MARCH, 1969 □ 75 cents

A HOWARD W. SAMS PUBLICATION

Electronic Servicing

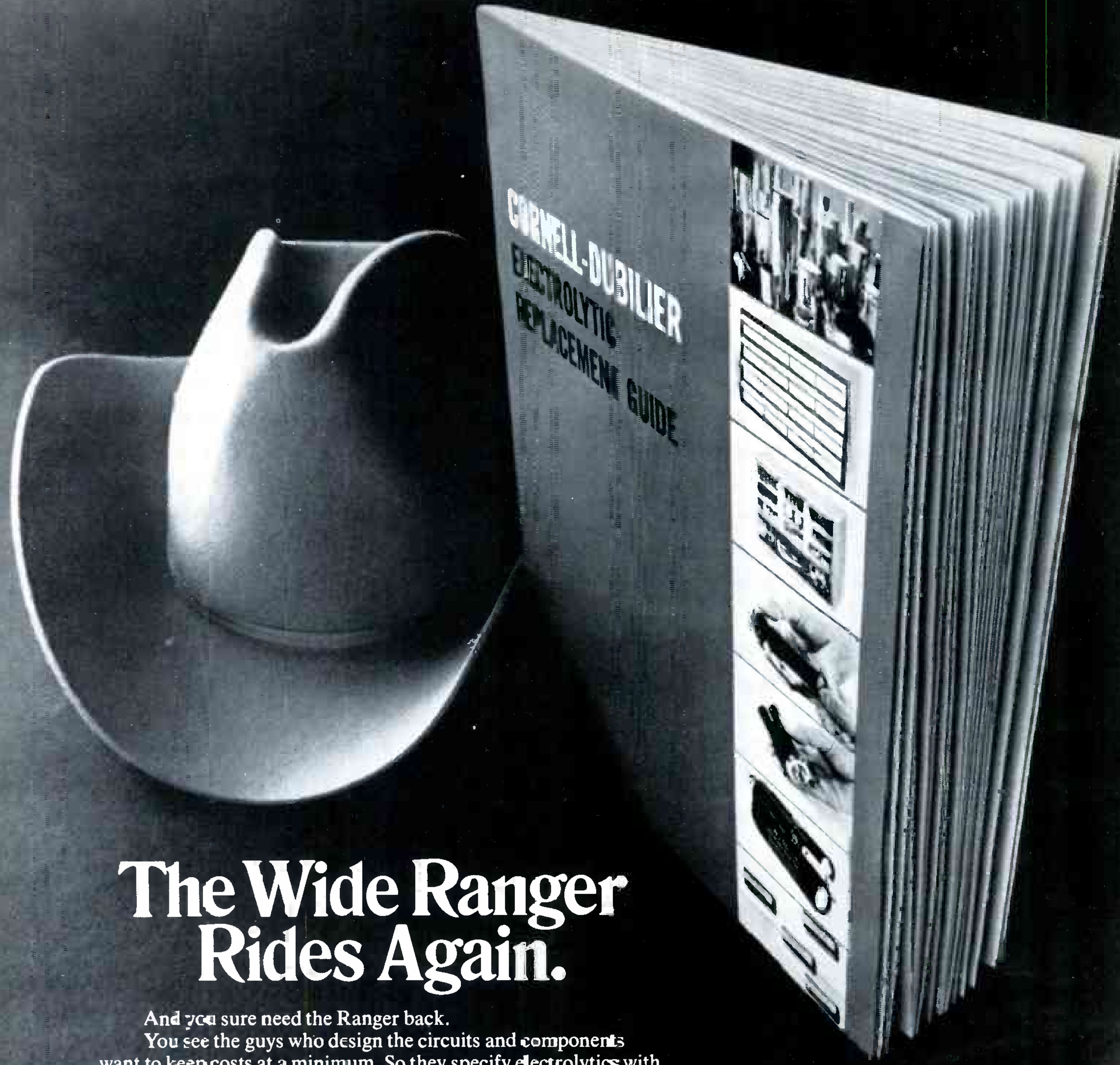
Formerly PF Reporter

Franchise-another approach to servicing

page 10

Test equipment available for servicing TV

page 44


CORNELL-DUBILIER
ELECTROLYTIC
REPLACEMENT GUIDE

March, 1969 • Volume 19, No. 3

Electronic Servicing

Formerly PF Reporter

in this issue...

DEPARTMENTS

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Robert E. Hertel, Publisher
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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.

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.

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

TSC

TUNER SERVICE CORPORATION *FACTORY-SUPERVISED TUNER SERVICE*

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

WATCH FOR NEW CENTERS UNDER DEVELOPMENT

Circle 3 on literature card

electronic scanner

news of the industry

Ohio Serviceman Selected for NEA Electronic Hall of Fame

John Graham, member of the Associated Radio and Television Service Dealers (ARTSD) of Columbus, Ohio, has been selected as a member of the National Electronic Associations' (NEA) Electronic Hall of Fame, Service Division. Mr. Graham is the first living member to be so honored.

Selections to NEA's Electronic Hall of Fame are made from among living and deceased men who have made outstanding contributions within the electronic industry.

Plans are currently being made to erect a building to house the awards. Howard W. Sams & Co., Indianapolis, has offered to house the display until a permanent site is made available.

—ARTSD News

New York State Again Trys TV Licensing

A bill for the licensing of TV technicians has been introduced to the New York State legislature for the fourth time according to a report in Home Furnishings Daily. Three previous attempts at licensing New York State TV technicians have failed. Increased consumer criticism of television servicing is given as the reason for introduction of the bill. According to informed sources, the bill has dim prospects for passage, although the National Electronics Association (NEA) has voiced approval of "the proper licensing of TV technicians."

NATESA Revises Code-of-Ethics Certificate and Assumes Arbitrator Role

The National Alliance of Television and Electronic Service Associations (NATESA) has updated its code of ethics and issued to its members new certificates of membership that indicate the member is a licensed "Electronician." Each certificate bears the name and license number of the member. The term "Electronician" is registered by NATESA in Washington, D.C.

NATESA is also offering set owners a method of recourse concerning complaints against members. According to NATESA, "When a complaint is received, it will be processed and evaluated by NATESA people in the area. If the customer is in error, he will be so informed and given a full explanation. If the licensed NATESA member is at fault, he will be so appraissed and billed for service necessary to make correction. Failure to pay this invoice will be cause for revocation of membership."

RCA Reduces Color Service Contracts

RCA is planning to eliminate home setups on new color sets, unless dealers specifically request that this procedure be continued, according to a recent report by Fairchild News Service.® "Improved quality of color sets" was given as the reason for doing away with home color setups.

A price reduction of color TV service contracts has also been announced by RCA Service Co. Price cuts range from 7 dollars on portables to 4 dollars on combination units.

American TV Manufacturers Interested in Single-Gun Color Tube

Sony Corporation's Trinitron single-gun color TV system has caught the interest of both American and Japanese television manufacturers, who, according to a recent report in Home Furnishings Daily, have made inquiries concerning licensing arrangements. However, according to the report, Sony has made no decision as to when licensing will begin.

Trade sources report that Sylvania, Motorola, Zenith and RCA have indicated their interest in the Trinitron system.

When the Sony single-gun system was first introduced, it was explained that the new color tube could be used with Chromatron grid, the conventional shadow mask, or the new operture grill.

It is expected that full U.S. distribution of a 12-inch Sony color set using the Trintron picture tube will be a reality later this year.

Preliminary EIA Home Electronics 1968 Sales Figures Show Increases

Based on preliminary statistics gathered by the Electronic Industries Association's Marketing Services Department, EIA's Consumer Products Division has announced that 1968 year-end figures on sales by domestic manufacturers of television, radio (including auto), phonograph and tape equipment all showed increases over 1967 sales.

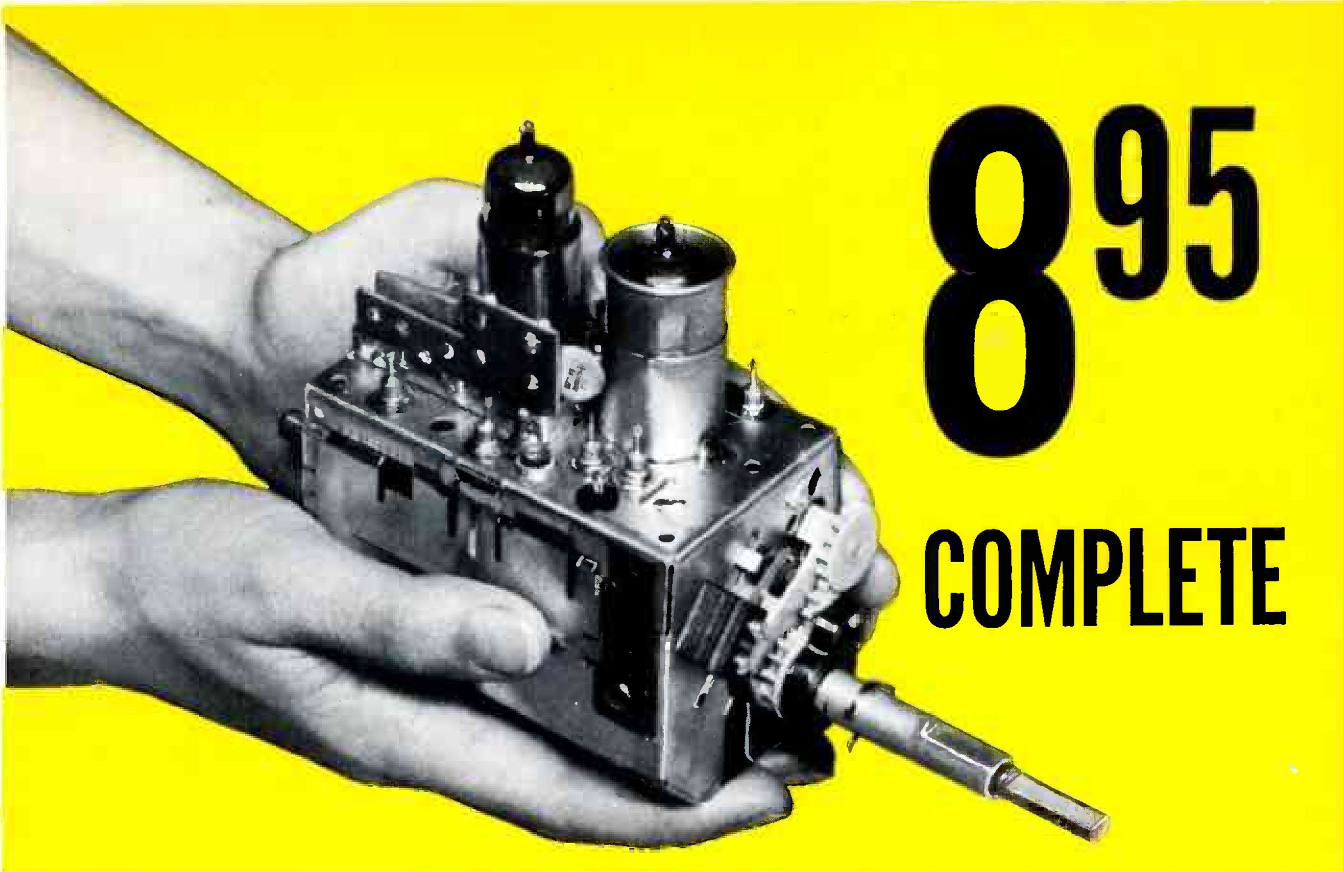
1968 CONSUMER ELECTRONICS SALES TO DEALERS*

RADIO:	1968	1967	% Change
Home	11,810,646	12,393,051	− 4.7
Auto	10,685,827	8,900,208	+20.1
Total Radio	22,496,473	21,293,259	+ 5.7
TELEVISION:			
Color	5,829,150	5,224,499	+11.6
Monochrome	5,555,339	5,434,702	+ 2.2
Total TV	11,384,489	10,659,201	+ 6.8
PHONOGRAPH:			
Portable & Table	3,946,001	3,766,541	+ 4.8
Console	1,565,373	1,498,645	+ 4.5
Total Phonograph	5,511,374	5,265,186	+ 4.7

*Preliminary figures. These data reflected total U.S. manufacturers' sales, including foreign-made sets sold under U.S. manufacturers' brand names.

While the statistics shown here are based on U.S. manufacturers' sales to dealers, imports—both domestic and foreign brand names—are a sizeable factor in the total U.S. Market consumption of consumer electronic products, EIA said.

EIA estimates that the total television market, including imports, will exceed 12 million units; that 1968 radio sales will be over 40 million units, counting home and auto figures; that phonograph sales will exceed 6 million units; and that tape equipment sales, the fastest growing consumer electronic product (including reel-to-reel, cartridge and cassette equipment) will exceed 5 million units.



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 (Guaranteed color alignment . . . no additional charge)	$9.95

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 Min.*	SHAFT Max.*	I.F. OUTPUT Snd.	I.F. OUTPUT Pic.	PRICE
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 4 on literature card

Nebraska Association Re-elects President for '69

At a recent statewide meeting held in Grand Island, Nebr., the Nebraska Electronic Service Association (NESA) re-elected Charles Enyeary, CET of Lincoln, as president for 1969. Elected as secretary-treasurer was Loren Daubendiek, CET, of Beatrice.

Admiral Introduces 12-inch Color

The development and full production of a 12-inch color picture tube (79 square inches) for portable television sets has been announced by Admiral Corporation. The exclusive tube size will be incorporated in Admiral's new 12-inch color portables. Another exclusive tube size for 16-inch sets was introduced by Admiral last November.

Sony Adds New Service Point

A new facility for sales, warehousing and service for Sony home entertainment products has been opened at 54 Cypress Lane in Brisbane, California, a suburb of San Francisco.

TC Becomes CRYSTEK

The name of Texas Crystals, a division of Whitehall Electronics Corporation, is being changed immediately to CRYSTEK, according to an announcement by L. R. Sheeley, president of the Fort Myers, Florida firm. Sheeley explained that the name CRYSTEK stems from the words crystal technology, the specialized field of the company. The parent firm of CRYSTEK, Whitehall Electronics, is a subsidiary of LVT-Ling Altec of Dallas, Texas. ▲

NARDA Convention

The National Appliance & Radio-TV Dealers Assn. (NARDA), meeting for its annual convention in Tucson from Feb. 5-9, touched on several aspects of servicing the products its members sell.

The only session of the convention program specifically scheduled to treatment of service was a talk by George T. Stewart, executive vice-president of Toshiba America, Inc. He pointed to some changes that may be expected in the industry: "The growth of our industry has been in technology—in research and development. Emphasis has been on the product. But servicing may well draw ahead of 'product' in the years coming, and the independent retailer will be forced to pay attention to it."

Stewart said also that those undertaking service should take the initiative in establishing uniform pricing and quality standards for the servicing industry.

"We at Toshiba believe in letting the independents provide the service," declared Stewart. He went on to say that the manufacturers tend to become lax regarding product control if they have their own service units.

An unscheduled talk on servicing was given by Ed Reich, Wholesale TV, Indianapolis, Ind. He had been scheduled to talk about the type of merchandise that distributors should stock. Instead, he told the NARDA members of a few basic changes in managing his service business that turned it from a financial loser durthe fiscal year of 1968 to a profit making operation.

The principal changes Reich discussed were:

1. Upgrading the image of the technicians by changing his attire from the traditional service man's uniform to white shirt and tie and suit or sport coat; and, his title from service man to technician.
2. Changing the pricing system. In November, 1968 Reich adopted a flat rate schedule based on what it takes the average man to do a job, and reduced the price of the house call to $6.95 from $9.95. Previously, potential customers were lost when they learned that the price of the house call was $9.95, he said. Three months after he adopted the changes, his firm was averaging $16 gross per service call, was completing 100 or more service calls per day, and making a profit.

His new pricing system has been successful, Reich said, because "management explains it to the technicians and the technicians explain it to the customers." He added, "I have yet to have a complaint about the cost of repair."

The subject of service was mentioned in other sessions of the convention, with the emphasis put on the theory that service can be a profitable pursuit in its own right, as well as a means for retailers to secure customers for their whole goods. ▲

Service was the subject of this speaker at the convention of NARDA held at the Pioneer Hotel in Tucson. George T. Stewart, vice-president of Toshiba America, Inc., suggested that in the years ahead the manufacturers and retailers will give more attention to servicing the products they manufacture and sell.

making a business out of service

Second in a series

TV servicing goes the franchise route

by J. W. Phipps and Wendall Burns

In the January issue we reported the operation of a large-scale independent electronic service shop. In this issue, we describe a chain or franchise operation. Coming up is a report rounding up what manufacturers are doing to expand their own service systems. These are all alternatives to the traditional self-employed, small-volume service shop.

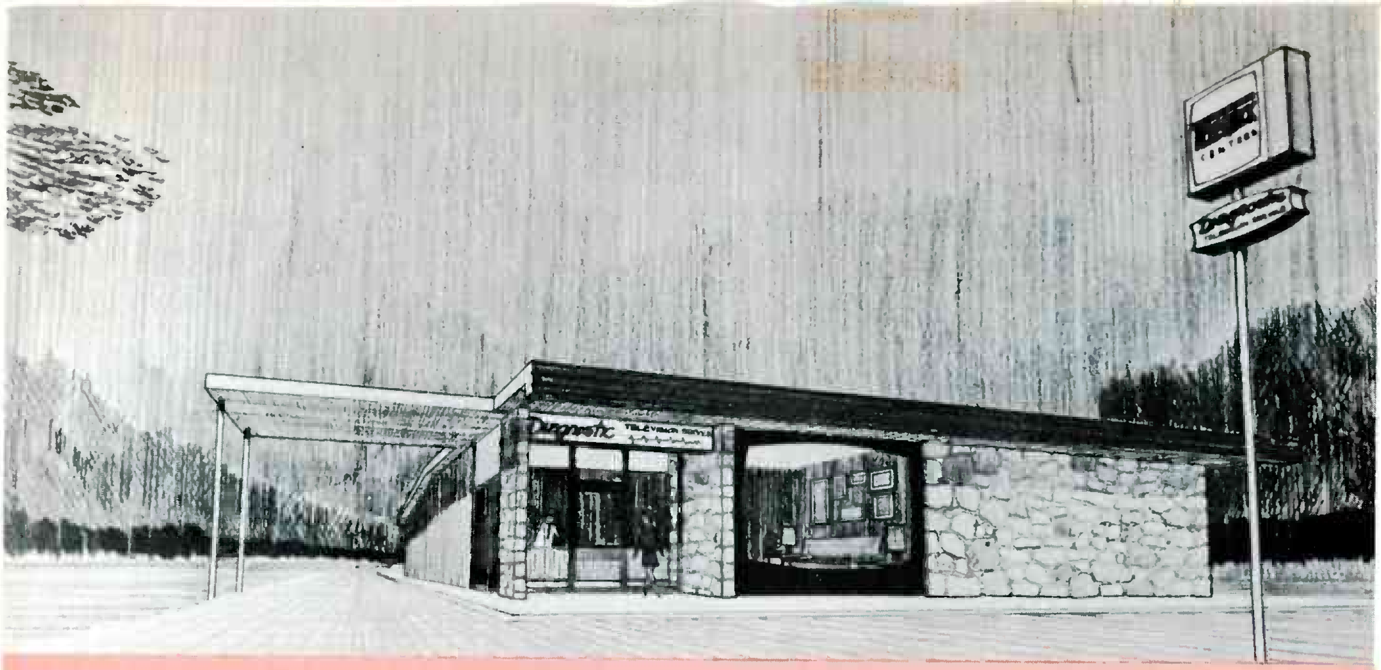
■ A high-volume TV service system, duplicated and expanded into a chain of service centers, has been developed by a New Haven, Indiana technician and his associates. The franchise system was chosen by the founders of this firm, Tele-Quick, as the business method best suited to reach their objectives of establishing a number of these high-volume centers using a minimum number of technicians (in some cases only one) in each center.

The first Tele-Quick franchise center was inaugurated less than two years ago in New Haven. Since then, centers have also been established in five different market areas. Now, the company is projecting expansion throughout the continental U.S.

In developing the

1. Determine the types of electronic service work that were franchise-able.—A franchise service operation demands standard service of uniform quality, and methods to control the standards. But, not all electronic service can be easily standardized and controlled. One major segment, TV bench work, can be. Tele-Quick's founders decided to select primarily that segment of the market as their business.

According to Royce Evans, Tele-Quick president, it was initially decided to exclude the outside TV service business from the franchise package because "It takes a skilled man on a service call, and we would have to have four skilled men in most areas to handle the calls. In our system we utilize skill more effectively by employing one technician aided by a few semi-skilled assistants."



Singer Pat Boone lends his name, prestige and time to Tele-Quick. Here with Tele-Quick's president Royce Evans, right, and Sidney Patterson, another director of the firm, he participates in a ground-breaking for a new service center. The famous singer, a member of Tele-Quick's board of directors, is active in promotion activities.

A model building—although the above-pictured prototype of a building has been adopted as a model for newly constructed Tele-Quick centers, centers are also being established in existing structures. 'We would like to have low rent, and in some cases will go for existing buildings,' Evans said. He indicated furthermore that he does not believe it is necessary for the service shop to be in a high-rent, high-traffic area: 'People do not buy this service on impulse as they might buy a TV set—or as they buy a meal at a restaurant when they get hungry.' Although the appearance of the centers' structures may vary, all will display the distinctive logo shown here. Evans said, 'We will want uniform identity. At this time the franchisees lease their own sites.'

Tele-Quick chain, founders of the firm had to:

2. Establish Confidence in a name—Tele-Quick management wants this name to be synonymous with the concept "efficient service of uniform quality at a fair price." To create the image of *efficient service* the centers are laid out and operated in a manner to reflect an aura of efficiency, and the personnel, all in Tele-Quick uniforms, are trained to bolster this concept of efficiency. The idea of *uniform quality* is conveyed to the customer, among other ways, when he is told "the Diagnostic equipment indicated . . . such-and-such defect." This indicates uniformity with less chance of human error. To assure the customer that he is receiving service at a *fair price,* Tele-Quick management insists that the charge may not exceed the estimate, and has adopted the practice of advising the customer of the diagnosis and estimate before any work is begun.

3. Adapt to this industry and the franchise system these other elements common to any commercial service operation:

a. A precise, standardized cost accounting system—Each account is assigned a number on the standardized chart of accounts adopted for the Tele-Quick centers. Each franchisee is instructed in bookkeeping methods and in methods of reporting and control required by the "parent" organization. A complete data processing system presently is being developed.

b. Efficient use of manpower—This is based on a shop system using adequate diagnostic equipment, efficient shop layout, and a step-by-step approach to diagnosis and repair. Tele-Quick's President Evans said a center can function "without a problem" using only one technician, one apprentice technician and one or two semi-skilled persons completing 10-15 sets a day. (Layout and methods, page 13.)

(Continued on next page)

Tele-Quick method of servicing

Regardless of the trouble symptoms displayed, each set received for servicing at Tele-Quick undergoes a routine step-by-step servicing procedure designed to uncover *all* troubles. When the trouble diagnosis is completed, an estimate of the cost of repair is made, and the customer is notified of the diagnosis and the cost. No repair is made until authorization has been received from the owner of the set.

Each set is processed in the following sequence:

Step 1: Set is brought in by customer. The customers name, address, phone number, etc., and the customer's description of the trouble symptom are recorded on a work order form called a Tele-Log. The Tele-Log is then placed inside a clear plastic bag called a Tele-Tote Bag, which is attached to the set.

Step 2: The set is placed on a roll-about cart and rolled to the first service station. If necessary, the chassis is removed from the cabinet. The chassis and picture tube are cleaned. All tubes are checked, with the exception of the high-voltage rectifier, horizontal output and damper tubes, which are checked in later tests. All defective tubes are listed on the Tele-Log.

Step 3. The chassis is rolled to a "Diagnostic island" which is equipped with all the test equipment required for a complete check of each receiver. A technician performs a complete Diagnostic procedure designed to uncover all troubles in the receiver. The results of the diagnosis are recorded on the Tele-Log, along with an estimate of the cost of repair.

Step 4: The customer is notified of the complete Diagnostic analysis and the cost of repair. If the customer cannot be reached at once, the set is put in a "hold" section until customer approval of the repair and cost is received. No repair is accomplished until the customer authorizes it.

Step 5: Once authorization for repair is received, the set is repaired as soon as possible. Defective tubes and parts removed from the chassis are placed in the Tele-Tote Bag and given to the customer when the set is picked up.

Step 6: After repair is accomplished, the chassis is reinserted in the cabinet. The cabinet is cleaned and polished and the set is left to operate several hours before the customer calls for it.

Efficient use of available manpower

Step 3 in the preceding sequence is the only servicing function requiring a skilled electronic technician. All other functions can be performed by semi-skilled personnel.

The fact that there are six distinct functions in the servicing sequence does not necessarily mean that six individuals are required. One individual can perform two or more of the functions, depending on the volume of business. For example, in a relatively low-volume operation one semi-skilled employee or trainee may perform steps 1, 2 and 4; one trainee may perform steps 5 and 6; and a skilled electronic technician performs step 3, the Diagnostic function. Thus, only three employees are required, of which only one is an experienced electronic technician.

Volume bench repair

According to Evans, the tube-check and Diagnostic functions are the primary factors limiting the volume of the operation. "However, a good, full-time, tube-check man can turn out 30 sets in an 8-hour day. Although we've never really determined exactly how many sets a given operation can average per day, we feel that 35 or 40 sets consistently every day would be a practical figure and would be a tremendously profitable operation."

(continued)

Technician performing Diagnostic procedure at Diagnostic island. All personnel wear white smocks with Tele-Quick logo on the back.

Customer data and description of trouble symptoms are entered in Tele-Log at check-in counter. Customers' first impression of Tele-Quick operation is enhanced by well decorated, neat reception area and white - smocked personnel. Wide entrance behind check-in counter provides customer with impressive view of service area, including the "Diagnostic island."

Final check-out and reassembly of set. Note Tele-Log attached to picture screen of set and Tele-Tote Bag containing replaced parts on lower shelf of roll-about cart.

