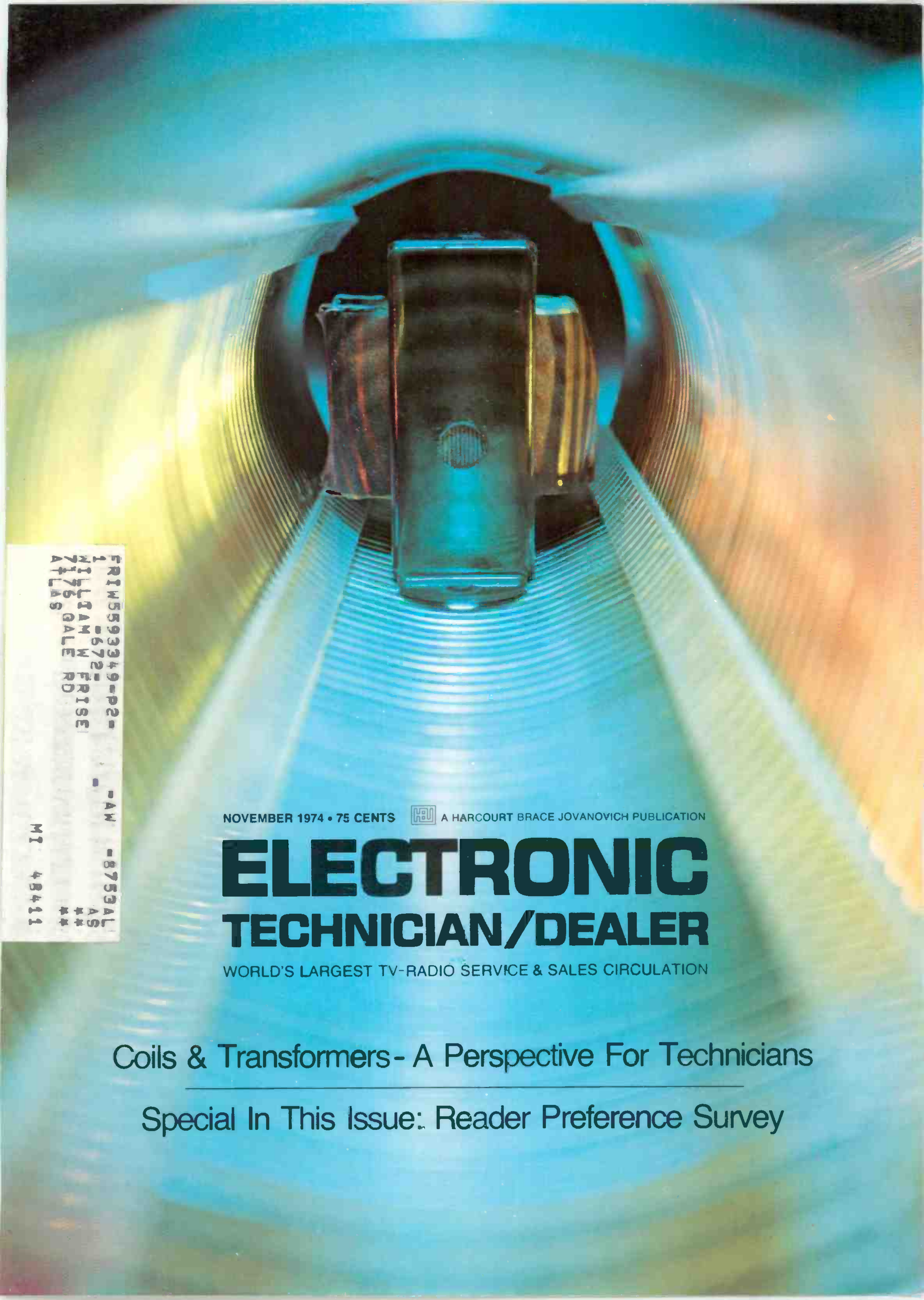

NOVEMBER 1974 • 75 CENTS

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ELECTRONIC TECHNICIAN/DEALER

WORLD'S LARGEST TV-RADIO SERVICE & SALES CIRCULATION

Coils & Transformers - A Perspective For Technicians

Special In This Issue: Reader Preference Survey

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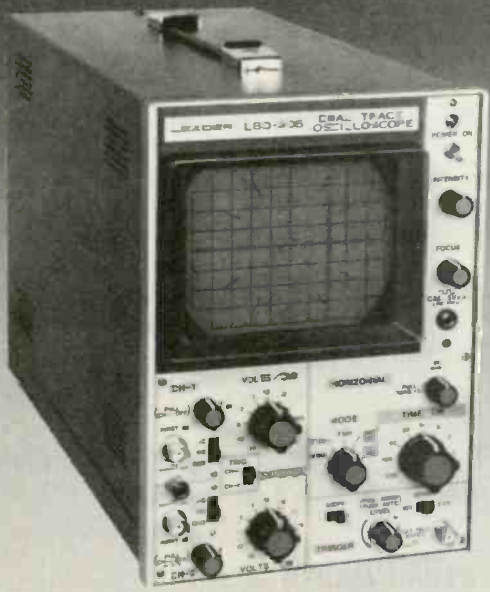

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NOVEMBER 1974 • VOLUME 96 NUMBER 11

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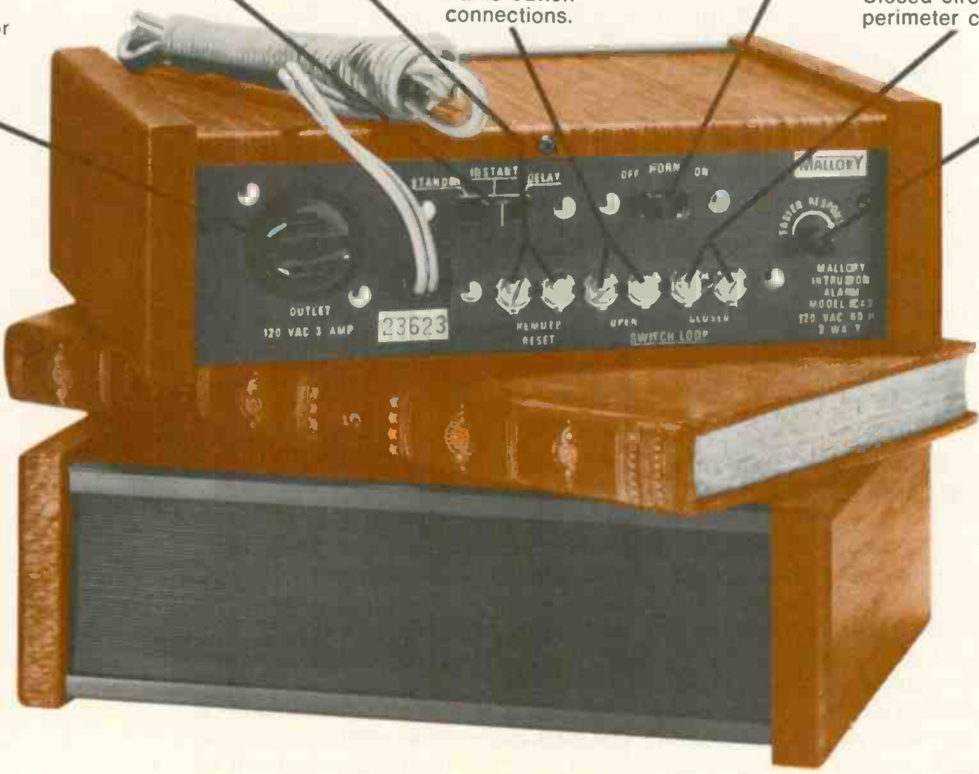

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NEWS OF THE INDUSTRY

Total TV Sales to Dealers Down 7.7% During First Eight Months of 1974

Statistics compiled and released by the Marketing Services Department of the Electronic Industries Association (EIA) reveal that total unit sales of color and black-and-white TV during the first eight months of this year were 7.7 percent below sales during the same period last year. Unit sales to dealers of all other consumer entertainment electronic products, except home FM radio, also were below levels during the same period last year.

UNIT SALES TO DEALERS
Jan.-Aug. 1974 Vs. Jan.-Aug. 1973
(Source: EIA Marketing Services Dept.)

	1974	1973	PERCENT CHANGE
TELEVISION			
Monochrome	3,689,724	4,057,149	− 9.1
Color	4,917,145	5,265,383	− 6.6
TOTAL TELEVISION	8,606,869	9,322,532	− 7.7
RADIO			
AM	6,753,259	9,158,928	−26.3
FM	11,125,106	10,083,979	+10.3
TOTAL	17,878,365	19,242,907	− 7.1
AUTOMOBILE	6,401,553	8,220,275	−22.1
TOTAL RADIO	24,279,918	27,463,182	−11.6
PHONOGRAPH			
Portable and Table*	2,128,678	3,177,057	−33.0
Console	470,866	492,142	− 4.3
TOTAL PHONOGRAPH	2,599,544	3,669,199	−29.2

*Includes compact and component systems

Zenith National Service Manager Tells Electronic Servicers Zenith Has No Plans to Enter Retail Service Business

Zenith Radio Corporation is not in the retail service business, it never has been, and it has no plans to engage in such in the future, the company's national service manager told two separate electronic-servicer audiences recently.

Speaking before the National Electronic Service Dealers Association (NESDA) convention in Kauai, Hawaii, August 9, and the National Alliance of Television and Electronic Service Associations (NATESA) convention in Chicago, August 16, Brian J. Marohnic, national service manager of Zenith, told members of these associations, "It is unlikely that we will ever make a product that will not require service sometime; however, if service is needed, it will be independent TV service technicians who will be doing it, not Zenith."

EIA Schools Prepare Minority Groups for Careers in Consumer Electronic Servicing

The Electronic Industries Association (EIA) Consumer Electronics Group, in cooperation with the Chicago Board of Education, officially opened its fourth Electronic Opportunity Training School at the Industrial Skill Center in Southwest Chicago, on June 11.

The school, and others similar to it in New York City; Detroit, Michigan; and Hickory, North Carolina, are designed to provide minority groups with instruction in the servicing of consumer electronics. Students receive more than 800 hours of detailed instruction over a period of approximately 48 weeks.

Speaking at the opening ceremony, Frank Steckel, EIA/CEG advisor and Appalachian University professor, said, "More than 30,000 technicians are needed now to service the growing number of consumer electronic products. Hopefully this pilot program will not only prove to be helpful in filling this important need but will also give minority citizens yet another opportunity to pursue a productive career."

The EIA/Consumer Electronics Group, through its Service Technician Development Program, provides television sets, test equipment, training materials, money and knowledge from its members and combines it with local resources to establish these local programs.

The EIA/CEG's experience with the first three schools reportedly has been encouraging. Data gained from these and the newest school in Chicago will go into plans for other schools being considered for such cities as St. Louis, Los Angeles and Miami. ■

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.

NESDA Elects Officers for '74-'75 Term

Members of the National Electronics Service Dealers Association (NESDA), at the Association's annual convention in Hawaii in August, elected the following officers: Charles R. Couch, Jr., CET, Florida, president (his second term); Leroy Ragsdale, Arkansas, senior vice president (a newly established office); Virgil Gaither, CET, California, secretary; Jack Kelly, CET, Arizona, treasurer; Norman Smith, Connecticut, 1st region vice president; Warren Baker, CET, New York, 2nd region vice president; John McPherson, CET, Virginia, 3rd region vice president; Thomas Ruth, CET, North Carolina, 4th region vice president; Gerald Hall, Wisconsin, 5th region vice president; George Simpson, Texas, 6th region vice president; Charles Varble, Missouri, 7th region vice-president; Paul Dontje, CET, Colorado, 8th region vice president; James Rolison, Oregon, 9th region vice president; and Everett Pershing, California, 10th region vice president.

Total NESDA membership, as of July, was 2,434. The state with the largest number of NESDA members is California (661), followed by Texas (263) and Wisconsin (134).

CET Exam Fee Increased to $20

The International Society of Certified Electronic Technicians (ISCET) has announced that, effective January 1, 1975, the fee for Certified Electronic Technician (CET) exams will be increased from the present $10 to $20. The fee includes one free retake. Additional retakes will be $10.

ISCET also has announced a new initiation fee of $5.

ISCET Elects New Officers

The International Society of Certified Electronic Technicians (ISCET), a subsidiary of the National Electronic Service Dealers Association (NESDA), at a meeting in Hawaii in August, elected the following new officers: Larry Steckler, CET, chairman; Robert Cook, CET, California, vice chairman; Jesse B. Leach, CET, Maryland, treasurer; and Gordon Turnbull, CET, Winnipeg, Canada, secretary.

NARDA Changes Name, Adds New Division

The Association formerly called the "National Appliance & Radio-TV Dealers Association (NARDA)" has been restructured into a two-division association called NARDA Inc. The restructuring and change of name were approved by the board of directors of NARDA at a meeting at the University of Notre Dame, South Bend, Indiana, on August 11.

One division of NARDA Inc. is now known as the "National Appliance & Radio-Electronics Dealers Association," and the other division is the "National Association of Retail Dealers of America," which is open to all retail firms regardless of the types of products they sell.

NARDA membership dues have been increased from $75 per year to $100, effective January 1.

Conventions:

- Georgia Electronic Technicians Association 1974 State Convention, Nov. 15-17, Buccaneer Lodge, Jekyll Island, Georgia.
- National Electronic Service Dealers Association 1975 National Convention, August 13-20, 1975, Hyatt House, Winston-Salem, North Carolina.

NATESA Member in Zenith TV Commercial

Nick Patis, a Chicago-area member of the National Alliance of Television and Electronic Service Associations (NATESA), is appearing this fall in a nationally aired Zenith TV commercial. In the commercial, Patis tells why he prefers Zenith color TV. The segment in which Patis appears was shot at his TV service shop in the Chicago area.

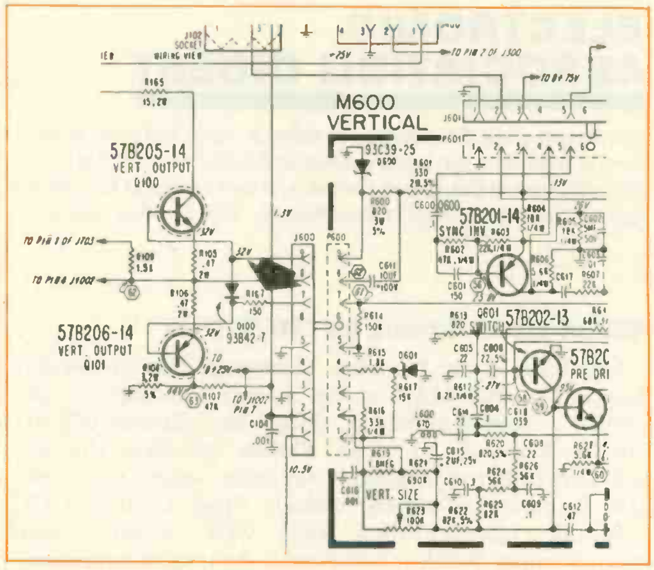
NATESA Officers Re-Elected to One-Year Terms

Members of the National Alliance of Television and Electronic Service Associations (NATESA), at that Association's annual convention in Chicago in August, reelected the following officers: Leon Skalish, Pennsylvania, president; Philip Holt, New York, vice president; H. O. Eales, Oklahoma, secretary general; and Howard Larson, Michigan, treasurer. ■

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

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 Chassis M10—Brightness and Contrast Control Adjustment

The type of brightness control circuitry employed in this chassis includes a black level clamp circuit. This circuit provides DC restoration, and the clamp level adjustment sets the peak limit of black video information. This, in turn, sets the minimum limit of picture tube beam current. It operates in conjunction with the brightness limiter circuit, which provides regulation of high-level picture tube beam current. The result is a stabilized brightness-to-contrast ratio during variations of scene intensity.

Correct operation of the clamp and brightness limit circuitry depends on proper adjustment of the black-and-white tracking controls.

Although the BRIGHTNESS control affects the overall picture tube brightness, it also sets the black clamp level. The CONTRAST control not only affects the amount of video drive, but also sets the brightness level of white information that is contained in the picture.

The complete procedure, including the clamp level brightness and contrast adjustments, is as follows:

1) Apply power to the TV set and allow it to warm up for 15 minutes.

2) Perform the black-and-white tracking procedure, if needed.

3) Switch *off* the COLOR MASTER control, if used.

4) Tune the TV receiver to a strong local station.

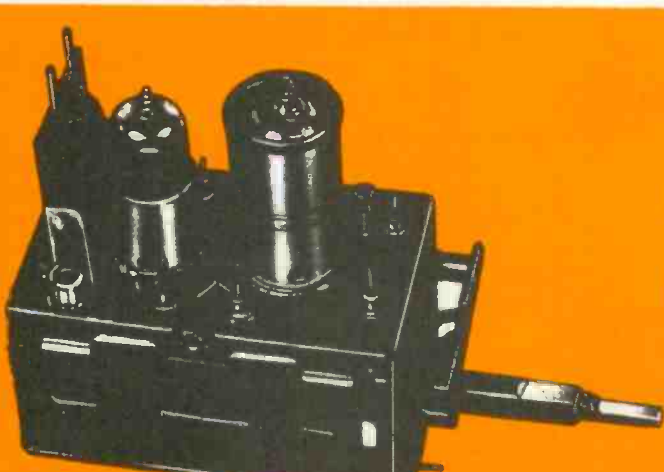
5) Rotate the COLOR control fully counterclockwise, to remove all color information from the TV screen.

6) Rotate the CONTRAST control fully counterclockwise to its *minimum* position.

7) Rotate the BRIGHTNESS control fully clockwise to its *maximum* position.

8) While observing the darkest areas in the picture, rotate the BRIGHTNESS control counterclockwise until the darkest areas just turn black. (Note: This adjusts the oper-

continued on page 8



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In this price all parts are included, tubes, transistors, diodes, and nuvistors are charged extra. This price does not cover mutilated tuners.

Fast efficient service at our conveniently located service centers.

All tuners ultrasonically cleaned, repaired, realigned and air tested.

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	MODESTO, CALIF. 95351	123 Phoenix Avenue	Tel. 209-521-8051
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OREGON	PORTLAND, OREGON 97210	1732 N.W. 25th Avenue	Tel. 503-222-9059
TENNESSEE	GREENEVILLE, TENNESSEE 37743	1215 Snapps Ferry Road	Tel. 615-639-8451
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WATCH US GROW

If you want to branch out into the TV Tuner Repair Business, write to the Bloomington headquarters about a franchise.

. . . for more details circle 140 on Reader Service Card

TECHNICAL DIGEST . . .

continued from page 6

ating point of the black clamp level circuit.)

9) Rotate the CONTRAST control clockwise for the desired brightness-to-contrast ratio and the most desirable black-and-white picture.

10) This same procedure should be followed to adjust both the main and the PRESET BRIGHTNESS and CONTRAST controls.

11) Repeat for PRESET control adjustment with COLOR MASTER switch on, if used.

Color TV Chassis M24, M25, M30—Vertical-Output Transistors

Whenever you replace vertical-output transistors 57A-205-14 and 57A206-14 in an M24, M25 or M30 color TV chassis, a 150-ohm, 10%, ½ w resistor should be added between pin 7 of J600 and the base of transistor Q101, as shown in the accompanying partial schematic.

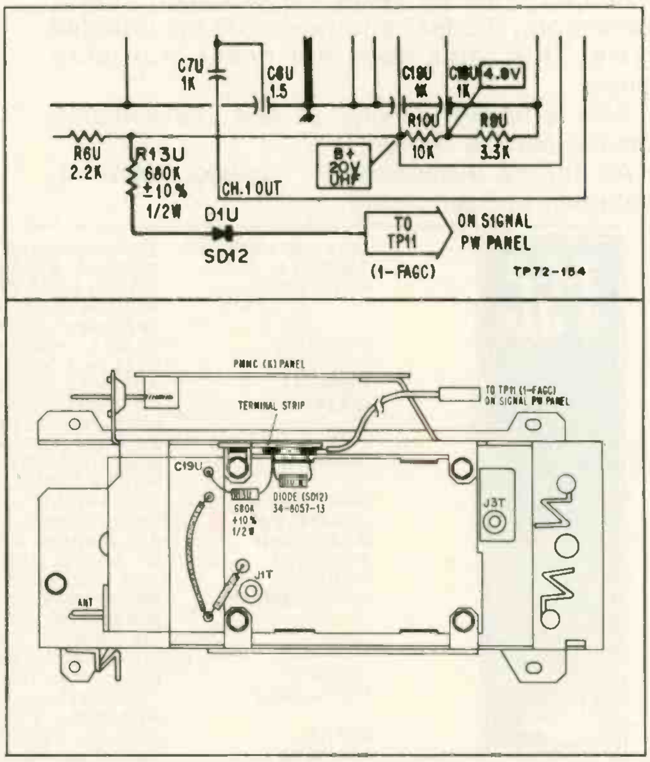
It is imperative that a silicon heat transfer compound be used when mounting these transistors.

PHILCO-FORD

Color TV Chassis 4CS73/4CY91—Medium Level Snow on UHF Channels Using VVC Tuner

A production change has been made on the VVC tuner to increase the receiver's gain and eliminate or reduce medium level snow on UHF channels.

The change involves mounting a three-lug terminal strip on the tuner frame and connecting a 680 K-ohm resistor (R13U) from capacitor C19U to the anode of diode SD12 (DIU) No. 34-8057-13, and then connecting the cathode of the diode to lug TP11 (1-FAGC) on the Signal PW Panel with an added wire. (Refer to attached illustration for layout of the new parts.)

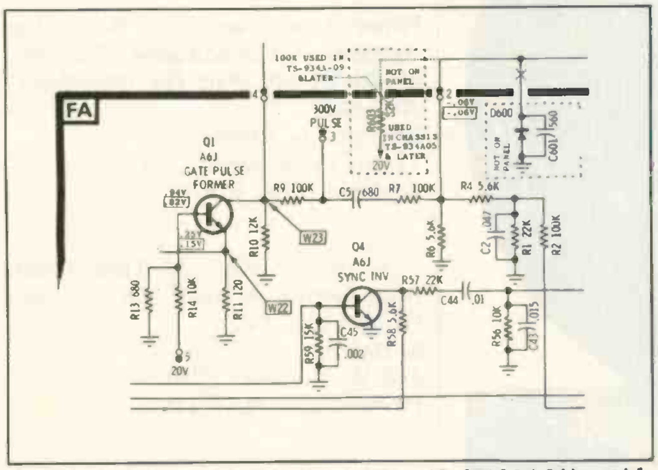


This modification should be made on tuners not already modified if a snowy UHF picture is produced in an area where a nearly snow free picture is possible (assuming no other defect is causing the snowy UHF picture).

MAGNAVOX

Color TV Chassis TS-934—Vertical Black Line at Top and Sometimes at the Bottom of the Screen

Remove resistor R603 (82K or 100K), connected at pin 2 of the FA panel. If the vertical line is still present on the

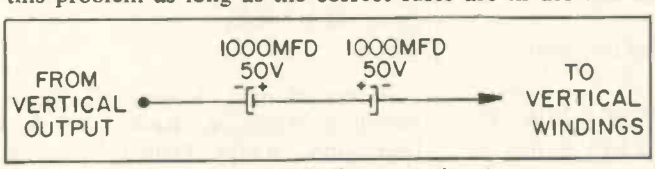


screen, add diode D600 (Part No. 48-67120A01), with 560-pf, disc capacitor in parallel, as shown in the accompanying illustration.

Color TV Chassis T989—Hookup to Test Fixtures

The two vertical windings of the deflection yoke used in the T989 chassis are normally connected in parallel. The parallel arrangement is maintained with T989 Adapter Cable, Part No. 171323-1, when the chassis is connected to the yoke in the Magnavox S973 Test Fixture. The vertical output stages in the T989 chassis are DC coupled to the yoke windings, and a 1-amp, fast-blow fuse is connected in series with each output stage, to protect against component damage should one of the output transistors become shorted.

If the chassis is connected to a test fixture which has the vertical yoke windings connected in series, a shorted vertical-output stage could cause a high DC current to flow through the windings, but not sufficiently high enough to open the 1-amp fuse. As a result, the electron beam might strike and eventually cut through the neck of the picture tube. (The CRT in the S973 fixture cannot be damaged by this problem as long as the correct fuses are in use and if



the fuses are not defeated by jumper wires.)

To prevent the possibility of damage to fixtures other than the S973, two 1000-Mfd., 50-v capacitors should be connected back-to-back and placed in series with the vertical-output lead between the chassis and the yoke. The capacitors prevent DC current from passing through the windings, so that the amount of deflection is determined only by the amplitude of the AC vertical sweep voltage.■

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READERS' AID

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Power transformer for a Hallicrafter Amateur Communication Receiver, Model SX-140. Part No. 052-000853 1052-625.
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Used, late-model, popular-brand TV test instruments in A-1 shape. Please write for details.
McKinley's Radio and TV Service
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High-voltage transformer for a Hoffman 19-inch color TV set, Model W-7419, Chassis No. 917-000026.
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R.R. 1, Box 8
Canton, S. Dak. 57013

Schematic and/or service manual for Sun-Mark SM12-TV, 12-inch solid-state Japanese portable TV set. Also, a high voltage transformer for a Raytheon 21-inch color TV, Part No. 12E26639 or 20126405, Sentinel Part No. 20E1107.
S. M. Pearlman
25 Wolcott Rd.
Lynn, MA 01902

Riders Manual, Volume 1, Radio Retailing Magazine, Radio and Refrigeration, Radio Doings, Citizens Radio Call Book, etc.
Larry La Duc
484 Arleta Ave.
San Jose, CA 95128

I would like to purchase a 12A7 tube.
Milton Wendroff
2016 Avenue "N"
Brooklyn, NY 11210

Schematic or cross reference for transistors used in a Winthrop, Model SE212, FET FM/AM Stereo Receiv-
continued on page 12

READERS AID . . .
continued from page 10

er, Eight-Track/Amplifier. All circuit boards include an identification No. CMK-4, and the number of the particular board.
AL'S RADIO & TV
P.O. Box 577
Milton, WA 98354

Picture tube for Symphonic, Model TPS-5050 portable TV. Symphonic Part No. C6407.
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1112 31st Ave.
Bellwood, IL 60104

Used test equipment, Sam's Photofacts, Zenith and RCA Service Manuals. I also have old radio and TV tubes for sale or trade.
WILLIAMS RADIO & TV SERVICE
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Operator's manual with schematic, that provides voltages and waveforms for a Squires Sanders, Model SS-310 closed circuit TV camera. Will buy or copy and return.
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Sam's Photofacts, CB Radio Series.
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Forked River, NJ 08731

Schematic diagram for an Audition Radio Model 2206 and a diagram for an 8-pin IC, No. F592 026 706.
JERRY A. DICKINSON
1313 Harrison Lane
Hurst, TX 76053

For Sale

Magazines: Popular Electronics, all issues from January 1955 through December 1971. Radio Electronics from March 1956 through August 1963. Radio & Television from January 1956 through December 1959.
SIGMUND KAPP
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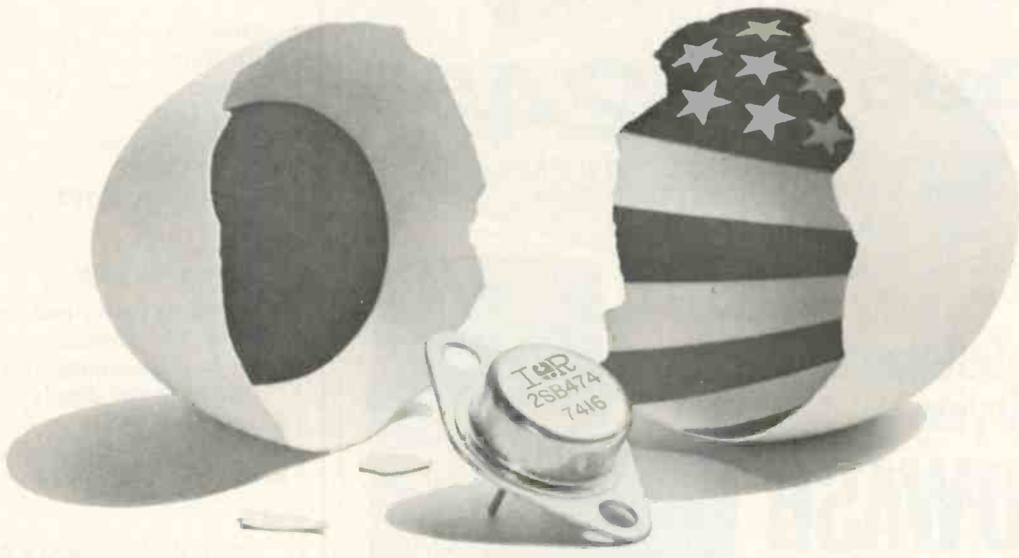
I have 940 Sams Photofacts, No. 1 through 796 complete, and mixed pages of others for sale. Many other service manuals will be included free
continued on page 14

How to crack the Japanese original equipment transistor problem.



