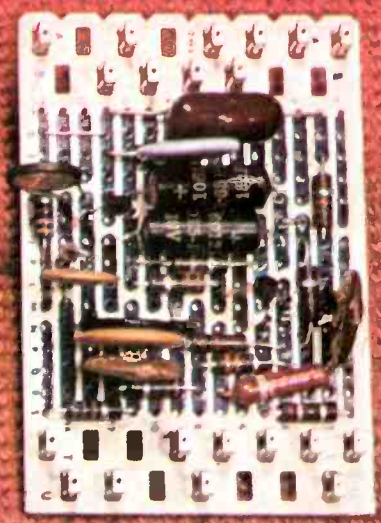
DECEMBER, 1969 ☐ 75 cents

A HOWARD W. SAMS PUBLICATION

Electronic Servicing

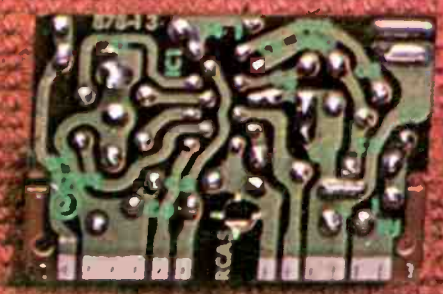
Formerly PF Reporter

Solid State Makes Gains in '70 Chassis, page 54



Two approaches to service pricing, page 10

Consumer Electronic Servicing, 1969—A Perspective, page 24



Put your parts in order.

All it takes is genius to arrive at simplicity. This new display stand is deceiving. It's more than a display stand. It's set up to operate like a store within your store for instant servicing.

Here, within this unit, is a complete stock of all the wide range twist prongs you'll need plus micas, miniature electrolytics, ceramics, wide range tubulars and dipped paper Mylar.* The selection was based on an extensive study of all capacitors used in the replacement market. Now, with the Re-Place, you're in the capacitor replacement business. The Re-Place only takes 2′ x 5′ in space and you have all your parts in order.

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CDE CORNELL-DUBILIER

Circle 1 on literature card

*DuPont Trademark

Six money-making reasons why Zenith's new CHROMACOLOR is the easiest color TV in history to service!

1

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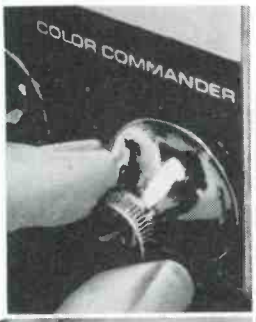
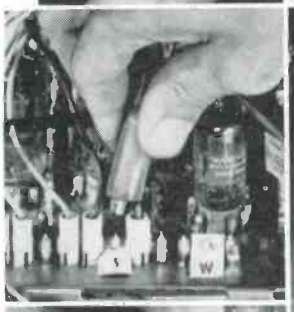


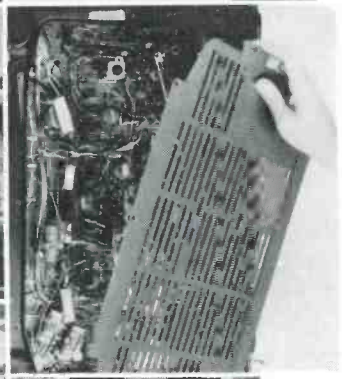
2

ADVANCED SIMPLIFIED CIRCUITRY. Zenith's Chromatic Brain in the exclusive Zenith solid-state Dura-Module has the first integrated circuit ever used to produce a color TV picture. It incorporates the equivalent of 19 transistors, 2 diodes and 24 resistors. And it plugs in easily!

3

TEST POINTS FLAGGED AND CODED. Easily seen numbers and flags identify chassis check points. They help you make a fast, accurate diagnosis. No "road map" needed.



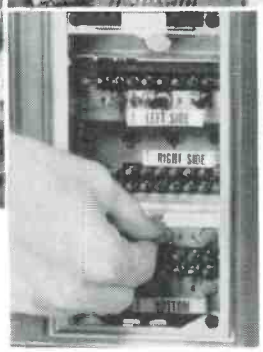


4

EASY ACCESSIBILITY TO ALL CHASSIS PARTS. Zenith's quickly removable "Easy Service" plate and horizontal chassis layout permit easy access and faster servicing. Up to 90% of the circuitry is accessible even with the chassis remaining in the cabinet.

5

PLUG-IN TRANSISTORS AND MODULES. In Zenith Chromacolor, all transistors are either plug-in or part of a module. And every module is a plug-in.



6

SIMPLIFIED ADJUSTMENT. Initial adjustment is easier. Zenith's easy-access front-mounted convergence panel assembly helps make adjustment quicker and more accurate.

ZENITH®

The quality goes in before the name goes on

Circle 3 on literature card

Electronic Servicing

Formerly PF Reporter

in this issue...

DEPARTMENTS

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Robert E. Hertel, Publisher

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FOR THE PROTECTION OF ALL TYPES OF ELECTRONIC & ELECTRICAL CIRCUITS & DEVICES

The complete BUSS line of fuses includes dual-element "slow-blowing," single-element "quick-acting" and signal or visual indicating types . . . in sizes from 1/500 amp. up—plus a companion line of fuse clips, blocks and holders.

Only a representative listing is shown here of the thousands of different types and sizes of fuses and holders available from BUSS.

You don't have to stock any other line when you handle BUSS fuses and fuseholders, because BUSS has the complete line to cover every requirement. Making BUSS your single standard line will save you time and trouble and money.

And if you're faced with a special requirement, call in the nearest BUSS representative. He's backed up by a staff of fuse engineers who can get the job done.

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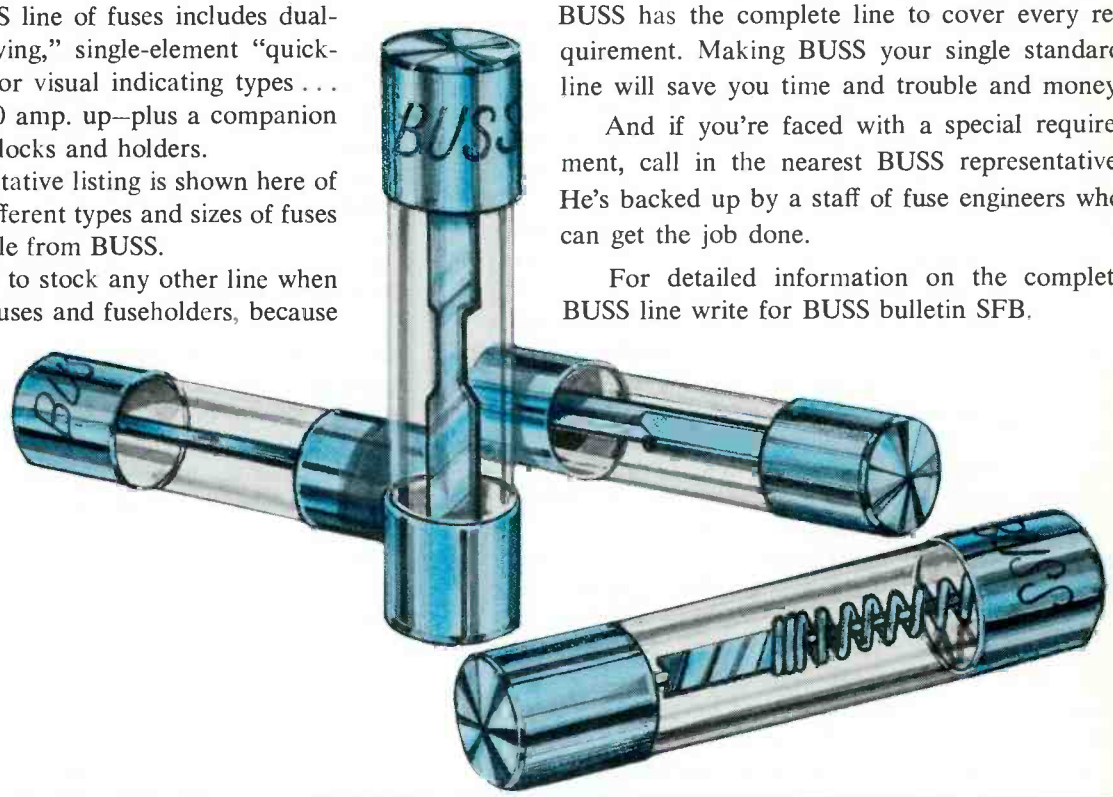

BUSSMANN MFG. DIVISION, *McGraw-Edison Co.*, ST. LOUIS, MO. 63107

Circle 4 on literature card

electronicscanner

news of the industry

Changes In Warranty Programs

Philco-Ford

Philco-Ford Corporation has simplified its warranties on its consumer electronic products and extended some of the coverage. Color and black-and-white television, phonographs, radios, tape recorders and various home appliances are included in the products whose warranties are changed.

Warranty statements are shipped with every product and are written in clear, simple language, using no small print. The warranties state the duration of coverage, what it covers and how service can be obtained. The provisions of the warranty are explained in a series of direct statements for the buyer's benefit, covering "components and service labor—all components" and "sealed system and service labor." The final section deals with obtaining service for the product.

The last paragraph states that the warranty is Philco-Ford's sole guarantee, and that "it does not cover damage caused by misuse or accident, fire, flood or other causes not within the control of Philco-Ford."

Ninety days' free service for all parts and labor is included in the new warranties, along with free replacement of all Philco radios and certain portable phonographs, should they fail and be returned within 30 days of original purchase.

Color TV picture tubes are now warranted for two years. B-W television sets and other color TV parts, stereo consoles, combinations and home entertainment systems are guaranteed for one year.

All parts and service warranties are included in the original retail price.

Radio Shack

Realistic, Radio Shack's private label television tubes, has been guaranteed to last as long as the set or the tube will be replaced free, unless there has been physical damage. This offer extends to those who change their own tubes.

Hitachi

Hitachi now has extended the warranty on all color television sets now being marketed.

Included in the coverage are solid-state components, which are under a five-year warranty, and the picture tube and all other parts, which are covered for two years. Labor costs will be free on a carry-in basis for one year.

Admiral

Admiral Corporation has announced that its line of Super-Bright replacement color picture tubes is now covered by its three-year warranty on color tubes. This is two years longer than the industry's standard replacement color tube warranty.

EIA Says TV Sets Are Safe

The Consumer Products Division of the Electronic Industries Association, representing a substantial segment of the U.S. Manufacturers of TV receivers, has released the following statement regarding the safety of TV sets:

Television sets are safe products. They are far from being one of the categories of household products which present an "unreasonable hazard to the health and safety of the consuming public." It was only such hazardous products which Congress was concerned with in setting up the National Commission on Product Safety.

A scholarly report on product safety prepared under the direction of Professor F. Reed Dickerson concludes that "the television industry represents a model of generally successful self-regulation"; and that, through industry safety efforts, a television set "if used properly is not dangerous." Dickerson (ed.), "Product Safety in Household Goods," 43 Indiana Law Journal 49 (1967). This report was submitted to the President's Committee on Consumer Interests, and the Special Assistant to the President for Consumer Affairs called it "magnificent" and a "comprehensive study."

Since the days of radio, before large-scale production of television sets, there have been continuing industry programs for control of fire and shock hazards in consumer electronic products. Each manufacturer employs a staff of safety experts, manufacturers have given top management direction to safety and maufacturers have spent millions of dollars in maintaining and improving safety through design, manufacture, and quality control. In addition, a Consumer Products Safety Committee of the Electronic Industries Association has been at work for more than twenty-five years.

This Committee consists of electronics experts, product engineers and others concerned with safety. It includes members from companies which belong to EIA and members from companies which do not; it includes members from the smaller manufacturers as well as from the largest. Committee recommendations are directed toward elimination of shock, fire and casualty hazards in television sets and other consumer products. Safety improvements in television sets which have been generally adopted as a result of Committee recommendations and joint efforts by the Committee and Underwriters Laboratories include the following:

(1) Interlock switches to protect against dangerous high voltage.
(2) Protective enclosures around high-voltage areas.
(3) Special fuses.
(4) Minimum standards for mechanical strength and thermal stability of materials.
(5) Continuous up-dating in specifications on components in critical areas of receivers (for example, line by-pass condenser, antenna insulation capacitors, yoke, flyback, etc.)
(6) Special factory dialetic tests for protection against shock hazards.
(7) Reduction of leakage limits for shock hazards.

The industry, of course, is constantly working toward improvement of safety features.

The experience of the millions of Americans who own television sets confirms the success of the manufacturers' safety efforts. There are now television sets in 95% of the nation's homes. At year end 1968, nearly

$9.75

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PROVIDES YOU WITH A COMPLETE SERVICE FOR ALL YOUR TELEVISION TUNER REQUIREMENTS AT ONE PRICE.

TUNER REPAIR

VHF Or UHF Any Type $9.75.

In this price all parts are included. Tubes are charged at cost.

24 hour service at our conveniently located service centers.

1 year guarantee backed up by the largest tuner manufacturer in the U.S.—SARKES TARZIAN INC.

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Replacement Tuner $9.75.

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Series 600 mA

All shafts have the same length of 12".

Characteristics are:
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UHF Plug In
Universal Mounting
Hi-Gain Lo-Noise

If you prefer we'll customize this tuner for you. The price will be $18.25. Send in original tuner for comparison purposes to our office in INDIANAPOLIS, INDIANA.

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SOUTH-EAST . . 938 GORDON ST., S. W., Atlanta, Georgia . . . . . TEL: 404-758-2232
WEST . . . . . SARKES TARZIAN, Inc. *TUNER SERVICE DIVISION* 10654 MAGNOLIA BLVD., North Hollywood, California . . . TEL: 213-769-2720

Circle 5 on literature card

85 million sets were in use in the United States. The annual ratio of reported instances of television set fire and shock to the number of sets in use would be measured in thousandths of one percent, counting even mistaken and unsubstantiated reports and reports of insignificant damage.

FCC Ruling Permits CATV To Carry Paid Ads and Originate Own Programs

Cable television systems with more than 3,500 subscribers must originate some of their own programs and may show commercials, the Federal Communications Commission has ruled.

The FCC also stated that more analysis is needed in the area of common carrier services for CATV systems and, therefore, no ruling has been made. However, the commission commented that it may require that sufficient carrier capability be provided to insure program diversity and to insure diversification of sources providing broadcasting service to the public, if needed.

The commission said it would not support any proposal prohibiting cable television systems from interconnecting with the communications system on a regional or national basis. It does not feel that the systems will encroach upon the strength of commercial broadcasting. However, action will be taken to prevent any injury to free broadcasting, if needed.

Japanese Develop 110-degree Color CRT

A 16-inch color picture tube employing 110-degree diagonal deflection has been developed by Shibawa Electric Company, Japanese manufacturer of Toshiba TV receivers.

The new color CRT, which measures 33 centimeters in overall length, is 7 centimeters shorter than the conventional 90-degree tubes.

Shipments of samples of the new tube to the U.S. will begin during the latter part of this year, and Toshiba will begin producing them at the rate of 30,000 per month around the middle of next year.

Standards Set For Pay-TV

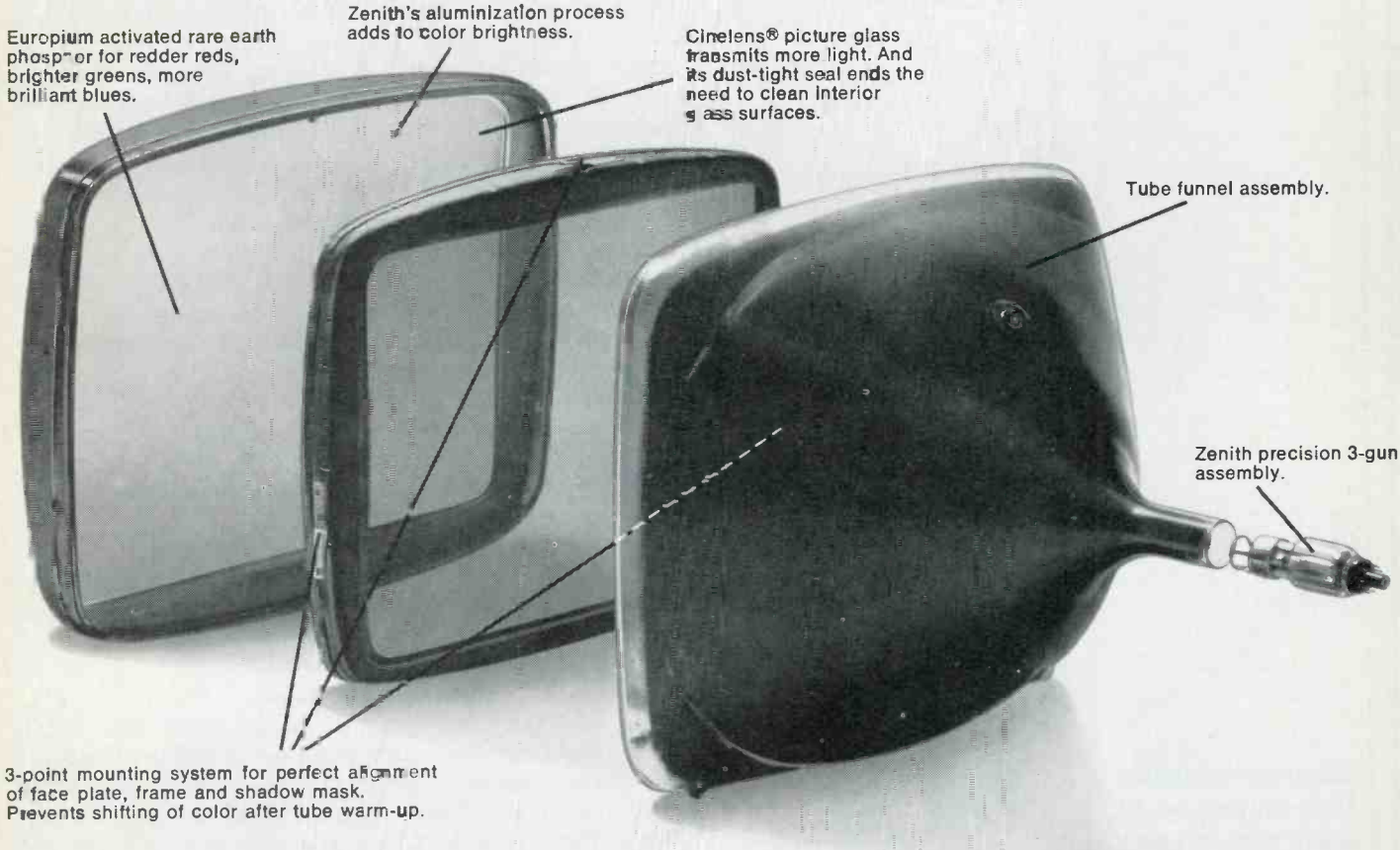
Pay-TV systems must meet the technical standards of operation now maintained by current television stations and networks, the Federal Communications Commission has ruled. The commission is now accepting applications for pay-TV systems. However, none will be approved until 60 days after the Court of Appeals of the District of Columbia has made a decision in a case involving movie theatre owners, who contend that pay-TV is illegal.

The FCC said they will grant no pay-TV authorizations unless the system has been approved in advance by the commission. The FCC's study of pay-TV, now concentrated on rules concerning the carrying of STV signals by CATV systems, is continuing.

Now that the technical standards are set and applications are being accepted, Zenith reports that it will be able to complete plans to manufacture the equipment. Joseph P. Wright, chairman of the board of Zenith Radio, has said that pay-TV could be initiated about a year after a ruling favorable to the system. ▲

Replacement quality you can depend on...

Zenith engineered and produced Color Picture Tubes!



Every Zenith replacement picture tube is made with the same care and engineering skill that go into the color TV picture tubes which Zenith produces as original equipment.

Zenith's uncompromising quality standards—which include tube testing at elevated line voltages for long periods—assure your customers of tubes with greater dependability and longer life.

Be sure. Order genuine Zenith picture tubes— for color or B&W TV—from your Zenith Distributor.

EXCITING SURPRISES FOR YOU—and Your Family! Fun for all! Get the details at your Zenith *Distributor's Parts Department.*

Zenith B&W replacement picture tubes are made only from new parts and materials except for the glass envelope which, prior to reuse, is inspected and tested to the same high standard as a new envelope. Zenith color picture tubes may contain used material which, prior to reuse, is carefully inspected, to meet Zenith's high quality standards.

Why not sell the best ZENITH®

The quality goes in before the name goes on

Circle 7 on literature card

letters to the editor

Torque-Measuring Spring Scale

(The following letter was directed to one of our contributing authors, Robert Middleton. I think Mr. Middleton's reply to this letter provides information that will be of interest to all readers—the Editor)

In the article titled "Troubleshooting the Mechanics of Tape Recorders," which appeared in the July 1969 issue of ELECTRONIC SERVICING, a torque-measuring spring scale is shown in Fig. 5 on page 40. I have been unable to locate one and, therefore, I would appreciate any information you could furnish.

Frank Szymanski
New Castle, Del.

The only source that I know of is Allied Radio. Their industrial division carries precision spring scales called "push-pull balances." Two ranges for this scale are listed in the catalog: 0-110 grams and 0-1000 grams (there are 28.35 grams in an ounce).

Since these are precision gauges, they are comparatively high-priced; you may prefer to check elsewhere to locate a less expensive brand.—Bob Middleton.

Source of GE Publication

This is in response to John A. McGregor's letter in the August, 1969 issue of ELECTRONIC SERVICING requesting information on where to obtain Volume I of General Electric's "Transistor Circuit Troubleshooting".

Individual volumes are not available but may be obtained as a complete set, Volumes I, II and III. This publication, part number 32-0034-1, is available through the General Electric Distributor in your area.

J. F. Camper
Technical Specialist
General Electric Co.
Washington, D. C.

More on Licensing

The objective of the California code was to prohibit untrue and misleading advertising. However, this cannot be true, because the public is being misled by the very machines we are servicing. For example, there are advertisements on television and radio that claim a certain product will prevent cavities. Yet a child gets a cavity. Isn't this misleading?

I think the licensing law examination fits the newcomers in this field, not the technicians who have already established businesses and have a lifetime of hard work behind them. They learned when there was very little written on the subject of servicing.

I have noticed that some of the newcomers have some very peculiar ideas which can be and sometimes are disastrous to the equipment they are using or servicing. The examination might

give them a better background of know-how. However, the oldtimers have this extra experience. I feel, therefore, the grandfather clause should be kept in respect for these men, pioneers if you will, who have made the servicing business.

Also, there are a few negative points which haven't been mentioned: If a servicing mechanic is forced out of business, he is left with a basement full of equipment, a few hundred customers who wouldn't take their sets to anyone else and all of his knowledge. Perhaps he receives social security or is on welfare, getting $100 or less a month. With his old customers bidding for his service, he will become a professional "nightcrawler", with more and more doing the same when they are pulled from their jobs. So, like prohibition, we'll have our "servicing speakeasies" going full blast. His customers won't tell and so what good will the law do? It would be more expensive to run them down.

Licensing hasn't kept the doctors or dentists honest. I read in the papers just weeks ago about a dentist who had to return over $50,000 in overcharges to prevent a check-up on his procedures, and there would be a lot more uncovered and a lot of red faces if more were checked into.

So I say, only use the exams for the enthusiastic beginner with the stars in his eyes and the yen to get into someone's set without the least bit of know-how.

I have been a subscriber since Sams first published a spiral-bound book of schematics. I am pleased with the changes you are making as time goes on.

H. H. Norton
Brentwood, Calif.

Help Needed

I am making a collection of Supreme Publications' TV Servicing Manuals. If anyone cares to sell back copies, please contact me.

I. Senberg
4624 N. Marvine St.
Philadelphia, Pa. 19140

I am very much in need of an instruction or operating manual for a B&K Television Analyst Model 1075. Perhaps one of your readers has one I can purchase or borrow for reproduction. Thank you.

Charles W. Ruffner
4032 Paseo Grande
Tucson, Ariz. 85711

I am in need of the circuit diagram of the Futterman H-3 stereo amplifier designed by Julius Futterman in 1965, and manufactured by Harvard Electronics Company of New York City. I am unable to contact Mr. Futterman and I found that Harvard Electronics is out of business. If anyone can supply a copy of the circuit diagram I would appreciate it very much. This was a direct-coupled amplifier that did not use an output transformer.

H. A. Rollins
355 Ashland Drive
San Antonio, Texas 78218 ▲

The pricing dilemma:

Reaching for a solution

by Wendall J. Burns

We present here two stories—examples of how two firms are dealing with a problem that is common to this industry: The problem of pricing labor. The owners of both firms, Electro-TV of Garden Grove, Calif., and Wholesale Television Corp., Indianapolis, Ind., have spoken before industry association members about pricing and attempted to show shop owners that they should raise their rates.

Their approaches to pricing are somewhat similar—they both use flat-rate schedules. Their prices are vastly different; so are the markets in which these two operations have a commonality, and we believe there is something in each of these stories that will benefit the reader.

We are not suggesting that the reader should adopt, as a whole, the pricing schedule of either Miles Sterling or Ed Reich. We do suggest that the whole industry will benefit if more and more shop proprietors apply some of the lessons these men have demonstrated.

Probing the upper limits that the consumer will pay proves profitable, and a prod to the industry.

Miles Sterling

Miles Sterling shows how high you can charge for the basic home call and other labor charges and still do a high volume of business. He reasons that the electronic servicing industry is sick, and the remedy he proposes is a radical departure from conventional business formulas. (To establish your service charge, stay within the range of rates established by the competition, and control costs of doing business to a level that will permit you to meet expenses and make a profit.) He has defied these conventions. The results: More profits, and both cheers and jeers from the sidelines.

What happens when a servicing firm, in one step, boosts its basic rates high above his competitors and many times above the norm for the industry?

The owner-manager of a firm that did that says the rate hike means several things to him: For the first weeks, worry; then, much more profit; customer complaints—about the same level as was received before the rate hike; some praise and some criticism from the servicing fraternity; a different class of customers; more pay for his technicians; and, because of increased salaries, he has been able to attract to his shop better technicians.

It was on Oct. 1, 1968 that technicians working for Electro-TV, Garden Grove, Calif., began presenting customers with service invoices based on new rates set by Miles Sterling, owner of the firm. For the basic service charge alone, there was a 40 percent price hike—from $17.50 for the first 30 minutes to $24.50. (For this and many other charges set in his flat-rate schedule, the rate is the same for color and monochrome TV.)

What did this do to the financial statement? How did it affect gross income? For the fiscal year ending June 30, 1969, the gross was three times what it was the previous year, Sterling says. The increase was primarily, but not entirely due to the rate hike. He expanded his market by opening up two new shops in April. They were functioning only 3½ months of fiscal '68, and a relatively small part of the gross income increase was from the new shops.

"I have received a lot of letters from other shop owners complimenting me on our service rates. A lot of them like the idea. Generally, the reaction is 'I wish we could do it here, but . . .'"

The reasons given to Sterling by other shop owners for not increasing their rates vary. A common belief is that communities not so affluent nor highly populated as Orange County, Calif., would not support rates in the range charged by Electro-TV.

"Not so!" Sterling replies to this objection. He claims that service rates can be raised considerably anyplace—in small towns, in the city, anyplace.

The technicians' fear, according to Sterling, is: "What would the customer do or say to me?" One service technician hired by Electro-TV actually became nauseated the day before he was to make his first service calls—just contemplating confronting customers with such charges was too much for him. But, he soon became convinced there was nothing wrong with it, and that the customers accepted it.

Sterling tells also of a Texan who declared he feared he would be shot before leaving the premises if he charged such rates.

Such fears are unfounded, Sterling says. The pattern of customer relations has remained about the same. "In former days, we had customers who called and complained bitterly. We still have customers who call and complain bitterly."

The customer complaints don't trouble Sterling greatly. What does bother him is criticism by competitors. He says this is because "they don't think enough of themselves."

Some technicians simply don't think they are worth the kind of rates he is charging, although they can see the plumber and electrician compensated at that level, Sterling says.

He admits that his rates instigated a competition between servicing firms—not a competition for customers, but, rather a competition for the best technicians. He can afford to pay them more, because he charges the customer more.

Most of those who have followed Sterling's example and sharply increased their service rates have been successful, he says.

Others have told him it wouldn't work in areas not so highly populated nor affluent as Orange County. Partially on a challenge, he opened a service center in Watts (the Negro ghetto in the Los Angeles area that erupted into a riot a couple of years ago), and another in Beverly Hills.

The success of the shops in these areas with such distinctly different economic and social makeup confirmed his belief that if you give good service and maintain a professional image, that you can operate anywhere at rates considerably above the average for the industry.

"The first thing is," Sterling says, "the technician has to think well of himself. He has to think as a professional, and act as a professional, and then he is one."

"It has always been our intent to have the best technicians, and to give satisfaction to the customer. Because we have a better salary structure, we have better technicians."

The experienced technician at Electro-TV starts at $4, and works up to $5.50 an hour. Fringe benefits include 100% of family medical insurance premium, paid vacations, and the national holidays. An unusual additional holiday is given each man—his own birthday.

The technician with most seniority has been with Sterling's firm since 1955. Electro-TV employs about 35 technicians.

Sterling admits that for the first week or two after his rate hike last year that he was worried enough that he may have been hard to live with.

Sterling's story has become well-known to service technicians across the nation. He has been asked to talk to groups of technicians to relate his experience and explain his philosophy. Some respect his daring in making this leap up in service rates, and even imitate him.

Others disagree sharply. However, even some technicians who disagree believe this Californian has done the servicing fraternity a favor in dramatically showing that the low service rate that the majority of technicians have imposed on themselves can be raised. They may believe he has done the industry a favor even though they do not believe his rate schedule—so much higher than the competitor—is based on sound business principles. The favor to the technicians is that they have a clear example of a rate hike that benefits the business, and does not cause a catastrophic loss of customers.

One man, who owns and manages a high-volume service center in the midwest, tells of discussing the subject at length with Sterling. He believes the example of Sterling's success in pricing can benefit the industry, but, he does not agree that it is a good policy. "It is all very interesting, but if you do this you are going to create a vacuum."

He reasons that if you create a vacuum, you open the way for factory service organizations—and thus perform a dis-service to the independent servicing industry.

Sterling, on the other hand, reasons that in addition to the financial benefits that his firm has enjoyed, his policy has enabled him to retain in this industry some technicians who may have otherwise gone into manufacturing or some other related fields. The biggest drain in Southern California, he says,

Example of labor charges for some typical repair jobs, based on Sterling's rate schedule:

Diagnosing color set and replacing picture tube: (Picture tube replacements are done only in shop)

Service call	$24.50
Picture tube replacement	38.50
Delivery	24.50
TOTAL LABOR	**$87.50**

Home Service call, B-W set

Service call	$24.50
Replace two tubes	n.c.
Clean tuner	14.50
TOTAL LABOR	**$39.00**

Shop repair of color chassis, replacing 1 transistor and 1 by-pass capacitor:

Service call (pick-up)	$24.50
Shop analysis	48.50
Delivery	24.50
TOTAL LABOR	**$97.50**

Labor Rates at Electro-TV, Past and Present

The last column in this chart shows an abbreviated form of the pricing schedule used by Electro-TV. The actual schedule consists of four pages. The other columns, as indicated, show prices in previous years. The rates for 1964 and 1965, when some very minor increases were adopted, are not shown.

