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ELECTRONIC TECHNICIAN/DEALER

WORLD'S LARGEST TV-RADIO SERVICE & SALES CIRCULATION

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CB Sales/Service: Which & How Many Brands

Quasar's "Super Module" Color TV

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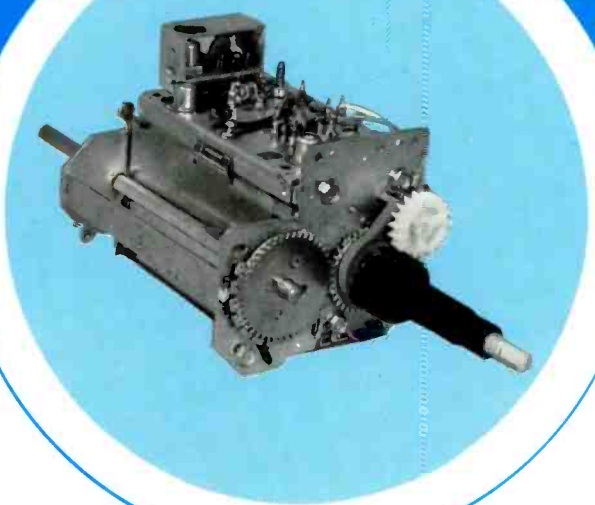

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THE COMPLETE LIST OF ALL PTS SERVICE CENTERS APPEARS ON THE NEXT PAGE.

...for more details circle 102 on Reader Service Card

TECHNICAL LITERATURE

TV Servicing Aids are illustrated and described in the newest catalog from TeleMatic. Everything from TV test rigs, yoke & convergence adaptors to CRT brighteners and substitute tuners is included in the new publication. Both the electric and battery-operated version of the TeleMatic substitute tuner is included, along with a crystal check and frequency standard for CB/Ham/TV/FM. Available free from *TeleMatic*, 2862 Fulton Street, Brooklyn, N.Y. 11207.

Soldering and Desoldering Equipment for electronic service, industrial, craft and military users is shown with prices in a new catalog offered by Enterprise Development. Included in the literature are soldering irons, desoldering irons, kits and the desoldering head that converts a soldering iron into a desoldering iron. Also shown are tips, desoldering bulbs, solder paks and soldering tool stands. Available free from *Enterprise Development Corp.*, 5127 E. 65th St., Indianapolis, Indiana 46220.

A TV Tuner Replacement Guide and parts catalog, new for 1976, is now available from PTS Electronics. The new catalog, 134 pages, includes an extensive listing of all major makes and models of tuners and replacement parts, including photo enlargements of tuners for quick detection of problems and easy location of the right replacement part. Available for $2 from *PTS Electronics, Inc.*, P.O. Box 272, Bloomington, IN 47401.

Electronic Service Oriented Products are detailed in a new catalog from Projector Recorder Belt Company. Included in the catalog is the newly developed FRM kit of 25 precision endless belts which will replace virtually all the 8-track-type belts marketed today. Many other service oriented products are also described in the 32-page catalog. Available free from *Projector Recorder Belt Co.*, P.O. Box 176, Whitewater, Wisconsin 53190.

Rental of Electronic Test and Measurement Equipment is described in a new 52-page directory from Electro Rent. The catalog lists thousands of items available for rental on a monthly, quarterly, and semi-annual basis. Includes such equipment as signal conditioners, component testing gear, frequency and time counters, and oscilloscopes. Available free from *Electro Rent Corp.*, 2230 Charleston Road, Mountain View, CA 94043.

A Guide to Test and Measurement Instruments available from the John Fluke Mfg. Co. are detailed in their latest product directory. Included are descriptions, illustrations and prices on digital multimeters and voltmeters, digital thermometers, differential voltmeters, calibrators, power supplies, frequency synthesizers, and automatic test equipment. Available free from *John Fluke Mfg. Co., Inc.*, P.O. Box 43210, Mountlake Terrace, WA 98043.

Test Instruments from Mura are illustrated and described in their latest two-color brochure. Included are multitesters for bench work and for portable uses, transistor testers, their new electronic thermotester for temperatures from −50° to +200°C, and their Clamprober, which measures AC current to 300 amperes without breaking into the circuit. Available free from the *Mura Corporation*, 50 So. Service Road, Jericho, N.Y. 11753.

The 1976 Edition of the GE Semiconductor Replacement Guide is now available. The 200-page catalog guide contains more cross-references than previously to help the service technician find the GE parts needed to repair both domestic and Far East equipment, including popular brands of CB gear and scanners. Products are listed in alpha-numeric order. Available for $1.00 from *General Electric Co.* P.O. Box 1008, Owensboro, Ky. 42301.

RF Loads and Wattmeters are described in a new "short-form" catalog from Bird Electronic. The new 4-page folder, SF-76, lists Thruline wattmeters, coaxial loads, RF termination wattmeters and attenuators covering from ½ to 2300 MHz and from milliwatts to 250 kilowatts. Available free from *Bird Electronic Corporation*, 30303 Aurora Rd., Cleveland (Solon), Ohio 44139.

UHF Power Director Antennas are described and illustrated in a new 8-page brochure from Antenna Specialists. The new literature highlights the 850 series of the company's products, all of which have ⅜" O.D. aluminum rod dipoles and are Heliarc welded at critical joints to provide low losses and highly efficient RF radiation. The brochure covers new antenna models offering a choice of controllable patterns and gain characteristics. Available free from *Antenna Specialists Co.*, 12435 Euclid Avenue, Cleveland, Ohio 44106. ■

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THE COVER: RCA has launched a "Module Remanufacturing Program" to insure the continuing availability at reasonable cost of replacement modules for their modular color TV receivers. (Story on page 42). The cover photo shows the alignment operation, one of the many steps in the new program.

8 Quasar's "Super Module" Color TV—Part 1
Introducing Quasar's new modularized chassis, TS-958 and TS-959, that feature 60 to 70% of the circuitry on a single repair-or-replace super module. By J.W. Phipps.

20 GE's "Broadcast-Controlled" Color System—Part 2
We conclude our analysis and description of GE's new VIR-controlled color TV system as contained in their new YM and YC-2 chassis

30 The CB Brand Decision
A review of important points for prospective CB dealers to consider when choosing brands of radios and accessories. By David F. Norman.

34 Pincushioning in Color TV Receivers
What causes pincushioning, circuits developed by TV designers to correct or reduce it, and tips on troubleshooting the correction circuits. By Paul Shih.

42 "Remanufactured Modules"—A Solution To Future Availability
An examination of RCA's approach to insuring that replacement modules for its modular color TV receivers continue to be available to servicers at reasonable cost. By Don W. Mason, ET/D Managing Editor.

DEPARTMENTS

6 NEWS OF THE INDUSTRY
44 TEST INSTRUMENT REPORT
48 NEW PRODUCTS
56 CLASSIFIED ADS
58 ADVERTISING INDEX
67 READERS SERVICE
69 TEKFAX

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NEWS OF THE INDUSTRY

Not Only CB—But the Whole Two-way Radio Industry—Grows On A Boom Basis

With all of the public attention focused on citizen's band radio during the past couple of years, it's natural that to most people, two-way radio communications means CB. Of course, two-way radio covers a lot more ground than just the "rubber duckies" and "good buddies" of CB—and, according to a Special Report on Two-way Radio in *Communications News,* all facets of the two-way industry are growing at an ever-increasing rate. "Mobile-radio equipment sales for 1976, for example, are, the report reveals, "expected to be approximately $1 billion for the first time, plus over $200 million additional for maintenance services. This increases by 1984 to over $4.2 billion in equipment sales, and over $580 million in maintenance." (See chart on the Growth Story)

"This phenomenal growth can be attributed to several factors," according to the report, "the most significant being the Class D citizens band 'explosion', as well as a very healthy increase in land-mobile equipment sales. Manufacturers of citizens-band equipment who are also suppliers of land-mobile equipment have expressed optimism concerning their future business."

The Two-Way Radio Growth Story

AUTHORIZED TRANSMITTERS IN SAFETY AND SPECIAL SERVICES

	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Citizens	2,397,852	2,561,363	2,718,505	2,781,101	2,759,111	2,842,645	3,991,738	3,908,479	3,842,775	4,129,763	5,988,398
Amateur	286,325	292,194	283,412	287,164	290,298	283,021	286,118	284,235	279,505	273,780	276,793
Aviation	176,558	169,034	196,723	225,876	230,993	242,165	177,171	180,658	186,448	212,295	225,748
Industrial	1,315,498	1,400,231	1,551,410	1,688,744	1,858,392	2,018,247	1,488,626	1,829,659	2,051,034	2,303,063	2,711,159
Public Safety	544,732	597,288	639,555	684,456	732,093	778,469	1,539,271	2,026,719	2,318,373	2,668,134	3,305,479
Marine	138,788	149,629	174,454	199,238	226,183	250,636	234,343	256,453	250,459	257,047	264,930
Transportation	416,387	446,214	489,835	522,381	551,567	573,822	1,140,955	1,357,518	1,451,449	1,643,729	1,402,790
Total	5,276,140	5,615,953	6,053,894	6,388,960	6,648,637	6,989,000	8,858,222	9,843,720	10,380,043	11,487,811	14,175,297

Source: Federal Communications Commission

Finally—CB Expands From 23 To 40 Channels

The long awaited—and much discussed—expansion of CB channels from 23 to 40 has been announced by the FCC. As of January 1, 1977, manufacturers will be permitted to sell citizen's band radios with 40 channels. The expanded band to be used by CB radio will now extend from 26.965 MHz to 27.405 MHz, with 10 kHz channel spacing. About 4,000 landmobile radio licensees currently assigned to expansion channels for business use will be displaced by the change, but they can continue to share their frequencies with CB'rs until December 31, 1979.

The FCC decision also prohibits the use of converters that would extend the range of existing 23-channel CB sets to 40 channels (in other words, the additional 17 channels will only be available to users who buy completely new radios after January 1st)—requires that the serial number of each new 40-channel CB radio be engraved on the chassis—retains channel 9 as emergency channel—and requires that a copy of Part 95 CB Rules, and license forms 505 and 505B be included with each new set sold.

There are varying opinions as to what effect the channel expansion will have on the 23-channel market. Some manufacturers fear that consumers will now hold back on purchases of 23-channel sets until the 40-channel units are available, thus hurting the Christmas sales prospects. Commenting in the *Wall Street Journal,* Carl E. Lindholm, senior vice president and general manager of Motorola Inc.'s automotive products division said "the expansion in the long term can only be positive for the industry and users. In the short term, the only disadvantage will be inventory adjustments." And Andrew Andros, chairman of Hy-Gain Electronics expects "sales to increase a great deal, and a significant number of the 15 million people who already own CB equipment will want new sets."

Another comment came from Paul Garver, RCA Distributor & Special Products Division vice president and general manager. Commenting in *TV Digest,* Garver said, "The decision will not obsolete 23-channel sets because of the many millions already in use. We

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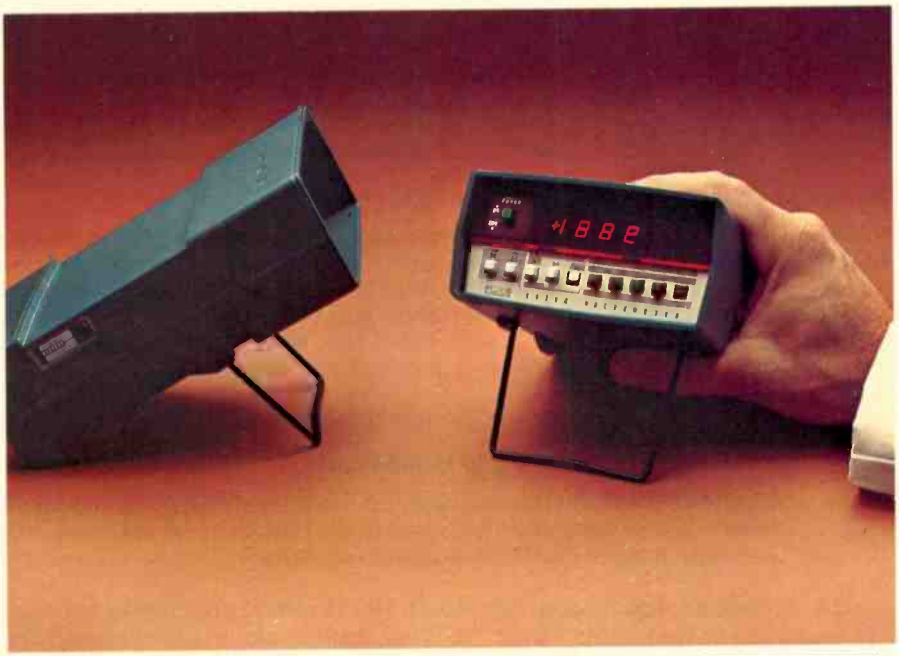

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expect, therefore, that 23-channel units will continue to sell at a very good rate."

Actually, as far as the present owner of a 23-channel radio is concerned, it doesn't seem that he will, as of January 1st, junk his 23-channel outfit and rush out to buy the new 40-channel unit. Emergency channel 9 and the trucker channel (19) are still in the original 23-channel band, and furthermore, it'll be some time after January 1st before there'll be enough other CB'rs to talk to on the additional 17 channels. For the brand new CB buyer, however, after January 1st it'll be a different story. He will most likely go for the 40-channel set. Prices on the new units are expected to range only 10 to 15% above the 23-channel sets.

Motorola Is Into CB On Several Fronts

One of the major producers of two-way radio equipment—Motorola—introduced its own line of CB transceivers this past spring, and now, according to *Electronic News,* is getting ready to produce CB equipment in conjunction with other firms. Motorola will be supplying the Ford Motor Company with CB radios, under the Aeronutronic Ford label for installation as original equipment in 1977 Ford cars, and is planning to produce in-dash AM-FM radio/CB radio combinations for Pioneer Electronics in a joint manufacturing venture with Alps Electric. Pioneer Electronics of America will handle the sales under the Pioneer brand name, but manufacture will be by Alps-Motorola Corporation, because of Pioneer's lack of manufacturing facilities in this country

1976 Was Not a Good Year For TV Sales

According to data from the Electronic Industries Association (EIA), only 11,834,174 1976-model tv sets were sold to dealers last year, the lowest of any model-year since 1968. As reported in *TV Digest,* the only increases "over 1975 model-year among sales-to-dealers were registered by auto radio and FM home-portable-clock radios." The complete story is shown in the chart below, compiled from EIA figures, by *TV Digest.*

MODEL-YEAR SALES TO DEALERS

Product	1976 Models	1975 Models	% Change	1974 Models
Total TV	11,834,174	12,308,649	– 3.9	15,770,254
color	6,840,443	6,917,192	– 1.1	9,061,922
monochrome	4,993,731	5,391,457	– 7.3	6,708,332
Total radio	37,107,379	40,106,994	–7.5	44,055,871
home, portable	25,840,925	30,209,785	–14.5	33,230,902
AM-only	6,200,144	10,838,743	–42.8	14,330,509
FM & FM-AM	19,640,781	19,371,042	+1.4	18,900,393
auto	11,266,454	9,897,209	+13.8	10,824,969
Port.-comp. phono	3,023,681	4,512,707	–33.0	4,810,274

Jerrold To Conduct MATV Classes This Fall

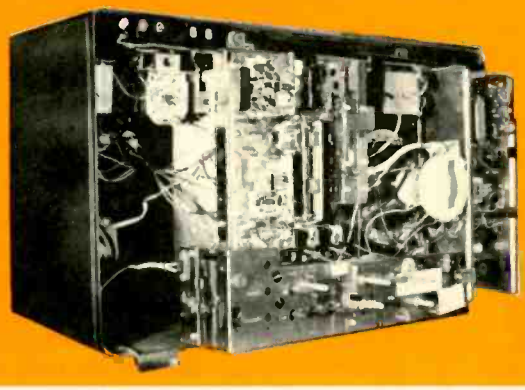
A series of master antenna television schools will be held in various locations this fall by the Distributor Sales Division of Jerrold Electronics. Courses will cover basic and advanced systems. Basic schools will be held in Miami, Sept. 1 & 2; St. Louis, Oct. 13 & 14; and Houston, Oct. 26 & 27. Advanced schools will be held in Cleveland, Sept. 28 to 30; New Orleans, Oct. 19 to 21; Pismo Beach, Calif., Nov. 9 to 11; and Philadelphia, Nov. 16 to 18. For additional information, contact Jerrold Distributor Sales Division, 200 Witmer Road, Horsham, PA 19044.

Hallicrafters Moves Plant From K C to Grand Prairie

The new home of The Hallicrafters Company, producer of CB, amateur and FM 2-way radio equipment, is a 50,000 square foot plant in the Dallas suburb of Grand Prairie. The Breaker Corporation purchased Hallicrafters from Wilcox Electric of Kansas City last fall.

Darrell Fletcher, board chairman of both Hallifcrafters and Breaker, commented on the purchase and the move to Texas: "The Hallicrafter's philosophy of manufacturing the finest personal communications products on the market has not changed, nor will it change. The same people who have worked for Hallicrafters for many years will continue to carry out the Hallicrafter's tradition of radio excellence."■

Tuner Service Corporation



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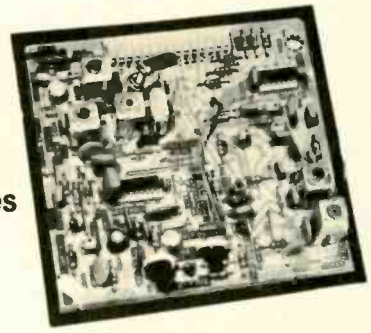

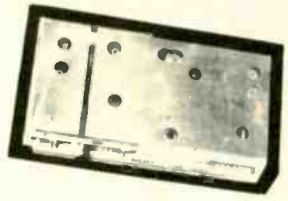

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	FT. LAUDERDALE, FLORIDA 33315	104 S.W. 23rd St. (Hwy 16)	Tel. 305-524-0914
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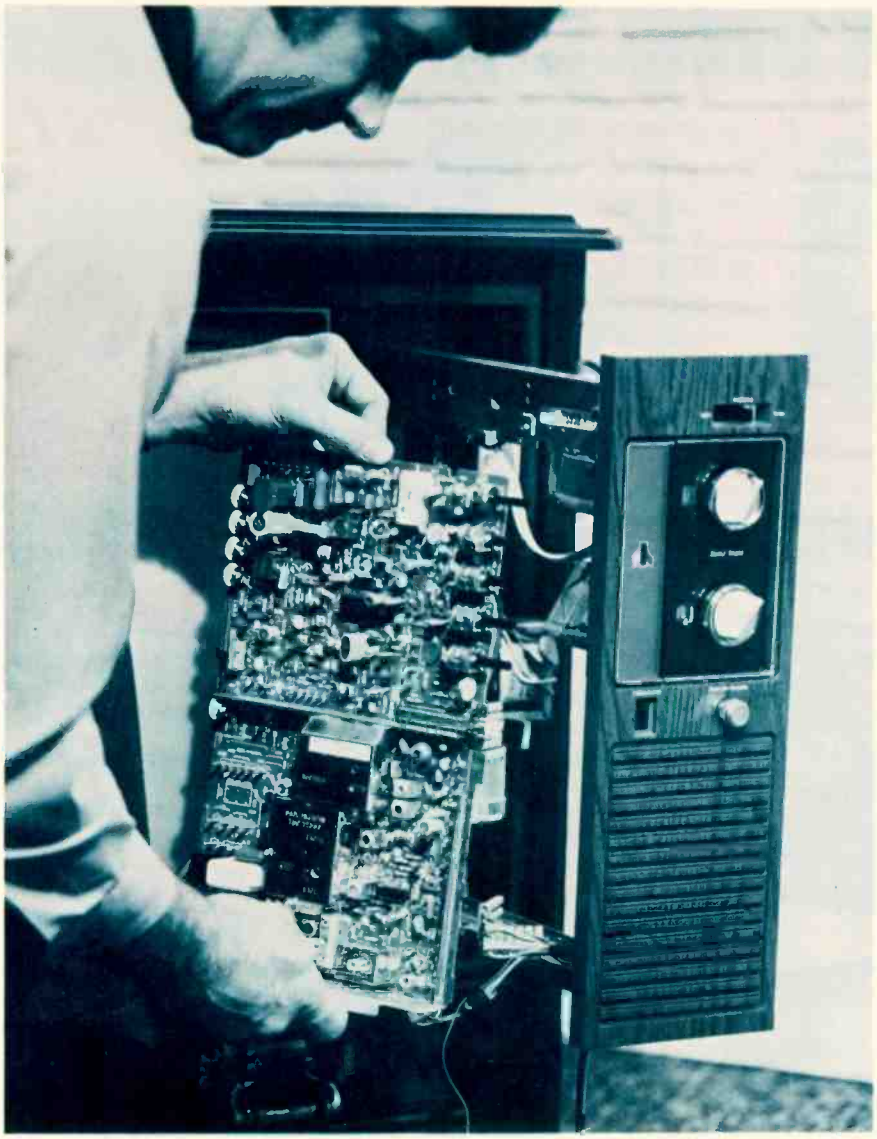

Quasar's "Super Module" Color TV—Part 1

By J. W. Phipps

An intro to the TS-958 and TS-959 modularized chassis, in which 60-70% of the circuitry is contained on a single repair-or-replace module

■ Quasar Electronics Company, under its former brand name, Motorola, in 1967 introduced the TV industry's first solid-state, modularized color TV chassis—the TS-915 "Works In A Drawer" chassis, in which eleven modules are mounted on a pull-out drawer.

Now, nine years later, in its 1977 line of color TV receivers—which is outlined in an accompanying list—Quasar has introduced another revolutionary concept in color TV modularization: the placement of about 60% of the chassis circuits on a single, easily removed, "replace or repair" printed-circuit panel (Fig. 1), which Quasar calls its "Super Module." This new approach to color TV modularization is employed by Quasar in two new color TV chassis, the TS-958 and the TS-959.

OVERVIEW OF TS-958/959 CHASSIS DESIGN

Fig. 2 is a simplified block diagram of these two "Super Module" chassis. As is evident in this block diagram, all of the video, sync, AGC, chroma and audio signal processing functions, with the exception of the VHF and UHF tuners and the video output stages, are performed by five soldered-in integrated circuits (ICs) and nine discrete bipolar transistors—all of which are mounted on the Super Module.

And, despite the fact that the TS-958 and TS-959 chassis use different low-voltage power supplies and different types of picture tubes, the *same* replacement Super Module is used in both chassis.

The TS-958 chassis—which is used in eighteen of the twenty console 25-inch receivers and in both of the 25-inch table model receivers in Quasar's 1977 color TV line—is a "Works In A Drawer" design in which the Super Module is mounted on the drawer, which, as shown in Fig. 3, slides forward, providing convenient and unencumbered access to both sides of the Super Module. All receivers which use the TS-958 chassis are equipped with *delta* type picture tubes.

The TS-959 chassis, shown in Fig. 4, is a non-"Works In a Drawer" design which is employed in two of the nine table model 19-inch receivers in Quasar's 1977 color TV line. In this chassis, the Super Module is mounted on a slide-back rack assembly on the left side of the receiver (viewed from the back, as in Fig. 4). Both of the receivers in which this chassis is used are equipped with *in-line* picture tubes.

The TS-959 chassis employs a regulated, bridge type low-voltage power supply which is an integral part of the Super Module. The TS-958 chassis is equipped with a ferro-resonant type low-voltage supply which is mounted on a separate, easily removed subassembly, as shown in Fig. 5. In the TS-958 chassis, the unused bridge type supply on the replacement Super Module is simply bypassed by rerouting a few slip-on connec-

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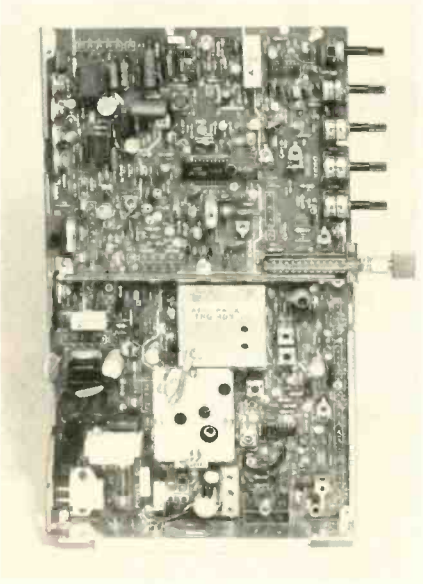
tions on the Super Module. These and two other easily performed, solderless "field modifications" make it possible to use one universal "SF" replacement Super Module in either chassis, regardless of whether the receiver is equipped with a mechanical or varactor type tuner and regardless of whether it employs Quasar's *Insta-Matic* or *Super Insta-Matic* automatic receiver-adjustment feature (both of which will be described in Part 2 of this series).

With the exception of the tuners in both chassis and the low-voltage power supply subassembly in the TS-958, almost all of the other receiver functions not mounted on the Super Module in the TS-958 and TS-959 chassis are contained on four other easily removed and serviced modules or subassemblies. These are: 1) the *pincushion correction module,* which in the TS-958 chassis is mounted in back of the Super Module on the pull-out drawer; 2) the *convergence module,* which also contains static and dynamic convergence controls, and which is mounted adjacent to the convergence yoke on the neck of the picture tube; 3) the *video output module,* which, because the picture tube socket is an integral part of the module board, is mounted on the base of the picture tube; and 4) the *flyback subassembly,* which, as shown in Fig. 6, is a sealed, oil-filled "can" containing the horizontal-output transformer and the high-voltage and focus rectifiers, and which is mounted on the pull-out drawer of the TS-958 chassis. (The horizontal- and vertical-output transistors are mounted on separate "outboarded" heat sinks, for more efficient heat dissipation.)

Because of electrical and mechanical incompatabilities resulting from the inherent electrical and mechanical differences between the delta type picture tube used in receivers equipped with the TS-958 chassis and the in-line picture tube used in receivers equipped with the TS-959 chassis, the pincushion correction, convergence and video output modules in these two chassis are not interchangeable, nor are the flyback assemblies.



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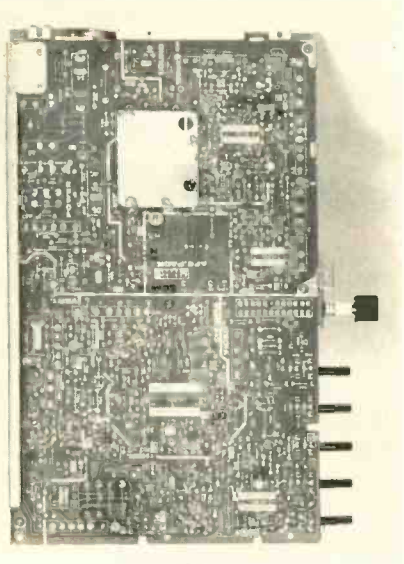

(B)

Fig. 1—A) "Component" side of Quasar's Super Module, an easily removed chassis subassembly which, depending on model features, contains about 60-65 % of the circuitry in color TV receivers equipped with the TS-958 or TS-959 "Super Module" chassis. Note that the Super Module is subdivided into functional areas and that components, test points and controls are clearly identified. B) "Bottom" side of Super Module.