Until now, there wasn't much you could do about the long delays in getting original transistor replacements for Japanese TV and audio equipment. IR has changed the picture. Now you can speed customer service with IR's DK22 Kit of 31 OEM transistors most often called out by Sony, Panasonic, Hitachi, JVC, Pioneer and Toshiba, and for many sets made in Japan for Sears, Penney's, Montgomery Ward and others.

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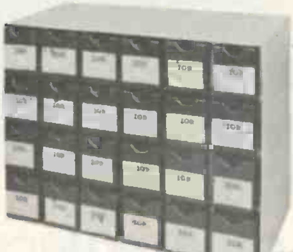

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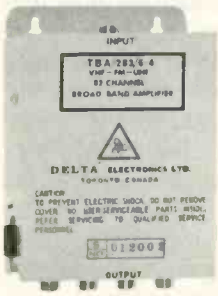
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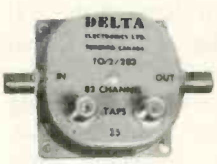
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Coils and Transformers–A Perspective for Technicians

By Bernard B. Daien

A general review of the theory of inductance, including phase shift, reactance and impedance matching

■ An inductor is an energy storing device, like a capacitor. The inductor's charge is stored in the magnetic field generated by the current flowing through the inductor. Opening the coil circuit causes a rapid collapse of the magnetic field, which cuts the turns of the coil, inducing a high counter-electromotive-force (opposite voltage, abbreviated *CEMF*).

If current is flowing when the circuit is opened, the stored charge will tend to keep it flowing, but, conversely, if we start with an open circuit (zero current) and then close the circuit, the inductor will attempt to prevent an increase of current.

An inductor opposes any *change* in the current flowing through it, because of the phenomenon of *CEMF*. The voltage induced in a coil by expanding or collapsing magnetic fields depends upon the number of turns in the coil and the rate at which the lines of magnetic flux cut the turns. Since the magnetic field expands and collapses slowly at low frequencies, it takes many turns to produce a useful voltage. Thus, magnetic components for use at low frequencies, as in high-fidelity transformers, are larger, heavier and costlier than devices intended for higher frequencies. (Which partly explains why you cannot use a good public-address transformer in a hi-fi amplifier.)

The counter EMF is a *self-induced* voltage. The ability to generate a self-induced voltage is called *self-inductance*, or just *inductance*. The unit of inductance is the *henry* (symbol hy) and is the amount of inductance which provides a counter EMF of 1 volt from a current changing at the rate of 1 ampere per second.

Inductance is proportional to the *square* of the turns on a coil. *Doubling* the number of turns results in *four* times the inductance. *Tripling* the turns produces *nine* times the inductance. (Because inductance changes so rapidly, remove only a few turns at a time when adjusting the inductance of a circuit for which an exact replacement coil is not available.)

THE CORE OF THE MATTER

Although the magnetic field is created by the current in the coil, its strength also depends upon the number of turns in the coil. The turns, times the amperes, is referred to as *ampere turns*. The resulting magnetizing force is defined in units called the *oersted*, which is equal to approximately two ampere turns per inch. The symbol for the oersted is the letter *H*.

The magnetizing force creates a magnetic *flux* around the coil, and the strength, or concentration, of this flux is termed *flux density* (or sometimes "magnetic induction"). Flux density is measured in units called *gauss*, which are defined in terms of the number of magnetic lines induced in each square inch of a cross section of the core. The symbol for flux density is *B*.

To sum up, as the magnetizing force (oersteds) increases, the resulting flux density (gauss) in the core also increases.

With an air core, a magnetizing force of one oersted produces a flux density of one gauss. But air is a poor magnetic core. If we use an iron core, one oersted produces much more than one gauss. In fact, the cheapest grade of iron core results in hundreds of gauss with a magnetizing force of just one oersted. This ability of certain core materials to increase flux density is called *permeability*, designated by the symbol *Mu*.

The magnetic equivalent of Ohm's law states that permeability equals the flux density (B) divided by the magnetizing force (H), or

$$\text{Mu} = \frac{B}{H}$$

And, like Ohm's law, it can be transposed to state that the flux density (B) equals the magnetizing force (H) multiplied by the permeability of the core, or $B = H \times \text{Mu}$.

From the preceding, it can be seen that permeability is a measure of the ease with which flux density can be achieved in the core. It can be compared to conductivity in a resistive circuit. And just as resistance is the opposite of conductance, so *reluctance* is the opposite of permeability. Iron cores have high permeability and low reluctance. Inserting a small gap in the core path changes the permeability of the series magnetic path, just as inserting a resistor in the middle of a wire increases the series resistance of the entire circuit. Air gaps are often designed into cores, to effect a tradeoff of certain magnetic characteristics, as will be explained later.

Because a high permeability core increases flux density, the CEMF also increases. And because inductance depends upon CEMF, the inductance also increases. Thus, by using the proper core material, we get more inductance from fewer turns, thereby producing smaller, lighter, less expensive transformers.

If an iron core is inserted into a coil and the current through the coil is increased steadily, the flux density will not continue to increase indefinitely. The core will sustain only a certain maximum level of gauss, and then it becomes *saturated*. After that, a further increase in the magnetizing force results in very little change in flux density in the core, as shown in Fig. 1. Without a changing flux, there is no CEMF, the inductance drops, and the input current increases sharply because of lack of opposition, and, consequently, the coil heats.

It would seem that, for transformer and inductor use, the core material with the highest permeability would be the best choice. There are many core materials, some of which have very high permeability. However, some materials with less permeability can handle more magnetizing force before saturating. For a power transformer, we

want a core that can handle a large amount of magnetizing force without saturating, and, consequently, we use a core that has a high maximum flux density (B max). For small-signal use, we are generally more concerned with permeability, because high permeability reduces the turns required, thus reducing the resistance of the winding and increasing circuit *Q*, which means better selectivity and lower losses.

REACTANCE

In AC circuits, it is inconvenient to deal with *henrys* of inductance, because we are concerned with the *effect* of the inductance rather than the inductance itself. The inductive opposition to change in current is therefore used. It is called *inductive reactance* (symbol X_L). Inductive reactance is measured in ohms; thus,

$$X_L \text{ (in ohms)} = \frac{\text{AC volts}}{\text{AC amperes}}$$

If you know the inductance in henrys and wish to calculate the inductive reactance, the formula is: Inductive reactance (in ohms) equals 6.3 times the frequency (in Hertz) multiplied by the inductance (in henrys). This neglects the series resistance of the circuit, which can lead to errors, but we now are considering only the effects of inductance.

If an alternating voltage is applied across an air core coil, current will flow. If an iron core then is inserted in the coil, the current will decrease because the high-permeability core causes an increase in inductance, which, in turn, causes an increase in inductive reactance (X_L).

If we place a secondary winding on the coil, we have a transformer, but as long as we do not place a load on the secondary, the current remains as it was before the secondary was introduced. That current is called *exciting current* and is the current that flows in a transformer primary when all loads are disconnected from the secondaries. It is the current drawn by the primary alone, acting as a coil. Some additional current is drawn to overcome losses, because transformers are not 100 percent efficient, and this current is considered part of the exciting current. The major causes of transformer losses are:

- *Hysterisis,* which is magnetic friction in the core as the direction of magnetism is continually reversed by the AC current in the coil. Hysterisis loss increases as the frequency is increased.
- *Eddy Currents,* which are small circulating currents induced in the core itself because the core iron is a conductor and it too is being cut by the magnetic field. To reduce these little "whirlpools" of current, the core is made of thin *laminations,* stacked parallel to each other, with insulating coating between them. Another way to reduce eddy current is to use finely powdered core material with an insulating binder, molding the core into the desired shape.

When a core is saturated, the exciting current increases sharply because of the drop in *primary* inductance. The increased current causes overheating of the primary winding. In addition, the output voltage peaks appear flattened as saturation starts. With more pronounced saturation, the output wave resembles a square wave more than a sine wave, and an AC voltmeter therefore will indicate a lower than normal reading. This will be discussed later.

PHASE SHIFT

The current through an inductor lags the applied voltage by 90 degrees. Because the 90-degree phase shift is the basis for tuned circuits and resonance, it is worth examining.

Fig. 2A shows a square wave of applied *voltage.* The resulting change in *current* when this waveform is applied to an inductor is shown in Fig. 2B. When the applied voltage is suddenly increased, there is an opposition to the change in current, and the current increases gradually, finally reaching level I_2, which is limited by the circuit resistance.

Similarly when the voltage falls, the current changes gradually back toward I_1. Notice that a positive voltage causes a "positive-going" current, while a negative voltage similarly produces a "negative-going" current. The word *going* is included to emphasize that we are talking about the *direction* in which the current is going, and not its absolute polarity. A positive current which is decreasing is going towards negative, although it is still positive. This is important, because the current rises and falls gradually, *after* the voltage changes.

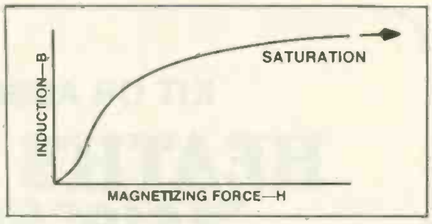

Fig. 1—Graphic illustration of saturation of an inductor.

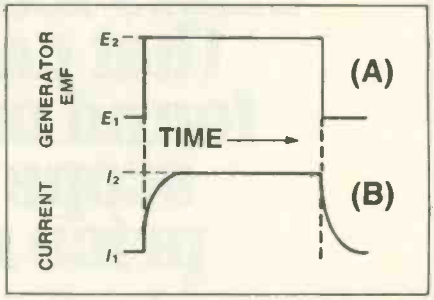

Fig. 2—Illustration of applied voltage (A) and resultant current (B) in an inductor.

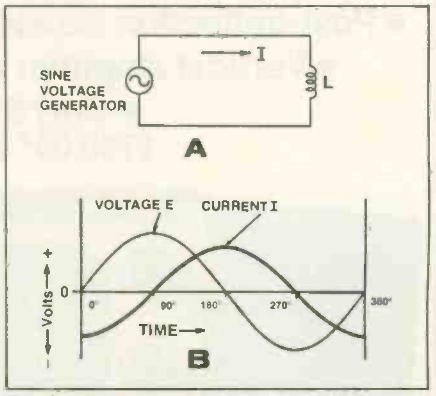

Fig. 3—Illustration of current lag in an inductive circuit. A) Circuit. B) Plot of voltage and lagging current.

Figure 3A shows a sine-wave (AC) voltage applied to an inductor, resulting in current "I" through the coil. Fig. 3B is a plot of the variation in voltage and the varying current produced by it. Note that between zero degrees and 180 degrees the applied voltage is positive, and, consequently, the current is positive going (increasing). From 180 degrees to 360 degrees the voltage is negative, and, therefore, the current is negative going (decreasing).

Because the voltage changes *polarity* at 0 degrees, 180 degrees and 360 degrees, the current changes *direction* at these points and reaches maximum when the voltage is zero. The current therefore reaches its peak 90 degrees after the applied voltage peak. This illustrates the phenomenon of *current lag* in an inductive circuit.

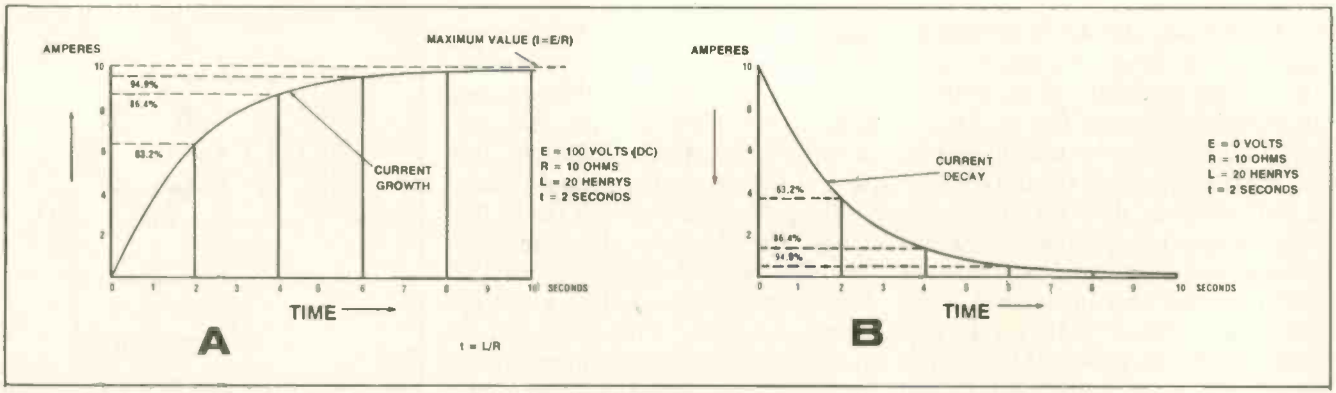

Fig. 4—Graphic illustration of charging (A) and discharging (B) current in an inductor.

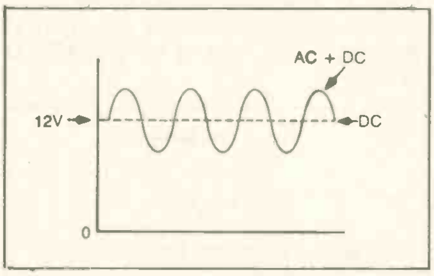

Fig. 5—Graphic illustration of an 8-volt peak-to-peak sine wave at a DC level of 12 volts.

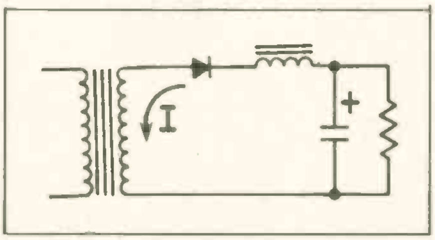

Fig. 6—The DC current in a half-wave rectifier flows through the transformer in one direction only. Saturation of the transformer can occur unless the transformer is designed for such use.

Because voltage is maximum when current is zero, power is also zero at these points. (Power = Volts × Amps). Similarly, when the voltage is zero, current is maximum, and, again, power is zero. As a matter of fact, *all* points on the curves of voltage and current equal zero power when phase shifts and polarity differences are taken into account. Therefore, in a purely inductive circuit, no power is consumed because of the 90-degree phase difference between voltage and current.

In reality, it is impossible to find a purely inductive circuit, because coils have resistance and other losses. Consequently, some power is consumed, depending on how much resistance and loss the coil has.

In a resistive circuit, the current is in phase with the voltage. In an inductive circuit, current lags voltage by 90 degrees. If the circuit contains both resistance and inductance, and the inductive reactance and resistance are equal, the current is midway between the two, at 45 degrees. For other ratios of resistance to inductance, the phase moves closer to one or the other, depending on which is greater.

CHARGING A COIL

As a capacitor charges through a series resistance, the *voltage* across the capacitor increases, rapidly at first, then more slowly as it approaches the supply voltage. This RC charging curve is familiar to service technicians, who often use the term *time constant* (the product of R × C). One *time constant* is the time it takes for the voltage across the capacitor to increase to 63 percent of the supply voltage. Capacitors store energy, which can be calculated with the formula: Energy (in watt seconds) = 1/2 Capacitance × Volts^2. (This is the energy discharged in electronic flash guns, capacitor discharge welders, etc.) Watt seconds is a measure of how many watts can be discharged in a given time in seconds.

Fig. 4 shows the RL charging and discharging curves of an inductor. It is identical to the RC curve previously described. Similar formulas apply, except that we are dealing with a charging *current* instead of voltage. To illustrate the point clearly, specific values of voltage, current and resistance are given in Fig. 4. An inductive time constant in seconds is equal to L/R (the 63-percent point on the charge or discharge curve). The energy stored in watt-seconds = 1/2 Inductance × Current^2. (This represents the energy discharged in such applications as ignition coils.) The maximum value of current that can be reached is determined by the series resistance of the coil and associated circuit.

The time constant curve is useful because it shows us what level of current will be reached in a given time if we know the inductance and the resistance. The more inductance (L), the slower the current changes, while the more resistance (R), the faster the current changes, as indicated by the formula. This is easy to remember, because the current increases instantly in a purely resistive circuit.

SATURATION

Saturation is a very important factor influencing the design of practical chokes and transformers. To control saturation effects, different core materials are used, even air, each with its own useful characteristics. An air gap has high reluctance, increasing the reluctance of the entire core path, just as inserting a resistor in the center of a long piece of wire increases the resistance of the entire circuit. As a result, a greater magnetizing force can be accommodated before saturation occurs.

Generally, an air core is employed when there is a DC current applied as part of the magnetizing current. Fig. 5 shows a 12-volt DC level with an 8-volt peak-to-peak ripple. This is exactly what the output of a class A transistor amplifier looks like. It is evident that the DC component will cause a current to flow, limited only by the series resistance of the circuit. This will occur in about 5 time constants (refer to Fig. 4) and will probably saturate the core unless an air gap is used. AC cannot saturate the core as readily, because the current falls to zero and reverses long before the 5-time-constant point is reached.

A core can also be saturated by applying an input frequency lower than that specified. If a 400-Hz transformer is used for 60 Hz, it will saturate, because a half cycle at 60 Hz is seven times the duration of a half cycle at 400 Hz. This is a much longer interval than the transformer was designed to handle. (At 400 Hz, much less inductance is required to achieve sufficient L/R.) This can be compensated for by reducing the input voltage so that a smaller level of magnetizing force is applied to the core. If a transformer is operated at half its rated frequency, the voltage must be reduced by a factor of 2. The voltage must be reduced by the same ratio that the frequency is reduced. Similarly, the AC voltage can be increased moderately if the frequency is increased, providing that the transformer insulation rating is not exceeded. Fortunately, most transformers are well insulated. In the case of a half-wave rectifier circuit (Fig. 6), current is always drawn through the transformer winding in the same direction, as shown by the arrow. This large DC current component saturates the core unless the transformer is designed for such use. Therefore, a filament transformer, designed for AC current loads only, is a poor choice for such use. If you build small power supplies for battery charging, alarm systems, etc., it would be better to use the full-wave bridge rectifier circuit in Fig. 7. Because the full-wave circuit rectifies both halves of the input cycle, current flows through the transformer in both directions, as indicated by the arrows (AC current); consequently, the transformer does not tend to saturate.

Transformers intended for full-wave rectification are often center tapped, as shown in Fig. 8A. You will quickly notice that this is really two half-wave rectifier circuits, with both windings on the same core, arranged so that the current in each winding flows in a direction opposite to that in the other winding. Thus, the core sees alternate directions of current flow as each rectifier conducts in sequence, and saturation caused by DC current flow is avoided.

Fig. 8B shows another application of the same method of avoiding saturation. A push/pull amplifier drives the common center-tapped audio transformer. The DC current component of the collector output of each transistor flows through one half of the winding. Since the currents flow in opposite directions, the magnetic fluxes cancel. Input signals to the push/pull stage are fed to the bases out of phase. Because they are also phased oppositely in the transformer, the signals wind up being in phase (reversing phase *twice* results in zero phase difference). Note, however, that only *one* phase reversal occurs with the DC current fed into the center tap.

Thus, you cannot use a push/pull transformer for single-ended use and expect it to handle much power. Because the push/pull configuration eliminates most of the DC flux, it generally has a very small air gap. A single-ended transformer usually has a much larger gap and more iron for the same power rating. The exception is the "universal replacement" type of transformer, which is designed for multi-use service.

IMPEDANCE MATCHING

If a transformer with a 10-watt load is driven with an input of 1 ampere of current at 10 volts, the impedance can be calculated by the formula:

$$\text{Impedance} = \frac{\text{Volts}}{\text{Amps}}, \text{ or } Z = \frac{E}{I}.$$

In this case, the impedance is $\frac{10 \text{ volts}}{1 \text{ amp}}$, or 10 ohms. If the transformer has a two-to-one step up ratio, the output will be 20 volts. Obviously, the output current cannot still be the one ampere of input current, for 20 volts of output multiplied by one ampere would be 20 watts, and a transformer cannot be more than 100 percent efficient. Transformers *cannot* increase the *power* level. Therefore, for the output power to equal the input power, the current must be reduced in the same ratio that the voltage is increased. Thus, output current is ½ ampere, and consequently, the output impedance is $\frac{20 \text{ volts}}{0.5 \text{ amp}}$, or 40 ohms. Similarly if the ratio of the transformer was three to one, the voltage would be changed by a factor of three, the current would be changed in the *opposite* direction by a factor of three, and the output impedance would be changed by a factor of nine because of the combined influence of current and voltage changes. Thus, the output impedance is changed by the *square* of the turns ratio.

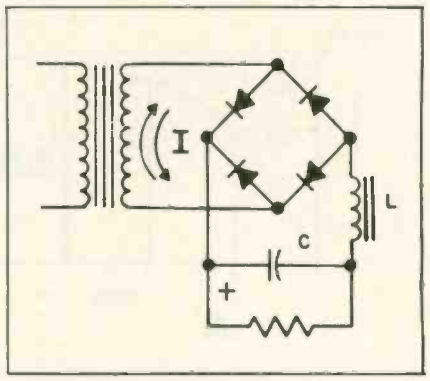

Fig. 7—DC current flow through the transformer of a full-wave bridge rectifier circuit changes direction on alternate half cycles of the input voltage, reducing the probability of saturation.

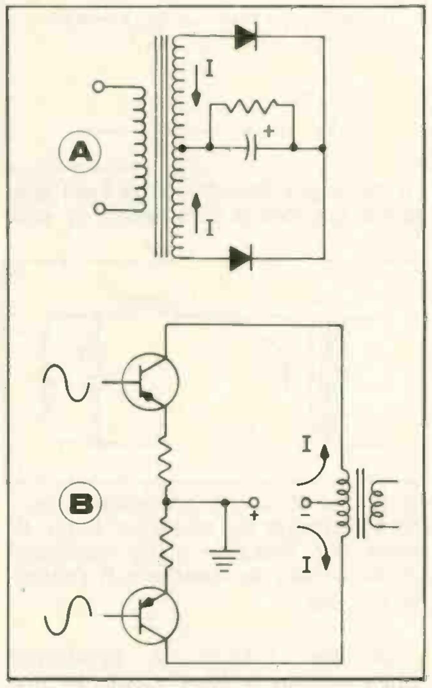

Fig. 8—Core saturation is avoided in full-wave rectifier (A) and push/pull amplifier (B) circuits by using a common core for the two windings of the transformer.

Maximum output is not the only reason to be concerned about impedance matching. Because we are discussing low frequencies here, standing waves are not a consideration. However, there are other factors which are worth examining.

Assume that we have a generator with 10 ohms internal resistance and which delivers 30 volts into an open circuit (no load current), as shown in Fig. 9. The accompanying chart shows what happens to output voltage, current, power output and internal power dissipated in the generator as we change the load.

Load Impedance Vs Power Transfer of Circuit in Fig. 9

LOAD	CURRENT	OUTPUT VOLTS	POWER IN LOAD	POWER DISSIPATED IN GENERATOR
Open Circuit	0	30	0	0
20 ohms	1 amp	20	20	10
10 ohms	1.5 amps	15	22.5 watts	22.5 watts
5 ohms	2 amps	10	20 watts	40 watts
short	3 amps	0	0	90 watts

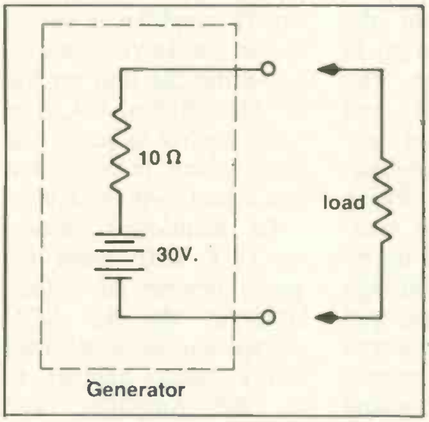

Fig. 9—Maximum power is delivered to the load when the impedance of the load matches the internal resistance of the generator. See the accompanying chart for the effects of mismatches.

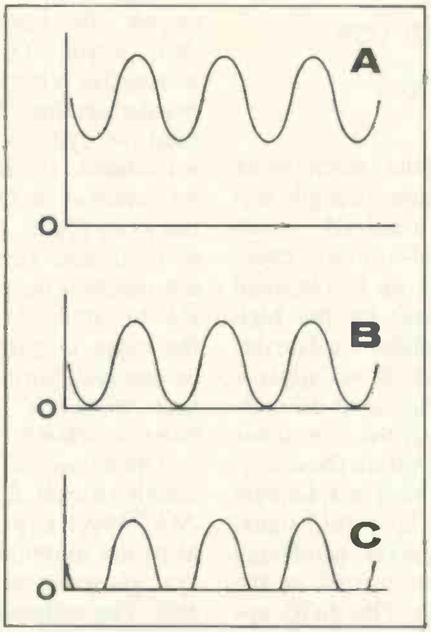

Fig. 10—Illustration of the effects of different ratios of ripple and DC current in a choke-input filter of a power supply. A) DC current greater than ripple. B) DC current and ripple the same. C) DC current less than that of ripple, causing interruption of power supply current.

Notice that maximum power is delivered to the load when the load matches the generator's internal resistance. But, just as important, the generator dissipation increases rapidly when the load impedance is less than that of the generator.

The importance of load matching is evident from the accompanying chart. This is why it is so necessary to have the right turns ratio on a transformer when making substitutions. The wrong ratio might only decrease power output 10 percent or so, but it also can raise dissipation in the power output circuitry to the point where parts fail in a very short time.

FILTER CHOKES

Some power supplies use choke-input filters, like those shown in Figs. 6 and 7. The DC current through the choke depends upon the load resistance, but there is also significant AC current caused by the large ripple content of the rectifier output waveform. So long as the DC current is *greater* than the AC current, as in Fig. 10A, the circuit behaves normally. When the DC current is reduced to the *same* amplitude as that of the AC, the output is like that in Fig. 10B. If the DC current is reduced *below* the level of the AC, as in Fig. 10C, the current is actually cut off, or clipped, on the negative peaks. This interrupted power supply current is an undesirable condition, and can be prevented in one of two ways: 1) The DC current level can be increased by connecting a heavy bleeder resistor across the output terminals of the supply. This wastes power, and requires a heavier power transformer and a high-wattage bleeder resistor. 2) The inductance of the choke can be increased, which reduces the amplitude of the ripple current. If the DC current is small, the AC current must also be small, and the choke becomes very large as a result. Also, high inductance means many turns, which increases the series resistance of the coil, increasing the series voltage drop across the coil, which is undesirable from both power loss and voltage regulation viewpoints.

