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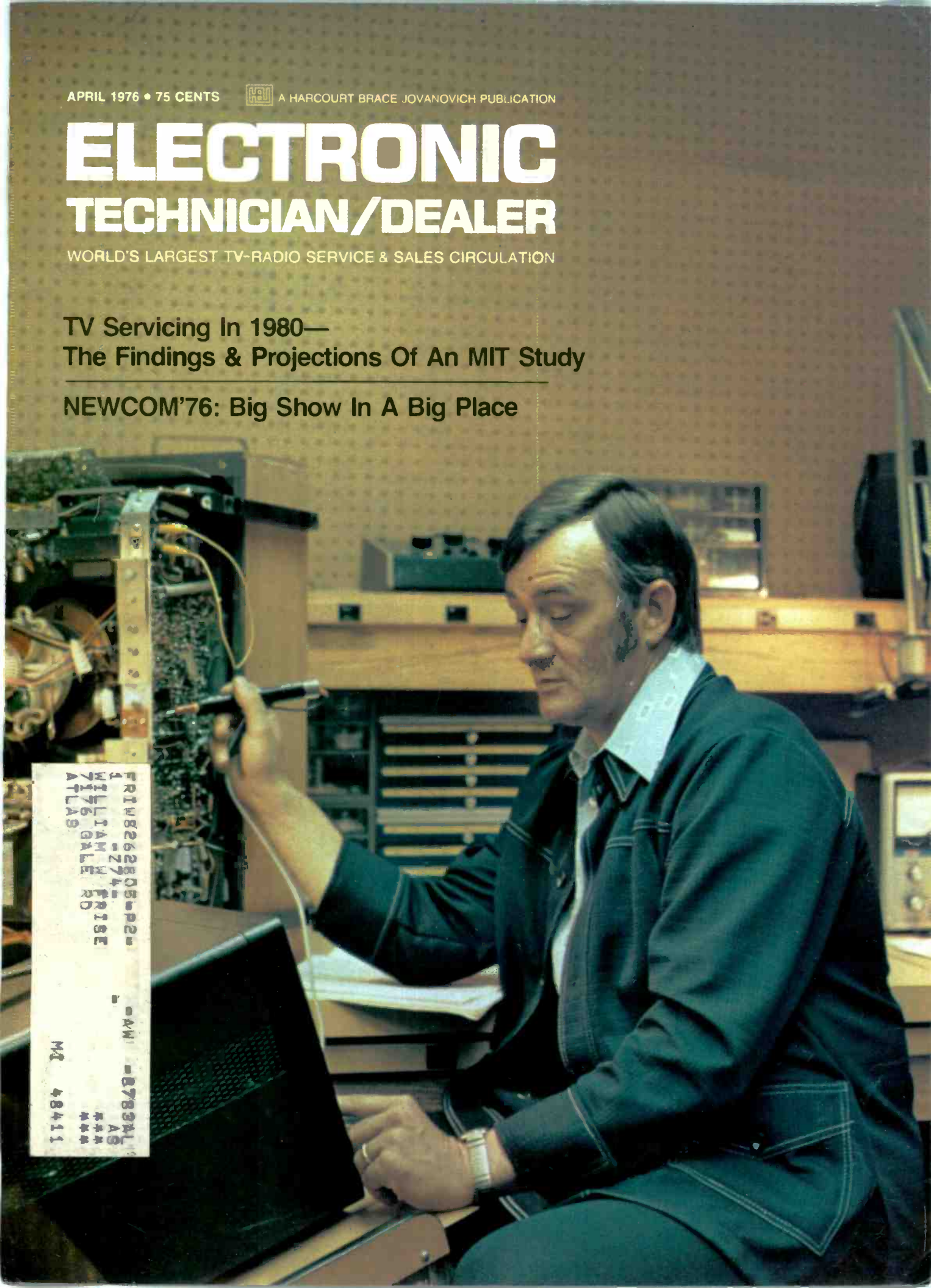
TV Servicing In 1980— The Findings & Projections Of An MIT Study

NEWCOM'76: Big Show In A Big Place



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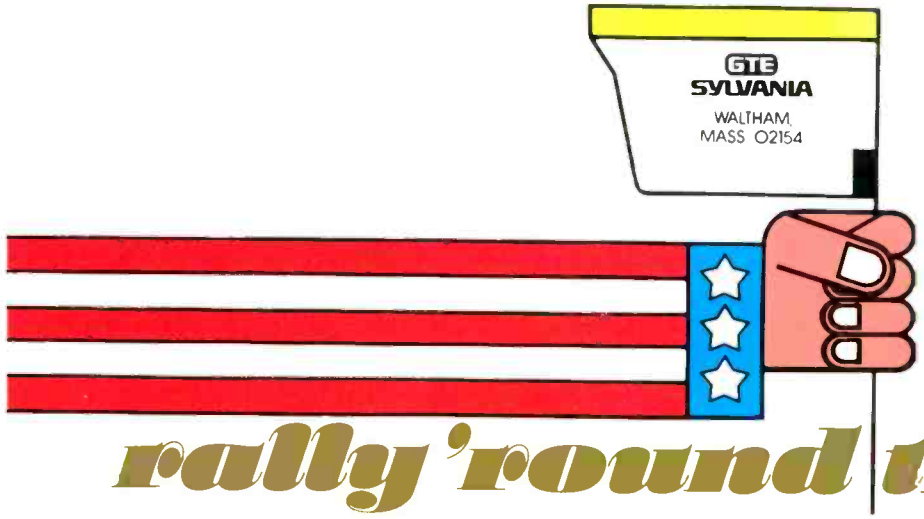

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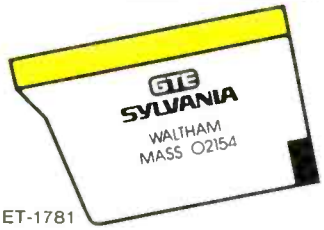

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THE COVER: In 1980, according to the forecasts of an MIT study reported on in this issue, the bench TV technician shown on this issue's cover, like most other bench technicians, probably will be handling a significantly larger percentage of his shop's total TV service business than he presently does.

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EDITOR'S MEMO

NEWCOM '76—A Really Big Show In A Really Big Place For A Bigger-Than-Ever Industry

■ NEWCOM '76, this year's edition of the annual trade show at which electronics manufacturers and marketers introduce their newest electronics products to distributors, promises to be as big as its site—the $163 million Louisiana Superdome, near New Orleans.

At press time—almost two months before the May 4th starting date of the three-day show—over 300 manufacturers and marketers already have laid down their money for a record total of 543 individual exhibit areas at NEWCOM '76. (Last year's NEWCOM Show, in Las Vegas, had a total of 281 exhibitors, who occupied 422 booths.)

Commenting on the reasons for the increase in NEWCOM exhibitors, David L. Fisher, Executive Vice President, Electronic Industry Show Corporation, said: "The phenomenal market performance of the Citizens Band radio sector undoubtedly has played a part in the vigor and vitality being shown by the NEWCOM '76 Show; however, other industry segments—including industrial and consumer electronics, and professional sound and video—also are playing a significant part in the boom, right along with general-line and service dealer products, the Show's traditional backbone."

If the response of electronics manufacturers and marketers to NEWCOM '76 is any indication—and historically it has been—it seems that you, our readers—who as a group are the biggest users and/retailers of most of the products which will be exhibited at NEWCOM—will have a wider-than-ever variety of products and product lines from which to choose—whether it be replacement parts, service aids, tools, test instruments, CB-related equipment, or antenna system components and accessories.

To help familiarize you with the broad range of new products which will be available at your local electronics distributors in the weeks following NEWCOM '76, the entire staff of ET/D will attend the show and, in a special NEWCOM '76 Wrapup Report in the July issue, we'll give you an overview of what we saw and heard. ■

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NEWS OF THE INDUSTRY

BRH Says Recall Of Zenith Color TV Not Necessary

The Bureau of Radiological Health (BRH) on January 26 advised Zenith Radio Corporation that it is satisfied that Zenith color TV receivers equipped with hold-down capacitor 22-7233 do not "create a significant risk of injury, including genetic injury, to any person" and therefore Zenith does not have to recall and repair these receivers.

Zenith was informed on October 20, 1975, that BRH had concluded that Zenith color television receivers using the capacitor 22-7233 were in non-compliance with the Performance Standard for Television Receivers. (See related *News Of The Industry* item in the Dec. 1975 issue of ET/D.)

Subsequently, Zenith submitted an application for exemption from notification and repair as provided in the Radiation Control for Health and Safety Act. To support this application, Zenith submitted results of "an extensive program of testing conducted by Zenith engineers and scientists and evaluation by independent consultants which provided the basis for Zenith's request for an exemption."

The January 26 BRH letter notifying Zenith that the exemption had been granted stated: "The Zenith submittal included a substantial amount of TV receiver testing data which has satisfied the Bureau that the failure to comply does not create a significant risk of injury, including genetic injury to any person."

The 22-7233 capacitor was not used in Zenith color TV receivers sold before January 1, 1974, and is not used in Zenith current model color TV receivers.

RCA Closes Down Its Only Domestic Receiving Tube Plant

RCA Corporation has announced that the manufacturing of receiving tubes at its plant in Harrison, N.J., will be phased out by July 30.

RCA's departure will leave only two remaining domestic receiving tube producers—General Electric and GTE Sylvania.

The Harrison facility is RCA's only domestic receiving tube manufacturing operation. (RCA will continue to operate its receiving tube manufacturing facilities in Mexico and Brazil, but, according to RCA, the output of these two facilities will not be marketed in the U.S.)

Paul B. Garver, Division Vice President and General Manager, RCA Distributor and Special Products Division, said the plant closing is attributable to the sharp decline in the demand for receiving tubes as a result of the continuing shift to solid-state devices in consumer, industrial and defense electronic systems.

"Since 1966, industry sales of receiving tubes have declined by almost 80 percent, with replacement usage in older electronic equipment accounting for the bulk of today's volume," Garver said.

RCA, which presently is the sole source for approximately 110 types of receiving tubes, said it plans "to meet all outstanding receiving tube commitments" and, "to the maximum extent possible, all future requirements for these types."

According to Garver, RCA will continue to merchandise and sell replacement receiving tubes, which they now will purchase from other sources.

Breaker Buys Hallicrafters

Breaker Corporation, an Arlington, Texas-based manufacturer of CB antennas and accessories, has acquired the Hallicrafters Communications Equipment Division of Wilcox Electric Co., Kansas City, Missouri.

Now a wholly owned subsidiary of Breaker, Hallicrafters will continue to manufacture and market amateur radio equipment, industrial two-way radio and para-military communications equipment for domestic and international markets.

Videotape Series On Digital Electronics Available from H-P

Hewlett-Packard recently announced that it has prepared a videotape course designed to acquaint electronic technicians with digital electronics.

The course is contained on a series of fourteen videotapes of less than 30 minutes duration and is available in either a ½-inch open reel (No. 90500C) or ¾-inch videocassette (No. 90500D) format. A 180-page textbook titled "Digital Troubleshooting" accompanies the videotapes.

For more information about the course and its cost, write: Dick Gasperini, Editor, H-P Bench Briefs, H-P, 1820 Embarcadero Rd., Palo Alto, California 94303.

$2.30 Minimum Hourly Wage Now In Effect For Some Retail & Service Employees

The minimum hourly wage for employees of retail or service firms with annual gross sales of at least $1 million and a $250,000 annual inflow of interstate goods was

automatically increased to $2.30 on January 1, the effective date of some provisions of the 1974 amendments to the Fair Labor Standards Act. (FLSA).

Employers who are in doubt about whether or not the new minimum hourly wage rate applies to their employees should contact their nearest Employment Standards Administration Wage and Hour Office, which in most phone directories is listed under "U.S. Department of Labor."

NESDA Figures Show Big Jump in Number of Technicians

The National Electronic Service Dealers Association (NESDA) says that there's been an increase of 6.5% in the number of service technicians around the country, or an additional 12,781 workers. This increase is based on new figures submitted to NESDA by the ten major state or city licensing boards in the U.S.

Dick Glass, CET, Executive Vice President of NESDA, attributes the increase to the recession. "I think the recession has cut overtime for many technicians working at jobs in other industries and has caused others to lose their jobs or be laid off, and therefore, many have obtained licenses in order to supplement their income," he says.

Fortunately, according to Glass, the electronic service industry can easily absorb a 6.5% increase.

NEWCOM CB Keynoter Is Former FCC Member

The CB/Communications program to be held in conjunction with, but preceding by one day, the NEWCOM '76 trade show in New Orleans, will have as the keynote speaker former FCC Commissioner Nicholas Johnson. Mr. Johnson's talk, "Why You Can't Second-Guess the FCC," will be followed by seminar sessions geared to the successful marketing of CB equipment. The seminar will be held, Monday, May 3, in New Orleans, with NEWCOM '76 starting the next day.

New System Stores Sound-Color Lessons At Home

The inventor of the long-playing phonograph record, Dr. Peter C. Goldmark, now has a patent for a new system that can transmit picture and sound recording by air or cable to home recording equipment. It can then be stored for later display on the home TV screen. The system is known as Rapid Transmission and Storage, or RTS.

According to a story in *The New York Times*, an early form of RTS will be introduced next fall in six community colleges. The RTS system also will be used in churches, libraries, and schools.

FCC Plans To Simplify CB Licensing

The FCC, in September, will make an attempt to reduce the mounting backlog of CB license applications. A self-mailer licensing system will be used, with the hope of reducing processing time to 15 days.

With the new system, manufacturers would include in CB radio packages, a two-part form—one part filled out by the applicant and mailed to the FCC and the other half retained by the purchaser as a temporary license, which would be valid for 60 days.

Currently, processing time for licenses ranges from 6 weeks to 2 months.

Nationwide Emergency Channel Designated by FCC

According to a report in *Communications News*, the FCC has designated 155.475 MHz as a nationwide emergency channel, for use in police emergency communications networks operated under statewide law-enforcement plans. Operations now authorized on that channel that are not limited to police emergency communications, however, may continue until January 1, 1985.

Survey Shows Increased Consumer Confidence

A *Conference Board* survey of 10,000 families in the U.S. shows that 32.7% plan to buy TV sets, air conditioners, & vacuum cleaners by the end of this summer—up 1.7% from a December, 1975 survey. Color TV will be bought by 6.9% and b/w TV by 1.6%.

Color TV Saturation of U.S. Homes Up From Last Year

A TV census by *Arbitron* last November showed 73% of U.S. households with color TV—up 3% from the year before. It is estimated that 53.1 million homes now have a color TV set. ■

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- Check the transceiver in the car to determine if the problem is in the antenna system or the transceiver

You can save $500—$1,500 in equipment costs because the CB Servicemaster eliminates many of the test instruments you would otherwise need for CB servicing. These instruments, or their functions, are built into the unit:

Audio wattmeter
Audio generator
Distortion meter
RF Wattmeter/dummy load
DB meter
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These instruments—which you should have, if you don't own them already, are all you need to get the maximum use from your CB Servicemaster. And the B&K CB Servicemaster is compatible with most oscilloscopes, frequency counters, signal generators and power supplies on the market today.

MODEL 1403A—3", 5 MHz Recurrent Sweep Oscilloscope
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MODEL 1640—Regulated Power Supply
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For additional information, contact your B&K-Precision distributor for our comprehensive brochure describing the operation of the Model 1040 CB Servicemaster and the CB Service Center—or write us for your free copy.

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TECHNICAL LITERATURE

Semiconductor Replacement Catalog Supplement is an update to the 1975 ECG guide and catalog from GTE Sylvania. The supplement adds 8,000 industry part numbers cross-referenced to the company's line of solid state devices. The basic guide cross-references 114,000 domestic and imported devices. Supplement is available for 35 cents and the basic guide is available for $2.95 at GTE-Sylvania distributors, or from *GTE-Sylvania* Advertising Services Center, 70 Empire Dr., West Seneca, N.Y. 14224.

Communications Antennas offered by the Antenna Specialist Company for mobile and base-station applications in CB and marine services are described in Catalog No. SD 315C along with monitor antennas and antenna replacement parts. Available free from the *Antenna Specialists Co.*, P.O. Box 5431, Cleveland, Ohio 44101.

Communications Test Instruments offered by Leader for troubleshooting, adjusting and monitoring CB, amateur and land-mobile two-way equipment are described in a 6-page brochure available free from *Leader Instruments Corp.*, Communications Div., 151 Dupont St., Plainview, N.Y. 11803.

CB Connectors and Accessories Handbook is a new booklet providing tips for optimizing overall CB antenna system installations. Information is included to correctly select, assemble and terminate both coaxial and microphone connectors and which RG-type cable is best for any given CB installation. The handbook also lists CB connectors and accessories available from Amphenol along with a guide to the national CB 10-code. Available free from *Amphenol distributors.*

VHF/UHF/FM Tuner Replacement Guide & Parts Catalog lists the new and rebuilt exact replacement tuner and tuner parts available from PTS Electronics, Inc. The catalog is available for $2.00 from *PTS Electronics, Inc.*, P.O. Box 272, 5233 Highway 37 South, Bloomington, Ind. 47401.

Tape & Phone Exact Replacement Drives & Belts Catalog is a cross-reference guide to exact replacement drive system parts and belts for over 200 brands of cassette and cartridge recorder/players and phonographs. Catalog No. WA-00CG-0290 is available free from *G.C. Electronics*, 400 S. Wyman St., Rockford, Ill. 61101.

Signal Tracing and Injection test procedures using LEL's Model E-C Serviset hand-held test instrument are outlined in a booklet titled "A New Approach To An Old Problem." Available free from *LEL Inc.*, Box 572, W. Acton, Mass. 01720.

TV Antenna Rod Replacement Guide & Cross Reference is a 28-page guide to selecting the correct replacement rod for all popular TV models. Available free at distributors of GC Electronics products, or from *GC Electronics*, 400 South Wyman, Rockford, Illinois, 61101.

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TV Servicing – Past Present & Future

By J.W. Phipps and Don Mason

A synopsis of a MIT study of where TV service has been and where it is heading

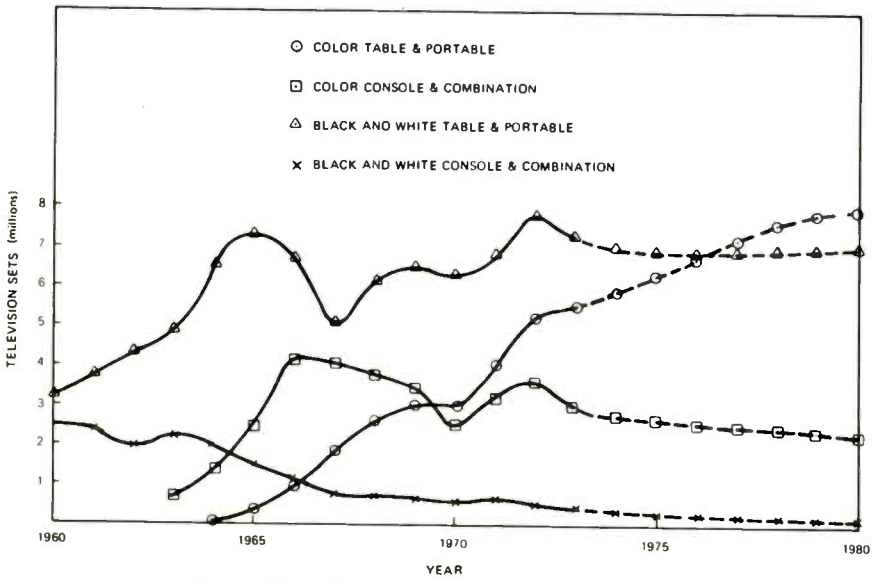

Fig. 1—TV receivers shipped to distributors and dealers during 1960-1972, with projections of shipments through 1980.

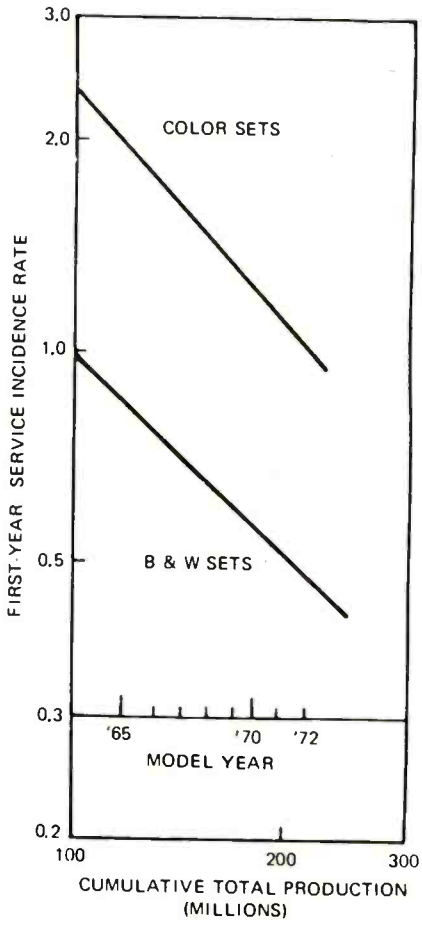

Fig. 2—First-year service-incidence rates of televisions introduced into use during model years 1965 through 1972, plotted as a function of total cumulative production.

