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ELECTRONIC
TECHNICIAN/DEALER

May 1976 • VOLUME 98 NUMBER 5

THE COVER: Our cover photo this month, contributed by Jim Kluge, a technical editor for the Winegard Company and a frequent contributor of antenna-related technical articles for ET/D, shows a TV antenna system used in an installation near Evergreen, Colorado, in the foothills of the Rocky Mountains—a TV reception area typical of those which require TV antenna preamplifiers, the selection and use of which is the subject of an article by Jim Kluge in this issue.

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When and how a preamp should be used to preserve the quality of TV signals, plus guidelines for selection of the best type for a particular reception condition. By James E. Kluge.

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NEWS OF THE INDUSTRY

TV Color Console Share Of Market Up In '75

Consoles' share of the color market showed a gain last year over the preceding year. This is the first time in history that this has occurred, and according to a report in *TV Digest*, this is a strong indication of a ripening replacement market, where consoles are most important.

Console sales held up better during the recent sales slump than did portables and table models, even though console sales were down in numbers in 1974. Console production of just over 2 million was down 24.9%, the report says, but it represented 32.3% of new supply, up from the 1974 share of 31.7%.

The *TV Digest* report also indicated that solid-state construction "virtually completed takeover of the color console market with a 97.9% share, versus 87.7% in 1974." Of total color TV supply, 89.7% were solid-state compared to 72.6% in 1974.

RCA Sells Part of Receiving Tube Operation To GTE Sylvania

Machinery, parts, raw materials, work in process and technical data related to the manufacture of Nuvistors and certain other receiving tubes have been sold by RCA to GTE Sylvania, and the RCA plant at Harrison, N.J. has been closed. RCA also operates a warehouse and distribution center in Edison, N.J., which will be closed the end of June because of the sale to GTE Sylvania.

In commenting on the sale, Alfred C. Viebranz, senior vice president of GTE Sylvania's Electronic Components Group, said "Production of the Nuvistor family of tubes will be moved from the RCA Harrison facility to our receiving tube plant in Emporium, Pa. The other types included in the agreement will be manufactured at our plant in Altoona, Pa. The Altoona production will start shortly, with manufacture of Nuvistors to be underway by the end of this year."

Workman Electronics Buys International Rectifier's Commercial Line

The retail and dealer service product line of International Rectifier has been bought by Workman Electronics of Sarasota, Florida, but terms of sale were not disclosed. The sale includes the inventory, part numbers, and various packaging equipment for IR's dealer service and hobbyist lines of universal transistors, zeners, SCR's, rectifiers, capacitors, switches, relays and semiconductor hardware.

"Purchase of the IR line of dealer service and retail products," said Workman president Robert Goldstein, "gives Workman one of the broadest lines in this market."

Workman is a subsidiary of IPM Technology, Inc., N.Y.C.

Delay In Expansion of CB Band Produces Varied Reactions

Some new product lines were not displayed at PC-76, the recent CB show in Las Vegas, because of an FCC delay in the proposed expansion of the 27-MHz band, but, according to a report in *TV Digest*, "the FCC is now holding out promise that industry will soon have a total of about 58 channels—which the FCC says could be boosted to 99, 105 or 115 through use of single-sideband." The commission has begun studies on "long-term needs of the general public for personal radio communications."

An FCC spokesman told *TV Digest* that the "exact configuration of expanded Class D service is still up in the air, pointing to a nearly infinite number of possible AM and SSB combinations."

New CB units designed around the proposed FCC expansion will probably not be seen by consumers, the report states, until April, 1977, or even later.

The FCC delay on expansion produced both disappointent and relief for CB manufacturers at PC-76. Although they couldn't display some new models, some manufacturers told *TV Digest*, "Now we don't have to anticipate a huge assault from the GEs, Motorolas, RCAs & Panasonics because I can't see them coming in with a lot of 23-channel equipment."

EICO Re-enters the CB Market

EICO has announced its re-entry into the rapidly expanding CB field, with an extensive new line of CB products. "EICO is not a newcomer to the CB market," EICO President Harry Ashley stated. "We are now announcing our RE-entry," he said, "not our 'entry'. When CB first came on the scene, EICO was there, one of the leading pioneers. And now with extensive research efforts, we will be providing the very latest in CB equipment at an affordable price."

The new line of products includes a 23-channel transceiver with synthesized crystal control, a CB converter, a line of antennas, test/power meters, a CB monitor, microphones and other accessories.

Summer Electronic Seminars For Instructors Are Announced

A total of 23 seminars, designed to help teachers update their curriculum in consumer electronic product service techniques, will be held this summer in 14 states.

The seminars, sponsored by the EIA/Consumer Electronics Group, are open to high

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school and vocational instructors. Emphasis will be placed on how to diagnose and repair the latest consumer electronic products including solid-state circuitry. College credit is offered for successful completion of the session.

Summer Consumer Electronics Show Promises to be Biggest Ever

According to reports from Jack Wayman, senior vice president, EIA/Consumer Electronics Group, the initial response from key exhibitors could indicate that this year's show, in Chicago, June 13-16, will be the largest ever held.

Over 250 companies have already requested exhibit space, Wayman said, and many past exhibitors are requesting larger spaces than ever before. Many new exhibitors in the CB radio, electronic watch and video systems categories will appear at this year's show.

Zenith's New Picture Tube Unveiled

A new color TV picture tube was unveiled by the Zenith Radio Corporation in Chicago at the beginning of March. U.S. & foreign TV receiver and picture tube manufacturers viewed the demonstration of the new tube, which company spokesmen say will allow Zenith to improve color TV performance, and to reduce picture tube costs in the future.

According to a report in *TV Digest* on the demonstration, "Attention was centered on the tube's new tri-potential electron gun, which—together with 100-degree deflection angle—makes possible beam spot size only 60% of comparable 90 degree delta-gun tube design, eliminating resolution problems which heretofore have plagued slot-mask tubes."

Developed in cooperation with the Corning Glass Works, the company currently plans to use the new tube in a portion of its 19-inch color TV line to be introduced late this summer, and later in other portions of their line.

In addition, the new picture tube will be offered for sale to other TV manufacturers, with licensing agreements to be negotiated with other picture tube manufacturers as well.

NESDA Time Study Shows "Tough Dogs" Take Time

In a "time study" of 81 electronic service shops just completed by the National Electronic Service Dealers Association (NESDA), 95% of respondent shops said they encounter "tough dog" repair jobs—with the time spent by all respondents on this kind of job averaging out to about 8.4 hours. One shop said they had spent 40 hours on one repair of this type.

The NESDA report said many shops chalk these "tough dog" repairs up to "experience" and the extra time spent is not charged to the customer.

Pre-recorded Video-cassettes On Rental Market Soon

According to a recent report in *TV Digest*, pre-recorded video-cassettes of recent movies and other programming should be available for home rental by this summer. *Betamax* cassettes by Sony will be used.

Time-Life Multimedia, who is also renting video-cassettes, is doing it by direct mail, and officials say response has been "on target" so far.

TV Digest suggests that "rental of *Betamax* tapes could be a dress-rehearsal for the forthcoming video-disc.

Winegard To Enter CB Antenna Business

A major, long term commitment to the manufacture and sale of CB antennas has been made by the Winegard Company. According to Robert M. Fleming, Jr., marketing manager, Winegard will begin delivery of a new CB antenna line by midsummer.

"We have obviously not rushed into this market," Fleming commented. "Our management is convinced there will be a long range, expanding market for 2-way communications and we intend to earn our share of this important market, starting with CB antennas."

Telephone Customers Can Install Own Equipment Without Fee

In a ruling handed down by the FCC in March, telephone customers can now install their own equipment in their office or home without having to pay a service charge to the phone company. According to a report in the *N.Y. Times*, the commission adopted the controversial proposal that states if customer-provided equipment meets Federal standards, it can be installed without "protective" connecting devices provided by the telephone company, for which customers have paid a monthly surcharge. The ruling is in effect as of May 1, and according to the Times, "sets the stage for aggressive competition in the telephone equipment business between such giants as the American Telephone and Telegraph Company's Bell System, and numerous small "interconnect" companies, which sell telephone equipment only." ■

TECHNICAL LITERATURE

Semiconductor Cross Reference Guide provides over 15,000 cross-references to 24 different types of semiconductors contained in the GE Kit No. K-934 that is stocked for service of TV sets, tape players, home and auto radios, stereos and CB rigs produced by Far East firms. Available free from *GE electronic component* distributors.

Test Instrument Catalog lists and describes the complete line of oscilloscopes, vectorscopes, color bar & pattern generators, DVM's, multimeters, signal generators, and other test instrument products from Leader Instruments. This is the 1975/76 catalog. Available free from *Leader Instruments Corp.*, 151 Dupont Street, Plainview, N.Y. 11803.

Extension Speakers For CB Transceivers is new literature providing application and technical information about six models of environment-resistant loudspeakers being introduced by Atlas Sound. The bulletin outlines the advantages or re-entrant type horns equipped with compression drivers when used as extension speakers for CB, amateur and business radio. Available free from *Atlas Sound*, 10 Pomeroy Road, Parsippany, N.J. 07054.

A Catalog of Home-Study Courses and a booklet on FCC licenses are now available from the Cleveland Institute of Electronics. The catalog highlights three additional home study courses that meet the needs of people who want to develop occupational skills in electronic troubleshooting. The first course is for beginners, while the other two are for those with an intermediate or advanced knowledge of electronics. All three courses include preparation for the First Class FCC License exam. Available free from the *Cleveland Institute of Electronics, Inc.*, Dept. ANR-O8, 1776 East 17th St., Cleveland, Ohio 44114.

Demountable Wall System Brochure details advantages of new demountable walls for retail merchandising applications. Literature describes standard 4 x 12-foot panels and custom-sized panels available in the Garcy DM-Wall System. Available free from *Garcy Corporation*, Department X, 2501 North Elston Avenue, Chicago, Illinois 60647.

Electronics Catalog is an illustrated mail-order catalog providing a quick reference guide to test equipment, CB equipment, tools, microphones, antennas and other products from Fordham Radio Supply. Available free from *Fordham Radio Supply Co.*, 558 Morris Avenue, Bronx, N.Y. 10451.

Broad-band Communication Systems Brochure illustrates the new *Broadcom* system from Jerrold Electronics. Literature explains systems used in diverse U.S. companies, police departments and universities. Available free from *Jerrold Electronics* Corp., 200 Witmer Road, Horsham, Pa. 19044.

TV Antenna Brochure illustrates and describes 40 models of TV antennas produced by Winegard. Pamphlet covers VHF-UHF-FM, VHF-FM, UHF, FM, and single channel VHF yagis plus Chromstar preamplifiers. Available free from *Winegard Company*, 3000 Scotten Blvd., Burlington, Iowa 52601.

Digital Multimeter Brochure describes and illustrates the Systron-Donner Model 7003 "Outclasser" DVM. It lists specifications for DC voltage, AC voltage, AC current and resistance ranges plus prices for DVM and options. Available free from *Systron-Donner* Corp., 10 Systron Drive, Concord, California 94518.

Security System Books describe background, methods, and equipment for security systems. One book is titled "Introduction To Security" and the other is "Alarm Systems & Theft Prevention." Available for $12.95 and $14.50 respectively from *Mountain West Alarm Supply Company*, 4215 North 16th Street, Phoenix, Arizona, 85016.

Industrial Rectifier Brochure describes a new redesigned line of general purpose, low voltage industrial rectifiers, 125 V and 250 V dc, in ratings from 3 to 300 KW from Westinghouse. Available free from Industrial Equipment Division, *Westinghouse Electric* Corporation, P.O. Box 225, Buffalo, N.Y. 14240.

Replacement Semiconductor Guide Supplement covers new devices which have been introduced since the basic guide was revised and reissued last May. The supplement, like the basic guide, includes suggested user prices on all GE universal replacement semiconductors. Available free at GE electronic component distributors, or from *General Electric*, 2100 Gardiner Lane, Louisville, Kentucky 40205.

A Color Picture Tube Wall Chart is available now from RCA. This is the 1976 version of their Interchangeability Wall Chart that provides a quick reference guide of all RCA color picture tubes and the types they replace. The chart highlights the fact that it takes only 78 RCA tubes to replace 444 industry types. Available free from *RCA distributors*.

CB Products Catalogs that describe CB microphones and antennas from Turner are now available. A 12-page catalog, 76-C, describes a new amplified base station mike and a new amplified mobile mike. A 16-page catalog, 76-A, describes 22 new Signal Kicker models featuring in-line connectors including a complete new section on RV antennas. Available free from *Turner Division* of Conrac Corporation, 716 Oakland Road N.E., Cedar Rapids, Iowa 52402.

A Reference Catalog of Professional Tools, in 2 colors, is now available from Klein Tools. Concise product descriptions, reference tables, information on OSHA & ANSI regulations on safety equipment and tips on the proper use of hand tools are included in this 80 page catalog, illustrated with large, clear photos and detailed drawings. Available free from *Klein Tools, Inc.*, 7200 McCormick Road, Chicago, Illinois 60645.

Electrical Maintenance Products are described in a new brochure from CRC Chemicals USA. The brochure includes information on the CRC product line for the maintenance and protection of electrical equipment and tools, especially the displacement of moisture, lubrication, cleaning and degreasing. Available free from *CRC CHEMICALS USA*, 885 Louis Drive, Warminster, Penna. 18974.

Cartridge Lamps and Lampholders catalog from Littelfuse has been revised to include information on recently introduced products, including solid state cartridge lamps with green, yellow and amber LED's; neon cartridge lamps with blue and green neons; and cartridge lamps with tin-plated stainless steel pins for PC board mounting. The 12-page catalog carries full specifications and ordering information on solid state, incandescent, and neon cartridge lamps and mating cartridge lampholders. Available free from *Littelfuse, Inc.*, 800 East NW Highway, Des Plaines, IL. 60016. ■

TECH BOOK DIGEST

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

Observing TV Waveforms

VIDEO WAVEFORM ANALYSIS

Probably the most important waveform in television servicing is the composite waveform consisting of the video signal, color information, blanking pedestals, and sync pulses. Composite video signals can be observed in various circuits in the television receiver to determine whether circuits are performing normally. The two most commonly observed characteristics of the composite waveform are the horizontal scan line (looking at one complete cycle of the television horizontal scan) and the vertical frame (looking at one complete frame of the television picture.)

Observing Lines and Frames

Fig. 1 illustrates how the B&K 1460 scope, with its special sync features, is used to observe two complete horizontal scan lines. After tuning the television receiver to an active local channel set the SYNC switch to "TVH" for horizontal pulse observation or to "TVV" for vertical pulse observation. Set the TRIGGERING-SOURCE switch to "int," the TRIG LEVEL control to "auto," and adjust the INTENSITY control for a trace. Move the AC-GND-DC switch to the AC position and connect the probe to the vert input jack. Connect the ground clip of the probe to the television chassis. With the probe set for 10:1 attenuation, connect the probe tip to the output of the video detector.

Set the VOLTAGE/CM control for the largest vertical deflection without putting the display off the scale. Set the TRIGGERING-SLOPE switch as described earlier. Now turn the STABILITY control counterclockwise until no sweep appears on the crt. Then, increase the STABILITY setting (clockwise) until the sweep reappears. This should result in a very stable waveform presentation. After setting the INTENSITY and FOCUS controls to achieve the desired brightness and sharpness, you are ready to observe the waveform.

To view a specific position of the waveform, such as the sync tip and color burst, pull the HORIZONTAL POSITION control out for x5 magnification, and adjust the position of the display by rotating the HORIZONTAL POSITION control.

Composite video waveforms may be checked at other points in the video circuits by moving the probe tip to those points and changing the voltage/cm control setting as required to keep the display within the limits of the scale, and by readjusting the STABILITY control to maintain stabilization. The polarity of the observed waveform may be reversed when moving from one monitoring point to another. Therefore, it is important to remember that best synchronization of the observed waveform is obtained if the triggering-slope switch is adjusted to correspond with the polarity of the waveform to be observed.

Other wideband oscilloscopes can be used for this observation. If your scope is equipped with special television sync features, syncing the scope with the sweep is a simple matter of switch setting. Otherwise, set the sweep speed of your scope to about 7875 Hz to display two complete horizontal scan lines.

To observe the vertical waveforms, a similar procedure is used, as shown in Fig. 2. Again, if your scope is not provided with circuits that aid in syncing the scope with the television waveform, you must manually sync the scope to the waveform. By setting the scope sweep speed to 30 Hz you will be able to observe two complete vertical traces. On the B&K 1460, just

(From Chapter 10, "Effective Troubleshooting With EVM & Scope," By Ben Gaddis, TAB BOOKS, Copyright 1976. A review of the complete book follows this article.)

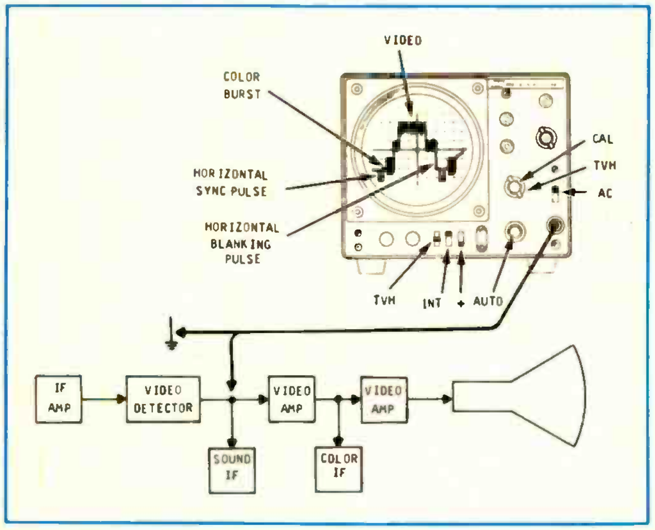


Fig. 1—Test setup for observing two complete horizontal scan lines of the composite TV signal. (Courtesy of B&K-Precision.)

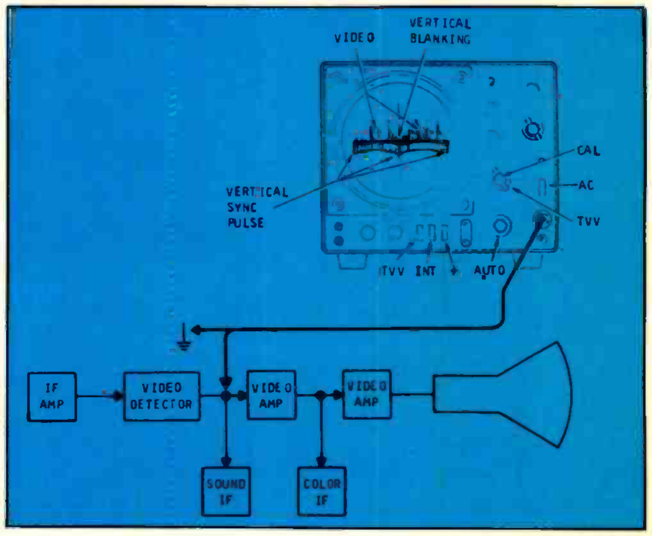


Fig. 2—Test setup for observing two complete vertical fields of the composite TV signal. (Courtesy of B&K-Precision.)

change the setting of the SYNC switch to "TVV" and set the SWEEP TIME—CM control to the "TVV" position.

Knowledge of waveform composition, the appearance of normal waveforms, and causes of various abnormal waveforms all help you locate and correct many circuit problems. You should study the waveforms in a television receiver known to be in good operating condition, noting the waveforms at various points and comparing them to those shown in the manufacturer's service literature.

Evaluating Amplifier Response

The IF amplifier response and general performance of the RF and IF stages of a television receiver can be evaluated to some extent by careful observation of the horizontal sync pulse waveform as it appears at the output of the video detector. The general appearance of the waveform is affected by the performance characteristics of the RF and IF circuits. Some examples are shown in Fig. 3. In Fig. 3-A, normal operation is depicted; the picture should be good. Notice the well defined appearance of the sync pulse and the shape of the receiver bandpass curve.

The fine details of the televised scene are made up of the high-frequency components. Any loss of high-frequency response will, therefore, degrade the picture detail. In Fig. 3B the bandpass curve drops off sharply toward the high end of the band, indicating a definite loss of high-frequency performance. Notice how this affects the horizontal sync pulse. Since the pulse is a rectangular waveform, we can expect to see a rounding of the leading and trailing edges. In severe cases, it will be hard to distinguish where the blanking level stops and the sync tip starts.

Next the effect of too much high-frequency response is illustrated. There is ringing (oscillation) in the IF stages, causing fine, vertical, black-and-white lines to trail (appear to the right of) any sharp vertical lines in the TV picture. The bandpass curve will have a definite tilt, showing the increase in high-frequency gain. The edges of the sync pulse will overshoot, and in some cases, will be followed by a dampened oscillating wave, indicating ringing.

The low-frequency components of a rectangular or square wave are evaluated by observing the flat surfaces of the pulses. A loss of low-frequency response in a television receiver would be indicated by a smeared appearance of the picture. The bandpass response curve will droop toward the center. The horizontal sync pulse of such a receiver will have a tilt in its flat surfaces.

Some IF faults might affect the picture synchronization before they are noticed in the actual video presentation. Bias faults in the IF amplifiers can cause the sync tops to be clipped or compressed as shown in Fig. 4. Such faults are usually noticed by the erratic operation of the receiver sync circuits.

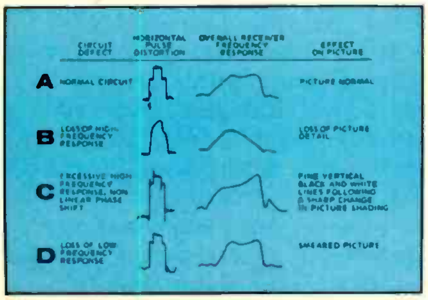


Fig. 3—How incorrect frequency response of the RF and video IF is revealed by the horizontal sync pulse. (Courtesy of B&K-Precision.)

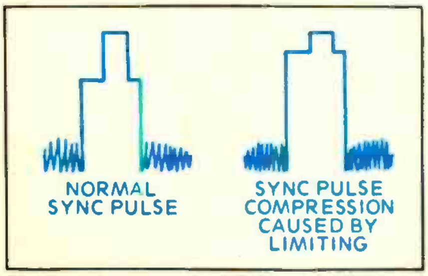


Fig. 4—A defect which shifts the operating point of the video IF amps can cause horizontal sync compression, as shown here. (Courtesy of B&K-Precision.)

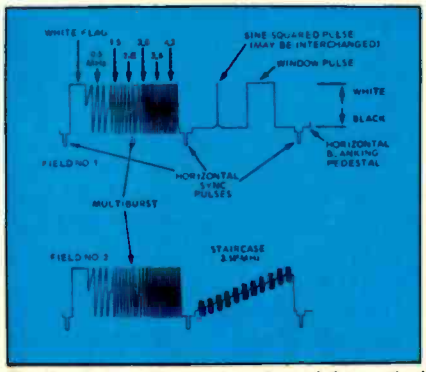


Fig. 5—Composition and content of the vertical interval test signal (VITS). Shown here are vertical fields 1 and 2. (Courtesy of B&K-Precision.)

VITS

Most network television signals contain a built-in test signal, the vertical interval test signal, or VITS, that can be a very valuable tool in troubleshooting and servicing television sets. The VITS can be an aid in localizing trouble to the antenna, tuner, IF, or video section, and shows when realignment may be required. The VITS is transmitted during the vertical-blanking interval. On the television receiver, it can be seen as a bright white line above the top of the picture when the vertical linearity and height controls are adjusted to view the blanking bar. On sets with interval-retrace-blanking circuits, the blanking circuits must be disabled to see the VITS.

VITS Composition

The transmitted VITS is a precision sequence of specific waveshapes at constant frequencies and amplitudes, as shown in Fig. 5. The television networks use these precision signals for adjustment and checkout of the network transmission equipment, but the technician can use them to evaluate television set performance.

In the interlace scanning technique, the scene is transmitted in a series of vertical frames; each frame is composed of 525 separate horizontal lines. Two complete top-to-bottom scanning sequences, called fields, are used to form a frame. During the first

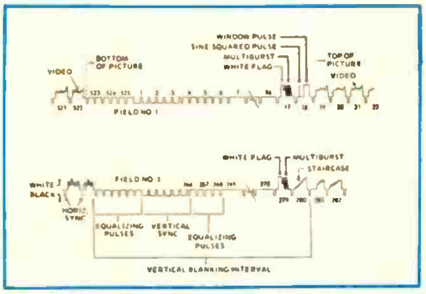


Fig. 6—Multiburst and vertical blanking interval segments of the vertical interval test signal (VITS). (Courtesy of B&K-Precision.)

