January, 1969 □ 75 cents

A HOWARD W. SAMS PUBLICATION

Electronic Servicing

Formerly PF Reporter

Making a business out of service

(First of a new series)

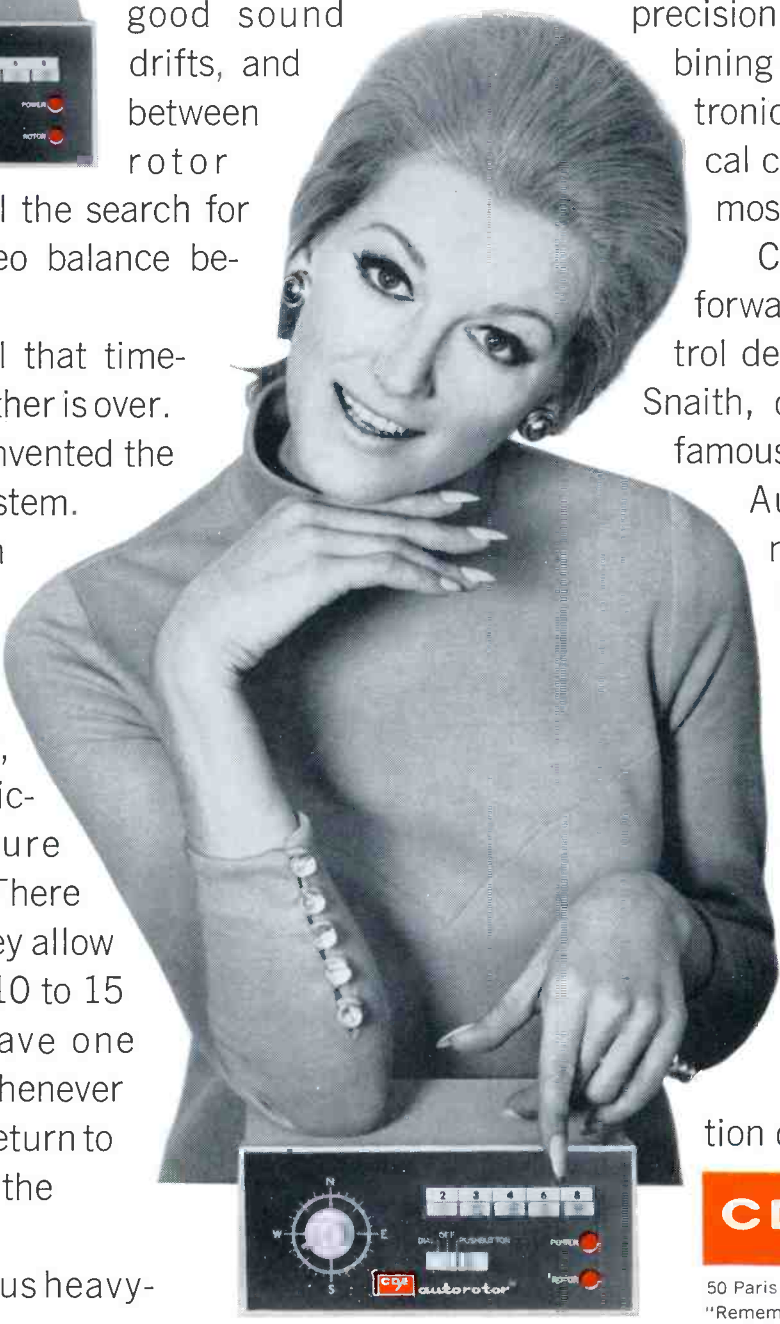
Index of 1968 content

The name of the game was hide and seek.

The good color picture hides. The viewer looks for it. And sometimes it takes quite a while to find. The good sound drifts, and between rotor and tuning dial the search for a perfect stereo balance begins again.

Well now all that time-wasting and bother is over. Because CDE invented the Autorotor™ system. It's more than an ordinary rotor. Buttons are easily set for clear, bright, perfect color pictures. And pure stereo sound. There are five and they allow you to pre-set 10 to 15 channels. Leave one channel and whenever you choose to return to it, just press the button again.

CDE's famous heavy-duty Bell Rotor gives you high repeatability and no antenna drift. It's an all-solid-state, silent operation. The Autorotor system's precision is within 1° and combining it with pushbutton electronic control, not mechanical control, makes it today's most advanced rotor.



CDE took another step forward in the Autorotor control design. They had William Snaith, of Loewy-Snaith, world famous designers, create the Autorotor console. He made it attractive. Made it so you can place it on a table top or shelf without it being an eyesore.

This is the story you can tell your customers to sell the top-of-the-line in rotors. The latest advance from the quality house of rotors — Cornell-Dubilier.

For complete information on new Autorotor write:

CDE CORNELL-DUBILIER

50 Paris Street, Newark, New Jersey 07101

"Remember to ask what else needs fixing"

Circle 1 on literature card

The absolute end of an old fear.

ANNOUNCING: The new B&K Sweep/Marker Generator. Does for TV sets what no other instrument or instruments can do. It makes alignment of color as well as black & white TV sets simpler, easier than ever.

We've remembered all your old fears about TV alignment. Especially color. So now you can forget them.

In the past, a marker generator and a separate sweep generator were used with a marker adder and a bias supply. All four of these now are combined in one easy-to-use instrument.

(We've made benchwork so much simpler by doing away with the need for hooking together a lot of cables and costly instruments.)

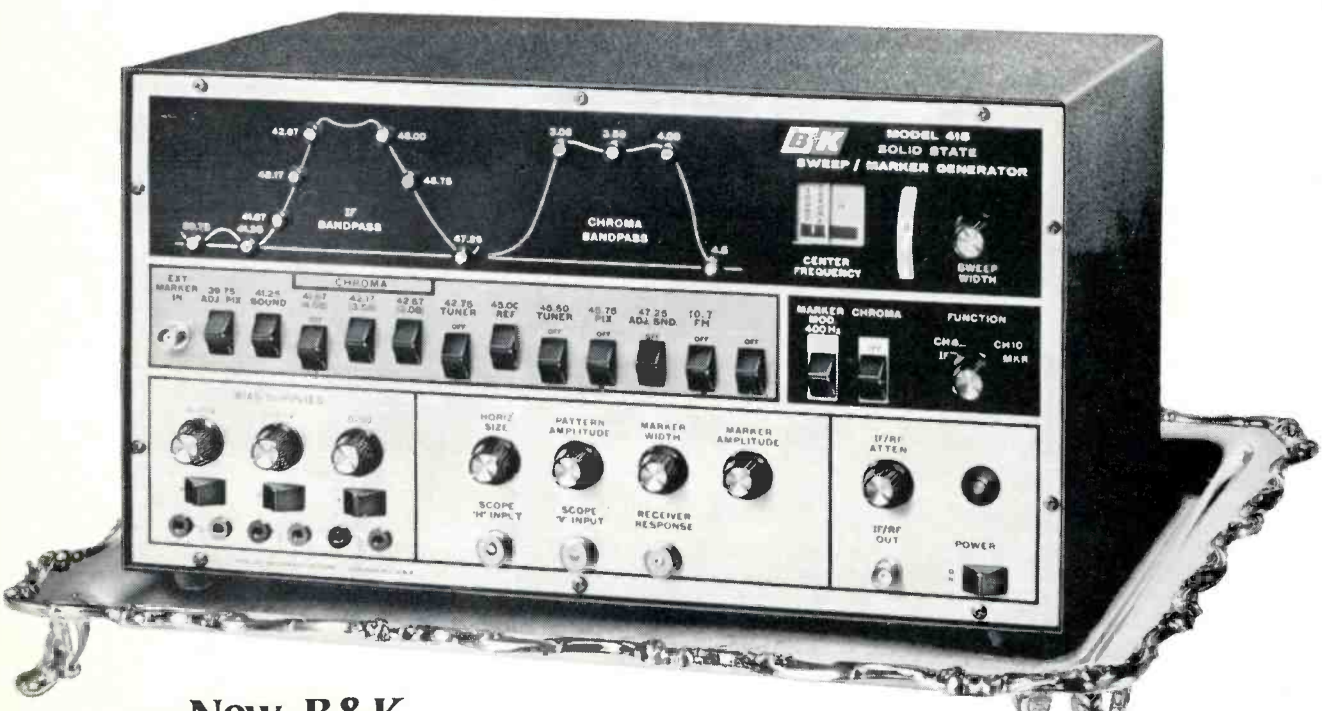
The Sweep/Marker Generator is both an instrument and a guide. As a guide, the bandpass and chroma bandpass curves are visually reproduced and the individual markers are clearly indicated by lights—right on the front panel—for quick, easy reference.

As an instrument, the Sweep/Marker Generator not only generates the marker frequencies (all crystal controlled), but also sweeps the chroma bandpass, TV-IF, and FM-IF frequencies.

See it soon at your B&K distributor or write us for advance information on the product that makes TV alignment procedures of old a fearless operation: simple, fast, accurate. The new Sweep/Marker Generator, Model 415.

B&K

A Division of DYNASCAN CORPORATION
1801 W. Belle Plaine • Chicago, Illinois 60613
Where electronic innovation is a way of life.



New B&K Sweep/Marker Generator.

Circle 2 on literature card

January, 1969 • Volume 19, No. 1

Electronic Servicing

in this issue...

DEPARTMENTS

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Robert E. Hertel, Publisher
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Circle 3 on literature card

electronic scanner

news of the industry

Laser TV Display System

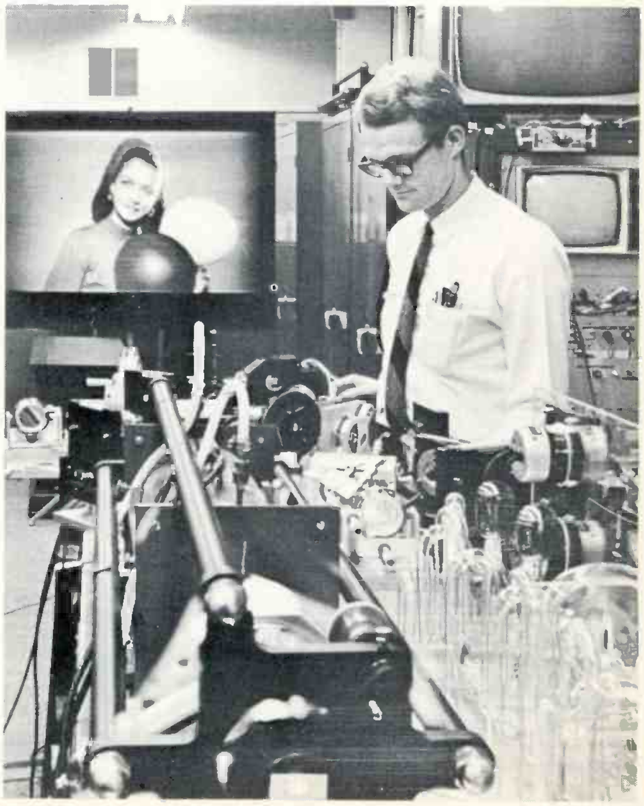
Development of a laser display system that produces large, bright, full-color television pictures has been announced by General Telephone & Electronics Laboratories Incorporated, research subsidiary of General Telephone & Electronics Corporation.

The technological breakthrough is a significant step toward achieving large-screen, color television pictures so bright that they could be shown in fully-lighted rooms for a variety of educational, entertainment and commercial uses.

The new laser display system—presently a laboratory model—takes "off-the-air" signals from a standard home television set, impresses them on three laser beams, and passes them through optical display devices to create bright, good-quality color pictures measuring 48 inches wide and 31 inches high on a projection screen.

"We believe that laser display systems have great potential for a wide range of important applications," said Dr. Lee L. Davenport, President of GT&E Laboratories. "Large-screen television is one obvious possibility, of course, but there are also a number of others."

Lasers are devices which contain an active material —various solids, liquids, or gasses—that can be stimulated by bright lamps or electrical energy into emitting "coherent" light, a narrow intense beam with great



purity of color. Lasers can produce light of different colors, depending on the type of active material employed.

The GT&E system uses two lasers to produce the light beams—a krypton gas laser providing the red light and an argon gas laser supplying the blue and green. The combination of the three primary colors creates the full-color images.

The three beams pass through electro-optic modulating equipment where the signals from a standard color television set are impressed on them. An arrangement of mirrors then combines the three beams into one multicolor beam which travels to a special prism that splits it into a pair of similar full-color beams.

The two beams are directed by mirrors to a rotating 15-sided mirror which scans them in rapid succession, producing the horizontal lines needed for a television picture. The scanned beams are then reflected to a vibrating mirror that produces the required vertical motion. From there the light rays are reflected to a large screen where 48-inch by 31-inch bright, full-color images are produced.

1969 Annual EIA Consumer Electronics Show

The Consumer Products Division of the Electronic Industries Association (EIA) will continue to sponsor and produce the Consumer Electronics Show, to be held at the New York Hilton and Americana Hotels, in New York City, June 15th thru June 18th, 1969, Jack Wayman, Staff Vice President, has announced.

Mr. Wayman said that a poll of its membership, just completed, resulted in a conclusive vote in favor of continued sponsorship of the show, which in 1967 and 1968 had established itself as the annual meeting place for the entire consumer electronics industry. A recent trade publication survey of buyers from major department stores, chain stores and specialty stores throughout the country also showed an overwhelming majority in favor of the show.

NEA Insurance Program

A national hospitalization group insurance program for members of the National Electronic Associations (NEA) has been adopted by the NEA board of directors at a board meeting in Albany, Georgia, October 19 and 20. A schedule of the benefits provided by the group insurance program are shown here. The tentative starting date for enrollment in the program was January 1, 1969.

NEA GROUP INSURANCE SCHEDULE OF BENEFITS

		Owners		All other EEs
Life Insurance		$5,000		$3,000
Accidental Death & Dismemberment		$5,000		$3,000
	Plan I	**Plan II**	**Plan III**	**Plan IV**
Hospital				
Room & Board	$ 40	$ 35	$ 30	$ 20
Services	Unlimited	Unlimited	Unlimited	Unlimited
Days of Care	70 days	70 days	70 days	70 days
Maternity	Unlimited Preg.			
Surgery	400	400	400	400
Normal Delivery	100	100	100	100
Medical Expense	420	420	350	350
Maximum per Visit	6	6	5	5
X-Ray and Lab	50	50	50	50
	Unscheduled per Disability (all plans)			
Additional Accident	300	300	300	300
Children covered from birth to age 23 if student	Yes	Yes	Yes	Yes
Major Medical				
Deductible—Cal. Year	100	100	100	100
Coinsurance—Benefit Pays:				
Mental Disorder				
Out-Patient	50%	50%	50%	50%
In-Patient	80%	80%	80%	80%
All other Conditions	80%	80%	80%	80%
Maximum	20,000	20,000	20,000	20,000
Private Room & Allowance	40 Plus $4	35 Plus $4	30 Plus $4	20 Plus $4
Complication of Pregnancy	Covered (all Plans)			
Major Medical Provision	$1,000 Automatic Reinstatement			

The insurance project began almost a year ago at a board meeting in Indianapolis, Indiana. After trying to compare the different coverages offered by various hospitalization plans, the NEA insurance committee recommended that NEA draw up a hospitalization program of its own that was tailored to the needs of the members. As a result, a bid specification sheet for an NEA hospitalization plan was prepared at the NEA annual convention in Pasadena, California.

The bid specification sheet was made available to five insurance companies that indicated a desire to bid. The bid guidelines stipulated that all interested bidders must attend the Albany board meeting with the power to change their bids in the event the NEA board deemed it necessary to modify the coverages and benefits. Only two bidders complied with this stipulation, and the successful bidder, Independence Liberty Life Insurance Co., was selected from the two by the committee. ▲

Circle 7 on literature card

EDITORIAL PROFILE

What you can expect from Electronic Servicing in 1969

The consumer electronic industry, like all other industries, is faced with demands for more reliable products, more efficient servicing of existing products, more realistic and better-applied warranty programs, and fairer service labor pricing.

At this very moment, forces are already at work within the consumer electronic industry to meet these demands.

Whether you are a self-employed service technician, a technician employed in a service shop or an owner or manager of an electronic service organization, you will be affected by the action taken to meet these demands. To keep your business management practices, shop operation and servicing techniques profitable and competitive, it is imperative that you keep abreast of industry developments and trends.

Accordingly, in 1969 the editors of *Electronic Servicing* (formerly *PF Reporter*) will provide a continuing series of articles and special reports on business management, shop operations, and industry trends.

Making a business out of service

Better business management and more efficient shop operations produce bigger profits. This series of articles will provide proven methods and policies for upgrading and improving independent electronic servicing, as well as investigating other approaches to servicing, such as franchising and manufacturer-operated service facilities. Part one of this series appears in this issue.

Electronic industry trends

Special reports covering subjects of vital interest to service technicians and shop owners will provide facts that will enable you to make more accurate judgements concerning present and future trends and developments in your industry. Topics covered include:

Warranties—existing programs and new developments; how they are applied and what manufacturers expect from the servicer.

Technician licensing—city and state programs; their objectives and effects.

Service labor pricing—existing rates in different areas of the country; methods for developing your own realistic pricing schedule.

Technician training—what manufacturers are doing about new-product familiarization; resident and correspondence courses currently available; apprenticeship programs; what the industry is doing to improve solid-state servicing.

Solid-state technology—recent developments; effects on service income, parts sales, service labor requirements and servicing techniques.

Design trends—present and future state of the art; what is coming and how soon.

Service associations—what they have done, are doing and intend to do.

Symptom evaluation, diagnostic procedures and circuit analysis of new and existing chassis designs will continue to be the major editorial emphasis of *Electronic Servicing.* The addition of articles on business management and shop operation and in-depth reporting of industry trends and developments will enable the editorial staff of *Electronic Servicing* to provide you with complete coverage of the electronic servicing industry.

The Editors

letters to the editor

Information Needed

I need a schematic for a Linearity Pattern Generator, Model A470, manufactured by Approved Electronic Instrument Corporation. I have written to the manufacturer, but the letter was returned with a comment from the Post Office indicating the company was no longer at that address.

Maybe a reader of ELECTRONIC SERVICING has a schematic or other information concerning this generator or the manufacturer. I will be glad to pay for it.

Russell Scarpelli
307 Main St.
Olypant, PA 18447

I need a schematic or wiring diagram indicating the battery hookup for an Atwater Kent Model 60, serial number 618294. I am also interested in obtaining tubes, speakers and other components for the same model radio.

Sam McCrea
312 S. Harper St.
Santa Ana, CA

We have a Knight Model KN760 stereo amplifier awaiting repair in our service department. We desparately need a serivce manual or schematic diagram for this unit. The supplier of this unit maintains that it is obsolete and service information is no longer available. Perhaps one of the readers of this column has a schematic of this unit that he is willing to share.

Max B. Hunsicker
Hunsicker TV
245 Turner Ave.
Ada, OH 45810

Okay readers, how about some assistance—Ed.

Why Hertz?

Beginning with the May '66 PF REPORTER we bumped up against abbreviations we had never seen before, such as KHz. Content indicated that this was being substituted for "cycle". In a later issue we learned that the abbreviated word was Hertz. We never did see anything in the Reporter mentioning why the new nomenclature was preferable, or even why it was being substituted. Most everyone has some idea as to what the word cycle means, but without the aid of an encyclopedia, who knows anything about Mr. Heinrich Hertz, or even then how his name could have anything to do with dropping the use of a familiar word. We think this change from "cycle" to "Hertz" is just about the silliest thing anyone has come up with yet.

This whole thing reminds us of a "name-change" we saw in the making some 60 years ago. At that time the manufacturer of flashlights (Eveready, we think, but can not be certain now) decided that since their lights were really more than just a mere "flash" light, the name should be changed to something that would denote a light of longer duration. A prize was offered for the best suggestion for a new name. "Daylo" was selected and used for a short time. Their ads said that "lo" was from something or other that meant light—hence daylight.

Where would you look today for a "Daylo" and what would you expect to get?

Daylo and Hertz are just about in the same category when used in the two instances above, and we hope that before too long we get back to calling a cycle by its proper name.

C. H. Alexander
Ebensburg, PA 15391

Mr. Alexander, I agree with your statement that cycle is a more descriptive name than Hertz. However, since Hertz has been adopted by the electronics industry as a standard term for cycles per second, we decided, for the sake of standardization, to use it. Perhaps, in the near future, someone who selects standards for the industry will rediscover the term cycle—Ed.

Reader Tip

In the November issue J. Lively of Jacksboro, TN, described a vertical sync problem in an RCA CTC11A chassis. Advise him to replace the 2-mfd, 350-volt capacitor in the 1st video amplifier circuit. I have found this capacitor to cause vertical rolling many times in RCA CTC7, CTC9, CTC10 and CTC11 chassis.

R. Ganger
Gashen, IN

▲

Separating management from the bench

The first step to growth

Job control and specialization, plus well-defined policies of managing manpower and charging the customer have put this electronic service center in a class all its own.

By Wendall J. Burns and J. W. Phipps

When an independent electronic service center has built its annual sales volume to a half million dollars, you can bet there has been some unusual management behind it.

The editors of *Electronic Servicing* visited such an establishment, Sperry TV, Lincoln, Nebr., and interviewed its founder, owner and general manager, John C. Sperry.

Here, we show the system and equipment that have boosted business at Sperry TV far above that of the average independent shop.

The firm's staff now includes 33 persons, 12 of them outside men with service trucks. The other 21 staff members include bench men, mechanical helpers, supervisory, management and clerical personnel, and a research engineer.

The firm's system and growth have been inter-dependent, and have come in steps. The system permitted the growth; the growth permitted the system. While the establishment's growth is proof enough that Sperry has been able to make practical application of new ideas for this industry, he says that the firm's system as it now exists could not have been developed without "think time".

For some time he couldn't seem to expand beyond a five- or six-man shop, counting himself as one of the five or six.

"I was too involved in shop work and administrative detail myself to have time to think and plan," Sperry said.

Now, that he has had this time to think and plan, and has seen this "think time" contribute to a practical, profitable system, John C. Sperry has agreed to give readers of *Electronic Servicing* the benefit of his experience. More . . .

John C. Sperry, who founded Sperry TV in Lincoln, Nebr., 20 years ago. The firm's staff has grown from three persons in 1950 to 33 today.

Profile of Policies and Operations

Although 80 percent of income at Sperry TV is from servicing TV, the firm offers service on nearly all types of electronic devices. The percentage of income from the other categories are: antennas, 10 percent; stereo and radio, 8 percent: other business, including amateur and personal communications equipment, electronic garage doors, etc., 2 percent.

Service is available 13 hours a day, from 8 a.m. to 9 p.m. Monday through Friday and until 1 p.m. on Saturdays. An answering service processes all other calls 24 hours a day, 365 days a year.

Less than two hours pass from time call is received until a service man is at the customer's set.