■ There is probably nothing in the 200 years of American industrial and cultural history that matches the phenomenonal growth of television. In the 29 years since that first regularly scheduled TV broadcast, Americans have bought 236 million TV receivers, of which over 67 million were color sets. Over ninety-six percent of the nation's homes now have television. Three-fourths of them have more than one set and nearly half of the TV sets ever sold are still in use.

When you add the fact of a rapidly changing technology from black-and-white pictures and vacuum tubes to color TV, solid-state, modular construction, and integrated circuits, it's no wonder that it's been hard to "get a handle" on where TV servicing is and where it's going.

This need for an accurate, definitive picture of the TV service industry was part of the impetus for the beginning in 1972 of a comprehensive study by the Center for Policy Alternatives at the Massachusetts Institute of Technology, through a grant from the National Science Foundation.

The MIT study actually had as its overall research objectives to "evaluate alternatives for increasing productivity of servicing consumer durable products and/or reducing the need for service." Although the study concentrated on the servicing aspects of both refrigerators and TV, we are highlighting for ET/D readers only the major points on the past, present and future of TV servicing. The results of the study should provide today's TV servicemen with valuable direction in planning future efforts.

THE RESEARCHERS' METHODOLOGY

To assess the volume and the nature of TV servicing which will be required through 1980 and the number of TV technicians which will be needed to meet this requirement, the MIT researchers first had to resurrect the past.

Beginning with the supposition that "the amount of service required at any time in the TV service industry is principally a function of the number of TV sets in use at that time and their associated service-incidence rates," the researchers gathered, developed and analyzed data from a number of sources to establish the state and trends of each of the following three principal factors at the time of their study (1972-1973):

1) The number and types of TV receivers in use

2) The service-incidence rate (reliability) of TV receivers in use

3) The productivity of the TV service industry.

Following is a brief synopsis of their findings regarding the state and trends of these and other related factors as of 1973, along with their projections of TV servicing through 1980.

NUMBERS AND TYPES OF SETS

Shown in Fig. 1 is a graphical presentation of the numbers and types of TV receivers shipped by manufacturers to distributors and

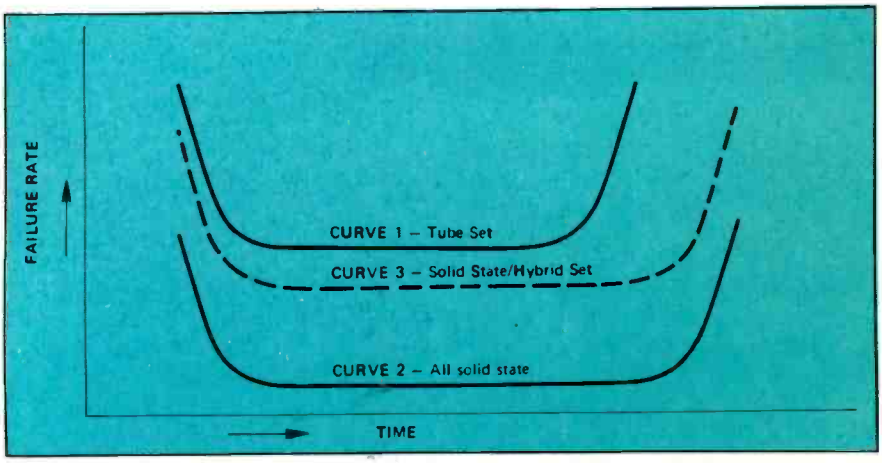

Fig. 3—Typical lifetime failure rates of all-tube, hybrid and early all-solid-state receivers, and later-generation all-solid-state receivers.

dealers during the period 1960 to 1972 and the MIT researchers' projections of TV receiver shipments from 1973 through 1980. This data was supplied to the researchers by the Electronics Industries Association (EIA).

According to the study findings, in 1972 the manufacture of TV sets in the U.S. was concentrated among a relatively few companies, with the four largest companies controlling about 64% of the market, the eight largest firms 86% of the market, and the 20 largest firms 99% of the market.

A total of 45 million color TV sets were in use in 1972, according to the MIT study, plus 68 million black-and-white sets. The percentage of U.S. households with TV had risen to 96% in 1972, compared to 87% in 1960 and 9% in 1950.

As revealed in Fig. 1, the MIT researchers found that during the period 1960 to 1972 there was a shift in the mix of console and combination sets and portable models, with "portable TV sets becoming a significant fraction of the set population." The MIT researchers projected that this shift in the product mix would cause carry-in service to become increasingly more important as portable TV sets became the predominant type.

The MIT researchers also predicted that "the crossover point at which the number of all-solid-state sets produced will exceed 50% of total production would probably occur around 1975."

SERVICE INCIDENCE RATES AND TRENDS

In their assessment of the amount of service which TV receivers require, the MIT researchers call each request for service—whether for in-home, in-shop or carry-in service—a *service incident*, and they call the *rate* at which requests for service occur the *service incidence rate*, which, expressed in percentage form, is the ratio of service incidents per 100 TV sets per year.

To assess the rates at which requests for TV service have occurred in the past and will occur in the future, the MIT researchers gathered and weighed service-incidence data from three principal sources: 1) manufacturers' warranty programs, 2) consumer polls, and 3) captive populations of TV receivers in hotels and motels.

The MIT researchers found that the average service-incidence rate for both color and b/w TV receivers during the first year of use by the consumer had declined significantly over the period 1965-1972. For example, while 1965 color TV receivers generated an average of two service incidents during the first year, 1972 color TV receivers generated an average of only one. B/w TV receivers exhibited a similar service-incidence decline, with 1965 b/w TVs generating an average of 1 service incident during the first year, while 1972 b/w receivers generated only .5 incidents.

The trend of declining first-year TV service incident rates found by the MIT researchers for the 8-year period ending in 1972 is graphically illustrated in Fig. 2.

The MIT researchers were unable to come up with the detailed data which they needed to develop individual breakouts of the specific service-incidence rates of all-tube, hybrid and all-solid-state TV receivers; however, they were able to develop a general comparison of the lifetime failure rates of these three types of receiver design. This comparison is graphically illustrated in Fig. 3.

All three curves in Fig. 3 reveal a high incidence of failure at the beginning of receiver use, followed by a constant failure rate for the next part of life, and then an increasing incidence of failure near the end of the receivers' functional life.

"According to the MIT researchers, the high failure rates at the beginning of life are attributable principally to "manufacturing defects," "production errors" and the need for "consumer education" in the use of the product.

The constant portion of the curve, says the MIT Researchers, reflects the failures attributable to "random part failures" and time- or stress-dependent mechanisms.

Curve 1 in Fig. 3 is what the researchers found to be a typical failure-rate curve for an all-tube receiver. Curve 2 represents the researchers assessment of the failure-rate of an all-solid-state receiver, which, because of the greater reliability of semiconductors, exhibits a longer lifetime and a smaller failure rate in the constant portion of the curve.

Curve 3 is described by the researchers as being representative of the failure rates of both hybrids and the state-of-the-art all-solid-state receivers in use at the time of their study. The differences between curves 2 and 3, say the researchers, are attributable to the fact that all-solid-state TV technology was relatively new at the time of the study and there was still a learning process going on in the testing, handling, specifying and assembling of solid-state components.

Using all of the data which they had gathered about the trends in TV service-incidence rates up to and including the period of the study (1972-73), the MIT researchers developed two computer-derived "models" which, according to the researchers, represent the average lifetime service-incidence rates of 1967 and 1972 color and b/w TV receivers and the projected average lifetime service-incidence rates of 1980

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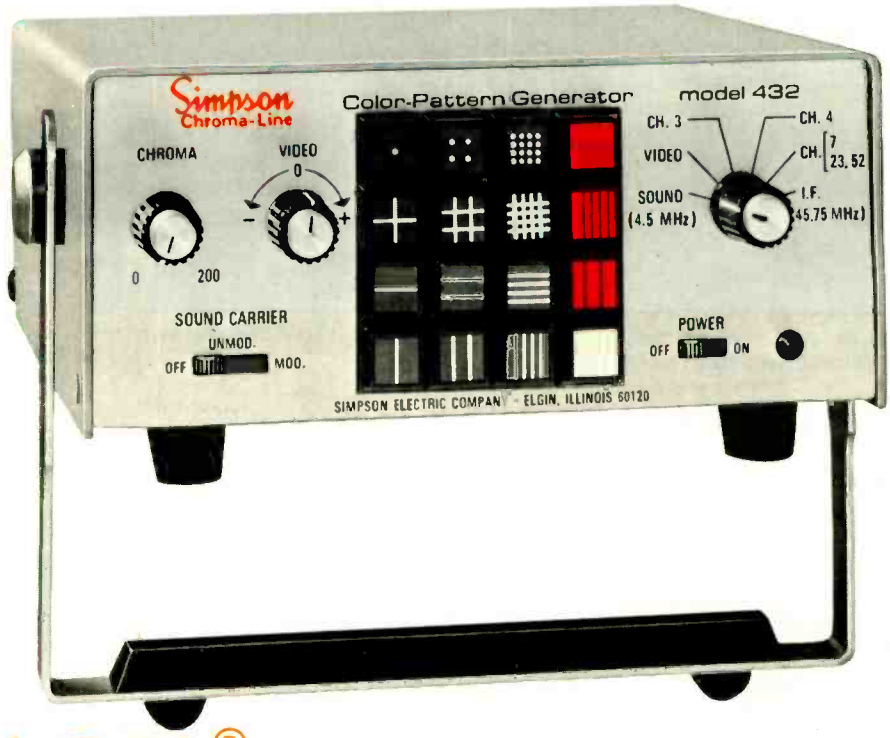

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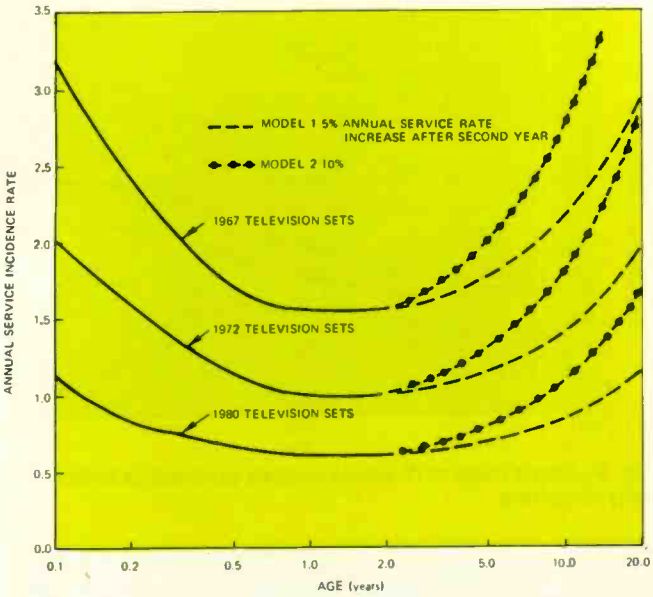

Fig. 4—Models of annual service-incidence rates of 1967, 1972, and 1980 model-year color TV receivers.

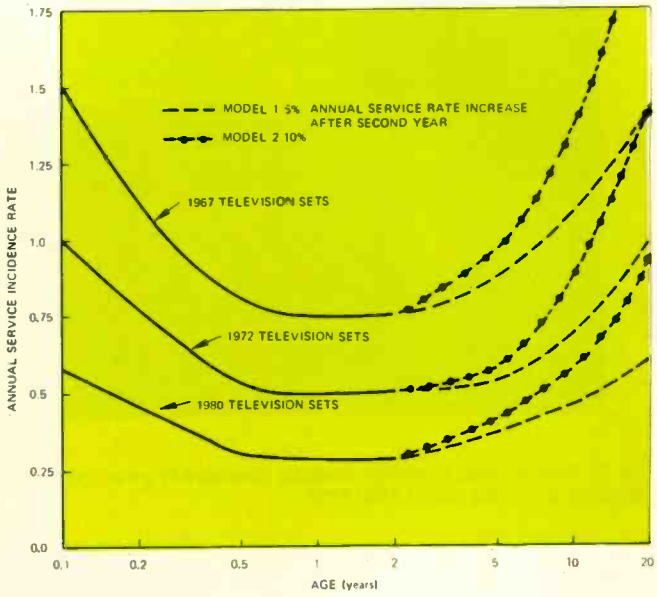

Fig. 5—Models of annual service-incidence rates of 1967, 1972 and 1980 model-year b/w TV receivers.

color and b/w receivers. The resultant lifetime service-incidence-rate curves are presented in Figs. 4 and 5.

The reason that there are two projections of all the model-year curves in Figs. 4 and 5 is that conclusive industry data on the service-incidence rate of TV receivers beyond the first two years of life was not available and, consequently, the researchers decided to use two "educated estimates" as a basis for the service-incidence rates beyond two years. One, called "Model 1," is based on an estimated 5% annual service-incidence rate increase after the second year of receiver use and the other, "Model 2," is based on an estimated 10% increase. (The researchers concluded that the actual service-incidence rate after 2 years probably lies somewhere between these two projections.)

THE PRODUCTIVITY OF TV SERVICERS

In their assessment of the productivity of the TV service business, the MIT researchers used the number of completed service incidents per technician-day as the basis of their measurement.

According to the report of their study, the researchers found that five to seven completed service calls per technician-day was the "typical" level of productivity in the TV service business in 1973, and this level had not changed much over "the preceding several years."

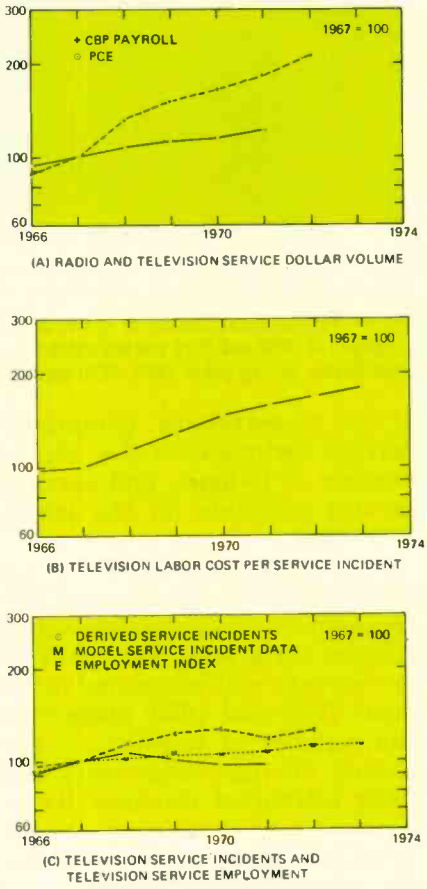

Fig. 6—Annual plots of A) TV and radio service dollar volume, B) TV labor cost per service incident and C) comparisons of service incidents and TV technician employment, for the years 1966-1972, indexed to 1967. In A) the data for the curve labeled "CBP" is from County Business Pattern volumes and the data for the curve labeled "PCE" is from Personal Consumption Expenditure figures.

To assess the *trend* in the overall productivity of the TV service business, the MIT researchers computed the annual number of service incidents over the period 1966-1973 and weighed these against the number of TV service technicians employed in each year during the period. This comparison is graphically illustrated in Fig. 6. The solid line in Fig. 6C is an index of service incidents derived by dividing the average dollar volume of radio and TV servicing in each year (Fig. 6A) by an index of TV service labor cost for each year (Fig. 6B).

The dotted line labeled "M" in Fig. 6C is a service-incidents index obtained from the computer-derived service-incidents "lifetime model" described previously. (Note that both of these curves indicate that the service-incident rate did not change significantly over the seven-year period.) The broken line labeled "E" in Fig. 6C is a plot of the TV service technician labor force.

A comparison of the two service-incidence index curves and the TV technician employment index curve indicates that the service labor force, during the seven-year period, increased slightly faster than did the total number of service incidents. Although this implies that the number of service incidents per technician-day decreased during the seven-year period, the researchers stated in their report that "the data probably only warrants a conclusion to the effect that the numbers of TV service incidents per technician-day has not been changing very much over the

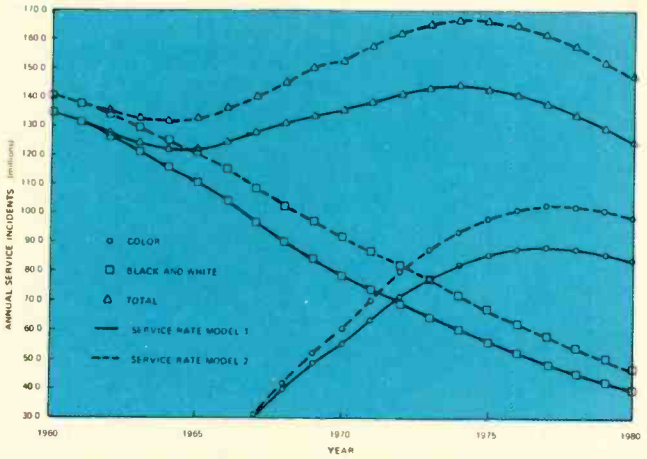

Fig. 7—Annual levels of service incidents generated by color and b/w TV receivers during the period 1960-1980.

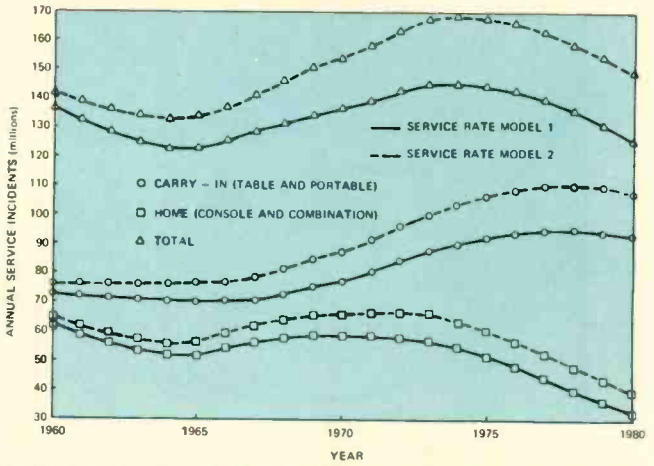

Fig. 8—Annual levels of TV service incidents generated by in-home and carry-in business.

past seven years, and that productivity growth by this measure has been small."

FUTURE TV SERVICE AND TECHNICIAN REQUIREMENTS

The preceding paragraphs have summarized the researcher's findings with regard to the state and trends in the TV set population, service-incidence rates, and the population and productivity of the TV service business at the time of their study (1972-73).

This and other related data was applied by the researchers to a computer program designed to translate the existing trends into a projection of annual TV service requirements through 1980, along with a projection of the number of TV technicians needed to meet these requirements.

The resultant projections, presented in Figs. 7, 8 and 9, are based on a TV receiver mean lifetime of 10 years. (This means that 50% of the sets sold in any year will have been discarded within 10 years and 97% will have been discarded after 17 years.)

(The curves and data labeled "Model 1" in Figs. 7, 8 and 9 are based on a 5% annual increase in the service-incidence rate after the second year of receiver use, and the curves and data labeled "Model 2" are based on a 10% increase after the second year.)

Fig. 7 shows the researchers' computer-derived estimates of the total number of color and b/w TV service incidents which occurred annually during the period 1960-1975 and their projections of the service incidents which will occur annually through 1980.

Fig. 8 is a graphical comparison of the researchers' computer-derived estimates of the annual number of in-home and carry-in service incidents for the period 1960-1980.

Year	Total Number of Service Calls per Year (millions)		Total Number of Technicians* (thousands)		Number of Service Calls per Day per Technician	
	Model 1	Model 2			Model 1	Model 2
1960	135	140	105		6.6	6.9
1970	136	153	137		5.9	6.8
			Model 1	Model 2		
1980	125	148	122	146	6.0	6.0
1980	125	148	106	126	7.0	7.0

*In 1960 80% of television technicians worked in the consumer sector, in 1970 this had dropped to 70% and it was assumed that this figure would also apply to 1980.

Fig. 9—Tabular presentations of 1) the total annual service calls, 2) total number of technicians employed in 1960 and 1970 and the number required in 1980, and 3) estimated levels of technician productivity, for the years 1960, 1970 and 1980.

Shown in the top half of Fig. 9 is a tabular presentation of the MIT researchers' computer-derived estimates of the total number of TV service calls which occurred in the years 1960 and 1970, along with the number of technicians employed during these years and their estimated productivity in terms of service-calls per day per technician based on the two different after-second-year service-incidence rate increases described previously.

