JANUARY 1977 • 75 CENTS A HARCOURT BRACE JOVANOVICH PUBLICATION

ELECTRONIC TECHNICIAN/DEALER

WORLD'S LARGEST TV-RADIO SERVICE & SALES CIRCULATION

Spectrum Analyzer Measurement Of Audio Parameters

What Servicers Say About TV Warranty Servicing

ANNUAL INDEX ISSUE:

Subject Reference Index
Of 1976 Editorial

TEKFAX 10-Year Index

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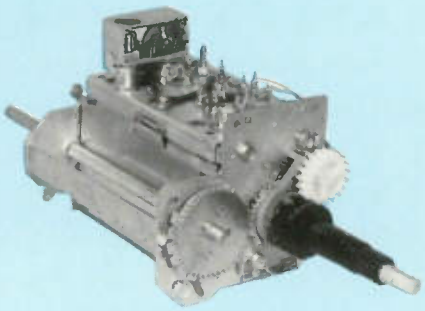

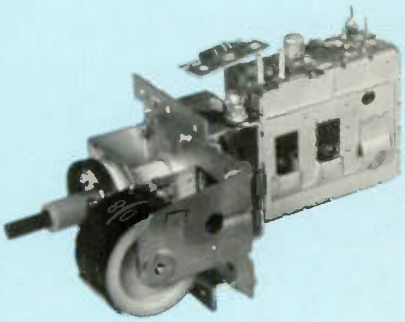

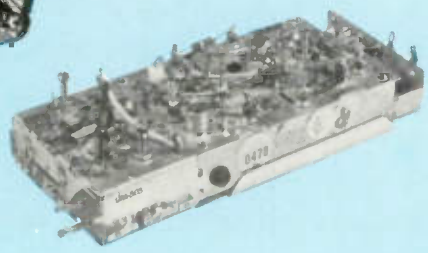

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PRECISION TUNER SERVICE

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EDITOR'S MEMO

ET/D: *"What advice would you give today to a servicer not presently involved in warranty servicing?"*
TV warranty servicer: *"If you can get by without it, don't get involved."*

The attitude reflected in the preceding answer—given to us by one of twenty randomly-selected TV service business owners whom we recently interviewed about their present experiences with TV warranty servicing—typifies the attitude which prevails among most, but not all, of the owners interviewed. (See article beginning on page 10.)

Based upon the results of our interviews of these twenty shop owners, it seems that, although there have been improvements in some aspects of TV warranty servicing, most still see 'excessive paperwork', 'low service labor rates', 'no parts profit' and 'slow payment of labor invoices' as significant problems which must be rectified—and soon.

One of two big surprises in our survey findings is that 'excessive paperwork' seemingly outranks 'low service labor rates' as the most troublesome warranty-related problem.

This, however, does not mean that most servicers are happy with the rates they currently are being paid for warranty service labor. They definitely are not. But, as one shop owner pointed out, "More manufacturers are at least willing to sit down and talk to us about labor rates, and that's at least a start toward mutually satisfactory warranty labor arrangements."

Nevertheless, only three of the twenty shop owners we interviewed said that the labor rates they presently are receiving provide a reasonable profit, and one of these three said that his profit is "minimal—certainly not realistic."

If most interviewed shop owners today are not realizing a profit from TV warranty servicing, why do they continue as 'authorized warranty service centers'? The most prevalent answer to this question given by non-retailing servicers was: "To generate more out-of-warranty servicing."

But few of the interviewed shop owners seem to really be convinced that warranty servicing actually generates sufficient additional out-of-warranty volume to justify the non-profitability of warranty work. Most seem to suspect that it's a bad trade-off. Yet, most seem unwilling to give it up—at least, not today or tomorrow. Some say that they need the 'fill-in volume' which warranty servicing represents, to keep their technicians busy full time. Others seem to be hanging on 'for a while longer' with the hope that warranty servicing will become reasonably profitable 'tomorrow or the next day.'

Most of those servicers who also retail say they continue to accept warranty servicing because—like it or not—they are locked into it by their dealership agreement with the manufacturer.

But not all TV warranty servicing is a potential short cut to the poor house. The second of the two big surprises in our warranty survey was the uncovering of two shop owners who seemingly couldn't be happier about the warranty service agreement they have with one TV marketer: Western Auto (True-Tone TV).

Unlike most other manufacturers or marketers, who reimburse warranty service labor on a flat-rate basis, Western Auto pays on a straight, time-consumed, hourly basis, at a negotiated hourly rate which is satisfactory to both parties. And, Western Auto permits a negotiated margin of profit on warranty replacement parts supplied by the servicer. It also pays warranty labor and parts invoices on a twice-monthly basis and delays billing the servicer's account for parts ordered from its distribution center until two weeks after the part is shipped—procedures intended to help ease the servicer's cash-flow situation. And, it provides free service literature to its warranty servicers.

To find out why Western Auto's warranty rates and policies are more realistic than those of most TV manufacturers and other private-label marketers, I called Western Auto's general service manager, Fred Clamons, at the company's headquarters in Kansas City.

Clamons' candid reply: "Because we represent to the servicer a smaller potential volume of service than do the major TV manufacturers, to attract and retain competent servicers we must be more sensitive to their profit requirements and other needs."

To summarize: Those owners of TV service businesses whom we interviewed recognize, and appreciate, the servicer-oriented improvements which some manufacturers are gradually incorporating into their warranty related procedures, but most still view warranty servicing as a necessary evil.

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ELECTRONIC TECHNICIAN/DEALER

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THE COVER: This photo of the bench set-up for performing audio tests and measurements on stereo amplifiers highlights the special feature on page 14 on the use of an LF spectrum analyzer.

A HARCOURT BRACE JOVANOVICH PUBLICATION

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NEWS OF THE INDUSTRY

Replacement Sets To Become Major Source Of Color TV Sales In Near Future

RCA marketing vice president Jack K. Sauter, has predicted that by 1978 or 1979 replacement sales of color TV will exceed original and second-set sales for the first time in history. According to Sauter, 40 per cent of the 130 million black-and-white and color TV sets in the U.S. are at least five years old and 8 to 10 per cent are at least ten years old. "The owners of these older TV sets represent a substantial potential market for color TV sets in the months and years ahead, and in fact," Sauter stated, "I see replacement sales accounting for about 60 per cent of total TV sales by 1978 or 1979."

Sauter noted that many TV set models actually cost less than they did five or 10 years ago, despite soaring costs of raw materials and the expense of adding such innovations as solid state circuitry, superior picture tubes, new fire retardant materials, improved tuners and other features.

At the same time, he pointed out, television offers the average family one of the cheapest forms of entertainment. He said it costs the average family about 3.5 cents an hour to own, operate and maintain a new color TV set over its lifetime.

"Our recent national trade-in promotion," Sauter said, "surprised us somewhat with the higher than expected number of people who traded in relatively new TV sets so they could have the most advanced model with more features and a better picture. It gave a clear indication that the TV receiver is joining the automobile as a frequently changed consumer product."

Length Of Time For Repair Is More Important Than Cost To Consumer

Consumers are more concerned about the length of time it takes to repair a TV set than they are with the cost, it was reported to executives of the California State Electronics Association (CSEA) during a meeting with consumer-interest groups recently in Sacramento.

This was the second meeting scheduled by CSEA as part of a consumer awareness program. It was designed not only to obtain consumer feed-back, but also to acquaint the groups with repair problems the shops face.

As explained by Don Surette, president, CSEA, "The consumer agencies reported that the most common complaint about TV repair was not the cost, but the excessive delay in returning sets."

New Device Eliminates Need For Converters On 20-Channel Cable TV

A new device called an isolation amplifier has been developed by Magnavox that will eliminate the need for a 20-channel cable TV converter when the system is hooked up to one of the firm's varactor-tuned color TV sets. The new device is designed for those cable TV markets that carry more than the normal 12 VHF channels (2 through 13) and utilize the 8 mid-band CATV channels B through I. The amplifier must be installed by a serviceman.

The FCC Arrests 19 Illegal CB'ers In Maryland

In a search and seizure operation conducted in Maryland recently 19 persons were arrested by the FCC for illegal operation of CB and ham equipment. A total of $65,000 worth of equipment was confiscated. The violations mostly involved CB sets that had been connected to linear amplifiers to boost power, and amateur transceivers that were modified to operate on CB frequencies.

The CB School Bells Are Ringing

Two different training programs, or schools, are scheduled at various locations in the country in 1977—one for distributors and dealers of SBE CB products, and the other for aspiring CB service technicians.

The SBE seminars are designed to give dealers and distributors concrete facts about the present CB situation and the future of 40-channel and 23-channel transceivers and to provide marketing know-how for CB radios and accessories.

The training program for technicians, a traveling Training Workshop, has been developed by well-known electronics author, Forest Belt. The five-day workshop will teach high-speed servicing for all brands and models of CB radio. It will be presented in 13 different U.S. cities, starting on January 24 and running through August. For more information, write Forest Belt Training Workshop, Box 68120, Indianapolis IN 46268.

GTE Sylvania Enters The CB Market With New Line of Antennas

The Electronic Components Group of GTE Sylvania has developed a new line of

now 3-strong

Xcelite® family of attaché tool cases

TC-150/ST

And here's the newest addition... Model TC-150/ST... containing an intermediate assortment of tools for the technician, serviceman, or field engineer. It contains 52 items in all, including 24 famous Xcelite "Series 99" interchangeable-blade tools, a broad variety of other Xcelite Professional screwdrivers, nutdrivers, pliers, cutters, strippers, measuring tapes, and specialized electronic tools, plus the Weller® Cordless Soldering Iron and recharger, an added convenience where outlets aren't accessible. Tools are mounted in see-thru pockets on removable pallets in a durable, attractive case with Whiskey-tan Marvelon exterior and sun-tan vinyl lining. Plenty of extra space for additional tools, prints and manuals! Solid brass hardware and padded handle are additional quality touches.

TC-100/ST

TC-200/ST

It joins the other members of the family... Model TC-100/ST, the "big daddy" of Xcelite's cased tool sets, with the greatest variety—a total of 86 types and sizes of drivers, wrenches, pliers, cutters, strippers...and Model TC-200/ST, the 37-piece set that's unequaled in economy and value.

See the new TC-150/ST at your distributor now. And ask for Xcelite literature, which will give you a detailed listing of the contents of all three Xcelite Attaché Tool Cases.

COOPER INDUSTRIES

Weller-Xcelite Electronics Division
The Cooper Group
Apex, N. C. 27502

...for more details circle 128 on Reader Service Card

antennas for all AM and SSB CB radios. Everett H. Frost, general marketing manager, said the line consists of one base station and five mobile models for automobiles, vans, trucks, campers and recreational vehicles. "They are constructed of quality materials to meet or exceed stringent electrical, mechanical and environmental specifications," Frost said.

Switchcraft Is Acquired By Raytheon

Plans for the acquisition of Switchcraft, Inc. by the Raytheon Company have been completed, according to an announcement from the two companies. Wilfred L. Larson, Switchcraft president, said "The company will operate under our present organization, utilizing present management and other personnel and plant facilities in Chicago and Paxton, Illinois."

Switchcraft manufactures over 6000 different electromechanical components in 10 product lines. Included are telephone jacks, plugs, many different switches, audio connectors, molded cable assemblies, and audio accessories.

Price Of GTE Sylvania Parts Goes Up

GTE Sylvania has announced an increase in the price of most of their replacement parts. Cliff Waldrop, national parts manager, said that "due to the increase in the cost of replacement parts from our vendors, it will be necessary for GTE Sylvania to increase the price of our parts by 10%, effective January 1, 1977."

Standard Time And Frequency Stations Will Modify Services

The National Bureau of Standards (NBS) plans to discontinue broadcasts on three frequencies from WWV (2.5, 20 25 MHz) and one frequency from WWVH (20 MHz). All broadcasts from these standard time and frequency shortwave stations on other frequencies will continue unchanged in power and format. The reduction in number of frequencies is proposed for February 1st, and will be undertaken to reduce station operation costs.

TV And Radio Sales To Dealers Finished On Plus Side in 1976

As 1976 moved into its last month, sales to dealers of all electronic home entertainment products except phonographs were all showing healthy increases. Total sales to dealers in unit figures developed by the Electronic Industries Association (EIA) through November 26, were as follows:

EIA Sales To Dealers Report For Week Ending Nov. 26

Products	Units Sold Through November, 1976	Units Sold Through November, 1975	Per Cent Change
Color Television	6,791,136	5,803,113	+17.0
Black & White TV	4,612,290	4,491,622	+ 2.7
Total Television	11,403,426	10,294,735	+10.8
AM Radio	8,223,834	6,268,755	+31.2
FM & AM-FM Radio	18,100,674	16,536,253	+ 9.5
Auto Radio	11,372,515	8,269,437	+37.5
Total Radio	37,697,023	31,074,445	+21.3
Phonographs/Stereo	2,799,351	3,074,635	- 8.9

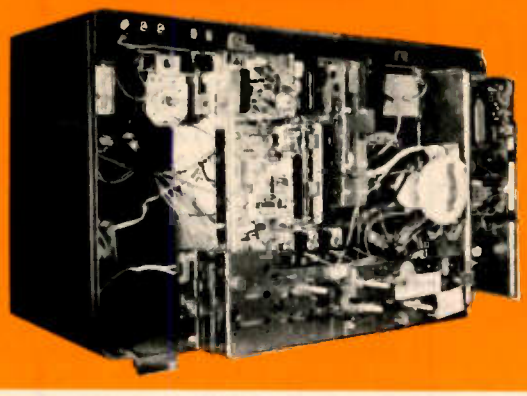
Three Unions Ratify Three-Year Labor Contracts With RCA

New labor contracts that provide over 21,000 RCA employees an immediate general wage increase and deferred general increases were approved at the end of 1976 by members of the International Brotherhood of Electrical Works, the International Union of Electrical, Radio and Machine Works, and the United Brotherhood of Carpenters and Joiners. The unions represent RCA employees at plants in California, Florida, Indiana, New Jersey, Ohio and Pennsylvania.

Misuse Of Marine Radiotelephones Reported in National Survey

A special committee of the Radio Technical Commission for Marine Services (RTCM) reported on a survey of marine radio usage and outlined principal abuses in five areas: 1) unnecessary and over-use of Channel 16 (emergency channel), 2) unnecessary and overlong conversations, 3) use of incorrect or improper channel, 4) interruption of other traffic with non-emergency calls, and 5) faulty identification and use of call signs. The survey report focused mainly on VHF/FM which will replace medium frequency double sideband transmission as of January 1, 1977. ■

Tuner Service Corporation



One Year Guarantee

$10.95 U.S.A. ONLY

Major Parts and Shipping Charged at Cost

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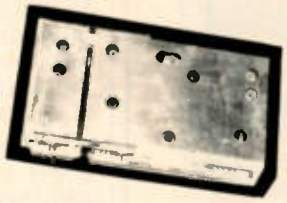
TSC has been repairing private brand TV modules for over 2 years.

Expanded facilities now include modules for

- RCA
- GE
- ZENITH
- W. T. GRANT
- J. C. PENNEY
- WESTERN AUTO
- GAMBLES

as well as Zenith IF subchassis.



For free Price List and complete information write or phone;
TSC HEADQUARTERS, BLOOMINGTON, IND.
or any of the TSC locations listed below.

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

REPAIR

VHF OR UHF ANY TYPE ..... (U.S.A. ONLY) **$10.95**
UHF/VHF COMBINATION ..... (U.S.A. ONLY) **$17.95**

MAJOR PARTS AND SHIPPING CHARGED AT COST.