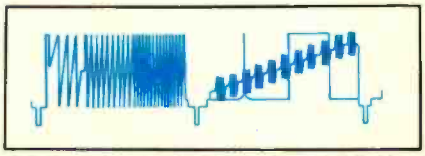


Fig. 7—Two expanded, superimposed fields of the vertical interval test signal. (VITS). (Courtesy of B&K-Precision.)

field of any frame, the scanning beam starts in the upper left corner of the field and travels at a constant horizontal rate, causing separate horizontal traces that are a fixed distance from each other. As each horizontal trace is completed, the beam is reset to the left of the field and another scan is started. When the beam reaches the bottom of the picture, 262.5 horizontal scans have been completed. This completes the first field of one frame. Then the beam is reset to the top center of the scene, and the horizontal sweep continues. However, this time the beam is scanning between the traces of the horizontal lines in the first field.

The VITS is transmitted during lines 17, 18, 279, and 280. Note that these lines would appear at the top of the picture.

The first VITS transmission, which occurs in line 17, begins with a "flag" of white video, followed by sine-wave signals of 0.5, 1.5, 2, 3, 3.6 and 4.2 MHz. This sequence of frequencies is called the *multiburst*. The multiburst is also transmitted during line 279, as shown in Fig. 6. These are the two transmissions that are the most valuable to the technician. The other two VITS transmissions, lines 18 and 280—which contain the sine-squared pulse, window pulse, and staircase of 3.58 MHz bursts at progressive lighter shading—are valuable to the network, but have less value to the technician.

Due to interlaced scanning, field 1 is interlaced with field 2, so that line 17 is followed by line 279, and line 18 is followed by 280. The entire VITS appears at the bottom of the vertical-blanking pulse and just before the first line of video. Since each of the multiburst frequencies is transmitted at equal strength, they can be used as a troubleshooting aid. By observing the comparative strengths of these frequencies after the signal is processed through the television receiver, the frequency response of the set can be estimated.

Observing VITS

To observe the VITS using the B&K 1460, set the probe for 10:1 attenuation and connect it to the output of the video detector. If the television receiver has a vertical-retrace-blanking circuit, follow the manufacturer's instructions for bypassing that circuit during these measurements. Set up the scope for TVV sinc and TVV sweep time, as previously described, to show two vertical fields. Place the VARIABLE-HOR GAIN control in the "cal" position. Now, reduce the sweep time to 0.1 msec/cm by placing the SWEEP TIME/CM switch to the "0.1 msec/cm" position. This expands the display by increasing the sweep speed. The VITS should appear to the right on the expanded waveform display.

Further expand the sweep by pulling outward on the HORIZONTAL POSITION control so that the x5 magnification feature is employed. Rotate the HORIZONTAL POSITION control in a counterclockwise direction, moving the trace to the left until the expanded VITS appears. The brightness level of the display will be reduced.

The waveform should be similar to that shown in Fig. 7. For the oscilloscope display, each vertical sync pulse starts a new sweep. This causes line 17 and line 279, the two multiburst transmissions, to be superimposed, as are lines 18 and 280. The multiburst signals are identical, reinforcing the trace. However, lines 18 and 280 are not identical, and the signals are superimposed over each other. This should present no problem, since the multiburst is normally the signal of interest.

All frequencies of the multiburst are transmitted at the same level, but they should not be equally coupled through the receiver, due to its response curve. Fig. 8 shows the desired response for a good color television receiver, identifying each frequency of the multiburst and showing the allowable attenuation for each. Remember that −6 dB equals the half reference voltage (the 20 MHz modulation should be used for reference).

To localize troubles, start by observing the VITS at the video detector. This will localize the trouble to a point either before or after the detector. If the multiburst is normal at the detector, check the VITS on other channels. If some channels look okay but others do not, you probably have tuner or antenna problems. If the VITS is abnormal at the video detector on

all channels, the trouble is probably in the IF amplifiers. Should the VITS response at the detector output prove normal for all channels, the trouble is in the video amplifiers.

SIGNAL TRACING

Signal tracing with an oscilloscope is one of the fastest methods to isolate television receiver problems. The importance of the shape of the transmitted composite signal at the output of the video detector was discussed earlier. In some instances, this broadcast signal is not as useful as one that can be readily generated and controlled at the test bench. Since the broadcast scene is constantly changing in content, the color generator offers a more constant signal for oscilloscope evaluation. This is especially true when making waveform observations in the video or color sections of the receiver. The color generator can also be used as a signal source for video troubleshooting in a monochrome receiver. As a general rule, use the station signal when troubleshooting the deflection section or other pulse circuits, and a color generator in the other circuits. Depending on the frequency of the generator's output, it may be connected to either the antenna terminals or the input to the IF section.

Video Section

The signal used for waveform observation in the video section may be either a station signal or a generator signal, and may be observed at either the horizontal or vertical rate.

A block diagram of a typical video section is shown in Fig. 9. The output of the video detector is routed through two stages of amplification and a delay line before final amplification by the driver. The first and second video stages are the source of sync, AGC and, chroma signals in most sets. The manufacturer's service data should be consulted for correct waveshapes.

To use the station signal as a signal source, the antenna and tuner connections must be in place. Tune the set for the best possible picture, and observe the waveshapes at the desired points

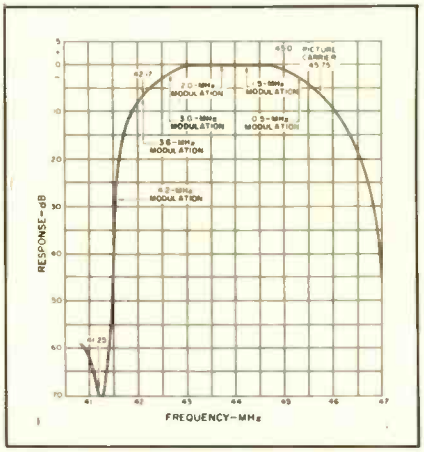


Fig. 8—Typical color TV video IF response curve. (Courtesy of B&K-Precision.)

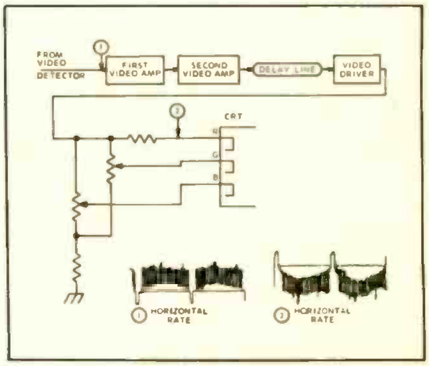


Fig. 9—Block diagram of typical video amp section, with input and output signals displayed at 7875-Hz rate.

using a low-capacitance probe. For displaying two complete horizontal scanning lines (as shown in Fig. 9), set the scope up for internal sync using the observed signal as the sync source, with the scope sweep set for 7875 Hz.

Another stage frequently associated with the video section is the blanker, shown in Fig. 10. This stage receives pulse signals during the horizontal and vertical retrace times to control the output of the video section. Usually, the output of the blanker is fed to the first or second video stage to bias that stage off during the retrace periods. Vertical signals should be observed at a 60 Hz rate, horizontal signals at a 7875 Hz rate.

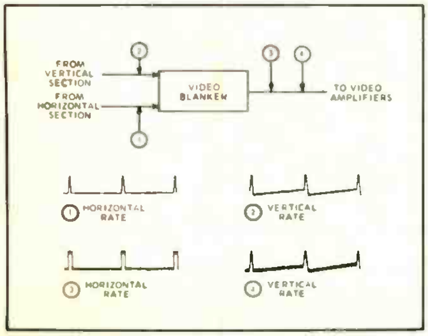


Fig. 10—Block diagram of video blanker stage and associated waveforms.

Sync

Sync signals can also be observed using the station signal. Basically, the setup is the same as that for video waveform display.

The block diagram in Fig. 11 shows two sync imputs. A noise signal from the video detector is applied to the noise gate circuit. This signal will cause the noise gate to bias the sync separator circuit off when large noise pulses reach the video section. The sync input is routed directly to the separator circuit, where vertical and horizontal sync signals are removed for their respective circuits. The outputs of the separator should be observed at either the 60 or 7875 Hz sweep rate.

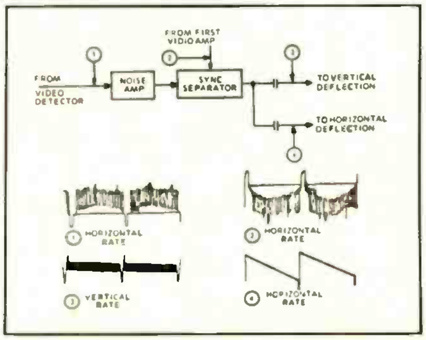


Fig. 11—Block diagram of typical noise amp/sync separator section and associated waveforms.

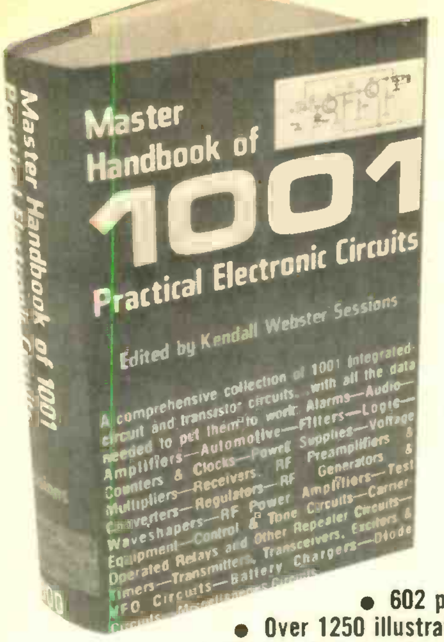
AGC

The AGC section usually employs two stages, a keyer and an AGC amplifier. A DC output is sent from the amplifier to the tuner and IF amplifiers for gain control.

A keying signal in the form of a pulse is applied to the keyer from the horizontal section, as shown in Fig. 12. This allows the AGC voltage to be referenced to the average signal strength of the received horizontal sync pulse rather than the average video signal. A video signal from the detector passes through the keyer when the keying pulse is present. Both signals should be observed at the horizontal rate.

Vertical

The vertical sync signal from the sync separator is applied to the vertical oscillator. Depending on the set, the vertical section may consist of a signal oscillator stage, an oscillator followed by a driver



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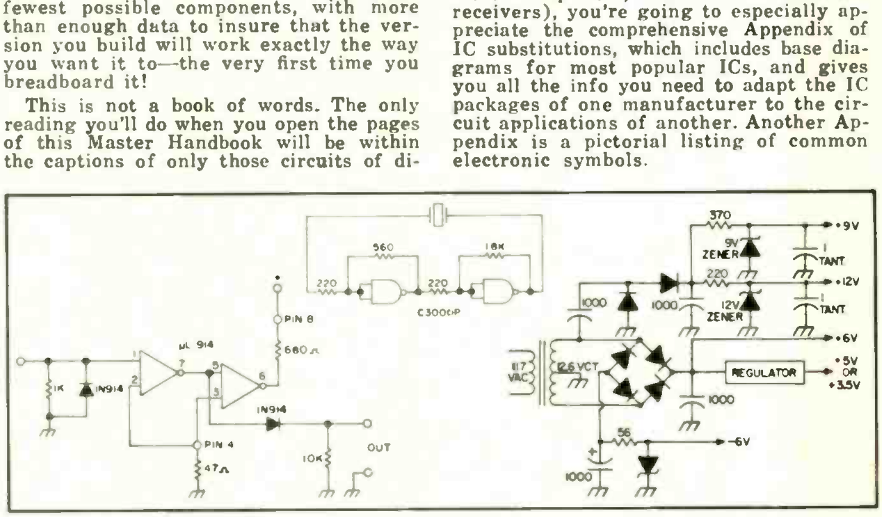
Partial List of Contents

Alarm Sensors & Triggering Circuits; Audio Conditioning Circuits; Audio Amplifiers; Automotive Circuits; Filters; Logic Circuits, Counters & Clocks; Power Supplies & Voltage Multipliers; Receivers, RF Preamplifiers & Converters; Regulator Circuits; RF Generators & Waveshapers; RF Power Amplifiers; Test Equipment; Control & Tone Circuits, CORs & Other Repeater Circuits; Timers; Transmitters, Transceivers, Exciters & VFOs; Battery Chargers; Diode Circuits; Miscellaneous Circuits; Appendix A: IC Substitution Guide; Appendix B: Electronic Symbols.



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(Fig. 13), or an oscillator followed by two or more stages of amplification. The waveforms are generally the same, and are observed at a 60 Hz rate.

Exercise care when making oscilloscope observations in the vertical output circuit. Insure that the signal being measured doesn't exceed the limits of your scope.

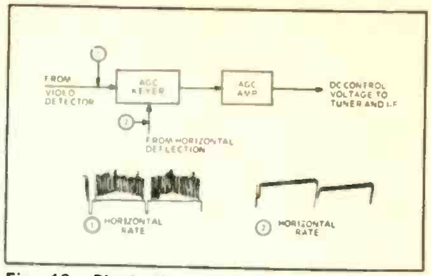


Fig. 12—Block diagram of typical keyed AGC system and associated waveforms.

Horizontal

The typical horizontal deflection section consists of three stages plus the output transformer and yoke, as shown in Fig. 14. Again, a station signal can be used as the signal source, provided all preceding stages are in good working order.

The AFC stage receives the horizontal sync signal from the sync separator and compares it to the actual horizontal output, as sampled from the output transformer. The DC output of the AFC unit, representing the difference between the two signals, is used to control the frequency of the horizontal oscillator. Sweep voltages from the oscillator are amplified and shaped in the output circuit for application to the output transformer and yoke.

The oscilloscope sweep rate should be set for 7875 Hz. Again, watch out for high voltages, especially near the output circuit.

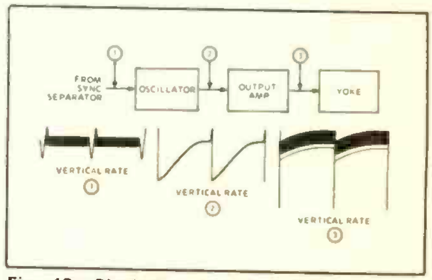


Fig. 13—Block diagram of vertical deflection system and associated waveforms.

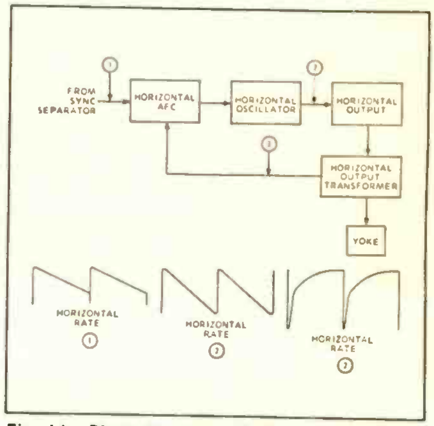


Fig. 14—Block diagram of typical horizontal deflection system, and associated waveforms.

Color Signal Observations

One piece of equipment often used in color television servicing is the keyed-rainbow (color bar) generator.

Originally, these generators were intended to be used in such service operations as convergence and color adjustments. Added features have moved these once-in-a-while tools into the most-often-used category. For example, some of the late-model color generators have outputs at RF, IF, and video frequencies. Couple this type of instrument with a good oscilloscope and—in my opinion—you have an unbeatable combination for general television troubleshooting. In this discussion, let's assume that the color generator has the capability to generate a 10-bar color display (similar to that in Fig. 15) at all the high video frequencies.

With such a generator connected to the receiver (either at the antenna terminals, IF input, or video section input, depending on the generator), and the generator and receiver tuned for the best color bar display, we can determine the operating condition of the color section, using an oscilloscope to observe various waveforms. The key points are shown in Fig. 16, all waveforms being observed at the horizontal rate.

A portion of the video signal is fed to the color sync circuits along with a pulse from the horizontal section. From these inputs, three outputs are derived. One, a gating signal for the color bandpass circuit, is used to eliminate the bandpass amplifier output during monochrome transmissions. The other two outputs are the 3.58

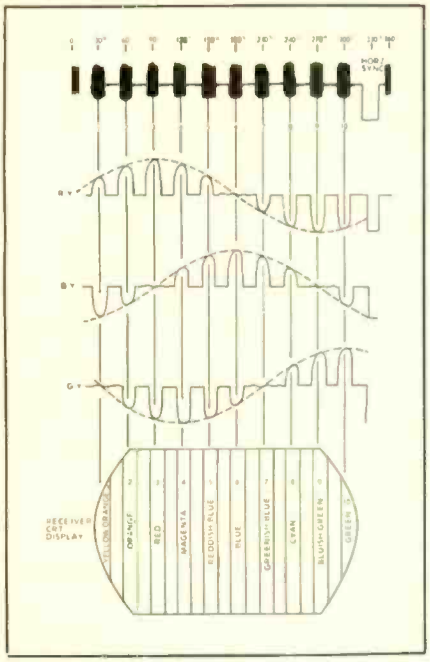


Fig. 15—Top waveform here is the input of the color bandpass amp section (point 1 in Fig. 16), with a keyed color bar signal applied to the input of the receiver. The three other waveforms are those at the outputs of the color difference amplifiers. The resultant pattern produced on the screen is shown at the bottom.

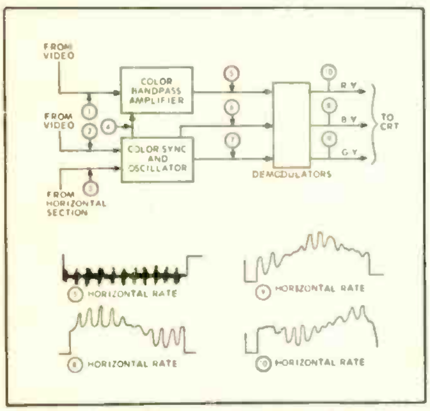


Fig. 16—Block diagram of a typical chroma section which shows key waveform observation points. Four key waveforms are shown below the block diagram.

MHz local oscillator and quadrature signals.

The bandpass amplifier receives, in addition to the killer bias from the sync circuits, the composite video signal from the video section. Bandwidth limitations of the amplifier limit the output to the color signal contained in the composite signal. The color components are routed to the demodulators along with the 3.58 MHz and quadrature signals. The output of the demodulator is the R-Y, B-Y, and G-Y signals for the CRT. ■

TECH BOOK REVIEW

Title: Effective Troubleshooting With EVM And Scope (TAB BOOK No. 730)
Author: Ben Gaddis
Publisher: TAB BOOKS, Blue Ridge Summit, Pa. 17214
Size: 238 pages, 185 illustrations
Price: $5.95 paperback; $8.95 hardbound.

The *one* book that really makes it easy to understand the *two* most important electronic troubleshooting instruments. This complete course on the theory and operation of the scope and EVM will eliminate looking from one book to another for information on what these instruments can do and how to use them—singly or as a complementary pair.

This book simplifies the theory and use of the versatile VOM, providing a framework for understanding the new electronic versions of the instrument—all kinds of EVMs: VTVMs, TVMs (transistor voltmeters), and FETVMs (field-effect transistor voltmeters). The complete theory of EVMs is provided to help the reader evaluate them and understand the measurements that can be made with them. Novice and pro alike will appreciate the big section on tested and proved time-saving troubleshooting techniques with the EVM, which shows the *logic* behind electronic troubleshooting and how the EVM fits in.

Equally thorough coverage of the oscilloscope is provided. The scope gives both quantitative and *qualitative* indications. But understanding these requires a knowledge of how to interpret them. This book includes a wide range of waveforms that are thoroughly explained and illustrated. All kinds of waveforms from all kinds of equipment are covered, with special emphasis on TV waveforms, useful in trouble analysis. Here is a book that will *de-mystify* all the loops, waves, lines, and patterns of the scope screen.

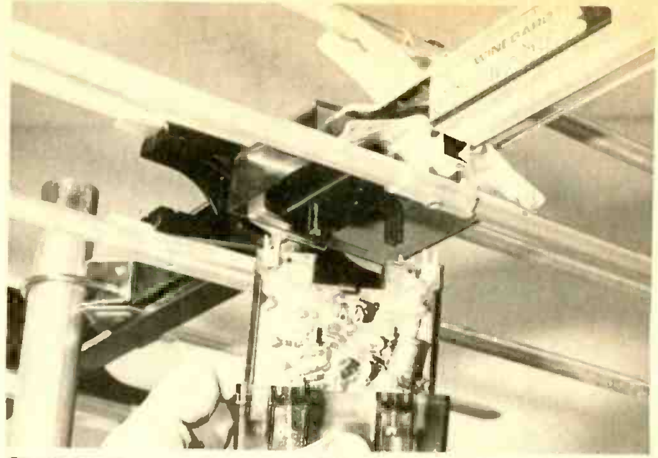
Full details on the circuits and operation of service-type, triggered-sweep, dual-trace,

continued on page 47

TV Antenna Preamps

By James E. Kluge*

Why, when and how to use them



Plastic housing protects preamp circuits from wind, rain and dirt. A rubber boot seals the opening where the cable enters the case.

■ According to a report by the Television Allocation Study Organization, (TASO), production of an "excellent" (no perceptible snow) TV picture by a properly operating receiver requires an input signal with a minimum signal-to-noise (S/N) ratio of 45 dB. In other words, to avoid even a slight amount of snow in the picture, the voltage level of the desired signal at the input terminals of the TV receiver should be about 200 times higher than the voltage level of the snow-producing noise signals.

By weighing this 200-to-1 S/N ratio requirement against the fact that the minimum possible level of noise generated in a 75-ohm TV signal distribution system is about 1 μV, it is evident that production of a *completely snow-free* TV picture requires a minimum signal level of about 200μV at the input terminals of the TV receiver. However, most modern TV receivers will produce an acceptable picture—one with a trace of snow which is not perceptible by most people—when supplied with a signal which has a 40 dB (100-to-1) S/N ratio, or a minimum signal voltage level of 100 μV.

The preceding signal and noise levels are for *ideal* reception conditions and *idealized* signal distribution from the antenna to the input terminals of the TV receiver; they do not provide a margin for the "real life" conditions of signal fading and the higher noise levels which can and do occur in actual signal distribution systems—conditions which not only reduce the level of the desired signal but also can reduce its S/N ratio to a point where the level of snow in the picture becomes objectionable.

Consequently, to provide a reasonable margin for these effects, most TV antenna manufacturers recommend that the TV receiver be supplied with a 100 μV signal, if economically practical. Compared to the "acceptable picture" signal level of 100 μV, this is a margin factor of 10, or 20 dB.

Now that we've established the range of "minimum" and "ideal" signal levels and S/N ratios which are necessary at the TV input terminals for acceptable levels of snow under typical conditions, let's examine the general characteristics of TV antenna preamplifiers and see how they can and should be used to help assure these input signal characteristics.

The author is a technical editor for the Winegard Company

TV PREAMP TYPES AND THEIR APPLICATIONS

Most TV antenna preamps can be categorized as either "high input," "high gain," "low noise" or a combination of these characteristics. Typical specs for each of these three categories are shown in an accompanying table.

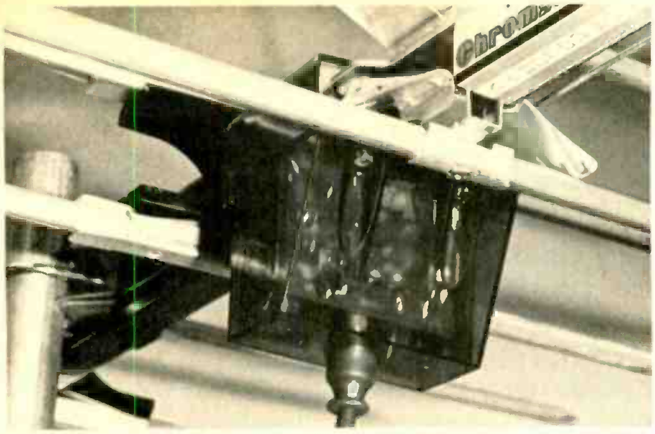
"High input" generally means *low gain*. The maximum total *output* of most preamps is typically about 1 volt. The maximum *input* of a high-input preamp is approximately 0.2 volt. This means a gain of 5 times, or 14 dB, between input and output. Any additional gain designed into the preamp does not increase the output capability; it simply increases the input *sensitivity*, which reduces the input level necessary to produce the 1-volt output. So, *high gain* and *high-input level*, in a TV-antenna preamp, are diametrically opposed quantities.

At this point, you probably are wondering why anyone would use a preamp if they already had an input level of .1 to .2 volt (100,000 to 200,000 μV). There are three principal reasons:

First, a high-input preamp provides 14 dB gain and yet does not easily overload from strong local signals.

