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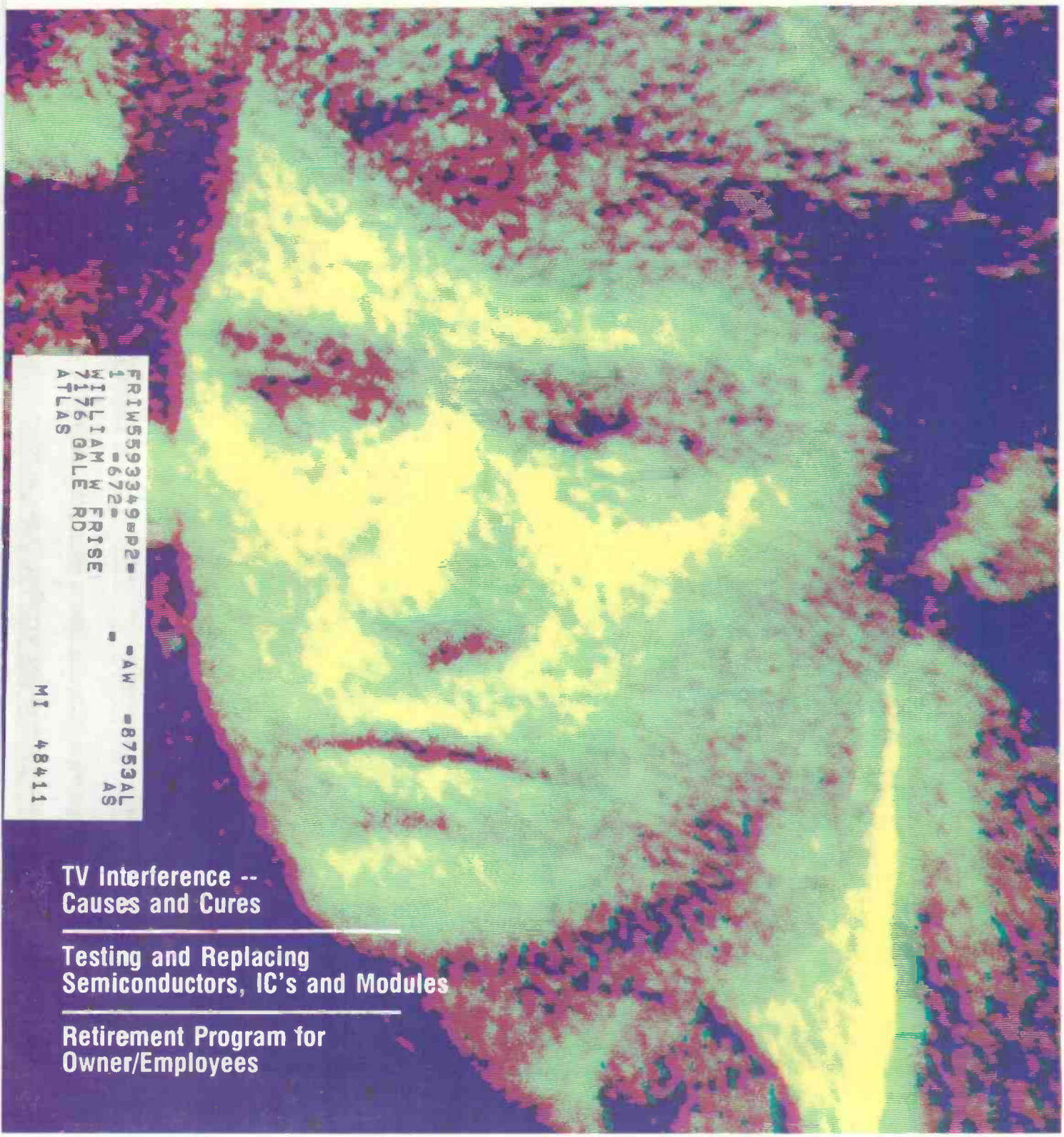

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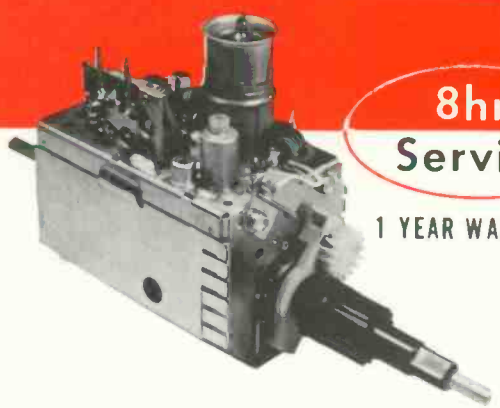

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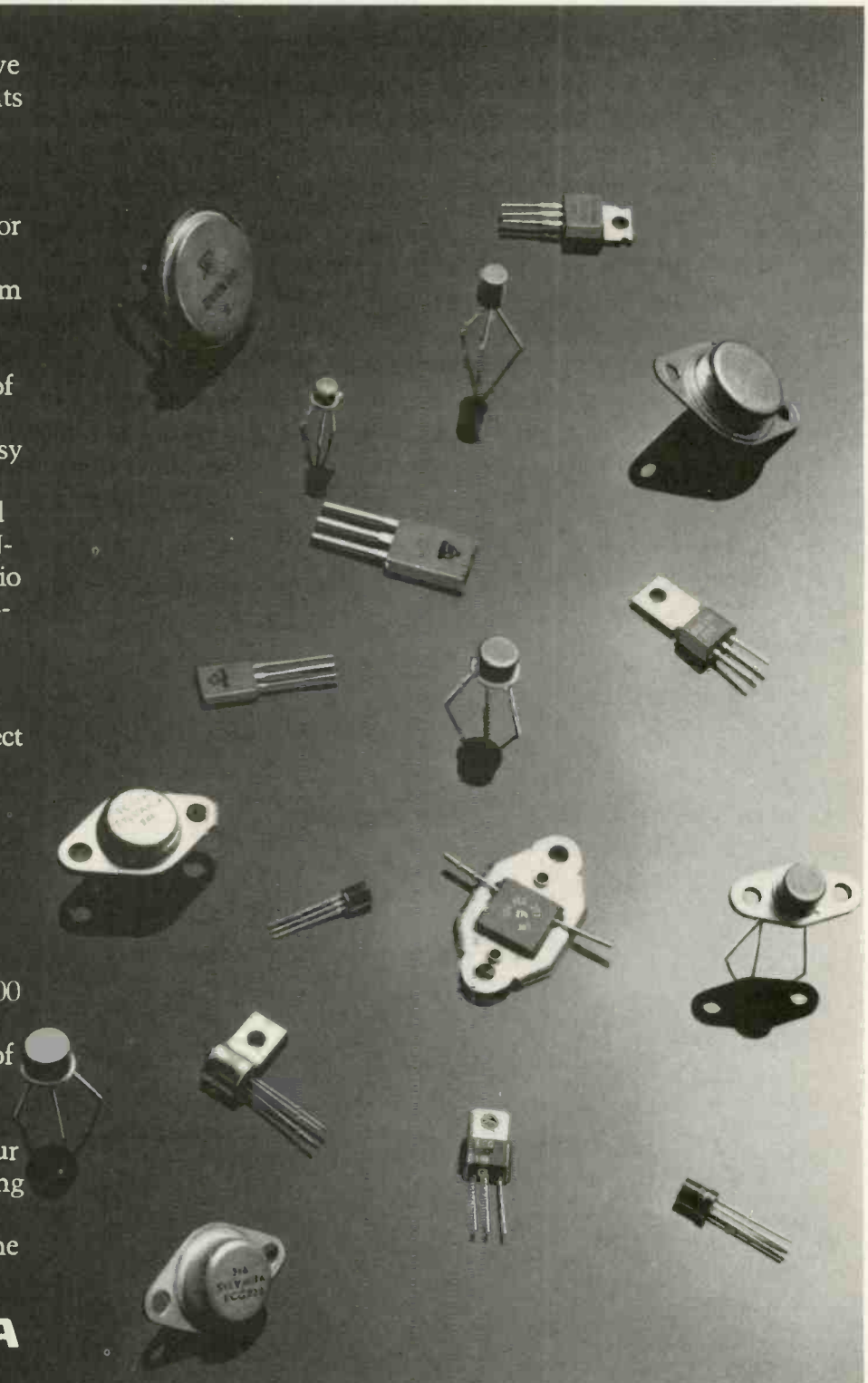

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EDITORIAL

Somewhere on earth there must exist a voluminous book titled "What Every Good Magazine Editor Should Know and Do." Although I've not had the opportunity to read it, I'm sure it exists, because many passages from it have been quoted to me by the readers, publishers, advertisers, editorial directors, other editors, advertising agency account executives, advertising space salesmen, association executives, printers, typesetters, artists and the many others who have had an interest in the magazine issues I've helped produce. I've listened to these people, and from them I'm sure I've learned as much, if not more, about editing a magazine as I would have learned in any other manner or from any other sources. I am still listening, and I am still learning.

During the short time I have been with ET/D and Harcourt Brace Jovanovich Publications, I've noticed and sensed the genuine enthusiasm and sincere concern which the people at all levels of this company have for the readers of their publications and the industries and businesses which they serve. While some of the concern can be attributed to a desire to produce profitable publications, a large measure of this concern and most of the enthusiasm seems to be an inherent characteristic of the people who make up this company. It is just their nature to want to do the best job possible. I'm pleased to have the opportunity to work with them.

With the assistance of the many individuals who are involved in publishing ELECTRONIC TECHNICIAN/DEALER, including Al Menegus, the publisher, and Joe Zauhar, the managing editor, I will do my best to produce each month a magazine which serves the interests and needs of the readers, the advertisers and all elements of the electronic industry in an honest and effective manner.

We encourage you to send us your views, comments, suggestions and criticisms about ELECTRONIC TECHNICIAN/DEALER or any facet of the electronic industry.

J. W. Phipps

LETTERS

Following are two reader responses to a letter published in the LETTERS department in the December, 1973 issue in which a recent graduate of a technical institute related the difficulty he has had finding a job as an electronic service technician, and at a liveable salary.

I wouldn't want to discourage any young man from entering the radio/TV service field, but he will have to make sacrifices as a beginner. . . . It takes years to become proficient enough to command a high salary as a technician. As a man gains more experience and depends less on help from more experienced technicians, his salary will increase.

I agree with the young man—a shop owner does not want to hire the beginner. He wants an experienced technician who will help him make a profit. He does not want to train a man at his expense, and then later lose him to another shop.

This should not be the case. All service shops should have a trainee program, and the salary of the beginning technician should increase with his proficiency, so that he will not have to change jobs to get a salary increase. . . .

The beginning technician should have completed a good course in electronic theory and should have some practical experience, perhaps gained from lab experiments during the course of instruction. To succeed as a technician he also must be thoroughly interested in electronics. And he must be willing to work as a trainee at low wages for at least a couple of years. . . . He also must be willing to continue his training in his off duty time. . . .

All electronic technicians at one time were beginners. They had to start at low wages as a trainee in a shop whose owner was willing to accept them. . . . Such a beginning is very difficult, but the result is very satisfying. Experienced electronic technicians are in demand, and they command a high salary.

JOHN P. COWDEN
Colonial Heights, Virginia

I too, am experiencing the same situation. . . . I have completed four years of technical training—two in radio/TV repair and two in CATV/CCTV.

After completion of training, I have looked for a position as an electronic technician, but with no success—not enough experience.

I have given considerable thought to

this problem, and have a suggestion: An association should be formed specifically for the purpose of finding service technician positions for individuals with the proper technical training. Such an association should be nation-wide, with service facilities of its own in which beginning technicians would gain the experience and advanced training needed to qualify for a position as an electronic technician. It could be funded by an existing association. . . .

I need work, as do many other individuals who have had formal technical training but seemingly do not have sufficient experience.

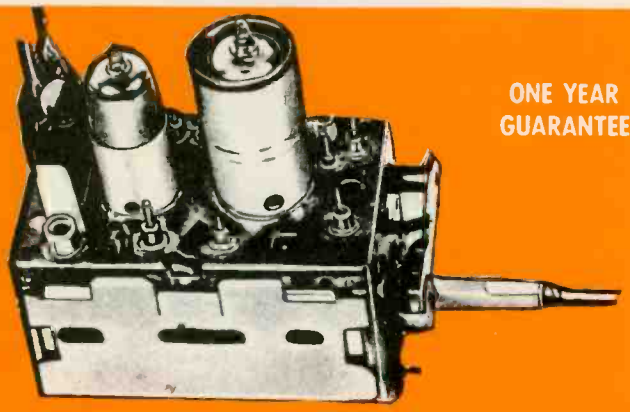
T. G. A.
Phoenix, Arizona

Both of these readers touch on key points of a continuing problem which some electronic service businesses and associations have dealt with successfully. Unfortunately for employer and trainee alike, too many owners of service businesses still regard apprentice training as an expense rather than as an investment. And it can be an investment, if approached in an organized, realistic manner.

To be effective, an apprenticeship program must meet the needs of both the employer and the trainee. For the employer, it should be compatible with his existing operation and should proceed at a rate which allows thoroughness but yet enables the employer to realize a return on his investment as soon as possible. For the apprentice, it must provide a reasonable entry-level wage, with periodic evaluation and commensurate wage increases at reasonable intervals.

Service business owners who are interested in establishing an effective apprenticeship program and individuals who are enrolled in or have completed a course of instruction in electronics and who are interested in enrolling in an apprenticeship program can obtain guidance from a number of sources, the most knowledgeable and experienced of which probably is the Bureau of Apprenticeship and Training of the U.S. Department of Labor. This agency has established and presently administers apprenticeship programs for a number of skilled and semi-skilled trades. (For the office in your area, look under the "United States Government" listing in your phone directory.) Other sources of guidance are state employment services and local, state and national electronic associations.

Electronic service business owners who are willing to accept apprentice technicians are invited to announce their willingness in the READERS' AID department of ET/D.



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I want to know the size of a choke used in a Geiger Counter Model GC-

continued on page 12

READERS AID...

continued from page 11

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Service information for a Stereo Loudspeaker Equalizer Model SE-III manufactured by Elektra Amplidyne Research, Box 698, Levittown, Pa. The company is now out of business.
JOEL HUNEKE
3671 Hudson Manor Terrace
Riverdale, N.Y. 10463

We have a new, unused copy of Tekfax 111 and will trade for a clean copy of Tekfax 109.
R. FROWERK
4330 SE. Woodward St.
Portland, Or. 97206

Heathkit OP-1 scope for parts—primarily the power transformer.
KENNETH PARROTTE
RD. 2 Box 233
Beaver Dams, N.Y. 14812

Operator's manual for a Pyramid Capacitance Resistor Analyzer. Serial No. PE 10020-Type-CRA-1.
ALEX NEMEITH
310 Henry Ave.
Steubenville, Ohio 43952

Schematic for a Signal Generator Model TS-452C/U made by Lewyt Manufacturing Corp. of Brooklyn, N.Y.
B. C. RUIZ
477 Blossom Hill Rd.
San Jose, Calif. 95123

Operator's manual for a Wintronix Dynamic Sweep Circuit Analyzer Model 820, made by Winston Electronics Inc.
DANIEL T. BROWN
922 15th St.
Portsmouth, Ohio 45662

Good working Sprague Model T06 Capacitor Tester or other good working testers and Video IF transformer Part No. 720127 for a Emerson Model 698B. Will accept used part.
LEON ARENDS
102 N. Webster
Shenandoah, Ia. 51601

A repairable RCA/Rider Channelyist or Hickock Traceometer. Also, 01-A and obsolete radio/TV tubes for sale. Will send listing.
JIM FARAGO
c/o Robert Paul TV
247 W. Park St.
So. St. Paul, Minn. 55107

Schematic for a radio manufactured by Audiophone Radio Mfg. Co., Waukegan, Ill., with a tube complement of (4) 24As; (1) 80; (1) 45; (1) NX-245.
ROBERT E. SEIBERT
Rt. 1 Box 248
Lambertville, N.J. 08530 ■

This unusual switch cable TV user into your customer.

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 short-changed. 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

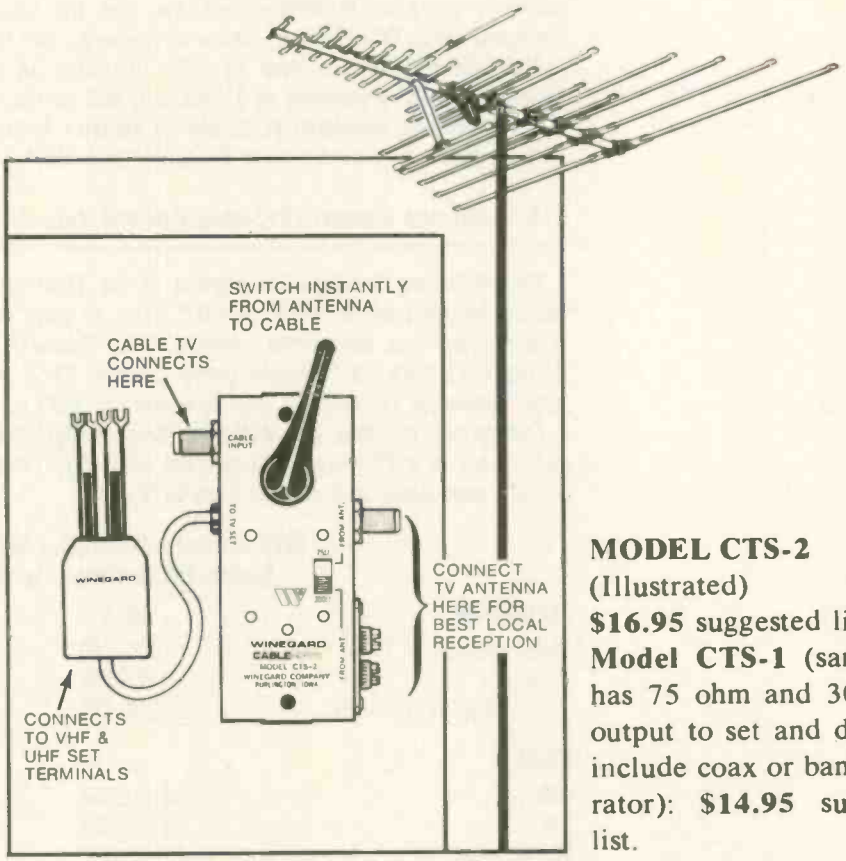
The problem of poor quality cable reception on one or more channels is a common one in city after city. Too often the TV technician is called for TV set repair when the cable is really at fault.

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.

can turn a new TV antenna



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.

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.

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 at 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.

For more information, circle the reader's service card or write to: Winegard Company, 3000 Kirkwood Street, Burlington, Iowa 52601

WINEGARD
TELEVISION SYSTEMS
Winegard Company / 3000 Kirkwood Street / Burlington, Iowa 52601

. . . for more details circle 138 on Reader Service Card

NEWS OF THE INDUSTRY

Philco Consumer Electronics to Be Sold by Ford to White

Ford Motor Company has agreed to sell its Philco-Ford home entertainment electronic products marketing operation to White Consolidated Industries, Cleveland, Ohio. The transaction, which industry sources say will be completed sometime in March, reportedly includes the sale of the Philco-Ford marketing organization, the Philco name and two Philco-Ford manufacturing plants. Philco-Ford will no longer market home entertainment electronic products in the U.S., but will continue to manufacture color TV receivers and refrigerators, which will be marketed by the White-owned Philco sales organization. Philco-Ford, in addition, reportedly will continue to manufacture radios, air conditioner parts and electronic control devices, for sale to the U.S. and Canadian automobile industries.

White Consolidated Industries currently is a manufacturer and marketer of appliances, including Gibson, Hamilton, Kelvinator, Roy and Vesta brands.

Philco-Ford manufacturing plants which will be sold to White include the cabinet and stereo assembly operation in Watsontown, Pa., and the Taiwan facility in Taipei, which produces black-and-white TV receivers, stereo components and radios.

Although Philco-Ford's color TV sales increased 14 percent over 1972 sales, compared to an overall industry increase of 11 percent, and its black-and-white TV sales in 1973 increased about 1 percent, compared to an overall industry decline of 13 percent, the company claimed only 5 percent of the total color TV market and about 7 percent of the black-and-white market.

EIA Statistics Reveal 1973 Was Record Year for Color TV Sales

The Marketing Services Department of the Electronic Industries Association (EIA) has released statistics which reveal that U.S. sales of color TV receivers to dealers in 1973 were up 10.6 percent over the number sold in 1972. However, monochrome TV set sales to dealers during 1973 were 13.7 percent below sales in 1972, producing a 1.4 percent decline in the total number of TV receivers sold to dealers in 1973 compared to the 1972 total.

Comparison of other EIA Marketing Service statistics for 1973 and 1972 reveal that auto radio sales in 1973 were up 22 percent over 1972 sales, while sales of home radio receivers in 1973 were down 10.5 percent from 1972 sales.

1973 Consumer Electronics Sales to Dealers
Source: EIA Marketing Services Dept.

	1973	1972	Percent
TELEVISION			
Monochrome	7,032,793	8,145,374	(−13.7)
Color	9,263,503	8,377,843	(+10.6)
TOTAL TELEVISION	16,296,296	16,523,217	(− 1.4)
RADIO			
AM	16,923,558	na	
FM	18,846,503	na	
TOTAL HOME	35,770,061	39,951,997	(−10.5)
Automobile	12,471,677	10,224,319	(+22.0)
TOTAL RADIO	48,241,738	50,176,316	(− 3.9)
PHONOGRAPH			
Portable	5,673,316	5,970,519	(− 5.0)
Console	922,758	948,581	(− 2.7)
TOTAL PHONOGRAPH	6,596,074	6,919,100	(− 4.7)

OSHA Compliance Costly to Independent Business, Enforcement Stepped Up

It has cost a relatively small segment of the business community almost seven million dollars to comply with the rules of the Occupational Safety and Health Act (OSHA), according to data gathered and reported by the National Federation of Independent Business (NFIB). This figure includes both the cost of changes made to comply with the act and fines levied against businesses for violations of OSHA rules.

The NFIB also reports that the data, obtained from its continuous field survey of independent businesses during 1973, indicates that the number of inspections have increased and the de-

mands of inspectors have become progressively tougher.

During the first quarter of 1973, seven percent of the 36,985 respondents to the NFIB survey reported that they had been inspected, and of that seven percent, 33 percent reported that they were charged with violations. Of that total, 18 percent either were assessed fines or were required to make changes, with total costs for both coming to $1,229,000.

In the second quarter of 1973, six percent of 38,721 respondents reported that they had been inspected, and 40 percent of those inspected were charged with violations. Of this 40 percent, 24 percent reported costs for payment of fines or for required changes, with the total coming to $1,510,000.

