).

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

EXAMPLE: TO C... TO R... TO C... TO R...



Jim is one of the busiest antenna installers in Pennsylvania. He does work for 17 major appliance dealers. But the bulk of his antenna sales come from his own advertising, yellow page listings and word-of-mouth recommendations from satisfied customers.

Jim doesn't try to be the cheapest — only the best. He stresses quality of workmanship plus quality of materials. With this philosophy and a lot of hard work, Action Sales has doubled sales volume each of the four years since Jim started the business.

"My reputation means everything to me," says Jim. "That's why I'm so delighted with the performance and durability of the Jerrold Super VU-Finder line. My customers aren't much interested in the technical specifications. But, they do want excellent color quality without interference and no problems from their antenna. And that's what Super VU-Finder delivers."

For more information on the Super VU-Finder line, contact your local Jerrold Distributor or ...

JERROLD ELECTRONICS CORPORATION
Distributor Sales Division
P.O. Box 350
200 Witmer Road, Horsham, Pa. 19044

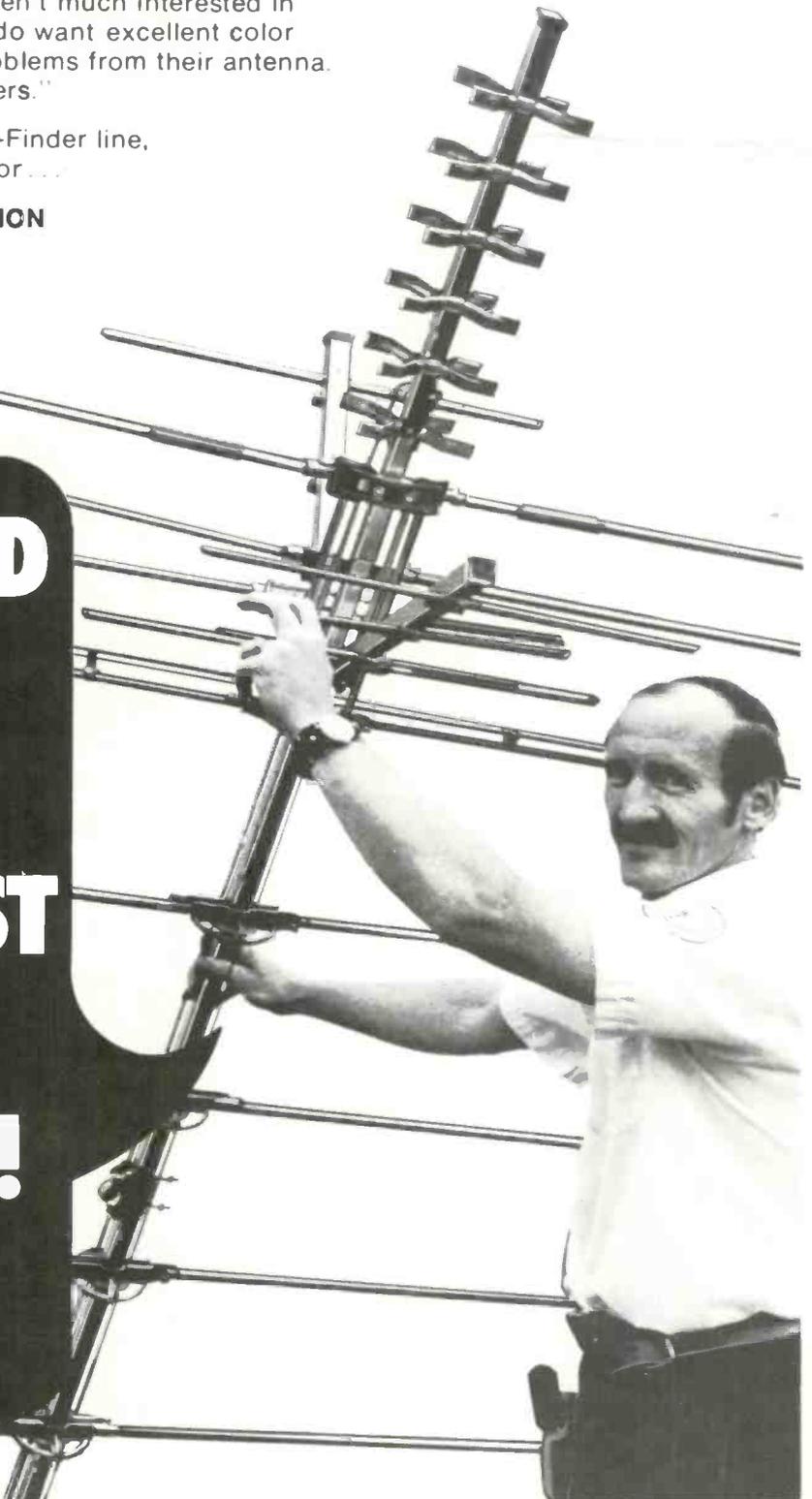
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a GENERAL INSTRUMENT company