SERVICEABILITY IMPROVEMENT FEATURES

Included in the chassis design characteristics described in the preceding overview are three features which together should not only contribute to better performance and greater realiability but also should prove particularly beneficial to servicers because of the potential savings in time, effort and parts inventory invest-

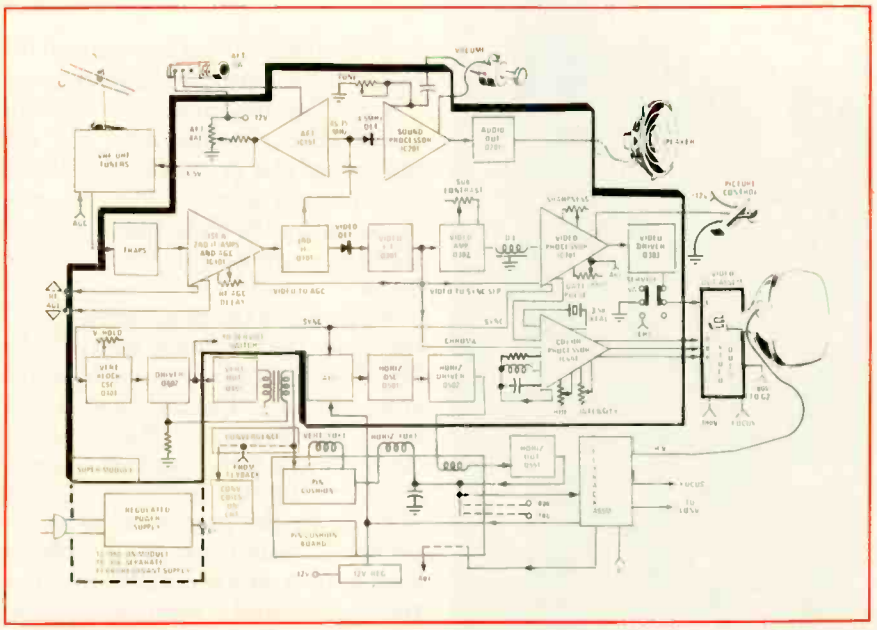

Fig. 2—Simplified block diagram of Quasar's two "Super Module" color TV chassis —the TS-958 and TS-959.

ment they represent. These three features are:

1) The concentration of about 60% of the circuitry in these two chassis on a single, easily removed and serviced or replaced subassembly—the Super Module.

2) Chassis-to-chassis interchangeability of the Super Module.

3) The concentration of about 95% of the remaining circuitry in these chassis on only *four* other easily-removed-and-serviced subassemblies in the TS-958 chassis and on only three other easily-removed-and-serviced subassemblies in the TS-959 chassis—excluding the VHF and UHF tuners and the remove-and-replace flyback subassembly.

Other design features of the TS-958 and TS-959 chassis which were not specifically pointed out in the overview analysis but which undoubtedly contribute significantly to the ease with which these chassis can be serviced are:

- A drawer-locking mechanism in the TS-958 "Works In A Drawer" chassis which can be released without removing the cabinet back
- Both chassis and all receiver functions remain completely operational when the chassis are positioned for unencumbered access during servicing (drawer pulled forward in TS-958 receivers, and the Super Module and chassis subassemblies group slid back in TS-959 receivers)

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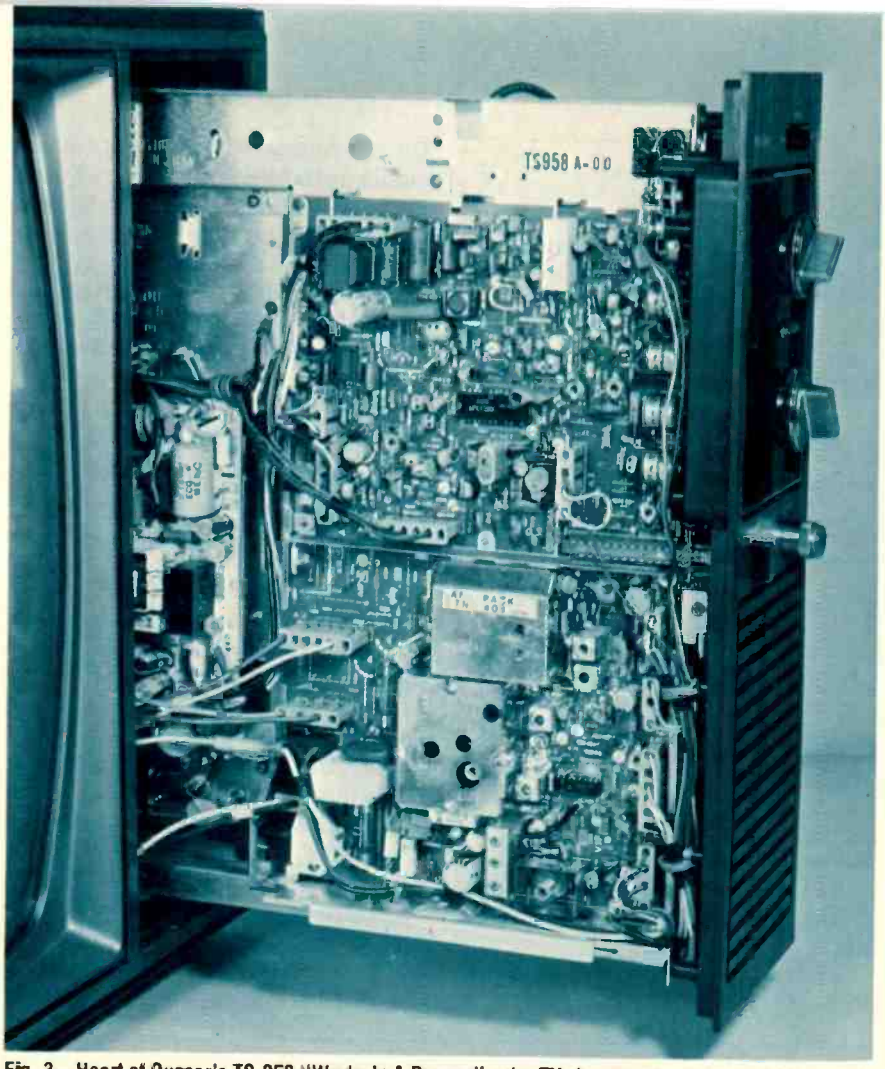

Fig. 3—Heart of Quasar's TS-958 "Works In A Drawer" color TV chassis, shown here slid forward in service position, contains the Super Module, the pincushion module (to rear of Super Module), and the flyback assembly (mounted on opposite side of drawer).

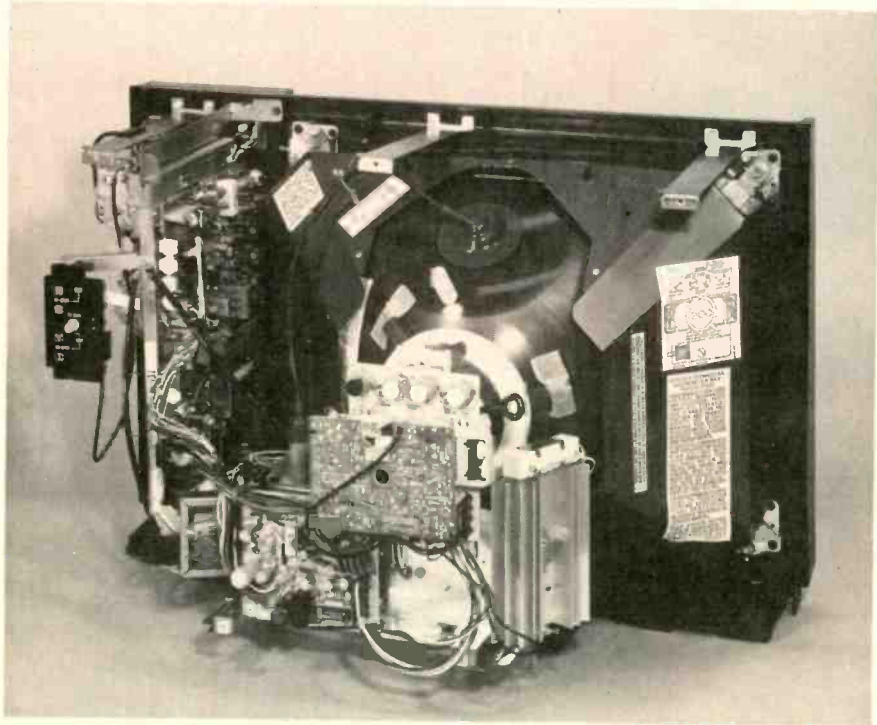

Fig. 4—Rear view of one of the two Quasar 1977 table model color TV receivers equipped with the TS-959 "Super Module" chassis. The Super Module is mounted on a slide-back assembly on the left, and the convergence and video output modules are mounted on the picture tube neck. The remainder of the TS-959 circuitry is mounted on an assembly below the picture tube and held in place by four screws.

- No cheater cord is required for "set-on" servicing of either chassis
- All service-related controls in the TS-958 chassis, with the exception of the gray-scale tracking and convergence controls, are mounted on the Super Module and therefore are accessible from the front
- Access to the gray-scale tracking and convergence controls in TS-958 receivers does *not* require removal of the cabinet back cover—as shown in Fig. 7, these controls are fully exposed merely by removing two screws and dropping down the picture tube neck-protector panel (on the inside of which is a chart which sequentially lists and graphically illustrates the adjustments involved in the static and dynamic convergence procedures)
- Removal and replacement of the Super Module involves only 6 screws and a few slip-on/slip-off connectors—no soldering is required
- No CRT tracking or video IF alignment adjustments are required when the Super Module is replaced
- Components, test points and controls are prominently and clearly identified by callouts on *both* the top *and* bottom of printed circuit boards; as shown in Figs 1A (top of Super Module) and 1B (bottom of Super Module)
- Slip-on/slip-off connectors and plugs are used on all interconnect wiring terminals on all modules.

QUASAR'S 1977 COLOR TV
Model/Chassis Lineup

SIZE OF SCREEN	TYPE OF MODEL	NUMBER OF MODELS	CHASSIS WITH WHICH EQUIPPED	PICTURE TUBE TYPE	
12-Inch	Portable	2	TS-957	In-Line	(320A60B22)
13-Inch	Portable	1	TS-951	In-Line	(370CUB22)
15-Inch	Portable	1	TS-951	In-Line	(420AZB22)
17-Inch	Table	3	TS-953	In-Line	(17VBLP22)
19-Inch	Table	1	TS-949	In-Line	(19VFJP22)
		6	TS-953	In-Line	
		2	TS-959	In-Line	
23-Inch	Console	4	TS-942	Delta	(23VCGP22)
25-Inch	Table	2	TS-958	Delta	(25VDRP22)
25-Inch	Console	4	TS-942	Delta	25VCZP22 or 25VDRP22
		16	TS-958	Delta	

TOTAL MODELS: 42

TOTAL CHASSIS: 6

TOTAL MODELS EQUIPPED WITH "SUPER MODULE" CHASSIS (TS-958/959): 20

MODULE EXCHANGE OFFERED ON 65 % OF CIRCUITRY, BUT PARTS KITS AVAILABLE FOR SERVICERS WHO CHOOSE TO REPAIR

All modules and subassemblies in the TS-958 and TS-959 chassis, with the exception of the flyback assembly, are repairable. (The flyback assembly, as noted previously, is a sealed, oil-filled unit and therefore must be replaced instead of repaired.)

However, for those servicers who find it more advantageous to replace instead of repair, Quasar is offering, through the parts departments of its distributors, module exchange on the Super Module and video output module—which together contain about 65%-70% of the chassis circuitry, including all video, chroma, AGC and sync processing circuits except those in the VHF and UHF tuners.

Based on a "suggested list" exchange price of $48.50 and a "dealer net" exchange price of

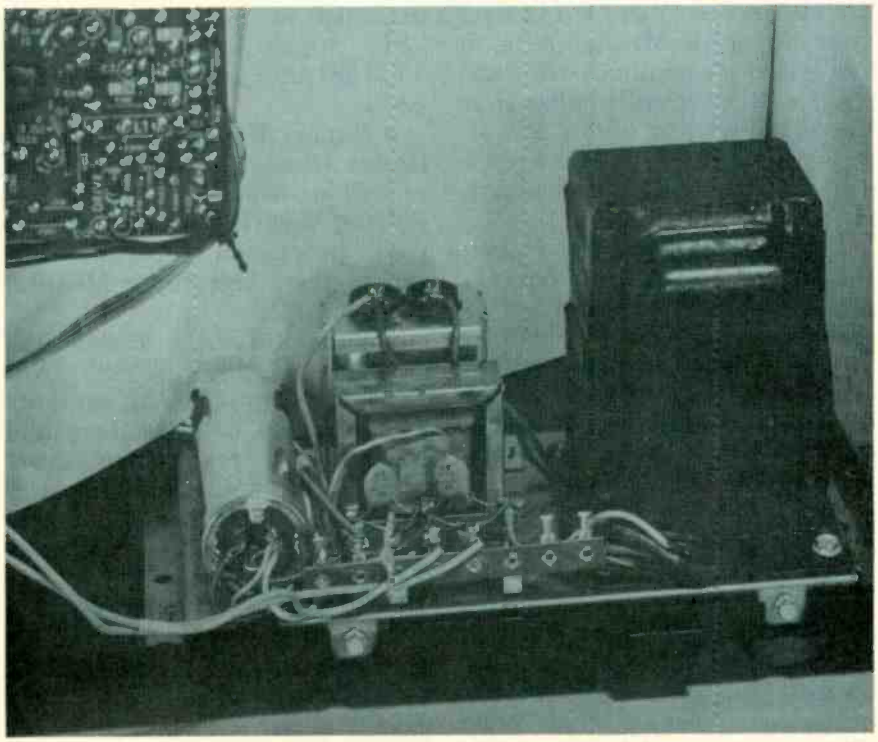

Fig. 5—Ferro-resonant low-voltage power supply of the TS-958 chassis is mounted on a separate, easily removed subassembly in lower right of receiver cabinet, as shown here viewed from the back of the receiver. (The TS-959 "Super Module" chassis is equipped with a bridge-type regulated low-voltage supply which is an integral part of the Super Module.)

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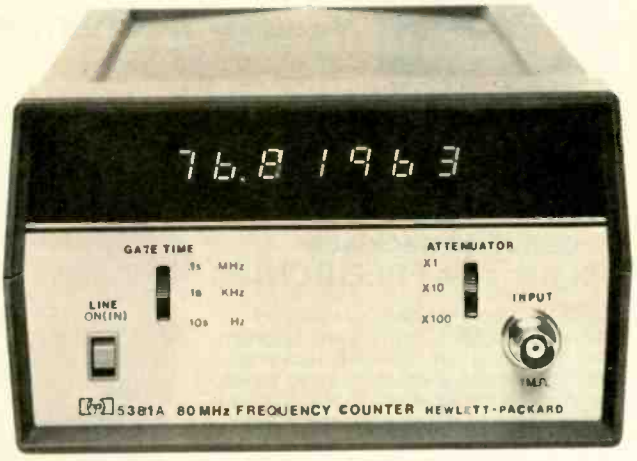

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$29.00, quoted to us by a Quasar distributor in Minneapolis, it seems that the nominal *parts gross profit* a servicer will realize from the replacement of an out-of-warranty Super Module is $19.50, if he charges the "suggested list" price.

For those servicers who elect to repair instead of exchange the Super Module and video output module, in addition to repairing all the other circuitry in the TS-958 and TS-959 chassis, Quasar is offering through its distributors the following four parts replacement kits (prices are "dealer net," quoted us by a Quasar distributor in Minneapolis):

- *Super Module Replacement & Off-Super Module Repair Kit* (Part No. 1P71543A32)—This kit includes a universal "SF" replacement Super Module, an off-Super Module transistor service caddy which contains 4 transistors and 9 diodes, and service data for the two chassis. Price is $97. (The non-exchange price for the universal "SF" Super Module (Part No. 1Y71681A28) purchased alone is $85.)
- *Super Module IC Service Caddy* (Part No. 51P71543A33)—This kit contains 4 ICs, for replacing the IF, video processor, color processor and audio ICs mounted on the Super Module. Price is $19.
- *Super Module Transistor Service Caddy* (Part No. 48P71543A34)—This kit contains 11 transistors, 6 diodes, 2 crystals and 2 fuses, for replacement of corresponding components *on* the Super Module. Price is $28.
- *Off-Super Module Transistor Service Caddy* (Part No. 48P71543A35)—This kit contains 4 transistors and 9 diodes, for replacement of corresponding components mounted *off* the Super Module. Price is $11.

NEXT MONTH IN PART 2—Analysis of the circuits in Quasar's TS-958 and TS-959 "Super Module" TV chassis. ■

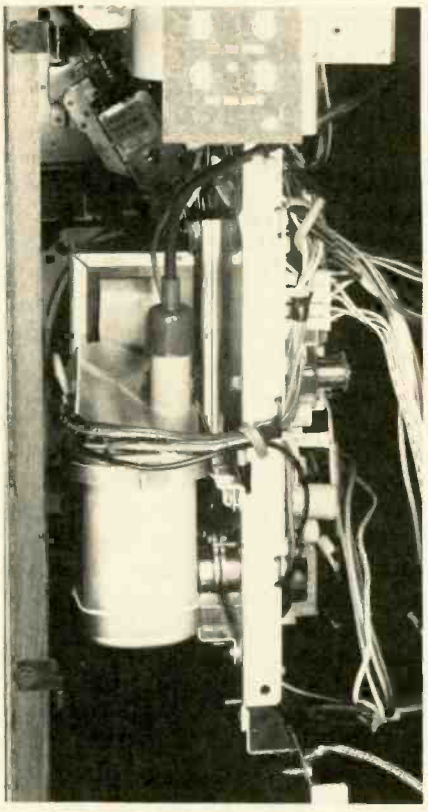

Fig. 6—The "flyback assembly," shown here mounted on the side of the drawer of the TS-958 chassis, is a sealed, oil-filled "can" which contains the horizontal-output transformer and the high-voltage and focus rectifiers.

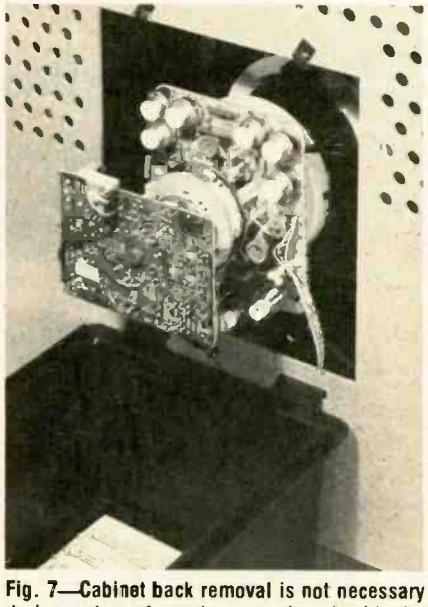

Fig. 7—Cabinet back removal is not necessary during setup of receivers equipped with the TS-958 "Super Module" chassis. Removing two screws and dropping down the picture tube neck-protector panel exposes the video output module (which is mounted on the picture tube base and contains the tracking controls) and the convergence module (which is mounted adjacent to the convergence yoke on the neck of the picture tube and contains the convergence controls). A chart in the bottom of the neck-protector panel graphically outlines the convergence procedure.

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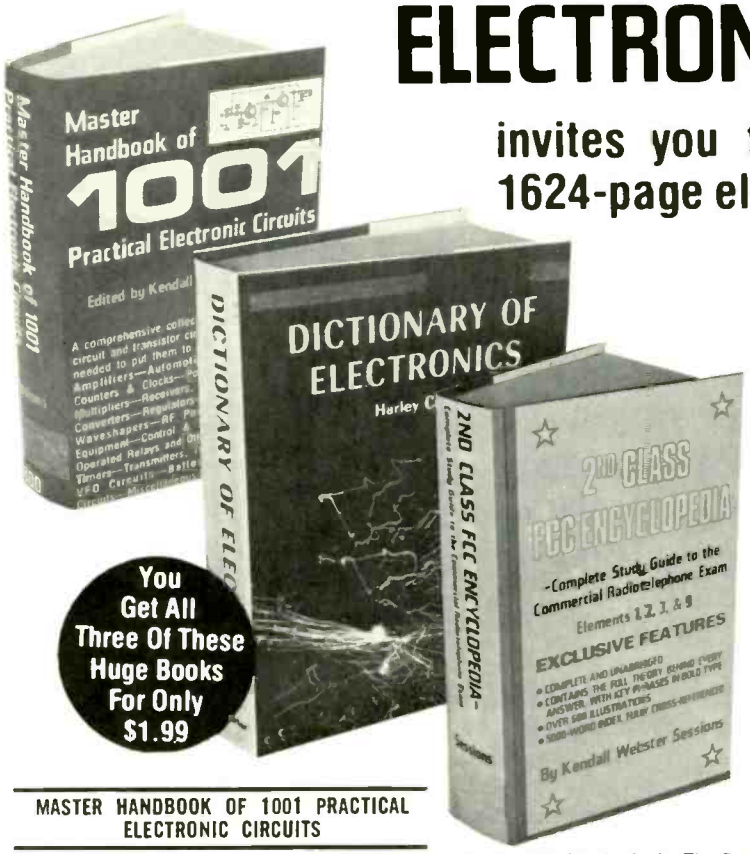

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AN EXTRAORDINARY OFFER...

GE's "Broadcast-Controlled" Color System—Part 2

Continuation of an analysis of General Electric's new color control system which uses the TV station vertical interval reference (VIR) signal to automatically adjust the color saturation and tint of receivers equipped with the new YM and YC-2 color TV chassis. (Part 1 appeared in the August issue of ET/D*

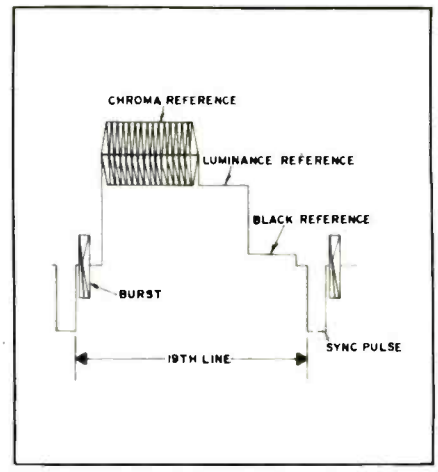

Fig 1—The vertical interval reference (VIR) signal as it appears on line 19.

■ General Electric, as described in Part 1 of this series, has introduced in its new YM and YC-2 color TV chassis an optional feature which detects the vertical interval reference (VIR) signal broadcast by many but not all TV stations and uses it to develop control voltages which automatically adjust the receiver's color saturation and tint to compensate for non-program related changes in the amplitude and phase of the station's chroma signal.

The VIR signal is broadcast on line 19 of the composite TV signal and, as shown in Fig. 1, contains a chrominance reference, a luminance reference and a black level reference. When the amplitude of the chrominance reference and black level reference at the receiver's *R-Y* output are equal, the phase (tint) of the receiver's chroma output matches that of the transmitted signal. Likewise, when the chrominance and black level references are equal at the output of the receiver's *blue* drive stage, he level (saturation) of the receiver's chroma signal matches that of the transmitted signal. These two "equal level" conditions are the basis of operation of GE's "Broadcast Controlled" system of automatically controlling the saturation and tint of the color displayed by the receiver.

The circuits which make up GE's "Broadcast Controlled" color system are mounted on an easily removed and replaced subassembly which GE calls its "VIR module." This module contains four separate but interdependent functional sections: 1) a power supply and, 2) a "line recognizer" section—the design and functioning of which was described in detail in Part 1—and, 3) a "tint controller" and, 4) a "color controller," the designs and functions of which are described in this, the second and concluding part.

As described in Part 1, the "line recognizer" section of the VIR module detects the presence of the VIR signal and develops related signals which, 1) switch the receiver color and tint circuits from manual to VIR-controlled operation and, 2) turn on comparator circuitry in the tint and color controller stages during the chroma and black level reference intervals of the VIR signal.

The functioning of the tint and color controller sections of the VIR module are described in the following paragraphs.

THE TINT CONTROLLER

Fig. 2 is a detailed block diagram of the tint controller stages of the VIR MODULE. The tint controller receives one input from the television receiver's external circuitry: R-Y from the chroma demodulator. It compares the VIR-related portions of this signal input during the chroma reference interval and black reference interval and produces a DC controlling voltage that is automatically switched to the receiver's chroma processing circuitry during VIR operation. In non-VIR operation, the receiver's *manual* TINT control is automatically switched into the circuit instead.

The tint controller also contains a "Preference Control" stage which is a customer control allowing slight adjustment of tint during VIR operation.

During VIR operation, the tint controller stages become part of a "closed loop" in series with the receiver's chroma processing circuitry. The tint controller develops a DC voltage from the comparison of the VIR related portions of the R-Y signal. This correction voltage is applied to the receiver's chroma processing circuitry, and, in turn, affects the R-Y signal.

Comparator

Fig. 3 is the comparator stage of the tint controller. The R-Y signal enters the stage through the impedance matching emitter follower, Q38. Excess noise is stripped from the signal by the combination of R37 and C37. From the emitter of Q38 the signal splits at the junction of R39 and R40, and encounters two pairs of switching diodes; Y40 and Y42, in the base circuit of emitter follower Q42; and Y39 and Y41, in the base circuit of emitter follower Q41. These switching diodes are controlled by the chroma reference interval keying pulses which are developed in the line recognizer.

