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ELECTRONIC TECHNICIAN/DEALER

WORLD'S LARGEST TV-RADIO SERVICE & SALES CIRCULATION

Coax or Twin Lead — Making The Choice

'74 NEW COM/SHOW ISSUE

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send faulty unit with tubes, shields and all broken parts to:

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or to any of our strategically located Service Centers

. . . for more details circle 124 on Reader Service Card

If you had to name the top electronics service company who would it be?

That's a tough question, because when it comes to service, it's hard to compare apples to apples. Some companies offer you many services—others very few. So before you make up your mind, we'd like to tell you about some of the services Panasonic has developed. Services that can make both our jobs a lot easier.

Like offering complete technical back-up information and assistance. We make available detailed service manuals on every product we've ever sold—over 11,000 since 1959. And if you need more information, call the regional office in your area. And if you still want assistance, we'll send out one of our traveling field service specialists as your personal problem solver. And there's more. We hold annual training seminars to acquaint you with our products, inside and out. And at industry conventions, you'll find a Panasonic representative to explain our latest service advances.

At the core of it all are our products. All designed with a high level of serviceability—meaning less time and effort for you. For instance, our Quatrecolor TV sets scored 94.6 in the NEA serviceability tests of January 1973. And we're continually looking for new improvements. The fact is that Panasonic pays as much attention to service as it pays to sales. And everybody is profiting—consumers, dealers and service technicians.

So before you consider who to name as the top electronics service company, run through the facts. The more you know about Panasonic, the better it is for everybody.

Panasonic.
just slightly ahead of our time

ELECTRONIC
TECHNICIAN/DEALER

APRIL 1974 · VOLUME 96 NUMBER 4

FEATURES

DEPARTMENTS

A HARCOURT BRACE JOVANOVICH PUBLICATION

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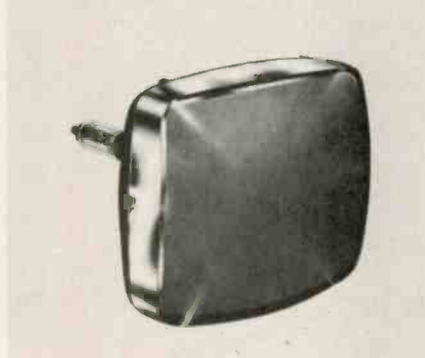
Now–a middle line of RCA replacement color picture tubes...

COLORAMA

INTRODUCING RCA COLORAMA A

It rounds out RCA's complete range of tube quality, price and warranties.

HI-LITE



Colorama . . . Good
This is RCA's commercial standard color picture tube line. Each tube has a new electron gun. The other components and materials are re-used, after careful inspection to meet RCA's high quality standards.
12 month warranty . . . additional 12 months available.

Colorama A . . . Better
This is RCA's grade "A" line. Every tube is totally remanufactured using the latest all-new rare earth phosphors, new electron gun, and used X-radiation attenuation glass.
18 month warranty . . . additional 12 months available.

Hi-Lite . . . Best
This is RCA's prestige line of all-new color picture tubes. Each incorporates a new electron gun, new X-radiation attenuation glass, latest new rare earth phosphors and Perma-Chrome, for locked-in color purity and uncompromised contrast and brightness.
24 month warranty . . . additional 12 months available.

And all three lines include RCA BLACK MATRIX Types,
the advanced RCA tubes that are as much as 100% brighter than any equivalent non-Matrix picture tube in RCA's history. So get the full choice of color picture tube quality, price and warranties. Make your choice RCA, leader in electronics for the home.

RCA

RCA/Electronic Components/Harrison, N.J. 07029

PUBLISHER'S MEMO

NEW/COM/74—A Vital Industry Show

NEW/COM/74 is devoted to professionalism in electronic parts and equipment distribution. Distributors and dealers, who now must cope with shortages, inflation and uncertainty, need to feel the pulse of the industry. The place to do this is NEW/COM. This year, the show, which is so vital to our industry, will be held at the Las Vegas Convention Center, May 8-10. This show has an impact on all ET/D readers. When I was at the distributor level in the '50's with Electronic Wholesalers and Sun Radio, the show was then known as the May "Parts" Show and was held each year at the Conrad Hilton in Chicago. Electronic technicians and service dealers were interested in the show then as they should be now.

NEW/COM/74 is arranged by Electronic Industry Show Corp. This is the third consecutive year it has been held in Las Vegas. In 1971, it was staged in Miami Beach. Next year, it will be held again in Las Vegas.

Supported largely by participating manufacturers, NEW/COM offers them an opportunity to exhibit their new products along with their regular line. It also provides the distributors with interesting and helpful seminars.

The end user of any product is the determining influence, according to basic marketing strategy. This is why surveys are conducted constantly by companies in all industries, particularly those in the consumer field. Accordingly, ELECTRONIC TECHNICIAN/DEALER continually surveys the purchasing power of electronic service technicians and service dealers.

One of the questions asked in a recent survey was: "On brand recognition or specification of replacement parts in the servicing of home entertainment electronic equipment, who determines the brands purchased by you from your distributor? Have you influenced your distributor to stock inventories of parts by brand name as specified by you?" Almost half of those who responded said they definitely ask their distributors to stock specific brands of products. From this, it is clearly evident that the readers of ET/D make their buying influences felt where they purchase parts and equipment. I recently received a communication from Vincent J. Lutz, CET, Director of Special Activities, National Electronic Service Dealers Association, Inc. (NESDA), concerning their yearbook. He affirms that NESDA members spend three-quarter billion dollars for items and products they use and sell. Overall estimates by the Consumer Electronics Group, Electronic Industries Association, indicate that there was a $7 billion market in our vibrant industry in 1973. Thus, it is an established fact that the readers of ELECTRONIC TECHNICIAN/DEALER are those to whom the distributors of electronic parts and equipment must merchandise their products.

Over 30 firms will exhibit for the first time, or for the first time in a number of years, at NEW/COM/74 in Las Vegas. Most of these 30 firms are new to the industry. Therefore, this vital show will be the initial time that electronics distributors will have an opportunity to meet the executives of these companies and see the products they have to offer. In one trip, under one roof, distributors and dealers meet with everybody who's anybody in electronic distribution. NEW/COM therefore is of great importance and interest to the readers and editorial and sales staffs of ELECTRONIC TECHNICIAN/DEALER. We will be there to look at the electronic parts and equipment that you will be purchasing in the near future. Of equal importance, the activities of this show and the products displayed will effect the working relationship that you will have with your distributor.

NEW/COM/74 promises to be the greatest show of its kind. If you plan on attending this show, be sure to look us up.

Al Menegus

READERS' AID

Space contributed to help serve the personal needs of you, our readers.

For Sale

Weston Sweep Generator Model No. 984 and Weston Calibrator Model No. 985.
J. STEPANICH
1036 Blouin Drive
Dolton, Ill. 60419

Needed

Schematic or service information on a Progress-Webster Soundguard Transistor Intercom, Model SG 8407.
W. HOLCOMBE, CET
4941 Harford Ave.
Beltsville, Md. 20705

Schematic and servicing information for a Model 5230 Beckman/Berkeley Universal EPUT and Timer.
W. CREAMER
23 Magalia Drive
Magalia, Ca. 95954

Schematic for Woodward Schumacker Elect. Corp. Battery Charger Model WS1010.
WILLIAM J. ZRAJA
38 Oxford Ave.
Dudley, Mass. 01570

Service information for a Walton-Morse Radio Model 5, Style T, manufactured in Saginaw, Mich.
A. R. ROTRUCK
4513 Delamar N.E.
Albuquerque, N.M. 87110

Wanted

B & K Tube Tester Model TC615 and B & K Panel 610. Please state condition and price.
MELVIN F. LAKIN
427 So. 5th St.
Jeannette, Pa. 15644

Schematic and service information for a Toshiba 19-in. Color TV Model 3340.
V. KHURANA
7019 Highview Ter: #301
Hyattsville, Md. 20782

Service information on a Webster

continued on page 12

We help him make it easier for you.

Your GE tube distributor is always there when you need him. With a complete line of GE entertainment receiving tubes, replacement semiconductors and ULTRACOLOR® or all-new Spectra-Brite® picture tubes.

Competitively priced. With fast delivery assured by his balanced inventory and the GE tube warehouse network. Along with all the technical information, business and technical aids you'll ever need. You can depend on him and GE tube products.

Tube Products Department,
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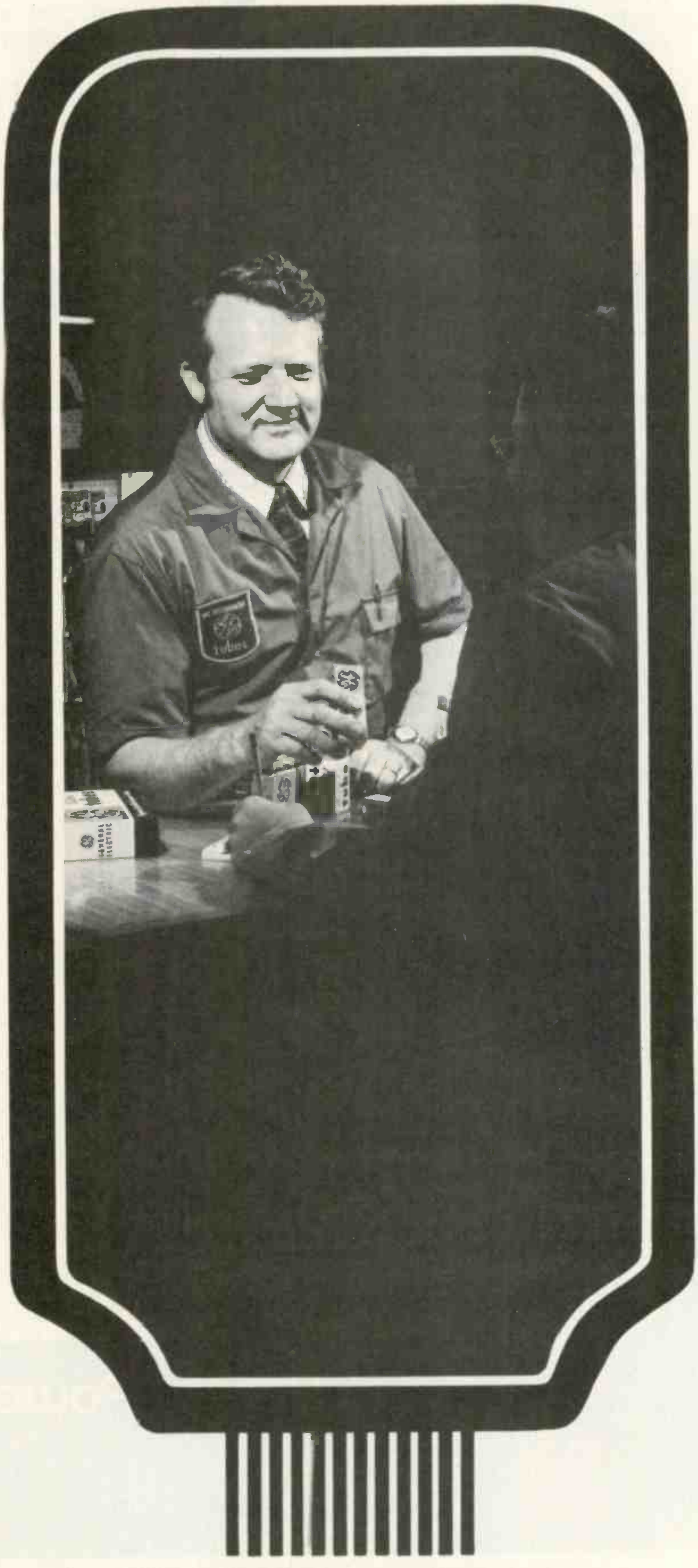
Owensboro, Kentucky 42301

We're in this business together.

GENERAL ELECTRIC



... for more details circle 110 on Reader Service Card

READERS AID...

continued from page 10

Chicago Corp. Wire Recorder Model No. RMA 375.
RAYMOND FRIEND
236 W. Pearl St.
Butler, Pa. 16001

Any service information for a U.S. Army Model AN/URM-105 multimeter manufactured by Advanced Measurement Inc.
DALE J. CARR
266 South Main St.
Doylestown, Pa. 18901

IF Transformer, Part No. 06100, for a Philco Radio Model 81.
ARTHUR A. HALL, JR.
603 Glenpark Ct.
Nashville, Tn. 37217

Tube placement chart and schematic for an International Short-Wave Receiver, Model No. 120.
RANDY MAURER
463 Pelham Rd.
New Rochelle, N.Y. 10805

Speaker cones for reconing purposes.
GILBERT TEJADA
Highway 28 RD #3
c/o Evelyn Cameron
Somerville, N.J. 08869

Tube chart for an Electronic Measurement Corp. Model 205 Tube Tester.
T. SWANSON
17371 Almelo Ln.
Huntington Beach, Calif. 92649

Service manuals or schematics for a Radar Eye made by Pinkerton Electro Security Corp., Webster, Mass., and for a Navy Scope OS-13 made by Lovoie Labs.
GLEN E. SPIETH
9292 So. Tacoma Way B-17
Tacoma, Wa. 98499

Used B & K Television Analyst Model No. 1077B.
D. B. FRITZ
3210 St. Laurence Ave.
Reading, Pa. 19606

DuMont Type 316 Probe, used with the DuMont 303 Oscilloscope.
D. TYWICKE
253 Falmouth Ave.
Elmwood Park, N.J. 07407

Variable tuning capacitor, Mitsumi Type PV2AF, for a Model CR-105 Tokai AM/FM radio.
WILLIAM H. BOWMAN
539 W. Lynn St.
Springfield, Mo. 65802 ■

"What gets me is his 'more electronically oriented than thou' attitude."

TECHNICAL LITERATURE

Cathode-Ray Tubes

A short-form catalog of professional cathode-ray tubes gives the electrical and mechanical specifications for forty different CRT types which are available for industrial and instrumentation purposes. Amperex Electronic Corp., Electro-Optical Devices Div., Slatersville, Rhode Island 02876.

Dealer Sales Aids

A full-color catalog showing all of Hitachi's 1974 retail sales promotion aids is available. Dealers are invited to choose from among the 25 items pictured, to find the ones particularly suited to their own sales efforts. The selection covers point-of-purchase materials for both store interiors and window use. Advertising Dept., Hitachi Sales Corp., 48-40 34th St., Long Island City, New York 11101.

RF Transmission Lines

This booklet is written for the many people engaged in two-way radio communications. A non-technical presentation is attempted in an effort to bring about a better understanding of transmission lines used in two-way radio systems. It discusses the application of transmission lines and how they affect communication systems. Decibel Products, Inc., P.O. Box 47128, 3184 Quebec St., Dallas, Texas 75247.

Soldering and De-Soldering Equipment

A new catalog, No. 514, describes the company's line of soldering and de-soldering equipment. Some of the equipment listed includes: standard line soldering irons, three-wire soldering irons, interchangeable tips, Princess Micro Line irons, Imperial heavy-duty irons, heat guns, de-soldering equipment, production aids and complete kits. Ungar, Division of Eldon Industries, Inc., 233 East Manville, Compton, Calif. 90220.

Electronic Parts

More than 2,000 hard-to-find electronic items are added to the company's parts and test equipment line with a special "Quik-Fill" 1974 Electronic Parts Catalog. The 52-page catalog is available on request from any Radio Shack store. ■

NEWS OF THE INDUSTRY

Philco-Ford Offers 5 Percent Allowance on In-Warranty Parts

A five percent allowance on all parts used for in-warranty service is now offered to independent servicers by the Parts and Service Department of Philco-Ford. At the same time, the company is increasing in-warranty labor payments for certain types of servicing.

These two changes in the warranty servicing policies of Philco-Ford were announced recently by John W. Miller, General Parts and Service Manager. Commenting on the changes, Mr. Miller said, "At present, an independent service outlet must absorb all costs related to procuring, warehousing and redistributing replacement parts for in-warranty work. These are legitimate expenses, normally passed along to the consumer in out-of-warranty work, and the industry simply cannot ignore them any longer."

To help offset the cost of the new program, Philco has discontinued its "stocking discount plan for parts purchases," which Mr. Miller says was not used by many independent servicers.

Solid-State Reduces TV Energy Consumption

The power consumption of an all-solid-state color TV receiver is almost 25 percent less than that of a comparable hybrid receiver, according to the Magnavox Company, who recently performed a comparative study of the power requirements of their own all-tube, hybrid and all-solid-state color TV receivers.

Examples of the differences in power consumption found among the three designs of comparable color TV chassis studied are: all-tube, 325 watts; hybrid, 260 watts; and all-solid-state, 176 watts. These ratings, which, according to Magnavox, are typical of all color TV receivers on the market, were made with a watt meter, with the receiver adjusted for maximum usable brightness.

Other TV power-consumption facts revealed by the Magnavox study include: A good antenna system will reduce power consumption slightly but not significantly; the difference in power consumption between a strong and weak (snowy) signal is about 2 watts. Cable TV doesn't influence power consumption. An "instant-on" feature will increase the power consumption of all of the three designs of color TV receiver chassis, but the increase attributable to the "instant-on" feature in all-tube or hybrid chassis is about five times that of all-solid-state chassis—a difference of between 46 or 43 watts and 9.5 watts, respectively.

Consumer Electronic Sales Decreased Drastically in January

Total U.S. Market Sales to Dealers of all categories of consumer electronics products were down in January 1974 over sales in January 1973, according to the Electronic Industries Association's Marketing Services Department. Total unit sales to dealers of color television, the industry's major product, were down 12.3 percent in January 1974 over sales in the same month in 1973.

Total unit sales to dealers of monochrome television were down 14.3 percent in January 1974 from sales in the first month of 1973. Total television sales of 929,549 sets were down 13.2 percent from the 1,070,307 sets sold in the same period in 1973.

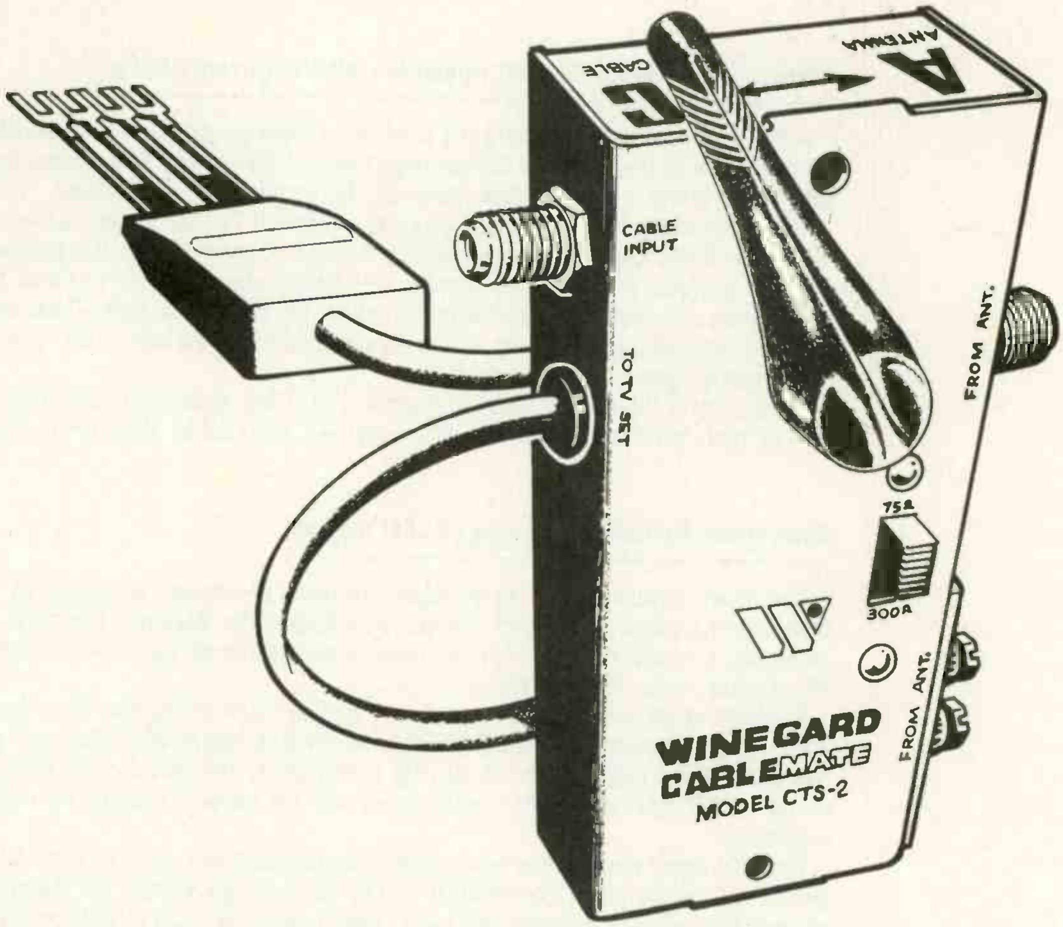
Home radio sales in January 1974 were down 60.5 percent from sales in January 1973. Automobile radio sales in the first month were down 19.4 percent over sales in January 1973.

Phonograph total unit sales to dealers in January 1974 were down 66.0 percent from sales in the same month in 1973.

Indianapolis and Cincinnati Technicians Receive Lower Wage Than Those in Minneapolis and Chicago

The average hourly wage of radio/television technicians in both Indianapolis and Cincinnati is $4.17, the lowest technician wage level of those reported in a recent U.S. Department of Labor Study of technician wages in four major Midwestern metropolitan areas. The average hourly rate for radio/television technicians in Chicago is $4.86, while those in the Minneapolis-St. Paul area receive $4.69. ■

How to sell a TV antenna to a cable TV subscriber.



The new exclusive Winegard Cablemate TV Signal Selector lets your customers enjoy the advantages of both cable and TV antenna reception.

If there's cable TV in your area, a lot of your customers already have, or someday will have, a cable hookup. Most of them sign up to get long distance stations or local programming not possible with an outdoor antenna. At the same time, cable people claim that every subscriber will get better reception all the way around.

But the cable subscriber usually gets shortchanged. He soon finds out that the channels he regularly watched with an outdoor antenna **don't** come in as clear on cable. And these are almost always the network stations, the ones people watch 90% of the time.

Technicians Frequently Get Blame

The problem of poor quality cable reception on one or more channels is a common one in city after city. Too often the TV technician is called for TV set repair when the cable is really at fault. Cable outages, too, are a frequent customer complaint.

That's where you come in. With a Winegard Cablemate TV Signal Selector and a Winegard outdoor antenna.

Cablemate lets you connect cable signal **and** the antenna signal to the TV receiver. The viewer simply flips a switch to select antenna or cable.

Not "Just Another Switch"

Cablemate, of course, is not an ordinary switch. It has specially designed circuitry with 58db isolation to prevent interference between cable and antenna signals. And it gives you a choice of coax or twinlead antenna input.

Customers Are Waiting For You

If your cable TV customer already has a good antenna on the roof, then all he needs is Cablemate. But if he has an inadequate antenna or none ar all, then he's a hot prospect for **both** an antenna and Cablemate. That's profitable business . . . and the easiest way yet to sell a TV antenna to a cable subscriber.

As you can tell, you stand to gain a lot from one switch! But then remember it comes from Winegard, the folks who consistently originate new and better products for the TV service industry.

MODEL CTS-2 (Illustrated): **$16.95** suggested list.

MODEL CTS-1 (same, but has 75 ohm and 300 ohm output to set and does not include coax or band separator): **$14.95** suggested list.

WINEGARD
TELEVISION SYSTEMS

Winegard Company • 3000 Kirkwood Street • Burlington, Iowa 52601

ATTENTION:

Channel Master, ACA, USAC, Jerrold, RCA and Other TV Antenna Manufacturers

WINEGARD® INVITES YOU TO "SWITCH"

Yes, we invite you to join us in helping TV service-dealers sell TV antennas in cable TV areas.

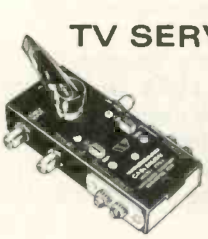
Extensive research by Winegard Company has revealed that cable TV reception on the regularly watched "local" channels is inferior to reception provided by a good outdoor TV antenna. As a result of our findings, we have developed a unique switching device called CABLEMATE. It lets the viewer switch instantly from antenna signal to cable signal. In this manner he can enjoy the best of both types of reception. As a bonus, the viewer has television reception even when the cable "blacks out."

CABLEMATE has already helped Winegard dealers sell hundreds of antenna installations to cable TV subscribers. It has helped create awareness of the importance of a good TV antenna and to revive antenna business in city after city.

This approach to selling TV antennas in the face of CATV growth is so important to the dealers of this country that we invite you to join us as a competitor. In other words, if all we antenna manufacturers promote better TV reception by means of a well-designed switching device, together we can reach every dealer and cable subscriber across the nation.

We invite you to design and market a cable/antenna switch of comparable quality to our CABLEMATE. Your efforts, combined with ours will be of lasting benefit to consumers and dealers alike.

JOIN US IN HELPING INDEPENDENT TV SERVICE DEALERS BRING BETTER TV RECEPTION TO THE AMERICAN PUBLIC



WINEGARD COMPANY

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

ELECTRONIC ASSOCIATION DIGEST

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

7,000 Certified Electronic Technicians Registered with ISCET

The International Society of Certified Electronic Technicians has announced that there now are 7,000 registered Certified Electronic Technicians (CET's). Of this number, 98 percent have qualified as CET's by successfully completing the optional Consumer Electronics examination, according to Ron Crow, CET, Executive Director of the CET program.

To qualify as a CET, applicants must have four or more years of experience and/or schooling in electronics servicing and related technology and must pass a written examination. The CET written exam is divided into two segments: a "basics" segment, which all applicants must pass, and, an optional segment, which is designed to test the applicant's knowledge and skill in the specialty area which he has chosen. There presently are five specialty areas from which an applicant may choose: Consumer Electronics, Audio/Hi-Fi, Communications, Industrial, and MATV/Reception specialist.

CET examinations are administered by 250 Certification Administrators at various locations throughout the 50 states. Exams are given quarterly, on March 15, June 15, September 15 and December 15. The exams fee is $10.00. For more information about the CET program, write: ISCET, 1715 Expo Lane, Indianapolis, Indiana 46224.

Conventions

The 10th Annual Convention of the Florida Electronic Service Association will be held June 21-23 at the Deauville Hotel, Miami Beach.

NATESA Processes 180 Parts Procurement Problems in 30-Day Period

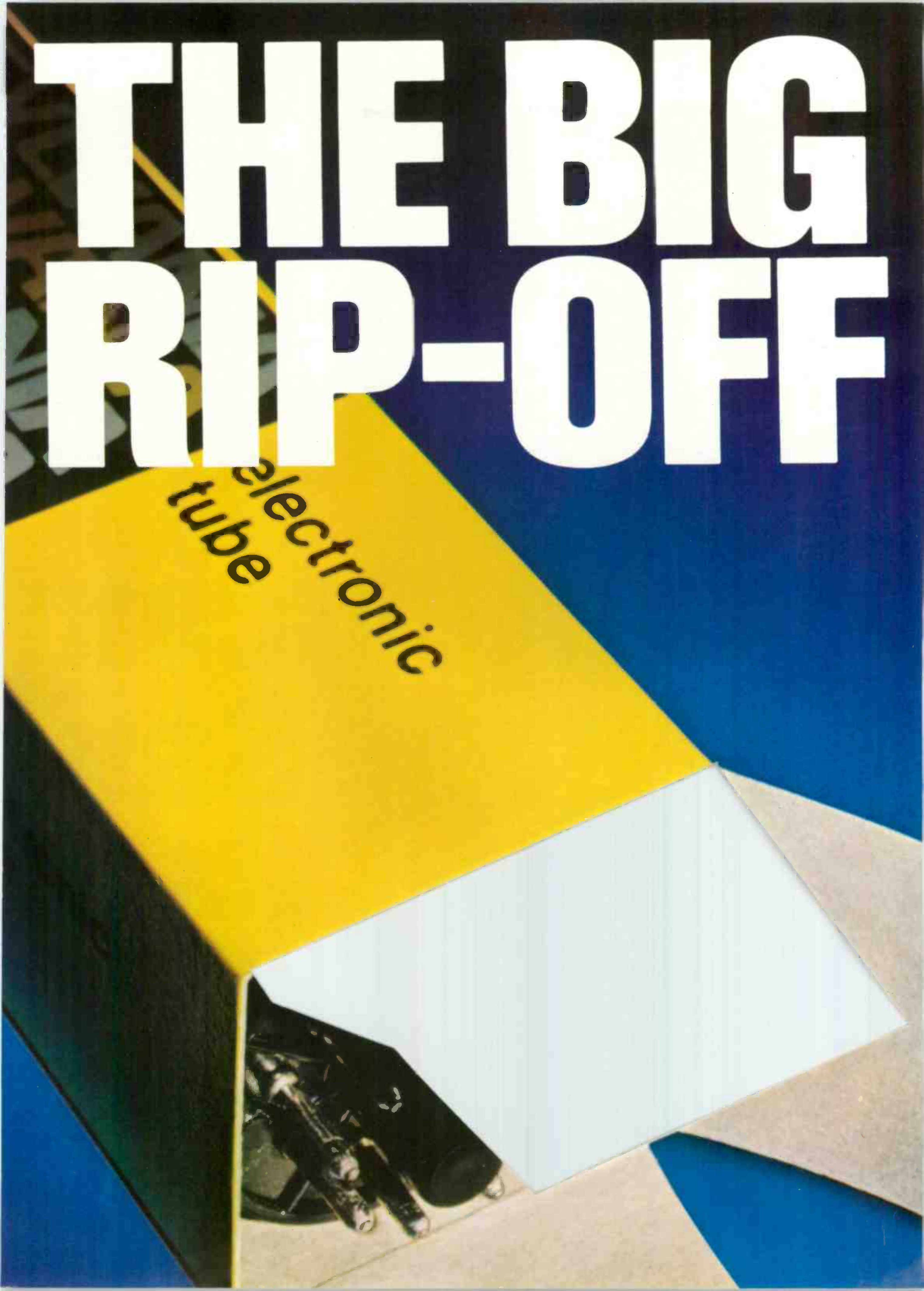
The National Alliance of Television & Electronic Service Associations (NATESA) during a recent 30-day period successfully fulfilled 180 requests from members for parts procurement assistance, according to Frank J. Moch, Executive Director, NATESA.