Second, the preamp may be called upon to handle as many as seven VHF, five UHF channels and maybe ten FM stations all transmitting from a central location. This *total* input, which is the sum total of all the voltages the antenna is capable of generating—including FM-broadcast, two-way radio or any interfering signal in the air—can easily total a few tenths of a volt. Some large metropolitan areas—such as New York/New Jersey, Chicago/Milwaukee and Los Angeles/San Diego—have as many as 15 TV plus numerous FM transmitters within viewing distance. Yet, some of the more distant stations in these areas produce individual-channel voltages that may be very low level, requiring preamplification. With this many local signals in a given locale, a high-gain preamp without an FM trap switched in would more than likely overload.

Third, preamps are frequently used to drive small MATV systems. There are always losses in the downlead and distribution components of a small MATV system, and a preamp sometimes becomes the most economical and practical means of powering it. Distribution or line am-



Metal clips on the circuit boards of the preamp shown here connect the preamp input directly to the antenna phasing lines, thereby providing optimum impedance matching and minimum loss.

plifiers are frequently employed, but it is always better, and sometimes necessary, to amplify the signal at the antenna before it is attenuated by the downlead, etc. This method establishes the best system signal-to-noise ratio.

High Gain

A "high-gain" preamp is simply one that has an extra stage(s) of gain to overcome either a very weak signal condition or excessive down-lead loss or a combination of both. High gain in a preamp is generally considered to be anywhere between 20 and 30 dB. A long downlead, high-frequency UHF channel, an extremely weak antenna signal, a remote antenna or any combination of these conditions demands a high-gain preamp to provide 1000 μV per channel when the signal gets indoors or to the head-end. Because the *noise factor* of the preamp is established by the first amplifier stage, a second stage of amplification doesn't hurt much as far as the S/N is concerned.

Low Noise

"Low noise" means that the preamp is designed to amplify weak and possibly snowy (low S/N ratio) signals while itself contributing a very minimum of noise to the already marginal signal level and S/N ratio. To realize a low *noise figure* for the preamp, the amplifying device in the first stage, usually a transistor, is selected for its *low noise figure*. Additionally, special pains are taken in the circuit design to preserve these low-noise characteristics by insuring proper impedance match, etc. The first stage of the preamp will establish the *minimum noise figure* for the entire TV signal distribution system.

Because the S/N ratio at the antenna is better than anywhere else in the system, the signal at the antenna should be amplified at this point before it undergoes any attenuation. Because the S/N ratio is reduced by the noise figure of the preamp, a preamp with as low a noise figure as possible should be chosen to amplify weak signals.

GENERAL APPLICATIONS & LIMITATIONS

The first and most obvious reason for using a preamp is, as we have just pointed out, to *preserve* a weak, marginal or snowy (low S/N ratio) signal.

However, no preamp available on the market today can eliminate or even reduce the amount of noise (snow) in the signal voltage *at the antenna*. To put it another way, a preamp *cannot* remove snow (i.e. noise) from the signal it is amplifying. The random electrical noise voltages which produce "snow" on the TV screen will be amplified in the preamp right along with the picture and sound signals. Consequently, the S/N ratio at the antenna can not be improved with an electronic amplifier, even a theoretically ideal preamplifier. And even the best preamplifiers contribute a small amount of noise to that which is already mixed with the signal voltage. Of course, the lower the noise figure of the amplifier, the smaller this contribution will be.

If the S/N ratio of the input signal is high enough, like 50 dB, the average noise figure contribution of the preamp will be barely perceptible in the picture. With a 30 dB S/N ratio, it would be noticeable.

Despite the preceding limitations with respect to the S/N ratio at the antenna output terminals, a TV antenna preamplifier nevertheless can increase the *level* of the signal and, by effectively canceling the signal attenuation caused by the lead-in loss between the antenna and the TV input terminals (or distribution amplifier in an MATV system), it also can *preserve* most of the S/N ratio which exists at the antenna output terminals. In other words, without an antenna preamp, a "marginal" signal voltage—for example, 200 μV at 40 dB—will be attenuated as it travels through the downlead and through the nonamplifying distribution system to the TV set. Because every dB of attenuation degrades the S/N ratio as well as the actual voltage level of the signal, by the time the signal reaches the input of the TV set its S/N ratio probably will have been degraded to about 35 dB (or below) and, consequently, snow will be produced in the picture. A preamp can prevent this from happening by amplifying the antenna output signal sufficiently to overcome system losses.

PREAMP SELECTION GUIDELINES

Following is a list of general guidelines which you should consider when attempting to decide whether or not to use a preamp and, once you decide to use one, which type is best suited for the particular conditions you have encountered:

- If you can't get at least 100 to 200 μV per channel (VHF and UHF) off the antenna, consider a bigger antenna or stacking antennas. (Stacking two antennas will nearly double the signal.) If a bigger antenna or a multiple antenna stack is not economically or physically feasible, use a preamp to increase the signal level and preserve the S/N ratio. The best S/N ratio in the system is at the antenna terminals. This is the best place to amplify the signal. Simply stated, amplify the signal before the S/N deteriorates. And remember, UHF signals suffer greater losses in the distribution system than do VHF signals.
- If the antenna signal shows any evidence of snow (i.e. less than 100 μV/ch.) use a *low-noise* preamp.
- In fringe areas (200 μV or less per channel) use a *high-gain* preamp if there are no strong local

signals or local FM stations received by the antenna. If necessary, trap out the FM signals ahead of the preamp. (Winegard preamps, for example, feature a switch-selectable FM trap to control strong local FM signals.)

• Near metropolitan areas having many TV channels originating in a common location or direction, use a *high-input* preamp to avoid overload from the many signals. If more gain is required to power the system, use a booster or line amplifier after the preamplified signal gets indoors.

In addition to the preceding "electrical" considerations, you also should consider the following physical design factors:

• Preamplifier circuitry and connections must be enclosed in a "weatherproof" housing which protects them from wind, water and corrosive deposits.

TV ANTENNA PREAMPS
Typical Specs

	High-Input	High-Gain	UHF Only Low Noise
Max. INPUT (Total)	0.200V	0.075V	0.125V
Max. OUTPUT (Total)	1.000V	1.200V	0.880V
Avg. GAIN	14 dB	24 dB	17 dB
Avg. NOISE FIGURE			
VHF	3.0 dB	3.0 dB	
UHF	8.5 dB	8.5 dB	2-3 dB

• Preamplifier input connections preferably should clip directly to the antenna phasing lines, to minimize any loss or mismatch before amplification.

• Weatherproof housing preferably should attach directly to the antenna boom rather than to the mast. This avoids interconnecting cables that cause loss, mismatch and damage from wind, rain and ice. Also, removing the antenna from the mast or turning it preferably should not require disconnecting cables or dismounting that preamp.

• The preamps should provide the option of either 300-ohm balanced or 75-ohm unbalanced output connections, to accommodate either type of downlead.

• Whatever preamp you choose, be sure its input is protected from high voltages. Voltages generated by static charges or induced by nearby lightning discharges can destroy the transistors used in solid-state circuits. Static charges built up on the driven elements of an antenna are applied to the preamp input. Voltages induced on the transmission line by lightning and other heavy-current sources usually damage the preamp via the "back-door." An extremely fast diode across susceptible transistor junctions usually provides adequate protection. A near or direct hit by lightning can hardly be protected against and will generally take out a lot more of the system than the preamp.

MOUNTING PRECAUTIONS

• You must power the preamp via the transmission-line conductors. Consequently, guard against shorts or grounds in them.

• Don't mount the antenna (or the preamp) over a chimney flue.

• Be sure the preamp is set for the correct downlead impedance. ■

...for more details circle 112 on Reader Service Card

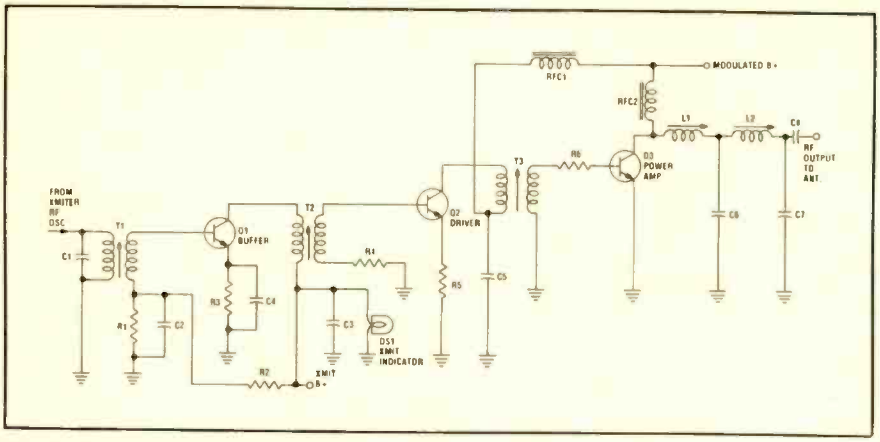


Fig. 1—A composite version of the circuitry typically found in the RF amplifier sections of today's CB transceivers.

Troubleshooting And Tuning CB RF Power Circuits

By David Norman

■ CB units have been refined in many ways during the past few years. By and large, however, the most significant refinements have been in the *receiver* circuits. The transmitter sections of modern CB units are fundamentally the same as they were ten years ago. To be even more specific, the transmitter sections of inexpensive units are basically identical, or nearly identical, to those in top-of-the line models. Only newcomers to CB place much emphasis on how much power the unit "puts out." The rest of us know that the real difference between a "fair" and a "super" transceiver is usually found in the *receiver* sections.

There are several reasons why the designs of transmitters are relatively standard. One reason is that the transmitter is required by law to meet certain technical standards. Another reason is simply that a 4-watt, 27-MHz, amplitude-modulated transmitter cannot be too different from another one designed to do the same job. This makes troubleshooting, tuning, and repair of these sections relatively easy, after the technician learns his way around. If the technician can locate the buffer, driver, and power amplifier and their associated components, he can usually find and cure the trouble without a schematic. (This comes in handy as the current CB boom causes new lines of equipment to precede service data.)

Fig. 1 is a "composite" design representative of the transmitter RF amp stages of most CB transmitters. For simplification, switching circuitry is not shown. While some features are borrowed from existing designs, no manufacturer actually uses this specific circuit. Certain stabilizing components have also been left out. These are mostly low-picofarad capacitors which help prevent feedback and spurious radiation. Such components seldom fail.

CIRCUIT OPERATION/COMPONENT FUNCTIONS

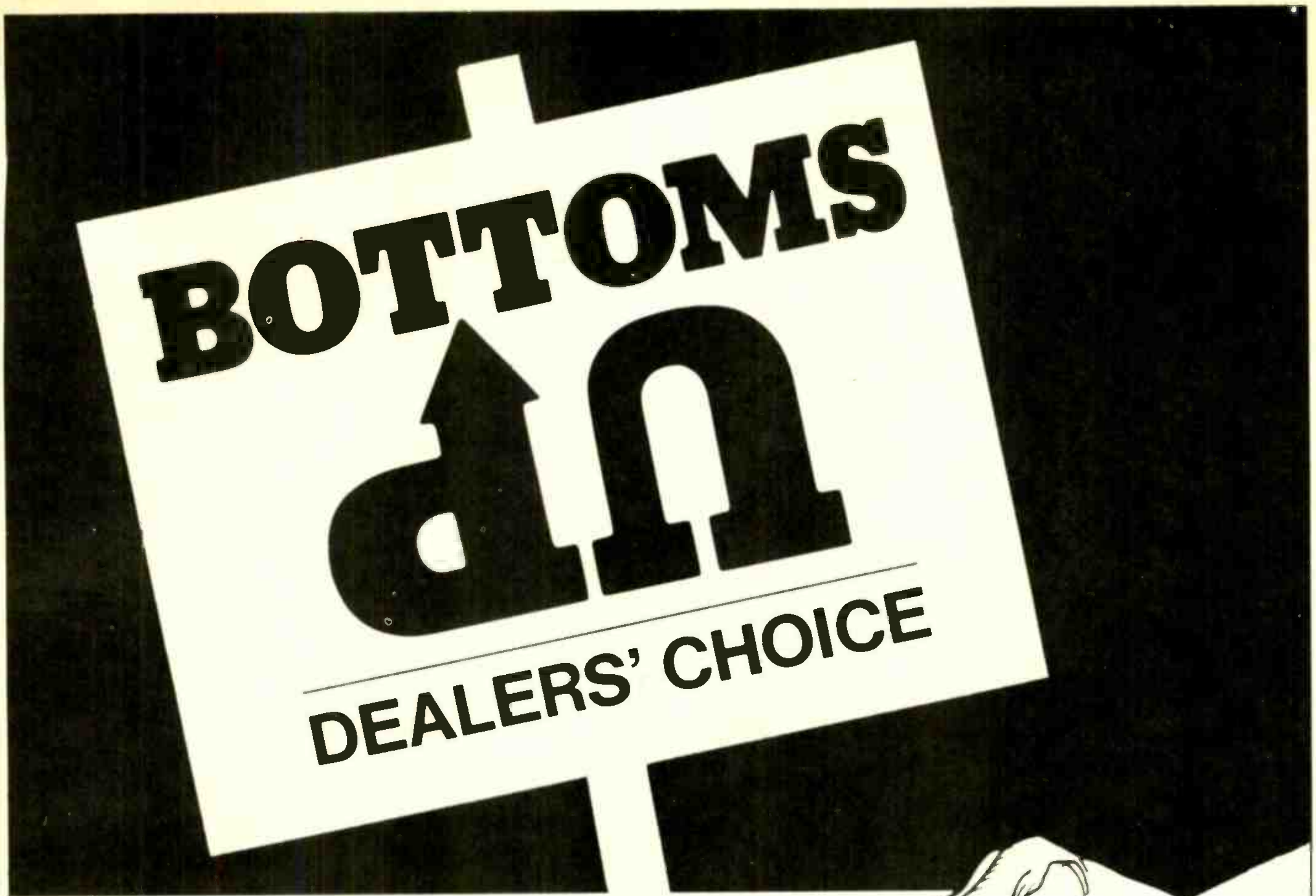
In our example, low-level RF from the transmit oscillator is coupled by transformer T1 to the base of buffer transistor Q1. Because the buffer operates at much lower levels of power than do succeeding stages, resistors R1, R2, and R3 are necessary to limit current to a safe level.

The output of Q1 is transformer-coupled to the base of driver transistor Q2. Transistor Q2 and power amplifier Q3 are self-biasing, using resistors R4 and R6 to raise their bases above ground. Emitter resistor R4 merely limits current through Q2. (Resistors R4 and R6 would normally be bypassed by capacitors.)

Modulated B+ is coupled to transistors Q2 and Q3 through radio frequency chokes RFC1 and RFC2, preventing RF from getting into the power supply.

Coils L1 and L2 capacitors C6 and C7 form an impedance matching network which mates the output of Q3 to the 50-ohm antenna system.

Capacitor C1 is representative of the capacitors across each side (normally) of every transformer in the circuit. These form part of the



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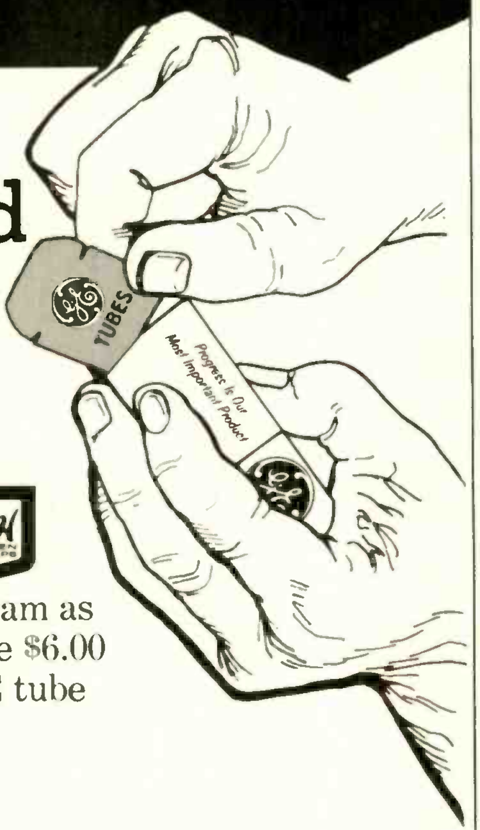

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tuned L/C networks.

Capacitors C2, C3, and C5 are filters which help keep RF from entering the power supply. Capacitor C4, in the emitter circuit of Q1, is typical of bypasses used to allow full flow of RF across limiting of biasing resistors. Obviously, C2 and C3 also perform this function in addition to their filtering duties. Capacitor C8 is for DC blocking/RF coupling.

Pilot lamp DS1 is a front panel indicator of the transmit mode. Connected in this manner, DS1 does *not* indicate relative RF or modulation. A simple way of indicating both would be loose transformer coupling of a small bulb to output coil L1 or L2. Another method used quite often is to tap off a little RF through a small capacitor at the RF output. This RF sample can be used to either light a small bulb or, after being rectified, to drive a meter—or both methods might be used.

A note of caution: Use of either a meter (built-in) or an "idiot" lamp to tune a transmitter is not very reliable.

A transformer-coupled indicator usually responds to current flow. A dead short at the antenna or RF current drawn by a tuning capacitor will cause maximum lamp brilliance or maximum meter deflection; consequently, it does not necessarily indicate maximum power delivered to an antenna.

The reverse is true of a tapped-off RF type of indicator. An open antenna circuit or a matching network tuned so that maximum RF voltage appears across the sample circuit *does* give a true indication of the relative power delivered to the antenna.

From the preceding it should be obvious that only a termination or in-line wattmeter or a field-strength meter should be used for transmitter tuning. Some of the fancier CB units have built-in wattmeter circuits; however, I never trust them without first checking them against an outboard wattmeter known to be accurate.

GENERAL TROUBLESHOOTING PROCEDURES

My favorite method of quick-tracing RF power circuits is to use a sensitive RF probe connected to a VTVM. If you have a scope which will respond to one volt or less of 27-MHz RF, that's even better. However, because most service-type scopes do not have response which extends to CB frequencies, a VTVM is usually your best bet.

All transistors in Fig. 1 are NPN types. If the circuit that you are tracing is similar, start at the input (oscillator output) and check base/collector, base/collector, etc. When you find a stage with less RF voltage at the collector than at the base, you usually have localized the trouble. Before you do anything rash like pulling a transistor, switch over to a DC probe and make sure that you have normal voltages and ground at that stage. An open RF choke or a cold solder joint can kill a stage just as dead as a defective transistor. Because this happens often, you should make a habit of checking for it. While rarer, a transformer also can open or short.

If you do pull a transistor, make circuit resistance checks before replacing it. This same procedure will also catch the rare shorted bypass or filter cap.

PNP or a combination of PNP/NPN transistors are used in some units. In these units, troubleshooting is a little more complex. You must decide what circuit point to use as a ground—for example, on older E.F. Johnson units, the B+ bus is the common—and you also must determine whether the output of the stage is taken from the emitter or the collector. It can be either. Because of this, a schematic is an essential aid for troubleshooting these units.

(For some reason, some technicians have not yet caught on to the simple fact that Japanese transistors are coded as to whether they are NPN or PNP. *Any* transistor that is labeled "2SC" or "2SD" is an NPN. Those labeled "2SA" or "2SB" are PNP. I have found that this little bit of information helps me make transistor subs even if I don't have an exact replacement. If you know what a transistor does and what type it is, usually you can come up with one that will work. However, it still can be difficult to crossmatch some of the "2N" series of American transistors to Japanese types. Even good cross references are not helpful in some of these cases.)

TYPICAL PROBLEMS

About 90% of all transmitter problems are related to transistor failures. There often is no obvious reason for the failure beyond the probability that a transistor "just gave up." However, it is always a good idea to check the antenna system any time that an output transistor fails.

A base-to-collector short or leakage in the RF power amplifier of late-model Johnson units (123A, etc.) will cause significant reduction of the RF output, and the unit frequently "squeals" on strong received signals. If this condition is not remedied, the RF driver might be destroyed also.

A high percentage of late-model Johnsons brought into our shop exhibit "no transmit" complaints. If the carrier is normal but modulation is weak or missing, the problem is almost always a mike element (Johnson calls them "cup resonators.") Another possibility is the diode in series with the modulated B+. If it is shorted, there can be no modulation. Sometimes this diode becomes intermittent. When that happens, the RF power will fluctuate a watt or more up or down. Replacement cures the problem. Watch for this problem in other brands in which diodes are used to isolate the modulated B+.

Probably the hardest problem to find is a component which has changed value and caused a degradation of performance. The most likely suspects are the transformers used for interstage coupling. Transformer substitution or checking winding resistances against those in a unit known to be good are about the only alternatives.

RF TUNING PROCEDURES

Procedures for transmitter tuning vary from one brand to another, but I have developed a "generalized" sequence which works well for me. You might wish to try it in your shop.

If I am satisfied that the unit is working properly and merely needs tuning, I start at the oscillator and work toward the output.

Because most units currently in use are relatively stable, peaking the oscillator has little effect on output frequency. However, this is not always the case. Therefore, you should monitor the transmitter frequency while tuning—at least until you are certain that a particular unit is indeed stable.

Proceed through the unit, peaking each tuned stage for maximum RF output. Check all channels to see that a peak on one crystal doesn't kill another. Most tuning adjustments fall off sharply on one side or the other. Usually the best tuning point is slightly on the "gradual side" of the peak.

Continue tuning back and forth until you have achieved maximum output. If you achieve 4 watts output or less and the unit modulates properly, consider the transmitter properly tuned. As a rule, however, you will have to back off on the final tuning to get the most linear output possible and/or to bring the output down to legal limits.

When a CB unit is properly tuned, the carrier level will "kick up" on modulation peaks. On a few units, the modulation is clipped, compressed, or limited so that the carrier seems rock steady even on modulation peaks. This is okay so long as modulation still measures 85 to 100% on a scope or meter. What you *don't* want is for the carrier to *drop off sharply* as modulation is applied. If only 2 watts of audio power are available to modulate a transmitter, there is no way that a Class C (all modern, solid-state units have Class C RF power amplifiers) final can be 100% modulated at input power levels in excess of 4 watts. This means that with a final efficiency of 75%, an output of 3 watts is the maximum that can be 100% modulated. With the same 2 watts of audio imposed on a carrier of 6 watts, the modulation would be only 50%.

Bearing in mind that we are talking about *sine-wave* modulation and *average* power, it becomes obvious that it is pointless to increase the carrier past the level where 100% modulation is obtained. The detector of an AM receiver follows the modulation imposed on a received carrier. It is therefore important to insure that the percentage of modulation is kept between 85 and 100%. A transmitter with an output of 3 watts at 100% modulation will *sound* exactly the same as one at the same location with 6 watts of carrier modulated 50%. The only advantage that the 6-watt unit would have over the 3-watt unit would be a barely measurable increase in field strength. The difference is hardly enough to justify a possible citation. A 6-watt carrier modulated 100% would have a definite advantage over a weaker signal, but an additional 3dB of antenna gain would have the exact same effect. Because few CB units are capable of fully modulating a 6-watt carrier anyway, this discussion might seem merely academic. The real point is, however, that the technician should try to tune the unit so that its maximum *legal* power (4 watts) is *fully* modulated.

If the unit will tune to 4 watts output, but modulation is below 85%, or if the carrier drops sharply with modulation, you should retune it to the point where 85% or higher modulation occurs. This might be as low as 2 watts, but it usually is just below maximum output. Wherever this point occurs, that's it—you have the unit tuned for optimum performance.

If a unit won't modulate fully at a reasonable output level (2 to 4 watts), you might need to check the modulating circuitry all the way back to the mike. A weak mike element, a bad audio output transistor, or a shorted turn in the modulation transformer can cause weak modulation.

If the unit shows full modulation, but the carrier *drops* when it is applied, and you can't find a point where power and modulation balance, you have another problem. The oscillator might be trying to quit as power is drawn by the modulation circuitry. If this is the case, a small adjustment at the oscillator might stabilize it properly.

Other causes of "downward modulation" are soft or inadequate power supplies. If a unit draws one ampere with carrier but no modulation, it normally—but not always, the Pace 2376, etc. is an exception—draws more on modulation peaks. If the power supply will only deliver 1 amp before the voltage across it drops, the carrier will drop as voltage drops. This applies to internal power supplies as well as to outboard supplies. You can check for this condition by monitoring the supply voltage as carrier and modulation are applied. If the voltage drops more than .5 volts, you have probably found an inadequate power supply. If the problem is traced to an outboard power supply, merely replace it with one which has better regulation. If the power supply is internal—as in a base station unit—and everything else checks normal, you might have to tune it as well as you can and let it go.

