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practices for
service shops.

page 16



All about
recurring scopes,
pages 20 & 30

simulated picture



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works to cut back
the need of
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replacement

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GENERAL  ELECTRIC



The ruggedized Color Crossfire stays home while other antennas hit the town!

No matter how stormy Winter nights get, you won't find the new Color Crossfire on the streets the morning after!

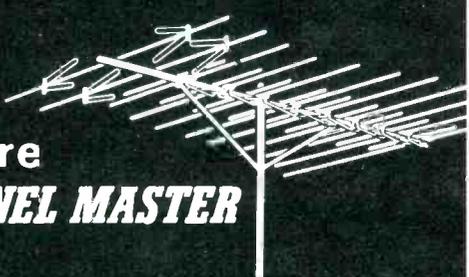
Channel Master has ruggedized this world famous powerhouse with 30% stronger rear elements that stand up to heavy wind, snow and ice loading...and still deliver the colorful message that's made the Crossfire series the nation's number one.

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The new ruggedized Color Crossfire
and Color Crossfire-82 from **CHANNEL MASTER**



Circle 4 on literature card

Electronic Servicing

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Second class postage paid at Kansas City, Mo. and additional mailing offices. Published monthly by INTERTEC PUBLISHING CORP., 1014 Wyandotte St., Kansas City, Mo. 64105. Vol. 21, No. 4. Subscription rates \$5 per year in U.S., its possessions and Canada; other countries \$6 per year.

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INTERNATIONAL MEDIA
REPRESENTATIVES LTD.
1. Shiba-Kotohiracho, Minatoku
Tele: 502-0656



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

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

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



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exact fact

Service technicians prefer exact replacements over "fits-all" capacitors because they're easier to install, and are less expensive, in most cases.

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E3-1102

New Indiana Bill Calls for Licensing of Both Technician and Shop; Florida Licensing Underway

A bill which would require the licensing of both electronic service technicians and electronic service shops has been introduced in the 1971 session of the Indiana General Assembly.

The current law licenses only technicians, not shops.

The proposed legislation reportedly will strengthen the power of the state board of television and radio service examiners by providing them with the legal machinery needed to establish and monitor the professional standards of both shops and technicians.

Provisions of the new bill reportedly include a \$500-a-day fine and up to six months imprisonment for operating without a license. The bill also would make it illegal to charge for parts not installed and services not performed.

NESA Re-Elects Hyde President

Henry (Hank) G. Hyde, CET, has been re-elected president of the Nebraska Electronic Service Association (NESA), according to a report in a recent issue of **The NESA News**, the Association's official publication.

Other officers elected include Fred Blevins, secretary; Don L. Barmore, treasurer; and John Sperry, CET, director-at-large.

Area vice presidents elected were Leroy Becwar, Larry Henry and Doug Leach, of areas 1, 3 and 5, respectively.

Rodger T. Brehm, CET, continues as executive director of NESA.

GE Announces New Direct, Per-Call Warranty Service Reimbursement Program

General Electric has announced that it will begin reimbursing their servicing dealers directly for in-warranty service on a per-call basis.

Previously, General Electric, like many other manufacturers, provided servicing dealers with a reserve which the dealers used to cover the expense of in-warranty service calls. The reserve was "paid" servicing dealers by charging them less for merchandise than that charged non-servicing dealers.

Under the new General Electric franchise and related warranty programs, merchandise will be sold to non-servicing and servicing dealers at the same price.

The new warranty reimbursement program reportedly covers General Electric appliance and television products but does not apply to this manufacturer's central air conditioning and heating products.

General Electric reportedly has been testing the new program in its Michigan and Gulf districts during the past year. The program will be initiated on the West Coast and ultimately will include dealers in all states.

TV Set Small As Cigarette Package Not Far Away Predicts Motorola Executive

"Someday a TV set will be only as big as a package of cigarettes, and you will be able to take out this package, take it down to the drug store and buy a new TV set. And that day isn't very far away."

This prediction was voiced by Edward P. Reavey, Jr., executive vice-president of Motorola, during a forum at the National Association of Home Builders convention in Houston, Texas, in January, according to a report recently published in **Home Furnishings Daily**.

Mr. Reavey reportedly also told the home builders: "You'll see more and more of this modular design concept for ease of service."

1970 Distributor-to-Dealer Domestic Label Sales Fall Below 1969 Totals

Total distributor sales of domestic-label television to dealers in 1970 was 10.8 percent below the 1969 sales volume, according to the following sales figures recently released by the Marketing Services Department of the Electronic Industries Association.

Total Distributor Domestic-Label Sales To Dealers

	1970	1969	
RADIO			
AM	4,798,996	5,870,495	-18.3
FM	3,183,901	3,842,204	-18.1
TOTAL HOME	7,982,897	9,712,699	-17.8
AUTOMOBILE	8,125,359	10,109,487	-19.6
TOTAL RADIO	16,108,256	19,822,186	-18.7
TELEVISION			
Monochrome	4,545,608	4,974,993	- 8.6
Color	4,821,505	5,523,752	-12.7
TOTAL TELEVISION	9,368,113	10,498,745	-10.8
PHONOGRAPH			
Portable and Table	3,019,245	3,711,792	-18.7
Console	1,086,551	1,357,574	-20.0
TOTAL PHONOGRAPH	4,105,796	5,069,366	-19.0

SOURCE: EIA Marketing Services Department

Packard Bell Names Southwest Field Engineer

Bobbie C. Barkley has been appointed Teledyne Packard Bell Field Engineer for the Southwest area, a new position, according to Paul Pekarsky, Director of Field Engineering.

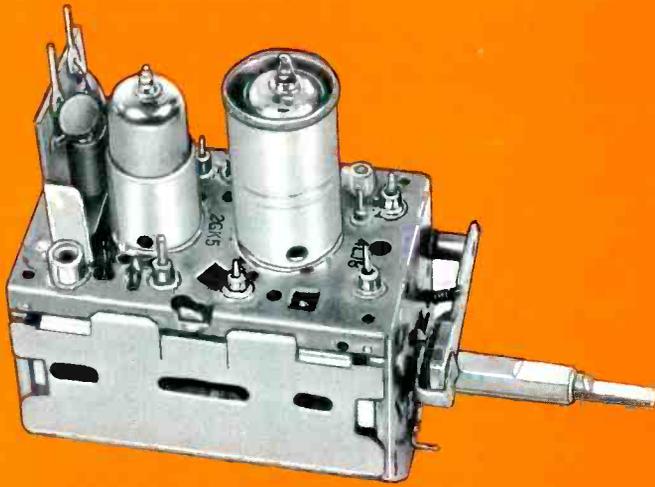
Based in Dallas, Texas, Barkley will service Packard Bell television and stereo distributors and dealers in Texas, Oklahoma, Kansas, Louisiana and Arkansas.

Admiral Discusses Sale of Color CRT Production Equipment With RCA

Admiral Corp. has been holding discussions with RCA concerning the possible sale of Admirals' equipment for manufacturing color TV picture tubes, according to a report in a recent issue of **The Wall Street Journal**.

Admiral, who reportedly produces only one type of color CRT, has cut back on its picture tube production, according to industry sources. Admiral reportedly buys all of the black-and-white picture tubes and some of the color CRT's it uses in production.

During the past year, several other producers of color CRT's have sold their production equipment,



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WEST	SARKES TARZIAN, Inc. TUNER SERVICE DIVISION 10654 MAGNOLIA BLVD., North Hollywood, California	TEL: 213-769-2720

Circle 6 on literature card

including Motorola, who sold to a General Telephone subsidiary which produces picture tubes in an overseas facility, and Avent, who has halted all production of new CRT's but continues to produce rebuilt color picture tubes. National Video Corp. discontinued its color picture tube production in February of 1969.

Remaining major producers of color picture tubes reportedly are: RCA, Zenith, and Sylvania. Other color CRT manufacturers include Philco-Ford, General Electric and Westinghouse. Sylvania, Westinghouse and RCA reportedly are the major industry suppliers.

IC's Contain 75 Percent of Circuitry In New Toshiba Solid-State Color Chassis

Tokyo Shibaura Electric Co., Japanese manufacturer of Toshiba television receivers, reportedly has introduced a solid-state color TV receiver in which about 75 percent of the circuitry is contained on integrated circuits (IC's).

Components of the new 20-inch (90-degree) color receiver reportedly include 15 IC's and 55 other semiconductor devices. Thirteen of the IC's are bipolar types and the remaining two are hybrid linear types.

Circuits not contained on the IC's are the video and audio output stages, the low- and high-voltage power supplies, the horizontal drive and output stages, the vertical output stage and the VHF and UHF tuner circuitry.

Toshiba itself reportedly is manufacturing all of the IC's used in the new chassis.

RCA Ends Its Production of B-W TV Picture Tubes; Converts Operation To Color CRTs

RCA has announced that this month it will phase out its black-and-white TV picture tube production.

The reason given by RCA for the curtailment of b-w picture tube production was that "current market conditions do not make it economical."

The Marion, Indiana plant previously used by RCA for b-w picture tube manufacture reportedly will be converted to color picture tube production, and will be operational again in the last quarter of 1971.

RCA will continue to sell black-and-white replacement picture tubes to the distributor market, but the tubes will be obtained from "qualified suppliers in the U.S. and Canada."

FCC To Reassign Part of Two Unused UHF TV Channels To Land Mobile Radio Users

The Federal Communications Commission (FCC) has announced its intention to reassign two unused UHF television channels in the 10 largest cities to land mobile radio users.

Each channel reportedly will be divided into 120 separate pairs, of which 31 will be assigned to business and industry users.

Cities affected by the new FCC ruling are: New York, Los Angeles, Chicago, Philadelphia, Detroit, San Francisco, Boston, Washington, Pittsburgh and Cleveland. ▲

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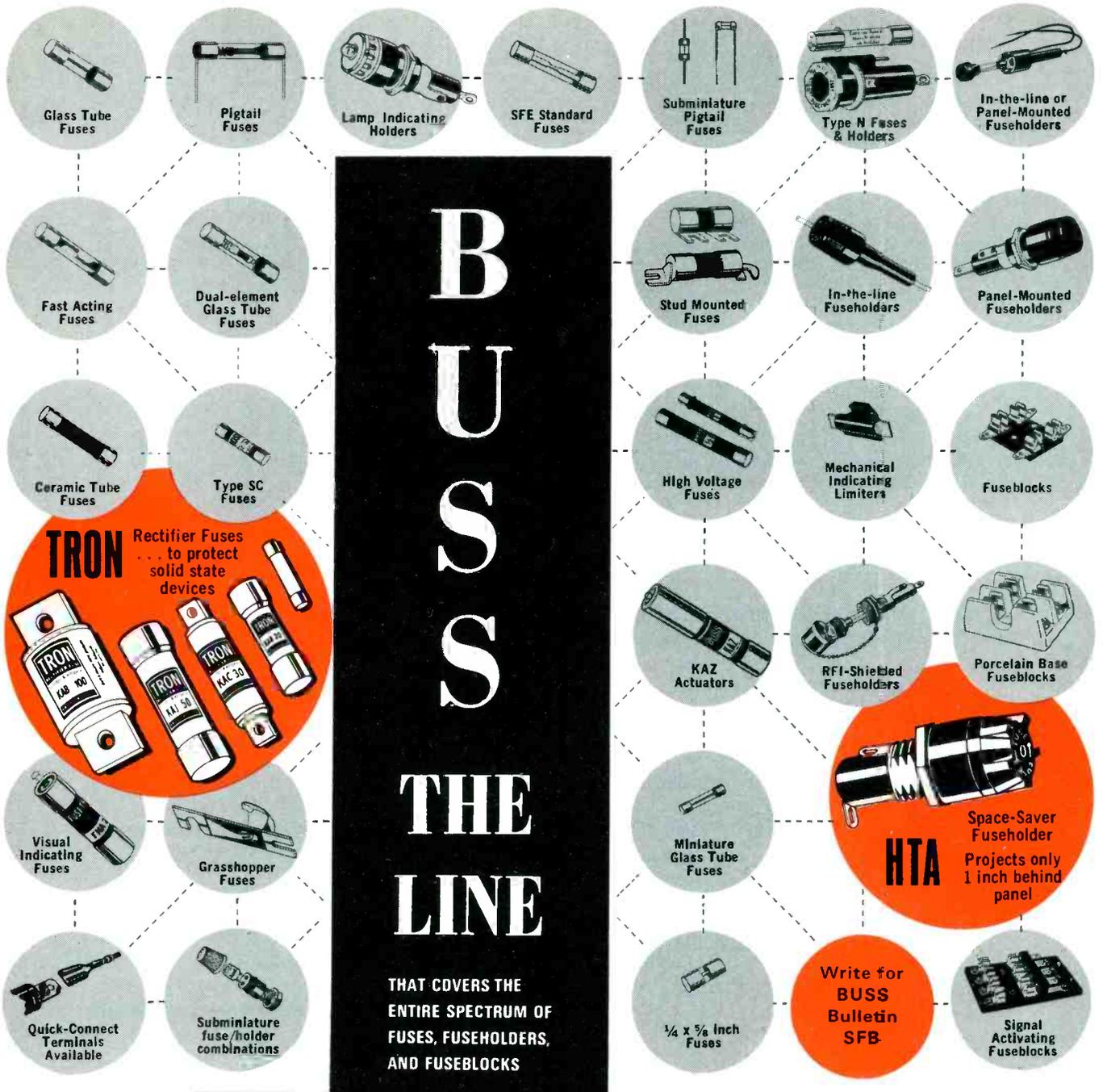


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Racine, WI 53403

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FUSES

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■ 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.

Business Opportunity

I have an excellent business here in South Georgia. The people are friendly and the climate is very pleasant, but the time has come for me to step down, because of age.

It would be an excellent venture for one or two younger men to take over. It is fully equipped and has been well established over the past 21 years in this same location. It includes a large shop, modern 3-bedroom home, all on approximately 1 acre of land with large front to a US highway.

We have enjoyed your publication for many years; in fact, we plan to stay on the mailing list for some time to come, so that we can keep up with the new things as they come out.

William H. Reynolds, Sr.
Emerson Park TV & Electrical
Appliance Service Co.
R.F.D. 3, Box 217
Waycross, Ga. 31501

For Sale

I have the following for sale:

- 1) Bud, 100 KC, frequency calibrator, \$20.00
- 2) Volumes, I, II, III, RCA Television Pict-O-Guides, Aid to TV Troubles by Picture Analysis, all three books, \$9.00.

Roy C. Miglorino
231 Birch La.
Forked River, N.J. 08731

I have a Precision, Model E-200-C marker generator for sale. Frequency coverage 88 KC to 60 MC on fundamentals 60 MC to 240 MC on harmonics. Will sell for \$65.00 and pay shipping.

John McNevin
60-93 Wilson Way
Milpitas, Calif. 95035

I have the schematics and service manuals for forty-two Estey electronic organs. I will sell for \$20.00, postpaid or trade.

I also have Rider's TV manuals, volumes 1 to 12 inclusive, with index. Would trade or sell.

Joseph T. Beck
3810 Leila Ave.
Tampa, Fla. 33616

I understand a lot of servicemen are looking for 12FR8 tubes. I have four RCA 12FR8 tubes that I will gladly sell. I do not know the list price, but I think \$3.00 each would be a fair price.

I also have Rider's manuals, volumes 2 to 4 and 12. If anyone is interested I will gladly make a deal.

Gornetski TV
78 W. Green St.
Nanticoke, Pa. 18634

I have Sams PHOTOFACT sets No.'s 1 through 199 which I would like to sell, very reasonably. They are nearly 100% complete and in good to excellent condition.

Ronald Champagne
26 Hancock St.
Westfield, Mass. 01085

Having retired from electronic servicing, I have the following for sale:

- 1) Kay Calibrated Megasweep,
- 2) Kay Megaligner,
- 3) TSW-50 Videosweep Generator.

This equipment is like new and is complete with instruction manuals. Anyone interested, please contact me.

Ralph Hunter
252 Jefferson Heights
Catskill, N. Y. 12414

I have the following test equipment for sale, all in like new condition as it was used very little:

- 1) Eico 460K, wide band scope with three probes, factory assembled,
- 2) Eico 368, sweep and marker generator, factory assembled,
- 3) Precision E 200C, audio generator,
- 4) Wintronix Dynamic sweep circuit analyzer,
- 5) PF Reporter, 1964 to present.

Will sell all of above at very reasonable prices and if I can sell as a package deal will throw in some small pieces of equipment at no charge.

John Martin
111 Bancroft Dr.
Rochester, N. Y. 14616

I have TV test equipment for sale too long to list. Please write for list of equipment, prices, parts and tools.

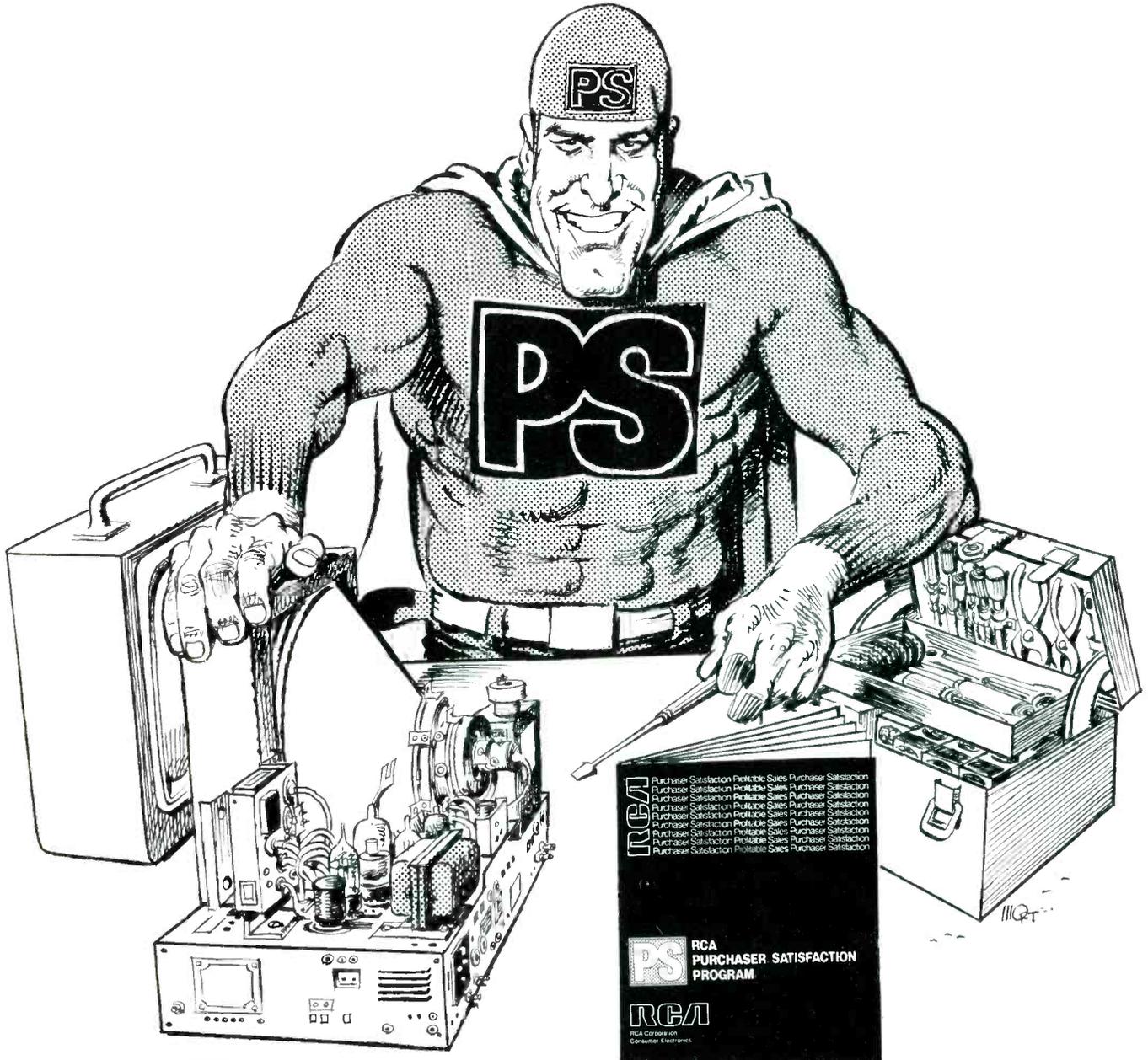
Joseph Trani
545 Clinton St.
Brooklyn, N.Y. 11231

Help Needed

I cannot locate service information on a Madison-Fielding, Model HI-563 tube type FM/AM/MPX stereo console. I bought the stereo in 1963 and it is

RCA's PS Warranty Program is at your service.

Just because we were #1 in 1970 color TV sales to consumers doesn't mean we've forgotten you today. We created "PS", a warranty program which backs you up as well as every AccuColor® TV. PS means Profitable Servicing for two reasons: First, because AccuColor owners can select any service agency they want. And, second, because RCA pays your going rate for warranty service rendered. Sound good? For details, read on.



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AccuColor Parts and Labor Basic Warranty Provisions. For **one full year** from the date of purchase, RCA Corporation warrants to the first retail purchaser that it will pay all labor charges for repair of defects in 100% solid state AccuColor models (**90 days** on AccuColor models with "New Vista" chassis) and will make available replacements for any defective parts. (If the picture tube becomes defective within **two years**, it will be exchanged for a rebuilt picture tube.) On portable models RCA will make available replacements for defective

parts and pay labor charges only on a "carry-in" basis; transportation to and from the service agency is the purchaser's responsibility. Installation and set-up, foreign use, antenna systems, and adjustment of customer controls are not included. To obtain warranty benefits, contact your RCA dealer or the service agency of your choice with your Warranty Registration Card.

For a copy of the PS booklet which covers all of our products, and the name of your field representative, write RCA Sales Corporation, Dept. 634, 600 N. Sherman Drive, Indianapolis, Indiana 46201.

Circle 9 on literature card

of the Berkshire series.

Any service information on this piece of equipment will be appreciated.

G. C. Valeri
1620 Pittston Ave.
Scranton, Pa. 18505

Could someone please help me acquire a schematic diagram for a 6-band short wave radio, model number 276 BR made by the Electro Brand Co.

The Electro Brand Co. has told me the diagram is not available. I would appreciate any information anyone has.

John A. Barga
2709 East 10th St.
Cheyenne, Wyo. 82001

I have been unable to locate a schematic or any information on a Lincoln Linear Power Amplifier. I have no serial number or model number. I would appreciate any help or assistance anyone could give me.

John Goforth
720 E. Clearwater
Kennewick, Wash. 99336

I need a schematic and/or operating manual for an Electronic Measurements Corp., Model 206 tube checker. Any information on this instrument would be greatly appreciated.

A. L. Meroney
2307 Glass St.
Chattanooga, Tenn. 37406

I am interested in purchasing a Model 1076 B&K Television Analyst. Anyone having one for sale, please contact me stating price expected.

Lee Noga
288 Wellsian Way
Richland, Wash. 99352

I would like to buy used Sams PHOTOFACTS. Please send the numbers you have for sale and the price you are asking.

Arnold Schaefer
603 Second Ave. S.E.
Watertown, S.D. 57201

I need the schematics and manuals for Baird Associates, Transistor Test Set, Model GP General Radio Co., Twin-T Impedance Measuring Circuit, Solar. EXAM-ETER.

William Misiek
405 Royalton Road
Silver Spring, Md. 20901

I need a schematic diagram and operating instructions for an Echolette Type NC51A or NG51A, the C could be a G. This is a German made audio amplifier that provides an adjustable delay in voice reproduction. The delay is accomplished by the use of an endless tape.

This unit is designed to be used between a micro-

phone and a power amplifier. A number of controls, mounted on the chassis are not labelled, so I don't know their function.

Any help I can get in locating information about this unit will be greatly appreciated.

Donald G. Harris
3332 N. 57th Ave.
Phoenix, Ariz. 85031

I am having trouble finding a schematic for a Sharp portable TV set, Model UP 8B. Any help will be appreciated.

George Swerda
6207 Balfour Dr.
Hyattsville, Maryland

We are looking for unusual and antique TV sets (before 1948) in b/w or first mechanical color wheel type color TV's. We would prefer reflection or projection types in b/w. The equipment does not have to be in operating condition but would like cabinet in good shape. Write model number, brand, condition (picture if possible) and price.

J. P. Patterson
703 West 7th St.
Austin, Tex. 78701

I am desirous of securing back issues of ELECTRONIC SERVICING and PF REPORTER. Anyone who will give or sell these magazines, please write giving issues available and costs involved.

Earl E. Kaiser
119 Beaumont Pl.
Traverse City, Mich. 49684

We have been trying to get the service manual for a Kenwood Model TK140 X (AK). We have written to Kenwood in California and in Woodside, Long Island, but all they can furnish is a schematic—which we already have.

Any help anyone can give us will be greatly appreciated.

T. E. Gregg
Montgomery Center,
Vermont 15471

Can anyone help me locate a schematic for a VOM Model 615, made by the Jackson Electrical Instrument Co. Will gladly pay for it or for making a copy of it.

John Borst
1034 Dudley Road
Schenectady, N. Y. 12303

I need a filament transformer for a Channel Master, Model 6612 AM/FM tuner. Channel Master has told me that parts for this tuner are no longer available.

If anyone has one I would appreciate it if they would contact me and let me know the price they are asking for it.

Lee's Radio & TV
Accord, N.Y. 12404



Model 5410
30db Gain
VHF Amplifier

Model 5416
45/30db Gain
UHF/VHF Amplifier

Model 5415
30db Gain
UHF/VHF Amplifier

Model 5414
45db Gain
UHF Amplifier

Model 5411
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55db Gain
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Circle 10 on literature card

Repair of Mainsprings in Old Phonos

I hope this will help reader Edward Lee and others asking about replacement springs for wind-up phonographs.

I have repaired two such motors with broken mainsprings. It is a dirty job, but can be done. In both motors the spring was torn out at the inner end, where there is a hole punched in the end for fixing the inner shaft with a rivet. In both cases I broke off about an inch of the defective end of the spring and punched a new hole for the rivet.

A word of warning: When you take the spring out of its case, be ready to manhandle it, it can slap you in the face. When you get it back in the case, lubricate it with a grease containing powdered graphite. If you can't find this type of grease, use phono grease with the powdered graphite (used on locks).

Be sure to apply a good grade of oil on the felt pads used on the governor of the motor. They run on a metal disc. If they dry out, the motor will run slow or unevenly. It is almost impossible to determine that lack of oil on the felts causes this trouble, unless someone tells you.

James O. Woodward
New Castle, Ind.

National Service Association Reaction To Part-Time Servicemen

I fully agree with Russell Harpers comments in the October, 1970, issue of ELECTRONIC SERVICING regarding the integrity and responsibility of part-time TV service technicians. Fly-by-night (defined as; insecurely financed, one who is irresponsible) could be applied equally as well (or more so) to the so called full-time service shop who makes a quick dollar the first consideration and customer satisfaction the last.

Could the editor add information pertaining to the various National Service Organizations position with regard to recognition of the part-time TV shop technician? Promotion of this recognition by service organizations could go a long way to distinguish between the so called fly-by-night shop and the part-time service shop who does a genuine service for his customers.

Lou Rall
North Babylon, N.Y.

Mr. Rall, to my knowledge, neither national electronic service association presently conducts or supports industry related programs which directly discriminate against electronic technicians who service consumer electronic products on a part-time basis, provided that such service is conducted in accordance with the business and technical standards required of the members of the associations. The national electronic service associations, to my knowledge, have never used "volume of business" as a basis for judging the competency of an electronic technician.—Ed.

RCA's ServiceAmerica

The article in ELECTRONIC SERVICING about RCA's new all-brand servicing business is certainly no surprise to me. Because a lot of other corporations are doing it, becoming a conglomerate seems necessary these days.

It seems that such a move as RCA is making will interest all the leading electronic manufacturers and, to some extent, they will follow suit.

If RCA can and will service their products through ServiceAmerica, why can't they service RCA products now?

The breakdown in communications between the independent serviceman and the corporations, I believe, was to some degree deliberate on the part of the corporation so that they can capitalize on servicing of their products, probably because of warranties.

This new innovation will eliminate the independent, no doubt. It will be a few years, but he will go as soon as the other industries join RCA.

General Electric has been operating service shops all over the United States for several years, so RCA really joined them as a competitor in factory authorized service in a factory owned shop. People will naturally go for this because they can get better service done, they believe, and perhaps they can. At any rate they can get it done quicker. For example, I have had an order out for a special RCA resistor for a year now and have received no word from them or from their distributors about its availability, and I do not expect to. I know RCA has it, I see the equipment is being used in their shops (it is a VOM of theirs).

I have had an order in for a special-purpose GE filter capacitor, which I know GE makes, but I have received no word on its availability. The order went out six months ago.

I have had an order in for a special-type of TV tuner Admiral makes for one of their sets; no word, and the order was sent six months ago.

So, it seems the pressure is on to get the independent out of business. I'm going; as of January 1, I will be headed back to school to try to get into computers.

Billie Fowler
Memphis, Tex. 79245 ▲

Penney Establishes "Home Electronics Product Service Center"

J. C. Penney and Company reportedly has opened its own service center in a suburb of Buffalo, New York.

Called a Home Electronics Product Service Center, the new Penney-owned-and-operated service facility reportedly will service only Penney's Penncrest label television and stereo receivers and other Penncrest home entertainment electronic products.

With Sylvania's 3 lines of color tubes, you can meet it. Customers' wallets come in different sizes. Thick, thin and in-between.

With Sylvania's 3 complete families of replacement color picture tubes, you can be sure of having the right-priced tube for each one.

At the top end of the line, you've got the *color bright 85®XR*, the tube with our brightest phosphors and X-ray inhibiting glass.

And in the middle, you have the *color bright 85®RE*. This is the tube that brought color TV out of the dark ages. Its bright rare-earth phosphors still

make it *the* tube to watch.

