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ELECTRONIC TECHNICIAN/DEALER

WORLD'S LARGEST TV-RADIO SERVICE & SALES CIRCULATION

TROUBLESHOOTING:

Synchronous Diode Chroma Demods

Horizontal Deflection & High Voltage

ELECTRONIC
TECHNICIAN/DEALER

FEBRUARY 1975 • VOLUME 97 NUMBER 2

THE COVER: Close-up photo which shows how the electron gun of a color TV picture tube is sealed into the neck of the tube during manufacture. *Courtesy of GTE Sylvania.*

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PUBLISHER'S MEMO

Discussing important industry event, NEWCOM '75, while attending AEM National Convention in Miami were (l-r) Al Menegus, Publisher, ELECTRONIC TECHNICIAN/DEALER; Tom Greney, ET/D Publishing Director and Vice President, Harcourt Brace Jovanovich Publications; David L. Fisher, Executive Director, DPD/EIA Central Region; and Kenneth C. Prince, Executive Vice President, Electronic Industry Show Corporation.

MANUFACTURERS GEAR UP FOR 1975

■ At the National Convention of the Association of Electronic Manufacturers (AEM), held in Miami, Fla., last November, the distributors gathered there heard of some important developments in the electronics industry which should be of considerable interest to the thousands of readers of ELECTRONIC TECHNICIAN/DEALER.

The merger of the AEM with the Distributor Products Division (DPD) of the Electronic Industries Association (EIA) was consummated at this last convention of the manufacturers' group. In his comments after the merger signing, EIA President V. J. Adduci noted that "we have greatly strengthened our force, not only to serve electronic distribution, but also to help our industry meet its biggest challenge: to realize the vast potential for growth which our technology gives us."

R. W. Woodbury, President, Sprague Products Company, has been elected to serve as the Division's chairman this year. Arthur F. Kelly, Jr., General Manager, Amperex Electronic Corp., and Herb Bowden, President, Sencore, Inc., are the newly elected vice chairmen of the DPD/EIA. The merger provides a strong base and effective representation in Washington, D.C., for the electronic manufacturers whose equipment and components the professional electronic technician and service dealer purchase as the end user. With such a strong and unified front, the DPD/EIA will meet the challenge of the times and help our industry back to a sound economy.

Presiding at the business sessions were Frank Vendely, General Sales Manager, Mallory Distributor Products Company, and Al Eisenberg of the Microtran Co.

Bud Mowrey of RCA Electronic Components was the keynote speaker at this convention. Executives of the manufacturers who spoke at this meeting were Herb Bowden, Sencore, Inc.; Al Roth, Arco; Ed Kason, Amphenol; Art Kelly, Amperex; Glenn Ronk, Sola; Howard Saltzman, Alpha Wire; Herb Taylor, Clarostat; and Roy Vetzner, Vaco.

Distributors who spoke at the convention included Jim McGowan, Kierulff; Tim Cronin, Cramer; Pete Heller, Pioneer-Standard; Jack Darcy, Arrow; Al Cowles, Jr., Bluff City Distributing and President of the NEDA; Manny Grossman, Ohm; Joel Girsky, Jaco; and Tony Hamilton, Hamilton-Avnet. Gene Foster and Bud Moulthrop discussed manufacturer-sales rep relationships.

Drawings were made of the exhibit areas for the vital industry show, NEWCOM '75, to be held May 6-7-8 in Las Vegas. Theme of this big show is the "World Series of Electronic Distribution." Indications are that this will be the largest show ever. According to some economic forecasts, the nation's business climate will begin to show signs of considerable improvement just about mid-May when this show is held.

After attending this convention and speaking to all concerned with the future of our industry, I am sure the manufacturers, sales reps, distributors and large dealers have a great combination of skill, experience and talent to bring about an impressive turnaround in the economy where our industry is involved. ■

LETTERS

"Bugged TV" Exposes

Exposing servicing malpractices by "bugging" TV receivers *might* be excellent advertising for the service technicians who have been *proven* honest by this method. Such exposes *might* build public confidence in the service technicians who have been *proven* honest by the expose. But how about the thousands of other technicians who were *not* involved in the expose and, consequently, did not have the *opportunity* to *prove* that they *also* are honest? . . .

In my opinion, the public wants to know who the "*good* guys" are. They are tired of reading about only the "*bad* guys."

The type of expose that "puts down" a service industry is, in my opinion, pornographic. It appeals only to morbid and prurient interests. Healthy people merely want to know who is a reasonably honest repairman. For example, from the viewpoint of a consumer, I don't want to be told only that I stand a certain chance of being cheated by an automotive mechanic. I want to know the *names* of the *honest* mechanics. I don't need to be told that there are some crooks in all types of servicing; I already know that. . . .

Perhaps *incompetence* is the real villain. A competent technician can earn a living without knowingly or unknowingly cheating. . . .

EDWARD H. SAMPLE
Waimanalo, Hawaii

Precisely what effect "bugged TV" exposes have had on the public's image of the TV service business is, in my opinion, difficult to assess.

Those who support such exposes tell us that their purpose is to eliminate unethical and incompetent servicers by exposing them to the public and, in some cases, to the local law enforcement authorities. They tell us that public reaction to such exposes is favorable to TV service businesses because the public is grateful to and less suspicious of an industry which attempts to police itself. They also tell us that such exposes serve as an effective warning to other servicers in their area to either "shape up or ship out."

Those who are opposed to "bugged TV" exposes argue that such exposes merely draw public attention to the undesirables in the business and, by doing so, give all servicers an unfavorable public image as a result of "guilt by association." The opponents of exposes also point out that some of the planners and executers of such exposes are more interested in the publicity they receive than in actually ridding the business of undesirables.

In my opinion, TV servicers and service associations should handle known or suspected cases of unethical business practices and/or incompetent servicing by alerting and cooperating with existing law enforcement, judicial and consumer protection agencies. If needed laws and agencies do not exist, TV servicers and service associations then should "encourage" their local and state legislative bodies to introduce and pass the required laws and establish whatever agencies are needed to enforce the laws effectively. Publicity gained from these types of activities will probably be more positive and fairer and more favorable to all service technicians than the negative approach of "bugged TV" exposes.—The Editor.

Module Availability

For years, many TV manufacturers have failed to realize that service technicians *must* be able to go to their local distributor, get the required replacement part and repair the set in the same day (or at least within two or three days). . . .

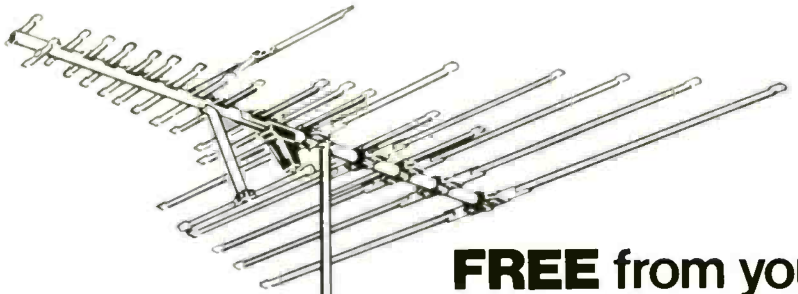
Now we have a new parts availability dilemma: modules. Most technicians cannot afford to tie up the capital required to maintain an inventory of modules for all brands of modular TV chassis . . . and the theory that technicians can solve this problem by specializing in a few brands is unrealistic.

I predict that any TV manufacturer who sells modular receivers without assuring that the modules are immediately available to servicers from *local* distributors is doomed. The public is already annoyed about the higher services charges for new sets, and to have to wait weeks while a needed module is being shipped either from the manufacturer or from the manufacturer's distributor to their service technician's local distributor is more than increasing numbers of consumers can tolerate.

Technician kits which contain *one* of each of the modules required for a particular chassis or brand of chassis are not realistic either (although they are better than no kits at all). I have too often used one module out of such a kit in the morning and needed the same module in the afternoon or the next day but, of course, was unable to obtain the module to restock the kit.

MAX GOODSTEIN
Flushing, N.Y.

This needed to be said, and you've said it.—The Editor. ■



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New "BIZ BOOMER UPPER KIT" gives you 15 ways to put more ring in your register... more profit in your picture in '75.

Antenna sales slipping? Profits sliding? We can give you some timely, tested, proved effective help. A special Biz Boomer-Upper Kit with 15 sales-getter ideas and the materials you need to put 'em in action.

The kit's yours at no cost from your Winegard distributor. Designed so that *together* you can launch a planned program to sell replacements for all those tired old weather-beaten or damaged antennas on homes in your area.

In today's competitive climate, this could be the extra promotion power you need to push profits up to—or ahead of last year's. Definitely, an offer you shouldn't refuse.

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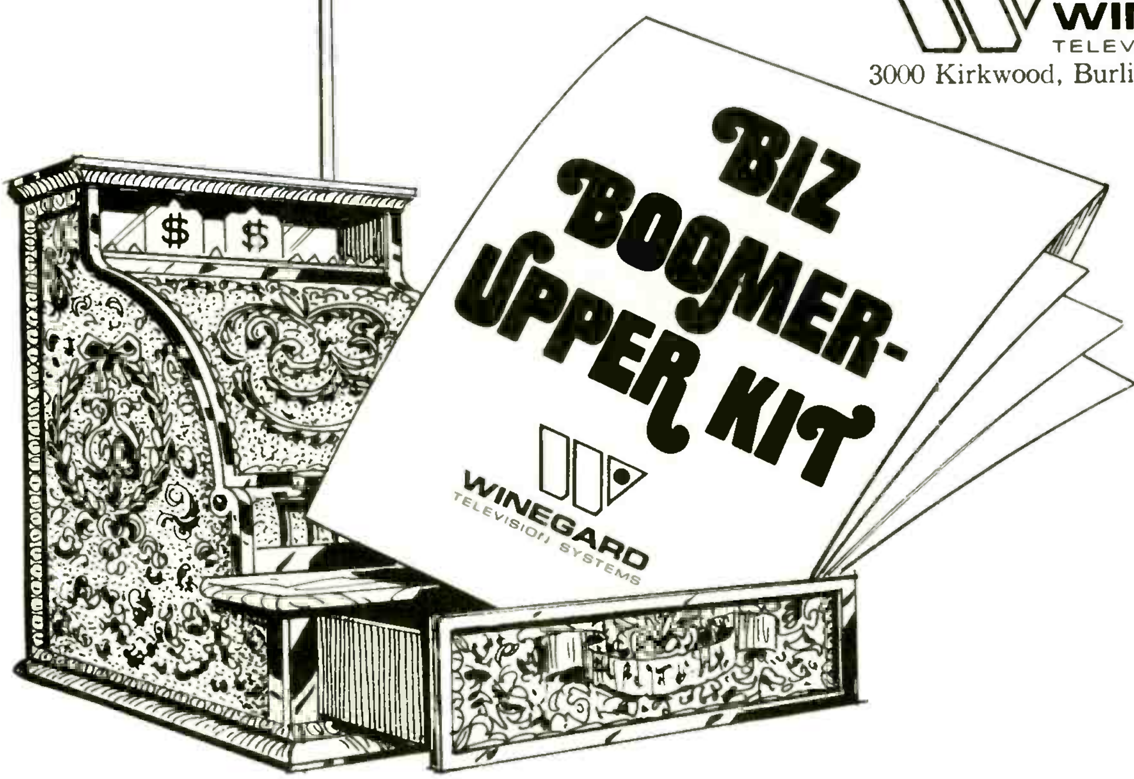

NEWS OF THE INDUSTRY

Magnavox Recalls Six Monochrome TV Models

The Magnavox Consumer Electronics Company has instructed all dealers and service personnel to stop the sale and delivery of the following models of Magnavox 19-inch (diagonal) black-and-white portable TV receivers:

ME5140	MD5140
ME5141	MD5141
ME5142	MD5142

Magnavox has issued the recall because of the possibility that these models have an intermittent or loose connection which can cause "an electrical arc and create the possibility of an ignition of the cabinet."

The company has advised owners of these sets to immediately unplug them and return them to their Magnavox dealer for free repair.

The six models were manufactured between late April, 1974 and October 14, 1974.

RCA Increases Prices of B-W and Color TV Replacement Picture Tubes

Price increases averaging three to ten percent have been announced by RCA Electronic Components for its black-and-white and color TV replacement picture tubes. The increases were effective December 15, 1974.

Price increases for specific RCA replacement picture tube products are: RCA HI-LITE color tubes, about five percent; RCA Colorama "A" color tubes, about ten percent; RCA Colorama regunned color tubes, about three and one-half to five percent; and RCA black-and-white tubes, about three to five percent, with larger increases for some types.

RCA Scientists Use New Liquid Crystal Technique to View Electron Flow Through ICs

RCA scientists have developed a simple technique for observing electron pulses flowing through integrated circuits (ICs), much as a biologist studies living cells under a microscope.

The new technique employs liquid crystals similar to those used for readouts in electronic watches and is valuable in pinpointing faults in integrated circuits, according to Dr. George C. Cody, Director of the RCA Physical Electronics Research Laboratory here.

With the new RCA technique, scientists can watch the electron pulses flow through an IC and can locate operational defects by observing where the electron flow is interrupted. This is made possible by the fact that the normally clear liquid crystal reflects or refracts light when "stimulated" by electricity.

Engineers at RCA's Solid-State Division have used the new liquid crystal technique to locate the exact points of design and fabrication failures as well as to uncover other faults in ICs manufactured or under design tests by RCA.

The new non-destructive technique was developed at RCA Laboratories by Dr. Donald J. Channin and Gerald E. Nostrand. It can be used for RCA's COSMOS ICs as well as for bipolar and other types of ICs.

First, a surfactant and then a drop of nematic liquid crystal are placed on the surface of the IC. A thin glass cover plate then is put on the liquid crystal, like a contact lens on an eyeball.

The surfactant causes all the rod-like molecules in the liquid crystal to align in the same direction. When electron pulses travel through the IC, the electric fields they create rotate adjacent molecules, thus changing the index of refraction of the liquid crystal.

The IC next is placed in a conventional metallurgical microscope and illuminated by light passed through a set of polarizers arranged so that normally none of the light reaches the microscope's eyepiece. However, when the IC is operating, the refractive index changes caused by the electrons' electric fields allow light to pass through the polarizers, and, in effect, give the viewer a "live" picture of the pulses or signals flowing in the IC, Dr. Channin explained.

This technique, he added, quickly pinpoints mask defects and metalization failures. In addition, "hot spots" caused by shorts, etc., change the liquid from its crystalline state to an isotropic one. This also affects the refractive index, thus pointing up the shorts as bright spots, as seen through the high-powered microscope.

The technique is quite useful in examining ICs undergoing life testing and in investigating other subtle problems. For example, an IC can be examined without and with loads, to determine what the loading does to the devices's timing and where it has an effect.

ICs can be examined at various speeds and at normal operating voltages—8 to 10 volts for COSMOS circuits, and as low as 2 or 3 volts for bipolars.

Zenith Closes Down Lansdale, Pa., Color CRT Plant Indefinitely

Zenith Radio Corporation has announced that its Lansdale, Pennsylvania, color TV picture tube facility will be closed down indefinitely.

The plant, which was first closed down in late December for year-end inventory, was previously scheduled for reopening in early January.

The company said that the Lansdale plant has been closed indefinitely because of "a significant reduction in consumer demand for color TV receivers as a result of the current recession, and TV industry manufacturing realignments which have reduced the potential for sale of Zenith's color picture tubes to other TV manufacturers."

TV Sales to Dealers Off 13.8 Percent During First Eleven Months of 1974

Total TV receiver sales to dealers during the first eleven months of 1974 were 13.8 percent below the volume for the same period in 1973.

Color TV sales to dealers during the eleven-month period were down 13.6 percent from sales during the same period for the previous year, and black-and-white TV sales were down 14 percent.

These and other consumer electronic sales to dealers are revealed in the following statistics compiled and reported by the Marketing Services Department of the Electronic Industries Association (EIA):

TOTAL U.S. MARKET STATISTICS
SALES TO DEALERS
NOVEMBER 1974 VS. NOVEMBER 1973
(In Units)
FIRST ELEVEN MONTHS

	1974	1973	% CHANGE
TELEVISION			
Monochrome	5,343,057	6,215,341	−14.0
Color	7,095,127	8,211,821	−13.6
TOTAL TELEVISION	12,438,184	14,427,162	−13.8
RADIO			
AM	10,880,932	14,711,301	−26.0
FM	17,422,034	16,446,039	+ 5.9
TOTAL	28,302,966	31,157,340	− 9.2
AUTOMOBILE	9,695,515	11,430,723	−15.2
TOTAL RADIO	37,998,481	42,588,063	−10.8
PHONOGRAPH			
Portable & Table*	3,835,215	5,005,840	−23.4
Console	707,493	769,362	− 8.0
TOTAL PHONOGRAPH	4,542,708	5,775,202	−21.3

* Includes compact and component systems.

NFIB Survey Reveals Small Independents Also Are Visited by OSHA Agents

During the month of November, 3.3 percent of independent businesses with an annual volume of $50,000 or less who responded to the continuous field survey of the National Federation of Independent Business (NFIB) reported that they had been inspected by Occupational Safety and Health Act (OSHA) agents. Of this group, 21.8 percent said they were cited for violations. ■

TECHNICAL LITERATURE

Digital Multimeter

A 4-page brochure describing their Model 21 handheld digital multimeter is now available. The multimeter is a palm-size, 3½ digit multimeter that measures capacitance along with AC volts, DC volts and resistance. Designed for field or bench operation, the unit operates from four rechargeable NiCad batteries. The brochure is fully descriptive, containing features and illustrations of the multimeter. Price is $269. **Data Technology Corp.**, 2700 South Fairview, Santa Ana, CA. 92704.

Record Retention Timetable

An 8-page up-to-date and revised 4th edition of the Record Retention Timetable, a guide to the question "How long must you keep important papers" is now available. The guide opens into a chart which names the government authorities and states the specified time the law demands for the retention of over 170 listed office records. With this timetable and record guide, designed and printed in two colors and easy to read, will come a three-page article describing the action to be taken in a paper disposal program and will include several illustrated brochures showing the different models of electric wastebaskets and paper shredders that destroy office records efficiently. **Electric Wastebasket Corp.**, 145 West 45th Street, New York, NY. 10036.

Solder

A complete new 8-page catalog is offered covering its broad line of solders, flux-core solders, soldering fluxes, vapor degreasing solvents, special purpose chemicals, and related products. More than 50 solders and related items are described, to cover virtually all soldering requirements. **Kester Solder**, 4021 Wrightwood Ave., Chicago, IL. 60639.

Alarm Equipment

A new alarm equipment catalog, designated the A-75, is now available. This 96-page catalog describes and offers over 450 intrusion and fire alarm products. The broad product lines presented provide a one-stop source of supplies for alarm installers, dealers and skilled industrial electronic and electrical technicians who require alarm systems, parts and accessories. Products are described in some detail regarding application, principle of operation and specifications to allow skilled technicians to make the right choices. Eight pages of "Application Notes" for alarm equipment is presented. Some basic installation procedures are presented. **Mountain West Alarm Supply Co.**, 4215 North 16th Street, Phoenix, AZ. 85016.

CCTV Security Equipment

A new catalog describing CCTV Security Equipment is now available. It contains nearly twice the items of the previous edition, the latest equipment specifications and the new price schedule. **Javelin Electronics**, 6357 Arizona Circle, Los Angeles, CA.

Radiotron Designer's Handbook

In response to persistent demand, a limited quantity of F. Langford-Smith's definitive text on audio and radio design, the Radiotron Designer's Handbook, has been made available. This audio-radio classic contains 1,500 pages of comprehensive vacuum tube theory and practical application information and is written in an easy-to-understand style with many illustrations. It contains hundreds of circuits, design aids, curves, and nomographs; 2,500 references; and a comprehensive 50-page index containing over 7,000 cross-referenced headings. Subjects covered in depth in this handbook include frequency voltage and power amplifiers, speaker networks, recording characteristics, fidelity and distortion, tone compensation and tone control, radio frequency amplifiers, rectification, regulation and filtering, AM and FM receiver design. Price $15.00 a copy. **RCA Commercial Engineering**, Harrison, NJ. 07029.

Security Equipment

A complete Alarm Installation Starter Kit is now available. The kit contains product information, wholesale cost, retail pricing information, sales literature, installation instructions and more. The Starter Kit is priced at $5.00. **PLC Electronics, Inc.**, 39-50 Crescent Street, Long Island City, NY. 11101.

Tools

A 16-page catalog, No. SD-168, Tools & Fixin Things, is now available. The catalog lists problem solving tools for the weekend professional. It lists hand tools, solderless electrical connectors, special fastening devices, etc., **Vaco Products Co.**, 510 North Dearborn Street, Chicago, IL. 60610. ■

ELECTRONIC ASSOCIATION DIGEST

Information about the activities of national, state and local associations of electronic servicers, dealers and manufacturers. Material for publication in this department should be addressed to: Service Association Digest, ET/D, 1 East First St., Duluth, Minn. 55802.

ISCET Rates Serviceability of Thirteen Color TV Models

Members of the International Society of Certified Electronic Technicians (ISCET) during November performed serviceability inspections of thirteen different brands of late-model color TV receivers.

Specific design features of each receiver were evaluated in accordance with serviceability criteria established by ISCET. A receiver in which all of the evaluated design features meet ISCET criteria for serviceability would be awarded the maximum 920 points, or a percentage rating of 100.

Following are the ISCET serviceability ratings given the thirteen receivers evaluated in November:

Brand	*Model*	*Percentage Rating*
Panasonic	CT253	75.34
Sylvania	CE4181W	75.11
Motorola (Quasar)	WL9219	73.1
J. C. Penney	2878MF3831	72.43
Zenith	F4028W	72.29
Magnavox	(Not Listed)	70.97
General Electric	MC9220MP	67.38
Admiral	525931	66.44
Sears	52841960304	64.43
RCA	FT518WEN (XL100)	60.3
Sony	KV1920	53.14
Hitachi	(Not Listed)	52.9
Toshiba	C924BM	34.37

All of the color TV receivers for which model numbers are given have 19-inch (diagonal) or larger picture tubes.

Design features which failed to meet ISCET serviceability criteria in many of the receivers were: back cover interlocks which did not match up readily; back covers which dropped down on the picture tube neck when unfastened; model and serial numbers which were not permanently attached or which were illegible; inaccessible high-voltage compartments; sharp edges on metal parts; field adjustments which were not labeled or whose component leads were not labeled; tuners which could be removed only by removing the entire chassis; excessive chassis or subassembly retaining devices; chassis and subassemblies which could not be safely operated or transported without props; unlabeled test points; and printed-circuit boards with circuit patterns on only one side. ■

NEXT MONTH IN ET/D:

- Understanding Scope Specs
- State of the Art of Auto Electronics
- Efficient Home Call Dispatching and Routing
- Semiconductor Diodes—A Perspective for Technicians
- New in Zenith Color TV for 1975

Transistor Beta – A Perspective for Service Technicians

By Bernard B. Daien, ET/D Contributing Editor

An analysis of transistor gain and its interrelationships with frequency, bias, input impedance and switching time

■ The term "beta" describes the forward current gain of a transistor connected in a common emitter circuit, as in Fig. 1. Beta is the ratio of current in the collector (output) circuit to current in the base (input) circuit (Beta = I_C/I_B). The larger I_C is in relation to I_B, the greater the value of beta.

Assume that R1 in Fig. 1 is adjusted (decreased) until a current of 1 ampere (1000 mA) is produced in the collector circuit. If the current in the base circuit is 100 mA at this setting of R1, the beta of the transistor is 1000 mA divided by 100 mA, or 10.

The value of beta just computed applies only when 1000 mA of current is produced in the collector circuit. Other levels of collector current will produce different values of beta. This is illustrated by Fig. 2, which is the gain-VS.-collector current curve of a typical power transistor. Note that beta decreases as collector current approaches zero and also as the collector current approaches the maximum current level the transistor can safely handle.

Actually, there are two "types" of beta. The one we have measured using the setup in Fig. 1 is called the *DC*, or *large-signal*, beta and is often referred to as H_{FE}. The other type is called *AC*, or *small-signal*, beta and is often referred to as H_{fe}. (Note that *large*-signal beta has *capitalized* letters in the subscript (FE), while *small*-signal beta has *lower*-case letters in the subscript (fe). This is one way of remembering which is which.)

Small-signal beta, H_{fe}, is measured by superimposing a small AC signal on the DC bias current in Fig. 1, and then measuring only the resulting AC component in the collector (output) circuit of the transistor. In the absence of signal, a transistor has only a DC output current which is produced by the forward input bias needed to "turn on" the transistor. (A transistor is cut off without forward bias.) When a varying (AC) signal is applied to the base (input) circuit, it "swings" the collector current up and down around the DC operating point.

HOW FREQUENCY AFFECTS BETA

The small-signal current gain and large-signal current gain may be quite different, especially at high signal frequencies, because gain falls off rapidly at the higher frequencies. Fig. 3 illustrates the variation of small-signal beta (H_{fe}) with frequency. Note that gain is relatively constant from DC up to the cutoff frequency, at which point it is 3 dB down (70 percent point). After that, it rolls off (decreases) at the rate of 6 dB per octave (gain is halved every time frequency is doubled). When H_{fe} reaches 1, it is said to be at a frequency of "F_T".

This loss of gain as frequency increases is caused by several factors. Internal capacitances exist. The charges stored in semiconductor junctions look like additional capacitances. And electrons do not move through semiconductors at the speed of light, but at a much slower rate, producing transit time effects which prevent rapid changes in current from being "transferred" from input to output efficiently. Finally, there is both resistance and inductance in the junctions and their connecting leads.

When you are thinking of substituting one device for another, remember that the beta must be specified so that the device gives the required gain at both the current level (H_{FE}), and the frequency (for H_{fe}) involved. This means the device must have an F_T at least *10 times* the working frequency, if it is to have good gain. This is illustrated in Fig. 3.