However, because severe "downward modulation" tends to cause splatter and distortion, you should avoid letting a unit go out in this condition, if at all possible. If you encounter a unit which exhibits *severe* downward modulation, try to get hold of a new one just like it and compare the two to determine if the problem is design-originated. Some of the Radio Shack units, for example, are prone to downward modulation, and there's not a thing you can do about it. It doesn't seem to adversely affect performance, at least in these units, so apparently it is a normal peculiarity. (Conversely, the carrier level of the Pace units mentioned previously *kickup* on modulation peaks in a manner that would indicate over-modulation in most other units. For some reason, the American-made Pace units also draw less power under modulation than with carrier alone. If anyone can explain why, I wish that he would write to me and let me know.)

CONCLUSION

All units have little quirks that make them unique. But as a rule you will find few surprises in the RF power circuits. Learn one of them well and the others will be like old friends.

One last hint: Make it a habit to use the same equipment when you are servicing different units. If you don't have some standard to go by, you will have a much harder time spotting something out of the norm. For example, although a bench power supply might indicate 13.6 VDC, the actual voltage might be 10% higher or lower. As long as you are using the same power supply all of the time, and are aware of its degree of inaccuracy it doesn't really matter. But, if you are used to a supply voltage of 14 VDC and you find yourself using 12.6 VDC, you are going to find yourself wondering whether the low voltage readings and/or the low transmitter output is normal or an indication of a problem. I make it a point to never trust anyone's equipment until I have had a chance to either compare it to mine or check it against a standard known to be accurate. Many shops keep one VTVM to be used only as a standard for the rest of the shop's meters. I think that it is a good idea. A technician is under a severe handicap if he doesn't have *justified* faith in his test equipment. ■

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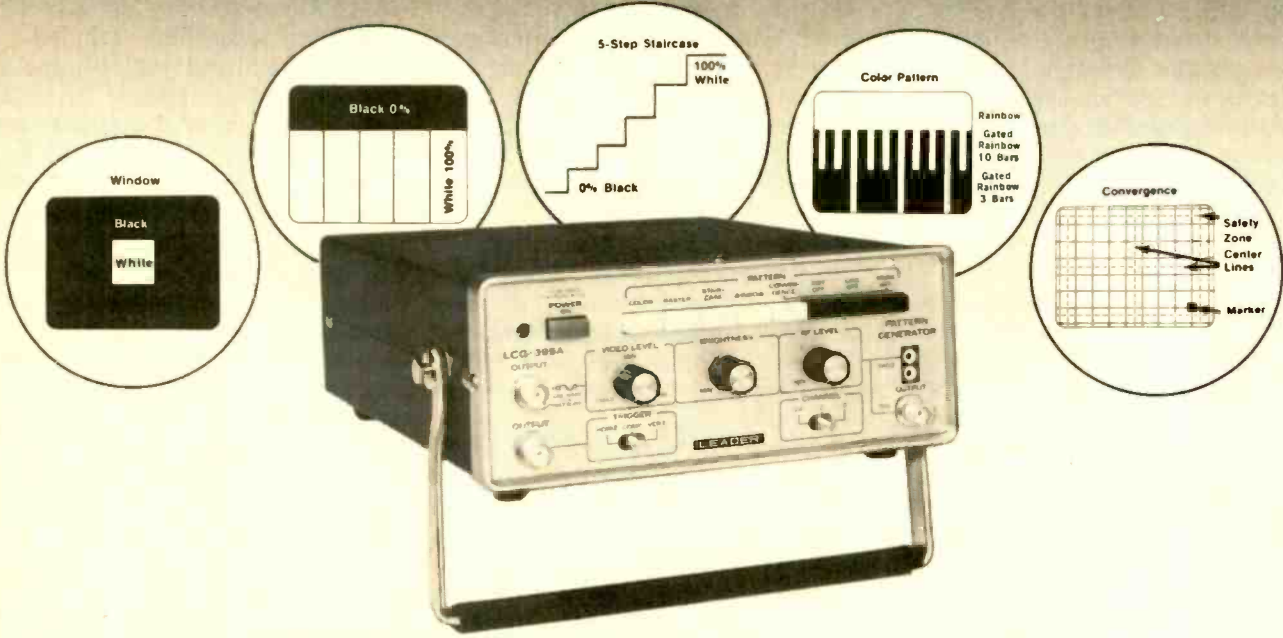

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Regulation Of Radio/TV Servicing in Indiana—Part 1

By Don W. Mason, ET/D Managing Editor

How the regulation of home entertainment electronic servicing works in the State of Indiana—for both technician and service dealer alike.

O.C. Brown, C.E.T., Jeffersonville, Indiana, was elected as Chairman of the Board of Examiners by the other four members of the Board, and will serve for at least one year.

■ There are eight states in the United States that now have some form of licensing and regulation of the radio/TV service industry. Some states require registration for only the technician and some just for the service dealer, or shop. Of the eight states, Indiana is the first to institute both technician licensing *and* shop registration.

Indiana's "Television and Radio Licensing Act," passed by that state's General Assembly on March 10, 1967 initially provided only for the licensing of electronic *technicians* who serviced television and/or radio receivers and/or who installed and serviced antennas used for the reception of TV and radio signals. In 1971, the act was amended to also provide for the registration of all *business* establishments which serviced TV and radio receivers and/or installed and serviced antennas for TV and radio reception.

Prior to the "dealer registration" amendment, the owner of a shop was immune from any regulatory action by the Board of Television and Radio Service Examiners. If, for example, the business practices or policies of a shop owner violated a rule or regulation of the licensing act, the licenses of the technician employees of the shop could be revoked or suspended, or the technician employees could be indicted, tried, convicted and fined and/or sentenced to jail terms, while the non-servicing shop owner continued operations in the same manner. If the shop owner was a licensed technician, the Board could prevent him from actually performing service by revoking or suspending his license, but it could not prevent him from continuing to *operate* the business by hiring other licensed technicians, whose licenses, in turn, would be jeopardized by the unethical business practices of the owner. The technician's only recourse in these situations where he had no control over the business methods of his boss was to find employment elsewhere.

To eliminate this unfair, partisan treatment of employer and employee, the 1967 Television and Radio Licensing Act was amended in 1971 to give the Board of Examiners the power to license and regulate the service shop as well as the individual technicians. The mandatory registration of "service dealers" became effective in Indiana on July 1, 1971.

JURISDICTION OVER CATV-MATV IS ATTEMPTED

The Board of TV and Radio Service Examiners and other state officials have also attempted to include under the jurisdiction of Law, the service technicians and antenna installers of those companies installing and operating CATV or MATV systems in the state. On May 8, 1974, the Board requested and received an opinion on the subject from Indiana Attorney General Theodore L. Sendak, that indicated that CATV service personnel should be included. "It is my official opinion," the attorney general concluded, "that the Indiana Board of Television and Radio Service Examiners is limited in its present jurisdiction under Indiana law to the licensing and regulating of television installers and technicians within the industry. This same authority would include the licensing and regulating of installers and technicians for the cable television industry in the same manner as it includes the licensing and regulating of installers and technicians in the commercial television and radio broadcasting areas. Within those limitations, it has the statutory authority to devise regulations which, when properly promulgated, cover such installers and technicians."

Armed with this official opinion, the Indiana Board of Examiners developed Rules and Regulations to cover the licensing of CATV technical personnel. But before the new rules could be enforced, the Indiana Legislature approved Senate Bill 99, which specifically *excluded* the cable TV companies from Board jurisdiction. Although the attorney general has declared Senate Bill 99 "unconstitutional," CATV companies and personnel today are still free from Board

Field Men of Indiana's Board of TV and Radio Service Examiners, David E. Box, C.E.T., left; Cecil W. Larson, C.E.T., 2nd from left, and James Baker, C.E.T., right, meet with Board Chairman O.C. Brown, C.E.T., center, and Harold Calvert, Executive Secretary, standing.

jurisdiction and licensing requirements.

MATV technicians and installers, on the other hand, are still under the jurisdiction of the Board and the rules and regulations of the Television and Radio Licensing Act. The Board has established Rule No. 122, called the MATV Endorsement, which states that "Any and all persons who install, service or maintain for compensation or hire an antenna system providing three or more outlets from a single signal source (cable or antenna) in any building or structure, must have been granted and be in possession of a valid MATV endorsement." Field men employed by the Board of Examiners are instructed to attend every seminar or other training session on MATV systems, according to Harold Calvert, the Board's executive secretary, "so that they can more effectively administer the Rules and Regulations covering the activities of those persons and companies involved in MATV."

MAKE-UP OF BOARD EXAMINERS

Enforcement of the provisions of the law is carried out by a five-member "Board of Television and Radio Service Examiners," an executive secretary and three investigators. By the law no more than three of the board members can come from the same political party—and no two board members can be residents of the same county in Indiana. Board members are appointed by the Governor to four-year terms and cannot succeed themselves. The current Board is made up of four individuals who are owner/operators of home entertainment electronic servicing businesses and one person who is a farmer and a former state legislator. The Board, with one member as chairman, meets regularly on the second Wednesday of each month in the State Office Building in Indianapolis. The chairman is elected by the other members of the board and serves in that position for at least one year.

Those currently serving on the Board are: O.C. Brown, C.E.T., who is chairman, Dean R. Mock, C.E.T., Elbert E. Powers, C.E.T., Ray E. Wood, and Ralph V. Rader.

The day-to-day administration of the agency, which is housed in the State Office Building in Indianapolis, is handled by the Board's executive secretary, Harold Calvert, who also oversees the daily operation of another state regulatory agency, the Watch Repairman's Board. Calvert supervises a three-member office staff, which performs the administrative chores for both agencies. The executive secretary is appointed to a one-year term, and may be successively reappointed, at the option of the Board.

The three field investigators, Cecil W. Larson, James Baker and David E. Box, are former owner/operators of electronic service businesses and are all CET's. They are full-time employees of the agency. Their salaries and expenses, and those paid the secretary and other members of the staff, are fixed by the State Personnel Board, subject to the approval of the State Budget Agency.

A deputy attorney general also is assigned to the Board on a retainer basis to represent the Board at formal hearings and to perform any other legal services needed.

WHAT THE AGENCY DOES

The principal assigned function of the Board of Television and Radio Service Examiners, according to the law, is to protect the public of the state of Indiana "from financial losses and other hazards resulting from irresponsible service methods, unethical practices, inferior installation, maintenance and repair of television and radio, including antenna receiving systems." This function or purpose, is accomplished by several different Board Activities.

An Examination of Technical Competency

The Board and staff develops and administers examinations that will qualify TV and radio servicemen, and -or antenna installers, for a state license. According to the law, examinations must be given at least once each three months, at a time and place of the Board's choosing. (Actually, at present, examinations are administered daily, Monday through Friday, from 8:30 AM to 1:00 PM, except on legal holidays.)

The "Grandfather Clause"

Although persons who apply now for any of the three "technician" licenses must pass a written or oral test, those individuals who at the time the original law was enacted had the equivalent of 24 months of experience servicing TV and radio receiving equipment or antenna installations at an established business in the state were awarded licenses without passing a written test. About 4000 licenses were issued under this section of the Act, commonly called the "Grandfather Clause."

Requirements for TV Radio Service Technician

Today, before any individual can actually take the examination, he or she must qualify under the provisions of Section 12 of Indiana Code, which requires that the applicant be at least 18 years of age and possess the necessary combination of completed apprenticeship, schooling or experience.

For those who apply for a television and radio service technician license there is a 150-question written or oral test that must be taken. In addition, the applicant must meet *one* of the following groups of requisites:

- Served two years as an apprentice television and radio service technician under the direct and personal supervision of a licensed television and radio service technician;
- Can prove to the Board that he has satisfactorily completed "a course in servicing receiving equipment conducted in a school" which either is under the jurisdiction of the Department of Education or is approved by the federal government for vocational training of veterans of the armed forces;
- Can prove that he 1) has satisfactorily completed a "course in servicing receiving equipment from a correspondence school or trade school which is approved by the Board," and 2) has served at least one year as an apprentice television and radio service technician in the state of Indiana (two years, if out of the state);
- Has at least four years of experience servicing receiving equipment outside the state of Indiana.

Note that practical experience is required in each requisite grouping, except if the applicant can prove that he has satisfactorily completed a course in servicing receiving equipment conducted by a school which either 1) is under the jurisdiction of the department of education or 2) is approved for veteran training by the federal government.

Antenna Installer Qualifications

Those who apply for an antenna installer's license must meet qualifications identical to those for TV and radio technicians, except the test and education and/or experience must be in servicing "antenna receiving systems." However, the experience required is less: one year as an apprentice; or six months as an apprentice (one year, if out of state), plus satisfactory completion of a correspondence or trade school approved by the Board; or two years of experience only, if it is served outside the state.

Application for Apprentice Certificate

Anyone without the necessary education and/or experience but who wants to become a licensed technician can apply for a registration certificate as either an apprentice television and radio service technician or as an apprentice antenna installer. The applicant must: 1) be at least 16 years of age, 2) be of "good moral character and temperate habits," and 3) have their application signed by the licensed TV and radio service technician or licensed antenna installer under whose "direct and personal supervision" they will be learning the trade.

The licensed technician or antenna installer who signs an apprentice's application for registration is held responsible for the acts of the apprentice which relate to his trade. When the licensed technician or installer wishes to terminate his responsibility for the apprentice, he must notify the Board of the termination within 30 days of the termination.

Service Dealer Registration

TV/radio service dealers who apply for a license are not required to take an exam, but they do have to make application to, and be approved by, the Board of Examiners. According to the amended rules of the Licensing Act, a "service dealer is a person engaging in the business of servicing receiving equipment, and having an established location for the performance of such service." The Act further stipulates that such persons must be licensed annually by the Board, to legally "engage in the business of installing, servicing, maintaining, reconditioning or repairing receiving equipment." The Act provides that the Board may refuse to issue a license to or can revoke or suspend the license of service dealers who "caused any service to be performed in an unworkmanlike manner showing negligence or carelessness."

Issuance of Licenses

Once an applicant qualifies, the Board issues a license certificate and/or wallet identification card and is directed by the Indiana Code to display their license "in plain view" in the place they perform their service, and to have on their person the wallet identification card whenever they perform service outside their shop. The "display" of the license is the method by which the Board identifies, for the public, that the technician and/or service dealer is qualified by knowledge and experience to service TV and radio receivers and to install antennas.

Establishing Rules & Regulations

In addition to the examination and licensing of technicians and dealers, the Board is directed by the Indiana Code to make any "reasonable" rules and regulations it deems necessary to carry out the provisions of the Act. The laws of the State of Indiana, however, stipulate that all rules and regulations established by such agencies must be approved by the Attorney General before they can be used by the agency to regulate the trades under the agency's jurisdiction.

NEXT MONTH—PART TWO

We've outlined so far, the main points of Indiana's "Television and Radio Licensing Act" of 1967 and its Amendment in 1971. We've described the make-up and functions of the Act's regulatory agency, "The Board of Television and Radio Service Examiners."

In next month's issue of ET/D we'll examine at some length how the Board of Examiners operates in the investigation of violations of the Act and enforcement of the law. We'll take a look at the activities of the Board of Examiners' three field investigators, and the attitudes of some of Indiana's licensed technicians and service dealers towards the "Licensing Act." ■

Delco's State-Of-The-Art For '76

By Joseph J. Carr

Analysis of this manufacturer's two newest car radios, with special emphasis on the new AM/FM model designed for use in Chevy's Chevette

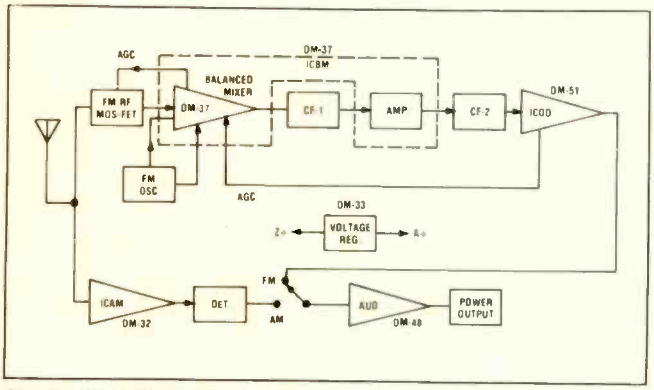


Fig. 1—Block diagram of 1976 Delco Chevette AM/monaural FM car radio.

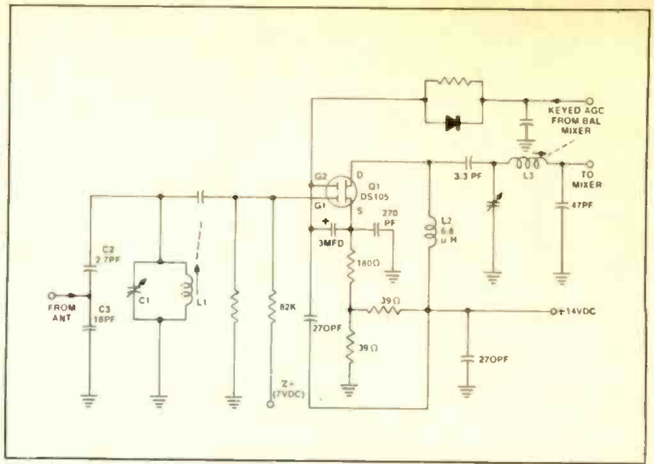


Fig. 2—FM RF amplifier section of Chevette radio.

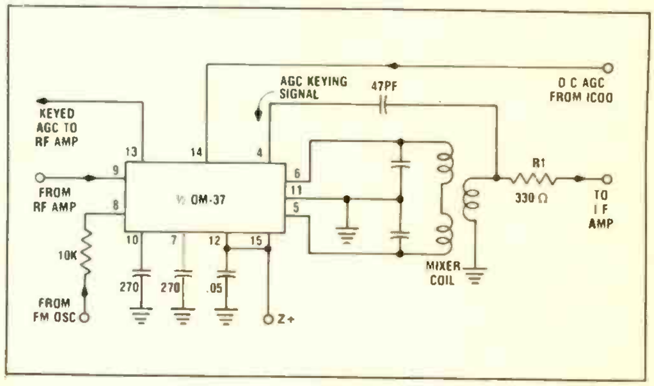


Fig. 3—FM balanced mixer section of the DM-37 IC used in the Chevette radio.

THE CHEVETTE RADIO

■ A block diagram of the new AM/ monaural FM radio recently introduced by Delco for use in Chevrolet's new subcompact, the Chevette, is shown in Fig. 1.

FM RF Amp

The FM RF amplifier in the Chevette radio is equipped with Delco's DS-105 dual-gate MOSFET. As shown in Fig. 2, the input circuit of the MOSFET (Gate 1) includes the tuned tank L1/C1. Inductor L1 of the tank is ganged to the permeability tuning mechanism (PTM), which is driven by the timing dial or pushbuttons.

The input impedance of the FM RF amp is matched to that of the antenna by a series capacitance voltage divider consisting of C2 and C3.

In most car radio RF amps equipped with bipolar (conventional) transistors, the supply voltage is "series fed" to the collector through the output tank of the stage. However, in Delco's MOSFET-equipped circuit in Fig. 2, the supply voltage is applied to the drain (equivalent of collector) in *parallel* with the output tank inductor, L3, so that the source-to-drain current of the MOSFET does not flow through the output tank. Instead, the output signal is developed across L2 and then capacitively coupled to the output tank via the 3.3-pF capacitor.

AGC voltage, from the keyed AGC section of the DM-37 IC, is applied to Gate 2 of the MOSFET.

FM Mixer/IF Amp IC

As revealed by the block diagram in Fig. 1, the FM mixer and FM IF amplifier sections in the Chevette radio are contained on a two-section IC, DM-37.

The mixer section of this IC is shown in Fig. 3. It is a balanced type mixer, with input signals applied to pins 9 and 8 from the FM RF amplifier and FM oscillator, respectively. The 10.7-MHz output of the mixer is transformer coupled from the balanced mixer coil (primary of transformer) to the input of the FM IF amplifier section via a ceramic piezoelectric filter, which is shown in Fig. 4. The "mixer coil" in Fig. 3 actually is a shielded tank circuit.

The balanced type of mixer used in the Chevette radio theoretically provides superior mixing action because the FM RF amplifier and FM oscillator signals are completely nulled out in the balanced output circuit of the mixer, leaving only the pure sum and difference signals.

Two types of AGC are used in this radio. A non-keyed, DC type is developed in the DM-51 quadrature detector IC and is applied to pin No. 14 of the DM-37 IC, as shown in Fig. 3. The other AGC voltage, a keyed type like that in most TV receivers, is generated in the FM balanced mixer section of the DM-37 IC and is applied to Gate 2 of the dual-gate MOSFET used in the FM RF amplifier stage, as described previously. The keying signal for the keyed AGC section of the DM-37 IC is picked off the secondary of the mixer coil and is applied to pin No. 4 of the DM-37 via a 47-pF capacitor, as shown in Fig. 3.

The FM IF amplifier section of the DM-37 IC is shown in Fig. 4. The 10.7-MHz output of the secondary of the mixer coil (Fig. 3) is applied to pin No. 1 of the FM IF amplifier section via an impedance match-

DELCO CHEVETTE RADIO
IC and Component Package Normal Pin Voltages

PIN	ICBM DM-37	ICQD DM-51	ICAM DM-32	AUDIO DM-48
1	1.9V	2.0V	5.00V	0.50V
2	1.9V	2.0V	7.00V	1.14V
3	0V	2.0V	7.00V	1.30V
4	1.0V	0V	5.00V	0V
5	13.3V	0V	0.22V	0V
6	13.3V	5.8V	13.80V	13.40V
7	3.4V	5.6V	0.66V	14.00V
8	3.4V	5.0V	0V	13.20V
9	1.8V	5.0V	0V	--
10	1.8V	5.0V	0.62V	--
11	0V	14.0V	0.62V	--
12	7.0V	0V	0.62V	--
13	7.0V	1.5V	4.30V	--
14	1.4V	0V	7.00V	--
15	7.0V	4.6V	--	--
16	4.5V	0V	--	--

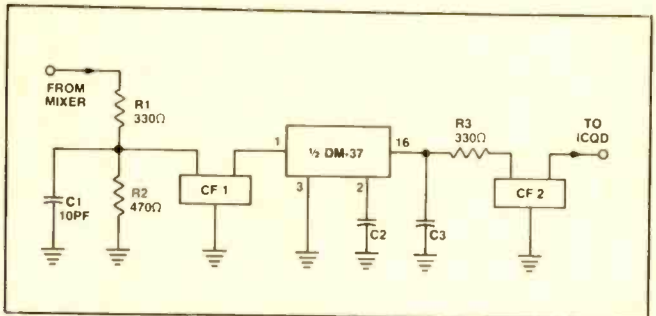


Fig. 4—FM IF amplifier section of DM-37 IC in the Chevette radio. CF1 and CF2 are ceramic piezoelectric filters.

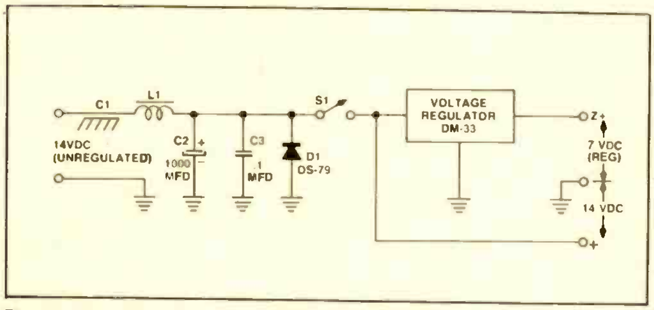


Fig. 5—Simplified schematic diagram of the Chevette radio's power supply. DM-33 is a new three-terminal voltage regulator device.

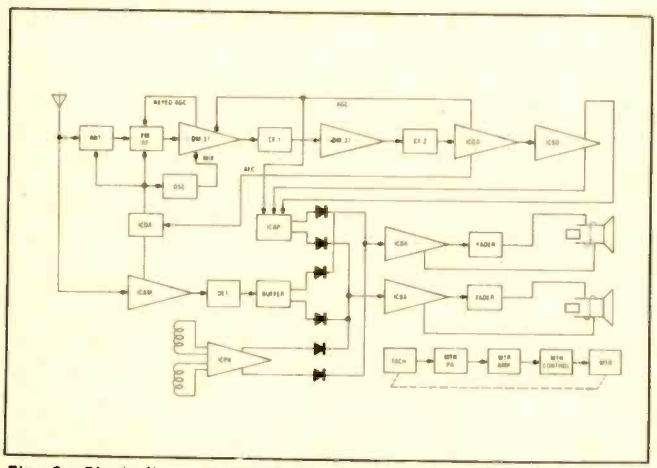


Fig. 6—Block diagram of Delco's latest AM/stereo-FM radio and tape player unit.

ing network (R1, R2 and C1) and a ceramic piezoelectric filter, CF1. The output of the FM IF amplifier section, at pin No. 16, is fed to the quadrature detector via another ceramic piezoelectric filter, CF2. These two ceramic filters, CF1 and CF2, establish the bandpass of the FM IF amplifier section.