FIELD RATES	1963 B & W—COLOR	1966 B & W—COLOR	1967 B & W—COLOR	1968 B & W—COLOR	1969 B & W—COLOR
Basic service call (30 minutes):					
First set or first section of a combo	$ 5.00—$ 7.50	$10.00—$12.50	$12.95—$15.00	$17.50—$17.50	$24.50—$24.50
Addn'l sets or addn'l sections of a combo (each)	$ 3.75—$ 6.25	$ 7.50—$10.00	$10.00—$10.00	$10.00—$10.00	$14.50—$14.50
Extra fees on service call:					
Any soldering—cleaning tuner contacts	N. C.	$ 9.50—$ 9.50	$ 9.50—$ 9.50	$14.50—$14.50	$14.50—$14.50
Dial cord replacement	Based on Time	$ 9.50—$ 9.50	$ 9.50—$ 9.50	$14.50—$14.50	$14.50—$14.50
Picture tube replacement	$ 6.00—$15.00	$ 4.50—$15.00	$ 9.50—$34.50	$14.50—$38.50	$14.50—$38.50
Extra trips—or—an extra man (15 minutes)	$ 2.50—$ 2.50	$ 5.00—$ 5.00	$ 7.50—$ 7.50	$ 9.50—$ 9.50	$14.50—$14.50
Additional time and waiting time (each addn'l ¼ man/hr)	$ 1.88—$ 1.88	$ 4.50—$ 4.50	$ 4.50—$ 4.50	$ 5.50—$ 5.50	$ 5.75—$ 5.75
*Color picture tubes installed in shop only (add: service call and delivery) convergence is included					
SHOP RATES					
Pick-up (one man only—add for an extra man, as above)	$ 5.00—$ 7.50	$10.00—$12.50	$12.95—$15.00	$17.50—$17.50	$24.50—$24.50
Shop analysis (Transistor sets add $10.00)	$15.00—$17.50	$24.50—$32.50	$28.50—$38.50	$38.50—$48.50	$38.50—$48.50
Delivery one man only (add for an extra man as above)	$ 2.50—$ 2.50	$ 5.00—$ 7.50	$ 7.50—$10.00	$10.00—$17.50	$14.50—$24.50
BASIC SERVICE FEE:	$22.50—$27.50	$39.50—$52.50	$48.95—$63.50	$66.00—$83.50	$77.50—$97.50
Convergence	— included	— $ 7.00	— $ 9.50	— —	— —
TOTAL:	**$22.50—$27.50**	**$39.50—$59.50**	**$48.95—$73.00**	**$66.00—$83.50**	**$77.50—$97.50**
DEPOSIT REQUIRED IN ADVANCE	None None	**$25.00—$30.00**	**$25.00—$30.00**	**$35.00—$40.00**	**$35.00—$40.00**
OVER THE COUNTER RATES					
Minimum check and minor repairs (30 minutes)	$ 3.75—$ 6.25	$ 7.50—$10.00	$ 9.50—$12.50	$ 9.50—$14.50	$19.50—$24.50
Minor repairs, when any simple soldering is required (volume control, etc.), Tuner cleaning	$7.50—$10.00	$ 9.50—$19.50	$17.00—$27.50	$19.50—$29.50	
Major repairs (Transistor sets add $10.00)	$15.00—$17.50	$24.50—$32.50	$28.50—$38.50	$38.50—$48.50	$38.50—$48.50

has been into the aero-space industry. He has produced a benefit to these technicians and to the servicing industry by keeping them in servicing, he says.

Sterling calculates that even if the effect of increasing service labor charges 25% would mean losing 25% of his customers, he would still come out with more profit. That is, if he didn't increase the technician's pay. In practice, the number of customers lost because of a price increase is not that great. After a rate hike begins to produce more revenue, part of the gain is passed on to the technicians in salary increases. Sterling says the additional revenue is used in various other ways to improve the business, including field checks made of the jobs performed by the outside men.

Sterling was asked if there are any characteristics of his customers that make them easily identifiable. He answered in the negative. However, he says, he does believe they are people who are looking for quality. "Our appearance gives the appearance of quality."

The information the consumer should seek, Sterling says, is not the price of the service call, but rather: What will the total bill be? and, What will the quality be?

"They cannot determine that by inquiring about the price of the service call," Sterling says. He says that some have had the experience of trying out shops who advertise $2.95 service calls, have found them unsatisfactory, and have come back to Electro-TV.

"Our's has become a TV shop's TV shop".

Technicians who are skeptical of his price schedule bring up the point that he doesn't need to depend on repeat customers as the market he serves is so vast (Orange County and the metropolitan Los Angeles area).

"We do a lot of repeat business," Sterling says. This is demonstrated by the fact that his shop in Orange County, which has been established the longest, does a much higher volume than do his shops located elsewhere in the Los Angeles area.

His labor service charges exclude warranty work from his shops. Nevertheless, Electro-TV is doing well over $500,000 a year in volume.

But as a whole, the electronic servicing industry is very sick and very downgraded, Sterling says. For this reason, he is not satisfied in basing his price schedule on existing pricing patterns or practices in the industry.

Instead, he uses as examples the wage structures of electricians and painters.

"Electricians are currently making $6.60 an hour plus 40% more in fringe benefits. As of July 1, 1970, they will be making $7.45 an hour; and as of July, 1971, they will be making $8.35 an hour plus fringe benefits."

"Or, take the case of painters. They are going up to $5.79 an hour. They are going up in January, 1971 to $6.04, and in July, 1973 to $7.93 an hour, plus 34 cents an hour for health and welfare fund. plus 34 cents an hour for pensions, 40 cents for vacation, 10 cents for life insurance, plus 2 cents an hour for the apprenticeship. Their wage (in 1973) will total $9.13 an hour."

Probing the lower pricing limits that can still give a profit on service labor

Ed Reich

Ed Reich demonstrates the bottom price he can charge for the basic home service call—$7.95—which he says is the cost of getting a technician to the customer's door. But, don't be misled. Service labor produces revenues averaging over $15 per call. He stresses the importance of knowing the cost of doing business, and establishing service rates that will meet that cost, and produce a profit. His policy depends on knowing, in detail, costs of performing labor, and charging accordingly. He believes that his service labor rate is the highest in his market area. Even at that, he turns down business for lack of technicians.

Ed Reich, owner and general manager of Wholesale Television Corp. in Indianapolis, believes you can operate at a profit with a basic service charge well below $10 if you establish a realistic price range for other charges to the customer.

"Each repair job should stand on its own," Reich says. As much as possible, he believes this pricing principle should be applied to the minimum service job, and begin with the basic home call (the cost of getting the man to the door.)

"It is unfair to everyone involved to charge one rate—$12.95, $13.95, or $14.95—for all home calls when you might be in one customer's home only 15 minutes and in another home 45 minutes or longer," Reich says.

A little over a year ago, Reich made a drastic modification in his pricing system.

Prior to November, 1968, he was charging $9.95 for service in the home, and $48.95 for a bench job. The results of this pricing policy were: Some customers were charged too little and some were charged too much; his own better technicians were not adequately rewarded for their skills; he had no logical explanation to offer for the prices he charged

for service labor; some customers thought $9.95 was too much for a home service call, and turned elsewhere for service. Reich says that in the 1968 fiscal year alone, his pricing system caused him to lose $78,000 in revenue.

He changed to flat-rate pricing, and established the basic home call at $6.95. That, he figured, was the cost of the technician arriving at the customer's door and saying 'Hello, Mrs. Jones'. (Later, faced with increased labor costs, he raised the basic service charge $1, to $7.95).

Three months after he made the change, results were so distinctly positive that he was able to tell an audience of retailers that the average gross revenue for a home service call was over $15. Also, fewer potential customers were lost when calling in to inquire about price. However, Reich says he has evidence now that price is not a big factor in the economic group of which his market is composed.

Reich has found flat-rate pricing more flexible, and can be periodically adjusted without re-evaluating his whole pricing structure. "If I need another $50 a day in revenue, I can produce it in any one of a number of ways. I can produce it by raising the basic service call rate, or by raising the flat-rate charge on cleaning and installing the tuner, checking tubes, or on any of the basic technical functions." His shop rates are established to produce $15 service revenue per hour per man. His flat rate for a given technical function is based on the time it takes the average technician to do the job. Before, the customers were all charged the same for bench-work on a TV set—$48.45, whether it was three hours or three days work.

It is the way the set is repaired, the image given by the technician and the guarantee behind the work that are the determining factors in obtaining and retaining customers, Reich says.

Complaints he receives are about the way a job is done, not about price, he says.

Reich has evidence to show that his customers are not price shoppers. The order takers at Wholesale Television Corp. indicate on the job order if a customer inquires about price. Of the 120 to 150 orders taken per day, only three or four show that customers inquired about price.

Although he has encountered relatively few 'price shoppers' for electronic service in Indianapolis, he admits this might not be the whole picture. He can only say with assurance that few 'price shoppers' are being attracted to Wholesale Television Corp. This might be due to the fact that he does no consumer advertising, except for the listing in the yellow pages.

He does not count among his customers those who purchase their products on a dollar-down, dollar-a-week basis. He believes his customers are from a "better strata of the economy, the upper 60% income bracket."

About 20 percent of his business is warranty and other work for dealers and distributors. The dealers are the channels through which Wholesale TV receives a lot of business. He receives a lot of repeat business from the consumers. He feels his firm has a good reputation. Complaints are important to him, and he wants to keep them at a minimum. His guarantee to the customer and call-back policy are "real liberal", but he considers them an inherent part of the cost of doing business, Reich says.

In order for the consumers to understand the flat-rate pricing system, Reich says it is important for management to explain it to the technicians and for the technicians to explain it to the customer.

In addition to overhauling his pricing structure, Reich moved to improve the image of his men. He provides the outside men with uniforms—black tie and suit coat or sport coat. He believes they should be called technicians, not service men.

Wholesale's outside men make $208 per week if they work 48 hours. They work 9½ hours a day on the average, Tuesday through Saturday, with Sunday and Monday off. They average 12 calls per day. The base pay for a journeyman is $4 per hour. They receive commissions on sales of accessories (such as antennas) and, commission on renewal contracts. (The original contracts for service are sold to the consumer by the retailer.)

Fringe benefits are: Five days a year paid sick leave, and an additional day's pay for each day of sick leave not taken; three weeks annual vacation after five years' employment; retirement plan, with the company paying five percent of the employee's base pay towards his retirement fund after two years'

Examples of labor charges for some typical repair jobs, based on Reich's rate schedule.

Diagnosing color set and replacing picture tube:

Service call	$ 7.95
Diagnosis	6.00
Replace picture tube	20.00
TOTAL LABOR	**$33.95**

Home service call, B-W set

Service call	$ 7.95
Replace two tubes	2.00
Clean tuner	6.00
TOTAL LABOR	**$15.95**

Shop repair of color chassis, replacing 1 transistor and 1 by-pass capacitor.

Service call	$ 7.95
Bench analysis	12.50
Replace 1 by-pass cap.	5.00
Replace 1 transistor	6.00
Reinstall chassis (deliv.)	8.00
TOTAL LABOR	**$39.45**

What can the works in a drawer mean to you?

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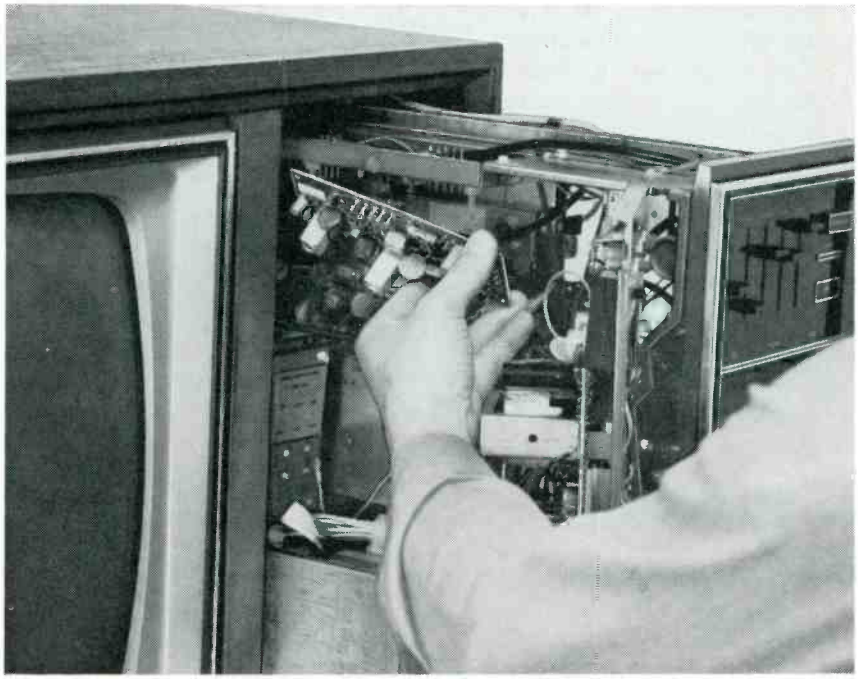
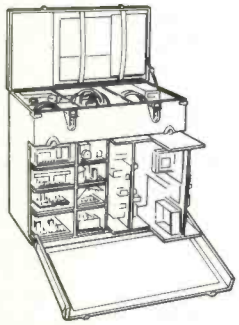


instead of

making call-back after call-back

We don't have to tell you how frustrating it is to replace a component in a color set and then be called back the next day or next week, because something else went wrong. You know how new components show up other weak spots hours or even days later. But all that your customer understands is that the set doesn't work right, and you get the blame. Quasar Color TV helps eliminate this problem. When a plug-in module is changed an entire circuit is replaced. What can the works in a drawer mean to you? A new respect for your professionalism by your customers.



All the reference materials you need to service Quasar Color TV are found in this panel caddy. If you feel you need additional information, call your distributor and he will set up training sessions.

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employment; company pays over 50% of the hospital and major medical insurance policy; uniforms furnished by the company. For a man with five years with the company and with a base pay of $4 an hour this amounts to about $27 per week, Reich says.

"I feel that my gross return per man should be three times what I pay him as an hourly rate. I feel that each outside man should bring in a gross of around $120 per day. We average 12 calls per day per man with no problem, and with no hurry." His crew of outside technicians is now large enough that travel time has been reduced—with each man averaging 20 to 30 miles per day.

In October of this year, Reich purchased another servicing business in Indianapolis and combined it with Wholesale Television Corp. He now has 12 outside men and nine inside radio and TV men.

He is in need of more personnel, and is considering organizing his program to train more technicians.

If he could get enough technicians, he could reach a volume of $1 million gross business within two years, Reich says. He finds himself at the stage now where he is turning down dealers' service work unless they were previous customers.

He says his current operation will yield about $750,000 annually in gross revenues.

"I feel like I should have five or six percent profit on service labor sales." In establishing the charge to the customer, he calculates a charge that will yield within that profit range.

While Reich is optimistic about the future of his firm, he sees trouble ahead for many in the industry.

"I pity the man who is charging too little for his labor and making up for it on parts. What is he going to do two or three years from now when there is going to be only labor?" ▲

Labor Rate Schedule of Wholesale TV

SHOP SERVICE RATES	COLOR	B&W
Bench analysis	12.50	10.50
Reinstall chassis or delivery	8.00	6.00
Replace A/C interlock	2.00	2.00
Antenna connections—repair	2.00	2.00
Capacitors—coupling or by-pass		
Replace one	5.00	5.00
Replace two or more	7.50	7.50
Capacitor—multi-section filter		
Replace one	9.00	9.00
Replace two or more	13.50	13.50
Circuit breaker—replace	3.00	3.00
Clean controls	4.00	3.00
Coils—replace or repair	6.00	6.00
Crystals—replace	6.00	6.00
Diodes—replace one or more	6.00	6.00
Printed circuit repair	10.00	10.00
Resistors		
Replace one	5.00	5.00
Replace two or more	7.50	7.50
Silicon rectifiers—replace	6.00	6.00
Transistors—replace		
Replace one	6.00	6.00
Replace two or more	9.00	9.00
Transformers		
High voltage	15.00	12.50
Other	10.00	10.00
Tube socket—replace	9.00	9.00
Tuner repair—major, includes removal and reinstallation	20.00	20.00
Wiring—replace or repair	8.00	8.00

FIELD SERVICE RATES	COLOR	B&W
Service call	7.95	7.95
Diagnosis—if set not repaired	6.00	6.00
Diagnosis—parts reschedule		
Knobs	n.c.	n.c.
Components—including CRT	6.00	6.00
Built-in antennas		
If no other work performed	4.00	4.00
If other work performed	n.c.	n.c.
Receiving tubes		
Replace one or two	2.00	2.00
Replace three or more	3.00	3.00
Check tubes—list quantity	6.00	4.00
Replace picture tubes		
Color—includes convergence	20.00	....
Black and white	....	12.50
Controls—replace		
Single	6.00	6.00
Dual	8.00	8.00
Components—replace	6.00	6.00
Clean tuner	6.00	6.00
Clean and repair in home	10.00	10.00
Convergence—minor	3.00	....
Convergence—complete, includes high voltage, tracking, AFPC	7.00	....
Complete set up	10.00	....
Align AFT—where applicable	3.00	....
Adjustments		
High voltage and/or focus	1.00	....
Tracking and/or gray scale	1.00	....
AFPC and/or color killer	1.00	....
Replace built in antenna	3.50	3.50
Replace dial light or lights	1.50	1.50
Control adjustments		
If no other labor performed	4.00	4.00
If other labor performed		
External controls	n.c.	n.c.
Rear controls—one or more	1.00	1.00

"My shop's been loaded since I got my FCC License... and I could kick myself for not getting it sooner. I'm pulling in all kinds of mobile, marine and CB business that I couldn't touch before; have even had some calls to work on closed-circuit television. I've hired two new men to help out and even with them, I'm two weeks behind."

And so it goes. Once you have that FCC ticket, you open the door to all kinds of new business. And that's not all. The knowledge you need to pass the FCC exam gives you a fundamental understanding of *all* electronics. You'll find you can do more work in less time ...work on almost *any* kind of electronics gear.

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Plain Talk About FET'S Part 1

A two-part series that discusses in practical terms the operation, applications and testing of field-effect transistors. by Wayne Lemons

How do field-effect transistors (FET's) work? How do you test one? How can you tell which lead is which if they aren't marked? How are they used in circuits? These and other questions we hope to answer in this two-part series on the field-effect transistor.

Conventional transistors (NPN and PNP) are called **bipolar** transistors because their operation depends on the reciprocal action of two charge carriers (electrons and holes). The FET is called a **unipolar** device because it uses essentially only one charge carrier (although that carrier may be either a positive or a negative charge, as we will see).

Because it is a unipolar device, the basic FET has no sense of direction between its main current terminals, source and drain; that is, the source and drain terminals may be interchanged. Only the **gate,** which in many respects corresponds to a grid in a vacuum tube, must have a specific polarity of voltage with respect to the source terminal.

How FET's Work

The best way to understand FET operation, I think, is to think of an FET as a "sheet-beam" vacuum tube. That is, the controlling force is a charge that pushes (or sometimes pulls) the main current carriers out of (or into) a channel. Fig. 1 shows the action of a sheet-beam tube with an internal deflector plate.

Fig. 2 is a circuit diagram of an FET. This is an N-channel FET, which means that the active element has an abundance of negative current carriers (electrons). (Remember that semi-conductor material by nature has a limited number of charge carriers, unlike a piece of wire, for example, which has an almost infinite number of charge carriers.)

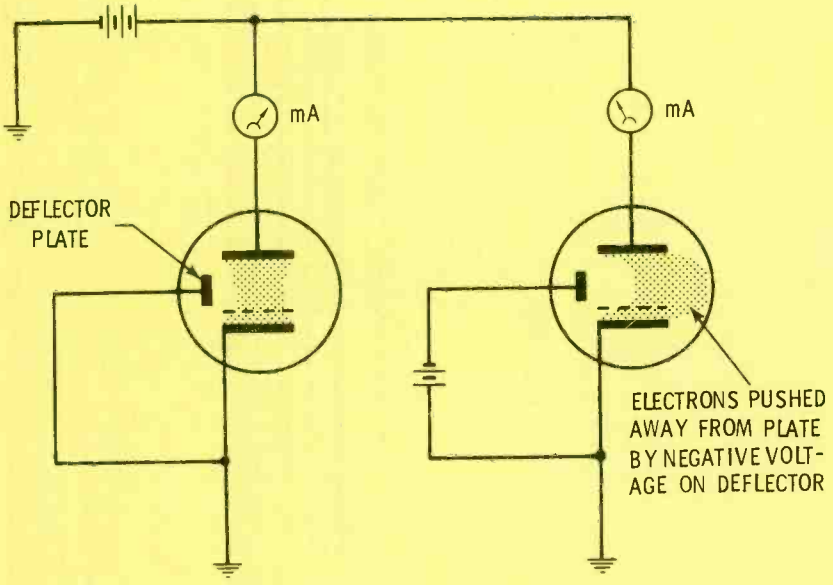

Fig. 1 Simplified action of a sheet-beam vacuum tube. The "gating" action of field-effect transistors is similar to that shown here.

Let's first consider Fig. 2A. At each end of the N-channel material is a connection to the semiconductor. One of these connections is called the **source** and the other the **drain.** Because of the current carriers in the "N" material, current can flow through it in either direction, depending on which way the battery is connected. Because of the limited number of current carriers in the channel, the channel looks not like a piece of wire but more like a 1000-ohm resistor.

Next, consider Fig. 2B. Here a new element is positioned between the source and drain. This element is called a **gate.** Like any gate, it can be completely open or shut or one-quarter open, half-way open, etc.

In an FET, ideally, there is a high resistance between the gate and the channel. The gate may be a piece of P-type material with a reverse bias, or there actually may be a very thin slice of insulation between the gate and the channel.

With the gate tied to the source, as in Fig. 2B, current continues to flow just as if the gate were not present.

Next, let's consider Fig. 2C. When a negative bias voltage is connected between the gate and source, the current between the source and drain of the FET decreases. What has happened? The negative voltage on the gate repels the electrons (negative charge) in the channel and forces them toward the substrate. This leaves fewer current carriers available in the channel, and less current flows. In other words, the original "1000-ohm resistor" now looks like a 5000-ohm resistor. Applying a negative charge to the gate of the FET has caused the resistance of the channel to increase. Fig. 2D shows what happens if the negative voltage on the gate is increased enough. The current flow is completely "pinched

off" between the source and drain. This is because all of the electrons have been forced out of the conducting channel.

No mention has been made of gate current flow. The reason? There is none! The flow of current between the source and drain is controlled by a **voltage** charge. This is why the FET, like the vacuum tube, has a high impedance . . . it requires **no power** in the input to control power in the output. The similarity that exists between vacuum tubes and FET's is reflected in the circuitry used with FET's, as you will see in next month's article.

Types of FET's

As mentioned previously in this article, there are two general types of gate structures. First, there is the junction FET (j-FET) which has the gate "junctioned" into the channel in much the same manner as a PN junction of a diode or bipolar transistor. This type of FET has the advantages of simplicity, ease of testing with an ohmmeter, and little likelihood of static-charge damage (to avoid such damage, the leads of some FET's must be kept shorted together until the FET is installed in the circuit). In the j-FET, the gate is reverse-biased by the circuit so that only a very small amount of current flows between the gate and channel.

The other general type of gate structure is itself divided into two distinct types: The MOS (metal-oxide semiconductor) and the IG (insulated gate), often referred to as MOSFET's and IGFET's. In these, the gate is actually insulated from the channel by an extremely thin layer of oxide. This insulation prevents current flow to the gate, whether it is positive or negative with respect to the source terminal. The input resistance of the MOSFET's and IGFET's can be in the hundreds of megohms.

Since the insulating coating between gate and channel is so thin, there is a danger of "static puncture" of the coating. Enough static

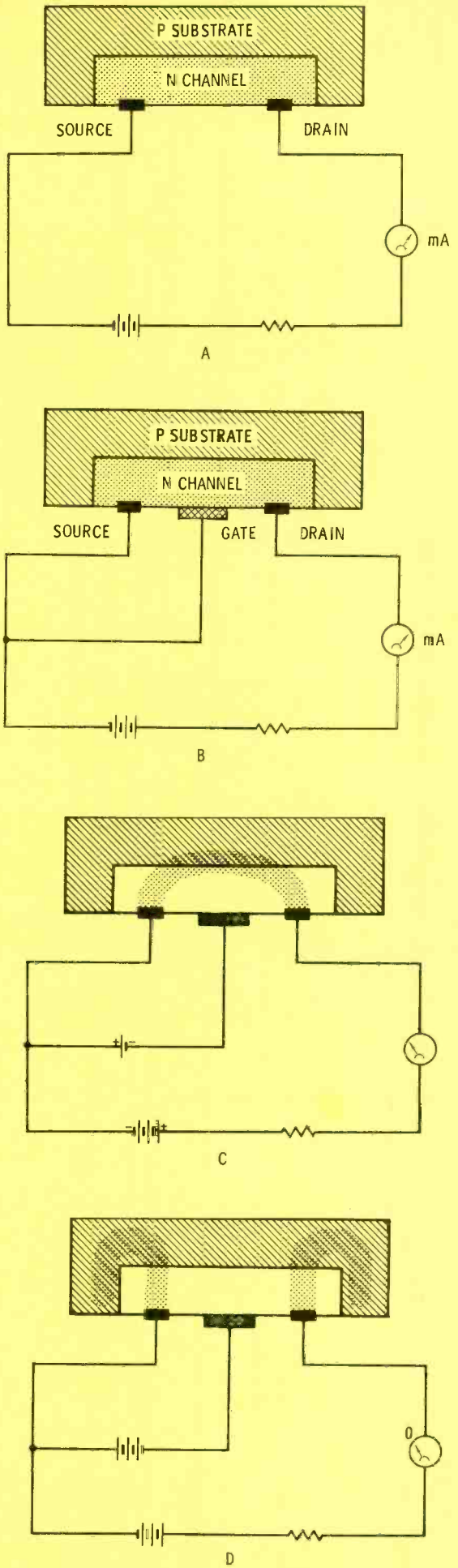

Fig. 2 Circuit diagrams showing construction and operation of N-channel FET.

A) Current can flow in either direction in region between source (cathode) and drain (plate). Limited number of current carriers made this region appear as a 1000-ohm resistor.

B) Variable control element called a "gate" is positioned between source and drain.

C) Current flow between source and drain is reduced when a negative bias voltage is applied between gate and source elements.

D) Complete "pinch off" of source-to-drain current is accomplished by gate when gate bias is high enough to force all electrons out of conducting channel.

charge can build up on an open gate lead to pierce the coating and make a high-resistance connection between gate and channel. (When this happens, the transistor often can still be used as a junction transistor by applying a reverse bias to the gate.)

Other Types and Classifications

In addition to the j-FET's, MOS-FET's and IGFET's, any of these various types may use either an N- or a P-channel. Basically there is no difference in the channel type, except that the gate bias is opposite for the two.

So far we have talked only of **depletion** FET's, in which a bias on the gate causes the current to be depleted or decreased. Insulated-gate transistors may also have an **enhancement** mode, in which the current is increased by a charge on the gate; in other words, more current carriers are pushed or pulled into the channel by the gate voltage rather than pushed out as in the depletion mode.

Next

We are just now beginning to see the FET used in a lot of commercial circuits. We will soon see more applications. Field-effect transistor technology is just now clearing the runway, and we'll be seeing new—and probably exotic—FET-equipped amplifiers in the very near future.

Next month we'll talk about the FET schematic symbols used by various manufacturers (they are by no means standard), why the FET is more like a tetrode than a triode, how you can check the FET, and how you can tell it from a NPN or PNP transistor. Plus, next month we'll also talk about how you can test FET's in-current and some standard and unusual circuits that now use the FET.

The FET, like the bipolar transistor, is here to stay. It won't replace the bipolar transistor—at least not for some time yet—but it ensures the further demise of the vacuum tube, and it will do with ease some jobs, such as audio-level control, that were almost impossible to do with either vacuum tubes or conventional transistors . . . but that's part of next month's article. ▲

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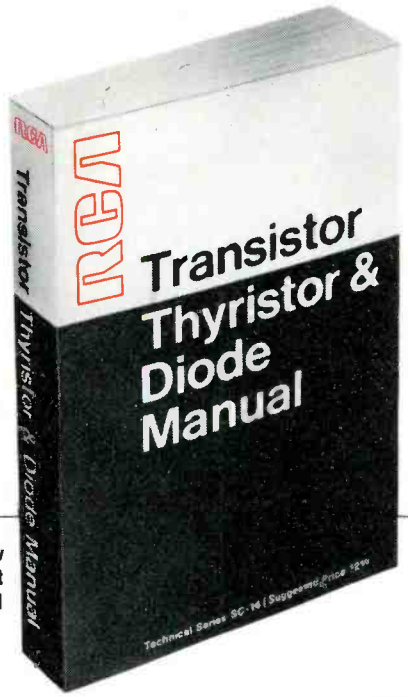

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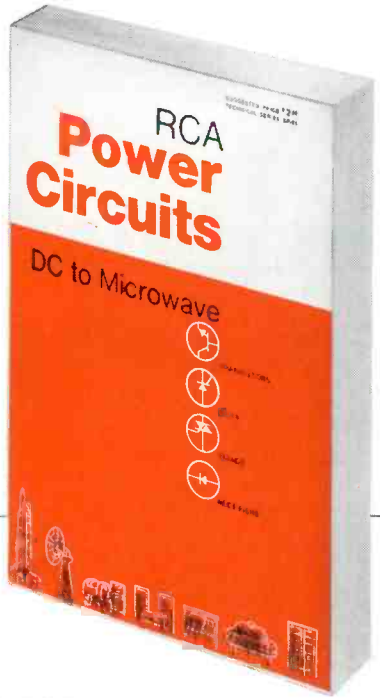

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Consumer Electronic Servicing, 1969—A Perspective

by J. W. Phipps

Approaches to Servicing, Business Techniques, Developments and Trends Analyzed in ELECTRONIC SERVICING in 1969

Approaches to Servicing	
• High-volume independently owned business with one shop	January
• Franchised chain of high-volume, independently owned service centers	March
• Manufacture-owned and operated service centers	April
• High-volume, multi-shop operation specializing in warranty and contract servicing	November
Making a Business Out of Service	
• Separating management from the bench	January
• Job control and specialization	January, February, November
• Efficient use of manpower	January, March, November
• Service labor pricing	January, March, November, December
• Technician training	January, April, November
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• Profile of consumer electronic servicing	June
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Reader Survey Provides Basic Facts About Servicers and Servicing

ELECTRONIC SERVICING in January surveyed all readers in an attempt to establish a profile of the business. The results of this survey, compiled and published in the June issue, present, for the first time anywhere, a comprehensive word-picture of a representative segment of our readers—whom we feel, in turn, are representative of the entire electronic servicing business. This profile, which will be updated periodically, enables you to compare various facets of your operations with those of others in the business.