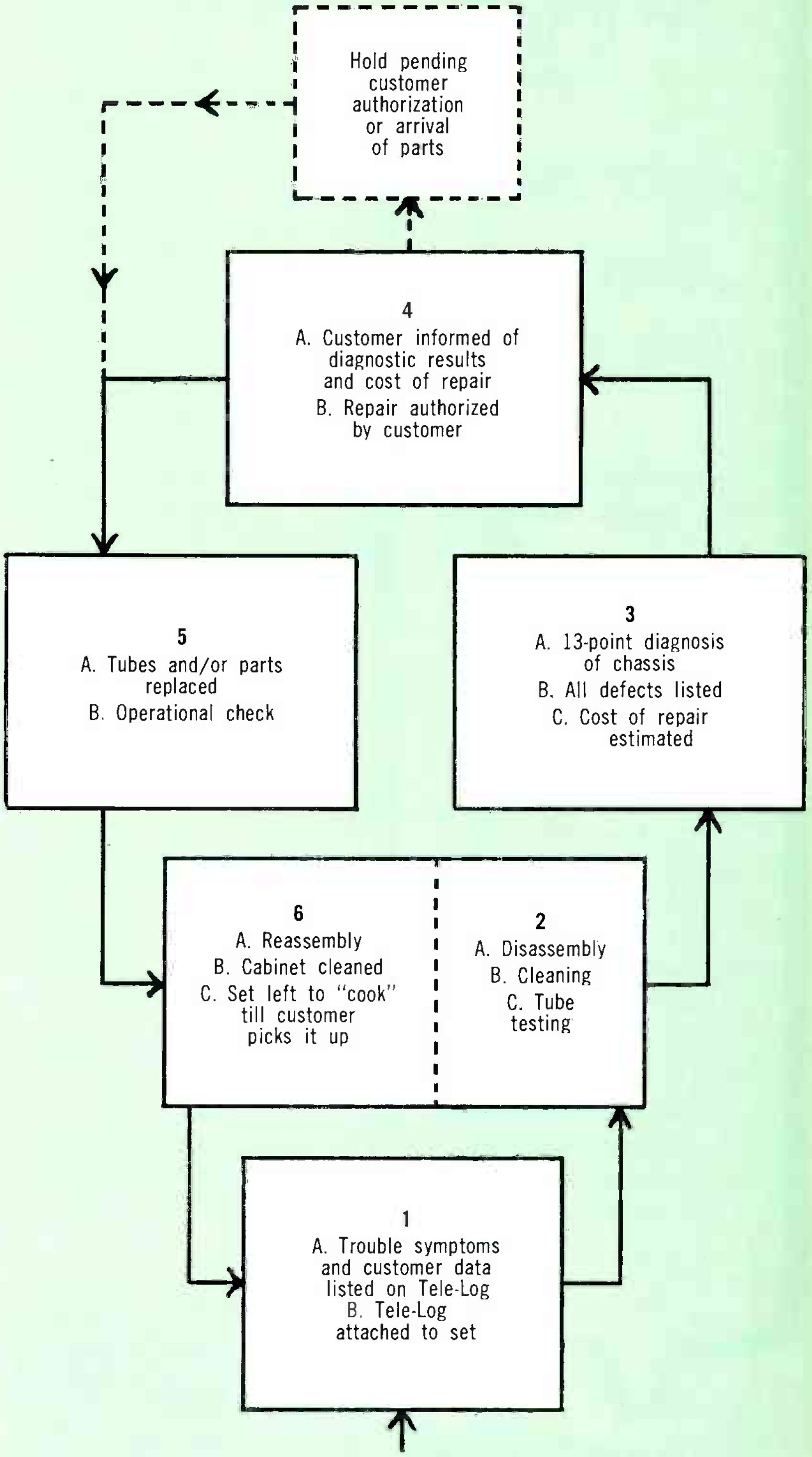


Diagram illustrating the Tele-Quick sequence of servicing.

TV servicing goes the franchise route

(continued)

Franchising not new—nor complicated

Although the concept of "franchising" has become popularly understood only in recent years, the method of doing business that this word describes is not new. It has long been in common use by the automotive and other well-established industries. Nor is the concept of franchising complicated. It merely describes a type of chain operation, with links of the chain being owned by operators of the various branches instead of all being owned by one central entity and operated by salaried managers.

Many believe that the franchise system can be the independent shopkeeper's road to affluence, or at least something akin to it. Business volume which many a businessman could not have built himself comes through identity with a nationally known product or service, and with less initial investment by himself.

The franchisee still has the freedom of being his own boss, with the added security of identification with an already established product. But, this means giving up some of the freedom he would have as an independent operator. He must conform to the discipline and restraints of the contract in areas of management such as record keeping, reporting, disclosure of financial position, merchandising, etc.

What is in Tele-Quick's franchise package?

The franchise package varies to meet the needs of each market area, and the price tag on the package varies accordingly. Basically, the package includes the Diagnostic service islands, Diagnostic equipment, initial parts inventory, training for the manager and other key personnel, and packaged advertising. The franchise package is presently being restructured to reflect the company's experience with those centers presently operating.

The price of the franchise package on a lease basis will be approximately $19,000, Evans indicated.

"The goal is to put these in at the lowest dollar we can, so we can get centers opened and operating. In addition to the capital that he must put up for purchase of the franchise, the franchisee must have a "good cushion of operating capital—between $5,000 and $8,000", said Evans. □

Royce Evans, president of Tele-Quick: 'We have a couple years behind us now, and several locations, and a lot of statistics. We set up centers in 5 market areas across the country in a 1½-year period, and this is small potatoes compared to what we have to do. We are making an analysis to see what we can do to make the centers better, and where to locate. We assemble and produce the franchise package, and get it out. The better we are organized internally, the more centers we can set up.'

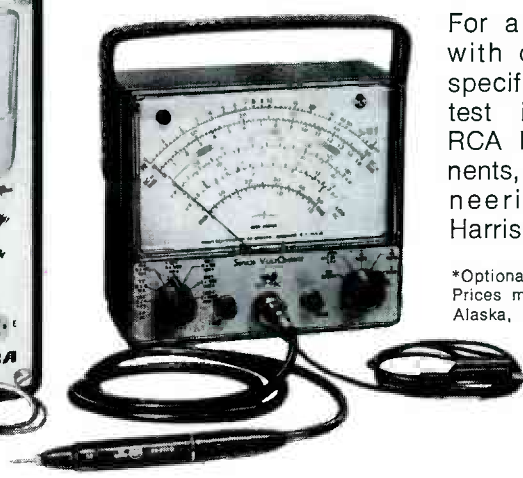
measure

NEW RCA WV-500B all solid state, battery operated VoltOhmyst eliminates warm-up time, zero shift that can occur in tube voltmeters. Completely portable. Only $79.00.* Now has eight overlapping DC current ranges from 2μA to 1.5A.

The RCA WV-77E Volt-Ohmyst® can be used for countless measurements in all types of electronic circuits. Reliability for budget price. Only $52.00.* Also available in an easy to assemble kit, WV-77E (K).

The RCA WG-412A R-C circuit box can help you speed the selection of standard values for resistors and capacitors, either separately or in series or parallel R C combinations. Only $30.00.* It's easy to use, rugged, and compact.

The RCA WV-38A Volt-Ohm Milliammeter is a rugged, accurate, and extremely versatile instrument. We think it's your best buy. Only $52.00.* Also available in easy to assemble kit, WV-38A (K).



The RCA-WT-501A in-circuit out-of-circuit transistor tester is battery operated, completely portable. It tests both low and high power transistors, has NPN and PNP sockets for convenient transistor matching for complementary symmetry applications. Only $66.75.*

The RCA WC-506A transistor-diode checker offers a fast, easy means of checking relative gain and leakage levels of out-of-circuit transistors. Compact and portable, it weighs 14 ounces, measures 3¾ by 6¼ by 2 inches. Only $18.00.*

The RCA WV-98C Senior VoltOhmyst is the finest vacuum-tube voltmeter in the broad line of famous RCA VoltOhmysts. Accurate, dependable, extremely versatile, it is a deluxe precision instrument. Only $88.50.* Also available in an easy to assemble kit, WV-98C (K).

For a complete catalog with descriptions and specifications for all RCA test instruments, write RCA Electronic Components, Commercial Engineering, Dept. C-33W, Harrison, N.J. 07029.

*Optional Distributor resale price. Prices may be slightly higher in Alaska, Hawaii, and the West.

RCA

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

Circle 10 on literature card

letters to the editor

Where Has Paco Gone?

Could you tell me if the Paco Electronics Company is still in existence? I recently sent a letter to this company, but it was returned to me with the notation "moved, unable to forward." The address I used was: 70-31 84 St., Glenwood, Long Island, New York.

Vernon Dalen
Rt. 2, Box 239
Ridgefield, WA

The only address we have for Paco is the one you used. We have been unable to determine if they are out of business or have moved. Perhaps a reader will be able to enlighten all of us on this matter—Ed.

Old Tubes for Sale

I have all types of old radio tubes for sale at reasonable prices.

I have been a subscriber for several years and really enjoy the magazine.

D. C. Goodwin
Goodwin Radio Shop
Rankin, IL 60960

Information Needed

I am hoping that you can help me out. I am in need of a schematic and/or operating manual for a VTVM, Electronics Design Model 100.

Does anyone have one I can buy, beg or borrow? If one isn't available, does anyone know the address of the manufacturer?

Gerard L. LeBlanc
331 Glen Rd. No.
Rome, NY 13440

I require a 1619 tube for a Heathkit power supply. I would appreciate any help in obtaining the name of a distributor for one or a substitute for one. If you can't, maybe one of your readers can.

Mark Abrams
3057 Cavendish Dr.
Los Angeles, CA 90064

Any assistance is welcome—Ed.

Atwater Kent Information

A request for a schematic or wiring diagram for an Atwater Kent Model 60 appeared in the Letters to the Editor column in the January, 1969 issue. I have a book covering this model. I do not wish to send the book, but will send a copy of it if Mr. McCrea desires.

A. Pacanowski
90 Linwood St.
London, Ontario,
Canada

. . . and Linearity Pattern Generator

Mr. McCrea asks for a schematic or wiring diagram-battery hookup for a Model 60 Atwater Kent radio. In my Rider's Manual, Vol. I, the Model 60 is not a battery radio and the schematic does not show any cables. It does show a power transformer and cathode heater-type tubes, but does not give the tube numbers. They are referred to as 1st RF, 2nd RF, DET, 1st AUDIO and 2nd AUDIO (push-pull). The 2nd audio tubes are marked 2A and 2A2. The output tubes do not show a cathode. The RF tubes show a screen grid.

Recently, I bought a Model A470 Linearity Pattern Generator similar to that mentioned by Russell Scarpelli (Jan., 1969 Letters to the Editor). Unfortunately it had no instructions or schematics with it. I got it at an auction more as an antique rather than for any practical use. I could open it up and draw a diagram for Mr. Scarpelli if no other information is available.

Arthur Krasenics
95 Henderson St.
Bristol, CT 06010

Service Association News Wanted

Congratulations on the new ELECTRONIC SERVICING magazine. The article on the John Sperry service firm was very informative. It is great to know we have people like John who are willing to share their knowledge with the industry. He is going to be an instructor in the management institute we are having here in Texas, *sponsored by the Texas Electronics Association.*

I was also impressed with the Reader Survey the magazine is taking. If possible, our association would like any advance information on this survey. It fits quite well in our future plans for the Texas Electronics Association.

I hope the new ELECTRONIC SERVICING magazine is association-minded and will print a few articles on the importance of it.

Gene Ware, President
Texas Electronics Association

Thank you, Mr. Ware, for your comments. The interest that you and the many other readers of ELECTRONIC SERVICING have shown in our new editorial direction is a real incentive to the entire staff. Of course, much of what we have done and will do in the future only can be accomplished with the help of such individuals as yourself and John Sperry and other technicians and shop owners who devote much of their time to improving the consumer electronic servicing industry.

The response to the reader survey, also published in the January issue, has been exceptional. By the time this issue goes to press, tabulation will have begun on the reader survey. We hope to have the results ready for the May issue.

Local, state and national electronic service association news and activities will continue to be reported in ELECTRONIC SERVICING. At this time we are preparing background articles on both the National Alliance of Television and Electronic Service Associations (NATESA) and the National Electronic Associations (NEA).

More Praise

Excellent! That's the one word that would best describe your "new" magazine, projected editorial emphasis as outlined in Editorial Profile (Jan., 1969 issue) and the first article in your new series of "Making a Business Out of Service." How badly this is needed.

For far too many years, electronic servicing has been referred to as the "business without businessmen" and all too unfortunately it was, and is, for the most part, a very accurate description.

letters to the editor

(Continued)

Many fine periodicals have done an admirable job of providing valuable technical information to help the concerned technician keep abreast of newer developments, equipment and procedures. Occasionally, some of these same journals would present an article devoted to some phase of business management. These infrequent blessings were devoured by some perceptive individuals, deliberately ignored by many, and probably completely undetected during the normal thumbnail skimming by the majority of the intended . . .

At our latest state association convention in July, 1968, the program planners decided to substitute the normal array of technical topics with one of introduction to basic operation procedures. The enthusiastic reception indicates that this diet will be continued . . .

Its effectiveness should be enhanced by the fact that yours is to be a continuing program which can be anticipated with certainty rather than an occasional "one shot" episode and will be presented with some semblance of continuity.

I personally am looking forward to the presentation of every topic hinted at in your editorial profile and I think that association leaders will be urging their members to let their thoughts dwell a little longer than usual between the pages of your fine magazine . . .

W. S. Harrison, Director
Virginia Electronics Association

May I congratulate you on your newly announced editorial policies as stated in the January issue. I have been looking forward to the time when a periodical such as yours would begin paying more than lip service to the electronic servicing industry.

In past years, there has been an almost complete vacuum in the reporting of industry news and the treatment of industry problems. Business type articles seemed to center around either diversification into some type of sales business or *into another branch of electronic maintenance other than consumer (entertainment) electronics. News seemed to predominately come from the manufacturing and distribution levels of electronics. I hope that your announced intentions and such things as your reader survey and the article on Sperry TV provide an accurate indicator of things to come.*

Knowing Mr. Sperry and having visited his place of business more than once, I can say that you have done an admirable job of reporting on his operation. You could have easily filled the entire issue with a more detailed study. Although my own business is extremely small compared to Sperry's, we differ in our outlooks in minor degree . . .

Consumer electronic service is capable of standing on its own two feet, regardless of whether it is operated separately or in conjunction with sales. Proper bookkeeping and cost allocation in combined sales-service businesses would show that owners consider service operating at a loss. Conversations with some of these owners at recent service association meetings revealed they do not compensate their service departments for delivery and in-warranty service even though these items represent a major portion of the service department work load. Conclusion? We all need education!

Lewis M. Edwards, Jr. CET
Trenton, NJ 08609

Name and address?
I Figured there would be a bunch of red tape.

More on Warranties

Just a line to endorse the letter by W. S. Harrison of the Virginia Electronics Association (Dec., 1968 Letters to the Editor).

The warranty situation is ridiculous. An independent serviceman cannot make a service call and replace warranty parts and then tag and make a trip to the distributor to get the parts replaced (if they have them), and do all this for a charge of $5 to $10 and long remain in business.

It also seems that the manufacturers that put out the shoddiest merchandise are the same ones that have the least supply of available parts.

It is difficult to get a customer to pay about $30 to replace a flyback transformer in an $80 TV, one and a half years old.

Please realize that there are still some quality manufacturers, but this trend to longer warranties and captive service serves no useful purpose to anyone.

Mel Bonenberger
Member TESA of Oklahoma

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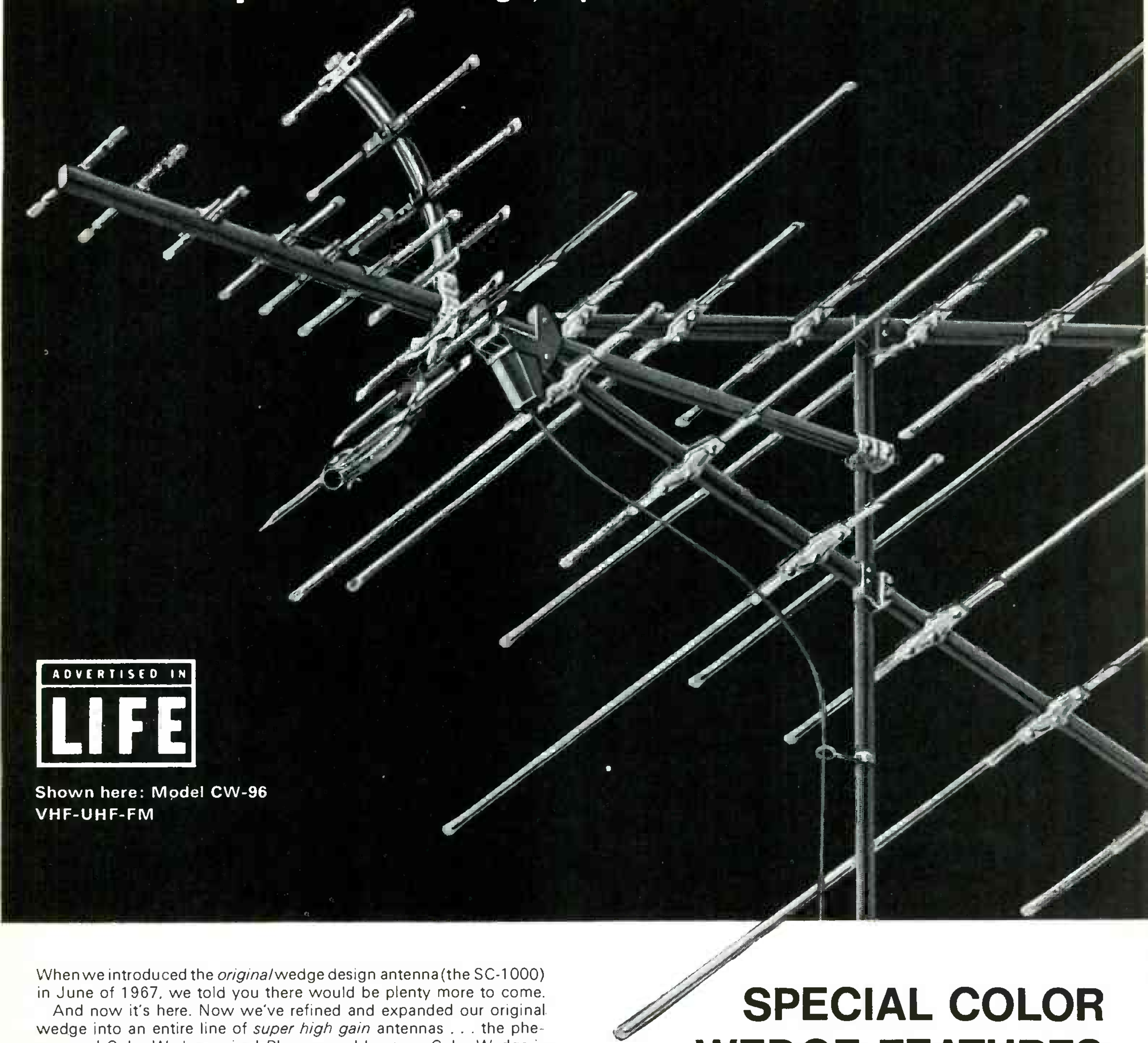

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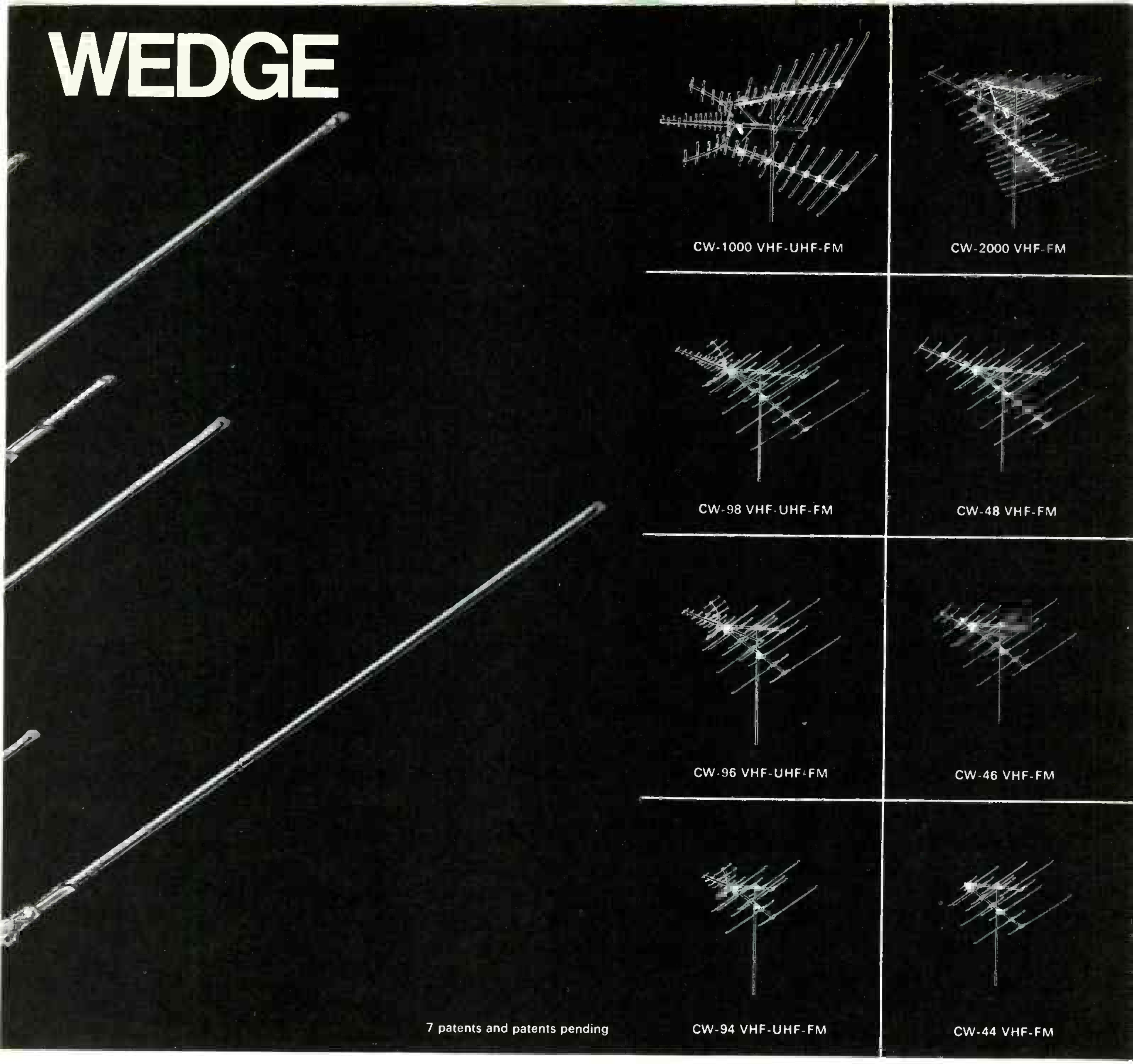

- Built-in transparent cartridge housing accepts solid state preamplifiers, and provides permanent weather protection for downlead terminals right at feed point of antenna, resulting in maximum signal transfer.
- FM control elements allow attenuation of strong FM signals where they interfere with TV reception.
- 82-channel models have special UHF control elements permitting antenna to be peaked for channels 70 to 83 in translator areas.
- New truss construction, with three mast clamps, makes this the most rugged, strongest antenna made. Two special Cycolac tuned mast clamps have built-in anti-resonant circuit to prevent signal leakage to antenna mast.
- Boom cone, made of unbreakable Cycolac, automatically positions upper and lower booms at 36° for maximum efficiency and rigidity.
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The in-circuit transistor tester—a time saver

by James Smith

The amount of solid-state units that have to be serviced is increasing, and, as a result, more and more service shops are turning to the in-circuit transistor tester to reduce the time required to service these units.

At present, there are more than 30,000 electronic service shops using the in-circuit AC beta transistor tester. Many more would use this time saver if they knew more about its operation and applications.

The following paragraphs explain how the in-circuit transistor tester operates and how it is applied to reduce servicing time.

Operation

With the tester connected to the transistor, the BETA CAL control is adjusted to the BETA CAL line on the meter. This sets the collector current to a normal level of about 2 milliamps, as shown in Fig. 1. When the TEST or GAIN button is depressed, the meter is transferred to the base circuit, as shown in Fig. 2, and the amount of base current it took to give the 2 milliamps of collector current is read on the meter.

Because beta is the ratio of input current to output current, the meter can be calibrated directly in beta. This is an extremely simple explanation, but the operation is just as simple and easy to perform.

Parameters

Beta is a very important parameter in a transistor because it indicates whether or not the transistor has enough gain (the ability to amplify a signal). As can be seen, the less base current it takes to produce the "set-up" collector current, the higher the beta or amplification of the transistor. This is the reason for the reverse-reading beta scale on these testers.

There is one more parameter that is just as important: leakage, or ICBO. Leakage is the reverse current that flows between the base and collector of a transistor, and is measured with the emitter lead open, as shown in Fig. 3.

Leakage in a transistor is important because it can affect the total operation of the circuit. Since the leakage current is in opposition to the normal current flow between the emitter and collector, it will lower the beta of the transistor. In many cases it may not lower the beta below the general beta spread of the transistor and, therefore, may not be detected during the beta test. The leakage measurement must be made out of circuit because any resistors or coils in the circuit will provide a path for the DC current and produce a false reading.

To measure leakage, a voltage of the opposite polarity is applied between the base and collector leads, and the resultant base current is measured on the meter. Normal leakage of a germanium transistor will be about 2 to 10 microamps in low-power types and up to 3 milliamps in power-output types. The leakage in silicon transistors is much lower and, in many cases, may not even be indicated on the meter of the tester.

Connecting the Leads

The leads from the tester must be connected correctly to the transistor to be tested. With the transistor out of circuit, this is simple because the leads are easy to get to. The only difficulty that may be encountered is identification of the base, emitter and collector leads. Fig. 4 shows some of the more common base diagrams of transistors. When there is some doubt about lead identification, consult a transistor manual, such as Howard W. Sams Transistor Specification Manual, or Sencore's FET and Transistor Reference Book. Look up the transistor by number and refer to the base diagram indicated.

Testing transistors in-circuit may be a little difficult. In many cases, transistors are soldered to the circuit board, and the leads are either too short or non-existent so that the test leads cannot be attached to them. To overcome this, connect the tester leads to the leads of a component that is connected to the different elements of the transistor, as shown in Fig. 5. A small light under the board will help trace out the leads and printed circuit for making the right connections.

