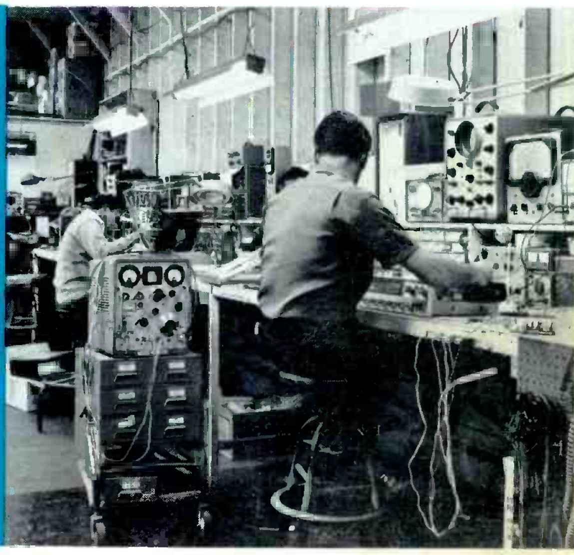
March, 1971 ☐ 75 cents

A HOWARD W. SAMS PUBLICATION

Electronic Servicing



Improved Shop Efficiency:

One way to offset rising costs page 34

Troubleshooting Stereo Separation Problems

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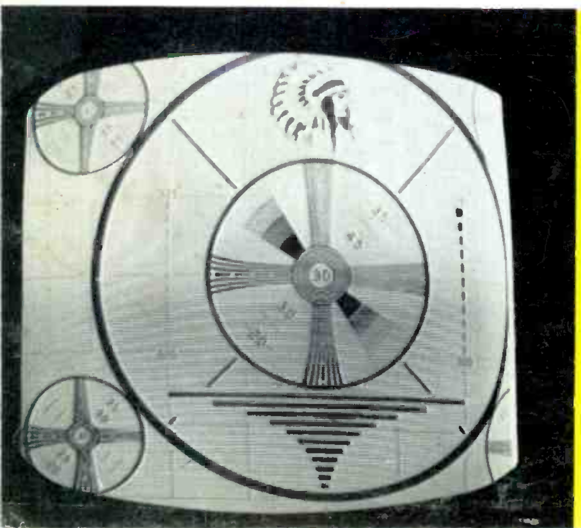

Common Causes of Horizontal Nonlinearity

page 26

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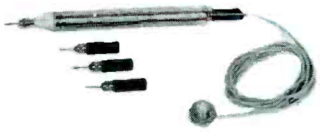

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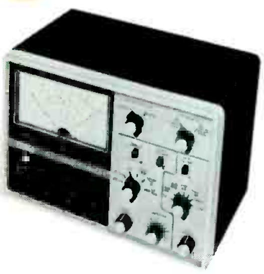

Tests transconductance and Beta in and out of circuit. Measures FETs, bipolars, diodes, rectifiers, SCRs, UJTs. Built-in voltmeter, ohmmeter. 50μa taut band meter movement. Eico 685, Kit $99.95, Wired $149.95.

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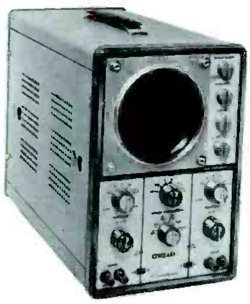

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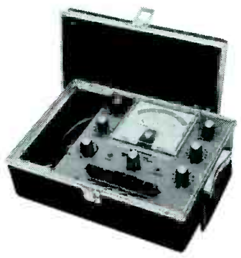

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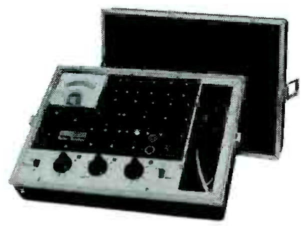
TUBE TESTER



Tests all standard tubes plus decals, magnovals, 7-pin nuvistors, popular TV picture tubes. Professional, compact, lightweight, and modest price. Eico 635, Kit $49.95, Wired $74.95.

NEW SOLID STATE SIGNAL TRACER

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March, 1971 • Volume 21, No. 3

Electronic Servicing

Formerly PF Reporter

in this issue...

DEPARTMENTS

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Robert E. Hertel, Publisher

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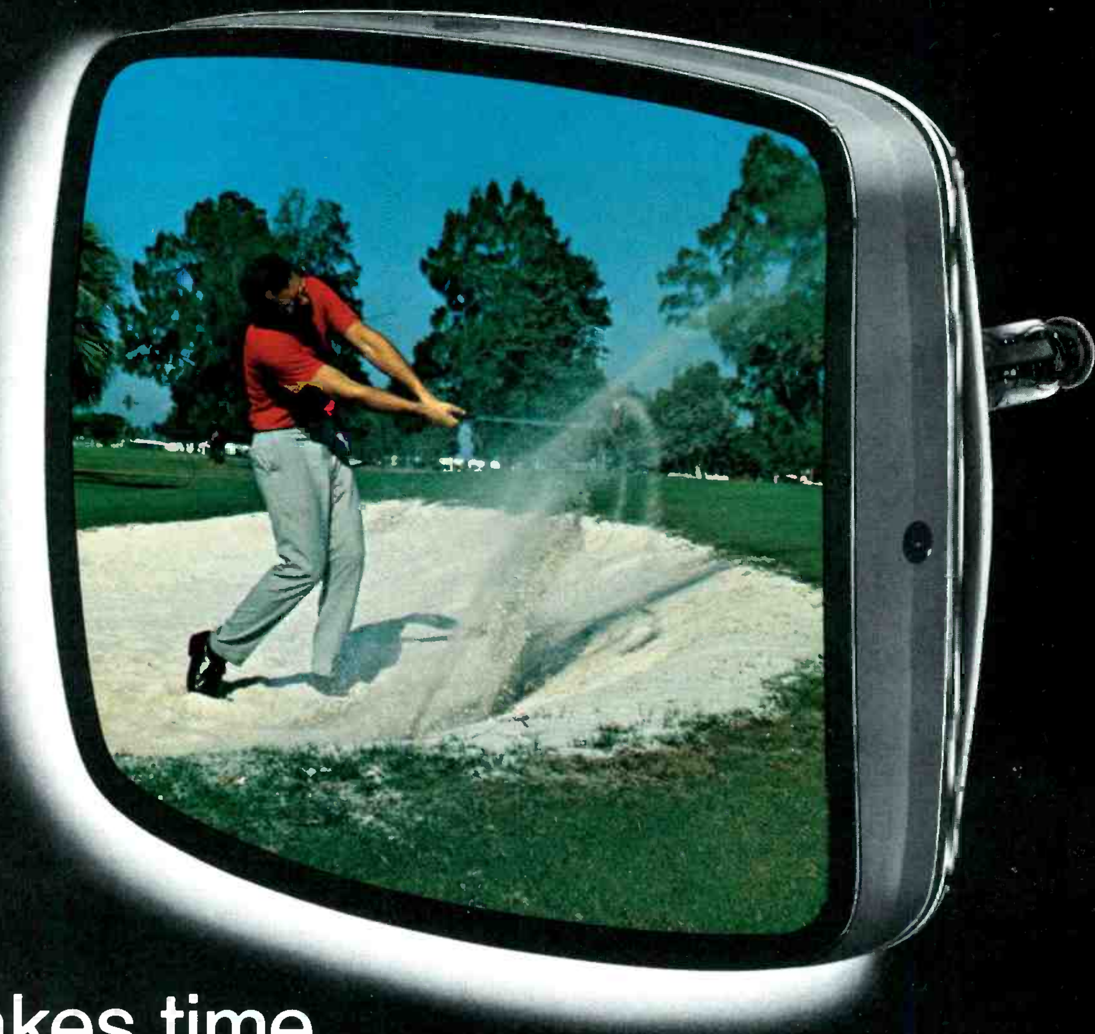

Who and How Many Own Color TV

Thirty-eight percent of all American families now own color television receivers, an increase of six percentage points over the 1969 estimates, according to the U.S. Bureau of Census.

Groups in which the incidence of color TV ownership is highest reportedly are: families who live in Western states; residents of the suburbs of metropolitan areas; homeowners; and households in which the head is age 25-54.

Those who do not yet own color TV reportedly, are concentrated in the South and Northeast, in the cores of central cities and in rural and farm areas. Renters (73 percent do not own color TV) and households whose heads are under 24 or over 35 years seem to comprise the bulk of nonowners of color TV.

Black-and-white TV ownership has declined from 79 per cent in 1969 to 77 percent at the end of 1970, according to the Bureau of Census report.

Cost of TV Repairs Drops While Cost of Other Services Increases

The cost of television repairs **dropped** 3.3 percent between September 1969 and September 1970, according to the Consumer Service Price Index. During the same period, the overall Service Price Index **increased** 8 percent, to 157.7 (1957-59=100.)

Viewers Watching TV More

The average number of hours per day Americans watch TV has increased for the eighth consecutive year, according to Norman E. Cash, president of the Television Bureau of Advertising, which reportedly conducts year-round studies of TV viewing habits and reactions.

Based on viewing data available for the first eleven months of 1970, Cash predicts that the average viewing time per day for 1970 will be at least six hours.

Retracts Charge That Packard-Bell Uses Rebuilt CRT's In New Receivers

Milton Kevreson, president of Uptown Radio Co., a TV sales and service firm in Detroit, has retracted his statement, published in the official publication of the Television Service Association of Michigan, that Teledyne Packard-Bell used regunned or rebuilt picture tubes in new TV receivers, according to a recent report in **Home Furnishings Daily.**

After Kevreson's statement was published in July, 1969, Packard-Bell filed a $1.5-million libel suit against Kevreson and the Association, charging that Kevreson's statement was "entirely and wholly false and without foundation in fact."

The retraction, to be published in the January issue of the Associations' publication, reportedly states that Kevreson is "now absolutely convinced that Teledyne Packard-Bell, as a matter of strict policy, equips their new television receivers with only new picture tubes and would never, under any circumstances, knowingly use regunned or rebuilt picture tubes in place of or instead of brand new picture tubes . . ."

Kevreson said, according to the HFD report, that his charge which led to the libel suit was based on his "examination of new picture tubes that had cut or splice marks around the neck of the picture tubes." Since then, he reportedly has learned that "a cut or splice mark on the neck of a picture tube does not mean that (it) has been rebuilt or regunned—in other words, the picture tube can be made up of all new materials, and still show a cut or splice mark."

Such splice marks, says Kevreson, can be caused "when the manufacturer of the picture tube, during a quality control check, finds that the electron gun assembly is either not properly aligned or defective in other respects. If that is the case, the picture tube neck will be cut and a new electron gun will be reinserted, (and) the picture tube neck will then be fused."

Kevreson's firm, which previously was an authorized "direct factory dealer", reportedly will again sell and service the Teledyne Packard-Bell product line in the Greater Detroit area.

National Service Agents Council Formed by Philco-Ford

Philco-Ford Corporation has announced formation of a National Service Agents Council as the culmination of a drive to recast its parts and service operation to ensure total customer satisfaction.

The Council consists of 18 independent service agents from across the country who are franchised by Philco-Ford.

The Council was formed after the 18 members recently met with top Philco-Ford executives at Downingtown, Pa., to analyze the company's recent restructuring of its parts and service organization.

That session also included an in-depth discussion of how the agents could better serve their customers and of how they could more effectively manage their own businesses.

"Our Downingtown session was so successful, and the service agents were so pleased with the dialogue that took place there, that we decided to form a permanent council," said Armin E. Allen, Philco-Ford's vice president for consumer affairs.

"Our meeting with the agents has convinced us more than ever that working through highly qualified independent service agents is the best way we can serve the customer," Mr. Allen added.

The Council has already submitted to Philco-Ford a list of items it would like to further discuss with the company. The list includes such topics as parts procure-

(Continued on page 6)

(Continued from page 4)

ment and availability, parts inventory training, warranties, service agent franchising, technical and customer relations training for agents, and methods of improving the service agent's image.

Council members have indicated ways they believe Philco-Ford can help them in these areas, and have made recommendations. The company, in turn, is analyzing the recommendations for further discussion with the council.

A second meeting of the council is scheduled for late spring. Philco-Ford also has told national council members that it wants to form local or regional councils, and has asked the 18 members for assistance in forming the regional councils.

At both levels, council members will represent a cross section of the approximately 5,000 independent service agents throughout the country who are authorized to perform service work on Philco products.

"These councils will provide us with an on-going means of directly and efficiently discussing with our agents the most pressing problems facing the service field," Mr. Allen said. "The councils will help us learn and improve by listening better."

Those appointed to the first Philco-Ford National Service Agents Council are: Wayne M. Thompson, C&W Service Co., 145 Cole, Dallas, Tex.; Dominic Delegato, Delegato Appliance Service, 3114 E. Davison St., Detroit, Mich.; Kenneth King, King Appliance Service, 10300 Muskogee, Fern Creek, Ky.; Dick Frank, Frank's Refrigeration, 2912 27th Ave. S., Minneapolis, Minn.

Also, David Epstein, Mutual Engineering, 304 Lockwood St., Providence, R.I.; Martin Baker, Baker Refrigeration and Air Conditioning Service, 5227 "C" St., Philadelphia, Pa.; Dave McKalip, Rex Service Co., 6011 S. Pulaski, Chicago, Ill.; Jerry Eppinger, Space Age Electric Co., 2970 Barber Road, Barberton, Ohio; Martin Butorac, H. & H. Television, 1415 Holman, Houston, Tex.; Clyde Carter, Wilshire Electric Co., 7161 Beverly Road, Los Angeles, Calif.; Robert Knudsen, Tel-Rad TV, 953 E. Oakland Blvd., Fort Lauderdale, Fla.

Also, George Fletcher, G&R Service, 3621 Kensington Ave., Philadelphia, Pa.; Cornelius Bell, Bell Radio & TV Service, 4829 Goodfellow, St. Louis, Mo.; Harry Boguch, Harry,s TV, 2205 4th St., S., Seattle, Wash.; Arthur German, Triplex Service, 1002 Castle Hill Ave., Bronx, N.Y.; D.D. Speagle, S&S Appliance Service, 705 6th Ave. N., Birmingham, Ala.; Douglas Smith, B&D Appliance Service, 525 Huston St., W. Sacramento, Calif., and L. F. Sloan, L. F. Sloan Appliance Service, 834 Holland Ave., Cayce, S.C.

Zenith Awarded Industrial Science Award

The Industrial Science Award of the American Association for the Advancement of Science (AAAS), largest scientific organization in the world, has been presented to Zenith Radio Corporation, for outstanding achievements in research and development over the past decade.

Dr. Robert Adler, Zenith vice president and director of research, accepted the award from Dr. Jordan Lewis of the Battelle Development Corporation at the 137th AAAS meeting in Chicago.

Zenith was cited for its "basic and applied research in the past decade that has resulted in significant contributions to science and technology in fields ranging from acousto-optics and acoustic surface waves to luminescence and neutron image intensification, and to advancements in consumer electronics . . ."

The recipient of the annual award is determined by officers of the AAAS Section on Industrial Science. The award was inaugurated at the Association's 1956 meeting to recognize outstanding technological achievement by an American industrial firm or other organization.

Zenith has played a major role in many important developments in radio, television, hearing aids, and certain medical diagnostic equipment.

Zenith research specialists developed the complete system of stereophonic FM transmitting and receiving approved in 1961 by the Federal Communications Commission and now in use.

In significant and sophisticated research areas, Zenith has worked on: light-sound electronic television projection system using a laser beam; visualization of sound waves, also involving laser light, that led to development of an acoustic microscope; integrated circuits, among which was the first IC color demodulator for TV sets; neutron image conversion, which was cited by **Industrial Research** magazine as one of the outstanding research projects of 1965; and low-level light devices which "see" and take pictures in darkness.

Previous winners of the Industrial Science award include General Electric Company, Instrument Department, 1956; P. R. Mallory and Company, 1957; Westinghouse Electric Corporation, 1958; Bell Telephone Laboratories, 1960; and Texas Instruments, Inc., 1968.

Panasonic Parts and Service Divided Into Two Divisions

The reorganization of the Service and Parts Division of Panasonic has been announced by Matsushita Electronic Corporation of America, the parent company of Panasonic.

Matsushita Electric Service and Parts has been split into two divisions: Panasonic Service Division, headed by Sol Fields, and Consumer Parts Division. ▲

letters to the editor

Servicing of Older and Newer Sets

I agree, to some extent, with Mr. McTierman's letter in Nov. '70 ELECTRONIC SERVICING, but I completely disagree with his philosophy of servicing only the newer sets.

We service both old and new sets, and by using Sams PHOTOFACTS we have little difficulty finding replacement parts. Occasionally, a part seems to be unavailable; however, with a little perseverence and a thorough study of the cross reference, we have always been able to put a set back in proper working condition.

There are times when you must improvise and make a part yourself, or modify one that is available; of course, if you lack the know-how, then by all means stick with the newer sets that don't require much major service. There's less money in it, but if you do enough minor service, you can make a living.

Wally Waddell
3009 Lawndale Ave.
Flint, Mich. 48504

Legislation: The Answer To Consumer Servicing Ills?

I have taken offense to a recently published letter from an ES reader who opposes technician licensing. I agree with his opposition of licensing; however, he makes mention of part-time TV repairmen and fly-by-nighters in the same breath.

I am a part-time electronic technician, as are many of your full-time readers. I resent the implication that if a man is a part-time technician, he is incompetent. In fact, the evidence in many cases is just the opposite. If the larger service organizations paid technicians a decent salary, these part timers would be working for them instead of seeking full-time employment in a less demanding profession.

Many part-time repairman, like myself, have full-time employment in industrial electronics, where the average pay is slightly higher than can be obtained in the consumer servicing market. Many part-time TV repairmen are capable and do a good job.

Because some of the larger service organizations have men working for peanuts, they can hardly retain any real technical talent for any great length of time. Even the bench technicians are drawing a miserable $178 per week. This is not even a living wage here in New Jersey. The technicians that have real ability are often forced to go into business for themselves, to make a decent living. All the service seminars and factory training methods are not going to help, only a decent salary will help.

It is true that TV technician licensing is a bad thing, and it should be pointed out in the right way and to the right people.

I feel that ELECTRONIC SERVICING and its editors, as well as the people in the service industry, have an obligation to themselves and to the electronics industry. That obligation is to take time to write to the people that can do some good for the industry: their state senators and other elected officials. These public officials are the ones who shape the legislation that is passed. All the belly aching in the world among ourselves isn't going to do a bit of good; we have to direct it to where it counts.

Very often our state senators receive little or no mail on key issues; therefore, they can only base their decisions on the response of their constituents who contact them, not on those who remain the silent majority. While we sit back and do nothing, the "very loud minority" are being heard. Let's rally round the flag boys and show them that the service industry has a voice, a voice that can be heard loud and clear. Publishing the U.S. Department of Labor statistics is nice, and it indicates how poorly paid our industry is, but it won't solve our problems. A concentrated effort by both full- and part-time servicers to force legislation that is more favorable to us is the only answer.

Alex Reid
Kearny, New Jersey

Mr. Reid, I agree with your contentions that:

1) many able electronic technicians are underpaid;
2) because of inadequate compensation, many able technicians have quit consumer electronic servicing;
3) a technician's competence cannot be judged accurately on the basis of whether he services consumer electronics products full or part time; and
4) all individuals and companies directly related to the business of servicing consumer electronic products, including the staff of ELECTRONIC SERVICING, should, whenever possible, exercise initiative to improve conditions in the industry.

However, Mr. Reid, I do not agree that legislation is the only effective source of solutions to the problems that confront this business. In my opinion, legislation should be considered only after all other possibilities have been tried and proven ineffective or unworkable.

The first step to solving any problem is to recognize that a problem indeed does exist. The next step is to identify the cause(s) of the problem and then determine how the cause(s) best can be eliminated or, at least, its effect(s) reduced. Statistics, such as those published in recent issues of ELECTRONIC SERVICING, not only help us recognize problems but also help us identify specific causes. Because many problems, such as inadequate compensation of technicians, are self-evident, statistics are not always necessary for recognition, although they do help prove the existence of the problem to the many doubting Thomas's that comprise at least a minor part of any group. However, statistics are vital even for self-evident problems because they help identify causes of the problem—unless the causes are identified and dealt with, there can be no solution to the problem. Reaction alone seldom cures problems; the real weapons are analysis and action. The staff of ELECTRONIC SERVICING feels that it can serve

(Continued on page 10)

Circle 8 on literature card

(Continued from page 8)

the industry more effectively by analyzing problems and recommending solutions rather than merely reacting to controversial issues.

Information we have obtained from a variety of reliable sources does indicate that, relative to the compensation of other skilled trades, consumer electronic technicians, as a group, are underpaid. After determining that this situation does indeed exist, we have attempted to identify the most probable causes.

From information gathered to date, we have concluded that the causes of this problem are all directly related to the shop owners **inability** to adequately compensate technicians, not his **desire** to do so. Most shop owners recognize the value of skilled employees and realize that if such employees are not adequately compensated, they will not be able to attract and retain them. They also realize that there is a shortage of skilled electronic technicians.

The factors which directly affect a shop owners ability to adequately compensate his technicians are:

- Service labor rates
- Shop efficiency

If a shop owner fails to adjust his service labor charges upward to compensate for increased operating and labor costs, he, in turn, probably will not be able to adjust his technicians wages to a level comparable to that paid other skilled trades. Also, he will not be able to afford the training required to maintain the proficiency of his techncians; consequently, the efficiency of his shop will decline, which, in turn, effectively increases his labor costs. Once this vicious circle of cause and effect and cause gets a good foothold, other problems are created: inadequate compensation prompts skilled technicians to seek employment in other more lucrative fields, and a shortage of skilled technicians is created; inadequate training compounds the problems of rapid-fire changes in technology, further reducing the proficiency of technicians and, consequently, the efficiency of shops and the service industry. I could fill up another two or three paragraphs with such cause and effect, and it all would lead back to the fact that many of the problems of the consumer electronic service industry can be attributed directly to inadequate service labor charges, which, in turn, do not enable shop owners to 1) pay wages that will attract and retain skilled employees and 2) maintain or improve the efficiency of their shop through, refresher and upgrade training programs.

Licensing and other forms of legislation might eventually help us rid this industry of the undesirables, but I doubt that it will help eliminate the major problems of this industry, most of which are related to economics and consequently require the adoption of more effective business management and shop operations. —Ed.

Remember: Removing Load Increases Voltage

When servicing a TV with a trouble symptom of low boost voltage, most technicians determine if the yoke is causing the trouble by disconnecting the yoke to see if the voltage increases. When making this check, do not be misled into thinking the yoke is bad by a normal increase in boost voltage.

In a Hotpoint HS 202 (Photofact Folder 356-8), I found boost voltage to be 150 volts (normal is 270 volts). I disconnected the yoke, and the boost voltage increased to 230 volts. My first reaction was that the yoke was bad. Then I thought it over. Why didn't it come up to 270 volts? Possibly there were two troubles. The yoke and another trouble each could be lowering boost voltage. Or is this increase in voltage normal when the yoke is disconnected?

I decided to assume that it was normal and proceed. I reconnected the yoke and the boost voltage came back down to 150 volts. I bridged the boost capacitor (C2BO and boost voltage came up to 330 volts). Previously I was being lead astray by a normal increase caused by removing a load.

Arthur Doehnert
Houston, Texas

More Tips About How You Can Help Speed Up Parts Distribution

Please accept sincere thanks for printing Mr. Stan Cmielewski's views on parts availability. *In his guidelines he mentions two of the most important aids when ordering parts from any Parts Dept.*

1) Try to have an "open account" with the distributors you do business with and keep it in an "open to buy" position.

2) Know the name of the order desk clerk you are dealing with. It's an invaluable assist, should you have to expedite later on.

All modern distributors are geared to handle their business on an "open account" basis; invoices are usually extended after the merchandise has been shipped. To do otherwise breaks the routine, causes delays and also costs both dealer and distributor more money (COD charges).

There is one more guideline we would like to add: Order your parts by number and description. It will avoid wrong call-outs and transposition of digits, which result in wrong parts shipped, unhappy dealers, upset consumers, shrinking profits and in general, cause all around loss of goodwill.

The distributors are here to help you give the quickest possible service to the consumer, because, indirectly, you are helping to enhance the image of the manufacturer whose set you happen to be working on at the time.

Walt Pasner, Manager
Parts & Service Dept.
RCA Distributing Corp.
Los Angeles, Calif. ▲

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readers exchange

■ Electronic technicians and owners or managers of electronic service shops who need assistance obtaining a part, service literature or any other item related to the servicing of electronic equipment, or who have for sale such an item, are invited to use this column to inform other readers of their need or offer. Requests or offers submitted for publication in this column should be sent to: Readers' Exchange, ELECTRONIC SERVICING, 1014 Wyandotte St., Kansas City, Mo. 64105. Include a brief but complete description of the item(s) you need or are offering for sale, your complete mailing address and how much you are willing to pay or want for the item(s). Individuals responding to a request or sale offer in this column should write **direct** to the requestee or seller.

Info About 13CM5 Tube

The December issue contained a letter from a reader in California looking for information on a 13CM5 tube for a Canadian made TV. These sets are manufactured in Canada under the brand name Philips or Rogers-Majestic by Philips Electronic Industries. The same people who manufacture in the U.S. under the Norelco name.

This tube 13CM5 is a horizontal output tube, and was used in chassis "S1", and "S2" and "S3" under Philips and Rogers-Majestic names. Also I have seen a few private branded under the Silvertone name.

This tube can be replaced by a 12DQ6G/B provided the screen dropping resistor is increased in value to hold the screen voltage under 150 volts. The 13CM5 is capable of operating at 175 volts or more; which is beyond the ratings on the 12DQ6G/B.

In some series of these chassis the screen was wired with two resistors in parallel, a seven watt and a two watt. To use the 12DQ6G/B it is merely necessary to clip one end of the seven watt blue resistor, leaving the two watt in the circuit.

Eric C. Duvar
Montague,
Prince Edward Island

Help Needed

I need a dial tuning glass with numbers for a Cornado battery radio, Model 43-6301, 1946 model.

I would like to buy a two or three tube Crosley battery radio. A 1922 to 1925 model.

I will gladly pay any cost for this information or any help.

Filo Henssler
McHenry, N.D. 58464

I would like to buy (new or used) two J10 AC/DC converters and J11 pre-amp KΩ/DC plug-in cards for Non Linear Systems (Del Mar, Calif.), Model X-2 digital multimeters.

Jack Aguilar
507 3rd Ave. B-404
Seattle, Wash. 98104

I need the manuals and schematics for a N.R.I. Professional signal tracer, and a Superior Instrument genometer, Model TV 50 If any money is due, please send C.O.D.

William Gutschmidt
11 Short Street
Clifton, N.J.

I was wondering if anyone could help me locate a book. I had a book on radio & TV circuits that was written by two men, the names of the authors has escaped me. It showed the diagrams of the circuits and described in detail its operation. The book was divided in sections numbered by letters such as AB, NM, etc. This book of circuits has been misplaced and I would like to buy a replacement. It was listed as costing $7.00 and I think it was about 15 years old. The size was approximately 7 inches x 9½ x ¾ inches thick. I think the book was yellow.

I would also like their revised edition if there is one available.

James Corum
Upham, N. Dak. 58789

I have a Pyramid capacitor-resistor analyzer, Model CRA-1.

The transformer has burned out and the company that makes it is no longer in business.

Can anyone let me know where I may be able to get a transformer, or one of these testers? I would be interested in one that is working or in need of repair as long as it has a good transformer.

Landon's Electric Shop
Wayne, W. Va. 25570

I have a GL Vis-U-All, Model V 300 picture tube tester that is in need of repairs. I wrote the company for circuit information but they no longer have anything on it. Can someone please help?

Harold C. Hoglin
5020 Zenith Ave. South
Minneapolis, Minn. 55410

I am trying to locate a schematic or shop manual for a Mopar Tac-Dwell Meter, Model TTD-1-351 made by Chrysler Corp., Mopar Parts Div. I have written to Mopar but have not received a reply.

George W. Miller
Route 2, Box 82
Montello, Wisc.

For Sale

I have for sale a Model E-200C, Precision Apparatus RF signal generator. This piece of equipment is clean, and calibrated. I would like $37.50. I also need a calibrater AC/VTVM to purchase or trade for the above item.

B. C. Grant
6546 Murdoch Ave.
St. Louis, Mo. 63109

(Continued on page 14)

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RCA

(Continued from page 12)

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1) Sencore, FE-14 Field Effect Meter VOM
2) Sencore, TC-136 Mighty-Mite Tube Tester
3) Lectrotech, Model V-7 Color Generator & Vectorscope.

Albert Chonka
816 Richford St.
Duquesne, Pa. 15110

I am forced to sell my CRT Champion TV Picture Tube rebuilding equipment. The unit is still in warranty and includes everything you need to get started in the business, plus many extras that are not included in the original price.

For a complete list or other information contact me. Everything must go for $2,450.00, deduct $150.00 if you can pick up the equipment.

Gary O'Mara
Eastway Electronics Co.
9305 Granville Lane
Indianapolis, Ind. 46229

I have Sams PHOTOFACT Folders No.'s 1 thru 609 for sale, no reasonable offer refused. I also have Riders Radio manuals No.'s 1 thru 15, also other radio and television books for sale. Please contact me.

John Bossone
24 Benjamin Drive
North Providence 4, R.I.

I have a Windsor Picture Tube Rebuilding outfit I would like to sell. Specifications include, complete oven control panel and bombarding equipment, #25 sealer complete, T2 color package, black light, hot cutter, dag dryer and tools.

I would like $4,500.00 for this equipment, it has never been used.

Satterlee TV
464 S. Lebanon
Mesa, Ariz. 85202

I have for sale, or trade hard-bound, like new books:
1) "Installing and Servicing Home Audio", (Hobbs), $2.50.
2) "Pinpoint Transistor Troubles in 10 Minutes", $2.50.
3) "Radio & TV Troubleshooting and Repair", (Ghirardi), $2.50.
4) "Radio Servicing", (Marcus), $2.00.
5) "10-Minute Test Techniques for Electronic Servicing", (Carlson), $2.00.
6) "TV Doctor", "Simplified Radio Servicing", "Radio & TV Hints", "Telefixit", "Handyman's TV Repair", all for $2.50, softbound.
7) "How to Build 78 Radio and TV Sets", $1.00.
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9) "Transistor TV Guide", (Tab), $1.00.

