April, 1972 □ 75 cents

A HOWARD W. SAMS PUBLICATION

Electronic Servicing

Color-TV Test Jigs

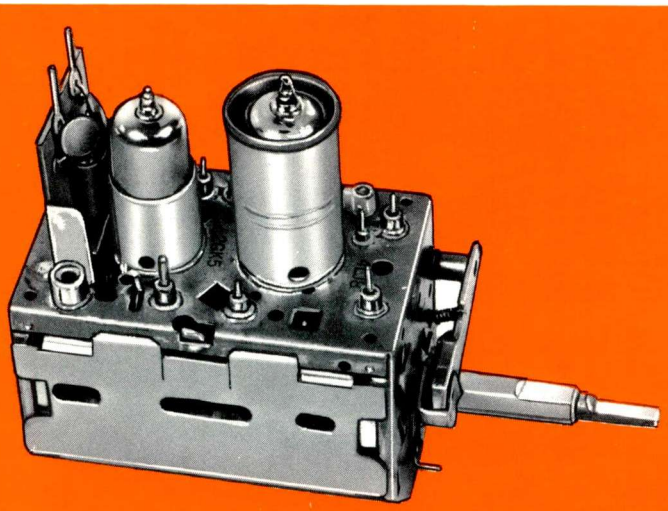
What's available and how to use them, page 14

Horizontal sweep and high voltage, page 40

Interference in TV, page 50

Transistor testing, page 58

Servicing German car radios, page 22



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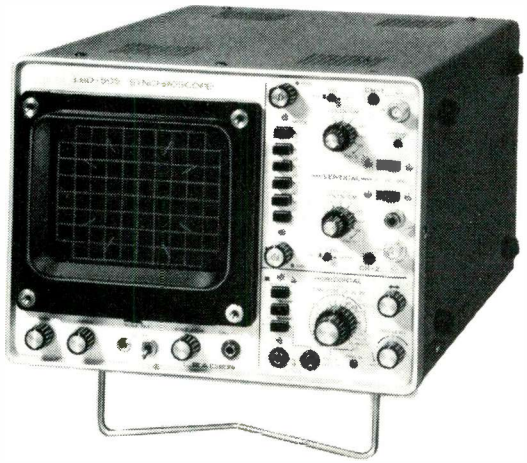

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Circle 4 on literature card

April 1972 • Volume 22, No. 4

Electronic Servicing

TEST EQUIPMENT

14 Color-TV Test Jigs—This general discussion about the primary function of a test jig and how it is used to perform that function, plus a look at the characteristics and specifications of the three major brands currently available, should put you on the right track to choosing the one which is right for you **(Notes On Test Equipment/ES Technical Staff).**

AUTO ELECTRONICS

22 Servicing German-Made Auto Radios—ES's auto electronics consultant takes a look at the major "problems" normally associated with servicing European auto radios—how to interpret European schematics, the availability of service literature, component identification and replacement and the most significant differences of circuitry **(Carr Electronics/Joseph J. Carr).**

COLOR TV

40 Horizontal Sweep And High Voltage In Color TV, Part 2—The horizontal-output, high-voltage, damper and focus circuitry are analyzed in this part of a three-part series which examines the functions of circuits and components, and the symptoms and causes of typical related defects and how to isolate them **(Shop Talk/Carl Babcoke).**

TELEVISION (GENERAL)

50 Externally-Generated Interference In TV—Methods for quickly determining whether the interference is externally generated and, if so, where it is entering the receiver and how it can be eliminated or reduced **(Bruce Anderson/ES Contributing Author).**

SERVICING TECHNIQUES (GENERAL)

58 The Terminology of Transistor Testing—A review of the characteristics commonly analyzed by technicians to determine the condition of transistors. Also included are related test setups **(Forest H. Belt).**

GUIDES

67 Supplement to 1972 Sams PHOTOFACT Annual Index (January thru March)—A complete listing of new models of entertainment electronic products covered in PHOTOFACT since the 1972 PHOTOFACT Annual Index was published in December.

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electronic scanner

news of the industry

Increased use of integrated circuits (IC) by Japanese manufacturers of color TV receivers was reported recently in **Home Furnishings Daily.** According to the report, Tokyo Shibaura Electric Co., which manufactures and markets home entertainment electronic products in this country under the name "Toshiba," will include IC-equipped color TV's in the line it exports to the U.S. this year. Also, Sony reportedly will employ more IC's in their Trinitron color receivers. Mitsubishi, which sells color TV in this country under the MGA label, is another Japanese manufacturer who has introduced IC equipped color chassis. However, a spokesman for Mitsubishi said that the manufacturer has not yet decided whether the new color TV's will be included in the MGA line marketed in this country this year. The IC-equipped units are already on the market in Japan.

Canada's largest retailer reportedly will establish its own TV and appliance repair organization within the next two years. Eaton, which sells through its own department stores and through catalogs and about 300 other outlets in Canada, will expand its present servicing operation to include consumer electronic units not purchased from it.

Television receiver sales during the next quarter century will exceed 370 million sets, according to a recent prediction by Barton Kruezer, RCA executive vice president, consumer electronics. Kruezer also predicts that by the end of the next quarter century annual sales of television receivers will be in excess of 17 million sets, and annual sales of black-and-white television receivers during the next 25 years probably will remain above 5 million.

A possible shock hazard exists in early runs of three Zenith 12-inch black-and-white television receivers, models C1335, C1340 and T2616, according to the manufacturer. The condition, an incorrectly secured antenna-assembly cover, was discovered during engineering tests. Zenith officials said that the company had had no reports of failures of these models which already have been sold and has no reason to believe that any failure has been experienced. However, the company notified Zenith distributors and dealers to hold, for modification, inventories of the models and to notify purchasers of the sets that a modification of the set was needed and would be performed by Zenith distributors and dealers, at Zenith's expense.

Daily television viewing is steadily increasing, according to Norman E. Cash, president, Television Bureau of Advertising. Cash reports that the latest Nielsen figures reveal that average daily home TV viewing in 1971 topped six hours for the first time (6 hours 2 minutes in 1971 compared to 5 hours 56 minutes in 1970). This reportedly was the ninth consecutive year of increased home TV viewing.

Teledyne Service Company has acquired nine of the former RCA Service-America facilities, according to a recent report in **Home Furnishings Daily.** Teledyne Service, the servicing arm of Teledyne Packard Bell, California-based manufacturer of color TV, reportedly purchased three each of the ServiceAmerica facilities in Philadelphia, San Francisco and Miami. This boosts

(Continued on page 6)

What do RCA SK series devices have that other replacements don't?

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Designed especially for replacement use, RCA SK units are backed by electrical characteristics that make them comparable to or better than original devices. There are no cast-offs or factory seconds.

All units and the types they replace are cross-referenced in the RCA Replacement Guide, SPG-202M. There's a Quick-Selection Wall Chart, too, 1L1367A, and new Audio-Visual service aids. These spell the industry's finest informational backup for replacements — all SK, all available from your RCA Distributor. See him today for your copies.

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RCA Electronic Components

the total number of Teledyne Service operations nationally to more than 100. Teledyne Service Company reportedly does not limit its servicing to Teledyne Packard Bell products. Five other former ServiceAmerica facilities remain up for sales; J.C. Penney Company reportedly is negotiating the purchase of these.

General Electric has introduced an all-solid-state color-TV receiver. The new 16-inch portable model receiver is equipped with a completely solid-state chassis which used the same "easy-service" design concept as the Company's recently announced all-solid-state 19-inch black-and-white line. Don Johnstone, general manager of General Electric's Television Department, said the new chassis is "the forerunner of a new generation of solid-state General Electric televisions to be introduced this year."

Sylvania recently introduced the first 17-inch color television receivers manufactured by the domestic television industry. A Sylvania spokesman said the 17-inch receiver "would become increasingly popular as 18-inch sets are phased out of production."

Hitachi's carry-in color-TV warranty covers transistors for five years; all other parts, including the picture tube, are covered for two years, and service labor during the first year of the warranty is free. Hitachi, which recently announced its first 19-inch color receiver, presently offers 13 all-solid-state color receivers.

PTS Electronics, Inc., authorized by RCA to repair in-warranty RCA tuners at no charge. PTS Electronics, Inc., Indiana-base tuner repair operation, with six locations throughout the country, recently was authorized by RCA to at no charge repair any RCA tuner in warranty. Dealers and service shops may send defective in-warranty RCA tuners directly to PTS, prepaid and with a completed return-material tag. PTS will repair and return the tuner prepaid the same day it is received, at no charge to the dealer. RCA warranties reportedly cover b-w TV tuners for 90 days and color-TV tuners for one year. PTS recently moved their Southeast location from Miami to Jacksonville, Florida. Other locations include Bloomington, Indiana; Springfield, Massachusetts; Longview, Texas; Denver, Colorado; and Sacramento, California.

52.6 per cent of U.S. households now have color television, according to recent National Broadcasting Company estimates. The total U.S. homes with color-TV receivers reportedly is now about 32.9 million.

Wage/price controls will continue indefinitely, according to a statement contained in the Council of Economic Advisers, (CEA) annual economic report to Congress. The statement, reportedly written personally by CEA Chairman, Herbert Stein, said that "speculation (that) the administration will abandon controls prematurely—out of fatigue, ideological aversion or other causes—is groundless. Having embarked on this course, the Administration has no intention of departing from it in circumstances where it would risk either resumption of inflation or the need to reimpose the controls". Service companies and servicing dealers reportedly are bound by the restrictions of Phase 2, regardless of their volume of business. When in doubt about wage and/or price restrictions, servicers should check with their local Internal Revenue Servcie office.

Motorola has discontinued offering portable and table radio, portable phonograph and portable tape players. The reason given by Motorola for bowing out of this segment of the entertainment electronic market is that it has become "increasingly difficult to gain the profit return" required to continue offering these "personal electronics."

1971 sales of color television receivers to dealers were 28.2 per cent above those of 1970, according to entertainment electronic sales statistics recently released by the Marketing Services Department of the Electronic Industries Association (EIA). Monochrome TV sales increased 11.9 per cent during the same period. Also up over 1970 levels were sales of home (+38 per cent) and auto radio (+29.9 per cent). □

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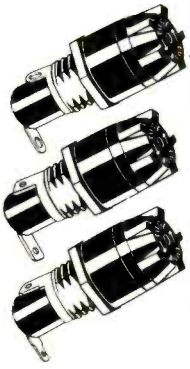

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HKP (Solder Terminals) **HKP-HH** (¼" Quick-Connect Terminals)
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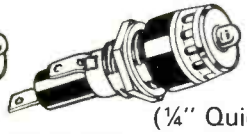

HLD (Solder Terminals) **HLD-HH** (¼" Quick-Connect Terminals)
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HKL (Octagon Knob) **HKL-X** (Flat-Sided Knob)
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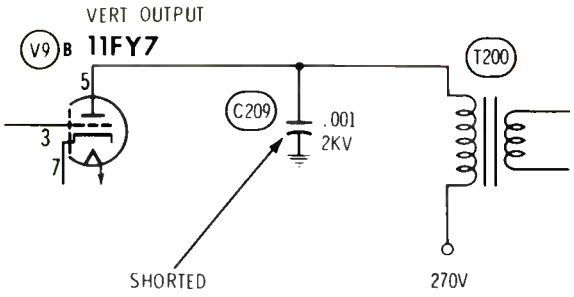
symcure

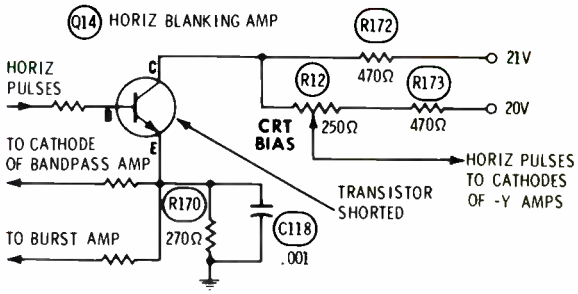
Symptoms and cures compiled from field reports of recurring troubles

Chassis—General Electric H-3 b-w
PHOTOFACT—1094-1



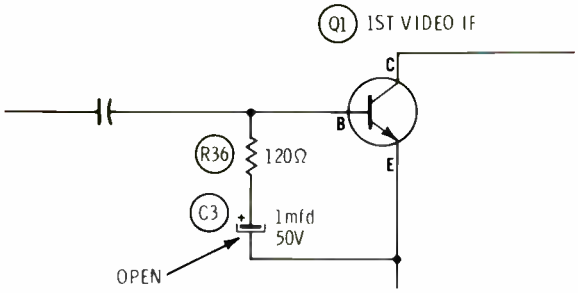
Symptom—No vertical sweep
Cure—Check for a shorted C209

Chassis—Sylvania D12 or D13
PHOTOFACT—1045-2 or 1021-2



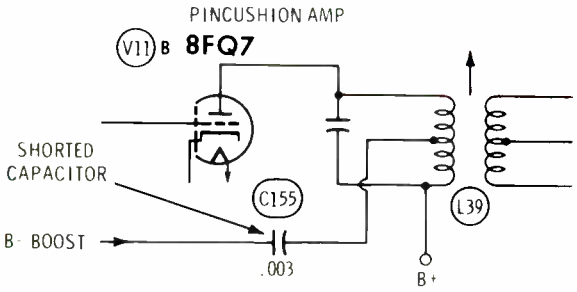
Symptom—Dim raster; weak color; poor color locking
Cure—Check for leakage in blanker transistor Q14

Chassis—Sylvania D12 or D13
PHOTOFACT—1045-2 or 1021-2



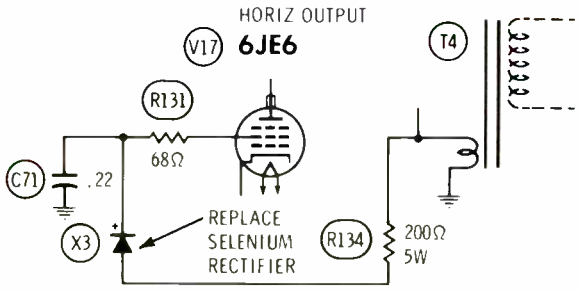
Symptom—Audio motorboat; IF oscillation; AGC overload
Cure—Check for an open C3

Chassis—Airline GEN8147A
PHOTOFACT—886-1



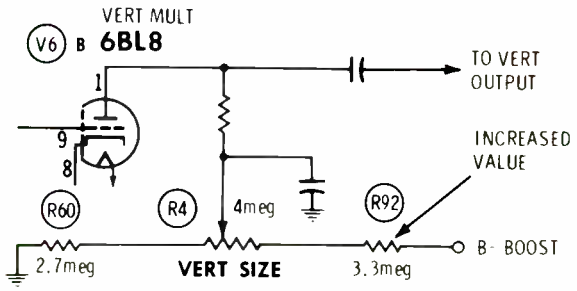
Symptom—No high voltage
Cure—Check C155 and replace, if leaking or shorted

Chassis—Setchell-Carlson U800
PHOTOFACT—715-3



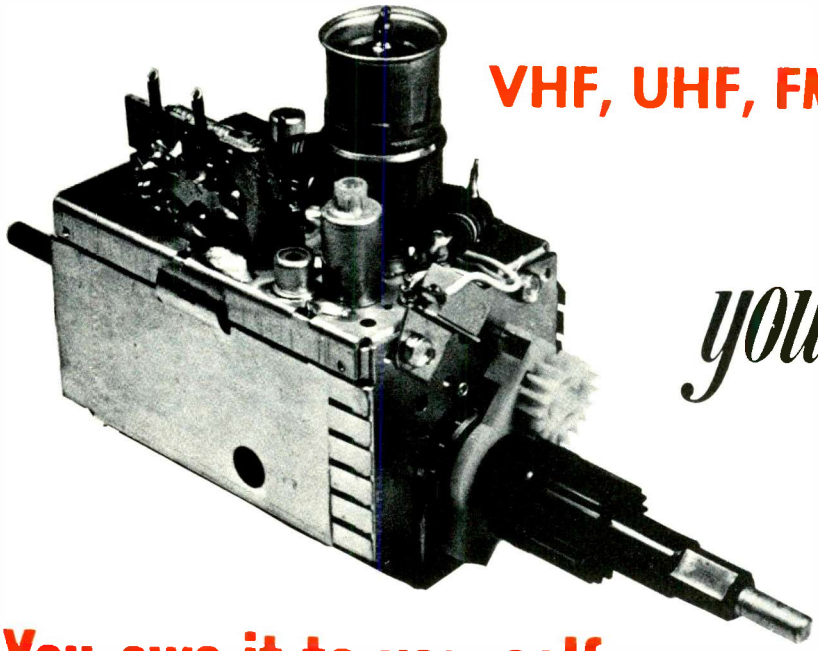
Symptom—Narrow width; poor focus; easy to bloom picture
Cure—Replace selenium rectifier X3

Chassis—Motorola ZDTS-589 b-w
PHOTOFACT—803-3



Symptom—Insufficient height
Cure—Check R92 and replace, if value above 3.3 megohms □

TV TUNER SERVICE



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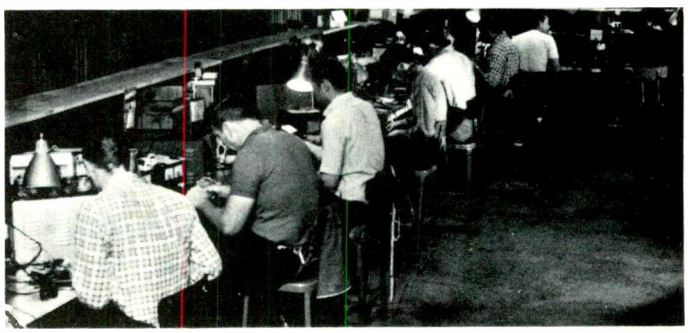

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Circle 8 on literature card

service bulletin

a digest of information from manufacturers

Addition of an AGC control
Magnavox T946 chassis

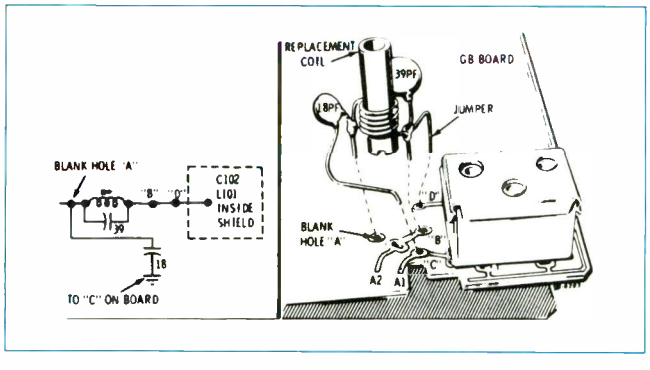
An AGC control has been added to the Magnavox late-production T946 chassis. This control replaces fixed resistor R50, which was used previously.

Adjust the AGC control for minimum snow on the weakest available channel, then monitor the picture produced by the strongest signal, to make certain there is no overload. If necessary, adjust the AGC control to just beyond the point at which overload is eliminated.

Install an AGC control, Magnavox part number 220217-5, in early-production T946 chassis, if any difficulty with weak-signal snow or strong-signal overload is experienced.

Adjacent-channel interference
Motorola TS599 b-w chassis

Adjacent-channel interference from the video carrier of a higher-channel television station can be reduced by the addition of a 39.75M-Hz trap,



Motorola part number 24P65175A09.

Remove the original coil (L100) and install the replacement trap, as shown in the drawing. This trap has been pretuned at the factory and should require no further adjustment. If some interference persists, carefully fine tune the desired channel, then tune the trap for minimum interference.

Interaction of ACC and color-killer adjustments
Magnavox T952 color TV chassis

Interaction between the ACC and color-killer adjustment might cause loss of color or incorrect color-killer action. The factory recommends the following sequence of adjustments:

- Preset the color control to maximum CW, and the ACC control (R196) to fully CCW, as viewed from the component side of the board. A screwdriver is required to adjust the ACC

(Continued on page 12)

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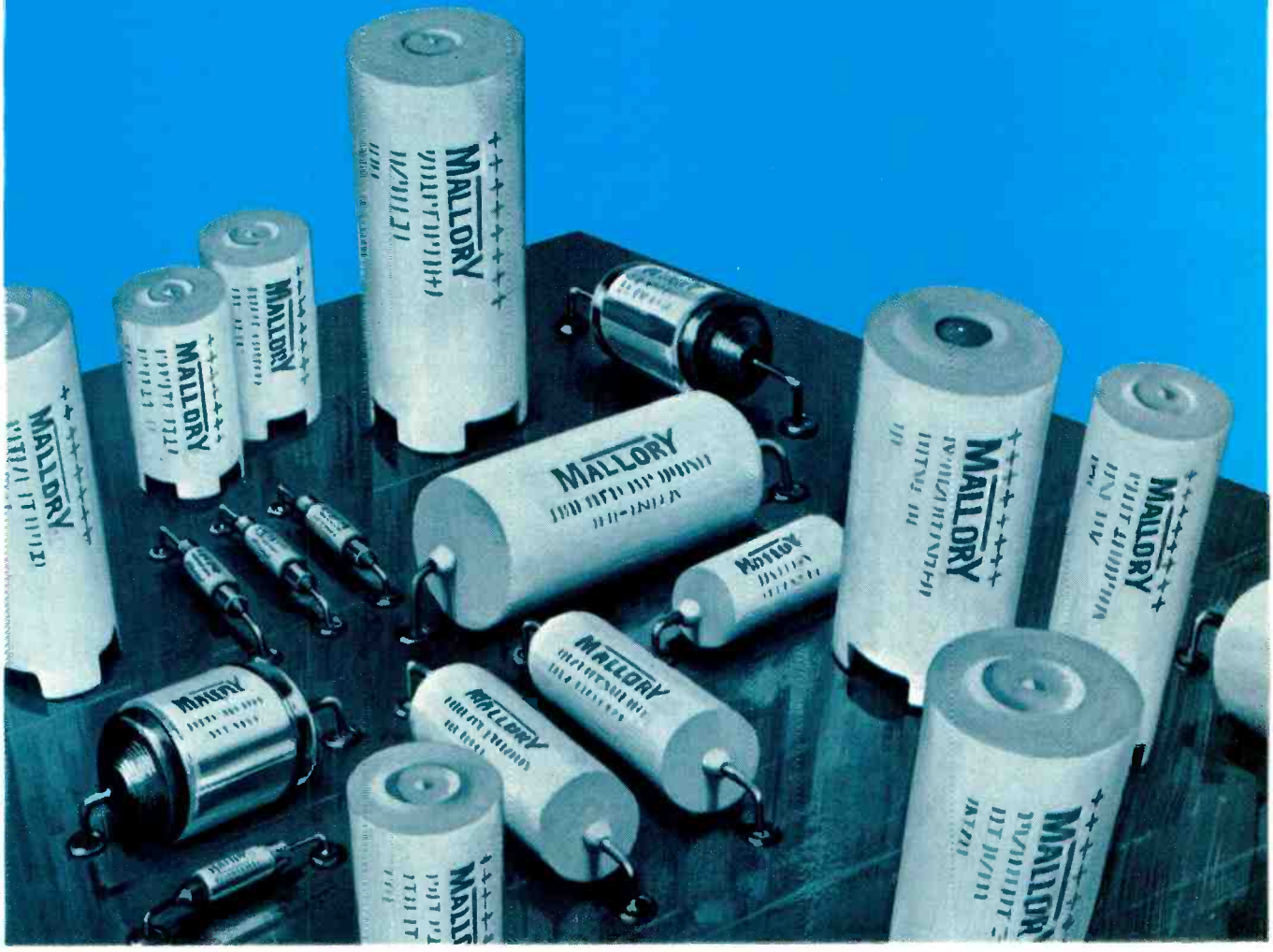

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Circle 10 on literature card

(Continued from page 10)

control, which is mounted near the service switch.

- Turn the channel selector to an unused channel.
- Rotate the color-killer control in the direction which produces colored snow. Reverse the rotation to just past the point at which the colored snow is eliminated.
- Tune in the weakest station signal that has color and rotate the ACC control CW until color just disappears. Reverse the rotation (CCW) about 1/8 turn beyond the point where the color reappears.
- Check the color performance on all available channels, to be sure color is obtained on each channel.

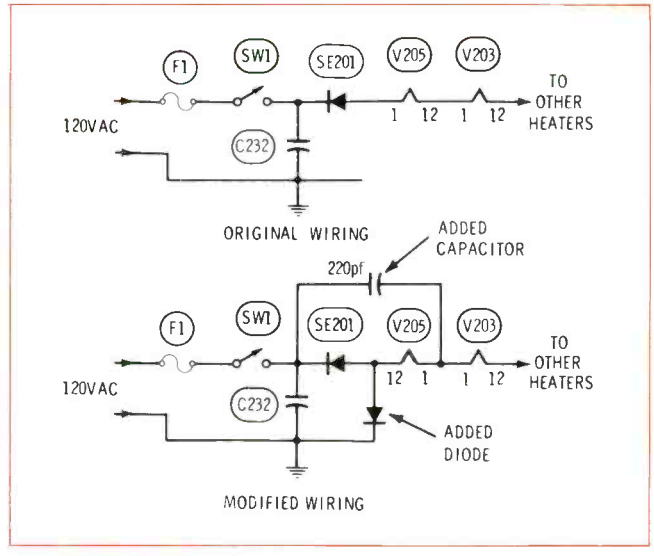
Modification to minimize tube failures
Zenith 12CB12X and 16DB12X TV chassis

Late-production runs of these two Zenith chassis include an additional diode which should minimize one type of tube failure.

The function of diode SE201 is to supply to the series heater string a voltage of about ½ the level of the line voltage. SE201 supplies a half-wave, unfiltered, negative DC voltage to the tube heaters, without the heat a dropping resistor would create.

However, if the SE201 diode shorts, the full line voltage is applied to the tube heaters. This can cause an abnormal number of tube failures.

The polarity of the added diode is such that the diode does not conduct when SE201 is not defective. If SE201 shorts after the other diode has been added, the full line voltage is applied to the added diode. The resultant overload would cause fuse F1



to blow and remove all power from the receiver. Although repairs are necessary before the receiver can be operated, the tubes are protected against overload.

A 220-pf, ceramic capacitor also has been added, to minimize "diode radiation"-type hum bars. To speed installation of the capacitor, the heater wiring of V205 is reversed. □

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To Be Replaced	ECG Replacement
HB33	102A
HB54	102A
HB55	102A
HB56	102A
HB75	102A
HB75C	102A
HB77	102A
HB77B	102A
HB77C	102A
HB156	102A
HB156C	102A
HB171	102A
HB172	102A
HB175	102A
HB176	102A
HB178	102A
HB186	102A
HB187	102A
HB263	102A
HB270	102A

To Be Replaced	ECG Replacement
MA393F	102A
MA393G	102A
MA393R	102A
MA815	102A
MA881	102A
MA882	102A
MA883	102A
MA884	102A
MA885	102A
MA886	102A
MA887	102A
MA888	102A
MA889	102A
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MA892	102A
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notes on
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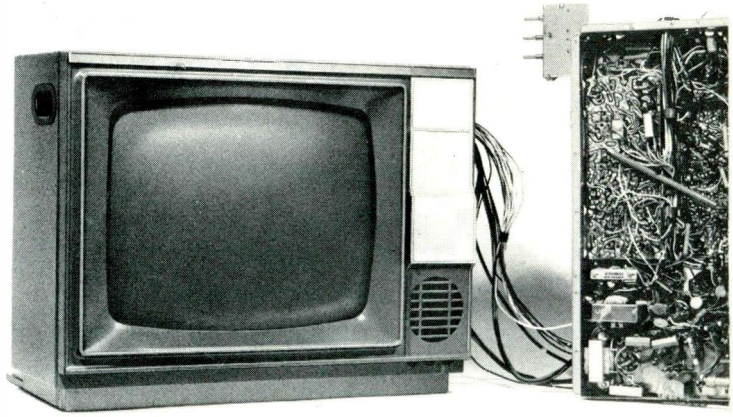
Operation and Application



Color-TV Test Jigs

by the ES technical staff

Basically, a color-TV test jig consists of a color picture tube and/or the convergence and yoke assemblies and other CRT-related circuitry, cables and sockets required to physically connect and electronically match a substitute picture tube to a particular color TV chassis.

The primary purpose of a color-TV test jig is to perform as an acceptable substitute for the picture tube normally used with a chassis. The major reasons for such substitution are:

- To eliminate the need for bringing into the shop the complete receiver. Instead, when in-shop servicing of the main chassis is required, the chassis and tuner assembly can be removed from the cabinet, brought to the shop and connected to the color-TV test jig, and the bulky, heavy and easily-damaged cabinet and color CRT can be left in the home.
- Rapid determination of whether a visual trouble symptom is caused by a defect in the chassis or whether it is caused by a defective picture tube. If the color-TV test jig is portable, this determination can be made in the home, providing the customer first-hand proof of the source of the defect, and, if the picture tube is defective and the policy of the shop permits in-home replacement of picture tubes, it can eliminate the need for in-shop servicing.

Adapting The Color-TV Test Jig To A Chassis

As implied previously, to acceptably perform as a substitute for the picture tube regularly used in a color-TV chassis, the test picture tube must be matched both physically and electrically to the chassis. Because of the physical and electrical differences which exist among the many makes and models of color-TV receivers in use today and those which will be produced in the future, adaptation of a test jig to a majority of these receivers requires a variety of different cables, sockets, plugs and matching devices, commonly referred to as "adapters."

The major differences of designs for which adapters usually are provided are:

- **CRT base**—This essentially is a "physical" match of the chassis CRT socket to the base plug of the picture tube in the test jig, to insure that the various elements of the substitute picture tube receive the correct operating voltages and/or signals.
- **Convergence**—In test jigs equipped with dynamic convergence circuitry and adjustments, this involves a "physical" match of the convergence socket of the color-TV chassis to the socket of the extension cable of the test-jig convergence board. In test jigs with only a static, or center, convergence assembly and no dynamic circuitry adjustments, this involves plugging into the convergence socket of the color-TV chassis a small assembly which electrically simulates the load normally imposed on the sweep circuit by the dynamic convergence circuitry.
- **Yoke**—This can involve both electrical and physical matching. Physically, the yoke socket of the color-TV chassis must be adapted to the plug of the test-jig yoke. The electrical match relates to the inductances of the coils of the test-jig yoke, which must approximate those of the coils of the TV chassis. If they do not, ringing, insufficient or excessive width and/or height, or some other form of abnormal raster might be produced. For example, if an old RCA CTC9 color-TV chassis is connected to a new RCA test jig, the set will operate normally except that the raster will be slightly too wide and the height reduced.

These small discrepancies in raster size are of no consequence in most cases. A bench technician should have no difficulty evaluating the performance of a chassis/jig combination with

(Continued on page 16)

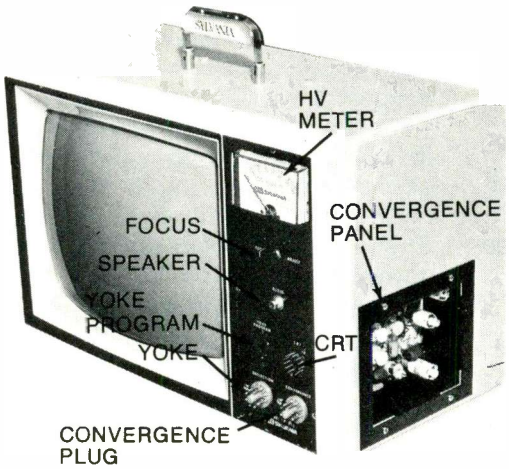


Fig. 1 Diagonal view of the GTE-Sylvania Model CK1500X Chek-A-Color Jig, showing the locations of the yoke-programmer plug and other components.

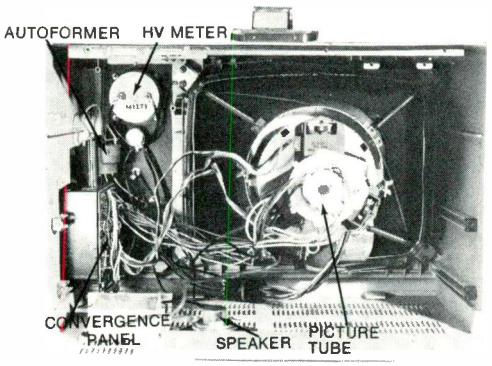


Fig. 2 Rear view of the Sylvania jig, showing the interior details.

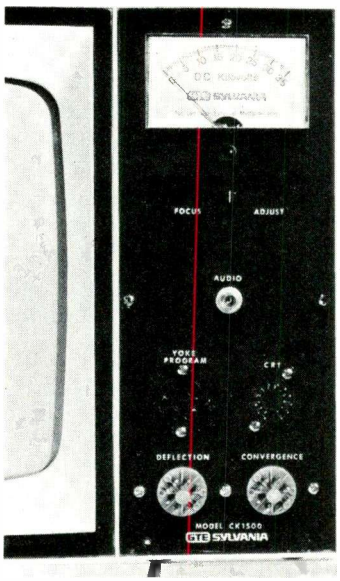


Fig. 3 A close-up view of the Sylvania test-jig panel with controls.

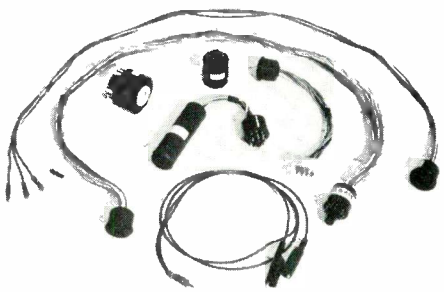


Fig. 4 Examples of the extension cables, plugs and adapters which are available from Sylvania distributors.

GTE-Sylvania Model CK1500X Chek-A-Color Jig

Cabinet: Made of two-toned plastic; apparently originally designed for a portable color receiver. Included are: a handle; a plastic back; a panel on side, for convergence board; a panel on front, for high-voltage meter, and plugs for yoke, yoke programmer, convergence, CRT base and speaker.
Picture tube: A 15-inch color-picture tube is furnished. A 4M-ohm resistor, which is wired in series with the anode lead, provides protection against damage by internal arcs.
Focus: Built-in source. A fixed amount of focus voltage for low-focus-voltage tube is provided by multiplier resistor assembly of high-voltage meter wiring.
High voltage meter: A built-in, high-voltage meter measures up to 35KV, in 500-volt increments.
Speaker: A 5-inch speaker is mounted on bottom of cabinet. A cable, with plug and clips, for connection between speaker jack on front panel and chassis, is supplied.
Center convergence: Components required for purity and four center-convergence adjustments are mounted on neck of CRT.
Dynamic convergence: A convergence board, accessible through a recess in side of cabinet, permits dynamic convergence, if needed.
Yoke matching: Switching of yoke coils by means of "yoke program" plugs plus an internal autotransformer gives a choice of 10 horizontal and 2 vertical yoke inductances, including those needed for hybrid and solid-state chassis.
Accessory cables, loads, and plugs: 6 "yoke programmer" plugs are furnished with the jig. 60 cables and plugs are available. A booklet which lists correct cables and plugs for use with each brand and chassis of receiver is included with jig. Prices of adapters and plugs range from $1.00 to $6.00.
Size and weight: GTE-Sylvania Model CK1500X Chek-A-Color Jig is 20½ inches x 14 inches x 16 inches, weighs 33 pounds.
Price: GTE-Sylvania Model CK1500X Chek-A-Color jig is priced at $239.15, and is available from distributors of Sylvania tubes and TV receivers.

GTE-Sylvania Model CK1500 Chek-A-Color Jig

Similar to Model CK1500X, except it does not have some of the deluxe features, such as the high-voltage meter, yoke autotransformer and speaker, and only one yoke-programmer plug is included. The price is $172.50.