Moch, in a report in the February issue of *Scope,* the official NATESA publication, stated that the Parts Expediting Program has been well received by NATESA members and manufacturers alike. In a letter to Moch, William (Dutch) Meyer, Manager, Product Service, General Electric, said, "Your letter sent to manufacturers on November 30 regarding parts availability is most commendable. . . . Your reply card will be most helpful, and if you do happen to get any cards relative to General Electric parts, I would appreciate getting them just as quickly as possible, or if you wish, just pick up the telephone and call me collect here in Portsmouth."

The NATESA Parts Expediting Program was introduced a few months ago to help NATESA members obtain parts quicker. Whenever a NATESA member encounters a parts availability problem, he describes the part on a NATESA Parts Expediting Card, and sends the card to NATESA, who then attempts to obtain the part for the member. ■

For more information about GTE Sylvania circle number 111 on Reader Service Card. →

THE BIG RIP-OFF









Introducing Sav-

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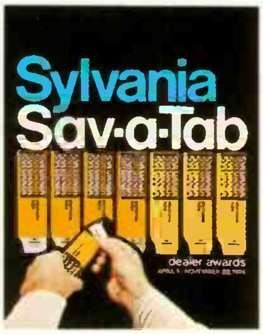

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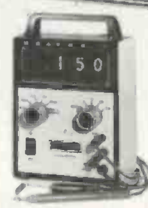

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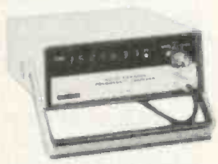

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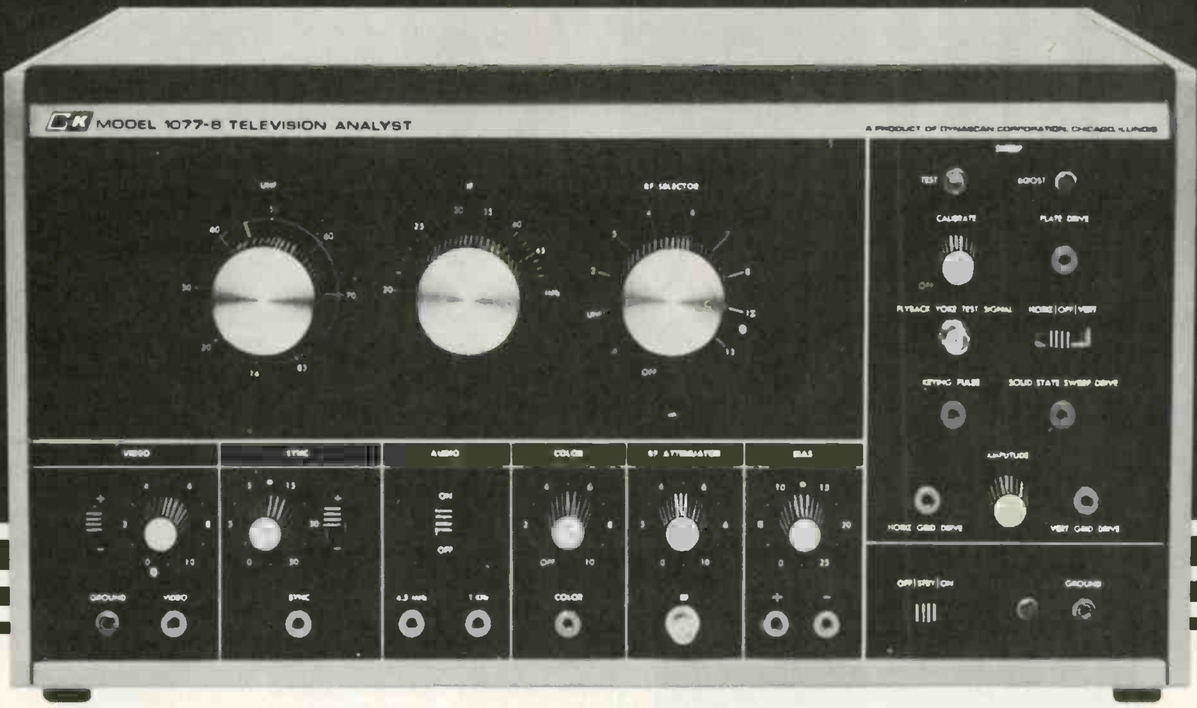

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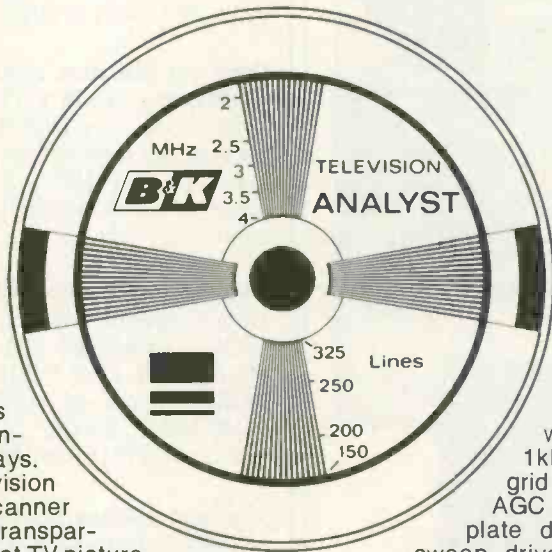

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TEKLAB REPORT

by Joseph Zauhar

Admiral's Modular Color TV Chassis M25

Modular construction combined with a slide-out chassis eliminates removing the chassis for most service problems

■ Each year we find manufacturers of color TV sets producing more all-solid-state, modular chassis. Admiral is no exception. The predecessor of the Admiral M25 chassis was a hybrid design employing eight tubes, whereas the new M25 chassis is completely solid-state, with the exception of the picture tube.

The M25-equipped Admiral color TV Model 5L5735 we received for review includes the following features:

One-knob selection of VHF or UHF channels—a single CHANNEL-SELECTOR knob, on the upper right corner of the front panel, selects either VHF or UHF channels, depending on the position of a pushbutton labeled UHF/VHF, on the top center of the control panel. When the UHF/VHF button is pushed in, the UHF channel indicator is lighted and any of 6 preset UHF channel positions can be selected by rotating the CHANNEL-SELECTOR knob. When the

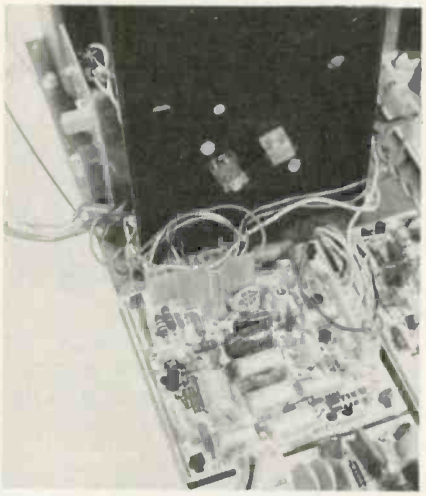
Admiral's Model 5L5735 Color TV equipped with the new M25 chassis.

UHF/VHF button is pushed in and then released to the out position, the VHF channel indicator is lighted and any of the standard 12 VHF channels can be selected by rotating the CHANNEL-SELECTOR knob.

Six preset UHF channels—As described previously, the CHANNEL-SELECTOR knob has 6 UHF positions. Each of these positions can be pretuned to any of the 70 UHF channels (14-83). The pretuning is accomplished by placing the UHF/VHF button in the UHF (in) position, rotating the CHANNEL-SELECTOR knob to one of the 6 UHF positions and then adjusting the corresponding thumbwheel of the six located behind a door on the right front of the cabinet.

The M25 chassis uses a 12-position VHF tuner and a varactor-tuned UHF tuner. Six thumbknob adjustments are used to pretune any six UHF channels.

One-button preadjustment of color, tint, contrast and brightness—This customer-convenience feature is activated by a pushbutton labeled COLORMASTER, on the upper left of the control panel. When the COLORMASTER button is pushed in, the picture qualities of color, tint, contrast and brightness are automatically reset to levels established by a factory-preset system called Colormaster V. Knurled controls inside the shafts of the conventional front-panel COLOR, TINT, CONTRAST and BRIGHTNESS controls permit field adjustment of the Colormaster V system, if needed. Adjustment of these Colormaster V preset controls can be accomplished from the front of the receiver with a special screwdriver, which is included with the receiver.



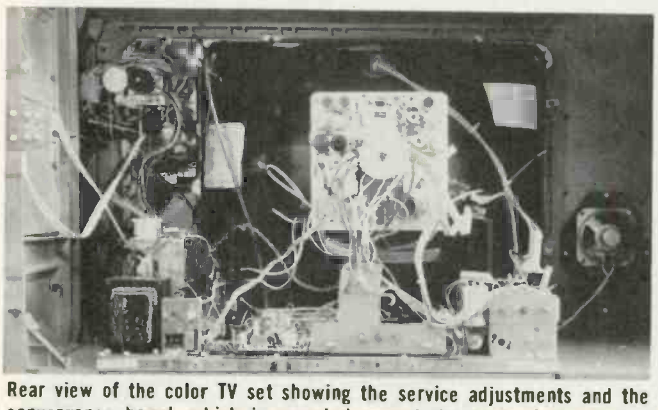
The M600 Vertical Module and the two vertical-output transistors, which are mounted on a large vertical heat sink.

Rail-mounted main chassis—Removal of two hold-down screws permits the rail-mounted chassis to be slid-out eight inches, for convenient component or module replacement.

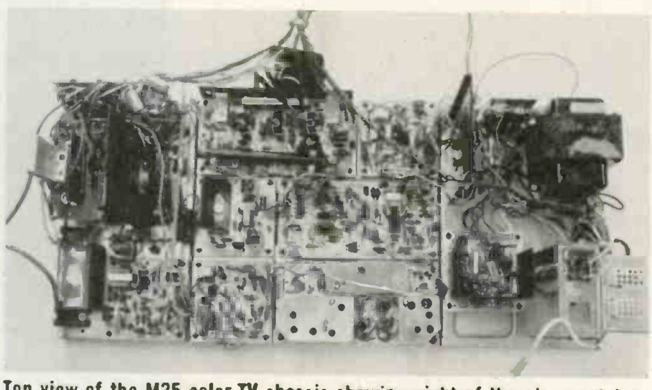
Easily-removed modules—The M25 chassis is equipped with nine modules, including the convergence board, which is mounted around the neck of the picture tube. Modules mounted on the main chassis are secured with wing-type fasteners, which release the module when repositioned a quarter of a turn. A special tool for turning the module fasteners is included with the receiver. Based on our experience, we suggest that you use the special tool—the plastic fasteners are easily broken by using pliers. Connections to the modules are through easily removed plug-in and push-in type connectors, all of which are on the top edges of the modules.

Other serviceability features—The circuitry on the modules, which comprises about 90 percent of that in the chassis, is clearly roadmapped on the top of the module, with key points and components marked for quick identification. All components are mounted on the top of the chassis or on the top of the modules.

The circuits employed in this chassis are similar to those in its predecessor, M20 color TV chassis. However, major changes have been made in the high-voltage system and in the sound, vertical, horizontal oscillator and chroma-output cir-



Rear view of the color TV set showing the service adjustments and the convergence board, which is mounted around the neck of the picture tube.



Top view of the M25 color-TV chassis showing eight of the nine modules. The convergence board, which also is considered a module, is not shown.

cuits, all of which were equipped with tubes in the M20 chassis.

The circuits in which major changes have been made are analyzed in the following paragraphs. During the analysis, you can refer to the simplified schematics included herewith or you can refer to Tekfax Schematic No. 1504 (ET/D, January, 1974), which covers the complete circuitry of the new chassis.

UHF Tuner Circuitry

To eliminate the mechanical wear inherent with moving parts, varactor diodes are used to tune the UHF tuner in place of a rotating tuning gang. The varactor diodes function much like a variable capacitor. The junction capacitance of the varactor is varied by changing the amount of reverse bias applied across it.

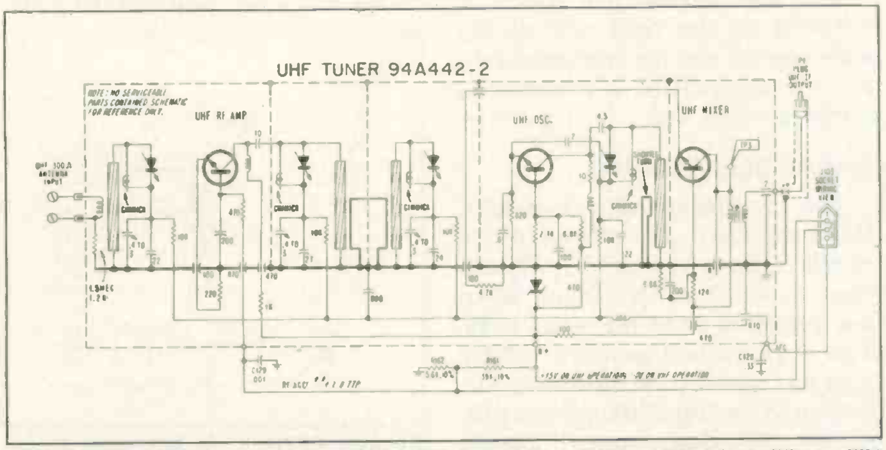
The UHF/VHF switch, S102, located on the front control panel, permits use of a single channel-selector control for both VHF and UHF channel selection. When pushed in, S102 connects B+ to the UHF tuner, for UHF operation. When released to the out position, S102 removes B+ from the UHF tuner, for VHF operation. During UHF operation, RF AGC voltage, filtered by capacitor C129, is applied through R53 to the base of the UHF RF amplifier transistor, Q51.

UHF channel tuning is accomplished by six preset potentiometers on the PW150 UHF tuning board. The controls are connected from ground to a B+ supply, which is regulated by IC100. The wiper of each control applies tuning voltage to tuning wafer switch, S5, located on the rear of the VHF tuner. The tuning is then coupled to the cathodes of the varactor diodes, reverse biasing them and establishing a particular value of capacitance.

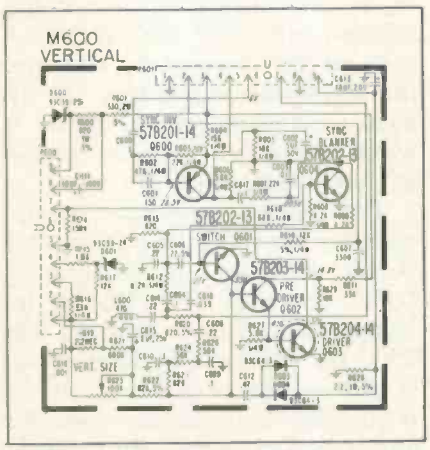
Transistor Q51 amplifies the UHF RF signal and couples it to the next compartment of the UHF tuner. A pick-up loop in this compartment couples the signal to the third compartment. A "gimmick" provides coupling of the RF and oscillator signals to the mixer transistor, Q53. Transistor Q52, the UHF oscillator stage, generates the desired local oscillator signal, which is 45.75MHz above the desired video carrier frequency. The two signals are mixed by Q53, producing the Video IF signal.

Horizontal-Output System

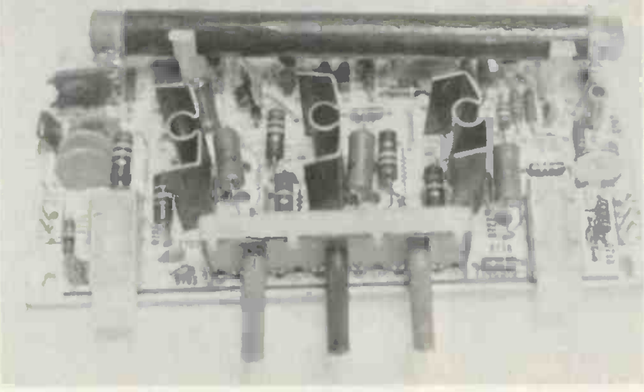
In this chassis, the horizontal-output stage is solid-state (the M20 used a 6LW6 horizontal-output tube and a 6DK3 damper tube). A voltage tripler develops the picture tube 2nd anode voltage, and, as in the



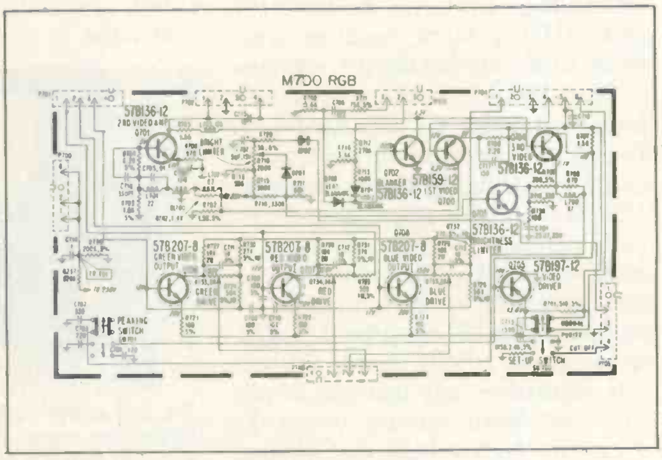
Schematic of the UHF tuner. It is equipped with three basic stages: a UHF RF amplifier, a UHF oscillator and a UHF mixer, all of which are tuned by varactor diodes. *Courtesy of Admiral.*



Schematic diagram of the M600 Vertical Module. *Courtesy of Admiral.*



The RGB M700 Module showing the green, red, blue video output transistors with large heat sinks. This module also includes the PEAKING and SET-UP switch, plus color DRIVE controls.



Schematic diagram of the M700 RGB Module. *Courtesy of Admiral.*

M20 chassis, a focus divider network is used along with the focus module to obtain the picture tube focus voltage.

The horizontal-output transistor, Q102, is turned on by the base drive current from the driver transformer, T801. During Q102 conduction, heavy current flow in the flyback windings provides the sawtooth current for the horizontal deflection coils. At the end of each line scan, the horizontal-output transistor is abruptly cut off by the drive current, causing the flyback field to collapse, which, in turn, develops a large positive pulse in the flyback. When the pulse returns to zero, the damper diode conducts, preventing the pulse from going negative, which would develop unwanted oscillations, or ringing.

The positive and negative pulses developed in the flyback are used for keying, blanking and power supply voltages. The 25v and 250v B+ voltages are obtained by rectifying the horizontal pulses from the flyback. The pulse at Terminal 9, which is negative going, is rectified by D105 to produce 25v.

The positive-going pulse on the collector of Q102, the horizontal-output transistor, is rectified by D106, providing 800v DC for the picture tube SCREEN controls. The 250v DC produced by diode D104 is unique because it is not only derived from the horizontal pulse but also is stacked on the 130v regulated supply. As a result, only a half-wave rectifier is needed to obtain the 250v DC voltage. Protector diodes D102 and D103 prevent negative transients from entering the B+ supplies.

Scan and high-voltage regulation are provided by the regulated 130v B+ supply. Because the collector of Q102 is connected to the regulated 130v B+ line through resistor R113, any increases of the picture tube beam current are prevented from reducing the 2nd anode voltage by the compensating effect of the B+ regulator on the M900 board. Without this regulation, any increase of picture tube beam current would decrease the high voltage and increase the current through Q102. The B+ regulator, on the M900 board, compensates for the increased current through Q102 by returning the B+ supply to 130v, thus restoring the high voltage to 26kv.

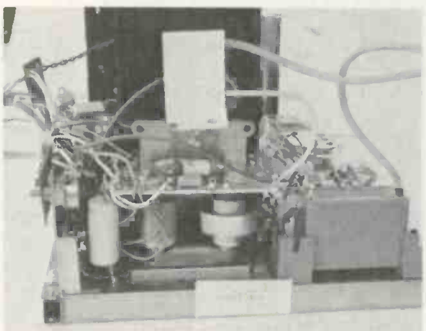
Capacitor C118 and resistor R118, connected to the low output tap of the high-voltage tripler, develop a negative DC voltage which is proportional to the picture tube beam current. This negative DC voltage is applied to the brightness limiter circuit, which provides supplemental beam current and high voltage regulation.

Diode D102 provides horizontal centering by establishing the DC component of the horizontal sawtooth drive current to the deflection yoke. Capacitor C107 modifies the yoke current, providing the "S" shaping needed for proper horizontal sweep linearity, to conform with the picture tube construction.

The horizontal-output system is mounted on the right rear of the main chassis, and the horizontal-output transistor, Q102, is mounted on a separate heat sink.

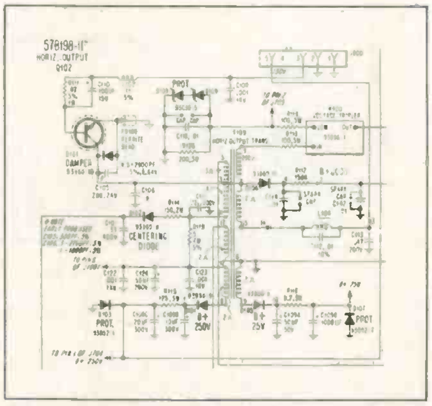
Vertical-Output Circuit

The vertical-output transistors, Q100 and Q101, are connected in a complementary symmetry configuration. In this type of circuit, when one transistor is **on** the other is **off**. This circuit action provides vertical scan and retraces the beam from the bottom to the top of the picture tube in the following manner: During scan from the top to the center of the picture tube, the conduction of Q100 gradually decreases, from maximum at the top to zero at the center of the raster. At the center, a drive signal from Q603 cuts off Q100, and Q101 begins to conduct, deflecting the beam from the center to the bottom of the raster.

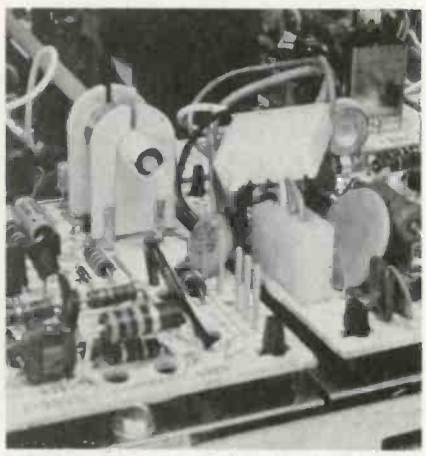


The high-voltage system is equipped with a high-voltage tripler and a focus divider network. The system is tuned to the fifth harmonic of the horizontal sweep rate.

The regulated bias supply for the vertical-output stage is developed by the voltage divider comprised of R614, diode D100, R600 and R601. Diode D600 provides the regulation. With this configuration, conduction of the two output stages depends entirely on the drive signal from transistor Q603. A .6v DC voltage difference between the two base elements is maintained by diode D100, to eliminate crossover distortion during transistor switching time. The retrace pulse and first half-cycle of the drive signal from Q603 forward biases Q100 into conduction; Q101 is reversed biased at this time. During the second half-cycle of input signal, Q100 is reverse biased and Q101 is driven into con-



Schematic diagram of the high-voltage system. *Courtesy of Admiral.*



Twist-type tabs are used to secure the modules. All wires are connected to the top of the modules through push-on-type connectors.

duction, thus completing one field of vertical sweep.

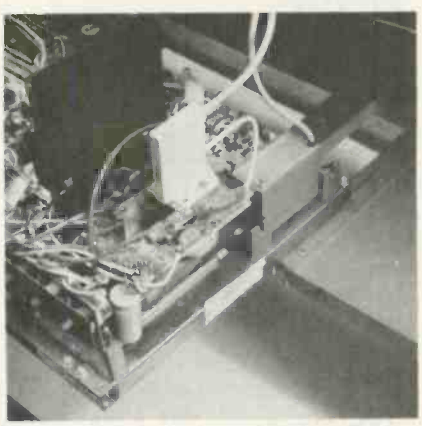
The vertical centering network consists of R128, R130 and the VERTICAL CENTERING control. The wiper voltage of the centering control determines the quiescent DC voltage in the deflection yoke, thus setting the reference point of vertical deflection.

RGB Output Stages

The RGB module, M700, contains the video/chroma output stages, NPN transistors Q706, Q707 and Q708.

A negative polarity composite video signal, at a DC reference level established by driver transistor Q705, is coupled to the emitters of each stage through SET-UP switch SW700, R721, R722 and R723. Color difference signals from the demodulator circuit on the chroma processor board, M400, is DC coupled to the base of each output stage. The DC component contained in this signal provides the DC supply bias of the output stages. When the SET-UP switch is in the CUT-OFF position, the preceding driver stage transistor, Q705, is disconnected and the output emitter circuits are grounded through resistor R738. This removes the video signal and provides a fixed emitter voltage, for gray-scale adjustment of the picture tube screen controls.

The filter capacitors are wired at the top to simplify removal, if required. Also shown are two of the wire harness plug-in connectors.



Slide rails allow the chassis to be pulled out approximately eight inches.

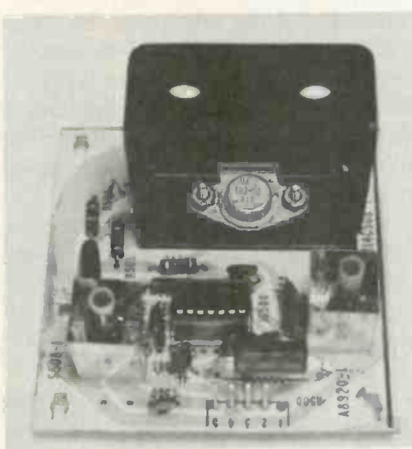
Decoupling capacitors C708, C709 and C710 remove 3.58MHz from the color difference signal applied to the base of each stage.

The demodulated color difference signal applied to the base of each output stage and the luminance signal applied to the emitters are matrixed. The resultant drive signal developed at the collectors of the output stages are coupled to their respective picture tube cathodes.

Resistors R724, R725 and R726 provide degenerative feedback for the three output stages. A DRIVE control in the collector circuit of each output stage permits independent adjustment of the drive signals applied to the cathodes of the picture tube.

Audio-Output Circuit

In the M25 chassis, transistor Q500 replaces the 6AQ5A audio-output tube which is used in the M20 chassis. This transistor is operated Class A, and is biased by DC coupled directly through resistor R511 from integrated circuit IC500. Resistor R504 provides the emitter ground return, while R502, R503 and capacitor C506 form a degenerative feedback circuit, for stage stabilization.



The audio module in the M25 chassis uses a NPN transistor audio-output stage in place of the 6AQ5 audio-output tube which was used in the M20 chassis.

The amplified audio signal on the collector is coupled to the speaker through transformer T101. The primary of the transformer also couples the regulated B+ 130v supply to the collector of the audio-output transistor.

Video and Chroma Buffer Amplifier

The detected composite video signal is fed to the base of Q204, the video and chroma buffer amplifier. The polarity of the signal at the collector of Q204 is negative, and is fed to Q700, the 1st video amplifier on Module M700. Positive video in the emitter circuit of Q204 is fed to the video buffer stage, Q300, on Module M300, to become the signal source for the sync and AGC circuits. This signal also is coupled to the input of the chroma amplifier section of M400, the chroma processor module.

Summary

Servicing of this chassis is simplified by the extensive use of modules and by the manner in which the components are mounted on the main chassis. The filter capacitors are mounted with the wire connections on the top side. All wire harnesses are connected to their respective circuits by plug-in connectors. The high-voltage wire terminals are on the top for easy access, and the high-voltage transformer can be removed from the main chassis by removing one screw.

The service literature for the M25 chassis also has been designed with serviceability in mind. The components and modules are laid out on the schematic in the same physical arrangement as they are on the chassis. ■

Coax or Twin Lead–Making the Choice

by Julius Green

■ When an antenna installation is designed, a great deal of attention is rightfully given to the antenna itself. We are all aware of the antenna's importance because of its prominent place at the head of the signal detection chain.

Unfortunately, choosing the lead-in-wire is often a much more haphazard procedure. The truly professional technician must be aware of the importance of the lead-in function and the factors that should be considered in its selection. Once the basics are understood, the choice of wire can be made quickly and intelligently, assuring the customer of the best value for his money. The customer can be made aware of the options. He understands durability, picture noise, interference and price.

After a comparison of the general construction and performance of coaxial cable and twin lead wire, variations within the two product types will be examined.

Equations have been included in the discussion, to give the technician a feel for how the impedance and attenuation of the transmission lines vary with their physical dimensions and how performance is affected.

Fields, Interference and Durability

Ideally, an effective FM/TV lead-in should be electrically transparent—that is, it should pass signal with no change. It should be immune from the temporary influences of automobile ignition and electric motor interference. Secondary pickup of the FM or TV signal itself by the line and the proximity of metallic objects such as rain-gutters and conduits wreak havoc with reception. Color TV is affected with phase distortion and ghosts, and FM with multipath distortion.

For long life, outdoor installations must resist the ravages of the weather and temperature extremes. The wire should be easy to install, and so should be flexible and reasonably sized.

Figures 1A and B show cross-sections of twin lead and coax with their electromagnetic fields represented by a series of solid and dotted curves.