Shown in the bottom half of Fig. 9 is a tabular presentation of the researchers computer-derived projections of the total number of service calls which will occur in 1980 and the number of TV technicians which will be needed to meet these service requirements. As described previously, two different percentages of service-incidence rate increases after the second year of TV life (Models 1 and 2) were used. This resulted in two different estimates of the total number of service calls in 1980—125 million and 148 million—which, when weighed against two different estimates of technician productivity (6 and 7 calls per day per technician), produced four different estimates of the total number of technicians needed in 1980, ranging from a "low" estimate of 106 thousand to a "high" estimate of 146 thousand. The MIT researchers selected the mean of this range—126,000—as their estimate of the total number of technicians which probably will be needed in 1980.

CONCLUSIONS

The principal conclusions which the MIT researchers drew from the findings of the TV-service-requirements portion of their study are:

1) "In 1970, a total of 137,000

continued on page 57

TV service technicians give their opinion about Zenith:

I. Best Picture.

In a recent nationwide survey of the opinions of independent TV service technicians, Zenith was selected, more than any other brand, as the color TV with the best picture.

Question: In general, of the color TV brands you are familiar with, which one would you say has the best overall picture?

Answers:

Zenith	**38%**
Brand A	20%
Brand B	10%
Brand C	7%
Brand D	6%
Brand E	3%
Brand F	2%
Brand G	2%
Brand H	2%
Brand I	1%
Other Brands	3%
About Equal	11%
Don't Know	4%

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

II. Fewest Repairs.

In the same opinion survey, the service technicians selected Zenith as the color TV needing the fewest repairs. By more than 2-to-1 (38% vs. 15%) over the next brand.

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

Answers:

Zenith	**38%**
Brand A	15%
Brand C	8%
Brand D	4%
Brand B	3%
Brand I	2%
Brand F	2%
Brand E	2%
Brand G	1%
Brand H	1%
Other Brands	4%
About Equal	14%
Don't Know	9%

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

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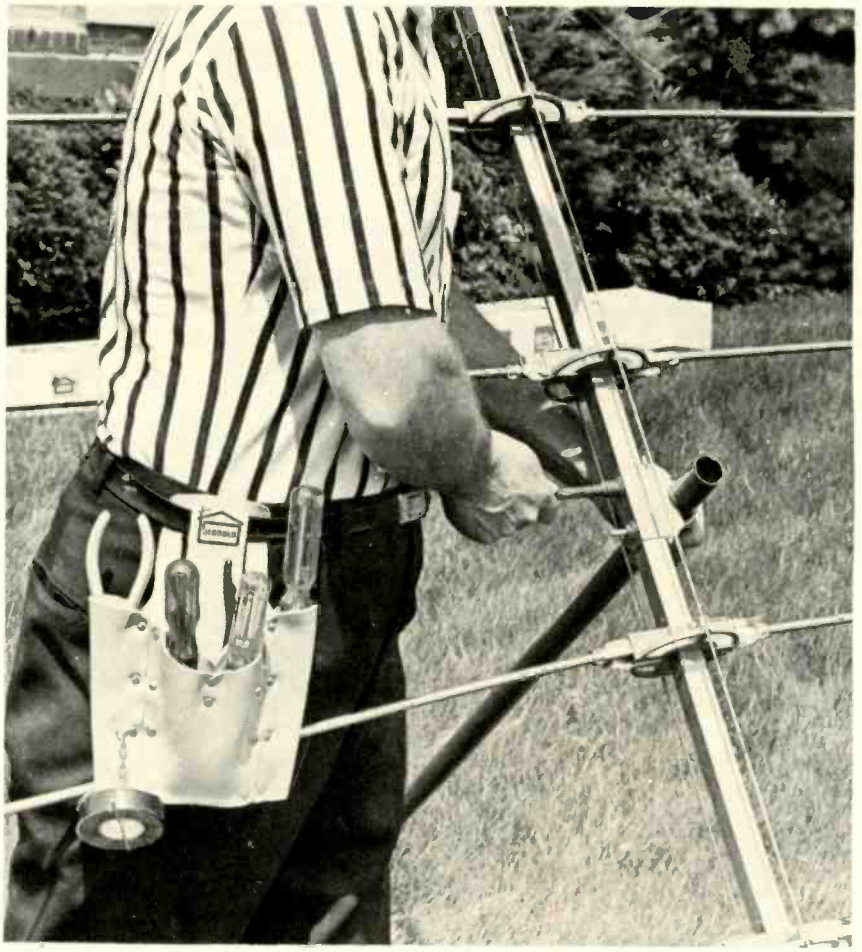


Techniques For Simple Home Antenna Installations

By Bert Wolf*

Procedures that make installing residential TV antenna systems both easy and profitable

■Many of your customers with black-and-white TV and mono FM will get by somehow with built-in antennas, indoor "rabbit ears", and cheap outdoor antennas. But when it comes to color TV, FM stereo and quadraphonic sound, it's time to suggest the installation of a quality outdoor antenna system.

CHOOSING ANTENNAS

Because there is no one antenna that is best for all reception conditions, your choice depends on what channels your customer wants to receive, how far he is from the transmitter, and local reception conditions.

Antennas are classified by the channels they receive. A VHF antenna picks up Channels 2 thru 13. A UHF antenna picks up Channels 14 thru 83. An FM antenna picks up 88 to 108 MHz. Many TV antennas are broadband: picking up VHF and FM or UHF, or VHF and FM.

Two specifications, 'gain' and 'directivity', are especially important in choosing antennas. Gain tells you how much signal the antenna will pull in, and directivity tells you how effective the antenna is in eliminating ghosts, reflections and other reception problems caused by unwanted signals. In most cases, high gain and high directivity are very desirable. Since it usually takes bigger antennas with more elements to provide more gain and directivity, such antennas generally cost more.

However, element count is not the only thing that is important. For color and stereo, a uniform, flat response is essential. Periodic type antennas do a good job of combining flat response with gain and directivity.

Rugged construction is also vital. You don't want to put up an antenna and have the elements start to bend, fall off or rattle in the wind after the first year or two. Therefore, your customer is better off to pay extra for an antenna that is solid and rugged, using rein-

*The author is Vice President and General Manager of the Jerrold DSD Division.

forced elements and heavy duty insulators.

Both TV and FM channels can easily be pulled in with the same antenna, provided it is an all-channel type. However, some all-channel and VHF antennas deliberately reject the FM band to prevent interference from a local FM station on Channel 6.

Fig. 1 shows the type of breakaway element currently being used by some antenna manufacturers. The intact element is long enough to reject FM stations. Broken off, on the other hand, the element acts as a director to FM signals, providing excellent FM reception.

For really top quality FM reception, your best bet is a very high gain quadraphonic type FM antenna (such as that shown in Fig. 2). The FM antenna can be mounted on the same mast as the TV antenna and the signal can be combined into a single downlead using a yagi coupler tuned to FM, as shown in Fig. 3

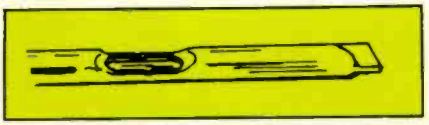


Fig. 1-An FM breakaway element used on some antennas. When intact, element rejects FM. Broken off, element accepts FM signals.

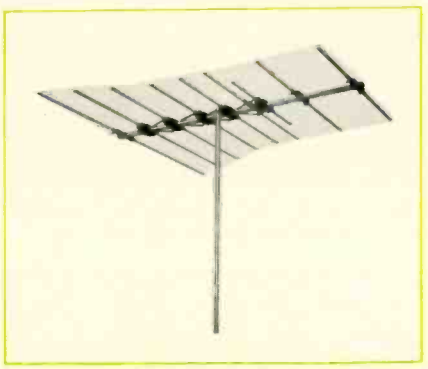


Fig. 2-An example of a high-gain, quadraphonic-type FM antenna.

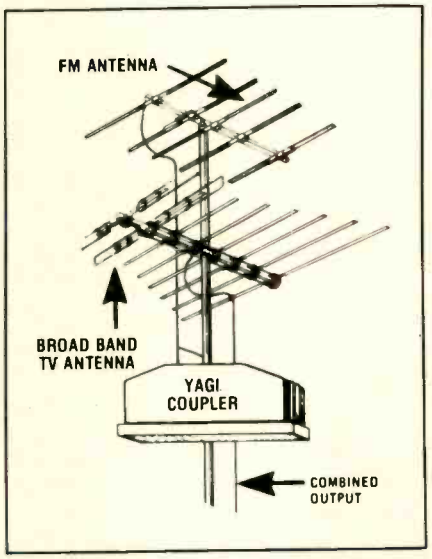


Fig. 3-An example of how a Yagi coupler is used to combine FM antenna with a broad-band TV antenna.

ANTENNA MOUNTING

Once you've chosen a good outdoor antenna, your next step is to decide how to mount it. There are many types of antenna mounts. Those most popular are shown in Fig. 4.

Chimney mounts (4A) are easiest and most convenient—provided your customer has a good, strong chimney. If the chimney is not solid and is at least 3 feet higher than the rooftop, use some other type of mount.

Trimounts (4B) are also very easy to use. They consist of three legs with a 5-foot mast attached. Fig. 4B shows a trimount on the peak of a roof. This mounting arrangement is convenient and works well on almost any roof surface.

Roof mounts (4C) are inexpensive. They do a good job, but you must use guy wires with roof mounts, as shown.

Wall mounts (4D) are handy for peaked roofs. Eave mounts (4E) are used in place of wall mounts where there are overhanging eaves.

If the mast is 10-feet or higher, you should use guy wires. Some technicians use four guy wires, but three usually do just as good a job. Using a guy ring clamp, space the guy wires equally about 120 degrees apart, as shown in Fig. 5. Each guy wire should be taken to an eyebolt which bites into *solid wood* in the roof. To balance the tension, at least two of the three guy wires should be equipped with turnbuckles.

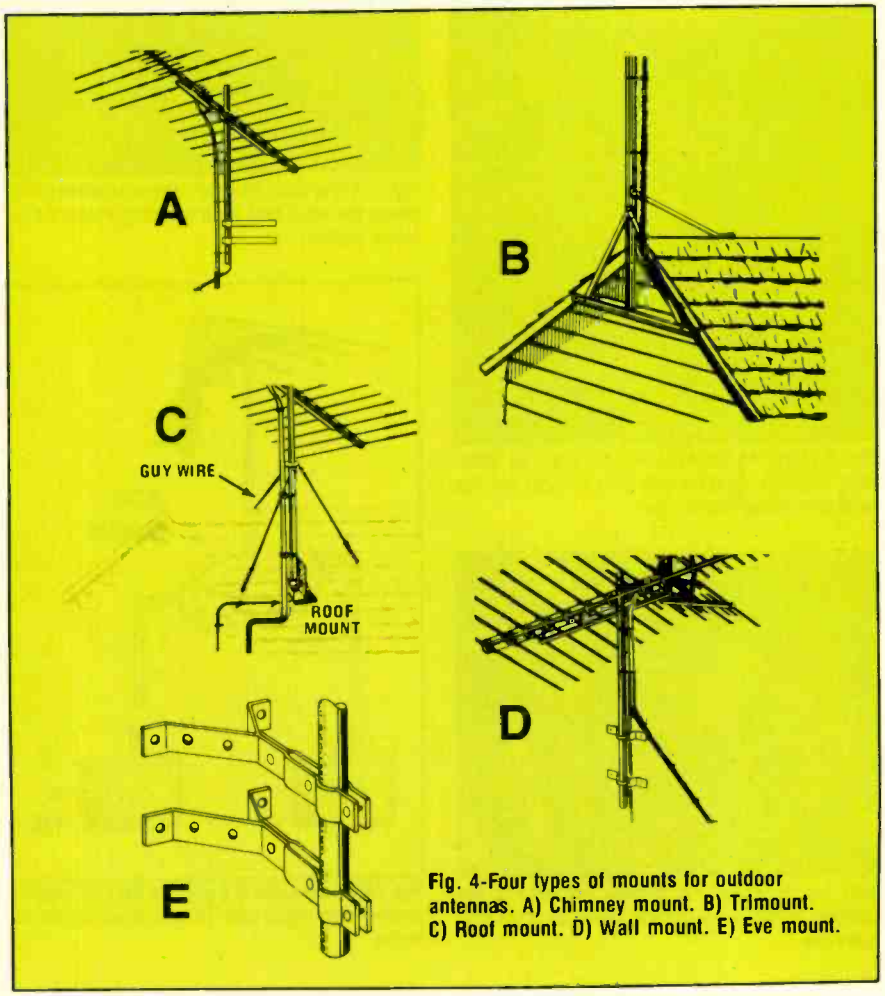


Fig. 4-Four types of mounts for outdoor antennas. A) Chimney mount. B) Trimount. C) Roof mount. D) Wall mount. E) Eve mount.

For areas where a lot of height is required, many people prefer towers to other types of mounts because they are sturdy and cause no damage to the chimney or roof.

LIGHTNING PROTECTION

There are two schools of thought on lightning protection. Some installers feel that ground wire is not really heavy enough to handle a lightning strike, while others feel that some protection is better

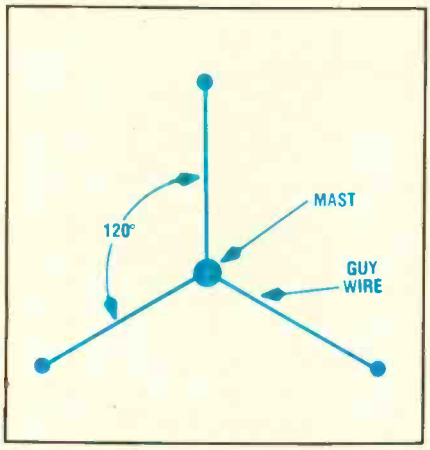


Fig. 5-The method of spacing three guy wires around an antenna mast. Wires should be spaced equally about 120 degrees apart.

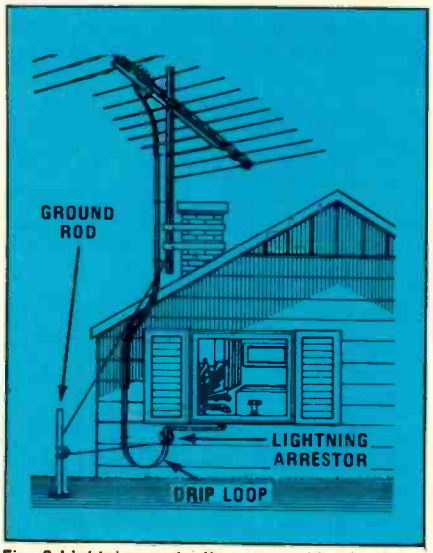


Fig. 6-Lightning protection as provided by lightning arrestor, ground wire and ground rod for twinlead transmission line.

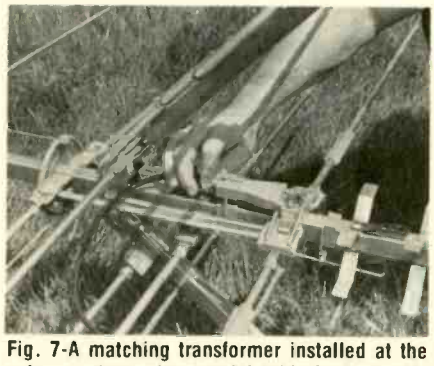


Fig. 7-A matching transformer installed at the antenna when using coaxial cable for transmission line.

Fig. 8-A combination matching transformer/U-V signal splitter mounted at back of TV set.

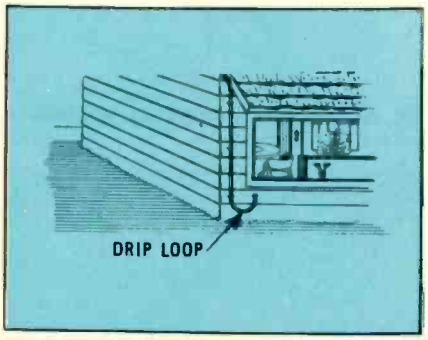


Fig. 9-A drip loop installed where antenna enters house prevents rain from entering house via antenna lead-in.

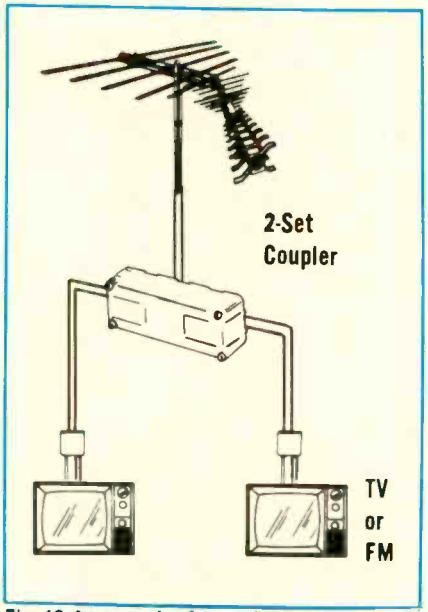


Fig. 10-An example of a passive two-set coupler, designed to serve two TV sets from single antenna.

than none. In any case, local electrical codes call for lightning protection.

If you're using twinlead as transmission line, use a lightning arrestor, ground wire and a ground rod as shown in Fig. 6.

Grounding wires must be made of corrosion-resistant metal such as copper or aluminum. It must be run as straight as possible from the antenna mast to the lightning arrestor and then to the ground rod. The ground rod must be driven at least 4 feet into the ground. (A cold water pipe also makes an excellent ground.)

If you're using coaxial cable, no lightning arrestor is necessary. Simply attach the ground wire to the mast and to the shield of the coaxial cable, using a grounding block. If the antenna is grounded to the mast, no connection is required to the coax shield and you don't need a lightning arrestor even for a 300-ohm installation.

LEAD-IN WIRE

Because some home TV antennas have an output impedance of 300 ohms, some installers still use 300-ohm twinlead as the downlead. However, shielded coaxial cable offers a number of advantages: 1) it does not pick up direct signals; 2) it does not pick up auto ignition or other types of interference; and 3) it can safely be run anywhere, even close to metal. Twinlead must be run through standoff insulators to keep it away from the house and especially any metal objects. Otherwise you are likely to wind up with interference and color smears.

Coaxial cable requires matching transformers at the antenna (see Fig. 7) and at the TV set. Fig. 8 shows a combination matching transformer/U-V signal splitter mounted to the back of a TV set.

One of your most difficult jobs is to get the lead-in into the house. If there is an attic louvre, this may be an easy solution because you can then go through air shafts and closets to reach the room or rooms with TV sets. Otherwise, you can go through the basement or the wall under a window convenient to the TV set.

Here's an important point: Always leave a *drip loop* where the lead-in enters the house (see Fig. 9). The drip loop prevents rain from following the lead-in into the house.

Once inside the house, run the lead-in along the baseboard to the TV set, as unobtrusively as possible. This is not as easy as it sounds, particularly if you are using twinlead. The question is, how do you attach twinlead to the baseboard? Many installers use staples, but staples are metal and therefore cause discontinuities in twinlead. Double sticky-back tape or pads don't cause problems, but don't always stick on all wall surfaces. Use foam pads if they'll work on the walls. Otherwise, staples are the only answer, but use them as sparingly as possible.

Of course, coaxial cable is no problem at all. You can staple it to

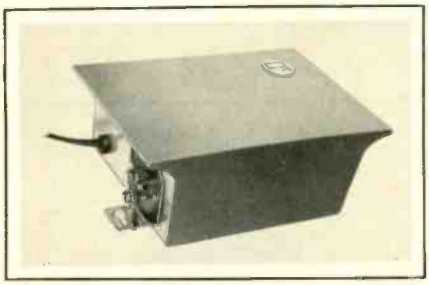


Fig. 11-An amplified coupler that is used when more than two sets are to be served by one antenna.

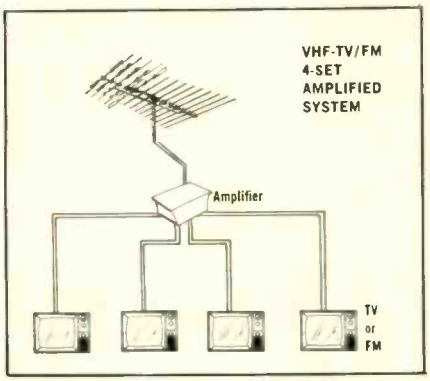


Fig. 12-An example of how an amplified coupler can be used to drive a home MATV system.

the baseboard with no ill effects, provided you are careful not to crush the cable or pierce it with a staple. Coax can also be coiled up behind the set so there will be a little slack to move the set out for cleaning. (But don't try this with twinlead. A coil of twinlead causes standing waves, which can destroy picture quality.)