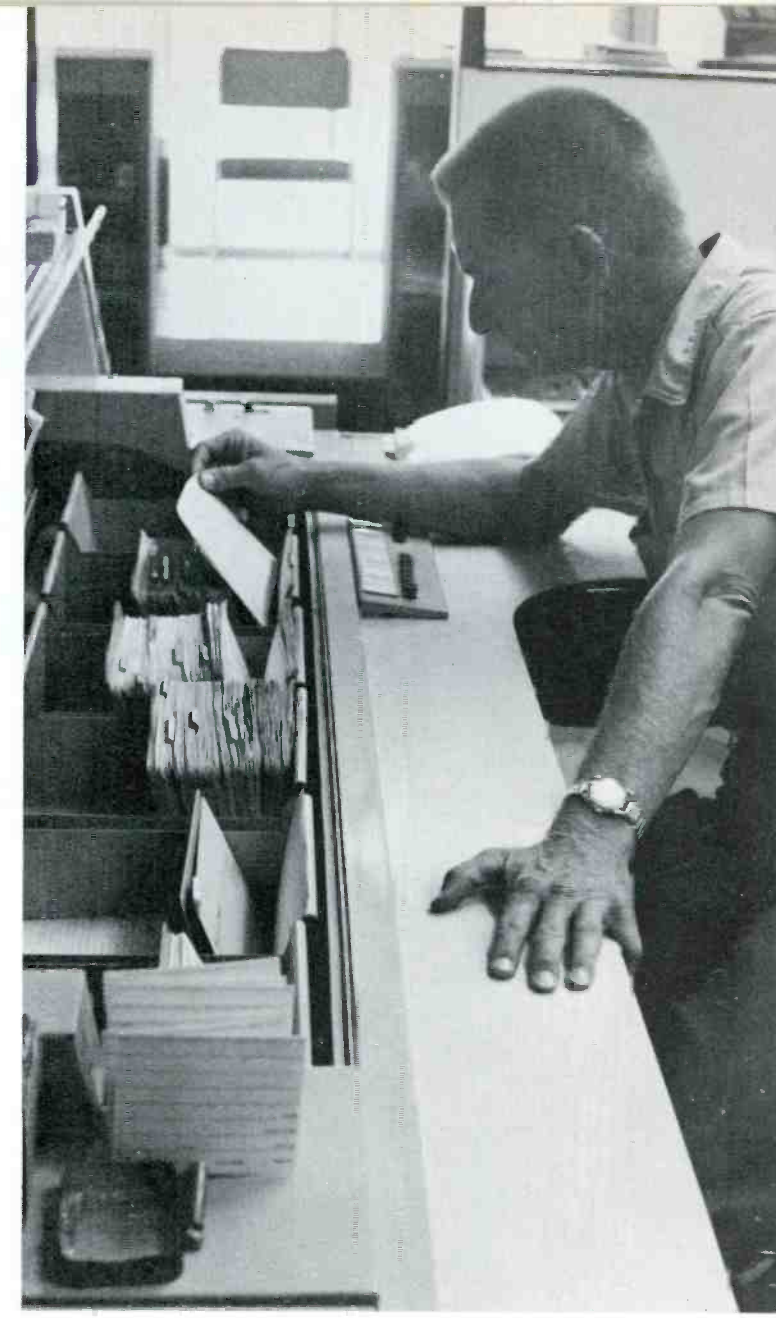
Free estimates? No! The charge for an estimate is based on a regular labor pricing schedule, if the customer wants a complete estimate. A superficial 'shotgun' estimate can be had at Sperry's for $4.50 or $5.00.

While-you-wait service is offered. The customer is told within 10 or 15 minutes how long a job will take.

Warranty work is neither encouraged nor discouraged. Sperry doesn't want it to exceed 7 per cent of total volume. Rates originally set by manufacturers have discouraged this firm from actively seeking additional warranty servicing.

Job control and specialization

Rapidly changing requirements inspired Sperry to build a plant and a system that can handle the demands of a growing business.



Specialization by brand makes technicians more efficient, and permits storage of frequently used parts close to work bench. Specialization is indicated even at back door. Outside men back the trucks up to the door that marks the entrance to the repair line for the models they are bringing in. There are four lines for major models; one for all other brands.

This job control center and communications hub handles all incoming calls (telephone, 2-way radio, walk-in trade), directs all traffic, dispatches service trucks, and provides easy contact between outside men, bench men, and supervisors. Productivity was increased 15 percent by using 2-way radio, but adoption of radio communications with the service trucks was not without its problems, Sperry declares.

'After the first 60 days, I was ready to take it out,' he says. 'They were using the radio, but everything was uncontrolled. This dispatch control resolved it. I locked myself in until I figured out the system to go along with the 2-way radio.

'Each outside man was driving 25,000 to 28,000 miles per year. Now, with 2-way radio, he drives only 8,000 to 10,000 miles per year.'

Rapid communication between management and the outside men is the biggest single advantage of the 2-way radio, Sperry explained.

This hub also controls records and 'surveils' all jobs in progress, providing immediate information as to status of each job underway. Average processing time for request of data is approximately seven seconds from time request is received.

Ready access to tubes and parts saves time for the technicians. Bins to store 10,000 tubes (over 1000 types), shown here, were tailor-made at Sperry's to save space. Shelves, 15 feet long, now house a third more tubes than were formerly stored in 21-foot long shelves. A full-time parts man controls inventory, although technicians serve themselves to parts as needed.

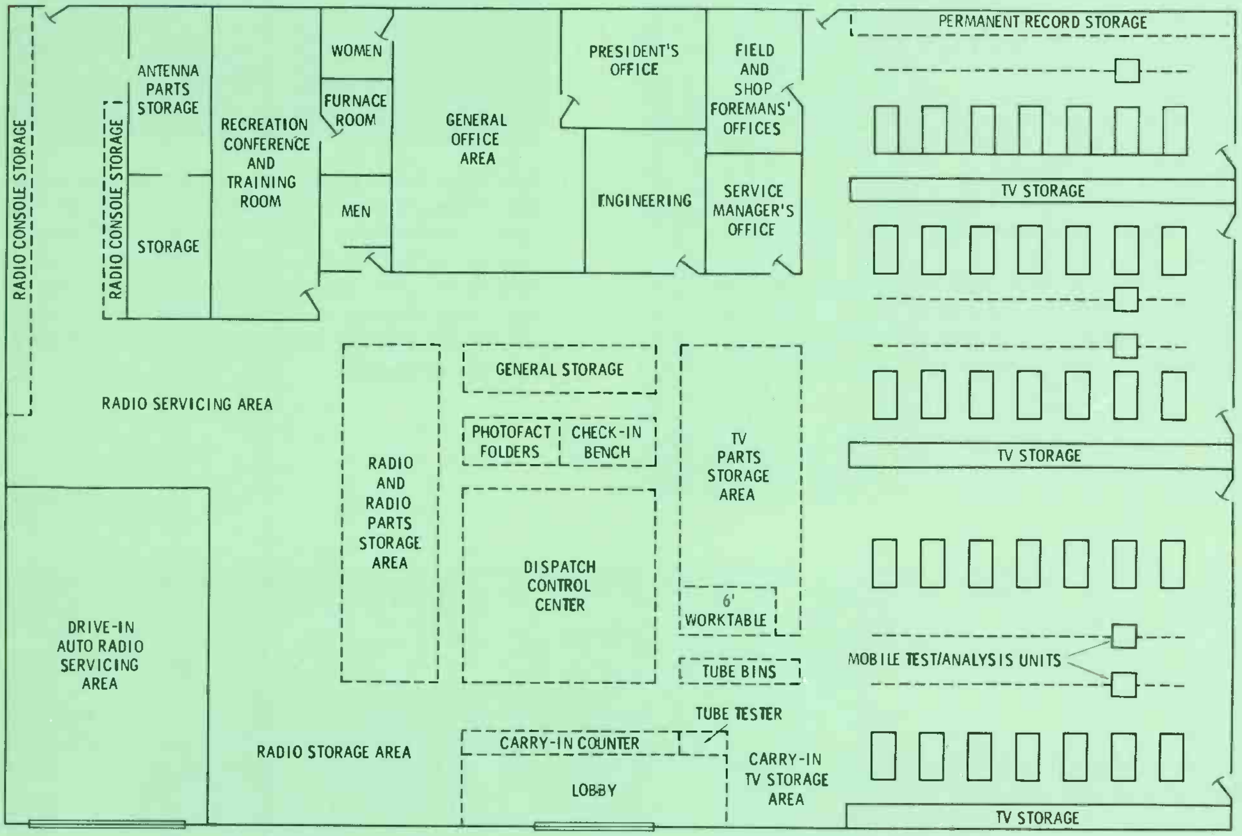
More . . .

The job stays put; tools and bench men move to it. The set under repair remains at one bench. The test panel (overhanging bench) is part of the mobile unit which can be rolled back and forth to the seven benches on each line. The mobile unit includes drawers to house frequently used component parts, inside and outside telephone communications, soldering iron, an independent supply of AC power, and an AC isolation transformer. Test signals and patterns from a 3-channel closed circuit TV system are available at each bench position: Channel 4 provides a crosshatch pattern; channel 5, a color bar pattern; and channel 2, a conventional test pattern.

Job control and specialization

(continued)

A sheltered drive-through at main entrance keeps customers dry during inclement weather. Door on left is entrance to auto radio service area. Large tower in center belongs to local radio station; site on which tower sits is leased to radio station by Sperry. Smaller tower on right is for Sperry's 2-way communication system. Entrances to TV service area and service truck parking are at right of building. Customer parking is located at front of building. Driveways and parking areas are now gravel but will be paved in near future.



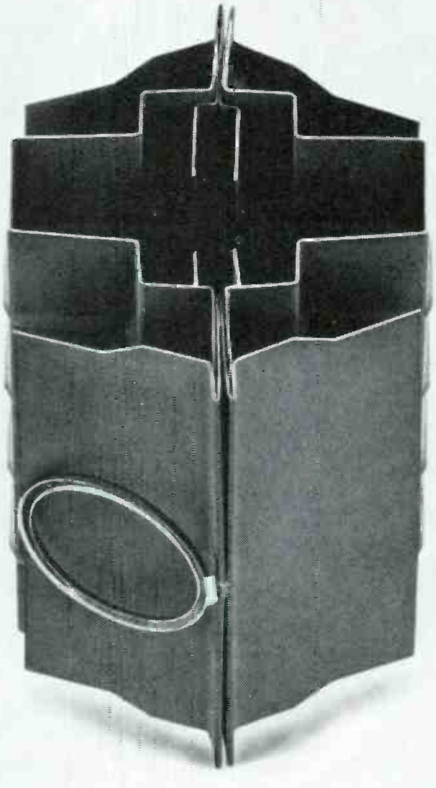
Simplified floor plan for Sperry TV. The concrete block building is a "free span" design having no internal supports or columns. This permits maximum use of available floor space and makes it possible to rearrange the layout without expensive and time-consuming removal and reconstruction of permanent interior walls. Outside dimensions of the building are 70′ 8″ x 120′.

Individual service areas are provided for all servicing functions. Each area has its own staff of specialists, test equipment and readily accessible parts and storage.

The TV servicing area is subdivided by brand into 5 separate units. Each unit contains 7 individual service benches and is equipped with its own set of tools and mobile test/analysis unit that is moved on an overhead track from bench to bench as needed. Each of the five mobile test/analysis units is equipped with all necessary test and alignment equipment, the most frequently used parts and tools, storage space, as well as direct communications to both inside and outside the building.

Radio and other service functions of the Sperry operation are currently handled on a more conventional basis; however, a system similar to that employed for TV servicing is also being developed for all other functions.

Introducing a cooling system for the 6JS6.



Our new cooling system takes the heat off horizontal amplifier tube replacement.

It's a design advance over the 6JS6A and B.

A patented fin radiator in our new 6JS6C conducts heat out of the plate structure, and dissipates it quickly and uniformly to prevent hot-spots.

The result . . . a cooler running, longer lasting tube. Fins don't buckle, electrical characteristics remain stable.

And better still, Sylvania's exclusive Cavitrap anode design and ripple-edge beam plate eliminate "snivets."

For you, the new "C" means fewer callbacks, more satisfied customers.

You might say our new cooling system helps everybody keep their cool.

Sylvania Electronic Components, Electronic Tube Division, West Third St., Emporium, Pa. 15834.

Circle 10 on literature card

The new "C" runs cooler, lives longer.

SYLVANIA

A SUBSIDIARY OF GENERAL TELEPHONE & ELECTRONICS

Managing manpower begins at the hiring stage

Owners of shops with only four or five employees have failed, more often than not, to develop either a system or philosophy for hiring and training personnel.

But if you keep an outside crew of 12 men working, to say nothing of bench men and non-technical personnel, you *learn* to manage manpower, preferably beginning at the hiring stage. That is the way it worked out at Sperry TV. John Sperry explains:

"A few years ago, we finally found our way on this thing of hiring and training. I bought a book on management, and learned a lot from it on how to hire a man. I interview 20 men to hire one! They are sometimes hour-long interviews.

"I don't necessarily look for experience. I look for quality in a man. Even if he has no experience, but has quality, I can make an outside man of him in six months. Interest and desire mean everything to me. I check his background, too. He must have: one, good credit; and, two, good character.

"Some of these men coming out of the armed forces make good technicians; however, they require training. After six months to one year of training they often prove to be better than men coming from civilian training programs," Sperry said.

First-hand proof of a candidate's ability in the shop is a major test for employment with this firm.

"A written test is not a good demonstration of skill. Sometimes, a man does real good on a written test, but lacks practical knowledge," Sperry commented.

Nevertheless, his theoretical knowledge is also sized up. Sperry knows that an applicant or new employee who claims to have experience has a lot of knowledge, but, he also presumes the man has a lot of weak spots.

The new "experienced" employee is put through a checkout test of approximately 1000 questions before his training program begins. If he answers 600 questions correctly, his training is tailored to fill in the knowledge gaps indicated by the 400 questions he missed.

"We train him in our methods, and if he is an outside man, we'll have him working in three weeks.

"There are several ways we train an apprentice technician. We work him on an antenna crew for a year. At the same time he is required to take a correspondence course. After a year, we bring him in and let him work as a mechanic, helping the bench man."

Salary Plan

"We operate on a 120 per cent burden factor. A service man who makes $8,000 a year must produce $17,600 in labor sales. He must bring in revenue to pay not only his own salary, but also salaries of non-revenue-producing personnel," Sperry explained.

Compensation of outside technicians is based on the amount of labor sales they generate. Sperry emphasizes quality service to his technicians by deducting the cost of all call backs from their total labor sales figure. Such a system of compensation provides each technician with an incentive to work hard but yet produce quality service. This protects both the customer and the reputation of Sperry TV from the effects of sloppy workmanship.

Sperry also rewards outside technicians for longevity with the company by putting vacation time and pay on a sliding scale. Added credit is given for up to 20 years of service.

Bench men are not at present on the firm's bonus program, but it is planned to pay them on that basis in the near future.

The salary of the service manager, now over $10,000 per year, is based on a percentage of net profit.

Apprentice technicians at Sperry's begin at $400 per month and receive raises of $37.50 every six months for two years, until they reach $550 a month. Then, they are put on the incentive program.

The apprentice can take care of routine mechanical work while technicians get on with more complicated details. After a little experience in the shop, he is given some troubleshooting to do. During this time in the shop (the latter part of his 1½-year training program) he also takes the 1000 question checkout program.

"In two years he is a real good technician,"

More . . .

Managing manpower

(continued)

Sperry says. The apprentice technicians must attend a workshop given by the service manager one night a week. The service manager also gives close attention to training the new outside man. He will go on a man's callbacks for a period of two weeks if necessary to discover his deficiencies. The man is then called in for more training.

"We build a lot of salesmanship into this outside man," Sperry said. "He has to be a special type. If he is an introverted type, he isn't a good outside man, but we can use him on bench work.

"For a new man on the staff, three to six months is the critical period. During that time, he should demonstrate that he can do satisfactory work and determine if he is satisfied with us," Sperry said. "But after two years, they stay and stay. Some men have been wtih me 18 or 19 years. Bob Tigeris, the service manager, has been with me for 11 years."

What to charge the customer?

First you must have: a) Precise job descriptions and data on time required to do each job. b) Accurate cost accounting figures.

"One of the things wrong with the electronic servicing industry is pricing. One customer is overcharged, and the next is undercharged. There is no consistency."

The problem described above by John C. Sperry has been bothering him ever since he went into business 20 years ago. But, at least for Sperry TV of Lincoln, Nebr., the problem has been resolved.

When he first went into business, Sperry attempted to develop a pricing system, but became discouraged after a few years and desisted. Four or five years ago, he renewed the attempt—this time with success!

His first step in working out a pricing system was the preparation of detailed descriptions of procedures on all jobs—descriptions of diagnostic as well as repair jobs—and then compilation of precise data on time required to do each diagnostic or repair function.

Job descriptions were written to rigidly define limits of work per increment. Time alloted to jobs is scaled down to tenths of an hour.

To establish time to allow for the various jobs, Sperry took figures from job tickets in the shop, and made time and motion studies of four of his benchmen at work. In evaluating time-study data, Sperry took into consideration the average daily productivity of each technician over a period of several months.

To determine the labor charge for a given job for his pricing schedule, Sperry takes the time allotted for the job and multiplies it by the hourly rate he has set for his shop, which is currently $10.

Development of a profitable and realistic hourly labor rate was another important part of Sperry's pricing system. Operating costs, including salaries of non-revenue-producing personnel, a reasonable return on investment (net worth) and the desired net profit were factors that were balanced against the available number of revenue producing man-

Minimum charges for home service calls by Sperry TV

Up to 30 Minutes		Over 30 minutes
Color TV	$10.50	
B & W TV	8.50	
Stereo	8.50	Charge on basis of $10 per hour
AM Radio	3.50	
FM Radio	5.50	
Color TV setup	10.50	

Example: If a home service call on color TV took 48 minutes, customer would be charged $10.50 for first 30 minutes, plus $3 for the three-tenths of an hour over the half-hour minimum.

Far Superior
TO ANY VTVM OR VOM
A NEW STANDARD OF THE INDUSTRY . . .

- Only Sencore makes a true field effect meter
- Less circuit loading than VTVM/obsoletes VOM
- Zero warm-up time — instant stability
- Complete circuit and meter protection
- Complete portability
- Greater frequency responses than most scopes

FE149 SENIOR FET METER

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- **Eight AC and DC ranges** .5V to 1500V full scale.
- **Zero center scale** with .25 v. either side assures measurements to less than .1 v. for transistor bias measurements.
- **AC peak to peak** readings to 4500V maximum with freq. response of 10HZ to 10MHZ ± 3DB.
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- **Eight decibel ranges** for audio measurements.
- **Three HI-Voltage ranges,** 5 KV, 15 KV, 50KV with 39A21 high voltage probe. **$14.95**
- **Absolute meter and circuit protection** against circuit overload.
- Non-breakable, scuff-proof, vinyl-clad steel case.
- **Three-way power.** Operates on AC, on self-contained rechargeable batteries, or on AC with batteries plugged in. Same readings all three ways.

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Exclusive push-button design. Just push two buttons for any test — top row selects function, bottom row selects range. Action is instant and automatic.

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ACCURACY DC ± 2.5%
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- 4½-inch meter, vinyl-clad steel case.

FE14 and FE16 popular 4 1/2 inch FET Meters

- **Hi Accuracy.** For unsurpassed measurements. Mirrored scales prevent parallax errors.
- **Minimum circuit loading.** 15 megohm input resistance on DC; 10 megohm on AC.
- **Zero center scale** ± 0.5 v. readings for transistor bias measurement.
- **Full meter & circuit protection** against possible circuit overload.
- **7 DC & AC voltage ranges** 1 to 1000 volts full scale.
- **AC peak to peak readings** 2800 v. maximum with freq. response of 10HZ to 10MHZ ± 3DB.
- **5 resistance ranges** to 1000 megohms.
- **5 DC current ranges** 100ma to 1 amp.
- **3 Hi-Voltage ranges,** 3 KV, 10 KV, 30 KV, extended with 39A19 ($9.95) high voltage probe.

$84.50

FE16 HI ACCURACY FET METER

ACCURACY DC ± 1.5%
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hours. The result is an hourly rate that Sperry feels is fair to both the customer and himself.

Sperry stressed that a comprehensive accounting system is an important part of any business operation. Analysis of data from the accounting system permits continuing evaluation of the pricing structure. If the operating costs of a specific area of servicing increase, or if efficiency in that area decreases, the accounting data should reveal these trends. Then, pricing, procedural, or personnel adjustments can be made to maintain the desired profit.

The irony of the pricing problem is that while inconsistency often alienates the customers and gives the industry a black eye, it at the same time limits profits of firms which charge too little for some types of jobs.

This was the case in Sperry's own radio repair department before the pricing system was established.

"After completing a component pricing schedule for servicing radios, we found that charges for radio repair increased 30 percent," Sperry said "We found this hard to believe and thought we had made an error in the study."

To clear up the uncertainty, the firm repeated the study and came up with the same answer.

"I decided we were grossly undercharging on radio. We increased our charges 30 percent. By using this new printed price list, we put the radio servicing department in the profit department."

Citing the industry-wide nature of the problem, Sperry recalled a conversation with other TV shop owners at a recent electronics association meeting. One was charging $15 for a flyback repair job; another reported charging $39 for exactly the same job.

Sperry told of an embarassing incident at his firm. It was a case of an "ornery customer who saves all his bills" he recalls with a smile. One day, the customer came to Sperry TV with two bills—each for exactly the same type job—with the bill for the later date showing a much higher charge than the earlier one. The customer wanted to know "Why?"—and Sperry did not have a good answer.

But, such incidents are now history for this Lincoln firm. With definite figures on time needed to do a job, and precise accounting data, he has taken the guesswork out of the business, can set a fair price, and be confident he will make a profit.

A breakdown of gross sales shows 40.5 percent is from sale of parts, and 59.5 percent from service. There is a basic $10 per hour labor charge.

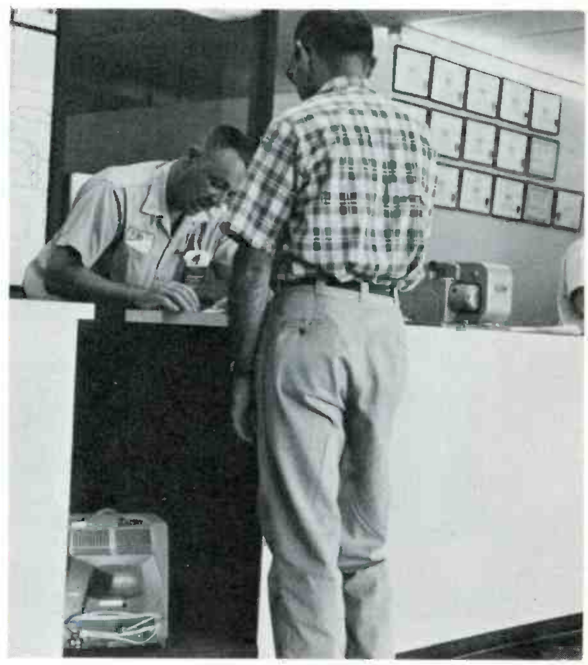
Sperry TV follows the manufacturers' recommended list price for parts.

"However, this doesn't handle all cases. If not, we mark the part up 100 percent. We have to consider COD, etc.," Sperry explained. □

Training of technicians

. . . and evaluation of performance go hand-in-hand at Sperry TV. Continuous, well-planned training and evaluation programs are provided for both apprentices and experienced technicians.

The training room's blackboard is where the theory is. Doors at the back of the room swing open into the shop for practical demonstrations. Bob Tigeris, service manager, here draws a schematic for a class. 'Inside' technical personnel meet regularly during week-day hours. 'Outside' men meet as a unit on Saturday mornings, and have special group or individual sessions as needed. Factory field representatives are periodically called in to bring the technicians up to date on new developments. Meetings are also held from time to time for non-technical staffers in order to clarify or revise operating procedures.



Certified electronic technician (CET) certificates awarded to Sperry service technicians by the National Electronic Associations (NEA) and certificates of training achievement received from TV manufacturers are exhibited on a wall behind the walk-in service counter in the lobby. This display of certificates provides the customer with visual evidence of the technical competency and training achievements of Sperry technicians. (Also note the airline-type feed-through service counter.)

Analysis of the HO1 Scanner chassis

Sylvania's color TV slide

by Ellsworth Ladyman

The Sylvania HO1 "Scanner" chassis makes it possible to view 35 millimeter (or any other 2" x 2") mounted color slides on a Sylvania D13 color television receiver chassis. A slide mechanism places slides into a flying spot scanner optical system. Color signal processing is similar to the process used for color signals in a color TV broadcast camera.