HOW BETA AFFECTS BIASING

The circuit in Fig. 4 is one stage of an IF amplifier (the same principles apply to audio amplifiers as well) which can be used to demonstrate how H_{FE} affects biasing. R1 and R2 are relatively high-value resistors which form a voltage divider that applies 3.7 volts to the base, with the base loading the voltage divider. Resistor R3, in series with the emitter, has 3.0 volts across it (the 3.7 volts base input minus the 0.7

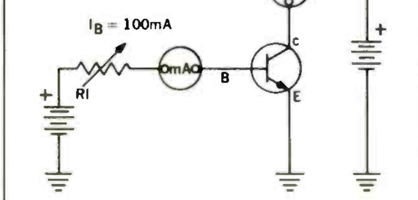

Fig. 1—Simplified test setup for measuring DC beta.

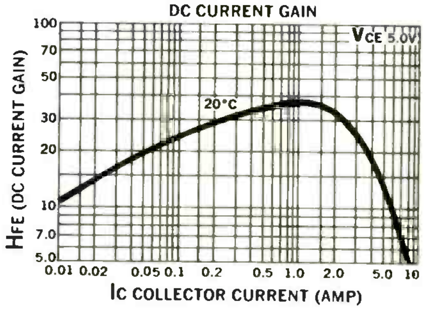

Fig. 2—Chart which illustrates how the DC beta of a typical power transistor varies according to the level of collector current.

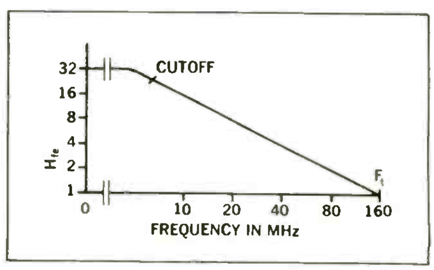

Fig. 3—Chart which illustrates that AC beta varies with frequency. Note that AC beta decreases as frequency increases.

volt base-emitter junction drop). Because the voltage drop across the base-emitter junction is relatively constant, the emitter voltage will follow changes in the base voltage. Substituting a transistor with one which has lower beta will result in higher base current, which, in turn, loads down the base voltage divider. The result is lower base voltage, lower emitter voltage, lower collector current and lower gain. If the stage is part of a series-connected section consisting of other stages, such as AGC'd IFs or DC-coupled audio amplifiers, the other stages in the section will also have their voltages and currents upset.

Conversely, the use of a much higher-gain transistor or one with very high F_T also leads to problems. For example, if an audio amplifier transistor with an F_T of 400 KHz is replaced by another transistor with an F_T of 40 MHz, the stage might oscillate at an RF frequency.

HOW BETA AFFECTS INPUT IMPEDANCE

Although you may not have thought much about it, beta affects input impedance, which, in turn, affects gain and, in the case of tuned amplifiers, also affects bandwidth. To understand this, let's look at Fig. 5, which is a PNP low-frequency power stage. Assume that we have a perfect transistor with no voltage drops across the junctions, and perfect meters without resistance.

With the collector power supply disconnected and 10 volts applied to the base-emitter junction (forward bias), there would be 10 volts across the emitter resistor (produced by the base current flowing through it). This would produce 1 ampere of current through the emitter resistor, as indicated by the base current meter.

Assume that the transistor has a H_{FE} of 9, and that we now connect the collector supply so that we get normal transistor action. For every milliampere of base current, we will now get 9 milliamperes of collector current. Again, the 10 volts of base input will produce 10 volts at the emitter; however, this time 900 mA of the emitter current will be from the collector, and only 100 mA will be from the base.

Now let's look at the input (base-emitter) impedance, which is E/I. Without transistor action, we had 10 volts at one ampere, or 10 ohms, which is exactly the value of the emitter resistor in the series base-emitter circuit. But with the transistor conducting normally from emitter to collector we have 10 volts at only 0.1 ampere, or 100 ohms. The formula to state this is "R input equals R emitter multiplied by the factor beta + 1," or $R_{in}=R_e(B+1)$. You can see that the higher the beta, the higher the input impedance.

But what if the circuit did not have an emitter resistor? Remember, we have been discussing perfect transistors, without voltage drops. In actuality, there is always resistance in the emitter junction itself, which varys with current. The value of that resistance is 26/emitter current (in milliamperes). Thus, if we had one milliampere of emitter current, the emitter resistance would be 26 ohms, and if the transistor had a beta of 99, the input resistance would be 2600 ohms. If there were a resistor in the emitter, the input resistance would be even higher.

So you can see that a high-beta transistor has a high input resistance, which reduces loading on the previous stage and on any tuned circuits feeding the input. This makes sense and is easily remembered because you would expect a high-beta transistor to have a lower current input for a given output current, and a low-beta transistor to draw more input current for the same collector current. And more input current means lower input resistance.

Substituting a high-beta transistor with a low-beta transistor might make a nonoperating circuit function again, but not properly. In voltage regulators, the regulation will be impaired. In tuned amplifiers, the gain and frequency response will be affected, because the Q of the input tuned circuits will be reduced, which, in turn, increases bandwidth (reduces selectivity).

BETA IN SWITCHING APPLICATIONS

Linear amplifiers need enough beta to establish the correct operating point, input impedance, etc. Usually, incorrect beta does not cause rapid failure of linear amplifiers. On the other hand, in power switching (nonlinear) applications adequate beta is a must to prevent quick failures.

Fig. 6A is a simplified basic inverter, with a square-wave AC output (Fig. 6B). The push-pull transistor switches are driven by an oscillator. The applied DC is 20 volts. Note that when the current through one of the transistors is zero (cut off) in Fig. 6C, the applied voltage is at maximum, as shown in Fig.

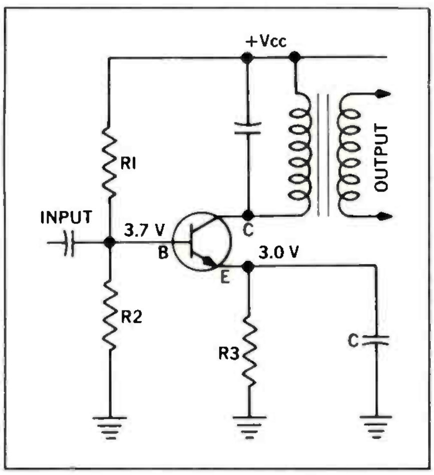

Fig. 4—One stage of an IF amplifier.

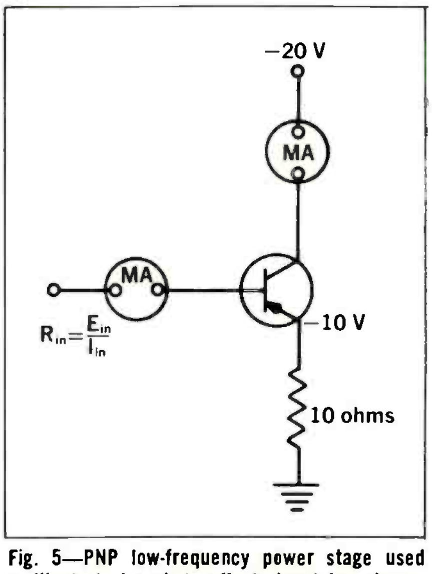

Fig. 5—PNP low-frequency power stage used to illustrate how beta affects input impedance.

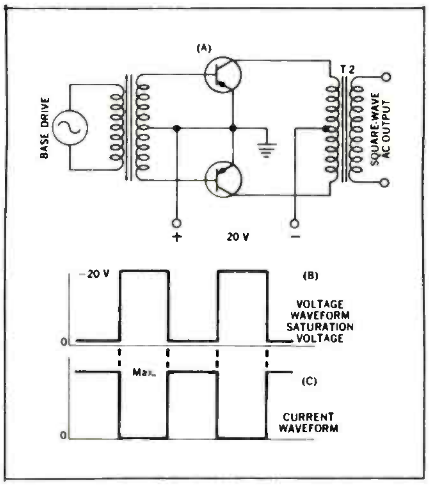

Fig. 6—Simplified power inverter and waveforms at collector. A) Circuit. B) Voltage waveform. C) Current waveform.

6B. Similarly, when the current is at the maximum permitted by the load impedance, the collector voltage is reduced almost to zero because of the voltage drop across the load. The remaining small voltage is called the *saturation voltage* and is caused by the fact that a transistor is an imperfect switch with some small voltage drop across it, even when it is in full conduction. Note that when the collector current is maximum, the voltage drop across the transistor is small, hence the power dissipated is small. But the voltage drop is small only if the transistor is driven hard into conduction by the input signal. However, if the transistor beta is low, the input signal will not be sufficient to turn on the transistor fully, and the voltage drop across it will be larger than normal. As a result, because the current is high and the voltage drop across the transistor is larger than normal during the "on" alternation, the amount of power (EI) dissipated by the transistor will be excessive, and the transistor will overheat to the point of destruction. (During the off cycle, forward current is zero and the transistor dissipates little, if any, power.)

Thus, it can be seen that in switching applications it is imperative that the beta be sufficiently high at the operating current and frequency to insure *full* saturation of the device.

Modern TV sets are using switching type circuits in the low-voltage supply. Inverters are used in mobile radio applications. Even the lowly golf cart now uses a duty-cycle speed control which is a transistor switch. You will be seeing much more of switching circuits now that reasonably priced transistors which can perform reliably in them are available.

"NORMAL" BETA

When you are seeking a replacement device, you will note that "first-grade" transistors offered by major transistor manufacturers have betas ranging over a 3 to 1 spread. A device may be rated, "B=50 minimum, 150 maximum" and, often, with "typical B = 75" thrown in. This simply means that the transistor manufacturer cannot sort closer without increasing the price. Some receiver manufacturers, on the other hand, to keep critical circuits within performance tolerances without the need for expensive circuit design, order transistors which are sorted closer than this. These "original replacement" devices often are assigned nonstandard "house numbers" by the receiver manufacturer. For this reason, you are usually better off getting an "original replacement" part or one "approved" for such use by the manufacturer of the equipment. Zenith, for example, offers interchangeability information in their own "approved" listing. Other such information is available from a number of source lists which are free for the asking. Some of these lists are not very accurate, so make sure they are approved by the equipment manufacturer before relying upon them.

In general, capacitor-or transformer-coupled audio stages are not critical. DC-coupled, IF, RF, and matched-pair stages are critical.

Devices with 2N—numbers are supposed to be directly replaceable, and usually are. Foreign numbered devices and house numbered devices often are not directly replaceable. ■

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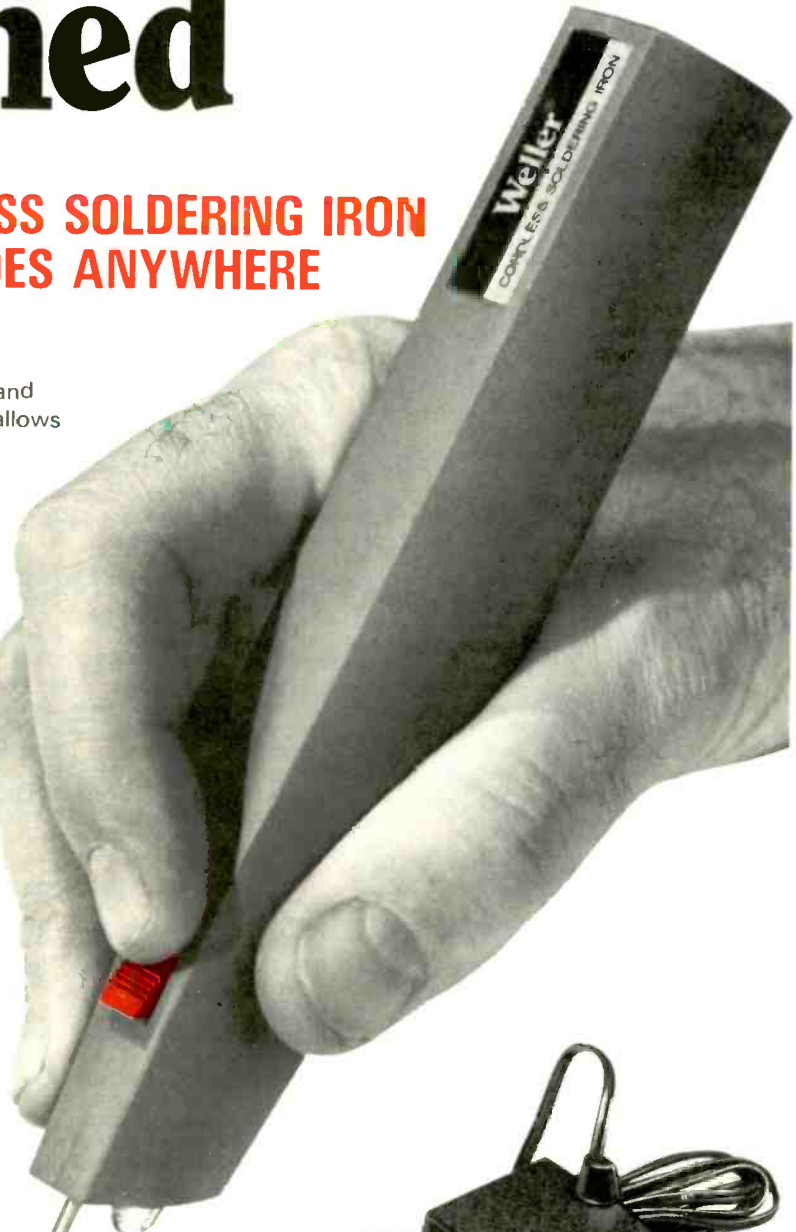

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Isolating Chroma Troubles in Synchronous Diode Chroma Demodulator Systems

By Joseph Zauhar

Although there are many different types of demodulators used in color TV receivers, they all function to separate the color information contained in the I and Q sidebands

■ We find an increasing number of color TV chassis employing synchronous diode chroma demodulator systems. The system which we will review is quite common, employing two pairs of diodes producing the R-Y and B-Y color signals. The G-Y color signal is developed by adding the −(R-Y) and −(B-Y) color signals in the color difference amplifiers.

Before getting into the chroma demodulator circuits we will briefly review the preceding color stages. A block diagram of the typical color stages employed in a color TV receiver is shown in Fig. 1.

All of the 3.58 MHz information received at the first video amplifier has been amplified, and then fed to the demodulators unchanged, but the burst signal is gated to synchronize the subcarrier generator. At this stage, it appears that no color information has been recovered, because the color information is still a part of the 3.58 MHz sideband signal, which is composed of 3.58 MHz wave components. The chrominance signal does not contain a carrier (sideband only), and a substitute carrier must be reinserted before demodulation. This function is accomplished by the subcarrier generator. This substitute carrier now permits demodulation of the chrominance signal.

Chroma Demodulation Circuit

In many of the new color TV chassis we will find two identical circuits used for the chroma demodulators: one called R-Y (red) and the other B-Y (blue). The circuits employ diodes instead of transistors and are called balanced demodulators, which means that in the absence of a sideband (chrominance) signal, there will be zero volts output.

A simplified balanced demodulator circuit is shown in Fig. 2, to illustrate the capacitor charging circuit. This circuit consists of a secondary winding of the subcarrier generator, T510, two diodes, and two 20pf capacitors. The output of the demodulator is referenced to chassis ground by grounding the center tap of the transformer. The diodes will only allow the current to flow in the

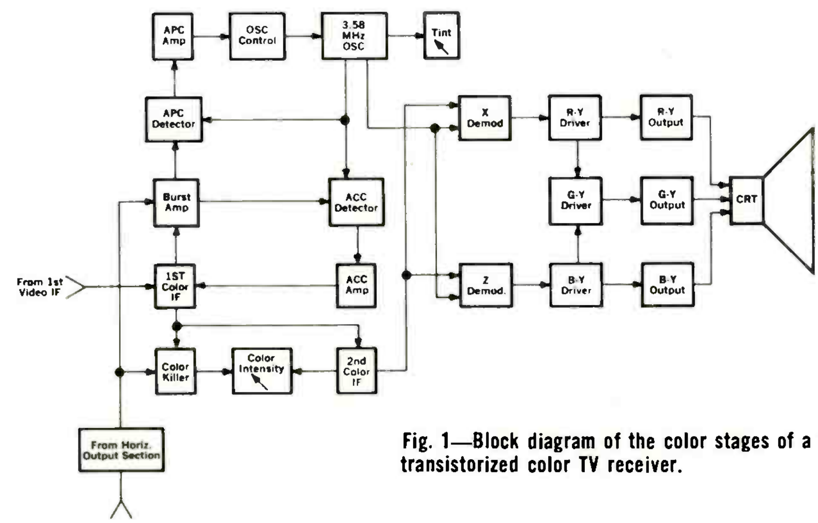

Fig. 1—Block diagram of the color stages of a typical transistorized color TV receiver.

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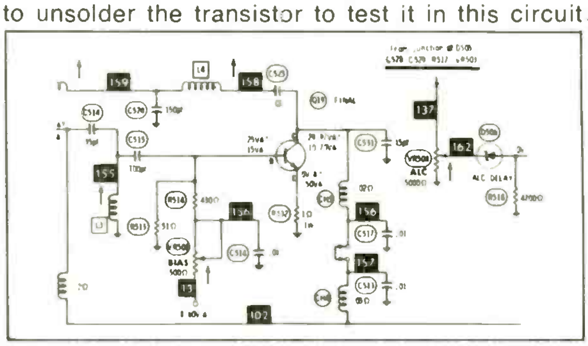

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direction shown by the arrow, and then charge the capacitors with a voltage of the polarity shown in the illustration. This charging current will only flow at the positive peak of the subcarrier generator signal and in the direction shown in the illustration.

In the simplified schematic of Fig. 3, the demodulator load resistors and the output terminals have been added to the circuit. The load resistors form the discharge circuit for the 20pf capacitors and a voltage matrix.

This matrix operation is shown in Fig. 4 and 5. The voltage developed at the two capacitors is shown in Fig. 4 and then in Fig. 5. Batteries are used to replace the capacitors, to illustrate the voltage development. In a sense, we have a battery which is center-tapped, with the negative terminal tied to one end of the resistors and the positive terminal tied to the opposite end of the resistors. The output of the circuit is formed from the center of the resistors to the center tap of the battery. If the voltage drop from the center of the resistor to ground in either direction is added, we would have an output of zero volts.

Up to this point, we discussed what occurs in the demodulator with only the subcarrier generator signal applied. Now we will apply a chrominance signal to the circuit and restore the color information.

The waveform in Fig. 2 illustrates the length and relative cycle time of the capacitor charging interval. This charging interval can be expressed as a "switched on" period in which conduction can occur. The diodes are "switched off" at all other times, by either the charge on the capacitors or the subcarrier generator signal.

As shown in Fig. 6, the chrominance signal is injected between the diodes. When the diodes are switched off, the chrominance signal views an open circuit and no signal flows; but if the diodes are switched on by the subcarrier generator signal, the influence of the chrominance signal causes the circuit to function. Suppose the chrominance signal has a positive component when the switching on time takes place and aids the conduction of

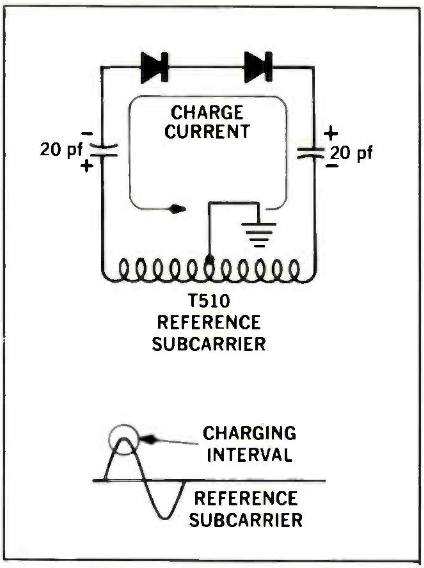


Fig. 2—Simplified balanced demodulator circuit illustrating the capacitor-charging circuit.

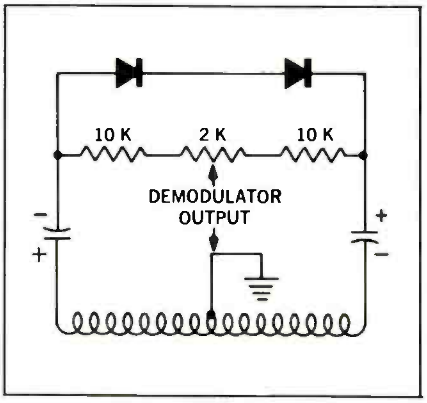


Fig. 3.—The demodulator circuit with load resistors added and its output received from the center of the potentiometer.

diode Y4 while at the same time opposes the conduction of Y3. Capacitor C7 now charges to a higher potential and capacitor C8 discharges to a lower potential.

If we add the potentials from the center of the resistors to ground in either direction, we will have a positive 5 volts output. The voltage drop across the resistors remains constant.

If a negative component was contained in the chrominance signal at the switched-on interval, the charge on capacitor C7 would have increased and the charge on capacitor C8 decreased. The resultant signal would then be negative.

This demodulator is capable of responding to phase (polarity) and amplitude variations contained in the chrominance signal.

The second demodulator circuit is identical except the charging inter-

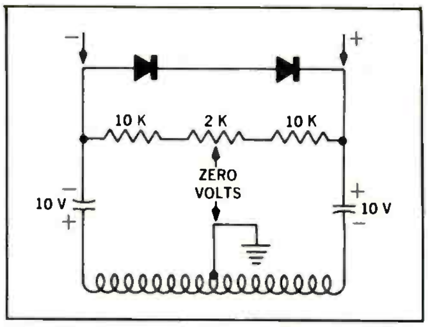


Fig. 4—The demodulator circuit is shown in balance, with zero volts output.

val has been shifted approximately 95 degrees by adding a capacitor in the other secondary winding of T510, as shown in Fig. 7.

After the chrominance signal has been demodulated, the resulting signals are called color difference signals.

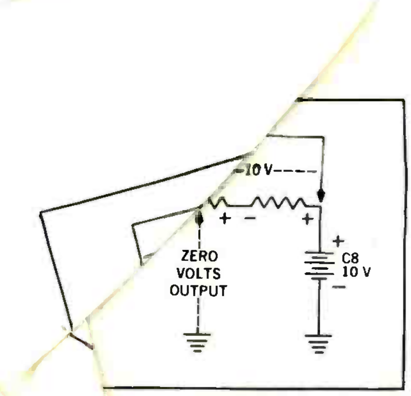
Troubleshooting Chroma Circuit Problems

Color circuit problems will not only cause weak or the lack of certain colors, but also incorrect colors.

One of the most commonly used methods for the troubleshooting and isolation of color problems is the employment of the color bar generator and oscilloscope. The generator is connected to the antenna terminals of the color TV receiver and adjusted to the color bar pattern position.

An ideal place to start checking circuit waveforms with the oscilloscope is at the output of the bandpass amplifier which is approximately the half-way point of the color stages. The scope waveform obtained at this point should be essentially the same as the input signal of the color stages. The waveforms received as we check the color circuits should be compared with the service data for the particular chassis. If the waveforms lack amplitude, the defective component is likely to be found in the bandpass amplifier or the associated control circuits.

Before attempting to pinpoint the defective component in the bandpass amplifier circuit, first check the control voltage inputs. If the color killer output signal is not correct, it can cause the bandpass amplifier to be cut off. The ACC or blanker stage feeding the bandpass amplifier can also cause weak or complete loss of color.



ries are substituted in place of ınd C7 to illustrate the voltage ·rming a balanced demodulator

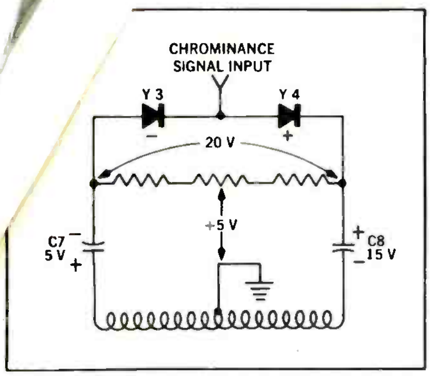


Fig. 6—Simplified schematic showing the influence of the chrominance signal on the charge of capacitor C8 and C7.

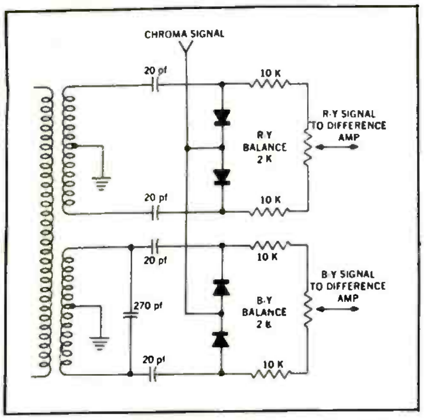


Fig. 7—Schematic diagram showing the chroma demodulation circuit producing the R-Y and B-Y color output signals. The G-Y output signal is developed by adding the —(R-Y) and —(B-Y) signals in the color difference amplifiers.

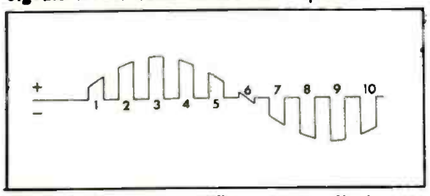


Fig 8—The R-Y amplifier output display as viewed with the oscilloscope.

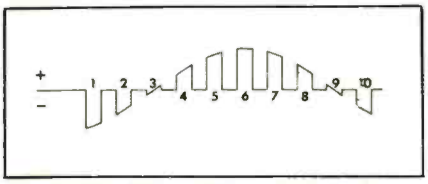


Fig. 9—The B-Y amplifier output display as viewed with the oscilloscope.

Improper chroma circuit alignment can also reduce gain and bandwidth. Incorrect operation of the tuned circuits can often be found while making the chroma alignment adjustments.