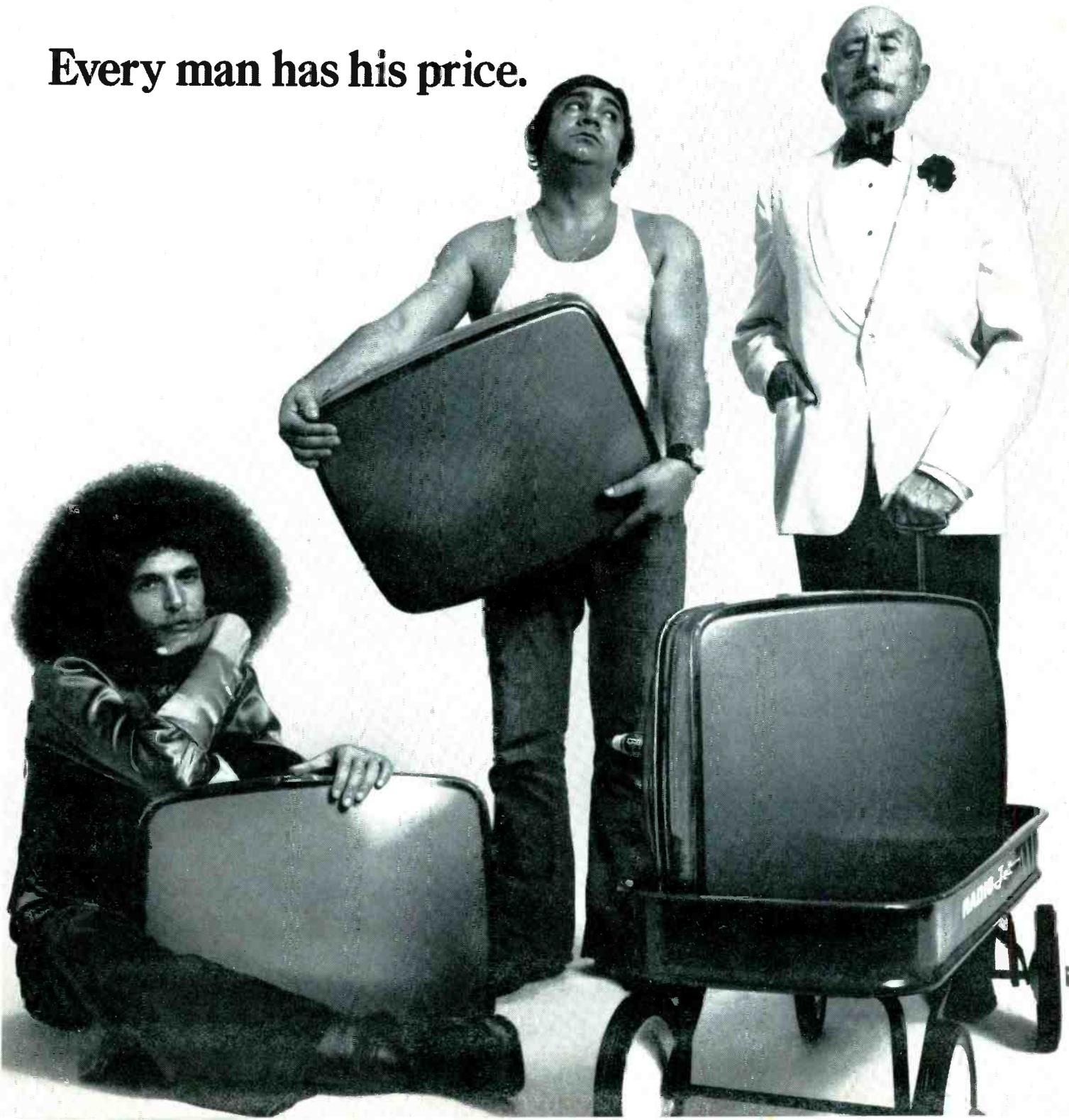
For economy, there is the *color screen 85* family of replacement tubes. But, economy doesn't mean cheap construction. You can still give your customer features like Sylvania's Sharp-Spot electron gun and a rare-earth phosphor screen without breaking his budget.

When you sell Sylvania, you're selling from the broadest line in the industry. You'll have the tube to match the set.

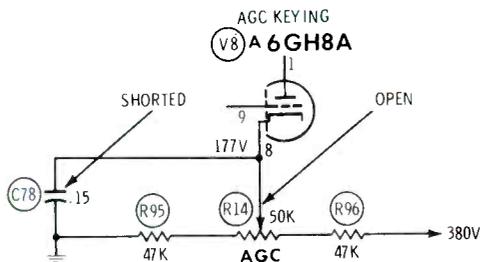
And a price to match the wallet.

SYLVANIA
GENERAL TELEPHONE & ELECTRONICS

Every man has his price.

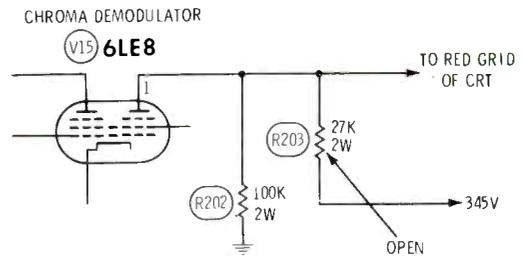


Chassis—Motorola TS921
PHOTOFACT folder—960-1



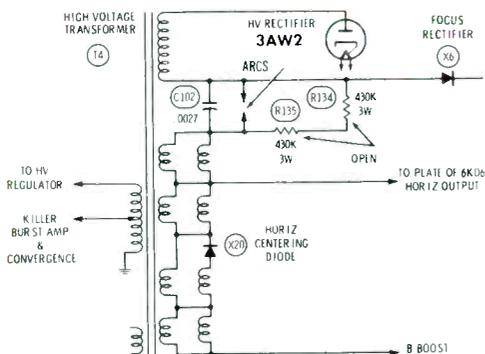
Symptom—raster displayed, but no sound or picture
Cure—check and replace C78, if it is leaking or shorted

Chassis—Motorola TS921
PHOTOFACT folder—960-1



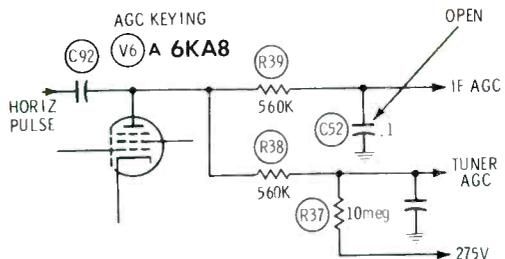
Symptom—no red in either color picture or raster
Cure—check and replace R203, if it is open

Chassis—Philco 19QT87
PHOTOFACT folder—1026-3



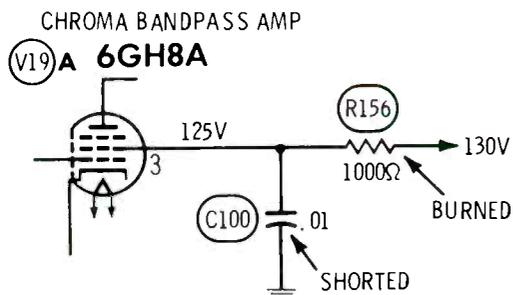
Symptom—continuous arcing across the spark gap of C102
Cure—R134 and R135 open, or C102 defective

Chassis—RCA CTC25
PHOTOFACT folder—879-3



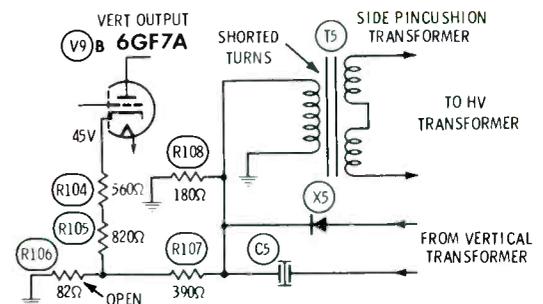
Symptom—sharp, black horizontal bars on some channels
Cure—check and replace C52, if it is open

Chassis—RCA CTC24
PHOTOFACT folder—912-3



Symptom—low brightness and no picture or sound
Cure—check C100; replace C100 and R156, if C100 is shorted

Chassis—RCA CTC24
PHOTOFACT folder—912-3



Symptom—narrow width and reduced high voltage
Cure—check and replace R106, if it is open; replace T5, if it operates too hot

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Making a Business out of Service

Better Management Guides

Part 1

by Robert G. Amich

Introduction to Practical Bookkeeping and Accounting For Electronic Service Shops

After 5 years experience as an electronics technician, and filled with an urge to be independent and build a profitable business of his own, Mike Farad decided to open his own TV and electronics service business.

Mike owned enough basic test equipment, his tools, and he had a market for his services and the know-how to satisfy his market. He also had a fair-sized cash reserve. He found a good buy in a used panel truck, rented an adequate shop space, ordered a new sign for "out front," bought the business forms and office supplies he needed and ordered a new color-bar generator he lacked. He made arrangements for telephone service and opened his doors for business.

The office-supply salesman showed Mike a simplified bookkeeping system intended for TV service businesses. A glance at all the complicated-looking columns turned Mike off.

"My business isn't that big, yet. I don't need all that complication," he tells the salesman, dismissing the subject.

But, while he put the finishing touches on his shop, set up the little office corner, and waited for his first call, Mike decided that he **will** need records. Just simple ones, to show what he takes in and what he pays out. A system that will take just a few minutes a day to keep up. At that point, his only record system was the register in his checkbook.

Mike's first bookkeeping system was a simple, two-column ledger from the dime store, made up as shown in Fig. 1. He opened it with entries of his start-up expenses, taken from his checkbook register. Then, faithfully, he recorded each day's receipts and expenditures. At the end of his first month, Mike totalled the two columns.

Those first-month totals were pretty startling. He spent quite a lot more than he took in. The start-up expenses explained that. Right then, Mike decided that classifying his expenses would help, separating the never-again and once-a-year expenses from the real operating expenses. He started all over with a seven-column book—one column for income, four for his major expense items, one for miscellaneous expenses and one for total expenses. Mike transferred his first

Fig. 1--Record of Mike's TV-Electronics

Date 1970	Item	Income	Expenses
Mar 1	2 Months Rent		150
	Truck-cash down		800
	Office supplies		6310
	Repair parts-cash paid		360
	Telephone deposit and installation		3250
	Electricity deposit		25
Mar 2	Occupational license		10
	Subscription to Electronic Servicing-3 years		10
	Newspaper ad		40
Mar 3	New sign (COD)		120
	New color-bar generator (COD)		20595
	First service call-Mr. Braun	24	
Mar 3	Cash received	64	
		60820	206510

month's entries into this new system, as shown in Fig. 2.

Mike's second try at designing his own bookkeeping system held up for several months. Then, several events made Mike wonder if it really was an adequate system.

First, Mike landed the service contract for the local hospital's 45 TV sets. The hospital wants the work performed as needed, but billed just once each month. Mike needs a record of work performed and the charges. That was easy enough, Mike merely set up a secondary record in a few pages at the back of his book. His records became two lists instead of one.

Next, one of Mike's competitors proposed a partnership with their two shops merged into one. Mike suspects that the promise of profits on the hospital contract brought on the offer. He refuses it, simply because he doesn't know what his new-well-started business is worth. But, the proposal starts some new questions: How can you tell what a business is worth? Shouldn't your books tell you? How?

Then, the state sales tax law is extended to cover parts and labor charges on TV repairs. Mike must collect this money from his customers and then pay it over to the state every three months. Mike handled it with another secondary system at the back of the book, to account for the tax collected and owed to the state. What started out as a purely cash record—Cash in and

Cash Out—has jumped the tracks. There's income which isn't cash collected, and costs which aren't cash expended. Mike's books don't just report cash any more. They're moving into **Accruals**—items which have to be on the books, but haven't yet been received or spent.

Finally, Mike tried to get credit with a number of suppliers so he could buy his parts on open account instead of paying cash each time he picks them up. That reduces check writing to once a month and it means delivery instead of picking up his order at the supplier's dock.

Mike's first attempt brings a surprise. The credit manager asks for a **financial statement**. That's a term that hasn't entered Mike's business vocabulary yet. Proud of his growing checking account balance, Mike shows his checkbook to the credit manager.

"I'm afraid this won't do Mr. Farad. It looks good, but for all I know you may owe two or three times this amount. I simply can't tell, without a financial statement."

Mike's bank came to his rescue with a credit reference, but the supplier's credit manager stayed cautious. He gave Mike a credit account, with a tighter ceiling than Mike had hoped for.

A service call to repair the hospital accountant's TV gave Mike his chance to ask an expert about financial statements.

"A Financial Statement is a summary statement of the **net worth** of your business. It shows what you own and what you have in the bank. It shows what you owe. The difference between the two is the Net Worth of your business. That is, the part of it you

actually own free and clear of any claims by your creditors," the accountant, explains.

"That credit manager wanted it to help him decide how safe it would be to let you buy on credit. Your investment in tools and equipment to do your work shows you're seriously in the business of servicing electronic equipment. It's also an investment you'll work to save when the going gets tough. Your financial statement will show whether you have working capital enough to withstand a slow start. After you've been in operation awhile, your financial statement might also include an **income statement** to show what progress your business has made. That gives some indication of your prospects, since it shows how well you manage your business."

Mike was scribbling notes on the back of his job order pad and asking questions at every opportunity. This is what he learned:

Every business has a value, even one just starting up. When Mike's began, it owned the truck, test equipment, tools, office equipment and furniture, repair parts and supplies. It also had money in the bank. These were the **assets** of Mike's business.

Mike's business owed some money, too. There was a \$950 mortgage on the truck, a \$120 balance on Mike's beginning stock of parts. These were the **liabilities** of Mike's business. Subtracting the liabilities from the assets gives the **proprietorship**, or **capital**, that belonged to Mike. That is the **net worth** of Mike's business.

By listing every item owned by his business, Mike developed three major inventories: Shop Equipment, Office Equipment and Repair Parts and Supplies. The

Fig. 2--Record of Mike's TV-Electronics

Date 1970	Item	Income	Expenses					Total Expenses
			Rldg-Util	Truck	Parts	Tools-Equip	Misc	
Mar 1	2 Months Rent		150					150
	Truck-cash down			800				800
	Office supplies						6310	6310
	Repair parts-cash paid				360			360
	Telephone deposit and installation		3250					3250
	Electricity deposit		25					25
Mar 2	Occupational license						10	10
	Subscription to Electronic Servicing-3 years						10	10
	Newspaper ad						40	40
Mar 3	New sign (COD)							120
	New color-bar generator (COD)						20595	20595
	First service call-Mr. Brown	24						

total owed him by the hospital for work he'd already performed but hadn't been paid for, and his checking account balance, and the present value of his truck, rounded out Mike's list of his assets.

Listing each of his creditors by name and amount gave him a summary of his liabilities.

He took these lists to Les who made up a **balance sheet** for Mike's TV-Electronics as of October 1, (Fig. 3).

"Most balance sheets are made up this way: Assets to the left, Liabilities and Proprietorship to the right. Note, too, that the bottom totals on each side—the total assets and the total liabilities and proprietorship—are equal. This is always so. I'll explain why in a minute," Les pointed out.

"You see, Mike, every transaction changes one or more of the values in the balance sheet. A transaction is a business exchange of values. I pay you for your services. You pay your suppliers for parts, equipment or supplies. You make a payment to the bank on your truck loan. You pay your landlord rent in exchange for the right to occupy his premises. These are all transactions to a bookkeeper or accountant."

"And they all affect the assets, liabilities or proprietorship?" Mike asked.

"That's right. Just as electronics has Ohm's Law as its fundamental equation, accounting has its fundamental equation too. It's this:

$ASSETS = LIABILITIES + PROPRIETORSHIP$
thus:

$PROPRIETORSHIP = ASSETS - LIABILITIES$
 $LIABILITIES = ASSETS - PROPRIETORSHIP$

"That's the Ohm's Law of accounting. And, as you can see, it's why those bottom totals on the two sides of the balance sheet are always equal. They're equal because that's what the equation says.

"Incidentally, the balance sheet is the first financial document of any business. That's where the books begin, that's what they're based on. Once you understand the equation, you see why. And, then it's easy to see how each transaction affects those three elements of the equation. Take the transactions I mentioned:

"You receive cash for your services. The asset called "Cash" increases. So does proprietorship. Paying a monthly supply bill decreases your cash and also your accounts payable. You have equal, but opposite, changes in assets and liabilities. The equation tells you there will be no change in proprietorship. You

pay your rent. That reduces your cash and your proprietorship."

"Then every transaction changes two of the three elements!" Mike exclaimed.

"It might look that way, but it isn't always so," Les returned. "Suppose you buy another piece of equipment for cash. You decrease cash, but you increase your shop equipment inventory. You've converted one asset into another of an equal value. Only those two asset accounts change. One goes down, the other goes up. Total assets are unchanged. So are liabilities and proprietorship."

"If I've got this whole thing right, I can only increase my proprietorship with Income," Mike said, thoughtfully.

Les smiled. "You've got it right. Income is defined as the result of a transaction which increases an asset and proprietorship. In the same way, an expense is defined as one which decreases your proprietorship."

Thinking about the session later, Mike realized his two tries at building his own bookkeeping system had missed a great deal. They weren't complete; they didn't follow the growth of the business, nor grow with it. They weren't systems at all. They simply recorded what happened to one asset—cash. They didn't reflect the true state of the business as it changed constantly through the effect of each transaction on assets, liabilities or proprietorship.

He understood then, that a proper set of books would give a complete, accurate financial history of the life of Mike's TV-Electronics. A record that would be acceptable to credit managers, tax examiners, bankers, or anyone else as proof that he could pay his bills, that his tax return was accurate, that he was a good loan risk, that he could run his business effectively.

Musing, glancing at his balance sheet, Mike suddenly discovered that the figures were already saying something to him. His inventory values came to just about \$3,000—in parts and supplies, shop equipment and office equipment. Another \$2,000 or more in equipment belonging to his customers stood about the shop awaiting service or to be delivered. His insurance didn't give that much coverage, he was sure. That was something he'd look into in the morning.

"I get the message," he said half aloud. "Good records give you information you need for good decisions

Fundamental Equations of Accounting

NET WORTH*	=	ASSETS	—	LIABILITIES
		(value of what you own)		(value of what you owe)
ASSETS	=	LIABILITIES	+	NET WORTH
LIABILITIES	=	ASSETS	—	NET WORTH

*Also called PROPRIETORSHIP or OWNER'S EQUITY or CAPITAL ACCOUNT

Fig. 3 Mike's TV-Electronics Balance Sheet October 1, 1970

<u>ASSETS</u>		<u>LIABILITIES</u>	
Cash	\$1,109.60	Accounts Payable	
Accounts Receivable		C E M Supply Company	112.00
Springville Hospital	134.00	Martin Supply Company	54.30
Truck	1,600.00	Sales Taxes Payable	48.20
Shop Equipment	1,900.00	Mortgages Payable	
Office Equipment	200.00	First National Bank	<u>761.10</u>
Parts and Supplies	<u>857.00</u>	Total Liabilities	975.60
Total Assets	<u>\$5,800.60</u>		
		<u>PROPRIETORSHIP</u>	
		Mike Farad, Capital	<u>4,825.00</u>
		Total Liab. and Propr.	<u>\$5,800.60</u>

and plans. Hey! I'm beginning to think like a businessman."

He stopped by to see Les the following evening, reporting his discovery and announcing his decision to have a "real set of books." What were Les's recommendations?

"One of your neighbors operates a bookkeeping service—right around the corner from your shop. It's a good one, too. For a reasonable monthly fee, they'll do a good job for you. It'll be worth it to you. Your time is better spent servicing your customers and managing your business, instead of trying to keep your own books. You furnish them accurate, complete information and they'll do the rest, furnishing you regular, periodic summaries. They'll explain them, too."

"That brings up a question I wanted to ask. What's the difference between an accountant and a bookkeeper?" Mike asked.

"Bookkeeping is mostly concerned with day-to-day recording of business transactions. It's the technician end of the business. Accounting is more concerned with designing systems and procedures to govern keeping the books, and with analyzing the books to give management the information it needs. Still, there are plenty of accountants who keep books, and quite a few bookkeepers who are sharp at systems and procedures or account analysis."

Systems and procedures? Here was a new area of management for Mike to look into. His new bookkeeping service made some recommendations:

1. Mike's personal finances and business finances had to be separated. Otherwise the books wouldn't accurately show the condition of the business.
2. Mike was to make daily deposits of his cash receipts to his bank account. No more leaving money

in an envelope in the bottom desk drawer for days at a time.

3. There should be a small petty cash fund to meet minor cash expenses. No more taking it from the cash receipts envelope, nor out of his own wallet. Records begin to wander off the straight and narrow when these sums are forgotten and not recorded.

4. All parts and purchases delivered should be promptly checked for quantity, condition and part number. Mike was to be sure he got what he ordered, and got what he would be paying for. Damage or shortages have to be reported soon after delivery to be sure of adjustment. Otherwise, they may be blamed on pilferage or carelessness in Mike's shop. In which case, Mike takes the loss, and losses are expenses that ease away Mike's proprietorship.

These procedures give Mike tighter control of cash handling, materials handling and record keeping. That reduces some risks of loss, eliminates others, and assures maximum record accuracy.

Finally, Mike learned to make his simple daily entries of receipts, payments and purchases according to standard bookkeeping practices. That saves bookkeeping time, which Mike pays for, when the service posts his information in the books.

Mike was a skillful, experienced technician. Now he's becoming a good businessman as well, aided by good records and systematic procedures. Reading about effective management for small businessmen, in the many booklets put out by the Small Business Administration, Mike learned that failure to adopt systematic practices and maintain good records accounts for many small business failures each year. He isn't going to let that happen to him. ▲

Service-type scopes — fundamentals of operation

by Carl Babcoke and Bruce Anderson

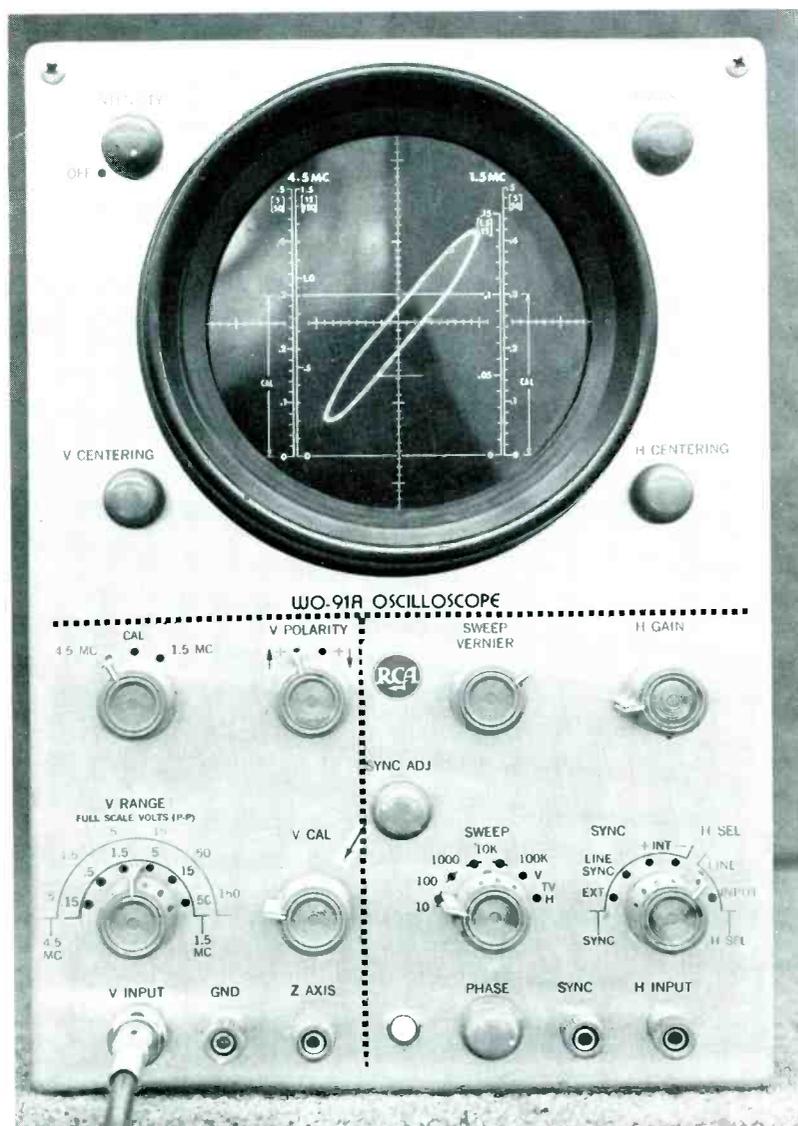
Some of the comparatively few problems related to using scopes are self-inflicted by over-zealous scope addicts, who try to use a scope for all sorts of things for which it might not be particularly well suited. For example, a DC-coupled scope can

be used to measure DC voltages—no question about it. But a VTVM or FET meter will far surpass a DC scope (when used to measure DC voltages) in accuracy, speed of measurement, and freedom from calibration adjustments or excessive drift.

A scope is unique in its ability

to show us the **shape** of an electrical signal, and to measure the peak-to-peak (p-p) voltage of any desired **portion** of a complex waveform. Even if these two functions were the limit of a scope's abilities, a scope would be worth much more than most of them cost.

CRT CONTROLS



VERTICAL SWEEP HORIZONTAL SWEEP

Fig. 1 Scope controls and input connectors usually are grouped together for more convenient operation.

Description of A Service-Type Scope

Beam Adjustment Controls

A typical service-type scope (Fig. 1) has three sets of basic controls. One set consists of CRT beam adjustment controls—horizontal and vertical centering, intensity (brightness), focus and graticule scale illumination. Fig. 2 shows some of the effects of these adjustments. (Some scopes also have an auxiliary focusing control called “astigmatism”.)

Vertical Control

Another category of controls are those that affect vertical deflection. These include a range switch (step attenuator) and a variable gain control. (Fig. 3) Some scopes have a switch that provides a choice of high vertical gain with a relatively narrow bandpass, such as 1 MHz or 1.5 MHz, or lower gain with wider bandpass, perhaps up to 4 MHz. However, many modern scopes have adequate gain with wide bandpass, making this control unnecessary.

The vertical range switch might be calibrated in “volts p-p per centimeter”, “volts p-p per inch”, or in the p-p voltage required for deflection of the CRT beam to certain marks on the graticule. Obviously, these ranges will be accurate only if the gain of the vertical amplifier remains constant, which often is not the case over long periods of time. Calibration of the vertical amplifier is performed with the vertical gain control and a source of voltage whose p-p amplitude is known or can be accurately computed.

Use the method of calibration outlined in the instruction book which came with your scope. If your scope does not have a built-in calibrating voltage, a 60-Hz sine wave obtained from a filament transformer can be used. Simply measure the voltage with an accurate voltmeter, then set the scope range switch and gain control (sometimes called VERT CAL) to produce the correct waveform amplitude, as indicated by the scope graticule. Remember, the RMS effective value of a sine voltage measured by a VOM or VTVM must be changed to peak-to-peak by multiplying it by 2.83.

Horizontal Controls

The next set of controls are the most numerous, and perhaps the most difficult to understand. They are the horizontal deflection controls shown in Fig. 4. The following discussion states in general terms the function of each control, although in some scopes one switch might control more than one function.

The horizontal input selector switch determines which input is used to provide horizontal deflection of the CRT beam (width of waveform). This switch usually has three positions: 1) external input,

2) a 60-Hz sine wave from a power transformer in the scope and 3) a sawtooth of variable frequency from an oscillator in the scope. Often, the sync selector switch is operated by the same shaft.

Two controls are used to select the horizontal sweep frequency, and these operate only when the input selector is set to the **internal** sawtooth sweep function. The frequency range switch often has positions (in addition to the variable overlapping ranges) for viewing the waveforms at **one-half** the normal frequency of the television line (TV H) and frame (TV V) frequencies. A sweep frequency of 7867 Hz will display two horizontal waveforms, and a sweep frequency of 30 Hz will display two vertical waveforms.

A frequency vernier (fine adjustment) control is provided for adjustment to any frequency within the range selected. On some scopes, the vernier control is not connected when the two special television frequencies are used. If so, internal trimmer adjustments usually are provided and are accessible through holes in the case of the scope.

In addition, the horizontal frequency range switch will have posi-

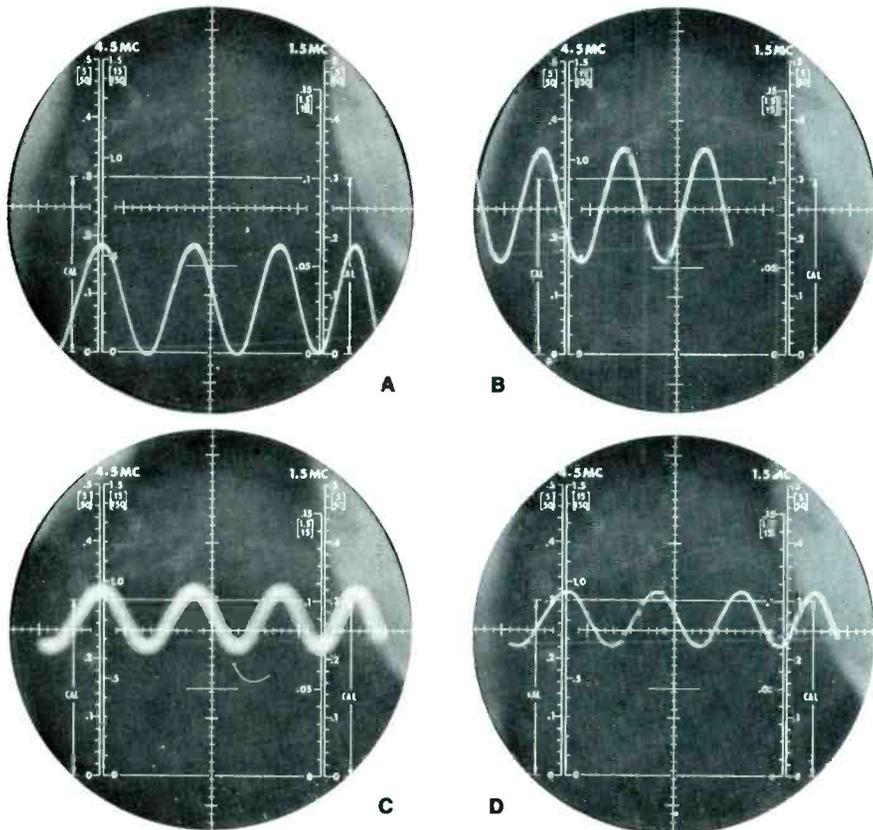


Fig. 2 Effects of the CRT beam controls. (A) Waveform is too low; use vertical centering to correct. (B) Waveform is too far to the left; use the horizontal centering to correct. (C) Waveform is too bright and badly out of focus; use

the intensity control to reduce brightness and the focus control (plus the astigmatism control in some scopes) to sharpen it. (D) Normal adjustment of the CRT beam controls.