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Stanton TV
4624 N. Marvine
Philadelphia, Pa. 19140

I would like to sell the following test equipment:
1) Hickok, Model 650C pattern generator, $50,
2) Hickok, Model 760 Video scanner, $80,
3) Hickok Cardamatic tube tester, Model 121, $70,
4) Riders TV service manuals 1 thru 28, $40 for all,
5) TS-164/AR, TS 221 Frequency meter, 110 volt model, $35.

I would like to hear comment from any one who has used a digital readout volt-ohm meter for bench service operations.

George Popdavid
1255 Shadyside SW
Canton, Ohio 44710

I have closed shop and wish to sell all of my Sams PHOTOFACTS No.'s 97 to 1026, including filing cabinets, I will take best offer plus freight. I have approximately $5000 in tubes that I would like to sell at 82% off list price. I have many volumes of Car Radio Repair and several volumes of Riders. Also many kinds of test equipment with manuals.

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Gilbert M. Lentz
532 Kensington
Fillmore, Calif. 93015
(805) 524-3501

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James Turley
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Decatur, Ill. 62526 ▲

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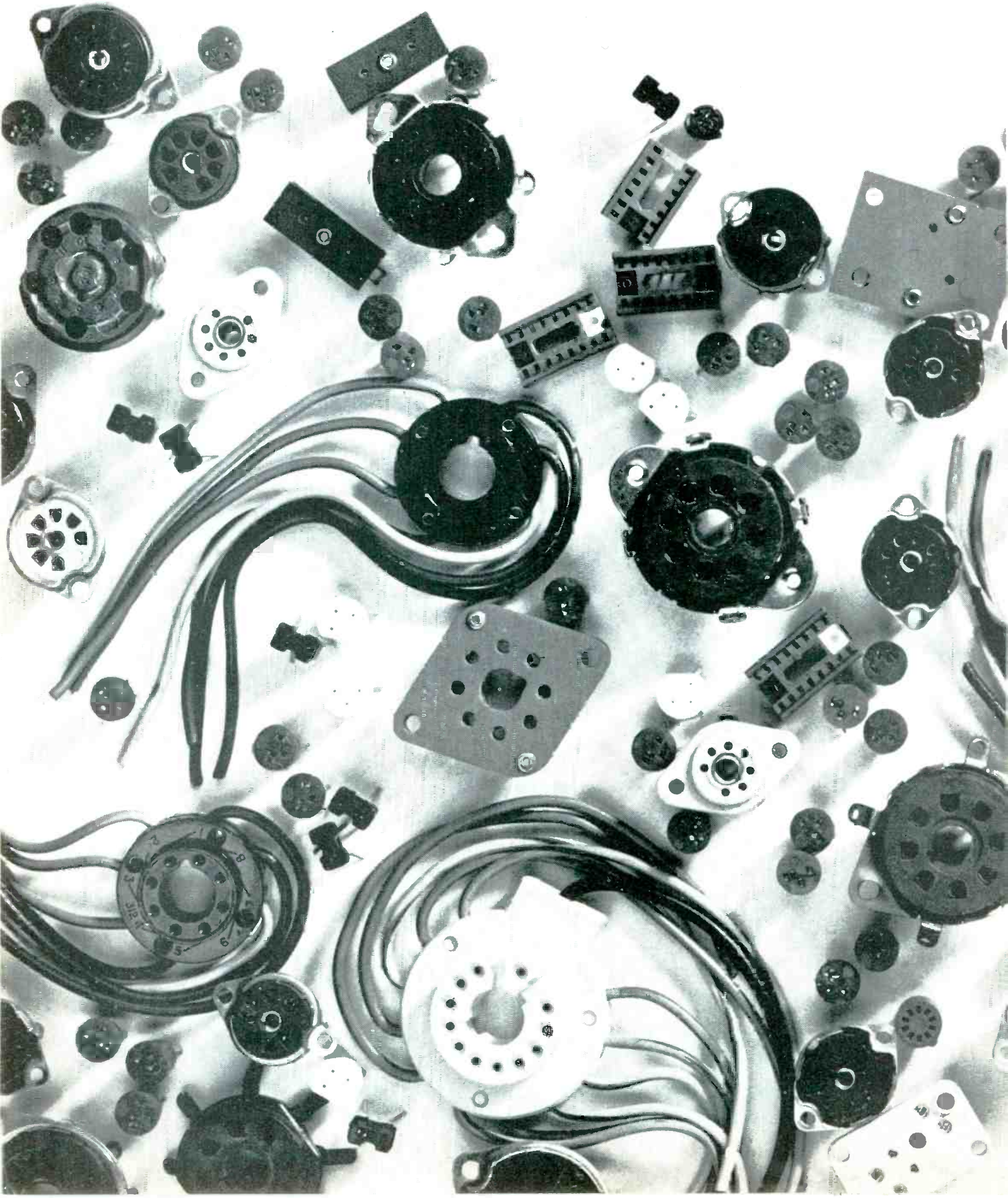

Simplifying stereo

What separation is, how it is achieved and how to track down defects that reduce or eliminate it, plus a simple device which you can construct and use to eliminate the need for two audio generators for channel-comparison tests.

by Leonard Feldman

How Stereo Separation is Achieved

Some fifteen years after the popularization of stereophonic sound reproduction in home music systems, there is still much that is misunderstood about two-channel, or stereo, sound by listeners and technicians alike. The nature of the "stereo illusion" is still being intensively investigated by top scientists in the field.

Before you can logically attempt to analyze "stereo faults" in a high-fidelity stereo system, it is important to understand the few elements that go to make up what we call the "stereo effect".

The easiest phenomenon to understand about stereo is "separation". If two microphones were used to record the original program, each microphone "heard" a different program because it heard it from a different vantage point. The left microphone, in the case of a typical symphony orchestra arrangement, will pick up the string section with greater intensity than, say, the brass section, while the converse will be true of the right-channel microphone. That is not to say, however, that the right microphone picks up **no** sound from the string section or that the left microphone "hears" **no** trumpets. What we can safely say though, is that the right microphone will pick up the string section with considerably diminished amplitude, and at a somewhat later point **in time.**

When listening to the recorded results, your ears and that part of your brain which translates into "intelligence" what the ear picks up will work with these two differences between channels—intensity **and** time of arrival (which may be looked upon as "phase" differences, since at all but the highest tonal frequencies, the difference in time of arrival will be but a fraction of one full wavelength). As implied, the job of any stereophonic amplifier is to faithfully reproduce both the amplitude and phase differences between the recorded material of both channels.

Manufacturers and technicians, as well as many users of equipment, have been conditioned to adopt the "purist" attitude that the **more** electrical separation you have between channels, the better the system. Thus, claims of 25, 30 and even 40 dB of separation are made (and met) by various pieces of equipment on the market.

The truth is, however, that in all but the most exaggerated stereo recordings (in which, for example, the two channels were actually recorded in two separate studios and even **on two** separate occasions) it has been proven that virtually all listeners cannot detect the difference between 10 or 15 dB of separation or cross-talk. By that we mean, it is better to have a balanced cross-talk situation (left to right and right to left) of 12 dB than to have, say 20 dB of cross-talk from left to right and only 8 dB of isolation from right to left. This condition, which is sometimes present in mis-adjusted

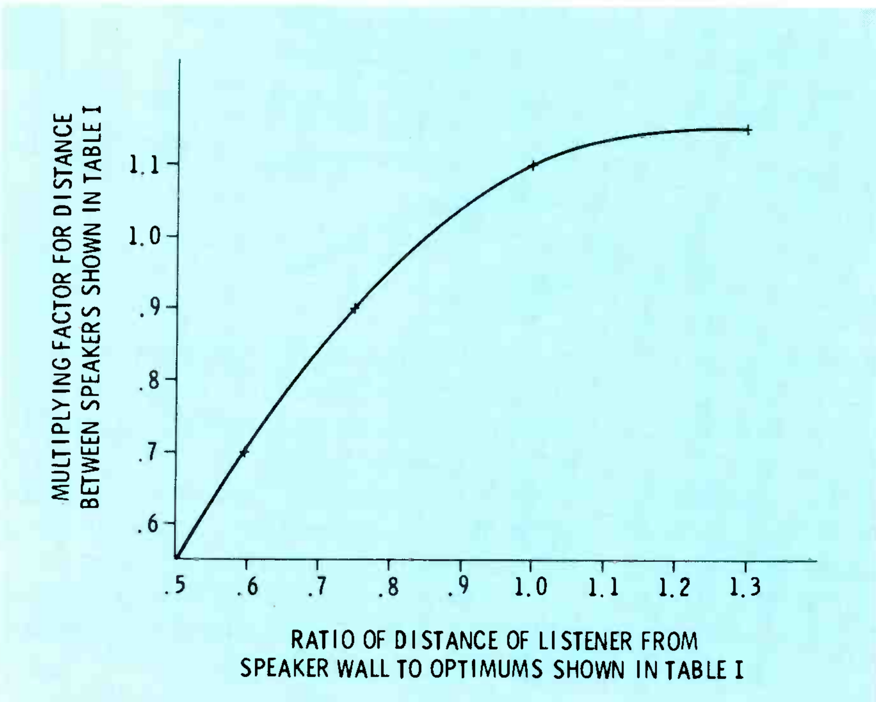

Fig. 1 Graph shows correction factor in speaker spacing when listener's distance to speakers is other than ideal.

separation problems

stereo FM circuits, causes listeners to try to re-balance the "center" sound (with no success, by the way) by means of the balance control on the amplifier.

Speaker Placement for Stereo

Ignoring any electrical problems, for the moment, it has been our experience that most complaints from customers involving "poor stereo effect" stem from improper speaker and/or listener placement.

Equipment manufacturers are often at fault here, because, in an effort to generalize, they make such statements in their instruction booklets as :"Place the speakers 8 to 10 feet apart for optimum stereo effect." Now, 8 to 10 feet of separation might be great for certain size rooms and with the listener in an optimum position, but in other situations the sound might fuse together in what sounds little better than a two-speaker monophonic system, while in other circumstances the apparent separation might be so extreme as to sound like two separate programs with a big "hole-in-the-middle".

Over the years, we have formulated a set of basic layout dimensions which work satisfactorily. These layout dimensions are tabulated in Table I, and are based upon the listener being positioned at distances shown. Of course, the listener cannot always position himself at the optimum listening point, and adjustments have to be made. For this purpose, the graph of Fig. 1 shows the necessary correction factors to apply to the table if the listener has to sit further away or closer to the plane of the loudspeakers. Some flexibility is, of course, permitted, but both the table and the graph are based upon consumer reactions which we have observed and cataloged over at least ten years of custom installation work.

"Odd-Room Problems"

Stereo installations would be simple if everyone lived in a perfectly rectangular room, with a wall ratio of approximately 4 X 5, and with no archways, doorways, open windows and broken sections of walls. Unfortunately, architectural aesthetics are often at odds with stereo requirements, which leads us to the bane of the stereo installer's existence—the "L"-shaped living room/dining room combination so prevalent in American architectural schemes.

A typical "problem" layout is shown in Fig. 2. Obviously, the information contained in Table I and Fig. 1 will not work here. The best compromise we have been able to devise for this typical arrangement is shown in Fig. 3. It is based upon the proposition that the extra cubic volume of the dining area is in reality a part of the living room volume (or, at least, about 50% of it is considered to be so) and makes use of the inherently better bass propagating characteristics of at least one of the loudspeakers when it is placed in a corner.

Because bass tones are not particularly directional in stereo programming, this bass enhancement from one corner will not noticeably detract from the overall stereo balance desired. By mentally increasing the dimensions of the major rectangular area by an amount equal to 50% of the dining area, you use the separation figures in

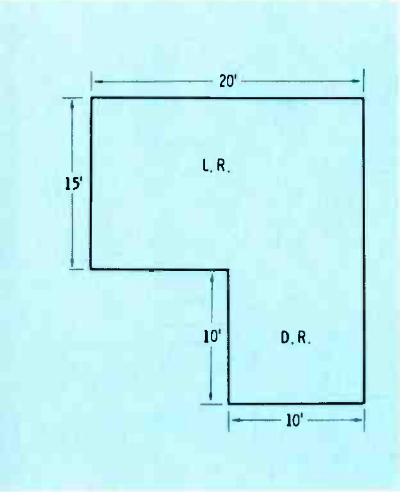

Fig. 2 A typical "problem" layout in stereo installations is the "L"-shaped living room/dining room arrangement.

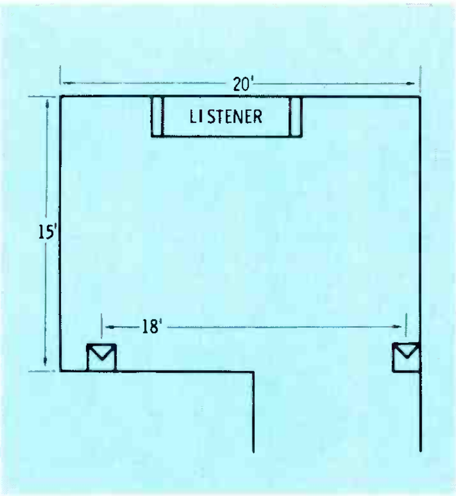

Fig. 3 By allowing for the extra room area, a reasonable speaker arrangement is calculated for the "problem" room of Fig. 2.

Table 1

Speaker placement for best stereo effect

Room Size	Listener's Distance to Speaker Wall	Optimum Distance Between Speakers
8' x 10'	4'	8'
10' x 12'	8'	11' or corners
12' x 15'	10'	13'
15' x 20'	12'	15'
18' x 24'	15'	18'
20' x 30'	18'	24'

Table I and Fig. 1. As an example, suppose the major dimensions (the large area) in Fig. 2 are 15 feet x 20 feet, and the dining area is 10 feet x 10 feet. The dining area is 100 square feet; the main area is 300 square feet. Add 50 square feet (50% of the dining room area) to the major area, for a result of 350 square feet. Keep the ratios of "length" to "width" approximately constant, to arrive at new arbitrary (though fictitious) main area dimensions of 16½ x 22 feet. The nearest available figures in Table I are for a 18 feet x 24 feet listening area, and that is how we arrived at the placement of speakers and listener in the finished layout of Fig. 3.

If you are faced with a situation in which the above calculations indicate that one speaker must be placed in the opening between living and dining areas, the only valid solution (short of compromising the whole installation) is to reverse listening and speaker positions, placing the speakers on the long, continuous wall that is not broken up at all. If such a reversal is necessary, use main area listening dimensions which are **reduced** by 50% of the dining area square footage. In other words, place the speakers **closer together** than would be called for by the basic dimensions of the large main area, per Table I.

Separation Problems Related to Circuit Defects

Of course, things can happen to the electronic components of a stereo system to reduce or completely eliminate separation, and no amount of speaker placement will compensate for these electronic shortcomings, which we shall consider next.

Aside from actual short circuits in amplifiers, the major cause of loss of stereo separation is the inadvertent placement, by the operator, of the "mode" switch in the mono setting.

Similarly, many "one speaker doesn't work" complaints can be traced to complete rotation of the "balance" control either to the extreme left or extreme right position which, in most cases, completely turns off the alternate speaker systems entirely.

In tuners or receivers, loss of stereo FM often can be traced to a selector switch being left in the FM instead of the FM-Stereo (or FM-MPX) position. In such equipment the case is further complicated by the "stereo indicator light", which denotes the reception of a station broadcasting in stereo. Many users erroneously presume that because the light is lit they are, in fact, listening to the program in the stereo mode. Newer sets which feature automatic switching from Mono to Stereo (on FM) have at least eliminated this erroneous use of the selector control; however, even in these sets there is a general "Mono-Stereo" switch which might have been left in the Mono setting.

Phono cartridges themselves can be connected wrongly so that only monophonic sound is produced, even though the stereo cartridge is okay. If the "hot" and "return" leads of one channel of a stereo cartridge are accidentally reversed while the terminals of the other channel are connected correctly, the only bad result will be phase reversal. If, however, one of the sections of the cartridge is internally grounded, either to the frame of the tone arm or to the frame of the record changer or turntable and this point, in turn, is grounded to the amplifier chassis, a total "short" will have been placed across the incorrectly wired section of the cartridge and sound will come through only one channel.

Many tape recorders also have mono switching arrangements that should be checked first, before checking the circuitry for defects. Remember, in some complex systems a tape deck may be connected to a preamplifier which, in turn, may be connected to an amplifier. All of these elements might have facilities for switching between mono and stereo operation, and if

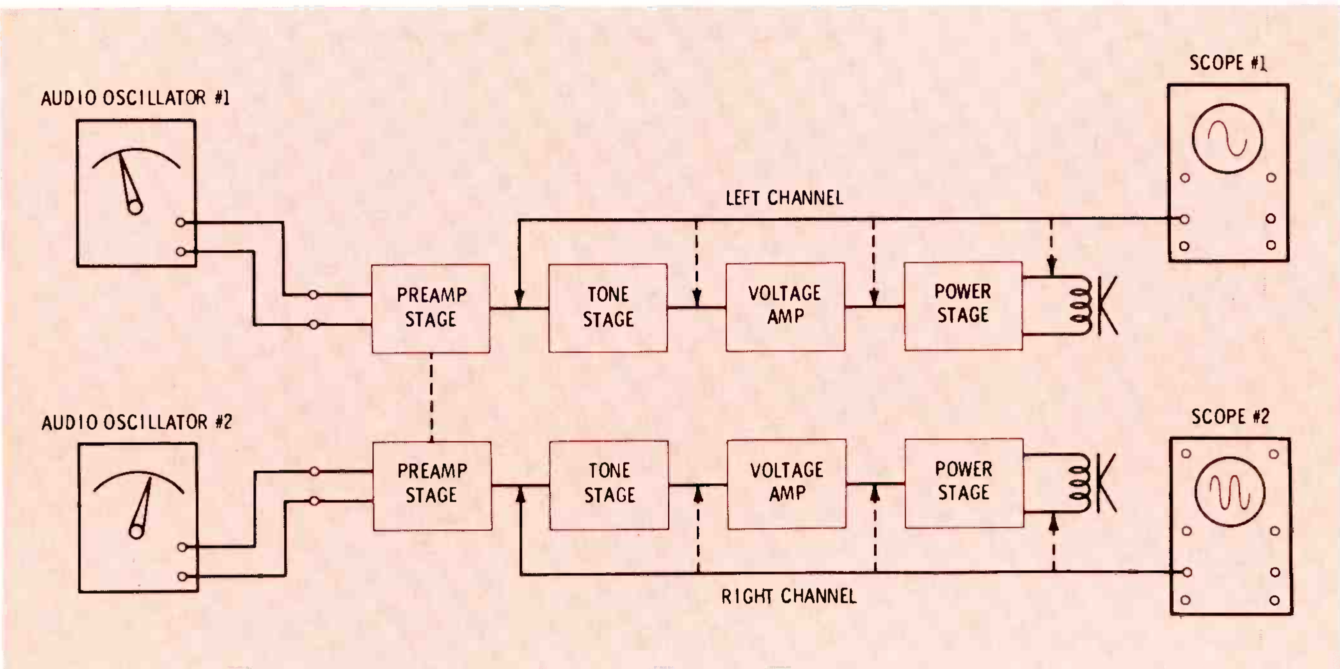

Fig. 4 Separation checks can be made using two audio oscillators set to different frequencies, as shown in the block diagram.

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any one of these switches is accidentally left in the mono mode, mono mixing of both channels will take place.

Locating Actual Circuit Defects

The most obvious way to trace stereo separation in amplifiers or preamplifiers is by means of two audio oscillators, each set to a different frequency, each feeding one channel of the amplifier. An oscilloscope can then be used to check for isolation of signals, stage by stage, as shown in the block diagram of Fig. 4. By examining the waveform at each point illustrated and by using two frequencies which are adequately separated (e.g. 400 Hz for the left channel and 1600 Hz for the right channel), the presence of two frequencies in the channel where only one should be will be very apparent, even if its undesired content is as low as 10% or less (equivalent to separation of 20 dB or more) of the desired signal.

The stage at which such "cross-talk" takes place can then be isolated and further investigated for the presence of shorts between channel components, shorts between "hot" conductors of audio cables from opposite channels, unbypassed power supply dropping resistors, etc., any one of which could be responsible for the presence of an excessive amount of cross-talk.

"Two" Signals for The Price of One

We have devised an inexpensive gadget which we use in troubleshooting separation problems. This device has two advantages over the method previously described.

Earlier in this article it was stated that the stereo illusion is produced by both amplitude **and** phase differences between channels. The "two-audio-generator" method can tell you all you want to know about the **amplitudes** of the left and right channel signals, but it can't tell you a thing about the **phase** responses.

The device whose schematic diagram is shown in Fig. 5, and which we have labeled, "Two-for-one" adapter, enables a technician to check **both** amplitude and phase of the two stereo channels—and requires only **one** audio generator.

The "Two-for-one" adapter produces two output signals whose phases are 180 degrees apart. As can be seen in Fig. 5, this is accomplished by three RC networks (R1-C1, R2-C2, R3-C3) each of which shifts the phase of the applied sinewave by approximately 60 degrees.

In addition to shifting phase, the networks, as shown, will attenuate the input sine wave by approximately 30 dB. To compensate for this attenuation, a fixed and a variable resistor have been added in the path of the "in-phase" channel. The potentiometer is needed so that the amplitude of the "zero phase" and "180-degree" signals can be set **exactly** equal before the instrument is used for testing. This is a lot less

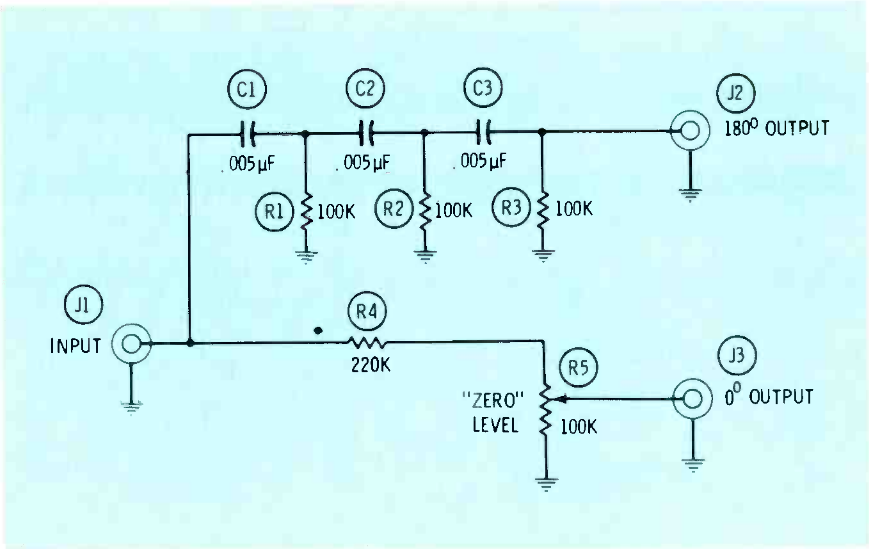


Fig. 5 Schematic of phase-shifting network used to produce two 180-degree, out-of-phase audio signals of approximately 800 Hz.

Fig. 6 The completed "two-signal" adapter, labelled for use in tracing separation problems.

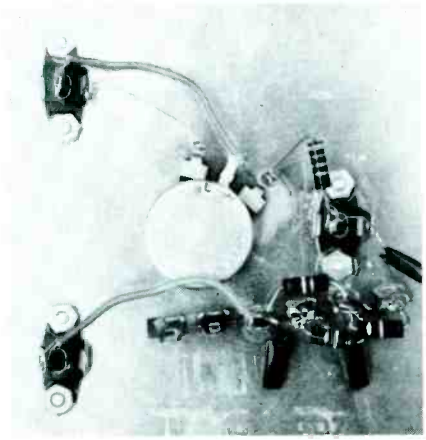


Fig. 7 Rear view of adapter shows wiring layout.

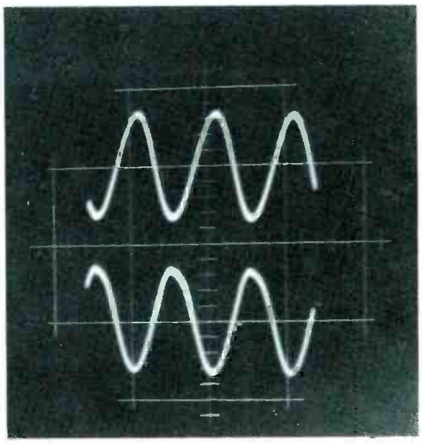


Fig. 8 When properly calibrated, the adapter provides two out-of-phase signals of equal amplitude, as shown in this dual-trace scope photo.

expensive than, say, using 1% resistors and capacitors, which would otherwise have been required to maintain such accuracy. As it is, 10% tolerance for all parts is adequate, and the potentiometer itself can have a 20%, or even a 30%, tolerance.

Since we are using such broad-tolerance capacitors and resistors, the exact frequency at which exactly 180 degrees of phase shift takes place cannot be predicted, other than to state that it will be around 800 Hz (a nice mid-frequency value). This presents no problem, however, because the frequency of your audio oscillator is variable, and you can set its output to the frequency which causes exactly 180 degrees of phase shift in the one channel of the device.

The "Two-for-one" adapter shown in Fig. 6 is constructed on an aluminum chassis, and the inputs and outputs have been labeled for easy identification. The simplicity of wiring is shown in the photo of Fig. 7. Parts layout is not at all critical, because only low audio frequencies are involved. A complete parts list is shown in Table II.

After completing the wiring and assembly, we set out to calibrate the device for use. We had access to a dual-trace oscilloscope and therefore were able to observe the relative phases of the two waveforms as the audio generator was tuned to the correct frequency (in our case, about 780 Hz). The potentiometer was adjusted so that the amplitudes of the two outputs were equal, as shown in Fig. 8.

If you have only a single-trace oscilloscope, connect one of the outputs to the vertical input terminals and the other to the horizontal (external) inputs, and switch the horizontal selector of the scope to "EXTERNAL". If the frequency of the generator is far removed from the frequency which will produce 180 degrees of phase shift a "lissajous" pattern will be produced which looks something like one of the three in Fig. 9. As the generator output approaches the correct frequency, you will first pass through a circular lissajous pattern (indicating 90 degree phase difference) and finally you will see a diagonal line sloping upward, to the left, indicating exactly 180 degrees phase difference between the two signals. Carefully note on your audio oscillator the frequency which produces 180 degrees of phase shift between the two outputs of the device, so that you don't have to repeat this procedure every time you want to use the device for signal tracing.

You might have to turn up the amplitude control on your audio oscillator relatively high, to compensate for the approximate 30 dB of attenuation noted earlier. Because most audio oscillators are able to produce 5 to 10 volts of audio output voltage (r.m.s.), there should still be about .15 to 0.3 volt available at the two outputs of the device after it has been calibrated.

The best way to calibrate the **amplitude** of the "zero-phase-shift" signal with respect to the 180-degree signal, using the potentiometer, is to measure each output separately with an AC VTVM, with the correct frequency applied from your audio oscillator.

To trim the frequency and amplitude for optimum, if desired, use a stereo amplifier which is known to be functioning properly and whose separation is at least 30 dB. Feed the "zero-shift" signal to one input, and the 180-degree signal to the other channel. Set the mode switch on the amplifier to MONO and, if the gain of both channels is equal, you should hear practically no sound coming from the speakers. Trim the frequency of your oscillator and the amplitude control on the device for an absolute null (no or minimum sound heard), alternately adjusting the audio oscillator and the potentiometer on the adapter a

Table II

Parts list for phase-shift adapter of Fig. 5

Symbol	Descriptions
C, C2, C3	Capacitor, Disc, Ceramic; 0.005 mfd, 10%, 100V
J1, J2, J3	Jack, Phono, Switchcraft 3501FP, or equal
R1, R2, R3	Resistor, Composition, 100K ohms, ½ Watt, 10%
R4	Resistor, Composition, 220K ohms, ½ Watt, 10%
R5	Potentiometer, 100K ohms, Mallory Type U-41, or equal
———	Chassis, utility, 4" x 4" x 2", Bud Metal AU-1083, or equal
———	Terminal strip, H. H. Smith type 859, or equal
———	Solder, hook-up wire, mounting hardware, control knob

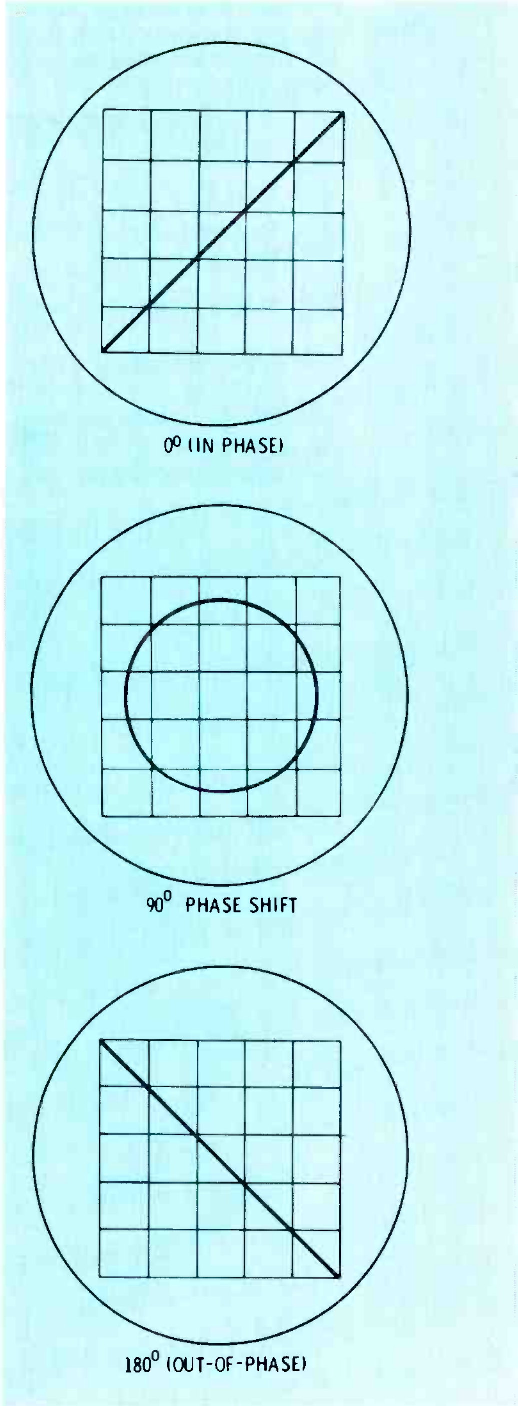


Fig. 9 Out-of-phase signals applied to the horizontal and vertical inputs so a scope will produce a diagonal line, as shown here.

bit at a time, until best null is achieved. Your "two-for-one" signal adapter is now ready to troubleshoot stereo amplifiers which exhibit separation problems.