Kits are available individually, at extra cost, to add the features of the CK1500X jig. Kits and prices are: K501 speaker kit, $6.90; K502 high-voltage meter kit, $33.90; K503 solid-state yoke transformer, with 5 yoke-programmer plugs, $25.85.

slightly mismatched yoke-coil inductances, if the home-call technician relates to him the width, height and vertical linearity produced by the yoke normally used with the chassis.

Some makes of test jigs actually provide a method of matching the inductances of the test-jig yoke coils to those of the coils of the yoke normally used with the chassis.

- **Focus voltage**—A test jig equipped with a picture tube which requires a focus potential of 4.7K or 5K volts will not produce a raster when operated by a chassis normally equipped with a picture tube which requires a much lower focus potential. To match up such a chassis/jig combination, either an external power source will be required to supply the high focus potential required by the test jig or the test jig will have to be supplied with an adjustable divider assembly for dropping down part of the chassis high voltage, for application to the focus element of the test-jig picture tube.

If a test jig has no "built-in" provision for matching the focus potentials of chassis and jig, a circuit for supplying the correct focus potential can be built from the special high-megohm resistor assembly and focus control which in some chassis are used to develop the focus potential from the high-voltage supply.

Application Notes

Recently, three different makes of color-TV test jigs were used and analyzed in the ES lab. The features, specifications and photos of these test jigs are listed and shown separately here.

During the use of the test jigs, the following application notes were made:

Jig-to-chassis grounding

Normally, the chassis and picture tube of a color-TV receiver are grounded together by a metal cabinet, which is common to both, or the chassis presses down against a flat, conductive ribbon which is connected to the metallic mask of the picture tube.

The chassis and picture tube must be grounded together because a voltage charge will develop on any ungrounded metallic surfaces near the face or bell of the picture tube and, when the potential is sufficient, will arc over to the nearest grounded surfaces—which could be a human hand on a control knob. Such arcs can be dangerous as well as annoying.

Because the "automatic" grounding which exists between chassis and picture tube when both are installed in the cabinet does not exist when the chassis is connected to the picture tube of a test jig, separate grounding connections between the two must be made.

All three of the test jigs used in the ES lab were equipped with a ground cable and clip for connection to the TV chassis. Be sure the mask and aquadag of the test-jig picture tube and the receiver chassis are connected together, to prevent a difference of potential between them.

Use of the test jig with a "hot-chassis" TV

One side of the input power line of some color-TV receivers is connected electrically to the chassis. To reduce the possibility of electric shock to anyone who touches them, these hot-chassis receivers are equipped with blocking filters in the antenna leads, plastic chassis mounts, fishpaper, plastic shafts for controls external to the cabinet, and a variety of other insulating devices.

However, when the "hot" chassis is removed from the cabinet, few of the previously described insulating devices are operative or effective. Consequently, when the chassis is removed from the cabinet and connected to a test jig, the chassis should be operated from an isolation transformer. (Do **not** use an autotransformer; the secondary of an autotransformer is not isolated and, consequently, does not provide the required protection.)

Degaussing

Because degaussing of the picture tube of the test jig seldom is needed unless the jig is moved, and because the variety of degaussing circuits used in color-TV receivers makes it impractical to design a test jig which will operate from all or most of them, most commercially-built color-TV test jigs are not equipped with degaussing systems.

Most automatic degaussing circuits used in TV receivers can be disconnected from the internal degaussing coils and the receiver operated without damaging either the degaussing circuit or any other receiver circuitry. The only exceptions which we are aware of are those automatic degaussing systems equipped with a thermally-operated switch. A jumper should be connected across the switch, to substitute for the coil.

If you are uncertain whether a particular chassis can be operated without damage while connected to a test jig, check the operating instructions provided with the test jig.

Use of extension cables

The use of an extension cable between the base of the picture tube in the test jig and the picture-tube socket of the chassis can cause unacceptable smearing of the fine detail in the picture. This is the only extension cable which noticeably changes the size or quality of the picture. Even an 18-inch extension cable with cardboard spacers separating the grid and cathode wires will significantly reduce the detail in the picture.

This reduction of picture detail is of no consequence when analyzing many color-TV trouble symptoms; however, if the complaint involves the sharpness or quality of the color of the picture, it can make the analysis more difficult or, in extreme cases, impossible.

If possible, position the TV chassis and the test jig so that no extensions are required between the two. For example, the test jig could be positioned facing the rear of the bench, with a mirror

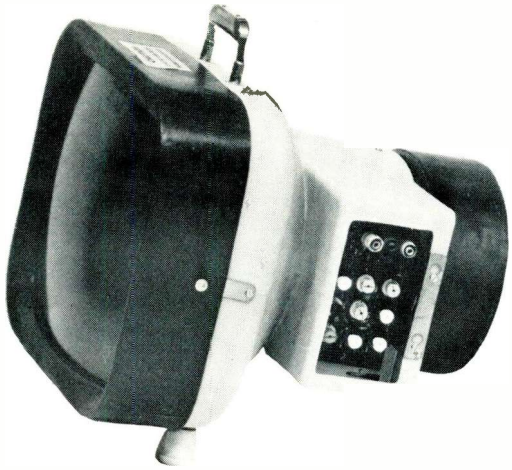


Fig. 5 Diagonal view of the RCA Mark III color-TV test jig. The optional high-voltage meter should be mounted above the convergence board.

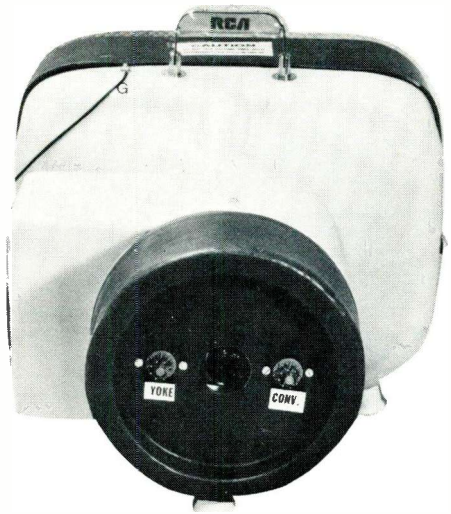


Fig. 6 Rear view of the Mark III shows the CRT, yoke and convergence plugs, which are accessible.

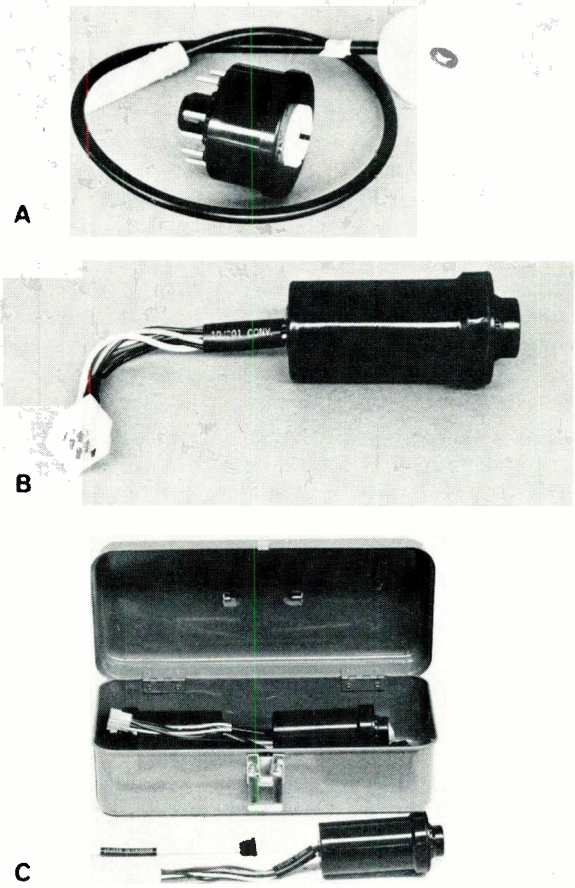


Fig. 7 A, B & C Examples of the extension cables, adapters and kits which are available from RCA distributors.

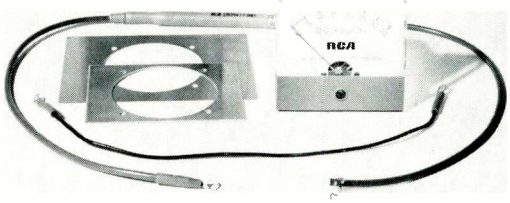


Fig. 8 The optional 10J110 high-voltage meter kit, which can be installed in the Mark II and the Mark III jigs.

providing a reflected view of the picture tube screen, and the chassis positioned at the front of the bench, so that it not only is as close as possible to the test jig but is more accessible to the technician. The only inconvenience involved in such an arrangement would be remembering that the mirror image is the reverse of that of the view it is reflecting, or left is right and right is left.

Diagnostic Limitations

The designs of commercially-built test jigs necessarily bypass, short out, open up or in some other manner incapacitate or provide a substitute for one or more picture-tube related circuits. Consequently, any defects in such circuits might be "covered up" by the test jig.

For example, the chassis of color-TV receivers equipped with rectangular picture tubes include pincushion-correction circuits. Because these pincushion-correction circuits usually are shorted across by the test jig, any trouble symptoms caused by defects in them would be effectively eliminated by the test jig.

Also, if the chassis circuit which produces the focus voltage for a picture tube which uses a relatively low voltage is replaced by a source built into the test jig or some other source external to the chassis, any defects existing in the chassis focus circuit (and the related trouble symptoms) will be effectively eliminated.

Determine which chassis circuits and/or functions are incapacitated or substituted by the test jig you use, so that you can be alert to any related defects and trouble symptoms which might be "covered up."

RCA Mark II and Mark III Color-TV Test Jigs

Cabinet, Mark II: Made of plastic; resembles that of a table-model receiver. No handle. A degaussing coil, with a plug to fit RCA chassis, is supplied.

Cabinet, Mark III: Two-piece, form-fitting plastic, with handle. Hooks can be added, if desired, for suspension of the unit from a ceiling.

Picture tube: Not furnished. A 19-inch color-picture tube which uses high-voltage focus (about 4.7KV) is required, and is available from RCA distributors for $64.50.

Focus: Approximately 4.7KV is required from the chassis under test. An external source must be used with chassis equipped with picture tubes which use lower focus voltage.

High-voltage meter: A meter kit, RCA stock 10J110, for installation in either the Mark II or Mark III, is available for $26.19.

Speaker: No speaker included. The Mark II cabinet has space on the inside of the front panel where one can be installed.

Center convergence: A complete convergence system around the neck of the picture tube is included.

Dynamic convergence: Convergence panel is recessed in the side of Mark III cabinet, where it is accessible for adjustments. Convergence board in Mark II cabinet is mounted to top, near back.

Yoke matching: Both jigs are available with either tube or solid-state yoke and convergence components. A solid-state yoke can be used to replace the tube-type yoke when servicing solid-state chassis.

Accessory cables, loads and plugs: A variety of adapters, cables, and plugs are available at prices ranging between $1.26 and $7.56. Three kits in "tool boxes", for Admiral, Magnavox and Zenith, are available, in addition to dozens of ICTJ-standard individual adapters. Adapters are listed by model, with explanatory notes, in the book: "RCA Industry Compatible Test-Jig Cross Reference". A kit of 8 cables, including one for automatic degaussing, is furnished with each Mark II jig. A kit of 7 cables is furnished with each Mark III jig.

Size: Mark III is 17½ inches x 16½ inches x 17¾ inches.

Price: Mark II or Mark III is available, in either tube or solid-state version, for $115.50, less picture tube, from distributors of RCA parts, tubes and accessories.

Cable Description	Test Jig 10J102 & 10J103 See note 1	Test Jig 11A1015-A See note 1
Picture Tube Socket Adapter	Not Required	Not Required
Picture Tube Socket Extension Cable	13B113	13B111
Deflection Yoke Adapter	10J220	10J118 and 10J220
Deflection Yoke Extension Cable	221X1	Not Required
Convergence Adapter	10J221	10J221
Convergence Extension Cable	221X1	221X1
Automatic Degausser Adapter	10J304	[Defeat Degausser Coil Circuit with Jumper]
Automatic Degausser Extension Cable	10J111	
High Voltage Extension Cable	13A100	13A100

Notes:

1 It may be desirable to obtain better convergence. This can be accomplished by removing the red lead with white tracer from Convergence Board Terminal "H" (Junction of GRN, RED/WHT and WHT leads) and connect to Terminal "F" (Junction of R-813 and GRN lead). After completion of tests, return wiring to its original position.

Zenith (cont'd)

Chassis	Models	Manuf. Page No.
16Z8C50 (cont'd)	Z4514M07/M08, Z4515H07/H08, Z4516W07/W08, Z4517M07/M08, Z4518DE07/DE08/P07/P08, Z4519P07/W07, Z4520M07, Z4524H07, Z4526W07, Z4528H07, Z4532DE07/P07, Z4533W07, Z4535M07, Z4538DE07/P07, Z6208W07	80
20X1C36	T2962W, T2974W, T2976H, T2978W, X4541W, X4543DE, X4545H, X6541W, X6543DE, X6545H/X, X6577M, X6549H, T2912M, T2961R/W, T2963W, T2965H, T2967M, T2968M, X4204L, X4206W, X4210R/W, X4214W, X4218M, X4222W, X4224H, 4226M, X 4228H, X4240W, X4242M, X4246H, X4257DE, X4501Y, X4502W, X4511W, X4514R/W, X4518R/W, X4519W	53
20X1C38	X4520W, X4525M, X4528H, X4531DE, X4533W, X4535W, X4537M, X4539H/R, X4547M, X6206W, X6218M, X6222W, X6226M, X6240W, X6242M, X6246H, X6247DE, X6507I/W, X6520W, X8220W, X8240W, X8260H, X8280M (Combination) X8520W, X8530W, X8540M, X8550H, X8560H, X8570DE (Combination) X8580OH (Combination)	53
20Y1C48	S2959R1/W1, S2990W3, T2955W3/W5, T2956W1, T2969W1, T2971M1, T2972H1, T2973W1, T2979W1, Y4202Y3, Y4204W3, Y4217W7/W8, Y4502W2/W3, Y4507W1, Y4514R3/W3, Y4516R3/W3, Y4517M3, Y4518W1, Y4519W5, Y4520M5, Y4522W1/W4,	53

Chassis	Models	Manuf. Page No.
20Y1C48 (cont'd)	Y4523H1/H4/R1, Y4525M1/M4, Y4528H1, Y4531DE1, Y4533W1, Y4537M1, Y4539H1/R1/R4, Y4541W1, Y4543P, Y4545H1, Y4547M1, Y8530W1, Y8548H1, Y8558H1, Y8563M1, Y8568DE1 (Combination) Y6507W1, Y6525M1, Y6547M1, Y6549H1, Y8550H1, Y8565M1, Y8560H1, Y8570DE1	53
20Y1C48 or 20Y1C50	GA50-34R/R2/W/W2, GA50-36W/W1, GA50-40W/W1, GA50-42H/R1, GA50-44M/M1, S2951R6/R7/W6/W7, S2959R6/W6, T2952L6, T2953W2/W6/W7, T2956W6, T2958P6/W6, T2968W6, T2969W6, T2971W6, T2972H6, T2973W6, T2979W6, T2991DE6/P6, Y4202Y6, Y4204W6, Y4207W6, Y4216W6, Y4502W6/W7/W8/W9, Y4507W6, Y4514R6/R7/R8/R9/W6/W7/W8/W9, Y4515W6/W7/W8/W9, Y4516DE6/DE7/DE8/DE9/P6/P7/P8/P9, Y4517M6/M7, Y4518W6, Y4519P6/W6, Y4520M6, Y4523H6/H8/R6/R8, Y4526M6/M8, Y4528H6/H8, Y4532DE6/DE8/P6/P8, Y4533W6/W8, Y4537M6/M8, Y4539H6/H8/R6/R8, Y4541W6, Y4543DE6/P6, Y4545H6, Y4547M6, Y8530W6, Y8548H6, Y8558H6, Y8563M6, Y8568DE6 (Combination Models), GA50-37W, GA50-41W, GA50-43H, GA50-45M, Y6207W6, Y6507W6, Y6519P6/W6, Y6520M6, Y6523H6/R6, Y6541W6, Y6545H6, Y6547M6, Y6549H6, Y6543DE6/P6, Y8550H6, Y8560H6, Y8565M6, Y8570DE6 (Combination Models)	53
20Z1C37	T2930L6, Y3905Y2, Y3905Y6, Y3910W6, Y5918W6	53

Fig. 9 Examples of the detailed listings in the RCA test-jig cross-reference book.

Summary

The two major advantages which can be realized from the use of a color-TV test jig—elimination of the need for bringing into the shop the receiver cabinet and picture tube, and being able to quickly determine whether or not a trouble symptom is caused by the picture tube—alone make it a valuable servicing aid, either in the home or on the bench.

Adaptation of a color-TV test jig to a particular chassis involves both physical and electrical matching. In most cases, the adapters provided with the test jig or which are available from the manufacturer of the jig reduce adaptation to merely selecting the correct cable, socket and/or plug.

If a particular adapter is needed and unavailable from the manufacturer of the test jig you are using, it is probable that an adapter designed for the application can be obtained from the adapter line of another brand of test jig, and used with yours. At least one test-jig manufacturer offers adapters which can be used with other makes of test jigs.

Adapters can be fabricated by a technician, but it can be time consuming, and such home-built adapters too often become more of a source of trouble than the chassis the technician is servicing. When a commercially-built adapter is available, even from the manufacturer of another make of test jig, buy it, and spend your time servicing TVs, not your own home-built test-jig adapters.

Color-TV test jigs are safe to use, provided the grounding and other related precautions previously outlined are heeded, including the use of an isolation transformer when servicing "hot" chassis.

(Continued on Page 20)

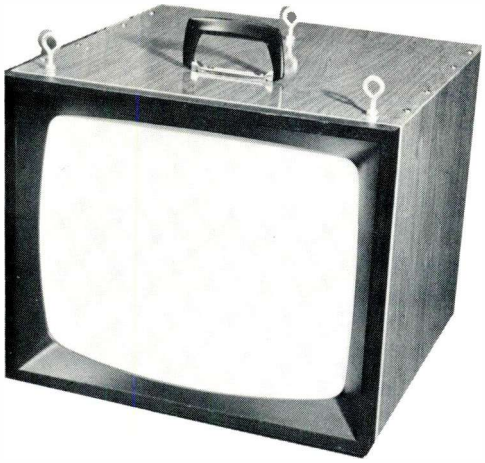


Fig. 10 The TeleMatic Econo-Jig, which can be carried, placed on a bench or hung from the ceiling.

Fig. 12 The components and accessories shown here are furnished with the TeleMatic Econo-Jig.

Fig. 11 Examples of the loads, adapters and extension cables which are available from TeleMatic distributors.

TO USE TELEMATIC YOKE ADAPTORS WITH JIGS LISTED BELOW:

EQUIP JIGS FROM	WITH MATCH CORD
MOTOROLA (KT-120) RCA 70° (11A1015)	MODEL MC-77
MAGNAVOX (701264)	MODEL MC-78
ZENITH (12 pin Molex) SUPERIOR (CJ-1900)	MODEL MC-79
ZENITH (8 IN-LINE MOLEX CONNECTOR)	MODEL MC-8

ADMIRAL

YA11 CD51 25 Series
YA11 CD55 D11 Series
YA11 CD52 G11 Series
YA12 CD55 G12 Series
YA12 CD52 G13 Series H12 Series, K15 Series
YA12 CD58 H10 Series

Fig. 13 Typical listing of adapters available from TeleMatic for other brands of jigs and the extensions and adapters needed for each brand and model of receiver.

TeleMatic Model EJ190 Econo-Jig

Cabinet: Shipped unassembled, the cabinet consists of two metal side panels, a top panel of metal reinforced with plywood, a wood bottom, a perforated fiberboard back, and a plastic mask which serves as the front panel. Captive nuts imbedded in the wood make assembly easy. Metal panels are finished in imitation walnut grain. Also furnished are: rubber feet, a handle and three eye-bolts, for ceiling mounting.

Picture tube: Not furnished. None available from TeleMatic. Any standard 19-inch color tube can be used.

Focus: Supplied by the TV chassis. Because the majority of color-TV chassis are equipped with picture tubes which use about 4.7KV of focus voltage, this type of picture tube should be selected for use in the EJ190 test jig. And, because a chassis which supplies a focus voltage of less than 800 volts probably would not produce a raster on this type of picture tube, a focus supply which is fed via special resistors from the high-voltage supply will be required, if you want to operate a low-voltage-focus chassis with the jig.

High-voltage meter: No provision is made for a built-in meter.

Speaker: No provision is made for a built-in speaker.

Center convergence: Components to be mounted on the neck of the picture tube, for center convergence and purity adjustments, are supplied with the jig.

Dynamic convergence: No provision is made for dynamic convergence; however, TeleMatic offers "convergence load" adapters which plug into the chassis and provide a load to the sweep circuits which is similar to that normally provided by the convergence system. TeleMatic states that dynamic convergence usually is not essential for proper test jig operation, and that testing is much faster without dynamic convergence.

Yoke matching: The yoke supplied with the jig matches most tube-equipped TV chassis. Their plug-in "Match-A-Yoke" adapter compensates for all but solid-state yoke differences. TeleMatic offers a "Solid-State Transvertor" adapter which matches any solid-state chassis to any jig equipped with a tube-type yoke.

Accessory cables, loads and plugs: About 32 extension cables, loads, and adapter plugs, for most brands and models of color receivers, are available from TeleMatic. Also, "match cords" are available, to convert other brands of test jigs to the use of TeleMatic cables and plugs.

Size: Econo-Jig Model EJ190 is 18¾ inches x 15¾ inches x 18¾ inches.

Price: Econo-Jig Model EJ190 sells for $49.95, with the leads and components shown in the photo here. The Match-A-Yoke unit is $6.95, and the improved Solid-State Transverter is $24.95. Any of these items can be obtained from distributors who sell TeleMatic products.

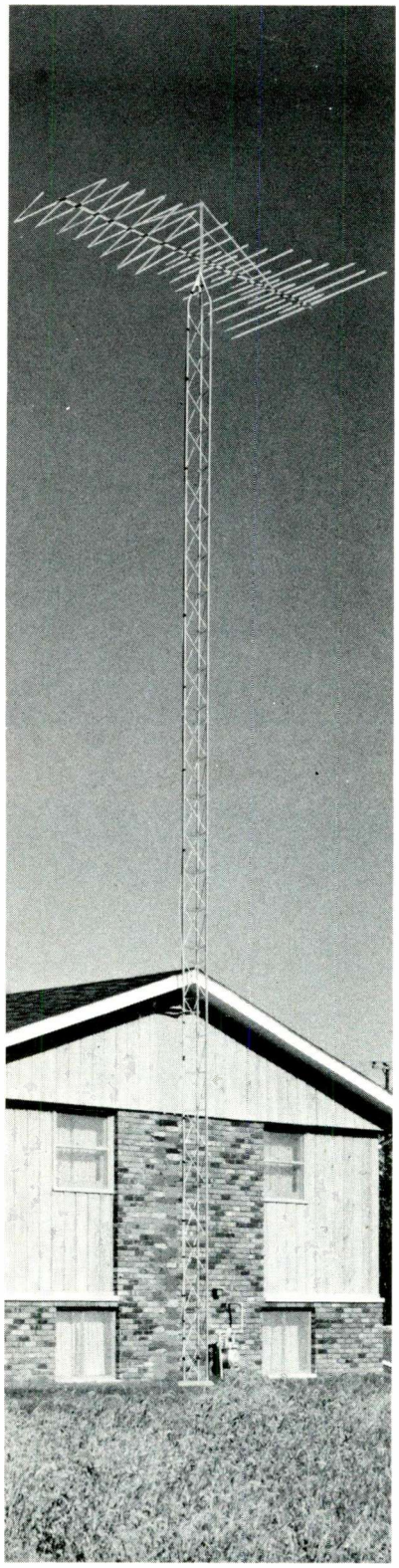
Fig. 14 The Match-A-Yoke by TeleMatic makes small changes in the matching of the test jig yoke and the chassis, to reduce ringing and possible insufficient or excessive picture size.

Fig. 15 Matching of a test jig with standard yoke to a solid-state chassis is accomplished by TeleMatic with their improved Transverter adapter.

(Continued from Page 18)

Because a color-TV test jig incapacitates and/or provides a substitute for some of the picture-tube-related circuitry in the color-TV chassis, you should study carefully the application notes which are provided with the test jig, to familiarize yourself with exactly which chassis circuitry does not function when the test jig is connected. Remember, defects in such circuitry usually are effectively "covered up" by the test jig.

A color-TV test jig is a useful test instrument and, in the opinion of the ES technical staff, should be purchased and used by all TV shops which service color TV's. But, as with all test instruments, the general design, operation, applications and limitations should be clearly understood by the technician before he uses it. Having read this article, you should now be in a position to select the test jig that best suits your situation, and, after carefully reading the application notes which accompany it, proficiently use it and realize from that use the ultimate advantage of any practical test instrument—quicker, more profitable servicing. □



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Circle 15 on literature card

carr electronics

by Joseph J. Carr/ES Auto Electronics Editor

Servicing German-made auto radios

Why Service German Auto Radios?

Because there is an extremely large number of German-made car radios in use, and they do need occasional repair, a shop willing to take them on might corner this segment of the local market.

With authorized repair stations for Blaupunkt and Becker auto radios so few and far between, it is possible that your local import car dealers are having to ship defective units to either the importer's service facility or a distant authorized independent repair shop. The shop in which this writer services auto electronics receives German car radios by mail or by United Parcel Service from dealers over a hundred miles away. When we told one local Mercedes-Benz parts manager that we could handle his in-warranty Becker repairs (as well as the more lucrative out-of-warranty repairs) he became so overjoyed that it looked for a moment like he was going to prostrate himself and kiss the ground we walked on.

Service Literature

One possible reason many technicians hesitate to service German car radios is that they believe that service manuals for these sets are not available. This is not true. Howard W. Sams has given for many years at least some coverage to the more popular German car radios. Also, the two major importers, Becker and Blaupunkt (Robert Bosch Corporation), have been most generous with their respective service manuals. I know of several shops which have requested manuals from these two companies and were surprised at the volume of material sent and the speed of the reply. Although there technically is a charge for the manuals, they frequently come through either without an invoice or with an invoice marked "no charge".

Another reason many technicians, particularly older ones, hesitate to service German-made car radios is that in the "old days" the service manuals were written only in German and used European schematic symbols. Some of the modern manuals, however, are printed in English and use symbols which are standard in the United States. The modern manuals which are printed in German have one line or an entire paragraph in German followed by a translation in English, French, and Spanish.

A glossary of German words commonly used in car radio service manuals is given in Table 1. Although most of the manuals covering the radios you will be servicing will be either all-English or German with an English translation, keep the glossary handy for the one out of ten manuals which is all-German.

One other source of service manuals, by the way, is the customer. Some German manufacturers pack at least a short-form manual with the warranty papers

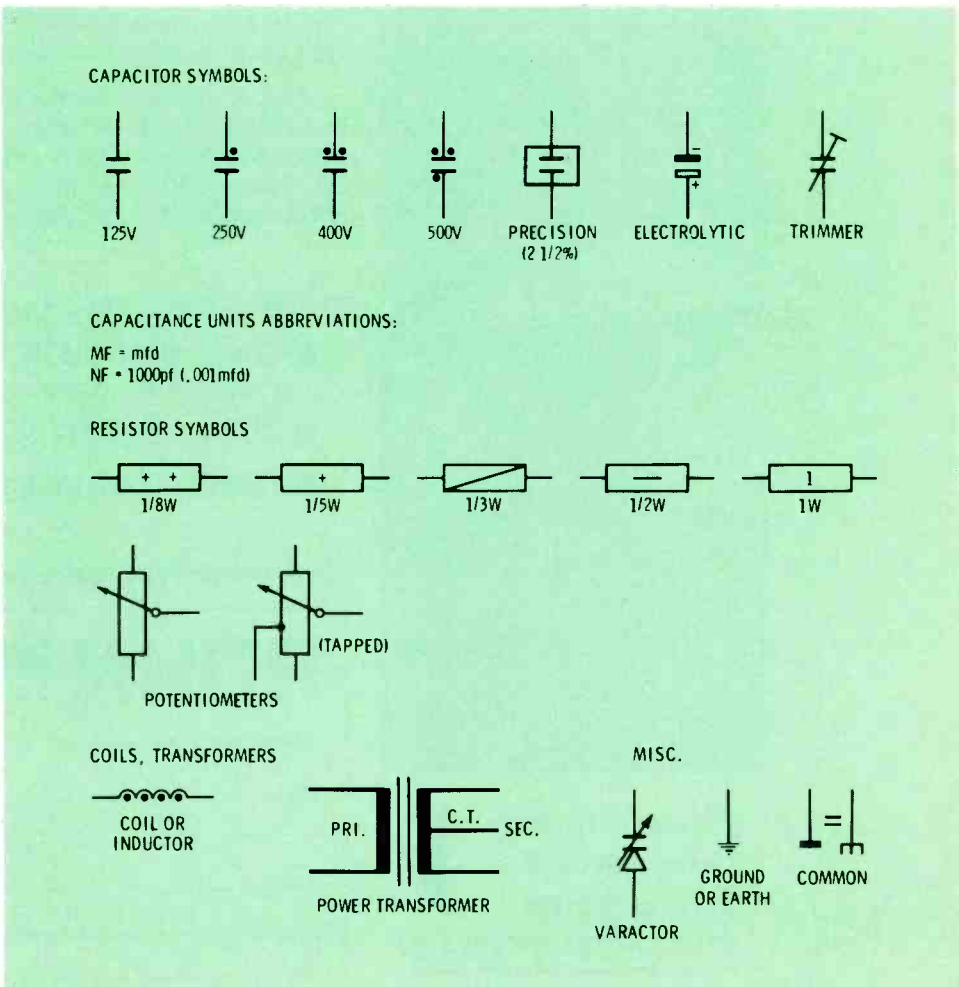

Fig. 1 Electronic component and other symbols used on most European schematic diagrams.

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that accompany each new radio. Frequently, you will also find a print of the schematic folded up inside one of the radio's cover plates. (The Germans rarely resort to that obnoxious practice of glueing the schematic to the radio.)

Schematic Symbols

Fig. 1 shows some of the more common schematic symbols used by the Germans. Although there will be any number of variations in use from maker to maker, those in Fig. 1 are relatively universal. Notice that the capacitor symbols show the voltage rating with a series of dots. One dot means 250 VDC, two dots indicate 400 VDC, and three dots mean that the rating is 500 VDC. Precision capacitors are indicated by a box around the normal capacitor symbol. The symbol for an electrolytic is only slightly different from our equivalent symbol.

The wattage ratings of resistors are also indicated by codes. The progression of wattage ratings is somewhat different from that used in the United States. We use one-quarter watt, one-half watt, one watt, etc. The Germans use one-eighth watt, one-fifth watt, one-third watt, one-half watt, one watt, etc.

These ratings codes allow a non-German technician to determine the rating without having to read a German-language spare-parts list (Ersatzreilliste).

When replacing one of the resistors with an odd wattage rating, use the next higher standard U.S. value. A one-fifth watt, for example, can be replaced with a one-half watt U.S. resistor.

Exact German resistance values, on the other hand, can be a problem to locate. A typical German resistor might have a value of 30K instead of the U.S. standard value of 27K or 33K. In the United States we have a "tolerance overlap" system in effect to compute the standard progression of values. If a German resistor needs replacement, use the closest standard U.S. value. For example, let's again use the German 30K value. 30,000 ohms plus or minus ten percent (3000 ohms) gives a range of 27,000 ohms to 33,000 ohms. It is likely that either a 27K or 33K with a ten per cent tolerance will fall within that range.

Fig. 1 also shows the standard European method of depicting an iron-core transformer. The windings are shown as black solid bars instead of as coils. In some schematics it appears that the thickness of the secondary bar (relative to the primary) indicates the relative current capacity, while the length indicates the relative voltage rating. This does not, however, give absolute val-

Table 1

Glossary Of Words Used In German Car Radio Service Manuals

German	English
Kundendienstchrift	Service manual
Schaltbild	Schematic
Ersatzreilliste	Spare parts list
Abgleichpunkt	Alignment point
Lautsprecher	Loudspeaker
ZF	IF (intermediate frequency)
Masse	Ground
Spannungen	Voltage
Oszallator	Oscillator
Gemessen	Signal
Bedruckte Platten	Printed-circuit board (PCB)
ZF-Platte	IF PCB
Widerstande	Resistor
Einstellregler	Adjuster
Transformatoren	Transformer
Transistoren	Transistor
Bandfilter or ZF-Filter	IF transformer
Spulen	Coils or inductors
Kondensatoren	Capacitors
Kunstfoilen Kondensatoren	Plastic film capacitor
Keramik Kondensatoren	Ceramic capacitor
Elektroly-Kondensatoren	Electrolytic capacitor

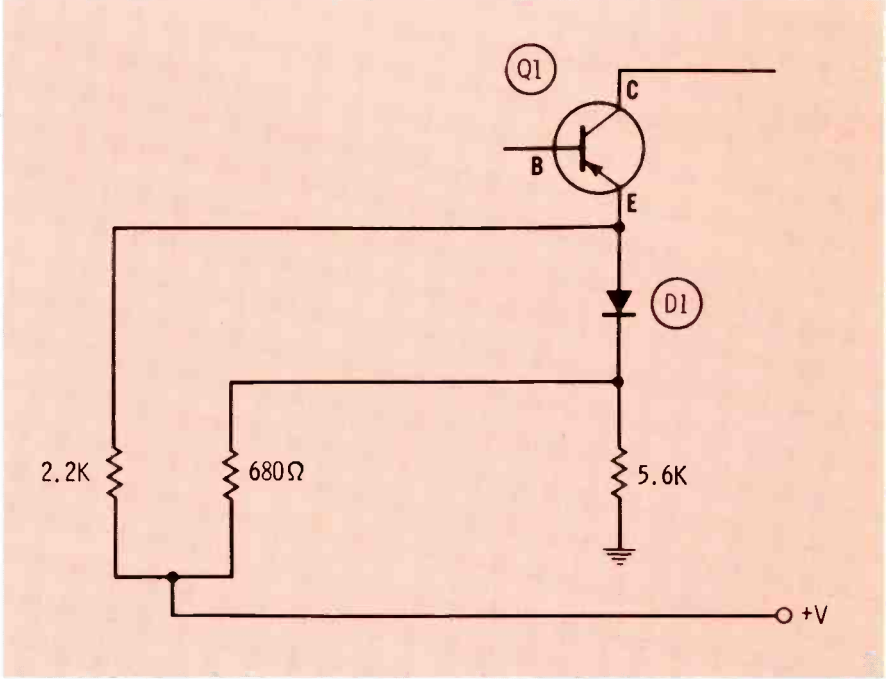

Fig. 2 Semiconductor diodes are used frequently to stabilize the bias of the front ends of German car radios.

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ues. The idea is best illustrated by example.

Suppose a transformer had a secondary that was designed to step up the voltage. This requires that the current capacity of the secondary be scaled down in the same proportion as the secondary voltage is scaled up. The diagram would show the bar representing the secondary winding as being longer and thinner than the bar representing the primary winding. For a filament transformer, the secondary bar would appear shorter (lower voltage) and thicker (higher current) than the primary. These indications are not always in use, but the author has seen them often enough to believe that they are true.

RF Band Identification

One of the first things that you will notice about some European car radios is the strange markings on the dial scale. The customer might complain that the FM band is dead. OK, let's get down to finding out why. Only . . . which pushbutton is for the FM band? There might be as many as five pushbuttons marked "L", "M", "K", "U" and possibly "Q". The band designations represented by these letters are shown in Table 2. The two bands of interest in the United States, AM and FM, will be marked "M" (medium wave) for AM and either "U" or "UKW" for FM. "U" simply means "VHF" or "Ultrakurzwaben" (ultra short waves).