Third-quarter data indicated that six percent of the 44,061 respondents had been inspected, and 41 percent of those inspected were charged with violations. Of this 41 percent, 26 percent reported fines or compliance costs, with the total amounting to $1,928,000.

NFIB data indicates that Labor Department agents stepped up their activity even more during the final quarter of the year. Of the 41,691 respondents during this quarter, eight percent reported being inspected, and the percentage of those reporting being charged with violations jumped to 43 percent, with 30 percent of this number reporting costs for fines and compliance totaling $2,112,000. Of this total fourth-quarter cost, 25 percent, or $516,550, was reported by independent business owners who classify themselves as retailers.

30KV Color TV Draws Attention of Bureau of Radiological Health

The designed increase of picture tube anode voltage from 26KV to as high as 31KV is a major source of concern at the HEW Bureau of Radiological Health (BRH), according to a recent report in **Television Digest**. Principal concern, says the report, is that multiple failures in a 30KV receiver might lead to dangerous levels of radiation. BRH is also worried about the possibility that replacement picture tubes designed for lower-voltage receivers might be used in higher-voltage models. The report states that an engineer for one TV manufacturer says that "any 25-inch (V) color picture tube will meet the letter of the law in even the highest-voltage set, but the margin of safety will be lessened if the tube was designed for lower operation voltage, because low-voltage tubes have less lead in glass."

Another BRH concern, according to the report, is the possibility that a "KV race" will develop among TV manufacturers. Responding to this concern, one color TV engineer reportedly said, "I doubt that industry will go any higher. The amount of lead we're using now already gives us a ripple problem and causes face-plate browning, and we're not too far from a flicker problem." The flicker problem reportedly is caused by the fact that the inherent 30-Hertz flicker of the U.S. TV system becomes more noticeable at higher brightness levels.

RCA presently has the highest-anode-voltage color TV receiver, with 31KV, followed by Magnavox and Zenith at 30KV, and General Electric and Motorola at about 28KV. Philco, Sylvania and Admiral all are under 27KV. The report said that a spokesman for one TV manufacturer in the under-30KV category (unidentified) told **Television Digest** that a 33KV chassis is "penciled in" for the company's 1975 line.

Xcelite Acquired by Cooper Industries

Xcelite, Inc., Orchard Park, New York, manufacturer of hand tools for the electronic industry, has been purchased by Cooper Industries. Xcelite will be combined with Weller, the soldertool and solder manufacturing operation of Cooper Industries, to form the Weller-Xcelite Division of The Cooper Group.

RCA to Increase TV Prices

Prices of almost all RCA color TV receivers introduced this year will be increased along with those of some current models, according to William E. Boss, Division Vice President, Marketing, RCA Consumer Electronics. Optional retail price increases of about $10 per set for most current and newly introduced black-and-white TV receivers also have been announced by RCA, and are effective February 10.

The reasons given by Mr. Boss for the price increases is that labor, material and other production costs have continued to increase to a level at which RCA no longer can absorb them. Citing some examples, Mr. Boss stated that the cost of copper, electrolytic capacitors, woods and plastics have increased approximately 30 percent over price levels of a year ago. ■

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.

Texas Electronics Association Management Institute March 15-20

The 11th annual Texas Electronics Association Management Institute will be held March 15-20 at the Stagecoach Inn, Salado, Texas. The course offers both fundamental and advanced management techniques. Instructors include John Sperry, Lincoln, Nebraska, who will explain the use of his new flat-rate pricing guide, titled "Tech's Guide to Pricing."

Wisconsin Association Changes Name, Joins NESDA

The Wisconsin Electronic Service Association, previously chartered under the name "TESA of Wisconsin," recently announced the change of name and its new affiliation with the National Electronics Service Dealer Association.

NATESA Offers Members Parts Procurement Assistance

The National Alliance of Television & Electronic Service Associations (NATESA) recently announced a "Parts Expediting" program designed to help members obtain a part which is not available locally.

"Procurement" cards have been sent to all NATESA members. If after a reasonable effort has been made by the member to obtain a part from local sources, but the part seemingly is not available, the member can fill out the "Procurement" card and mail it to NATESA. NATESA then attempts to get the part for the member.

Additional information about the "Parts Expediting" program can be obtained by writing: NATESA, 5908 S. Troy St., Chicago, Ill. 60629.

Missouri Forms New Association, Affiliates with NESDA

The Missouri Electronics Service Dealers Association (MESDA), formed recently by a group of existing locals, has announced its affiliation with the National Electronics Service Dealers Association. Len Jacob, St. Louis, is President of MESDA.

Annual Conventions Announced

Colorado Professional Electronics Association, June 21-23, at the Holiday Inn, Vail, Colorado.

North Carolina Electronic Technicians' Association, June 21-23, at the Holiday Inn, Charlotte, North Carolina.

NESDA Reschedules House of Representatives Meeting

The National Electronics Service Dealers Association has postponed its House of Representatives meeting, previously scheduled for January 24 and 25 in San Antonio, Texas, and rescheduled it for April 11 and 12 in San Antonio, in conjunction with the regular meeting of the Texas Electronics Association. ■

We're making it our business to make your business easier.

All GE 18"and 19"diagonal color TV's have in-home warranty service.

Whatever went wrong with their new General Electric television set isn't your fault. But by the time your customers get around to calling you, somehow you're the guy they vent their frustrations on. So to try to save wear and tear on your nerves, we're doing what we can to help reduce your customers' irritation.

Specifically, we're giving in-home warranty service on all our 18 and 19-inch diagonal color sets (with and without handles). And if you don't think that's important, ask the next lady who has to lug a 60 lb. set into your shop.

We're keeping your customers happier by keeping their sets at home.

GENERAL ELECTRIC

TV Receiver Products Dept., Portsmouth, Va.

. . . for more details circle 117 on Reader Service Card

NEW AND NOTEWORTHY

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.

VHF/UHF PORTABLE TV TUNERS 700

Three models available either for trouble analysis or to give the customer use of the TV receiver while the tuner is being repaired

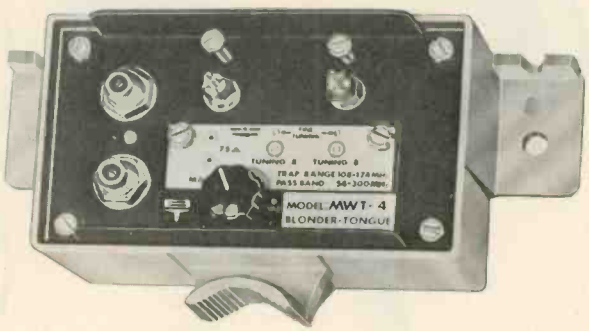
The three models of PTS Electronics solid-state VHF/UHF Portable TV Tuners are easily connected to any TV receiver and provide low-noise reception on all VHF and UHF TV channels. Model 3001 Port-A-Tuner, shown here, is AC powered and can be left connected to the receiver while the customer's tuner is being repaired. It is available in green, blue or black vinyl cabinet, has an on/off pilot light and a gain adjustment on the front panel, and costs $49.95. Model 3002 Port-A-Analyst can be operated from either AC or DC and also can be left in the home, to give the customer uninterrupted use of the receiver while the receiver tuner is being repaired, or it can be used as a substitute tuner for trouble analysis. It costs $59.95. Model 2002 Analyst is a battery-powered substitute tuner intended primarily as a portable trouble analysis instrument. The price of Model 2002 is $44.95.

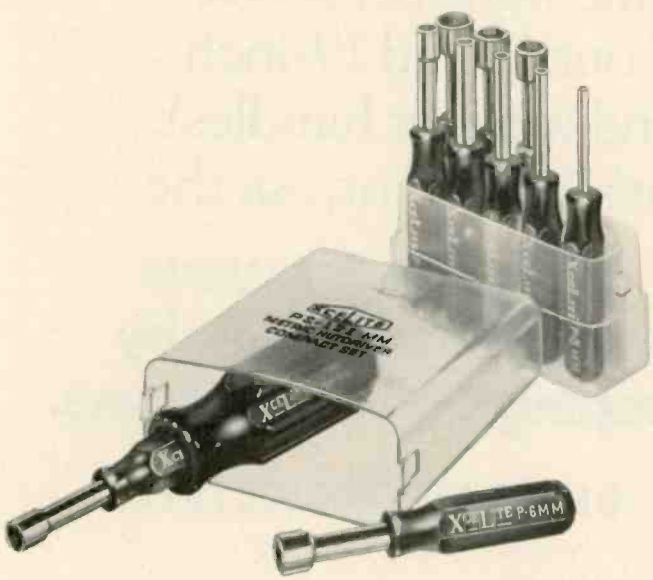
FOR MORE NEW PRODUCTS SEE PAGE 46

CATV MIDBAND TRAP 701

Attenuates undesired 108 to 174 MHz CATV signals

The Blonder-Tongue Model MWT-4 CATV Midband Trap is designed to attenuate undesired 108 to 174MHz CATV midband signals. The trap is continuously adjustable over this range and its attenuation may be varied between 0.5 and 40dB. It also has a single-frequency attenuation of 60dB and passes all other frequencies from 54 to 300MHz with a maximum loss of 1dB outside notch. The notch bandwidth is 2.0MHz at 3dB down; 100kHz at 30dB down and 35kHz at 40dB down. The 75Ω thruline has a return loss of 20dB from 54 to 216MHz and 12dB at 300MHz. Other specifications include: depths of individual notches—notch A, 9dB; notch B, 13dB. The variable depth range is 10 to 40dB in the cancellation mode, and 0.5 to 13dB in the single-section (B) model.





METRIC NUTDRIVER SET 702

Useful, and often essential, when servicing foreign-made equipment

A compact convertible nutdriver set, Xcelite Model PS-121MM is designed with precise metric dimensions. The set consists of ten pocket-size metric nutdrivers plus a "piggyback" torque amplifier handle that slips over the top of the midget tools to provide longer reach and greater driving power whenever needed. The sockets of the 3½ in. long drivers have hex openings ranging from 3mm to 10mm. The drivers and 1 1/16 in. x 3⅛ in. auxiliary handle are housed in a convenient, flexible plastic, see-thru, stand-up case with a snap-lock cover. The nutdrivers are finished in bright nickel chrome and embedded in black plastic handles.

No other 10 MHz oscilloscope gives you all this for $475

The TELEQUIPMENT D61 is a low priced 10 MHz dual trace oscilloscope with sweep rates up to 10 ns/div. It is ideally suited for students, technicians, and hobbyists.

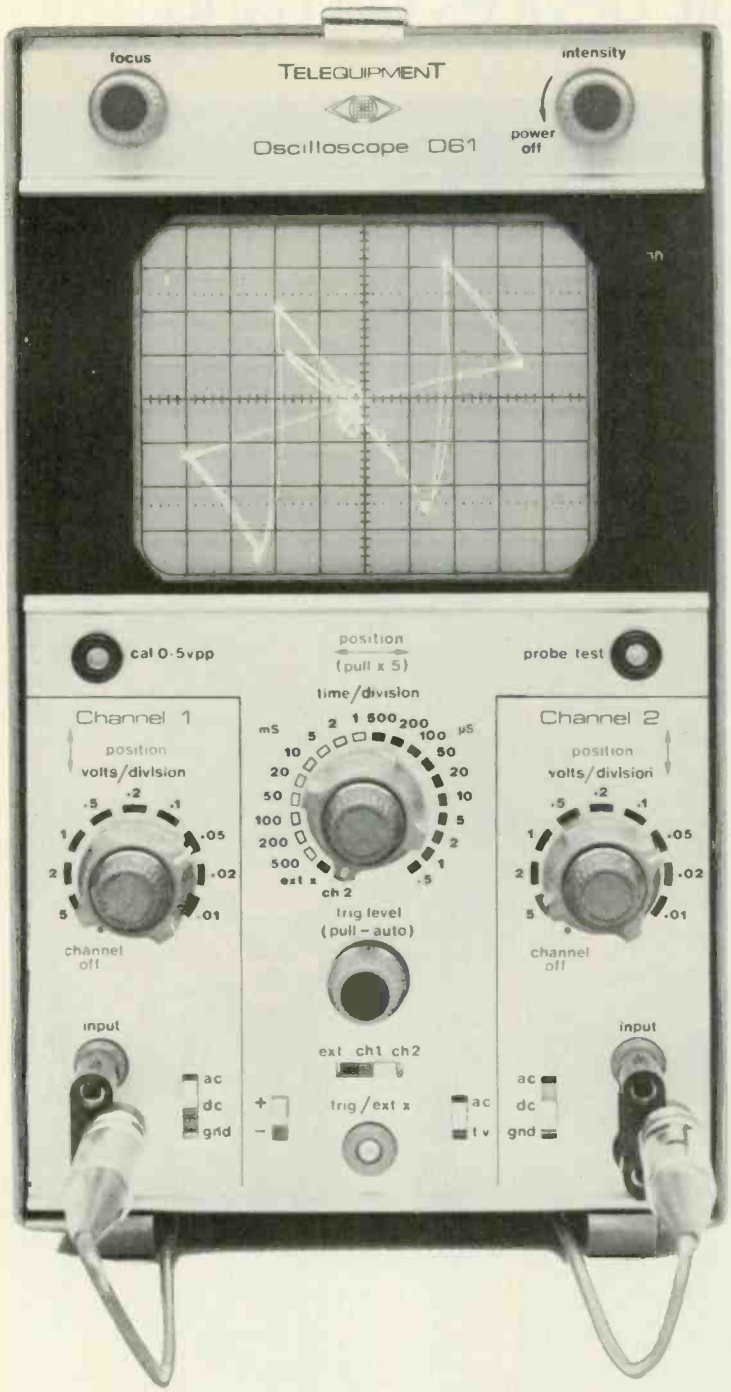
Operating Ease. Front panel controls are engineered for instant recognition. Line or frame displays are selected automatically in the TV trigger position. And, chopped or alternate modes are determined automatically to optimize display clarity.

Bright, stable viewing. Stable waveforms, displayed on an 8 x 10 cm crt, are easy to view, even under unfavorable ambient light conditions. Two identical input channels simplify generation of X-Y displays. This is particularly useful in analysis of vector patterns.

Application versatility. Because of its X-Y capability, the D61 simplifies alignment and troubleshooting of color television sets. Its performance equals or exceeds the requirements for servicing audio equipment, pocket calculators, public safety control, alarm, and communications systems, microwave ovens, digital clocks, and similar consumer electronic products.

Compact, portable. Fully transistorized, and weighing only 15 pounds, the D61 occupies only 6.3 inches of bench width. It's easy to transport and use in confined working areas.

Tektronix reliability. TELEQUIPMENT products carry the well-known Tektronix warranty and are marketed and supported by the Tektronix organization.



Automatic triggering. TV Frame and line triggering. Dual-trace, X-Y and vector modes.

☐ Send me the D61 Spec Sheet and Telequipment catalog.

☐ Have your field engineer call to arrange a demonstration.

Tektronix, Inc., P.O. Box 500, Beaverton, Oregon 97005

Name _____

Title _____ Telephone No. _____

Company _____

Address _____

City _____ State _____ Zip _____

TEKTRONIX®
committed to technical excellence

. . . for a demonstration circle No. 133 on Reader Service Card
. . . for literature only circle No. 139 on Reader Service Card

Stocking these 9 ECG™ semiconductors is like having hundreds of solid-state deflection circuit devices on hand.

GTE Sylvania has checked out hundreds of different TV set models to find out what they have in common.

And we've been able to boil down practically all of their deflection circuit needs to just nine parts.

Then, we put together a brand-new cross-reference guide (ECG-212E) that tells you which of the nine units replaces which numbers.

But, we didn't stop at deflection circuits. Our new guide also covers over 75,000 other parts including industrial components as well as all types of home and auto entertainment equipment.

Because we've reduced the number of parts that you have to have on hand, it's easier to keep a complete stock.

And that makes it easier for you to be sure you have the part you want when you want it.

GTE SYLVANIA

GTE Sylvania Electronic Components, Waltham, Mass. 02154.

TEKLAB REPORT

Magnavox's Color-TV Chassis T982

by Joseph Zauhar

This modular solid-state chassis and the new in-line picture tube used with it are evidence of this manufacturer's commitment to improved serviceability

■ Last month in Teklab Report the Videomatic Color System, Video Control Preset Centering Circuit and the "RGB" Color System in this chassis were described. This month, the other new circuits are examined. The circuits and features discussed are illustrated in the simplified schematics included in the article, or you can refer to the complete schematic diagram, Tekfax Schematic No. 1498.

The new in-line picture tube used in this chassis will reduce installation time if the picture tube is replaced, because all of the neck components are replaced as a unit, which makes replacement comparable to that of a B/W picture tube. Another advantage of the in-line system is that it completely eliminates the dynamic convergence circuitry, thereby drastically reducing set-up time. The scan and pincushion correction circuits do not affect the convergence or purity of the picture tube. The slight corrections needed for static convergence and purity are accomplished by positioning of permanent magnets which are an integral part of the picture tube. These magnets are factory pre-set and should seldom require adjustment.

The deflection yoke is precision wound and matched to the picture tube, then cemented permanently to the picture tube.

A conventional delta picture tube is equipped with three electron guns arranged in a triangular (delta) formation, and has a shadow mask with round holes and a screen with the phosphors arranged in a delta dot pattern. The three electron guns in the new in-line picture tube are arranged in a straight *horizontal* line, and the beam openings in the shadow mask and the phosphors on the screen are arranged in vertical lines.

To provide more brightness and better focus, the 19VDKTC02 color picture tube employed in this chassis requires 27kv anode voltage. This higher anode voltage could not be used in previous TV sets because the picture tubes were not designed for such a high voltage. The new in-line picture tubes are produced with glass having a higher lead content, which prevents the possibility of x-radiation outside of the TV set. Also, the new chassis incorporates a hold-down circuit in conjunction with the horizontal oscillator circuit, to prevent excess high voltage in case of a circuit problem which could cause it to exceed the maximum 27kv.

Convergence Touch-Up

The convergence adjustments of the in-line system are different because the dynamic convergence circuitry has been eliminated. The slight adjustments that might be necessary for static convergence and purity are accomplished with permanent magnets on the neck of the picture. The procedure is outlined in an accompanying chart.

Video Delay Module

The detected composite video signal from the emitter of the Video Amplifier transistor, located on Module 101, is applied through the CONTRAST control to Video Delay Module 105. This module amplifies the luminance signal and delays it by 0.6μsec. It also contains the beam limiter and vertical blanking circuits. The output of the module is the luminance signal with vertical blanking pulses. This signal is directly coupled to the three Video Output Modules.

Signal Processor Module

The detected composite video signal from Video IF Module 101 is coupled to Signal Processor Module 106. This module also receives a positive 5v pulse from the horizontal-output transformer. The Signal Processor module provides positive-going IF AGC, positive- and negative-going RF AGC, and two polarities of composite sync pulses. (The negative composite sync and the positive RF AGC signals are not used in this chassis.)

Chroma Processor Module

The composite video signal from the Video Amplifier transistor, on Module 101, and a negative pulse from the horizontal-output transformer are fed to the inputs of Chroma Processor Module 107. This module controls the production of color in the picture, and includes

the color killer and automatic color control (ACC) functions. The module separates the chroma signal from the composite video signal and generates a 3.58MHz reference signal, then amplifies both to produce output signals which are fed to the inputs of the Chroma Demodulator.

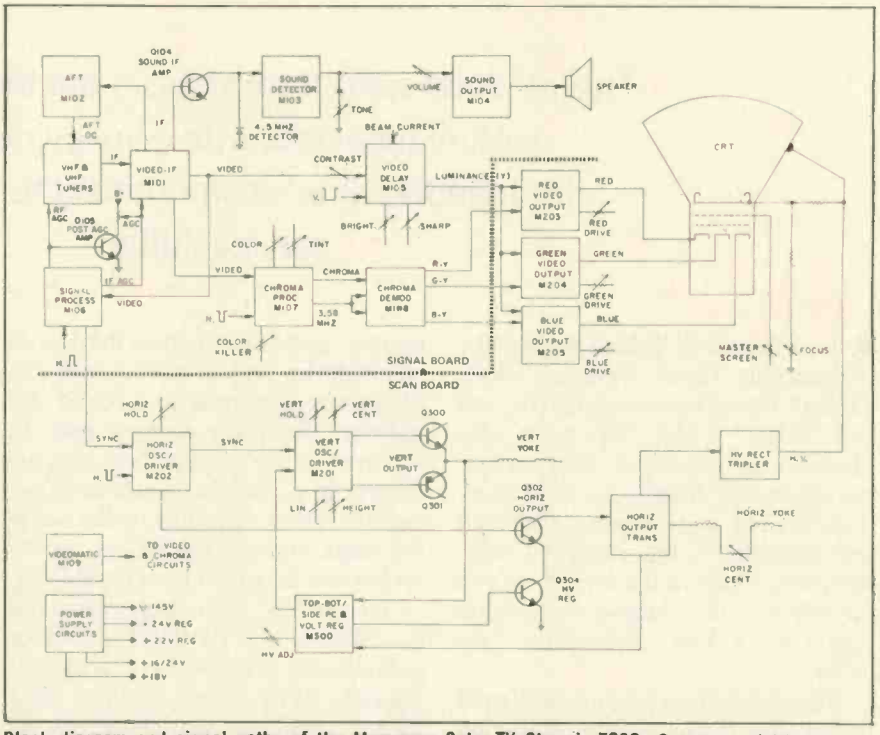
Chroma Demodulator Module

The Chroma Demodulator Module has as its main element an integrated circuit, IC1. Chroma output from Chroma Processor Module 107 is coupled through transformer T101 and capacitor C2 to pin 3 of IC1. The 3.58MHz reference signal from Module M107 is applied to two tuned circuits. The first tuned circuit, consisting of capacitor C154, coil L113 and capacitor C4, applies a 3.58MHz signal to pin 6 of IC1. The second tuned circuit, consisting of coil L112 and capacitors C150 and C3, produces a 110° phase lag in the 3.58MHz reference signal applied to pin 7. Integrated circuit IC1 uses the two phases of 3.58MHz signal to demodulate the R−Y and B−Y color difference signals from the chroma signal. The G−Y color difference signal is derived from matrixing the R−Y and B−Y signals in IC1. The three color difference outputs from the module are directly coupled to the three video output stages.