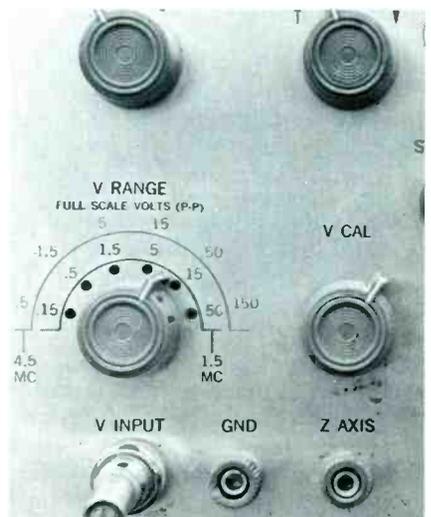


Fig. 3 Vertical sweep controls and input connectors are grouped together.

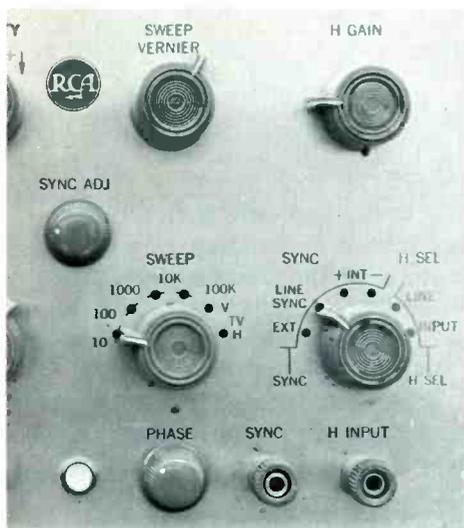


Fig. 4 Horizontal sweep, phase, sync and input controls are grouped together.

tion designations such as 10-100 Hz, 100-1000 Hz, 1-10 kHz, 10-100 kHz, and possibly 100 kHz-1 MHz. The vernier horizontal frequency control varies the sweep frequency between the numbers marked on the range switch, to provide horizontal sweep locking at any frequency within the range.

The combination adjustments of a sync selector switch and a variable sync control are used most often for horizontal sync locking. The selector switch permits sync (for locking the internal sawtooth oscillator) to be obtained from: 1) the signal being observed on the scope, 2) an externally generated signal applied to the external sync jack of the scope, or 3) a 60-Hz

sine wave signal from the power line. There might be two internal sync positions: one for positive-going waveforms and one for negative-going.

When the horizontal sweep frequency range is set to either the television horizontal (TV H) or vertical (TV V) positions, the internal sync is often obtained from the observed signal by means of a TV-type sync separator. If this is true of your scope, the locking on TV video waveforms should be much tighter when the pre-set TV horizontal or vertical positions are used than when the locking is obtained by using the normal range switch positions and frequency vernier controls.

A sync level control is provided to regulate the amount of sync applied to the internal horizontal sweep oscillator. In some scopes, this control has a "center zero", at which position no sync is applied. Turning the control CCW from the center progressively increases the sync needed for negative-going signals, and turning it CW from the center increases the sync needed for positive-going signals.

Sync amplitude is relatively critical; too little will not permit locking, and too much often makes the oscillator jump from showing the normal two cycles of waveform to just one. See Fig. 5. Only the optimum amount, considering wave-shape and signal amplitude, will permit good steady locking.

Phase Control

Some scopes have a control on the front panel for adjusting the phase of the 60-Hz signal used for horizontal sweep when the horizontal selector switch is in the LINE position. The phase shifter is used for some kinds of sweep alignment, for example. The phase control has no effect unless the horizontal selector switch is in the LINE position.

Sequence For Setting Up A Scope

Adjusting a new scope (or one that is strange to you) is done best by pre-setting most of the controls before turning on the power. Try this procedure:

- Set the focus control and both centering controls to their mid-points.

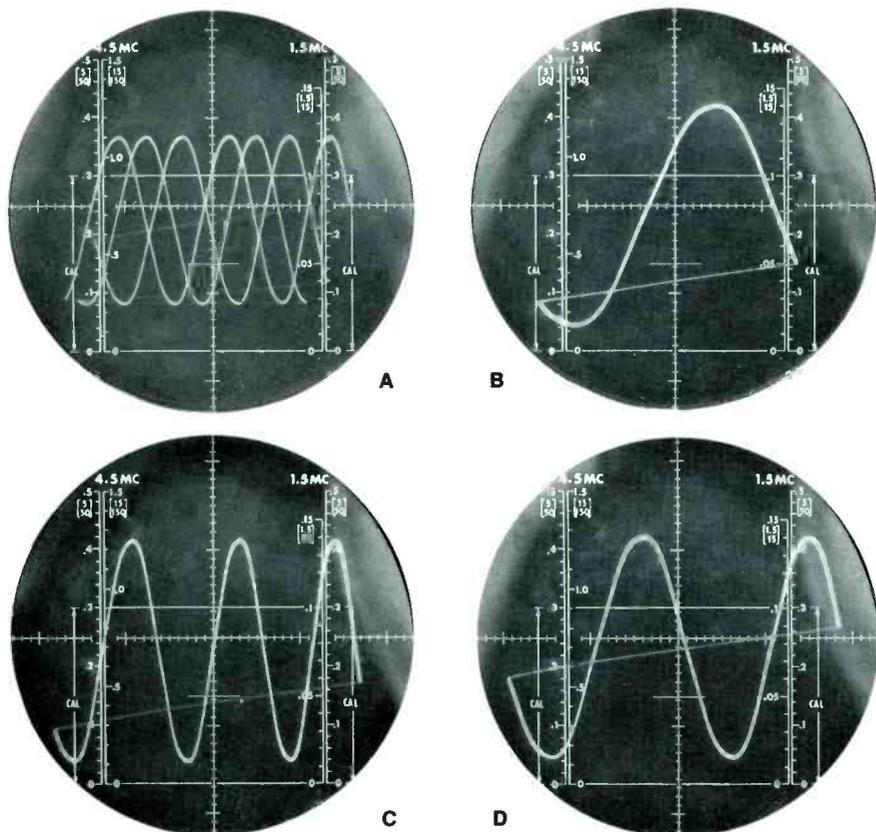
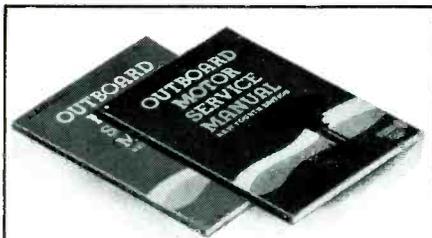


Fig. 5 Effects of the horizontal sweep frequency vernier and sync controls. (A) The input signal is not locked: the pattern is unstable and the waveforms overlap one another. (B) The waveform is locked. Because the vertical signal and horizontal sweep frequencies are the same, one waveform is displayed. (C) The waveform is locked with the horizontal sweep frequency at one third of the vertical signal frequency. Three cycles of the waveform are displayed. (D) Because the waveform is locked with the horizontal sweep frequency at one half of the vertical signal frequency, two cycles of the waveform are displayed. This is preferred for most analysis functions.

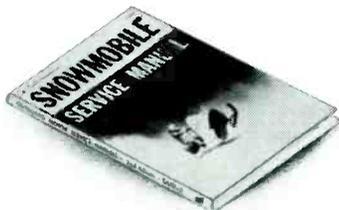
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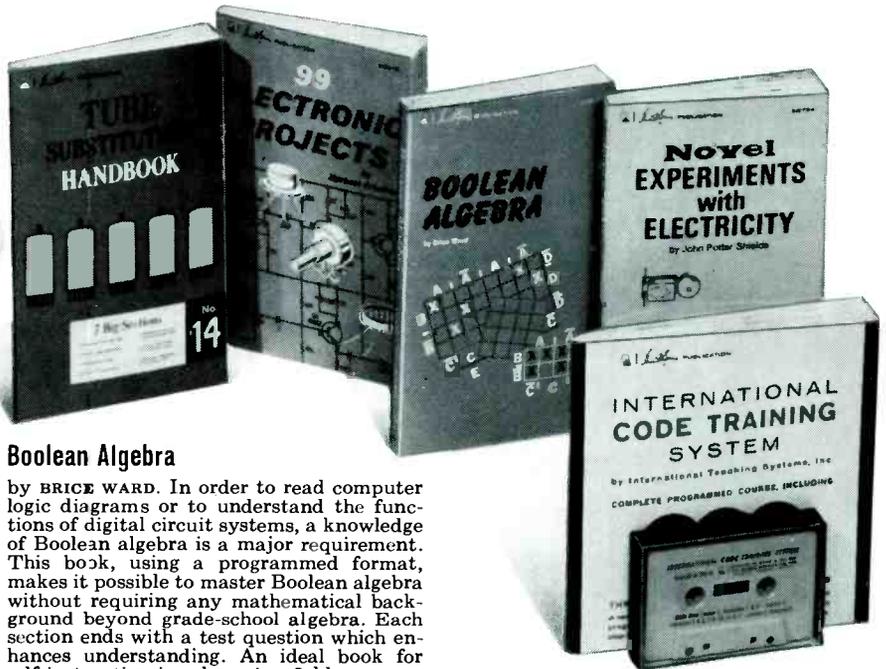
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Circle 13 on literature card

- Locate the horizontal input selector switch and set it for internal sweep and sync.
- Turn the sync level control (if any) to zero, and the horizontal gain control to about the midpoint. (Sweep frequency and vernier settings are not important at this point.)
- Remove the vertical input cable.
- Turn the power on and the intensity control up about three-fourths.

After about 30 seconds, a horizontal line should appear somewhere on the screen. If not, slightly adjust the intensity and centering controls until the line

appears.

- Adjust the centering controls for approximate centering of the line on the face of the CRT. Adjust the horizontal gain control so the line is almost as wide as the screen.
- Turn the intensity control up and down to determine the points where blooming (enlarging of the line) starts; leave the control at the point where blooming just begins.
- Adjust the focus control to sharpen the line.

The scope is now ready for a signal to be applied to the vertical amplifier. (After the desired waveform is obtained, the preceding adjustments should be touched-up.)

The following steps are an easy method of testing the functioning of vertical and horizontal sweep, and horizontal locking:

- Attach a shielded cable and probe to the vertical input connector. If the probe has a DIRECT/LOW-CAP function, use the DIRECT setting.
- Pre-set the vertical range switch to the 15- or 50-volt position, and the vertical gain (calibrate) control to midpoint.
- Touch a finger to the tip of the probe and adjust the range switch and vertical gain control until the height of the waveform is more than one half of the screen height.
- Select the TV V position of the horizontal sweep switch (or the 10-100 Hz range). Alternately adjust the SWEEP VERNIER and SYNC controls until stable locking is achieved, with two cycles of the slightly-distorted sine wave displayed. (The signal is stray 60 Hz picked up capacitively from the power wiring of the scope.)

These simple adjustments, which take much longer to read than to accomplish, test several basic functions of the scope. If the scope passes these tests, it is ready to be connected to equipment that needs analyzing, or for the factory-recommended calibration procedure when peak-to-peak measurements of complex waveforms are needed.

Characteristics and Applications of Probes

All scopes add resistance and capacitance to the circuit being

Fig. 6 The input capacitance (including a large amount from the high-frequency compensation on the range switch) and input resistance are in parallel with the circuit to which the scope is connected.

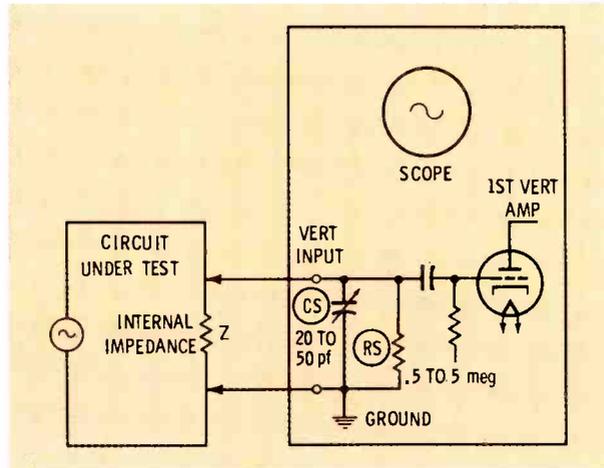


Fig. 7 A shielded cable and direct probe eliminates pickup of unwanted signals, but adds more capacitance to the circuit being tested.

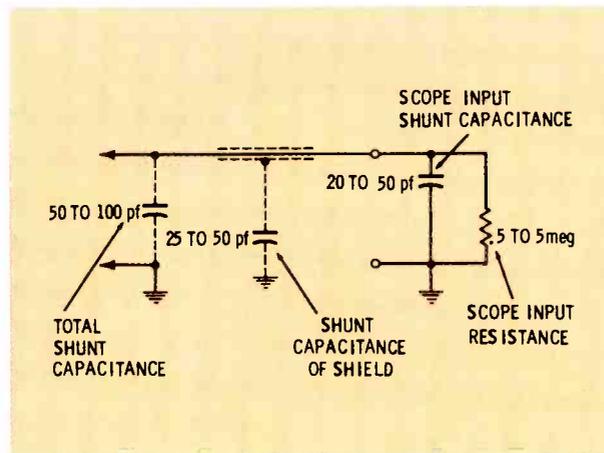
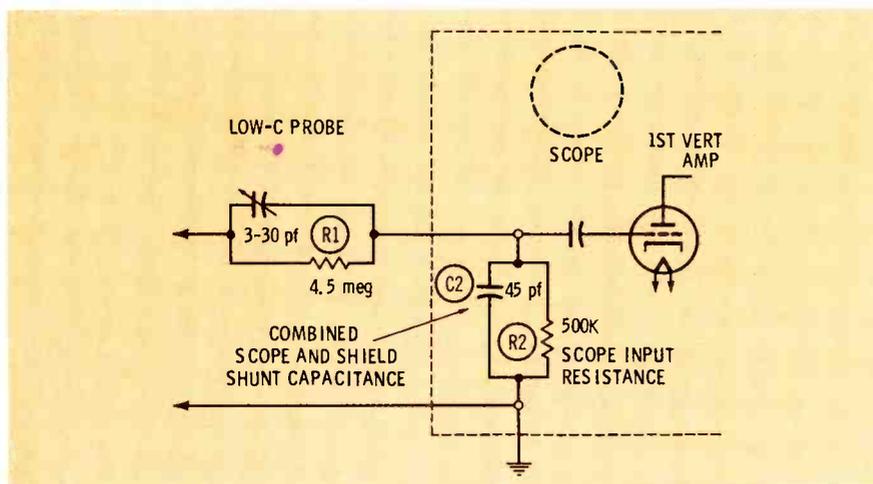


Fig. 8 Capacitive and resistive loading from the scope and shielded probe is reduced to 1/10 by the use of a low-capacitive type probe. The probe also reduces the signal applied to the scope to 1/10 its normal amplitude.



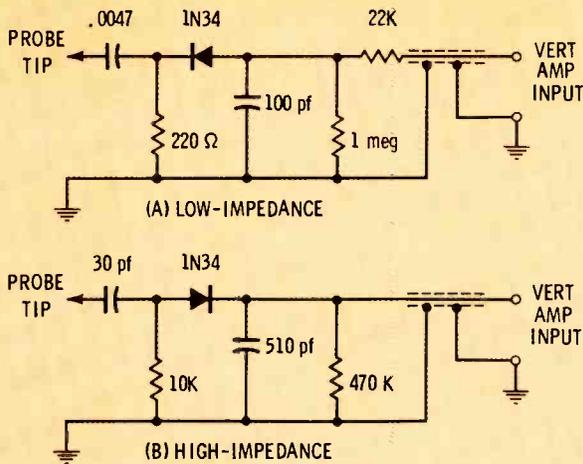


Fig. 9 Demodulator probes often use series-rectifier circuits. (A) Low-impedance probe used in sweep alignment. (B) High-impedance probe used for sweep alignment of the chroma IF's, or for signal tracing video IF's. To reduce the loading, some probes increase the 10K-ohm resistor to 82K ohm.

tested. Whether or not this "loading" by the scope changes the tuning, amplitude of signal, or bandwidth enough to cause concern, depends upon the impedance, frequency of the signal and other characteristics of the circuit to which the scope is connected.

The simplest connection between scope and circuit, as shown in Fig. 6, is by two unshielded test leads. Although this type of probe does not attenuate the signal nor add appreciable capacitance above that of the scope, it has a serious drawback: pickup of unwanted signals—including noise, radio station carriers, stray 60 Hz, or, worst of all, radiated horizontal pulses from a TV receiver you might be testing—becomes nearly intolerable.

Use of a shielded cable eliminates most of these drawbacks, but introduces one more: added capacitance. (See Fig. 7). The total capacitance at the end of the shielded direct probe is 60 to 100 pf, plus a parallel resistance of 1 megohm (average). This is enough capacitance to round the corners of the sync and blanking pulses in the composite video waveform, or to disable a horizontal oscillator or a chroma IF stage.

Cable, probe and scope capacitance can be reduced to about 10

percent of the original value by the use of a 10-to-1 probe, which commonly is called a low-capacitance, or high-impedance, probe. The tip of such a typical probe (Fig. 8) might have 11 pf of capacitance in parallel with 10 megohms of resistance.

The recommended procedure for selection of probes is to use the low-capacitance probe with a shielded cable for all signals whose amplitudes are sufficient to produce a measureable waveform on the screen of the scope. (Most waveforms on PHOTOFAC T schematics are obtained by using a low-capacitance probe). In later articles, we will point out critical parts of circuits, such as color oscillators and chroma IF's, where loading is a prime consideration.

Capacitance-divider probes, which provide an AC loss of 100-to-1, also can be built or purchased. These are used principally for looking at vertical and horizontal sweep signals, the value of which would be in excess of the voltage rating of the vertical input coupling capacitor in the scope, or otherwise dangerous or potentially destructive.

Demodulator or detector probes are useful for measuring waveforms whose fundamental frequencies are above the acceptable frequency re-

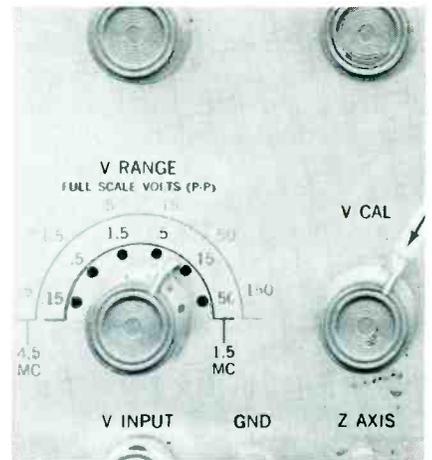


Fig. 10 Mark the position of the vertical gain (calibration) control on your scope when it is accurately calibrated. Because many measurements do not demand high accuracy, servicing time can be saved by setting the calibration control to the mark instead of completing the full calibration each time.

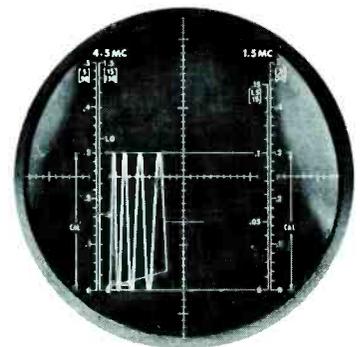


Fig. 11 To calibrate the RCA WO-91A scope, turn the bandwidth/calibrate switch to CAL (which internally connects 60 Hz to the vertical amplifier following the range switch), and adjust the V CAL gain control and vertical centering control so the waveform just fills the space between the CAL markings on the graticule. This can be observed much better if the width is reduced with the H GAIN control.

sponse of the vertical amplifiers in the scope. Fig. 9 shows two such examples. The circuit in (A) is a low-impedance type often used in sweep alignment because it loads down the circuit to which it is attached (consequently, the response of the tuned circuit will be broadened so that it will not affect the response curve of the previous stages).

The demodulator circuit in Fig. 9B has a much higher impedance. In some versions used for chroma IF alignment, the 10K-ohm resistor is increased to 82K ohms to further reduce circuit loading.

Demodulator- or rectifier-type probes are to be used for signal tracing the video IF's, for example; they are **not** to be used in video amplifiers, sync or sweep circuits (the low-capacitance probe is best to use in these circuits). Only the extreme low-frequency parts of any amplitude modulation of the carrier being tested will be displayed on the scope. For this reason, when the demodulator probe is used to signal trace the video IF's the video components are usually viewed with the horizontal sweep of the scope set at 30 Hz.

All the cables and probes previously described are to be connected to the vertical input connector of the scope; the horizontal sweep of the scope usually is supplied by the internal sawtooth oscillator, which is synced internally.

Unshielded test leads often are used to apply signals to the external horizontal input connector when frequency identification (by Lissajous figures), alignment with some brands of sweep equipment, transistor testing by curve tracers, or vector pattern analysis is to be done. Unshielded leads can be used in these applications because frequency response is not critical, and pickup of unwanted signals is no problem.

Tips For Operating A Scope

Vertical Section

Nearly all scopes bloom to some extent when the intensity of the CRT beam is increased. The blooming can be very pronounced, if the high-voltage rectifier is weak. Because blooming changes the size of the waveform, it also changes the calibration. **Always** calibrate the vertical gain with the **same** intensity setting you use when observing the waveforms. Mark the knob position of the vertical gain control (see Fig. 10) immediately after calibration is completed. Returning the knob to this mark each time will give sufficient accuracy for many measurements, without the bother of exact calibration.

Service-type scopes, like the RCA

we are using for picture illustrations, can be calibrated or read easier and more accurately when measuring p-p amplitudes, if the horizontal width is reduced by adjustment of the horizontal gain control. Any tilt between the graticule lines and the scope beam will be less noticeable. Also, reading the various scales is much easier if the narrowed waveform is moved sideways, close to the scale in use, as shown in Fig. 11.

Don't overload the probe or scope with excessive voltage, either AC or DC, or a combination of both. Arcs in the probe or across the range switch can cause a complete loss of scope operation. Don't try to measure at the plate of the horizontal output tube when the pulses are present, and don't try to check the small amount of ripple on a 1200-volt boosted-boost circuit without first adding to the probe an external coupling capacitor rated at 2KV, or higher.

Horizontal Section

Certain waveforms, such as the color-bar pattern in the chroma IF's, or video observed at 30 Hz, are very difficult to lock. The easy solution to these, and comparable waveforms, is to use external sync for locking the horizontal sweep oscillator. For any waveform to be observed at 7867 Hz, attach one end of a clip lead to the horizontal sync terminal, and position the other end near one of the wires going to the horizontal yoke windings. (Looping the two wires together or fastening the sync lead to the **insulation** of the yoke wire will provide satisfactory locking.) Change the sync switch to external, and alternately adjust the sweep frequency vernier and sync controls for the best locking. Remember, maximum sync is seldom the amount which provides best locking.

Vertical sync, for the times you need better locking at 30 Hz, can be obtained from some low-impedance point in the vertical sweep circuit, such as the cathode of the vertical output stage (if it is not grounded), or one of the vertical output transformer windings that supply the vertical convergence circuit in a color receiver. This last sync point is excellent because a vertical pulse of either polarity can

be found.

Remember to try the "+" or "-" sync polarity when you are using internal sync. Use the one which gives best locking.

Observe two cycles of the waveform. A portion of one cycle is normally lost in the retrace of the beam. If more than two cycles are displayed, much detail will be lost.

If you wish to see only a part of the waveform—for example, the color burst on the back porch of the horizontal blanking—set the scope to produce just one cycle of the waveform, then use the horizontal gain and centering controls to enlarge only the area of interest. However, if the retrace blanks out the area you wish to see, the horizontal vernier control should be changed to produce two waveforms.

Z Axis

The "Z" axis function found on some scopes permits brightness modulation of the waveform in much the same way that the video signal modulates the beam current and brightness of a television picture tube. For example, a positive-going pulse of more than 30 volts p-p applied to the "Z" axis terminal will cause the waveform to be brighter (or darker, depending on the model of scope) at the tip of the pulse.

To determine the relative times of occurrence of two signals (such as color burst vs flyback pulse), one signal should be applied to the vertical amplifier in the usual way, and the other to the "Z" axis, which will cause a darker or lighter area on the normal waveform.

Summary

None of the preceding information will be of any value to you unless you use it. If you do not now use a scope as much as you should, we urge you to practice, and to try some of the tips we've discussed. At the start, troubleshooting with a scope might take a little longer, but with solid-state and more complex circuits, using a scope is a **must**.

Future issues of ELECTRONIC SERVICING will include articles about waveform analysis, triggered-sweep scopes, and other scope-related subjects. In the meantime, use your scope regularly. ▲



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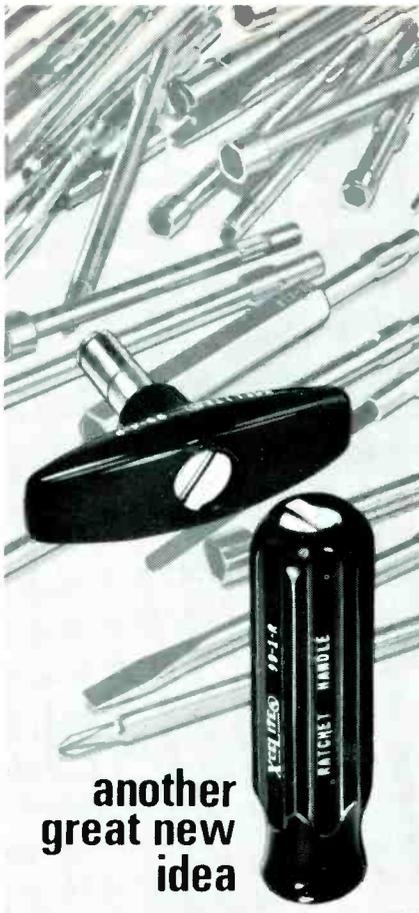
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audio systems report

Torque Indicator

A calibrated torque indicator, self-contained in a standard cassette case, has been introduced by Hartak Instrument Company.

The Model X-87 Torquette cassette unit is inserted in the recorder and the actual tape take-up torque in grams per centimeter reportedly can be read through the window of



the unit after the recorder "play" button is depressed. The conditions of the clutch assembly, a major problem area, then can be judged, based on the torque reading.

The price of the X-87 Torquette is \$6.90.

Circle 50 on literature card

"Multi-Tap" Paging and Intercom Speaker

A new public-address loud speaker featuring built-in transformers and four-way power selector connections has been introduced by Fanon Electronics.



Model HDA-30T speaker reportedly enables you to match the power you need merely by "rotating a plug". There are four different power selections on each horn.

Model HDA-30T is designed for

general paging purposes, and also is efficient when used as a microphone in intercom systems, according to the manufacturer.

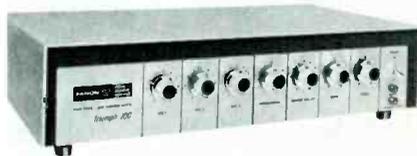
Constructed of aluminum with a baked enamel finish, Model HDA-30T measures 10 inches x 12 inches, comes complete with molded plug and cable, and is weather-proof. The price is \$26.65.

Circle 51 on literature card

Solid-State Amplifiers

Fanon Electronics has introduced two new, heavy-duty, solid-state amplifiers with either a 50- or 100-watt power output at 1 KHz.

Both amplifiers feature all-silicon, solid-state design; resettable safety circuit; two loudspeaker plug-in sockets plus screw terminals; two constant-voltage outputs of 25 volts and 70 volts, balanced and unbalanced; separate master volume, bass and treble controls with control-setting markers for all controls; simultaneous mixing of all inputs; high microphone sensitivity; and output impedances of 4, 8 and 16 ohms.



Model TRI-50, the 50-watt amplifier, has two microphone inputs, while the 100-watt amplifier, Triumph Model TRI-100, has three microphone inputs. The input voltage for both models is 105-125 volts AC, 50-60 Hz, and both measure 4½ inches x 11 inches x 16 inches. Model TRI-50 weighs 11¾ lbs. and sells for \$209.95, and Model TRI-100, which is priced at \$243.75, weighs 12¾ lbs.

Circle 52 on literature card

Microphones for Acoustically Equalized Sound Systems

Two new microphones with uniform feedback thresholds specifically designed for use in acoustically equalized sound systems have been announced by Shure Brothers, Inc.

Both models reportedly have undergone extensive, standardized room tests, which showed that in

the 110- to 5,000-Hz range, feedback will occur at the same amplifier gain level for every half octave step. In the critical feedback areas above 5,000 Hz, the response of both microphones has been smoothly tailored without peaks to increase feedback rejection, according to Shure.



Model ES-50 is a hand-held, low-impedance unit with a stand adapter and a shock-mounted cartridge for quiet operation. Model ES-51 is a stand-mounted, dual low-impedance unit with microphone body and cartridge separately shock-mounted for isolation from mechanical vibration noises. Both units have a true cardioid pickup pattern that has a symmetrical axis and is uniform at all frequencies.

Both models come with Cannon XLR-3 type connectors and protective storage cases. Model ES-50 sells for \$80.00 while Model ES-51 sells for \$130.00.

Circle 53 on literature card

Cassette Bulk Tape Eraser

A new cassette bulk tape eraser is announced by Duotone.



The cassette bulk tape eraser, designated Model SA-69, reportedly removes recorded sounds from the entire tape in seconds.

Complete with plug-in cord, the Duotone SA-69 is priced at \$12.95.

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Inside The Service-Type Scope

Analysis of design and characteristics, plus practical maintenance procedures

Theory of Operation

An oscilloscope can be compared to a stroboscope, which appears to stop a continuously rotating object by flashing on it a short-duration, repetitive light in synchronism with the movement of the object. Similarly, a repetitive voltage waveform can be "stopped" for observation on the screen of an oscilloscope by synchronizing the horizontal movement (scanning) of the beam to the frequency of the signal that is moving the beam in the vertical direction.