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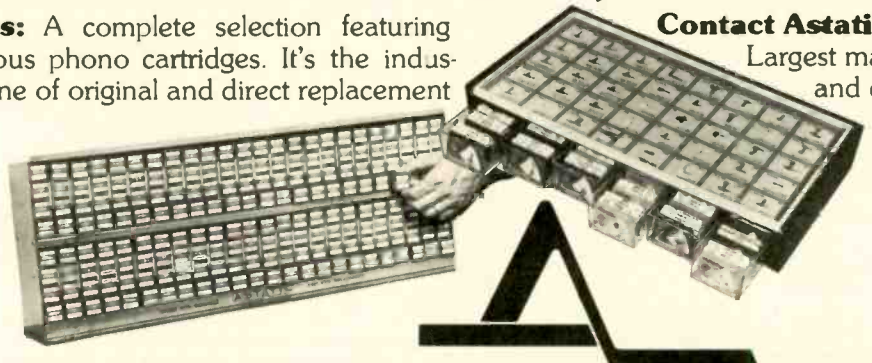

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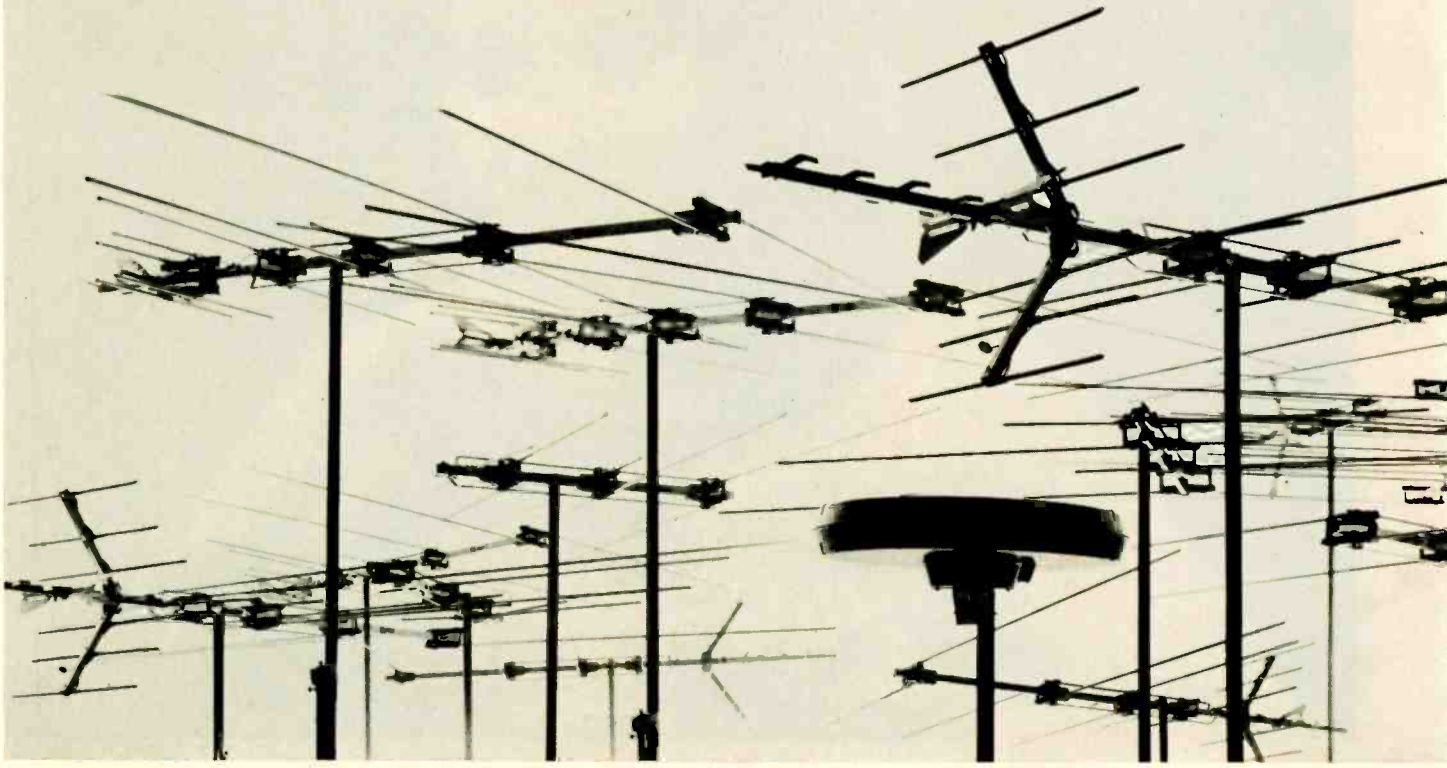


Diode Y39, for example, normally has 0 volts applied to its cathode and is forward biased. In this condition it presents a low impedance to the signal, preventing it from reaching the base of Q41. But, during the *chroma reference interval* (15 microseconds) a +28-volt pulse is applied to the cathode of Y39. The pulse reverse biases the diode and allows the signal present during that time interval to pass through Y41 into the base of Q41. *The signal then charges capacitor C41 to a voltage dependent on the chroma reference amplitude at that precise time.*

Diode Y41, in addition to coupling the signal, provides additional isolation in the base circuit of Q41. When Y39 is forward biased between pulses, Y41 is reverse biased because no more than .6 volt can be obtained on the anode of Y39. During the keying pulse interval, when Y39 is reverse biased, its anode potential rises high enough to forward bias Y41.

Y40 and Y42, in the base circuit of Q42, perform in exactly the same manner *except that they allow the signal to charge C42 during the 35 microsecond interval of the black level reference pulse.*

The charges stored in C41 and C42 are coupled through R41 and R42 to the inputs of the Tint Comparator, which is an operational amplifier (¼ of IC60). This device is an industry type LM3900 connected as a "difference amplifier." It compares the charges stored in C41 and C42 and produces

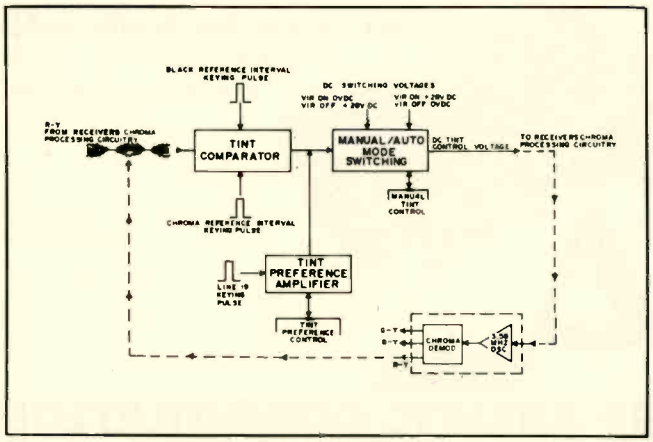


Fig. 2—Tint controller section of the VIR Module.

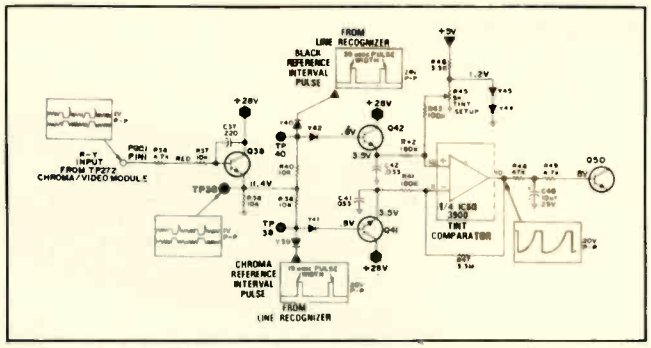
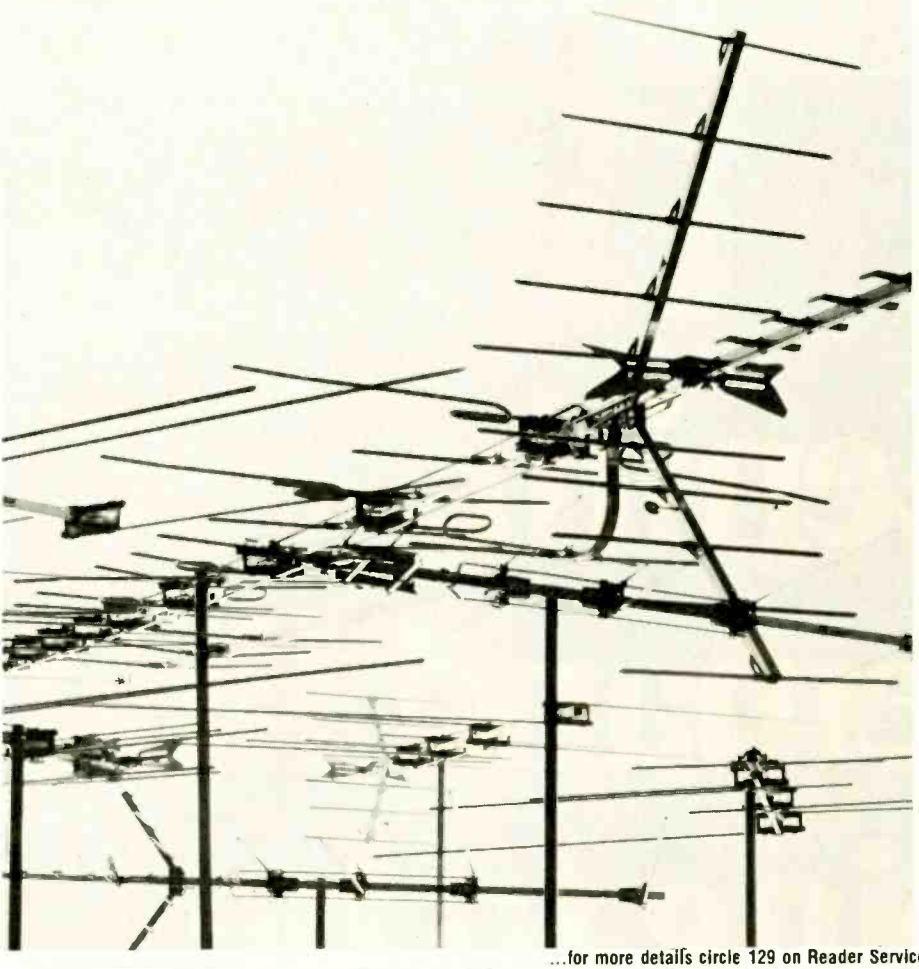


Fig. 3—Tint comparator stages of the tint controller section compare the chrominance and black level references at the receiver's R-Y output during the respective portions of the VIR interval and, if a difference exists, develop a DC control voltage which corresponds to the difference.



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an amplified output representative of their difference.

We stated early in our analysis of the VIR signal that *when chrominance reference and black level reference were equal in amplitude at the receiver's R-Y output, chroma phase (tint) conforms to that of the transmitted reference signal.* This statement would seem to imply that in normal VIR operation the output from the "difference amplifier" would be zero. This is not strictly correct. Fig. 4 shows the charges stored in C41 and C42 and the output at pin 10 of the Tint Comparator. We see that the operation amplifier's output is indeed zero at the precise time that both capacitors are charged. But, even though they charge to the same potential, some variance must necessarily exist in the capacitor's discharge curves. It is this difference, amplified, that accounts for the rather unlikely looking waveshape present at the output (pin 10) of the Tint Comparator. *This output is integrated by the network R48, C48, R49 to produce the DC tint-controlling voltage for the receiver's chroma processing stages.*

A measure of control over the Tint Comparator is provided by R45, the tint setup adjustment. This variable resistance, which divides the voltage from a diode-clamped 1.2-VDC source, not only affects the DC level of the operational amplifier's output but also changes the discharge curve of C42. The tint setup adjustment is capable of causing

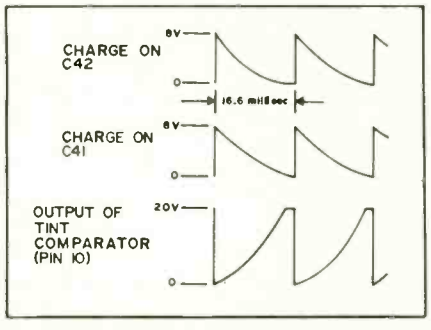

Fig. 4—Waveforms of the charges stored in C41 and C42 in the tint comparator, and the output of the tint comparator, which is an amplified waveform representative of any difference between the capacitor's discharge curves.

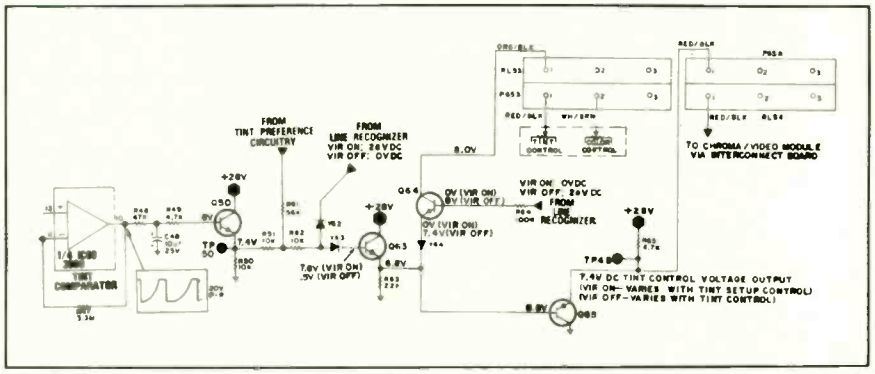

Fig. 5—VIR/manual switching stage of the controller section. In the VIR-on mode, the DC tint-control voltage from the tint comparator is applied to the receiver's chroma reference oscillator section. In the absence of the VIR signal, the tint is controlled by the setting of the manual TINT control.

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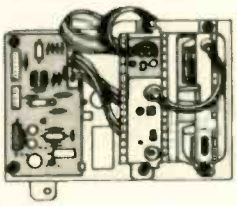

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changes in the waveshape, and in the resultant DC controlling voltage at the output of the Tint Comparator.

Tint VIR/Manual Switching

The tint controller has, up to now, developed its DC controlling voltage based on the comparison of the chrominance and black reference levels of the R-Y signal during the chrominance reference and black reference intervals of the VIR signal. Now, the tint controller must automatically switch this voltage to the receiver's chroma processing stages during VIR operation, and switch in the DC voltage from the receiver's manual TINT control should non-VIR operation occur. Fig. 13 shows the circuitry used to accomplish this automatic/manual mode switching. *The circuitry responds to the DC switching voltages developed in the VIR sensor stage of the line recognizer circuitry.*

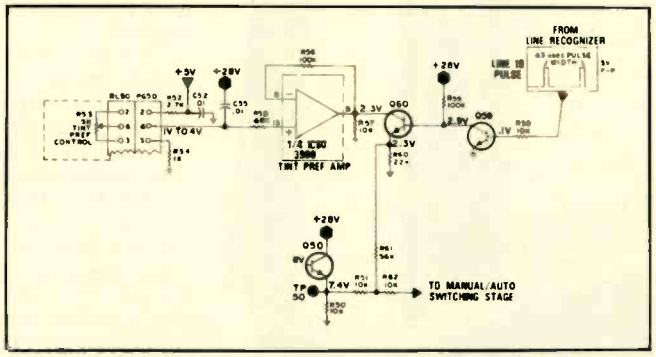

Fig 6—The preference control stage of the tint controller section pemits limited customer control of tint during VIR-on operation.

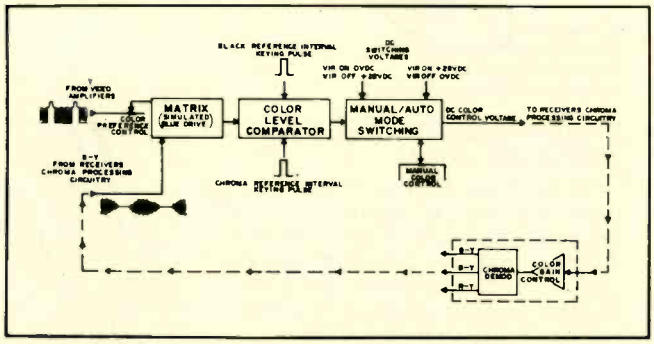

Fig. 7—Block diagram of the color controller section of the VIR Module.

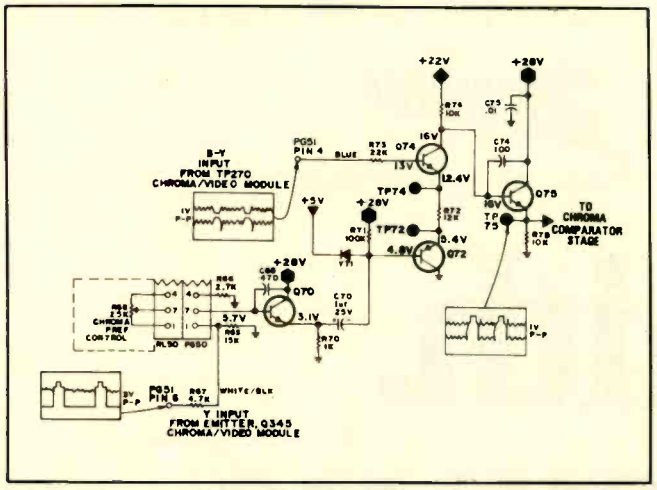

Fig. 8—The input stages of the color controller section develop a simulated blue drive signal by matrixing B-Y and Y from the associated receiver outputs.

The tint controlling voltage, present at the emitter of Q50, is applied to the junction of two switching diodes, Y62 and Y63. The cathode of Y62 is connected to the collector of Q34 in the line recognizer stages. Q34 develops +28 volts in response to the presence of a VIR signal, and 0 volts in its absence. The diode is, therefore, reverse biased in the automatic mode and forward biased in the manual mode of operation. This action is similar to the diode gates already explained in the Comparator stage of the tint controller except that the DC switching voltages are constant (not pulses). In the automatic mode (VIR present) the DC voltage developed in the Comparator stage passes through the diode switch to the base of Q63. In the manual mode (VIR absent) the forward bias on Y62 places the Comparator-developed DC voltage effectively at ground.

Transistor Q64 is switched by the opposite switching voltage developed in the line recognizer. Q64's base is connected through R64 to the collector of Q32. With VIR present (automatic mode), 0 volts is applied to the base of Q64. With VIR absent (manual mode), +28 volts is applied, through R64, to the base. *Q64, thus, also acts as a switch. In the automatic mode of operation it is turned fully "off," and in the manual mode it is fully "on."* The collector of Q64 connects directly to the receiver's manual TINT control.

Summarizing the automatic/manual switching circuitry: With VIR present, the junction of Y62 and Y63 allows the Comparator-developed voltage to pass through emitter followers Q63 and Q65 into the chroma processing circuitry. At the same time, Q64 is switched "off," presenting an open circuit to the receiver's manual TINT control. With VIR absent, Y62 and Y63 switch the Comparator-developed voltage "off." At the same time, Q64 is driven into saturation, presenting a low impedance path for the DC control voltage from the manual TINT control, which passes through Q65 and into the chroma processing circuitry.

Customer Preference Control Of Tint

The tint controller stages of the VIR MODULE also provide customer control of tint during VIR operation. This is accomplished by the circuitry shown in Fig. 6. A customer-available Tint Preference Control provides limited adjustment of the receiver's tint during the automatic mode of operation. The circuitry does this by adding its own small DC voltage to the DC controlling voltage developed in the Comparator stage.

Tint Preference Control R53 varies the input voltage to the Tint Preference Amplifier (¼ of IC60), which is one section of an industry type LM3900 operational amplifier. The device is connected in the configuration of a "DC amplifier." Small DC voltage changes at the input (pin 13) appear as relatively large DC voltage shifts at the output (pin 9). Transistors Q59 and Q60 operate as switches. The base of Q59 is connected to the line 19 keying pulse developed in the line recognizer stages. Q59 is thus normally "off" by virtue of having 0 volts applied to its base. In its "off" condi-

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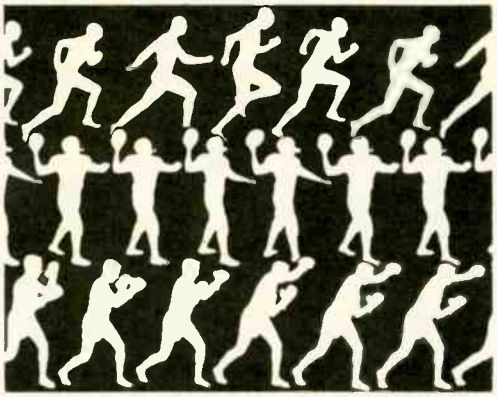

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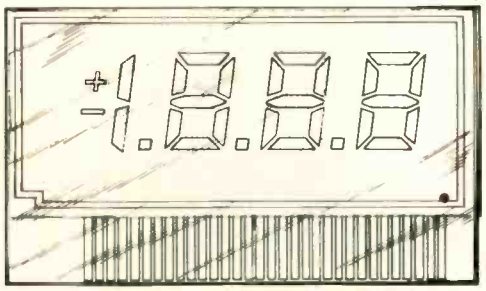

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tion, Q59's collector voltage rises to about +2.9 volts, biasing Q60 "on" (saturation) and allowing the DC voltage developed by the Preference Amplifier to appear at Q60's emitter. During the interval of line 19, the +5 volt pulse applied to the base of Q59 through R58 turns the transistor fully "on." Q59's collector voltage drops to near 0 volts. Q60 cuts "off" and the Preference Amplifier's DC voltage is switched out of the circuit for the time interval of the 19th line.

The disabling of the tint preference voltage during line 19 is necessary because of the "closed loop" configuration of the tint controller system. While it may be desirable to artificially change the DC voltage level produced by the Tint Comparator, it is equally important to maintain the actual Comparator voltage during the time interval that the Comparator is making its comparison. In other words, it is undesirable for the Comparator to correct for the wrong DC voltage level during each 19th line. The switching system of the tint preference circuitry provides the means to artificially change the DC controlling voltage, yet still maintain a true comparison during line 19.

THE COLOR CONTROLLER

Fig. 7 is a detailed block diagram of the color controller stages of the VIR MODULE. The color controller receives two signal inputs from the external television receiver circuitry: B-Y from the chroma demodulator, and Y from the video amplifiers. The color controller matrixes these two inputs to produce a simulated blue drive signal. It then compares the chrominance reference and black level reference portions during the related VIR intervals and develops a DC voltage proportional to any difference, for control of color gain in the receiver's chroma processing circuitry.

The color controller also provides manual/automatic switching. It switches in its comparator-developed DC voltage during VIR operation, and the DC voltage from the receiver's manual COLOR control during non-VIR operation.

The color controller, like the tint controller, is connected in a "closed loop" system with the re-

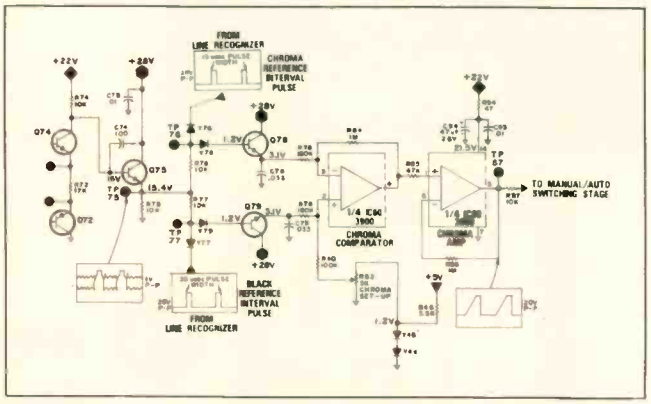

Fig. 9—The color comparator stages of the color controller compare the chroma reference and black level reference of the simulated blue drive signal during the respective intervals of the VIR signal and, if a difference exists, develops a DC color-control voltage which corresponds to the difference.

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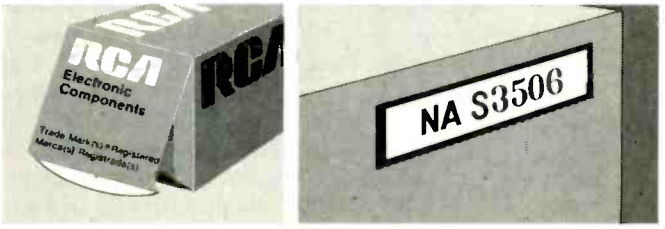

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ceiver's chroma processing circuitry.

Much of the circuitry of the color controller is a duplication of that previously analyzed in the tint controller. Therefore, our analysis of these stages will concentrate on the differences between the two controller systems.

The input stages of the color controller, shown in Fig. 8, matrix the B-Y and Y signal inputs to form a simulated blue drive signal for the succeeding Color Comparator stage. COLOR PREFERENCE CONTROL R68, located in the base curcuit of Q70, provides a degree of customer control over color level during VIR operation by varying the amount of Y signal fed to the matrix.

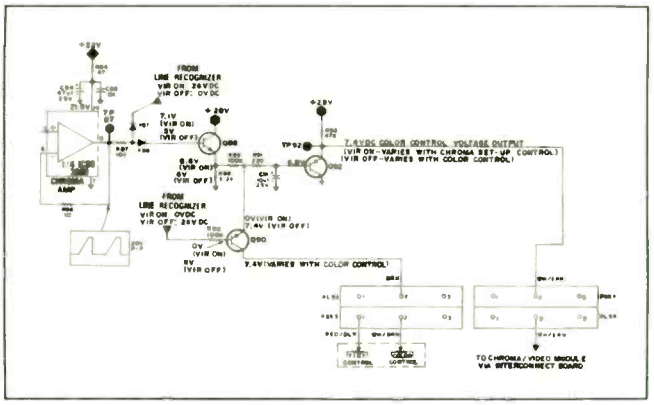

Fig. 10—VIR/manual switching stage of the color controller section. In the VIR-on mode, the DC color-control voltage from the color comparator is applied to the color amplifier section of the receiver, to control chroma gain. In the absence of a VIR signal, the setting of the receiver's manual COLOR control establishes chroma gain.

The comparator stage of the color controller, shown in Fig. 9, functions almost identically to the comparator stage in the tint controller. An operational amplifier (¼ of IC60), connected in a "difference amplifier" configuration, compares the charges developed on C78 and C79 during the chrominance reference and black reference intervals of line 19 and produces a waveshape proportional to the difference in the discharge curves of the two capacitors. The output from the Chroma Comparator is fed to another operational amplifier stage (¼ of IC60), which is connected to a "noninverting" amplifier. The output of the two operational amplifiers is then fed into the manual/automatic mode switching circuitry of the color controller.

Color VIR/Manual Switching

Fig. 10 shows the color controller's manual/automatic switching circuitry, which is essentially the same as that previously analyzed in the tint controller. The same DC switching voltages from the line recognizer are used to route either the comparator-developed DC controlling voltage or the DC voltage from the manual COLOR control into the receiver's chroma processing circuitry. The only significant difference between the two switching circuits is the location of the integrating network for the Color Controller's VIR-developed DC voltage. This network is composed of R89, R91, and C91. ■

The CB Brand Decision

By David F. Norman

Tips for prospective CB dealers on choosing lines of CB radios and accessories

■ If the CB wave which has been sweeping the country has finally got you intrigued with the idea of adding CB radios and accessories to your inventory, the question will probably arise—which brands should I carry? Up to now, at least, the question hasn't been so much *which* brands to carry, or which brands will sell best, but on which brands can I get delivery. Predictions from several quarters now, however, are that by the end of this year, or early in 1977, the supply of CB radios and accessories should somewhat catch up with the demand—and that should make more brands available from which to choose.

There is, of course, no set formula for deciding which particular brands of anything are best. The qualities which make one line, or brand, of products ideal for one operation might make the brand totally unacceptable to another operation. For example, if a dealer plans to handle only minor in-shop service and installation he should buy from a manufacturer who does not require that he *personally* service what he sells. However, if he is presently equipped to handle full service, or plans to expand to that point, he should buy from a company which will offer reimbursement for in-warranty repairs.