In Figure 1A the twin lead picture is symmetrical because the line is made up of two identical parallel conductors separated and supported by a plastic dilectric, or insulator. The solid lines circling the two conductors are the electric lines of force, which are always at right angles to the magnetic field lines (dotted). These field lines satisfy a rather complicated set of relations known to the engineering world as Maxwell's equations.

The significance of the diagram is that, even though the energy contained in the field decreases rapidly as the distance from the line increases, the lines of force extend beyond the physical limits of the supporting material, and, consequently, are affected by the physical and electrical environment in which the line is run. The reaction of this uncontained field to external influence makes the line subject to electrical interference and to the antenna mast and other metallic objects such as raingutters.

Because it should not affect the electromagnetic field, the jacket, or covering, of the wire must be made from a material that is a compromise between weather resistance and electrical performance. Polyethylene is the material usually chosen for the job. After several years of exposure, polyethylene begins to deteriorate. As the plastic hardens and cracks, the line's performance drastically decreases, and the destruction is accelerated by contaminants such as dirt, water, snow, salt and ice entering the physical defects in the jacket.

Figure 1B shows a considerably different situation for coax. The electric field is a set of radial lines extending between the inner conductor and the grounded outer shield because they effectively are blocked, and the magnetic field is represented by concentric circles. Because they effectively are blocked by the electrical boundary of the outer shield, the fields are completely contained within the cable, except for some extremely small, insignificant leakage through the gaps in the braided wire or overlapped foil of which the shield is constructed. In a converse manner, the outer shield also blocks external fields, making the cable practically immune to interference. The only time when the shield effectiveness of coax should be questioned is when the cable must be run in proximity to another cable with a much higher signal strength, such as that of a powerful amateur radio transmitter.

Selection of the jacket material is not limited by its dielectric properties because the jacket is not in the field. Polyvinyl-chloride is usually chosen, simply because it is a physically strong and weather durable plastic.

Summarizing, coaxial cable is much superior to twin lead in endurance and interference rejection. It is easier to install because it can be run adjacent to or in contact with metallic objects. This superiority results from its more complicated structure. The larger amounts of material and more complex manufacturing procedure needed to fabricate coax give it a higher price. Although the initial cost of coax is more than that of twin lead, long-term costs of coax is lower because coax will outlast the installation, while twin lead will need replacement at least once during the life of the installation.

Impedance

At its input or output, a line matched with its characteristic impedance looks like it is infinitely long. Looking into either end of a properly terminated line, you see an impedance equal to the characteristic impedance of the line. For maximum power transfer and a minimum of reflected energy, the line must match the impedances of both the antenna and the receiver.

The impedance of typical twin lead is in the range of 240 to 350 ohms, nominally 300 ohms. When the twin lead is isolated from ground, the impedance determining equa-

The author is Chief Engineer for Channel Master Antenna Laboratories

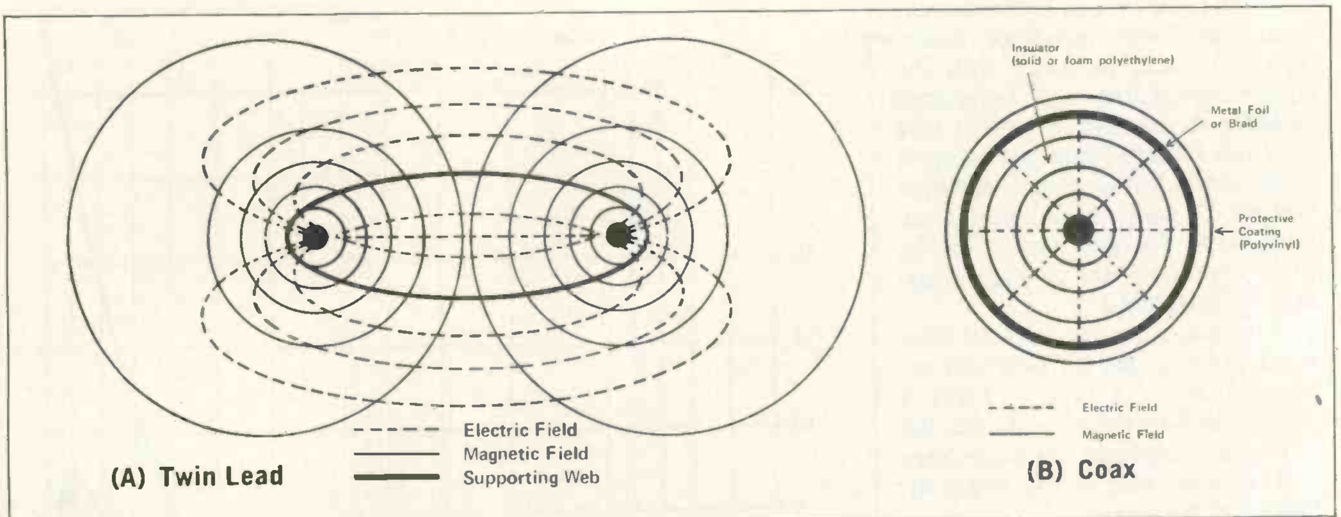


Fig. 1—End view of twin lead (A) and coax (B) showing construction and electric and magnetic fields.

TABLE 1

Channel Master 9358 Twin Lead Losses vs Frequency

Freq. (MHz)	Resistive Loss (dB/100 ft.)	Dielectric Loss (dB/100 ft.)	Total Loss (dB/100 ft.)
75	1.0	.049	0.9
200	1.6	.13	1.6
500	2.5	.32	2.6
900	3.4	.59	3.7

TABLE 2

Channel Master 9537 Coax Losses vs Frequency

Freq. (MHz)	Resistive Loss (dB/100 ft.)	Dielectric Loss (dB/100 ft.)	Total Loss (dB/100 ft.)
75	2.5	0.093	2.56
200	4.0	0.25	4.28
500	6.4	0.62	7.00
900	8.6	1.11	9.67

tion is $Z_0 = \frac{276}{\sqrt{\varepsilon}} \log_{10} \frac{2D}{d}$, where ε is proportional to the dielectric constant of the plastic and D and d are the distance between the conductors and their diameter, respectively. For proper perspective ε is one in air. Because of the insensitive log term in the equation, relatively large changes in the physical proportioning of the wire causes only relatively small changes in its impedance.

For coax the impedance equation is $Z_0 = \frac{138}{\sqrt{\varepsilon}} \log \frac{D}{10d}$. 138 is half of 276 and D/d for a practical coaxial FM/TV cable is many times smaller than the 2D/d term for twin lead. This gives a second factor of ½ making the coax impedance approximately ¼ that of twin lead, and typically is between 50 and 90 ohms. The normal value for TV reception is 75 ohms.

The higher balanced impedance of twin lead is directly matched by most TV/FM antennas and the inputs of FM and TV receivers. Coax usually requires a matching transformer to balance it to the unbalanced transformer, or balun, at the 300-ohm input of a TV receiver and the output of a 300-ohm antenna. Recently, this difference is becoming insignificant because of the current trend of receiver manufacturers to provide 75-ohm inputs. This convenience is a byproduct of the growing popularity of CATV. With a receiver so equipped, only a single balun at the antenna terminals is needed.

Attenuation or Loss[1]

Ideally, an antenna line should not attenuate the level of the signal fed through it. Signal loss down the transmission line degrades the signal-to-noise ratio at the input of the receiver. The attenuation of an antenna line must be appraised over the entire TV/FM signal spectrum, from 54 to 800 MHz, with allowances made for normal weather variations.

Table 1 shows the losses for Channel Master 9358 twin lead. The conductors are foam-clad pure copper, 7-strand wire. Table 2 is a similar tabulation for Channel Master 9537 coax. Note that the losses listed in both tables are broken into two categories: resistive and dielectric.

The attenuation relationship in dB/100 ft. is given for twin lead by: $A = .434\frac{R_t}{Z_0} + 2.78\, f\sqrt{\varepsilon}\, F_p$, where F_p is the power factor of the dielectric and R_t the total effective resistance of the wire. $R_t = .2\sqrt{f}/d$ ohms. The expression is broken into two parts corresponding to the columns of tabulated losses. The first is the resistance losses in the metal conductors. As you would intuitively expect, Z_0 is in the denominator; larger impedances mean smaller currents and decreased I^2R power loss-

[1] *All measurements and figures used here were determined expressly for this article in the Channel Master Antenna Laboratories. All measurements were made using Channel Master wire, in the interests of consistent and uniform results, so that the reader may make meaningful comparisons between different kinds of wire. Loss and other performance figures will vary among brands.*

es. Twin lead, with its higher impedance, has lower resistance losses. This first term increases with the square-root of frequency (expressed in MHz) because of skin effect (the tendency of high frequency currents to be concentrated at the conductor surface. In coax, these currents are confined to the outer surface of the inner conductor and the inner surface of the shield.)

The attenuation equation for coax is the same as that for twin lead except that $R_t = .1\ (1/d + 1/D)\sqrt{f}$ ohms. The only difference is that the 1/D term replaces an equivalent 1/d term because of the larger diameter of the shield.

The second term, which gives the dielectric loss due to current leakage in the insulator, is usually negligibly low when compared to the first term. However, be suspicious of off-brand "bargains," in which poor quality polyethylene might increase the power factor loss. In the case of twin lead, rain and snow increase the losses (greatly at UHF) above their dry dielectric values because the normally lossless air surrounding the wire is displaced by water and dirt, which dissipate energy.

Air is an excellent dielectric, which accounts for the advantages of celogen foam dielectrics, particularly at UHF frequencies. Large amounts of air are trapped in the foam bubbles, thus lowering the losses. Although celogen foam cannot be used as the outer jacket in twin lead because it will absorb moisture and thereby lose its advantage, it can be used as the inner layer of a doubly extruded wire. Celogen foam also makes an excellent coax dielectric, but it also must be protected from moisture contamination. Braided and overlapped foil shields will allow moisture to permeate the dielectric through any tiny defects or damages in the coax outer jacket. Only sealed shield construction is usable with a celogen polyfoam dielectric. Foam dielectric is also used in coax to reduce resistance losses by increasing its impedance, however, this causes a small (.1dB) mismatch loss.

Losses can be further reduced by enlarging the cable. For example, doubling the inside diameter of the shield (D) and the outside diameter of the conductor (d) of coax or doubling the outside diameter of the conductor of twin lead will halve the resistance losses without affecting the impedance.

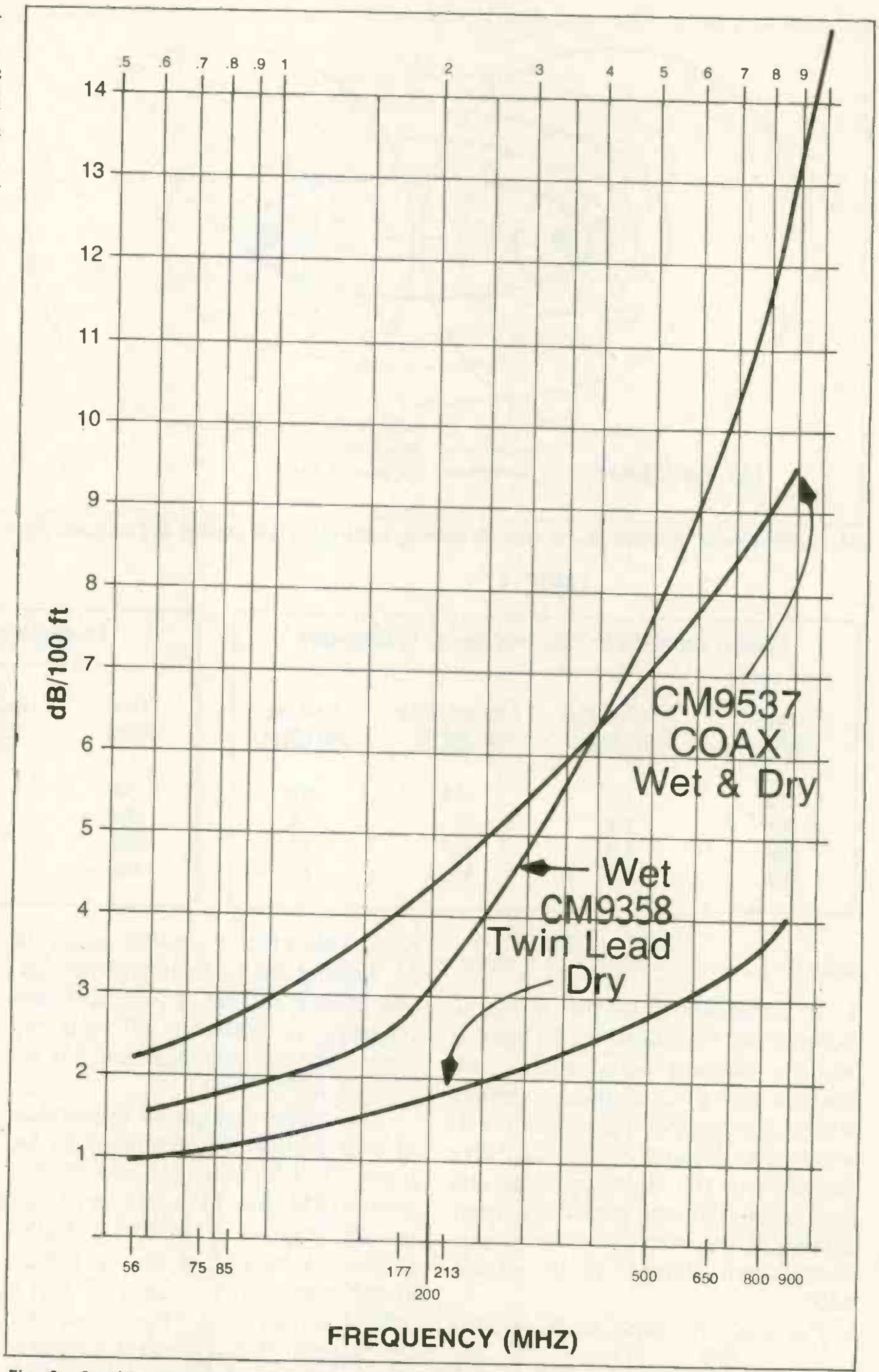


Fig. 2—Graphic comparison of wet and dry characteristics of Channel Master 9358 twin lead and Channel Master 9537 coaxial cable.

Figure 2 is a comparison of Channel Master 9358 twin lead and Channel Master 9537 coaxial cable under both dry and wet conditions. When dry, the twin lead has an average of 2dB less VHF loss per hundred feet while in the UHF band the loss differential increases to around 4dB/100 ft. The twin lead wet losses increase exponentially, with a 50 percent increase in the FM and VHF band and more than 100 percent at UHF. Wet loss figures are important because nobody stops watching TV or listening to FM radio when it rains. The customer doesn't want a qualifying excuse when the weather is bad. Comparing the twin lead wet curve with that of

TABLE 3

Channel Master Twin Lead Key Characteristics

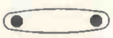
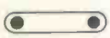
Channel Master Number	Cross Section	Maximum Dimensions	Loss (dB/100 ft.) vs. 57	213	500	900	Freq. (MHz)	Cost (Per Ft.)	Misc. Remarks
9567		.256 x .475"	.9 1.0	2.0 2.3	3.2 6.0	5.4 10.3	dry wet	9.3¢	Foamed jacket
9350		.210 x .400	.9 1.3	2.0 3.1	3.2 7.0	5.4 12.9	dry wet	6.0	Foamed jacket
9290		.150 x 4.15	.9 1.3	2.0 3.8	3.2 8.1	5.4 14.7	dry wet	4.7	Stripping grooves
9354		.150 x .415	1.2 1.7	2.0 3.2	3.2 7.2	5.4 13.5	dry wet	5.7	Celogen foam
9358		.150 x .400	1.0 1.5	2.2 3.4	3.7 7.7	6.3 14.4	dry wet	4.5	Celogen foam
9547		.150 x .475	.8 1.8	1.3 3.4	2.1 9.9	3.6 33.5	dry wet	5.9	18 ga.
9561		.080 x .400	.9 1.8	2.0 5.2	3.2 14.0	5.4 46.0	dry wet	4.4	Good VHF line
9580		.080 x .400	.9 1.8	2.0 5.2	3.2 14.0	5.4 46.0	dry wet	4.0	Copper-clad wire
9588		.075 x .350	1.2 2.2	2.7 6.0	— —	— —	dry wet	3.0	Clear economy

TABLE 4

Channel Master Representative Coax Key Characteristics

Channel Master Number	Diam. (Inch)	Loss (dB/100 ft.) 57	213	500	900	Freq. (MHz)	Cost (Per Ft.)	Misc. Remarks
9537	.242	2.3 2.3	4.4 4.4	7.0 7.0	9.4 9.4	dry wet	7.2¢	100% Shielded
9536	.242	2.1 2.1	3.8 3.8	5.9 5.9	8.0 8.0	dry wet	7.2¢	Foam Dielectric

TABLE 5

Channel Master Coax and Twin Lead Comparison of Essential Parameters

(+) superior (−) inferior

PARAMETER	COAX	TWIN LEAD
Attenuation	−	+
Interference	+	−
Durability	+	−
Installation	+	−
Cost	−	+

coax, note that there is only a 1dB relative loss per hundred feet in the VHF band, and at UHF frequencies the coax outperforms twin lead by 1.5dB. Also, remember that the average condition of contaminated twin lead will produce even more loss, further reducing the already narrow loss difference at VHF.

Twin Lead Types

Some representative twin lead cable types are listed in Table 3 along with their key characteristics. The wire is listed in approximate descending order of quality and price. Types from 9547 down are for VHF only. The highest grade wires are thickened in the region of strongest electromagnetic fields. The jacket material is concentrated symmetrically around the conductors in the intense field regions, giving it a dumbbell shape. Some of the better twin leads use inner foam extrusions for good UHF performance. The wet losses increase with frequency and the increase becomes more significant farther down the chart.

Most types use stranded pure copper wire, although one on the list uses copper-coated steel for added mechanical strength.

Because better grades of twin lead have larger amounts of plastic for strength and to minimize wet losses, this tends to lower the characteristic impedance of the line. To compensate for this without sacrificing attenuation characteristics, wider conductor spacing must be used.

The clear, flat twin lead type appearing at the bottom of the table is meant only for indoor, inconspicuous use because ultraviolet radiation from the sun will deteriorate this lead much more quickly than one with a dark dye to filter out the harmful rays.

Coax Types

Table 4 lists two representative TV/FM coax cables. The first is conventional type RG59 (¼-inch diameter) coaxial cable. The second is 82-ohm impedance foam insulator type. Both use copper-clad steel for the inner conductor; the additional strength of steel is needed because the inner conductor is often used as the connector pin. Both types are 100 percent shielded with an aluminum tubular shield, and have 4 cop-

continued on page 56

Fault Finding In MATV Systems

by William J. Spero

An analysis of the common sources of signal degradation in MATV systems and their symptoms, plus a proven technique for isolating them

■ The sources of signal degradation in MATV systems can be categorized into four principal problem areas:

- Main signal trunk line
- Passive devices
- Active devices
- Terminations

Before we discuss these areas, however, we will briefly review the signal paths through a typical MATV system.

Two Typical MATV Systems

There are two general types of residential MATV systems: One type is that used in high-rise apartment houses. The other type is that used in condominium or garden apartment complexes.

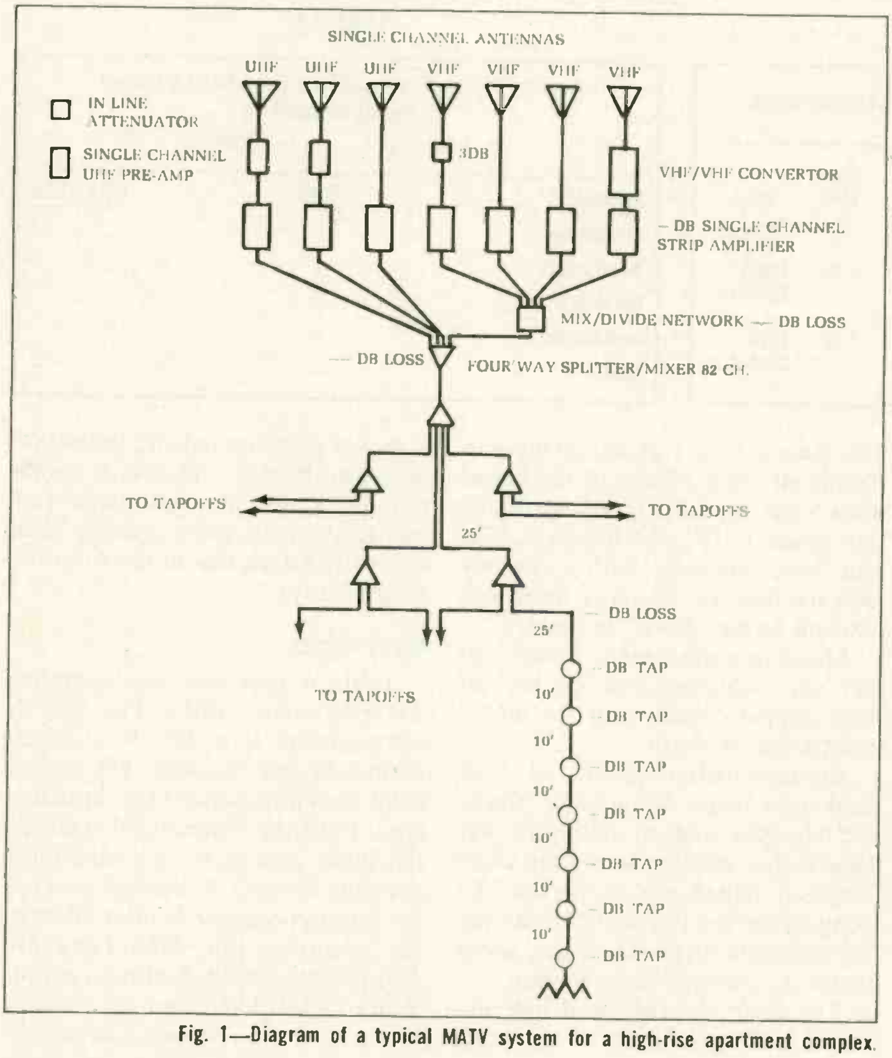


Fig. 1—Diagram of a typical MATV system for a high-rise apartment complex.

The basic elements of a Master Antenna Television System consist of:

- Headend
- Transmission (or trunk) line
- Risers, reamplification amplifiers (if necessary) and passive devices (splitters, taps, terminations).

Television signals received by the antenna are amplified and distributed by the MATV system. Figure 1 illustrates the elements of an MATV system for a high-rise apartment complex. (A system for a condominium or townhouse complex is similar to this, except that the feed lines are horizontal instead of vertical.) The output of the head-end is fed to one or more signal splitters. The output of the splitter(s) is coupled to a number of trunk lines or risers. The risers, which usually run vertically in a building, are usually looped through each apartment and are connected to a tap-off device. This device performs the dual function of 1) signal feed through to the next tap, and 2) signal tap off to the television set connected to it.

Propagating down the line, the received signal passes through the various devices, reaches the last tap and is absorbed by the final device in the riser, the terminating resistor.

Tap-Off Devices

A tap-off device has a number of important characteristics:

- It has an isolation value (isolates the television set from the rest of the transmission line).
- It has a return loss, which is probably the most important characteristic because it determines how much signal is reflected back into the system. These reflections are out of phase with the main signal, and, therefore, arrive at the television set at a different time than the main signal, producing the phenomenon known as *ghosting*. Obviously, the lower the return loss of the device, the greater the ghosting effect.

Figure 2 shows the relationships between return loss and VSWR (voltage standing wave ratio). From Figure 2 it is immediately evident that the lower the return loss, the greater the percentage of reflection of unwanted signal, and the poorer the match ratio. This mismatch

The author is Field Service Engineer for GTE Sylvania Commercial Electronics Corporation causes a high VSWR on the line, which contributes to the ghosting problem.

It might be assumed that if a room tap is terminated in the input circuit (balun or tuner) of a television set, it is always matched to its characteristic impedance and, therefore, there will be no reflections. This is not true. The match is valid only for the channel that the television set is tuned to. The tuner is mismatched for all other channels. It is this mismatched voltage which is coupled back into the transmission line by any device (room tap, through-line splitter, etc.) with a poor return loss.

Amplifiers

Amplifiers are active devices, and, if designed properly, exhibit high return losses. They, therefore, should reflect very little unwanted energy back into the system. Manufacturers of amplifiers state the return loss (in dB) in their published specifications. The important point to remember is: The higher the return loss, the lower the VSWR, and the less chance of signal degradation.

RETURN LOSS-VSWR CHART

RETURN LOSS	VSWR	REFLECTION COEFFICIENT	PERCENTAGE REFLECTION	MATCH RATIO
2 dB	8.71	.79	79%	1.26 : 1
4 dB	4.42	.63	63%	1.59 : 1
6 dB	3.01	.50	50%	1.99 : 1
8 dB	2.32	.40	40%	2.51 : 1
10 dB	1.92	.32	32%	3.16 : 1
12 dB	1.67	.25	25%	3.98 : 1
14 dB	1.50	.20	20%	5.01 : 1
16 dB	1.37	.16	16%	6.31 : 1
18 dB	1.28	.13	13%	7.94 : 1
20 dB	1.22	.10	10%	10.0 : 1
22 dB	1.17	.079	7.9%	12.6 : 1
24 dB	1.13	.063	6.3%	15.9 : 1
26 dB	1.11	.050	5.0%	19.9 : 1
28 dB	1.08	.040	4.0%	25.1 : 1
30 dB	1.07	.032	3.2%	31.6 : 1
32 dB	1.05	.025	2.5%	39.8 : 1
34 dB	1.04	.020	2.0%	50.1 : 1
36 dB	1.032	.016	1.6%	63.1 : 1
38 dB	1.026	.013	1.3%	79.4 : 1
40 dB	1.020	.010	1.0%	100 : 1
46 dB	1.010	.005	0.5%	199 : 1
50 dB	1.006	.003	0.3%	316 : 1
54 dB	1.004	.002	0.2%	501 : 1
60 dB	1.002	.001	0.1%	1000 : 1

Fig. 2—Table which illustrates the relationships of return loss and VSWR and the resultant amount of signal reflection produced on an MATV line by a tap-off device.

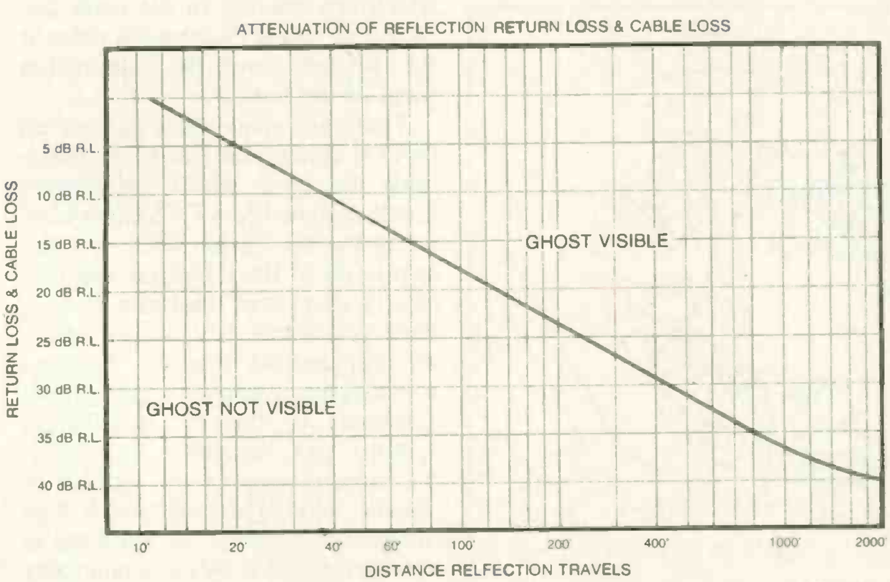


Fig. 3—Chart which illustrates the relationship of MATV line length and visibility of ghosting caused by reflected signal on the line.

Cable Length and Type

The length of the transmission line is important because there is a definite relationship between line length and visibility of ghost. This relationship can be plotted in terms of the "Attenuation of Reflection" versus the "Distance A Reflection Travels." Figure 3 illustrates this relationship.[1]

Because coaxial cable (rather than flat, ribbon type) is used in properly designed MATV systems, we will restrict our problem analysis to this type. Characteristics of the cable used are as follows:

- Nominal impedance—75 ohms
- Dielectric—solid or foam
- Center Conductor—copper or copper-clad steel
- Shield—single or double copper braid, Mylar wrap, Aluminum
- Jacket—PVC
- Attenuation—dB/unit length

The impedance of a coaxial cable is a function of the ratio of the inside diameter of the outer conductor (shield) to the outside diameter of the inner conductor, as shown in Figure 4. Consequently, if the size of the outer conductor is reduced, the characteristic impedance is reduced. This is exactly what happens to the impedance in an area where the cable becomes crushed. This can occur if the cable is deformed by pinching under support staples or clips. The resultant change of impedance causes reflections back

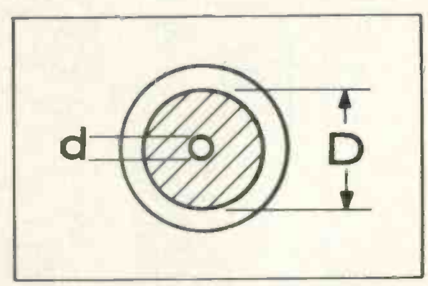


Fig. 4—The ratio of the inside diameter (D) of the outer conductor (shield) to the outside diameter (d) of the inner conductor of a coaxial cable is one factor which affects the impedance of the cable.

down the line, producing ghosting. In some instances, if the deformation is severe and cyclic rather than random, the cable will act as a filter, attenuating some specific frequency. The exact frequency will be some multiple of the frequency which is a quarter wavelength of the distance between the deformed points.