Major Problems and Their Causes

A variety of major and lesser problems face today's shop owners and managers and electronic technicians. Most problems have existed for some time, but their effects are now becoming more pronounced as technology continues to snowball and a wave of consumerism sweeps the country, demanding more reliable products and improved service. The major problem areas and their prime causes are:

1) *Shortage of Electronic Technicians*—Higher pay, shorter hours and better fringe benefits available in manufacturing and other segments of the electronics industry have lured both experienced and trainee electronic technicians away from independent service shops. The root of the problem is shop owner's hesitancy to charge service prices that will enable him to adequately compensate technicians and, thus, retain experienced ones and attract trainees. A lesser cause of the problem is inefficiency of shop operations, which makes skilled technicians less productive and, consequently, reduces shop income and the owners ability to adequately compensate technicians. One other lesser, but apparent, cause of the technician shortage is failure of the country's secondary and college-level educational systems to adequately promote skilled trades, including consumer electronic servicing, during career guidance and to

Shop owners and managers and electronic technicians must be familiar with the problems, developments, conditions and trends that affect the present and future of their businesses and jobs.

Recognizing this need, ELECTRONIC SERVICING in the January issue embarked on a four-dimensional editorial program designed to provide our readers with accurate and timely information about these vital subject areas:

- Diagnostic and Repair Procedures
- Successful Business Management Policies and Techniques
- Efficient Shop Operations
- Trends and Developments

This new editorial program was announced in the January issue in an editorial profile titled "What You Can Expect From ELECTRONIC SERVICING In 1969". During the course of the year we have attempted to focus in on the areas of coverage promised in that profile.

Following is a brief review of the developments, trends and problem areas discussed in ELECTRONIC SERVICING in 1969. It is intended to give you a broader perspective of the business of consumer electronic servicing and to acquaint you with what you can expect from ELECTRONIC SERVICING in 1970.

provide sufficient entry level courses relating to electronics.

2) *Proliferation of Consumer Electronic Products and Designs*—An avalanche of rapid-fire technological developments have produced more sophisticated circuitry and new types of products which, together with an increasing lack of standardization of both domestic and foreign-manufactured products, have forced on the industry a need for larger parts inventories, unwieldy libraries of service literature and an added strain on the knowledge and proficiency of technicians, who already have too little time to spend keeping abreast of new developments. Solutions to these related problem areas are: increased standardization of components and designs, specialization of servicing by brand and/or type of product, and more and better training of technicians by both shop owners and manufacturers—including taking better advantage of the free product and technical training offered by various manufacturers.

3) *Poor Public Image*—Few technicians and shop owners deny that an image problem exists; the majority disagree only about *how bad* the image really is, what caused it, and how it can be improved. There seem to be a multiplicity of interrelated factors responsible for the poor public image. These factors and possible cures include:

• A minority element of incompetent technicians and irresponsible shop owners whose appearance, business practices and service methods keep a part of the public skeptical of electronic service shops and technicians. An effective system of self-policing is deemed by many to be the answer to this situation, although, to date, no such system has evolved. As reported in the May issue, both national service associations have "certification" programs whose aims are a form of self-policing, but since the combined membership of both associations represents less than a quarter of the service industry, they presently have neither the membership nor the finances necessary to promote an effective system of industry-wide policing. An alternative to self-policing is state or municipal licensing or registration, both of which exist and were reported on in the July issue. Although neither self- nor state or local government regulation have proven to be the ultimate answers, no other form of control, including federal-government policing, has been proposed, although a majority of technicians responding to a reader survey favor some form of policing or regulation.

• A large segment of the public, and some writers, categorize all members of the service industry with the few really bad ones. The effect of such unfair publicity is multiplied by the conspicuous absence of an effective rebuttal to such charges by a representative voice of the servicing industry. As reported in the May issue, both national service associations have public relation programs; however, as pointed out earlier, neither has sufficient membership and finances to support an effective program.

• Manufacturers' warranty programs, parts distribution practices, product design and other areas over which the servicing technician has no control cause problems that, to the uninformed consumer, appear to be the result of improper servicing methods or lack of cooperation on the part of the servicer. An effective nation-wide consumer-education campaign is one immediate solution to this problem, but, again, no service organization has the necessary finances for such a program. Closer liaison with manufacturers to promote alleviation of such problems by the manufacturers themselves is being attempted, but again, not by a representative element of the service industry.

Other Problem Areas

ELECTRONIC SERVICING, during the year, also has attempted to provide you specific facts about some of the problem areas that are elements of the major areas discussed in the foregoing para-

graphs. These include manufacturers' warranty programs, technician licensing and service-labor pricing.

Warranty and the Service Technician—Lack of consumer understanding of poorly phrased warranty terms, excessive paper work, inadequate warranty labor reimbursement, no allowable profit on parts replaced under warranty and alleged chronic unavailability of parts are the prime factors that have made most warranty servicing a nightmare for shop owners and technicians. As reported in the September issue of ELECTRONIC SERVICING, some of these problems are being alleviated by more liberal labor and parts reimbursement policies of some manufacturers' new warranty programs. However, many servicers still are critical of the extended periods of some warranties, which in many cases effectively remove the service of such items from the hands of the independent for the length of the warranty period.

72% of full-time technicians responding to the ES reader survey said their shop did some warranty servicing.

Technician Licensing—The status of this controversial issue among technicians was reported on in depth in the July issue. Adverse consumer reaction to the activities of a relatively small number of incompetent technicians and fraudulent shop owners and managers continues to plague the majority of the industry. To date, industry efforts at self-policing through service association programs have proven ineffectual by themselves because of the lack of majority representation by either of the national service associations. The other alternative, city or state regulation, has been adopted by five states and six cities, and generally has been judged as being at least partially effective in ridding the industry of the small segment of undesirables. However, with such government regulation comes a partial loss of independence—a loss that a vocal, if not large, group of shop owners and technicians cannot tolerate. Consumers, on the other hand, favor government regulation of electronic servicing because it allegedly provides them a degree of protection and, under most licensing laws, a responsive and impartial body to which they can address their grievances.

75% of full-time shop owners and technicians responding to the ES reader survey said they favor some form of licensing or certification of technicians.

Service Labor Pricing—Inconsistent pricing continues to rank high on consumers' lists of gripes about the electronic servicing industry. Differences in shop operating techniques that affect efficiency and operating expenses are expected to produce rates that differ from one shop to another; however, drastic differences in prices charged different customers for identical service by the same shop produce consumer reaction that gives the industry a black eye. Failure to establish a firm rate of charges is usually the result of a failure to keep an accurate account of operating expenses, which is essential to establishing a realistic and profitable rate of charges.

Departures From Traditional Approaches To Servicing Reflect Different Methods of Solving Mutual Problems

Different approaches to the business of servicing consumer electronic products have evolved, in part, as a result of attempts to solve or lessen the effects of the major problems confronting the industry. To date, five distinct approaches to servicing have been observed:

- Traditional one-to-four-man, low-volume independent shop
- High-volume, independent business operating out of one shop
- Franchised, high-volume chain operation
- Manufacture-owned and -operated service centers
- High-volume, multi-shop operation specializing in warranty and contract servicing

During 1969, ELECTRONIC SERVICING has analyzed successful business firms which we feel are representative of these existing approaches to servicing. In each case we have attempted to focus in on the management philosophies and techniques and the shop operating procedures that we feel were most responsible for the success of these businesses in adapting to the problems and demands of today's consumer electronic servicing market.

• *Traditional Low-Volume Independent Shop Prevails Yet*—According to information gained from the survey of readers conducted in the January issue, the majority of service shops in operation today continue to be small, low-volume businesses employing four men or less, with the owner or manager also actively engaged as a technician because the volume of business is not sufficient to support a full-time manager.

• *High-Volume Independent Shop Separates Management From the Bench*—A close look in the January issue at an independent service shop that has attained an annual gross volume of over a half million dollars revealed that, if a shop is to grow, management must be freed from the service bench to permit adequate time for planning and implementing effective operating policies and procedures. Devoting full time to management has enabled John Sperry, owner of Sperry TV, Lincoln, Nebraska, to develop an efficient operating system that meets today's challenges. Specialization of technicians overcomes the problem of product and design proliferation and improves shop productiveness. High shop efficiency and a realistic labor pricing schedule insure sufficient shop income to adequately compensate technicians. Technician incentive programs and continuing training help promote and maintain a high level of productiveness.

Now there is a better Color-Bar Generator for your servicing work

THE RCA WR-502A.

New . . . solid state . . . battery or AC operated . . . portable, weighing only four pounds.

The RCA WR-502A "CHRO-BAR" color-bar generator provides *six* separate test signals: color bars, dots, cross-hatch, vertical lines, horizontal lines, and blank raster.

The sound carrier, pattern, RF output, and color subcarrier are all crystal controlled. Designed for exceptional stability with no flicker.

Included as part of the package — at no extra cost — is an AC adaptor for line operation. This unit was formerly available only as an accessory at a cost of $9.00*.

The new CHRO-BAR Generator WR-502A, complete with separate AC adaptor — now only $148.50*.

RCA Electronic Components, Harrison, N. J. 07029.

* Optional Distributor resale price.

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• *Franchising Offers Management and Bookkeeping Assistance and a Marketable Name That Can Improve Volume*—Any effective franchise system offers at least one prime advantage: A name in which consumers have confidence. This advantage, if realized, can help overcome the poor image of consumer electronic servicing. An Indiana-based franchise system that has established a chain of high-volume service centers in five market areas, and is projecting expansion throughout the continental U.S., was examined in the March issue. Service centers in the chain are owned by independent operators. Consumer confidence in the firms' name reportedly is attained by offering a uniform quality of service through professional-appearing shops manned by professional-appearing personnel, and by giving the customer an accurate estimate of the cost of service before it actually is performed. Competitive pricing and a sufficient margin of profit to permit paying technicians well reportedly are assured by an efficient operating system that is geared to produce high volume with a minimum of skilled personnel. More effective use of skilled personnel is this system's answer to the shortage of technicians.

Electronic Processing of Management Data and Restricting Servicing To Their Own Brand Are Key Factors That Favor Manufacturer Owned and Operated Service Centers—An analysis of two major manufacturers' systems of service centers in the April issue emphasized the fact that manufacturer-owned and operated centers face about the same problems as the independents, although it is probable that they also have an advantage in the areas of parts availability, technician salaries and fringe benefits, their ability to absorb the cost of training apprentices from scratch, and sale of service contracts through manufacturer-franchised retail dealers.

Diversification, Realistic Prices That Reflect Accurate Cost Accounting and Preoccupation With Customer Relations Help Make Warranty and Contract Servicing Profitable—Careful cultivation of customers to assure a high percentage of contract renewals, servicing of air conditioners in summer to offset seasonal slump in servicing of home entertainment electronic products and establishment of prices that assure profit regardless of nuisance calls inherent in such servicing are the prime factors that have enabled a Chicago-based firm to build a $1 million annual business on warranty and contract servicing, as reported in the November issue. Other factors responsible for this high volume include: an operating system that makes effective use of skilled technicians, establishment of branch operations to reduce travel time, close scrutiny and follow up of parts availability and related problems and an enforced system of prescheduled delivery that lets the customer know exactly when the set will be returned.

Of those full-time technicians and shop owners who responded to the ES reader survey, 72% said their shop performed some warranty servicing, while 69% said their shop did *not* offer service contracts.

Conflicts and Lack of Majority Representation Reduce Effectiveness of Two National Service Associations

Analysis of the organization, objectives, and active programs of the two existing national service associations was presented in the May issue. The annual convention activities of both associations—the National Electronics Association (NEA) and the National Alliance of Television and Electronic Service Associations (NATESA)—were reported in the September and October issues, respectively.

The effectiveness of both national associations is reduced by three major factors:

- Continuing conflicts involving policies, principles, programs and personalities.
- Duplication of costs and effort on many projects.
- Lack of active representation and participation of majority of full-time shop owners and technicians. Neither association has a large membership; the combined membership of both national associations reportedly represents less than 30% of the full-time shop owners and electronic technicians in the industry. Only 28% of full-time technicians and shop owners responding to ES reader survey said they belong to a service association—and some of these probably do not belong to a national association.

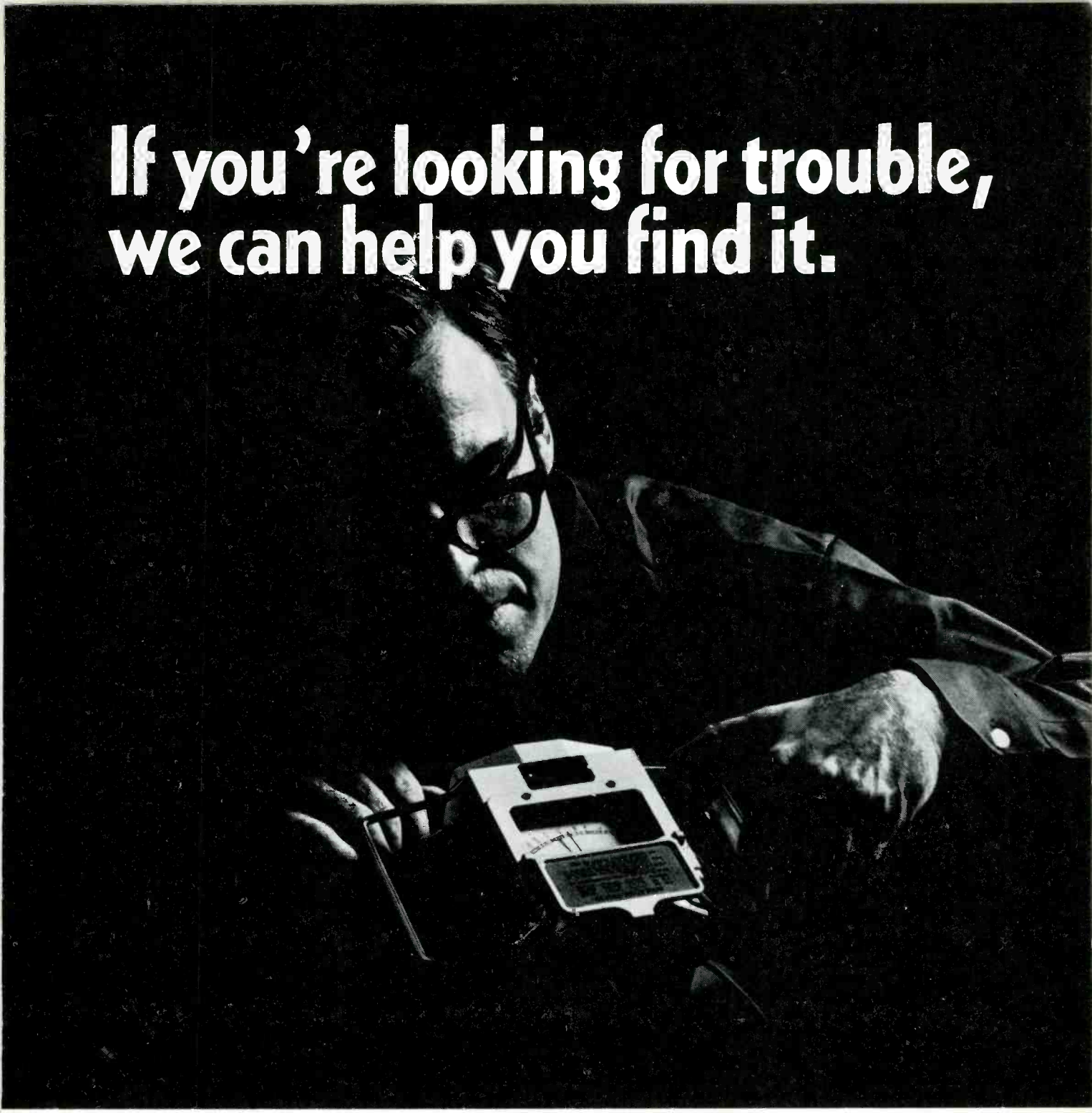
Both national associations have many sound programs that could prove effective against many of the service industry's ills if properly backed by the numerical and financial weight of the majority of the servicing industry. However, petty bickering and personality clashes continue to stand in the way of reason, although some responsible members of both associations have attempted to bring up for discussion the subject of unification of the two associations. Meanwhile, many members of the servicing industry are denied the benefits of representation by a national alliance or association that speaks and acts for the majority of the servicing industry.

Coming Up In ES In 1970

ELECTRONIC SERVICING in 1970 will continue to probe, analyze and report to you about the developments, conditions and trends that affect consumer electronic servicing, as well as continuing to provide practical information about business management, shop operations and diagnostic techniques.

Technician training and parts availability are two vital areas that ES will report on in the first issues of 1970. First-hand reports of different approaches to servicing and the opinions about key issues expressed by various shop owners and technicians throughout the country also will begin appearing in the first issues of 1970. ▲

If you're looking for trouble, we can help you find it.



Now there's a way to get to the trouble before it gets to you. A portable, easy to use way to check insulation and conductance. To locate shorts and defective electrical connections. To detect breakdowns and conductor failures, even those difficult intermittents.

It's called the Hitachi E-17 Insulation Tester. And quite simply, they can test almost any type of electrical operation in a huge variety of fields, from TV equipment to home construction.

The E-17's are self-powered, so you can simulate tests without a system's own voltage being connected. So it can safely save thousands of hours in locating defects. It will read out on a calibrated meter insulation leakage from 5 ohms to 10,000 megohms. Built to industrial standards, it is highly resistant to shock, vibration and external magnetic fields. And though the E17's weigh only 6 lbs., they generate up to 2500 volts, and need no external power or batteries.

If you're in electronics or electrical maintenance or repair, look out for trouble. The E-17's are the instruments to help you find it. And find it fast. Anywhere, any time, in any kind of situation. And that's the next best thing to no trouble at all.

Look for trouble before you have to. Call or write JPC for information on the full line of Hitachi E-17 Troubleshooters.

Japanese Products Corporation, 51 Cliff Street, New Rochelle, N.Y. 10801/Tel: (914) 636-8830

testequipment

notes on analysis of test instruments, their operation and applications

Dual-Beam Oscilloscope

Tektronix, Inc. has introduced a non-plug-in oscilloscope. The Type R5030 is a dual-beam, high-gain, differential and current input, low-frequency oscilloscope.

Tektronix states that while adding more capability, the design stresses usability. Sections of controls are color-coded to outline functions; switching is simplified; scale factors are read out via fiber optics; and the viewing area of the CRT is increased by 50% over conventional 8 cm x 10 cm CRT's, it is stated.

Each beam has a full scan of 8 cm x 10 cm divisions (1.27 cm per division). Readouts indicate current

or voltage deflection factors plus the time as set by the deflection controls. If any controls are in an uncalibrated position, the variable knob will show red and a "greater-than" sign will appear in front of the scale-factor readout. A LOCATE function, associated with the time-base magnifier, reportedly allows the operator to pick out where on the trace he has chosen magnified sweep.

The trigger circuit is simplified by the addition of a peak-to-peak auto circuit and a combined trigger level/slope control, according to the manufacturer. Beam finders on the intensity controls and lamps that indicate the operating mode are also included in the design.

The Type R5030 is specified as a dual-beam oscilloscope having 10 μv/div sensitivity, differential inputs for each beam with 1000,000:1 common mode-rejection ratio, current probe inputs for each beam with deflection factors of 1 ma to 200 ma/div and a constant bandwidth of 1 MHz at all deflection factors.

The Type R5030 is available as a rackmount instrument that requires 5¼" of rack, or as a low-profile cabinet model. The price is $1850.00.

Circle 55 on literature card

Portable Tester/Color-Bar Generator

Sylvania Electric Products Inc. has introduced a combination portable solid-state tube tester and color-bar generator.

It is reported that the 73-socket tube tester can check all of the popular U.S. and foreign-type receiving tubes used in home entertainment electronic products. Sylvania states that the tester, in three steps, will test dynamic power output, leakage and shorts, gas and, in the case of multi-section tubes, it will test each section individually.

The color-bar generator portion of the unit provides six patterns: a clear raster, color bars (a 10-bar keyed rainbow), 10 vertical lines, 13 horizontal lines, a pattern of 130 dots and a 10 x 13 cross-hatch pattern.

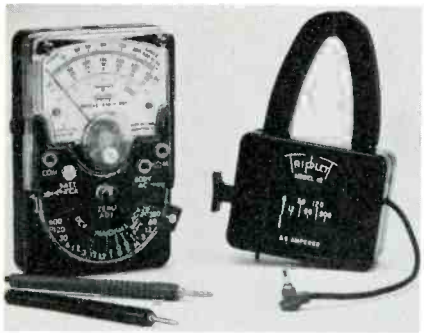
The unit, housed in an attache-type case, weighs 27 lbs. and operates on 105 or 125 volts. The cost of the unit, with all test leads included, is $299.95.

Circle 56 on literature card

Miniature FET VOM

Recently introduced by the Triplett Electrical Instrument Company is their Model 310-FET, a small battery-operated volt-ohm-milliammeter utilizing field-effect-transistorized circuitry to provide a 10-megohm constant input resistance on all DC voltage ranges.

DC voltage ranges are: .3, 1.2, 6, 30, 120, and 600 with a full-scale accuracy of 3%. AC voltage ranges are: 3 (separate scale), 12, 60, 300, and 600 with a sensitivity of 5,000 ohms per volt and an accuracy of 4%. Two DC current ranges are provided, 0-120 microamperes and 0-1.2 microamperes. The four resistance measurement ranges are X1, X100, X10K and X1M, with 50 ohms in the center of the X1 scale. There is provision for attaching an AC clamp-on meter for measuring the current in AC power wiring. The internal 7-volt and 1½-volt batteries may be tested by the meter without additional accessories.



This meter weighs 14 ounces and measures 2¾" x 4¼" x 1⅛". Model 310-FET is priced at $70 net, complete with test leads. ▲

Circle 57 on literature card

TROUBLESHOOTING TIP?

If you've recently run across an unusual trouble symptom and have determined what caused it, pass the info on to other readers by sending it to:

Troubleshooting Tip,
Electronic Servicing
1014 Wyandotte Street,
Kansas City, Mo. 64105

When the troubleshooting tip is published, you will receive a check from ELECTRONIC SERVICING for sharing your servicing experiences with other readers.

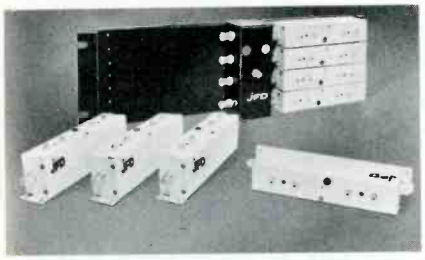
antenna systems report

Solid-State "82" Channel AGC Modules

A series of single-channel, solid-state AGC modules for all UHF and VHF channels has been developed by JFD Electronics Corp./Systems Division.

According to JFD, the versatile automatic gain control units can be used to improve TV reception in any MATV or CATV Head End. It is stated that the modules maintain constant output (±1.0 dB) with input signal voltage variations as great as 20 dB, while providing up to 25 dB gain.

Completely self-contained, the



AGC units can be used with broadband or single-channel amplifiers and antennas. It is also reported that they can be used individually as AGC strip amplifiers, providing 25 dB gain and up to 50 dB output.

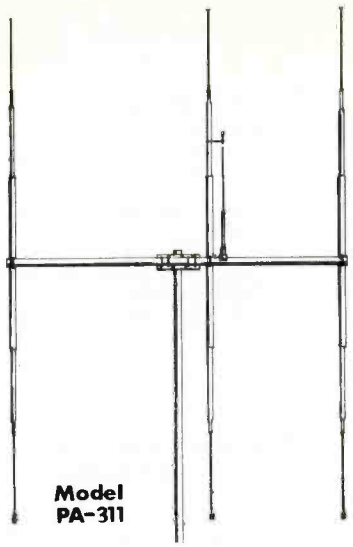
The units incorporate IC's and field-effect transistors. VHF modules can be used with JFD's Model 8201 mixing base, and UHF modules can be used with their Model 8290 mixing base. Both UHF and VHF channels can be combined by using Model 8200.

There are 82 AGC modules, Models SL-3302 through SL-3382. The last two digits of the model number indicate the channel number. The units list for $75.00.

Circle 58 on literature card

Three-Element CB Beam Antenna

Mosley Electronics, Inc., has announced a new deluxe three-element beam antenna for Citizens Band radio. The Model PA-311 Paragon Beam features a three-piece boom and balanced elements with swaged tubing to reduce vibration in the wind, it is reported. Mosley also states that its improved gamma



matching system includes a molded base and connector for greater convenience and durability.

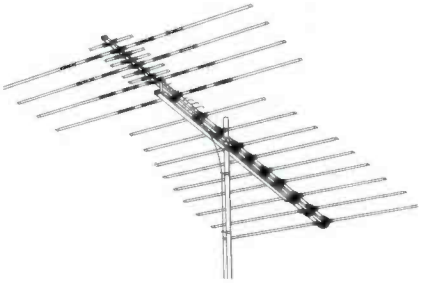
Specifications:

- Forward Gain: 8 dB compared to reference dipole; 10.1 dB over isotropic source
- Front-to-Back Ratio: 24 dB
- SWR: 1.5/1 or better.
- Type of Match: Gamma
- Feed Point Impedance: 52 ohms, nominal
- Radiation: Uni-directional
- Maximum Element Length: 19′ 2½″
- Boom Length: 12′
- Assembled Weight: 11 lbs.

The cost of the Paragon Beam Model PA-311 antenna is $46.65.

Circle 59 on literature card

All-Channel TV Antennas



Jerrold Electronic Corp. has introduced a series of television antennas that reportedly provide improved color and monochrome reception on all channels of VHF and UHF and strong, clear radio reception on the FM band.

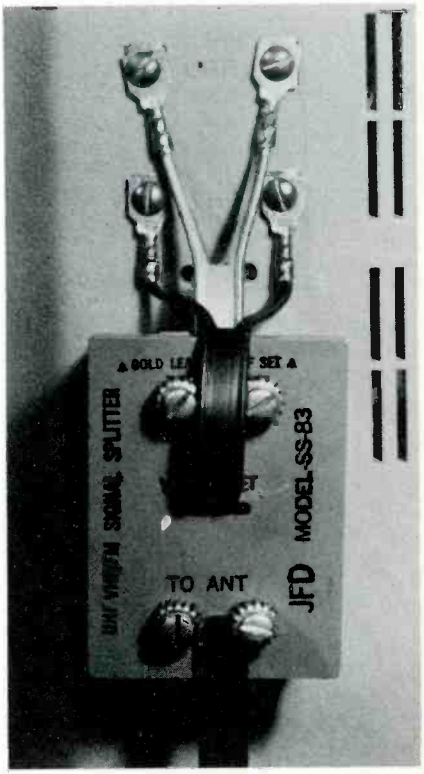
It is stated that improved electronic design of the VUfinder Plus antennas results in better pictures on the most significant UHF and VHF bands than those provided by comparable antennas, as confirmed in field tests.

The five models in the series, available for direct 300-ohm installation and convertible to 75-ohm operation by means of snap-on transformers, are designed for use in areas with signal strengths classified from "local" to "deep fringe".

The antennas are compact, lightweight and factory preassembled for easy and secure mounting on a mast. An optional extra "Power Zoom" UHF element, available at $4.95, can be used to increase gain an average of 35 percent on difficult channels, it is reported. The VUfinder Plus antennas range in prices from $21.95 to $64.95.

Circle 60 on literature card

UHF/VHF/FM Signal Splitter



This new JFD signal splitter, Model SS83, provides three separate twinlead outputs (UHF, VHF and FM) from a single 82-channel twinlead input.

The SS83 is said to have less than 1 dB insertion loss, 18 dB isolation between outputs, and response that is flat within ±0.5 dB over the TV and FM bands. The signal splitter easily can be attached to the back of any TV receiver with "instamount" adhesive.

Model SS83 signal splitter lists for $4.95.

Circle 61 on literature card ▲

Don't sell a color picture tube unless its been on a test ride.

Down at the bottom of the page, you have a major advance in space-age homeliness.

And a major advance in color tube testing as well.

That machine squatting down there is our beloved Iron Horse, the fully-automated, revolving carousel we use to test our color bright 85® tubes for emission, gas leakage, shorts, arcing and screen uniformity prior to shipment.

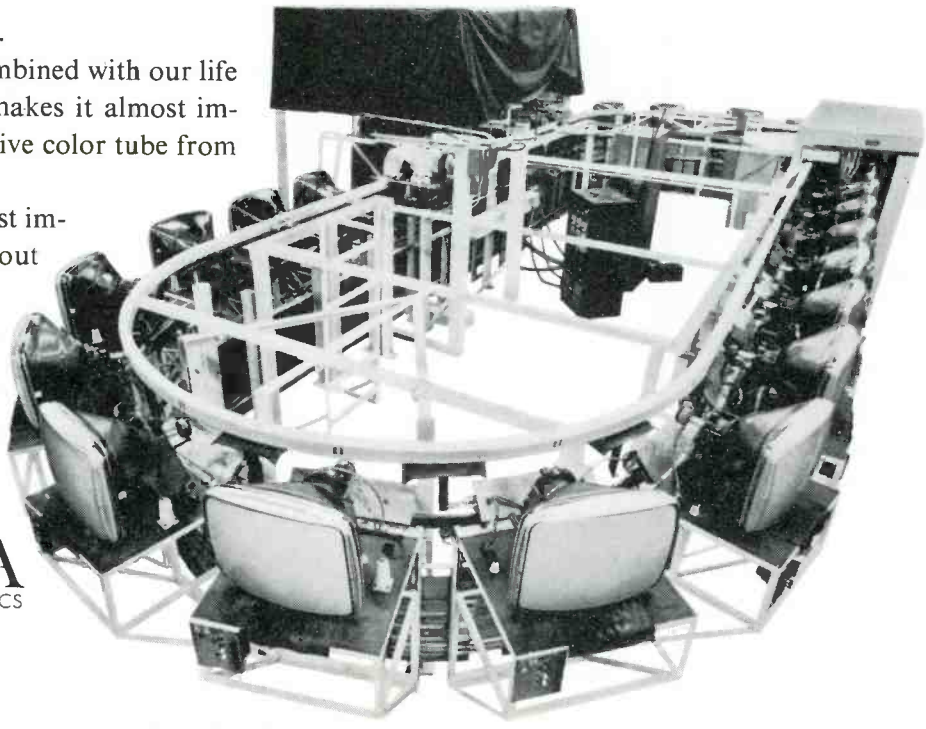
Now we don't intend to go into a song and dance on how total automation reduces testing error.

But we will tell you one thing.

Our Iron Horse test ride, combined with our life testing and 100% set testing, makes it almost impossible for you to get a defective color tube from us.

Which in turn makes it almost impossible for you to get chewed out by a customer.

Next time you need a color replacement tube, remember the great thing about the color bright 85. We don't send it to you till it's been around.



SYLVANIA
GENERAL TELEPHONE & ELECTRONICS

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The only complete SWEEP & MARKER GENERATOR

$395.00 (Lowest price going on a complete crystal controlled generator and marker combination)

ALL SOLID STATE- INSTANT ON

FREE WITH YOUR SWEEP AND MARKER:

80 full color reproductions direct from Sencore technical training film clearly depicts alignment from beginning to end using SM152. Pictures are numbered so you can review a section at a time if you are in trouble. 35 minute LP record direct from film clearly leads you all the way. Also packed with each SM152. Numbers are announced for each picture so you can review a section when necessary.

