

January, 1969  75 cents



A HOWARD W. SAMS PUBLICATION

Electronic Servicing

Formerly PF Reporter

LA 3M 1806 169
P. J. BREIDEL
BREIDELS RADIO-TV SVC.
1316 S. 13TH ST.
LA CROSSE, WIS. 54601



**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

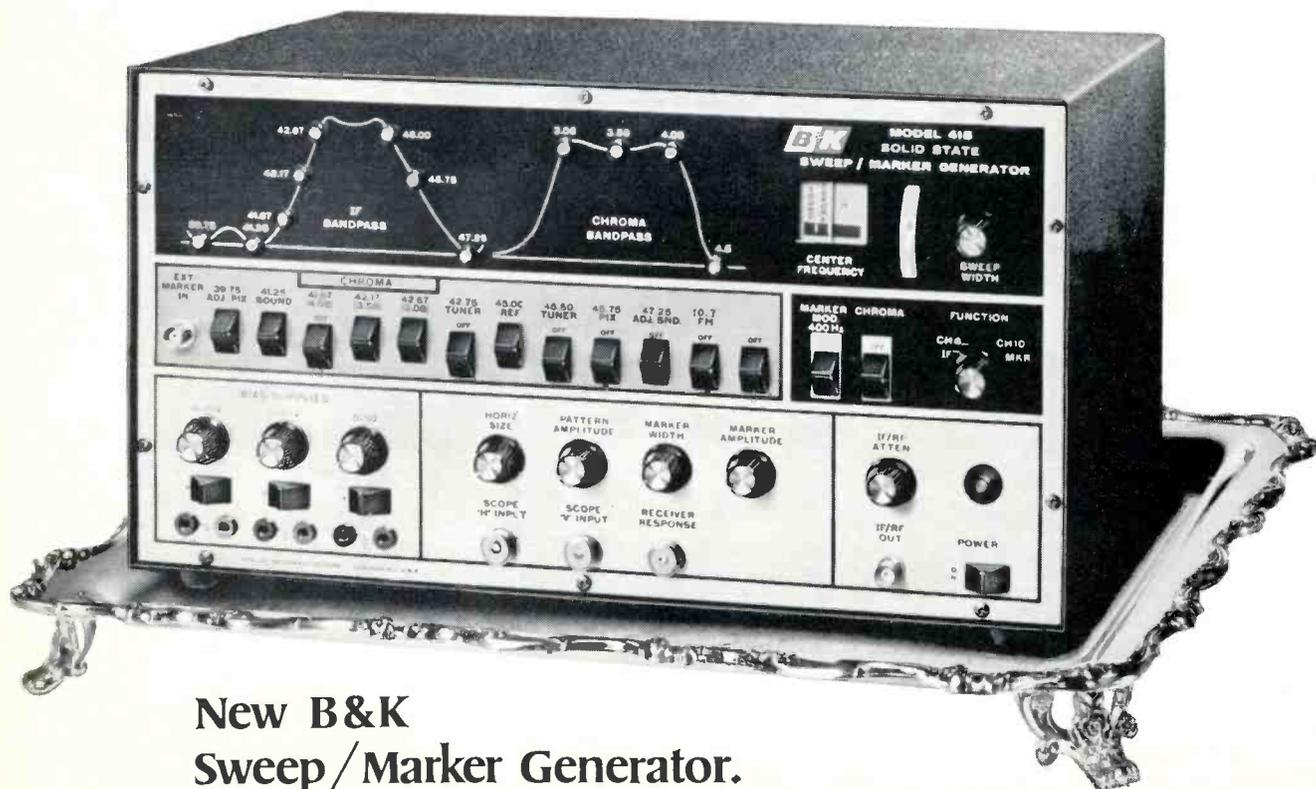
and chroma bandpass curves are visually reproduced and the individual markers are clearly indicated by lights—right on the front panel—for quick, easy reference.

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.



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

Electronic Servicing

in this issue...

- 8 Editorial Profile: What You Can Expect from Electronic Servicing in 1969.**

- 10 Separating Management from the Bench—The First Step to Growth.** First of a series titled "Making a Business Out of Servicing." Business management and shop operation techniques that have helped Sperry TV of Lincoln, Nebraska, become a high-volume shop. **by Wendell Burns and J. W. Phipps.**
Cover photo: Owner John Sperry and engineer discuss operation of Sperry TV.

- 22 Sylvania's Color TV Slide Projection System.** Analysis of this manufacturer's new "Scanner" HO1 chassis. **By Ellsworth Ladyman.**

- 32 Reader Survey.** Your answers to the eighty questions asked in this questionnaire will indicate your preference of subject matter to appear in **Electronic Servicing** and will help us provide you with a more accurate profile of your industry.

- 36 A Look at RCA's Solid-State Color, Part 2.** Detailed description of the sound, AFT, vertical sweep and pincushion correction circuits employed in the CTC40 chassis. **By Ellsworth Ladyman.**

- 44 Practical Stereo FM Servicing, Part 3.** Balance, crosstalk and distortion tests. **By Robert G. Middleton.**

- 65 Index of 1968 Content**

DEPARTMENTS

Tube Substitution Supplement	a	The Troubleshooter	57
The Electronic Scanner	4	Book Review	60
Letters To The Editor	9	Product Report	61
Notes On Test Equipment	54	Advertisers' Index	63
		Catalog and Literature	64

Second-Class Postage Paid at Indianapolis, Ind. Published monthly by INTERTEC PUBLISHING CORP., 1014 Wyandotte St., Kansas City, Mo. 64105.

Copyright, 1969, Howard W. Sams Co., Inc. All Rights Reserved. Material may not be reproduced or photocopied in any form without written permission of publisher.

EDITORIAL

GEO. H. SEFEROVICH, Director
J. W. PHIPPS, Managing Editor
ELLSWORTH LADYMAN, Associate Editor
B. J. MILLER, Editorial Assistant
DUDLEY ROSE, Art Director
LEILA JOHNSON, Assistant Artist

TECHNICAL CONSULTANT

JOE A. GROVES

EDITORIAL ADVISORY BOARD

LES NELSON, Chairman
Howard W. Sams & Co., Indianapolis

CIRCULATION

R. VINCENT WARD, Director
EVELYN RODGERS, Manager

ADVERTISING SALES

Kansas City, Missouri 64105
Tele: 913/888-4664
E. P. LANGAN, Director
R. JACK HANCOCK, Manager
S. F. WILSON, Production
LEE MILLER, Promotion

REGIONAL ADVERTISING SALES OFFICES

Indianapolis, Indiana 46206
ROY HENRY
Howard W. Sams & Co., Inc.
4300 W. 62nd St.
Tele: 317/291-3100

New York, New York 10019
ALFRED A. MENEGUS
3 W. 57th St.
Tele: 212/688-6350

Mission, Kansas 66208
JAKE STOCKWELL
C. H. Stockwell Co.
4916 W. 64th St.
Tele: 913/722-4417

Los Angeles, California
THE MAURICE A. KIMBALL CO., INC.
2008 Carson St., Suites 203-204
Torrance, California 90501

San Francisco, California 94104
THE MAURICE A. KIMBALL CO., INC.
580 Market Street, Room 400
Tele: 415/392-3365

London W. C. 2, England
JOHN ASHCRAFT & CO.
12 Bear Street
Leicester Square
Tele: 930-0525

Amsterdam C. Holland
JOHN ASHCRAFT & CO.
W.J.M. Sanders, Mgr.
for Benelux & Germany
Herengracht 365
Tele: 020-240908

Paris 5, France
JOHN ASHCRAFT & CO.
9 Rue Lagrange
Tele: 033-2087

Tokyo, Japan
INTERNATIONAL MEDIA
REPRESENTATIVES LTD.
2-4, 6-chome, Akasaka, Minato-ku
Tele: 582-8741



ELECTRONIC SERVICING (with which is combined PF Reporter) is published monthly by Intertec Publishing Corp., 1014 Wyandotte Street, Kansas City, Missouri 64105.

Subscription Prices: 1 year—\$5.00, 2 years—\$8.00, 3 years—\$10.00, in the U. S. A., its possessions and Canada.

All other foreign countries: 1 year—\$6.00, 2 years—\$10.00, 3 years—\$13.00. Single copy 75¢; back copies \$1.



Robert E. Hertel, Publisher
Intertec Publishing Corp.
Subsidiary of Howard W. Sams & Co., Inc.



ARC ENEMY

**SPRAGUE TYPE 302C
SPARK GAPS** keep
transient voltage surges
(caused by momentary
arcing or shorting) from
damaging TV picture
tubes. They're in stock
at your Sprague
distributor now.

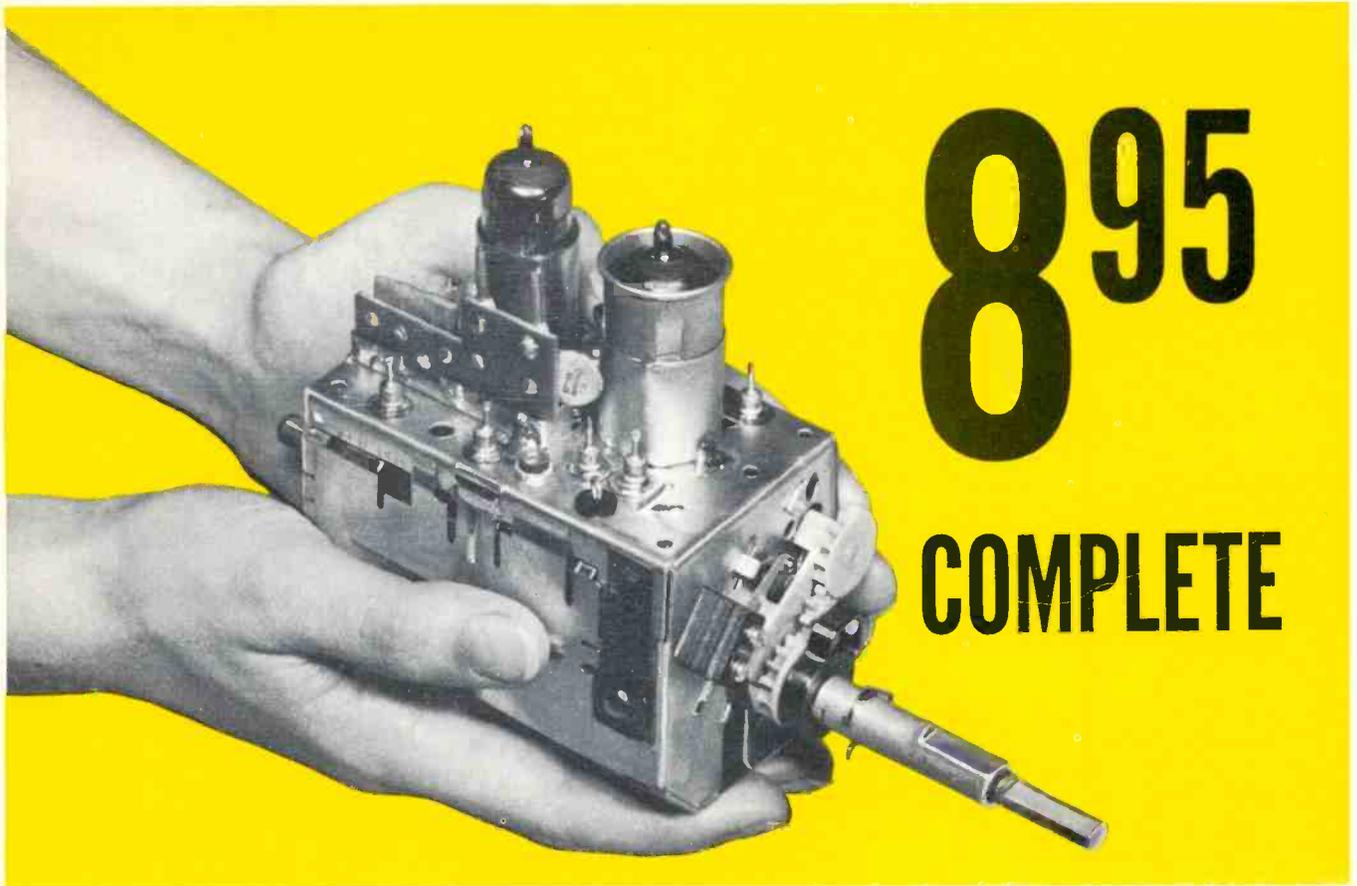
P.S. Don't forget to ask 'em,

"What else needs fixing?"

Circle 3 on literature card



'Sprague' and '®' are registered trademarks of the Sprague Electric Co.



895 COMPLETE

Castle, the pioneer of television tuner overhauling, offers the following services to solve ALL your television tuner problems.

● **OVERHAUL SERVICE** — All makes and models.

- VHF or UHF tuner \$9.95
- UHF-VHF combination (one piece chassis) \$9.95
- TRANSISTOR tuner \$9.95
- COLOR tuner \$9.95
(Guaranteed color alignment . . . no additional charge)

Overhaul includes parts, except tubes and transistors.

Simply send us the defective tuner complete; include tubes, shield cover and any damaged parts with model number and complaint. Your tuner will be expertly overhauled and returned promptly, performance restored, aligned to original standards and warranted for 90 days.

UV combination tuner must be single chassis type; dismantle tandem UHF and VHF tuners and send in the defective unit only.

And remember—for over a decade Castle has been the leader in this specialized field . . . your assurance of the best in TV tuner overhauling.

● **CUSTOM REPLACEMENTS**

Exact replacements are available for tuners that our inspection reveals are unfit for overhaul. As low as \$12.95 exchange. (Replacements are new or rebuilt.)

● **UNIVERSAL REPLACEMENTS**

Prefer to do it yourself?

Castle universal replacement tuners are available with the following specifications.

STOCK No.	HEATERS	SHAFT		I.F. OUTPUT		PRICE
		Min.*	Max.*	Snd.	Pic.	
CR6P	Parallel 6.3v	1¾"	3"	41.25	45.75	8.95
CR7S	Series 600mA	1¾"	3"	41.25	45.75	9.50
CR9S	Series 450mA	1¾"	3"	41.25	45.75	9.50
CR6XL	Parallel 6.3v	2½"	12"	41.25	45.75	10.45
CR7XL	Series 600mA	2½"	12"	41.25	45.75	11.00
CR9XL	Series 450mA	2½"	12"	41.25	45.75	11.00

*Selector shaft length measured from tuner front apron to extreme tip of shaft.

These Castle replacement tuners are all equipped with memory fine tuning, UHF position with plug input for UHF tuner, rear shaft extension and switch for remote control motor drive . . . they come complete with hardware and component kit to adapt for use in thousands of popular TV receivers.

Order universal replacements out of Main Plant (Chicago) only.



CASTLE TV TUNER SERVICE, INC.

MAIN PLANT: 5701 N. Western Ave., Chicago, Illinois 60645
EAST: 41-90 Vernon Blvd., Long Island City, N.Y. 11101

Circle 5 on literature card

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.

Make your MOVE to "GAME"



**YOUR ONE SOURCE FOR A COMPLETE*
LINE OF RECORD CHANGER PARTS**

The 6 cartridges shown here are in the GAME JK-8 Cartridge Kit. GAME has the only complete line of Japanese cartridges.

64 DIFFERENT MODELS

<p>9000C</p>  <p>G. E. Show N Tell</p>	<p>9001C</p>  <p>Magnavox and Singer</p>	<p>9002C</p>  <p>Channel Master Magnavox Nicol, Singer</p>
<p>9005C</p>  <p>Channel Master Delmonico, G. E., Mastercraft</p>	<p>9008C</p>  <p>Arvin, G. E., RCA, Magnavox, Philco, Montgomery Ward</p>	<p>9019C</p>  <p>Decca, National, Panasonic, Viscount</p>

***TRY US... WE DO MEAN COMPLETE
CATALOGS AVAILABLE**



fife ELECTRONIC PRODUCTS
and
GAME INDUSTRIES INC.
AVAILABLE FROM
YOUR LOCAL DISTRIBUTOR.



Circle 6 on literature card

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				
	Plan I	Plan II	Plan III	Plan IV
Life Insurance		Owners \$5,000		All other EEs \$3,000
Accidental Death & Dismemberment		\$5,000		\$3,000
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.

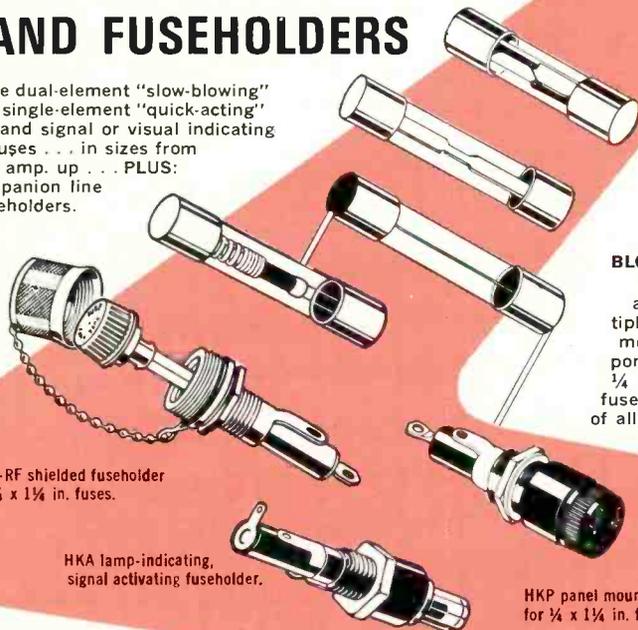
The bid specification sheet was made available to five insurance companies that indicated a desire to bid. The bid guidelines stipulated that all interested bidders must attend the Albany board meeting with the power to change their bids in the event the NEA board deemed it necessary to modify the coverages 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. ▲

The Single Source For Reliable Protection For Every Type Of Electronic And Electrical Circuit And Device

BUSS QUALITY

SMALL DIMENSION FUSES AND FUSEHOLDERS

Include dual-element "slow-blowing" fuses, single-element "quick-acting" fuses and signal or visual indicating type fuses . . . in sizes from 1/500 amp. up . . . PLUS: a companion line of fuseholders.



HMR-RF shielded fuseholder for 1/4 x 1 1/4 in. fuses.

HKA lamp-indicating, signal activating fuseholder.

HKP panel mounted fuseholder for 1/4 x 1 1/4 in. fuses.

THE COMPLETE LINE OF SIGNAL-INDICATING ALARM-ACTIVATING FUSES

For use on computers, microwave units, communication equipment, all electronic circuitry.



BUSS GLD-1/4 x 1 1/4 in. Visual-Indicating, Alarm-Activating.

BUSS GBA-1/4 x 1 1/4 in. Visual-Indicating.



BUSS Grasshopper Fuse, Visual-Indicating, Alarm-Activating.



BUSS MIN-13/32 x 1 1/2 in. Visual-Indicating.

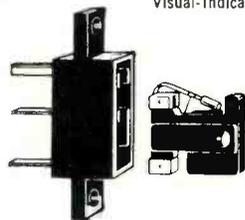
BUSS MIC-13/32 x 1 1/2 in. Visual-Indicating, Alarm-Activating.



FNA FUSETRON Fuse 13/32 x 1 1/2 in. slow-blowing, Visual-Indicating, Alarm-Activating. (Also useful for protection of small motors, solenoids, transformers in machine tool industry.)

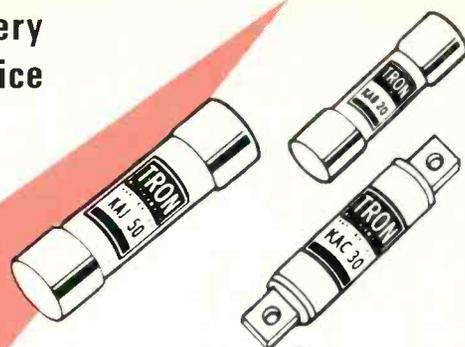


BUSS ACH Aircraft Limiter, Visual-Indicating.



BUSS GMT and HLT holder, Visual-Indicating, Alarm-Activating.

FOR FUSES AND FUSEHOLDERS OF UNQUESTIONED HIGH QUALITY FOR EVERY PROTECTION NEED INSIST ON . . .



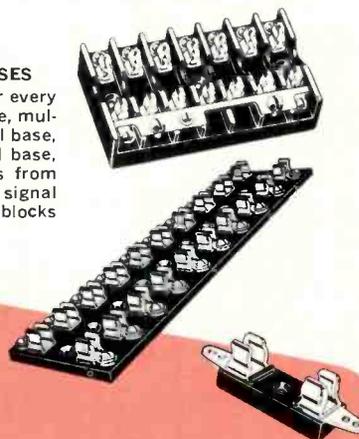
TRON Rectifier Fuses

For the Safe Protection of Solid State Devices

Provide extremely fast opening on overload and fault currents, with a high degree of restriction of let-thru current. Many types and sizes available. Ampere ratings from 1/2 to 1000 in voltages up to 1500.

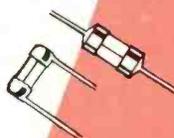
BLOCKS FOR BUSS FUSES

All types available for every application. Single pole, multiple pole, small base, full base, molded base, laminated base, porcelain base for fuses from 1/4 x 5/8 inches up. Also signal fuse blocks and special blocks of all types.

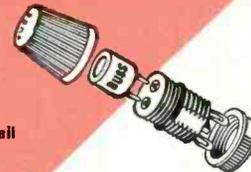


SUB-MINIATURE FUSES

Ideal for space tight applications, light weight, vibration and shock resistant. For use as part of miniaturized integrated circuit, large multi-circuit electronic systems, computers, printed circuit boards, all electronic circuitry.



TRON Sub-Miniature Pigtail Fuses - Body size only .145 x .300 inches. Glass tube construction permits visual inspection of element. Hermetically sealed. Twenty-three ampere sizes from 1/100 thru 15.



BUSS Sub-Miniature GMW Fuse and HWA Fuseholder. Fuse size only .270 x .250 inches. Fuse has window for visual inspection of element. Fuse may be used with or without holder. 1/200 to 5 amp. Fuses and holders meet Military Specifications.

FOR MORE INFORMATION ON THE COMPLETE BUSS LINE, WRITE FOR BUSS FORM SFB

BUSSMANN MFG. DIVISION, McGraw-Edison Co., St. Louis, Missouri 63107

SUPPLIED THE ECONOMICAL WAY . . . THRU DISTRIBUTORS

BUSS QUALITY

FUSES

Circle 7 on literature card

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

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.
Olyphant, PA 18447

I need a schematic or wiring diagram indicating the battery hook-up 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 separately need a service 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 ▲

FAST

Complete Service On All Makes OF TV TUNERS

Maximum Time In Shop 24 Hrs.

Price Change Effective August 1, 1968

(WE SHIP C.O.D.)

\$9.95

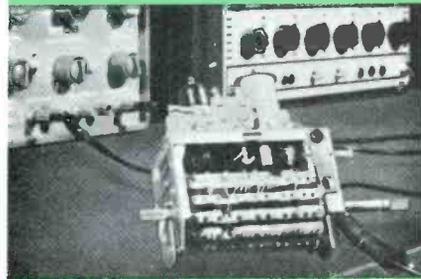


Black &
White
or Color

VHF or
UHF

UV Combo's \$16.50

Price includes all labor and parts except Tubes, Diodes & Transistors. If combo tuner needs only one unit repaired, disassemble and ship only defective unit. Otherwise there will be a charge for a combo tuner. Ship tuners to us complete with Tubes, Tube Shields, Tuner Cover and all parts (including) any broken parts. State chassis, model number and complaint.



All tuners are serviced by **FACTORY TRAINED TECHNICIANS** with years of experience in this specialized field. All tuners are **ALIGNED TO MANUFACTURERS SPECIFICATION** on crystal controlled equipment and air checked on monitor before shipping to assure that tuner is operating properly.

GEM CITY TUNER REPAIR SERVICE

Box 6C Dabel Station
2631 Mardon Drive
Dayton, Ohio 45420

Circle 8 on literature card

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.

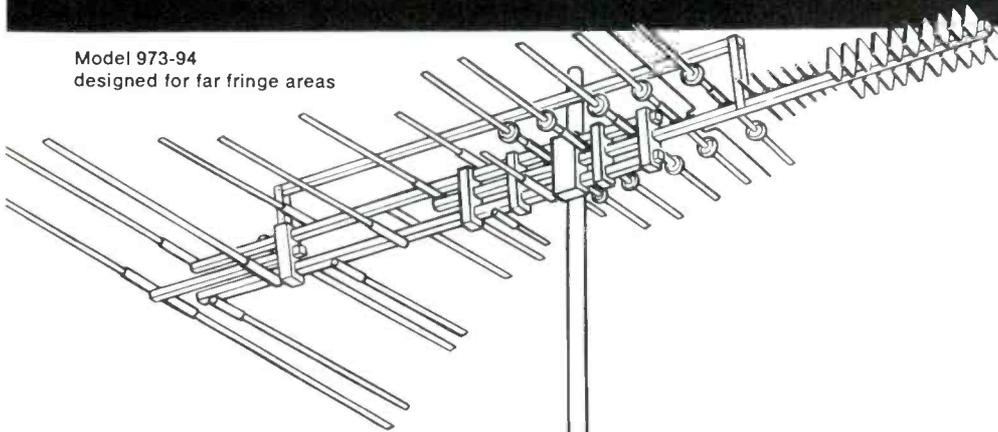
While-you-wait service is offered. The customer is told within 10 or 15 minutes how long a job will take.

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.

The best TV deserves the best antenna!

Install a Zenith Quality-Engineered Antenna!

Model 973-94
designed for far fringe areas



Exciting Surprises
for You—
and Your Family!
Fun for all!
Get the details
at your Zenith
Distributor's
Parts Department.