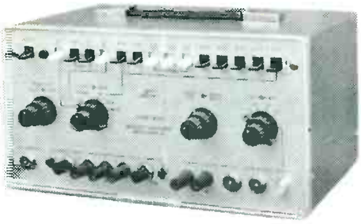
Using The "Two-For-One" Signal Adapter

There are several ways in which you can use this device for tracing separation problems. If the circuit of the defective amplifier is such that mono mixing takes place early in the circuit, you can operate the amplifier in the MONO mode and check for little or no audio voltage between the output points of the respective left and right channel equivalent stages. The stage which first shows a substantial departure from zero audio voltage, as you go down the line, is the one to investigate for possible loss of gain or other defect.

If you prefer, you can leave the amplifier in the stereo mode and observe lissajous patterns at the outputs of each stage (of each channel) as before, noting the proper 180-degree phase shift and the equality of amplitude levels at the output of each stage. When a stage fails to meet either condition, the stage should be tested further. Remember that although an extreme difference in phase shift characteristic between stages (observed as a shifting of a lissajous pattern from the desired sloping line, upward to the left), is not strictly speaking, a definite indication of loss of separation or an increase in cross-talk, it nevertheless can impair the stereo illusion and should be analyzed and corrected if possible.

Limitations of the Adapter

It should be realized that this device is useful in only the audio circuits of stereo equipment. Loss of stereo in the stereo FM (multiplex) circuits of a tuner or receiver cannot be analyzed easily using this device, unless the problem is with the one or two audio stages that usually follow the demodulator circuitry. To troubleshoot stereo FM separation problems, a stereo FM generator is still essential. However, the "Two-for-one" adapter, at least, can help you eliminate the audio stages of the system as the source of the separation problem, after which you can proceed directly to the stereo FM circuitry. ▲



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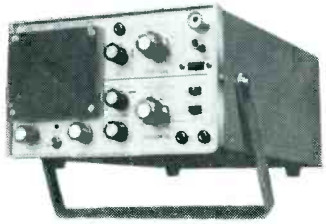

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Common causes of horizontal nonlinearity

Analysis of typical defects in tube-, transistor- and SCR-equipped horizontal-output circuits.

by Robert G. Middleton

From a practical point of view, the first half of the horizontal scan is produced by discharge of the boost capacitors, and the second half of the scan is produced by drive from the horizontal-output tube.

At the end of each horizontal scan and the start of retrace the damper circuit begins to recharge the boost capacitors. Consequently, defects in the damper-boost circuit tend to produce picture symptoms on the left side of the screen. Defects in the horizontal-output circuit tend to produce picture symptoms on the right side of the screen. However, there are exceptions to the rule of thumb, because of interactions in the horizontal-deflection system.

Conventional Horizontal-Deflection System

Fig. 1 shows the configuration for a conventional flyback system. When horizontal nonlinearity occurs, first determine whether the trouble is in the oscillator section or the sweep section. This can be accomplished by checking the horizontal drive waveforms, an example of which is shown in Fig. 2. The

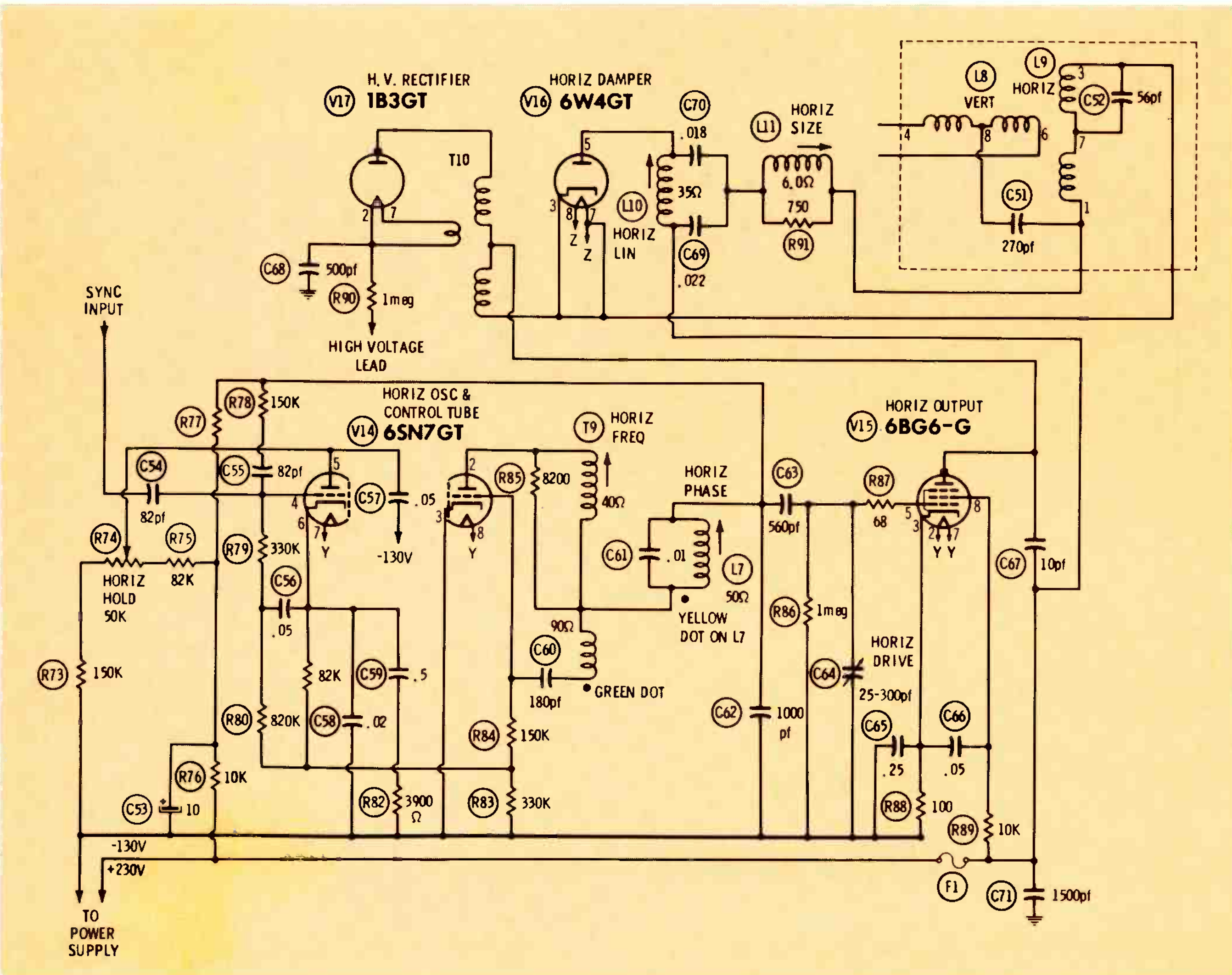


Fig. 1 Schematic diagram of a conventional flyback system.

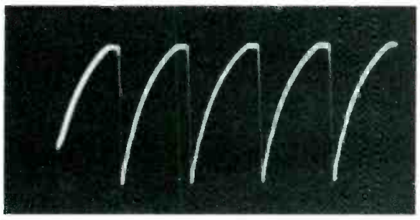


Fig. 2 Normal drive waveform on the grid of the horizontal output stage.

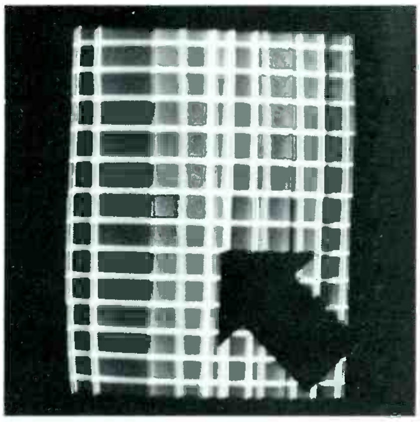


Fig. 3 Open input boost capacitor causes nonlinearity, center-screen foldover, and reduced width.

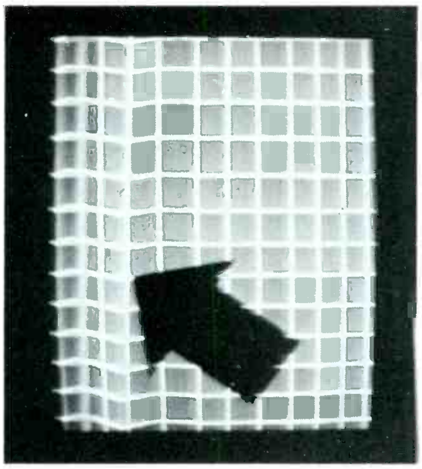


Fig. 4 Open output boost capacitor causes nonlinearity and reduced width.

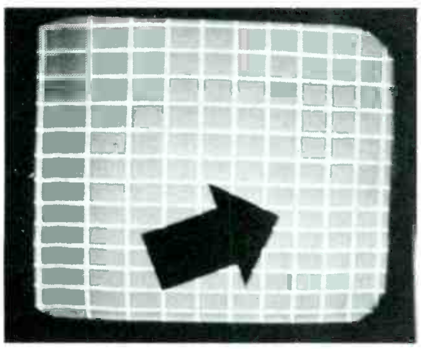


Fig. 5 Short in linearity coil causes compression on right of screen and reduced width.

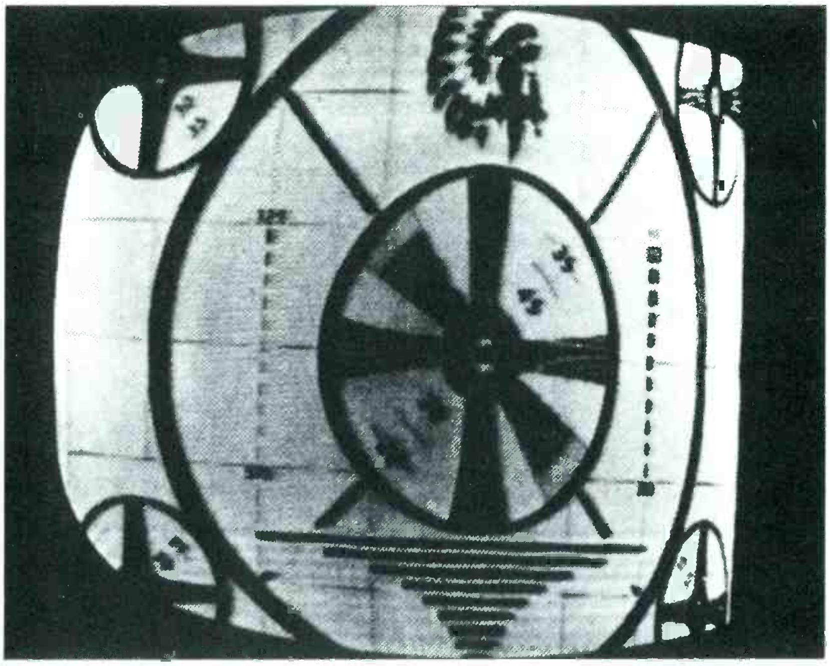
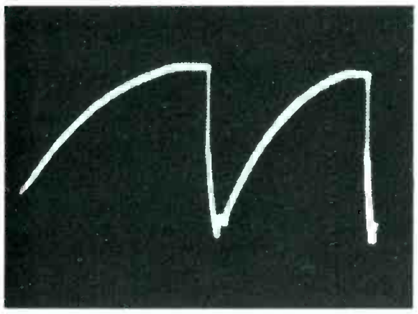
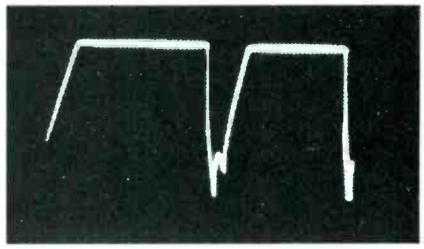


Fig. 6 Classic symptom of nonlinearity: compression at right side of screen.



(A) Undistorted.



(B) Distortion caused by leaky coupling capacitor.

Fig. 7 Normal and abnormal drive waveforms at grid of horizontal output stage.

amplitude of the waveform is as important as its shape. Because there is no interaction between the sweep section and the oscillator section, a drive waveform with distortion or reduced amplitude localizes the trouble to the oscillator circuitry, and vice versa.

Common Defects

Defective capacitors are the most common troublemakers. For example, if the input boost capacitor (C70 in Fig. 1) opens up, the trouble symptoms will be horizontal nonlinearity, foldover in the center of the screen, and reduced width, as shown in Fig. 3. If the output boost capacitor (C69) opens up, nonlinearity and reduced width will be produced (Fig. 4).

A short-circuit between layers of the linearity coil produces compression toward the right-hand side of the screen, as shown in Fig. 5. This same general type of picture symptom can be caused by a leaky coupling capacitor in the grid circuit of the horizontal-output tube; Fig. 6 shows the degree of nonlinearity which results. The distortion that occurs in the drive waveform as a result of a leaky coupling capacitor is shown in Fig. 7.

Watch Replacement Values

Linearity coils, with their associated capacitors, operate as waveshaping circuits. Consequently, to obtain proper waveshaping and good horizontal linearity, replacement coils and capacitors for these functions must have correct values. Similarly, if a defective yoke is replaced with one that has incorrect value of inductance and/or resistance, horizontal nonlinearity is certain to occur, accompanied by width

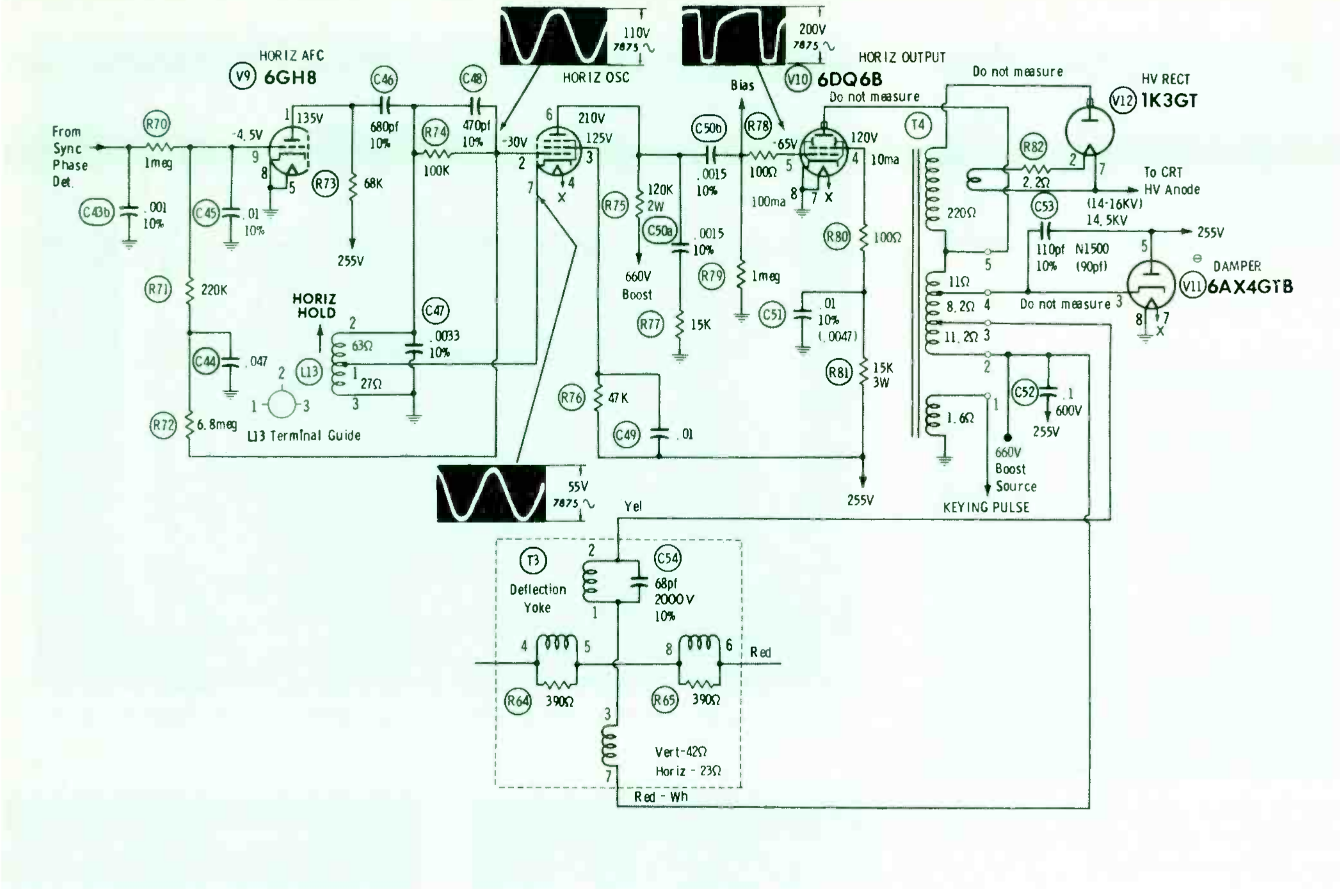


Fig. 8 Typical autotransformer type of horizontal-deflection system.

trouble. All experienced technicians have had this unexpected development, both as a result of improper yoke substitution and improper flyback substitution. The receiver service data should be considered the final authority for replacement criteria.

Autotransformer Horizontal-Deflection System

A typical autotransformer horizontal-deflection system is shown in Fig. 8. This arrangement uses a peaking capacitor, C50A, in the plate circuit of the horizontal oscillator. If the peaking capacitor opens the drive waveform becomes misshaped and horizontal nonlinearity occurs, similar to the picture symptom in Fig. 6.

If the boost capacitor (C52 in Fig. 8) opens, the resulting horizontal nonlinearity is even more severe, as illustrated in Fig. 9.

As an example of the importance of observing correct replacement values, consider C50B in Fig. 8. If this capacitor becomes leaky, the picture symptom will be similar to that shown in Fig. 6. However, suppose that we make a decimal-point error, and replace the 0.0015 pf capacitor with a 0.00015 pf unit. The result will be horizontal nonlinearity which resembles that produced by an open capacitor.

Note that the coupling capacitor and the grid-leak resistance in Fig. 8 form a differentiating circuit. When the time constant of this circuit is too short (caused, for example, by use of too small a replacement capacitor), the drive waveform becomes excessively differentiated. This causes attenuation of the sawtooth component in the peaked sawtooth waveform. Thus, the practical effect is somewhat the same as if the drive waveform had been compressed or clipped as the result of leakage in the coupling capacitor, which bleeds some of the plate voltage from the horizontal oscillator into the grid circuit of the output tube. This, in turn, causes the operating point of the tube to be shifted, and the peak of the drive waveform is compressed or clipped because of plate-current saturation.

Solid-State Horizontal-Output System

Fig. 10 shows a typical solid-state horizontal-output system. Most nonlinearity symptoms in such circuits are caused by defective capacitors. For example, if C86 loses capacitance, the picture symptom will be similar to that of Fig. 6. With substantial loss of capacitance, foldover also occurs at the right side of the picture. If C86 becomes leaky, the picture will be more or less decentered.

If C84 opens, the picture be-

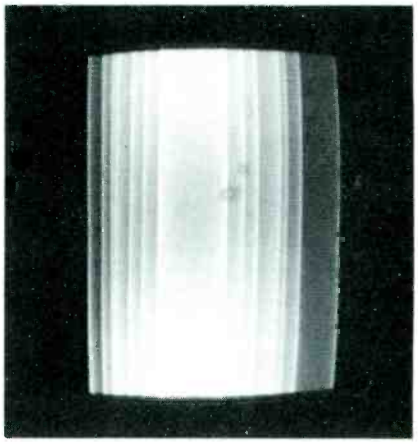


Fig. 9 Open boost capacitor causes severe foldover and nonlinearity shown here.

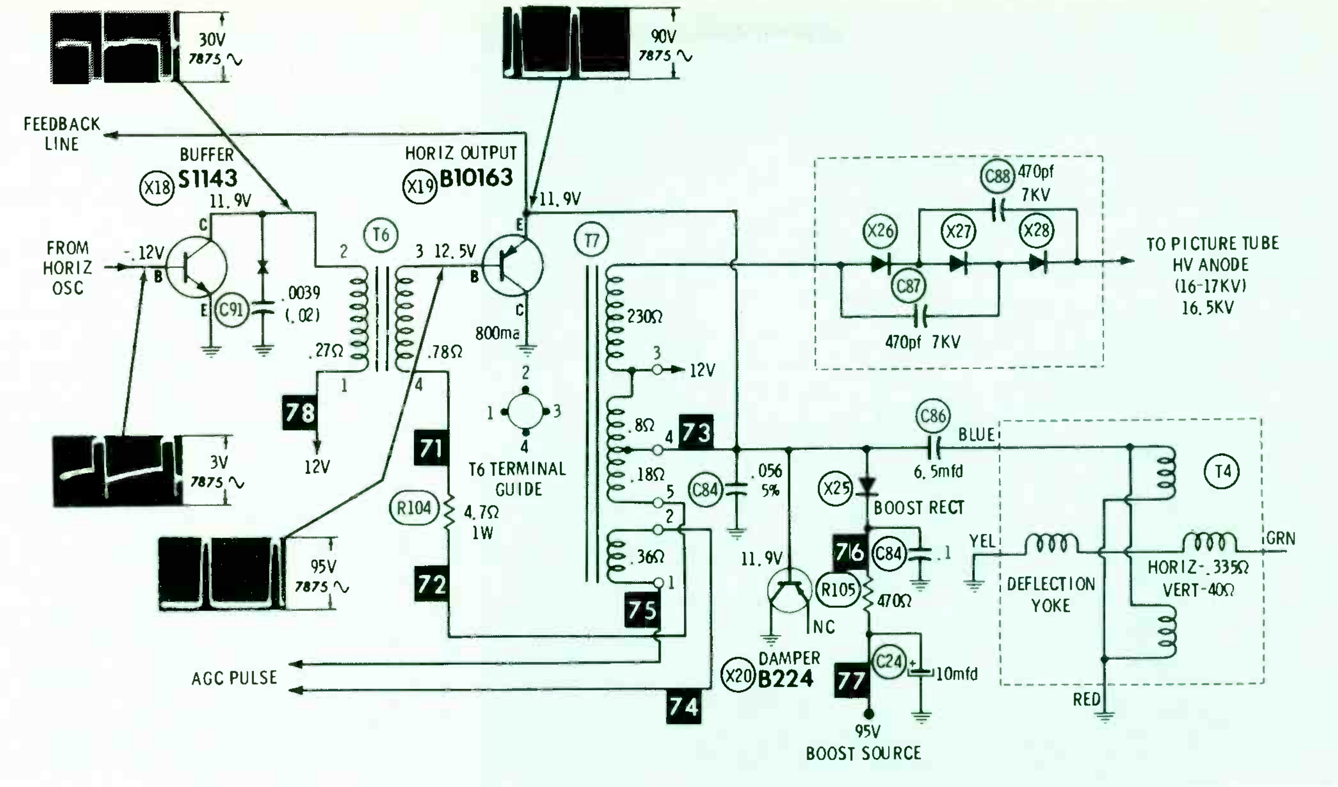


Fig. 10 Schematic diagram of a typical transistor-equipped solid-state horizontal-output system.

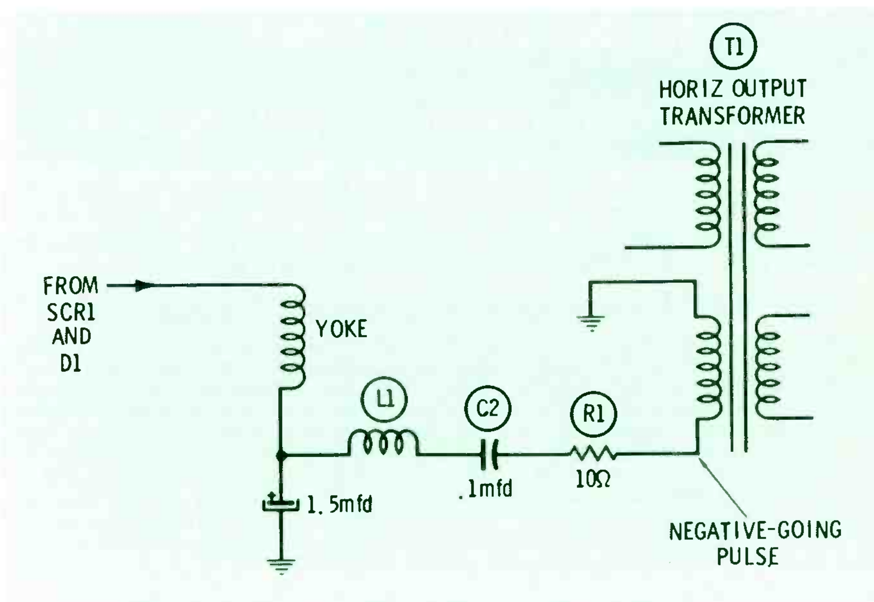


Fig. 11 SCR-equipped horizontal-linearity circuit.

comes nonlinear in the same way as with an open C86, but to a lesser extent. To distinguish between faults in C86 and C84, note whether the picture has a bright edge on the right (incipient foldover). If a bright vertical line is present, the trouble might be in C84, but will not be in C86. Of course, foldover at the right-hand edge of the picture could be caused by component defects other than capacitors. However, first check the capacitors, because they are statistically the most likely troublemakers.

Transistors are normally very long-lived, and if they fail, they tend to do so catastrophically. However, a buffer or output transistor will occasionally develop an abnormal amount of leakage current. This defect does not show up definitely on an in-circuit transistor tester, but is quite apparent when an out-of-circuit test is made. Marginal transistor leakage causes reduced picture width and noticeable compression on the right side of the screen. Usually, an audible power-supply hum occurs also, caused by the abnormal current drain. (Power-supply hum also can be caused by leakage in C24, C84, or C85 in Fig. 10). Remember, when a power transistor is replaced, it must be firmly secured to its heat sink before power is applied.

As in the case of tube-type receivers, horizontal nonlinearity can be caused by incorrect types or values of replacement components. Thus, a decimal-point error in selecting a replacement capacitor is very likely to cause unsatisfactory circuit action.

There is less chance of making an incorrect flyback transformer or yoke replacement, because these components are more distinctive and fewer varieties are manufactured for solid-state chassis than for tube-type chassis. However, this possibility does exist, and any replacement for an inductive component should be checked against the replacement parts list in the receiver service data.

Finally, let us consider the most common causes of horizontal nonlinearity in horizontal deflection systems equipped with silicon-controlled rectifiers (SCR). As shown in Fig. 11, a linearity coil with an adjustable slug is provided in such systems. This inductor operates in combination with capacitor C2 as a waveshaper to provide linearity correction.

As semiconductors age, the scanning linearity tends to change; tolerances of replacement components are also a factor. Inability to obtain satisfactory horizontal linearity by means of slug adjustment points to a marked defect in the horizontal-output circuit or in the linearity circuit. For example, if C2 is leaky, slug adjustment will have little effect on linearity. On the other hand, if slug adjustment has a substantial effect on linearity, but is out of range, check the SCR and its associated damper diode for marginal defects.

Semiconductor faults usually produce reduced width, along with the nonlinearity symptom.

Summary

Horizontal nonlinearity is usually caused by defects in the sweep section; however, it also can be caused by defects in the oscillator section. To determine which section is at fault, check the drive waveform at the horizontal-output stage. A distorted or off-amplitude drive waveform points to trouble in the oscillator section, and vice versa. Open or leaky capacitors are the most common troublemakers, aside from defective tubes. However, flyback transformers and linearity coils occasionally produce nonlinearity symptoms.

Usually, nonlinearity on the left-hand side of the screen is more likely to be produced by damper-booster defects, whereas nonlinearity on the right side is more likely to be produced by output-circuit defects.