Only a linear scanning of the horizontal sweep gives an undistorted picture of a waveform. Therefore, for most uses in a service shop, the horizontal deflection waveform is an ascending-ramp voltage with a very rapid drop to zero. This often is called a "sawtooth" waveform, and is generated inside the scope.

Electrostatic deflection of the electron beam for scanning the cathode ray tube (CRT) is used in all general-purpose scopes, because magnetic deflection (such as used in TV receivers) cannot cover the wide bandwidths and frequencies that are required. Two opposing metal plates located in front of the electron gun are used for vertical electrostatic deflection and another two, mounted at right angles to the vertical plates, are used for horizontal deflection. The moving electron beam is attracted toward the plate which is more positive than its mate, and the beam is repelled by a more negative plate.

Most modern scopes apply out-of-phase AC signals to the two plates, although a simple scope can be built in which an AC signal is applied to only one plate. Application of AC signals to both plates produces a push-pull movement of the beam that results in greater

deflection and better linearity. The deflection plates are direct-coupled to the amplifiers in DC scopes so either pure DC or DC with an AC component can be measured, whereas AC scopes often are capacitance coupled between the amplifiers and the deflection plates.

Centering of the waveform is accomplished by adjustment of a control that increases the DC voltage applied to one plate while simultaneously decreasing the DC voltage on the other plate.

Typical Scope Functions

A typical service scope consists of a CRT and three general groups of circuits. (Refer to the block diagram in Fig. 1.) These circuits are:

- High-voltage and low-voltage supplies.
- Vertical deflection amplifier.
- Horizontal deflection amplifier and internal sweep oscillator.

Compared to the circuits of a television receiver, they are all relatively simple, and easy to understand and troubleshoot.

Power Supplies

High voltage supplied to the CRT is between 1200 and 2000 volts, depending upon the design, and usually is of negative polarity, with the positive grounded. Use of a negative supply voltage enables the deflection plates to be operated at zero volts in AC-coupled scopes. This simplifies connection of the plates to external circuits for uses at frequencies above the range of the internal amplifiers. In DC scopes, the collectors or plates of the amplifiers are connected directly to the deflection plates.

Scopes are invariably "cold chassis" types using power transformers. Those scopes with a two-prong power plug can be connected across almost any low voltage point in a

TV, radio or amplifier. Just remember that the scope and the circuit under test always share the same 120-volt power line, and excessive voltage between the chassis ground and the scope ground might arc over and cause a short in the scope power transformer.

Caution: The newer scopes equipped with the 3-prong power plug have the extra grounding prong connected to the scope case and the ground of the probe. Do **not** connect such a scope to a "hot chassis" receiver, for example, unless an isolation transformer is used to power the receiver.

Vertical Amplifier Circuits

The vertical amplifier (sometimes called the "Y" channel amplifier) is a video-bandwidth voltage amplifier which has relatively high gain. Such extended high-frequency response requires low values of plate or collector resistors, which reduce the maximum gain that is possible from each stage. Consequently, a low-priced scope might have satisfactory low- and mid-frequency gain but the gain at 1 MHz and higher might be down 3 dB (about a 30 percent loss). Another scope whose vertical amplifier section contains more stages might produce the same maximum gain as the one in the previous example, but the flat gain (-3 dB or above on response curve) might be extended to 5 or 8 MHz, or even 10 MHz.

The minimum scope bandwidth recommended for measuring and analyzing waveforms in color TV receivers is approximately 4 MHz.

Attenuation of the gain in calibrated steps is necessary for the measurement of peak-to-peak voltages; Fig. 2 shows the schematic of a scope input circuit, including the capacitor and switch (S1) used to change the scope from a DC to an AC measuring type, also shown is the voltage range switch. A simple resistive voltage divider is adequate for DC and low audio frequencies;

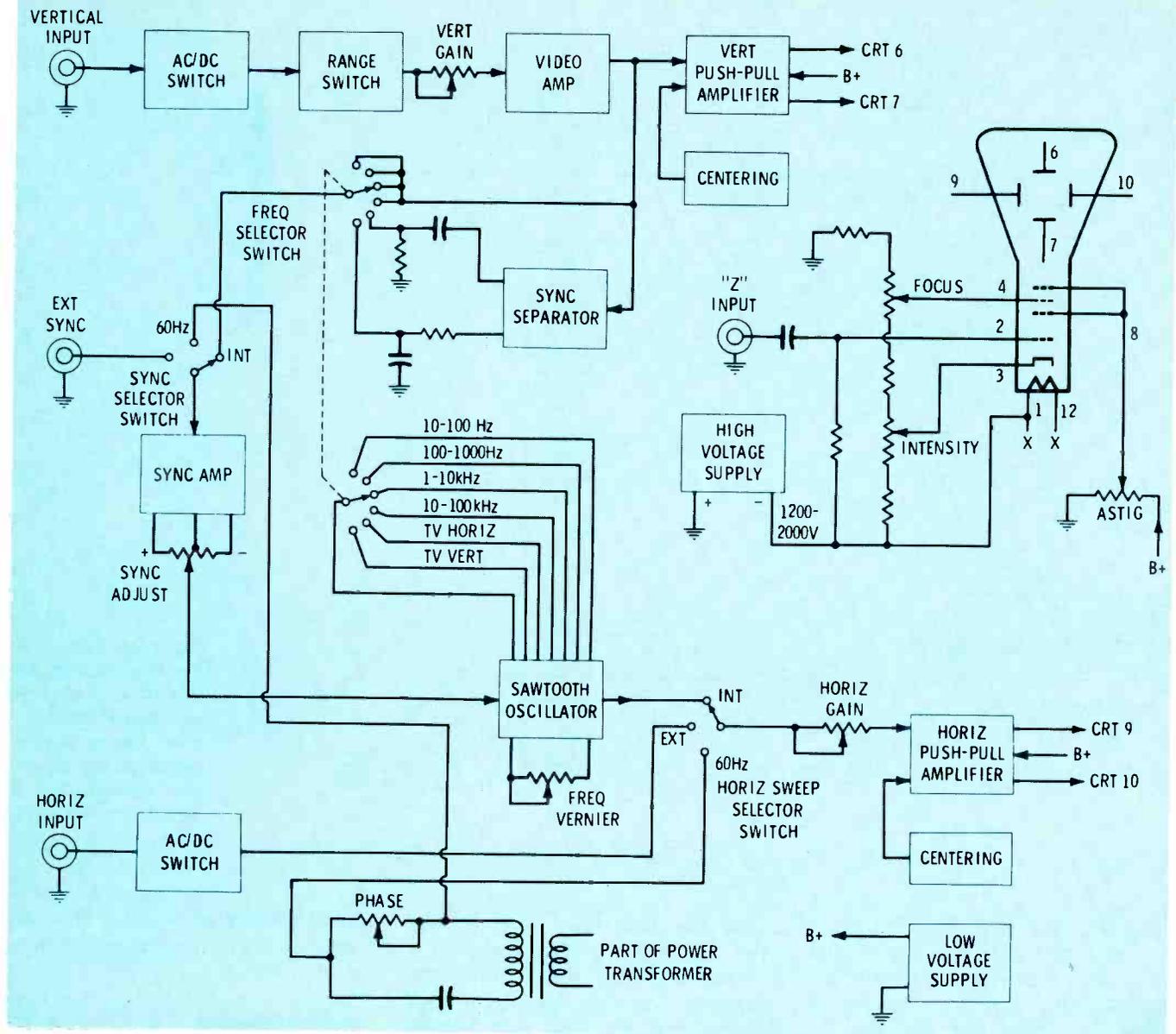


Fig. 1 Block diagram of a typical recurrent-sweep, service-type oscilloscope.

however, a severe loss of high-frequency response is inevitable without compensation. The voltage dividers are compensated by the capacitors connected across each resistor. The capacitors form a capacitive voltage divider which is in parallel with the resistive one. The input capacitance of the scope is increased by this compensation, but the frequency response can be adjusted by the variable capacitors to a value that is equal to that of the vertical amplifiers.

The direct/low-capacitance probe merely carries the resistive and capacitive voltage dividers one step farther. Typical specifications might be for the probe, cable and scope input impedance to measure 80 pf paralleled by 1 megohm in the DIRECT position, and 10 pf paralleled by 10 megohm in the LOW

CAP position of the switch.

To minimize any concern about which probe function to use, just adjust it for low-capacitance at all times, unless the amplitude of the waveform is too low to permit it to be measured or analyzed on the X1 position of the scope's range switch.

A continuously variable vertical gain control is needed to adjust the waveform for good visibility, and also to permit exact calibration for precise p-p measurements. This gain control must not narrow the bandwidth at any position; therefore, many of these are degenerative controls, and not just simple, variable voltage dividers.

Vertical centering in DC-coupled scopes is accomplished by increasing the bias (or other operating voltage) on one tube or transistor

of a push-pull stage and decreasing the same voltage to the other tube or transistor. This voltage change, multiplied by passage through subsequent amplifier stages, changes the DC voltage potential between the vertical deflection plates, thus moving the waveform up or down.

Normally, a positive-going pulse (AC) produces upward movement of the CRT beam, and a positive DC voltage (when the scope is direct coupled) deflects the "average" position of the beam nearer the top of the screen.

Horizontal Amplifier Circuits

Horizontal sweep amplifier circuits are not required to have as much gain or as wide a frequency response as the vertical amplifiers. However, additional deflection power to widen the waveform for an

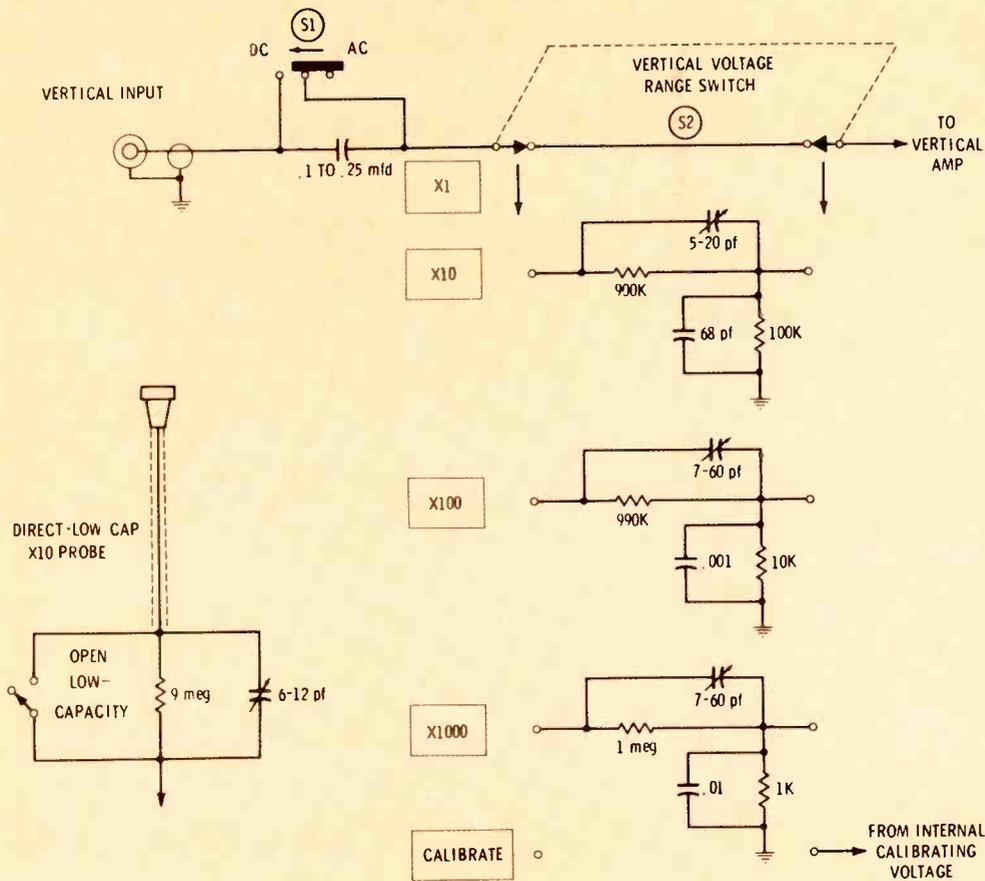


Fig. 2 Input circuit of a scope, including the DC/AC switch and associated capacitor, plus frequency-compensated signal voltage dividers and a direct/low capacitance probe.

enlarged view is desirable in many instances. Variable gain control and horizontal centering are usually accomplished by circuits similar to those in the vertical amplifier.

Two major additions make the horizontal sweep section different from the vertical. The first addition is a variable frequency (10 Hz to 100 KHz) oscillator whose output waveform is a linear sawtooth. The second difference is the sync circuit, which takes a sampling of an external signal or the signal that is present in the vertical amplifier and, in conjunction with the vernier frequency control, synchronizes the horizontal sweep rate to that of the vertical waveform.

Most modern scopes with recurrent sweep use a multivibrator oscillator. The frequency of a freerunning multivibrator is very unstable, but it is easily synced to another, more stable signal.

TV-type sync separators are used in some scopes when the horizontal sweep frequency switch is placed in either the TV H or TV V pre-set position. Without such a sync sys-

tem, the composite video is very difficult to lock properly when it is viewed at 30 Hz. The built-in sync separator improves locking. If your scope does not have this feature, the next best bet is to use external locking by obtaining a sync signal from the vertical or horizontal sweep circuits of the TV receiver. This technique is particularly effective when a color-bar pattern is the source of signal and the waveforms in the chroma channel of the TV are being analyzed.

Various controls and circuits are used in different model scopes to select the best polarity and source of sync signal. Some scopes use a sync amplifier stage, which overloads or saturates easily; consequently, no amplitude control for the sync is needed. If a sync adjust or sync amplitude control is provided, remember that too much sync amplitude is nearly as undesirable as too little. Positive-going pulses ordinarily lock best when the sync polarity also is positive, and negative-going pulses need negative sync. For other types of waveforms, use

either positive or negative sync, according to which provides the most stable locking.

Scope Maintenance

Symptoms obtained from the screen of the scope and responses to the adjustments of the various controls are often the best clues to the location of a defect in a scope. Much of the logic we use in troubleshooting TV receivers also can be applied to scope servicing.

Insufficient height or width of the waveform indicate a defect in the vertical or horizontal amplifiers. When a displayed waveform brightens unusually slow, the most probable trouble is a weak CRT, while excessive blooming can be caused by a weak high-voltage rectifier or other component in the high-voltage circuit.

Some symptoms are quite different, however. No horizontal sweep or a wrong frequency on just one of the positions of the sweep range switch indicates a defective resistor or capacitor associated with that one switch position. Similarly, a

wrong amplitude or frequency response on just one of the positions of the vertical voltage range switch points to a defective component in the resistive or capacitive voltage dividers for that one switch position.

A leaky coupling capacitor should be suspected in an AC-coupled scope which will not center properly. A defective tube, transistor or resistor in one of the push-pull deflection stages would be a likely cause of improper centering in a DC-coupled scope. (Incidentally, centering might be so bad that no waveform can be seen on the screen.)

If a blurred waveform is produced, even when the focus control is turned completely to one end, the most probable cause is a change in the value of a resistor in the voltage divider of which the focus control is a part.

Replacement power transformers for some of the older model scopes are sometimes very difficult to find. A universal replacement transformer plus a separate filament transformer might work satisfactorily. If you should install an extra or a different type transformer, position it very carefully. Magnetic fields from a transformer can cause a slight but noticeable deflection of the electron beam if they reach the gun of the CRT. Most of the shields around the neck of the CRT are fabricated from Mu-metal, one of the very few metals that effectively block magnetic fields. The magnetic shielding characteristic of Mu-metal can be reduced or destroyed by bending. Do not bend, cut or drill any CRT shields.

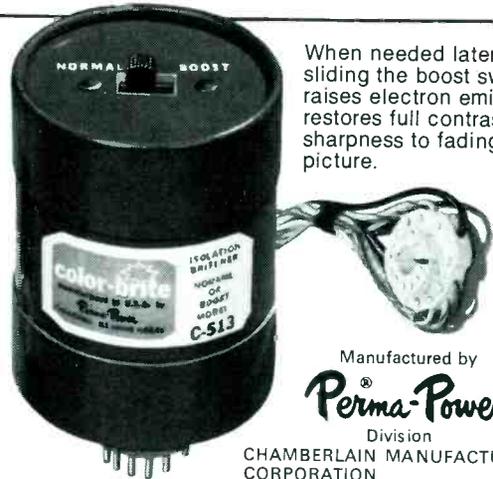
Erratic responses to adjustments of any controls can be caused by corroded or intermittent potentiometers. Cleaning with tuner repair chemicals often is effective, or the controls can be replaced with new ones of similar characteristics.

Most repair or maintenance operations inside scopes can be done with less work and problems than equivalent repairs to TV receivers. Most parts for the newer model scopes are available from the manufacturers. However, if the repair involves a power transformer or CRT which is obsolete, replacement of the entire scope with a new one having better functions and specifications might be the wise move. ▲

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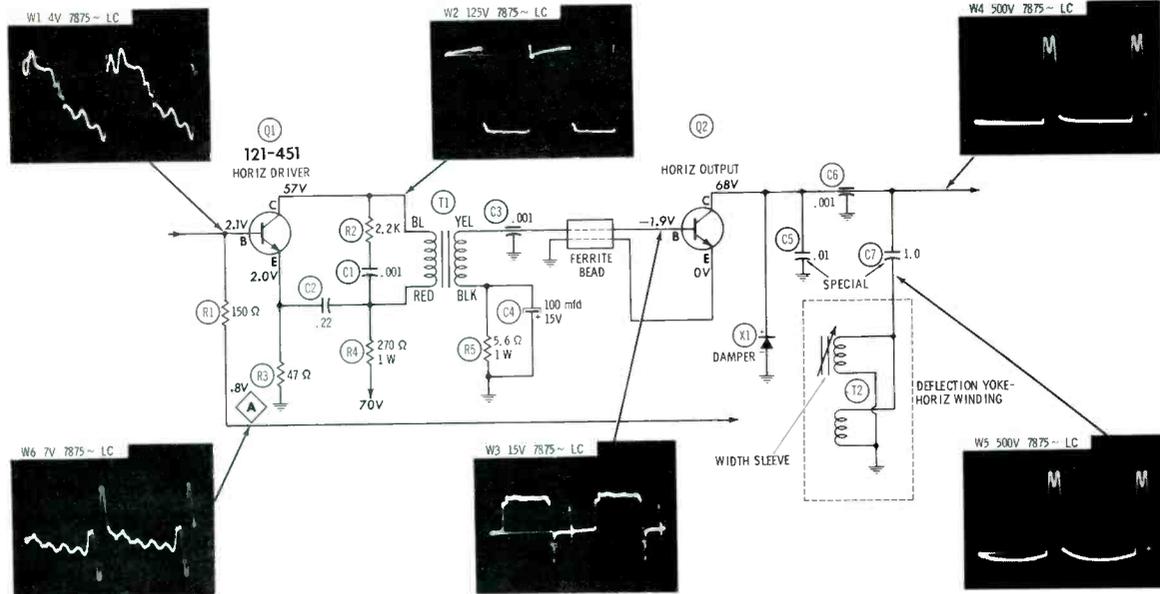
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DC VOLTAGES taken with VTVM—no color signal input. *Indicates voltage taken with color-bar input—see "Operating Variations."

WAVEFORMS taken with wide-band scope; TV controls set to produce normal color-bar pattern. LC (low-cap) probe used to obtain all waveforms.

Normal Operation

Circuit shown (Zenith Ch. 1Y21B55) is typical horizontal driver/output stage used in both small- and large-screen, all-transistor TV receivers. Configurations may vary, but action is similar. Driver stage receives pulses at horizontal rate, shapes signal into square wave, and powers the output transistor. Both driver and output transistors operate as switches; driver conducts only on positive pulses from oscillator. Output transistor is cut off during negative portion of waveform present at base, but conducts heavily during positive-going portion. Zenith Ch. 1Y21B55 uses sine wave horizontal oscillations at collector (sine-wave pulse occurring at horizontal rate). Emitter is direct-coupled to base of Q1 (driver); oscillator collector pulses are shaped into a square wave (W1). Q1 (NPN) conducts on positive portion; collector output is square wave with positive portion starting simultaneously with occurrence of horizontal sync pulse. W2 is transformer-coupled (matches impedance of Q1 collector to Q2 base) to output stage. With transformer inversion of signal, first portion of W3 (negative going) drives Q2 into cutoff, second half cycle (positive going) saturates Q2. Output transistor (Q2) circuit action: During Q2 cutoff capacitor C7 discharges through yoke winding, deflecting CRT electron beam linearly. At center of trace Q2 becomes saturated by positive portion of W3 and conducts heavily, supplying power to yoke, sustaining remainder of trace. Combined action—Q2 cutoff/saturated—results in linear trace across CRT (W4, W5). At end of trace W3 drives Q2 into cutoff, causing overshoot pulse in flyback transformer. This pulse reverses yoke current, producing retrace. Capacitor C7 charges during Q2 conduction time.

Operating Variations

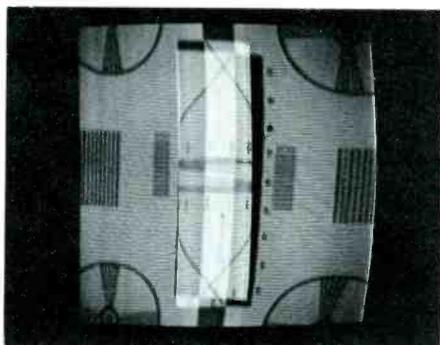
- Q1** Very slight DC variation with changing signal strength; drops approximately 0.1 volt only because B+ source drops approximately 0.1 volt. Adjustment of horizontal hold control to point where picture is out of sync effects a slight change in contour of wave shape; however, basic peaks remain the same.
- Q1E, Q1C** Little or no variation at these points in either voltage or waveshape. Neither signal strength nor adjustment of control produces a change in waveshape or amplitude.
- Q2B,C** Very slight change with signal variation, voltage difference caused by slight change in B+ source voltage. Contour and magnitude of waveforms remain fairly constant.
- Yoke-Input** Contour and magnitude of waveform remains fairly constant under change of signal strength. Slight variation in voltage although contour of waveshape does not change when brightness control is varied.
- Boost** Signal voltage composed of rectified output of Q2. This signal then filtered and used for focus action. Magnitude of signal voltage remains fairly constant under different signal strengths and control adjustments.
- High Voltage** High voltage varies 1.5K from minimum to maximum brightness control settings; 20KV at normal brightness, 19KV at maximum brightness and 20.5KV at minimum.

SYMPTOM 1

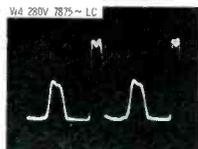
Horizontal Foldover

**Narrow Picture
R4 Increased in Value
(Q1 Collector—270 ohms, 1 watt)**

Symptom Analysis

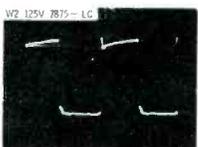


Raster shows 2" to 3" foldover in center of screen. Width is insufficient regardless of adjustment of width sleeve. Picture is dim and slightly out of focus. High-voltage measures 10KV but blooms slightly more than normal. Vertical sweep excessive; however, controls work normally.

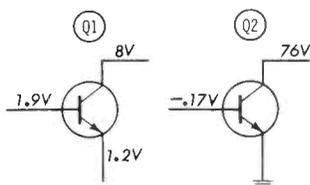


Waveform Analysis

W4 is key: large pulse decreased to 280 volts p-p with an unaccountable trailing pulse. W1 is decreased (3 volts p-p, normally 4 volts p-p), but sufficient basic content provides proper square-wave output at collector of Q1. W2, at Q1 output, indicates timing is off (Q1 not on long enough during each cycle). W2 is reduced (30 volts p-p, normally 125 volts). W3 supports findings of W2 (5 volts p-p, normally 15 volts). W6 could also be key: only 3 volts p-p compared to normal 7 volts.



Voltage and Component Analysis



B+ on collector of Q2 measures higher than normal, indicating horizontal output stage not conducting. B+ source voltage is high (77 volts). Reading at Q2 base (-0.17V) indicates reduction in drive. Q1 collector measures only 8 volts—condition affects B+ and bias circuits. Symptom usually originates as compression in center of screen, critical horizontal sync or "Christmas tree" when brightness control advanced. Reduced amplitude of W2 is relevant, but important clue is change in "on-off" cycle of square wave. Shorter duration of "on" cycle, coupled with voltage inversion in T1, reduces cutoff time of Q2, distorting W4 and W5.

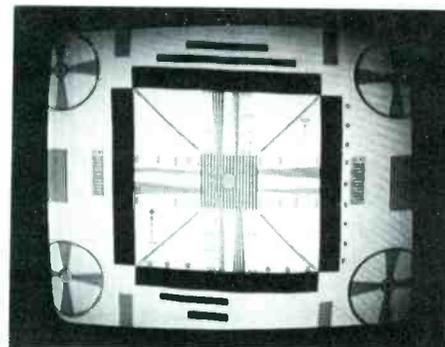
Best Bet: Scope, then VTVM.

SYMPTOM 2

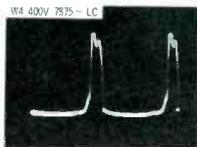
Narrow Raster

**Dim Picture
Q1 Leaky
(Horizontal Driver—NPN)**

Symptom Analysis

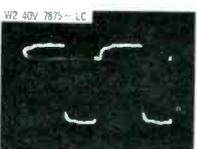
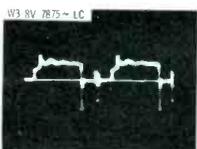


Right side of raster lost. Raster can be expanded by centering and adjusting width sleeve. Right side compressed, left side expanded. Raster blooms when brightness control is advanced; focus poor; second anode voltage low (10 to 12KV, normally about 20KV with normal brightness adjustment).

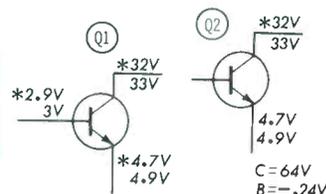


Waveform Analysis

W4 and W5 appear near normal in content but reduced in amplitude (W4 at 400 volts p-p, W5 at 420 volts p-p, normal is 500 volts). W3, only about 50% of normal amplitude, also shows distortion—not a linear square wave—positive-going portion (used to switch Q2 "on") of shorter duration than negative portion. W2 weak in amplitude and distorted (positive-going portion much longer in duration than negative portion). W1 slightly increased in amplitude—proper polarity, but distortion is evident.



Voltage and Component Analysis



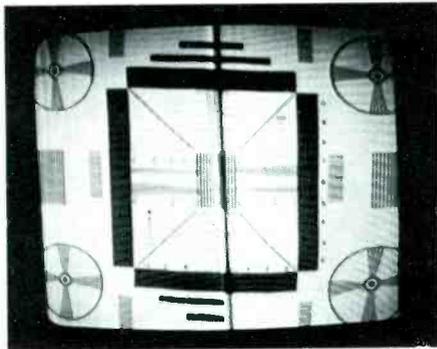
The clue is reduced Q1 collector voltage (32 volts, normally 57 volts). Q1 emitter voltage is above normal and Q1 is potentially cut off, producing change in switching time. Further increase in Q1 leakage will completely cut off Q1 and raster will disappear. VTVM readings indicate 470 ohms between collector and emitter of Q1. Right side of raster is affected since second half of trace and retrace is produced by conduction of Q2. Leakage of Q2 reduces drive signal at Q2 base, therefore limiting conduction of Q2. In this instance, Q2 conduction allows nearly normal high-voltage production and flyback action.

Best Bet: VTVM and component substitution.

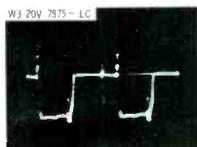
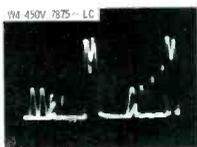
SYMPTOM 3

Center Drive Line Christmas Tree Effect R5 Increased in Value (5.6 ohms, 1 watt)

Symptom Analysis



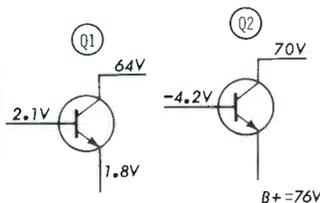
Drive line in exact center of screen. Raster narrow; can be adjusted with width sleeve. Raster has Christmas tree effect at higher brightness control settings. High-voltage decreased slightly (18KV) at normal brightness; drops to approximately 15KV at maximum.



Waveform Analysis

First W4 amplitude near normal; however, spike halfway through trace causes compression of raster (drive line). Second W4, taken with brightness control advanced, contains series of spikes associated with Christmas tree effect which places increased load on output transformer. Amplitude of W3 increased 30 to 35% and slightly distorted (negative portion longer). W2 amplitude also increased (200 volts p-p, normally 125 volts), and distorted interval of negative-going portion should be shorter. W2 indicates defect probably in drive control circuit.

Voltage and Component Analysis



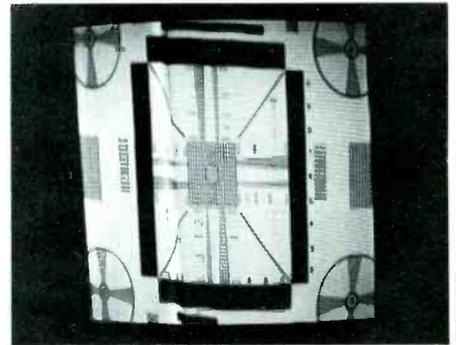
Relatively high bias voltage at base of Q2 is best clue (-4.2 volts, normally -1.9). Negative bias on NPN type transistor misleading, but bias set so that Q2 conducts only on positive-going portion of square wave, cut off on negative going portion. In this instance, incorrect bias upsets Q2 switch-action timing. Trouble compounded by interaction of stages. Example: horizontal oscillator emitter bias is through R1 to bottom of output secondary winding and a 100-ohm resistor to B-; thus, erroneous output signal is fed back to oscillator through driver output stage.

Best Bet: VTVM for voltage and resistance.