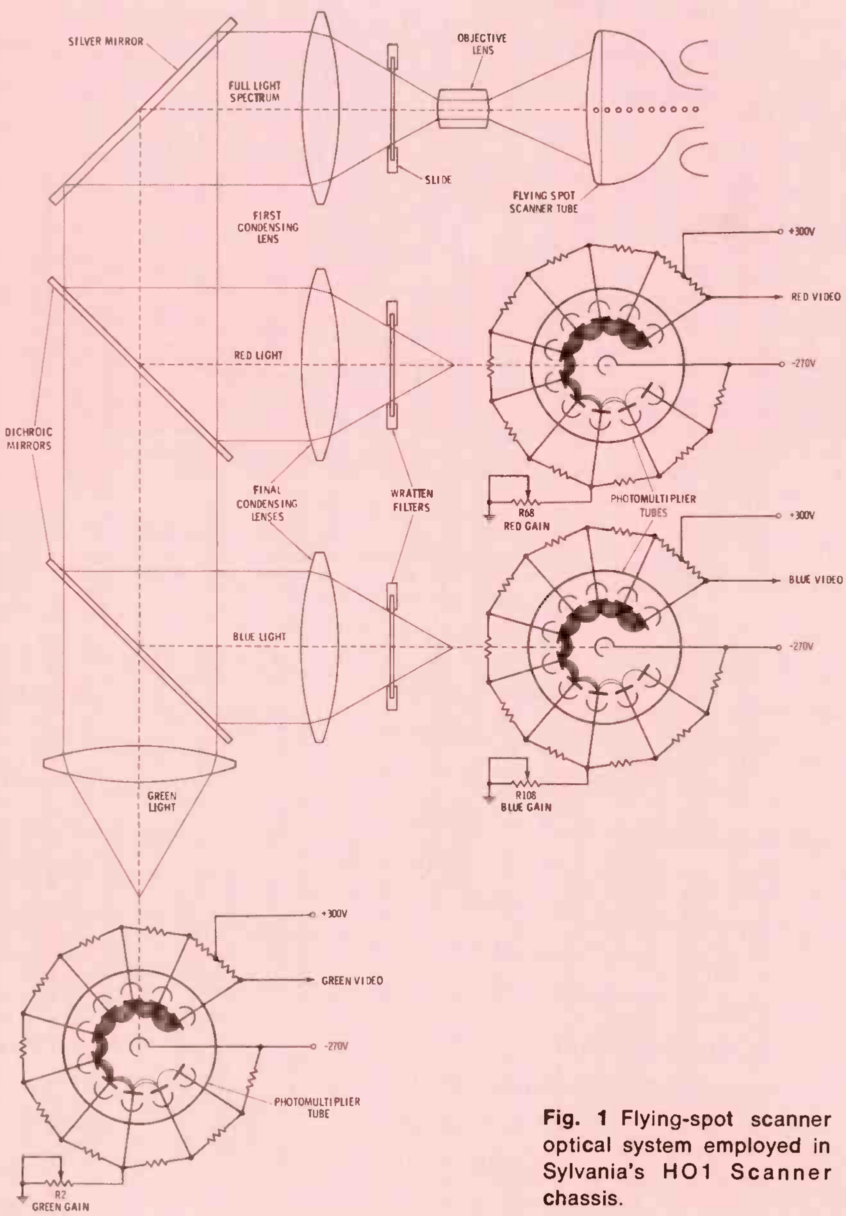


Fig. 1 Flying-spot scanner optical system employed in Sylvania's HO1 Scanner chassis.

Scanner Operation

When the TV receiver is turned "on" and the slide scanner section function switch is in the "UP" position, two four-pole, double-throw switches insert a monochrome Y signal and X and Z color signals into the normal television circuitry to reproduce on the receiver screen the video information present on a projected color slide. All circuits of the D13 TV chassis are energized during slide presentations.

The color slide being projected is scanned by a high-resolution, 5-inch cathode-ray tube, which is also the light source. This light is projected through the slide to a lens and mirror arrangement. Dichroic mirrors and Wratten filters are used to separate the three primary colors.

Dichroic mirrors have the property of reflecting some colors and passing others. Wratten filters absorb the undesired colors. A Wratten filter is inserted in each light path to the red and blue photomultiplier tubes. These filters assure that only pure red and blue lights reach their respective photomultiplier tubes. Dichroic mirrors do not provide perfect filtering. The Wratten filters are used to absorb the remaining impurity that may be mixed with the basic primary color. Green light is pure enough that additional filtering is unnecessary.

The three light primaries—red, blue, and green—are then applied to corresponding photomultiplier tubes. These tubes greatly amplify the color signals. The output of each photomultiplier stage is then applied to a two-stage preamplifier circuit (Fig. 2).

Automatic brightness compensation (ABC) for each projected slide is accomplished by applying a feedback voltage, derived from the average brightness level of the green channel, to the scanner tube cathode. This feedback voltage minimizes the brightness variations of the slides. For optimum results when

projection system

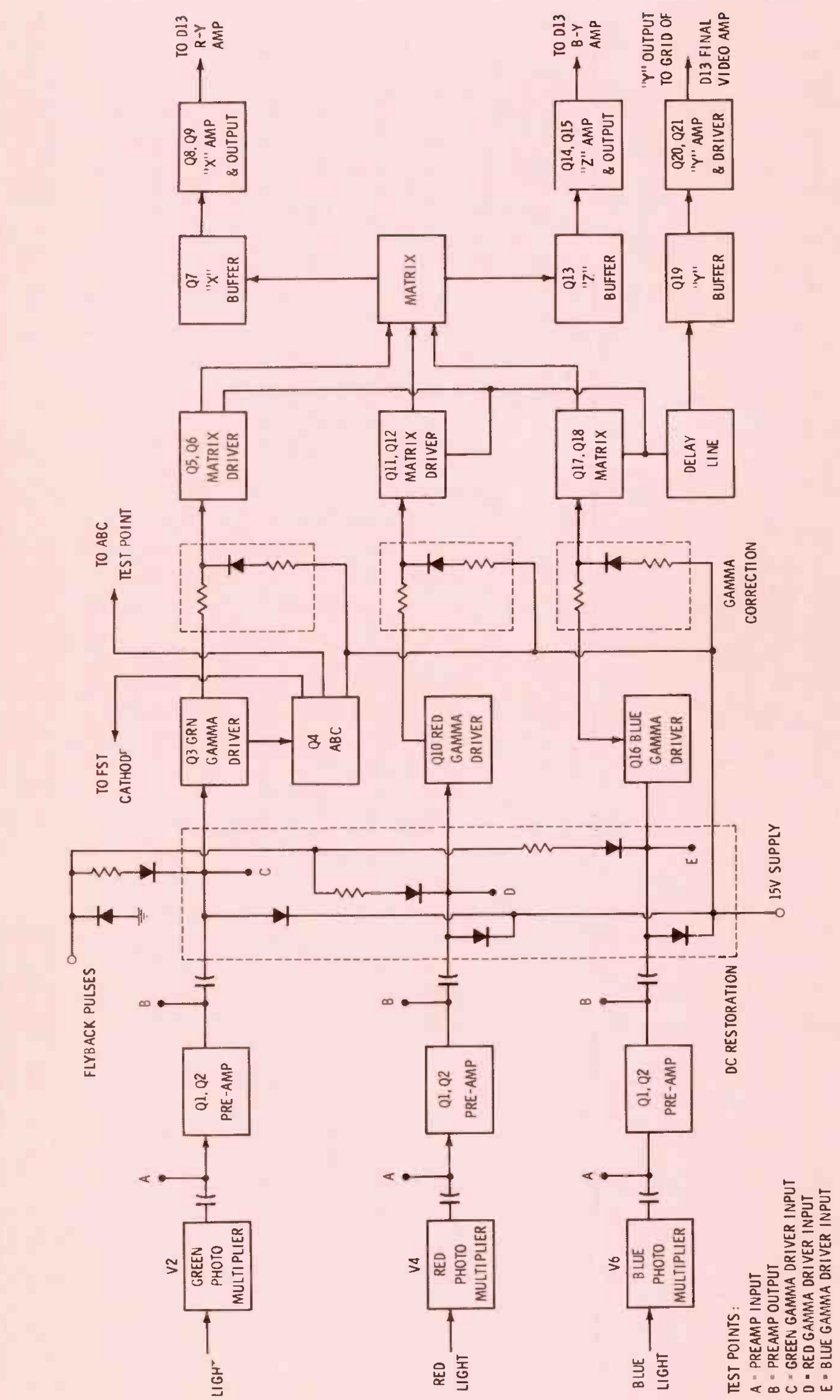


Fig. 2 Block diagram of the HO1 Scanner chassis.

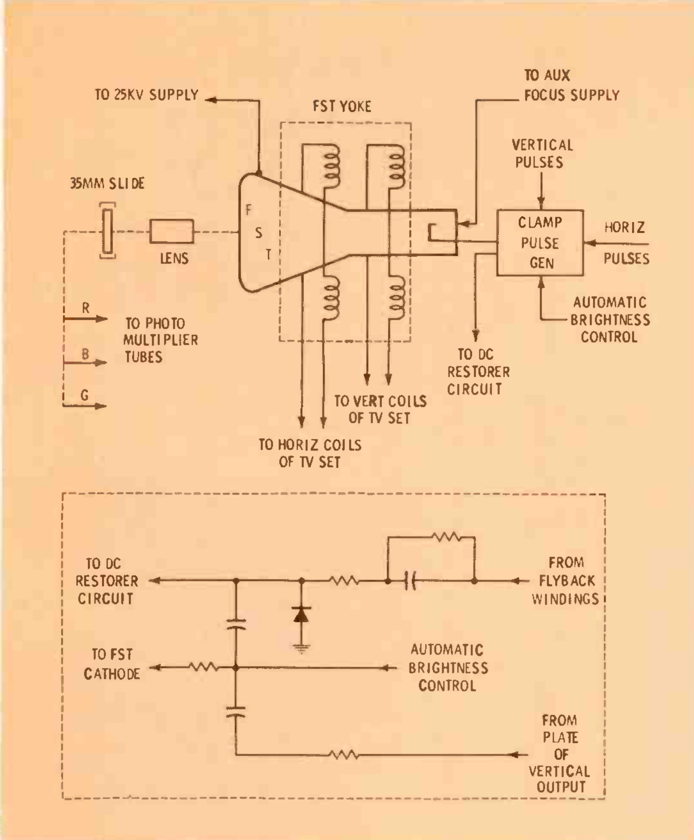


Fig. 3 Circuits associated with the flying-spot scanner.

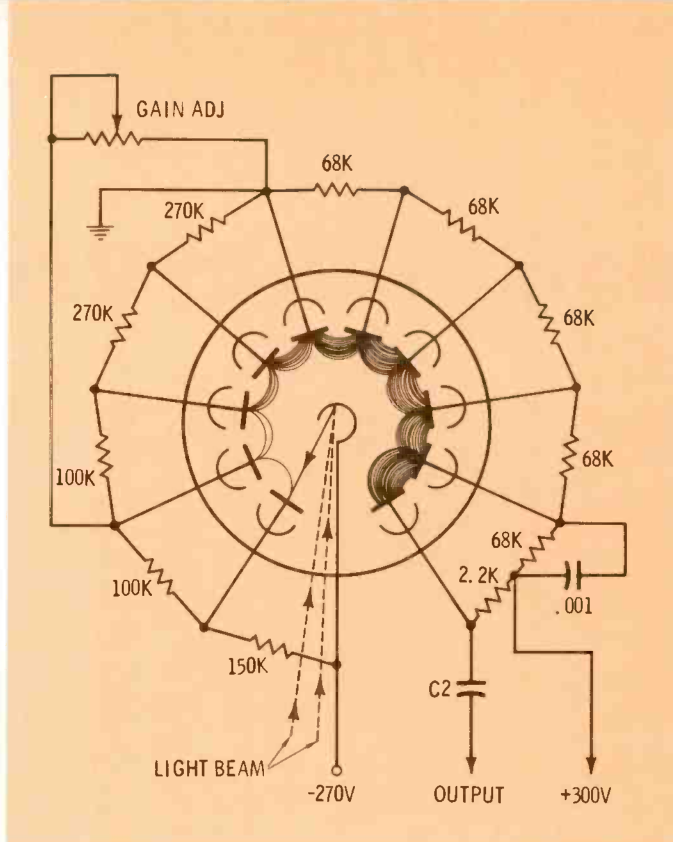


Fig. 4 Diagram of photo-multiplier tube.

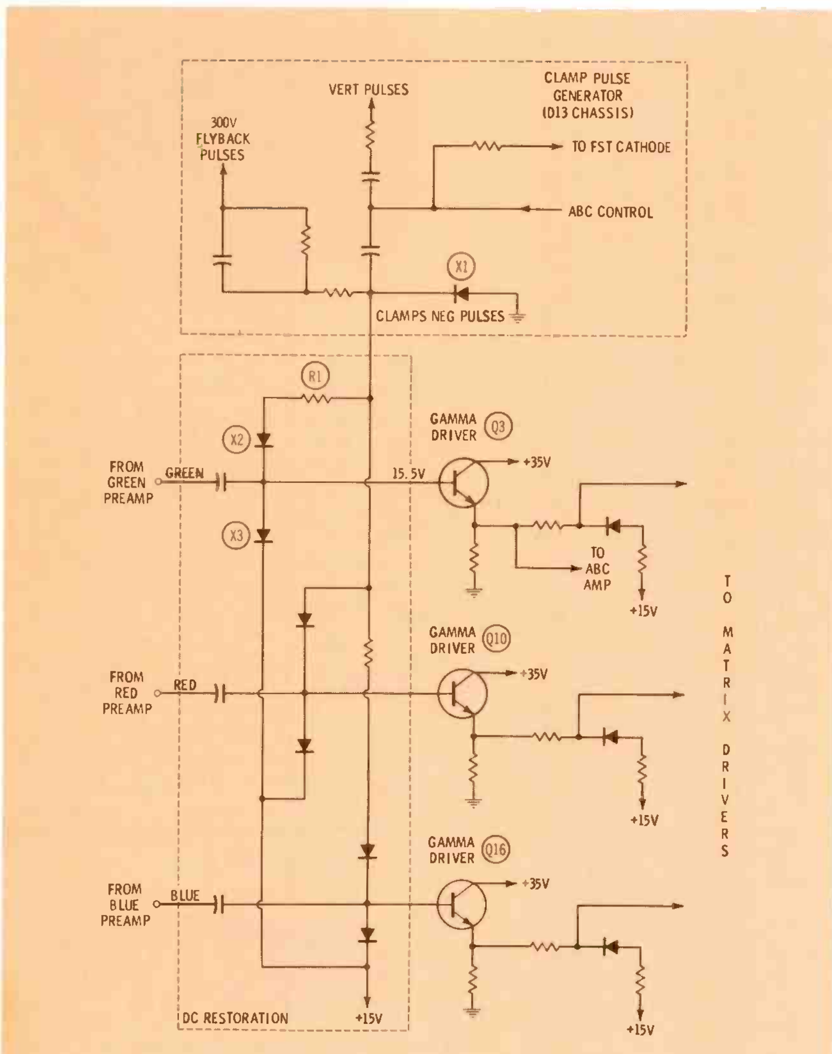


Fig. 5 Schematic of DC restoration circuit.

viewing slides, the TV receiver should be tuned to an active station. This will provide sync signals to the receiver, resulting in improved interlace and better scanning stability.

Flying-Spot Tube Circuitry

The circuits illustrated schematically in Fig. 3 are the associated components necessary to the operation of the flying-spot scanner tube (FST). To assure proper synchronization, the FST yoke coils are fed deflection power from the TV receiver circuit. The 25-kv source voltage also is obtained from the receiver chassis high-voltage supply. The focus circuit of the FST also obtains its supply voltage from the TV receiver chassis, although a separate rectifier diode and control are provided for this purpose in the chassis.

The clamp pulse generator acts as a waveshaping circuit. It receives horizontal pulses from the flyback winding and vertical pulses from the output plate. These pulses are shaped by the clamp pulse generator to provide gate pulses for the DC restorer and a blanking signal for the FST cathode.

Photomultiplier Tube Theory (Fig. 4)

Photomultiplier tubes employ the principles of photo emission and secondary electron emission for their operation. Incident light from the scanner circuit or system is directed to the photomultiplier cathode after passing through the associated lenses and filter. This releases electrons from the cathode. The electrons liberated from the cathode are accelerated and directed to a secondary emission surface called a dynode. Several electrons are emitted from the dynode for each incident primary electron. These secondary electrons are then directed to the next dynode where additional electrons are emitted. This process is repeated a total of nine times, to produce a final electron current as high as 100,000 times the initial electron emission from the photomultiplier cathode.

Power supply requirements for photomultiplier tubes are provided by a regulated —270-volt line and a positive 300-volt source. Combination of the negative 270 volts and a positive 300 volts produces a 570-volt plate potential with respect to the cathode.

The output of each photomultiplier stage is applied through a coupling capacitor to a two-stage preamplifier circuit. The two-stage preamplifier provides a stage gain of 60 for each color signal.

The output of the preamplifiers is first fed to a DC restorer and then is applied to the gamma driver stage on the video signal panel. The gamma driver stage is an emitter-follower amplifier that functions as a buffer stage between the gamma corrective diode network and the DC restorer circuits.

DC Restoration (Fig. 5)

The scanner's video signal, with positive blanking pulses, is AC coupled to a gated DC restorer circuit. Operation of the DC restorer is as follows:

Flyback pulses from the convergence winding are clamped and shaped by diode X1. The resulting positive pulses are applied through coupling resistor R1 to restorer diodes X2 and X3. This action maintains the blanking level at the junction of X2 and X3 at just slightly above 15 volts. This circuit theory also applies to the red and blue channels.

Gamma Correction Circuit

The gamma correction circuit provides attenuation for picture highlights and comparatively large amplification of low-luminance video. This tends to compensate for the characteristics of the CRT, which usually exhibits large high-light gain and poor low-light gain.

The gamma correction network consists of diode X1 and resistors R1 and R2. These components are connected between the base of each matrix driver (Fig. 6) and the output of each gamma driver and are referenced to the positive 15-volt line. The reference voltages shown on the base and emitter of Q1 and Q2 represent black level. (This can be approximated by inserting a black slide into the scanner.) When the color video for each channel is applied across this network, the negative-going, high-light information turns on series diode X1, resulting in increased attenuation. As the signal drops to the darker and black regions, this attenuation decreases. The black portions of the video between 15V DC and 14.5V DC are unaffected, and the white portion be-

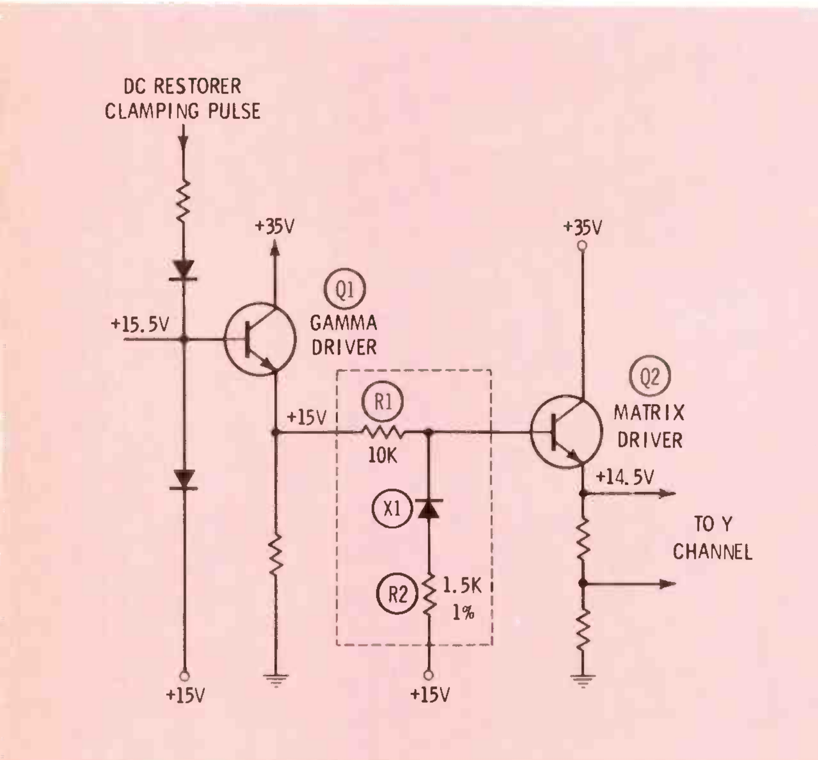


Fig. 6 Gamma correct circuit (blue channel).

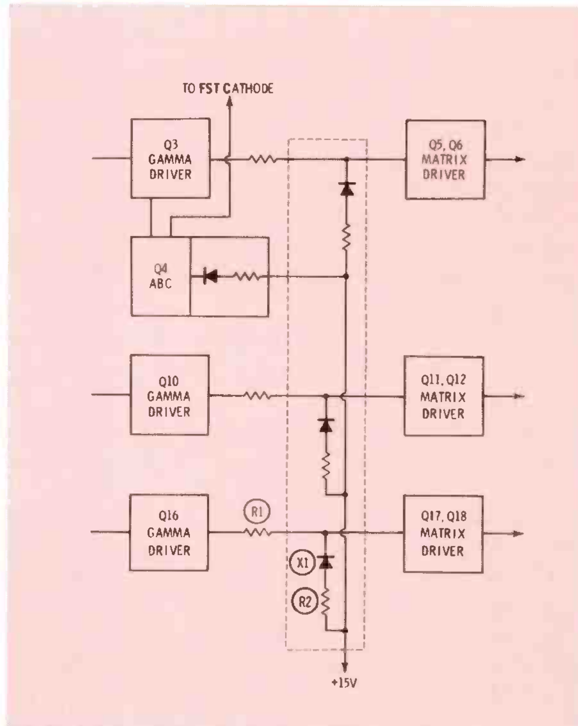


Fig. 7 Block diagram of gamma correction network (all channels).

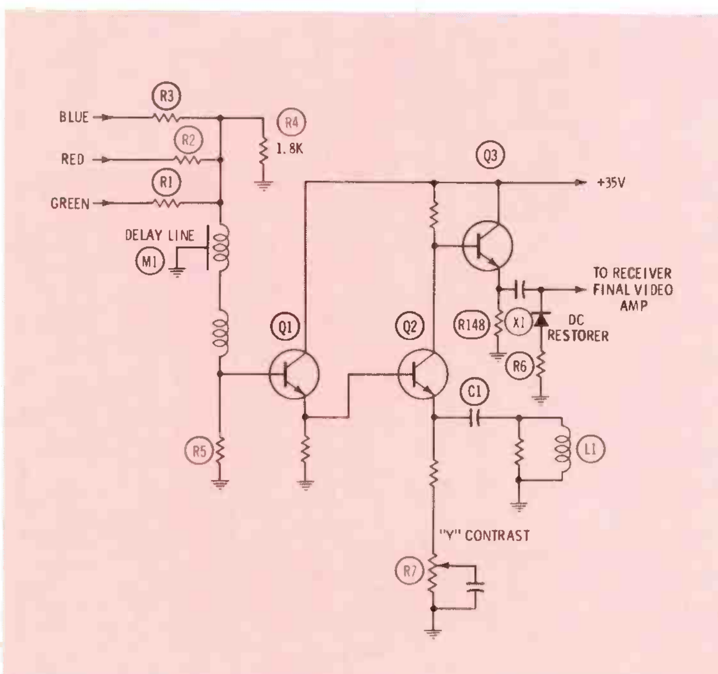


Fig. 8 A matrix circuit consisting of R1, R2, R3, R4 and R5 add red, green and blue signals to produce the Y signal.

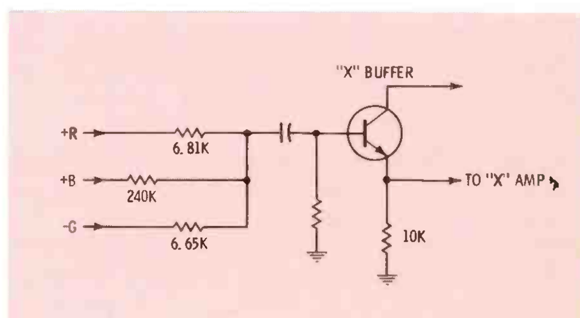


Fig. 9 Matrix circuit for X signal.

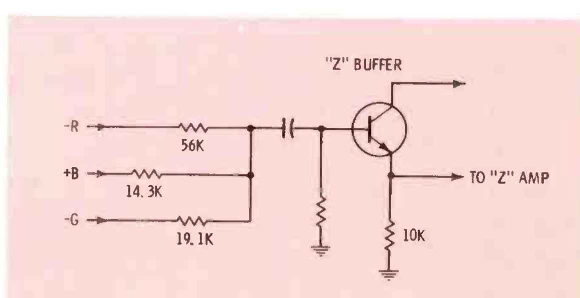


Fig. 10 Matrix circuit for Z signal.