Solid-state horizontal-deflection systems can be classified into transistor and SCR types. The former seldom includes a linearity coil, whereas the latter design will almost always include one. In solid-state circuits, as in tube-type designs, open or leaky capacitors are the most likely cause of nonlinearity symptoms. However, diodes can develop poor front-to-back ratio, power transistors occasionally become leaky, and SCR's can slowly deteriorate as they age. ▲

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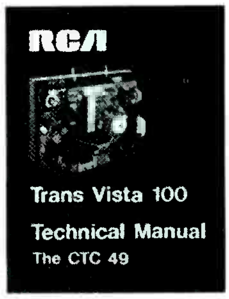

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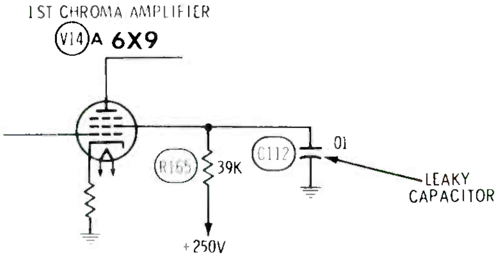
symcure

Symptoms and cures compiled from field reports of recurring troubles

Chassis—Admiral 6H10
PHOTOFACT folder—949-1



Symptom—weak or no color
Cure—check and replace C112, if it is leaking or open

Chassis—Admiral 6H10
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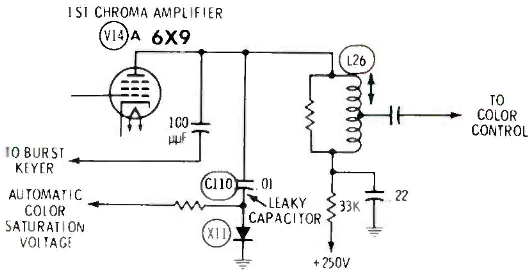
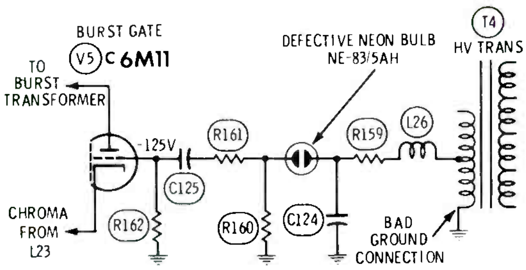


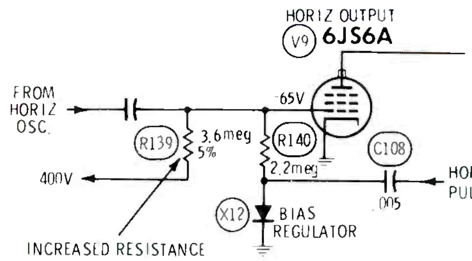
Symptom—weak color and voltage on plate of V14A low
Cure—check and replace C110, if it is leaking or open

Chassis—GE KC
PHOTOFACT folder—903-1



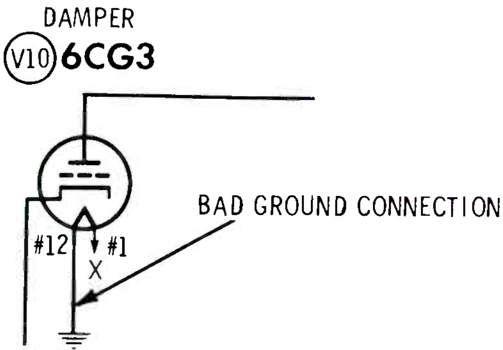
Symptom—missing or intermittent color
Cure—replace neon bulb, if dark, or repair bad ground on transformer winding

Chassis—GE KC
PHOTOFACT folder—903-1



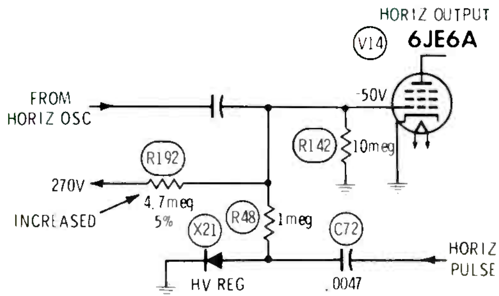
Symptom—narrow picture and reduced high voltage
Cure—check and replace R139, if its value has increased

Chassis—GE KD
PHOTOFACT folder—959-1



Symptom—narrow picture and reduced high voltage
Cure—check ground connection on heater (pin 12) of 6CG3 damper; connect a wire from pin 12 to the nearest chassis lance

Chassis—Magnavox T933
PHOTOFACT folder—1005-1



Symptom—narrow width and decreased high voltage
Cure—check and replace R192, if its value has increased ▲

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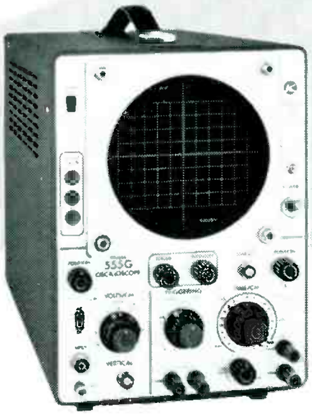

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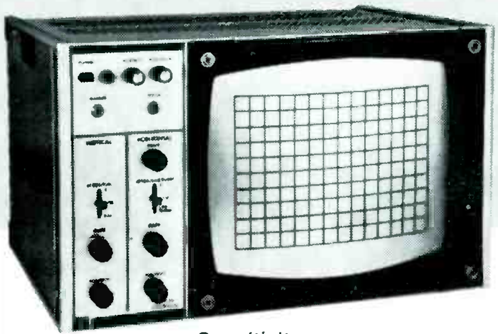

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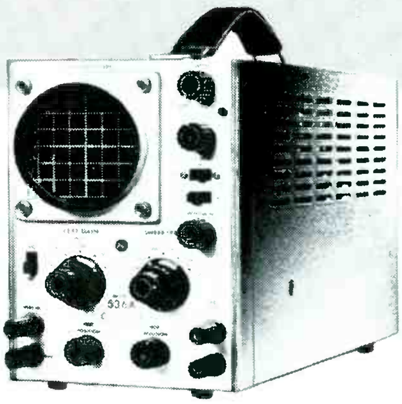

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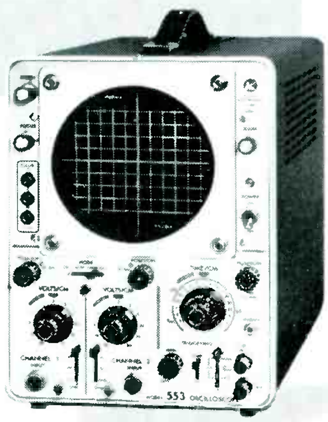

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Improved shop efficiency: The way to bigger profits

by J. W. Phipps and John Stapp

- I need more profit from my shop without increasing my capital investment, hiring more technicians or raising my prices. How can I do it?
- Increased operating costs and technician salaries have reduced my margin of profit. If I increase my service charges to regain a reasonable profit margin, I no longer will be competitive in my market area. By what other method can I regain the profit margin I desire?

The answer to both of these questions: Increase shop productivity without increasing your cost. To accomplish this, you must improve the overall efficiency of your shop.

How Shop Efficiency Affects Profits

The profitability of any business is directly proportional to how efficiently it produces a product or service of a desired quality.

Quality and cost of production are two related measures of efficiency. If efficiency is improved so that a product or service can be produced for less cost without reducing quality, the margin of profit is increased. For example, if the efficiency of a service shop that previously produced four jobs per hour is improved so that it produces five jobs per hour using the same amount of service labor, the cost per job will be reduced by 20 percent. If the average cost per job was $12.50 at the four-job-per-hour rate, the average per-job cost will be reduced to only $10.00 at the five-job-per-hour rate. The $2.50-per-job, (or $10.00-per-shop-hour) savings is additional profit—or all or part of it can be used to reduce the shop's service labor rate, to make the shop's service charges more competitive.

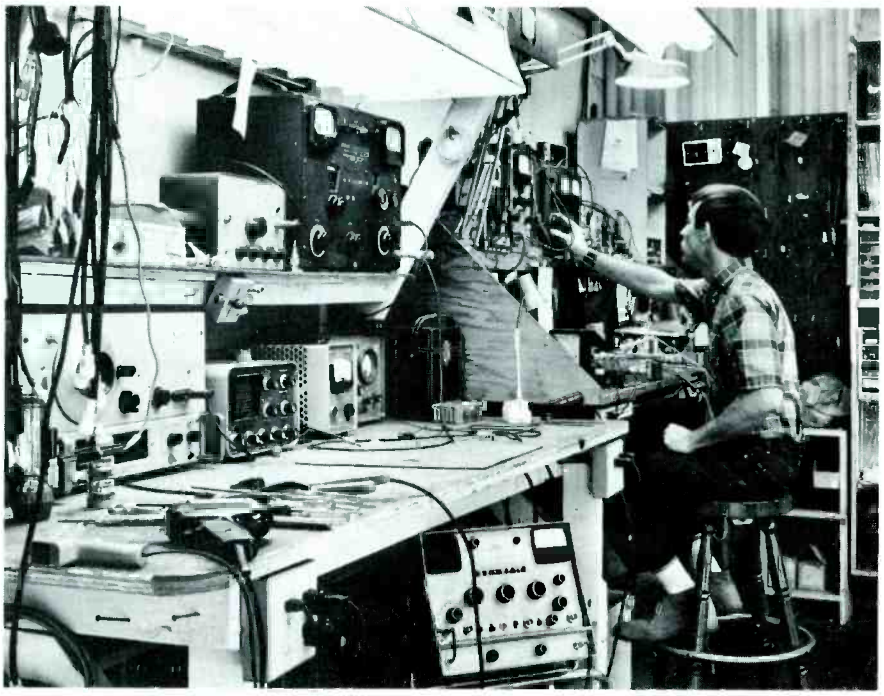
(In many other types of businesses, efficient use of materials also is a significant factor; however, because the amount of consumable materials—solder, wire, etc.—used to service consumer electronic products usually represents such a small portion of the total costs, it is not considered significant.)

Factors That Affect Shop Efficiency

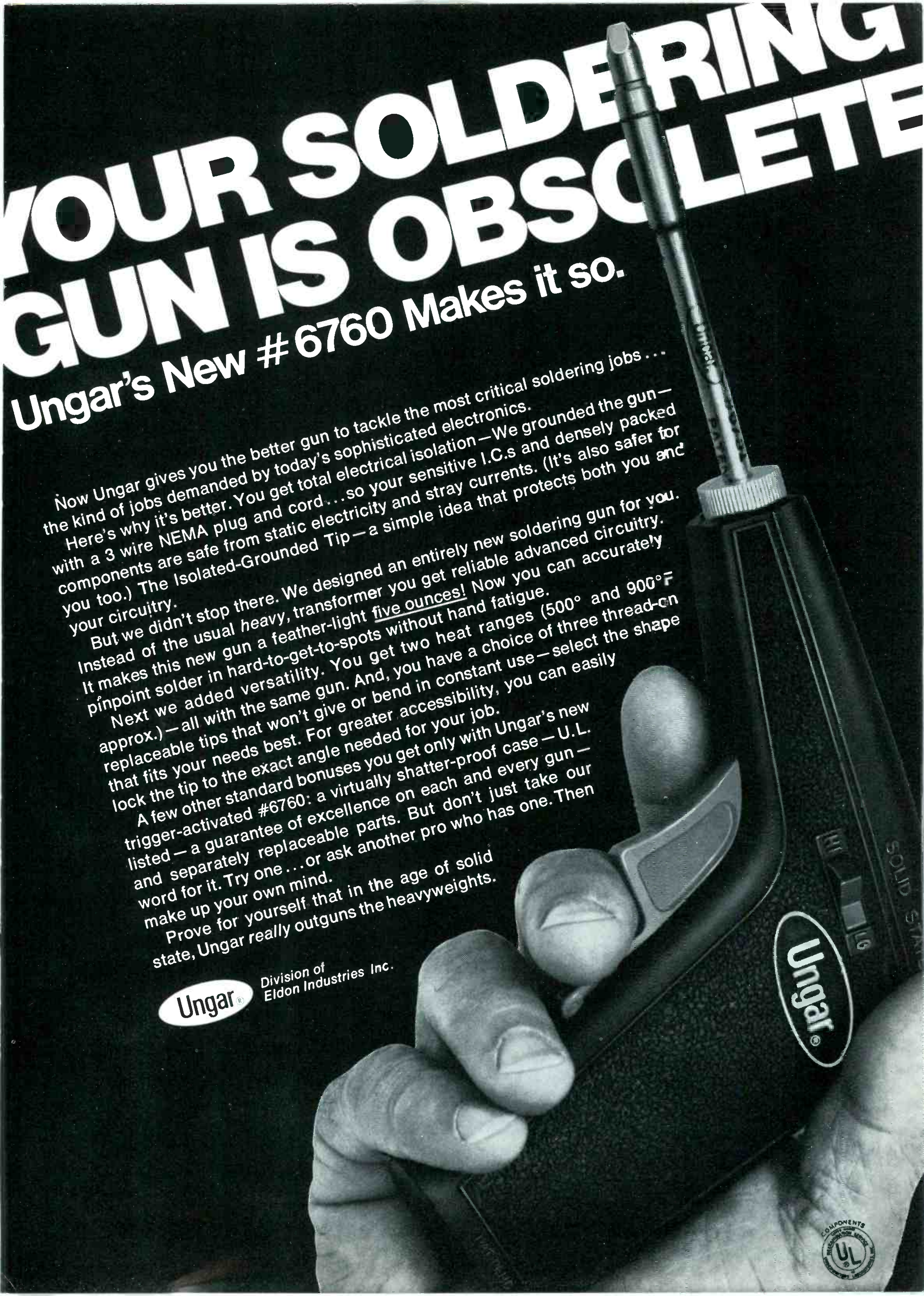
The factors that significantly affect shop efficiency are:

- Proficiency of individual technicians
- Control and system of processing work through shop
- Quality control

It has been shown how the profitability of a service shop is dependent on how efficiently the manager utilizes available manpower and resources. These factors and their related elements are outlined in the accompanying "Efficiency Check List", which you can use to evaluate the efficiency of your shop. Each of these factors and their related elements were evaluated in the following example of how management improved the efficiency of one electronic service shop.



The two-way radio bench is completely equipped both for repairs and for setting up net systems. Each of the two stations at the two-way bench are equipped with the following test instruments:
Frequency meters, oscillator, digital readout counter, signal generator, wattmeter, scope, and VTVM.
Variable power supplies produce 10 to 80 volts (necessary because of the variety of equipment serviced—for example, marine radio).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The Goal: More Profit Through Improved Efficiency

- Shop labor recovery rate better than 80%.
- Average time-in-shop per repair reduced from six days to less than three days.
- Service volume up more than 50% over the same period two years ago.

These statistics illustrate the results of improved service shop efficiency achieved by Lafayette Radio Electronics' reorganized six-man service shop in San Francisco. Relocated, re-equipped, and reoriented under the direction of a new service manager, what had been a losing service operation became a profit producer when it passed the break-even point in less than a year.

Lafayette Radio Electronics, with three associate stores in the San Francisco Bay area, specializes in the sale and service of stereo and two-way radio.

Change of Management's Attitude Toward Service Was First Step to Profit

The switch from loss to profit began over two years ago when Sid Levin, general manager, determined it was time for management to stop viewing the service shop as a "necessary evil."

"Ironically enough, I broke into this business as a manufacturer's representative, and used to give lectures to servicemen on shop efficiency," Mr. Levin smiles. "But when I got into retail sales, I found I was getting pulled away from the shop orientation. Insensibly, I began to look at the shop as necessary from the sales view, but unprofitable."

The San Francisco store was franchised in 1961. With growth, branches were opened in near-by Berkeley and Mountain View.

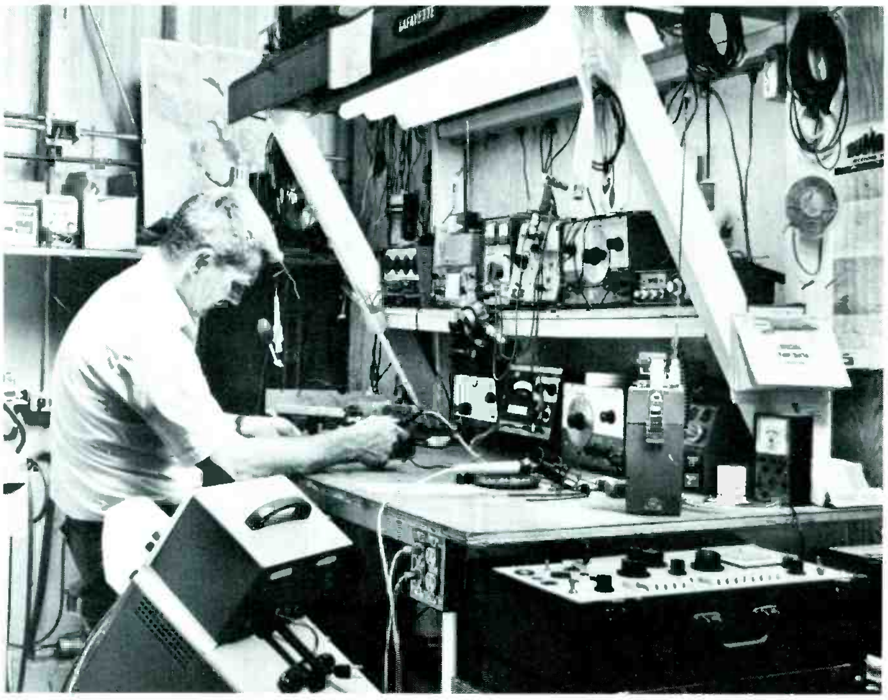
"At first, we farmed out the service," Mr. Levin recalls. "It was cheaper at the time, but poor from the standpoint of customer relations. We soon decided to get into service ourselves, recognizing its importance for customer follow-up and also for our professional image."

Decentralize-Centralize?

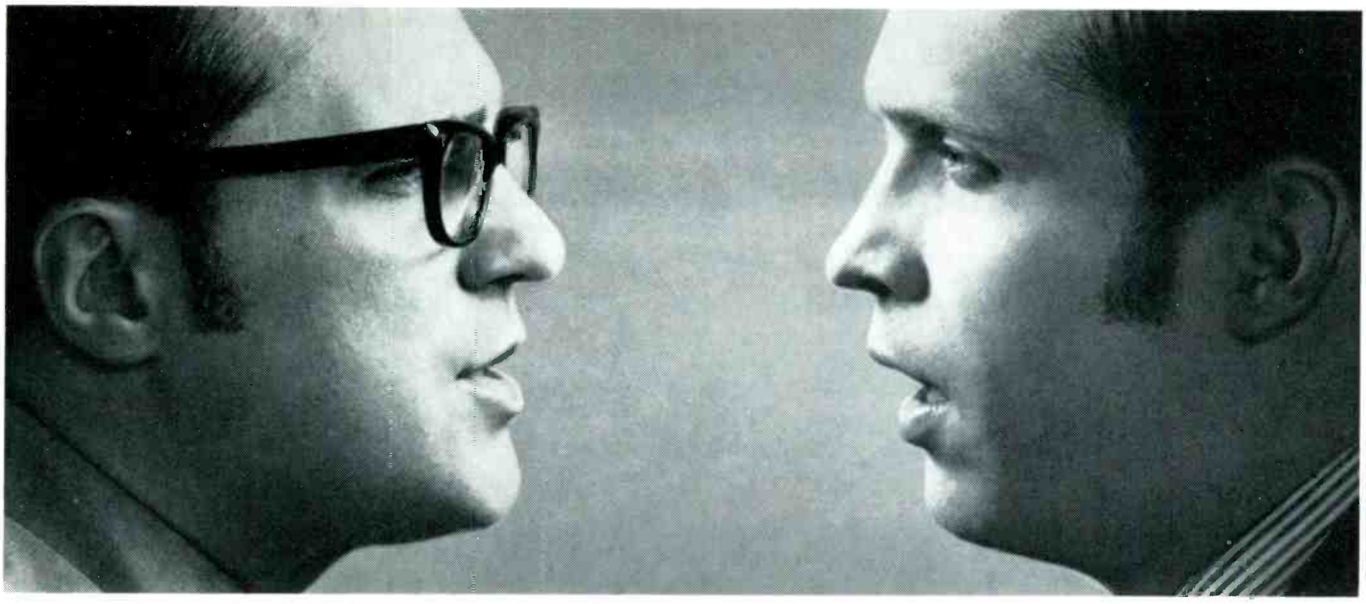
Management first tried a decen-

Shop Efficiency Check List

- **Technician Proficiency**
  1) Knowledge and Skill
     a) Interpretation of normal and abnormal circuit operation
     b) Logical sequence of troubleshooting
     c) Operation and application of test equipment
     d) Customer relations
  2) Quality and quantity of supportive material and equipment
     a) Test equipment
     b) Tools
     c) Service literature
     d) Parts and consumables
  3) Motivation
     a) Incentive pay program
     b) Appeal to professional pride
     c) Appeal to competitive nature
     d) Establishment of goals
- **Work Flow**
  1) Shop physical layout
     a) Accessibility of material, parts, tools and test equipment
     b) Adequate bench space
     c) Isolation of technicians from interference
     d) Minimum movement and setup of equipment
  2) Shop operating procedures
     a) Definite work, break and lunch periods
     b) Well-defined system of processing equipment
        1) Sequence of procedures
        2) Priorities
        3) Labor and parts accountability
  3) Utilization of personnel
     a) Catagorization and grouping of jobs according to knowledge and skill requirements of each
     b) Assignment of work according to skill required to complete it.
- **Quality Control**
  1) Standards
  2) Pre-delivery testing
  3) Preventive maintenance procedures
  4) Motivation of personnel
     a) Incentive pay based on incidence of callbacks
     b) Appeal to professional pride
     c) Establishment of goals



James MacAlister at the service manager's bench, which is located at the front of the shop so he can monitor both the customer area and the shop itself. The service manager's bench, intended primarily for servicing Citizens-band gear, but as completely equipped as the two-way radio benches in the rear of the shop, also handles two-way commercial radio, such as that used in taxicabs and fleets.



The Proficient Electronics Technician— Basic Skills He Must Possess

An electronics technician essentially is a diagnostician. He deduces the cause of a trouble by gathering and analyzing the symptoms exhibited by it. Elimination of possible and most-probable causes in a logical sequence enables him to pinpoint which circuit(s) and/or component(s) is the cause of the trouble symptom(s).

How quickly a technician can diagnose and repair a trouble symptom is dependent, in part, on how skillfully he can perform the following:

• Interpretation of normal and abnormal circuit operation—The technician first must be able to distinguish between normal and abnormal operating conditions. He must know how each section, circuit and component affects the frequency, amplitude and shape of the signal it generates or processes and the amplitudes and polarity of the voltage and currents it generates or with which it is supplied.

• Execution of a logical sequence of troubleshooting—An understanding of the inter-relationships and inter-actions of sections, circuits and components is essential to the system of logical deduction that is the primary tool of the diagnostician. A logical sequence of troubleshooting is based on such inter-relationships and inter-actions. Unless these are clearly understood, the process of elimination becomes illogical and unproductive, and, consequently, the technician reverts to mere guessing.

• Operation and application of test equipment—The gathering of supportive data in the form of voltage, resistance, current waveshapes, and other qualitative and quantitative measurements is an essential part of the technician's function. The more accurate are such data, the quicker the technician will be able to pinpoint the cause of the trouble. The accuracy of supportive data and the speed with which it is gathered depends primarily on the technician's knowledge of the application and operation of a variety of test instruments.

tralized operation, with independently operated service shops at each of the three retail stores. This proved unsatisfactory. It was difficult to maintain adequate management control. Also, with only one man at each location, it was impossible to develop a crew of technician specialists, each proficient in a specific type of service work.

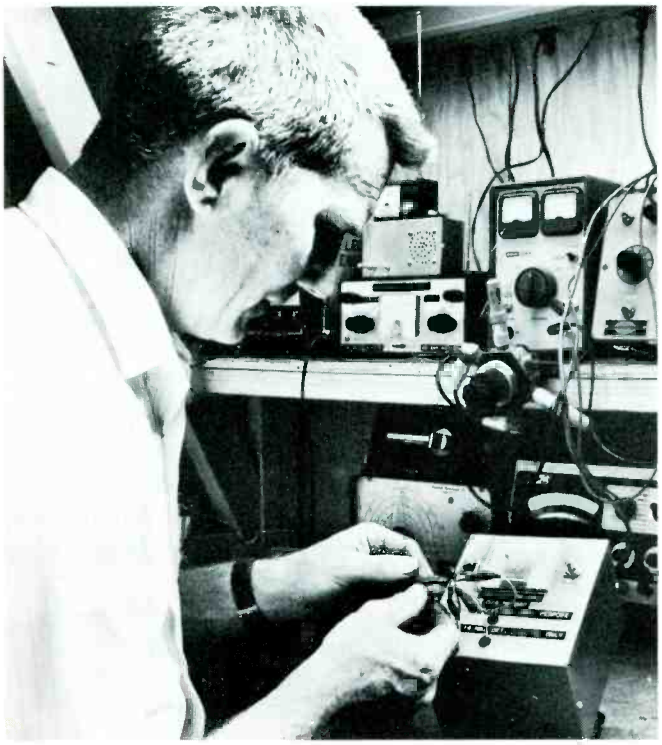
Consequently, service was centralized in the San Francisco store. But here the problem of shop productivity continued to plague management.

Analysis indicated at least three primary reasons why the service operation was unprofitable:

1) improper utilization of technicians' time;
2) poor physical arrangement and organization of the shop and equipment;
3) inadequate supervision.

To Keep Technicians at the Bench Productively Employed, Isolate Them From Salesmen and Customers

"A major weakness we found was



Using IC meter to test integrated circuitry against manufacturer's specifications. Pre-use testing of semiconductors improves shop efficiency by pinpointing faulty new components before the technician installs them, thus saving installation and removal time. Counterman performs most of pre-use testing in spare time, freeing technicians for "more technical" duties.

Good communications system is an important element of maximum shop efficiency. The system shown here has four components: telephone, with calls routed through office switchboard; private intercom to company office; two-way radio to stores, vehicles, and warehouse; and intercom net tying in stores, office, and shop.

the technicians were spending a lot of time discussing service problems with customers," Mr. Levin explains.

"No matter what we tried, we couldn't stop the salesmen from calling a technician up to the counter whenever a customer wanted to talk with a service man. This is almost inevitable because salesmen are oriented toward pleasing customers and seldom consider the cost of a technicians time. Our technicians were losing hours of production time as a result."

The solution to this problem was to completely isolate the service department from sales by physically removing the service department from the store.

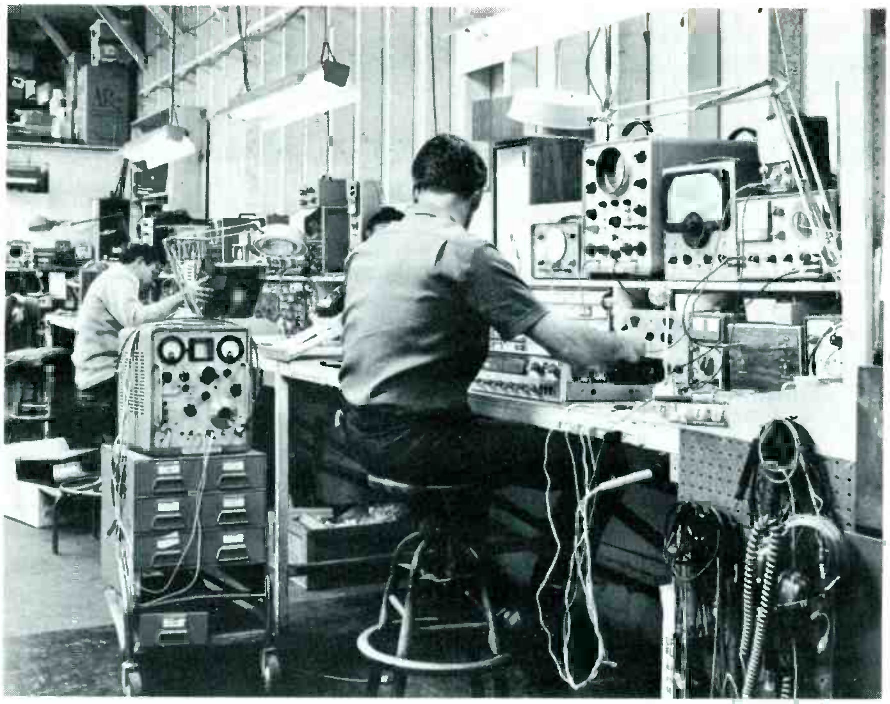
In early 1969, James MacAlister, a man with extensive experience in shop operation, was hired to manage the service shop. At the same time, management leased a 3,000-square-foot building around the corner from the store. It had a truck entrance which was converted to a drive-in bay. A small waiting room with a counter was set up at the front of the building, and an uncluttered and uncrowded service department was set up in the rear.

Customers enter the waiting room. A sign on a locked gate at one end of the counter advises, "Employees only. Customers not permitted in shop."

A non-technical counterman handles the drive-in and walk-in service customers. He's trained to ask intelligent questions, but firmly and politely points out that it's against the rules for a service technician to come to the counter.

Since the counterman has some spare time, he also serves as the parts man, taking the needed parts to the technicians, who, as a result, seldom need to leave their benches. Mr. MacAlister estimates that it costs an average of $5 every time a technician has to leave his bench to find a part.

A CCTV camera in the waiting room is focused on the counter and monitored in the shop so that the shop manager or his assistant can keep track of what's going on at the counter when the counterman is out on an errand or is getting parts. Another CCTV camera is focused down the shop's audio service aisle so that customers waiting at the counter don't feel completely alienated from the shop, but can watch some of the technicians at work.



Each of the two audio specialist employed by Lafayette is provided with two completely equipped benches. This double-bench concept reportedly has greatly increased productivity. When a priority or rush job is received, the technicians to which it is assigned does not have to waste time "clearing" his bench; instead, he uses his standby bench.
The double-bench concept also helps Lafayette avoid excessive backlogs of equipment awaiting servicing; if the volume of audio servicing increases, the service manager, his assistant or one of the other technicians can help by using one of the audio standby benches—and without wasting time rounding up the necessary test equipment, or waiting for an item of test equipment to be made available by one of the other audio technicians. The capital invested in the extra test equipment is more than offset by increased productivity and a more flexible shop capability.
Each of the four audio service benches is equipped with the following test instruments:
High-quality oscilloscope, multiplex generator, harmonic and intermodulation distortion analyzer, calibrated signal generator, sweep-marker generator, vacuum-tube voltmeter, test speakers, and wattmeters.
One of the audio benches is equipped with the instrumentation required to check wow and flutter of tape recorders against broadcast standards.

Specialization By Type and Brand Effectively Reduces Competition and Improves Shop Productivity

Lafayette Radio Electronics sells and services their franchise brand plus, Fisher, Scott, Sony, Ampex, Garrard, Dual, E. F. Johnson, and Concord.

Specializing in hi fi and two-way radio systems and Citizens-band radio, the shop also handles sound systems for night clubs. Engineering industrial net layouts is another important element in the service and sales mix. Both Mr. MacAlister and assistant shop manager Gary Nock have FCC first-class licenses.

The shop is a six-man operation, plus the counterman. There are two men who specialize on audio, two on two-way radio and outside commercial, plus the service manager and his assistant, who specialize in engineering communication nets and pitch in on the benches whenever needed.

"We stick to our specialties," Mr. Levin says. "We don't for example, handle TV service. There are too many good shops in TV service already, but there aren't enough good ones in hi fi and two-way radio, so they're profitable specialties for us.

"Since we don't sell large consoles, we've dropped in-home calls, giving outside service on commercial accounts only. This profile of our sales, of course, is what determines the equipment requirements and layout of our service shop."

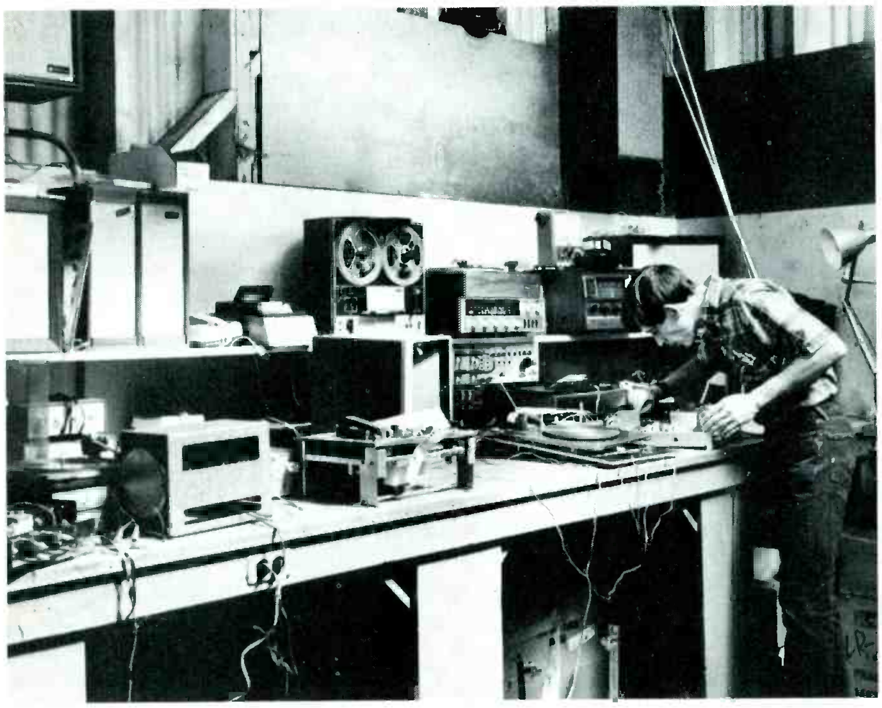
For Maximum Efficiency, Layout of Shop Must Keep Unnecessary Motion at a Minimum

An audio bench with four stations extends along the right wall of the shop from front to rear. Two technicians are assigned to the four stations.