After the transistor tester has been connected properly to the transistor, either in or out of circuit, rotate the BETA CAL control on the tester until the meter pointer rests on the BETA CAL line on the

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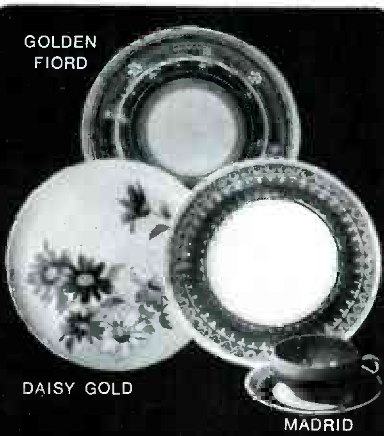

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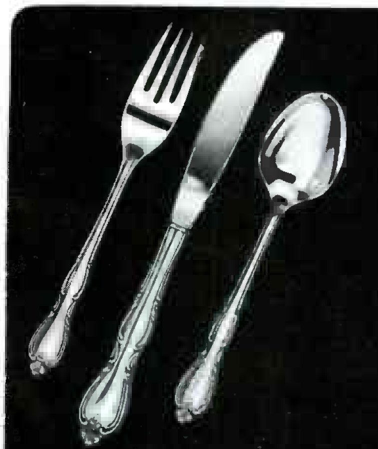

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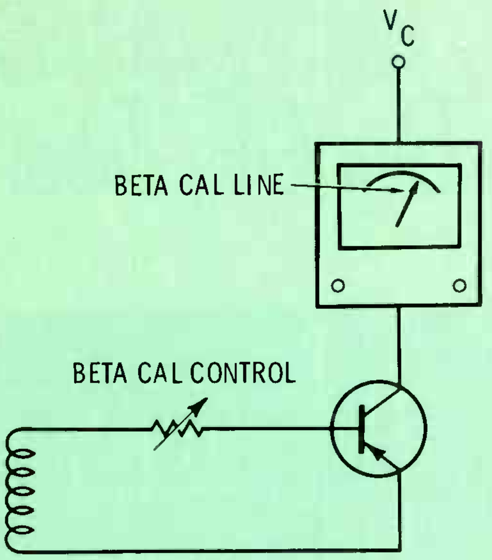

Fig. 1 BETA CAL control sets the collector current to a normal, or reference, level of about 2 ma.

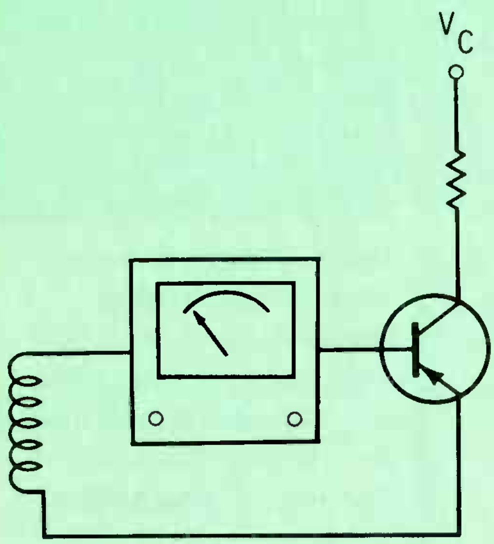

Fig. 2 Depressing TEST or GAIN button switches meter to base circuit. Meter indicates amount of base current it took to produce 2 ma of collector current, although meter scale is actually calibrated in terms of beta.

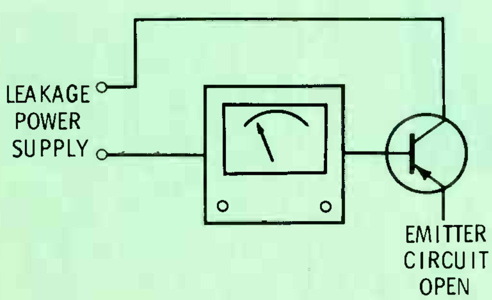

Fig. 3 Reverse current flowing between base and collector (ICBO) is measured with this basic test setup.

right hand side of the meter. As explained earlier, the collector current is now being set to a 2-milliamp reference level. With the meter calibrated, depress the BETA TEST or GAIN button, and read the beta direct from the meter scale. Most testers have two ranges of beta. In most cases, the high range will be used. The lower range will be used mostly for older transistors and many of the audio output transistors, since they have a lower beta figure than the low-power audio-driver transistor.

Checking for Defects

The chart on page 28 shows the meter indications for different transsistor defects. For example, if one of the transistor elements is open, the tester will not calibrate out of circuit, but may appear to calibrate in-circuit due to current paths created by the circuit impedances. When the gain or test button is depressed, no beta reading will be obtained. For various other defects the tester will not calibrate or will not give a beta reading, indicating that the transistor or the circuit around it is defective. This will be the case in over 85 percent of the circuits that are tested. If the transistor tester can be calibrated and a gain reading in beta obtained on the meter, the transistor is not defective.

This simplicity and ease of testing is the one big reason why the in-circuit AC beta transistor tester has become so popular for solid-state servicing.

Leakage

In some cases, a beta reading will be indicated, but the transistor will still be defective. There are several ways to tell if the transistor is at fault.

First, if the meter needle vibrates rapidly during the beta reading, it indicates that the transistor could be leaky or have excessive ICBO. The vibrating needle indicates that a large amount of current is being drawn from the power supply of the tester. Any time this is indicated, recheck the transistor for leakage out of circuit. (In low-im-

pedance circuits, the circuit itself, or a defective component in the circuit, could also cause this effect.) If the transistor is not found to be defective, check the circuit for the source of the problem. In either case, the defect has been isolated to a given stage or component.

If the beta reading of the transistor being checked is low, it is generally due to leakage of the transistor. It is a good idea to list on the schematic of the various sets that you service regularly, the beta readings taken in-circuit on a normally operating set. These readings can be used for comparison in the future. Also, consult a transistor manual for the values of beta that can be expected from the various types of transistors.

Examples of Application

Using an in-circuit transistor tester and the preceding information, servicing time on solid-state devices can be reduced. Here are a few examples and points that can be used for servicing solid-state devices in the shop.

The customer complained of distorted audio after his radio operated for several minutes. The unit was opened and the audio output transistor was replaced. When the unit was connected to the bench power supply, it operated normally for over 30 minutes without distorting, so it was buttoned up and returned to the customer. Two days later he returned the radio for servicing.

When asked how long it played before distorting, he said 30 minutes. Without opening the unit, it was allowed to play, and after 20 minutes, the sound became distorted. The output transistor was checked but it registered normal on both beta and leakage.

The audio stages were the most likely suspects, so beta readings of the transistors in the audio were taken and recorded while the unit was cold. The radio then was allowed to play until the distortion became very noticeable, and another beta reading was taken. The reading of the first audio amplifier was almost half the value of the reading taken earlier, and the leakage was high when checked out of circuit.

When the transistor was tapped, the leakage changed, indicating an intermittent problem. The first audio amplifier transistor was replaced, and the radio returned to the customer, who reported much later that the radio played better than ever. The moral: Don't jump to conclusions before having all the facts.

While servicing a small-screen, portable imported TV set, it was found that an exact replacement transistor is not always the answer. The original complaint had been no video. Another technician had discovered that the first video amplifier transistor was defective, and had put in the recommended replacement transistor from a replacement line. The result: a weak and washed-out picture. This prompted him to get an exact replacement transistor for the set, but it produced only slightly better results.

The in-circuit transistor test showed the driver and video output transistors to be high-gain types, while the exact replacement transistor was a low-beta type.

Another transistor in the set had the same markings as the replacement transistor so its beta was measured. It measured high.

The beta of various transistors in the general replacement transistor stock was checked. One transistor out of the group was high, but just under that of the driver and output stage. This was installed and the picture improved. The FET and transistor reference book was consulted, and it was discovered that the general replacement transistor

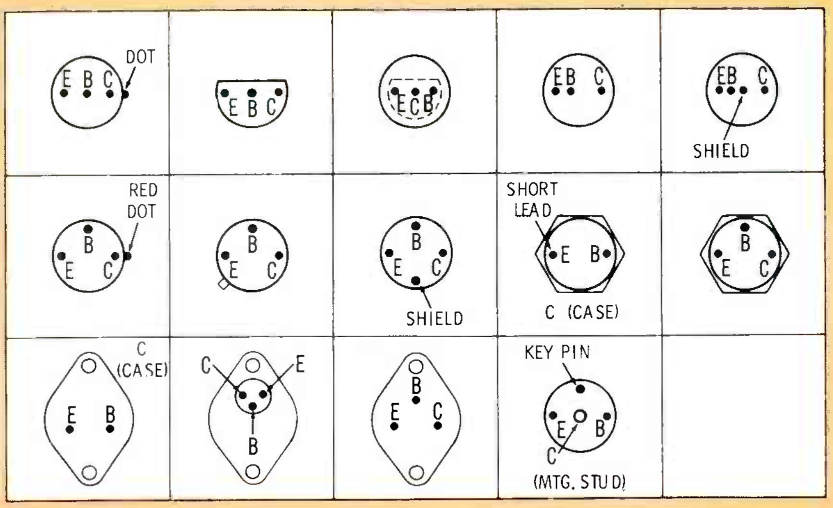

Fig. 4 Base diagrams of common transistor types currently in use.

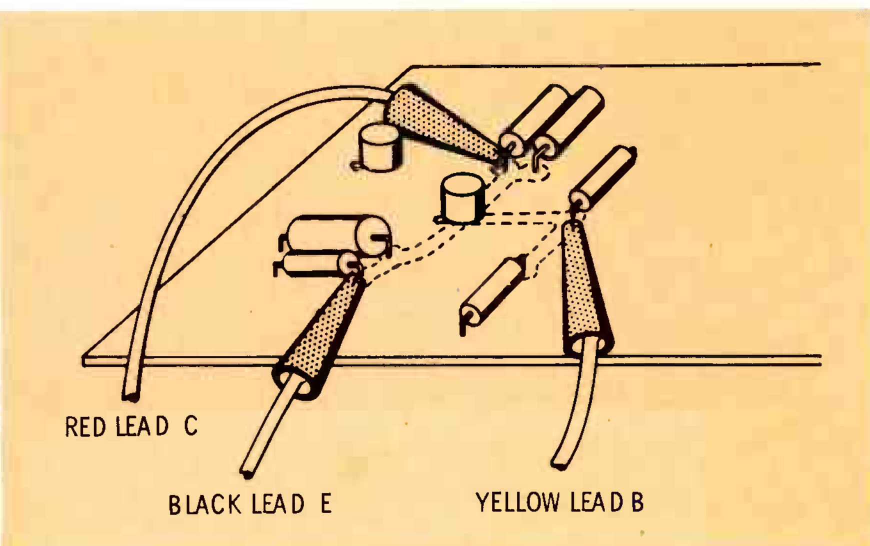

Fig. 5 Tester leads connected to components whose leads are electrically connected to leads of transistor under test.

was usable since its beta reading of 75 fell within the indicated normal beta spread of 50 to 180. However, the transistor that finally solved the problem had a beta of 165. Apparently, the design of the video circuit left much to be desired and would work only with high-beta transistors in all three stages.

In most cases, the circuit will operate normally with a transistor whose beta falls within the given beta spread of the general replacement transistor, but don't overlook the fact that some circuit designs are more gain sensitive than others.

Other Tips About Transistors

There is such a thing as an intermittent transistor. The AC beta can be checked hot or cold. Using freeze spray can speed up servicing time.

Connect the in-circuit tester to the suspected transistor, and check the beta. While depressing the TEST or GAIN button, spray the transistor with the freeze spray. If the beta reading disappears, the transistor is defective. Beta gradually decreasing is normal for a transistor operating in cold ambient temperatures. Any sudden or drastic change indicates a thermally intermittent transistor.

Another problem involves the transistor that is not listed in any specifications book. In this case, look for a transistor with markings similar to the defective transistor, and use its beta reading to select a replacement transistor. Usually a similar transistor can be found in the TV set, but if not, look for one with a similar function, such as an audio driver for a video, horizontal or vertical driver.

In the IF there are usually three transistors. Compare the two good ones and average the readings. IF and RF transistors generally have lower beta than audio transistors.

Conclusion

Servicing time can be reduced by using the in-circuit transistor tester. The amount of time saved is dependent on the technician's knowledge of the operation and application of the instrument and his ability to interpret the information it supplies. A thorough understanding of the parameters and peculiarities of solid-state devices is also essential to quicker solid-state servicing. ▲

Transistor Tester Meter Indications For Defective Transistors

TROUBLE	METER INDICATION
Open Base, Emitter or Collector	Cannot BETA CAL when transistor is tested out of circuit. In circuit tester may BETA CAL through circuit impedances but no beta reading can be obtained when GAIN button is depressed.
Base to Emitter short	Tester will BETA CAL, but TYPE switch must be in wrong position. Beta reading will be all the way to left or greater than infinity with meter pointer vibrating.
Base to Collector short	Tester will BETA CAL, but when GAIN button is depressed, meter indication will not change.
Emitter to Collector short	If there is a dead short, testor will not BETA CAL. If there is a low resistance short the tester may BETA CAL, but the meter needle will vibrate rapidly when checking beta.
Collector and Base leads interchanged	Tester will BETA CAL, but meter reads to right (a beta of less than one).
Emitter and Collector leads interchanged	Tester will BETA CAL, but meter may read to right (a beta of less than one). Indicates a very low beta figure. A few transistors may read the same because they are made to have the Emitter and Collector leads transposed.
Base and Emitter leads interchanged	Transistor will BETA CAL as opposite-polarity transistor, and no Beta reading is obtained when GAIN button is depressed.

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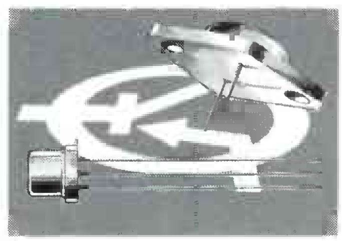

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Practical stereo-FM servicing, Part 5

Cartridge and turntable

by Robert G. Middleton

Cartridge and turntable measurement tests are required to obtain and verify performance within accepted high-fidelity limits. These tests are listed below.

Cartridge Tests

1. Measurement of needle pressure
2. Checking of cartridge output voltage
3. Hum Tests
4. Test of frequency response
5. Measurement of tracking distortion
6. Verification of stylus angle
7. Observation of stylus tip
8. Verification of tracking angle

Turntable Tests

1. Measurement of turntable speed
2. Check for wow
3. Check for flutter
4. Level test
5. Tests for wobble and/or eccentricity
6. Approximate measurement of rumble.

Measurement of Needle Pressure

Fig. 1 shows a typical needle-pressure gauge. Other types may be used, but all indicate the pressure in grams.

Normal needle pressures are different for various types of recordings. A typical hi-fi, super lightweight, pickup employs 1, 2.5 or 3 mil radius sapphire tips. (One mil equals 0.001 inch.) A 25-ohm pickup of this type uses a nominal needle pressure of 9 grams, ±1 gram. On the other hand, a 400-ohm pickup operates with a nominal needle pressure of 5 grams, ±1 gram. For precise evaluations, stylus pressure must be checked within specified tolerance limits against tracking distortion. This measurement is discussed later in this article.

The needle-pressure gauge should be placed so that the indication is obtained at the normal playing level of the pickup. This level varies in most changers; therefore, measurement is made at the average playing level. Although the pressure usually varies as the pickup is raised, and decreases as the pickup is lowered, this variation should not exceed 25%. If a greater variation is measured, look for a defect in the arm assembly. Obscure defects must be corrected by replacement of the arm assembly.

Checking of Cartridge Output Voltage

Cartridge output voltage is checked with an AC VTVM or with a calibrated oscilloscope. The advantage of a scope is that hum voltage can be distinguished from the normal cartridge output. Only the VTVM method will be discussed in this section.

The test setup for checking cartridge output voltage is shown in Fig. 2. It is desirable to employ a test record that provides a constant level at a standard test frequency, such as 1 KHz or 400 Hz.

A typical hi-fi super lightweight pickup that works into a 25-ohm load (R in Fig. 2) normally provides about 10 mv rms. If the output is weak, it is advisable to check the stylus tip, as explained later. If the tip is in good condition, but output is weak, the cartridge should be replaced.

The 25-ohm pickup described previously is often used with a 1-to-5 ratio transformer. Normal loading of the transformer results in a secondary output voltage of approximately 300 mv rms. On the other hand, a 400-ohm pickup normally is used with a 1-to-6 ratio transformer. In this case, about 40 mv rms output will be measured across the secondary. Note that the secondary must be connected to the correct value of load impedance to obtain a meaningful voltage measurement.

With reference to Fig. 3, Np denotes the number of primary turns, and Ns denotes the number of secondary turns. The winding ratio is equal to Np/Ns.

The voltage ratio of the transformer is the same as the turns ratio (except for losses due to leakage flux under normal load). The current ratio of the transformer is the inverse of the turns ratio (except for losses). The impedance ratio is equal to the square of the turns ratio. This means that if the cartridge has an impedance of 400 ohms, and the transformer winding ratio is 1-to-6, the impedance ratio is 1-to-36, and the secondary impedance is 14,400 ohms. Thus, the nominal secondary load resistor has a value of 14,400 ohms. Note, however, that a somewhat different value of secondary load impedance might be chosen to compensate for incidental transformer characteristics such as distributed capacitance. This topic is explained in greater detail in this article under "Test of Frequency Response."

The normal output voltages of common types of cartridges may be summarized as follows: A variable-reluctance cartridge will provide from 10 to 30 mv rms; a ceramic cartridge, 500 to 1200 mv rms; and crystal cartridges, 0.5 to 5 volts rms. These values assume that the cartridge works into its specified load.

The load is an impedance which consists of both the load resistance, cable capacitance, and any leakage reactance of the transformer primary. The variable-reluctance pickup works into a load impedance of

measurement tests

5,000 to 50,000 ohms, with a stylus pressure of 16 grams or slightly more. The ceramic pickup works into a load impedance of approximately 1 megohm, with a stylus force of about 22 grams. The crystal pickup works into a load impedance as high as 5 megohms, with a stylus force of less than 70 grams.

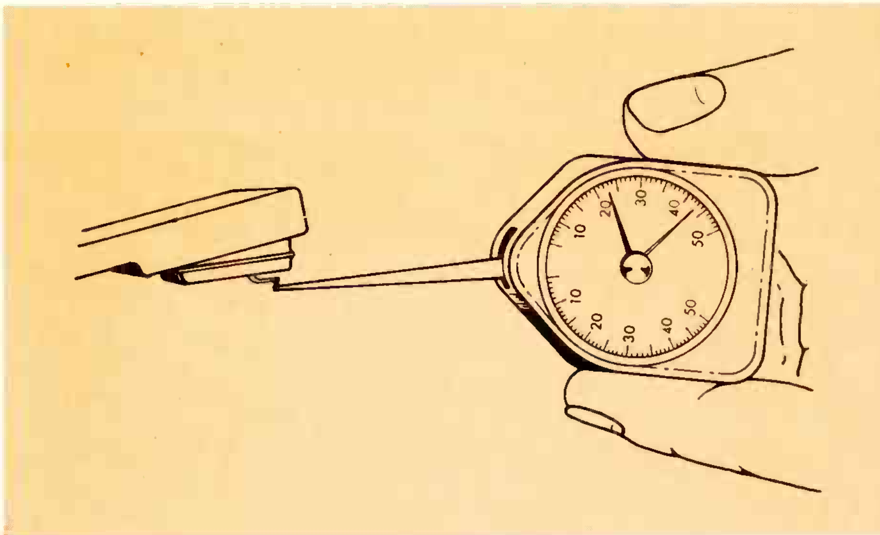


Fig. 1 A typical needle-pressure gauge used for measuring the pressure exerted at the tip of the needle.

Hum Tests

Pickups that employ iron and coil construction are more likely to be affected by stray hum fields than crystal pickups. Of course, a poorly shielded lead from a high-impedance pickup is susceptible to stray electrostatic hum fields. Pickups with iron and coil construction are generally used with solid-steel turntables, because magnetic shielding is thereby provided against stray hum fields from the motor and power supply.

To check for hum, use the test setup shown in Fig. 2, with the pickup held slightly above the record surface. Any reading on the meter is probably the product of hum pickup.

A better test for hum is made by using a scope in place of the VTVM in Fig. 2. Hum voltage is then seen as a 60-Hz (or 120-Hz) waveform, and can be definitely identified. Note that 120-Hz hum is most likely to stem from stray fields of a filter inductor. When playing a test record that has a 1-KHz tone, hum shows up with the tone signal superimposed on the low-frequency waveform, as shown in Fig. 4. The hum level can be minimized in any case by correction of shielding defects to prevent stray fields from gaining access to the pickup.

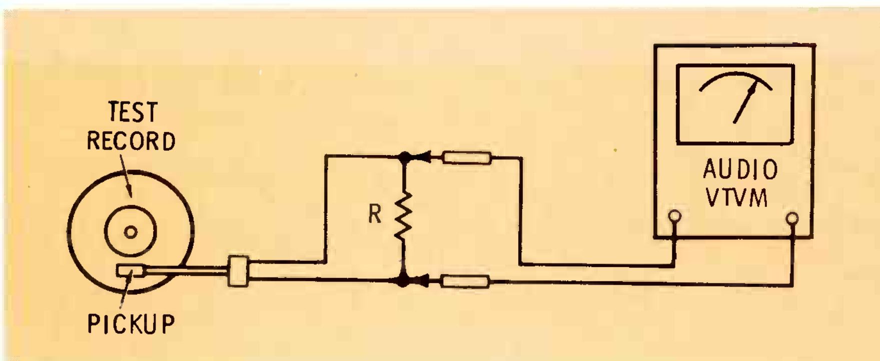
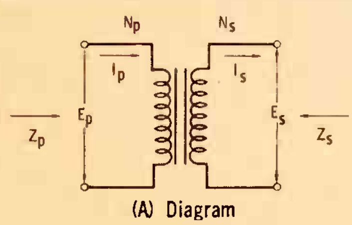


Fig. 2 Test setup for checking cartridge output voltage.

Test of Frequency Response

Frequency response is checked with a test record and an audio VTVM, using the setup shown in Fig. 2. Various types of test records



(VOLTAGE) $\frac{E_p}{E_s} = \frac{N_p}{N_s}$

(CURRENT) $\frac{I_s}{I_p} = \frac{N_p}{N_s}$

(IMPEDANCE) $\frac{E_p I_s}{E_s I_p} = \frac{N_p^2}{N_s^2} = \frac{Z_p}{Z_s}$

(B) Equations

Fig. 3 Diagram and equations showing basic transformer relationship between number of turns, voltage, current and impedance.

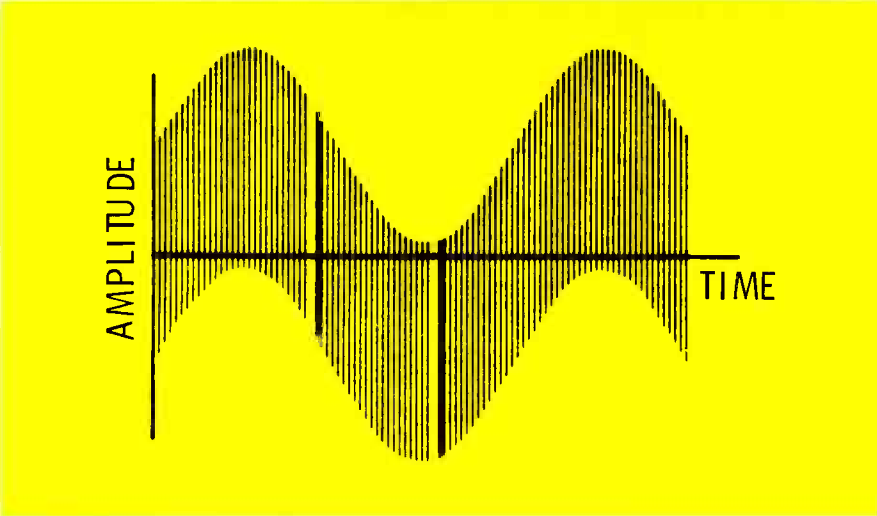


Fig. 4 Hum voltage superimposed on low-frequency waveform.

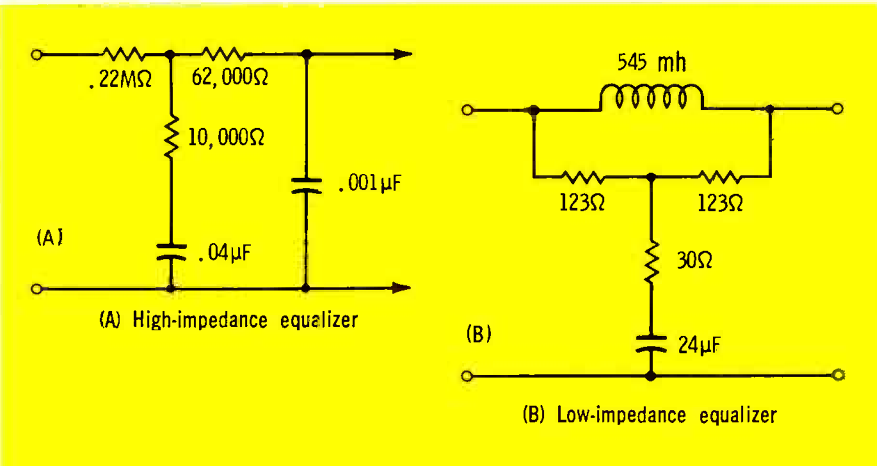


Fig. 5 Equalizer circuits can be used to improve frequency response.