These features help a Zenith outdoor antenna provide the superior reception that makes for satisfied customers:

- Capacitor coupled cap-electronic VHF dipoles.
- Tapered UHF grid driver.
- Staggered square UHF directors.
- Low-impedance, triple boom construction.

You can choose from twelve all-new Zenith VHF/UHF/FM or VHF/FM antennas. All are gold color alodized aluminum for better conductivity, greater corrosion resistance and longer service.

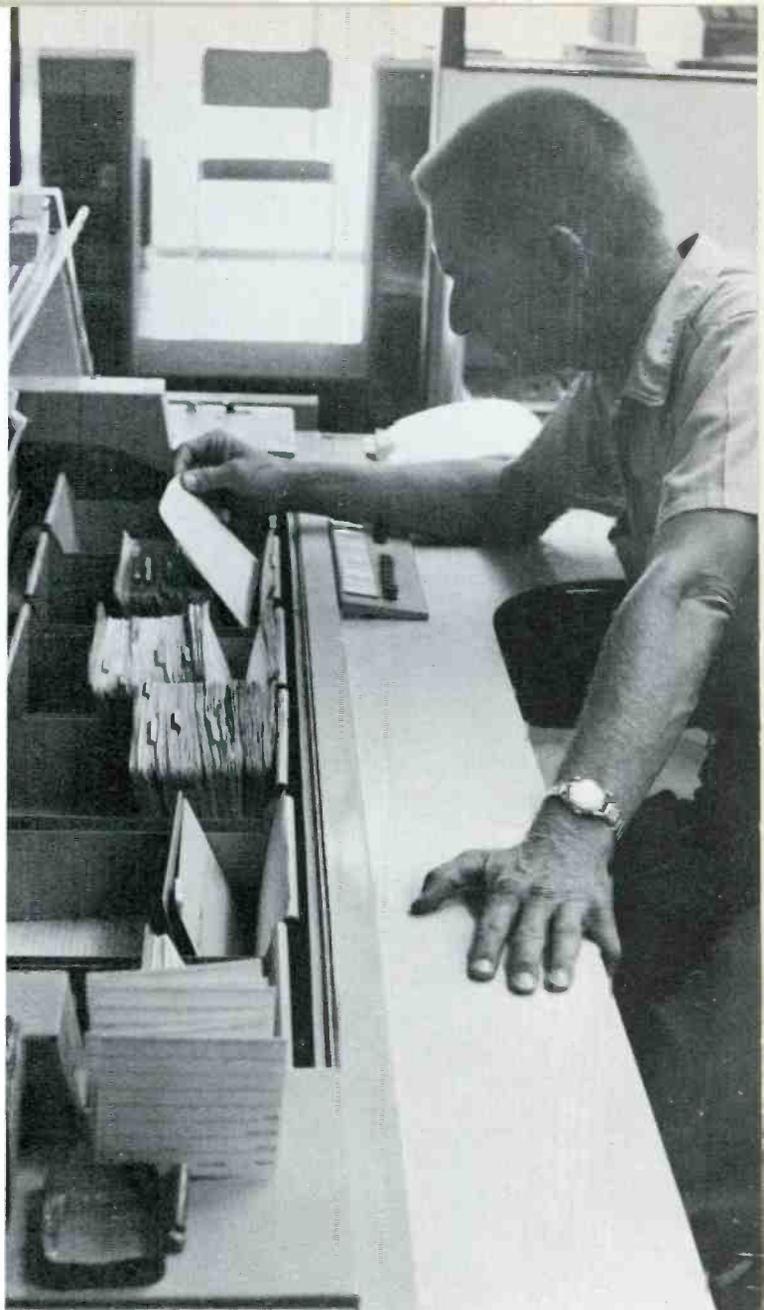
Ask your Zenith distributor for a *free* technical manual. He has charted the reception characteristics of your area, so he can recommend the best antenna for each installation.

WHY NOT SELL THE BEST

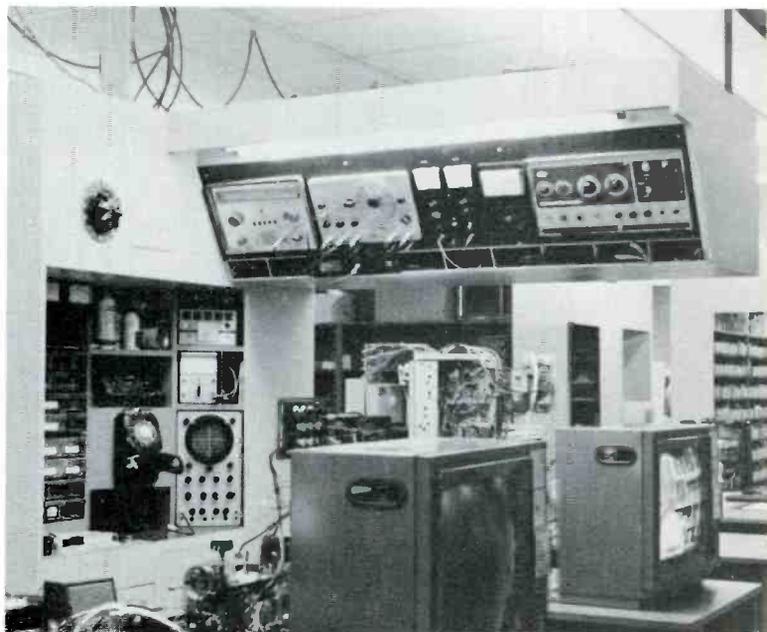
ZENITH
®
*The quality goes in before
the name goes on*

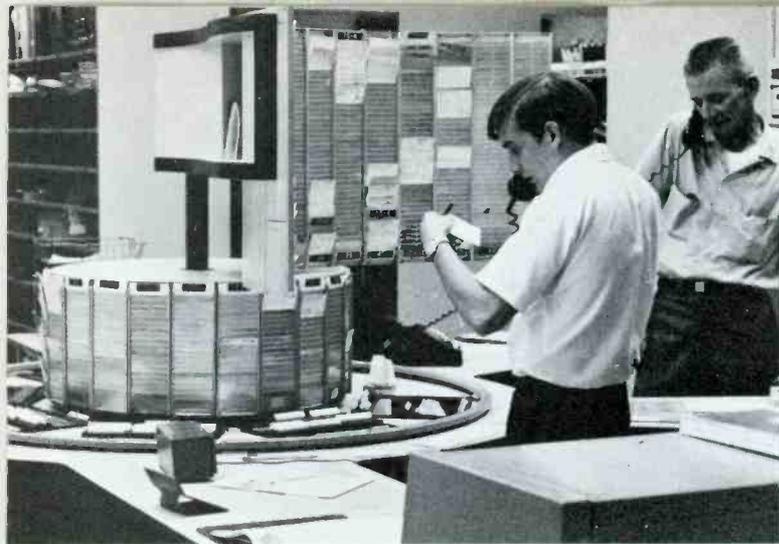
Job control and specialization

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.





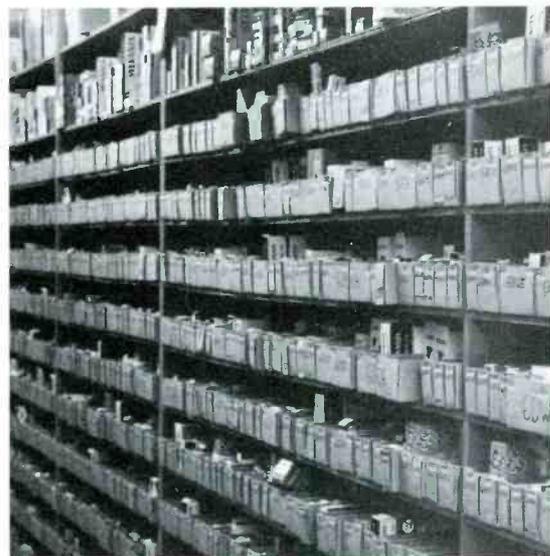
This job control center and communications hub handles all incoming calls (telephone, 2-way radio, walk-in trade), directs all traffic, dispatches service trucks, and provides easy contact between outside men, bench men, and supervisors. Productivity was increased 15 percent by using 2-way radio, but 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.

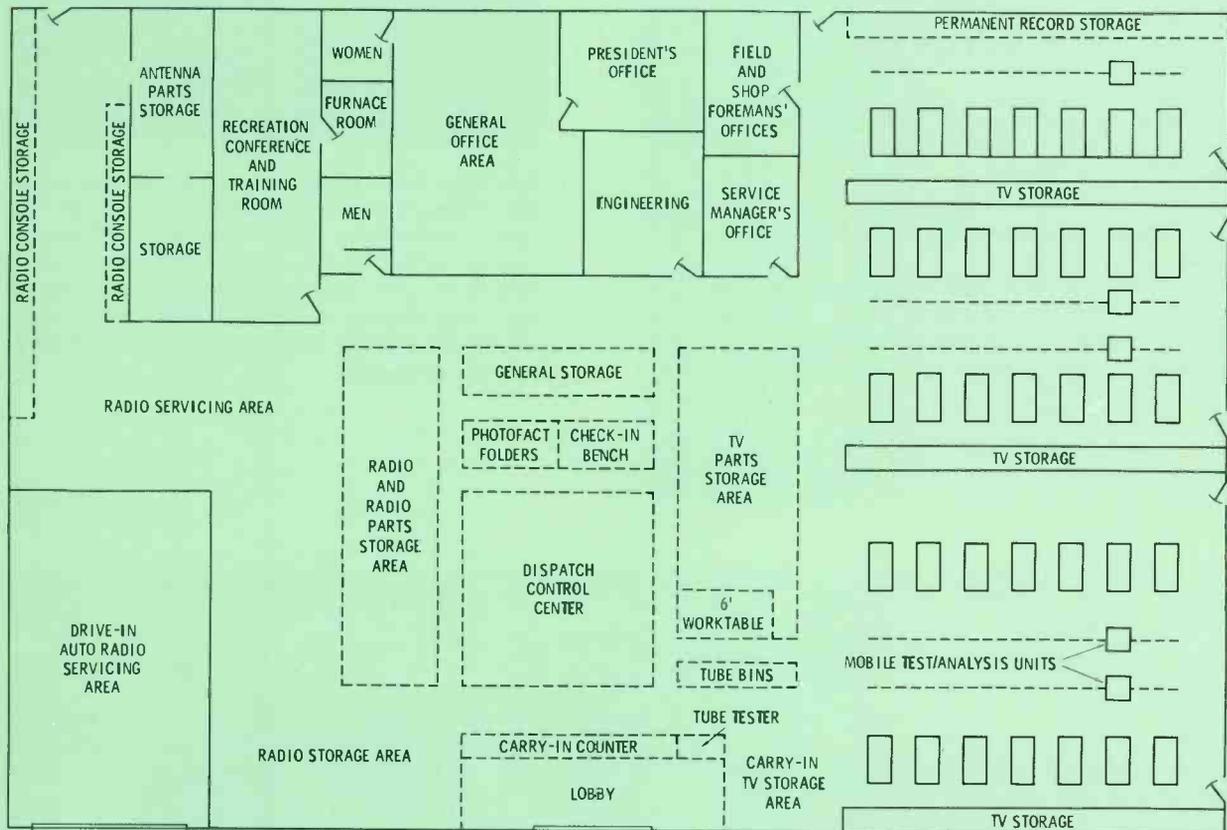


Job control and specialization

(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.



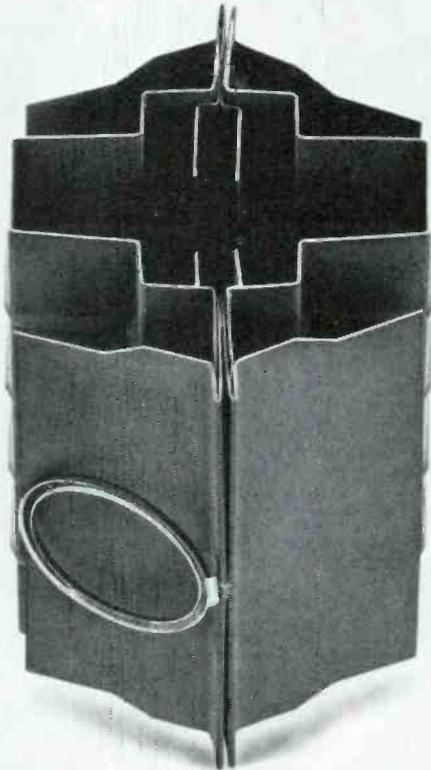
Simplified floor plan for Sperry TV. The concrete block building is a "free span" design having no internal supports or columns. This permits maximum use of available floor space and makes it possible to rearrange the layout without expensive and time-consuming removal and reconstruction of permanent 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,

Circle 10 on literature card

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.



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.

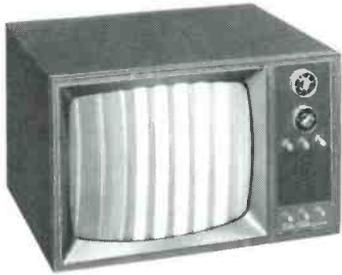
"In two years he is a real good technician,"

More . . .

You're making money in electronics now.

RCA offers 4 ways to make more.

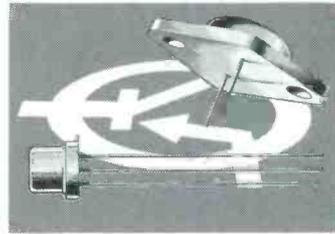
Study at home... set your own pace.
RCA Institutes has an easy approach
to bring you bigger earnings.



COLOR TV During this course you'll perform over 50 experiments—and receive all parts and instructions to build your own color TV.

The cost of the Color TV Kit is included in the tuition—in both the beginner's program and the advanced course in color TV servicing.

Course is based on the latest receiver circuitry and equipment.



TRANSISTORS Transistor circuitry is what the TV repairman must cope with in most receivers today. This course gives you the necessary background.

You'll discover an easy way to an effective understanding of semiconductor technology, including characteristics of tunnel diodes, rectifiers and other solid state devices. Transistorized TV Receiver Kits also available.

FCC LICENSE TRAINING Get your license—or your money back! We're *that* sure you'll succeed with RCA Institutes Home Study Training. Course is all new—both in content and in the up-to-date method of study.

Choose the course for the FCC License you want: third, second or first phone. If you need basic training first, apply for the complete License Training Program.

CATV TRAINING Technicians are in short supply in CATV (Community Antenna Television Systems).

That's because CATV is expanding, as people seek better reception and more than local stations.

You'll receive two comprehensive lessons, covering the practical phases of CATV systems in either the Television Servicing or Communications courses.

WHEN YOU STUDY THROUGH RCA INSTITUTES HOME TRAINING, YOU CAN PAY FOR LESSONS AS YOU ORDER THEM, OR TAKE ADVANTAGE OF EASY MONTHLY PAYMENT PLAN. LICENSED BY NEW YORK STATE EDUCATION DEPARTMENT. APPROVED FOR VETERANS. ACCREDITED MEMBER NATIONAL HOME STUDY COUNCIL.

MAIL THE COUPON NOW FOR COMPLETE INFORMATION

RCA

RCA INSTITUTES, Inc., Dept. PF-19
320 West 31st Street, N.Y., N.Y. 10001

Please rush me FREE illustrated catalog. I understand that I am under no obligation, and that no salesman will call.

Name _____ Age _____
(please print)

Address _____

City _____

State _____ ZIP _____

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 with 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 allotted 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 benchmarked 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
AM Radio 3.50	of \$10 per hour
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

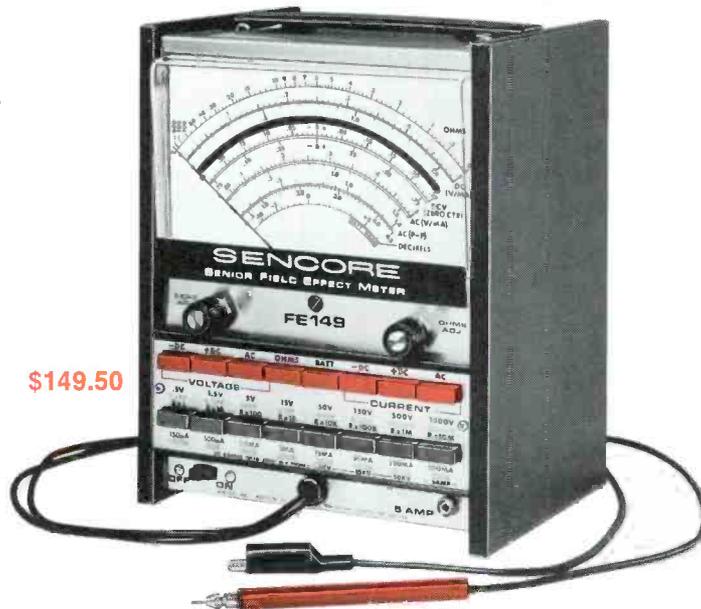
A NEW STANDARD OF THE INDUSTRY...

- 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

The only true Senior FET meter available today with outstanding accuracy and unbelievable ease of operation.

- **Unmatched Accuracy.** 1.5% on DC, 3% on AC, plus large 7-in. meter and mirrored scale, assure the most accurate tests possible.
- **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 \pm 3DB.
- **Eight resistance ranges** to R x 10 megohms with 6 OHMS center scale.
- **Nine DC and nine AC current ranges** 150ma to 5 amps.
- **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.



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

FE14 and FE16 popular 4 1/2 inch FET Meters

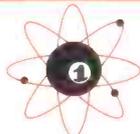
- **Hi Accuracy.** For unsurpassed measurements. Mirrored scales prevent parallax errors.
- **Minimum circuit loading.** 15 megohm input resistance on DC; 10 megohm on AC.
- **Zero center scale** \pm 0.5 v. readings for transistor bias measurement.
- **Full meter & circuit protection** against possible 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 \pm 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.



FE14 — STANDARD FET METER
ACCURACY DC \pm 2.5%
 AC \pm 4.5%
 ● 4½-inch meter, vinyl-clad steel case.



FE16 HI ACCURACY FET METER
ACCURACY DC \pm 1.5%
 AC \pm 3%
 ● 4½-inch high-styled meter, high-styled knobs, and special meter-tilting metal handle. Vinyl-clad steel case.



See your Sencore distributor today or write factory for complete line catalog.

SENCORE

STANDARD OF THE ELECTRONIC INDUSTRY

426 SOUTH WESTGATE DRIVE,
 ADDISON, ILLINOIS 60101

Circle 11 on literature card

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 embarrassing 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.

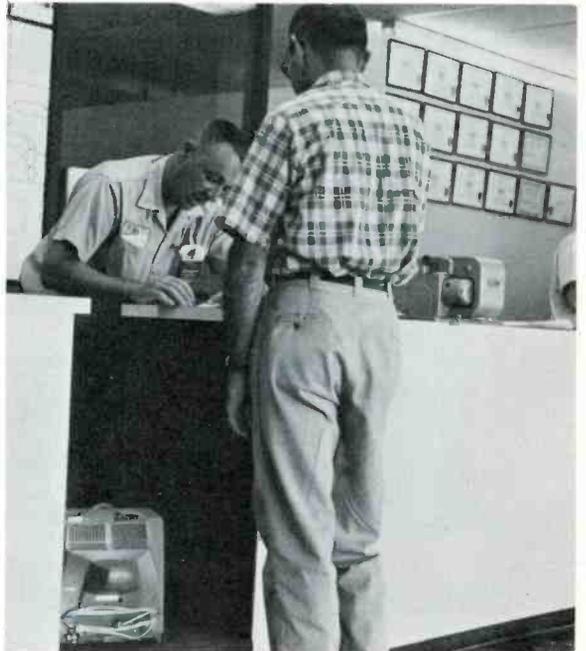
"However, this doesn't handle all cases. If not, we mark the part up 100 percent. We have to consider COD, etc.," Sperry explained. □

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.)



OVERHAUL

\$9.75

GUARANTEED for 1 Year

OVERHAUL \$9.75 • REPLACEMENT TUNERS...\$10.45

Nine-seventy-five buys you a complete tuner overhaul—including parts (except tubes or transistors)—and *absolutely no hidden charges*. All makes, color or black and white. UV combos only \$15.

Guaranteed means a full 12-month warranty against defective workmanship and parts failure due to normal usage. That's 9 months to a year better than others. And it's backed up by the only tuner repair service authorized and supervised by the world's largest tuner manufacturer—Sarkes Tarzian, Inc.

Four conveniently located service centers assure speedy in-and-out service. All tuners thoroughly cleaned, inside and out... needed repairs made... all channels aligned to factory specs, then rushed back to you. They look—and perform—like new.

SEND ORDERS FOR UNIVERSAL AND CUSTOMIZED REPLACEMENT TUNERS TO OUR OFFICE IN INDIANAPOLIS.

Prefer a universal replacement? Sarkes Tarzian will give you a universal replacement for only \$10.45. This price is the same for all models. The tuner is a *new* tuner designed and built specifically by Sarkes Tarzian for this purpose. It has memory fine tuning—UHF plug-in for 82 channel sets—universal mounting—hi-gain—lo-noise.

ORDER TUNERS BY PART NUMBER, AS FOLLOWS:

Part #	Intermediate Frequency	AF Amp Tube	Osc. Mixer Tube	Heater
MFT-1	41.25 mc Sound 45.75 mc Video	6GK5	6LJ8	Parallel 6.3V
MFT-2	41.25 mc Sound 45.75 mc Video	3GK5	5LJ8	Series 450 MA
MFT-3	41.25 mc Sound 45.75 mc Video	2GK5	5CG8	Series 600 MA

Prefer a customized replacement tuner? The price will be \$18.25. Send us the original tuner for comparison purposes, also TV make, chassis and model numbers.



TUNER SERVICE CORPORATION FACTORY-SUPERVISED TUNER SERVICE

MIDWEST..... 817 N. PENNSYLVANIA ST., Indianapolis, Indiana TEL: 317-632-3493
(Home Office)
EAST..... 547-49 TONNELE AVE., Jersey City, New Jersey TEL: 201-792-3730
SOUTH-EAST..... 938 GORDON ST., S. W., Atlanta, Georgia TEL: 404-758-2232
WEST..... SARKES TARZIAN, Inc. TUNER SERVICE DIVISION
 10654 MAGNOLIA BLVD., North Hollywood, California TEL: 213-769-2720

WATCH FOR NEW CENTERS UNDER DEVELOPMENT

Circle 12 on literature card

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.