The other bands frequently found on German car radios are "L" (long wave) and "K" (kurzwaben or short wave). The existence of a long wave band doesn't indicate a peculiar European penchant for monitoring aviation beacons and maritime CW traffic. In Europe, there is a very active broadcast band situated in the 150K to 300K-Hz segment of the radio spectrum. In fact, a lot of returning Americans claim that "L" was their favorite band because of the superior reception it offered. The "K" shortwave band will be a small segment of the spectrum between 2 and 10 or possibly 12M-Hz.

"Q" usually designates an outboard accessory such as a cassette tape player or a multiband short-wave converter. In sets of recent design the "Q" pushbutton operates the cassette player by switching the audio leads of the receiver from internal to an external jack. It also might turn on power to the cassette deck. European-made radios encountered in the U.S. with either "L" or "K" bands are probably export models.

Some of the older sets made exclusively for the European market have an FM band that is slightly different from ours. These sets will tune from around 85M-Hz to 100M-Hz. You will pick up channel 5 TV audio on the low end of the dial while the upper portion of our FM band will be missing.

If you encounter one of the German car radios with a tuning dial marked in wavelength instead of frequency, you can convert the dial readings, for calibration purposes, by using the equations given in Table 2. It once was standard practice in Europe to use wavelength. Some of the older designs of European-made radios have been brought into the U.S. For example, you might encounter one on which the AM radio dial scale is marked from 594 (or 600) to 181 meters. The FM dial will be marked 3.43 to 2.78 meters.

On most modern domestic-production and on all U.S. model export sets the dial is marked according to frequency.

Circuit Differences

One difference worthy of note is the widespread use of semi-

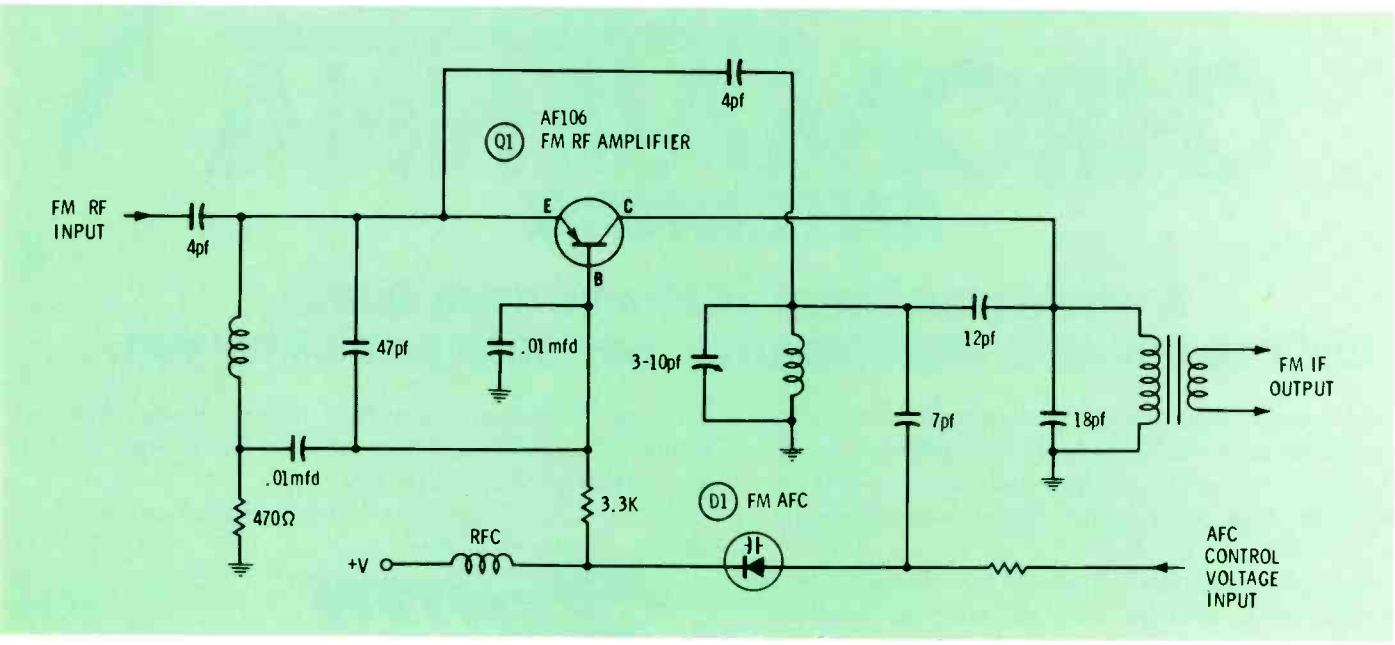

Fig. 3 The use of a single converter transistor, as shown here, in the FM front-end of a Becker Europa MU (AM/FM) receiver, is probably one reason that most German auto radios have lower sensitivity than their American-built counterparts.

conductor diodes to stabilize the bias on the front-end transistors. This type of circuit is shown in Fig. 2. The thermal coefficient of a semiconductor diode used for this purpose is such that the bias of the stage will tend to remain stable over a wide range of ambient temperatures.

This characteristic in the past has led to certain rather interesting service problems. In one older AM Blaupunkt, for example, a frequent complaint was that the radio would change stations as the customer depressed the automobile's accelerator! Because this was before the days of varactor diode tuning, and on the AM band to boot, many technicians would at first tend to disbelieve the customer. Once he road tested the car, however, he would become a believer. These radios would actually shift frequency several dozen kilohertz as the car accelerated from a stand-still to 30 or 40 miles per hour.

The cure was a new diode and a voltage check of the regulator in the car. When I encounter one of these sets, I place a Zener diode across the internal B+ line, to prevent a possible callback. Then, if the problem re-occurs the customer will hold us responsible even if he has failed to have a VW automotive electrician

Table 2

Labels Commonly Used On The Bandswitch And Pushbuttons Of German Car Radios

LABEL	MEANING
L	Longwave (150-290 KHz)
M	Medium Wave (515-1640 KHz) AM Broadcast band
U	Ultra Short wave (VHF) 87-108 MHz
UKW	"Ultra Kurz Waben" Same as "U"
K	Shortwave usually a band between 2 and 10 MHz

WAVELENGTH CALIBRATED DIALS

Some older European car radios had dial scales calibrated by wavelength rather than frequency. The unit is the meter.

Examples:

AM Broadcast 594-181 Meters
FM Broadcast 3.43-2.78 Meters

For conversion to frequency use the formulas:

$$F_{KHz} = \frac{300,000}{\lambda \text{ (meters)}} \quad \text{or} \quad F_{MHz} = \frac{300}{\lambda \text{ (meters)}}$$

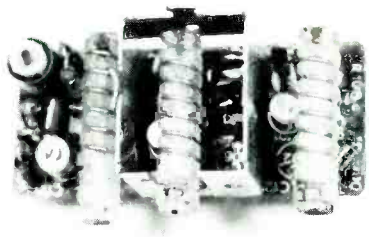

Fig. 4 The FM tuner subassembly of a Blaupunkt Model '3670 Frankfurt auto radio. Comparing the sizes of the two small, type TO-18 transistors and the rest of the circuit board will put into perspective the relatively small size of the subassembly.

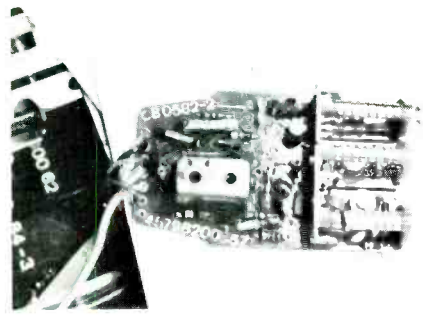

Fig. 5 The FM tuner subassembly of a Blaupunkt "Emden III" export model receiver. This subassembly is slightly larger than that in Fig. 4 because the 1st FM IF transformer is mounted on it.

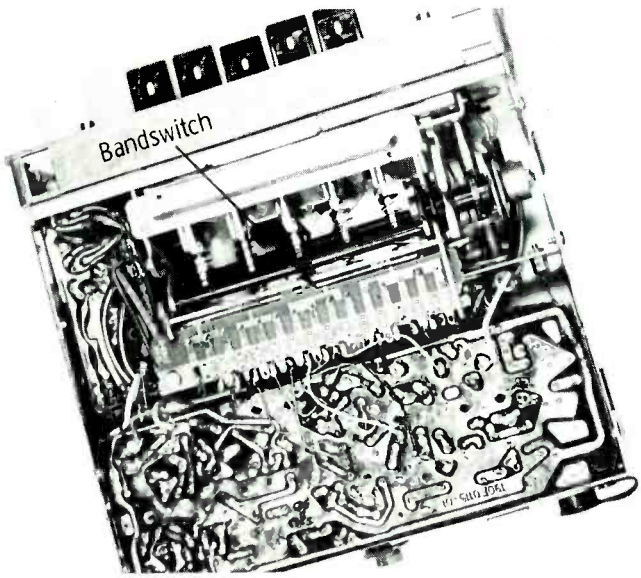

Fig. 6 Bottom view of the Becker Europa AM/FM receiver showing the bandswitch and the main printed-circuit board.

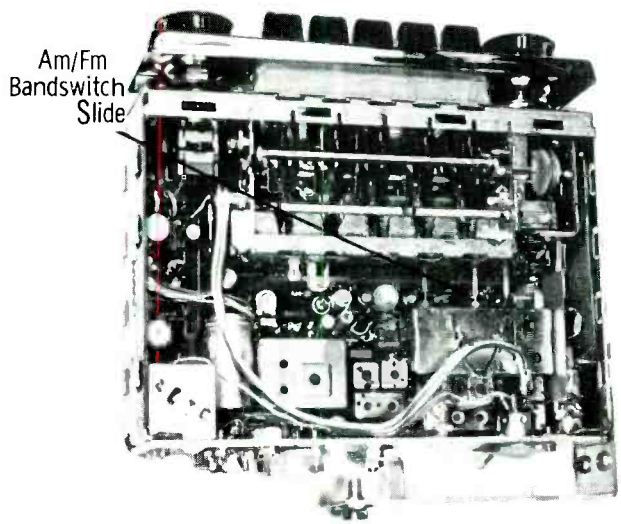

Fig. 7 The AM/FM bandswitch of the Blaupunkt '3670 series Frankfurt receivers has been the chief cause of "dead" or intermittent-operation complaints.

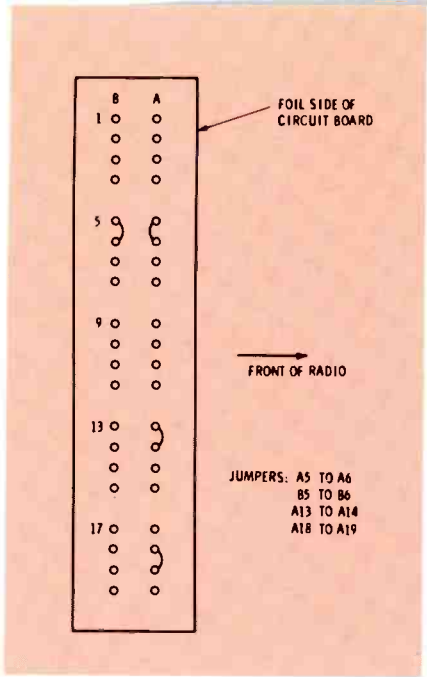

Fig. 8 Illustrated here is the factory-recommended modification of the bandswitch board of Blaupunkt Frankfurt receivers.

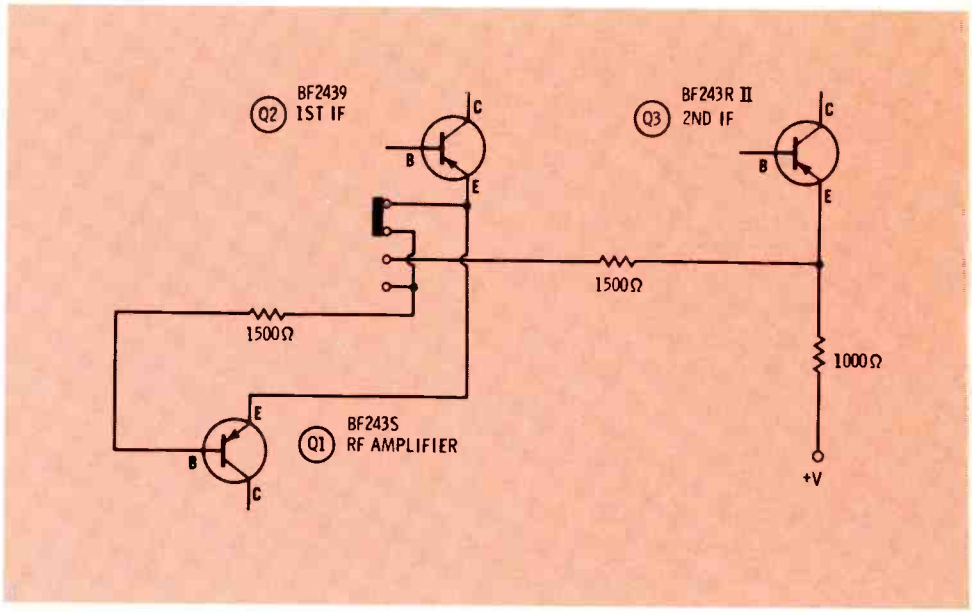

Fig. 9 The bias and AGC voltage for the RF amplifier stage of the Blaupunkt Frankfurt receiver is developed in the emitter circuits of the 1st and 2nd AM IF amplifiers. See text for related trouble.

check out the voltage regulator (there are cures for THAT too . . . no warranty unless the customer provides a bill from a VW dealer showing that the regulator has been checked and is okay).

In most American car FM radios, the tuner is equipped with separate oscillator and mixer transistors. most German designs, however, use a single converter transistor in the FM front end. This probably is the reason why most German-built auto radios have lower sensitivity than American radios.

A typical German FM converter stage is shown in Fig. 3. This particular circuit is from a Becker Europa MU. ("Europa" is the model, and "MU" indicates that it is an AM/FM set). The actual circuit is not too unusual except that it isn't used extensively in this country. It is basically a common-base Colpitts oscillator with the signal from the RF amplifier injected at the emitter terminal.

Two typical German FM tuner subassemblies are shown in Fig. 4 and 5. The tiny tuner in Fig. 4 is from a Blaupunkt model '3670 "Frankfurt (U.S.)". The transistors on the circuit board give an indication of the small size of this tuner. They are not TO-5 types but instead are the much smaller TO-18 types. Note that the oscillator coil in the center is shielded from the other circuits.

The slightly larger tuner in Fig. 5 is from a Blaupunkt "Emden III", an overseas delivery model. One reason for the larger size of this tuner is that the 1st FM IF transformer is mounted on the same printed-circuit board.

The same types of trouble which occur in domestic auto radios also occur in German car radios. Common defects include defective RF amplifier and converter transistors and AFC diodes. As is also true of American radios, resistors and capacitors are not particularly common sources of trouble. There seems to be fewer defective solder joints in most German models. This does not mean that there is no chance of finding a workmanship defect in a German car radio. They have their quality-control problems, too.

One of the biggest problems in German car radios is the bandswitches. With all of those bands, the Germans frequently resort to some complex switching circuits. The bandswitch in the Becker Europa MU (stereo) is shown in Fig. 6. The part showing in the photograph is only one section of the total bandswitch mechanism. It is a good idea to clean the bandswitch on every German radio which is brought in for service.

The '3670 series of Frankfurt (U.S.) sets by Blaupunkt are installed by many VW dealers. Historically, these radios have exhibited a problem with the AM/FM switch. A common complaint is that the radio is either dead or intermittent on AM but operates normally on FM. A too-quick reading of these symptoms might lead you to believe that the auto antenna is open intermittently when it actually isn't. The stator element of the AM/FM bandswitch is a printed-circuit board rather than a manual assembly.

When this complaint is encountered, set the radio to AM and gently rock from side to side the moving slide on the bandswitch. (The location of this slide is shown in Fig. 7. It is directly behind the Permeability Tuning Mechanism (PTM) and in front of the FM tuner housing.) If this causes the radio to operate, even momentarily, it will be necessary to clean the switch and perform the following Blaupunkt-recommended circuit modification: As illustrated in Fig. 8, cause solder to flow across terminals A5 to A6, B5 to B6, A13 to A14, and A18 to A19. The view in Fig. 8 is from the printed side of the board.

European designers have used some unusual AGC and bias circuits in their car radios. A typical arrangement is the Blaupunkt Frankfurt circuit shown in Fig. 9. Notice that the bias and AGC for

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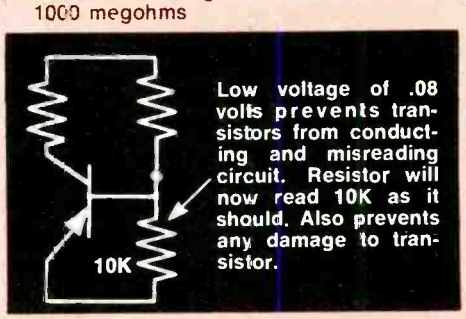
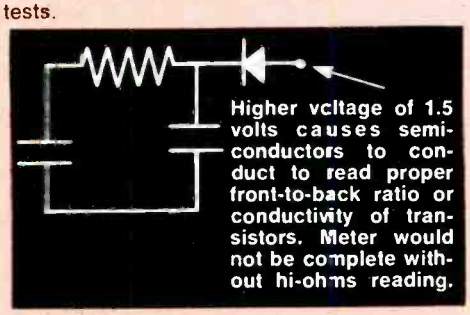
- 9 DC zero center ranges from .05 volts to 500 volts . . . a must for delicate transistor bias measurements
- 7 resistance ranges from 1000 ohms full scale to 1000 megohms
- 9 DC current ranges from 100 microamps to 1 amp
- Automatic built-in battery test . . . never a worry about rundown batteries, just push the switches under the meter and read.
- Standard .6 amp fuse tc protect the ohms and milliamps scales if voltage or overload is accidentally applied. No more need to return the meter to factory for repair . . . just replace the fuse.
- Special probe with 100K isolation resistor in probe to prevent AC pickup or to prevent loading oscillator circuits. Leave in normal position for most tests.



Low voltage of .08 volts prevents transistors from conducting and misreading circuit. Resistor will now read 10K as it should. Also prevents any damage to transistor.

Here is why you should have both Hi and Lo battery voltages for correct in-circuit resistance measurements in solid state circuits:



Higher voltage of 1.5 volts causes semiconductors to conduct to read proper front-to-back ratio or conductivity of transistors. Meter would not be complete without hi-ohms reading.

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Circle 18 on literature card

the RF amplifier is developed by the emitter circuits of the 1st and 2nd AM IF amplifiers. (Multiple AM IF amplifiers are common in European sets.)

Excessive leakage current in Q3 in Fig. 9 can cut off the RF amplifier, Q1. The hiss produced in such a case sounds like that produced by a bad RF amplifier transistor. Consequently, when the RF amplifier in these radios is cut off, check the IF amplifiers.

Because a lot of relatively well-to-do folks drive new Mercedes-Benz automobiles, it seems only natural for the Mercedes-Benz radio supplier, Becker, to offer an AM/FM/stereo FM car radio. Becker chose the Motorola integrated-circuit stereo decoder as the means for converting the Europa series radios to stereos. It was something of a surprise to lift the Becker stereo printed-circuit board and find a Motorola MC1304. (In some cases, this chip can be purchased through Motorola Semiconductor Products distributors for less than its available for through Becker, MAPI, Delco, etc.)

The Becker people have added a composite preamplifier (Fig. 10) of their own in the MC1304 external circuitry. A photo of the actual board is shown in Fig. 11. Although it might appear to be a bit difficult to troubleshoot, it really is relatively simple. Becker has mounted the printed-circuit board on hinges so that it can be swung up into the vertical position. The leads attached to the board are long enough to permit this.

All but the least expensive German AM manual car radios use externally-mounted transistors which have a size and shape much like our TO-66 package transistors. An example of these, shown mounted on a Blaupunkt Emden III, can be seen in Fig. 12. These transistors are located behind the radio mounting bezel. In other models they are found on the rear chassis panel.

Some models of the units produced by both major German companies use an external audio power-amplifier chassis. This package will mount either to the firewall of the car or can be suspended on stiff brackets beneath the radio.

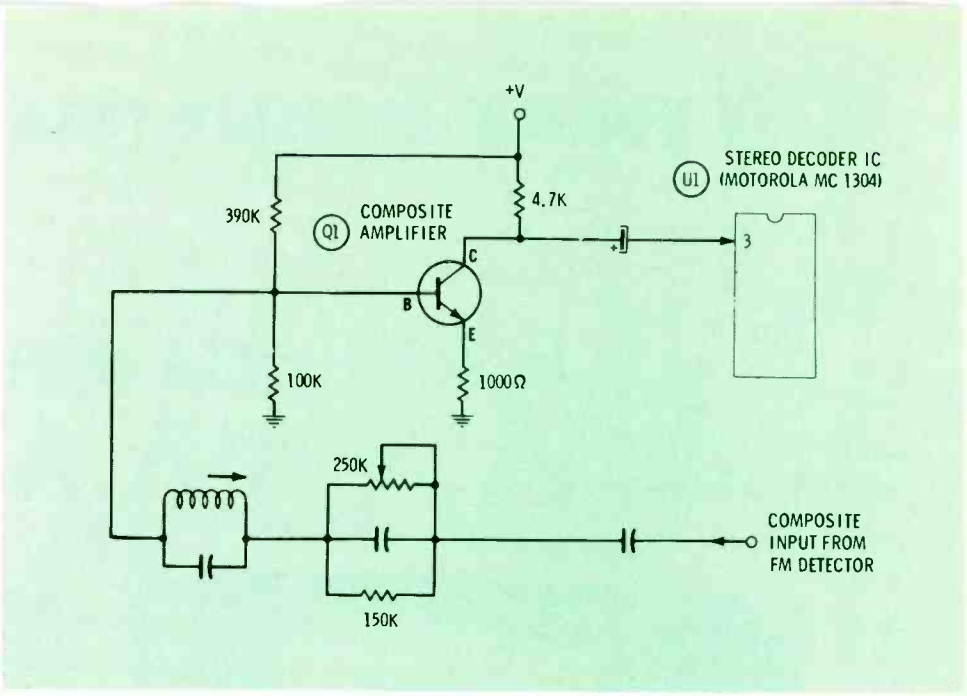


Fig. 10 The Becker Europa series of auto radios have been converted to stereo by use of a Motorola integrated-circuit stereo decoder. Becker has added to the external circuitry of the IC decoder their own composite preamplifier, the circuitry of which is shown here. See text for details.

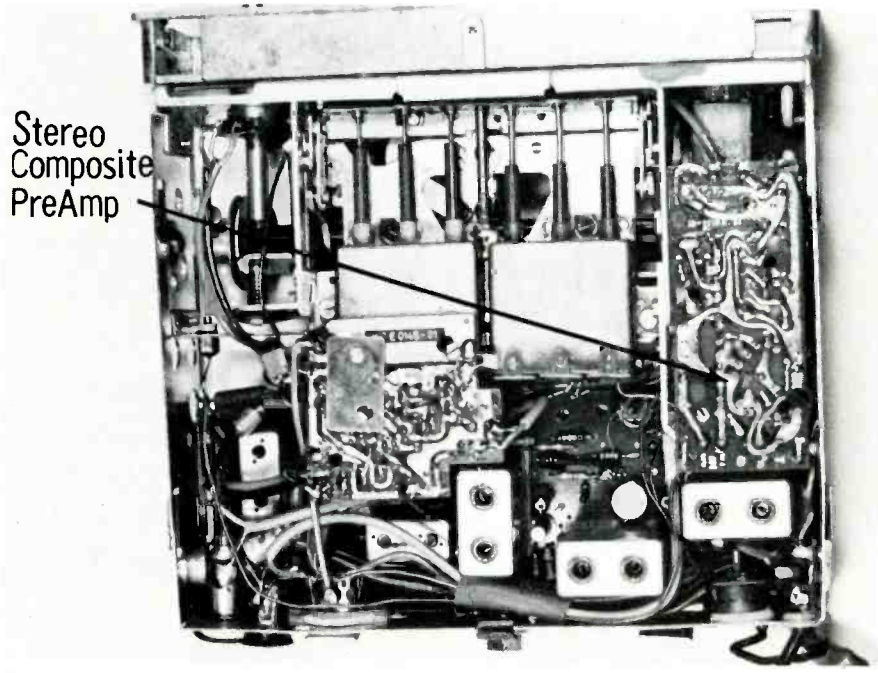
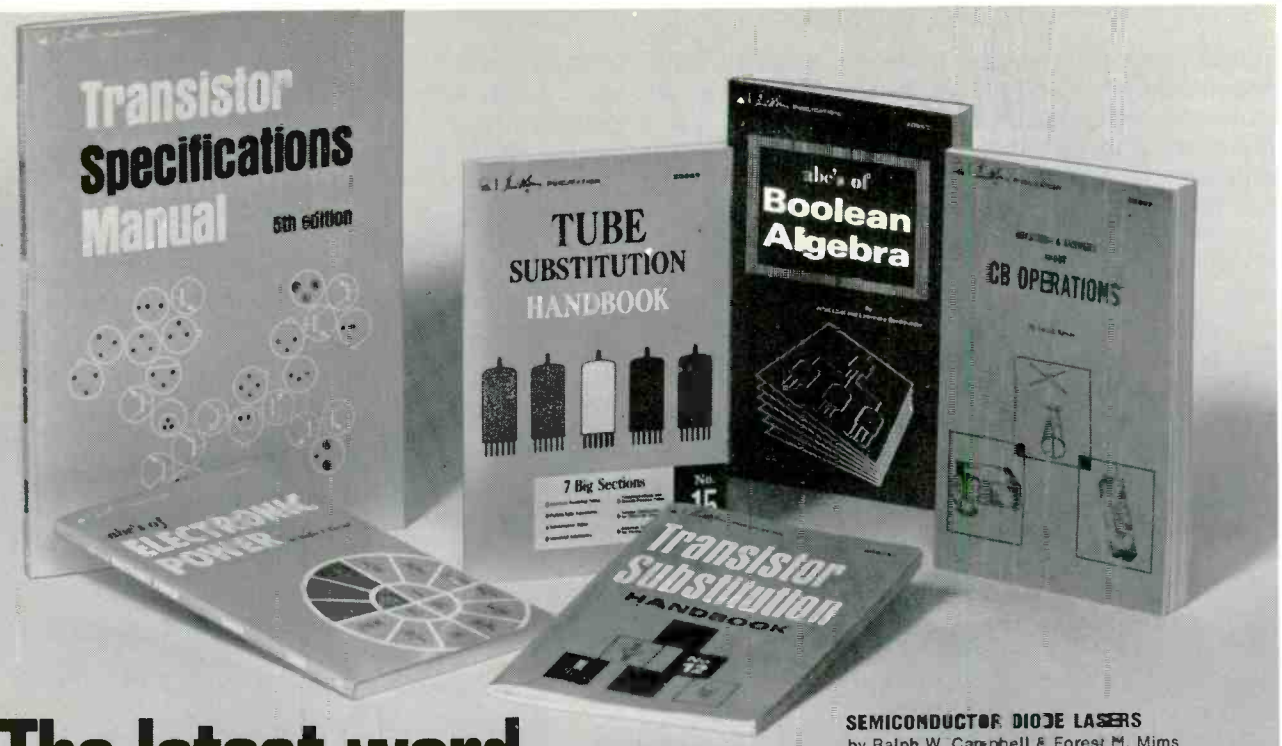


Fig. 11 Bottom view of Becker Europa auto radio with stereo composite amplifier printed-circuit board pointed out.

In certain of the now obsolete hybrid designs, it was common to find an outboard package containing a solid-state, push-pull audio amplifier and a solid-state, DC-to-DC high-voltage converter. These tube-type sets can be identified by the three type TF 80/30 power transistors along one side of the outboard package. Push-pull audio stages are a rarely violated rule in German designs. In American sets, however, they are the exception.

Try to use only original replacements for these transistors. The problems encountered in trying to use American TO-3 or



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A quick and handy reference source of information about CB radio; its classes and uses, licensing and FCC rules, operating procedures, selection of CB equipment, and installation of transceivers and antennas in mobile and fixed-station locations. As valuable for anyone who works with CB radio as it is for electronics engineers and technicians.

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Circle 19 on literature card

TO-36 transistors in the limited space offered in the typical German car radio make them impractical. Some of the universal replacement guides optimistically offer one of their numbers that are electrically identical. The identity, however, is electrical only.

If you encounter one of the older tube-type classic Becker "Mexico" models, you probably will find a significant lack of sensitivity. This might be caused by a faulty "antenna" section of the bandswitch (see Fig. 13). This switch is not located on the master bandswitch assembly but instead is a small, leaf-spring-powered unit located close to the antenna input jack. It is operated by a long bar connected to the master switch slide.

If cleaning and retensioning of the leaf spring do not cure the problem, it might be necessary to order a new switch from Becker. (Addresses for both Becker and Blaupunkt can be found in the latest edition of your Sams Annual PHOTOFACT Index and in the Source Guide to Imported Sets published annually in the November issue of ES.) The usual reason these switches fail is a loss of tension in the spring. When this occurs, you can see daylight through the point where the contacts are supposed to come together. If you have a supply of surplus Delco Wonder Bar parts, try using the spring from either the Wonder Bar start switch or the solenoid recocking switch. I have found from experience that many of the springs from older Delco switches will fit perfectly into the space occupied by the spring in the Becker antenna switch.

German composite AM and FM IF amplifiers at first examination might appear complex and difficult to service. A typical Blaupunkt circuit is shown in Fig. 14. It is the coupling between two IF stages. Although it is the reason for the excellent selectivity figures for which these radios have a justified reputation, it can be somewhat difficult to troubleshoot. One problem is the extreme small size of those coils. (I once heard an electronics instructor say that solid state is fine but do not expect too high a degree of set miniaturization. His pre-1960 reason was that no one could find a way to miniaturize the henry and the watt. The Germans and the Japanese have obviously never got the message because they have succeeded in miniaturizing the henry, and, judging from recent Hi-Fi advertising, the watt is on it's way down.)

Although not yet typical, the audio stage shown in Fig. 15 offers evidence that the Germans soon might be making extensive use of integrated circuitry. It is the preamplifier stage from one channel in the Becker Europa

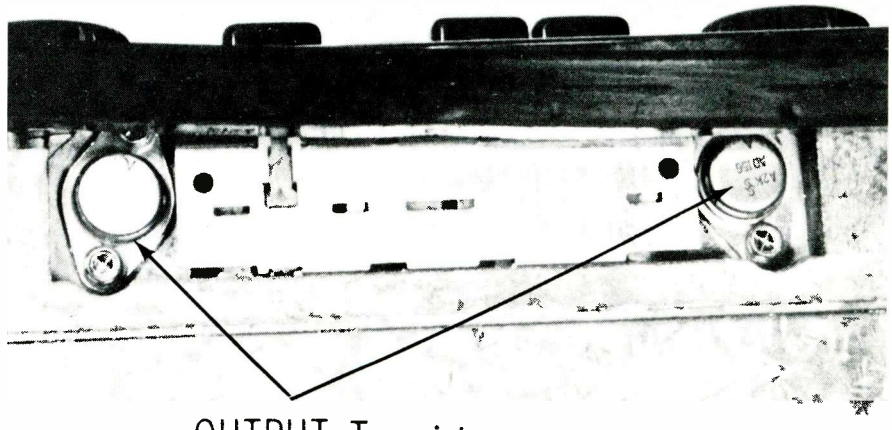


Fig. 12 Bottom view of Blaupunkt Emden III showing externally-mounted output transistors, a feature of all but the least expensive German AM manual auto radios.

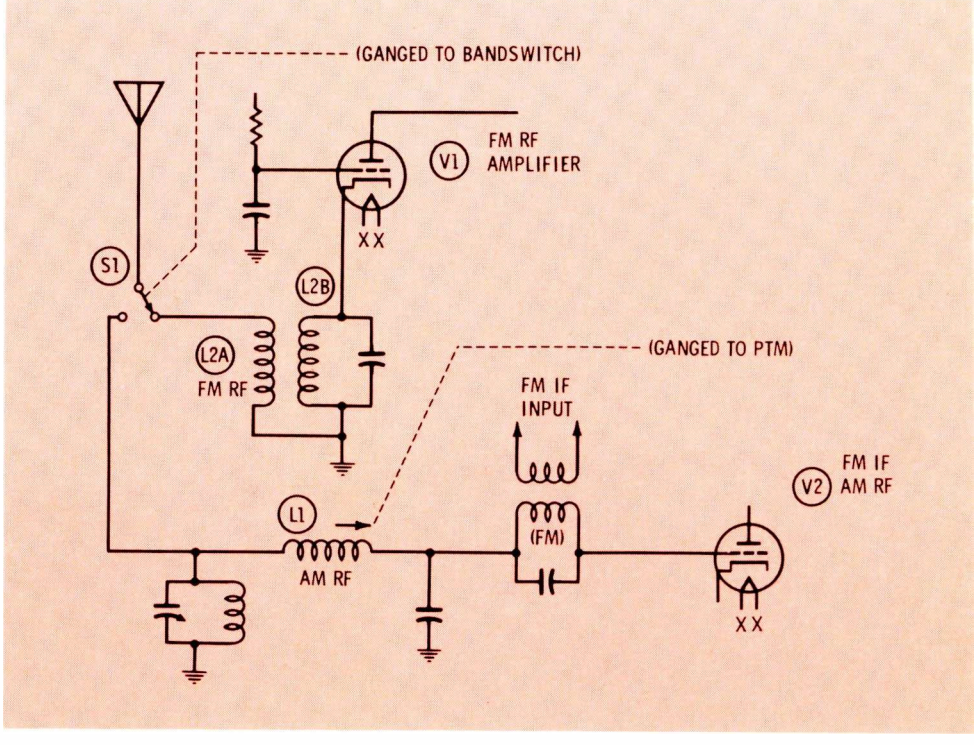


Fig. 13 Leaf-spring-powered antenna switch, shown here, which is ganged to the bandswitch, is one source of reduced sensitivity in the older, tube-type Becker "Mexico" model receivers.