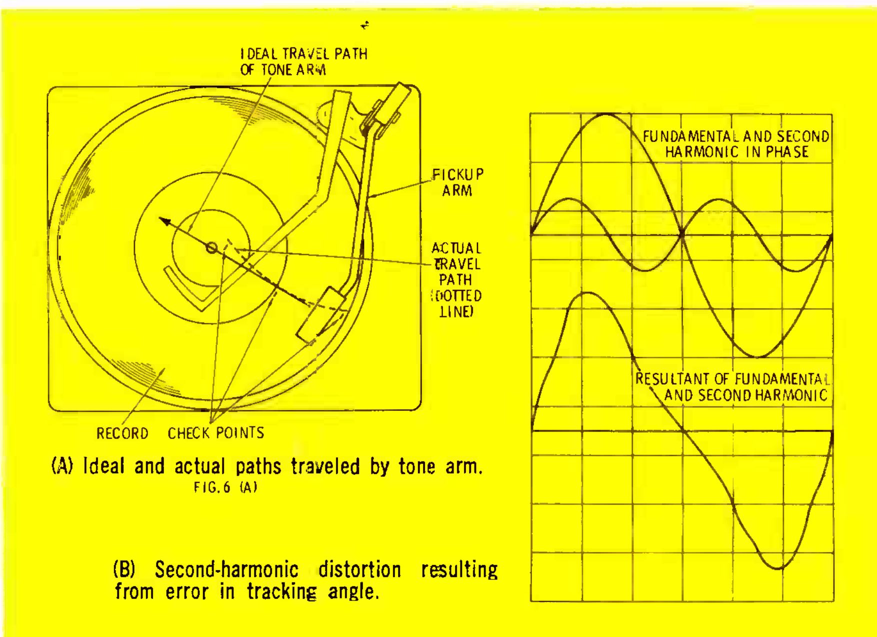


Fig 6 Illustrations showing tracking characteristics and harmonic distortion resulting from improper tracking.

are available. A **gliding-tone** test record can be compared to an audio sweep generator. One standard test record starts at 14 KHz and ends at 10 Hz. Another starts at 10 KHz and ends at 50 Hz. A **banded-tone** test record provides only a 1-KHz tone in steps with increasing output levels. This type of record is suitable for harmonic-distortion tests, but not for frequency-response checks. Some test records provide both banded-tone and gliding-tone outputs. For example, a banded-tone sequence may be followed by alternate gliding and constant audio frequencies from 3 KHz to 30 Hz. **Two-tone** test records are used only for IM distortion measurements.

The frequency response of a good ceramic or crystal cartridge should be reasonably uniform from 50 Hz to approximately 15 KHz. Variable-relutance cartridges should have reasonably flat frequency response to approximately 20 KHz. Some types of high-output cartridges have an upper frequency limit of 8 KHz. Although one or more peaks in frequency response will often be found, the peak amplitude(s) should be less than 2 dB. An audio VTVM with a dB scale is particularly useful for these tests.

Load-impedance values can have considerable effect on the frequency response of a ceramic or crystal cartridge. Poor frequency response can sometimes be improved by a change in load resistance and/or capacitance. Equalizer circuits for standard recordings are shown in Fig. 5. If the high-frequency response of a pickup drops off gradually, this characteristic will often be acceptable, inasmuch as the pre-emphasis employed in most recordings must be equalized in the hi-fi system.

Measurement of Tracking Distortion

An ideal tone arm and pickup would track a record (see Fig. 6A) so that the stylus would always move perpendicularly to the tangent at the record groove. In practice, this can occur only at one groove in the record because the pickup moves on a curve from the outer to the inner grooves, as shown in Fig. 6A. A reasonably good test of the tracking angle is to place the stylus at the outer grooves, then at an intermediate groove, and finally at an inner groove, and to observe whether the edge of the cartridge is **reasonably** tangent to the grooves.

A tracking error of 3° or 4° is normally expected at the outer and inner grooves. Large tracking errors are plainly visible, but small errors must be detected by careful measurement. Excessive errors in the tracking angle produce second-harmonic distortion, as shown in Fig. 6B. Harmonic distortion is measured with the test setup shown in Fig. 7. In such tests, it is assumed the preamplifier has been checked previously for distortion, using a quality audio oscillator.

Note that the percentage of harmonic distortion measured in Fig. 6B is not entirely accounted for by tracking error and possible preamplifier distortion. That is, the pickup might have inherent harmonic distortion. At this point in the procedure, we are concerned with minimizing the harmonic distortion due to tracking error. Since this is a function of stylus pressure, it is advisable to try the effect of increasing the stylus pressure within reasonable limits. Some pickups are rated for minimum stylus force to provide optimum tracking. If a recording or turntable is warped, or slightly eccentric, a 50% increase in stylus force may be required to obtain good tracking.

After checking for harmonic distortion, it is good practice to make an intermodulation distortion test, as depicted in Fig. 8. The two-tone test record must provide suitable frequencies. Assuming that the preamplifier has been checked previously and found to have acceptably low IM distortion, an objectionably high meter reading is due to nonlinearity in the pickup. A banded-tone 1-KHz test record with progressive output levels may show that IM distortion is negligible except at high output level. In any case, a defective pickup must be replaced.

Verification of Stylus Angle

Even if the needle pressure is optimum, distortion will occur if the stylus angle is incorrect. Therefore, it is good practice to check the stylus angle against the manufacturer's specifications, if available. Angles can be conveniently measured with a protractor, such as depicted in Fig. 9. If the stylus angle is out of tolerance because of me-

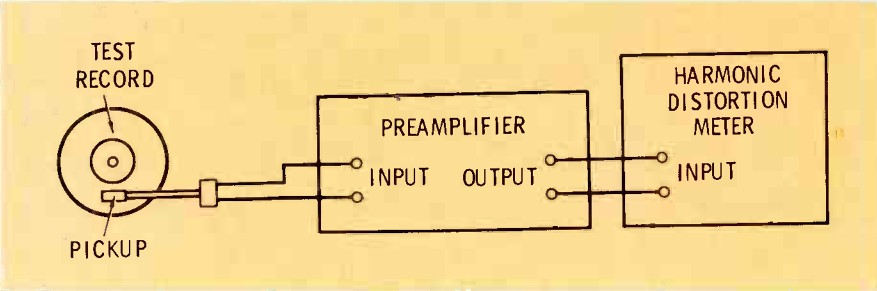


Fig. 7 Test setup for measuring harmonic distortion.

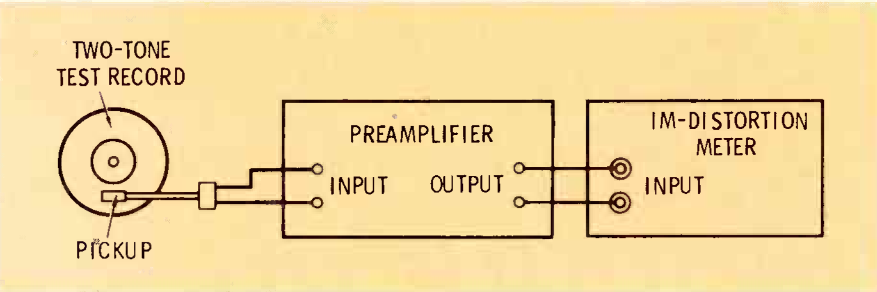


Fig. 8 Test setup for measuring intermodulation distortion using two-tone test record.

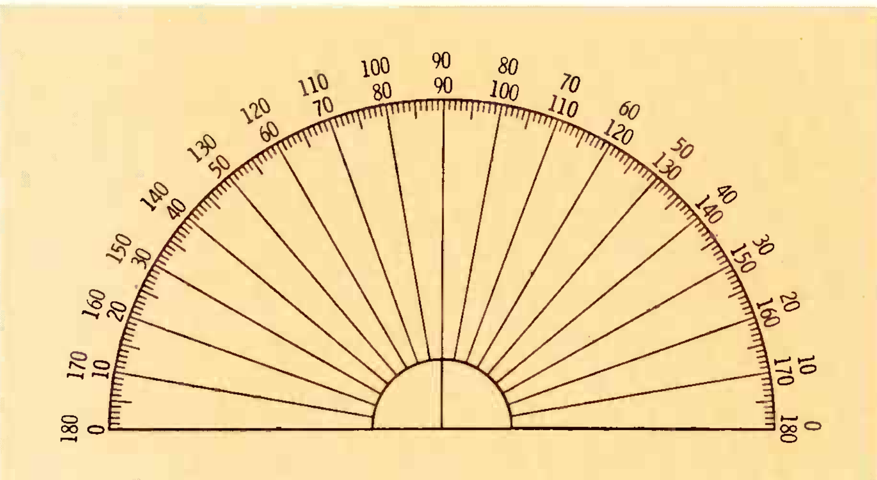


Fig. 9 Protractor can be used for measuring stylus angle.

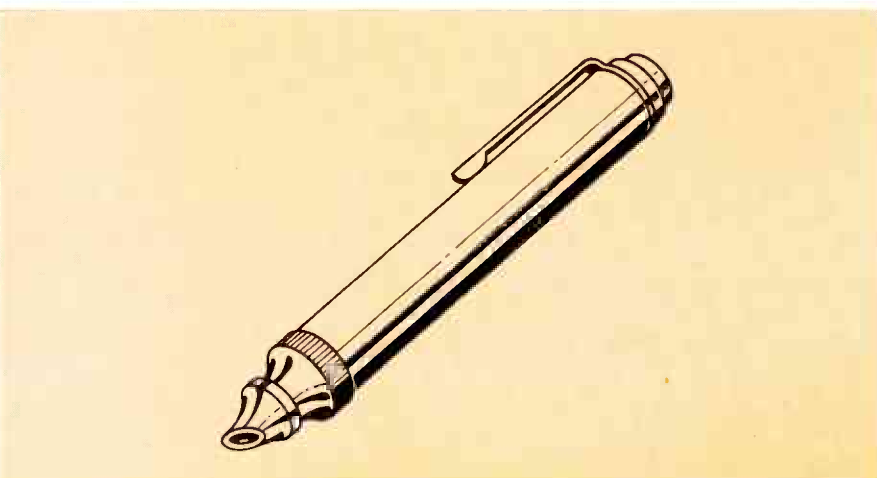


Fig. 10 Fifty-power microscope for visually inspecting condition of stylus.

chanical distortion, it is generally impractical to correct the trouble—replacement should be made at the outset.

Observation of Stylus Tip

Unless a new stylus is used in making performance measurements, it is a good practice to inspect the stylus for wear with a 50-power stylus inspection microscope, as shown in Fig. 10. If the stylus shows signs of wear, it should be replaced before playing a test record. By the same token, a test record should be checked periodically for harmonic and IM distortion, using a good stylus. When the test record begins to show appreciable distortion, it should be discarded.

Measurement of Turntable Speed

A turntable must rotate at constant speed, even during lightly and heavily recorded passages. Turntable speed is conveniently measured with a stroboscopic disc illustrated in Fig. 11. The strobe disc is viewed under a neon or fluorescent light powered from a 60-Hz source. One of the barred circles will appear to stand still, or to rotate slowly clockwise or counterclockwise. Motionless bars indicate the calibrated speed of the particular barred circle. Clockwise rotation indicates that the actual speed is slower.

In some cases, the barred circle will appear to stand still momentarily, rotate for a while, and then to stand still again. This trouble is sometimes caused by oil or other foreign substances on the drive wheel. These parts can be cleaned with alcohol.

The same trouble symptom can be caused by defective turntable or motor bearings. Also, there may be unsuspected mechanical interference, such as the turntable rubbing against some surface or object.

Wow

If a turntable does not rotate at constant speed, the condition is technically termed **wow.** It is basically a mechanical form of frequency modulation. Economy-type turntables may be unsatisfactory for hi-fi reproduction because of marginal motor power and lack of sufficient flywheel effect. A strobe disc test under playing conditions will disclose wow which, in this case, cannot be eliminated.

Motor and turntable units are often specified by manufacturers for motor type, power consumption, and the torque required to brake the turntable from a given speed to a lower speed (such as from 78 rpm to 77 rpm). Torque denotes a twisting force, as depicted in Fig. 12. The magnitude of torque is expressed as the product of force and distance (F and r in Fig. 12.) Braking torque for a turntable is stated in ounce-inch units.

Of course, wow will become evident if the motor is operated at subnormal line voltage. Noticeable wow will be observed on heavily recorded passages. Another obvious cause of wow is a warped record; the tolerable limit of warp is about 1/16 inch. Special instruments are available to measure wow, and indicate the percentage in rms deviation of a tone frequency with respect to its average frequency. However, a strobe disc serves the same purpose for routine shop tests. The only requirement in strobe-disc application is that the changes in apparent speed of bar rotation be observed carefully. When wow is slight, it might be overlooked in an off-hand test.

Flutter

Flutter is related to wow, but has a comparatively higher deviation rate. The human ear is more sensitive to flutter than to wow. Flutter is usually caused by small defects in the motor or the mechanical drive system. It tends to occur in units that have been in extended service, with little or no attention to lubrication. The resulting wear causes poor mechanical fit, which must be corrected by replacement of the faulty parts. Although flutter meters are available, a strobe disc serves adequately for routine shop tests. Both wow and flutter meters are comparatively expensive instruments, and their cost can be justified only by the larger shops or labs.

Understandably, a turntable must be level to provide optimum performance. A typical turntable level is illustrated in Fig. 13. The turntable must also be free from wobble, and should maintain its level against moderate vertical pressure near the edges. If a wow and/or flutter meter is available, note that a meter reading of less than 1% is considered acceptable. A good hi-fi turntable

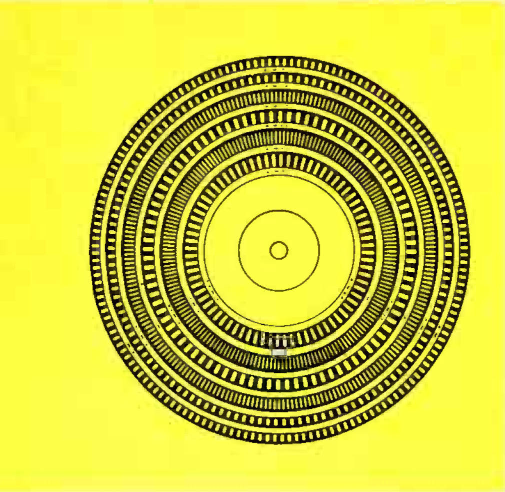


Fig. 11 Stroboscopic disc for measuring turntable speed.

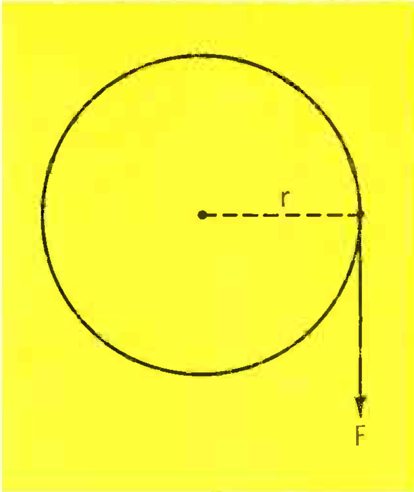


Fig. 12 Illustration of twisting force called torque.

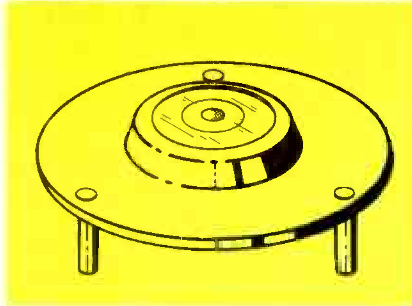


Fig. 13 Device for leveling a turntable.

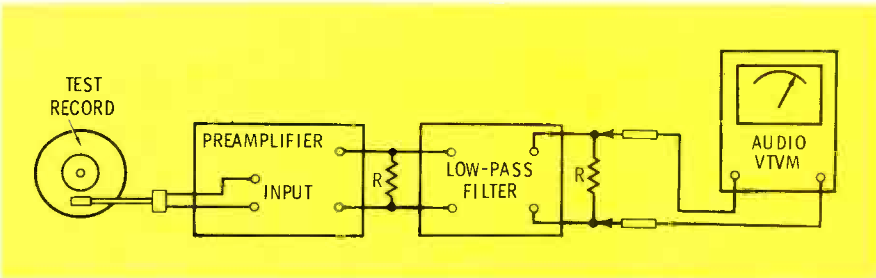


Fig. 14 Test setup for measuring rumble.

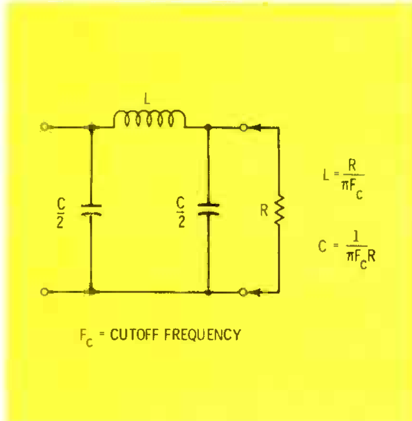


Fig. 15 A single-section, low-pass Pi filter used in rumble test.

may show as little as 0.1% wow or flutter, even on heavily recorded passages.

Rumble

Both wow and flutter are distinguished from **rumble.** Rumble consists of a series of random pulses (not a cyclic low-frequency interference). It is caused by vibrations within the player, and is often decribed as noise "like furniture moving around upstairs." A scope test quickly shows whether interference has a rumble waveform—the pattern is random and does not have a steady cyclic form in the case of rumble. Although rumble can be reduced or eliminated by means of an amplifier rumble filter which cuts off sharply below 50 Hz, it is obviously desirable to correct the cause of the rumble if it is practical to do so.

When rumble is a problem, check the motor for vibration. Any mechanical defect that causes vibrations to be transmitted to the turntable can cause rumble. Note that rumble can be measured, using the test setup shown in Fig. 14. The low-pass filter has a cutoff frequency of approximately 300 Hz. The test procedure is as follows:

First, the low-pass filter is removed from the circuit, and the output is measured using a 1-KHz test record. The preamplifier controls are adjusted for maximum-rated output and flat frequency response. Then, the low-pass filter is connected into the test circuit, and the VTVM sensitivity is advanced to obtain a convenient reading. Finally, lift the pickup from the test record and note any change in VTVM reading. The amount of rumble is expressed as the number of dB below maximum rated output from the preamplifier.

Let us briefly consider the component values used in a low-pass filter. With reference to Fig. 15, choose a cutoff frequency, fc, and a terminating resistance, R. Then find the required values of L and C as indicated. For example, if fc=300 Hz, and R=75 ohms, then L=80 mh and C=0.071 mfd. One-half of C, or 0.035 mfd is connected at each end of L to form the filter. A sharper cutoff characteristic can be obtained by connecting several filter sections in series. (Note that the inductors of the multi-section filter must not couple into one another.)

Conclusion

Although other types of tests are made in audio laboratories, these are generally out of the question for the service shop because of the costly test equipment that is required. For example, measurement of the static compliance of a stylus requires a calibrated shadowgraph and a sensitive balance. However, the simpler tests that have been explained in this series of articles permit almost any service problem to be solved with a minimum of time and effort. Apprentice technicians are often awed by ordinary harmonic and intermodulation distortion meters, and occasionally by a scope. However, practice makes perfect, and the modern shop cannot hope to remain competitive unless modern test equipment is utilized. ▲

A look at RCA's solid-state color

Part 4/by Ellsworth Ladyman

The horizontal section of the CTC40 is discussed in this, the final installment of a serise of articles analyzing the circuitry employed in this manufacturer's first solid-state color chassis.

Horizontal AFC and Oscillator

The function of an automatic frequency control (AFC) circuit in the horizontal section of a television receiver is to hold the horizontal oscillator frequency at exactly the same frequency and phase as the broadcast horizontal sync pulses. Color television receivers demand even more exact performance from the horizontal AFC circuit because the color burst amplifier is keyed by pulses obtained from the horizontal circuit. Any change in frequency or phase existing between the occurrance of color burst and the horizontal keying pulse for the burst amplifier will result in an incorrect color display.

The design of the AFC circuit employed in the CTC40 chassis is such that it will hold the horizontal oscillator at the exact frequency of the incoming horizontal sync pulses as long as the free-running frequency of the oscillator is within a tolerance of ±300 Hz of the broadcast horizontal sync signal.

Theory of Operation

The horizontal AFC and oscillator circuitry is illustrated schematically in Fig. 1. The phase splitter stage supplies equal and opposite sync pulses to the familiar dual-diode phase detector. Incoming sync pulses are differentiated at the base of the phase-splitter transistor to reduce interference from the vertical sync pulses that are present in the output of the sync separator.

Output pulses from the collector and emitter of the phase splitter are coupled to the phase-detector diodes by capacitors C1 and C2.

A reference voltage taken from the high-voltage transformer is applied to the common diode junction through a waveshaping network. This network shapes the negative-going pulses from the high-voltage transformer into a sawtooth signal that is applied to the AFC circuit. The frequency of the pulses sampled from the high-voltage transformer is the same as that of the horizontal oscillator.

When the pulses from the high-voltage transformer and the incoming horizontal sync pulses occur at the exact same frequency, each diode is keyed into conduction by the sync pulses as the reference voltage passes though zero. The current through each diode will be equal, resulting in equal and opposite charges on capacitors C1 and C2. As these capacitors discharge through resistors R1 and R2, equal and opposite voltages are developed across the resistors. The voltage at their junction is zero (with respect to ground), and, consequently, the amount of correction voltage developed is zero.

If the horizontal oscillator is running at a frequency less than that of the incoming horizontal sync pulses, a change in the relative position of the reference voltage waveshape during the application of the sync pulses will result. The sync pulses will key the diodes into conduction during the positive portion of the retrace slope; diode X1 will conduct more strongly than diode X2; and the charge on capacitor C1 will become more positive, while the charge on capacitor C2 will become less negative.

Discharge action of these capacitors through resistors R1 and R2 will result in an imbalance of current flow through R1 and R2, and the voltage developed at their junction will go positive. This positive voltage is the correction voltage for the horizontal oscillator and will cause the oscillator to increase in frequency.

Should the oscillator be running at a frequency greater than the incoming sync pulses, a negative correction voltage will be developed at the junction of R1 and R2 as the result of circuit action similar but opposite to that described in the preceding paragraph. Application of the negative correction voltage to the oscillator will produce a decrease in the oscillator frequency.

The DC correction voltage present at the junction of R1 and R2 is fed to an AFC limiting and filtering circuit comprised of diodes X3 and X4, capacitors C3 and C4, and resistor R3. The function of this circuit is two-fold: The limiting diodes prevent the AFC correction voltage from exceeding —0.5V to 0.5 volts; and the filter network prevents the AFC output from being contaminated by unwanted frequencies, such as 60 Hz. (A 60-Hz signal present at this point would result in horizontal bending, twisting, etc.)

Horizontal Oscillator

A blocking oscillator circuit is employed as the horizontal oscillator in the CTC40 chassis. Basic circuit action is as follows:

Voltage pulses present on the collector of the horizontal oscillator transistor are transformer-coupled into the base circuit, driving the stage into cutoff. During the time that the oscillator transistor is cutoff, capacitor C5 discharges through the horizontal hold control circuitry to the "turn-on" potential of the oscillator. The oscillator conducts, a pulse appears at the collector and is coupled to the base, and the cycle repeats.

The settings or adjustments of the horizontal linearity and horizontal hold controls determine the discharge time of capacitor C5 or, in other words, the length of time the transistor remains cut off. In this manner the horizontal hold control determines the frequency of the horizontal oscillator.

This is accomplished by adding the correction voltage from the AFC circuit to the charge capacitor C5. This correction voltage, depending on its polarity and amplitude, will either add or subtract from the charge on capacitor C5, which, in turn, either increases or decreases the time required to discharge C5 to the turn-on potential of the oscillator. This circuit action alters the frequency and phase of the oscillator in accordance with the broadcast sync pulse.

Horizontal Oscillator B+ Source

A special 30-volt source is used to supply B+ to the horizontal oscillator. This is done to assure that the horizontal oscillator will be capable of supplying adequate drive to the horizontal output stage at the instant power is first applied to the receiver. The filter circuit of the normal +30-volt supply source requires too much time to reach full value; therefore, the special circuit, comprised of X5 (zener diode) and resistor R4, is used to develop the required 30 volts from the more lightly filtered 155-volt source. This circuit functions to reduce the time required for the oscillator output to reach its normal operating level.

Horizontal Output Circuitry

It is necessary to slightly alter the shape of the horizontal oscillator output waveform to minimize the possibility of pretriggering the commutator switch. This is accomplished by the waveshaping network composed of diode X5, capacitor C6 and resistors R5 and R6.

The voltage developed across the output winding of the horizontal blocking oscillator transformer is coupled to this waveshaping network. R6 and C6 function as a differentiating network, producing a positive voltage spike to turn on the commutator switch. The diode, X6, is reverse biased during the negative-going portion of the output voltage waveshape. This permits capacitor C6 to discharge through the parallel paths provided by R5 and R6. This discharging action holds the waveshape negative until the next positive pulse arrives. Thus, the commutator gate is held negative during trace-time, reducing commutator pretriggering.

Control of Temperature Induced Frequency Change

It is an inherent characteristic of transistors that their operation will vary with changes in ambient and internal temperature. A thermistor, RT, in conjunction with resistor R7, functions as a temperature-sensitive, voltage-divider network. As the temperature of the horizontal oscillator transistor changes, its operating frequency tends to change.

The same changes in temperature that affect the transistor also affect the thermister (RT). The transistor base-circuit voltage will be altered by the temperature-induced changes in the divider network comprised of RT and R7. This change in base-circuit voltage will be in a direction that will cancel out the effects of temperature on the transistor.

Horizontal Deflection

The RCA CTC40 chassis utilizes two silicon-controlled rectifiers (SRC's) and their associated components to generate the necessary yoke current and fulfill high-voltage requirements.

The function of any horizontal deflection system used in television receivers utilizing electromagnetic deflection is to provide a linear flow of current through the yoke windings which, in turn, moves an electron beam from one side of the picture tube screen to the other in a linear sweep. This action is normally referred to as "trace", and the yoke current that caused the deflection is called "trace current."