- Fast, efficient service at our conveniently located Service Centers.
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REPLACE

UNIVERSAL REPLACEMENT TUNER $13.95 (U.S.A. ONLY)

- This price buys you a complete new tuner built specifically for this purpose.
- All shafts have a maximum length of 10½" which can be cut to 1½".
- Specify heater type parallel and series 450mA. or 600mA.

CUSTOMIZE

- Customized tuners are available at a cost of $14.95 and up (U.S.A. ONLY).
- Send in your original tuner for comparison purposes to any of the Centers listed below.

SAME DAY SERVICE — ONLY ORIGINAL FACTORY PARTS USED

TSC

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ALABAMA	BIRMINGHAM, ALABAMA 35212	5623 1st Ave., N.	Tel. 205-592-9150
CALIFORNIA	NORTH HOLLYWOOD, CALIF. 91601	10654 Magnolia Boulevard	Tel. 213-769-2720
	MODESTO, CALIF. 95351	123 Phoenix Avenue	Tel. 209-521-8051
	SAN MATEO, CALIF. 94402	600 S. Amphlett Blvd.	Tel. 415-348-3292
FLORIDA	TAMPA, FLORIDA 33606	1505 Cypress Street	Tel. 813-253-0324
	FT. LAUDERDALE, FLA. 33309	3516 N.W. 10th Avenue	Tel. 305-566-4882
GEORGIA	ATLANTA, GEORGIA 30310	646 Evans Street S.W.	Tel. 404-758-2232
ILLINOIS	SKOKIE, ILLINOIS 60076	5110 West Brown Street	Tel. 312-675-0230
	URBANA, ILLINOIS 61801	908 E. Main St.	Tel. 217-384-2052
INDIANA	INDIANAPOLIS, INDIANA 46204	142 West St. Clair Street	Tel. 317-632-3493
KENTUCKY	LOUISVILLE, KENTUCKY 40205	2244 Taylorsville Rd.	Tel. 502-452-1191
LOUISIANA	SHREVEPORT, LOUISIANA 71104	2423 Southern Avenue	Tel. 318-221-3027
MASSACHUSETTS	SPRINGFIELD, MASSACHUSETTS 01108	405 Dickinson Street	Tel. 413-788-8206
MISSOURI	ST. LOUIS, MISSOURI 63132	9577 Page Avenue	Tel. 314-429-0633
NEVADA	LAS VEGAS, NEVADA 89102	1412 Western Avenue	Tel. 702-384-4235
NEW JERSEY	TRENTON, NEW JERSEY 08638	1139 Pennsylvania Avenue	Tel. 609-393-0999
	JERSEY CITY, NEW JERSEY 07307	547-49 Tonnele Ave., Hwy. 1 & 9	Tel. 201-792-3730
NEW YORK	ROCHESTER, NEW YORK 14615	37 Pullman Ave.	Tel. 716-647-9180
NO. CAROLINA	GREENSBORO, NO. CAROLINA 27405	2914 E. Market St.	Tel. 919-273-6276
OHIO	CLEVELAND, OHIO 44109	4525 Pearl Road	Tel. 216-741-2314
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CANADA	ST. LAURENT, QUEBEC H4N-2L7	305 Decarie Boulevard	Tel. 514-748-8803
	CALGARY, ALBERTA T2H-1Y3	P.O. Box 5823, Stn. "A"	Tel. 403-243-0971

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If you want to branch out into the TV Tuner Repair Business write to the Bloomington Headquarters about a franchise.

...for more details circle 124 on Reader Service Card

TECHNICAL LITERATURE

The Impending Ban On Fluorocarbons in Aerosols is discussed in a new pamphlet titled "The Ozone Layer vs. Your Television Set," available now from Tech Spray. The booklet reports on the use of the fluorocarbon-propelled aerosols used in the electronic service industry and suggests that a proposed ban would cost the industry about a billion dollars a year. If the ban is imposed, an exclusion for electronic service use is recommended by the report. Available free from *Tech Spray*, Box 949, Amarillo, Texas 79105.

Speakers, Horns, Drivers and Microphones are illustrated and described in the new 1977 catalog from University Sound. The 16-page catalog contains information on life-safety speakers, explosion-proof speakers, column speakers, horns, multiduty speakers and underwater and weatherproof speakers. Technical aids are included. Available free from *University Sound*, 1515 S. Manchester Ave., Anaheim, California 92803.

CB Service And Test Instruments for the professional servicers are pictured and described in the new full-color folder from Hickok Instruments. The literature covers the firm's new Model 388 CB In-line tester which provides digital read-out of frequency, power output, standing-wave ratio, and percent of modulation. Also included in the folder are descriptions of the Model 256 CB/RF generator, the model 244 Mobil/comm power supply, frequency counters, and the model 270 function generator. The folder is free from *Hickok Electrical Instrument Co.*, 10514 Dupont Avenue, Cleveland, Ohio 44108.

Transformer Products which meet virtually every transformer and filter requirement for military and industrial use are described in an extensively revised 84-page catalog from TRW/UTC. The book is divided into five sections—audio transformer and inductors, power transformers and inductors, pulse transformers, high Q inductors and electric wave filters. The sections contain technical information, photos, drawings, charts and graphs and explanation of product terms and theory. Catalog 771 is available free from *TRW/UTC Transformers*, 317 N. McLewsen St., Kinston, N.C. 28501.

CB Automotive and Appliance Noise Filters are described in the new selector guide from Cornell-Dubilier.

Basic definitions and applications are presented plus descriptions of the complete CDE line of alternator/generator filters, co-axial feed-thrus, L-C tuned filters, appliance filters and low pass TV filters. Also described are the firm's heavy duty rotors for base station use. Free from Mr. Wm. Carlson, *Cornell-Dubilier,* 150 Avenue L, Newark, N.J. 07101.

CB Interference from automobile engines and CB Base Station interference with nearby TV, FM and stereo sets is discussed in detail in the 12-page booklet, "The CB Noise Story." The new second edition, which also introduces the firm's Emi-Line radio interference control filters, is available free from *Marine Technology*, 2780 Temple Avenue, Long Beach, California 92660.

Electronic Test Accessories, from IC test clips to universal testing harnesses are described and pictured in the new 75 page catalog from ITT Pomona Electronics. In addition to a broad line of off-the-shelf test accessories, specialization items such as molded patch cords, molded test leads, connecting leads and special design accessories are described in the catalog. Prices are included. Available free from *ITT Pomona Electronics*, 1500 East Ninth St., Pomona, Calif. 91766.

A Catalog Of Hard-to-Find Tools is offered now by Jensen Tools. It describes over 2,800 tools of particular interest to scientists, engineers, electronic technicians and instrument mechanics working on fine assemblies. Included is technical data on tool selection, known as "Jensen Tool Tips." Available free from *Jensen Tools and Alloys*, 4117 No. 44th St., Phoenix, AZ 85018.

A Solid State Replacement Guide that cross references more than 112,000 domestic and foreign solid-state devices which can be replaced by 313 RCA SK semiconductors is now available from RCA. The guide also features an index of RCA SK-Series semiconductors and accessories and application information. SPG-202S costs $1.00 at RCA distributors, or from *RCA Distributor & Special Products Division,* P.O. Box 85, Runnemede, N.J. 08078.

Circular Connectors, that were designed originally for aircraft but are now used in other electronic applications, are described in a new 32-page brochure from ITT Cannon. Brochure MS-20 describes MS connectors including general purpose, quick disconnect, pressured bulkhead, environment-resistant, potting ER connectors and high temperature and hermetically-sealed connectors. Free from *ITT Cannon Electric,* 666 East Dyer Road, Santa Ana, California 92702.

Power Transistors are listed and described in a new 16-page catalog from Lansdale Transistor & Electronics, Inc. The booklet—Catalog No. 101—provides both single and quantity prices on 260 germanium transistors plus mounting kits. It includes a selector guide for quick selection of power alloy transistors with 3A to 60A ratings, diffused base power transistors with 10A to 60A ratings and low current transistors for audio amplifier and switching applications. Available free from *Lansdale Transistor & Electronics, Inc.,* 600 West 24th Street, Tempe, Arizona 85282.

A Replacement Guide & Catalog For Semiconductors, with almost 106,000 types listed, has been issued by GTE Sylvania. Included in the new 220-page catalog are descriptions, circuit drawings, and a cross-reference guide to transistors, diodes and rectifiers, SCR's, TRIAC's, special purpose devices, quartz color oscillator and burst filter crystals, modules and integrated circuits, and accessories. The new catalog is now available at *GTE Sylvania* distributors, or *GTE Sylvania Advertising Services Center,* 70 Empire Drive, West Seneca, N.Y. 14224.

Tools & Equipment For Electronic Service are fully described and illustrated in the latest discount mail-order catalog from Fordham Radio Supply. This 1977 catalog is tailored for use by radio/TV servicemen, electronic technicians, CB users and hobbyists. Included are test equipment, CB equipment, tools, service and repair kits, tubes, phono cartridges and needles, speakers and microphones, antennas, components and many servicing aids of various major manufacturers. All products are shown with discounted prices and an ordering form is included. Available free from *Fordham Radio Supply Co.,* 855R Conklin St., Farmingdale, N.Y. 11735.

CB Antennas and Accessories are pictured and described in full color in the latest catalog from Antenna Specialists. The booklet contains complete information about the firms base station CB antennas, mobile antennas, mounting hardware, and the Ascom line of antenna matchers, external speakers, three-way meters, and speech processors. Available free from *The Antenna Specialists Co.,* 12435 Euclid Avenue, Cleveland, Ohio 44106. ■

What Servicers Say About TV Warranty Servicing: An ET/D Special Report

By Don W. Mason, Managing Editor, ET/D

Benefits And Problems

What is the chief benefit you derive from doing in-warranty servicing?

It increases my out-of-warranty business	80%
I'm a sales-and-service dealer, and my dealer agreement with the manufacturer requires that I do in-warranty service	15%
We make a profit	5%

What is the most troublesome aspect of in-warranty service?

The large amount of paperwork	50%
The lack of profit	10%
The long wait for payment of invoices	10%
The non-profit "educational" house calls	10%
Exchanging parts with the manufacturer/distributor	10%
We have no significant problems with in-warranty servicing	15%

*Percentages for each question exceed 100% because of multiple answers

"We make a profit because we get the same price for our in-warranty work as we do for out-of-warranty service."

■ Profit is most certainly *not* the incentive for doing TV warranty servicing, according to a survey of TV service shop owners from all parts of the United States. The majority are in the warranty service business as a means to an end—the end being more customers for their more profitable "out-of-warranty" servicing.

This representative group consists of 20 full-time service shops across the country, selected at random from the ET/D readership. We surveyed the group to get a better picture of the current state of TV warranty servicing, and to learn what their attitudes are on the benefits of being an authorized warranty service station.

Why Do They Do It?

Of those interviewed, 80% said they have taken on warranty service to increase their out-of-warranty business. Some of the servicers who also sell TV (55% of those queried) said they have to perform warranty service as a condition of their sales contract with the manufacturer.

Only one service shop owner, Jack Lang, owner of Lang Electronics, Reno, Nevada, said that TV warranty servicing is profitable. When asked what was the chief benefit of doing warranty service work, Lang replied, "We make a profit because we get the same price for our in-warranty work as we do for out-of-warranty service."

The prevailing attitude with most shop owners interviewed is that in-warranty servicing is a necessary evil—it is not economically feasible by itself—and only a few expressed any amount of enthusiasm for the benefits of warranty servicing.

Henry Yerby, owner, Yerby Radio & TV, Jackson, Michigan, said, "In the beginning when we were first getting established in this area, we did TV warranty work to get new customers. The manufacturers told us that by doing warranty work we would get all the out-of-warranty business, but this has proven to be not quite true. I know we get a fair amount, but too often when the warranty runs out, and the customer has to pay out of his own pocket, he goes to some 'friend' who is in the TV service business."

The problem of warranty customers going elsewhere after the warranty period ends was also described by Ralph Harris, owner of Ralph's TV Clinic in Monohan, Texas. However, Harris says that the advent of modules has changed that situation for him. "Before modules, my experience was that when a customer's TV warranty ran out," Harris stated, "the customer carried his TV to someone else for service. But now, with the only stock of replacement modules in this area, I get 95% of all Quasar TV service business."

The concept that in-warranty service actu-

Products And Income

For which home entertainment products do you provide in-warranty servicing?

Television (weighted by selection of known TV servicers)	100%
Radios and Audio Products	50%
Citizen Band Radio	20%
Appliances	5%

What is your approximate total income from all in-warranty servicing?

Lowest annual income reported	$600
Highest annual income reported	$20,000
Average Income	$5,344
Median Income	$1,500

What percentage of your total annual service income comes from in-warranty service work?

Lowest percentage	.05%
Highest percentage	100%
Average of all shops reporting	28%
Median percentage	10%

ally begets non-warranty service was called 'hypothetical' by Kenneth Duncan, service manager, Green's TV in Antioch, California. "The thing I wonder about," said Green, "does the after-warranty work we get compensate for the money we lose while doing the in-warranty work?"

A slightly different attitude and approach to in-warranty servicing was cited by Bill Tobin, owner, Bill's Electronics, Chico, California. "Warranty servicing can be profitable. We do service only for TV dealers who don't have their own service department," Tobin said, "and we do nothing but warranty work. This allows us to operate without advertising and with as low an overhead expense as we can possibly have. In fact," Tobin said, "we don't even have a store front."

What Bothers Them Most About Warranty Servicing

When asked what was the most troublesome aspect of warranty servicing, 50% of the shop owners complained about the excessive amount of paper work involved in making out warranty labor invoices, and in ordering and exchanging replacement parts. Several of the servicers did say that some of the manufacturers recently have been making efforts to reduce the paperwork problem. For example, Gene Fayollat, service manager for Tri-County TV Sales and Service in Troy, Illinois, in citing paperwork as a drawback, said "But most of the companies we deal with have cut down on the paperwork involved, and that's a great improvement over the 15 copies of everything that Philco used to require. So I would say that as for paperwork, things are looking up."

The small—or non-existing—profit derived from warranty work was mentioned by 10% of the shop owners, with another 10% citing the long wait—sometimes 60 and 90 days—for payment of warranty labor invoices.

The non-profit "educational" home calls for customers who haven't been properly briefed by the dealer on how to operate their newly purchased TV was mentioned by 10% of the shop owners, while 10% mentioned the problems involved in the exchange of warranty parts.

Three of the servicers queried (15%), said they had no big problems with warranty work. (Because several respondents mentioned more than one problem, our percentages add up to more than 100%.)

How And What They Get Paid For Their Warranty Service

Annual income derived from TV warranty servicing varied greatly among the 20 shops in our survey—all the way from $600 to $20,000. The average annual TV warranty income was $5,344, but because of the wide range of answers, the median annual warranty labor income of $1500 is probably more representative of the average shop doing warranty work.

The shop owners were also asked what percentage their warranty work was of their annual overall volume of all TV service, both warranty and non-warranty work. The average percentage was 28%, but again, because of the wide range of answers from less than 1% to 100%, the median figure of 10% is probably more representative.

We also asked the servicers who they dealt with in the warranty set-up, the manufacturer or distributor. Seven of the shop owners, or 35% of those queried, said they dealt with the regional distributor, 6 owners (30%) said they dealt directly with the manufacturer, and 7 (35%) said they dealt both with distributor and the manufacturer, depending on the brand of TV involved.

With 90% of the shops surveyed, warranty labor reimbursement is based on the manufacturer's flat-rate schedule of charges. Two shop owners (10%) said they were able to charge for warranty work on a straight, time-expended, hourly shop rate. (Both are warranty service stations for Western Auto's line of Tru-tone TV.)