Remember, more inductance is needed when the DC current decreases (the load resistance increases) or if the ripple current increases. Because ripple current would increase if the ripple frequency were lowered (choke reactance decreases as frequency decreases), more inductance is required with a half-wave rectifier than with a full-wave rectifier. (A full-wave rectifier has a ripple of twice the input frequency.) Thus, to determine the minimum inductance needed for proper operation of a choke-input filter, the load resistance and the frequency also must be considered. The formula is:

$$L = \frac{R}{10\,F},$$

where R is the load resistance in ohms, and F is the *ripple* frequency. This is known as the *critical inductance*.

By utilizing saturation effects, we can use a small, low-resistance choke, avoiding all the undesirable alternatives previously discussed. This is accomplished by using a core with a very small gap, despite the large DC current the choke carries at full load. The small gap results in a high-permeability core, with high inductance at low DC current level, which is just what is needed. As the DC current increases, the core partially saturates, decreasing the inductance. But at high DC currents, less inductance is required, as discussed earlier. Thus, the choke inductance "swings," being high when needed, and decreasing when high inductance is not required. This type of choke is therefore called a *swinging choke*.

Because most entertainment-grade filter chokes are designed for small size, weight and cost, they operate close to the edge of saturation, and are, in effect, swinging chokes. You can use this information for substitution purposes, because a 2-henry, 200-ma choke might be expected to have a higher inductance if run at only 100 ma. Running a choke at more than its rated current is somewhat risky, because the current limit is often set by the power dissipation of the winding and by severe saturation, which renders the choke almost useless for normal filtering purposes. ■

Servicing Solid-State AGC Circuits

By Joseph Zauhar

Form a step-by-step systematic approach to isolate an AGC problem and remember most TV sets use forward biased AGC systems

■ Troubleshooting automatic gain control (AGC) circuits can be difficult if we don't understand the relationship of other circuits which interact with the operation of the AGC circuit. AGC problems can be caused by faulty antenna systems, tuner, IF amplifiers, picture detector, sync circuits and video amplifier circuits.

There are a number of different AGC systems used in TV receivers, but the most common is still the "gated," or keyed, AGC system.

AGC Circuit Function

The RF and IF gain in a TV receiver has to be regulated inversely with relative strength of the received signal. When the incoming TV station signal becomes too strong, the gain of the RF and IF amplifiers must be reduced to prevent overloading. If a medium strength signal is received, only a reduction in the IF gain is necessary, allowing the RF amplifier to operate with maximum gain. During a weak signal, the AGC circuit is seldom used, and if all signals were weak, the RF AGC could be eliminated. In brief, the output of the RF and IF amplifiers must be held fairly constant regardless of the strength of the received signal. If we don't apply AGC voltage to the RF amplifier when weak and medium strength signals are received, excellent signal-to-noise characteristics can be obtained in the tuner by the high RF amplifier mixer-to-noise ratio. If we apply a large RF signal to the mixer, it overrides the noise generated within the mixer. We now have a relatively noise-free IF output signal from the mixer, producing a noise-free picture on the TV screen. The AGC applied to the tuner is delayed until the receiver is of such magnitude that any increase in signal would cause overloading of the tuner. The delayed RF AGC stage will then function and allow a reduction in the gain of the RF amplifier for any further increase in the received signal.

Forward IF AGC Circuit

Some new color TV chassis now employ dual-gate field-effect transistors (MOSFETs) in the video IF stages and a field-effect transistor (FET) as the RF Amplifier in the VHF tuner. The conduction of a FET must be decreased to reduce its gain and, therefore, it requires reverse AGC action. The new AGC system will provide a forward IF AGC output and a reverse RF AGC output.

The composite video signal with negative-going sync pulses (Fig. 1) is coupled from the video driver stage to the base of the AGC keyer transistor, Q5. If noise pulses are present on the sync tips, they are cancelled by the noise canceller transistor, Q6. When a TV station signal is received, the increased DC current through the video driver causes the base of the AGC keyer, Q5, to go in a negative direction. The negative-going DC and negative sync pulses forward biases the base-emitter junction of Q5 during the sync cycle. This transistor is also keyed on by a horizontal pulse through D3 to the collector, and the stage is only allowed to conduct during retrace time when the horizontal pulse is present.

The amount of collector circuit current flow in the AGC keyer is proportional to the amplitude of the sync pulses at its base circuit. The collector current charges C10, and this charge is also proportional to the amplitude of the sync tips. This is how the DC voltage is obtained which increases and decreases with respect to the amplitude of the composite video signal. The charge on C10 is coupled to the base of Q4, the IF AGC Buffer transistor, which is coupled as an emitter follower. The emitter output of Q4 is coupled to the Second IF Amplifier and controls its conduction, which, in turn, controls the conduction of the first IF Amplifier and the gain of the two amplifiers.

A voltage divider consisting of R30, R31 and R32 through diode D4 provides the forward bias for the second IF amplifier. A clamp is provided by D4, to prevent the "no signal" AGC voltage from decreasing below the minimum voltage of approximately 3 volts established by R30, R31, and R32.

When a TV station signal is received, and Q4 conducts sufficiently, the voltage at its emitter will reverse bias D4 and increase the IF AGC voltage up a maximum of about 6 volts, to reduce gain. The amount of AGC voltage applied to the second IF amplifier is varied by the AGC LEVEL control, by setting the bias on the IF AGC Buffer, Q4. The AGC control is set to the point which provides the best signal-to-noise ratio.

As mentioned earlier, the FET VHF tuner requires reverse RF AGC. However, the RF AGC voltage has to be delayed before being applied to the RF Amplifier. The function of the RF AGC Inverter circuit (Fig. 2) is to allow the RF Amplifier in the tuner to operate at peak amplification on weak-to-medium strength signals, while the IF AGC system is simultaneously reducing the gain of the IF stages. This circuit action provides maximum signal-to-noise ratio with a minimum of snow (noise) on the screen of the TV set. Then as the signals get stronger, the RF AGC Inverter starts to reduce the gain of the RF Amplifier by decreasing the positive RF AGC voltage applied to the tuner.

The RF AGC voltage will vary from plus 8 volts on the weakest transmitted signals (approximately 500 microvolts or less) from the TV station, to a minus 1.6 volts on the strongest signals. Diode D8 rectifies the negative-going horizontal pulse from the horizontal-output transformer, because a negative voltage is required for strong signals. This DC voltage is filtered and then applied to the RF AGC circuit. When a

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weak station signal is received, the charge on capacitor C10 is low, diode Z5 is not conducting, and Q10 is cut off. With Q10 being cut off, the RF AGC bus line is clamped by D7 at the voltage level obtained from the 18-volt divider network, which is approximately 8 volts. If the signal level is increased, the charge on C10 also increases until it exceeds the 6.8 volts and Zener diode Z5 now starts to conduct. With this circuit action, the RF AGC is delayed until a medium-strength signal is received.

When diode Z5 starts to conduct, Q10 receives a forward bias, and a collector current begins to flow. The collector voltage which was 14.8 volts (8 volts at D7 and the 6.9-volt drop across Z6) begins to decrease; but the voltage drop across Z6 remains constant, allowing the RF AGC voltage to decrease at the same rate. If a strong station signal is received, Q10 is saturated and the voltage at the collector is 5.2 volts, obtained from the voltage divider consisting of R20 and R21. With the constant voltage drop of 6.8 volts across Z6, the RF AGC bus voltage is at minus 1.6 volts, and the RF Amplifier gain is very low.

AGC Circuit Problem Symptoms

The electronic service technician should have a clear understanding of what symptoms may lead him to suspect AGC circuitry problems. He should keep in mind that the AGC voltage controls the level of the video signal which modulates the picture tube.

The best place to start is to view the screen of the TV receiver. A dark picture with excessive vid-

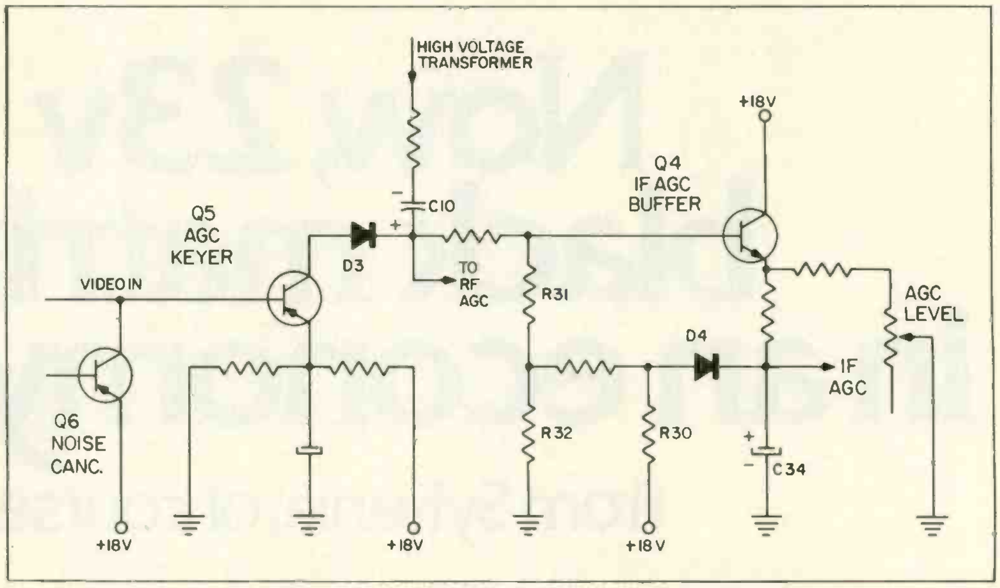


Fig. 1—Simplified schematic diagram of the AGC keyer and the IF AGC buffer stage.

eo signal may cause the sync tips to be clipped off by the video driver transistor, causing horizontal tearing and loss of sync in the TV picture. This condition is usually caused by excessive gain in the RF and IF amplifier stages, because of insufficient AGC action. In an extreme case the screen may be completely black, and the second anode voltage of the picture tube and the sound may be normal, indicating excessive video signal. A white raster with a slight trace of video is usually an indication of excessive AGC action.

Troubleshooting Keyed AGC Circuits

The first logical approach to take when troubleshooting the AGC circuit is to make sure the AGC control is properly adjusted. This is probably one of the most common problems. If the control is rotated too far in one direction, the circuit becomes inoperative and no AGC voltage is developed, allowing the TV set to overload on strong signals.

If the AGC control is rotated to the extreme opposite direction, the keyer transistor will conduct very heavily, and excessive AGC voltage will be

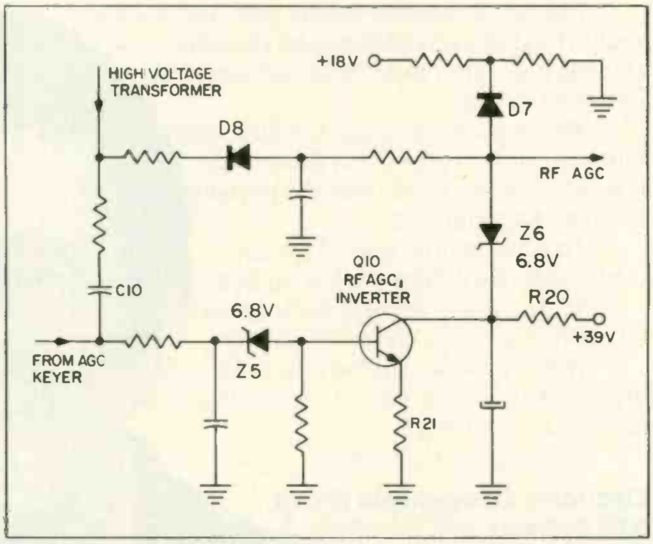


Fig. 2—Simplified schematic diagram of the RF AGC inverter circuit.

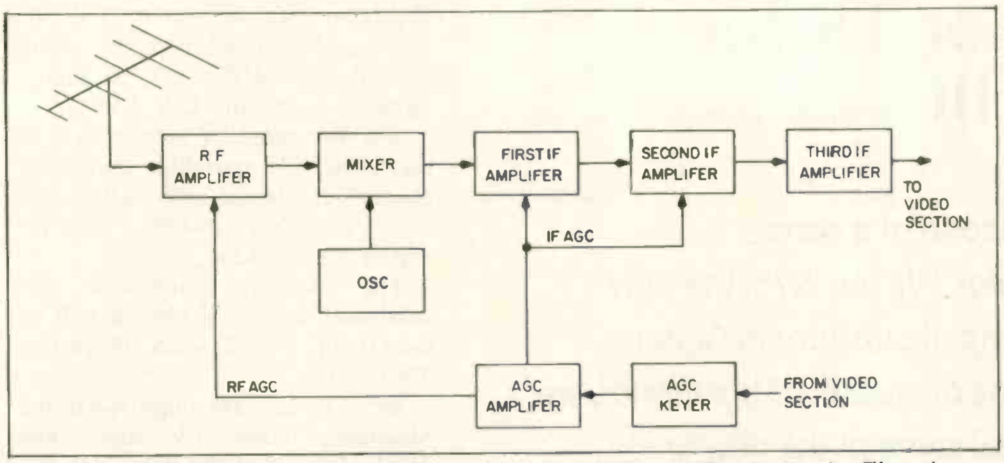
produced, reducing the gain of the RF and IF Amplifiers to practically nothing. With this AGC control setting, we will lack both picture and snow on the screen of the TV set, but may possibly have some sound. After making sure the AGC control is properly adjusted, according to the manufacturer's service information, and an overload condition still seems to exist, proceed with the following measures to isolate the problem.

Turn the channel selector on the TV receiver to an unused channel and if a raster appears with snow, it is an indication that the RF and IF Amplifiers are functioning. Then, turn the channel selector back to an active channel.

Remove the antenna leads from the antenna terminals of the TV set and loosely couple the lead or hold it a few inches from the antenna terminals. If a picture appears on the screen as the antenna lead is moved away, this is an indication of a gain problem.

Measure the AGC voltages. If the IF AGC voltage is approximately 3 volts (Fig. 1 and 2) and the RF AGC voltage is about 8 volts, then the RF and IF amplifiers are operating at maximum.

If the noise canceller



Block diagram showing the RF AGC and IF AGC voltages applied to the amplifier circuits of a TV receiver.

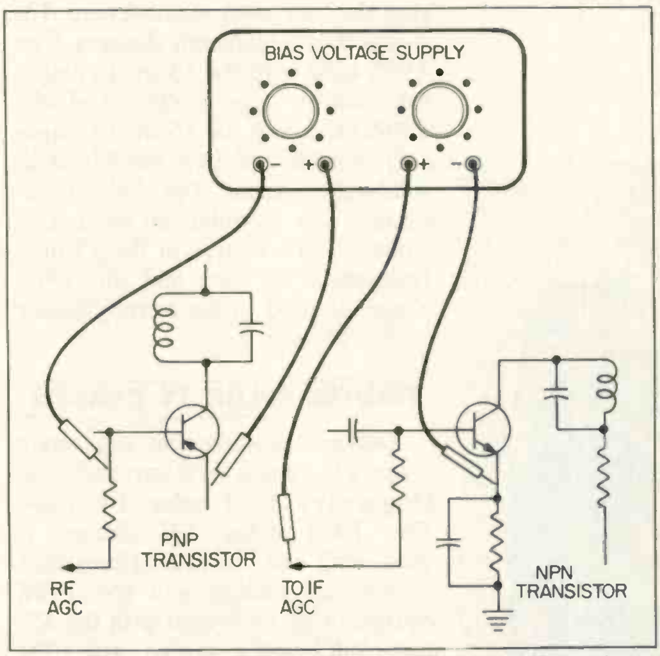


Fig. 3—Bias voltage connections for the PNP and NPN transistors employed in the AGC circuit of a transistorized TV receiver.

transistor, Q6, is shorted or leaky, it will cause Q5 to turn off, causing the AGC circuits to function as if the video signal is weak, and, in turn, causing the RF and IF amplifiers to operate at higher gain. Substitute the noise canceller transistor or temporarily remove it from its socket and the TV receiver should function properly, if it is defective.

After removing Q6 from its socket and normal operation is not restored, try checking transistors Q4, Q5, and Q10.

If all transistors check good, the diodes should be checked with an ohmmeter, in-circuit, with the TV set turned off. Measure the voltage to ground from the junction of C10 and the cathode of D3. If this voltage is approximately 2 or 3 volts, then the AGC keyer stage is functioning properly and the problem is the adjoining circuitry. If this voltage is within 9 to 11 volts, then the AGC keyer stage is operating properly, and the problem lies within the circuitry associated with the IF AGC buffer stage or the RF AGC inverter stage.

Clamping the AGC Circuit

An overloaded video condition on the screen of the TV set when applying normal and high signal levels to the antenna terminals, in most cases is a defect in the AGC circuit, but we should make sure.

Clamping the AGC line can be a very quick method of determining if an AGC circuit problem does exist.

First, check the manufacturer's schematic for the AGC test points and the proper voltages. Then, apply a voltage using a battery or variable bias voltage substitution unit to the AGC bias voltage line, starting at the lowest voltage, to prevent damage to the transistor. On transistor circuits, the picture should be quite dark or cut off with the bias voltage control set at zero. Then, as the voltage is increased, normal operation should be restored, then the overloaded video symptom should return if the AGC circuit is at fault. This proves that the amplifier can function normally if the proper AGC voltage is provided.

If overload video conditions still persist, check the voltages and resistances of components that would disable the keyed AGC amplifier stage.

Disconnect the AGC circuit from the base of the second IF amplifier and connect a bias voltage source in its place.

Adjust the bias control to zero voltage. Connect the bias test voltage to the AGC line, using the emitter of a transistor as reference. Connect the polarity to provide a forward bias voltage (Fig. 3).

If the AGC circuit is shorted, it will now be disconnected from the amplifier circuit. Now vary the bias voltage and observe the picture on the screen of the TV receiver. With no bias voltage, the picture will be dark or cut off. As the voltage is increased, normal operations should be restored, then the overload video conditions should be restored and the overload video conditions should return. Then repeat these steps for the first IF amplifier and RF amplifier stages. If the video overload conditions don't appear continuously at any of these stages, it is likely that the trouble is in the AGC circuit.

Disconnect the AGC filter capacitors and substitute them one at a time until the defective capacitor is located.

If the overload video conditions reappear and the bias voltage has no effect upon the picture in any one of the stages, check for a defective component in that stage.

Common Keyed AGC Circuit Problems

In a large majority of cases of AGC circuit problems, we find a defective AGC keyer transistor, which is usually shorted from the collector to emitter. If we find that the transistor is shorted, replace the associated diode used in the collector circuit with one having a high reverse breakdown voltage. The diode can be checked in-circuit with an ohmmeter. When using an ohmmeter, the resistance of the diode should measure a fairly low resistance

continued on page 49

New in Color TV for 1975–Part III

By Joseph Zauhar

Last month, in the second of a series reviewing the new color TVs for 1975, the new and significantly changed circuitry in General Electric's new line was discussed. This month, we will continue to review some of the new or significantly changed circuitry employed in the new Magnavox color TV line.

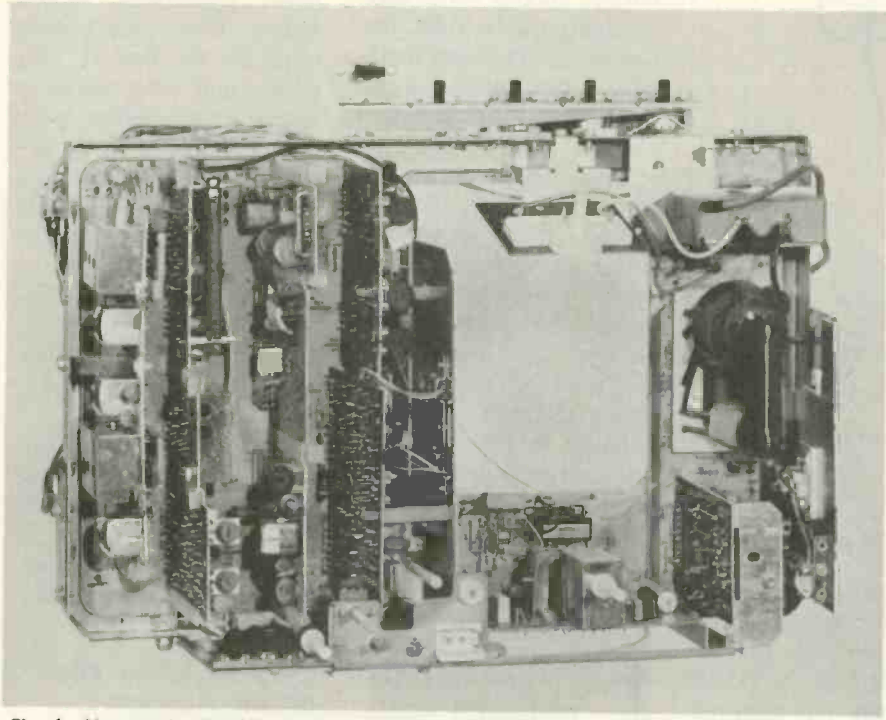


Fig. 1—Magnavox's T985/986 Modularized Color TV Chassis. *Courtesy of Magnavox.*

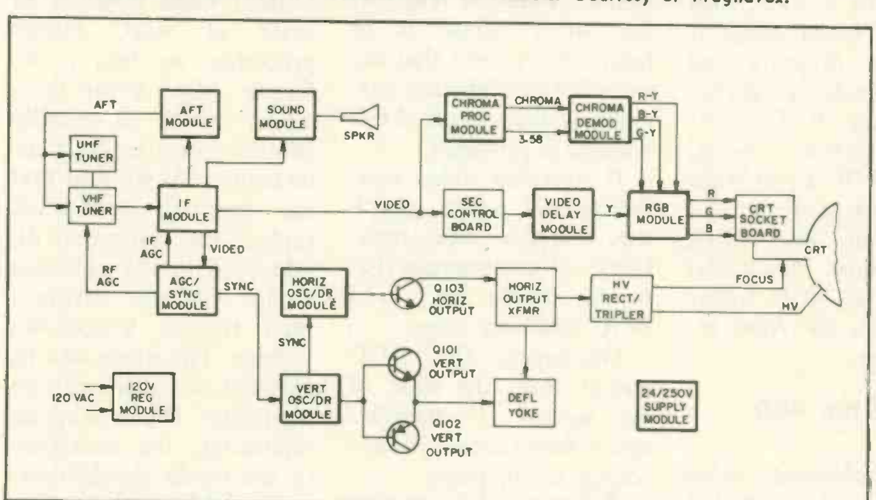


Fig. 2—Simplified block diagram of the T985/986 color TV chassis. *Courtesy of Magnavox.*

■ Magnavox's new color TV line will consist of all-modular, solid-state designs which will be manufactured within the U.S.

The full range of screen sizes in the color TV portables and table models feature the new high-resolution, precision in-line, negative matrix picture tube.

The "Second Generation" all-solid-state color TV chassis will be used in all of the 25-inch (diagonal) TV models.

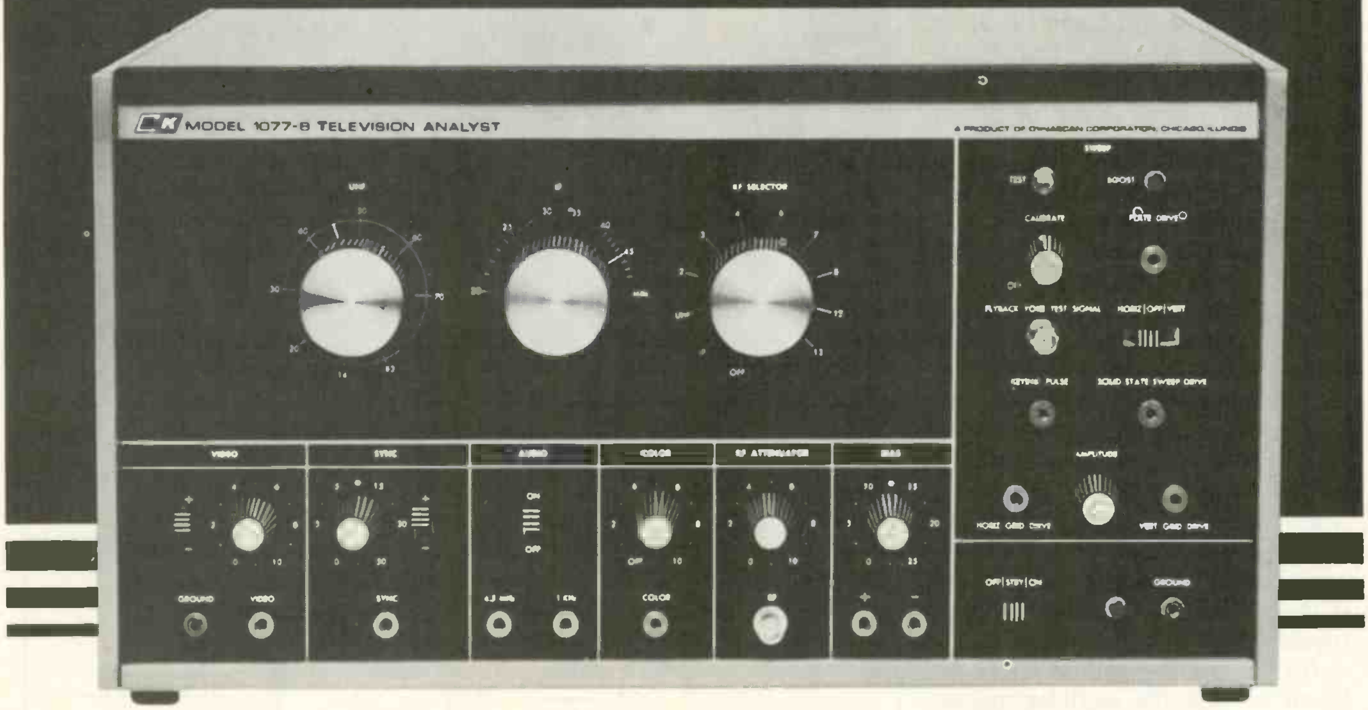
Seven chassis are employed in the Magnavox color TV line: The T981, T982, and the T987 are all-solid-state chassis introduced last year for use with small-screen TV sets without significant changes. The T985 used with the 13-inch (diagonal) screen size models and the T986 used with the 15-inch (diagonal) models are new modularized, solid-state chassis. The T995 chassis is a new modularized solid-state chassis which is used in the 25-inch (diagonal) TV sets and the T989 chassis is used in the stereo/theater model TV sets.

T985/986 COLOR TV CHASSIS

Two new modularized, solid-state color TV chassis are introduced in Magnavox's 1975 color TV lines. The T985 color TV chassis is used with the 13-inch (diagonal) screen size models and the T986 chassis (Fig. 1) is used with the 15-inch (diagonal) screen size TV models. Both chassis use the same plug-in modules. The only essential difference between the T985 and T986 chassis is the horizontal-output transformer and the size of the picture tube screen. A simplified block diagram of the T985/986 color TV chassis is shown in Fig. 2. These chassis are used in portable color TV receivers equipped with in-line picture tubes, employing permanent deflection yokes and no dynamic convergence circuitry.

The chassis is constructed in a vertical configuration and is hinged on the right side, and swings outward to allow access to the 120-volt Regulator Module and other components. The remainder of the 13 modules are accessible from the back of the chassis. Molex connectors are used on the modules to mate with the main chassis member. The IF, AFT, and AGC/Sync modules used in the T985/986 chassis are identical to those used

the only prime time test pattern.