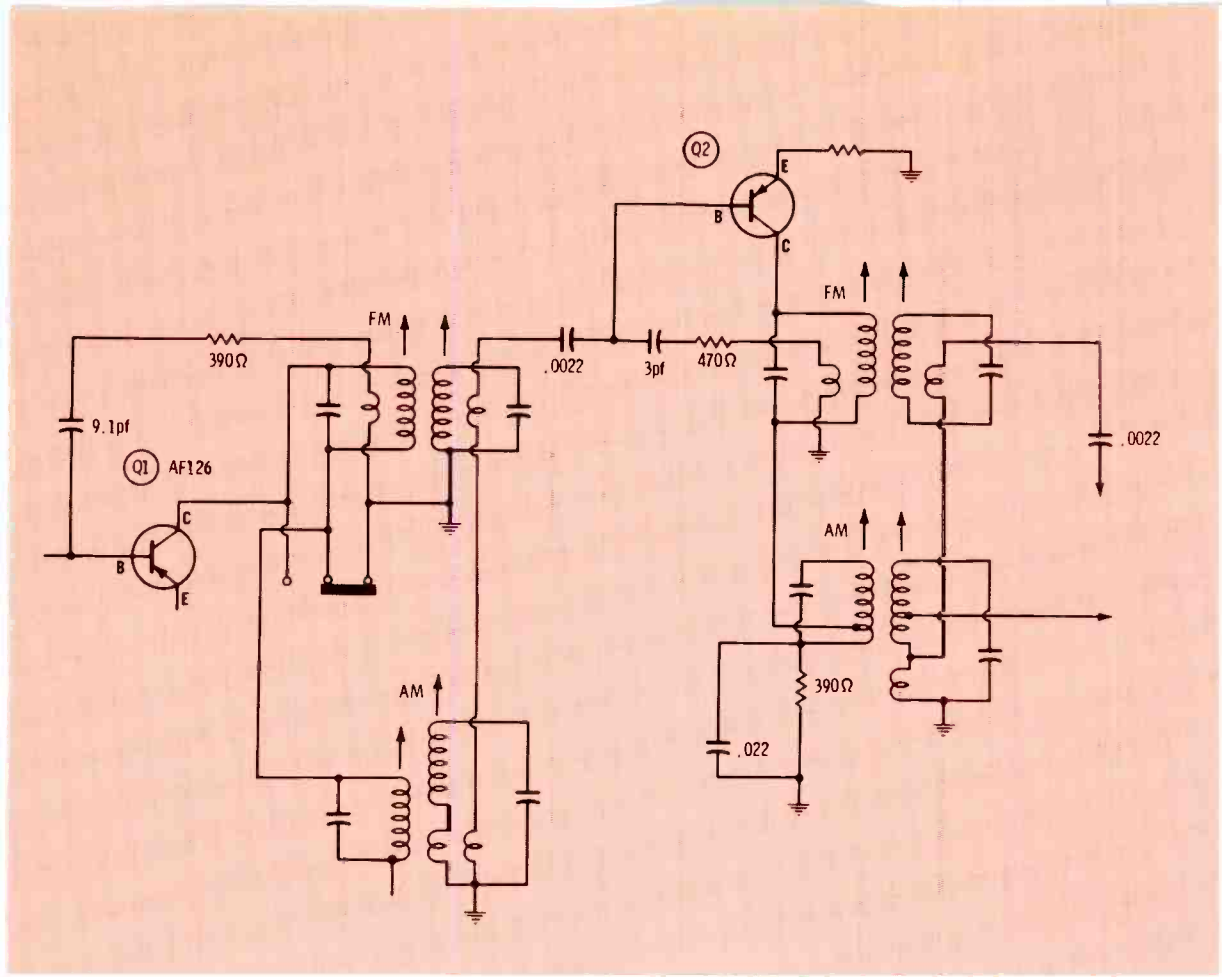


Fig. 14 Complex coupling between two IF stages of a composite AM/FM IF amplifier, shown here, is a typical Blaupunkt design.

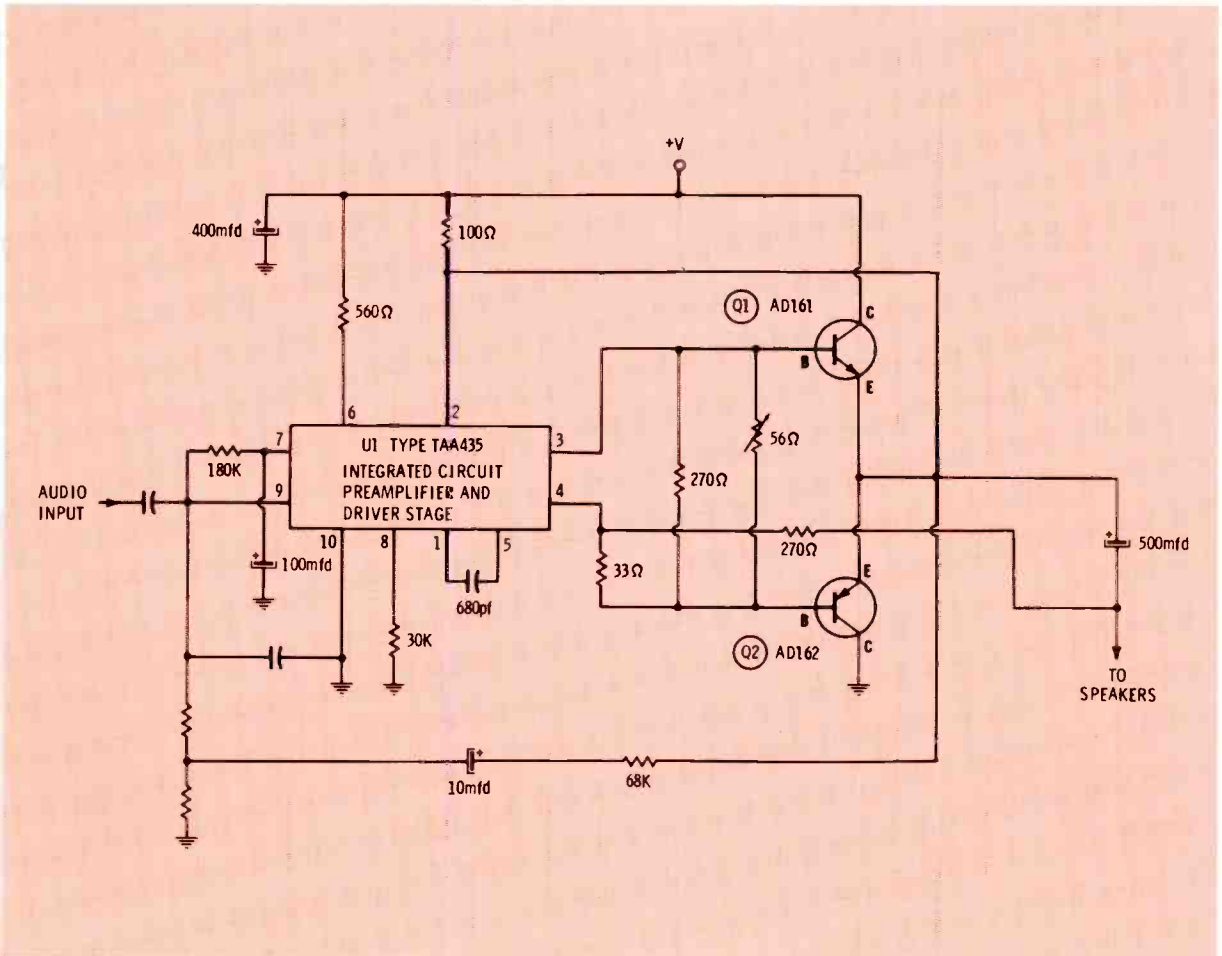


Fig. 15 Use of IC's by German auto-radio manufacturers is evidenced by the IC-equipped audio preamplifier and driver section of the Becker Europa MU stereo auto radio.

MU stereo receiver. The type TAA435 IC takes the place of the several preamplifier and driver components needed to make a decent complementary-symmetry audio amplifier stage.

The output transistors in Fig. 15 are more difficult to find than the replacement catalogs indicate. The type AD162 is available while the AD161 is somewhat harder to find. Many of the universal replacement catalogs list a silicon NPN unit for the AD161 replacement. Although the silicon might operate satisfactorily in a single-ended stage, it can cause distortion in the complementary configuration unless a silicon replacement for the PNP transistor can also be located.

These transistors can be ordered under original type number from several sources. First, try the manufacturers of the radio being repaired. Both Becker and Blaupunkt use this pair. Also, try a distributor that handles parts for the O.E.M. Chrysler radios made by Philips, Ltd., of Canada. The 1969-1970 model Philips radios used the AD161 and AD162 transistors.

Give It Some Consideration

Well, there you have a brief look at German car radio servicing.

If there is stiff competition among auto radio shops in your area, you can get an edge over the others by offering import dealers total service. If you can handle O.E.M. Bendix and MAPI (Motorola) warranties as well as the next guy, what is the difference to the local VW dealer? If, on the other hand, you are the only guy that can also handle his Becker and Blaupunkt work, he will probably shoot all of his business your way.

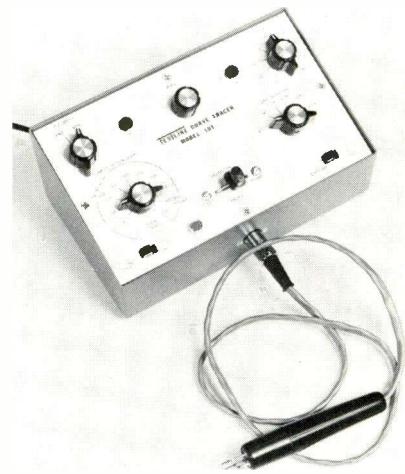
Warranty and retail repairs to the German brands give you a better shot at VW, Porsche, Mercedes-Benz, Volvo, Saab, and Audi dealers. Keep life simple for the parts managers of the auto dealers and they will reciprocate by giving you a lot of business. □

test equipment report

Features and/or specifications listed are obtained from manufacturers' reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Transistor Curve Tracer

Product: Model 101 curve tracer
Manufacturer: Testline Instruments
Function and/or Application: Checks transistors in- and out-of-circuit.
Features: Plugs into any conventional oscilloscope for displaying curves. Two styles of probes for in-circuit checking of transistors of any configuration. In-circuit checking of high-voltage, focus rectifiers and FET's can be made. Two transistor sockets for testing and matching transistors out-of-circuit. NPN or PNP displays, in- or out-of-circuit; germanium or



silicon transistors checked; FET or bi-polar transistors checked. FET curves displayed for enhancement or depletion mode. Zener diode displays from a few microamps to 100 mA.
Specifications: Base current: 1 μA per step to 1000 μA per step in nine ranges. Gate voltage: 250 mV per step to 1000 mV per step in three discrete ranges. Collector voltage: 0 to 80 V; 0 to 100 mA, dependent on dissipation resistors. Load resistance: 470 ohms to 47K ohms. Power re-

quirements: 115 VAC; 60 cycle, ½ amp.
Price: Model 101 sells for $150.00.

Circle 50 on literature card

CRT Auto Tracker

Product: CR161 auto-tracker
Manufacturer: Sencore, Inc.
Function and/or Application: Automatic checking of color CRT gun tracking.
Features: Computer memory circuits store CRT information during emission checks, color guns are automatically compared to each other for a 1:5 to 1

ratio by pushing a Automatic Tracking button. Results can be read as "Good" or "Bad." The CR161 tests the standard three-gun color CRT as well as the "single-gun" Trinitron and black and white. Filament voltage setting, gun balance setting, shorts test, shorts removal, emission check, and three rejuvenation positions are covered with a single switch. The CR161 is housed in a brushed steel and vinyl-clad carrying case with setup book included.
Specifications: N/A
Price: The CR161 sells for $140.00.

Circle 51 on literature card

Dual-Trace Triggered-Sweep Scope

Product: Model IO-105 dual trace triggered-sweep DC-15 MHz oscilloscope
Manufacturer: Heath Co.
Function and/or Application: The IO-105 provides dual-trace, triggered-sweep display
Features: Switch selected AC or DC coupling permits triggering at a given point or at a prese-

(Continued on page 36)

(Continued from page 35)

lected DC level; positive and negative slope triggering is also switch selectable. Other features: rear panel sweep gate output delivers a 3.5 volt pulse in sync with sweep for special applications; TTL-compatible external blanking input; 8 x 10 cm rectangular flat-face CRT with standard camera mount on bezel; removable side panels for accessibility; 15-inch depth.

Specifications: X-Y capability permits each input to be displayed as a function of the other; Channel 1 controls the Y axis and Channel 2 controls the X axis. Both inputs are balanced for less than 5 per cent phase shift to 50 KHz. An 18-position time base switch in a 1, 2, 5 sequence gives sweep rates from 100 msec/cm to 0.2 usec/cm. DC-15 MHz bandwidth and 24 nsec rise time permits analysis of high frequency and sharp-front waveforms. Full bandwidth is provided from 20 V/cm to 50 mV/cm.

Price: The IO-105 scope sells for $399.95

Circle 52 on literature card

Digital Multimeter

Product: Model 3300A 3-½ digit multimeter

Manufacturer: Hickok

Function and/or Application: Measures AC and DC voltages

Features: The 3300A can operate for 24 hours from an internal nickel cadmium battery; the battery is good for 1000 recharges minimum. Cycolac case and shock-mounted components allow accurate measurements over a wide range of environmental conditions. The 3-½ digit display is non-blinking. Automatic zeroing circuit adjusts for zero before every reading. Decimal point is automatically positioned and polarity is automatically displayed.

Specifications: Ranges are: **5 AC voltage ranges,** from 100 millivolts to 1 kilovolt; maximum resolution is 100 microvolts; accuracy is 0.5 per cent of reading ±1 digit. Bandwidth for AC measurements is to 100KHz. **5 DC voltage ranges,** from 100 millivolts to 1 kilovolt; maximum resolution is 100 microvolts; accuracy is 0.1 per cent of reading ±1 digit. **5 AC current ranges,** for 100 microamperes to 1 ampere; maximum resolution is 100 nanoamperes; accuracy is 0.5 per cent of reading ±1 digit. **5 DC current ranges,** for 100 microamperes to

1 ampere; maximum resolution is 100 nanoamperes; accuracy is 0.2 per cent of reading ±1 digit. **7 resistance ranges,** for 100 ohms to 100 megohms; maximum resolution is 100 milliohms; accuracy is 0.3 per cent of range ±1 digit. The 3300A measures 8 inches X 5⅞ inches X 4 inches, and weights 6 pounds.

Price: Model 3300A sells for $435.00.

Circle 53 on literature card

Frequency Counter

Product: Model IB-1101 100M-Hz frequency counter

Manufacturer: Heath Co.

Function and/or Application: Frequency measurements from 1 Hz to over 100 MHz.

Features: Input circuit accepts input levels from less than 50 mV

to more than 200 V, depending on frequency. Overrange circuitry can expand five-digit readouts to eight-digit capabilities. The decimal point is automatically placed with range selection, while front-panel lights indicate MHz, KHz, overrange and gating. A one megohm input impedance and low input capacitance reduce the chance of circuit over-

loading. The 26 digital IC's and five color-cathode readout tubes plug into individual sockets. A built-in variable-level signal source permits initial sensitivity setup, a conventional AM radio can be used as time-base oscillator adjustment standard.

Specifications: N/A

Price: The IB-1101 sells for $269.95.

Circle 54 on literature card

Dual-Trace Triggered Oscilloscope

Product: Model 553P 5-inch scope

Manufacturer: Kikusui Electronics Corp.

Function and/or Application: Measurement and waveform monitoring applications

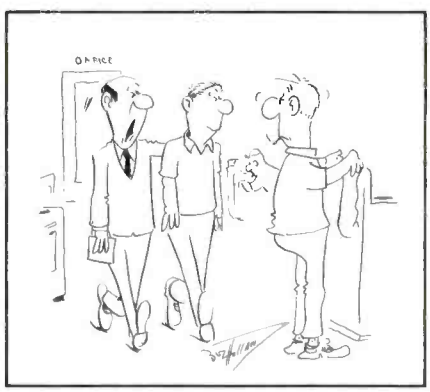
Features: Single gun 5-inch flat faced CRT with helical PDA operating at 3000V. The dual-trace system displays either channel separately, alternates between channels or choppers between channels, all solid-state circuitry.

Specifications: The 553P that contains a vertical differential DC amplifier that produces a bandwidth of DC to 10MHz, with a voltage accuracy of ±3 per cent. Model 553P measures 8⅛ inches X 11⅝ inches X 18⅛ inches and weighs 24 pounds.

Price: Model 553P sells for $538.00. □

Circle 55 on literature card

For more information about above products use reader service card



"Pheany, take 5 minutes out and show the new man here all you know about the repair department."

shoptalk

With Carl Babcoke
ES Associate Editor

Horizontal sweep and high voltage in color TV, Part 2

Second of a three-part series which analyzes the functions of circuits and individual components, and the symptom and causes of typical defects, and proven techniques for quickly isolating them.

Part 1 of this series described how the horizontal AFC and horizontal oscillator circuits of a typical tube-type color TV receiver, RCA CTC7AA functioned together to produce a signal with the correct phase, frequency, shape and amplitude required to properly drive the horizontal-output stage. Included also were analyses of the function of each component in the horizontal AFC and oscillator circuits and how defects typical of each affect the characteristics of the drive signal.

In this second part of the series, the functions of the horizontal sweep and high-voltage sections will be analyzed, by examining how each component, when operating correctly, contributes to the function(s) of the section or stage in which it is electrically located and, when defective, adversely affects that function.

A complete schematic diagram of the circuitry analyzed is given in Fig. 6.

- **R123 (16K-ohm, 7-watt resistor)**—Reduces the 395-volt supply to the level required by the screen grid of the 6DQ5. An increase of the resistance of R123 reduces the screen voltage, width and high voltage in the same way that leakage in C78 does. (See Line "H" in Table 3.) A reduction of the resistance of R123 increases the screen voltage, width and high voltage, and also increases the 6DQ5 dissipation above the maximum rating, which, in turn, reduces the life of the tube.
- **C78 (.1m-fd capacitor)**—Bypasses the screen grid of the 6DQ5, to prevent degeneration and loss of gain produced by the tube. The value is not very critical; however, a capacitance of less than .01m-fd reduces the width and high voltage. A capacitance of less than .0005m-fd black out the raster and eliminates the high voltage. Not all TV receivers lose their raster when the screen-grid bypass capacitor opens, but most exhibit some loss of width.

Severe leakage of 10K ohms or less across C78 is necessary to significantly reduce the width.

- **6DQ5, the horizontal-output tube**—The symptoms produced by a defective 6DQ5 widely vary according to the exact defect and the extent of the defect. The voltage readings produced by two 6DQ5 tubes which had different amounts of reduced emission are shown on Lines "B" and "C" in Table 2. Figure 7A shows the slight reduction in width and the compression along the right edge of the picture which were produced by the weak tube the readings of which are given on Line "B" in Table 2.

A 6DQ5 tube which was too weak to produce a raster produced at the damper the waveform shown in Fig. 7B.

A typical cause of repeated burn-outs of the 6DQ5 output tube is shown in Fig. 8. It is a tiny crack around a rivet where the printed circuit for the heater of the oscillator tube is soldered to a lance on the chassis. For a permanent repair, resolder the joint, and also add wires between all of the grounds on the horizontal-oscillator board.

- **T5, the horizontal-output/high-voltage transformer**— An impedance-matching transformer which supplies sweep current to the yoke, and horizontal pulses to the rectifiers and the convergence circuit.

Open or shorted turns in the windings which are connected to the output, damper or rectifier tubes usually eliminate the high voltage (and with it, the raster).

An open in the winding which is connected to the convergence circuits would cause inadequate horizontal dynamic convergence action. Shorted turns in these

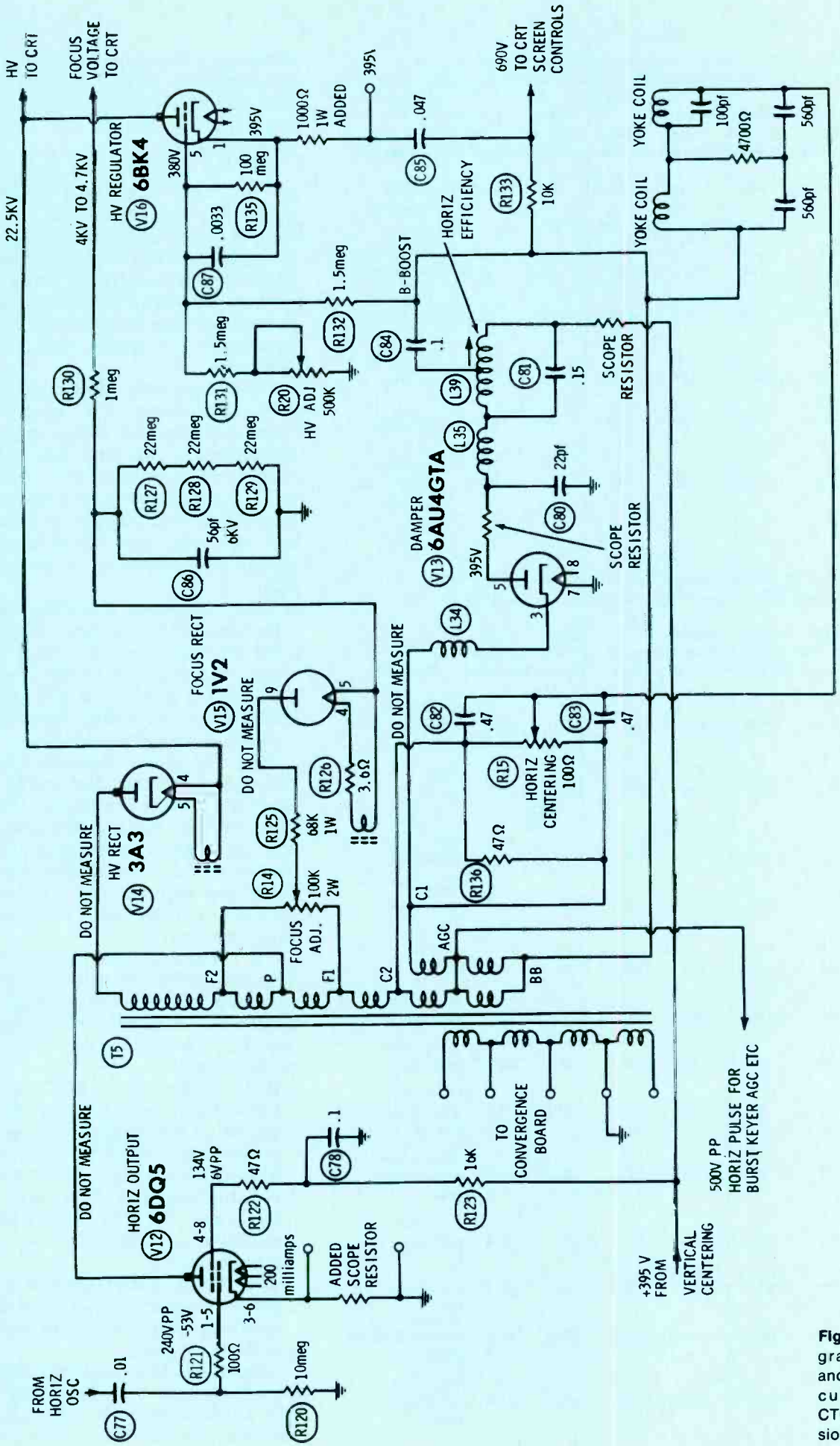


Fig. 6 Schematic diagram of the sweep and high-voltage circuits of the RCA CTC7AA color television chassis.

Table 2

Voltages And Currents Produced At Key Points By Various Degrees Of Failure Of The Horizontal-Output And Damper Tubes

Defect or condition	6DQ5 DC grid voltage	6DQ5 cathode milliamps	6DQ5 screen voltage	B-boost voltage	6BK4 cathode milliamps	High voltage kilovolts	Remarks
(A) Normal	-53	200	134	740	.80	22.5	Normal crosshatch
(B) 6DQ5 slightly weak	-53	160	180	690	.00	20.0	1" narrow each side
(C) 6DQ5 very weak	-53	60	275	510	.00	00.0	No raster—see Fig. 7B
(D) 6AU4 slightly weak	-53	180	145	710	.00	24.0	Stretched on left—
(E) 6AU4 very weak	-53	40	85	350	.00	00.0	No raster—
(F) 6AU4 dead	-53	15	75	00	.00	00.0	No raster—output tube is cooler

Table 3

Comparison Of Normal Voltages And Currents At Key Test Points In CTC7AA Chassis And Those Produced By Typical Defects

Defect or condition	6DQ5 DC grid voltage	6DQ5 cathode milliamps	6DQ5 screen voltage	B-boost voltage	6BK4 cathode milliamps	High voltage kilovolts	Remarks
(A) Normal operation	-53	200	134	740	.80	22.5	normal crosshatch
(B) Normal brightness down	-53	200	134	745	1.20	22.7	black raster
(C) Normal high brightness	-53	200	134	715	.10	21.9	near blooming
(F) Insufficient drive	-44	210	145	740	.60	22.7	Fig. 6 1" narrow each side
(G) R120 open	-56	175	140	730	.50	23.0	little vis-change
(H) Low screen voltage	-53	150	105	740	.10	22.0	½" narrow each side
(I) C81 shorted	-53	215	142	735	.40	22.0	1" narrow on left
(J) Open yoke	-53	70	84	820	.70	6.5	no raster—waveform in Fig. 12
(K) No regulation	-53	200	132	790	.00	25.0	size changed with brightness
(L) C84 boost cap leaking	-53	185	140	690	.00	20.0	1" narrow each side
(M) Horiz out of lock	-48	210	140	745	.90	22.7	out of lock
(N) Osc dead —no drive	0	600+	110	300	.00	00.0	no raster—damper & 6DQ5 bright red
(O) R20 HV control open	-52	215	150	600	1.80	10.0	narrow on left & poor focus

windings (or certain shorts in the convergence wiring) reduce the width and the high voltage; however, such shorts do not eliminate the raster.

Shorted turns in any winding of T5, except those used for convergence, increase the plate current of the 6DQ5 tube, causing it to operate with a glowing red plate. This overload usually quickly destroys the tube. A gassy high-voltage or focus rectifier produces the same red-plate symptom.

Other receivers which employ pincushion-correction circuits have side-pincushion-correction transformers with some windings connected in parallel with those of T5. Shorted turns (or an excessive DC current through the control winding) can cause a red output plate and loss of high voltage.

- **R14 (100K-ohm, 2-watt potentiometer**—This control adjusts the amount of focus voltage by varying the amplitude of pulses which are applied to the plate of the focus rectifier from the sweep transformer windings.

Many of these controls have developed burned and carbonized resistance elements. This carbonization has shorted across the windings of T5, to which the control is connected, and eliminated the high voltage. This defect also causes the 6DQ5 plate to glow a dull red.

To measure the resistance, remove the control from the circuit. Any reading below 100K is sufficient reason for replacement. A 2-watt-rated control must be used.

- **R125 (68K-ohm, 1-watt resistor)**—This resistor has been added to late-production runs, to limit the current which flows through the focus control during high-voltage arcs. Add a resistor to any CTC7AA-equipped models which do not already have it.
- **C86 (56-pf, 6-KV ceramic capacitor)**—The input (or peak-reading) capacitor for the focus rectifier circuit.

Leakage in this capacitor causes poor focus. A shorted capacitor eliminates both the focus voltage **and** the raster, although

SEX AND THE SINGLE CAN

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The great "space war"

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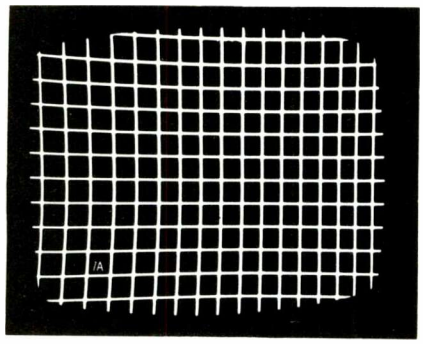


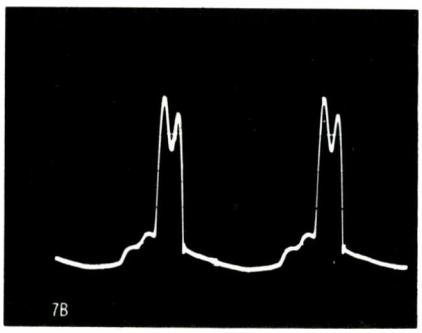


Fig. 7 Crosshatch pattern displayed on the CRT and the yoke waveform produced by two different degrees of weakness of the horizontal-output tube. **(A)** A moderately weak 6DQ5 narrowed the picture about 1 inch, mostly on the right edge, and slightly reduced the brightness. **(B)** A 6DQ5 which was too weak to permit high voltage or a raster produced this 900 volt p-p waveform at the cathode of the damper tube.

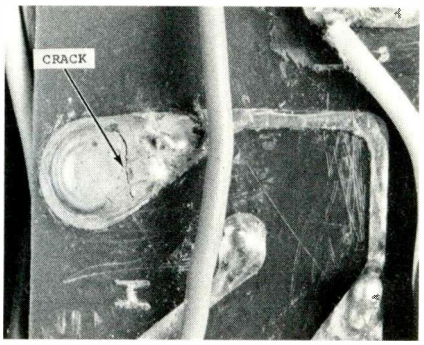


Fig. 8 This intermittently-open ground point of the heater supply to the horizontal oscillator caused the horizontal-output tubes to fail before the defect was found. We suggest that all the grounds on the board be connected together by insulated wire.

the high voltage remains.

If the capacitor opens, the focus voltage will be reduced, and even maximum CW adjustment of the FOCUS control will not produce acceptable focus.

- **R127, R128 and R129 (22M-ohm carbon resistors)**—These resistors stabilize the DC voltage which is applied to the focus electrode of the CRT. Without these resistors as bleeders, the focus electrode would be "floating", and might become too positive because of current flow inside the CRT. Such a possible, but rare, condition would cut off the focus rectifier tube and thereby make the FOCUS control inoperative.

The tolerances of these bleeder resistors are not critical.

- **R130 (1M-ohm, carbon-type resistor)**—Limits the current which might flow back through the focus circuit during arcs inside the CRT. The value is not critical.
- **R15 (100-ohm potentiometer)**—The horizontal-centering control. Centering is accomplished by a small amount of DC which is forced through the horizontal-yoke windings.

A DC voltage is developed across R15 and the paralleled windings of T5 because they are in the path of DC current flow between the damper tube (and the B+ supply) and the plate of the 6DQ5.

When the centering control is adjusted to the electrical center, a bridge circuit—consisting of the windings of T5 from "AGC" to "C2" and "AGC" to "C1", plus the two halves of R15— is in balance and no DC flows through the yoke coils. At this point, the picture is centered as though there were no centering circuit.

When R15 is turned in one direction away from dead center, a "positive" current flows through the yoke, and the picture is moved to the right. The farther R15 is turned in this direction the more current flows, and the more the picture is moved to the right.

When R15 is turned away from dead-center in the other direction a "negative" current flows through the yoke, moving the picture to the left. The farther R15 is turned in this direction, the more "negative" current flows through the yoke coils, and the farther the picture is moved to the left.

Thus, movement of the picture about one inch either side of dead center is possible.

If the picture cannot be centered properly, R15 probably is open near one end terminal. The control should be removed from the circuit, for an ohmmeter test.

- **C82 and C83 (.47-mfd capacitors)**—These capacitors remove from R15 the AC voltage which would be produced by the sawtooth of yoke current if they were missing. Such an AC voltage drop would quickly burn up R15.
- **L34 and L35, anti-parasitic RF choke**—Their precise function is not clear. However, incorrect inductance of these two chokes in some receivers have caused narrow, rounded, black vertical bars on the extreme left side of the raster.

Because the coils are not wound over a resistor, an open circuit in either choke will eliminate all horizontal sweep and high voltage.

- **C80 (22-pf ceramic capacitor)**—Operates in conjunction with L35. The waveform produced by a scope with width expanded X5 and connected in parallel with L35 is shown in Fig. 9. A short circuit in this capacitor would blow the ¾-amp fuse.
- **L39, the HORIZ EFFICIENCY coil**—With C81 and C84, this coil tunes the entire sweep system to produce an impedance of sufficient value to minimize current and heating in the 6DQ5 horizontal-output tube. It is wrong to call this a "horizontal-linearity" coil, because the linearity is changed very little by adjustment of this coil. Because this efficiency circuit requires special consideration during troubleshooting, it will be discussed more fully in the next installment, which will outline specific troubleshooting procedures.
- **C81 (.15-mfd paper- or mylar-type capacitor)**—Tunes L39. The waveshape in Fig. 10 shows that the "Q" is insufficient to produce a sine wave. Line "I" of Table 3 shows the effect of a shorted C81.

- **6AU4, the damper tube**—The function of this tube is to rectify the negative-going portion of the sine-wave ringing voltage which is produced by the cessation of yoke current. The current produced by this rectification is the "negative" yoke current which produces deflection from the extreme left side of the screen back to the center.

This rectification also acts as a brake, to damp out the ringing after its usefulness is over.

The DC voltage produced as a side-effect of the rectification is added to the power supply voltage to increase the plate voltage applied to the 6DQ5.

Damper action effects the width and linearity of the left half of the screen and the amount of high voltage. The waveforms produced at various points in the damper circuit are shown in Fig. 10.

- **C84 (.1-mfd paper- or mylar-type capacitor)**—The B-boost bypass capacitor. It is the input, or peak-reading, filter capacitor for the damper circuit.

An open C84 eliminates the high voltage and, consequently, the raster. The best clue to an open C84 is the huge, distorted waveform of 700 volts p-p found on the B-boost line. This waveform and the normal 110-volt p-p rounded-parabola waveform are shown in Fig. 11.

Significant leakage in C84 narrows the picture. A leakage of 4.7K ohms reduced the width about 1 inch at each edge of the picture (see Line "L" in Table 3). A shorted C84 eliminated the high voltage.

The exact capacitance of C84 is not very critical, although the width and high voltage are reduced if the capacitance is less than .02 mfd.

- **The two horizontal coils in the deflection yoke**—These coils magnetically deflect the beams of the CRT.

Any unbalance in the current through the coils or any difference in the number of turns will cause a trapezoidal raster (wider at the top than at the bottom, or vice-versa).

An open in either coil stops all horizontal deflection and usually eliminates the high voltage and, consequently, the raster. The waveform picked up by positioning the scope probe near a yoke wire when a yoke coil is open is shown in Fig. 12. The width of the pulse is wider than normal (more damper conduction and higher boost voltage) and the amplitude is reduced (less high voltage). Line "J" in Table 3 shows the voltages that were produced by an open yoke.

Excessive leakage or an open in either of the two 560-pf capacitors which are inside the yoke cover, or even a serious unbalance in the coils, will cause the 4.7K-ohm balancing resistor to overheat and possibly be destroyed. If one of the capacitors shorts and the balancing resistor burns open, the picture will be slightly wider. If one of the capacitors opens and the resistor burns open, the picture will be slightly narrow. If either capacitor shorts and the value of the resistor is reduced by overheating, the picture becomes trapezoidal. If either capacitor opens and the resistance is reduced because of overheating, the picture becomes slightly narrow and exhibits yoke ringing. If both capacitors short, the high voltage and, consequently, the raster, are eliminated.

The 100-pf capacitor which parallels the "hot" yoke coil is used to balance the high frequencies so that each coil receives the same. If this capacitor shorts, the picture will be trapezoidal and the high voltage reduced. If the capacitor opens, the scanning lines on the left edge of the picture will exhibit some ringing.

- **6BK4, DC-shunt-type, high-**

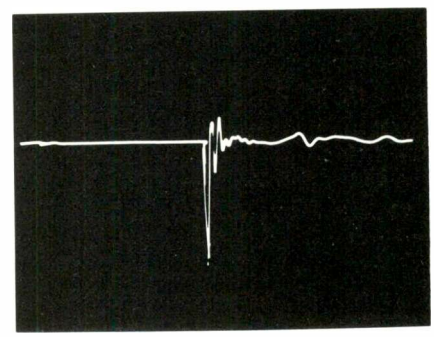
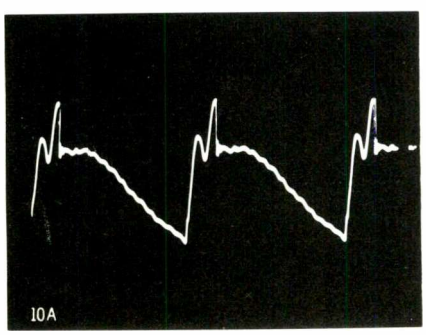
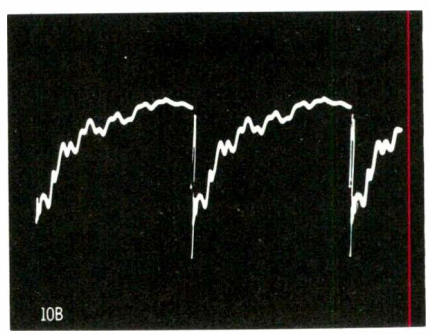


Fig. 9 A sudden decrease in damper current triggered this short damped-wave-train, because of the resonant circuit consisting of L35 and C80 in Fig. 6. The scope sweep was increased X5, to widen the waveform.