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

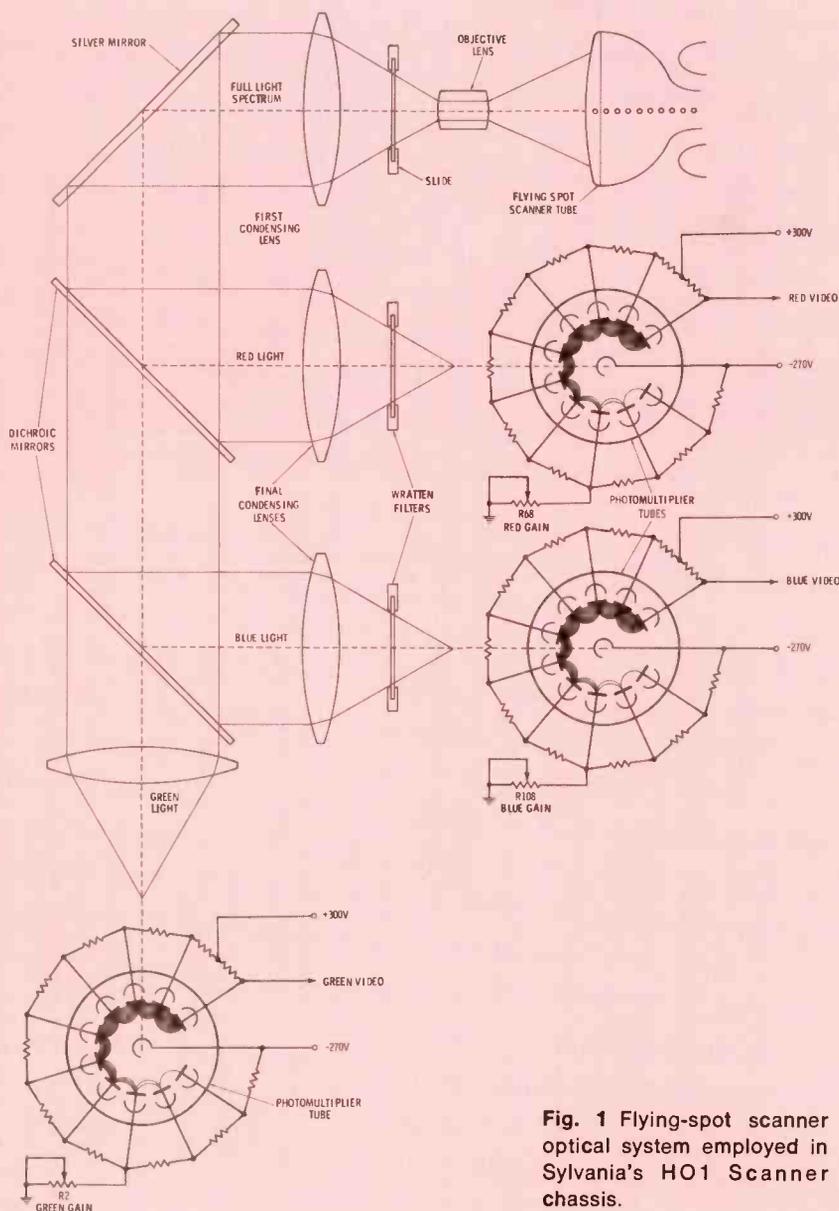


Fig. 1 Flying-spot scanner optical system employed in Sylvania's HO1 Scanner chassis.

projection system

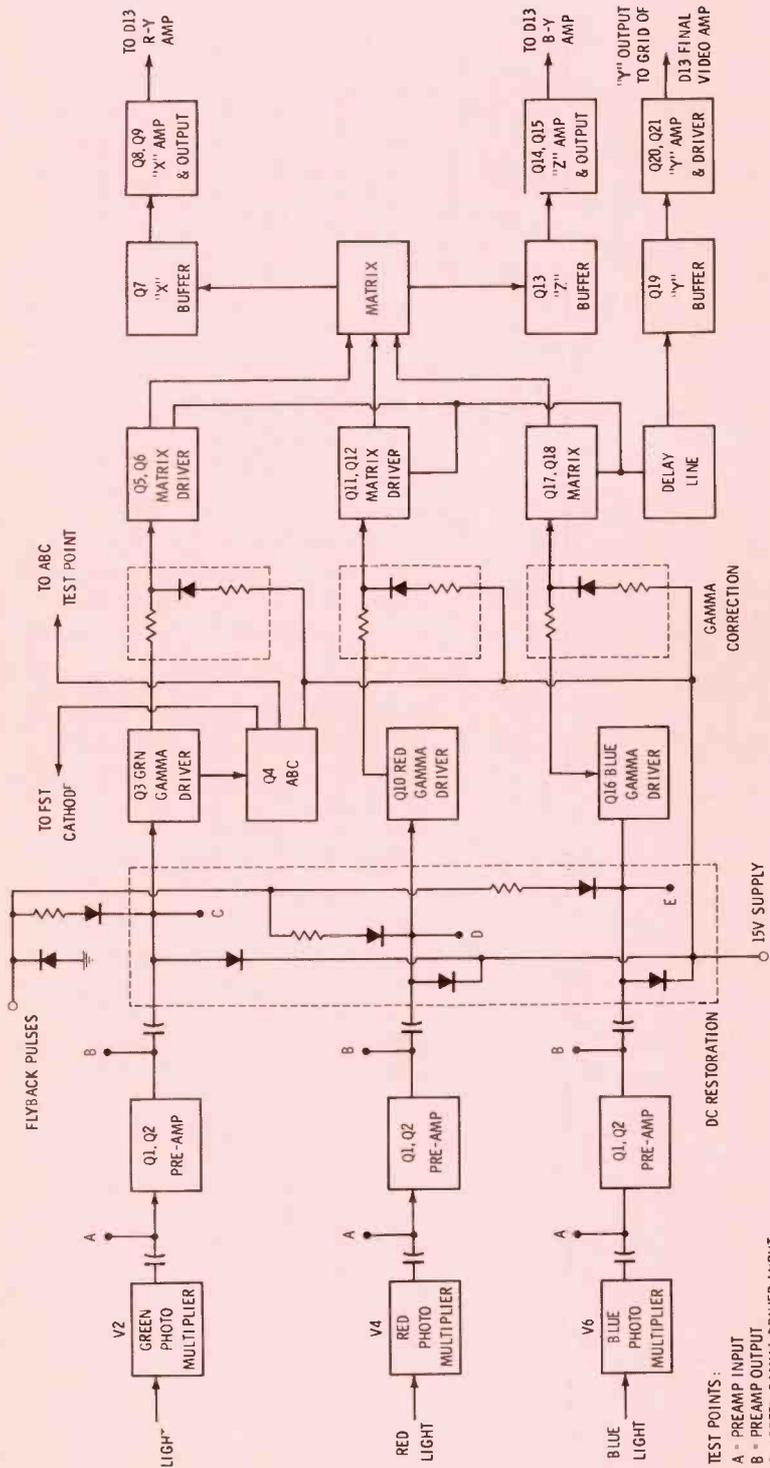
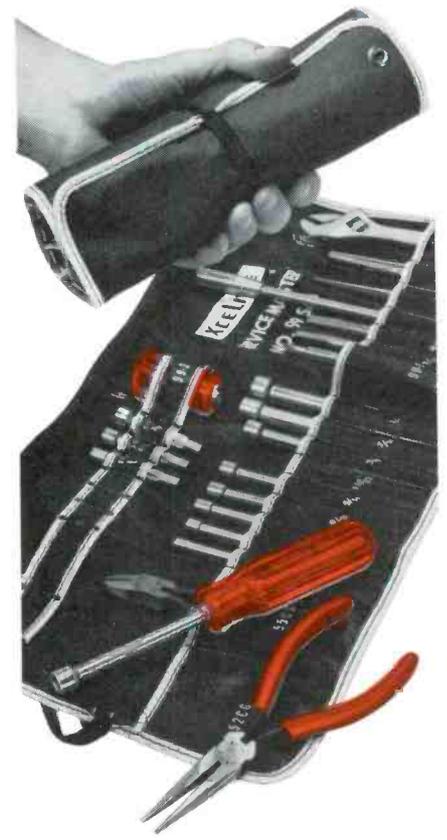


Fig. 2 Block diagram of the HO1 Scanner chassis.

TEST POINTS:
 A = PREAMP INPUT
 B = PREAMP OUTPUT
 C = GREEN GAMMA DRIVER INPUT
 D = RED GAMMA DRIVER INPUT
 E = BLUE GAMMA DRIVER INPUT

SERVICE MASTER HANDIEST HANDFUL of service tools



23 essential tools at your fingertips in this light-weight (only 2¾ lbs.), compact, easy-to-carry, roll-up kit. Contains long nose plier, diagonal plier, adjustable wrench, regular and stubby plier, with these interchangeable blades: 9 regular and 3 stubby nutdriver, 2 slotted and 1 Phillips screwdriver, 2 reamer, 1 extension. Eyelets in plastic-coated canvas case permit wall hanging. New elastic loop secures roll, eliminates need for tying.

many optional accessories:

Junior and Tee handles... Additional nutdriver, Phillips & slotted screwdriver, and extension blade sizes... Allen hex type, Bristol multiple spline, Frearson, ScruLox, and clutch head blades... Awl/Scraper... Chuck adaptors to use blades in spiral ratchet drivers.

WRITE FOR CATALOG 166



XCELITE, INC., 18 Bank St., Orchard Park, N. Y. 14127
 In Canada contact Charles W. Pointon, Ltd.

Circle 13 on literature card

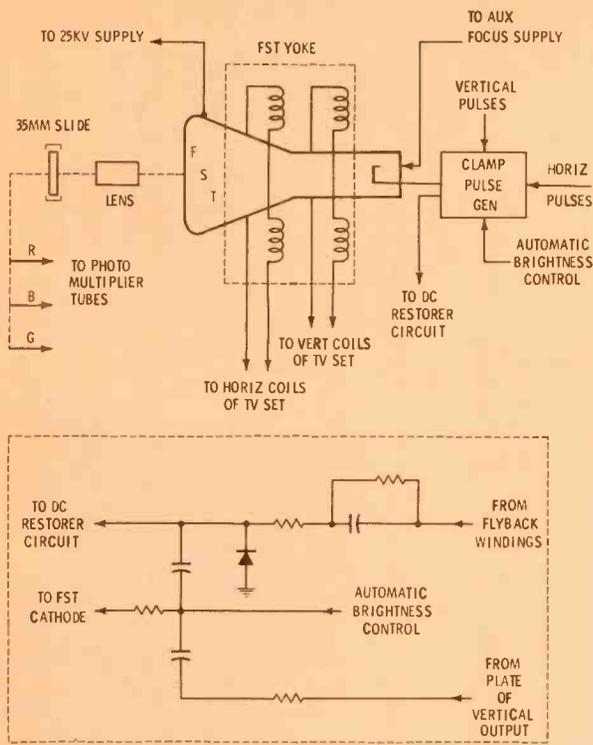


Fig. 3 Circuits associated with the flying-spot scanner.

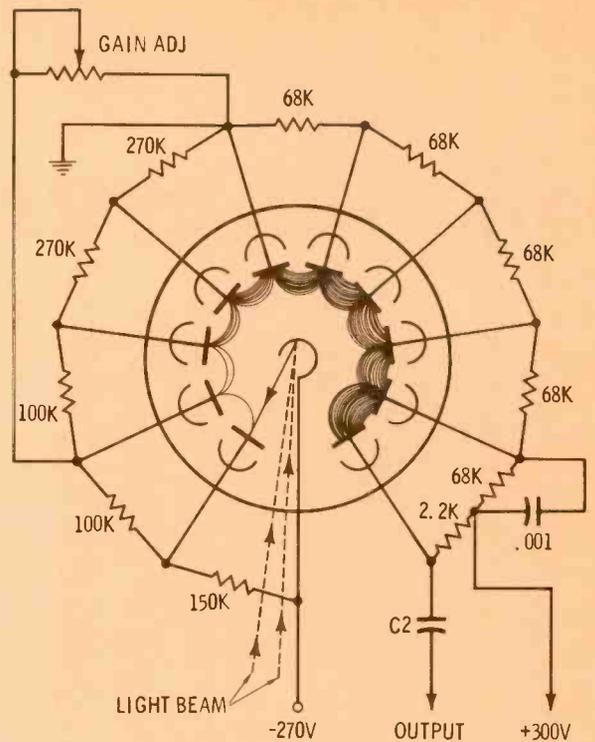


Fig. 4 Diagram of photo-multiplier tube.

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

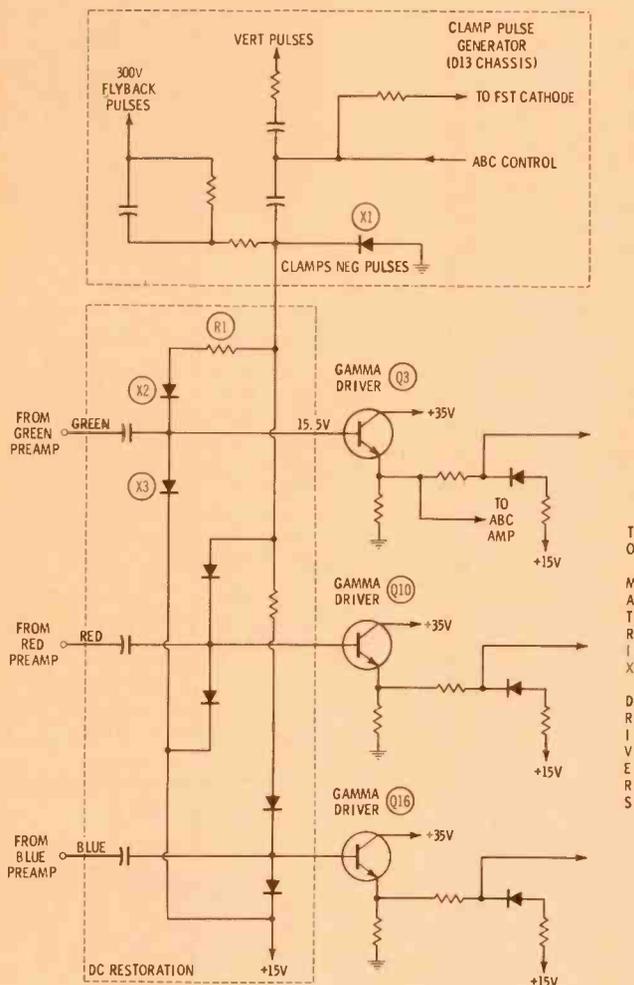


Fig. 5 Schematic of DC restoration circuit.

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 pre-amplifier circuit. The two-stage pre-amplifier 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

SPRA-LUBE

non-drift tuner cleaner



specifically formulated by GC for color TV tuners

CATALOG No. 8888
Suggested Net \$1.95

Only SPRA-LUBE safely cleans away all oxidation, dust and dirt, dries quicker, will not harm plastics, and leaves a fine, light protective lubricating coating essential to keeping color tuners in peak operating condition. Often imitated, never duplicated... SPRA-LUBE is the one proven cleaner-lubricant for all color TV tuners, the only product in its field carrying the proud GC label, your assurance of quality in electronic chemicals.

Always insist on GC... you'll get more for your money, everytime!



GC ELECTRONICS
A DIVISION OF HYDROMETALS, INC.
MAIN PLANT: ROCKFORD, ILL. U.S.A.



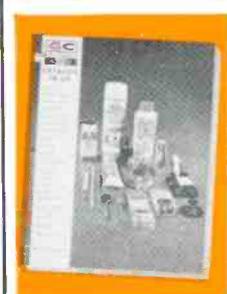
Giant FREE Catalog...

Only GC gives you everything in electronics... has for almost 40 years. Match every part and service need from over 10,000 quality items. Write for your copy today!

Circle 14 on literature card



has everything in CHEMICALS



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-

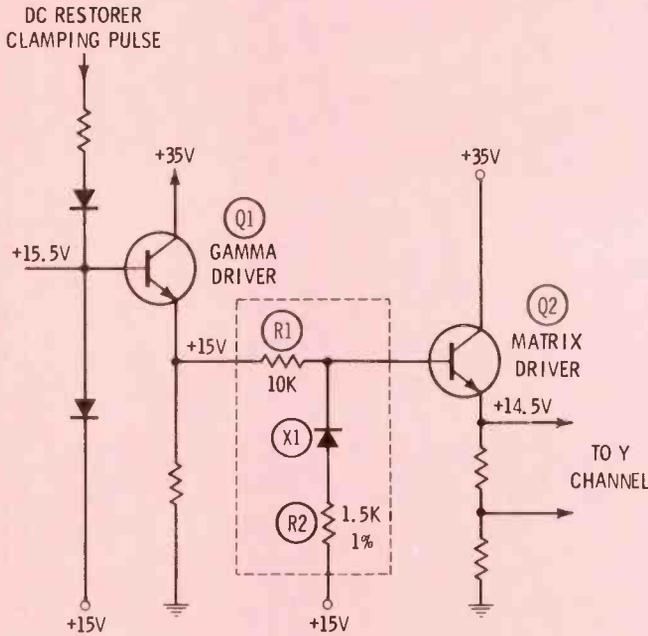


Fig. 6 Gamma correct circuit (blue channel).

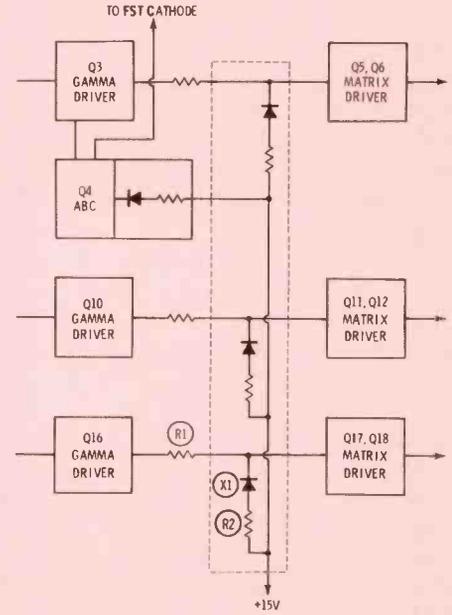


Fig. 7 Block diagram of gamma correction network (all channels).

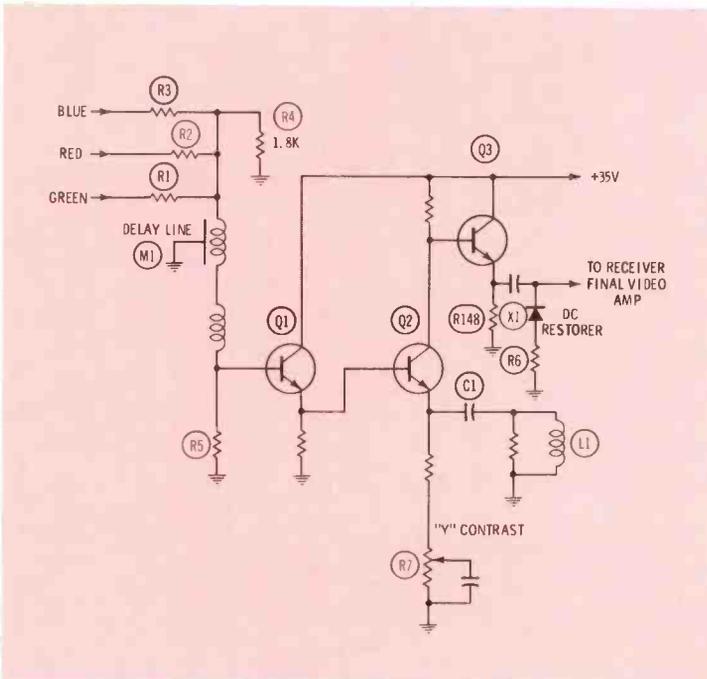


Fig. 8 A matrix circuit consisting of R1, R2, R3, R4 and R5 add red, green and blue signals to produce the Y signal.

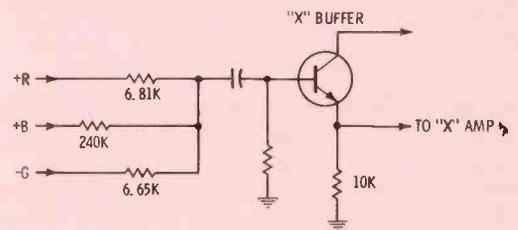


Fig. 9 Matrix circuit for X signal.

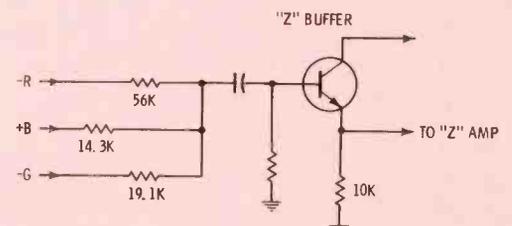


Fig. 10 Matrix circuit for Z signal.

General Electric announces the end of the foreign tube replacement- run-around.



Now, head straight to your General Electric Tube Distributor for "Hard-to-get Off Shore Tubes" (H.O.S.T.). You'll cut down those embarrassing, costly delays spent hunting all over town for the tubes to fix the growing number of imported TV sets. Your GE Distributor now has the types you need most often. In one short visit you can save hours of job time . . . and that's worth money! The new H.O.S.T. selection at your GE Distributor's adds one more dimension to the "service designed" line — a line you can stake your reputation on for *whatever* needs fixing. Stock up today.

Replace Tubes in these TV Imports, Faster, Easier: Sony • Panasonic • Toshiba • Hitachi • Truetone • Coronado • Delmonico • Sharp • Standard • Silvertone • Airline • J. C. Penney • and many more. 288-20

TUBE DEPARTMENT • OWENSBORO, KENTUCKY

GENERAL  ELECTRIC

Circle 15 on literature card

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 between 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:

$$\begin{aligned} X &= 3R - 3.1G + 0.1B \\ Z &= .57R - 1.66G + 2.23B \\ Y &= 59G + 0.30R + .11B \end{aligned}$$

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 fly-ing-spot tube (FST). This circuit

Meet the Pro's Pro!



CONTINENTAL II

MU150

World's Finest Tube Analyzer

Sophisticated Circuitry
Plus Advanced
Mechanical Design
For The Ultimate
In Performance



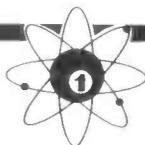
This is the MU150 Continental II—Sencore's new combination emission and mutual conductance tube tester. So precisely accurate you'll never have to guess again whether a tube is good or bad. See why we say it's the professional's professional tester.

NEW

Replaceable tube socket chassis
Simplified setup book
Sectioned and reinforced panel and case
Portable high-style attache case

- Checks over 3000 tubes—foreign and domestic.
- Mutual conductance test with 5000 Hz square wave truly analyzes the tube.
- Emission tests at near full rated cathode current on power tubes. Not available on other mutual conductance testers.
- 100 megohm grid leakage sensitivity check. A must to catch troublesome tubes with grid leakage or gas.
- 180K short sensitivity check. Compares each element in the tube against all others for possible shorts.
- Regulated for complete accuracy and assurance on marginal tubes.

If you want to go first class—go with the MU150 Continental II. Only **\$229⁵⁰**



SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Circle 16 on literature card

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 adjust-

ment 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.

How to break into the big money servicing 2-way radios!

HOW WOULD YOU LIKE to start collecting your share of the big money being made in electronics today? To start earning \$5 to \$7 an hour... \$200 to \$300 a week... \$10,000 to \$15,000 a year?

Your best bet today, especially if you don't have a college education, is probably in the field of two-way radio.

Two-way radio is booming. Today there are more than five million two-way transmitters for police cars, fire trucks, taxis, planes, etc. and Citizen's Band uses—and the number is growing at the rate of 80,000 new transmitters per month.

This wildfire boom presents a solid gold opportunity for trained two-way radio service experts. Most of them are earning \$5,000 to \$10,000 a year more than the average radio-TV repair man.

Why You'll Earn Top Pay

One reason is that the U.S. doesn't permit anyone to service two-way radio systems unless he is licensed by the FCC (Federal Communications Commission). And there aren't enough licensed electronics experts to go around.

Another reason two-way radio men earn so much more than radio-TV service men is that they are needed more often and more desperately. A two-way radio user must keep those transmitters operating at all times, and must have them checked at regular intervals by licensed personnel to meet FCC requirements.

This means that the available licensed experts can "write their own ticket" when it comes to earnings. Some work by the hour and usually charge at least \$5.00 per hour, \$7.50 on evenings and Sundays, plus travel expenses. Others charge each customer a monthly retainer fee, such as \$20 a month for a base station and \$7.50 for each mobile station. A survey showed that one man can easily maintain at least 15 base stations and 85 mobiles. This would add up to at least \$12,000 a year.

How to Get Started

How do you break into the ranks of the big-money earners in two-way radio? This is probably the best way:

1. Without quitting your present job, learn enough about electronics fundamentals to pass the Government FCC Exam and get your Commercial FCC License. Then start getting practical experience in servicing two-way radio systems in your area.
2. As soon as you've earned a reputation as an expert, there are several ways you can go. You can add mobile radio maintenance to the present services offered by your shop, or start your

ENROLL UNDER NEW G.I. BILL

All CIE courses are available under the new G.I. Bill. If you served on active duty since January 31, 1955, or are in service now, check box in coupon for G.I. Bill information.

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

own separate mobile radio business. You might become a franchised service representative of a big manufacturer and then start getting into two-way radio sales, where one sales contract might net you \$5,000. Or you may be invited to move up into a high-prestige salaried job with one of the major manufacturers.

The first step—mastering the fundamentals of electronics in your spare time and getting your FCC License—can be easier than you think.

Cleveland Institute of Electronics has been successfully teaching electronics by mail for over thirty years. Right at home, in your spare time, you learn electronics step by step. Our AUTO-PROGRAMMED™ lessons and coaching by expert instructors make everything clear and easy, even for men who thought they were "poor learners." You'll learn not only the fundamentals that apply to all electronics design and servicing, but also the specific procedures for installing, troubleshooting, and maintaining two-way mobile equipment.

Your FCC License... or Your Money Back!

By the time you've finished your CIE course, you'll be able to pass the FCC License Exam with ease. Better than nine out of ten CIE-trained men are able to pass the FCC Exam, even though two out of three non-CIE men fail. This startling record of achievement makes possible our famous FCC License Warranty: you'll pass the FCC Exam upon completion of your course or your tuition will be refunded in full.

Find out more. Mail coupon for two FREE books, "How To Succeed In Electronics" and "How To Get A Commercial FCC License."

CIE

Cleveland Institute of Electronics

1776 E. 17th St., Dept. PF-55, Cleveland, Ohio 44114

Cleveland Institute of Electronics
1776 E. 17th St., Cleveland, Ohio 44114

Please send me without cost or obligation:

1. Your 40-page book "How To Succeed In Electronics" describing the job opportunities in Electronics today, and how your courses can prepare me for them.
2. Your book on "How To Get A Commercial FCC License."

Name _____ Age _____
(please print)

Address _____

City _____

State _____ Zip _____

Check here for G.I. Bill information.

Accredited Member National Home Study Council.

PF-55

Circle 17 on literature card

"TV REPAIR" PROMOTION SUPPLEMENT —

ONE TV Repair Shop in your locality . . . will soon stand out head and shoulders above every other competitor in town. It could be YOU.

Want to know HOW? Very simply:

by using a regular series of clever, inexpensive 'column' ads in your local newspaper! You doubt it? Well . . .

. . . A TV shop in Maryland had to hire more help within 3 weeks after starting their series!

. . . A dealer in Montreal has had people come in from all over Canada, from his ads.

. . . An enterprising repair man in Louisiana has acquired 4 other places in his area from the surge of business that his series brought.

. . . Two cousins in a New England community attribute 75% of their business to these ads.

You can see their secret . . . adapt their method . . . improve your business . . . gain an immediate edge on competition . . . and develop a friendly, permanent clientele . . . by judiciously using the same inexpensive idea!

Our new folio—which we'd like you to try out for six months—is called "How to Double Your Business with Unique 'Column' Ads."

It shows how others have done it . . . replete with case histories.

It shows how you can do it, too. It shows how and when, where and why—the whole fascinating story of this cheapest means of advertising . . . with most effective RESULTS! Here are ads that will attract attention—stimulate curiosity . . . arouse interest, amuse readers and make YOU known and remembered for quality . . . service . . . integrity . . . dependability.

All at trivial cost!

Among the Advantages you will learn . . . how to create interest among prospects who never even knew you existed!

. . . how to influence people to switch over to your business or service!

. . . how to create excitement—even though your business seems dull and drab!

. . . how to get the most out of your promotional dollar (something most business men never learn!)

. . . how to get your customers to "work" for you!

. . . how to get fast action from a \$3 investment!

. . . how to keep interest sustained over an extended period!

. . . how to make people laugh . . . and agree with you . . . and seek to meet you personally!

. . . how to get maximum assistance without charge from the newspaper staff!

. . . how to develop continuing ideas!

And, above all —

A Special "TV REPAIR" PROMOTION SUPPLEMENT!

H. K. SIMON ADVERTISING
BOX 236
HASTINGS-ON-HUDSON
NEW YORK 10706

shows you:

- . . . How to out-smart (instead of out-spend) the competition!
- . . . Why most ads fail . . .