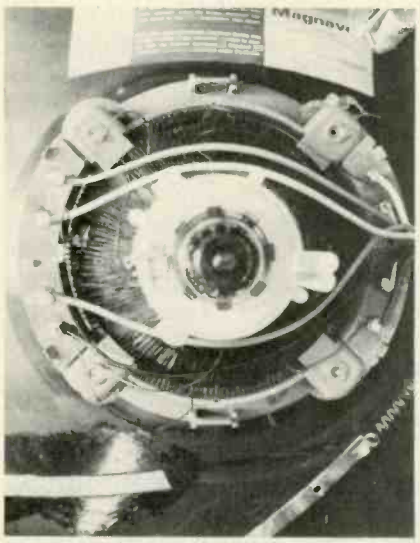
Side Pincushion and High-Voltage Regulator Circuits

The side pincushion correction and high-voltage regulator circuits modify the output of the horizontal sweep circuit to correct for pincushioning at the sides of the picture and to maintain a constant level of high voltage at the picture tube anode.

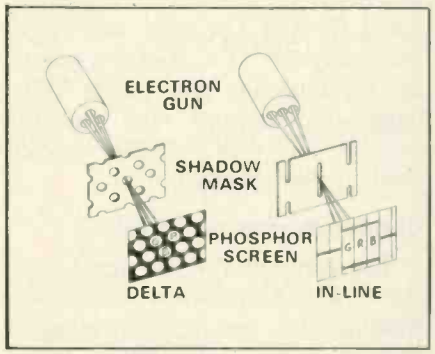
A trapezoidal voltage waveform from the vertical deflection yoke is fed to the integrating network consisting of resistor R1 and capacitor C1, the output of which is a parabolic wave at the vertical rate. The parabolic wave is AC coupled by capacitor C2 and resistor R2 to the



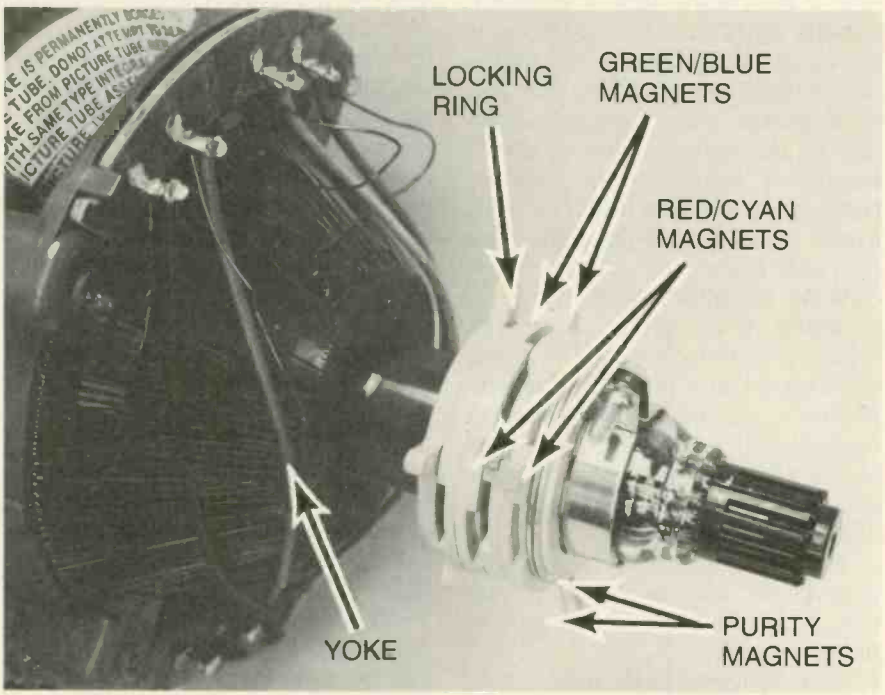
Block diagram and signal paths of the Magnavox Color-TV Chassis T982. *Courtesy of Magnavox.*



The deflection yoke is precision wound and matched to the picture tube, then cemented in place.



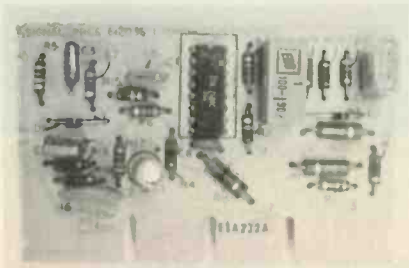
The precision in-line picture tube has its guns arranged in a straight horizontal line and is equipped with a slit shadow mask and phosphor screen with vertical lines. *Courtesy of Magnavox.*



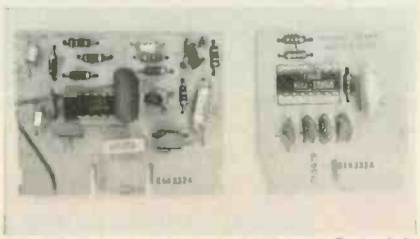
The static convergence and purity assembly are preset at the factory and should seldom require adjustment.

base of transistor Q1. This transistor amplifies and inverts the parabolic wave. The inverted parabolic wave is coupled through capacitor C3 to the base of transistor Q2. Transistor Q2 amplifies and inverts the signal, which then is AC coupled through capacitor C4 to the base of transistor Q4. The collector of Q2 is connected through zener diode Z2 to the +145v supply so that any AC ripple in this voltage is cancelled in the horizontal-output stage. Transistor Q4 and Q304 are connected in series with the emitter of horizontal-output transistor Q302 and ground; therefore, the signal at the base of Q4 causes the horizontal sweep voltage to be modulated at a vertical rate, to correct pincushioning at the sides of the picture.

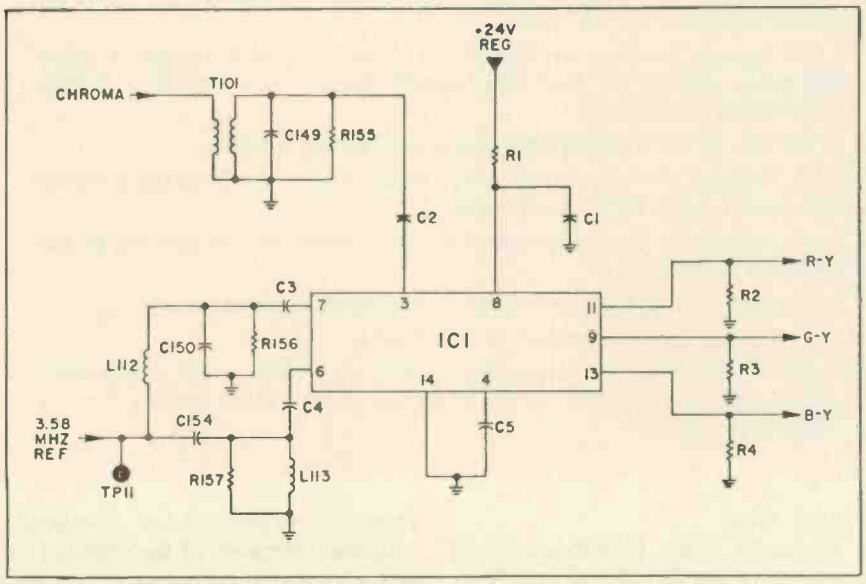
The DC bias voltage for Q4 is set between 22 and 35v by the HIGH VOLTAGE ADJUST control, R13. This bias voltage level follows the +145 supply voltage by the action of Z1, which always keeps the bottom of R13 123v below the supply voltage. As the supply voltage drops, the base voltage of Q4 will also drop, causing an increase in emitter-to-base forward bias voltage. If Q4 conducts more, it causes Q304 to conduct harder. Any change in the +145 supply voltage changes the base current of Q4 and Q304, which, in turn, changes the output current. This voltage change varies the emitter voltage of horizontal-output transistor Q302 an amount proportional to the change in the +145v supply. In this manner, the sweep output voltage of Q302 is kept constant except for the vertical modulation needed for pincushion correction.



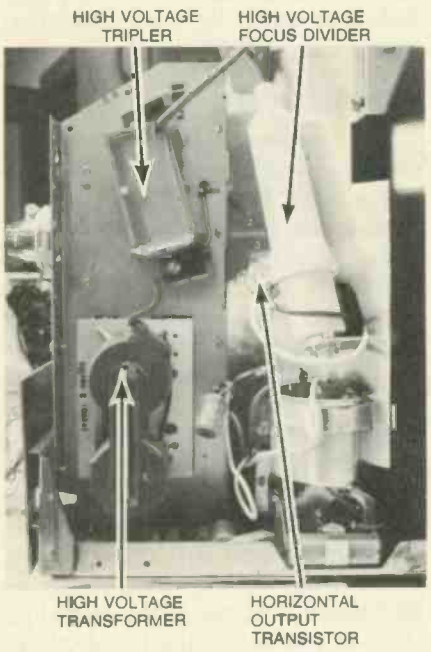
The Signal Processor Module employs one integrated circuit, and is held in place by the edge connector contact springs and retainer.



The Chroma Processor and Chroma Demodulator modules employ integrated circuits, which contain most of the color circuit components.



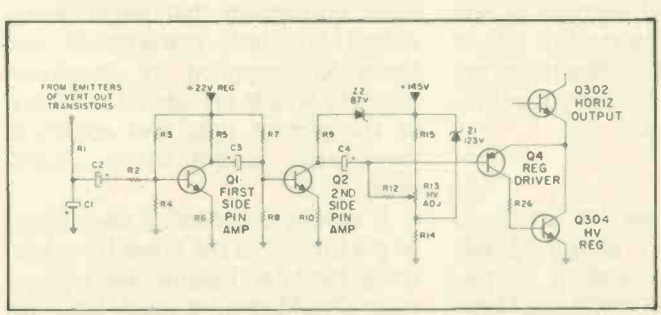
Simplified schematic of the Chroma Demodulator circuit. *Courtesy of Magnavox.*



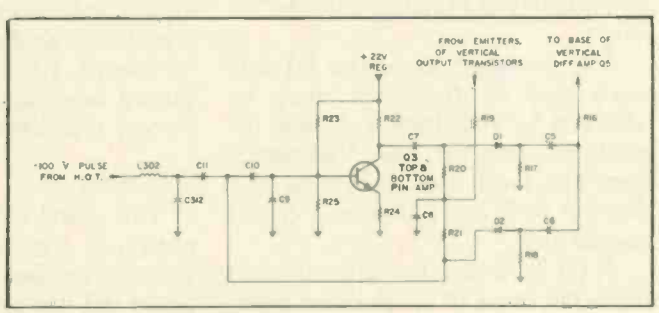
Front view of the sweep circuit assembly.

Top and Bottom Pincushion Correction Circuit

The top and bottom pincushion correction circuit eliminates distortion at the top and bottom of the raster. A positive 100v pulse at the horizontal frequency, obtained from the horizontal-output transformer, is applied through coil L302, capacitor C11 and C10 to the base of transistor Q3. The input network of L302 and C312 shapes the 100v spike into a parabolic wave with an amplitude of approximately 30v p-p. A portion of the parabolic wave is taken from the junction of capacitive divider C11, C10 and C9 and is fed to the cathode of modulating diode D2. Transistor Q3 amplifies and in-



The Side Pincushion and High Voltage Regulator Circuit. *Courtesy of Magnavox.*



Top and Bottom Pincushion Circuit. *Courtesy of Magnavox.*

verts the parabolic wave, which then is fed to the anode of modulating diode D1. A trapezoidal wave, from the vertical-output circuit, is applied through R19 to the junction of R20 and R21. Capacitor C8 filters out the high-frequency component of the vertical wave and produces a slightly rounded sawtooth at the vertical frequency which, in turn, is fed through R20 and R21 to the diodes. Modulating diode D1 is forward biased only during the positive halves of both the vertical sawtooth and the horizontal parabolic waves. When diode D1 conducts, it modulates the vertical sawtooth with the horizontal parabolic signals at its anode. Similarly, D2 conducts only during the negative halves of both the vertical and horizontal pulses and modulates the vertical with the horizontal pulses at its cathode. The modulated outputs of the diodes are capacitively coupled to R16 and then to the base of vertical differential amplifier transistor Q5, on Module 201. The modulated signal is amplified and coupled to the vertical deflection yoke, for top and bottom pincushion correction.

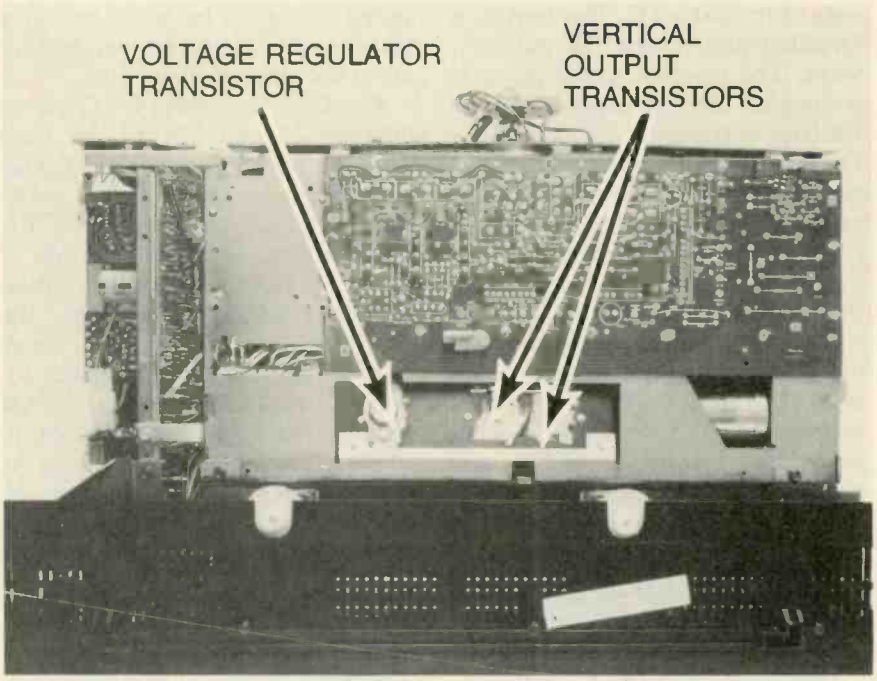
Troubleshooting

If a malfunction occurs in this chassis, it can be normally corrected by an adjustment or by replacing a module or plug-in transistor. The Video IF, AFT, Pincushion/Voltage Regulator and Horizontal Oscillator/Driver Modules are held in place by a metal bracket. The remainder of the modules are secured by their connectors.

Before replacing anything, the technician should check all affected controls on the front and back of the TV set. The chassis should be thoroughly inspected for loose module connectors, broken wires, overheated components, etc. If the preceding steps fail to locate the cause of the problem, use the handy troubleshooting guide provided with the TV set.

The module or transistor listed in each step in the guide may be checked by substitution. Unless the problem involves the Videomatic function, most steps should be performed with the Videomatic circuit turned OFF.

If the module substitution method fails, the cause of the problem probably is in the main Signal Board, Scan Board, chassis, tuner, or the picture tube.



Bottom view of the chassis showing the location of the voltage regulator and the two vertical-output transistors.

Static Convergence/Purity Adjustments

(1) Turn the red background control off and adjust the blue background controls to produce a Cyan raster.

(2) Connect a color bar generator to the antenna terminals of the TV set and tune in a crosshatch or dot pattern.

(3) Converge the Green and Blue pattern at the center of the screen by spreading and/or rotating the Green/Blue magnets. (Do not move the purity magnets while setting convergence.)

(4) Turn up the red background control until the red is visible.

(5) Converge the Red and Cyan pattern at the center of the TV screen by spreading and/or rotating the Red/Cyan magnets.

(6) Retouch the Green/Blue and Red/Cyan magnets for the best overall convergence, as necessary.

(7) Rotate the locking ring to lock all the magnets in place.

(8) Perform the Color Temperature adjustments.

Note: If the purity and convergence magnets are completely out of adjustment, set all three pairs of tabs to the 12 o'clock position before starting the convergence procedures.

Removal and identification of components on the Signal and Scan Boards is simplified because of the clearly roadmapped component and signal path guides on the foil side of the board. Also, the transistors are placed in sockets, for easy substitution or replacement.

Summary

The color-TV set we analyzed obviously was very accurately adjusted at the factory, and the convergence did not need touch-up. However, if models equipped with this chassis do require set-up, the convergence procedure is drastically simplified because of the elimination of the dynamic convergence circuitry. As described previously, the slight corrections that might be required for static convergence and purity are supplied by permanent magnets which are an integral part of the picture tube and which, in most cases, do not require adjustment.

If service is needed, it usually can be performed in the home by substituting modules. Picture tube replacement should require much less time and effort because of the new in-line system. ■

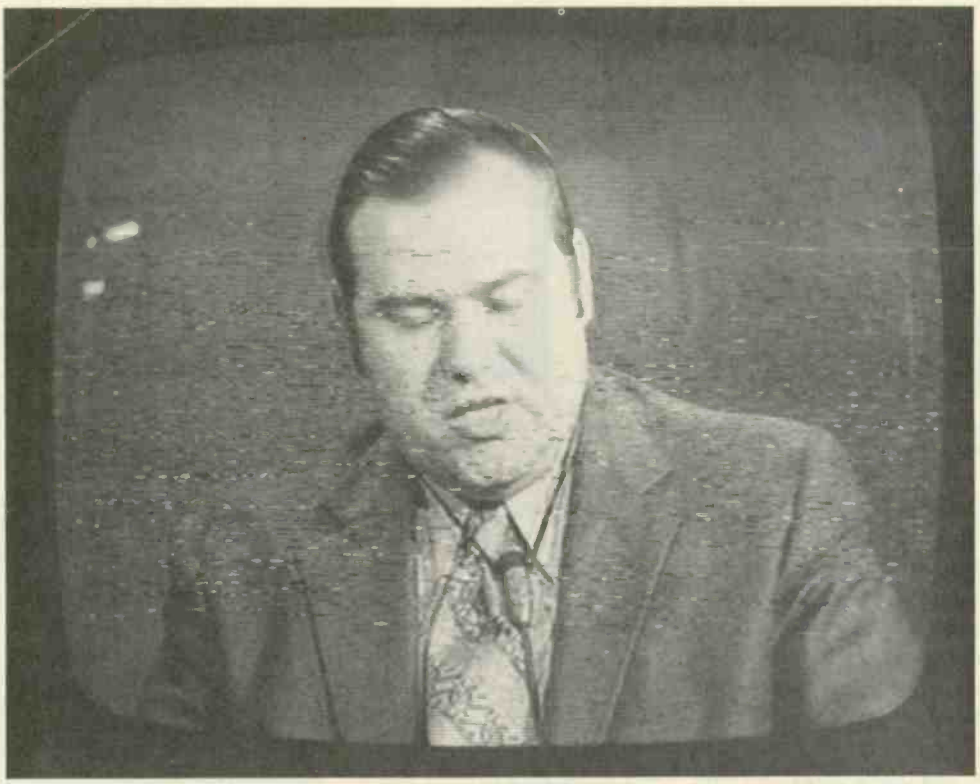


Fig. 1—Ignition or powerline interference is characterized by dots and dashes moving horizontally across the screen of the TV set.

TV Interference–Causes and Cures

How to identify and eliminate the most common types

by Bert Wolf

Ignition or Powerline Interference

Ignition or powerline interference (Fig. 1) is a very common type of interference, characterized by dots and dashes moving horizontally across the TV screen, usually intermittently.

Ignition and powerline interference generally are picked up by the twinlead between the antenna and the TV set. Because the twinlead itself is a good antenna, it can easily pick up auto ignition interference.

The most obvious solution to these two types of interference is to replace the twinlead with coaxial cable or shielded twinlead. Shielded twinlead is superior to ordinary twinlead, but does not eliminate interference pickup as effectively as does coaxial cable. Because the shield of shielded twinlead often is not properly terminated, interference may not be completely grounded out.

Coaxial cable does a much better job of eliminating interference, but often requires matching transformers at the antenna and the TV set. (Some antennas and TV receivers are matched to 75Ω.)

The TV set matching transformer is very important in eliminating interference. Even the best coaxial cable shield picks up some interference. However, a good matching transformer, if properly balanced, will feed signals picked up by the shield in opposite directions at equal amplitudes, canceling the interfering signals. Typical of the new, well balanced matching transformers is the Jerrold Model T-4000 (Fig. 2).

Vacuum cleaners, sewing machines, mixers, garbage disposals, hair dryers and other DC-powered household appliances also can cause dots and dashes moving horizontally across

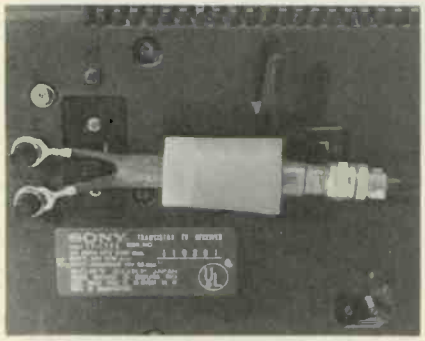


Fig. 2—Jerrold's Model T-4000 Matching Transformer.

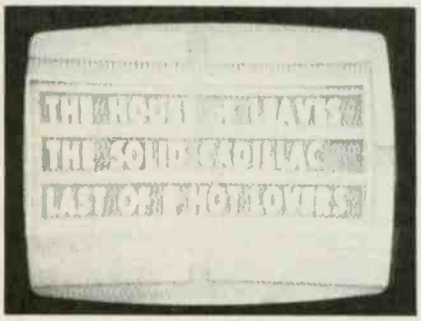


Fig. 3—A "herringbone" pattern on the screen of the TV set is usually caused by FM station interference.

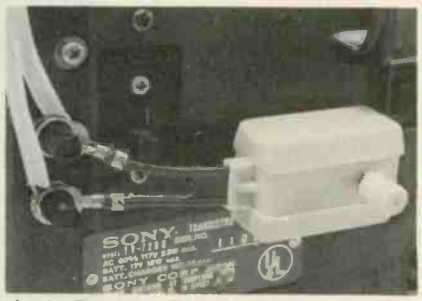


Fig. 4—The 300Ω FM Trap eliminates the "herringbone" patterns caused by strong local FM stations and attenuates the entire FM band signal by about 20dB.

the TV screen similar to auto ignition interference. Dirty motor brushes can cause the same type of interference, not only within the house in which it is installed, but to the whole neighborhood, especially in weak-signal areas. If the offending motor or appliance is found in your customer's home, install new brushes and connect an 0.15μf AC-type capacitor across the motor line or use a plug-type noise eliminator. Be sure you connect the capacitor to the motor side of the ON/OFF switch, so it is connected across the AC line only when the appliance is switched ON. In a really stubborn case, try connecting a capacitor across the primary of the power transformer. If it is a transformerless TV set, the capacitor is placed across the input line.

Even your best efforts might not be sufficient to eliminate *all* types of appliance interference. In many cases, you simply have to tell the customer that when her husband uses his electric drill, she's going to see interference on the screen of her TV set.

In some cases, it is the power company's utilities that cause the interference. This problem is characterized by more or less constant interference in a number of houses in the neighborhood. If you suspect that the power company is at fault, advise your customer and call the power company. Often, an experienced power company serviceman can locate a loose C-clamp or Kearney connector, which, when tightened, will eliminate the interference.