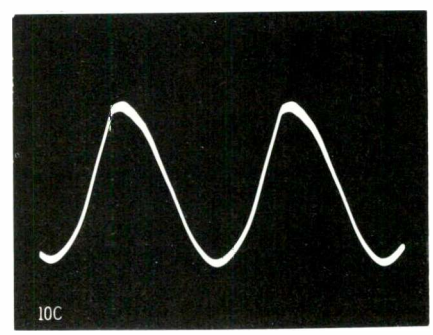


Fig. 10 Waveforms observed at various points in the damper circuit. **(A)** Waveform of the damper current through a temporary "scope" resistor which was connected between B+ and the junction of L39 and C81 in Fig. 6. **(B)** Waveform of the damper current through a "scope" resistor connected between the plate of the damper and L35. The polarity of this and the waveform in **(A)** are opposite because C84, the boost capacitor, is connected to the midpoint of L35. **(C)** Waveform produced when the scope was connected in parallel with C81. It is almost a sine wave, but with some of the pulse remaining.

voltage regulator—The width, horizontal linearity and high voltage are regulated by maintaining a constant high-voltage current through the rectifier tube. The manufacturer establishes the maximum beam current for the CRT according to each chassis, and any portion of the high-voltage current which is not being used by the picture tube should flow through the regulator tube. For example, the maximum regulator current specified in the service data for the CTC7AA chassis is 1.2 milliamps. If the CRT draws .8 milliamp, the 6BK4 should draw .4 milliamp. If the CRT draws 1.2 milliamps, the 6BK4 should have zero conduction. If the brightness control is turned to black out the raster, the 6BK4 should draw 1.2 milliamps. (These amounts apply only to the CTC7AA chassis; later models are rated at 1.4 milliamps.)

In fact, the best way of obtaining valuable information about regulator action is to monitor the regulator current while you adjust the brightness control.

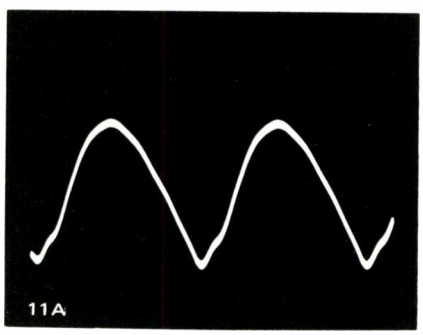
Measurement of the regulator current with the picture tube blacked out is more informative than is measurement of the high voltage using a high-voltage probe and meter. However, the best, and recommended, method is to measure **both.**

For example, consider the case of a receiver which has a very efficient horizontal sweep circuit, and which is operated on a line voltage of 125 volts. If the high voltage is reduced to the specified amount by adjustment of the HV ADJ control, the regulator current might be 1.9 to 2.0 milliamps. This, of course, exceeds the ratings, and will shorten the lifespan of the regulator tube. If both the high voltage and the regulator current had been measured and analyzed, the line voltage could have been reduced, or the value of the screen resistor of the horizontal-output tube increased, or both. Then both the high voltage and the regulator current could have been brought within tolerance.

At the other extreme, assume that the receiver has a weak horizontal-output stage, is operated on low line voltage, or has an open input filter capacitor which reduces the B+ voltage, or is subject to all three conditions at once. If the HV ADJ control is adjusted for the rated high voltage, the regulator tube might be drawing only .2 milliamp, even when the screen is black. These conditions permit a CRT gun current of only .2 milliamp before regulation is lost and poor focus and narrow width are encountered.

Or, think about the case of the opinionated customer who insisted that the picture was brighter before you worked on the receiver. How do you prove to yourself **and** the customer that the receiver does indeed have maximum brightness? Just monitor the regulator current while you adjust the brightness control from the point which produces a black raster to that which produces maximum brightness. If the regulator current is normal when the picture is blacked out (say .8 to 1.1 milliamps for older models or 1.2 to 1.4 milliamps for newer ones), and the current decreases smoothly when the brightness is increased, it proves that the brightness level at which the regulator current almost is zero is the true maximum brightness. Any attempt to increase the brightness above this point probably would cause blooming and defocussing.

Incidentally, the amount of high voltage has only a slight effect on the brightness. If the high voltage is increased or decreased 2KV and all other voltages remain the same, the difference in the brightness is just barely perceptible. Remember, most receiver conditions which increase the high voltage also increase the B-boost (and the boosted-boost), which is the source of the CRT screen voltages. Higher screen voltages on the guns of the CRT cause more conduction and more brightness. This increase in screen voltage, not high voltage is responsible for most of the change in brightness when the high voltage is changed with the HV ADJ control. Small changes in DC voltage to the screen grids, control grids or cathodes affect the brightness level far more than do larger changes in high voltages. Don't try to guess the amount of high voltage, **measure it!**



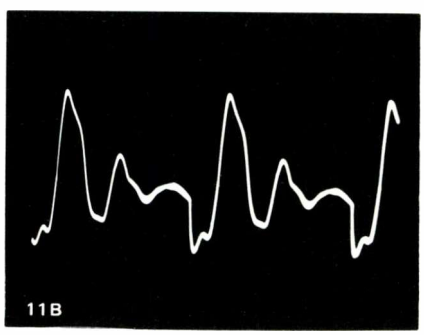


Fig. 11 Waveforms observed between terminal "BB" of T5 (Fig. 6) and ground, with different conditions of C84. **(A)** Normal waveshape is a slightly-distorted parabola of 110 volts p-p. **(B)** When C84 is open, this huge 700 volts p-p waveform is produced.

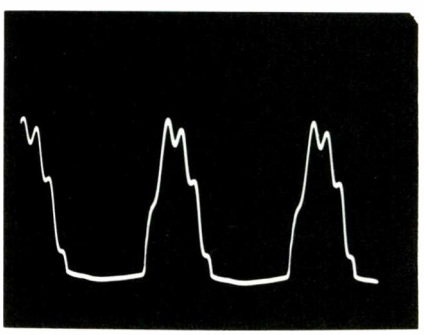


Fig. 12 Waveform produced by an open yoke winding. The scope probe was held near the yoke wire. The wider-than-normal pulse produces more b-boost voltage (from rectification by the damper) and the lower-than-normal amplitude eliminates the high voltage.

- **Resistor in cathode circuit of high-voltage regulator**—Later-model RCA's include a 1000-ohm resistor in the cathode circuit of the 6BK4. One milliamp of cathode current produces a 1-volt drop across the resistor. By measuring this voltage, you can determine the value of the regulator current without the difficulty of opening the circuit to insert a current meter. (Add a 1000-ohm resistor to any early-model CTC7AA chassis you service.)

If you should discover that one of these 1000-ohm resistors in the cathode circuit of the 6BK4 is badly burned because of overload, be sure to replace the regulator tube. It is almost certain to be shorted.

Excessive regulator current caused by a leaky capacitor or incorrect bias on the regulator tube usually is not sufficient to destroy the resistor. However, check it anyway.

- **C87 (.0033-mfd paper- or mylar-type capacitor)**—This capacitor slows down the response time of the regulator, to avoid "hunting", and also bypasses stray horizontal pulses, which might upset regulator action.

A leakage of 330K in parallel with C87 increased the regulator current (during operation with a picture of normal brightness) from .5 milliamp to 1.2 milliamps. Brightness decreased, focus blurred and the width narrowed on the left side of the screen.

- **R131 and R132 (1.5M-ohm, 5-per cent, 2-watt resistors)**—These resistors mainly determine the grid-to-ground voltage applied to the regulator tube. R20, the HV ADJ control, is in series with R131, to provide a vernier adjustment of the grid voltage. The cathode voltage of the regulator tube is clamped by connection, through the 1000-ohm resistor, to the 395-volt supply. As the B-boost voltage increases and decreases in step with any change in the high-voltage rectifier current, the grid of the 6BK4 receives slightly more than 50 per cent of the change in B-boost voltage.

In practice, the values of resistors which normally are in the megohms usually increase, if they change at all. If the value of R131 increases, the regulator tube draws more current. If the value of R132 increases, the regulator draws less current.

The values of R131, R132 and R20 are very critical because a bias of about −14 volts cuts off a 6 BK4. Notice Lines "K" and "O" in Table 3.

In Part 3

This completes the analysis of the function of the stages, sections and individual components of the horizontal sweep and high voltage system of a typical tube-type color TV receiver.

In the final installment of this series, part 3, specific trouble-shooting tips and procedures will be presented. □

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Transistor Specifications Manual (5th Edition, Catalog No. 20883)
Author: The Howard W. Sams Engineering Staff
Publisher: Howard W. Sams & Co., Inc.
Size: 8 5/16 X 10 3/4, 160 pages
Price: Softcover, $4.50.

This large, easy-to-use manual provides the electrical and physical characteristics needed to select the most suitable replacements for both recent and older designs of transistors.

The manual is divided into three principal sections: specifications, outlines and lead identification.

The specifications section lists essential electrical characteristics, including design polarity, leakage (I_{CBO}) gain (hFE), and minimum frequency response plus maximum design limits such as element voltages, collector current, power and temperature. Also included for each transistor are code numbers which, when cross-referenced to the other two major sections, give the manufacturer and indicate the lead and terminal arrangement and which outline illustrates the physical characteristics.

This edition includes a special specifications section for RF power transistors, which, in addition to the other characteristics listed previously, gives the G_{PE}, P_{OUT}, frequency limitations, V_{CC} and the efficiency.

The outlines section illustrates the physical shape of each transistor and gives all pertinent physical dimensions.

The lead and terminal section identifies the collector, emitter and base elements.

Contents: Key to Transistor Specifications—Transistor Specifications—Key to RF Power Transistors—RF Power Transistor Specifications—Registered Transistor Outlines—Transistor Outlines—Lead and Terminal Identification—Key to Manufacturers. □

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Externally Generated Interference In TV

How to determine where the interfering signal is entering and how to eliminate or reduce it. by Bruce Anderson/ES Contributing Author

When we stop to consider all the sources of electromagnetic radiation in existence today, we wonder why there aren't more instances of interference than there are. Nevertheless, it is small consolation to the occasional victim to learn that he is one of a very small group—he simply wants the problem solved.

Eliminating interference seldom is an easy task. The television designers have taken a lot of pains to make their products immune to most interference, and the FCC has all sorts of restrictions which remove most of the possible causes. This means that there is seldom a "standard fix" for an interference problem. There are, however, some standard approaches to the problem, and these are the subject of this discussion.

Some Practical Considerations

Because the interference is probably a local problem, immediately hauling the set off to the shop seldom accomplishes anything. This seems obvious, but we know of an instance where a combination was brought in, not once, but twice, to get rid of interference in the audio. Because the source of the interference was about one block from the home, and sixty blocks from the shop, very little was accomplished. Once the exact nature of the problem was determined, the fix required about forty-five minutes to install—in the home.

In some instances, it will be necessary to remove the receiver to the shop to do the work, but this should not be done until it has been determined what fix is required. Even when the required procedure is known, it often is simpler to finish the job on the spot. This does not mean that your customer should expect the job to be done for the price of a service call. On the contrary, the fact that you have to "bring your shop into the home" demands that you charge regular shop rates, perhaps more. The customer should be told this before you begin.

Interference in the Audio

Interfering conversations in the audio are most often encountered in combination receivers which use the amplifiers of the radio/record player for TV sound.

The first step is to prove that the interfering signal is actually being injected into the audio system. This can be done by switching the function selector to the record-player position and observing whether or not the interference is still present.

Starting from the switch, disable each stage of the audio amplifier by shorting the emitter to the base, until the interference is eliminated. When you locate the stage which eliminates the problem, bypass the base to the emitter with a small capacitor. Usually, a capacitance of 100 to 1000 pfd will be sufficient.

Fig. 1 illustrates the cause and fix for this problem. The basic problem here is that, although the input impedance of a solid-state audio amplifier might be low at audio frequencies, it might be relatively high for RF signals. Quite often a large capacitor will effectively function as an inductor at RF, or the copper pattern of the printed circuit will act as an antenna. The leads of the capacitor which you install also can have enough impedance at RF to cause trouble, so keep them as short as possible, and locate the capacitor as close to the transistor leads as you can.

Interference in the IF Amplifier

More often, a spurious signal will find its way into the IF amplifiers of the TV receiver. Again, the first step is to prove that this is the case.

To determine that the IF strip is the point of entry, disable the tuner and see if the interference persists. If it does, it is probably that the interference is entering one of the IF amplifiers.

It is unlikely that a video amplifier is picking up the unwanted signal, because the gain of the video amplifiers is relatively small. However, to be certain that the problem is not in the video system, disable the video detector and observe whether or not the interference persists.

There are several ways to eliminate the tuner output. Disconnecting the coaxial cable which conducts the tuner output to the IF-amplifier input is the easiest method in many cases. Disconnecting B+ from the tuner is another. If tubes are used in the tuner, removing them is the easiest method.

There is a possibility that the action of the AGC system can be misleading if the interference persists when the tuner is disabled. Disabling the tuners causes the AGC circuit of the receiver to drive the IF amplifiers to maximum gain. This, in turn, might cause the IF strip to pick up interference which would not be noticeable if the amplifier were operating at its normal gain. To avoid this trap, measure the IF AGC bias under normal operating conditions on the weakest channel, and then inject this amount of fixed bias when the

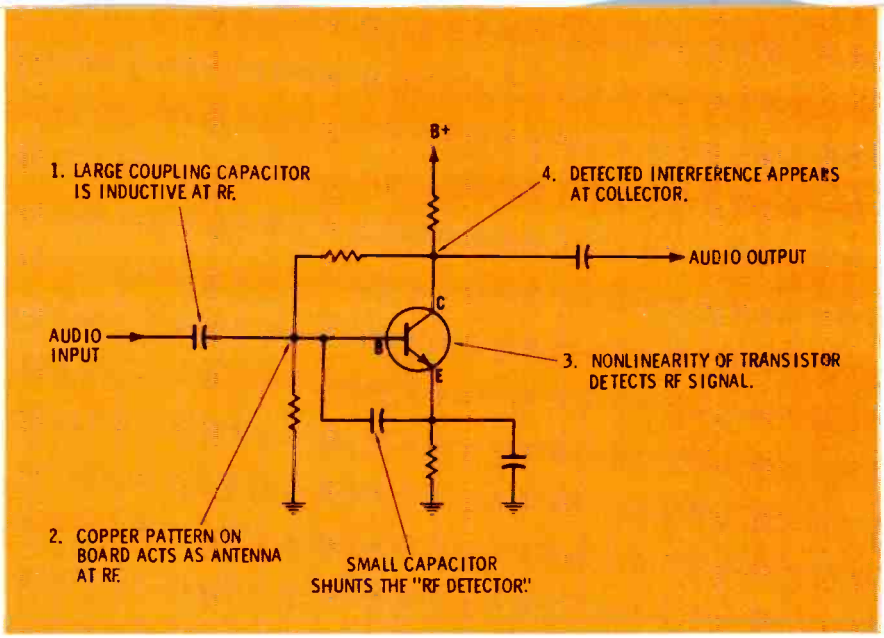


Fig. 1 How an audio amplifier can become a "crystal radio".

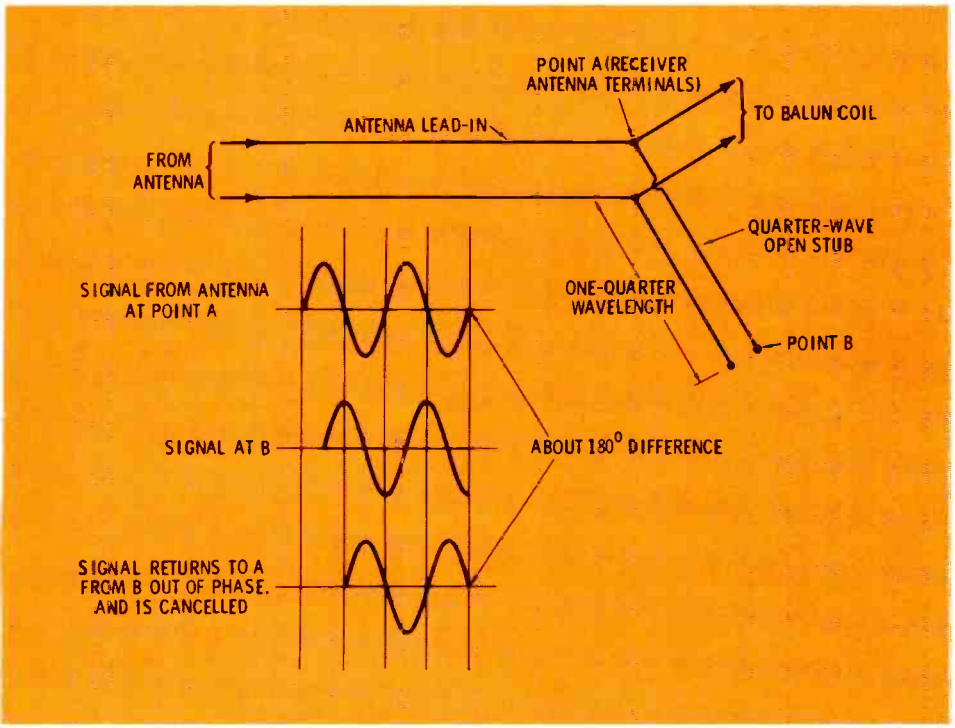


Fig. 2 Construction and operation of a quarter-wave, open-stub trap.

tuner is disabled. If the unwanted signal is still present, you can be assured that it really is entering one of the IF amplifiers.

Shielding is the simplest way of getting rid of IF interference, and a piece of ordinary aluminum foil is an excellent shielding material. If the IF amplifiers are transistors, there is very little heat dissipation, and a close-fitting piece of foil may be formed over the IF strip. Naturally, the foil must be securely grounded to the chassis, and it must not come in contact with any points of the circuit which have voltage on them.

Do not use paper as an insulating material between the foil and the circuit elements. Even though there is practically no heat generated by a transistorized IF amplifier under **normal** conditions, a failure in the future might produce enough heat to ignite the paper. It is better to fabricate some metal supports for the aluminum shield. A few lengths of solid-copper wire, about 14- to 16-gauge, can be soldered to the chassis or to ground points on a printed-circuit board. These will support the foil away from the circuitry, and also can serve as convenient ground connections for the shield.

If the IF amplifier uses tubes, the circuit is usually less susceptible to interference in the first place, particularly if the tubes are shielded. If the shields are missing, they should be replaced, of course. If there were no shields originally, it usually is no problem to install some. It probably will be necessary to ground any added shields. This can be done with a short length of ground braid soldered to the shield and the chassis, or to a ground point on the circuit board. Installation of additional tube shields might make it necessary to realign the IF amplifier, because the shields can detune the circuits.

Shielding the under side of the IF strip might also be necessary. This looks like a tough job at first, but actually it is simpler than shielding the top. Just shield the whole bottom of the cabinet. A flat piece of window screen is handiest for this job. (Aluminum foil obstructs the ventilation holes in the bottom of the cabinet.) Cut the screen to the right size, stretch it tightly across the cabinet bottom and fasten it with a few thumb tacks. When the chassis is installed, it will make contact with the screen all around its perimeter.

Shielding the entire inner surface of the cabinet can be effective, but it is quite a chore, and unless it is done carefully, it won't be very effective. The sides of the cabinet are easy to shield,

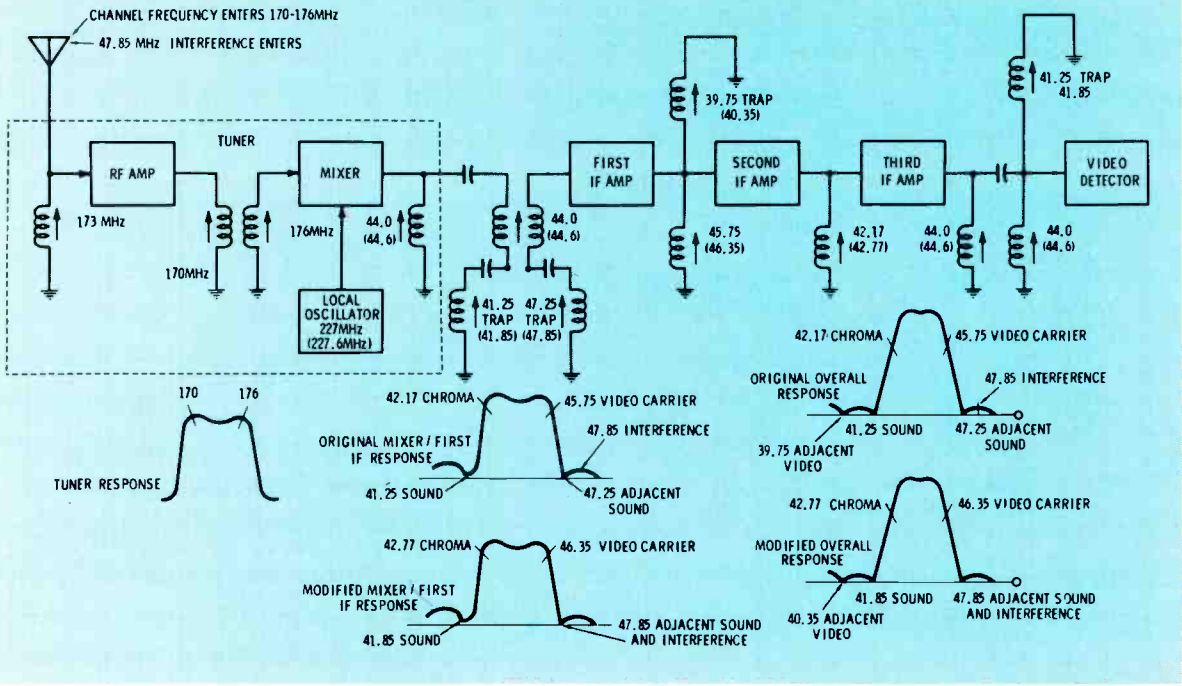


Fig. 3 Effect on interference of realigning the IF amplifiers and retuning the local oscillator. New frequencies are shown in parentheses.

Table

Frequencies listed here illustrate how to realign the video IF's to trap out interference in or near the IF passband. In this example the interfering signal has a frequency of 47.85MHz.

Old Frequency	New Frequency	Marker Point
47.25 MHz	47.85 MHz	Adjacent-channel trap
47.75 MHz	46.35 MHz	Video IF carrier
42.17 MHz	42.77 MHz	Chroma subcarrier
41.25 MHz	41.85 MHz	Sound trap
39.75 MHz	40.35 MHz	Adjacent-channel trap

but the front (if it is not metallic) and the back can be difficult.

Tuner Interference

By far, the part of the receiver which is most susceptible to interference is the tuner. There are several reasons for this: (1) Smaller interfering signals will be objectionable, because of the relatively high gain of the tuner; (2) most interference "rides" into the receiver right along with the broadcast signals, making shielding ineffective; (3) because of the local oscillator, a spurious signal having any frequency which can mix with either the broadcast frequency, the local-oscillator frequency, their sum, and perhaps their harmonics, can produce energy at the IF frequency.

Shielding the tuner is fairly simple, and although it might not solve the problem, it is a good place to start. If you prefer to know whether shielding will do the trick without trying it, disconnect the tuner input cable and clamp the AGC bias as described before. If the interference still is present, shielding probably will be effective.

Another quick method which can be used to determine if shielding the tuner will help, is to disconnect the antenna lead-in, wrap the tuner in paper towels, then wrap aluminum foil around the towels and ground the foil at one or more points.

Assuming that the unwanted signal is entering through the antenna input, attempt to improve the ratio of the signal level between the TV signal and the interfering signal. Increasing the level of the TV signal with a more sensitive antenna or one with better directivity is always a good approach. Sometimes, relocating the antenna to a place which is naturally shielded from the interference will solve the problem.

The use of shielded lead-in often can eliminate or reduce interference. If you try this, extend the shielding all the way to the balun, not just to the back of

the cabinet, and ground the shield. In some instances, the results might be better with the shield ungrounded, so try it both ways. If the receiver has a "hot chassis," make the RF ground connection with a capacitor which has at least a 500-volt rating and a value of about 1000 pfd.

Some receivers have a built in 72-ohm coaxial antenna terminal. If this is the case, a coaxial lead-in might be the simple solution.

When the interference is from an FM station, a simple trap often is effective. These are marketed by several companies, and should be available from your local parts distributor.

If the exact FM trap you require is not available, and you know the frequency of the interference, you can sometimes obtain acceptable results from a "homemade" trap. This trap is properly called an "open quarter-wave stub" and its construction and operation are illustrated in Fig. 2.

As a signal passes down a lead-in, its phase continuously changes, going through 360 degrees as it travels a full wavelength, or 90 degrees in one-fourth wavelength. If the signal encounters an open end (or a short for that matter), it is reflected back along the line. If the signal travels one-fourth wavelength to an open, it has been shifted 90 degrees before it is reflected back. By the time it reaches the original starting point, it is shifted another 90 degrees, so that the reflected signal is exactly out of phase with the original signal at that point. The sum of these two signals, therefore, is zero.

To make a trap, cut a piece of lead-in which is slightly more than one-fourth as long as the wavelength of the frequency to be trapped.

Calculating the exact length is laborious, because the velocity of a signal in a lead-in is involved, but dividing 180 feet by the frequency in MHz is accurate enough.

Connect one end of the stub to the antenna terminals, along with the lead-in, and start cutting off the other end, a quarter-inch at a time, until the interference is eliminated or reduced to an acceptable level.

Aligning Out Interference

Although it is seldom mentioned, there is really nothing "sacred" about the marker frequencies specified for alignment of IF amplifiers in a TV receiver. As shown in Fig. 3, the receiver local oscillator is tuned 45.75M-Hz above the video carrier of the channel to be received. Then the IF stages are stagger-tuned to provide bandpass for the TV signal. The precise frequency of each of the video IF circuits is seldom specified, since only the *overall* response is of prime importance.

As an example, suppose that there is a 47.85M-Hz interfering signal in an area. While this is outside the normal passband of the IF strip, it can still produce enough output at the video detector to cause interference patterns on the CRT. But, if this signal could be made to fall exactly in the trap frequency of the adjacent-channel sound trap, normally 47.25 MHz, the trap would attenuate it below the level at which it becomes troublesome.

Impossible? Not at all. Just get out the alignment data for the chassis and add 0.6 MHz—the difference between the adjacent-channel sound trap and the frequency of the interfering signal—to all the alignment check frequencies. It is best to write down all of them as shown in the accompanying table, to avoid confusion. Then realign the receiver to these new frequencies.

Alternatively, the receiver

could be aligned "low"—video IF carrier at 44.75 MHz, chroma subcarrier at 41.17 MHz, etc.—to provide more separation between the TV signal and the interference.

The same procedure can be used to trap out an interfering frequency which is below that of the IF's. For example, an interfering 40.15M-Hz signal can be attenuated by shifting up the whole IF tuning so that the 39.25M-Hz trap is set to 40.15M-Hz. In this case, 0.8M-Hz would be added to each of the original IF alignment frequencies.

Even if the interfering signal is within the normal TV IF passband, realignment might be effective. You may be able to "slip" a 42M-Hz signal over into the 41.25M-Hz trap (if it is amplitude modulated), or a 46.5M-Hz radiation can be shifted over into the 47.25-MHz trap. Generally, all the tuned circuits in the IF strip can be tuned at least 1M-Hz in either direction from their nominal frequencies. and some can be retuned much farther.

Another scheme which can be used in some instances is to retune only one trap to the interfering frequency. The 39.75M-Hz trap is not necessary for normal operation unless the next higher channel is occupied. It usually can be tuned across three or four MHz, allowing it to tune out anything from 38.25 to 41.25M-Hz. The 47.25M-Hz trap can sometimes be used the same way, but it might be necessary to "touch up" the rest of the strip to obtain the specified bandpass.

Summary

Eliminating interference can be one of the toughest jobs encountered in television servicing. Because of this, many technicians prefer to leave all but the simplest of these problems to someone else, and unless he is something of a diplomat, this is often a wise decision.

For those who are willing to tackle the interference problems, there are some basic rules to follow, some technical and some not. We feel that the following are vital:

1. Before doing anything, explain to the customer that he has a serious difficulty; that your time is worth a certain amount and that you might have to spend several hours finding and curing the problem; that you will have to do some (perhaps all) of the trouble-shooting and repair in his home; and that you cannot guarantee satisfactory results. (Remember, doctors, lawyers, dentists, and ministers don't guarantee success.)

2. Find out where the interfering signal is entering the receiver. This is done by signal tracing, much the same technique used in day-to-day receiver servicing.

3. Signals entering the audio system are usually removed by shunt capacitors which are large enough to attenuate RF but small enough that they do not seriously affect the quality of sound reproduction.

4. Signals entering the IF strip are best handled by shielding. This might involve simply laying a piece of screen wire beneath the chassis; but you might have to shield the entire IF amplifier.

5. Shielding the tuner might solve the problem, but usually signals enter the tuner by way of the antenna input. Try a better antenna, relocating the antenna, shielding the lead-in, or trapping at the receiver antenna terminals.

6. Only if there is no other solution, realign the receiver IF amplifiers so that the interfering signal is outside the passband or in one of the traps of the receiver. Most IF's can be shifted a megahertz or more in either direction without changing the quality of the picture or sound an unacceptable amount. Sometimes a single trap can be retuned to "take out" the unwanted signal. □

audio systems report

Features and/or specifications listed are obtained from manufacturers' reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Five-Channel Mixer/Power Amplifier

Product: Power amplifier
Manufacturer: Altec, Inc.
Function and/or Application: To mix and amplify audio signals from separate power sources.
Features: Designed for installation in churches, schools, hotels, theatres, convention halls, ball parks, recording studios, etc. Built-in test oscillator for system level adjustments, set-up and testing; five mixing inputs with

controls, visual overload indicators; circuit breaker for amplifier protection. The 1607A has a 600 ohm line level link between the mixer/line amplifier and power amplifier input.
Specifications: 75 watts rms power from either AC or DC power source. Low noise mixing circuits for switchable input gain giving it flexibility for the varying types of audio.
Price: Model 1607A sells for $648.00.

Circle 60 on literature card

DC Tape Player Motors

Product: Tape player motors
Manufacturer: Weltron Co.
Function and/or Application: Motors for cartridge players
Features: Motors have been designed for use in many cartridge players including: Toshiba, Bowman, AudioVox, Pioneer, Panasonic, Times, Electro, Muscat, Electra, Westbury, Pianola, Craig, Kraco, Weltron and others. In the selection are universal

motors, universal motors less shields, motors with shields, and motor-and-shield brackets.
Specifications: The 12-volt DC replacement motors operate at 2000 to 3000 rpm. Voltage and direction vary according to model.
Price: The price of the tape player motors are from $9.40 to $10.75.

Circle 61 on literature card

Line-Matching Transformer

Product: Model A97A line matching transformer
Manufacturer: Shure Brothers, Inc.
Function and/or Application: Transformer matches low-impedance microphones to medium impedance tape recorders.

Features: The A97A improves the overall audio input signal and permits the use of very long cables without loss of high frequency and without hum and noise pickup. The Shure A15 series of attenuators, equalizers, and filters can be used with A97A for further improved performance.
Specifications: Model A97A measures 2 1/2 inches X 3/4 inches.
Price: The A97A sells for $21.00.

Circle 62 on literature card ☐

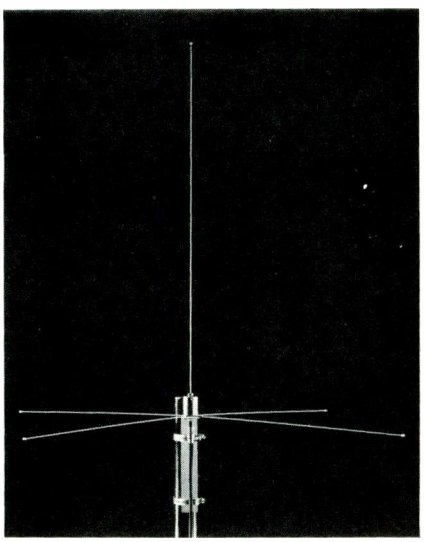
For more information about above products use reader service card

antenna systems report

Features and/or specifications listed are obtained from manufacturers' reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Antenna Mounting Kit

Product: BSAK base station mounting kit
Manufacturer: Larsen Electronics
Function and/or Application: Adapt vehicular units for base station use
Features: Kit includes hardware for mounting to any tower or mast, ground plane rods and complete tools and instructions. Unit accomodates either the 150 or 450 MHz bands.

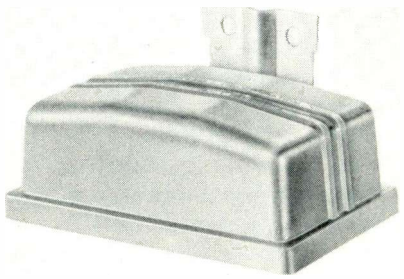


Specifications: Gain approaches the 3 or 5 dB mark for the 150 MHz and 450 MHz models when used in mobile service. Weight is less than one pound with next to zero wind load.
Price: The BSAK kit sells for $24.50.

Circle 70 on literature card

Antenna Couplers

Product: Yagi antenna couplers for home and commercial MATV system.
Manufacturer: Jerrold Electronics
Function and/or Application: Combining output of two antennas into a single lead-in.
Features: The YC-300 is used in areas where channels are broadcast from different directions. Multiple single channel antennas can be combined into a single downlead to the TV set and also can be used to combine a single channel antenna with a broad band antenna. In many cases, the couplers eliminate the need for an antenna rotator. The Yagi couplers are encased in weatherproof housings, complete with straps and thumbscrews for mast mounting. The YC-75 includes F



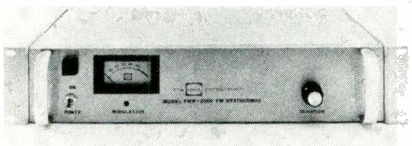
connectors, weather boots and an extension tool.
Specifications: The YC-300 series is used for 300 ohm twinlead installations. The YC-75 series is used for 75 ohm coaxial systems. 300 and 75 ohm models are available for each VHF channel, 2 to 13; there is a 75 ohm model for FM. Two paths are provided for TV signals; one passes a specific TV channel with a minimum of loss, 2.0 dB, but attenuates all other channels, 20 dB. The other path attenuates the channel to which it is tuned by about 10 dB, passing all other channels with only about 1 dB attenuation.
Price: The YC-300 and YC-75 couplers sell for $11.65 each.

Circle 71 on literature card

FM Receiver-Modulator

Product: Weathermod FM receiver-modulator for weather broadcasts
Manufacturer: Catel Corp.
Function and/or Application: FM applications in coaxial cable systems.
Features: The Weathermod combines a VHF-FM receiver and an FM modulator to add weather broadcasts to CATV and MATV system. The usual 162.55 MHz or 162.40 MHz can be converted to any frequency in the FM band from 88 to 108 MHz. Audio output

is provided to add the broadcasts to the aural frequency of a CATV weather channel. Input jacks facilitate the addition of a microphone or music source to the system. The Weathermod is solid-state, using silicon transistors, integrated circuits and FET field effect transistors.



Specifications: Sensitivity is 0.5 uV for 20 dB quieting and adjacent channel rejection is 80 dB. Stability is 0.005 per cent with the use of crystal-controlled circuitry. Output is 45 dB, continuously variable, and the spurious beats are 60 dB below the output level. The Weathermod is designed for 117 volts AC operation and requires 3 1/2 inch of vertical space in a standard 19-inch relay rack.
Price: The Weathermod sells for $695.00.