"This arrangement of our stations for two technicians greatly improves productivity," Mr. MacAlister explains. "All four stations are completely equipped. When a man is working on a job and another job comes in that has to be handled right away, he doesn't have to pick up everything he has spread out on the bench, but simply turns to his second station and works on the rush job there. This is a great timesaver."

A two-way radio bench with two stations is located along the rear wall, fronting a closed-in parts department. The cookout bench is along the left wall at the rear. In front of this, parts shelves and "holding" shelves have been built, extending out from the left wall to form walk-in bays immediately across from the audio benches.

The service manager's bench, set up to service primarily Citizens-band two-way radio, was placed at the front paralleling the parts and "holding" shelves, so that it is convenient to both the waiting room and shop proper.



The cookout bench (at the rear of the shop, out of the normal traffic flow) is equipped with a patch panel, speakers, dummy loads, and switch network.
Some of the shop equipment is roll-around, so it can be used with the cookout setup. Each technician is responsible for monitoring the cookout on his jobs. Nearly everything going through the shop is cooked out, the length of time depending on the technician's estimate of need.
"Cookout is the shop's best means of maintaining a low percentage of callbacks—and good customer relations," Mr. MacAlister says. "Too often, the technician has repaired what seemed to be wrong but something else was also wrong which he didn't catch. So the only answer is to make liberal use of the cookout bench as a part of each technician's responsibility for returning the job to the customer in first-class shape."

Systematic Shop Procedures Also Save Time and Increase Shop Productivity

Shop procedures also have been overhauled to produce higher productivity per technician-hour.

"The first thing is to have everything ready to go the minute technicians punch in for their first jobs," MacAlister points out. "We have a master switch, and the voltage to all benches is turned on at 8:30 A.M. At 9 o'clock, when the men come in, all equipment is warm and ready to go."

Each morning, Mr. MacAlister prepares a "priority list" which establishes the order in which repairs are to be undertaken. First priority is given customers' items by date of receipt, then after that the store stock by date of receipt in the shop.

Each technician is given a list of his priority repairs. Prior to arrival of the technicians the counterman procures the necessary parts for the first jobs (provided the first job isn't troubleshooting) and places these and the work-assignment sheet on a low roll-around cart next to each bench.

Time Control

As he begins each assignment, the technician punches in his starting time on a card, then punches out the time when he completes that particular job.

If the job is one that requires being handled in stages—for example, moving it to the cookout bench for cooking out, then moving on to another job—each stage of the job is punched in and out to give a complete record of labor time required for each stage and for the whole job.

Parts Ordering

Another small but effective improvement has been to supply each technician with his own parts order book which he fills out at his bench whenever he needs anything not in the parts stock. A "holding status" ticket is then attached to the customer's item and it goes on one of the "holding" shelves along the left wall.

Pre-use Testing of Replacement Components

The shop has established a pre-use testing program for replacement transistors and integrated circuits (IC's).

"Say we have two dozen transistors come in from the manufacturer," Mr. MacAlister says. "We have nothing but the manufacturer's word to prove they're working properly. Therefore, we have the counterman test all of the transistors with a transistor tester in his spare time. This is saving us quite a few hours of bench time."

An IC meter with associated circuitry, designed and built by Mr. MacAlister, is used to test integrated circuitry against manufacturer's specifications. IC's that don't meet the specs are returned to the manufacturer or are used in systems that don't require close tolerances.

These and other quality control procedures guarantee that every transistor and every IC in the bench stocks will perform satisfactorily when the technicians install them.

Complete and Easy-to-Find Service Literature

A complete file of schematics and service manuals, set up in easy-to-find categories, is the final point in shop efficiency. Material is filed under three main classifications—audio, radio, industrial. A separate category is considered necessary for industrial because there are so many brands that are never encountered in the consumer field.

Continuing Training Is Key To Maintaining Proficiency of Technicians

Two-hour training seminars for shop technicians are held one night each month. Technicians are paid at the scale rate to attend these.

Recurring problems that keep coming up in service, new service techniques being developed, and what to watch for when servicing new lines and changes in old lines are detailed at these seminars. Mr. Nock generally handles the engineering and analytical aspects when such problems are discussed. The technicians also are sent to factory seminars whenever possible. ▲

Got a Troubleshooting Tip?

If you've recently run across an unusual trouble symptom and have determined what caused it, why not pass the info on to the other readers of ELECTRONIC SERVICING. You'll not only be saving other service technicians valuable troubleshooting time, you'll also be making a little extra change for yourself. Send a thorough description of the trouble symptom and the solution along with a brief discussion of your troubleshooting technique to:

Troubleshooting Tip, ELECTRONIC SERVICING
1014 Wyandotte Street, Kansas City, Missouri 64105

troubleshooter

FACTS ABOUT SOUND BARS AND STATION INTERFERENCE

Interference on television channels has increased greatly because more stations are broadcasting maximum legal power, receivers and antennas are more sensitive, and CATV systems often occupy all the VHF channels, thus crowding strong station signals into adjacent channels.

However, we should not blame all interference on these conditions without first considering some receiver defects which can produce nearly the same symptoms.

Imagine, for example, you are testing a TV receiver that shows varying, dark horizontal streaks across the picture, but does so only when the volume control is turned up to a normal listening level. These streaks are synchronized with the audio and look much like sound bars, but there are no beat patterns such as those that usually accompany sound bars. This trouble must be caused by a receiver defect, but not a trap or IF transformer misadjustment. The proof is that no horizontal bars are seen when the volume control is turned down.

Disconnect the speaker voice coil without lowering the volume of the sound, as the first step in troubleshooting. If the bars are still there, the defect is electrical in nature. Most often such a defect is an open filter capacitor which allows unfiltered audio from the audio output stage to modulate the voltage source for tuner, IF's, AGC stages or video amplifiers.

A circuit often used in the older television receivers to supply a low B+ voltage to such stages as the third IF tube and the AGC keyer is shown in Fig. 1. C1 and C2 are suspected of being open. An open electrolytic capacitor which bypasses the B+ end of the audio output transformer is also a possibility.

The defect causing the bars is mechanical in origin, if the bars are missing after the voice coil of the speaker is disconnected. Possible sources include corroded tube sockets, bad grounds around the IF circuits or boards, or microphonic tubes in the tuner or IF stages. Delicate tapping of all the parts on the chassis and tuner with a small insulated screwdriver handle often proves the location of the defect.

In one "tough dog" case, a nearly-new color receiver had the symptoms of "windshield wiper" type interference on some channels and the appearance of overload on strong stations. The preliminary diagnosis was AGC trouble, but use of the AGC analysis method described in the January '70 issue of ELECTRONIC SERVICING (page 42) quickly pointed to a tuner or IF defect. A shorted feedthrough capacitor in the tuner had removed the grid-leak bias from the mixer, thus causing excessive cross-modulation and overload on normal-strength signals.

Freedom from cross-modulation interference ("windshield wiper") varies according to the design of non-defective TV receivers. Bi-polar transistors wired in the common (or grounded) emitter circuit give the most gain, but they are also more susceptible to cross-modulation. Transistors operated in the common (or grounded) base mode, with the signal entering via the emitter, are nearly equal to tubes, while MOSFET's are slightly less prone to cross-modulation. A comparison test against a known-normal receiver is an excellent way of solving borderline cases.

Many schematics appear to promise an easy way out of interference problems. Input wiring to the IF stages of the Admiral G13 chassis in the PHOTOFACT schematic (see Fig. 2) shows a control, R17, labelled ADJACENT SOUND REJECT. It seems logical to assume that we should just turn this control, if we suspect station interference from the sound carrier of the next lower channel. Such logic is wrong!

R17 is there to establish the necessary phase of the primary winding of L2 so that the 47.25-MHz adjacent sound trap (L1 and C120), which is common to both the primary and secondary windings of L2, achieves maximum phase cancellation (signal loss) at the resonant frequency of the trap. When R17 is correctly adjusted, approximately 60 dB loss occurs at the trap frequency. The farther R17 is adjusted away from this optimum value, the less attenuation the trap can give. Alternate careful adjustments of L1 and R17 are necessary to obtain best results. Obviously, adjustment of

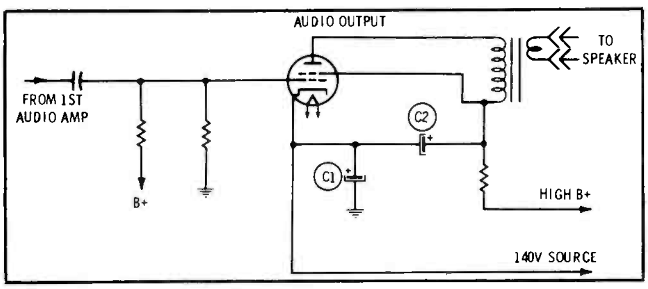


Fig. 1

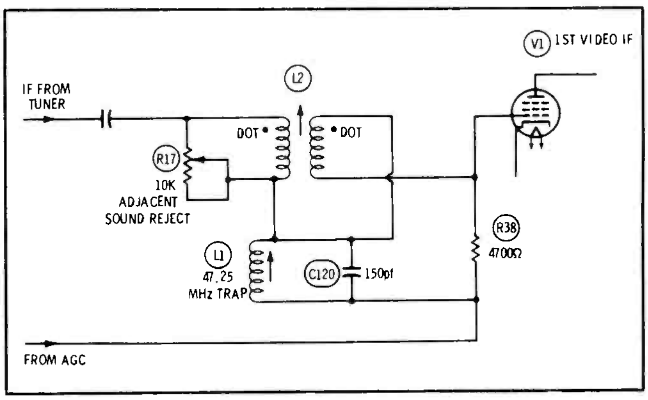


Fig. 2

R17, L2 and L1 can ONLY be done correctly by using good sweep alignment equipment.

Another potentially misleading label is shown in Fig. 3, the schematic of the 3rd IF circuit of the same Admiral G13 chassis. Control (R18) is labelled SOUND REJECT, but it is NOT to be adjusted if the audio volume is too loud or too weak, for it has no effect on the sound channel. R18, plus the paralleling coil L6, is the fourth arm of a bridge whose other three sections are the secondary winding of L5, the 41.25-MHz trap, and the video detector components. Adjustment of R18 permits the bridge to balance more completely, thus increasing the attenuation of the trap to better than 50 dB.

Visually, the only effect of a wrong adjustment of either the trap or R18 is to increase the diagonal crosshatch which is the 920-KHz beat pattern that is possible during color reception. This trap has little effect on the general shape of the IF curve (unless it is moved to a higher frequency where it degrades the color), and misadjustment of it in a vain attempt to eliminate adjacent channel interference will result in poor color.

Remember that incorrect adjustment of the fine tuning changes the station picture and sound carrier frequencies present in the IF's into frequencies other than those for which the IF's were so carefully aligned. A slight adjustment of the fine tuning on each side of the point where best color is obtained gives the same effect as retuning the traps, but there is no danger of ruining the alignment. If varying the fine tuning does not help the interference, re-alignment of the traps will not help either.

Many normal receivers will show the blanking bars ("windshield wiper") of interfering channels when the signal input is excessively strong. A variable "T" or "H" loss pad inserted between the antenna leads and the receiver terminals will often show improvements from various settings that are very enlightening. Cases where the cross-modulation was insufficient to show blanking bars often show a small background pattern that makes the picture appear rough or grainy. Elimination of this objectionable pattern by a reduction of signal strength is very worthwhile.

Failure to reduce the interference patterns by reduction of signal strength might indicate the cross-modulation is occurring before the receiver. This is possible in individual antennas with boosters, corrosion on the antenna or lead wires, or CATV equipment. Nothing done to the TV receiver will help eliminate the interference if the cross-modulation occurs before the receiver. ▲

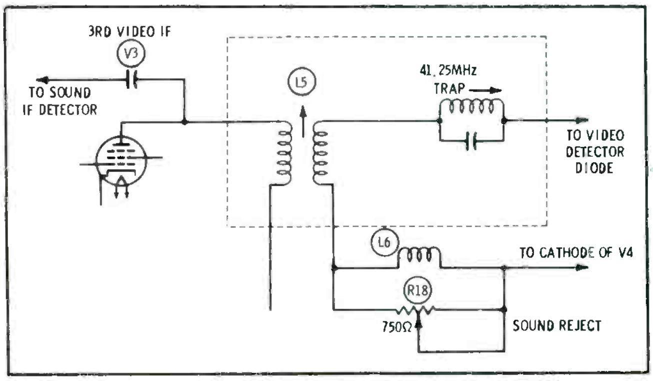


Fig. 3

Troubleshooter Topics

If troubleshooting a particular type of circuit or section in a TV or other consumer electronic product has always seemed unusually difficult for you, let the Troubleshooter know about it and he'll discuss it in the Troubleshooter department. Send your suggestions to: Troubleshooter, ELECTRONIC SERVICING, 1014 Wyandotte St., Kansas City, Mo. 64105.

photofact bulletin

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

ADMIRAL
Chassis 11H1273-9/-13/-19, 11H1297-6, 14H1273-21 . . . 1151-1
Remote Control Receiver 11A9N, Transmitter S376AN . . . 1153-1-A

AMC
5P-107 . . . 1150-1

BRADFORD
WTG-53579A . . . 1155-1
1104D39 (WTG-89722), 1104H30 (WTG-96537), 1104J40 (WTG-96354) . . . 1156-1

BROADMOOR
7009TR . . . 1156-2

CHANNEL MASTER
6135 . . . 1149-1
6140 . . . 1154-1

CORONADO
TV2-6634A/35A/36A/37A/38A/39A, TV2-6815A . . . 1157-1
AM-FM Radio . . . 1157-1-A

MAGNAVOX
Chassis T941-01-AA, T941-02-AA . . . 1150-2

PANASONIC
CT-391E, CT391EC . . . 1151-1
TR-339RN . . . 1152-1
CT-97P, CT-97PC . . . 1153-2
AN-219, AN-219C, AN-229, AN-229C, AN-239D/DC . . 1154-2

PHILCO-FORD
B521TBE, B521UAV, B531TWA (Ch. 20P24) . . . 1148-1
Chassis 20HT70, 20HT71 . . . 1155-2

RCA
AP133B/N/Y, AP136Y (Ch. KCS177C) . . . 1149-2
Chassis KCS183A . . . 1151-2
Chassis KCS168D (1971 Prod) . . . 1152-2

SEARS
(Ch. 564.80160) . . . 1147-1
562.40800000 . . . 1154-3

SHARP
CN-62T/TA . . . 1148-2

TOSHIBA
C31B (Ch. TAC-4320/21) 1150-3
C7A, C8A (Ch. TAC-3350, TAC-3351) . . . 1152-3

WARDS AIRLINE
GCI 12420A/B/C/D . . . 1147-2
GEN-11431A, GEN-11461A, GEN-11481A . . . 1148-3

ZENITH
Chassis 14B38/Z, 14B39/Z . . . 1156-3
Remote Control S-85833 . . . 1156-3-A
Chassis 12A13C52, 12B13C52, 12B14C50, 12B14C52 . . . 1157-2
Remote Receiver S-77536, S-87286, Transmitter S-83596 . . . 1157-2-A

PRODUCTION CHANGE BULLETIN

EMERSON
Chassis 120905A, 120934A, 120935A/C . . . 1152-4

GENERAL ELECTRIC
Chassis S-2 . . . 1152-4
CAM722BG-A1, XCM719WD-A1 (Ch. A1) . . . 1154-4

PENNCREST
4351-48A, 4352-46A, 4354, 4355, 4391-48A . . . 1157-3

RCA
Chassis CTC22AD . . . 1152-4
Chassis KCS171D/E/F/H/J/K/L

SEARS
Chassis 562.10525

SYLVANIA
Chassis D05-14/-15 . . . 1151-3

WARDS AIRLINE
GEN-13460A . . . 1152-4

▲

NEW Service Literature

TV TECH AID, Edward G. Gorman, Kings Park, L.I., New York 11754; printed monthly; yearly subscription $7.95.

A monthly summary of actual color and b-w TV trouble symptoms, their possible causes and the cure for each. Where needed, a schematic of the circuitry involved is included.

The troubles and cures are grouped according to manufacturers, which, in turn, are listed alphabetically. The format of the publication is designed to facilitate filing the troubles and cures according to manufacturer and chassis number—**a definite aid to quicker servicing.**

Newest SAMS Books

Hi-Fi Stereo Servicing Guide

by ROBERT G. MIDDLETON. A complete guide to effective hi-fi and stereo servicing. Provides the basis for a full understanding of hi-fi tuner and amplifier circuitry and procedures for servicing this type of equipment. The proper use of audio test and measurement equipment and the basic principles of acoustics are also given. Covers all hi-fi components (except record players and tape recorders). Order **20785**, *only* . . . **$3.95**

ABC's of Avionics

by LEX PARRISH. Provides a basic understanding of avionics—the electronic equipment used to insure the safety of crew and passengers. The type of equipment and the techniques employed in private aircraft operations are featured. Discusses requirements for basic communications, navigation aids, instrument flight aids, weather guidance, and flight control safety devices.
Order **20764**, *only* **$3.50**

Mobile-Radio Systems Planning

by LEO G. SANDS. Here is practical, basic information about various types of mobile-radio systems, how they work, their capabilities and limitations, system requirements, licenses, channels, band and frequency selection, transmitter-receiver selection, antenna systems, and accessories. Includes an invaluable system-requirements form for planning a mobile-radio system.
Order **20780**, *only* **$4.50**

Transistor-TV Servicing Made Easy

by JACK DARR. This practical guide will help you become skilled in the special techniques of transistor-TV servicing. Covers tools and equipment required; transistors and transistor-servicing techniques; power supplies; horizontal and vertical sweep circuits; video i-f and output circuits; agc and sync-separator problems; tuners; audio circuits; and selecting replacement transistors.
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Security Electronics

by JOHN E. CUNNINGHAM. Explains the operating principles of modern electronic devices and systems used to provide security against crime. Describes intrusion alarms and intrusion-detection devices. Includes chapters on the detection of hidden metal objects, announcement of detected intrusions, bugging, debugging, and speech-scrambling systems, and future developments.
Order **20767**, *only* **$4.50**

How to Hear, Police, Fire, and Aircraft Radio

by LEN BUCKWALTER. After World War II, police, fire, and aircraft radio moved to the less crowded vhf bands, and the "police band", which was found in many older radios, was silenced. Few listeners had receivers capable of covering the vhf band, because they were relatively expensive. With the advent of solid-state circuitry, a wide variety of relatively low-cost monitoring equipment is available. This book is a guide to the selection and use of vhf radio.
Order **20781**, *only* **$3.50**

101 Questions and Answers About Transistor Circuits

by LEO G. SANDS. Answers the most commonly asked questions about transistor circuitry. Explains transistor nomenclature, biasing, the three basic circuit configurations, input and output impedances, current and voltage gain, and other basic considerations. Covers power supplies and circuits; af circuits; rf circuits, and oscillators.
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1-2-3-4 Servicing Automobile Stereo

by FOREST H. BELT. This book first applies the ingenious "1-2-3-4" repair method to both mechanical and electrical equipment. It then proceeds to cover the electronic and mechanical principles of automobile stereo, fm multiplex and tape cartridge systems. Finally, the book shows how to apply the method to auto stereo systems.
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Aviation Electronics, 2nd Edition

by KEITH W. BOSE. This practical handbook for aircraft owners, pilots, technicians, and engineers explains the design, operation, and maintenance of aviation electronics equipment. Covers automatic direction-finders, distance-measuring equipment, omnirange, ATC transponders and weather radar, communications and instrument-landing systems, and related devices and systems used in aviation today.
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Questions & Answers on Short-Wave Listening

by H. CHARLES WOODRUFF. A helpful ...ide to the interesting world of listen... fforded by short-wave receivers. ...ns and answers cover interna... ...ort-wave broadcasting, fre... ...nd services; how short-wave ...ed; how short-wave is re... ...how short-wave receivers ...d and operated.
...nly **$3.50**

1-2-3-4 Servicing Transistor Color TV

by FOREST H. BELT. The "1-2-3-4 Method" is a simple, logical, step-by-step process that helps do the service job the right way and the easy way. In this book, the fundamentals of transistor color TV are covered, followed by a detailed explanation of how to apply the method for quick troubleshooting and easy repairs.
Order **20777**, *only* **$4.95**

North American Radio-TV Station Guide, 6th Edition

by VANE A. JONES. Lists all radio and TV stations in the U.S., Canada, Mexico, and the West Indies. Includes operating a-m, fm, and television stations, as well as those that are about to start operating, or are temporarily off the air. Separate listings arranged by geographical location, frequency (or channel), and call letters make this guide the most useful one available.
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☐ 20783 ☐ 20779

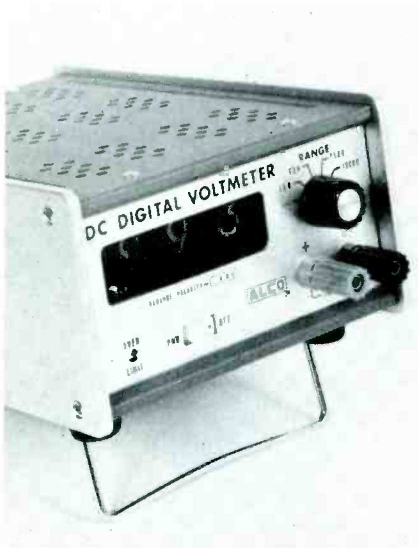
Circle 21 on literature card

test equipment report

DC Digital Voltmeter

A new portable DC digital voltmeter (DVM) is now available from ALCO Electronic Products.

Model DVM-110 has 3½ digits and is capable of measuring DC levels up to 1000 volts in 4 ranges of 1.5, 15, 150 and 1000 volts.



Input impedance is reported to be approximately 2 megohms for the 1.5-volt range and 10 megohms for all other ranges, with an accuracy of .5%. A neon light warns when the input has exceeded the full-scale value of the selected range. When the input data is in the wrong polarity, the digital readouts will indicate "zero". An automatic overload protection also is built-in, according to the manufacturer.

Model DVM-110 measures 3 inches x 5⅜ inches, weighs 4½ pounds, and operates on line voltage.

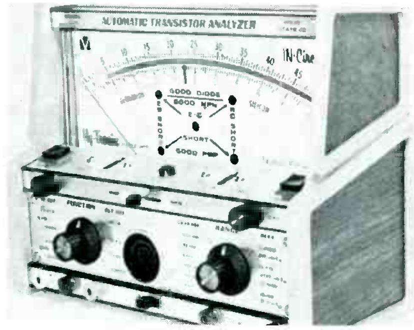
Model DVM-110 is priced at $189.50.

Circle 50 on literature card

Dynamic Transistor Tester

A new transistor tester that directly measures beta in and out of circuit and leakage out of circuit has been developed by Hy-Tronix Instrument.

The tester, designated Model 900, reportedly is equipped with an 8-



inch, linear, mirrored meter panel which directly indicates beta and measures leakage to the nearest nanoamp. The unit also automatically differentiates between PNP and NPN transistor types and indicates whether the transistor is silicon or germanium, according to the manufacturer.

A very unique feature of Model 900 is an aural indicator which tells the technician whether a transistor or diode is good or bad, without the need for visual readout.

Dimensions of the tester are 8⅞ inches x 4½ inches x 7 inches; weight is 6¾ pounds; and price is $287. An in-circuit probe is available for $15.

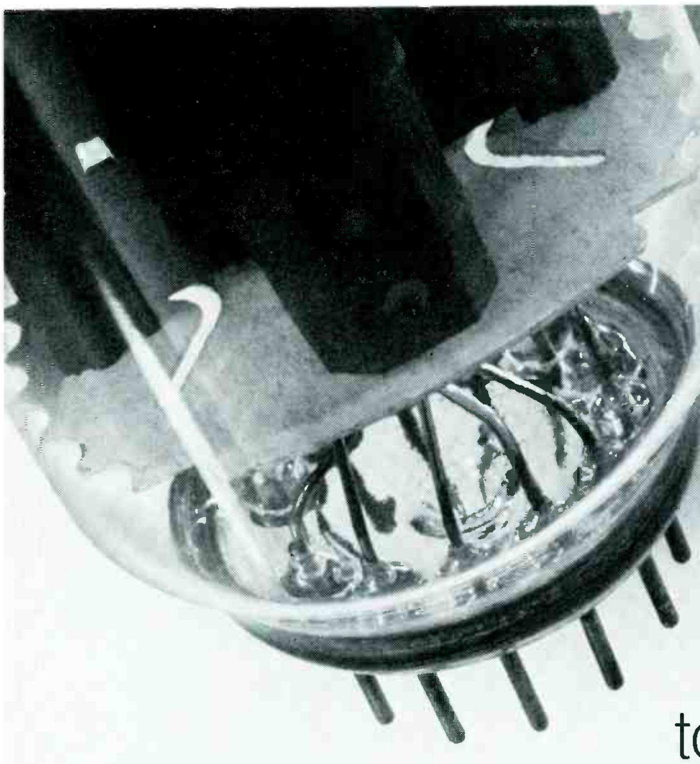
Circle 51 on literature card

100K Ohm/Volt VOM

A VOM with a DC sensitivity of 100,000 ohms per volt and an AC sensitivity of 10,000 ohms per volt has been introduced by RCA Electronic Components.

Functions of the unit include: DC voltage measurements from 10 mV

to 1,500 volts, in six ra voltage measurements fro to 1,500 volts, in five current measurements




tube

to 5 amps; resistance measurements from .05 ohm to 20 megohms; and decibel measurement from –20 dB to +55.5 dB. Selection of both range and function is accomplished by positioning one front-panel knob.

Other features of the instrument include a polarity reversing switch and a large, three-color meter panel with a mirror scale to prevent paralax.

The voltage measuring range of the unit, designated Model WV-520A, can be extended to 50 KV by use of a RCA high-voltage probe WG-297 and RCA multiplier resistor WG-408A.

The VOM measures 7½ inches x 5¼ inches x 3⅜ inches, weighs 3 pounds and is priced at $48.00, complete with test leads and two 1.5-volt "C" cell batteries.

Circle 52 on literature card

Circle 23 on literature card

Mercury VTVM

A new VTVM, Model 1700C, has been introduced by Mercury Electronics, Corp.

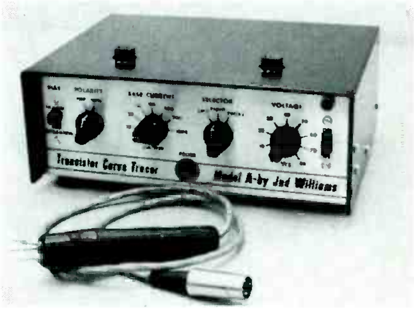
Model 1700C has a 6-inch, wide-view meter with mirror scale, and wide-frequency response on AC voltage to accommodate color TV servicing.

Model 1700C weighs 5 lbs. and measures 8½ inches x 6 1/16 inches x 4½ inches. The price is $49.95, wired. The unit also is available in kit form, Model 1700BK, which is priced at $39.95.

Circle 53 on literature card

Dynamic Transistor Curve Tracer

The ability of a transistor to faithfully amplify an AC signal now can be determined by viewing a "family of curves" on the screen of an oscilloscope. This is made possible by Jud Williams' Model A Transistor Curve Tracer, an instrument designed to test the beta and leakage of a transistor both in and out of circuit. Also indicated are the polarity (NPN or PNP) and cut-off voltage of the transistor.



The curve tracer applies two signals to a transistor: A 120-Hz pulsating DC voltage, variable from

0-80 volts, is applied across the collector-emitter junction; and a staircase waveform with six current levels from 10 μa to 1 mA, spaced 10 μa apart, is applied between the base-emitter junction of the transistor.

The voltage dropped across the collector-emitter junction is applied to the horizontal axis of a scope, and the collector current (voltage dropped across emitter resistor) is used to drive the vertical axis. The result is a family of curves (usually six, depending on the gain of the transistor and/or the setting of the vertical gain control of the scope).

The design of the curve tracer prevents damage to the transistor or its associated circuitry as a result of lead reversal; instead, only an easily identifiable false curve is produced.

Separate sockets and a switching arrangement permit easy matching of transistors.

Model A measures 8 inches x 3 inches x 7 inches and is priced at $135.00, complete with a three-pronged, in-circuit probe.

Circle 54 on literature card

Knight-Kit Tube Tester

A tube tester that checks more than 2500 tube types has been introduced by Allied Radio in their new Knight-Kit/Model KG-600C.

The unit has 16 switch-selected filament voltages from 0.63 to 117 volts. Tube data, on an illuminated roll chart, is provided for more than 2500 of the latest tube types.

Specifications include; Good/Replace emission scale, Good/Bad gas test scale and 0-100 numerical scale. A neon indicator shows filament continuity and leakage or shorts between tube elements.

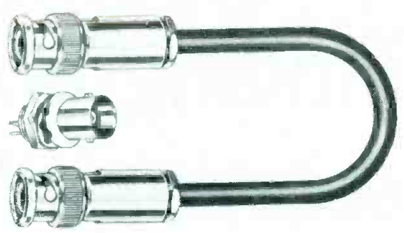
The Knight-Kit KG-600C is housed in a gray fabrikoid-covered case measuring 6½ inches x 4½ inches x 10½ inches, and comes complete with a step-by-step assembly instruction booklet. The unit weighs 11 lbs. and is priced at $44.95.

Circle 55 on literature card

Patch Cords and Jacks

A new Twinax patching system, designed for low-level signal and balanced line applications, has been introduced by Pomona Electronics Co., Inc.

Model 358-J incorporates a patch cord of shielded two-conductor cable with male Twinax plugs at both ends, plus mating



female Twinax receptacles. The manufacturer states the connectors feature concentric construction, which eliminates the alignment of mating halves of stepped insulators connectors, and permits easy one-hand connect and disconnect.

Patch Cord, Model 3581-J, is supplied in 18-, 24-, 36-, 48-, and 60-inch lengths and sells for $14.85. ▲

Circle 56 on literature card

Circle 24 on literature card

Finding and eliminating sources of auto radio noise.

by Joseph J. Carr

The usual cause of motor noise is sparks. The very nature of a spark gives some indications why this is so.