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low 14.5V DC is attenuated. Any signal voltage below the 14.5V DC level will turn on the diodes, allowing greater attenuation. The lower the signal voltage, the greater will be the attenuation.

Signal Matrixing and Amplification (Fig. 8)

Y matrixing follows the NTSC system standard; however, X and Z matrixing produces color signals equivalent to the output of the X and Z demodulators in the TV receiver chassis.

The Y signal is obtained by adding specific amounts of red, green and blue signals in a resistance matrix circuit consisting of R1, R2, R3, R4, and R5. The parallel combination of R4 and R5 form the common resistance of the matrix.

The signal is delayed by delay line M1 and applied to buffer amplifier Q1. This stage functions as a buffer and impedance matcher beween the Y amplifier, Q2, and the matrixing inputs. Q2 drives the video Y output driver, Q3, which provides the Y signal output to the video stage of the TV receiver.

DC restoration for the Y signal is provided by diode X1 and resistor R6. The contrast control, R7, is connected in the emitter circuit of Q2.

The output of each gamma correction network is applied to a Y matrix driver. This stage is an emitter-follower and is coupled to the matrix drivers.

Each color channel is similar, with the exception of the green channel matrix driver, which has a video-peaking network, consisting of a coil and capacitor, placed in its emitter circuit. This network provides peaking of video frequencies near 3 MHz for greater picture detail. A similar circuit, consisting of C1 and L1, serves the same purpose in the emitter circuit of Q2 (Fig. 8).

X and Z Matrixing

It is necessary to produce X and Z signals to drive the grids of the R-Y and B-Y amplifiers in the color receiver. Red, blue, and green signals are matrixed by outputs from their respective matrix drivers and are produced in the following proportions:

X=3R—3.1G+0-1B
Z=.57R—1.66G+2.23B
Y=59G+0.30R+.11B

The X signal, which is composed primarily of red and green signal information, is matrixed at the base of the X buffer amplifier, as illustrated in Fig. 9. The Z signal, comprised primarily of blue and green signals, is matrixed at the base of the Z buffer amplifier, as shown in Fig. 10.

Automatic Brightness Control (ABC)

A satisfactory reference signal for ABC is derived from the green video signal and is used to control the brightness bias level. It is possible to use only the green video signal to obtain this reference voltage, since the green signal is the largest contributor to the brightness information (Y signal).

The green gamma driver provides a DC-restored video input to the ABC amplifier base. The collector load for the ABC amplifier is shared with the cathode of the flying-spot tube (FST). This circuit configuration will cause the FST cathode bias voltage to vary with the input signal under certain conditions.

The emitter of the ABC amplifier is coupled through diode X1 and resistor R1 to the 15-volt source. Whenever the base voltage exceeds 15 volts, the stage is biased off, and, should the emitter become more positive than 15 volts, diode X1 will be biased off.

Normal collector voltage with the ABC amplifier cutoff is approximately 1 volt since the FST beam current through R2 is 100 microamperes. If a video signal containing a large amount of brightness is applied to the base of the ABC amplifier, a large portion of the signal will be negative, and the ABC amplifier will conduct. This conduction occurs after the turn-on voltage of X1 and Q1 is exceeded. When Q1 conducts, its collector will go more positive because of the increased voltage drop across resistor R2. This voltage, applied to the FST cathode circuit, will tend to bias off the FST. To allow extra brightness on dark slides, diode X1 provides some initial delay before Q1 can start conducting.

Automatic Slide Changing and "Beep" Insertion

When a slide presentation is narrated by a pre-recorded tape, a "beep" tone is inserted at the end of each slide commentary. This is accomplished in the following manner:

When the hand-held slide change button is depressed for approximately one-half second, a 60-Hz "beep" tone is automatically recorded on the tape. The playback action will duplicate the recording action, and the 60-Hz "beep" tone will actuate the slide change mechanism and allow automatic viewing of the slides along with a running audio commentary.

The "beep" tone is fed from the recorder preamplifier, through a trigger amplifier circuit, Q1 (Fig. 12), to the relay driver stage, Q2. The relay driver stage actuates the slide change relay MI.

The cueing "beep" passes through a sharply responsive, twin-T, 60-Hz band-pass filter that rejects all frequencies other than the recorded 60-Hz tone. Relay driver Q2 is provided with a sensitivity adjustment control, R1, which can be adjusted, when necessary, to prevent spurious or false triggering of slide change relay K1.

Adjustments and Set-Up

NOTE: The television receiver should be operating correctly before adjustment procedures are attempted.

FST Beam Current Adjustment:

1. Turn the TV receiver on and tune in a good televised picture.
2. Set the slide tape TV switch to the slide/tape position and insert an opaque slide into position.
3. Adjust down the TV brightness control until the TV raster is completely extinguished. Turn the FST bias adjustment, A1 (Fig. 13), fully counterclockwise.
4. Monitor the high-voltage regulator current and adjust the FST bias adjustment, A1, to reduce regulator current to

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100 microamperes. This is the proper FST beam current.

Scanner Centering, Size and Focus:

1. Insert a normal 35 millimeter slide for presentation on the CRT screen; use a resolution-pattern slide if available.
2. Loosen the four holding screws on the FST housing and the one screw locking the objective lens (see Fig. 13). NOTE: Both the flying-spot scanner tube and the objective lens must be movable to permit size and focus adjustments.
3. Adjust the FST assembly and the objective lens to obtain the desired size and best focus. This adjustment can be varied to favor the particular type slide being used (35mm, Instamatic, or Super slides).
4. Adjust the scanner centering rings for best picture centering (use minimum magnetism). This will occur when the centering tabs are at 100 degrees.
5. If necessary, adjust the scanner tube focus coil. This component is located near the FST yoke plug on the TV receiver high-voltage cage.
6. Adjust the TV receiver focus coil for the best scan line definition on the receiver CRT.

Photomultiplier Gain Adjustment:

1. Follow procedure previously outlined for FST beam current adjustment.
2. Ground the collector of the ABC amplifier transistor.
3. Place "window slide" (Fig. 14) in scanning position.
4. Using an output indicator (scope or p-p reading VTVM) monitor test points at R, B, and G while adjusting A2, A3 and A4 for 8 volts p-p at each test point.
5. Gain adjustments can be made by eye on the TV picture tube while viewing a window slide by turning each gain control up to the point that provides a white window. CAUTION: Low or insufficient contrast results if gain controls are set too low; overloading results if gain controls are set too high. ▲

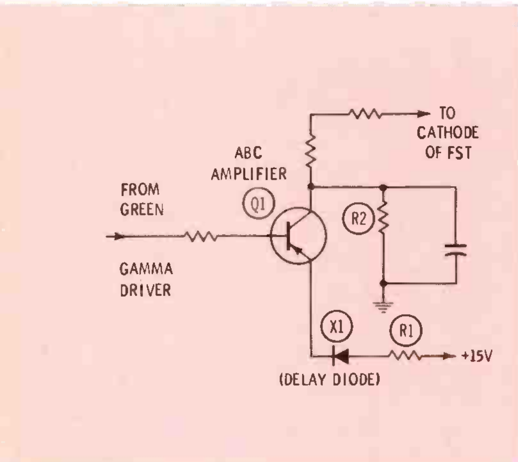


Fig. 11 Automatic brightness control (ABC) circuit.

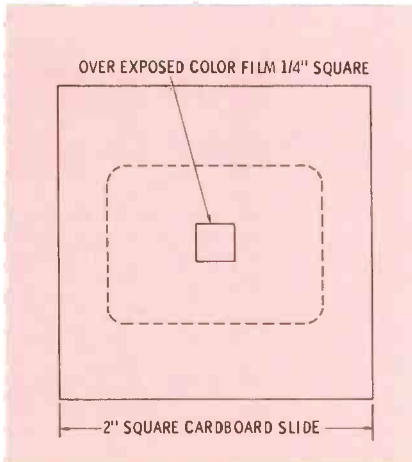


Fig. 14 Illustration of "window" test slide.

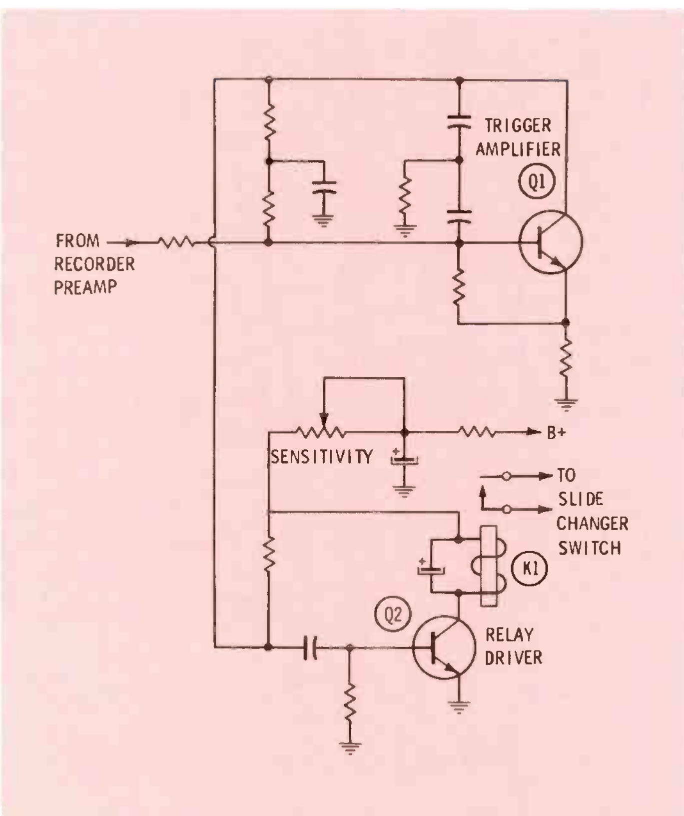


Fig. 12 60-Hz "beep" circuit generates signal for automatically changing slides.

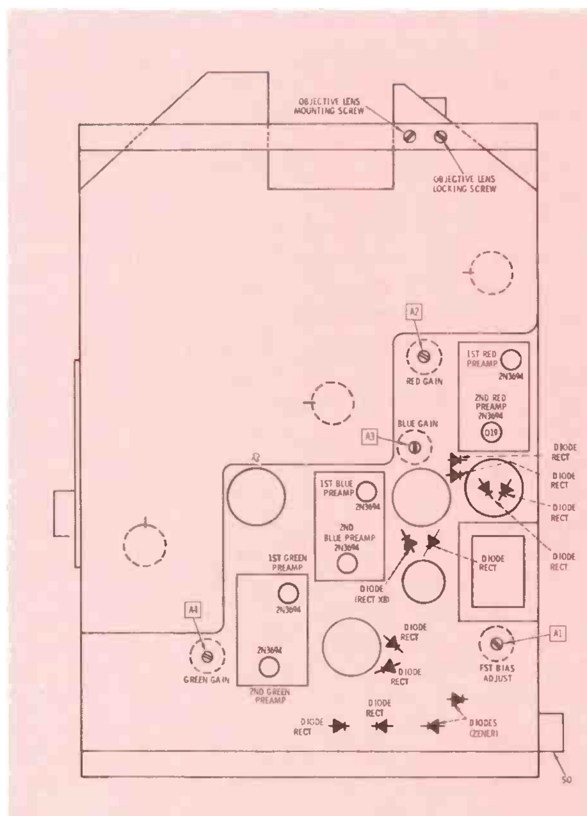


Fig. 13 Illustration of Scanner chassis showing adjustments.

Electronic Servicing
READER SURVEY

We need your assistance in a special editorial project that will provide valuable information to *you* and to the editors of *Electronic Servicing.*

The purpose of this survey is two-fold: (1) to provide *our readers* with an accurate profile of the electronic servicing business and (2) to provide us with your preferences for subject matter in future issues of *Electronic Servicing.*

All replies to this survey will be *strictly confidential*. The results will be published only in statistical form as totals and averages.

To help us provide *you* with a clearer picture of *your* industry and to indicate *your* preferences of the subject matter in *Electronic Servicing,* please take a few moments to complete this survey. The more replies we receive, the more accurate and useful will be the information we furnish *you.*

A tear-out, self-addressed, postage-free answer card is provided on the opposite page. Instructions for completing the survey are included next to the answer card.

Thank you—the Editors

1. full-time service technician
A. yes **B.** no

2. part-time service technician
A. yes **B.** no

3. bench man
A. yes **B.** no

4. outside man
A. yes **B.** no

5. combination bench/outside man
A. yes **B.** no

6. owner of service shop, do servicing myself
A. yes **B.** no

7. owner of service shop, do no servicing myself
A. yes **B.** no

8. manager of service shop, do servicing myself
A. yes **B.** no

9. manager of service shop, do no servicing myself
A. yes **B.** no

10. student in resident electronic course
A. yes **B.** no

11. student in correspondence electronic course
A. yes **B.** no

12. years employed as service technician
A. Less than 2 years
B. 2 but less than 5 years
C. 5 but less than 10 years
D. 10 years or more

13. hourly rate of pay
A. $1.50 to $2.00
B. $2.01 to $3.00
C. $3.01 to $4.00
D. $4.01 to $5.00

14. Are bench men in your shop on incentive pay plan?
A. yes **B.** no

15. Are outside men in your shop on incentive pay plan?
A. yes **B.** no

Following coded responses apply to items 16-29.
A. now use
B. now own
C. plan to buy
D. plan to replace

16. VOM
17. VTVM
18. FET meter
19. color generator
20. sweep generator
21. oscilloscope
22. vectorscope
23. RF signal generator
24. audio generator
25. transistor tester
26. tube tester
27. CRT tester
28. frequency meter
29. stereo generator

30. full-time **bench** men employed in your shop
A. 2 or less
B. 3 but less than 6
C. 6 but less than 9
D. 9 or more

31. full-time **outside** men employed by your shop
A. 2 or less
B. 3 but less than 6
C. 6 but less than 9
D. 9 or more

32. if employee, years you have worked for present employer
A. under 2
B. 3 but less than 6
C. 6 but less than 10
D. 10 or over

33. if shop owner, years you have been in business
A. under 2
B. 3 but less than 6
C. 6 but less than 10
D. 10 or over

Items 34-44 are servicing categories. Use the following coded responses to indicate what percentage of your shop's total service labor income is derived from each category:
A. none
B. 20% or less
C. 21% to 50%
D. 51% to 75%
E. over 75%

34. b-w TV
35. color TV
36. stereo
37. home radio
38. auto radio
39. MATV systems
40. CATV systems
41. home antenna systems
42. communications equipment
43. industrial electronics
44. medical electronics

Top range of hourly pay for full-time technicians employed by your shop (items 45-47):

45. experienced bench men
A. $2 or less
B. $2.01 to $3.00
C. $3.01 to $4.00
D. over $4.00

46. experienced outside men
A. $2.00 or less
B. $2.01 to $3.00
C. $3.01 to $4.00
D. over $4.00

47. trainees
A. $2.00 or less
B. $2.01 to $3.00
C. $3.01 to $4.00
D. over $4.00

48. average hourly rate charged customer for bench labor in your shop
A. $9.00 or less
B. $9.01 to $12.00
C. $12.01 to $14
D. over $14

Home call rates charged by your shop for categories in items 49-52 (first 30 minutes):

49. b-w TV
A. $8.00 or less
B. $8.01 to $10
C. $10.01 to $12
D. over $12

50. color TV
A. $8.00 or less
B. $8.01 to $10
C. $10.01 to $12
D. over $12

51. color TV setup
A. $8.00 or less
B. $8.01 to $10
C. $10.01 to $12

D. over $12

52. stereo and other
   A. $8.00 or less
   B. $8.01 to $10
   C. $10.01 to $12
   D. over $12

53. Method of pricing replacement parts
   A. cost plus 50% or less
   B. cost plus 51% to 75%
   C. cost plus 76% to 100%
   D. cost plus over 100%

Does your shop retail:

54. TV
   A. yes B. no

55. radio and stereo
   A. yes B. no

56. communications equipment
   A. yes B. no

57. antennas
   A. yes B. no

Indicate percentage of total (100%) gross income your shop obtains from categories in items 58-60.

58. service labor
   A. 25% or less
   B. 26% to 50%
   C. 51% to 75%
   D. over 75%

59. replacement parts sales
   A. 25% or less
   B. 26% to 50%
   C. 51% to 75%
   D. over 75%

60. retail sales (TV, etc.)
   A. 25% or less
   B. 26% to 50%
   C. 51% to 75%
   D. over 75%

61. Does your shop perform warranty service?
   A. none
   B. exclusively one brand
   C. more than one brand

62. Does your shop offer free service estimates?
   A. yes B. no

Does your shop offer service contracts on categories listed in items 63-65:

63. TV
   A. yes B. no

64. radio and stereo
   A. yes B. no

65. communications equipment
   A. yes B. no

66. Do you favor any regulation of service technicians?
   A. governmental licensing
   B. association certification
   C. do not favor any type of regulation
   D. only local (city or state) regulation

67. Does your shop presently employ apprentice technicians?
   A. yes B. no

68. Do you belong to any electronic service associations
   A. yes B. no

69. How many service trucks does your shop employ?
   A. 1
   B. 2 but less than 5
   C. 5 but less than 10
   D. more than 10

70. Do technicians in your shop attend manufacturers' training sessions?
   A. yes B. no

71. Major sources of service information (schematics, etc.)
   A. manufacturers
   B. PHOTOFACTS
   C. other

72. Where did you obtain your initial electronic training?
   A. practical experience on the job, no formal schooling
   B. civilian technical school
   C. military technical school

Use the following coded responses to indicate your preference for each of the Electronic Servicing subject categories listed in items 73-80.
   A. no interest
   B. present coverage adequate
   C. some coverage desired
   D. coverage in each issue

73. analysis of circuit operation
74. business management
75. test equipment
76. troubleshooting procedures
77. industrial electronics
78. medical electronics
79. solid-state servicing
80. servicing communications equipment

A Look at RCA's Solid-State Color

Part 2 / by Ellsworth Ladyman

Analysis of the sound, AFT, vertical sweep, pincushion correction and power supply circuits employed in RCA's CTC40 color chassis.

Sound Section

An integrated circuit (IC) contains the bulk of the sound section. This IC performs the functions of sound IF amplifier, detector and audio driver. For circuit analysis purposes, the IC can be considered as made up of three parts, each section representing a specific circuit function. The first section functions to amplify the incoming 4.5-MHz IF signal to a useful level. The output of the first section (sound IF amplifier) is applied to the second, or FM detector, section. The FM detector removes the audio portion of the signal, which is then applied to the audio driver, the third section of the IC. The purpose of the audio driver is to raise the amplitude of the audio signal to the level required to drive the audio output stage.

Detailed Circuit Analysis (See Fig. 1)

The 4.5-MHz FM sound signal is generated in the conventional "mixing" method by diode X1. This signal is coupled by IF transformer L1 to the sound IF amplifier section of the IC. The output signal from the sound IF amplifier is applied to the phase shift transformer, T2, and, in turn, to the ratio detector diodes. The output of the ratio detector is the audio signal, which is capacitance-coupled to the volume and tone controls. The audio signal is then capacitance-coupled from the volume control to the audio driver section of the IC.

The audio driver section functions to provide the required current gain to raise the signal to a

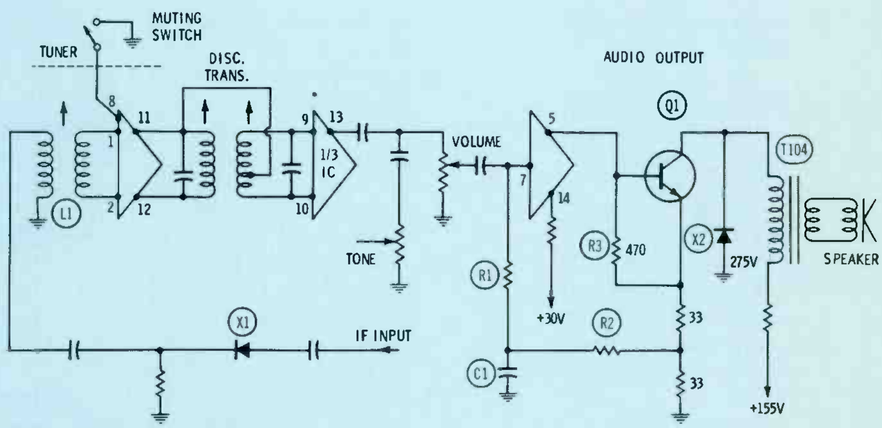


Fig. 1 An IC functions as the sound IF amplifier, detector and audio driver in the CTC40 chassis.

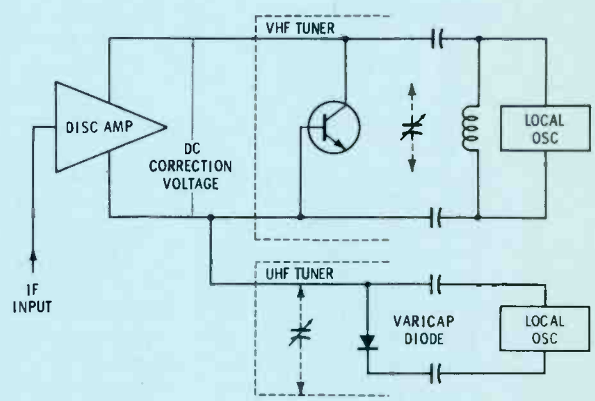


Fig. 2 Simplified illustrations of the CTC40 AFT system.

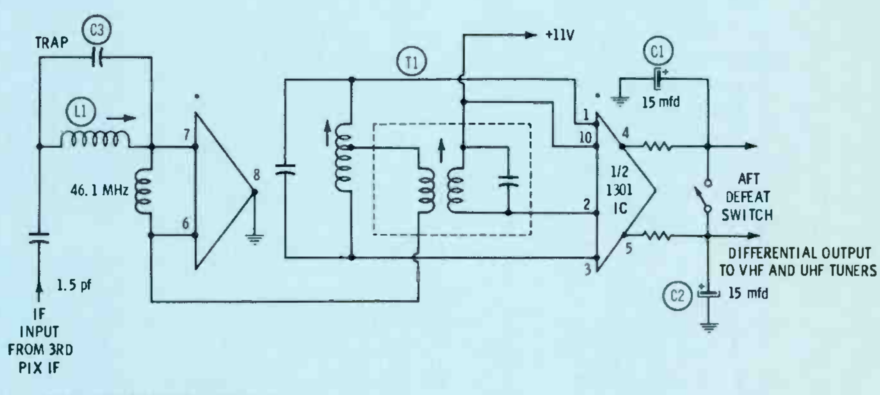


Fig. 3 Simplified schematic of the AFT circuitry.

level sufficient to drive the audio output stage, Q1.

The audio output stage is a common-emitter, class A amplifier. The transistor is protected against high-amplitude voltage spikes by a 275-volt zener diode connected from collector to ground. DC stability is enhanced by a feedback network (R1, R2) connected from the emitter of the audio output stage to the input of the audio driver section. Capacitor C1 provides low-frequency compensation for this feedback network. Resistor R3, located between the base and emitter of the audio output stage, functions to provide an additional load for the driver section. This minimizes the effects of output transistor leakage current.

Automatic Fine Tuning (AFT)

The fundamental AFT system is illustrated in Fig. 2. This system is basically the same as that previously used in the RCA CTC30 chassis. In this system, an integrated circuit (IC) discriminator/amplifier produces a differential DC voltage that is proportional to the applied IF frequency. This signal is then applied to a special "variable capacitance" transistor in the VHF tuner and a varicap diode in the UHF tuner that produce a correction voltage for application to the local oscillator.

Shown in Fig. 3 is a simplified schematic of the CTC40 AFT circuitry. The IC utilizes an internal, regulated power supply and does not require an external reference voltage for defeating the UHF AFT function. Automatic degeneration of the output amplifiers is such that it eliminates all AFT correction signals when the output terminals are shorted for AFT defeat action.