- The ONE BIG SECRET of successful TV Repair advertising.
- . . . The Greatest Compliment any ad can Pay You.
- . . . The mistake that is made by 98 out of 100 local advertisers.
- . . . 94 examples of enticing "come on in" copy (distilled from thousands).
- . . . 26 Merchandising Ideas that you can adapt, to stimulate business.
- . . . 37 Illustrations that enliven the ad, attract the eye.

Here are "Big Time" ideas at "small time" prices. Prepared by a \$25,000 copy group . . . but your cost is less than 40¢ per week!

You'll refer to this for years—every time you need copy to promote special occasions . . . or an idea for a layout . . . or an eye-catching border . . . or a good illustration!

You'll see how to establish your name as an outstanding source: as helpful . . . friendly . . . sincere . . . intelligent . . . courteous . . . dependable.

You'll see how to have people looking forward to your ads—wondering what you will say next!

You run very little risk, if you accept this opportunity—because we GUARANTEE that any one using these ideas six months or more who does NOT hear favorable comment—who does NOT think his own staff has been stimulated—who does NOT see direct results at lower cost—can simply say so, and we'll REFUND 100% of every penny you paid us!

We think this offer is unique We dare to make it only because we KNOW this will prove profitable to you.

Who in your community will benefit by this? Will YOU? Better advise us at once.

Write or wire us TODAY. Use the handy blank below.

Suppose YOU spent 3 weeks with an advertising agency . . .

. . . developing a year's program for your business that would make you well known—give you a competitive edge . . . bring customers to your door . . . stimulate your sales . . . save wasted efforts on unproductive promotion.

Personal service, of course, is expensive. The ad agency's fee would be about \$2,000, plus your traveling and maintenance expenses.

But we have completed just such an intensive 3-week conference . . . and you may have the results for a tiny fraction of that cost!

Let me ask: how is your present ad program going—now? Was it prepared well in advance, by a "pro"? Or do you promote your services, catch-as-catch-can, when you can spare a moment?

The difference between the two methods can mean a doubling of your annual gross. Perhaps you've always thought, "I can't afford a high-priced ad man."

But surely, you COULD afford him if he cost you only 40¢ a week!

And if that 40¢ weekly expense brought you \$7,500 a year—you couldn't afford to be without him!

"True", you say, "If it is so good as all that."

We think it is. But we want YOU to be the judge.

Try the ideas for the next six months. Then—6 months from now—if you don't expect to get back at least \$1,995 for your \$19.95 investment (a return of 100 to 1—or better) simply send it back for full refund.

Could anything be fairer?

Since there's no obligation, why not accept? Promotion-wise, I doubt if you'll EVER get another opportunity to equal it. But . . .

Better act TODAY. This offer may be withdrawn when our supply of copies run out. So write or wire NOW!

H. K. SIMON, Advertising Co.
Box 236, Dept. ES-41
Hastings-on-Hudson, N. Y. 10706

Kindly send "HOW TO DOUBLE YOUR BUSINESS WITH UNIQUE 'COLUMN' ADS" along with your "TV REPAIR" PROMOTION SUPPLEMENT to:

NAME _____

ADDRESS _____

CITY, STATE _____

ZIP _____

We enclose our check for \$19.95.

It is understood that if we use your ideas for six months or more and are not fully satisfied, every cent will be refunded.

REFERENCES: Any publication in the U.S.A. • Rated by Dun & Bradstreet

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

Sine & Square Waves, Simultaneously, To 100 kHz, Switch-Selected, At 0.1% Distortion, <50 nanosec. Rise Time



NEW Heathkit® IG-18 Solid-State Sine-Square Audio Generator Kit \$67.50* Assembled \$99.50*

- Generates sine waves from 1 Hz to 100 kHz
- Generates square waves from 5 Hz to 100 kHz
- Repeatable switch-selected output frequency
- Variable third-place frequency control permits Zero-beat
- Metered sine wave output voltage and dB scales
- Floating outputs
- 8 output voltage ranges for sine wave from 0.003 V to 10 V
- 3 output voltage ranges for square wave from 0.1 V to 10 V
- Switch-selected internal 600 ohm load
- 5% frequency accuracy

A precision source of sine-square waves for design or service, the IG-18 is ideally suited for such applications as testing audio amplifiers for gain and frequency response, as a signal source for harmonic distortion or as an external modulator for an RF signal generator.

Kit IG-18, 10 lbs., no money dn., \$7 mo. \$67.50*
 Assembled IGW-18, 9 lbs., no money dn., \$10 mo. \$99.50*

IG-18 SPECIFICATIONS — GENERAL: Frequency Selection: Digital selection consisting of: 0-100 switch (steps of 10), 0-10 switch (steps of 1), 0-1 control (vernier) & multiplier switch (x 1, 10, 100, 1000). Frequency Accuracy: Within ±5%. **SINE WAVE OUTPUT:** Frequency Range: 1 Hz to 100 kHz. Output Voltage Ranges: 8 ranges, .003 to 10 volts RMS (full scale) with 10 K ohm or higher external load. 6 ranges, .003 to 1 volt (full scale) with 600 ohm internal or external load. dB Ranges: —62 dB to +22 dB, —12 dB to +2 dB on the meter and —50 dB to +20 dB on the amplitude switch in 10 dB steps. +2 dB maximum into 600 ohm load. (0 dB = 1 mw in 600 ohm.) Output Variation: +1 dB 10 Hz to 100 kHz. Output Indication: Two voltage and one dB scale on meter. Output Impedance: 10 volt range: 0-1000 ohm; 3 volt range: 800-1000 ohm; 1 volt range and lower: 600 ohm. Meter Accuracy: ± 5% of full scale with proper load termination. Distortion: Less than 0.1% from 10 Hz to 20 kHz. Type of Circuit: Differential amplifier with complementary-pair output. Notch filter frequency determination. **SQUARE WAVE OUTPUT:** Frequency Range: 5 Hz to 100 kHz. Output Voltage Ranges (Peak-To-Peak): Three Ranges: 1, 1, 10 volt into 2000 ohm load or higher. Output Impedance: 1 V and 1 V ranges: 52 ohm; 10 V range: up to 220 ohm. Rise Time: Less than 50 ns. Dimensions: 5 3/4" H. x 13 1/4" W. x 7" D. Net Weight: 7 lbs. Power Requirements: 105-125 VAC or 210-250 VAC, 50/60 Hz, 6 watts.

FREE 1969 Heathkit Catalog

World's largest selection of electronic kits . . . over 300 to choose from . . . for school, home, and industry. Send for your free copy today.

HEATHKIT

HEATH COMPANY, Dept. 25-1
 Benton Harbor, Michigan 49022

Rush my FREE Heathkit Catalog.
 Enclosed is \$_____ including shipping.

Please send model(s) _____

Name _____

Address _____

City _____ State _____ Zip _____

Prices & specifications subject to change without notice.
 *Mail order prices; F.O.B. factory. TE-195

Circle 19 on literature card

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.

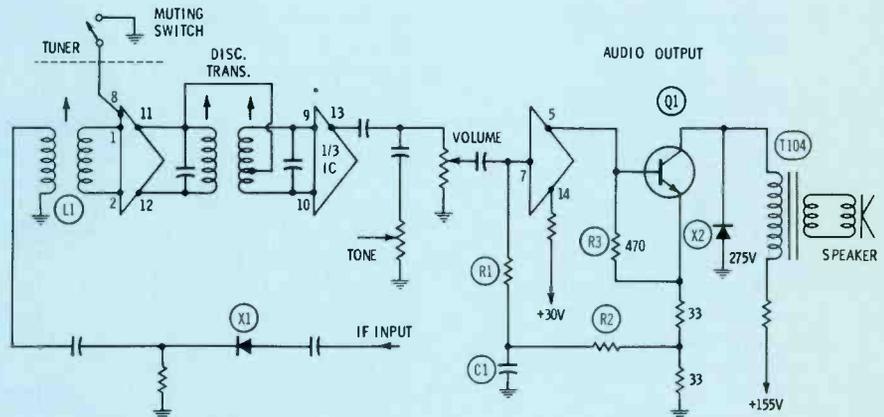
Sound Section

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



* PART OF INTEGRATED CIRCUIT (IC)

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

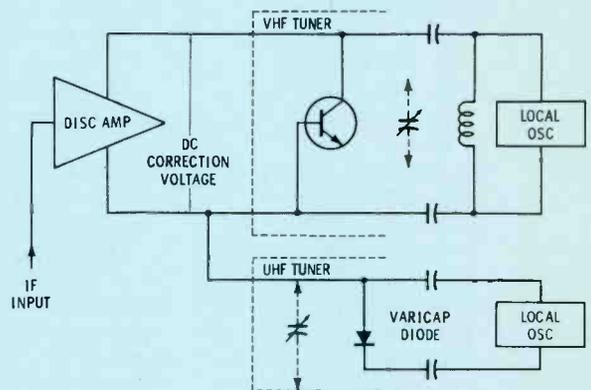
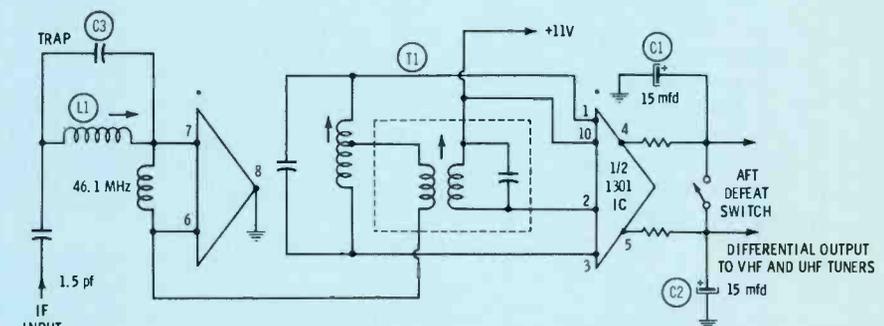


Fig. 2 Simplified illustrations of the CTC40 AFT system.



* PART OF INTEGRATED CIRCUIT (IC)

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 video IF amplifier. This signal is ap-

plied 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 trans-

the Color King is the winter king

Exclusive Built-in Heating Element Assures Cold Weather STABILITY

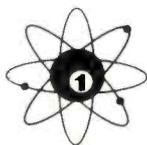
Rock-solid stability — even if it's 20 below zero outside! That's what you get with Sencore's Color King color bar generator.

Only the Color King has a built-in warmer-upper — a thermostatically controlled heating element surrounding the timer circuitry to give you quick warm-up for the most reliably stable patterns in any color generator.

All five standard color pattern — PLUS a single dot and single cross to speed up dynamic convergence. Snap tuning for channels 2 through 6. Interlace control to stop dot bounce. Increased chroma and sync signals. Color gun interruptors with switches on the panel. All solid state, AC operated.

So forget cold weather instability problems. When you've got a Sencore Color King, you've got it made!

CG141 COLOR KING
\$169⁹⁵



SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Circle 20 on literature card

former, 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

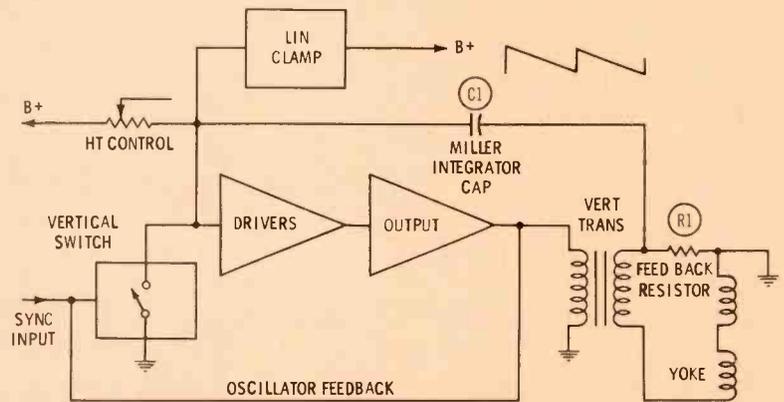


Fig. 4 Illustration of the fundamental sweep system employed in the CTC40.

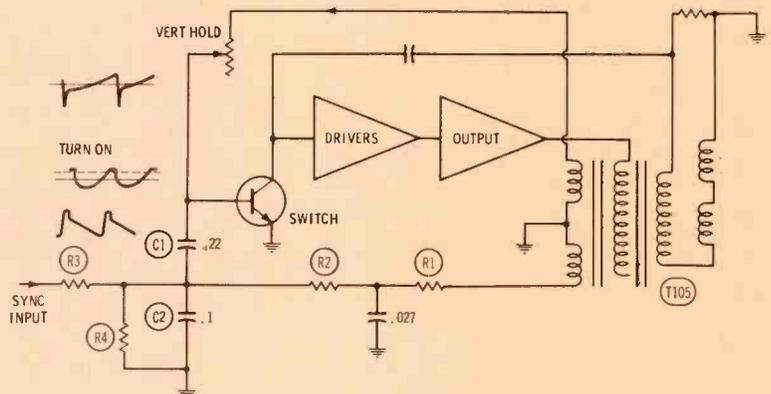


Fig. 5 Partial schematic of the vertical switch and associated circuitry.

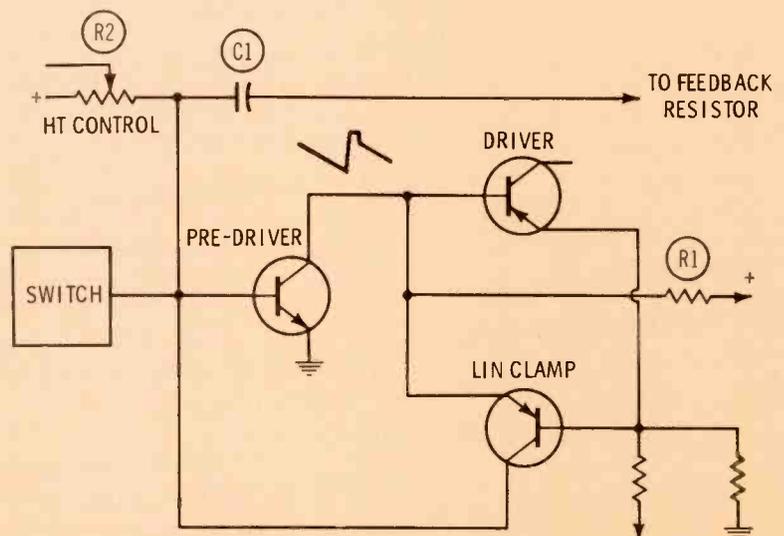


Fig. 6 Schematic showing basic circuitry of linearity clamer stage.

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 clamping 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



ROHN® THE UN-DECEIVER

Rohn says, "Don't be deceived by painted products." The experts there threw out paint long ago in favor of hot dipped galvanizing — the only permanent finish that gives more value for lower cost. Paint's a cover up, say the men at Rohn — an inferior finish whether it's gold, blue or purple. Sooner or later it chips, peels, wears off and then what do you have? A rusty installation that will soon be on its last legs. Plain, honest hot dipped galvanizing is the only finish really suitable for an antenna installation. It looks good, keeps on looking good, resists rust and corrosion, gives you an honest finish on an honest product that means less maintenance, longer life, better service. And that's what the customers are looking for. So look to Rohn for all your installation needs because Rohn doesn't cover up. They don't have to.

ROHN MANUFACTURING CO.
Post Office Box 2000
Peoria, Illinois 61601

ROHN®

ROHN SOUTH
VULCAN TV MAST & TOWER CO., INC.
911 Thomason Ave., Post Office Box 6537
Tarrant, Birmingham, Alabama 35217

Circle 21 on literature card

components
of
all speakers
basket
pot
cone
voice coil
magnet

extra
components
of
Quam
speakers

customer-oriented
engineering

top grade
raw materials

scrupulous
manufacturing

precision
assembly

conservative
ratings

QUAM

gives you a premium in quality, asks no premium in price. That's how we've stayed out in front for almost half-a-century!

QUAM-NICHOLS COMPANY
234 East Marquette Road, Chicago, Illinois 60637

Circle 22 on literature card

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-

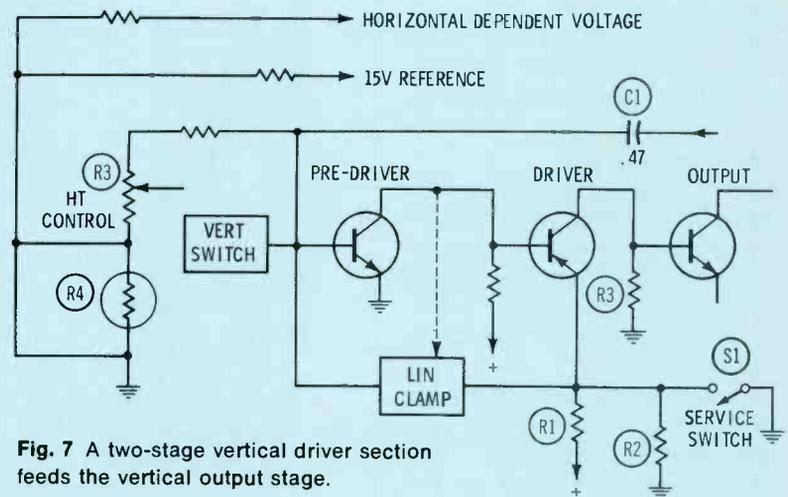


Fig. 7 A two-stage vertical driver section feeds the vertical output stage.

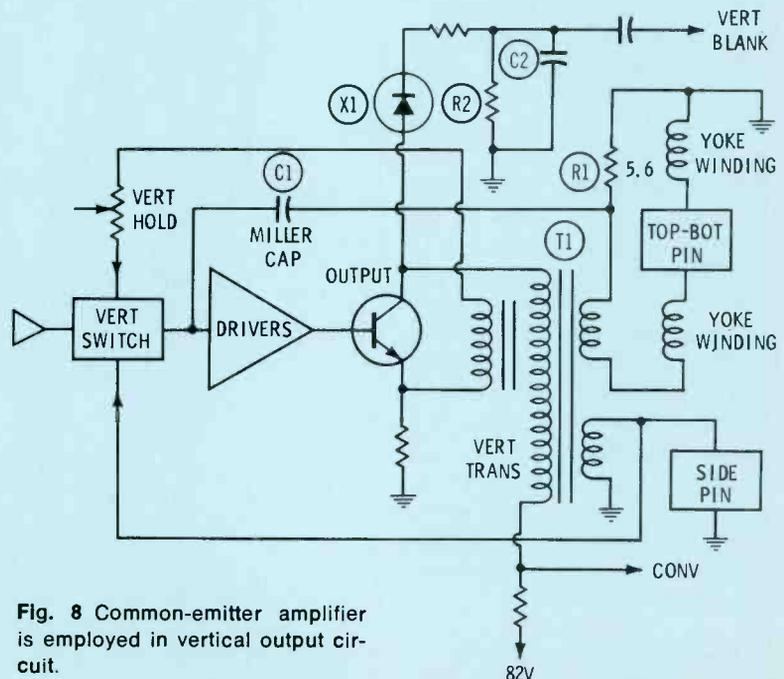


Fig. 8 Common-emitter amplifier is employed in vertical output circuit.

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-

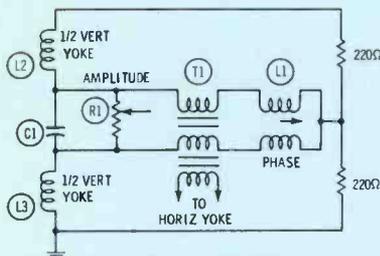


Fig. 9 Top and bottom pincushion correction circuitry.

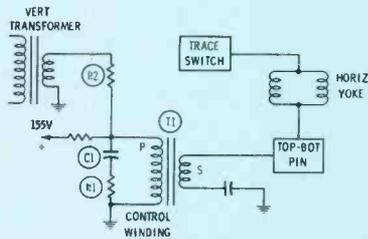


Fig. 10 Side pincushion correction is accomplished by amplitude modulation of the horizontal deflection current.

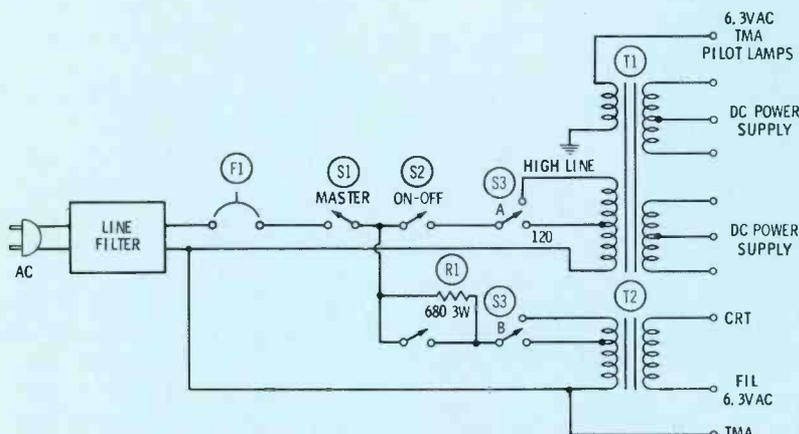


Fig. 11 Schematic of the switching circuitry that permits the CTC40 to take advantage of the "instant-on" characteristics of semiconductors.

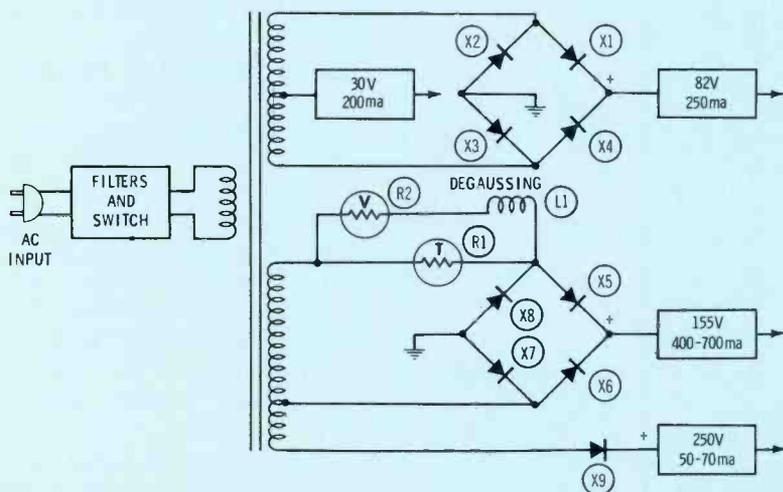


Fig. 12 Three separate rectifier circuits provide the CTC40 with four separate DC sources.

NEW!

- TUBE TESTER
- GRID CIRCUIT TESTER



- ✓ CHECKS B & W PICTURE TUBES
- ✓ CHECKS COLOR PICTURE TUBES



MODEL 88A IN NEW MOLDED ROYALITE CASE

Complete coverage of all popular receiving tubes including novars, nuvistor, newest 10-pin types, compactrons, decal and magnovals — PLUS a black and white CRT Adapter and two COLOR CRT ADAPTERS. Patented Grid Circuit Test makes up to 11 simultaneous checks for leaks, shorts and grid emission — plus Tube Merit and Filament Continuity Tests. For 115 VAC operation. Complete with speed indexed setup data. Mounted in durable NEW MOLDED ROYALITE CASE. Dimensions: 9½" x 12½" x 5". Shipping weight 6 lbs.

MODEL 88A Complete with Adapters **\$89.50 NET**
 Model 88A Less Adapters **\$84.50 NET**



SECO ELECTRONICS CORPORATION

1003 2nd St. So., Hopkins, Minn. 55343
 Circle 23 on literature card

RATCHET-TYPE CHIMNEY MOUNT

With Stainless Steel
Strapping



Catalog No. 8008
Suggested Net \$4.28
(12' lengths)

Catalog No. 8008-L
Suggested Net \$5.10
(18' lengths)

New in design... tops in materials... first in service life. Here is the quality-constructed two-bracket chimney mount designed to give maximum service in high wind, seasonal storms, adverse weather conditions. Available with 12 or 18-foot lengths of stainless steel strapping to fit any chimney, a locking "U" bolt that accepts antenna masts up to 1 1/2" in diameter. This mount installs in minutes, requires only a single wrench to secure to chimney. Buy with confidence from the world's largest basic manufacturer of television hardware... you'll make your job easier, faster, and more profitable... more satisfying to your customer.

Always insist on **GC**...
you'll get more for your money, everytime!



GC ELECTRONICS
A DIVISION OF HYDROMETALS, INC.
MAIN PLANT: ROCKFORD, ILL. U.S.A.



Giant FREE Catalog...

Only GC gives you everything in electronics... has for almost 40 years. Match every part and service need from over 10,000 quality items. Write for your copy today!

Circle 24 on literature card

GC

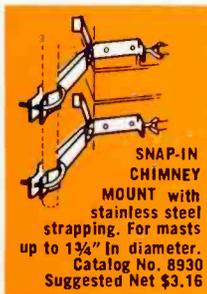
has
everything
in
**TELEVISION
HARDWARE**

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. ▲

50,000

users can't be wrong!

TECHNICIANS EVERYWHERE RELY ON FAMOUS SENCORE MIGHTY MITES. HERE'S WHY.

- Grid Leakage Test with ultra-high sensitivity of 100 megohms
- Emission Test at full rated cathode current
- Shorts Test picks out interelement shorts of 180K ohms or less
- Mighty Mite accurately checks over 3,000 tubes, including foreign



NEW MIGHTY MITE

V

TC142

Now, Sencore's new Mighty Mite V gives you the same reliability and accuracy, plus new features that make the "V" the most up-to-date tester of all.

NEW—Magnoval socket so you check many more tubes.

NEW—Horizontal in-line switch layout saves setup time.

NEW—Rugged vinyl-clad steel case stays new longer.