Most cable manufacturers build cable so that the outer-conductor-to-center-conductor spacing is as constant as possible, so that the impedance is the same along the length of the cable.

The choice of a cable dielectric (foam or poly) is usually based on the maximum attenuation that can be tolerated. Foam has lower attenuation characteristics than solid poly. Figure 5 is a graph of attenuation vs frequency for various types of cable and dielectric. Foam, however, has some negative qualities which should be considered. For example, it will absorb moisture and water if its jacket and outer conductor are punctured. When this happens, the attenuation increases, and the cable has to be replaced. A common entry point for water is at the connector to an antenna, if no weather boot is used. Another area for moisture and water entry is when the cable is used in underground runs without some form of jacket protection or a self-flooding silicone compound.

The end of the riser or trunk line should always be terminated in its characteristic impedance. Failure to do this causes out-of-phase reflections, because the forward-going signal now sees an open-circuit, or impedance mismatch, at the end of the cable. These reflections ultimately degrade the system performance.

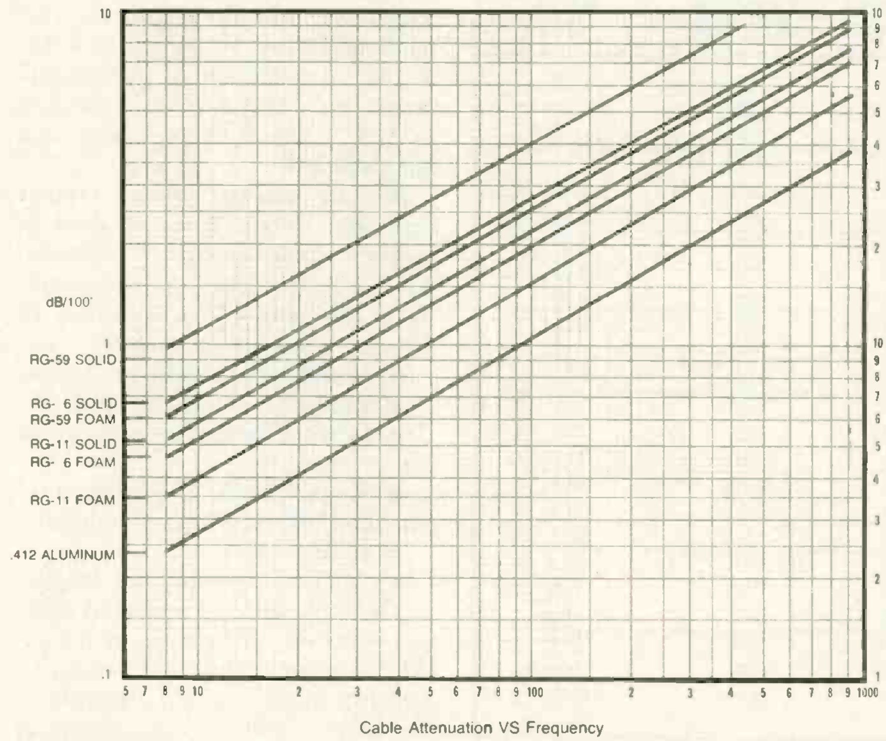


Fig. 5—Chart which shows the attenuation of various types of cable and cable dielectric at various frequencies.

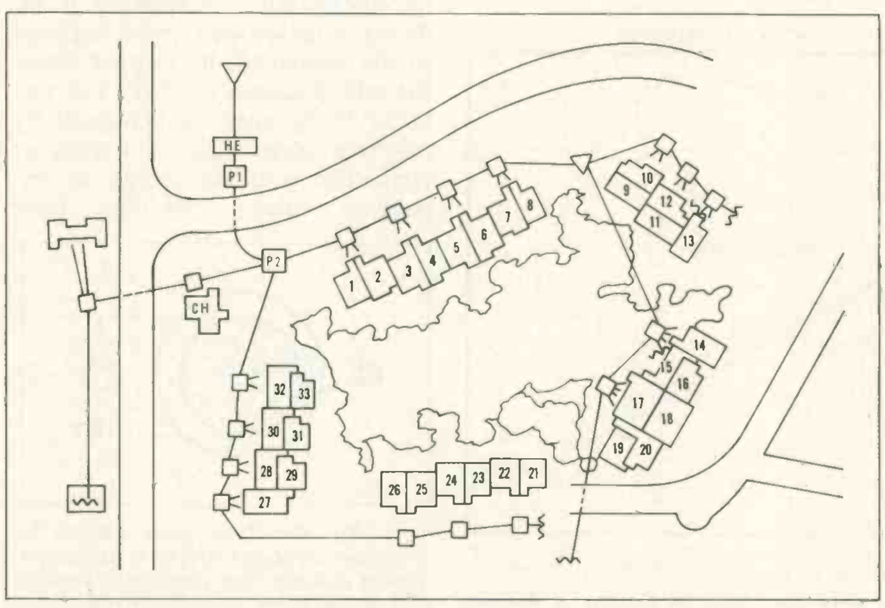


Fig. 6—Diagram of a typical MATV system for a condominium or townhouse complex.

The Fault Finding Technique

We have discussed briefly four areas of possible system faults:

- Transmission line
- Passive devices (splitters, tapoffs)
- Active devices
- Transmission line termination

We will examine now a typical problem in which these four areas are explored as possible contributors to poor system performance. We will use a dynamic technique for checking out MATV cable signal distribution lines and devices. This method can best be described as "Fault Finding Techniques." The term "fault finding" might seem to be a misnomer, because this technique also will provide significant information about the various parameters of the cable end and of any devices which are inserted in the cable between the signal distribution point at the headend and the termination point of the cable.

There are many other parts of an MATV system, besides those previously discussed, which can prevent a well-designed MATV System from delivering acceptable television signals to all of the television sets ultimately connected into the system. However, because of limited space, we will assume that the headend is delivering signals of the proper amplitude to the TV distribution system. (As described previously, the headend consists of a number of passive splitting devices which feed the rises throughout the buildings in a complex.) We will examine only what happens to the signal after it gets on to the main trunk distribution line and how you can use the technique mentioned previously to locate the problem areas which degrade the signal.

Figure 6 is a diagram of a typical condominium or garden apartment-type system. The system has been installed and in operation for a number of months. The tenants have been complaining of poor television reception. The builder is faced with the possibility of a lawsuit. He has asked you to do whatever is necessary to make the system work.

At your first meeting with the electrical contractor who installed the system, you determine that:

a) The system was designed properly.

b) The equipment originally specified in the electrical contract (amplifiers, splitters, etc.) was not used.

c) While the trunk line cable is presumed to be installed as shown on the riser drawings, there are no data to substantiate this.

d) There is no information indicating where the various trunk line devices are located.

e) The majority of the cable installed is .412 PVC jacketed aluminum.

First, you physically examine the system. Devices called *pedestals* are used throughout the complex to house the splitters for trunk subfeeds. Examination indicates some cable (.412 aluminum) has been run above the ground as well as in trenches. You also notice some of the cable is RG-11, and the copper shield shows signs of corrosion where it enters the connectors. Investigation has convinced you that the trunk line possibly might be run differently than is shown on the riser drawings. There could be cable breaks in various areas, especially where the cable is above ground and unprotected. Continuity checks would give you the information to determine if a cable is open or shorted, but it will not indicate *exactly where* the fault is located.

The Cable Fault Finder

At this point, you decide that you need a Cable Fault Finder. This is a device which generates a fast-rise-time pulse (approximately 0.1 to 12μsec). When the transmission line is connected at the input to the Fault Finder, the pulse propagates down the line until it "sees" an impedance discontinuity. This could be a poor-quality or defective passive device or an open or a short. When the pulse sent down the transmission line encounters a discontinuity, the resultant reflection travels *back* down the line towards the source. The time it takes to travel to the discontinuity and return can be accurately measured. This time can be converted into a distance because:

$$T = \frac{2L}{V} \text{ and } L = \frac{TV}{2}$$

Where: T = time
L = distance pulse travels to discontinuity
V = velocity of propagation of pulse.

The factor "2" is used because the total distance the pulse travels to the discontinuity and returns is equal to 2L.

The Fault Finder is used in conjunction with an oscilloscope, which serves as the display device. Figure 7 shows the setup used by the author. The Fault Finder shown is a Craftsman Model 107, and the oscilloscope is a Tektronix Model 321A.

You connect the Fault Finder to the trunk cable at the first pedestal (P-1). The distance to the first discontinuity is measured. Assuming there is no break in the cable, this should be at the second pedestal (P-2). By opening and shorting the cable at this point, you determine that you are in fact looking at the P-1 to P-2 area. An open circuit display would be a positive-going pulse (Figure 8A), while a short circuit is represented by a negative-going pulse (Figure 8B). Figure 8C shows the end of the cable terminated in its characteristic impedance. If there were a break between two locations, the positive pulse would not change when the cable at the second location was shorted. By using the Fault

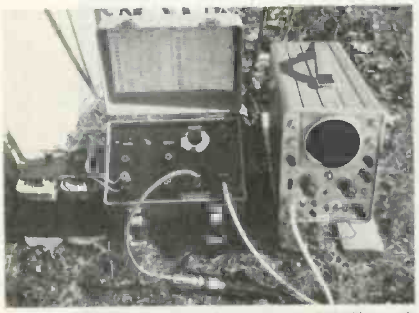


Fig. 7—Test setup for checking an MATV trunk cable with a Cable Fault Finder and an oscilloscope. The instrument package is battery operated for field use. It also can be operated on 110vAC at headend locations. The .412 aluminum trunk cable is connected to the RG-59 test cable through an adaptor, as shown in the bottom portion of the photo.

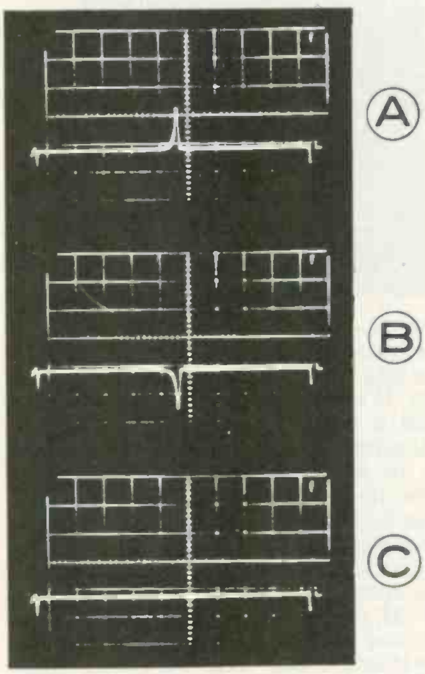


Fig. 8—Oscilloscope displays produced by three conditions during testing of an MATV trunk cable. The displays have a vertical amplitude of 200 mv/cm at a horizontal deflection rate of .5μsec./cm. The reference pulse is at the right side of the display. (The sweep is reversed because of image reversal in the camera.) The pulse produced by reflection is just to the left of the center line of the graticule. A) Open circuit. B) Shorted Circuit. C) Cable terminated in its characteristic impedance. The termination produces a slight impedance discontinuity to the left of the center line.

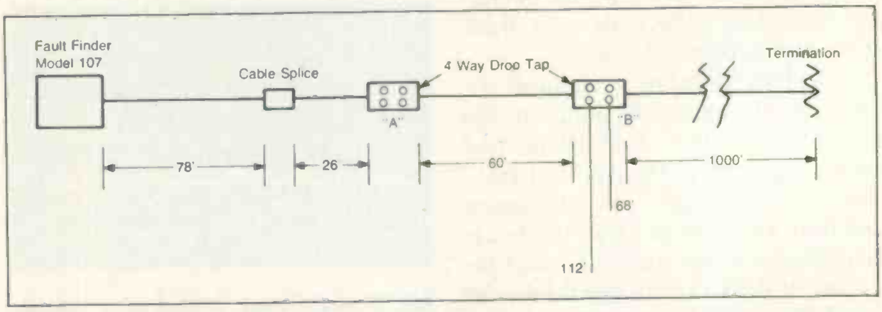


Fig. 9—Diagram of a cable run tested during the typical case discussed in the text. The 4-way drop tap B, which had low return loss, caused ghosting.

Finder measurement dial, you read out the distance (in feet) to the cable break. In this manner, you check out the entire system. Cable runs up to 2800 feet (foam) can be checked out by this technique.

We will now examine a cable run in which reflections were produced by a poor splitter (low return loss and high VSWR compared to those from a well-matched device). Figure 9 shows the devices found in the cable run. The distances between the devices and the termination of the cable run are indicated. The end of the line was terminated, because it was put in for future use to another area. The 4-way drop tap "A," which also had been put in for future use, did not have any cables connected to it. There were no terminations in the unused ports. This did not have any degrading effect on the signal because the return loss was high (29 dB) and the back match was excellent. This is revealed by Waveform 9A. Device "B," also a 4-way thru-line drop tap, had two cables run to separate apartments. Two ports were unterminated. Because the Fault Finder display showed multiple reflections (Figure 10A), it was assumed that the end of the cables were not terminated. This was found to be true. Properly terminating the cable produced waveform 10B, which reveals that the reflections were reduced. Substituting a high-return-loss device like that in drop tap "A" in place of the one in drop tap "B" produced a definite improvement of the response, as indicated by waveform 10C. (Compare it to 10A and 10B.) When the cables are properly terminated, the reflections are further reduced. This points out the obvious need for devices with good back-match. If, for example, someone disconnected the television set from one of the room taps of the poor-quality tap used previously in 4-way tap "B," there would be signal-degrading reflections sent back down the main trunk line.

The Fault-Finding technique enables you to assess the status of the main trunk line, subfeeders and passive devices. Using the "distance" data thus obtained, you can assign accurate attenuation losses to the cable runs, and can map the exact location of devices connected into the trunk line. With this information you also can determine whether or not

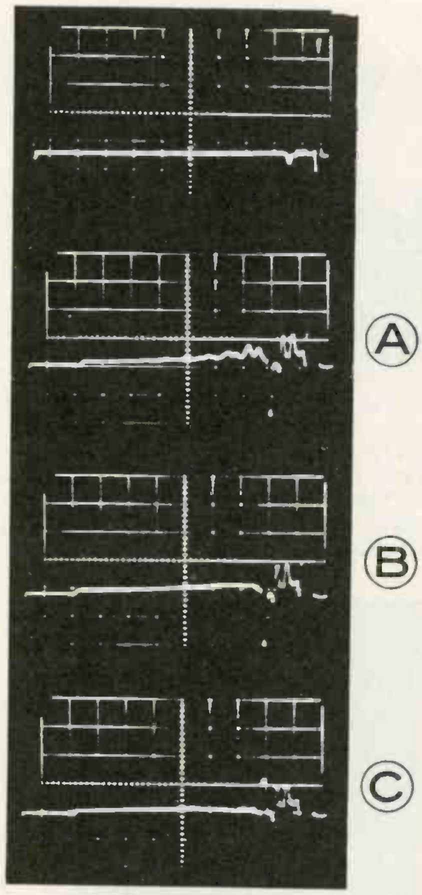


Fig. 10—Oscilloscope displays produced by the Fault Finder during testing of the cable run illustrated in Fig. 9. The vertical amplitude for Fig. 10 is 200 mv/cm and the horizontal sweep rate is .5μsec./cm. There are three distinct discontinuities displayed by Figs. 10A, B and C. The first is caused by a splice found in the line. The second is produced by a hybrid four-way drop tap with 29dB return loss. The third is produced by a resistive drop tap with 12dB return loss. Figure 10A is identical to Figure 10 except that the vertical has been changed to 50 mv/cm and the horizontal sweep is changed to .4μsec./cm, to present a more meaningful display. Notice the multiple reflections starting at 2cm from the end. These continue down the end of the line to the termination (at 8.5cm). Also notice the increased amplitude of the overall trace (reflection area). Figure 10B, as pointed out in the text, displays the response when both cables to the drop tap were terminated. Observe in 10C the improved match (lower-amplitude change and much lower-amplitude reflections) when a high-return-loss tap was substituted for the poorer one. Compare it to 10A; the cable ends were unterminated for this waveform.

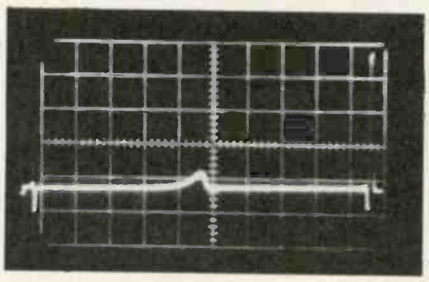


Fig. 11—Oscilloscope display of a normally operating 1000 feet of cable with a DC-blocked termination.

the headend is capable of providing the level of signal required to provide quality reception at the last outlet.

In the typical case we have examined, reception was improved significantly by finding and replacing substandard passive devices with ones of superior characteristics and by proper termination. There is one other point about our typical case which should be examined. It was mentioned that some RG-11 cable had been found in the system, and the copper shield had shown evidence of corrosion. In examining the system, we found that line-powered amplifiers had been used to increase the gain on the main trunk line. Unfortunately, the installers had used DC-powered ones (−21v DC). This choice was a poor one, because the underground cable and connectors were exposed to earth ground. This factor, coupled with an aluminum-copper interface where the shield entered the cable connectors, set up galvanic action. A better choice would have been an AC-power source—15 to 25v DC, with the correct amplifier for this voltage. DC power for line-powered amplifiers can be used, but it should not be used where cable is run underground. One more word of caution: When using a DC-powered system, use a DC-blocked termination. Failure to do this will result in the terminating resistor heating up and possibly changing value. When using a Fault Finder to look at a DC-blocked termination, you will *not* see the waveform in Figure 8C. Instead, you will see the waveform in Figure 11. The reason for the difference is the capacitor built into the termination.

Other Uses for Fault Finding—Later

This has been but a brief introduction to the utilization of MATV System Fault Finding. There are many more uses for this technique. It can also be used to evaluate connector mismatches, cable impedance mismatch and connector delay, as well as to measure the amplitude of reflected signals and antenna-to-transmission-line mismatches. Some of these uses will be the subject of a future article. ■

[1] *Blonder Tongue Laboratories, Old Bridge, N.J., Locating Mismatch with a TV set (November 12, 1971).*

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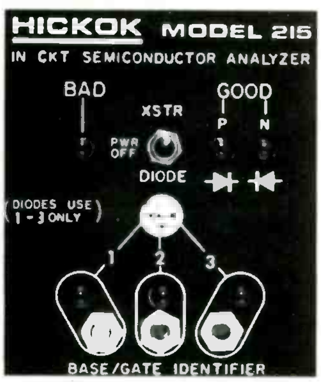

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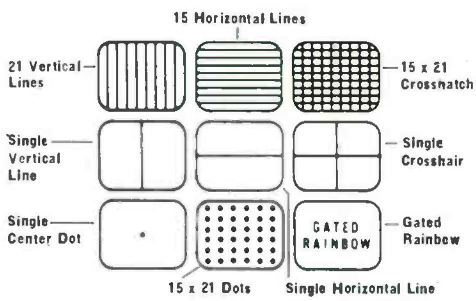

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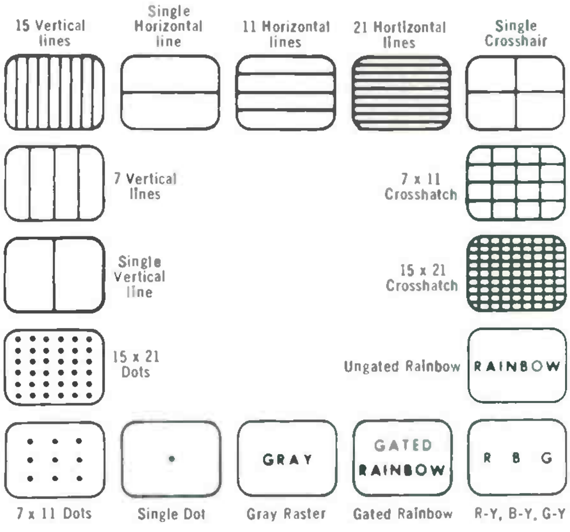

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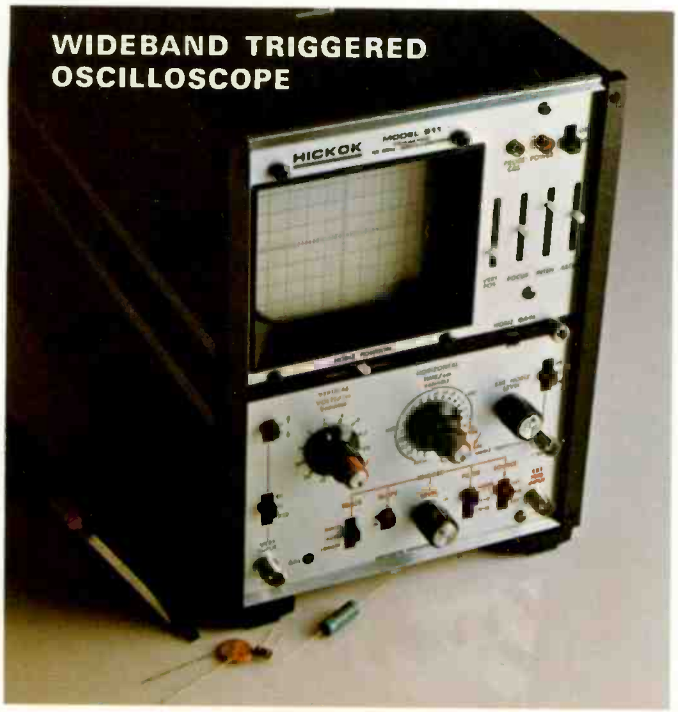

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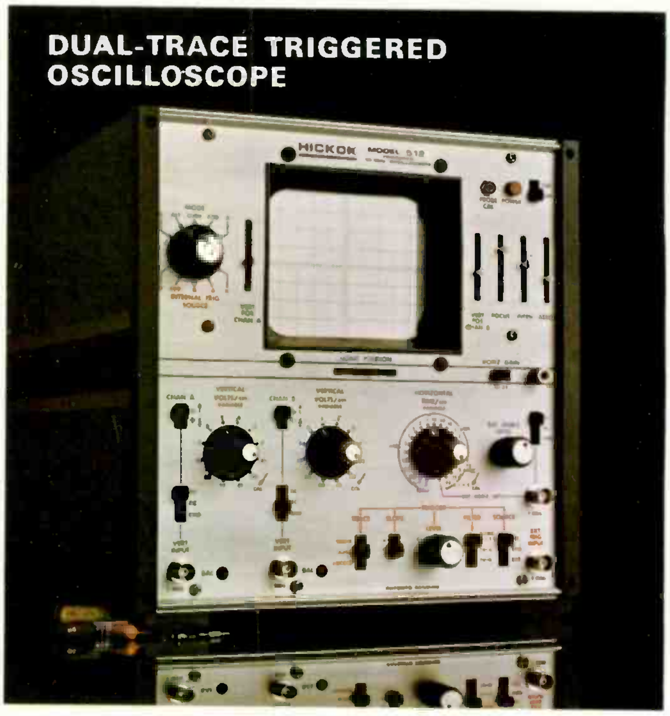

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1) In the screening room, blue, red and green color phosphors are applied to the inside of the faceplate. Each color is applied separately by automatic equipment, as shown in the background. Note that the aperture masks, above each station, accompany their premated faceplates through this process. In the foreground, a technician places an assembled faceplate and aperture mask on an exposure table. Here, ultraviolet light "fixes" the phosphor dots in precise position on the screen. To insure that the electron beams in the operating picture tube hit the proper dots and produce pure colors, a computer-designed lens system is used in the exposure table. Sylvania has just introduced a new "TRU-MATCH" lens system which matches the electron optics better than any lens system used previously by Sylvania.

The Making of a Color TV Picture Tube

by Henry Kindig

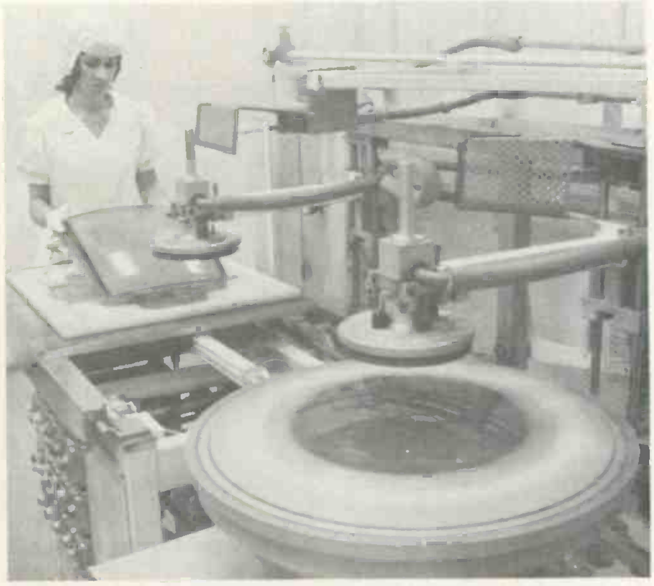
■ Color television picture tubes are highly sophisticated cathode ray devices and manufacturing them is a complex and exacting science. The Electronic Components Group of GTE Sylvania, Inc. has been producing them since 1953.

The company pioneered in the production of black-and-white television picture tubes, developing an experimental prototype in 1931. In 1948, Sylvania opened manufacturing facilities in Ottawa, Ohio and Seneca Falls, N.Y. Over the years, both plants have underwent major expansions. Today, Seneca Falls is headquarters for Sylvania's Electronic Tube Division and includes a complete research and development facility as well as color picture tube manufacturing operations. The Ottawa plant produces both black-and-white and color television picture tubes.

One of the largest television picture tube manufacturing plants in the world, Sylvania's Ottawa facility takes in almost 1 million square feet. The photos in this article were taken recently in the Ottawa plant, and depict, in sequence, the principal processes involved in making a color television picture tube.

The author is Vice President of Manufacturing for Electronic Tube Division, GTE Sylvania

2) In making "Chromatrix" black matrix tubes, before the color phosphor dots are applied, a black material is placed on the face panel. Exposure tables, with similar optical systems, are used to produce holes or windows at the proper locations in the black material. The panel then proceeds to the screening room, where the phosphor dots are applied over their respective windows. The foreman is watching the spinning operation which dries the polyvinyl alcohol on the tube panel before exposure.

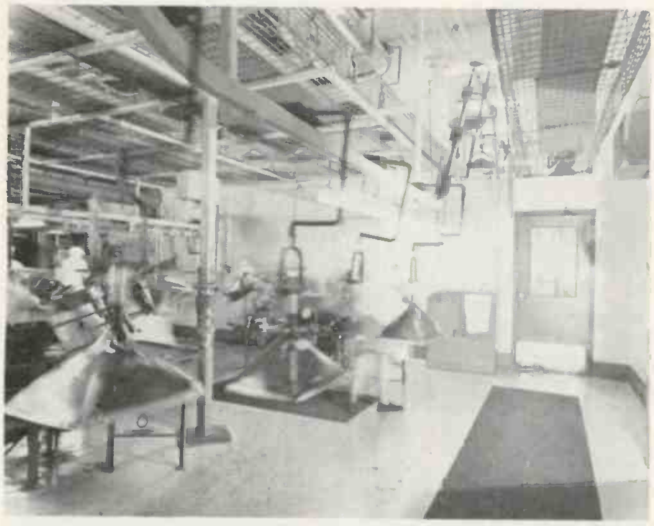


3) A technician positions a screened television faceplate for the lacquering process. Another faceplate can be seen spinning on the machine in the foreground as a pre-wet solution is applied prior to actual lacquering. Lacquering each faceplate provides a smooth, glass-like surface for aluminization, which is another step in the manufacturing process.

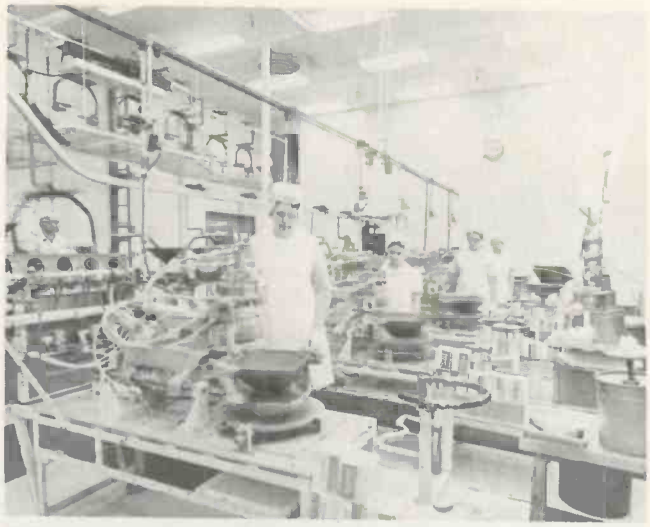
4) The methacrylate lacquer is applied automatically in the booth in the background, while the faceplate is spun to assure even surface distribution. The vacuum chuck removes the lacquered faceplate from the booth and deposits it on the blotting material in the foreground.

5) An inspector examines a faceplate for any defects. Rejects are carefully examined and recycled.

6) The aluminizing equipment shown here puts a reflective surface on the inside of the face panel. The panels are vacuum-sealed in individual frames, and as they proceed through this process, aluminum is evaporated evenly over the entire inside section of the faceplate. After aluminizing, the panels are baked in an oven, to remove any impurities and moisture in the screen and glass.