Circle 72 on literature card

Adjustable P-Clips

Product: N/A
Manufacturer: Electrovert, Inc.
Function and/or Application: Bundles and secures cable and/or wire. Applications include: cables, bundles of wires, components, pipes and tubing where a clamp, strain-relief or strap is required.
Features: P-clips in nine sizes to fit bundle diameters from 1/8 inch through 2 inches. The P-clips are molded of virgin nylon for service indoors and outdoors. The clips are lightweight, abrasion resistant, tough, have high tensile strength, resilience and minimum absorption rate with chemical resistance to common solvents, alkalies, dilute acids, oils and grease.
Specifications: N/A
Price: The price of the adjustable P-clips start at $2.75.

Circle 73 on literature card

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The Terminology of Transistor Testing

A review of the terms applied to the qualities and quantities commonly measured to determine the condition of transistors. Associated test setups are also included.

by Forest H. Belt

We've had transistors more than twenty years. In that time, most of us have picked up transistor jargon. Most of us talk freely about leakage and beta and gain. Some of us even know what "bipolar" means, although it took the FET to bring significance to the word.

But awhile back I had the chance to quiz a large group of technicians. Included in what I asked were some transistor terms. The number of those who didn't really understand the terms surprised me. They could use them, but only a small percentage knew exactly what they meant.

For example, all the technicians quizzed knew what leakage is. But barely more than half knew the alphabet symbols for the various kinds of transistor leakage. Only one out of three knew which kind of leakage most affects transistor operation.

They all knew about JFETs and IGFETs. Yet, only a few recognized the peculiarities that make testing FETs so different. And none could tell me what I_{DSS} is. That's no calamity in itself, but it can hinder those technicians when they service equipment which uses FETs.

Here's the point: Transistor testing has a language of its own. Fortunately, you don't need to learn the dozens of engineering parameters. Instruments that technicians buy test only the few parameters that are important for servicing. Learn those fairly well, and you're set for transistors of any kind.

Design Features

Polarity

You might already know the basic language of transistor testing. One term is **polarity.** It signifies whether a bipolar transistor is NPN or PNP, or whether a FET is N-channel or P-channel. Set up the tester wrong and you'll get no reading or, at best, a wrong one.

Some instruments have a chart with polarities listed. But new transistor types are introduced every month. Charts are outdated quickly. Consequently, it is better to refer to the diagram of the equipment you're servicing. Fig. 1 shows the schematic symbols for popular transistors.

Elements

Be familiar with transistor **elements.** Ordinary (bipolar) transistors have a collector, base, and emitter. The base is the control element. Its material determines the polarity in which operating voltage are applied. However, the polarity arrow is in the emitter element of the schematic symbol.

The JFET has drain, source, and gate elements. The gate is the control element. Electrons usually flow through the channel from source to drain, but they can flow the other way too. The polarity of the channel material determines the polarity of bias applied to the gate.

The symbol for a junction FET (JFET), also shown in Fig. 1, has the "polarity" arrow in the gate element. The arrow points in-

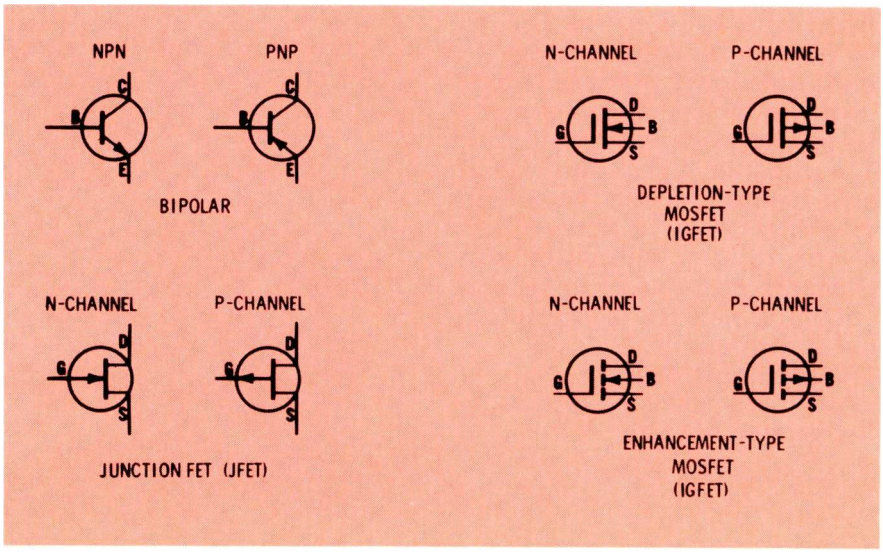


Fig. 1 Schematic diagram symbols of the available types of transistors. The arrows on the elements of the symbols indicate the polarity of the design of the transistor and, consequently, the polarity of the bias voltage required for normal, or forward-bias, operation. For normal operation, the voltage applied to the gate of the N-channel JFET should be positive, and that applied to the P-channel type should be negative. Normal bias voltage applied to the gate of the N-channel enhancement-type MOSFET should be positive and that applied to the gate of the P-channel unit should be negative. The depletion type of MOSFET's operate with voltages of either polarity applied to the gate.

Table 1

Bipolar Transistor Ratings

	Voltage (max)	**Current** (max)	**Power** (max)
Small-Signal	50V	50mA	2W (?)
Low-Power	100V	1 A	10-20W
High-Power	above 100V	several amps	over 25W

Table 2

Typical Values Of I_{CBO}

Size	**Germanium**	**Silicon**
Small-Signal	0-5μA	0-2μA
Low-Power	up to 50μA	0-5μA
High-Power	up to 1000μA	up to 500μA

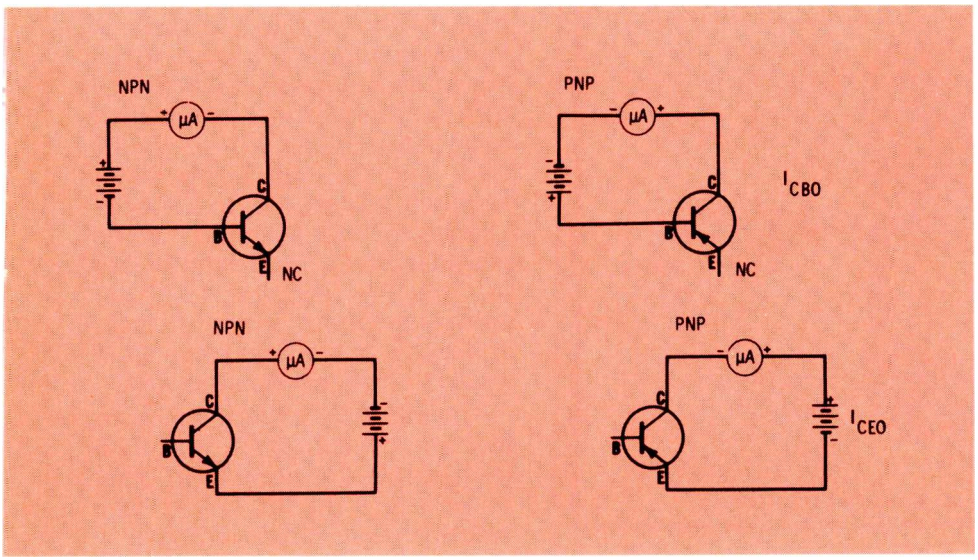


Table 3

Typical Values Of DC Beta

Transistor	**Beta**
Small-Signal	2-50
Low-Power	10-100
High-Power	50-500

Fig. 2 Test setups for measuring the leakage of bipolar transistors. The setup for measuring I_{CES} (not shown) is the same as that for measuring I_{CEO} except that the base lead is connected to the emitter lead instead of "floating."

ward, toward the channel, to indicate an N-channel JFET. It points outward, away from the channel, for a P-channel.

Insulated-gate FETs (IGFET's) are available in two modes: depletion and enhancement. With an IGFET, the polarity of the bias voltage for the gate depends on this mode of operation as well as on the substrate or channel material. The caption of Fig. 1 explains the bias polarities for the types shown.

One kind of IGFET not shown has two gates. Both gates control the flow of electrons through the channel. In use, one gate is for DC control of the overall gain; the signal is applied to the other gate. For testing, the two gates are usually tied together, because if either one is bad, the transistor is useless.

Physical and electrical size

Transistors fall into three categories of size. Table 1 gives some general idea of the operating limits within these groupings. RF and IF transistors, and a few used in audio preamplifiers, are considered small-signal transistors. Audio amplifiers, a very few RF transistors, and low-power output transistors fall into the second group. Audio output, current-switching, and a few powerful RF transistors belong in the third group. Remember these categories. You'll encounter them again and again.

Types Of Measurements

Testing any transistor involves two sets of measurements: a group of tests for leakage, and another group for gain. When you know these two qualities of any transistor, you know whether it will operate satisfactorily. These are the qualities transistor testers measure for you.

Leakage

When you talk about transistor leakage, the terms sound like you're reciting the alphabet. Leakage is a measure of backward, or reverse, current between two transistor elements. The capital letter "I" represents current. The letters for the elements are printed inferior (like $_C$ and $_B$). If the inferior letters are capitals, leakage is DC; if lower case, AC. Thus, DC leakage between collector and base is I_{CB}.

The operating condition of the remaining element during the test is denoted by a third inferior letter. Collector-base leakage in a bipolar transistor is measured with the emitter open. So the inferior capital letter $_O$ is added. When you see I_{CBO}, you know it means collector-base leakage current measured with the emitter open, or floating.

Fig. 2A shows the setup for measuring I_{CBO} in NPN and PNP bipolar transistors. The base and collector are biased opposite to their normal forward operating polarities. Silicon transistors should have no more than 1 or 2 microamps of leakage: germaniums can have 3, 4, or even 5 microamps and still operate properly. Table 2 lists typical limits of leakage.

You should easily figure out now that I_{CEO} indicates collector-emitter leakage, measured with the base open. Fig. 2B shows this test setup in which the collector and emitter are reverse biased, and the base has no connection. This type of leakage can be sev-

eral microamps, even a milliamp or more in some power germaniums.

Not all testers have a configuration for measuring I_{CEO}. But it is handy for power transistors. The normal I_{CBO} of some is so high that it's difficult to tell when one is defective. The I_{CEO} test is more revealing.

One tester has an I_{CES} test. It's the same as measuring I_{CEO} except the base is shorted to the emitter. The amount of I_{CES} for any transistor should be less than its I_{CEO}. If not, the transistor is defective.

If you make all three leakage measurements, they should shape up like this: The I_{CES} must be lower than I_{CEO}, and the I_{CBO} must be lowest of all. Any other relationship reveals a faulty transistor.

Field-effect transistors (FET's) have their own letter symbols for leakage, but they're formed the same as those for bipolar transistors.

I_{GSS} is the most common FET leakage measurement. That's leakage from gate to source, with the drain element shorted to source. The test setups are diagrammed in Fig. 3. A tiny bit of leakage is permissible in a junction FET. However, even slight leakage between gate and channel of an insulated-gate FET (IGFET or MOSFET) makes the transistor not usable.

Testers that check FETs usually include a test labeled I_{DSS}. It's not leakage. It stands for current between drain and source when the gate is shorted to source for zero bias. It is sometimes called zero-bias drain current. Its greatest usefulness is in matching up two or more FETs. It reveals the conductance of their channels.

Gain

Once a transistor has passed its leakage tests, the next thing you measure is gain—the amount of amplification. The word for gain in bipolar transistors is **beta.**

Most testers measure DC beta. It's a ratio of collector current to base current. You may see it abbreviated H_{FE} in some transistor manuals. For all practical purposes in the testers you're likely to buy for servicing, DC beta is about the same as AC beta. Only at RF and high audio frequencies is there a significant difference in the two figures, and the accuracy required for these applications is found usually only in lab instruments.

There are at least two steps in the measurement of beta. The first, a calibrate step, is necessary because most transistors have at least a slight leakage. A few testers have two such steps. To calibrate most testers, you turn the function knob (or push a button) to "BETA CAL" or "BETA SET" and then adjust the meter needle to full scale or to a special "calibrate" line. Do it the way the manufacturer's instructions say to. This first step (or first two) compensates for whatever leakage exists in the transistor. Beta wouldn't be accurate otherwise.

The second (or third) step is to switch to "READ BETA." The meter needle comes to rest somewhere on the scale. You read the value of beta directly.

There might be more than one scale on the meter face. If so the beta switch usually has high/low positions or X1 or X10 multipliers. Use the appropriate scale and/or multiplier.

Ranges of DC beta for bipolar transistors are listed in Table 3. Remember these figures are obtained by dividing the base-current change into the collector-current change. Specific values depend on bias level as well as on the individual transistor.

Instruments that test AC beta show figures in the same range as for DC beta. However, the lower-case letters are used in the inferior part of symbols which relate to AC. The symbol for AC beta is H_{fe}. That's how you tell which kind of beta is being measured.

Measuring the gain of FET's is a whole different ball game. They are not **current**-controlled. The current flowing in their channels is affected by the **voltage** on the gate. Therefore, gain is reported in terms of **mutual conductance,** as in tubes. The abbreviation or symbol is G_m.

The unit of measure is a **mho.** Measured this way, the gain figure is always fractional. The

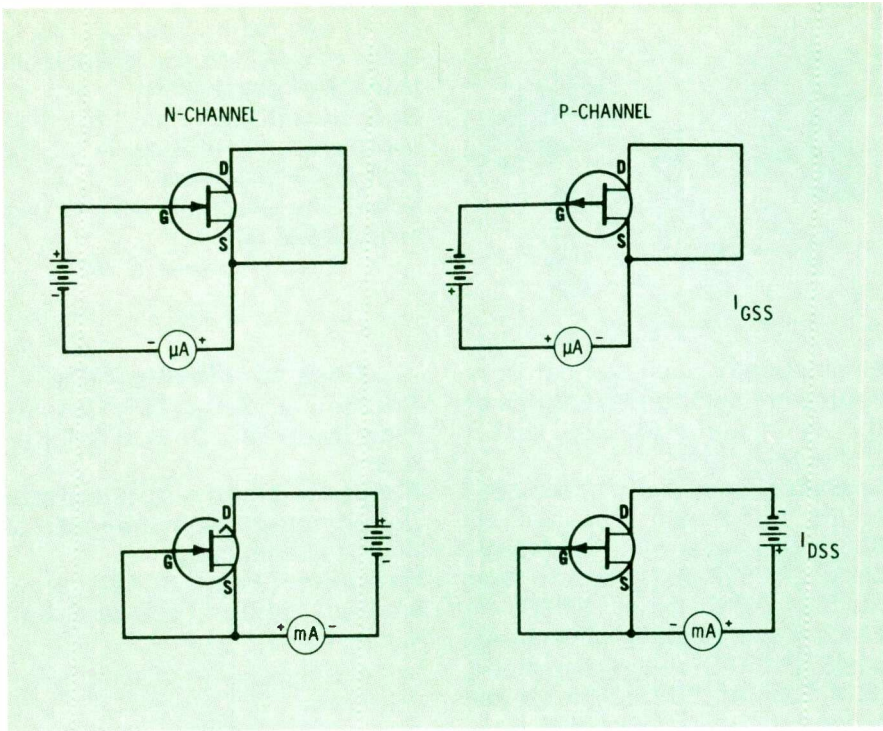


Fig. 3 Test setups for measuring the leakage (I_{GSS}) and drain current (I_{DSS}) of JFET's of both polarities. The same qualities of IGFET's are measured in the same way except that the base (subtrate, or B) should be connected to the source during the tests.

practice, therefore, is to show G_m in millionths of a mho, or **micromhos.** Sometimes it's abbreviated mho or MHO.

The figure of G_m is arrived at by dividing a specific change in source-to-drain current by the change in gate voltage needed to achieve it.

For example, suppose a FET is letting 50 milliamps of source-drain current (I_{DS}) through its channel, with 5 volts bias between source and gate (V_{GS}). When bias is changed to 7 volts, source-drain current drops off to 10 milliamps. That's an I_{DS} change of 40 milliamps for a V_{GS} change of 2 volts. (Remember, it's the **change** you're interested in here.) Dividing 0.040 by 2, gain or G_m of this FET computes to 0.02 mhos, or 20,000 micromhos.

You calibrate the FET tester with a given set of operating conditions. You use a "G_mCAL" or "G_m SET" knob. Then you switch to "READ" and see where the new conditions make the needle pointer stop on the FET gain scale. If the meter has more than one G_m scale, use the one that corresponds to the function-knob position.

Diodes

You can check diodes with the leakage section of your transistor tester. Just set up for measuring ICBO and connect the diode to the collector and base test leads.

Connecting the diode across one polarity of voltage should produce high leakage in one direction and none in the other. If leakage is indicated in both directions, the diode is shorted or leaky. If no leakage is produced in either direction, the diode is open.

Curve Tracers

These instruments are relatively new to the transistor-testing field. So far only two have been introduced specifically for technicians, but at least one more is scheduled to be introduced soon.

The terminology defined previously also is used with curve tracers. Additionally, a curve tracer can display on your scope a whole family of I_B/I_C or V_G/I_D curves. There are special terms: "signature pattern," V_{ce}, avalanche point, and so on. But they are another story, which will be discussed later, when curve tracers are more popular. □

productreport

Features and/or specifications listed are obtained from manufacturers' reports. For more information about any product listed, circle the associated number on the reader service card in this issue.

Sockets For Radio And TV

Product: Replacement sockets for various applications
Manufacturer: Workman Electronic Products
Function and/or Application: N/A
Features: Included are: octal sockets, novar sockets, printed-circuit sockets, tube sockets and miniature sockets in laminated and molded models; seven, nine and twelve pin plug sockets with

Nuvistor, transistor, silicon rectifier, crystal and general purpose sockets. High-voltage cups, sockets and lids to fit the high-voltage cups together with needed socket components such as mica collector and nylon screw insulators, power transistor mounting kits and sockets also have been added.
Specifications: N/A
Price: Prices of the replacement sockets start from $.34 to $2.93.

Circle 80 on literature card

Replacement Components

Product: SOLID-TUBE replacements
Manufacturer: Electronic Devices, Inc.
Function and/or Application: Replacements for color TV components
Features: Cool operating temperature, fast starting, longer voltage life, the prevention of circuit and socket damage and

elimination of one potential x-ray source are among the features of the solid-state SOLID-TUBES and renewal parts.
Specifications: The four replacements for vacuum tubes are: R-3A3 high voltage rectifier (45KV-5mA), $9.95; R-3AT2 high voltage rectifier (45KV 5mA), $9.95; R-2AV2 focus rectifier (9KV-5mA), $4.45 and R-DW4 damper diode (6KV 250mA), $6.95. The six renewal parts are: R-36M solid-state tripler (30KV 2.5mA), $29.95; R-48M solid-state quadrupler (32KV 2.5mA), $29.95; R-12C SOLID-STICK high-voltage rectifier (45KV 5mA), $9.95; R-158 silicon focus rectifier cartridge (8KV 5mA), $3.55; S-168 selenium focus rectifier cartridge (16.8KV 1mA), $2.45 and S-1208 selenium boost diode cartridge (800V 2mA), $1.60.

Circle 81 on literature card

Electronic Service Bag

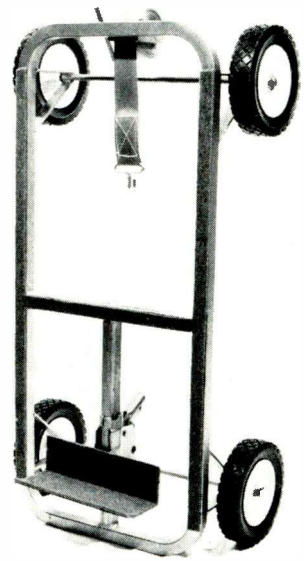
Product: Tool bag for electronic personnel.
Manufacturer: K. Leather Products, Inc.
Function and/or Application: Bag for carrying tools, parts, meters and various electronic equipment.

Features: Lower section of bag has three sliding trays with divided compartments for parts and components. Bag can be equipped with an outside pouch for carrying service manuals, books and paper. The tool bag is made of cowhide and is available in black or ginger color.
Specifications: The tool bag measures 17 inches X 11 1/2 inches X 5 1/4 inches.
Price: The electronic service bag sells for $45.00.

Circle 82 on literature card

Dolly for Moving TV's

Product: TELE-CASTER TV dolly
Manufacturer: Becker & Fuhrmann
Function and/or Application: Permit movement by one man of TV and the cabinets
Features: Four 8-inch steel wheels, rubber tires and ball



bearings permit easy movement up or down stairs or into a truck. The dolly can remain strapped to the cabinet during transportation.
Specifications: N/A
Price: The TELE-CASTER TV dolly sells for $79.50. □

Circle 83 on literature card

catalogs literature

Circle appropriate number on Reader Service Card.

ANTENNAS

100. *Blonder-Tongue, Inc.*—announces a booklet presenting the basic facts necessary to understand MATV systems. A Glossary of Terms is included for further understanding.
101. *Gavin Electronics, Inc.*—has introduced new full color literature for its Colorfinder outdoor color TV antenna line. The 6-page brochure describes all seven Gavin Colorfinder models. Featured are antennas with a reception range from metro to deep fringe.
102. *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.

AUDIO

103. *Arista Enterprises, Inc.*—announces their 58-page needle and cartridge catalog. The needle cross reference reportedly has up-to-date cross references of all major needle marketers, in addition to cross reference sections of phonograph manufacturers' needle and cartridge numbers.
104. *GC Electronics*—an updated line of exact replacement rubber drives and belts is detailed in the new Walsco cross-reference catalog. Included are a variety of phono and recorder drive wheels and pulleys, pinch rollers, round rubber belts, square cross-section rubber belts, spring belts and fabric drive belts, felt pressure pads, phono mounting "E" and "C" clips in an assortment kit, motor mounting grommets, changer switches, and a kit of assorted phono drives and belts.
105. *G-V Controls*—Bulletin No. 4007 announces specifications, applications, line drawings, photographs and ordering information for the self dialing "hot-line" telephone unit.
106. *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.
107. *Shure Brothers*—has published a new catalog describing their line of microphone and circuitry products for broadcasting, recording, motion pictures, and professional sound reinforcement. Included are illustrations and technical specifications.

AUTO ELECTRONICS

108. *Littelfuse, Inc.*—has released a new 32-page, 1971 automotive replacement fuse guide for passenger autos, sports cars, trucks, and taxi cabs. Fuse descriptions and circuits they protect are included.
109. *Nortronics Co., Inc.*—announces a revised brochure describing the Model 5800 replacement head for a reported 90 per cent of all 8-track auto and home stereo players. A listing of players is offered by more than 70 different manufacturers in terms of model number or head part number.

CAPACITORS

110. *Cornell-Dubilier Electronics*—has issued an 80-page cross-reference, 1972 catalog for location of single, dual, triple, and quadruple section replacement electrolytics.
111. *Loral Distributor Products*—has made available a 24-page electrolytic capacitor replacement guide. The catalog features replacement products by the original manufacturers part number.
112. *Sprague Products Co.*—has announced a 40-page manual which lists original part numbers for each manufacturer, followed by ratings, recommended Sprague capacitor replacements, and list prices. More than 2,500 electrolytic capacitors are included.

COMPONENTS

113. *Bulow Internationl*—announces a new parts list for spare-parts and replacement parts for several major European radio and electronics manufacturers. Components, transistors, diodes and mechanical parts are included.
114. *P. R. Mallory & Co., Inc.*—introduces a 64-page general catalog containing approximately 10,000 items. Included in the catalog are

batteries, capacitors, controls, resistors, semiconductors, switchers, and timers plus security systems, cassette recorders and cassette recording tapes.

115. *Precision Tuner Service*—announces a new tuner parts catalog, including a cross reference list of antenna coils and shafts for all makes of tuners.

116. *Workman Electronic Products, Inc.*—has released a 68-page 1972 catalog of replacement components for radio and television. Included are resistors, fusing devices, circuit breakers, sockets, convergence controls, electronic chemicals, audio cables, adapters for hi-fi and cassette type recorders battery holders and prototype kit components.

CONTROLS & SWITCHES

117. *Centralab Dist. Products*—introduces a chart which covers all Fastatch II rotary and push-pull action line switches. Diagrams are illustrated for each switch plus photographs for quick reference guide to replacement push-pull line switches.

KITS

118. *Heath Co.*—announces their 1972 Heathkit catalog, reportedly featuring over 350 kit projects. Projects for the home, the car, and workshop are included.

MARINE ELECTRONICS

119. *Raytheon Co.*—introduces the Webster antennas and seven new antennas designed for use with standard and single sideband marine radio-telephone and citizens band radios. The Webster antennas for VHF/FM radio are offered in 3 dB, 6 dB, and 9 dB models.

SECURITY ELECTRONICS

120. *Mountain West Alarm Supply Co.*—a 64-page catalog describes and offers over 350 intrusion and fire alarm products. Six-pages of Application Notes for alarm equipment also is included.

SEMICONDUCTORS

121. *Electronic Devices, Inc.*—announces a 4-page catalog on solid-state replacement and renewal parts for color TV receivers including solid-tubes, cartridges and multipliers. Solid-state solid-tube high-voltage rectifiers, focus rectifiers and damper diodes, silicon and selenium focus cartridges, diagrams showing dimensional drawings and socket connections for solid-tube solid-state replacements of vacuum tubes with maximum ratings for pulse rectifier service is also included.

122. *GTE Sylvania, Inc.*—introduces a 73-page illustrated catalog which provides information for more than 41,000 semiconductor devices, and outline drawings of the 124 components in the ECG semiconductor line. A complete alphanumeric cross-reference by type number is contained in the guide.

123. *General Electric Tube Products Dept.*—announces the 80-page ETRM 4311H, 1972 Entertainment Semiconductor Almanac. 33,000 cross references from JEDEC, or OEM part numbers, to GE part numbers for universal replacement semiconductors, selenium rectifiers for color TV, dual diodes and quartz crystals, are included.

124. *Motorola*—announces release of the HEP HMA-07 semiconductor cross-reference guide and catalog. Replacements are reportedly listed for over 30,000 semiconductor device numbers. A product catalog plus 168 new hobby, dealer and industrial M.R.O. devices are also included.

125. *RCA Distributor Products*—introduces a 72-page "SK Series Top-Of-The-Line Replacement Guide" (SPG-202L) which cross-references over 20,000 semiconductor device numbers. In addition a Solid State Quick Selection Replacement Chart (1L1367) listing 79 entertainment SK-Series devices is included.

126. *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.

127. *Sylvania Electric Products, Inc.*—a 73-page guide which provides replacement considerations, specifications and drawings of Sylvania semiconductor devices plus a listing of over 35,000 JEDEC types and manufacturers' part numbers.

SERVICE AIDS

128. *Chemtronics*—announces a new 12-page, 1971-1972 catalog of products, including: tuner sprays, circuit coolers, insulating sprays, contact and control sprays, lubricants, tape head cleaners and conditioners, electronic glues and cements, solder, and spray paints.

129. *Kester Solder*—has released an 8-page brochure presenting the company's full line of soldering products. Presented are: "44" resin core solder, acid-core solder, solid-wire, bar solder, TV-radio solder and Metal Mender.

130. *M. P. Odell Co.*—a new 12-page booklet entitled "The Whys and Hows of Cleaning Electronic Equipment" reviews some of the effects of dirt and air pollution on electronic equipment performance together with cleaning methods and systems.

SOLID-STATE

131. *Electronic Devices, Inc.*—offers a replacement guide on tubes and parts replaced by the EDI solid-state replacement components for color TV.

132. *International Rectifier*—64-page volume, JD-451, has been revised and lists information on diodes, zeners, capacitors, rectifiers and SCR's. There are a reported 4000 new transistor listings.

Specifications, characteristics, tables and wall charts are also included.

TECHNICAL PUBLICATIONS

133. *Howard W. Sams & Co., Inc.*—announces publication of a new 96-page 1972 Technical and Scientific Book Catalog. Described are over 800 hardbound and softbound books which cover "do-it-yourself" titles from the Audel Division, amateur radio publications, audio visual materials, instructor's guides and student workbooks. Titles range from "ABC's of Air Conditioning" to Writer's and Editor's Technical Stylebook".
134. *Sencore, Inc.*—Speed Aligner Workshop Manual, Form No. 576P, provides 20 pages of detailed, step-by-step procedures for operation and application for Sencore Model SM 158 Speed Aligner sweep-marker generator.
135. *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.
136. *Tab Books*—has released their Spring 1972 catalog describing over 170 current and forthcoming books. The 20-page catalog covers: schematic/servicing manuals, broadcasting; basic technology; CATV; electric motors; electronic engineering; computer technology; reference; television, radio and electronics servicing; audio and hi-fi stereo; hobby and experiment; amateur radio; test instruments; appliance repair, and transistor technology.

TEST EQUIPMENT

137. *Dynascan Corp.*–announces a new 24-page 2-color catalog of B&K Precision Test Equipment. A total of 21 instruments are reportedly presented; from a Mutual Conductance Tube Tester to a new DC to 10 MHz Triggered Sweep Oscilloscope.
138. *Eico*—has released a 32-page, 1972 catalog which features 12 new products in their test equipment line, plus a 7-page listing of authorized Eico dealers.
139. *Information Terminals*—has introduced a new brochure featuring the M-100 Tension Monitor, the M-200 Torque Tester and the M-300 Head and Guide Gage.
140. *Leader Instruments Corp.*—announces the 1972 Catalog of Leader Test Equipment. Test equipment included is the LBO-301 portable triggered-sweep oscilloscope, LSW-300 new solid-state post injection sweep/marker generator, and the LCG-384 miniportable, solid-state battery operated color-bar generator.
141. *Lectrotech, Inc.*—announces the 1972 catalog. "Precision Test Instruments for the Professional Technician". It contains specifications and prices on sweep marker generator, oscilloscopes, vectorscopes, color bar generators and other test equipment.
142. *Tektronix, Inc.*—a 14-page test equipment booklet if available presenting the Telequipment line of oscilloscopes and a curve tracer. Single-trace, dual-trace, and dual-beam scopes are discussed. Also listed are Field Engineering offices where technical assistance may be obtained.
143. *Testline Instruments*—has issued a brochure for their new Model 101 Curve Tracer for checking transistors in- and out-of-circuit. All features, specifications, applications and warranty information are included.
144. *Speco Components Specialists, Inc.*—announces their 43-page, 1972 catalog of VOM multitesters and meters for TV technicians. Individual features and specifications for each instrument are included.

(Continued on page 66)

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TOOLS

145. *Chapman Manufacturing Co.*—offers a pamphlet containing their line of tools and tool kits. Kit No. 6320, the Midget Ratchet is featured along with other available tool kits.

146. *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.

147. *Janel, Inc.*—announces a three-color catalog on precision hand tools used primarily in miniature and microminiature electronic assembly and production applications.

148. *Xcelite, Inc.*—Bulletin N770 describes this company's three new socket wrench and ratchet screwdriver sets.

TRANSFORMERS/COILS

149. *J.W. Miller Co.*—announces a new 92-page radio and TV replacement coil cross reference guide for known domestic and foreign color and black-and-white TV sets, home and car radios. Over 22,000 replacement coils for 327 manufacturers names reportedly are listed.

TUNER REPAIR

150. *PTS Electronics, Inc.*—62-page catalog with over 600 exact-replacement tuners are listed under their original manufacturer number for ease of exchange. A replacement guide for antenna coils and shafts is also provided.

TV ACCESSORIES

151. *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 Adapters and convergence loads.

TV PICTURE TUBES

152. *GTE Sylvania*—50-page brochure which describes characteristics of over 900 television picture tubes, plus data on interchangeability information and tips on installation and handling of TV picture tubes.

153. *GTE Sylvania, Inc.*—has published an interchangeability guide listing 191 commonly used color TV picture tubes which can be replaced with 19 GTE Sylvania Color Bright 85® □

The MARKETPLACE

This classified section is available to electronic technicians and owners or managers of service shops who have for sale surplus supplies and equipment or who are seeking employment or recruiting employees.

Advertising Rates in the Classified Section are:

- 25 cents per word (minimum $3.00)
- "Blind" ads $2.00 additional
- All letters capitalized—35 cents per word

Each ad insertion must be accompanied by a check for the full cost of the ad.

Deadline for acceptance is 30 days prior to the date of the issue in which the ad is to be published.

This classified section is not open to the regular paid product advertising of manufacturers.

FOR SALE

Obsolete radio and TV tubes. For free price list and types available send stamped, self addressed envelope to Delux Electronics, 156 Robert St., Westport, Mass. 02790 4-72-1t

FOR SALE:
1—HEAT GUNS, Used, Good Cond.
a. 5amp- 200°/300° F., 8amp-250°/350° F., 10amp-300°/500° F.,
New price; $47.50, Our price; $12.50 plus postage.
b. 14amp-500°/750° F., 20amp-750°/1000° F.,
New price; $57.50, Our price; $16.50 plus postage.
2—POLARAD MULTI-BAND SPECTRUM ANALYZERS. Mod. SA-84 Freq. 10MC to 40.88GC. Excellent cond. Calibrated.
New price; $6,930.00, Our price; $1,250.00. post. pre-pd.
3—TEKTRONIX TYPE C-A DUAL-TRACE PLUG-INS. Excellent cond. Calibrated.
New price; $460.00, Our price; $200.00. post. pre-pd.
4—FLUKE POWER SUPPLIES. Mod. 407D.
a. Main output voltage; 0-555VDC
b. Main output current; 0-300ma
c. Bias output; 0 to −250VDC
d. AC outputs (2) 6.3V at 5amps
Brand new units in original cartons.
New price; $450.00, Our price; 250.00. post. pre-pd.
5—PORTABLE WHEATSTONE BRIDGE & DECADE BOXES. L&N Mod. 5340A 0.1ohms to 11.5 Meg ohms. New cond. With Galvanometer.
New price; $292.00, Our price; $85.00. plus postage.
Many other items in stock. Rentals also available. Complete listing of Equip. available upon request. We also maintain a complete Calibration & Repair facility for Test Equipment; Write for information.
IMTRONIX INC. 305 N. Broadway, Fresno, Calif. 93701 ph. (209)485-2741

For Sale—Perfect condition—Sweep Circuit Analyzer, Sencore Model SS137, $45.00. Prepaid. Send check to Walter L. Rochow, 19 Canterbury Rd, Asheville, N.C. 28805. 4-72-1t

For Sale: Sams Photofacts. For information call 1-203-423-6937 after 6pm or write Paul Barbeau, R.R. #1, Storrs, Conn. 06268. 4-72-1t

EQUIPMENT WANTED

RCA WR99A crystal-calibrated TV marker generator. Michael Brady, 461 N. Harper Ave., Los Angeles, Calif. 90048 4-72-1t

"WANTED, CRT rebuilding plant, only new, write: A. Icaza, P.O. Box 806, New York, NY 10459" 4-72-1t

SAMS PHOTOFACT / Supplement to 1972 ANNUAL INDEX

Covers PHOTOFACT Set Numbers 1218 thru 1235 and Specialized Volumes AR-109 thru AR-116, CB-37, CB-38, MHF-21 thru MHF-23, TR-90 thru TR-95, TSM-129 thru TSM-131 Released.

JANUARY thru MARCH 1972

This Supplement is your Index to new models covered by PHOTOFACT since December 1971. For model coverage prior to this date see the 1972 PHOTOFACT Annual Index. Use this Supplement with the Annual Index—together they are your complete Index to PHOTOFACT coverage of over 88,000 models.