MULTI SET INSTALLATIONS

Chances are your customer has more than one TV set in his home. About half of American TV households do. There is no reason why you shouldn't use one outdoor antenna for all of his TV sets, as well as the FM receivers. In fact, you might want to sell your customers on a TV outlet in every room. A home master antenna TV (MATV) system enables the customer to carry a portable from room to room or out on the patio and to enjoy good signals wherever he goes.

Fig. 10 shows a passive 2-set coupler used to serve two sets from a single antenna. Passive couplers work well in very strong signal areas, but you might not have enough signal for more outlets. In that case, you will need an amplified coupler, as shown in Fig. 11. Fig. 12 shows how you can use an amplified coupler to drive a home MATV system. ■

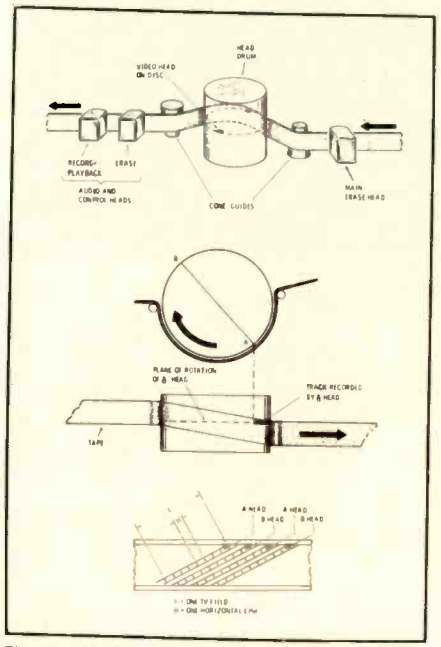


Fig. 1—The tape scan action of a typical helical videotape player/recorder equipped with two heads. As the tape is pulled across the head drum by the capstan, the two rotating heads inside the drum swipe across the tape in a slanted (helical) path. One TV field (262-½ horizontal lines) is recorded on (or played back from) the tape as each head swipes across the tape. (Courtesy of Howard W. Sams Co.)

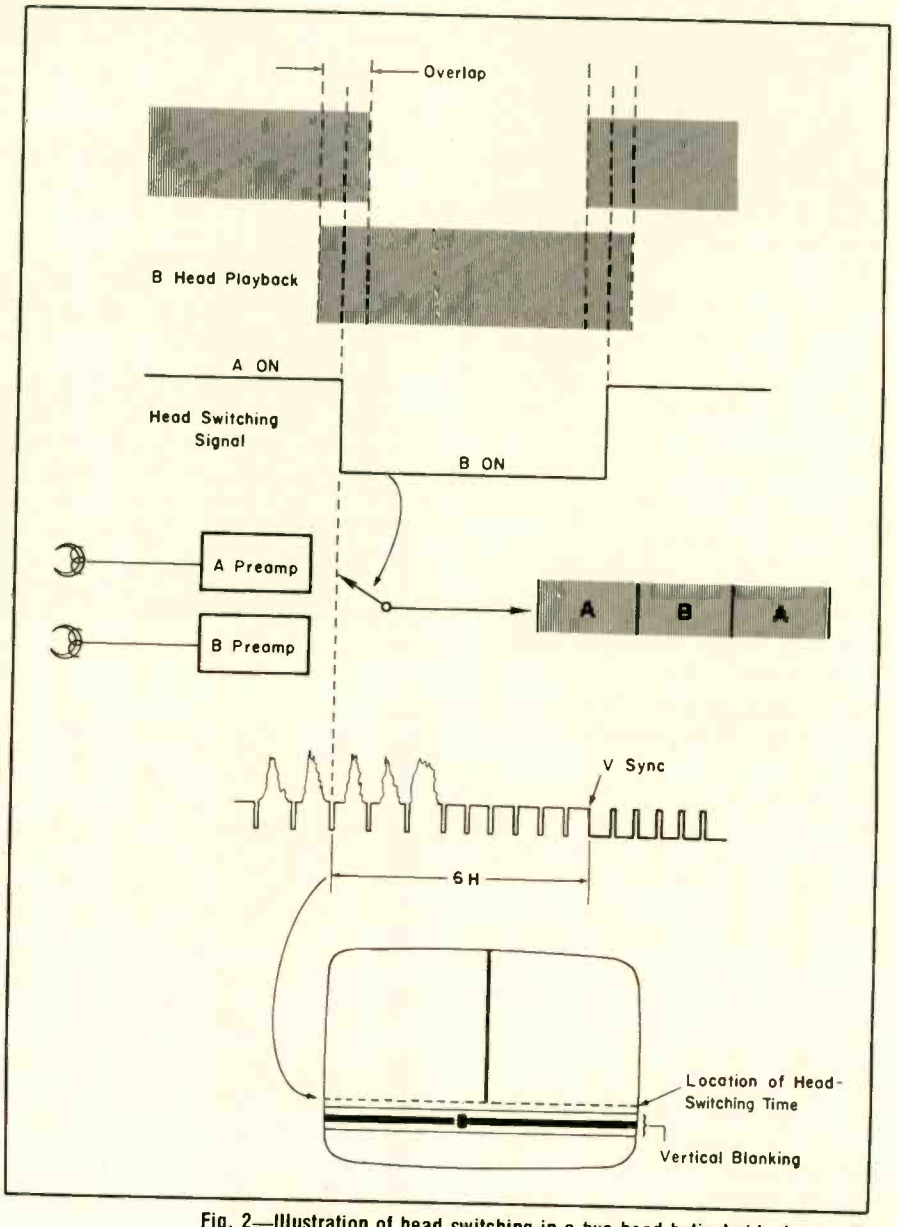


Fig. 2—Illustration of head switching in a two-head helical videotape unit.

Curing VTR-Caused TV Jitters

By Edward Woodall

Examination of the most prevalent causes of sync time-base errors in helical-scan videotape player/recorders and how the horizontal sync AFC systems of some TV receivers can be slightly modified to cope with them

■ As shown in Fig. 1, all helical-scan player/recorders use a rotary scanner with one or two video heads which record tracks that slant across the width of the tape. In both single- and two-head machines, the length of time that the head is in contact with the tape is a little over 1/60th of a second. A complete field of video is recorded (or played back) for each swipe of a rotating video head across the tape. The length of each swipe contains a little more than one field, or in excess of 262-½ horizontal lines of video.

If the relative speed between head and tape is absolutely uniform, the sync pulses are equally

Fig. 3—Displacement of performer's sleeve just above the vertical blanking bar is indicative of back-tension error in the videotape unit—an error which causes the switch from head B to head A to occur too early.

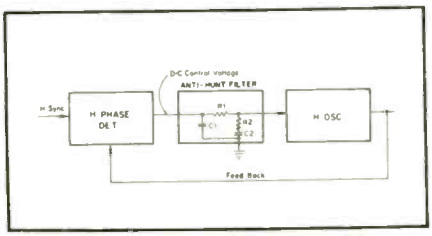


Fig. 4—Diagram of typical anti-hunt filter in a horizontal AFC system. Principal function of filter is to slow down changes in AFC control voltage so that horizontal sync is not affected by random noise impulses.

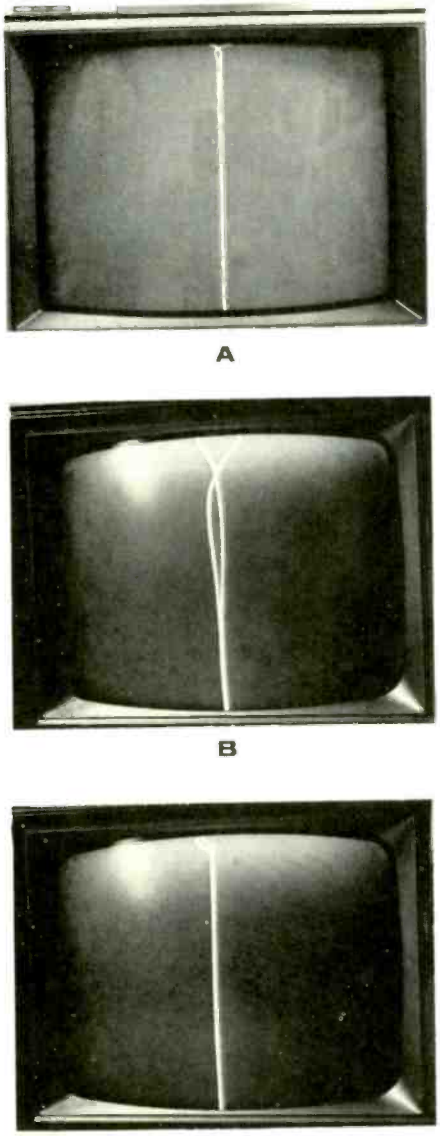
spaced on the tape and will be played back equidistant in time. Any variations in speed translate into variations in sync pulse spacing, which, in turn, produce sync-timing errors.

Longitudinal vibrations in the tape, set up by friction as the tape runs past stationary guides, produces random timing errors which appear as slight displacements or wiggles in the vertical lines in the picture.

A more severe timing error occurs if the back tension applied to the tape at the input to the scanner is different in the playback machine than it was on the machine that made the recording. In this case, the actual length of the recorded swipe might be different. For example, if the back tension is too high, the tape is drawn more tightly around the scanner, and the length of the swipe is a little shorter. The resultant timing error appears most noticeably at the transition between the end of one swipe (recorded field) and the beginning of the next.

In most VTRs which use two video heads, slightly more than a complete field is recorded for each swipe of the head past the tape, as shown in Fig. 2. That is, because the length of each recording is greater than 1/60th of a second, there is a small time interval when both heads are in contact with the tape. This time interval is called *overlap* and refers to the time when one head is just leaving the tape path and the other head is entering it.

To provide a continuous playback signal, an electronic switch turns off the head leaving the tape and turns on the head that is just entering. In most two-head machines, the time chosen to make this transition is just before vertical blanking.



A

B

C

Fig.5—Comparison of horizontal sync recovery times of two color TV receivers. A) Late-model Sony 19-inch receiver. B) Three-year-old Zenith. C) Same Zenith receiver with horizontal AFC filter modified to speed up response time.

The reason that head switching is performed in the VTR ahead of vertical blanking is to give the horizontal AFC and oscillator in the receiver as much time as possible to catch up (the entire vertical blanking period), so that the oscillator is synchronized before the start (top) of the next field in the picture.

In ¾-inch videocassette machines, the switching point is just six lines before vertical sync, or three lines before (above) vertical blanking. This is where you see the results of back-tension error at its worst. If you roll down the picture on the TV set or reduce the vertical size, you can spot this switching point, which is the "signature" of most two-head VTRs. An example is shown in Fig. 3. Look at the performer's sleeve on the right just above vertical blanking. Note how the vertical line formed by the sleeve is torn off to the right in two places. This trouble symptom was simulated by readjusting the VTR so that the switch from head A to head B was correct but the switch from head B to head A was three lines too early. Incorrect tape back tension causes the same sync-time displacement. The actual timing error is the lateral displacement at the switching point. After that point, the receiver's AFC system is trying to catch up. Recovery time differs from set to set.

Not all TV sets react the same way to sync timing errors. Some show severe "flagging," or horizontal displacement at the top of the picture, while other sets show little picture movement when fed from the same VTR. Japanese color sets, Sony in particular, appear to be immune to the types of jitter introduced by helical-scan VTRs. This doesn't mean that the Japanese sets are any better in terms of overall performance. It just means that they have been designed to follow timing errors better because the manufacturer is also in the business of selling helical-scan videotape recorders. The change in design represents a compromise between 1) the ability of the horizontal AFC system to follow timing errors and 2) the immunity of that system to

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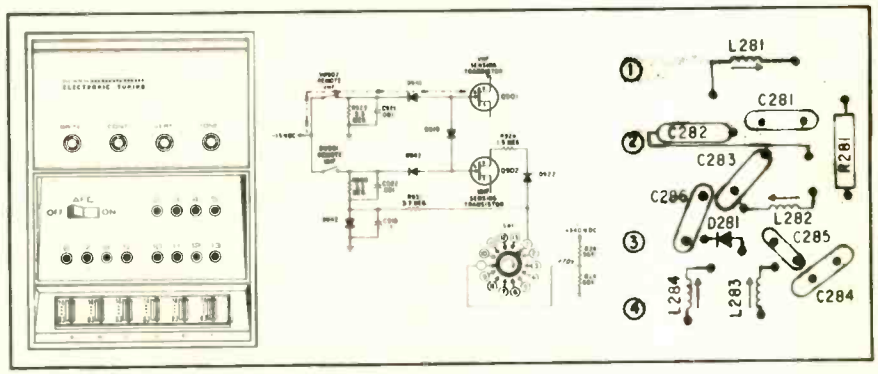

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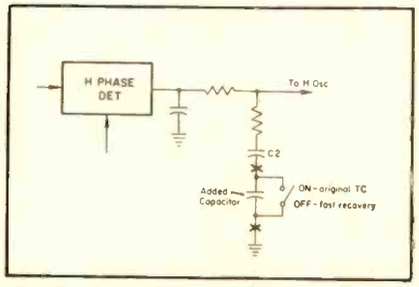


Fig. 6—Connecting additional capacitor in series with C2 reduces total capacitance, thereby speeding up AFC response time.

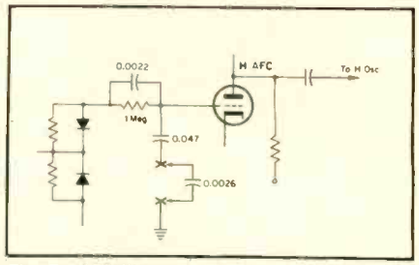


Fig. 7—AFC filter modification illustrated here increased horizontal AFC response time of three-year-old Zenith color receiver from that shown in Fig. 5B to that shown in Fig. 5C.

impulse-type noise interference. (Examples of the latter types of interference are those caused by car ignition or electric shaver motors, particularly if the antenna signal is weak.) It follows that there will be many cases where great immunity to impulse noise is not needed and better response to timing error is more important to the viewer.

Just how fast a receiver can recover from a sync timing error depends on the components in the filter which couples the horizontal phase detector to the voltage-controlled horizontal oscillator. Fig. 4 shows a typical arrangement. This filter is usually a double time-constant RC network referred to as a "lag network," or an "anti-hunt network." Its function is to *slow down abrupt changes in error voltage* so that the system ignores the effects of random noise pulses. The filter also reduces the loop gain of the system at correction frequencies where feedback becomes regenerative. You have probably seen the effects of an open in the larger of the two capacitors in the network: The system oscillates, producing the so-called "Christmas-tree" or "pie crust" effect.

A rough idea of how quickly a receiver recovers from a timing error can be illustrated with the aid of a special signal generator put together for the purpose of receiver evaluation. The generator provides a very simple picture: a single vertical line near the middle of the screen (Fig. 5A). An artificial timing error is introduced by alternately retarding and advancing horizontal sync about five microseconds on alternate fields. This simulates a form of timing error produced by two-head VTRs when the heads are not precisely 180 degrees apart—a fault known to VTR techs as "dihedral error."

Fig. 5 shows the results when the test signal is applied to a one-year-old Sony 19 incher (Fig. 5A) and a Zenith 25-inch color set of about three years vintage (Fig. 5B). The difference in the time taken for recovery is indicated by the percentage of the field taken for the two vertical lines to come together. This doesn't mean that Sony or other Japanese receivers have superior horizontal AFC action. It just means that they recover faster and display less jitter from VTR causes than does the Zenith. (The Zenith, on the other hand, displays less horizontal displacement or picture break up from the effects of impulse noise.) Reducing the time constant on the horizontal AFC filter allows the error voltage generated by the AFC system to change more rapidly and, as a result, the horizontal oscillator is brought into sync quicker.

Capacitor C2 in Fig. 4, the larger of the two capacitors in the filter network, has the most effect on AFC response time. At the frequency at which the reactance of C2 is extremely small, the loop gain of the system is reduced by the voltage-divider action of R1 and R2. A reduction in the value of C2 usually speeds up recovery time sufficiently to eliminate the usual forms of jitter caused by VTRs.

It is difficult to give a "general cure" that applies to all sets, but a trial-and-error aproach will give useful results if you're careful not

to overdo it. For example, try reducing the capacitance of C2 by one half. After any change, check the set during reception of a normal broadcast signal to make sure there is no tendency for the AFC system to oscillate, as evidenced by pie-crust effects, or line-to-line lateral displacement of the vertical lines in the picture. Continue making the value of C2 smaller in half-size increments until the desired stability is achieved.

Recovery time can also be affected by altering the values of R1 and R2 in Fig. 4. The value of R1 must be reduced and that of R2 increased to increase loop gain.

However, sufficient improvement can be achieved in most cases by merely reducing the value of C2. One approach is to put a capacitor in series with C2 to reduce its total capacitance, as shown in Fig. 6. A switch placed across this added capacitance can be used to restore the original action of the filter during reception of over-the-air broadcast signals.

As an example of what might be expected, the picture in Fig. 5C shows horizontal AFC recovery of the Zenith receiver after the modification in Fig. 7 was added. (The original sync recovery time of the receiver was shown in Fig. 5B.)

While a recent FCC advisory committee reported on cable-system specifications has recommended the use of electronic time-base correctors to get CATV and VTR signals back into line with over-the-air broadcast signals in terms of time-base error, there will be considerable time before time-base correctors are in common use throughout the country. In addition to CATV and closed-circuit (hotel/motel) operations, home videotape recorders are now making their appearance in the market place, with disc systems (they have similar sync-timing errors) just over the horizon.

TV manufacturers are taking steps to alter horizontal AFC systems to cope with the types of timing errors that home VTRs or disc systems might introduce. For example, current Magnavox color

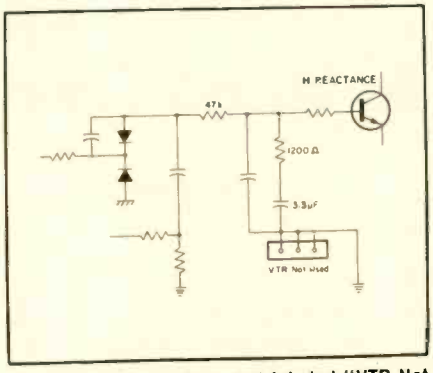


Fig. 8—The three-pin socket labeled "VTR Not Used" in this simplified schematic of the horizontal AFC system of a late-model Sears color chassis seems to be indicative of this and other TV manufacturers' increasing awareness and response to the need for quicker-responding horizontal AFC systems.

sets I have checked seem to have very fast recovery times. Another example of industry awareness is found on the schematics of recent Sears color sets: The 3-pin socket labeled "VTR Not Used" in the schematic in Fig. 8 seems to make possible future alterations to the horizontal AFC filter network of these chassis. Another major TV manufacturer replaces the module that contains the horizontal AFC network with one having a different part number when complaints of horizontal instability during CATV reception are reported.

The need for the minor modifications suggested in this article eventually should be eliminated by the horizontal AFC design changes which these and other TV manufacturers are beginning to incorporate in their newer TV chassis.

In the meantime, the suggested minor modifications should help service technicians eliminate or lessen the effects that such time-base errors have on the quality of pictures displayed by existing TV chassis equipped with slow-responding horizontal AFC systems.

(IMPORTANT: When a technician performs the modifications suggested in this article, he should attach to the back of the receiver cabinet a notification which conspiciously and clearly explains precisely why, how and by whom the original horizontal AFC filter circuit has been modified.)■

Sizing Up TV Antenna Gain

By James E. Kluge*

■ For all of us, the name of the game is clear, snow-free pictures on the customer's picture tube. Unless you can get adequate signal levels off the antenna, you'll have snowy pictures at the set. There is no way to improve them. You may be able to trap out the unwanted signals that creep in, but you can never improve the main signal that the antenna supplies. If you can't get sufficient signal for a snow-free picture *at the antenna*, then you must use a bigger antenna (higher gain) or a multiple-antenna stack.

MINIMUM SIGNAL REQUIREMENTS

The minimum level of signal which an antenna must supply at its output terminals is dictated principally by 1) the signal losses between the antenna output terminals and the receiver input and 2) by the level of noise voltage present in the signal-distribution system.

Whether or not the noise voltage of the system produces snow in the displayed picture is dependent on how much stronger the received signal is than the noise. The level of the received signal voltage in relation to the existing system noise voltage is called the *signal-to-noise ratio* (S/N).

This ratio usually is expressed as a decibel equivalent. For example, if an antenna supplies a 200-μV (.000200 volt) signal and 1 μV (.000001 volt) of noise is present in the system, the signal-to-noise ratio is 200/1, or, expressed in the decibel equivalent, 46 dB. (See the dB-vs-equivalent ratio chart in Table 1.)