FM Detector IC

FM demodulation in the Chevette radio is accomplished by a quadrature detector IC, DM-51 in Fig. 1, the basic design of which was pioneered by Delco in the older DM-11 detector IC.

AM Radio Section

The AM RF amp, mixer, and IF stages of the Chevette radio are contained on a DM-32 IC (Fig. 1), which was introduced previously by Delco sometime ago and used in other Delco car radio designs.

Audio Section

A few years ago, Delco developed a *packaged module,* designated DM-8, which contains most of the components and circuitry for an audio preamp/driver section. The design of this packaged module, which technically is not an IC but an *electronic component package,* later was "modernized" into two updated versions designated DM-28 and DM-29. The latest version of this audio preamp/driver component package is called the DM-48 and, as shown in Fig. 1, is used in the Chevette radio.

The audio output transistor used in conjunction with the DM-48 component package is the Delco type DS-503, which, along with the somewhat higher-power-rated DS-501, has been used in car radio and tape player class A power amps since the early '60s.

Voltage Regulator & Power Supply

In previous Delco car radio designs, development of a regulated "Z+" voltage from the unregulated "A-line" voltage (supplied by the car's electrical system) was accomplished either by a Zener diode (DS-49 or DS-149) or by a series-pass transistor regulator in conjunction with a Zener diode.

This function is performed in the Chevette radio by a new three-terminal voltager regulator device, the Delco DM-33. The device, which looks like a bipolar transistor, has three leads—one for application of the unregulated input voltage, one for connection to chassis ground, and a third which provides the regulated output.

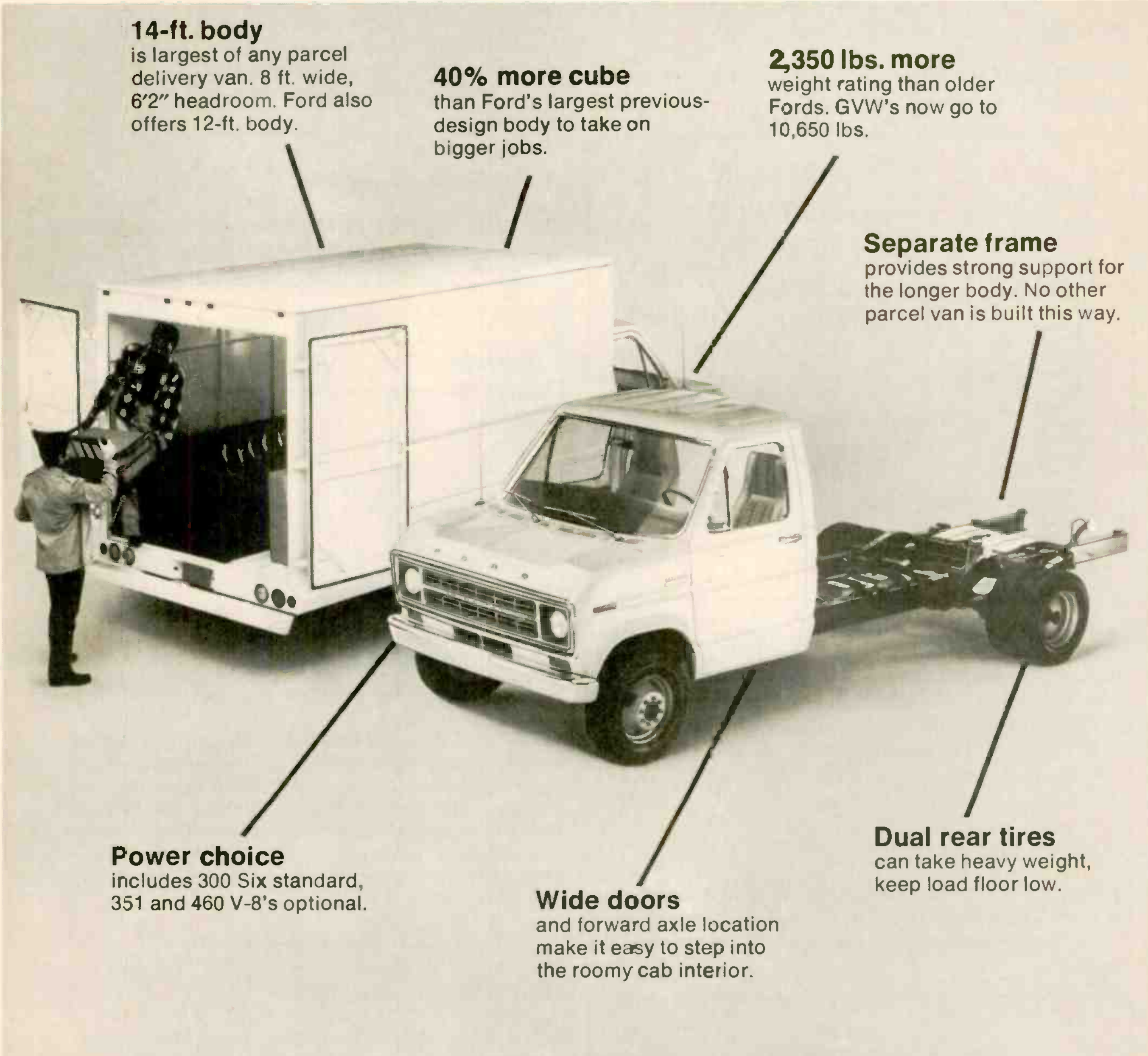
The Chevette radio power supply section in which the new DM-33 regulator is used is shown in Fig. 5. Coil L1 and the associated capacitors form a low-pass filter which reduces noise and other forms of interference picked up by the "A" line.

Capacitor C1 in Fig. 5 is a spark plate type made from a piece of fishpaper sandwiched between two pieces of copper foil. One side of C1 is soldered directly to the chassis, close to the point where the A-line leads enter it. The other side of C1, which is insulated from the chassis, is soldered directly to the "A" line.

Capacitor C2 is used to filter out low-frequency interference, and C3 decouples RF and IF from the power supply and also bypasses to ground any spark

continued on page 47

FROM FORD: THE BIGGEST PARCEL VAN EVER BUILT



Ford Parcel Delivery Vans not only take on big jobs, they make the driver's job easy.

The engine's forward out of the way. There's more room to get in, more room to drive in. You can step right across the cab or into the load area. Power front discs are standard, Cruise-O-Matic Drive available. See what's new in vans; see your local Ford Dealer.

...for more details circle 113 on Reader Service Card

93 out of 100 of all Ford trucks registered in the last 12 years are still on the job.

FORD ECONOLINE VANS

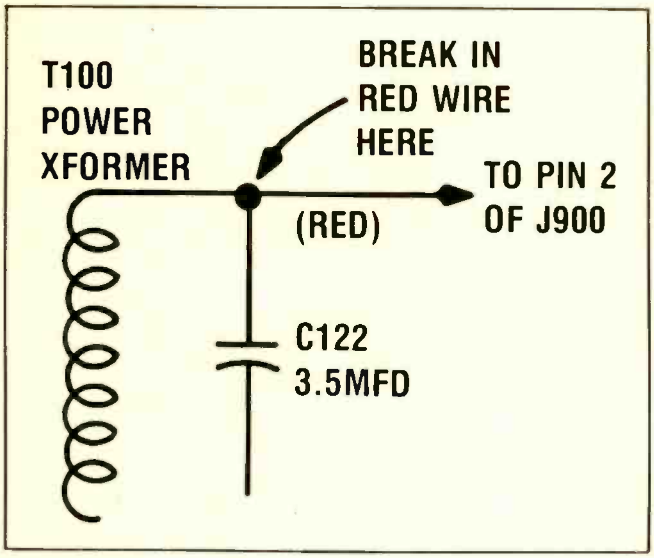
FORD DIVISION Ford

TECHNICAL DIGEST

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

CHASSIS: Admiral 1M30B

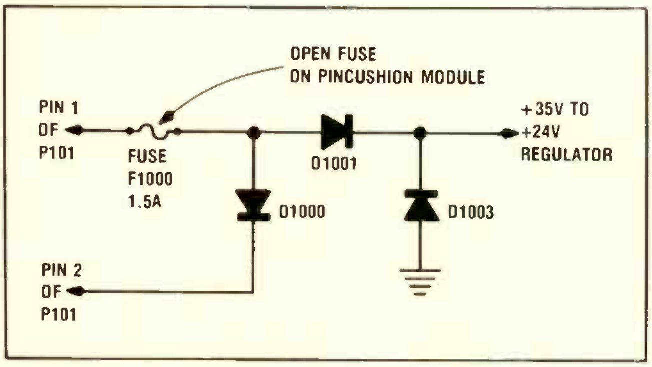
TROUBLE SYMPTOM: Raster pulls in from both sides as brightness is increased.



CAUSE: Break in small red wire in power transformer circuit at the point where capacitor C122 connects to it. This red wire, which is dressed in a bundle of other wires, connects C122 to pin 2 of J900. A break in this wire causes the regulated 130V B+ supply to decrease below 130V as the brightness level is increased.

CHASSIS: Admiral M10

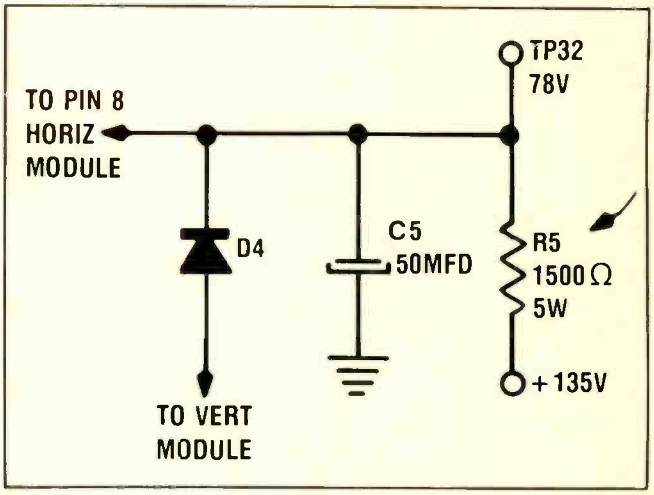
TROUBLE SYMPTOM: Vertical sweep and sound missing (only a thin horizontal line displayed on screen) and a "raspy" buzz eminating from the high-voltage section of the chassis.



CAUSE: Open fuse F1000 (1.5A) on A8954-3 pincushion module. Opening of this fuse eliminates the 33- and 24-volt supplies, disabling the vertical sweep and sound sections. In some cases there is no apparent cause for the opening of fuse F1000 (Admiral part No. 84-A4-7), and replacing it restores both vertical sweep and sound. In other documented cases involving earlier runs of the M10 Chassis, the opening of fuse F1000 has been found to be caused by excessive current in the vertical output transistors, which is cured by replacing 75-ohm resistor R632, on the M600 vertical module, with a 56-ohm, 5%, ½-W type (Admiral part No. 61A172-560). (In some early runs of this chassis series, R632 is 39 ohms, but still should be replaced with the 56-ohm type. Also, the callout "R632" is not printed on some early versions of the M600 module because the resistor replaced a diode (D603) which originally had been planned for this location on the module; consequently, if you cannot find a resistor designated "R632," look for one with a callout "D603" and replace it with a 56-ohm type.

CHASSIS: Magnavox T995

TROUBLE SYMPTOM: Incorrect horizontal scan or complete loss of raster (sound unaffected).



CAUSE: If cause is traced to a defect on the horizontal module or a defective horizontal output transistor Q1, always check the voltage at TP32 after replacing either the module or Q1. The voltage at TP32 should be about 78 volts. If it is significantly higher, the value of R5 (1500 ohms, 5W) probably has decreased, in which case R5 should be replaced to prevent repeated failure of the horizontal module or transistor Q1.

CHASSIS: Magnavox T985

TROUBLE SYMPTOM: Buzz heard during turn on of receiver.

CAUSE: Cores of degaussing coils are too close to picture tube mounting bracket and vibrate against it during turn on of the receiver. Place a screwdriver between the core and the picture tube mounting bracket and gently bend the core slightly away from the bracket or, alternatively, place a piece of tape between the core and the mounting bracket.

CHASSIS: Sylvania D16

TROUBLE SYMPTOM: Repeated failure (short life) of 6LR6 horizontal output tube (V4).

CAUSE: VDR R446 (assuming that drive to control grid of V4 is normal and high voltage is adjusted properly). ■

We planned to do a hard-hitting, gutsy comparison ad. Their specs versus ours. Sort of a "High Noon" for signal generators.

Then we began checking out the competition, if you can call it that. Our new Model 3000 signal generator sells for $2,265.

Among other things, it features 0.001% accuracy, phase-lock stability, AM and FM modulation, 20 milliwatts leveled output power, and programmable frequency capability (at no added cost).

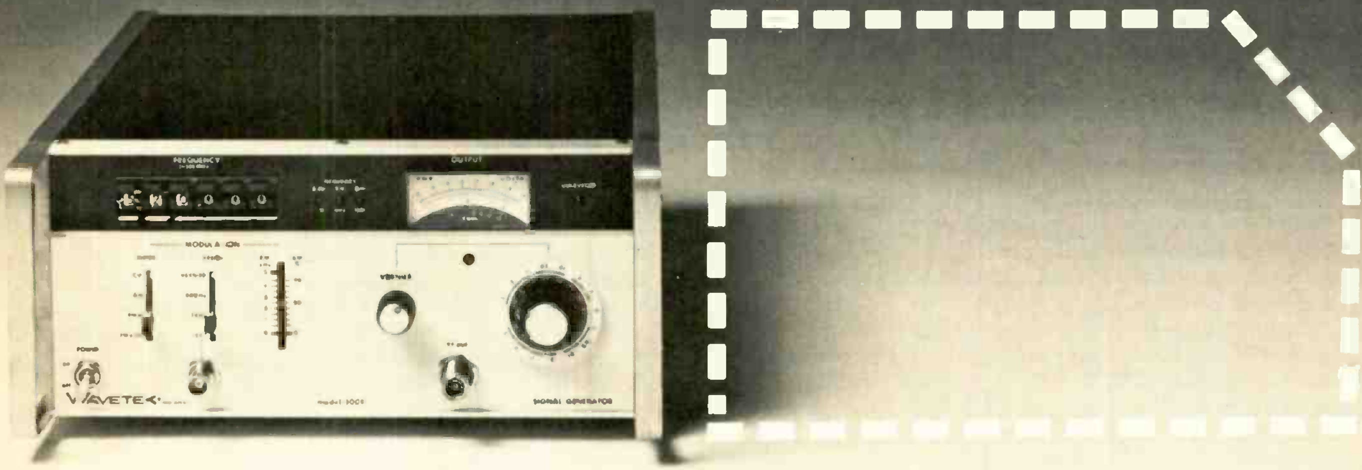
There are other signal generators in the 1 to 520 MHz frequency range that match our accuracy. But the cheapest one is $4,300. Hardly competition.

And although you can pay up to $6,400 for other VHF signal generators, none of them offers programmable frequency.

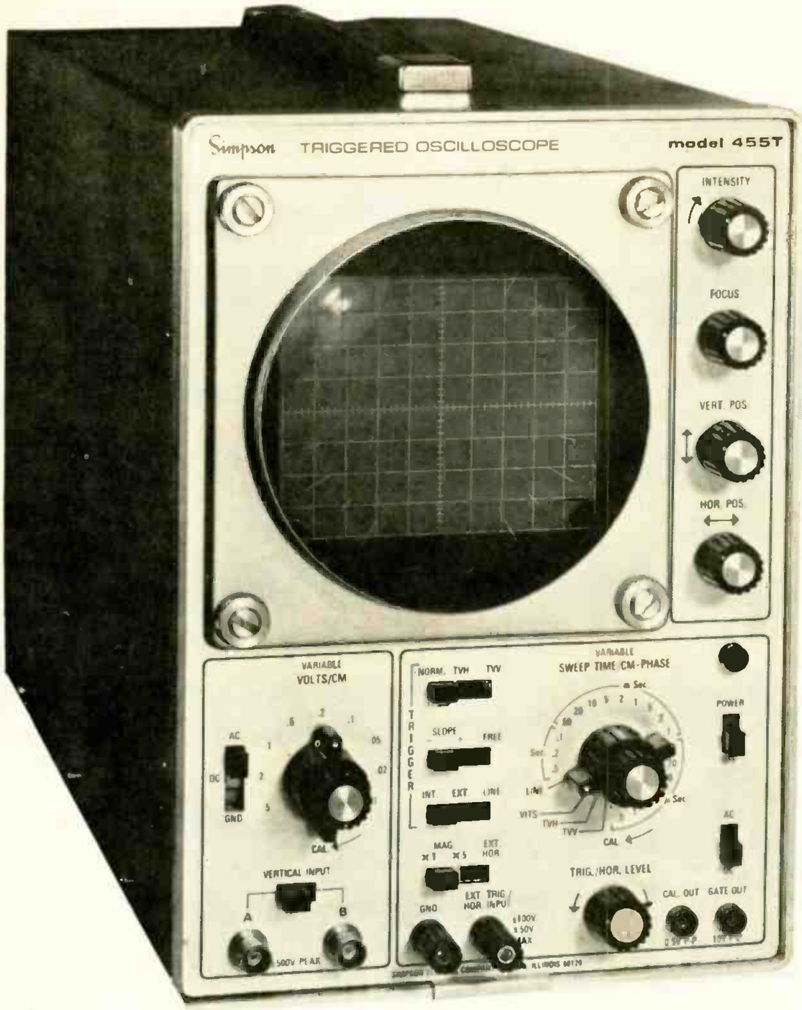
How can we do a comparison ad when we're stuck with a product this good? Not possible. So we'll just have to be content with running non-comparison ads. And taking orders. WAVETEK Indiana, Incorporated, P.O. Box 190, 66 North First Avenue, Beech Grove, Indiana 46107, Phone (317) 783-3221, TWX 810-341-3226.

WAVETEK®

We'll compare our signal generator with the competition. Just as soon as there is any.



...for more details circle 132 on Reader Service Card



TRIGGERED, WIDEBAND SCOPE

The most recent addition to Simpson Electric Company's line of service-type test instruments is the Model 455T oscilloscope, a 12-MHz, single-trace, triggered type with a number of features which make it particularly applicable to TV servicing.

The gain of the vertical channel of the Model 455T is flat to within -3dB throughout the frequency range of DC to 12MHz in the direct-coupled (DC) mode and from 2Hz to 12MHz in the capacitive-coupled (AC) mode. Selection of direct or capacitive coupling to the vertical amplifier input is provided by a three-position slide switch, the third position of which, labeled "GND", disconnects the signal source and grounds the input of the first vertical amplifier stage, to provide a trace reference position for easier DC level measurements.

The 455T's vertical channel attenuator control, labeled "VOLTS/CM" and calibrated in a 1-2-5 sequence, provides nine pre-calibrated sensitivity levels over a range from 10 mV/cm to 5V/cm. A concentric control, labeled "VARIABLE," permits adjustment of the sensitivity between the nine pre-calibrated levels established by the VOLTS/CM control. When the VARIABLE control is rotated completely clockwise to the "CAL" position, the peak-to-peak voltage level of the displayed waveform can be measured directly, within an accuracy of ±3%, by multiplying the setting of the VOLTS/CM control by the height of the waveform in centimeters. (A .5V P-P, 1-KHz squarewave is available from a jack on the front panel, for checking the calibration of the vertical channel attenuator.)

The vertical channel of the 455T is equipped with two electrically isolated input jacks, labeled "A" and "B", either of which can be selected as the input merely by positioning a slide switch. This built-in feature makes it easy to switch the vertical channel between two signal sources whose waveforms you want to compare.

The input impedance at the vertical channel input jacks without an input cable attached is 1 megohm shunted by 35 pF of capacitance; with the shielded input cable supplied with the 455T attached, the input impedance is 1 megohm shunted by 90 pF. (The direct/low-capacitance probe, available with the instrument on an optional basis, modifies the input impedance to 1 megohm shunted by 135pF in the probe's DIRECT mode, and to 10 megohms shunted by 15pF in the probe's LO-CAP mode.)

The maximum input rating of the 455T's vertical channel inputs is 500 volts (DC + AC peak).

The horizontal sweep system of the Model 455T can be operated in either a free-running or triggered mode. In either mode, the sweep can be synchronized to 1) a signal from an external source (applied to the scope via the EXT. TRIG/HOR. INPUT jack), 2) to a portion of the signal being observed (applied internally from the vertical channel) or 3) to an internally applied 60-Hz signal picked off the power transformer of the scope.

Twenty-three pre-calibrated sweep speeds—ranging from .5 μ sec/cm to 50m sec/cm at an accuracy of ±5% and from .1 sec/cm to .5 sec/cm at an accuracy of ±10%—are provided by the SWEEP TIME/CM/PHASE control when the concentric VARIABLE control is in the "CAL" position. The VARIABLE sweep speed control also permits variation of the sweep speed between the limits established by the SWEEP TIME/CM-PHASE control, and when the sync source selector is in the "LINE" position, the VARIABLE control functions as a sync *phase* adjustment, for use during TV sweep alignment and any other procedures which require that the sweep be synced to the frequency *and* phase of the AC line.

To facilitate synchronization of the 455T's sweep system to the horizontal and vertical sync pulses of composite TV signals, the 455T is equipped with a sync separator and two separate calibrated sweep control positions, labeled "TVH" and "TVV," which provide pre-set sweep speeds for viewing TV horizontal (TVH) lines and TV vertical (TVV) fields.

Another "pre-set" sweep control position, labeled "VITS," establishes the correct sweep speed for display of the TV vertical interval test signal (VITS), which is broadcasted by TV stations as an integral part of the composite TV signal. This feature, combined with the 455T's pushbutton-activated X5 "sweep magnifier," which increases the gain of the horizontal amplifier by a factor of 5, makes setup of the 455T for VITS display a relatively easy procedure. (Of course, the X5 sweep magnifier can be used to enlarge a portion of almost any waveform which requires "close-up" analysis of detail.)

The gain of the 455T's horizontal amplifier is flat to within -3dB throughout the frequency range of DC to 800KHz in the direct-coupled (DC) external-input mode and from 10Hz to 800KHz in the capacitive-coupled (AC) external-input mode. The minimum deflection sensitivity of the horizontal amplifier is 300mV/cm. In the "external input" and "line sweep" modes of operation, the gain of the horizontal amplifier can be varied by the TRIG/HOR. LEVEL control, which also serves as the trigger level adjustment in the triggered mode of operation.

The maximum input voltage rating of the horizontal amplifier external input is 50 volts (DC + AC peak).

Other features of the Model 455T include: a Z axis (CRT cathode) input on the back of the instrument, for intensity modulation of the displayed waveform by a 5-to 25-volt P-P signal; a 10-volt P-P "gating" signal, from the sweep generator of the scope and available at a front-panel jack labeled "GATE OUT;" plus other ease-of-operation features such as functionally grouped controls which are spaced far enough apart and are sufficiently large enough for convenient, error-free manipulation.

The Model 455T is equipped with a 5-inch, flat-faced CRT with an 8 x 10cm graticule and blue filter. Also imprinted on the graticule are angle reference marks at 30 degree intervals, for analysis of color TV vector displays.

The scope weighs 24 lbs and is 10-⅜ inches high, 8 inches wide and 16-½ inches deep.

The price of the Model 455T is $395, including a 4-ft RG62/μ shielded input cable equipped with clip leads, plus a comprehensive operator's manual which, in addition to precise operating and maintenance instructions, also provides detailed procedures for using the scope to troubleshoot, align and adjust TV and radio receivers. Available on an optional basis is a direct/low-capacitance probe.