SYMPTOM 4

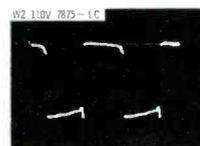
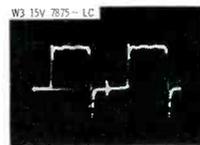
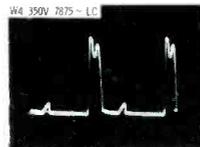
Narrow Raster Raster Compressed At Left Center X1 Leaky (Damper Diode)

Symptom Analysis



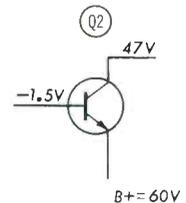
Raster quite narrow, drawn in from both sides with distinct horizontal drive line (compressed area) at the left center portion of the screen. Raster blooms when brightness control is advanced. Picture and sound information normal.

Waveform Analysis



Waveform at Q2 collector (W4) is low in amplitude (350 volts p-p, compared to a normal of 500 volts). Content distorted showing a positive going spike (same direction as retrace) about halfway through trace, thus indicating the compressed area of raster. Waveform W3 at base of Q2 is near normal in content and amplitude, a symmetrical square wave with negative going spikes, the first spike initiates Q2 cut-off, the second has no effect as Q2 is cut off at this time. W2 also near normal in content and amplitude. Waveform analysis isolates trouble to Q2 or Q2 output circuitry.

Voltage and Component Analysis

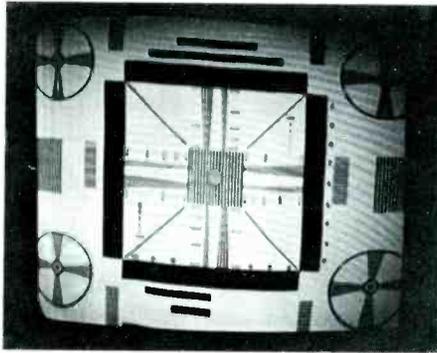


Q2 collector voltage decreased to 47 volts, 13 volts below B+. Collector supply circuit is through 10-ohm varistor and primary of output transformer, should be little drop in voltage. Horizontal output circuit is major portion of total load on B+ supply. Short causes severe B+ loading. Leaky capacitors C5, C6 or C7 could cause similar symptom, as could Q2. Damper diode serves same purpose as tube type, but if diode (damper) opens only linearity is affected since Q2 acts as damper. High voltage not lost as boost, not supported from damper circuit.

Best Bet: Scope, then VTVM.

SYMPTOM 5

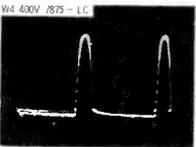
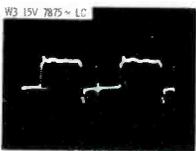
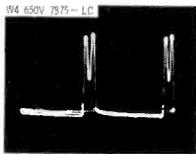
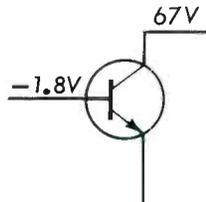
Narrow Raster
Linearity Near Normal
C5 Decreased in Value
 (Flyback Tuning Capacitor)

Symptom Analysis

Raster narrow. Vertical sweep near normal; width sleeve adjustment helps, but corner shadows appear before attaining proper width. Horizontal linearity slightly off—compression at left, expansion at right. Brightness excessive. Second anode voltage 22KV at normal brightness (should be 20KV).

Waveform Analysis

W4 has relatively linear baseline portion (nearly straight line), retrace portion is distorted—instead of one pulse with dip at peak, it is now two separate spikes, and amplitude is excessive (650 volts p-p, normally 500 volts). Increased amplitude of W4 results in incorrect control of CRT electron beam—trace completed before entire screen scanned. W3 near normal in content and amplitude, isolating defect to output stage. W5 shows results of change in capacitance of C5.

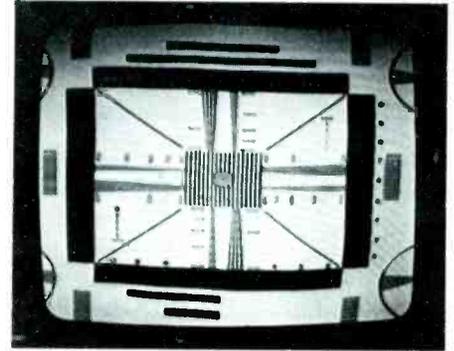
**Voltage and Component Analysis**

DC voltages measure well within tolerance and offer no clues to the source of trouble. Primary function of capacitor C5 (in conjunction with other components in circuit) is to resonate with flyback and yoke inductances at a frequency of 50KHz. C5 value is extremely critical and should be replaced only with capacitor having exact same specifications. A small change in either direction results in a noticeable change in raster width and the amplitude of high voltage.

Best Bet. Careful scope work; component substitution.

SYMPTOM 6

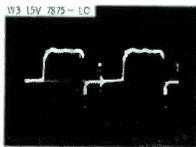
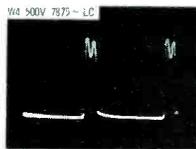
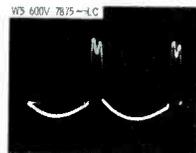
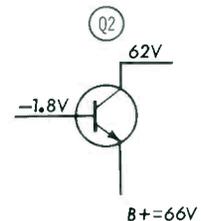
Excessive Width
Vertical Sweep Normal
C7 Decreased in Value
 (Yoke Coupling—1 mfd)

Symptom Analysis

Raster far too wide. Vertical sweep appears near normal. Much of picture is lost at edges. Width sleeve adjustment narrows picture but in process causes non-linearity, compressed edges, and expanded center. High voltage is normal, but some blooming at maximum brightness.

Waveform Analysis

Waveform W5, at input to horizontal deflection coil, distorted, excessive in amplitude (600 volts p-p versus normal 500 volts), dropping to an exaggerated low in base line portion. Waveform W4 is normal in both content and amplitude. Waveform W3, at input of Q2, is also normal in content and amplitude. Due to the interaction of components in the output stage, waveform analysis is far more useful in isolating a defective stage than in attempting to isolate the specific defective component.

**Voltage and Component Analysis**

Q2 collector voltage lower than normal, but within tolerance. C7 is close-tolerance capacitor and should be replaced only by exact type. Functions of C7: block DC from deflection yoke, couple and shape yoke drive signal. C7 charged during Q2 conduction cycle. Q2 ceases conducting at end of trace, flyback ringing starts, large pulses reverse yoke current (retrace). X1 damps ringing pulses as C7 discharges through yoke, producing linear trace through first half of sweep. ▲

Best Bet: Scope; component substitution.

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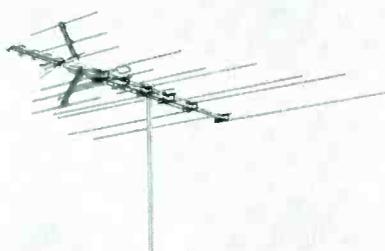
Circle 20 on literature card

antenna systems report

TV/FM Outdoor Antennas

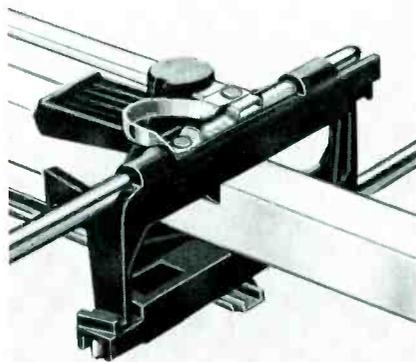
A new line of TV/FM outdoor antennas which feature solidly riveted, permanent connections between elements and feed lines has been announced by RCA Parts and Accessories.

Called Permacolor, the new line also features snap-off elements for quickly adjusting FM and UHF models for local reception requirements.



Included in the new line reportedly are a full range of UHF/VHF/FM and VHF/FM combination antennas, with individual models designed for specific applications ranging from metropolitan to deep-fringe areas. The combination models reportedly feature an improved UHF corner reflector which also augments VHF reception, plus a wide-band, bow-tie UHF dipole.

The permanent connections featured in the new antenna line are achieved by a flexible strap (shown here) riveted between each element



and feedline. This construction reportedly is an integral part of a new insulator design in which the entire

insulator pivots when the elements are unfolded, compared to previous designs in which the element pivots within a fixed insulator. When completely open, opposite insulators lock together to form a rigid, truss-like structure for greater strength, according to the manufacturer.

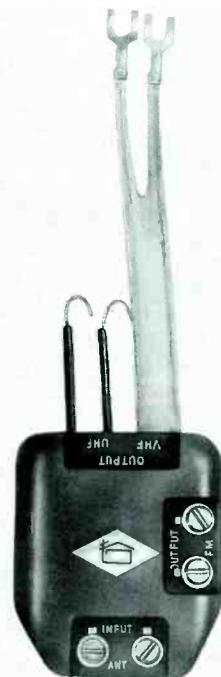
Prices range from \$9.45 for the 12-element UHF model to \$68.95 for the combination UHF/VHF/FM model, which features 36 "Perma-tuned" circuits. Model 4BG23, shown here, is priced at \$42.50.

Circle 60 on literature card

All-Channel Signal Splitter

A 300-ohm, color-rated VHF/UHF/FM signal splitter for TV's, designated Model FS-1314-FM, is announced by Jerrold.

The unit is connected to the lead from any all-channel antenna and reportedly produces signals for all-channel television reception in color or in black and white, and for FM mono or stereo. The splitter is said



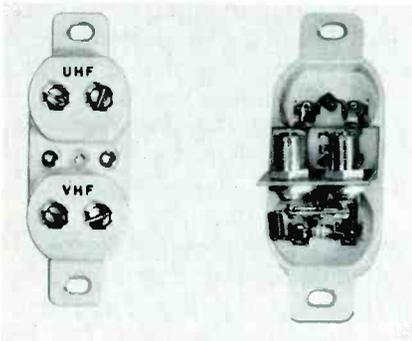
to separate the incoming signals according to frequency range; the signals then are made available at three different sets of 300-ohm outlets: VHF TV from 54 to 216 MHz, UHF TV from 470 to 890 MHz and FM from 88 to 108 MHz.

The price of the unit is \$3.95.

Circle 61 on literature card

UHF/VHF Tapoffs

A new series of MATV tapoffs which reportedly provide separate UHF and VHF outputs from a single all-channel trunkline have been introduced by JFD Electronics Corporation.



Recommended for fringe- and medium-signal areas, the new tapoffs utilize 300-ohm screw outputs, fit into any single-gem box for flush mounting, and can be covered by any standard AC wallplate.

The Model P-5117, reportedly provides 17 dB isolation with 0.5 dB UHF loss. Two F-59 type male fittings are supplied for the thru-line connections.

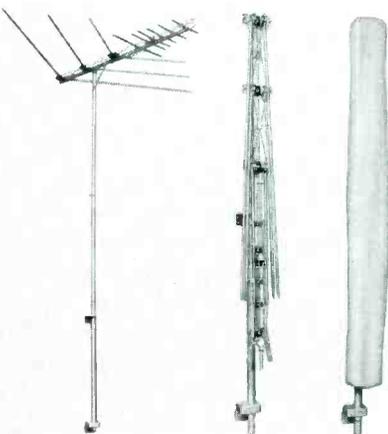
Model P-5117 sells for 5.95.

Circle 62 on literature card

RMA-1 Marine Antenna

A collapsible, rotating, all-channel TV/FM RMA-1 marine antenna designed for use on power cruisers, houseboats, sailboats and auxiliaries has been introduced by The Finney Company.

The RMA-1 reportedly consists of an all-channel, VHF/UHF/FM color spectrum antenna mounted on a telescoping mast equipped with a manual motor mechanism which makes possible a 360-degree rota-



tion of the antenna.

The all-weather, 75-ohm shielded co-axial transmission line system reportedly prevents pickup of unwanted noise or distortion from metal boat parts or operating generators or motors and combined with a 75-300 ohm set matching-transformer/splitter assures fine television reception.

Gold Corodizing protects the antenna and all its parts from fresh and salt water corrosion.

The RMA-1 sells for \$89.95. ▲

Circle 63 on literature card

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Ghosts, blurs, wiggles, jitters . . . whatever you call them, you won't get them with our two new digital color generators. You can converge, install or trouble-shoot color TV's quickly and accurately. Because these two units employ totally new concepts that take the trouble out of trouble-shooting.

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The 1243 is a basic 6 pattern color generator. The deluxe 1246 has nine patterns, three more than the 1243, and

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2. B&K Model 1243 Color Generator \$99.95



Circle 21 on literature card

Model 179 FET VOM

A new solid-state, FET VOM with wide-band AC frequency response to 3 MHz, and an input impedance of 10 megohms has been announced by B&K Mfg. Div., Dynascan Corp.



Model 179 features: eight DC voltage ranges, from .3V to 1000V; DC current, .03 to 300 milliamps; AC volts, .3 to 1000V; AC current, .03 to 300 milliamps; and seven ohm ranges, 0 to 500 megohms. Accuracy on DC volts and DC current is $\pm 2\%$ typical, $\pm 3\%$ maximum. Accuracy on AC volts and AC current is $\pm 3\%$ typical, $\pm 4\%$ maximum. Positive and negative DC ranges and RMS and peak-to-peak AC ranges are included.

Model 179 measures 5 inches x 7 $\frac{5}{8}$ inches x 4 $\frac{3}{8}$ inches, is supplied with batteries, instruction manual and shielded test cord set. Price is \$74.95.

Circle 70 on literature card

General-Purpose Scope

A 5-inch general-purpose oscilloscope with a sensitivity of 20mV/cm over a frequency range of DC to 1.5 MHz has been announced by Kikusui Electronics Corporation.

Other features of the new scope, Model 556A, include: simplified front-panel controls grouped according to function; AC/DC vertical



input; and sweep frequency from 10 Hz to 100 KHz in four continuously variable ranges.

Price is \$239.00.

Circle 71 on literature card

50K-Ohm/Volt VOM

A VOM with a DC sensitivity of 50,000 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 5mV to 1,200 volts; AC voltage measurements from 0.1 to 1,200 volts; DC current from five microamperes to six amperes; resistance from one ohm to 100 megohms; and decibels from -20 dB to +57 dB.



Another feature of the instrument is a polarity switch which permits measurement of negative

DC voltages without reversing the test leads.

The voltage measuring range of Model WV-519A can be extended to 30KV by use of RCA high-voltage probe WG-297 and RCA multiplier resistor WG-441A.

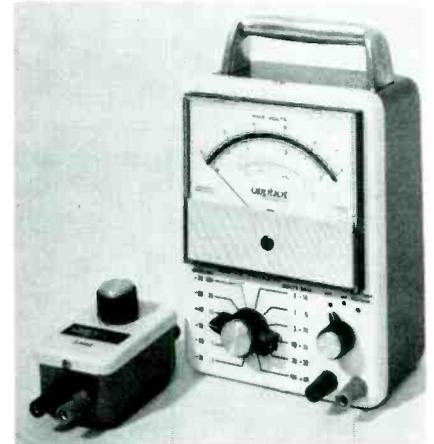
The VOM measures 6 $\frac{3}{8}$ inches x 4 $\frac{1}{4}$ inches x 1 $\frac{7}{8}$ inches, weighs 1 $\frac{1}{2}$ pounds and is priced at \$36.00, complete with test leads and two 1.5-volt penlite batteries and one 22.5-volt photoflash battery.

Circle 72 on literature card

Electronic Analog Voltmeter

A battery-operated, electronic analog voltmeter has been introduced by the Abphot Corp.

Model 1001 is used for the meas-



urement of AC signals having amplitudes of 30 microvolts to 100 volts in the frequency range of 10Hz to 1MHz.

Specifications include: 300 microvolt full-scale sensitivity; 4 $\frac{1}{2}$ " taut-band meter movement; 1 megohm impedance. Available standard frequencies are: 50Hz, 100Hz, 400Hz, 1KHz, 7.5KHz, and 15KHz.

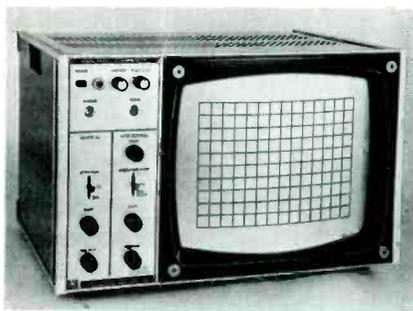
Model 1001 measures 5 $\frac{1}{2}$ inches x 4 $\frac{1}{4}$ inches x 7 $\frac{1}{2}$ inches and weighs 4 lbs. The cost is \$160.00.

Circle 73 on literature card

Large-Screen Alignment Oscilloscope

A new solid-state, single-trace alignment oscilloscope with a 12-inch screen, AC clamping and a marker intensity modulation system has been introduced by Kikusui Electronics Corp.

Model 5121 employs a 12-inch



television-type CRT with electro-magnetic deflection. Sensitivity of the vertical axis is 2 mv/cm. Frequency response of the vertical amplifier is DC-10 KHz (-3 dB). Sensitivity of the horizontal amplifier is 100 mv/cm; frequency response is DC-1 KHz (-3 dB).

Model 5121 measures 17 inches x 10 inches x 14 inches and sells for \$580.00.

Circle 74 on literature card

Megohmmeter

A new portable megohmmeter which operates on standard AC, 105-125 volts 50-60 Hz, has been introduced by Freed Transformer Company. The unit reportedly makes insulation and leakage measurements of transformers, motors, cables, electronic assemblies and components, dielectric materials, electrical appliances, tools, capacitors and resistors.



No. 1620 has a reported range of 0.1 to 4,000,000 megohms or 1 to 2,000,000 megohms @500 volts. Test ranges for voltage are from 50 to 1000 volts DC.

No. 1620 measures 15 inches x 9 inches x 7½ inches, and weighs 24 pounds.

The price is \$360.00.

Circle 75 on literature card

Connection Verifier

A new device which reportedly locates broken wires, bad connections, poor solder joints and incomplete welds without disconnecting

any wires has been introduced by the Electronic Tools Division of the C. H. Mitchell Co.

When the Connection Verifier is turned on there is a continuous audible tone of constant pitch. If the probe is touched to a defective connector pin, the pitch does not change, and you have found your trouble. If the connection is good, there will be a distinct change of pitch.

The connection Verifier measures 4 inches x 3 inches x 1½ inches, weighs 10 ounces, and operates on



a NEDA-1604 9-volt battery. The price is \$29.95.

Circle 76 on literature card

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Circle 22 on literature card

1971 auto radio design— Changes that affect servicing

Significant modifications and additions which require changes in service techniques and/or eliminate or introduce possible trouble-prone circuitry.

Many changes in auto radio design were introduced during the period 1969-1970. Perhaps the most significant change was the introduction of integrated circuitry (IC's). In 1971 models we witness, also, several mechanical changes, such as the Delco slide tuner and an easy change system for dial lights. In the next few paragraphs we will detail several of the more important changes that probably will affect the servicing of the new models.

Delco

GM has solved the antenna "ugliness" problem by molding a right-angle dipole into the front wind-

shield glass, with the coaxial connector at the bottom, behind the dashboard. In doing away with ugliness, however, they created other troubles. Among these was fading caused by impedance mismatch between the more or less traditional FM input circuitry and the new "windshield" antenna. Delco has eliminated the mismatch with a redesigned input circuit, shown in Fig. 1. In older models the center conductor of the antenna cable was connected to a series capacitive voltage divider, as shown in Fig. 2.

It is hoped that some of the fading problems that are not associated with the antenna mismatch also will soon be solved. It will be a lot easier to repair a truly defective radio than to try and explain that both directional fading and "rainy day" FM swish are normal characteristics of a particular model.

In 1970, Delco introduced auto FM stereo radios that used a version of the Motorola stereo Multiplex demodulator IC, called the DM-14. Consumer service technicians first saw this IC a few years ago in H. H. Scott stereo receivers. This IC is being used in more and different types of equipment. (For those interested in the internal workings of this IC there is available a Motorola Applications Note that fully explains the theory of operation, shows internal circuitry, lists specifications, and provides examples of typical applications. Write to: Motorola Semiconductor Producers, Inc., Post Office Box 20912, Phoenix, Arizona 85036. Ask for publication No. AN-432A and the data sheets on the types MC1304 and MC1305 integrated circuits. Mark the envelope "Attention: Technical Information Center.")

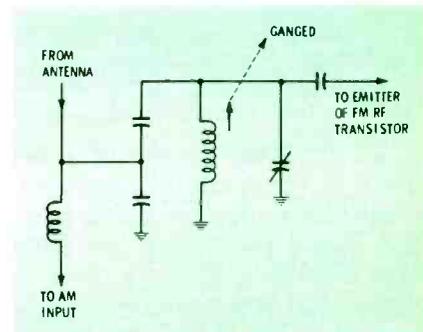
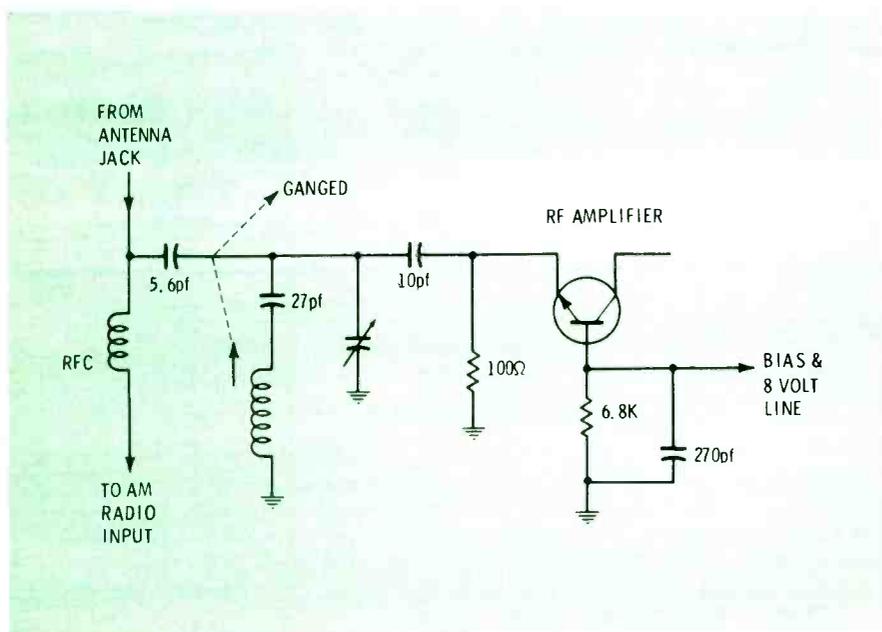


Fig. 2 Design of input circuitry formerly used in Delco auto radios created mismatch and resultant fading.

Fig. 1 Redesigned input circuitry of new Delco auto receiver reportedly has eliminated the impedance mismatch that existed between the conventional input circuit (Fig. 2) and the new "windshield" antenna. The mismatch caused fading.

Delco recently introduced a newer version of this IC. The newer version, called the DM-24, is basically the same as the DM-14 used last year, except that the external buffers have been moved inside the IC package. Fig. 3 shows the new stereo demodulator circuit in 1971 Delco FM Stereo radios. Because of the internal buffers, this circuitry is simpler than that of last year. Also missing are the muting inputs (see AN-432A) and the light sensitivity-separation input. The light sensitivity adjustment on the newer version is a 500-ohm potentiometer in series with one of the 19-KHz tank circuits.

As you are probably aware, FM broadcasters pre-emphasize the upper audio frequencies to gain a better signal-noise ratio. The amplitudes of these frequencies must be restored to their original relationships with the rest of the audio spectrum passed by the receiver. In the Delco's 1971 stereo FM receivers this is accomplished by two parallel RC combinations, each consisting of a 5.6-k ohm resistor and .022-mfd. These RC networks are connected between the +8-volt line and pins 8 and 11 of the integrated circuit.

The author recently attended a Delco service seminar during which the circuitry in 1971 radios was analyzed. One thing that I noticed about some of the new models is the pin-type connectors used between the audio PCB and the main board. The Delco engineer giving the seminar stated that these connectors proved reliable during testing. However, my own personal field experience leads me to suspect that they will be a source of open circuits or, most likely, a troublesome kind of intermittent in the future. Should some of these radios exhibit an intermittent condition, soldering these connectors might solve the problem. On most models, the pin connectors are on the left side of the main PCB (front bezel of the receivers pointed toward the technician).

The circuit of the tape pre-amplifier used in Delco cassette tape players (also a new item in 1971) is shown in Fig. 4. The IC is a 14-lead D.I.P. containing both right- and left-channel preamplifiers. From

analysis of the feedback network and a quick look at the internal circuitry during the Delco seminar, I can tentatively state that this IC is either a pair of operational amplifiers or something closely related to an operational amplifier (op-amp). (It might be well to note that the op-amp is an IC configuration that has seldom been used in consumer electronics. However, because it is so versatile, we can expect to see its use increase as production costs come down. Motorola, International Rectifier and Sylvania (among others) already offer dual op-amp stereo preamplifier IC's. If there is enough demand, we will include a brief explanation of op-amps in ES in the near future.)

When using the Delco service manual during the repair of a cassette tape player, be sure to look in the back of the manual for an update section (not all Delco service manuals have this section). The update section contains the newer printed-circuit board foil pattern which is used in the majority of the players in service. The foil pattern shown in the regular section of the manual was used, according to a source at Delco, in less than three hundred early production sets.

Almost all car radios, except for the 1971 Delco sets, have to be removed from the dashboard and opened up before the dial lamps can be replaced. To the customer this means a \$1.50 to \$10.00 RNR charge to replace a 30¢ light bulb. Delco has solved this problem by making the lamp accessible through a removable dial scale face plate. Although complete instructions for all GM cars would be too lengthy for inclusion here, we can say that a collection of small allen wrenches, a small screw driver (set-screw size) and a pair of long-nose pliers are all the tools that are necessary on most models. On all models tune the dial pointer to the high end of the band. On some models there is an allen set screw underneath the band-changing selector bar. On others it is only necessary to pry in the proper direction (which varies from model to model). In any event the complete instructions are in the Delco 1971 service manual and in the appropriate Howard W. Sam's Auto-Radio Series book.

Bendix

There are two separate generic types of 1971 Bendix radios used in Ford Motor Company products.

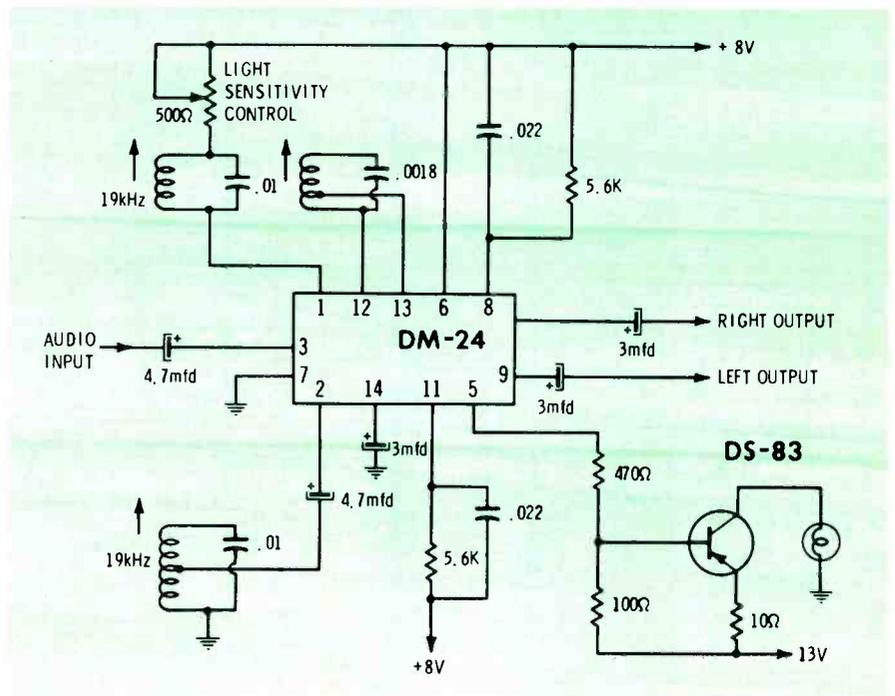


Fig. 3 New IC stereo demodulator circuit included in Delco's 1971 design. Circuitry is basically the same as earlier design except that more of external circuitry is now inside the new IC.

One of these types is a so-called "interim" series, which is marked "use 1970 service manual". A newer and more sophisticated type was introduced at a slightly later date. The newer 1971 Bendix receivers use two ICs, a new type of audio circuit, and a noise squelch circuit.

The 1971 Bendix audio amplifier circuit is shown in Fig. 5. As in previous years, Bendix has chosen a direct-coupled circuit which includes the preamplifier, driver, and power amplifier functions. This year, however, there are quite a few departures from the standard design of former years. One of these

departures is the use of Zener diodes to stabilize the audio amplifier bias voltages. One Zener is used between the emitter of Q2 and ground. It effectively holds the Q2 emitter potential at 5.6 volts. Another Zener diode is used at the junction of the 3300- and 270-ohm resistors. This diode holds the voltage supplies to the collector of Q1 relatively constant. In previous years, the only use of Zeners was to regulate the voltage supplied to either the FM oscillator or, usually that supplied to the entire FM tuner.

Note that Q3 is a PNP transistor. This is a change from previous design; since 1967, Bendix has been using an NPN epoxy tab-mounted transistor in AF output circuits. Apparently, excessive failure of this type has led them back to the standard TO-3 diamond case.

The big surprise in the circuit in Fig. 5 is Q1. Officially, this device is known as either a Darlington amplifier or Darlington Pair. It is so named after it's inventor. Although Q1 appears physically similar to a normal economy line (epoxy) NPN transistor, it actually is altogether different. Do **not** use a universal replacement NPN device as a substitute for Q1. It won't work—and might cause further damage.

A Darlington pair used two transistors (usually within one case, as in Fig. 5) with their collectors tied together. One transistor is used as the input to the system. It's base is the effective base for the pair. It's emitter is connected to the base of the second transistor. The emitter of the second transistor is the common terminal for the system. In Fig. 5 this element is connected to the "hot" side of a grounded 150-ohm resistor. This configuration offers a higher input impedance than a conventional bipolar configuration. It also has a higher gain than would the two transistors if they were used as separate cascaded amplifier stages.

Also note that the two 1000-mfd/4 VDC electrolytic capacitors, which gave so much trouble in previous designs, have been eliminated in the 1971 model.