Trace current must be in sync with the incoming TV signal. The

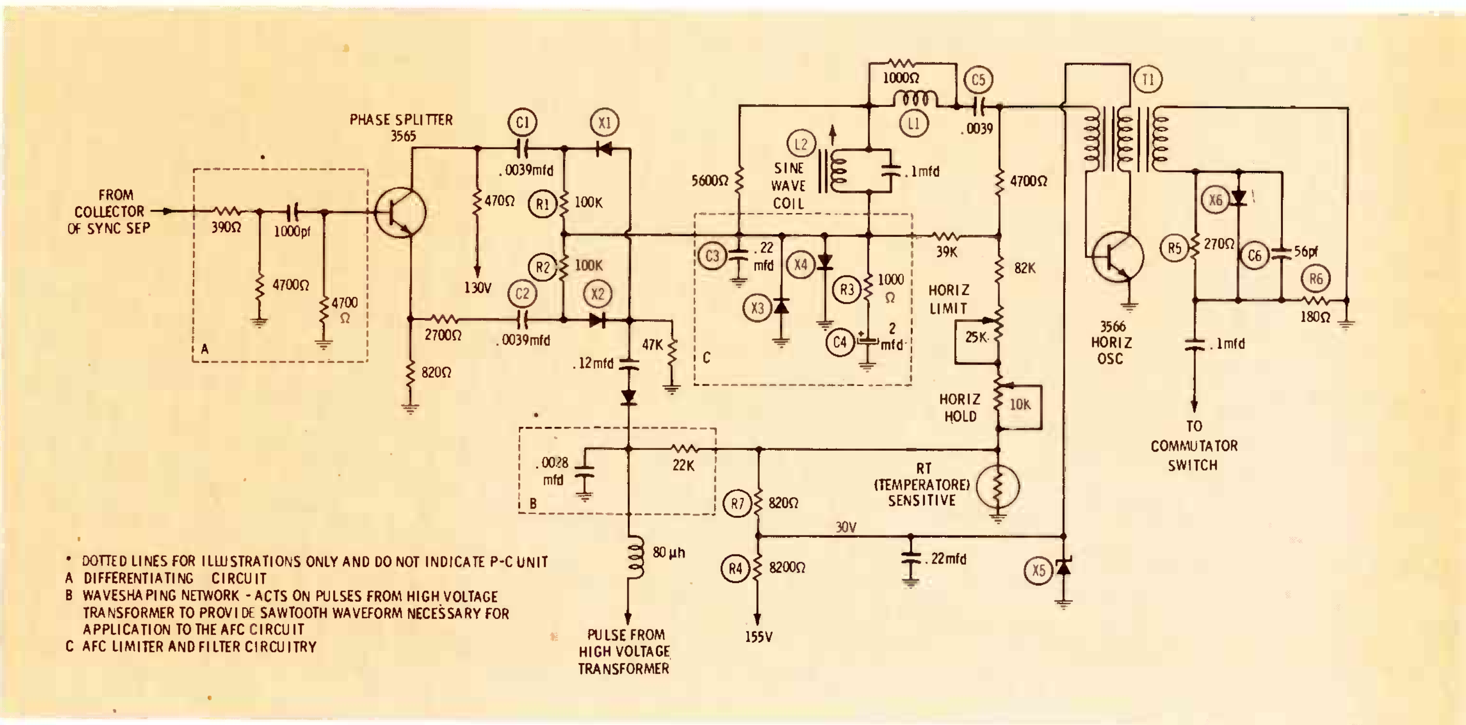


Fig. 1 Schematic diagram of horizontal AFC and horizontal oscillator circuitry employed in RCA CTC40 chassis.

yoke current must also provide a means of returning the CRT beam to the starting side of the CRT screen. The current that accomplishes this is referred to as retrace, or flyback, current.

Circuit Action

A partial schematic of the horizontal output circuit is shown in Fig. 2. Diode X1 and silicon-controlled rectifier SCR1 control the flow of current through the horizontal yoke windings during the CRT beam trace time. Diode X2 and silicon-controlled rectifier SCR2 control the flow of current through the horizontal yoke windings during retrace time.

Energy storage and timing properties are provided in the circuit by components L1, C1, C2 and Cy. Inductors L2A and L2B provide a charge path for L1 and C1, and a gating, or keying, signal to SCR1. The complete horizontal-deflection yoke-current cycle can be divided into a sequence of individual actions involving different modes of horizontal circuit operation. These actions are accomplished during discrete intervals of the horizontal deflection yoke current cycle.

During the first one half of CRT beam trace time, the current through the horizontal deflection coils decreases towards zero and flows through trace diode X1, resulting in a charge build-up on capacitor Cy. During this interval (first half of trace time), silicon controlled rectifier SR1, the trace SCR, is prepared for conduction by the application of the proper gate-voltage pulse. However, the SCR1 will not conduct until its anode/cathode junction is forward biased. This condition will be satisfied during the sec-

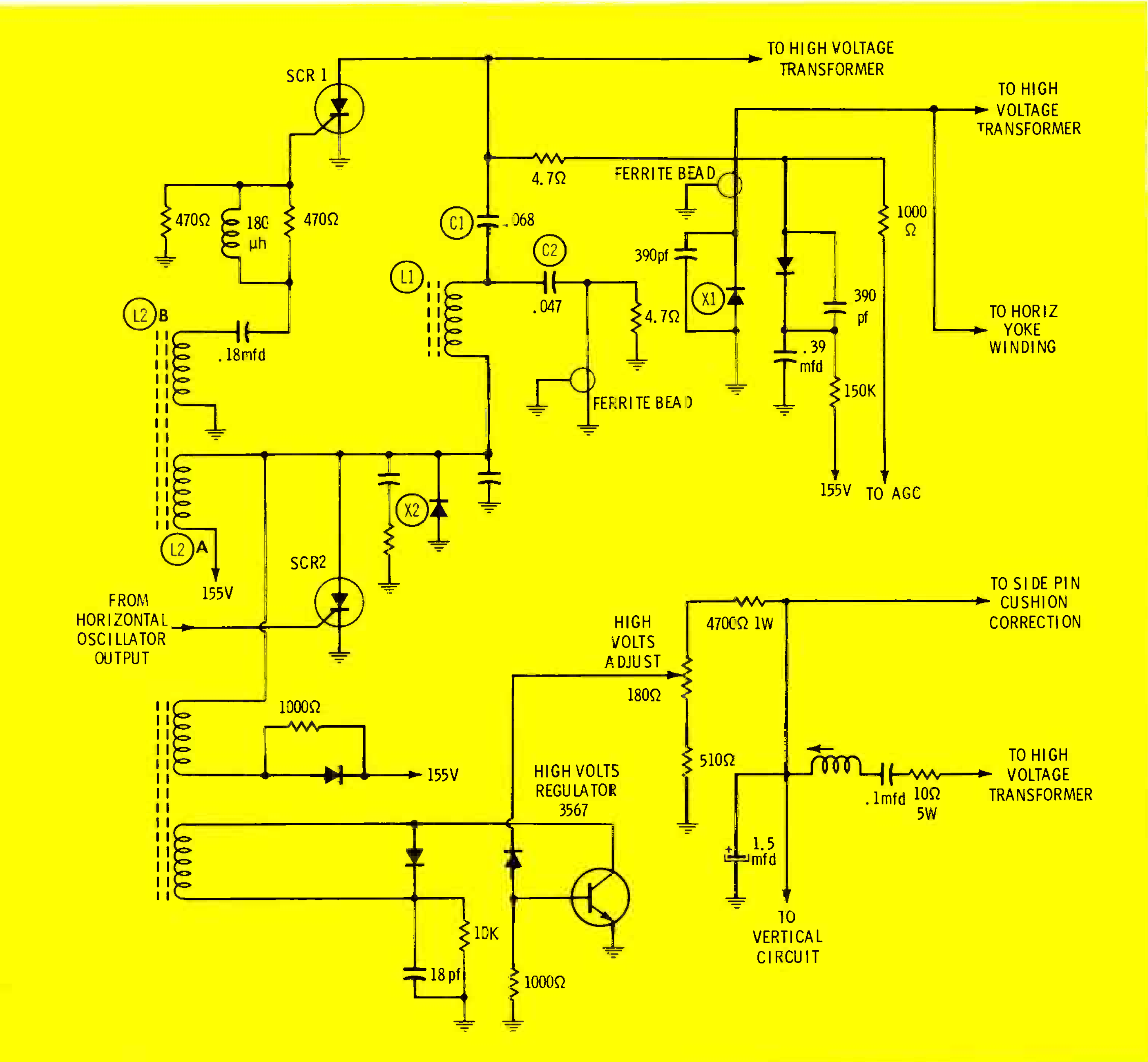


Fig. 2 Partial schematic diagram of horizontal output circuitry found in CTC40.

ond half of the beam trace cycle.

At the end of the first half of trace, yoke current reaches zero, capacitor Cy starts discharging through the yoke inductance, and the current flow through the circuit reverses, reverse-biasing diode X1 and, simultaneously, forward biasing the SCR1. The capacitor discharges into the yoke inductance through SCR1 and the resulting yoke current completes the second half of trace.

When the second half of trace is concluded, the CRT beam has scanned across the entire width of the CRT screen. At this point, a pulse, derived from the horizontal oscillator circuit, keys the retrace SCR into conduction. This action releases the charge previously built up, or stored, on capacitor Cy, and current flows into the commutator circuit comprised of inductor L1 and capacitor C1.

Because of heavy forward current flow through the yoke circuit (SCR1, Ly and Cy), the net current resulting from the combined circuit actions of the commutating switch circuit and the yoke circuit continues to allow the trace rectifier, SCR1, to conduct.

At this point both rectifiers, SCR1 and SCR2, are conducting. However, the current flowing in the commutator circuit increases much more rapidly than the current flow in the yoke circuit. After an extremely short period of time (two to three microseconds) the net current flowing in SCR1 reverses, turning off SCR1 at the start of retrace.

Circuit conditions are now set to initiate retrace: Trace rectifier SCR1, along with diode X1, is cut off, and retrace rectifier SCR2 is conducting. The result is a series resonant circuit comprised of inductor L1, capacitor C1 and the horizontal yoke windings. (Capacitor CY is also in series with these components, but, because of its value, can be disregarded.)

The current through this circuit causes the CRT beam to retrace half way across the screen. At this point the current flow has decreased to zero. Current flow in the series resonant circuit now reverses, and retrace rectifier SCR2 ceases conduction because the current flow in the circuit is opposite the normal flow of forward current.

Diode X2 is now forward-biased

by this reversal of current and starts conducting, supplying the energy for the remainder of retrace. The energy previously stored on capacitor C1 has been returned to the yoke inductance.

Retrace current flowing in the horizontal yoke winding returns the electron beam to its starting point. The time interval of yoke retrace current flow is made equal to the desired retrace time by selection of the proper values of components L1, C1 and Ly.

These components are selected to be resonant at a frequency which has a period equal to two times the retrace time interval. Therefore, the current flowing during one half cycle of circuit oscillations will accomplish the full retrace function.

After completion of one full cycle (trace and retrace), the circuit must be made ready for the next cycle. This includes restoring energy to the commutator circuit and resetting the trace rectifier, SCR1. Both of these functions are performed by utilizing circuitry which includes inductor L2.

During retrace, inductor L2 is connected between B+ and ground by the conduction of SCR2 and diode X2, respectively. When X2 ceases conduction, inductor L2 is removed from ground. A charge is built up on C1 from the B+ line through inductor L2. This charging process continues throughout the trace interval, until retrace begins. The charge on C1 serves to replenish energy to the yoke circuit during the retrace interval.

The voltage developed across inductor L2 during the charging of capacitor C1 is used to forward-bias the gate of SCR1. This sets up SCR1 and enables it to conduct upon receiving the proper signal. The voltage developed across inductor L2 is coupled to the gate of SCR1 via L2A, C2 and R1.

These components form a waveshaping network that forms a pulse with the proper shape and amplitude to enable SCR1 to conduct when its anode/cathode junction is forward-biased. This will occur approximately mid-way through the trace interval.

This concludes our analysis of RCA's solid-state CTC40 color chassis. (Schematic diagrams used in this article series courtesy of RCA.) ▲

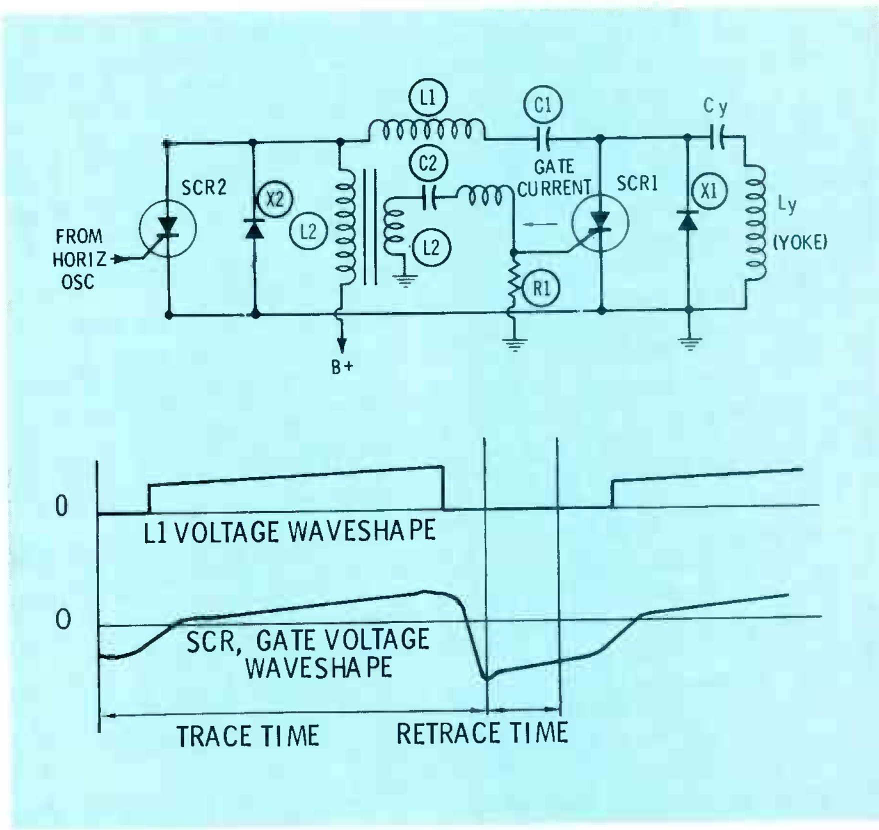


Fig. 3 Simplified schematic of horizontal output circuit, and diagram showing instantaneous voltages across L1 and SCR1 during trace and retrace times.

bookreview

Using Scopes In Transistor Circuits: Robert G. Middleton, Howard W. Sams and Company, Inc., Indianapolis, Indiana, 1968; 192 pages, 5½" x 8½", soft cover, $4.50 (Catalog No. 20663).

Written chiefly for the electronics technician, this text tells how and when to use oscilloscopes in transistor circuits, with special emphasis on scope waveform analysis. It includes detailed discussions of waveforms and circuit theory of transistor oscillators, amplifiers, waveshaping circuits, monochrome and color TV and electronic computers.

Practical CB Radio Servicing: R. R. Freelander, Hayden Book Company, Inc. New York, 1968; 192 pages, 6" x 9", soft cover, $4.75.

Specifically written for professionals who must diagnose and repair CB radios quickly, the content of this text is arranged so that each chapter discusses a specific aspect of CB servicing. Thus, the book can be used as a review source for spot testing and troubleshooting techniques.

The text begins by detailing check-out procedures for both fixed and mobile units. Discussed next is a step-by-step method for measuring transmission and receiving frequencies for optimum performance and compliance with FCC rules, followed by measurement and corrective procedures for modulation and symmetry, input and output power, sensitivity and selectivity.

Later chapters are devoted to diagnosing and repairing receiver, transmitter and power supply troubles. Causes and cures of interference are also discussed.

Rounding out the content is an overall review of CB equipment and applications, and a glossary of CB radio terms. ▲

Test equipment available for TV servicing

The test equipment described in the following pages is representative of the quality, variety and cost of common test instruments currently available for servicing both b-w and color TV.

The list does not include all items currently available. Included are only the instruments of those manufacturers who respond to our request for information. (NA indicates that the information was not available at press time.)

Compare the characteristics of the test equipment you are currently using with those of the instruments listed here. If yours comes out second best, perhaps it is time you considered updating your test equipment inventory.

Color-bar generators

AMPHENOL MODEL 865

Patterns

Color:
- Keyed rainbow
- Three-bar (80°, 180°, 270°)
- Single bar, variable between 30° and 300°

Convergence:
- Crosshatch (20 x 15 lines)
- Dots (300 in 20 x 15 array)
- Horizontal lines
- Single crossbar (movable)
- Single dot (movable)
- Vertical lines

Outputs

RF:
- All patterns, channels 3 or 4, level variable to about 50 mv p-p

Video:
- All patterns, black positive, level fixed at about 1 volt p-p

Chroma Level:
Level variable 0-200%

Power Requirements:
Battery—12 AA cells
Line—115V AC, 60 Hz

Size (HWD):
6⅝″ x 9¼″ x 5″

Weight:
4 lbs.

Price:
$189.95

B&K MODEL 1242

Patterns

Color:
- Keyed Rainbow (crystal controlled)

Convergence:
- Crosshatch (9 x 14 lines)
- Dots
- Horizontal lines
- Vertical lines

Outputs

RF:
- Channels 3 or 4, level fixed to 5 mv p-p

Chroma Level:
Variable 0-200%

Added Features:
Gun killers

Power Requirements:
Line—115V AC, 60 Hz

Size (HWD):
7″ x 2¼″ x 9⅜″

Weight:
3 lbs.

Price:
$99.95

B&K MODEL 1245

Patterns

Color:
- Keyed rainbow (crystal controlled)

Convergence:
- Crosshatch
- Dots (0.25 microseconds wide)
- Horizontal lines
- Vertical lines

Size (HWD):
2⅞″ x 8⅞″ x 8½″

Weight:
3 lbs.

Price:
$139.95

EICO MODEL 385

Patterns

Color:
- Keyed rainbow (crystal controlled)

Convergence:
- Crosshatch
- Dots
- Horizontal lines
- Vertical lines

Added Features:
Gun killers
Size (HWD):
2½" x 8⅔" x 8⅜"
Weight:
7 lbs.
Price:
$109.95 (wired)
$79.95 (kit form)

HICKOK MODEL 661

Patterns
Color:
- 6 separate NTSC color bars (each bar covers ⅔ of screen)
- 4 phase test signals (R-Y, B-Y, G-Y/90 and −G-Y)

Convergence:
- Crosshatch (15 x 20)
- Dots (approx. 300)
- Horizontal bars (15)
- Vertical bars (20)

Outputs
RF:
- channels 3 and 4, all pattern, variable gain control

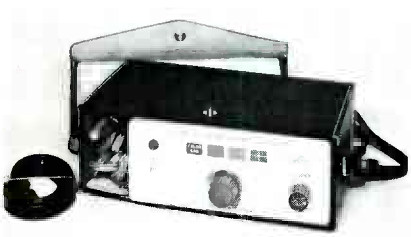
Video:
- All patterns available at separate video jack

Chroma Level:
Fixed, on/off switch provided
Power Requirements:
105-125V AC, 60 Hz
Size: (HWD):
11$\frac{1}{16}$" x 15" x 1⅛"
Weight:
18½ lbs.
Price:
$359.50

LEADER MODEL LCG-387

Patterns
Color:
- Keyed rainbow

Convergence:
- Crosshatch (11 x 14 lines. Horizontal bars are one scan line wide, with blanking. Vertical bars are 0.2 us wide with 4 us spacing)
- Dots (at crosshatch intersections)
- Single Crossbar (centered on raster)



Outputs
RF:
- Ch. 5 or 6 ±0.5%, switch selectable. 10 mv on open circuit

Chroma Level:
Variable
Added Features:
Solid-state
Power Requirements:
115V AC, 2 watts
Size: (HWD):
2¾" x 6¾" x 4¾"
Weight:
3½ lbs.
Price:
$140.00

LECTROTECH MODEL V6-B

Patterns
Color:
- Keyed rainbow (crystal controlled)

Convergence:
- Crosshatch
- Dots (size adjustable)
- Horizontal lines (width adjustable)
- Vertical lines

Outputs
RF:
- Channels 3, 4 or 5 (+10,000 mv)

Chroma level:
Variable
Added features:
Dial-a-line
Gun killers
Hand-wired circuitry
Power Requirements:
115V AC, 60 Hz
Size (HWD):
3½" x 7⅝" x 9"
Weight:
5½ lbs.
Price:
$99.50

RCA MODEL WR-64B

Patterns
Color:
- Keyed rainbow

Convergence:
- Crosshatch
- Dots

Added Features:
Chroma variable
Standby Switch
Size (HWD):
10" x 13½" x 8"
Weight:
13½ lbs.
Price:
$129.00

RCA CHRO-BAR MODEL WR-502A

Patterns
Color:
- Keyed rainbow

Convergence:
- Blank raster
- Crosshatch

- Dots
- Horizontal lines
- Vertical lines

Added Features
Gun killer switches
All solid-state circuitry
Battery condition-indicating meter
Size (HWD):
6½" x 7½" x 4"
Weight:
4 lbs.
Price:
$168.00

SENCORE MODEL CG10

Patterns
Color:
- Ten standard RCA-licensed color-bar patterns (NTSC phased colors)

Convergence:
- Crosshatch (14H x 10V)
- Dots (adjustable)
- Horizontal lines
- Vertical lines

Chroma Level:
Variable to 200%
Added Features
Interlace control (eliminates "dot bounce" due to receiver chassis design variations)
All solid state
Gun killers
Power Requirements:
Battery (Zener regulated 12-volt supply)
Size (HWD):
10" x 8⅜" x 3⅛"
Weight:
8 lbs.
Price:
$89.95

SENCORE MODEL CG12

Patterns
Color:
- Keyed rainbow

Convergence:
- Crosshatch (14H x 10V)
- Dots (adjustable size)
- Horizontal lines
- Vertical lines

Chroma Level:
Variable to 200%
Added Features:
4.5-MHz crystal controlled signal modulated into the RF
Color gun killer switches
Positive or negative picture phase
Solid state
Power Requirements:
120V AC, 60 Hz
Size (HWD):
10″ x 8⅜″ x 3⅛″
Weight:
NA
Price:
$109.95

SENCORE MODEL CG-141

Patterns
Color:
- RCA licensed standard color bars

Convergence:
- Crosshatch
- Dots
- Horizontal lines
- Single cross (can be placed anywhere on CRT)
- Single dot (can be placed anywhere on CRT)
- Vertical lines

Outputs
RF:
- Ch. 2 through 6

Chroma Level:
Variable to 200%

Added Features
Interlace control (eliminates "dot bounce")
Crystal-controlled sound carrier
All solid state
Gun killers
Size (HWD):
10″ x 9″ x 3½″
Weight:
9 lbs.
Price:
$149.95

SENCORE COLOR ANALYZER MODEL CA122B

Patterns
Color:
- Standard RCA licensed color bars

Convergence:
- Crosshatch
- Dots (adjustable)
- Horizontal lines
- Vertical lines
- Blank raster (no modulation)

Outputs
RF:
- Ch. 2-6 variable

Video:
- 20 MHz to 50 MHz (for signal substitution: composite video, chroma and horizontal and vertical sync pulse)

Chroma Level:
Variable to 200%

Added Features:
Color gun killer switches
Combination circuit analyzer
Video and sync variable up to 30 volts p-p
Power Requirements:
115V AC, 60 Hz
Size (HWD):
10″ x 14″ x 8″
Weight:
15 lbs.
Price:
$187.50

CRT testers

AMPHENOL MODEL 855

CRT's Tested:
Color and black-and-white
Tests Performed:
Emission
Interelectrode shorts
Measures anode and screen potentials
Color gun balance
Gas (direct meter readout)
Corrective functions:
Cathode rejuvenation

Shorts removed
Welds open cathodes
Size (HWD):
NA
Weight:
NA
Price:
$79.95

AMPHENOL MODEL 857

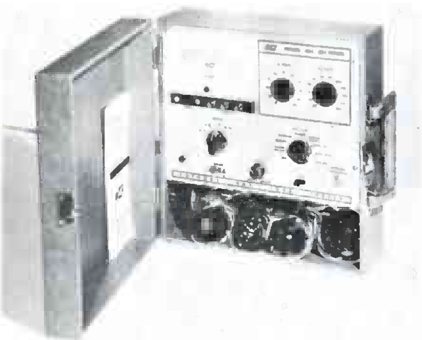
CRT's Tested:
Color and black and white
Tests Performed:
Emission
Interelectrode shorts
Measures DC voltage (two ranges, 0-1000 volts and 0-50,000 volts with optional TV probe).
High-voltage internal leakage (direct meter reading)
Gas (direct meter readout on 50-ua meter)
Corrective functions:
Cathode rejuvenation (three level, time controlled)
Shorts removal
Welds open cathodes

Added Features:
Adjustable filament voltage (metered)
G1 and G2 tests adjustable
Size (HWD):
NA
Weight:
less than 6 lbs.
Price:
$99.50

B&K MODEL 465

CRT's Tested:
Color and black and white

Tests Performed:
Emission
Interelectrode shorts
Cutoff voltage
Life test
Leakage
Color gun balance
Corrective functions:
Cathode rejuvenation (three levels, time controlled)
Shorts removed
Open cathodes welded
Added Features:
Variable G1 and G2 voltages
Meter sensitivity switch for testing CRT's with normally low emission
Calibrated heater voltage meter



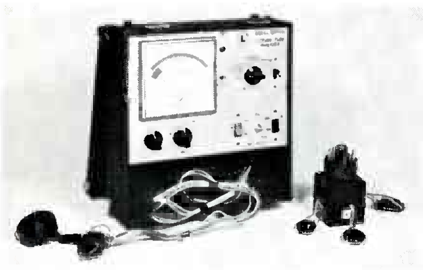
Size (HWD):
10½" x 11½" x 4½"
Weight:
7 lbs.
Power Requirements:
117V AC, 60 Hz
Price:
$89.95

HICKOK MODEL CR35

CRT's Tested:
Color and black and white
Tests Performed:
Emission
Interelectrode shorts
Cut-off voltage
Life test
Corrective functions:
Cathode rejuvenation (three levels, time controlled)
Shorts removed
Size (HWD):
10¾" x 10½" x 5¼"
Weight:
9 lbs.
Power Requirements:
117V AC, 60 Hz
Price:
$99.95

LECTROTECH MODEL CRT-100

CRT's Tested:
All black-and-white and color
Tests Performed:
Emission
Interelectrode shorts
Grid-to-Cathode leakage (direct meter readout)
Color gun balance
Leakage (neon lamp)
Life tests
Corrective functions:
Cathode rejuvenation
Shorts removed



Added Features:
Line voltage adjust
Variable G2 voltage
Size (HWD):
NA
Weight:
NA
Price:
$89.50

SENCORE MODEL CR13

CRT's Tested:
Color and black-and-white
Tests Performed:
Emission
Interelectrode shorts
Cut-off voltage
Life tests
Color gun balance (individual tests)
Corrective functions:
Cathode rejuvenation (time controlled)
Cathode to grid shorts removed
Open cathodes welded
Added Features:
Variable G1 and G2 voltages
Line voltage compensation
Replaceable plug-in socket cables
Power Requirements:
105-125V AC, 50-60 Hz
Size (HWD):
10¼" x 10¾" x 4¼"
Weight:
8½ lbs.
Price:
$79.95

SENCORE MODEL CR143

CRT's Tested:
All color and black and white
Tests Performed:
Emission
Interelectrode shorts
Cut-off voltage
Life tests
Color gun balance (individual tests)
Corrective functions:
Cathode rejuvenation (three level, time controlled)
Removes shorts
Welds open cathodes
Added Features:
Separate screen grid controls for each gun to duplicate receiver conditions
Power Requirements:
117V AC, 60 Hz
Size (HWD):
9" x 10" x 3½"
Weight:
10 lbs., 2 oz.
Price:
$99.50

FET meters

AMPHENOL MODEL 870

DC Volts Ranges:
0 to 0.1, 0.3, 1, 3, 10, 30, 100, 300, 1000
AC Volts Ranges:
0 to 0.01, 0.03, 0.1, 0.3, 1, 3, 10, 30, 100, 300
dB Ranges:
−40, −30, −20, −10, 0, 10, 20, 30, 40, 50, (−12 to 2 scale)
Accuracy:
±3% of full scale on all ranges from 50 Hz to 50 KHz
Input Impedance:
10 mv to 1V, 10 megohms shunted by 31 pf
3V to 300V, 10 megohms shunted by 20 pf
Size (HWD):
5¾" x 9¼" x 6⅞"
Weight:
5 lbs. (with batteries)
4.5 lbs. (less batteries)
8.5 lbs. (shipping weight)
Price:
$99.95

HEATH MODEL IM-17

DC Volts Ranges:
0 to 1, 10, 100, 1000 volts full scale
AC Volts Ranges:
0 to 1.2, 10, 100, 1000 full scale
Ohms Ranges:
R x 1, 100, 10K, 1 meg
Input Impedance:
11 megohms on DC
1 megohm shunted by 100 pf (38 pf on 1000V scale) on AC
Accuracy:
±3% full scale on DC
±4% full scale on AC
Frequency Response:
±1 dB 10 Hz to 1 MHz
Power Requirements:
1.5V

Size (HWD):
4¼" x 8½" x 7¼"
Weight:
2½ lbs.
Price:
$19.95 (kit form)

RCA MODEL WV-38A

DC Volts Ranges:
0 to 0.5, 1.5, 5, 15, 50, 150, 500, 1500
AC Volts Ranges (values of sine waves):
0 to 1.5, 5, 15, 50, 150, 500, 1500 (peak-to-peak values of sine waves and complex waves)
0 to 14, 42, 140, 420, 1400, 4200
Accuracy:
±3% of full scale (accuracy of AC ranges based on use of sine-wave signals having less than ½ of 1% total harmonic content)
Ohms ranges:
Seven ranges, from 0 to 1000 megohms
Input Impedance:
11 megohms on all DC ranges
Frequency Response:
30 Hz to 3 MHz (checked at 1.5 and 5V AC)
Maximum Input Voltages:
DC voltages with no AC voltages present—1500V
AC voltages with no DC voltages present—1500V

rms for sine waves—1500V
peak-to-peak for sine waves—4200V
peak-to-peak for complex waves—2000V

Combined AC and DC voltages:
Sum of DC voltage and AC peak voltage—2000V

Meter Movement:
50 ua DC current for full-scale deflection

Size (HWD):
6⅞″ x 5¼″ x 3⅛″

Weight:
3½ lbs.