FACTORY WARRANTY SERVICE

It's true that no one ever gets rich on manufacturer's payments for in-warranty repairs, but they do help carry a shop through those times when the volume of regular across-the-counter repairs is down. Warranty service income can also help finance the cost of equipment needed for full service work. In other words, the shop that can offer "full service" on CB equipment should naturally buy from the manufacturer who will designate him as an "authorized warranty station."

Another important reason for looking for factory warranty designation, if you're capable of full service, is the matter of customer relations. The consumer generally takes a dim view of being told that all in-warranty equipment has to be sent back to the factory, which means a delay in getting the equipment back into service. The outcome, too often, is that, to please the customer, the non-warranty dealer ends up absorbing the cost of in-warranty service himself. As low as most warranty payments are, they are better than none.

Some successful dealers insist on warranty service authorization on everything they sell—and they try also for warranty service on other brands that they work on often. Their reasoning is that if a customer is pleased with the warranty service he gets from their shop, he is likely to return to the warranty service shop when replacement time rolls around. Anytime you can get a competitor's customers into your store, you're making headway.

There are a few other aspects of a dealer/factory warranty relationship that should be considered before make that final decision. For example, what is the actual warranty reimbursement rate? And, is the hourly rate high enough for the dealer to live with? And, if the reimbursement is made on a flat-rate basis, is it realistic?

Most efficiently operated, well-equipped shops can break even at average rates currently being paid by the major CB manufacturers—assuming that they would probably end up doing some of this work "free" and charging it off to "customer relations."

FACTORY BACKUP ON PARTS & SERVICE

Parts availability from the manufacturer can be a lethal problem for the beginning CB servicer and it deserves careful consideration when deciding which brand or brands to carry. The dealer should ask these questions of the manufacturer: Are replacements parts readily available? How much turn-around time on parts orders? What's the "back-order" record of the company? How complicated is the parts-ordering procedure? Will they pay a handling charge on parts used on in-warranty repairs?

One good method of determining the "parts backup" track record of any CB manufacturer is to make a few phone calls to CB dealers in distant, non-competing marketing areas. Dealers who are unhappy with parts availability on the brands they sell and

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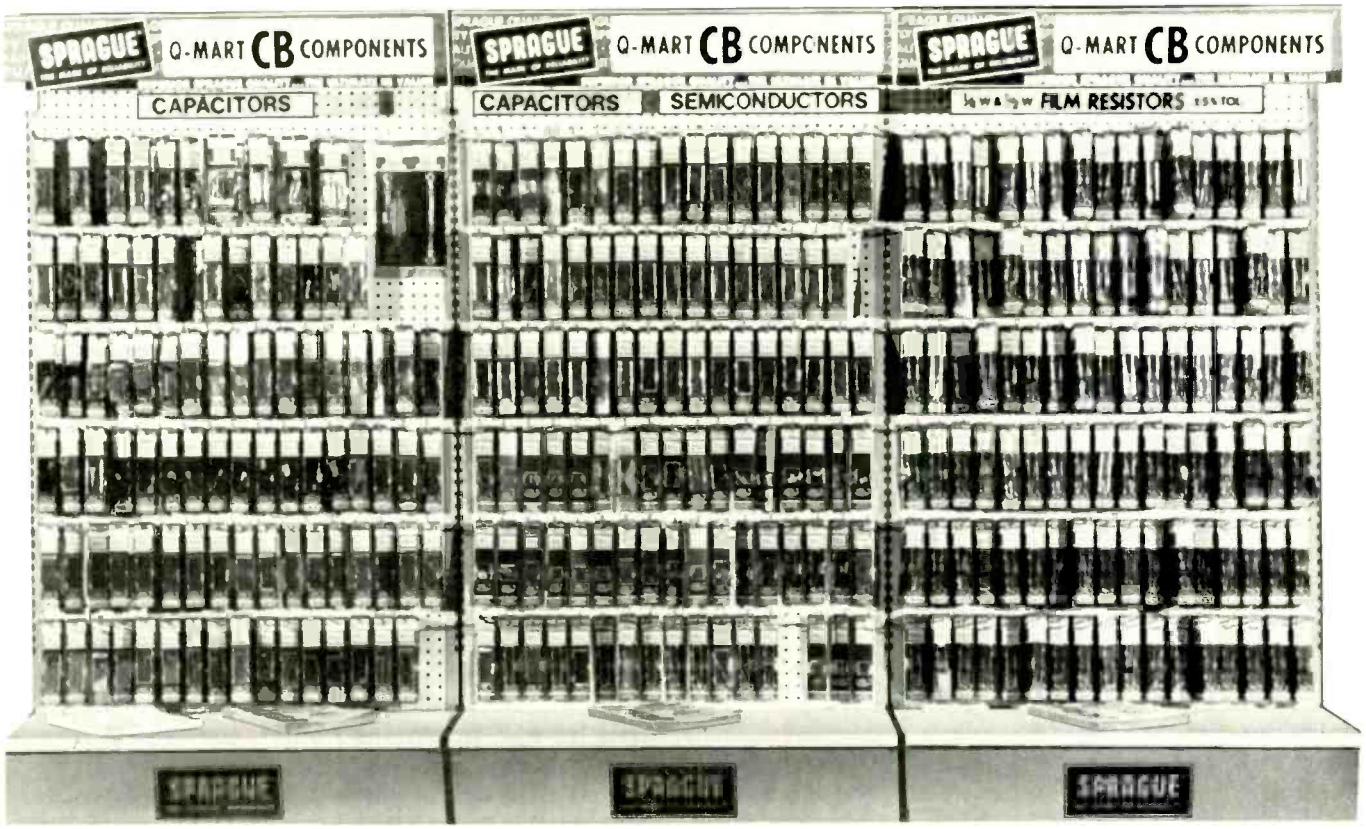

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service will usually say so in no uncertain terms, even if they think the call is being made on behalf of the manufacturer.

Another good indication of a manufacturer's philosophy is his policy on "long-term parts back-up." Most reliable manufacturers continue to stock parts for discontinued items for up to 6 or 8 years. If parts become hard to get soon after an item is dropped from the company's catalog, it's fairly obvious that the manufacturer is more interested in short-term profit than he is in a good reputation. The dealer who sells "one-shot" merchandise will soon realize just how closely his reputation is tied to that of the manufacturer.

AVAILABILITY OF MANUFACTURER FINANCING

Ideally, a dealer would be better off to have enough working capital to finance a large enough inventory of CB units and accessories to handle any good sales promotion opportunities that come along. Realistically, however, the more possible course is a combination of working capital and a credit arrangement with the suppliers. It's a course, though, that should be followed with a good deal of caution. In the past several years of recession and tight money, manufacturers have been forced to establish tougher credit policies—and delinquent accounts are put on C.O.D. a lot sooner than before. A dealer should never bet it all "on the come."

To illustrate what we mean, let's say that a dealer who has been selling 25 units a month decides that with a little extra promotional effort he can sell 50 units a month. He orders 50 units from his supplier but things don't go exactly as planned. He gets paid for only 35 units but because he is on a 30-day open account basis with his supplier, he has to come up with the money for all 50 units, plus the costs of extra advertising needed for the promotion. If he doesn't have necessary working capital to solve the problem, he will probably hear from his supplier—"Sorry, Mr. Jones, until this account is cleared up, we will have to put you on a C.O.D. basis." And if he asks for additional time from his supplier, he might get the answer—Sorry, Mr. Jones, the company policy on that is made quite clear on page 3 of the dealer agreement."

To avoid this kind of problem, arrangements for extra time should always be made in advance if there is the slightest chance that it will be needed. Some manufacturers have flexible financing or credit plans, but one way or another it is essential for the dealer to leave himself some sort of an "out." And remember, verbal agreements for extra time are worthless, so *get it in writing*.

CB ACCESSORIES & ANTENNAS

As a rule, every policy which applies to CB units should be applied to the accessories that are sold with them, with the possible exception of the warranty on antennas. There are few CB items manufactured today that can compare in reliability with the CB antenna—assuming proper installation. The fact is that most antenna manufacturers work very hard at maintaining a good reputation. A defective part of an antenna is usually replaced without questions—even if the factory suspects customer abuse. In short, don't worry about well-known antenna brands. If CB units were as good, everyone would be better off.

CB gadgets are a different story. Since many add-on gimmicks serve no purpose whatsoever, except of course, to separate a fool from his money, the percentage of disallusioned customers complaining about the gadget items is inordinately high. The wise dealer learns early in the game that these are probably sales he can do very well without.

The best protection against making a good customer unhappy for a five or ten dollar profit is to see that he gets the best advice you can give him. This is where you get ahead of the discount stores selling CB. A discount store salesman probably would be fired if he told someone that the gadget which its makers claim is great and wonderful is actually worthless. The customer who buys such an item from the discounter and then finds out the truth himself is probably going to wish he had taken the advice of the bonafide, servicing CB dealer who said he didn't stock the gadget because it was worthless.

THE PROFIT MARGIN IN CB EQUIPMENT

Because the only money you get to spend, or pay bills with, comes from profit, it would appear that the biggest discount off the list price is also a definite plus factor with CB equipment. That can be very misleading and can lead to trouble. Dealer discounts on CB equipment vary from around 25% to 50% when buying direct from the factory at maximum quantity breaks—and in a few cases, factories have offered discounts in excess of 50% off list price. However, when those "super-discounts" appear, it is a pretty safe bet that the list prices "suggested" by the factory are highly inflated. The consumer eventually catches on to this type of "rip-off", and then the legitimate dealer finds that in order to sell these units he must discount them until they are competitive with other units of the same quality. And—poof!—there goes that handsome profit. So, the first thing to check for in offered dealer discounts is whether or not the customer is really getting his money's worth. A legitimate 25% discount may be much easier to live with in the long run than an inflated 60%.

The smaller dealer may find, as he shops around, that he cannot reasonably buy at the lowest price break. Because quantity requirements vary from one manufacturer to another, the dealer in this position may find that he can do better with one company at his desired quantity level than he can do with another. If he only handles a few units a month, he might be better off to buy from one of the large multi-brand wholesalers. As a rule,

companies such as CB Center, BFJ, and others sell in single unit quantities at a price somewhere below the factory single unit price, but above the maximum quantity discount.

Another factor which must be considered part of the dealer discount are the charges for freight. If a $2000 order has freight charges of $60 added, then there is less profit per unit. Many manufacturers and wholesalers pay freight charges on large orders, which means the large buyer usually has no problem. Small buyers, however, should always take these charges into consideration when computing the profit margins of the various brands available.

HOW EXCLUSIVE IS THE BRAND?

On the subject of "protected franchises" on CB lines, it's a good rule of thumb to figure that whatever a company tells you about the exclusivity of his brand in your territory, the shopowner down the street could very well end up selling "your" brand, if he wants to. Most CB manufacturers have open sales policies. What is important to the dealer is whether this manufacturer will attempt to sell his products within the electronic sales and service industry, or whether he will sell to the discount department store chains at prices *below* those paid by regular dealers.

For example, if the discount department store down the street is selling Brand X CB units for only $10 more than you would have to pay for them, why make him look good by trying to sell the same brand? You can always find a better line than that carried by the discount store. And remember, it is much easier to sell a *different* product at a higher price than it is to sell the same product at a higher price. And let's face it, the smaller dealer cannot make it with a gross profit of only $10 per radio. Small or large, the average service shop operator cannot compete with the discount store. He doesn't have to, and he shouldn't try.

In other words, if the manufacturer under consideration sells to the trade alone—fine. But if he is greedy enough to sell to anyone, forget him. You can't afford him.

To sum it all up, the dealer desiring to build a CB business on quality products and professional service must take a number of factors into consideration when choosing the brands he will handle—profit margin, parts and service backup, brand exclusivity, warranty programs, financing, antennas and accessories, and serviceability of the product. He must decide whether or not he can "live" with the lines he chooses and he must be certain that his customers will be getting full value for their money. Buying and selling prices are way down on the list of things to look for when choosing brand names. Quality products that you can be proud of and expert service that keeps your customers happy and coming back in the future will keep you in business long after the "quick buck artists" have moved on to some other kind of consumer boom.■

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Pincushioning In Color TV Receivers

By Paul Shih

What causes it, the circuits TV designers have developed to correct, it, and how to troubleshoot them

THE CAUSE OF PINCUSHIONING

■ The electron beam in a CRT, emitted from the fixed electron gun, is deflected across the CRT screen by the magnetic field created by the deflection yoke. If the screen were a truly spherical (curved) surface, the distance the electrons travel before they strike the screen would be the same for all beam positions, and a raster with straight edges would be produced. However, the screen of a color TV picture tube is far from spherical; in fact, it is relatively flat. Consequently, the distance from the electron gun to where the beam strikes the screen is shortest at the center and greatest at the four corners. This difference produces a distorted raster, with the four corners stretched out and the sides bowed in, as shown in Fig. 1. This distortion of the raster is called *pincushioning* and increases approximately as the square of the tangent of half of the deflection angle. This means that pincushion distortion is much greater in a 110-degree tube than in a 90-degree version.

PINCUSHION CORRECTION CIRCUITS

Less severe pincushioning sometimes can be concealed by overscanning the raster height and width. However, most large-screen CRTs require some form of correction to reduce the pincushion effect. The amount of correction needed depends on several factors: the curvature of the CRT, the deflection angle, the inherent interdependent characteristics of the picture tube and the yoke, and the level of the viewer's eye in relation to the CRT screen. Normally, top pincushioning is more noticeable than bottom or side pincushioning, and left side pincushion error is greater than the error on the right side.

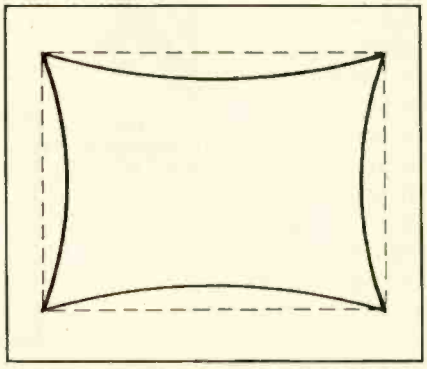

Fig. 1—The effect of pincushioning on the raster of a color TV picture tube.

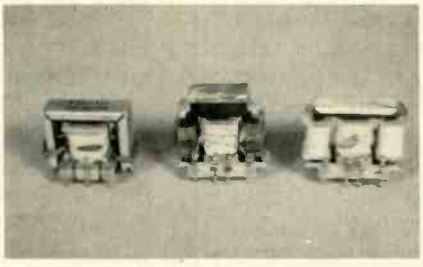

Fig. 2—Three examples of pincushion correction transformers: (left) side pincushion transformer; (center) top/bottom pincushion transformer; and (right) combination side and top/bottom pincushion transformer.

Pincushioning in black-and-white TVs in commonly corrected by using permanent magnets mounted near the face of the picture tube or embedded in the deflection yoke liner. The magnets exert a corrective bending force on the beam as it scans near the edges of the raster. With this correction on the beam landing, the edges of the raster appear straight.

Unfortunately, this simple method can not be used with satisfaction in a tri-color CRT because the magnets can not be placed in such a way that they have the same corrective effects on all three beams. The different influence on each beam would upset the purity and convergence. Therefore, another method, called *dynamic pincushion correction,* is used in all color TV's. The correction is accomplished by modifying the vertical sweep waveform for the top and the bottom, and by changing the horizontal sweep magnitude for the sides.

Side Pincushion Correction

Side Pincushion correction can be accomplished in several ways. Some of the most common ones will be discussed here.

One method is to use a saturable reactor (pincushion modulator) to change the horizontal sweep current magnitude at the vertical scanning rate. A saturable reactor is a special type of transformer which varies its secondary (or controlled) winding's inductive reactance according to the amplitude of the current flowing in the primary, or control, winding. A good example of this type of correction is the use of a side pincushion transformer (Fig. 2, left) in RCA Chassis CTC46A. A sample of the vertical sweep waveform is shaped by R22, C13 and R16 in Fig. 3 and then is applied to the primary or the center control winding of T4. The operating point of the primary is set by a DC bias current flowing through R15. The vertical parabolic current in the primary increases the inductive reactance of the secondary (or the outer controlled windings) during the beginning and the end of the vertical scan. Being connected in series

GE 19"diagonal MODULAR Solid State Set gets 91.7% serviceability rating from panel of NESDA members.

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It's based on a comprehensive checklist of items considered by NESDA (National Electronic Servicing Dealer Association) to be key factors in allowing service technicians to quickly and easily diagnose and repair a TV set.

According to Dick Glass, Executive Vice-President of NESDA, the panel found the overall serviceability of GE's 19" diagonal model WYC7608WD was "excellent".

The YC chassis is modular in design . . . Seven module subassemblies contain approximately 85% of all set components. But, like all General Electric modular chassis, it's designed to be serviced with or without modules. Its swing-away design provides easy access to module components and each module has abundant, clear markings.

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with the horizontal deflection yoke, the secondary windings cause the yoke current to decrease when the beams are scanning near the top and the bottom of the screen. The result is that the raster width is reduced near the top and the bottom, counteracting the pincushioning effect.

Another type of side pincushion transformer is connected so that its secondary is in parallel with the horizontal yoke or the flyback transformer. (The polarity of the parabolic current in the primary is reversed in relation to that of the transformer previously described.) This establishes a low impedance in the secondary windings near the beginning and the end of the vertical scan. The resultant low impedance shunt across the yoke or the flyback diverts some deflection current from the horizontal yoke, thus decreasing the raster *width* near the top and the bottom of the screen.

General Electric, in their YA chassis, uses still another type of pincushion transformer, whose operation is opposite to the common saturable reactor types described in the preceding paragraphs. That is, the inductive reactance of the controlled windings increases, instead of decreasing, when the current in the control winding increases. This "opposite" characteristic is due to an additional bar-type, permanent magnet placed above and parallel to the "I" part of the transformer core, as shown in Fig. 4. The magnet saturates the core so that the inductive reactance of the controlled windings on the outer legs is low when the parabolic current at the vertical rate is not flowing in the center control winding. The vertical parabolic current, derived from a waveshaping network and a diode bridge circuit, is unidirectional. It has maximum magnitude at each end of the vertical sweep and minimum magnitude at the center of the sweep. With minimum parabolic current during the vertical center sweep, the core is still saturated by the bar magnet, and the reactance of the controlled windings is low. This allows maximum horizontal sweep current to flow through the yoke, producing maximum deflection at the center portion of the raster. At each end of the vertical sweep, the

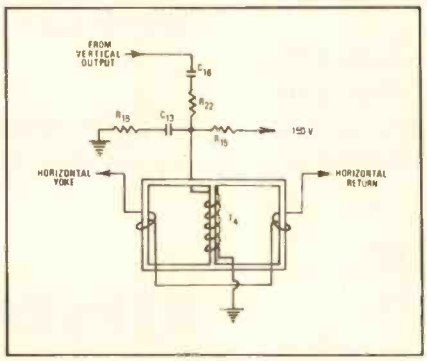


Fig. 3—Side pincushion correction circuit used in RCA's CTC46A color TV chassis.

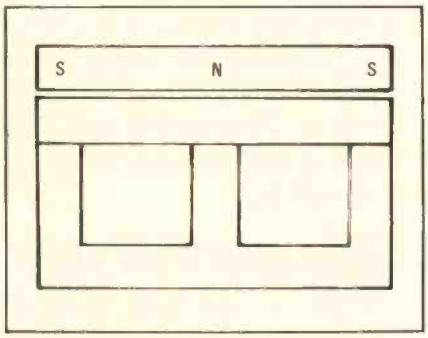
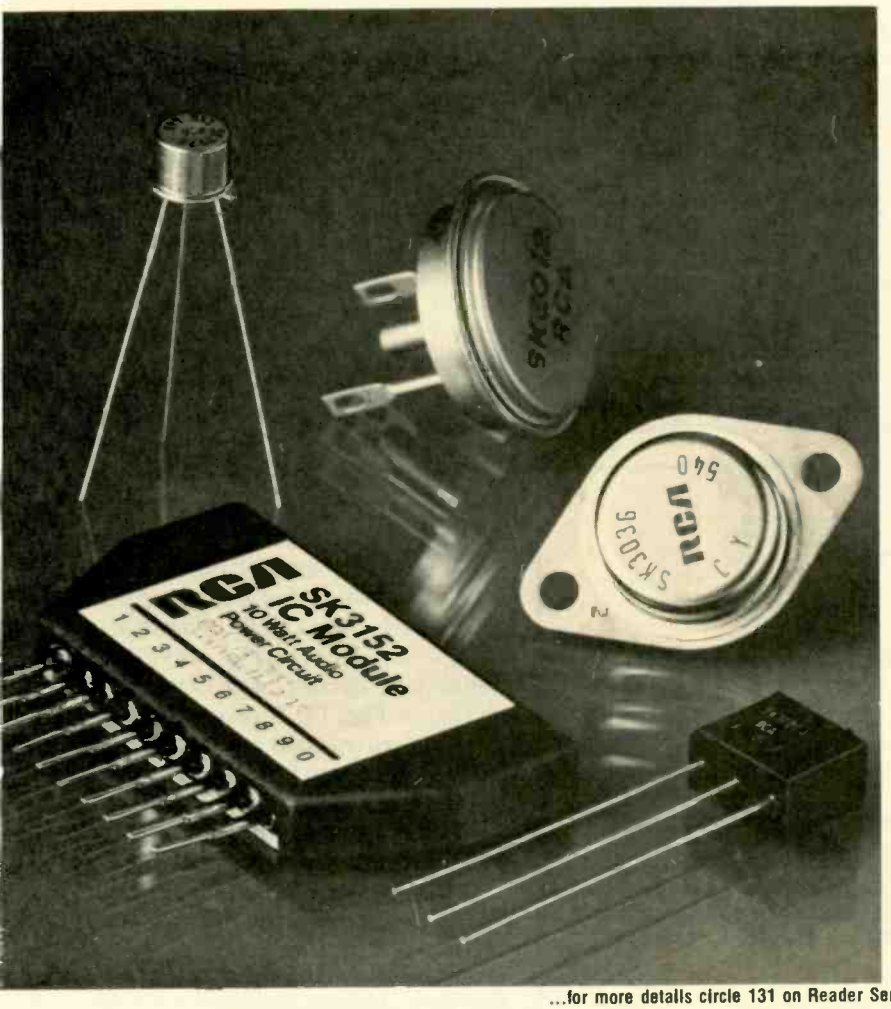


Fig. 4—Physical construction of the side pincushion transformer used in GE's YA color TV chassis.



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maximum current flowing in the center control winding produces a magnetic flux which is opposite to the one set up by the bar magnet. As a result, the core saturation is decreased and the reactance of the outer windings is increased. The increased reactance at each end of the vertical sweep reduces the horizontal sweep width at the top and the bottom portions of the raster. In this way the horizontal or side pincushioning is corrected.

Side pincushioning can also be corrected by using an active pincushion modulator instead of a passive transformer modulator. An active pincushion modulator is nothing more than a transistor amplifier. A sample of the vertical deflection current controls the conduction of the amplifier, which in turn modulates the horizontal output system. Sony uses this type of modulator to control the horizontal-output stage in their SCC-25C-A chassis, as shown in Fig. 5. The vertical parabolic pulse varies the conductivity of the pincushion modulator, which is connected in series with the collector circuit of the horizontal-output transistor. The magnitude of the horizontal-output sweep current, and consequently the current in the horizontal yoke, is varied at the vertical rate. The magnitude and the phase of the parabolic current are properly adjusted so that the horizontal scan is increased toward the center of the vertical sweep and is decreased toward each end of the vertical deflection. In this manner the bowing-in effect of side pincushioning is eliminated.

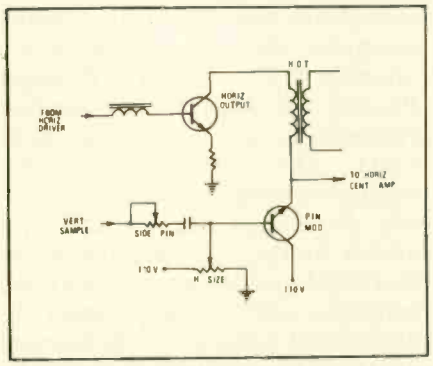

Fig. 5—Side pincushion modulator circuit used in Sony's SCC-25C-A color TV chassis.

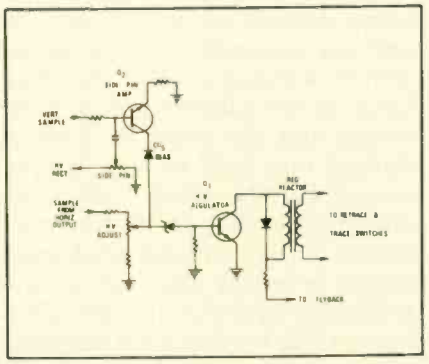

Fig. 6—Side pincushion correction circuit used in RCA's CTC49XA color TV chassis.

RCA employs an active pincushion modulator (Fig. 6) in the high-voltage regulator circuit in Chassis CTC49 and 59. The modulator constantly varies the base current of the high-voltage regulator at the vertical rate. Since the high-voltage regulator in these circuits controls the amount of energy supplied to the flyback and the horizontal yoke, the current in the yoke, or the width of the raster, is actually varied in a parabolic fashion at the vertical rate. The result is that the sides of the raster are straightened.

A side pincushion amplifier is used in Magnavox T995 chassis to modulate the 125-volt horizontal-output DC supply (Fig. 7). A

sample of the vertical sawtooth is amplified by pincushion modulator Q5 and then changed to a vertical parabolic wave by integrating capacitor C4. The parabolic signal then goes through C3 to the base of regulator driver Q3, modulating the regulator output at the vertical rate. With this modulated 125-volt supply, the output of the horizontal stage is varied at the vertical rate. A corresponding variation in the horizontal sweep current in the yoke produces more deflection near the center of the screen, thus counteracting the side pincushioning effect there.

Top/Bottom Pincushion Correction

A number of different circuits are used to correct top and bottom pincushioning, but the principle underlying the correction process is the same. In brief, the vertical deflection current must drive the yoke harder for more *upward* vertical deflection at the top-center portion of the screen, and for more *downward* deflection at the bottom-center. The vertical current waveform necessary to accomplish this consists of a number of parabolic waves at the horizontal scanning rate which, in turn, are superimposed on the regular vertical sawtooth wave (Fig. 8). Two common methods used to develop this "modified vertical sawtooth" are described in the following paragraphs.

One method employs a saturable reactor (Fig. 2, center), which is similar to the one used for side pincushion correction. However, the physical operation is slightly different. In addition, a small magnet is placed at the top of the reactor core and is slightly offset from the center of "I" core (Fig. 9). This off-center arrangement is used to provide more correction at the top than at the bottom, because the top pincushioning is always more noticeable than the bottom.