If the signal reaching the output of the bandpass amplifier is at the proper amplitude, we will likely find the defective component in the demodulator stages or the color difference amplifiers.

The output signal waveforms of the demodulators should be taken with the scope and compared with the ones in the service information. If the waveforms do not compare, the defective component will likely be found in the demodulators and associated circuits.

When we receive a color bar display on the screen of the TV receiver and one of the primary colors is absent, note the color and check the associated color difference amplifier and the demodulator circuit. If all colors are present but the color bars in the color bar pattern are out of place, check the AFPC circuits.

Locating the Defective Component

Color demodulator circuit problems are in most cases the result of some DC component failure: 1) A diode can be shorted or open, and may have excessive leakage. 2) Open coil. 3) Open resistor or a change of value. 4) Open transformer, or poor solder connection at the base terminals. In some cases, damaged while servicing the circuits. 5) Open capacitor or with leakage. The phase shift circuits are seldom found defective and only contain a few components.

A common method of locating the defective component in the demodulator circuit is to remove the power to the circuit and check the individual components with an ohmmeter. Check the diodes, making sure they are not open or shorted. Unsolder and lift one end of the diode and measure the front to back resistances. If a diode is defective, replace both diodes with a matched, original type.

If electrolytic capacitors are used in the circuit, and in many cases found open, they can be bridged with a capacitor of equivalent value to restore the operation of the circuit.

An oscilloscope can be used to check the coupling capacitance. Approximately the same amount of signal should be present on each side of the capacitor.

Chroma Demodulator Circuit Alignment

There are several different types of demodulator systems in use, and some require a different set-up procedure for the proper phasing adjustment, but the oscilloscope waveforms obtained at the grids of the color picture tube are the same except for the amplitude of the output waveform obtained.

(1) Connect the output leads of the color bar generator to the antenna terminals of the color TV set.

(2) Set the function switch of the generator to the color bar pattern position.

(3) Adjust the controls of the color TV for the best possible picture.

(4) Connect a wide-bandwidth oscilloscope to the output of the R-Y amplifier. The sweep frequency of the oscilloscope should be set to 15,750 Hz. We should now obtain a waveform display on the oscilloscope screen similar to the one shown in Fig. 8.

(5) Set the *tint* control of the TV set to the center of its range, then adjust the *course tint* control adjustment for zero amplitude on the 6th bar of the oscilloscope display.

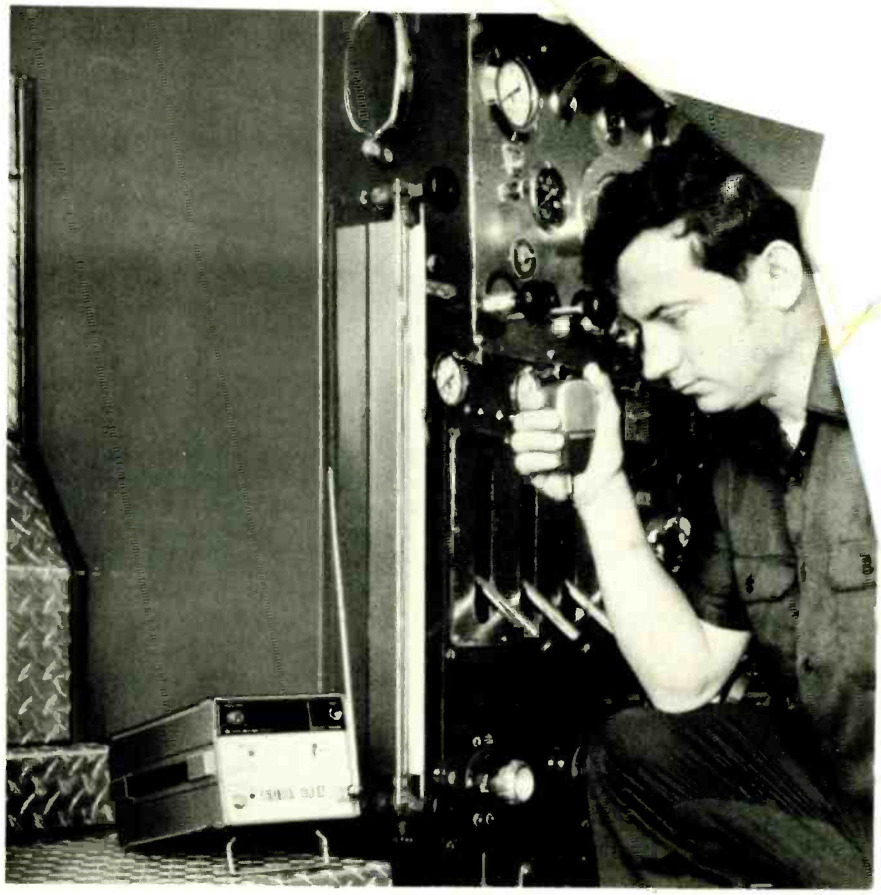
(6) Next, connect the oscilloscope to the output of the B-Y amplifier. Adjust the quadrature transformer driving the B-Y demodulator until the 3rd bar is at zero amplitude as shown in Fig. 9.

The 6th bar is the blue color bar and should be adjusted for zero amplitude in the red demodulator circuit. The 3rd bar is the red color bar and should be adjusted for zero amplitude in the blue demodulator. The blue signal will not pass through the red amplifier, and the red signal will not pass through the blue amplifier. The red or blue signal can not pass through the green amplifier, because the G-Y amplifier is commonly driven by the output of the red and blue demodulator. ■

Digital Frequency Counters for Servicing–Part 2

By Joseph J. Carr, ET/D
Contributing Editor

Typical service-shop applications



TRANSMITTER FREQUENCY MEASUREMENTS

■ Measurement of the output frequency of a two-way communications transmitter is probably the most common "servicing" application of digital-readout frequency counters.

The operating frequencies of communications transmitters and the tolerances beyond which these frequencies must not deviate are specified by the Federal Communications Commission (FCC). Examples of the frequency ranges and required frequency tolerances of transmitting equipment typically serviced by independent electronic service technicians are given in an accompanying table. This table lists the required and recommended frequency specs for transmitters certified by the FCC for use in the two-way land and maritime communications categories. The frequencies of most transmitters in these categories must be checked and certified *at least* once a year by a technician with a First or Second Class Radiotelephone license, and some must be checked even more frequently. In addition, the frequency of all transmitters must be rechecked and certified by a licensed technician whenever the circuitry of the transmitter is repaired or serviced.

Frequency counters used to check the output frequency of transmitters used in two-way land and maritime communications applications (and most other categories of two-way communications) must be type-approved by the FCC. (Exceptions to this rule include frequency measuring equipment used to check amateur and class D Citizens Band transmitter frequencies.) To qualify for FCC type-approval, a frequency counter must meet specific stability and time-base accuracy specifications. A synopsis of the specs required and/or recommended for frequency counters which are used to measure the output frequencies of two-way land and maritime communications equipment is also given in the accompanying table. (Any frequency counter which meets or exceeds the specs listed for the land mobile 25-50 MHz band also will be *more* than adequate for servicing Class D Citizens Band equipment.)

The simplest method of checking transmitter output frequency with a frequency counter is illustrated in Fig. 1. A short whip antenna is connected to input of the frequency counter via a coaxial cable. The transmitter is then keyed on, and the transmitted signal radiated by the transmitter antenna is picked up by the whip antenna of the frequency counter. If the frequency counter is close enough to the transmitter antenna (usually 500 feet or less, depending on the transmitter power), sufficient signal will be applied to the input of the frequency counter to trigger it, and the output frequency of the transmitter will be measured and displayed by the frequency counter. Because the signal radiated by the transmitter's antenna might interfere with normal communications on the same frequency, this method of frequency measurement is legal only for checking Class D Citizens Band transmitters, and then only after it has been determined that the CB channel is free of normal communications.

To prevent interference with normal communications, FCC rules require that frequency checks of land, maritime and most other types of two-way communication transmitters be performed with the transmitter output connected to a *non-radiating* load. One variation of this specified technique is illustrated in Fig. 2. Here the transmitter output is applied to a dummy load which is

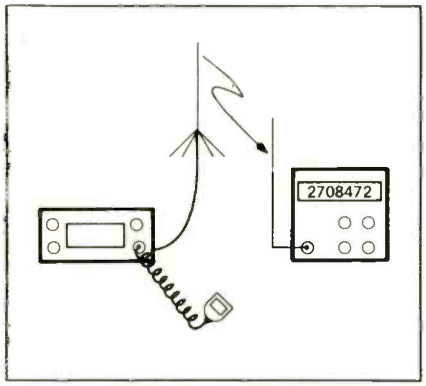


Fig. 1—A small whip antenna connected to the input of the frequency counter serves as the "link" between transmitter antenna and counter in applications in which this technique is permitted by the FCC.

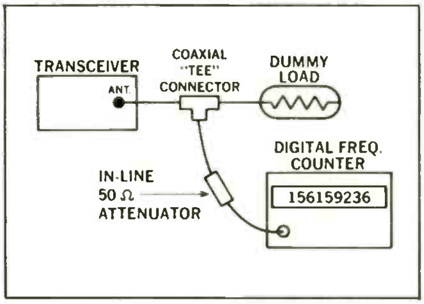


Fig. 2—One method of measuring the output frequency of a transceiver connected to a dummy (nonradiating) load. Value of the attenuator should be sufficient to reduce the transmitter output signal to a level that can safely be handled by the frequency counter.

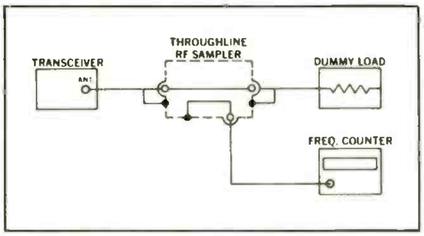


Fig. 3—Another method of tapping off a portion of the output of a transceiver connected to a dummy load. A few frequency counters are equipped with the "throughline" RF sampler illustrated here.

a shielded, noninductive resistor with a power rating which *exceeds* the maximum possible power the transmitter is capable of delivering. A coaxial "tee" connector and 50-ohm in-line attenuator feeds a portion of the output signal to the frequency counter. The attenuator must reduce the signal to a level that can safely be handled by the frequency counter. If insufficient attenuation is used, the frequency counter will be damaged. (**CAUTION:** Never feed the output of a transmitter *directly* into a frequency counter, and never connect the frequency counter *directly* across a dummy load.)

Another legal method of measuring the frequency of a transmitter's output is shown in Fig. 3. This method employs a coaxial "throughline" RF sampler between the transmitter output and the dummy load. The RF sampler picks off a small portion of the output signal and routes it to the frequency counter. (Some frequency counters are equipped with an RF sampler.)

TEST EQUIPMENT CALIBRATION

Digital-readout frequency counters can be used as accurate and convenient calibrators of signal generators during TV, radio and stereo receiver alignment procedures or for *periodic* calibration of signal generators used only for servicing applications not "governed" by FCC specifications. (Periodic calibration specified by the FCC for test instruments used to check and certify the performance characteristics of two-way communications equipment should be performed by metrology or manufacturers' labs equipped with FCC-approved standards.)

For example, a digital-readout frequency counter can be used during TV and FM receiver alignment to accurately adjust and/or check the output frequencies of marker generators and the subcarrier and pilot frequencies of stereo generators. They can also be used to adjust and/or check signal generator output frequency during communications receiver alignment. Some "laboratory grade" signal generators are equipped with a special *high-level* "counter" output intended specifically for such applications. The generator output (usually about 100,000 microvolts) at this jack is applied to input of the frequency counter, and the "regular," attenuable generator output is applied to the receiver being aligned.

If your generator is not equipped with a special high-level, constant-amplitude output, you still can use your frequency counter to accurately adjust and monitor the generator output frequency by using the following method: 1) connect the frequency counter to the attenuable output, 2) increase the generator output to the *minimum* level required to trigger the frequency counter, 3) adjust the generator output to the desired frequency, as indicated by the frequency counter, 4) disconnect the frequency counter from the generator output jack, 5) readjust the generator output to the level specified for the receiver, and 6) reconnect the receiver to the generator output. (*Caution:* The output frequency of some generators shifts slightly when the output load is changed. This is the reason that in step 6 the generator output should be increased only to the *minimum* level required to trigger the frequency counter.)

ADJUSTMENT OF TAPE RECORDER/PLAYER MOTOR SPEED

Many tape recorder/player manufacturers recommend that a digital-readout frequency counter be used to set the speed of the motors in their equipment. This procedure requires the use of a special test tape on which is recorded a single-frequency audio tone.

The frequency counter input is connected to the audio output terminals of the tape player, the tape is inserted into the player and then, while the tape is playing, the motor regulator circuit is adjusted to produce a frequency counter readout identical to the frequency of the tone on the tape.

I prefer a 1000-Hz test tape for this procedure because it permits me to read directly from the frequency counter display the percent of motor speed error, without the need for any mental arithmetic. A 1000-Hz tone will automatically "translate" a one-percent error of motor speed into a frequency counter display of 1010 Hz or 990 Hz (in other words, a shift of 10 Hz above or below 1000 Hz for each one-percent error in motor speed.) By using a 1000-Hz test tape, motor speed errors as small as .1 percent ("translated" by the frequency counter to a shift of 1 Hz above or below 1000 Hz) can be detected with a reasonable degree of accuracy (resolution in frequency counter terminology).

A 100-Hz test tape, on the other hand, produces only a 1-Hz shift above or below 100 Hz for a one-percent error in motor speed. Because most frequency counters are not capable of measuring to *closer* than 1 Hz, and because even then the reading is subject to the inherent digital readout inaccuracy of ±1 count, the 100-Hz test tape might not produce a sufficiently accurate indication of motor speed error.

STEREO FM RECEIVER ADJUSTMENTS

In addition to the use of a frequency counter to verify the subcarrier and pilot frequencies of stereo generators, a frequency counter can also be used to measure the frequency of the 76- or 152-KHz voltage-controlled oscillator (VCO) signal in stereo decoder circuits equipped with a phase-locked loop (PLL).

If the VCO is not on frequency, it is not locked to the 19-KHz pilot. Although such "lock-on" can be verified by applying the VCO and pilot signals to a scope and checking for a stable Lissajous pattern, it is much easier to measure the frequency of the VCO signal with a frequency counter.

CHECKING AM RADIO CONVERTER FREQUENCY

Most technicians who service AM radios, particularly those who service car radios, have encountered a local oscillator which is operating but is so far off frequency that the receiver can not receive on any frequency. In such cases, DC voltage measurements are useless for diagnosis because the converter transistor (Fig. 4) is still operating normally although the local oscillator signal is off frequency. Even the voltage drop across the emitter resistor will change normally as the radio is tuned from one end of the band to the other.

The quickest and most positive method of confirming that the local oscillator is the cause of these symptoms (or lack of symptoms) is to connect a frequency counter to the collector of the converter transistor and, with the receiver tuned to the high end of the band, measure the local oscillator frequency.

ELECTRONIC ORGAN ADJUSTMENTS

The "heart" of all electronic organs and synthesizers consists of

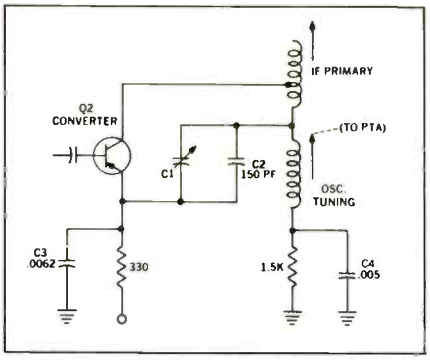


Fig. 4—AM converter stage of a car radio. If off-frequency converter causes "dead radio" trouble symptom, tune radio to high end of band and use a frequency counter to measure the converter frequency. If C1 or C2 is open, the frequency will be in the 2100-2200 KHz range. If C3 is open, the frequency will be in the 2500-3000 KHz range.

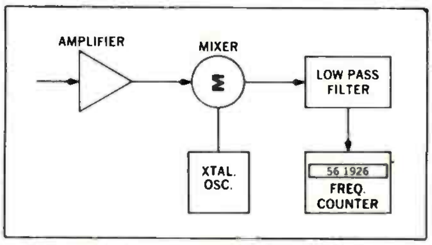


Fig. 5—Heterodyne method of extending the measurement range of a frequency counter.

audio tone oscillators, which occasionally need adjustment. A digital frequency counter is the logical test instrument for measuring the frequency of tone generators. However, because the frequency of many of the tone generators in an organ must be accurate to within a .01 or .001 Hz, you either must use a high-resolution frequency counter capable of resolutions to within .01 or .001 Hz or, if you do not have a high-resolution frequency counter you must use a period counter and convert the "time" readout to frequency by dividing the time into one.

An alternative to both of these approaches is to buy, beg or borrow a frequency/period counter such as the Hewlett-Packard Model 5307A module of the Hewlett-Packard 5300 series of "snap together" digital counters. This instrument measures the period (time) of a signal and then automatically converts the number of 10-MHz time-base cycles (registered in a special calculator circuit during the period) into a direct readout of the *frequency* of the measured signal. The 10-MHz clock

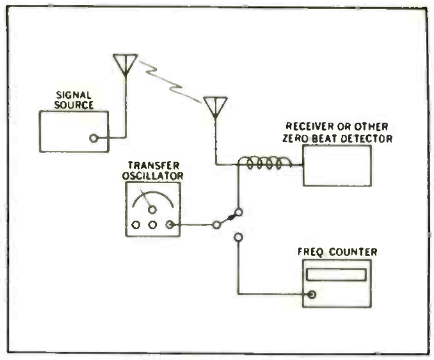


Fig. 6—Transfer oscillator method of extending the measurement range of a frequency counter.

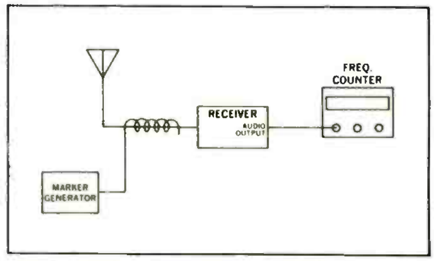


Fig. 7—Marker comparison method of extending the measurement range of a frequency counter.

rate produces a maximum resolution which exceeds the .001 Hz required for organ tone generator measurements.

EXTENDING THE FREQUENCY RANGE

If the frequency range of the digital-readout frequency counter you own or can afford to buy does not permit direct measurement of all the frequencies you need to measure, you can effectively extend the frequency range by one of the following three methods:

Heterodyne

The heterodyne method of extending frequency counter range is illustrated in Fig. 5. The signal to be measured is mixed with a signal from an accurate, calibrated source. This mixing produces sum and difference frequencies, which, in turn, are applied to a low-pass filter. The filter "blocks" the sum frequency, and only the difference (smaller) frequency is applied to and measured by the frequency counter. The resultant readout is then mentally *added* to the frequency of the calibrated source. The total of these two is the frequency of the signal being measured.

Frequency Specs For Land And Maritime Two-Way Communications Equipment

Frequency Band And Categories Of Stations	Freq. MHz	Required Tolerance In PPM	Required Tolerance In Hz	Desired Tolerance in PPM	Desired Tolerance In Hz	Frequency Counter Least Significant Resolution	± Counter Error in PPM	Required Time Base Tolerance In PPM	Recommended Maximum Time Base Calibration Cycle	Recommended Gate Time
Land Mobile	25-50 MHz	20	500 1000	4	100 200	10 Hz	.4 .2	3.6 3.8	3 yrs. 7 mo.	10 Ms.
Land Mobile	150.8 to 174 MHZ	5	750 870	1	150 174	10 Hz	.066 .057	.93 .94	11 mo.	1 sec.
Land Mobile	470 to 512MHz	5	2350 2560	1	470 512	100 Hz	.21 .19	.79 .81	6 mo.	100 Ms.
Base	25 to 50 MHz	20	500 1000	4	100 200	10 Hz	.4 .2	3.6 3.8	3 yrs. 7 mo.	100 Ms.
Base	150.8 to 470 MHz	5	750 870	1	150 174	10 Hz	.066 .057	.93 .94	11 mo.	1 sec.
Base	470 to 512MHz	2.5	1175 1280	0.5	235 256	10 Hz	.021 .019	.479 .481	5 mo.	1 sec.
SSB Coast Stations	1.6 to 27.5MHz	12.5 .72	20	3.1 .18	4	1 Hz	.62 .036	2.5 .14	2 yrs. 6 mo. 1 mo.	1 sec.
SSB Coast Stations	156 to 162MHz	5	780 810	1	156 162	10 Hz	.064 .062	.93 .93	11 mo.	1 sec.
Maritime Mobile	1.6 to 27.5MHz	31.25 1.8	50	7.81 .45	10	1 Hz	.62 .036	7.2 .41	5 yrs. 5 mo.	1 sec.
Maritime Mobile	156 to 162MHz	10	1560 1620	2	312 324	10 Hz	.064 .062	1.93 1.93	1 yr. 11 mo. 1 yr. 11 mo.	1 sec. 1 sec.

Courtesy of John Fluke Co.

Transfer Oscillator

In the transfer oscillator method of extending frequency range, illustrated in Fig. 6, the signal being measured is zero beated against a lower frequency signal from the transfer oscillator. A receiver (with an "S" meter) or a phase detector is used as a beat indicator. The receiver is tuned to the approximate frequency of the signal to be measured. The transfer oscillator then is adjusted until an audio tone is heard. As the zero beat audio tone drops below your range of hearing, you use the "S" meter as a zero beat indicator. The "S" meter will initially waver back and forth and then, when true zero beat is attained, the meter needle will remain stationary. When this is accomplished, you switch the transfer oscillator output to the input of the frequency counter and measure the frequency.

Because you are measuring the "unknown" frequency by beating it against the transfer oscillator signal, which is a subharmonic of the "unknown" frequency, it is essential that you be able to determine to which subharmonic of the "unknown" the transfer oscillator is tuned. To avoid miscalculating the subharmonic, use a transfer oscillator frequency which is not *less* than 1/20 of the estimated frequency of the "unknown" signal.

To calculate the frequency of the "unknown" signal, you merely multiply the frequency counter readout by the harmonic. For example, if the transfer oscillator is tuned to the 5th harmonic of the "unknown" signal, you multiply the frequency counter readout by 5.

Marker Comparison

The marker comparison method, illustrated in Fig. 7, uses the beat tone (audio) generated by heterodyning together the input signal and a standard marker frequency supplied by a precision crystal oscillator. If, for example, you wish to measure the output of a 4500-KHz signal source, you could beat a harmonic of a 100-KHz oscillator against the signal, using a communications receiver as the best indicator. Let us assume that the actual frequency was 4500.9 KHz. This will produce a beat note of 900 Hertz in the receiver's output. The counter then is used to measure the frequency of this beat note. The counter readout is added to or subtracted from the known 4500-KHz marker to find the frequency of the "unknown" signal. In this case, the signal is 900 Hertz above the marker, but the same beat note would have been produced had the frequency been 4500 KHz − .9 KHz, or 4499.1 KHz. The problem is to determine whether the signal is *above* or *below* the marker. By using a communications receiver, we can "rock" the dial back and forth to see the respective positions and thereby make the necessary determination. When using a fixed-tuned receiver, however, it might be necessary to use a marker frequency that is one harmonic higher and then observe whether the frequency of the beat note went up or down.

CONCLUSION

The applications described in this article are but a few of the many for which digital-readout frequency counters can be used in the service shop.

Recent advances in digital-readout frequency counter technology have made it possible to produce low-cost instruments that are both versatile and accurate. Service technicians not only can afford them, many cannot afford to be without them. ■

New in Color TV for 1975–Part 6

By Joseph Zauhar

Continuation of a series which analyzes the new and significantly changed circuits in 1975 color TV receivers. This month we will review the new circuits employed in GTE Sylvania's GT-Matic II chassis

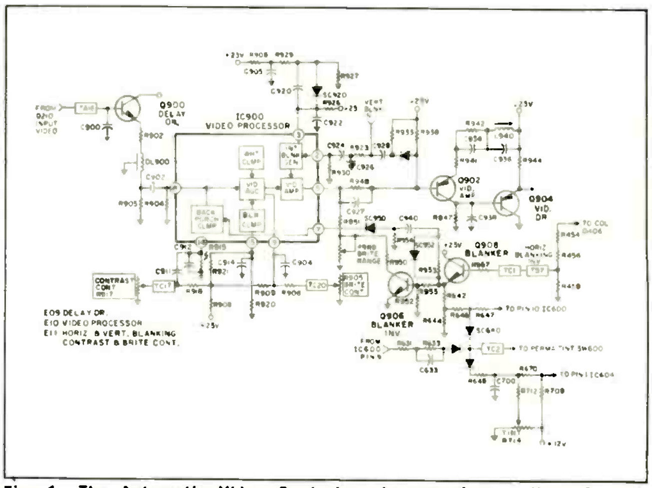


Fig. 1—The Automatic Video Control system employs a "sample and hold" circuit made possible by using a new integrated circuit IC900. This circuit keeps the blackest and whitest part of the picture at the preset levels. The circuit employs 100 percent DC coupling. *Courtesy of GTE Sylvania.*

■ GTE Sylvania's new color TV line features the second generation of self-adjusting TV receivers. The GT-Matic II color tuning system is employed in the GT-300 and GT-200 solid-state color TV chassis.

New integrated circuits now make possible the addition of a new automatic color system and a automatic contrast and brightness system.

The new line also features a picture tube which absorbs room light to provide higher contrast and a sharper picture. In the small screen TV sets, a new in-line picture tube is used.

GT-MATIC II CIRCUITS

Most of the GT-Matic II's updating on previous GT-Matic systems takes place on the Chroma module, by the utilization of integrated circuit IC-900, IC602, and IC600. The new automatic circuits are employed in the E09/10/11 color TV chassis.