Most TV receivers in use today will produce a snow-free picture when supplied with an input signal having a signal-to-noise ratio of 200/1, or about 46 dB. Because the theoretical *minimum* noise level in a 75-ohm TV antenna sys-

TABLE 1
Voltage Ratios Vs Approximate Equivalent Gain Expressed In Decibels

RATIO	dB	RATIO	dB
1/1	0	100/1	40
2/1	6	200/1	46
3/1	10	1000/1	60
10/1	20	10,000/1	80
30/1	30	100,000/1	100

TABLE 2
Signal Level In dBmV Compared To Signal Level In μV

μV	−dBmV	+dBmV	μV
1000	− 0	0	1000
900	− 1	1	1100
800	− 2	2	1300
700	− 3	3	1400
630	− 4	4	1600
560	− 5	5	1800
500	− 6	6	2000
450	− 7	7	2200
400	− 8	8	2500
360	− 9	9	2800
320	−10	10	3200
200	−14	14	5000
100	−20	20	10,000
50	−26	26	20,000
25	−32	32	40,000
20	−34	34	50,000
10	−40	40	100,000
5	−46	46	200,000
2.5	−52	52	400,000
1	−60	60	1,000,000 (1.0 volt)

TABLE 3
Antenna Gain (In dB) Over That Of Folded Dipole Translated To Corresponding Voltage Gain Factor At Antenna Terminals

GAIN OVER FOLDED DIPOLE (In dBs)	SIGNAL VOLTAGE INCREASE (X)
3	1.4
6	2.0
10	3.2
12	4.0
18	8.0
20	10.0
30	31.6
40	100.0
46	200.0
60	1000.0

*The author is a technical editor for the Winegard Company

tem is about 1 μV, snow-free TV reception requires a receiver *minimum* input signal level of about 200 μV.

However, because of inevitable flucuations in the strength of the signal received by the antenna and because more noise is added when the signal is amplified, it is best to shoot for a *minimum* of 1000 μV on each channel at the antenna.

The receiver minimum input level of 1000 μV is referred to in some TV antenna literature as "O dBmV," which is merely a variant of the decibel system of expressing the ratio of two electrical quantities (voltage, current or power). Instead of referencing all ratios to 1, as is done in the "pure" dB system, in the dBmV system all ratios are referenced to 1000 μV, which is 1 mV. (See the simplified dBmV-vs-μV chart is Table 2.)

ANTENNA GAIN

The antenna-gain spec, usually expressed in dB, is little more than a relative indicator of how one antenna compares with another under *identical* reception conditions. Specifically, gain specs usually tell you how much *more* signal voltage an antenna will generate *compared* to a simple folded dipole resonant at the same frequency and under *identical* conditions. (See Table 2.)

"Identical" is a key word here because, unless you have a calibrated outdoor antenna range operated under controlled conditions, you might measure from the same antenna 7dB of gain at noon and 10 dB in the evening.

Furthermore, some manufacturers specify antenna gain referenced to an isotropic radiator. Such a radiator exists only in theory and theoretically radiates (or receives) signals equally in *all* directions. According to antenna theory, a standard reference dipole has a gain of +2.2 dB over that of an isotropic radiator. Therefore, specifying antenna gain referenced to an isotropic radiator (which does not exist in practice) provides gain specs that are 2.2 dB (or about 1.29 times) *higher* than most published specs, thus, making the antenna gain look larger than it actually is.

Antenna gain can be, and frequently is, vastly different at one channel compared to another. So, to specify antenna gain, some manufacturers choose the channel having the highest gain, some average all channels, and some take a "typically ideal" figure. Others, instead of specifying gain, provide a "figure of merit" which takes into consideration several performance factors to help select antennas on the basis of overall performance.

Because of these variances in the method used to measure and state the gains of antennas, whenever you need to know precisely how much comparative gain a particular antenna offers and the published gain spec does not state to what it is referenced, you should consult the manufacturer to determine exactly how the published gain figure was derived and what it really means. ■

TUBE WARRANTY EXPIRATION DATE CODES 1975-1976

Expiration Date	Admiral Amperex Westinghouse Zenith	GE	Raytheon	RCA	Sylvania
June 75	7426	JI	J-14	EU	KG
July 75	7431	KI	J-12	EV	KH
August 75	7435	LI	J-10	EW	KJ
September 75	7439	MI	J-08	EX	KK
October 75	7444	NI	J-06	EY	KL
November 75	7448	RI	J-04	EZ	KM
December 75	7452	SI	J-02	FA	KA
January 76	7505	CJ	L-24	FB	KB
February 76	7509	EJ	L-22	FC	KC
March 76	7513	FJ	L-20	FD	KD
April 76	7518	HJ	L-18	FE	KE
May 76	7522	IJ	L-16	FF	KF
June 76	7526	JJ	L-14	FG	KG
July 76	7531	KJ	L-12	FH	KH
August 76	7537	LJ	L-10	FI	KJ

Material in this department is condensed from a single chapter of a recently introduced TAB book, by permission of TAB BOOKS, Blue Ridge Summit, Pa. 17214

Safety & Special Service Communications

By Clayton L. Hallmark

An overview of how the FCC categorizes two-way radio activities, and general descriptions of the types of services in each category

All over-the-air communications activities within the U.S.–whether one-way such as commercial radio and TV broadcast stations, or two-way such as citizens band radio–are regulated by the Federal Communications Commission (FCC).

Consequently, it is imperative that anyone who operates, sells and/or services over-the-air communications equipment be familiar with the manner in which the FCC categorizes such equipment for regulatory purposes and which volume(s) and part(s) of the FCC Rules and Regulations pertain to the type(s) of equipment they are operating, selling and/or servicing.

Table 1A is a chart which shows how the FCC categorizes the various communications activities it regulates.

Generally speaking, those communications activities which are operated on a for-hire *basis fall within the three major categories titled* Broadcasting, CATV *and* Common Carrier. *Those which are* not *for hire fall within the major category titled* Safety and Special Services, *the subdivisions of which are analyzed in this article.*

With the exception of some radio relay systems employed by common carriers (telephone companies, etc.), all over-the-air two-way *communications activities fall under the two subcategories titled* Safety Radio Services *and* Special Radio Services.

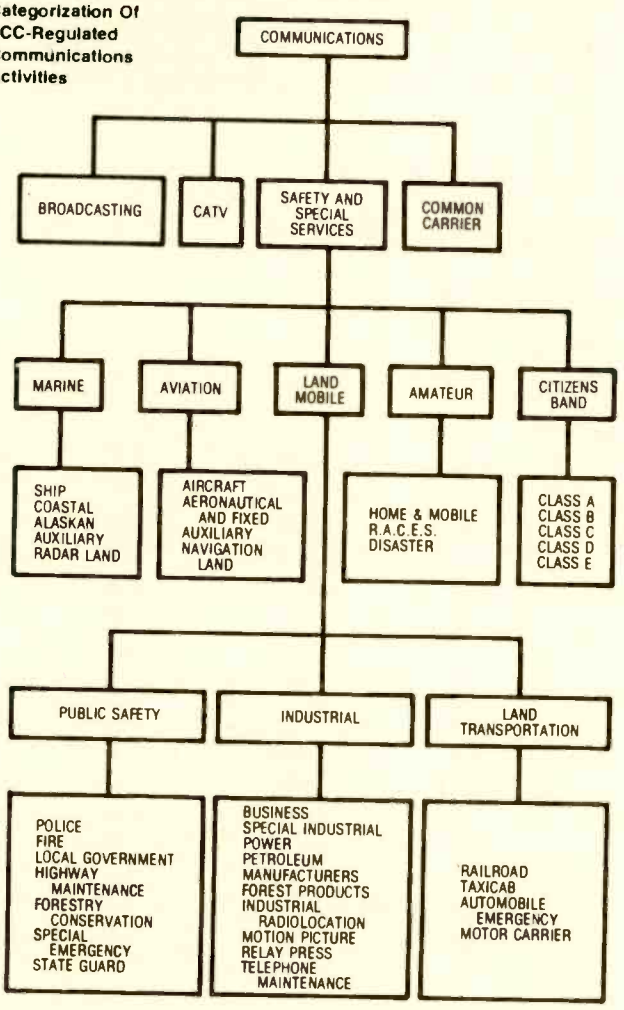
The communications activities in the Safety Radio Service, *as shown in Table 1, are further subdivided according to their principal operating environment–sea* (Marine), *air* (Aviation) *and land* (Land Mobile).

The Special Services *subcategory is separated into the* Amateur Radio Service *and* Citizens Radio Service.

The makeup of each of these subcategories of the Safety and Special Services classification and their subdivisions are described in the following paragraphs.

Table 1B lists the FCC Rules and Regulations which apply to the various types of radio activities categorized under the Safety and Special Services Classification.

TABLE 1A
Categorization Of FCC-Regulated Communications Activities



LAND MOBILE RADIO SERVICES

The land mobile services are covered by Volume V of the FCC Rules & Regulations.

Public Safety Radio Services

Police Radio Service. Types of stations in the police radio service include base and mobile, mobile relay, control, and zone and interzone stations. Subject to certain limitations, installations may be made in vehicles, which, in an emergency, would require the cooperation of the police, such

(From Chapter 2, The Complete FM 2-Way Radio Handbook, *by Clayton L. Hallmark, Copyright 1976, TAB BOOKS. A review of the complete book follows this article.)*

as fire department vehicles, ambulances, public utility emergency units, lifeguard emergency units, and school buses.

Radio facilities authorized for public safety services must not be used to carry program material of any kind for use in connection with radio broadcasting, and must not be used to render a communications common carrier service except for stations in the special emergency radio service while being used to bridge gaps in common carrier wirelines.

Coordinated service may be rendered without cost to subscribers, or contributions to capital and operating expenses may be accepted by the licensee. Such contributions must be on a cost-sharing basis and prorated on an equitable basis among all persons who are parties to the cooperative arrangement. Records that reflect the cost of the service and its nonprofit, cost-sharing nature shall be maintained by the base station licensee and held available for inspection.

Arrangements may be made between two or more persons for the cooperative use of radio station facilities provided all persons are eligible to hold licenses to operate the type of station shared.

A *zone station* is a fixed station that communicates with similar stations in the same area by means of AM continuous-wave (unmodulated) telegraphy (A1). An *interzone station* uses AM telegraphy to communicate with interzone stations in other zones.

The frequency bands used by the police and the types of stations used in each band are listed in Table 2.

'There are a couple of points to be made regarding the frequency assignments given in this chapter. For one, the bands listed are discontinuous; there are rather wide gaps in some cases. For another, the type of modulation employed may be either AM or FM, under FCC rules; but AM is generally used below 25 MHz, and FM above.'

Fire Radio Service. Fire department base stations are authorized to intercommunicate with mobile units on fire apparatus, with other stations in the public safety services, and with receivers at fixed locations. Relay stations will be authorized only where a showing is made that a fire radio system cannot function satisfactorily over necessary distances, or where, in an integrated system comprising two or more fire licensees, the number of necessary frequencies can be reduced.

Frequencies used in the Fire Radio Service are listed in Table 3.

Forestry-Conservation Radio Service. Forestry-conservation base stations are authorized to intercommunicate with mobile units in the same service, with other stations in the public safety services, and with receivers at fixed locations. Relay stations will be authorized only where a showing is made that a forestry-conservation radio system cannot function satisfactorily over necessary distances, or where, in an integrated system comprising two or more forestry-conservation licensees, the number of necessary frequencies can be reduced.

The frequencies available to this service are listed in Table 4.

Highway Maintenance Radio Service. Highway maintenance base stations are authorized to intercommunicate with other fixed and mobile stations in the same service, with other stations in the public safety services, and with receivers at fixed locations. Relay stations will be authorized only where a showing is made that a highway maintenance radio system cannot function satisfactorily over necessary distances, or where, in an integrated system comprising two or more highway maintenance licensees, the number of necessary frequencies can be reduced.

Authorized frequencies for the Highway Maintenance Radio Service are listed in Table 5.

Special Emergency Radio Service. Special emergency stations are intended for use by persons having establishments in remote locations where other communications facilities are not available, relief agencies that have a disaster

TABLE 1B

FCC Rules and Regulations* Safety & Special Services

TYPE OF SERVICE	VOLUME	PART
Marine (on land)	IV	81
Marine (Shipboard)	IV	83
Aviation	V	87
Public Safety	V	89
Industrial	V	91
Land Transportation	V	93
Citizens	VI	95
Amateur	VI	99
Private Operational-Fixed Microwave **	V	94

*FCC Rules and Regulations are grouped and sold in volume units by the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402.

**A new radio service classification which covers not-for-hire operational-fixed radio facilities licensed for and operated in the microwave spectrum above 952 MHZ. Stations authorized in this service may communicate with associated operational-fixed stations and fixed receivers and with units of associated stations in the mobile service licensed under Safety and Special Radio Service rules.

TABLE 2

Police Radio Service Frequency Allocations

1.610-7.935 mhz	Base, mobile, zone, and interzone
37.02-46.02 MHz	Base and mobile
72.02-75.98 MHz	Operational fixed
154.65-159.210 MHz	Base and mobile
453.050-458.950 MHz	Base and mobile
952-960 MHz	Operational fixed

TABLE 3

Fire Radio Service Frequency Allocations

1.63 MHz	Base and mobile
33.42-46.5 MHz	Base, mobile, and fixed
72.02-75.98 MHz	Operational fixed
153.77-170.150 MHz	Base, mobile, and fixed
453.050-465.625 MHz	Mobile and base
952-960 MHz	Operational fixed

TABLE 4

Forestry-Conservation Radio Service Frequency Allocations

2.212-2.244 MHz	Base and mobile
30.86-45.04 MHz	Base and mobile
72.02-75.98 MHz	Operational fixed
151.145-172.375 MHz	Base and mobile
453.050-458.950 MHz	Base and mobile
952-960 MHz	Operational fixed

TABLE 5

Highway Maintenance Radio Service Frequency Allocations

33.02-47.4 MHz	Base and mobile
72.02-75.98 MHz	Operational fixed
150.995-159.195 MHz	Base and mobile
453.05-458.95 MHz	Base and mobile
952-960 MHz	Operational fixed

S&S COMM CONTINUED...

communications plan, physicians normally practicing in remote areas, ambulance services, beach patrols responsible for lifesaving, rural school buses, and communications common carriers. Special emergency base stations are authorized to intercommunicate with other fixed and mobile stations in the same service, with other stations in the public safety services, and with receivers at fixed locations. Transmission of nonemergency communications is strictly prohibited, except that common carriers may use communications for restoring temporarily a normal communications service disrupted as a result of an emergency.

Operation of mobile systems in the special emergency service is limited to use of one frequency per system. The allocations are listed in Table 6.

Local Government Radio Service. Official activities of cities and other municipalities, other than fire and police protection, may be aided by stations in this service, which are authorized in the frequencies listed in Table 7.

Industrial Radio Services

The industrial radio services are used by certain enterprises that require radio communications to function safely or efficiently.

Power Radio Service. Individuals or companies eligible to operate power radio systems are: (1) those engaged in generating, transmitting, collecting, purifying, storing, or distributing—by means of wire or pipeline—electrical energy, artificial or natural gas, water, or steam for use by the public or use by the members of a corporation or organization; or (2) a nonprofit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of those activities. Applicants and licensees must cooperate in the selection and use of assigned frequencies authorized. Each frequency or band is available on a shared basis only, and will not be assigned for the exclu-

TABLE 6

Special Emergency Radio Service Frequency Allocations

2-3 MHz	Fixed
2.726 MHz	Base and mobile
3.201 MHz	Base and mobile
33.02-47.66 MHz	Base and mobile
72.02-75.98 MHz	Operational fixed
155.16-155.4 MHz	Base and mobile
952-960 MHz	Operational fixed

TABLE 7

Local Government Radio Service Frequency Allocations

37.10-46.58 MHz	Base and mobile
72.02-75.98 MHz	Operational fixed
153.755-158.955 MHz	Base and mobile
453.025-458.975 MHz	Base and mobile
952-960 MHz	Operational fixed

TABLE 8

Power Radio Service Frequency Allocations

2.292-4.6375 MHz	Base and mobile
27.235-27.275 MHz	Base, mobile, and operational fixed
37.46-48.54 MHz	Base and mobile
72.02-75.98 MHz	Operational fixed
153.41-173.4 MHz	Base, mobile, and operational fixed
406.025-467.525 MHz	Fixed relay and special
952.-960 MHz	Operational fixed

sive use of any one applicant. Such use may be restricted as to geographical area.

Mobile system frequencies have been made available on the basis of single-frequency, simplex operation. Not more than one frequency or band of frequencies is assigned to a single applicant normally. Available frequencies are listed in Table 8.

Petroleum Radio Service. Those eligible to operate stations in the petroleum radio service are persons engaged in prospecting for, producing, collecting, refining, or transporting (by means of pipelines) petroleum or petroleum products, including natural gas; or a nonprofit organization formed for the purpose of furnishing a radio communications service solely to persons who are actually engaged in one or more of those activities.

Frequencies for this service are allocated in the bands listed in Table 9.

TABLE 9

Petroleum Radio Service Frequency Allocations

1.614-4.6375 MHz	Base and mobile
25.02-49.5 MHz	Base and mobile
72.02-75.98 MHz	Operational fixed
153.05-173.4 MHz	Base and mobile
406.025-467.525 MHz	Base, mobile, and operational fixed
952-960 MHz	Operational fixed

Forest Products Radio Service. Those eligible to operate stations in the forest products radio service are persons engaged in tree logging, tree farming, or related woods operations; or a nonprofit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of those activities.

Frequencies available to this service are listed in Table 10.

TABLE 10

Forest Products Radio Service Frequency Allocations

27.235-49.58 MHz	Base and mobile
72.02-75.98 MHz	Operational fixed
153.05-173.4 MHz	Base and mobile
406.025-467.525 MHz	Base, mobile, and operational fixed

Motion Picture Radio Service. Eligible to operate stations in the motion picture radio service are persons engaged in the production or filming of motion pictures, or a nonprofit organization formed for the purpose of furnishing a radio communication service solely to persons engaged in one of these activities. The available frequencies are listed in Table 11.

TABLE 11

Motion Picture Radio Service Frequency Allocations

27.235-27.275 MHz	Base, mobile, and operational fixed
72.02-75.98 MHz	Operational fixed
152.87-173.375 MHz	Base and mobile
952-960 MHz	Operational fixed

Relay–Press Radio Service. Those eligible to operate stations in the relay—press radio service are persons engaged in the publication of a newspaper or in the operation of an established press association; or, a nonprofit organization formed for the purpose of furnishing a radio communication service solely to persons who are actually engaged in one or more of these press-related activities.

Frequencies assigned to this service are listed in Table 12.

Special Industrial Radio Ser-

vice. Eligibility for special industrial radio service is limited to those engaged in plowing, soil conditioning, seeding, fertilizing, or harvesting for agricultural or forestry activities; spraying or dusting insecticides, herbicides, or fungicides in areas other than enclosed structures; livestock breeding; maintaining, patrolling, and repairing gas or liquid-transmission pipelines, tank cars, water or waste-disposal wells, industrial storage tanks, or distribution systems of public utilities; acidizing, cementing, logging, perforating, or shooting activities, and similar services incidental to the drilling of new oil or gas wells, or the maintenance of production from established ones; supplying of chemicals, mud, tools, pipe, and other unique materials or equipment to the petroleum production industry as the primary activity of the applicant; delivering ice or fuel to the consumer in solid, liquid, or gaseous form for heating, lighting, refrigerating, or power-generation purposes by means other than pipelines or railroads; or delivering and pouring of ready-mixed concrete or hot asphalt mix.

Frequency assignments are listed in Table 13.

Business Radio Service. The business radio service is something of a catchall for activities not otherwise encompassed by the industrial radio service, nor included in the public safety or transportation categories. Users of this service are: businesses, schools, charitable organizations, churches, hospitals, clinics, and medical associations; or anyone providing a nonprofit radiocommunications service for any of the above.

Bands in which the business radio authorizations are made by the FCC are listed in Table 14.

Industrial Radiolocation Radio Service. Allocations in this service are made to concerns that must establish a position, distance, or direction by means of radio for purposes besides navigation. Examples of such concerns are those engaged in geographical, geological, or geophysical activities. Frequency allocations for this service are in the LF, MF, and VHF and high bands. Specific bands used are 1.605 to 1.8 MHz, and 3.23 to 3.4 MHz.

Manufacturers Radio Service. This is a service for factories, shipyards, or mills employing power-driven machinery and material-handling equipment to manufacture or merely assemble some product. Concerns that are primarily wholesalers, retailers, or providers of services are not eligible for licenses in this service, but are eligible for licenses in the business radio service.

Frequencies employed in the manufacturers radio service are in the ranges listed in Table 15.

Telephone Maintenance Radio Service. Assignments in this service are made to telephone companies and others providing wireline or radio communications services to the public for hire.

The telephone maintenance bands are given in Table 16.