Price:
$52.00 (wired)
$38.00 (kit form)

RCA MODEL WV-500A

DC Volts Ranges:
0 to 0.5, 1.5, 5, 15, 50, 500, 1500

AC Volts Ranges:
rms—0 to 1.5, 5, 15, 50, 150, 500, 1500
Peak-to-peak—0 to 14, 42, 140, 420, 1400, 4200

Ohms Ranges:
Seven ranges, 0 to 1000 megohms

Accuracy:
±3% for full scale on both AC and DC

Input Impedance:
DC—11 megohms (all ranges)
AC—0.83 megohms shunted by 70 pf (1.5, 5, 50, 150V ranges); 1.3 megohms shunted by 60 pf (500V range); 1.5 megohm shunted by 60 pf (1500V range)

Frequency Response:
± dB 30 Hz to 3 MHz

Maximum Input Voltages:
DC voltages with no AC voltage present—1500V

AC voltages with no DC present.
rms for sine waves—1500V
peak-to-peak for sine waves—4200 volts
peak-to-peak for complex waves—2000V

Combined AC and DC voltages:
Sum of DC voltage and AC peak voltage—2000V

Meter Movement:
50 ua DC current for full-scale deflection

Power Requirements:
Ohms—one 1.5V "C" cell battery

Metering Circuit:
Three 9-volt batteries.

Size (HWD):
6⅞″ x 5¼″ x 3⅛″

Weight:
3½ lbs.

Price:
$75.00

SENCORE MODEL FE14

DC Volts Ranges:
0 to 1, 3, 10, 30, 100, 300 and 1000, full scale
Zero center scale— −0.5 to 0.5, −1.5 to 1.5, −5 to 5, −15 to 15, −50 to 50, −150 to 150 and −500 to 500

AC Volts Ranges:
rms—0 to 1, 30, 30, 100, 300 and 1000 full scale (frequency compensated)
Peak-to-peak—0 to 2.8, 8.4, 28, 84, 280, 840 and 2800, full scale (frequency compensated)

Input Impedance:
DC volts—15 megohms shunted by 14 pf
AC volts—10 megohms shunted by 29 pf

AC Rejection:
30 to 300 times (30 to 50 dB)

Accuracy:
±3% full scale from 32° F to 122° F on DC
±5% full scale from 32° F to 122° F on AC

Frequency Response:
Flat from 25 Hz to 1 MHz

Size (HWD):
NA

Weight:
NA

Price:
$69.95

SENCORE MODEL FE149

DC Volts Ranges (AC rejection 30 dB):
0 to 0.5, 1.5, 5, 50, 150, 500, 1500 full scale.

Zero center ranges:
−0.25 to 0.25, −0.75 to 0.75, −2.5 to 2.5, −7.5 to 7.5, −25 to 25, −75 to 75, −250 to 250, −750 to 750

AC Volts Ranges:
0 to 0.5, 1.5, 5, 15, 50, 500, 1500 full scale (frequency compensated)

Input Impedance:
DC—15 megohms shunted by 45 pf
AC—15 megohms shunted by 125 pf

Frequency Response:
Flat; 25 Hz to 1 MHz, 3 dB
Points; 8 Hz to over 10 MHz

Accuracy:
DC—±1.5%
AC—±3%

Size (HWD):
NA

Weight:
NA

Price:
$149.50

SENCORE MODEL FE16

DC Volts Ranges (AC rejection 30 to 50 dB):
0 to 1, 3, 10, 30, 100, 300, 1000 full scale
Zero center scale ranges— −0.5 to 0.5, −1.5 to 1.5, −5 to 5, −15 to 15, −50 to 50, −150 to 150, −500 to 500

AC Volts Ranges:
rms—0 to 1, 3, 10, 30, 100, 300, 1000 full scale
Peak-to-peak—0 to 2.8, 8.4, 28, 84, 280, 840, 2800 full scale, frequency compensated

Frequency Response:
25 Hz to 1 MHz, 3 dB points: 10 Hz to 10 MHz flat
Ohms Ranges:
0 to 1000 ohms, 10K, 100K, 10 megohms, 1000 megohms
DC Current Ranges:
0 to 100 ua, 1 ma, 10 ma, 100 ma, 1 amp
Internal voltage drop: 200 mv
Input Impedance:
DC volts—15 megohms shunted by 14 pf at jack or 37 pf through cable
AC volts—10 megohms shunted by 29 pf at jack or 118 pf through cable
Accuracy:
DC volts—±1.5%
AC volts—±3%
Ohmmeter—±2° arc
DC current—±3% full scale
Size (HWD):
$7\frac{3}{16}$" x 5" x $3\frac{1}{16}$"
Weight:
3¼ lbs. (less batteries)
Price:
$84.50

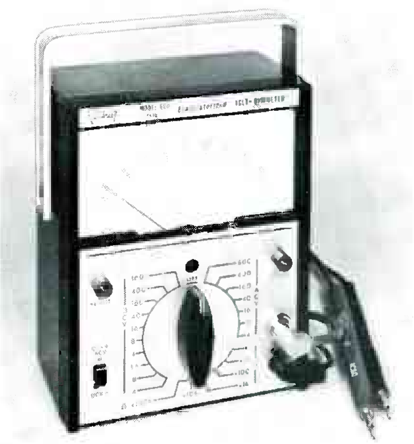
SIMPSON MODEL 313

DC Volts Ranges:
0 to 0.3, 1, 3, 10, 30, 100, 300, 1000 volts
AC Volts Ranges:
0 to 0.3, 1, 3, 10, 30, 100, 300, 1000 volts

DC Current Ranges:
0 to 0.1, 1, 10, 30, 100, 300, 1000 ma
Resistance Ranges:
Rx1 (10 ohm center), Rx10, Rx100, Rx1K, Rx10K, Rx100K, Rx1 meg
Input Impedance:
DC volts—11 megohms
AC volts—10 megohms
Frequency Response:
±0.5 dB from 20 Hz to 100 KHz on 0 to 0.3, 1, 3 volts ranges
±0.5 dB from 20 Hz to 20 KHz on 0 to 10, 30, 100 volt ranges
Accuracy:
±3% of full scale on DC
±3% of full scale on AC
±3° of arc on ohms

Size (HWD):
NA
Weight:
NA
Price:
$100.000

TRIPLETT MODEL 600 TYPE 1

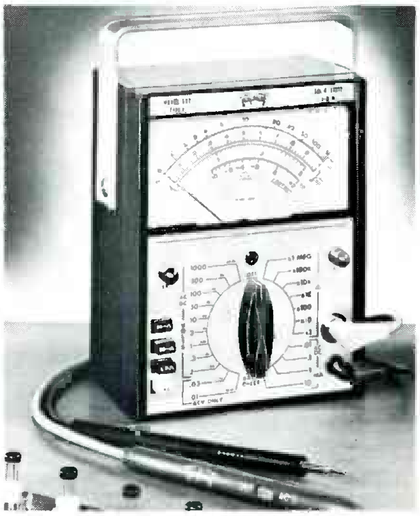


DC Volts Ranges:
0 to 0.4, 0.8, 1.6, 4, 8, 16, 40, 160, 400, 1600
AC Volts Ranges:
0 to 4, 8, 16, 40, 160, 400, 800
Ohms Ranges:
0 to 1K, 10K, 100K, 1 meg, 100 megohm with 10 center
Input Impedance:
DC—2.75 megohms at 0.4V, 5.5 megohms at 0.9V, 11 megohms remainder of scales
AC—175 megohms minimum
Accuracy:
±3% on DC
±3% on AC
Power Requirements:
One size D cell, two size AA cells, one 9-volt #216 cell
Size (HWD):
6½" x 5½" v 3½"
Weight:
2½ lbs.
Price:
$78.00

TRIPLETT MODEL 601

DC Volts Ranges:
0 to 0.1, 0.3, 1, 3, 10, 30, 100, 300, 1000 @ 11 megohms
AC Volts Ranges:
0 to 0.01, 0.03, 0.1, 0.3, 1, 3, 10, 30, 100, 300, 100 @ 11 megohms
Ohms Ranges:
0 to 1000, 10K, 100K, 1 meg, 10 meg, 100 meg, 1000 meg (standard 1.5V, 5.5)
0 to 1000, 10K, 100K, 1 meg, 10 meg, 100 meg, 1000 meg (low power 0.1 mw, 75 mv)
Center scale value 10 ohms on x1 range
DC Current Ranges:
0 to 10, 100, 1000, 10,000 ma at 100 mv
AC Current Ranges:
0 to 10, 100, 1000, 10,000 ma at 100 mv

dB Ranges:
−40 dB to +50 dB in 10 dB steps
Meter Size and Type:
4½" suspension meter movement
Sensitivity:
10 mv on AC
Accuracy:
±2% of full scale on DC
±3% of full scale on AC
Input Impedance:
11 megohms on all ranges
Frequency Response:
50 Hz to 50 KHz
Power Requirements:
Battery—10 1½-volt "AA" cells, NEDA #15
Size (HWD):
NA
Weight:
NA
Price:
$150.00



Field-strength meters

AMPHENOL MODEL 840-13

Bands:
VHF and FM (UHF plug-in optional)
Input Impedance:
300 or 75 ohms

Power Requirements:
Battery
Size (HWD):
8¾″ x 4″ x 4½″
Weight:
3½ lbs.
Price:
$232.85
$54.95 (UHF plug-in)

CHANNEL MASTER MODEL 7275

Bands:
UHF, VHF and FM
Input Impedance:
75 ohms
Power Requirements:
Battery
Size (HWD):
NA
Weight:
7½ lbs.
Price:
NA

THE FINNEY CO. MODEL M-550

Bands:
VHF and FM
Input Impedance:
300 or 75 ohms
Power Requirements:
AC or battery
Size (HWD):
NA
Weight:
7 lbs., 10 oz.
Price:
$435.00

JERROLD MODEL AIM-718

Bands:
UHF, VHF and FM
Input Impedance:
300 ohms
Power Requirements:
Battery
Size (HWD):
4″ x 6½″ x 9″
Weight:
5½ lbs.
Price:
$330.83

JERROLD MODEL 727

Bands:
VHF and FM (UHF plug-in optional)
Input Impedance:
75 ohms

Power Requirements:
Battery
Size (HWD):
8″ x 13¼″ x 8¼″
Weight:
15 lbs.
Price:
$595.00

SENCORE MODEL FS-134

Bands:
UHF, VHF and FM
Input Impedance:
300 or 75 ohms
Power Requirements:
Battery
Size (HWD):
10″ x 9″ x 5″
Weight:
9 lbs.
Price:
$199.50

Marker generators

HEATH MODEL IG-14

Output Frequencies:
100 KHz (beat marker)
3.08, 3.58, 4.08 MHz (color bandpass)
4.5 MHz (sound IF)
10.7 MHz (FM IF)
39.75, 41.25, 42.17, 42.50, 42.75, 45.00, 45.75, 47.25 MHz (TV IF)
67.25 MHz (channel 4)
193.25 MHz (channel 10)
Modulation:
400 Hz
Input Impedance:
Sweep sample, 75 ohms, external marker, 75 ohms
Demodulated input, 220K ohms
Output Impedance:
RF output, 75 ohms
Scope, 22K ohms

Bias Supply:
0 to 15V DC, 10 ma
Size (HWD):
5½″ x 13½″ x 11″
Weight:
8 lbs.
Price:
$99.95 (kit form)

RCA MODEL WR-99A
Crystal Calibrated

Output Frequencies:
VFO tuning ranges—19 MHz to 28 MHz, 27 MHz to 40 MHz, 39 MHz to 50 MHz, 50 MHz to 90 MHz, 75 MHz to 140 MHz, 140 MHz to 180 MHz, 170 MHz to 220 MHz, 200 MHz to 260 MHz.
Crystal controlled—1 MHz, 4.5 MHz and 10 MHz
Modulation:
Internal—1 MHz, 10 MHz, 4.5 MHz, 4.5 MHz and 600 Hz, and 600 Hz
External source—up to 10 MHz
Plug-in fundamental crystal—1 MHz to 30 MHz
Plug-in LC circuit—100 KHz to 10 MHz
Output Voltage Level:
VFO range—at least 0.1 volt rms
Output Impedance:
90 ohms
Size (HWD):
13½″ x 10″ x 7″
Weight:
17 lbs.
Price:
$256.50

Oscilloscopes

B&K MODEL 1450

Vertical Amplifier:
Sensitivity—25 mv/inch (70 mv p-p/inch)
Undistorted Deflection—greater than 6 inches
Positioning—±2 inches minimum
Frequency Response—5 Hz-4.5 MHz (±1.0 dB), —3 dB at 5.5 MHz
Rise Time—120 nanoseconds maximum
Input Impedance—3 megohm shunted by 47 pf
Vertical Attenuator—7 step, frequency compensated
Horizontal Amplifier:
Sensitivity—0.5 volts rms/inch (or better)
Positioning—any portion of trace can be placed on screen
Frequency Response—2 Hz to 750 KHz, ±3 dB
Input Impedance—5 megohms minimum shunted by 30 pf
Sweep:
Frequency Range—5 Hz to 500 KHz, sawtooth
Special Sweep—Line phaseable, TV-V and TV-H
Synchronization—Automatic, Interval + and —, line and external

Intermittent Analyzer:
Sensitivity—adjustable, triggers on ±10% to ±50% changes in signal level.
Output—110V AC, 100 watt latched "on" after triggering change occurs
Frequency Response—20 Hz to greater than 5 MHz
Added Feature:
Intermittent analyzer indicates intermittent conditions (optional intermittent monitor available for $24.95)
Size (HWD):
13⅜″ x 8¾″ x 17¼″
Weight:
NA
Price:
$279.95

DATA INSTRUMENTS MODEL 555

Vertical Amplifier:
Sensitivity—0.02 v/cm (10 v/cm in a 1-2-5 sequence)
Accuracy—±3%
Frequency response—7 MHz ±3 dB DC (2 Hz-7 MHz when AC connected)
Rise time—50 nanoseconds
Input Impedance—1 megohm shunted by 33 pf
Horizontal Amplifier:
Sensitivity—0.2 v/cm (10 v/cm, continuously adjustable)
Accuracy—±5%
Sweep rate—1 us/cm (1 sec/cm in a 1-2-5 sequence with 5X expander)
Response—2 Hz to 200 KHz ±3 dB
Input Impedance—1 megohm shunted by 40 pf

Trigger:
Internal—20 Hz (7 MHz with 1 cm deflection)
External—20 Hz-7 MHz, 1V p-p
Calibrator:
Waveshape—1-KHz square wave
Amplitude—5, 0.5, 0.05V p-p
Accuracy—±3%
Power Requirements:
117V AC, 40 watts
Size (HWD):
11½″ x 8″ x 17½″
Weight:
24 lbs.
Price:
$284.00

EICO MODEL 435

Vertical Amplifier:
Frequency Response—from DC to 4.5 MHz, +1 to 3 dB (useful to 10 MHz)
Sensitivity—18 mv rms/cm (50 mv peak to peak/cm)
Input Impedance—1 megohm, 35 pf
Horizontal Amplifier:
Frequency Response—from 1 Hz to 500 KHz, 1 to 3 dB
Sensitivity—0.7V rms/cm
Input Impedance—4 megohms, 40 pf
Sweep Ranges:
10 to 100 Hz, 100 to 1 KHz, 1K to 10 KHz, 10K to 100 KHz

TV-vertical (30 Hz), TV-horizontal (7875 Hz)
Synchronization:
(+), (—), internal, external or line frequency
Power Requirements:
117V AC, 110 watts (approx.)
Size (HWD):
8½″ x 5¾″ x 12⅝″
Weight:
18 lbs.
Price:
$169.50 (wired)
$119.95 (kit form)

HEATHKIT MODEL 10-14

Vertical Amplifier:
Sensitivity—0.05 v/cm
Frequency Response—DC to 5 MHz (1 dB); DC to 8 MHz (3 dB)
Input Impedance—1 megohm shunted by 15 pf
Attenuator—9-position compensated, calibrated in 1-2-5 sequence. Continuously variable uncalibrated control between steps. Accuracy ±3%
Maximum Input—600 volts p-p. 120 volts p-p provides full-scale deflection on highest scale.
Horizontal Amplifier:
Sensitivity—Triggered 18 steps in 1-2-5 sequence from 0.5 sec/cm to 1 ms/cm. Continuously variable uncalibrated control on each step.
Accuracy—±3%
Magnifier—X5, accuracy is ±5% when magnifier is on
Trigger:
Capability—+ or — slope, AC or DC coupling, variable slope control. "Auto" position provides triggering at about 50 Hz. Internal, external or line input.
Requirements—Internal: ½ to 6 cm display; External: 0.5 volts to 120V p-p
Added Features:
CRT—5ADP2 or 5ADP31 (interchangeable with any 5AD or 5AB series tube
Magnetic shield
Power supply—fully regulated over range of 105-125V AC or 210-250V AC line voltage
Z—axis input—access for direct coupling to vertical plates
Power Requirements:
115 or 230V AC, 50/60 Hz
Size (HWD):
15″ x 10½″ x 22″
Weight:
40 lbs.
Price:
$259.00 (kit form)
$399.00 (wired)

SENCORE MODEL PS127

Vertical Amplifier:
Sensitivity—0.017 volts rms/inch
Frequency response—10 Hz to 4.5 MHz ± dB, −3 dB at 6.2 MHz
Rise time—0.055 usec

Input Impedance—2.7 megohms shunted by 99 pf (27 megohms shunted by 9 pf when using built-in low-capacitance probe)
Horizontal Amplifier:
Sensitivity—0.6 volts rms/inch
Frequency Response—10 Hz to 650 KHz ±3 dB
Sweep:
Range—5 Hz to 500 KHz in 5 steps
Synchronization:
Internal, 60 Hz and external
Screen Size:
5″
Size (HWD):
12″ x 9″ x 15½″
Weight:
25 lbs.
Price:
$199.50 (demodulator probe $5.75)

SENCORE MODEL PS148
Oscilloscope/Vectorscope

Vertical Amplifier:

Voltage measurements—peak-to-peak voltages are read directly

Frequency response—10 Hz to 5.2 MHz, ±1 dB

Rise time—0.055 microseconds

Sensitivity—0.17V rms per inch vertical deflection

Input Impedance—27 megohms shunted by 9 pf (Lo-Cap probe), 2.7 megohms shunted by 99 pf (Direct probe)

Horizontal Amplifier:

Frequency Response—3 dB from 10 Hz to 650 KHz

Sweep:

5 Hz to 500 KHz in 5 overlapping ranges

TV-horizontal and TV-vertical ranges are preset on coarse control

Standby Switch:

Cuts instrument to half power when not in use and provides "instant on" when required

Size (HWD):

NA

Weight:

NA

Price:

$219.50

TELEQUIPMENT MODEL 554

Vertical Amplifier:

Bandwidth (3 dB down)—DC to 10 MHz at normal gain; DC to 4 MHz at 10X Y gain

Rise time—35 nanoseconds at normal gain; 90 nanoseconds at 10X Y gain

Sensitivity—100 mv/cm in a 1-2-5 sequence (continuously variable between steps. 10X gain switch produces 10 mv/cm maximum sensitivity)

Input impedance—1 megohm shunted by 47 pf.

Accuracy—±5%

Horizontal Amplifier:

Sweep rate—200 nanoseconds/cm to 2 sec/cm in a 1-2-5 sequence (continuously variable to 5 s/cm. Expandable to 40 ns/cm)

Sensitivity—0.6 v/cm to 3 v/cm

Frequency response—DC to 750 KHz

Input Impedance—1 megohm shunted by 30 pf

Trigger:

Automatic—50 Hz to 1 MHz

Level—Any point on the input waveform, 10 Hz to 3 MHz

HF sync—synchronized sweep 1 MHz to 25 MHz

TV—triggers on TV frame or line

Internal—2 mm deflection

External—1.5-400V p-p

Calibrator:

Line frequency, 0.5V p-p ±2%

Sawtooth—1 to 35V p-p, 30K ohms load

Probe test—5V p-p

Size (HWD):

9¼" x 6¾" x 16¼"

Weight:

17 lbs.

Power Requirements:

100-125V. 200-250V; 48-440 Hz

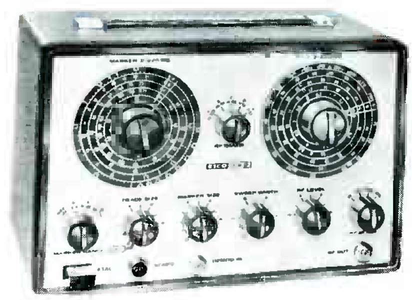
Price:

$350.00

RF signal generators

(sweep type included)

EICO MODEL 369
SWEEP GENERATOR



Sweep Output:

3 MHz to 220 MHz, 6:1 vernier for frequency adjustment

Sweep Width:

Continuously variable to 20 MHz, depending on range selected

Marker Frequencies:

2 MHz to 225 MHz (to 75 MHz on fundamental frequencies), 6:1 vernier for frequency adjustment

Output Impedance:

50 ohms

Added Features:

Retrace blanking

AGC (3 stage)

Size (HWD):

12½" x 8½" x 7"

Weight:

16 lbs.

Price:

$149.95 (wired)

$99.95 (kit form)

HICKOK MODEL 288 AX
Crystal-Controlled Signal Generator

Sweep Outputs:

AM—35 KHz to 110 MHz in 8 bands

FM—35 KHz to 10 MHz in 8 bands (0-30 KHz sweep)

1 MHz to 160 MHz (0 to 150 KHz and 0 to 450 KHz sweep)

1 MHz, fixed (0 to 30 KHz sweep)

Crystal Outputs:

100 KHz or 1000 KHz unmodulated or modulated at 400 Hz

100 KHz output provides useful harmonics to 15 MHz

1000 KHz output provides useful harmonics to 125 MHz

Modulation:

External or internal modulation on both AM and FM ranges. Internal FM sweep width continuously variable to 450 KHz. Choice of 60 Hz or 400 Hz sweep rate. Sweep synchronizing voltage available on front panel.

Audio Output:

20 Hz to 15,000 Hz variable; or 400 Hz, fixed

dB Meter Ranges:

−10 dB to 6 dB, 6 dB to 22 dB, 22 dB to 38 dB

Size (HWD):

16" x 13" x 7"

Weight:

33 lbs.