A spark is a transient waveform consisting usually of short duration, high intensity oscillations across an air gap. Some theorists believe that even in a DC circuit the spark actually oscillates, AC style, across the air gap. Because all waveforms (except those that really are pure sinewaves) are rich in harmonic content, we can expect some of their energy to fall in the radio frequency spectrum. In fact, as some old timers might remember, up until just before World War II spark gap transmitters were used by some amateur and commercial CW radio stations. Some amateurs actually used the vibrator/spark coil unit from a Ford model T as their ham station transmitter.

Do not make the mistake, however, of thinking that the spark coil or other ignition components are the only spark generators in a car. Other potential sources include:

- Alternator or DC generator
- Electromechanical (relay type) voltage regulators
- Electric motors (such as those that operate power seats, windows, and heater/air conditioner fans)
- Gas gauge sending units
- Vibrating elements such as the horn
- Numerous other electrical or electromechanical accessories

Although most of these items generate their own characteristic noise, there are several that sound alike (all motors, for example).

The Basic Auto Ignition System

The simple car ignition system in use in most cars has changed little since it was introduced several decades ago. It still uses a standard battery, coil, breakers, and a distributor.

A circuit diagram of this type of ignition system is shown in Fig. 1. When the breaker points close, current from the battery develops a magnetic field around coil L1. The magnetic field produced by this current collapses as soon as the cam of the distributor causes the breaker points to re-open. The collapsing magnetic field of the coil and the discharge of capacitor C1 induce current into the coil's secondary, L2. Because this is essentially a high-ratio, step-up transformer, a very high voltage (of about the same amplitude as that on the second anode of a TV) is applied across the spark plug gap. This causes current to arc across the gap and ignite the air/gasoline vapor mixture in the cylinder.

Most transistor ignitions are merely electronic switches used to relieve the breaker points of handling such a high current load. The breakers are then used to trigger the transistor. Exceptions to these two basic designs are the capacitor discharge ignitions on some cars and the energy transfer system used on some European motorcycles.

Tracking Down the Source of Noise

The first step in eliminating motor noise is to determine it's origin. First, start the engine, turn on the radio, and observe the noise. If necessary, tune the radio off station so that you can hear the noise better. Turn on the headlights and note whether this eliminates or reduces the noise. If it does, the car probably has a noisy regulator.

Next, remove the antenna lead from the radio and note, again, whether the noise either disappears or is attenuated. In either case, look for an open shield on the coaxial antenna lead-in or an ungrounded hood, fender, etc. This noise source is extremely common on cars with fiberglass body parts.

Also be sure to note whether or

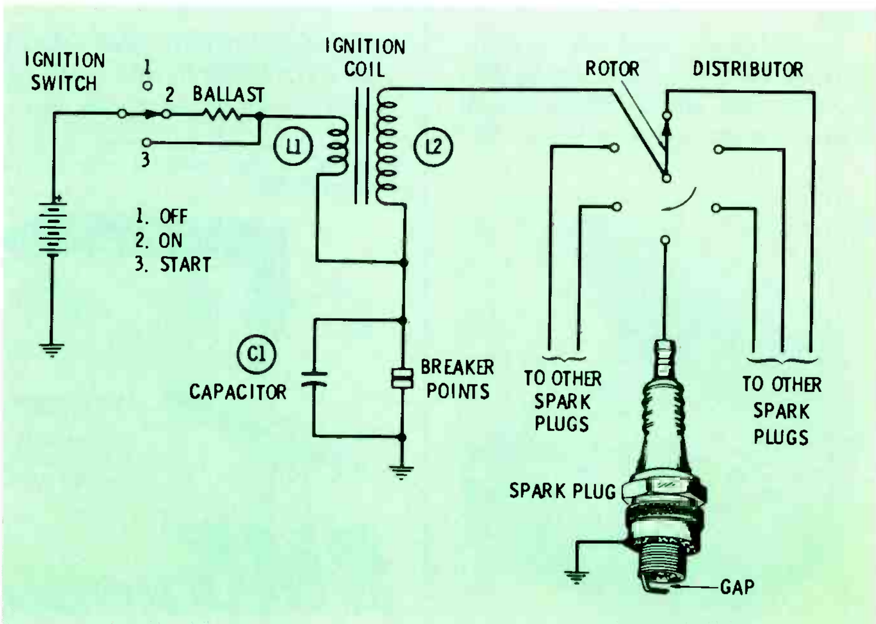


Fig. 1 Schematic diagram of conventional auto ignition system.

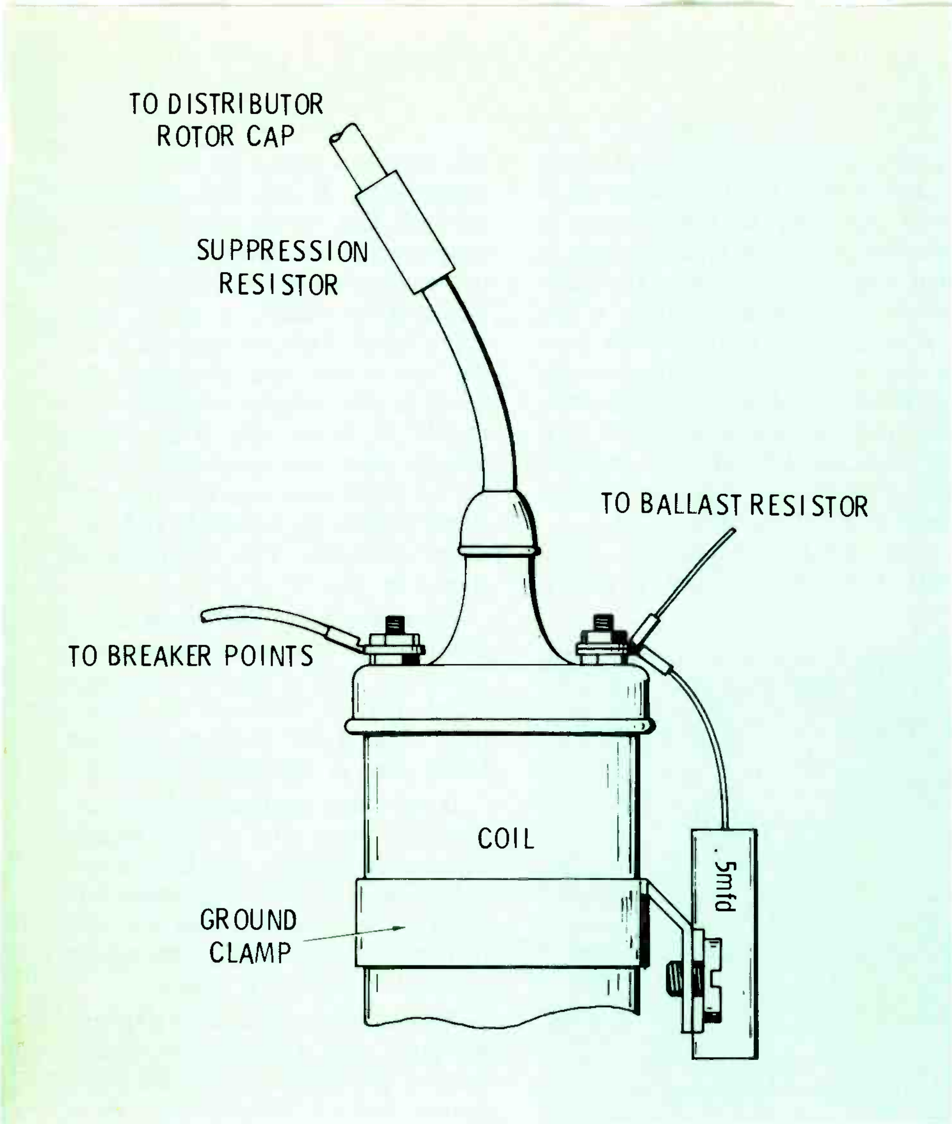


Fig. 2 Suppression resistor and .5-mfd capacitor shown here are two primary cures for ignition-generated noise. Noise-suppression (carbon) spark plug wire can be used in place of suppression resistor.

not the noise is audible when the the volume control is turned down all the way. If the noise level remains constant, it is another indication that the noise is entering via the DC power lead. If possible, check to make sure the radio is properly grounded. Many modern cars have plastic or fiberglass dashboards. In these installations the manufacturer usually supplies a ground wire for the radio.

The accompanying chart lists common noises and their associated sources and cures. Determine the most probable source of the motor noise and then try one of the standard cures listed in the chart or discussed in the following paragraphs. In many cases, especially where high-frequency communications receivers are involved, more than one cure might be required. As a rule of thumb, the higher a mobile receivers sensitivity, the more noise suppression required.

Cures

Fig. 2 shows some of the more common cures for noise caused by the ignition system. The resistor is designed to be screwed into the high-voltage lead that is connected from the coil to the distributor. If connected properly, this resistor will cause little trouble. However, if it is not properly installed, it will fall out, causing the engine to stop.

The customer also can equip his car with Radio-TV Suppression high-voltage leads. These make separate resistors unnecessary. Radio wire is used in place of the normal spark plug wires. Instead of a copper conductor, it has a carbon impregnated filament made of an insulating material. The typical resistance of this filament is 10k ohms to 100k ohms.

Frequently, the car owner will disclose the fact that the noise appeared shortly after he recently had the engine tuned up. Carbon wire does require replacement occasionally, and some mechanics can't seem to remember that copper wire (of which there usually is a 200-foot spool in the parts department) will cause interference on the radio.

The capacitor shown in Fig. 2 is a .5-mfd, 200-volt metal-can unit which has one or more mounting tabs protruding out either the side or rear of the housing. At least one of these capacitors will be packed with every new car radio. Replacement capacitors usually are available from electronic parts distributors. Also available are coaxial bypass capacitors which can be used for very stubborn cases or for applications involving high-frequency receivers. It is almost mandatory for coaxial units to be used on Citizens-Band or other high-frequency AM installations.

Re-radiation is another type of ignition noise. Although suppression of the noise source will help, it often is not enough. Things like emergency brake cables or power wires that pass through the firewall between the engine and passenger compartments can pick up noise and reradiate it to the radio power leads. An L-section filter, such as is shown in Fig. 3 sometimes will cure the problem if the offending wire or cable cannot be bypassed with a capacitor or effectively grounded. The capacitor is one of the .5-mfd units mentioned previously. The coil is made from twenty or thirty turns

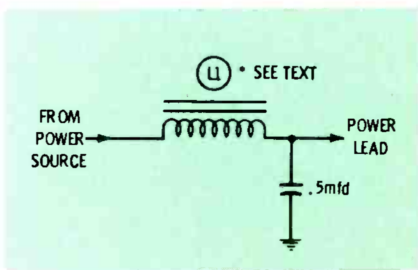


Fig. 3 L-section filter shown here can be employed to suppress noise picked up by power leads. Filter is connected between power source and power input of radio.

of enameled wire and an old transistor radio loopstick antenna core. The wire must be large enough to prevent the filter from heating up or causing an intolerable voltage drop. The filter is connected between the power source and the power lead of the radio. It should be mounted on the radio chassis so that the connecting lead to the radio can be as short as possible.

Fig. 4 shows a typical generator-type battery charging system. In older cars equipped with electromechanical voltage regulators, this system can produce a spurious sound similar to frying eggs. It is most annoying to the listener. A peculiarity of this type of noise is that it will disappear when the headlights are switched on. This is because the large drain of the head lamps causes the regulator contacts to close. Methods of eliminating such noise are shown in Fig. 5. First try capacitor C1. The RC network and capacitor C2 will help difficult cases and CB installations.

One particular type of .1-mfd coaxial bypass capacitor is especially suited to voltage regulator noise suppression. It has one connector on each end, as do other types of coaxial units. However, on this type the connectors are female and are threaded to accept a 10/32 machine screw. This just happens to be the size screw used to secure the wires to the voltage regulator terminals of most cars. The author usually cuts the head off a ¾" 10/32 screw and uses the threaded shank to join the capacitor and regulator terminal. This technique is shown in Fig. 6.

Generator noise and some alternator noise can be eliminated by bypassing with a capacitor the terminal marked "battery" or "armature" (this is the terminal with the heavy wire in unmarked systems).

If the car is equipped with an alternator, check with a local manufacturer-authorized service dealer before using a noise suppression capacitor. Some alternators can be damaged if a capacitor (or the wrong value of capacitor) is used.

Most modern automobiles are equipped with a variety of electric motors. The motor used to drive the heating and air conditioning fan is a common offender. This motor almost always is located in an inaccessible place. However, the method of tracing the noise to this source is simple: Turn everything off, including the engine, and see if the noise has disappeared. If it has, turn on one accessory, then another, until the noise returns. Another .5-mfd capacitor installed across the power lead of the offending motor usually will eliminate the problem. Install it as close to the motor as possible.

As noted in the accompanying chart, the gas gauge can cause a peculiar type of noise. This noise is best described as a "sloshing" sound.

Fig. 7 shows a typical gas gauge circuit. The sender is a variable resistor mounted on a pendulum float. This float varies the resistance of the potentiometer according to the level of the gasoline. The meter displays these variations as changes in current flow.

The cure for this "sloshing" type of noise is usually a .5-mfd bypass capacitor between ground and the

Auto Radio Noise Causes and Cures

Description of Sound	Source	Cure	Remarks
Popping, speed of which varies with engine RPM	Ignition system	Resistive spark plug wires, and bypass battery side of coil with a .5-mfd capacitor	Use coaxial bypass on communications and FM band radios
Whine (older cars)	DC Generator	.5-mfd capacitor between armature and ground	Same as above, armature wire is the heavy one
Whine or whistle (newer cars)	Alternator	Follow manufacturer's instructions	Might indicate a bad alternator
"Frying Eggs"	Regulator	See Figs. 6 & 7	Turn on headlights and see if noise disappears
Slow popping sound, sounds like sloshing	Gas gauge sender	.5-mfd capacitor across sender, also, contact car dealer for any possible special noise kits	Rock car side to side and see if noise changes
Whirring, often with same hash sound generated by fluorescent lights	Small DC motors in heater, power windows, seats, antenna, etc.	.5-mfd capacitor across motor winding	Motor may need new brushes
Popping when turn signals are operated	Flasher	.5-mfd capacitor across flasher	Flasher unit may be worn out
Popping when brakes applied	Brake light switch	.5-mfd capacitor across switch or between brake light power lead and ground	

(Severe motor noise might require severe measures. Several manufacturers offer completely shielded ignition systems for use with aircraft and automotive communications systems. Power leads might require shielding and direct connection to battery. Heavy coaxial cable, such as RG-8 or RG-11 can be used as shielded power lead.)

sender wire. If it is accessible under the matting in the trunk, first try to install the capacitor as close to the sender as possible. Some car manufacturers offer an alternate suppression method in the form of either a capacitor or a coil designed to mount directly on the meter itself. This usually proves sufficient for all but the most stubborn cases.

Another source of noise is the electromechanical vibrating element in the car's horn. This noise is a hoarse or rasping sound every time the horn is blown. A .5-mfd capacitor connected across the horn lead usually will eliminate the problem. (Be sure to hook the capacitor across the horn lead, not the relay lead.)

Case Histories

Stories about motor noise told among auto radio and communications technicians often equal the believability (or is that unbelievability?) of some fishing and deer hunting stories. This is because some noise suppression problems really are mind-benders. Most technicians that do noise suppression eventually run across a one-of-a-kind case. Some of the following might be classified in this category, but they actually happened.

Case 1

The first case involved a 1956 Ford. This particular car had a CB transceiver mounted beneath the dashboard. It was one of those newer all-solid-state units which are no bigger than a small cigar box. The unit had just been checked out on the bench, using both AC and DC power supplies. This particular set had been especially well looked over because an FCC Official "Notice of Violation" repair of the modulator was necessary. Because of this we were pretty sure that the set itself was alright.

Inspection of the engine compartment revealed that both coaxial capacitors and radio suppression wire were in use. Also, the metal ground bonding straps between the frame and the engine, firewall, fenders, etc. were all in place.

Disappearance of the noise when the antenna was removed from the transceiver proved that the noise was entering the set at that point. An ohmmeter check showed that the antenna lead-in wire shield was still grounded. Just to be on the safe side, however, another rig and another antenna were substituted into the system. The noise persisted.

Then came the lucky break we all need occasionally. Weary and wanting to think out the problem, I leaned against the car. The noise stopped! I later found that the chrome moulding around the roof line on that car had been restored by the new owner. This was in a southeastern seaport town where rust and corrosion is a major prob-

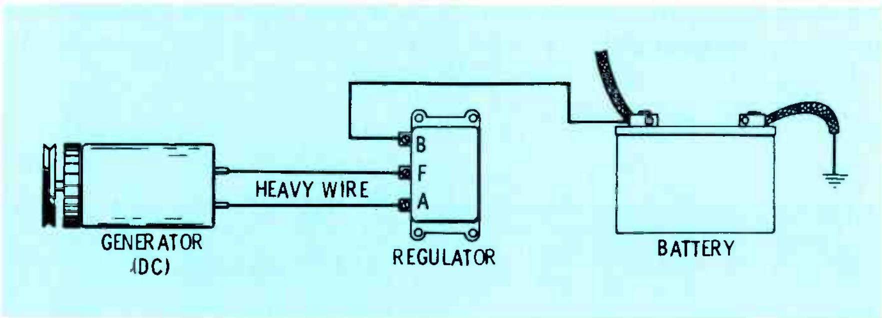


Fig. 4 Typical battery charging system equipped with generator (DC). Arcing across contacts of electromechanical voltage regulator used in this system can produce radio noise that sounds like frying eggs.

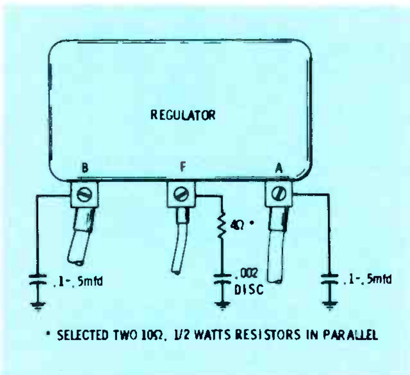


Fig. 5 Method eliminating "frying eggs" noise produced by battery charging system diagrammed in Fig. 4.

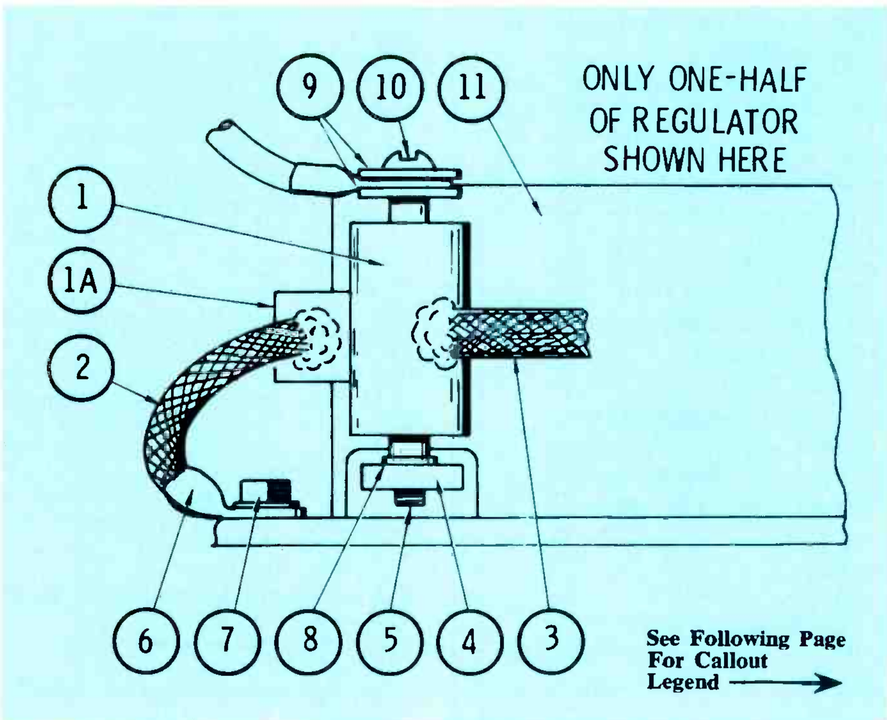


Fig. 6 How to connect a coaxial bypass capacitor to voltage regulator terminals to suppress regulator noise.

lem. The metal beneath that chrome strip was used to secure the hold down strips. It was in miserable shape. Would you care to guess where the customer had mounted the clip that held the whip CB antenna in it's down position? Right on that chrome strip. To make matters worse, the strip was close to an eighth wavelength long (around 50 inches). A little scraping and grounding cured this one.

Case 2

The second case also was an uncommon one. It involved a 1968 Buick equipped with a Delco T-400 eight-track tape player. The customer's complaint read: "Tape changes tracks when power seat is operated". This was one time when the customer was absolutely correct. The tape player actually **did** change tracks when the seat was moved.

Most tape players use a solenoid to change tracks. It is usually operated by two contacts that are shorted together by the aluminum foil which splices the tape ends together. The earlier Delco T-400's, however, used a silicon controlled rectifier (SCR) to actuate the solenoid.

An SCR is a rectifier that passes current only after being triggered by an AC or DC pulse applied to the gate terminal. The SCR then will pass current until either a proper commutating pulse is supplied or the cathode-to-anode current is reduced below a certain critical point. On the T-400 Delco units this is accomplished by a little glass-enclosed circuit breaker in series with the SCR and solenoid.

A .5-mfd capacitor shunted across the motor did little to alleviate the problem. It was found that the tape player had both an open input filter capacitor and a shorted power line choke. Under these circumstances electrical hash generated by the motor could get into the SCR gating circuit, triggering on the SCR, which, in turn, actuated the

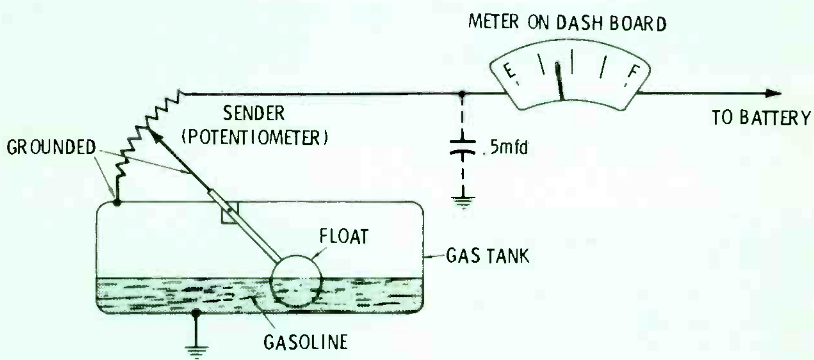


Fig. 7 Diagram of typical gas gauge circuit. .5-mfd capacitor connected between "sender" wire and ground eliminates "sloshing" noise generated by this circuit.

Callout Legend For Fig. 6

1. .1- to .5-mfd coaxial bypass capacitor
1A. Mounting tab for bypass capacitor
2. Braided ground wire, ⅜" to ½" soldered to mounting tab and eye lug
3. Same as above. Soldered to capacitor body. Runs to other bypass capacitor
4. Either "Armature" or "Battery" terminal of regulator
5. A ⅜" 10/32 machine screw with the head removed and burrs ground down
6. Eye type solder lug
7. Regulator mounting bolt (connected to ground)
8. Lock washer, #10
9. Heavy flat washers
10. ½" 10/32 machine screw
11. Automotive voltage regulator

track-changing solenoid.

Case 3

The owner of a 1969 Corvette Stingray complained that since a local mechanic had tuned the engine he couldn't use the radio on the AM band because of the noise. At first, we thought that the mechanic had used straight copper wires in the ignition system. A quick look, however, revealed that he had used genuine Chevrolet radio-suppression wire.

Because there had been some recent minor repairs to the left rear fender, we decided to check the ground strap that runs between the antenna and the car frame. Sure enough! It had been removed. Replacing it eliminated the noise.

Case 4

A Buick dealer supplied us with the next case, which involved an Opel GT 1600. Listening to the radio indicated that the problem was one of classic ignition noise. A quick look at the spark plug wires revealed that straight copper wire was in use. The car was returned to the Buck dealership with instructions to change those wires to carbon noise-suppression wire.

That should have been the end of the case. Far from it. About an hour later an irate service manager called with the news that the noise persisted after the new wires were installed and that the customer was there waiting for his car. The author was dispatched to the Buick shop to find the trouble. Walking into the repair area, I noticed the service manager, sales manager, and the customer watching a mechanic look for motor noise with the auto's hood in the up position. I closed the hood and the noise stopped . . . providing all of us a good laugh at the mechanics expense.

Conclusion

There is more to auto radio noise than can be discussed in a single article; new things pop up all the time. However, the preceding should make it easier for you to find and cure all but the most unusual noise sources in autos.

Noise suppression isn't one of the more glamorous jobs in electronics but it is necessary to the success of most auto radio, CB, and communications shops. ▲

Circle 27 on literature card

Dale's service bench

by Allan Dale

"Sync" troubles caused by AGC defects

Sometimes you get careless after you've been fixing television sets for many years. You overlook things you shouldn't. This happened recently to Bill, a friend of mine.

Bill has had an apprentice in the shop for about a year. The boy is good. He's been doing most of the bench work while Bill makes calls. He leaves the occasional tough one for Bill to take care of in the late afternoon. With such good help, Bill has been getting a little out of practice.

The boy left a sync problem for Bill one afternoon. It was intermittent—at least, that's what his apprentice had told him. So Bill set it to one side and left it running while he did other things.

Bill eventually noticed it twisting near the top (Fig. 1A). He checked everything he could think of in the horizontal AFC and oscillator. After an hour, he dropped that line of thinking and turned his attention to the sync separator.

The schematic of the separator is shown in Fig. 1B. This type of noise-canceling stage is common in tube sets; it combines sync and AGC in one tube. Bill performed several tests of the sync separator, and finally decided he'd also have to check out the AGC side of the stage. Another half-hour wasted.

Eventually, he got around to clipping the scope probe across the 4-mfd cathode bypass capacitor, an electrolytic which is part of a multiple can. The waveform he obtained is shown in Fig. 1C. Its amplitude was almost 5 volts PP. Because it was in the cathode, it let video modulate the sync, causing the twisting and flagwaving. Poor AGC bypassing was producing what looked like sync trouble.

Bill bridged a known-good electrolytic across the original, but still got the hum waveform shown in Fig. 1D. The amplitude was almost 1 volt PP, too much for proper operation. There was leakage between sections of the multiple-section can. It required a whole new electrolytic can to cure the problem. The bottom waveform is a normal one.

Open Bypass Eliminates Required Filtering of AGC Line

Cases of sync trouble symptoms actually caused by AGC defects are common. Probably the fault most frequently encountered is the AGC-line bypass capacitor opening or developing too large a power factor. One type of circuit this happens in is shown in Fig. 2A.

One example of this type of problem involved an intermittent. The set, when first brought into the shop, exhibited an extreme AGC symptom—buzz, overloading, and bad sync. The screen symptoms are shown in Fig. 2B. A new 6HS8 tube seemed to cure it.

The set operated three days, and the customer then brought it back, saying, "It does the same thing it did before." Plugged in at the counter, it operated normally. The customer left it anyway, and it was treated as intermittent.

For nearly a week it continued to operate normally all day, every day. Increased line voltage, reduced line voltage, on a while and off a while, a box over it to trap heat, a work-out on the chassis vibrator—nothing made it act up. Then one afternoon, there it was, the symptom shown in Fig. 2B had returned. The bench technician touched his scope probe to the AGC line, and the trouble cleared up and seemed to remain normal.

The next week, however, someone noticed the return of the same trouble symptom. This time the scope probe was placed across the AGC line. Again, the symptom cleared up. An unused scope was connected to the AGC line and left there. When the trouble occurred again a short time later, the waveform in Fig. 2C appeared on the scope.

An intermittently open AGC bypass electrolytic was the cause of the trouble. Any kind of electrical shock in the circuit, such as that caused by connecting a test lead, healed the electrolytic. The waveform then returned to normal, like that in Fig. 2D.

Sometimes The Trouble is A Tube

A baffling trouble occasionally can be traced to a tube you might not even suspect.

One example of this involved the symptom shown in Fig. 3. It had all the earmarks of a sync-and-AGC fault. The natural place to look for trouble was in that section. However, nearly an hour of hunting didn't reveal much. All waveforms appeared normal, and DC voltages were within tolerance.

The first step had been to try a new sync/AGC tube. After wasting so much time without curing the fault, they tried another tube. Still no change.

Because part of the symptom seemed to be related to an AGC defect, a more exhaustive check of the AGC system was made. DC voltage measurements all along the AGC line (schematic in Fig. 3B) revealed an oddity; AGC voltage was developing as it should at the plate of the AGC keyer. When no station signal was received, the voltage was close to zero. With a strong station, it went considerably negative, as you'd expect. But only a slight negative voltage was present at the IF

(Continued on page 59)

(Continued from page 56)
grid, even with a strong station signal.

Capacitors and resistors connected to the AGC line were checked. All tested okay.

Finally, on a hunch, AGC resistor R1 was disconnected at its junction with C1 and R2. The FET-VOM measured nearly 3 volts **positive** at the junction where the resistor had previously been disconnected. Pulling the second IF tube out of its socket made the positive voltage disappear instantly.

The IF tube was gassy; but not enough to show up in a tester. A new tube cured the lack of sync and the overloading.

Transistor Massacre

One design feature that often enables AGC trouble to cause poor-sync symptoms is the noise-canceling stage. Generally, it exists to clip noise pulses off the video for both sync and AGC stages. These stages operate more stably if the video fed to them is as noise-free as possible.

One transistor color chassis brought to me exhibited the symptom in Fig. 4A. The picture ran wild.

Scope tracing through the rather elaborate sync section of this chassis was inconclusive. There were a number of bad waveforms. In fact, they all looked bad, and it was difficult to determine where to start analyzing. (The block diagram in Fig. 4B might help you imagine the complication.) Video (Fig. 4C) and keying waveforms were reaching the section, but that's about all I could be sure of.