...for more details circle 136 on Reader Service Card

HIGH-VOLTAGE TEST PROBE

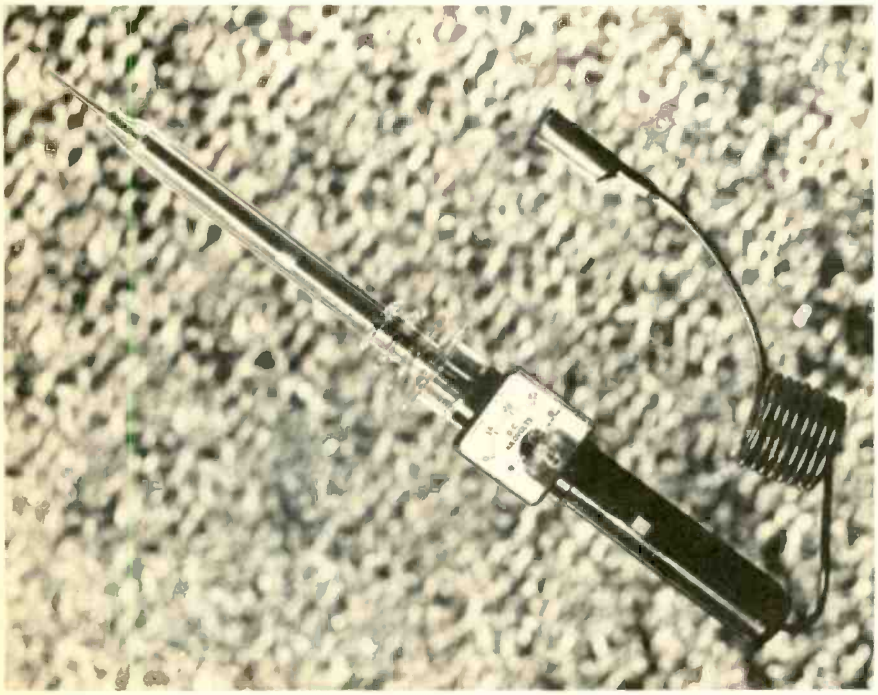
ITT Pomona Electronics' Model 4242 high-voltage test probe is a self-contained meter/probe combination capable of measuring DC voltages up to 42KV with an accuracy of ±2% of the full-scale reading.

The Model 4242 has an input impedance of 20,000 ohms/volt, is 14-¾ inches long and weighs 8¼ ounces. Its handle is made of high-impact thermoplastic and its probe is made of high-impact polycarbonate.

Measurements are made with the test probe by attaching the alligator clip of the probe's ground lead to the chassis of the receiver and then pressing the point of the probe against the voltage source being measured.

The Model 4242 is priced at $24.95.

...for more details circle 137 on Reader Service Card



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.

SOLDERING IRON BELT CARRIER 138

A heavy-duty leather holster for carrying cordless soldering irons and accessories is now available from the *Wahl Clipper Corporation*. The holster, termed by its manufacturer as a "further step in soldering portability", features a snap closure that secures the holster firmly to any belt up to 2½ inches wide.

EXPANDED CHANNEL CB ANTENNAS 139

A new line of antennas capable of handling the new expanded channel Class D citizens radio service expected to be authorized soon by the FCC are being developed by *Antenna Specialists Co.* The mechanical and electrical specifications will be the same as the firm's present CB antennas with each antenna individually tuned to frequencies and VSWR matched to 1.2 or less at resonance. The expanded channel antennas, to be identified by special markings, will be compatible with present 23-channel radios. Shipment of the new antennas will begin in the near future, well before the new authorization date for the new spectrum, according to company spokesmen.

MINI RECHARGE BATTERY SYSTEM 140

A new low-cost, modular "mini" recharge battery system using nickel-cadmium batteries that are capable of being recharged up to 1,000 times or more has been introduced by the *General Electric Company*. The system in-

cludes four components that can either be purchased separately or together, including the model BC-3 charger and three battery-holding modules. Individual modules are designed to hold two pairs of AA and one pair of either C or D size GE nickel-cadmium batteries.

RF MODULATOR 141

A new RF modulator has been introduced that takes a signal from any video source and transforms it into an RF signal tunable over TV channels 2 through 6. The RFM-26 meets present FCC rules and regulations governing RF devices used with MATV, CATV, and RF distribution systems. Pro-

duced by *Crest Electronics, Inc.*, the RFM-26 also features an RF gain control and a video gain control.

ALL-WEATHER TOOL KIT 142

A new attache-style tool kit that features a volcanized fibre case designed for hard usage in environments unfavorable to executive type cases has been introduced by *Jensen Tools*. The kit contains more than 60 essential tools needed to perform a wide range of electronic, electrical and mechanical service tasks including:

screwdrivers, nutdrivers, ignition wrenches, hex-keys, pliers, penlight, scissors, mini-hacksaw, 40-watt soldering iron plus many additional items. Most of the tools are mounted on two fixed pallets of heavy canvas. The bottom of the case provides room for additional parts and tools. The case is black and sells for $150.

SOLDERING AIDS 143

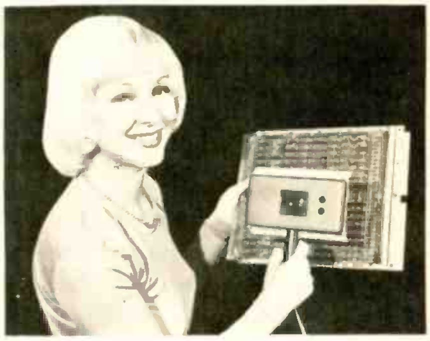
An assortment of soldering aids with non-magnetic steel blades to which solder won't adhere is available now from *Hunter Tools*. With hex-shaped plastic handles, blade types included are: forked end, reamer, hook, knife-scraper, and brush. The aids are available in a standard size of 8 inches, or 6 inches for micro work. Price is $1.39 for standard size and $1.79 for micro models.

CB POWER MIKE 144

A new power microphone for the citizen's band, amateur and industrial radio user has been introduced by *Mura Corporation*. A sensitive amplifier built into the microphone is powered by a standard 9-volt battery. The new mike, Model DX-120, may be adjusted to any of three gain levels with optional sensitivities of −54, −45 and −43 dB to fully modulate any CB transceiver. It features a push-to-talk switch, medium impedance output and fully transistorized circuitry and sells for $24.95.

PCB INSPECTION LAMP 145

A new, portable inspection lamp that will reveal common PCB faults in ambient light conditions has been introduced by the *Hampton Manufacturing Co*. With safe blue-black light lamps and a 2.5x optical quality magnifier, the LV-1 lamp will detect voids in plating or in plated-through holes,



cracks in copper etching, underdeveloped dry-film residue, uneven conformal coating and solder mask residue. Priced at $75.

PORTABLE FIELD TELEPHONE 146

A new portable field telephone that operates on two "D" flashlight cells for both talking and magneto ringing is now available from *Bohnsack Equip-*

ment Co. Billed as "the first commercially produced field telephone since the introduction of its predecessor, the famous U.S. Army EE8," the new phone provides temporary and portable telephone service for construction outfits, ski and hunting lodges, house-to-barn, or anyone who doesn't have regular plant telephone service available. It's built of steel with a baked enamel case, 9½ x 4-¼ x 10½ inches and weighs 11½ lbs. The range is from 11 to 17 miles on standard twisted pair cable. Price: $49.50.

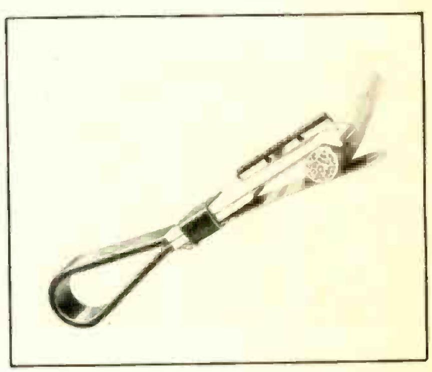
TOOL KIT & CASE 147

A new tool case for technicians, servicemen and field engineers, available now from *Xcelite*, contains 41 individual tools, 16 interchangeable screwdriver/nutdriver blades and handles, and five specialized space-saving kits. Included are seven types of pliers, an adjustable wrench, electrician's knife, electronic snips, straight nose seizer, and wire stripper/cutter. The sets and kits cover

Phillips, slotted and hex screwdrivers, hex nutdriver blades, and a selection of handles and other specialty blades. The tool case is covered with a leather-grain fabric, and holds a removable pallet and tray with see-thru plastic tool pockets.

CABLE CUTTING TOOL 148

A new tool designed for "ring" cutting of the sheathing on inside type plastic, fabric or rubber covered cable is now available from *P.K. Neuses, Inc.* Most practically suited for the inside type 3/16 in., 3/8 in., or 1/2 in. cables, the new tool will also handle thin sheathed cable up to 1 in. diameter. To use, the cable is pushed into the tool and against a spring, and then by applying back pressure, the cable is held firmly against the cutting blade for



the ring cut. An accurate .031 in. deep cut is made as the tool is rotated around the cable. It weighs only 3 ounces.■

TV WAVEFORMS

continued from page 21

dual-beam, and vector oscilloscopes are given. A wide range of oscilloscope measurements are simplified by this book: modulation, distortion, gain, phase, frequency, frequency response, transistor characteristics, etc. All of this is topped off by a whole Chapter on troubleshooting the scope itself.

CONTENTS: Electrical Meters — VOM — Meter Specs — VTM— EVM — Accessories — EVM Measurements — Troubleshooting with the EVM — Stage Testing — Component Testing — Voltage Analysis — Waveform Analysis — Scope Circuits and Controls — Synchronization — Square-Wave Testing — Response Curves — Wideband Scope —Triggered Sweep — Dual Trace — Vectorscope — Vectorgram Interpretation — TV Waveforms — TV Troubleshooting. ■

DELCO'S STATE OF THE ART

continued from page 47

noise which manages to get by coil L1.

IC & Module Voltages

The voltages which should appear on the pins of the three ICs and the DM-48 component package used in the Chevette radio are listed in an accompanying chart.

DELCO'S NEWEST RADIO/TAPE UNIT

The block diagram of Delco's latest AM/stereo-FM radio and tape player package is shown in Fig. 6.

This unit employs a relatively sophisticated diode gating system to select audio from any of three sources: tape player preamps, AM radio or stereo-FM radio.

The AM and FM tuner/IF/detector sections used in this combo unit are similar to those in the Chevette radio. The principal difference in the FM radio section, other than the addition of a stereo decoder IC (ICSD in Fig. 6), is the use of dual varactors (variable capacitance diodes) to tune the RF amplifier tank circuits. The control voltage for the varactors is developed from the AFC voltage by a special DM-43 IC (ICDA in Fig. 6). This type of frequency control has been used to tune FM local oscillators since the inception of car FM receivers.

Another significant design difference beween this combo unit and the Chevette radio is that the complete audio amplifier section in the combo unit, including the audio output stages, is contained on two ICs, one for the right channel and one for the left, as opposed to the outboarding of the discrete audio power amplifier in the Chevette radio.

NEXT MONTH: "Audio Output Defects in Car Radios.■

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REBUILD PICTURE TUBES: Save 50 to 75% by rebuilding your own picture tubes. You can purchase a plant from us to rebuild from one to 50 tubes per day with one week of schooling and follow up instructions in your plant. Factory Outlet, 951 E. Hudson St., Columbus, OH 43211, 614-263-0645. TF

TV SHOPS needed to repair and update master antenna systems with new patented method. I will train you. No competition. You will be one of a select number directly under my technical assistance by WATS telephone. Send resume and credit references: Melvin Cohen, Television Broadcast Engineer, May Company Building, 3651 Prospect Avenue, Riviera Beach, Fla. 33404. Enclose 13¢ addressed envelope. Be patient for my reply. 4/76

BUSINESS FOR SALE. T.V. Sales & Service. Zenith Franchise. For more information contact Harold Schumaker, Box 265, Whittmore, Iowa 50590. 6/76

ADVERTISING PACKAGE FOR TV service shops. Inexpensive eye catching ads contain personal message from you-build customer confidence. Keeps your name before the public weekly. PROVEN RESULTS. Thirty ads with instructions. $19.95. Sample $1.00 refundable. TV TIPS, 430 South Jefferson, Lebanon, Mo. 65536. 10-76

TV Repair Shop on Wheels franchise available. We supply 1½ ton step van, fully equipped. Low investment. Excellent income. Technicians must have at least 5 years field and 2 years formal training. Write to M.R.S. Electronics, 1616 Hinckley Road, Orlando, FL 32808. 6/76

Manuals and Periodicals

Convert any transistorized T.V. tuner to a tuner substituter. Plans $2.00. New accelerated Radio & T.V. course, RADIO TELEVISION TRAINING, Box 279, ET-56, Syracuse, N.Y. 13206 TF

Construction Plans

SURPRISE! Free Catalog! **WE SELL THE MOST UNUSUAL CONSTRUCTION PLANS USING NUMERICAL READOUTS!!** Digital Plans: Capacitance Meter, VOM, Frequency Counter, Oral Thermometer, Automobile Tachometer, Speedometer, Sobriety Tester. ALSO: Ten Band Graphic Equalizer, LED Volume Indicator, Human Pluse Tachometer, TV Video Ping-Pong Game. **PLAN SETS** are $3.49 each or **ALL** eleven for only $15.98 Airmailed Postpaid! **GREEN BANK SCIENTIFIC,** Box 100X, Green Bank, W.Va. 24944 TF

JAPANESE TRANSISTORS -All Transistors Original Factory Made. Free Catalog. West Pacific Electronics, Box 25837, W. Los Angeles, CA 90025. 12 76

SURPRISE! SURPRISE! Digital Piano Tuning Device tunes **ALL** musical instruments Accurately! Perfectly! Inexpensively! Tuner Construction—Piano Tuning Instruction **PLAN SET** Complete $12.98 Airmailed Postpaid! Moonlighting quickly repays $40 electronics investment!! **GREEN BANK SCIENTIFIC,** Box 100W, Green Bank, WV 24944. TF

For Sale

TV FLY-BACK TRANSFORMER AND YOKE TESTER. Save time, money; Prevent miss-diagnosis on TV repairs. Full instructions included. $69.95. Free literature. Guaranteed. Discount Electronics, Box 1535, Pinnellas Park, FL 33565. 6/76

BURGLAR ALARM DIALING UNIT automatically calls police. $29.95. Easy to program and easy to install. Free literature. S&S Systems, 5619-E St. John, Kansas City, Mo. 64123. (816) 483-4612. 5/76

PRESSURE sensitive miniature cable for burglar alarm systems. Place under carpet in any contour for intrusion detection or secret switching. $4.95 for twenty feet. Cable Switch Corp. Box 72-ET. West Long Beach, N.J. 07764. TF

For Sale—Tektronix Scope 465 Option 5 Dual Trace—Video Sync, Original Owner. Less than 20 hours use. $1,500. Call area 516-585-9060. 5/76

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Convert black/white TV to Color: experience not neccessary. $3.00 (refundable). Tayo Paul, 980 Greene Ave., Brooklyn, NY 11221. 7/76

Classical LP records, unscratched, Bought-Sold. Classical Record Exchange, 583 6th Avenue, San Francisco, CA 94118. 5/76

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

ELECTRONIC TEST EQUIPMENT FOR SALE. Reconditioned or repairable, from Aerospace Industry and DOD. $0.50 for catalog. James Walter Test Equipment, 2697 Nickel Street, San Pablo, CA 94806. 8/76

Late model Color TV's (some with minor problems) for $10.-$20.-$30. All you can use. Simple, legal system makes $100. plus per day for TV techs. Detailed plans, instructions, $10. P.P. Money back if not satisfied. Economy TV Rentals, Box 2890, Denver, CO 80201. 5/76

COLLECT YOUR OVER-DUE BILLS — NO COLLECTION FEES. Unique, effective collection system. Satisfaction guaranteed. Free guide. Audit Controls, Inc., 103 Brookside Ave., Fair Lawn, NJ 07410. TF

DYNACO-A-R-TRANSISTORS, REPAIR BOARDS & UNITS SPEAKER SERVICE. SEND FOR PRICES AND DETAILS: BEAR ELECTRONICS—177-E-HILLCREST ROAD, MT. VERNON, N.Y. 10552. 5/76

For Sale—Sam's Photofax 142-1332 with four cabinets and Zenith literature. Steve Huffman, 50A West Campus, Big Rapids, MI 49307, 616-796-6635. 5/76

Wanted

Wanted-TV sales and service business. Will also work with option to buy. Southern area. G. Ganzer, 1423 Chicago Avenue, Bay Shore, NY 11706. 4/76

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ELECTRONIC TECHNICIAN/DEALER TEKFAX

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 4 NEW SETS

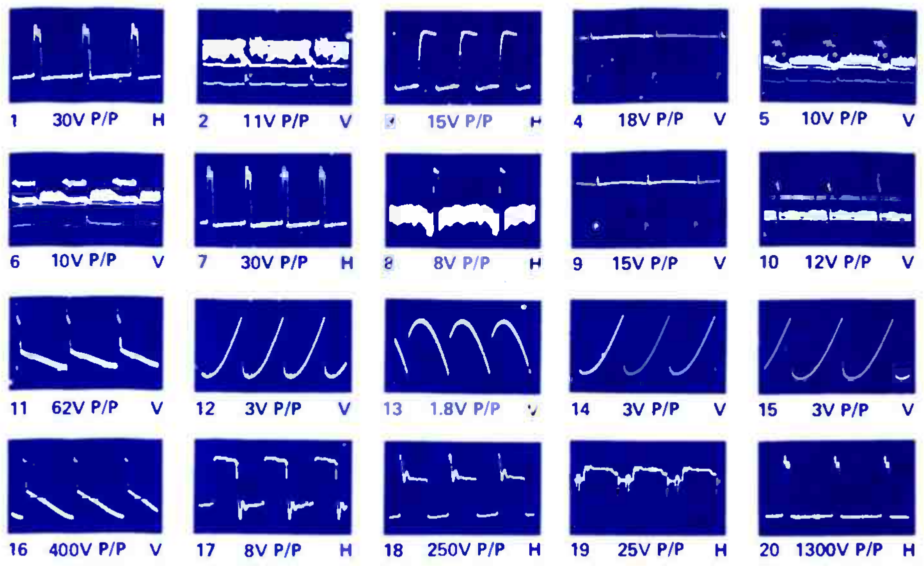
GROUP 285

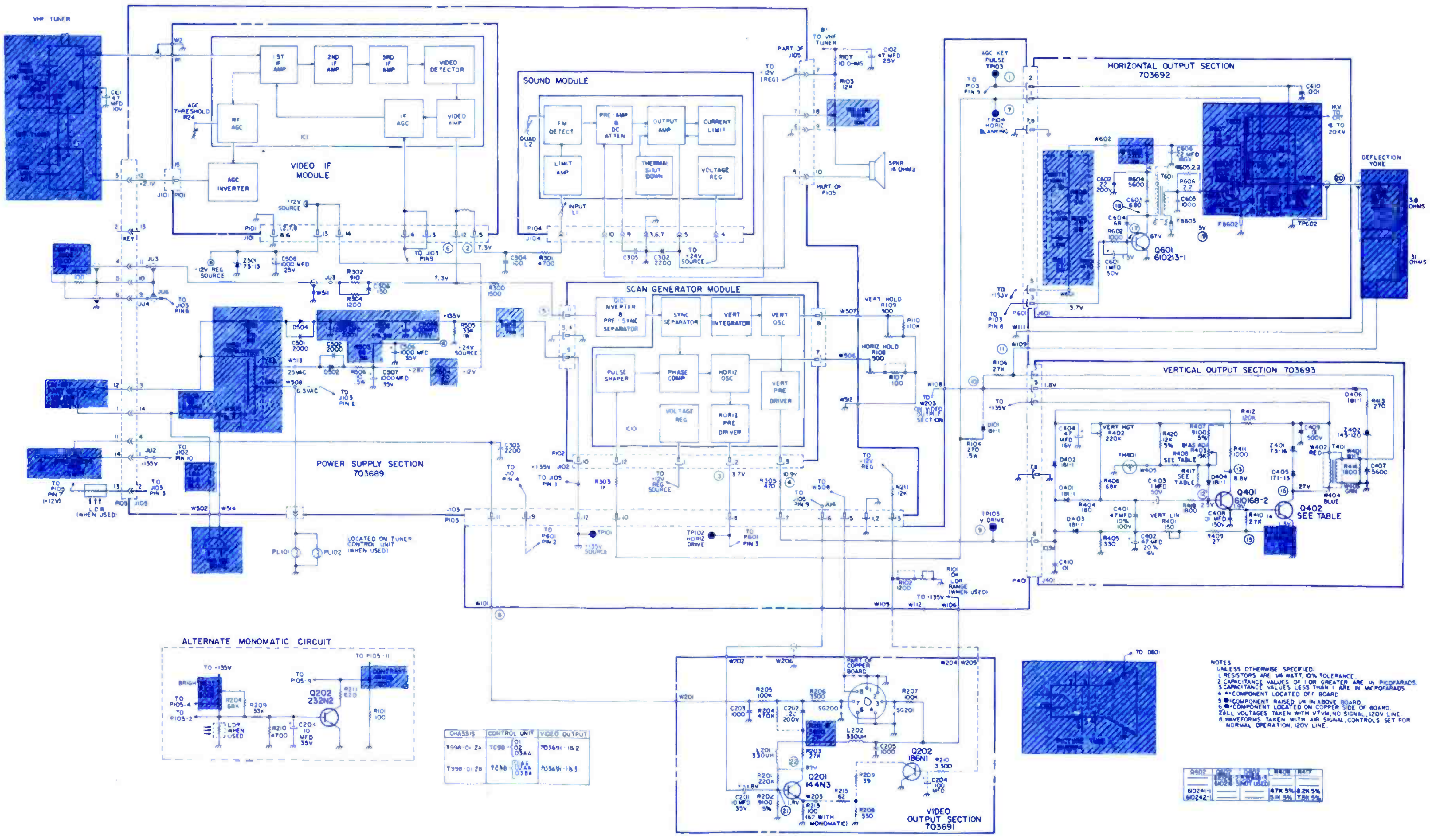
	SCHEMATIC NO.		SCHEMATIC NO.
MAGNAVOX V-W TV Chassis T998	1641	SYLVANIA Color TV Chassis E21-1	1643
PANASONIC Color TV Chassis NMX-P3A	1642	ZENITH B-W TV Chassis 22FB12	1644

1641

MAGNAVOX B-W TV Chassis T998

MAY • 1976





1642 PANASONIC

Color TV Chassis NMX-P3A

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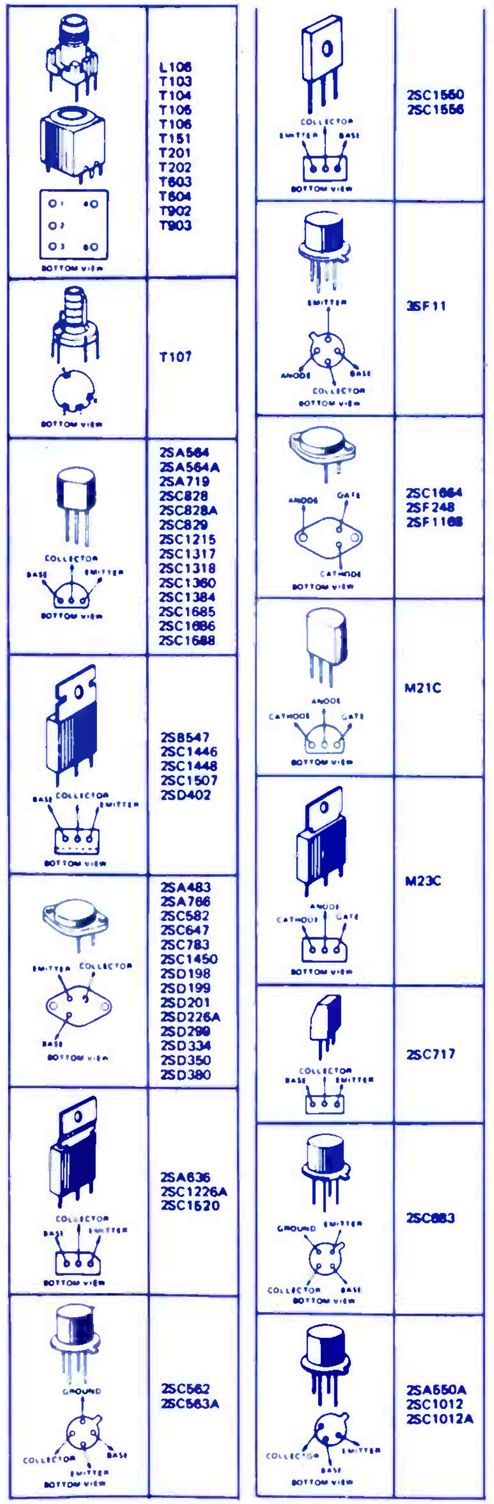