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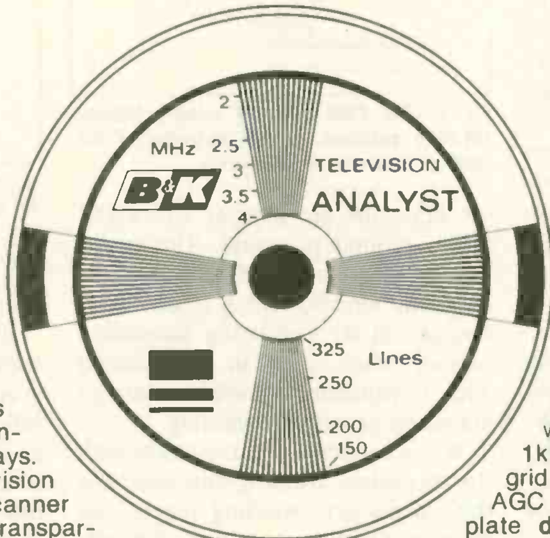

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in the 25-inch (diagonal) solid-state chassis, T995.

Many of the controls are accessible from the back of the TV set without removing the cabinet back, which include the three *Videomatic Preset, Vertical Hold,* and the *Horizontal Hold* controls. The *Focus* control is accessible through a ventilation slot located at the top of the cabinet back.

T-995 COLOR TV CHASSIS

The new T995 color TV chassis (Fig. 3) is a "second generation" all-solid-state, modular chassis which is used in the 25-inch (diagonal) color TV receivers. It employs fifteen plug-in modules and an Interconnect Board Assembly. The vertical design of the chassis allows it to be tilted outward and down from its vertical position, to a 45 degree position and one at 20 degrees from a horizontal position, as shown in Fig. 4, to aid servicing if required.

All of the module sockets are keyed so that the modules cannot be installed incorrectly and are secured by plastic pins, hold down wires or by screws to a heat sink. A few of the modules use plugs which have to be disconnected before removal of the modules. Molex connectors with metal-to-metal contacts are used throughout the chassis, with the exception of the Convergence Board.

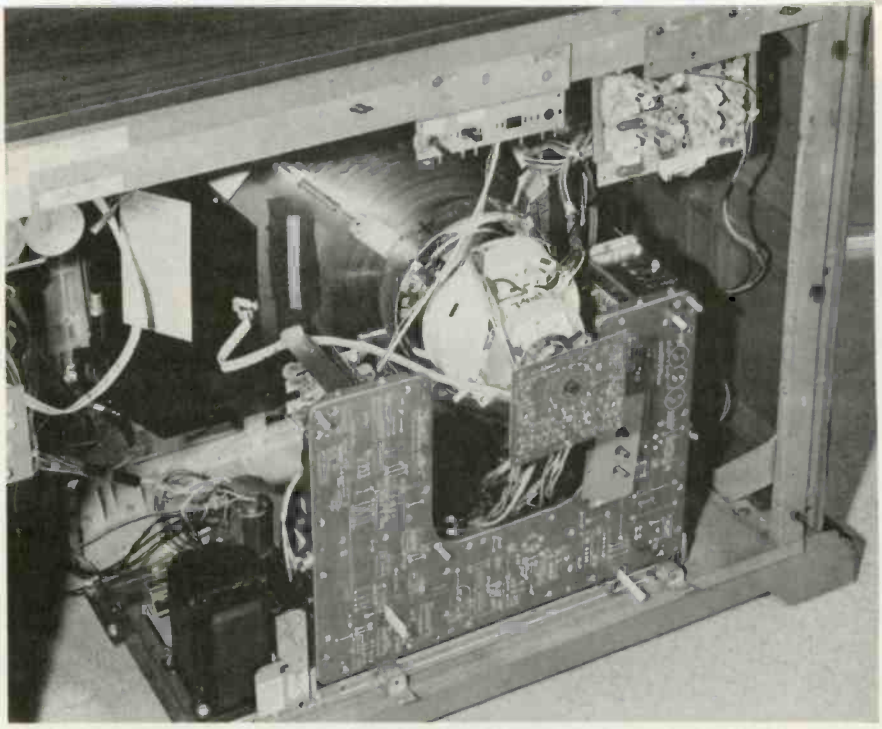

Fig. 3—Rear view of a Magnavox color TV set equipped with the T995 chassis. *Courtesy of Magnavox.*

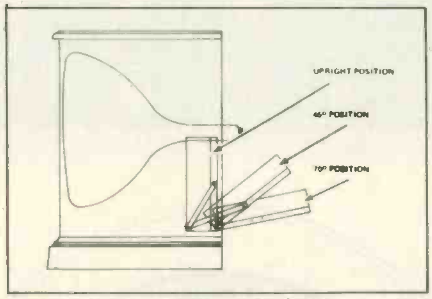

Fig. 4—The T995 color TV chassis features tilt-down positions, to aid servicing of the chassis. *Courtesy of Magnavox.*

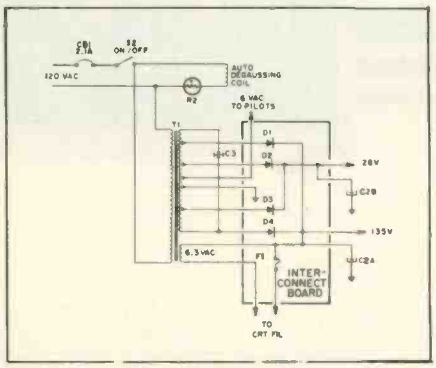

Fig. 5—The AC input circuit of the T995 color TV chassis features a saturable, self-regulating type power transformer. *Courtesy of Magnavox.*

Low Voltage Power Supply

To protect the TV set from power line surges or to maintain adequate performance during low voltage "brown out" a new saturable, self-regulating-type power transformer is used in the T995 color TV chassis.

Only two basic DC voltages are provided by the low-voltage power supply and all circuits are powered either directly or indirectly by the two DC voltage sources. The only tertiary winding provides the picture tube filament voltage. Most of the power supply circuits are found on the Interconnect PC board and the plug-in Power Supply Module.

When line switch S2 (Fig. 5) is closed, it energizes the power transformer, providing the supply voltages and 6.3 v AC to the picture tube filaments. To prevent arc-over to the cathodes of the picture tube, the filaments are kept at 135 v DC above ground potential. The transformer is constructed with built-in magnetic shunts, which allows it to operate in its regulating saturation region, when used in conjunction with a capacitor which is shunted across its secondary winding.

When capacitor C3 resonates with the secondary winding and saturates the secondary winding core, the primary winding core does not saturate because of the magnetic shunts. This arrangement is often referred to as a ferroresonant regulator.

Since the secondary winding of the transformer is normally saturated, the primary winding may fluctuate, while the output of the secondary remains relatively constant. For example, if the AC line voltage changes approximately 10 percent, there would be less than a 1-percent voltage variation at the secondary output of the transformer. Since the secondary winding operates in saturation, its outputs are essentially square wave.

The secondary winding of the transformer is center tapped to ground. Diodes D2 and D3 form a full-wave rectifier, providing the 28 v DC source voltage which is filtered by capacitor C2B. Another full-wave rectifier is formed by diodes D1 and D4, providing the 135 v DC source voltage which is filtered by C2A. Both supply voltage outputs are coupled to the Power Supply Module.

MOS-FET Video IF Circuit

A new MOS-FET (field-effect transistor) Video IF Circuit (Fig. 6) represents a departure from previous Magnavox chassis designs.

The first, second and third Video IF amplifier circuits use dual-gate field-effect transistors. These stages require reverse AGC voltage, and a new AGC circuit has been designed to accommodate this requirement.

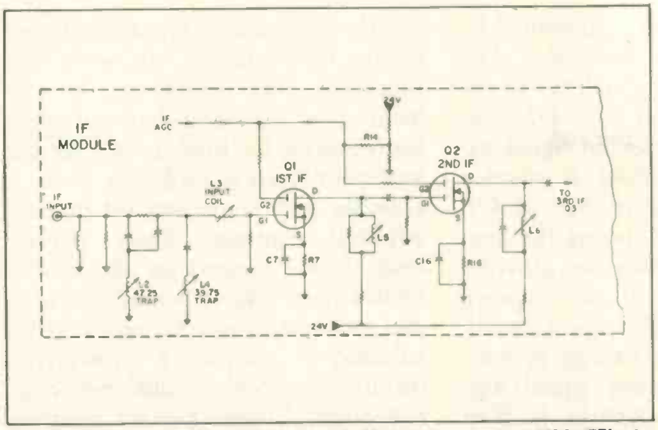

Fig. 6—Schematic diagram of the IF Module employing MOS-FET's in the first and second IF Amplifier stages. *Courtesy of Magnavox.*

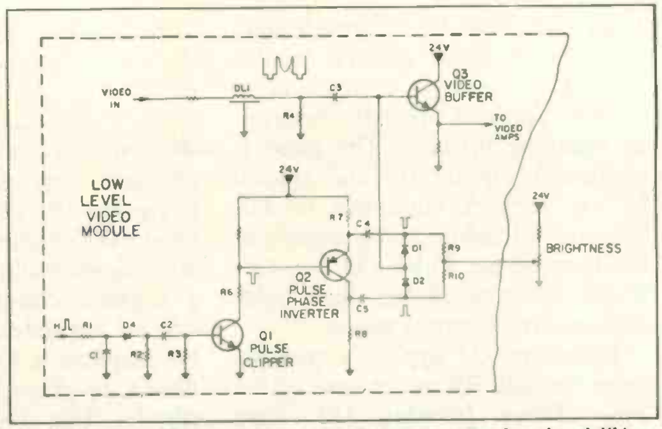

Fig. 7—The new Video DC Clamp circuit found on the Low Level Video Module helps to maintain the darker portion of the picture at constant level. *Courtesy of Magnavox.*

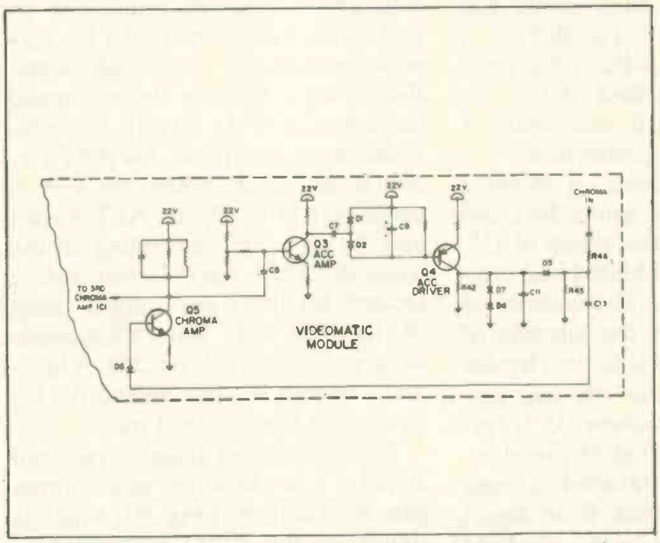

Fig. 8—The Automatic Chroma Control (ACC) circuit is part of the Videomatic Module. *Courtesy of Magnavox.*

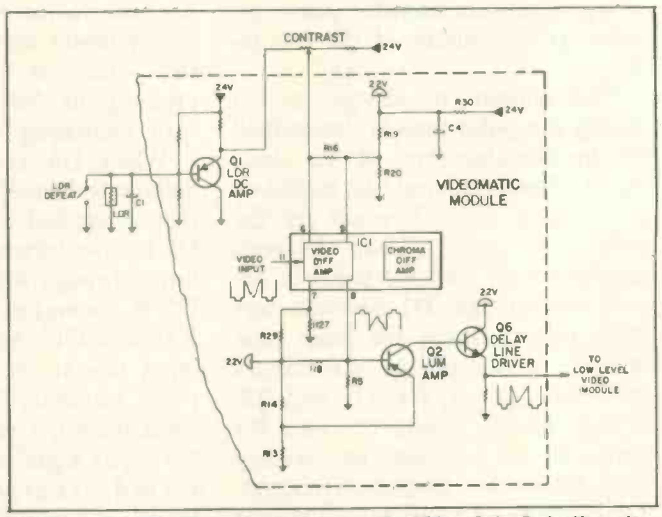

Fig. 9—Simplified schematic diagram of the Video Gain Reduction circuit found on the Videomatic Module. *Courtesy of Magnavox.*

The use of MOS-FETs has many advantages over conventional transistors; among these are: 1) lower feedback capacity, 2) better cross-modulation performance, 3) less AGC power consumption, 4) improved thermal stability, 5) higher gain, and 6) lower current requirements.

The bias on G1 of transistors Q1 and Q2, which prevents excessive DC current flow, is provided by resistors R7 and R16. These resistors are bypassed by capacitors C7 and C16 to obtain maximum gain. A 24-volt voltage divider provides the G2 bias to both stages and is influenced by the IF AGC voltage. The input signal to Q1, obtained from the tuner IF link, is trapped at 47.25 MHz and 39.75 MHz to minimize the amplifier response to adjacent channel picture and sound carriers. The input coil, L3, is tuned to the center frequency of 44 MHz. Because of the low input Q of the IF input circuit, the tuner of IF module may be replaced without any link adjustments needed.

The IF signal then appears at the drain of Q1 and the 45.75 MHz picture carrier is optimized by the tuned circuit controlled by coil L5. The signal is then further amplified when it is applied to G1 of Q2. The tuned circuit at the drain of Q2, controlled by coil L6, optimizes the frequency response to the color intercarrier frequency of 42.17 MHz. The IF signal is then coupled to G1 of Q3, the third IF amplifier, for further amplification.

DC Video Clamp Circuit

The new video circuit employed in the T995 chassis, maintains the darker portion of the picture at a constant level to help prevent "grey shift" during certain scene changes. The circuit allows the average brightness level of the original scene to be transferred to the picture tube screen. If we have black in the original scene, we will have black on the screen and not grey.

The DC video clamp circuit (Fig. 7) is found on the Low Level Video Module. The luminance signal received is coupled and delayed by the delay line, DL1, and developed across resistor R4. It is then coupled through C3 to the base of the video buffer transistor, Q3, and DC coupled from Q3 to the picture tube. Transistors Q1 and Q2 are part of a DC clamping circuit which clamps the blanking pedestal backporch of the video signal found at the base of Q3 to the DC level determined by the setting of the brightness control. The base voltage of Q3 is determined by the DC voltage on C3 and R4. Approximately 1.5 v is applied to diodes D1 and D2 from the brightness control wiper arm through R9 and R10. During the backporch time of the horizontal blanking interval, the voltage across C3 and R4 is momentarily compared to the 1.5 v set by the brightness control and then equalized.

A horizontal pulse obtained from the horizontal-output transformer is coupled into the circuit through R1. This pulse is delayed by R1 and C1, to make it correspond to the backporch of the video horizontal blanking pedestal. The pulse is rectified by diode D4 and shaped by the network consisting of R2, C2, and R3 before being applied to the base of the Pulse Clipper, Q1, which saturates during each pulse and cuts off between pulses.

Transistor Q1 applies a positive pulse through R6 to the base of the Pulse Phase Inverter, Q2. Two equal-amplitude, opposite-polarity pulses are produced by Q2. The positive pulse appears at the collector, while the negative pulse appears at the emitter of the transistor.

The amount of charge on C3 during the pulse time is determined by the blanking level of the video signal. This level could be higher or lower than the 1.5 v set by the brightness control. When the voltage across C3 and R4 tends to exceed the voltage, D1 becomes forward biased during the pulse time and C3 discharges to the correct level through D1, C4, Q2 and R8. If the voltage across C3 and R4 tends to drop below the voltage level set by the brightness control, D2 becomes forward biased during the pulse time and a charge is added to C3, obtained from the 24v supply through R7, Q2, C5, and D2. To prevent discharging of C3 between clamp pulses, Q3, a high input impedance emitter follower transistor, is used.

In short, the function of this circuit is to keep the blanking pedestal of the video signal clamped to the DC level set by the brightness control.

Chroma Leveling Circuit

The new chroma leveling circuit, or more commonly known as the Automatic Chroma Control (ACC), reduces or eliminates surges of color that may occur on the TV set screen during scene changes.

The chroma ACC circuitry is a part of the Videomatic Module.

This closed-loop-circuit configuration keeps the chroma level relatively constant regardless of burst amplitude or chroma saturations.

The chroma signal obtained from the collector of Q5 is coupled through C5 to the base of Q3, located on the Videomatic Module (Fig. 8). The signal is amplified by the ACC Amplifier transistor, Q3, and then coupled through C7 to the junction of D1 and D2. D1 conducts during the positive signal excursions, then provides a positive charge to the positive side of C9. Diode D2 conducts during the negative signal excursions and provides a negative charge to the negative side of capacitor C9. As a result, C9 acquires a DC voltage proportioned to the chroma signal amplitude. This DC voltage is then coupled to the base of the ACC Driver transistor, Q4, controlling its conduction. As the chroma signal tries to increase, the charge on C9 increases and reduces the positive voltage at the base of Q4, increasing its forward bias and, in turn, increasing its conduction.

When Q4 conducts, a positive voltage is developed across R42 and then is applied to the anode of D5. D5 is now forward biased and conducts through R45. The cathode of D5 is connected at the junction of R46 and C13, which is the chroma input line to Q5, the chroma amplifier transistor. Because D5 is forward biased, a portion of the chroma input signal is shunted through D5 and C11 to ground. If the signal tends to increase, Q4 conducts more, and D5 becomes more forward biased, causing it to conduct more. When D5 conducts more, its impedance decreases and more of the input signal is shunted to ground, and counteracts the original signal, making it a closed loop arrangement.

Diode D5 is always slightly forward biased during chroma broadcasts, and the circuit can compensate for amplitude excursions of about plus or minus 3 dB. This circuit operates in addition to the burst control on the First Chroma Amplifier, which can provide up to 15 dB correction in the chroma level with respect to burst amplitude. Diodes D7 and D8 function as a clamp to prevent the anode of D5 from exceeding 1.4 v.

Videomatic One-Button Tuning System

Most Magnavox color TV sets for 1975 will be equipped with Videomatic one-button tuning systems. It will be offered for the first time on the new 13-inch and 15-inch (diagonal) color TV portables.

The Videomatic system employed in the T995 chassis will serve two functions: One, it monitors the ambient room light and then automatically adjusts the brightness, contrast and color levels accordingly. Two, it switches in a secondary set of pre-adjusted controls. These pre-set controls are located on the instrument's front panel, behind the normal customer controls, and can be adjusted by inserting a screwdriver through the hollow customer control shafts. These pre-set controls do not completely defeat the operation of the normal customer controls, but allow the customer to make minor adjustments for his personal preference. The *Videomatic Button* also activates the automatic fine tuning (AFT) circuit. With the Videomatic system *on*, the AFT circuit is activated. When the Videomatic system is *off*, the AFT circuit may be *on* or *off*, depending on the position of the AFT Defeat switch located on the front control panel of the TV set. The Videomatic switch is mounted on the Videomatic Switch Module behind the instrument's front control panel.

The video input signal is received at pin 11 of the video and chroma gain reduction IC (Fig. 9), which is found on the Videomatic module. This IC consists of a dual amplifier, with the gain of each amplifier being controlled by DC voltages. One amplifier is used as a video amplifier and the other is used as a chroma amplifier. The input 24-volt source voltage is decoupled by R30 and C4, providing a 22-volt source, then divided by voltage divider networks to provide the various operating voltages required in the circuit. These dividers prevent exceeding the maximum 20-volt rating of the IC.

The Video Differential Amplifier's output is coupled from pin 8 of the IC to the base of the Luminance Amplifier transistor, Q2. The gain of this transistor is controlled by the DC voltage found at pins 6 and 9 of the IC and varied by the contrast control and the emitter voltage of the LDR DC Amplifier. The DC voltage applied to pins 6 and 9 sets the nominal gain of the Video Differential Amplifier and is received through the voltage divider consisting of R19 and R20. The DC operating voltages applied to pins 7 and 8 are received through the voltage divider consisting of R27, R29, R5 and R8. The video output received from pin 8 of the IC drives the Luminance Amplifier, Q2. This transistor amplifies and inverts the signal which is applied to the Delay Line Driver transistor, Q6, driving the Delay Line on the Low Level Video Module.

When the *contrast* control is rotated to the right, the voltages at pins 6 and 9 become more positive. The voltage will be higher at pin 6 than at 9 because of the resistance of resistor R16, and the voltage differences between the pins increases. As a result, we will find less contrast on the screen of the TV set. The conduction level of Q1 is affected by light dependent resistor (LDR), connected to its base circuit. The LDR is located on the front control panel of the TV set and is exposed to the ambient room light. When the ambient room light is high, the resistance of the LDR is low, causing Q1 to conduct more. As its conduction increases, its emitter voltage drops and the DC voltage difference between pins 6 and 9 also drops, applying more signal to Q2. The contrast of the picture on the TV set's screen also increases to compensate for the increase in ambient room light. If the ambient room light decreases, the opposite reaction takes place. If the LDR *Defeat* switch is closed, Q1 becomes saturated and only the *contrast* control has affect on the gain of the amplifier.

T981, T982 and T987 COLOR TV CHASSIS

The T981, T982 and T987 are all-solid-state color TV chassis introduced last year to be used with small screen, in-line picture tubes in the portable color TV line. The T981 chassis will be used in the 17-inch portable TV models, and the T982 in the 19-inch (diagonal) table model color TV sets.

The T981 chassis consists of two main circuit boards and 14 or 15 plug-in modules. The Signal Board Assembly is mounted vertically, containing modules and components used in the video, IF sound, chroma, AFT and signal processing circuits. Also, on some models the signal board contains a Videomatic Module. The Scan Board Assembly is mounted horizontally, containing modules and components used in the vertical and horizontal scan circuits, including the video output.

The sound, high-voltage, vertical-scan, video-output and parts of the horizontal-scan circuits are basically the same as those used in the T989 color TV chassis.

T989 COLOR TV CHASSIS

The 25-inch (diagonal) stereo theater color TV sets will be equipped with the T989 chassis.

Although all of the circuits are solid state in the T989 chassis, it still maintains the configuration of the tube-type chassis, and the service adjustment controls remain essentially the same.

Most of the circuitry is located on four circuit panels which plug into the main chassis pan, and the circuit modules are located on these panels and are provided with plug-in sockets for easy removal.

This chassis also uses what is commonly referred to as the "RGB System," in which all matrixing of the luminance and R-Y, B-Y and G-Y is accomplished prior to driving the picture tube control elements, eliminating the luminance chain. ■

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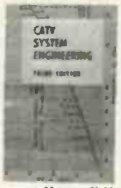

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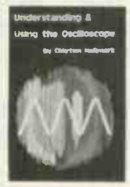

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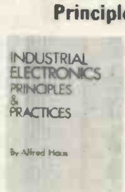

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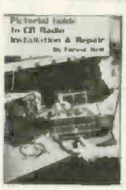

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TEST INSTRUMENT REPORT

RCA WO-33B Oscilloscope/Quicktracer

By J. W. Phipps

■ RCA's WO-33B is more than just a 3-inch, recurrent-sweep, tube-equipped scope. Combined with the scope function are a built-in version of RCA's *Quicktracer* Transistor/Diode Tester and built-in, front-panel provisions for using the WO-33B as a vectorscope. In addition, a pulse for performing ringing tests of coils, transformers and TV deflection yokes is available from a jack on the right side of the WO-33B.

THE SCOPE

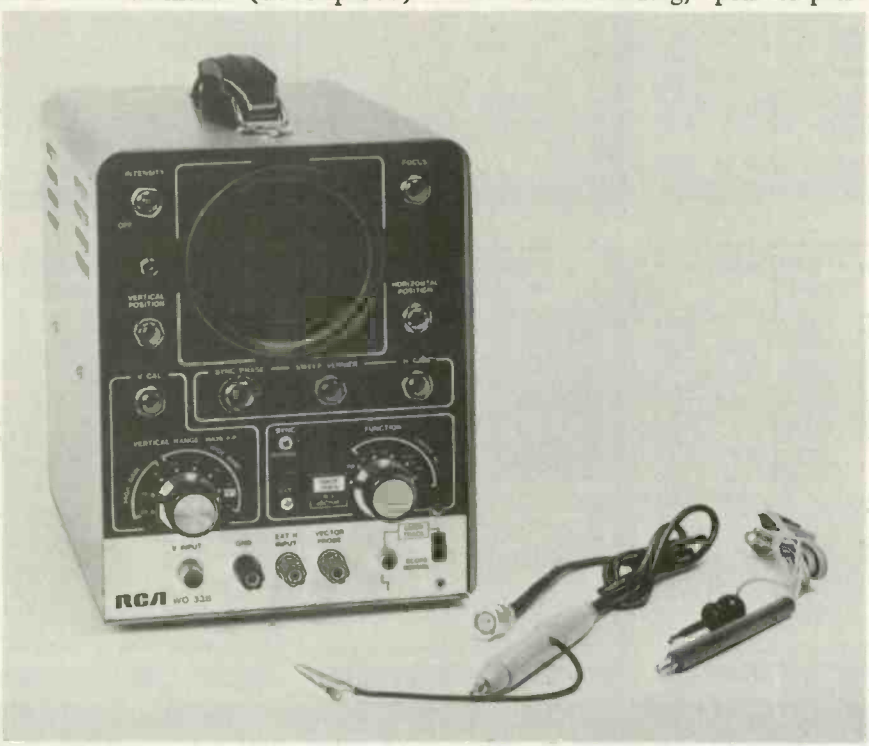
Features related directly to the conventional scope function of the WO-33B include:

Two-Band Vertical Input

The frequency compensated vertical attenuator has two bands: One band provides a frequency response from 20 Hz to 150 KHz (−3dB), with a maximum (direct-probe) sensitivity of 10 mv p-p per inch, and the other band provides a frequency response from 3 Hz to 5 MHz (±1dB), with a maximum (direct-probe) sensitivity of .3v p-p per inch.

Internally Applied Vertical Calibration Signal

In the CAL position of the VOLTAGE RANGE switch, an internal calibration signal is automatically applied to the vertical input of the scope. The V CAL control then is adjusted so that the calibration pulse extends from the horizontal line labeled "CAL" on the bottom of the screen graticule to the horizontal line labeled "CAL" on the top of the graticule. Thereafter, as long as the V CAL control is not moved, the peak-to-peak amplitude of signals displayed on the screen can be read directly from the appropriate scale on the right side of the graticule. Two direct-reading, peak-to-peak scales are printed on the graticule: The 0-5 scale is used for the .05-, .5-, 5-, and 50-volt positions of the VERTICAL RANGE switch, and the 0-15 scale is used for the .15-, 1.5-, 15- and 150-volt positions.



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

Sweep Phase Adjustment

The WO-33B is equipped with a SYNC PHASE control which, when the FUNCTION switch is in the LINE position, synchronizes the phase of the scope internal sweep signal with the phase of a line-frequency sweep-alignment generator.

THE QUICKTRACER FUNCTION

Built into the WO-33B is a version of RCA's WC528 *Quicktracer* Transistor/Diode Tester, a simplified schematic diagram of which is shown in Fig. 1.

The connections labeled "SCOPE VERT," "SCOPE GND" and "SCOPE HORIZ" in Fig. 1 are permanent, internal connections in the WO-33B. The only external connections required for use of the *Quicktracer* function of the WO-33B are the two connections labeled "TEST LEADS" in Fig. 1. These are internally connected to a jack labeled QUICK TRACE on the bottom right front of the scope. Inserted into this jack is the male plug on one end of a special two-wire test lead, which is furnished with the WO-33B. The other end of the test lead is separated into two leads, one of which corresponds to the "BLACK" test lead in Fig. 1, and is equipped with a black, clip-on probe. The other lead, which corresponds to the "RED" test lead in Fig. 1, is equipped with a red, needle-type probe.

Testing Diodes Out of Circuit

The procedure for setting up and connecting the WO-33B to test diodes and transistors is illustrated in Fig. 2. For testing diodes, the black, clip-on probe is connected to the cathode and the red, needle-type probe is placed on the anode.