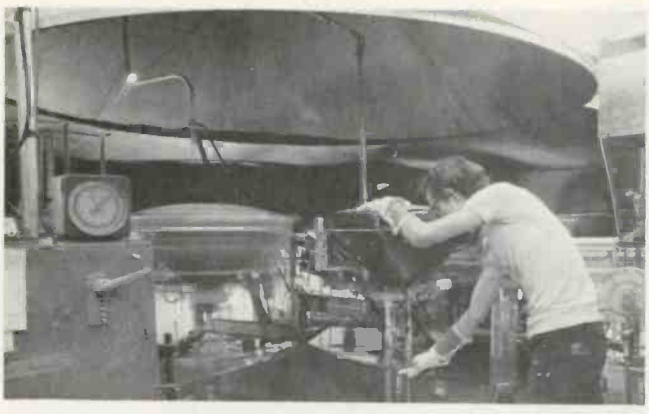
7) In this room, picture tube funnels receive a non-reflective conductive internal blackcoating. The funnels enter on conveyor belts and are individually coated in spray booths. Then, a portion of the neck is coated, and the funnel proceeds to the next manufacturing step.



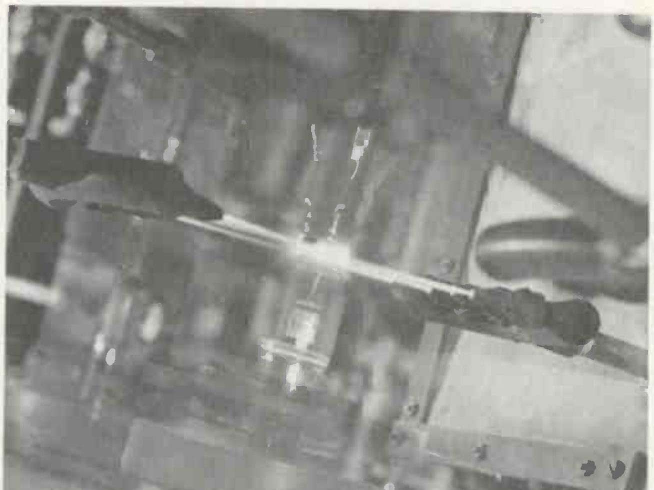
8) Operators are shown monitoring machines which apply a frit compound to the perimeter edges of the funnel. The frit bonds the faceplate and the funnel into a single unit in a later production step.

9) After frit application, the funnel and faceplate are joined and travel, for approximately one hour, through an oven at temperatures up to 450° (C). During this operation, the frit is converted to a ceramic-like material, and the resulting bond between panel and funnel is made permanent. The panel and funnel are held in the precisely adjusted fixtures shown here, to insure accurate alignment of the bonded parts.

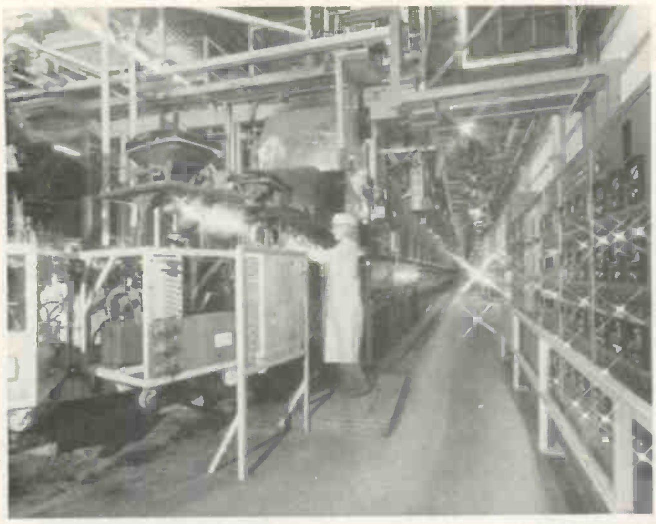
10) In this operation, electron guns are being prepared for mounting in the tubes. The operator is welding "getters" onto the mounts. They receive a liquid nitrogen bath prior to mounting, to remove any particles of lint or weld splatter that may have accumulated.



11) This machine seals the electron gun mount into the tube. At station #1, the mount is placed in the lower part of the equipment, with the bulb directly above it as shown. The mount is automatically inserted and precisely oriented, then is indexed into the neck of the bulb. At succeeding stations on the turntable, it is subjected to glass-melting temperatures while spinning rapidly. In this manner, the seal is made permanent.

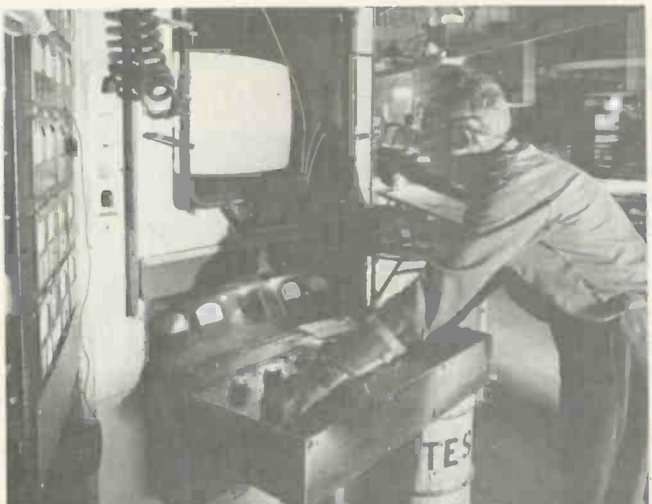


12) Close-ups of the gas jets which seal the electron gun mount into the neck of the bulb.

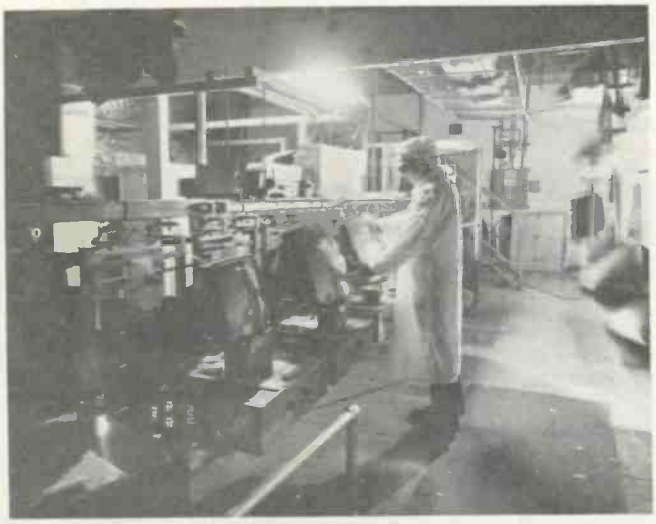


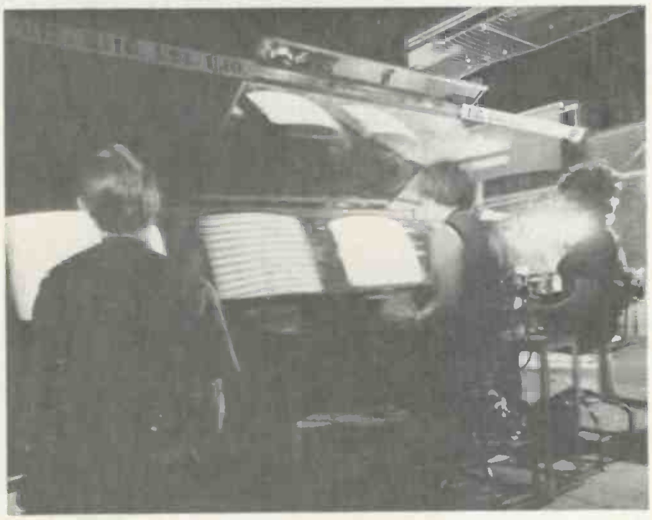
13) Here, the tubes go through a process that exhausts air and gas, to create a vacuum inside the tube. This operation is performed by pumps which remove the air and gases released by a heating and cooling process, creating as nearly a perfect vacuum as possible.

14) An external conductive coating is applied on the tube funnel, to form a capacitor. After this process, the tubes are placed on a huge conveyor, as shown here, and special heaters dry the external conductive coating.

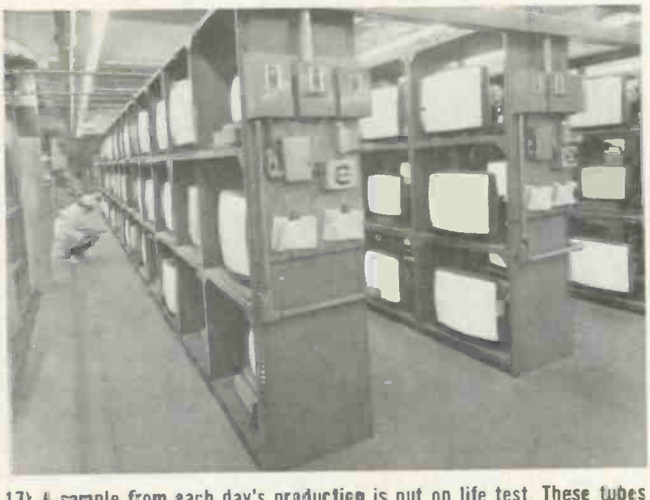


16) After automatic testing, approximately 5 percent of the picture tubes are inspected again on these upright test sets. All characteristics previously checked are screened again. This procedure insures that the automatic test equipment is performing flawlessly.





15) The finished tube is now ready for testing. Here, an inspector checks the tube for color purity in each of the three fields—red, blue and green. After this, the tubes proceed through a series of automatic test stations where visual as well as electronic checks are performed. They are tested for screen blemishes, heater-to-cathode leakage, anode leakage, voltage output, emission cutoff, and a number of other parameters. Tubes are identified in lots of 200. The Quality Control Department takes 20 from each lot for 100-percent testing. If even one defect is found in any tube, the entire lot is rejected and must be retested and sampled again.



17) A sample from each day's production is put on life test. These tubes are "on" continuously at 10 percent above rated anode voltage and normal line voltage for 5,000 hours. Each tube on life test is monitored daily to insure that it is still operating. Some of these tubes continue to be tested to ultimate life. Normally, 1000 picture tubes are on life test simultaneously. ■

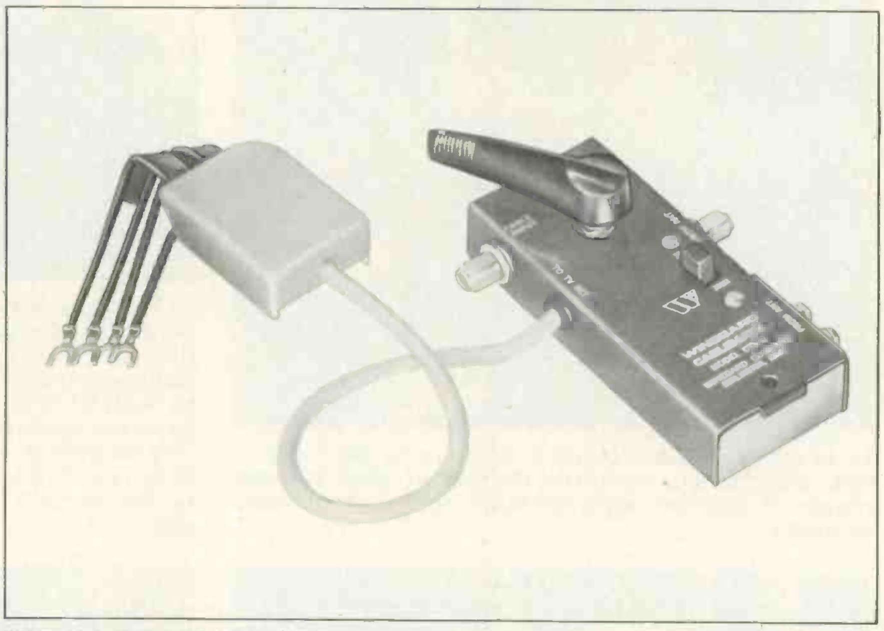
MERCHANDISING

Selling TV Antennas To CATV Subscribers

by Robert M. Fleming, Jr.

A new device for conveniently switching between CATV and home antenna systems opens the door for sales of home antenna systems in areas served by CATV

Winegard Cablemate Model CTS-1.



Winegard Cablemate Model CTS-2.

■ Community antenna television (CATV) systems originally were developed and built to deliver television signals to remote and mountainous areas of our country which otherwise would not have had television reception. From this original concept, CATV systems gradually spread into less remote areas, and, finally, today we find CATV systems in many suburban and urban areas which have over-the-air TV signals of sufficient strength for good reception through home antenna systems. This growth of CATV systems is attributable principally to the system operator's promise of better TV reception and more programming.

Ever since the first CATV systems were constructed, antenna manufacturers, distributors, dealers and consumers have looked at CATV as a case of either/or—either use cable *OR* an antenna for TV reception.

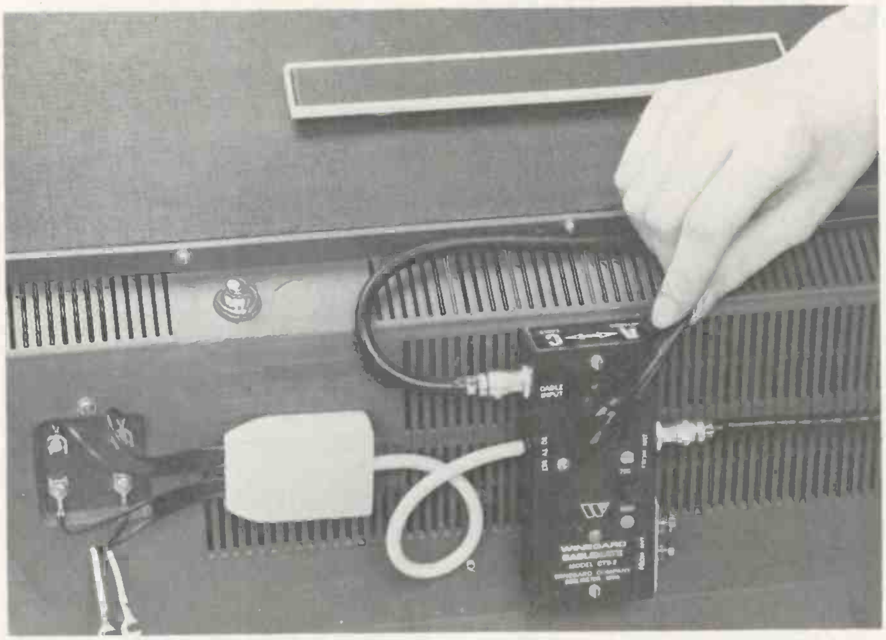
Even today, with cable systems being built in strong-signal areas where TV reception is good through home antenna systems, we tend to go along with the cable salesman who tells our customers that they won't need a TV antenna when their TV receiver is connected to a CATV cable. The promise of better reception on all channels, plus additional programming, makes a pretty convincing sales story for CATV.

The author is Marketing Manager for the Winegard Company

But the fact is that many cable systems don't deliver the crisp, clear color reception they promise. People who subscribe to CATV *do* get the distant channels they couldn't get before, but instead of better reception on their local channels, it is often worse. The term "local channel" refers to those stations within a 50 or 60 mile radius of the viewer. They usually are the network stations, the ones people watch up to 90 percent of the time.

If you service TV receivers in areas served by CATV systems, you've probably been called to service receivers which display poor quality pictures, and have found, in some cases, that the cause of the problem is not the receiver but, instead, the CATV system to which the receiver is connected. If the CATV system representative refuses to accept your diagnosis, both you and the customer are caught in the middle—and the customer doesn't know who to believe.

There are many possible reasons why a particular CATV system does not deliver the crisp, clear color reception which the subscriber expects. These include insufficient or nonlinear amplification throughout the TV spectrum and mismatched or



Rear cabinet view of a television receiver showing how Winegard Cablemate Model CTS-2 is Installed. Cable from home antenna system is connected to a coaxial input on right of Cablemate. Cable from CATV system is connected to coaxial input on left of Cablemate. Placing switch in position shown here connects signal from home antenna system to input of TV receiver. Flipping switch to the left disconnects input from home antenna system and connects receiver input to CATV cable. Screw-type connectors on bottom right side of Cablemate and 75/300 ohm switch permit connection of 300-ohm home antenna system via twin lead. Either CATV or home antenna signals are fed from Cablemate to receiver input through an 18-inch length of coax and a VHF/UHF splitter.

defective amplifiers, splitters, cables and/or tap-off devices. And the symptoms are just as varied, including weak (snowy) pictures, ghosting, insufficient or incorrect color and/or a variety of visible interference.

For reception of local TV signals, a well designed and properly installed home antenna system usually outperforms a CATV system in urban or suburban residential areas. The few exceptions include residences in the noise-laden and signal-reflecting environment of downtown or industrial areas.

The preceding statements are based on a study of CATV and TV reception conducted by the Winegard Company. Reception problems were found on one or more channels in every CATV system the company studied.

In some cases, we found consumers using both cable *and* a TV antenna. Why? The cable system gives them additional programming and the distant channels a home antenna can't offer . . . but the home antenna gives them better reception on the local channels they are used to watching regularly.

The only problem in using both is the inconvenience of disconnecting and reconnecting antenna and cable leads to the receiver terminals. To solve this problem, Winegard Company engineers have developed a device we call the Cablemate TV Signal Selector. It allows the viewer to change an antenna signal to a cable signal at the flip of a switch. And it gives the service dealer a new opportunity to sell the cable TV subscriber a new antenna. Test marketing has already proven that this approach to optimum TV reception makes sense to the customer.

For example: In December 1973, Lindstrom's, a TV sales and service business in Galesburg, Illinois, received 48 Cablemates. They connected one to a floor demonstrator receiver so that in-store customers could instantly see the difference between cable system reception and that of the store's antenna system. In addition, each of Lindstrom's technicians carried Cablemate switches on their service trucks.

Lindstrom's sold all 48 units in just 2½ weeks—with no advertising. Perhaps more important, owner Dean Lindstrom reports his people sold a number of complete new antenna installations that would not have been sold if they had not had the antenna-to-cable switching device.

A bit of advice from Lindstrom technicians: Don't install a cable/antenna selector unless the customer has a good up-to-date antenna. Connecting the receiver to an old antenna or one with deteriorated or inadequate lead-in will not provide the good reception you are after.

Now a logical question you might ask is, "Why can't I use a simple knife switch like the ones ham operators use for switching from one antenna to another?" The answer is that there must be a minimum of 52dB of isolation between the CATV and the home antenna signals. This is absolutely essential to prevent interaction and leakage of signal, which can ruin both the CATV and home antenna reception. In the Cablemate, we use a custom-made, two position switch and special circuitry which provides 58dB of isolation.

The Cablemate switch mounts on the back of the receiver with one or two screws. Because installation is so simple, it can be connected in just a few minutes during a regular service call. A screwdriver is the only tool required.

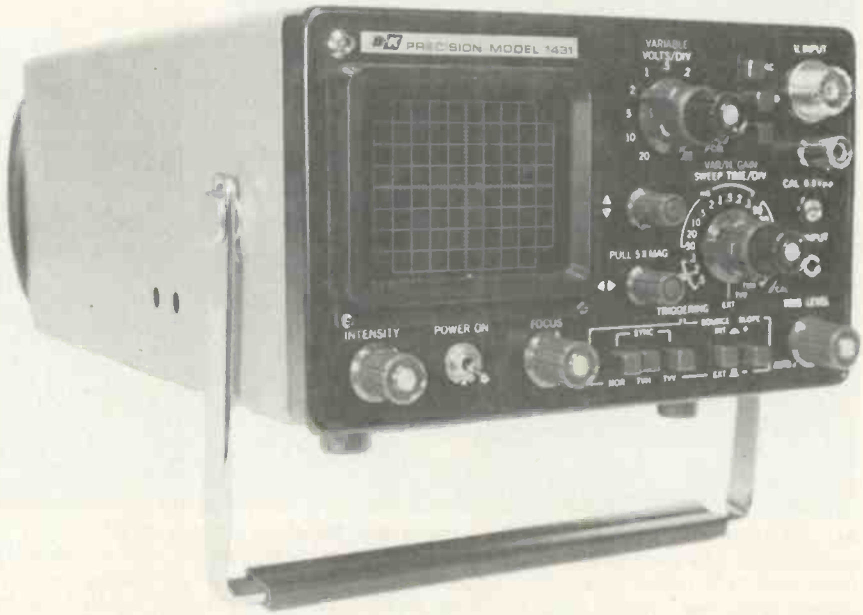
Winegard manufactures two Cablemate models. One, the CTS-2, has a 75-ohm cable input, a switch-selectable choice of 75-ohm or 300-ohm antenna input, and an output to the set through an attached 18-inch length of coax and a VHF/UHF band splitter. The CTS-1 is similar, but does not include coax or a band splitter, and it has switch-selected output terminals for both coax and twin lead.

In review, we look at this product as a means for reviving and sustaining TV antenna business in CATV areas. A profitable market is there for the dealer who is willing to go after it. ■

TEST INSTRUMENT REPORT

B & K Precision Model 1431 Oscilloscope

by J. W. Phipps



Side view of B & K Model 1431 scope. The two access holes on the side are for the screwdriver-type STAB and DC BAL controls. These are factory preset controls which reportedly should not need readjustment for the majority of scope applications. However, the STAB (stability) control of the instrument we received for review did require readjustment, which is simple and is performed in the following manner: 1) Set TRIG LEVEL to AUTO position, 2) turn STAB control CCW until trace disappears, then 3) turn STAB control CW just past the point where trace reappears. Once properly set, the STAB control of our instrument required no further adjustment.

GENERAL DESCRIPTION AND FEATURES

■ The B & K Precision Model 1431 Solid-State Triggered-Sweep Oscilloscope is a compact instrument with a number of features which make it particularly suited for servicing of home entertainment electronic products, as well as for a variety of communication, laboratory and industrial test applications. Many of these features, including a DC-to-10 MHz bandwidth, a vertical amplifier sensitivity of 0.01v/div., and preset positions for TV vertical and horizontal sweep rates, are evident in the accompanying list of specifications. Additional features which are not listed in or are not readily evident from the specifications table are:

Compactness and portability—The small size (8½ inch x 5¼ inch x 14 inch) and the lightweight and ruggedness inherent in the all-solid-state design of the Model 1431 make it an instrument which truly is portable and which does not take up much room on the service bench or in the test instrument cart.

Choice of triggered or recurrent sweep—The inherent stability of the triggered-sweep mode, combined with a calibrated time base and DC vertical input, makes square-wave, phase, rise-time and nonrecurrent signal measurements easy and accurate. Recurrent-sweep operation, which is available when the TRIG LEVEL control is in the AUTO position, provides convenient viewing of recurring signals, such as those in television receivers.

Front-panel provisions for vector analysis of TV chroma demodulators—The regular inputs and controls on the front panel of the Model 1431, plus a vector overlay graticule which is supplied with the scope, permit convenient vector analysis of the chroma demodulator outputs of color TV receivers.

DC input with convenient zero reference—Pushing in a button labeled GND, on the front panel, opens the circuit from the V INPUT jack and grounds the input of the first vertical amplifier, establishing a convenient zero-reference trace for measurement of the DC component of a waveform. Both AC and DC inputs to the vertical amplifier channel are provided.

CRT positioning without cover removal—A CRT positioning device on the back of the scope case permits realignment of the scope trace with the graticule without removal of the scope case, if the CRT should ever physically shift or if external magnetic fields deflect the trace.

Separate toggle-type POWER ON switch and pilot lamp—Although they might seem to be minor features, the separate toggle-type POWER ON switch and the pilot lamp, which lights when power is applied to the scope, are important features for a triggered-sweep scope, because in the triggered mode no trace is produced until the STABILITY and TRIG LEVEL controls are properly adjusted, and a technician can feel foolish when, after repeatedly readjusting these controls to produce a trace, he suddenly discovers that no power is being supplied to the scope.

BLOCK DIAGRAM ANALYSIS OF SCOPE CIRCUITS

Vertical Input

The signal to be observed is applied at the V INPUT jack. If the AC button is pushed in, the signal is fed to the vertical attenuator through a .1mfd (630v) capacitor. If the DC button is pushed in, the signal is bypassed around the capacitor, so that both the AC and DC components of the signal are applied to the vertical amplifier channel. Pushing in the GND button opens the vertical input circuit and connects the vertical amplifier input to ground, to establish a convenient zero reference trace for DC voltage measurements.

Vertical Attenuator

The vertical attenuator, one section of which is in the vertical amplifier, provides attenuation of the input signal in 11 steps ranging from .01v/div. to 20v/div., as selected by the VOLTS/DIV switch on the front panel. The VARIABLE portion of the VOLTS/DIV control permits continuous adjustment of the attenuation through each of the 11 ranges, and with the VARIABLE portion in the CAL position, the exact peak-to-peak amplitude of the displayed waveform can be computed directly by multiplying the VOLTS/DIV setting by the number of vertical divisions the waveform covers on the screen graticule.

B & K Precision Model 1431 Solid-State Triggered-Sweep Oscilloscope

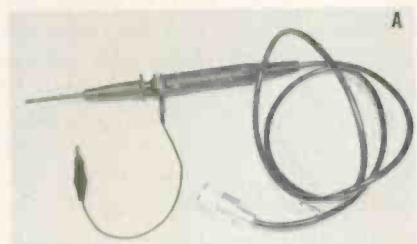
Close-up view of the conveniently grouped vertical, horizontal and sync controls of the Model 1431.

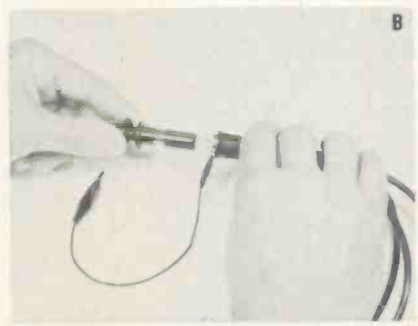
Rear view of the Model 1431. The jack above the line cord input is the Z-AXIS input, which provides intensity modulation for time or frequency marking of the displayed waveform. The line fuse is located beside the line cord input. The circular disc with a long slot is the CRT positioning device, which is described in the text.

Vertical Amplifier

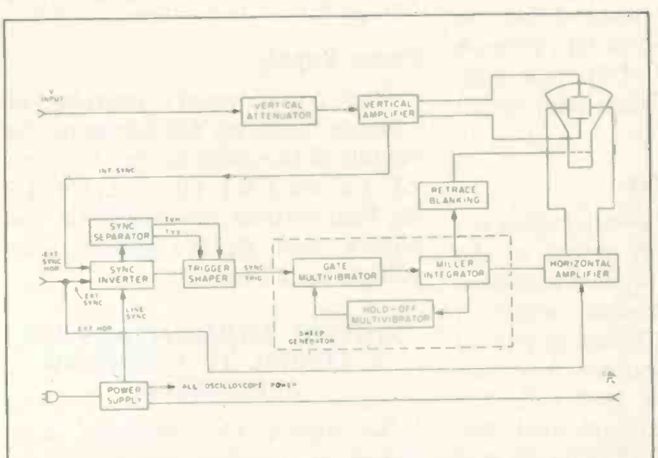
The overall gain of the vertical amplifier is approximately 60dB, producing a sensitivity of 10mv/div.

The output of the first section of the vertical attenuator is applied through an FET-equipped input protection circuit to an FET-equipped balanced amplifier pair. The input protection circuit limits the input signal to ±1v. The output of each of the FET stages in the balanced amplifier pair is fed through an emitter follower and the second section of the vertical attenuator to a cascode

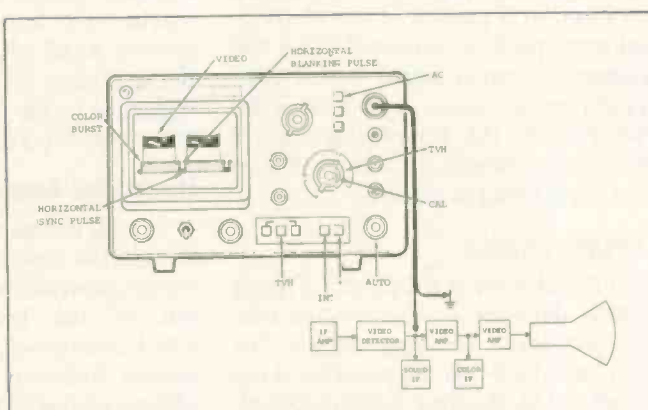




The direct/low-capacitance probe shown here is one of two models of this type probe which are available on an optional basis. In the low-capacitance position, this probe increases the scope input resistance to 10 megohms (10:1) and reduces the scope input capacitance to 18 pf. Switching from direct to low-capacitance is accomplished by pulling the head of the probe out, as shown in (B), rotating it and reinserting it.



Block diagram of the circuitry of the B & K Model 1431 scope. The function and operation of each section is explained in the text.



Test setup and control positions for using the Model 1431 to view and measure a TV composite video waveform. Waveform shown on screen is composite video produced with SWEEP TIME/DIV control in TVH position. Step-by-step procedure is outlined in text.

differential amplifier. The outputs of this differential amplifier are fed through another emitter follower to the final cascode differential amplifier, the outputs of which drive the vertical deflection plates of the CRT.

The vertical amplifier is direct-coupled throughout, from the input through to the deflection plates of the CRT.

Sync Inverter

This section receives input from one of two sources. When the TRIGGERING SOURCE switch is set for INT sync, the signal that is being observed on the CRT is also used to trigger the sweep. When EXT sync is selected, the sweep trigger input is applied at the EXT SYNC/HOR jack. The sync inverter is a dual input stage which inverts for negative polarity input or double inverts for positive polarity input. It also limits high amplitude input, so that a wide range of amplitudes and either polarity of input provides the correct sync trigger output. For NOR (normal) sync, the output of the sync inverter is routed directly to the trigger shaper, but for TVV and TVH sync, the signal is routed through the sync separator.