The new Bendix integrated-circuit 10.7-MHz FM IF amplifier is shown in Fig. 6. Notice the sim-

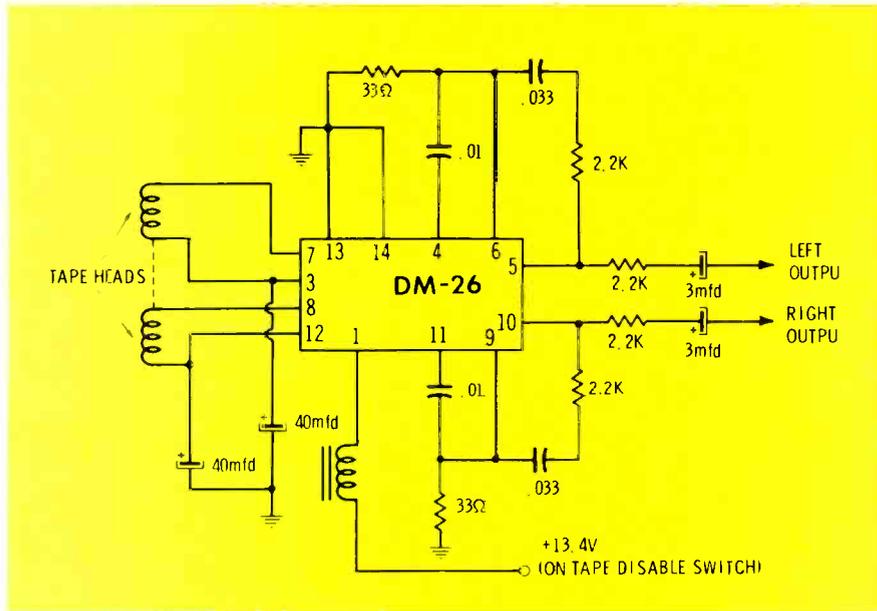


Fig. 4 IC-equipped tape preamplifier used in new Delco cassette tape players. See text for caution about different printed-circuit board foil pattern used in later versions of Delco's cassette tape player.

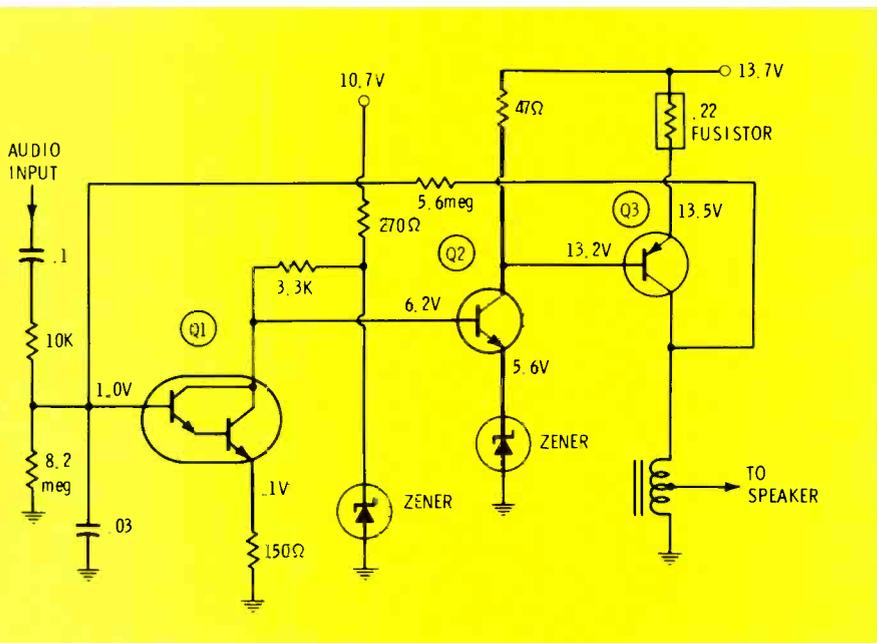


Fig. 5 A Darlington amplifier (Q1), use of a PNP third-stage transistor in place of an NPN, and the addition of Zener diodes for improved voltage stabilization are the most notable changes in the audio amplifier circuitry of Bendix's 1971 auto radios.

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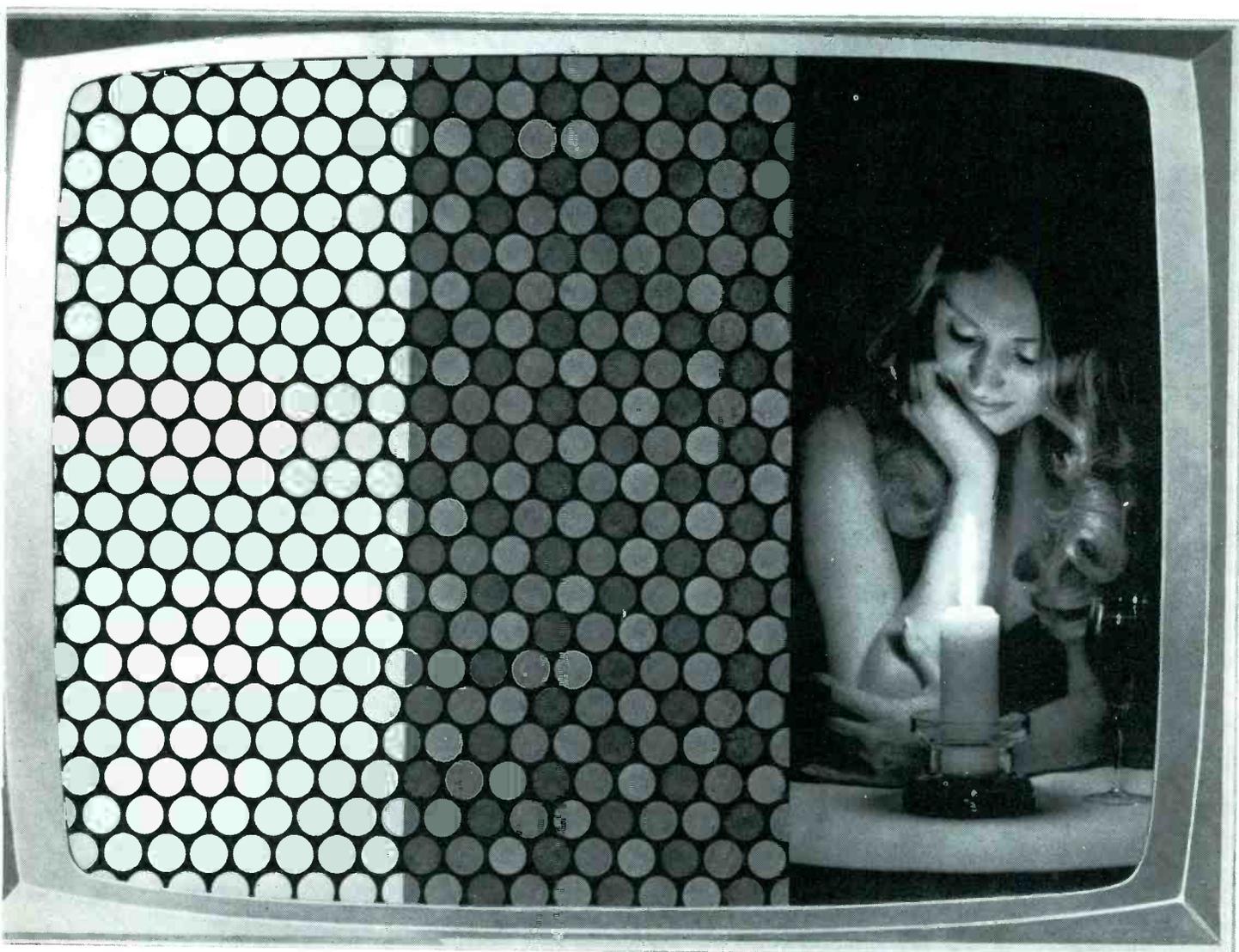
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Spectacular! In operation, a new, unique high-resolution gun "shoots" the phosphors with more energy than any other gun previously available. Result: black matrix + phosphors + high-resolution gun = maximum sharpness over the entire brightness range, truer colors under all viewing conditions.



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*Magnified drawing **Simulated

RCA

plicity of the circuit. The IC used in this function is housed in a 10-lead package similar to the familiar TO-5 transistor package. Both input and output tuned circuits are of the quadruple-tuned variety. Bias is supplied to the IC via the 120-ohm resistor. B+ is applied through the 1000-ohm resistor. Bypassing is accomplished by .005-Mfd and .1-Mfd capacitors.

The internal circuitry of the IC consists of two differential amplifiers in cascade driving a differential output amplifier which is connected in the popular common-emitter/common-base configuration. This type of circuit produces very high gain, which can be troublesome at 10.7-MHz, if bypassing and lead dress are not maintained as originally designed. Be on guard against

any oscillations in these circuits.

Transformer T4 in Fig. 7 is the same transformer shown at the output side of Fig. 6. It supplies input signal to the IC. An AFC correction voltage is obtained from pin 8 of the IC and fed through a 470k isolation resistor to the FM oscillator. T5 is a quadrature coil used in the FM detection process. Demodulated FM audio signals are

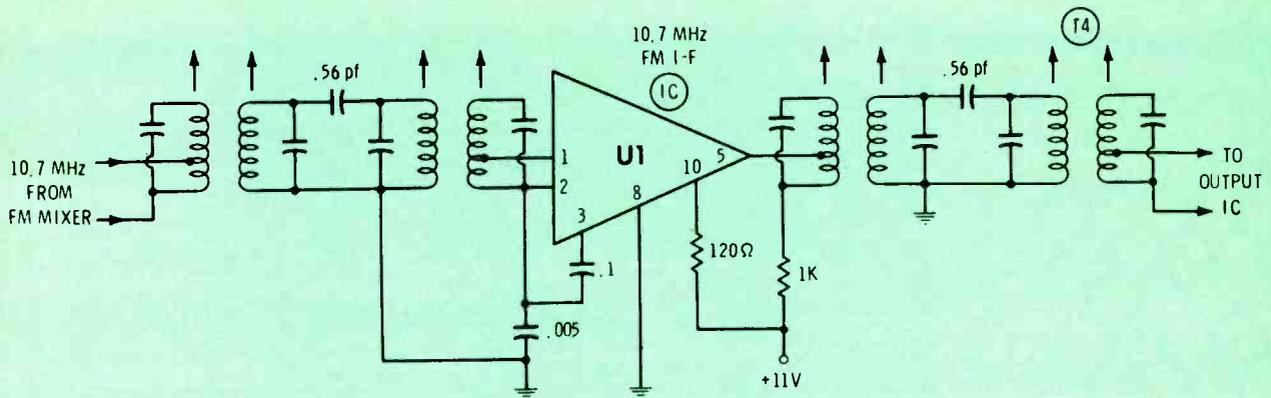


Fig. 6 Integrated-circuit 10.7-MHz FM IF amplifier used in 1971 Bendix receivers is high-gain design that might present oscillation problems, if proper lead dress and bypassing are not maintained.

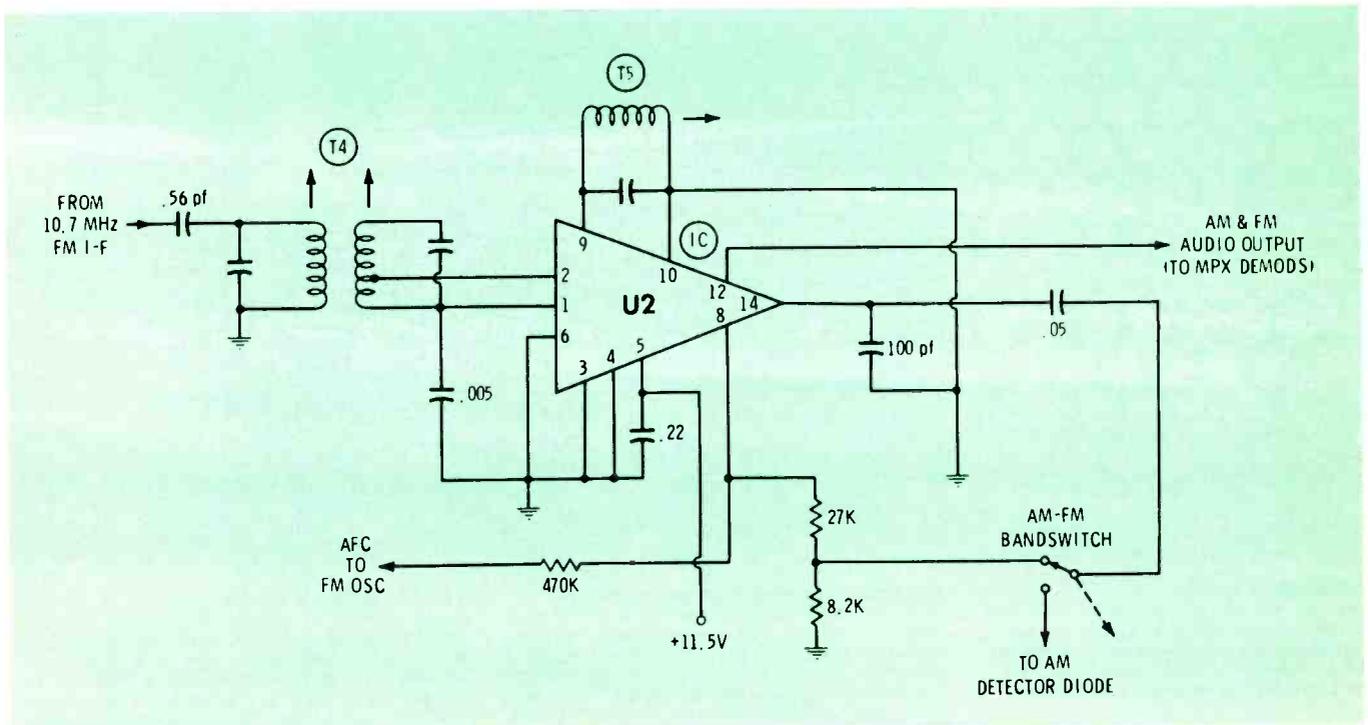


Fig. 7 Incorrect adjustment of quadrature coil, T5, which directly affects the AFC correction voltage, can cause an unwanted shift of the FM oscillator frequency. See text about other cautions relating to this and other IC-equipped circuits.

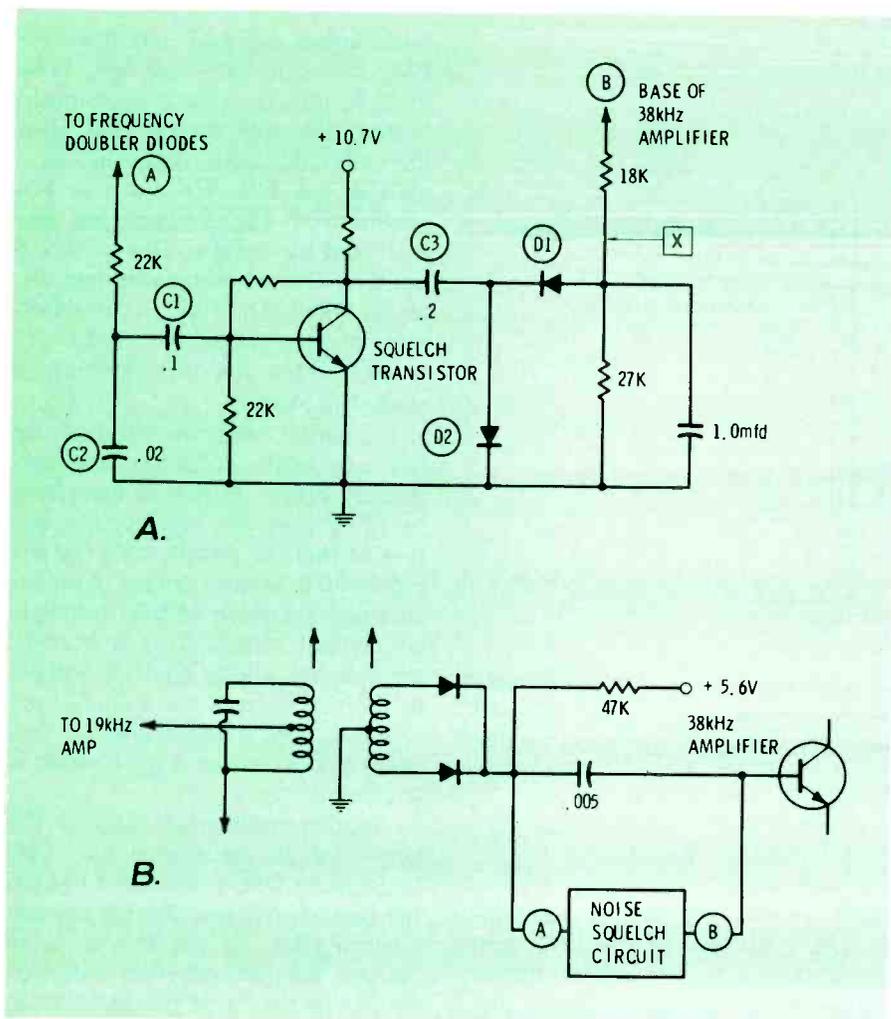


Fig. 8 Defects in new noise squelch circuit employed in Bendix FM stereo receivers can produce such symptoms as poor signal-noise ratio and continuous illumination of the stereo indicator lamp.

obtained from pin 8 of the IC and fed to the bandswitch. Demodulated AM audio goes to the other side of the bandswitch. AM or FM audio, depending on the position of the bandswitch, is fed back to the IC via pin 14. It then is amplified and routed to the volume and tone control circuits via pin 12.

Do not attempt to adjust T5 without first consulting the appropriate service manual. Because of its direct effect on the AFC correction voltage, this coil can, and does, cause a relatively large and sudden shift in FM oscillator frequency whenever it is adjusted incorrectly.

DC troubleshooting in either of these IC circuits is best performed with a high-impedance meter. To avoid damaging a good IC, the

input of the meter should have an impedance in excess of 10 megohms.

AC analysis should be performed with a high-gain oscilloscope. If the gain of your scope decreases 3 dB or more at a frequency appreciably less than 10.7 MHz, use a demodulator probe with it.

Recent statements in several trade magazine articles (not in ES) might lead the unwary to be less than careful when working around ICs. Several of these articles have claimed that almost no combination of short circuits, whether by tools or a solder bridge, can cause damage to an IC. A similar statement appears in a Howard W. Sams book titled "RTL Cookbook", by Donald E. Lancaster. Mr. Lancaster, however, specifically warns his readers

that this information applies only to digital ICs of the RTL type (such as used in computers, etc.).

A linear IC circuit, such as those used in consumer electronics products, can be destroyed almost instantaneously by such shorts. Consequently, always keep a firm and steady hand on all tools and probes used around ICs. Also, when replacing a defective IC, before applying power to the set be sure that there are no solder shorts on the board. The proper soldering tools for IC work are pencil-type irons in the 40- or 50-watt class. Even with these, however, do not stay on any one pin too long. Allow a 2-3 second cooling off period between soldering of adjacent pins. With a little care, these components are easy to replace as other solid-state devices.

Tracking sensitivity in any FM receiver is critical; especially in fringe areas. Consequently, a good check of overall operating conditions can be made by running a sensitivity test, using the sensitivity figures published by the manufacturer. This test does, however, require a good-quality signal generator with extremely low leakage and linear FM modulation. It should be capable of being modulated to a frequency deviation of 22.5 KHz by a 400-Hz sine-wave tone. Peak the oscillator on this Bendix set for maximum output at 108.5 MHz. Peak the RF and antenna trimmers at approximately 98 MHz. To measure the tracking sensitivity, set both the radio and the generator to the same frequency. Set the generator output attenuator at least 2 dB below limiting sensitivity. Note both the levels of the generator output (in microvolts) and the radio output (400 Hz signal across the speaker leads.) Do not change the setting of the volume control. Peak the RF and antenna trimmers slowly while lowering the generator output to maintain the same amplitude signal across the speaker leads. Tuner mistacking is generally measured in dB. Mathematically it is: $\text{dB} = 20 \log E_1/E_2$. E_1 is the initial setting of the generator (in microvolts); E_2 is the generator setting after the tuned circuits are adjusted. Most electronics reference data books in-

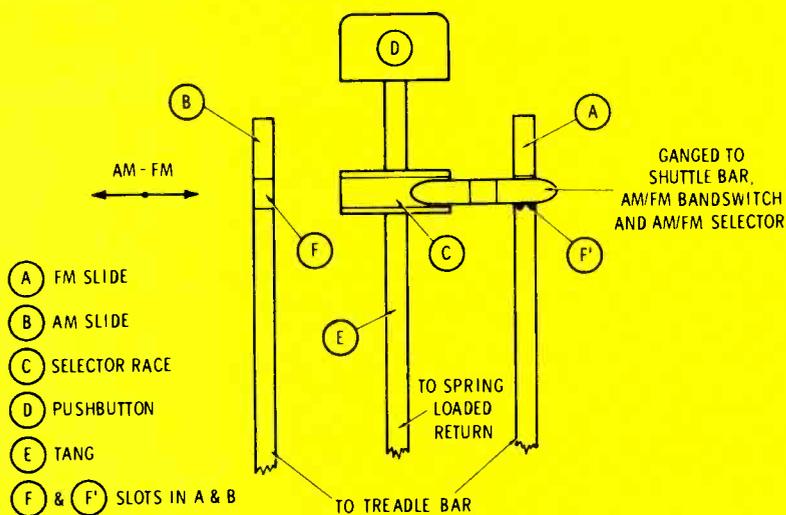


Fig. 9 Five-pushbutton, ten-slide station selector system used in 1971 Bendix AM/FM receivers gives the same station-selecting capability as a receiver equipped with five AM and five FM pushbuttons. See text for troubles and related causes that could show up in this design.

clude a chart of dB equivalents for various voltage ratios, if you want to avoid arithmetic.

Fig. 8 shows the new noise squelch circuit used in Bendix FM stereo receivers. The function of this circuit is to suppress interstation and weak-signal noise before they get into the output circuit. This improves the signal-noise ratio. Noise signals from the frequency doubler stage are coupled into the base circuit of the squelch transistor via C1 and C2. The pulses are amplified by the transistor and passed on to the diode network consisting of D1 and D2. At this point they are rectified and used to bias the 38-KHz amplifier to cutoff. When a strong stereo signal is present, the 38-KHz signal from the doubler will be passed to the amplifier by the .005-mfd coupling capacitor shown in Fig. 8B. The low reactance of capacitor C2 prevents the squelch transistor from being triggered by a stereo signal.

Any defect of the semiconductors in the squelch circuit will cause several symptoms. One interesting symptom is that the stereo lamp will remain on between stations. It

will, however, get dimmer and dimmer as the amplitude of the FM input signal increases. It will extinguish altogether on strong monaural signals. Another symptom will be a very poor signal-noise ratio. The peculiar thing about such a defect is that it will not significantly affect the FM stereo measurements (19 and 38 KHz, etc.)

When a set exhibits little or no stereo separation and/or excessive distortion on stereo stations, the trouble often can be isolated by grounding point X in Fig. 8A. This will eliminate the squelch circuit as a possible cause of the problem. If this action clears up the problem, make a more careful check of the squelch circuit components. Grounding of the junction of C1 and C2 is called for in cases of poor noise suppression. If the defect is in another section of the receiver, this will not affect the trouble symptom.

Ten-Slide Tuners

In past years, any AM-FM pushbutton radio had the pushbuttons divided between AM and FM. A particular radio might have two

pushbuttons for AM and three for FM. A couple of years ago, however, Bendix introduced a five-pushbutton, ten-slide system that gives the radio the same capability as a set that has five AM and five FM pushbuttons. Fig. 9 shows the system used by Bendix. One pushbutton tang is used to operate two different slides. On FM, the pushbutton operates slide "A". Slide "B" is used when the bandswitch is shifted to AM.

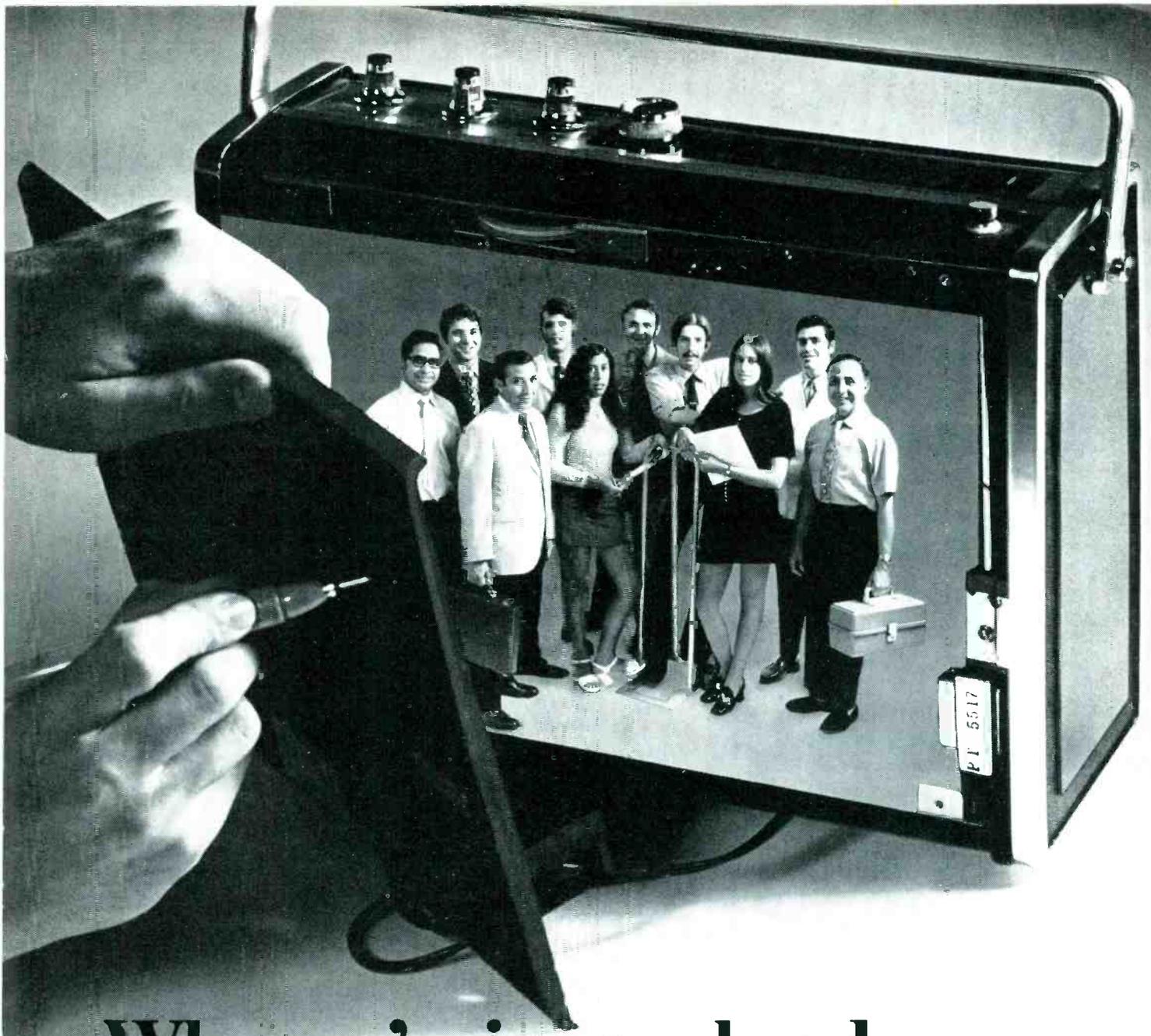
On earlier sets, the selector race (C) was made of plastic and frequently broke. A typical complaint resulting from the malfunction was that neither the pushbuttons nor the bandswitch would operate. Another common symptom of this trouble is no manual tuning. This is because the manual tuning shaft is ganged to the pushbuttons via a clutch mechanism. The manual shaft is disconnected whenever a pushbutton is depressed.

Another mechanism used on the newer sets is the shuttle bar. This is the piece that is connected to both the bandswitch and the bandswitch operating bar. It has five slots, to operate the five selectors indicated by (C) in Fig. 9. If the bandswitch feels rough, check the shuttle bar for signs of bending or warping. It should be replaced rather than straightened.

Although there are some specific differences, the Delco ten-slide tuner basically is similar to the Bendix tuner. Do **not** bend any of the parts in either type of tuner. The alignment of most parts is critical and must not be tampered with, except as directed by the service manual or any subsequent service notes. On the older five-slide systems, we often made minor repairs by bending or straightening out-of-true parts. On a ten-slide system, however, this almost always leads to trouble.

Summary

The changes and additions described in the preceding paragraphs are the ones we feel most significantly affect servicing procedures. There are other changes, but, in my opinion, they are minor and do not require changes in servicing techniques. ▲



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bookreview

TV Servicing Made Easy

(Book No. 20811)

Author: Wayne Lemons

Publisher: Howard W. Sams & Co., Inc.

Size: 5 $\frac{3}{8}$ inches x 8 $\frac{1}{4}$ inches, 223 pages

Price: Softcover, \$5.25.

Circuit operating characteristics of and practical techniques for servicing solid-state, hybrid and tube-type color and black-and-white television, using conventional test instruments available to all electronic technicians. Written by an experienced service technician who, in addition to conducting service seminars, teaching high school vocational courses on electronics and operating his own service business, has managed to author or coauthor five other well-received books about servicing consumer electronic products.

Contents: Tuners—IF Amplifiers and Detectors—Video Amplifiers and Picture Tubes—AGC and Noise Limiters—Sync Circuits—Horizontal-Sweep and High-Voltage Circuits—Vertical Sweep Circuits—Audio Circuits—Power Supplies—Circuits Peculiar To Color-TV Sets—General Servicing Procedures and Techniques.

Radio Receiver Servicing Guide

(Book No. 20790)

Author: Robert G. Middleton
Publisher: Howard W. Sams & Co., Inc.

Size: 96 pages, 8 $\frac{3}{8}$ inches x 11 inches

Price: Softcover, \$3.95

Written primarily for professional electronic technicians, this text explains both general and specific techniques for localizing and isolating defects in solid-state and tube-type

radio receivers. Also included are practical notes about the application and use of test instruments, plus analysis of the most-frequent troubles.