When the sine wave applied across the secondary of T1 in Fig. 1 produces a negative alternation at the "bottom" of the transformer, the diode connected between the two test leads is reverse biased and sufficient voltage is developed across R3 to produce a horizontal trace on the scope screen. The following alternation of the sine wave produces a positive voltage at the "bottom" of T1, which forward biases the diode. The resultant conduction of the diode effectively shorts out the voltage divider consisting of R3 and R4, eliminating the input required for a horizontal trace, and producing sufficient negative voltage across R2 to develop a negative-going vertical trace.

The scope pattern produced by the two alternations of the sine wave across T1 is shown in Fig. 3A. Reversing the test lead connections to the diode produces the scope pattern in Fig. 3B. If the diode is open, only a horizontal trace will be produced. If the diode is shorted, only a vertical trace will be produced. Leakage in the diode is indicated by tilting of the horizontal trace portion of the pattern. The greater the leakage, the greater the tilt.

Zener diodes also may be tested with the *Quicktracer* function of the WO-33B. However, as shown in Fig. 4, they produce scope patterns which are slightly different than those of "standard" diodes. The negative-going vertical deflection at the right in each scope pattern is produced by conventional forward conduction, and the positive-going vertical deflection at the left is produced when the *Quicktracer* voltage exceeds the Zener voltage of the diode, causing it to conduct in its normal, or reverse, direction. The length of the horizontal trace is a direct indication of the Zener voltage of the diode (from left to right in Fig. 4: 30-, 15- and 7-volt Zener diode patterns).

Testing Bipolar Transistors Out of Circuit

For the purpose of testing with the *Quicktracer,* a bipolar transistor is considered to be two diodes connected in series but with opposite polarities. The base-emitter junction is one "diode," and the base-collector junction is the other "diode."

The setup and procedure for testing the two "diodes" of a bipolar transistor are the same as those for testing "conventional" diodes except that, as will be explained, the resultant scope patterns are slightly different.

For testing the two "diodes" of a PNP transistor, the base serves as the *cathode* for both "diodes" and, consequently, the black, clip-on probe is connected to it. To test the base-emitter "diode," the red, needle-type probe is placed on the emitter lead. The resultant scope pattern is shown in Fig. 5A. The negative-going deflection at the right of the pattern is produced by normal conduction of the "diode." The slightly shorter, positive-going vertical deflection at the left is produced because the *Quicktracer* voltage exceeds the peak-inverse-voltage (PIV) rating of the base-emitter "diode" and, consequently, Zener (reverse) conduction of the diode occurs. (Because R1 in Fig. 1 limits the current through the "diode," no damage is caused by the Zener conduction.)

To test the base-collector "diode" of a PNP transistor, the black, clip-on probe is left connected to the base, and the red, needle-type probe is shifted to the collector lead, as indicated by the broken lines in Fig. 2. The resultant scope pattern, which resembles that of a "conventional" diode, is shown in Fig. 5B. It does not contain the positive-going vertical trace on the left, as did the base-emitter pattern, because the output voltage of the *Quicktracer* is less than the PIV of most base-collector junctions.

Testing of the two "diodes" of NPN transistors is the same as for testing those of PNP transistors except that, because the P-type base of the NPN transistor functions as an *anode,* instead of as a cathode as in the PNP transistor, the vertical traces of the scope patterns produced by the NPN "diodes" are opposite those of the corresponding patterns for the PNP type. The patterns produced by the two "diodes" of an NPN transistor are shown in Figs. 6A and B.

As was true for "conventional" diodes, leakage in either of the "diodes" of a bipolar transistor pro-

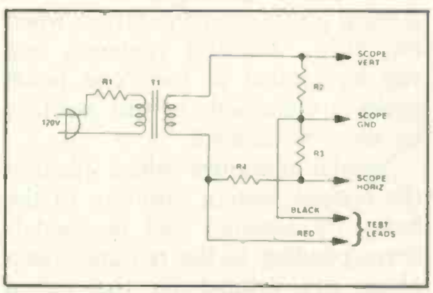


Fig. 1—Simplified schematic diagram of the Quicktracer circuitry of the WO-33B.

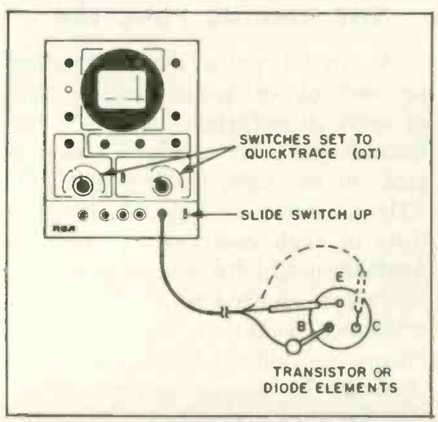
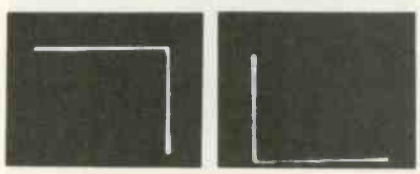
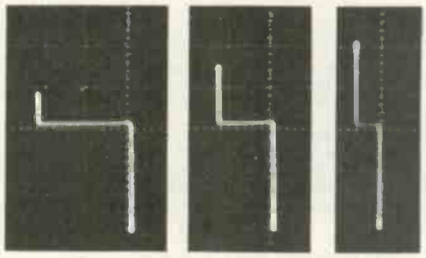


Fig. 2—Test setup for testing diodes and transistors with the Quicktracer function of the WO-33B.



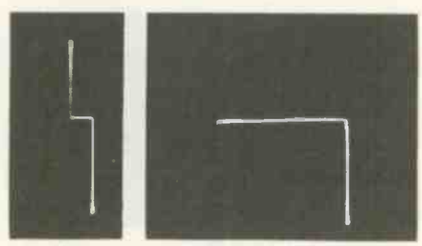
A B

Fig. 3—Quicktracer scope patterns produced by a normally operating "standard" diode. A) Pattern produced with the clip-on probe (BLACK) connected to the cathode and the needle-type probe (RED) placed on the anode. B) Leads reversed.



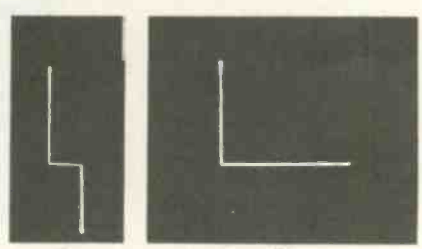
A B C

Fig. 4—Quicktracer scope patterns produced by three normally operating Zener diodes with different voltage ratings. A) 30-volt Zener. B) 15-volt Zener. C) 7-volt Zener.



A B

Fig. 5—Quicktracer scope patterns produced by a normally operating PNP transistor. A) Base-emitter junction. B) Base-collector junction.



A B

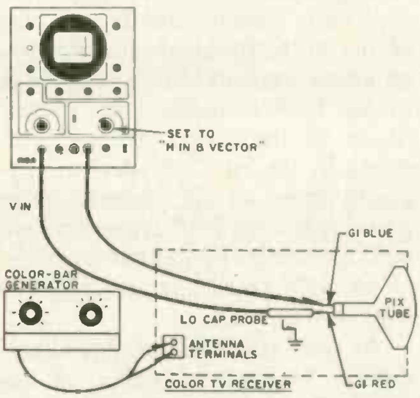
Fig. 6—Quicktracer scope patterns produced by a normally operating NPN transistor. A) Base-emitter junction. B) Base-collector junction.

duces tilting of the horizontal trace portion of the pattern.

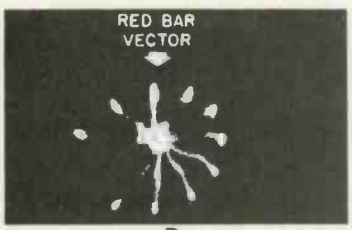
In-Circuit Testing

Because of the shunting effects of other components in the circuit, interpretation of the scope patterns produced by *Quicktracer* in-circuit testing of diodes and transistors is not as easy or as conclusive as it is for out-of-circuit tests. Components and circuits which shunt the device being tested cause various degrees of tilt of the horizontal trace portion of the pattern. To determine whether or not the tilt is caused by leakage in the transistor or diode or whether, instead, it is caused by the shunting effect of other components in the circuit requires that you have available, for comparison, service literature containing drawings or photos of normal in-circuit patterns for the device. An alternative to such drawings or photos is to make corresponding *Quicktracer* tests in a normally functioning duplicate of the equipment being tested.

If neither source of comparative patterns is available, in-circuit tests with the *Quicktracer* still are useful on a go/no-go basis: If only a vertical trace is produced on the scope, the device probably is shorted. If only a horizontal trace is produced, the device probably is open. In both cases, the device should be removed and tested out of the circuit.

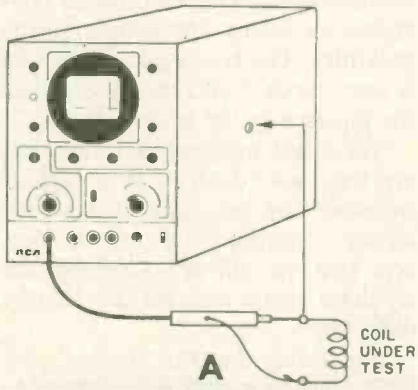


A

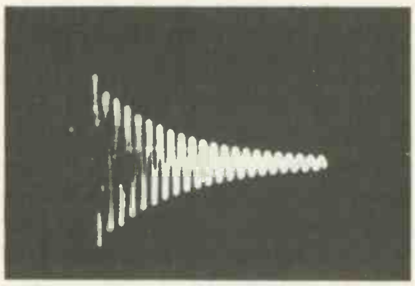


B

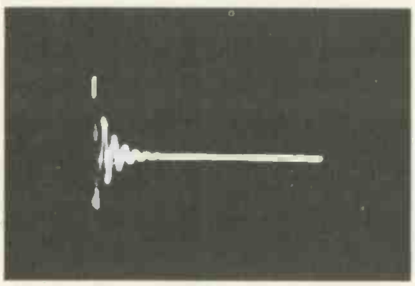
Fig. 7—Test setup for and vector pattern produced by AFPC alignment of a color TV receiver with the vectorscope function of the WO-33B. A) Test setup. B) Vector pattern.



A



B



C

Fig. 8—Test setup for and patterns produced by ringing tests of coils, transformers or TV yokes with the WO-33B. A) Test setup. B) Normal damped train of ringing pulses. C) Damped train of ringing pulses produced by winding with shorted turns.

THE VECTORSCOPE FUNCTION

The test setup for use of the vectorscope function of the WO-33B, for alignment of the AFPC of a color TV receiver, is shown in Fig. 7A. The V INPUT of the scope is connected to the G1 (control) grid of the picture tube red gun through the low-capacitance function of the probe supplied with the WO-33B. The VECTOR PROBE input of the scope is connected directly to the G1 grid of the blue gun.

The vector pattern produced by a properly aligned AFPC system is shown in Fig. 7B. (Some color TV receivers produce a normal vector pattern which is upside-down compared to the one shown in Fig. 7B. For the correct pattern and AFPC alignment procedures, always consult the service literature for the receiver being serviced.)

AFPC alignment procedures usually involve adjustment of the 3.58-MHz oscillator and burst transformer to produce a pattern which 1) is relatively symmetrical, 2) is stationary (does not rotate), and 3) is positioned so that the third (red) "pedal" is at the 12 o'clock position on the screen when the TINT control is centered, and can be rotated at least one pedal position either side of this position by the TINT control.

Special markings which identify the normal pattern positions of the burst (0 degrees) and the pedals corresponding to the red and green phase are printed on the screen graticule of the WO-33B.

THE RINGING FUNCTION

A special pulse for performing in- and out-of-circuit ringing tests of coils, transformers and TV deflection yokes is available from a jack on the right side of the WO-33B, as shown in Fig. 8A. Ringing tests of such components are particularly useful for detecting a relatively few shorted turns or a high-resistance condition, both of which effects are difficult to diagnose conclusively by simple voltage or resistance measurements.

Ringing tests are based on the

continued on page 48

SPECIFICATIONS

RCA WO-33B Oscilloscope

FREQUENCY RESPONSE
Vertical Amplifier:
Wide Band Positions (1.5v to 150v Range): 3 Hz to 5 MHz, ±1 dB, Usable to 10 MHz
High Gain Positions (.05v to .5v Range): 20 Hz to 150 KHz, −3 dB
Horizontal Amplifier: 10 Hz to 200 KHz, −3 dB

DEFLECTION SENSITIVITY	Wide-Band Positions	High-Gain Positions
Vertical Amplifier:		
Direct Probe:	0.3v p-p/In	10 mv p-p/In
Lo-Cap Probe:	3v p-p/In	100 mv p-p/In
Horizontal Amplifier:	2.5v p-p/In	

RISE TIME
Vertical Amplifier (Wide-Band Positions): 0.1 microsec.

INPUT RESISTANCE AND CAPACITANCE
Vertical Amplifier:
At **v INPUT** connector: 1 M ohm shunted by approx. 12 pf
With probe on "direct": 1 M ohm shunted by 80 pf
With probe on "Lo-Cap": 10 M ohm shunted by 13 pf
Horizontal Amplifier: 250 K ohms
Sync Input Terminal: 250 K ohms to 55 K ohms

SWEEP OSCILLATOR
Frequency Range: 15 Hz to 75 KHz

SYNC: Internal Pos. or Neg., and External

MAXIMUM AC INPUT VOLTAGE: 600v p-p (In presence of 400v DC)

PHASE CONTROL RANGE: 0 to 160 degrees

OTHER FUNCTIONS: 1) Quicktracer Transistor/Diode Test
2) Vectorscope Input
3) Ringing Test

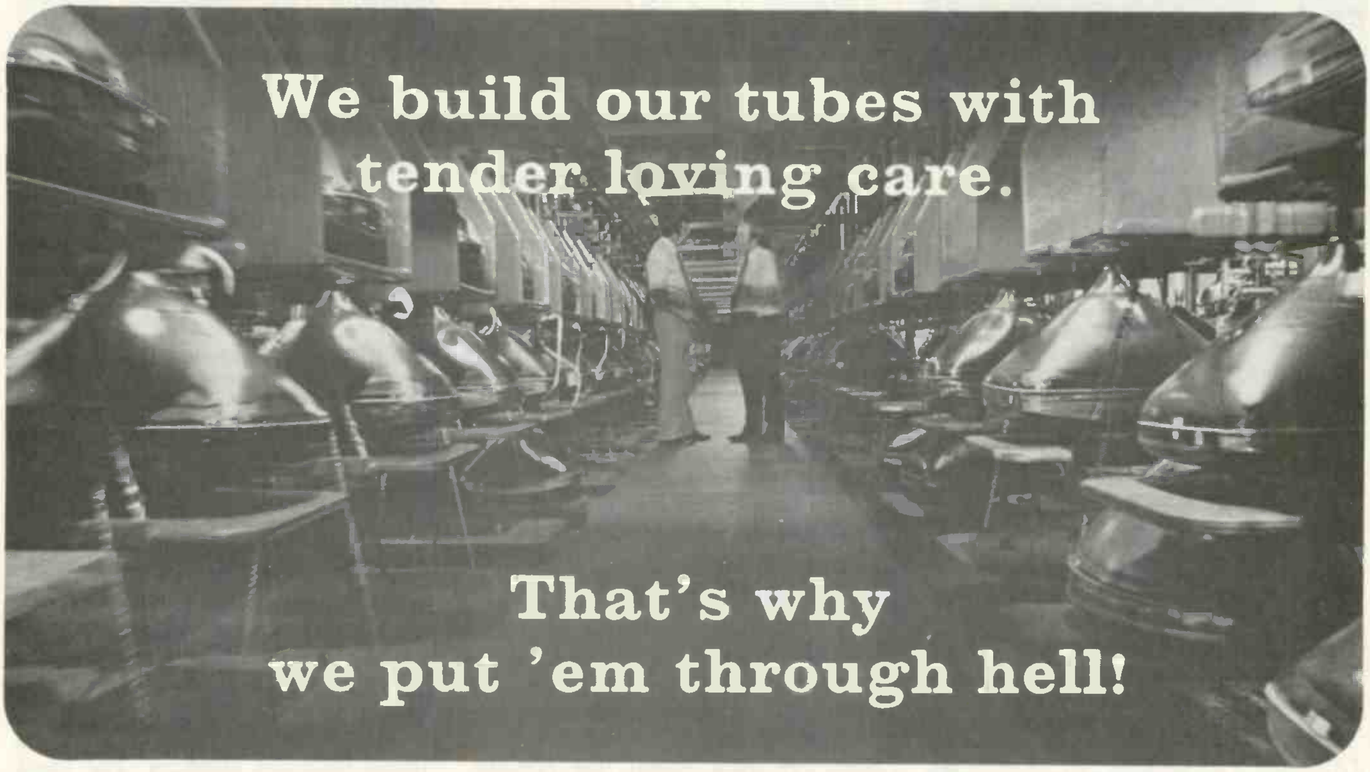
POWER REQUIREMENTS: 105-130 VAC, 50-60 Hz
(With provisions for 240 VAC operation)

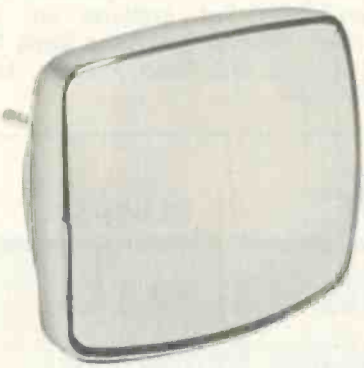
DIMENSIONS: 8¾ inches high x 6½ inches wide x 10¼ inches long

WEIGHT: 14 lbs.

PRICE: $229.00 (including low-cap/direct probe and Quicktracer probe)

OPTIONAL PROBES: WG-302B Signal-Tracing Probe ($15.00)



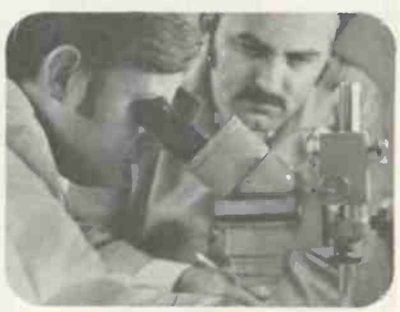


This is a Channel Master color Opti-Vue Plus.

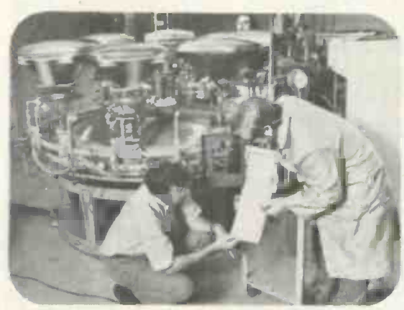
It's been baked for 2½ hours at precision-controlled temperatures up to 420°C in an oven almost as long as a football field. That's to drive out all the harmful gasses and assure the best possible vacuum.

It's been "burned" with 65,000 volts for long stretches of time. That's to destroy particles of foreign matter that can shorten tube life and even damage a set's chassis.

It's been electrostatically charged to demagnetize and remove loose particles inside the tube before they make trouble. That's a process hardly anyone else even knows about.



It's been examined, monitored, and tested over 20 times for characteristics like color purity high voltage stability, interelectrode leakage, cathode activation and stabilization, convergence, and emission and gas ratio. The screen has been tested to higher-than-OEM standards.



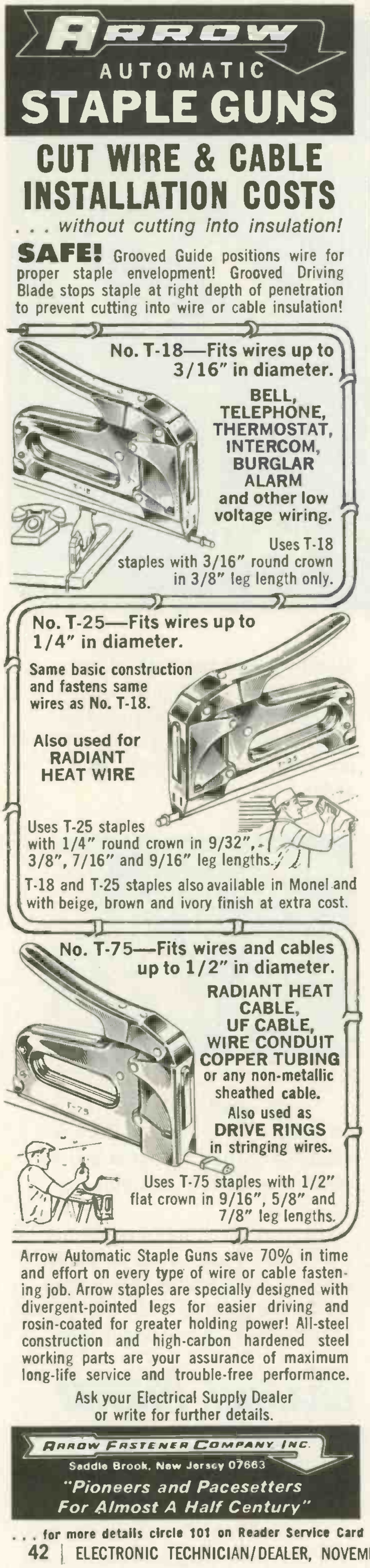
We even took the tube on a 65 mile ride over bumpy roads--and then tested it again --before shipping it to you.

It's not easy to become an Opti-Vue Plus. That's why, when a tube makes the grade, we can guarantee it for the life of the set you're putting it into.

Channel Master
OPTI-VUE PLUS
LIFETIME PROTECTION*

* 3 Year Warranty Plus Guaranteed Discount for Life of Set

. . . for more details circle 105 on Reader Service Card



TECHNICAL LITERATURE

Semiconductors

The 1974-75 edition of the Maintenance, Repair, and Operations catalog is now available. The 16-page catalog lists replacement components for industrial electronics equipment, including germanium, silicon and selenium rectifiers, zener diodes, bridges, SCR's, protective devices and semiconductor fuses, switches and relays. Charts give complete specifications including voltage range, current rating, case style, and price information. **Semiconductor Division, International Rectifier Corp.,** 233 Kansas Street, El Segundo, CA 90245.

Broad-band Antennas

A 70-page brochure describing broad-band antennas and various antenna designs is now available. The publication contains specifications and performance characteristics for more than 100 horn, spiral, log periodic, omni-directional, and rotating direction-finding antennas. It also covers antenna pedestals and controls; custom and system design capabilities; scale model measurements, and test, laboratory, and fabrication facilities. **GTE Sylvania, Antenna Capabilities,** Box 205, Mountain View, CA 94042.

Tool Catalog

A 112-page tool catalog describing over 2,500 individual items is now offered. *Tools for Electronic Assembly and Precision Mechanics* is a handbook of particular interest to electronic technicians, engineers, and instrument mechanics working on fine assemblies. A tool section features Jensen kits for field engineers, service engineers, assembly technicians, students and kit builders. **Jensen Tools and Alloys,** 4117 North 44th Street, Phoenix, AZ. 85018.

Alarm Equipment

A 96-page alarm equipment catalog, No. A-75, describes over 450 intrusion and fire alarm products. The alarm equipment offered ranges from relatively simple kits with instructions to the latest ultrasonic, radar and infrared intrusion detectors. The applications, principle of operation and specifications of products are described. **Mountain West Alarm Supply Co.,** 4215 North 16th Street, Phoenix, Ariz. 85016. ■

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.

FM DEVIATION METER 700

Covers the 512 MHz band

Radio Specialty Mfg. Co. introduces an FM Deviation Meter that gives a visual and "in-use" measure of deviation even under actual talk conditions covering the 512 MHz band. Designated as the Model 1163-63-1, the instrument provides the 145-175 MHz and 25-55 MHz VHF, in addition to the 453-513 MHz band. The unit provides

in a single instrument a specialized oscilloscope linked with a broad-band FM receiver, a calibrated discriminator and a crystal controlled calibration marker.

CORDLESS SOLDERING IRON 701

A cordless unit providing instant heat to 700 degrees F

A fully self-contained **Weller** soldering iron providing instant heat to 700-degrees F for intricate to heavy-duty soldering with three interchangeable

tips is announced by **The Cooper Group.** The heat-resistant handle holds a ni-clad battery unit which provides about 15 minutes of constant tip temperature, more than sufficient for normal in-home soldering jobs. After its own charger has been plugged overnight into an ordinary outlet, it's ready for use again. The battery unit has an average life of 500 chargings, and the more frequently it's used, the greater the between-charges operating time.

PHONE PLUG ADAPTERS 702

Simplify phone plug interconnections

Three phone plug adapters have been added to the line of test adapters offered by **ITT Pomona Electronics.** The adapters are designed to provide interconnections with equipment fitted with standard two-conductor phone plugs, BNC receptacles or plugs and standard ¾-inch-spaced double banana plugs. The Model 4043 (phone plug jack to BNC plug) provides connection to equipment or cable assemblies fitted with either phone plugs or BNC receptacles. The Model 4026 (phone plug jack to BNC receptacle) provides connection to equipment or cable assemblies fitted with phone plugs or BNC plugs. The Model 4044 (phone plug jack to standard double banana plug) with single piece molded construction, provides connection to equipment or

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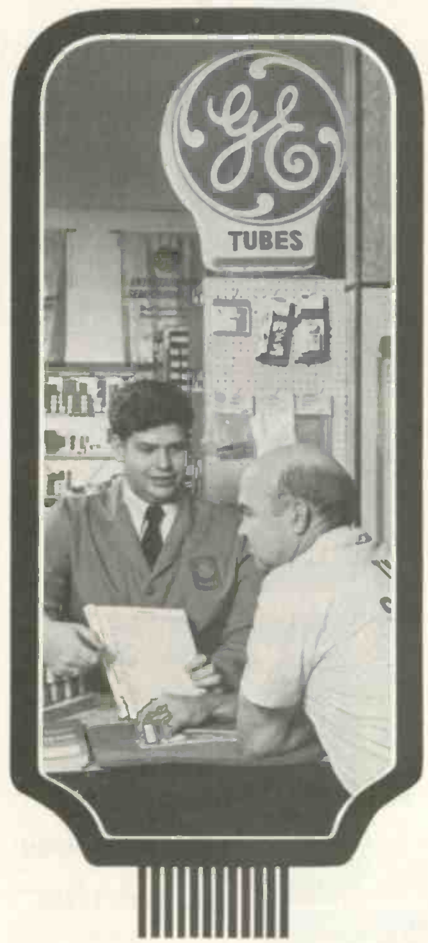

NEW PRODUCTS . . .

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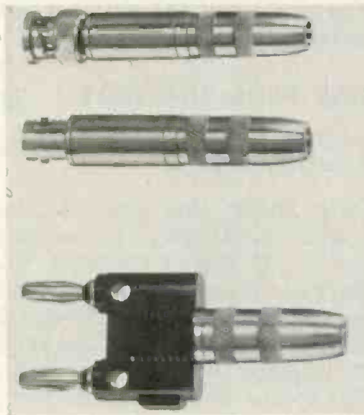
cable assemblies fitted with phone plugs and standard double banana jacks or binding posts. Two conductor

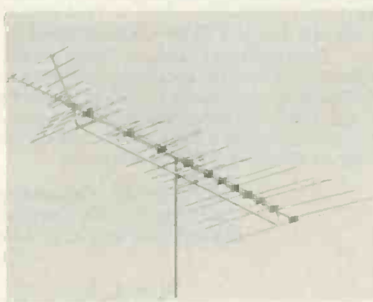


phone plug jacks on all three adapters accept standard ¼-inch diameter by 1-3/16-inch long phone plugs. Standard ¾-inch-spaced double banana plug (Model 4044) features cross holes in the body for side stack-up connections.