Automatic Video Control System

The regular contrast and brightness control functions have been replaced with this new Automatic Video Control system (Fig. 1). This circuit package compensates for extremely wide variations in station characteristics and program material, to keep the blackest and whitest parts of the picture at the viewer's preset levels.

The video signal from the first video amplifier, Q210, drives the base of an emitter follower delay line driver, Q900. The output of the delay line DL900, is AC coupled by C902 to the input (pin 8) of the video processing integrated circuit IC900.

This AC coupling is necessary, because all black and white levels are to be re-established within the video processing IC by the black and white clamp blocks.

The black portions of the picture information is sampled internally in IC-900 and clamped to a fixed DC level. This clamping action provides a constant DC reference at the picture tube, regardless of variations in modulation at the transmitter. The contrast control, R917, provides a manual over-ride to permit adjustment for personal preference.

A white clamp circuit detects the average brightness level of the video signal and applies a correction voltage to IC900 the variable gain video stage (or video AGC) to maintain a constant average brightness level at the picture tube. The brightness control, R905, provides manual adjustment to accommodate personal preference.

The horizontal rate pulse at the emitter of the blanker, Q908, is integrated by SC952, R953, C940, R954 and shaped so that its positive tip (Fig. 2) coincides with the horizontal pulse back porch. This pulse is fed to pin 7, of IC900. Conduction within IC900 during the pulse interval charges C902 at pin 8, keeping the horizontal blanking DC level constant. The composite video signal is now clipped at the blanking level, preventing any noise which extends above it from reaching the black clamp circuit. This noise protection circuit prevents noise impulses from establishing an incorrect reference level in the black clamp circuit. This accomplishment assures that the black clamp responds only to the black portion of the picture.

The color level circuit is based on the "Sample and Hold" technique which is made practical through the use of IC's. This circuit examines the chrominance portion of the incoming signal to find the highest peak chroma level. It "remembers" this peak and automatically adjusts the chroma gain of the receiver so that the peak will be displayed at a predetermined level set by the user-preference control.

There are three areas of performance improvement over the previous GT-Matic system: (1) The "Sample and Hold" circuit is a more sensitive peak detector and is not adversely influenced by "typical" highly saturated scenes. (2) More correction loop gain. (3) It contains a noise inverter virtually immune to electrical noise interference.

Color Killer and ACC Circuits

The color killer control, R660 (Fig. 3), sets the threshold level in IC602, which is related to a no color condition and holds IC602, the second chroma amplifier off during the monochrome transmission.

The differential output

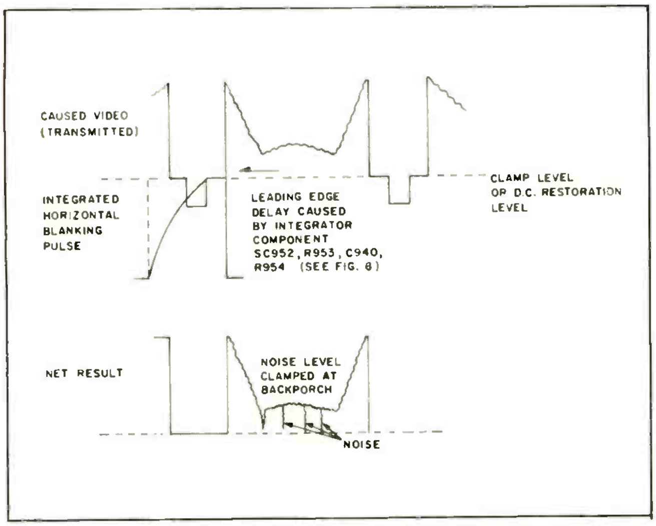


Fig. 2—The composite video signal is clipped at the blanking level, preventing any noise which extends above it from reaching the black clamp circuit. *Courtesy of GTE Sylvania.*

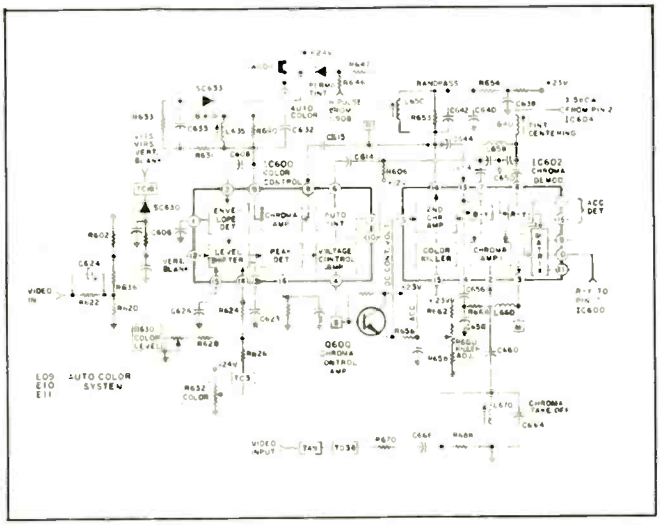


Fig. 3—The Automatic Color system employs the "sample and hold" technique made practical through the use of IC's. *Courtesy of GTE Sylvania.*

voltages from the ACC detector in IC604 are fed to pins 1 and 16 in IC602. When a high level chroma signal is present, pin 16 is positive with respect to pin 1. A low level chroma signal will produce a voltage on pin 16, which is negative with respect to pin 1. The relationship of these differential voltages is used to vary the gain of the first chroma amplifier in IC602 to maintain a nearly constant chroma output at pin 3, when the source, 3.58 MHz chroma input signal at pin 1 of IC602 varies.

Preference level control R632, is a part of a bias network, consisting of R626, R628 and R630, from +24 volts to ground. Its DC voltage is fed to the level shifting circuit in the color control, IC600, through pin 14. Here it is combined with the envelope detected 3.58 MHz signal being received. The resultant signal is then sampled by the automatic color control systems' peak detector. The envelope related DC level is amplified by IC600, the control voltage amplifier. This DC output signal controls the gain of Q600, the chroma control amplifier, and IC602, the second chroma amplifier. Resistor R630 is a factory/service adjustment which compensates for internal variables in IC600 and is adjusted for a no color condition when the color control is at minimum.

Automatic Color Level Control Circuit

Amplified 3.58 MHz chroma information from the second chroma amplifier (Fig. 3) pin 14 of IC602, is applied to pin 8 of IC600. This signal is then amplified at pin 9 by the chroma amplifier of IC600. The tuned 3.58 MHz load, R640, C632 and L635, feeds the signal through C608 to pin 2 of IC600. This signal is then envelope detected and combined with the DC control voltage from the color control, R632, in a level shifting circuit. Vertical blanking is also applied through pin 12 to the level shifter to remove any vertical interval signals (VITS or VIR) which may be present. The resultant information from the level shifting circuit is then peak detected to provide a control voltage which is dependent on the peak amplitude of the chroma signal. The desired color level as determined by the color control setting, remains quite accurate. This control voltage appears at pin 4 of IC600 and is fed through Q600, the chroma control amplifier, to pin 6 of IC-602 to control the gain of the second chroma amplifier. The 3.58 MHz chroma signal level at pin 14 is dependent on the color control setting and the peak amplitude of the chroma signal existing within the transmitted scene.

Chroma Demodulator Circuits

The −(R-Y) and −(B-Y) signals are recovered by a pair of synchronous detectors operating on the R-Y and B-Y axis contained in IC602. The G-Y signal is a product of R-Y and B-Y matrixing internally in the IC.

The 3.58 MHz CW from pin 2 of IC604 (Fig. 4) is fed through a phase shift network, L640 and C650, to pin 8 of the chroma amplifier and demodulator integrator circuit, IC602, providing the proper reference angle for the R-Y demodulator. Coil L640 is adjustable to achieve the proper demodulation angles with the tint control, R714, in the center of its range.

A second network, consisting of L658 and C654, shifts the phase angle of the R-Y reference signal at pin 8 of IC602 and feeds the proper reference angle for the B-Y demodulator to pin 7 of IC602.

Dark-Lite 50 Color Picture Tube

The Sylvania Dark-Lite 50 (Blackface) picture tube is a combination negative guard band matrix screen and dark filter glass.

The picture tube absorbs room light in three ways: Once in the dark filter glass as the light goes in towards the screen, a second time by the Black Matrix screen itself and a third time as it passes through the dark glass again.

Light being emitted by the phosphor screen passes through only one absorption mechanism as it passes through the dark filter glass. This high absorption of light gives the screen its black appearance and the capability to display a much greater range of contrast and deeper colors.

The 25-inch color picture tubes must be operated at 30 kv to provide enough brightness reserve and will be used only with the 30 kv, E11 chassis.

COLOR TV CHASSIS E11

The E11, color TV chassis which is used in 25-inch (diagonal measurement) color TV receivers is the highest performance chassis, providing 30 kv of second anode voltage for the new "Blackface" color picture tube.

It employs a self-regulating Ferro-Resonant transformer, a new AFC and AGC circuitry for improved varactor tuner performance.

The E11-1 chassis uses a turret-type dual FET VHF tuner and a 70-detent type UHF tuner. The E11-2 features a 2-button Remote Control along with a 20-button Electronic Varactor tuning system.

The chassis employs seven plug-in IC's (eight in varactor tuner models) approximately 39 plug-in transistors (70 in varactor tuner models) and a solid-state high voltage multiplier.

IC circuits are used in the Auto Color/Auto Tint, Auto Black/White, Chroma Amp/Subcarrier Regenerator, Chroma Demodulator/Driver, Vertical Countdown, Horizontal/Sync, Sound Demodulator, and Voltage Regulator circuits (Varactor Models).

There are four plug-in modules used in this chassis which are as follows:

(1) IF/Sound module which is new and not interchangeable with other existing chassis or parts and contains improved AFC and AGC circuits.

(2) Video / Chroma module which contain the new GT-Matic circuitry. It is identical to and interchangeable with the E09 and E10 Video/Chroma panel, but not interchangeable with older models or panels.

(3) Deflection panels which are newly designed to drive the 30 kv deflection system. It is not interchangeable with other existing panels or chassis.

(4) Bandswitch panel which is used only with varactor tuner models. The panel is new and not interchangeable with previous E04 modules.

Power Supply

The E11 color TV chassis differs from the E09/E10 by employing a constant voltage transformer (Fig. 5) to provide B+ regulation. This voltage regulating transformer consists of a core having two magnetic loop paths, one is used for the primary flux and the other for the secondary flux.

A regular power transformer core has a common flux path for both the primary and secondary windings which permits changes in secondary voltages when the primary voltage changes because of line voltage variations.

The transformer has a large capacitor, C503, across the entire secondary winding that maintains secondary loop saturation. Because of the primary to secondary magnetic loop isolations, the primary current does not go to extremely high values trying to support the saturation effect, as the secondary loop is kept in the saturation region by the large capacitor.

Line voltage variations fed to the primary winding have little effect on the secondary voltage levels under this condition.

The transformer secondary taps provide the output voltages for the various B+ sources.

There are seven taps on the secondary winding. One, three and five are used for the +135 volt full wave supply. Taps two, three and four are used for the +36 volt full wave supply. Tap three is the common return or center tap.

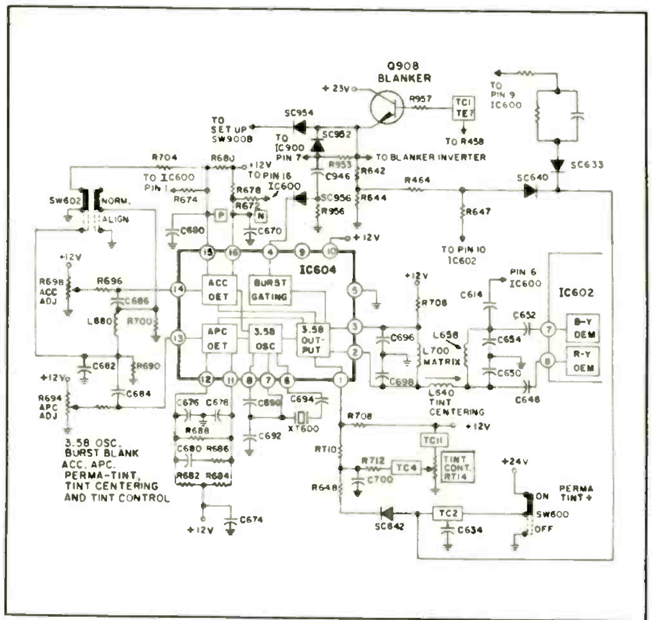


Fig. 4—A new color processing integrated circuit, IC600, maintains the color level and aids in tint correction. *Courtesy of GTE Sylvania.*

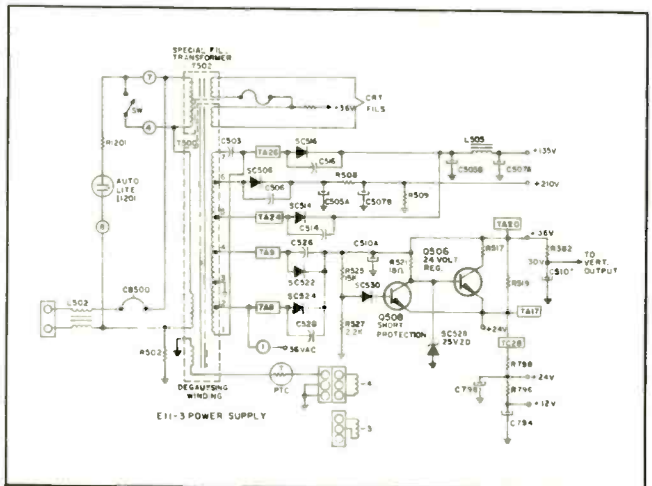


Fig. 5—The E11 color TV chassis differs from the E09/E10 by employing a constant voltage transformer to provide B+ regulation. *Courtesy of GTE Sylvania.*

COLOR TV CHASSIS E09/E10

The E09, E10 color TV chassis are electrically identical and use the same set of circuit modules. The E09 (Fig. 6) chassis is designed to be used in 19-inch models; the E10 chassis is used with 21-inch and 25-inch TV models.

Both chassis provide a high voltage output of 26.5 kv for the picture tube.

The majority of the circuits are placed on plug-in circuit boards and the major components and sub-assemblies also plug-in for servicing convenience.

In the E09 and E10 chassis, the IF/Sound and Deflection modules are identical to and interchangeable with those used on the E05 and E03 color TV chassis. A new Video/Chroma panel contains the GT-Matic II circuitry and is not interchangeable with previous models.

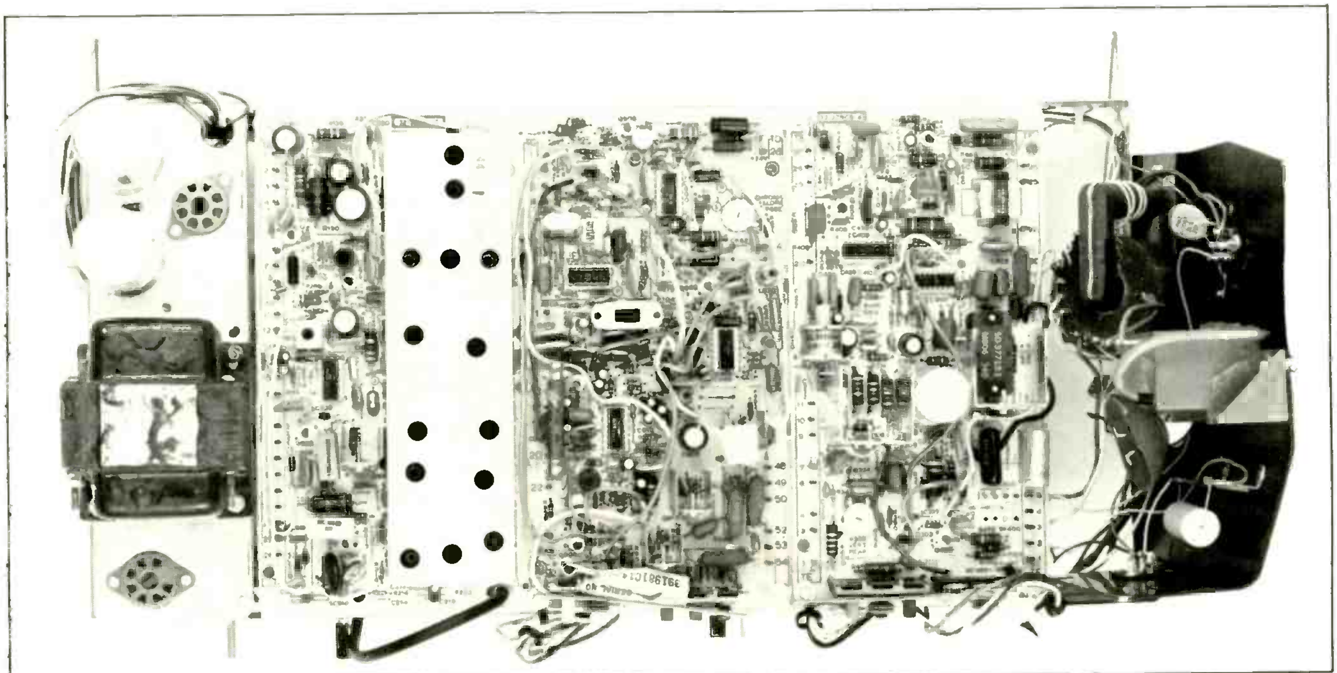


Fig. 6—Shown in the photo is the E09 chassis which is designed to be used in 19-inch (measured diagonally) color TV sets. The majority of the circuits are placed on plug-in circuit boards. *Courtesy of GTE Sylvania.*

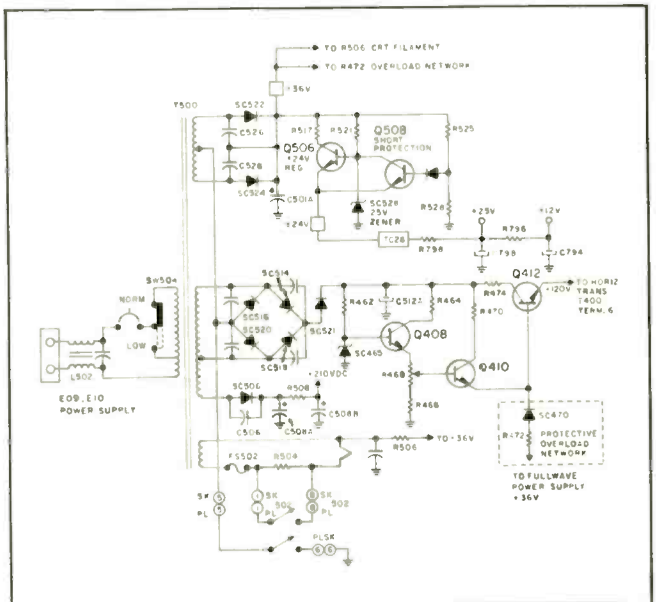


Fig. 7—The E09/E10 color TV chassis features a full transformer powered, electronic regulated power supply. *Courtesy of GTE Sylvania.*

Seven plug-in IC's contain the Auto Color/Auto Tint, Auto Black/White, Chroma Amp/Subcarrier Regenerator, Chroma Demodulator/Driver, Vertical countdown, Horizontal/Sync and the Sound Demodulator circuits.

The chassis is laid out in a flat-bed design which permits free access from both sides of the chassis and circuit panels. The cabinet bottom cover can be easily removed for free access to the chassis. The TV chassis can be serviced either by conventional techniques of analysis and replacement of individual components, or by replacing the entire plug-in circuit module.

An Aperture Correction circuit is employed in the E09/E10/E11 chassis to supplement the video peaking. A three-position video peaking switch permits the set to be matched to the reception environment or the viewer's preference. The range of this switch has been altered to provide an improved compromise between picture sharpness and background noise.

The chassis features a full transformer powered electronic regulated power supply as shown in Fig. 7.

COLOR TV CHASSIS E08

The E08 color TV chassis is all solid state and employed in portable TV sets where size, weight and carry-in service are major considerations.

This chassis is line connected and features single-panel construction employing eight plug-in integrated circuits, 31 plug-in transistors and a solid-state high-voltage multiplier.

The E08 chassis provides 28 kv of second anode voltage for the picture tube, which is about 4 kv higher than the previous 19-inch hybrid chassis and 6.5 more than the previous 17-inch hybrid models.

Chroma-Line Picture Tube System

The Chroma-Line picture tube system used with the E08 color TV chassis consists of a 90 degree in-line picture tube and a precision-wound dual toroid deflection yoke. The picture tube is approximately 1¾ inches shorter than conventional delta gun designs. The line screen is used with vertical phosphor strips instead of dots, which improves color purity and makes it less susceptible to change when the TV set is moved.

A quadrapole convergency system is used with the in-line picture tube simplifying the convergence adjustments. There are only four dynamic convergence adjustments compared to fourteen on Delta-gun systems. The dynamic convergence is accomplished by four quadrapole windings on the toroid deflection yoke.

Matrix and non-matrix versions of these tubes will be used. The matrix types will be the new "Blackface" dark filter glass. ■

Condensed from a single chapter of a recently introduced TAB book, by permission of TAB BOOKS, Blue Ridge Summit, Pa. 17214

Troubleshooting Horizontal Deflection & High Voltage Circuits -Part 2

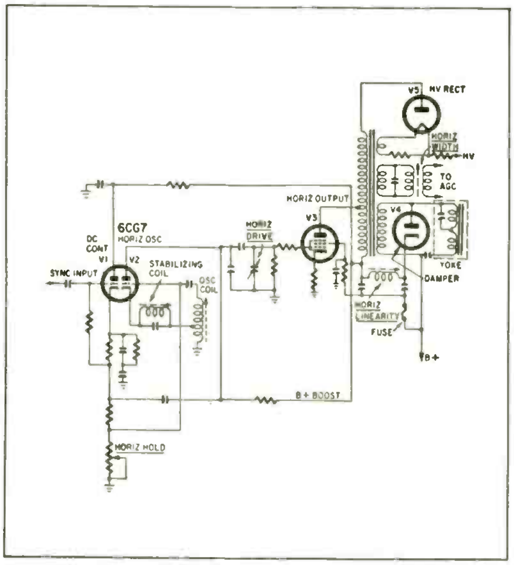


Fig. 10—Typical tube-equipped horizontal and high-voltage circuits.

TROUBLESHOOTING HORIZONTAL AND HIGH-VOLTAGE SECTIONS

The horizontal deflection and high-voltage section of the color set can give the inexperienced technician a very difficult problem when it comes to troubleshooting. Besides being driven hard in normal operation, these circuits are complex, and it's sometimes difficult to understand the operation from studying the schematic. In addition, these circuits operate within very close tolerances, which must be taken into account. The various feedback paths and interdependence of one circuit's operation on the proper operation of an adjacent stage must be considered. Shock from high voltages in this section can be very painful, if not fatal. Therefore, extra care must be exercised, not only from the standpoint of personal safety, but equipment safety as well. For example, a momentary short across the high-voltage output of a tube-type receiver will draw a heavy arc, but there is not much danger of damage to the equipment. This same short, although momentary, can destroy many transistors in a solid-state model.

Preliminary Checks

The first step in the isolation of troubles in the horizontal deflection and high-voltage section is to decide whether the problem is in the deflection system itself, or in the horizontal oscillator. If a raster is visible on the CRT and the picture can be synced with the station signal, regardless of picture and raster quality, there is usually little reason to suspect the oscillator. When the visual symptoms do not preclude the possibility of oscillator problems, tests will have to be made before accurate conclusions can be drawn.

Some tube-type receivers use a keyed-AGC system, which is triggered by pulses from the horizontal oscillator. In these sets, the sound will come on before the raster, due to the slower heating of the deflection tubes. If you can hear the sound and there's trouble with the raster, you can assume that the oscillator is running, because the AGC is working and allowing the sound section to function. However, the oscillator can still be off frequency.

The best test for determining proper operation of the oscillator at this time would be to observe the waveform at the input of the horizontal output stage with a scope. This waveform is the sawtooth drive for the output amplifier, and varies in exact shape with different models of receivers. Check the manufacturer's service data for the correct shape. In tube-type models, as well as in some solid-state sets, this sawtooth will be slightly flattened on top under normal conditions. This indicates grid (or base) clipping of the sawtooth. If tests reveal that the oscillator is the source of the deflec-

From Chapter 11, LOGICAL COLOR TV TROUBLESHOOTING, by Ben Gaddis, TAB BOOKS, Copyright 1974. A review of the complete book follows this article.

tion problem, refer to the earlier discussion concerning the horizontal oscillator.

Trouble Symptoms

Faults in the deflection and high-voltage circuits of Fig. 10 can affect the shape and brightness of the raster. Remember that some of these symptoms, especially those regarding brightness, can be caused by problems in other sections of the receiver. To insure that the deflection and high-voltage circuits are not the cause of dim raster problems, make the tests of the CRT electrode voltages as described earlier.

Principle symptoms of trouble in the horizontal and high-voltage circuits are those that affect the shape of the raster, the linearity of the horizontal scan, and the brightness of the raster. These visual symptoms will be accompanied by incorrect voltages somewhere in the circuits shown in Fig. 10.

A dim or missing raster can result from a malfunction in the high-voltage or focus supplies or in the grid or cathode circuit of the CRT. If the voltage measurements at the CRT point to the deflection system, measure both second-anode and focus voltages. Also check for presence of the boost voltage across the boost capacitor. If the focus and boost voltages are present but the second-anode voltage is off, the trouble is confined to the second-anode supply. If the focus is the only missing voltage, check the components in the focus circuit. When two or more of these voltages are low, the problem must be in a circuit common to all, such as the boost or horizontal output circuit.

Failure of the second-anode supply or its associated regulator will cause an incorrect high-voltage output. If the supply is only low, usually the raster will be present, but picture width and height will be affected. If the size of the raster is affected by the setting of the *brightness* control, look for trouble in the high-voltage supply or its regulator. A bad regulator can also cause fluctuations of raster width and focus, blooming of the picture, and fluctuations in brightness. In its early stages of failure, the regulator might cause a change in brightness when the scene changes. Convergence will sometimes fluctuate also.