FM Interference

Strong local signals from FM stations often cause a "herringbone" pattern (Fig. 3) on the screen of a TV set. Such interference can be identified with a field strength meter, and can be corrected by the installation of FM traps. Insert the FM trap (Fig. 4) between the TV set and the antenna. The trap will attenuate all signals in the FM band by about 20dB, thereby eliminating the TV interference. The traps are available in either 300Ω or 75Ω, depending on the impedance of the antenna system in which it is to be installed.

If you prefer to connect an FM radio to the TV antenna, simply insert a TV/FM coupler in the lead-in at a point ahead of where the trap is inserted.

In some installations, FM interference is the result of a local station overloading a mast-mounted preamplifier or a multiset amplified coupler. If this is the case, replace the preamplifier with a unit that includes a built-in tuneable FM trap.

Fig. 5—Cross-modulation interference, shown here, is caused by a strong local TV signal during reception of a distant signal on the same channel.

Strong Local Channel Interferes with Distant Channel

This trouble is not easy to recognize because the interference can produce any of a variety of symptoms. However, the pattern shown in Fig. 5 is quite common. You might also hear sound distortion or see cross-modulation (bars moving across the screen). This problem is recognized by seeing or hearing the interference on distant channels, but not on the local channels.

To correct this problem, insert a Single Channel Trap (Fig. 6) between the antenna and the TV set. Such a unit provides about 20dB of attenuation on the channel to which it is tuned. This amount of signal attenuation should eliminate the interference on the distant channels without causing any reduction in picture quality on the local channels. If a preamplifier is used for the distant channels, mount the Single Channel Trap at a point ahead of the preamplifier.

Ham, CB or Police Band Interference

This interference prob-

Fig. 6—A Single Channel Trap is used to correct cross-modulation interference, and provides 20dB of attenuation on the channel to which it is tuned.

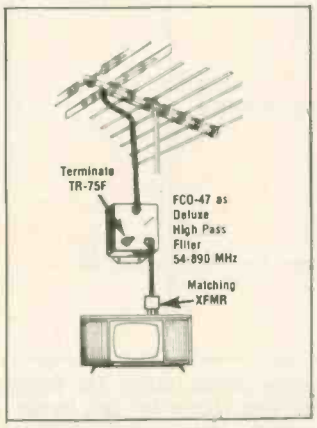


Fig. 8—The Frequency Splitter separates the TV band (54 to 890MHz) from the sub-TV band (0 to 47MHz) frequencies, and is installed in the lead-in wire ahead of the preamplifier.

Fig. 7—The interference shown is caused by Ham, CB, or Police band radio transmissions.

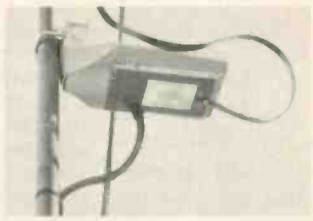


Fig. 10—Solid-state mast-mounted preamplifier.

Fig. 9—"Snow" is actually noise which appears on the TV screen as tiny white dots, and is caused by a weak signal.

lem (Fig. 7) can usually be found with a field strength meter and usually occurs only at certain times of the day. (For example, when the Ham radio operator is transmitting.) To correct the problem, you could try complaining to the FCC, but if you know who is causing the problem, call and tell him politely, and he might correct the problem as soon as he is notified. However, the best method is to use a frequency splitter (Fig. 8). This unit separates the TV band (54 to 890MHz) from the sub-TV band (0 to 47MHz) frequencies. Because Ham, CB and Police frequencies fall below 47MHz, this type of device is very effective. Use the Frequency Splitter ahead of any preamplifier or amplified coupler used in the installation.

"Snowy" Picture

"Snow" is actually internally generated noise which appears on the TV set screen (Fig. 9) as tiny white dots. Because the noise is within the same frequency range as the transmitted TV signal, the amplifying stages of the TV set amplifies the noise as well as the picture and displays the noise on the screen of the TV set.

To eliminate "snow" caused by a weak signal, you must amplify the TV signal to a level sufficiently above that of the noise. This can be accomplished with a mast-mounted antenna preamplifier. (Fig. 10), which should be installed as close to the antenna as possible. The best signal-to-noise ratio is at the output of the antenna, and it is reduced by the downlead. As the distance between the amplifier and antenna is increased, the signal attenuation is increased.

Preamplifiers themselves can be overloaded by a strong local TV or FM signal. To solve or prevent this problem, you also should install either a single-channel trap or an FM trap. (Some pre-amplifiers include built-in tuneable FM traps—an excellent feature.)

Ghosts and Smears

Ghosts and smears are both caused by multiple signals reaching the TV set. A ghost signal looks like a faint outline displaced to the right of the picture. Some smears are actually closely spaced ghosts; the multiple signals are so close together that they simply show up as ragged edges on picture images.

Ghosts are caused by reflected signals that reach the TV set through two paths—a direct path and a reflected path. The direct signal travels a straight line from the transmitter to the receiving antenna. The reflected signal bounces off a tall building or hill and then reaches the antenna. Because it travels a longer distance, the reflected signal reaches the TV set a fraction of a second later, causing ghosts in the TV picture.

Smears usually are caused by a mismatch in the antenna distribution system, which causes the received signal to be reflected back and forth in the line. This, in turn, produces very closely spaced multiple images. If twinlead is used, a stand-off, pipe, or a piece of metal can easily cause a mismatch. Such smears are most noticeable in color-TV pictures.

continued on page 45

Testing and Replacement of Discrete Semiconductors, IC's and Modules

by B. B. Dee

The first of a continuing series of articles in which the nation's leading authorities on electronic servicing discuss proven techniques and philosophies for profitable servicing of the latest designs of home entertainment electronic equipment

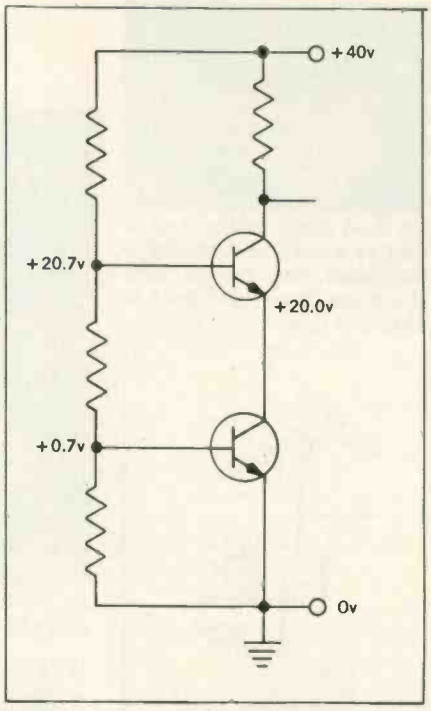


Fig. 1—A voltage divider across the power supply sets the base voltage for each transistor. Since the emitter follows the base voltage very closely, the transistors divide the supply voltage equally. This type of circuit is used in AGC systems, "stacked" IF and audio amplifiers, and cascode circuitry. It is a common circuit with many variations.

Discrete Semiconductor Devices

■ Out-of-circuit testing is preferable for plug-in transistors and silicon-controlled rectifiers. Although the temptation is to use "home brew" test methods and equipment, even the simple-appearing SCR must be checked for sensitivity, latch-up, turn-off, forward drop, reverse leakage, voltage breakdown and breakdown under fast voltage change (called dv/dt), to name only the most vital characteristics required for horizontal sweep service. Most solid-state devices, particularly JFET's and MOSFET's, are best tested in modern, good-quality commercial test equipment designed by people who spend every working day at it.

In-set testing is fast and practical. The disadvantage is that, if a probe slips, several devices can be destroyed in a chain reaction, often without a spark, a sound or a wisp of smoke. There are some small insulated mini-clamp probes which hook firmly around each lead, but unfortunately many semiconductor devices have very close pin spacing, and a rock steady hold is required. It is safer to turn off the set, make a solid connection and then turn the set back *on*. Similarly, all semiconductor devices should be removed and plugged back in with the power *off*. (The same rule applies to modules, discussed later. Further, any meter or other test device used on a "live" TV chassis must be isolated from the power line by a transformer and "grounded" to the TV set, because capacitive discharges can ruin semiconductors. With line-operated transformerless TV sets, an isolation transformer must be used on the TV set as well—before *any* test connections are made.

A quick check of transistors can be made by measuring the base-to-emitter and collector-to-emitter voltages and comparing them to the voltages on the schematic of the set. It is best to measure the various power-supply voltages first, because an incorrect supply voltage will cause incorrect voltages on all devices fed by that supply. The input signals to the device and the output signals from the device can be checked with a suitable detector and scope or meter.

When testing semiconductors, what *not* to do is as important as what to do. Some technicians have learned little "tricks," such as shorting the base to the emitter of a transistor while monitoring the collector voltage. Because a base-to-emitter short removes all forward bias, *bipolar* transistor will turn *off* fully. Without collector current, there is no voltage drop across the collector load, and the voltage at the collector increases to the level of the supply voltage. This test works only under certain conditions. For example, if two transistors are in series across the supply voltage, as in Fig. 1, turning off one will cause the full supply voltage to appear across it. Depending on the voltage rating of the device, it may break down under the abnormally high voltage, because in normal operation each transistor sees only *half* the supply voltage. Or, if the device is an oscillator, turning it *off* might cause loss of drive to a following amplifier, and then things cook! Further, the device might be an FET, in which case the test results can be totally misleading, because bipolar transistors work with *current* inputs, while FET's require *voltage* inputs.

The safe performance of such "quickie" types of tests requires knowledge of the device and circuitry under test. If the technician has a schematic, testing for the presence or absence of the indicated voltages and currents is a safer and a more accurate procedure.

Fig. 2 shows *some* of the many types of transistors, with their elements and polarities identified. Bipolar transistors come in NPN and PNP triode configurations, but JFETS come not only in N channel and P channel, but also in symmetrical and non-symmetrical construction, and as tetrodes. MOSFET's (sometimes called IGFET's) come in N channel and P channel types, single and dual gates, and enhancement and depletion modes. The

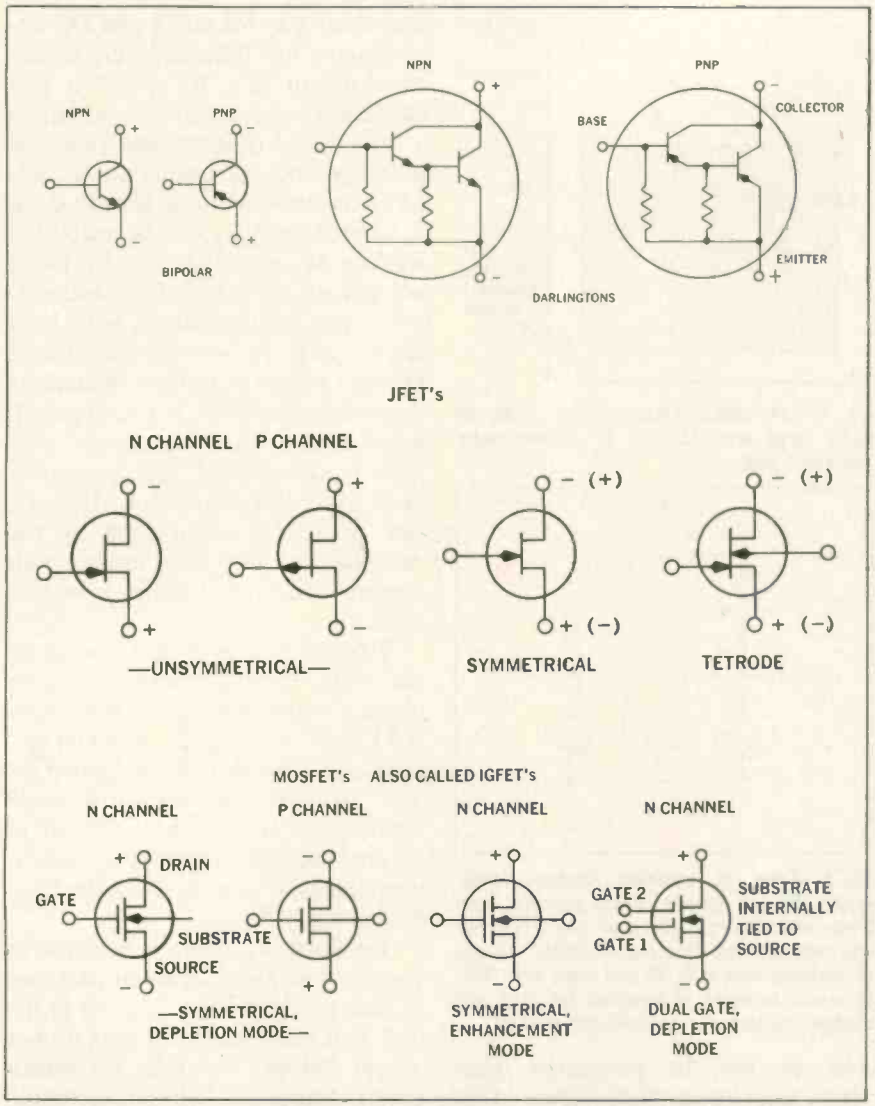


Fig. 2—These are only some of the possible discrete semiconductor configurations. For example, MOSFET's are available in most combinations of single and dual gate, enhancement and depletion, P channel and N channel, symmetrical and non-symmetrical. As the symbols show, the input of JFET is a reverse-biased junction (Junction Field Effect Transistor), while the input to the MOSFET is via a small capacitor formed by a metal deposit on top of a layer of silicon oxide (glass), thus forming a Metal Oxide Silicon Field Effect Transistor. The thin oxide is easily punctured by static charges, unless the gate input is protected by means of diodes between gate and source.

dual-gate devices have two inputs, which make them useful for mixers, AGC controlled amplifiers, and provide extra isolation between output and input terminals. The term "enhancement" means that the device normally runs near cutoff until it is biased further *on*. The term "depletion" means that the device is normally run nearly full *on* without bias, and must be biased so that the current through the device is reduced towards the middle of the possible "swing." Darlington transistors are two devices in cascade on one chip, but are treated as if they were one transistor with higher beta and input impedance than usual. As you can readily see, the technician can no longer assume that a device that looks like a simple bipolar transistor is indeed a bipolar transistor!

Integrated Circuits

IC's are yet another story. Since neither set nor semiconductor manufacturers have developed suitable service-type testers for the IC's used in home entertainment electronic equipment, in-set testing is the best bet. Another argument for in-set testing is the fact that most IC's are soldered in. If incorrect voltages, currents or signals indicate a defective IC, it should be carefully removed from the set, and low-power ohmmeter readings taken from each pin to every other pin and recorded. The readings then should be taken again on the ohms x 100 high-power scale, and again with the test leads reversed, to read forward- and reverse-biased junctions as well as resistive paths. These readings should also be recorded. (The high-power ohms x 100 scale does not put out enough current to destroy semiconductors.) Before putting a new IC into the set, the new one should be tested in the manner just described. If a significant difference exists, it can be assumed that the original IC was defective. If no difference is noted, *no* conclusion can be drawn as to the state of the original IC. This is because of the nature of the IC internal circuitry.

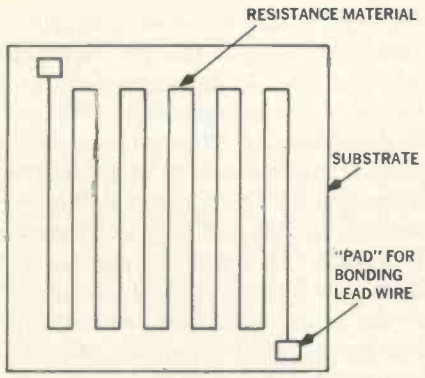


Fig. 3—High ohmic value resistor, made by zig-zagging thin pattern to achieve length on small chip.

Extremely high- and low-value resistors are seldom used in IC's because their size is impractical on the small chips commonly used (see Fig. 3). Because *high* ohmic values require a long resistance path with the type of material inherent in monolithic silicon processing, such resistors would use up most of the area on the chip as the resistive material is zig-zagged back and forth to obtain the required length. (The methods of obtaining high- and low-resistivity material for resistors results in large temperature coefficients. "Pinch" resistors, which restrict electron flow by means of electric fields, cannot be made with any accuracy.)

Low values of resistors require thick cross-sections, because very thin films have too much resistance per unit length. Monolithic resistors are measured in microns of thickness; therefore, low ohmage resistors can be made only by increasing the *width* of the resistor to provide, in effect, many parallel circuit paths, as shown in Fig. 4. This too uses up much of the chip area for a single resistor. To get around this problem, circuits have been devised which use only resistance values between about 500Ω and 50K. Fig. 5

illustrates such a circuit. Because transistors Q1 and Q2 are made at the same time, by the same methods and of the same materials, and are on the same chip, they are very similar, and are in the same temperature environment. This close matching is the key to much IC-circuit design. Transistor Q1 is used only to establish a bias for transistor Q2, in place of the usual high resistance base-bias resistor and low-value emitter-bias resistor. Q1 is biased on by resistor R3 through collector resistor R1. Q2 is then also biased from Q1's collector through resistor R4. Because the operating point of Q1 is set, and Q2 tracks Q1 because they are "twins," Q2's operating point is also established. If the temperature increases, the collector current of Q2 tends to increase, but the collector voltage of Q1 decreases because its collector current has also increased. Consequently, the bias on the base of Q2 decreases, bringing the current back to the correct operating point. In this manner, only resistors in the range of thousands through tens of thousands of ohms are used to establish stable circuits. This technique works because the active devices on the chip are very closely matched. This cannot be accomplished with separate (discrete) devices except by very costly matching. The point of all this is that there is no way to tell when devices are no longer matched because of an overload, etc. The factory uses a performance test. That should be the tip-off to the technician. What better performance test than an actual operating TV set?

Modules

The basic concept of modules is not new. They merely are replaceable subassemblies, most of which can be serviced the same way each separate printed-circuit board in a multiboard set is serviced.

Modules come in two types, coated and uncoated. The trend seems to be away from the coated modules, which were not repairable on a profitable basis. Uncoated modules can be tested, component by component. Replacement components are best purchased by part number from the TV-set manufacturer. Some enterprising technicians have "discovered" that parts which are seemingly interchangeable with both discrete and IC devices used in TV

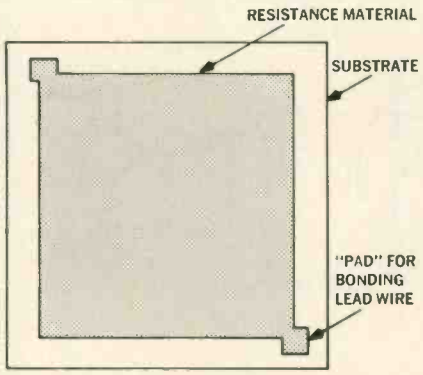


Fig. 4—Low ohmic value resistor made by using large area of chip to achieve more "parallel" paths.

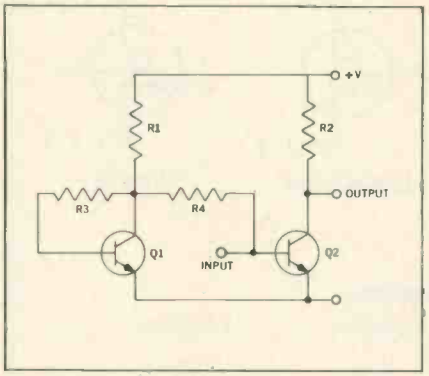


Fig. 5—Basic IC amplifier showing fundamental biasing scheme which depends upon close matching of transistor characteristics and temperatures. This circuit avoids the use of resistors less than 1K and more than 30K, as would normally be required for base and emitter resistors in conventional circuits.

sets can also be purchased from semiconductor manufacturers. Unfortunately, most TV-set manufacturers perform special "sorting" tests or make changes in the basic device, to meet their own special needs. The difference is often discovered when attempts are made to realign the set, or after it is installed in the customer's home. It is tempting to try to improve the parts supply situation by looking for additional sources of semiconductor parts, but the fact is that they are not interchangeable in the way that vacuum tubes are. Semiconductor devices with 1N, 2N and 3N numbers are JEDEC registered devices (standard parts with a registered set of characteristics), and usually are interchangeable unless the device in the set has been "test sorted" to a special specification by the manufacturer of the equipment in which it is used.

Devices with other "house numbers" are a different breed of cat. Unfortunately, many TV parts fall in this category . . . enough said. The so-called "cross-reference" lists are often okay for audio and DC applications, but frequently are unsatisfactory for IF's, RF's, mixers and oscillators, and integrated circuits.

The circuit diagram and values of parts on modules usually are included in the manufacturer service data.

Coated modules can be tested the way an IC is tested . . . by in-set voltage and signal readings and out-of-set pin-to-pin readings with both high- and low-power ohmmeter ranges of both polarities. Whenever a new model of set is encountered, make up your own "data sheet" with such readouts on it, and keep it in your loose-leaf data book. Because one module is often used by the manufacturer in several models with similar chassis, the effort is worthwhile.

Why not just plug in a new module? One popular brand of set uses about a dozen modules, costing nearly $150 per module kit. If the technician plugs one into the defective set and "blows it out," who pays for it? Usually "blown" module cost has to be absorbed by the shop, because it was damaged as a result of servicing negligence.

Traditionally, customers refuse to pay for two modules when only one of that particular type is used in the set! And most manufacturers do not accept "blown" modules for return credit. More . . . without a "data" book, or test device, how can the shop be sure that the new module is good? New IC's and modules can be defective just as vacuum tubes were, although they too were supposed to have been tested at the factory. With modules as expensive as they are, assuming an average of 12 modules per set, and 10 popular brands of sets, each outside technician will be carrying close to $2000 worth of modules in his caddy, assuming one of each type, plus extras for those modules that fail most often. Some modules are available on a "rebuilt" basis, but the cost of handling and paperwork usually makes it preferable to repair modules when technically and economically practical. In any event, the cost of modules, and of their stocking and use, makes it essential that the typical TV service shop pay close attention to good purchasing and inventory practices. Too many shops have shelves stocked with modules of yesteryears' sets which will never be sold. ■

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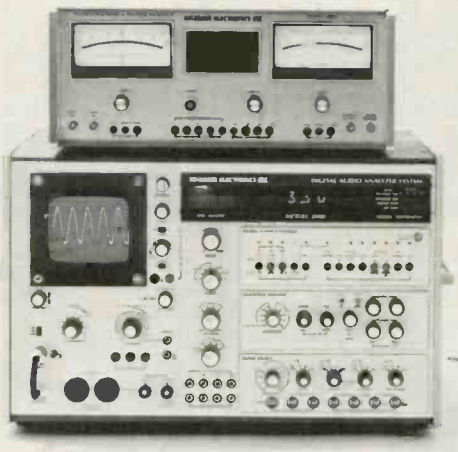

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Just above the McAdam Tester is the new McAdam Phase Lock Wow and Flutter Analyzer. It does exactly what it sounds like it should do, for tape decks and turntables. You can either use our test tapes or the two built-in oscillators. We also can furnish test records. The "almost" is because we're missing an FM Alignment Generator. Fortunately, Sound Technology makes one — the Model 1000A. But if you don't need sweep, you can buy the Leader LSG 231 FM Stereo Generator instead. Add either one to the picture and your laboratory is complete. For more information circle our reader service number or contact McAdam Electronics, 7360 Convoy Court, San Diego, CA 92111, Telephone (714) 278-0300. Call collect.