Price:

$385.00

RCA MODEL WR-50B (K)
RF Signal Generator

Sweep outputs:

455 KHz center frequency

10.7 MHz center frequency

Sweep Width:

Approximately 10% of center frequency

Variable Oscillator Outputs:

85 KHz to 40 MHz in 6 bands

RF Output Level:

0.05 volt rms on all ranges

Modulation:
Internal—400 Hz, FM (percentage variable to 30%)
External—maximum 15 KHz
Dial Calibration Accuracy:
±2%
Size (HWD):
7¾″ x 5⅜″ x 4¾″
Weight:
5 lbs.
Price:
$65.00

RCA MODEL WR-69A
TV/FM Sweep Generator

Sweep Outputs:
TV channels 2 through 13—54 to 216 MHz
FM band—88 to 108 MHz
IF/video—50 KHz to 50 MHz
Sweep Width (all continuously variable):
TV channels—at least 12 MHz
FM—at least 20 MHz
IF/video—at least 20 MHz
Output Voltage Levels (rms):
TV channels—at least 0.1 volt
FM—at least 0.1 volt
IF/video—at least 0.1 volt
Output Cable Terminations:
RF—300 ohms balanced to ground
IF/video—100 ohms
Size (HWD):
13⅝″ x 10″ x 7″
Weight:
16 lbs.
Price:
$295.00

SENCORE MODEL SM152
Sweep and Marker Generator

Sweep Output:
10 MHz to 920 MHz (VHF fundamental frequencies), dial calibrated in MHz and TV channel numbers.
Sweep Width:
0.3 MHz to 15 MHz, calibrated
Marker Frequencies:
IF and RF—39.75 MHz, 41.25 MHz, 41.67 MHz, 42.17 MHz, 42.67 MHz, 44.25 MHz, 45.75 MHz, 47.25 MHz, 4.5 MHz, 4.08 MHz, 3.58 MHz and 3.08 MHz (all preset and selected by pushbutton)
FM crystal-control markers—10.7 MHz, 10.6 MHz and 10.8 MHz generated simultaneously for observation of FM center frequency, plus 100 KHz markers on each side of center frequency for "S" curve FM alignment.
Variable marker—special generator marker for IF spot alignment of older TV chassis, variable from 39 MHz to 48 MHz
Size (HWD):
NA
Weight:
NA
Price:
$349.50

Semiconductor testers

AMPHENOL MODEL 830
Transistor Commander
Tests Performed:
Good/bad test in- or out-of-circuit

In-circuit test of diodes for "opens" and "shorts"
Out-of-circuit tests for both high- and low-power transistors for DC beta and ICBO leakage
Zener, silicon and germanium diodes checked out-of-circuit for forward and reverse current
Features:
Components under test protected against damage by tester
A 0-100 volt DC voltmeter combined with transistor/diode tester
Size (HWD):
NA
Weight:
NA
Price:
$79.95

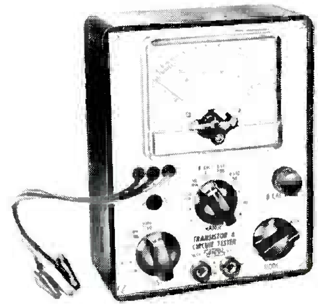
B&K MODEL 161
Tests Performed:
AC beta—in- and out-of-circuit, (two ranges—2 to 100 and 10 to 500)
Leakage (ICBO)—0 to 5000 ua
Diode checks (out-of-circuit, front-to-back ratio)

Features:
Components under test protected against damage
Polarity switch
7″ mirrored meter
Size (HWD):
7⅛″ x 7¼″ x 3⅝″
Weight:
6 lbs.
Price:
$89.95

EICO MODEL 443
Semi-Conductor Curve Tracer
Tests Performed:
Tests characteristics of diodes—forward voltage (V), forward current (I), reverse current (IR), peak inverse voltage (PIV) variable from 0 to 1400 volts
Low- and high-power transistor checks—hfe, hfo, ICEO, VCESat and BVCEO
Size (HWD):
NA
Weight:
NA

Price:
$99.95 (wired)
$69.95 (kit form)

EICO MODEL 680
Transistor and Circuit Tester



Tests Performed:
Checks low- and high-power transistor for DC beta
Checks ICBO and ICEO checks
Features:
VOM facilities including five DC current ranges down to 50 ma full scale
Two DC volts ranges and three resistance ranges
Size (HWD):
NA
Weight:
NA
Price:
$49.95 (wired)
$34.95 (kit form)

JACKSON MODEL 810
Tests Performed:
Beta—(two ranges: 2 to 100 and 10 to 500) in- or out-of-circuit, signal or power
Leakage—0 to 5000 ua
Diodes—open or short in-circuit. Forward and reverse current out-of-circuit

Signal Generator Output:
8.5V p-p semi-square wave
Power Requirement:
117V AC
Size (HWD):
7½" x 7½" x 4⅝"
Weight:
4½ lbs.
Price:
$89.95

LECTROTECH MODEL TT-250

Tests Performed:
Good/bad test in- or out-of-circuit
Out-of-circuit beta (two scales: 0 to 250 and 0 to 500)
Leakage (ICBO)—measured directly in ua
Diode front-to-back ratio
Electrolytic capacitor leakage current (test voltage: 6 volts)

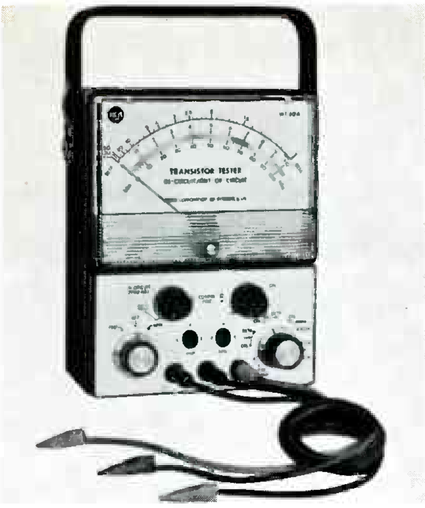
Transistor type (PNP or NPN)
Features:
Components under test protected against damage by tester
6" meter
Separate power transistor socket
Size (HWD):
7" x 10" x 4½"
Weight:
5½ lbs.
Price:
$87.50

RCA MODEL WC-506A

Tests Performed:
Checks grain and leakage levels of out-of-circuit transistors
Checks either NPN or PNP transistors
Checks low- or high-power transistors
Checks relative front-to-back current ratios of diodes
Features:
Transistor socket and test leads are provided
Special spring terminals for connecting diodes
Size (HWD):
6¼" x 3¾" x 2"
Weight:
14 oz.
Price:
$18.00

RCA MODEL WT-501A

Tests Performed:
In- or out-of-circuit DC beta (1 to 1000)
High- and low-power transistors in- or out-of-circuit
Collector to emitter leakage (ICBO), collector to emitter leakage (ICEO)
Relative front-to-back ratio of diodes at appropriate current levels
Features:
Battery operated, completely portable
Variable collector current allowing many transistors to be checked at their rated current level
Complete DC forward current transfer ratio curve can be plotted up to 1 amp



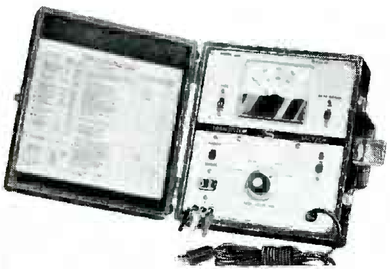
Zero control to cancel the effects of leakage on beta reading

Size (HWD):
6⅞" x 5¼" x 3⅛"

Weight:
NA

Price:
$66.75

SECO MODEL 260



Tests Performed:
Quality on a relative scale
In-circuit dynamic (AC) beta
Out-of-circuit beta (two ranges: 0 to 200 and 0 to 1000)
Out-of-circuit leakage (ICEO and ICBO)
Transistor type (NPN and PNP)

Size (HWD):
4¼" x 7⅜" x 8¾"

Weight:
4¼ lbs.

Price:
$69.50

SENCORE MODEL TF151

Tests Performed:
Transistors in- or out-of-circuit for AC beta and out of circuit tests for ICBO leakage
Gm mutual conductance tests for field effect transistors (FET's) in- or out-of-circuit
IGSS leakage tests for FET's out of circuit

Features:
Increased current checks for high power transistors
Special checks provided for critical RF transistors
Special Gate 2 checks provided for FET's with two gates

Size (HWD):
9½" x 7½" x 6"

Weight:
9 lbs.

Price:
$129.50

SENCORE MODEL TR139

Tests Performed:
AC beta checks in- and out-of-circuit for low- and high-power transistors
ICBO leakage on high and low power transistors
Diodes in- and out-of-circuit with "go" or "no go" indicator

Features:
Automatic circuit impedance compensation for in-circuit tests

Size (HWD):
9" x 7½" x 6"

Weight:
8 lbs.

Price:
$89.50

TRIPLETT MODEL 3490-A

Lab-Type Transistor Tester

Tests Performed:
Transistors—most large- and small-signal and power types; also tetrode, diodes, rectifiers (germanium, silicon and selenium), and SCR's
Collector-junction leakage current—ICO, ICBO, ICSS, ICER, ICBR; alpha (hfb); DC beta (hfe); AC beta (hfe); VCESat; RSTA; reach thru (punch-through)

Rectifier and diode—forward voltage drop, forward leakage current, reverse leakage current
SCR—reverse leakage (IR), forward leakage (IS), gate-firing current (Igf)

Features:
Full-scale collector-current ranges—0 ma to 30 amps in 11 overlapping ranges
Full-scale collector-voltage ranges—0 to 120 volts DC in 7 overlapping ranges
Indicator lights—power on, input on, collector on, reduce power

Power Sources:
105-125V AC, 60 Hz, approximately 200 watts, maximum

Size (HWD):
8¼" x 18¾" x 15½"

Weight:
30 lbs.

Price:
$441.00

Solid-state equipment analysts

B&K MODEL 970

Functions:
DC Power Supply:
Adjustable in 1.5-volt steps from 1.5V DC to 15V DC with 5 amps available at each setting, ripple does not exceed 5% fuse protection, bias control permits 0 to 100% adjustment of DC voltage between 1.5-volt settings.
VOM:
Sensitivity—5.5K ohms per volt
DC voltage ranges—2V, 20V, 200V, 500V
Voltage accuracy—within 5% of full scale
DC current ranges—20 ma, 200 ma, 2 amps, 5 amps
Current accuracy—within 7% of full scale
Resistance ranges—x1, x10, x100
Resistance accuracy—within 20% of midscale
(Patch cord supplied for measuring current drawn from DC power supply)

RF and Audio Signal Generation:
Frequencies—four bands
Band A—250 KHz to 750 KHz AM modulated
Band B—750 KHz to 2 MHz AM modulated
Band C—10 MHz to 11.4 MHz AM or FM modulated
Band D—88 MHz FM modulated (70 KHz Dev)
Accuracy—within 2% at 455 KHz, 1600 KHz and all frequencies on band.
All other frequencies within 5%
RF Level—minimum output of 0.025 volts rms on Bands A, B and C. Minimum of 0.01 volts rms on Band D
Modulation—400 Hz tone. 30% for AM and 70 KHz deviation for FM
Audio Output—minimum of 50 mv rms at 400 Hz across a 3-ohm load. Minimum of 1.25 volts at 400 Hz across a 72-ohm load
Transistor Tests:
Out of circuit test for DC beta (0-300) and leakage (ICEO)
Power Requirements:
105 to 125V AC, 60 Hz
Size (HWD):
15½″ x 8½″ x 9″
Weight:
22 lbs.
Price:
$209.95

PRECISION APPARATUS MODEL V-95

DC Volts Ranges:
0 to 0.5 to 1500 in a 5-15 sequence
Input resistance—11 megohms
Accuracy—±3% full scale
AC Volts Ranges:
rms—0 to 1.5 to 1500 in a 5-15 sequence
Peak to peak—0 to 4 to 4000 in a 4-14 sequence
Accuracy—±5% full scale
Response—±1 dB, 40 Hz-4 MHz
dB scales—−6 to +66 dBm
Ohms Ranges:
0 to 1000 to 1000 meg (10 center)
Power Requirements:
105-125V AC
Size (HWD):
7½″ x 8″ x 4″
Weight:
6¼ lbs.
Price:
$79.95

Television analyst

B&K MODEL 1077

General Description:
RF/IF generator modulated by test pattern video output of flying-spot scanner. The scanner uses slides of standard test patterns that are supplied with the instrument.
Signals and voltages generated:
RF—all VHF and UHF channels, modulated by test pattern video
IF—20 to 48 MHz
Audio—FM modulated 4.5-MHz sound channel modulated by a 400-Hz tone generator. 400-Hz tone signal also is available as separate signal
Sync—Negative or positive sync signals, adjustable to 50 volts p-p
Sweep Circuit—vertical and horizontal plate and grid driving signals
Video—various test patterns, produced by scanning positive transparencies with flying-spot scanner system
AGC Keying pulse—high level
Bias voltage—low impedance, calibrated
Chroma—white dot, crosshatch and crystal-controlled color-bar (keyed rainbow) patterns
Size (HWD):
NA
Weight:
NA
Price:
$379.95

Vectorscopes

LECTROTECH MODEL V-5
Vectorscope Indicator

General Description:
Display instrument used in conjunction with color-bar generator to provide visual display of color vector patterns.

Size (HWD):
7⅜″ x 4¼″ x 7⅝″
Weight:
5 lbs.
Price:
$79.50

LECTROTECH MODEL V-7

Color Generator and Vectorscope
General Description:
Combination vectorscope and color generator that provides visual display of color vector patterns
Color Generator:
Patterns-generated—keyed rainbow color bar, crosshatch, vertical lines, horizontal lines and dots
Outputs—RF (channels 3, 4 and 5) and video
Additional Features:
Individual gun-killer switches
Color and video level variable

Size (HWD):
8¼″ x 7½″ x 12⅞″
Weight:
13 lbs. (approx.)
Price:
$189.50

VTVM's

B&K MODEL 175

DC Ranges:
±0 to 1.5, 5, 15, 50, 150, 500, 1500
AC Ranges:
rms—0 to 1.5, 5, 15, 50, 150, 500, 1500
Peak-to-peak—0 to 4, 14, 40, 140, 400, 1400, 4000

Response:
±1 dB, 40 Hz to 3 MHz. (600-ohm source, 5-volt range)
Resistance:
Full scale—1000, 10,000, 100,000 ohms; 1, 10, 100, 1,000 megohms
Mid-scale—10, 100, 1000, 10,000, 100,000 ohms; 1 meg, 10 megohms
Input Resistance:
11 meg (1 megohm in probe)
Accuracy:
±3% full scale DC and ±5% full scale AC
Meter Movement:
400 ma
Added Features:
Built-in battery eliminator—no ohmmeter battery required
Zero center scale—Single AC/ohms/DC test probe with switch and ground lead
Power Requirements:
117V AC, 50/60 Hz
Accessories:
Model AV-1A RF Probe—increases frequency range up to 250 MHz. Price: $7.95
Model AV-2A high-voltage probe—increases DC voltage range up to 60,000 volts. Price: $12.95
Size (HWD):
7½" x 5⅜" x 4¼"
Weight:
6 lbs.
Price:
$59.95

B&K MODEL 177

DC Ranges:
±0 to 0.5, 1.5, 5, 15, 50, 150, 500, 1500
AC Ranges
rms—0 to 1.5, 5, 15, 50, 150, 500, 1500
Peak-to-peak—0 to 4, 14, 40, 140, 400, 1400, 4000
Response:
±1 dB, 40 Hz to 3 MHz (600-ohm source, 5-volt range)
Resistance:
Full scale—1000, 10,000, 100,000 ohms; 1, 10, 100, 1,000 megohms
Mid-Scale—10, 100, 1000, 10,000, 100,000 ohms; 1, 10 megohms

Input Resistance:
11 megohms (1 megohm in probe)
Accuracy:
±3% full scale DC and ±5% full scale AC
Meter Movement:
100 ma, 7", mirrored
Added Features:
Built-in battery eliminator: no ohmmeter battery required.
Zero center scale—Single AC/ohms/DC test probe with switch and ground lead
Power Requirements:
117V AC, 50/60 Hz
Size (HWD):
7⅛" x 7¼" x 3⅝"
Weight:
7 lbs.
Price:
$84.95

EICO MODEL 235

DC Ranges:
0 to 0.5, 1.5, 5, 15, 50, 150, 500, 1500
AC Ranges:
rms—0 to 1.5, 5, 15, 50, 150, 500, 1500
Peak-to-peak—0 to 4, 14, 42, 140, 1400, 4200
Response:
3 Hz to 3MHz, ±1dB (up to 250 MHz using accessory probe)
Resistance:
0 to 1000 megohms in seven ranges
Input Resistance:
DC—11 megohms
AC—1 megohm shunted by 60 pf
Accuracy:
AC/DC—±3% on all scales
Added Feature:
Zero center scale—used in TV-FM sound detector alignment
Size (HWD):
8½" x 7½" x 5"
Weight:
9 lbs.
Price:
$69.95 (wired)
$49.95 (kit form)

HICKOK MODEL 470A

DC Ranges:
0 to 0.5, 1.5, 5, 15, 50, 150, 500, 1500
AC Ranges:
rms—0 to 0.5, 1.5, 5, 15, 50, 150, 500, 1500
Peak-to-peak—0 to 1.4, 4, 14, 40, 140, 400, 1400, 4000
Resistance:
Rx1, x10, x100, x1K, x10K, x100K, x1 meg, x10 meg
Input Impedance:
DC—17.7 megohms
AC—17.7 megohms shunted by 150 pf
Added Features:
Zero center scale—15 Hz to 2.5 MHz
Size (HWD):
6⅜" x 7½" x 4½"
Weight:
6 lbs.
Price:
$89.50

RCA SENIOR VOLTOHMYST MODEL WV-98C (K)

DC Ranges:
0 to 0.5, 1.5, 15, 50, 150, 500, 1500
AC Ranges:
rms—0 to 1.5, 5, 15, 50, 150, 500, 1500
Peak-to-peak—0 to 4, 14, 42, 140, 420, 1400, 4200
Ohms Ranges:
Seven ranges from 0 to 100° megohms
Input Resistance:
DC—11 megohms
AC—(1.5, 5, 50, 150 volt ranges) 0.83 megohm shunted by 70 pf
500 volt range—1.3 megohm shunted by 60 pf
1500 volt range—1.5 megohm shunted by 60 pf
Frequency Response:
1.5, 5 and 15 volt AC ranges—±1dB 30 Hz to 3 MHz
Accuracy:
All ranges—±3% of full scale
Size (HWD):
6½" x 7" x 3¾"
Weight:
6 lbs.
Price:
$57.95

Test equipment manufacturers

The following is a list of manufacturers who are active in the service equipment industry. The names of those manufacturers who deal exclusively with the laboratory and production markets have purposely been left out. In compiling this list, every effort has been made to insure completeness and accuracy. Nevertheless, because of changes of address, corporate names, etc., this listing is not as complete as we would like it to be. ELECTRONIC SERVICING will welcome any corrections to this list.

Amphenol Distributor Division, 2875 South 25th Avenue, Broadview, Illinois 60153

B&K Instruments Inc., 5111 W. 164th St., Cleveland, Ohio 44142

B & K division of **Dynascan Corporation,** 1801 W. Belle Plaine Ave., Chicago, Illinois 60613

Blonder-Tongue Laboratories, Inc. 9 Alling Street, Newark, New Jersey 07102

Channel Master Corporation, Ellenville, New York 12428

Components Specialties, Inc., 101 Buffalo Avenue, Freeport, L. I., N. Y. 11520

Eico Electronic Instrument Co., Inc., Malta Street & Wortman Ave., Brooklyn, New York 11207

Electronic Measurements Corp., 625 Broadway, New York, New York 10012

The Finney Company, 34 West Interstate, Bedford, Ohio 44014

Hallmark Instruments, 6612 Denton Dr., Dallas, Texas 75235

Heath Company, Benton Harbor, Mich. 49022

The Hickok Electrical Instrument Co., 10514 DuPont Avenue, Cleveland, Ohio 44108

Jackson Electrical Instrument Co., 35 Windsor Avenue, Mineola, New York 11501

Jerrold Electronics Corporation, 401 Walnut Street, Philadelphia, Pennsylvania 19105

Karg Laboratories, Inc., 162 Ely Avenue, South Norwalk, Conn. 06854

Lampkin Laboratories, Inc., Bradenton, Florida 33505

Leader Instruments Corp., 101-103 Rome Street, Farmingdale, L. I., N. Y. 11735

Lectrotech, Inc., 1221 W. Devon Ave., Chicago, Ill. 60626

Mercury Electronics Corp., 315 Roslyn Road, Mineola, New York 11501

Pace Communications Corp., 24049 Frampton Ave., Harbor City, California 90701

Precise Electronics division of **Designatronics Inc.,** Mineola, L. I., N. Y. 11501

Precision Apparatus division of **Dynascan Corporation,** 1801 W. Belle Plaine Ave., Chicago, Ill. 60613

Precision Electronics, Inc., 9101 King Street, Franklin Park, Illinois 60131

Radio Corporation of America, Electronic Components and Devices, Harrison, New Jersey 07029

Seco Electronic Corp., 1001 S. 2nd St., Hopkins, Minn. 44343

Sencore, Inc., 426 South Westgate Drive, Addison, Illinois 60101

Simpson Electric Company, 5200 West Kinzie Street, Chicago, Illinois 60644

Sprague Products Company, North Adams, Mass. 01247

The Triplett Electrical Instrument Co., Bluffton, Ohio 45817

Waterman Instrument Corporation, 400 South Warminster Road, Hatboro, Pa. 19040

Workman Electronic Products, Inc., Box 3828, Sarasota, Fla. 33578 ▲

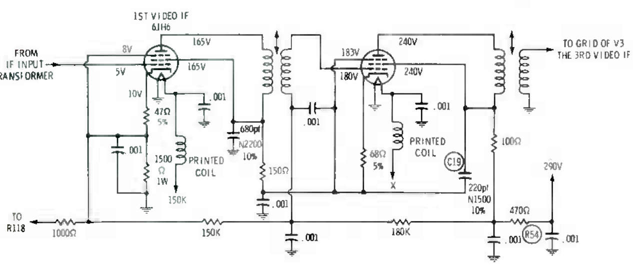
troubleshooter

Weak Video—Weak Sound

I would like to report on a circuit defect I recently fround in an RCA CTC28 chassis. The trouble symptom was very weak video and sound, with both antenna and CATV inputs. Voltage measurements revealed the plate and screen voltages on the first video IF amplifier to be abnormally high, with the plate, screen and cathode voltages of the second video IF amplifier all practically the same. Component checks then isolated the trouble to defective capacitor C19 (shorted) and resistor R54 (decreased in value to 7 ohms). I replaced the faulty components and returned the set to normal operation.

Roy Pope

Clarksville, TX



Thanks, Roy. We are glad to pass along to other readers all service tips received from the field. Such tips can save other technicians time—and time saved means more profits.

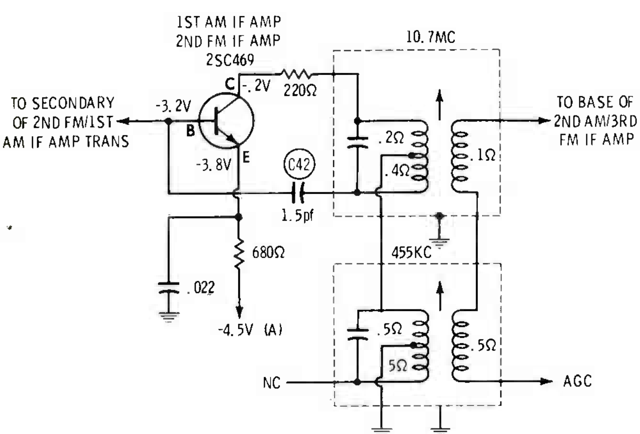
Squeal on AM

*The FM section of a Panasonic AM/FM radio Model RE746/756 (*Photofact *Folder 933-6) operates well, but the AM squeals on the high end of the dial.*

I replaced the AM IF's, thinking it might be within the coils. I've checked about every component I thought could cause this, and I have run out of ideas. Could you help with this dog?

George W. Miller

Hales Corners, WI 53130



The trouble symptom you describe is indicative of improper neutralization. Capacitor C42, the 1st AM, 2nd FM IF amplifier neutralizing capacitor is probably defective or changed in value. I would replace that capacitor following the procedure outlined under "Alignment Instructions" in the Photofact Folder.

Diminishing Sound

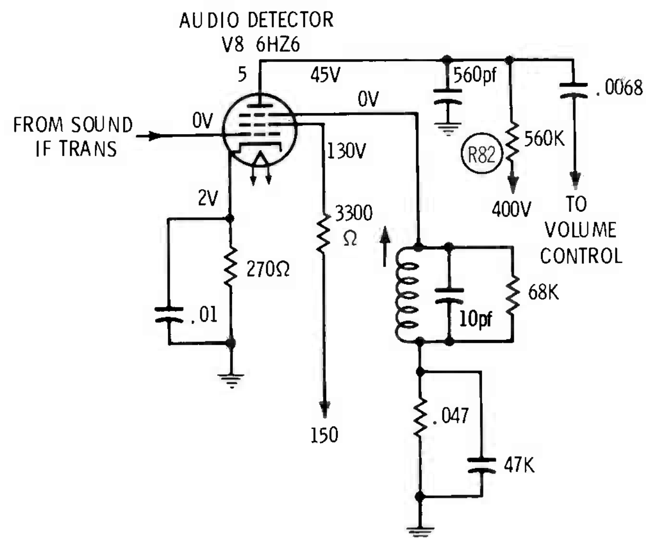
*I am an amateur hobbyist and have been a subscriber to your magazine for many years. The time has come when I need an explanation. The chassis in question is an RCA CTC16 (*Photofact *Folder 736-4). The trouble symptom was a steadily diminishing sound level and, over a period of several weeks, the sound disappeared. The picture was fine at all times.*

All tubes checked normal, with the exception of V8, the audio detector. This tube was replaced without correcting the sound defect. Circuit tracing isolated an open resistor (R82, 560K ohms). I replaced the resistor, and sound came in loud and clear. However, the plate voltage (pin 5, V8) was 125 volts rather than the 45 volts indicated on the schematic. I put the set together and it has been operating normally ever since.

My question: Why the 125 volts on pin 5 of V8?