Voltage Checks

The best approach to any of these troubles is a check of the DC voltages in the high-voltage and regulator circuits. In tube-type receivers, substitute new high-voltage rectifier and regulator tubes to eliminate these as possibilities. A check of regulator current in shunt regulator circuits is also a good troubleshooting aid. Some receivers include a small resistor in the cathode circuit of the regulator tube so that this current can be easily measured by measuring the voltage drop across the resistor. Compare this current to that specified in the service data.

Good focus not only depends on proper operation of the high-voltage and focus circuits, but also on the other voltages applied to the CRT. Only after a check of CRT voltages leads you to the deflection system are you ready to service this section. The best way to observe the focusing action is by means of the horizontal scanning lines. Many technicians mistake a smeared video condition, resulting from IF or video problems, as a focus problem. While adjusting the *focus* control, notice the horizontal scanning lines. The control should be able to bring these lines into sharp focus.

There are three principle sources of poor focus: (1) the second-anode voltage, (2) the focus voltage, and (3) the CRT. A voltage check should reveal either of the first two problems. If the high voltage is off, check out this problem first. In correcting the high-voltage problem, you will probably clear up the focus trouble as well.

Should the high voltage be at its correct value while the focusing voltage is off, replace the focusing rectifier. If this doesn't solve the problem, check the other components in the focus circuit. Capacitors that are leaky or that tend to change value with a change in temperature are common. Check the operation of the focusing adjustment pot with a VTVM.

Damper Defects

The damper and its associated circuits are a common cause of high-voltage problems. Remember that this circuit works in conjunction with the horizontal output, flyback transformer, and yoke to produce deflection and the high-voltage pulse for the high-voltage rectifiers.

Improper setup of the horizontal deflection circuits is the cause of many failures in this section. Always check the high-voltage and efficiency adjustments after making any replacement in the horizontal deflection section. In fact, it is good procedure to check these adjustments routinely on all bench jobs. Checking these adjustments early in the troubleshooting procedure can save a lot of wasted time. A general adjustment procedure is given in the following paragraph, but always refer to the service data for the *exact* procedure.

The purpose of these adjustments is to insure that the horizontal deflection system and the high-voltage circuits are adjusted for proper output and do not overload the horizontal output stage. Insert an ammeter in the cathode circuit of the output tube. (Some models provide a detachable link for this purpose.) Adjust the horizontal efficiency coil for a *dip* in the cathode current indicated by the meter. Refer to the manufacturer's info sheets for exact values. Set the *brightness* control to *minimum* to insure minimum CRT and maximum regulator currents. Set the *high-voltage* control to give the proper second-anode voltage. Now check the cathode current through the regulator—the cathode resistor can be used for this purpose. Insure that the regulator current should decrease. If the regulator current is not within limits, check the components for proper value. After the above adjustments have been completed, recheck the output current and readjust it as necessary. Never operate the set for more than a very short period of time if the cathode current is high . . . the flyback as well as the output stage may be damaged.

When working with problems in the output and damper stages, keep in mind the sequence of operation discussed earlier. The damper causes deflection from the left side of the screen toward the center, while deflection from the center to the right-

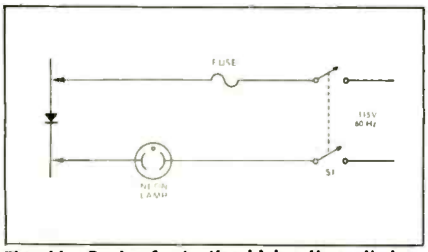


Fig. 11—Device for testing high-voltage diodes.

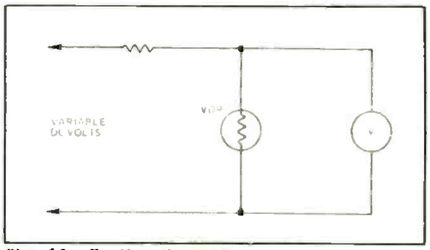


Fig. 12—Testing the VDR.

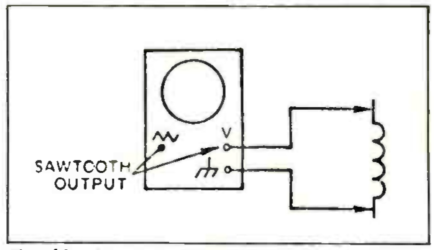


Fig. 13—Sawtooth test of inductors.

hand edge is accomplished with output stage current. Distortion at the left of the screen can usually be attributed to the damper circuits, while distortion on the right side is usually caused by defects in the output stage.

Since the damper furnishes the DC supply for the output stage (and for other stages in some sets), loss of the damper will naturally cause a failure of the stage. A shorted damper capacitor may cause a loss of boost voltage. An open boost capacitor will eliminate the high voltage.

Transformer Troubles

Defects in the yoke can cause abnormal output voltages as well as a distorted raster. In sets employing series yokes (Fig. 10), an open yoke winding will cause a loss of horizontal deflection. A shorted yoke will cause a keystone-shaped raster or other distortions. If parallel horizontal yoke coils are used, as in solid-state sets, an open in one yoke coil will cause a distorted raster and a short will decrease raster width. If there are many turns in the yoke shorted, the high voltage may be completely missing.

A ringing yoke—one that tends to oscillate—will usually cause the horizontal scanning lines to appear wavy near the left edge of the screen. This problem can usually be traced to the capacitors in the yoke. Replacement of the capacitors will cure the problem.

Defects in the horizontal output stage or flyback transformer will generally affect the entire deflection system. If only a few turns are shorted in the flyback, the focus, high-voltage, and boost voltages will all be low. Usually, the width will also be reduced. The greater the number of turns shorted, the greater the loss of high voltage. Don't overlook the possibility of shorts in secondary windings such as the AGC takeoff. These shorts can also result in high-voltage defects. Most shorts will cause heavy conduction in the output stage. Voltage checks and waveform observation at the various connections to the output stage will usually pinpoint any problems in this area.

Just as in other sections of the receiver, a point is reached in this troubleshooting procedure when individual components must be tested. Due to the high power in the horizontal deflection system, standard tests cannot be used on some components. Tube testers may be fine in some instances, but in this section the best tube tester is the *set itself*. Use either in-circuit voltage tests or tube substitution.

Solid-state rectifiers have replaced vacuum tube rectifiers in many sets. Due to their high-voltage characteristics, these diodes do not respond to conventional front-to-back resistance measurements that can be used with their low-voltage counterparts. The circuit in Fig. 11 may be used to test high-voltage rectifiers for proper operation. After the rectifier has been connected to the test circuit, close switch S1. Only one element in the lamp should light, indicating DC. Should both elements light, the diode is shorted. When the rectifier is open, neither element will light.

Voltage-dependent resistors attempt to keep the voltage across them constant; therefore, a test such as shown in Fig. 12 can be used as a quick check of VDR operation. As the DC input voltage is increased, the voltage across the VDR should increase very slowly. If the voltage increases linearly, the VDR is defective. A more accurate test can be made by using the VDR's specified voltages as inputs and plotting the IR drop across the VDR. Comparing this chart with the specification sheet will reveal any defects.

Some deflection circuits contain another type of variable resistor known as a *thermistor*. The thermistor is a *temperature* sensitive resistor whose resistance usually decreases with a rise in temperature. This device may be tested by applying the temperatures listed in the specification sheet and comparing the resistance across the thermistor with the stated resistance. A quick check can be made by holding a soldering gun near the device and measuring the resistance. Be careful not to actually bring the soldering gun in contact with the thermistor nor to overheat it.

Although a resistance check of the windings will readily reveal an open in an inductor, seldom will the test reveal the presence of a few shorted turns. There are test instruments on the market that offer an easy means of testing such components.

Sawtooth testing is a convenient way of making a quick check of inductors. Remove any resistance in parallel with the inductance and connect the vertical input to the scope, as shown in Fig. 13. Jumper the sawtooth output of the scope to the vertical input. The horizontal sweep of the scope should be set to the operating frequency of the inductor—60 Hz for power transformers, for example. Normally, a slowly damped train of oscillations will be evident on the scope. If there are turns shorted in the inductor, the oscillations are damped very rapidly, and only a few alternations are present. This test is fast, but requires a lot of experience in judging the scope presentation. Try this on various inductors at different frequencies to see how an inductor should respond at various frequencies.

Keep in mind that one of the fastest and most accurate means of component testing is component substitution. ■

TECH BOOK REVIEW

Title: Logical Color TV Troubleshooting (TAB BOOK No. 690)
Author: Ben Gaddis
Price: $8.95, hardbound; $5.95, softbound

Published: August 1974
Size: 240 pages, 151 illustrations

This unusual new book combines TV theory and repair know-how, and covers every aspect of TV circuit troubleshooting from a *practical common-sense* point of view. It is very difficult to get so much information in one book . . . that's why it's so rarely done and why this is probably the first book on TV receivers that is at once universal and understandable.

Starting with a systems approach to color TV, author Gaddis concisely explains the receiving and transmitting subsystems and how the TV signal conveys information between them. Then, it's on to a functional description of the color TV receiver and a down-to-earth introduction to troubleshooting.

The author shows how to use the receiver itself as a valuable test instrument for TV troubleshooting. The screen becomes, in essence, an "oscilloscope" any servicer can use to interpret symptoms with unerring accuracy. The text also explains the need for such test instruments as dot-bar and sweep-marker generators, vectorscopes and oscilloscopes, CRT testers, color TV analyzers, flyback and capacitor checkors, etc.

Once the trouble has been isolated to a stage, the next step is to find out which parts to replace. This often requires a thorough knowledge of circuit theory. Accordingly, Mr. Gaddis has included an entire Chapter on tuners, one on IF amplifiers, another on the color section, and so on—in short, there is a whole chapter devoted to each section of the b-w or color receiver. From tube circuits to integrated circuits —nothing is overlooked. Just about any circuit one can name is explained and illustrated for easy understanding. Complete information on resistance and voltage checks is also included. ■

CONTENTS: Troubleshooting — Test Equipment — TV Signal — Raster Symptoms — Color Receiver — Controls — Setup Procedure — Waveforms — Tuners — IF Stages — Alignment — TV Sound — Video Section — Sync and AGC — Deflection Systems — Convergence — Purity Adjustment — Vertical section — Horizontal and High-Voltage Sections — Color Section — Power Supplies — Voltage Checks — Resistance Checks. ■

TECHNICAL DIGEST

The material used in this section is selected from information supplied through the cooperation of the respective manufacturers or their agencies.

ADMIRAL

Color TV Replacement Modules

The chart lists the replacement modules for current solid-state modular TV chassis.

Note that there is no column for the M10 chassis. There are three replacement boards for the 3M10 and 4M10 chassis; all other boards are wired into the chassis and are to be repaired, not replaced. The three boards available for replacement are:

M600	Vertical	A8952-2
M700/800	RGB/Horizontal	A8951-2
M1000	Pincushion	A8954-3

* Starting at Run 13, the M25 chassis used a new IF module, A8919-2, and a 4.5 MHz amplifier, A8931-1. If you need a replacement for Run 12 or earlier, use A8919-2 or -4 plus A8931-1 (Orders for A8919-1 will be filled with A8919-2 or -4 plus A8931-1).

** IF modules A8919-2 & -4 include M200A, A8930-1, 39.75 MHz trap. The -4 can sub for -2.

A8923-4 will replace -1 or -3; A8923-3 will replace -1. Do not sub lower dash number for higher dash number.

A8926-1 and A8926-4 are interchangeable; either may be replaced by the other.

@ Substitute A8926-3. Do not sub -5 for -3.

@@ A8923-4 was used in Run 10 through Run 12. A8926-5 was used in Run 13. The only difference in the two boards is that resistors R145, R146 and R147 were in the CRT socket leads (at the plug) in Runs 10 through 12; in Run 13, they are placed on the board and become R745, R746 and R747.

Color TV Chassis G11/G13/H10/H12/K15—Service Hint

If the Left Blue Horizontal control, R601, overheats make the following changes:

Replace the 2 w, Left Blue Horizontal control, with a 3 w control, No. 75A64-39. Add a 30 Ω, 5 w resistor, No. 61A20-95, in series with either side of control R601 by cutting the foil and adding the resistor on the back side of the board. Make a good mechanical connection, then solder. This change was made in production as shown in the illustration. Also change coil T601 (on convergence board) if it has been overheated.

When ordering replacement parts for the convergence board components, check the service manual for the model being serviced; components are not the same on all boards.

Color TV Chassis M25/M24—Service Hint

A condition of no vertical sweep and no sound can be caused by the following defective components.

In some cases, vertical output transistors are being replaced unnecessarily. If you encounter the condition of no vertical sweep on the mentioned chassis, check for absence of sound. If the sound is also missing, check diode D105 and resistor R116, 8.2 Ω, 3w. The B+ 25 volt voltage source is scan-derived and diode D105 is mounted on the high voltage transformer.

Color TV Chassis K18—Service Hint

A 60 Hz hum bar in the picture can be caused by an open or poor solder joint at capacitor C337 (100mfd, 30 volt, Part No. 67A200-101-5).

Color TV Chassis G11/G13/H10/H12/K15—Service Hint

If a symptom of insufficient vertical sweep, picture up from the bottom approximately four or five inches is noted, make the following changes:

Capacitor C606, 50mfd, 150 volts may have an open or poor solder connection. Check the screws making the ground connection between the foil on the board and the bracket. Capacitor C602, 50mfd, 10 volts can cause vertical jitter at the bottom of the picture as it opens. If the capacitor is open, picture will be up at the bottom and red/green vertical lines will not converge. These parts are found on the convergence board.

Color TV Chassis 4M10—Service Hints

If poor AFC performance is observed in this chassis, the discriminator coil, L217, should be adjusted to enable the AFC to pull in to the correct tuning point. All available channels should be checked for performance after this adjustment.

If a 920 KHz beat is observed on the low channels, the RF AGC Delay control, R319, should be checked for the 0.1 volt rise setting.

In the event that either of the above conditions is not corrected by the recommended action, the overall IF alignment should be checked and realignment performed where necessary.

MAGNAVOX

Color TV Chassis T981/T982—Resistor R303 Location Change

The electrical location of resistor R303 has been changed in these chassis and it is recommended that all chassis without this change be modified as preventative maintenance when they are in the shop for service. Use the following procedure and accompanying illustrations to change the electrical location of resistor R303.

1) Unplug the set and remove the cabinet back. 2) Remove the lead of resistor R303 from capacitor C300. 3) Remove jumper B7 from the bottom master PC board. 4) Remove the wire from point W11 and solder this wire into one of the PC board holes left vacant by the removal of B7. 5) Install a piece of insulated wire from the other vacant B7 hole to the free lead of R303. Solder both ends of the wire. 6) Install a piece of insulated wire from W11 to the junction of C300 and R300. Solder both ends of the wire.

NOTES: A) Dress wires on top of master PC board and toward the front of the instrument. B) Resistor is not used on the T987 chassis.

Color TV Chassis T989—6F Remote, 120 Hz Hum Bars

Some six-function, remote color TV chassis T989 exhibit 120-Hz hum bars because of a ground loop. These bars are most noticeable on UHF channels. The problem is corrected by placing a jumper wire between the grounds at pin 5 and 15 on plug P/J2.

This plug is located among the three molex plugs behind the power supply filter capacitors. Plug P/J2 is the center plug, and pins 5 and 15 each serve as a ground for shielded wires.

Color TV Chassis T981/2/7—Loss of Flesh Tones

A defective capacitor, C154, can be the cause of loss of flesh tones in these chassis. Capacitor C154 is a 180-pf, polystyrene capacitor mounted on the signal board, between the Chroma Demodulator module and the Chroma Processor module. Since the capacitor is polystyrene, it is subject to degradation from excessive heat, flux, cleaning solution, etc. ■

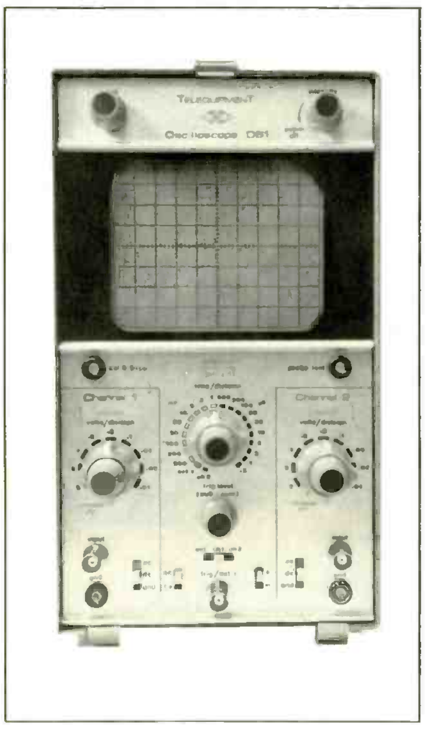
TEST INSTRUMENT REPORT

TELEQUIPMENT MODEL D61 DUAL-TRACE SCOPE

■ Simplified controls which make waveform measurements easier and quicker highlight the many features of Telequipment's Model D61 dual-trace, triggered-sweep, all-solid-state, 10-MHz oscilloscope.

The need for continuously variable external vertical gain controls and manual gain calibration have been eliminated in the D61 by use of 9-position, detent-type "volts/division" controls which are internally precalibrated in each position. The 9 positions and the 5-2-1 sequence in which the positions are precalibrated provide vertical sensitivities over a range of .01 volts p-p per division to 5 volts p-p per division of the 8-centimeter-high screen graticule. Because the gain from one position to the next is never more than 2½ times, a continuously variable external gain control is not needed.

The concentric position traditionally occupied by the continuously variable vertical gain control on most other scopes is occupied on the D61 by the vertical *positioning* controls. (Rotating either of the vertical positioning controls completely counterclockwise until it clicks eliminates the respective trace.)



For more information about this test instrument, circle 900 on the Reader Service Card.

The design of the D61 also has simplified the selection and adjustment of the horizontal sweep rate. A detent-type "time/division" switch which provides 19 precalibrated sweep ranges from .5 microsecond per division of the 10-centimeter-wide screen graticule to 500 millisecond per division has eliminated the need for a continuously variable external horizontal sweep control.

The concentric position usually occupied by the continuously variable horizontal sweep control on most scopes is occupied on the D61 by the horizontal *positioning* control, which, when pulled out, magnifies (increases) the sweep rate by a factor of 5.

The horizontal sweep ("time/division") control of the D61 also has two additional positions, labeled "ext x" and "ch 2." In the "ext x" position, an external sweep signal from the "trig/ext x" jack on the front of the scope is applied to the horizontal amplifier. In the "ch 2" position, the output of the channel 2 vertical amplifier is applied to the horizontal amplifier, making it possible to use both the channel 1 *and* channel 2 vertical amplifiers and their respective gain controls to establish equal horizontal (X) and vertical (Y) deflection sensitivities during X-Y displays such as color vector patterns. Because the X and Y deflection sensitivities can be equalized, the resultant vector display provides clearer and more meaningful indications of vector pedal amplitudes and their relative phases. (The phase difference between the channel 1 and 2 vertical amplifiers is less than 1 degree at 50 KHz.)

The D61 operates in one of two different modes of dual-trace operation, either "chopped" or "alternate." The mode is automatically selected by the setting of the "time/division" control. When the "time/division" control is in any of the eight sweep positions between "2ms/div" and "500ms/div" or is in the "ext x" position, the channel-switching circuit operates as a free-running multivibrator and "chops" between the outputs of the two vertical amplifiers at a rate of approximately 100 KHz. When the "time/division" control is in any of the eleven positions between ".5μs/div" and "1ms/div," the channel switching circuit operates as a bistable multivibrator and switches the vertical output amplifier from one vertical channel to the other at the end of each horizontal sweep. This is called the "alternate" mode.

The time base of the D61 can be operated in either a triggered mode, in which no horizontal trace is produced on the screen unless a trigger signal is applied to the trigger circuit, or the time base can be operated in an "auto," or free-running, mode, in which a horizontal trace is produced on the screen even when no trigger signal is present. The "auto" mode is selected by pulling out the "trig level" control, which is located immediately below the "time/division" control. (During "auto" operation, if trigger pulses above 10 Hz are applied to the trigger circuit, the time base automatically reverts to the normal triggered mode.)

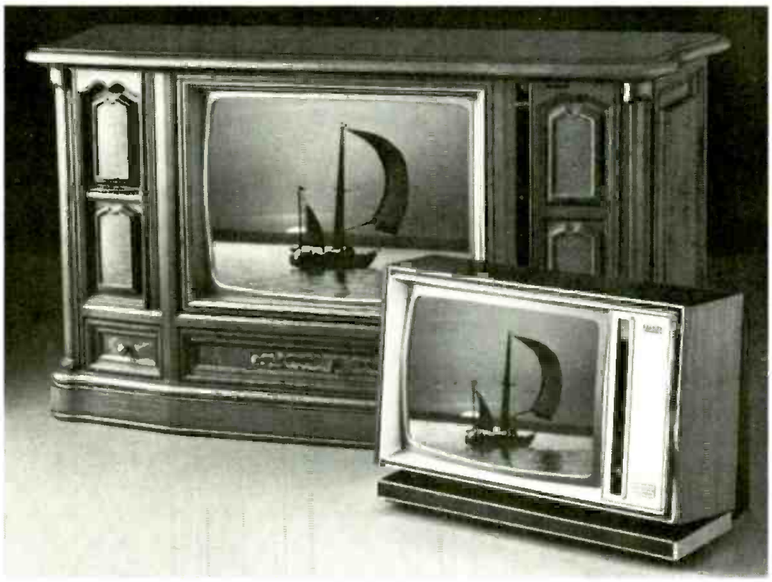
A three-position switch immediately below the "trig level" control selects the *source* of the trigger signal whenever the "time/division" control is in any position other than "ext x" or "ch 2." When the three-position switch is in the "ext" position, an external trigger signal can be applied to the trigger circuit via the "trig/ext x" jack. In the "ch 1" and "ch 2" positions of the switch, the signal from the respective vertical amplifier is applied to the trigger circuit.

Either the negative or positive slope of a signal can be used to trigger the time base. The desired trigger polarity is selected by the "+/−" switch, located immediately to the right of the "trig/ext" jack.

The D61 is equipped with provisions for automatically triggering the time base at either the TV horizontal line or field rate, depending on the setting of the "time/division" control. When the "time/division" control is in any position other than "ext x" or "ch 2" and the "ac/tv" switch is in the "tv" position, one half of the Schmitt trigger in the trigger circuit operates as a sync separator which drives the other half, the time constant of which is dependent on the setting of the "time/division" control. If the "time/division" control is any position between "200μs" and "500ms," the time constant is long, and the time base is triggered at the TV *field* rate. If the "time/division" control is in any position between "50μs" and ".5μs," the time constant is reduced, and the time base is triggered at the TV *horizontal line* rate. (When the "ac/tv" switch is in the "ac" position, the Schmitt trigger and other trigger circuits function in the normal triggered mode.)

The "input" signals to the attenuators of the two vertical channels can be either AC or DC coupled from the "input" jacks, depending on the position of the respective "ac/dc/gnd" switch. In the "gnd" position of these switches, the respective input circuit is opened and the vertical amplifier input is grounded, providing a convenient zero reference trace without the need for disconnecting and

In times like these, it makes even more sense to choose a Zenith. For 6 good reasons.



Left: The Cézanne, model SF2569P. Right: The Daumier, model SF1750R. Simulated TV picture.

These days, you're probably more determined than ever to make sure you're getting your money's worth.

That's why the things that have made a Zenith color TV such a good value are even more important today.

1. Fewest repairs.

A leading research organization asked independent TV service technicians from coast to coast which color TV needed fewest repairs. For the third straight year, they named Zenith, by more than 2 to 1 over the next brand.

Question: In general, of the brands you are familiar with, which one would you say requires the fewest repairs?

Answers:

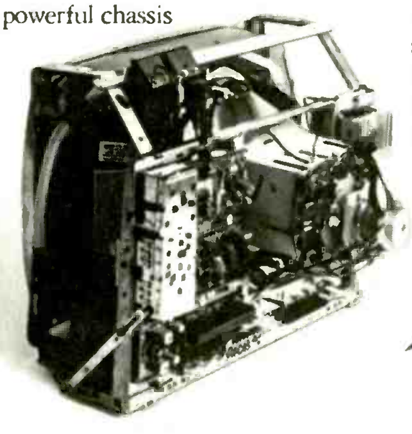
Zenith	**34%**
Brand A	15%
Brand B	11%
Brand C	7%
Brand D	4%
Brand E	3%
Brand F	2%
Brand G	2%
Brand H	2%
Brand I	1%
Other Brands	3%
About Equal	16%
Don't Know	9%

Note: Answers total over 100% due to multiple responses.

And whether you buy a giant-screen console or compact portable, today's Zenith solid-state Chromacolor II brings you several important features designed to give you years of good, dependable service.

2. 100% solid-state reliability.

Built into every Chromacolor II set is a rugged 100% solid-state chassis. The most powerful chassis Zenith has ever built, for a brighter, sharper picture. Modular solid-state design keeps it running cool so it lasts longer, makes service easier if it's needed.



And Zenith's patented Power Sentry voltage-regulating system protects components against household voltage variations you can't even see.

3. Saves energy.

Many color sets, 3 or more years old, use about as much power as five 75-watt light bulbs. Chromacolor II actually uses less power than you'd need to light just two of the same bulbs.

The money you save won't pay for your new Zenith. But it'll help.

4. Best picture.

The heart of the Chromacolor II system is Zenith's patented Chromacolor picture tube, with a level of brightness, contrast, and sharp detail that set a new standard for the TV industry. Which may be one reason why independent TV service technicians name Zenith, more than any other brand, as the color TV with the best picture.

5. Owner satisfaction.

For a lot of people, though, the best reason for choosing a Zenith is also the simplest.

They already know Zenith quality because they already own a Zenith.