Sync Separator

The sync separator consists of a two-stage circuit which generates output pulses whenever the peak amplitude of the input exceeds the cutoff bias of the second stage. When the TVH button, on the front panel, is pushed in, the output of the sync separator is applied directly to the trigger shaper circuit. When the TVV button is pushed in, the horizontal sync pulse is removed from the composite video signal by an integrator circuit and a sync pulse is developed by the tip of the vertical sync pulse, which, in turn, is fed to the trigger shaper circuit.

Trigger Shaper

This section is a Schmitt Trigger which develops a square-wave output whenever it is triggered on. The level at which it is triggered on is determined by the TRIG LEVEL control. The square-wave output of the Schmitt Trigger is fed to a differentiator circuit, which shapes it into a trigger for the gate multivibrator.

Gate Multivibrator

The gate multivibrator is a bistable type which is controlled by the trigger signal from the square-wave shaping circuit. When the TRIG LEVEL control is in the AUTO position, the gate multivibrator is converted into an astable multivibrator operating at 40 to 50 Hz. Because this astable multivibrator oscillates weakly, it is easily pulled into synchronization with the input signal, to generate the trigger signal for automatic (recurrent) triggering.

The threshold at which the gate multivibrator begins operating is established by the STAB control, a screwdriver-type adjustment on the side of the scope. When the multivibrator is triggered on by the trigger shaper circuit, the operational state of its transistors is inverted, turning off two switching diodes, which, in the off mode, permit the time-base capacitors in the Miller integrator to charge at a rate which is determined by the capacitors and resistors selected by the SWEEP TIME/DIV control.

Miller Integrator and Holdoff Multivibrator

The Miller integrator circuit and the holdoff multivibrator form a DC loop which generates a linear sawtooth waveform. One output of the Miller integrator is fed back to one side of the time-base capacitors, to provide the constant charging current needed for linearity of the sweep. The other output of the integrator circuit is fed back through the holdoff circuit to the gate multivibrator. When this delayed signal reaches the level required for the desired width of the sweep, it resets the operating state of the gate multivibrator to the original state, which completes the sweep.

Horizontal Amplifier

For all modes of sweep except external, the sawtooth output of the sweep generator is applied to the input of the horizontal amplifier, which consists of a balanced pair of emitter followers and two final amplifiers connected in push-pull. The outputs of the push-pull final amplifier are applied directly to the horizontal deflection plates of the CRT.

For EXT HOR operation, the signal applied at the EXT SYNC/HOR jack is fed through the VAR/HOR GAIN control to the input of an FET-equipped source follower. From the source follower, it is fed through the EXT contacts of the SWEEP TIME/DIV control to the horizontal amplifier, thereby bypassing the trigger and sweep generator circuits.

Retrace Blanking

The blanking circuit prevents display of a retrace on the CRT screen during sweep flyback. It consists of an emitter follower and a switching transistor. During trace time, the switching transistor is reverse biased, and the CRT control grid is connected to a voltage divider network between −1500v DC and B+, which permits the CRT to conduct. At the end of trace, a positive-going pulse from the gate multivibrator is coupled through the emitter follower to the base of the switching transistor. With the switching transistor saturated, the B+ reference of the voltage divider connected to the CRT control grid is temporarily grounded through the switching transistor, and the CRT is cut off for the duration of the retrace.

Calibration Voltage

Voltage from the secondary of the power transformer is applied to the base of an overdriven amplifier, which, because of saturation clipping, produces a 10v p-p, 60 Hz square wave on its collector. A variable voltage divider in the collector circuit reduces the output, to produce a 0.8v p-p square wave at the CAL jack.

Power Supply

The power supply provides all voltages necessary for operating the circuits of the oscilloscope: 6.3 volts AC for the CRT filament, B+ for the final vertical and horizontal amplifiers, and Zener-regulated low-voltage for all circuitry.

CONTROL ADJUSTMENTS FOR A TYPICAL TV SERVICING APPLICATION

To view a TV composite video waveform on the screen of the scope, the scope controls are adjusted in the following manner:

1) Tune the television receiver to an active channel.

2) Set the SYNC switch to TVH for horizontal pulse sync or TVV for vertical pulse sync. Then set the SWEEP TIME/DIV control to TVH for horizontal line viewing or to TVV for vertical frame viewing.

3) Set the TRIGGERING SOURCE switch to INT.

4) With the TRIG LEVEL control initially set to AUTO, adjust the INTENSITY control for a trace.

5) Push in the AC pushbutton and connect the probe to the V INPUT jack. Connect the ground clip of the probe to the television set chassis. With the probe set at 10:1, connect the tip of the probe to the video detector output.

6) Set the VOLTS/DIV control to the position which produces the largest vertical deflection without going off the graticule.

7) Set the TRIGGERING SLOPE pushbutton as follows:
   a) If the sync and blanking pulses of the observed video signal are positive, use the (−) switch position.
   b) If the sync and blanking pulses are negative, use the (+) switch position.

8) Turn the STAB control counterclockwise until no sweep appears. Finally, increase the STAB setting (clockwise) until the sweep reappears. This should provide a stable waveform presentation.

9) Adjust the INTENSITY and FOCUS controls for desired brightness and best focus.

10) To measure the peak-to-peak amplitude of the waveform, rotate the VARIABLE portion of the VOLTS/DIV control completely clockwise to the CAL position and, if necessary, readjust the VOLTS/DIV control to produce the highest vertical trace without the waveform extending beyond the viewable portion of the screen. Count the number of vertical graticule divisions through which the waveform extends, and multiply this number by the setting of the VOLTS/DIV control. (If the 10:1 setting of the probe is being used, multiply this product by 10.)

11) To view a specific position of the waveform, such as the color burst, pull outward on the horizontal trace positioning control, for 5X magnification. Rotate the same control left or right to select the desired portion of the waveform to be viewed.

12) Composite video waveforms may be checked at other points in the video circuits by moving the probe tip to those points and changing the VOLTS/DIV control setting as required to keep the display within the limits of the scale. The polarity of the observed waveform might be reversed when moving from one monitoring point to another; therefore, it is important to remember that the best waveform is obtained if the TRIGGERING SLOPE pushbutton is used as outlined in step 7.

SPECIFICATIONS
B & K Precision Model 1431 Oscilloscope

VERTICAL AMPLIFIER

Sensitivity: 0.01v/div. to 20v/div. ± 5%, 11 ranges, variable or calibrated
Freq. Response:
(DC) DC to 10 MHz, within −3dB
(AC) 2 Hz to 10 MHz, within −3dB
Risetime: 35 nanoseconds
Overshoot: 3% or less
Input Resistance: 1 Megohm (approx.)
Input Capacitance: 35 pf
Maximum Input Voltage: 300v (DC + AC peak) or 600v p-p
Tilt: 5% or less

HORIZONTAL AMPLIFIER

Sensitivity: 300 mv/div.
Freq. Response: DC to 1 MHz, within −3dB
Input Resistance: 1 Megohm (approx).
Input Capacitance: 40 pf or less

SWEEP

Sync Type: Triggered and Automatic (recurring)
Timebase: 0.5 μsec./div. to 0.5 sec./div. ± 5%, 19 ranges, variable or calibrated, plus TV Horiz. (13 μsec./div.) and TV Vert. (3.6 msec./div.)
Magnification: 5X

SCREEN SIZE

3 inch (2¾ inch wide x 2 inch vertical viewable area)

TRIGGERING

Sources: Internal and external (0.5v p-p or more)
Range: 20 Hz to 10 MHz (min. 1 div. of deflection, as measured on scope CRT)
Slope: Positive or negative

CALIBRATION VOLTAGE

Type: Square wave
Frequency: 60 Hz
Amplitude: 0.8v p-p ± 5%

INTENSITY MODULATION
(2-axis input at back of scope)
Input Level: 30v p-p or less

POWER REQUIREMENTS

117v AC, 50/60 Hz, 30 watts (3-wire line cord), fuse protected (located on back of scope)

PRICE

$399.95

ACCESSORIES AVAILABLE
B & K Models PR-16 and PR-20 combination low-capacitance and direct probes. (Low-cap input impedance: 10 Megohm resistance, 18 pf, 10:1 attenuation; direct input impedance: 1 Megohm, 120 pf.)

Summary

Although some of the electrical specifications of the Model 1431 exceed those usually considered essential for servicing home entertainment and communications electronic products, it also offers a number of features which make it particularly suited for such servicing. These features and the price, plus a well-written instruction manual which provides comprehensive, step-by-step procedures for using the Model 1431 to service TV and FM receivers, should make this scope attractive to consumer electronic technicians. ■

COAX OR TWIN LEAD . . .

continued from page 35

per drain wires running down the outside of the foil throughout the length of the cable. These conductors lower the shield resistance and permit simple connection to the shield.

The Final Choice

Entered in Table 5 are the essential parameters of the two lead-in types, coax and twin lead. From the table you see that there are two areas in which twin lead outperforms coax: First, it has lower VHF losses, and, second, its cost is lower.

Summary

By considering this table, along with the other facts that have been presented, a number of guidelines can be established:

1. *If cost is an overbearing criterion, use twin lead* . . . but remember that initial cost is only a short-term advantage. It is very difficult to justify twin lead on a cost-only basis if other performance factors suffer. The cost of the cable must be considered with respect to the cost of the entire installation. Coax should not be simply thought of as a 100 percent increase in cost because the wire is twice as expensive, but perhaps more realistically it should be considered as a 20 percent factor, depending on the installation size.
2. *If the installation is completely indoors and interference and installation problems are minimal, use a good grade of twin lead.* Weather protected twin lead can give very long life and the lowest attenuation over the whole frequency spectrum. This guideline can be extended to where there is only a short 5 or 6 foot run to an attic distribution point.
3. *In all other cases use coax.* . . . With the FCC stimulating an increasing number of UHF stations, and the set manufacturers recognizing the advantages of coax, added to the fact that coax outperforms wet twin lead, coax is logically the preferred choice.

Actually, even in the VHF band, when there is any amount of interference, twin lead's low-loss advantage can be eliminated if interference destroys the signal-to-noise ratio. ■

COLORFAX

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

MAGNAVOX

21 Detent Tuner—Cleaning Precautions

The 21 detent tuner is used in many models of the portable and console color televisions, including all remote-controlled models. This tuner uses both VHF and UHF strips. The UHF strips are actually potentiometers which are enclosed in a plastic housing. The popular aerosol type tuner sprays should not be used with the 21 detent tuner because the chemical might deteriorate the plastic housing on the UHF strips. If the service technician finds it necessary to clean the contacts in the tuner, the job should be performed properly, and a new tuner wiping pad (part number 171013-1) should be installed.

Color TV Chassis T989—Hum at Low Volume Level

A recent production change in the T989 chassis incorporates an additional filter network in the audio B+ line, to eliminate the possibility of low level hum, which may be noticeable in the sound at low volume. If this problem is encountered and the hum cannot be eliminated by the normal procedure of panel or module replacement, the additional filter network components are available as a kit, for field installation. The resistor and capacitor for the filter network along with complete instructions for installation of the components are included in the kit. The part number for the kit is 171343-1. It is available at the district parts centers.

Color TV Chassis T989—Intermittent Brightness Variation

A condition of intermittent brightness variation which might appear with the T989 chassis can be caused by high contact resistance at pin 8 of the Videomatic module (part number 703508-2). This problem can be eliminated by installing a jumper wire from pin 8 of the Videomatic module to pin 29 of the "B" panel. Replacement Videomatic modules are now being supplied with a jumper wire (connected to pin 8) which has a "push-on" connector for easy connection to pin 29 of the "B" panel.

MOTOROLA

Color-TV Color/Video Panel LA/MA/WA—Noise Immunity Circuits

The "CA" Panel has an adjustable noise "limiter" circuit to reduce the undesirable effects of noise under weak signal conditions.

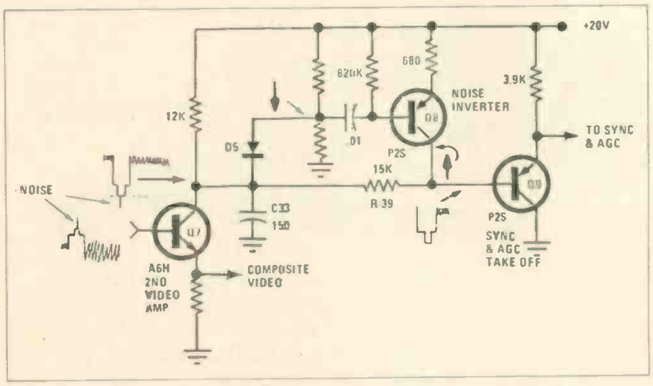
In the "LA" Panel, a new noise "inverter" circuit cancels the noise signal by inverting its phase and feeding it back on itself. No adjustment is required in this circuit, although misadjustment of the AGC control (detector level) can affect its operation.

Composite video at the base of transistor Q7 (second video amplifier) contains positive-going sync and blanking. High-frequency video information is taken from the emitter of this stage and applied to the picture tube.

Sync and blanking signals, amplified and inverted by transistor Q7, are present at the collector of Q7. High-frequency video information is rolled off by capacitor C33 because the signals needed for sync and AGC action have lower frequencies.

When a noise-free signal is received, the low-frequency sync signal is passed to the base of transistor Q9 through resistor R39, and is unaffected by transistor Q8. When noise is present along with the sync signal, and it exceeds the sync amplitude, it can affect sync and AGC. This is prevented by passing any negative-going voltage that exceeds sync amplitude (in the negative direction) through diode D5 and capacitor C34 to the base of transistor Q8. (Diode D5 is normally reverse biased but is made conductive by the noise pulse.)

Common emitter stage Q8 conducts with this negative-going signal (noise) on its base, resulting in a positive-



going voltage at its collector. This voltage cancels out the negative-going voltage (noise) from Q7. In this manner, Q8 inverts the noise pulse, to cancel its effect on Q9, producing a clean signal for application to the sync and AGC circuits, which should be unaffected by noise pulses that might be present. ■

TECHNICAL DIGEST

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

GENERAL ELECTRIC

TV Chassis SF—Symptoms Caused by Shorted IC301

Symptoms such as no raster, no horizontal sync, intermittent raster, intermittent horizontal sync and sound, which might or might not be affected, can be caused by low +12v source voltage.

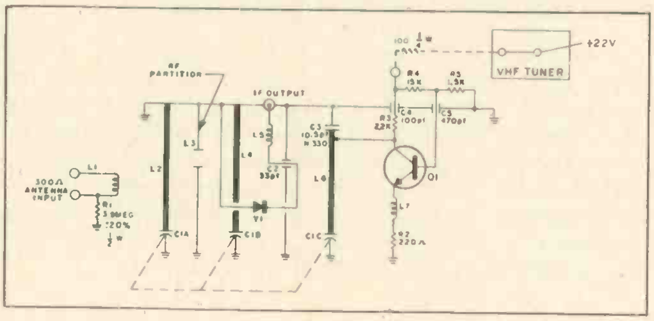
The above symptoms all can be caused by decreased B+ (12v) to the horizontal oscillator, caused by a short circuit in IC301.

Short circuit conditions in the internal zener diode regulator will cause the regulator to draw more current, thus dropping the 12v B+ to a lower voltage. When troubleshooting the above symptoms, measure the DC voltage present at the Drain of the horizontal oscillator, Q251. Normally this voltage will be +10.5v DC. If it is lower, replace IC301 (replace complete audio module in early-production receivers).

Be sure the receiver is unplugged when replacing IC301 (or audio module in early production), and do not operate the receiver with IC301 removed.

TV Chassis U1/UA—UHF Tuner

These tuners are customarily used in television receivers in which the chassis is connected to one side of the AC power line. To prevent possible hazards to the user, the tuning shafts are molded from nonconductive plastic and the antenna circuit is isolated from chassis ground by a 3.9M, ½w resistor, R1. For continued protection, these items should be checked, and any defects corrected, each time the tuner is serviced. Both the value and wattage



rating of R1 are important. Replace only with a 3.9M, ½w resistor. Replacement tuners must provide similar isolation.

Before condemning the tuner, be sure to check the supply and control voltages and the UHF input of the VHF tuner. A known good tuner can be quickly "patched in" to confirm or contradict your initial diagnosis.

Extensive repairs and/or alignments are difficult to perform without special equipment. If such repairs are necessary, replace the entire tuner or send it to an agency specializing in tuner repair. ■

MOVING?

Be sure to let us know your new address. Please enclose a complete address label from one of your recent issues.

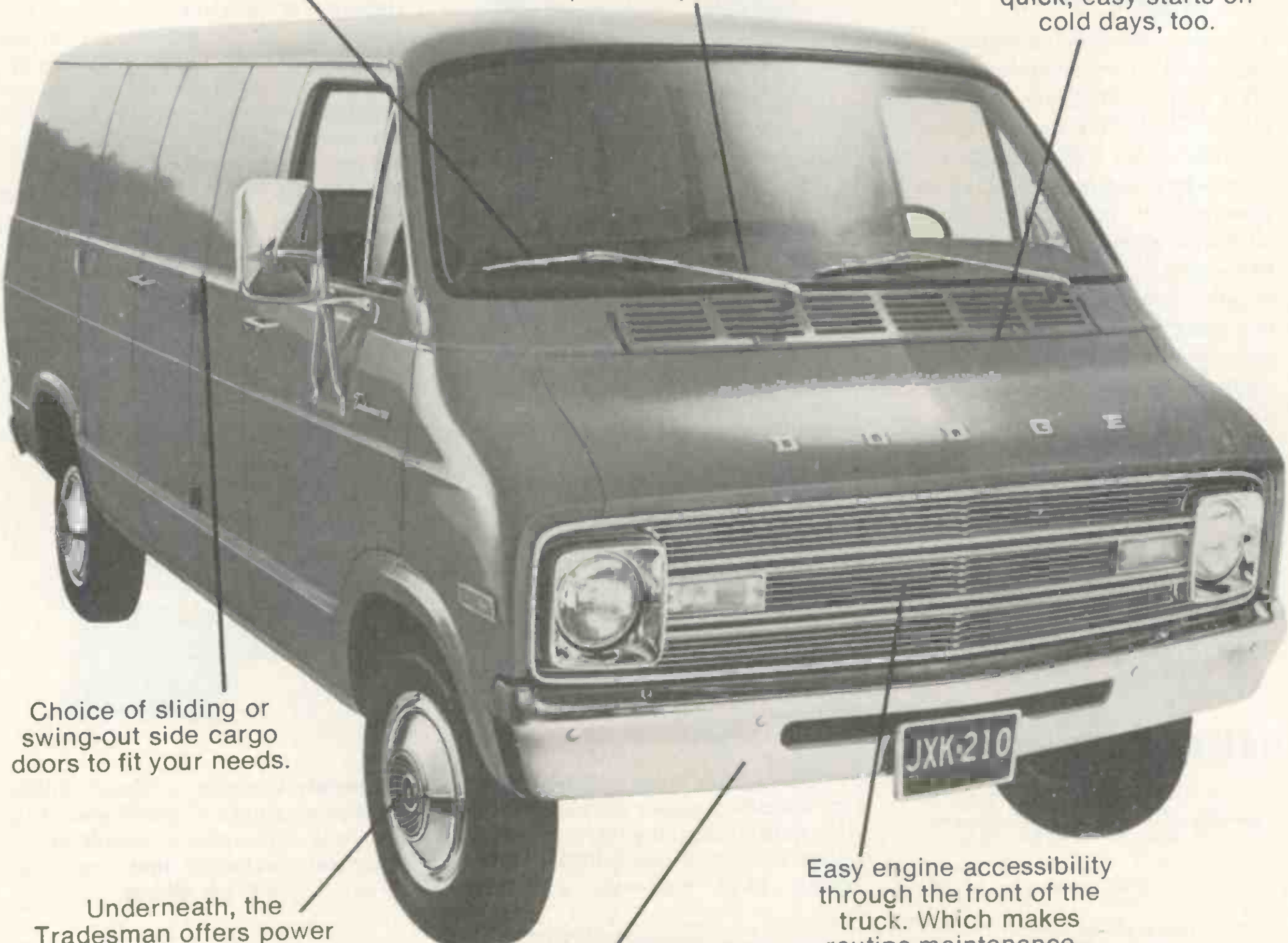
The Dodge Tradesman Van:

The things that make it so easy to buy are the things that make it so easy to sell.

A passenger compartment with wide, moulded foam seats and an attractive dash panel with easy-to-read instruments that make you feel as if you're riding in a car.

Our dependable Dodge engines. Today, your choice begins with our famous 225 Slant Six (smallest displacement engine offered in any American van) and continues with two V8 engine options for more power, if you need it.

An Electronic Ignition System that gives you a virtually maintenance-free ignition system. (All you change are spark plugs.) And gives you quick, easy starts on cold days, too.



Choice of sliding or swing-out side cargo doors to fit your needs.

Underneath, the Tradesman offers power front disc brakes,* independent front coil suspension, and a heavy galvanized coating on body parts most exposed to moisture, road salt, etc.

*Standard on B200 and B300 models.

Dodge gives you the widest choice in van sizes. There are eight models on two wheelbases—including the Dodge Maxivan, the biggest van in the field.

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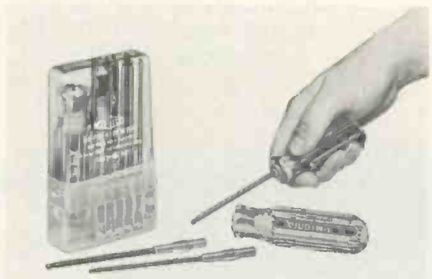
NEW PRODUCTS

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

SCREWDRIVER SETS 700

Engages work from virtually any angle

Xcelite's "ballpoint" hex socket screwdrivers, which engage work from virtually any angle, are available in seven metric interchangeable blade



sizes, either as part of a compact kit, complete set, or singly. The 99-PS-41MMBP Kit includes seven drivers, with point dimensions from 1.27mm to 5mm and 101.60mm (4 in.) long, a 4 in. extension blade and regular Series "99" plastic handle. All are housed compactly in a flexible plastic, see-thru case which permits easy tool identification and has a flat base for use as a bench stand. Blades have a protective black oxide finish. The design permits these screwdrivers to tighten, adjust, or remove hex socket rews which, because of obstructions, nnot be reached straight-on.

FREQUENCY COUNTER 701

Reads to 8-digit by over-ranging

The Scarpa Model SC-1A Frequency Counter features the ability to read to 8-digit accuracy by over-ranging, standard-size Hewlett-Packard 7-segment LED read-outs, a precision

10MHz Quartz Crystal time base generator, counter reset within 200msec of completed count, leading zero suppression and 50mv input sensitivity. The unit is powered by a 3a, 5v regulated power supply. The frequency range is 1Hz to 40MHz selected by a 2-position panel control. Input impedance is 1M, shunted by 20pf, to a dual gate, diode-protected MOSFET/Schmitt trigger input stage. Accuracy is ±1 count plus time base stability. The unit measures 8 in. wide x 3 in. high x 6 in. deep. Price is $185.

SOLDERING IRON 702

Features new recharging stand

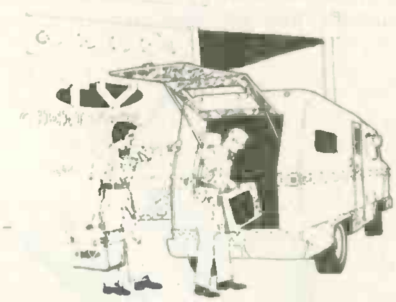
A new recharging stand accompanies the Model 7500 Wahl Iso-Tip Cordless Soldering Iron. Featuring a broader base and lower silhouette, the recharger is less prone to accidental tipping. For operator convenience, the stand also has a compartment on top designed to hold a spare soldering tip. The stand automatically makes the electrical recharging connection when the iron is placed into the stand. There are no plugs to connect—no "positioning" of the iron. The recharger can

completely recharge a "dead" soldering iron overnight. Depending on wire size and atmospheric conditions, a completely recharged unit can solder up to 150 joints per charge.

COMMERCIAL VEHICLE 703

A versatile vehicle for business or pleasure

Champion Home Builders Handi-Van is a commercial vehicle with a Chevrolet or Ford chassis with a six-cylinder engine and standard transmission. It can be ordered with nothing but the carpeting throughout its 17-ft. long by 6-ft., 1-in. interior with four seats, and when it becomes necessary, it easily accommodates a desk, typewriter, filing cabinet, spare parts or samples. This multipurpose vehicle is designed to accommodate seven persons comfortably with unique fold-over seats which will convert to two roomy double beds. It can seat up to 12 people with optional, portable rear bench seats. And, with the large rear overhead bunk, the vehicle provides sleeping for six adults. Other standard features include power brakes, heater,



shag carpeting, window curtains in rear of van, rear pop-up door hinged at top, panoramic 32 in. x 84 in. windshield, and steel-cage construction with urethane-foam insulation. Price is under $5,000.00.

RF WATTMETER 704

Digital readout to 1000w in six ranges

The Bird Model 4371 Directional High-Power Wattmeter is the first digital insertion instrument for measuring forward or reflected CW power in coaxial transmission lines. It measures power flow under any load condition from 25 to 520MHz and from 1-1000w in six ranges. Insertion VSWR in 50-ohm systems is 1.1 and accuracy is ±5% OFS. The user can calibrate the instrument in the field to known RF power standards, eliminating weeks of transit for periodic certifications. The unit measures CW, AM, FM and SSB signals. The readout requires no mental transposition or attention to full-scale switch posi-

tion. No plug-in elements are needed because all variable measurement parameters—frequency range, forward/reflected power and full-scale values—are push-button selectable on the front panel. The six power ranges feature 25 percent over-ranging. The instrument is finished in gold vinyl jute with a dark non-glare front panel. Price is $950.

CLEANING AEROSOL 705

Gets the dust you can't reach

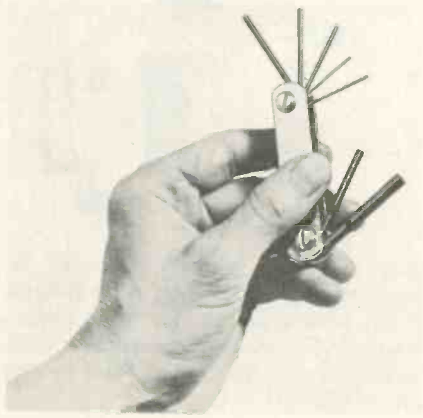
Falcon has added a new mini version to the Dust-Off family. The clean, dry blast from Dust-Off gets to the

dust you don't want to touch on records, cartridges, turntables and tape-recorder heads. The extension nozzle gets into those out-of-reach places. The aerosol can stands 3½ in. tall and weighs 3½ oz. Price is $.99.

METRIC HEX KEY SET 706

A folding metric set on the jackknife principle

A compact folding set of metric hex keys is introduced by Vaco. The set of seven folds away on the jackknife principle and includes sizes 1.27mm,



1.5mm, 2mm, 2.5mm, 3mm, 4mm, and 5mm. Blades are made of #8650 nickel-chromemolly wrench steel. The set is individually carded and identified as stock number 70156. List price is $2.48.

MULTITESTER 707

Low-cost compact unit

A pocket multitester, Model 51-150, comes with a rotary switch for easy range selection. The multitester

reportedly has 1K/v volt-ohms-milliampmeter capacity, plus the following ranges: (AC) 15v, 150v, 1000v (1K

1v); (DC volt) 15v, 150v (1K 1v); (DC current) 1ma, 150ma; (Resistance) 100K, 1.5Ω (UM-3) × 1 (center 2.5K). The ac and dc test leads, plus the size AA penlight cells are reportedly included. Weltron Co.

SERVICE CHEMICAL 708

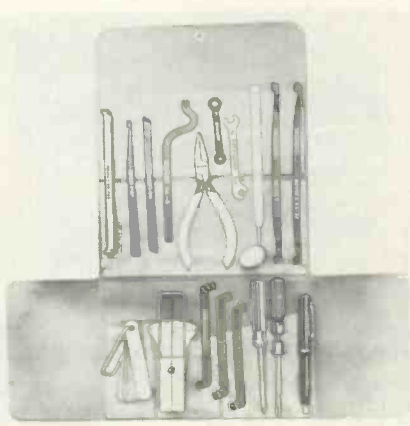
Displaces water while it lubricates

A new unique formulation of chemical compounds which displaces water while it lubricates stationary or rotating electrical/electronic components is said to be introduced. Designated as CD-250, the aerosol demoisturizer reportedly forms a liquid barrier while laying a protective coating over electrical parts, which are subject to excessive moisture conditions, without interfering with electrical conductivity. Upon application it reportedly acts as an inert lubricant and may be safely used on all surfaces commonly found in electronic/electrical parts, components and equipment. The effective life of the demoisturizer varies depending upon environmental conditions, and one application on some parts, like relays, would be effective for up to one year. The Cole-Flex Corp.

RELAY SERVICE TOOL KIT 709

Tools needed for adjusting, checking and trouble-shooting relays

A set of tools designed specifically for servicing relays is offered by P. K. Neuses, Inc. Model TK-18 Tool Kit is a set of tools exactly suited for any job required in the servicing, aligning, checking and maintenance of relays.

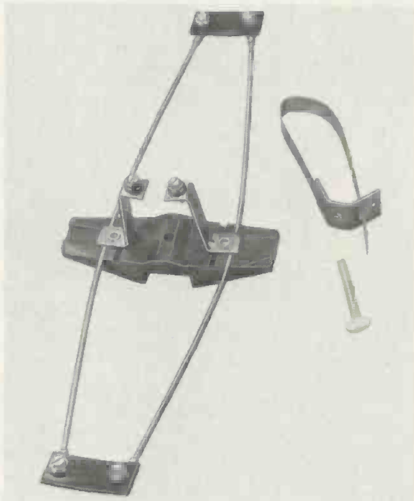


The kit comes complete in a handy vinyl plastic case and includes a contact burnisher with extra blades, spring tension gauge, wrenches, thickness gauge set, and an inspection mirror.