Some, but not all, of the manufacturers who reimburse warranty service labor on a flat-rate basis are willing to negotiate their warranty labor rates with servicers, usually on an annual basis. Sixty percent of the shop owners surveyed said that they were able to negotiate their warranty labor rates with manufacturers. However, 20% said that one or more of the manufacturers for whom they perform warranty servicing were not willing to negotiate labor rates, and another 20% said that they were able to negotiate only some portions of their labor-rate agreements.

One of the Western Auto warranty servicers, Richard Lucas, owner of Lucas' Television, Ravenswood, West Virginia, in describing his warranty arrangement said, "The Western Auto representative told me to just charge for in-warranty labor at my regular hourly rate and give them 20% off on parts used, and to do a good job and make them look good. Furthermore," Lucas continued, "they have never refused any of the service labor or parts bills I've turned in."

Warranty Policies & Procedures

For your warranty arrangements, do you deal directly with the manufacturer or through his distributor?

Direct with the manufacturer	30%
Through his distributor	35%
We deal with both the manufacturer and his distributor	35%

How do you bill for your warranty labor?

On the basis of the manufacturer's flat-rate schedule	95%
We charge on the basis of time expended multiplied by our regular hourly labor rate	5%

Is the rate of reimbursement for warranty labor negotiable, or is it totally dictated by the manufacturer?

It is negotiable, usually annually	60%
It is dictated by the manufacturer	20%
Portions of our warranty service agreement are negotiable	20%

What percentage of your warranty labor invoices are rejected by the manufacturer?

None of our invoices have been rejected	45%
Average reject percentage of others	6%

The In-Warranty Parts Inventory

Where do you get most of your warranty replacement parts?

From the manufacturer's distributor	55%
Direct from the manufacturer	20%
From both the distributor and the manufacturer, depending on brand	25%

What is your approximate total investment in warranty-related replacement parts?

Smallest investment	$100
Largest investment	$10,000
Average investment	$2,239
Median investment	$1,000

What percentage is your warranty-related parts inventory of your total shop's parts inventory?

Smallest percentage	5%
Largest percentage	77%
Average percentage	31%

Does the manufacturer provide any compensation for your stocking and handling of warranty parts?

Does not provide compensation	65%
Provides some compensation	35%

We asked the other shop owners about the rejection rate for warranty labor invoices. Forty-five per cent of the shop owners said they have never had any invoices rejected by the manufacturer. The remaining 55% of shop owners said that from 1 to 25% of their invoices have been rejected by the manufacturer or distributor, with an average rejection rate of 6%.

Parts Inventory For Warranty Work

An adequate stock of manufacturer's replacement parts is an integral part of TV warranty service, but, according to 80% of the shop owners we interviewed, the manufacturer and/or distributor does not require a specific parts inventory as part of the warranty service agreement. With the increasing use of modules, however, 20% of the servicers said they are now required to carry an adequate supply of the manufacturer's replacement modules.

Subscriptions to the manufacturer's service literature is required, on the other hand, as part of the warranty agreement by 90% of the shops interviewed. Only 10% said they got the literature free, and those shops, again, were the Western Auto warranty service shops. All agreed, pay or free, that service literature was necessary.

Replacement parts, with 55% of the shop owners, come through regional distributors, while 20% get their parts *direct* from the manufacturer. Both the distributor and manufacturer are parts sources for 25% of the shop owners.

The investment in warranty-related replacement parts varies greatly among the 20 shops surveyed, primarily depending on the size and volume of the shop. Dollar investments in warranty parts ranged from $100 to $10,000, with an average investment of $2,239, but, because of the wide range of answers, the median parts-investment figure of $800 is probably more representative. When asked what percentage warranty parts were of their total parts inventory, the surveyed shop owners gave answers ranging from 4 to 77%, with an average percentage of 31%.

Replacement parts installed during warranty service are a totally non-profit venture for most service shops interviewed, and there is no compensation offered by the manufacturers for *handling* warranty replacement parts, according to 65% of the shop owners. Those who do receive some 'parts-handling' compensation (35%) said that such compensation amounts to only 10 to 15% allowance over cost.

None of the warranty servicers get any warranty replacement parts on consignment from the manufacturer or distributor.

Although our survey was conducted primarily to determine the current state of *TV* warranty servicing, we did ask the shop owners if they do warranty servicing on any other types of home entertainment electronic products. Of the 20 owners surveyed, 10 (or 50%) said they also do warranty service of radio and stereo products, 4 (or 20%) handle warranty work on citizen's band radios, and one (or 5%) also has warranty service for home appliances. ■

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MODEL 1040
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You can save $500—$1,500 in equipment costs because the CB Servicemaster eliminates many of the test instruments you would otherwise need for CB servicing. These instruments, or their functions, are built into the unit:

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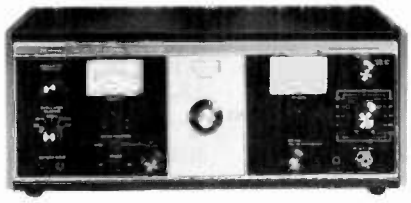

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Covers all 40 channels, AM and SSB with built-in capability. Ultra-stable crystal-controlled, phase-locked-loop frequency generation. Has 5 ppm accuracy. Output attenuator and vernier provide calibrated outputs from 100,000 μV to 0.1 μV for receiver sensitivity measurements. Includes EIA standard noise test signal generator to check receiver noise suppression. Internal 400, 1000 and 2500 Hz modulating frequencies—can also be externally modulated. Internal protection against 5W RF input. **$475**

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Professional Audio Tests & Measurements Using An LF Spectrum Analyzer

By J.W. Phipps

Part 1 of a two-part series which describes how to use a low-frequency spectrum analyzer to evaluate the performance parameters of stereo audio amplifiers

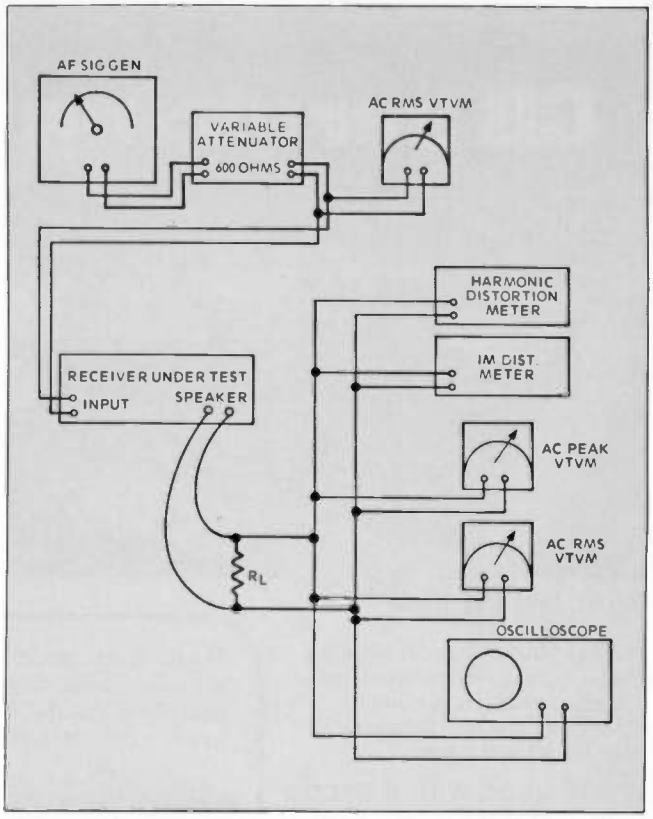

Fig. 1—'Composite' test setup which shows the number and types of test instruments typically required for conventional methods of measuring audio amplifier performance parameters.

■ Most owners of 'medium' and 'high-quality' stereo audio components purchase such higher-price systems because they truly desire 'quality' sound. And because many of these 'audiophiles' *can* tell the difference between 'quality' and 'mediocre' audio, when the performance of their systems deteriorate even slightly, they quickly seek the service of a 'professional' audio servicer—one who is equipped not only to track down and repair 'major' defects which produce readily evident and easy-to-diagnose trouble systems, but who also is capable of ferreting out the causes of more subtle trouble symptoms such as "it just doesn't sound like it used to" or "the highs seem to be distorted."

Tracking down the causes of these subtle changes in quality usually requires accurate measurement of two or more of the following standard amplifier performance parameters:

- Power Output
- Harmonic Distortion
- Intermodulation Distortion
- Frequency Response
- Signal-to-Noise
- Crosstalk
- Sensitivity

Performance of these and other related audio amplifier tests heretofore has involved the purchase and use of specialized test instruments—including a harmonic distortion meter, an intermodulation distortion meter and 'true RMS' and peak-reading AC VTVMs—all of which, as illustrated by the simplified, composite test setup in Fig. 1, must be interconnected and used with more-standard test instruments such as an AF signal generator and an oscilloscope.

Because of the inconvenience of such a test setup and—depending upon the type and quality of the instruments—the somewhat difficult-to-interpret and frequently inaccurate results produced by it, a lot of otherwise well-equipped and highly competent TV service shops have elected to ignore the more-demanding servicing needs of audiophiles, thereby leaving a very profitable segment of the electronic service market to a relatively few 'audio specialty' shops.

THE LOW-FREQUENCY SPECTRUM ANALYZER

However, there *are* more convenient and, in some ways, significantly more meaningful and easier-to-interpret methods of measuring audio amplifier performance parameters than those which employ the setups represented in Fig. 1. These easier methods involve the use of a low-frequency (LF) spectrum analyzer,

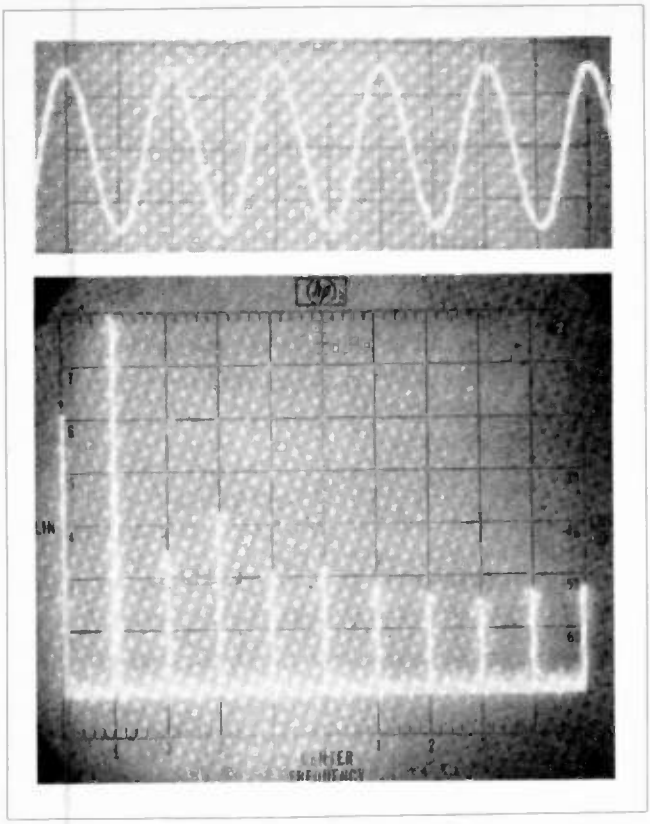

Fig. 2—The seemingly 'olean' sine wave (top photo) displayed by a conventional scope actually contains many harmonics, as revealed by the spectrum analyzer display in the bottom photo. *(Courtesy of TAB BOOKS).*

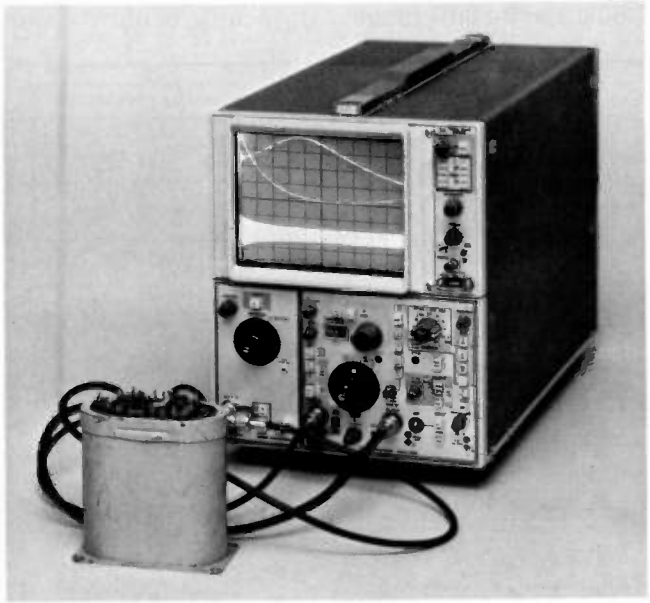

Fig. 3—Tektronix 5L4N Low-Frequency Spectrum Analyzer installed in a 5100-Series CRT Display Mainframe along with a 5A15 vertical amplifier module.

which replaces the harmonic distortion and intermodulation distortion meters in Fig. 1.

For the benefit of those technicians who are not familiar with spectrum analyzers, they basically are instruments in which the output of a swept local oscillator is beat against the fundamental input signal and its harmonics (or sidebands), thereby producing a series of pulses whose amplitudes are directly proportional to the amplitudes of the fundamental and harmonic pulses which created them. When these beat-produced pulses are applied to and displayed panoramically (in 'time' sequence from left to right) on the screen of a properly swept CRT, as shown in the bottom photo in Fig. 2, the *relative positions* of the pulses from left to right will correspond to the frequencies of the 'fundamental' signal and related harmonics which produced them, and the amplitudes (height) of the pulses will correspond to the amplitudes of the fundamental signal and related harmonics.

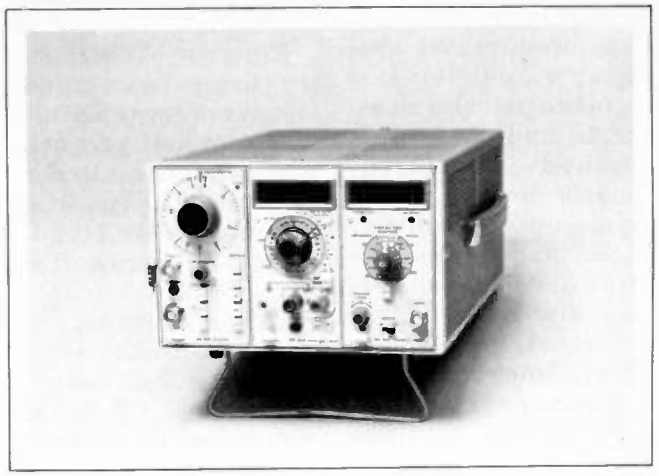

Fig. 4—Tektronix TM-503 'audio test' mainframe equipped with (left to right) SG502 Audio-Frequency Generator, DM502 Digital Multimeter and DC-504 Digital Frequency/Time Counter.

Thus, the spectrum analyzer provides a CRT display which simultaneously reveals the amplitude (voltage or power level) of a test signal after it has been processed by an audio amplifier, *plus* the amplitudes of all significant harmonics of the test signal.

Such harmonics are created by nonlinearity in one or more stages of the audio amplifier and therefore are a direct indication of the degree to which the amplifier distorts signals. This nonlinearity-related distortion in an amplifier is called *harmonic distortion* and usually increases as the level of the amplifier input signal is increased or as the gain of the amplifier is increased.

Consequently, in addition to providing a direct indication of the amount of nonlinearity in an amplifier, harmonic distortion also provides an indication of how much an amplifier can increase (amplify) the level of a signal before it appreciably distorts it. For this reason, the amplifying ability of an audio amplifier—its *rated power output*—usually is expressed in terms of the maximum power (in watts) the amplifier can deliver without exceeding a specified level of harmonic distortion. The allowable level of harmonic distortion usually is specified as a certain percentage of the power output level (or dBs below output power level).