The AFT system is disabled during VHF channel change by the same method used to accomplish AFT defeat during fine tuning—shorting together of the AFT control-voltage outputs. This combination defeat action is initiated by a single switching mechanism built into the plastic housing located on the front of the VHF tuner shaft. The two 15-mfd electrolytic capacitors, C1 and C2, act to prevent undesired correction voltages generated during channel change time from affecting the local oscillator frequency. These capacitors also function to remove residual video information from the AFT output terminals, allowing only the undistorted DC correction voltage to reach the tuner.

AFT Operation

The IC AFT circuit is a type TA5360 that functions as follows:

A sample of the video IF output is applied to the AFT system through a coupling capacitor located in the collector circuit of the vidio IF amplifier. This signal is applied to a tuned input circuit comprised of L1 and C1. Coil L1 and capacitor C1 perform a dual role: They act as both an adjacent channel sound trap and as an IF frequency peaking circuit. Correct trap frequency is obtained automatically by peaking the input tuned circuit (L1, C1) at 46.1 MHz.

The output of the input tuned circuit is applied to the buffer amplifier section of the IC, the output of which appears across the primary windings of the discriminator transformer, T1. The discriminator primary is tuned to 46.1 MHz; the secondary winding is peaked at 45.75 MHz.

The discriminator transformer secondary windings feed the IC discriminator diodes. The output voltages of the diodes are applied to an amplifier that delivers a differential voltage output. This differential output contains two voltages, one appearing at each of the IC output terminals. The difference existing between these two voltages (differential) is indicative of the amount and direction the incoming IF signal deviates from the desired 45.75-MHz frequency. If the incoming IF signal is exactly 45.75 MHz, each output signal voltage will be exactly 6.5 volts, and no differential voltage will exist. When the incoming IF signal deviates from 45.75 MHz, one output voltage will increase, and the other will decrease an equal amount. The voltage at each output terminal will increase or decrease, depending on which direction the incoming signal deviates from 45.75 MHz. The maximum differential voltage produced by this circuit is +9 volts, well within the "pull-in" range of the AFT system.

Vertical Sweep

Basic System

The fundamental sweep system employed in the CTC40 chassis is illustrated in Fig. 4. The integrator sweep circuit consists of a high-gain amplification system operating in conjunction with an integrating capacitor. Operation is as follows:

At the start of vertical trace, the integrating capacitor, C1, is charged from a voltage source. This capacitor charge causes the amplifier to supply yoke current, resulting in a voltage being developed across the feedback resistor, R1, which is coupled directly to the integrating capacitor. This feedback action maintains the amplifier input voltage at a constant level, producing a constant rate of voltage "build-up" across the integrating capacitor. The voltage developed across the feedback resistor is directly proportional to the yoke current; therefore, increase of the yoke current is constant, and a linear scan is produced.

The vertical sweep rate is determined by an electronic switch which discharges the integrating capacitor at a 60-Hz rate. Vertical sync pulses are applied to the switching transistor and determine the exact instant the switch is pulsed "on". This action synchronizes the vertical switching action with the transmitted vertical scanning interval. The "linearity clamping" transistor provides the initial charging current to the integrating capacitor.

Vertical Switch (Fig. 5)

The function of the vertical switch is to provide a discharge path for the integrating capacitor at the end of each vertical scan interval. This

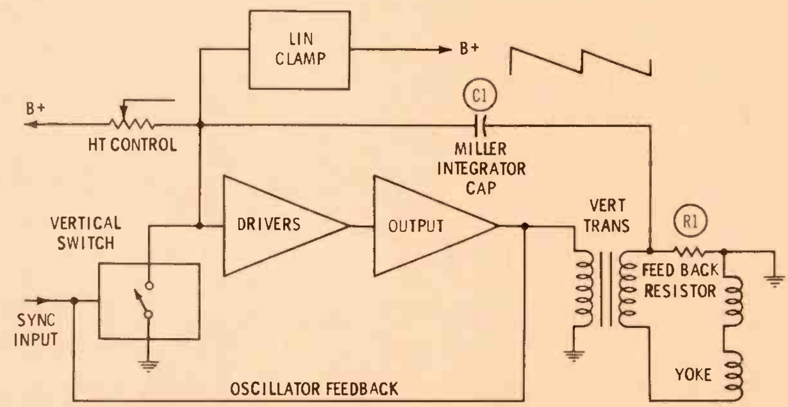


Fig. 4 Illustration of the fundamental sweep system employed in the CTC40.

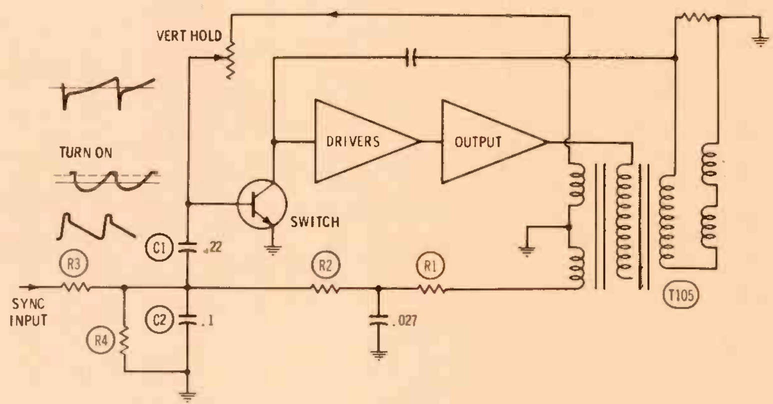


Fig. 5 Partial schematic of the vertical switch and associated circuitry.

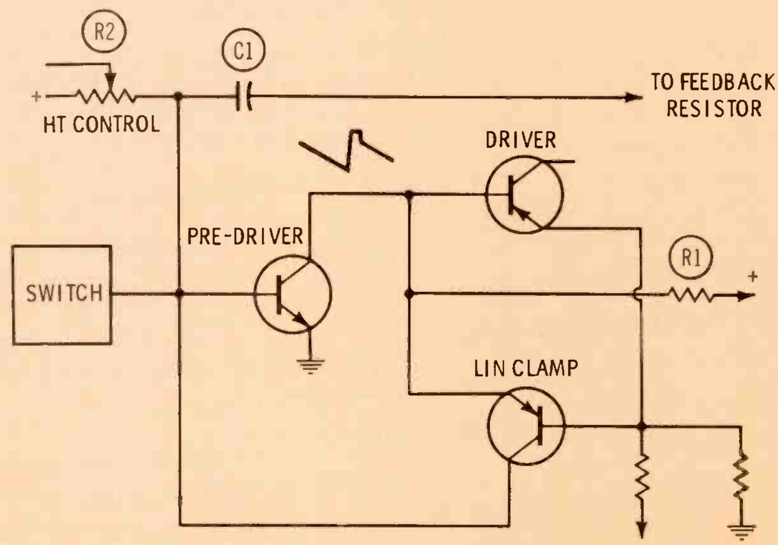


Fig. 6 Schematic showing basic circuitry of linearity clamper stage.

action causes beam retrace and prepares the circuit for the next vertical scan function. Operation of the vertical switch is made self-sustaining by the action of two feedback paths: One path, consisting of resistors R1 and R2 and capacitor C1, is applied to the base and provides the appropriate pulse to initiate "turn on". Vertical sync pulses, from the sync separator, are integrated by resistors R3 and R4 and capacitor C2 and add to the triggering waveshape. An additional feedback voltage is applied to the switch from the vertical output transformer via the vertical hold control. This additional voltage causes the switch base to pass rapidly through the "turn on" voltage potential. As a result, switch "turn-on" is extremely stable and comparatively immune from random noise pulses. The vertical hold control has some control of the "turn-on" point and, therefore, the frequency at which the circuit operates.

Linearity Clamp (Fig. 6)

Since it is necessary to provide a sufficient amount of initial charging current for the integrating capacitor, a special clamping circuit called the "linearity clamp," is utilized. Operation of this circuit is as follows:

The action of the vertical switch discharging capacitor, C1, also cuts off the predriver transistor. This produces a positive voltage on the collector of the predriver. This voltage is of sufficient amplitude to forward bias the linearity clamp transistor. The linearity clamper conducts; current flows through the transistor via R1 and the vertical switch. The vertical switch turns off after approximately 700 microseconds, and the linearity clamp then rapidly charges capacitor C1. As the charge rapidly builds up on capacitor C1, the predriver and driver stages start to conduct, causing the linearity clamp base-emitter junction to become reverse biased due to the voltage drop across the driver base—emitter junction. This circuit action cuts off the linearity clamp and originates vertical scan. Capacitor C1 continues to charge through the height control, R2, for the duration of scan time.

Vertical predriver and driver (Fig. 7)

The vertical driver section is comparatively more familiar. It consists of two stages: a predriver (NPN transistor operating as a common-emitter amplifier) directly coupled to a driver (PNP transistor operating as a common-emitter amplifier). Emitter supply voltage for the driver stage is obtained from a voltage divider network composed of R1 and R2. The driver collector load is comprised of R3 and the base-emitter junction resistance of the vertical output stage.

Provisions for picture tube setup are provided by switch S1, which functions to "short" the driver emitter to ground when actuated. The waveshape of the input signal to the predriver is determined by the charging action of the integrator capacitor, C1, which is charged through the height control, R3. The height control supply voltage is made relatively immune to temperature-induced variables by the action of thermistor R4. A degree of dynamic regulation for the circuit is provided by a signal from the horizontal deflection system. The insertion of this voltage tends to maintain a constant vertical sweep or height, regardless of horizontal scan and high-voltage fluctuations.

Vertical Output (Fig. 8)

The function of any vertical output circuit is to provide the power necessary to fulfill the vertical deflection requirement of the CRT beam. In the RCA CTC40 chassis the vertical output stage is a com-

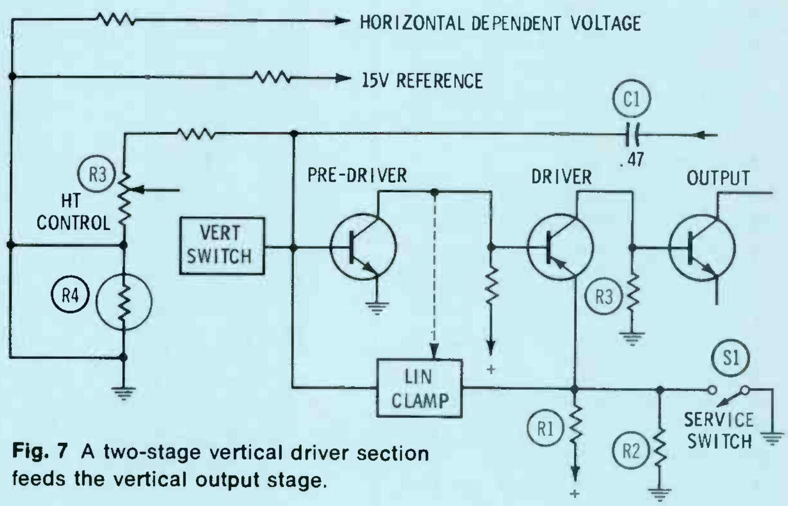


Fig. 7 A two-stage vertical driver section feeds the vertical output stage.

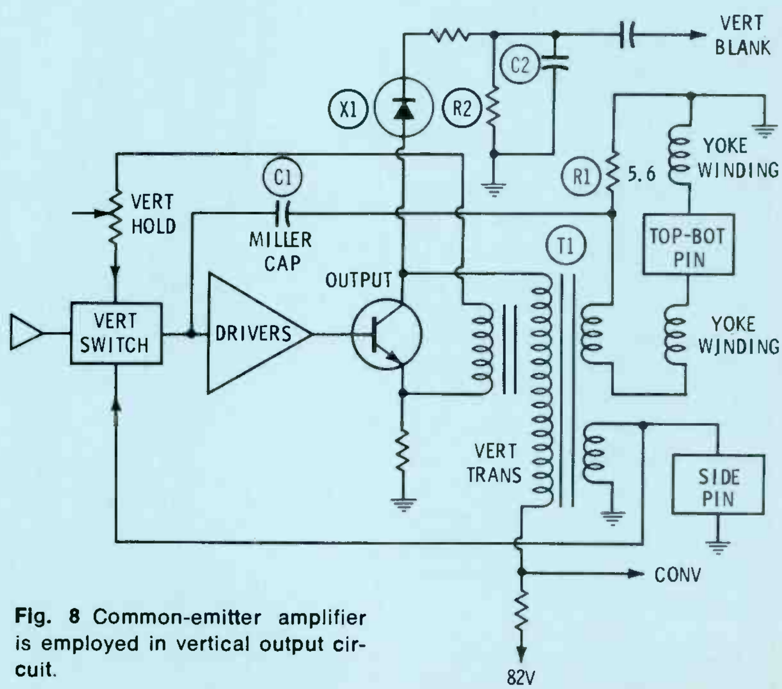


Fig. 8 Common-emitter amplifier is employed in vertical output circuit.

mon-emitter amplifier with an input from the driver stages. Loading for the vertical output stage is provided by the vertical output transformer, T1, and the vertical convergence circuit.

The vertical output transformer is loaded by the vertical windings of the yoke, two feedback networks, and the pincushion correction circuit. Integrating capacitor C1 is connected to the output circuit by resistor R1, a 5.6-ohm feedback resistor in series with the secondary windings of the vertical output transformer and the vertical yoke windings. There are two feedback networks connected to the vertical switch transistor from the vertical output circuit; both of these networks perform waveshaping functions to provide stable, self-sustain-

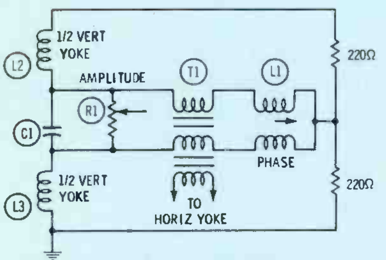


Fig. 9 Top and bottom pincushion correction circuitry.

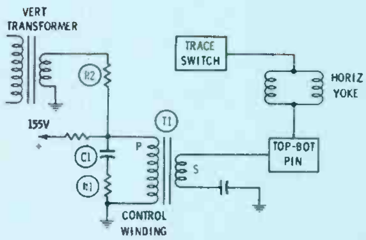


Fig. 10 Side pincushion correction is accomplished by amplitude modulation of the horizontal deflection current.

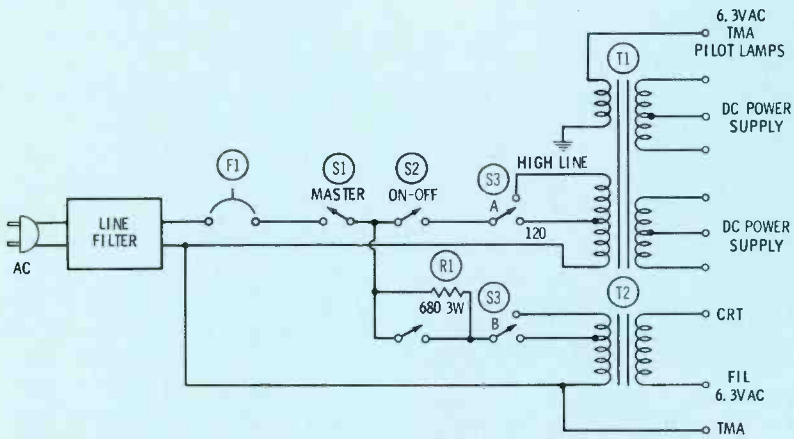


Fig. 11 Schematic of the switching circuitry that permits the CTC40 to take advantage of the "instant-on" characteristics of semiconductors.

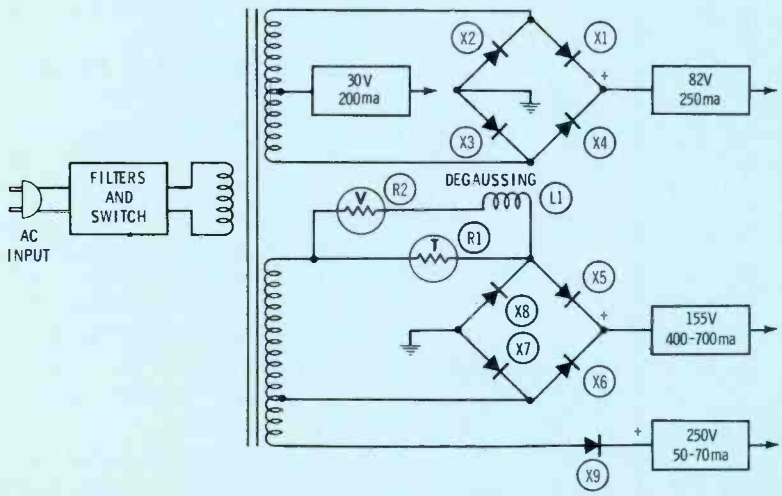


Fig. 12 Three separate rectifier circuits provide the CTC40 with four separate DC sources.

ing vertical switching. Diode X1, in conjunction with capacitor C2 and resistor R2, provides a protective clamping action for the vertical output transistor. Positive-going retrace voltage pulses cause diode X1 to conduct, effectively clamping the vertical output collector to the voltage existing across capacitor C2. A relatively slow discharge path is required for capacitor C2. This is provided by resistor R2. This discharge action sufficiently reduces the voltage across C2 during retrace time to insure the necessary voltage difference across diode X1 when retrace pulses occur. The pulses that appear across capacitor C2 during conduction of X1 are applied to the 2nd video IF stage to provide vertical retrace blanking.

Pincushion Correction (Top and Bottom) Fig. 9

Top and bottom pincushion correction in the CTC40 chassis is accomplished in a manner similar to methods used in previous RCA color chassis.

A signal voltage derived from the horizontal yoke circuit is coupled to transformer T1. This action energizes a circuit composed of capacitor C1 and coil L1, which is tuned to 15,750 Hz and is in series with the vertical yoke windings, L2 and L3. The resultant sine wave is added to the vertical yoke current waveshape in the proper phase and amplitude to effectively correct top and bottom pincushion distortion. A limited amount of control over the correcting sine wave phase and amplitude is provided by variable inductor, L1, and the damping resistance of R1.

Side Pincushion Correction (Fig. 10)

Side pincushion correction is accomplished by amplitude modulation (at a vertical rate) of the horizontal deflection current. This produces an increase in horizontal scanning width at the center of the raster with respect to the width at the top and bottom. This operation is made possible through the utilization of the saturable reactor circuit illustrated in Fig. 10.

A parabolic waveshape occurring at the vertical frequency is initiated by the action of the control winding of transformer T1, capacitor C1 and resistors R1 and R2. This waveform, coupled to the horizontal yoke circuit by transformer T1, modulates the amplitude of the horizontal yoke scanning current, producing the proper change in raster width.

Power Supply

The CTC40 power supply provides four DC sources for general circuitry requirements and two AC power sources. The AC power sources are for the CRT filaments and pilot lamps.

Power supply switching circuits allow the CTC40 to take advantage of the "instant on" characteristics of solid-state devices. This switching circuitry is illustrated in Fig. 11.

Switching Circuit

AC power is applied through the line filter and circuit breaker to the master power switch, S1. The master power switch applies power through the "instant pic" switch, S2, to both the DC supply transformer, T1, and the CRT filament transformer, T2. However, when switch S2 is in the "off" position, reduced power is supplied to filament transformer T2 through resistor R1, a 680-ohm, 3 watt component. Using this method, the CRT filament is kept "warm" until full power is applied by closing switch S2. This design insures the full operation of the CTC40 within four to five seconds after turn on.

The master power switch, S1, is a rotary type switch located at the top of the auxiliary consumer-controls bracket. Switch S2 is a push-pull switch located at the top of the consumer-controls panel and is adjacent to the brightness control.

DC Supply Circuitry (Fig. 12)

The DC power supply provides four separate DC sources generated from three separate rectifier circuits. This is illustrated schematically in Fig. 12.

Rectifiers S1 through X4 are responsible for providing both the 82- and 30-volt sources. The 82-volt supply is derived from the full-wave bridge configuration of rectifiers X1 through X4. The transformer secondary winding that feeds this bridge circuit is centertapped and is used to feed two of the four rectifiers comprising the bridge network. This forms a full-wave, centertapped circuit, the output of which is 30 volts.

A second full-wave bridge circuit is comprised of rectifiers X5 through X8. The output of this circuit is the 155-volt source.

The automatic degaussing circuit is coupled to the secondary winding of T1, which feeds rectifiers X5 through X8. This circuit consists of thermistor R1, voltage dependent resistor R2 and degaussing coil L1. Operation of this circuit is the same as that of degaussing circuits previously employed in RCA color chassis.

The 250-volt DC source is obtained from the output of rectifier X9. During normal operation, the CTC40 chassis draws approximately 1.8 amperes of AC current at 120 volts AC input. The average DC current supplied by each leg of the power supply is as follows:

82-volt source—200 ma.
30-volt source—200 ma.
155-volt source—400-700 ma. (varies with beam current)
250-volt source—50-70 ma. (varies with beam current)

Part 3 of this continuing analysis of RCA's CTC40 color chassis will discuss the horizontal, chroma, and convergence circuits. ▲

Practical stereo-FM servicing, Part 3

BALANCE, CROSSTALK AND DISTORTION

by Robert G. Middleton

An FM stereo multiplex system employs two audio-amplifier channels. High-fidelity amplifiers are provided in all of the better systems. Although there are no absolute standards for hi-fi reproduction, it is generally agreed that an amplifier should have essentially flat frequency response from 40 Hz to 15 KHz; flat response from 30 Hz to 20 KHz is preferred. "Essentially flat" means that the output should not vary more than ±1 dB; a variation of less than ±0.5 dB is preferred. Variations are measured with reference to the mid-band level. A flatness check is always made at maximum rated power output, and is usually rechecked at medium and low levels of power output.

DC Balance in Push-Pull Stages

Basic push-pull stage configurations are shown in Fig. 1. A fundamental requirement is good DC balance. This means equal emitter currents for Q1 and Q2 in Fig. 1A, or equal cathode currents for V3 and V4 in Fig. 1B. Various types of balance adjustments may be provided; for example, one or both of the emitter or cathode resistors might be adjustable. To facilitate checks of DC balance, jacks are often included in the circuits. A DC milliammeter is plugged into the jacks to measure the current values.

A cathode current of approximately 60 ma can be expected in a typical tube-type amplifier that is operating normally. The measurement should be made under no-signal, medium-signal, and full-rated output conditions; an audio oscillator is commonly used to provide a drive signal. Since objectionable

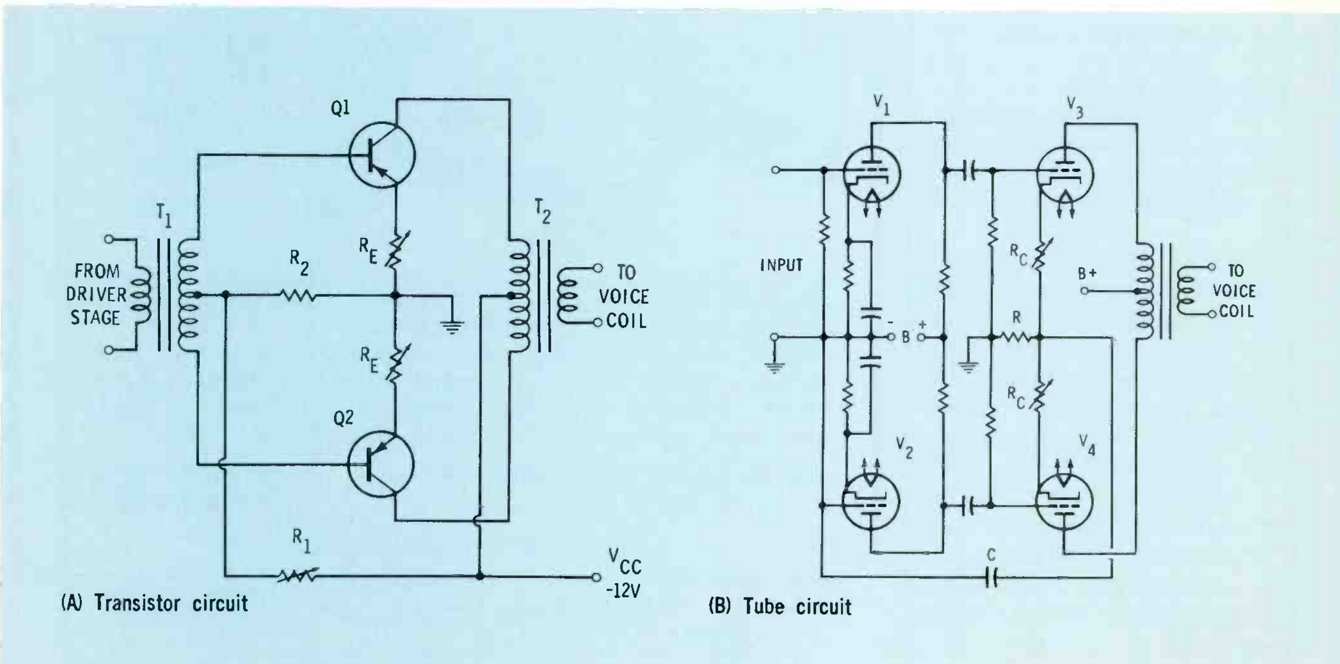


Fig. 1 Basic transistor—and tube-type push-pull circuits.