Contents: General Troubleshooting and Isolating Procedures—Troubleshooting in RF and Mixer Stages—Servicing IF Amplifiers—Troubles in the Audio Section—Automatic Volume Control Troubles—Troubleshooting Power Supplies—Restoring Antique Radio Receivers.

How To Repair Solid-State Imports

(Book No. 532)

Author: Paul Lawrence

Publisher: TAB Books

Size: 8 $\frac{1}{2}$ inches x 11 inches, 160 pages of text, plus a 36-page foldout schematic section

Price: Paperbound, \$4.95; leatherette-covered, \$7.95.

A guidebook about foreign-built home entertainment electronic products which combines descriptions of how basic circuits operate; servicing procedures, with and without schematics; schematic diagrams of almost 100 of what reportedly are the most popular foreign-made home entertainment products; and an Appendix listing the importers and/or distributors of Japanese consumer electronic products, plus a list of the U.S. office of Japanese electronic manufacturers.

Contents: General Information (how the circuitry and characteristics of imported products differ from domestically built equipment, and tips about obtaining parts and service data)—Basic Circuits—Servicing Procedures—Troubleshooting Without A Schematic—Typical Circuit Diagrams—Appendix of Importers and Suppliers. ▲

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Circle 27 on literature card

Signal subbing in hybrid color

How to track down circuit defects by using substitution signals from such sources as B&K's Model 1077B TV Analyst and Sencore's Model SS137 Sweep Circuit Analyzer.

by Forest H. Belt

Half-a-dozen TV makers have produced all-solid-state color TV models for 1971. But the type of color receiver design which is used most is the hybrid—part solid-state and part vacuum tube. Of nearly 150 color chassis for 1971, at least one-half employ a significant number of solid-state circuits.

One reason for the popularity of hybrids is the cost of complete transistorization. At the present state of the art, certain stages are more economical, and perhaps more dependable, if left with tubes. This is particularly true of deflection stages. Vertical and horizontal sweep sections are invariably tube operated unless the chassis is completely solid-state. Other tube stages

in hybrid designs include video output, some audio outputs, and the color-difference amplifiers. All of these require either high voltage or high current, or both (meaning high power).

The split personality of hybrid chassis confuses some technicians. And unnecessarily. Hybrids are no harder to service than any other color designs. You just need a **method**. One of my favorites is signal substitution. It fits any chassis. It's easy, logical and unusually quick.

However, you must pay close attention to how the sections and stages are arranged, particularly in transistor-equipped sets. Otherwise, the signal you inject might fool you.

My method of signal substitution in hybrid TV receivers is demonstrated in the following paragraphs using a new Zenith 4B25C19 hybrid color chassis and a B&K Model 1077B Analyst, which supplies a test pattern to the antenna terminals of the receiver.

Vertical Deflection

In a way, the vertical deflection system is one of the easier sections for signal substitution. A block diagram of this section is shown in Fig. 1. It is part transistor, part tube. This version also has a transistor regulator which stabilizes the screen voltage of the vertical output tube.

I test an oscillator by changing it first to an amplifier. Just disconnect the feedback. One capacitor usually does the trick.

The photos in Fig. 2 show what you can expect on the screen of the receiver during testing. Fig. 2A is the screen symptom produced by the set.

First, disconnect the feedback

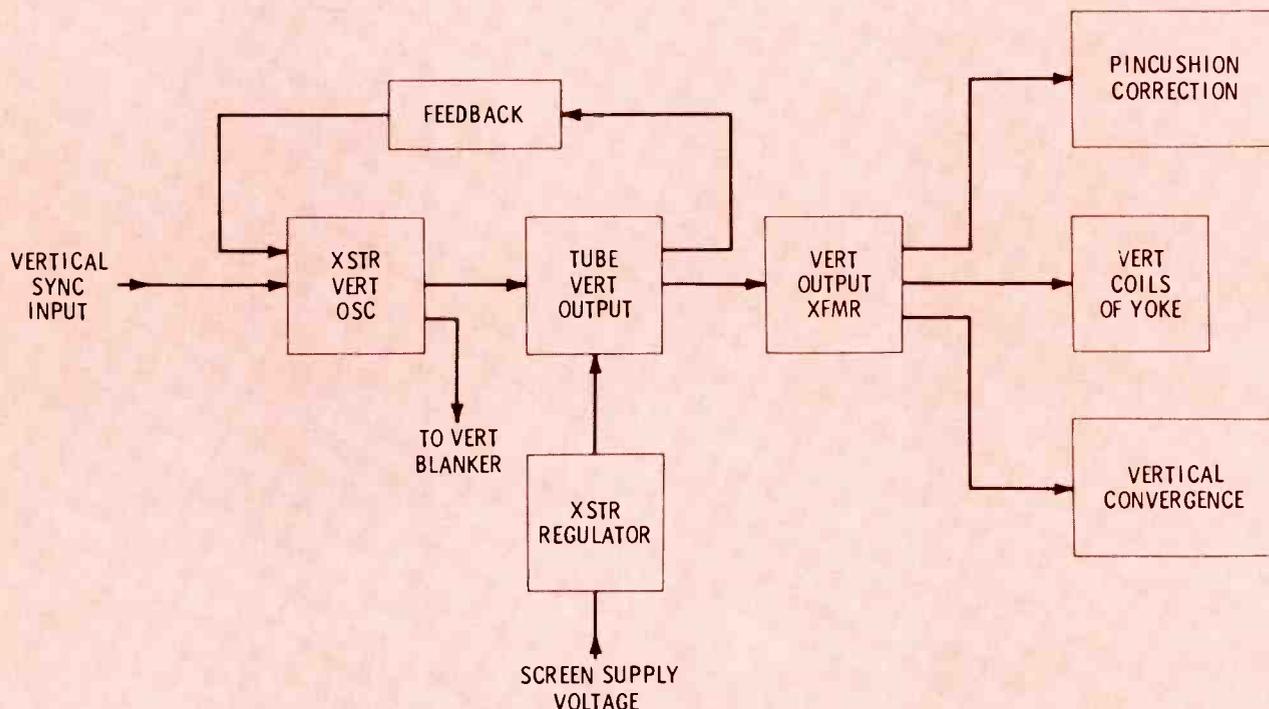


Fig. 1 Vertical sweep system in Zenith 4B25C19 hybrid chassis.

line, and then start injecting signal. The first injection point is at the amplifier plate. Fig. 2B shows the screen with a vertical-sweep test signal applied to the plate of the vertical output tube. The signal, and, consequently, the raster are nonlinear, but the screen does show that the transformer is okay. Likewise, you know that the yoke is all right, and that nothing in the pincushion or convergence circuits is killing the vertical signal.

If this signal-subbing test produces no vertical sweep, first disconnect the connections from the vertical sweep to the pincushion-stage, and then those to the convergence circuitry. The raster will return if either section was loading down the transformer.

If unloading doesn't restore sweep, disconnect the yoke and apply the vertical yoke test signal to it. If the yoke is faulty, there still will be no vertical sweep.

If feeding the test signal through the transformer and yoke produces a raster, move to the output-tube grid. The Model 1077B has a special signal for insertion at this point. Fig. 2C shows what the raster looks like if the output tube is functioning properly.

Next, move the grid-test signal back to the collector of the vertical oscillator transistor; this checks the coupling components. If they are okay, the raster should look like that in Fig. 2D.

Turn down the amplitude of the grid-test signal till the raster in Fig. 2D is only an inch or two high. Then move the test signal to the base of the transistor. If the oscillator transistor is functioning properly the raster in Fig. 2E will be produced (this stage is operating as an amplifier, you know).

By this time, you'll have isolated the trouble to a particular circuit of a specific stage. With the vertical sweep restored and operative, the pattern in Fig. 2F will be produced on the screen. (Remember, the test pattern itself is fed into the antenna terminals of the receiver.)

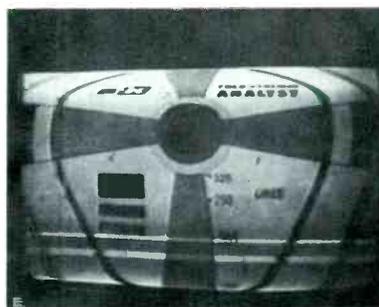
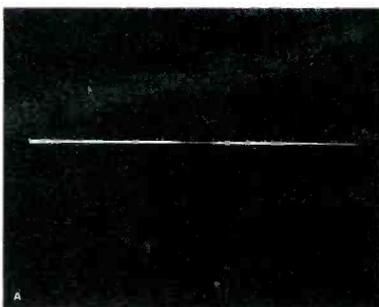


Fig. 2 Disconnect feedback and test vertical sweep section as you would cascaded amplifiers. (A) No vertical sweep. (B) Plate-drive signal checks output tube. (C) Grid-drive signal

checks output tube. (D) Grid-drive signal at the oscillator collector. (E) Reduced-amplitude grid-drive signal at base of oscillator transistor. (F) Restored pattern.

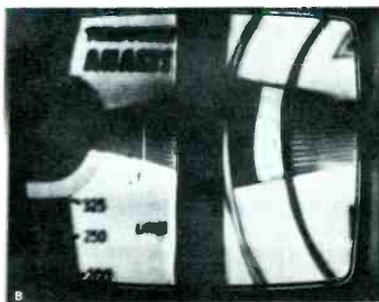
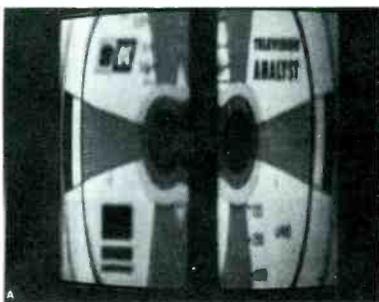


Fig. 3 Pattern may look irregular because raster lines don't lock straight, but insertion of horizontal plate-drive signal proves flyback and yoke

are functioning (A). (B) Grid-drive signal can be used all the way back to the horizontal oscillator.

Horizontal Sweep System

Signal substitution is especially valuable in the horizontal deflection system, because its various stages are so interdependent.

Suppose you have a set which

will not produce a raster. You measure no high voltage and your scope reveals no horizontal sweep.

Start by connecting the horizontal plate-drive test signal to the plate cap of the horizontal output

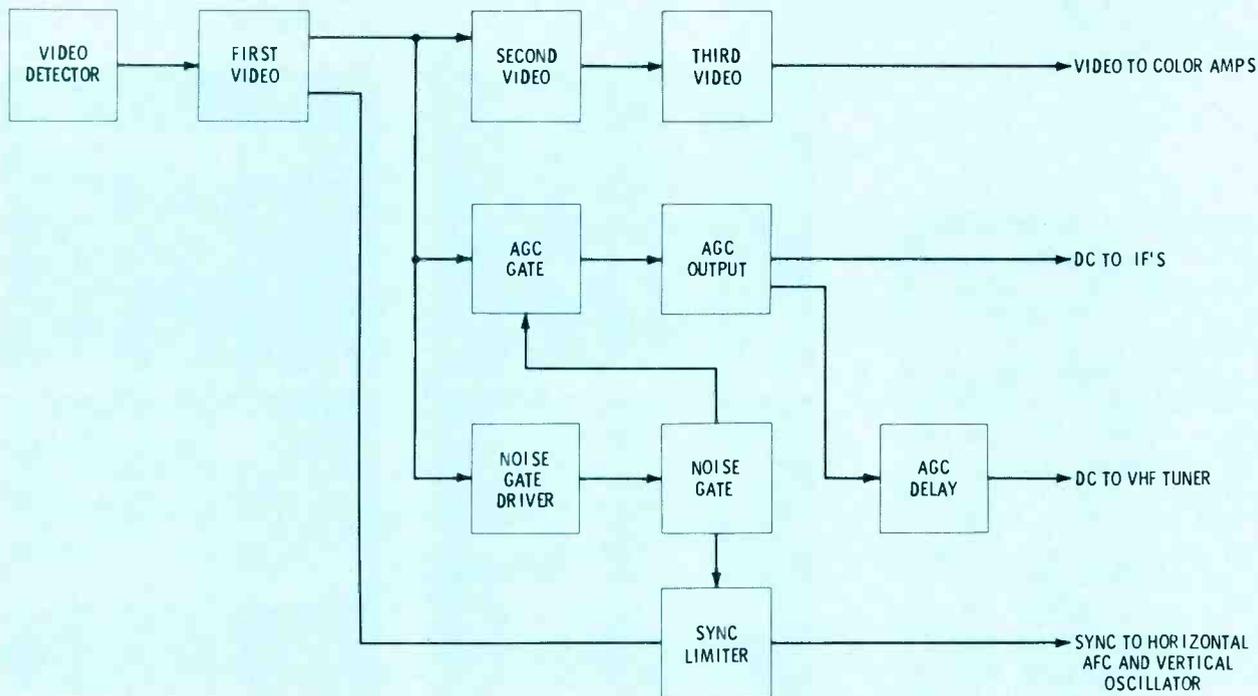


Fig. 4 Video, sync, and AGC in Zenith Hybrid chassis are taken from same stage, but different circuits. You have to know from where signals come and to where they go before you can successfully use signal-substitution.

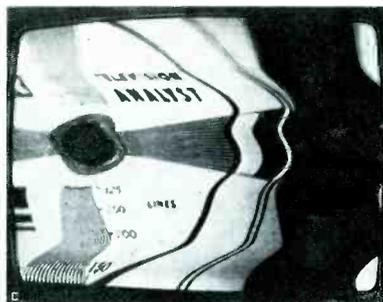
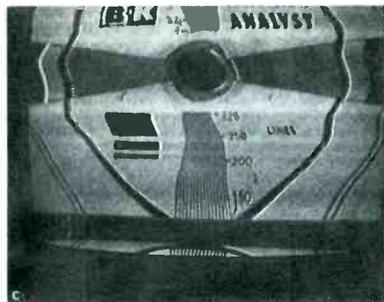
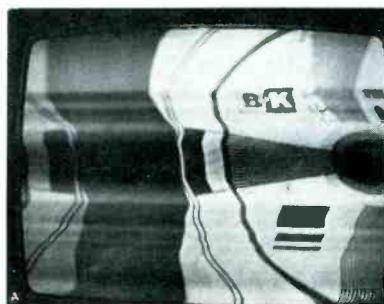


Fig. 5 (A) Pattern fed into second video amplifier (Fig. 4) can't be synchronized with hold controls of receiver. (B) Sync injected into sync stage holds picture steady, even

though it might look ragged. (C) Snow from IF overriding video signal fed into second video amplifier. (D) Wrong-polarity sync might lock pattern, but incorrectly.



Fig. 6 Lack of sync can be tracked down with substitute sync signal from video generator. (B&K Model 1077B is used to demonstrate technique.) Pattern should lock in with sync injected at any of several points.

feedline; focus adjust coil; and pulse feeds to blanking, AGC, horizontal AFC, etc.

The horizontal yoke winding can be tested separately by an inductance Q-checker built into the Model 1077B. You can also test the flyback with the same device, but the injection method I just described is adequate.

If the raster doesn't appear (or high voltage return) after the flyback is "unloaded," the flyback is faulty.

If plate drive restores the raster, move to the grid of the output tube. The raster produced by injecting the grid-drive signal might look like

tube (just lift it off the top of the tube and clip the test lead to the cap lead). If the flyback transformer is okay, and isn't loaded down by some defective circuit connected to it, the raster should return. If it doesn't, unload the flyback by dis-

connecting each auxiliary circuit, one at a time. These include, in most color chassis: the high voltage; a pulse regulator that feeds a diode or voltage-dependent resistor (VDR); pincushion circuits; convergence circuits; the boost-voltage

the pattern in Fig. 3A. It's an odd pattern, but it proves the output stage and flyback are functioning.

If there's a discharge stage in the horizontal section, move the grid-drive signal to its grid. Fig. 3B or some similar pattern should result.

Likewise, you can disable the feedback in the horizontal oscillator and apply the signal to the tube grid there.

Suppose the trouble is only an off-frequency oscillator. You can use a variable DC voltage to check control-tube or oscillator operation. If the horizontal AFC circuit seems to be the culprit, substitute a keying pulse and horizontal sync from the generator. If both don't restore control, the AFC circuit must be bad.

Sync, Video, and AGC Circuits

In hybrid chassis, substitution in these stages can be a bit tricky because of the manner in which the signals are split up. You might substitute a video signal, expecting to see a pattern on the picture tube, only to find whatever appears is very unsteady and not viewable. When you investigate, you find the sync takeoff is prior to your injection point; consequently, the sync stages have nothing on which to lock.

This Zenith chassis is a good example of the interconnections of

sync, video, and AGC in hybrid chassis. They're shown in block form in Fig. 4. The important thing to notice is the different signal takeoff points.

For example, the video for AGC, noise inversion, and for the 2nd video amplifier are all taken from the 1st video amplifier. Video for sync separation also is taken from the 1st video amplifier, but from a different part of the stage; the sync feed is from the collector, while the other supply signals are taken from the emitter circuit. Consequently, if you inject "raw" video from the analyst anywhere after the first video stage, no signal will be fed to the sync stage. The pattern in Fig. 5A is the result produced when video is injected after the sync takeoff point. The pattern next to it, in Fig. 5B, is with sync from the Analyst injected at the input to the sync limiter. The pattern is crooked but steady.

The pattern in Fig. 5B also illustrates one other point about substituting video and sync signals in different brands and models: Time constants in the circuits might cause the line-by-line sync to be irregular, as in Fig. 5B, but remember you are testing for stage and circuit action. Regardless of the irregular circle, the pattern proves the video stages are okay from the point of injection to the picture tube. You

needn't worry about exact shape in this case.

A couple of other points about video signal subbing: If you don't bias the IF section off, you might see snow along with the video pattern, as in Fig. 5C. Also, if you don't feed in the correct polarity of sync it might lock the pattern in the manner shown in Fig. 5D.

Finally, remember that the video output of the generator used in these examples is only about 10 volts PP, which is not enough to drive video or color-difference output stages. As a result, you might see only a very light gray pattern or none at all. The best procedure is to inject the video signal at the detector output and trace it with your scope stage by stage to the CRT cathodes.

Suppose the substitution signal is fed into the antenna terminals, but the pattern won't sync. It floats wildly, as in Fig. 6. To check out the sync, apply a substitute signal at the output of the sync limiter. If this locks the signal, try it at the input. If it works there, move back to the sync takeoff point in the video section. You'll eventually find a point where the substitution signal will not lock the picture. That isolates the point where the sync path is interrupted.

You can use the same technique with AGC faults. Fig. 7A shows

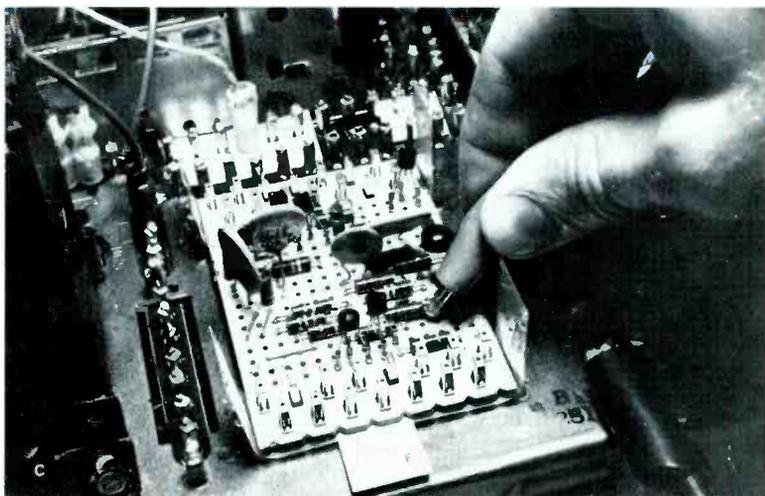
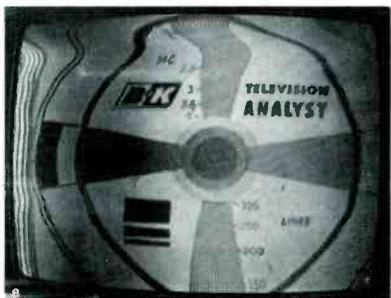


Fig. 7 (A) AGC not working right. (B) Substitute keying pulse clears up AGC fault, though it does not keep pattern exactly straight. (C) Injection point for substitute AGC keying pulse.

one AGC trouble symptom. First, clamp the AGC line with a DC voltage. If this clears up the pattern (you might have to clamp both IF and tuner AGC lines), hunt for defects in the AGC stage.

Next, remove the AGC clamp. Substitute the keying pulse going to the AGC station. Inject it at the collector diode of the AGC keying transistor. If this clears up the symptoms, move on back toward the flyback winding that supplies the keying pulse.

Fig. 7B shows the screen pat-

tern produced with the keying pulse subbed in. The pattern is crooked, but the AGC problem is cleared up. The AGC system in this Zenith chassis is on a plug-in Duramodule board. Fig. 7C shows the injection point.

If substituting a keying pulse doesn't clear up the fault, substitute a video signal at each point from the AGC takeoff at the first video amplifier to the AGC gate stage. If this doesn't eliminate the trouble symptom, the AGC stages themselves are at fault.

A caution: The noise gate stages affect both AGC and sync. Even if you clear up the action of one of these functions you'll probably not know it because the other will still produce the same or similar symptoms. If really odd symptoms seem to defy ordinary substitution procedures, suspect the noise gate system. Check its transistors and diodes.

An IC Chroma System

This Zenith hybrid chassis, and a "companion" all-solid-state chas-

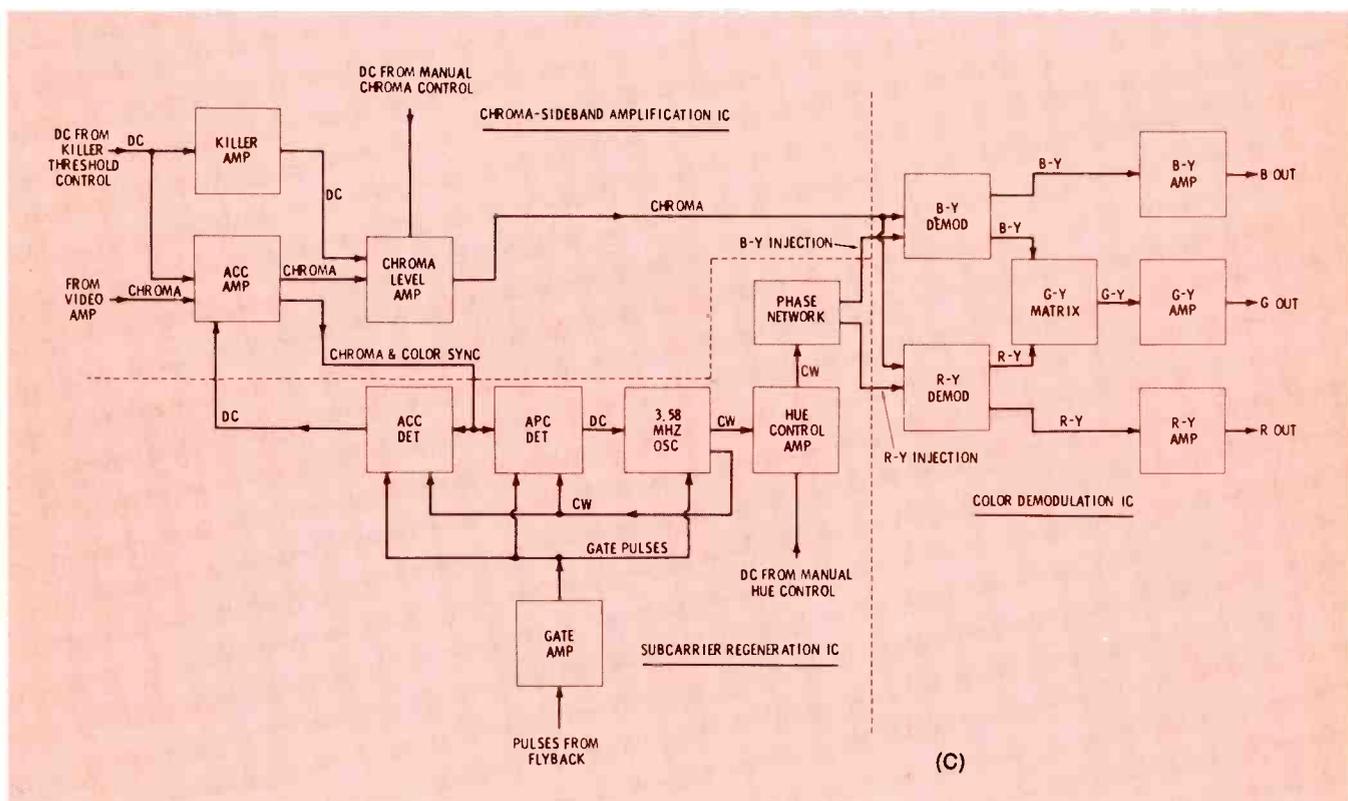
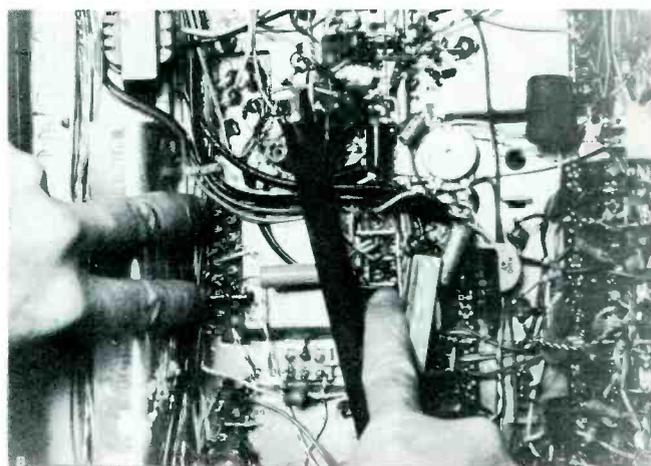


Fig. 8 Complete Zenith chroma processing system is contained on three IC's. (A) Two of the IC's are shown here on their plug-in Duramodule printed board. (B) Underchassis connections for Duramodules are easy to get at. (C) Block diagram of complete three-IC chroma system.

sis, having something unique among color sets for 1971. The whole chroma system is on three integrated-circuit chips.

The system is divided roughly into three major functions: chroma-sideband amplification and control; subcarrier regeneration and synchronization; and color demodulation. One IC performs each function. Two of the integrated circuits are shown on their Duramodule board in Fig. 8A. The underchassis connections are shown in Fig. 8B. Fig. 8C is a block diagram of the system.

The substitute signal for any chroma section is a keyed rainbow. Fig. 9 shows the bar colors labeled in sequence. The bars and the lettering come from a positive slide inserted in the Model 1077B. You inject this video signal at the output of the video detector, so that it is fed to both the video and sync stages. No color will be produced until you also inject the color signal (an unkeyed rainbow) from the Analyst at the input to the chroma Duramodule. If the hue control of the receiver is set correctly, the colors should be positioned exactly as indicated in Fig. 9A.

If some colors are in the right place but others are not, the demodulators are at fault. If you have to run the color level control wide open, amplification is weak. If the colors float around or are positioned diagonally across the screen (Fig. 9B), the 3.58-MHz oscillator isn't locking into phase.

You can inject the color signal from the Analyst anywhere in the chroma sidebands section. At any point, the screen should show color overlaying the video bar pattern. The place to start is at the output of the chroma level amplifier, where chroma sidebands are fed to the demodulators. As with substitution of signals in other stages, the pattern might not be precise at these interim points, but you should see color. It might be faded at one edge, but the color should be there, with one exception: If the subcarrier regenerator IC is faulty, there will be no color output from the demodulators, even though chroma signal is fed directly into them. You can check with a scope to see if there is R-Y or B-Y injection from

the 3.58-MHz oscillator. If either or both subcarrier injection signals are missing, the IC or an associated component is faulty. Just remember that the subcarrier regenerator IC not only generates 3.58-MHz CW signal for the demodulators but also synchronizes it with the incoming color signal (automatic phase control, or APC).

Subbing Other Signals

You can inject sound IF (4.5 MHz), complete with a 1-kHz audio signal modulated on it directly at the sound takeoff point. You also can inject the 1-kHz signal alone into the audio amplifier and output stages.

You can inject IF signals, once you gain access to the IF printed board; it's usually shielded. In this Zenith hybrid, the main access points are atop the printed board, beneath a shield. Be careful when making connections; to avoid creating a short which would damage a transistor, don't touch more than one point.

The video generator in the An-

alyst also produces convergence video patterns. They're positive on slides which you insert into the unit. Figs. 10A and 10B show the dot and crosshatch patterns used for convergence. The signal is fed in on RF via the antenna terminals.

A blank signal — with video turned down at the generator—is handy for checking purity. It keeps snow out of the picture without having to turn down the contrast control or block the IF's with the AGC control.

An extra feature has been added to the Model 1077B Analyst (all recent models have it). There's a special waveshaping network and output jack for the signal needed to drive solid-state horizontal sweep systems. This is handy when you get into the new all-solid-state chassis. Keep your eye open for a future article on how to substitute signals in solid-state horizontal deflection systems—including the unique silicon-controlled rectifier (SCR) deflection used in RCA CTC40 and CTC44 solid-state color chassis. ▲

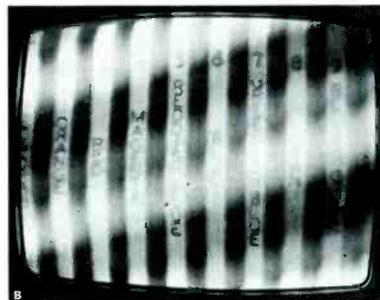


Fig. 9 (A) Video pattern showing correct sequence of colors when rainbow signal is superimposed by color signal fed into chroma section. **(B)** Rainbow signal out of color sync might float sideways or break over into diagonal stripes, either moving or still.