NEW—Brushed chrome panel; detachable cover.

The new TC142 is truly Sencore's mightiest Mighty Mite and it's only

\$79.50

IN STOCK AT YOUR DISTRIBUTOR NOW.



SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Circle 25 on literature card

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

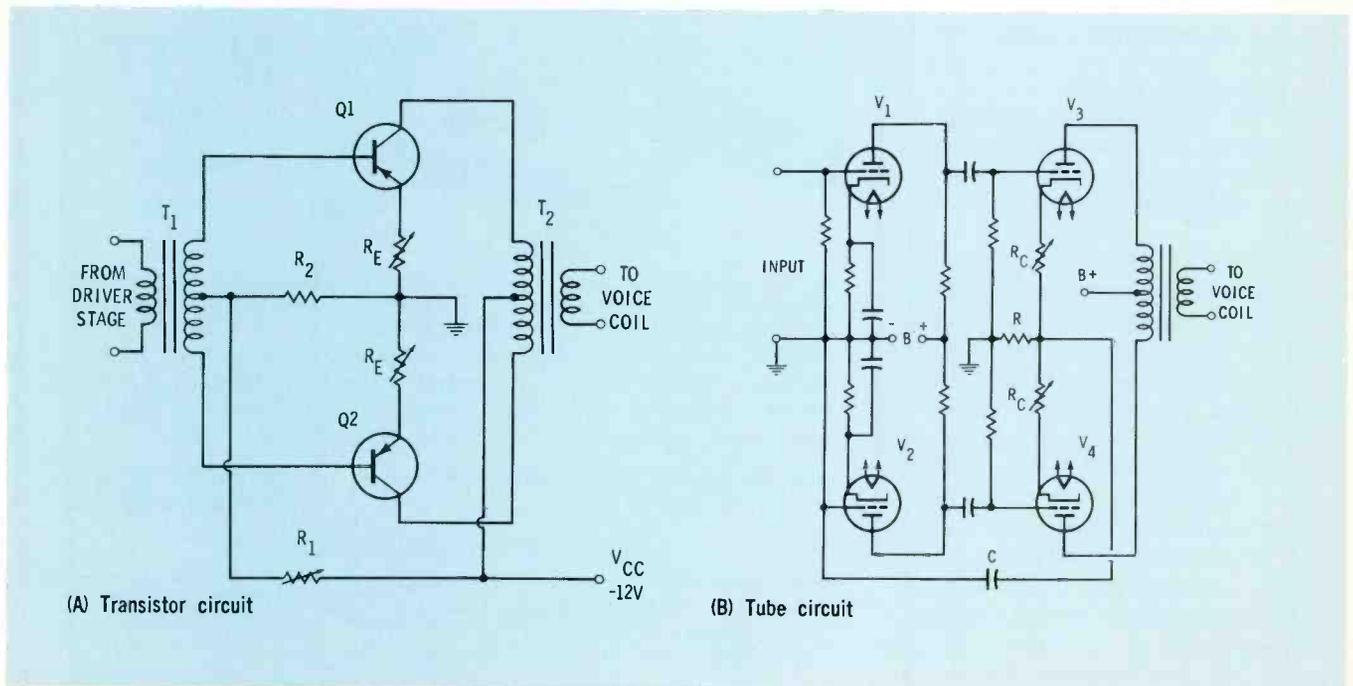


Fig. 1 Basic transistor—and tube-type push-pull circuits.

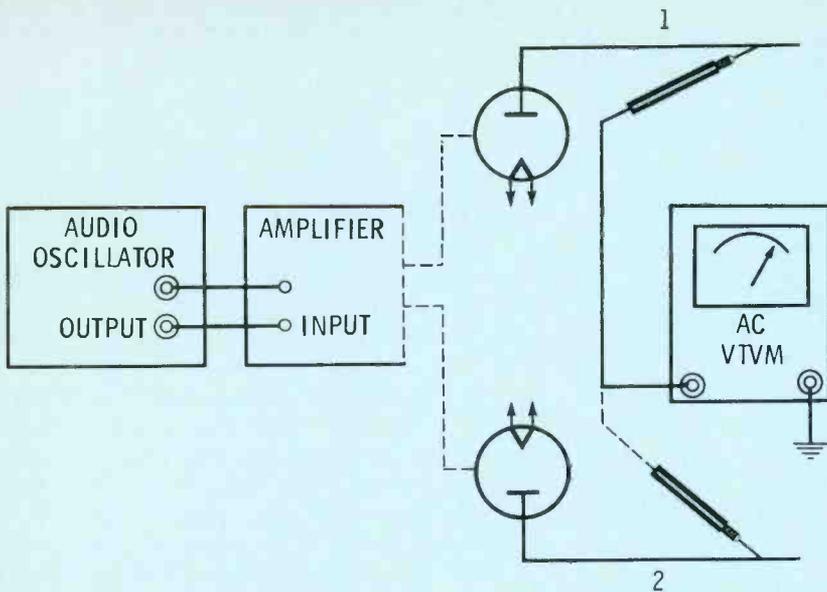


Fig. 2. Test setup for checking AC balance.

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.

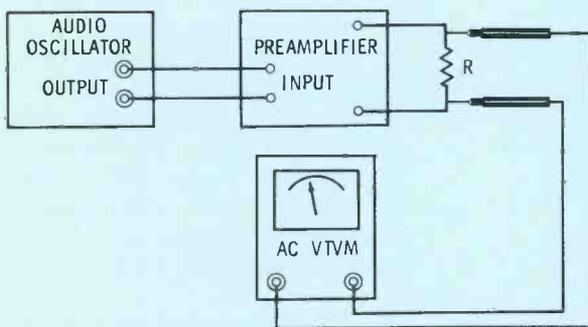
The DC balance of a push-pull output stage should be adjustable to within 5%, and preferably within 2%. It is often necessary to choose a slight compromise adjustment to

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.

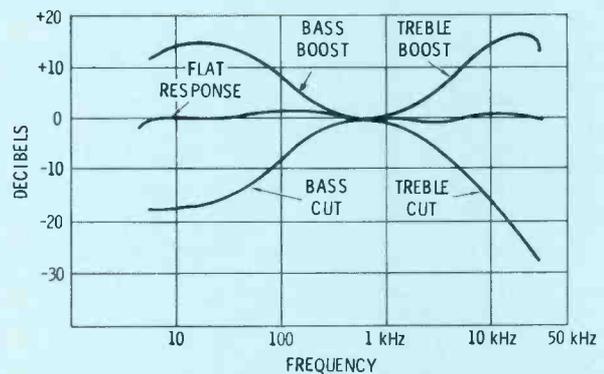
Sources of Hum Interference

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.

BEST SELLING SAMS BOOKS

FOR EVERY ELECTRONICS INTEREST

NEWLY PUBLISHED AND IMPORTANT!

101 Questions & Answers About Fixed Radiocommunications

A valuable reference for all who work with microwave and other fixed radio systems. Covers long distance, high-frequency voice and teletype communications, short range vhf and uhf links, low-density and high-density microwave multi-channel transmission of telephone, telegraph, data, tv, and other intelligence. Essential for anyone who designs, operates, or maintains fixed radio communications systems. Includes examples of specifications of microwave and other types of fixed radio systems. Order 20584, only...\$3.95

Using & Understanding Miniature Neon Lamps

Describes the neon lamp in detail: electrode size, gases used, firing, extinction voltages, aging characteristics, and maintenance. Explains its uses as an indicator, voltage regulator and voltage reference, oscillator, pulse generator, flasher, and applications in computers. Includes fascinating, easy-to-build circuits for the experimenter. Also includes the characteristics of most available neon lamps. Order 20698, only...\$2.95

Novel Electronics Circuits

Offers 77 novel circuits and devices for the experimenter, ham, or technician. Circuits range from functional devices, such as light sensor, audio oscillator, and infra-red sensor, to unusual scientific types, such as an electronic lock and an earth telephone. Includes thorough descriptions and illustrations for each device. Order 20692, only...\$2.50

Short-Wave Listener's Guide—3rd Ed.

Lists all short-wave stations by country, city, call letters, frequency, power, and transmission time. Includes Voice of America and Radio Free Europe stations and a listing of stations operating behind the Iron Curtain. With conversion chart and handy log. Order 20695, only...\$2.25

Amateur Radio SSB Guide

Essential for anyone owning or planning to build or buy ssb equipment. Covers basic principles, purpose of ssb transmission; detailed analysis of the balanced modulator circuit and its application in a typical transmitter. Includes schematic diagrams for those interested in building or troubleshooting ssb transmitters and receivers, along with circuit analysis. Order 20629, only...\$3.95

Learn Electronics Through Troubleshooting

A new and practical approach to learning and understanding electronics theory. Provides a thorough grasp of the subject through the technique of solving practical troubleshooting problems. Includes two appendices containing valuable reference data. Order 20651, only...\$6.95

Motorcycle Service Manuals—2nd Ed.

Provides full information on how to service virtually every present-day scooter or motorcycle. The two volumes cover hundreds of popular domestic and foreign models. Vol. 1. Order 20665, only...\$4.95
Vol. 2. Order 20666, only...\$4.95
2-Vol. Set. Order 20667, only...\$9.50

RECENT AND TIMELY BESTSELLERS

101 Questions & Answers About CATV and MATV

Describes the growing applications of catv (community antenna television) and matv (master antenna television) in the fields of home entertainment, schools, public safety, and industry. Fully covers equipment and system designs and installations, and the future for this field. Order 20655, only...\$2.50

101 Questions & Answers About Color TV

Here are the complete and clear answers to the most frequently asked questions about color tv: about its basic theory, installation, servicing, and modifications. Answers are reinforced by dozens of schematics, illustrations, and photographs. Order 20624, only...\$1.75

ABC's of Electrical Soldering

An invaluable book on the art of soldering—what it is and does, how to make a good connection, how to make solder repairs. Explains solder alloys, fluxes, soldering irons, instant-heat guns, production soldering, and other connecting methods. Order 20627, only...\$2.95

How to Repair Major Appliances

This fact-packed volume explains theory, functioning, major components, and repair of refrigerators, freezers, washing machines, dryers, ranges, dishwashers, garbage disposers, room air conditioners, water heaters, humidifiers, and dehumidifiers. Order 20650, only...\$4.95

Semiconductor Handbook

Here, in one comprehensive heavily illustrated volume, is the most complete, modern source-book for industrial semiconductor data. Covers latest circuitry in a wide variety of applications; provides full data on industrial semiconductors, including grown-junction, alloyed-junction, drift, MADT, mesa, planar, and epitaxial mesa types. Order 20620, only...\$5.75

49 Easy Transistor Projects

Provides simple, easy instructions, schematic diagrams, and parts lists for building a-m and f-m radios, light relay controls, audio amplifiers, code-practice oscillators, and test equipment, using inexpensive or salvage parts. A fascinating, instructive book. Order 20617, only...\$1.75

More Bestselling Sams Titles

- ABC's of Transformers and Coils. Order 20612, only...\$2.50
Understanding Electronic Test Equipment. Order 20613, only...\$4.50
101 Questions and Answers About CB Operations. Order 20604, only...\$2.50
Modern Dictionary of Electronics, 3rd Ed. Order 20600, only...\$9.95
ABC's of Vacuum Tubes. Order 20576, only...\$2.95

HOWARD W. SAMS & CO., INC.

Order from any Electronic Parts Distributor, or mail to Howard W. Sams & Co., Inc., Dept. PF-1 4300 W. 62nd St., Indianapolis, Ind. 46268

Send books checked at right. \$_____enclosed.

Send FREE 1969 Sams Book Catalog

Name _____
PLEASE PRINT

Address _____

City _____ State _____ Zip _____

- | | |
|--------------------------------|--------------------------------|
| <input type="checkbox"/> 20584 | <input type="checkbox"/> 20624 |
| <input type="checkbox"/> 20698 | <input type="checkbox"/> 20627 |
| <input type="checkbox"/> 20692 | <input type="checkbox"/> 20650 |
| <input type="checkbox"/> 20695 | <input type="checkbox"/> 20620 |
| <input type="checkbox"/> 20629 | <input type="checkbox"/> 20617 |
| <input type="checkbox"/> 20651 | <input type="checkbox"/> 20612 |
| <input type="checkbox"/> 20665 | <input type="checkbox"/> 20613 |
| <input type="checkbox"/> 20666 | <input type="checkbox"/> 20604 |
| <input type="checkbox"/> 20667 | <input type="checkbox"/> 20600 |
| <input type="checkbox"/> 20655 | <input type="checkbox"/> 20576 |

Circle 26 on literature card

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

NEW BERN'S PERFECT PIN CRIMPER

Picture-Tube Repair Tool

Also for—5U4, 65N7, 6BQ6, etc.

Eliminates that hard soldering job

only \$1.49 each

A MUST for round color pic tubes

PT-1
3/32" PIN

Fix loose pin connections in seconds. Pays for itself in time saved on first job. Less than 3" long. Carry it in your pocket.

Patented

Intermittent operation of picture tubes and other tubes due to defective solder connections easily corrected. Provides solid electrical connections, can also be used as channel-selector wrench and screwdriver. Pin keeps its original form. A 3-in-1 tool.

3 MODELS ELIMINATE SOLDERING

Makes Solid Electrical Connections

Phono Pin-Plug Crimper

Slip wire in "pin plug," insert in tool, and squeeze... job is done.

AU-2
1/8" PIN

C-Rings 3 for 5¢

Use end of tool to push on C-ring for ground connection.

Ant. plugs, hi-fi, multiple plugs, public address, radio and TV tubes, radar, speakers, and loop connections. Many, many more uses.

Model LC-3 for 5/32" pin diameter

At your parts distributor, or write us

BERN'S MANUFACTURING CO.
60000 KUNSTMAN
WASHINGTON, MICH. 48094

Circle 28 on literature card

NEW FROM INJECTORALL



HERE'S PROOF!

PROOF that "SUPER 100" tuner cleaner is BETTER!

Tested by a leading independent laboratory against competitive products!

	SUPER 100	A	B	C
CLEANING	Excellent	Good	Fair	Fair
LUBRICATION	Good	Fair	Fair	Poor
PLASTIC ATTACK	None	None	None	None
FLAMMABILITY	None	None	None	None
CONDUCTIVITY	None	None	Slight	Slight
ANTI-STATIC PROTECTION	Excellent	Fair	Poor	Poor
DRIFT	None	Slight	Yes	Yes

SUPER 100 TUNER CLEANER... for COLOR and Black and White TV tuners
6 oz. spray can with INJECTORALL steel needle CAT. NO. 100-6 net \$1.95
Buy it at your Electronic Dealer.
For free catalog on the complete line, write to:

INJECTORALL ELECTRONICS CORP.

Great Neck, New York 11024

Circle 29 on literature card

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 mid-band frequency rise will be observed, as illustrated in Fig. 5. Be sure that you do not apply the

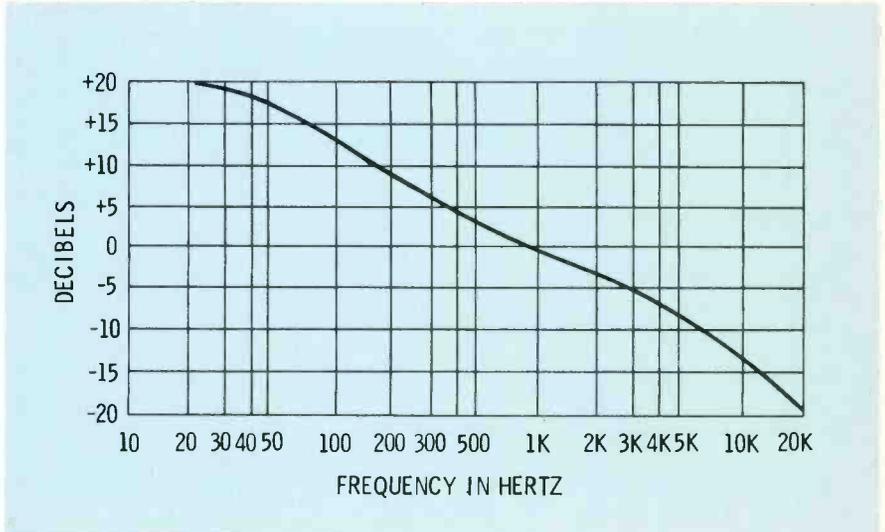


Fig. 7 Record Industry Association of America (RIAA) equalization curve for playback of records.

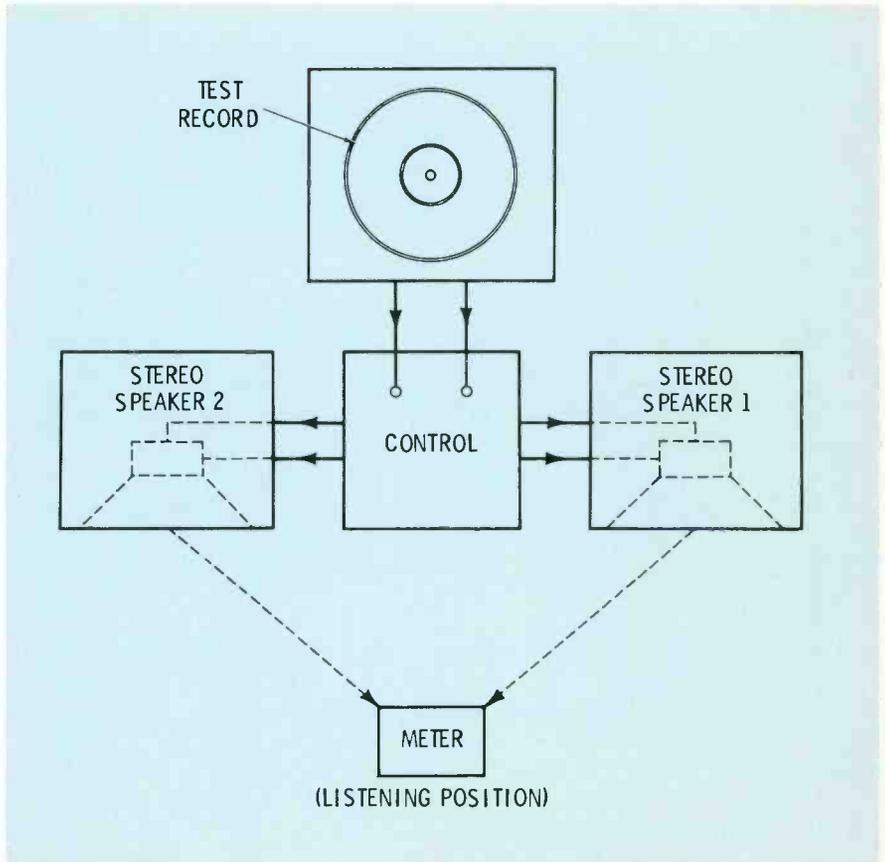


Fig. 8 Test setup for checking the balance of a stereo system.

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-

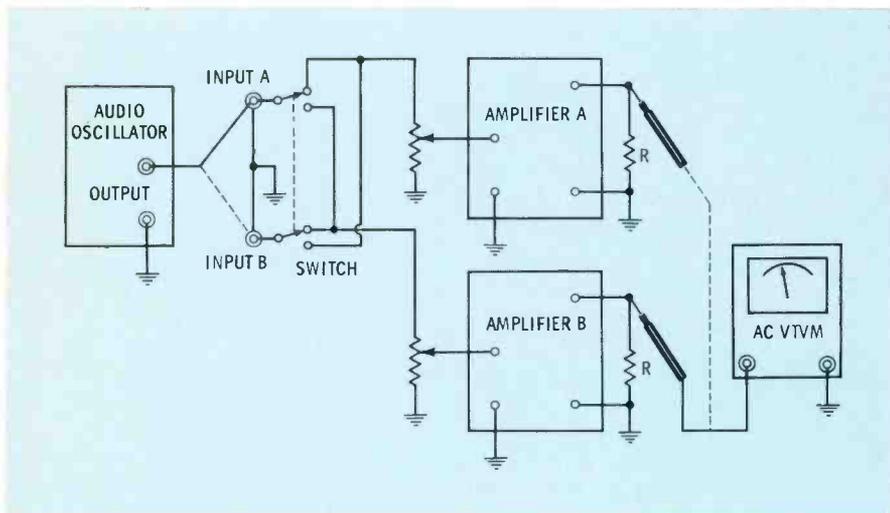


Fig. 9 Checking crosstalk between stereo amplifiers.

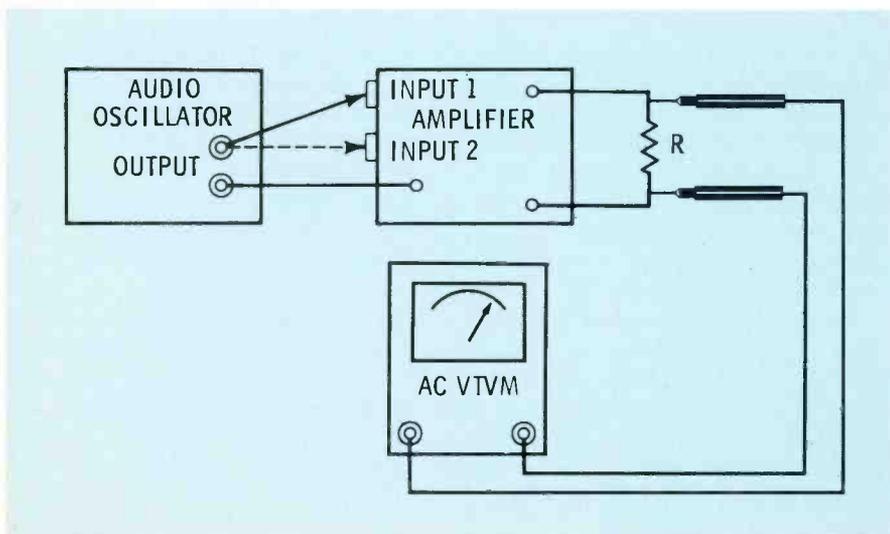
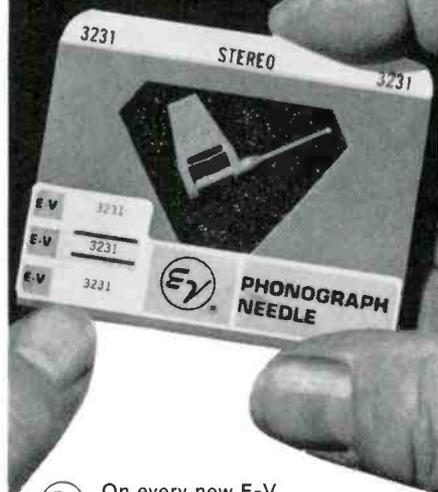


Fig. 10 Test setup for checking crosstalk between inputs of an amplifier.

This new E-V phono needle package helps you buy, sell, then sell again!



On every new E-V needle package you'll find the model number printed three extra times on pressure sensitive tabs. Here's why:

The tabs can help you order replacements. Or keep track of sales. Or you can stick one on a file card in a follow-up system that tells you what and when a customer last bought (so that you can tell him when to buy again)! Or put a tab on the customer's tone arm to simplify service on the next call.

But don't be surprised if one of the tabs is missing. Your E-V distributor may be using one to keep track of his stock —so that you always have the needle you want, when you want it.

Smart ideas in packaging of the world's finest phono service parts help make Electro-Voice your best buy. Available only from the parts distributor with much more than parts to offer!

Ask for your copy of the latest Electro-Voice phono needle/cartridge combined catalog. It's free at your E-V distributor's.

ELECTRO-VOICE, INC., Dept. 197R
632 Cecil Street, Buchanan, Michigan 49107



Circle 30 on literature card

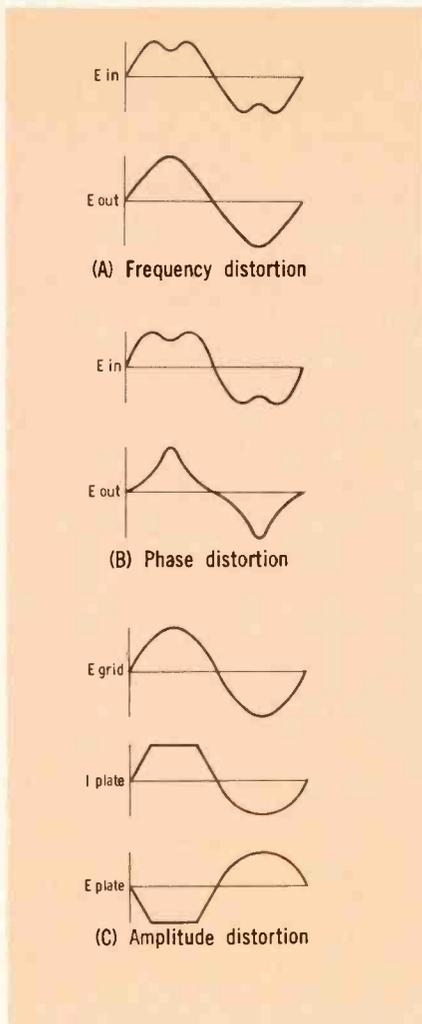


Fig. 11 Three basic types of amplifier distortion.

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

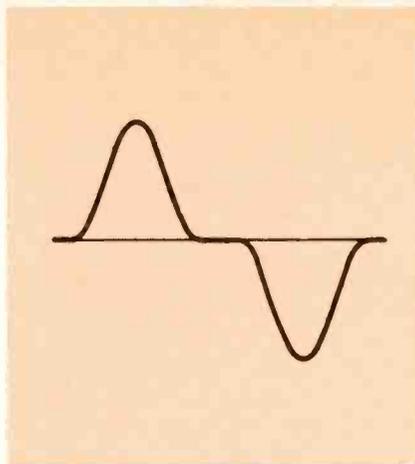


Fig. 12 An example of crossover distortion.