From the preceding, it can be seen that, because the CRT display produced by the spectrum analyzer simultaneously provides a direct indication of the output power of the audio amplifier (amplitude of the displayed pulse whose position corresponds to the fundamental frequency of the test signal) *and* the power levels of all significant harmonics (amplitudes of the pulses whose positions correspond to

the harmonic frequencies) produced at that power output level, it therefore provides an accurate and convenient method of *simultaneously* measuring two prime audio amplifier performance parameters—*harmonic distortion* and *rated power output*—which also are prerequisites to accurate measurement of most other audio amplifier performance parameters.

AVAILABILITY OF A LOW-COST LF SPECTRUM ANALYZER

Although spectrum analyzers which cover the relatively low frequencies involved in audio servicing have been available for some time, most were designed principally for development applications and therefore are too costly for the typical service facility.

However, Tektronix, the Oregon-based manufacturer of electronic test instruments, recently made available a moderately priced LF spectrum analyzer in its plug-in module-type series of test instruments.

This LF spectrum analyzer, the 5L4N, plugs into the Tektronix 5100-Series CRT display mainframe, as shown in Fig. 3. (The other plug-in module in the CRT display mainframe in Fig. 3 is a 5A15 vertical amplifier, which permits the CRT display of the mainframe to also be used as a conventional single-trace scope. Dual-trace vertical amplifier plug-ins also are available.)

An accurate audio-frequency signal generator is the only other test instrument required for audio amplifier performance evaluation and testing with an LF spectrum analyzer. The one employed in the procedures outlined in this article series is the Tektronix SG502, a plug-in module type shown installed in a TM-503 mainframe in Fig. 4, along with two other module-type instruments—a DM502 Digital Multimeter (capable of dBV or dBm readout) and a DC504 Digital Frequency/Time counter—both of which, although not essential for performance of the techniques described in this article series, are nevertheless useful in these and other audio servicing procedures.

'ACCESSORY' ITEMS

The only essential 'accessory' items needed for the techniques described herein are:

- An attenuator with a 0-60 dB or 0-80dB range, for establishment of the correct levels of signals applied to the amplifier input. Two types to consider are the 'potentiometer' type (Fig. 5) and the 'step' type (Fig. 6).
- Non-reactive impedance- and load-matching devices, as subsequently described.

IMPEDANCE-MATCHING & LOAD DEVICES

For accurate measurements, the characteristic input and output impedances of both the amplifier under test and the test instruments used to perform the measurements must be matched as closely as possible.

The power outputs of the amplifier must be applied to a nonreactive (pure resistive) load which matches their characteristic impedance (typically 8 ohms) and

*(*Portions of this article series were adapted from* The Tektronix Cookbook of Standard Audio Tests, *by Clifford Schrock, Copyright 1975, Tektronix, Inc.)*

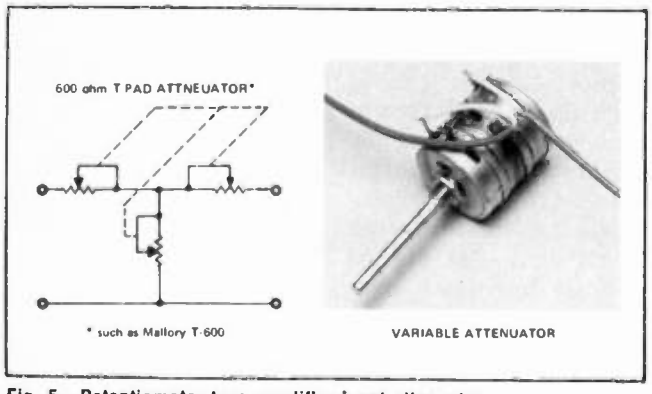

Fig. 5—Potentiometer-type amplifier input attenuator.

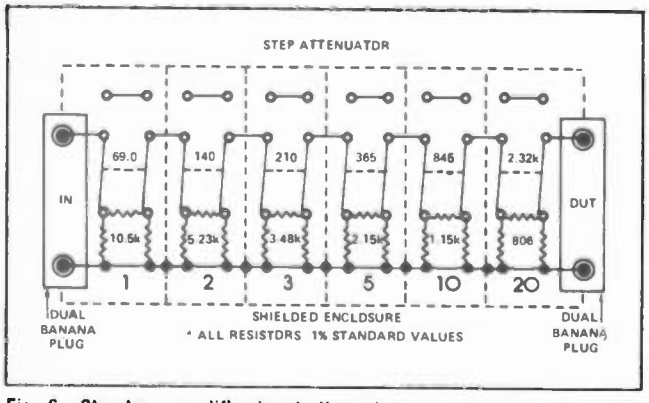

Fig. 6—Step-type amplifier input attenuator.

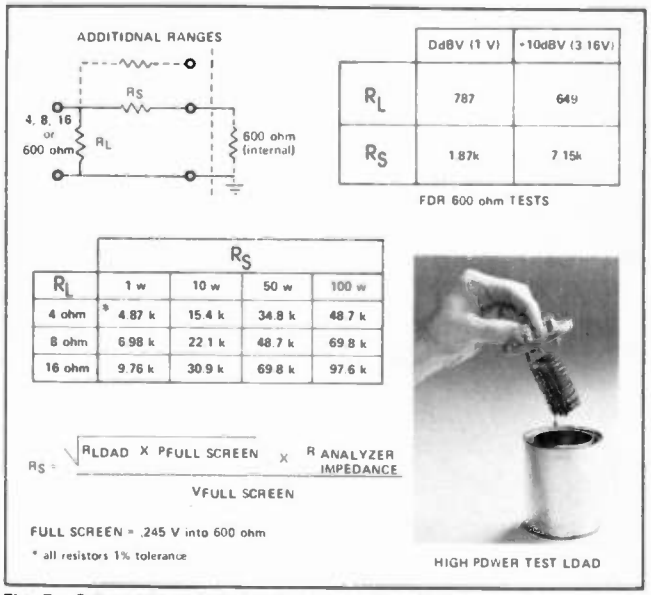

Fig. 7—Schematic and photo of a nonreactive, high-power load for audio amplifiers plus charts of component values for various common output-input impedances and power levels.

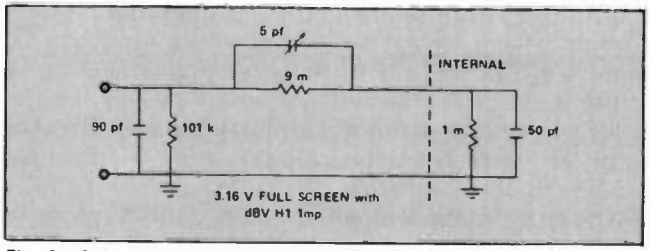

Fig. 8—Schematic of device for matching signal generator output impedance to preamplifier input impedance.

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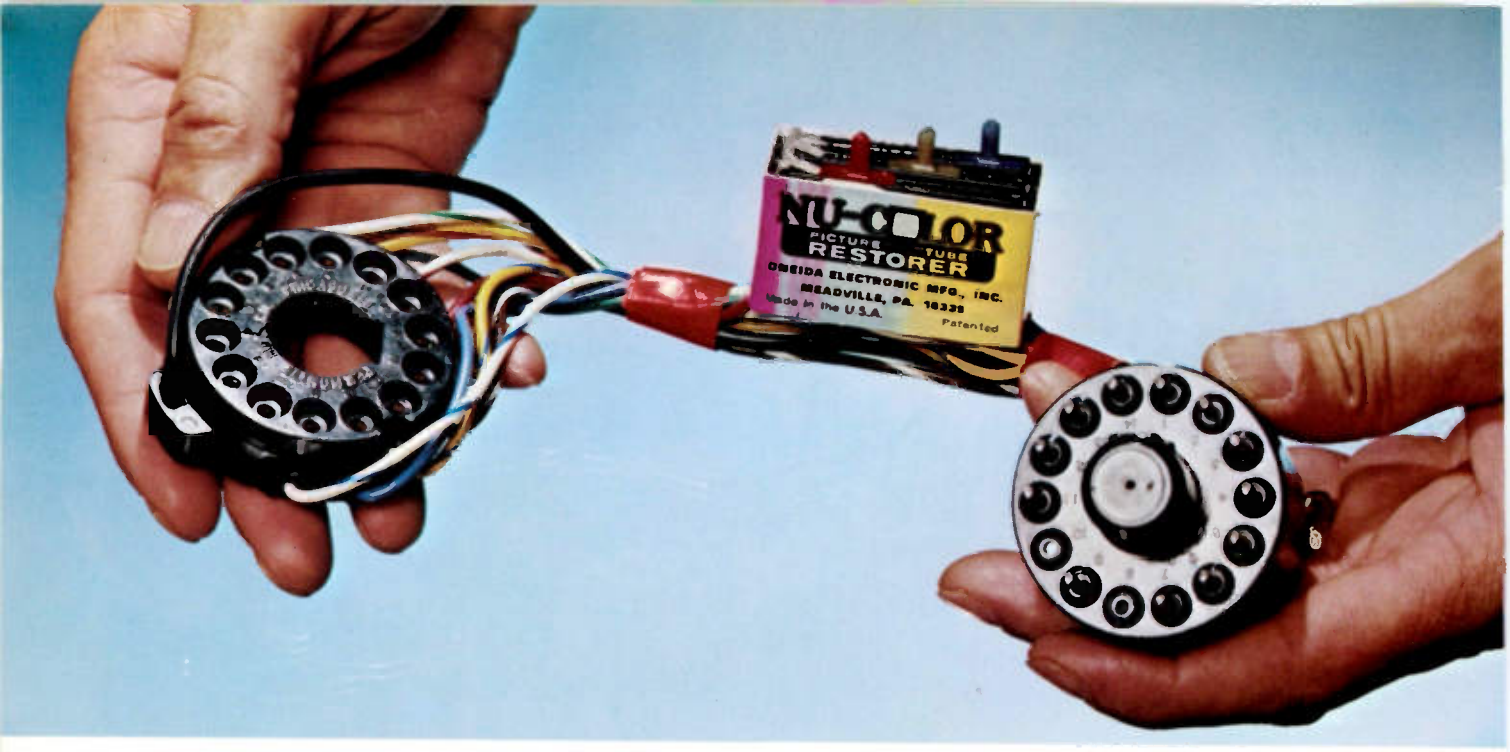

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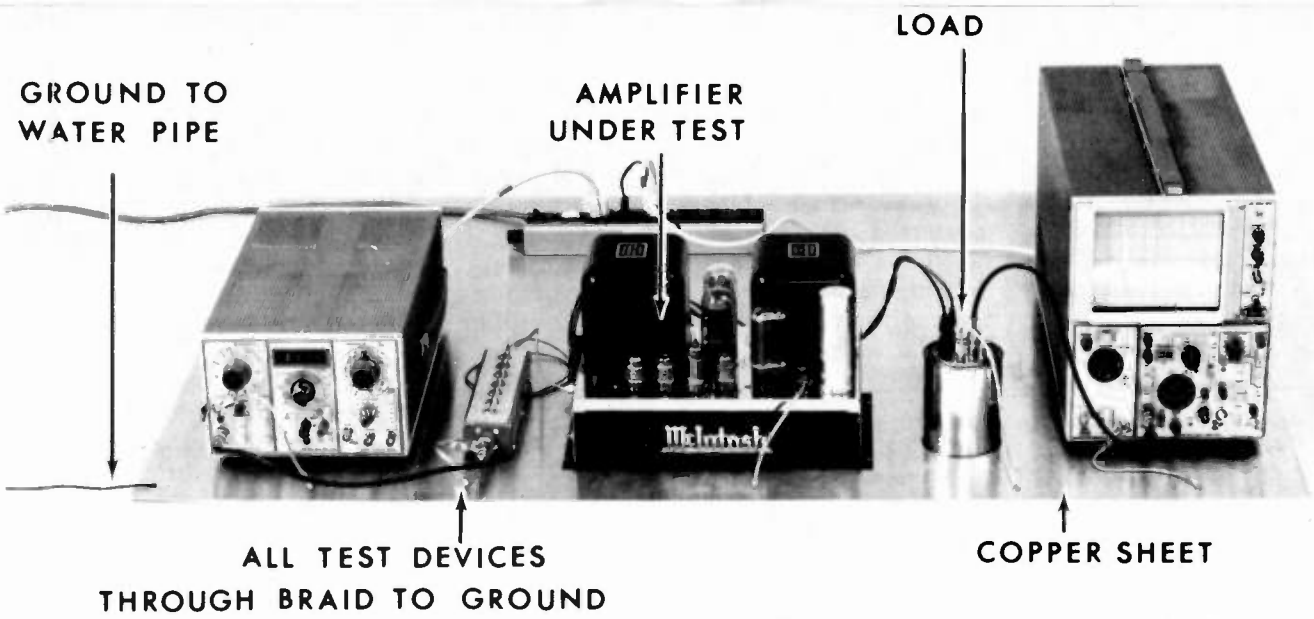

Fig. 9—Typical test setup for measuring audio amplifier performance parameters with a spectrum analyzer. Copper sheet on bench top and grounding straps help prevent external interference.

which is capable of dissipating the maximum power produced by the amplifier. The output of the load device, in turn, must be matched to the input impedance of the measurement device—in this case, the 600-ohm input impedance of the spectrum analyzer. The schematic and photo of an accurate, nonreactive, high-power load device are shown in Fig. 7, along with charts of the values of RL and RS required for typical amplifier output (RL) and measurement device (RS) impedances to be matched.

If large-wattage nonreactive resistors are not available, the required wattage rating for RL can be achieved by constructing it out of suitable values of 1- or 2-watt carbon resistors connected in parallel. Also, as illustrated in the photo in Fig. 7, the load device should be constructed so that it can be immersed in oil during operation, for adequate heat dissipation.

The output of the signal generator should be applied to the amplifier input(s) in series with an impedance equal to the *source* impedance for which the amplifier was designed. The 'preamplifier' inputs of an audio amplifier typically should 'see' a 100-Kohm, slightly capacitive impedance, such as the matching device in Fig. 8 would provide. The auxiliary inputs of audio amplifiers typically should be fed in series with a resistance of 5K ohms (±5%).

The inputs of all undriven channels should be terminated in their appropriate source impedances, as previously described.

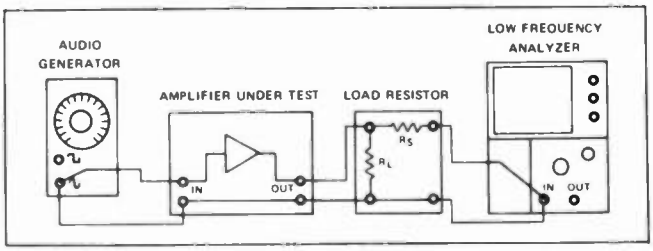

Fig. 10—Functional diagram of test setup for measuring audio amplifier power and distortion with a spectrum analyzer.

INTERFERENCE PRECAUTIONS

High-level RF fields

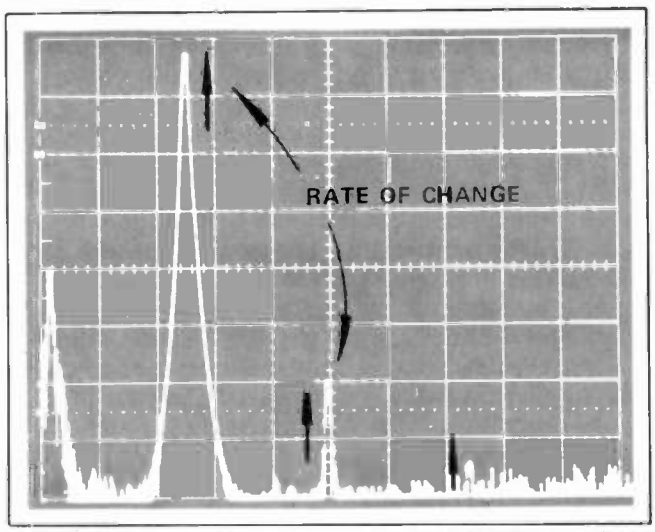

Fig. 11—CRT display with spectrum analyzer in 10 dB/DIV mode. Highest amplitude pulse with arrow is produced by fundamental 1-KHz test signal. The two smaller pulses with arrows beside them are produced by 2nd and 3rd harmonics of test signal (from left to right). Other low-amplitude pulses are higher-order harmonics and noise.