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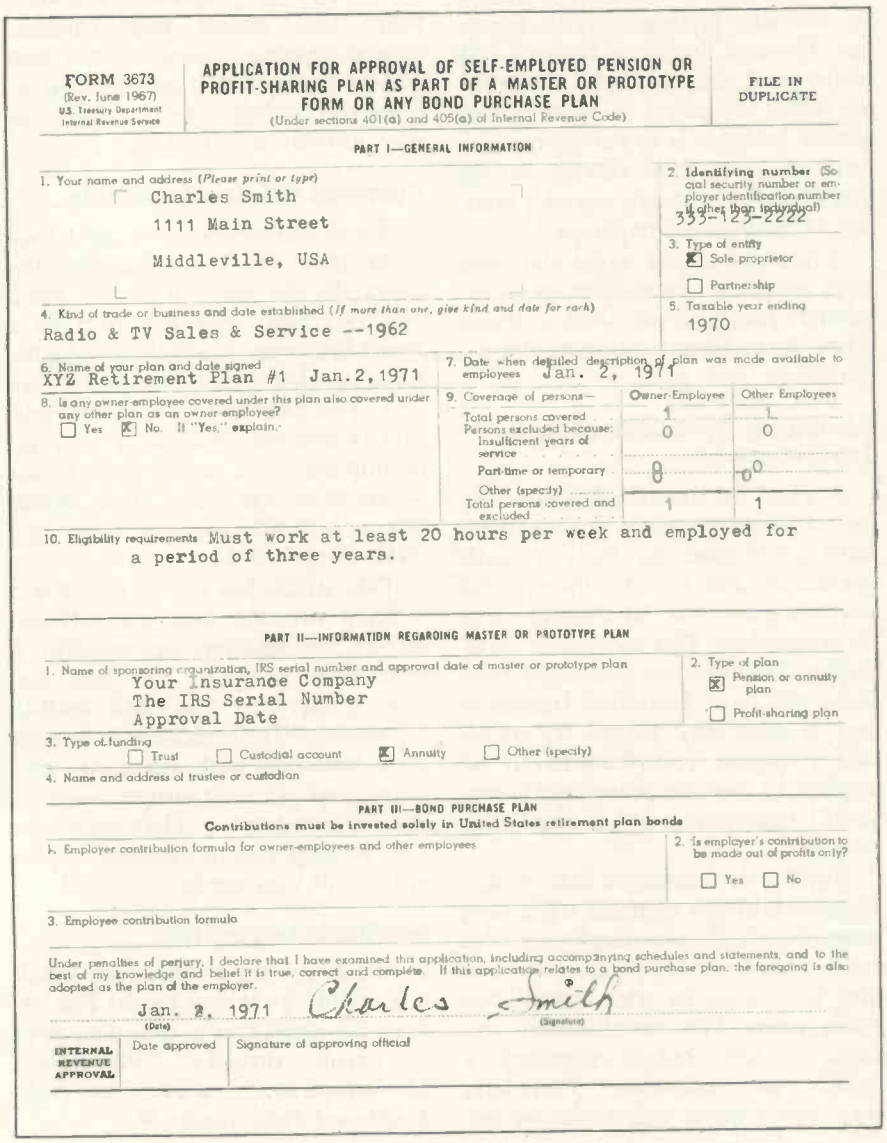
Retirement Programs For Owner/Employees

by Elliott S. Kanter

A capsule analysis of the principal provisions of the Self-Employed Individuals Tax Retirement Act of 1962



FORM 3673 (Rev. June 1967)
U.S. Treasury Department
Internal Revenue Service

APPLICATION FOR APPROVAL OF SELF-EMPLOYED PENSION OR PROFIT-SHARING PLAN AS PART OF A MASTER OR PROTOTYPE FORM OR ANY BOND PURCHASE PLAN
(Under sections 401(a) and 405(a) of Internal Revenue Code)

FILE IN DUPLICATE

PART I—GENERAL INFORMATION

1. Your name and address (*Please print or type*)
Charles Smith
1111 Main Street
Middleville, USA

2. Identifying number (Social security number or employer identification number if other than individual)
333-12-2222

3. Type of entity
[X] Sole proprietor
[ ] Partnership

4. Kind of trade or business and date established (*If more than one, give kind and date for each*)
Radio & TV Sales & Service --1962

5. Taxable year ending
1970

6. Name of your plan and date signed
XYZ Retirement Plan #1 Jan. 2, 1971

7. Date when detailed description of plan was made available to employees Jan. 2, 1971

8. Is any owner-employee covered under this plan also covered under any other plan as an owner-employee?
[ ] Yes [X] No. If "Yes," explain.

9. Coverage of persons—

	Owner-Employee	Other Employees
Total persons covered	1	1
Persons excluded because: Insufficient years of service	0	0
Part-time or temporary	0	0
Other (specify)		
Total persons covered and excluded	1	1

10. Eligibility requirements Must work at least 20 hours per week and employed for a period of three years.

PART II—INFORMATION REGARDING MASTER OR PROTOTYPE PLAN

1. Name of sponsoring organization, IRS serial number and approval date of master or prototype plan
Your Insurance Company
The IRS Serial Number
Approval Date

2. Type of plan
[X] Pension or annuity plan
[ ] Profit-sharing plan

3. Type of funding
[ ] Trust [ ] Custodial account [X] Annuity [ ] Other (specify)

4. Name and address of trustee or custodian

PART III—BOND PURCHASE PLAN
Contributions must be invested solely in United States retirement plan bonds

1. Employer contribution formula for owner-employees and other employees

2. Is employer's contribution to be made out of profits only?
[ ] Yes [ ] No

3. Employee contribution formula

Under penalties of perjury, I declare that I have examined this application, including accompanying schedules and statements, and to the best of my knowledge and belief it is true, correct and complete. If this application relates to a bond purchase plan, the foregoing is also adopted as the plan of the employer.

Jan. 2, 1971 (Date) Charles Smith (Signature)

INTERNAL REVENUE APPROVAL	Date approved	Signature of approving official

The Need

■ Because the monthly benefits from Social Security alone do not provide sufficient income on which to retire, most large businesses provide their employees the opportunity to participate in a company-sponsored retirement program, the monthly benefits of which can be used to supplement those received from Social Security. A few years ago, Congress enacted legislation which permits self-employed individuals to establish similar retirement programs for themselves and their employees by investing a portion of their income on a tax-exempt basis.

The Law

This legislation, Public Law 87-792, THE SELF-EMPLOYED INDIVIDUALS TAX RETIREMENT ACT of 1962, usually referred to as the Keough Act H.R. 10, provides self-employed individuals with a method of deducting from taxable income those contributions which they invest in approved retirement plans.

Who Qualifies

A Self-Employed Retirement Plan can be established and maintained by an individual considered to be self-employed if he is a sole proprietor or a partner who has earned in-

continued on next page

come from his *unincorporated* business for a taxable year. According to applicable laws and regulations, two classifications of self-employed individuals exist: The Owner/Employee, who owns the entire interest in an unincorporated trade or business (a proprietorship), or in the case of a partnership, one who owns *more* than 10% of either the capital interest or the profit interest of such a partnership. In the case of multiple-partners in a business, any self-employed individual who owns 10% or less of either the capital interest or the profit interest qualifies.

Because most electronic service businesses are comprised of a single owner or possibly a simple partnership, we will consider only the steps taken to establish a retirement program on behalf of the Owner/Employee and his employees.

Not only are you as the owner/employee included in this retirement plan, but, if you have employees, you must include them in the program if they meet certain requirements as to hours worked and length of time in your employ.

Contribution Limit

The law allows you to contribute on your own behalf up to 10% of your earned income or $2500.00, whichever is less. However, the Internal Revenue Service has rules to govern what you can or cannot do with this money, and just how you go about establishing your private retirement fund.

I.R.S. Approval Required

Of paramount importance to you is that *any* plan you might elect to use to save for your retirement under this act *must first be approved by the I.R.S.* You may, with approval, elect to invest in Mutual Funds, Treasury Bonds or Insurance Policies specifically designed to meet all I.R.S. requirements.

Must Also Cover Employees

Under the law, you, as the owner/employee, are entitled to participate in this program, and likewise, you must also establish a similar program for all employees working at least 20 hours per week and who have been in your employ for a period of three (3) years.

Insurance $\frac{1}{M}$ the Most Common Investment Medium

The most widely used medium for investment under this act is insurance. Most insurance companies have established programs and have gone to the trouble of securing I.R.S. approval. These programs are referred to as a Retirement Annuity or Retirement Endowment Policy. To participate in a prototype plan, a simple one-page form, shown here, must be filed with the Internal Revenue Service. Should you elect plans based on other than insurance investments, you should be prepared to seek approval on an individual basis and also to establish a trustee or custodial intermediary to supervise the fund. For many reasons, one of the most practical approaches for the owner/employee of an electronic service business is to participate in a retirement program already set up and approved through any of a number of insurance companies.

Assuming at this point that you have elected to participate in an insurance program, we shall examine a few of the facts relating to you establishing your plan.

Computing Contributions and Tax Deductions

A plan we examined allows for owner/employees to make contributions predicated on their average earned income for the three years preceding the year that the plan is to be established. This method of computing contributions seemingly provides the most favorable treatment and is especially geared for plans which require contributions to be applied to pay the premium for annuity, endowment or life insurance contracts.

Earlier, we mentioned that the law requires that you establish a like program for all of your employees who both work at least 20 hours a week and have been in your employ for three years. The contributions *you* make on their behalf represents a 100% tax deduction. Therefore, any contribution you make on behalf of covered employees reduces *your* earned income by the amount of that contribution. This becomes very important in calculating your own contribution.

For example, Charles Smith runs a successful TV Service Shop in Middleville. He has one full-time employee, Carl Schultz. This year, Charles Smith's earned income from his business was $20,000.00. He paid Carl a salary of $10,000.00. Under the provision of his retirement plan, Charles made a contribution of 10% of Carl's salary, or $1,000.00, to the retirement plan. The cost of the insurance protection afforded Carl is included as taxable income for that tax year. We noted that the I.R.S. treats contributions made on behalf of covered employees (Carl) as a 100% tax deduction. This means that Charles' earned income is now $19,000.00 ($20,000—$1000) and his own allowable contribution is 10% of $19,000.00, or $1900.00.

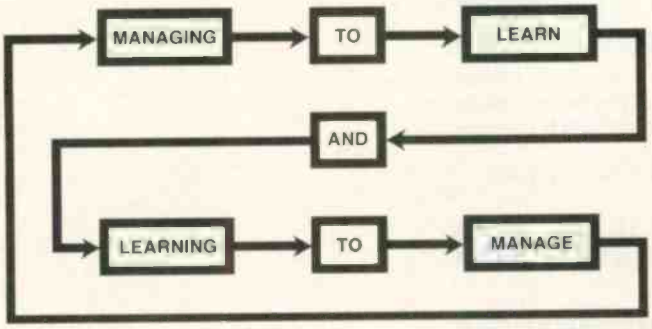
Proceeds Not Tax-Deductible

While contributions to the retirement plan are tax-deductible, the proceeds are *not*. However, when you do retire, you are then in a much lower tax bracket and eligible for a double exemption (after age 65). You can elect to start distribution of benefits (to retire) after attaining age 59½ and before the attainment of age 70½. This means you can retire anytime from age 59½ to age 70½.

This article has briefly outlined a method whereby you, the self-employed businessman, can establish a retirement program for you and your employees, and with built-in tax savings. To implement it in your own business, pick up your telephone and call your insurance agent, attorney, or banker. They should be able to help you to establish a program to fit your needs.

Additional Information

The following publication, which is available from your local I.R.S. office, can assist you in planning your retirement program: Publication 560—*Retirement Plans for Self-Employed Individuals.* ■



by Ray Sawyer

In this series, problems or situations involving business management and/or shop operations are presented for your consideration. You are invited to submit to Mr. Sawyer your opinion of how the problem or situation should be resolved. In a subsequent issue, Mr. Sawyer will again state the problem or situation along with how the owner, service manager and/or technician actually handled it. He also will include selected reader responses which are representative of those received or which offer a novel or unique approach. Address your response to:

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c/o Editorial Dept.
ET/D
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Duluth, Minn. 55802

Because the envelope containing your response will be forwarded unopened to Mr. Sawyer, please do **not** include in it other correspondence to ET/D.

■ The owners of a sales/service operation have an ongoing argument about whether to service only what they sell or to service anything that comes along. One is arguing for servicing only what the store sells and avoiding all of the inherent problems of all-brand servicing (parts, technical knowledge, etc.). The other feels that a greater service can be rendered to the community by servicing everything that comes in. He also feels that it is an opportunity to expand the business and that this is just one more growing pain. Further, he feels that more sales will result directly from this effort.

Each argument, of course, has merit. They have asked for assistance from the service manager on this problem and are pretty much ready to swing in whatever direction he wishes to go for a six-month to one-year period. What would *you* do at this time? ■

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.

Data Technology Model 20 Digital Multimeter

Measures AC/DC voltage and resistance plus capacitance

Data Technology's Model 20 Digital Multimeter. For more details circle 900 on the Reader Service card.

■ This 3½-digit, 2000-count, bench-type Multimeter, Data Technology Model 20, measures not only AC and DC volts and ohms but also capacitance.

Model 20 has a capacitance resolution of 1pf and an accuracy of 0.2% of reading. It has four DC voltage ranges with 1mv resolution and 0.1% accuracy; four AC voltage ranges with 1mv resolution and 0.5% accuracy; and four resistance ranges with 1Ω resolution and 0.2% accuracy.

The instrument is housed in a high-impact-resistant polycarbonate plastic case with aluminum top and bottom covers. A single-print circuit board is used, with all components laid down to prevent the components from dangling from their leads.

There are no screws to remove when opening the case for service. Two pop-release buttons make disassembling quick and easy—the unit can be field-stripped in a relatively short time. A spare fuse and circuit card connector, for testing, are housed behind a rear entry panel. The calibration chart is silk screened to the inside of the case, preventing misplacement. The unit operates in any position, and a snap-out stand can be used to tilt the meter.

The instrument weighs 2.5 lb and measures 2.5 in. x 6.25 in. x 9 in. Price is $269. ■

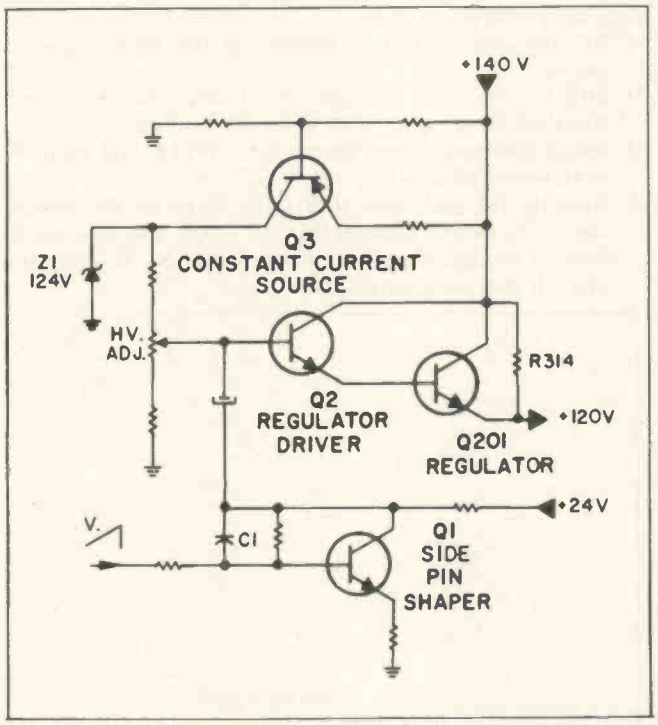
COLORFAX

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

MAGNAVOX

Color-TV Chassis T989—Troubleshooting the Power Supply

The pilot lamps are important indicators when diagnosing AC problems in the power supply. If the lamps do not light when the AC switch is in the ON position, the following checks should be made:



1) Be sure the AC line cord is connected to the wall outlet, then push the circuit breaker reset button.
2) Check the AC voltage at the wall outlet with a voltmeter or by turning on a floor lamp on the same house circuit, to determine if the house fuse or circuit breaker has opened.
3) Check the continuity of the AC cord. It should measure 100K with the AC switch OFF and only a few ohms with the switch ON.
4) If the resistance reads infinity, first determine that the ¼-in. retaining screw above the AC interlock is in place and is holding the AC plug securely in the interlock receptacle. Then check the AC cord, the interlock connections, the circuit breaker, and the line filter for opens or poor contacts.
5) If the reading is 100K regardless of the ON/OFF switch position, check the switch, the AC connections to the switch, and the primary winding of the power transformer.

If the circuit breaker opens instantly when the receiver is switched ON, it is likely that one or more of the diodes in the power supply is shorted. A shorted input capacitor will produce the same effect. Resistance checks of each rectifier circuit will reveal which circuit is at fault. Reverse the leads of the ohmeter while taking the readings, because the meter battery will forward bias the rectifiers to produce a low reading in one direction. A high reading should be obtained with the leads reversed. Of course, a short circuit will produce low readings regardless of lead polarity.

Open and leaky filter capacitors can produce a number of trouble symptoms, such as hum in the sound, hum bars in the picture, and regeneration. A combination of these symptoms frequently result. Open capacitors may be checked by bridging a known good capacitor across the suspected one. (The connection should be made with the set switched OFF.) Leaky capacitors can be detected by resistance checks or by disconnecting them from the circuit and substituting another of the same approximate value and voltage rating.

A problem in the 140v DC supply could be caused by a defective regulator module or regulator transistor. The 120v DC output from the regulator transistor is fused to protect the supply from the heavy surge of current that would result from a short in the horizontal deflection circuit. Resistance checks and module substitution will help isolate problems in this circuit.

Modularization of circuits in modern TV receivers has simplified the business of troubleshooting. However, certain components such as transformers, filter capacitors, power transistors and high-wattage resistors often are not installed on modules because of their extreme weight, size or heat dissipating requirements. A number of other components also are installed on the chassis because of functional or mechanical considerations. Problems relating to these off-module components can be solved using the conventional troubleshooting techniques. ■

TECHNICAL DIGEST

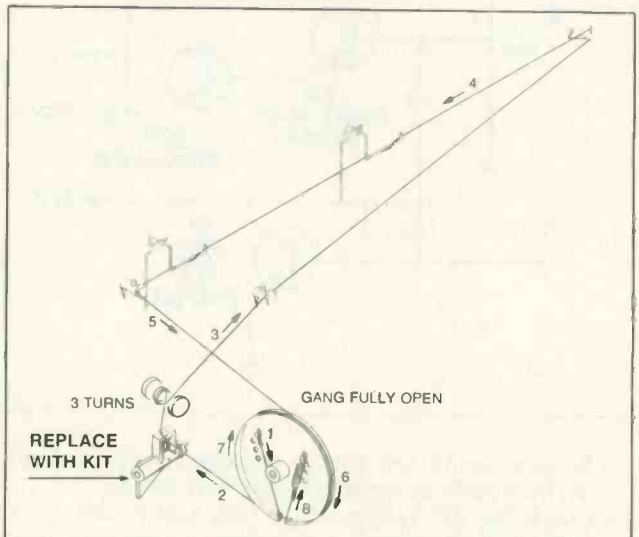
The material used in this section is selected from information supplied through the cooperation of the respective manufacturers or their agencies.

RCA

Tuner/Amplifier Models VZT100/VST113—Dial Cord Guide Replacement

The RC1249 chassis uses a one-piece plastic chassis pan with a dial cord guide molded into the chassis, directly under the tuning shaft. In those chassis where failure of this guide is encountered, the following procedure is recommended for repair:

1) Remove any remaining portion of the broken plastic guide.
2) Drill ⅛ in. hole through the plastic chassis, ¾ in. from the front, and ¾ in. from the bottom.
3) Install new guide from Repair Kit 139918, and position as shown in illustration.
4) Restring the dial cord with three turns on the tuning shaft, and thread through the new guide. The new guide may be rotated slightly in either direction, to compensate for dial cord length variations.



REVISED DIAL CORD STRINGING DIAGRAM

Courtesy RCA Consumer Elect.

The dial cord string on some chassis may require shortening to accommodate this procedure. Other string guides on this chassis may be replaced with Repair Kit 139918 by drilling a ⅛ in. mounting hole through the locating key of the broken guide. After replacing any of these guides, restring the dial cord with three turns around the tuning shaft.

GENERAL ELECTRIC

Video Display Chassis MUA—Chassis Description

The new MUA chassis used in Models MUA1960 and MUA2260 are video display devices with sound. The Model MUA1960 display device is a monochrome unit with a 19 in. (diagonal measurement) picture tube and the Model MUA2260 is the same but uses a 22-in. picture tube.

These display devices are not television receivers and do not have either VHF or UHF tuners. All of the controls are located at the rear and either project through or are accessible through the cabinet back. The devices are used

principally to display the outputs of game machines.

The MUA chassis is a modified UA chassis. The UA chassis circuit board is used but the Video and Audio IF circuits are not functional even though the components for these circuits are on the circuit board. The video and audio signals are connected to a terminal board at the back, which is located where antennas were formally connected. Be sure to observe the caution printed on the label adjacent to the terminal board. Horizontal and vertical synchronizing signals must be supplied by the machine which is connected to the display inputs. Operating the MUA chassis at reduced horizontal scan rates can cause excessive high voltage. For continued protection against X-radiation, do not operate the unit at horizontal scan rates lower than 14,750Hz. The picture tube filament is powered by a secondary winding on the high-voltage transformer. Picture width can be adjusted by the WIDTH control, which is located under the BRIGHTNESS control at the back.

To test if either horizontal or vertical sync is operational, connect a good audio signal generator to the video input ■

TV INTERFERENCE...

continued from page 29

The most effective cure for ghosts is a highly directional antenna that picks up strong, direct signals, but rejects the reflected signal, which comes from a different direction. Generally, the high-gain antennas with the most elements provide the most directivity. In extreme cases, you may have to use two identical antennas stacked horizontally.