Fact is, in another recent nationwide survey, more Zenith color TV owners said they'd buy the same brand again than did the owners of any other brand.

Question: If you were buying another color TV today, would you buy the same brand you bought before?

Answers:

Zenith	**82%**
Brand A	70%
Brand D	69%
Brand B	66%
Brand E	63%
Brand C	56%
Brand F	51%
Brand J	49%
Brand H	49%
Brand G	47%
Brand I	45%
Other Brands	40%

And that, we think, says more about the way we build things than anything else.

6. We built it. We back it.

We're proud of our record of building dependable, quality products. But if it should ever happen that a Zenith product doesn't live up to your expectations—or if you want details of our surveys—write to the Vice President, Consumer Affairs, Zenith Radio Corporation, 1900 North Austin Avenue, Chicago, IL 60639.

He'll see that your request gets personal attention.

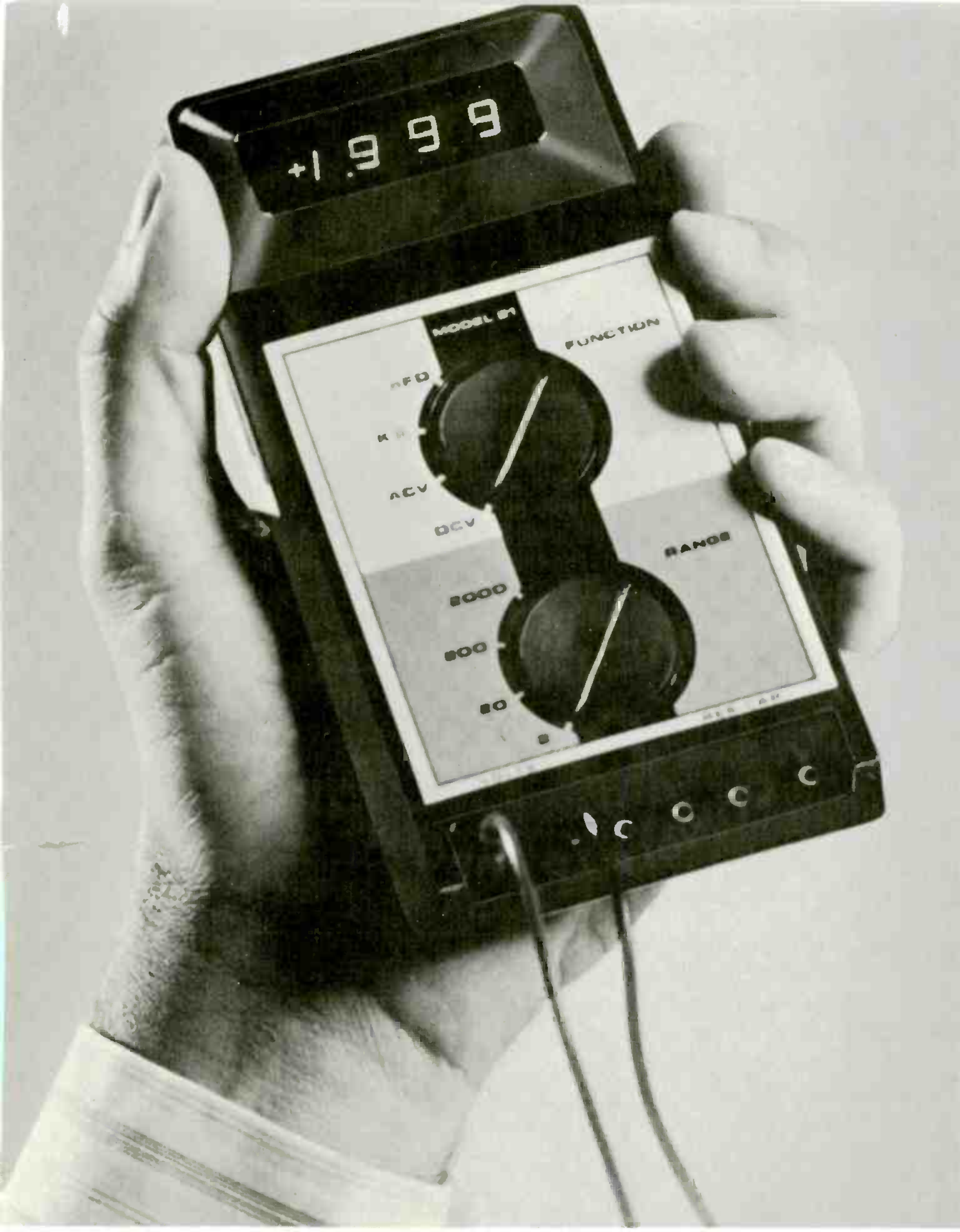
And in times like these, that means something, too.

ZENITH®

SOLID STATE CHROMACOLOR II®

The quality goes in before the name goes on.®

. . . for more details circle 131 on Reader Service Card



For more information about this test instrument, circle 901 on the Reader Service Card.

grounding the test probe.

A 60-Hz, 500 mv p-p square wave accurate to within 1 percent is available at the "cal 0-5vpp" jack on the front panel of the D61. This square wave can be used to check the internal calibration of the vertical channels or it can be used for triggering the sweep at the line frequency.

A negative-going rectangular pulse at a frequency determined by the timebase setting of the scope is available at the "probe test" jack on the front panel. This pulse can be used to quickly check the frequency compensation of test probes used with the D61.

The display of the D61 can be intensity (Z-axis) modulated by applying a 10-volt or larger signal to the AC-coupled "Z-MOD" jack on the back panel of the instrument. A negative-going signal blanks the display, and a positive-going signal intensifies it.

The Telequipment D61 scope is equipped with a 5-inch CRT (standard P31 phosphor) and an 8 by 10 centimeter graticule. The CRT accelerating anode potential is 3.5 Kv. The scope is 6¼ inches wide by 11¼ inches high by 16 inches deep and weighs 14.3 lbs. Price is $475.

DATA TECHNOLOGY HANDHELD DMM

If a combination of rugged portability, versatility and an easy-to-read display are what you are looking for in a digital multimeter, Data Technology's Model 21 palm-size, 3½-digit multimeter might be the answer.

This battery powered instrument is capable of measuring DC voltages (1mv to 1000v), AC voltages (1mv RMS to 707v RMS) and resistances (1 ohm to 2 megohms) *plus capacitances* (1pf to 2 microfarad). Input impedance in the DC measuring mode is 10 megohms, and 10 megohms shunted by 40 pf in the AC measuring mode.

Although the Model 21 itself is only 6.8 inches long by 3.25 inches wide by 1.75 inches thick, its light-emitting diode (LED) display is an easy-to-read .27 inches high.

The Model 21 is powered by four rechargeable nickel-cadmium "AA" batteries. The external battery charger supplied with the instrument fully charges the batteries within 14 hours. (The charger DC output is plugged into a jack on the left side of the instrument.)

A power-saver, push-to-read switch on the right side of the Model 21 makes possible up to 2000 readings between rechargings. Or, if you prefer, the push-to-read switch can be locked in the "on" position, for up to 1 hour of continuous, hands-off measurements before recharging is necessary.

A choice of three battery chargers are available with the Model 21, for recharging from either 115v, 100v or 230v AC sources.

The four measurement functions of the instrument are selected by a single, four-position, rotary switch. The four ranges (2, 20, 200 and 2000) of the instrument also are selected by a four-position rotary switch.

When the quantity being measured exceeds the range selected, the overrange condition is indicated by continuous flashing of the display. (In the capacitance measuring function, an overrange condition which exceeds the next higher range is indicated by blanking of the three least significant digits.)

Input to the Model 21 is via two separate pairs of miniature banana jacks on the bottom front of the instrument. One pair is for AC and DC voltage measurements, and the other pair is for resistance and capacitance measurements. (The extra pair of jacks between the two "regular" pairs is for an optional probe equipped with a separate push-to-read switch. The optional probe is available for $10.)

A tilt-up bail on the bottom of the case serves as a convenient prop-up stand when the unit is not being handheld.

The surface of the Model 21's impact-resistant polycarbonate case is textured to reduce the chance of slippage when the unit is handheld.

Price of the Model 21, complete with battery charger and a carrying case which can be clipped to your belt, is $269. An optional high-voltage probe, for voltage measurements up to 30Kv, is available for $15. ■

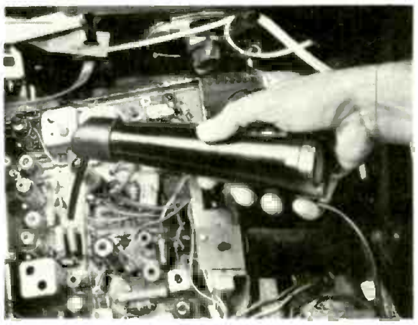
NEW PRODUCTS

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.

THERMAL SPOT TESTER 700

Approaches the problem of thermally caused intermittents

Wahl Clipper Corp. has added the Thermal Spot Tester to their electronic product line. The tester approaches the problem of thermally caused intermittents logically—no heating and then

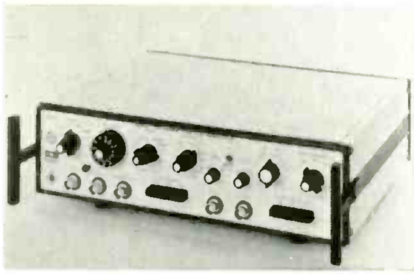


artificially cooling the component with sprays. The tester directs heat to the suspected capacitor or transistor, one component at a time and heats them as in normal operation. The manufacturer used its dryer background and built a product to meet a specific need. The unit is small, lightweight, easy to use and carry. Retail price $21.95.

FUNCTION GENERATOR 701

Flexibility combined with excellent generator capabilities

The Model 129 function generator, introduced by **Exact Electronics Inc.**, offers more waveforms and versatility. A carrier generator produces sine,



square, triangle, positive pulse, negative pulse, and positive sine waveforms from .1 Hz to 5 MHz, while an internal AM/FM generator produces square, triangle and sine waveforms from 1 Hz to 1MHz for modulating the carrier generator. The carrier may be manually, externally or internally gated or triggered. A pulse mode allows variable width and repetition rate to be set as desired, while a burst mode allows variable burst widths to be set utilizing the burst width control without affecting the carrier frequency or repetition rate. FSK (Frequency-Shift Keying) and PSK (Phase-Shift Keying) extends the generator capabilities even further. FM width is variable from 0 to ± 500:1 about a center frequency utilizing either the square, triangle, or sine waveform of the AM/FM generator. AM modulation is adjustable from 0% through 100% providing double sideband suppressed carrier capability. Simultaneous AM/FM allows independent control of amplitude modulation and frequency modulation simultaneously without any additional generators. Price is $795.

DIGITAL MULTIMETER 702

Features 4½ digit readout and 21 function-range operation

The Model 1450 4½ Digit Multimeter introduced by **Data Precision Corp.** is a full-function, bench-model multimeter featuring ½-inch, seven-seg

continued on next page

NEW PRODUCTS...

continued from preceding page

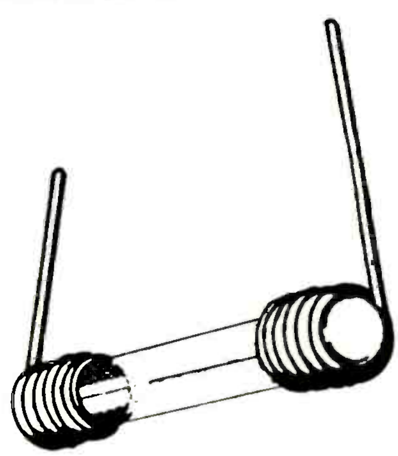
ment planar display, 100% overrang-

ing and 21 function-range operation. DC volts are measured from 100 microvolts to 1000 v; AC volts from 100 microvolts to 500 v RMS; resistance from 100 milliohms to 20 Megohms; and current, both AC and DC, from 1 microamp to 2 amps. Frequency response for AC current and voltage is from 30 Hz to 50 KHz. Basic accuracy on DCV is ± 0.02 percent of reading ± 0.01 percent full scale, ± 1 digit. Overload protection of ± 1000 volts is achieved electronically on all DC ranges; 500 volts on all AC voltage ranges; and 115 v DC or AC on all resistance ranges. Current is protected to two amperes with a rear-panel-mounted fuse. Common mode protection is 500 v DC or peak AC with CMRR of 120 dB at DC, greater than 100 dB at 50 and 60 Hz. The meter measures 8½ inches wide by 3½ inches high by 7¼ inches deep without the handle assembly. Price is $325.

FUSE ADAPTER 703

Converts pigtail fuses to standard 3 AG fuses

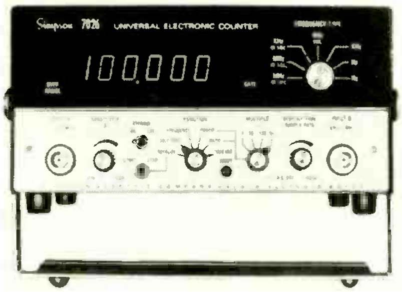
A permanent replacement adapter, introduced by **Workman Electronics**, converts pigtail fuses to standard 3 AG fuses. The conversion is made by connecting the spring ends to the lead wires, then simply insert the fuse ends into the spring coils. The adapters are available in a package of 12, Model 33-125 or display card of 12 packages. Model 33-125-12.



ELECTRONIC COUNTER 704

Features bright planar readout

An electronic counter, Model 7026, is introduced by **Simpson Electric.** It has a total display range of 1 to 1999999, a frequency range of 5 Hz to 50 MHz, and is guaranteed accurate to ± 1



count. The unit has been designed and engineered for line voltage operation. The compact, lightweight unit measures 4 inches high by 8½ inches wide, by 8 inches in depth and weighs approximately 6.5 lb. It has an operating temperature range of from −40° C to +70° C. A new .55 inch high bright planar readout can be read easily from a distance of several feet. The sample rate is continuously adjustable from five readings per second to hold. Hold input on optional rear panel connector provides sampling by either contact closure or external potentiometer with display storage being selectable by rear panel switch.

OVER-VOLTAGE PROTECTOR 705

Protects electronic equipment against damaging voltage transients

A solid-state device to protect home entertainment equipment against potentially damaging voltage transients is a new profit-maker for electronic service dealers. It is being made available through authorized entertainment semiconductor distributors by the Distributor Sales Operation of **General Electric's Tube Products Department,** Owensboro, Ky. Called GE-MOV, the device is a metal oxide varistor (voltage sensitive resistor) which responds to voltage transients in 50 billionths of a second, absorbs them, and dissipates them as heat. It is designated GE-750. When wired-in to the main power circuit of a television, or stereo or tape player system, it will protect against voltage spikes, line surges and many lightning created surges. The device will not protect equipment against a direct lightning hit. Each device is individually packaged in a clear plastic bag with installation instructions and a self-adhesive label to be affixed to the equipment. ■

DEALER SHOWCASE

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.

AUTO STEREO CASSETTE PLAYER 706

In-dash player with FM/AM/FM multiplex

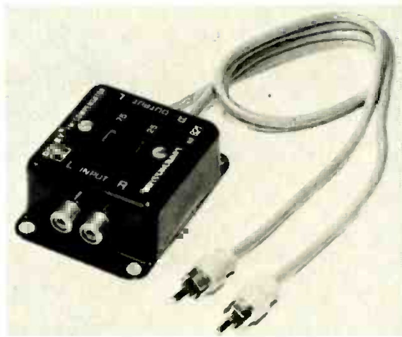
Panasonic has added a stereo cassette player with built in AM/FM multiplex to its car cassette line. The Model CQ-840 is a compact cassette car entertainment center offering adjustable control shafts that permit mounting in

almost any dashboard, a radio with AM antenna trimmer and FM distant/local switch. Other features include a stereo indicator light, fast forward control and tape ejector that switches radio on automatically. Price is $149.95.

DOLBY FM COMPENSATOR 707

Provides direct listening pleasure for Dolbyized FM broadcasts

Switchcraft, Inc., has introduced a 2-channel compensator for enhanced direct listening pleasure for Dolbyized FM broadcasts. The Model 621 Dolby FM Compensator changes conventional 75 microsecond FM de-emphasis

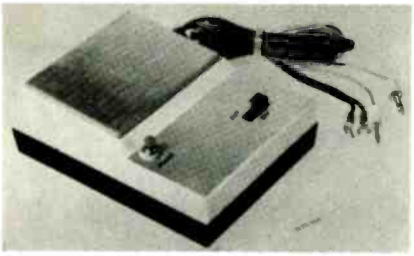


characteristic to the 25 microsecond characteristic used in Dolbyized FM broadcasts. The unit should be used by listeners now using Dolby circuits in free-standing noise reduction receivers or tape recorders so that these Dolby circuits can function properly. The compensator permits: 1) Listening to decoded Dolby FM broadcasts with a separate Dolby B-type noise reduction unit. 2) Recording Dolby FM broadcasts in B-type encoded form. 3) Listening/recording Dolby FM broadcasts with a separate Dolby B-type noise reduction unit. Installation of the unit is simple: "record out" leads from receiver, amplifier or tuner that are connected to "line in" jacks or recorder are disconnected. "Record out" leads are connected to the compensator input jacks and compensator is then connected to output leads of recorder or noise reduction unit. Price is $12.95.

TELEPHONE AMPLIFIER/MONITOR 708

Automatically records incoming and outgoing conversations

Workman Electronics Products, Inc., introduced a battery-operated telephone device called "TELE-SECRETARY" which can be used with any standard portable tape recorder. The telephone amplifier and monitor has three leads extending out, the wire with two alligator clips is connected directly to the telephone or telephone line. The second wire with a small phone plug is the "Remote" wire. The third wire with the larger phone plug is used as the "audio" wire. By connecting the device to both the telephone and the tape recorder, it will automatically record all incoming and outgoing con-



versations. The main purpose of the unit is to start and stop the tape recorder whenever your telephone is being used, even while you are out. The unit can be used on any extension.

IN-STORE SIGN 709

Constructed of brushed aluminum

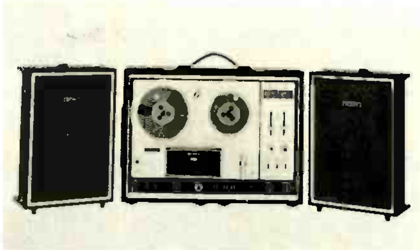
Altec Corp., Sound Products Div., has prepared an in-store dealer sign with the words: "Altec . . . The Sound of Experience." The sign is made of brushed aluminum with the Altec name etched out and appearing in black. The sign measures 24 inches

wide by 12 inches high and is part of a new promotional campaign that includes speaker cutaways, consumer literature and booklets and other point-of-purchase material to reinforce the "experience" theme.

TAPE SYSTEM 710

Completely self-contained, open reel stereo system

A completely self-contained, open-reel tape recording system is introduced by **Sony.** Designated the Model TC-570, the new recorder features Sound-On-Sound and echo recording capability. The tape system includes built-in power amplifiers and two full-range, lid-integrated stereo speakers. Among the features developed for the system are three-head recording/playback for full monitoring capabilities, straight-line record-level controls, record equalization selector switch, and left and right tape/source monitor selector switch. The three-speed unit offers the convenience of a 4-digit tape counter, non-magnetizing record head,



mic and auxiliary inputs, and calibrated VU meters. Price is $499.95.

SMOKE ALARMS 711

The alarm is triggered if its battery is about to be expended

Two smoke alarms, one powered by a battery and the other by electricity, have been added to the family of security products offered by **Mallory Distributor Products Co.**, a division of P. R. Mallory & Co., Inc. The smoke alarms are designed for use in homes, apartments and businesses and can be easily installed. Each alarm is about six and one-half inches in diameter and three inches thick. The battery-powered smoke alarm, the Model SDA-3, is powered by a 12.6-volt DURACELL mercury-cadmium battery (304116). A feature of the battery is that it is engineered to trigger the smoke alarm if its power is about to be expended,

continued on next page

DEALER SHOWCASE...

continued from preceding page

thus calling attention to the need for a replacement battery. The Model SDA-2 smoke alarm operates from standard electrical current. The device

has a built-in pilot light to indicate it is functioning. The Model SDA-2 is priced at $61.60 and the Model SDA-3 is $81.

CASSETTE RECORDER 712

Ideal for educational and visual aid consultants

A full-feature cassette player/recorder, engineered to meet the recommendations of educational and visual aid consultants, has been introduced by **Channel Master**. It incorporates a number of design features to benefit both student and teacher. The recorder, Model 6323, has a digital counter with reset button that permits the student to log specified points within a taped lecture and locate them instantly for playback. A pushbutton pause control permits a student to proceed at his own pace. The unit has a built-in condenser microphone and a full complement of input and output jacks for remote control microphone, private earphone, and auxiliary input. An auto-

matic shutoff protects the unit against excessive wear. The recorder functions on either house current or four "C" batteries. Price is $74.95.

REMOTE CONTROL SPEAKER TIMER 713

Includes a 60 minute timer

A new Remote Control Speaker Timer, Model No. N70-162 from **Workman Electronic Products, Inc.**, allows you to listen in private or through a remote speaker. It will turn a TV set on or off from a distance of 15 feet.

The system contains a 60-minute timer, volume control, TV remote selector switch, 2½ inch full fidelity speaker and 15 feet of five conductor cable with AC cord. Also included is an earphone jack which allows you to plug in an earphone or pillow speaker for private listening. ■

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-CONTENTS-

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Conar—Color Television Chassis, Model 600 with Cabinet, less Picture Tube	25.00
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Electro—Transistor-Power Supply, Model-E3 0-24 @ 100 ma.	10.00
Kine—Color Circuit Analyzer, Model CA378	10.00

Contact: William D. Shevtchuk
1 Lois Avenue, Clifton, N.J. 07014. Phone: 201-471-3798

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We have for sale, copies of old Radio & TV diagrams (Atwater Kent, Crosley, Philco, ATC). Complete Rider Perpetual Troubleshooter Manual. Charges are 25¢ per sheet, minimum order $2.00. Send stamped self-addressed envelope. We also have for sale original old tubes and parts. Hartsville Television & Cable Service, R.D. 1, Hornell, N.Y. 14843.

DYNACO-A-R, transistors, repairs—boards & units, speaker service. Send for prices and details: BEAR ELECTRONICS, 177-ET-Hillcrest Road, Mt. Vernon, NY 10552.

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Complete Construction Plans—TELEPHONE: Answering Device, Automatic Dialer, "Black Boxes," Call Diverter, Call Limiter, Conference Bridge, Central Dial Exchange, Melodic Ringing, Recorder-Actuator, Remote Control, Schematics, Speakerphone, Telelink Burglar Alarm, Voice Scrambler, $3.00 each. ELECTRONIC: Biofeedback Conditioner, Horticulture Stimulator, Multifrequency Encoder Network (Speeds telephone calling 100%!). $5.00 each. ONE YEAR SUBSCRIPTION: Telephone-Electronics Newsline $3.00. Super-illustrated, 16-page catalog of plans, many more, 50 cents. All of the construction plans above, $14.95. TELETRONICS COMPANY OF AMERICA, P.O. Box 3486, Hollywood, CA 90028. USA.

T.V. shop close-out sale: Common Tubes 70% off list price. 20% off list price of Heath Kit Vectorscope, Marker/sweep generator, B & K CRT Tester, Channel Master Field Strength Meter & other misc. items. Postage paid. For more information write: Ainsworth Communications, P. O. Box 23, Ainsworth, Nebr. 69210, or phone 1-402-387-1990.

MANUALS — instruction books for Gov't surplus receivers, transmitters, test sets, scopes, radar. Thousands in stock. Send 50¢ (coin) for large list. Books, 7218 Roanne Drive, Washington, DC 20021.

OLD RADIO SHOWS on cassettes. $1.50 per show. Free catalog. Radio Classics, Box 804, Mattituck, NY 11952.

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PRACTICAL applications of digital IC's. 100's of tips, circuits, projects on TTL. 443 pp. $19.95, money-back guarantee. GEA, P.O. Box 285, Northfield, OH 44067.

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ELECTRONICS book discounts. Save! Free selected, reviewed list. **T/DOC,** Box 340, Centerville, VA 22020.

BUSINESS FOR SALE: Well equipped TV shop with good business, virtually NO COMPETITION, in two-county area, South-Central Georgia. Lucrative, unlimited potential. Admiral dealership and Mastercare Service Center available. Magnavox service also available, possibility of Zenith service contract. Owner has two shops, cannot devote sufficient time to both. Selling most lucrative shop in order to have more time in home area. For full details, write or call (not collect) Mickey's TV Sales & Service, 103 First St. South (Next to Sears), P.O. Box 476, Soperton, GA 30457. Phone (912) 529-4440.

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EVERYTHING you always wanted to know about service contracts, but didn't know who to ask. "THE SERVICE CONTRACT COOKBOOK" only $15.00 postpaid when you ask NATESA, Dept. SC, 5908 S. Troy, Chicago, IL 60629.

CONSTRUCTION PLANS. Digital tachometer, regulated power supply, others. Send 25 cents for listing. MIKRONICS, P.O. Box 338, Dundee, Ill. 60118.

For Sale: One-man shop, Zenith Dealer—in beautiful valley of Mont. Want to retire. John Mednansky, Box 259, Stevensville, MT. Ph. 777-5111.

MUST SELL: Complete inventory of parts and test equipment for TV servicing. Most equipment & parts less than one year old and of latest design. Includes Sam's Photofacts, mostly B & K equipment, & several parts kits and new tubes. Total approx. $6,500 worth. Write—Ron's TV, R.R., Black River Falls, WI 54615. Call—715-284-9569.

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TV Ping-Pong Game. Plays through your set's antenna terminals. Plans $3.25. Also available: 4-channel digital scope plans and others. ARS SYSTEMS, P.O. Box 1922E, Sunnyvale, CA 94088.