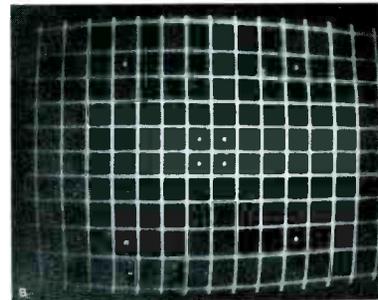
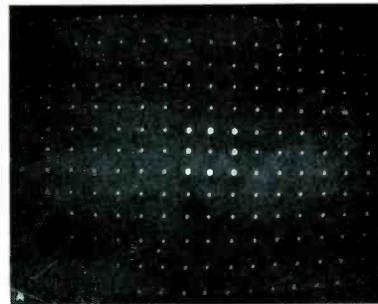


Fig. 10 Convergence signals can be injected into antenna terminals, just as with any color-bar convergence generator. **(A)** Dots. **(B)** Crosshatch.

Techniques For Troubleshooting AGC Defects

AGC problems still cause lost time and frustration, according to letters we receive. Consequently, in the following paragraphs we will discuss some important, but often overlooked, facts and tips about AGC troubles and their diagnosis.

Quantity and Quality Analysis of The Video Detector Signal is Essential

All of the circuits shown in the block diagram of Fig. 1 are required to provide at the video detector an undistorted video signal of the desired waveform, phase, amplitude, bandwidth and signal-to-noise ratio. The best system of tests for AGC trouble **must** include this vital detector signal.

One Test Is Not Sufficient

A few weeks ago I read a book in which the author recommended that the AGC voltages to the RF and IF amplifiers **always** be clamped (substituted with voltages from an external bias supply) when any AGC defect was suspected. Clamping is an excellent test in many cases, but not always. What of the many times when more than one defect exists? For example, if the video amplifier (from whose plate circuit the signal for the grid of the AGC keyer tube is obtained) is inoperative, clamping the AGC voltages will bring back the correct signal to the video detector, but no picture will be produced on the screen of the CRT.

Or suppose the last video IF stage is excessively noisy or oscillating, and the DC detector voltage and both RF and IF AGC voltages abnormally high. Clamping the AGC voltages will not bring the signal back to either the video detector or the screen of the CRT, nor will it reduce the excessively high detector voltage.

Older tube-equipped TV receivers invariably supply negative AGC voltages to RF and IF stages. Clamping is an easy and fast testing method in such chassis. However, what do you do with a receiver that normally operates the grid of the first picture IF tube at about +5 volts (relative to ground) on a strong signal? Worse yet, what bias do you apply to a first video IF **transistor**? The schematic indicates the DC voltage that is average for operation **without** signal. Does the circuit normally increase or decrease the forward bias to accomplish gain reduction? Clamping methods are fine sometimes, but they rate only kindergarten level in the school of hard knocks.

One Helpful Method

The best method I know for analyzing AGC problems was detailed starting on page 42 of the January, 1970 issue of *ELECTRONIC SERVICING*. Briefly stated, this method consists of measuring, while a station is tuned in, the DC voltages at three of the test-points shown in Fig. 1. These are:

- TP-1, the video detector signal;
- TP-2, the AGC voltage to the IF's;
- TP-3, the AGC voltage to the RF tube.

Logical analysis of these three voltages, plus visual symptoms from the screen of the CRT, usually will indicate in which general area the defect lurks. Occasionally, it is helpful to check the voltages and/or signal at one or two other testpoints with a VTVM or scope.

AGC Is Part Of A Closed Loop

Any defect in a closed-loop system affects voltages and other conditions in all other parts of the system.

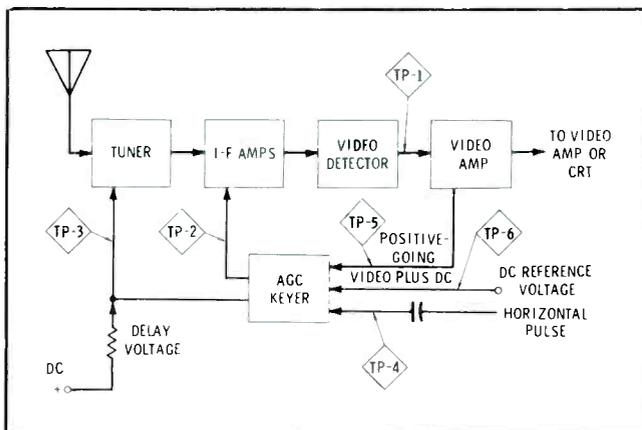


Fig. 1 Block diagram showing the closed loop of a typical AGC system used in an all-tube chassis.

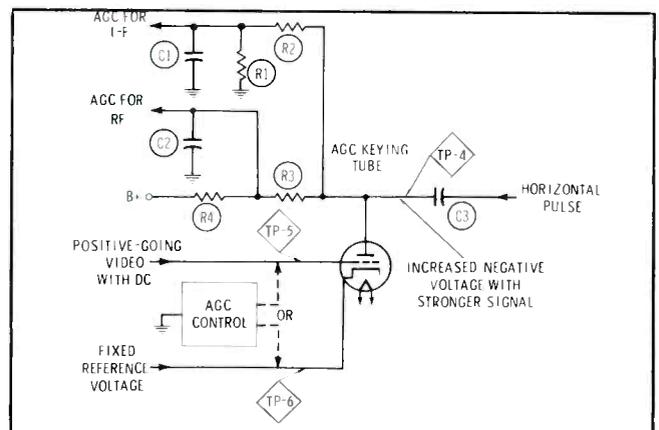


Fig. 2 Simplified schematic of a typical AGC keyer circuit.

We can turn this disadvantage into an asset by correctly analyzing the DC voltages inside the loop.

Basic AGC action calls for any increase in detector signal to increase the AGC voltage, which, in turn, reduces the signal at the video detector. Consequently, if one voltage is high, the other probably is too low, and vice-versa.

Two nearly separate paths exist for the AGC voltages applied to the RF and IF stages. Both voltages originate at the plate of the AGC keying tube; then they separate, as shown in Fig. 2. The reason why this is good engineering will be discussed later. The important point is that the existence of two AGC voltages helps us more closely pinpoint the origin of the defect. For example, if a defect reduces the AGC voltage applied to the IF section, the AGC circuit will increase the DC voltage at the plate of the keyer tube, which in turn, increases the AGC voltage supplied to the RF amplifier. Conversely, a defect which increases the voltage applied to the RF amplifier AGC circuit, automatically will reduce the AGC voltage which is applied to the IF amplifier. It works both ways. In either case, overload might be avoided, but an abnormal condition is established whose result is a poor signal-to-noise ratio (snow).

If the RF and IF AGC voltages both are too high or too low, the defect probably is in the keyer, or in the voltages applied to the keyer.

Analyze The Voltages

An all-tube color TV receiver has no raster or picture, although sufficient levels of high voltage, focus voltage and screen voltage are applied to the CRT. Noisy sound can be heard. The DC voltage at TP-1 is high, about -12 ; TP-2 voltage is low at -4 ; and TP-3 measures $+8$ volts. Analysis: 1) The tuner and IF's have good gain, as evidenced by the excessively high detector voltage; and 2) both AGC control voltages are too low. Conclusion: Total loss of AGC, probably at the keyer tube. The slight negative voltage measured at the IF AGC undoubtedly is produced by grid rectification of the excessively large signal at the grid of the first IF tube. If the antenna is removed and an unused channel selected, normal snow should be seen. Clamping the AGC also will work in this case; however, it would only prove what is already known.

Positive AGC Voltage To RF Tube

Tubes must have negative grid bias; everyone knows that. Then how can the RF tubes operate correctly during weak signal reception, when the AGC voltage supplied to them is positive? The answer to that ques-

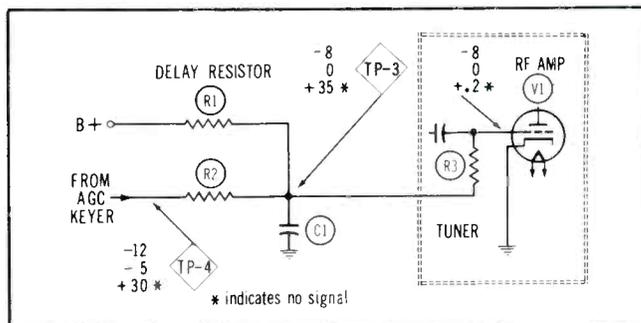


Fig. 3 Diode action of the grid and cathode in the RF amplifier prevents the grid bias from becoming positive.

tion is evident in Fig. 3. The grid and cathode of the RF amplifier tube effectively function as a diode, clipping off (by conduction) any positive voltage. The high value resistors between the RF grid and the plate of the AGC keyer provide good clipping with minimum grid current. DC voltages at the grid do not exceed a few tenths of a volt.

Why should the AGC voltage to the RF tube be positive? This is one way the design engineers have of reducing snow in the picture. It's called "voltage delay". Signals which are low enough in amplitude that they will not overload the mixer stage in the tuner would only have snow added to them if the gain of the RF tube were reduced by AGC. Therefore, the first gain reduction (as the signal is increased from zero level) is accomplished in the IF's. At a certain signal level, overload of the mixer tube occurs, even though the AGC applied to the IF can prevent overload of the IF. Consequently, RF AGC action must start just prior to this signal level.

Fig. 4 shows the RF and IF AGC voltages as the signal strength is progressively increased. The voltage delay resistor effectively moves the RF AGC voltage curve of the graph to the right, and the diode action of the RF amplifier tube prevents the voltage at the grid from rising above a few tenths of a volt positive.

To summarize AGC symptoms when the receiver is operated on strong signals: Mixer overload occurs if the RF gain is not reduced sufficiently. Excessive snow is seen if the RF gain is reduced too much. The value

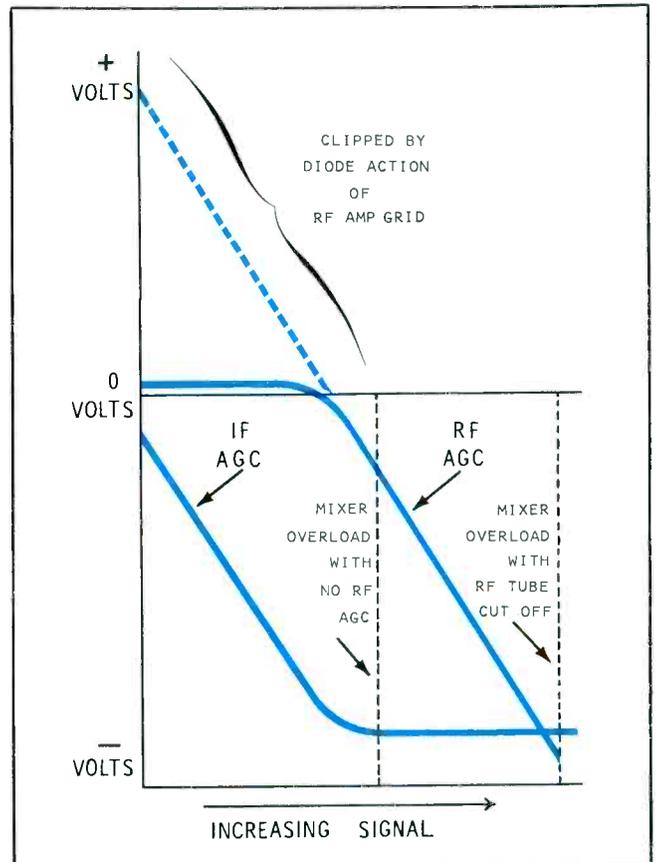


Fig. 4 RF and IF AGC voltages produced by different signal levels. The curve of the RF voltages is effectively moved to the right by addition of delay voltage; the positive part of the curve is clipped by the diode action of the RF tube.

of the voltage delay resistor is critical for best receiver performance.

Positive AGC Voltage To The IF

Positive voltage AGC (relative to ground) is found in many models of color receivers. Of course, the cathode is more positive than the grid, because of the large cathode resistor (R46 in Fig. 5), therefore the tube always has negative bias. R40 is the voltage delay resistor. In this instance, the positive delay voltage is applied to both IF and RF AGC, but is cancelled in the IF AGC by the large cathode voltage.

Two tests work well in finding the true bias for use in troubleshooting by the voltage analysis method. Direct reading of the bias is obtained by connecting a VTVM or FET meter between cathode of V1 and point A. The voltage at point A should always be negative relative to the cathode. Or, separate readings can be taken from point A to ground and cathode to ground and then the cathode voltage is subtracted from the grid voltage (point A). For example, the grid voltage is +24 with no signal. Subtract the cathode reading of +27 and the bias is -3 volts.

Correct The Positive Voltages, Then Use Voltage Analysis

AGC analysis using the voltage from three test-points can be done just as easily as though all three were negative, if we use these corrections:

- Use the true grid-cathode voltage in IF circuits that measure positive to ground.
- Count a positive voltage at the tuner AGC as zero, count zero as zero, and read a negative voltage without any change.
- Video detector DC voltages, which are floated above ground by cathode voltages or the forward bias voltage for a transistor, must be measured across the video detector load resistor.

Troubleshooting The AGC Keyer Circuit

Let's assume you have analyzed the trouble symp-

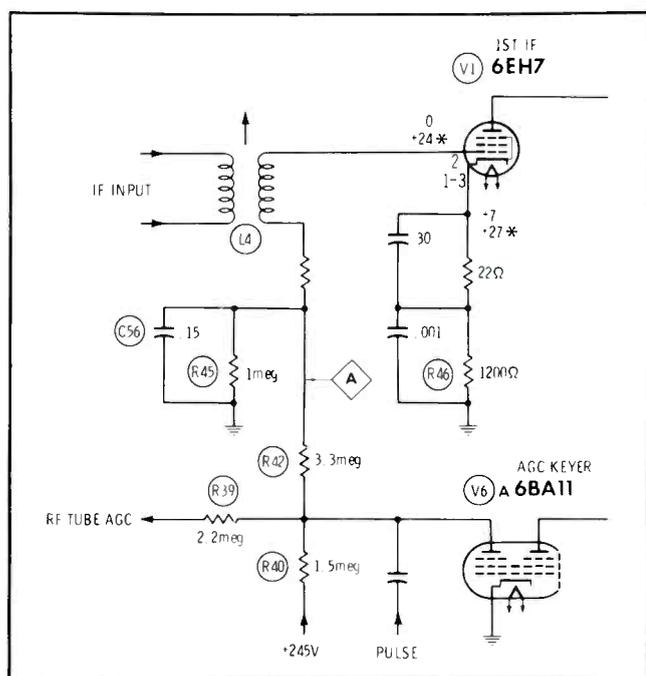


Fig. 5 The AGC voltage to the IF amplifier tube often measures positive relative to ground. True tube bias is measured between the cathode and the grid return at point A.

toms and the DC voltages present at TP-1, TP-2 and TP-3 (Fig. 1). Total failure of the AGC keyer in Fig. 2 is indicated.

Negative voltage is generated by the diode action of the plate and cathode in the keyer tube rectifying (shunt type rectifier circuit) the horizontal pulse present at the plate. A review of "Rectifier Circuits ..." starting on page 56 of the September, 1970 ELECTRONIC SERVICING might be helpful at this point.

Negative bias (grid-cathode voltage) of the keying tube causes an increase in the resistance of the plate-cathode current path. Increasing the negative bias gives precisely the same effect as increasing the value of a variable resistor in series with the plate. More bias results in less negative voltage being developed at the plate.

A fast test for the ability of the keyer circuit to produce more negative voltage than is usually needed, is just to connect the grid and the cathode together, thus giving zero bias. This test applies to triode tubes or single pentodes; special instructions for using the test with 6BA11- and 6BU8-type tubes will be given next month.

Between -30 and -200 volts should be measured at the AGC keyer plate, depending on the exact model of receiver. This is proof a horizontal pulse is at the plate, and the ability of the tube and circuit to rectify, if the grid-cathode voltage is correct.

Notice in Fig. 2 that the grid has video signal with DC and the cathode has DC without video (in most cases). The instantaneous tube bias depends upon the difference in DC voltage of grid and cathode plus the peak voltage of the video.

Lack of enough negative voltage at the plate (with resulting signal overload) is just as often caused by excessive voltage on the cathode as by too low a voltage on the grid (voltage usually obtained from a video stage).

In the opposite condition, too much negative voltage at the plate (resulting in a "white out", or no signal) is more often caused by too low a positive voltage on the cathode than by too high a positive voltage on the grid.

Measure both grid and cathode voltages. I can't emphasize this point too strongly.

Know What The Schematic Voltages Mean

The manufacturers of home entertainment products know that the signal levels where TV receivers are operated will vary greatly according to the locations and antenna systems used. Therefore, they list on their schematics the only signal condition that can be duplicated anywhere: No signal. This leaves you to guess at what voltages to expect with a signal. My belief is that any hint of the voltages expected with a strong signal would be of immense help. More complex solid-state circuits make this information imperative, for a transistor can have its gain reduced by either increasing or decreasing the forward bias from the voltage which gives maximum gain.

Next Month

Next, we will discuss AGC circuits which use the 6BU8- and 6BA11-type tubes that combine AGC keying with sync separation and noise inversion cancelling. We'll also discuss solid-stage AGC troubleshooting. ▲

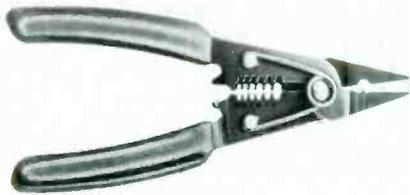
productreport

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

Combination Tool

A combination tool that is a wire cutter, stripper, terminal crimper and wiring plier combined has been introduced by Techni-Tool, Inc.

The Plike #55 is cushioned for



hand comfort. The stripper function of the unit reportedly accommodates solid wire from 14 to 24 AWG.

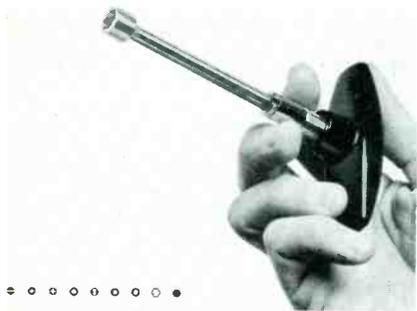
The terminal crimper handles all standard solderless connectors, and is priced at \$2.75.

Circle 80 on literature card

Ratchet Handles

Two new handles which will accommodate more than 60 individually available nutdriver, screwdriver and special-purpose snap-in blades are the latest additions to the Xcelite Series "99" line.

The ratchet mechanism reportedly



is fully enclosed to keep out dirt and grit.

Regular (Model 99-1R) and Tee type (Model 99-4R) ratchet handles sell for "about \$4.95".

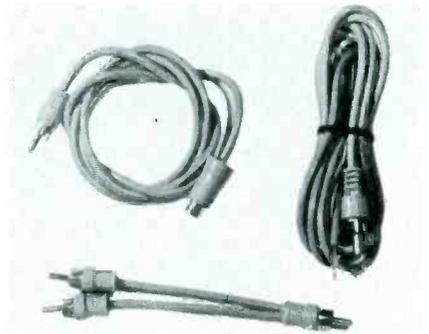
Circle 81 on literature card

"Y" Jumper Cables and Plugs

The Weltron Company has made available a series of "Y" jumper cables, Models 44-339, 40, and 41.

The cables have molded ends and, according to the manufacturer, come in variable configurations for ease of adaptation. The "Y" jumper cables sell for \$1.15.

Also available are RCA type open-end plugs with tinned ends, Model 44-435, in 72-inch lengths, and RCA type one-end plug with female-in-jack at the other end,



Models 44-364 (36 inch length) and 44-367 (72 inch length.) These plugs sell for \$.99.

Circle 82 on literature card

Citizens Band Scanner

A new 23-channel Citizens Band scanner that permits visual identification of all channels in use has been announced by Commander Electronics.

Designated Scanalyzer 23, Model 779, the unit reportedly also can be used to determine the signal strengths of all 23 channels by use of its adjustable sensitivity control.

Scanalyzer 23 visually indicates each channel having carrier activity exceeding the pre-selected sensitivity level. Response time of individual channel indicators reportedly is less than 10 milliseconds. The manufacturer states that sensitivity is better than .5 microvolt, with selectivity rated at -80 dB at ± 10 KHz. The sensitivity adjustment permits the RF sensitivity to be adjusted over a range of from .5 uV to 100 uV.



The Scanalyzer 23 is priced at \$149.95.

Circle 83 on literature card

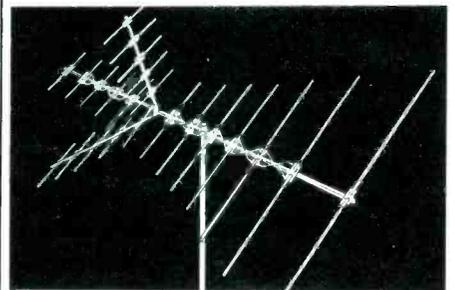
UHF Monitor Receiver

A new scanning type monitor receiver, which offers 8 UHF channels and features both automatic search and manual push-button selection, has been introduced by Petersen Electronics, Inc.

Model 808 reportedly has a selectivity of 30 KHz and 6 dB and a frequency range of 450-470 MHz, in a 10 MHz spread.

Housed in a cyclac case, with mounting brackets for mobile use, Model 808 can operate on either 110 volts AC or 12-14 volts DC, according to the manufacturer. The

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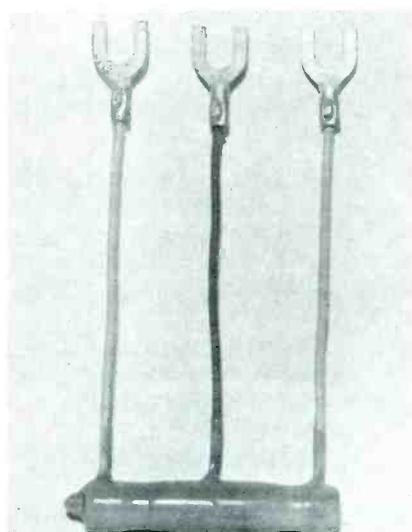


unit is 2 $\frac{7}{8}$ inches x 6 $\frac{3}{4}$ inches x 8 inches, weighs 4 $\frac{1}{2}$ pounds, and is priced at \$149.95.

Circle 84 on literature card

Electrode Gas Arresters

A three-electrode gas arrester, Model 316, which reportedly offers total protection against both longitudinal and metallic voltage surges



has been announced by Telecommunications Industries, Inc.

To prevent damage to sensitive equipment and solid-state networks, a surge on one line ionizes the rare gas in the common chamber,

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grounding the other lines.

TII Model 316 is reportedly easy to install in carbon block fuse and fuseless protectors, ready access enclosures, pedestals, repeater huts, buffer protectors and equipment terminals.

TII Model 316 sells for \$4.97.

Circle 85 on literature card

Solid-State Inverter

A new solid-state inverter for the operation of 117-volt 60-Hz AC equipment from 12-volt DC storage battery power is available from ATR Electronics, Inc.



Model 12U-S6M has an output capacitance of 600 watts continuous and 650 watts intermittent while maintaining frequency at 60 Hz with varying load or input voltage.

This inverter, which is filtered and comes complete with battery cables, is priced at \$249.75.

Circle 86 on literature card

CB Modulation Indicator

A modulation indicator designed for monitoring microphone output signals in CB systems has been developed by The Turner Company.

The solid-state indicator, called "Mod 1", reportedly allows a CB operator to instantly determine, and correct, output modulation. The manufacturer reports an operator no longer has to depend upon incoming reports to determine what kind of signal he is transmitting.

The unit operates on a standard 9-volt battery and is compatible with all CB sets. "Mod 1" measures 7 $\frac{1}{2}$ inches long x 3 $\frac{1}{8}$ inches high x 4 inches deep, and sells for \$39.50. ▲

Circle 87 on literature card

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ANTENNAS

100. *Jerrold Electronics Corp.*—has released a 56-page full line general distributor catalog which includes a guide to MATV systems and nearly 300 Jerrold products. The catalog cost is \$1.00.
101. *Jerrold Electronics Corp.*—Catalog S, titled "Systems and Products for TV Distribution," lists specifications of this manufacturer's complete line of antenna distribution products, including antennas and accessories, head-end equipment, distribution equipment and components, and installation aids.
102. *Russell Industries* — announces the availability of a complete line of telescoping antenna rods with swivel bases and sliding adapters for rods to disappear. This line is ideal for walkie/talkie and all portable radio applications.
103. *Vikoa, Inc.* — is making available a 64-page, illustrated catalog covering their line of wire and cables and IDS/MATV equipment. Hardware, accessories, connectors, fittings and an index also are included.*
104. *Winegard Antenna Systems* —has made available a 32-page catalog designated No. 710 which gives specifications and descriptions on their line of outdoor and indoor TV and FM antennas, preamplifiers, wire, home TV systems equipment and commercial systems equipment. Winegard offers a complete selection of fine quality solid-state amplifiers, boosters and electronic devices for MATV systems.

AUDIO

105. *Altec Lansing* — introduces a 12-page brochure for information on sound systems

in the sports and entertainment field, stadiums, automobile speedways, hotels, restaurants and other public entertainment facilities.

106. *Bell P/A Products Corp.*—a new 6-page catalog gives detailed specifications and descriptions of the company's broad line of commercial sound components and special purpose sound system products.
107. *Darome, Inc.*—has released an 8-page brochure showing how a complete background music, local public address, and constant level paging system can be installed without using relays or complicated wiring.
108. *Duotone Company*—has made available a new color replacement needle wall reference chart. The chart covers almost all of the major manufacturers from American Microphone and Audax to Telefunken and Zenith. All categories are grouped according to manufacturer, enabling quick and precise answers.
109. *Jensen Manufacturing Div.* —has issued an 8-page, catalog, No. 1090-E, which describes applications of 167 individual speaker models. Special automotive, communications, intercom and weathermaster speakers, plus a complete line of electronic musical instrument loudspeakers are featured.
110. *Shure Brother, Inc.*—has published a 4-page brochure, "Professional Sound Systems in High Schools, Colleges, and Universities." No. AL 398 describes the company's Vocal Master Sound System and how it helps solve public-address problems.

COMMUNICATIONS

111. *The Hallicrafters Co.*—has published a 4-page, two color brochure which provides the complete mechanical and general specifications of the Porta Command PC-230 FM 2-way radio, including the full line of accessories which expand the new radio's versatility.

112. *Sonar Radio Corp.* — Catalog titled "Sonar Business Radio, FM Monitor Receivers and CB Equipment," lists specifications and prices of this manufacturer's line of transceivers, receivers and communications accessories.

COMPONENTS

113. *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.*
114. *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.*
115. *Loral Distributor Products* —has made available a 24-page electrolytic capacitor replacement guide. The catalog features replacement products by the original manufacturers' part number.
116. *Motorola, Inc.* — has made available a HEP cross reference guide catalog No. HMA07 which lists replacements for over 27,000 different semi-conductor device type numbers available through authorized HEP suppliers.
117. *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.*
118. *RCA/Solid State Division*— announces a revised edition of the Power Transistor Directory, which reflects new product programs, as well as new product data. All product matrices have

been updated to include the latest commercial types as well as preliminary data on developmental types, including RCA power transistors, both silicon and germanium. The Index of Types has been expanded to include DT types as well as JEDEC (2N-Series) types and RCA 40-K series types. Copies are \$.40.*

119. *Semitronics Corp.* — has a new, revised "Transistor Rectifier, and Diode Interchangeability Guide" containing a list of over 100 basic types of semiconductors that can be used as substitutes for over 12,000 types. Include 25 cents to cover handling and postage.
120. *Stancor Products*—pocket-size, 108-page "Stancor Color and Monochrome Television Parts Replacement Guide" provides the TV technician with transformer and deflection component part-to-part cross reference data for over 14,000 original parts.
121. *Sylvania Electric Products, Inc.*—a 73-page guide which provides replacement considerations and specifications and drawings of Sylvania semiconductor devices plus a listing of over 35,000 JEDEC types and manufacturers' part numbers. Copies are \$1.00.*
122. *Workman Electric Products, Inc.*—has released a 32-page, pocket-size cross reference listing for color TV controls. 105 Workman part numbers are listed in numerical order with specifications and illustrations of the part.*

SPECIAL EQUIPMENT

123. *The Denson Electronics Corp.* — has released their new 25th Anniversary Catalog featuring the largest selection of new and used TV cameras and associated equipment.
124. *Switchcraft, Inc.* — This new catalog, which marks Switchcraft's 25th Anniversary as a manufacturer of quality electronic compo-

nents, contains 25 new product listings and over 400 new individual items. All new listings are clearly marked. The 36-page book covers such major Switchcraft product categories as jacks, plugs, switches, connectors, molded cable assemblies, and audio accessories.

TV ACCESSORIES

125. *Telematic*—introduces a 14-page catalog featuring CRT brighteners and reference charts, a complete line of test jig accessories and a cross reference of color set manufacturers to Telematic Adaptors and convergence loads.

TECHNICAL PUBLICATIONS

126. *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 about every phase of electronics.*
127. *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.*
128. *Sylvania Electric Products, Inc., Sylvania Electronic Components Div.*—has published the 14th edition of their technical manual, which includes mechanical and electrical ratings for receiving tubes, television picture tubes and solid-state devices. Price of this manual is \$1.90.*

TEST EQUIPMENT

129. *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 specifications included.*
130. *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.*

131. *Mercury Electronics Corp.* 14-page catalog provides technical specifications and prices of this manufacturer's line of Mercury and Jackson test equipment, self-service tube testers, testers, test equipment kits and indoor TV antennas.
132. *Sencore, Inc.* — has issued its 12-page 1970 catalog, Form No. 517, which describes the company's complete line of test instruments, and features 5 new instruments, with performance data and prices included.*
133. *Triplet Corp.*—Bulletin No. 51570, a 2-page technical bulletin which provides the specifications and price of Triplet's new Model 602 VOM.

TOOLS

134. *Brookstone Co.*—introduces a new, expanded 32-page catalog offering hundreds of unusual and extremely useful hard-to-find tools. Among the new tools are: hand vises, jewelers' screwdrivers, watchmakers' loupes and many other hand and small power tools.
135. *General Electric* — has issued a 2-page brochure No. GEA-8927, describing the features of GE's new soldering iron.*
136. *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.
137. *Xcelite, Inc.*—Bulletin N770 describes this company's three new socket wrench and ratchet screwdriver sets.*
138. *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" nut-driver, screwdriver and special purpose blades.*

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

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It's the tube that saves you time, trouble and dissatisfied customers . . . because it minimizes arcing in rectifier circuits of TV receivers and other high voltage applications.

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815001	.650	8153.25	2.2
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81501.5	1	81504.5	3
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