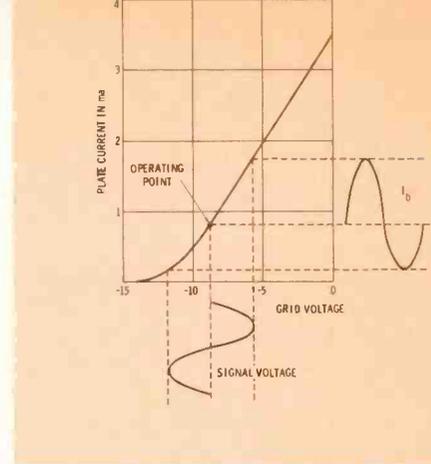


Fig. 13 Compression of the negative half cycle.

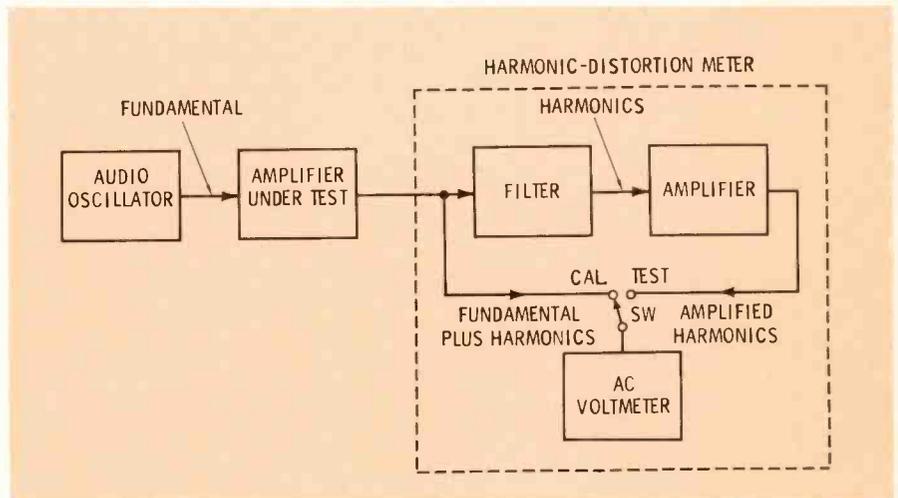


Fig. 14 Test setup for measuring harmonic distortion.

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

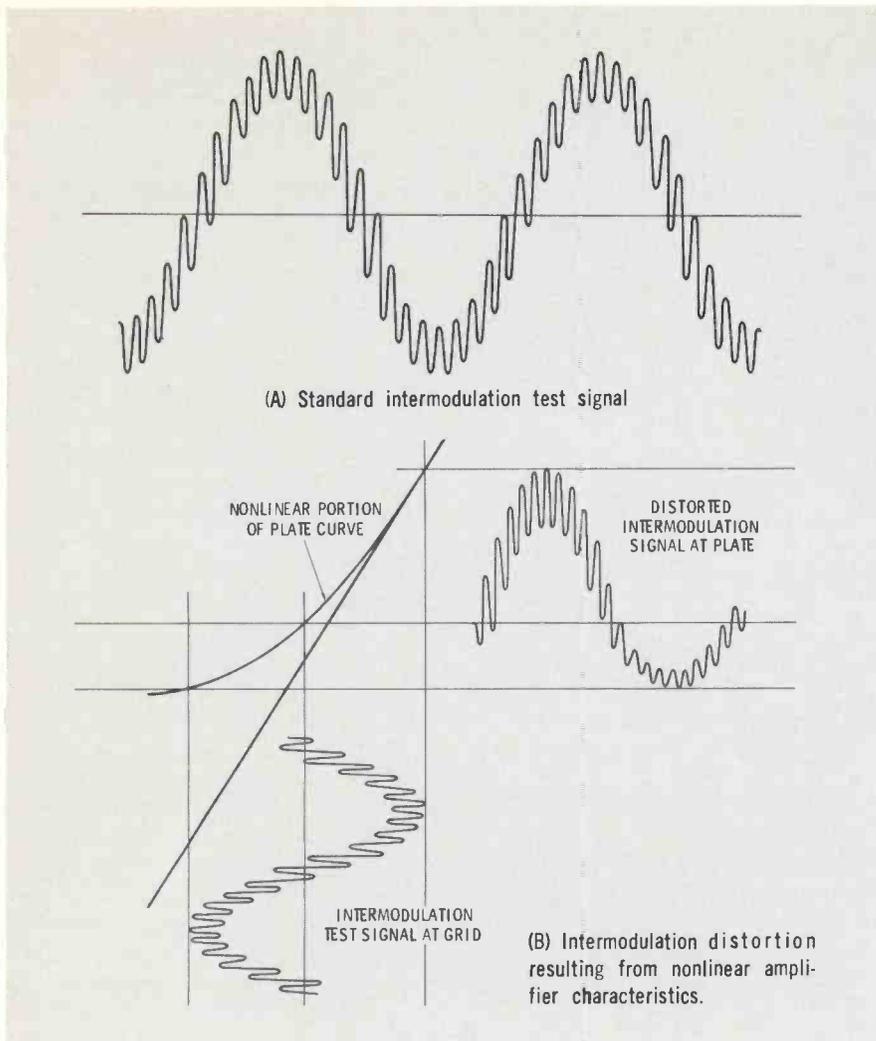


Fig. 15 Test signal and results of intermodulation distortion test.

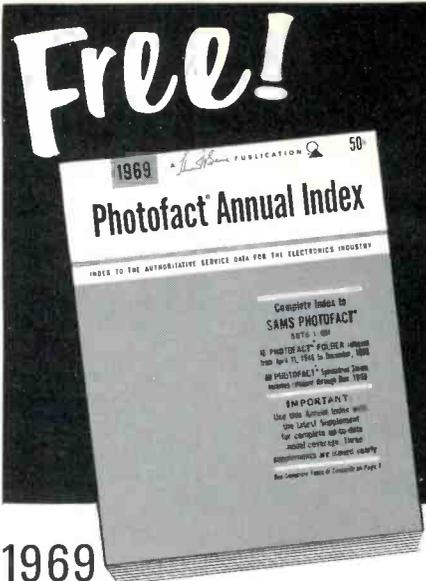
shown in Fig. 11. First, consider frequency distortion. The input waveform, "Ein", has a low-frequency component and a high-frequency component. However, because of poor high-frequency response, the high-frequency component does not appear in the output waveform, "Eout."

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.



1969 Photofact® Annual Index

your instant guide to the world's finest troubleshooting data...

COVERS OVER 78,000 DIFFERENT MODELS:

- TV Receivers
 - Home & Auto Radios
 - Phonos & Hi-Fi
 - CB Radios
 - Tape Recorders
 - Record Changers
- Special Color TV Index*

Send today for this valuable 136-page index to PHOTOFACt troubleshooting data for virtually every model of electronic home-entertainment equipment produced since 1946!

PHOTOFACt provides *everything* you need in complete, uniform style for quick, effective repairs: Famous Standard Notation Schematics packed with the trouble-shooting details you need; Full Photo Coverage of all chassis views; Complete Replacement Parts Lists; Tube Placement Diagrams; Troubleshooting Charts; Alignment Instructions; CircuiTrace® for printed boards; Disassembly Instructions; Dial Cord Diagrams; Changer and Recorder "Exploded Views"—plus dozens of other great features.

Get your FREE copy of the latest PHOTOFACt Index to the service data you need!

Available from
your Sams Distributor,
or send coupon today

FREE
INDEX

Howard W. Sams & Co., Inc.
Dept. PFF-1

4100 W. 62nd St.,
Indianapolis, Ind. 46268

- Send FREE 1969 Photofact Annual Index
- Send full details on money-saving Photofact-of-the-Month Club subscription plan

Name _____

Address _____

City _____

State _____ Zip _____

Circle 31 on literature card

Fig. 16 Basic configuration of an intermodulation distortion analyzer.

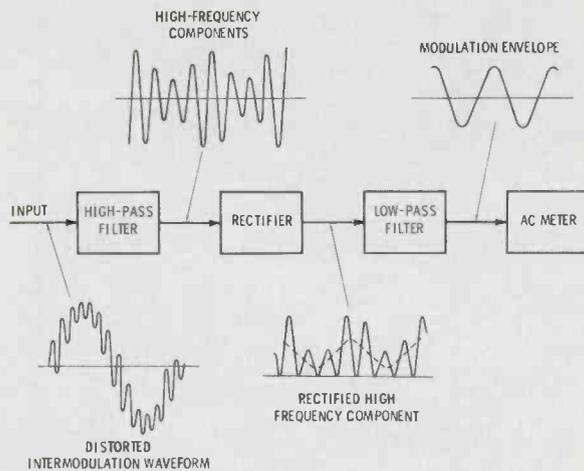


Fig. 17 Characteristics of the filters in a typical intermodulation distortion analyzer.

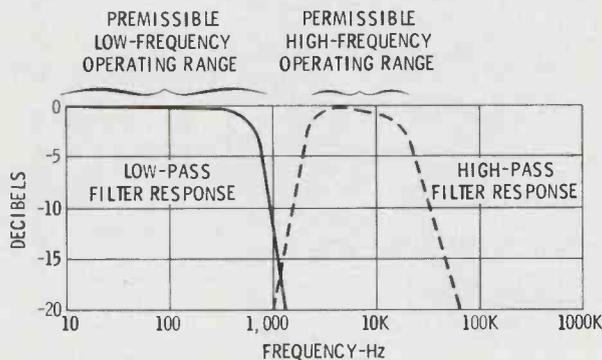


Fig. 18 Test setup for measurement of intermodulation distortion.

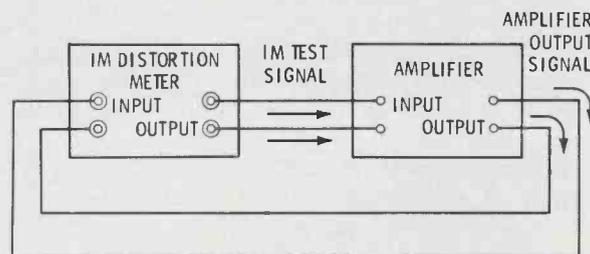
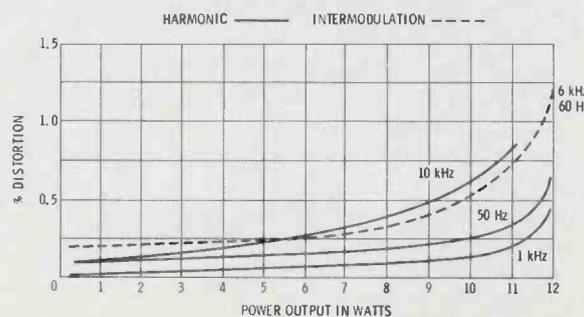


Fig. 19 Harmonic and intermodulation distortion percentages for a typical high-fidelity amplifier.



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 opera-

tion. 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.

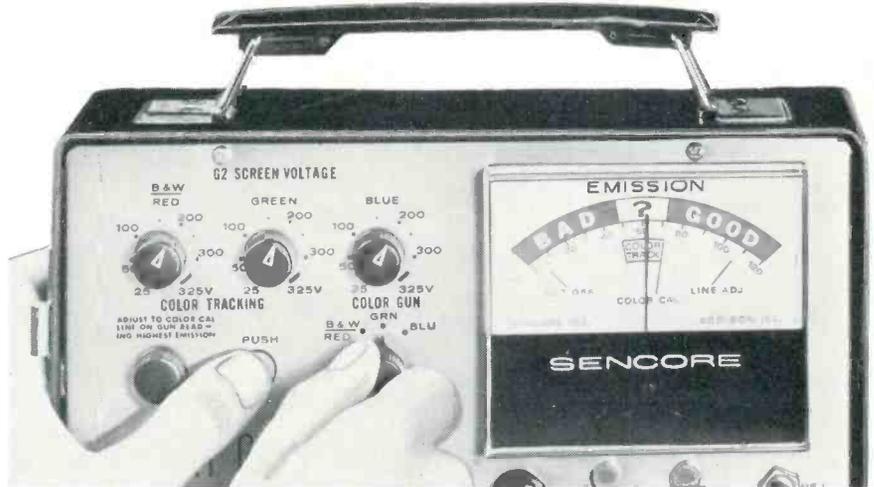
When an amplifier exhibits objectionable intermodulation distortion, the probable causes are the

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. ▲

Now—Compare CRT Color Guns AUTOMATICALLY!



- Simplifies Color CRT Tracking Test
- Tests Each Gun in Color or B&W CRT's Completely

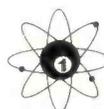
Now, for the first time, you can test CRT color guns for color tracking automatically; and exactly according to industry standards. No more time-consuming logging of each color gun reading at every setting of the G2 control like other testers.

Only the Sencore CRT CHAMPION has three separate G2 screen grid controls just like the color TV itself. A color tracking scale right on the meter makes the all-important tracking test easy, fast, and accurate. This is most important when claiming credit for a defective color CRT.

The CHAMPION also makes all the standard color and black and white CRT tests — short, emission, and life tests. Line Adjust control assures exceptional accuracy. An exclusive three step Automatic Rejuvenation Circuit lets you save many a faulty black and white tube or equalize gun currents in color tubes. Plug-in sockets are provided for fast testing and easy updating. Rugged vinyl-clad steel case has spacious lead compartment.

CRT manufacturers, set manufacturers, distributors, technicians all recommend the CR143 CRT tester as the only tester that does a complete job. Why not check with them before you buy.

Sencore CR143 — CRT CHAMPION ... \$99.50



SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Circle 32 on literature card



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 preceding 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)	Sound Carrier
4.5 MHz	
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-

JFD'S NEW ...

'82' CHANNEL HEAD-END AMPLIFIER IS EXACTLY WHAT YOU NEED!



JFD's Model SL-3155 '82' channel color perfect Head-End Amplifier is an industry first. This new and unique solid state unit guarantees total UHF/VHF/FM - FM Stereo reception.

30 db gain — over 54 dbmv output capability.

Automatic circuit breaker cutoff to detect shorts on the line.

17 volt DC spare output for powering preamplifiers and up to 10 JFD SMOOTHLINE amplified accessories.

Like SL-3155, V-3130 VHF and U-3140 UHF Head-End Amplifiers are solid state and set a new high industry standard.

For complete details — write for catalog SYS-68 or see your local JFD representative.

JFD SMOOTHLINE

JFD ELECTRONICS CO./SYSTEMS DIVISION

15th Avenue at 62nd Street • Brooklyn, N.Y. 11219/Phone 212-331-1000

Circle 33 on literature card

CRT Rebuilder



Rebuild your own CRT's. Average cost B/W \$1.50—Color \$8.50. Easy to operate. Requires only 4x8 feet of space.

Supplies for your first 50 picture tubes free!

Color — black and white. Rebuilt while you are here. See the results for yourself. Terms Available

Lakeside Industries - Div. Associated Ind.
6338 N. Clark St.
Chicago, Ill. 60640
Phone: 312-465-2881

- Free demonstration appointment
- Send me more information

Name

Address

City

State

Circle 34 on literature card



check the "Silencer" . . .

QUIETROLE

Check QUIETROLE . . . the "Silencer" for noisy radio, TV, (black and white, color too) and instrument controls, that protects your reputation, guards your profits.

QUIETROLE, the quality lubricant-cleaner for over 20 years, is harmless to plastics and metals, is non-conductive, non-corrosive, non-flammable . . . with zero effect on capacity and resistance.

For best results, specify QUIETROLE . . . Mark II for tuners Spray Pack for controls and switches Silitron for general use Available in Aerosol Can or Dropper Bottle



manufactured by
QUIETROLE COMPANY
Spartanburg, South Carolina

Circle 35 on literature card

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 47K-ohm resistor is located at each gun killer switch. This configuration substantially 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.

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 re-

turned 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 tolerance. 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

FREE

GIANT 1969 RADIO-TV ELECTRONICS CATALOG

228 GIANT VALUE-
PACKED PAGES



YOUR BUYING GUIDE FOR . . .
TV's, Radios, Recorders, Phonos,
Amateur and CB equipment, elec-
tronic parts, tubes and test equip-
ment . . . plus featuring B-A's
famous bargain packed section!

WRITE FOR YOUR FREE CATALOG TODAY!

BURSTEIN-APPLEBEE CO., DEPT. PFR-A
3199 MERCIER ST., KANSAS CITY, MO. 64111

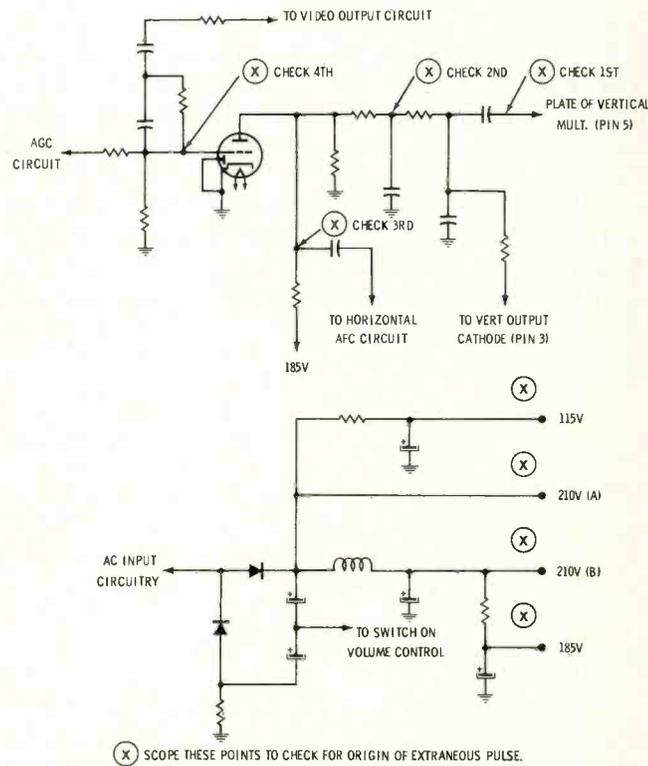
Name _____

Address _____

City _____

State _____ Zip Code _____

Circle 36 on literature card



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.

color



The **RCA WT-509A** Picture Tube Tester is a precision instrument in the famous RCA tradition. It tests both color and black and white picture tubes for emission quality, interelectrode leakage, and shorted elements. It's all solid-state AND IT'S ONLY \$118.00.*



The **RCA WR-64B** Color-Bar/Dot/Crosshatch Generator has for years been the finest instrument of its type. Exceptionally stable, portable, it's a precision instrument designed for use in the laboratory and factory as well as for servicing on-the-bench and in-the-home. AND IT'S ONLY \$129.00.*



The **RCA WR-502A** "CHRO-BAR" color-bar generator has even more features than the famous WR-64B. It's all solid-state, battery operated. It provides color bars, dots, crosshatch, vertical lines, horizontal lines, blank raster. It has rock-solid stability. All new circuit design. THE "CHRO-BAR" IS ONLY \$168.00.*

*Optional Distributor resale price.

For a complete catalog of descriptions and specifications for all RCA test equipment see your RCA Test Equipment distributor or write RCA Electronic Components, Commercial Engineering, Department No. A-33-W Harrison, N.J. 07029.

LOOK TO RCA FOR INSTRUMENTS TO TEST/MEASURE/VIEW/MONITOR/GENERATE

Circle 37 on literature card

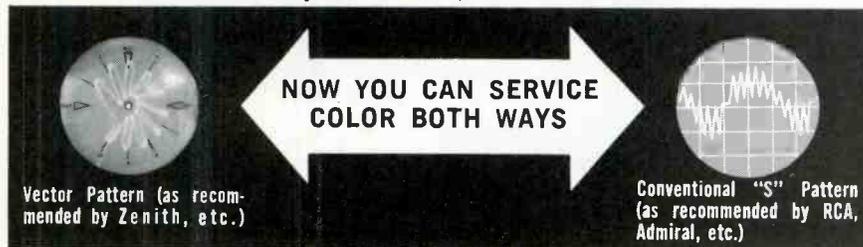
RCA

THE FIRST REALLY COMPLETE SCOPE



NEW OSCILLOSCOPE/VECTORSCOPE

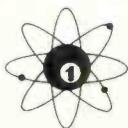
With just the flip of a switch



A truly remarkable service scope; complete for every servicing test recommended by any and all TV manufacturers. For the very first time, here is a scope sensitive enough to view the IF tuner output but with adequate high voltage protection to view the plate of the horizontal output tube directly. Leave the rear view switches in their normal position and you can use the PS 148 to service color TV from chroma take off to the tri-color tube following the standard RCA "S" pattern approach. Flip the VECTOR switch on the rear and you have converted to a standard vectorscope . . . and for only \$20.00 more than the Sencore scope without vectors. Compare these specifications and you will be convinced that the PS 148 is the most complete, versatile scope on the market today.

- **Direct Peak to Peak Voltage Measurements.** Read the peak to peak waveform voltage directly from the vertical input controls. Faster and easier than a VTVM and extremely accurate.
- **Wide Band.** Vertical amplifier frequency response is flat from 10HZ to 5.2MHZ \pm 1DB.
- **High Sensitivity.** Vertical amplifier sensitivity of .017 volts RMS per one inch deflection. Ultra sensitive for transistor servicing and for viewing signals directly off a TV tuner.
- **Direct and Lo-Cap Probe** on one cable for maximum versatility. The Lo-Cap probe can handle high voltage signals up to 6000 volts peak to peak.
- **Extended Horizontal Sweep Frequencies.** Horizontal sweep ranges from 5HZ all the way to 500 KHZ in five overlapping steps; allows you to look at higher frequency waveforms. Sync is so positive you would think it has triggered sweep.
- **Exclusive Vectorscope Features.** Flick one switch at the rear of the PS 148 and you have an easy to use vectorscope. This new vector pattern greatly simplifies chroma trouble shooting and bandpass alignment.
- **Minimum Circuit Loading on Vectors.** Prevents distorted vector patterns due to lead capacity loading by having vectorscope connections on rear of PS 148.
- **Special Vectorgraph Screen.** Shows exact degree of chroma demodulation.
- Provisions for intensity modulation and direct connections to CRT deflection plates on rear for forming lissajous patterns, etc. Just a flick of two switches; no need to disconnect leads or make special connections.

PS 148
\$229⁵⁰



SENCORE

NO. 1 MANUFACTURER OF ELECTRONIC MAINTENANCE EQUIPMENT

426 SOUTH WESTGATE DRIVE, ADDISON, ILLINOIS 60101

Circle 38 on literature card

bookreview

TV Servicing Guidebook, Problems and Solutions: Art Margolis, TAB Books, Blue Ridge Summit, PA, 1968; 176 pages, 5½" x 8½", 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 gray-scale 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.

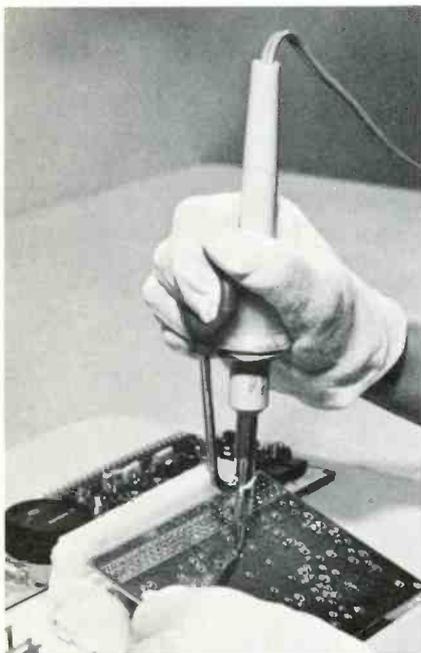
Chapters 8 and 9 encompass troubles peculiar to sound and power supply circuits. ▲

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 Sniffer, 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

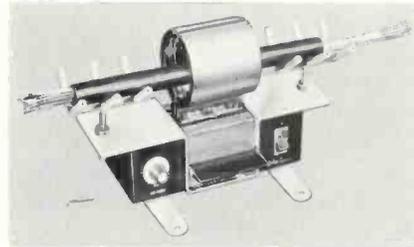
television interference rejection which is guaranteed 40 dB or better. The CB operator inserts the filter between the antenna and transmitter and sets the selector dial of his television to channel two or channel six. When transmitting he adjusts the control knob on the filter until the TVI has been 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.



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. ▲

15 patterns!

Color Bar Pattern Generator



LCG-388

Pattern appears instantly when turned on, and has laboratory standard stability. Only 3 1/8 x 7 3/4 x 7 3/4, and weighs about 4 1/2 lbs.

- Crystal controlled oscillator.
- Flipflop and logic circuitry assure highest operating stability
- One receiver input to TV antenna
- Two selectable TV channels
- Chroma level control — 0 to 200%
- Horizontal line flickering prevented by progressive scanning
- Video output
- Gun killers for convergence adjustments
- Trigger output for scope synchronization

ONLY \$149

**LEADER
INSTRUMENTS CORP.**

24-20 Jackson Avenue
Long Island City, New York
(212) 729-7410

Circle 39 on literature card

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 1/4" regular blade and a No. 2 Phillips blade; an SA-711 adjustable nut driver

RMS BEST PERFORMING
UHF CONVERTERS



**SOLID-STATE TWO TRANSISTOR
DELUXE UHF CONVERTER
HAS BUILT-IN AMPLIFIER!**

Updates any VHF TV Set to receive any of the 83 UHF/VHF Channels. Low noise, drift-free operation. Simple hook-up. Charcoal Gray Hi-Impact Plastic Housing has Silver-matte finish front panel. Features accurately calibrated UHF dial, UHF/VHF antenna switch, advanced pilot light indicator, and tuning control. Model CR-300..... List \$34.95

**RMS SOLID-STATE
ECONOMICAL
UHF CONVERTER**



Two transistor advanced circuitry. Durable metal housing has wood grain finish and Satin Gold front panel with Black knobs having Gold inserts. #CR-2TW..... List \$27.95

RMS UHF ANTENNAS . . .