A

ADMIRAL
Admiral Corp.-National Service Div.
P.O. Box 845
Bloomington, Illinois 61701

★Chassis K16-1A/-2A ..1218–POM
★Chassis K1663-33 (Similar to Chassis) 1204–1
★Chassis 1K70-B (Runs thru 16) .....(PCB1211-4) 1083–1
★Chassis 1K18-1A,-2A .1218–POM
★Chassis 1K1697-9,-10 (Similar to Chass s) 1204–1
★Chassis 12K2084-6 ...1218–POM
★Chassis 12K2086-2 ...1218–POM
★Chassis 12K2088-1, -2.1218–POM
★Chassis 13K2089-1 ...1218–POM
★Chassis 15K1673-33 .1218–POM
★Chassis 15K1680-1 ...1218–POM
★Chassis 15K1686-1,-5 ..... 1218–POM
★Chassis 15K1687-1, -2 ..... 1218–POM
●C1897PM (Similar to Chassis) 1068–1
KS611-B (Similar to Chassis) 1083–3
KS643 (Similar to Chassis) 1083–3
PS561 (Similar to Chassis) 1201–3
PS571C (Similar to Chassis) 1111–4
PSF541M (Similar to Chassis) 1083–3
★SK5241 .....1218–POM
★SK5245 .....1218–POM
★SK5248 .....1218–POM
★3L1381 .....1218–POM
★3L1385 .....1218–POM
★3L1388 .....1218–POM
★5AL5145 .....1218–POM
★5AL5148 .....1218–POM
★5L5151 .....1218–POM
★5L5155 .....1218–POM
★5L5158 .....1218–POM
★5L5161 .....1218–POM
★5L5171 .....1218–POM
★5L5178 .....1218–POM
★5L5181 .....1218–POM
★5L5185 .....1218–POM
★5L5188 .....1218–POM
★5L5191/93/95 .....1218–POM
★5L5201/03/05 .....1218–POM
★5L5253 .....1218–POM
★5LS5231/33/35 ....1218–POM
★5ST5213 .....1218–POM
★5ST5223 .....1218–POM
★8T791C (Similar to Chassis) 1204–1
★8T911C (Similar to Chassis) 1204–1
★8T941C 1218–POM
★8T950 .....1218–POM
★8TS911C (Similar to Chassis) 1204–1
●16P267, M (Similar to Chassis) 1068–1
●18P28FS (Similar to Chassis) 1068–1
●19M419M (Similar to Chassis) 1068–1
●19P27CFS (Similar to Chassis) 1068–1
●19P428 (Similar to Chassis) 1068–1
●19P437C (Similar to Chassis) 1068–1
★19T100C 1218–POM
★19T111C 1218–POM
★19T118C/119C 1218–POM
★19T201C 1218–POM
★19T208 .....1218–POM
★21T701C 1218–POM
★21TS711C 1218–POM
●22C91/95 ..(Similar to PCB1013-3) 975–1
●22T81C ..(Similar to PCB1013-3) 975–1
★6047PC-M ..(PCB1211-4) 1083–1

AIRCASTLE
Spiegel Inc.
1061 West 35th Street
Chicago, Illinois 60609

TRS-25, TRS-27 .....TSM–129
23-02 .....CB–38

ALLIANCE
The Alliance Mfg. Co., Inc.
22790 Lake Park Blvd.
Alliance, Ohio 44601

C-225 (Antenna Rotator) 1211–SED

ALLIED
Allied Radio Shack
2617 West Seventh Street
Fort Worth, Texas 76107

14A50502 .....MHF–22
1450 (14A50502) MHF–22

ALLIS CHALMERS
(See Auto Radio Listing)

AMBASSADOR
(Also See Recorder Listing)
Allied Purchasing Corp.
401 Fifth Avenue
New York, N. Y. 10016

●AM7112WD (Late Prod.) .1225–1
★AM7116WD 1229–1

AMPEX
(See Auto Radio and Recorder Listings)

ARVIN
(Also See Recorder Listing)
Arvin Industries Inc.
1531 Thirteenth Street
Columbus, Indiana 47201

30R56-12 (Ch. 1.00711)..1212–4
40R56-12 (Ch. 1.00721)..1212–4
80M35-11 (Ch. 1.00791).1230–4
80M35-16 (Ch. 1.00791).1230–4
Ch. 1.00711 1212–4
Ch. 1.00721 1212–4
Ch. 1.00791 1230–4

ASTRO LINE
(See Auto Radio Listing)

B

BENNETT
Bennett Laboratories, Inc.
5800 Christie Avenue
Emeryville, California 94608
(Address Change)

BLONDER-TONGUE
Blonder-Tongue Laboratories
9 Alling Street
Newark 2, New Jersey

DA-4V (1435) (TV Distribution Amp) ..1232–SED
Suburban 4542 (UHF/VHF Amp) ...1232–SED

BOMAN ASTROSONIX
(See Auto Radio and Recorder Listings)

BRADFORD
W. T. Grant Company
1441 Broadway
New York, N. Y. 10018

★WTG-54346 1228–1
★WTG-54353 1228–1
★WTG-54395 1220–1
★WTG-54403 1220–1
★WTG-54411 1220–1
★1104K31 1228–1
★1104L41 1228–1
★1142A21/B21/C21 1220–1
★1205A42/B42 1210–1

BRITISH LEYLAND
(See Auto Radio Listing

BROWNING
Browning Laboratories Inc.
1269 Union Street
Laconia, N. Hampshire 03246

SST CB–37

BUICK
(See Auto Radio and Recorder Listings)

C

CADILLAC
(See Auto Radio and Recorder Listings)

CARTAPE
(See Auto Radio and Recorder Listings)

CATALINA
White Stores, Inc.
Wichita Falls, Texas 60639

●122-752F 1229–2
●122-2147A 1229–2
★122-2815A 1234–1
★122-2820A 1234–1
★122-2845A 1234–1
★122-2850A 1234–1
★122-2855A 1234–1
★122-2865A 1234–1
★122-2885A 1234–1
★122-2890A 1234–1

CHANNEL MASTER
(Also See Auto Radio and Recorder Listings)
Channel Master Corp.
Ellenville, N. Y. 12428

★6106A, 6107A 1223–1
★6111A 1223–1
★6119A 1223–1
★6121A/22A/23A/24A ...1223–1
6201 .....TSM–129
6202 .....TSM–131
6205 .....TSM–130
6208 .....TSM–130

CHEVROLET
(See Auto Radio and Recorder Listings)

CHRYSLER
(See Auto Radio Listing)

CORNELL-DUBILIER
Cornell-Dubilier Electronics
118 East Jones Street
Fuquay-Varina, N. C.

AR-20 (Antenna Rotator) 1223–SED
TR-15/-16 (Antenna Rotator) 1213–SED

CORONADO
Gamble-Skogmo, Inc.
P.O. Box 458
Minneapolis, Minn. 55440

●TV2-1408A 1231–1
●TV2-1420A 1231–1
★TV2-2021A 1227–1
★TV2-2031A 1227–1
★TV2-2041A 1227–1
★TV2-2051A 1227–1
★TV2-2061A 1227–1
★TV2-2071A 1227–1
★TV2-2081A 1227–1
★TV2-2081B (Similar to Chassis) 1227–1

COURIER
Courier Communications, Inc.
100 Hoffman Place
Hillside, New Jersey 07205

Caravelle CB–38
CCT-3 .....CB–37
Conqueror CB–38

CRAIG
(See Recorder Listing)

CROWN RADIO
(See Recorder Listing)

CURTIS MATHES
Curtis Mathes Mfg. Co.
P.O. Box 5610
Dallas, Texas 75222

Ch. 47-2 1230–5

D

DELCO
(See Auto Radio and Recorder Listings)

DODGE
(See Auto Radio Listing)

DUMONT
DuMont Radio & Television
14th & Coles Streets
Jersey City, N. J. 07302

★19DP01 (Ch. 30K18-1B) 1224–POM
★19DP02W (Ch. 31K18-1B) 1224–POM
★25DC04W/06S/07M (Ch. 32K16) 1224–POM
★59T01WN (Ch. 120976A) .....(PCB1211-4) 1102–1
★59T02WN (Ch. 120984A) .....(PCB1211-4) 1102–1

DUMONT—Cont.

★Ch. 30K18-1B 1224–POM
★Ch. 31K18-1B 1224–POM
★Ch. 32K16 .....1224–POM
★Ch. 120976A .....(PCB1211-4) 1102–1
.....(PCB1211-4) 1102–1

E

ELECTROHOME
Electrohome Limited
809 Wellington Street North
Kitchner, Ontario, Canada

★Ch. C9-B 1213–1

ELECTROPHONIC
(Also See Recorder Listing)
Electrophonic Corp. of America
101-10 Foster Avenue
Brooklyn, New York 11236

T-9 .....TSM–131
T-16 .....TSM–130
T-17 .....TSM–131
T-107 .....MHF–22
T-108 .....MHF–23
T-109 .....MHF–23
T-4100 .....MHF–21
Ch. 24M 1217–4
Ch. 26C (Similar to Chassis) 1207–3
Ch. 31H 1222–4
Ch. 41, 43 1224–4
Ch. 64M 1217–4
Ch. 76K 1214–4
Ch. 77K 1221–5

EMERSON
Emerson Television Sales Corp.
14th & Coles Streets
Jersey City, New Jersey

●9FP02/03/04W (Ch. T2R2-1A, -2A)....1230–1
10ES01W/02M/03S (Ch. 121007) 1151–5
●12FP01/02/03W (Ch. T2R3-1A, -2A)....1230–1
★18EP04 (Ch. 30K17-1A) 1218–POM
★19EP01 (Ch. 30K18-1A) 1218–POM
★19EP02W (Ch. 31K18-1A) 1218–POM
★19EP03R (Ch. 32K18-1A) 1218–POM
●19FP04/05W (Ch. 11H5) .1222–1
●19FP10 (Ch. T12K3-1A) 1218–POM
●19FP11W (Ch. T12K3-1B) 1218–POM
●19FP12W (Ch. T13K3-1B) 1218–POM
●20FP01/02W (Ch. 16H5) .1222–1
●21ET01 (Ch. 11K1663-40) (Similar to Chassis) ...1207–1
●21ET02W (Ch. 32K1687-2) 1218–POM
●22FC01W/02M/03S (Ch. 12H5) 1222–1
●22FC06W/07M/08S (Ch. 12H5) 1222–1
●22FS01W (Ch. 14H5) ...1222–1
●22FT01W (Ch. 12H5) ...1222–1
●22FT04W (Ch. 12H5) ...1222–1
●23EC10W/12S (Ch. 5K1675-4) (Similar to Chassis) ...1207–1
●23EC13W (Ch. 11K1670-2) (Similar to Chassis) ...1207–1
●25EC11W (Ch. 11K1663-41) (Similar to Chassis) ...1207–1
●25EC14M/15W/16S (Ch. 32K1673-32) ..1218–POM
●25EC17W/19S (Ch. 32K1686-4) ..1218–POM
●Ch. T2R2-1A, -2A 1230–1
●Ch. T2R3-1A, -2A 1230–1
●Ch. T12K3-1A, -1B ...1218–POM
●Ch. T13K3-1B 1218–POM
●Ch. 5K1675-4 (Similar to Chassis) 1207–1
●Ch. 11H5 (Run 24) 1222–1
●Ch. 11K1663-40, -41 (Similar to Chassis) ..1207–1
●Ch. 11K1670-2 (Similar to Chassis) ..1207–1
●Ch. 12H5 (Rue 24) 1222–1
●Ch. 14H5 (Rue 24) 1222–1
●Ch. 16H5 (Run 24) 1222–1

EMERSON—Cont.

★Ch. 30K17-1A 1218–POM
★Ch. 30K18-1A 1218–POM
★Ch. 31K18-1A 1218–POM
★32K18-1A 1218–POM
★Ch. 32K1673-32 .....1218–POM
★Ch. 32K1686-4 .....1218–POM
★Ch. 32K1687-2 .....1218–POM

F

FANON-MASCO
Fanon Electronic Industries
100 Hoffman Place
Hillside, New Jersey 07205

SFT-900 (Guardsman) CB–37
T-808 .....CB–38
CHB-4 .....CB–37

FORD
(See Auto Radio Listing)

G

GENERAL ELECTRIC
For TV Models
General Electric Company
College Blvd.
Portsmouth, Virginia 23705
For Radio and Phonograph Models
General Electric Company
1101 Broad Street
Utica, New York 13501

A401g (Ch. TU540, PA40, CP1) 1219–5
A534h (Ch. TU540-1, PA40, CP1) 1219–5
A634h (Ch. TU540-1, PA40, CP1) 1219–5
C151k (Ch. PK160) 1209–4
C351k (Ch. TU540-11, PA40, CP1) 1219–5
C445g (Ch. TU540-1, PA40, CP1) 1219–5
C524k (Ch. TU540-1, PA40, CP1) 1219–5
C550g (Ch. TU540, PA40, CP1) 1219–5
C557g,h,j (Ch. TU540-14, PA40-5,-6) (Similar to Chassis) 1219–5
C614g (Ch. TU540-1, PA40, CP1) 1219–5
C651g (Ch. TU540, PA40, CP1) 1219–5
C657g, h (Ch. TU540-15, PA40-3) (Similar to Chassis) 1219–5
★CBM250NWD-2 (Ch. N-2) .1219–1
★CBM261CWD-2 (Ch. C-2) .1231–2
★CBM264CWD-2 (Ch. C-2) .1231–2
G402g (Ch. TU240, PA40, CP1) 1221–4
G402h (Ch. TU540, PA40, CP1) 1219–5
G514g (Ch. TU540-1, PA40, CP1) 1219–5
G542g (Ch. TU540, PA40, CP1) 1219–5
G543h,k (Ch. TU540-1, PA40, CP1) 1219–5
G618g (Ch. TU540-1, PA40, CP1) 1219–5
H530g (Ch. TU540-1, PA40, CP1) 1219–5
★M810CWD-2 (Ch. C-2) .1231–2
★M910LWD-2 (Ch. L-2) .1231–2
★M911LMP-2 (Ch. L-2) .1231–2
★M913LPN-2 (Ch. L-2) .1231–2
★M916LPN-2 (Ch. L-2) .1231–2
★M930LWD-2 (Ch. L-2) .1231–2
★M931LMP-2 (Ch. L-2) .1231–2
P464g,h (Ch. T7N-J) (Similar to Chassis) ...979–5
P794g (Ch. TU540-14, PA40-5) (Similar to Chassis) ...1219–5
P2835A TSM–130
P4830A TSM–130
●TR105TVY (Ch. T-6) .1218–POM
●TR110TEB (Ch. T-6) .1218–POM
●TR120RVY-1 (Ch. R-1) .1220–2
●WM020WEB-1/WVY-1 (Ch. W-1) 1221–1
●WM153SCH-3 (Ch. S-3) 1217–1
●WM194SWD-3 (Ch. S-3) 1217–1

GENERAL ELECTRIC—Cont.

★WM201HGR-4/202HVY-4 (Ch. H-4) 1223–2
★WM205HWD-4/206HWD-4 (Ch. H-4) 1223–2
★WM225HWD-4 (Ch. H-4) 1223–2
★WM257NWD-2 (Ch. N-2) 1219–1
★WM264CWD-2 (Ch. C-2) 1231–2
★WM266CWD-2 (Ch. C-2) 1231–2
★WM270CBW-2 (Ch. C-2) 1231–2
★WM274CWD-2 (Ch. C-2) 1231–2
★WM277CWD-2 (Ch. C-2) 1231–2
★WM279CCT-2/279CEA-2 (Ch. C-2) 1231–2
★WM381CWD-2/382CWD-2/383CWD-2 (Ch. C-2) .1231–2
★Ch. C-2 1231–2
Ch. CP1,-1,-6,-7,-8, -11,-12,-13 ...1219–5, 1221–4
★Ch. H-4 1223–2
★Ch. L-2 1231–2
★Ch. N-2 1219–1
Ch. PA40,-1,-2,-3,-4 .....1219–5, 1221–4
●Ch. R-1 1220–2
●Ch. T-6 .....1218–POM
Ch. TU240,-8,-9,-10, -11,-12,-13 1221–4
Ch. TU540,-1,-11 1219–5
●Ch. W-1 1221–1

GENERAL MOTORS CORP. (GMC) (See Auto Radio and Recorder Listings)

H

HITACHI
(Also See Auto Radio and Recorder Listings)
Hitachi Sales Corporation of America
48-50 34th Street
Long Island City, N. Y. 11101

★CFA-461 1231–3
★CNU-881 1231–3
★CNU-891 1231–3
★CSU-790 1231–3
★CTU-970 1231–3
★CWU-220 1230–2
●IU-54 1223–3
KC-770E,H 1225–4
●SU-86 (Ch. SV-A) 1233–1
●TU-76 (Ch. SV-A) 1233–1
●TWU-68/69 (Ch. SV-A) .1233–1
●TWU-73 (Ch. SV-A) 1233–1
●Ch. SV-A 1233–1

I

INTERNATIONAL
(See Auto Radio Listing)

J

JERROLD
Jerrold Electronics Corp.
The Jerrold Building
15th & Lehigh
Philadelphia, Pa. 19132

AMA-50 (AM RF Rebroadcast Amp.) ..1226–SED
AT-* (Audio-Trol) 1229–SED
SPM-2 (VHF/UHF Amp) 1225–SED
SPM-106 (VHF/UHF Amp) 1225–SED
U5V 1232–SED
106 (VHF/UHF Amp) .1225–SED
454T (UHF Converter Amp) 1232–SED
465SS (Oscillator/Power Supply) 1232–SED
3550 (VHF-FM Amp) ..1224–SED

JOHN DEERE
(See Auto Radio Listing)

JULIETTE
(See Recorder Listing)

NOTE: ● Denotes Television Receiver. ★ Denotes Color Television Receiver. AOR Denotes Available On Request. AR Denotes Auto Radio Series Volume. CB Denotes CB Radio Series Volume. HTP Denotes Home Tape Player Series Volume. MHF Denotes Modular Hi-Fi Series Volume. PCB Denotes Production Change Bulletin. POM Denotes Bonus Schematic in Photofact-of-the-Month Package—Unavailable After Month Of Issue. SED Denotes Special Equipment Data. TR Denotes Tape Recorder Series Volume. TSM Denotes Transistor Radio Series Volume.

K

KAY-TOWNES
Koy-Townes Antenna Company
Turner Chapel Road
Rome, Georgia 30161

AB-4000/4100 (VHF/FM Amp) 1225–SED
AB-4200 (VHF-UHF-FM Distribution Amp) ... 1224–SED
AB-4400 ..... 1224–SED
AB-4600 (VHF/UHF Distribution Amp) .. 1223–SED
AB-4700 (VHF/UHF/FM Distribution Amp) .. 1223–SED
AB-4800 (VHF/FM Distribution Amp.) .. 1223–SED
AB-4900 (VHF/FM Amp) 1225–SED
AB-5000 (VHF/UHF/FM Amp) 1225–SED
AB-5100 (Antenna-Mounted Amp) 1224–SED
AB-5200 (VHF/UHF/FM Amp) 1225–SED
AB-5300 (VHF/UHF/FM Amp) 1229–SED
AB-5400 (VHF/UHF/FM Distribution Amp) ... 1229–SED
AB-5800 (VHF/UHF/FM Distribution Amp) ... 1229–SED
AB-6000 (VHF/FM Mast-Mounted Amp) 1223–SED
AB-6100/6200/6300 (VHF/FM Amp) 1229–SED
AB-7100 (VHF Amp) ... 1225–SED
AB-7200 (UHF Amp) .. 1228–SED
AB-7800 (VHF/UHF/FM Amp) 1228–SED
AB-8000 (VHF/FM Antenna Mounted Amp) 1232–SED
AB-8200 (VHF/UHF/FM Antenna Mounted Amp) 1232–SED
AB-8700 (VHF/FM Amp) 1228–SED
AB-8800 (VHF/FM Amp) 1228–SED
AB-9100 (VHF Distribution Amp) 1226–SED
AB-9400 (VHF/UHF/FM Distribution Amp) ... 1226–SED

L

LAFAYETTE
Lafayette Radio Electronics
111 Jericho Turnpike
Syosset, L. I., New York 11791

Dyna-Com 3A (99-31940L) .CB–37
Dyna-Com 12a (99-32484) .CB–38
HB-23A (99-32351WX) CB–38
LR-100 (99-02214WX) .. MHF–23
Telsat SSB-25 (99-32377W) CB–37
99-02214WX MHF–23
99-31940L CB–37
99-32351WX CB–38
99-32377W CB–37
99-32484 ..... CB–38

LLOYD'S
(See Recorder Listing)

M

MACK TRUCK
(See Auto Radio Listing)

MAGNAVOX
(Also See Recorder Listing)
The Magnavox Company
Bueter Road
Fort Wayne, Indiana 46803

1P9282 ..... MHF–21
1R1707 ..... 1212—5
1R1729 ..... 1229—5
1R1736 ..... 1216—5
Chassis A510-02-AA,-BA (Similar to Chassis) .... 923—5
Chassis A511-01-BA (Similar to Page 57) .. MHF–16
Chassis A512-01-AA MHF–21
Chassis A512-02-AA (Similar to Page 5) MHF–21
★Chassis T952-06 Series 1218–POM
★Chassis T952-08 Series 1218–POM
★Chassis T952-10 Series 1218–POM
★Chassis T952-11 Series 1218–POM
★Chassis T952-12 Series 1218–POM
★Chassis T952-13 Series 1218–POM
★Chassis T957-01-AA, -BA,-CA,-DA,-EA,-FA 1218–POM
★Chassis T957-02-AA, -BA,-CA,-DA,-EA,-FA 1218–POM
★Chassis T960 Series . 1230–POM

MEDALLION
(See Auto Radio and Recorder Listings)

MERCURY
(See Auto Radio and Recorder Listings)

MGA
Mitsubishi International Corp.
7045 North Ridgway Ave.
Lincolnwood, Illinois 60645

● BB-092 ..... 1218–POM
● BS-130 ..... 1222—2
● BS-131 ..... 1218–POM
● CH-121 ..... 1218–POM
● CH-141 ..... 1218–POM
● CH-160 ..... 1218–POM
● CH-190/191 ..... 1218–POM
● CS-165 ..... 1218–POM
● CS-195 ..... 1218–POM

MIDLAND
(Also See Recorder Listing)
Midland International Corp.
For CB Models
Midland Communicotions Co.
P.O. Box 19032
Kansas City, Mo. 64141
For All Other Models
P.O. Box 1903
Kansas City, Mo. 64141

13-868 ..... CB–37
13-874 ..... CB–38
● 15-1128 ..... 1232—1

MORSE ELECTRO PRODUCTS
(Also See Recorder Listing)
Morse Electro Products Corp.
101-10 Foster Avenue
Brooklyn, New York 11236

T-9 ..... TSM–131
T-16 ..... TSM–130
T-17 ..... TSM–131
T-107 ..... MHF–22
T-108 ..... MHF–23
T-109 ..... MHF–23
T-4100 ..... MHF–21
Ch. 24M ..... 1217—4
Ch. 26C (Similar to Chassis) ..... 1207—3
Ch. 31H ..... 1222—4
Ch. 41, 43 ..... 1224—4
Ch. 64M ..... 1217—4
Ch. 76K ..... 1214—4
Ch. 77K ..... 1221—5

MOTOROLA
(Also See Auto Radio and Recorder Listings)
Motorola, Inc.
9401 West Grand Avenue
Franklin Park, Ill. 60131

● BP309HH (Ch. C12TS-465,T) (Similar to PCB1185-3) 1091—2
● BP318HW (Ch. E12TS-465,T) (Similar to PCB1185-3) 1091—2
● BP403HW (Ch. C12TS-465) (Similar to PCB1185-3) 1091—2
● BP461HW (Ch. 16TS-597,T) (Similar to Chassis) .. 1087—2
● BP523HN (Ch. Q19TS-597) (Similar to Chassis) .. 1087—2
● BP529HW (Ch. K19TS-597) (Similar to Chassis) .. 1087—2
● BP530HW (Ch. Q19TS-597) (Similar to Chassis) . 1087—2
SK104GW MHF–22
SK550GS-1/552GC-1 (Ch. GHS-2500/2600) (Similar to Chassis) .. 1080—5
SK559HW (Ch. GHS-2500/2600) (Similar to Chassis) .. 1080—5
SK564HK (Ch. GHS-2500/2600) (Similar to Chassis) .. 1080—5
SK570HP/572HS/573HW (Ch. EHS-6235I) (Similar to Chasiss) .... 1089—4
★TT687HW (Ch. ATS-938) 1212–POM
★TT934HW (Ch. ATS-938) 1212–POM
★TU905HW (Ch. ATS-938) 1212–POM
★TU944HW/945HS/946HK (Ch. ATS-938) 1212–POM
★WP581HW (Ch. 19TS-931) 1230–POM
★WT685HW, HWC (Ch. TS-938) 1212–POM
★WT688HW, T (Ch. TS-938) 1212–POM
★WT933HW, HWC (Ch. TS-938) 1212–POM
★WU904HW, HWC/906HW, HWC/907HS/908HP,HPC (Ch. TS-938) 1212–POM
XC1HHA (Ch. FHT12) ...1085—6
● YBP403HW (Ch. YC12TS-465) (Similar to PCB1185-3) 1091—2
● YBP523HN (Ch. YQ19TS-597) (Similar to Chassis) .. 1087—2
● ZD402HU (Ch. ZDCTS-465) (Similar to PCB1185-3) 1091—2
● ZD523HN (Ch. ZDQ19TS-597) (Similar to Chassis) . 1087—2
ZP232HN (Ch. CHS-3504) . 1074—5
● ZW402HU (Ch. ZWC12TS-465) (Similar to PCB1185-3) ..... 1091—2
● ZW523HN (Ch. ZWQ19TS-597) (Similar to Chassis) 1087—2
★Ch. ATS-938 ..... 1212–POM
● Ch. E12TS-465, T (Similar to PCB1185-3) ..... 1091—2
Ch. EHS-6235I (Similar to Chassis) ..... 1089—4
Ch. GHS-2500/2600 Chassis) ..... 1080—5
● Ch. K19TS-597 (Similar to Chassis) ..... 1087—2
● Ch. Q19TS-597 (Similar to Chassis) ..... 1087—2
★Ch. TS-938 ..... 1212–POM
● Ch. YQ19TS-597 (Similar to Chassis) ..... 1087—2
● Ch. ZDQ19TS-597 (Similar to Chassis) ..... 1087—2
● Ch. ZWQ19TS-597 (Similar to Chassis) ..... 1087—2
★CH. 19TS-931 ..... 1230–POM

N

NORELCO
(See Recorder Listing)

OLDSMOBILE
(See Auto Radio and Recorder Listings)

OLYMPIC
Olympic Int'l. Ltd.
Service Dept.
89-89 Union Turnpike
Glendale, N.Y. 11227

● 6P71 ..... 1221—2
● 9P94 ..... 1219—2

O

OPEL
(See Auto Radio Listing)

P

PACKARD BELL
(Also See Recorder Listing)
Teledyne Packard Bell Electronics
12333 West Olympic Blvd.
Los Angeles, Calif. 90064

RPC-234 (Ch. 18HF6) ..... 1215—4
RPC-238 (Ch. 18HF6) ..... 1215—4
RPC-252 (Ch. 18HF7) ..... 1215—4
RPC-311/312/314 (Ch. 36HF2) (Similar to Chassis) ..... 1204—4
RPC-344/346/348 (Ch. 18HF6) ..... 1215—4
RPC-352 (Ch. 18HF7) ..... 1215—4
RPCT-344/346 (Ch. 18HF6, TPAK-25) For Radio Ch... 1215—4
For Tape Player (Similar to Page 80) ..... HTP—1
RPS-09 (Ch. 18HF7) ..... 1215—4
RPS-105/107 (Ch. 36HF2) (Similar to Chassis) .... 1204—4
RTS-115 (Ch. 36HF2, TRA-14) For Radio Chassis ..... 1204—4
For Recorder Chassis (See Page 107) TR–66
★1C624 ..... 1164—2
● 1M123/125 ..... 1172—1
● 1M323/325 ..... 1172—1
● 1M523/525 ..... 1174—1
● 1M623/625 ..... 1175—2
Ch. 18HF6,18HF7 ..... 1215—4
Ch. 36HF2 (Similar to Chassis) ..... 1204—4

PANASONIC
(Also See Auto Radio and Recorder Listings)
Matsushita Electric Corp. of America
Panasonic Service & Parts Div.
10-16 4t4h Drive
Long Island City, N.Y. 11101

★CT-392, C 1218–POM
★CT-394, C 1218–POM
★CT-395VR 1230–POM
★CT-991P (Late Prod.) ..... 1228—2
RE-6451, C ..... 1211—5
RE-7800, C MHF–22
RS-820S MHF–23
SG-435 ..... 1228—5
● TR-003, C 1224–POM
● TR-005, C 1224–POM
● TR-425R, RC ..... 1235—1
● TR-465R 1230–POM
● TR-522 ..... 1230–POM
● TR-539 ..... 1224–POM

PENNEYS-PENNCREST
(Also See Recorder Listing)
J. C. Penney Co., Inc.
1301 Avenue of the Americas
New York, N.Y. 10019

★CR201 (TV Remote Control Unit) 1225–2A
★CT202 (TV Remote Control Unit) 1225–2A
★685-4827A/4828 ..... 1233—2
● 2341 ..... 1230–POM
★2852 ..... 1230–POM
★2853 ..... 1225—2
★2855, A ..... 1221—3
★2856 ..... 1218–POM
★2857 ..... 1230–POM
★2861/62/63 ..... 1221—3
★2871, A ..... 1218—1
★2872 ..... 1230–POM
★2885A (PCB 1229-4) ..... 1130—2
★2886 ..... 1224—2
★2887, A ..... 1218—1
3840 ..... TSM–129
3850 ..... TSM–130
● 4356A/57A/58A ..... 1226—1
● 4392A ..... 1226—1
5906 ..... 1224—5
6825, A MHF–21

PHILCO-FORD
Philco-Ford Corporation
Tioga & "C" Streets
Philadelphia, Pa. 19134

● B522AWH (Ch. 20P24) .....(PCB-1211-4) 1148—1
● B532AWA (Ch. 20P24) .....(PCB-1211-4) 1148—1
★C7310AWA (Ch. 22ST80).. 1235—2
★C7320AWA (Ch. 22ST80) . 1235—2
★C7340AWA (Ch. 22ST80).. 1235—2
★C7345AWA (Ch. 22ST80) . 1235—2
★C7360AFW/61AMA (Ch. 22ST80) ..... 1235—2
★C7362APC, AMD (Ch. 22ST80) ..... 1235—2
★C7370AWA/72ALP (Ch. 22ST80) ..... 1235—2
★C7382ALK (Ch. 21ST91P).. 1235—2
★C8180AWA/82ALK (TV Ch. Only 22ST81) ..... 1235—2
★C9440AWA (Ch. 22ST80).. 1235—2
★C9450AWA/52APC (Ch. 22ST80) ..... 1235—2
H540UWA (Ch. U150ST) .. 1232—5
H572UDK (Ch. U150ST) .. 1232—5
Ch. U150ST ..... 1232—5
● Ch. 20P24 (Run 7) .....(PCB 1211-4) 1148—1
★Ch. 21ST91P ..... 1235—2
★Ch. 22ST80/81 ..... 1235—2

PIONEER
U.S. Pioneer Electronics Corporation
178 Commerce Road
Carlstadt, New Jersey 07072

SX-440 ..... MHF–22
SX-990 ..... MHF–21

PLYMOUTH
(See Auto Radio Listing)

PONTIAC
See Auto Radio and Recorder Listings)

R

RCA
RCA Sales Corporation
600 North Sherman Drive
Indianapolis, Indiana 46201

● AP191W (Ch. KCS171E) .....(PCB 1216-4) 1061—1
● AP301W (Ch. KCS174H) .....(PCB 1232-4) 1115—2
● AQ098E (Ch. KCS176XB, RC-3006) ..... 1224—1
● AQ122W (Ch. KCS188A) .. 1227—2
● AQ127B (Ch. KCS188A) .. 1227—2
● AQ186F, WEN (Ch. KCS171F,R,AB) .....(PCB 1216-4) 1061—1
● AQ191W (Ch. KCS171E,P,AA) .....(PCB 1216-4) 1061—1
● AQ194W (Ch. KCS171E,P,AA) .....(PCB 1216-4) 1061—1
● AQ198WEN/200W (Ch. KCS172D,E) (Similar to Chassis) .... 1198—3
● AQ201WEN (Ch. KCS174H,L,M) .....(PCB 1232-4) 1115—2
★EQ325E,H (Ch. CTC51B) (Similar to Chassis) .... 1209—3
★EQ446EEN (Ch. CTC52A) (Similar to Chassis) .... 1211—3
★EQ449WR (Ch. CTC55XT) (Similar to Chassis) .... 1203—2
★EQ475W (Ch. CTC59XA) 1212–POM
★EQ475WR (Ch. CTC59XB) 1212–POM
★FQ485W (Ch. CTC50XR) .. 1226—2
★GQ561W/563L (Ch. CTC50XR) ..... 1226—2
★HP908L/910D,S (Ch. CTC39XP, RC-1239D, RS-253F) For TV Chassis ..... 1126—3
For Radio/Amp. Chassis (Similar to) ..... 1169—6
● JP192W (Ch. KCS171J,T,AC) .....(PCB 1216-4) 1061—1
RVM694E TSM–130
RZS476W ..... 1217—5
VS1001W (Ch. RS-265D) .. 1207—4
VS1200W (See Page 75) .. MHF–20
VZP30G (Ch. RS-270B) ..... 1208—4
★Ch. CTC50XR ..... 1226—2
★Ch. CTC51B (Similar to Chassis) ..... 1209—3
★Ch. CTC55XT (Similar to Chassis) ..... 1203—2
★Ch. CTC59XA,XB 1212–POM
● Ch. KCS171AA,AB,AC,E,F, J,P,R,T .....(PCB 1216-4) 1061—1
★Ch. KCS173K,L,N,P ..... 1061—1
● Ch. KCS174H,L,M .....(PCB 1232-4) 1115—2
● Ch. KCS176XB ..... 1224—1
● Ch. KCS188A ..... 1227—2
Ch. RC-3006 ..... 1224—1A

RANGER
(See Auto Radio and Recorder Listings)

RAYMER
Trutone Electronics, Inc.
14660 Raymer Street
Von Nuys, California 91405

LTS-1 (Speaker Line Tester) 1217–SED
795 (10 Watt Amplifier) 1217–SED

REALISTIC
(Also See Recorder Listing)
Allied Radio Shack Corporation
2727 West 7th Street
Fort Worth, Texas 76107

TRC-100B (21-134) CB–38
21-134 ..... CB–38

REGENCY
Regency Electronics, Inc.
7900 Pendleton Pike
Indianapolis, Indiana 46226

CB-291 ..... CB–37
Sprint/23 (CB-291) CB–37

ROBERTS
(See Recorder Listing)

ROBYN
Robyn Company
P.O. Box 478
Rockford, Michigan 49341

TR-123C CB–38

S

SAAB
(See Auto Radio Listing)

SANYO
Sanyo Electric Inc.
1200 West Walnut Street
Compton, California 90220

● 21T41 ..... 1232—2
● 21T42 ..... 1224–POM
● 21V71, 21V72 ..... 1219—3
● 51C11 ..... 1224–POM
● 91C16/17 ..... 1224–POM
● 91C18 ..... 1230–POM
● 91V17 ..... 1224–POM

SEARS-SILVERTONE
Sears, Roebuck & Company
303 East Ohio Street
Chicago, Illinois 60611

132.20890000 ..... 1222—5
132.20920000 ..... 1214—5
132.22800001 ..... TSM–131
132.31003000/3001 ..... 1227—4
499.74060000/60001 ..... MHF–23
528.31214100–101 (Similar to Chassis) ..... 1175—6
528.31216100/101 (Similar to Chassis) ..... 1175—6
528.31303006/007 (Similar to Chassis) ..... 1175—6
528.31304006/007 (Similar to Chassis) ..... 1175—6
528.31305006/007 (Similar to Chassis) ..... 1175—6
528.31314101 (Similar to Chassis) ..... 1175—6
★528.41880100 ..... 1212–POM

SEARS-SILVERTONE–Cont.