ANTENNA MATCHING HARNESS 710

Combines identical UHF antennas into a single downlead

A new tapered line 300-ohm matching harness for combining identical UHF antennas into a single downlead is designed by Jerrold. Called Model JSL-U, the harness is particularly useful where vertical stacking of UHF antennas is required for increased gain and added vertical capture area. Because the harness causes extremely low loss, stacking gain is better than 2.5dB. Theoretical maximum stacking gain is

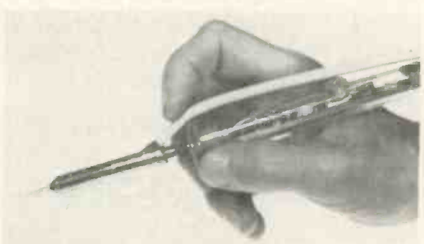


3.0dB. The stacking harness can also be used as an efficient low-loss mixer, to combine two identical UHF antennas which are oriented in different directions. Price $4.95.

SOLDERING IRON ACCESSORY 711

Directable hot air source at temperatures of up to 400°F

Introduced is a hot-air tip attachment, Part No. HA120, for the Loner Soldering Instrument. With this attachment it is now reportedly possible to make your own hot air for shrinking tubing or troubleshooting, while



still being able to do routine soldering. The operator merely blows into the mouthpiece supplied, or connects it to an air supply. Edsyn, Inc.

DIGITAL MULTIMETER 712

Operates from battery or line power

A 10,000-count (4-digit) digital multimeter, Model 45, by Data Technology, will operate from either line or battery power. This instrument is particularly applicable for "tuning" precision power supply and amplifier

circuitry. It has five AC and five DC voltage ranges with 10μv resolution, six resistance ranges with 10m ohm resolution and five AC and five DC current ranges with 10na resolution. Two pop-release buttons make disassembly quick and easy. Other specifications include: battery charge life, 10 to 12 hours; power consumption, 3w; display: .33-in., 7-segment Sperry's; weight is 2.3 lb. Price is $399.

FREQUENCY COUNTER 713

Kit-form and reads to 180MHz

The Heathkit IB-1103 Frequency Counter reads to 180MHz through use of solid-state counter circuitry which features a phase-locked frequency mul-

tiplier. Pushbutton selection permits multiplication by 1 (direct), 10, 100 or 1000. An input frequency of up to 10KHz can be measured with an accuracy of 0.001Hz. A temperature-compensated crystal oscillator generates the time base, and three pushbuttons provide 1msec, 100msec and 1sec gate times. Input sensitivity is 50mv to

120MHz and 100mv to 180MHz. A rear panel switch permits bypassing of the internal oscillator to allow use of any external time base up to 3v. Cold-cathode display tubes provide 8½-digit readout with range lamps for MHz, KHz and Hz. Indicators are provided for Gate, Overrange and unlocked operating conditions. Price is $379.95.

THREE-WAY SPLITTER 714

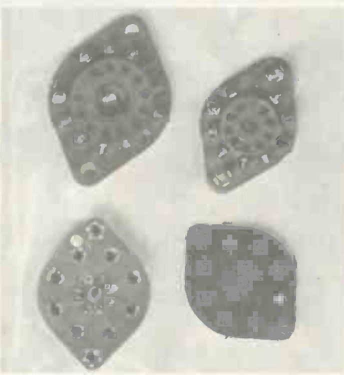
Provides equal outputs, nominally 5.5dB below input

A new 5-300MHz balanced 3-way hybrid splitter, Model MSB3, is designed by AEL Communications. The splitter provides equal outputs, nominally 5.5dB below input level, and is ideally suited for bidirectional systems. Models are available for stand or pedestal mounting.

SOCKETS 715

Exact replacement Zenith sockets

Oneida has expanded its line of tube sockets with the addition of exact replacement Zenith sockets. Kit No. 39 contains a general purpose assortment of four sockets, none of which has a substitute. In addition to this kit, Zenith sockets S-74-C (an exact 9-pin replacement) and S-75-C (an exact 12-pin replacement) are available. The combination of the kit assortment plus the other two sockets proyides complete Zenith coverage. ■



DEALER SHOWCASE

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

4-CHANNEL RECEIVER 716

Features frequency response of 20Hz to 20KHz with less than 1% harmonic distortion

Sylvania's Model RQ3746 receiver provides four channels of 15w continuous (RMS) power, with a frequency response of 20Hz to 20KHz at less than 1% total harmonic distortion

and two channels with 30w of continuous (RMS) power in a special stereo bridge mode. The unit offers FM sensitivity of 2.3μv (IHF) and 67dB signal-to-noise ratio. Other features include a thermal circuit breaker, to protect the speakers from amplifier malfunction; a primary circuit breaker, for component failure protection, and a scratch filter in all four channels, to reduce high-frequency noise. Also included is a tape monitor pushbutton for comparison of 4-channel or stereo recordings with the original program source. Price is $369.95.

TAPE DECK 717

Speeds of 15 ips and 7½ ips plus a 10½-in. reel capacity

A new three-motor open reel tape deck, Model TC-755, reportedly includes a newly designed logic control transport and electronics. The unit features 10½-in. reel capacity and speeds of 15 ips and 7½ ips. The servo-control motor reportedly adjusts to any line voltage changes to assure constant tape speed, and the closed-loop dual capstan tape drive reduces wow and flutter mechanically isolating the section of tape passing before the heads. The deck is also said to feature mechanical memory capability that works with an optional timer to engage the tape drive mechanism at a pre-set time. Other facilities include a

record equalization selector and accessible bias switching for optimum performance from any type of recording tape; variable playback VOLUME control with detents to pre-set the playback level for monitoring; two VU meters; mic/line mixing, adjustable tape height guides; feather-touch control buttons; and a three-position microphone attenuator switch. Sony.

TRANSCEIVER 718

Solid-state, five channel

This solid-state, portable ComData FM transceiver, Model HT-910, features a single-conversion receiver, a monolithic crystal filter, and solid-state T/R switching. It has five channels, with plug-in crystals to make channel changes fast and easy. Jacks for external microphone, speaker, and earphone are included along with a BNC antenna connector and a heliflex antenna. The unit measures only 1-9/16 in. deep x 3-1/16 in. wide x 8-5/16 in. high and weighs approximately 1.5 lb. Price is $399.95.

CB MOBILE RADIO 719

Uses a "radiotelephone" configuration for ease of listening

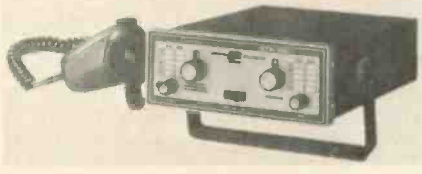
A new E. F. Johnson citizens two-way radio with a "radiotelephone" configuration is the first of its type. The radio, which is designated the "Johnson Messenger 130," features

automatic control of the built-in speaker function. With the handset in the cradle position, the speaker is activated so that incoming calls can be heard. When the operator lifts the handset, the speaker is automatically silenced to permit private handset listening. Optionally, the operator can continue to have the speaker active by flipping a switch to the "speaker" position. The handset contains a push-to-talk bar in the handle. Other controls provide full CB functions, including operation on all 23 channels plus PA capability. The completely solid-state circuitry also features automatic gain control and noise limiting on receive, plus electronic speech compression on transmit. Price is $199.95.

FM TRANSCEIVER 720

1¼-meter unit with 12w of output power

A new 1¼-meter transceiver from Genave, designated the Model GTX-100, provides 12w of output power, nominal, with 10w minimum at 14v DC input. It features rotary channel selection with independent selection of 10 transmit and 10 receive frequencies, for a potential total of 100 channels. A front panel switch locks in preselected frequency pairs, to allow one-knob operation. Another front panel



switch includes a low power setting for long low-drain operation. The front panel is backlighted for high visibility night operation, and the rear panel is equipped with an external speaker jack. A dual-gate MOS FET is used in the receiver head end. Capability for an optional microphone gain control is also included on the circuit board. The unit, which comes with a hand microphone and a mobile mounting bracket with anti-theft device, is priced at $269.95. ■

READERS SERVICE INDEX

ADVERTISER'S INDEX

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105	113	121	129	137	145	153
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NEW PRODUCTS

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705	713	721	729	737	745
706	714	722	730	738	746
707	715	723	731	739	747

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TEKFAX

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

GROUP 260

	SCHEMATIC NO.		SCHEMATIC NO.
ADMIRAL TV Chassis TK6	1519	SYLVANIA Color-TV Chassis E06-1	1521
AIRLINE TV Models GAI-13444A/44B	1523	ZENITH Color-TV Chassis 19EC13	1522
MGA Color-TV Model CS-165	1520		

1519

ADMIRAL

TV Chassis TK6

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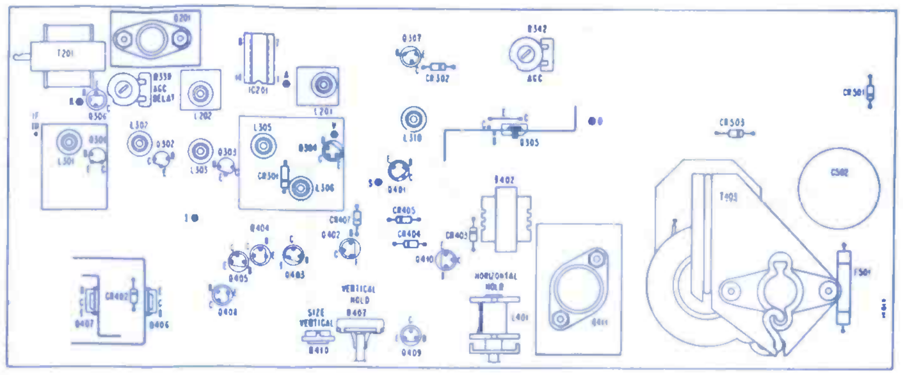
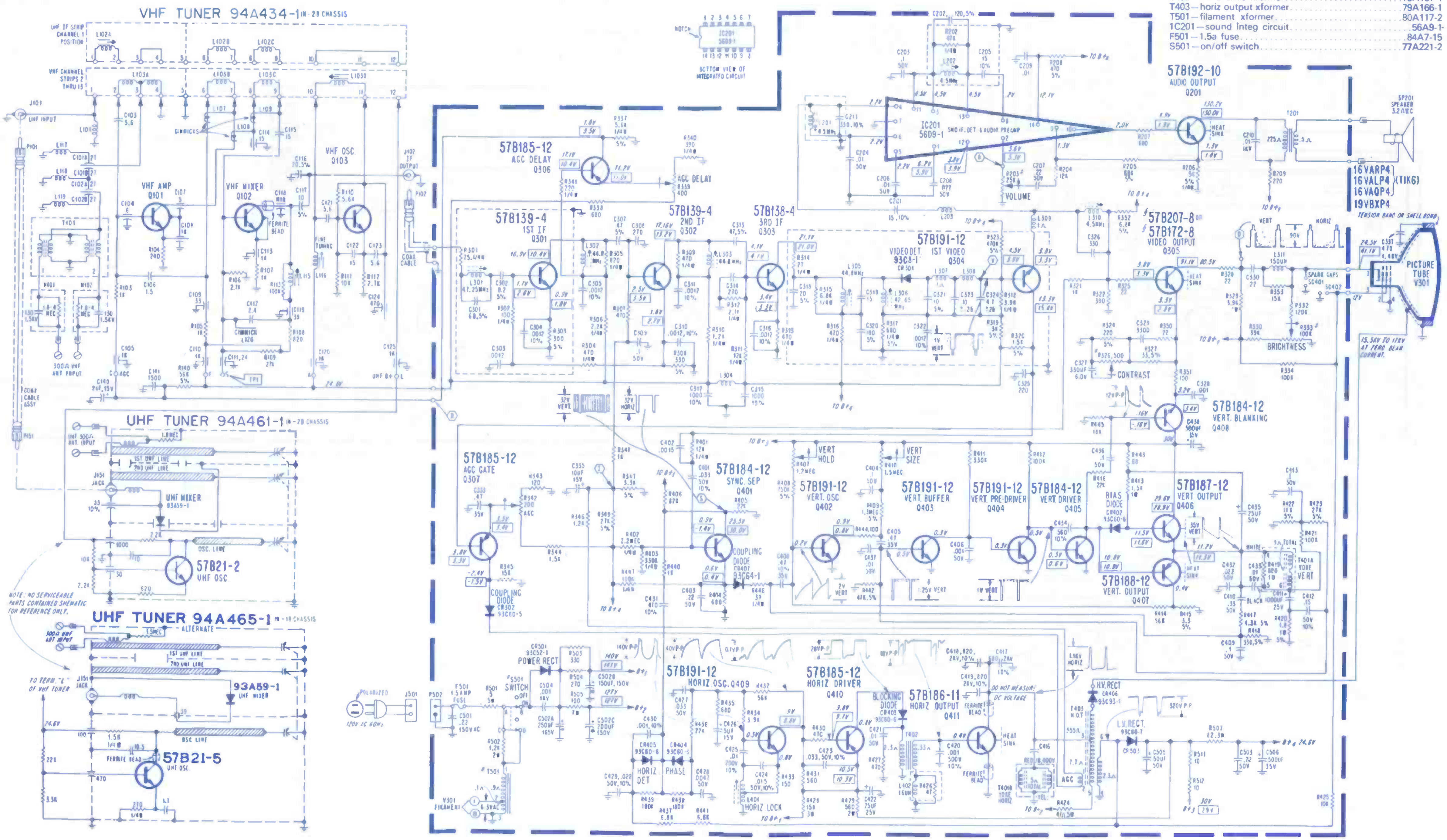


SYMBOL DESCRIPTION	ADMIRAL PART NO.
C502A—250 μf 165v electro	67A30-11
C502B—150 μf 150v electro	67A30-11
C502C—200 μf 150v electro	67A30-11
R505—100Ω, 10% 7w	61A59-101-172
R203—25K volume	75A167-9
R326—500 Ω contrast	75A167-5
R333—100K brite	75A167-4
R339—400Ω AGC delay	75A101-50
R342—200Ω AGC	75A101-49
R407—1.2M vert hold	75A191-1
R410—1.5M vert size	75A101-57
L201—sound input coil	72A317-1
L202—4.5MHz sound coil	72A317-6
L310—4.5MHz trap	72A317-1
L401—horiz lock coil	94A480-1
T201—audio output xformer	79A124-7
T401A, B—deflect yoke	700A1089-15
T402—horiz drive xformer	79A167-1
T403—horiz output xformer	79A166-1
T501—filament xformer	80A117-2
1C201—sound integ circuit	56A9-1-
F501—1.5a fuse	84A7-15
S501—on/off switch	77A221-2



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MGA

Color-TV Model CS-165

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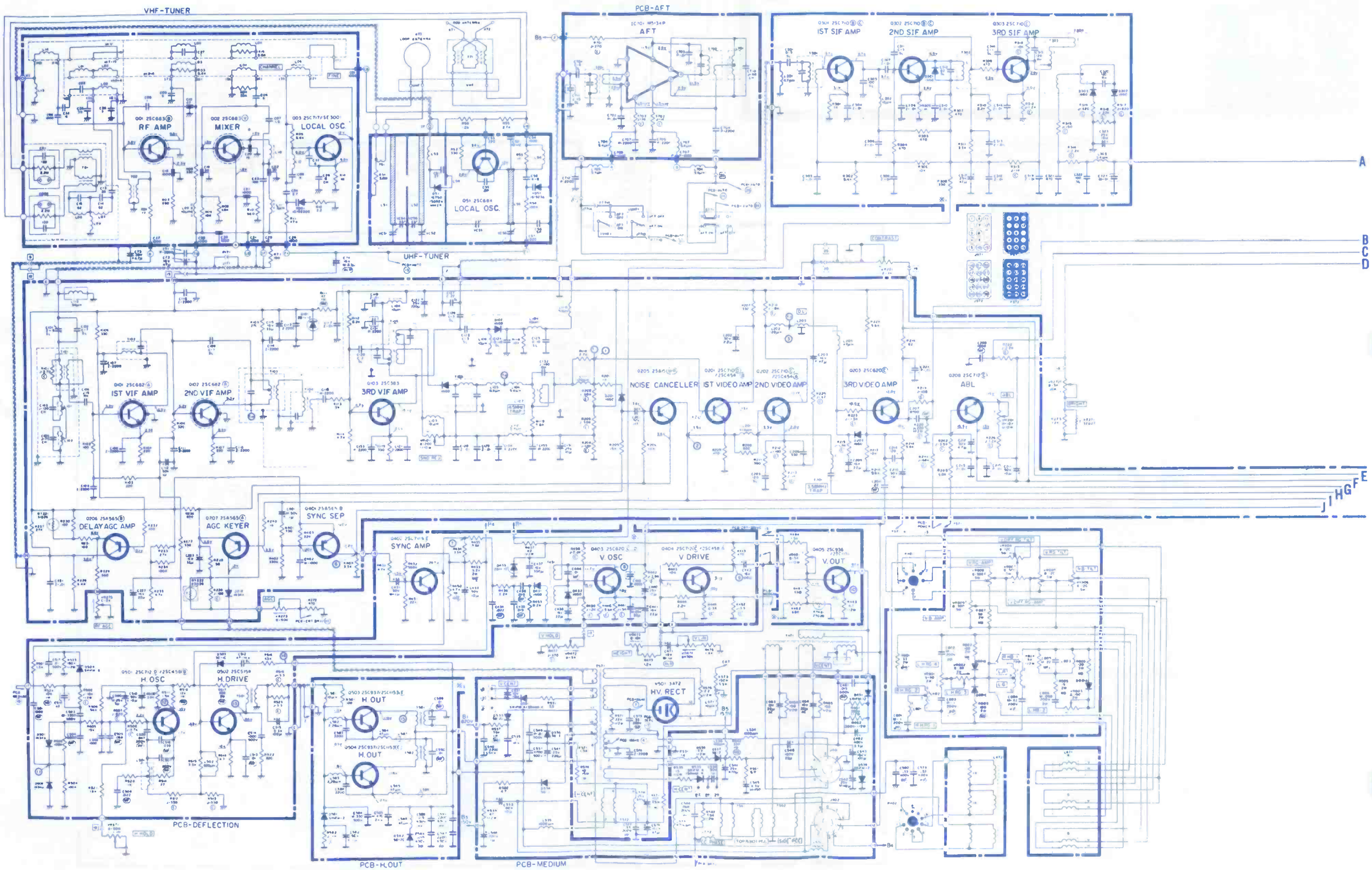
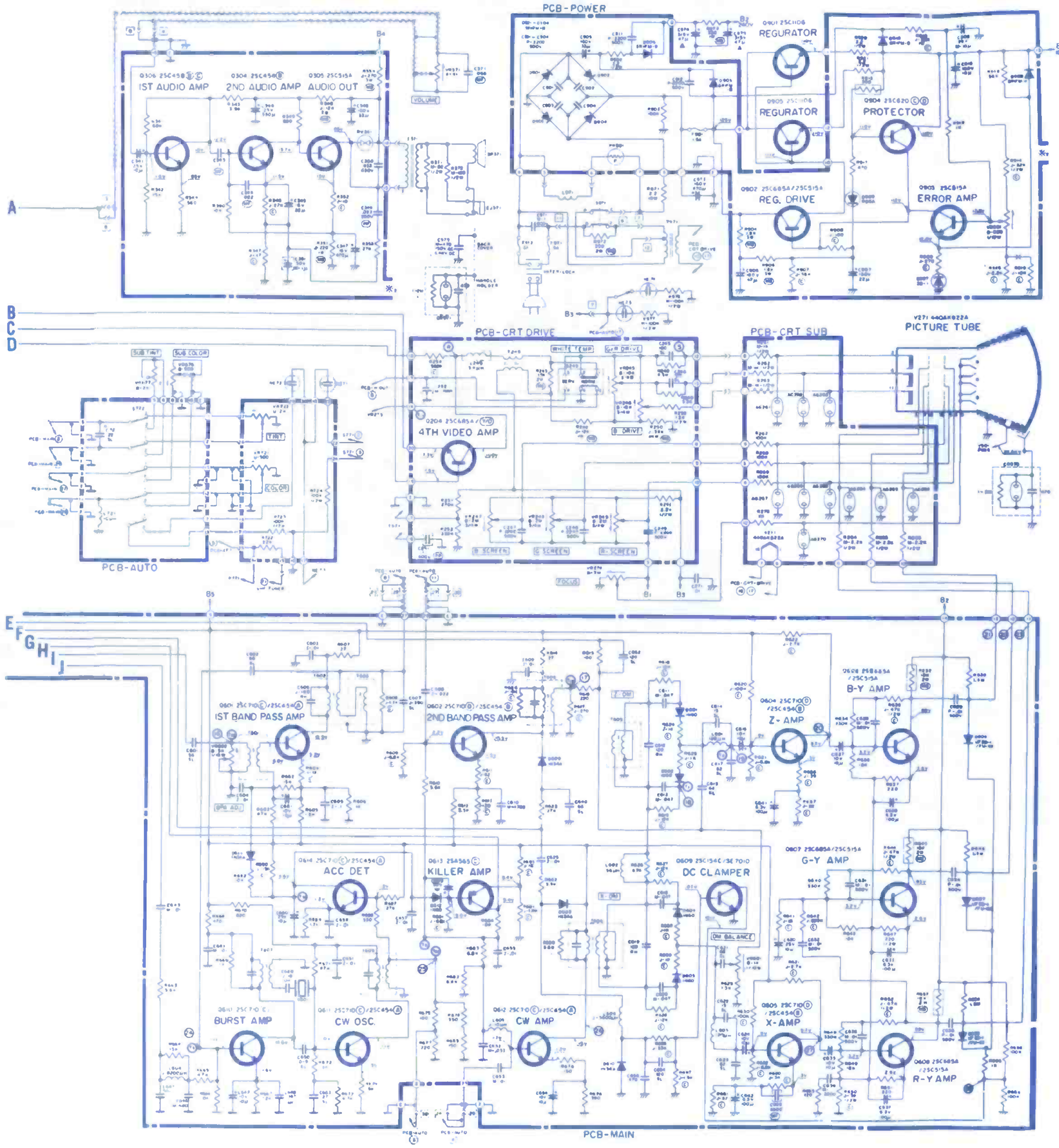
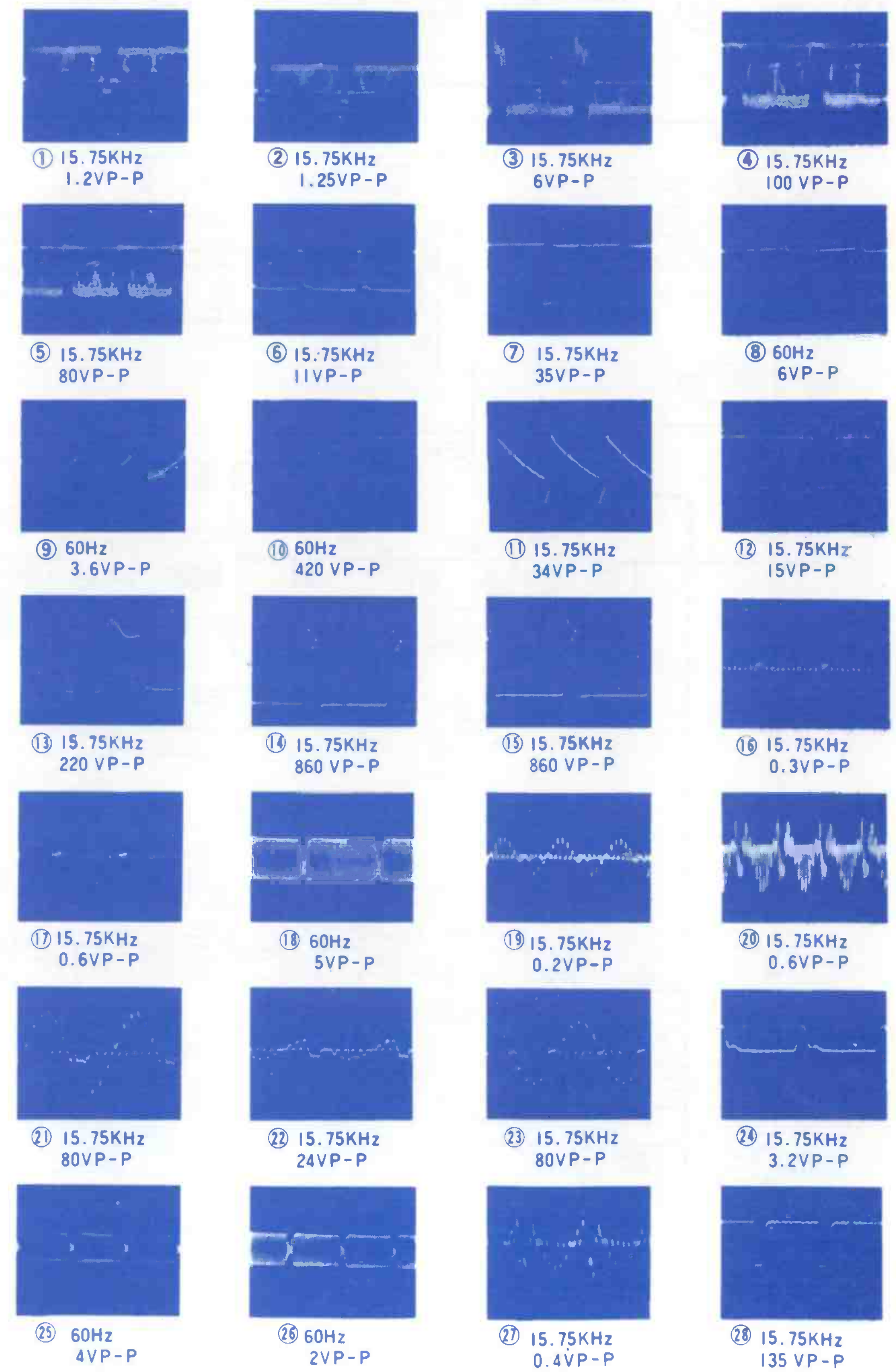
SYMBOL	DESCRIPTION	PART NO.
T371	audio output xformer	352P01401
T431	vert osc xformer	409P00101
T471	vert output xformer	329P00801
T501	horiz drive xformer	336P00503
T571	flyback xformer	334P05501
T572	react xformer	409B00301
T603	1st bandpass amp xformer	349P01201
T604	2nd bandpass amp xformer	349P01301
T607	burst amp xformer	349P01701
T971	power xformer	350C03001
L205	peaking 47MHK	325C01009
L472	deflect yoke	330P02904
L501	horiz osc coil	332P00501
VR271	1K contrast control	120C10101
VR272	5K brite control	120C12208
VR273	500Ω AGC control	121C01001
VR274	5M focus control	129P00402
VR275	2K RF-AGC control	121C01101
VR371	5K SW-volume control	120C13105
VR472	5K vert hold	120C12208
VR473	10K height control	121C01104
VR474	30K vert lin control	121C01403
VR481	semifixed 0.1w B-5K vert bias control	129D02505
VR571	50K horiz hold control	120C12209
VR677	2K sub tint control	121C03009
VR721	slide 500Ω color control	129C02201
VR722	slide 2K tint control	129C02204
	main	920B02202
	CRT drive	920B02302
	medium	920B02001
	power	920B02102
	auto color	920B02403
	CRT sub	920C04101
	deflect	920C04402
	AFT	920C04203
	convergence	920B01601
F531	fuse 1a	283P00101
F571	fuse 1.5a	283D00106
F971	fuse 5a	283D01607
F972	fuse 5a	283D01607



MGA
Color-TV Model
CS-165





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SYLVANIA
Color-TV Chassis
E06-1