The next step was to make DC

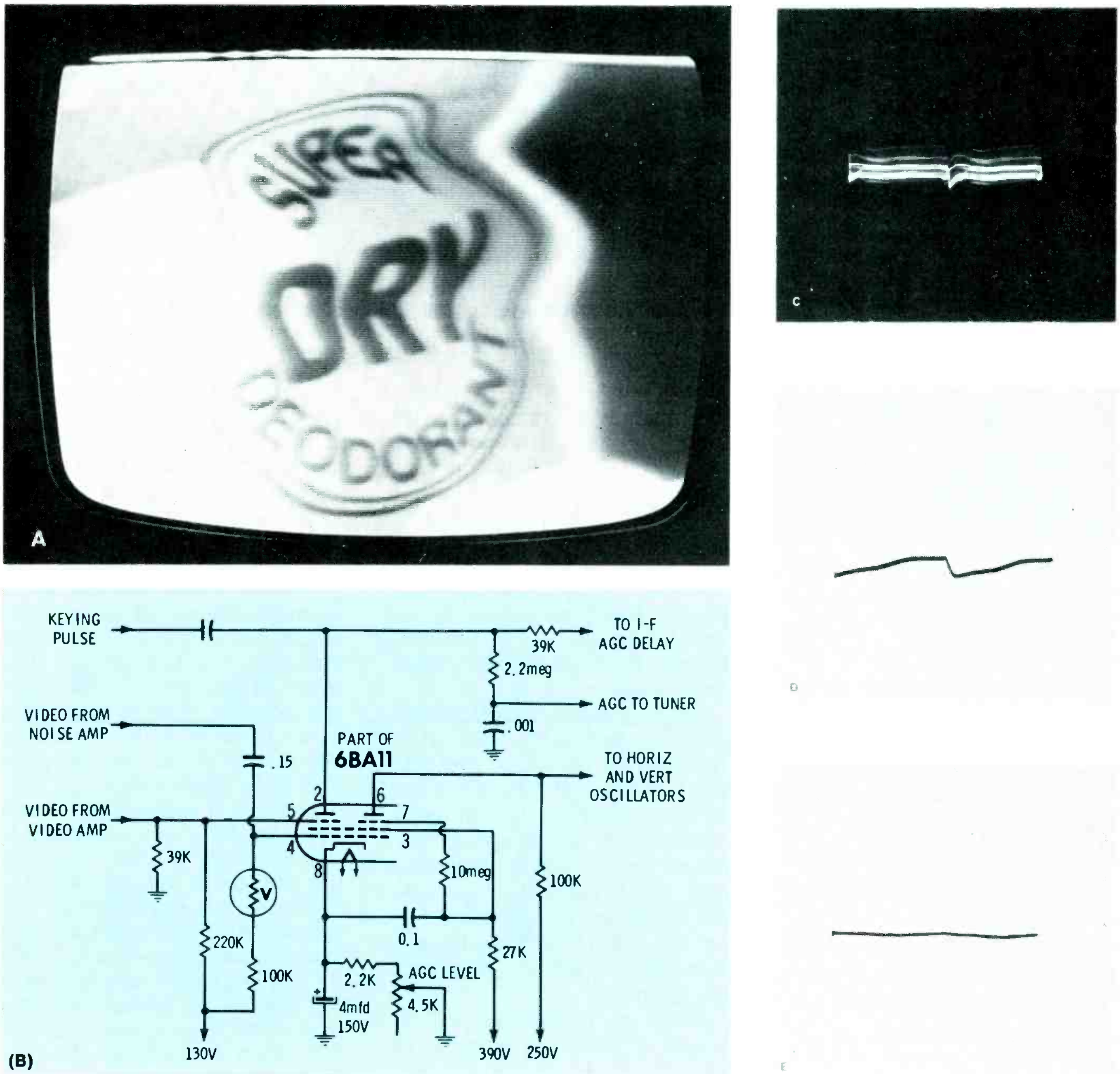


Fig. 1 Flagwaving and twisting in picture **(A)** can be caused by AGC trouble in noise-canceling type of stage shown in **(B)**. Waveform in **(C)** is video, more than should exist across bypass capacitor. Waveform in **(D)** is better, but still has too much hum. Waveform in **(E)** is normal.

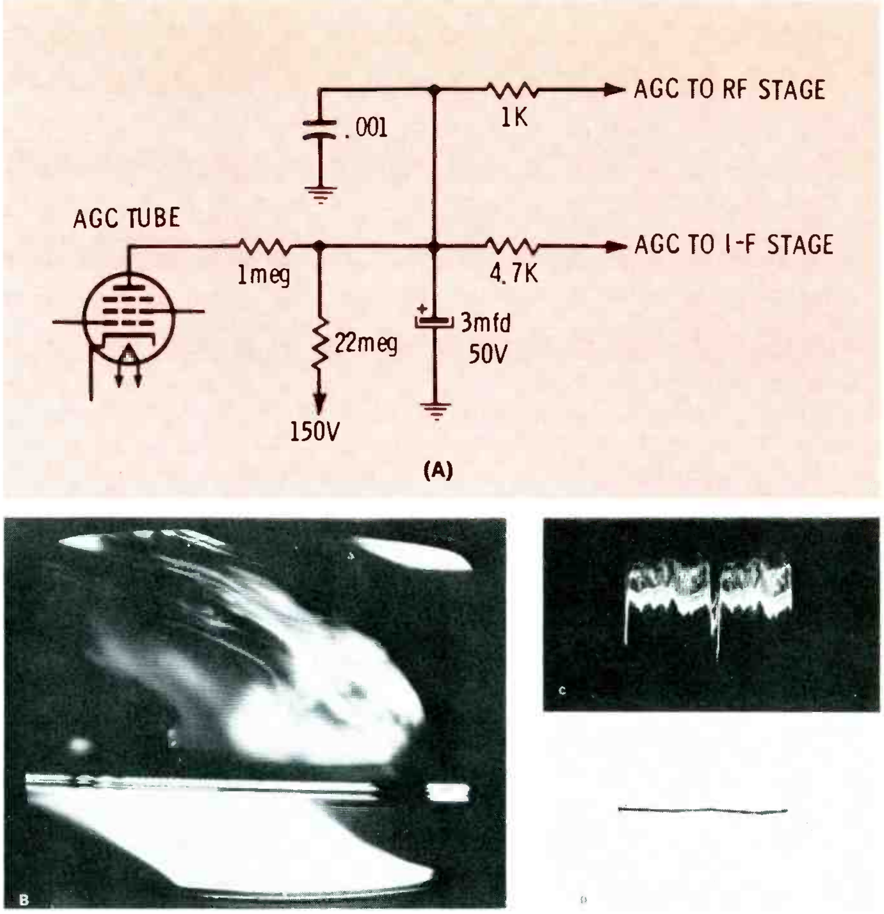


Fig. 2 Open AGC line electrolytic shown in **(A)** permits AGC overload **(B)**, but sync symptom is most important clue in this kind of stage. Waveform in **(C)** was taken across AGC capacitor while symptom was present. Shock healed the dielectric of the electrolytic, and made the waveform normal **(D)**.

voltage checks in the five stages, even though DC voltages in transistor sync stages don't usually offer valid clues. Almost all of them were incorrect.

One by one, I disconnected the transistors from their circuits and checked each with a transistor tester. The tester indicated that four of the five transistors were bad. At this point I almost decided my tester was haywire, but it checked new replacements okay.

Before I replaced the four transistors, I checked the resistors and capacitors in the stages. This took time, but I needed to determine why so many transistors burned out simultaneously. Supply voltages were normal, and all the parts checked okay. There was nothing to do but put in four new transistors and hope for the best. I did. They operated normally, and they cured the trouble symptom.

When the repaired set was delivered, I asked the customer exactly when and how the set had previously quit operating. It had made a "loud SNAP and then the picture wouldn't stand still," the customer said. Apparently, high voltage had arced, possibly in the picture tube. The resulting pulse had shot back through the AGC and sync stages and blown every transistor it reached.

The Missed Lead

Another chassis also sent to me by another shop exhibited a touchy intermittent symptom. When it appeared, it was lack of sync. Upended on the bench, the set operated normally. With the chassis flat on the bench or in the cabinet, the picture could be sent into wild gyrations by the slightest jar.

As usual, I asked what the first technician had found. According to the technician, an AGC transistor was bad, and it was replaced. (The set was a late-model Zenith, and the sync and AGC stages are on a printed-board Dura-Module.) The set then operated normally until it was back in the cabinet. Then the intermittent sync symptom began. Mocked up on the bench, the chassis exhibited the symptom only occasionally. Jarring seemed to start and stop it.

(Continued on page 62)

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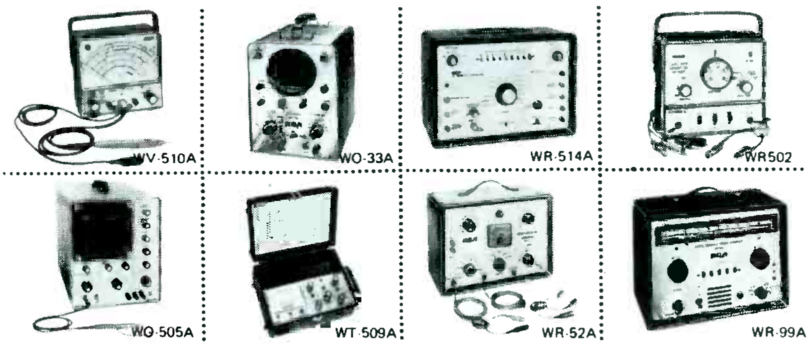

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Circle 29 on literature card

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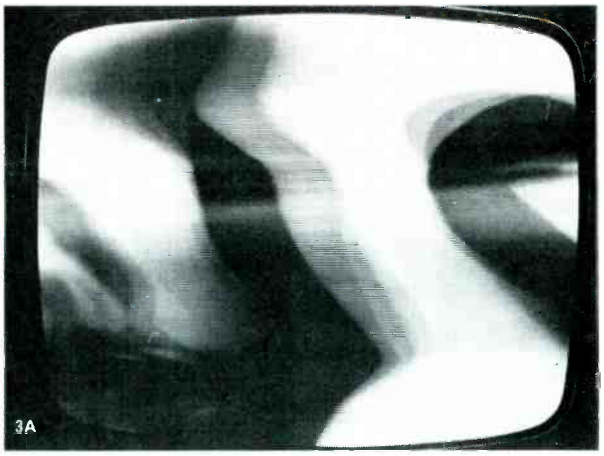
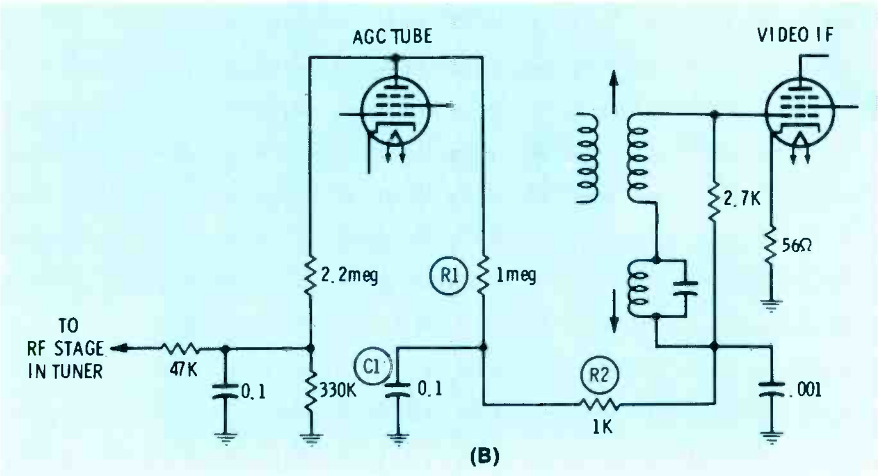
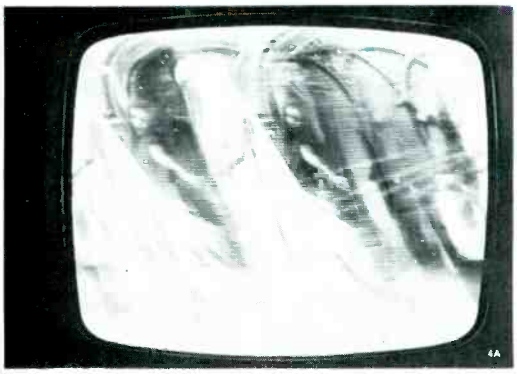


Fig. 3 Symptom in **(A)**, poor sync accompanied by signs of AGC overload, was traced to the IF tube shown in the schematic diagram **(B)**.





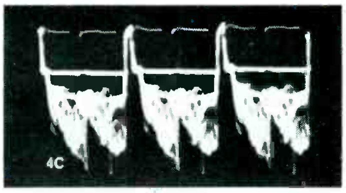
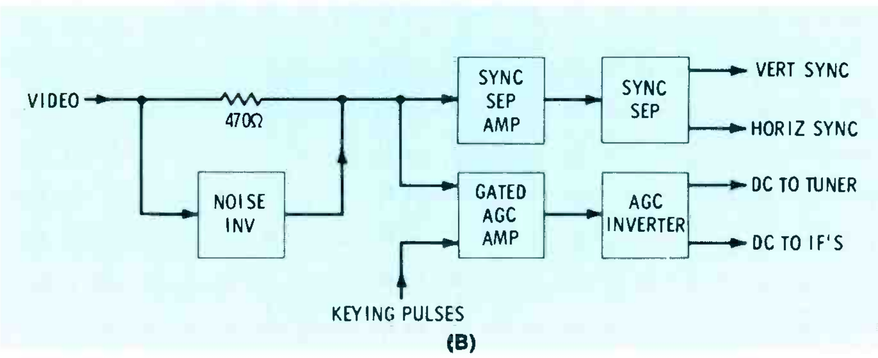
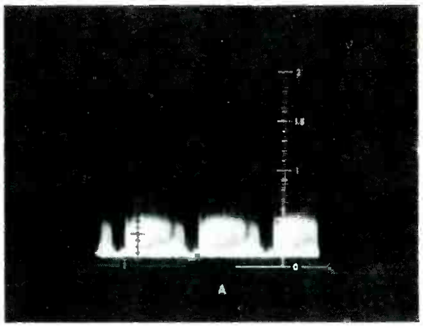


Fig. 4 Symptom shown in **(A)** was exhibited by a transistor color chassis equipped with sync/AGC system in **(B)**. Trouble was traced to wholesale transistor damage caused by picture tube arc. **(C)** Normal video applied to keyer grid.





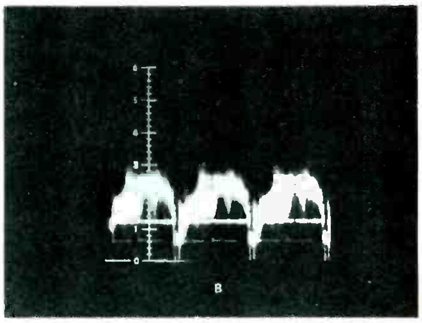
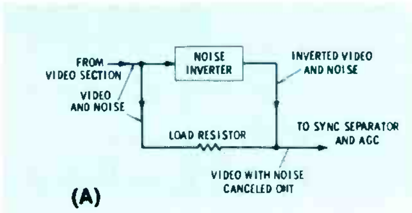


Fig. 5 Sync pulses in waveform **(A)** are drastically compressed. Waveform **(B)** shows that sync signal is present at input when IF overload is eliminated by clamping AGC line with external DC voltage.



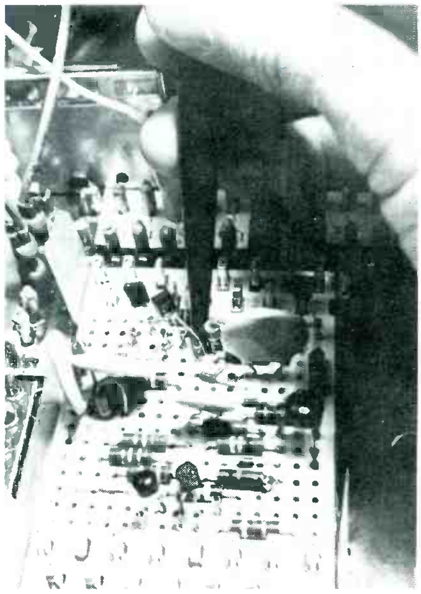


Fig. 6 Symptom was bad sync, but with earmarks of AGC trouble. Trouble was in noise inverter **(A)**. Transistor lead in photo **(B)** hadn't been properly pushed down inside socket pin. ▲

I clipped the scope to a few key test points on the Dura-Module terminals. The video waveform reaching the Dura-Module was compressed (Fig. 5A), and it was almost impossible to lock the scope display. This meant AGC was probably letting the IF's overload, which would compress the sync coming out of the video detector. It looked as if the trouble might be AGC instead of sync.

Watching both the waveform display and the TV picture, I biased (clamped) the AGC line with an external DC voltage. The waveform took on the shape in Fig. 5B, which is how the sync and video should look at the input of the sync/AGC Dura-Module. The picture was still out of vertical and horizontal sync, but now there was no sign of overload. Conclusion: both AGC and sync defects were causing the trouble, because although I was compensating for the AGC fault by clamping the AGC line, the sync problem persisted.

I was about to start tracing through both stages when I happened to think about the noise inverter. The block diagram in Fig. 6A gives you some idea how it works. As usual, it's common to both sync and AGC.

Fig. 6B shows you what I found. When the technician plugged in the noise-inverter transistor after testing it, he missed one of the socket pins. This transistor handles video for both AGC and sync, so it fouled up both. The lead would touch the socket every now and then, making the set intermittent. I plugged it in properly and the set operated normally.

Next

While we're on the subject of trouble symptoms, I've been digging into another one for you: contrast troubles. There are four kinds: 1) No video at all, but sound okay; 2) no video and no sound; 3) weak contrast; and 4) contrast excessive and not controllable.

In my next **service bench,** I cover these symptoms at length. The stages and circuits involved are reasonably standard, even in transistor and color sets. Experienced technicians know how unusual some of the things that happen to contrast are. And there'll be plenty to help those of you who haven't seen all the odd causes of poor contrast.

Panasonic Parts Division Headquarters Moves Into New Facility

The headquarters of Panasonic's Consumer Electronics Parts Division has moved into a new 80,000 square-foot facility in Woodside, New York, according to Sol Fields, General Manager of Panasonic's Consumer Electronics Service Division. The address of the new facility is 30-30 60th Street, Woodside, New York 11377.

shoptalk

With Carl Babcoke
ES Technical Editor

Practical of

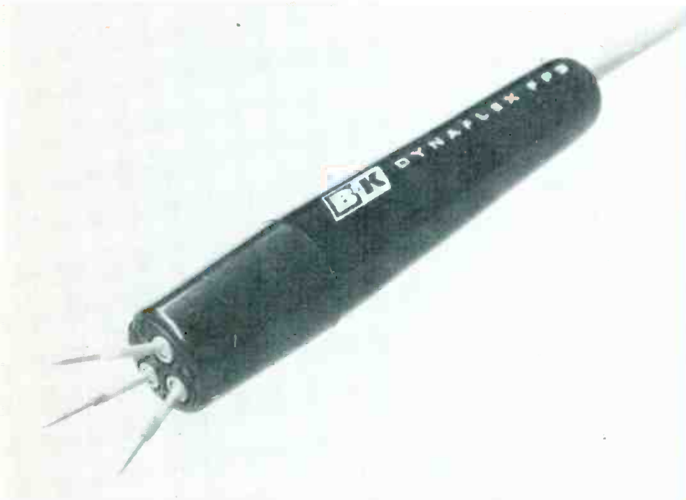
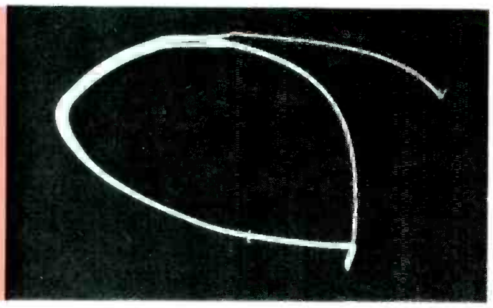


Fig. 1 Probe (for testing transistors on circuit boards) supplied with the Jud Williams Curve Tracer.

Fig. 2 A near-ellipse is produced by connection of a .25-mfd capacitor between the base and collector clips of the probe.



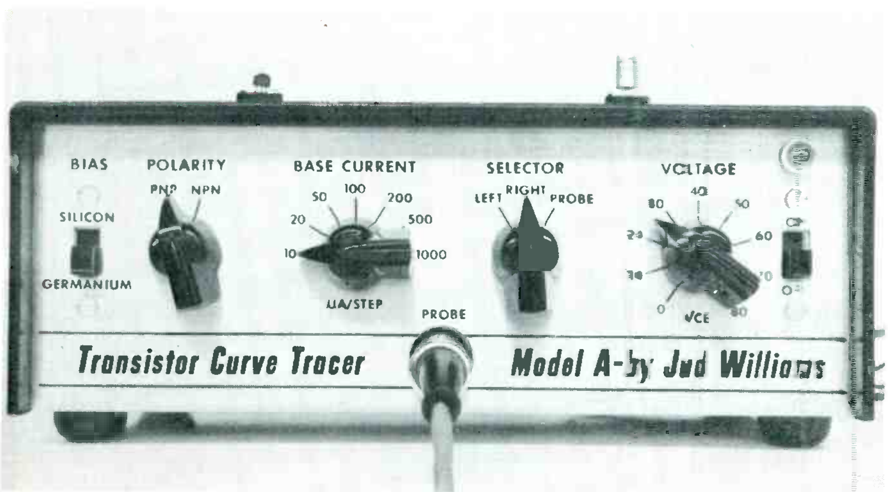


Fig. 3 Front panel controls of the Williams curve tracer.

How to use the curve tracer for in-circuit testing of transistors and out-of-circuit tests of diodes, including comparisons of results obtained with Jud Williams' Model A and Eico's Model 443 curve tracers and a conventional meter-type transistor tester.

Because many transistors are soldered to the circuit board, in-circuit testing can save valuable time ordinarily spent unsoldering and removing the transistor. Also, the possibility of damaging the transistor is reduced.

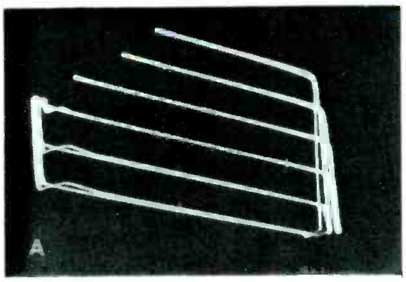
The Jud Williams Transistor Curve Tracer Model A is reported to have the capability of finding defective transistors in most circuits. One plug and cable supplied with the tracer has three small clips on the end for connection to out-of-circuit transistors or diodes which do not fit the sockets on top of the tracer, or for in-circuit connection to any transistor where space permits. A three-tip B&K probe (see Fig. 1), with cable and connector, also is supplied. Each of the three sharp tips is free to swivel in a circle, and each is spring loaded to retract partially into the probe when under pressure so that solid electrical contact can be maintained against any copper foil circuit board. Each tip has a color band, to identify the base, emitter and collector connections.

The family of curves produced by in-circuit tests are radically different than those produced with the transistor out of circuit. Mr. Williams advocates that these displays

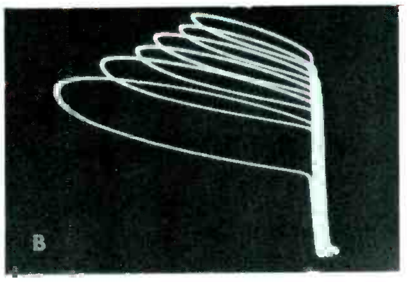
applications transistor curve tracers

be called "signature patterns", and suggests that they be included by the manufacturers in their service data, or added by technicians to their PHOTOFACT schematics after the pattern for each normal in-circuit transistor has been determined.

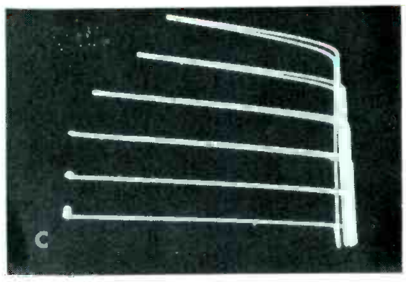
Capacitances and inductances in the circuit often make loops out of the curves, while resistances cause the curves to tilt as though the transistor were leaky. For example, a .25-mfd capacitor (without any transistor) connected between the base and collector clips of the tracer probe produces an approximately oval shape, as shown in Fig. 2.



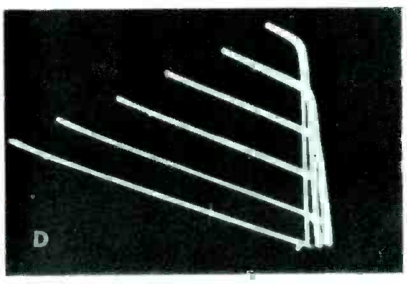
(A) Curves of a 2N408 PNP transistor in a resistance coupled audio amplifier. Base-emitter conduction in the following transistor amplifier stage causes what appears to be an avalanche condition at the end of the zero base current line.



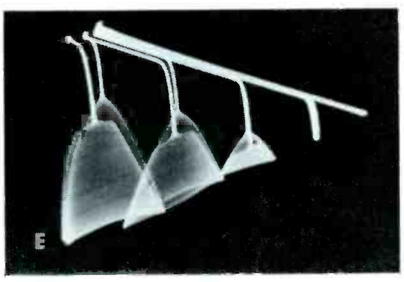
(B) Signature pattern curves of a 2N408 PNP transistor in an output circuit which includes a transformer in the collector circuit, but with the speaker disconnected. BASE CURRENT set for 10 μA.



(C) A NPN audio output transistor with a transformer and speaker connected to the collector circuit produced curves resembling out-of-circuit ones. BASE CURRENT switch set for 20 μA.



(D) Signature pattern curves of a mixer-oscillator PNP transistor in a portable radio resemble those of a leaky out-of-circuit transistor. However, a BASE CURRENT setting of 1000 μA was necessary because of loading by the circuit.



(E) The same transistor and circuit as in (D) gave this set of false curves which include pulses of RF oscillation when the POLARITY switch was changed to the incorrect NPN.

Fig. 4 Examples of in-circuit transistor curves.

Higher setting of the BASE CURRENT switch (often to the full 1000 μA position) and the VOLTAGE control are required to overcome the loading of some circuits. By comparison, most transistors can be tested out of circuit with only 10 μA of base current. Locations of these controls on the panel of the curve tracer are shown in Fig. 3.

Distortion of the signature patterns often can be reduced by connecting together the positive and negative voltage supply terminals of the circuit under test (no power is applied to the circuit during in-circuit tests with the tracer).

Several typical signature patterns of good in-circuit transistors and one interesting pattern resulting from the use of wrong polarity are shown in Fig. 4.

It is clear that effective in-circuit testing of transistors can be done with this curve tracer, especially if comparisons with known good transistors are used to aid interpretation of borderline cases.

Testing Other Solid-State Components

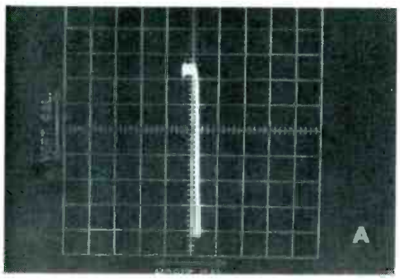
Go/no-go tests of solid-state components, such as diodes, zener diodes, SCR's and FET's, also can be made with the Williams curve tracer, although the instrument was primarily designed for transistor testing. Typical waveforms obtained when these other solid-state devices were tested out-of-circuit are shown in Fig. 5.

The base-emitter junction of silicon transistors exhibit zener action when tested as a diode. This is a positive way of identifying silicon alloy type transistors, since germanium types do not exhibit zener action.

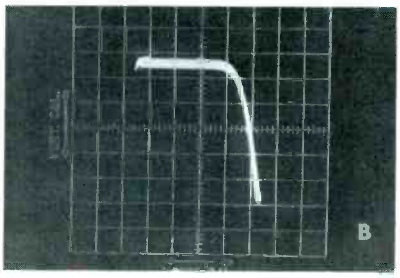
Inside the Jud Williams Transistor Curve Tracer

A simplified schematic of the Williams curve tracer is shown in Fig. 6. A pulsating DC staircase waveform is applied to the base of the transistor under test, through fixed resistors selected by the BASE CURRENT switch. During the time each step of the staircase is present at the base, a pulsating DC voltage of parabolic waveshape is applied to the collector. This voltage starts at zero, increases to the maximum determined by the setting of the VOLTAGE control, then decreases to zero. Because there is one parabola for each step of the 6 step staircase, and the parabola frequency is 120 Hz, the repetition

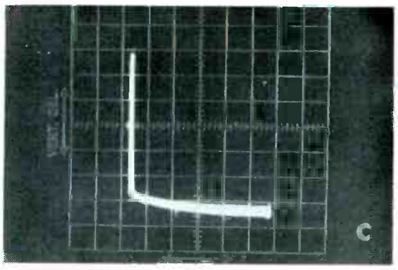
Fig. 5 Out-of-circuit tests of diodes, FET's and SCR's.



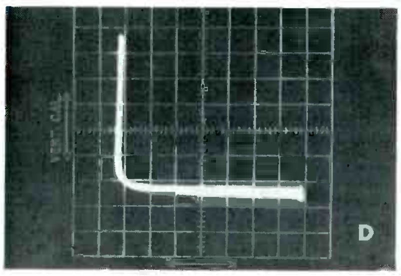
(A) Curve of a power supply diode connected between the emitter and collector clips of the external probe. POLARITY switch is set for NPN. Reverse the polarity and a horizontal line should be obtained, indicating an open circuit.



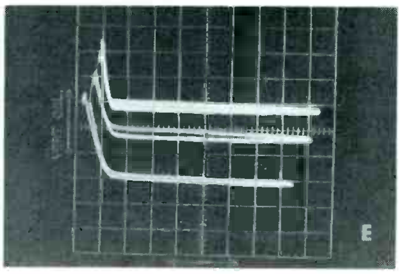
(B) The right angle curve of (A) widened by increasing the horizontal gain of the scope. A good diode should have this horizontal part of the angle, while a shorted diode will produce only a vertical line.



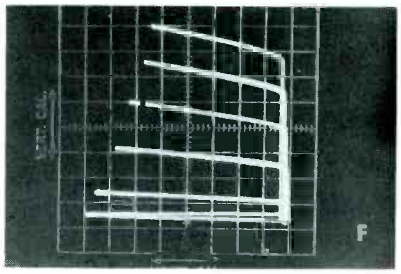
(C) Curve produced by a zener diode connected with its cathode to the emitter clip and its anode to the collector clip. The POLARITY switch should be set for PNP. The base-emitter junction of a silicon transistor shows the same zener curve. Incorrect setting of the POLARITY switch produces the normal diode curve shown in (A).



(D) Leakage and avalanche voltage are best shown with the base disconnected, but emitter and collector connected normally. This 2N410 transistor was not leaky, but showed avalanche at about 28 volts.



(E) A FET of unknown characteristics produced this unusual waveform. It seems advisable to test a known-good FET as a standard before testing a suspected one.