Smears usually can be eliminated by switching from twinlead to coaxial cable and using good matching transformers, if needed, at the antenna and the TV set. Make sure all lines are properly terminated, and avoid sharp bends in the cable. Crushing the coaxial cable also can cause smears in the TV picture.

Miscellaneous Interference

Some of the less common interference sources occasionally cause reception problems. Airplane flutter is one example. The signals bounce off of the airplanes as they fly overhead, sometimes causing the picture to flutter, roll or lose sync. This problem is usually associated only with indoor antennas, but if it becomes a problem, use an outdoor antenna with a large vertical capture area. In extreme cases, the only real solution is to use two identical vertically stacked antennas.

Adjacent channel interference is usually a problem only when you are receiving a very distant channel. (For example, a distant Channel 4 signal in an area with a strong local Channel 3 signal might cause a herringbone pattern on Channel 4.) The solution is to employ a high-gain, very directional antenna on a rotor. If this doesn't correct the problem, try a horizontal stack on a rotor or a high-Q trap tuned to the sound carrier of the lower channel.

Because of FCC frequency allotments, co-channel interference (two channels with the same number, but broadcasting from different areas) is very rare. If you have this problem, the more distant channel is usually considerably weaker than the closer channel. You can usually solve co-channel problems by using a high-gain antenna and orienting it to produce the best interference-free reception. ■

Comments from our readers are always welcome.

Address your letters to:

J. W. Phipps, Editor
Electronic Technician/Dealer
1 East First Street
Duluth, Minnesota 55802.

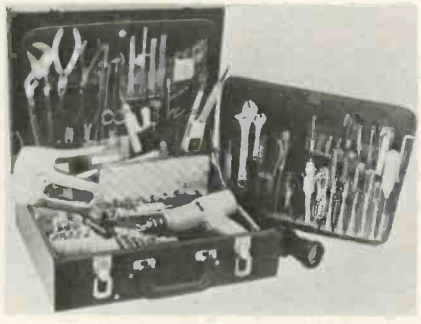
NEW PRODUCTS

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.

ALARM INSTALLERS' TOOL KIT 703

Tools for installation and repair of burglar and fire alarms

A custom designed, 60 piece tool kit for use by professional alarm installers is designed by Mountain West Alarm. Designated Model MW-700, this all-new kit contains a set of tools selected for installation and repair of burglar and fire alarms, new motion detectors,



closed-circuit TV and all other systems and devices currently in use in the alarm industry. The kit, supplied in an attache case, includes many standard tools and many selected special tools which are not normally available from local suppliers. Most of the tools are mounted on two removable pallets which are mounted in a case measuring 18 x 14 x 6 in. Price is $329.

DIGITAL VOM 704

Rugged construction for field use while containing large LED displays

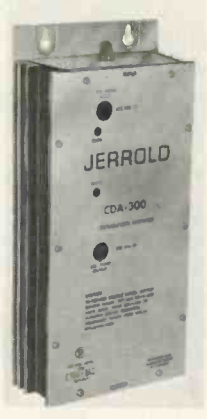
The Model 360 solid-state digital VOM contains 0.33-in.-high, bright-red LED displays (3½ digit) that are

said to be easily read, even at a distance of up to 15 ft; while an analog indicator just beneath the display is designed for quickly scanning nulls and peaks. Polarity selection is said to be automatic, with an appropriate "+" or "−" indication. Overrange indication is also said to be automatic with the lower half of the "1" flashing while the remaining three digits register the amount of overrange—linear to 250 counts beyond maximum. The instrument reportedly has 29 ac, dc, and resistance ranges, including "low-power ohms." Maximum full-scale response time to within rated accuracy is reportedly 2 sec on dc and 5 sec on ac. Simpson.

DISTRIBUTION AMPLIFIER 705

Internal broadband "Push Pull" apartment house system

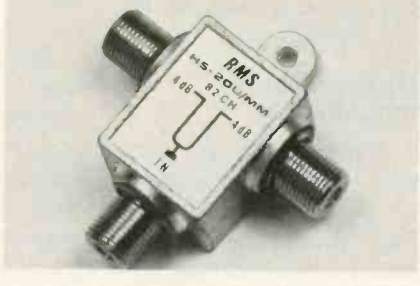
The CDA-300 series of internal broadband push-pull distribution amplifiers reportedly incorporates the latest integrated circuit technology throughout. It is offered to the MATV/CATV industry in a variety of configurations: Cable powered (30v or 60v), line powered-wall mounting (ac), rack mounting (19-in.), plus intermediate or high-gain capability. These units are designed for use where the BP-23 standard must be maintained. They reportedly also feature high output with low distortion and noise figures without degradation to picture quality in multi/channel applications. Jerrold.



TWO-WAY VHF/UHF SPLITTER 706

Its small size is ideal for difficult MATV systems

The Model HS-20U/MM, VHF/UHF hybrid splitter is a miniaturized version designed by RMS Electronics,



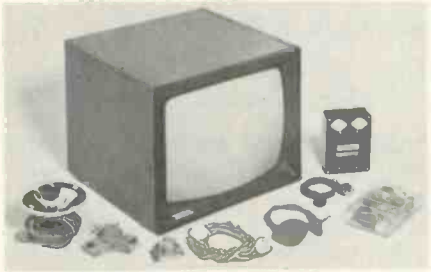
Inc. Its small size is ideal for difficult MATV systems and multiple set installations. Featuring a sealed non-corroding housing, the splitter is weatherproof for indoor or outdoor mounting and is designed to split or combine two 75Ω coaxial cables. Impedance at all terminals is 75Ω unbalanced. "F"

connectors are included, and a built-in bracket facilitates simple mounting. The unit measures 1¾ in. wide x 1-15/16 in. long x 11/16 in. deep. Price is $7.15.

TEST RIG 707

Designed for both tube and solid-state service work

A Combo-Rig, Model CJ, test rig is designed for both tube and solid-state service work. The unit is said to be a complete set up which eliminates the need to bring in the complete TV set for shop service. It is packaged

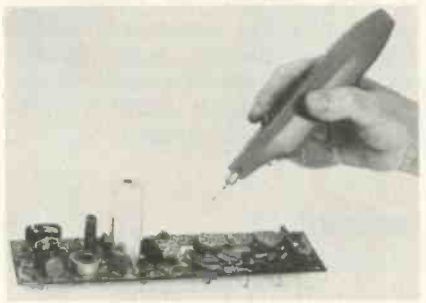


without the picture tube but includes all extensions and deflection components needed for a 19-in. picture tube. The Transverter, a plug-in accessory, is used when servicing solid-state chassis and is reportedly an excellent accessory that can be used with every brand of test rig. The MAP 3500 kit includes the transverter and four adaptors for Motorola, Sylvania, RCA and Zenith TV sets—all included with the test rig. Additional adaptors for tube and solid-state service work are available individually and in kit form. Telematic, Div. of U.X.L. Corp.

SOLDERING IRON 708

Approximately 100 solder joints can be made from one charge

Introduced is a battery powered soldering iron with a built-in spotlight for working in dark areas. This cordless electronic soldering iron,



measures 8 in. long with tip, weighs only 6 oz. It is said to operate on rechargeable nickel cadmium battery

continued on page 48

NEW PRODUCTS...

continued from page 47

and reportedly heats in about 5 sec. A UL listed recharger is included with the unit, which can be recharged overnight by plugging the unit into a 110-120v, 60Hz ac outlet. The tip temperature is reportedly over 700°F and approximately 100 joints can be soldered from each charge, depending on the wire size. The iron can also be used while recharging. An OFF/ON button provides finger touch control and the small tip permits pin-point work. Wall-Lenk Manufacturing Co.

TEMPERATURE PROBE 709

Measures soldering iron tip temperatures

A temperature Probe, Part No. TP110, is designed to accurately mea-

sure the initial temperature that a solder termination would feel. The operator merely tins the proprietary probe end while holding it against his soldering tool tip. The meter readings will reportedly repeat each time you measure the temperature, showing your test results and controlling your soldering methods. Edsyn, Inc.

ELECTRONIC CALCULATOR 710

Features a full memory system

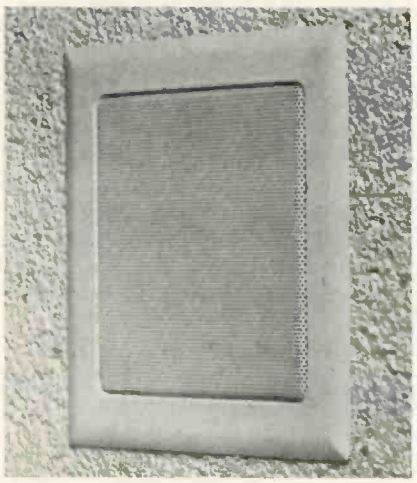
A new portable, memory electronic calculator has been added to Texas In-

struments line of calculators. Designated the TI-2550, the unit features a full memory system which stores and recalls numbers and also sums numbers in the memory. In addition to the four basic functions, the unit performs percentage calculations, percentage problems such as amount of tax, discount, and ratios expressed as a percent can be solved to find the amount of the percentage, as well as a final total. Recalling a number from memory does not erase the stored number. The keyboard on the calculator is composed of 10 digit keys, a decimal key, and 12 function keys. All keys are single function for simple entry in long or complex problems. It operates from three replaceable, rechargeable "AA" size Nickel-Cadmium batteries. Price is $99.95.

SPEAKER BAFFLES 711

Designed for fast installation of ceiling- or wall-mounted speakers

Electro Sound has an "FS" Series of torsion-spring-mounted square speaker baffles for ceiling and wall installations. They are die-formed from 20 gauge CRS or satin-plated steel. All feature beveled edges, perforated metal grille, and the back-angle supports are designed to prevent unwanted vibrations. The smaller baffles are de-



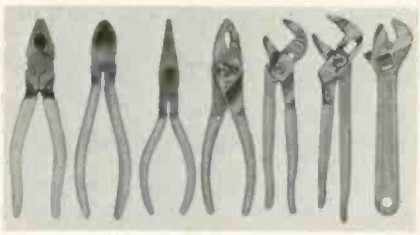
signed to allow space for volume controls and switches where completely self-contained assemblies are required. The mounted baffle, without a screw in sight, presents an exceptionally clean, attractive appearance and is available in painted, brass, chrome, wood, with or without a fabric-covered grille. The baffles are available for 5-, 6-, 8-, and 12-inch speakers.

HAND TOOLS 712

Handles feature thick, yellow, dipped plastic covering for comfort

These tools from ITT Holub Industries have a thick, yellow, dipped plastic covering for maximum comfort and good grip. The line includes

side cutting, diagonal cutting, long nose, slip joint, tongue and groove, and quick-release pliers, plus adjustable wrenches. The quick-release

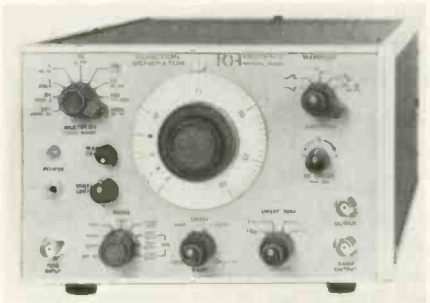


pliers are of a new design with a multiple slip joint that automatically closes and locks on the part being held. The pliers are available in 6½ in. and 10 in. sizes.

FUNCTION GENERATOR 713

Both a waveform and ramp generator in one package

The Model 5200 Function Generator is said to actually be two generators in one package: A waveform generator reportedly capable of providing

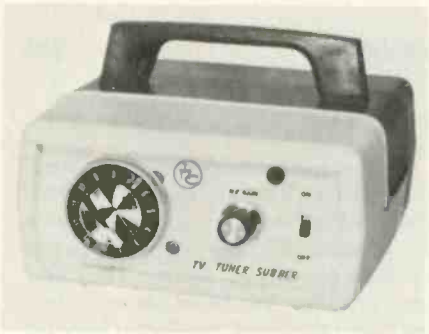


sine, square, triangle and positive and negative ramps over the frequency range of 0.002Hz to 3MHz; and a ramp generator, which provides a linear ramp over the frequency range of 0.1Hz to 100kHz. The main output is 20v p-p open circuit, with a 50Ω output impedance, while the ramp output is 10v p-p open circuit with a 200Ω output impedance. In the pulse mode, it is possible to produce pulses as narrow as 200ns at rep-rates anywhere between 100kHz and 0.1Hz. The ramp generator provides a linear output and when internally connected to the waveform generator in the sweep modes, provides an output voltage proportional to the main output frequency. Krohn-Hite Corp.

TUNER SUBBER 714

Operates from 120v AC or batteries

For added convenience in shop use, Castle TV has designed a new model of the Subber Mark IV. Designated the Subber Mark IV-A, the unit operates from 120v AC or battery, and comes complete with batteries plus wall plug-in transformer and built-in power supply. Change-over to battery operation is automatic when the AC transformer is disconnected. All other



specifications are the same as the Subber Model Mark IV. Price is $54.95.

TRANSISTOR/FET TESTER 715

Requires no set-up information

Introduced is a new pushbutton transistor and FET tester, the TF26 Touch Tone Cricket. The tester reportedly requires no set-up book or knowledge of lead configuration. The test leads can be connected in any order. The pushbutton operation, coupled with the NPN/PNP button, tests all possible combinations of basing for any transistor or FET. A unique audible "chirp," indicating a "GOOD" test, is incorporated into the design and this audible tone reportedly tells you instantly when a good transistor is under test. A sensitive

out-of-circuit leakage test in microamps is also included to back up the in-circuit gain test. The unit was designed with portability and ruggedness in mind. The unit is housed in an unbreakable acrylic case and sliding meter cover. A specially designed spring loaded, jewel pivot meter movement, built to absorb shock, is also featured in the unit. Sencore, Inc. ■

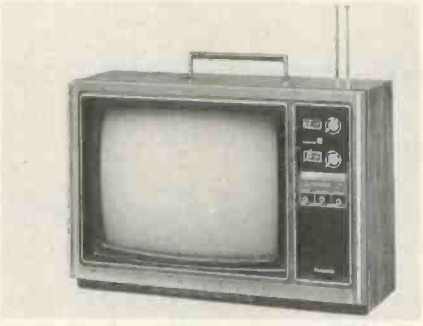
DEALER SHOWCASE

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.

COLOR-TV 716

Features a new color picture tube

This 19-in. (diagonal) Panasonic Quatrecolor TV set, Model CT-944, features the new Quintrix picture tube for greater picture brightness while maintaining sharp focus. The new tube includes five-electrode construction; an additional pre-focus lens for sharper picture detail; a negative



guard-band black matrix for improved contrast; and a high-voltage, 100 percent solid-state Quatrecolor chassis. It is housed in a walnut grain cabinet and features five snap-on boards which simplify serviceability. Price with stand is $499.95.

TURNTABLE 717

Features a new deep, heavy, die cast platter

A top of the line magnetic turntable, Model 620AX, is designed by BSR

(USA) Ltd. It features a walnut-grained wood base plus tinted dust-cover, a magnetic cartridge with elliptical diamond stylus, and a deep, heavy (approximately 4 lb) die cast platter. The jam-proof tone arm of low-mass aluminum design is equipped with an adjustable counter-weight, dual-range anti-skate control and a slide-in cartridge head. Also included is a stylus force adjustment, viscous damped pause and cue control, swing-away arm for manual play and an automatic arm lock.

AUTO FM AMPLIFIER 718

Installed under the dash, it amplifies only the FM signal

This FM stereo amplifier, designed by Antennacraft, is easily installed un-

der the dash and amplifies only the FM signal. There is less station fading, improved sound clarity and cleaner stereo reception. The unit does not affect AM listening and operates from any 12v negative-ground system.

STEREOPHONE DISPLAY 719

Occupies less than 1 sq ft of counter space

A gold foil covered display designed to produce stereophone sales for dealers is now available from RCA. Strong, lightweight, and occupying less than 1 sq. ft. of counter space,

this eye-catching point-of-purchase display, Model MDA-1222, is easily assembled and set up. It's designed for use with any model in RCA's line of stereo headphones. The units can be displayed on the attractive placard or even hooked into a sound source to demonstrate the stereophones.

TECHNICAL LITERATURE

Test Packs and Master Electronic Kits

Bulletin SP-41 describes the complete series of combination snap-around and multitester test kits. A.W. Sperry Instruments Inc., 245 Marcus Blvd., Hauppauge, N.Y. 11787.

Antenna System Components

A revised, 36-page commercial products catalog, No. 110, contains illustrations, descriptions and specifications for over 250 antenna system products. Winegard Co., 3000 Kirkwood St., Burlington, Ia. 52601.

Electrolytic Capacitors

This brochure describes the two series of aluminum electrolytic capacitors available from International Importers, Inc., 2242 S. Western Ave., Chicago, Ill. 60608.

Components & Test Equipment

This 32-page illustrated, discount mail-order catalog is designed as a quick-reference component and test equipment ordering guide. Fordham Radio Supply Co., 558 Morris Ave., Bronx, N.Y. 10451.

Security Systems

A 32-page catalog lists 17 professional security systems designed for installation by the electronic technician. PLC Electronics, Inc., 39-50 Crescent St., L.I.C., N.Y. 11101.

Linear Integrated Circuits

The 3rd edition of the Linear Integrated Circuits Data Book has been expanded to over 800 pages, one hundred pages more than the previous edition. In addition to device listings and data sheets, an interchangeability guide and listing of available application notes is included. Price per copy $3.00. Motorola Semiconductor Products, Inc., P.O., Box 20924, Phoenix, Ariz. 85306.

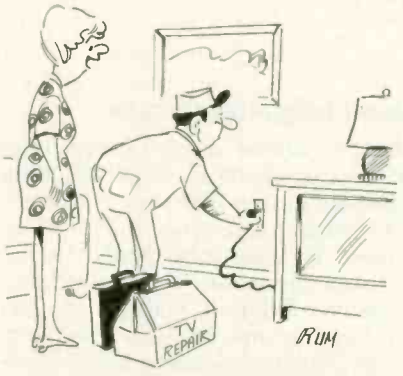
READERS SERVICE INDEX

ADVERTISER'S INDEX

NEW PRODUCTS

TEST INSTRUMENT

"My husband worked on it for two hours. Do we get anything off for that?"



"I love my new service contract. I'll bet you appreciate my being your best customer."

ELECTRONIC TECHNICIAN/DEALER

TEKFAX

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

GROUP 259

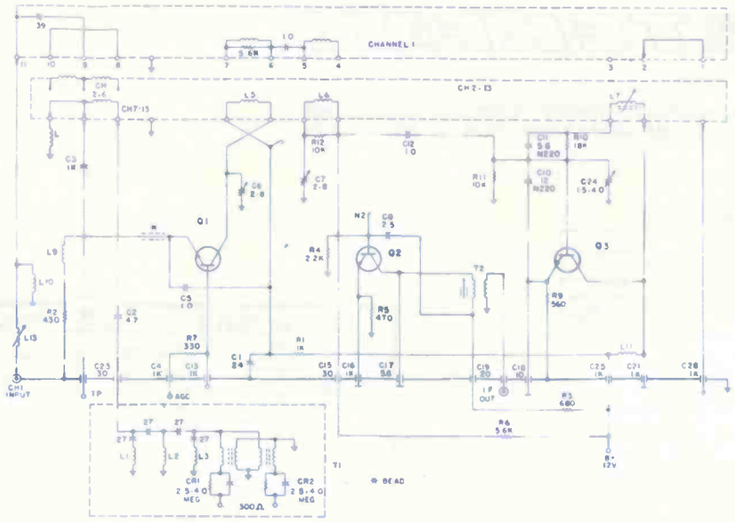
	SCHEMATIC NO.		SCHEMATIC NO.
ADMIRAL Color-TV Chassis T15K10/T16K10	1515	MGA Color-TV Model CS-197	1516
AIRLINE TV Models GAI-13133A/B	1518	MOTOROLA Color-TV Chassis TS-931	1517
MAGNAVOX TV Chassis T984 Series	1514		

1514

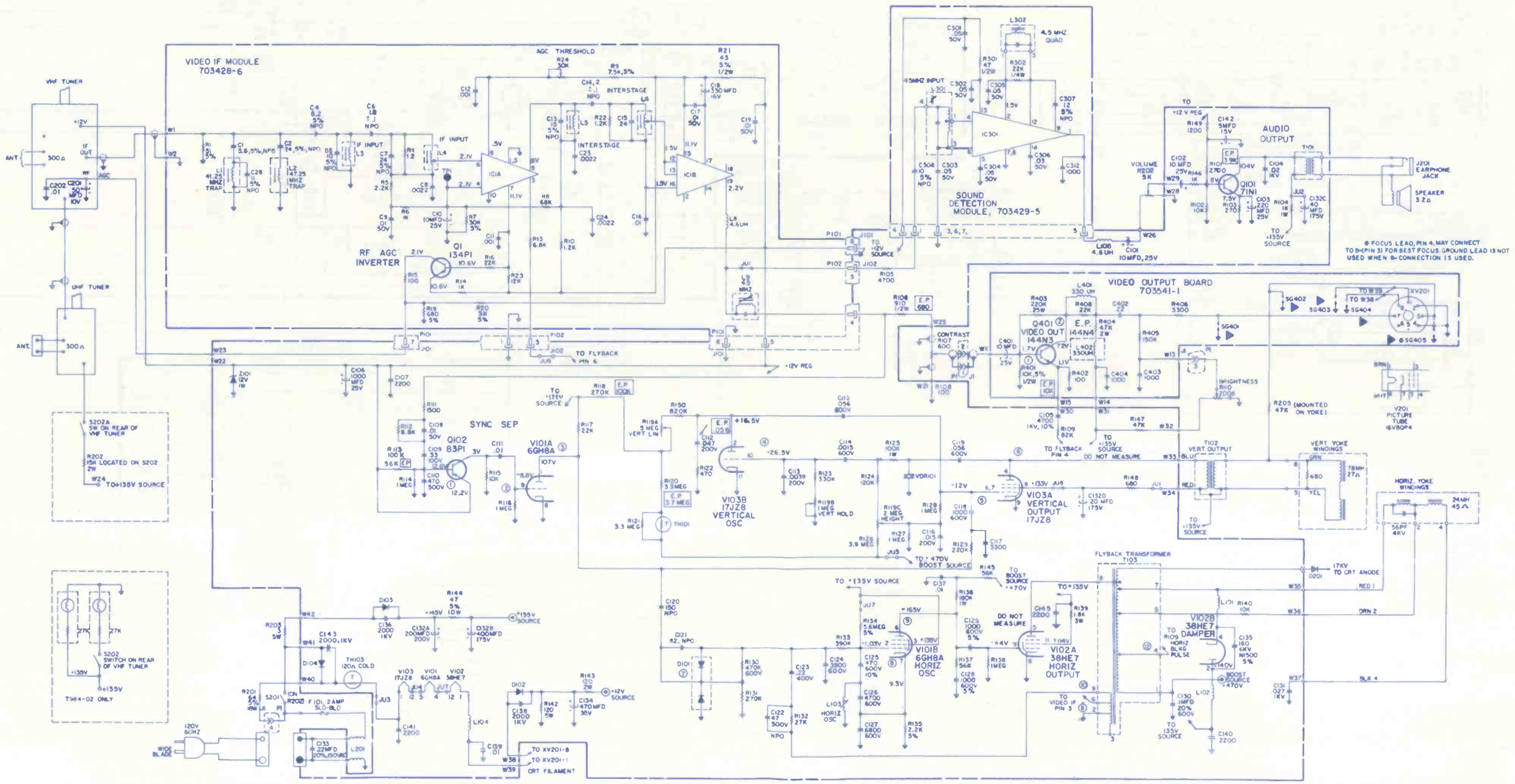
MAGNAVOX

TV Chassis
T984 Series

MARCH • 1974



SYMBOL	DESCRIPTION	PART NO.
L103	horiz osc coil	361367-7
L201	line filter	361400-3
T101	audio output xformer	320382-2
T102	vert output xformer	320390-1
T103	high volt xformer	361484-1
C132A, B, C	electr 200µf, 200v, 400µf, 40µf, 20µf, 175v	270099-32
R119A, B, C	vert lin, hold & height	220266-7
D201	high volt rect diode	530119-8
TH101	thermistor	230130-6
TH103	thermistor	230170-8
VDR101	varistor	230167-6
F101	fuse, 2a, slo-blo	180865-5200