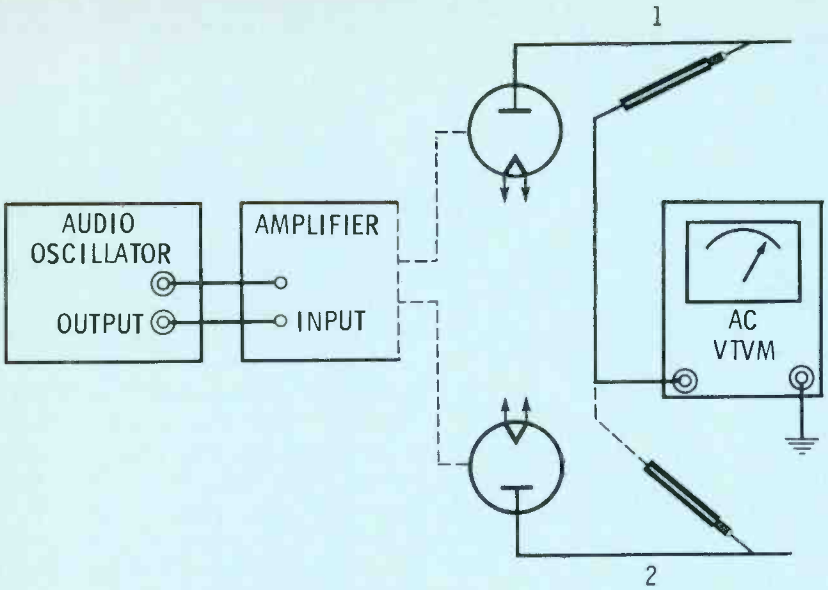


Fig. 2. Test setup for checking AC balance.

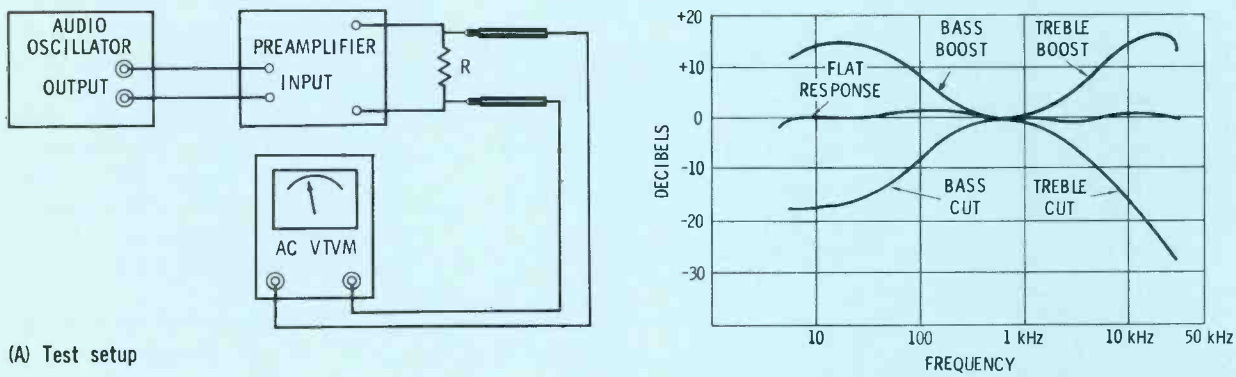
sound output results in a high-level test, the speaker is usually replaced by a power resistor of suitable value (resistance equal to the rated speaker impedance). If substantial DC imbalance is observed, first check the transistors or tubes.

The DC balance of a push-pull output stage should be adjustable to within 5%, and preferably within 2%. It is often necessary to choose a slight compromise adjustment to obtain best balance from the no-signal condition to the maximum rated output condition. When tubes or transistors are unbalanced, hum, harmonic distortion and intermodulation distortion tend to increase. If DC balance controls are not provided, it becomes necessary to select a matched pair of transistors or tubes. Distortion will be analyzed later; however, common sources of hum will be discussed at this point.

Sources of Hum Interference

Hum in the output of an audio amplifier is not always due to filter defects in the power supply, although a routine scope check of ripple voltage should be made. A common offender is heater-cathode leakage in tubes that have cathodes operating above ground. Tube selection is helpful, particularly in low-level input or driver stages. Some amplifiers have a hum-balance control in the heater circuit; if so, the control is adjusted for minimum hum output. Note also that poor ground connections or improperly ground components that cause circulating ground currents are sometimes responsible for objectionable hum output.

High-impedance, low-level grid circuits can pick up stray hum fields if defective shielding is present. To check this possibility, go through the amplifier stage-by-stage, and shunt each grid to ground in succession with a large bypass capacitor. This test will show whether a grid circuit is picking up stray field hum. Sometimes a low-level audio



(A) Test setup

(B) Flat response, with added curves showing the effect of bass and treble controls

Fig. 3 Test setup and desired results of frequency-response tests.

cable needs to be grounded at one end only; at other times, hum can be reduced by grounding the shield braid at both ends.

AC Balance in Push-Pull Stages

After the DC balance is verified (or adjusted), turn your attention to AC balance of the push-pull stage. This test requires an audio oscillator and an AC VTVM, as shown in Fig. 2. Adjust the audio oscillator to provide nearly maximum-rated power output from the amplifier. Note that power output is measured by checking the AC voltage across the output resistor (or voice coil) and applying the power law: $W = E^2/R$, where W is in watts, E is in rms volts, and R is the ohmic value of the output resistor or impedance value of the voice coil.

AC balance is usually checked at a standard test frequency; this is either 400 Hz, or 1 KHz, depending upon the particular standard that is preferred.

Apply the VTVM input lead, in turn, from plate 1 to ground and from plate 2 to ground, as illustrated in Fig. 4. The two readings should be nearly equal. If the readings are substantially different, it is possible that the push-pull tubes have unequal Gm values, or that the push-pull transistors have unequal beta values. Other possibilities are unequal plate voltages or unequal collector voltages. If the output stage has been cleared of suspicion, next measure the AC levels in the driver stage. For example, in Fig. 1B, defective tubes, faulty capacitors, or off-value resistors could cause AC imbalance. Note that although good AC balance can always be obtained at a mid-band frequency, such as 400 Hz or 1 KHz, more or less imbalance can be anticipated at very low and at very high audio frequencies. At the extreme ends of the frequency range, circuit reactances cause unequal drive signals to the grids of the push-pull tubes, or bases of the push-pull transistors.

Measurement of Frequency Response

We are concerned next with frequency response measurements. The frequency response of a preamplifier is checked as depicted in Fig. 3. Note that the bass and treble controls must be set for flat response. It also is necessary to use an audio

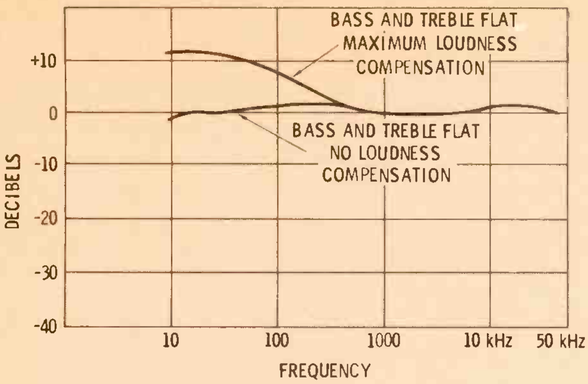


Fig. 4 Typical frequency response of a preamplifier, with tone controls set for flat response and the volume control at maximum.

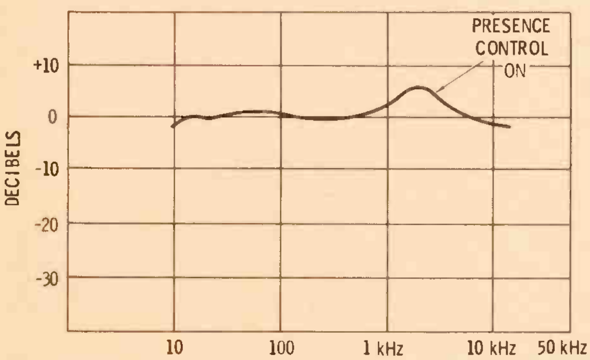


Fig. 5 Preamplifier response obtained with presence control on.

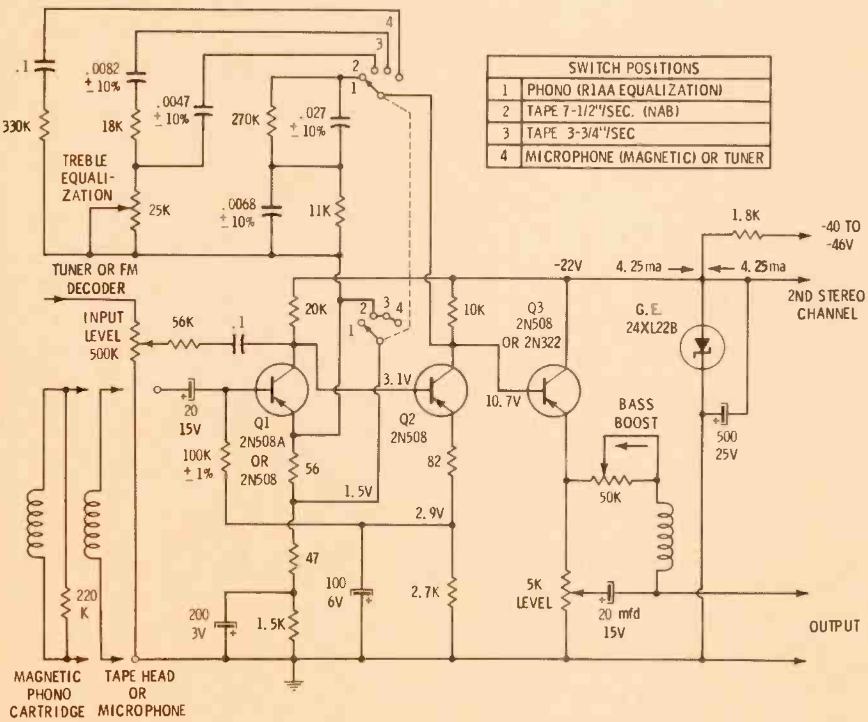


Fig. 6 Typical solid-state preamplifier circuit.

oscillator that has a very flat output; otherwise, a VTVM must be connected across the audio-oscillator output terminals to monitor the output level as the operating frequency is changed. If the amplifier has a loudness control, this control must be set for zero loudness compensation. Otherwise, a low-frequency rise will be observed, as shown in Fig. 4.

Some hi-fi amplifiers have a presence control. This control must be turned off during a frequency-response check, otherwise, a midband frequency rise will be observed, as illustrated in Fig. 5. Be sure that you do not apply the

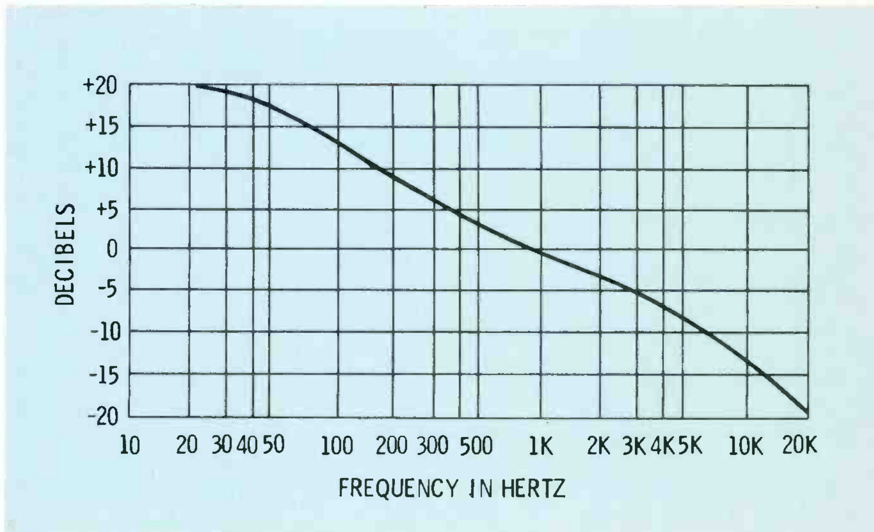


Fig. 7 Record Industry Association of America (RIAA) equalization curve for playback of records.

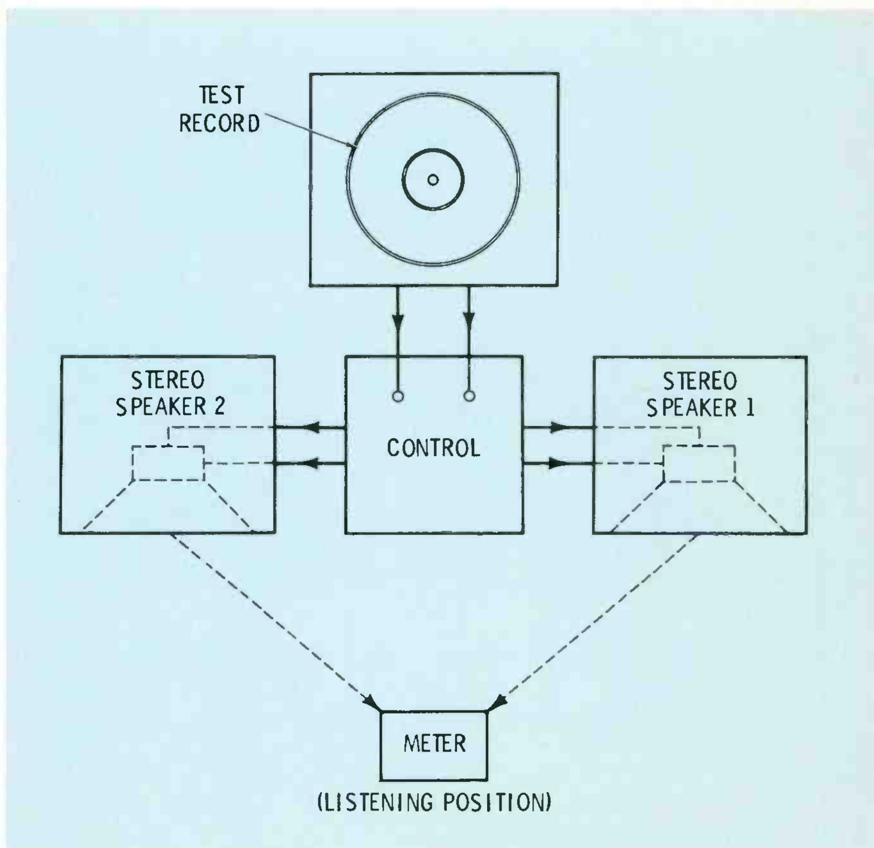


Fig. 8 Test setup for checking the balance of a stereo system.

audio-oscillator signal through the scratch filter. If this error is made, the amplifier will appear to have poor high-frequency response. The same precaution applies to a rumble filter. If the audio-oscillator signal is passed through the rumble filter, the amplifier will appear to have poor low-frequency response.

A typical solid-state preamplifier circuit is shown in Fig. 6. In the RIAA equalization switch position, high-frequency attention is provided, as depicted in Fig. 7.

When troubleshooting poor frequency response, first suspect defective tubes or transistors. The next most likely source of trouble is a defective capacitor. In a transistor preamplifier, capacitors are more likely to fail than transistors because of the low power level present in the circuit. On the other hand, transistors are prime suspects in output amplifiers because the higher power requirement operates the transistors at or near maximum design ratings.

Balance Check of a Stereo System

It is necessary that the gain of each channel in a stereo system be the same; otherwise, the full stereo effect is not obtained. To check for proper balance and precise adjustment of the stereo balance control, a stereo balance meter and test record may be utilized as shown in Fig. 8. A stereo balance meter is basically the same as a noise-level meter. The meter is placed in the position normally occupied by a listener, and the 400-Hz or 1-KHz tone from the test record is repro-

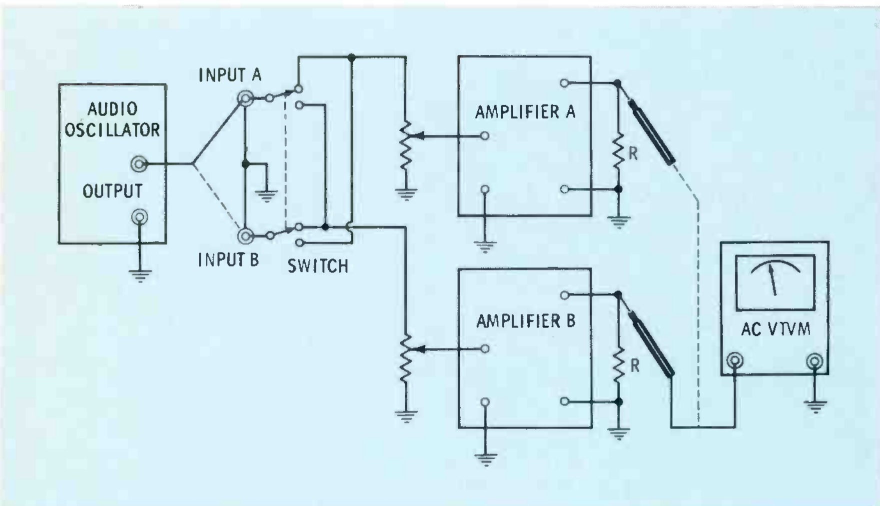


Fig. 9 Checking crosstalk between stereo amplifiers.

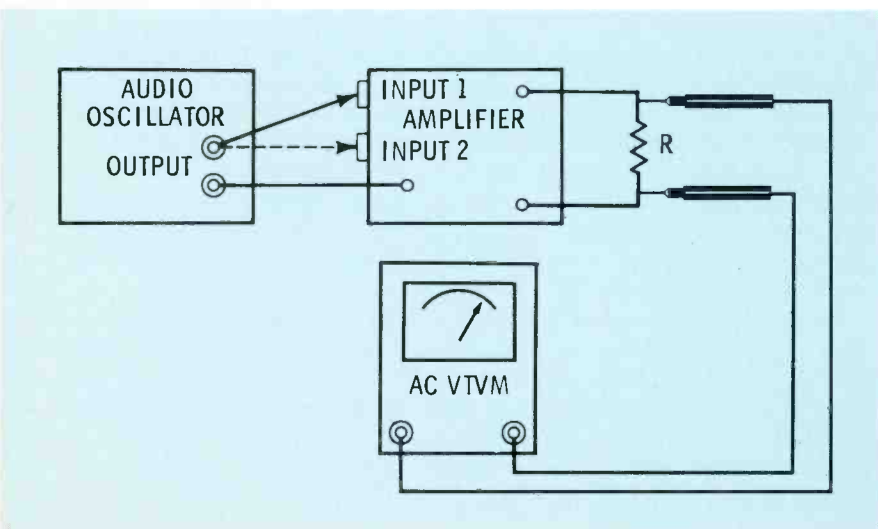


Fig. 10 Test setup for checking crosstalk between inputs of an amplifier.

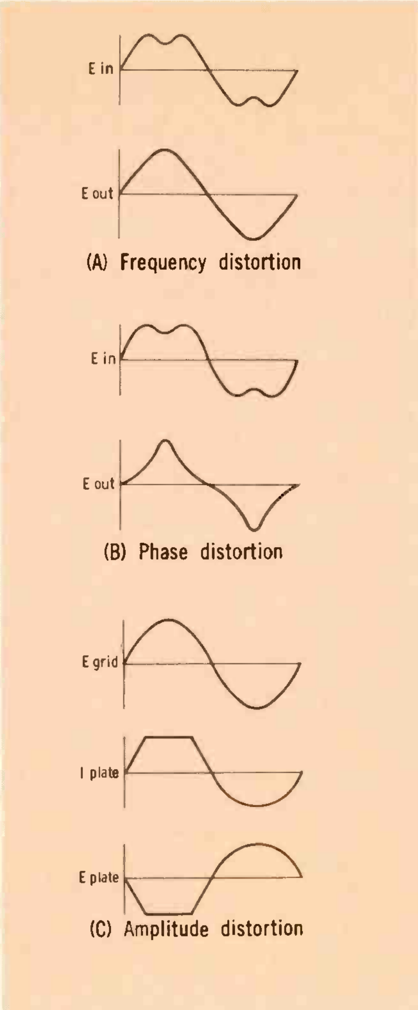


Fig. 11 Three basic types of amplifier distortion.

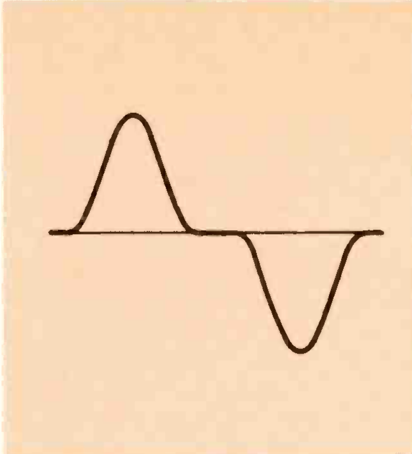


Fig. 12 An example of crossover distortion.

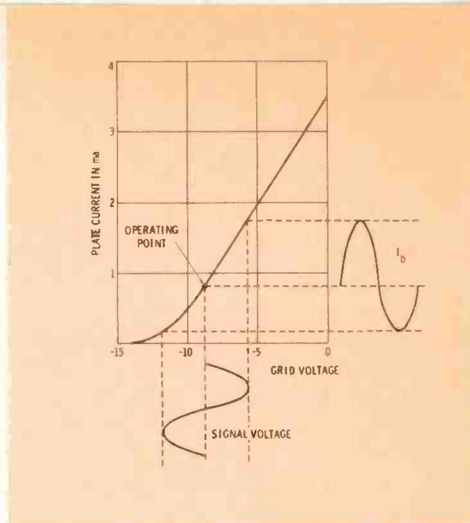


Fig. 13 Compression of the negative half cycle.

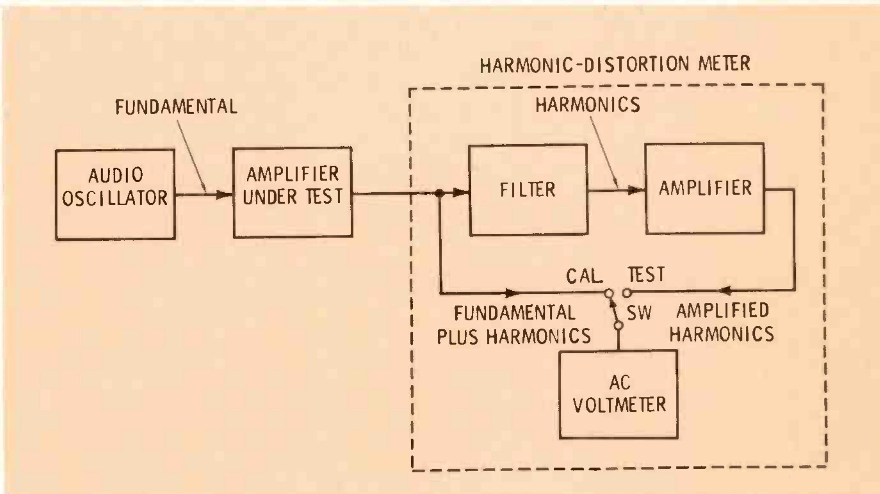


Fig. 14 Test setup for measuring harmonic distortion.

duced at normal level. Each channel is operated in turn, and the stereo-balance control is adjusted to obtain the same reading from each channel.