Land Transportation Radio Services

The various modes of land transportation—railroads, trucks, buses, and automobiles—are served by land transportation stations. Also, organizations such as the American Automobile Association are eligible for licensing in this service.

Motor-Carrier Radio Service. This service is used by truckers, bus lines, moving and storage companies, or by a nonprofit organization furnishing radio communications to any of these on a shared-cost basis.

The frequencies used in the motor-carrier radio service are in the bands listed in Table 17.

Railroad Radio Service. Railroads were among the earliest industrial users of two-way radio.

Frequency allocations for the Railroad Radio Service are listed in Table 18.

Taxicab Radio Service. Those eligible to operate stations in the taxicab radio service are persons regularly engaged in furnishing to the public a nonscheduled passenger land transportation service not operated over a regular route or between established terminals.

TABLE 12

Relay-Press Radio Service Frequency Allocations

27.235-27.275 MHz	Base, mobile, and operational fixed
72.02-75.98 MHz	Operational fixed
173.225-173.375 MHz	Base and mobile
452.975-458 MHz	Base and mobile
952-960 MHz	Operational fixed

TABLE 13

Special Industrial Radio Service Frequency Allocations

2.292-4.6375 MHz	Base and mobile
27.235-49.58 MHz	Base, mobile, and fixed or operational fixed
72.02-75.98 MHz	Operational fixed
151.505-173.4 MHz	Base, mobile, and operational fixed
406.05-465.625 MHz	Base and mobile
952-960 MHz	Operational fixed

TABLE 14

Business Radio Service Frequency Allocations

27.235-43.0 MHz	Base, mobile, and operational fixed
72.02-75.98 MHz	Operational fixed
150.815-173.4 MHz	Base, mobile, and operational fixed
406.05-465.975 MHz	Base, mobile, and operational fixed
952-960 MHz	Operational fixed

TABLE 15

Manufacturers Radio Service Frequency Allocations

27.235-27.275 MHz	Base, mobile, or fixed
153.05-158.43 MHz	Base and mobile
451.175-467.525 MHz	Base and mobile

TABLE 16

Telephone Maintenance Radio Service Frequency Allocations

27.235-43.16 MHz	Base, mobile, and fixed
151.985-158.34 MHz	Base and mobile
451.175-467.525 MHz	Base and mobile

TABLE 17

Motor-Carrier Radio Service Frequency Allocations

27.235-27.275 MHz	Base, mobile, and operational fixed
30.66-44.6 MHz	Base and mobile
72.02-75.98 MHz	Operational fixed
159.495-160.2 MHz	Base and mobile
452.325-457.875 MHz	Base and mobile
952-960 MHz	Operational fixed

When you install a B-T Booster outside, you get a lot of new boosters inside.

The service technician's job is a tough one. Customers are always grumbling about the high cost of TV service calls. And they complain about poor reception—even when it's almost impossible to get a good signal.

But now and then a TV service technician wins one. And one of the products that can make him a winner, and create customer goodwill, is a Blonder-Tongue outdoor booster.

B-T Boosters can produce a dramatic improvement in picture quality, particularly on color and especially in difficult reception areas. After 25 years of making outdoor boosters, B-T is number one in sales, and enjoys the finest reputation for making products of highest performance and reliability. B-T Boosters do cost a bit more than competition, but they perform and last longer. And that's what makes satisfied customers.

The VAULTER, for example, is the number one outdoor booster today in the B-T line... *and* in the entire industry. This ultra-high performance, all-channel amplifier offers the ideal combination of lowest possible noise figure (4.6dB, VHF; 7.0dB, UHF) and high gain (15dB). While it can't make unusable, snowy pictures perfect, it *can* reduce fading, loss of color, overcome cable loss and reduce lead-in cable noise. It can even feed more than one TV set from the same antenna in fringe reception areas. It has separate U/V inputs and a coax output. Finally, it's specially designed for lightning prone areas.

The B-T line consists of 5 all-channel models (including the popular VOYAGER); 5 VHF models and 4 UHF boosters (the ABLE-U2bis a favorite).

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S&S COMM CONTINUED...

The frequencies used in the taxicab radio service are given in Table 19.

Automobile Emergency Radio Service. Those eligible to operate stations in this service are associations of owners or private automobiles that provide emergency road service, and public garages operating vehicles used in emergency road service. The frequencies of the automobile emergency road service are listed in Table 20.

AVIATION RADIO SERVICES

The aviation radio services cover 17 classifications of aircraft and ground stations—some used for communications, some for navigation, and some for both.

Almost all stations licensed in the aviation radio services use amplitude modulation. There are some FM hand-held, vehicular and base units, but they are licensed in the business radio service.

Pilots of departing aircraft communicate with the control tower on the appropriate *ground control* frequency for taxi and clearance information, and remain on that frequency until they are ready to request takeoff clearance. At that time, the pilot switches to the *control tower* frequency.

The airport ground control frequencies of 121.7 and 121.9 MHz are normally provided to eliminate frequency congestion on the tower frequency.

In general, control towers operate on different frequencies. The frequency at which a specific control tower operates may be obtained from aeronautical charts published by the U.S. Coast and Geodetic Survey, or from the Airman's Information Manual, published by the Federal Aviation Administration. There is, however, an additional "standard" frequency for transmission from control towers: 122.5 MHz.

A Flight Service Station (FSS) is a facility operated by the FAA to provide flight assistance to aircraft. Common FSS transmitting frequencies are 122.1, 122.2, 122.3, 122.6, and 123.6 MHz.

Unicom stations are privately owned stations used for communicating with private aircraft. These stations are frequently operated by aircraft sales and service organizations. Unicom stations do not issue clearances to aircraft, but at airports with no FAA control tower they provide an advisory service concerning air traffic, wind, altimeter setting, and so forth. At stations *with* a control tower, a Unicom station provides communications not related to safety of flight. A pilot might use such a station to order a taxicab before landing, for example. Unicoms operate at 122.8 MHz at airports with no control tower, and at 123.0 MHz at airports that have a control tower.

MARITIME RADIO SERVICE

One of the earliest practical applications of radio was summoning aid for ships in distress. This is, of course, still the most important application of the maritime radio service. Other important applications include: (1)1 obtaining navigational and weather information, (2) arranging for passage through locks, bridges, and waterways, (3) arranging rendezvous with tugboats and other vessels, and (4) making telephone calls to points on land.

Most ocean-going and Great Lakes vessels are required to have two-way radio facilities on board. Also, *any* vessel that is transporting more than six persons for hire and is operated on the open seas or in any U.S. tidewater adjacent to the open seas must have two-way radio. Ocean-going vessels also have radio*telegraph* facilities. Many small boats on inland waterways and lakes have two-way radios, even though they are not required to by the FCC.

Older marine units operate in the so-called 2 to 3 MHz band, which is actually a band of frequencies between 1.6 and 2.85 MHz. Specific frequencies in this band are reserved for specific purposes. For example, there are a number of frequencies for ship-to-ship communication. On these frequencies, direct communication is allowed between all ships licensed for this band. Other frequencies in the band are reserved for ship-to-shore communication. Communications with shore is restricted to contact with Coast Guard stations, *limited private shore stations,* and *commercial shore stations.*

Limited private shore stations may be operated by persons engaged in the operation of commercial vessels, and are used mainly for communicating with the vessels operated by the station owner. However, these stations may also sometimes communicate with the vessels of other licensees.

Commercial shore stations are used to provide telephone service to ships. These stations, concentrated along shorelines and waterways, are linked to the national telephone system. To receive calls, the shipboard receiver is left on, tuned to the frequency of the coastal station from which a call may be expected.

Besides the 2 to 3 MHz band, there are other marine bands in the LF, HF, and VHF spectrums. The trend now is toward the use of the VHF band by stations that operate within about 50 miles of shore. This band includes marine channels between 156.3 and 157.4

TABLE 18
Railroad Radio Service Frequency Allocations

27.235-27.275 MHz	Base, mobile, and operational fixed
72.02-75.98 MHz	Fixed
160.215-161.565 MHz	Base and mobile
452.325-457.95 MHz	Base and mobile

TABLE 19
Taxicab Radio Service Frequency Allocations

27.235-27.275 MHz	Base, mobile, and operational fixed
152.27-157.71 MHz	Base and mobile
452.05-457.5 MHz	Base and mobile

TABLE 20
Automobile Emergency Radio Service Frequency Allocations

27.235-27.275 MHz	Base, mobile, and operational fixed
150.815-157.5 MHz	Base and mobile
452.925-457.6 MHz	Base and mobile

Imperial Electronics installers
Dean Johnson and Pete Childers say:

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Installers in Every Part Of the U.S. Praise Chromstar Performance, Construction.

Imperial Electronics of Joliet, Ill. is no exception. They state "We sell and install Winegard antennas because we consider Winegard to be the best manufacturer, making the strongest and best performing TV antennas, the Chromstar Line.

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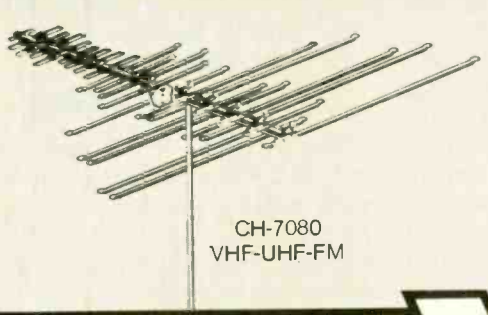
Because the Winegard name is so well known, and we have full confidence in their products, we feature them in our newspaper and radio advertising. This boosts our sales, and keeps us busy putting up Winegard antennas in our area."*

*Upon request, a copy of the letter from Mr. Johnson and Mr. Childers will be sent to you.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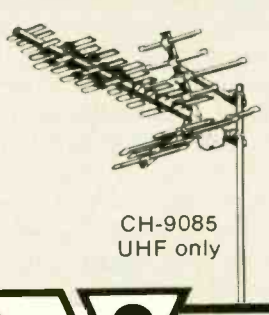
VHF-UHF-FM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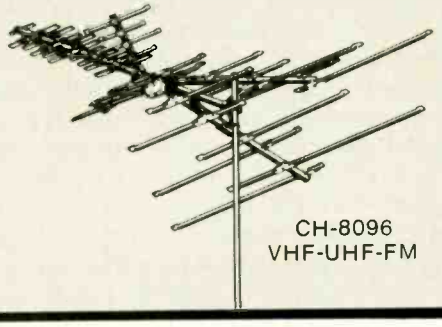
UHF only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MHz, and marine telephone channels between 161.9 and 162.0 MHz. Besides the natural advantages of the VHF band, that band has much less congestion.

Stations in the 2 to 3 MHz band have employed double-sideband AM for telephony, but recently the FCC has moved to require these stations to convert to single-sideband operation. Stations in the increasingly important VHF band use FM.

AMATEUR RADIO SERVICE

Relatively speaking, the amateur radio service is loosely regulated, and it is a tribute to amateurs that the amateur bands tend to be fairly orderly. Frequencies authorized for amateur use range from 1800 kHz to well beyond 40 GHz. Fifteen different types of emissions are authorized, and just about every conceivable type of emission is actually used. Furthermore, the equipment used by amateurs, unlike the equipment used by other services, need not be approved specifically by the FCC. In fact, a great many amateurs build their own transmitters, antennas, and so on. The equipment used must, however, meet certain technical standards.

Every amateur station must have a fixed transmitter location. Only one fixed transmitter location will be authorized per callsign, but one amateur may have many callsigns. The fixed transmitter location is designated on the license for each amateur station. These are exceptions: When remote control is authorized, the location of the control position as well as the location of the remotely controlled transmitter are considered fixed transmitter locations and are so designated on the station license. Unless remote control of the transmitting apparatus is authorized, such apparatus must be operated only by a duly licensed amateur radio operator present at the location of such apparatus. Besides a fixed transmitter, many amateurs also operate portable (hand-carried) and mobile (vehicular, airborne, or shipboard) transmitters.

An amateur station may be used to communicate only with other amateur stations, except that in emergencies or for test purposes it may also be used temporarily for communication with other classes of stations licensed by the Commission, and with the United States Government stations. Amateur stations may also be used to communicate with any radio station other than amateur which is authorized by the Commission to communicate with amateur stations. Amateur stations may be used also for transmitting signals or energy to receiving apparatus for the measurement of emissions, temporary observation of transmission phenomena, radio control of remote objects, and for similar experimental purposes.

CITIZENS RADIO SERVICE

The purpose of CB radio is to provide for private short-distance radio communications service for the business or personal activities of licensees, for radio signaling, for the control of remote objects or devices by means of radio—all to the extent that these uses are not specifically prohibited.

There are three different classes of CB Stations:

Class A

Class A stations in the citizens radio service are licensed to be operated on an assigned frequency in the 460-470 MHz band and with input power of 60 watts or less.

Class A stations may be authorized as mobile stations, base stations, fixed stations, or as stations to be operated at unspecified or temporary locations.

Class A stations in this service will normally be authorized to transmit AM or FM telephony only. However, the use of tone signals or signaling devices solely to actuate receiver circuits such as tone-operated squelch or selective-calling circuits, the primary function of which is to establish or establish and maintain voice communications, is permitted. The use of tone signals solely to attract attention is prohibited.

Class C

Class C stations in the citizens radio service are licensed to be operated on an authorized frequency in the 26.96-27.23 MHz band, or on the frequency 27.255 MHz, for the control of remote objects or devices by radio, or for the remote actuation of devices that are used solely as a means of attracting attention, or on an authorized frequency in the 72-76 MHz band for the radio control of models used for hobby purposes only.

Class C stations in this service are authorized to use amplitude tone modulation or on-off unmodulated carrier only, for the control or remote objects or devices by radio or for the remote actuation of devices that are used solely as a means of attracting attention. The transmission of any form of telegraphy, telephony, or record communications by a Class C station is prohibited. Telemetering, except for the transmission of simple, short-duration signals indicating the presence or absence of a condition or the occurrence of an event, is also prohibited.

Class C stations are authorized as mobile stations but may be operated at fixed locations under some circumstances.

Class D

Class D stations in the citizens radio service are licensed to be operated on an authorized frequency in the 26.96-27.23 MHz band or on the frequency 27.255 MHz with input power of 5W or less, and for radiotelephony only.

Class D stations are authorized to use amplitude voice modulation, including single-sideband and reduced or suppressed carrier, for radiotelephone communications only. However, the use of tone signals or signaling devices solely to actuate receiver circuits such as tone-operated squelch or selective-calling circuits, the primary function of which is to establish or establish and maintain voice communications, is permitted. The use of tone signals solely to attract attention or for the control of remote objects or devices is prohibited.

Class D stations are authorized as mobile stations but, as with Class C stations, may be operated at fixed locations under certain prescribed circumstances.

TECH BOOK REVIEW

Title: *The Complete FM 2-Way Radio Handbook* (TAB BOOK No. 735)
Author: Clayton L. Hallmark
Price: $9.95 hardbound
$6.95 paperbound

S&S COMM CONTINUED...

Published: December 1974
Size: 294 pages, 111 illustrations.
Publisher: TAB BOOKS, Blue Ridge Summit, Pa. 17214

This all-in-one guidebook covers *both* servicing and operation of transmitters and receivers for police and firemen's radio, taxicab and business radio, boaters' radio, amateur radio and citizen's band. Starting with explanations of types of systems (simplex, duplex, repeater, remote-controlled), types of stations (fixed, land, base, mobile, land mobile, etc.), FCC technical terms, types of emissions, and technical standards, author Hallmark covers every facet of the field before introducing the technical aspects of radio theory and two-way servicing. This serves as a broad-spectrum refresher course in radio fundamentals (with emphasis, of course, on FM and PM).

This practical handbook will prove particularly valuable to servicers of VHF radio, who are more and more frequently finding themselves immersed in the sprawling field of FM communications, remote base-station operation, and repeaters. The author, recognizing this, has included much detailed information on transmitter and receiver alignment and adjustment, in addition to descriptions of the requirements for test equipment needed in servicing communications systems. In fact, there's virtually a book within a book on such gear as wavemeters, wattmeters, signal generators (FM and audio), frequency counters, and all-in-one service monitors.

A representative sampling of FM two-way radio equipment is explained and illustrated to give the reader a feel for the systems he'll be servicing. With the information in this book and the appropriate manufacturer's service manual, the reader should be able to service any FM transceiver—tube-type or solid-state—with complete confidence. This should enable him to take advantage of the growing opportunities in the field of 2-way radio service. (This book is intended to take up where the license study guides and radio courses leave off, to give the reader the best possible help short of actual experience).

The author goes into elaborate detail in the actual setup and checkout of repeaters, remotes, base stations, mobile units, hand-held portables, as well as station accessory items such as wireline control terminals and repeater logic elements. This up-to-date volume concentrates on solid-state gear throughout—which includes the types of equipment found in actual service applications.

Most of the information in this book is applicable to all radio services, since the principles of FM communication are essentially the same whether the user is an amateur, a commercial enterprise, or a yachtsman. Where distinctions are significant, however, they are covered in the final chapters, where amateur radio, citizens band radio (now being considered for FM authorization by the FCC) and marine VHF FM radio are discussed separately.

To make this new text really complete, three Appendices are included: *Technical Standards for Amateur Operation,* which includes applicable excerpts from FCC rules governing operation in the amateur service; *FCC Rule Excerpts Pertaining to Citizens Band;* and *Recommended Test Equipment,* which includes information that applies equally to all radio services.

CONTENTS: Two-Way Radio Fundamentals—The Mobile Radio Services—Review of FM Fundamentals—Transmitter Principles and Circuitry—Receiver Principles and Circuitry—Two-Way Radio Equipment—Test Equipment—Transmitter Adjustment and Alignment—Servicing Control Systems—Servicing Hand-Held Units—Amateur Radio—Citizens Band FM—VHF-FM Marine Radio—Appendices. Index. ■

Profits soar with the new Silver Eagle Push-to-Talk

Now the world famous Astatic D104 Grip-to-Talk desk stand has been given even more versatility with the addition of a Push-to-Talk bar. And a slide lock clamp for "no hands" transmission. Operation couldn't be easier!

The Silver Eagle couldn't be more attractive in appearance either. Astatic has chrome plated all exterior parts, the base and handle to a brilliant mirror finish.

Technically the Silver Eagle has convenience built in, too. Astatic factory wires this great microphone for universal hook-up application—easily converted to electronic or relay operation. Wired with an open audio line on receive and comes with a 5 conductor plus shield coil cord. Switching requirements determined by proper hook-up at the plug end of cable.

Start profits soaring with the new super-versatile Silver Eagle microphone from Astatic. Call or write for details.

THE ASTATIC CORPORATION

CONNEAUT, OHIO 44030

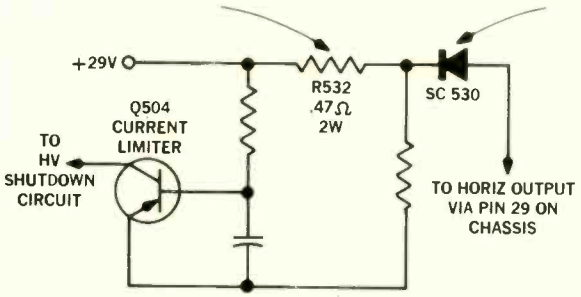
...for more details circle 107 on Reader Service Card

TECHNICAL DIGEST

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

CHASSIS: GTE Sylvania E08

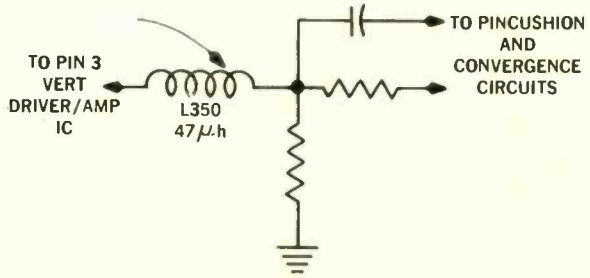
TROUBLE SYMPTOM: Picture and sound absent.



CAUSE: Diode SC530 shorted, burning open R532.