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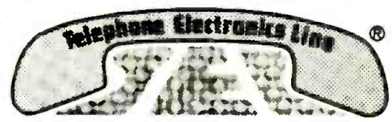

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Wanted: Picture tube rebuilding equipment and supplies. Call or write: George Antimisiaris, 20 Coleville Road, Wayne, NJ 07470. (201) 839-4925.

COLLECTOR WANTS: Collections or dealer's stock of 78 rpm records—jazz, blues, country; 1925 to 1940. Also old comic books. Will travel. Dunner, 11 Golden Hills, Saugus, Mass. 01906.

Wanted: An extra instruction manual for Winston Electronics Corporation DYNAMIC SWEEP CIRCUIT ANALYZER Model 820, or the present address of the Winston Electronics Corporation of Philadelphia. Philip Butler, Box 581, West Brookfield, MA 01585.

WANTED—ELECTRONIC TECHNICIAN, UNUSUAL OPPORTUNITY FOR ONE WELL QUALIFIED IN COLOR TV. TOP SALES AND SERVICE SHOP HAS 40 YEAR REPUTATION. WE MUST REPLACE RETIRING PARTNERS. MUST BE HONEST, EAGER TO LEARN, AND ENJOY SERVING PEOPLE. CONTACT: WELLS & LaHATTE, VICKSBURG, MS. 39180.

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REPAIR TV TUNERS—High Earnings; Complete Course Details, 12 Repair Tricks, Many Plans, Two Lessons, all for $2. Refundable. Frank Bocek, Box 3236, Ent., Redding, CA 96001.

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MOVING? BE SURE TO LET US KNOW YOUR NEW ADDRESS.

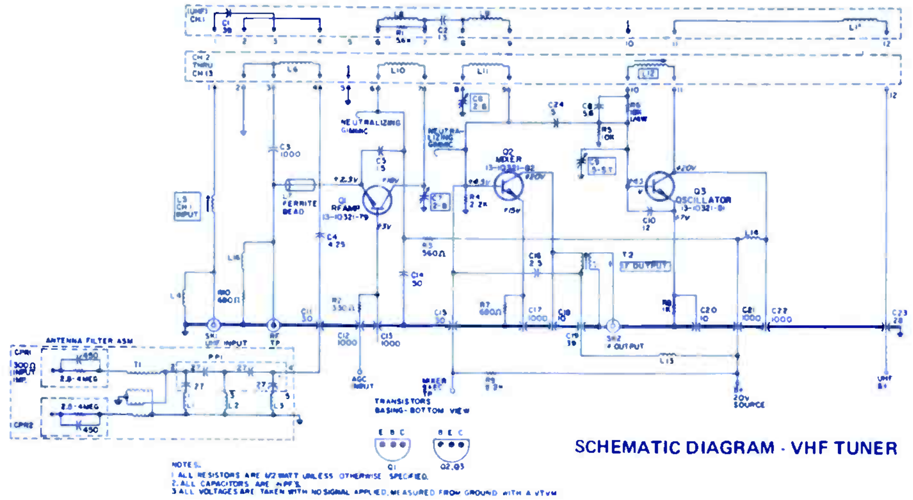
ELECTRONIC TECHNICIAN/DEALER
TEKFAX

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

GROUP **270**

1568
SYLVANIA
TV Chassis A19-1, -2

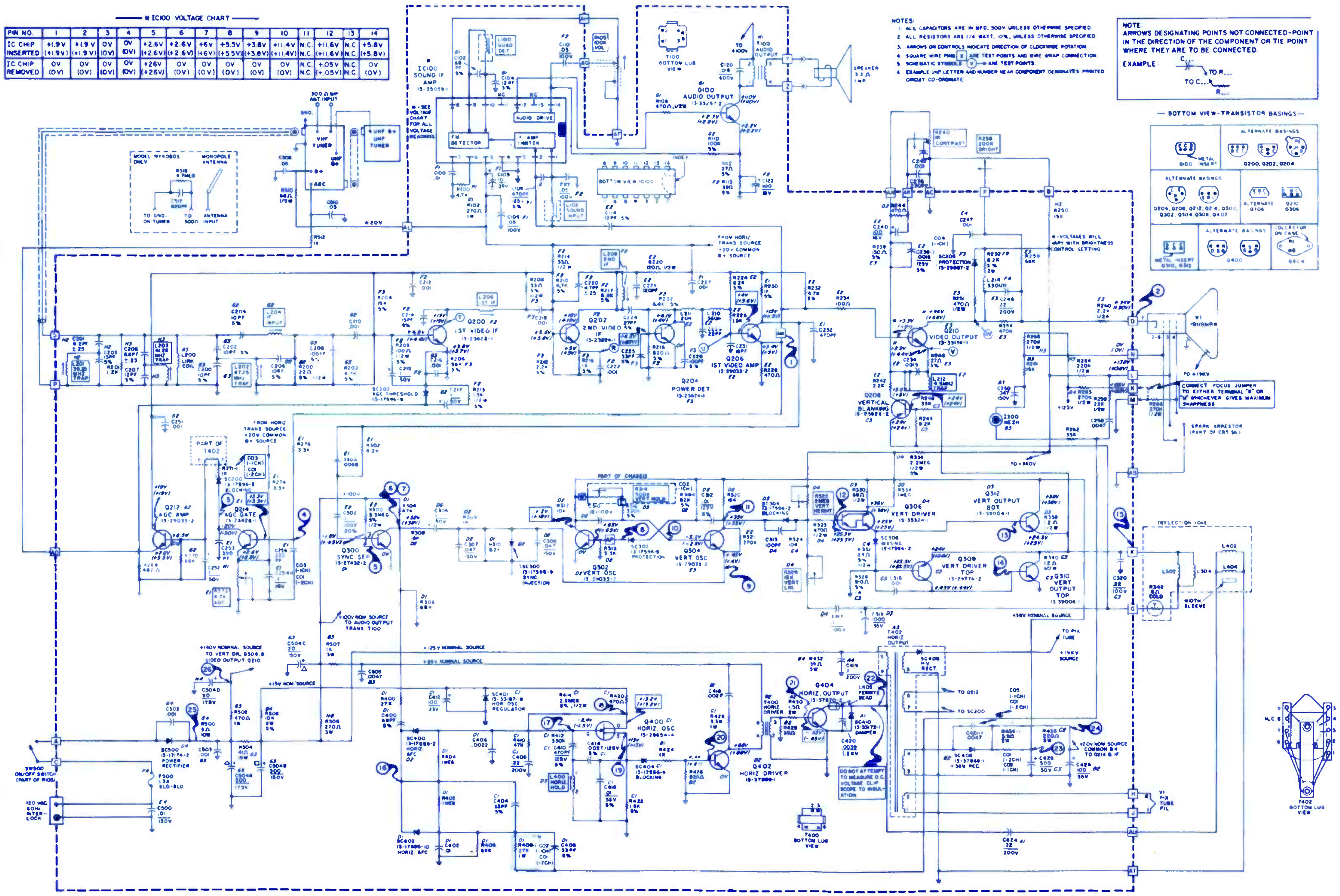
FEBRUARY • 1975

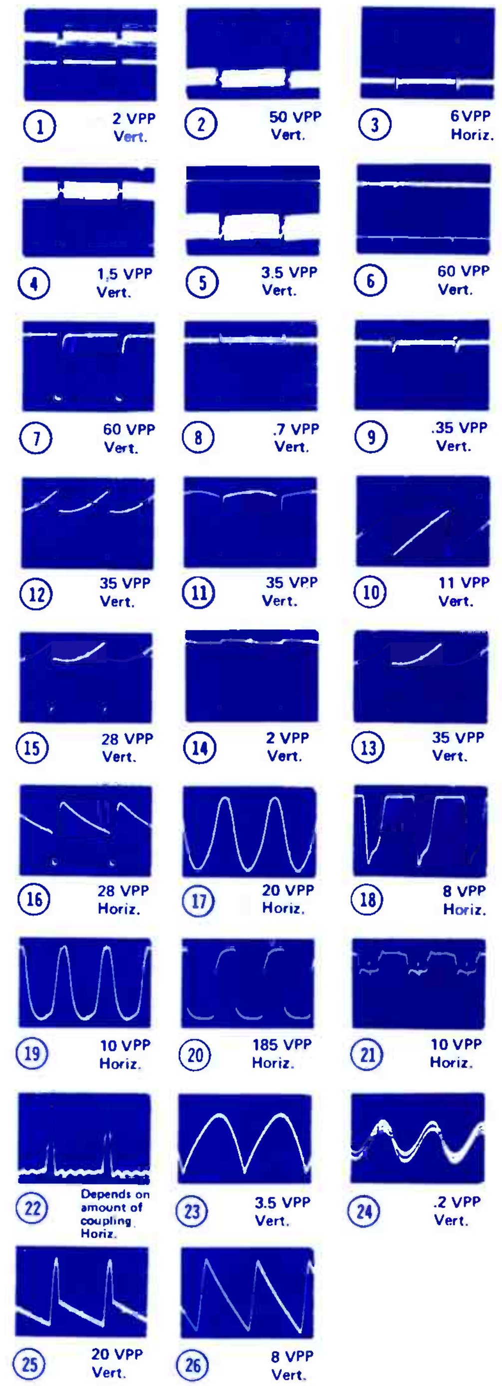


SCHEMATIC DIAGRAM - VHF TUNER

— * IC100 VOLTAGE CHART —

PIN NO.	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC CHIP INSERTED	+1.9V (+1.9V)	+1.9V (+1.9V)	0V (0V)	0V (0V)	+2.6V (+2.6V)	+2.6V (+2.6V)	+6V (+6V)	+5.5V (+5.5V)	+3.8V (+3.8V)	+11.4V (+11.4V)	N.C. N.C.	+11.6V (+11.6V)	N.C. N.C.	+5.8V (+5.8V)
IC CHIP REMOVED	0V (0V)	0V (0V)	0V (0V)	0V (0V)	+26V (+26V)	0V (0V)	0V (0V)	0V (0V)	0V (0V)	0V (0V)	N.C. N.C.	+.05V (+.05V)	N.C. N.C.	0V (0V)





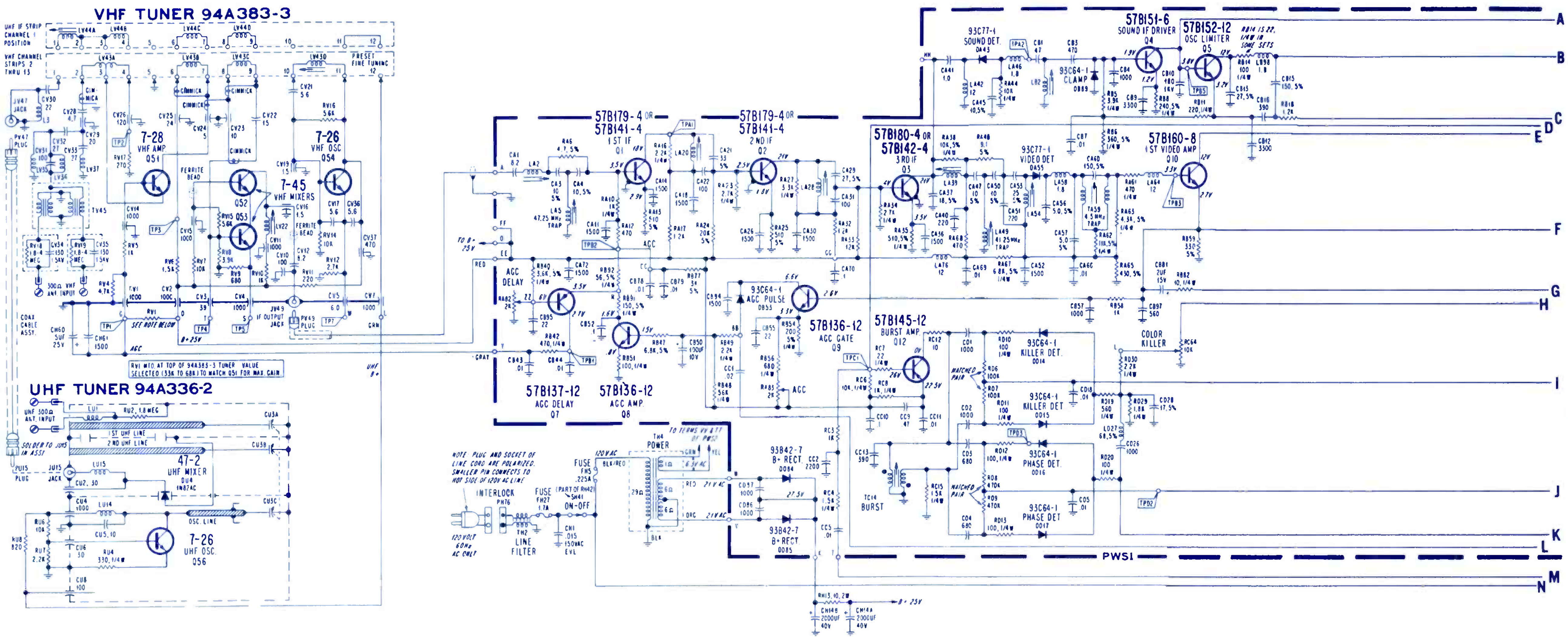
1569

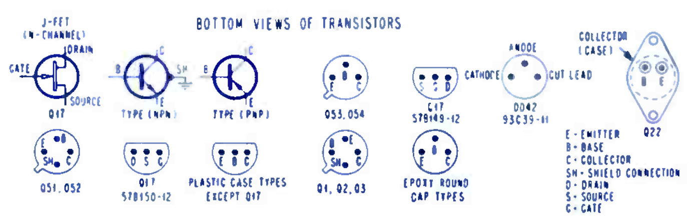
AIRLINE
Color TV Model
GAI-12103B

FEBRUARY • 1975

ELECTRONIC TECHNICIAN/DEALER TEKFAX

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





NOTES: UNLESS OTHERWISE SPECIFIED RESISTANCE VALUES ARE IN OHMS, 10%, 1/2 WATT; CAPACITANCE VALUES 1 OR HIGHER ARE IN PF; CAPACITANCE VALUES LESS THAN 1 ARE IN UF; INDUCTANCE VALUES ARE IN UH. ⏚ INDICATES CHASSIS GROUND. Hz INDICATES CYCLES PER SECOND.

DC VOLTAGES ARE MEASURED WITH VTVM PLACED BETWEEN POINTS INDICATED & CHASSIS GROUND, LINE VOLTAGE SET AT 120V AC & ALL CONTROLS SET FOR NORMAL PICTURE UNLESS OTHERWISE INDICATED. VOLTAGE READINGS ARE TAKEN WITHOUT SIGNAL, WITH VHF TUNER SET AT UNUSED CHANNEL. VOLTAGES SHOWN IN BRACKETS ( ) ARE MEASURED WITH RECEIVER TUNED TO A COLOR SIGNAL.

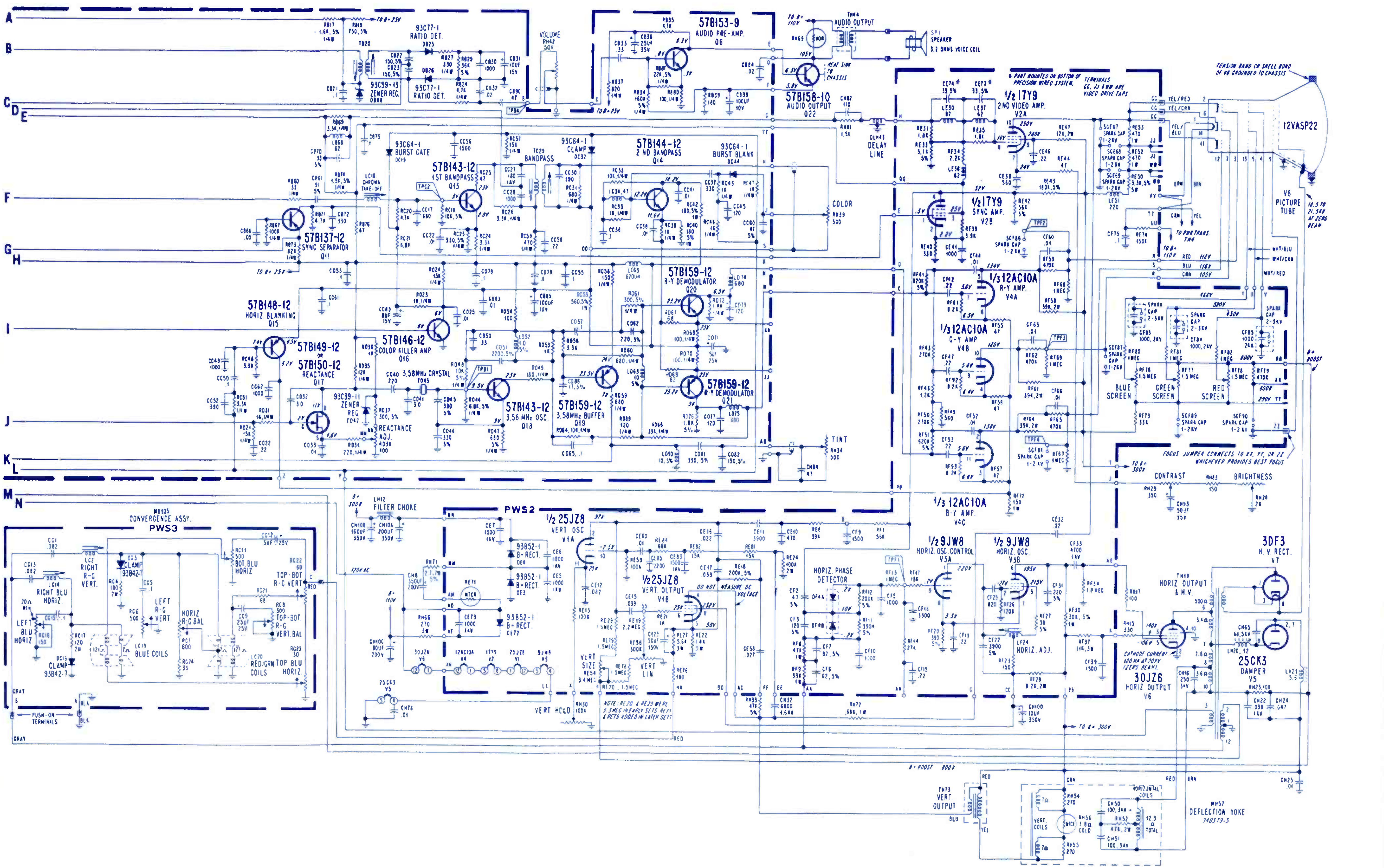
WARNING: CHASSIS IS CONNECTED DIRECTLY TO ONE SIDE OF AC POWER LINE. USE AN ISOLATION TRANSFORMER WHEN SERVICING TO AVOID THE POSSIBILITY OF ACCIDENTAL ELECTRICAL SHOCK & DAMAGE TO TEST EQUIPMENT.

TRANSISTOR CAUTION: TO AVOID DAMAGE TO TRANSISTORS, DO NOT OPERATE CHASSIS WITH PICTURE TUBE DAG DISCONNECTED FROM CHASSIS GROUND. DO NOT TURN SET ON WITH TRANSISTOR (S), TUBE (S) OR LEADS REMOVED OR UNSOLDERED. DO NOT ARC 2ND ANODE LEAD TO CHASSIS GROUND. DISCHARGE 2ND ANODE ONLY TO PICTURE TUBE DAG OR DAG GROUND. USE CAUTION TO PREVENT ACCIDENTAL SHORT BETWEEN COMPONENT TERMINALS OR TO CHASSIS GROUND. DO NOT APPLY EXCESSIVE HEAT TO TRANSISTOR LEADS. DO NOT USE AN ORDINARY OHMMETER FOR RESISTANCE MEASUREMENT, USE VTVM ON Rx100 RANGE OR HIGHER.

TP SYMBOLS IN RECTANGLES INDICATE TEST POINT CONNECTIONS.
HEXAGONS IDENTIFY WAVEFORM OBSERVATION LOCATIONS. CONDITIONS FOR TAKING WAVEFORM MEASUREMENTS ARE GIVEN WITH WAVEFORM PHOTOGRAPHS

SYMBOL	DESCRIPTION	AIRLINE PART NO.
CH10A, B, C, D	200μf/350v, 160μf/350v, 80μf/200v 10μf/350v elect	67A15-403
CH14A, B	2000μf/40v, 2000μf/40v, elect	67A15-413
RE71	therm NTC	61A57-6
RH69	VDR	61A46-7
RA82	2K AGC delay	75A101-31
RA83	2K AGC	75A101-31
RC64	10K color kill	75A101-18
RE54	3.4 M vert size	75A107-4
RE56	300K vert lin	75A107-4
RF76	1.5M blue screen	75A95-17
RF77	1.5M green screen	75A95-17
RF78	1.5M red screen	75A95-17
RH28	2K brite	75A140-1
RH29	350Ω contrast	75A140-3
RH30	100K vert hold	75A140-2
RH34	500Ω tint	75A141-3
RH39	500Ω color	75A141-3
SH41	50K on/off volume	75A141-7
LA5	coil 47.25MHz trap	72A316-12
LA49	coil 41.25MHz trap	72A316-12
LC16	coil chroma take-off	72A329-1
LC34	coil 47 μh 2nd band pass	73A55-28
LD52	coil 1μh 3.58MHz output	73A55-37
LF24	coil horiz adj	94A351-1
LH12	coil filter choke	74A30-5
MH57	deflect yoke	94A379-5
TA59	xformer 4.5MHz trap	72A216-7
TB20	xformer ratio detect	72A318-1
TC14	xformer burst	72A325-3
TC29	xformer bandpass	72A327-1
TH2	xformer line choke	73A31-16
TH4	xformer power	80A108-9
TH18	xformer horiz output	79A158-2
TH44	xformer audio output	79A141-1
TH73	xformer vert output	74A131-1
	fuse .225a chemical	84A28-12
	fuse 1.7a chemical	84A28-6
	tuner VHF	94A383-3
	tuner UHF	94A336-2