A partial schematic of the top and bottom pincushion correction system used by RCA is shown in Fig. 10. the two sections of the center control winding and the two outer controlled windings are connected in series with the vertical yoke windings and the horizontal yoke windings, respectively. It is important to notice that these two

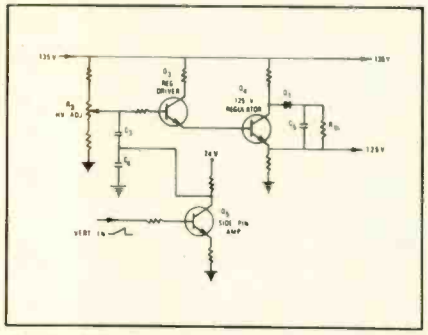

Fig. 7—Side pincushion correction circuit used in Magnavox's T995 color TV chassis.

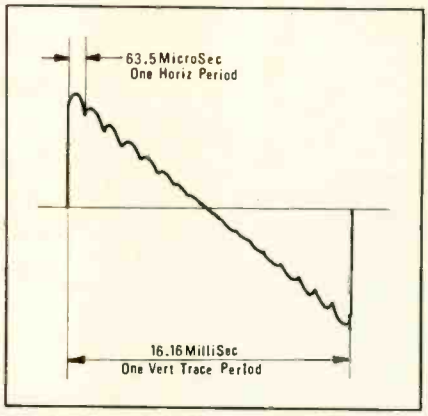

Fig. 8—Representation of a modified sawtooth waveform which provides top/bottom pincushion correction.

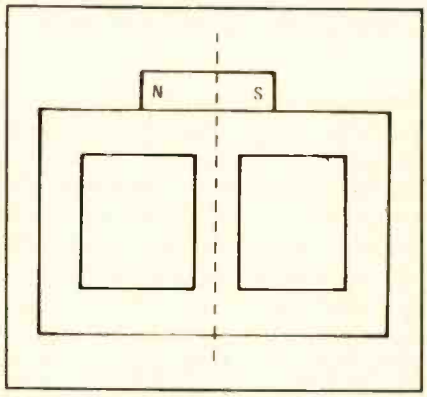

Fig. 9—Physical construction of the core of an RCA top/bottom pincushion correction transformer.

sections of the center control winding are connected in such a way that there is no transformer action from the control winding to the outer controlled windings. The vertical sawtooth current in the center winding causes the reactance of one outer winding to increase and the other to decrease during one half of the vertical sweep. On the other half of the sweep, the change in the reactances of the two controlled windings is reversed. This variation of reactance in the controlled windings at the vertical rate, together with the magnetic flux variation in the cores, caused by the horizontal deflection current passing through the controlled windings, produces horizontal pulses in the center control winding. Capacitor C14 and Phase coil L3 shape the induced horizontal pulses into approximate parabolic waves. Being in direct proportion to the magnitude of the vertical sweep current in the center winding, the magnitude of the induced parabolic waves is highest at the beginning and at the end of the vertical scanning period and is zero slightly after the center sweep, due to the unbalanced effect of the off-center magnet.

Pincushion amplitude control R17 is provided for adjusting the amplitude of these parabolic waves. An interesting waveform developed across this control is shown in Fig. 11. It consists of the vertical sawtooth on which the high-frequency horizontal parabolic waves ride, as evidenced by widening at each end of the sawtooth (commonly referred to as the "butterfly wings"). Straightening of the top and bottom of the raster is obtained by proper adjustments of the pincushion amplitude control and the phase coil.

The second basic method used to produce the modified vertical sawtooth wave needed for top and bottom pincushion correction involves the use of an active pincushion amplifier. The amplifier modulates a vertical current driver with a pincushion correction signal. A pincushion correction circuit in Magnavox Chassis T995 exemplifies this approach (Fig. 12). With a negative-going horizontal pulse applied to its base, horizontal phase splitter Q4 produces two equal-amplitude but opposite-polarity pulses, one at its collector and the other at its emitter. These pulses are then coupled to diodes D8 and D9, and, at the same time, a sample of the vertical sawtooth wave is applied to the junction of R16 and R17 through R8 and C6. During the negative excursions of the vertical sawtooth, D8 conducts and the negative-going horizontal pulses are developed across R36 and added to the vertical sawtooth. During the positive excursions, D9 conducts and the positive-going horizontal pulses are developed across R36 and added to the vertical sawtooth. Resistor R18 allows

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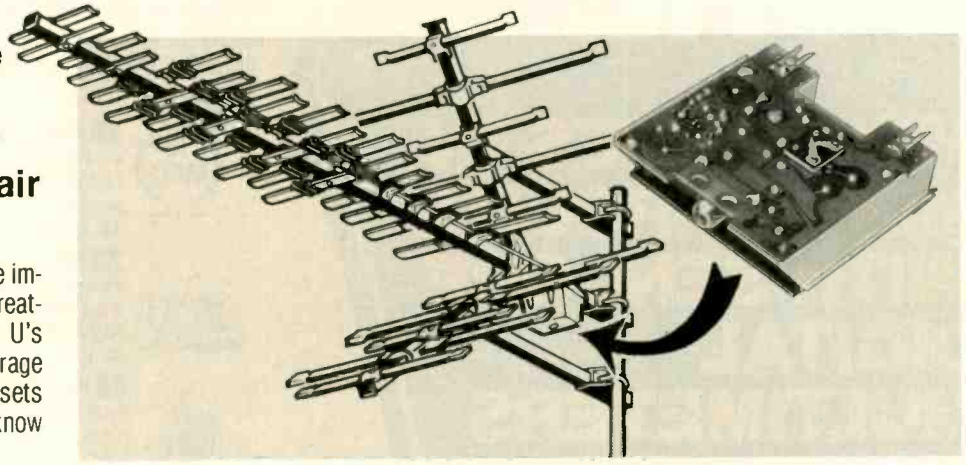
Good reception of UHF stations is more important than ever. Programming has greatly improved in recent years on the U's and many offer exclusive sports coverage viewers so eagerly want. If you sell sets or install antennas in UHF areas, you know what we're talking about.



Winegard AC-4990 Preamplifier Combined With CH-9095 Antenna Delivers Amazing UHF Reception.

The Problem

You also know what we're talking about when we say that reception of UHF stations in most areas is rarely as good as you get on the VHF stations. This is a major, universal problem.

Why the problem? For one thing, many UHF stations are not on full authorized power. And, transmission line losses at UHF frequencies present difficulties. But the biggest culprit of all is the high noise figure of the TV set tuners at UHF frequencies.

Generally speaking, you have to deliver *3 times* as much clean UHF signal to the set as you do VHF signal—in order to get comparable reception.

The quantity and quality of UHF signal you feed the set is greatly determined by the antenna and preamplifier you use.

SPECIFICATIONS	AC-4990
GAIN	
UHF	17.5db
BANDPASS (MHZ)	
VHF-FM	54 to 216
UHF	470 to 890
MAX. TOTAL OUTPUT (Volts)	
UHF	.882
MAX. TOTAL INPUT (Volts)	
UHF	.126
NOISE FIGURE	
UHF	2.2db

The Solution

A few months ago Winegard Company introduced a new line of Chromstar UHF antennas featuring a new Tri-linear director system. This configuration offers the highest gain we've ever seen on a UHF antenna and the field reports we've been getting from professional installers have been most enthusiastic.

Now Winegard Company is introducing another...and even bigger breakthrough. This is a super lo-noise UHF preamplifier, Model AC-4990.* It has a 6db signal-to-noise improvement over the best UHF preamps previously available.

Combine the AC-4990 with a Winegard CH-9095 Chromstar UHF antenna and you get a 9db improvement or *3 times cleaner signal.*

This means you can give good UHF pictures to customers who can barely get UHF now. It means you can deliver "excellent" reception to those who now receive just "fair" pictures.

*Pat. Pending.

In actual practice, good reception of all UHF stations is now extended up to 30 additional miles...in many cases nearly doubling the effective reception range.

New Sales Potential

Potential sales of CH-9095's and AC-4990's are greatly increased. This combo can be sold in areas where UHF reception hasn't been good enough to bother with *and,* as a replacement for customers who are only getting "fair" reception now.

Incidentally, the AC-4990 preamp has a VHF bypass so it can also be used with any Winegard V-U Chromstar antenna with excellent results.

Antenna dealers in UHF areas are advised to try this new Winegard antenna-preamp combination as soon as possible. Seeing is believing...and the new profit opportunities are tremendous.

NOTE: Due to demand, the AC-4990 preamp will be in short supply for a few months. An order should be placed now with your Winegard distributor.

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PROTECTED INSIDE AND OUT so you can be sure that your meter is working and not in the repair shop. Drop it from 10 feet, apply 1000 volts overload and even apply volts on ohms accidentally and Sencore digitals keep right on working.

more positive-going horizontal pulses to be added to the sawtooth wave, for more pincushion correction at the top than at the bottom. C12 blocks the vertical sawtooth, but allows the horizontal pulses to pass. These horizontal pulses are shaped into parabolic waves by R19 and C13 before being applied to the base of the pincushion amplifier Q5. After amplification by Q5, these horizontal parabolic pulses are added to the regular sawtooth waves through Q6, the vertical current amplifier. The resultant modified vertical sawtooth current applied to the yoke has the correct waveform for pincushion correction at the top and the bottom.

Because of the similarity in the modulation processes, some TV chassis today use a single saturable reactor to perform simultaneously both top/bottom and side pincushion corrections. The physical construction of this kind of reactor (Fig. 2, left) is similar to that of a top/bottom pincushion reactor, except that more turns are used for the center and the outer two windings, and the small magnet is eliminated. The vertical sweep current flowing through the center control winding modulates the horizontal sweep current in the parabolic fashion at a vertical rate, for side pincushion correction. At the same time, this vertical sweep current in the center winding unbalances the core saturation of the two outer limbs, on which two controlled windings are wound. The result is that the horizontal sweep current in the controlled windings produces a variable flux in the center limb from which horizontal pulses are induced into the control winding. With the proper phase and amplitude adjustments, the modified sawtooth current in the center winding will have the necessary waveform (Fig. 8) for top and bottom correction, as was described previously.

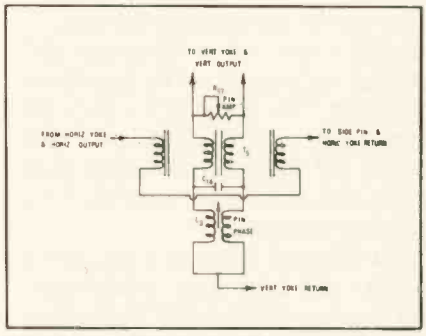

Fig. 10—Top/bottom pincushion correction circuit used in RCA's CTC46A color TV chassis.

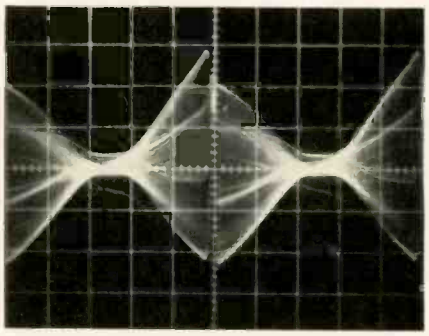

Fig. 11—Photo of typical waveform which provides top/bottom pincushion correction.

DYNAMIC PINCUSHION ADJUSTMENT

Pincushion correction in some chassis is a fixed amount with no variable control provided, while in others the amount of correction can be adjusted by one or two controls. These controls are normally "factory adjusted," and readjustment is seldom needed. Occasionally, however, it becomes necessary to readjust the controls dur-

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3½ digit LED display,
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DVM32 $198
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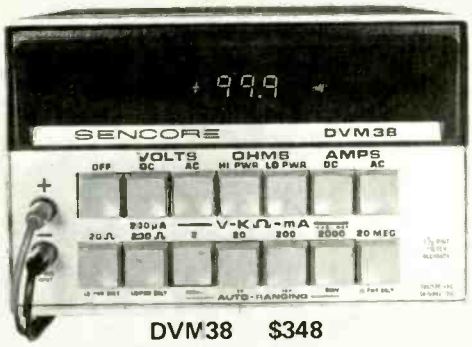

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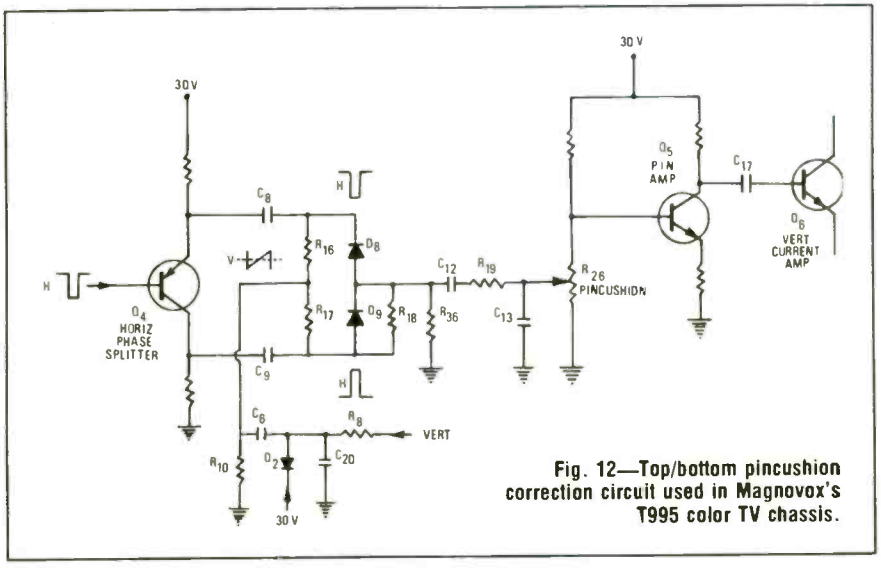

Fig. 12—Top/bottom pincushion correction circuit used in Magnovox's T995 color TV chassis.

ing initial color convergence setup or after a repair is performed in the deflection yoke or pincushion circuits. In such cases, the manufacturer's recommended procedure should be followed.

The most common procedure is to display a normal crosshatch pattern on the screen and then alternately adjust the pincushion amplitude control and the pincushion phase or linearity coil for straight horizontal lines at the top and bottom of the screen (for top and bottom correction) or straight vertical lines at left and right sides of the screen (for side correction).

TROUBLESHOOTING PINCUSHION CORRECTION CIRCUITS

If adjustment of the controls fails to produce any response, a defective pincushion stage is indicated. Check the waveforms in the pincushion circuit. If the characteristic "butterfly" waveform (Fig. 11) or related parabolic waves are missing or distorted, voltage and resistance measurements should be used to locate the trouble.

An open or defective component in the pincushion circuit may render the circuit inoperable and sometimes may even cause a trapezoidal raster. A fast test for this type of trouble is to place a jumper wire across the pincushion amplitude control, or simply turn the control completely *counterclockwise*. Restoration of a normal but pincushioned raster is proof of an open circuit element. Resistance and continuity tests then can be used to isolate the defects.

Another fast method to determine an open or defective component in a reactor type of correction circuit is to short out the pincushion transformer windings, one at a time, by placing the jumper wire across proper points in the circuit. Restoration of full height is an indication of a defect between the "short-out" points. **Caution:** The

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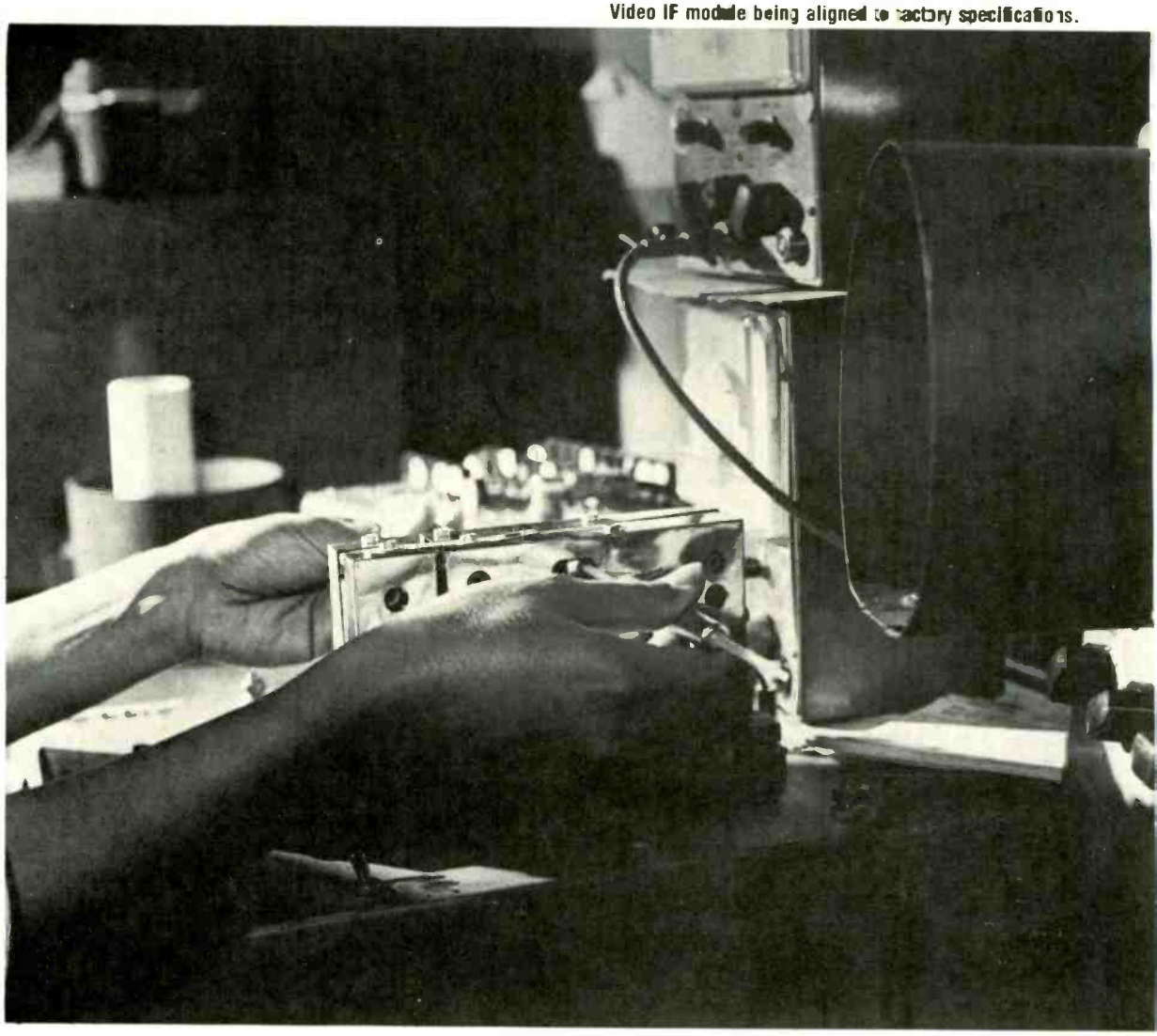
Video IF module being aligned to factory specifications.



"Remanufactured" Modules—

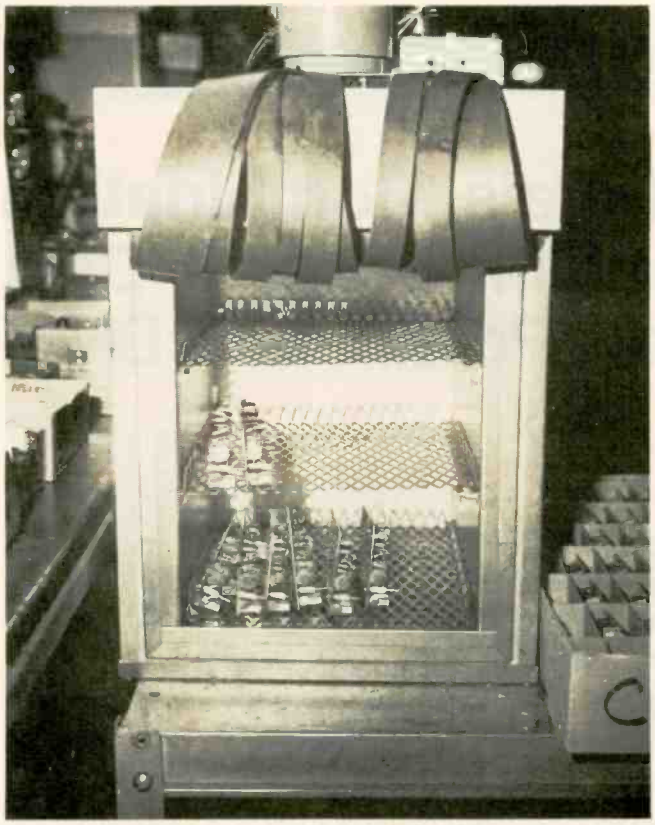
By Don Mason, ET/D Managing Editor

A Solution to Future Availability

■ Suppose tomorrow you went into a customer's home to replace a module in his TV set. You remove the defective module from the set and call your local distributor to order a replacement. And suppose the distributor matter-of-factly tells you "We don't have any. There's a shortage. And those that are available are priced out of sight."

Hopefully, this won't happen. But it is important that servicing

After passing quality control tests, modules are individually packed in RCA boxes, identified with the appropriate part number, and labeled "Remanufactured."



Remanufactured modules are cycled through the environmental chamber which simulates extreme temperature conditions.

Modules are subjected to a vibration test while monitoring frequency and output as well as an air-check to uncover intermittents.

Modules undergo specific updates to assure latest specifications for performance and reliability.

Production line at RCA for remanufacturing modules to factory specifications.

dealers and technicians understand that as more and more modular sets are phased out of production to make way for new modular designs, the ability of manufacturers to supply replacement modules at reasonable prices will become more difficult. If manufacturers have to produce new modules in small quantities for the replacement market only, this will surely drive up the cost.

Most of the major TV manufacturers have some type of program for the repair and reconditioning of defective modules, at least for the larger and more expensive modules in their lines. One company—RCA—has developed a method to assure a steady supply of replacement modules at reasonable prices for all the module-equipped models in their line. RCA has launched what they call their "Module Remanufacturing Program" to recover defective modules from the field, and to remanufacture them to include, where possible, the latest design improvements. These modules are then made available to service dealers through normal distribution channels.

"Recover" is a key word in the RCA program, and the recovery system begins with you, the servicing dealer and technician. Your role is to recover defective modules from customers at the time repairs are made. The modules are then returned by you to the local RCA Parts Distributor who, in turn, ships them to RCA's Replacement Parts center in Deptford, New Jersey. Here, the defective modules are inspected and screened to determine whether they can be restored to their original factory performance. Credit allowances are provided, through the distributor, to servicing dealers and technicians for returned modules.

The actual remanufacturing is done at RCA's TV production plant in Bloomington, Indiana—the same plant where RCA is building its *XL-100* and *Color-Trak* receivers. The word "remanufactured" is used, according to RCA, because the process "goes beyond a conventional repair or reconditioning procedure."

For example, all modules that are returned to the Bloomington plant are updated, where possible, to include the latest circuit and component improvements. According to RCA, this is done to assure the highest level of product reliability, quality and safety, and that with some modules, these improvements can actually result in performance that is bet-

continued on page 53

Vu-Data's Combination DMM/Counter/Mini-Scope & Data Precision's Pocket Size DMM

■ The following two test instruments are examples of how innovative applications of state-of-the-art microelectric technology are not only making test instruments more compact, lightweight and portable but are also making them easier to use and more accurate and versatile—and with price tags which are acceptable to a broader range of the electronic service industry

DMM/COUNTER/MINI-SCOPE

If you need, 1) a DC-20 MHz, triggered-sweep, single-trace scope; 2) a 3½-digit, auto-ranging digital multimeter (DMM) capable of measuring AC and DC voltage levels up to 1000 volts RMS and resistances up to 2 megohms; and 3) a 4-digit frequency counter capable of measuring frequencies up to 20 MHz—and you want all three instruments combined in a single package which weighs a mere 10 lbs and fits within a space 3½ inches high by 8½ inches wide ty 12½ inches deep—with built-in provisions which permit all three measurement functions to be used either simultaneously through a single test probe or independently through separate inputs—then Vu-Data's Model PS915A/975A DMM/Counter/Mini-Scope (Fig. 1) is probably the test instrument for which you've been looking—especially if its $1250 price tag fits within your test instrument budget.

The waveform display function of this unique test instrument package is performed by Vu-Data's Model PS915A "Mini-Scope," a compact, single-trace, triggered-sweep DC-20 MHz type which is equipped with a 1.6-inch by 2.4-inch screen. (The PS915A is available without the DMM/Counter feature for $825.)

The DMM and frequency counter functions of the package

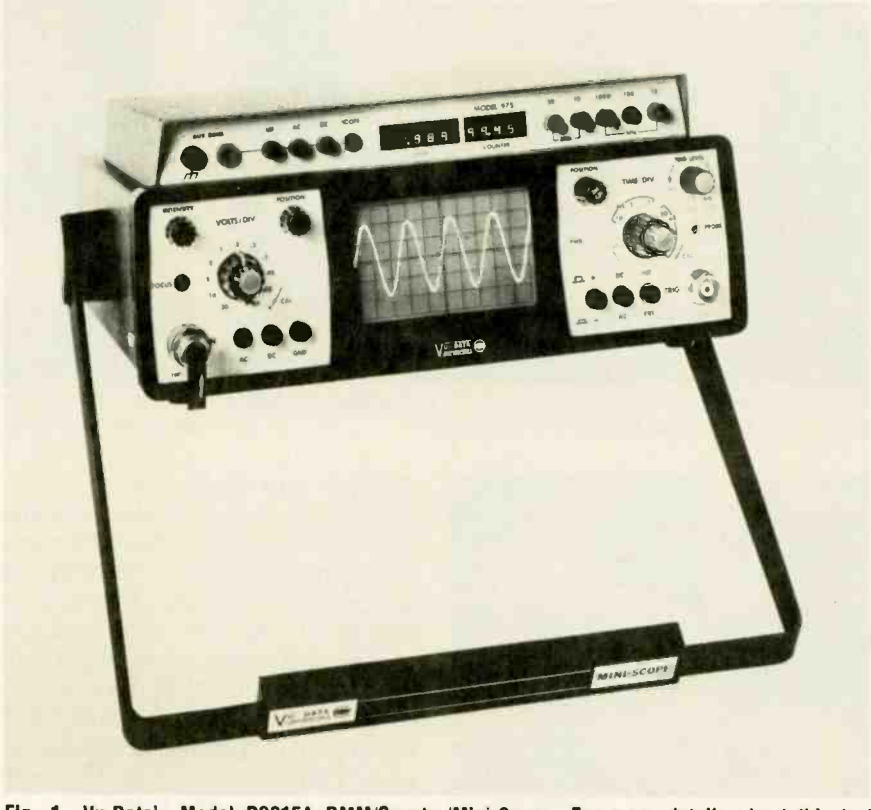


Fig. 1—Vu-Data's Model PS915A DMM/Counter/Mini-Scope. For more details about this test instrument circle 148 on the Reader Service Card in this issue.

are performed by Vu-Data's Model PS975A DMM/Counter combination, which is mounted atop and receives its operating voltages from the "Mini-Scope." The separate digital readouts of the DMM and frequency counter are provided by light-emitting diodes (LEDs) the size of those typically used in pocket-size digital calculators. The DMM is a 3½-digit, auto-ranging type (which eliminates the need for manual range selection). The five ranges of the frequency counter are manually selected by pushbuttons to the right of its 4-digit display. (The PS975A DMM/Counter is available only ir combination with the PS915A "Mini-Scope.")