CHASSIS: GTE Sylvania E08

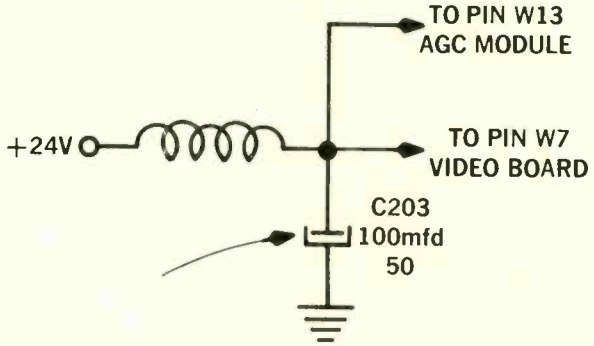
TROUBLE SYMPTOM: Vertical sweep absent



CAUSE: Choke L350 open

CHASSIS: Zenith 25FC45

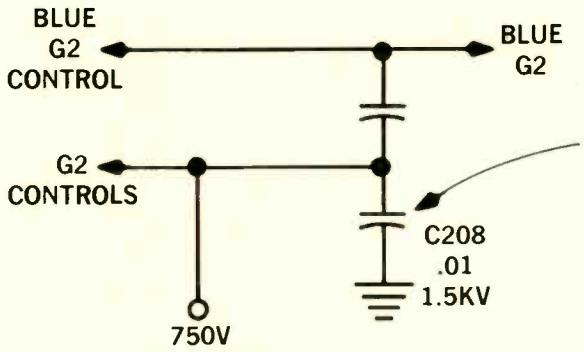
TROUBLE SYMPTOM: Horizontal sync loss; vertical bar moving through raster (windshield wiper effect).



CAUSE: Capacitor C203 defective

CHASSIS: Zenith 25FC45

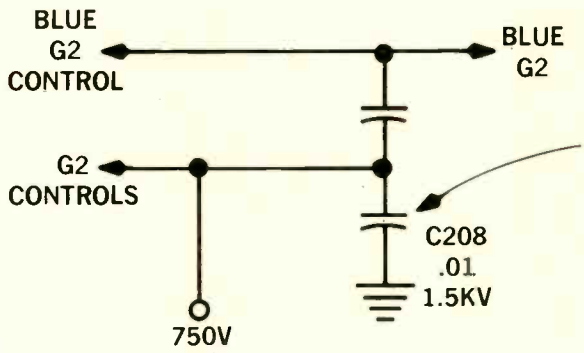
TROUBLE SYMPTOM: Color fidelity poor overall; color smeared on edges of dark objects in picture; G2 voltage reduced; absence of setup line in service position of NORMAL/SERVICE switch.



CAUSE: Leaky C208. About 5 megohms of leakage measured across C208.

CHASSIS: Zenith 25FC45

TROUBLE SYMPTOM: Low brightness; absence of setup line in service position of NORMAL/SERVICE switch.



CAUSE: Leaky or shorted C208, in CRT screen grid circuit. About 100K ohms of leakage measured across C208.

CHASSIS: General Electric MB-75, MC (no illustration)

TROUBLE SYMPTOM: Adjacent-channel interference (higher channel stronger) evidenced by display of video and/or blanking bar of the adjacent higher channel

CAUSE: Need for slight readjustment of L202, the 39.75-MHz trap on the video IF module. Tune the receiver to a weak VHF channel below a strong channel; switch on AFC; rotate the slug of L202 *clockwise* to a position which eliminates or minimizes the adjacent-channel video and/or blanking bar, *but do not turn the slug of L202 more than 180 degrees.*■

TEST INSTRUMENT REPORT

For more details circle 166 on Reader Service Card.

PHILIPS 15-MHz DUAL-TRACE SCOPE

■ Philips Test & Measuring Instruments, Inc., recently announced that it is offering three new service-type test instruments through Magnavox Parts Centers, located in Fort Wayne, Indiana; East Rutherford, N.J.; Greeneville, Tenn.; Atlanta; Cleveland; Chicago; and Los Angeles.

One of the three new service-type test instruments is an all-solid-state, triggered-sweep, dual-trace scope, Model PM 3226 (bottom unit in accompanying photo).

The vertical amplifiers of the PM 3226 have a bandwidth (−3 dB) of DC to 15 MHz in the direct-coupled (DC) mode and 2 Hz to 15 MHz in the capacitive-coupled (AC) mode. Maximum permissible input is + 400 V (DC + AC peak).

The sensitivity range of the two vertical amplifier channels is 2 mV/div. to 10V/div. in twelve calibrated steps, with display on a 3-inch (apprx.) screen equipped with an external, nonilluminated 8x10-division graticule. Vertical channel input impedance is 1 megohm shunted by 25 pF of capacitance. Risetime is 23 ns.

The input signal of either vertical channel can be displayed separately (single-trace display) or both can be displayed simultaneously (dual-trace display) in either an alternate or chopped (400 KHz) mode.

Both vertical channels are equipped with a pushbutton-operated provision which opens the input circuit and grounds the input of the amplifier to establish a zero reference trace for DC level measurements.

The horizontal amplifier of the PM 3226 has a bandwidth (−3 dB) of DC to 1 MHz and an external input impedance of 1 megohm shunted by 25 pF. The sensitivity of the horizontal amplifier is 5 V/div. A switch-operated provision increases the horizontal amplifier gain by a factor of 5 (1 V/div. sensitivity) to permit magnified display of a portion of the trace. Maximum permissible input to the horizontal amplifier is + 400 volts (DC + AC peak).

The time-base generator of PM 3226 operates in either a free-running or triggered mode and provides 18 calibrated sweep speeds over a range of .2 sec/div. to .5μ sec/div., with manual adjustment possible between calibrated sweep-speed settings. When no trigger signal is applied to the time-base generator, or when the trigger level is not sufficient to inititate sweep, as determined by the setting of the trigger level control, the time base generator operates in the free-running mode and, consequently, a horizontal trace is produced to facilitate scope preliminary setup adjustments.

The time-base generator can be triggered on by an external signal applied to the trigger section via a BNC type connector labeled "TRIG or X EXT" on the front panel of the scope, or it can be triggered on by signals applied internally from either Channel A or B or, for "line triggering", by a 60-Hz signal from the power transformer of the scope. "Level" and "±" slope controls establish which portions of the trigger signal will turn on the time-base generator in the triggered mode.

Triggering by either TV line (15,750 Hz) or frame (60 Hz) signals is facilitated by a built-in sync separator and peak detector. When the TV/NORMAL pushbutton is depressed to the "TV" position, the time base is automatically triggered by the vertical sync pulses of the composite TV signal if the TIME/DIV switch is in any one of the positions between .5 ms/div. and 200 ms/div., and by the horizontal sync pulses if the TIME/DIV switch is in any of the positions between .2ms/div. and .5μs/div.

A pulse for compensation of probes is provided at a "touch contact," labeled "PROBE ADJ," on the front panel.

The Model PM 3226 is 5.4 inches high, 11.9 inches wide, 12.4 inches long and weighs 9 pounds, 10 ounces. The price—including a protective front cover, two BNC-4mm adapters and an operating manual—is $650. Optional accessories available include passive low-capacitance probes, passive direct probes, a 2 KV (100:1) passive probe and a set of miniature probe clips.

A single-trace scope with electrical specs identical to those of the PM 3226 also is available. This scope, Model 3225 (top unit in the accompanying photo), is priced at $495.

B&K—PRECISION SEMICONDUCTOR TESTER

B&K-Precision recently introduced a new battery-operated seminconductor tester, the Model 510, which performs good/bad testing of bipolar transistors, FETs, SCRs, and monolithic and hybrid Darlington transistors—both in and out of circuit.

The Model 510 provides two switch-selectable levels of base current: In the "LO" position, which is always used first, a 1-mA (5Hz, 2% duty cycle) pulse is applied, permitting valid good/bad testing in circuits with shunt resistances as low as 1.5 K ohms and shunt capacitances as high as .3 mfd. In the "HI" position, a 250-mA (5Hz, 2% duty cycle) pulse is applied, permitting valid good/bad testing in circuits with shunt resistances as low as 10 ohms and shunt capacitances up to 25 mfd.

For more details circle 167 on Reader Service Card.

Good/bad testing of bipolar transistors either in or out of circuit with the Model 510 is accomplished in the following manner:

1) The three color-coded, clip-type test probes are attached in a random manner to the three element leads of the transistor (or, if out of circuit, the transistor optionally can be plugged into the socket on the front panel).

2) The OFF/LO/HI switch is placed in the "LO" position.

3) The TEST switch is rotated through its six positions. If the transistor is okay, either the NPN/OK or PNP/OK LED-equipped indicator on the front panel will light up. This not only tells you that the transistor is okay, but also identifies the transistor type (NPN or PNP) and, by matching the color coding of the TEST switch position with that of the three test

probes, you can quickly identify which transistor lead is the base, which is the emitter and which is the collector.

4) If the transistor is being tested in-circuit, and neither the NPN/OK nor PNP/OK light is illuminated on any position of the TEST switch, the OFF/LO/HI switch should be moved to the "HI" position and the previously described procedure repeated. If in the "HI" position neither light is illuminated in any position of the TEST switch, the transistor then should be removed and tested out of circuit.

FETs and SCRs are tested in and out of circuit by the Model 510 in the same manner as bipolars, except that FETs are identified either as N- or P- Channel and the gate lead is identified (source and drain are functionally interchangeable).

The Model 510 is powered by four AA batteries. A flashing LED-equipped indicator on the front panel serves as a reminder to turn off the unit when it is not in use, thereby prolonging battery life.

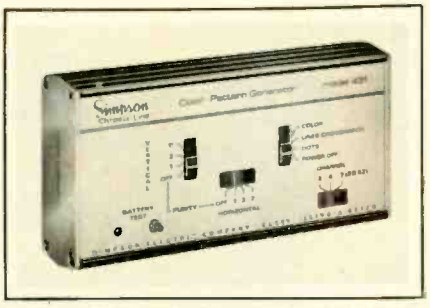
The unit is 3.75 inches wide, 6.63 inches deep, 1.75 inches high, and weighs 1 pound (less batteries, which are not supplied with the unit).

Price of the Model 510—with carrying case and clip-on test leads—is $90.

SIMPSON COLOR GENERATOR

Simpson Electric Company's new battery-powered color TV pattern generator, Model 431, weighs but 13 ounces and is only slightly over 3 inches high by 6 inches wide by 1.4 inches deep, yet produces 28 different color TV patterns—including an ungated rainbow, for color killer adjustment; a ten-bar gated rainbow, for AFPC and color sync lock adjustments; a three-bar gated rainbow (RY, B-Y and-[R-Y]); a blank raster, for purity adjustments; single dot and single crosshatch, for static convergence and centering; eleven vertical lines, for horizontal linearity; seven horizontal lines, for vertical linearity; and combinations of three-by-three dots and crosshatch, and seven-by-eleven dots and crosshatch, for dynamic convergence.

Pattern selection is accomplished by three slide switches on the front panel, and a fourth slide switch selects one of five possible output channels—VHF Channels 3, 4 or 7 or, by use of harmonics, UHF Channels 23 and 52. The chroma and RF output levels are controlled by two thumbwheels on the side of the unit. The output is applied



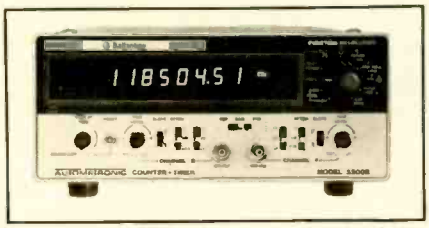
For more details circle 168 on Reader Service Card.

to the receiver's antenna terminals via a single shielded cable which plugs into the Model 431.

The price of the Model 431, complete with 9-volt *Alkaline* battery (NEDA type 1604A) and instruction manual, is $89.

UNIVERSAL COUNTER/TIMER

Ballantine Laboratories' Model 5500B Universal Counter/Timer with automatic microprocessor-controlled circuitry provides 10 modes of operation including frequency measurement capability up to 118 MHz. Automatic resolution and auto-ranging makes the instrument particularly suited to ATE (automatic test equipment) systems use where the ROM



For more details circle 169 on Reader Service Card.

used in the instrument's self-programming circuitry greatly simplifies and reduces the number of control lines and commands needed from the ATE system controller. Featured on the front panel is a "Resolution" control which guarantees full use of the most significant digit in any measurement; insuring against overflow or loss of data. The display uses new jumbo-sized digits with 0.43-inch high LEDs. Resolution is selectable in 5, 6, 7 or 8 digits.

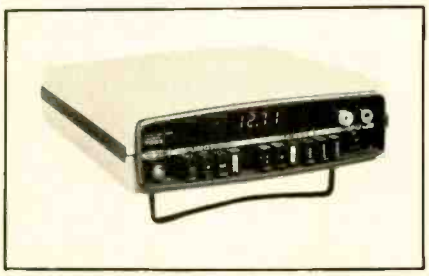
AUDIO GENERATOR

Pushbutton operation for easy switching of frequency ranges along with built-in solid state circuitry to hold distortion down to 0.1 percent are among the features of the Model LAG-120 sine/square audio generator from *Leader Instruments Corp.* The audio generator generates a wide range of sine and square waves from 10 Hz to 1 MHz. It offers external triggering through the use of the built-in trigger terminals and has a switchable output generator which ranges from 0 to 20 dB continuously variable with frequency accuracy at ±3 percent (+1 Hz). Input impedance is 10K while the synchronization range is ±1 percent per volt. Compact, portable and lightweight, the instrument measures 5-7/8 inches high by 5-3/16 inches wide by 9-13/16 inches deep and weighs approximately 6.5 lbs. It is priced at $219.95.

For more details circle 170 on Reader Service Card.

DIGITAL MULTIMETER

Systron-Donner introduced a new 3½-digit multimeter. This unit is the first unit design to include true RMS AC capability and a circuit-breaker current overload protection circuit. The Model 7003 has five complete functions, 26 ranges, 2000 count capacity, large 0.4-inch seven-segment LED display, and can be ordered with an internally-mounted battery option. Circuit design makes use of latest LSI technology to assure high reliability. Packaging design features an unbreakable case, simple push-button controls, and a pop-up stand that can be mounted to either tilt the unit up or down for convenient bench use. Price is $295. ■



For more details circle 171 on Reader Service Card.

THE COLUMN THAT SUPPORTS AMERICA.

You, the small businessman, are the very backbone of our country. The heart of free enterprise. The employer of millions.
But you're letting it down in one respect. By not supporting U.S. Savings Bonds.
While 40,000 American companies operate successful Payroll Savings Plans, comparatively few small businesses are among them.
Why?
Maybe you feel you're too busy?
Well, so is General Motors, but they have 92% participation in Payroll Savings.
Or maybe you just think you're so small you won't be missed?
But that's not true either. Small business is a big and powerful block. And it's desperately needed.
This nation still needs the kind of backbone small business has demonstrated in the past.
So won't you support Payroll Savings? And America?

Take stock in America.

Buy U. S. Savings Bonds

Ad Council A Public Service of This Magazine & The Advertising Council

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.

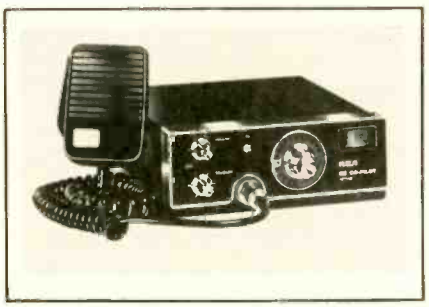
TRANSMITTER MONITOR 144

A pocket size transmitter monitor called "Radio-Sentry Mini-Meter" which makes rapid transmitter radiation checks, saving money and trouble on maintenance calls is introduced by

Electronic Specialists, Inc. Completed installation performance can be easily demonstrated to the customer. It provides a meter readout and does not require batteries or wires. Available for aviation, marine VHF, municipal and CB bands. Price $27.95.

MOBILE CB TRANSCEIVER 145

A new economy-priced mobile CB transceiver is being introduced by *RCA*. The RCA 14T100 Co-Pilot is a solid-state, 23-channel unit with up to 4 watts power output, with all channels frequency synthesized from built-in crystals. The new unit fea-



tures a PA function, and S/RF meter, transmit light, squelch control, automatic-level-control circuit, external speaker jack, and will operate from 12 volt DC, positive or negative ground. Suggested list price is $124.95.

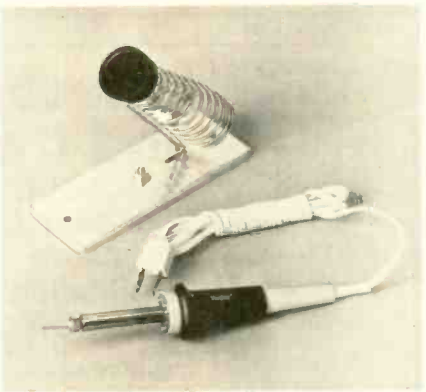
QUICK-DISCONNECT CONNECTOR 146

A new, quick-disconnect connector that connects and disconnects for fast installation and quick removal of CB radios and other mobile gear is avail-

able from *Breaker Corp.* The new device is designed to prevent equipment theft and make removal for base operations easier. QDC is insulated and polarized with a positive lock between male and female sections and is disengaged by pressure on flexible molded clasps on either side of connector. Sells for $2.95.

PENCIL/TYPE IRON 147

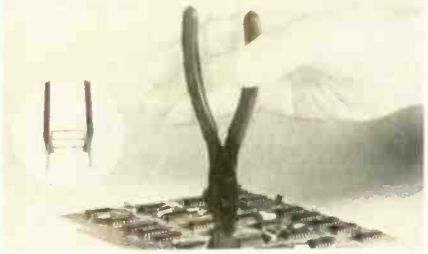
A new pencil-type iron with stainless steel barrel and a heat shield handle for hand comfort and secure grip has been introduced by *Weller-Xcelite Electronics*. The WP-25 iron has a selection of eight interchangeable double-coated tips for general



purpose soldering. With a nominal temperature range of 840 degrees F., the 25-watt iron is 7⅞ inches long and weighs only 1¾ ounces. An aluminum stand with non-heat-sinking spring and funnel that can be free standing or mounted is available.

IC EXTRACTOR TOOL 148

A newly designed IC extractor tool with a thin gripper for use on densely



...for more details circle 125 on Reader Service Card

populated circuit boards is now available from the *Air-Vac Engineering Co.* Constructed of hardened spring steel, the tool features gripper jaws that fit between leads on both sides of the IC. When lifting force is exerted, pressure is on the IC body, assuring removal without damage to leads. Comes with plastic-coated handles and tension controlled pivot. It is priced at $9.75.

MOBILE CB POWER SUPPLY 149

A compact, regulated, 12-volt DC power supply which converts mobile CB transceivers for use as base stations, has been introduced by the

Breaker Corporation. Powerful enough for SSB rigs, the Model 13-110 has a built-in pilot light and off/on switch. The unit will work with any automotive equipment requiring up to 2.5 amps continuous current and up to 5 amps temporary surge. Output voltage is 12-14 VDC regulated from a 120 VAC, 50-60 Hz line and has a circuit breaker.

DIP-IT-YOURSELF PLASTIC GRIPS150

A new plastic compound that allows you to make your own plastic grips on all kinds of hand tools is available from the *Brookstone Company.* With this new compound, you just dip the tool handle and let dry for 24 hours. It's a bright red in color and comes in a 13 fluid ounce can. Priced at $5.30.

SELF-SERVICE CRYSTAL DISPLAY 151

Retail customers will be able to locate specific monitor crystals by type and frequency with a new self-service wall display unit now available from the *United States Crystal Co.* Marking the introduction of the company's new

"Center Frequency" line of monitor crystals, the display has space for 600 crystals in blister-packages. The type and frequency is imprinted on each crystal for permanent, easy identification.

CB LIGHTNING ARRESTORS 152

Protection from static lightning charges is available with a new line of CB lightning arrestors being introduced by *AVA Electronics Corp.* Model LA76 is for use indoors or in a car or truck. Featuring a male and female end, it is installed between CB Antenna connector and antenna lead.

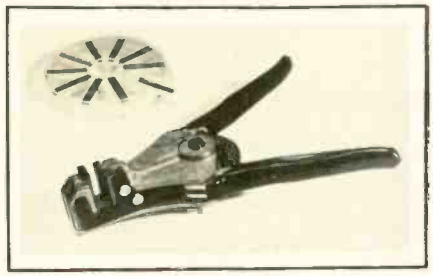
No. LA 76

No. LA076 OUTDOOR

Model LA076 is for use outdoors and has only female ends. The ground wire is connected from a screw on both models of the arrestor to water pipe or grounding rod. Both are usable also with TV receivers. Price for indoor model is $3.95, and for outdoor model, $3.50.

HAND WIRE STRIPPER 153

A new hand wire stripper that uses plastic blades is introduced by the *Alpha Wire Corporation.* The cutting edges, of Stilan plastic, are harder than insulation, but softer than copper, to allow them to strip insulation without damage to the conductors. The manufacturer states that the blades cutting edges last up to 50,000 strips on simple hook-up wire. Also strips any size wire from AWG 12 through AWG 28 with almost any type of insulation. It lists for $39.95, supplied with three sets of blades.



CB BASE STATION 154

A new 23-channel CB base station with a dual-conversion receiver is now introduced by *Pathcom, Inc.* It features a 3-P; transmitter network; an 'S' meter; PA circuit with front panel

control and speaker jack; ANL control for noise suppression; and transmit and receive mode indicator lights. It operates on 117 VAC or 13.8 V DC, plus or minus ground. Retail price is $159.95.