1515

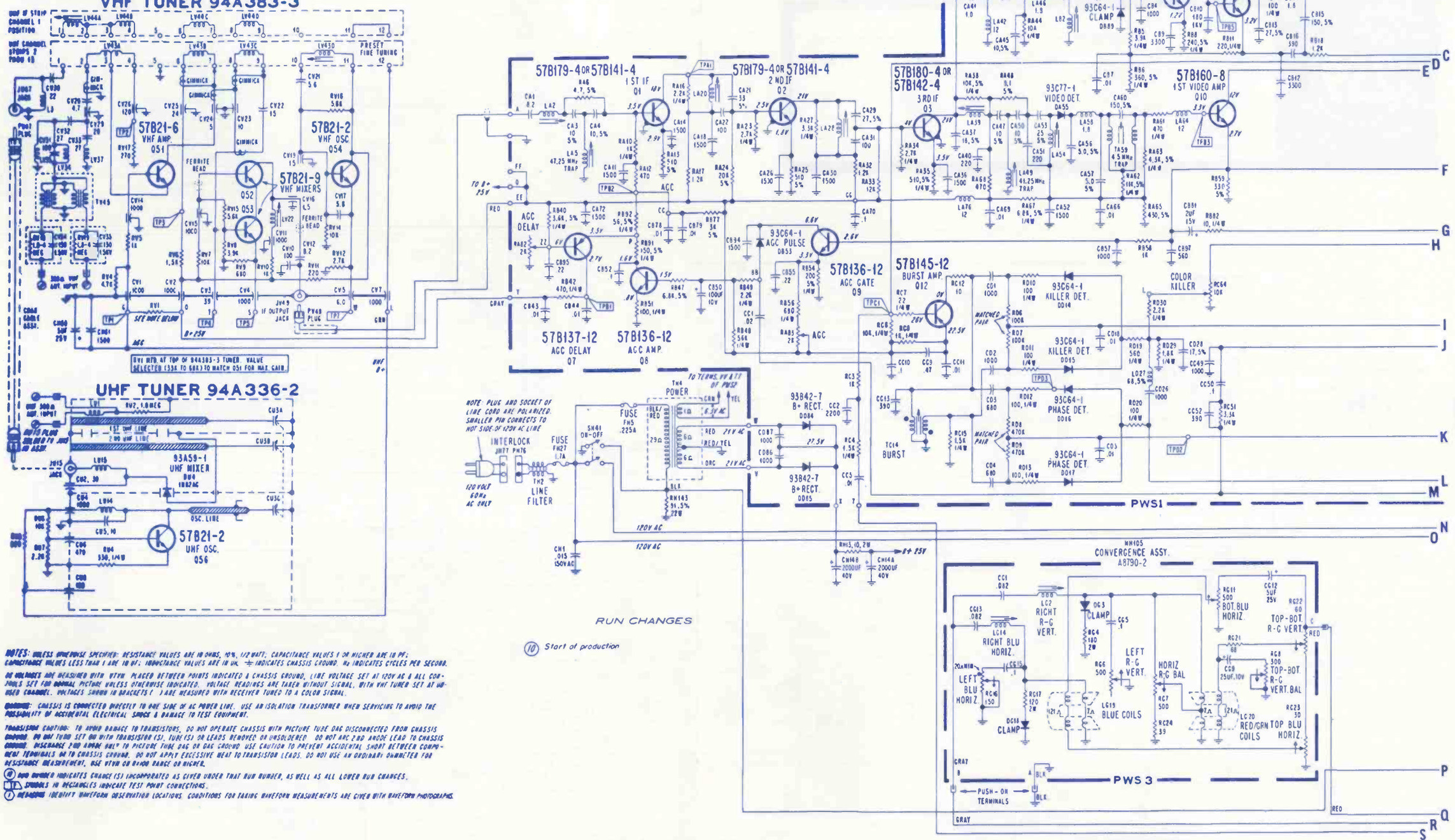
ADMIRAL

Color-TV Chassis
T15K10

MARCH • 1974

ELECTRONIC TECHNICIAN/DEALER **TEKFAX**

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



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

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

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

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

(#) RUN NUMBER INDICATES CHANGE (S) INCORPORATED AS GIVEN UNDER THAT RUN NUMBER, AS WELL AS ALL LOWER RUN CHANGES.

[1A] SYMBOLS IN RECTANGLES INDICATE TEST POINT CONNECTIONS.

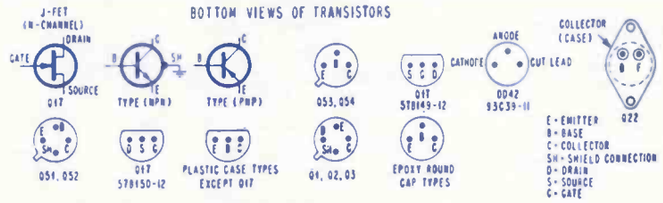
(1) INDICATES WAVEFORM OBSERVATION LOCATIONS. CONDITIONS FOR TAKING WAVEFORM MEASUREMENTS ARE GIVEN WITH WAVEFORM PHOTOGRAPHS.

RUN CHANGES

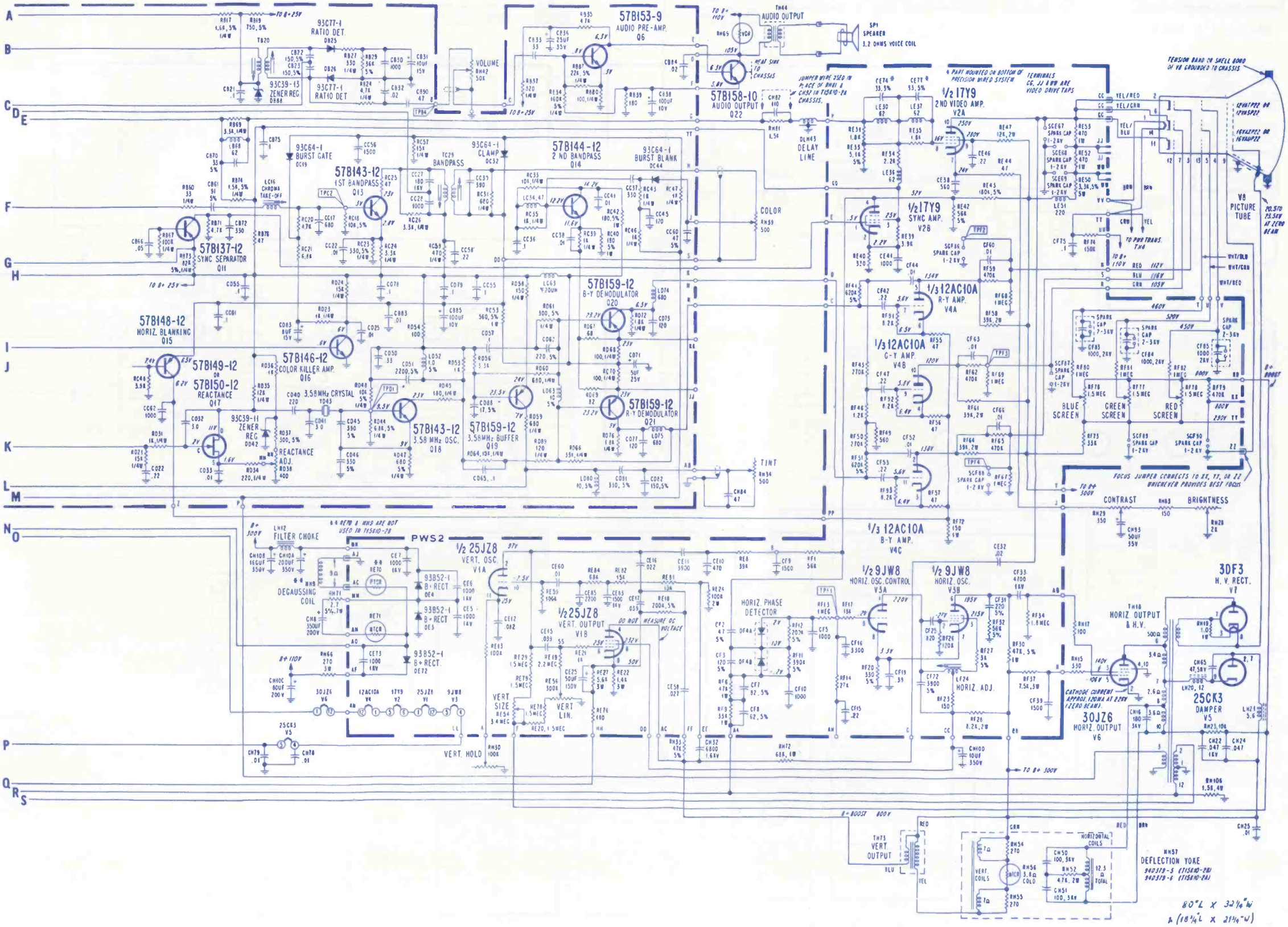
(10) Start of production

SYMBOL	DESCRIPTION	PART NO.
RA82	2K AGC delay	75A101-31
RA83	2K AGC control	75A101-31
RC64	10K color killer control	75A101-18
RD38	400Ω reactance control	75A101-35
RE54	vert lin	
RE55	green drive triple cont	75A107-4
RE56	blue drive	
RE70	positive temp cof	61A52-3
RE71	negative temp cof	61A57-6
RH28	2000Ω brightness cont	75A140-1
RH29	350Ω contrast cont	75A140-3
RH30	100K vert hold cont	75A140-2
RH34	500Ω slide tint cont	75A141-9
RH39	500Ω color slide cont	75A141-9
ZE23	vert integrator	63A6-29
CH10A	200µf, 350v	
CH10B	160µf, 350v	67A15-403
CH10C	80µf, 350v	
CH10D	10µf, 350v	
LB2	4.5MHz coil	72A317-1
LC16	chroma input coil	72A329-1
LC63	3.58MHz SR coil	73A55-48
LF24	horiz hold cont	94A351-1
TB20	ratio xformer	72A318-1
TC14	burst xformer	72A325-3
TC29	bandpass xformer	72A327-1
TH2	line choke	73A31-16
TH4	power xformer	80A108-13
TH18	horiz output xformer	79A158-2
TH44	audio output xformer	79A141-1
TH73	vert output xformer	79A165-1

BOTTOM VIEWS OF TRANSISTORS



ADMIRAL
Color-TV Chassis
T15K10



1516

MGA

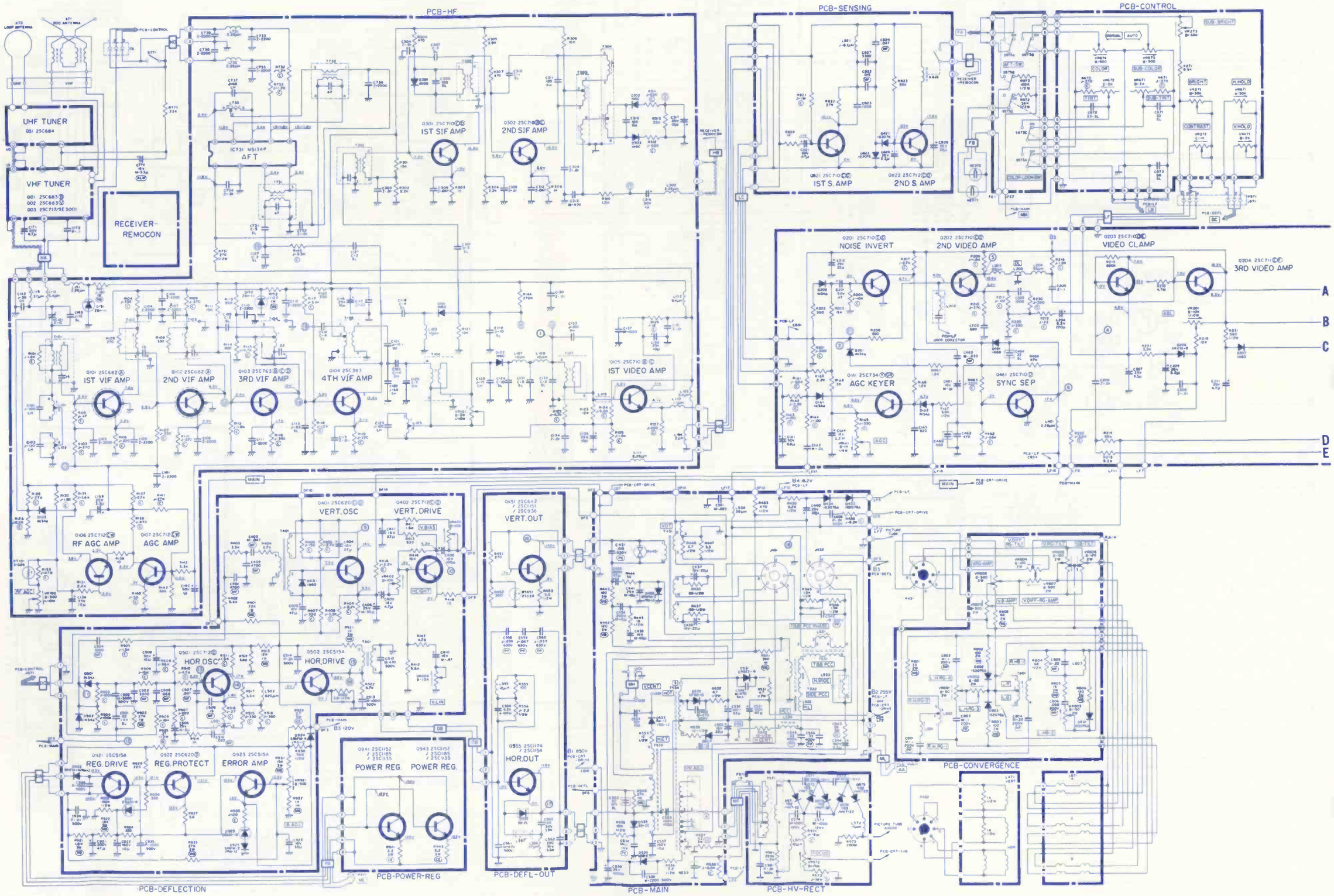
Color-TV Model
CS-197

MARCH • 1974

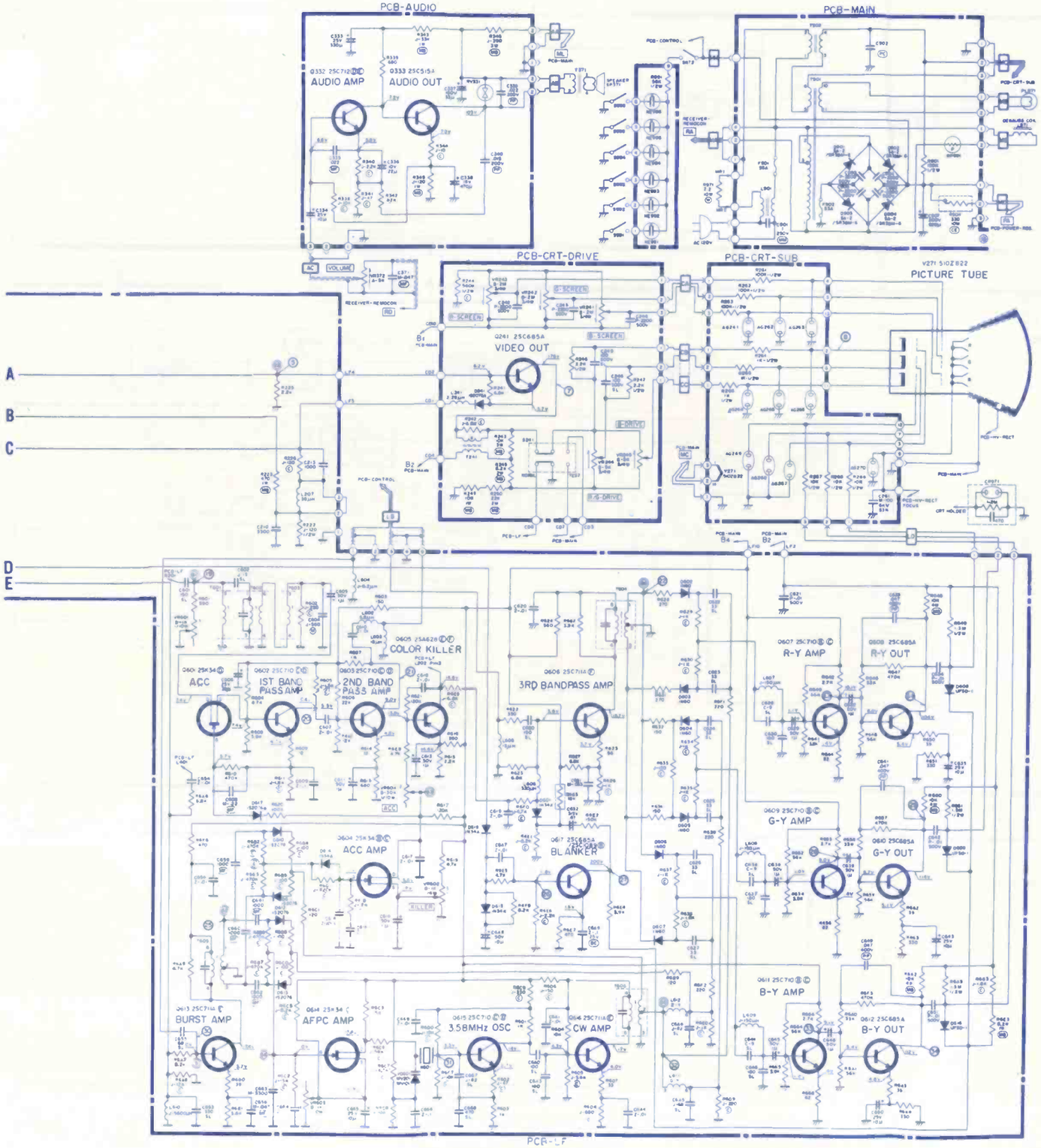
ELECTRONIC TECHNICIAN/DEALER TEKFAX

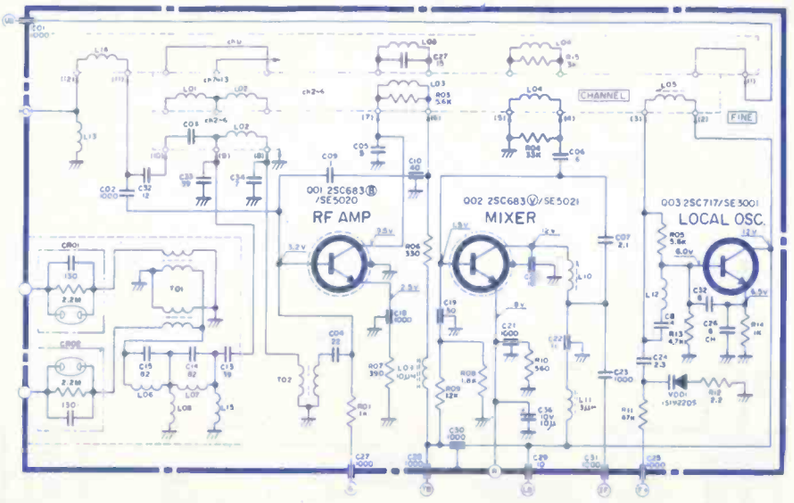
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS