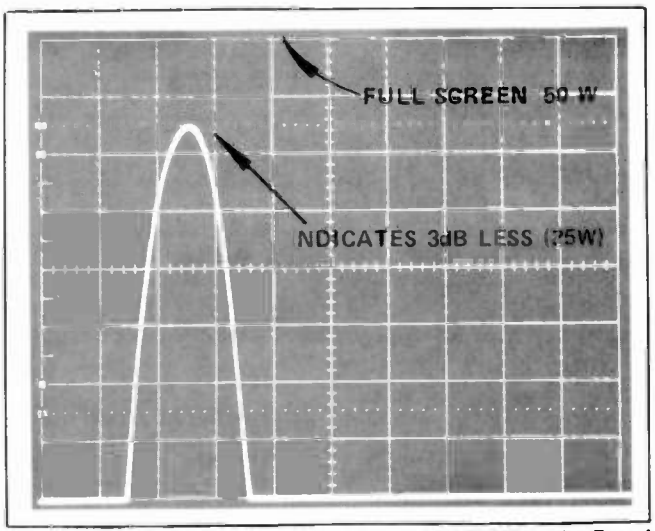

Fig. 12—CRT display with spectrum analyzer in 2dB/DIV mode. Top of graticule is 50 watt level. Fundamental pulse (output of amplifier channel) is 3 dB down from full-screen level; therefore RMS power output of amplifier channel is 50% of 50 watts, or 25 watts. (– 3 dB is equivalent to 50% reduction of power level.)

from local radio or TV transmitters can interfere with the low-level signal measurements involved in audio tests. To avoid such interference, all equipment should be well shielded and grounded during testing. As illustrated in Fig. 9, use a copper sheet or other suitable conductive material for the top of the test bench and ground all equipment through short pieces of copper braid, to the copper sheet.

An AC live filter is also recommended. (Try reversing the AC plugs of all equipment to obtain minimum hum.)

Whenever tests procedures permit it, perform measurements with amplifier input signal levels about 30 dB above the measured (or specified) reference sensitivity of the amplifier and use the preamplifier volume control to establish the specified reference output power.

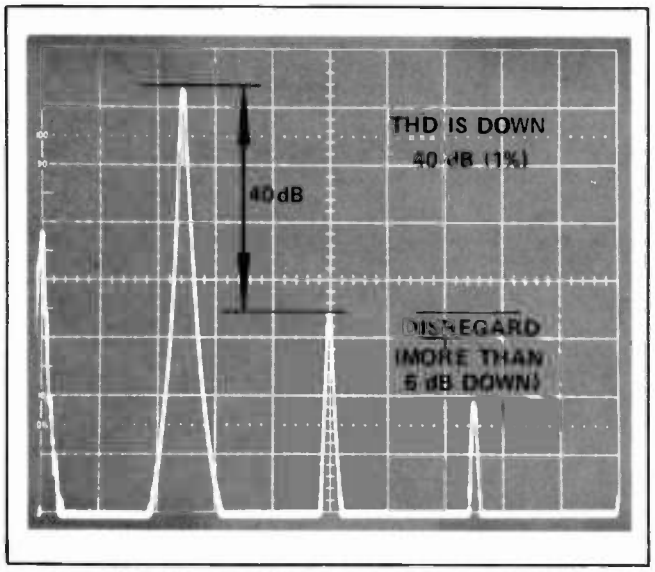

Fig. 13—CRT display with spectrum analyzer in 10 dB/DIV mode. Pulse representing 2nd harmonic is 40 dB below fundamental pulse and 3rd and higher harmonic pulses are 6dB or more below 2nd harmonics. Therefore, difference (in dB) between amplitudes of fundamental and 2nd harmonic pulses can be used to compute % of total harmonic distortion (THD). dB- % chart in Fig. 14 indicates 40 dB difference is THD of about 1%

RATIO in dB	% of READING	RATIO in dB	% of READING
20. (40;60)	10% (1% .1%)	30 (50,70)	3.16% (.31,.031%)
21	8.9	31	2.87
22	7.94	32	2.51
23	7.08	33	2.24
24	6.31	34	2.00
25	5.62	35	1.78
26	5.01	36	1.59
27	4.47	37	1.41
28	3.98	38	1.26
29	3.55	39	1.12

Fig. 14—Chart for converting dBs to %THD reading.

POWER OUTPUT & HARMONIC DISTORTION MEASUREMENTS

Now that we've gotten the 'preliminaries' out of the way, let's examine the general procedures involved in using the spectrum analyzer to measure the power output and harmonic distortion of an audio amplifier. The test setup for these measurements is illustrated in Fig. 10.

To accurately determine whether or not an audio amplifier is capable of delivering *rated* power output (that specified by the manufacturer) you must duplicate the following operating conditions under which the manufacturer measured the power:

- The impedance into which the amplifier was operating
- The number of channels being driven
- The length of time and the power level at which the amplifier had been operating prior to the measurement
- The frequency (or frequencies) and level(s) of the test signal(s) applied to the amplifier
- The amount of permissible total harmonic distortion (THD).

Unfortunately, prior to November 1974, these operating conditions were not always spelled out by manufacturers and, further compounding the problem, rated power output was often stated in terms which are not directly translatable into a value that can be measured by a service shop. For example, *instantaneous peak* (IP) power and *music power* are terms which describe power levels obtained either by holding supply voltages at an artificially constant level or by making the power measurement over a very short operating period (before the power supply is loaded down).

However, in November 1974 the Federal Trade Commission (FTC) enacted a regulation which requires manufacturers to state rated power output in specific RMS values per channel and to specify the operating (THD and test frequencies) conditions under which the rating was obtained. Consequently, the rated power specified for audio amplifiers sold after November 1974 can be accurately measured and evaluated by operating all channels of the amplifier at one-third of rated power with a 1000-Hz tone applied for one hour prior to the tests and then, with both channels driven, measuring the constant RMS output power of each channel for at least 30 seconds.

Spectrum analyzer techniques for measuring the constant RMS power output and total harmonic distortion (THD) of each channel of a stereo amplifier with all channels driven are:

1) Select from the chart in Fig. 7 the combination of RL/RS which meets the output-impedance/load requirements of the amplifier under test and connect them to the output terminal of each channel

2) Interconnect the amplifier and test instruments as shown in Fig. 10. (The generator output should be applied to the preamplifier inputs of all channels through appropriate impedance-matching devices like those in Fig. 8.)

3) Set all amplifier tone controls to their flat-response positions and set the volume control(s) to maximum

4) Set the analyzer to the 10dB/DIV display mode and connect it across the output load of one channel

5) Select the 1-KHz output from the signal generator and slowly increase the generator output level until the pulse corresponding to this

continued on page 43

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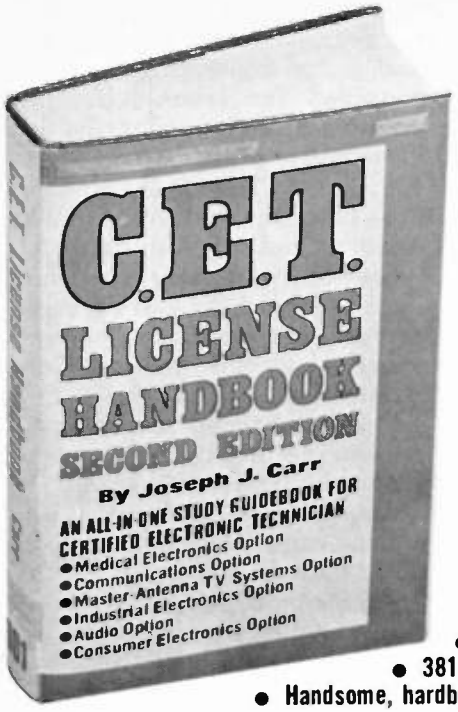

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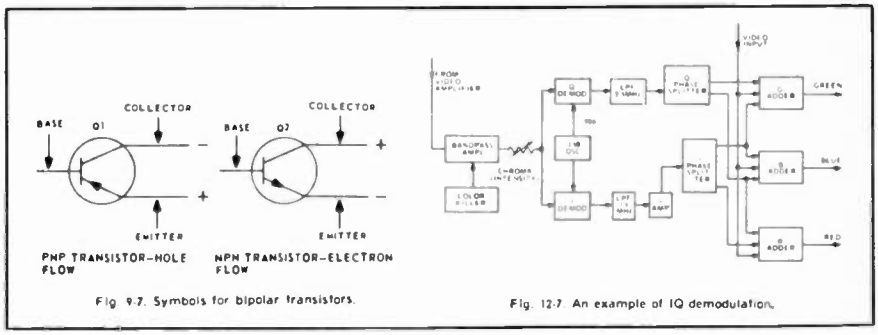

Fig. 9-7. Symbols for bipolar transistors.

Fig. 12-7. An example of IQ demodulation.

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Sencore's Model CB42 CB Analyzer—A Special Feature-Length Look At This Unique, Multi-Function Test Instrument

By J. W. Phipps

■ The cost- and space-saving advantages inherent in today's state-of-the-art microelectronic technology have made it possible for test instrument manufacturers to design and build test instruments which not only are smaller, more rugged, less costly and more accurate, but which also are easier to operate and interpret.

Relatively recent advances in microelectronic technology also have made it possible to combine two or more related measurement and/or signal-generating functions in one compact, multi-function test instrument which, in many cases, is significantly less costly than the discrete, single-function instruments it replaces. And, because many such multi-function test instruments incorporate switch-controlled, internal interfacing between functional sections, they significantly reduce or eliminate the 'rats nest' of interconnecting wiring and impedance-matching devices typically involved in multi-instrument test setups. This means easier, quicker and more accurate tests and measurements—which, in turn, mean increased technician productivity and, therefore, increased profits.

Sencore's Model CB42 CB Analyzer is an excellent example of such multi-function test instruments. It weighs but 24 lbs., is only 11 inches high by 14 inches wide by 11 inches deep, and costs only $895. Yet, it is capable of performing nearly all of the measurement and signal-generating functions required for troubleshooting, aligning and measuring the performance parameters of 23- *and* 40-channel Class-D CB transceivers—both conventional double-sideband and single-sideband AM types—and with accuracies which meet or exceed Class-D CB transceiver performance criteria specified by the Federal Communications Commission (FCC), as well as related measurement criteria specified by the Electronic Industries Association (EIA).

Measurement and signal-generating capabilities built into the CB42 include:

- *RF signal generation* (all 40 FCC-specified CB channel carrier frequencies, plus upper and lower sideband frequencies)
- *IF signal generation* (the entire CB IF spectrum, 375 KHz - 12 MHz)
- *Audio signal generation* (three EIA standard test frequencies: 400 Hz, 1000 Hz, and SSB two-tone 500 Hz/2400 Hz)
- *Frequency measurement* (digital readout of all frequencies between 50 Hz and 50MHz, at a rated accuracy 50 times better than that specified by the FCC, plus direct digital readout of % by which channel carrier or sideband frequency deviates from that specified by FCC)
- *RF power measurement* (digital readout of levels between 0 and 20 watts, average AM carrier or SSB PEP)
- *Audio power measurement* (digital readout of levels between 0 and 10 watts, calibrated to read RMS)
- *Percentage-Of-Modulation measurement* (digital readout of % of positive modulation from 0-200% and negative modulation from 0-95%)

Supplementing the preceding 'primary' measurement and signal-generating capabilities of the CB42 are a number of other built-in or plug-in features which further simplify CB servicing. Included among these 'auxiliary' features are:

- A built-in 50-ohm RF load capable of handling 20 watts of RF power
- Built-in, switch-selectable 4-, 8- and 16-ohm audio loads capable

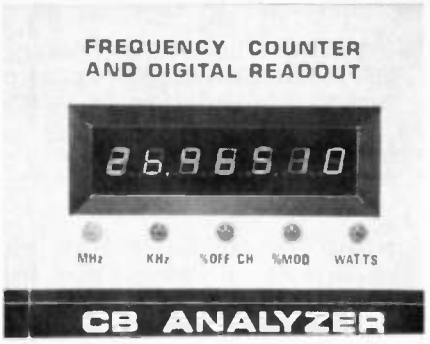


Fig. 1—Auto-ranging, 7-digit, LED digital display provides readout of all CB transceiver characteristics measured by CB42, plus frequencies of RF and IF signals generated by CB42.

Fig. 2—'DIGITAL READOUT SELECTOR' switch of CB42 determines which CB transceiver characteristic is to be measured and read out by digital display. In addition, 'RF-IF' position of switch provides readout of internal generator output frequency.

Fig. 3—Eight-position 'RF-IF GENERATOR' switch of CB42.

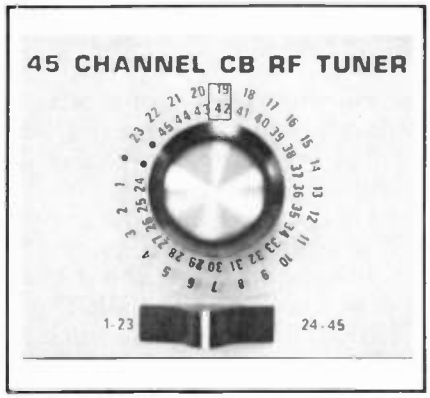


Fig. 4—Detent-type channel-selector switch of CB42 and two-position band-selector switch below it determine which of 40 CB RF carrier frequencies RF/IF generator of CB42 produces.

of handling 10 watts RMS of audio power

- A built-in 'Scope Adapter' circuit which reduces the frequency of a transmitter's RF output signal to corresponding frequencies in the 40-480 KHz range, thereby permitting the transmitter output signal to be viewed on the screen of any general-purpose scope with a vertical bandwidth of at least 1 MHz
- A plug-in 'Dynamic Mike Tester' which makes it possible to feed the audio output of the CB42 directly into the microphone of the transceiver under test, thereby providing a 'performance' test of not only the mike but also the entire 'modulating' system of the transmitter. The 'Dynamic Mike Tester' also can be used to 'substitute test' a suspected defective speaker.
- A built-in, pushbutton-operated 'EIA receiver sensitivity' feature which reduces the sensitivity of the audio wattmeter by 10 dB, thereby eliminating the need for a decibel-reading meter for performance of EIA receiver sensitivity tests.
- Built-in provisions for operation from either a standard 115 VAC source or from a 12 VDC (negative ground) source capable of delivering 1 amp of continuous current. The CB42 is equipped with two power cords: one with a standard three-prong plug, for AC power, and one with a plug that inserts into any automotive cigarette lighter socket, for operation from DC.

DIGITAL READOUT OF ALL MEASUREMENTS

All transmitter and receiver characteristics measured by the CB42 are displayed on an auto-ranging, 7-digit, light-emitting diode (LED) digital display in the upper right quarter of the front panel (Fig. 1).

The electrical characteristic to be measured and displayed is selected by a nine-position switch labeled 'Digital Readout Selector', situated below and to the right of the digital display (Fig. 2). Five LEDs immediately below the display—labeled 'MHz', 'KHz', '% OFF CHAN', '%MOD', and 'WATTS'—indicate the type of quantity or characteristic selected for measurement and readout. (The 'MHz' and 'KHz' LED indicators are controlled by the auto-ranging circuitry of the digital counter.)