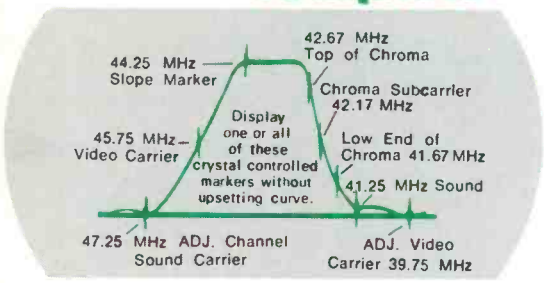
SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

ONLY GENERATOR THAT GIVES YOU A COMPLETE IF, CHROMA, ALL CHANNEL VHF, UHF AND FM ALIGNMENT SIGNALS IN ONE UNIT

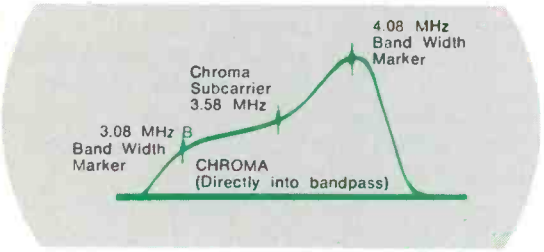
complete IF SWEEP AND CRYSTAL CONTROLLED MARKERS



View the complete IF response curve with full 15 MHz sweep width (competition has only 12 MHz, restricting view on RF and some solid state receivers that have extra traps). Press one or all of the crystal controlled marker push buttons without upsetting response curve. Post injection is used all the way to prevent overloading the TV receiver. Crystal markers are provided for all critical check points as shown on the response curve. Also sweeps 20 MHz IFs as found on older sets and new import color sets. Major competition does not cover these frequencies. Special spot align position converts the sweep generator to a regular signal generator for spot alignment or dipping odd traps. Only Sencore goes all the way.

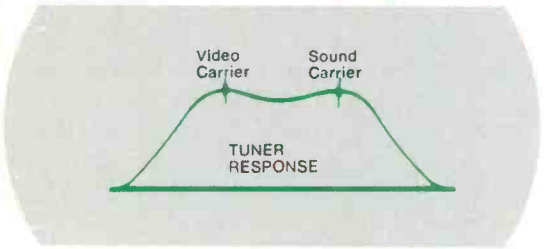
Note that Sencore has a base line giving you a reference to zero. Competitive models do not.

complete CHROMA SWEEP AND CRYSTAL CONTROLLED CHROMA MARKERS



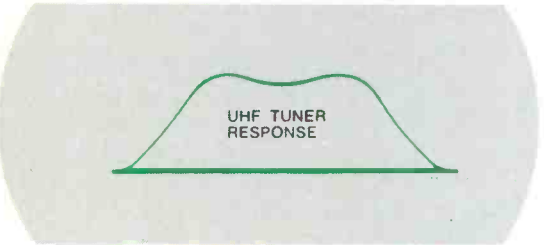
You can inject the chroma signal directly into the chroma amplifiers as shown here or through the IF amplifiers for a flat response. You are equipped to follow manufacturer's recommendation either way. Injection directly into the chroma amplifiers is a must for fast trouble shooting of color circuits.

complete ALIGNMENT SIGNALS FOR VHF TUNER OR OVERALL ALIGNMENT



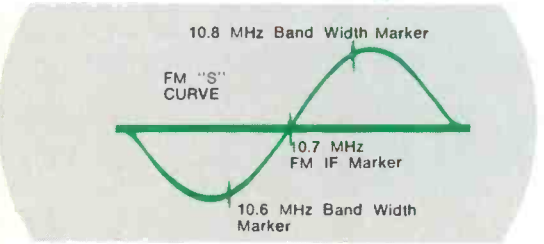
The SM 152 sweeps all of the VHF channels for complete tuner check from channel 2 through 13. Competitive models sweep only two VHF channels. Push button markers are provided for channels 4, 5, 10 and 13 for both the video carrier and the sound carrier. The second low and high channels are available in case you have a station operating on the same channel . . . which will cause the patterns to be upset. You want to align on an unused channel and check it on the channel in operation for best results. Only Sencore goes all the way.

complete UHF SWEEP FROM CHANNEL 14 THROUGH 82



After completely aligning a TV set, you'll want a complete check on the UHF tuner to be sure that it is operating on all channels. Markers aren't necessary as you just view the RF or over-all curve to see that the curve looks the same as the VHF and output remains reasonably constant. Only Sencore has UHF output; all new tuners are required to cover all UHF channels and you will come up short if you own any other alignment generator than the SM 152. A UHF sweep generally costs hundreds of dollars more.

complete FM SWEEP AND CRYSTAL CONTROLLED MARKERS



You won't be stopped with just TV alignment. You can align the IF amplifiers of the FM receivers with the 10.7 MHz crystal for maximum as indicated in service manuals. Then, throw on the scope and sweep the amplifiers and view the "S" curve if you have stereo. Two markers, 100 KHz above and below the 10.7 MHz mark the limits of the curve for good stereo. You can align the front end of the receiver too. Competitive units cover only the IFs and you find the job only half done.

There are other features too numerous to mention that makes the Sencore SM152 the most complete sweep and marker generator on the market. Ultra linear sweep, covering all frequencies that you need, from 10 MHz to 920 MHz, exclusive calibrated sweep width that is constant on all channels and RF calibrated output for circuit trouble shooting are only a few of the things that places the SM152 in a class by itself. Dare compare and you'll see your distributor today for a good look at the SM152.

Circle 19 on literature card

Dale's service bench

by Allan Dale

Which Type of Scope—Recurrent or Triggered?

Facts to help you decide which type of scope is best suited for servicing home-entertainment electronic products.

If you're planning to get a new scope, you have an important decision ahead. Should you buy an ordinary wide-band service scope or one of the new triggered-sweep jobs? It depends only partly on how much you plan to spend. Some triggered models now cost only a little more than a top service scope.

As you may have guessed from my September column, I prefer the triggered type for my own work. Odd waveshapes can be locked in steadier. Frequency response is usually wider and flatter, without humps and irregularities near the ends.

Your dilemma boils down to: Should I pay the extra money for a triggered scope? There is no pat answer. But there are some comparisons I can help you make. Then you can decide for yourself.

Another Way of Thinking

The first thing you'll notice about a triggered scope is its unfamiliar dial labels and markings.

Take the sweep-frequency knob, for instance. It may be labeled "Time Base" or something like that instead of "Sweep". And, instead of being marked with frequencies as it is on a common scope, the sweep dial is marked with increments of time, like in Fig. 1. Each marking tells the duration of each sweep of the CRT beam across the scope face.

Suppose you set the sweep dial for 5 milliseconds per centimeter (5 msec/cm). If the scope graticule is 10 cm wide, the full-width trace takes 50 msec from start on the left edge to finish on the right. The scope's base line, or trace, is 50 msec wide. At that time-base setting, the scope displays three cycles of 60-Hz signal. That's because each cycle is about 17 msec in duration.

With the dials set for 20 μsec/cm, a trace 200 μsec wide fills the graticule. Three cycles of 15,750-Hz TV horizontal-line waveform fit into that width with a little space left over. Each horizontal-rate cycle is about 64 μsec long.

So you have to gear your thinking to the **duration** of waveform cycles instead of to the **frequency** at which they recur. But it's not hard to get used to.

In place of a "Sync" control, the triggered scope has two knobs—marked "Stability" and "Trigger" (Fig. 2).

The first one keeps the scope beams and sweep cut off when there's no input signal. It biases off the time-base generator. Setting it is simple. With the ground lead clipped to the probe tip, set the Stability knob till you see the base

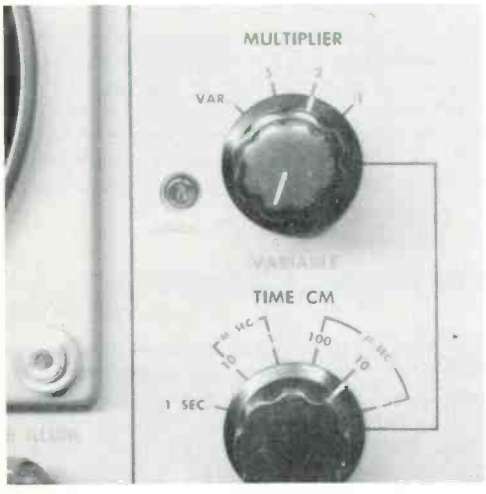


Fig. 1 Time base controls of triggered scope take place of frequency selector of recurrent-sweep scope; determines length of time sweep takes to move beam across face once.

Fig. 2 Concentric Stability and Trigger Level controls take place of Sync control or switch on ordinary servicing scope.

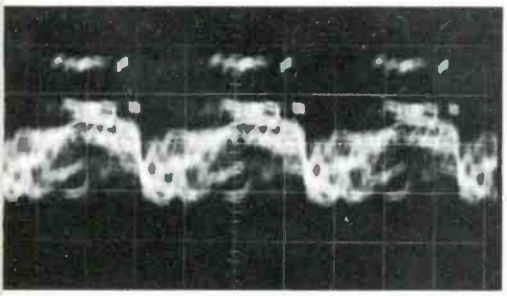
Fig. 3 Video waveform doesn't lock in tight if trigger polarity is wrong (A).

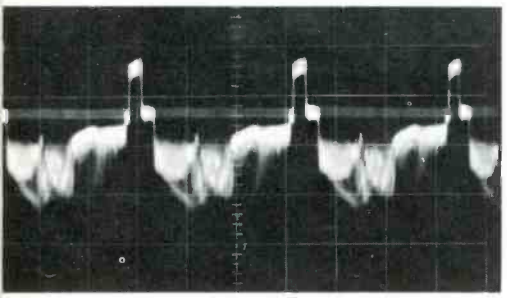
Positive polarity of sync pulses (B) means Trigger Level control must be set in positive direction.

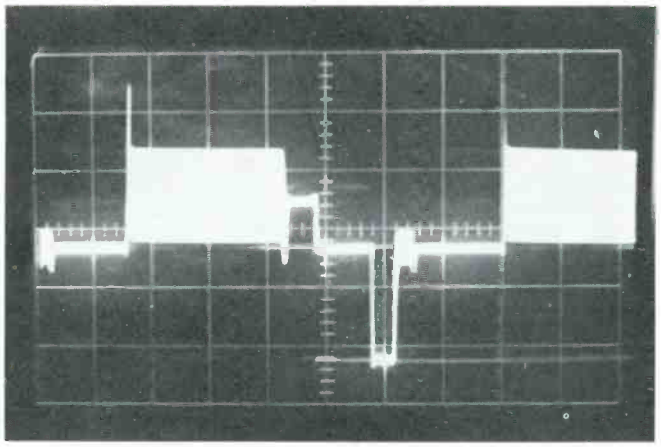
line. Then turn the knob back till the trace disappears. Don't quench it too "deep" or the generator won't trigger when you want it to.

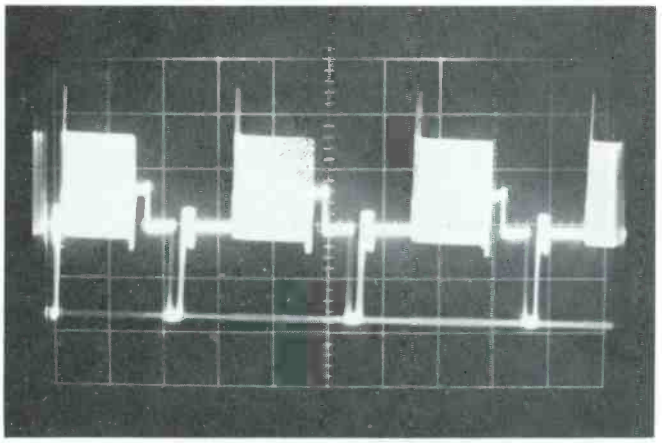
The Trigger knob, often called "Trigger Level", lets you choose where the trace starts on the waveform. The scope triggers best on a fast-rising leading edge. But you set how high on the waveform it starts by adjusting the Trigger control. Try it. With an input signal fed in, adjust the Trigger control to start the trace at whatever point on the waveform's leading edge you want.

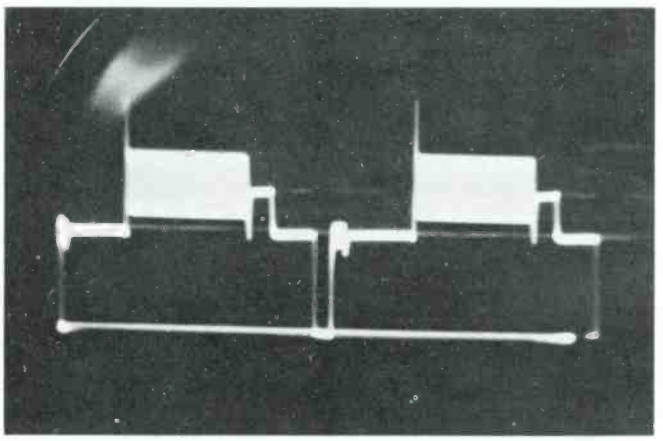
With video waveforms you have to choose the trigger point carefully. If you set the level too low, any of the lower-level video can trigger the sweep. The display won't stand still (Fig. 3A). Triggered at a higher level, up on the sync pulse, the display locks in solid (Fig. 3B). With triggering level set too high, above the tips of the sync pulses, the trace











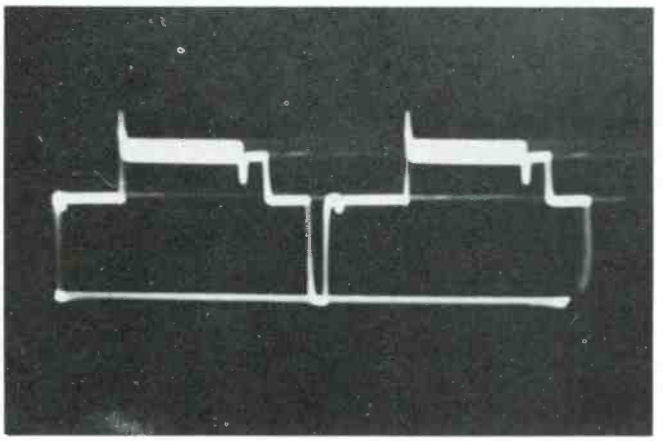


Fig. 4 NTSC color bar pattern locked in on (A) high-quality triggered scope; (B) medium-quality triggered scope; (C) wide-band service-type scope; and (D) narrow-band scope.

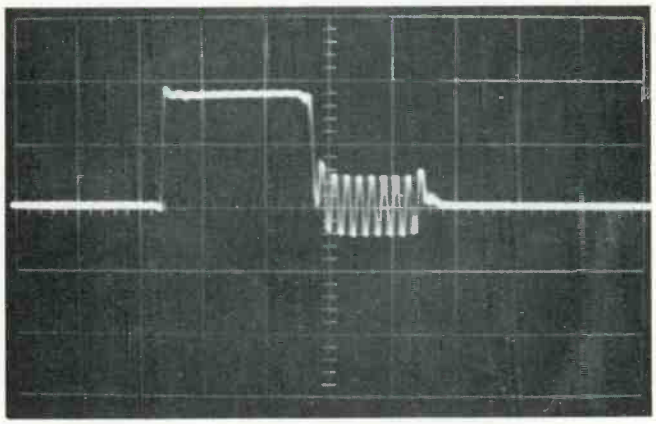
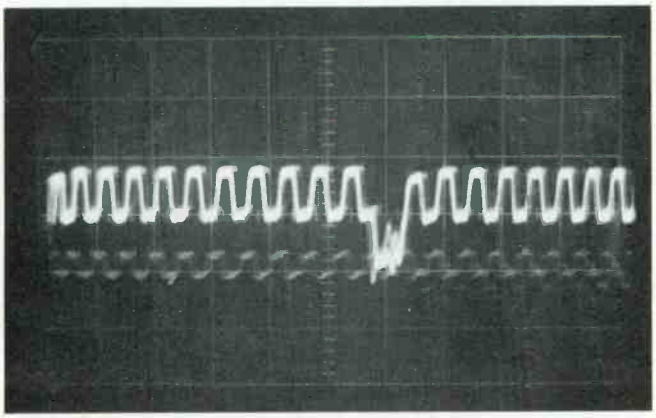
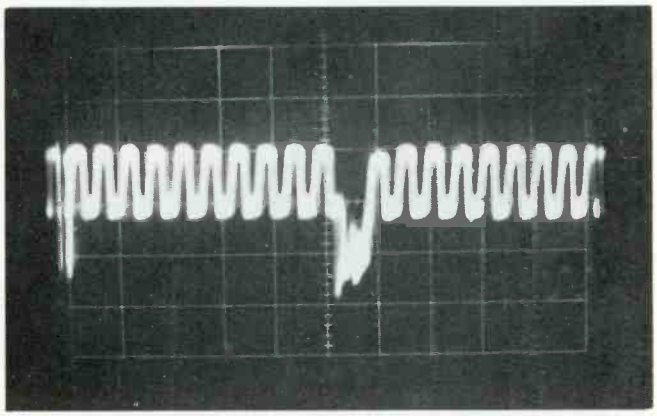


Fig. 5 Using expander or magnifier controls or switches, you can spread out some small portion of waveform for close inspection. This is 3.58-MHz color burst, but scope time base is set for TV lines (10 μsec/cm without X5 expander).





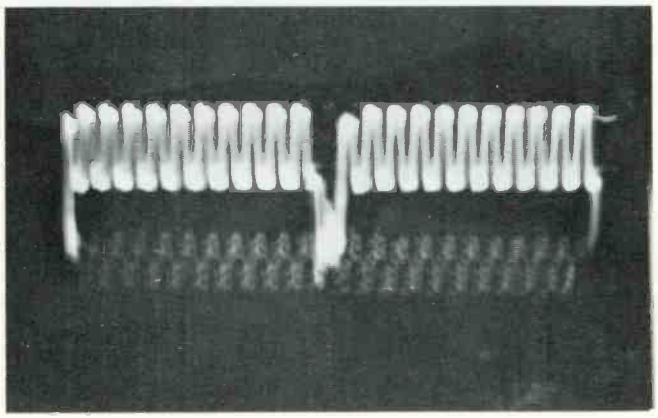


Fig. 6 Keyed rainbow signal taken from video detector, displayed on (A) high-quality triggered scope; (B) medium-quality triggered scope; and (C) wide-band recurrent-sweep service scope.

disappears because the time-base generator can't trigger at all.

So be prepared to think of duration of the cycle (or pulse) and time-base instead of frequency, and of triggering **level** instead of sync strength. Once you've made the transition, you'll find you understand waveforms better, too. Waveform duration and shape is more important to troubleshooting than frequency.

The Matter Of Bandwidth

An argument over what bandwidth means in a scope can go on and on. Some technicians don't think it's worth worrying about. However, it's for you to judge for yourself; the following discussion will help you decide.

Extended response is useful in a scope only if it's flat. One way some scope designers boost high-frequency response is by over-peaking. But this introduces two problems: (1) The response curve has peaks and valleys which distort certain waveforms. (2) The low end is usually neglected, giving an unwanted tilt to the curve and sometimes cutting off important low frequencies. The result of either is an untrue waveshape.

The waveform photos in Fig. 4 are from four different scopes. The waveforms in each are an NTSC color bar, complete wtih horizontal sync pulse, and with a color-sync burst on the back porch of the blanking pedestal. (For an explanation of this waveform, see my column in the September issue, page 19, Fig. 2.)

Notice how square and sharp the corners are in Fig. 4A. This is the waveform as you see it on a triggered scope with excellent, flat bandwidth—almost to 8 MHz. You can even see plainly the spiked overshoots that are characteristic of the generator producing this waveform.

Shown in Fig. 4B is a photo taken from a triggered scope with poorer bandwidth. You can see the difference immediately. Also, this scope doesn't have the definition and trace clarity the first one does. As I hinted earlier, not all triggered scopes have extra bandwidth and quality.

The photo shown in Fig. 4C is taken from a recurrent-sweep scope. It's a good-quality scope, with wide bandpass. However, the quality ob-

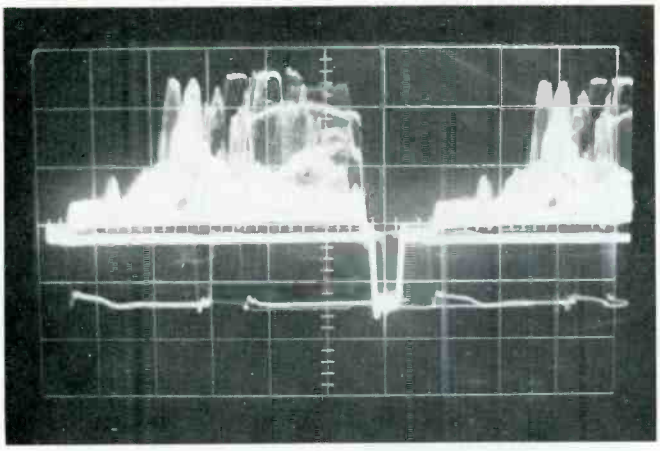
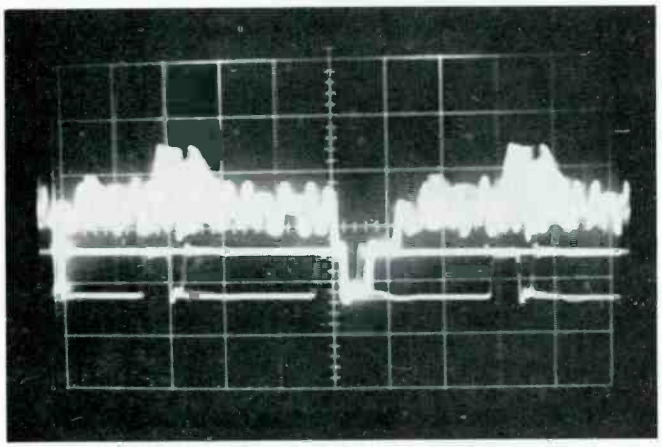
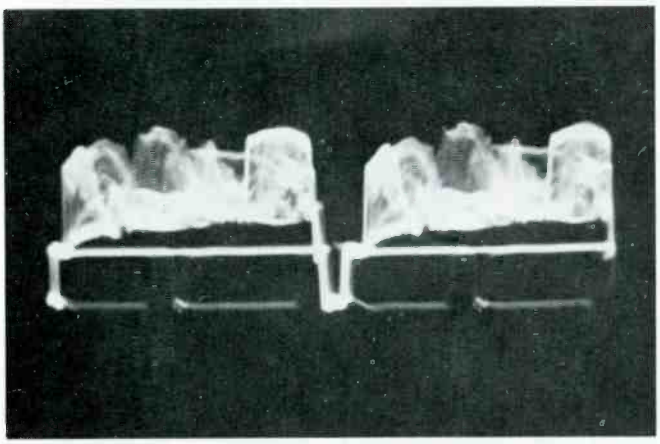


Fig. 7 Video waveform at video detector, with station signal.

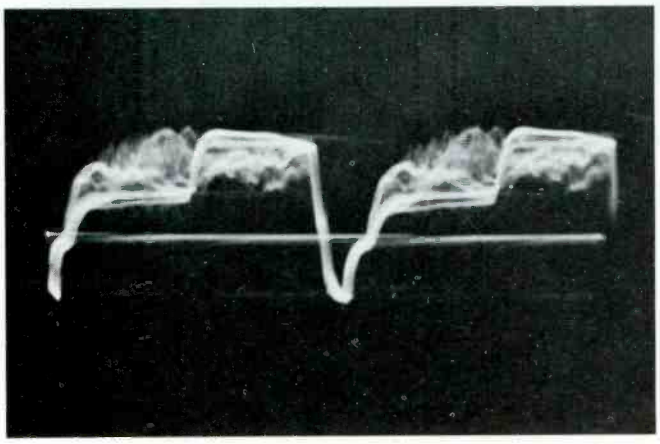
(A) On top-quality wide-band triggered scope;



(B) on plain, triggered scope;



(C) on wide-band service scope;



(D) on cheaper scope.

viously isn't up to the first scope, although the display is just about as good as on the second triggered model. Something you can't see in the photo, though, is how much more difficult it is to lock in the trace on the recurrent scope.

Shown in Fig. 4D is an example of an old-fashioned recurrent scope. Bandwidth is narrow, and the trace isn't really stable. Notice the rounding off that distorts the waveshape. Most important, notice how little of the 3.58-MHz chroma signal shows. No kidding, it's the same waveform I used for all the other photos. If your shop scope cuts down a waveform like that, get rid of it (or fix it).

For Practical Purposes

If your scope has bandwidth and stability, you can use some of the trace-expanding devices triggered scopes have to examine waveforms in detail. Fig. 5 shows the NTSC waveform, viewed on the screen of the best of the scopes mentioned in Fig. 4, spread out so you can see the color burst close up. You do this with an extra time-base control usually marked "X5" or "Magnifier". One version of this control is visible at the top of Fig. 1.

But the question keeps arising: How important is that extra bandwidth for practical servicing? To show you the differences, I fed a keyed-rainbow signal into a color receiver. One by one, I clipped the three wide-band scopes at the output of the video detector. You can examine the results in Fig. 6. These demodulated versions of the color bars show the advantages of scope quality. The waveform in Fig. 6A is quite clear on the better triggered scope, with nice square corners. The waveform taken with the other triggered scope (Fig. 6B) is okay but isn't as sharp as the first. The waveform obtained with the recurrent-sweep scope (Fig. 6C) is almost as good as that produced by the poorer of the two triggered models, but it isn't locked in as steadily.

A final test is how the different scopes respond to the video waveform from a station signal. The results are pictured in Fig. 7. The photo in Fig. 7A is from the best scope, the photo in Fig. 7B is from the lesser triggered model. The photo in Fig. 7C is from a wide-band recurrent-sweep scope. The one shown in Fig. 7D was obtained

using the old narrow-band job—the kind you should not try to use for TV servicing.

Television Alignment

If you're worried you can't use your triggered scope for sweep alignment, forget it. There's no problem. You connect it just as you do with an ordinary scope. Turn the Horizontal Display switch to External, and feed the horizontal signal from the sweep generator to the Horizontal Input terminals.

The vertical input, you handle the same, too. Just set the input attenuator for about 0.5 volts/cm. That way, a 3-volt sweep curve from the video detector of a TV set makes a display about 4 cm high. The curve looks the same as on a regular service scope.

And So . . .

The advantages narrow down to only a few, but they're important ones. With a scope like the best one mentioned here, you can really **see** waveshapes in home-entertainment instruments. And the triggered feature makes it easier to use than a recurrent scope. Once you've adapted your thinking to the new approach and become familiar with the controls, you'll be as sold as I am on triggered scopes for servicing. The slightly higher price is worth it, as far as I'm concerned.

I've written this extra column about triggered scopes because they are an exceptionally popular topic of conversation among technicians now. Your editor has been asked for more information, I've been asked, and other writers and teachers tell me they regularly hear questions about triggered scopes.

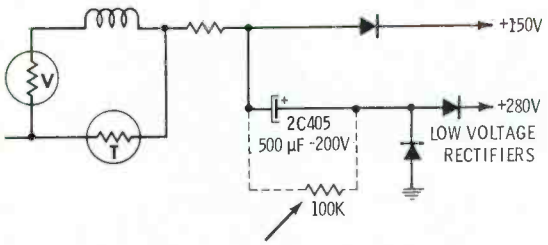
Next month, I get to a subject I promised earlier. It's multiplex alignment. A good way to troubleshoot an FM stereo receiver, once you're sure the IF strip and front end are okay, is by aligning the multiplex section. I'll pass along some hints that'll simplify it for you —with or without a stereo generator.