UHF/VHF/FM ANTENNA 703

Designed for deep-fringe areas

A new *Permacolor* UHF/VHF/FM outdoor antenna, specifically engineered for deep-fringe areas, is announced by **RCA Parts and Accessories Division**. The Model 4BG48 antenna has riveted connections of flexible aluminum between the elements and feed lines. A bow tie and corner reflector provide reception from UHF stations. Other features include special polypropylene insulators, break-off elements for FM broadcast reception control, and V-shaped mast clamps. It is pre-assembled and packaged so that all elements unfold easily and lock into



place. This all-channel antenna includes eight reception control elements and 48 *perma-tuned circuits*, each active on one or more of the TV frequency bands. It measures 198 inches in length and 108 inches wide, with a turning radius of 114 inches for rotation. The UHF corner reflector measures 38 inches by 23 inches. It is constructed with a double boom for strength, and is coated with a blue and gold plastic finish for weather protection. Price is $99.95.

HOME ANTENNA/CABLE TV SWITCH 704

Allows choice of cable system TV or reception from a home antenna

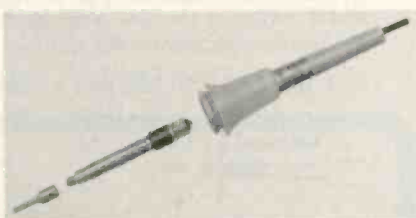
ACA has added two new electronic devices to their line of antenna products. The Cable Master is an easily installed switching device that mounts on the back of the TV set so that the

consumer can choose between watching programs from the cable system or from his own antenna. The Model CM 10 300-ohm antenna input device lists for $13.95 and the Model CM 50 75-ohm antenna input device lists for $14.50.

SOLDERING IRON 705

Double-insulated to meet safety standards

A new heater and handle with two-conductor cord set and safety plug are double-insulated to meet the latest safety standards. Four stainless steel heaters and three heat ranges provide flexibility. The handle is molded of durable plastic with finger-ease cool grip



for comfort. The No. 555 Double Insulated Two-Wire Handle by UNGAR, Division of Eldon Industries, Inc., accepts thread-in No. 300 series heaters for different heat range requirements. Use any UNGAR Standard Line ¼-inch thread-on tips or with Adapter No. 100 for all ⅛-inch tiplets and nibs. Adapter No. 101 can be used for all 3/16-inch thread-in tips. ■

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 CASSETTE PLAYER 706

Features an automatic tape-tightener

Pioneer Electronics of America introduces the Model KP 345 Auto Reverse Cassette Stereo Player. The unit features an automatic "Tape-Tightener," a mechanism which virtually eliminates cassette player malfunction caused by loose tape. The under-dash

unit is compact enough to be installed in a glove compartment. It has volume, balance and tone controls; manual direction change; automatic reverse; IC's for audio; and a chrome finish. RMS power is 7.6 watts; frequency response is 40 to 10,000 Hz; wow and flutter is 0.3 percent. The unit measures 5⅛-inches wide by 2 inches high by 7¼ inches deep.

QUADRAPHONIC AUDIO CONSOLE 707

Features CD-4 circuitry and discrete quad 8-track tape player

GTE Sylvania Inc. introduces its first quadraphonic audio console, a 4-channel system with CD-4 circuitry, for

discrete recordings, and a built-in discrete-quad 8-track tape player. In addition to the CD-4 four-channel disc demodulator, and the discrete 8-track tape player, the quad console, Model QCT4648A, features a solid-state chassis. It provides 15-watts continuous (RMS) power per channel from 40 Hz to 20 KHz at less than one percent total harmonic distortion, all four channels driven. The system has a full-size BSR 510 automatic turntable and a Pickering UV-15/2000Q discrete 4-channel magnetic cartridge. The sealed air suspension speaker system in the main unit has two 10-inch bass woofers, two 3-inch mid-range speakers and two 2½-inch tweeters. Each of the two rear channel speakers has a 10-inch bass woofer, a 3-inch mid-range speaker and a 2½-inch tweeter. Price is $1,095.

AUTO ALARM 708

Employs a current sensor

This solid-state Auto Alarm offered by **Detection Systems** employs a current sensor to protect a car. The compact control unit measures 3¼ by 2¼ by 1⅛ inches and will mount in your glove compartment without drilling

holes. Installation is completed in minutes because no complicated wiring is required. Adjustable entrance delay allows the owner time to enter the vehicle and disarm the system. If anyone opens the car door, hood or truck, the car horn blasts for two minutes, turns off, then automatically resets. Price is $11.95.

MULTI-BAND PORTABLE RADIO 709

Listen to police, fire and other emergency transmissions

Magnavox introduces the Model 3092 Multi-Band Portable Radio with FM/AM and Public Service Bands one and two. These include ambulance, taxi and a special government weather broadcast located at 162.40 or 162.55

MHz. It also receives police, fire and other emergency transmissions. The unit includes fixed automatic frequency control, vernier tuning and automatic volume control. Price is $54.95. ■

Test Instrument Report...

continued from page 40

fact that, when a suitable pulse is applied across the winding of a coil, transformer or yoke, the combination of inductance and inter-turn capacitance will cause the winding to produce damped oscillations, or ringing, such as those of a properly operating winding shown in Fig. 8B. The amplitude and length of the resultant train of pulses is a direct indication of the condition of the winding. If the winding has shorted turns, the amplitude of the pulses produced by ringing will be small and the number of pulses will be reduced, as shown in Fig. 8C.

CONCLUSION

RCA's WO-33B is obviously a versatile test instrument, and should be a particularly useful and timesaving addition to the service bench of any technician who takes the time to learn how to use it effectively. (The detailed and well-illustrated operating manual furnished with the WO-33B should make this relatively easy.) And, at $229, the price is right. ■

STATEMENT REQUIRED BY THE ACT OF OCTOBER 23, 1962 (39 U.S. Code, 4369) SHOWING THE OWNERSHIP, MANAGEMENT AND CIRCULATION OF ELECTRONIC TECHNICIAN/DEALER published monthly by Harcourt Brace Jovanovich, Inc., 757 Third Avenue, New York, New York 10017, for November 1974.

1. The names and addresses of the publisher, editor and managing editor are: Publisher, Alfred A. Menegus, 757 Third Avenue, New York, New York 10017; Editor, J. W. Phipps, 1 East First Street, Duluth, Minnesota 55802; Managing Editor, Joseph Zauhar, 1 East First Street, Duluth, Minnesota 55802.

2. The owner is: Harcourt Brace Jovanovich, Inc., 757 Third Avenue, New York, New York 10017. Holders of One Per Cent (1.0%) or more of the outstanding shares of Harcourt Brace Jovanovich, Inc., as of August 21, 1974; Cede & Co., Box 20, Bowling Green Station, New York, New York; Comptroller of the State of N.Y. in Trust for the Common Retirement Fund, c/o Director of the Retirement Accounts, Governor Alfred E. Smith Building, Albany, New York 12225; Cudd & Co., P.O. Box 1508, New York, New York; Katherine Brace Cummings, c/o Ernst, Cane, Berner & Gitlin, 5 West 45th Street, New York, New York 10036; C. A. England & Co., P.O. Box 1368, Church Street Station, New York, New York 10008; Donald H. Harcourt, 2444 Brinkeroff Ave., Santa Ynez, California; Ellen Knowles Harcourt, William I. Jovanovich & Peter J. Ryan as Trustees u/t/a dated 5/23/66, 20 Exchange Place, New York, New York 10015; Ince & Co., Morgan Guaranty Trust Co. of N.Y., P.O. Box 1479, New York, New York 10008; Walter J. Johnson, 19 Hewitt Avenue, Bronxville, New York 10708; Thekla E. Johnson, 19 Hewitt Avenue, Bronxville, New York 10708; William Jovanovich, P.O. Box 295, Briarcliff Manor, New York 10510; Kane & Co., Chase Manhattan Bank, 1 Chase Manhattan Plaza, New York, New York 10005; Lazard Freres & Co., 1 Rockefeller Plaza, New York, New York 10020; Lynn & Co., P.O. Box 2010, Church Street Station, New York, New York 10008; O'Neil & Co., P.O. Box 11028, New York, New York 10049; Ronis & Co., Bankers Trust Co., P.O. Box 704, Church Street Station, New York, New York 10008; Saxon & Co., 1632 Chestnut Street, Philadelphia, Pennsylvania 19103; Shaw & Co., P.O. Box 1426, Church Street Station, New York, New York 10015; Sigler & Co., c/o Manufacturers Hanover Trust Company, New York, New York 10015; Stawis & Co., P.O. Box 1479, Church Street Station, New York, New York 10008; Joseph C. Sindelar, 794 Park Boulevard, Glen Ellyn, Illinois 60137; Robert J. Sindelar, 1838 Somerset Lane, Northbrook, Illinois 60062.

3. The known bondholders, mortgagees and other security holders owning or holding 1 percent or more of total amount of bonds, mortgages, or other securities are: None.

4. The average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the 12 months preceding the date shown above was 68,442. Free distribution by mail carrier or other media: 2,267. Total distribution 70,709.

(Signature) Richard Moeller
Treasurer

AGC CIRCUITS . . .

continued from page 27

in one direction, and a high resistance in the reverse direction. If we are in doubt about the measurement, open one lead of the diode and take another measurement or substitute it with a known good diode.

Another common problem is the lack of the AGC keying pulse, which is obtained from the horizontal-output transformer. The pulse is received from a tap on the transformer, or a separate AGC winding, if open, would only affect the keyed AGC circuit. The resistance of this winding can be measured with an ohmmeter, for continuity. An oscilloscope can be used to check for the presence of the horizontal keying pulse, but should be used with a low-capacitance probe. If the probe is not employed, the waveform at the collector of the transistor will be altered and an improper waveform will be obtained.

The keying pulse coupler capacitor from the high-voltage transformer often breaks down under the high pulse voltage. If this capacitor shorts, it provides a DC path, other than the AGC load resistors for the collector of the AGC keying transistor. This voltage will then be fed directly into the AGC voltage line and, depending on the design of the circuits, the TV will have excessive gain or lack of gain, resulting in no picture or sound. ■

READERS SERVICE INDEX

ADVERTISER'S INDEX

NEW PRODUCTS

TEST INSTRUMENT

ELECTRONIC TECHNICIAN/DEALER

Reader Preference Survey

The purpose of this survey is to help us determine the type of editorial material which will best serve **your** needs and interests. Your answers to the questions in this survey will tell us what types of editorial you find interesting, informative and of practical value.

For your convenience, and to save you postage and insure confidentiality, a tear-out, pre-addressed, postage-paid answer card is provided on page 53. Simple instructions for completing the survey are given next to the answer card.

Individual responses to this survey will be **strictly confidential** and will be reviewed only by the staff of ET/D. Individual responses will **not** be made available to anyone outside of Harcourt Brace Jovanovich Publications, the publishers of ET/D. Your assistance in helping us serve you better is appreciated.

J. W. Phipps, Editor

1. Type of electronic business which you own or in which you are employed
   A) service business, no retailing B) retail business, no servicing C) combination service/retail business D) distributor E) none of above
2. Which one of the following **best** describes the position presently held by **you**
   A) owner or partner who is also a technician B) owner or partner who is not a technician C) technician employee D) service manager E) none of above
3. Is your electronics servicing and/or retailing business or vocation
   A) full time (principal source of income) B) part time (not principal source of income)
4. If you circled (B) in question 3, which one of the following **best** describes your **full-time** occupation
   A) electronics-related technical position B) non-technical position in electronics industry C) teacher of electronics-related course D) student in electronics-related course E) none of above
5. Approximate **annual gross income** of the electronics servicing and/or retailing business which you own or in which you are engaged
   A) less than $25,000 B) $25,000 but less than $50,000 C) $50,000 but less than $100,000 D) $100,000 or more E) not in electronic servicing and/or retailing business
6. Number of **technicians** employed by your business or your place of employment
   A) none B) 1-2 C) 3-5 D) 6-9 E) 10 or more

Indicate the amount of coverage in ET/D you prefer for each of the items listed in 7-32. Circle either A, B or C opposite the item number on the answer card.

	NO INTEREST OR NEED	PRESENT COVERAGE ADEQUATE	MORE COVERAGE DESIRED
7. TV circuit theory	A	B	C
8. TV troubleshooting procedures	A	B	C
9. Test instrument operation and applications	A	B	C
10. Audio circuit theory and troubleshooting	A	B	C
11. Tape player/recorder theory and troubleshooting	A	B	C
12. Communications equipment theory and troubleshooting	A	B	C
13. Antenna systems theory and installation techniques	A	B	C
14. Electronic security systems theory and installation techniques	A	B	C
15. Medical electronics theory and troubleshooting	A	B	C
16. Industrial control electronics theory and troubleshooting	A	B	C
17. Basic theory of solid-state devices	A	B	C
18. Record changer servicing	A	B	C
19. Auto radio troubleshooting	A	B	C
20. Business management techniques	A	B	C
21. Service shop operating techniques and procedures	A	B	C
22. Manufacturers' service tips	A	B	C
23. News of the industry	A	B	C
24. Association news	A	B	C
25. New product information	A	B	C
26. Merchandising and sales techniques	A	B	C
27. TEKFAX schematics	A	B	C
28. DEALER SHOWCASE	A	B	C
29. TEST INSTRUMENT REPORT	A	B	C
30. Appliance servicing	A	B	C
31. Articles about other service shops	A	B	C

continued on next page

32. Articles about other electronic retail dealers A B C

33. Indicate the **frequency** with which you use **ET/D TEKFAX** schematics
A) Regularly B) Occasionally C) Seldom D) Never

34. Which one of the following is your **principal** source of schematic diagrams
A) TEKFAX schematics in ET/D B) Those obtained from product manufacturers via service data subscriptions C) Photofacts D) Do not use schematic diagrams E) Source other than above

*Items 35-62 are types of test instruments. If you now own or use one of the types listed, circle the letter A opposite the corresponding item number on the answer card. If you plan to buy a type or plan to replace the one you have now, circle the letter B. (You can circle **both** letters A **and** B if you now own or use a type **and** plan to buy another or replace the one you now own.) Circle the letter C if you presently have no need for that type.

TYPE	NOW OWN OR USE	PLAN TO BUY OR REPLACE	HAVE NO NEED FOR
35. Conventional VOM	A	B	C
36. FET or Solid-State VOM	A	B	C
37. Digital-Readout VOM	A	B	C
38. VTVM	A	B	C
39. Color-Bar Generator	A	B	C
40. Transistor Beta/Leakage Tester	A	B	C
41. Transistor Curve Tracer	A	B	C
42. Tube Tester	A	B	C
43. CRT Tester/Rejuvenator	A	B	C
44. Recurrent-Sweep Scope	A	B	C
45. Triggered, Single-Trace Scope	A	B	C
46. Triggered, Dual-Trace Scope	A	B	C
47. Vectorscope	A	B	C
48. TV/FM Sweep Alignment Generator	A	B	C
49. Stereo Generator	A	B	C
50. Audio Signal Generator	A	B	C
51. Function Generator	A	B	C
52. RF Signal Generator (non-swept)	A	B	C
53. Field-Strength Meter	A	B	C
54. Frequency Meter	A	B	C
55. Wattmeter	A	B	C
56. Grid-Dip Meter	A	B	C
57. DC Power Supply	A	B	C
58. Audio Distortion Analyzer	A	B	C
59. Spectrum Analyzer	A	B	C
60. TV Analyst	A	B	C
61. TV Tuner Substituter	A	B	C
62. Color TV CRT Test Jig	A	B	C

63. What is your **general** opinion of **digital-readout test instruments**
A) I think they are worth the extra cost and now own or plan to buy them
B) I do **not** think they are worth the extra cost and **do not** plan to buy them
C) I have not yet formed an opinion about them but might purchase some
D) Would like to have some but feel I cannot afford the extra cost
E) No need for test instruments

Items 64-76 are types of electronic products. Indicate the approximate percentage of **total annual gross income** your shop or the one in which you work receives from the **servicing and/or installation** of each.

	NONE	UP TO 20%	21% TO 50%	51% TO 75%	OVER 75%
64. Color TV	A	B	C	D	E
65. B-W TV	A	B	C	D	E
66. Home audio	A	B	C	D	E
67. Home radio	A	B	C	D	E
68. Auto radio and/or tape players	A	B	C	D	E
69. Home antennas (including MATV)	A	B	C	D	E
70. Citizens Band Radio	A	B	C	D	E
71. Communications equipment other than Citizens Band	A	B	C	D	E
72. Commercial sound systems	A	B	C	D	E
73. Industrial Electronic control equipment	A	B	C	D	E
74. Medical electronics	A	B	C	D	E
75. Home or commercial security systems	A	B	C	D	E
76. Appliances	A	B	C	D	E

(Items 77-84) Indicate the approximate percentage of total annual gross **income** your business or the business in which you work receives from retail sales of the following electronic products

	NONE	UP TO 20%	21% TO 50%	51% TO 75%	OVER 75%
77. TV (B-W & Color)	A	B	C	D	E
78. Home radio & audio	A	B	C	D	E
79. Home antennas and/or antenna systems	A	B	C	D	E
80. Commercial audio systems	A	B	C	D	E
81. Auto radio and/or tape players	A	B	C	D	E
82. Communications equipment (including CB)	A	B	C	D	E
83. Home and/or commercial electronic security systems	A	B	C	D	E
84. Home appliances	A	B	C	D	E

85. Approximate percentage of total annual **gross income** your business or the business in which you are employed receives from **sales of replacement parts**
A) None B) Up to 20% C) 21% to 50% D) 51% to 75% E) Over 75%

86. Approximate percentage of total annual **gross income** your business or the business in which you are employed receives from **warranty servicing** of electronic products
A) None B) Up to 20% C) 21% to 50% D) 51% to 75% E) Over 75%

87. How many **service and/or delivery vehicles** are owned or leased by you or the business for which you work
A) None B) 1-2 C) 3-4 D) 5-6 E) 7 or more

88. Which one of the following **best** describes your general opinion of the **degree of difficulty** of servicing all-solid-state products vs comparable tube-type products
A) Most are easier to service than comparable tube-type products
B) Most are **more difficult** to service than comparable tube-type products
C) No significant difference between two
D) Do no servicing, so question not applicable

89. Which one of the following best describes the impact which modular construction of electronic products has had during the past year on the income of your shop or the one in which you are employed
A) **Increased** income by 10% or more B) **Decreased** income by 10% or more C) No significant impact as yet but anticipate that it **will decrease** income within next two years D) No significant impact as yet and do not anticipate that it will decrease income within next two years E) Do no servicing, so question not applicable

90. Which **one** of the following **most accurately** describes how you or the shop in which you are employed handles **modules for TV**
A) Carry relatively complete inventory for **most** major brands, **seldom** repair defective modules
B) Carry relatively complete inventory for **most** major brands, usually repair defective modules
C) Carry relatively complete inventory for only **1-3 major brands,** order others as needed and/or repair defective module if replacement not on hand
D) Inventory **no** modules, order as needed or else repair defective modules
E) Do no **TV** servicing, so question not applicable

91. Volume of **receiving** tubes sold by you or your business during past year compared to that of five years ago
A) Increased by 10% or more B) Decreased by 10% or more C) Remained about the same D) Do not know E) Do not sell receiving tubes

92. Which one of the following was the **principal** method by which you received formal electronic training. (If you are not an electronic technician, circle the letter E on the answer card.)
A) Civilian resident course B) Civilian correspondence course C) Military school D) Other than above E) Not an electronic technician

93. Which **one** of the following types of electronic courses, if any, are you presently most interested in
A) Resident electronic course (basic) B) Resident electronic course (advanced or refresher) C) Correspondence electronic course (basic) D) Correspondence electronic course (advanced or refresher E) None of above

*94. To which of the following magazines do you presently subscribe
A) Electronic Technician/Dealer B) Radio Electronics C) Electronic Servicing D) Mart E) Merchandising Weekly ■

ET/D Reader Survey Answer Card

NAME ....

STREET ADDRESS ....

CITY ....

STATE .... ZIP ....

1.	A	B	C	D	E	48.	A	B	C	D	E
2.	A	B	C	D	E	49.	A	B	C	D	E
3.	A	B	C	D	E	50.	A	B	C	D	E
4.	A	B	C	D	E	51.	A	B	C	D	E
5.	A	B	C	D	E	52.	A	B	C	D	E
6.	A	B	C	D	E	53.	A	B	C	D	E
7.	A	B	C	D	E	54.	A	B	C	D	E
8.	A	B	C	D	E	55.	A	B	C	D	E
9.	A	B	C	D	E	56.	A	B	C	D	E
10.	A	B	C	D	E	57.	A	B	C	D	E
11.	A	B	C	D	E	58.	A	B	C	D	E
12.	A	B	C	D	E	59.	A	B	C	D	E
13.	A	B	C	D	E	60.	A	B	C	D	E
14.	A	B	C	D	E	61.	A	B	C	D	E
15.	A	B	C	D	E	62.	A	B	C	D	E
16.	A	B	C	D	E	63.	A	B	C	D	E
17.	A	B	C	D	E	64.	A	B	C	D	E
18.	A	B	C	D	E	65.	A	B	C	D	E
19.	A	B	C	D	E	66.	A	B	C	D	E
20.	A	B	C	D	E	67.	A	B	C	D	E
21.	A	B	C	D	E	68.	A	B	C	D	E
22.	A	B	C	D	E	69.	A	B	C	D	E
23.	A	B	C	D	E	70.	A	B	C	D	E
24.	A	B	C	D	E	71.	A	B	C	D	E
25.	A	B	C	D	E	72.	A	B	C	D	E
26.	A	B	C	D	E	73.	A	B	C	D	E
27.	A	B	C	D	E	74.	A	B	C	D	E
28.	A	B	C	D	E	75.	A	B	C	D	E
29.	A	B	C	D	E	76.	A	B	C	D	E
30.	A	B	C	D	E	77.	A	B	C	D	E
31.	A	B	C	D	E	78.	A	B	C	D	E
32.	A	B	C	D	E	79.	A	B	C	D	E
33.	A	B	C	D	E	80.	A	B	C	D	E
34.	A	B	C	D	E	81.	A	B	C	D	E
35.	A	B	C	D	E	82.	A	B	C	D	E
36.	A	B	C	D	E	83.	A	B	C	D	E
37.	A	B	C	D	E	84.	A	B	C	D	E
38.	A	B	C	D	E	85.	A	B	C	D	E
39.	A	B	C	D	E	86.	A	B	C	D	E
40.	A	B	C	D	E	87.	A	B	C	D	E
41.	A	B	C	D	E	88.	A	B	C	D	E
42.	A	B	C	D	E	89.	A	B	C	D	E
43.	A	B	C	D	E	90.	A	B	C	D	E
44.	A	B	C	D	E	91.	A	B	C	D	E
45.	A	B	C	D	E	92.	A	B	C	D	E
46.	A	B	C	D	E	93.	A	B	C	D	E
47.	A	B	C	D	E	94.	A	B	C	D	E

Instructions for Completing the ET/D Reader Preference Survey

1) Tear out the pre-addressed, postage-paid answer card and fill in the name and address portion.

2) Before answering a question, read **all** of the possible answers.

3) Indicate your response(s) to each question by circling the corresponding letter opposite the numerical designation for that question or item.
NOTE: Although most questions require one answer, some provide options for two answers. Those that do are indicated by an asterisk.

4) After you have answered **all** questions, drop the answer card in the mail—no postage is required.
Thank you for taking the time to help us serve you better.

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TECHNICIAN/DEALER

1 EAST FIRST STREET, DULUTH, MINNESOTA 55802
Editor/ETD

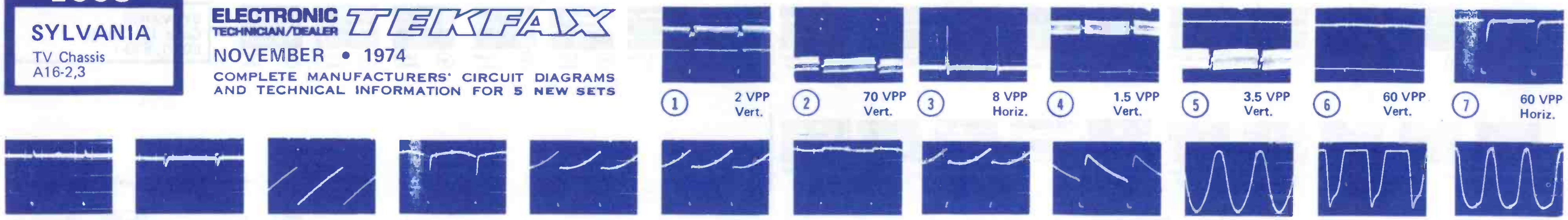
1558

SYLVANIA
TV Chassis
A16-2,3

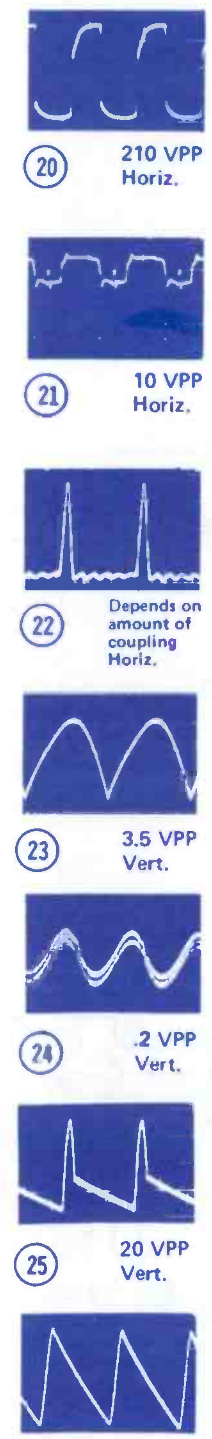
ELECTRONIC TECHNICIAN/DEALER TEKFAX

NOVEMBER • 1974

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



(1) 2 VPP Vert.
(2) 70 VPP Vert.
(3) 8 VPP Horiz.
(4) 1.5 VPP Vert.
(5) 3.5 VPP Vert.
(6) 60 VPP Vert.
(7) 60 VPP Horiz.
(8) 7 VPP Vert.
(9) 3.5 VPP Vert.
(10) 11 VPP Vert.
(11) 35 VPP Vert.
(12) 30 VPP Vert.
(13) 30 VPP Vert.
(14) 14 VPP Vert.
(15) 28 VPP Vert.
(16) 28 VPP Horiz.
(17) 20 VPP Horiz.
(18) 8 VPP Horiz.
(19) 10 VPP Horiz.



(20) 210 VPP Horiz.
(21) 10 VPP Horiz.
(22) Depends on amount of coupling Horiz.
(23) 3.5 VPP Vert.
(24) .2 VPP Vert.
(25) 20 VPP Vert.
(26) 8 VPP Vert.