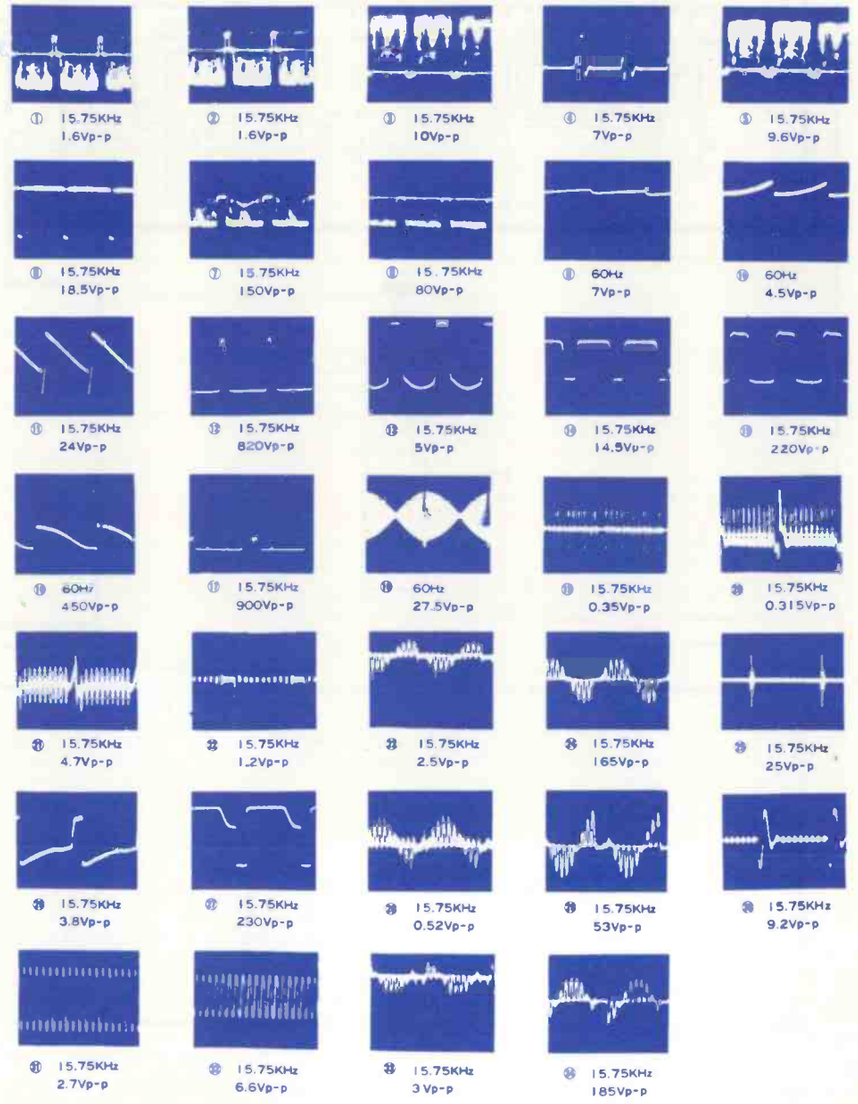
SYMBOL	DESCRIPTION	PART NO.
IC731	integrated circuit M5134P AFT	260P00301
RV331	varistor	265P02001
T301	sound IF	327P02002
T304	sound detector	327P03301
T371	audio output xformer	327P01402
T401	vert OSC	328P00302
T431	vert output	329C01901
T534	horiz output xformer	336B00202
T571	flyback	334P05802
T601	chroma take-off	349P03301
T602	chroma 1st band pass	349P03401
T604	chroma output	349P03601
T605	chroma burst	349P03701
T901	power	350P03504
L471	deflection yoke	330P02903
L501	horiz OSC	332C00201
L532	horiz width	335C00102
VR271	bright cont	120C14901
VR272	contrast cont	120C14006
VR273	sub-bright cont	129D03803
VR372	pull-on/vol cont	120C13505
VR401	vert bias	129D03304
VR402	height	129D03304
VR404	vert lin	129D03304
VR471	vert hold cont	120C14101
VR571	horiz hold cont	120C14306
VR602	killer cont	129D03301
VR672	tint cont	120C14102
F571	Fuse, 1a	283D01801
F902	fuse, 3a	283D02005
F901	fuse, 5a	283D02006



MGA
Color-TV Model
CS-197







1517

MOTOROLA

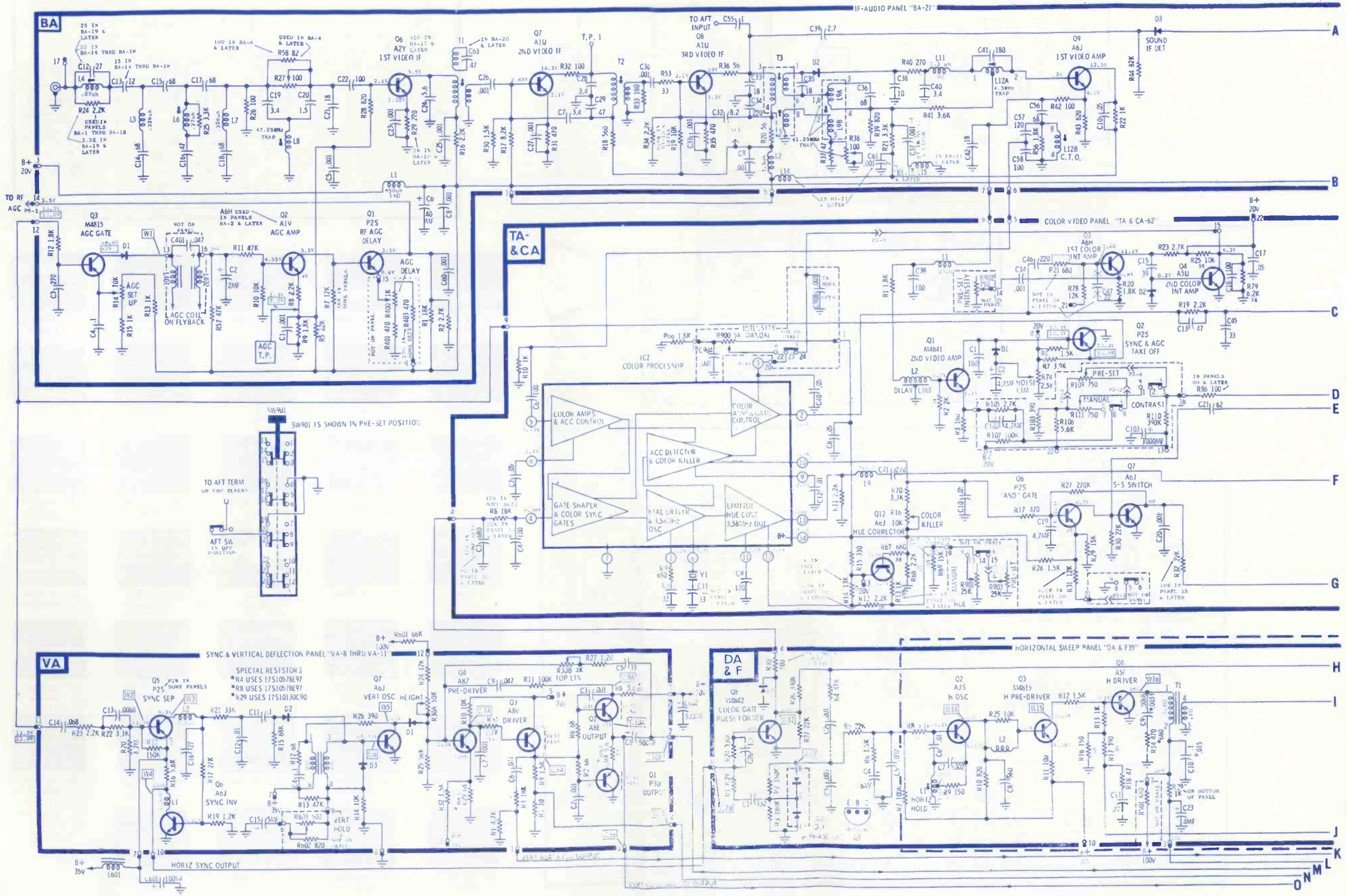
Color-TV Chassis
TS-931

MARCH • 1974

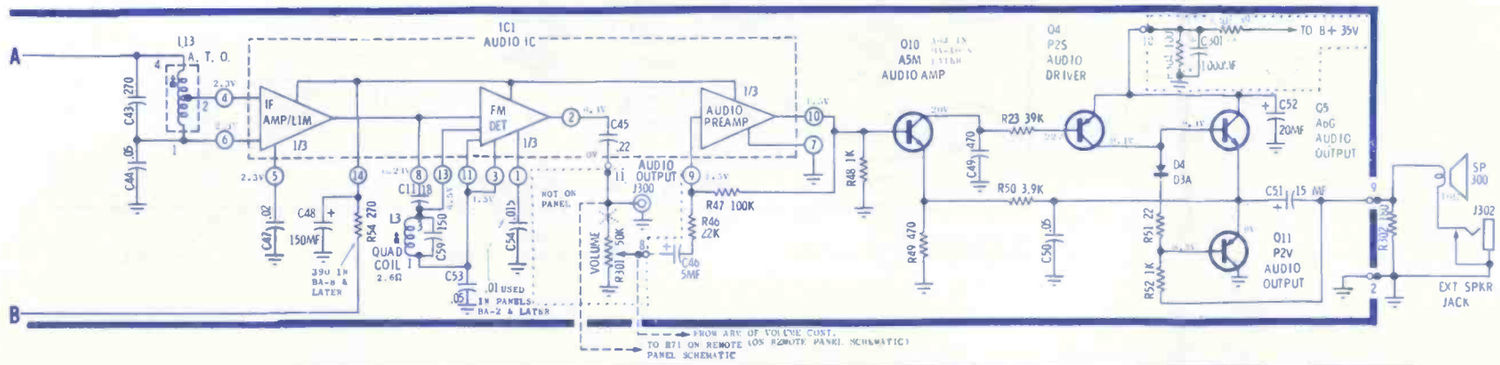
ELECTRONIC TECHNICIAN/DEALER **TEKFAX**

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

SYMBOL	DESCRIPTION	PART NO.
CB800	Circuit breaker	80C66390A22
R109	contrast: dual: 750Ω manual & preset (R-111)	18D65082A39
R213	focus: 10M	18D67502A20
R218	master brightness, 1.5K	18D67858A21
R219	brightness, dual, preset 2K & manual 1K (R223)	18D65082A40
R301	vol, 50K, incls on-off switch (E19TS931)	18D67562C31
R400	AGC delay, 1K	18D67858A06
R507	HV adjust, 180K	18D67858A09
R603	vert hold, 500Ω	18D65082A43
R901	hue, dual 25K, manual & preset (R903)	18D65082A42
R902	part of R900	
T501	HV xformer	24D70809A04
T800	power xformer	25D68548A15



MOTOROLA
Color-TV Chassis
TS-931



IMPORTANT NOTES:

PANEL DESCRIPTION & COMPONENT IDENTIFICATION
EACH PANEL IS ASSIGNED A LETTER DESIGNATION (i.e., BA) WHICH IDENTIFIES THE PANEL SEE CHART BELOW.

PANEL CODING	PANEL FUNCTION
A	UHF TUNER
BA	IF AUDIO
CA OR TA	COLOR/VIDEO
DA	HORIZONTAL DEFLECTION
GA	PINCUSHION
HA	CONVERGENCE
JA	POWER SUPPLY
KA	AFC (AFT)
VA	VERTICAL DEFLECTION
YA	REMOTE CONTROL

EACH COMPONENT IS IDENTIFIED WITH A REFERENCE NUMBER AND A PREFIX LETTER (i.e., L70, WHICH IS RELATED TO LEGEND ON THE PANELS. ALL "ON" PANEL COMPONENTS ARE IDENTIFIED BY ONE OR TWO DIGIT NUMBERS (1 THRU 99).

ALL "OFF" PANEL COMPONENTS ARE IDENTIFIED BY A 3 DIGIT NUMBER, WHICH VARIES WITH CIRCUIT ASSOCIATION AS INDICATED BELOW.

ASSOCIATED CIRCUIT	REFERENCE DESIGNATION
IF & VIDEO	100 199
PIX TUBE	200 299
AUDIO	300 399
AGC SYNC	400 499
HORIZ & HI VOLTAGE	500 599
VERTICAL	600 699
CONVERGENCE	700 799
POWER SUPPLY	800 899
COLOR CIRCUIT	900 999

1. VOLTAGE MEASUREMENTS: EXCEPT WHERE NOTED, TAKEN FROM POINT INDICATED TO CHASSIS WITH A VTVM (10MΩ).

AC INPUT TO RECEIVER 122V. VOLTAGE READINGS TAKEN WITH AIR SIGNAL AND ALL CONTROLS AT THEIR NORMAL SETTING

VOLTAGE READINGS WILL VARY WITH ASSOCIATED CONTROL SETTINGS AND SIGNAL STRENGTH.

2. WAVEFORM MEASUREMENTS: COLOR WAVEFORMS TAKEN WITH A COLOR BAR GENERATOR PROVIDING A SIGNAL OF STANDARD GATED RAINBOW (10 BAR) TYPE COLOR BAR PATTERN. RECEIVER ADJUSTED FOR NORMAL VIEWING AS IN TRANSMITTED AIR SIGNAL.

IF THE COLOR BAR PATTERN ON THE SCREEN IS USED TO DETERMINE THE RANGE OR PROPER SETTING OF THE HUE CONTROL, THE 2ND VISIBLE BAR (FROM LEFT) WILL BE THE CORRECT BAR THAT CORRESPONDS TO RED. THE FIRST BAR (FROM LEFT) IS NOT NORMALLY VISIBLE BECAUSE IT IS PARTIALLY BLANKED AND THE RASTER IS SLIGHTLY OVERSCANNED. TO SEE THE FIRST COLOR BAR, ADJUST THE HORIZONTAL HOLD CONTROL IN THE DIRECTION THAT CAUSES THE RASTER TO SHIFT TOWARD THE RIGHT. THEN READJUST CONTROL TO CENTER OF ITS RANGE.

3. ALL VIDEO AND COLOR WAVEFORMS TAKEN WITH A WIDEBAND SCOPE AND A PROBE WITH LOW INPUT CAPACITY, SHAPE AND PEAK TO PEAK AMPLITUDES MAY VARY DEPENDING ON CALIBRATION AND TYPE OF TEST EQUIPMENT USED, AND CONTROL SETTINGS.

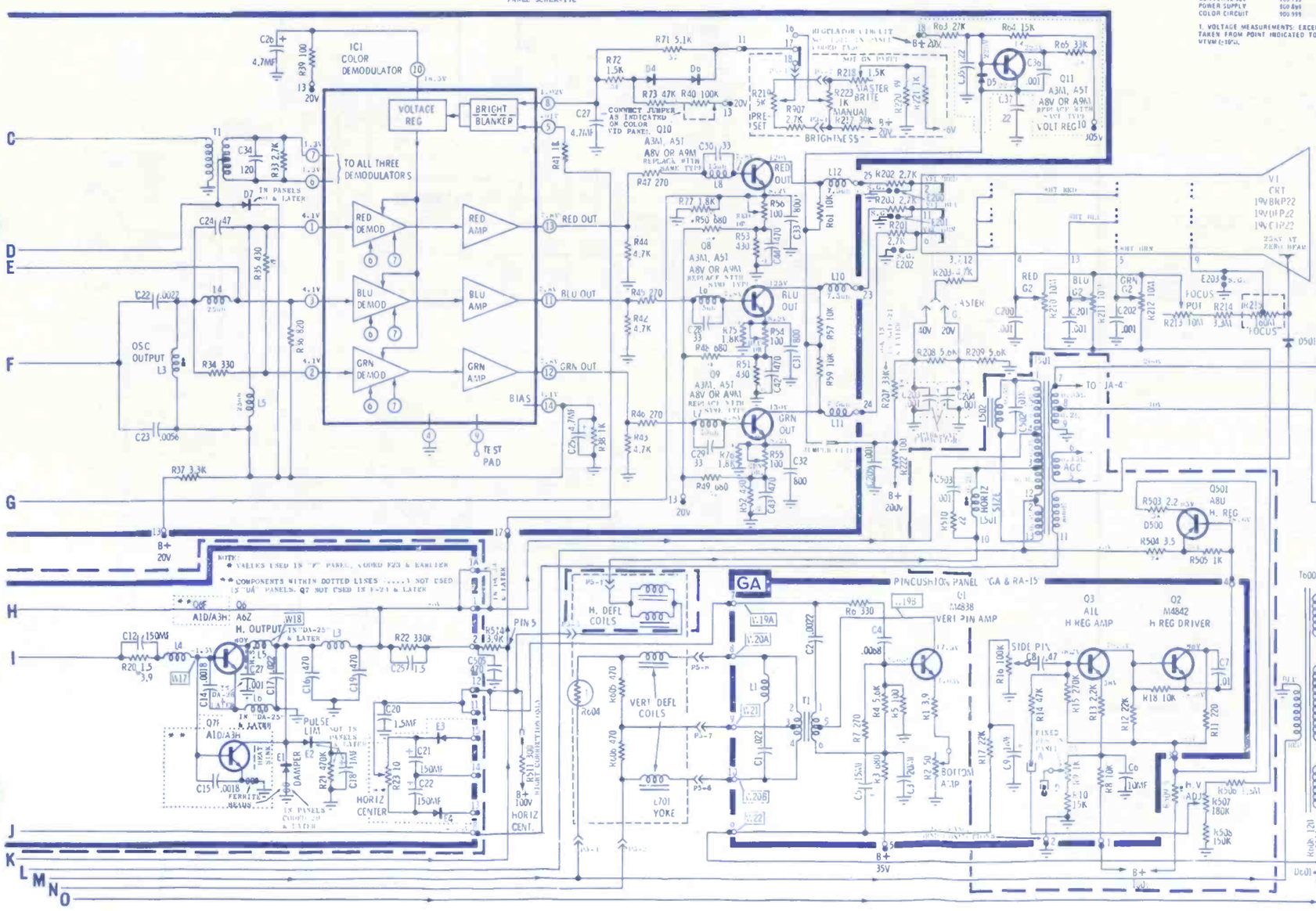
4. THE OUTPUT WAVEFORMS OF THE IC COLOR DEMODULATOR CAN BE OBSERVED AT THE COLLECTOR OF THE VIDEO OUTPUT TRANSISTORS OR TERMINALS 20, 24, AND 23 ON COLOR VIDEO PANEL.

UNLESS OTHERWISE SPECIFIED: CAPACITOR VALUES LESS THAN ONE (1) MF. ALL OTHERS IN PF. CAPACITANCE VALUES ONLY ARE SHOWN ON SCHEMATIC DIAGRAM FOR COMPLETE DESCRIPTION OF CAPACITORS, REFER TO PARTS LIST. RESISTORS ARE 10%, 1/2W.

COIL RESISTANCES LESS THAN 1 OHM NOT SHOWN.

TYPICAL
SOCKET & PLUG
KEY WAY
WIRE SIDE

PLUG NO.	NUMBER OF PINS
P3	10 PINS
P5	8 PINS
P6	6 PINS
P6	8 PINS

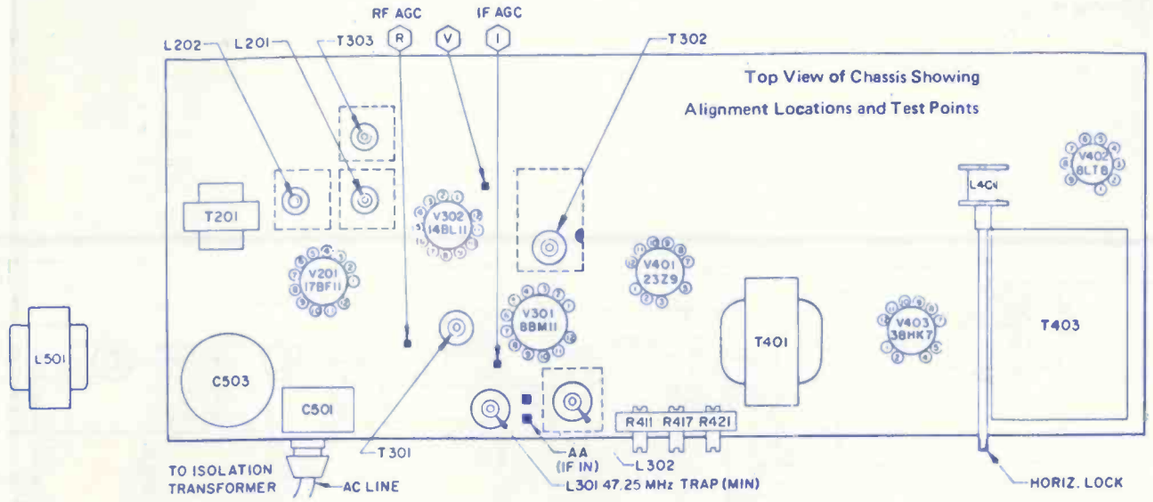


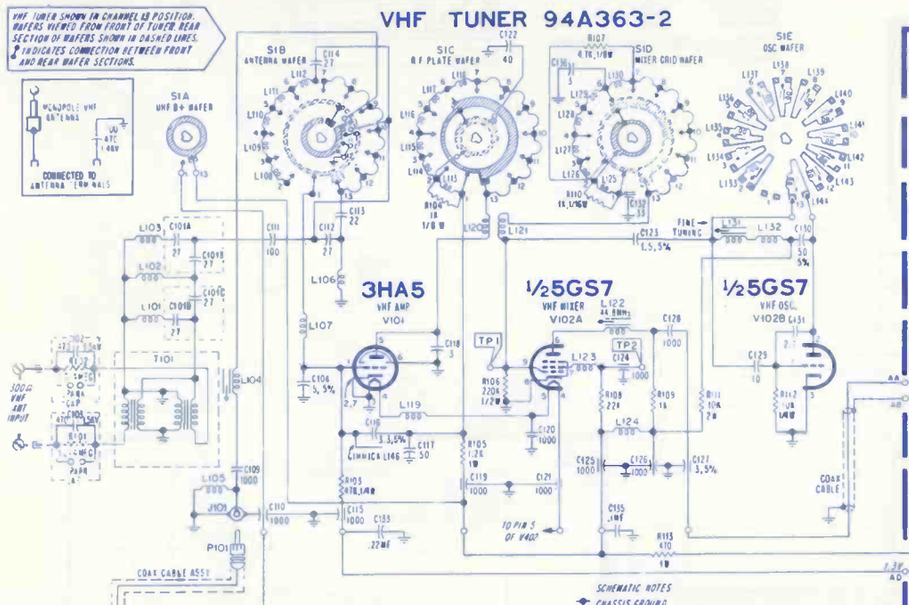
1518
AIRLINE
TV Models
GAI-13133A/B

MARCH • 1974

ELECTRONIC TECHNICIAN/DEALER TEKFAX

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





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A new 310-Type 3. Made to take a fall.

The rugged new "drop-resistant," hand size Triplett Model 310, Type 3 is priced at just $48.

The latest addition to the rugged Triplett 310, general purpose, multi-range V-O-M family—the Model 310, Type 3—has impressive new features. Its case is made of nearly-indestructible thermoplastic ABS and the clear front material is a high impact-resistant polycarbonate thermoplastic. The low Ohms range Rx1 has been fused to protect against damaging overloads. These two improvements should eliminate over half of all repair requirements resulting from field use damage.

But that's not all. The case of the new Triplett 310, Type 3 sports an elegant new non-slip "finger-tread" surface finish. The meter movement brackets and pointer feature a new rugged design as well as newly designed lead jacks and Model 10 jack. Added to this, the front range and tester dial markings are changed to read easier when used with Triplett's Model 10 Clamp-on-Ammeter.

(Actual Size)

Outstanding features:

1. **Drop-resistant, hand size V-O-M with high impact thermoplastic case.**
2. **20,000 Ohms per Volt DC and 5,000 Ohms per Volt AC; diode overload protection with fused Rx1 Ohms range.**
3. **Single range switch; direct reading AC Amp range to facilitate clamp-on AC Ammeter usage.**

The durable new 310, Type 3, self-shielded for checking in strong magnetic fields, is an extra-rugged, high-torque, bar-ring instrument with spring back jewels. An interchangeable test prod fits into the top of the tester, making it a common probe and freeing one hand. All this for only **$48.**

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