P.S. And if you have another technical subject you'd like to read about in this column, drop me a note. The editor passes letters along to me. ▲

symcure

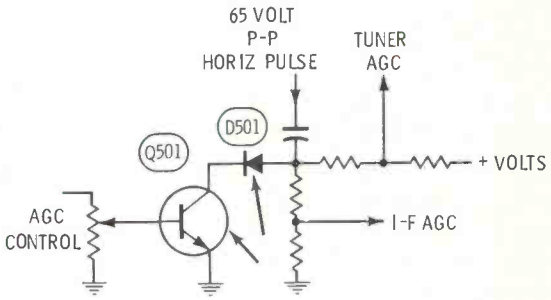
Symptoms and cures compiled from field reports of recurring troubles

Chassis—GE C1
PHOTOFACT—None



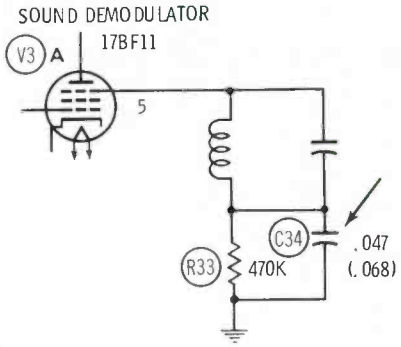
Symptom—Insufficient degaussing
Cure—Add 100K, ½-watt resistor in parallel with capacitor 2C405

Chassis—Electrohome C5
PHOTOFACT folder—972 POM



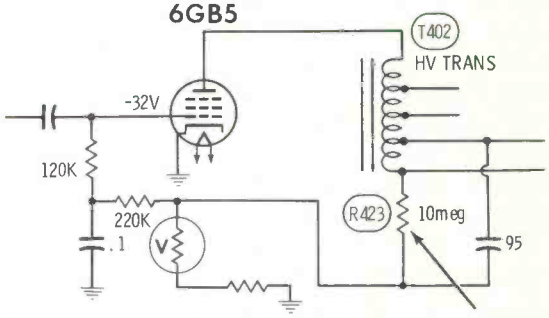
Symptom—picture overload; AGC control has no effect
Cure—replace shorted diode D501 or transistor Q501

Chassis—GE S2
PHOTOFACT—965-1



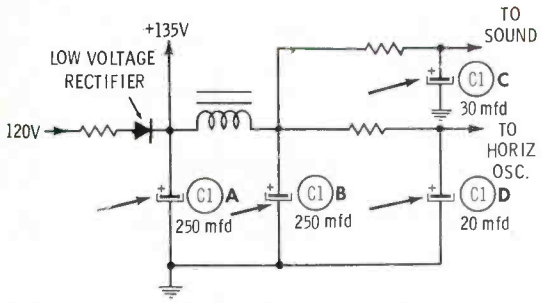
Symptom—No sound, only buzz
Cure—Replace C34

Chassis—Electrohome M4
PHOTOFACT folder—937-1



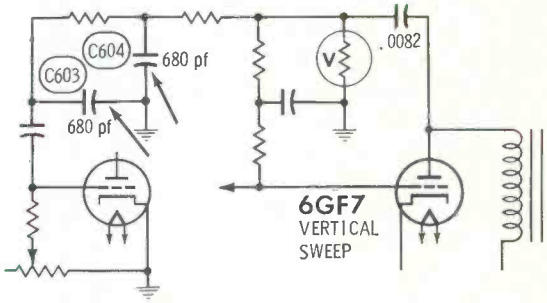
Symptom—insufficient width or no raster
Cure—check or replace R423 with a 10-meg, 1W resistor

Chassis—Olympic NDP
PHOTOFACT—840-2



Symptom—Picture pulling and weak vertical sync
Cure—Replace 4-section capacitor C1

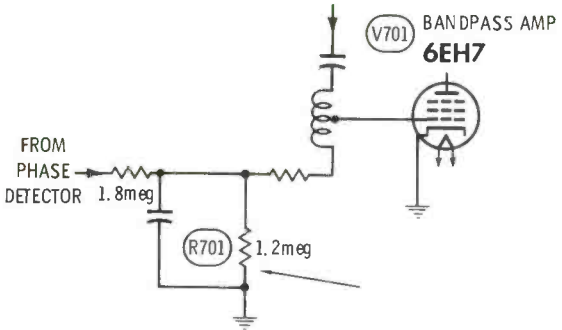
Chassis—Electrohome C5
PHOTOFACT folder—972 POM



Symptom—vertical hold critical during warmup
Cure—check C603 and C604; both should be 680pf, not 6800pf

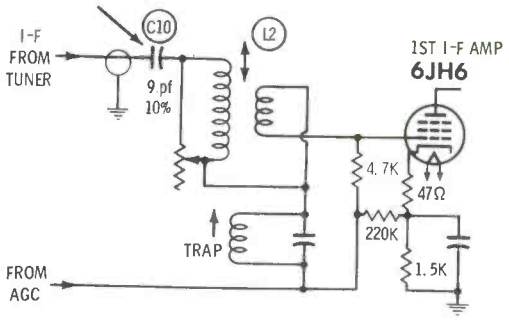
symcure

Chassis—Electrohome C4
PHOTOFACT folder—991-1



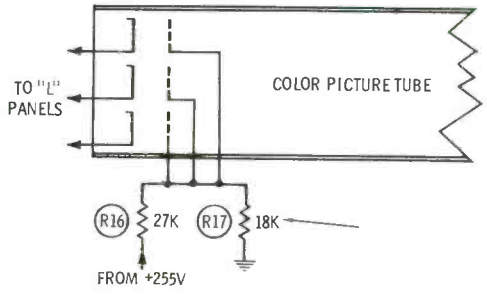
Symptom—weak color
Cure—reduce R701 from 4.7 meg to no lower than 1.2 meg

Chassis—Sylvania D02
PHOTOFACT folder—821-2



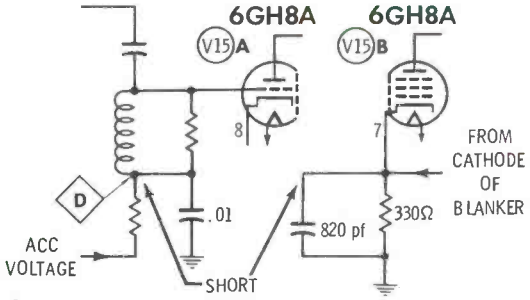
Symptom—excessive snow
Cure—check C10 for leakage, or 6JH6 tube for gassy condition

Chassis—Motorola TS915/919
PHOTOFACT folder—953-1



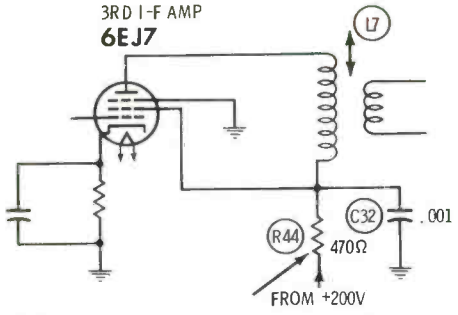
Symptom—picture too bright
Cure—check CRT grid voltage; if above 100 volts, check for loose connections around R17, 18K-ohm resistor

Chassis—Sylvania D05
PHOTOFACT folder—905-3



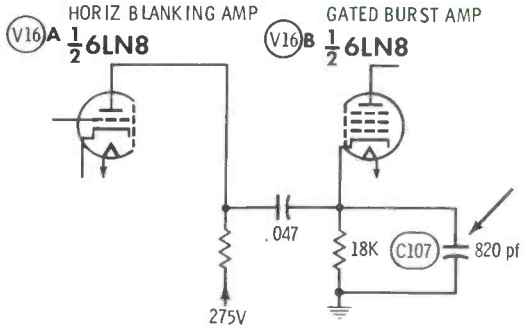
Symptom—no color on left side of raster
Cure—remove solder splatter, or check for short between point "D" and pin 7 of V15B, the bandpass amplifier

Chassis—Sylvania D02
PHOTOFACT folder—821-2



Symptom—picture overload and instability
Cure—check and, if necessary, replace the 470-ohm B+ resistor, R44

Chassis—Sylvania D05
PHOTOFACT folder—905-3



Symptom—wrong hue, or erratic color locking
Cure—replace open C107, 820-pf capacitor ▲

A Look at Today's Stereo FM Auto Radio

Analysis of the designs and the troubles common to major brands, along with a brief review of troubleshooting techniques. by Joseph J. Carr

Automotive FM stereo receivers have been on the market for several years. Delco, Bendix, Motorola and Phillips (Canada) all manufacture these units in either OEM or aftermarket models. Almost all manufacturers use the "time-sharing" method for demodulation of the stereo signal.

In the paragraphs that follow we will look into the systems used by the major auto radio manufacturers, the recommended troubleshooting procedures and some of the common troubles that have been encountered. First, however, it might be wise to review briefly some of the basics of time-sharing multiplex circuits.

Basic Operation of FM Stereo

The stereo demodulation system used by most car radio manufacturers has as its heart a resistor-diode matrix such as that shown in Fig. 1. This circuit functions much like a product detector. The 38-KHz signal from the full-wave transformer (T1) switches each channel on and off so that only one channel is "demodulating" at any specific instant. This 38-KHz switching rate is too fast for the human ear to notice. Audio take-off is through the two 38-KHz filters. It is then passed by way of buffer amplifiers to the two stereo audio channels.

The 38-KHz signal is derived from the 19-KHz synchronization pilot signal transmitted by the broadcast station. The signal is developed by either a pilot-locked oscillator or a frequency doubler circuit. The L + R and L − R signals are fed, usually by way of an amplifier or emitter-follower circuit, to the center tap of the full-wave transformer (T1).

A more thorough analysis of the fundamental operation of auto-radio stereo FM multiplex circuitry was presented in the November '69 issue of ELECTRONIC SERVICING.

The Delco System

General Motors (Delco) receivers, except for some found in Cadillacs, use a separate multiplex adapter with a standard AM-FM radio. These adapters are located either under the dash or hidden behind the dash, depending upon the year of manufacture, brand of the car and/or specific model of the car. The adapter is connected to the radio via a 9- or 12-conductor cable. (On non-stereo installations there is a jumper plug in the multiplex adapter socket on the radio.)

From year-to-year there are variations in the adapter circuit. The models that employed the 12-conductor cable have the left and right channels returned to the radio chassis before being fed to the audio power amplifier sections. The present adapters, which use the 9-conductor cable, do not do this. Except for the Cadillac "dual audio" receivers, all Delco multiplex receivers now use the regular radio audio stages for one channel and an identical circuit on the stereo adapter for the other.

Delco systems also use a buffer amplifier inside the multiplex chassis for isolation from the radio. The L + R and L − R signals are taken off the collector of this amplifier, and the 19-KHz pilot signal is taken from the emitter. In series with the composite signal (L + R and L − R) path is a 67-KHz trap to eliminate interference from any SCA background music signals that might be present. After further amplification, the composite signal is fed to the demodulator transformer (T1 in Fig. 1). The 19-KHz signal, also after further amplification, is fed to a 38-KHz oscillator, where it is used for synchronization of the output frequency.

The Bendix System

With only a few differences, the above paragraphs also describe the multiplex system used by Bendix in the AM-FM stereo receivers they make for the Ford Motor Company. One difference is the mechanical arrangements: Except for the receivers used in Lincolns, all of the Ford stereo receivers are self-contained on one chassis. It is a little crowded in most of them, but the majority of the components are accessible (there are the usual exceptions to this rule). There are three main areas in which there are circuitry differences: The 38-KHz source, the 19-KHz pilot amplifier and the stereo-indicator lamp drivers.

Bendix uses a diode frequency doubler to develop the 38-KHz switching signal in most of their sets. The non-linearity of the diode distorts the waveform of the 19-KHz sinewave, making it rich in harmonics. The 38-KHz tuned transformer then picks out the second harmonic (38 KHz).

Fig. 2 shows the Bendix 19-KHz pilot amplifier and signal threshold detector used in the 1968-69 Ford receivers. Q1 is the pilot amplifier. It is normally reverse biased to prevent noise and other spurious signals from tripping the frequency doubler. When a 10.7-MHz IF signal is applied to the threshold detector (Q2), conduction of the transistor causes a voltage drop across its emitter resistor. This voltage drop biases Q1 into conduction, allowing the signal to pass to the diode doubler.

The Motorola System

Motorola's universal FM stereo receivers also use a frequency doubler circuit to develop the 38-KHz signal; however, they use a signal diode-transistor arrangement for this purpose. The waveform-distortion diode is connected between the base

of the doubler transistor and ground.

Motorola does not use a composite amplifier as do Bendix and Delco. The Motorola multiplex printed-circuit board can be found in several "FM-stereo only" underdash models as well as in one of their automotive 8-track stereo tape players. The latter can be used in conjunction with any Motorola AM-FM radio, FM-only radio or FM converter.

Stereo-Indicator Lamp Circuits

All automotive FM-stereo receivers incorporate an indicator lamp to let the user know that he is tuned to a stereo station. This lamp is usually triggered during the presence of either the 19-KHz pilot signal or the associated 38-KHz switching signal. In some radios the bulb for this circuit is behind a little colored "jewel", while in others it is behind a lettered panel marked "stereo", "FM" or some similar title.

There are two relatively similar indicator circuits used in the various Delco receivers. One uses a relay to control the lamp, while the other uses a transistor switch.

In the older circuit using a relay (Fig. 3) a sampling of the 19-KHz pilot signal is taken from a tap on the tuned transformer in the emitter circuit of the isolation preamplifier. This signal is amplified, then applied to the base of the lamp-amplifier transistor. This drives the lamp-amplifier into conduction. The base of the relay control transistor is connected across the emitter resistor of the lamp amplifier. The relay control transistor, therefore, can conduct only when the lamp amplifier also is conducting. The SPST relay contacts apply 14 volts to the light bulb.

The newer all-solid-state Delco circuit (Fig. 4) uses a slightly different approach. This type of circuit takes a sampling from the collector of the 38-KHz oscillator and passes it through a .0022-mfd capacitor to a half-wave diode bridge rectifier. The bridge rectifier consists of two Delco DS-27 signal diodes, such as are used in the AGC and AM detector stages. The negative voltage produced by the bridge is applied to the base of the lamp preamplifier transistor. The negative voltage drives this transistor into a state of non-conduction whenever a 38-KHz signal is present. When this occurs, the collector voltage of the transistor rises. This turns on the lamp amplifier which, in turn, drives the lamp switching transistor into conduction. The lamp switching transistor will turn off again as soon as the 38-KHz signal disappears.

The most common indicator lamp circuit used by Bendix is shown in Fig. 5. In this circuit the lamp switching transistor (Q1) is forward biased by the voltage drop across the emitter resistor of the 38-KHz amplifier (Q2). This type of operation prevents the lamp from turning on except when the receiver is tuned to a stereo station.

The Motorola stereo-indicator circuit uses the 38-KHz signal applied to the demodulation matrix to

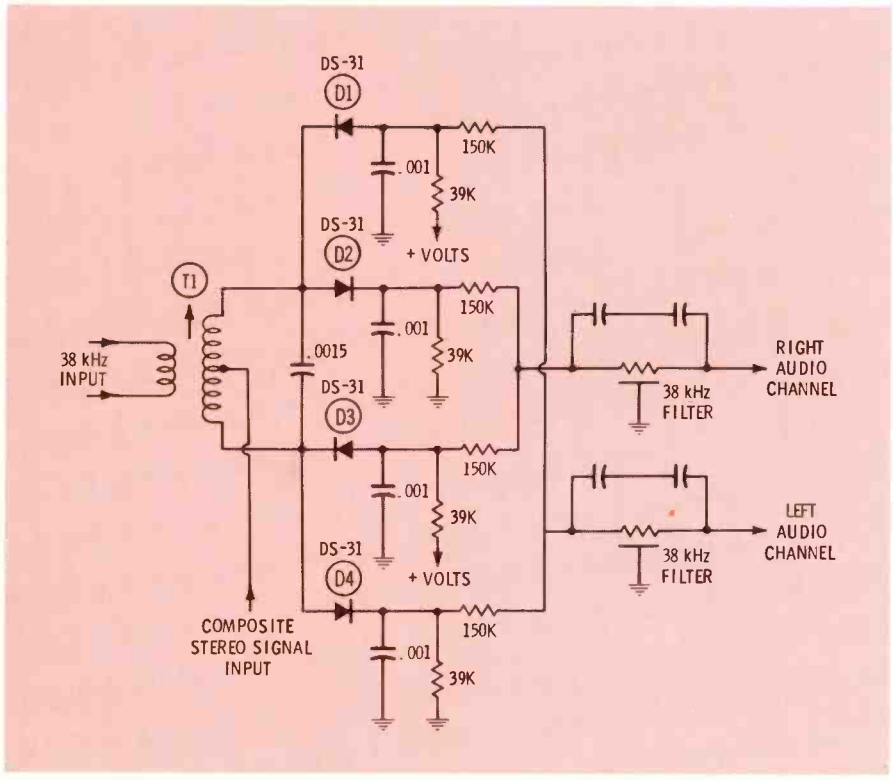


Fig. 1 Diode matrix circuit used to accomplish multiplex demodulation in Delco stereo adapters.

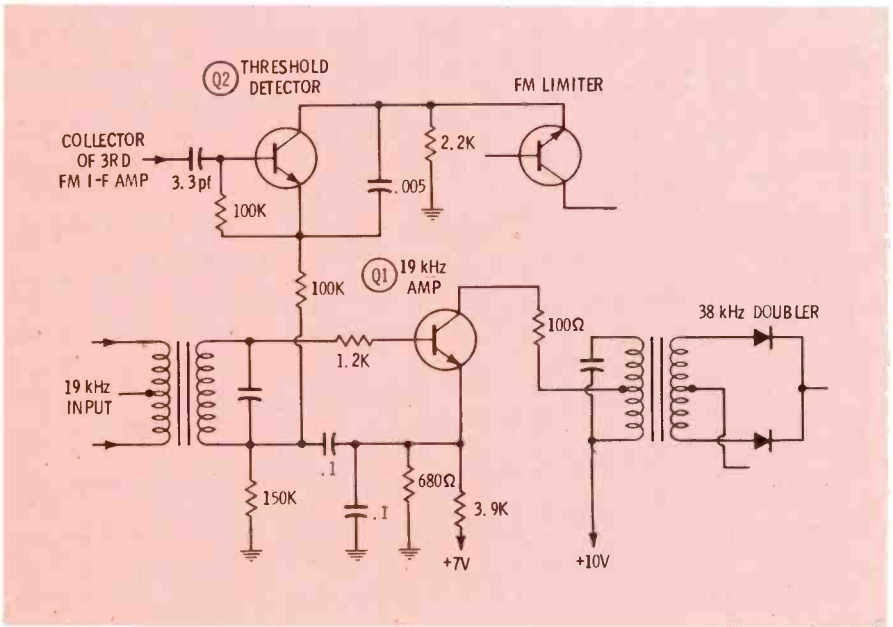


Fig. 2 19-KHz amplifier and threshold detector employed in Bendix units that are used in Fords.

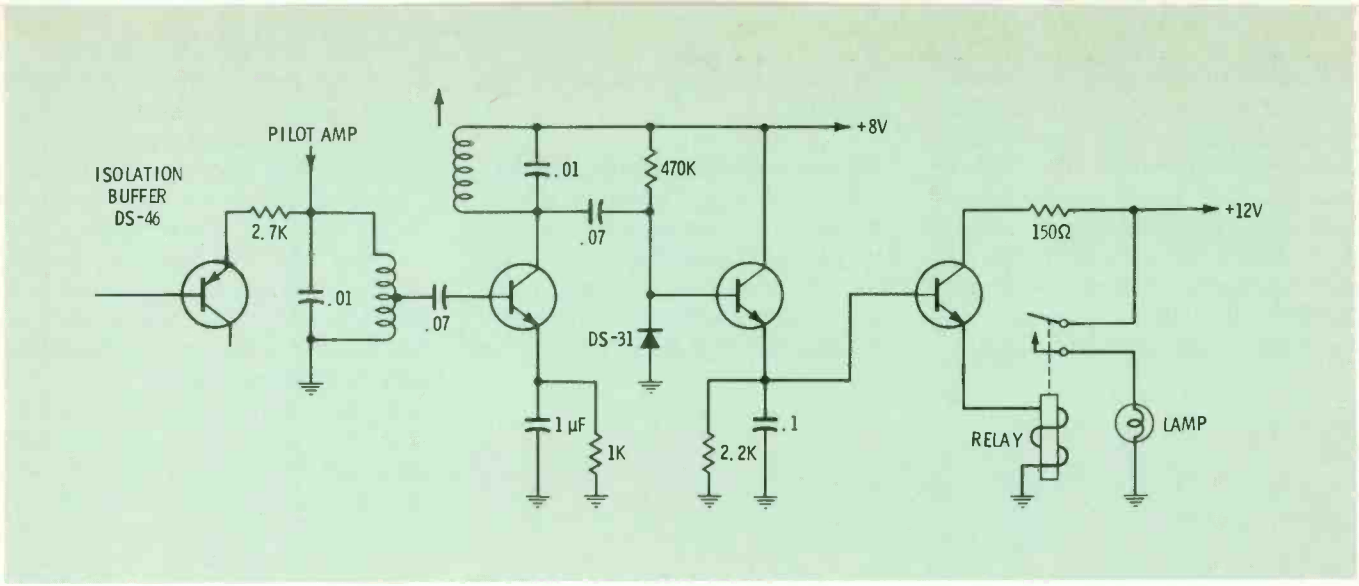


Fig. 3 Relay-controlled lamp circuit used in previous Delco units.

drive a two-stage lamp indicator circuit (Fig. 6).

Troubleshooting

The first step in troubleshooting an FM-stereo car radio on the bench is to find out whether the stereo is malfunctioning because of trouble in the multiplex section or trouble in the "radio" section.

In many high-signal-level areas it is possible to pass enough signal through a dead IF stage to satisfy the audio amplifiers, but not the multiplex section. This is due to the fact that the other two (or in some cases, three) IF amplifiers will have enough gain to provide a decent signal to the high-gain audio stages.

The multiplex stages require a much higher signal level. An indication of this lack of sensitivity can be realized by monitoring any fringe-distance stations that might be present in your locality. Most of these stations will be inaudible if one or more of the IF amplifiers is not functioning properly. In an area that lacks such stations, it is possible for the technician to check the level of background hiss between local stations. This admittedly takes a bit of practice and, even then, is not absolute. The best check is to read the DC voltage across the emitter resistors of the three or four IF amplifiers and the limiter. On sets that use NPN transistors in the IF stages, this is done with the negative probe of the voltmeter attached to the chassis and the positive probe attached to the emitter of the transistor under test. PNP stages are checked with the negative probe on the B+ line and the positive probe on the respective emitters. The meter should be set to read minus DC volts. The readings that should be expected vary between .5 and 5 volts, depending on which stage and what model of radio is being tested. Consult either the manufacturers' literature or the appropriate Sams "AR-series" PHOTOFACT book for the exact readings on any particular model.

Once it is known that the radio portion of the stereo receiver is working properly, you can then concentrate on the multiplex section. Signal tracing is done preferably with an oscilloscope set to show two or more cycles of the 19-KHz pilot signal. Following the path of both the pilot/switching and the composite signals with the scope's low-capacitance probe usually will locate quickly a defective stage. A VTVM can be used then to determine whether the problem is the transistor or one of the other components in the defective stage. Be careful of circuits such as the Bendix threshold detector arrangement. They can give a false "dead 19-KHz amplifier" indication to the signal tracer if either the threshold detector or one of the IF's is bad.

Troubleshooting the lamp circuits is usually a simple affair. Once it is determined with an oscilloscope that the 19- or 38-KHz driving signal is actually reaching the lamp circuit, a few checks with a DC VTVM usually will pinpoint the problem. A quick check of bias and conduction conditions on each of the transistors normally is all that is required.

One exception to this rule is when the driving signal is below the level needed to trigger the lamp stage; it is possible to have a high enough level to drive the demodulator but not the lamp circuit. While it is possible that such a condition could be due to an alignment problem, this is rarely the case. In Delco adaptors a number of cases have

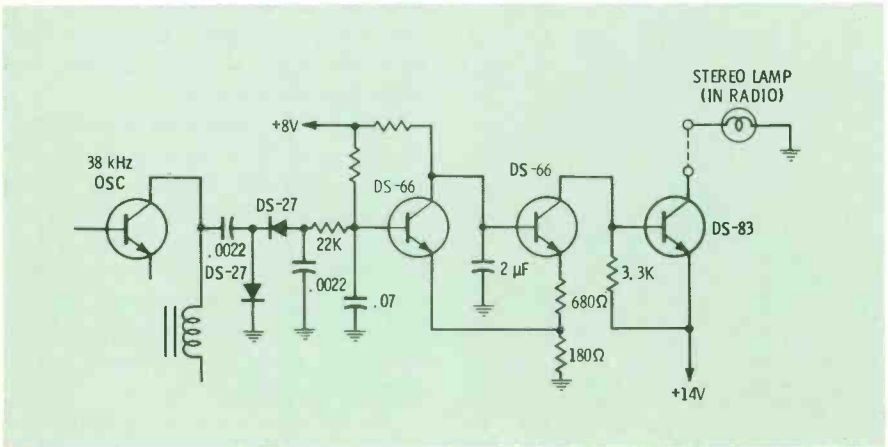


Fig. 4 Solid-state lamp circuit employed in newer Delco receivers.

It's a color bar generator, too.

You're looking at the only tube tester that can check out almost every receiving tube and throw an alignment signal into the picture tube.

It's a combination tube tester and color bar generator.

So now all you need is a single instrument to do two of your most important servicing jobs: Make sure the tubes in a set are good. And make the adjustments you need to get a good, sharp picture on color and black-and-white TV sets.

We built it like a brick. (After you've carried it through a thousand doorways, you'll know why.)

And we've done everything to make it accurate and stable.

The new instrument starts off with a regulator-type transformer that doesn't give a hoot how the line voltage is acting up. (It doesn't even need a fuse.) There are 73 tube sockets that let you run all kinds of tests on all kinds of tubes. All you have to do is set 3 knobs. You can even check each section of a multi-section tube separately.

The color bar generator is all solid state. It puts out 6 crystal-controlled, rock-stable test patterns: 10 color bars, a clear raster, 10 vertical lines, 13 horizontal lines, 130 dots and a 10 x 13 crosshatch. All operating and calibration controls are right in front of you on the panel.

Putting both instruments into one package also gives you a small bonus.

It leaves your other hand free to carry something else.

For more information, see your Sylvania distributor or write to: Sylvania, CADD, 1100 Main Street, Buffalo, N.Y. 14209.

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Circle 22 on literature card

been encountered in which the mylar drop capacitors that are used to tune the 19- and 38-KHz transformers and tank circuits have been open. These capacitors are mounted on the printed-circuit board, not inside the transformers. Their values are usually .01 mfd in 19-KHz circuits and .0015 mfd in the 38-KHz circuits. Bridging these units with a known-good capacitor generally will tell the technician if an open capacitor is the trouble.

Casebook of Common Troubles

1) Bendix 1968-69 output transistors.

In the 1968-69 receivers made for Chrysler, Ford (stereo) and Volkswagen the output transistor has been responsible for a great deal of trouble. These transistors have a habit of opening up between the base and emitter. Since they are NPN types, there is normally from 1 to 3 volts between the base and ground. When the base-emitter path opens, this voltage increases to almost the same level found on the collector.

There are two different types of output transistors in use. One type, the older of the two, is on a regular diamond-shaped baseplate, but lacks the dome covering normally found on power transistors. It has a small PCB for the base and emitter connections and either a solder lug or screw-in connector for the collector. The epoxy "dot" that is the actual transistor is blue in color.

The other NPN output transistor encountered in Bendix sets is one of the square-case, tab-mounted types. It has a black or gray epoxy body with three heavy wire leads protruding out one end. DO NOT BEND these leads right at the body of the transistor, as this will break the internal connections. Use a generous film of silicon grease on both sides of the mica mounting insulator, or that new replacement will not last long.

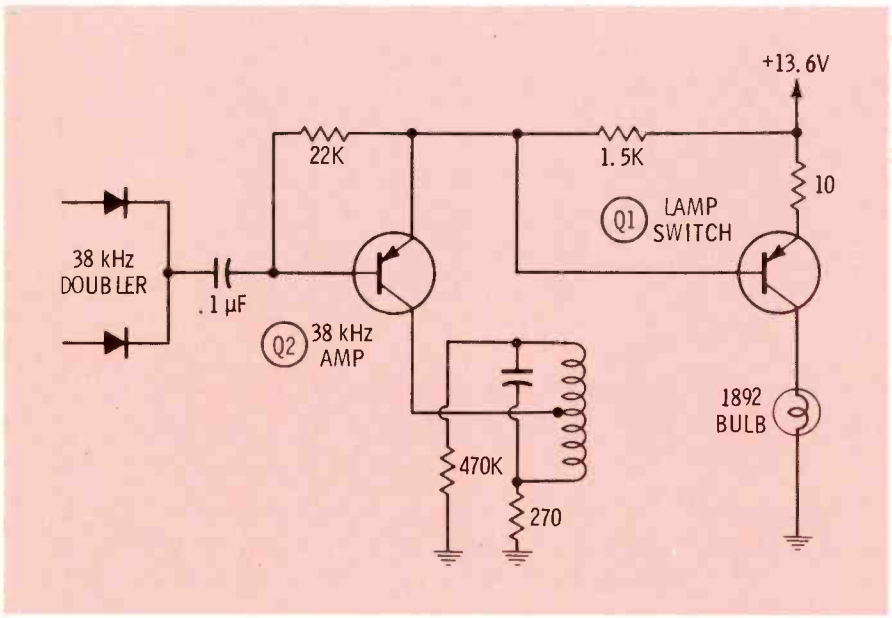


Fig. 5 Bendix-designed stereo-indicator lamp circuit used in Ford FM multiplex receivers.

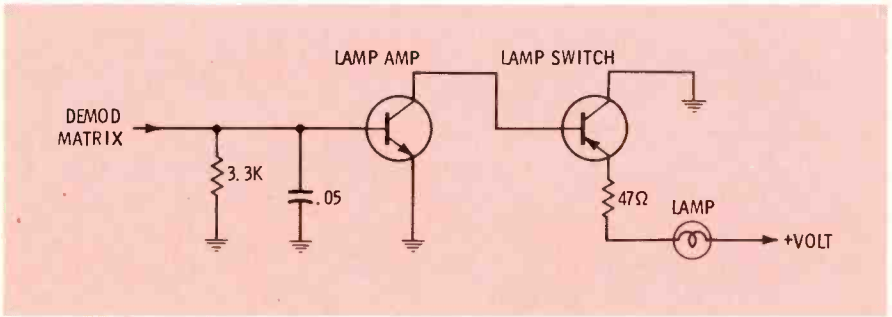


Fig. 6 Lamp circuit that indicates reception of stereo signal in Motorola units.

2) Loose transformer wires on Bendix receivers.

Several audio output transformers on Bendix radios have been encountered with one or more of the winding wires not soldered to its terminal. While this type of intermittent has been found on all Bendix products at one time or another, in 1968 and 1969 it has been especially prevalent on the Lincoln-Continental underdash stereo adapters. When an "intermittent dead" or "intermittent distorted and weak" channel is the complaint, be sure to check these wires.

3) Bendix audio output emitter bypass capacitors

The 1000-mfd electrolytic bypass capacitor used in the emitter of the AF driver transistors has a habit of opening. The symptom is very weak volume in one channel. (It usually is so weak that the volume control must be all the way up for any sound to be heard.) These filters are about .5 inch in diameter by 2 inches long and are black in color. Except for one application in which one is mounted on the AM printed-circuit board, these filters are clipped to spring mounts attached to the case of the radio.

4) Delco output stage bias pots

The 600-ohm potentiometer used to set the bias in Delco output stages has been a troublemaker. These pots, located between the emitter of the pre-driver transistor and ground, tend to open intermittently. When this occurs, the base-to-emitter voltage on the following stage increases drastically. Tapping lightly on the potentiometer will cause the "A" lead current or the collector voltage on the DS-501 output transistor to increase sharply. If a set comes in with an "intermittent distortion" complaint (usually, but not always, it is the left channel), or a fuse resistor blown for no apparent reason, check the bias pot. One of these pots will be found on the multiplex adaptor chassis, and the other will be found on the vertical PCB to which the volume control is soldered on the radio side. The one on the radio is visible through a small access hole cut in the bottom cover.

5) "Picket fencing"

While **not** more prevalent on

stereo receivers than it is on monaural FM receivers, this problem still causes a lot of headaches. One reason for this is that it only shows up when the car is in motion. The symptoms are a "ffft-ffft-ffft" sound and, on stereo sets, a flickering of the stereo indicator lamp. The principle cause of this problem is repeated drifting of the local oscillator which is periodically corrected by the AFC circuit. The sources of this trouble are, unfortunately, many and varied. A weak stage, improper alignment (especially of the RF circuits), an antenna adjusted to a height other than 32 inches, an unbalanced detector (one diode open or shorted), intermittent components, bad AFC diode, etc., all, at one time or another, have been blamed for this problem. Although to some extent it has been a problem associated with all the major manufacturer's sets, it has been especially prevalent on Motorola and Delco receivers.

6) Motorola "sealed" FM tuners

Some Motorola FM stereo car radios use a Mallory "sealed" tuner. It is a rather compact affair that houses all the normal tuner functions. While they produce about the same amount of trouble as tuners made by other manufacturers, their sealed construction makes them difficult to repair profitably. If one of these units is found to be defective, try replacing it. Be careful not to "spring" the backlash gear attached to the tuning shaft on these units. They are plastic and, therefore, easy to break.

7) Cadillac cracked multiplex PCB's

In the 1968 Cadillac "dual audio" receivers the multiplex and radio sections are on one main chassis while the pre-amplifiers and audio outputs for both channels are on a separate chassis. These sets are encountered often with an intermittent condition that can be traced to a nearly invisible crack or series of cracks in the printed wiring on the multiplex board. Such cracks are often, but not exclusively, located adjacent to the holes for the board-mounting screws. A moderately quiet day, a magnifying glass, an insulated "tapper" and a mountainous supply of aspirin tablets are usually required to uncover the source of this problem. ▲

EIA Committee Gets NATESA Viewpoint About Problem Areas

A statement calling for industry-wide cooperation in easing problems facing the independent electronic service technician was submitted to a session of an Electronic Industries Association (EIA) committee in Los Angeles last month by Frank Moch, executive director of the National Alliance of Television and Electronic Service Associations (NATESA).