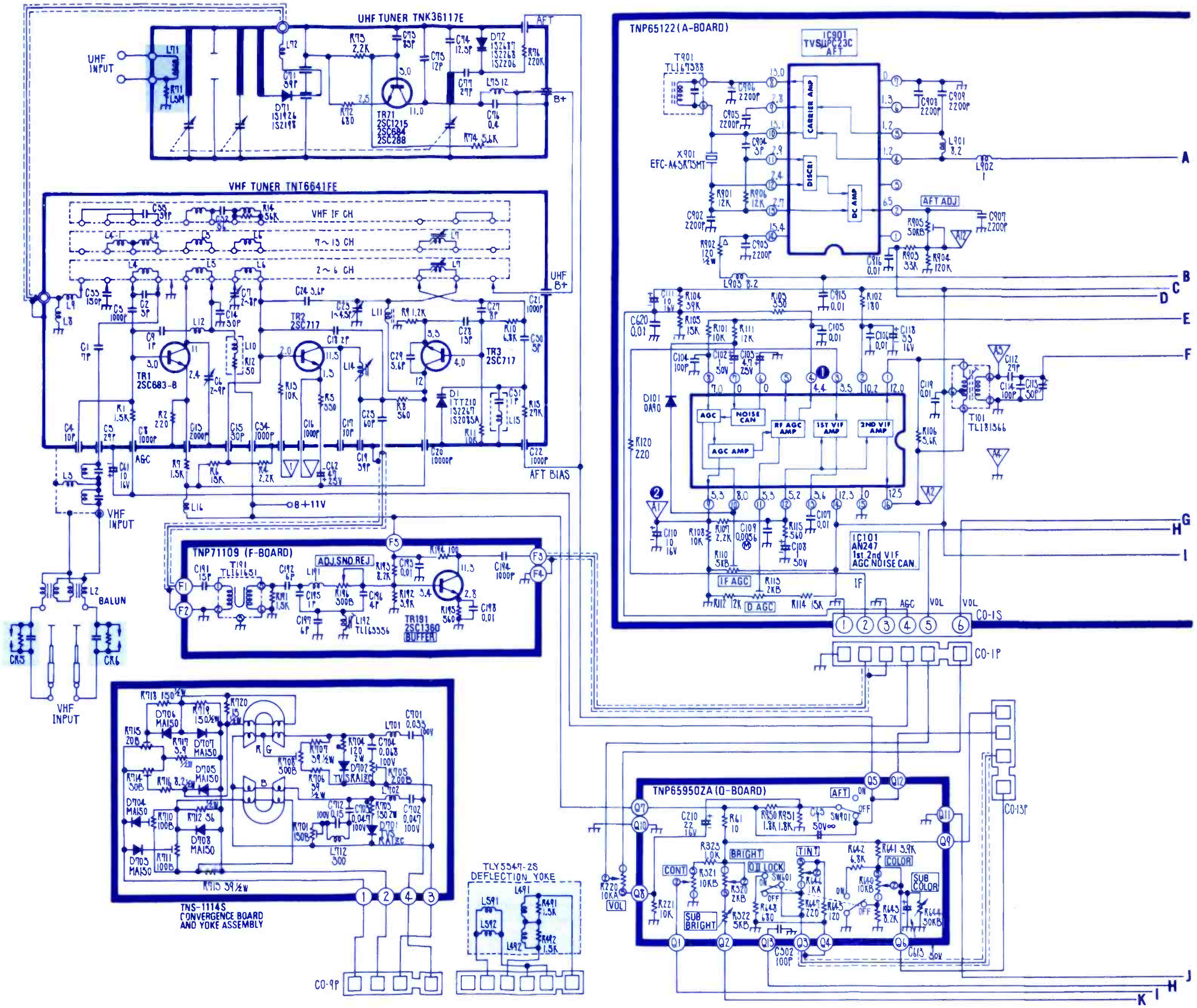

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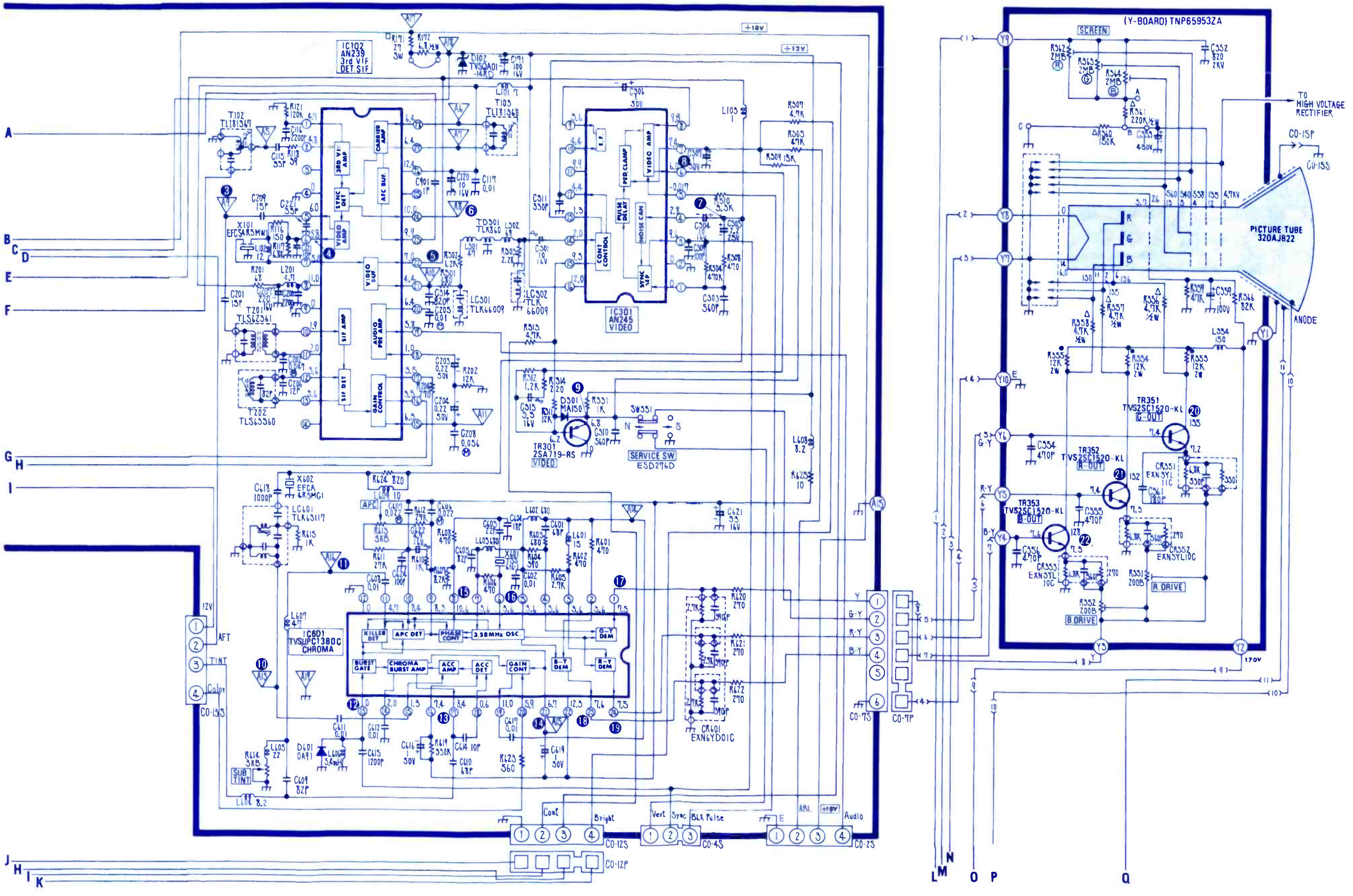
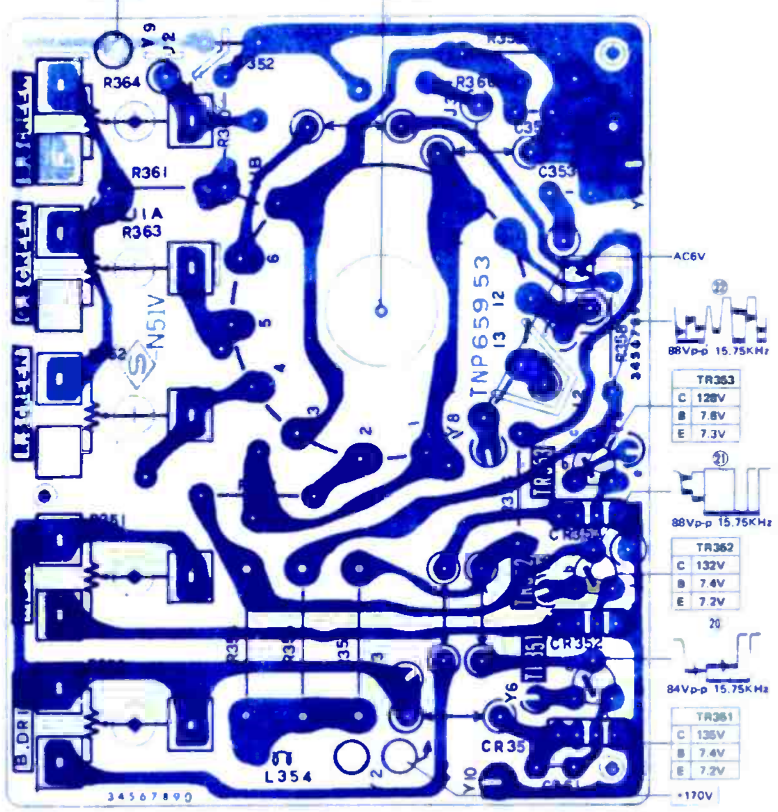


PANASONIC
Color TV Chassis
NMX-P3A

CRT Socket			
1	0V	7	26V
2	135V	9	4.7KV
3	26V	11	130V
4	538V	12	135V
5	540V	13	560V
6	136V	14	6.0V

Y-BOARD TNP65953ZA



TR353	
C	128V
B	7.8V
E	7.3V

TR362	
C	132V
B	7.4V
E	7.2V

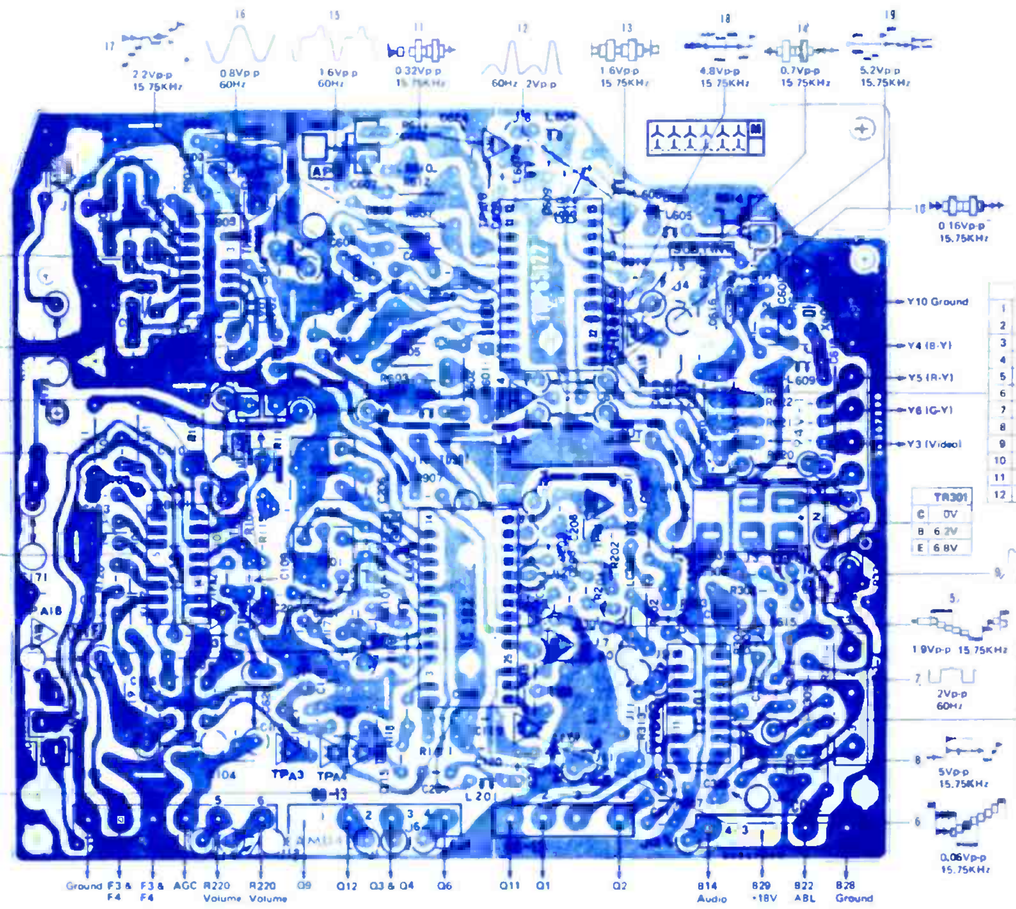
TR361	
C	135V
B	7.4V
E	7.2V

CONDUCTOR VIEW
A-BOARD TNP65122

IC901			
1		8	13.0V
2	6.5V	9	2.8V
3		10	13.1V
4	1.2V	11	2.9V
5	1.2V	12	2.4V
6	1.3V	13	2.7V
7	0V	14	15.4V

IC101			
1	12.0V	9	5.3V
2	10.2V	10	8.0V
3	3.5V	11	5.3V
4	4.4V	12	5.2V
5		13	3.6V
6	0V	14	12.3V
7	0V	15	0V
8	7.0V	16	12.5V

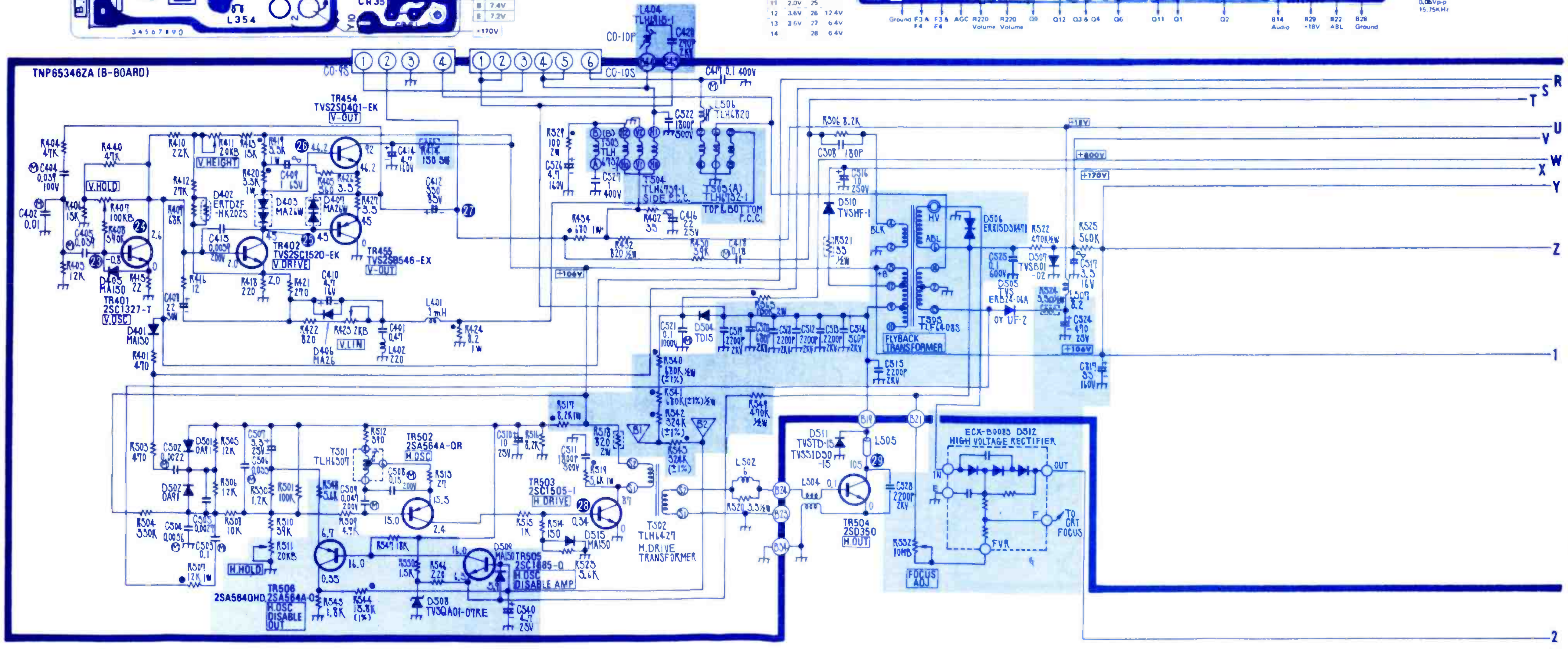
IC102			
1	4.7V	15	6.3V
2	4.8V	16	3.5V
3		17	3.5V
4	0V	18	1.0V
5	6.0V	19	5.8V
6	5.8V	20	6.4V
7	5.8V	21	4.4V
8	11.0V	22	7.0V
9	0V	23	3.9V
10	1.9V	24	10.0V
11	2.0V	25	
12	3.6V	26	12.4V
13	3.6V	27	6.4V
14		28	6.4V



IC601			
1	7.5V	13	0V
2	3.6V	14	2.0V
3	3.6V	15	1.3V
4	3.6V	16	7.4V
5	3.6V	17	8.4V
6	3.6V	18	0.6V
7	3.8V	19	11.0V
8	10.6V	20	5.9V
9	8.3V	21	6.7V
10	8.4V	22	12.3V
11	4.7V	23	7.6V
12	0V	24	7.5V

TR301	
C	0V
B	6.2V
E	6.8V

IC301			
1	0V	9	3.8V
2	0V	10	4.4V
3	9.6V	11	9.9V
4	2.8V	12	4.4V
5	-0.017V	13	1.3V
6	6.0V	14	2.0V
7	7.4V	15	9.3V
8	9.8V	16	12.0V



PANASONIC
Color TV Chassis
NMX-P3A

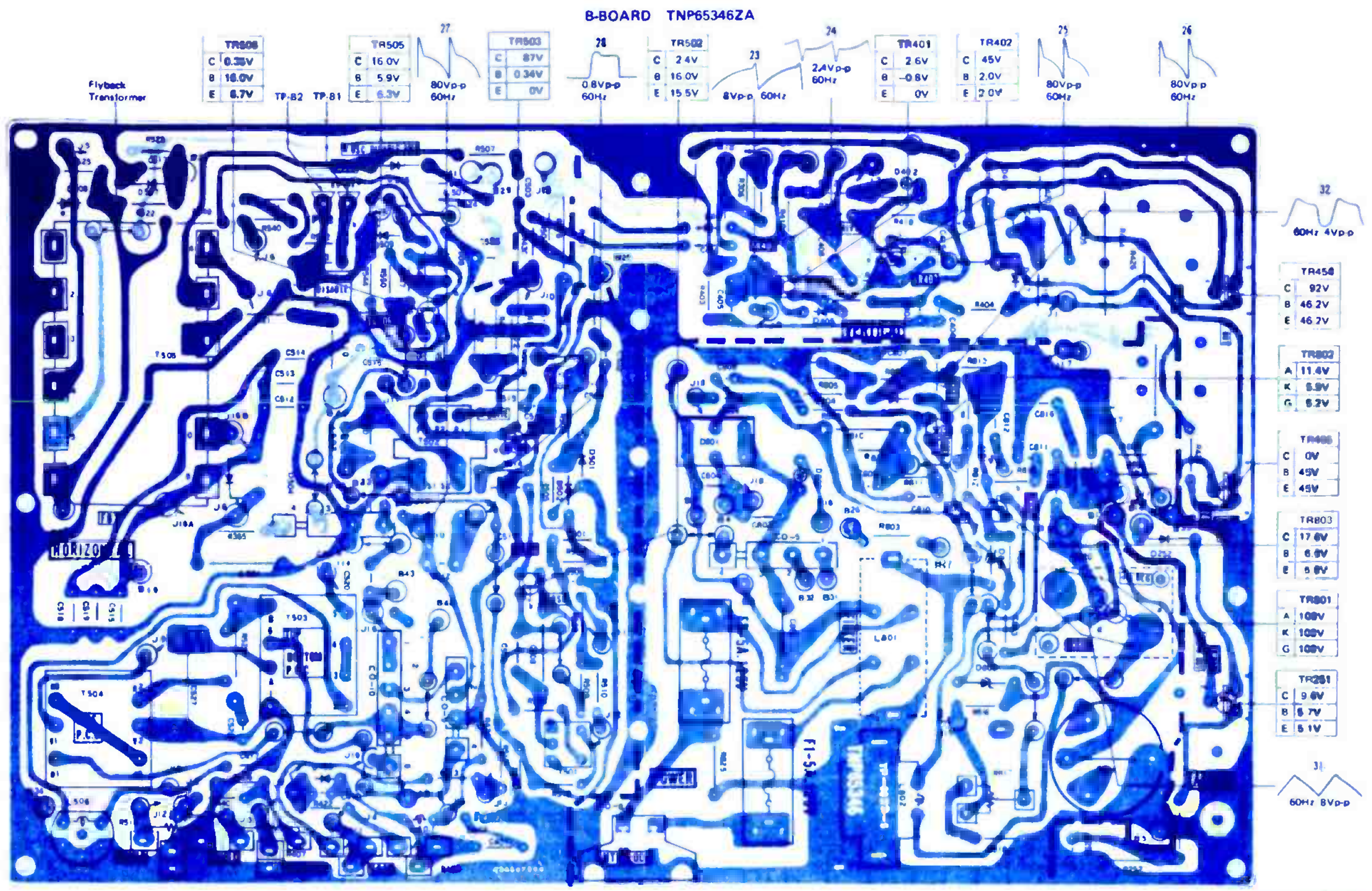
NOTICE

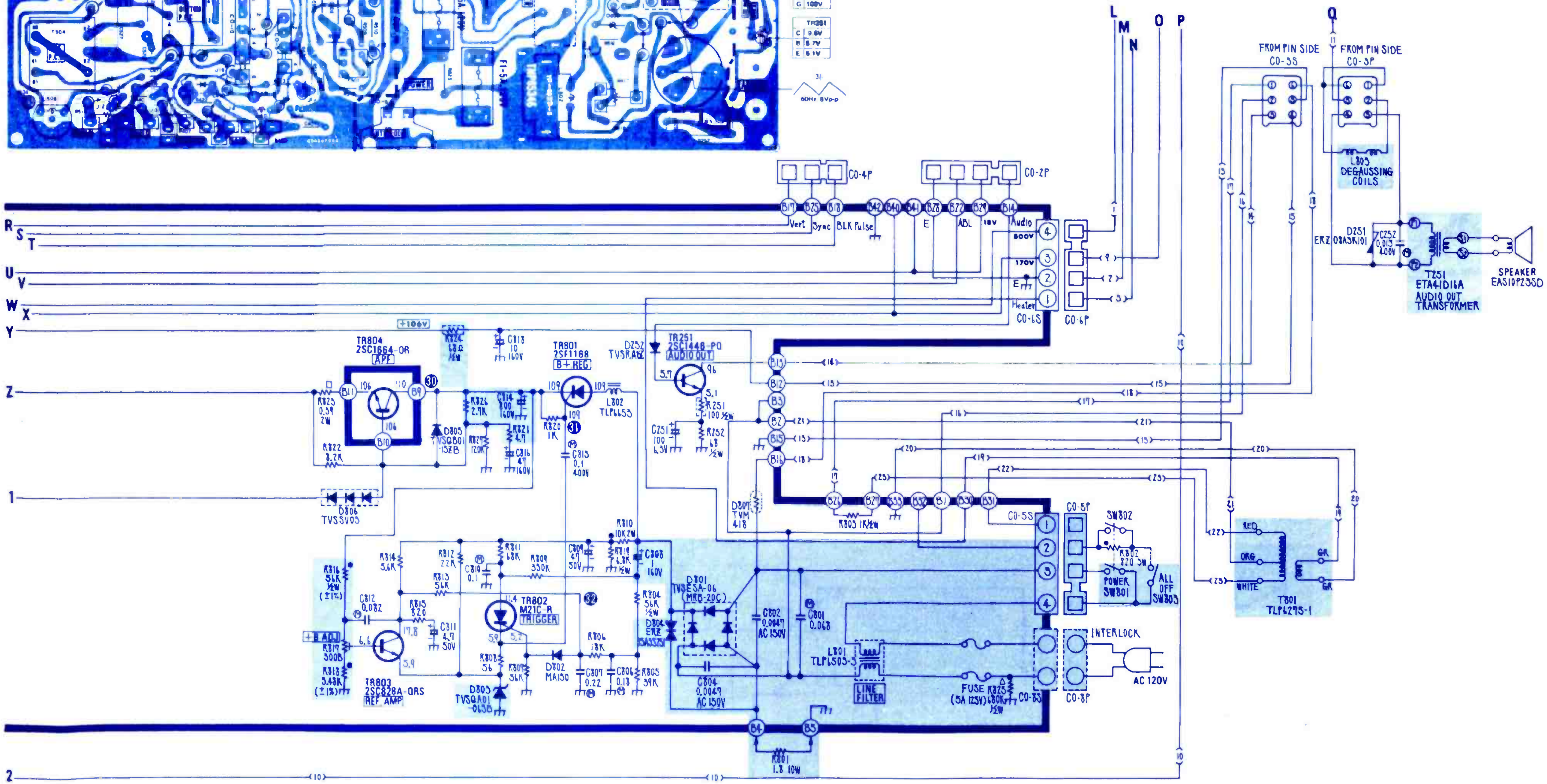
1. RESISTOR
   All resistors are carbon 1/4W resistor, unless otherwise noted the following marks.
   Unit of resistance is OHM (Ω). K : 1,000, M : 1,000,000
   - △ : Solid resistor
   - ● : Metal oxide resistor
   - □ : Wire wound resistor
   - Thermistor
   - Fuse resistor
2. CAPACITOR
   All capacitors are ceramic 50V capacitor, unless otherwise noted the following marks. Unit of capacitance is uF, unless otherwise noted.
   - M : Polyester capacitor
   - S : Polystyrene capacitor
   - Electrolytic capacitor
3. COIL
   Unit of inductance is uH.
4. TEST POINT
   Test point position (TPA2)
5. VOLTAGE MEASUREMENT
   Voltage is measured by a volt ohm meter with DC 20K OHM/V receiving color bar signal, when all controls are set to the maximum position.
6. Number in red circle indicates waveform number (See main manual.)
7. When arrow mark is found, connection is easily found along with the direction of an arrow.
8. When schematic diagram of a board is described in more than two places, they are encircled with dotted line.