★528.43050001 thru 43050021 .....(PCB 1219-4) 1127—3
● 528.51140007/0008/0009/0010 .....(PCB 1220-4) 1134—3
● 528.51150007 thru .51150015 .....(PCB 1220-4) 1134—3
● 528.51710906 thru .51710915 .....(PCB 1220-4) 1130—3
● 528.51720906 thru .51720915 .....(PCB 1220-4) 1130—3
★562.40801000/1001 .....(PCB 1216-4) 1154—3
564.22790100 ..... TSM–129
★564.40050100 ..... 1224–POM
★564.40570000/0001 ..... 1229—3
● 564.49980100 ..... 1184—1
● 564.50080100 ..... 1228—3
★4033 (Ch. 562.10512) .....(PCB 1229-4) 1123—3
★41101 (Ch. 564.80161/162) .....(PCB 1228-4) 1147—1
★Ch. 562.10512 .....(PCB 1229-4) 1123—3
★Ch. 564.80161/162 .....(PCB 1228-4) 1147—1

SHARP
(Also See Recorder Listing)
Sharp Electronics Corp.
10 Keystone Place
Paramus, N.J. 07652

★C-2011 ..... 1218–POM
★C-2031 ..... 1218–POM
★C-9311 ..... 1218–POM
FXH-47 ..... 1218—4
★TF-90P ..... 1218—2
★TF-90PA 1218–POM
● TU-95PA 1218–POM
● TW-93P/94P ..... 1218—2
● 2U-121S 1218–POM
● 3S-111 ..... 1218–POM

SIMCA
(See Auto Radio Listing)

SONY
(Also See Recorder Listing)
Sony Corp. of America
47-47 Van Dam St.
Long Island City, N.Y. 11101

★KV-1210U (Late Prod. Ch. SCC-06-E) ..... 1232—3
★KV-1220U (Ch. SCC-10-A, SCC-A04-AA,-CA) ..... 1218—3
★KV-1224 (Ch. SCC-19A-A) 1224–POM
★KV-1720 ..... 1212–POM
★KV-9000U (Ch. SCC-B-01-AA,-BA,-DA) ..... 1222—3
● TV-730 (Ch. SMC-155A) . 1235—3
● TV-900UA (Ch. SMC-160 ☐) ..... 1234—2
● TV-940 (Ch. SMC-157) ..... 1234—2
★Ch. SCC-A01-AA,-BA,-DA 1216—2
★Ch. SCC-A04-AA,-CA ..... 1218—3
★Ch. SCC-B-01-AA,-BA,-DA . 1222—3
★Ch. SCC-06-E (Late Prod.) . 1232—3
★Ch. SCC-08-A,-B ..... 1216—2
★Ch. SCC-10-A ..... 1218—3
★Ch. SCC-19A-A 1224–POM
● Ch. SMC-155A ..... 1235—3
● Ch. SMC-157 ..... 1234—2
● Ch. SMC-160 ☐ ..... 1234—2

SYLVANIA
(Also See Recorder Listing)
GTE Sylvania Inc.
700 Ellicott Street
Batavia, N.Y. 14021

BK370WH, YL (Ch. 375-2) . 1226—4
BK375WH (Ch. 375-2) .... 1226—4
BK380W (Ch. 375-2) ..... 1226—4
BT320GN, WH (Ch. 375-1) 1226—4
BT330WH (Ch. 375-1) ..... 1226—4
BT335W (Ch. 375-1) ..... 1226—4
BT350W (Ch. 375-3) ..... 1226—4
BT355P (Ch. 375-3) ..... 1226—4
Exponent 7/20BG (Ch. P61-1) ..... 1213—4
Exponent 7/30BG (Ch. P61-2) ..... 1213—4
● MW228K (Ch. A09-1) .... 1230—3
● MW1041AV/1042GD (Ch. B14-1) ..... 1202—3
● MW1044/45 (Ch. A09-1) . 1230—3
● MZ200 (Ch. B12-2) .....(PCB 1211-4) 1094—2
SC422-2/424 (Ch. R44-1).. 1208—5
TR144BK (Ch. 373-1) TSM–129
● Ch. A09-1 ..... 1230—3
● Ch. B12-1,-2 (Codes 01, 02) .....(PCB 1211-4) 1094—2
Ch. P61-1,-2 ..... 1213—4
Ch. 373-1 ..... TSM–129
Ch. 375-1,-2,-3 ..... 1226—4

SYMPHONIC
(Also See Recorder Listing)
Symphonic Radio & Elec. Corp.
Foot of John Street
Lowell, Massachusetts 01852

P2711A (Ch. A-886) (Similar to Chassis) .... 1139—6
● TPS-300 ..... 1226—3
1143 (Ch. R-835) MHF–23
Ch. R-835 ..... MHF–23

T

TENNA
(See Auto Radio and Recorder Listings)

TOSHIBA
Toshiba America, Inc.
41-06 Delong Street
Flushing, N.Y. 11355

★C501S (Ch. TAC-6410) 1230–POM
★C811S (Ch. TAC-6350) 1230–POM
★C812D (Ch. TAC-6350 1230–POM
★Ch. TAC-6330 ..... 1230–POM
★Ch. TAC-6350 ..... 1230–POM
★Ch. TAC-6410 ..... 1230–POM

TOYOTA
(See Auto Radio and Recorder Listings)

TRIUMPH
(See Auto Radio Listing)

TRUETONE
(Also See Auto Radio and Recorder Listings)
Western Auto Supply Co.
2107 Grand Avenue
Konsas City, Mo. 64108

★ADM2255A-27 ..... 1212–POM
1ST5929A-17 ..... 1215—5
● MIC3909B-17 (Similar to Chassis) .... 1109—3
● MIC3912C-17 ..... 1212–POM
● MIC3916B-17/3918C-27/ 3919B-17 ..... 1224—3
TEW6295A-17 (Similar to Chassis) ..... 1001—5
★2DC2255 ..... 1212–POM
● 2DC3912 ..... 1212–POM
● 2DC3916B/18C/19B ..... 1224—3
4DC5929 ..... 1215—5
4DC6295 (Similar to Chassis) ..... 1001—5

V

V-M
V-M Corporation
375 West Main Street
Benton Harbor, Mich. 49023

323BL-1, BR-1, RG-1, YE-1 (Ch. 20116) ..... 1033—7
3398K-1 (Ch. 20117) ..... 1045—9

VOLVO
(See Auto Radio Listing)

W

WARDS AIRLINE
(Also See Auto Radio and Recorder Listings)
Montgomery Ward & Co.
619 Chicago Avenue
Chicago, Illinois 60607

● GCI-13162A 1230–POM
GCI-2090A ..... 1231—4
GCI-2095A ..... 1231—4
GCI-2521A ..... 1219—6
GCI-2531A ..... 1219—6
GCI-2541A ..... 1219—6
GCI-2551A ..... 1219—6
GCI-2621A ..... 1220—5
GCI-2641A ..... 1220—5
GCI-2651A ..... 1220—5
● GCI-11102A, B, C, D . 1212–POM
● GCI-11132A, B, C, D . 1212–POM
★GCI-12102A 1212–POM
● GCI-14821A ..... 1227—3
● GCI-14841A ..... 1227—3
● GCI-14851A ..... 1227—3
★GCI-15921A For Similar TV Ch. ..... 1217—3
For Similar Radio Ch. ..... 1219—6
★GCI-15951A For Similar TV Ch. ..... 1217—3
For Similar Radio Ch. ..... 1219—6
★GCI-16322A 1224–POM
★GCI-16342A 1224–POM
★GCI-16522A 1224–POM
★GCI-16542A 1224–POM
★GCI-16552A 1224–POM
★GCI-17321A,B ..... 1220—3
★GCI-17341A,B ..... 1220—3
★GCI-17351A,B ..... 1220—3
★GCI-17421A ..... 1220—3
★GCI-17441A ..... 1220—3
★GCI-17451A ..... 1220—3
GEN-1352A (See Page 89) TSM–99
GEN-1971A ..... 1223—4
GEN-6011A MHF–23
GEN-6211A TSM–129
● GEN-11562A 1230–POM
● GEN-11741B 1218–POM
● GEN-11961B 1230–POM
● GEN-13442A ..... 1234—3
JWR-2814A,B MHF–21
62-1352 (See Page 89) TSM–99
62-1971 ..... 1223—4
62-6211 ..... TSM–129
● 63-13442 ..... 1234—3

WELTRON
(Also See Auto Radio and Recorder Listings)
Weltron Company Inc.
514 East Peabody Street
Durham, North Carolina 27702

WFMX-104 ..... TSM–129
2001 ..... TSM–131

WHEEL HORSE
(See Auto Radio Listing)

WOLLENSAK
(See Recorder Listing)

Y

YORK
(See Recorder Listing)

Z

ZENITH
Zenith Sales Corporation
1900 N. Austin Ave.
Chicago, Illinois 60639

● C1335C,C1,C2,C3,F,F1,F2,F3, L,L1,L2,L3,P,P1,P2,P3 (Ch. 12CB12X) 1212–POM
● C1340W,W1,W2,W3 (Ch. 12CB12X) 1212–POM
★C3510C1,C3,C6 (Ch. 14CC14) ..... 1233—3
★C3510C7 (Ch. 14CC14Z) .. 1233—3
★C3520W1,W3 (Ch. 14CC14) ..... 1233—3
★C3520W7,W8 (Ch. 14CC14Z) ..... 1233—3
★C3710C1,C3,L1,L3 (Ch. 14CC15) ..... 1233—3
★C3710C7,C9,L7,L9 (Ch. 14CC15Z) ..... 1233—3
★C3722W3 (Ch. 14CC16) .. 1233—3
★C3722W8 (Ch. 14CC16Z) .. 1233—3

NOTE: ● Denotes Television Receiver. ★ Denotes Color Television Receiver. **AOR** Denotes Available On Request. **AR** Denotes Auto Radio Series Volume. **CB** Denotes CB Radio Series Volume. **HTP** Denotes Home Tape Player Series Volume. **MHF** Denotes Modular Hi-Fi Series Volume. **PCB** Denotes Production Change Bulletin. **POM** Denotes Bonus Schematic in Photofact-of-the-Month Package—Unavailable After Month Of Issue. **SED** Denotes Special Equipment Data. **TR** Denotes Tape Recorder Series Volume. **TSM** Denotes Transistor Radio Series Volume.

ZENITH—Cont.

	Set No.	Folder No.
★C3910W8 (Ch. 18CC29)		1225–3
★C3914W8 (Ch. 18CC30)		1225–3
★C4025W5 (Ch. 19CC19) (Similar to Chassis)		1215–3
★C4030W5 (Ch. 19CC19) (Similar to Chassis)		1215–3
★C4730X (Ch. 25CC25)		1212–POM
★C4787P/88DE/89P (Ch. 25CC55)		1212–POM
★C5722W1 (Ch. 14CC16)		1233–3
★C5722W7 (Ch. 14CC16Z)		1233–3
★C6030W4 (Ch. 19CC19, S-86335) (Similar to Chassis)		1215–3
★C6730X,X11 (Ch. 25CC25)		1212–POM
★C6787P/88DE (Ch. 25CC55)		1212–POM
★C8775P (TV Ch. Only 25CC55)		1212–POM
Royal 73J2 (Ch. 23-1, 24-1)		TSM–131
R73J2 (Ch. 23-1,24-1)		TSM–131
★S-87861 (TV Remote Control Unit)		1233–3A
★S-87941 (TV Remote Control Unit)		1233–3A
●T2616W,W1,W2,W3 (Ch. 12C812X)		1212–POM
★T2824W1,W3 (Ch. 14CC14)		1233–3
★T2824W7,W9 (Ch. 14CC14Z)		1233–3
★T2828W1,W3 (Ch. 14CC16)		1233–3
★T2828W8 (Ch. 14CC16Z)		1233–3
★T2833W8 (Ch. 18CC30)		1225–3
★T2836W5 (Ch. 19CC19) (Similar to Chassis)		1215–3
●Ch. 12CB12X		1212–POM
★Ch. 14CC14,Z/15,Z/16,Z		1233–3
★Ch. 18CC29/30		1225–3
★Ch. 19DC20		1230–POM
Ch. 23-1		TSM–131
Ch. 24-1		TSM–131
★Ch. 25CC25		1212–POM
★Ch. 25CC55		1212–POM

AUTO RADIOS AND TAPE PLAYERS

A

ALLIS-CHALMERS

1BTAC		AR–112

AMPE
Ampex Consumer Equipment Division
2201 Lunt Avenue
Elk Grove Village, Illinois 60007

Micro 40		AR–111
Micro 44		AR–110

ASTRO-LINE
(See Boman Astrosonix)

B

BOMAN ASTROSONIX
Boman Astrosonix-Div. of California Auto Radio Inc.
9426 Stewart & Gray Road
Downey, California 90241

BM-907		AR–116
BM-910		AR–111
CR-500		AR–109
CR-800		AR–109
SP-90		AR–116
100-M		AR–115
400-FM		AR–112
600-MPX		AR–113

BRITISH LEYLAND
(See Triumph)

BUICK
United Delco Distributors

14BPBT2		AR–114
24APB1		AR–115
24AT411		AR–112
24BFM1		AR–113
24BFP1		AR–110
24BPBT1		AR–114
24BT411		AR–112
7307554		AR–112
7313604		AR–115
7930134		AR–114
7930234		AR–110
7930244		AR–113
7935374		AR–112

C

CADILLAC
United Delco Distributors

15CFMT3		AR–114
25CFMT1,2		AR–114
25CFP1		AR–112
25CMW1,2		AR–110
25CT411		AR–112
7930015		AR–112
7930025		AR–110
7930495		AR–112
7937005		AR–114

CARTAPE
Car Tapes Inc.
9180 Kelvin Ave.
Chatsworth, California 91311

CT-8900		AR–116

CHANNEL MASTER
Channel Master Corp.
Ellenville, N.Y. 12428

6203		AR–116
6204		AR–113

CHEVROLET
United Delco Distributors

11BPBT2		AR–115
21AFM1		AR–109
21APB1		AR–110
21APBK1		AR–110
21AT411		AR–112
21BFM1		AR–114
21BFP1		AR–113
21BFP2 (See Page 61)		AR–113
21BFPK1		AR–113
21BFPK2 (See Page 61)		AR–113
21BPB1		AR–112
21BPBK1		AR–112
21BPBT1		AR–115
21HPB1		AR–112
21HPBK1		AR–112
21TPB1		AR–110
21TT411		AR–112
21XPBT1		AR–115
7305841		AR–110
7313971		AR–112
7314201		AR–112
7314211		AR–114
7930061		AR–115
7930161		AR–115
7933241		AR–110
7933261		AR–109
7933291		AR–112
7933301		AR–113
7933501		AR–110
7933641		AR–112
7935021		AR–112
7936011		AR–113
7936181		AR–115
7936601		AR–112

CHRYSLER
Chrysler Corp.
P.O. Box 1118
Detroit Michigan 48231

28BFW1		AR–109
2884759 (0BBJ, 1BBJ)		AR–89
3501164 (28BFW1) (1972 Prod.)		AR–109

D

DELCO
United Delco Distributors

20BCT11		AR–115
7937400		AR–115

DODGE
(Also See MoPar)
Chrysler Corp.
P.O. Box 1118
Detroit, Mich. 48231

1DP2010		AR–109
3420889 (1DP2010)		AR–109
3501157		AR–109

F

FO-MO-CO
(See Ford, Lincoln, Mercury)
FORD
Ford Motor Co.
Dearborn, Mich.

D2BA-18810 (Similar to Page 51)		AR–59
D2HA-18810 (Similar to Page 51)		AR–51
1BTF		AR–115
2BTB/BTT/BTW (Similar to Page 51)		AR–59

G

GENERAL MOTORS CORP. (GMC)
United Delco Distributors

26TRMP1		AR–110
26TT411		AR–112
26TTCP1		AR–110
7305516		AR–110
730B166		AR–112
7931766		AR–110

H

HITACHI
Hitachi Sales Corporation of America
48-50 34th Street
Long Island City, N.Y. 11101

CS-1000IC		AR–111
TRQ-206		AR–116

I

INTERNATIONAL
International Harvester Co.
180 N. Michigan Avenue
Chicago, Illinois 60601

1BTIH		AR–110

J

JOHN DEERE

1AR4231		AR–110
1BTJD		AR–113
7SMJD		AR–110

M

MACK TRUCK

U7MMT		AR–112
204SX28		AR–108

MEDALLION
Medallion Automotive Products Company
P.O. Box 1903
Kansas City, Missouri 64141

65-500		AR–116

MERCURY
Ford Motor Co.
Dearborn, Mich.

D0RJ-19A241A		AR–109
1CP2033		AR–109

MOTOROLA
Motorola, Inc.
9401 West Grand Ave.
Franklin Park, Ill. 60131

P718S		AR–116
TM200S		AR–111
TM718S		AR–116
7SMFT		AR–109
10P3598		AR–109
Ch. TD138J		AR–116

O

OLDSMOBILE
United Delco Distributors

23AFM1		AR–112
23AFP1		AR–115
23AT411		AR–112
23BFM1		AR–110
23BFP1		AR–114
23BPB1		AR–115
7935013		AR–112
7935023		AR–115
7935033		AR–110
7937413		AR–112
7938303		AR–115
7938313		AR–114

OPEL
United Delco Distributors

24LPB1		AR–114
24PPB1		AR–112
7312234		AR–112
7930254		AR–114

P

PANASONIC
Matsushita Elec. Corp. of America
Panasonic Service & Parts Div.
10-16 44th Drive
Long Island City, N.Y. 11101

CX-351EU		AR–111
CX-830EU		AR–111

PLYMOUTH
(Also See MoPar)
Chrysler Corp.
P.O. Box 1118
Detroit, Mich. 48231

3501157		AR–109

PONTIAC
United Delco Distributors

12BFMT2		AR–115
21AFM1		AR–113
21APB1		AR–114
21APBK1		AR–114
21XFMT1		AR–115
22AFM1		AR–113
22APB1		AR–114
22APBK1		AR–114
22AT411		AR–112
22BFM1,2		AR–112
22BFMT1		AR–115
22BFP1		AR–109
22BFP2 (See Page 99)		AR–109
22BFPK1		AR–109
22BFPK2 (See Page 99)		AR–109
22BPBK2		AR–115
22BT411		AR–112
22FBPK1		AR–114
22FFM1		AR–113
22FPB1		AR–114
22FT411		AR–112
22GFM1		AR–113
22GPB1		AR–114
22GPBK1		AR–114
22XT411		AR–112
7307302		AR–114
7307332		AR–114
7307702		AR–112
7312332		AR–113
7312892		AR–114
7312912		AR–114
7313522		AR–114
7313542		AR–113
7313552		AR–114
7930022		AR–109
7930032		AR–112
7930202		AR–115
7930212		AR–109

PONTIAC—Cont.

7930252		AR–115
7930492		AR–112
7930542		AR–113
7933241		AR–114
7933261		AR–113
7933501		AR–114
7934782		AR–112
7936191		AR–115
7936232		AR–112

R

RANGER
Ranger Auto Radio
19201 Cranwood Parkway
Warrensville Heights, Ohio 44128

R-71-T		AR–111

S

SAAB
Saab, Inc.
100 Waterfront
New Haven, Conn.

0BSA,0BSAA,0BSAB		AR–113
0BSA99		AR–113
1BSA		AR–113
1BSA99		AR–113
9FBSA,9FBSAB		AR–110
9FBSA99		AR–110

SIMCA
Chrysler Corporation
P.O. Box 1118
Detroit, Michigan 48231

1BSI,1BSIB		AR–114

T

TENNA
Tenna Corporation
19201 Cranwood Parkway
Warrensville Heights, Ohio 44128

TC-80-T		AR–116
TC-82-T		AR–111

TOYOTA
Toyota Motor Sales U.S.A., Inc.
2055 West 190th Street
Torrence, Calif. 90501

CR-127FT		AR–114
CX-161FTB		AR–114
CX-165FTB		AR–114
RT-60LFT		AR–115
86120-20090 (CR-127FT)		AR–114
86120-22040 (RT-60LFT)		AR–115
86260-14010 (CX-165FTB)		AR–114
86260-20011 (CX-161FTB)		AR–114

TRIUMPH
British Leyland Motors Inc.
600 Willow Tree Road
Leonia N.J. 07605

0BTR,0BTRA,B		AR–110
1BTR		AR–110
9FBTR		AR–113

TRUETONE
Western Auto Supply Co.
2107 Grand Avenue
Kansas City, Missouri 64108

ITC7004A-07		AR–111
MIC7003A-17		AR–116
4DC7003		AR–116
4DC7004		AR–111

V

VOLVO
Volvo Distributors, Inc.
Volvo Drive
Rockleigh, New Jersey

0BV0,0BV0C,D		AR–109
1BV0,1BV0C,D		AR–109
9FBV0,9FBV0C,D		AR–112

W

WARDS—RIVERSIDE
Montgomery Ward & Co.
619 Chicago Avenue
Chicago, Illinois 60607

ZCX-16753A,B,C,D		AR–116
61-16753		AR–116

WELTRON
Weltron Company Inc.
514 East Peabody Street
Durham, North Carolina 27702

717,718		AR–111

WHEEL HORSE
Wheel Horse
515 West Ireland Road
South Bend, Indiana 46614

1BTWH		AR–114

RECORDERS AND TAPE PLAYERS

A

AMBASSADOR
Allied Purchasing Corp.
401 Fifth Avenue
New York, N.Y. 10016

2V960		TR–95

AMPEX
Ampex Consumer Equipment Division
2201 Lunt Avenue
Elk Grove Village, Illinois 60007

Micro 9A (Similar to Page 5)		TR–81
Micro 40		AR–111
Micro 44		AR–109
761		TR–95
767		TR–95
1461		TR–95
1467		TR–95

ARVIN
Arvin Industries, Inc.
1531 Thirteenth Street
Columbus, Indiana 47201

40L31-19 (Ch. 1.48701, 1.48702)		TR–92
Ch. 1.48701/702		TR–92

B

BOMAN ASTROSONIX
Boman Astrosonix-Div. of California Auto Radio Inc.
9426 Stewart & Gray Road
Downey, California 90241

BM-907		AR–116
BM-910		AR–111
SP-90		AR–116

BUICK
United Delco Distributors

14BPBT2		AR–114
24AT411		AR–112
24BPBT1		AR–114
24BT411		AR–112
7307554		AR–112
7930134		AR–114
7935374		AR–112

C

CADILLAC
United Delco Distributors

15CFMT3		AR–114
25CFMT1,2		AR–114
25CT411		AR–112
7930495		AR–112
7937005		AR–114

CARTAPE
Car Tapes Inc.
9180 Kelvin Ave.
Chatsworth, California 91311

CT-8900		AR–116

CHANNEL MASTER
Channel Master Corp.
Ellenville, N.Y. 12428

6201		TSM–129
6202		TSM–131
6203		AR–116
6204		AR–113
6205		TSM–130
6208		TSM–130

CHEVROLET
United Delco Distributors

11BPBT2		AR–115
21AT411		AR–112
21BPBT1		AR–115
21TT411		AR–112
21XPBT1		AR–115
7313971		AR–112
7930061		AR–115
7930161		AR–115
7936181		AR–115
7936601		AR–112

CRAIG
Craig Corp.
2302 East 15th Street
Los Angeles, California 90021

2606		TR–90

CROWN RADIO
Crown Radio Corp.
228 E. Harris Ave.
South San Francisco, Calif. 94080

CTR-320W		TR–93
CTR-8750		TR–94

D

DELCO
United Delco Distributors

20BCT11		AR–115
7937400		AR–115

E

ELECTROPHONIC
Electrophonic Corp. of America
101-10 Foster Avenue
Brooklyn, New York 11236

T-9		TSM–131
T-16		TSM–130
T-17		TSM–131

G

GENERAL MOTORS CORP. (GMC)
United Delco Distributors

26TT411		AR–112
7308166		AR–112

H

HITACHI
Hitachi Sales Corporation of America
48-50 34th Street
Long Island City, N.Y. 11101

CS-1000IC		AR–111
TRQ-206		AR–116
TRQ-232S		TR–95
TRQ-250,E,R,W		TR–91
TRQ-260 (A),(W)		TR–92
TRQ-280 (A),(E),(W)		TR–93

J

JULIETTE
Topp Electronics, Inc.
4201 N. W. 77th Ave.
Miami, Florida 33166

CTP-2032		TR–91

L

LLOYD'S
Lloyd's Electronics of California, Inc.
18601 South Susana Road
Compton, California 90221

1V20-114A		TR–92

M

MAGNAVOX
The Magnavox Company
Bueter Road
Fort Wayne, Indiana 46803

1V9002		TR–90

MEDALLION
Medallion Automotive Products Company
P.O. Box 1903
Kansas City, Missouri 64141

65-500		AR–116

MERCURY (PAX LTD.)
Pax, Ltd.
5125 Church Street
Skokie, Ill. 60076

20-1025		TR–90
20-1035		TR–92

MIDLAND
Midland International Corp.
P.O. Box 1903
Kansas City, Missouri 64141

12-140		TR–94
12-157		TR–91
12-440		TR–92

MORSE ELECTRO PRODUCTS
Morse Electro Products Corp.
101-10 Foster Avenue
Brooklyn, New York 11236

T-9		TSM–131
T-16		TSM–130
T-17		TSM–131

MOTOROLA
Motorola, Inc.
9401 West Grand Ave.
Franklin Park, Illinois 60131

CP500EN-1 (Ch. CHS-3600) (See Page 91)		HTP–7
GP40GW		TR–91
LP200HE (Ch. DHS-3600) (Similar to Page 91)		HTP–7
P718S		AR–116
TM200S		AR–111
TM718S		AR–116
Ch. DHS-3600 (Similar to Page 91)		HTP–9
Ch. TD138J		AR–116

N

NORELCO
North American Phillips Co., Inc.
30-10 Review Avenue
L.I. City, New York 11101

1440		TR–90
1530		TR–94
2400,P		TR–92

NOTE: ● Denotes Television Receiver. ★ Denotes Color Television Receiver. **AOR** Denotes Available On Request. **AR** Denotes Auto Radio Series Volume. **CB** Denotes CB Radio Series Volume. **HTP** Denotes Home Tape Player Series Volume. **MHF** Denotes Modular Hi-Fi Series Volume. **PCB** Denotes Production Change Bulletin. **POM** Denotes Bonus Schematic in Photofact-of-the-Month Package—Unavailable After Month Of Issue. **SED** Denotes Special Equipment Data. **TR** Denotes Tape Recorder Series Volume. **TSM** Denotes Transistor Radio Series Volume.

	Set No.	Folder No.
O		
OLDSMODILE **United Delco Distributors**		
23AT411		AR–112
7937413		AR–112
P		
PACKARD BELL **Teledyne Packard Bell Electronics** **12333 West Olympic Blvd.** **Los Angeles, Calif. 90064**		
TRD-120 (Similar to Page 34)		TR–73
PANASONIC **Matsushita Electric Corp. of America** **Panasonic Service & Parts Div.** **10-16 44th Drive** **Long Island City, N.Y. 11101**		
CX-351EU		AR–111
CX-830EU		AR–111
RQ-209DAS		TR–90
RQ-222AS		TR–95
RQ-226S		TR–94
RQ-236S		TR–93
RS-256UAS		TR–95
PENNEY'S–PENNCREST **J. C. Penney Co., Inc.** **1301 Avenue of the Americas** **New York, N.Y. 10019**		
3840		TSM–129
3850		TSM–130
6232,6233 (Similar to Page 136)		TR–18
PONTIAC **United Delco Distributors**		
12BFMT2		AR–115
21XFMT1		AR–115
22AT411		AR–112
22BFMT1		AR–115
22BT411		AR–112
22FT411		AR–112
22XT411		AR–112
7307702		AR–112
7930252		AR–115
7930492		AR–112
7934782		AR–112
7936191		AR–115
7936232		AR–112
R		
RANGER **Ranger Radio** **19201 Cranwood Parkway** **Warrensville Heights, Ohio 44128**		
R-71-T		AR–111
REALISTIC **Allied Radio Shack Corporation** **2727 West 7th Street** **Fort Worth, Texas 76107**		
TR-8 (14-912)		TR–91
TR-8A (14-912A)		TR–91
14-912,A		TR–91
ROBERTS **Rheem Manufacturing Co.** **Califone-Roberts Div.** **6050 West Jefferson Blvd.** **Los Angeles, Calif. 90016**		
525		TR–93
530		TR–93
S		
SHARP **Sharp Electronics Corp.** **10 Keystone Place** **Paramus, N. J. 07652**		
RD-426U		TR–92
SONY **Superscope, Inc.** **8150 Vineland Ave.** **Sun Valley, Calif. 91353**		
TC-100 (Serial #258,171 and Later (USA) #309,101 and Later (Canada)		TR–90
TC-160		TR–93
TC-650		TR–94
SONY–Cont.		
TC-651 (Similar to Page 65)		TR–94
TC-707C (Similar to Page 65)		TR–94
TC-2200		TR–93
SYLVANIA **GTE Sylvania Inc.** **700 Ellicatt Street** **Batavia, New York 14021**		
CT150 (Ch. TC4)		TR–94
Ch. TC4		TR–94
SYMPHONIC **Symphonic Radio & Electronic Corp.** **Foot of John Street** **Lowell, Massachusetts 01852**		
AT-115		TR–90
CR-142		TR–90
T		
TENNA **Tenna Corporation** **19201 Cranwood Parkway** **Warrensville Heights, Ohio 44128**		
TC-80-T		AR–116
TC-82-T		AR–111
TOYOTA **Toyota Motor Sales U.S.A., Inc.** **2055 West 190th Street** **Torrence, Calif. 90501**		
CX-161FTB		AR–114
CX-165FTB		AR–114
86260-14010 (CX-165FTB)		AR–114
86260-20011 (CX-161FTB)		AR–114
TRUETONE **Western Auto Supply Co.** **2107 Grand Avenue** **Kansas City, Mo. 64108**		
ITC7004A-07		AR–111
MIC7003A-17		AR–116
4DC7003		AR–116
4DC7004		AR–111
W		
WARDS (AIRLINE-RIVERSIDE) **Montgomery Ward & Co.** **619 Chicago Avenue** **Chicago, Illinois 60607**		
GEN-3930A		TR–95
GEN-6211A		TSM–129
ZCX-16753A,B,C,D		AR–116
61-16753		AR–116
62-6211		TSM–129
62-3930		TR–95
WELTRON **Weltron Company Inc.** **514 East Peabody Street** **Durham, North Carolina 27702**		
WFMX-104		TSM–129
717,718		AR–111
2001		TSM–131
WOLLENSAK **3M Company** **Revere-Mincom Div.** **2501 Hudson Rd.** **St. Paul, Minnesota 55119**		
6150 (Lots A,B)		TR–93
6154 (Lots A,B)		TR–93
6250		TR–91
6350		TR–91
6360		TR–91
6364		TR–91
Y		
YORK **York Radio Corp.** **15 Empire Blvd.** **So. Hackensack, N. J. 07606**		
CTR-12		TR–95

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Replaces 98 19″ types

18VABP22
18VACP22
18VADP22
18VAHP22
18VAJP22
18VAQP22
18VARP22
18VASP22
18VATP22
18VBAP22
18VBCP22
18VBHP22
19EXP22
19EXP22/ 19GVP22
19EYP22
19EYP22/ 19GWP22
19FMP22
19FXP22
19GLP22
19GSP22
19GVP22
19GVP22/ 19EXP22
19GWP22
19GWP22/ 19EYP22
19GXP22
19GYP22
19GZP22
19HBP22
19HCP22
19HCP22/ 19HKP22
19HFP22
19HJP22
19HKP22
19HQP22
19HRP22
19HXP22
19JBP22
19JDP22
19JHP22
19JKP22
19JNP22
19JQP22
19JYP22
19JZP22
19KEP22
19KFP22
490AB22
490ACB22
490ADB22
490AEB22
490AFB22
490AGB22
490AHB22
490AHB22A
490AJB22
490AJB22A
490AKB22
490AKP22A
490ALB22
490AMB22
490AMB22A
490ANB22
490ARB22
490ASB22
490ASB22A
490BAB22
490BCB22
490BDB22
490BGB22
490BHB22
490BRB22
490CAB22
490CB22
490CHB22
490CUB22
490DB22
490DB22A
490EB22
490EB22A
490FB22
490GB22
490HB22
490JB22
490JB22A
490KB22
490KB22A
490LB22
490MB22
490NB22
490RB22
490SB22
490TB22
490UB22
490VB22
490WB22
490XB22
490YB22
490ZB22

Replaces 22 21″ types

19VABP22
19VACP22
21AXP22
21AXP22A
21AXP22A/ 21AXP22
21CYP22
21CYP22A
21FBP22
21FBP22A
21FBP22A/ 21GUP22
21FJP22
21FJP22A
21FJP22A/ 21GVP22
21FKP22
21GUP22
21GUP22/ 21FBP22A
21GVP22
21GVP22/ 21FJP22A
21GXP22
21GYP22
21GZP22
21HAP22

Replaces 75 25″ types

23EGP22
23EGP22A
23VABP22
23VACP22
23VADP22
23VAHP22
23VALP22
23VAMP22
23VANP22
23VAQP22
23VARP22
23VASP22
23VATP22
23VAUP22
23VAWP22
23VAXP22
23VAYP22
23VAZP22
23VBAP22
23VBCP22
23VBDP22
23VBEP22
23VBGP22
23VBHP22
23VBJP22
23VBRP22
23VBTP22
25ABP22
25ADP22
25AEP22
25AFP22
25AGP22
25AJP22
25ANP22
25AP22
25AP22A
25AP22A/ 25XP22
25AQP22
25ASP22
25AWP22
25AXP22
25AZP22
25BAP22
25BCP22
25BDP22
25BFP22
25BGP22
25BHP22
25BJP22
25BMP22
25BP22
25BP22A
25BP22A/ 25YP22
25BRP22
25BSP22
25BVP22
25BWP22
25BXP22
25BZP22
25CBP22
25CP22
25CP22A
25FP22
25FP22A
25GP22
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25VP22
25WP22
25XP22
25XP22/ 25AP22A
25YP22
25YP22/ 25BP22A
25ZP22

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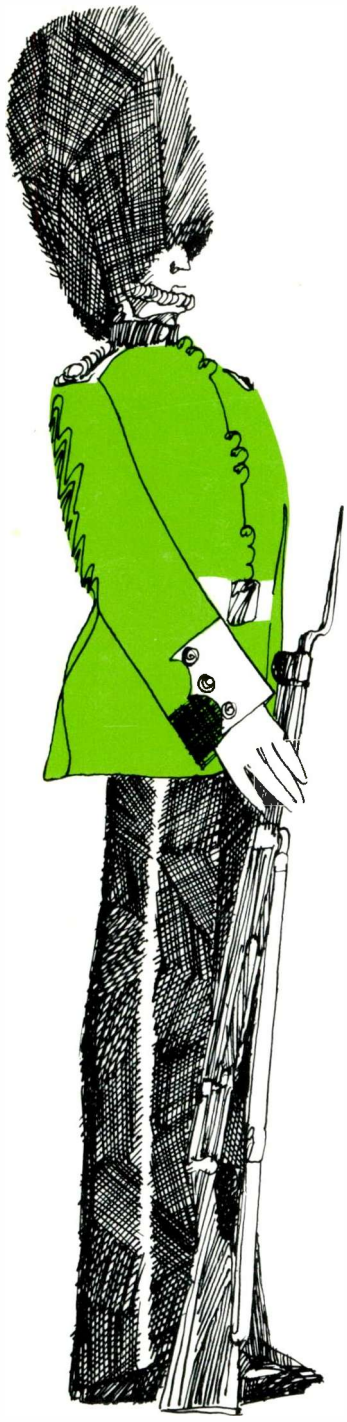

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