The nine positions of the DIGITAL READOUT SELECTOR switch and the electrical characteristic measured and displayed in each position are:

- *RF-IF GEN*–Frequency to which the built-in RF/IF signal generator is tuned
- *EXT XTAL*–Fundamental frequency of whatever crystal is plugged into the CRYSTAL CHECK socket (bottom center of front panel)
- *EXTERNAL FREQ/50Ω LOAD*–Frequency of whatever signal is applied to the EXTERNAL FREQUENCY/50ΩLOAD jack (bottom right of front panel)
- *EXTERNAL FREQ/1 MEG LOAD*–Frequency of whatever signal is applied to the EXTERNAL FREQUENCY/1 MEG LOAD jack (bottom right of front panel)
- *% OFF CHAN*–Percentage by which the transmitter RF output signal applied to the EXTERNAL FREQUENCY/50ΩLOAD jack deviates from the corresponding channel carrier or sideband frequency specified by the FCC
- *% POS MOD*–Percentage of positive modulation of the transmitter RF output signal applied to the EXTERNAL FREQUENCY/50ΩLOAD jack. (CB42 determines this by comparison of the positive peaks of the modulation envelope and the average carrier level.)
- *% NEG MOD*–Percentage of negative modulation of the transmitter RF output signal. (Determined by CB42 in same manner as used for positive modulation except negative peaks of modulation envelope are 'sampled'.)
- *RF WATTS*–SSB Peak Envelope Power (PEP) or average AM carrier power of the transmitter RF output signal applied to the EXTERNAL FREQUENCY/50ΩLOAD jack
- *AUDIO WATTS*–RMS power of receiver output signal applied to the SPEAKER SUB jack (bottom right of front panel). (Setting of SPEAKER SUB switch, immediately above the SPEAKER SUB jack, determines which of three built-in audio load impedances the receiver output power is measured across—4, 8 or 16

ohms—or whether it is measured across an 8-ohm external load, as is possible in the 'SPEAKER' position.)

RF/IF GENERATOR

The crystal-controlled RF/IF signal generator built into the CB42 provides a choice of modulated or unmodulated output signals at all RF and IF frequencies and output levels required for servicing both 23- and 40-channel double- *and* single-sideband AM CB transceivers.

The output of the RF/IF generator is available at a 50-ohm BNC-type jack labeled 'RF-IF' in the lower left corner of the front panel.

The seven controls which determine the type, frequency, level and modulation of the generator output signal are grouped together on the left half of the CB42's front panel.

Selection of one of three available types of CB or RF signals—conventional double-sideband (AM), upper single-sideband (USB) or lower single-sideband (LSB)—or one of five available overlapping bands of CB IF signals is accomplished by an eight-position switch labeled 'RF-IF Generator' (Fig. 3).

RF Output

In the three extreme CCW positions of the RF-IF GENERATOR switch—labeled 'LSB', 'AM' and 'USB'—the signal generator operates in the CB RF frequency spectrum (26.965 - 27.405 MHz).

The frequency of the generator RF output signal is selected by a detent-type CB channel-selector switch (Fig. 4), which controls a phase-locked-loop (PLL) tuning system that is preprogrammed to automatically tune the generator to the RF carrier (or sideband) frequency of the selected CB channel. (The PLL tuning system is 'factory programmed' to tune the generator to all 40 CB channels presently authorized by the FCC, with provisions for 'wiring in' five additional channels should the FCC authorize them.)

In the 'AM' position of the RF-IF GENERATOR switch, the generator produces a signal whose frequency is equal to the RF carrier of the selected channel. In the 'LSB' and 'USB' positions, the generator produces an RF signal whose frequency is respectively 1000 Hz *below* the carrier frequency of the selected channel (LSB) or 1000 Hz *above* it (USB).

The 45-position CB channel-selector switch is concentrically calibrated in two bands of CB channels—1-23 and 24-45—which are selected by a two-position, slide-type switch situated immediately below the channel-selector switch (Fig. 4).

As noted previously, the output frequency of the RF/IF generator can be monitored on the digital display by placing the DIGITAL READOUT SELECTOR switch in the 'RF-IF GEN' position.

IF Output

Whenever the RF-IF GENERATOR switch (Fig. 3) is placed in

SPECIFICATIONS AND FEATURES SENCORE MODEL CB42 CB ANALYZER

RF GENERATOR

FREQUENCY: Crystal-controlled, 40 standard Class-D CB channel carrier frequencies (26.965-26.405MHZ), selected with detent-type channel-selector switch of crystal-controlled, digitally programmed phase-locked-loop tuning system. (5 additional CB channels from 27.415-29.985MHz available by additional wiring of channel-selector switch.) Switch-selectable LSB (channel carrier-1000Hz) and USB (channel carrier-+1000Hz) frequencies also available.
ACCURACY: Setability ± .0001% (1 ppm) @ 25° C; temperature stability: 1 ppm/° C; aging: 5 ppm/mo, 10 ppm/year max.; warmup time: 45 minutes for rated accuracy.
MODULATION: Internal AM modulation at 0, 30, or 100% using internal Audio Generator, or external input on rear panel. External input: 4 V P-P required for 100% modulation.
OUTPUT IMPEDANCE: 50 Ω
OUTPUT ATTENUATOR RANGE: .1μV-100,000 μV, in 6 continuously variable steps
OUTPUT PROTECTION: Diode-protected against accidental keying of transmitter
OUTPUT FREQUENCY MONITORING: Can be monitored via built-in digital frequency counter

IF GENERATOR

FREQUENCY: 375KHz-12Mhz, in 5 continuously variable bands
ACCURACY: Same as RF generator
MODULATION: Same as RF generator
OUTPUT IMPEDANCE: 50 Ω
OUTPUT ATTENUATOR RANGE: Same as RF generator
OUTPUT PROTECTION: Same as RF generator
OUTPUT FREQUENCY MONITORING: Can be monitored via built-in digital frequency counter

AUDIO GENERATOR

FREQUENCY: 400Hz, 1000Hz and EIA SSB two-tone (500Hz + 2400Hz)
ACCURACY: ±10%
OUTPUT LEVEL: Variable 0-4 V P-P, AC-coupled into 50 Ω or greater load. Usable into 8 Ω load.

FREQUENCY COUNTER

DISPLAY: 7-digit, 7-segment, LED display, auto ranging. LED "KHz MHz" indicators controlled by auto-range.
RANGE: 50Hz-50MHz (guaranteed), 55MHz (typical)
CRYSTAL ACCURACY: Setability ± .0001% (1 ppm) @ 25° C; temperature stability: 1 ppm/° C; aging: 5 ppm/mo, 10 ppm/year max.; Warmup time: 45 minutes for rated accuracy
INPUT IMPEDANCE: 1 Megohm or 50 Ω, depending on input selected
RESOLUTION: 10Hz
SENSITIVITY: 300MW (50 Ω input, 25 Watts PEP max), 25 mV (1 Megohm input, 50Hz-30 MHz).

CRYSTAL CHECK

METHOD: Series resonant circuit for fundamental crystal frequency, displayed on built-in digital frequency counter
RANGE: 1-20MHz
ACCURACY: Same as Frequency Counter

% FREQ. OFF CHANNEL

METHOD: Displays percent of frequency deviation of transmitter carrier compared to frequency of corresponding channel-carrier output of CB42 RF generator

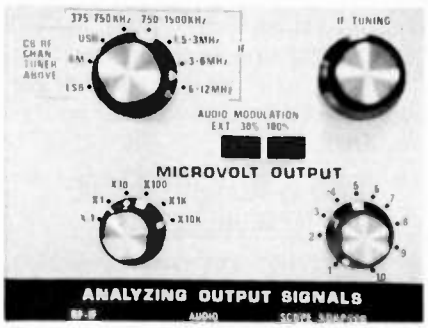


Fig. 5—CB42 RF/IF generator controls which determine: 1) the type of RF signal produced (three CCW positions of 'RF-IF GENERATOR' control), 2) the IF frequency band and precise frequency within that band (control labeled 'IF TUNING'), 3) the type of modulation (control labeled 'AUDIO MODULATION'), and 4) the generator output level (two controls labeled 'MICROVOLT OUTPUT').

Fig. 6—CB42 audio generator frequency-selector ('AUDIO') and output level ('AUDIO OUTPUT') controls.

RANGE: 0-1.000% transmitter error
ACCURACY: ±.0002% (25° C), +.002% (15° −35° C)
DISPLAY: 6-digit, 0.0001% resolution, LED "% OFF CHANNEL" indicator

% MODULATION
METHOD: Indicates percent of continuous-tone AM modulation, positive or negative, for sine-wave modulation. Compares peak audio to average RF carrier.
RANGE: (Positive): 0-200%, (Negative): 0-95%.
ACCURACY: ±5% of reading (30-100%)
DISPLAY: 3½ digit, 0.1% resolution, LED "% Mod" indicator

RF WATTMETER
POWER RANGE: 0-20 watts Peak Envelope Power (PEP)
FREQUENCY RANGE: 20-30MHz
ACCURACY: ±5% of reading from 2-25 watts PEP
INPUT IMPEDANCE: 50 Ω (built-in RF load)
DISPLAY: 3½ digit, 0.01 watt resolution, LED "WATTS" indicator

AUDIO WATTMETER
POWER RANGE: 0-10 watts RMS (peak-detecting, calibrated to read RMS power of sine wave across internal load)
ACCURACY: ±15% of reading

LOADS:
Internal: Built-in, switch selectable 4, 8 and 16 Ω, capable of handling 10 watts continuous (20 watts for 30 seconds)
External: Calibrated for 8 Ω

DISPLAY: 3½ digit, 0.01 watts resolution, LED "WATTS" indicator

SCOPE ADAPTER OUTPUT
METHOD: Heterodynes built-in 26.925MHz oscillator signal against RF output of CB transmitter and applies resultant below-1MHz signal to SCOPE ADAPTER output jack.
RF RANGE: 26.965-27.9400MHz
LOCAL OSCILLATOR: 26.925MHz Approx.
OUTPUT VOLTAGE: .5V P-P per 1 Watt RF
OUTPUT FREQUENCY: 40 KHz-480 KHz (Class D CB channels 1-40).
INPUT IMPEDANCE: 50Ω

SIGNAL-TO-NOISE SENSITIVITY TEST
METHOD: Increases built-in audio wattmeter sensitivity by 10dB to establish noise reference level for EIA 10dB (S+N)/N test
ACTIVATION: Front-panel 'S/N CHECK' pushbutton

GENERAL SPECS & FEATURES:
POWER REQUIREMENTS: 105-130 VAC, 50-60Hz; or 12 VDC, 1 amp. (built-in AC and DC power cords)
POWER SUPPLY PROTECTION: 2-amp., 3AG fast-blow fuse in B+ source circuit (primary of power transformer internally protected)
SIZE: 11 inches high x 14 inches wide x 11 inches deep
WEIGHT: 24 lbs.
PRICE: $895 (includes 'standard' accessories)
ACCESSORIES:
Standard (supplied with instrument):
39G102 Dynamic Mike Tester
39G104 RF Cable Assembly (isolation)
39G105 RF Probe Assembly (Test clips)
39G110 RF Probe Assembly (50 Ω Terminated)
39G106 Audio Lead Assembly
39G109 Audio Lead Assembly (Min. Phone).
Optional:
NL204 Impulse Noise Generator

Fig. 7—39G102 Dynamic Mike Tester, shown here being used to feed output of CB42 audio generator directly into mike of CB transceiver.

Fig. 8—Rear view of CB42 with door of power cord/test lead storage compartment open. Also shown are the two types of power cords with which the CB42 is equipped, one for AC line operation and the other (held in hand here) for DC operation from lighter socket of vehicle.

one of the five overlapping 'IF' band positions—labeled '375-750 KHz', '750-1500 KHz', '1.5-3 MHz', '3-6 MHz', and '6-12 MHz',—the generator can be tuned to any IF frequency within the selected band merely by placing the DIGITAL READOUT SELECTOR switch in the 'RF-IF GEN' position and monitoring the digital readout of the frequency counter while adjusting the generator output frequency with the continuously variable IF TUNING control (Fig. 5).

Modulation Of RF/IF Output

Modulation of the generator RF or IF output signal is controlled by the three-position, slide-type switch labeled 'Audio Modulation' (Fig. 5).

In the 'EXT' position of this switch, the generator output signal can be either unmodulated (CW) or it can be modulated from 0-100% by an external modulating signal applied to the jack labeled 'EXT MOD' on the back panel of the CB42. (A 4V P-P externally applied signal produces 100% modulation of the generator output signal.)

In the '30%' and '100%' positions of the AUDIO MODULATION switch, the generator output is modulated to the indicated percentages by the CB42's built-in audio generator. Three switch-selectable modulating frequencies (Fig. 6) are available from the audio generator: 400 Hz, 1000 Hz, and a balanced two-tone signal (500 and 2400 Hz), for use in testing and adjusting the balanced modulator of a SSB transmitter.

RF/IF Output Level Adjustment

A built-in 50-ohm, calibrated output attenuator permits relatively precise adjustment of the generator RF and IF outputs to any level between .1 μV and 100,000 μV.

Two calibrated controls, immediately under the 'MICROVOLT OUTPUT' label on the left side of the front panel (Fig. 5), are used to establish the generator output level: One is a detent-type 'multiplier' control, and the other is a continuously variable control calibrated in microvolts from 1-10. To establish a 500 μV output level, for example, the continuously variable control is placed in the '5' position and the 'multiplier' control is placed in the 'X100' position.

AUDIO GENERATOR

The built-in audio generator of the CB42 provides three standard, switch-selectable, CB audio test frequencies: 400 Hz and 1000 Hz, for servicing of both double- and single-sideband CB transceivers, and a balanced two-tone signal (500 Hz and 2400 Hz), for SSB test applications.

Selection of these audio output frequencies is accomplished by a four-position control labeled 'AUDIO' in the center of the CB42's front panel (Fig. 6).

The output of the audio generator can be applied internally to the RF/IF generator, to modulate it as described previ-

continued on page 41

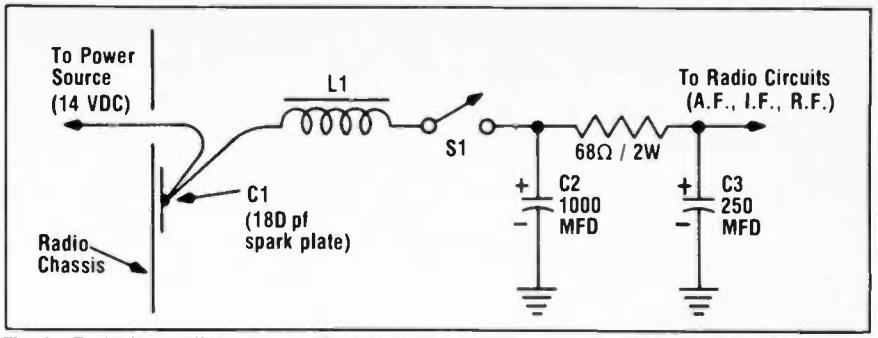


Fig. 1—Typical car radio power supplies have several noise suppression features such as L1, C1, and C2. Capacitor C3 is usually used for audio, I.F., and R.F. stage decoupling.

Noise Sources In Auto Electronics

How to track down and correct those elusive noises in car radios, tape players and CB

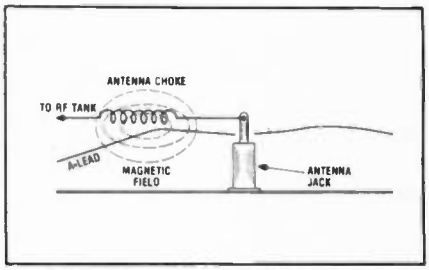


Fig. 2—One source of car noise in radio equipment occurs if the antenna input choke is dressed parallel, or nearly so, to the A-lead.