Saul Miller

Orange, CA

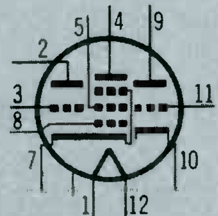


The reading obtained at the plate of V8, the audio detector, is a nebulous thing at best. The conditions under which this voltage is read is the deciding factor. I have seen this potential vary from 30 volts to 150 volts from chassis to chassis of the same design. Whether the reading is taken with signal, without signal, noise in circuit when measuring under no signal conditions, etc., determines what the plate voltage will be at a given instant. Witness your own experience. As long as you had any plate voltage at all, you had some sound present. The voltage readings on Photofact schematics are taken under no-signal conditions—tuner off channel, antenna terminals shorted, volume control at minimum. ▲

31AL10

Pentode—Vertical output
Triode 1—Vertical Oscillator
Triode 2—Sync Clipper
Fil.—31.5 @ 0.315A (11 sec)

		Pentode	Triode 1	Triode 2	
Ep	=	120	150	150	V
Esg	=	110	---	---	V
Eg	=	−8	−2	−5	V
Rk	=	---	---	---	---
Ip	=	46	5.4	5.5	ma
Isg	=	3.5	---	---	ma
Gm	=	7100	3900	2300	μmhos
Mu	=	---	43	20	---

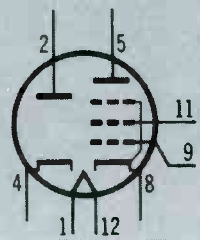


12HR

32HQ7

Pentode—Horizontal Output
Diode—Damper
Fil.—32.6V @ 0.31A (11 sec)
Diode PIV—3300V @ 600 ma
Diode Section—tube voltage drop approx. 16V

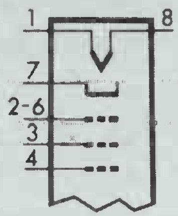
		Pentode	Diode	
Ep	=	110	---	V
Esg	=	110	---	V
Eg	=	−22.5	---	V
Rk	=	---	---	---
Ip	=	42	---	ma
Isg	=	2.4	---	ma
Gm	=	4500	---	μmhos
Mu	=	---	---	---



12HT

22ZP4

Protection—Banded Rim & Tension band
Deflection—114°
Fil.—6.3V @ 0.45A
Grid 2—400V



8HR

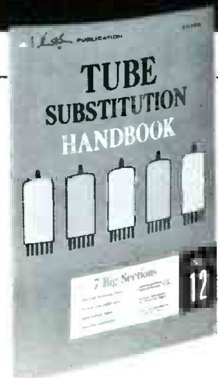
d

March, 1969

Electronic Servicing

Tube Substitution Supplement

This Supplement has been designed to provide you with the latest up-to-date information on new tubes. The format allows maximum use during a house call or at the bench.



REMOVE THIS SUPPLEMENT FROM **Electronic Servicing** and put it in the back of your **TUBE SUBSTITUTION HANDBOOK**

direct substitutes

Included are the older tubes that will substitute directly for the new tubes. This information supplements the sections in the Tube Substitution Handbook for American Receiving Tubes and Picture Tubes.

basing diagrams

The basing diagram for each new tube will help you in the servicing of new receivers when service literature is not available.

typical characteristics

The typical, or average, characteristics of each new tube can be of great help when troubleshooting new circuits.

easy reference

The direct substitution list will be cumulative each month. Thus, only the latest edition need be carried in the Tube Substitution Handbook.

Direct Substitutions

To Replace	Use	To Replace	Use
5MQ8	*	16LU8A	16LU8
6AG9	6AL9	31AL10	*
6AK10	*	32HQ7	*
6AL9	6AG9	12DEP4	*
6MQ8	*	12DHP4	*
8AL9	*	19HNP22	*
9AK10	*	22TP4	*
10LY8	*	22ZP4	*
16BX11	*	25ALP22	*
16LU8	16LU8A		

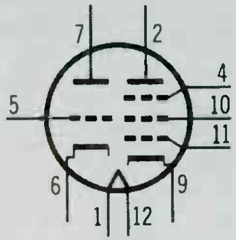
*No substitution at present time.
Twelfth edition of Tube Substitution Handbook now available at your distributor.

General Specifications

6AL9

Pentode—Video amplifier
Triode—General purpose
Fil.—6.3V @ 0.82A

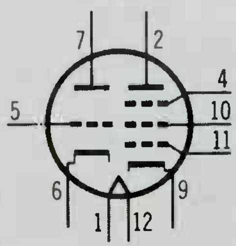
		Pentode	Triode	
E_P	=	250	200	V
E_{SG}	=	150	---	V
E_G	=	0	---	V
R_K	=	56	270	Ω
I_P	=	28	7.6	ma
I_{SG}	=	5.6	---	ma
G_m	=	30,000	6300	μmhos
M_u	=	---	59	---



12HE

8AL9

Same as 6AL9 except for heater Voltage.
Fil.—8.6V @ 0.04A



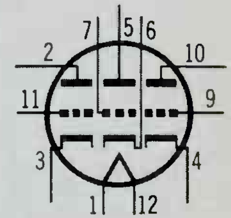
12HE

b

9AK10

Triode 1—Color difference amplifier
Triode 3—Color difference amplifier
Triode 3—Color difference amplifier
Fil.—9.5V @ 0.6A (11 sec)

E_P	=	200V
E_G	=	7V
R_K	=	7500
I_P	=	10 ma
G_m	=	7000
M_u	=	53

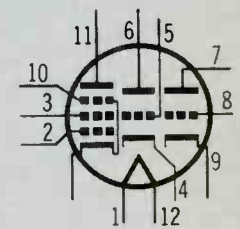


12FE

16BX11

Pentode—Video amplifier
Triode 1—General purpose
Triode 2—General purpose
Fil.—16V @ 0.315A (11 sec)

		Pentode	Triode 1	Triode 2	
E_P	=	125	150	150	V
E_{SG}	=	125	---	---	V
E_G	=	0	−6	−4.5	V
R_K	=	56	150	220	Ω
I_P	=	12	11	7.6	ma
I_{SG}	=	3.8	---	---	ma
G_m	=	11,300	6200	6800	μmhos
M_u	=	---	42	57	---

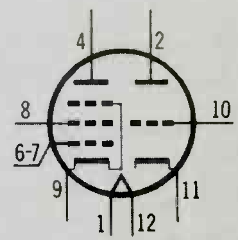


12CA

16LU8A

Pentode—Vertical output
Triode—Vertical oscillator
Fil.—16V @ 0.6A (11 sec)
Direct Replacement—16LU8

		Pentode	Triode	
E_P	=	135	250	V
E_{SG}	=	120	---	V
E_G	=	−10	−4	V
R_K	=	---	---	---
I_P	=	56	2.3	ma
I_{SG}	=	3	---	ma
G_m	=	9300	3600	μmhos
M_u	=	---	58	---



12DZ

c

photofact bulletin

Photofact Bulletin lists new Photofact coverage issued during the last month for new TV chassis. This is another way Electronic Servicing brings you the very latest facts you need to keep fully informed between regular issues of Photofact Index Supplements issued in March, June, and September.

ARVIN

67K58 (Ch. 1.22801) 1018-1

BRADFORD

DMAT-55319, DMAT-55327 . 1016-1
DWGE-89706A,
DWGE-89714A 1013-1
AM-FM Radio 1013-1A

GENERAL ELECTRIC

Chassis AE, A1 1015-1

MAGNAVOX

Chassis T932-01-AA,
T932-01-BB 1017-1

NIVICO

2600, 2610 1018-2

PANASONIC

AN-32, AN-42D 1013-2
AN-52W 1014-1
TR-339R 1016-2
AN-69/C, AN-79/C
(Ch. N49A) 1017-2

SEARS

5024 (Ch. 562.10450) 1014-2
4109 (Ch. 564.80090) 1015-2
81661 (Ch. 562.10412) 1016-3

WARDS AIRLINE

GHJ-17349A/359A/
429A/449A/459A 1018-3

ZENITH

Chassis 16Z7C17, 16Z7C19 .. 1014-3
Remote Receiver S-80373,
Transmitter S-68933 .... 1014-3A

Production Change Bulletin

ADMIRAL

Chassis 2H525-1, M2H525-1,
M3H554-1, M4H531-1 1013-3

PHILCO

Chassis 17MT80/A/B 1017-3

RCA

Chassis KCS165A 1013-3

SEARS SILVERTONE

Chassis 456/528/529.70282
thru 456/528/529.70288 1017-3

WESTINGHOUSE

Chassis V-2486-6/-13/-14,
V-2660 1013-3
Chassis V-2436-1/-2 1017-3

ZENITH

Chassis 13X15, 13X15Z
14M20Z 1017-3
Chassis 14N26Z, 14X26 1013-3

Circle 33 on literature card

testequipment

notes on analysis of test instruments, their operation and applications

Sencore Model TF151 Transistor and FET Tester

Sencore TF151 Transistor and FET Tester

The design trend in home entertainment equipment is increasingly in favor of solid-state devices. Most manufacturers who have not gone completely solid state are using solid-state devices in over 50% of their circuits.

With the increase of solid-state devices the use of the transistor checker will also increase, and, in the very near future, it will be not only a bench instrument but, also, a must in the service truck.

One of the latest entries in the field of transistor checkers is the Sencore Transistor/FET tester, Model TF151.

Transistor Tests

The model TF151 performs the following tests of transistors:

1. AC beta—both in- and out-of-circuit tests of high- and low-power and RF-type transistors.
2. Leakage (I_{CBO}) tests of low- and high-power and RF-type transistors.
3. Transconductance (Gm) of FET's—both in- and out-of-circuit tests.
4. Gate leakage of FET's (I_{GSS}).
5. Diode ratios—both in- and out-of-circuit tests.

Circuit Description

Beta is the ratio of average collector current to the average base current of a transistor connected in a common-emitter circuit. In testing the AC beta of a transistor, the TF151 simultaneously applies 60-Hz signals between the collector and emitter and base and emitter. The ratio of the average collector current to the average base current of one cycle of operation is the AC beta.

The amplitude of the AC signal applied to the transistor under test is set by the BETA CAL control. The BETA CAL control is adjusted for each transistor under test according to that transistor's specifications.

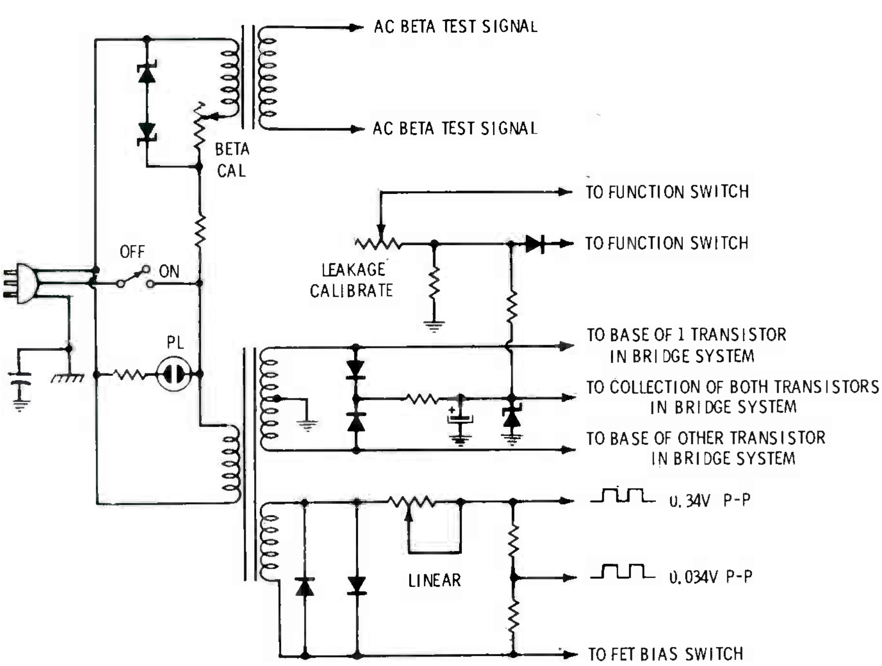
BETA CAL settings are 0.2 ma, 2.0 ma or 20 ma. The 0.2 ma setting is used for low-saturation types of transistors, 2.0 ma for low-power types and the 20 ma setting for high-power types. The average collector current is indicated by the meter, and is set for proper value by adjusting the BETA CAL control for full scale meter deflection with the function switch set at the desired input level.

When the pushbutton labeled GAIN is depressed, the meter is transferred from the collector circuit to the base circuit of the transistor, and the meter indicates the average base current. With the function switch set at the X1 range, the meter has the same sensitivity as previously mentioned and will measure 0.2, 2.0 or 20 ma of base current. Placing the function switch in the X10 range increases the sensitivity by a factor of 10.

Zener diodes are utilized to clamp the applied AC signals to the selected level and prevent any sudden change due to line-voltage fluctuation.

Capacitors are connected to the base and collector circuits of the transistor under test to provide a return path for the AC signal.

A neutralizing capacitor is provided to prevent the component under test from developing spurious oscillations.



Schematic diagram of basic circuitry used in Model TF151

A switch, located immediately under the meter face at the left hand side of the tester, controls the polarity of the meter for beta checks and the polarity of the applied voltages when making leakage tests.

Leakage tests are performed by applying 4 volts DC between the collector and base, then measuring the current flow. A potential of 6 volts DC is developed by a rectifier circuit and clamped at the 6-volt level by a zener diode. A resistance-type voltage divider then provides the 4 volts DC necessary for leakage checks.

A diode and resistor shunt the meter during leakage tests to increase the full-scale deflection current from 200 ua to 5000 ua. The non-linear characteristics of the diode and series resistor cause the meter to read direct for the first half of the scale. The diode then conducts and a portion of the current is shunted, producing the non-linear leakage scale on the meter. The leakage circuit is the same for both conventional transistors and FET's.

Because FET's are tested for transconductance (Gm) rather than beta, the FET section is independent of the regular transistor test section. The system employed in Model TF151 for testing FET's utilizes two transistors and four resistors in a bridge configuration.

The transistors function as switches and are turned on or off by the applied AC signal. An input transformer applies the AC signal to the base of the two transistors in the bridge configuration. With the system connected between the drain and source of an FET, the Gm ZERO control, directly under the meter at the right-hand side, is adjusted for equal current flow in the bridge circuit so that the meter reads zero.

The impedance of the bridge circuit is low, and voltage applied to the drain of the FET under test is held constant to conform to the formula for testing Gm.

A constant-amplitude square wave "generator" circuit is then applied to a resistance-type voltage divider network, which includes the LINEAR control. The LINEAR control is adjusted so that the applied square wave is 0.34 volts p-p when the function switch is in the "Gm X1" range. When the function switch is in the "Gm X10 range, the 0.34-volt p-p signal is fed through a voltage divider made up of precision resistors, which lowers the signal to 0.034 volts p-p.

When the square-wave signal is applied to the gate of the FET under test, the FET will conduct more on one half of the cycle than the other. This results in an imbalance in the bridge system (more current flowing in one half than the other). The meter indicates the extent of the imbalance. The amount the FET will conduct is related directly to the Gm specification of the device. An FET BIAS switch, located in the lower center directly under the function switch, selects either NORM (reverse bias) for depletion, or POS (forward bias) for enhancement types of FET.

A grounded (3-prong) line plug is used to keep the case of the instrument at ground potential to prevent the possibility of damage to insulated-gate type FET's when they are checked out of circuit.

Calibration Procedures

Chassis Removal:

1. Remove the two retaining screws from the bottom of the case.
2. Remove the two retaining screws located at the top of the reference book holder on rear of case.
3. Lift the front panel away from the case to expose the leakage and Gm calibration controls located on the top of the chassis.
4. To reassemble, reverse the procedure.

Leakage calibration:

1. Set the TYPE switch to the NPN or PNP position.
2. Set the FUNCTION switch to the LEAKAGE position on the regular transistor side of the switch.
3. Connect the positive lead of a 1-ma meter to the C (collector) jack and the negative lead to a 2000-ohm potentiometer.
4. Connect the other side of the 2000-ohm potentiometer to the B (base) jack of the TF151.
5. Adjust the 2000-ohm potentiometer to obtain a reading of 1 ma on the external meter.
6. The meter on the TF151 should now indicate 1 ma; if it does not, adjust the leakage calibration control until the TF151 meter indicates 1 ma.

Gm calibration:

1. Connect the vertical input of an oscilloscope to the G1 (gate) jack of the TF151.
2. Connect the oscilloscope ground lead to the S (source) jack.
3. Set the FUNCTION switch to X1 position of the GATE 1 section and depress the GAIN pushbutton.
4. The signal observed on the oscilloscope should be a square wave of 0.34 volts p-p.
5. If the signal is not 0.34 volts p-p, adjust the Gm CAL control until the indication is correct. The signal in the Gm X10 range is derived from a fixed precision resistor and requires no adjustment. ▲

Sencore Model TF151 Specifications

Regular Transistor (Bi-Polar) Testing
Beta (Hfe) measured at 60 Hz

Ranges:	Beta	Ic
Low Power		
X1	1-50	2.0 ma
X10	10-500	2.0 ma
High Power		
X1	1-50	20 ma
X10	10-500	20 ma
RF types		
X1	1-50	0.2 ma

Leakage

ICBO measured at VCB = 4 volts, IE = 0

One Range

0-100 microamperes first half of scale

100-5,000 microamperes last half of scale

Field Effect Transistors
Transconductance (Gm) measured at VDS = 5 volts, VGS = 0

Range:	Gm
X1	0-5,000 microhms
X10	0-50,000 microhms

Gate Leakage

IGSS measures at VGS = 4 volts, VDS = 0

One Range

0-100 microamperes first half of scale

100-5,000 microamperes last half of scale

Zero Bias Drain Current

IDSS measured at VDS = 5 volts, VGS = 0

Size (HWD):
9½" x 7½" x 6"

Weight: 9 lbs. Price: NA

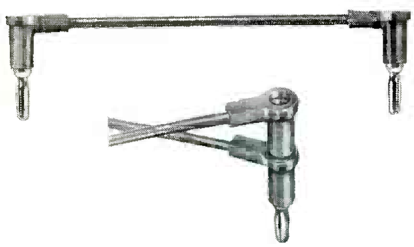
productreport

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

Patch Cord
(45)

A new right angle banana plug patch cord, featuring stack-up capability, has been introduced by **Pomona Electronics Co., Inc.**

The vertical stacking feature of the new Model 2864 permits endless circuit connections, and right angle design keeps wires close to chassis. An oversize shoulder allows easy connect and disconnect. Also offered is a similar patch cord, Model 2860, with miniature banana plugs to fit 0.104 diameter banana jacks.



Banana plug springs are made of one piece beryllium copper, heat treated for maximum life, and rounded for greater contact area. Tough thermoplastic insulation, molded to nickel plated brass body and wire, provides a strong moisture-proof integral unit.

Both models are available in 10 colors and wire length from 4″ to 60″. The price is $1.50.

Tape Head Cleaner
(46)

The availability of a new aerosol-type cleaner for all audio and video magnetic tape heads, guides and film gates, has been announced by **GC Electronics.**

The product, Audio-Video Tape Head Cleaner, is completely safe for use on all types of recording heads and will quickly remove all dirt, film and oxide build-up. It will not harm valuable tapes, tape coatings or the finish of the recorder itself. When used as directed, the cleaner will not interfere with transmission and may be safely applied on running tape. Audio-Video Tape Head Cleaner is non-toxic, non-conductive and non-flammable.

The cleaner is available in a 16-ounce aerosol can equipped with a 6″ spray extension. The price is $2.35 per can.

Record Cleaning and Maintenance Kit
(47)

The new Watts Hi-Fi Parastat introduced by **Elpa Marketing Industries, Inc.,** is designed and intended for use on new records or records in new condition which are to be played with cartridges requiring very low tracking pressures of 2 grams or less.

With a pressure of about 2 lbs. applied to the brush, which is ground down to near infinity, the pressure of each individual bristle on the surface of the disc is of the order of 1/10 gram. The pointing angles used, the natural resilience of the nylon and the very large number of bristles produce countless oscillations as the myriad twists and turns of the groove are followed.

A correct level of humidity is ensured in the case of the Hi-Fi Parastate by the maintenance of a humid atmosphere within the case and activation immediately before use. The price is $15.00.

Diode Curve Tracer
(48)

Measurement Control Devices has introduced its Model CT-501 Diode Curve Tracer for high speed selection or comparison of diodes in the lab, on production lines or for quality control. Incorporation of a 3″ CRT for visual display permits the tracer to present characteristics of all types of diodes. A built-in cal-

product report

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

(continued)

ibrator on the tracer facilitates precise calibration, and the unit's line and load are regulated to 1% while overall accuracy is within 3%.

The unit analyzes diode operating conditions to a maximum of 2 kv in the reverse direction or 10 amps in the forward direction. Horizontal axis of the CRT is calibrated in volts/division ranging from 0.1V to 100V; vertical axis is calibrated in amperes/division ranging from 10 ua to 2 amps. Each axis is provided with an "x" 1 and "x" 2 multiplier. The tracer operates with an input voltage of 115 VAC, 60 Hz.

Compact and lightweight, the unit diode curve tracer is 9" x 8½" x 12" and is priced at $295.

Oscilloscope/Vectorscope (49)

A new wide-band, high-sensitivity 5-MHz oscilloscope-vectorscope specifically designed for waveform observation in TV is announced by **Mercury Electronics Corp.**

Vectorscope calibrations on the scope's graticule and deflection-plate terminals at the rear of the cabinet permit the Model 3000 to be used as a vectorscope.

The wide-band vertical amplifier has a sensitivity of 4.6 mv rms/cm. The horizontal amplifier has a frequency response of 5 Hz up to 500 KHz, ±3dB. The unit is 11" x 9" x 16" and weighs 22 lbs. Price is $159.95 wired, or $109.95 in kit form.

Portable VOM-type Instrument (50)

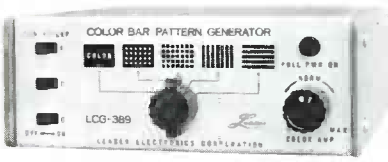
A portable VOM-type instrument, able to measure exact values of resistances in-circuit, has been introduced by **Hirst Associates.** Known as Guardohm, it has a solid-state circuit design which provides isolation "guarding" without having to remove resistances from a circuit before an exact measurement can be made.

Other features include a selectable, constant current output from one microampere to 100 milliamperes, a taut-band meter movement featuring greater resistance to shock and vibration, increased sensitivity, anti-glare window, magnetically shielded meter movement; a meter scale with all readings, including resistance, displayed linearly; one percent accuracy; console-type housing, convenient bench use, tip-over resistant; sturdy, high-impact resistant plastic case; and is AC operated.

Matrix functions include resistance measurement, DC current measurement, DC voltage measurement and DC current generation. The price is approximately $330.00.

Color Bar Pattern Generator (51)

The Model LCG-389 is a compact, solid-state color-bar pattern generator used extensively for production testing and field servicing. Introduced by **Leader Instruments Corp.,** the instrument is designed for convergence and synchronizing adjustments in color and monochrome TV receivers. Five basic patterns are displayed: gated rainbow color bars, square crosshatch, horizontal lines, vertical lines, and small well-defined dots. Gun killers are provided for convergence adjustments. The only connection is made to the TV receiver antenna input.



The price is $99.50.

FM Signal Generator
(52)

Radio Research Company has recently introduced their new FM Signal Generator Model 61. The instrument provides full control over RF level from high level to fractional microvolt. For use either in the laboratory or production line.

Completely solid state with rugged, high-quality construction throughout, the warm-up drift is negligible. Proper attention to thermal stability assures the user of virtually unchanged performance over a wide ambient range.

The unit employs a wide modulation bandwidth which allows true stereo separation measurements to be made when driven by an appropriate stereo source. Phase shift and flatness errors on external modulation have been minimized.

Features include an AF output jack to facilitate scope monitoring of the complex modulation waveform, which may also be used for scope horizontal drive when used in sweep applications.

The price is $695.00. An optional low-frequency adapter is $145.00.

advertisers' index

catalogs literature

ANTENNAS

100. *Ava Electronics* — Cross reference guide sheet #1-69 for CATV "F" connecors gives parts numbers and crosses Jerrold, Craftsman, Blonder-Tongue, Viking and AVA.

101. *Hy-Gain Electronics*—64-page catalog of Antennas and Antenna Systems includes all antenna configurations covering a frequency range of 2 MHz to 1100 MHz.

102. *JFD Electronics* — New MATV specification book features printing on gummed stock and perforations for easy removal. It includes system functions, antennas, amplifiers and tests.

AUDIO

103. *Jensen*—Catalog 1090-C Concert and Viking Series Loudspeakers gives replacement applications and information on custom installation.*

COMPONENTS

104. *Bussmann*—16-page 1969 booklet "Buss Fuse Car and Truck List" gives fuses for all model cars and trucks, foreign and domestic.*

105. *Cornell-Dubilier* — 68-page cross-reference helps locate single, dual, triple and quadruple section replacement electrolytics. A listing of their new tubular capacitors is also included.*

106. *Essex*—SC-4 RBM Standard Controls Catalog lists 450 electronic relays and contractors with pictures, prices, full technical data and specifications.

107. *Raytheon*—74-page catalog describes nearly 400 types of high reliability silicon transistors.*

SPECIAL EQUIPMENT

108. *Seton*—Catalog 69-B shows 155 different identification products including advertising posters, truck signs, decals, name plates and property identification tags.

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

TEST EQUIPMENT

110. *Heath*—68-page Scientific Instrumentation Catalog features new instruments available with full specifications, illustrations and many schematics.*

TOOLS

111. *Janel*—Catalog on precision hand tools includes tweezers, cutters, pliers, soldering tools, semi-conductor tweezers, brushes, and hemostats.

TUBES AND SEMICONDUCTORS

112. *Motorola*—6-page catalog, SG-15 Field-Effect Transistors Selector Guide, covers the company's line of field-effect transistors.

113. *Thor Electronics*—16-page "1969 Wholesale Electronic Tube Purchasing Guide" lists over 7,000 tubes and prices.

***Check "Index to Advertisers" for additional information.**

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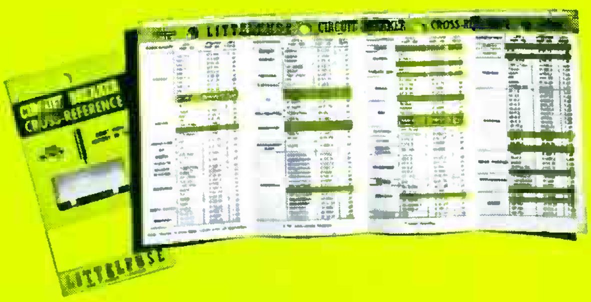

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