The written statement from Moch was presented to the Service Dealer Committee of the Distributor Products Division of the EIA. Because of previous commitments, the NATESA director was unable to accept the invitation to address the group in person.

Moch cited the values and strengths of independent servicing, as well as five "highly interwoven areas" of concern to the servicing industry. He listed "profit" first. ". . . Past practices seldom generated profit, and this prevented payment of adequate wages and benefits, truly professional level appearance of men, shops and vehicles, regular replacement and additions of test gear to meet new conditions, and even the funds and time to belong to and participate in associations that have been and are very vital to the welfare of all phases and the public, as disseminators of facts, ideas and updating."

He identified three ways in which various segments of the industry could work together to ease the image problem: "Policing service, educating the public, and countering accusation leveled indiscriminately against the servicing industry."

One cause of the bad image, Moch asserted, is "Over-enthusiastic consumer advertising that claims perfection at any location or under any condition merely by plugging in the set, or the claim that sets need not be taken to the shop . . ."

The NATESA executive said that the abuse of warranties is a major contributor to problems, and said unsound warranty practices deprive set buyers of a free choice of a service agency, set rates that are illogical, and deprive the servicer of the essential mark-up on parts while burdening him with far greater than usual costs of procurement and reporting.

Regarding serviceability, Moch urged "either panelizing or some other methods of quick break-up of circuit image." He said the chassis should be easy to remove from the cabinet and easy to work on, and solid-state devices must be identified directly by a readily available layout guide.

To make present training programs more effective, the NATESA spokesman proposed coordination of training sessions, with NATESA acting as the coordinating agency.

Moch's statement, in conclusion, expressed a hope "that brand new service techniques and reliable new test gear is developed and its use encouraged." ▲

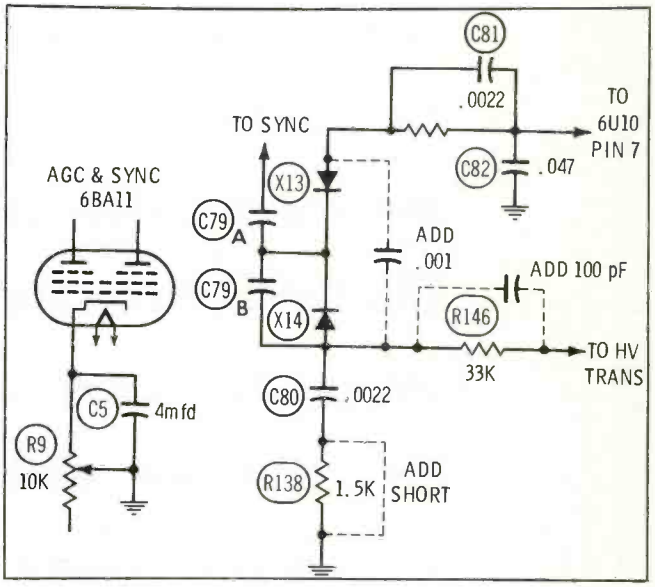
troubleshooter

Method for Checking Horizontal Sync

What is the best method for locating the cause of "touchy" horizontal locking in Zenith color sets? The waveform at the cathode of the horizontal phase detector is 15 volts instead of the 20 volts specified in PHOTOFACT folder 932-3. All other waveforms seem within reason.

R. G. Fruehauf
Eastlake, Ohio

My first guess on the Zenith horizontal locking problem is to check C5, the 4-mfd capacitor across the AGC control—it may be open. Have you replaced the double-diode phase detector? The 20 volts p-p expected at the common cathode should be about 75 percent sawtooth from the horizontal output transformer and about 25 percent sync spike. If the sync spike is weak, you would still read around 15 volts there.



The local Zenith distributor says the p-p voltage at pin 6 of the 6BA11 sync/AGC tube should be about 80 volts, not 38 as specified in the PHOTOFACT schematic. Also, he says there is a factory series of modifications designed to eliminate "hooking" at the top of the picture. This may not help the particular problem you have written about, but here are the changes:

Short across R138 (1.5K).
Add a 100-pf capacitor across R146 (33K).
Add a .001-mfd capacitor from anode-to-anode on the AFC duo-diode.

Intermittent Color

An RCA chassis CTC25A has intermittent color on only channel 13. Channels 3 and 10 are normal. I have checked all tubes. Thank you for any help you can give me.

S. Everett
Norfolk, VA 23504

Offhand I would say you have antenna trouble; however, without more information this is just an educated guess. We need more information, such as: How far away are the transmitters? Have you replaced the RF amplifier tube in this chassis lately, and, if so, did you check the tuner circuit for component damage resulting from a shorted RF amplifier?

The antenna and lead-in become more important as operating frequency increases. Therefore, it is possible for the antenna to perform well on channel 3, and even channel 10, but leave something to be desired on channel 13.

Which Capacitor?

"New SYMCURE is great, but printing resolution is so poor that I can't read it. Also in item four, page 25, September ELECTRONIC SERVICING, the diagram shows value of C33 in RCA CTC35 as 5pf, while the cure lists 3.5pf. Which is right?"

H. Heller
Cleveland, Ohio

Long before your letter appears in print, Mr. Heller, the fuzzy printing will be only a memory. All the diagrams will be specially drawn for Symcure from now on.

The CTC35 was the *only* 3-tube-IF RCA chassis that used a 5pf capacitor as coupling to the second video amplifier. All the other chassis had a 3.5pf capacitor, and typically none have video ringing. Enough said? ▲

New in Color TV for 1970

by Carl Babcoke

ELECTRONIC SERVICING's technical editor takes a look at the new circuitry you will encounter in 1970 color TV's.

General Trends

Innovations in solid-state circuitry highlight the 1970 TV designs, while very few changes are evident in tube-powered chassis. Hybrid receivers are numerous, with all the circuits transistorized except for vertical sweep, horizontal sweep, high voltage, video output and chroma –Y amplifiers.

Color TV continues to be the center of attention, with more color portables and more solid-state circuits. Field-effect transistors, spark gaps inside the CRT sockets, more plug-in boards or modules, and the beginnings of a trend to pre-CRT matrixing of chroma and video signals are just a few items of interest.

Emphasized in the manufacturers' service data are such safety precautions as high-voltage adjustments and the measurement of line-voltage leakage from exposed receiver parts to earth ground. High-voltage shunt regulators of the 6BK4 type are not used in many of the new receiver designs, as the manufacturers remain concerned about possible radiation hazards and more stringent government standards in the future.

Here are some of the most interesting 1970 features and circuits of the new color television receivers, with the manufacturers listed in alphabetical order:

Admiral

Only seven tubes, plus the picture tube, are used in the Admiral K10 chassis, a hybrid design found in their 12", 14" and 16" portable color receivers. Horizontal sweep, vertical sweep, high-voltage, video output and –Y chroma stages employ tubes. All other functions utilize solid-state components.

Fig. 1 shows the schematic of the automatic degaussing circuit. Don't operate this chassis without a substitute load on the degaussing circuit; such a load can be a 5-ohm, 3-watt resistor, which is substituted for the coil during bench tests. Full degaussing is completed in a fraction of a second by the charging currents of filter capacitors CH8 and CH10A. The picture tube would be magnetized by the steady current drawn by the tubes after they heat and become conductive; therefore, the degaussing coil is shorted out before this time by a thermally operated switch whose heat is supplied by an internal element connected to the 6.3-volt winding on the power transformer.

A ratio detector is used for sound demodulation, and better sound limiting is accomplished by the final sound IF stage, which is designed to oscillate. The sound IF signal applied to the input of this stage acts as a sync signal to lock the frequency of oscillation. So long as there is enough sound IF signal to make the oscillator lock to it, the amplitude of the signal applied to the ratio detector will be constant.

The burst signal is usually taken off prior to the stage that is controlled by the color killer, because the burst must be passed regardless of the color control setting or the killer action. The Admiral K10 chassis is an exception to this usual design. Fig. 2 is a simplified schematic of the color killer and first color IF amplifier. When burst is present at the killer phase detector, there is zero voltage output from the detector to the base of Q16, which has no forward bias and does not conduct. The voltage at the collector is an amount determined by the voltage divider that supplies the base of Q13, the first color IF amplifier. Normal bias from this source is supplied to the base of Q13, which amplifies the chroma signal, including the burst.

During b-w reception, the output from the killer detector is about +0.6 volt. This is nearly normal forward bias and causes the killer amplifier, Q16, to draw collector current, which reduces the collector voltage to about 5 or 6 volts. The forward bias at the base of Q13 is reduced to about .2 volt (measured from emitter to base) and Q13 is cut off.

With the burst signal obtained from the collector of the stage (Q13) controlled by the color killer, it is apparent that without some other action the 1st color amplifier would remain cut off during color broadcasts and no burst would be passed to the color killer circuitry to trigger on the 1st color amplifier. (Note the closed-loop action described here). However, to prevent such a situation and to insure that the 1st color amplifier passes the burst signal, it is keyed on during burst time by a horizontal pulse. (Remember, the burst signal is positioned on the "back porch" of the horizontal blanking pulse.) Admiral calls this action "burst assurance" and it functions in the following manner: Before a pulse is applied to the anodes of diodes CRC19 and CRC32, both diodes are reverse-biased by the positive voltage on their cathodes, and are open circuits as a result. When the positive-going pulse at the anode of CRC19 exceeds the DC voltage at the cathode, the diode becomes a short circuit and allows the rest of the pulse to temporarily increase the forward bias of Q13 to the point where it conducts. If burst is being received at this time, it will be amplified. CRC32 is a pulse clipper that prevents the pulse from ever exceeding about 6.6 volts positive. When the pulse tries to rise above the 6.5 volts (plus a drop of about .1 volt across the diode), the diode is forward biased and connects the anode with the pulse to the +6.5-volt DC source. Therefore, Q13 is always normally biased at the time of burst, regardless of the color killer action.

Normal transistors do not perform well as reactance control devices. In the Admiral K10 chassis, 3.58-MHz oscillator frequency control is accomplished by using a field-effect transistor (FET) for a react-

ance control stage. The circuit, shown in Fig. 3, is nearly identical with ones that use tubes, except that the source voltage is varied to adjust the frequency instead of using a reactance coil.

Andrea

The Andrea VCX325 color TV chassis is patterned after the standard three-tube-IF design and has solid-state sound. A tuning eye (schematic in Fig. 4) is used to aid accurate fine tuning. The indicator shows when the picture carrier is tuned to 45.75 MHz.

Another rarity is an extra video circuit, evidently included to feed an external video tape recorder (VTR). This circuit, shown in Fig. 5, employs two emitter followers in cascade (Darlington), with no peaking coils or other compensation.

General Electric

A novel focus-tracking circuit (Fig.6) is a feature of the GE C-1 chassis. (This chassis is used in a hybrid 18″ diagonal portable color receiver.) The tuner, AGC, sync, horizontal reactance, horizontal oscillator and horizontal discharge circuits are transistorized. Two transistor amplifiers and one blanker transistor are used in the video circuit, which has a tube-equipped output stage. The chroma section has one transistor, which is used as a 3.58-MHz buffer.

Most focus circuits add the B-boost to the rectified DC from the focus rectifier to provide the required focus voltage. For best focus, the high voltage and focus voltage should track together, with both increasing or decreasing in the same ratio. The C-1 chassis (see Fig. 6) has two 430K-ohm series resistors (for a total of 860K) common to the flyback voltages fed to both the focus rectifier and the high-voltage rectifier. Assume that the color picture tube draws one milliampere of current; this will cause 860 volts to drop across the resistors, which will reduce both the high voltage and the focus voltage by that amount. Thus, proper focus is maintained at all brightness levels.

Adjustment of the tint in GE's KE color chassis is accomplished by varying the DC reverse-bias on a varactor diode, which changes its internal capacitance. This change in capacitance changes the phase of

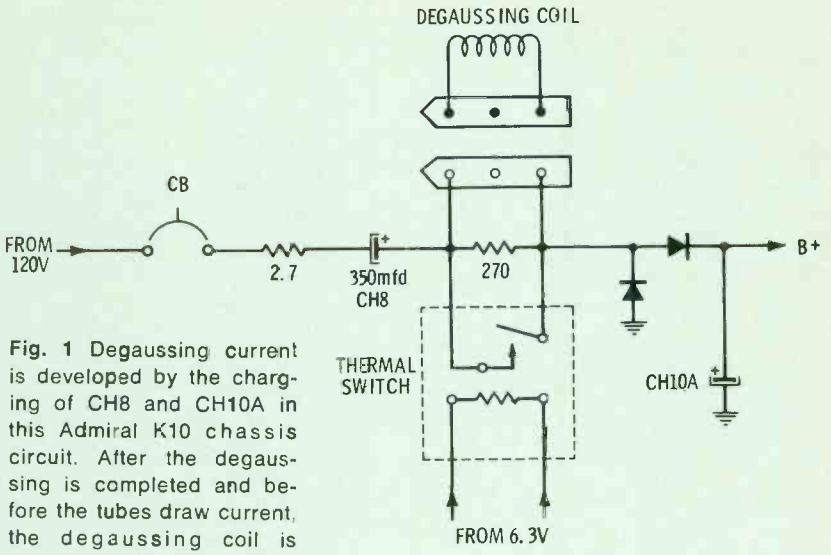


Fig. 1 Degaussing current is developed by the charging of CH8 and CH10A in this Admiral K10 chassis circuit. After the degaussing is completed and before the tubes draw current, the degaussing coil is shorted out by the contacts on the thermal switch, which has been heated by a resistive element connected to 6.3 volts AC.

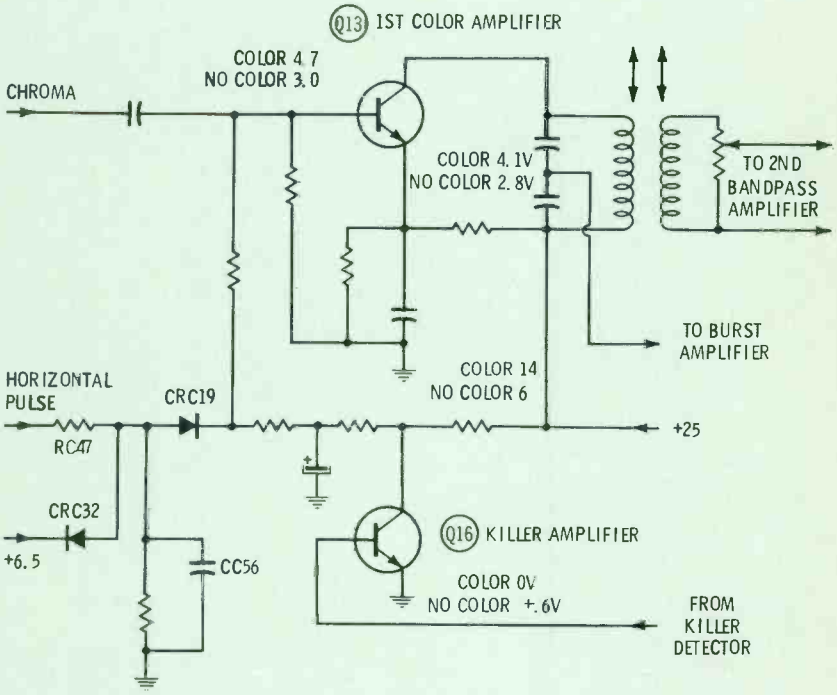


Fig. 2 During b-w reception, the Admiral K10 killer detector output is about +.6 volt, enough to make Q16 conduct and reduce the voltage on its collector to about 6 volts. This voltage is used as base supply voltage for Q13, which will have only .2 volt of forward bias and no gain. When color is received, the killer detector output voltage is nearly zero, Q16 has no bias, draws no current and the collector voltage is high (around 14 volts). This higher source voltage makes the base of Q13 about .6 volt more positive than its emitter, producing normal bias and gain. See the text for a description of the "burst assurance" action.

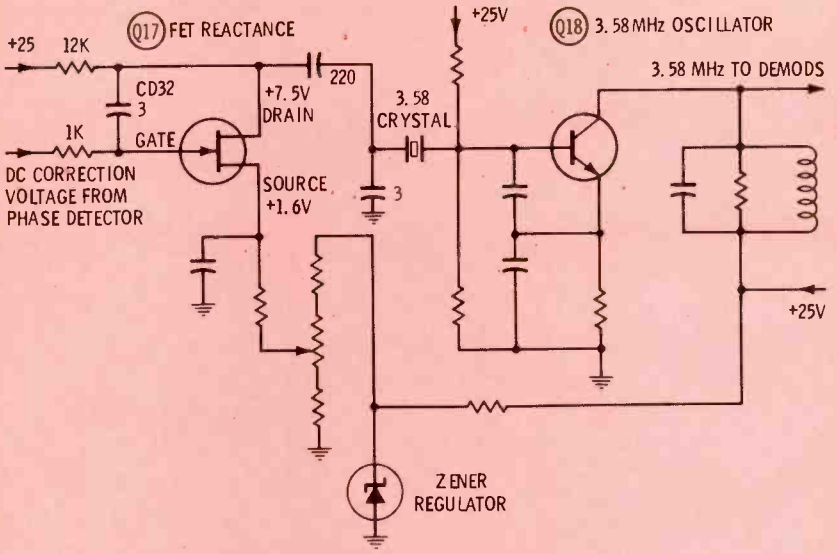


Fig. 3 A FET works just as well as a tube does in a reactance stage. The theory is the same, except a variable source voltage is used to set the basic oscillator frequency instead of the more conventional reactance coil.

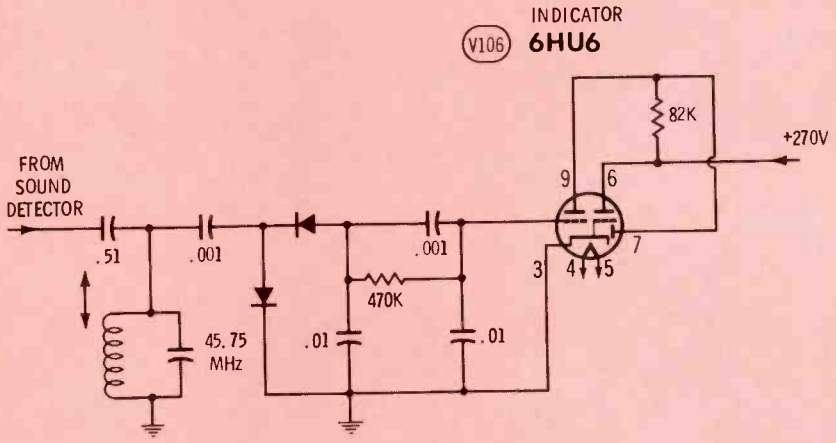


Fig. 4 This tuning-eye circuit is employed in the new Andrea color chassis.

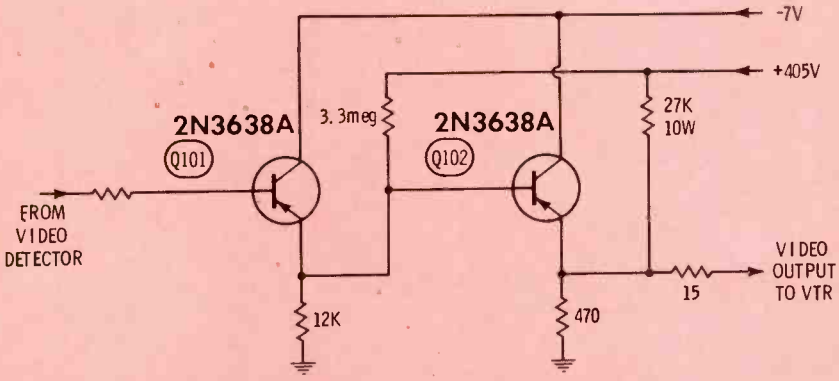


Fig. 5 Andrea has thought about the future and included a 75-ohm video output signal for use with a video tape recorder.

the 3.58-MHz carrier, which is obtained by ringing the 3.58-MHz crystal with the burst signal, as shown in Fig. 7.

The GE KE chassis, which is found in 23″, 20″ and some 12″ color receivers, uses less solid-state circuitry than does the C-1 chassis; only two video stages, the blanking amplifier and the 3.58-MHz buffer are transistorized. High voltage is regulated by a 6LJ6 shunt regulator tube.

A separate negative power supply for the emitter of Q201, the first video amplifier, is provided so that the base can be direct-coupled to the negative-going video detector. The schematic is shown in Fig. 8. Just keep in mind that this circuit can be a source of hum which might be overlooked, and any decrease in the negative emitter voltage will make the picture darker, or eliminate the raster altogether.

Magnavox

New from Magnavox this year is the T940 color chassis which features TAC (Total Automatic Color). TAC consists of AFT (automatic fine tuning), pioneered by Magnavox in 1965, plus the completely new ATC (automatic tint control). These last two circuits were thoroughly discussed in the October '69 issue of ELECTRONIC SERVICING. Briefly, the principle of ATC is to change greenish-yellow and reddish-purple chroma phases into a 57-degree orange that is satisfactory as skin color. This is accomplished by overbiasing and gating two channels that have fixed amounts of phase shift in each, and combining this correction signal with the normal chroma signal just before it goes to the demodulators. Fig. 9 shows the complete schematic of the ATC circuit.

ACC voltages for gain reduction of the first chroma amplifier are taken from two different sources. One is from the killer detector, and is a conventional circuit (see Fig. 10). The other is from an additional DC voltage created by the rectification of the chroma signal itself. Control from the killer detector voltage is very good up to about 75% to 100% burst level; above that, its control is not effective. The control voltage from rectification of the chroma IF signal is very helpful above 100% burst level, and is es-

pecially effective where a station may transmit normal burst with color that is too strong.

Motorola

The new Motorola TS930 chassis is designed for 16″ diagonal color portables. It is a hybrid design with very few tubes, and is identical (except in cabinet styling) to the Admiral K10 previously described. A rumor in the industry says that Motorola furnished transistors and other parts, while Admiral supplied the design and manufacturing.

The Quasar, Motorola's pioneering solid-state color receiver with the plug-in circuit boards, is manufactured in two different versions: The number of the familiar vertical chassis assembly that rolls out the front is TS915. The newer TS919 uses the same plug-in boards, but the horizontally mounted chassis slides out the rear for servicing.

All Quasars with the code letter "F" before the chassis number incorporate a new electronic voltage regulator for the 120-volt line input. As shown in the block diagram of Fig. 11, the filament transformer and the power transformer have 105-volt primaries. Between the transformers and one side of the line-voltage input are two resistors in series whose combined rating is 25 ohms at 100 watts of dissipation. A triac (bi-directional SCR) parallels these resistors and gives the effect of a variable voltage drop by shorting out the resistors for part of each cycle.

If the line voltage is 105 volts, the triac must conduct all the time so that the full voltage is applied to the transformers and no voltage is dropped across the resistors. With an input of 130 volts, the triac must be open at all times. The 25-ohm resistance develops 25 volts across itself, leaving the required 105 volts for the transformers. For line voltages between these extremes, the triac must be conducting for just part of each cycle. The lower the input voltage, the longer the triac conducts during each cycle.

The complete Motorola regulator schematic is shown in Fig. 12. The base of the regulator, transistor Q1Z, is supplied with a sample from the +95-volt power supply through a regulator control which sets the operating range. A low-pass filter eliminates most of the 120-Hz rip-

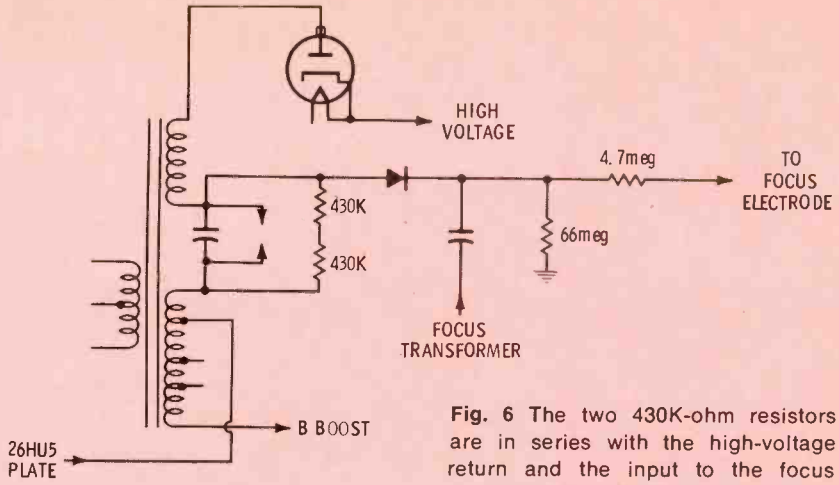


Fig. 6 The two 430K-ohm resistors are in series with the high-voltage return and the input to the focus rectifier in the GE C-1 chassis. More high-voltage current causes both the high voltage and focus voltage to drop and, thus, maintains good focus.

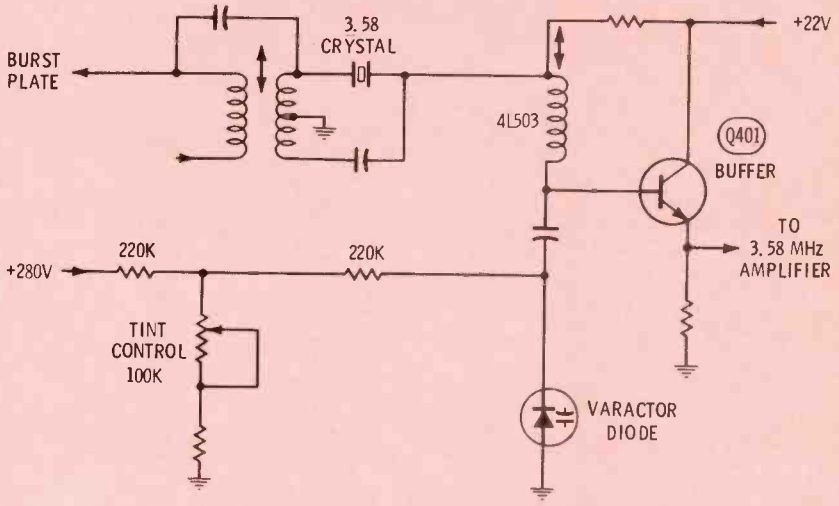
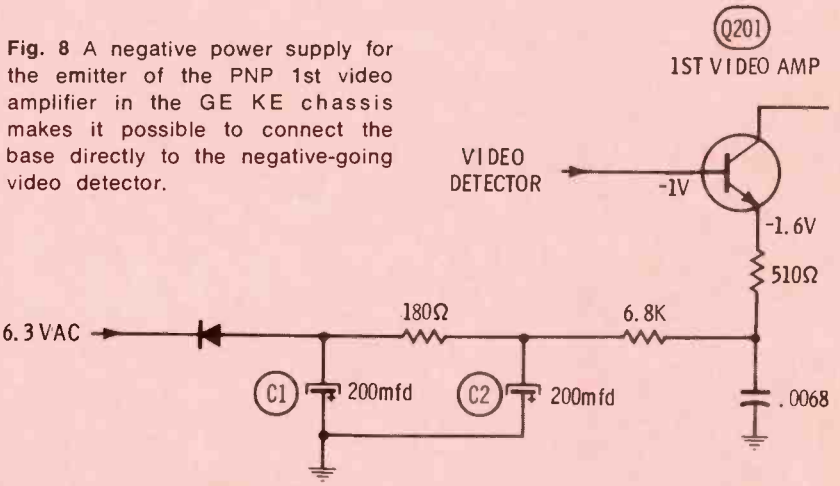


Fig. 7 Tint control action in the new GE color chassis is accomplished by changing the DC voltage on a varactor diode.

Fig. 8 A negative power supply for the emitter of the PNP 1st video amplifier in the GE KE chassis makes it possible to connect the base directly to the negative-going video detector.



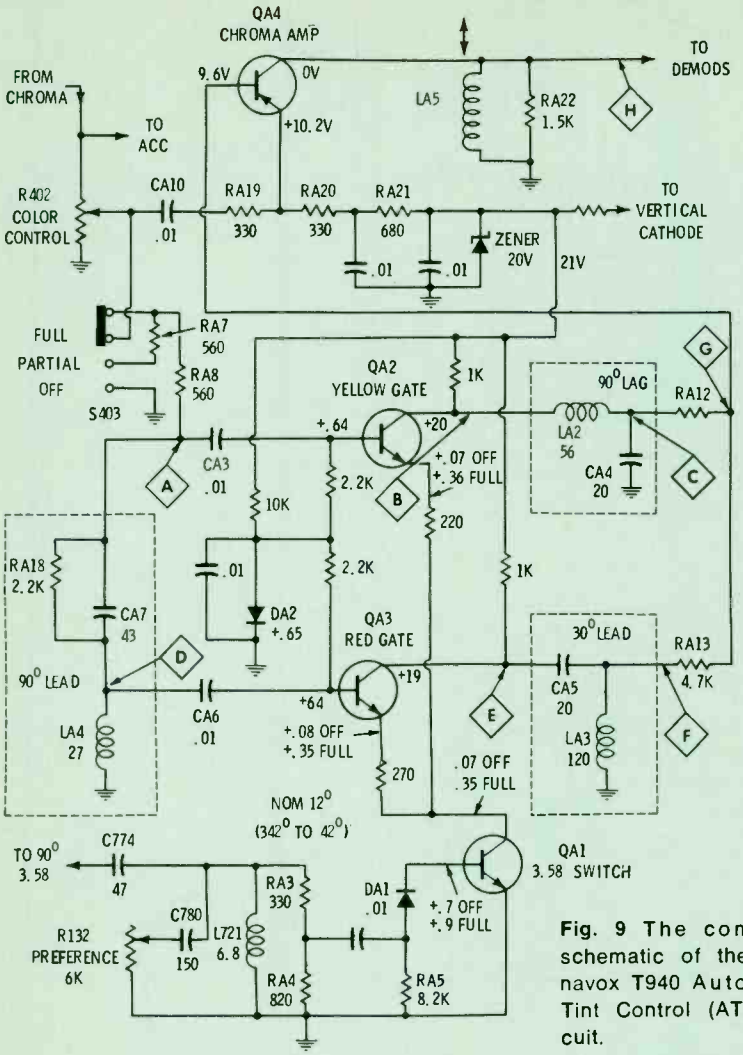


Fig. 9 The complete schematic of the Magnavox T940 Automatic Tint Control (ATC) circuit.