**THE JERROLD
SUPER
VU-FINDER
IS THE FINEST
ANTENNA
EVER BUILT!**

**SAYS JIM WELLENER
ACTION SALES
FEASTERVILLE, PA.**



The reader that can stay on, and on, and on. The 603.

The price of the Model 603 V-O-M is only \$173.

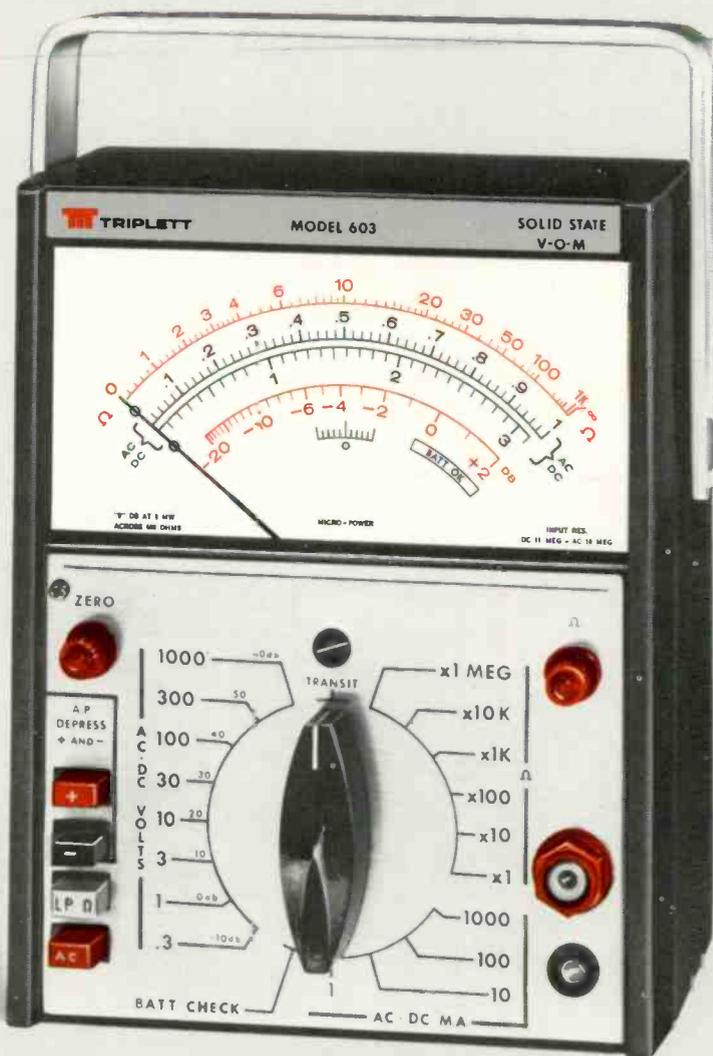
The one V-O-M you can forget about forgetting to turn off. The incredible Model 603 FET V-O-M with exclusive Triplet Micro-Power™ draws only 10 uA, can stay on indefinitely without impairing performance. Ideal wherever frequent test changes, interruptions, distractions—or gremlins—keep your V-O-M working when you're not.

Truly outstanding features:

1. Exclusive Triplet Micro-Power (TMP™) provides battery life in excess of a year for carbon batteries with unit left on continuously 24-hours a day.
2. Low-Power Ohms (LPΩ™)—6 ranges with 70 mV power source for in-circuit measurements without damage to components.
3. FET V-O-M with Patented Auto-Polarity—convenient and time-saving, always reads up scale.

Accurately measures electric and electronic circuits on production lines, in quality testing, during maintenance, in service shops and on calls, in the laboratory or classroom, in the field.

One range selector switch operates the unit. One probe handles all functions—AC, DC, MA, Ohms—and a simplified scale utilizes only 4 arcs for all 44 ranges. The Low Power Ohm circuit permits fast circuit measurements without biasing semiconductor device junctions. The



Model 603 also has a unique, Patented Auto-Polarity circuit: push a button, measure either plus or minus voltages without switching leads. Make very fast voltage checks where polarity is known or doesn't matter.

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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