Top performers for all areas! Brings clearest Color and Black and White Reception on all UHF Channels 14-83. Features Reynolds Aluminum COLORWELD!

Write for FREE Information on these and other Profit Building Products. . . .

RMS ELECTRONICS, INC.

TEL. (212) TY 2-6700

50 ANTIN PLACE, BRONX, N. Y. 10462

Circle 40 on literature card

**SPOT
CHECK**

**A RED INDICATOR
APPEARS ON THE
FACE OF YOUR TAPE
HEAD WHEN THERE
ARE ABOUT 100
HOURS OF WEAR LEFT**

FREE BROCHURE

ASK FOR
SPOT CHECK
BROCHURE

MICHIGAN MAGNETICS

A DIVISION OF VSI CORPORATION
VERMONTVILLE, MICHIGAN 49096
Telephone (517) 259-8911

Circle 41 on literature card

**advertisers'
index**

Arrow Fastener Co., Inc. 63

B & K Div. of Dynascan Corp. 1

Berns Mfg. Co. 48, 64

Burstein-Applebee Co. 58

Bussmann Mfg. Div.,
McGraw-Edison Co. 7

Castle TV Tuner Service, Inc. 5

Cleveland Institute of Electronics 29

Cornell-Dubilier Cover 2

Electro-Voice, Inc. 49

GC Electronics, A Div. of
Hydrometals, Inc. 25, 42

Game Industries, Inc. 6

Gem City Tuner Repair Service 9

General Electric Co., (Tube Div.) 27

Heath Co. 35

The Hickok Electrical
Instrument Co. 47

Injectorall Electronics Corp. 48

JFD Electronics Co. 55

Lakeside Industries, Div.
Associated Industries 56

Leader Instruments Corp. 62

Lectrotech, Inc. 4

Littelfuse, Inc. Cover 4

Michigan Magnetics,
A Div. of VSI Corp. 63

Quam-Nichols, Inc. 40

Quietrole Co. 56

RCA Electronic Components
Test Equipment 59

Picture Tubes Cover 3

RCA Institutes, Inc. 17

RMS Electronics, Inc. 63

Rohn Mfg. Co. 39

Howard W. Sams Co., Inc. 46, 51

Seco Electronics Corp. 41

Sencore, Inc. 19, 28, 37, 43, 53, 60

H. K. Simon Co. 31

Sprague Products Co. 3

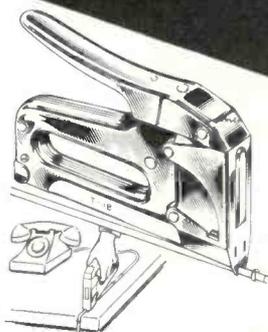
Sylvania Electronic Products Co. 15

Tuner Service Corp. 21

Xcelite, Inc. 23

Zenith Sales Corp. 11

ARROW
Automatic
STAPLE GUN TACKERS
Specially designed for
SAFE - FAST - SECURE
WIRE & CABLE FASTENING



No. T-18
For wires up to
3/16" in dia.
Uses round crown
staples in
3/8" leg only.

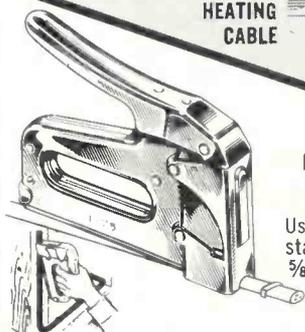
**BELL, TELEPHONE, THERMOSTAT,
INTERCOM, BURGLAR
ALARM and other
low voltage
wiring.**



No. T-25
For wires up to
1/4" in dia.
Uses round crown
staples in 9/32",
3/8", 7/16", and
9/16" leg.

Fastens same wires
as No. T-18

Also
used for
**RADIANT
HEATING
CABLE**



No. T-75
For wires and
cables up to
1/2" in dia.
Uses tack-pointed
staples in 9/16",
3/8" and 7/8" leg.

**SHEATHED CABLE, RADIANT
HEATING CABLE, WIRE
CONDUIT, COPPER
TUBING, DRIVE
RINGS, ETC.**

• All-steel,
chrome finish.
• Jam-proof mechanism
for trouble-free operation

SAFE! Driving blade automatically
halts staple at right depth of penetration!
Can't cut or injure wires and cables.

FAST! Powerful single stroke action
shoots staples in 1/1000 of a second!
Saves 70% in time, effort and efficiency!

HOLDS! Staple points diverge to
imbed firmly in wood. Rosin-coated for
tremendous holding power!

Write for catalog and information.

ARROW FASTENER COMPANY INC

Saddle Brook, New Jersey 07863

**"Pioneers and Pacesetters
For Almost A Half Century"**

Circle 42 on literature card

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 sub-miniature 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.

NEW BERN'S PERFECT PIN CRIMPER

Picture-Tube Repair Tool

Also for—5U4, 6SN7, 6BQ6, etc.

Eliminates that hard soldering job

only \$1.49 each

A MUST for round color pic tubes

PT-1
3/32" PIN

Fix loose pin connections in seconds. Pays for itself in time saved on first job. Less than 3" long. Carry it in your pocket.

Patented

Intermittent operation of picture tubes and other tubes due to defective solder connections easily corrected. Provides solid electrical connections, can also be used as channel-selector wrench and screwdriver. Pin keeps its original form. A 3-in-1 tool.

3 MODELS ELIMINATE SOLDERING

Makes Solid Electrical Connections

Phono Pin-Plug Crimper

Slip wire in "pin plug," insert in tool, and squeeze—job is done.

AU-2
1/8" PIN

C-Rings 3 for 5¢

Use end of tool to push on C-ring for ground connection.

Ant. plugs, hi-fi, multiple plugs, public address, radio and TV tubes, radar, speakers, and loop connections. Many, many more uses.

Model LC-3 for 5/32" pin diameter

At your parts distributor, or write us

BERN'S MANUFACTURING CO.
60000 KUNSTMAN
WASHINGTON, MICH. 48094

Circle 28 on literature card

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.

AGC

- Operation, analysis ofLE Nov 11
- Theory of operation, tube circuitTS Mar 64

ANTENNA SYSTEMS

- Antenna add-on kit, UHF, GavinPR Sep 65
- Antenna, indoorPR Mar 70
 - GavinPR Jul 65
 - GavinPR Aug 64
- CB antenna, New-TronicsPR Jul 65
- Coax fittings, GC Electronics .PR Feb 68
- Color antenna series, Finco .PR Apr 76
- Combiner/Splitters, Blonder TonguePR Jan 61
- InstallingMay 22
 - antennaMay 24
 - antenna mountsMay 22
 - distribution systemsMay 26
 - lead-in, selectionMay 23
 - mastsMay 23
 - running lead-inMay 23
 - step-by-step procedureMay 52
 - tools neededMay 22
 - trouble areasMay 27
- Lead-in, facts aboutMay 30
 - applicationsMay 35
 - attenuationMay 30
 - costsMay 34
 - durabilityMay 31
 - impedanceMay 31
 - interferenceMay 34
 - selectingLE Dec 13
- Lubricant for rotatorsLE Nov 13
- MATV
 - channels 4 and 7, good; 13, weakTS Nov 66
 - designingMay 44
 - maintenanceMay 48
 - power supply, JFD Model SL-6514PR Jun 73
 - preparing bidMay 48
 - sellingMay 43
- Matching transformer, WorkmanPR Feb 70

Mobile

- color TV antenna, for selling . May 4
- FincoPR Feb 68
- Parapet mount, South River . .PR Mar 68
- Planning systemsMay 15
 - lead-inMay 20
 - multi-set systemsMay 21
 - rotatorsMay 21
 - selecting antennaMay 15
 - signal splittersMay 20
- Preamplifiers, VHF/FM, JFDPR May 69
- Roof tower antenna mount, South RiverPR Oct 63
- Rotators, antenna
 - cold weather tipsMay 40
 - color tipsMay 41
 - control cableMay 38
 - groundingMay 40
 - installationMay 37
 - JerroldPR Sep 61
 - mounting proceduresMay 40
 - multi controlMay 38
 - remoteMay 40
 - selectingMay 36
 - servicingMay 42
- Splitter/Mixers, MosleyPR Apr 76
- UHF converter
 - amplifier, RMSPR Sep 65
 - TompkinsPR May 68
- UHF coupler, GavinPR Nov 74
- UHF/VHF mixer, JFDPR Jul 65
- VHF/UHF 82-channel antenna, WinegardPR Aug 66

AUDIO GENERATORS

- RCA WA-504APR Mar 70

ASSOCIATIONS, SERVICE

- Director of NEA Technician CertificationES Dec 6
- EIA 1969 New ShowES Nov 10
- EIA president electedES Aug 10
- FTC decision, challenge to by NATESAES Apr 4
- ICS grading of NEA certification testsES Apr 5

- Keynote address, by Frank Moch at NATESA ConventionES Nov 4
- Motion picture on electronic technicians, NATESA, NEAES Jun 8
- Oklahoma TESA honors distributorsES Dec 6
- Oregon association joins NEAES Nov 10
- NEA convention activitiesES Oct 7
- Price survey conducted by Michigan TSAES Dec 6
- Project Transition, EIAES Apr 6
 -ES Jun 4
- Radiation fact sheet, NATESA .ES Jun 6
- Salary and pricing survey, TEAES Sep 12
- Sell-Service Program, EIAJun 10
- STDP program, EIA'sAug 39
- TEA joins NEAES Aug 8
- Training programs, NATESAES Apr 4
- Virginia Electronics Association's stand on warrantiesLE Dec 10

AUDIO SYSTEMS

- Alignment of TV sound system . .Feb 62
- Compressor-Preamp, Caringella Model ACP-1PR Sep 58
- IC phono cartridgeJul 18
- Impedance matching and power distribution, PA systemsJul 37
- Level controls, JensenPR Jun 71
- Loudspeaker, Atlas Model CJ-125PR Jun 74
- Mixer/PreamplifierPR Jan 59
- Mixing transformer, AlcoPR Oct 62
- PA system, Mobile, Bell P/A .PR Jul 69
- Record changer repairOct 16
 - adjustmentsOct 23
 - cycling problemsOct 20
 - lubricationOct 23
 - motor problemsOct 17
 - speed control unitsOct 18
 - speed problemsOct 16
- Shut-down control, Saxton . . .PR Nov 74
- Speakers, public-addressFeb 10

Tape case, Winegard PR Sep 58
 Tape recorders, repairing
 portable Aug 26
 Test equipment for servicing Mar 22

AUTO RADIO

Alignment procedures, general . . . Sep 38
 Bench checking Sep 34
 —distortion Sep 38
 —inoperative radio Sep 34
 —intermittent conditions Sep 36
 —weak reception Sep 36
 Fading
 —Mercury 6TMM Jul 27
 —Motorola GV800 Jul 30
 In-Auto checks Sep 34
 Inoperative
 —Buick Apr 49
 —distorted, Ford 5TMF Jul 30
 —Mercury 4TBM Jul 42
 —Rambler 5TMR Jul 32
 Intermittent
 —Chevy 986544 Jul 32
 —Delco 983873 Jul 26
 —Ford 6TBF Feb 30
 Left channel dead, Ford Model
 T6SMS TS May 61
 Noisy and intermittent operation,
 Bendix 5BV Jul 30
 Removing and installing auto
 radio Sep 38
 Squeal, Ford 5TBF Jul 26
 Vibration in speaker, Motorola
 TM296M Jul 27
 Volume low, Chevy 988295 Jul 30

BOOK REVIEWS

AM-FM-TV Alignment Apr 70
 CB Radio Antenna May 64
 How To Use Signal Generators . . . Aug 58
 How To Use Signal Generators
 in Color TV Servicing Feb 54
 Know Your Sweep Generator Jan 62
 Lasers and Masers Mar 10
 Measuring Methods and Devices
 in Electronics Sep 67
 Modern TV Waveform Analysis . . . Dec 67
 RCA Receiving Tube Manual,
 RC-26 Oct 66
 Servicing Transistor Equipment . . . Oct 66
 Transistor Fundamentals,
 4-volume series Nov 78
 Understanding and Using Your
 Oscilloscope Feb 59
 Understanding Electronic Test
 Equipment Oct 66
 Understanding Silicon Controlled
 Rectifiers Jun 70

B-W TELEVISION

AGC, transistorized Jun 50
 Alignment procedure, alternate,
 RCA KCS109 TS Feb 60
 Bending, horizontal and vertical
 distortion, Airline GTM-
 2565A TS Dec 59
 Blooming, brightness increased,
 Catalina 122-772B TS Sep 54
 Boost voltage low, Westinghouse
 V2372-27 TS Feb 60
 Brightness level reduced as sound
 level increased, Emerson
 120517E TS Apr 73
 Christmas treeing, Sears
 562.10080 TS Nov 70
 Compression at left of raster,
 Zenith 1Y21B55 SYM Sep 51
 Dark picture, RCA KCS142 TS Jan 43
 Drive line, Christmas treeing,
 Zenith 1Y21B55 SYM Sep 50

Flyback failure
 —repeated, Westinghouse
 V2373 TS Dec 59
 —Zenith 14M23 TS Jun 68
 Foldover, horizontal, Zenith
 1Y21B55 SYM Sep 48
 Foreign conversion LE Jan 35
 Height reduced, Magnavox
 T908CA TS Nov 68
 High voltage missing
 —G.E. TA TS May 60
 —Zenith 14M23 TS Jan 41
 High-voltage problems, Zenith TS Jan 47
 High voltage tube insulator
 arcing, Muntz TS Oct 60
 Horizontal sync intermittent TS Feb 61
 Intermittent vertical roll,
 RCA KCS136Y Feb 50
 Ion spot and halation,
 Zenith 17B20 TS Jan 47
 Multi-troubles, troubleshooting . . Oct 24
 —checking audio Oct 27
 —checking sync Oct 29
 —checking tuner Oct 25
 Narrow raster
 —linearity near normal,
 Zenith 1Y21B55 SYM Sep 52
 —Zenith 1Y21B55 SYM Sep 49
 Picture and sound missing,
 Dumont Model RA-168 TS Mar 64
 Picture fades, arcing, Muntz TS Aug 61
 Picture intermittent, sound
 normal TS Aug 60
 Picture missing, sound normal,
 RCA KCS159A TS Nov 69
 Raster missing, high voltage
 low, RCA KCS107 TS Nov 70
 Retrace lines, Emerson
 U1840 TS Dec 61
 Smear in direction of scan,
 white TS Sep 53
 Sound system alignment Feb 62
 Sync and brightness troubles,
 RCA KCS136YA TS Jan 43
 Tuner defects, symptoms
 resulting from Dec 40
 —pulling, distortion, partial
 blanking Dec 42
 —ringing, ghosts and smear . . . Dec 43
 —separation of sound and
 picture Dec 42
 —snowy picture Dec 40
 Tuner repair Dec 36
 —fine tuning & oscillator
 adjustments Dec 43
 —general service procedures . . . Dec 43
 —intermittents Dec 38
 —mixer stage Dec 38
 —oscillator stage Dec 36
 —removal Dec 36
 —RF amplifier Dec 40
 Vertical hold marginal,
 Philco Q1214 TS Jul 62
 Vertical roll
 —intermittent, GE 14TO10 TS Nov 67
 —intermittent raster shrinkage,
 RCA 17PD8094 Sep 4
 —Zenith TS Jan 46
 Video detector shorted,
 G.E. AY, AA TS May 60
 White bar creeps up raster,
 Sears 528-51784 TS Jun 69
 Width
 —excessive, Zenith
 1Y21B55 SYM Sep 52
 —reduced after 20 minutes,
 Hotpoint 21S407 TS Oct 58
 —reduced, RCA KCS109 TS Feb 60
 —reduced, wavy raster
 edges, RCA 233B605 TS Nov 68

BUSINESS

Future profits, planning for Feb 46
 Microfilm service data system,
 Sylvania ES Nov 9
 Occupational outlook report ES Nov 10
 Rate schedule for TV servicing,
 FTC ruling on ES Oct 4
 Relocating Jan 36
 Truck signs, Seton PR Oct 64

CITIZENS BAND

Base station antenna, New-
 Tronics Model GP-1 PR Jun 72
 Test equipment for servicing Mar 26

COLOR GENERATORS

Amphenol Model 865 PR Apr 75
 NTE Jul 59
 Leader Model LCG-387 PR Jan 60
 NTE Feb 64
 RCA Model WR-502A PR Jul 67

COLOR TV

AGC, operation of
 —Admiral CT Jan 18
 —RCA closed loop CT Jan 13
 —RCA CTC31 SYM Apr 33
 —Zenith CT Jan 20
 AGC, transistorized Jun 50
 Antenna, mobile unit for selling . . . May 4
 Automatic Saturation Control,
 Admiral CT Jan 18
 Blooming picture Nov 24
 —excessive, RCA CTC25 Nov 27
 Blue missing SYM Aug 32
 —G.E. SYM Mar 60
 —green weak SYM Jul 36
 Blue tinted screen during
 warmup Aug 34
 Boost voltage reduced,
 RCA CTC19D TS Sep 54
 Brightness
 —excessive Apr 26
 SYM Aug 32
 —excessive, Sylvania DO2 TS Jun 68
 —low, hum bars, RCA
 CTC22 Jul 50
 —missing Apr 26
 —not controllable,
 Zenith 25NC37 VSS Mar 51
 Burst amplifier, operation of
 —Admiral CT Jan 18
 —Zenith CT Jan 19
 Buzz in sound
 —Magnavox T/U904 VSS Jan 49
 —Zenith 25NC37 VSS Mar 51
 B-W picture poor Nov 22
 —RCA CTC16XL Aug 20
 Chroma demodulator and CRT
 input troubles Nov 22
 Chroma demodulator, operation of
 —balanced diode type SYM Mar 59
 —diode type Feb 33
 —low-level pentode Feb 39
 —low-level triode Feb 39
 —sheet-beam Feb 39
 —twin pentode Feb 47
 Chroma reference oscillator,
 operation of SYM Jul 33
 Color adjustment critical,
 RCA CTC22 Jul 49
 Color bars wrong hue, Philco
 17QT85A Nov 60
 Color erratic due to
 lightning strike TS Nov 72
 Color fades, fine tuning
 returns, Symphonic TS Aug 60
 Color in b-w picture, RCA
 CTC17 VSS Apr 54
 Color intermittent

- RCA CTC15 Aug 22
- RCA CTC17, 25 Nov 25
- Color killer inoperative, Zenith 25NC37 VSS Mar 52
- Color killer, operation of
 - Admiral CT Jan 19
 - RCA CT Jan 16
 - RCA CTC31 SYM Apr 33
 - Zenith CT Jan 20
- Color missing
 - Admiral G11, 13 CCM Feb 57
 - G.E. CA VSS Feb 41
 - incorrect color SYM Jul 34
 - Magnavox T/U904 VSS Jan 49
 - VSS Jan 50
 - Motorola STS-914 VSS Mar 50
 - overloaded SYM Jul 36
 - RCA CTC17 VSS Apr 53
 - VSS Apr 54
 - RCA CTC20C TS Dec 61
 - RCA CTC31 SYM Apr 35
 - SYM Apr 36
 - SYM Apr 36
 - Sylvania 580-1, -2 VSS Feb 43
 - VSS Feb 44
 - Truetone 2DC1695A VSS Apr 55
 - VSS Mar 56
 - Zenith 25NC37 VSS Mar 52
 - Nov 22
- Color overshoot, Zenith 25NC37 VSS Jan 52
- Color phase wrong, Zenith 25NC37 VSS Mar 51
- Color smeared and slightly wrong, RCA CTC38 Nov 60
- Color stripes behind regular color picture, RCA chassis Nov 61
- Color Sync
 - alignment or defect Apr 15
 - erratic, Magnavox T/U904 VSS Jan 50
 - intermittent, G.E. CA VSS Feb 41
 - intermittent, RCA CTC17 VSS Apr 53
 - intermittent, Sylvania 580-1, -2 VSS Feb 43
 - lost when channel switched TS Aug 63
 - lost when channel switched VSS Jan 52
 - missing, no color SYM Jul 35
 - missing, RCA CTC25X TS Jul 63
 - poor, Zenith 25NC37 VSS Mar 52
 - weak, RCA CTC25X Nov 59
- Color tracking circuit, Hoffman CT Feb 49
- Color unstable, Motorola STS-914 VSS Mar 50
- Color weak
 - color sync unstable SYM Jul 34
 - G.E. SYM Mar 60
 - RCA CTC19 CCM Aug 57
 - RCA CTC31 SYM Apr 35
 - SYM Jul 35
- Contrast
 - poor, Zenith 25NC37 VSS Jan 52
 - varying, Truetone 2DC1695A VSS Apr 56
- Convergence
 - dynamic circuits Apr 67
 - rectifiers, GC PR Mar 69
 - shifting, Zenith 23XC36 TS Jul 62
- Crackling sound, intermittent, Motorola STS-914 VSS Mar 50
- CRT
 - grid clampers, RCA CT Feb 49
 - testing Dec 44
- Dark picture, brightness control has little effect, RCA CTC16X CCM Jun 66
- Defects, steps for isolating Dec 45
 - brown dots Dec 46
 - b-w picture poor Dec 45
 - convergence poor Dec 48
 - flashes Dec 45
 - focus poor Dec 46
 - gray-scale changing Dec 45
 - low brightness Dec 45
 - purity changing Dec 46
 - raster dead Dec 48
 - raster missing Dec 45
- Difference amplifiers, operation of SYM Aug 31
- Dim picture
 - RCA Nov 27
 - RCA CTC12, 15 CCM Jan 53
- Dim raster, Zenith 25NC37 VSS Jan 51
- Fading Picture, RCA CTC15 CCM Jan 54
- Flashing lines in picture
 - picture distorted, RCA CTC24 Aug 24
 - Zenith 23XC36 TS Aug 62
- Flesh tones
 - fair, other colors wrong, Admiral D11 Nov 60
 - too purple or green, RCA CTC24 Nov 60
- Flyback
 - failure, repeated, RCA CTC4A TS Nov 69
 - overheated, RCA CTC25 Aug 23
- Focus poor
 - RCA CTC24 Aug 23
 - Zenith 25NC37 VSS Jan 51
 - Nov 24
 - Apr 28
- Gas symptoms in tubes, RCA CTC28 TS Jun 69
- Green flashes on right of screen, RCA CTC16 TS Aug 63
- Green lines at top of raster, RCA CTC22 Jul 50
- Green missing, RCA CTC19P Aug 22
- Green reproduction poor, Admiral G11 CCM Feb 57
- Green screen during colorcast, G.E. SYM Mar 61
- Green spacing between keyed rainbow color bars, RCA CTC10 CCM Feb 56
- Green tinted screen Aug 33
- Grounding of PC boards, proper TS Dec 59
- Height reduced
 - Motorola TS-914 CCM Feb 57
 - RCA CTC16A TS Dec 60
- High voltage
 - fluctuation, RCA CTC22 Jul 50
 - missing, Motorola STS-914 VSS Mar 49
 - missing, RCA CTC24 CCM Jan 55
 - reduced, Zenith 23XC36 TS Aug 62
 - regulator arcing, Westinghouse TS Apr 71
 - section smoking, RCA CTC9B CCM Dec 58
- Horizontal bars of color during B-W, RCA CTC19, 20, 24 CCM Jan 54
- Horizontal jitter, Philco 12L80 TS May 62
- Horizontal output tube draws excessive current, Admiral D11 TS Oct 59
- Horizontal shift with blanking bar on right, RCA CTC20C TS Nov 68
- Horizontal sync weak, RCA CTC16, 17, 19 TS Jun 68
- Hue cannot be changed, Motorola STS-914 VSS Mar 49
- Inoperative receiver Apr 29
- Impurity in b-w, hues wrong, RCA CTC28 Nov 60
- Intermittent sound, RCA CTC17 CCM Aug 57
- Left side of picture green, right side dark purple, RCA CTC28 Nov 26
- Left side of screen dark, RCA CTC16 TS Jul 63
- Motorboating in sound, RCA CTC25 CCM Dec 58
- Narrow raster, blooming
 - Curtis Mathes CMC 22 Apr 38
 - Truetone 2DC-1605 Apr 40
- Overloaded color, RCA CTC31 SYM Apr 34
- Picture and sound missing
 - RCA chassis with KRK120 UHF tuner TS Nov 72
 - RCA CTC15AE CCM Jun 66
- Picture dark, RCA CTC16X CCM Dec 58
- Picture dim, RCA CTC19A Aug 19
- Picture missing
 - RCA CTC22 Jul 48
 - RCA CTC25 Aug 18
 - Sound normal, Philco 17MT80 TS Aug 59
 - Sound normal, RCA CTC11 CCM Dec 58
 - Sound normal, Truetone SYM Apr 56
 - Squeal in sound, RCA CTC25 CCM Jun 64
- Picture tube, operation of Apr 62
 - purity Apr 63
 - convergence, dynamic Apr 66
 - convergence, static Apr 65
 - pincushion effect Apr 67
- Pincushion circuitry Apr 68
- Plug-in transistors, Sylvania ES Aug 6
- Preset tuning, Zenith ES Aug 6
- Radiation
 - facts about Apr 8
 - G.E. KC Jul 6
 - Packard Bell booklet on ES Oct 4
 - survey, Public Health Service ES May 11
- Raster
 - and sound missing, RCA CTC12 CCM Jan 55
 - disappeared when degaussed, RCA CTC12 TS Nov 68
 - intermittent, Sylvania DO6-1 TS Dec 60
 - missing, arcing, Westinghouse TS Aug 60
 - missing G.E. CA VSS Feb 42
 - reduced top and bottom, Sylvania DO5-1 TS Oct 58
 - shrunk at bottom, Motorola WTS-907 CCM Jan 56
 - tinted green-red, RCA CTC17 VSS Apr 54
- RCA CTC22, analysis of Jul 44
- RCA's solid-state color, analysis of Dec 14
- Red-green and/or blue fields not obtainable, Zenith 25NC37 VSS Jan 51
- Red lines, intermittent, Philco 17QT85A Nov 59
- Red missing
 - G.E. SYM Mar 62
 - green incorrect, G.E. SYM Mar 62