AIRLINE
Color TV Model
GAI-12103B



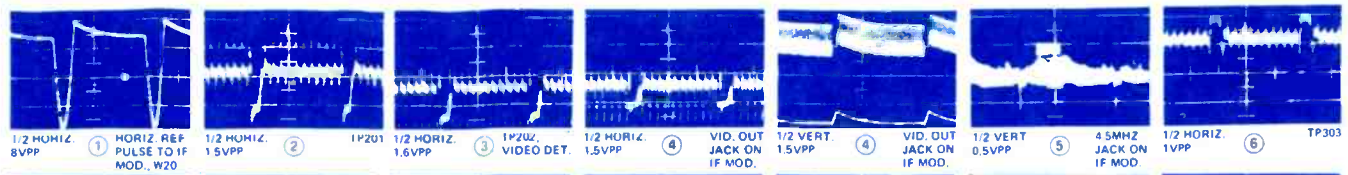
1570 GENERAL ELECTRIC

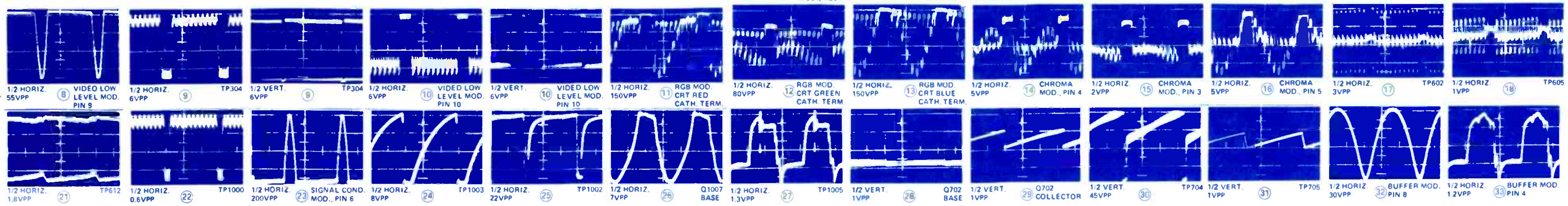
Color TV Chassis MB-75

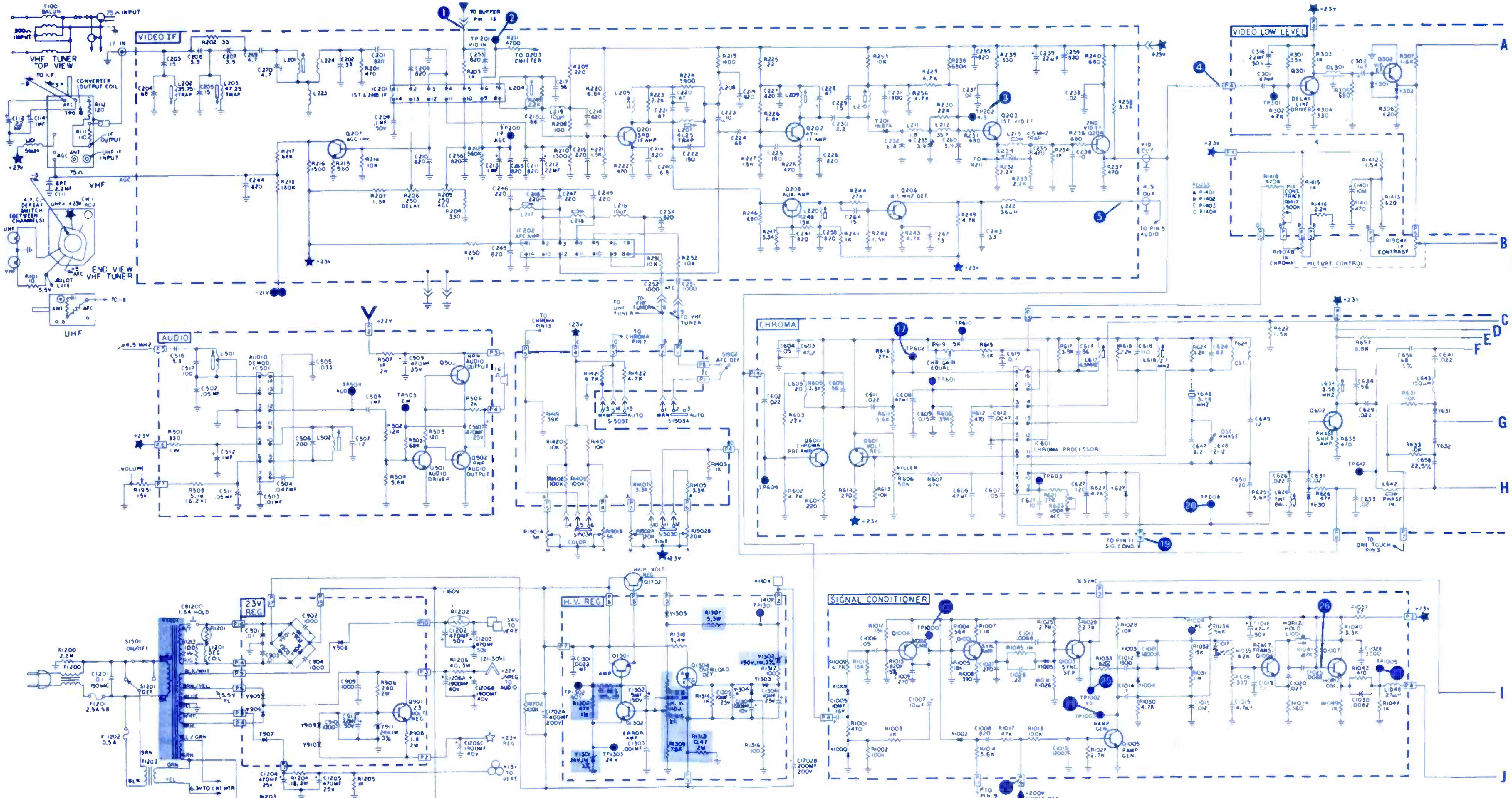
ELECTRONIC TECHNICIAN/DEALER TEKFAX

FEBRUARY • 1975

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

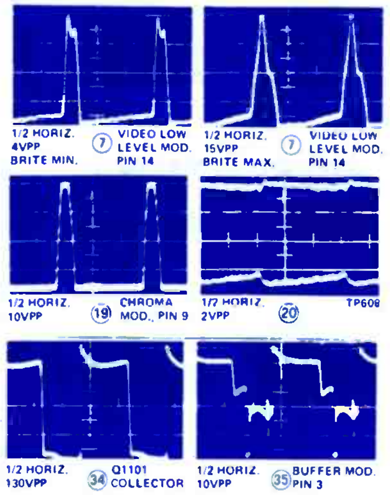






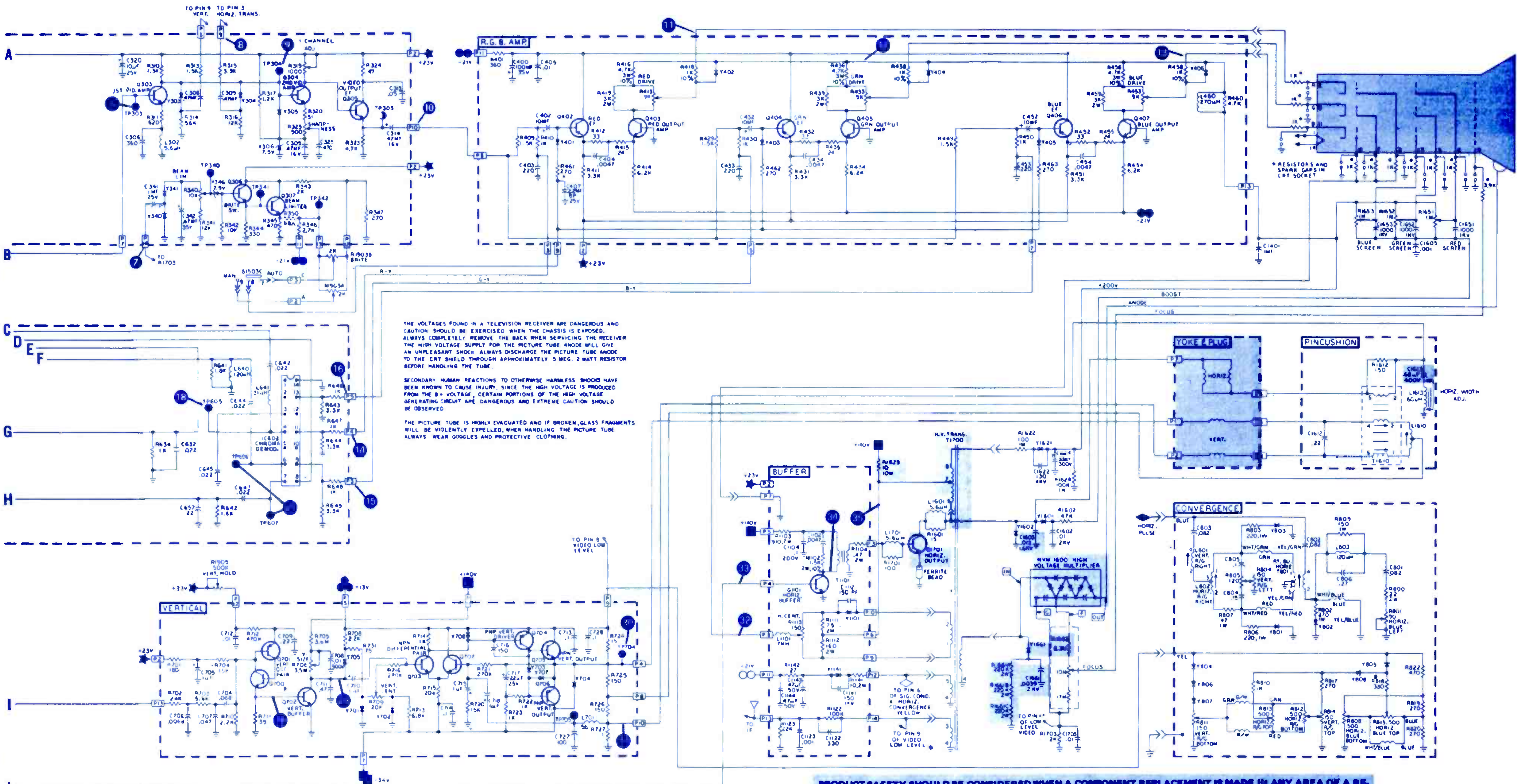
UNLESS OTHERWISE NOTED
K=1,000 M=1,000,000
CAPACITORS MORE THAN 1=uuf=uf
CAPACITORS LESS THAN 1=uf
RESISTORS ARE 1/2 WATT

VOLTAGE MEASUREMENTS ARE 20,000 OHM PER VOLT METER READINGS TAKEN WITH RESPECT TO CHASSIS COMMON. RECEIVER TUNED FOR NORMAL PICTURE. AC LINE VOLTAGE SET AT 120V. READINGS MAY VARY 10% FROM THOSE SHOWN.



GENERAL ELECTRIC
Color TV Chassis
MB-75

SYMBOL — DESCRIPTION	GENERAL ELECTRIC PART NO.
R205 — IF AGC 250Ω	EP49X142
R206 — RF AGC 250Ω	EP49X142
R413 — red drive	
R433 — green drive	EP49X141
R453 — blue drive	
R606 — kill adj 50K	EU49X35
R619 — chroma gain equal 5K	ES49X627
R623 — ACC adj 100K	EP49X143
R706 — vert size 3.5M	EP49X144
R709 — vert center	EP49X144
R1113 — horiz center 150Ω	EP49X147
R1315 — HV adj 2K	EP49X90
R1662 — focus pot asm	EP62X42
C1206A — 1900μf, +100 — 10% 40v	EP31X42
C1206B — 1900μf, +100 — 10% 40v	EP31X42
C1206C — 1900μf, +100 — 10% 40v	EP31X42
C1702A — 400μf, +100 — 10% 200v	EP31X40
C1702B — 200μf, +100 — 10% 200v	EP31X40
L202 — 39.75MHz trap	EP36X108
L203 — 47.25MHz trap	EP36X13
L207 — 41.25MHz trap	EP36X92
L215 — 4.5MHz trap	EP36X111
L222 — choke	ES36X751
DL301 — delay line	EP36X105
L501 — audio take off	EP36X106
L502 — quad	EP36X107
L617 — chroma 4.3MHz	EP36X112
L701 — choke	EP36X119
L1001 — horiz osc hold	EP35X2
T1201 — power xformer	EP62X45
T1202 — CRT filament	EP64X34
T1610 — pincushion	EP51X2
T1700 — high voltage	EP77X13
CB1201 — circuit breaker 1.5a	ES10X18
F1201 — fuse 2.5a 125v slo blo	EP10X13
F1202 — fuse .5a 250v fast blo	ES10X43



THE VOLTAGES FOUND IN A TELEVISION RECEIVER ARE DANGEROUS AND CAUTION SHOULD BE EXERCISED WHEN THE CHASSIS IS EXPOSED. ALWAYS COMPLETELY REMOVE THE BACK WHEN SERVICING THE RECEIVER THE HIGH VOLTAGE SUPPLY FOR THE PICTURE TUBE ANODE WILL GIVE AN UNPLEASANT SHOCK ALWAYS DISCHARGE THE PICTURE TUBE ANODE TO THE CRT SHIELD THROUGH APPROXIMATELY 5 MEG. 2 WATT RESISTOR BEFORE HANDLING THE TUBE.

SECONDARY HUMAN REACTIONS TO OTHERWISE HARMLESS SHOCKS HAVE BEEN KNOWN TO CAUSE INJURY. SINCE THE HIGH VOLTAGE IS PRODUCED FROM THE B+ VOLTAGE, CERTAIN PORTIONS OF THE HIGH VOLTAGE GENERATING CIRCUIT ARE DANGEROUS AND EXTREME CAUTION SHOULD BE OBSERVED

THE PICTURE TUBE IS HIGHLY EVACUATED AND IF BROKEN, GLASS FRAGMENTS WILL BE VIOLENTLY EXPELLED. WHEN HANDLING THE PICTURE TUBE ALWAYS WEAR GOGGLES AND PROTECTIVE CLOTHING.

PRODUCT SAFETY SHOULD BE CONSIDERED WHEN A COMPONENT REPLACEMENT IS MADE IN ANY AREA OF A RECEIVER. THE SHADED AREA OF THIS SCHEMATIC DIAGRAM AND THE PARTS LIST DESIGNATE COMPONENTS IN WHICH SAFETY CAN BE OF SPECIAL SIGNIFICANCE. IT IS PARTICULARLY RECOMMENDED THAT GENERAL ELECTRIC CATALOGED PARTS BE USED FOR COMPONENT REPLACEMENT IN THE SHADED AREAS OF THIS SCHEMATIC.

USE OF SUBSTITUTE REPLACEMENT PARTS WHICH DO NOT HAVE THE SAME SAFETY CHARACTERISTICS AS RECOMMENDED IN FACTORY SERVICE INFORMATION MAY CREATE SHOCK, FIRE OR OTHER HAZARDS.

1571

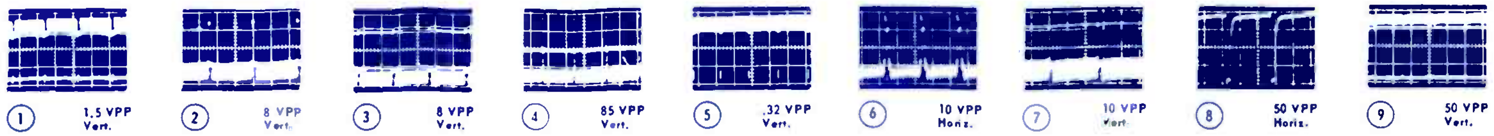
SYLVANIA

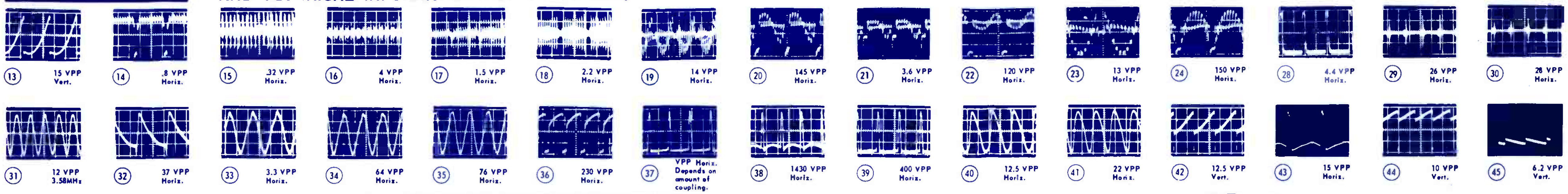
Color TV Chassis
D16-3 Thru -9

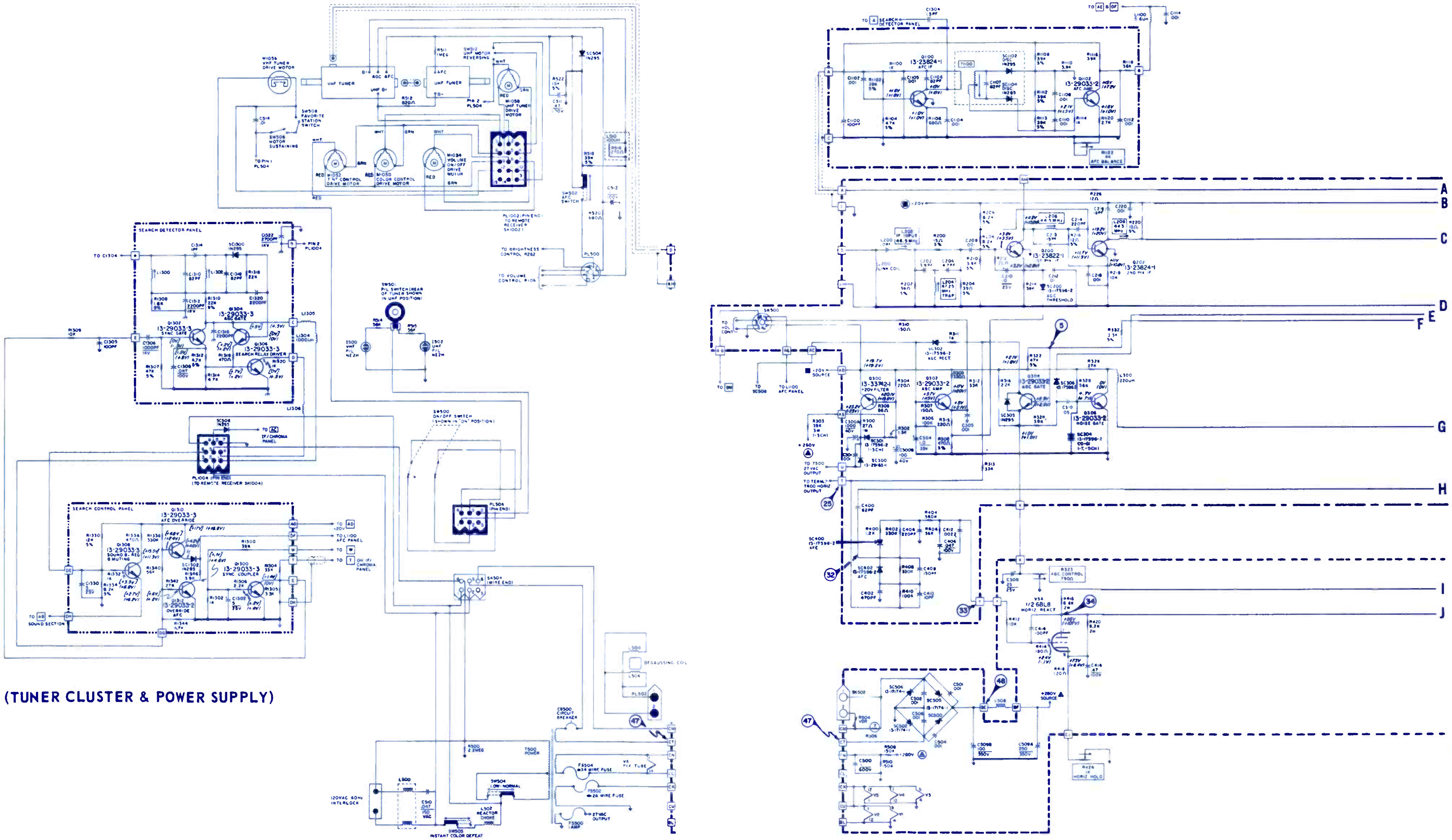
ELECTRONIC TECHNICIAN/DEALER TEKFAX

FEBRUARY • 1975

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

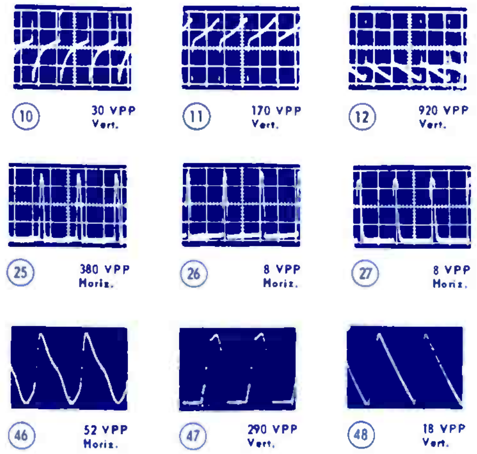


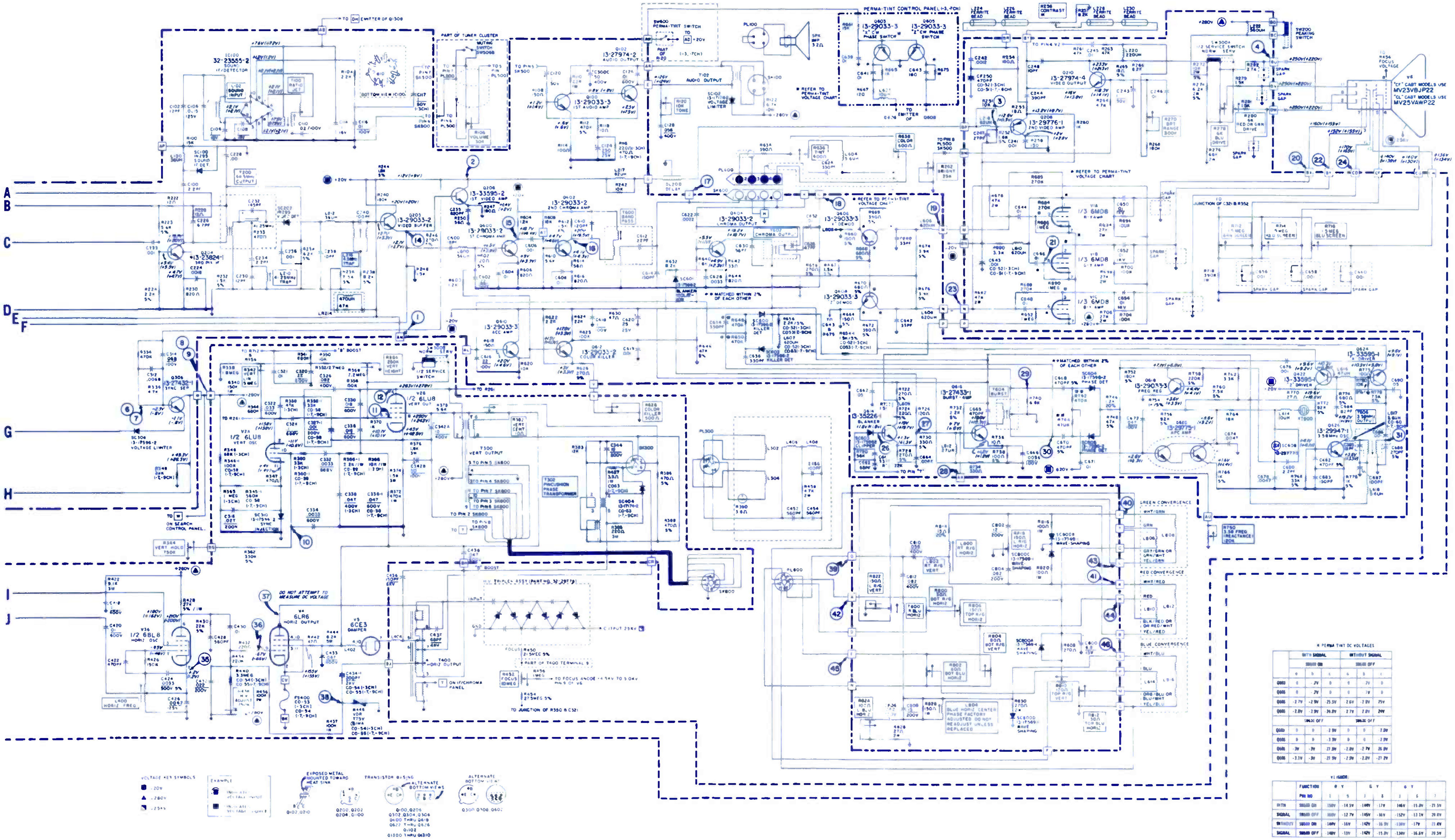




(TUNER CLUSTER & POWER SUPPLY)

SYLVANIA
Color TV Chassis
D16-3 Thru -9





* PERMA TINT DC VOLTAGES

	WITH SIGNAL			WITHOUT SIGNAL		
	SW600 ON			SW600 OFF		
	e	b	c	e	b	c
[illegible]	0	-.7V	0	0	-.7V	0
[illegible]	0	-.7V	0	0	-.7V	0
[illegible]	-2.7V	-2.9V	25.5V	-2.6V	-2.8V	25V
[illegible]	-2.8V	-2.9V	24.8V	-2.7V	2.8V	24V
	SW600 OFF			SW600 OFF		
[illegible]	0	0	-2.9V	0	0	-2.8V
[illegible]	0	0	-3.3V	0	0	-2.9V
[illegible]	-3V	-3V	27.5V	-2.8V	-2.7V	26.8V
[illegible]	-3.1V	-3V	-27.5V	-2.9V	-2.8V	-27.2V

V1 (6MD8)

	FUNCTION	R-Y		G-Y		B-Y		
	PIN NO	1	5	1	4	1	6	7
WITH	SW600 ON	150V	-14.5V	140V	-17V	146V	-15.8V	-21.5V
SIGNAL	SW600 OFF	160V	-12.7V	145V	-16V	152V	-13.1V	20.8V
WITHOUT	SW600 ON	148V	-16V	142V	-16.5V	136V	-17V	21.4V
SIGNAL	SW600 OFF	148V	-15V	142V	-15.8V	130V	-16.6V	20.5V

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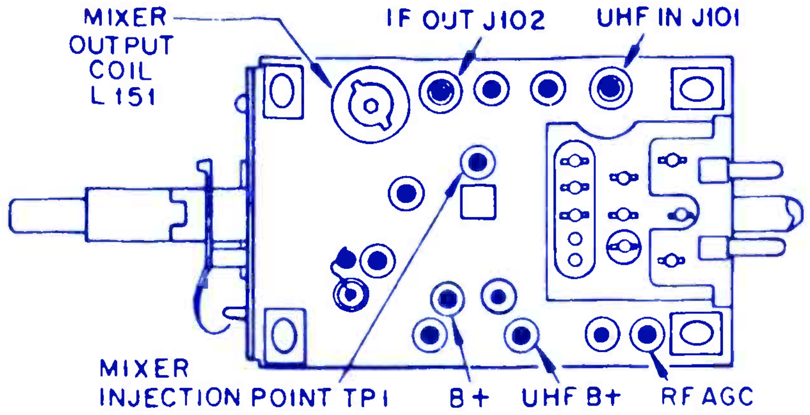
AIRLINE

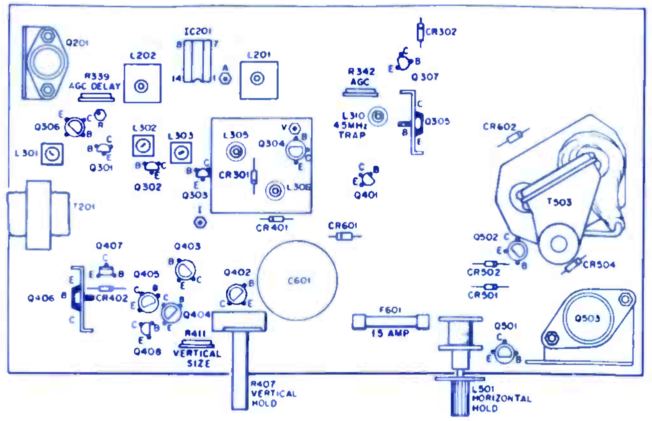
TV Models
GAI-11115A,B
GAI-11155A,B

FEBRUARY • 1975

ELECTRONIC TECHNICIAN/DEALER TEKFAX

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





SYMBOL	DESCRIPTION	AIRLINE PART NO.
C603	250/200/150µf, 165v, elect	67A30-11
L301	coil 47.25MHz trap	72A415-2
L306	coil detect	72A316-15
L310	coil 4.5MHz trap	72A317-9
L501	coil horiz lock	94A480-1
T201	xformer audio output	79A172-1
T401A, B	yoke deflect	94A372-3
T501	xformer, horiz driver	72A417-1
T503	xformer horiz output	79A166-2
T601	xformer filament	80A117-6
R203	25K vol	75A1-210
R326	500Ω contrast	75A1-211
R333	100K brite	75A1-212
R339	400Ω AGC delay	75A101-35
R342	400Ω AGC	75A101-35
R407	1.2M vert hold	75A191-1
R411	2M vert size	75A101-61
F601	fuse 1.5a	84A7-15
	tuner VHF GA1-11115A, GA1-11155A	94A433-2
	tuner VHF GA1-11115B, GA1-11155B	94A434-2

SAFETY NOTICE

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.