(F) Surprisingly, one SCR produced a set of curves very similar to those of a power transistor.

frequency of the staircase pattern is 20 Hz and some visual flicker is noticed on the pattern.

A dynamic visual display of the emitter current at zero and five increasing base current steps is created on the screen of any scope by: 1) applying the voltage developed across the emitter resistor to the vertical amplifier and 2) by applying the collector voltage to the horizontal sweep amplifier. (Refer to Fig. 6 on page 39 of the February '71 issue of ELECTRONIC SERVICING for an illustration that clarifies these voltage and current relationships.)

Although it is seldom necessary in practical servicing to measure accurately the DC beta (the height of the curves tell the approximate gain), such a reading is possible. Calibrate the gain of the vertical amplifier of the scope so that each vertical division of the graticule is .1 volt. Then with the BASE CURRENT switch set for 10 μA, each division represents a beta of 100, when the space between the two desired curves is measured. Fig. 7 shows transistor curves for a beta of 40. Each division represents a beta of 50 when the base current is 20 μA, etc.

Several minor trade-offs in the curve tracer design prevent the curves displayed from being true base current-vs-collector current graphs, such as those found in transistor manuals. Collector-emitter current is measured by the voltage drop across an emitter resistor, and the voltage there (see Fig. 8) is degeneration, which subtracts from the base signal and makes the display slightly more linear. This was done so you can use your normal service scope and avoid the expense of obtaining a special scope with an ungrounded vertical amplifier. Inversion of the vertical waveform (negative voltages go up, positive go down) is the result of this small compromise.

Horizontal sweep for the scope is taken from the parabolic voltage at the collector of the transistor under test. Therefore, changing the setting of the VOLTAGE control also changes the width of the waveshape on the scope; width can be restored by use of the horizontal gain control. This apparently was done so that a shorted transistor will cause a vertical line, and so a right angle will result from diode and zener diode tests.

The effect on the family of curves when the horizontal sweep for the scope is taken from the parabolic supply **before** the VOLTAGE control is shown in Fig. 9. The reason for the slanted zero-collector voltage side is that before collector current can flow, the collector voltage must exceed the base voltage (both voltages relative to the emitter). As the base voltage is increased at

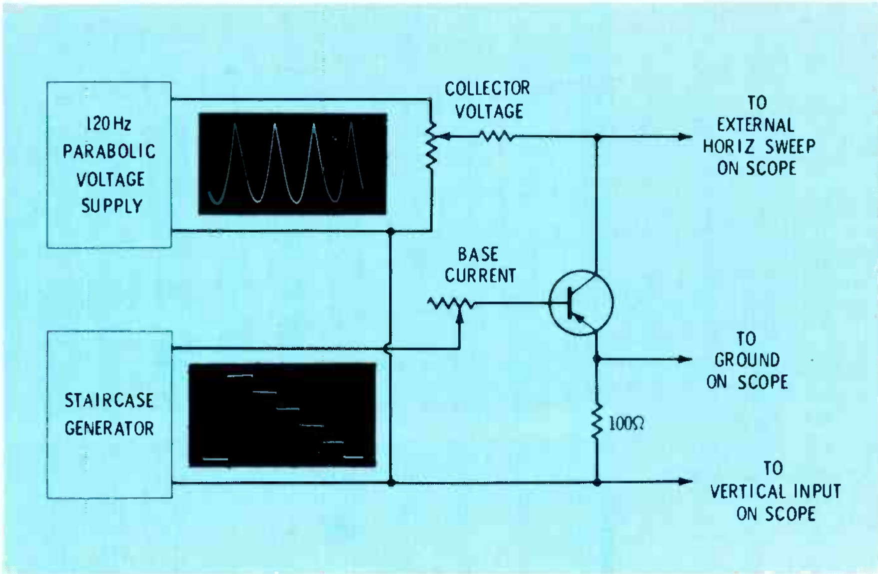


Fig. 6 Simplified schematic of the Williams curve tracer showing the polarity of waveforms required to test a PNP transistor.

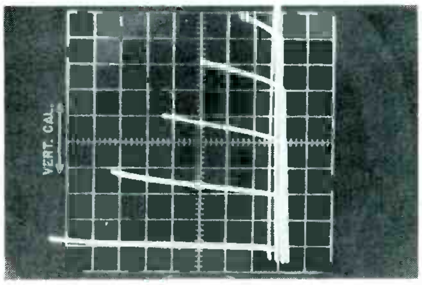


Fig. 7 Curves of a transistor measuring a beta of 40. Calibrate the scope for .1 volt per vertical division on the graticule, then with the BASE CURRENT switch set for 10 μA, each division between the curves represents a beta of 100; at 20 μA each division represents a beta of 50. In this example, the BASE CURRENT switch was set for 50μA, therefore each division represents a beta of 20.

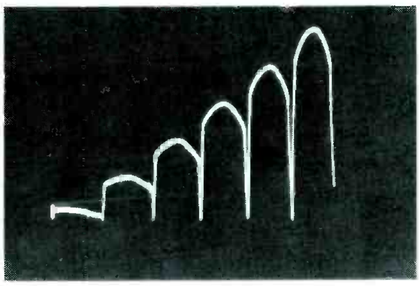


Fig. 8 Waveform across the emitter resistor when the sawtooth horizontal sweep in the scope is used instead of the parabolic horizontal sweep supplied by the curve tracer.

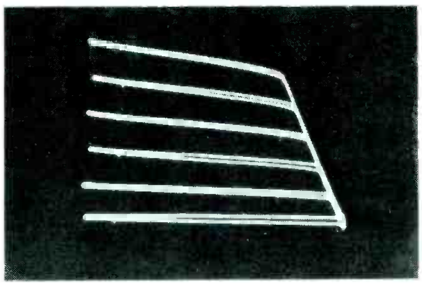


Fig. 9 A sloping zero-collector-voltage side of the curves is the result of experimentally taking the horizontal deflection voltage for the scope from the parabolic supply before the VOLTAGE control.

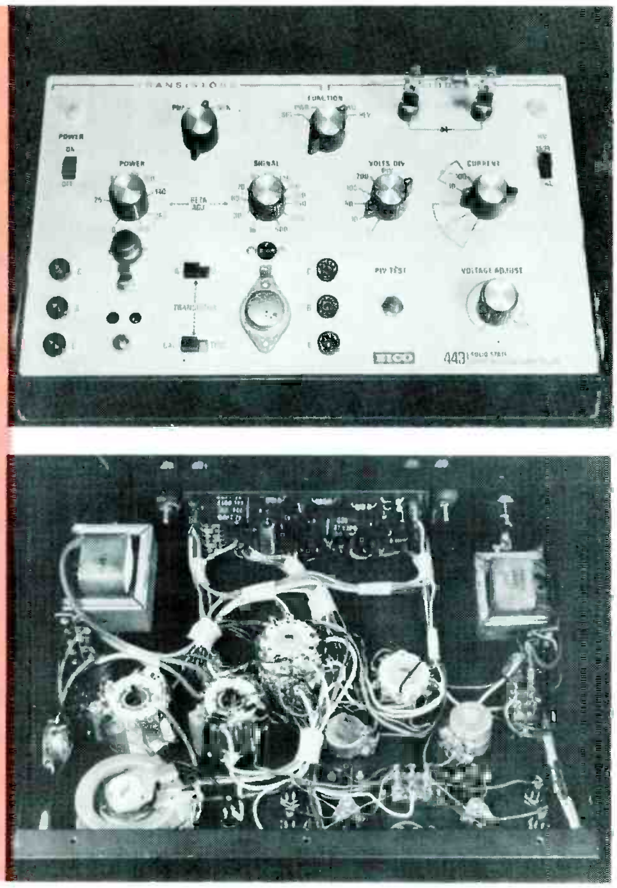


Fig. 10 Front panel layout and the internal wiring of the Eico 443 Semiconductor Curve Tracer.

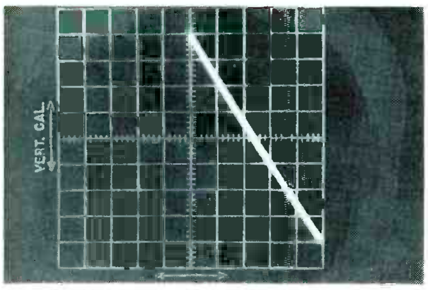


Fig. 11 Calibrate the scope for transistor beta tests with the Eico 443 by adjusting the horizontal gain, vertical gain and the centering controls on the scope for a 5-by-8 division diagonal line.

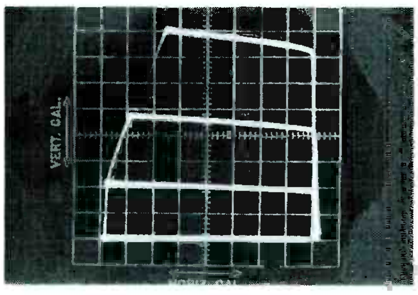


Fig. 12 Typical of curves obtained using the Eico 443 are these curves of a non-defective PNP transistor which measures a beta of 60. Adjust the beta knob until the total height of the waveform is 8 divisions, then read the beta from the dial calibration.

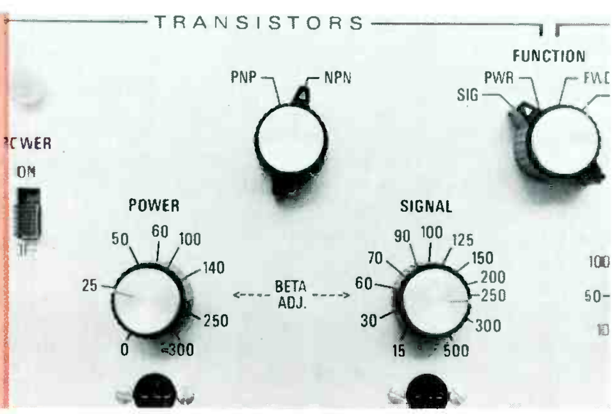


Fig. 13 Power and signal beta calibrations on the transistor-testing side of the curve tracer.

each step of the staircase, more collector voltage must be applied before current can flow. This actually produces a more accurate set of curves.

These explanations of the minor trade-offs are not intended as criticism, but are given for anyone who really wants to understand completely the electronic principles involved in this curve tracer.

Using The Eico 443 Transistor-Diode Curve Tracer

Another solid-state curve tracer suitable for use in electronic servicing shops is the Eico 443; both the front panel and the internal wiring are shown in Fig. 10. The design of this tracer seems to be somewhat different than that of the Jud Williams tracer previously described, and, consequently, so is the resultant pattern.

One strong feature of the Eico 443 is the accurate series of tests for diodes. including reverse leakage, maximum PIV and voltage drop in the forward direction.

Four combination binding post/banana plug jacks are provided on the rear of the cabinet, for connection to a scope. It appears, from the function and spacing of the posts, that the tracer can be plugged directly into the binding posts of the Eico 465 DC scope by the use of four male-to-male banana plug adapters. A 10-by-10 division graticule for use on any scope is included.

The Eico 443 is available in either kit or wired form. We built our sample from the kit and encountered no problem; the tracer worked on the first try.

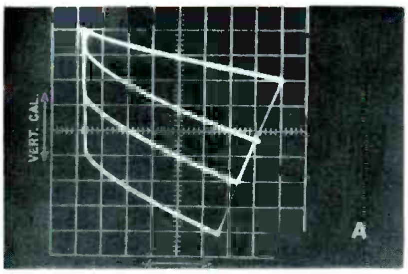
Testing Transistors With The Eico 443

A zero base current line and three steps of base current are supplied by the Eico unit; thus, four curves are displayed. All small, or "signal", transistors are tested with 10 volts applied to their collectors and a maximum current of 12 milliamps. Power transistors are tested separately, using another beta-calibrated scale at 10 volts of collector voltage and a maximum of 1 ampere.

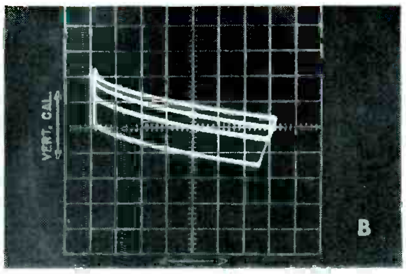
Pre-setting of the vertical and horizontal gain controls of the scope by means of standard voltages from the curve tracer is necessary if calibrated readings are to be obtained. Use these steps for maximum accuracy of readings:

• Connect leads (not supplied with the unit) from the binding posts on the tracer to the matching vertical and horizontal inputs on the scope.
• Slide the POWER switch to OFF and plug in the power cable of the tracer.
• Slide the diode TEST-CAL switch to TEST and the transistor TEST-CAL switch to CAL; then turn the FUNCTION switch to SIG for small transistors or PWR for power transistors.
• Slide the POWER switch to ON.
• Select the DC function of the scope, if the scope is thus equipped. Calibrate the scope by using the vertical and horizontal gain controls and the centering controls to produce a diagonal line 5 divisions wide and 8 divisions high, as shown in Fig. 11.
• Change the transistor TEST-CAL switch to TEST, and the polarity switch to either PNP or NPN, according to the type of transistor you wish to test. If the transistor polarity is not known, try both positions after a transistor is connected; use the one that produces a family of curves.
• Connect the transistor to be tested either by using test leads (not supplied with the unit) or by plugging it into one of the two different sockets. Position the A-B transistor selector switch correctly.
• Measure the DC beta by turning either the POWER or SIGNAL beta knob (according to which type was selected by the FUNCTION switch) until the total height of the pattern (meaning all curves) is 8 divisions, as shown in Fig. 12. Use centering controls as needed. Read the beta from the dial calibration, as shown in Fig. 13.

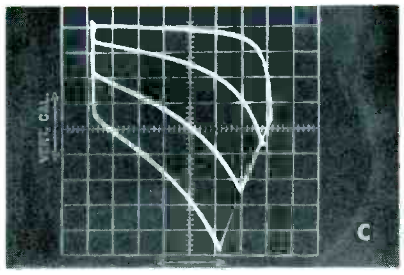
Several typical curves of abnormal transistors are shown in Fig. 14. Leakage, if any, is shown by the tilt of the zero base current line.



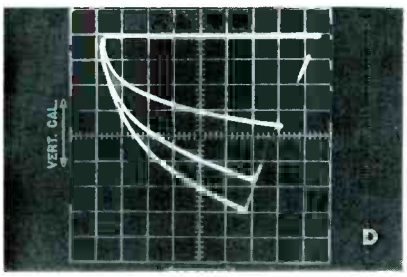
(A) A NPN silicon transistor with excessive leakage that causes the curves to be tilted.



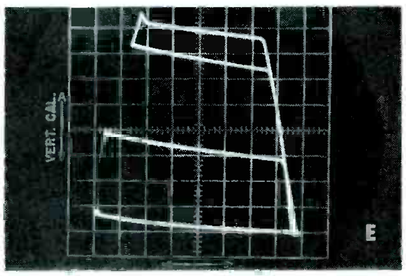
(B) These curves of a NPN small-signal transistor show excessive leakage, and a beta below 15 (because the curves cannot be adjusted to 8 divisions high).



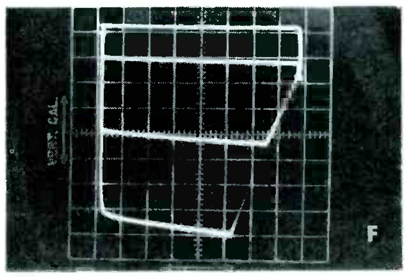
(C) Another NPN small-signal trantor with a beta measuring over 500, but with avalanche at a low collector voltage and excessive leakage.



(D) The forward resistance of the base-emitter junction measured on an ohmmeter a normal 110 ohms, but the base-collector resistance was an abnormal 1.2K ohms. Notice the sloping zero-collector-voltage side of the curves. Beta measured less than 15 on the Eico curve tracer. This is the same transistor tested in the February '71 issue of ELECTRONIC SERVICING in Fig. 12 on page 43. A meter-type tester gave a beta reading of 170 for this defective transistor.



(E) Excessive leakage is indicated in these tilted curves of a NPN power transistor, and the beta tested only 25.



(F) A high beta of over 500 was measured on this NPN silicon small-signal transistor. However, the avalanche at only 10 volts would prevent satisfactory operation in many circuits.

Fig. 14 Typical curves obtained from defective transistors.

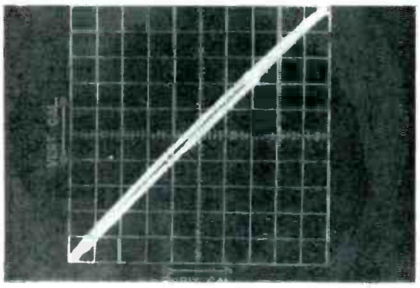


Fig. 15 Scope calibration for diode measurements requires the vertical gain, horizontal gain and the centering controls on the scope to be adjusted for a 10-by-10 division diagonal line.

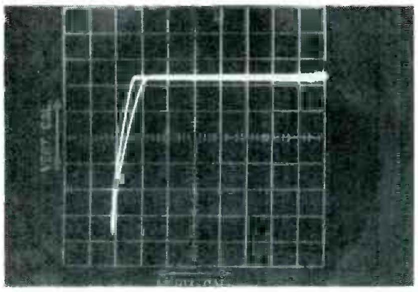


Fig. 16 The diode true PIV rating shown here is 700 volts, because the horizontal line is 7 divisions wide before avalanche occurs and the VOLTS-DIV PIV switch was set to 100.

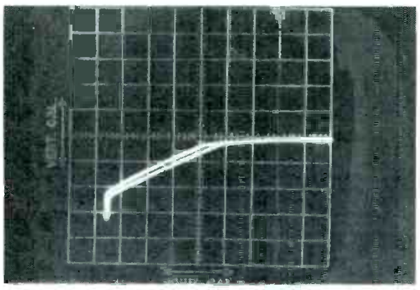


Fig. 17 This zener diode should be rated at 8.5 volts, because the VOLTS-DIV PIV switch was set to 1.

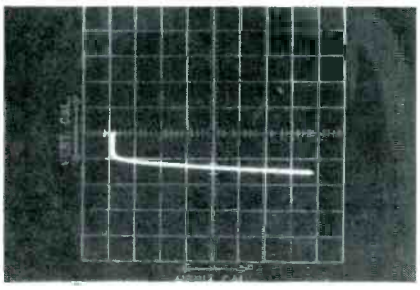


Fig. 18 A forward voltage drop of .75 volt at 800 milliamps is measured by this diode curve.

Testing Diodes With The Eico 443

A different scope calibration is needed for diode tests:

- Slide the diode TEST-CAL switch to CAL position.
- Rotate the VOLTAGE ADJUST control to minimum (CCW).
- Turn the FUNCTION switch to REV position.
- Adjust the vertical and horizontal gain controls of the scope for a diagonal line across 10 divisions, as shown in Fig. 15.
- Slide the diode TEST-CAL switch to TEST. The HV neon bulb above the switch should flash on and off.
- Turn the CURRENT switch to 10 μa, and the VOLTS/DIV PIV switch to an appropriate scale, such as 10 for a detector diode or 100 for a power supply rectifier.
- Connect the diode to be tested. (Observe polarity markings.)
- Press the PIV TEST button and advance the VOLTAGE ADJUST control. The horizontal line should move to the left until, at a definite voltage reading, a vertical line is formed on the left terminus of the horizontal line; the height of the vertical line will increase with CW movement of the VOLTAGE ADJUST control, as shown in Fig. 16. Use the centering control of the scope to position the extreme right end of the horizontal line on the right border line of the graticule.
- Read the maximum PIV by the number of divisions from the right end of the trace to the vertical angle line. Multiply the number of divisions by the setting of the VOLTS/DIV PIV switch. Don't be surprised if the PIV of many diodes measures better than the manufacturers' ratings.

A horizontal line indicates an open diode, and a vertical line a shorted one. A horizontal line also can indicate that the VOLT/DIV PIV switch is set too low.

Zener diodes are measured the same way, except the VOLTS/DIV PIV switch is set to a lower scale in anticipation of what the zener voltage should be. See Fig. 17 for the curve produced by one zener diode.

Forward tests of diodes use the same scope calibration as for PIV tests. Use this procedure:

- Turn the VOLTAGE ADJUST control completely down (CCW).
- Change FUNCTION switch to FWD position.
- Set the CURRENT switch for 10 or 100 mA/DIV, according to the expected rating of the diode.
- Slide the diode TEST-CAL switch to TEST position.
- Connect, or insert into the test clips, the diode to be tested.
- Increase the VOLTAGE ADJUST control (do NOT press the PIV test button) to produce a horizontal waveform similar to that in Fig. 18. Position the vertical portion of the trace on the left borderline of the scope graticule, with the trace initially starting on the zero voltage (horizontal) line. The vertical divisions are .5 volts each (many silicon rectifiers will measure about .7 or .8, as shown). A vertical line indicates no current (an open diode).

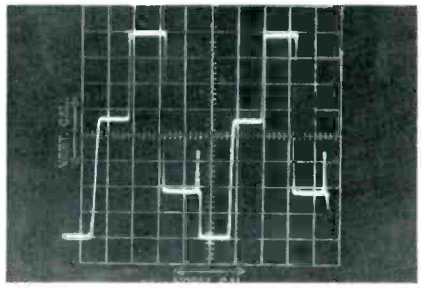


Fig. 19 Base-to-emitter voltage (without a transistor) in the Eico 443 curve tracer shows zero and three steps of base voltage.

How The Eico 443 Works

The voltage applied between base and emitter during beta tests is shown in Fig. 19. There are zero and three different steps of voltage, but they are not in sequence. This accounts for the faint lines across the ends of the curves.

Conclusion

A 2N410 PNP transistor was measured for beta by both curve tracers and a good commercial meter-type beta tester. The meter measured a beta of 42 at 10 milliamps and 38 at 1 milliamp. The Eico 443 indicated a beta of 60, and the Jud Williams tracer showed a beta reading of 40. Since all three instruments applied different voltages to the transistor under test conditions, we believe the degree of difference is satisfactory. After all, the DC beta of a transistor varies according to the conditions under which the transistor is operated, and an **exact** beta is not essential in service work. ▲

advertisers' index

productreport

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

Vacuum Desoldering Pump

Techni-Tool introduces the T-2 vacuum desoldering pump.

Constructed of sturdy lightweight aluminum, the pump has a "solid vacuum" piston for increased performance. Only 7 inches long over-

all, the tool can be loaded and discharged with one hand. Wasted motion and the danger of rapidly ascending plunger are reportedly eliminated.

Replaceable tips made of Teflon give additional long life.

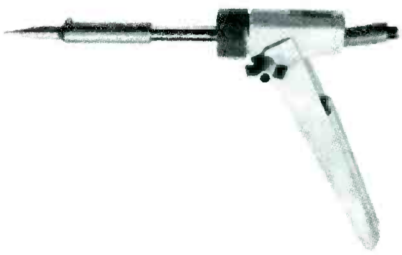
The T-2 vacuum desolder pump sells for $12.50.

Circle 60 on literature card

Industrial Soldering Iron

The Ersa Varius, a soldering iron designed for continuous heavy duty soldering operations, has been introduced by Edysn, Inc.

Added features reportedly include an adjustable pistol grip for optimum hand control and the Ersadur long-life tip which requires no filing or shaping during its life.



Available in 40- or 50-watt sizes, and weighing less than 8 oz., the Ersa Varius sells for $10.75.

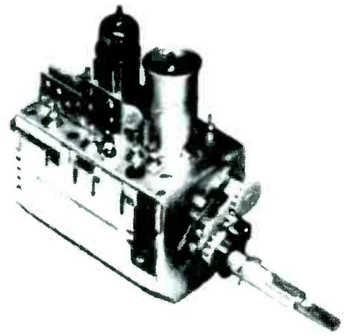
Circle 61 on literature card

Universal Replacement Tuners

A complete range of television tuners for use as replacements in color or black-and-white receivers with 40-MHz IF systems has been introduced by Castle Television Tuner Service, Inc.

Units are available with heater circuits for wiring into 6.3-volt, 600mA, 450mA and 300mA supplies. B+ voltage requirement of each tuner is 135 volts with resistors furnished for adaptation to supplies up to 280 volts, reports the manufacturer.

All models are aligned for 41.25-MHz sound IF and 45-75-MHz video IF. Each tuner is equipped with a memory fine tuning system and a UHF position and plug input for use with UHF-equipped receivers. The B+ supply for the UHF



tuner is automatically switched on when the UHF position is selected.

Available in eight models to adapt for use in thousands of TV receivers, these universal replacement tuners are priced from $8.95 to $11.00, complete with instructions.

Circle 62 on literature card

Bypass Capacitor Kit

A bypass capacitor kit, which includes an assortment of dipped Mylar/paper capacitors packaged in a series of three interlocking plastic drawers, has been introduced by Aerovox Corp.

The DBE capacitors included in Kit No. AK-115ET are dipped, radial-lead types. The assortment of 115 capacitors all are rated at 600 volts, in popular capacitance ratings.

Suggested retail price to service dealers, including a special bonus of an electric warmer, is $24.95. ▲

Circle 63 on literature card

catalogs literature

ANTENNAS

100. *Vikoa, Inc.* — is making available a 64-page, illustrated catalog covering their line of wire, cables and IDS/MATV equipment. Hardware, accessories, connectors, fittings, and an index also are included*

AUDIO

101. *E-V/Game, Div. of Electro-Voice*—announces a new 120-page Needle Catalog 71N. Expanded into six major sections, the entire line of E-V needles, the numerical needle cross reference and quick reference pictorial guide are but three sections whose format shows how to use this guide.

102. *Jensen Manufacturing Div.*—has issued an 8-page catalog, No. 1090-E, which describes application of 167 individual speaker models. Special automotive, communications, intercom and weathermaster speakers, plus a complete line of electronic musical instrument loudspeakers are featured.

COMPONENTS

103. *General Electric Tube Department*—has released a new 52-page Entertainment Semiconductor Almanac, No. ETRM-4311F. The almanac contains approximately 20,000 cross references from JEDEC, or OEM part numbers to GE parts numbers for universal replacement semiconductors, selenium rectifiers for color TV, dual diodes, and quartz crystals.

104. *General Electric*—a 12-page, 4-color, illustrated "Picture Tube Guidebook", brochure No. ETRO-5372, provides a reference source for information about GE color picture tube replacements and tube interchangeability.*

105. *RCA Distributor Products*—is offering an 8-page illustrated pamphlet entitled "When, Where and Why It Pays To Switch To RCA Alkaline Rechargeable Batteries," No. 1P1385.*

106. *Sylvania Electric Products, Inc., The Electronic Tube Division*—is offering a 65-page reference brochure which gives characteristics of over 2,000 types of receiving tubes. Data is given for both GTE Sylvania tubes and those of other manufacturers to provide fast information on principal electrical and physical properties of popular electron receiving tubes, including the latest designs for color television sets. Copies are $.50.

107. *Sylvania Electronic Products, Inc.*—a 73-page guide which provides replacement considerations, specifications and drawings of Sylvania components plus a listing of over 35,000 JEDEC types and manufacturers' parts numbers. Copies are $1.00.*

108. *Workman Electronic Products, Inc.*—introduces a new 1971 catalog of replacement components for radio and television. 64-pages of resistors, fusing devices, circuit breakers, convergence controls, service accessories, electronic chemicals, audio cables, adapters for hi-fi and cassette type recorders, battery holders and prototype kit components.

INSTRUCTIONAL MATERIALS

109. *Cleveland Institute of Electronics*—has made available a 24-page, full-color brochure which describes a practical approach for training of employees in the electronic field. Explains how full-time employees can

(Continued on page 74)

(*Continued from page 73*)
be trained on their own time, at home, or on company time.

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If you would like to see an article about a particular subject directly related to servicing consumer or communications electronic products, send us your suggestion.

We value your comments and criticism.—Ed.

PROTECTION DEVICES

110. *Bussmann Mfg. Div., McGraw-Edison Co.*—has announced a 16-page, 1971 edition of the "Buss Fuse Car and Truck List", which shows the proper fuse to use and where the fuse is located for the protection of radios, tape decks, stereos, and many other electrical/electronic automotive accessories. The information covers all 1971 models of cars and trucks, as well as older models for 12 model years back.

TECHNICAL PUBLICATIONS

111. *Howard W. Sams & Co., Inc.*—literature describes popular and informative publications on radio and television servicing, communications, audio, hi-fi and industrial electronics, including their 1970 catalog of technical books on every phase of electronics.*
112. *Sencore, Inc.*—Speed Aligner Workshop Manual, Form No. 576P, provides 20 pages of detailed, step-by-step procedures for operation and application of Sencore Model SM158 Speed Aligner sweep/marker generator.*

TEST EQUIPMENT

113. *B&K Mfg. Div., Dynascan Corp.*—is making available an illustrated, 24-page 2-color Catalog BK-71, featuring B&K test equipment, with charts, patterns and full descriptive details and specifications included.*
114. *Bird Electronic Corporation*—has made available a new catalog of quality instruments for RF power measurement GC-71. This comprehensive reference of RF measurement instrumentation from 25 milliwatts to 250 kilowatts features over fifty new listings.
115. *Eico*—has released a 32-page, 1970 catalog which features 12 new products in their test equipment line, plus a 7-page listing of authorized Eico dealers.*
116. *Hickok Electrical Instrument Co.*—introduces the new Hickok Service Test Instruments 1971 catalog which contains photographs, condensed specifications and prices for Hickok tube testers, transistor testers, oscilloscopes and signal generators.
117. *Mercury Electronics Corp.* 14-page catalog provides technical specifications and prices of this manufacturers' line of Mercury and Jackson test equipment, self-service tube testers, testers, test equipment kits and indoor TV antennas.
118. *Sencore, Inc.*—Catalog No. 579P (1971) describes this company's complete line of test equipment. Sixteen pages of photographs, specifications, prices and other important data.*

Tools

119. *General Electric*—has issued a 2-page brochure No. GEA-8927, describing the features of GE's new soldering iron.
120. *Jensen Tools and Alloys*—has announced a new catalog No. 470, "Tools for Electronic Assembly and Precision Mechanics." The 72-page handbook-size catalog contains over 1,700 individually available items.
121. *Starnetics Co.* — has published a 54-page, 1971 catalog of popular, labor-time saving tools for microelectronic and conventional electronic production.
122. *Xcelite, Inc.*—has published a 2-page illustrated Bulletin N670, which introduces two new reversible ratcheting handles for use with more than 60 of the company's available Series "99" nutdriver, screwdriver, and special purpose blades.
123. *Xcelite, Inc.*—Bulletin N770 describes this company's three new socket wrench and ratchet screwdriver sets.

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