By Joseph J. Carr, C.E.T.

■ Noise problems are among the most difficult problems that must be solved by the auto electronics technician. In a future article we will cover noises generated *inside* the radio, but in this article, our concern is *motornoise*.

The word 'motornoise' is an all-inclusive term that doesn't mean noise generated *only* by the engine, but noise from *all* sources external to the radio or tape unit.

In the old days we would have told you to "brute force" the job by installing resistors in the spark plug lines plus a handful of cheap capacitors. Today, however, such advice might lead to poor performance of the engine, and may even cause damage.

The situation has changed since the author last considered the problem of noise suppression. For one thing, all autos made in the last decade or more have been factory equipped with carbon spark plug wires. These are marked "radio-TV" or "carbon" and are actually resistors fashioned into the form of wires. If the customer has attempted to defeat this resistance effect by installing regular wires, he has no complaint coming, especially under the terms of most warranties.

Some mechanics will tell their customers that 'radio wire' cuts down the performance of the engine, and as I am not an expert on automobile engines, for all I know this might be true. It is, however, a moot point if the "modification" results in an unusable radio. It may not even be legal.

Whenever a customer complains that motornoise (in this case, real spark plug noise) has suddenly appeared, look to his engine first. Ask whether he has recently had a tune-up. If so, inspect the wire to be sure that is truly carbon wire. Remove one of the high tension wires, (the wire from ignition coil to distributor is the easiest) and check its resistance with an ohmmeter.

If the customer has substituted copper ignition wires, either offer to change them, or send him to a mechanic for installation of proper wires. Sometimes it is the case that a single, popping sound will occur. This may be due to a single spark plug or its high tension cable being open. Again, it may be wisest to send the customer to a mechanic.

Car Radio Noise Defenses

Auto radios and most tape units have several built-in defenses against motor noise interference. In the power supply, for example, much of the circuitry is designed to provide a quiet radio. A typical car electronics power supply is shown

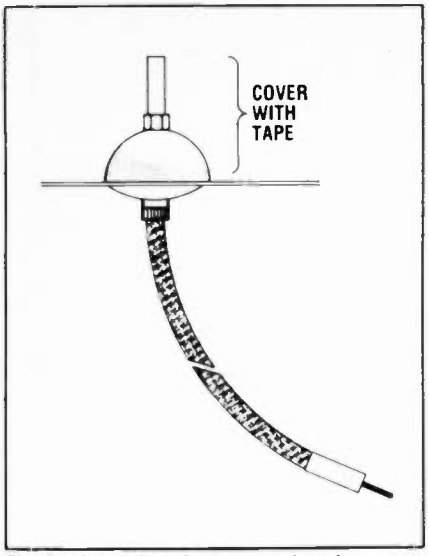


Fig. 3—A drawing of a homemade noise source probe using a salvaged antenna and the customer's car radio speaker as the indicator.

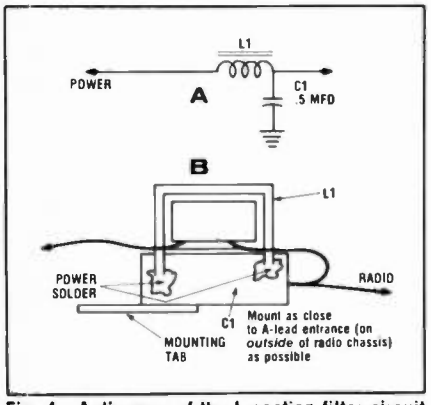


Fig. 4—A diagram of the L-section filter circuit (A) that will take the alternator whine out of radios and tape players in cars. DC resistance of the choke must be very low. The filter is installed as shown in part B.

in Fig. 1. The "A" lead (power line) to the set is brought into the radio through a hole in the radio chassis, or sometimes it is attached, through a feedthrough bushing, to a spark plate capacitor. This device is a one or two inch square piece of 'fishpaper' with copper foil glued to both sides. To be effective, one side of this capacitor (about 180 pf) must be soldered directly to the chassis of the radio, with the other side connected to the A-lead as close as possible to the point where the A-lead enters the chassis. The choke (L1) may be wound on an E-frame core in the manner of small transformers, or it may be on a solenoid-type form made of ferrite rods. The latter type is often found on Bendix car radios. L1 may be mounted either on the outside or inside of the car chassis.

Radio Defects

There are several common radio defects that can contribute to motor noise. In older cars, the sudden appearance of noise may be due to faults in the power supply, such as a shorted L1 or an open C2.

Less easily recognized, perhaps, are problems with component layout and lead dress, more common in warranty radios, either O.E.M. or after-market. Here, the customer will complain bitterly about the noise in his new toy—and it's time for you to check for a poor lead dress. The power supply A-lead must be dressed close to the chassis in a manner that avoids the audio circuits and the volume control. This latter requirement is sometimes difficult to meet fully because the A-lead must connect to a switch ganged to the volume control. The problem here is that impulse noise can be coupled from the power wire to the sensitive circuits.

Another cause of noise in the audio circuit or volume control wiring is the improper placement of power supply components or the antenna choke. Sometime, when tubular electrolytics are used for C2 and C3 (Fig. 1), their placement is critical because they can carry noise voltages. When placed in close proximity to the audio or volume control circuits, noise can be produced. Usually, they can be repositioned to reduce or eliminate the noise. Such noise, incidentally, often appears right after the radio has been serviced, and is likely to occur if the volume control or power supply electrolytics have been replaced. Auto electronic manufacturers try to design their component and wire layout to reduce the noise, so be sure to follow their original lead dress setup when you make replacements.

Fig. 2 shows another common component placement problem where the axis of the antenna input choke is parallel, or nearly so, with the power supply A-lead. Noise impulses in the A-lead create a magnetic field that couples energy to the choke. This transmits impulses rich in harmonics directly to an RF amplifier. If the antenna choke cannot be repositioned at right angles to the A-lead, or if the A-lead cannot be rerouted through another entrance point in the chassis, try shielding the A-lead. Copper tub-

ing used in air conditioning or the braid stripped from a piece of small size coaxial cable (RG58 or RG59) will be proper. Solder the shield to the chassis.

Car Defects

There are times when no amount of troubleshooting in the radio can solve the noise problem. In these cases, look for a problem with the car itself. One of the most common defects is an open antenna cable ground. The coaxial cable from the antenna is shielded, and the shield must be grounded at both ends. This problem can be diagnosed rather easily by removing the antenna plug from the radio input jack. Turn up the volume and listen for the noise. If the noise reduces substantially, or disappears entirely, change either the antenna or its cable. The latter is the course to follow if the antenna is of the windshield type.

A handy, homemade probe which can be used to pinpoint noise sources under the dashboard is shown in Fig. 3. The probe is made from a salvaged antenna and is cut off to a length of approximately 1 to 2 inches. It is a good idea to wrap the exposed portion of the antenna probe with electrical tape to prevent sparks from flying in case you accidentally touch an exposed hot wire.

With the cable connected at the antenna input of the receiver, use the probe to touch the various dashboard structure and wires. Your indicator is the radio itself, tuned off station, with volume turned way up. When, and if, the noise level increases greatly, you've probably found your trouble.

If the fault is a noise-carrying wire, at least two courses of action are open. One is to reroute the offending wire away from the radio wiring. Another is to use a 0.5 mfd. capacitor to bypass the noise to ground. If this is the case, use a coaxial type (found in CB shops) mounted close to the firewall. Even an ordinary motor noise suppression capacitor is suitable.

Do not overlook the possibility of noisy dashboard structures. Many of these structures, especially the braces, are poorly grounded. The use of plastic and silicone anti-rattle "gunk" in today's cars often places a dashboard part above RF ground, even though it is nominally DC ground. In many cases, the radio support itself is the offending part. If this is the case, use a heavy, short, ground strap attached to the firewall to eliminate this problem. Again, coaxial cable braid can be used if regular grounding braid is not available.

Another car-caused noise, alternator whine, can also be caused by any of the same things that cause spark noise. But remember, it isn't always safe to just zap a capacitor across the alternator, as you may resonate the circuit. Consult the car maker's suggestions in this case. Most recommend a certain value capacitor that can be attached safely.

A 'brute-force' method, but still effective, is the use of an L-section filter, as shown in Fig. 4. The choke may be almost any car radio input choke that has a DC resistance low enough to prevent excessive voltage drops. This is especially true in signal seeker radios or in eight-track tape players with high-current solenoids.

The author prefers chokes made by Delco because their DC resistances tend to be lower. Check Sam's AR-series Photofacts or a Delco service manual for the right kind of low DC resistance chokes.

Gas gauges, voltage regulators, and small DC motors also can cause noises in car radios. In some cases, with the motors, a 0.5 mfd. motornoise suppression capacitor will take care of the problem. In others, it might be necessary to consult the car maker's literature for solutions. If such noise pops up suddenly, do not overlook the possibility that its appearance heralds an impending failure of the offending device. In that case, fixing the noise may be only covering up the real problem.

Noise problems are very irritating to the customer and can cause a public relations problem for the car dealer. If you can get rid of a problem for the dealer's favored customer better than one of your competitors can, the dealer likely will become one of your best customers.

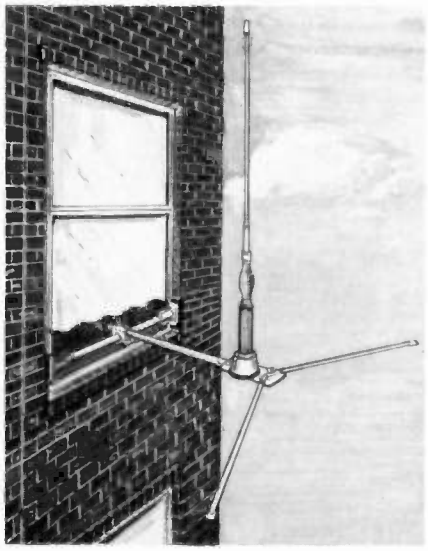
One last suggestion: Do not try to troubleshoot car noises in radios or tape players with the hood of the car up and open. In this position, the hood acts as a shield, and noisy reception is a natural condition. ■

NEW PRODUCTS

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

CB WINDOW ANTENNA MOUNT 132

A new CB window antenna mount for use in buildings where outdoor roof-top antennas are prohibited has been introduced by *RMS Electronics*. The mount, Model CBWM-50, accommodates any mobile CB antenna and assembly and installation are simple.



An adjustable extension fits windows up to 42-in. wide and additional extensions are available for larger windows. Featuring ground plane elements similar to large base station antenna, the mount is self-grounding and is built of heavy duty aluminum. List price is $12.95 in a regular carton, or $13.95 skin packed on a peg-hang card.

CCTV DIGITAL CONTROL SYSTEM 133

A new digital control system for CCTV that can control one to twenty CCTV cameras plus any electrically operated remote function from a central location is being introduced by *Motorola*. The new system can control camera and remote functions by

transmitting signals over twisted metallic pair wire (up to 10,000 feet), a voice grade telephone line (up to 20 miles), an optical link, or microwave equipment. Camera selection, camera power, camera motion, and lens operation can be controlled by the device. Remote functions include: intercom with remote camera site, opening and closing doors or gates, turning lights on or off, and control of any electrically operated function. The system is designed on a modular basis to fit the changing needs of the user.

NEW INTEGRATED CIRCUITS 134

Twelve new integrated circuits for TV and other consumer electronic products have been introduced by *General Electric*. The new IC's include two FM IF amplifiers, a tape recorder audio amplifier and a low-noise audio-preamplifier, and eight devices for color TV, including a chroma processor, video amplifier, IF amplifier, chroma signal amplifier, vertical processor and a color demodulator. Available through GE distributors. List prices are from $4.85 to $12.50.

THEFT-PROOF CB TRANSCEIVER 135

A new concept in CB radios, a transceiver that is separated from its controls, has been introduced by *Hy-Gain*. Called the Hy-Gain 9, the new unit is designed so that the transceiver can be located in a remote, protected spot on the vehicle, away from the eyes and hands of would-be thieves. All controls are located on a microphone/speaker/control unit that is attached to a connector at the dash. From there, a cable carries audio and control commands to

the transceiver. When not in use, the control unit can be locked up in the glove compartment. The transceiver is an advanced phase-lock-loop system, generating 23 or 40 channels.

TERMINAL STUD KIT 136

A new terminal stud kit for two-way communications equipment is avail-

able now from *Gold Line Connector*. The kit, Model 1105, is designed for batteries with side-mounted terminals and includes the necessary connecting hardware for direct-to-battery applications where standard battery studs do not work. The kit allows for easy hook-up for communications equipment, tape players and automobile tune-up equipment.

IN-LINE DIGITAL CB MONITOR FOR USERS 137

A new digital-readout CB monitor providing display of frequency, power, and SWR has been announced by *Hickok Instruments*. Designed for use by the CB owner, Model 38 is installed in-line between the transceiver and antenna. It provides 6-digit frequency readout accurate to 10 parts per million (.001%), 3-digit power output measurement of 1.0 watt to 10.0 watts, or if modified, 1 watt to 100 watts, accurate to 5%, and 4-digit SWR readings of 1.00:1 to 10.00:1. About the size of a small mobile CB unit, Model 38 can be operated from standard line voltage of 105 to 125 VAC, or a 12-volt car battery. Comes complete with mounting hardware and is priced at $279.

"HANDS FREE" MOBILE COMMUNICATIONS SYSTEM 138

A new mobile communications system that provides clear, vocal transmission without the operator having to touch the microphone is now available from *Shure Brothers*. Called the HF52 mobile communications microphone, the new system consists of a tiny dynamic microphone, an amplifier with adjustable gain, and a heavy-duty corrosion-proof footswitch. It operates from any standard 12-volt negative ground vehicle battery system, is easily installed, and can be connected with most inputs designed for high impedance, dynamic, controlled magnetic, carbon or transistorized microphones. The system's miniature mike can be mounted on the sun visor, dashboard, or steering wheel column. When used within 18 inches of the voice source, the microphone provides the same output as a "close-talked," hand-held microphone. User net price is $99.60.

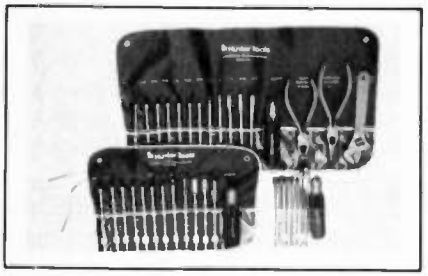
UNIVERSAL DC ADAPTER 139

A new DC adapter that converts 12 volts DC from a vehicle battery to 3 to 12 volts DC for transistor radios, cassette recorders, and other low voltage devices is now available from *Dynamic Instruments*. Called the Auto-Vert, the new device has four interchange-

able plug tips to accommodate the various receptacles and polarities of the devices to be powered. The combined converter and cigarette lighter plug unit measures 3½ x 1½ x 1 inches. Available in blister pack.

INTERCHANGEABLE BLADE SERVICE KITS 140

A new series of interchangeable blade service kits is being introduced by *Hunter Tools*. The kits, known as the "Fred" series, consist of various screwdriver-nutdriver combinations. The blades, which are manufactured in Japan, will interchange with "99" series tools made by other manufacturers. They are made of carbon steel with a highly polished nickel chrome finish. Comfort grip handles hold the blades firmly, yet permit quick, easy insertion and removal.