—Sylvania DO5-1 TS Oct 58
 —Truetone 2DC1695A .. VSS Apr 55
 Apr 28
 Red picture, both b-w and color Aug 20
 Red predominant color,
 G.E. SYM Mar 61
 Red shading in raster,
 Sylvania 580-1, -2 VSS Feb 43
 Red tinted screen
 —Sylvania 580-1, -2 VSS Feb 44
 Aug 34
 Red weak, b-w tinted red .. SYM Aug 33
 Reference oscillator, operation of
 —Admiral CT Jan 18
 —G.E. CT Jan 20
 —Motorola CT Jan 21
 —RCA CT Jan 16
 —Zenith CT Jan 19
 Right side of raster pulled in,
 Magnavox C/U 43-02-10 TS May 60
 Slides added to color TV,
 Sylvania ES Jul 9
 Smear B-W and color pix,
 G.E. CA VSS Feb 42
 Solid-state
 —chrome circuits CT Jul 53
 —high-voltage rectifier,
 Motorola Jul 4
 —horizontal circuits CT Jul 57
 Sound distorted, bottom of
 picture washed out,
 Sylvania DO5-1 TS Oct 58
 Sound system alignment Feb 62
 Snow on channel 5 Apr 30
 Sync
 —intermittent, RCA
 CTC16XA Feb 29
 —lost when brightness
 reduced, RCA CTC22 Jul 49
 —vertical and horizontal,
 Truetone 2DC1695 VSS Apr 55
 Test equipment for color TV Jul 22
 —accessories Jul 24
 —color generators Jul 24
 —oscilloscope Jul 22
 —sweep alignment equipment .. Jul 23
 Tint control
 —inoperative, G.E. CA .. VSS Feb 42
 —produces only shades of
 green, Zenith 20K1C36 Nov 60
 —produces purple flesh tones,
 Zenith 20Y1C50 Nov 61
 Training sessions on RCA
 CTC40 Nov 49
 Transistors in color TV CT Jul 52
 Vectorscope, using to solve
 color problems Nov 14
 Vertical foldover and insufficient
 height, G.E. CA VSS Feb 41
 Vertical jitter
 —Magnavox T/U904 VSS Jan 50
 —RCA CTC17 TS Jun 67
 Vertical reduced, RCA
 CTC25 Aug 22
 Vertical sync drifts,
 Motorola STS-914 VSS Mar 49
 Vertical sync missing,
 RCA CTC11A TS Nov 70
 Video overload
 —Magnavox T/U904 VSS Jan 49
 —Packard Bell
 98CTD98C8 CCM Jan 53
 Washed out picture, fine
 detail blurred, Airline
 GHJ537A CCM Jun 66
 Weak, intermittent color,
 RCA CTC31 SYM Apr 34
 Wrong-hue symptoms, solving .. Nov 52

CONNECTORS AND ACCESSORIES

Adapters, connector,
 switchcraft PR Jun 73
 Cable cover, low-voltage,
 3M Co. PR Feb 68
 Low-voltage, 3M Co. PR Jan 61
CRT TESTERS
 Amphenol Model 857 PR May 67
DIODES
 Tunnel diodes, operation and
 application Jun 29
 Zener diodes, operation and
 application Jun 29
FET METERS
 Circuit analysis NTE Sep 40
 Heath Model IM-17 VOM NTE Aug 56
 Sencore Model FE14 PR Jan 60
 NTE May 58
 NTE Sep 42
 Sencore Model FE16 NTE Sep 46
 Sencore Model FE149 NTE Sep 46
 Servicing Mar 35
FM RADIO
 Gain testing, stage-by-stage Sep 28
 Monitor, FM, Cushman PR Aug 68
 Tuner alignment Nov 34
GUIDES
 Antenna systems components ... May 73
 Tube stock guide, TV Apr 22
HIGH VOLTAGE
 Fluctuation, RCA CTC22 Jul 50
 Flyback overheated, RCA
 CTC24 Aug 23
 Low, RCA KCS107 TS Nov 70
 Missing
 —G.E. CA VSS Feb 42
 —G.E. TA TS May 60
 —Motorola STS-914 VSS May 49
 —RCA CTC24 CCM Jan 55
 —Zenith 14M23 TS Jan 41
 Probe, Pomona Model 2900 NTE Jan 24
 Problems in Zenith chassis .. TS Jan 47
 Reduced, Zenith 23XC36 TS Aug 61
 Regulator arcing,
 Westinghouse V2650 TS Apr 71
 Solid-state rectifier,
 Motorola Jul 4
 Tube base insulator, arcing
 at, Muntz TS Oct 60
HIGH-VOLTAGE PROBE
 Color TV, for Jul 25
 Pomona Model 2900 NTE Jan 24
HORIZONTAL SWEEP
 Compression at left of raster,
 Zenith 1Y21B55 SYM Sep 51
 Drive line, Zenith 1Y21B55 SYM Sep 50
 Flyback failure
 —repeated, RCA CTC4A. TS Nov 69
 —Zenith 14M23 TS Jun 68
 Foldover, Zenith
 1Y21B55 SYM Sep 48
 Horizontal driver/output
 stage, operation of SYM Sep 47
 Horizontal output tube draws
 excessive current, Admiral
 D11 TS Oct 59
 Narrow raster
 —Curtis Mathes CMC22 Apr 38
 —linearity near normal,
 Zenith 1Y21B55 SYM Sep 52
 —Truetone 2DC-1605 Apr 40
 Right side of raster lost,

Zenith 1Y21B55 SYM Sep 49
 Right side of raster pulled in,
 Magnavox C/U 43-02-10 TS May 60
 Shift with blanking bar visible
 on right, RCA CTC20C TS Nov 68
 Width
 —excessive, Zenith
 1Y21B55 SYM Sep 52
 —reduced after 20 minutes,
 Hotpoint 21S407 TS Oct 58
 —reduced, RCA KCS109 .. TS Feb 60
 —reduced, wavy raster edges,
 RCA 233B605 TS Nov 68

HORIZONTAL SYNC

Intermittent
 —RCA CTC16XA Feb 29
 TS Feb 61
 Jitter, Philco 12L80 TS May 62
 Lost when brightness reduced,
 RCA CTC22 Jul 49
 Missing, Truetone
 2DC1695A VSS Apr 55
 Weak, RCA CTC16, 17, 19 .. TS Jun 68

INTERFERENCE

TVI, methods for tracing and
 eliminating Oct 10

INTERMITTENT TROUBLES

Auto radio
 —Chevy 986544 Jul 32
 —Delco 983873 Jul 26
 —Ford 6TBF Feb 30
 Clock radio, Admiral 5E3 Feb 28
 Contrast varying, Truetone
 2DC1695A VSS Apr 56
 Color
 —RCA CTC15 Aug 22
 —RCA CTC17, 25 Nov 25
 —RCA CTC31 SYM Apr 34
 Crackling sound, Motorola
 STS-914 VSS Mar 50
 Horizontal sync TS Feb 61
 Picture fades, RCA
 CTC15 CCM Jan 54
 Picture intermittent, sound
 normal TS Aug 60
 Raster intermittent,
 Sylvania DO6-1 TS Dec 60
 Sound, RCA CTC17 CCM Aug 57
 Sync intermittent, RCA
 CTC16XA Feb 29
 Testing procedures for Feb 25
 —capacitors Feb 25
 —resistors Feb 28
 —tubes Feb 28
 —transistors Feb 28
 —transformers Feb 28
 Tuners, in Dec 38
 Vertical roll
 —G.E. 14 to 10 TS Nov 67
 —RCA KCS136Y Feb 50

MARKER GENERATORS

Color TV, for Jul 24
 Heath Model IG-14 NTE Jun 60

MISCELLANEOUS

Battery-powered bus ES Aug 10
 Garage door opener,
 Perma-Power PR Aug 67
 Power outlet boxes with
 timer, Waber PR Oct 64
 Reference material Aug 36
 Safety practices Mar 43
 Waveform quiz Oct 50

OSCILLOSCOPES

Cart, Waber PR Nov 74
 Cart, Waber Model LOW-25 PR Dec 65

Data Instrument Model 555 NTE Jun 61
 Frequency of waveform,
 determining Sep 9
 High frequencies attenuated,
 Heathkit Model IO-12 TS Apr 71
 Measurement Control Devices
 Model 300 PR Dec 62
 Repairing Mar 17
 Tequipment Model S54 PR Jul 66
 NTE Aug 54
 Theory of operation Mar 17
 Troubleshooting with scope Aug 12

OHMMETERS

Digital, Hickok Model
 DMS-3200/DP-170 PR Jan 59

PICTURE TUBES

Arcing, Muntz TS Aug 61
 Rebuilder, Lakeside
 Industries PR Jun 71
 Warranties, manufacturer ES Jun 7

PROTECTION DEVICES

Auto theft protection device,
 Bussmann PR Aug 64
 Circuit breaker
 —characteristics Feb 5
 —workman PR May 69
 Fuse characteristics Feb 6
 Intrusion alarm, Euphonics
 Model A-1 PR Jun 74
 Ultrasonic Annunciator,
 Euphonics PR Sep 59

RADIO

Clock radio, typical troubles in .. Oct 32
 Gain testing, stage-by-stage Sep 28
 Intermittent clock radio
 Admiral 5E3 Feb 28
 Power adapter, Amphenol
 Model 790 PR Sep 57
 Transistor radio, technique for
 troubleshooting Oct 42
 —noise Oct 42
 —distortion at low volume Oct 43
 —weak and distorted Oct 44
 —inoperative Oct 45

REMOTE UNITS, TV

All-electronic remote,
 Motorola ES Sep 13
 Servicing and operation Aug 44
 —alignment Aug 51
 —receivers Aug 46
 —servicing Aug 49
 —transmitters Aug 45
 —troubles Aug 48

SERVICE AIDS

Battery charger, G.E. Model
 BC1 PR Jun 71
 Component substitution units,
 Sencore PR Mar 67
 Flashlight, flexible, Amertest
 Products PR Dec 65
 Isolation transformer,
 Stancor PR Oct 63
 Lamp and magnifier PR Jan 57
 Line voltage monitor, 240-volt,
 RCA Model WV-503A .PR May 67
 Lubricant, dry, Sprayon .PR Nov 76
 Microfilm service data system,
 Sylvania ES Nov 9
 Record changer repair rack,
 CED PR Aug 64
 Scope cart, Waber PR Nov 74
 PR Dec 65
 Scope dolly, Metal Dynamics PR Sep 63

Solder remover, Solder
 Removal Co. PR Dec 66
 Test adapter holder, Pomona PR Mar 68
 Test probe, RF, Triplett PR May 67
 Tuner cleaner, Tech Spray PR Jul 68
 Tuner degreaser, Chemtronics PR Dec 65

SIGNAL GENERATORS

Color TV, for Jul 23
 Sine/Square-Wave generator,
 Heath Model IG-18 PR Dec 62
 Square-wave generator, Hewlett
 Packard Model 220A ... PR Jun 72

SOLID-STATE COMPONENTS

Application in
 consumer products Jul 14
 Color TV, in CT Jul 52
 Evolution of Jun 12
 —diodes Jun 12
 —integrated circuits Jun 13
 —modularization Jun 13
 —parameter spreads
 of transistors Jun 13
 —standardization Jun 14
 —transistors Jun 12
 High-voltage rectifier, Motorola .. Jul 4
 IC kit, Vector PR Nov 74
 IC kit, Motorola PR Aug 66
 IC kit, RCA Jun 58
 Operation and application of
 —FET's Jun 30
 —SCR's Jun 29
 —thermistors Jun 28
 —tunnel diodes Jun 29
 —varactors Jun 30
 —VDR's Jun 30
 —zener diodes Jun 29
 Plug-in transistors, Sylvania .. ES Aug 6
 Power-output transistors,
 new from RCA ES Oct 8
 Power transformers for
 transistor power supplies,
 Essex Wire PR Dec 64
 SCR used as a horizontal
 gate control switch Jun 45
 Servicing techniques Sep 18
 —general hints Sep 22
 —selecting replacements Sep 24
 —signal tracing Sep 19
 —voltage measurements Sep 20
 Test equipment required
 for servicing Sep 18
 Transistor parameters NTE Nov 62

STEREO

Analysis of intended function... Sep 14
 FM stereo signal, generation of .. Dec 26
 FM tuner alignment Nov 34
 Frequency response, tests
 and characteristics Nov 28
 Left channel inoperative
 —Ford T6SMS TS May 61
 Apr 29
 Motorboating, Pilot 602M TS Jun 68
 Multiplex adapters,
 dynamic tests of Dec 32
 Poor separation, defects
 that cause Dec 33
 System analyzer,
 Amphenol Model 880. NTE Apr 57
 Test equipment for servicing... Mar 20
 Troubleshooting Oct 36
 —acoustic problems Oct 39
 —distortion Oct 36
 —loss of stereo Oct 38

TEST EQUIPMENT (General)

Auto Radio, requirements

for servicing Sep 34
 Audio test set, Century
 General Model 140 PR Dec 64
 Bridge circuits for test purposes.. Mar 53
 Apr 44
 Circuit tester, Burnworth PR Jun 74
 Circuit tester, Vaco PR Apr 77
 Component substitution
 units, Sencore PR Mar 67
 DC power supply,
 Julie Research PR Aug 65
 Developments and
 applications, recent Mar 13
 —color generators Mar 14
 —meters Mar 13
 —oscilloscopes Mar 14
 —signal generators Mar 15
 FM monitor, Cushman
 Model CE-3 PR Aug 68
 Inverter, ATR PR Jul 69
 Manufacturers' addresses Mar 66
 Minimum current indicator,
 Eby Sales PR Jul 67
 Power supply, variable
 voltage, Power/Mate
 Model BP-89 PR Dec 64
 Solid-state, for servicing Sep 18
 Thermostester, Mura PR Sep 62

THEORY

AGC operation, tube circuit .. TS Mar 64
 Bridge circuits for test purposes.. Feb 17

TOOLS

Alignment tool kit,
 Injectorall PR May 68
 Box-end wrenches, Vaco PR Jul 69
 Cable stripper, Grand W. PR Mar 69
 Bench grinder,
 Wen Model 1030 PR Sep 60
 Dolly, scope, Metal Dynamics PR Sep 63
 Drive socket set, Kraeuter ... PR Oct 65
 Flexible light source,
 Amertest PR Dec 65
 Mini tool set, Vaco PR Feb 69
 Nutdriver
 —four in one, Upson PR Jul 66
 —Xcelite PR May 67
 Riveter, Vaco PR Sep 64
 Screwdriver
 —insulated, reversible,
 Moody PR Sep 63
 —miniature, Moody PR Aug 66
 —ratchett, 3-way, Vaco. PR Aug 67
 Socket sets, Kraeuter PR Mar 67
 Soldering iron, miniature, Caig PR Oct 63
 Solid-state servicing, for Sep 20
 Swivel-head plier set PR Jan 57
 Wrench, combination socket,
 monkey open-end and
 pipe, Vaco PR Nov 76

TRAINING

Philco-Ford expanded program ES Aug 8
 Semiconductor courses
 —ITTES PR Apr 77
 —Norelco Nov 49
 Solid-state color training
 sessions, RCA Nov 49
 TV repair course, ICS Nov 49
 TV training program for
 jobless, RCA ES Nov 6

TRANSISTOR TV

AGC, transistorized Jun 50
 Color TV, solid-state devices in CT Jul 52
 Gain testing, stage-by-stage..... Sep 26
 Height reduced,
 Magnavox T908CA TS Nov 68

Horizontal driver/output stages, operation of . . . SYM Sep 47
 Solid-state applications . . . Jul 14
 —biased diodes . . . Jul 18
 —horizontal centering . . . Jul 20
 —integrated circuits . . . Jul 16
 —regulators . . . Jul 19
 —varactor diodes . . . Jul 18
 —video amplifiers . . . Jul 14
 Troubleshooting . . . Jun 18
 —AGC troubles . . . Jun 24
 —power supply . . . Jun 26
 —tuner troubles . . . Jun 22
 —vertical stages . . . Jun 25
 —video IF stages . . . Jun 22
 —video stages . . . Jun 24

TRANSISTOR TESTERS

Amphenol Model 830 . . . PR Oct 64
 . . . NTE Nov 65
 Jackson Model 810 . . . NTE Mar 45
 RCA Model WT-501A . . . PR Jan 58
 Seco Model 260 . . . NTE Jan 25
 Sencore Model TF151 . . . PR Dec 62
 Triplett Model 3490-A . . . NTE Nov 62
 Use of . . . Sep 20

TUBES

Gas symptoms . . . TS Jun 69
 TV tube stock guide . . . Apr 22

TUBE TESTERS

Triplett Model 3444-A for industrial tubes . . . PR Oct 65

TUNERS, TV

Electronic switching, Standard Kollsman . . . ES Sep 11

VECTORSCOPES

Color problems, analyzing . . . Nov 14
 Jackson Model CRO-4 . . . PR Dec 66
 Lectrotech Model V-5 . . . NTE Dec 53
 Lectrotech Model V-7 . . . NTE Dec 54
 Operation of and trouble analysis with . . . NTE Oct 52
 Sencore Model PS148 . . . NTE Oct 56

VERTICAL SWEEP

Bottom shrunk, Motorola WTS-907 . . . CCM Jan 56
 Foldover and insufficient height, G.E. CA . . . VSS Feb 41
 Height Reduced
 —Magnavox T908CA . . . TS Nov 68
 —Motorola TS-914 . . . CCM Feb 57
 —RCA CTC25 . . . Aug 22
 —vertical distortion, RCA CTC16A . . . TS Dec 60
 Jitter, Magnavox T/U904 . . . VSS Jan 50
 Retrace Lines, Emerson U1840 TS Dec 61
 Top and Bottom Reduced, Sylvania DO5-1 . . . TS Oct 58

VERTICAL SYNC

Drifts after set warms up, Motorola STS-914 . . . VSS Mar 49
 Intermittent, RCA CTC16XA . . . Feb 29
 Intermittent Roll

G.E. 14 to 10 . . . TS Nov 67
 RCA KCS136Y . . . Feb 50
 Jitter, RCA CTC17 . . . TS Jun 67
 Lost when brightness reduced, RCA CTC22 . . . Jul 49
 Marginal, Philco Q1214 . . . TS Jul 62
 Missing
 —RCA CTC11A . . . TS Nov 70
 —Truetone 2DC1695A VSS Apr 55
 Problems, Zenith Chassis . . . TS Jan 46
 Roll, Intermittent Raster Shrinkage, RCA 17PD8094 . . . Sep 4

VOM'S

Acculine Model TVM 4A . . . PR Jul 65
 Amphenol Model 870
 Solid-State VOM . . . NTE Sep 42
 Current Measurement, Adapter for, Simpson . . . PR Nov 76
 Heath Model IM-17
 FET VOM . . . NTE Aug 56
 Phillips Model PM-2400 . . . PR Sep 62
 Servicing . . . Mar 29
 Transistorized, RCA Model WV-500A . . . PR Feb 68
 Triplett Model 601
 Solid-State VOM . . . PR Aug 66
 . . . NTE Sep 42

VTVM'S

Precision Apparatus Model V-95 . . . NTE Mar 46
 Servicing . . . Mar 33

INDEX OF TITLES

A Look at a Portable Color Chassis . . . Jul 44
 A Look at RCA's Solid-State Color, Part 1 . . . Dec 14
 A Look At Success . . . May 4
 A Proper Approach to Tuner Repair . . . Dec 36
 A Short Story About An Auto Radio . . . Jul 42
 Analyzing Color Problems With the Vectorscope . . . Nov 14
 Antennas Are Quick . . . May 52
 Antenna Systems
 Component Guide . . . May 73
 Bridge Circuits—A Review/ Part 1 . . . Feb 17
 Bridge Circuits—A Review/Part 2 . . . Mar 53
 Bridge Circuits—A Review/Part 3 . . . Apr 44
 Chroma Demodulator And CRT Input Troubles . . . Nov 22
 Color CRT or Chassis Defect . . . Dec 44
 Color Sync—Alignment or Defect Apr 15
 Color TV Service Training—Part 5 . . . Jan 12
 Color TV Service Training—Part 6 . . . Feb 32
 Color TV Service Training—Part 7 . . . Apr 62
 Color TV Service Training—Part 8 . . . Jul 52
 Eliminating TVI . . . Oct 10
 Facts About Antenna Lead-In . . . May 30
 Fix That Scope Yourself . . . Mar 17
 From GI To TV Technician . . . Aug 39
 Future Profits Take Planning Today . . . Feb 46

How Are You and Progress Getting Along? . . . Jun 56
 Impedance Matching and Power Distribution in PA Systems . . . Jul 36
 Installing Antenna Systems . . . May 22
 Intermittents Are A Challenge . . . Feb 25
 Is Your Test Equipment Up To '68 Standards . . . Mar 13
 Lightning Protection For Transistor Amplifiers . . . Dec 50
 MATV Systems . . . May 43
 One Round To Go . . . Apr 26
 Planning Antenna Systems . . . May 15
 Practical Stereo—FM Servicing, Part 1 . . . Nov 28
 Precision Sound Alignment—The Easy Way . . . Feb 62
 Radiation Revisited . . . Jul 6
 Radiation—What Does It Mean To You . . . Apr 8
 Record Changer Repair . . . Oct 16
 Reference Material—How Well Are You Equipped? . . . Aug 36
 Repairing Clock Radios . . . Oct 32
 Repairing Portable Tape Recorders . . . Aug 26
 Rotators—Selecting, Installing, Servicing . . . May 36
 Routine Servicing of Auto Radio . . . Sep 34
 Scoping For Trouble . . . Aug 12
 Service Your Own Multimeter . . . Mar 29
 Servicing TV Remote Control . . . Aug 44
 Solid-State Auto Radio Problems . . . Jul 28
 Solid-State Devices—A Refresher . . . Jun 28
 Solving Stereo Separation Problems . . . Dec 26
 Solving Wrong-Hue Symptoms . . . Nov 52

Stage-By-Stage Gain Testing in Solid-State TV . . . Sep 26
 Sync Is Simple—Almost . . . Sep 4
 Techniques For Troubleshooting Transistor TV . . . Jun 18
 Ten Tough Color Problems . . . Aug 18
 Test Equipment For Color TV . . . Jul 22
 Test Equipment For Servicing CB Mar 26
 Test Equipment For Servicing Stereo . . . Mar 20
 The Circuit Breaker Is Trying To Tell You Something . . . Feb 5
 The Diagnosis That Wasn't . . . Apr 38
 The SCR As A Horizontal Gate Control . . . Jun 45
 The Solid-State High Voltage Rectifier Is Here . . . Jul 4
 The Stubborn Hybrid . . . Apr 49
 This Thing Called Stereo . . . Sep 14
 Time-Saving Techniques for Transistor Radio Repair . . . Oct 42
 Time To Move Your Business . . . Jan 36
 Toward More Proficient Servicing Nov 49
 Transistorized AGC . . . Jun 50
 Transistors: A Report on the State of the Art—Part 1 . . . Jun 12
 Transistors: A Report on the State of the Art—Part 2 . . . Jul 14
 Transistors: A Report on the State of the Art—Part 3 . . . Sep 18
 Troubleshooting A Multi-Trouble TV . . . Oct 24
 Troubleshooting Stereo . . . Oct 36
 TV Tube Stock Guide . . . Apr 22
 Volts Are Where They Find You Mar 43
 Waveform Quiz . . . Oct 50
 What's New In Public Address Speakers . . . Feb 10

All new from every angle ...RCA HI-LITE

You end all doubts and confusion when you specify RCA HI-LITE. Then you can be certain that here is the all-new replacement picture tube from the leader in Color TV. All-new glass...gun...the works.

OEM QUALITY from every angle: the same tubes that go into original equipment sets, incorporating the latest technology of the world's most experienced color picture tube manufacturer. Everything about them exudes know-how, confidence, leadership.

If you've set your sights on quality, then look to RCA HI-LITE for your replacement tube needs. Available in the broadest line of types in the industry from your Authorized RCA Distributor.

RCA Electronic Components,
Harrison, N. J.



RCA



Give yourself a break you can depend on!



actual size
1 3/4" x 1 1/8" x 1/2"



CIRCUIT BREAKER CADDY

10 ratings, one each 2-1/4, 2-1/2, 2-3/4, 3, 3-1/4, 4, 4-1/2, 5, 6 and 7 amps.

SERVICE CADDY

Breakers and Fuses

One service call is all—8 breakers—one rating each 2-1/4, 2-3/4, 3, 3-1/4, 4, 4-1/2, 5 and 7 amps and 30 fuses—five each type C3/10, C1/2, C3-1/2, N3/10, N7/10 and N1.



Designed for the protection of television receiver circuits, the Littelfuse Manual Reset Circuit Breaker is also ideally suited as a current overload protector for all types of electronic and electrical control wiring such as model railroads and power operated toy transformers, hair dryers, small household appliances, home workshop power tools, office machines and small fractional horsepower motors.

Available individually packaged one breaker per display card; or 5 breakers of same rating per unit pack or as complete, versatile assortments for shop use or replacements in the field.



Included with each assortment:

Pocket size cross reference on color and black/white TV circuit breaker applications.
Form No. CBCRP-1266H

LITTELFUSE

DES PLAINES, ILLINOIS

Circle 43 on literature card