In some cases, a slight difference in setting of the stereo-balance control may be noted at low and high audio frequencies, due to system tolerances. In such a case, make a compromise setting based on tests at 100, 1000, and 8000 Hz. The technician should not confuse stereo balance with DC balance or AC balance. Stereo balance concerns equality of gain in the two audio channels, whereas DC and AC balance refer to conditions in the push-pull output stage of an individual channel. We normally check stereo balance after the DC and AC balance conditions are satisfied.

Crosstalk

Crosstalk pertains to a stray coupling of signals between the inputs of an amplifier. For example, let us consider a check for crosstalk between stereo amplifiers, as shown in Fig. 9. With the audio oscillator connected to input A, measure the relative output from amplifiers A and B. Then, with the audio oscillator connected to input B, again measure the relative outputs from each amplifier. The crosstalk figure is the number of dB measured in these tests. Note that the crosstalk figure tends to change with the test frequency; therefore, we state the frequency of maximum crosstalk in evaluating a stereo amplifier.

Crosstalk can be caused by any form of stray coupling, such as capacitance between leads. However, an objectionable crosstalk figure is usually due to defective decoupling capacitors that result in common impedances in the power-supply leads. Crosstalk shows up most prominently when operating at maximum rated power output. A scope check across suspected capacitors is the best method of localizing the trouble. The output filter capacitor is also a ready suspect; if this capacitor is defective, the ripple amplitude will also be higher than normal.

Next, let us consider crosstalk between inputs of the same amplifier, as depicted in Fig. 10. The audio oscillator is connected to input 1, and an input level is applied which produces maximum rated power output. The test may be made at 1 KHz. Next, the amplifier is switched to input 2, and the meter reading observed (if any). A similar test is made with the audio oscillator driving input 2. Objectionable crosstalk between inputs can be caused by poor grounds, disturbed lead dress, or similar defects that produce stray coupling between the input circuits.

Harmonic Distortion

Three basic types of distortion are

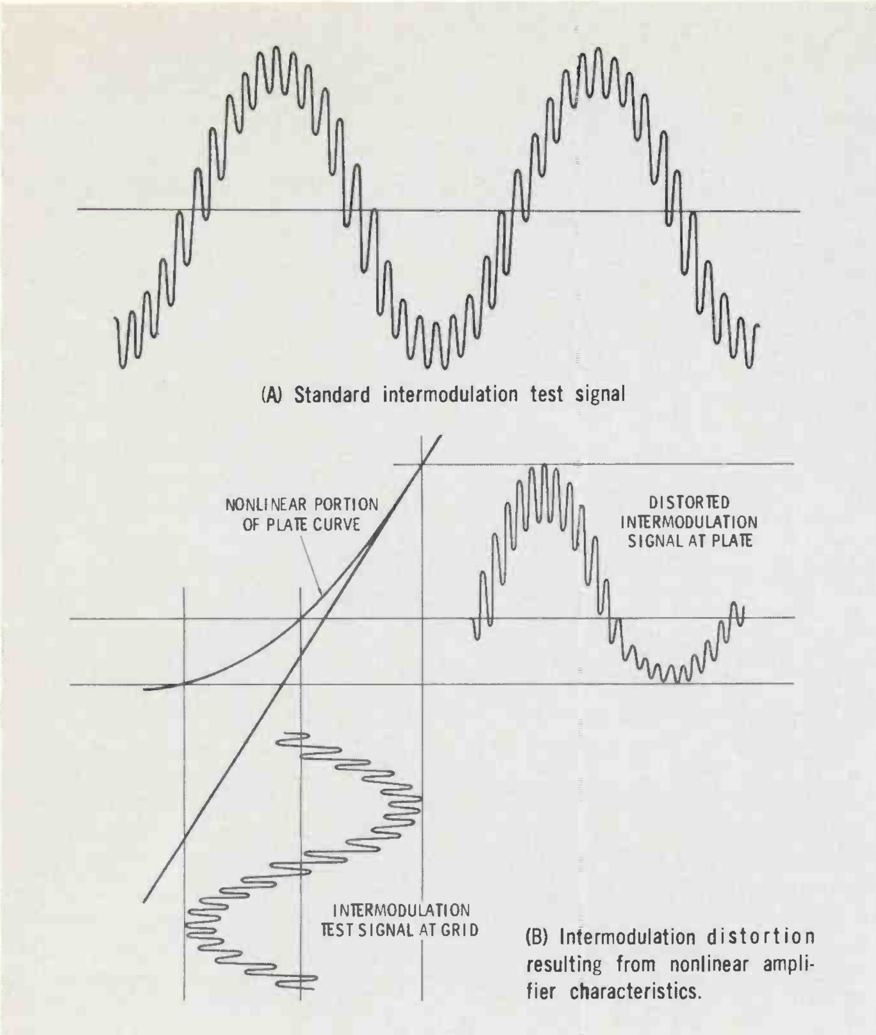


Fig. 15 Test signal and results of intermodulation distortion test.

shown in Fig. 11. First, consider frequency distortion. The input waveform, "Ein", has a low-frequency component and a high-frequency component. However, because of poor high-frequency response, the high-frequency component does not appear in the output waveform, "Eout."

In Fig. 11B frequency distortion does not occur; however, the high-frequency component has been shifted in phase. This type of distortion is called phase distortion; it is of minor importance in audio systems, although phase distortion is minimized in better equipment.

We are chiefly concerned with amplitude distortion, a basic form of which is illustrated in Fig. 11C. This type of amplitude distortion is termed clipping. Clipping may occur in the center of a waveform, as well as on a peak of the waveform. For example, Fig. 12 shows a waveform with crossover distortion. It is the result of overbias in a push-pull stage that clips the initial portion of the drive waveform. Another type of nonlinear distortion, called compression, is depicted in Fig. 13. Compression and clipping are merely various degrees of amplitude nonlinearity in amplifier operation.

The distinctive characteristic of any type of amplitude nonlinearity is the production of harmonics, which appear in the amplifier output when a single-frequency drive waveform is applied to the amplifier input. Therefore, this general class of distortion is called harmonic distortion. Although there are no absolute standards, it is generally agreed that a hi-fi amplifier should have less than 1% harmonic distortion, and preferably as little as 0.1% harmonic distortion. If an amplifier has 1% harmonic distortion, this means that the algebraic sum of the harmonic voltages is equal to 1% of the fundamental output voltage.

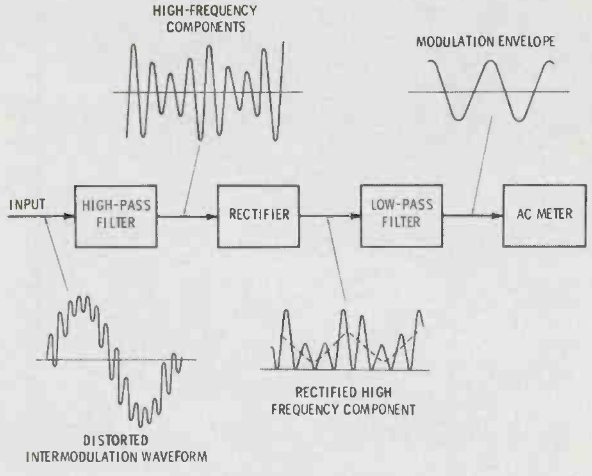


Fig. 16 Basic configuration of an intermodulation distortion analyzer.

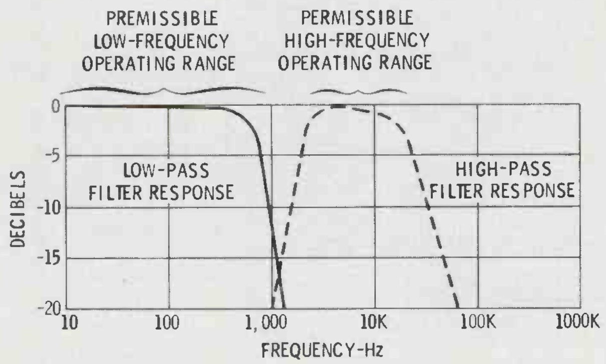


Fig. 17 Characteristics of the filters in a typical intermodulation distortion analyzer.

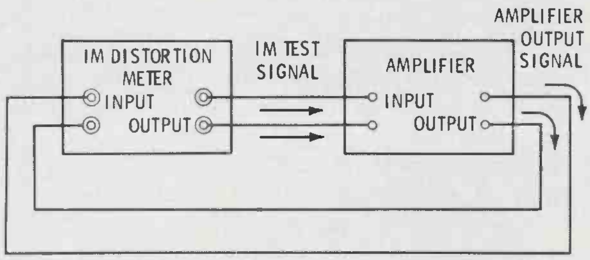


Fig. 18 Test setup for measurement of intermodulation distortion.

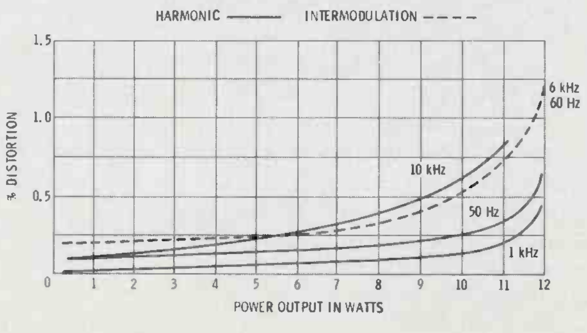


Fig. 19 Harmonic and intermodulation distortion percentages for a typical high-fidelity amplifier.

It is a basic law of electronics that harmonics are always integral multiples of the fundamental frequency. For example, the distorted waveforms shown in Figs. 11C, 12 and 13 will have harmonic frequencies which are 2 times, 3 times, 4 times, etc., higher than the fundamental frequency. Harmonic distortion is measured with a harmonic distortion meter; a block diagram of this instrument is shown in Fig. 14. The amplifier is driven by a sine waveform with a typical frequency of 1 KHz. If the amplifier develops harmonic distortion, frequencies of 1 KHz, 3 KHz, etc., will be fed to the harmonic distortion meter.

If the audio oscillator in Fig. 14 operates at 1 KHz, the filter in the harmonic distortion meter is tuned to eliminate frequencies below 2 KHz, but passes frequencies of 2 KHz, 3 KHz, etc. That is, a high-pass filter is employed. The harmonic voltages are stepped up through a calibrated meter amplifier, and the percentage of harmonic distortion is indicated by an AC voltmeter. The voltmeter scale is calibrated in percentage values in order to be direct-reading. It is obvious that the test equipment must have lower distortion than the amplifier under test. That is, the audio oscillator must have very low distortion, and the meter amplifier also must have very high fidelity.

Amplifier distortion is usually measured at maximum rated power output. Accordingly, a test setup includes an AC VTVM, as shown in Fig. 14. The output from the audio oscillator is advanced until the power in R is equal to the maximum rated value for the amplifier. To repeat an important point, the power in the resistor is calculated by the formula $W = E^2/R$, where W is in watts, E is in rms volts, and R is in ohms. The percentage of harmonic distortion is then indicated by the harmonic distortion meter for a condition of maximum power output.

When an objectionably high value of harmonic distortion is measured, look for non-linearity in the amplifier. The trouble, most likely, is caused by defective tubes or transistors. Nonlinearity is seldom caused directly by capacitor or resistor defects, since these are basically linear components. However, defective capacitors or resistors indirectly can cause nonlinear operation. For example, a leaky capacitor can shift the normal bias on a tube or transistor, causing operation in a nonlinear region. Similarly, an off-value resistor can cause bias shift. Although the incidence is rare, shorted turns in an audio transformer also can cause nonlinear operation.

Intermodulation Distortion

Intermodulation distortion is another characteristic of amplitude nonlinearity. It is basically a two-tone test, as depicted in Fig. 15. The two test frequencies are applied simultaneously, with typical frequencies of 60 Hz and 6 KHz. When amplitude nonlinearity is present in the amplifier under test, intermodulation of the test frequencies will result. In turn, sideband frequencies appear in the amplifier output waveform. These are sum and difference frequencies; thus, the sideband frequencies in the foregoing example are 5940 and 6060 Hz.

Fig. 16 shows the basic design of an intermodulation distortion analyzer. The high-pass filter picks out the high-frequency components in the 6-KHz region, and feeds this modulated waveform to a rectifier. In turn, the rectifier applies the demodulated waveform to a low-pass filter. This low-pass filter permits the frequency of the modulation envelope to energize an AC meter that is calibrated in percentage of intermodulation distortion. The frequency characteristics of filters utilized in an intermodulation distortion analyzer are shown in Fig. 17.

The two-tone signal used in an intermodulation distortion test is usually obtained from audio oscillators which are built into the instrument. Thus, a test setup as shown in Fig. 18 is employed. It is customary to drive the amplifier to maximum rated power output in the test, because intermodulation distortion tends to increase at high power levels.

Fig. 19 shows the results of both intermodulation and harmonic distortion tests on a hi-fi amplifier. We will find that there is no simple correlation between harmonic distortion and intermodulation distortion values. Therefore, it is good practice to check both values.

When an amplifier exhibits objectionable intermodulation distortion, the probable causes are the same as for harmonic distortion. To localize the trouble to a particular stage, it is advisable to leave the distortion meter connected at the output of the amplifier, and to inject the test signal step-by-step, working back from the output stage. That is, the test signal is injected through a blocking capacitor progressively at the bases of the transistors, or at the grids of the tubes. Signal tracing with a scope is not practical because it is very difficult to observe small percentages of distortion in a scope waveform.

Coming Next

Thus far, we have considered individual units of the FM stereo multiplex system. We are now in a position to consider system response and system tests. This is an important topic because it is quite difficult to predict what the system response will be on the basis of unit or section tests. System tests will be explained in the next article. We will also consider variations in design of commercial equipment, and step-by-step system alignment procedures. ▲

test equipment

notes on analysis of test instruments, their operation and applications

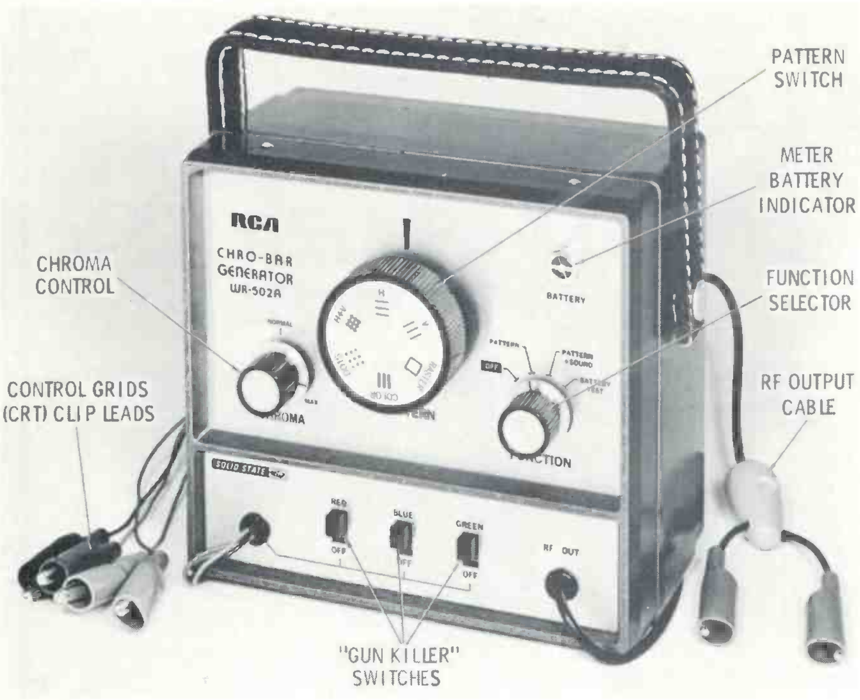


Fig. 1 RCA Model WR-502A color-bar generator.

The RCA Model WR-502A Chro-Bar color-bar generator is a solid-state, battery operated instrument. It is capable of producing the the following pattern: color bars, crosshatch, vertical lines, horizontal lines, and a blank raster. These patterns make it possible to perform convergence, color-phasing, matrixing, purity and linearity adjustment for color television receivers.

One of the features of Model WR-502A is the newly designed crystal-controlled, solid-state circuitry. In test applications in our lab, the patterns generated were extremely stable, with no evidence of that annoying flicker that can make convergence more difficult than it is.

Slide switches are provided to kill the CRT color guns during purity and convergence adjustment. Leads are provided for direct connection to the control grid leads of the CRT socket in the receiver.

The color-bar pattern provides ten color bars, including R-Y, B-Y, I, and Q signals spaced at 30 degree phase angles. This pattern is used primarily for checking color phase and matrixing circuits and adjustment of the automatic frequency phase-control circuit (AFPC). Narrow brightness bands are inserted at the edge of each color bar to aid in

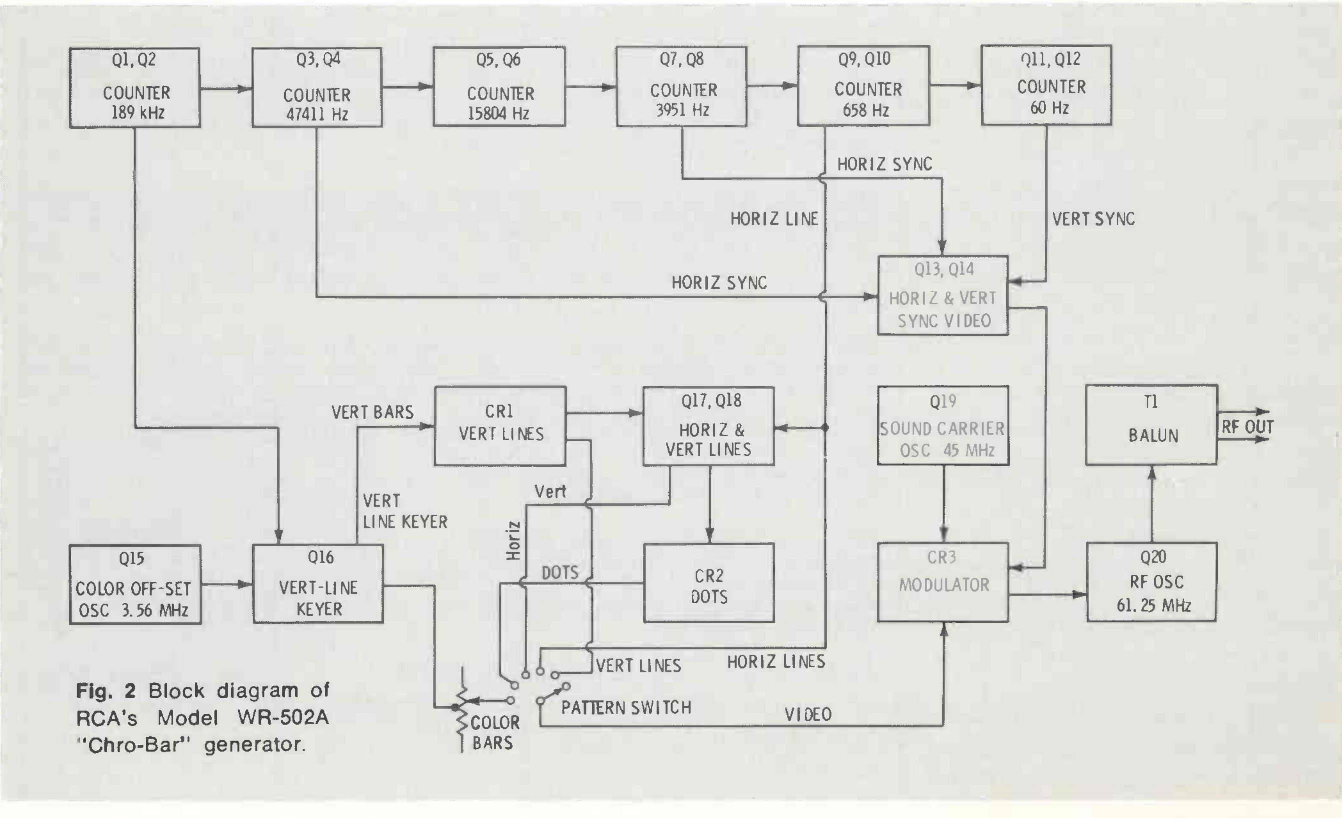


Fig. 2 Block diagram of RCA's Model WR-502A "Chro-Bar" generator.

checking or evaluating the brightness and color registration.

A crystal-controlled 4.5-MHz sound carrier is added to the color-bar pattern in the "Pattern and Sound" mode. This sound carrier produces "beats" in the color-bar pattern that are extremely helpful for adjusting the fine tuning.

The primary purpose of the dot pattern is, of course, convergence adjustments. The pre-shoot and over-shoot areas (small black fringe preceeding and following each dot) are useful in evaluating the overall quality of receiver alignment.

Horizontal lines, vertical lines, and crosshatch patterns are used for adjusting the linearity of both monochrome and color receivers, and can also be used to advantage in checking convergence quality.

The blank raster mode is helpful for both purity and color temperature checks and adjustments.

Crystal-controlled RF output is provided on channel 3; however, this generator also can be operated on channel 4 by replacing the channel 3 crystal with one for channel 4. (Refer to "Maintenance" section of manufacturer's instruction book for this procedure.)

Power for the color generator is provided by a 4.2-volt mercury battery, RCA Part No. VS133. Provision is made for installing a second battery and a battery selector switch to prevent loss of power during service calls. A meter on the front panel of the instrument allows constant monitoring of relative battery strength.

A plus feature of Model WR-502A is the rugged, die-cast aluminum case. The unit is completely portable, requires no warm-up time, weighs only 4 pounds and is 6½" wide by 7" tall by 4" deep.

Generator Operation

The operation of the TV receiver under test should be checked before operating the color generator. Turn the receiver on and observe the quality of reception of a broadcast station signal.

1. Disconnect the antenna lead-in from the receiver antenna terminals. Attach the two output leads from the generator RF output to the receiver antenna terminals.
2. Rotate the receiver channel-selector switch to channel 3 and turn receiver color control to the minimum, or fully counter-clockwise, position.
3. Set the function switch to the "pattern" position, and the "pattern" switch to the "crosshatch" position. Adjust the receiver fine-tuning control so that the vertical and horizontal bars are approximately the same brightness.
4. Turn the pattern selector to "Dots" or other desired output position.

Color-Bar Pattern Mode

1. Set the function switch to the "Pattern" position and the pattern switch to "color". Set the chroma control to "Normal".
2. Adjust the receiver fine tuning as required, and the receiver color control for proper intensity of color bars.
3. If the receiver is operating normally, with the horizontal centering and width adjusted properly, ten color bars will be visible on the receiver CRT. Adjust the receiver "tint," or "hue," control so the colors appear as shown in Fig. 1. Adjust the brightness and contrast controls as required.

Circuit Description

The Model WR-502A color generator is completely solid-state. A total of twenty transistors and three diodes are used in the circuitry; seventeen of the twenty transistors are the same type. A 264 single-line scan system is utilized, rather than the conventional 525 line interlace system. This system has some inherent advantages, namely, smaller dots, single horizontal-line registration and no flicker.

The unit develops the following signals:

Frequency	Function
15,804 Hz	Horizontal Sync.
60 Hz	Vertical Sync.
61.25 MHz	Picture Carrier (Channel 3)
65.7 MHz (61.25 MHz 4.5 MHz)	Sound Carrier
3,563.741 KHz	Color Off-Set Frequency
189.5 KHz	Vertical Lines
659 KHz	Horizontal Lines

The sync and line frequencies are developed by five multivibrator counters and originate from a 189.6-KHz crystal-controlled circuit. Tran-

testequipment

notes on analysis of test instruments, their operation and applications

continued

sistors Q13 and Q14 (see block diagram, Fig. 2) combine the vertical and horizontal sync pulses. Vertical lines are developed by differentiating and clipping the 189.6-KHz signal. Horizontal lines are developed by sampling the 659-KHz output of the Q9-Q10 frequency counter. Both horizontal and vertical line signals are increased in amplitude by the Q17-Q18 amplifier circuit.