IMPORTANT SAFETY NOTICE

THE SHADED AREA ON THIS SCHEMATIC DIAGRAM INCORPORATES SPECIAL FEATURES IMPORTANT FOR PROTECTION FROM X–RADIATION, FIRE AND ELECTRICAL SHOCK HAZARDS. WHEN SERVICING IT IS ESSENTIAL THAT ONLY MANUFACTURER'S SPECIFIED PARTS BE USED FOR THE CRITICAL COMPONENTS IN THE SHADED AREAS OF THE SCHEMATIC.

B-BOARD TNP65346ZA



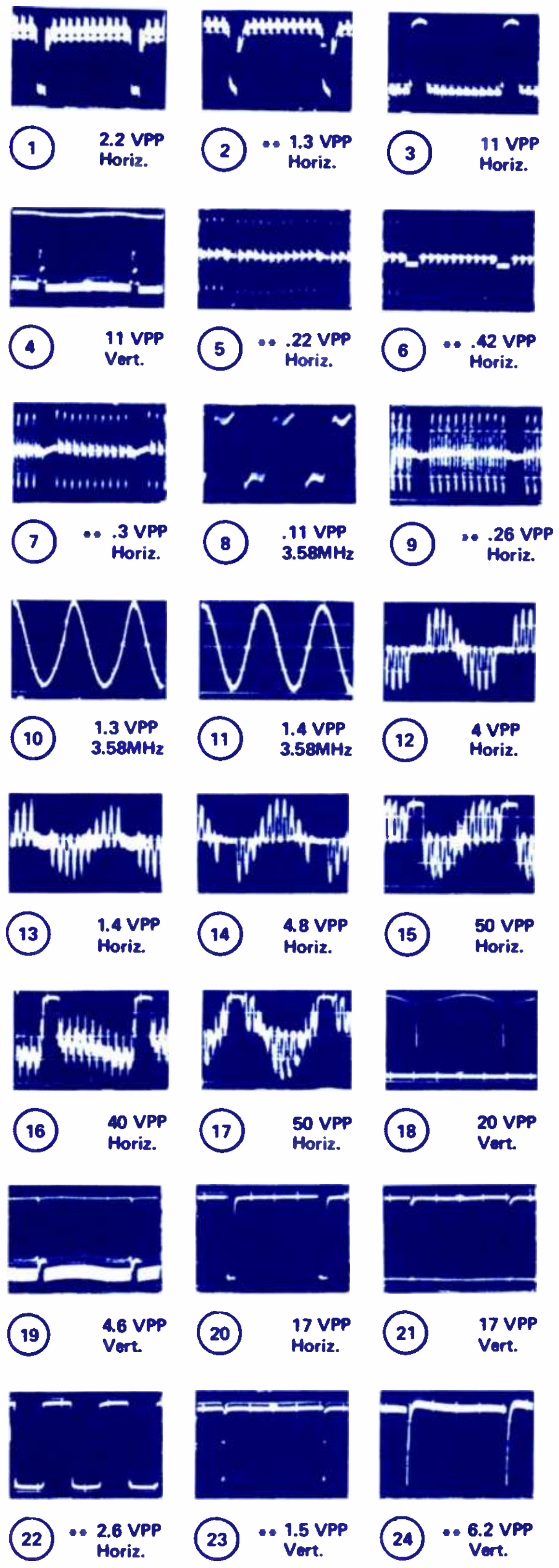


1643 SYLVANIA
Color TV
Chassis
E 21-1

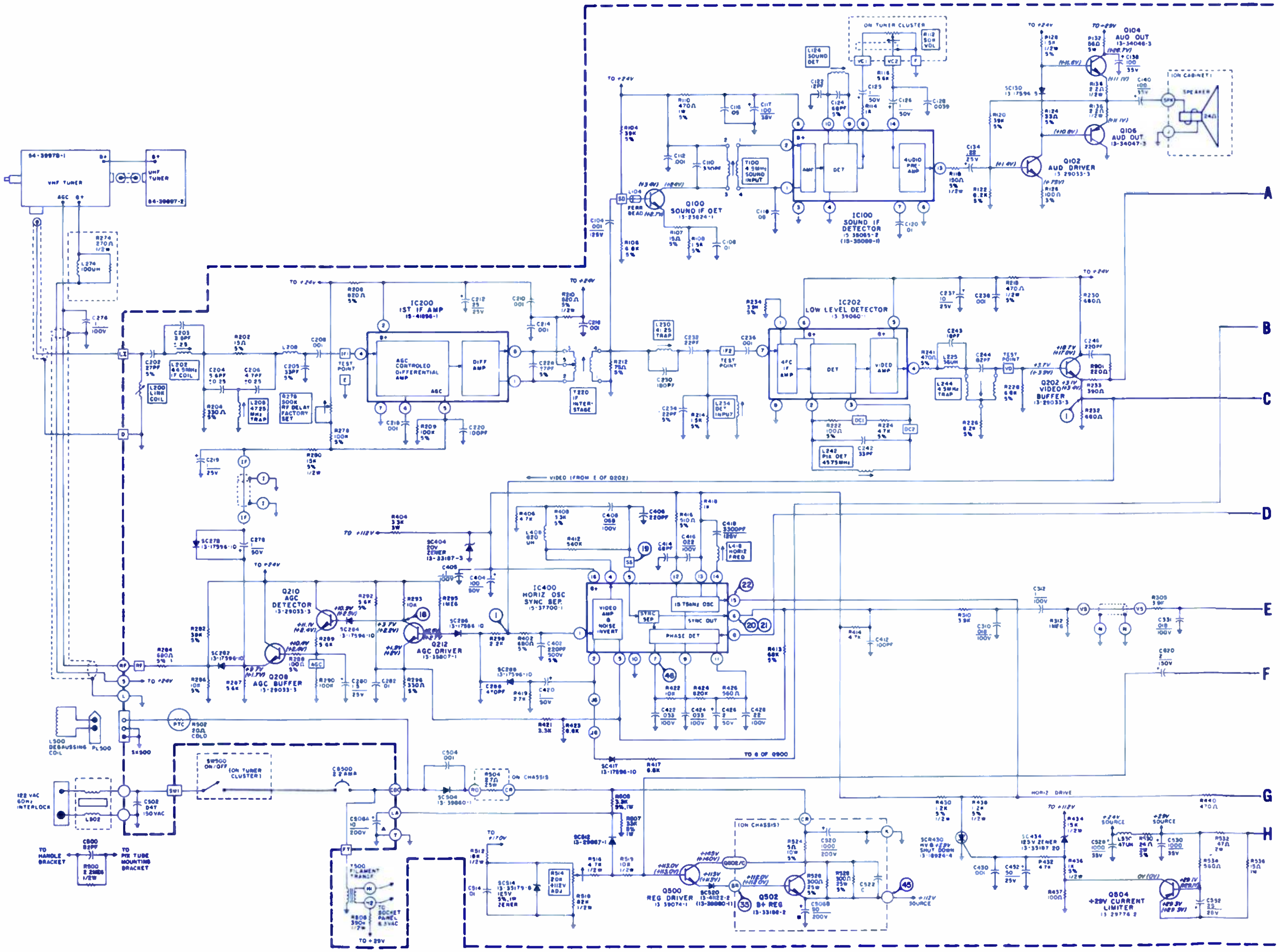
MAY • 1976

ELECTRONIC TECHNICIAN/DEALER TEKFAX

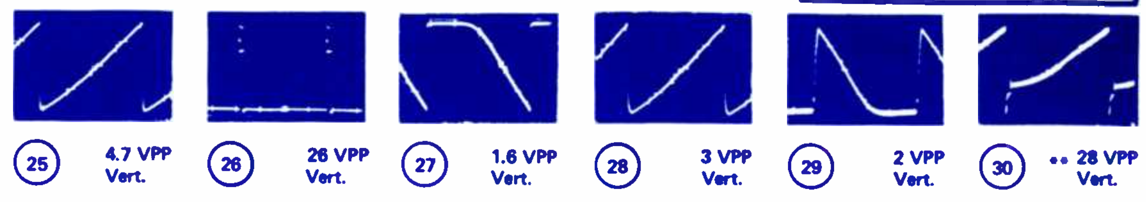
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 4 NEW SETS

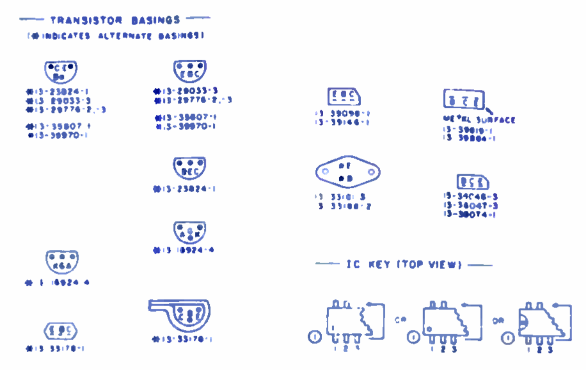


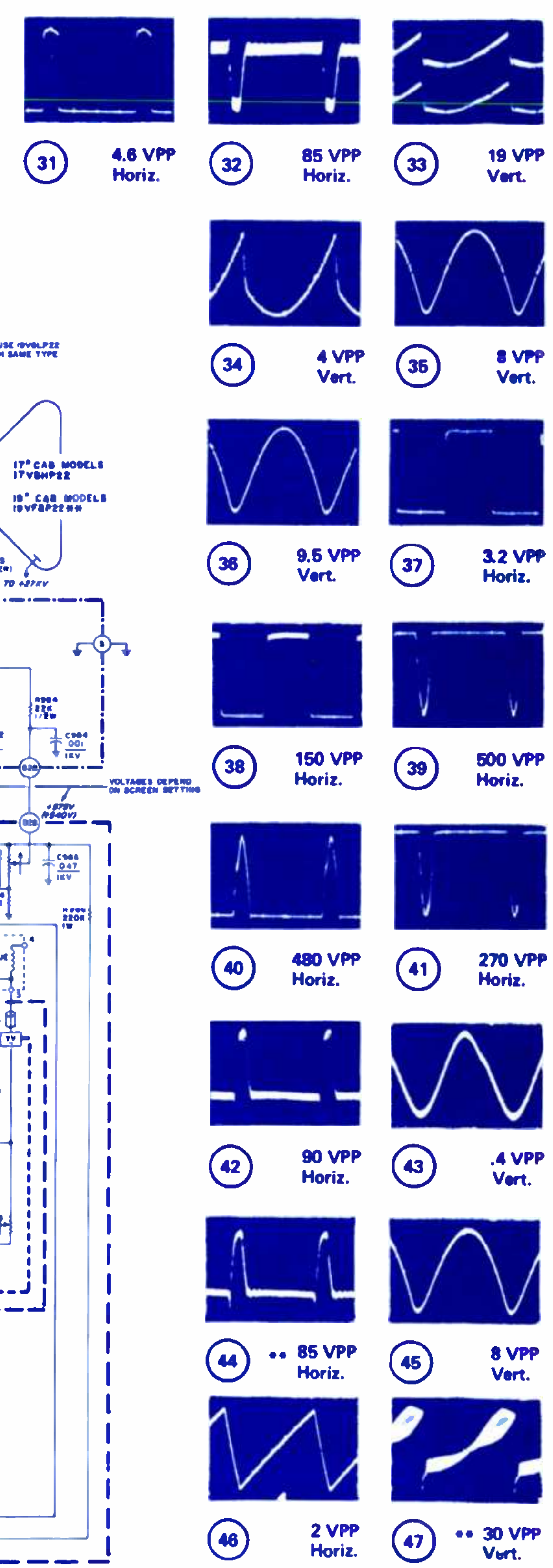
**NOTES:
WAVEFORM NUMBER 2, TAKEN WITH CONTRAST CONTROL AT MID-RANGE OF ROTATION.
WAVEFORM NUMBERS 5, 6, 7, 9, OSCILLOSCOPE GROUND CLIP AT NEAREST CHASSIS GROUND.
WAVEFORM NUMBER 22 MEASURES APPROXIMATELY 8.5 VPP ON -1,-2,-7 CH.
WAVEFORM NUMBER 27, OSCILLOSCOPE GROUND CLIP AT +29V.
WAVEFORM NUMBER 30, APPLIES TO E21-1 ONLY.
WAVEFORM NUMBERS 7, 23, 24, 44, 47 APPLY TO E21-2,-3,-6,-7 ONLY.

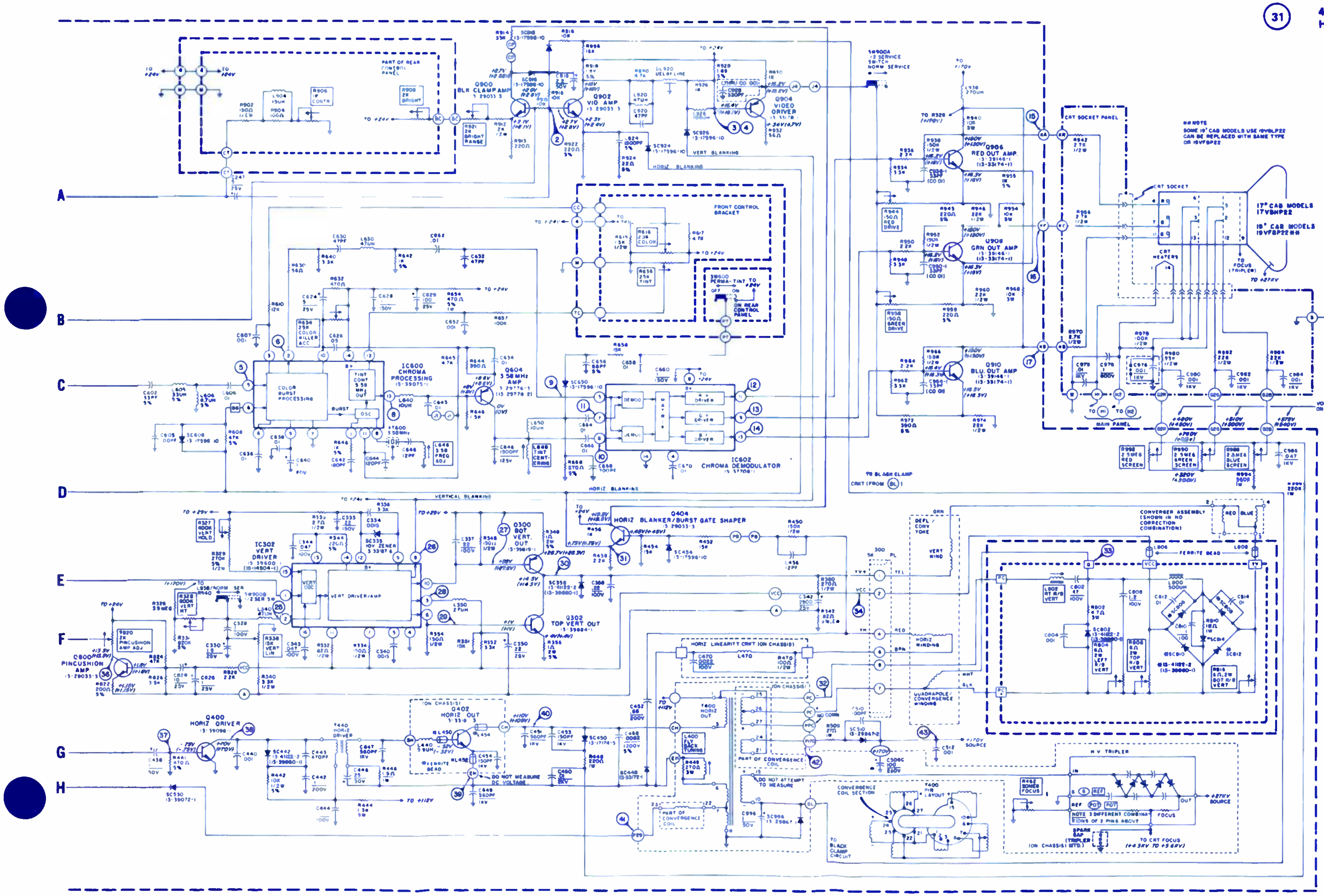


SYLVANIA
Color TV Chassis
E 21-1









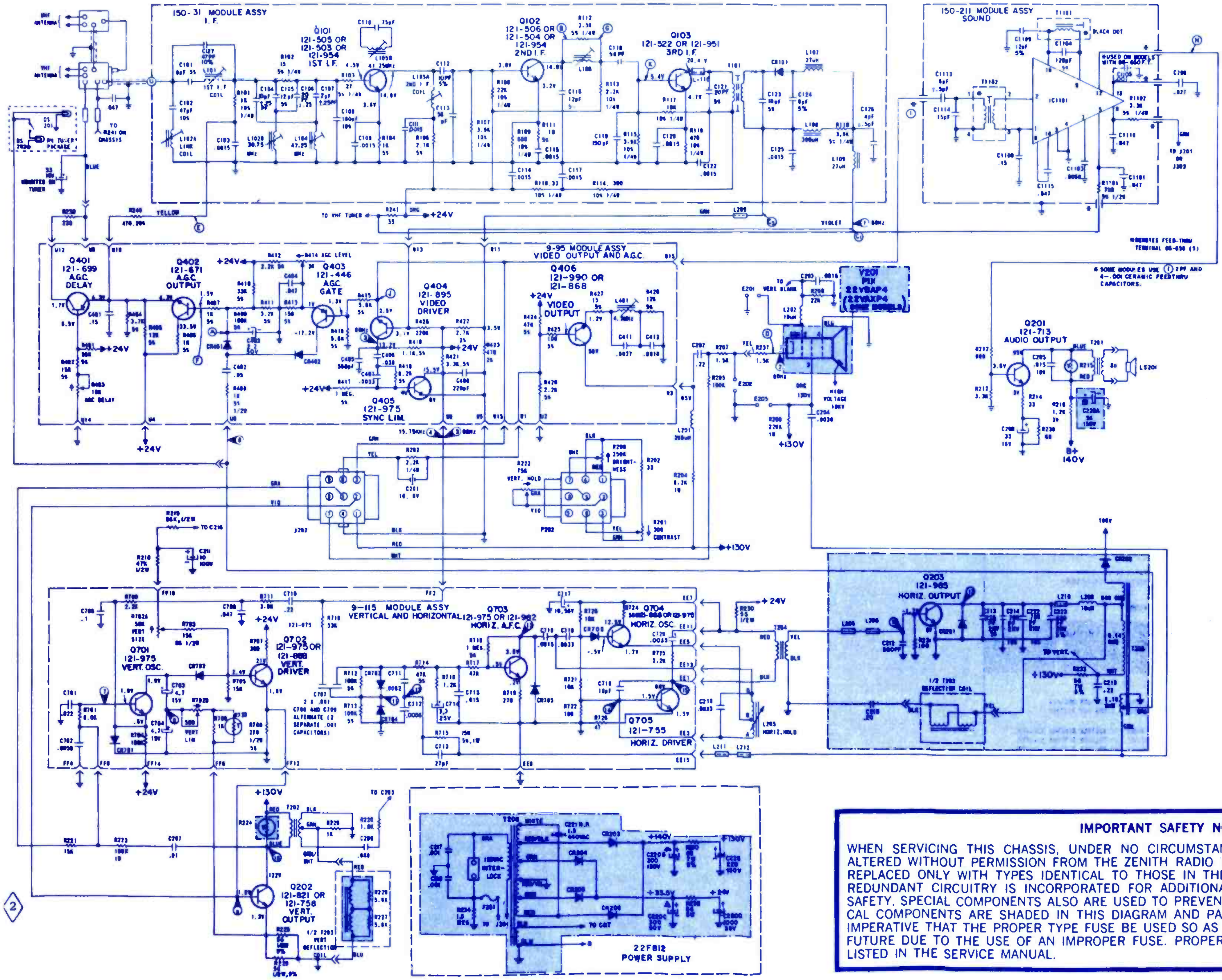
1644

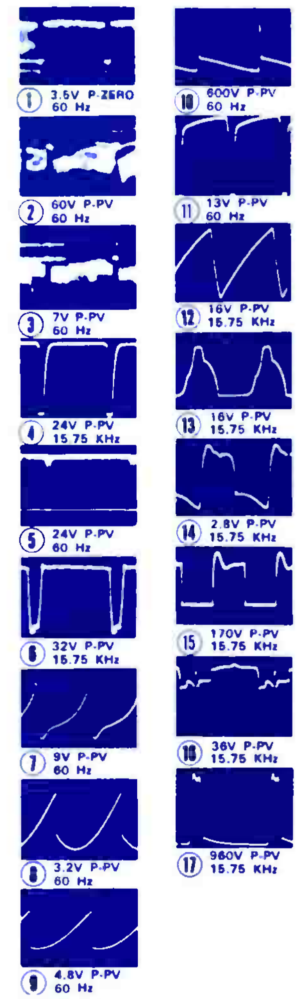
ZENITH
B-W TV Chassis
22FB12

MAY • 1976

ELECTRONIC TECHNICIAN/DEALER TEKFAX

COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 4 NEW SETS





IMPORTANT SAFETY NOTICE

WHEN SERVICING THIS CHASSIS, UNDER NO CIRCUMSTANCES SHOULD THE ORIGINAL DESIGN BE ALTERED WITHOUT PERMISSION FROM THE ZENITH RADIO CORPORATION. COMPONENTS SHOULD BE REPLACED ONLY WITH TYPES IDENTICAL TO THOSE IN THE ORIGINAL CIRCUIT. IN SOME INSTANCES REDUNDANT CIRCUITRY IS INCORPORATED FOR ADDITIONAL CIRCUIT PROTECTION AND X-RADIATION SAFETY. SPECIAL COMPONENTS ALSO ARE USED TO PREVENT SHOCK AND FIRE HAZARD. THESE CRITICAL COMPONENTS ARE SHADED IN THIS DIAGRAM AND PARTS LIST FOR EASY IDENTIFICATION. IT IS IMPERATIVE THAT THE PROPER TYPE FUSE BE USED SO AS NOT TO CREATE A SAFETY HAZARD IN THE FUTURE DUE TO THE USE OF AN IMPROPER FUSE. PROPER FUSE VALUES AND PART NUMBERS ARE LISTED IN THE SERVICE MANUAL.

Sylvania solves the problems of old age.

If you still have sentimental attachments for your old color test jig, Sylvania has attachments for it, too.

Our attachments put your old test jig back to work on the latest high voltage, hybrid and all solid-state sets.

For example, our CK2000 and CK2001 regulators will adapt your present jig to safely handle up to 35 kV. The CK2000 comes with an anode voltage meter and three range programmers covering 19-26 kV 25-31 kV and 27-35 kV. The CK2001 has all the same features as the CK2000 without the anode meter.

If your present jig handles only tube sets, attaching the Rig-A-Jig™ CK1900X will improve its versatility to handle solid-state and hybrid sets as well.

But most important of all, we don't let any of our test equipment grow old. Our complete line of cables and adapters comes out almost as soon as the new sets do. A continually revised set-up manual shows you which adapters to use with which set.

By updating your present jig, Sylvania is giving it a longer lease on life. See your Sylvania distributor today.

We're helping you make it.

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