WIDE BAND MATV AMPLIFIER 141

A new wide band push-pull amplifier capable of handling up to 30 TV channels in a master antenna TV system has been developed by *Jerrold Electronics*. Designated Gibraltar Model 3770P-P, the new unit amplifies the entire mid-band (120 to 174 MHz) and the super band (216 to 300 MHz), as well as the low VHF band (54 to 108 MHz) and the high VHF band (174 to 216 MHz). Push-pull design provides suppression of a second order harmonics to −65 dB, making the 3770P-P useful as an

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TEST INSTRUMENT RPT.

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ously, or it can be used for external applications from a phono-type jack labeled 'AUDIO' on the bottom left of the front panel.

A front-panel, continuously variable control labeled 'AUDIO OUTPUT' (Fig. 6) permits adjustment of the signal level at the AUDIO jack throughout the range from 0 to 4 volts P-P, and without affecting the level of the audio modulating signal applied internally to the RF/IF generator.

SCOPE ADAPTER

The built-in Scope Adapter of the CB42 is a heterodyne circuit which beats an internally generated 26.925-MHz signal against the modulated RF output signal of a CB transceiver and applies the resultant *difference* signal to a pair of jacks labeled 'SCOPE ADAPTER' on the bottom center of the CB42 front panel.

Thus, the RF carrier and sideband frequencies of the modulated RF output of a 40-channel CB transceiver—which range from 26.965 MHz (+ modulation) on channel 1 to 27.405 MHz (+ modulation) on channel 40—are reduced to corresponding frequencies in the range from 40 KHz (channel 1) to 480 KHz (channel 40), thereby permitting display of the CB transmitter RF carrier and

modulation envelope on the screen of any general-purpose scope with a vertical bandwidth as narrow as 1 MHz.

ACCESSORIES

The following 'standard' accessories are included in the $895 price tag of the CB42:

• *39G102 Dynamic Mike Tester*–This plug-in, combination mike/speaker (Fig. 7) is designed to perform two functions:

1) It can be used to modulate the transmitter of a CB transceiver directly through the transceiver's mike, thereby not only providing a convenient method of modulating the transmitter with the audio output of the CB42, but, at the same time, providing a quick-and-easy check of the complete modulating system of the transmitter—from the mike, through the audio section, to the RF output of the transmitter.

For this application, the phono-type plug of the Dynamic Mike Tester is plugged into the AUDIO jack of the CB42 and the transceiver's mike is placed on the sponge rubber ring of the mike tester (Fig. 7), establishing a direct, acoustically tight coupling between the CB42 audio generator output and the mike input of the transceiver.

2) The Dynamic Mike Tester also can be plugged into the external speaker (or PA) jack of the transceiver (through a phono-plug adapter, if necessary), for use as a substitute speaker or to 'substitute test' a suspected defective transceiver speaker.

• *Five cable/connector assemblies*–These five RF and audio cable assemblies satisfy all the cable/connector combinations required for connecting the inputs and outputs of the CB42 to all inputs and outputs of a CB transceiver, including the specially isolated and/or terminated assemblies required for injection of the RF, IF and audio output signals of the CB42 into the transceiver circuits during signal substitution testing, and for 'picking off' and measuring transceiver generated signals during signal tracing procedures.

Also available for use with the CB42, but at additional cost, is an NL204 Impulse Noise Generator. This plug-in accessory generates the reference noise pulses required for the performance of the CB receiver impulse noise test specified by the EIA. This test measures the noise-cancelling ability of a transceiver's automatic noise limiter (ANL) or automatic noise blanker (ANB) circuit, and indicates to what degree the action of these circuits degrades the sensitivity of the receiver.

CB42 APPLICATIONS—NEXT MONTH

Procedures for using Sencore's CB42 CB Analyzer to service both double- and single-sideband AM CB transceivers will be presented next month in a special feature article which also provides block diagram analyses of the designs and functioning of representative CB transceivers. ■

AUDIO TESTS

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frequency is visible on the screen of the CRT (Fig. 11)

6) While watching the CRT display (Fig. 11) increase the generator output level until the amplitudes of the 2nd or 3rd harmonic pulses begin increasing more rapidly than the 1-KHz pulse.

7) In turn, connect the analyzer input across the load of the other channel(s) and perform step (6) for each.

All channels will now be operating at or near their maximum undistorted output levels. You can now measure the RMS power output and % of THD of each channel by performing the following steps:

8) With the analyzer input connected across the output load of one channel, again adjust the generator output to the level at which the amplitude of the 2nd or 3rd harmonic pulse in the CRT display begins to increase more rapidly than the 1-KHz pulse ().

9) Switch the analyzer to the 2dB/DIV mode, for better resolution. The graticule of the CRT display (Fig. 12) is calibrated in dB/DIV. The power level represented by the top line of the graticule (full-screen vertical deflection) is equal to the maximum power rating of the amplifier output load selected in Step (1). Therefore, you can determine the RMS output power delivered by the amplifier channel merely by counting the number of dB the displayed 1-KHz pulse is below the top of the graticule. For example, in Fig. 12 the top of the graticule is equal to 50 watts (the rating of the output load) and the pulse is 3 dB (or 1.5 div. x 2 dB/DIV) below this level. Because −3 dB represents a power reduction of 50%, the power output of the amplifier channel is 25 watts (or 50% of 50 watts).

10) Compare the power level measured in Step (9) with the rated power level (per channel) specified by the manufacturer. If it is equal to or greater than that specified by the manufacturer, proceed to Step (11). If it is not, first increase the output level of the signal generator until the CRT display indicates an RMS power level equal to that specified, then proceed to Step (11).

11) Switch the spectrum analyzer to the 10 dB/DIV mode and determine the number of dB between the top of the 2nd harmonic pulse and the tops of the 3rd and higher harmonic pulses, as shown in Fig. 13.

a) If, as shown in Fig. 13, the amplitudes of all other harmonic pulses are at least 6 dB *below* the 2nd harmonic pulse, you can compute the THD of the amplifier channel merely by counting the number of dB between the tops of the 1-KHz and 2nd harmonic pulses and then converting this figure to % of distortion by use of the chart in Fig. 13. (In Fig. 12 the difference is 40 dB, which converts to a THD of less than 1%.)

b) If the difference between the amplitude of the 2nd harmonic and those of higher harmonics is less than 6 dB, you must compute the dB difference between the 1-KHz pulse and the RMS sum of the levels of all other measurable harmonics and then convert this dB level to a % reading via the chart in Fig. 13.

The accuracies obtainable with the preceeding power output and %-of-total-harmonic distortion measurement techniques are more than adequate for most service applications.

IN PART TWO

Next month in this article series we will examine other audio amplifier performance parameters—such as frequency response, intermodulation distortion, sensitivity, crosstalk and signal-to-noise ratio—and how to measure them with a spectrum analyzer. ■

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We at ET/D invite you to share with other ET/D readers your comments and opinions about controversial issues and/or business-related problems confronting the electronic service industry. Send them to: LETTERS TO THE EDITOR, ET/D, 1 East First St., Duluth, MN 55802. (Only signed letters will be considered for publication.)

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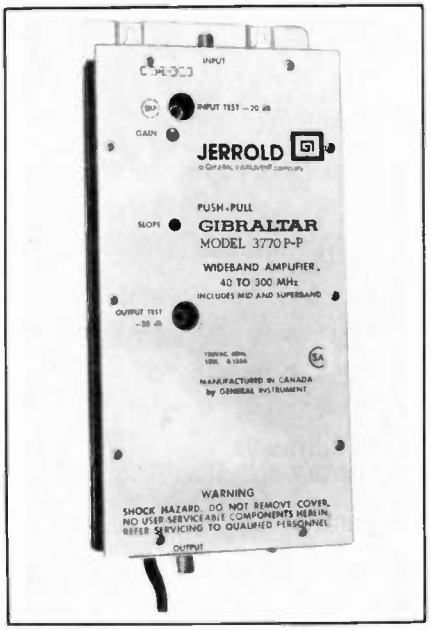
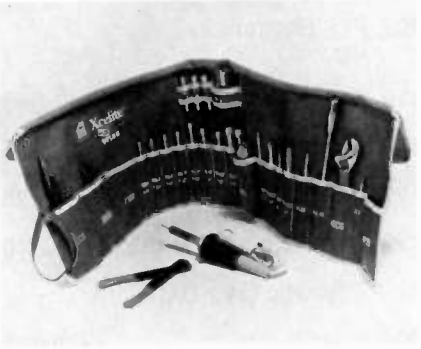
continued from page 41

MATV distribution amplifier served by a CATV feed. Output capability is +50 dBmV at −46 dB cross modulation with 12 channel CATV feed, and +56 dBmV for seven channel MATV operation. List price is $465.



ELECTRONIC/APPLIANCE SERVICE KIT 142

A new 26-piece service kit for electronic and appliance repair has been introduced by *Weller-Xcelite*. Designated the 99SMW tool set, the new kit includes a wire stripper/cutter, a 25-watt soldering iron, long nose and



diagonal cutting pliers, adjustable wrench, and an assortment of quick-change regular and stubby blade screw and nut drivers. Drivers feature both regular and stubby handles, extension blade and reamer.

RADAR DETECTOR TEST SET 143

A new hand-held test set for dealers and servicers who sell radar detectors is available now from *Prime Electronics*. The PR-7 test set will test and demonstrate all radar detectors on the market. When the trigger button on the pistol grip handle is pressed, the unit emits a low power X band signal.

Output range is calculated as a direct ratio with 50 paces simulating ½ mile, and 100 paces simulating one mile of a typical moving or fixed speed radar. The test set, classified and offered as a repair shop signal generator, requires no license to operate. It is powered by a 9 volt transistor battery. Dealer cost is $149.95.

AEROSOL REFRIGERANT 144

A new aerosol refrigerant that instantly freezes small parts to −50° F has been introduced by *Sprayway, Inc.* The new product has been developed for electronic servicers who need to freeze small areas and parts for shrink fitting of shafts, pins and bushings—to protect adjoining parts while solder-

ing, fitting or heat testing and to find faulty capacitors, transistors and oxidized joints. Called Instant Freeze No. 103, the new product is non-flammable and leaves no residue. Comes with pin-point application tube. ■

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READER SERVICE INDEX

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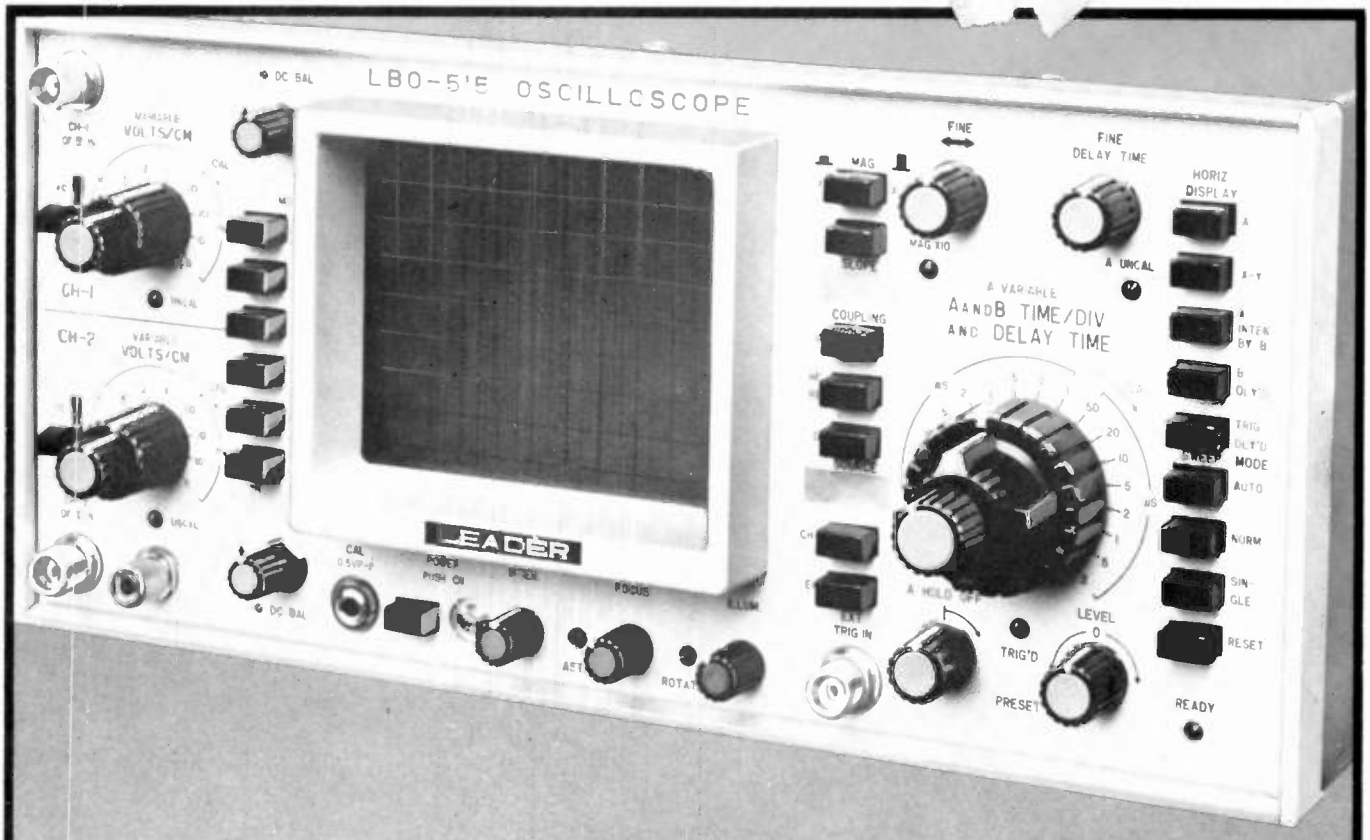

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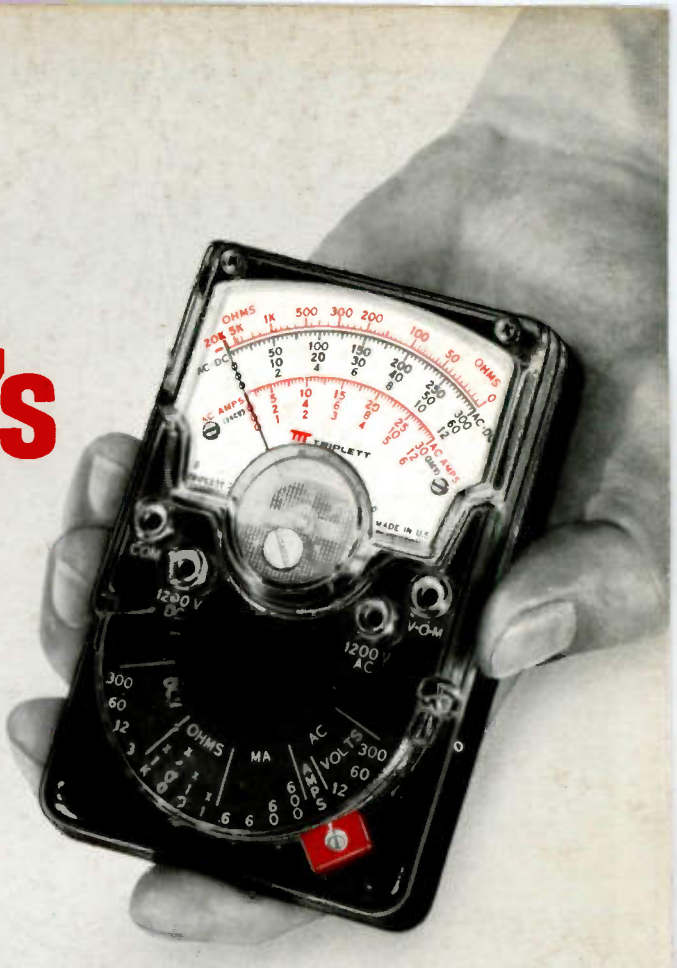

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