A diode and resistor are used to develop the dot pattern. This is accomplished by clipping the level of the combined horizontal and vertical signals in such a manner that only the sum of the two signals appears at their point of intersection.

The output of the 4.5-MHz oscillator is applied to the modulated sound carrier. This sound carrier then produces a "beat" in the pattern that is extremely useful for adjusting the fine tuning of the color receiver.

A crystal-controlled oscillator is used to generate the 3.563741-KHz color subcarrier signal. This signal, combined with a signal from the 189-KHz oscillator is applied to the keyer, which gates the color signal at the 189-KHz rate. This action provides ten separate color bars of a specific phase when compared with the 3.58-MHz standard color subcarrier in the color receiver chassis.

The picture or video carrier (61.25 MHz) is generated by a crystal-controlled oscillator, Q20. The low-impedance output is transformed, or matched, to 300 ohms by the balun enclosed in the RF output cable.

When placed in the "off" position, the red, blue and green gun killer slide switches short the grids of the CRT to ground through two 47K-ohm resistors connected in series (94K ohms). One 47K-ohm resistor is located in the housing of each clip lead, and the other 47 K-ohm resistor is located at each gun killer switch. This configuration substantually reduces the effects of capacitance loading by the switch cables. ▲

SPECIFICATIONS

Frequencies
*Picture Carrier = 61.25 MHZ
*Sound Carrier = 65.75 MHZ

Voltage
Horizontal Sync
Picture Carrier = 10,000 uv, 15,804 Hz

Color Subcarrier
3,563.741 KHz and 20 Hz keyed at 189 KHz

Sound Oscillator
4.5 MHz

Output Impedance
300 ohms

Test Patterns
Color Bars (Variable Color Level)
Dots
Crosshatch
Horizontal Bars
Vertical Bars
Blank Raster

Battery (Power Supply)
4.2 Volts (NEDA 1306M)
(RCA VS133)

CONTROL FUNCTIONS

Pattern—A rotary type switch acts as a mode selector; it selects either color-bar, dot, crosshatch, horizontal bars, or blank raster function.

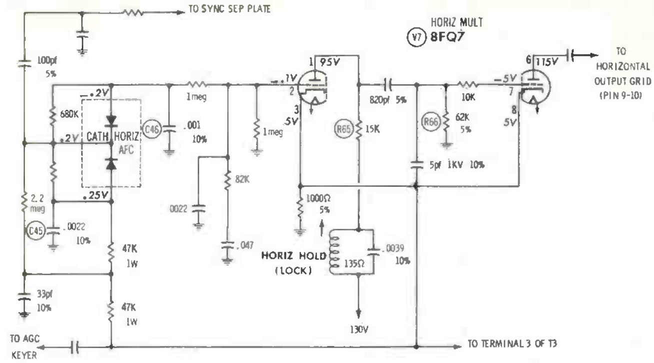
Chroma—Control used to vary the amplitude or strength of the 3.58-MHz color subcarrier.

Function—A rotary function switch; it is used to turn instrument off ("OFF" position), supply power to all circuits except sound carrier ("Pattern" position), supply power to ALL circuits ("Sound and Pattern" position), and check strength of battery ("Battery Test" position).

Battery Meter—Used to indicate battery strength or condition when function switch is in "Battery Test" position.

Gun Killer—The slide-type gun-killer switches are used to "short out" red, blue, or green guns of the CRT. Clip leads are provided and must be connected to the control grids of the CRT.

troubleshooter



Retrace Lines ? ? ? ? ?

I have an RCA chassis KCS130F in which I replaced a defective yoke (RCA part No. 109070). The replacement I used was a DY-32. Horizontal sweep is fine. The picture is linear and clear except for a group of horizontal white lines grouped closely together and extending about one quarter of the way down from the top. I will probably have to replace the vertical blanking circuit. Your help would be appreciated.

AL MILES

Kenosha, WI

I think your problem is one of replacement selection. DY-32 is a direct replacement for a Motorola yoke and although its specifications are close to those of the original it is not quite close enough. The correct replacement is a DY-27A. Connect as indicated in the PHOTOFACT Folder parts list.

Horizontal AFC

I have an Admiral portable TV chassis with no raster, no high voltage and a squeal in the flyback. Adjusting coil L16 changes the pitch of the squeal. I have substituted capacitors C43, C49, and C50. I have replaced horizontal AFC diode X3, the deflection yoke, and the horizontal output transformer. I have connected the control grids of the horizontal output of a properly operating set to the defective receiver's horizontal output grids. This killed the raster on the "operating" receiver. I have also replaced the boost capacitor, but nothing I have done has helped. I do not have a scope, but here are the voltages I measured in the horizontal sections:

V7, 8FQ7		V8, 33GY7	
Pin	Voltage	Pin	Voltage
1	110V	2	130V
2	1V	9-10	-28V
3	3V	11	80V
6	80V		
8	3V		

HARRY WAYT, JR.

Wheeling, WV

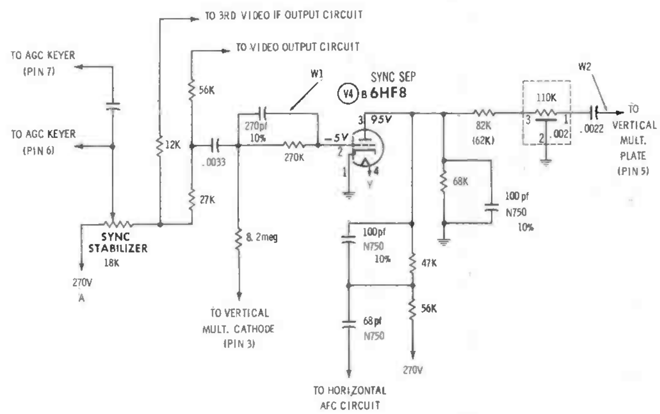
Your problem is not so much servicing procedure as it is lack of equipment. The sophisticated circuitry of modern electronic equipment requires proper test equipment if you hope to effectively service it. The symptom you describe indicates the horizontal oscillator frequency is far too low. This frequency is determined by pulses from the horizontal sync "take off" and comparison pulses from the horizontal output circuit. Servicing this type of trouble is a simple matter of evaluating the shape and magnitude of these pulses by observation and comparing them to the waveforms shown on the schematic. To do this you must have a scope. I would suspect that either capacitor C46 or C65 is defective; however, you can prove this only through waveform analysis.

Sync

I have an RCA chassis KCS140A that exhibits a 2" foldover in the center of the CRT. I can get rid of this foldover by rotating the vertical hold control; however, the picture then runs from left to right and rolls vertically. I have replaced all tubes, and the grid voltage on the oscillator is normal. A few resistors that were out of tolerance were replaced. I also replaced several coils, adjusted the oscillator, etc.

E. A. MACANDO

Des Plaines, IL



The problem is one of defective sync. We have covered this in PF REPORTER on several occasions, an article in September PF REPORTER titled "Sync is Simple . . . Almost" being the most recent. This problem cannot be solved by either wholesale parts replacement or DC voltage readings. A waveform analysis of the sync signal path is a prerequisite. Check waveforms for both shape and amplitude at points indicated on the schematic diagram. When you have determined the point at which the sync is deteriorating, voltmeter and ohmmeter checks should be made to finally isolate the defective component.

Dead Short

My problem is with an old RCA KCS68E chassis. I have started my service training on this chassis and have run into a snag right at the start—a dead short. I know I should junk this chassis but I just hate to *give up. I have checked all the tubes, taken resistance readings, checked transformers, electrolytic capacitors, etc. However, the receiver continues to blow fuses. I can only take readings for an extremely short period. The 200-ohm resistor connected to the horizontal linearity control gets red hot when the set is on for a short period of time.*

AURIE ANTILLA

San Diego, CA

Your inexperience is the major problem. The first step in solving troubles of this nature is to remove all loads from the low-voltage power supply outputs. Next, reconnect the loads, one at a time, carefully checking for signs of excessive current after each load is reconnected. This procedure will isolate the dead short to a specific circuit. I would suspect, in your case (due to overheating of the resistor), the trouble is located in the horizontal output circuit and quite possibly is the horizontal linearity coil.

Insufficient Vertical Sweep

I have a problem with a Silvertone chassis 528.51800. The height is not sufficient to fill the screen. About 1/4 of the screen is black at both top and bottom. Adjustment of height and linearity controls only result in foldover at the bottom. I replaced the vertical multivibrator and vertical output tube (V8). The picture filled the screen momentarily, then returned to the original size. I have replaced capacitors C40, C41, C42, C43, C45 and C3c. Height and linearity controls check normal. All resistors in the vertical multiplier/vertical output circuit check within tolerence. I substituted the vertical output transformer, but this didn't help. With the height and linearity controls adjusted for a linear picture. I observed the following conditions:

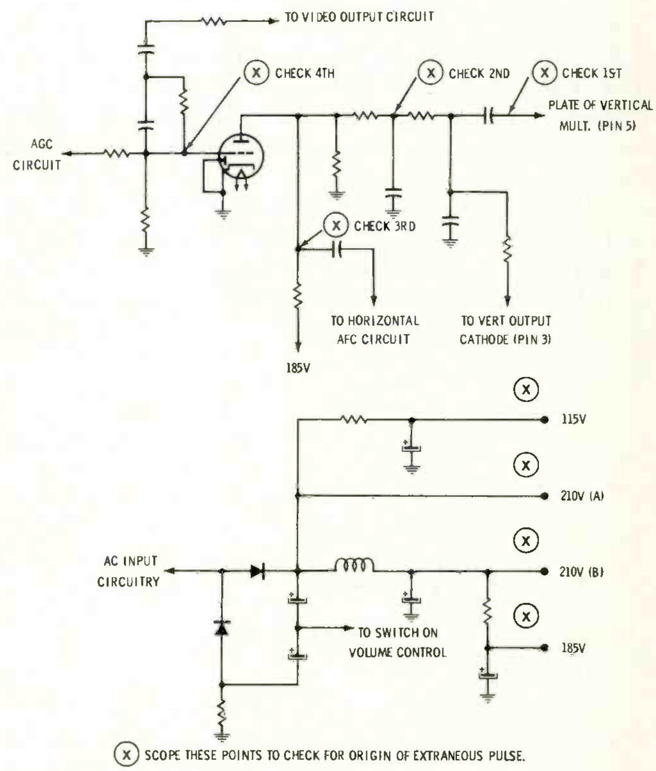
1. The waveform at pin 1 of V8B was not distorted but was reduced in amplitude to 65V p-p compared to the 12V p-p indicated on the schematic.

2. The waveform at the vertical multivibrator grid (pin 4, V8A) was undistorted but was reduced in amplitude from the 60V p-p, indicated on the schematic, to approximately 30V p-p. There also seems to be a spurious pulse riding up the slope of the sync pulse.

3. With pin 1 of the tube grounded, the waveshape at pin 5 has the correct amplitude; however, the negative spike continually moves to the right, while the remainder of the waveform remains stationary.

LEWIS HAMPTON

Ridgetop, TN



Your description of the problem indicates that an extraneous pulse is causing a change in the operation of the vertical stage. Further waveform analysis should uncover the origin of this pulse. It could be originating in either the sync of the low-voltage power supply circuits. I personally would suspect, and this is an educated guess, the power supply as the source of the extraneous pulse. ▲

bookreview

TV Servicing Guidebook, Problems and Solutions: Art Margolis, TAB Books, Blue Ridge Summit, PA, 1968; 176 pages, 5½" x 8⅝", hardbound, $6.95; paperbound, $3.95.

A TV benchman's handbook detailing shop-proven service procedures that will pinpoint circuit troubles in both monochrome and color television receivers.

The author has categorized all TV troubles into 62 common symptoms. The discussion of each symptom begins with a brief but adequate description of the symptom and the operation of the circuit involved. Step-by-step procedures to pinpoint the defect are presented next including selection of the proper test equipment.

Chapter 1 details initial setup procedures for color TV receivers, including grayscale tracking, color screen adjustments, purity, degaussing and convergence.

Chapter 2 is devoted exclusively to color problems—no Y signal, no color; excessive red, green or blue; incorrect colors; pastels; "confetti," "worms," etc.

An entire chapter is devoted to the CRT and its trouble symptoms. To eliminate unnecessary replacement, many repairs are suggested.

Chapter 4 lists seven video troubles, what causes them and tells how to correct them.

Chapter 5 analyzes the 13 basic high-voltage faults, including flyback, yoke, and the oscillator circuits.

Horizontal and vertical deflection circuits are explored for defects in Chapter 6.

Chapter 7 exposes elusive sync and AGC troubles from sync takeoff to integrator and AFC circuits.

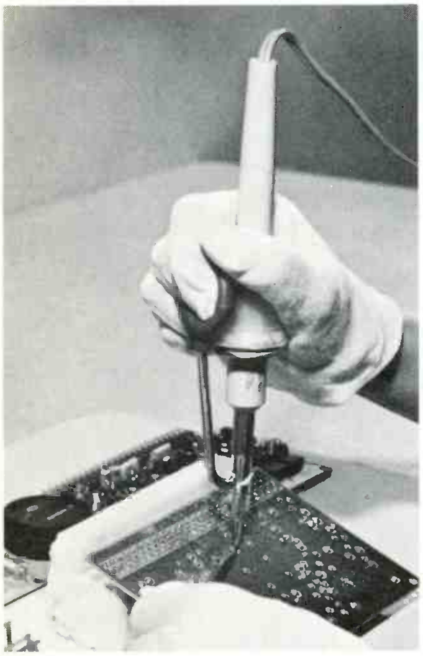
Chapters 8 and 9 encompass troubles peculiar to sound and power supply circuits. ▲

productreport

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

Desoldering/Soldering Tool
(50)

A new patented desoldering/soldering iron, called TIP Solder Snifer, created especially for repair of printed-circuit boards that require replacement of faulty solder joints or components, has been introduced by **Thermal Industrial Products, Inc.**



For desoldering, the unit is held as illustrated in the photo; the rubber bulb is depressed with the index finger. As the solder melts, a sudden release of the bulb draws the melted solder into the reservoir. The old solder is ejected by rapidly compressing the rubber bulb. To replace the solder, use the unit as you would a conventional soldering iron.

The unit is available in three configurations, each designed to fit specific types of soldering irons. Basic price of each, including a C2 tip, is $7.49. A matched set of tips for a variety of applications is available for $9.95. Individual tips are priced at $.80.

Three-Tip Test Probe
(51)

Designed specifically for use with in-circuit transistor testers, VTVM's and VOM's, this new three-tip probe has been developed by B&K Div. of **Dynascan Corporation.** It permits the user to simultaneously test with one hand three printed-circuit terminals or component elements. The

"Dyna-Flex" probe has three spring-loaded needle-point tips which tilt or swivel on ball joints to permit automatic adjustment to any terminal or element spacing from 1/32″ to 5/8″. The three color-coded leads terminate in insulated alligator clips. The price is $12.95.

Liquid Soldering Flux and Solid Bar Solders
(52)

Three new formulas of Ersin Liquid Soldering Flux and a high purity extruded solid bar solder have been introduced by the **Multicore Sales Corp.**

Two of the new fluxes are activated and contain a high grade WW Rosin which has been subjected to a chemical process to increase its fluxing action without impairing the non-corrosive and protective properties of the original rosin.

The fluxes will remove surface oxides and prevent their formation during the soldering operation while acting as a heat transfer between the heat source, the joint members and the solder. A non-tacky, non-corrosive insulating residue is left on the soldering joint.

The other flux is non-activated and has all of the advantages described above and contains a high grade WW Rosin dissolved in a non-chlorinated solvent.

The price of the liquid flux is 2.50 per pint, $3.40 per quart and $7.95 per gallon.

The Ersin Multicore Extruded Bar Solder is supplied in 2 lb. packages (2 bars, 1 lb. each) in shipping cartons of 14 lbs. It is also available in 16″ bars, for industrial use.

Miniature Banana Plug Adapters
(53)

Two new miniature banana plug adapters have been added to the line of electronic test accessories by **Pomona Electronics Co., Inc.**

Model 2943 Adapter converts miniature (1/2″ on centers) double banana plug to a standard (3/4″ on centers). Model 2952 Adapter converts standard double banana plug to a miniature.

The plugs are tough thermoplastic, molded directly to a metal body for maximum strength, insulation and moisture resistance. Springs are one piece heat-treated beryllium copper alloy 170 per QQ-C-533. Plug bodies are nickel plated brass. The price is $5.95.

TVI Filter
(54)

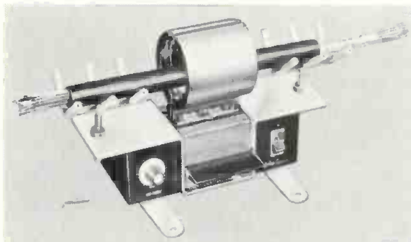
Citizens Band operators can eliminate TV interference caused by CB with a TVI filter now offered by **Gold Line Connector, Inc.**

This unit features a tuning control knob to allow for maximum television interference rejection which is guaranteed 40 dB or better. The CB operator inserts the filter between the antenna and transmitter and sets the selector dial of his television to channel two or channel six. When transmitting he adjusts the control knob on the filter until the TVI has been corrected. The price is $5.95.

Shrinkable Tubing Reduced
(55)

The Big Shrinker, Model LTH 350, introduced by **Hi-Shear Corp.,** quickly reduces heat shrinkable tubing as large as three inches in diameter by encirclement with six rings of intense radiant heat. High or low temperature insulating or encapsulating tubing, and solder sleeves can be applied to wire bundles or cables.

The unit is a table model design manually operated and has a controlled infrared heating device. It does not vibrate or blow air to cause shifting of wires or sleeves.



The circular radiant heating elements are energized with a switch and their heat intensity is regulated by a solid-state device. The semicircular halves of the heat tunnel are closed and locked by depressing a handle. The cylinderical working area inside the heat tunnel is 3″ in diameter by 4″ long. The heat tunnel shield is gold-fired for maximum heat reflectivity. Height-adjustable, V-shaped, plastic-covered guides center and support the work as it passes through the heat tunnel.

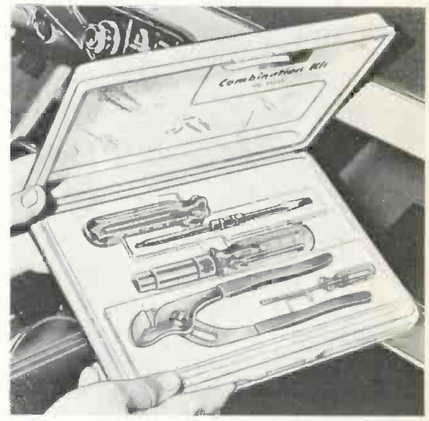
The unit weighs 7½ lbs. and occupies a little more than one square foot of work space. The power output is 1800 watts. It uses 115V AC. 50/60 Hz, 16 amps. A six-foot, three-prong power cord is furnished. The price is $395.00.

Tool Kits
(56)

Three new tool kits, each in a blue, unbreakable plastic box with a self-locking hinged cover, have been introduced by **Vaco Products Company.**

The kits are compact in size, making them easy to carry and to store in a small space. Each kit has a custom-molded tray which provides a place for every tool in the kit.

The combination kit, priced at $9.95 retail, contains a DUH-4 reversible driver with a ¼″ regular blade and a No. 2 Phillips blade; an SA-711 adjustable nut driver for driving all nuts or hex bolts from ¼″ to 7/16″ in size; a pair of No. 9602 Vacgruv adjustable pliers; and a No. A-130-2 pocket clip driver for smaller regular screws.



Kit No. 70002 features nut drivers and contains a set of seven hollow-shaft drivers with super-hard sockets that won't round out from use. Each driver has a Vaco Comfordome handle which is color-coded to indicate the size of the socket. The kit sells for $10.20.

Terminal Kit No. 70003 contains a crimping tool with bolt slicer and an assortment of solderless terminals for on-the-job use. This kit retails at $7.95.

Test Clamps
(57)

Trico Fuse Mfg., Co. introduces Kliplok test clamps that have a shockproof molded or fibre handle for easy gripping and tightening. Heavy duty jaws are of tempered brass construction and give an excellent electrical current carrying characteristic. They have a patented jack screw and internal wedge design. A stranded or solid cable may

be run through the hollow handle and soldered into the internal screw for use as temporary jumpers or for testing purposes. They can also be attached to flat or round objects and their vise grip insures ample and dependable current carrying capacity. The price ranges from $1.65 to $6.10 depending on quantity of order and size needed. ▲

advertisers' index

catalogs literature

ANTENNAS

100. *Vikoa, Inc.*—98-page catalog #1068 lists and pictorially describes complete product lines of wires and cables for building and servicing CATV, MATV, CCTV and ETV.

AUDIO

101. *Jensen Mfg. Div.*—High Fidelity Sound Products Catalog 165-P lists all new Jensen speaker systems plus accessories with color illustrations.

102. *Shure Bros.*—8-page catalog covers the complete Shure cartridge line with complete specifications and performance information, charts and definitions of trackability, and application data and prices.

103. *Stanford Int'l*—Catalog describes Stanford-MB headphones, condenser ribbon and dynamic microphones. Also included is complete technical and use data.

104. *3M Company* — 24-page guide book called "Recording Basics" includes information on construction and manufacture of recording tape, splicing, editing, the use of leader and timing tape, recorder maintenance and care of magnetic recording tape.

COMPONENTS

105. *Cornell-Dubilier* — 6-page Color-Lytic listing includes every electrolytic capacitor manufactured by the company including single, dual, triple and quadruple section lytics.*

106. *Cornell-Dubilier* — 12-page brochure covers the selection of relays with information on trade-offs.*

107. *Dialight*—Catalog L-178C describes two terminal subminiature indicator lights with data, specifications, drawings and ordering information.

108. *Ohmite Mfg. Co.*—Catalog 300 is a quick reference for ordering and an application information guide for components including resistors, rheostats, potentiometers, transformers and capacitors.

109. *Sangamo Electric Co.*—12-page bulletin 2236B describes the Type 500 capacitor with complete performance data and curves.

110. *Sangamo Electric Co.*—12-page Bulletin 2240A contains application, stability, design and performance data for the Type 557 capacitor.

111. *Sylvania*—Pocket dictionary contains definitions of most terms used in integrated circuit field and also contains an appendix of standardization for input and output switching signals.*

MISCELLANEOUS

112. *Vocational Films* — Brochure describes 12-minute, sound, color 16mm film titled "So You Want to be an Electronics Technician" for purchase or rental.

SERVICE AIDS

113. *Molex Products Co.*—6-page catalog describes crimping, ejection and insertion tools, specifications for nylon connectors, connector housings and pin terminals.

114. *Vaco Products Co.*—14" x 18" wall catalog shows styles of solderless terminals and connectors in actual size plus hand operated tools for both insulated and non-insulated styles.

TECHNICAL PUBLICATIONS

115. *Howard W. Sams*—Literature describes popular and informative publications on radio and TV servicing, communication, audio, hi-fi and industrial electronics, including special new 1968 catalog of technical books on every phase of electronics.*

116. *TAB Books*—Illustrated 16-page catalog describes over 100 current and forthcoming books covering various subjects including broadcasting, basic technology, CATV, test instruments and transistors.

TOOLS

117. *Wen Products, Inc.*—16-page catalog #158 includes tool performance characteristics; power tool applications, accessories; power tool and soldering gun kits and suggested retail prices.

*Check "Index to Advertisers" for additional information.

INDEX OF 1968 CONTENT

The following code system is used to indicate department coverage of a subject: CCM, Color Countermeasures; CT, Color TV Service Training; ES, The Electronic Scanner; LE, Letters to the Editor; NTE, Notes On Test Equipment; PR, Product Report; SYM, Symfact; TS, The Troubleshooter; and VSS, Video Speed Servicing.

OHMMETERS

PICTURE TUBES

PROTECTION DEVICES

RADIO

REMOTE UNITS, TV

SERVICE AIDS

SIGNAL GENERATORS

SOLID-STATE COMPONENTS

STEREO

TEST EQUIPMENT (General)

THEORY

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TRAINING

TRANSISTOR TV

INDEX OF TITLES


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