The principal electrical specs of the scope, DMM and frequency counter functions of the Model PS915A/975A are listed separately in an accompanying table.

Built-in "interface" circuitry between the scope and both functions of the DMM/frequency counter permit simultaneous measurement and display of the three basic qualities of a signal—waveshape, amplitude and frequency—or any one or two of these qualities can be measured and displayed independently.

The "simultaneous" measurement mode is initiated by pressing in the SCOPE pushbutton, which is positioned immediately to the left of the DMM readout. In this mode, the DMM receives its input from the vertical amplifier of the scope and is automatically programmed for either AC or DC voltage measurement by pressing in either the AC or DC input coupling pushbut-

VU-DATA PS915A/975A DMM/COUNTER/MINI-SCOPE

Electrical Specs
PS915 MINI-SCOPE SPECIFICATIONS

VERTICAL DEFLECTION

BANDWIDTH:
DC to greater than 20 MHz within 3 dB.

COUPLING:
AC, DC or Ground, selectable. Low frequency limit with AC coupling is less than 2 Hz.

RISETIME:
Less than 18 nsec.

DEFLECTION FACTOR:
10mV/div to 20V/div in 11 calibrated ranges, 1-2-5 sequence; all ranges accurate to within 3% with vernier in Calibrate position. Vernier: Continuously variable between ranges; extends deflection factor to approximately 50V/div.

INPUT IMPEDANCE:
1 Megohm (within 2%) paralleled by approximately 47pF.

MAXIMUM INPUT VOLTAGE:
400 V (DC + peak AC).

HORIZONTAL DEFLECTION

TIME BASE:
100 nsec/div to 10 msec/div in 6 calibrated decade ranges; all ranges accurate to within 3% full scale with vernier in Calibrate position. Vernier: Continuously variable between ranges; extends slowest sweep rate to approximately 100 msec/div.

X5 MAGNIFIER:
Magnifies sweep by a factor of 5; extends fastest sweep rate to 20 nsec/div.

X-Y MODE:
X-Y operation selected by additional positions on time base switch.

BANDWIDTH:
DC to greater than 50 KHz.

DEFLECTION FACTOR:
100 mV/div to 1V/div in two ranges. Vernier: Continuously variable between ranges; extends deflection factor to approximately 10V/div.

TRIGGER

MODES:
Automatic or normal, with trigger level adjustment; "+" or "−" slope selection; internal or external. Automatic operation is functional above 40 Hz.

COUPLING:
AC and DC for both internal and external triggering; 200V maximum input voltage (DC + peak AC).

AMPLITUDE REQUIREMENTS:
0.4 div deflection (internal) or 200mV external to 1.0 MHz, increasing to 1 div deflection (internal) or 1V external at 20 MHz. Requirements increase below 40 Hz with internal or external AC coupling.

INPUT R AND C (EXTERNAL TRIGGER):
1 Megohm paralleled by approximately 47pF.

975 DMM-COUNTER SPECIFICATIONS

DC AND AC VOLTS

FULL SCALE RANGES:
2.000, 20.00, 200.0, 400 (scope input) or 1000 (auxiliary input) volts DC or volts AC (RMS), Auto-ranging. (Up-range at 1.999; Down-range at 0.100).

ACCURACY:
DC: 0.5% RDG ± 1 digit
AC: 0.5% RDG ± 5 digits

MAXIMUM INPUT VOLTAGE:
Using scope input, 400 volts DC + peak AC; using direct input, 1000 volts RMS max.

INPUT IMPEDANCE:
Scope input, 1 Megohm; Direct Input, 10 Megohm.

AC FREQUENCY RANGE:
30 Hz to 5 KHz.

OHMS

RANGES:
2.000 Kohms, 20.00 Kohms, 200.0 Kohms, 2,000 Kohms; Auto-ranging.

TEST CURRENTS:
1 mA, 100 µA, 10 µA, 1µA.

ACCURACY:
0.5% RGD ± 1 digit.

MAXIMUM OVERLOAD VOLTAGE:
50V RMS.

COUNTER

RANGES:
10 KHz, 100 KHz, 1000 KHz, 10 MHz, 20 MHz, manually selected; flashing display for over-range condition.

READING RAGE:
.5 readings/second on 10 KHz range and 5 readings/second on all other ranges.

INPUT:
Counter display is frequency of scope trigger signal. Mode, level, source and coupling controlled by scope trigger controls.

ACCURACY:
±0.1% RDG ±1 digit.

tons of the scope. Thus, depending upon which type of vertical amplifier input coupling is selected—either AC or DC—the DMM will automatically measure and display, respectively, either the RMS value of the sine wave displayed on the scope screen or the value of the DC component of the displayed AC signal(or the DC level if no AC signal is present). And—assuming that the scope is in the "internal trigger" mode and the horizontal sweep rate of the scope is properly synced to the frequency of the displayed signal—constant-level pulses with a frequency directly representative of that of the displayed signal are developed by the trigger generator of the scope and are automatically applied to the input of the frequency counter, which, in turn, measures and displays the frequency.

For measurement of resistances, or for measurement of AC or DC voltage levels without simultaneous waveshape display or frequency measurement, the input to the DMM is made directly via two "banana" type plug-in connections on the left side of the DMM/Counter unit. In this "independent" mode of DMM operation, the type of measurement to be performed is selected by pressing in either the "KOHM," "ACV" or "DCV" pushbutton on the DMM/Counter unit.

Independent measurement of frequency without simultaneous scope display is possible by placing the scope in the "external trigger" mode and applying the signal to the BNC type connection labeled "XIN," in the lower righthand corner of the scope. This directly applies the signal to the trigger generator of the scope which, in turn, generates and applies to the input of the frequency counter constant-level pulses whose frequency is directly representative of that of the measured signal.

Vu-Data's unique three-in-one test instrument package can be powered either from an AC source—four ranges from 100-240 VAC (50-400Hz), selectable by a switch on the back panel—or it can be powered from an external 10-16 VDC source via a built-in jack on the bottom panel. Available for $100 is an optional rechargeable battery pack, Model No. PS9110, which plugs into the DC input jack on the bottom panel and provides up to 2.5 hours of operation before recharging is needed.

(Recharging circuitry is included.)

Accessories included in the $1250 base price of Vu-Data's Model PS915A/975A DMM/Counter/Mini-Scope are a technical manual, a detachable AC cord, a front-panel protective hood and a 3-ft alligator clip probe.

Accessories available on an optional basis, in addition to the rechargeable battery back, include a switchable 10:1/1:1 probe kit, a viewing hood, a rack-mount kit, an accessories storage pouch, and a CRT with P-7 phosphor, which enhances the display of low-frequency waveforms. (The standard CRT employs P31 phosphor.)

PORTABLE 3½-DIGIT DMM

Data Precision's Model 175 portable digital multimeter (Fig. 2) weighs but 1.1 lb and is a mere 1-¾ inches high by 5-½ inches wide by 3-½ inches deep, yet, as revealed by the accompanying table of specs, is capable of measuring, and displaying on its 3-½-digit, .43-inch-high LED readout, DC voltages throughout the range from 100mV to 1000V, AC voltages throughout the range from 100mV to 500V, resistances from 100 milliohm to 20 megohms, and AC and DC currents throughout the range from .1μA to 2 amps.

The Model 175 is powered directly by a built-in, rechargeable *Nicade* battery module which, when fully recharged, provides 6 hours of continuous operation, or it can be powered indirectly from an AC line via the plug-in battery charger/line cord unit supplied as standard equipment with the DMM. (A 105-125VAC, 47-63Hz charger unit is supplied with the Model 175, and a 210-250 VAC, 47-63Hz charger is supplied with the Model 175E.) The battery module requires only 12 hours for full recharging and, when used in conjunction with the battery charger/line cord unit, it is always being recharged regardless of whether the DMM is on or off.

Use of the Model 175 involves the positioning of only two controls—one selects the function and the other the range.

Other features of the Model 175 not evident in the accompanying table of specs include:

- *Auto-polarity*–Automatic indication of plus or negative polarity is displayed on all DC voltage and current ranges
- *Overrange indication*–When a level in excess of the 100% overrange capability of the Model 175 is applied to it, the numerical part of the display is blanked out (only the polarity and decimal point remain on)
- *Overload protection*–Built-in provisions protect all voltage and resistance ranges against damage from overload, and the current ranges are protected by a replaceable fuse in the test leads (a spare fuse is supplied with the unit)
- *Low battery indication*–When the battery charge falls to a level which will provide only 10 minutes more of "in-spec" operation, the decimal point in this display begins blinking at a 2.5 per/sec rate, alerting the user to the need for battery recharging
- *HI/LO resistance measuring functions*–In the "LO V" resistance measuring mode the maximum open-circuit voltage between the test leads is only 300mV, to prevent turning on the junctions of silicon semiconductors during in-circuit measurements; in the "HI V" mode the maximum open cir-

continued on next page

DATA PRECISION MODEL 175 DMM Electrical Specs

DC VOLTS
Full-Scale

Range		Overrange	Resolution
±100.0mV	DC	±199.9	100μV
±1.000V	DC	±1.999	1mV
±10.000V	DC	±19.99	10mV
±100.0V	DC	±199.9	100mV
±1000.V	DC	±1000.	1V

Input Impedance: 10 megohms, all ranges
Maximum Voltage: ±1000V, all ranges
Accuracy*: ±0.1% input ±1 l.s.d.**

AC VOLTS
Full-Scale

Range		Overrange	Resolution
100.0mV	AC	199.9	100μV
1.000V	AC	1.999	1mV
10.00V	AC	19.99	10mV
100.0V	AC	199.9	100mV
1000.V	AC*	500.	1V

* Maximum Input Voltage (sinewave RMS): 30Hz to 10kHz: 500V
Above 10kHz: Decreases linearly to 200V at 50kHz
Input Impedance: 10 Megohms in parallel with 75pF or less
Sensing and Calibration: Average sensing, calibrated in RMS of sinewave

Accuracy: 30Hz: ±1% input ±5 l.s.d.
50Hz to 500Hz: ±0.4% input ±2 l.s.d.
5kHz: ±1.0% input ±2 l.s.d.
50kHz: ±3.0% input ±2 l.s.d.

specs continued next page

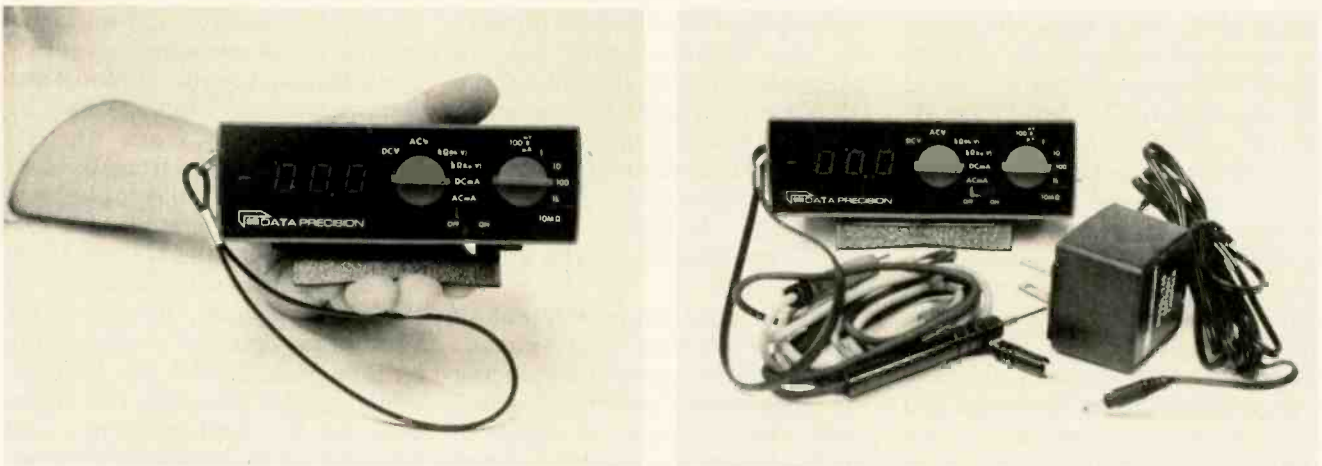


Fig. 2—Data Precision's Model 175 Portable DMM. For more details about this test instrument circle 149 on the Reader Service Card in this issue.

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Harmonic distortion measurements as low as 0.03% can be made on the 0-0.3% range over a frequency range of 5 Hz to 100 kHz allowing you to check and service amplifiers and receivers claiming the finest specifications. Residual distortion is less than 0.03% and the meter is accurate to within 5% of full scale over five ranges. A built-in AC Voltmeter with full scale ranges from 1 mV to 300 VAC makes your THD measurements move even faster.

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TEST INSTR. RPT.

continued from page 46

cuit voltage is 2.5 volts

• *Once-a-year recalibration*– The Model 175 is designed to provide specified accuracies for at least a 12-month interval between recalibrations. In addition, each unit is shipped with an individualized test report of the initial calibration results on that particular instrument, certifying that it has been calibrated to standards established by the National Bureau of Standards (NBS). (Procedures for recalibration are detailed in the manual supplied with each unit.)

Accessories included in the $189 price tag of the Model 175 are: the battery recharger/line cord unit, the battery module, a set of test leads, two alligator clips, a vinyl carrying case and a spare fuse. Among the optional accessories available for use with the Model 175 are: A 40KVDC high-voltage probe ($45), a bench stand ($25), a rack mount ($45) and a leather carrying case ($19.50). ■

DC Current (No external shunts required)
Full-Scale

Range	Overrange	Resolution
±100.0µA	±199.9µA	0.1µA
±1.000mA	±1.999mA	1µA
±10.00mA	±19.99mA	10µA
±100.0mA	±199.9mA	100µA
±1000.mA	±1999.mA	1mA

Maximum Current: Series 2A fuse (250V)
Nominal Full-Scale Voltage across Shunts: 100mV
Accuracy: ±0.3% input ±1 l.s.d.

AC Current (No external shunts required)
Full-Scale

Range	Overrange	Resolution
100.0µA	199.9µA	0.1µA
1.000mA	1.999mA	1µA
10.00mA	19.99mA	10µA
100.0mA	199.9mA	100µA
1000.mA	1999.mA	1mA

Maximum Current: Series 2A fuse (250V)
Nominal Full Scale Voltage across Shunts: 100mV RMS
Accuracy: 30Hz: ±1.5% input ±5 l.s.d.
50Hz to 10kHz: ±0.75% input ±2 l.s.d.
at 50kHz: ±3.0% input ±2 l.s.d. (±5% on 100µA range)

RESISTANCE (HI & LO Excitation)
Full-Scale Nominal

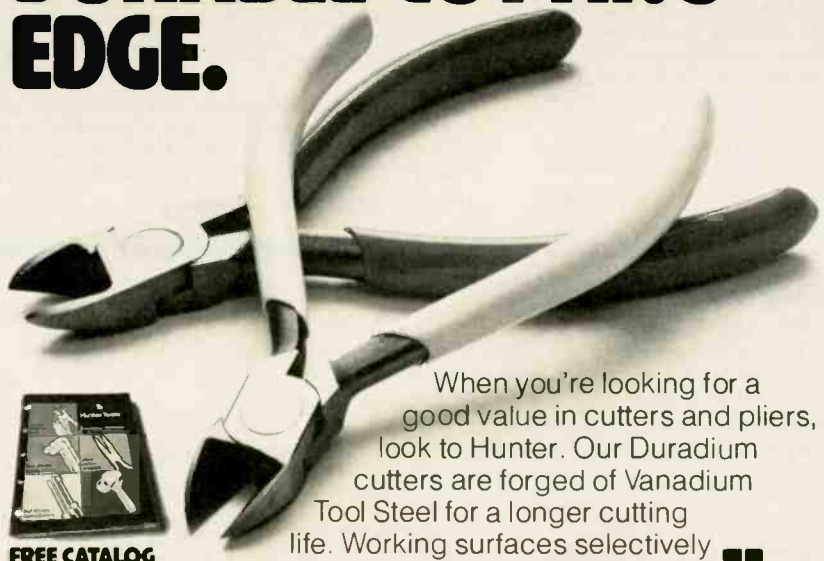
Range	Overrange	Resolution	Test Current
100.0Ω	199.9Ω	100mΩ	1mA/1mA
1.000kΩ	1.999kΩ	1Ω	1mA/200µA
10.00kΩ	19.99kΩ	10Ω	200µA/20µA
100.0kΩ	199.9kΩ	100Ω	20µA/2µA
1000.kΩ	1999.kΩ	1kΩ	2µA/200nA
10.00MΩ	19.99MΩ	10kΩ	200nA/20nA

(*Values show HI/LO test excitation.)

ACCURACY:
100.0Ω:
±0.2% Input ±2 l.s.d. + 100mΩ (HI)
±0.1% input ±1 l.s.d. + 100mΩ (LO)
1.000kΩ to 100.0kΩ:
±0.1% input ±1 l.s.d. (HI)
±0.2% input ±2 l.s.d. (LO)
1000.kΩ:
±0.1% input ±1 l.s.d. (HI)
±0.3% input ±2 l.s.d. (LO)
10.00MΩ:
±0.2% input ±1 l.s.d. (HI)
±1.0% input ±2 l.s.d. (LO)

Maximum Open-Circuit Voltage: 2.5V (HI), 300mV (LO)
Maximum Input Voltage: 250 Volts RMS AC or DC
*All accuracy specs apply for 1 year calibration period and 23°C +5°C
**Abbreviation "l.s.d." means "last significant digit"

CUTTERS WITH THE DURABLE CUTTING EDGE.



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NEW PRODUCTS

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

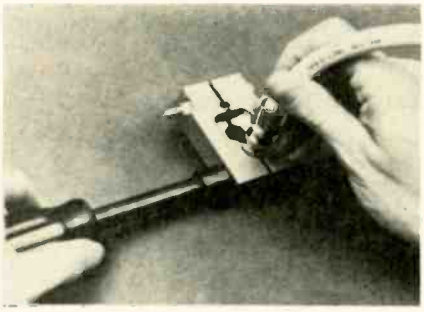
CB CASES 143

A new line of lightweight, molded cases for CB equipment and accessories is being introduced by *Platt Luggage*. The new cases are molded of

high density polyethylene with a double wall. The interior is of shock absorbent polyfoam. Two sizes are available and all feature a 5 year guarantee. Retails at $14.95 and $19.95.

INVISIBLE MARKING FOR EQUIPMENT 144

A new theft-deterrent marking system for CB radios and other electronic equipment is being introduced by the *Sanford Corporation*. It consists of a pen-type marker that applies invisible ink to the equipment, a crime-deterring emblem that warns that the property has been invisibly protected, and a procedural guide on how to use the system. In case of theft, the invisible marking identifies the owner when the item is placed under long-wave ultra-violet light, available at most police stations and other law enforcement agencies. The marking kit is available for $2.95 at many stationery, department and other stores.

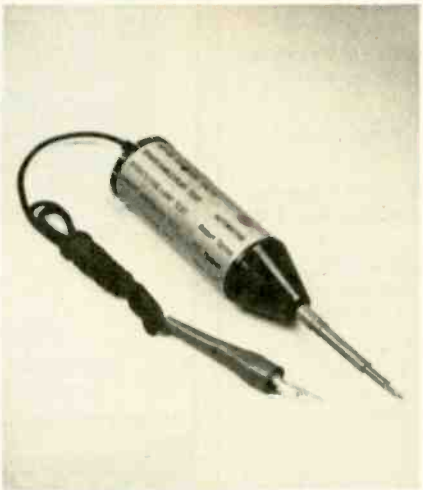


CB CONNECTOR CRIMPER 145

A new crimping tool designed for rapid, on-site attachment of a PL-259 connector with any standard antenna cable has been introduced by *Gold Line*. The new PL-259 Crimper generates high torque that compresses the connector to the cable in a tight, solder-free attachment that the manufacturer claims will withstand 40 lbs. or more of hanging weight. A standard nut driver or small hand wrench is used to open and close the Crimper's control bolts. The new tool is for use with RG-58U or RG-8U cables. Quarter-inch cables need UG-175 adapters for standard PL-259 use. Comes in kit form with filler pins to allow for tight crimping around the cable's center wire. Retails for less than $5.

AUTOMOTIVE CIRCUIT TESTER 146

Automotive coils, condensors, cables, spark plugs, fuses, regulators, alternators, and batteries can now be tested in-circuit without worry about contacting hot leads and wires with a new automotive circuit tester from *LEL Inc*. The new troubleshooting device, called Serviset Model E/A, is portable, self contained, and features a built-in spot light. Voltage ranges are 1.5 to 1.9 VDC and 60 to 120 VAC. Resistance ranges are 0 to 2000 ohms



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TE-338

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voltage protected, and resistance substitution 500 K and 600K ohms. It retails at $24.98.

CB REPLACEMENT SEMICONDUCTOR KIT 150

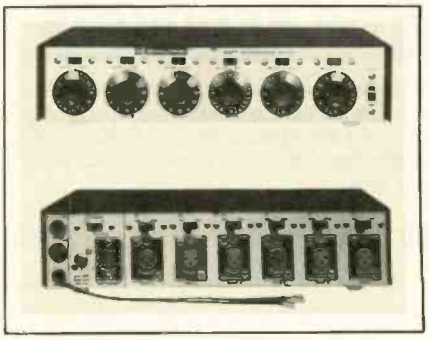
A new replacement semiconductor kit designed to meet CB radio service requirements has been introduced by *Raytheon*. The kit is packed in a 24-drawer cabinet and includes 34 different "RE" semiconductor types that are direct electrical and mechanical replacements for the 474 part numbers most used in CB equipment. The kit includes the latest CB replacement guide. Available now from Raytheon distributors for $76.

POWER SURGE ARRESTER 151

Electronic and electro-mechanical equipment can be protected from damage caused by power line voltage surges resulting from lightning, line disruptions and other causes by a new surge arrester introduced by *Wiltronics*. To operate, a grounded male plug on the new device is inserted into a standard wall outlet and the equipment to be protected is plugged into one of three female outlets on the device. The arrester is rated at surge currents up to 20,000 amperes.

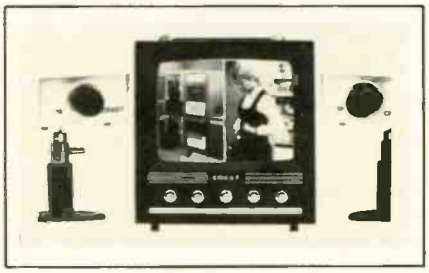
SOUND SYSTEM MIXER 152

A new add-on accessory microphone mixer that can add up to six additional low impedance, balanced microphone inputs to a sound system has been introduced by *Shure Brothers, Inc.* Named the Model M677, the new unit is designed as a "slave" mixer for such Shure products as the M67 and M68 series microphone mixers, the SE30 gated compressor/mixer, the M610 feedback controller and the M63 audio master. The new mixer can be powered either from the nominal 28 to 30 VDC output of the attached master mixer or from a battery power supply. Net price is $181.20.



SPLIT SCREEN SECURITY SYSTEM 153

Video images from two cameras can be viewed simultaneously on a single monitor screen in a vertical or horizontal split with a new video surveil-



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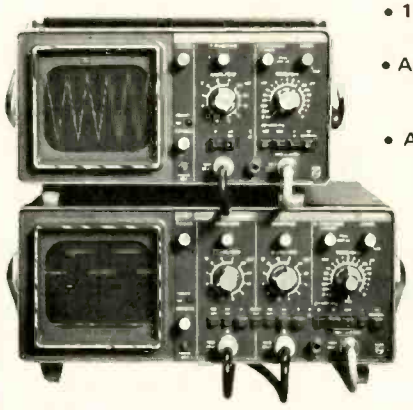
Two ways of taking a closer look



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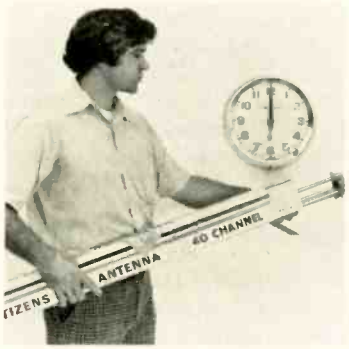

Slide antenna from box

Raise top radiator

Attach static wires

Tighten collar coupler, securing top radiator

Break the time barrier!

Channel Master's Golden Hawk assembles in less than 60 seconds...

When it comes to omni-directional base station antennas.....specify **Golden Hawk** from Channel Master! It's the fastest assembling antenna in its class. Sixty seconds from package to completely assembled antenna. And it's ready to go up.

Speed and power... Golden Hawk's winning Combination!

Pop Golden Hawk from its package....screw in a few parts....then open like an umbrella and it's ready for mounting. Fast and easy....a perfect assembly every time. But that's just part of Golden Hawk's great features: 5 dB gain over ground plane, 1.2:1 max. SWR, unlimited wattage capacity, tough gold EPC weather protective coating, made of quality aircraft aluminum with a heavy-stress aluminum support/terminal block, hurricane tested for durability and strength. All in a compact 16 ft. high center fed ½ wave dipole.

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Open like an umbrella....secure ground radials....fully extend bottom radials and tighten.....attach coaxial, slip onto mast and up she goes!

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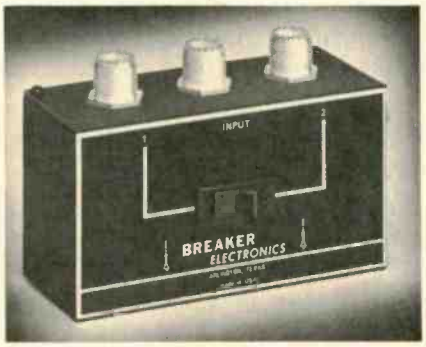
lance system introduced by *Crest Electronics*. The system also allows for a corner insert or a complete wipe of either camera. Called the Model SS707, it is completely self contained with no extra black boxes required. It includes two random interlace cameras and a nine inch monitor with a loop through system that allows for larger screen monitoring. Retails for $1250.

COAX ANTENNA SWITCH 154

A quick change-over from single to duals, or other CB antenna arrangements, can be now accomplished with a new coax antenna switch being introduced by the *Breaker Corporation*. The switch features a single SO-239 transceiver input connector and is switchable to either of two SO-239 antenna cable connectors. Designed for either mobile and base station usage, the Model 13-200 switch is said to eliminate tedious changes in transmission line connection and concern over proper impedance matching. Lists for $7.95.