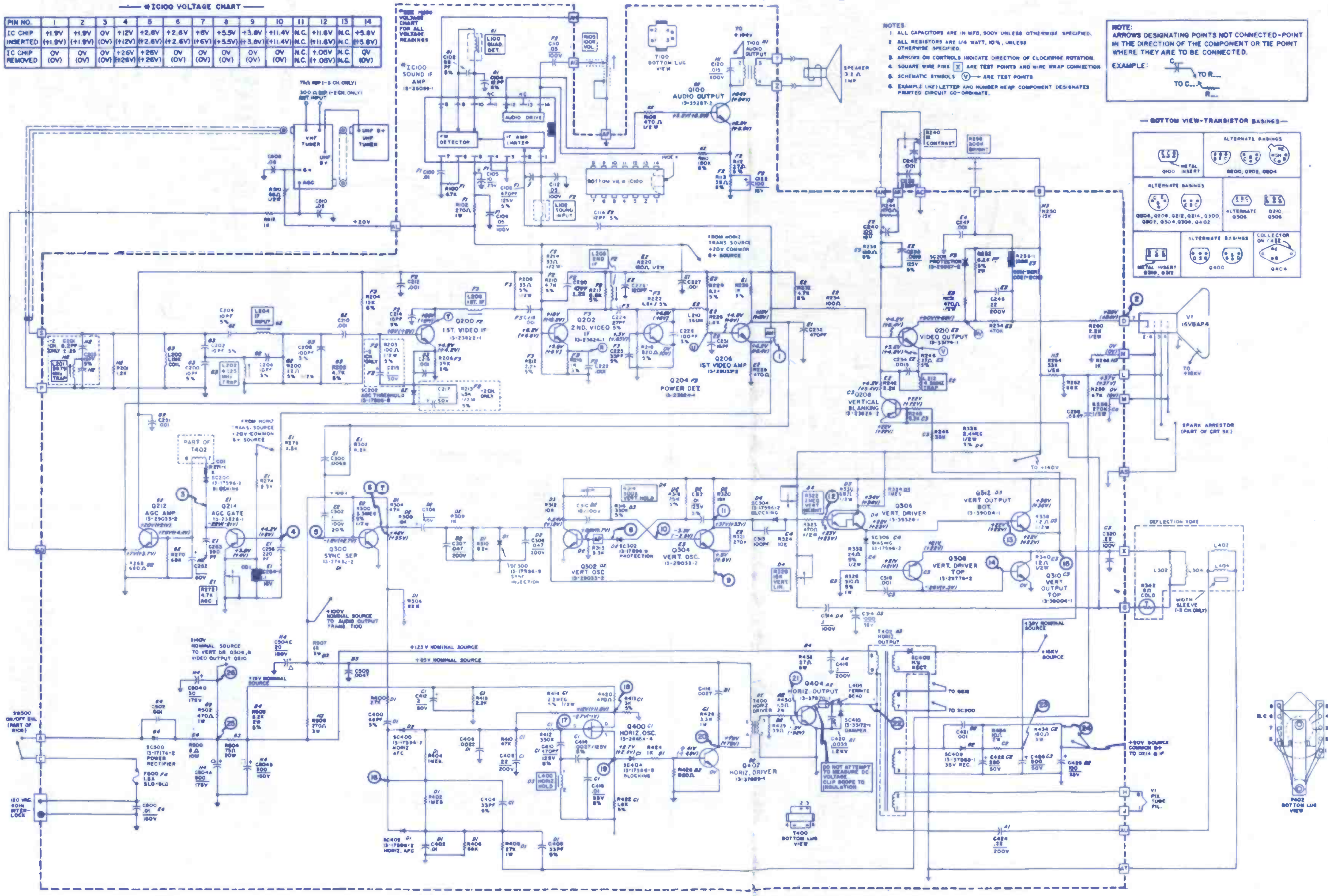
*IC100 VOLTAGE CHART

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)	+12V (+12V)	+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)	+26V (+26V)	+26V (+26V)	0V (0V)	0V (0V)	0V (0V)	0V (0V)	0V (0V)	N.C. N.C.	+.06V (+.06V)	N.C. N.C.	0V (0V)

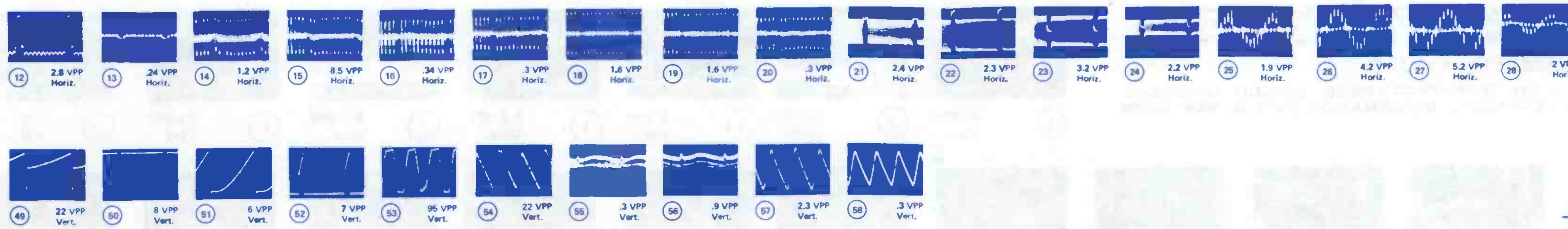
NOTES:
1. ALL CAPACITORS ARE IN MFD, 500V UNLESS OTHERWISE SPECIFIED.
2. ALL RESISTORS ARE 1/4 WATT, 10%, UNLESS OTHERWISE SPECIFIED.
3. ARROWS ON CONTROLS INDICATE DIRECTION OF CLOCKWISE ROTATION.
4. SQUARE WIRE PINS [X] ARE TEST POINTS AND WIRE WRAP CONNECTION.
5. SCHEMATIC SYMBOLS (V)→ ARE TEST POINTS
6. EXAMPLE (N2) LETTER AND NUMBER NEAR COMPONENT DESIGNATES PRINTED CIRCUIT CO-ORDINATE.

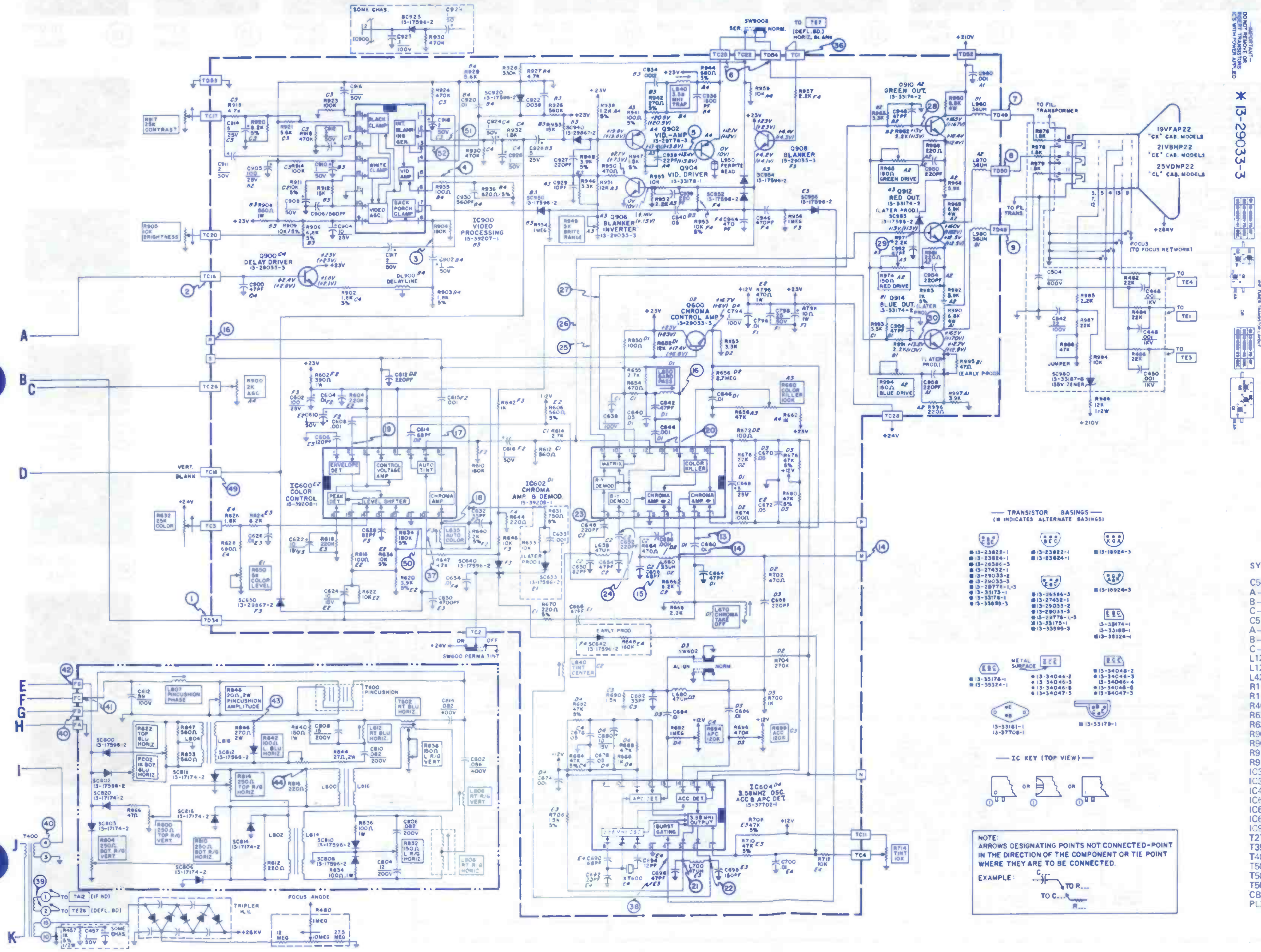
NOTE:
ARROWS DESIGNATING POINTS NOT CONNECTED-POINT IN THE DIRECTION OF THE COMPONENT OR TIE POINT WHERE THEY ARE TO BE CONNECTED.
EXAMPLE: C__ TO R__ TO C__ R__

— BOTTOM VIEW-TRANSISTOR BASINGS —



SYLVANIA
Color TV Chassis
E09-1, E10-1

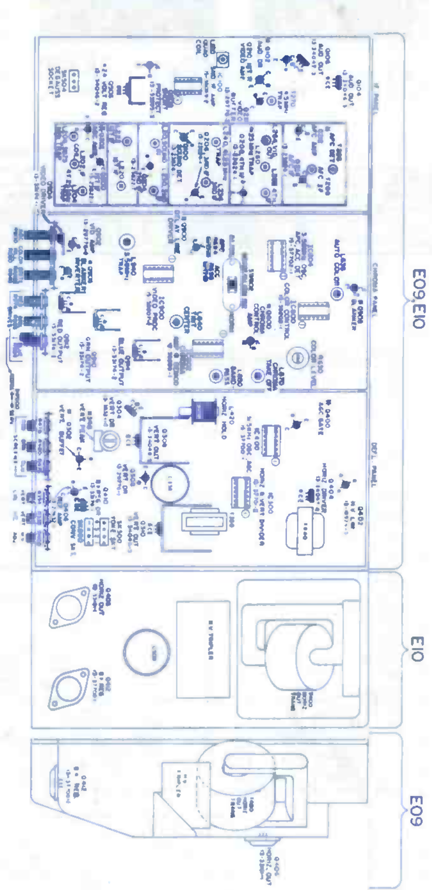




NOTE:
ARROWS DESIGNATING POINTS NOT CONNECTED-POINT IN THE DIRECTION OF THE COMPONENT OR TIE POINT WHERE THEY ARE TO BE CONNECTED.

EXAMPLE: C... TO R... TO C... R...

TRANSISTOR LAYOUT



SYMBOL	DESCRIPTION	SYLVANIA PART NO.
C508	3 section electrolytic	41-37720-1
	A—100/250v	
	B—100/250v	
	C—150/200v	
C510	3 section electrolytic	41-37580-1
	A—1500/50v	
	B—1500/50v	
	C—200/50v	
L120	quad early prod	50-33195-1
L120	quad later prod	50-33195-2
L420	horiz hold	50-37711-4
R112	100K volume E09-1, E10-1	37-35924-1
R112	100K volume E09-14	37-27242-41
R460	focus network	32-37705-1
R632	25K color E09-1, -14	37-27242-43
R632	25K color E10-1	37-27242-48
R905	10K brite E09-1, -14	37-27242-40
R905	10K brite E10-1	37-27242-45
R917	25K contrast E09-1, -14	37-27242-53
R917	25K contrast E10-1	37-27242-54
IC300	horiz vert divide early prod	15-37701-1
IC300	horiz vert divider later prod	15-37701-2
IC400	31.5kHz osc AGC	15-37700-1
IC600	color control	15-39208-1
IC602	chroma amp demod	15-39209-1
IC604	3.58MHz osc ACC APC	15-37702-1
IC900	video processing	15-39207-1
T270	4.5MHz trap	50-35309-1
T350	side pincushion	50-37712-1
T400	horiz output	50-39287-1
T500	power E09-1, -14	55-37722-1
T500	power E10-1	55-37722-3
T502	low voltage E09-14	55-11121-1
CB500	circuit breaker	29-39696-13
PL300	plug deflect yoke	73-10302-12
	tripler HV E09-1, -14	32-35894-3
	tripler HV E10-1	32-35894-7
	VHF E09-14	54-37851-2
	VHF E10-1	54-37851-1

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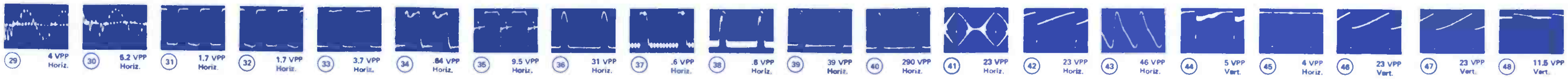
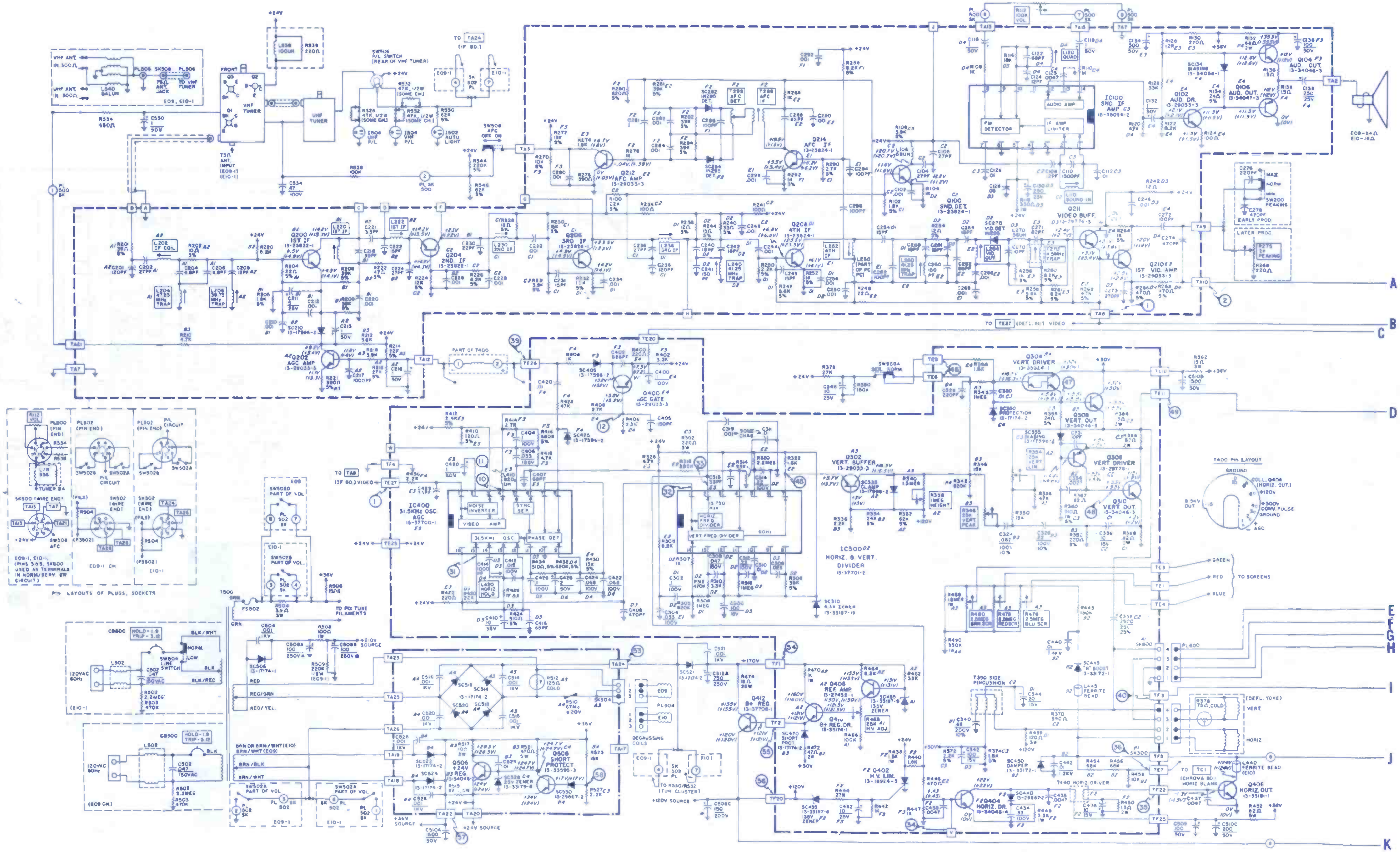
SYLVANIA

Color TV Chassis
E09-1, E10-1

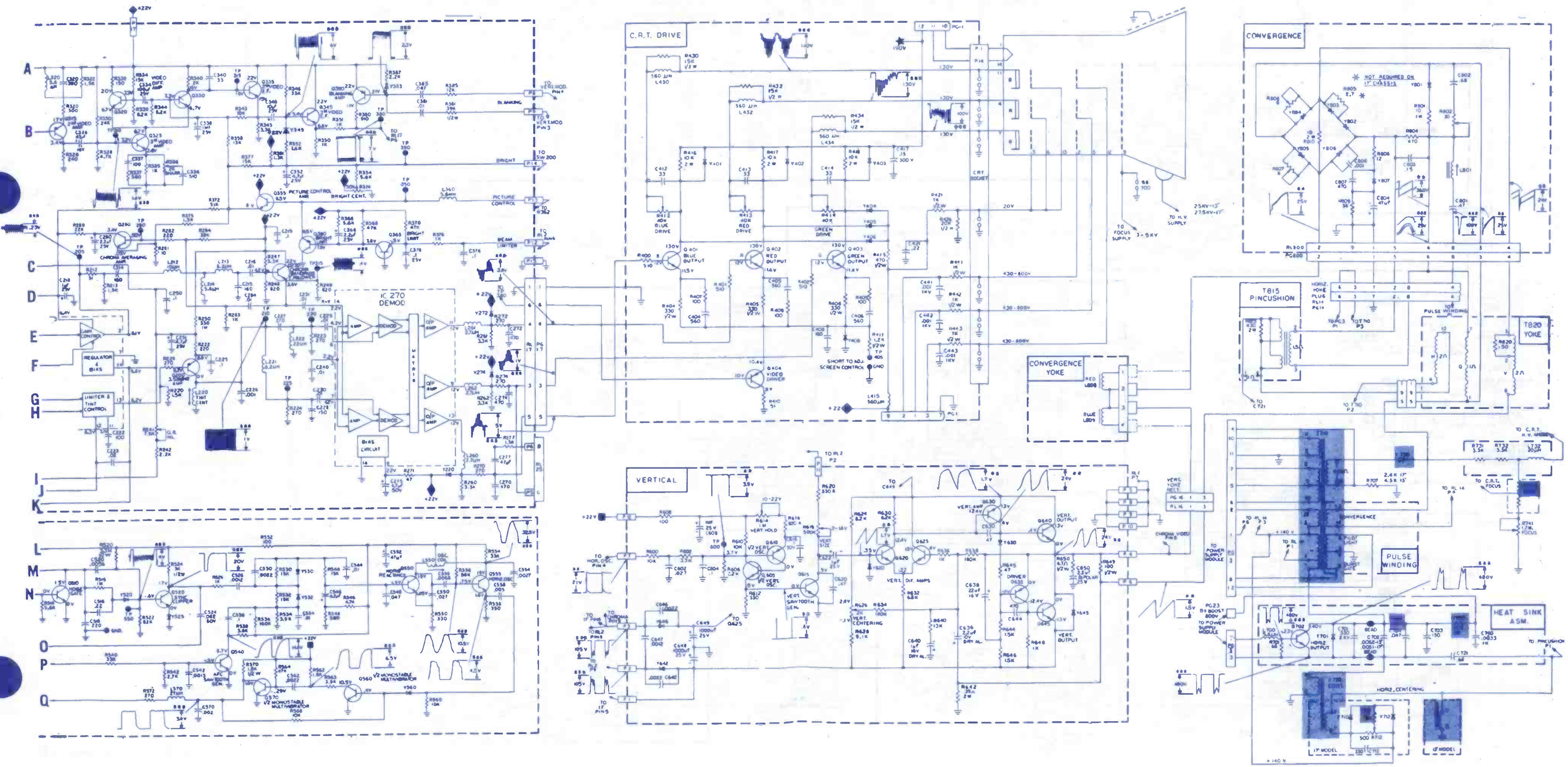
ELECTRONIC TECHNICIAN/DEALER TEKFAX
NOVEMBER • 1974

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





GENERAL ELECTRIC
Color TV Chassis
YA



1556

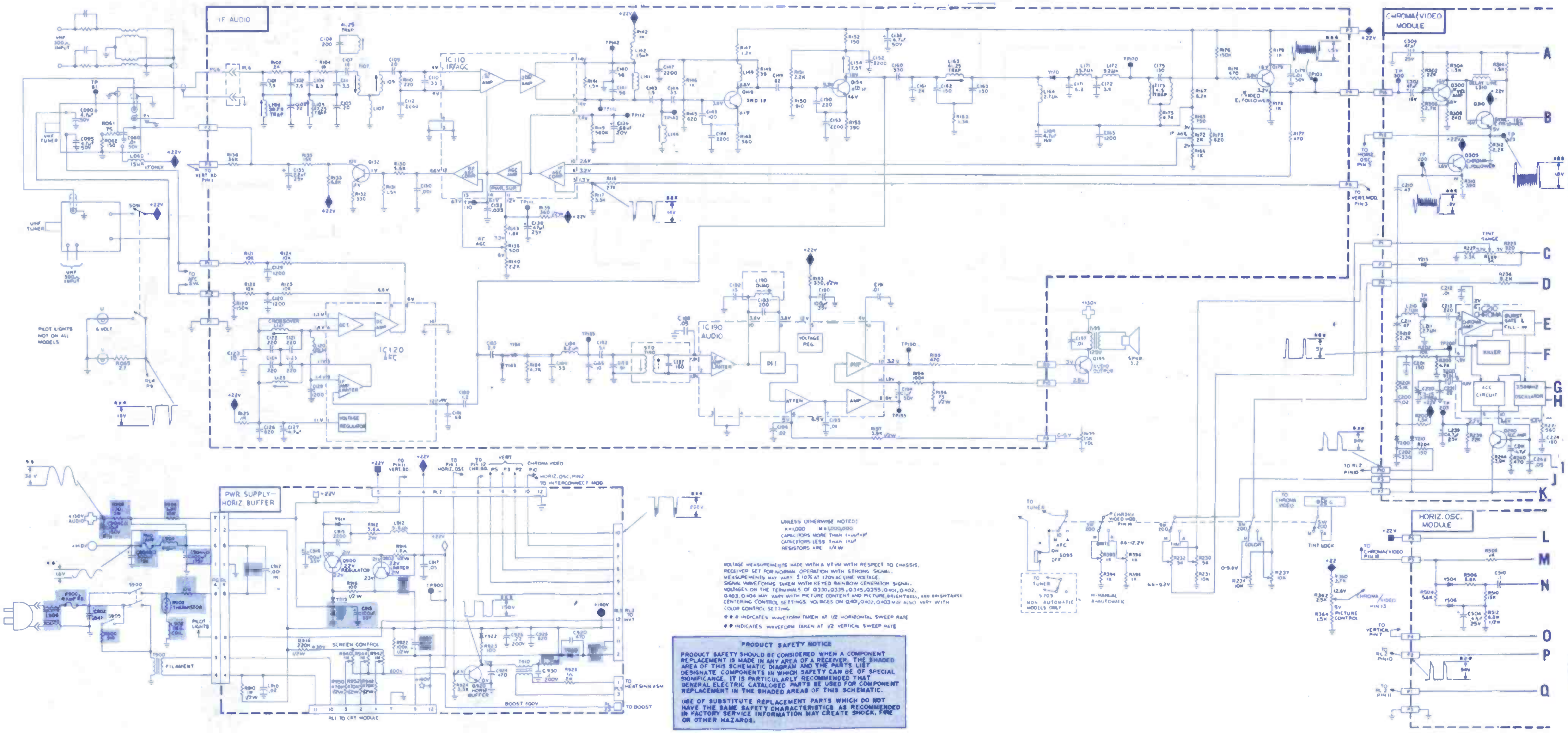
GENERAL ELECTRIC

Color TV Chassis YA

NOVEMBER • 1974

ELECTRONIC TECHNICIAN/DEALER TEKFAX

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 = µµf = pf
CAPACITORS LESS THAN 1 = µf
RESISTORS ARE 1/4 W

VOLTAGE MEASUREMENTS MADE WITH A VTVM WITH RESPECT TO CHASSIS. RECEIVER SET FOR NORMAL OPERATION WITH STRONG SIGNAL. MEASUREMENTS MAY VARY ± 10% AT 120VAC LINE VOLTAGE. SIGNAL WAVEFORMS TAKEN WITH KEYED RAINBOW GENERATOR SIGNAL. VOLTAGES ON THE TERMINALS OF Q330, Q335, Q345, Q355, Q401, Q402, Q403, Q404 MAY VARY WITH PICTURE CONTENT AND PICTURE, BRIGHTNESS, AND BRIGHTNESS CENTERING CONTROL SETTINGS. VOLTAGES ON Q401, Q402, Q403 MAY ALSO VARY WITH COLOR CONTROL SETTING.