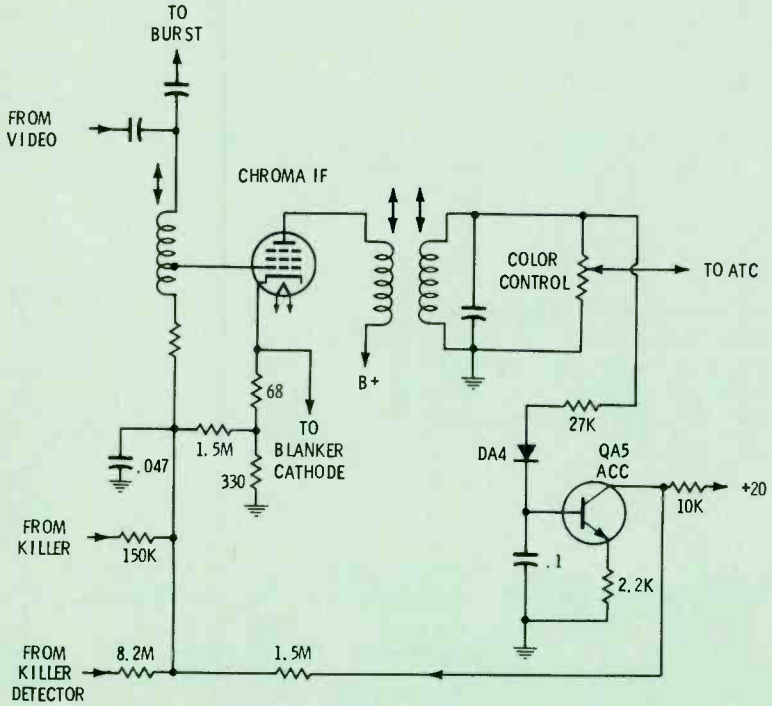


Fig. 10 Magnavox ACC has a double action which is especially helpful when the station broadcasts very strong color without excessive burst.

ple and slows down the response just enough to serve as an anti-hunt circuit. Voltage on the emitter is stabilized by a zener diode. Current from the emitter charges the .1-mfd capacitor, C3Z. When the voltage reaches the required level, a bi-directional switch (similar to two diodes back-to-back), E3Z, conducts somewhat like a zener and connects the capacitor to the transformer. The capacitor discharge current flowing through the transformer (T3Z) primary generates a sharp pulse in the secondary, which forces the triac (E1Z) into conduction. The triac will continue to conduct until its anode voltage drops to zero.

So far in our description, the firing of the triac is random, which would give very poor regulation. A synchronizer is needed to bleed the charge out of capacitor C3Z 120 times per second. This is accomplished by transistor Q2Z, which is reverse-biased and non-conductive until it is forward biased through C4Z by the positive-going tips of the parabolic waveforms from the rectified outputs of E4Z and E5Z.

Now, back to the regulator transistor. Assume the regulator control has been set correctly and the receiver is plugged into 120 volts AC. If the +95 volts decreases for any reason (such as increased drain on the supply or a reduction in line voltage), the forward bias on Q1Z is **increased.** This results in more emitter current, which charges C3Z faster, thus causing the triac to start conducting **sooner** in the cycle. Once fired, the triac stays on until the anode voltage goes to zero. With the triac conducting during **more** of each AC cycle, the voltage drops across the loss resistors are reduced, and the voltage applied to the transformers is increased. This, in turn, raises the +95-volt supply. These actions are all reversed if the +95-volt supply should increase.

Packard Bell

Integrated circuits (IC's) and field-effect transistors (FET's) are of special interest in the chroma circuit of the Packard Bell 98C-21 chassis. The "X" and "Z" chroma demodulators in this chassis are both dual-gate FET's, with the chroma applied to one gate and the 3.58-MHz signal applied to the other, as shown in Fig. 13. (Notice the similarity to circuits which use

pentode tubes.)

An IC unit that is the equivalent of five transistors and two resistors is used as the 3.58-MHz oscillator crystal, and by power and brute force causes the oscillator to lock to the amplitude and phase of the burst. A separate phase detector supplies the control voltage for the color killer and ACC functions, as shown in Fig. 14.

Philco

The Philco 19FT60 chassis utilizes only seven tubes; all other active components are solid state. A new method of degaussing used in this chassis is shown in Fig. 15. Line voltage is supplied to the degaussing coil in series with a positive-temperature-coefficient resistor called a "posistor." When the receiver is first turned on, a large amount of AC flows through the low-resistance posistor and the coil. The current heats the posistor, and its resistance increases until it has shut off all significant degaussing action. Philco states that this system results in a stronger field at the start of degaussing.

Varactor diode control of an IC color oscillator is a noteworthy addition to the chroma channel (see Fig. 16). The positive feedback path from pin 7 of the IC back to pin 3 is through the 3.58-MHz crystal and the varactor diode. Any correction voltage from the phase detector changes the internal capacitance of the varactor diode and shifts the frequency or phase of the 3.58-MHz oscillator. To adjust the frequency, ground the phase-detector end of the 68K-ohm resistor and adjust coil L100 for zero beat with the station or a color-bar generator signal applied.

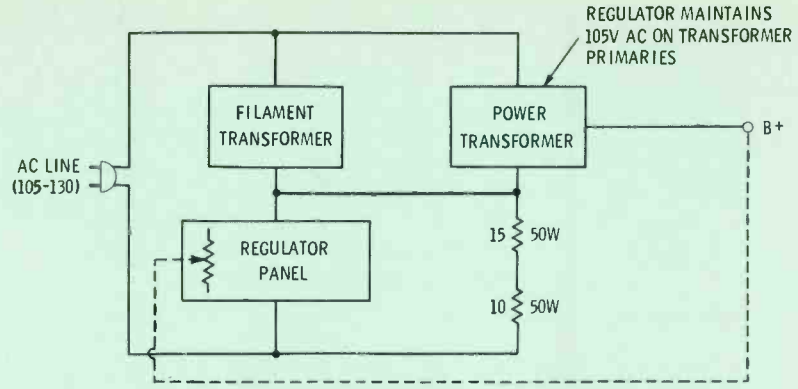


Fig. 11 All power supplies are regulated in the new Motorola Quasar color receivers.

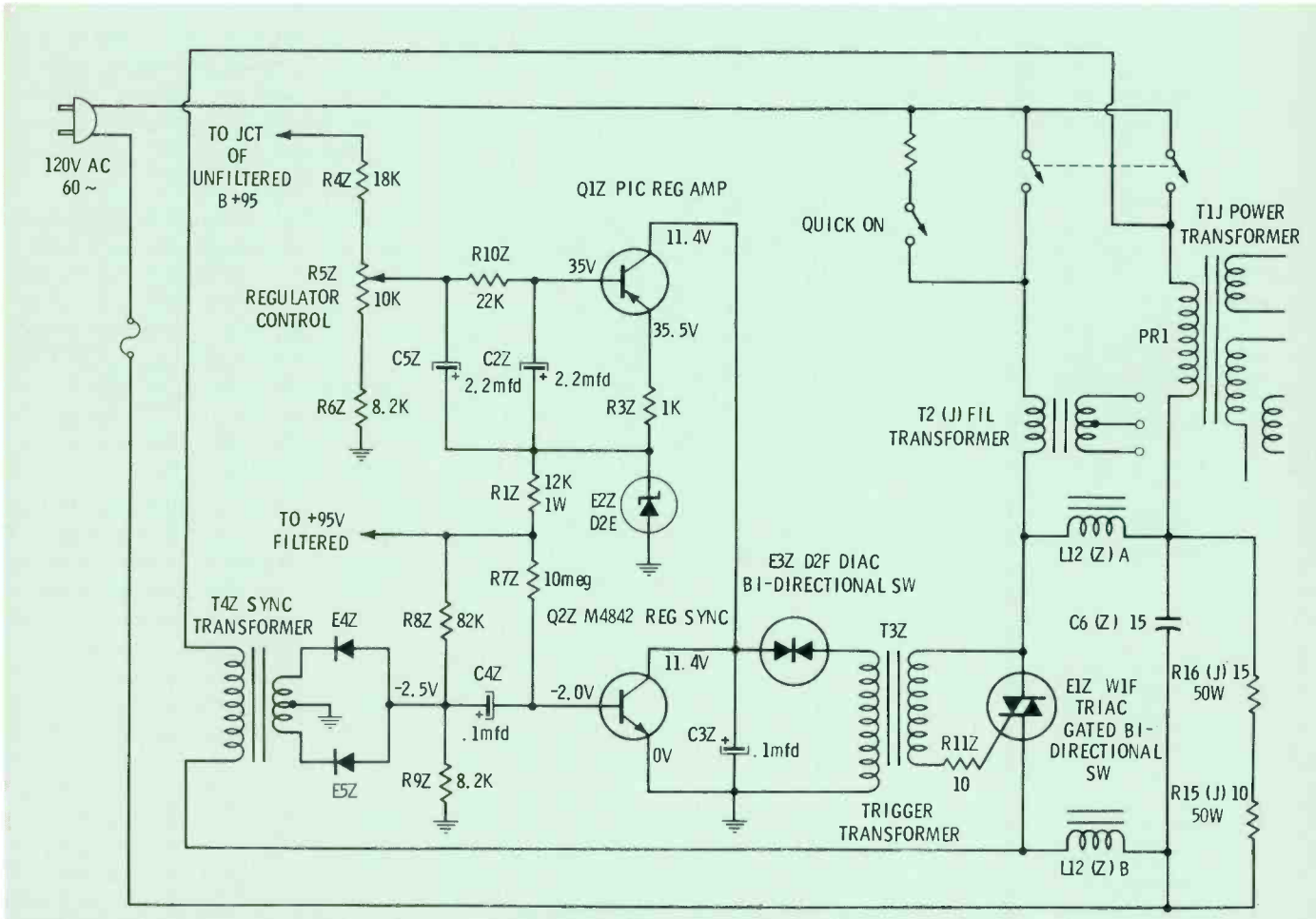


Fig. 12 A simplified schematic of the power supply regulation circuit in the Motorola Quasar chassis.

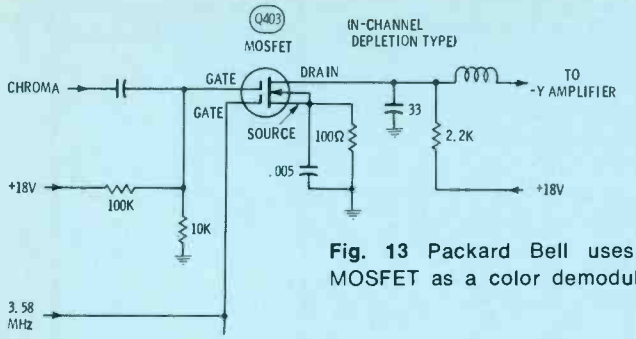


Fig. 13 Packard Bell uses a dual-gate MOSFET as a color demodulator.

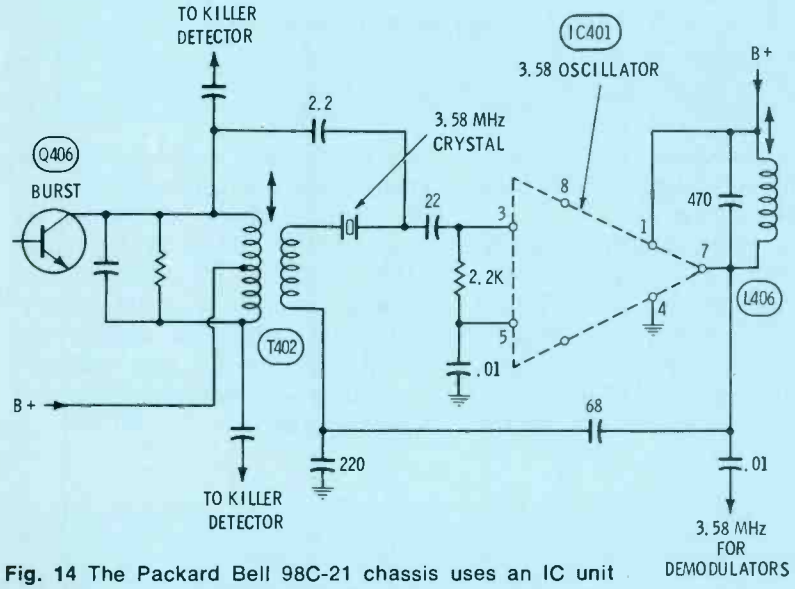
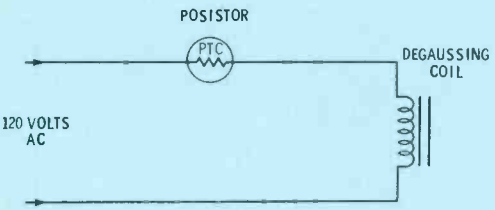


Fig. 14 The Packard Bell 98C-21 chassis uses an IC unit equivalent to 4 transistors and 2 resistors as the active element in the 3.58-MHz oscillator.

Fig. 15 A "posistor" is used to stop the degaussing action in the Philco 19FT60 chassis. The resistance increases along with temperature and squeezes off the degaussing current to the coil.



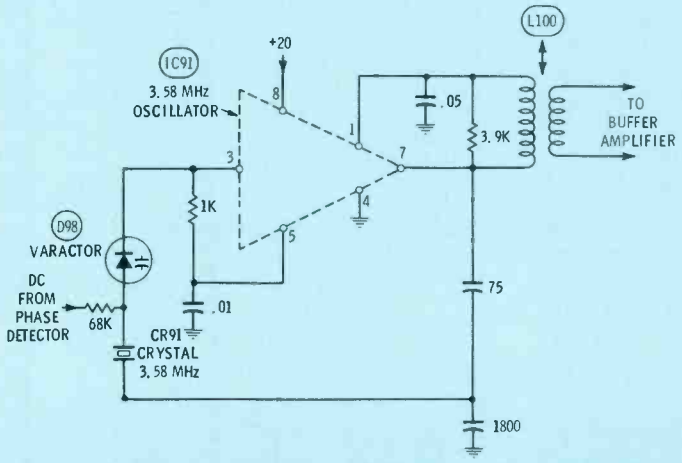


Fig. 16 Color locking in the Philco 19FT60 chassis is accomplished by a varactor diode wired between the crystal and the 3.58-MHz IC oscillator. Correction voltages from the phase detector change the internal capacitance of the varactor.

RCA

Several of RCA's current chassis are being continued, but there is a new CTC42X chassis used with 16" color kinescopes. The CTC42X is a hybrid design with 13 tubes (including 5 duals), 17 transistors, 2 IC's, 17 diodes, 2 zeners and 1 damper diode. The tuner, IF and chroma circuits are very similar to those in the CTC38, except that a 2DS4 is used as the RF amplifier in the tuner because of the series heater connections. High-voltage regulation is by AC pulse regulation exactly as is used in the CTC36 chassis. No high-voltage adjustment control is provided. A diode in the regulator cathode is a safety precaution; if the regulator draws no current, the diode is reverse biased and acts as an open circuit. The cathode voltage of the diode drops to zero and there is no plus voltage there to be fed back to the grid of the horizontal output tube. This makes the grid too negative, and the width and high voltage are both reduced until the regulator circuit is repaired.

The television industry has started to produce tuners without switches; in most designs, varactor diodes are used as variable capacitors by varying a DC voltage applied to them.

The RCA design does NOT function in that manner. In the CRC47, RCA has a switchless VHF tuner that is tuned by coils and stray-circuit capacitance, but the switch contacts have been replaced by switching diodes. Fig. 17 shows part of the antenna and RF tuned circuits in which the channels are selected by diodes.

Any diode is a voltage-controlled switch, regardless of the kind of circuit in which it is used. Assume that none of the channel selector inputs have voltage on them, so that all the diodes are reverse-biased and, therefore, are open circuits. If a more positive voltage (+16 volts) is applied to the anodes of CR2313 and CR2213 than is present on their cathodes, they become low-resistance short circuits. C13 acts as an AC ground, and the channel 13 coils are switched into the circuit. When the +16 volts is removed from the channel 13 diodes and applied to CR2311 and CR2211, channel 13, 12 and 11 coils will

be bypassed to ground through the diodes. Channel 11 is then switched into the circuit. And so on, with the coils adding in series down to channel 2. The mixer and oscillator stages are tuned this same way by using voltage to key the diodes on or off.

This system would have one small advantage even if a regular switch were used to supply the keying voltage to the diodes: Dirty switch contacts would have no effect on the tuning until the voltage at the anode of the diode dropped below the voltage at the cathode. But there is much more to the system, and manual switches are NOT used. RCA's "The Two Thousand Technical Manual" uses 120 pages to explain the complete RCA system of electronic VHF tuning and motorless remote operation, which employs 78 transistors, 122 diodes, 4 FET's, 9 zeners and 6 IC's. The "Two Thousand" model is a prestige, limited-production version of RCA's well-known CTC40 Transvista chassis.

Before you read the manual, it would help if you studied some basic computer principals, because the operation of this tuner is based on binary mathematics and computer functions. For example, here is the binary code for the various channels:

channel 2	0000
channel 3	0001
channel 4	0010
channel 5	0011
channel 6	0100
channel 7	0101
channel 8	0110
channel 9	0111
channel 10	1000
channel 11	1001
channel 12	1010
channel 13	1011
channel 14	1100 (UHF)

A positive-polarity pulse is designated "1", and means "closed" time, "on" time or "yes" voltage. "O" designates alternate, or "off", half-cycles. According to this binary code for the channels, four sources and four gates are required to select the right channel.

Electronic scanning from one VHF channel to another is started by a "clock", which is merely a 330-Hz multivibrator oscillator. This is followed by three dividers (or counters). The clock and the counters have outputs of "1" or "0",

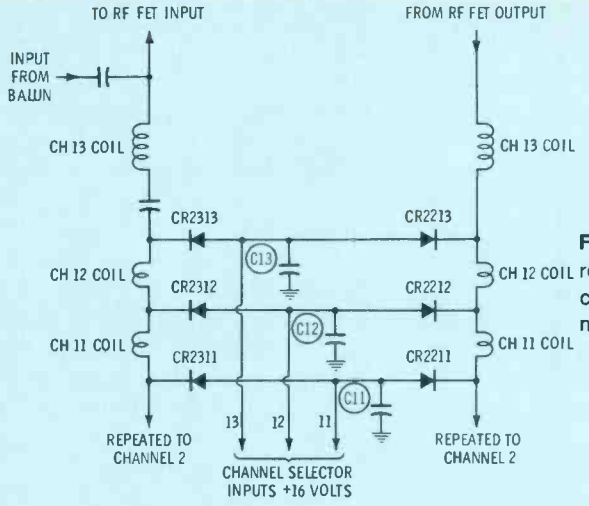


Fig. 17 Diodes replace switch contacts in the new RCA tuner.

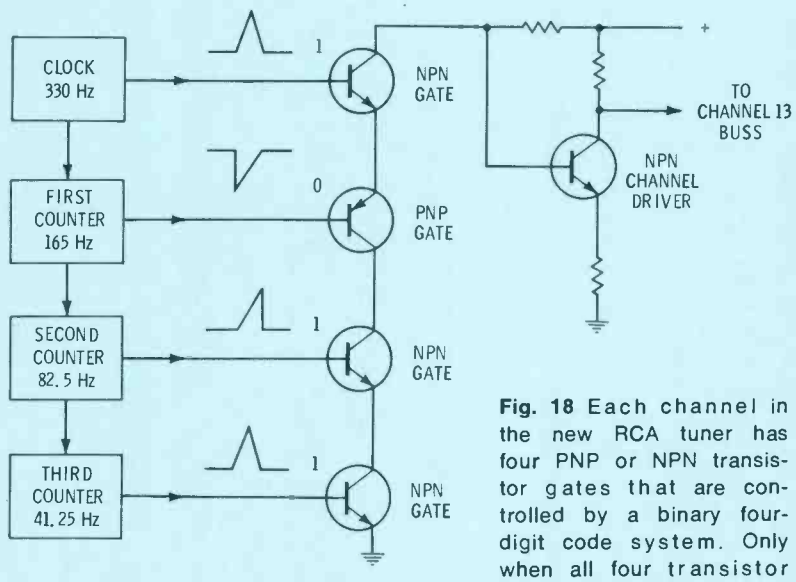
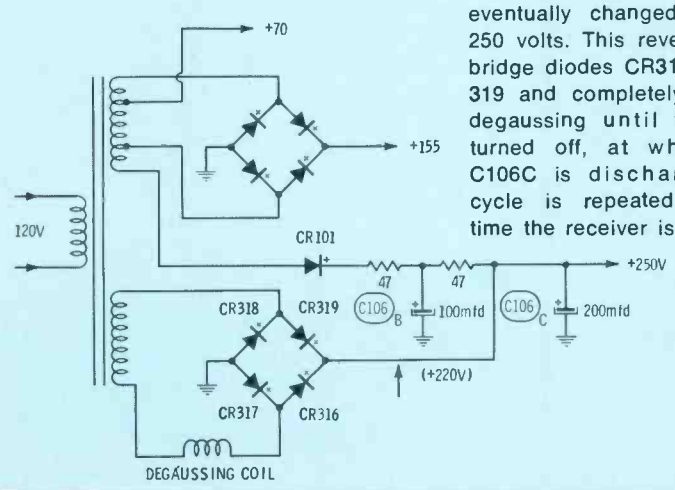


Fig. 18 Each channel in the new RCA tuner has four PNP or NPN transistor gates that are controlled by a binary four-digit code system. Only when all four transistor gates are conductive at the same time (proper pulse at the base of each) can the diodes for that channel be forward biased.

Fig. 19 In the RCA CTC47 chassis the picture tube is degaussed by a bridge rectifier (CR316, CR317, CR318 and CR319) charging C106C to about 220 volts. C106C is subsequently charged more slowly from CR101 through the two 47-ohm resistors and C106B until it is eventually changed to about 250 volts. This reverse biases bridge diodes CR316 and CR319 and completely stops all degaussing until the set is turned off, at which time C106C is discharged. The cycle is repeated the next time the receiver is turned on.



and the outputs change during each cycle, thus making the combination for one channel, then the next, etc., until a channel is found with the programming switch set to stop. Fig. 18 shows the outputs from the clock and the counters going to both NPN and PNP polarity gates. An NPN transistor "closes" on a "1" and a PNP transistor closes on a "0". For example, when the gates are supplied with pulses that produce binary code 1011, all the gates close at the same time, current flows to reduce the base voltage of the channel driver, whose collector voltage rises and forward biases all the diodes used for switches on channel 13. Other channels have a different combination, but all work on the same principle as that given for channel 13.

Do you know what "interface" means? It is a word that has gained increased popularity in scientific and broadcasting circles during the last few years, and it means interconnected, or better yet, an interconnection of unmatched or unequal equipment. The new RCA tuning system must have interface between the gating, the read-out (channel indication) programming switch and the circuits that mute the picture and sound and disable the AFT during channel change. Remember, there is **no manual** channel selector.

The motorized UHF power tuning system can be directed up or down in frequency. There are no detents or manual tuning; the motor

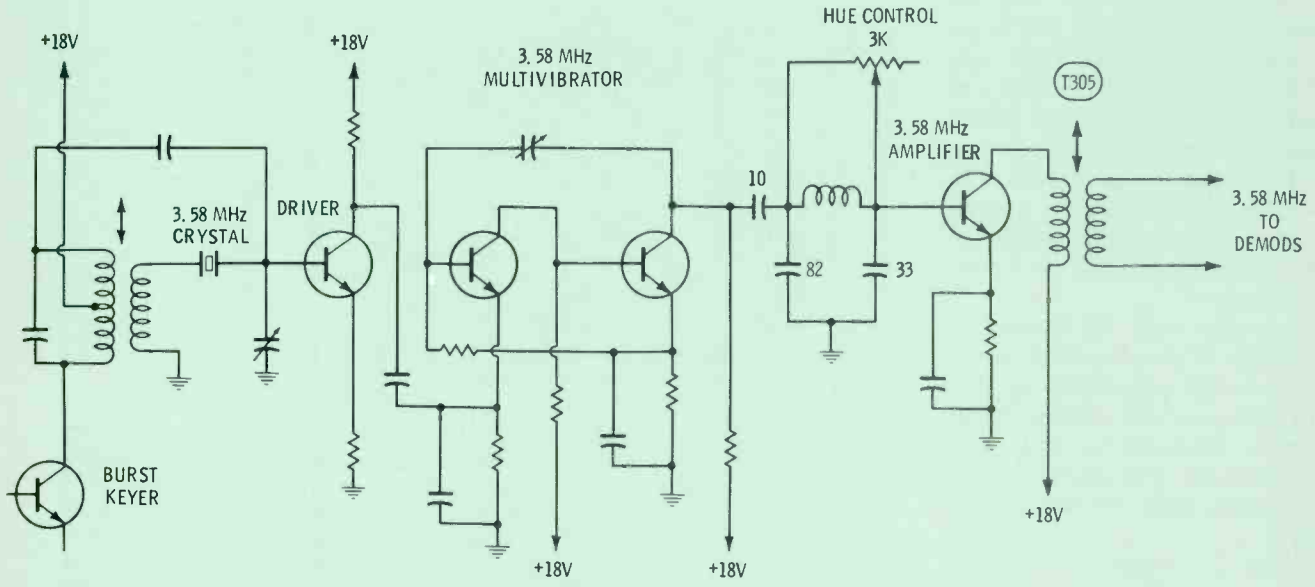


Fig. 20 The Sony 3.58-MHz multivibrator oscillator is synchronized at the correct frequency and phase by a signal produced by ringing a quartz crystal with the broadcast burst signal.

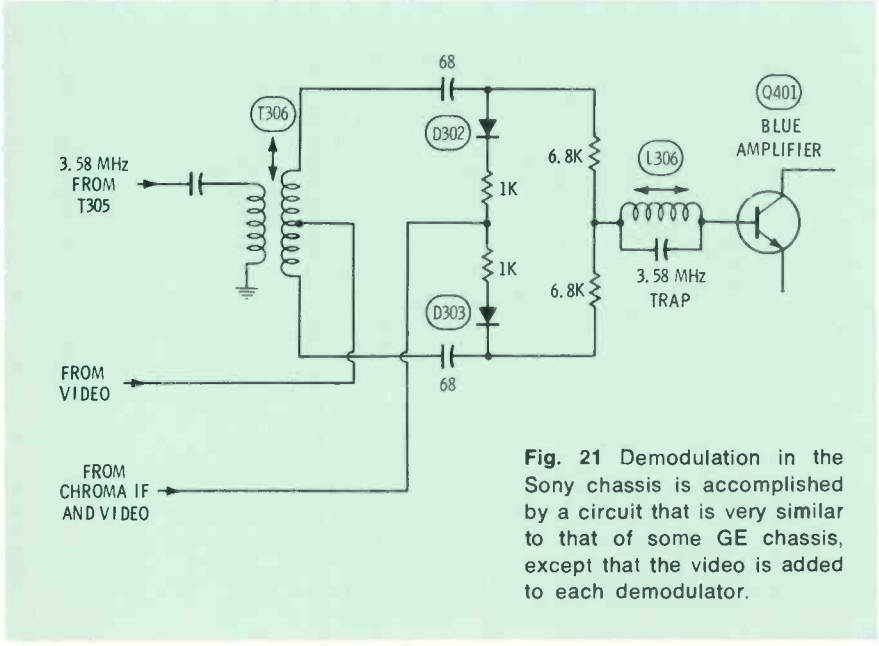


Fig. 21 Demodulation in the Sony chassis is accomplished by a circuit that is very similar to that of some GE chassis, except that the video is added to each demodulator.

keeps running until a signal of a certain pre-set minimum amplitude with horizontal sync is received. The motor then stops and the AFT pulls the signal into correct tuning.

Remote control is an integral part of the tuning assembly. It has only one motor and relay for the UHF function; all other active components are solid state. Control over volume, color and tint are by FET's, whose gate voltages are determined by voltages stored in "memory modules".

Less exotic circuit changes are also found in the CTC47, such as in the automatic degaussing system, the schematic of which is shown in Fig. 19. When the receiver is first turned on, C106C is charged to about +220 volts by a rapidly dwindling train of rectified full-

wave pulses from the bridge rectifier, consisting of CR316, CR317, CR318 and CR319. This charging current passes through the degaussing coil and demagnetizes the picture tube in about 20 milliseconds. DC voltage from CR101 is also supposed to charge C106C, but it is delayed by the two 47-ohm resistors and C106B, the 100-mfd filter capacitor, and does not rise above +220 volts until degaussing is completed. When fully charged from CR101, C106C has +250 volts on it. This voltage reverse biases CR316 and CR319 (in the bridge), and absolutely no current comes through the bridge. When the receiver is turned off and C106C is discharged, the set can be immediately turned back on and full degaussing obtained. There is no thermistor to introduce a time delay.

Sony

A 12″ Trinitron color picture tube is used in the Sony KV-121OU chassis, which employs 44 transistors, 35 diodes and 1 high-voltage rectifier tube. The Trinitron color picture tube has only one electron gun, although it does have three cathodes, to which are applied the b-w video and chroma signals. The

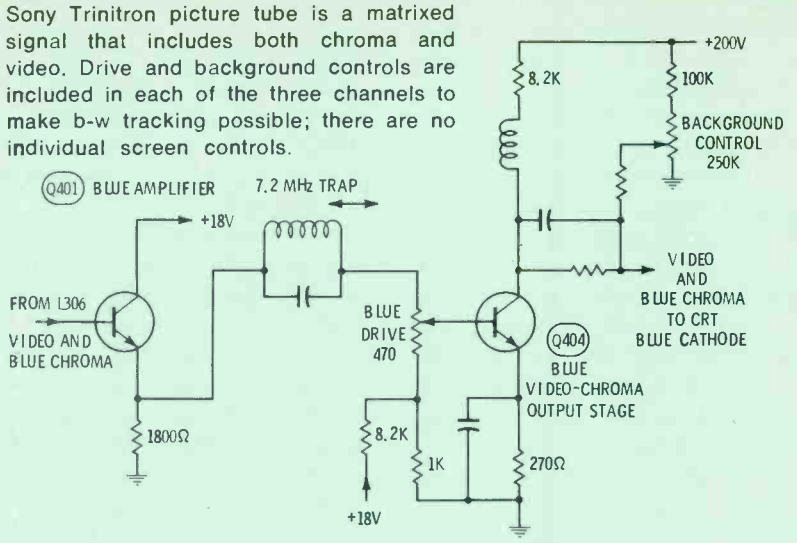


Fig. 22 The output to each cathode of the Sony Trinitron picture tube is a matrixed signal that includes both chroma and video. Drive and background controls are included in each of the three channels to make b-w tracking possible; there are no individual screen controls.

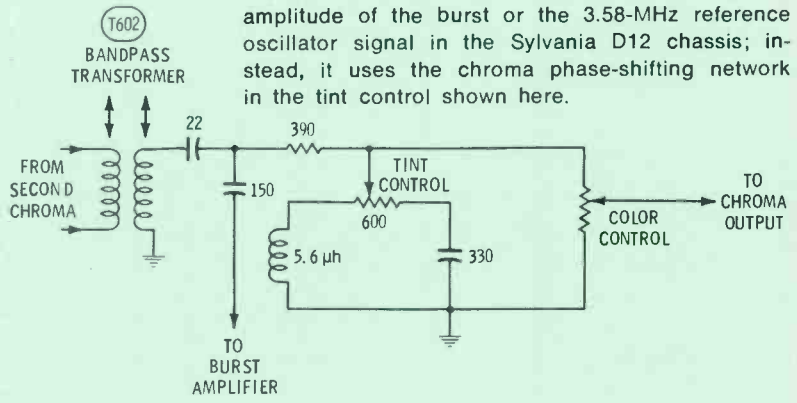


Fig. 23 Tint control adjustments do not change the amplitude of the burst or the 3.58-MHz reference oscillator signal in the Sylvania D12 chassis; instead, it uses the chroma phase-shifting network in the tint control shown here.