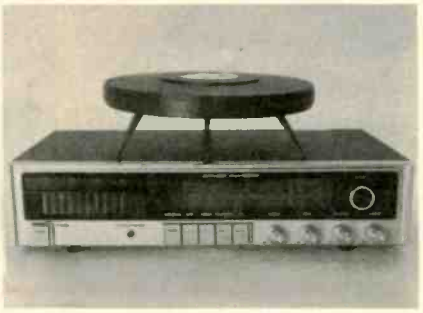


CB BASE STATION TRANSCEIVER 155

A new compact base station CB transceiver that features fail-safe circuitry is now available from *SBE*. The SBE-30CB "Trinidad II" can operate on either 117 VAC or 12 VDC and thus can be switched instantly from base station operation to a mobile application. The "fail-safe" circuitry automatically switches the unit from VAC to battery operation in the event of a power failure. The new unit is less than ten inches wide, five inches high and nine inches deep, and offers synthesized frequency control of all 23 CB channels. It has a tilt-up control panel, back-lighted channel identification numbers and an illuminated dual-purpose meter that indicates both power output and incoming signal strength.

ELECTRONIC FM/STEREO ANTENNA 156

A new miniature FM antenna that helps receive clearer FM audio, better FM stereo separation, higher signal-to-noise ration, and less distortion and interference has been introduced by *JFD Electronics Corporation*. The FM500 antenna utilizes an omni-directional condensed dipole element for better reception from all directions. Its balanced output is fed directly into a solid state RF amplifier that provides 8 dB average gain over a stan-



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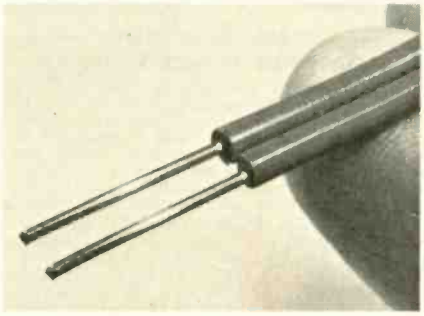
dard reference folded dipole—plus a noise figure of less than 4 dB. Includes antenna, power supply, 10-ft. coaxial cable and mounting hardware. It lists for $51.95.



BURGLAR ALARM CABLE 157

A new two-conductor cable for burglar, fire, smoke detection and other alarm systems is being introduced by the *Belden Corporation*. The new cable features solid copper conductors for rigidity and a tough, abrasion-resistant 105° C vinyl plastic insulation that is color-coded for easy identification. Conductors are 19 ga. copper with one tinned for termination identification. Insulation wall thickness is 30 mils. It is UL-listed under both "Low Energy Circuit Cable" and "Limited Energy Inside Wiring" classifications.

MODULES

continued from page 43

ter than that of the original factory module.

Every module to be remanufactured by RCA goes through the following processes:

1) Each module is inspected for physical damage, appearance, correct parts, copper pattern stability, damaged contacts, resin joints, cold solder joints, and shorts. Any modules that cannot pass this initial inspection and which cannot be corrected to like-new status are scrapped.

2) Specific design updates involving replacements of parts are then made to bring the module up to latest specifications for performance and reliability.

3) Each module is checked for critical lead dress and brought to specifications.

4) Each module is subjected to environmental testing (hot test and cold test) simulating extreme conditions of temperature. This important test minimizes the possibilities of intermittent performance and technician callbacks

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3AU6	6BN6	6GJ7	12AX7
3BU8	6BQ5	6GW8	12BE6
3CB6	6BQ7	6HA5	12BH7
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3GK5	6BZ6	6J6A	12L6
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5AT8	6CG7	6LE8	17JZ8
5GJ7	6CG8	6LM8	21LR8
5U4GB	6CJ3	6SL7	24LQ6
6AB4	6CM7	6SN7	33GY7
6AC7	6CU8	6X8	35W4
6AF4	6DQ6	6Z10	50C5
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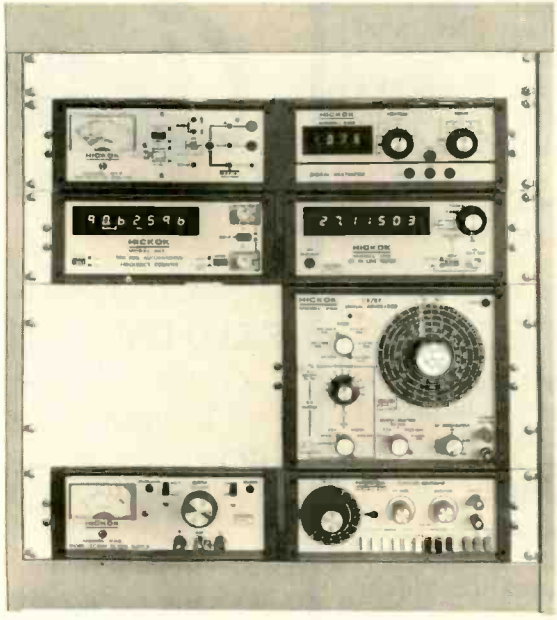
Make working on CB's easier with the CommLine from Hickok.



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e) Model 388X Pro CB In-Line Tester. **$475**
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after the module is installed in the customer's set.

5) Each module is subjected to a vibration test to simulate the rigors of shipping and to uncover intermittents.

6) Alignment (where applicable) is made on each module in accordance with current specifications to insure the best performance. Included are all IF and chroma sweep alignment and calibration adjustments, and setting of all circuit board pots and adjustments.

7) After inspection, test, repair, and alignment, the Quality Control Engineering department random samples each production lot.

8) If any of these random samples do not pass quality control tests, the entire module lot is rejected and rerun through the complete remanufacturing cycle.

9) Each module has date-code labels applied.

10) All modules then are individually packaged in RCA boxes and identified with their part number and place of original manufacture, and labeled as "remanufactured". They are then placed into RCA's inventory of exact replacement parts, where they carry the same warranty as all other replacement parts.

RCA emphasizes that these are much more than reconditioned modules. The amount of remanufacturing on a particular module varies with the number of technological changes that have occurred. This is best illustrated by citing two examples:

1) One module, a Pix/IF/AFT unit used in XL-100 sets, undergoes 20 circuit and component improvements.

2) Another module, a Video/Sync unit, receives seven improvements.

RCA spokesmen say, "We believe our Module Remanufacturing program is the most reliable answer to the long-range need for quality replacement modules at reasonable prices."■

PINCHUSHIONING

continued from page 41

jumper-wire method should *not* be used when the main element of the correction circuit is in *parallel* with the yoke or the flyback transformer. If a short is placed across an element which is in parallel

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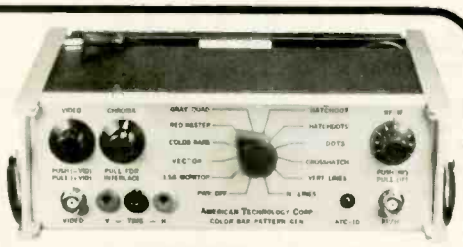
with the sweep system, the sweep output system will be damaged by overloading.

Troubleshooting an active pincushion modulator is identical to troubleshooting any other transistor-equipped amplifier circuit. Waveform observation together with voltage and resistance measurements should solve most troubles.

Certain troubles originating in the pincushion circuit or related sections can be particularly difficult to isolate. Examples are: 1) Vertical white bars or foldover on the left side of the raster, which can be caused by an open damping resistor across the horizontal controlled windings, if one is used; 2) a "hook-like" raster distortion at the top of the screen, which is caused by the magnetic interaction between the pincushion transformer and the horizontal oscillator coil and; 3) a cracked pincushion transformer frame, which might produce high-frequency squeal similar to that caused by a loosely mounted flyback transformer. Fortunately, these "odd" symptoms do not occur very often. ■

the Money Generator



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ADVERTISER'S INDEX

101 American Technology Corp. . .55
127 Antenna Corp. of America 54
103 Astatic Corp. 21
135 Blonder-Tongue Labs. Inc. . . .15
105 Channel Master 51
106 Charous & Niebergall, Inc. . . .48
142 Dana Labs. Inc. 57
107 Eico Electronic Instruments Co. 10
147 Electronic Book Club 16-19
108 Elenco Electronics, Inc. 58
109 Elin Mfg. Co. 55
110 Enterprise Development Corp. 58
111 Fluke Mfg., John 5
112 Fordham Radio Supply Co., Inc. 58
113 General Electric Co., TV Business Div. 35
General Electric Co., Tube Div. 33
GTE Sylvania, Consumer Renewal . . .Cover 3, 3
114 Heath Co., The 47
115 Heath Co., The 49
116 Hewlett-Packard 13
117 Hickok Electrical Inst. Co. 53
118 Hufco 52
119 Hunter Tools 48
120 Mallory Distributor Products Co. 9
Motorola Semiconductor Products, Inc. 27
122 Mountain West Alarm Supply Co. 50
123 Nationwide 53
124 Perma-Power Co. 14
125 Philips Test & Measuring Inst. (for information) 50
126 Philips Test & Measuring Inst. (for demonstration) 50
102 PTS Electronics, Inc. . . . . .Cover 2, 1
128 Qualitone Industries, Inc. 58
129 RCA-Outdoor Antennas . . .22, 23
130 RCA-Picture Tube Distributor 28, 29
131 RCA-Semiconductors 36, 37
132 RMS Electronics, Inc. 52
133 Sencore, Inc. 40, 41
Sprague Products Co. 31
Supreme Publications 54
134 Techni-Tool, Inc. 50
104 Triplett Corp. . . . . .Cover 4
136 Tuner Service Corp. 7
137 T & T Sales Co. 54
138 Ungar, Div. of Eldon Ind. 11
139 VIZ Mfg. Co. 55
140 Winegard Co. 39
Zenith Radio Corp. 24, 25

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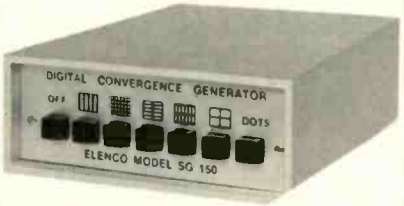

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ELECTRONIC TECHNICIAN/DEALER

TEKFAX

COMPLETE MANUFACTURER S' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS

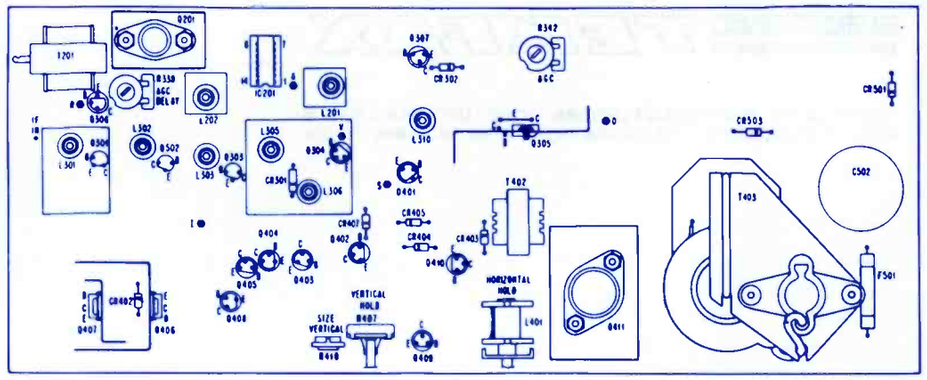
GROUP 289

	SCHEMATIC NO.
AIRLINE ..... B/W TV Chassis T20K8-1B, -2B	1657
GENERAL ELECTRIC ..... Color TV Chassis YC-2	1658
GENERAL ELECTRIC ..... B/W TV Chassis XB	1661
ZENITH ..... Color TV Chassis 13HC10, Z1	1659
ZENITH ..... Color TV Chassis 23HC50Z	1660

1657

AIRLINE
B/W TV Chassis
T20K8-1B, -2B

SEPTEMBER • 1976



Top View of Chassis Showing Alignment Locations and Test Points

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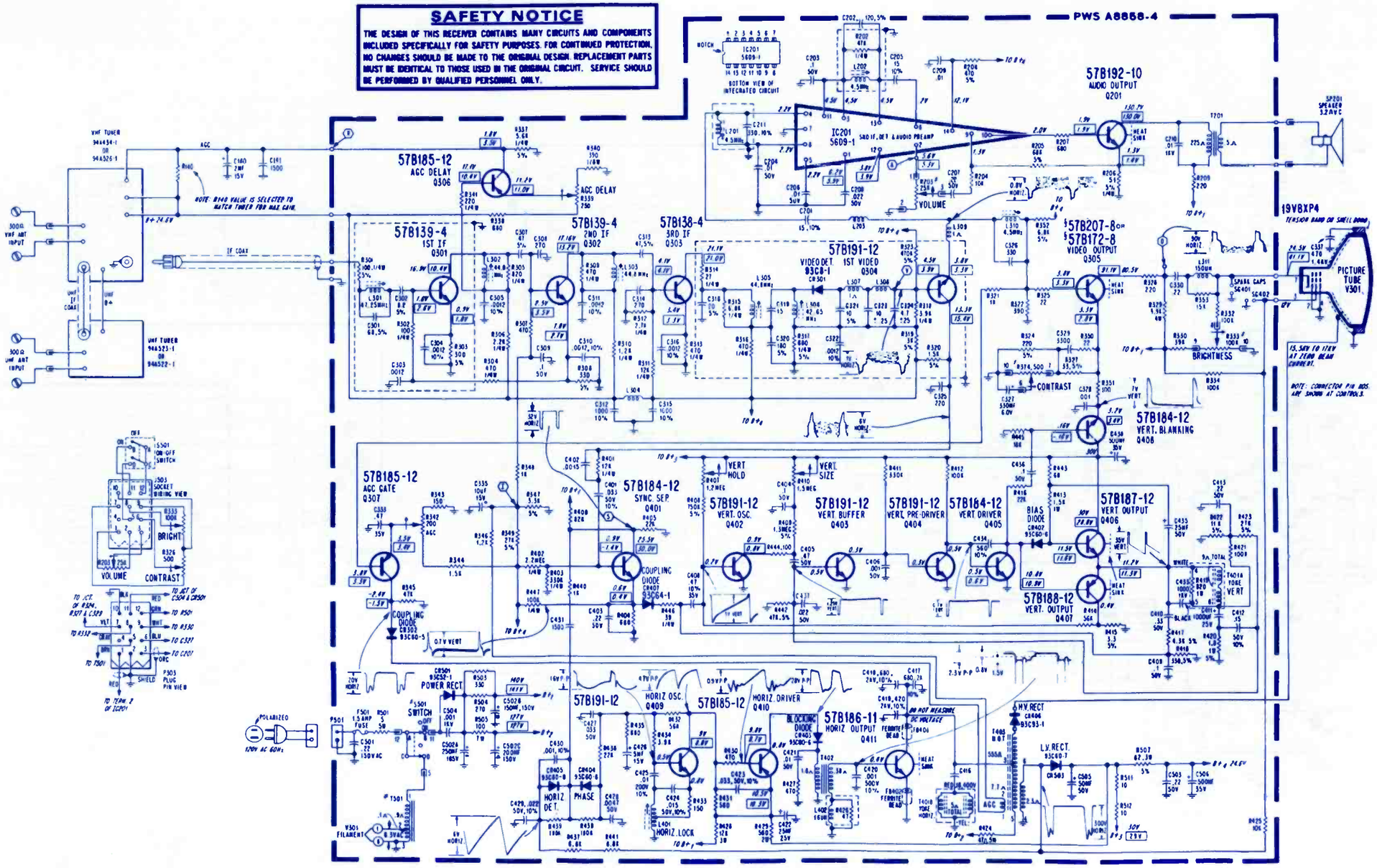
THE DESIGN OF THIS RECEIVER CONTAINS MANY CIRCUITS AND COMPONENTS INCLUDED SPECIFICALLY FOR SAFETY PURPOSES. FOR CONTINUED PROTECTION, NO CHANGES SHOULD BE MADE TO THE ORIGINAL DESIGN. REPLACEMENT PARTS MUST BE IDENTICAL TO THOSE USED IN THE ORIGINAL CIRCUIT. SERVICE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY.



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1658
GENERAL ELECTRIC
Color TV Chassis
YC-2

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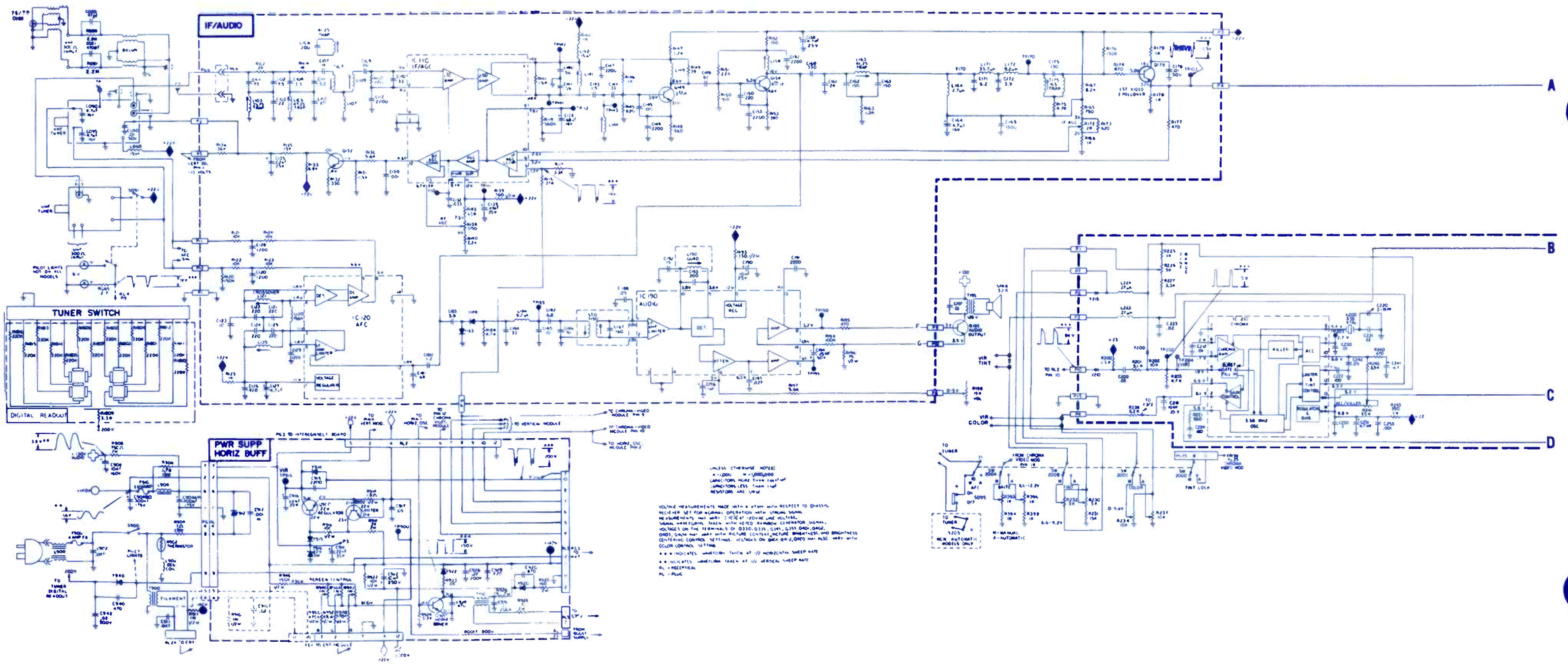
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS



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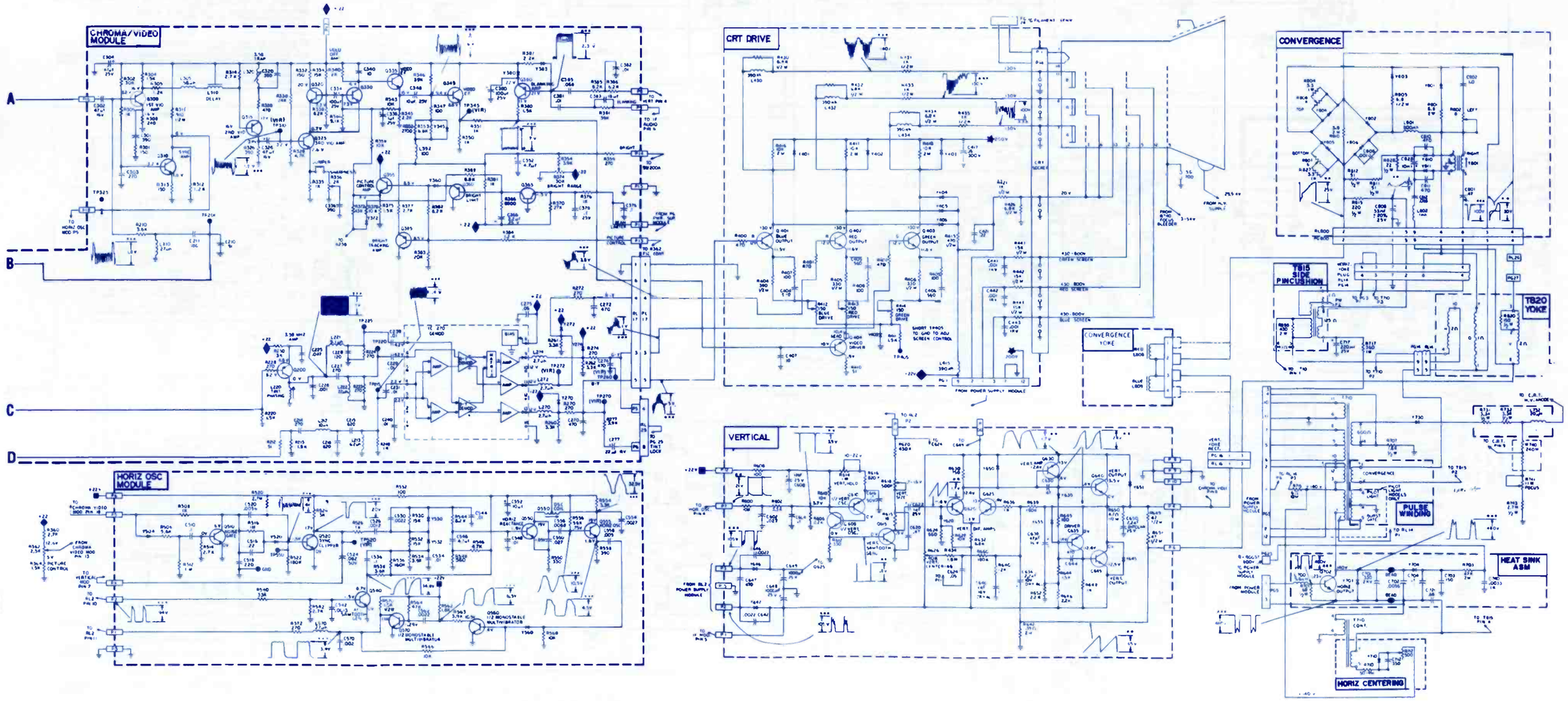
GENERAL ELECTRIC
Color TV Chassis
YC-2



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1659

ZENITH
Color TV Chassis
13HC10, Z1

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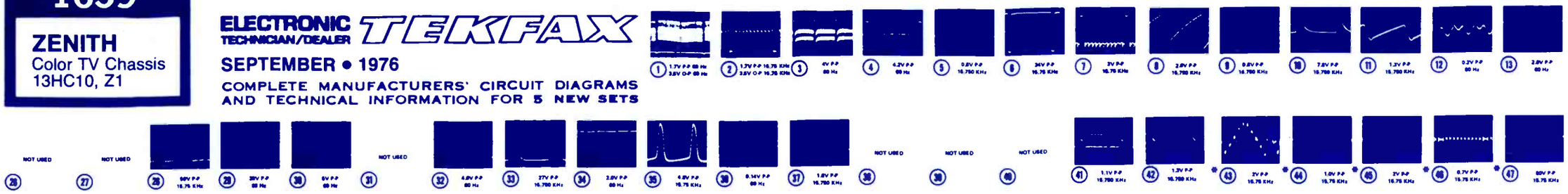