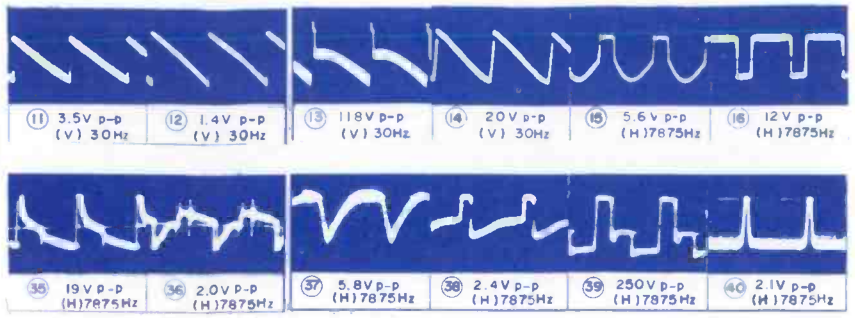
● ● ● INDICATES WAVEFORM TAKEN AT 1/2 HORIZONTAL SWEEP RATE

● ● INDICATES WAVEFORM TAKEN AT 1/2 VERTICAL SWEEP RATE

PRODUCT SAFETY NOTICE

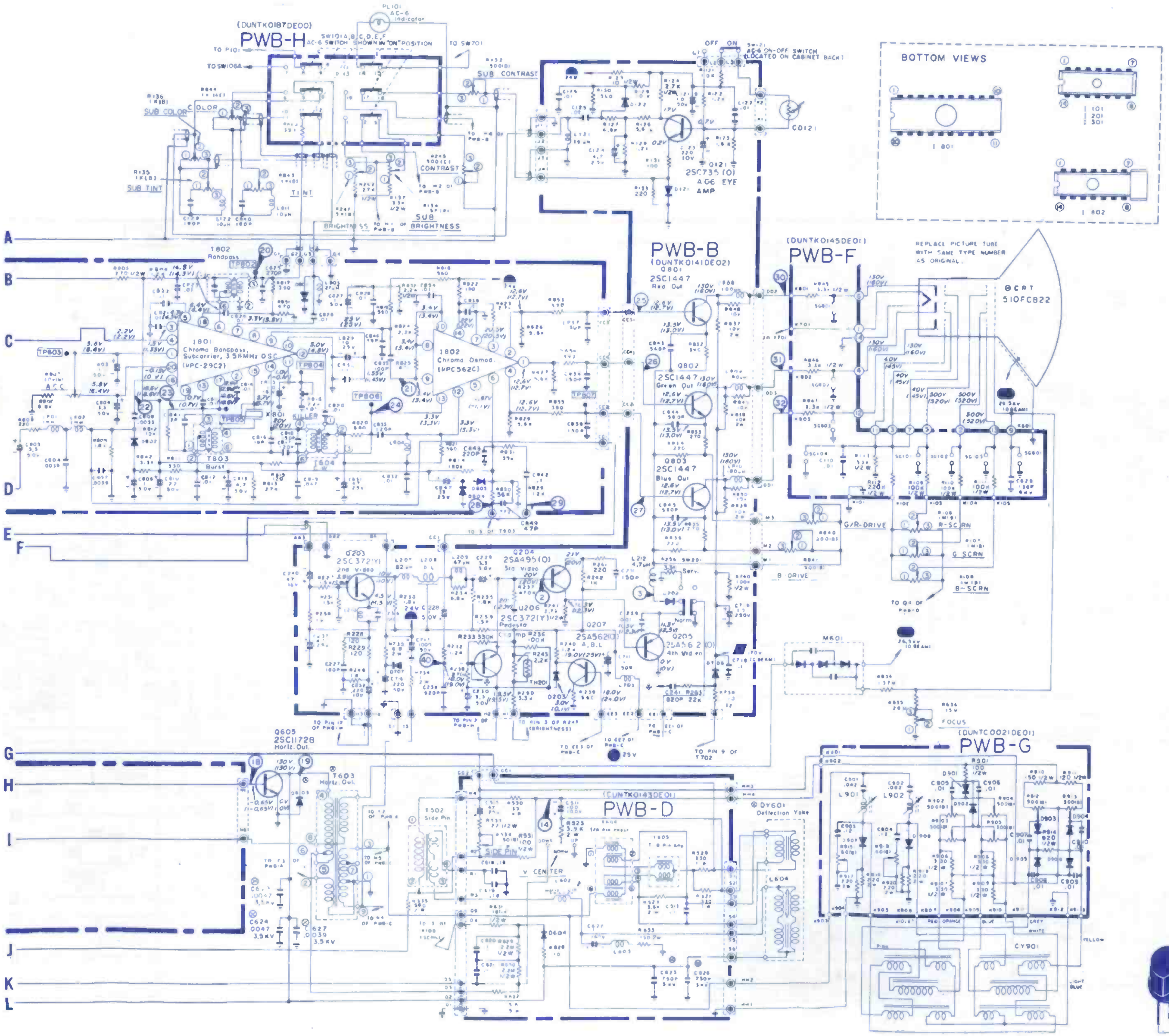
PRODUCT SAFETY SHOULD BE CONSIDERED WHEN A COMPONENT REPLACEMENT IS MADE IN ANY AREA OF A RECEIVER. THE SHADED AREA OF THIS SCHEMATIC DIAGRAM AND THE PARTS LIST DESIGNATE COMPONENTS IN WHICH SAFETY CAN BE OF SPECIAL SIGNIFICANCE. IT IS PARTICULARLY RECOMMENDED THAT GENERAL ELECTRIC CATALOGED PARTS BE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

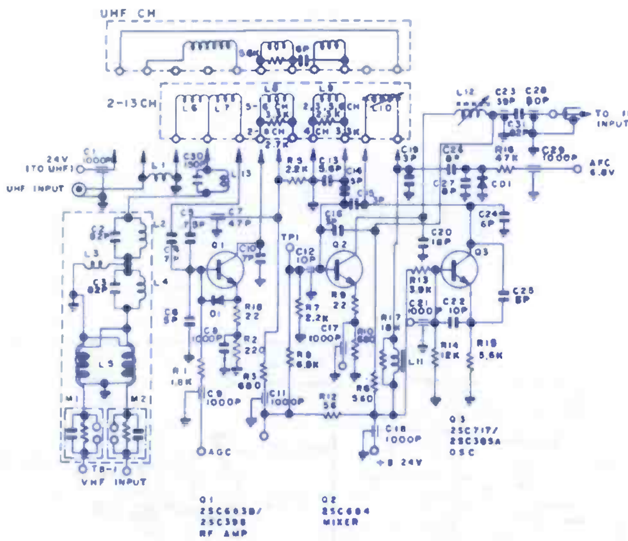


SYMBOL	DESCRIPTION	AIRLINE PART NO.
R207	4.7K, Pot., RF AGC	J25618
R807	10K, Pot., ACC	J25620
R816	22K, Pot., Color Killer	J25621
L303	Coil, sound detector	J611113
T303	xformer, sound trap	J611109
T801	xformer, chroma take-off	J611115
T802	xformer, bandpass	J611117
T803	xformer, burst	J611122
T804	xformer, C.W.	J611119
L208	Coil, delay line	J611123
TH201	Thermistor	J241237
R248	6.8K, Pot., auto brightness	J25619
R506	50K, Pot., vert. hold	J25624
R509	6.8K, Pot., vert. size	J25622
R614	50K, Pot., horiz. hold	J25624
T501	xformer, vert. oscillator	J11419
T601	xformer, horiz. oscillator	J611101
R717	1K, Pot., +130V adjustment	J25623
C706A C706B C706C	470µf @ 200V 330µf @ 200V, Electrolytic 47µf @ 250V	J321064
R132	500Ω, Pot., Sub. contrast	TV25523
R135	1K, Pot., Sub. tint	J25614
R136	1K, Pot., Sub. color	J25614
R245	500Ω, Pot., contrast	J25625
R247	5K, Pot., brightness	J25613
R308	50K, Pot., Volume (slide)	J25631
R636	15M, Pot., focus	J25612
R843	1K, Pot., tint	J25617
R844	1K, Pot., color	J25626
DY601	coil, deflection yoke	J611126
T301	xformer, audio output	J11421
T502	xformer, side pincushion	J11420
T603	xformer, horiz. output	J11417
T701	xformer, power	J11418
T702	xformer, power choke	J11429
F701	fuse, 4a pigtail (slo blo)	315004
	tuner, VHF	J35428

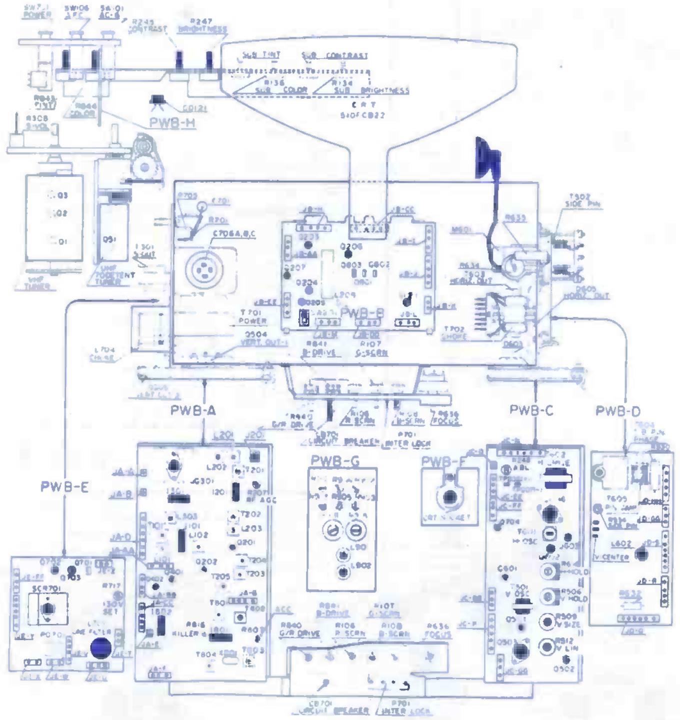
AIRLINE
Color TV Model
GEN-12985A

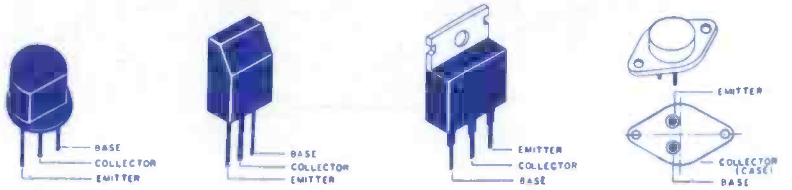


VHF TUNER ASSEMBLY



CHASSIS LAYOUT





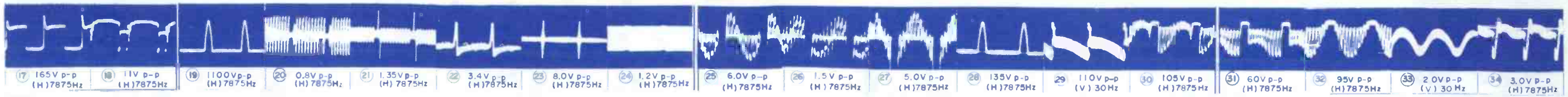
1555

AIRLINE
Color TV Model
GEN-12985A

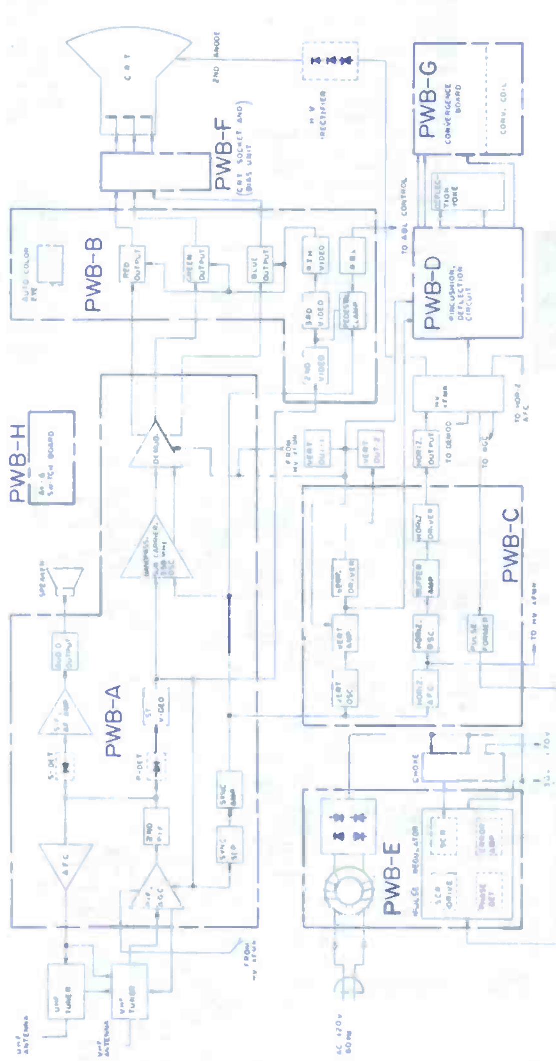
ELECTRONIC TECHNICIAN/DEALER TEKFAX

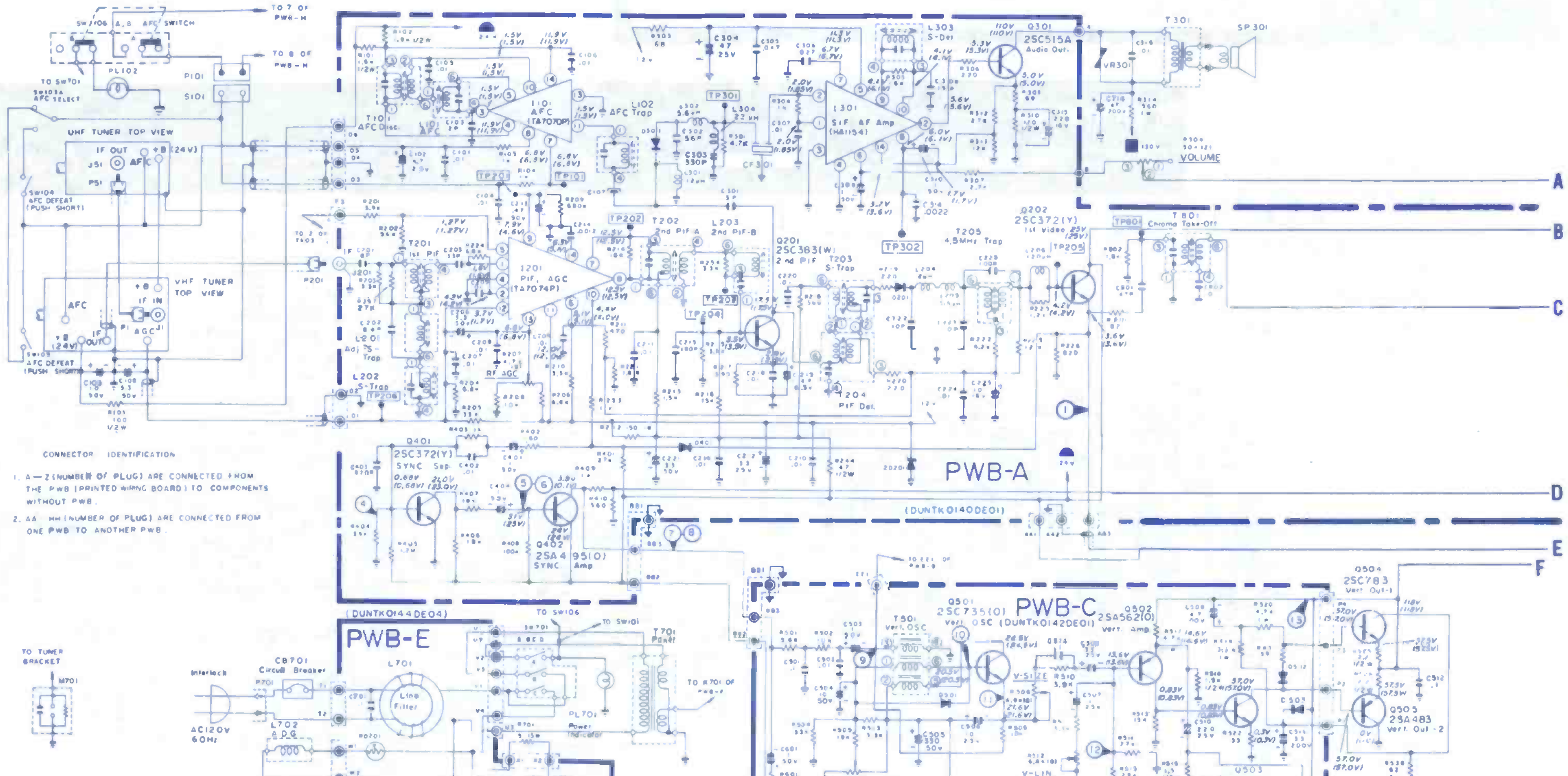
NOVEMBER • 1974

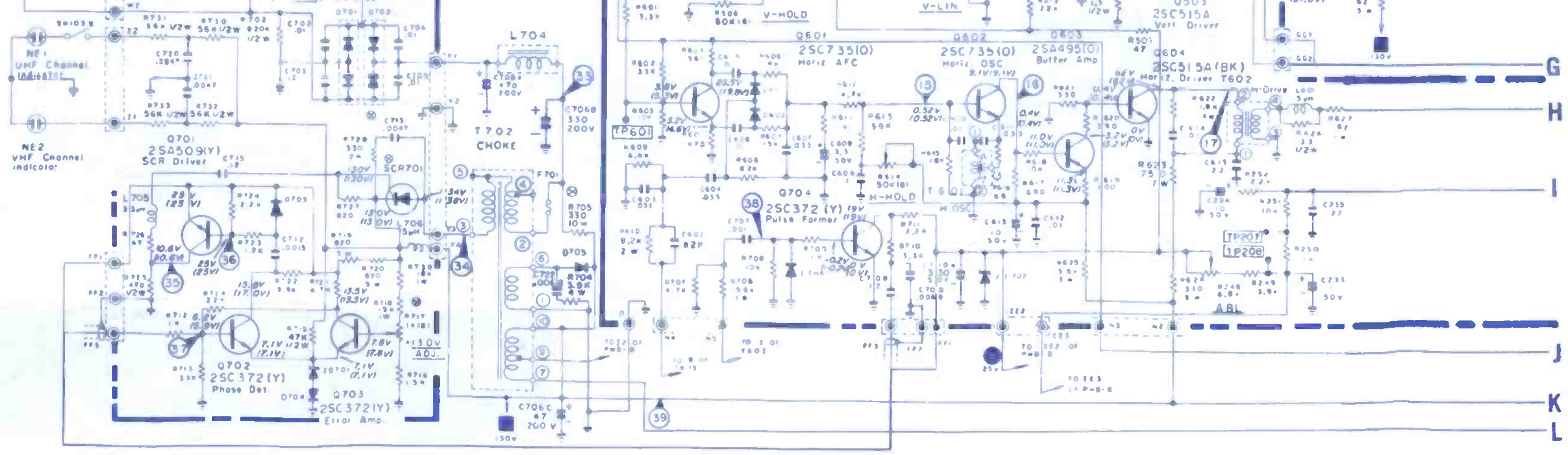
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS



BLOCK DIAGRAM







TELEVISION ELECTRICAL SPECIFICATIONS

POWER INPUT	120 Volts AC, 60Hz
POWER CONSUMPTION	150 Watts
PICTURE SIZE	Approx. 185 sq. in.
SWEEP DEFLECTION	Magnetic
CONVERGENCE	Magnetic
FOCUS LENS	Bipotential
AUDIO POWER OUTPUT RATING	1.0 Watt @10% Distortion
SPEAKER SIZE	3 15/16" Dia., 1.0 oz Mag.
VOICE COIL IMPEDANCE	8.0 ohms @400 Hz
ANTENNA INPUT IMPEDANCE	300 ohms balanced
TELEVISION RF FREQUENCY RANGE	
All 12 television channels	54MHz to 88MHz
	174MHz to 216MHz
Any of 70 UHF channels	470MHz to 890MHz
INTERMEDIATE FREQUENCIES	
Picture IF Carrier Frequency	45.75MHz
Sound IF Carrier Frequency	41.25MHz
Color Sub-Carrier Frequency	42.17MHz (Nominal)

T603 BASING DIAGRAM

VOLTAGE	SYMBOL	LEGEND
HV		26.5KV (0 BEAM)
B		170V (0 BEAM)
B1		130V
B2		25V
B3		24V

ELECTRONIC TECHNICIAN/DEALER

TEKFAX

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

GROUP 267

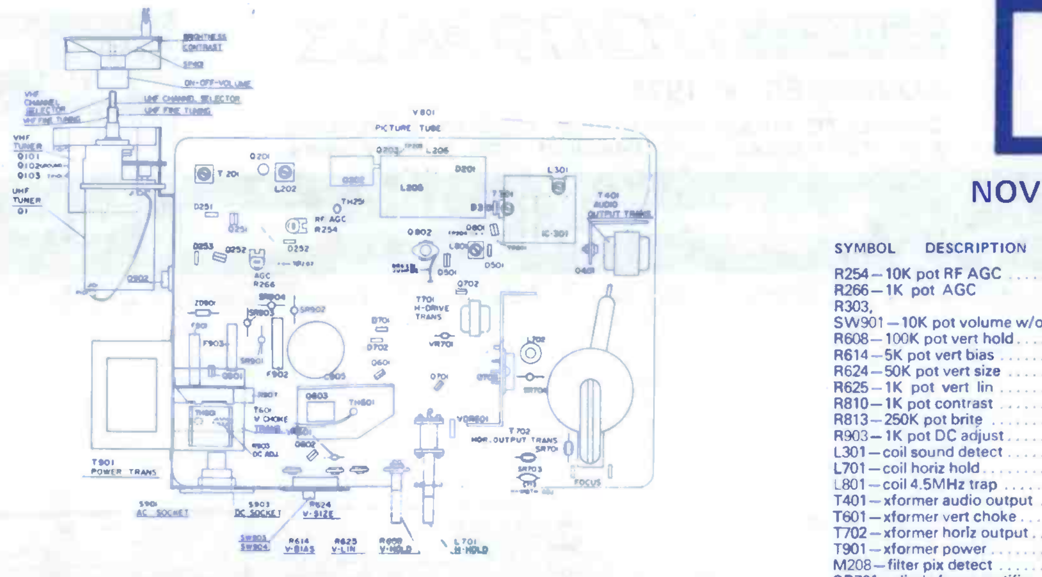
	SCHEMATIC NO.		SCHEMATIC NO.
AIRLINE TV Model GEN-11765A	1554	SYLVANIA TV Chassis A16-2,3	1558
AIRLINE Color TV Model GEN-12985A	1555	SYLVANIA Color TV Chassis E09-1, E10-1	1557
GENERAL ELECTRIC Color TV Chassis YA	1556		

1554

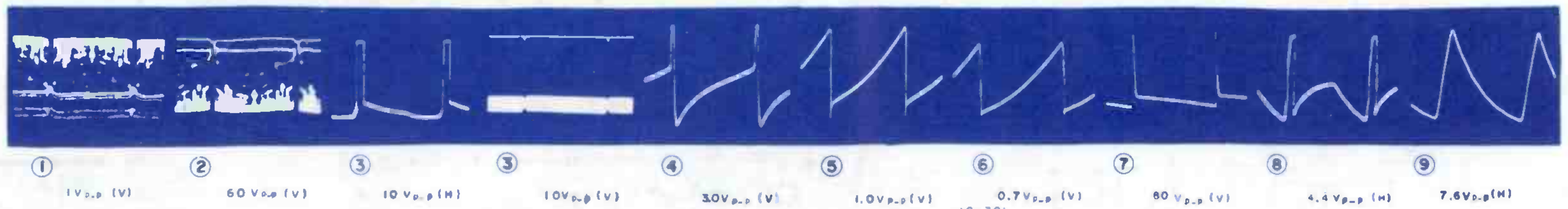
AIRLINE

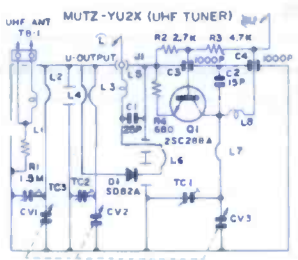
TV Model GEN-11765A

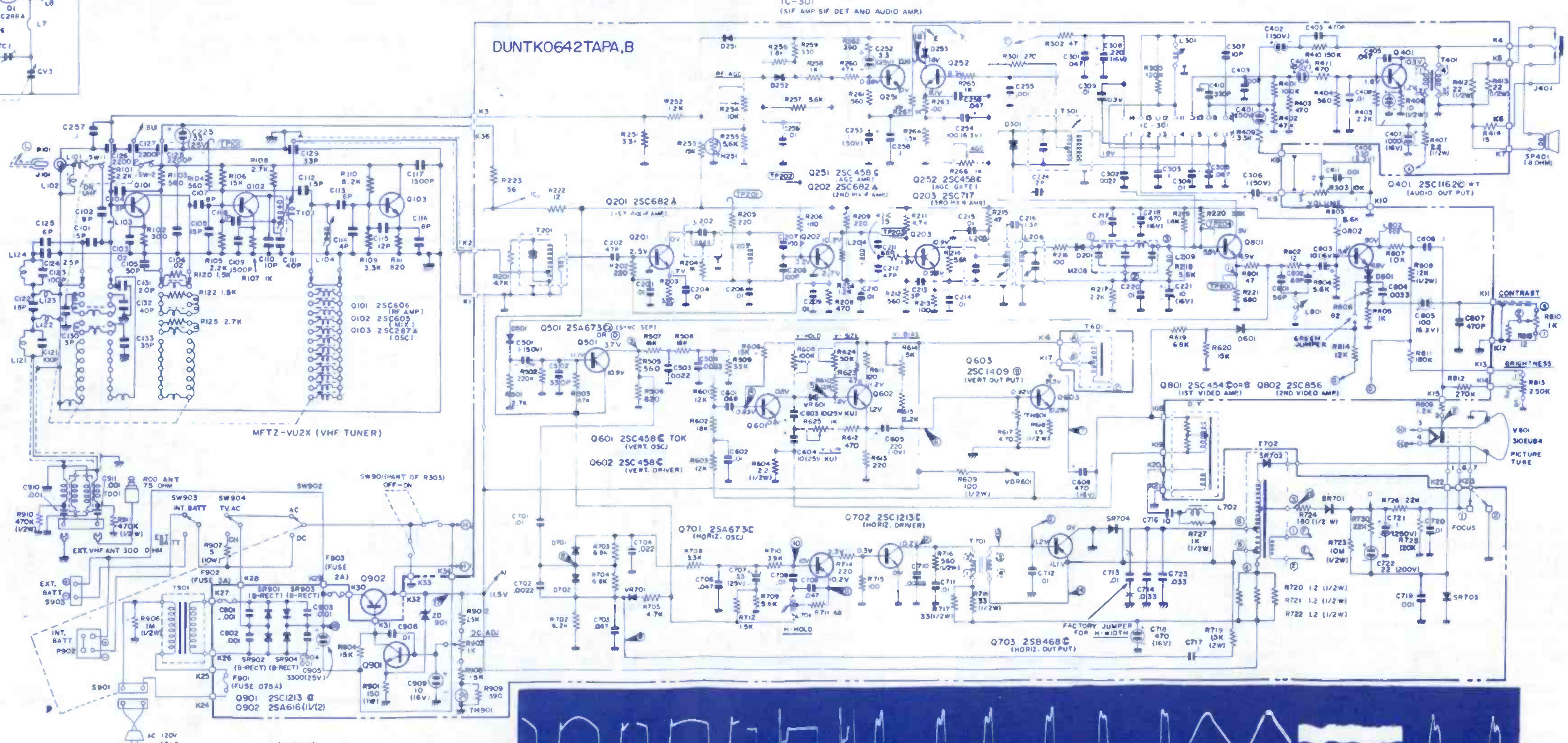
NOVEMBER • 1974



SYMBOL	DESCRIPTION	AIRLINE PART NO.
R254	10K pot RF AGC	J25635
R266	1K pot AGC	
R303, SW901	10K pot volume w/on-off switch	J25644
R608	100K pot vert hold	J25637
R614	5K pot vert bias	J25638
R624	50K pot vert size	J25639
R625	1K pot vert lin	J25640
R810	1K pot contrast	J25641
R813	250K pot brite	J25642
R903	1K pot DC adjust	J25643
L301	coil sound detect	J611143
L701	coil horiz hold	J611141
L801	coil 4.5MHz trap	TV62258
T401	xformer audio output	J62762
T601	xformer vert choke	TV11169
T702	xformer horiz output	J11430
T901	xformer power	J11431
M208	filter pix detect	J611140
SR701	diode focus rectifier	J241271
TH251	therm AGC	J241263
VDR601	volt dependent resistor	TV24250
VR601	varistor vert	J241261
VR701	varistor horiz	J241261
F901	fuse 0.75a 250v slo blo pigtail	J18512
F902	fuse 3A 125v slo blo pigtail	315003
F903	fuse 2a 125v slo blo pigtail	315002
	tuner VHF	J35446
	yoke deflect	J611147

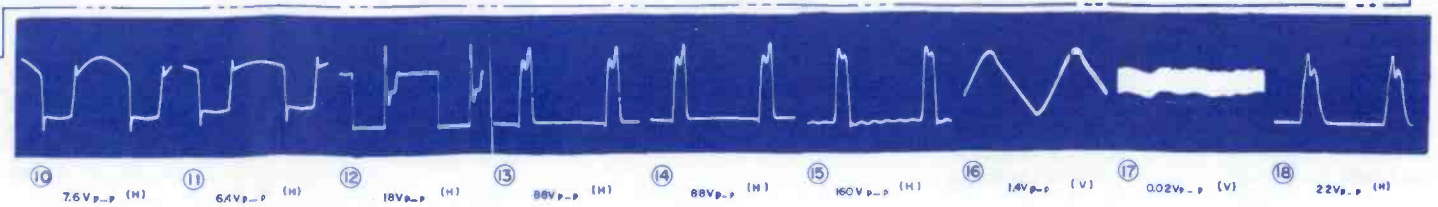






CAUTION

This circuit diagram is original one. Therefore there may be a slight difference from yours.



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