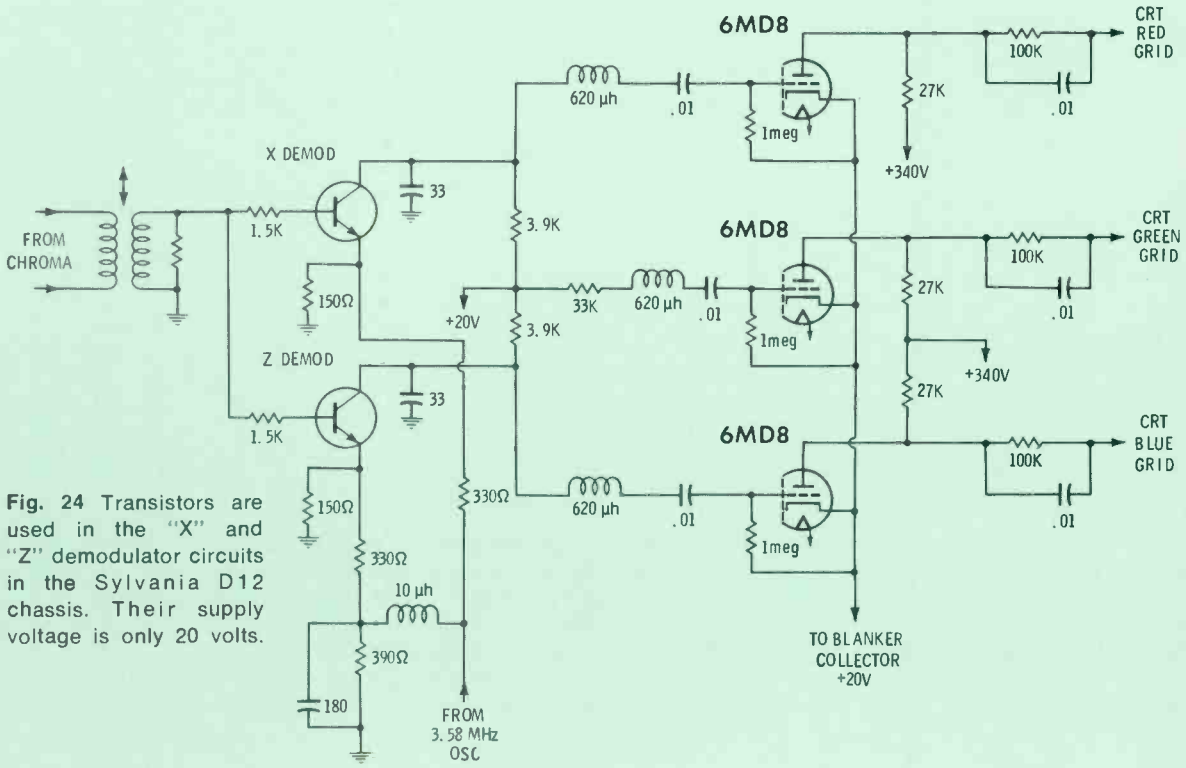


Fig. 24 Transistors are used in the "X" and "Z" demodulator circuits in the Sylvania D12 chassis. Their supply voltage is only 20 volts.

manufacturer claims twice the brightness of conventional three-gun tubes, and much simpler convergence adjustments.

Generation of the 3.58-MHz reference carrier also is accomplished in a different way in this chassis. The burst rings a 3.58-MHz crystal, and this nearly continuous signal is used to synchronize a 3.58-MHz multivibrator oscillator. The oscillator signal is fed through a hue control (see Fig. 20), an amplifier and a tuned transformer before it is applied to the three balanced diode demodulators.

One diode demodulator is used for each primary color. These demodulators, shown in Fig. 21, are similar to the ones used in some GE receivers, but do not have balancing controls. Matrixing is accomplished in the demodulator rather than at the picture tube; the video is applied to the junction of the two diodes and will go through either diode that is forward biased. Video and chroma both must be matrixed and brought to the CRT cathodes because there is only one control grid.

Fig. 22 shows more of the blue channel (the other two channels are nearly identical to this one), in which an emitter follower, Q401, drives the base of the power output stage through the adjustable control labeled "blue drive". There are no individual screen voltage adjustments because there is only one screen grid, so the three drive controls and the three background controls are used to obtain correct screen color and b-w tracking.

Sylvania

The Sylvania D12 (Gibraltar) chassis is another hybrid. It has 24 transistors, one IC and 9 tubes.

Generally speaking, tint-control circuits that tune a burst or 3.58-MHz reference signal transformer have one major drawback: A large amplitude change in the signal during tint adjustments.

Sylvania changes the tint in the D12 chassis by varying the phase

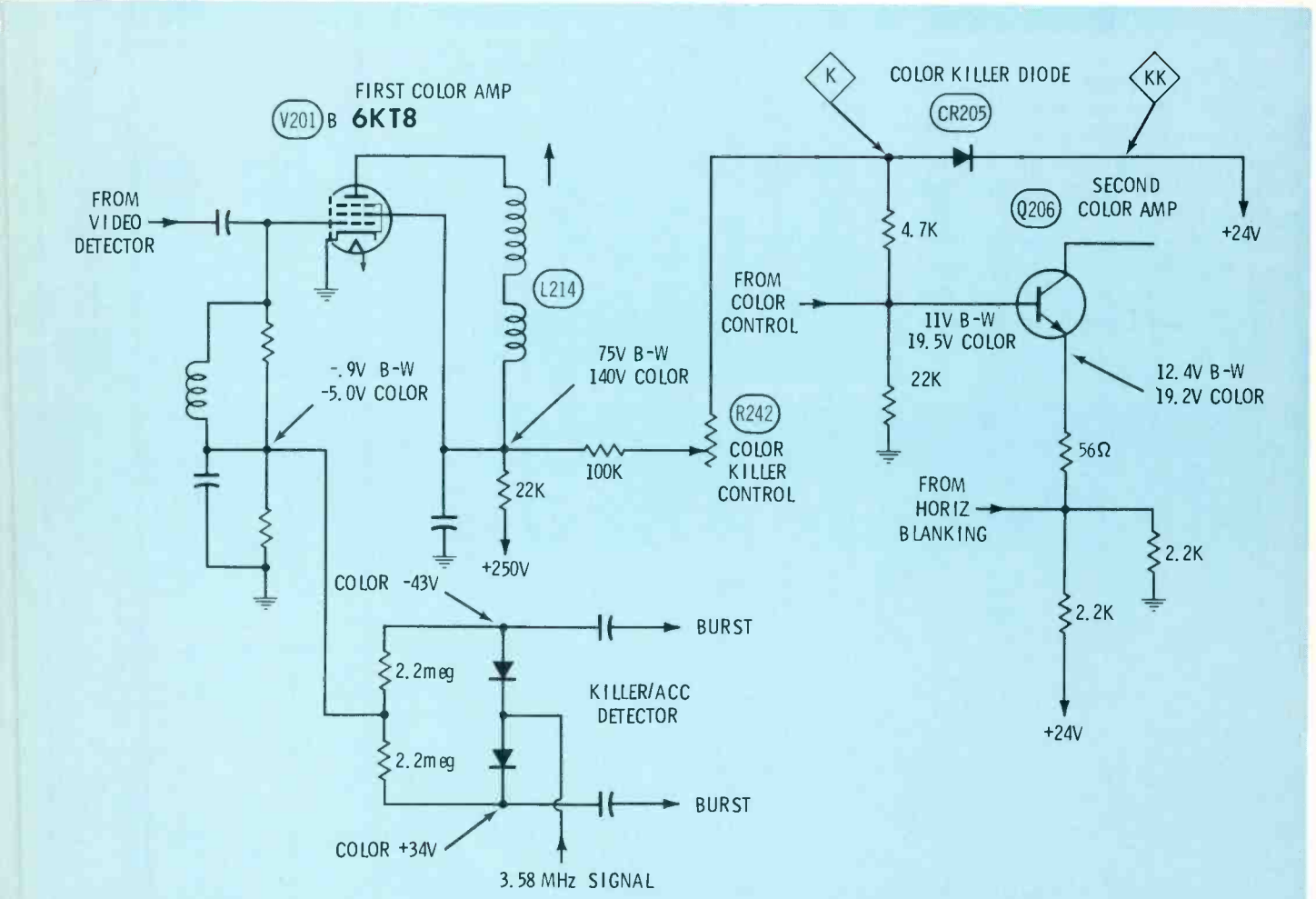


Fig. 25 Color-killer action in the Zenith 14A9C51 chassis is rather devious. ACC action changes the plate and screen voltages of V201B, the first color amplifier; these voltages, in turn, determine the bias on Q206, the second color amplifier. During b-w reception, the plate voltage on V201B is very low and the base of Q206 is less positive than its emitter; thus, the transistor is reverse-biased. With strong color tuned in, the plate voltage of V201B will be +140 volts or higher, and Q206 will have normal bias for good amplification. The color-killer diode is not essential for operation of this circuit, but is a refinement to prevent excessive forward bias on Q206. This is done by clamping the voltage at testpoint "K" to +24 volts whenever the voltage tries to exceed that limitation.

of the chroma signal between the bandpass transformer and the color control (Fig. 23). The 600-ohm tint control, in effect, switches in a capacitor or a choke to make the phase lag or lead, and a 390-ohm resistor isolates the variable part of the circuit from the burst.

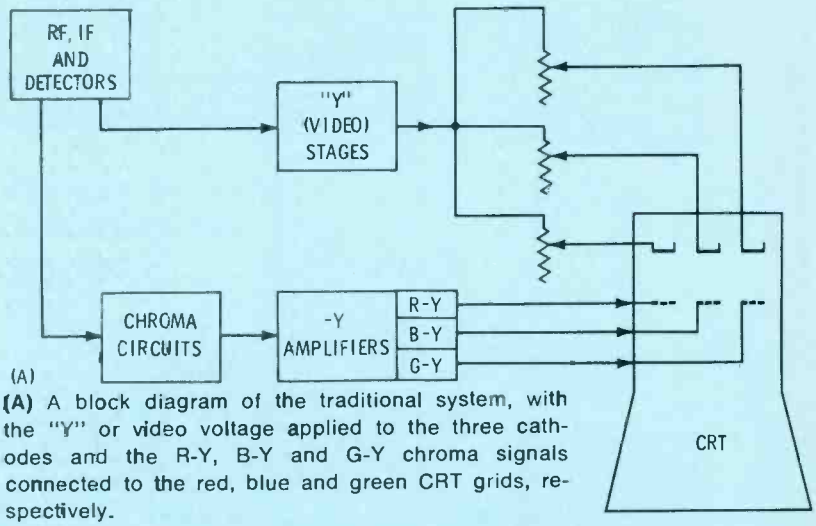
Transistors are used as demodulators in the D12 chassis, as shown in Fig. 24. Chroma is applied to the bases, while a 3.58-MHz reference signal with a 90-degree phase difference is supplied to the emitters. The demodulator collector circuits and the following –Y amplifier circuits are nearly identical to previous tube versions.

Zenith

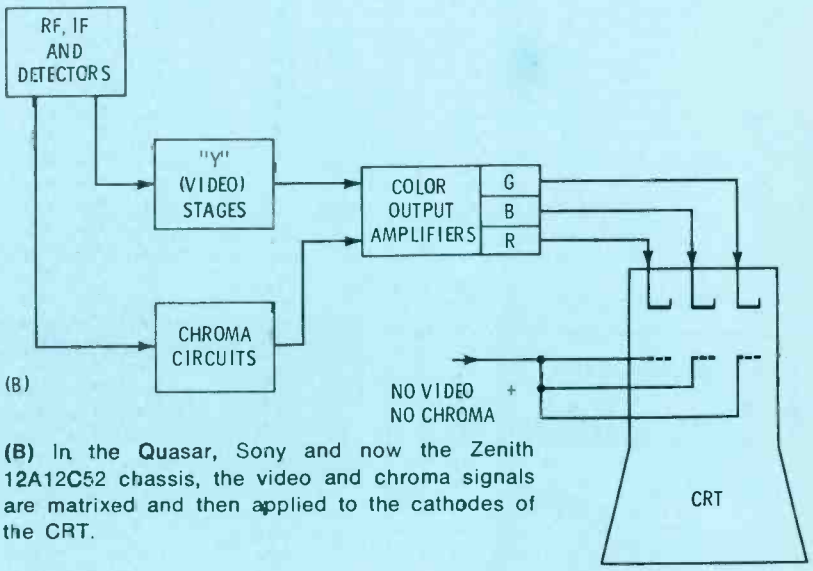
A different kind of color killer is used in the Zenith 14A9C51 chassis. The schematic of this circuit is shown in Fig. 25. Assume that the set is tuned to a b-w program. Q206, the second color amplifier, is biased to cut-off by the 12.4 volts applied to its emitter by the voltage-divider action of the two 2.2K-ohm resistors between the +24-volt source and ground. Its base voltage is only 11 volts because of the low source voltage of +75 volts at the screen of V201B. Thus, the transistor is 1.4 volts reverse biased. When color is tuned in, the killer/ACC detector has an output of several volts negative, which reduces the gain of V201B and causes the screen voltage to rise above +140 volts. This increases the base voltage of Q206 to about +19.5 volts; the resulting emitter raises the emitter voltage to about +19.2 volts, and the transistor amplifies. CR205, the killer diode, has two functions: One is to make sure that the anode voltage does not increase above +24 volts. If it does, the diode conducts and clamps the circuit to the +24 volts as protection and bias limiting for the second color IF amplifier transistor. The other function is to provide a convenient way to defeat the color killer so that the second color amplifier can conduct: short across the diode from test points "K" to "KK".

The first commercial color receiver ever placed on the market in 1954 had a very complex matrixing system to combine the chroma and video signals into three pure primary color signals that were fed separately to the three picture tube

Fig. 26 Matrixing of the b-w and chroma signals traditionally has been accomplished in the picture tube.



(A) A block diagram of the traditional system, with the "Y" or video voltage applied to the three cathodes and the R-Y, B-Y and G-Y chroma signals connected to the red, blue and green CRT grids, respectively.



(B) In the Quasar, Sony and now the Zenith 12A12C52 chassis, the video and chroma signals are matrixed and then applied to the cathodes of the CRT.

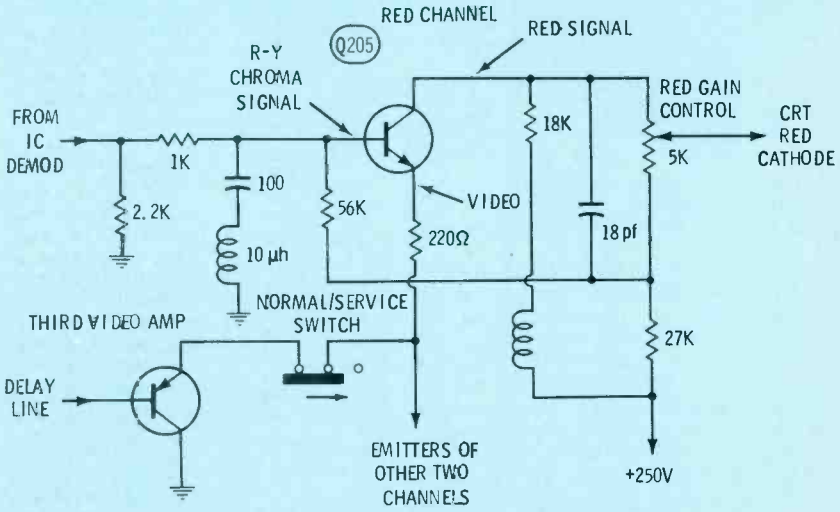


Fig. 27 In the red channel of the Zenith chassis, the chroma signal from the IC demodulator goes to the base of Q205, while the video signal goes to the emitter. The true red signal (not R-Y) is taken from the collector of Q205 and is routed through the red gain control to the red cathode of the CRT.

grids. This can be called pre-CRT matrixing. RCA used this system in the 1954 and 1955 model color receivers, then it was not used for years until Motorola updated it in the Quasar chassis.

Fig. 26A shows a block diagram of the traditional system of matrixing in the picture tube by feeding the video to the CRT cathodes and the chroma –Y signals to the three control grids. There apparently are no basic drawbacks in this system, except that four powerful amplifiers are necessary to completely modulate the CRT current. In solid-state circuits, this means that these amplifiers must operate with 160 to 200 volts on the collectors; consequently, elimination of the video output stage seems a good idea. Also, the new Trinitron color picture tube demands pre-CRT matrixing. Fig. 26B is a block diagram of a system in which the chroma/video matrixing is accomplished ahead of the picture tube.

The schematic of the red amplifier channel in the Zenith 12A12-C52 color chassis is shown in Fig. 27. The green and blue channels are similar to the red. From the IC, the R-Y signal is connected to the base of Q205. Video from the emitter of the third video amplifier is applied to the emitter of Q205. The true input to Q205 is between base and emitter, and the transistor sees the resultant voltage as though the video had been inverted in phase and applied to the base. The red signal on the collector includes both video and chroma and is applied to the CRT red cathode. The CRT grid has no signal on it, just a DC voltage to maintain normal brightness.

Conclusion

The preceding paragraphs have described briefly the most revolutionary designs we are aware of in the 1970 color chassis. For additional knowledge of the operation of these new circuits, we suggest that you obtain the manufacturers' literature about the circuits you are interested in and, whenever possible, attend manufacturers technical training sessions—in most cases such sessions are open to all electronic technicians and there is no charge. ▲

photofactbulletin

PHOTOFACT BULLETIN lists new PHOTOFACT coverage issued during the last month for new TV chassis. This is another way ELECTRONIC SERVICING brings you the very latest facts you need to keep fully informed between regular issues of PHOTOFACT Index Supplements issued in March, June, and September. PHOTOFACT folders are available through local parts distributors.

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productreport

for further information on any of the following items, circle the associated number on the reader service card

"Rollaway" Storage Unit

Bay Products Division of American Metal Works, Inc. has introduced a 4-drawer mobile storage unit for use in shops, industrial plants, electronic laboratories, etc. It is designed to facilitate the moving of tools and parts to and from the job.

The ball-bearing drawers are 5" x 20" x 20", and each drawer has an upper sliding tray to keep small

parts separated. Padlock hasps are standard; cylinder locks are optional.

The top of the Bay "Rollaway" storage unit has a ½" flange stop on all four sides and may be inverted. Equipped with Bay 5" all-swivel casters for easy maneuverability, the unit is finished in gray baked enamel and is easily assembled, according to the manufacturer.

The Model 20-2020 "Rollaway" storage unit is shipped in 5 cartons and weighs a total of 120 lbs. Dimensions are 33½" x 22" x 20½". The cost is $98.80.

Circle 62 on literature card

Cassette-Tape Splicing Kit

A new compact tape splicing kit is now available from Robins Industries Corporation.

The kit comes in a plastic case about the size of a deck of cards and may be carried in the pocket,

handbag or cassette carrying case; it is instantly available for on-the-spot editing or repair, without opening the cassette itself.

Included in the kit is a splicing block, a supply of pre-cut patches and, also, guides for conventional 45° and critical-editing 90° cuts.

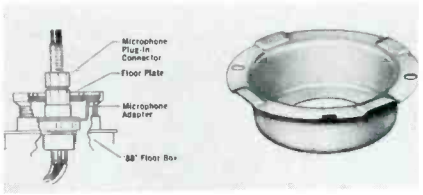
The cassette splicer, Model TS-215, lists at $10.

Circle 63 on literature card

Microphone Adapter

The Electrical Products Division, Midland-Ross Corporation, has announced its new microphone adapter designed for use with standard floor boxes.

Designated as catalog number 489-MA, the adapter has a 1¼-inch diameter opening to accommodate standard microphone jacks, and is recessed to hold the microphone connector beneath the surface of



the floor, available for plug-in of the microphone cord.

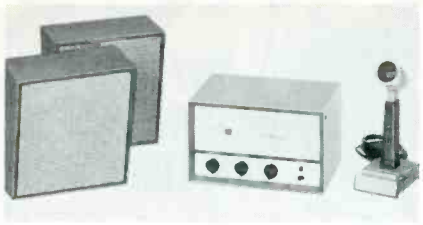
The new microphone adapter has a list price of $.50.

Circle 64 on literature card

Sound System Package

Bell P/A Products Corporation has introduced four more packaged, pre-engineered sound systems for easy installation and operation in offices, stores, warehouses and other low noise areas.

The new systems are factory-engineered, pre-matched and pre-wired. The group consists of two standard and two deluxe (or solid-



state) systems ranging in output from 20 to 45 watts to cover low-noise areas from 7,500 to 45,000 square feet.

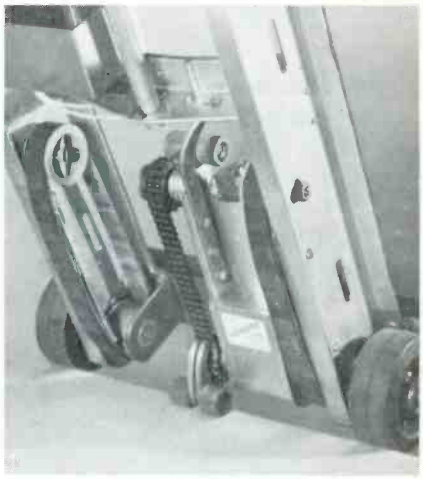
List prices range from $200 to $500 for complete systems including 50 feet of cable and the necessary number of wall baffle speakers to cover specified areas.

Circle 65 on literature card

Mechanically-Powered Dolly

Yeats Appliance Dolly Sales Co. has taken the basic hand-truck and incorporated a simple, self-contained stair climbing mechanism, enabling one man to move up to 600 lbs. up or down stairs with a touch of his finger, it is reported.

A "mar-free" set of electromechanically-powered grippers "cycle" the entire truck and load up onto each step in turn. In reverse cycle, they move a load down stairs. Yeats



states that vertical application of thrust allows the unit to be used on wet, carpeted or waxed surfaces.

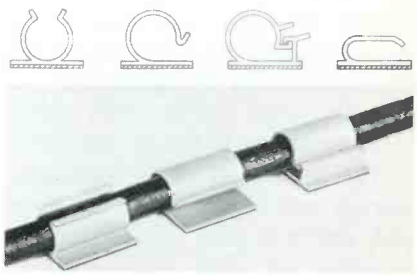
There are no lead-in cords or wires; the power source and lifting mechanism are self-contained within the hand-truck frame. The operator simply balances the load. The total weight of unit and truck is 66 lbs.

It is reported that the 10-amp battery power source will lift loads all day on one charge (i.e. 300 lbs. up 15 flights, or two typical deliveries every hour for seven hours). A plug-in overnight recharger is included with the unit.

The Yeats Model 24 Mansaver Dolly sells for $495.00.

Circle 66 on literature card

Cable or Tubing Clip



Kwik-Klips, manufactured by Richco Plastic Co., are made in three styles in sizes for cables ranging from ⅛" to ¾" in diameter, plus a size designed especially for three-conductor appliance leads.

These clips are used to support leads, cables or flexible tubing. They are made from a resilient P.V.C.

plastic and have an adhesive back that permits mounting on any relatively smooth surface, without screws, nails or any other hardware.

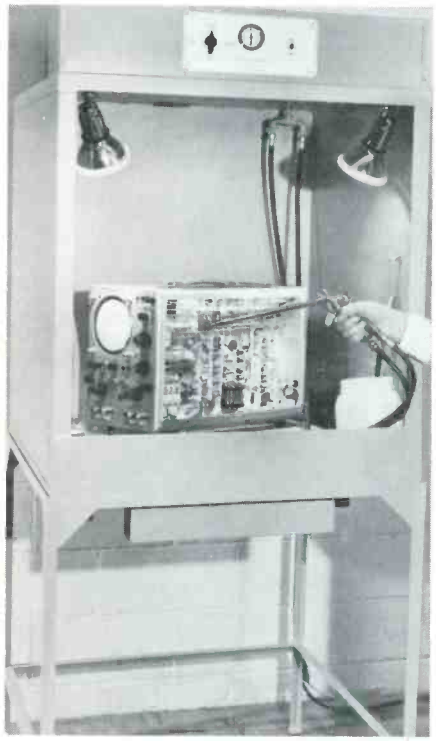
The price ranges from $30 to $75, depending on the size, style and quantity purchased.

Circle 67 on literature card

Electronic Equipment Cleaner

The Model 16 Cleaner has been added to the SAN-DEL line of cleaning systems manufactured by the M. P. Odell Company.

Dirt, dust, oily smoke residue and other leakage-causing contaminants on electrical equipment are flushed away by spray application of SAN-DEL cleaning solutions, according to the manufacturer. It is stated that items such as the largest cathode ray oscilloscopes, digital voltmeters, recorders, TV chassis and/or other



equipment weighing up to 150 lbs. are readily accommodated.

Equipment features include instrument turntable, flood lamp illumination, air pressure gauge, regulator and new semi-automatic function controls.

The cleaning system requires approximately 360 watts at 115 volts, 60 Hz, single phase and a compressed air source in the range of 50 to 200 psi.

The cost of the Model 16 Cleaner is $1,175.00.

Circle 68 on literature card

Line-Voltage Regulator

The Terado Corporation has announced the production of a new device for the improvement of color television performance.

The Saturn Model 50-172 is claimed to insure lifelike color and improve clarity and brightness by correcting low or changing AC line voltages to normal.

Saturn can be connected in seconds to the color television set. The easy-to-read edge view meter and six-position switch allow the viewer fingertip control of AC line voltage, resulting in a clear, sharp, full and more lifelike picture, according to the manufacturer.

The suggested retail price is $26.95. ▲

Circle 69 on literature card

Avoid Marking on or Attaching Material to Etched Face-Plates

The surface of the etched face-plates used on some color and monochrome picture tubes to reduce glare and reflections have random microscopic indentations. If adhesive material, such as glue off the backing of tape or wax from crayons, becomes embedded in these indentations, it is virtually impossible to remove it. Such material will cause refraction of light passing through the face-plate; this distortion will be noticed most when color programing is being displayed. Consequently, never attach to etched face-plates any adhesive-backed material, and never write on the surface of such face-plates with wax crayons, marking pens or graphite pencils. ▲

bookreview

How To Fix Transistor Radios & Printed Circuits: Leonard C. Lane, TAB Books, Blue Ridge Summit, Pa. 17214, 1969; 256 pages, 5½" x 8½", hardbound, $7.95; paperbound, $4.95.

The purpose of this revised edition is to acquaint the technician with semiconductors and their uses in home entertainment equipment. This updated edition has been revised, rearranged and expanded to include field-effect transistors, zener diodes and FM radio, along with the other subjects related to transistor radios which were covered in the first, two-volume edition.

Chapters 1 and 2 cover the basic fundamentals of transistor physics, including the introduction and construction of basic circuits. Chapter 3 goes into amplifier fundamentals, basic circuit configurations, biasing and the different FET's.

Chapters 4 and 5 are devoted to RF and IF amplifiers, detector and AGC circuits plus more advanced audio circuitry.

Auto radio is covered thoroughly in Chapter 6, while Chapter 7 concentrates on FM radios. The description of each type of receiver begins at the "front end" and proceeds step-by-step to the output stages.

Solid-state servicing, repair techniques, measurements, transistor testing and alignment are explained in Chapters 8, 9 and 10, respectively, and printed circuits are covered in the same thorough manner in Chapter 11.

Chapter 12 presents troubleshooting charts to help the servicer locate and repair many common complaints in transistor radios. ▲

catalogs literature

AUDIO

100. *Bogen Communications Div./Lear Siegler, Inc.*—"Solid-State Intercom Systems From Bogen" describes their three new intercom systems, including features, uses and wiring for the systems.
101. *Stanford International*—has announced the availability of "How to Choose and Use Microphones".

COMPONENTS

102. *Amphenol Distributor Div. /Bunker-Ramo Corp.*—Amphenol Astroplate D-Form 181 is a 4-page brochure listing their line of BNC and UHF RF connectors.
103. *Axel Electronics, Inc.*—has released a 16-page catalog describing their line of Drimica high-voltage capacitors.
104. *Chicago Miniature Lamp Works*—has issued a 21-page catalog which contains design information, technical information and a cross-reference guide to lamp substitution.
105. *Liberty Leasing Co., Inc.*—a catalog listing Liberty's entire line of relays and solenoids has been released, with specifications and descriptions included.
106. *Mallory Capacitor Co.*—has announced the availability of technical bulletin No. 4-810, which describes their line of TDC solid electrolyte tantalum capacitors.
107. *National Semiconductor Corp.*—is making available a TTL series 74N Cross-Reference Guide listing 13 manufacturers in cross reference with National's TTL line.
108. *Ohmite Manufacturing Co.*—new 8-page catalog No. 709 describes Ohmite's complete line of solid-state variable time delay relays.

MISCELLANEOUS

109. *Team Electronics*—has issued a 132-page, 4-color catalog which includes Team's complete line of home, industrial and educational electronic products.

SPECIAL EQUIPMENT

110. *Amphenol Industrial Div./ Bunker-Ramo Corp.*—is offering a connector selector slide rule that catalogs Amphenol's Min-Rac® 17 Series connectors, with a cross-reference provided on the reverse side.
111. *Bourns-Euphonics*—has released Engineering Applications Bulletin No. 1, which discusses the effect of humidity on the operation of ultrasonic intrusion alarms.
112. *Equipto*—announces the availability of Steel Equipment Reference Manual No. 493, which contains over 100 pages of their standard steel storage, shop and office equipment and new products.
113. *Lambda Electronics Corp.*—a 72-page general catalog of their line of power supplies for systems, laboratory, test equipment and OEM applications is now available.

TECHNICAL PUBLICATIONS

114. *Howard W. Sams*—Literature describes popular and informative publications on radio and TV servicing, communication, audio, hi-fi and industrial electronics, including 1969 catalog of technical books on every phase of electronics.*

TEST EQUIPMENT

115. *Julie Research Laboratories*—has issued a 12-page catalog covering Julie's complete line of test and measurement equipment.
116. *Simpson Electric Co.*—Bulletin 2080 introduces 5 new test instruments, with operating specifications included.

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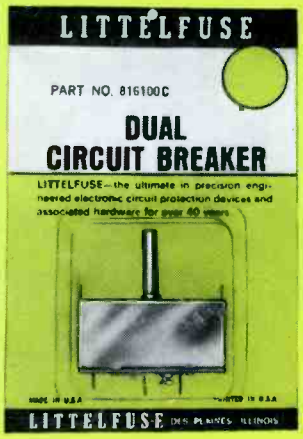

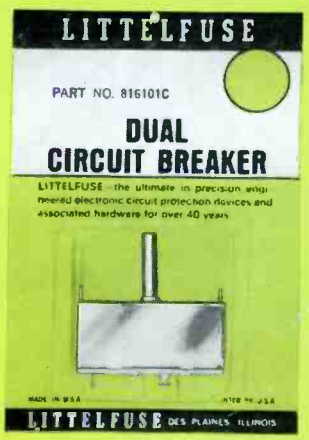

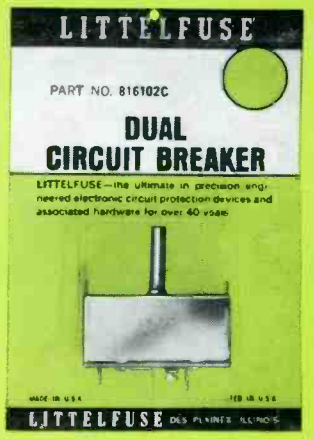

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