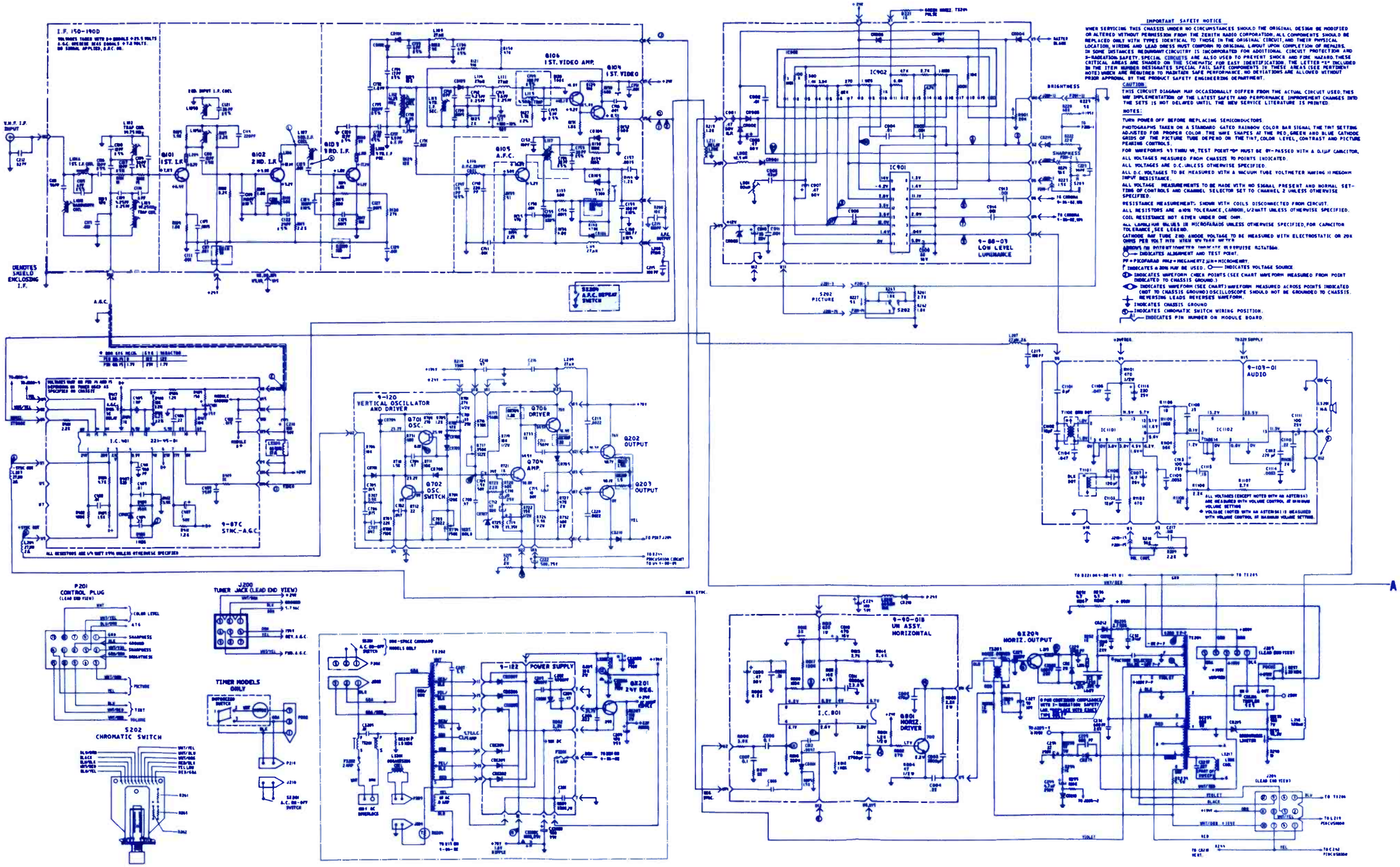

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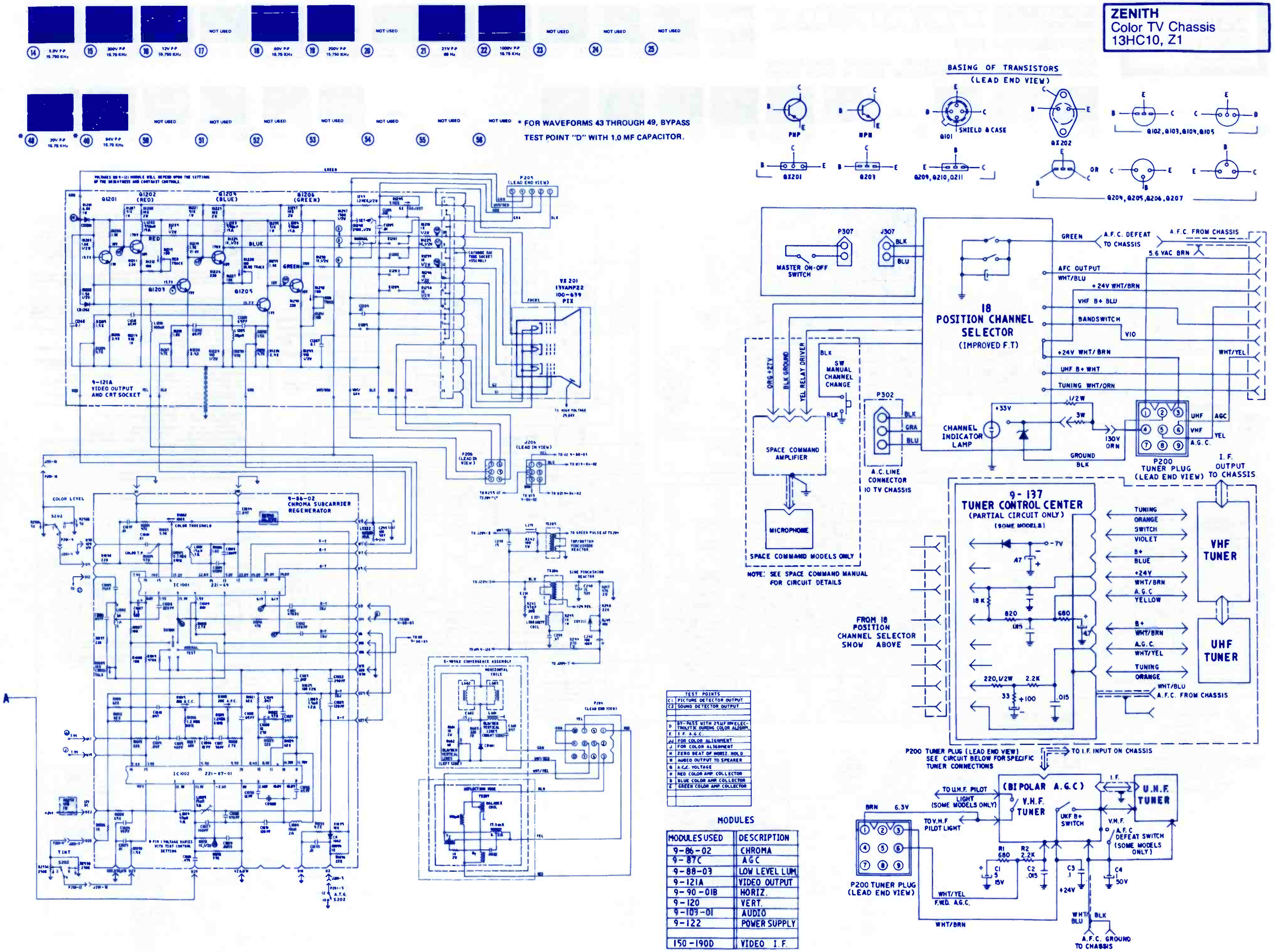
ZENITH
Color TV Chassis
13HC10, Z1



TEST POINTS	
C1	PICTURE DETECTOR OUTPUT
C2	SOUND DETECTOR OUTPUT
D	BY-PASS WITH 25µF ELEC-TROLYTIC DURING COLOR ALIGNM.
F	I.F. A.G.C.
JJ	FOR COLOR ALIGNMENT
J	FOR COLOR ALIGNMENT
H	ZERO BEAT OF HORIZ. HOLD
N	AUDIO OUTPUT TO SPEAKER
G	A.G.C. VOLTAGE
R	RED COLOR AMP COLLECTOR
B	BLUE COLOR AMP. COLLECTOR
G	GREEN COLOR AMP. COLLECTOR

MODULES

MODULES USED	DESCRIPTION
9-86-02	CHROMA
9-87C	AGC
9-88-03	LOW LEVEL LUM
9-121A	VIDEO OUTPUT
9-90-01B	HORIZ.
9-120	VERT.
9-103-01	AUDIO
9-122	POWER SUPPLY
150-190D	VIDEO I.F.

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1660

ZENITH
Color TV Chassis
23HC50Z

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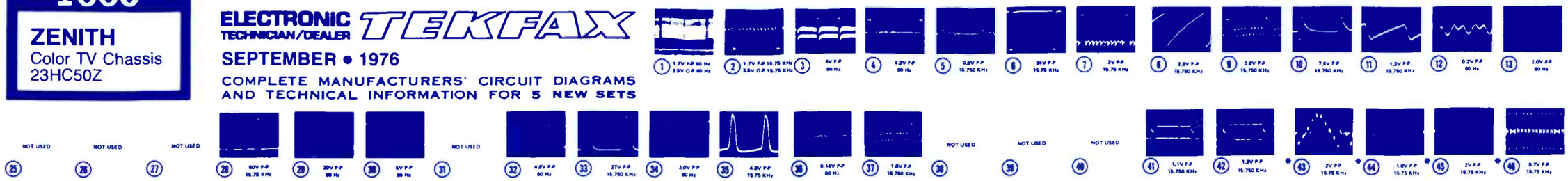

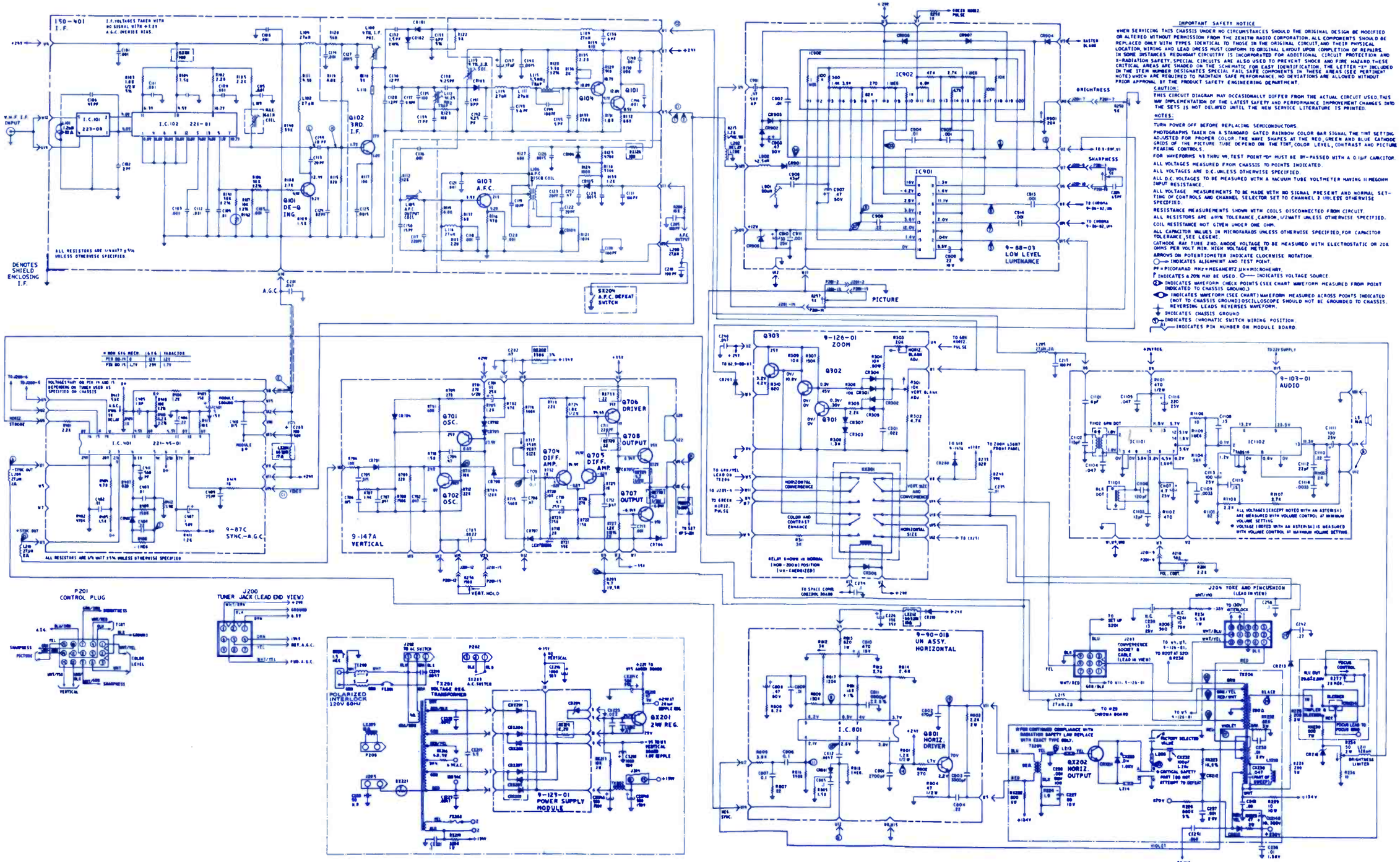

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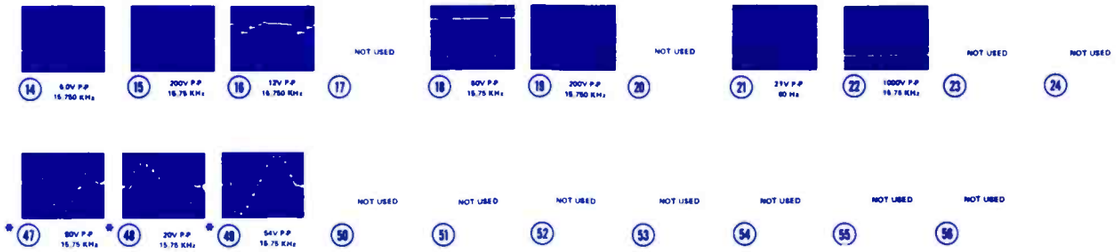
Color TV Chassis
23HC50Z

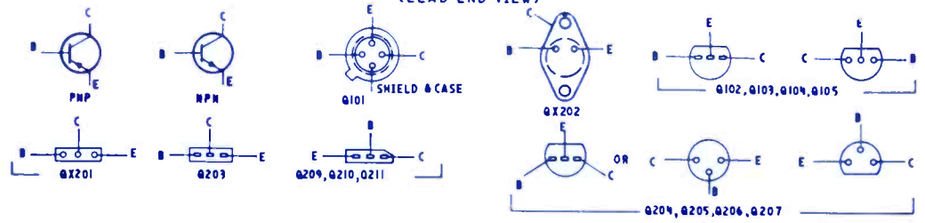


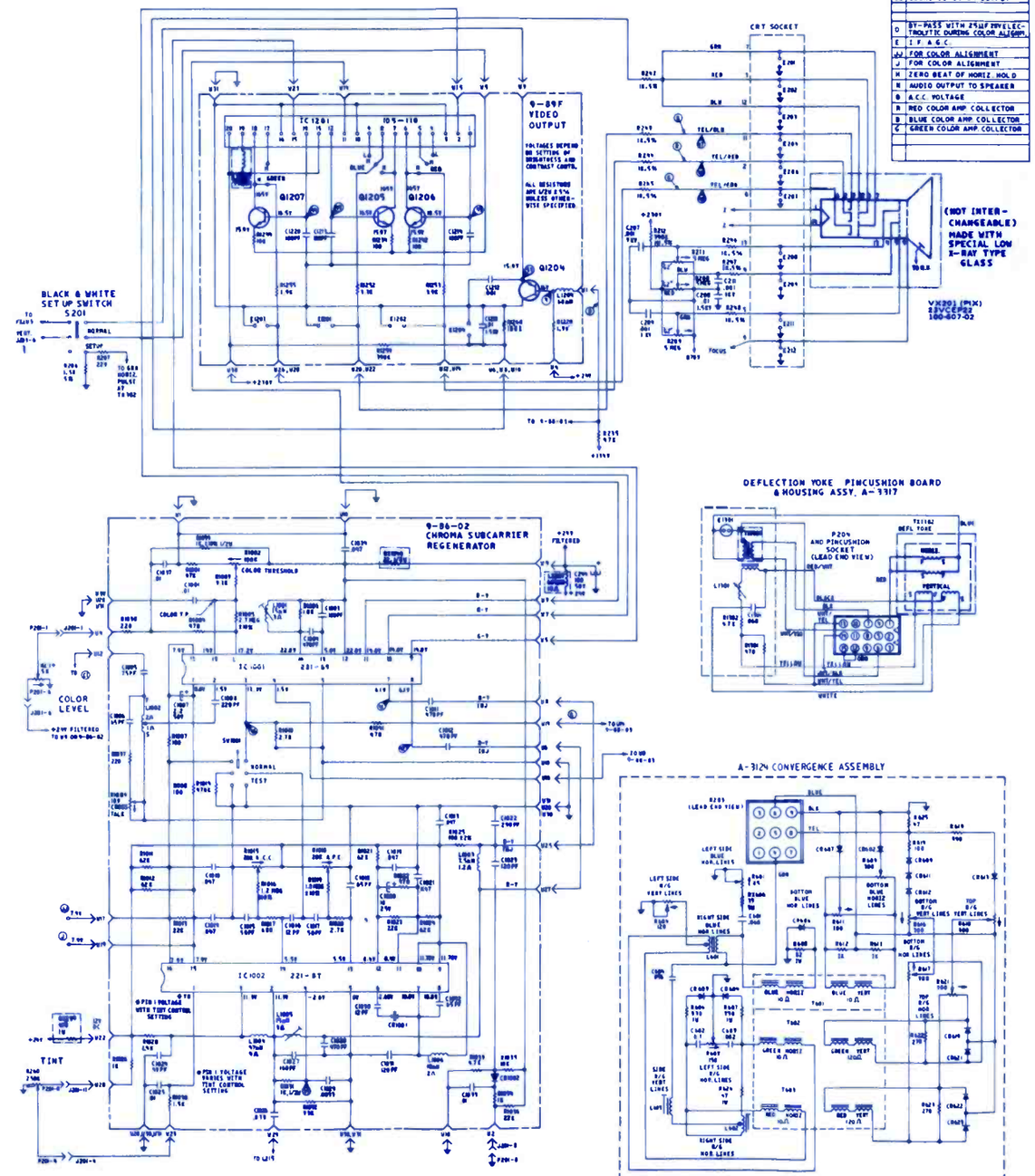
* FOR WAVEFORMS 43 THROUGH 49, BYPASS TEST POINT "D" WITH 1.0 MF CAPACITOR.

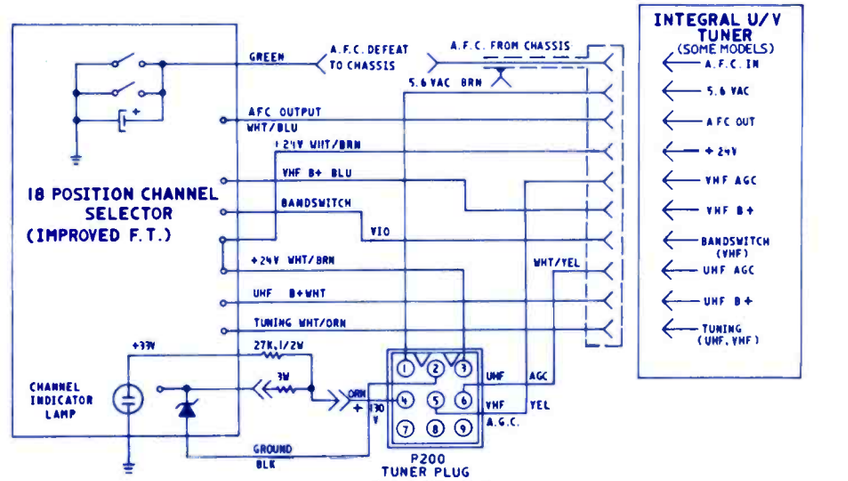
MODULES

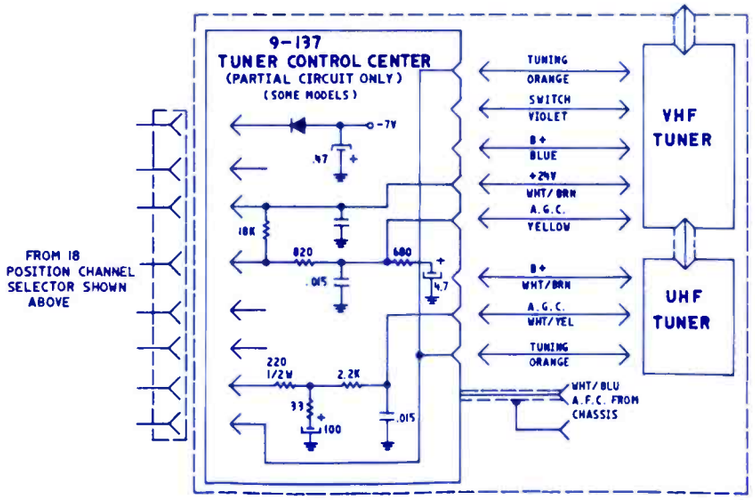
MODULES USED	ALTERNATES	DESCRIPTION
9-86-02		CHROMA
9-87C	9-87, -87A	AGC
9-88-03		LOW LEVEL LUM
9-89F	9-89E, -89-01C	VIDEO OUTPUT
9-90-01B		HORIZ
9-147A	9-147, -92B, -92C	VERT
9-103-01		AUDIO
9-123-01		POWER SUPPLY
9-126-01		ZOOM
150-401		VIDEO I.F.

BASING OF TRANSISTORS
(LEAD END VIEW)









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1661
GENERAL ELECTRIC
B/W TV XB

SEPTEMBER • 1976

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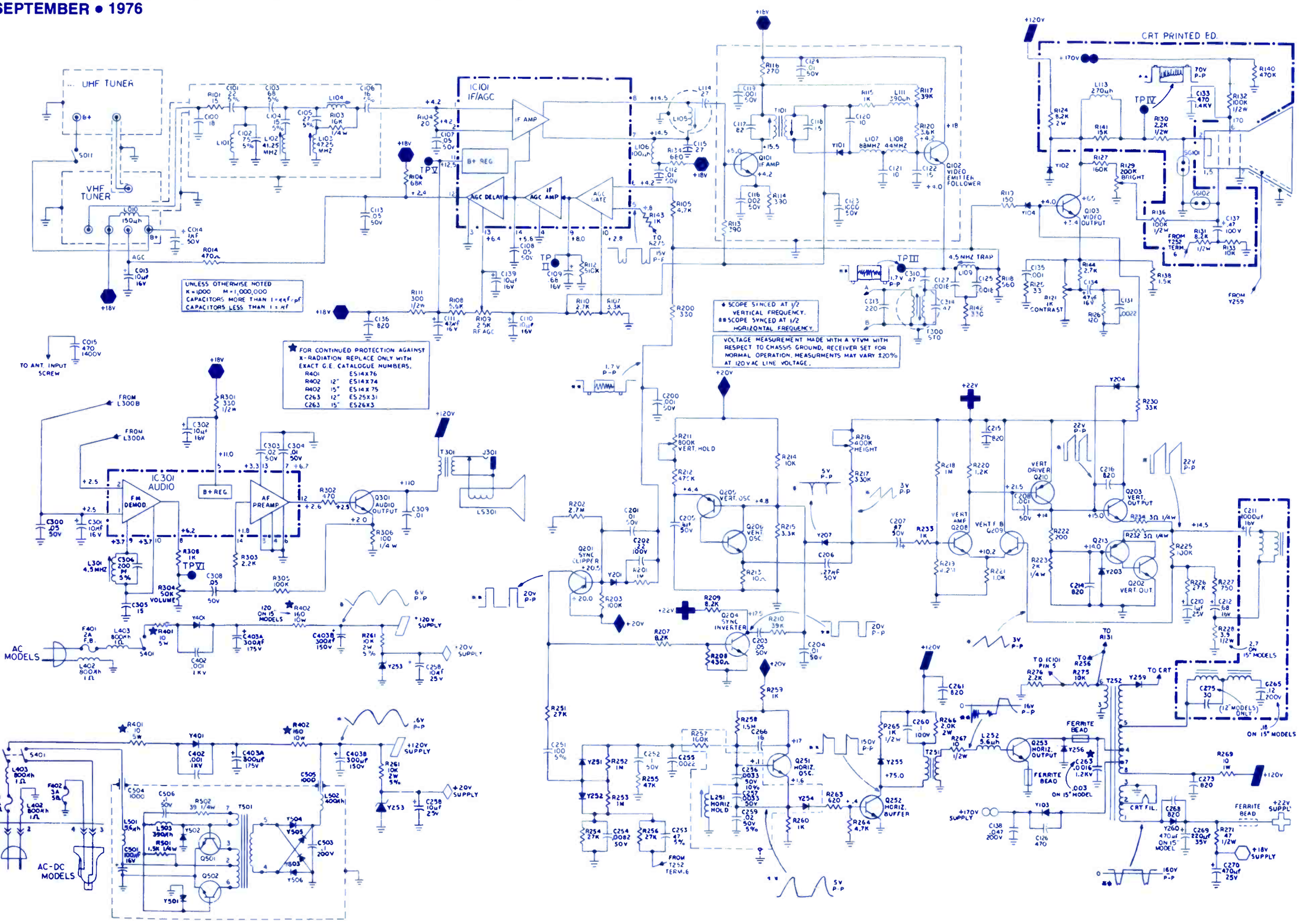
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS



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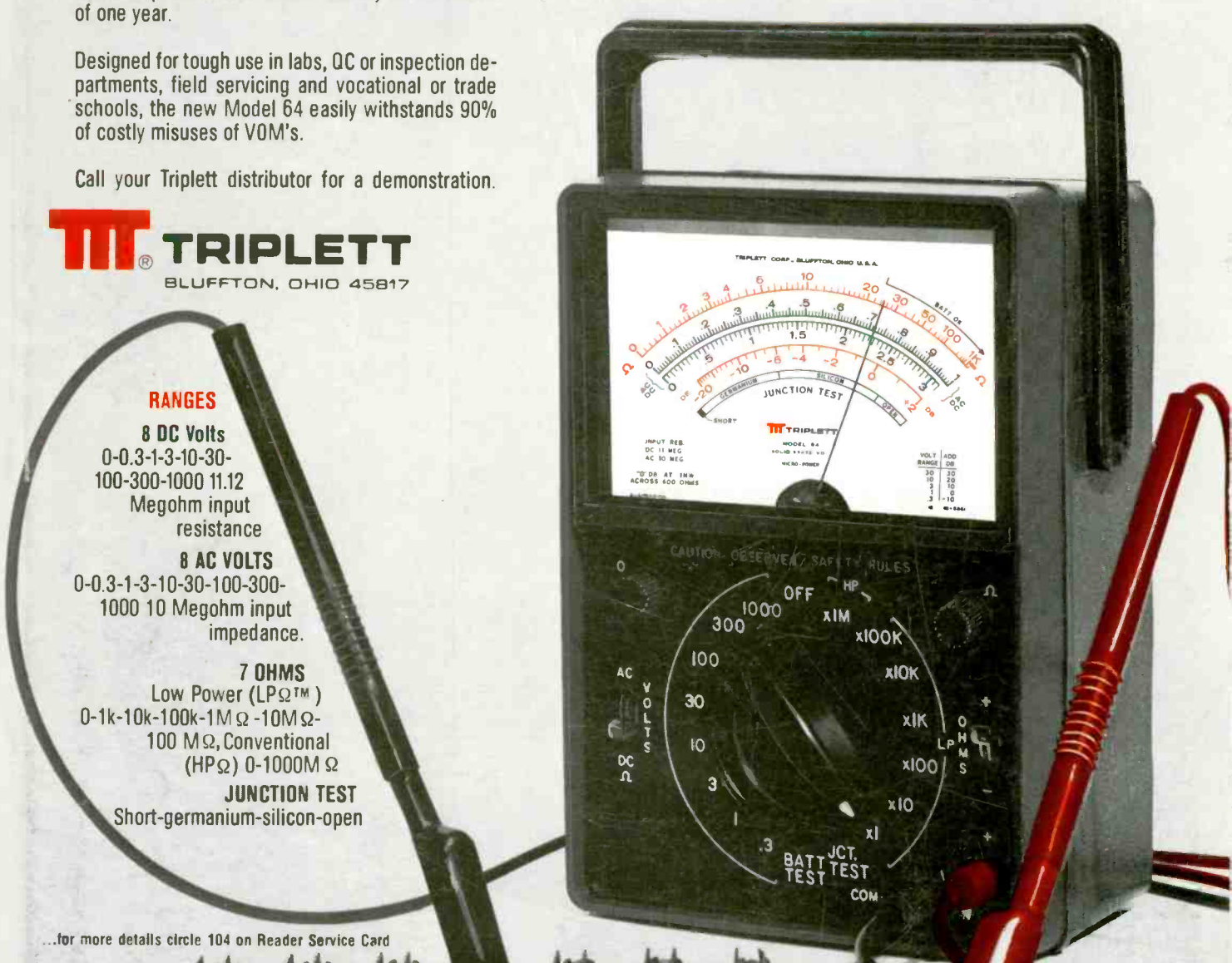

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