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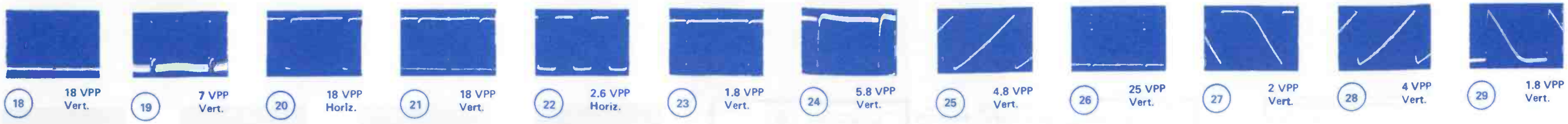
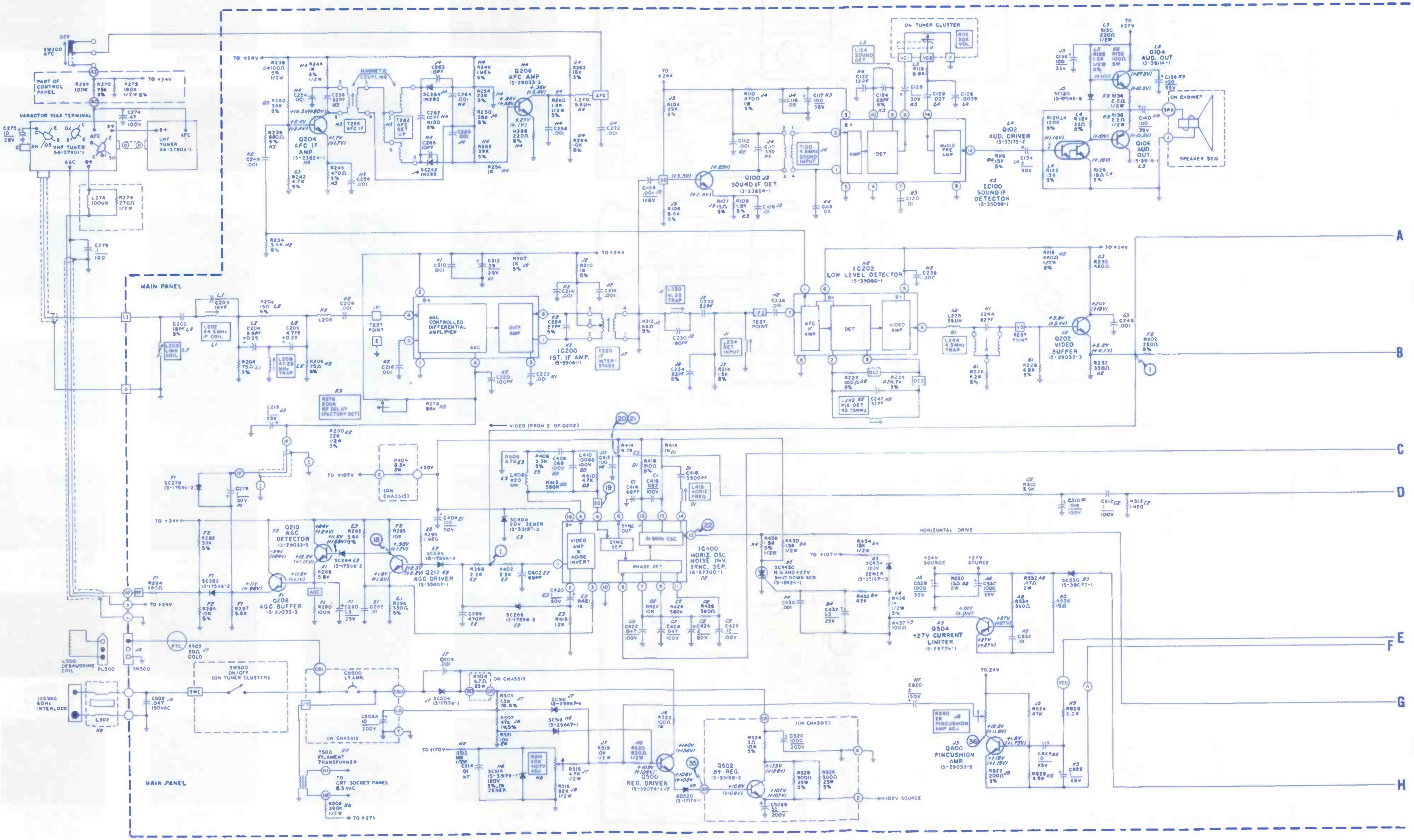
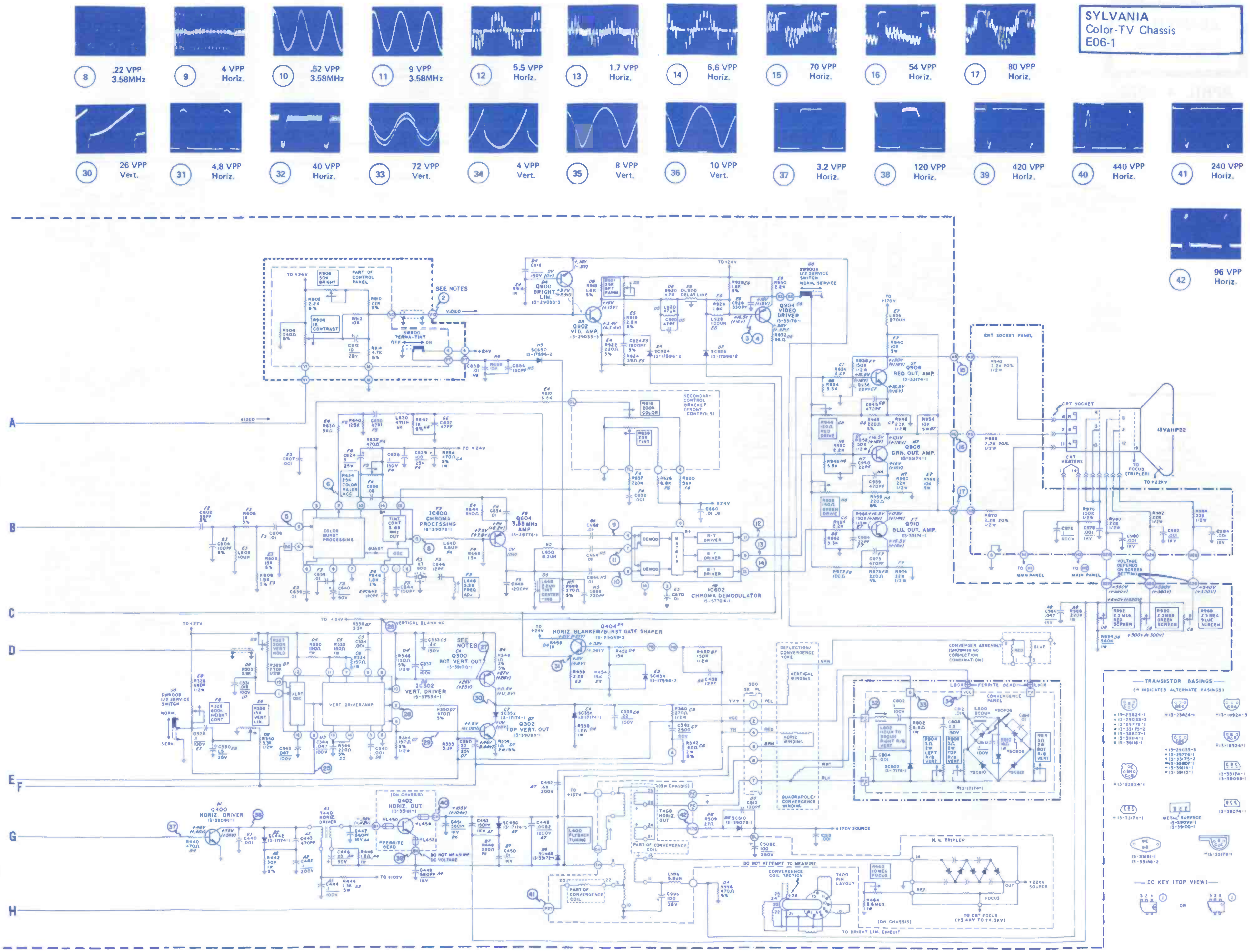
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS





SYLVANIA
Color-TV Chassis
E06-1



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ZENITH

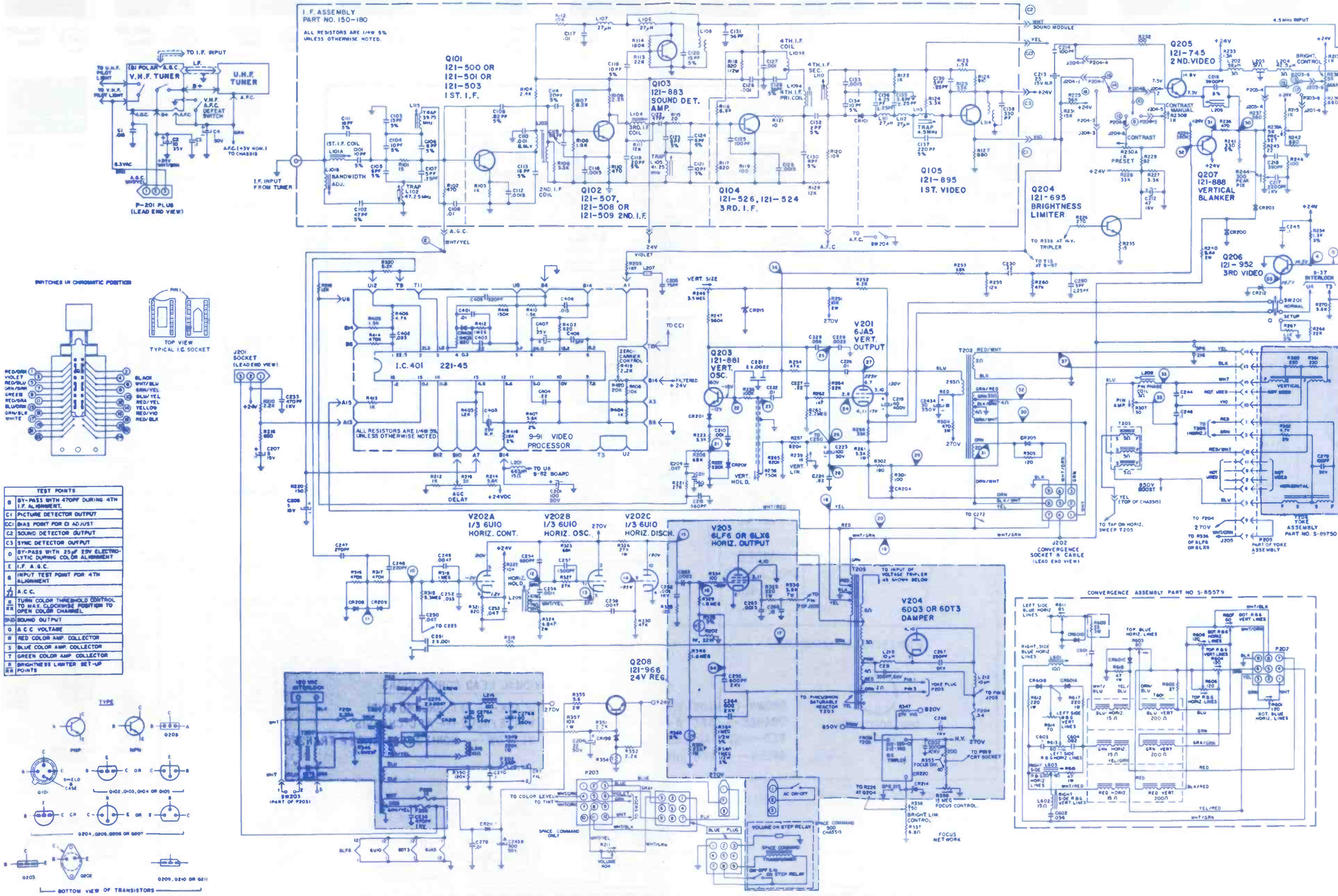
Color-TV Chassis 19EC13

APRIL • 1974

ELECTRONIC TECHNICIAN/DEALER TEKFAX

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

SYMBOL DESCRIPTION	ZENITH PART NO.
C276A—80 μf electro cap, 350v	22-7230
C276B-80 μf electro cap, 350v	22-7230
C276C—15 μf electro cap, 350v	22-7230
R219—3K AGC delay control ½w	63-9116
R230A—contrast control (preset)	63-9269
R230B—contrast control (manual)	63-9269
R238A—5K brite control (preset)	63-9282
R238B—5K brite control (manual)	63-9282
R244—300 Ω peak pix control	63-9119
R248—3.5M vert size control	63-9115
R307—30Ω pincushion amp control	63-8473
R309—100K killer threshold control	63-8501
R310A—5K chroma level control	preset
R313—25K CTA control	63-9117
R333—voltage dependent resistor 5%	63-8688
R338—50Ω brite limiter control	63-8989
R344—therm	63-8687
R353—focus divider	63-9897
R356—15M focus control	63-9961
R365—voltage dependent resistor 5%	63-8688
R420—20K detect level control	63-8576
R1013—20K AGC control	63-8676
R1016—20K APC control	63-8676
L203—delay line	S-91401
L205—3.58MHz trap coil	20-1838
L209—horiz osc coil	S-86164
L216—filter choke	95-2917
L901—chroma take-off coil 9-97 module	95-3080
L902—2nd chroma output coil 9-97 module	S-86109
T202—vert output xformer	95-3083
T204—power xformer	95-3116
T205—horiz xformer	S-90754
T206—deflect yoke	S-89750
T207—AC line choke	95-2964
T1101—detect xformer	95-2789
F202—3a fuse pigtail type	136-47
F203—.1a bel-fuse	136-71
F204—.5a bel-fuse/with leads	S-90985



TEST POINTS	
B	BY-PASS WITH 470PF DURING 4TH I.F. ALIGNMENT.
C1	PICTURE DETECTOR OUTPUT
CC1	BIAS POINT FOR CI ADJUST
C2	SOUND DETECTOR OUTPUT
C3	SYNC DETECTOR OUTPUT
D	BY-PASS WITH 25μf 25V ELECTROLYTIC DURING COLOR ALIGNMENT
E	I.F. A.G.C.
G	INPUT TEST POINT FOR 4TH ALIGNMENT
H	A.C.C.
K / KK	TURN COLOR THRESHOLD CONTROL TO MAX. CLOCKWISE POSITION TO OPEN COLOR CHANNEL
SND	SOUND OUTPUT
Q	A C C VOLTAGE
R	RED COLOR AMP. COLLECTOR
S	BLUE COLOR AMP. COLLECTOR
T	GREEN COLOR AMP COLLECTOR
R / RR	BRIGHTNESS LIMITER SET-UP POINTS

ZENITH
Color-TV Chassis
19EC13

NOTES:

TURN POWER OFF BEFORE REPLACING SEMICONDUCTORS.

PHOTOGRAPHS TAKEN ON A STANDARD GATED RAINBOW COLOR BAR SIGNAL. THE TINT SETTING ADJUSTED FOR PROPER COLOR. THE WAVE SHAPES AT THE RED, GREEN AND BLUE CATHODES OF THE PICTURE TUBE DEPEND ON THE TINT, COLOR LEVEL, CONTRAST AND PICTURE PEAKING CONTROLS. FOR WAVEFORMS 43 THRU 49, TEST POINT "D" MUST BE BY-PASSED WITH A .01 µF CAPACITOR.

ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED.

ALL VOLTAGES ARE D.C. UNLESS OTHERWISE SPECIFIED.

ALL D.C. VOLTAGES TO BE MEASURED WITH A VACUUM TUBE VOLTMETER HAVING 11 MEGOHM INPUT RESISTANCE.

ALL VOLTAGE MEASUREMENTS TO BE MADE WITH NO SIGNAL PRESENT AND

NORMAL SETTING OF CONTROLS AND CHANNEL SELECTOR SET TO CHANNEL 2 UNLESS OTHERWISE SPECIFIED.

RESISTANCE MEASUREMENTS SHOWN WITH COILS DISCONNECTED FROM CIRCUIT.

ALL RESISTORS ARE ±10% TOLERANCE, CARBON, 1/2 WATT UNLESS OTHERWISE SPECIFIED.

COIL RESISTANCE NOT GIVEN UNDER ONE OHM.

ALL CAPACITOR VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.

FOR CAPACITOR TOLERANCE, SEE LEGEND.

CATHODE RAY TUBE 2ND ANODE VOLTAGE TO BE MEASURED WITH ELECTROSTATIC OR 20K OHMS PER VOLT MIN. HIGH VOLTAGE METER.

ARROWS ON POTENTIOMETERS INDICATE CLOCKWISE ROTATION.

INDICATES ALIGNMENT AND TEST POINT

PF = PICOFARAD MHz = MEGAHERTZ µH = MICROHENRY

INDICATES ±20% MAY BE USED. INDICATES VOLTAGE SOURCE

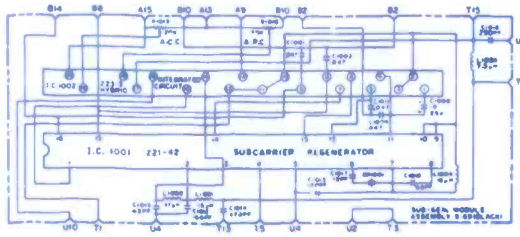
(2) INDICATES WAVEFORM CHECK POINTS. (SEE WAVEFORM CHART) WAVEFORM MEASURED FROM POINT INDICATED TO CHASSIS GROUND.

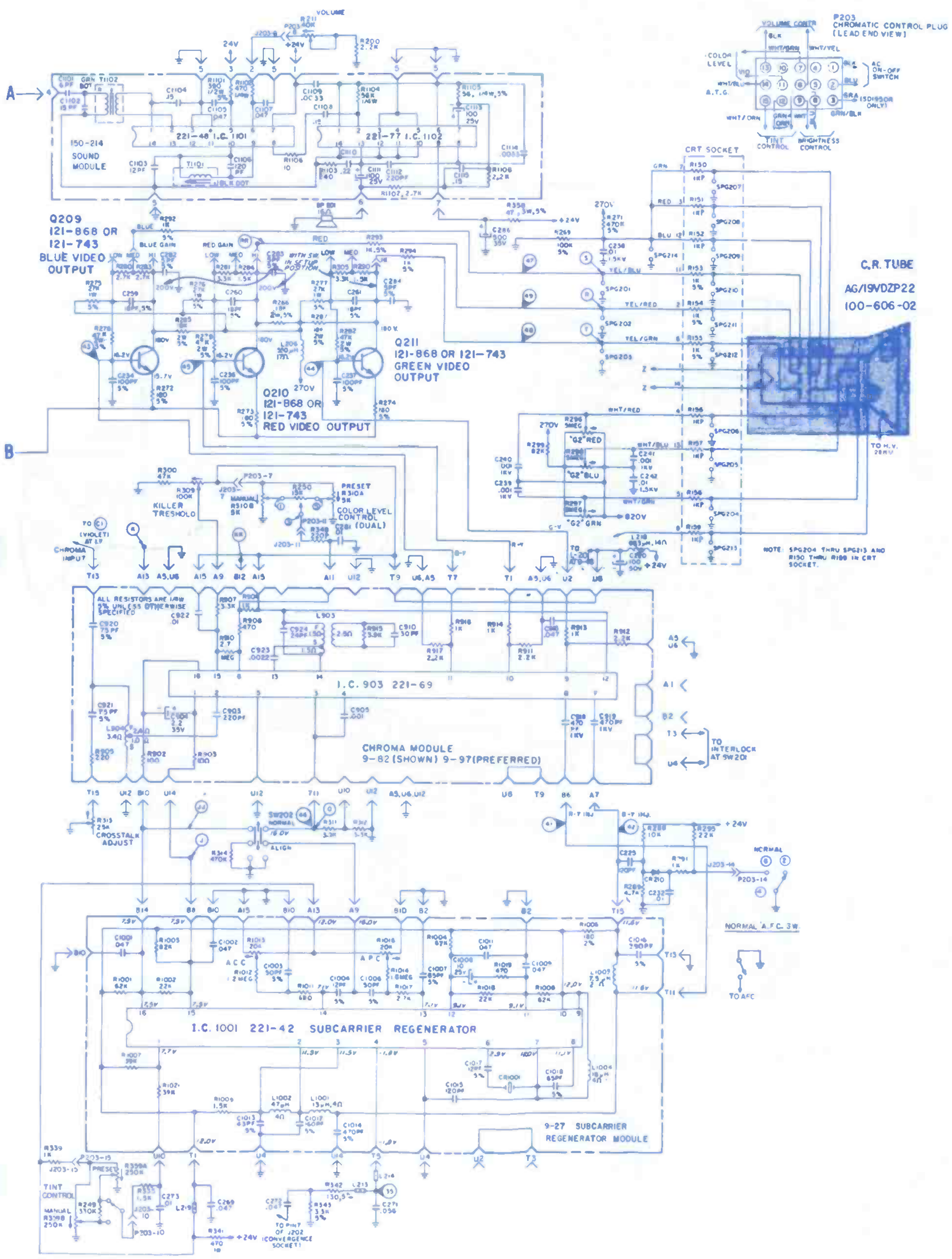
INDICATES CHASSIS GROUND. (6) INDICATES CHROMATIC SW. WIRING POSITION.

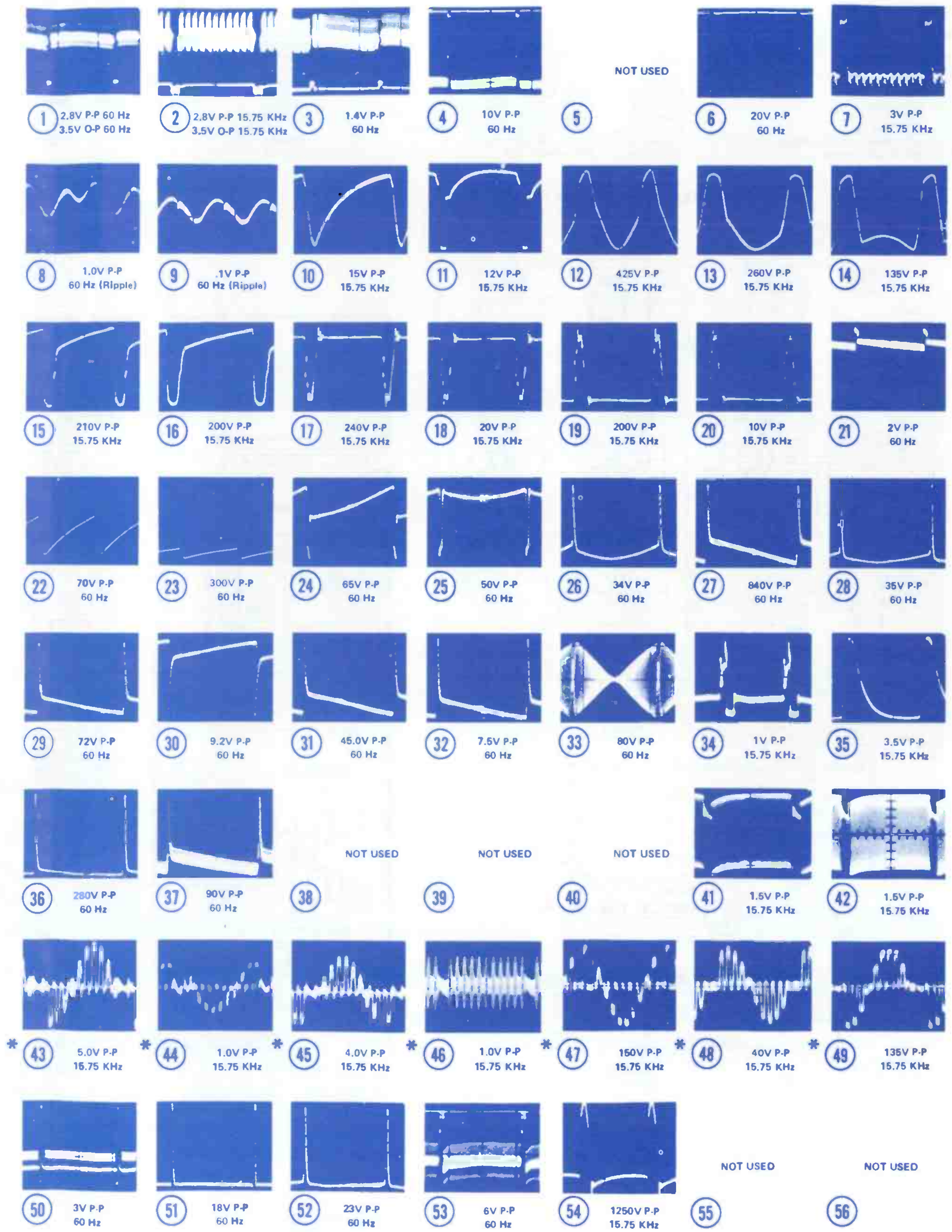
INDICATES MODULE BOARD.

A1 INDICATES PIN NUMBER ON MODULE BOARD

INDICATES WAVEFORM (SEE CHART) WAVEFORMS MEASURED ACROSS POINTS INDICATED. (NOT CHASSIS GROUND) OSCILLOSCOPE SHOULD NOT BE GROUND TO CHASSIS. REVERSING LEADS REVERSES WAVEFORM.







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

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AIRLINE

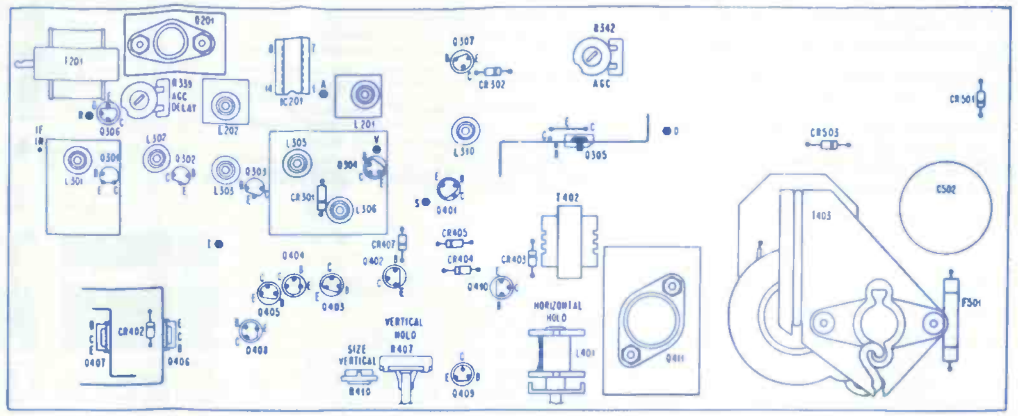
TV Models
GAI-13444A/44B

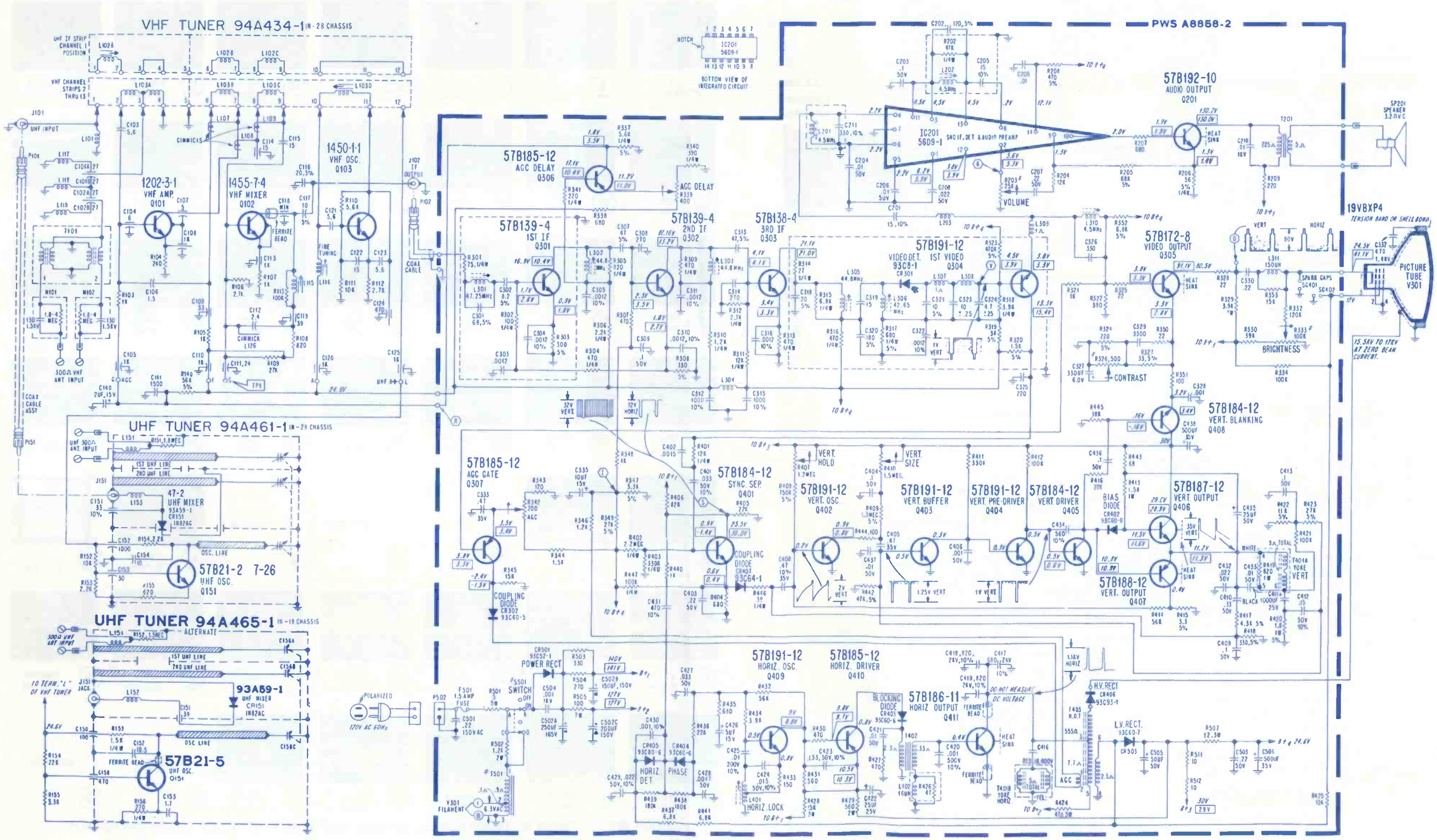
APRIL • 1974

ELECTRONIC TECHNICIAN/DEALER TEKFAX

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

SYMBOL	DESCRIPTION	PART NO.
C502A,B,C	250 µf/165v, 150µf/150v, 200 µf/150v, Electrolytic	67A30-11
R203	25K , volume	75A167-9
R326	500Ω, contrast	75A167-5
R333	100K , brightness	75A167-4
R339	400Ω, AGC delay	75A101-50
R342	200Ω, AGC	75A101-49
R407	1.2M, vert hold	75A191-1
R410	1.5M, vert size	75A101-11
L202	coil, 4.5MHz, phase shifting	72A317-6
L301	coil, 47.25MHz trap	72A316-4
L306	coil, video detector	72A316-15
L310	coil, sound take-off	72A317-1
L401	coil, horiz osc (lock)	94A480-1
T401A,B	yoke, deflection	750A1089-15
T402	xformer, horiz driver	79A167-1
T403	xformer, horiz output	79A166-1
T501	autoformer, filament	80A117-2
CR302	diode, AGC coupling	93A60-5
CR402	diode, bias	93A60-6
IC201	Integrated circuit, sound IF, det pre-amp	56A9-1
F501	fuse, 1.5a	84A7-15





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