SEMICONDUCTOR BENCH ASSORTMENT 155

A new service bench assortment that features 20 types of RF power transistors most commonly used in recent CB transceivers is now available from *Workman Electronics*. The DS10 assortment comes in a bench top or shelf storage box accompanied by the company's X74 CB Semiconductor Cross Reference Guide. The 2SC semiconductors in the assortment are

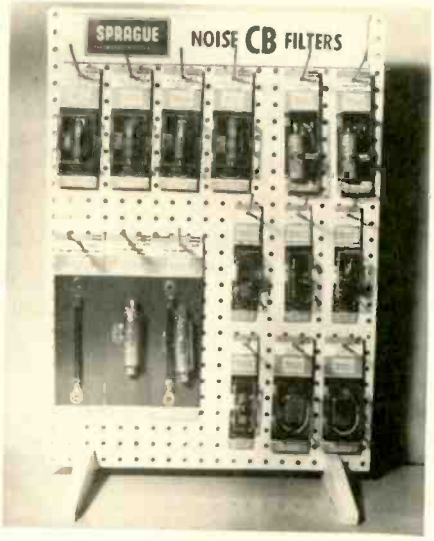
all off-shore manufactured and are exact replacements in accordance with original specifications. Priced at $132.50.

COAX SWITCH 156

A new coax switch for use with multiple antennas or multiple transceivers has been announced by *Kris, Inc.* The switch has three switched positions plus a 10-watt dummy load in the fourth position, for checking transceiver performance and SWR bridge calibration. It is housed in an anodized aluminum extrusion with input and output connectors located on the rear panel to facilitate both base or mobile mounting. Frequency range is up to 50 MHz. Priced at $12.95.

NOISE SUPPRESSION FILTERS 157

Vehicle-originated noise in CB and other two-way radio can be cleaned up with a new line of noise suppression filters now being introduced by *Sprague Products Co.* The line includes six filter types, and several installation hardware items. Four filters



are of feed-thru design for mobile applications, with ratings of 20, 40, 60 and 100 amperes. The fifth filter is a DC electrolytic power-line filter for mobile use, and the sixth is an AC power-line filter for fixed station 125/250 VAC application.

CAR FM SIGNAL BOOSTER 158

A new FM signal booster designed to help eliminate signal fade and flutter from weak FM signals is being offered by the *Finney Company*. Stereo One, for use with auto AM/FM radios, is a two piece unit with an amplifier section that mounts close to the radio and an "on-off" switch that self-mounts on the dash. The switch features an LED

indicator light. All necessary mounting hardware and instructions are included.

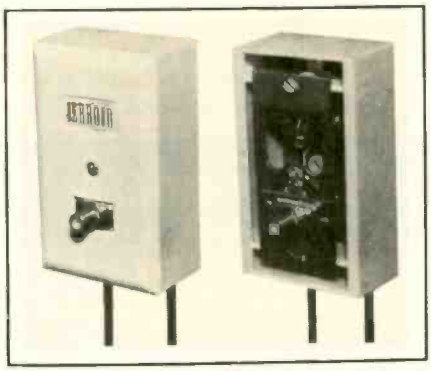
PHONOGRAPH NEEDLE 159

A new phonograph needle from *Astatic Corporation* will replace Tetrad-type needles. The new Unatet needle

can be installed and ready for use with a single slide adjustment. It is available with both diamond LP and sapphire 78 turnover tips.

MATV SURFACE MOUNT HOUSING 160

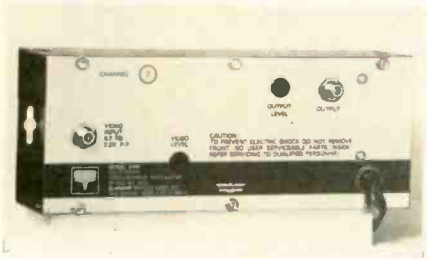
Designed for adding MATV systems to existing buildings, a new universal surface mount housing is now available from *Jerrold Electronics*. The new housing accepts virtually any type of



MATV tap-off and is made of high-impact plastic. It accepts cables via convenient break-away plastic sections, with room for both input and output cables. It can be used in the same way as a standard gem box that is used for concealed wiring. It lists for $1.00.

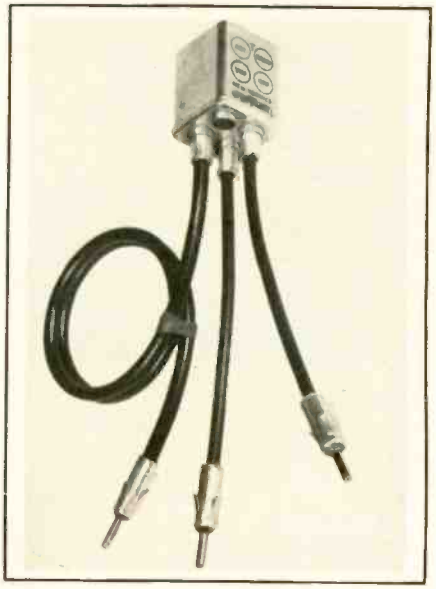
VIDEO CHANNEL MODULATOR 162

A new low-cost video channel modulator, the VCM-4924, for use in CCTV surveillance systems, has been introduced by *Blonder-Tongue Laboratories, Inc.* Video signals from a TV camera or other source, monochrome or color-TV, can be applied to an existing MATV system or to a single TV receiver or any unused VHF TV channel. Price is $99 with LC control, or $136 with crystal control.



AUTO ANTENNA SIGNAL SPLITTER 163

A new signal splitter that fulfills antenna requirements for mobile radio reception is introduced by *Hustler*. Called the Monitor-Match, the new splitter can be used with outside-mounted or windshield antenna for AM/FM radio & single, dual or all-band monitor radios from 25 to 175 MHz and 300 to 515 MHz. No permanent installation is required. It is priced at $8.95.



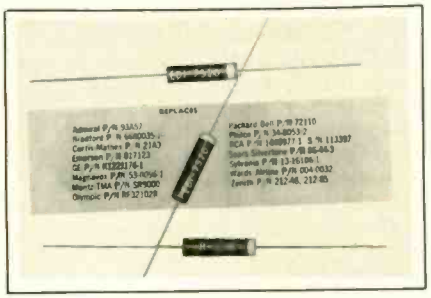
HIGH PASS FILTER MATCHING TRANSFORMER 164

A new high-pass filter/75-to-300 ohm matching transformer that blocks interference from CB, ham radio, two-way radio, X-ray, auto ignition noise, etc. is now offered by *RMS*

Electronics, Inc. The RMS 2600F transformer has miniaturized printed circuitry, shielded network & housing, & heavy duty twisted & tinned twin-lead. Frequency range is 50 to 300 MHz. A wide assortment of MATV hook-up cables in 6-, 9-, 12-, 15- & 25-ft. lengths is available.

REPLACEMENT SILICON FOCUS RECTIFIER 165

A direct silicon replacement for most selenium OEM focus rectifiers is now available from *Electronic Devices, Inc.* The silicon type is said to exhibit greater resistance to high temperature and heat aging. Specifications are 5mA and 8,000 peak reverse voltage.



TV SERVICING

Continued from page 18

TV and radio technicians were employed in TV servicing. This total is expected to drop to 126,000 by 1980. It should be noted, however, that increased service in cable TV, video-tape systems, and audio systems, may lead to an increasing demand for technicians."

2) "In 1970, approximately 40% of TV set failures were color sets. By 1980 this will have risen to 67%."

3) "In 1970, approximately 57% of the TV serivce was carry-in business. By 1980 this will have risen to 74%.

Summarizing their view of TV servicing in 1980, the researchers stated: "The TV service business in 1980, as compared to 1970, will be smaller and will service predominantly color TV sets and mostly carry-in business. Larger service facilities will be required to accommodate this increased carry-in business. This will entail larger rents and insurance costs." ■

CLASSIFIED

RATES: 35¢ per word: 45¢ per word Bold Face Type. Add $3.00 if you wish Box Number. Minimum $10.00 charge. Classified Display Rate billed $40.00 per inch, 1 inch minimum. Remittance must accompany order. Mail ad copy to: Roz Markhouse, ET/D, 757 3rd Ave., N.Y., N.Y. 10017.

Business Opportunities

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

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

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

TV SHOPS: Qualify for my telephone assistance to solve your "Tough Dog" TV repairs that waste bench space. Send resume and credit references: Melvin Cohen, Television Broadcast Engineer, May Company Building, 3651 Prospect Avenue, Riviera Beach, Fla. 33404. Enclose 13¢ addressed envelope. Be patient for my reply. 4/76

TV sales and service in same location 15 years. Retiring. Net $25,000. per year. $25,000 including truck. A. Bolin, 6361 Balsam Lake, San Diego, CA 92119. 4/76

Manuals and Periodicals

Convert any transistorized T.V. tuner to a tuner substituter. Plans $2.00. New accelerated Radio & T.V. course, RADIO TELEVISION TRAINING, Box 279, ET-46, Syracuse, N.Y. 13206 TF

SUPREME Television-Radio Diagram Servicing manuals discounted 50%. Information. Supreme Publications, 1760 Balsam, Highland Park, Illinois 60035. 4/76

Catalogs

CANADIANS SAVE BIG MONEY! SURPLUS, CLEAROUTS AND BANKRUPTCY INVENTORIES. HIFI AND PARTS. CATALOGS $1.00. ETCO-D ELECTRONICS. Box 741, MONTREAL H3C 2V2.

TV & RADIO TUBES .36¢ EA!! Send for free color parts catalog Your order free if not shipped in 24 hours. Cornell Electronics 4215-17 University San Diego California 92105

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

Construction Plans

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

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

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ELECTRONIC TECHNICIAN/DEALER CLASSIFIED

For Sale

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

DEALER INQUIRIES invited. Add color telephones and accessories to your sales. Send for additional information on business letterhead. Telectra Sales, Box 9218-ET, Richmond, VA 23227. 4/76

CONVERT YOUR B & K 465 OR 466 REJUVENATOR TO A POWERFUL C.R.T. RESTORER SYSTEM. Step by step detailed plans with pictures, parts-list and operating instructions $25.00. James Chancellor, 1708 Edgerly Ave., Albany, Georgia 31707. 4/76

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

TV Owners: Automatic, diagnostic, dial-a-fix, guaranteed to save you on your TV repairs, ($3.00) refundable. Tayo Paul, 980 Green Ave., Brooklyn, NY 11221. 4/76

COLOR TELEPHONES New American made with one year warranty. Free information or send $1.00 for color digest and prices. Telectra Sales, Box 9218-ET, Richmond, VA 23227. 4/76

FOR SALE: Telequipment, TLD67 dual trace triggered oscilloscope brand new w/probes...$925.00. Pickett, log slide rule Model 800-ES...$10.00. William Shevtchuk (201) 471-3798. 4/76

16 patterns—dots, lines, crosshatch, color-bar generator. Pocket size. CMOS — LSI chip. Complete plans — $5. Boards, parts, wired, complete kits also available. Workshop, Box 393E, Bethpage, NY 11714. 4/76

BURGLAR ALARM DIALING UNIT automatically calls police. $29.95. Easy to program and easy to install. Free literature. S&S Systems, 5619-E. St. John, Kansas City, MO 64123, (816) 483-4612. 4/76

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

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

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

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

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

Wanted

Wanted. Service Manual on Utility Monitor, T.V. video receiver. Manufactured by Conrac of California under RCA number TM-7DR-MI-26142D. Sold by Diebold, Inc. John E. Riley, 5229 Lucile Lane, Shawnee, Kansas 66203. 4/76

READER SERVICE INDEX

ADVERTISER'S INDEX

ELECTRONIC TECHNICIAN/DEALER

TEKFAX

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

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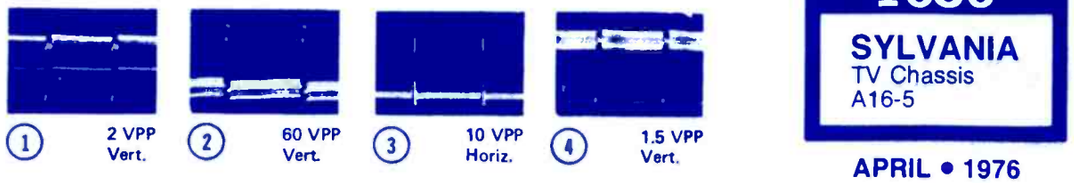
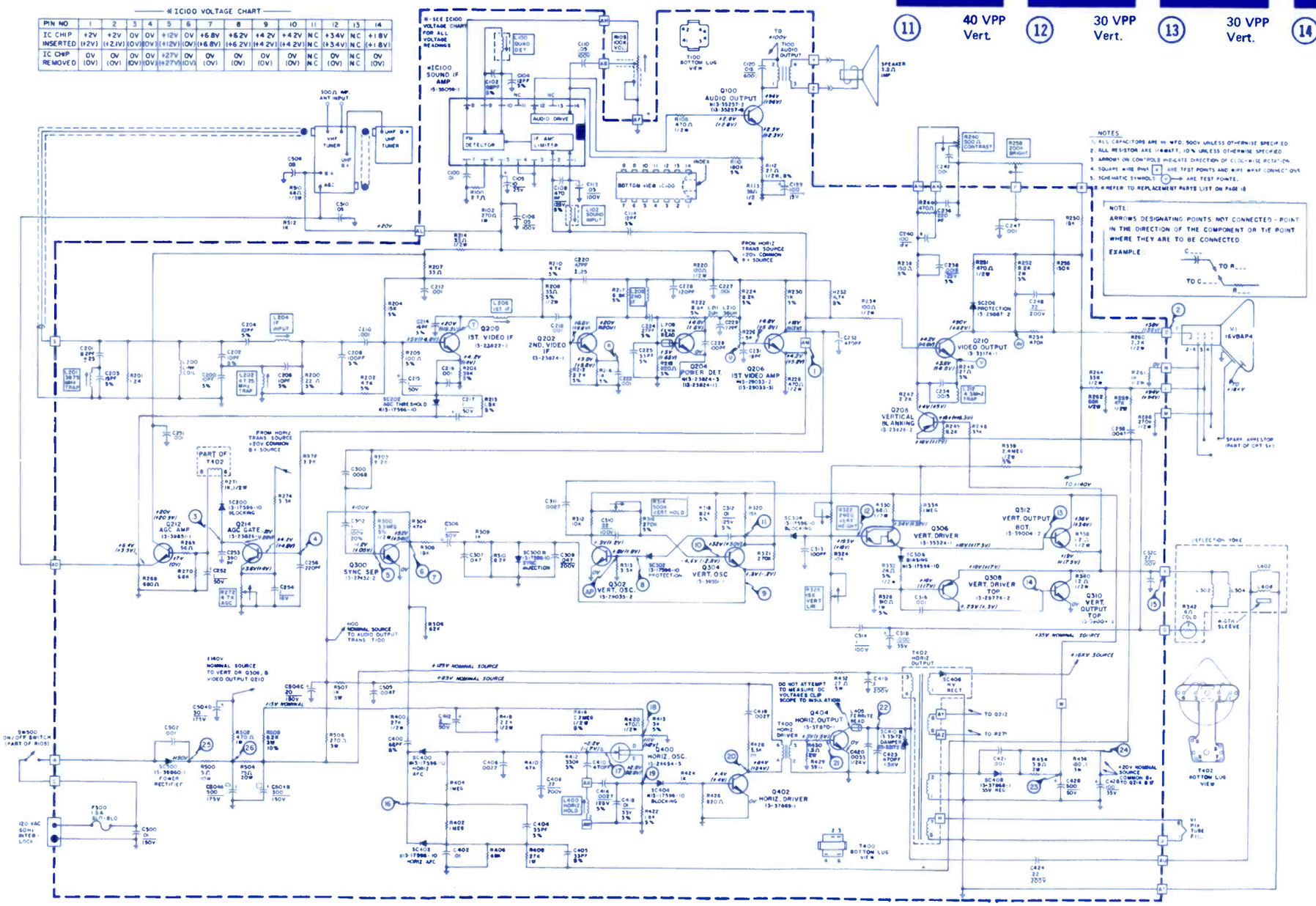
QUASAR Color TV Chassis TS-951	1638
SYLVANIA TV Chassis A16-5	1636
SYLVANIA Color TV Chassis E40-1	1639
ZENITH TV Chassis 12FB22X	1640

1636
SYLVANIA
TV Chassis
A16-5

APRIL • 1976





1637
ADMIRAL
Color TV Chassis
4M10C/H

ELECTRONIC TECHNICIAN/DEALER TEKFAX

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

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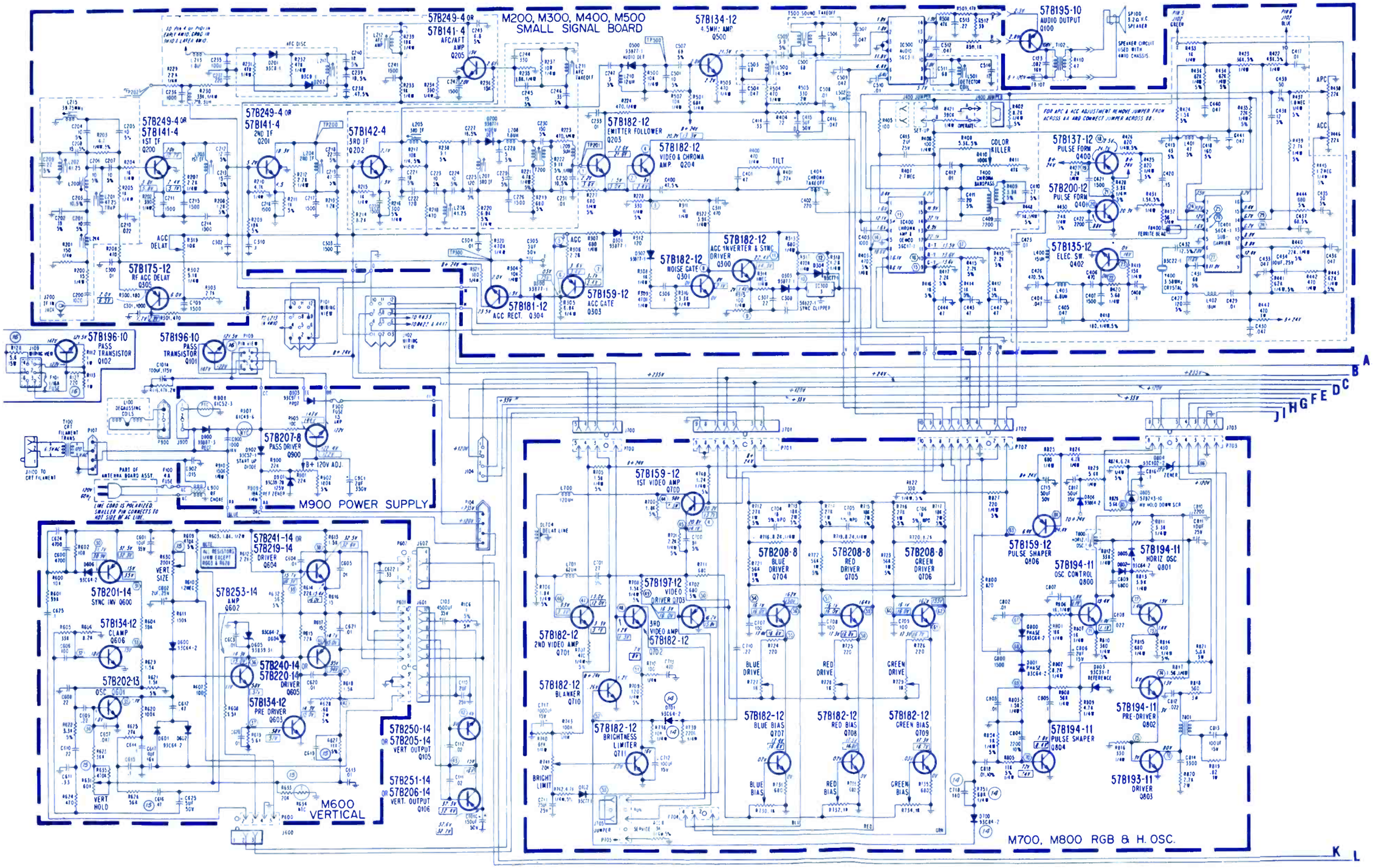
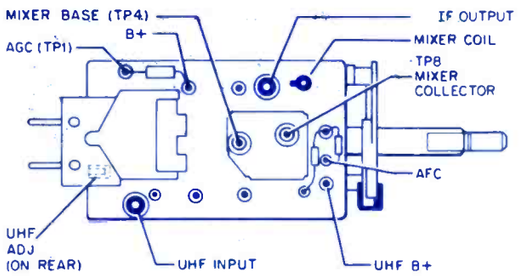
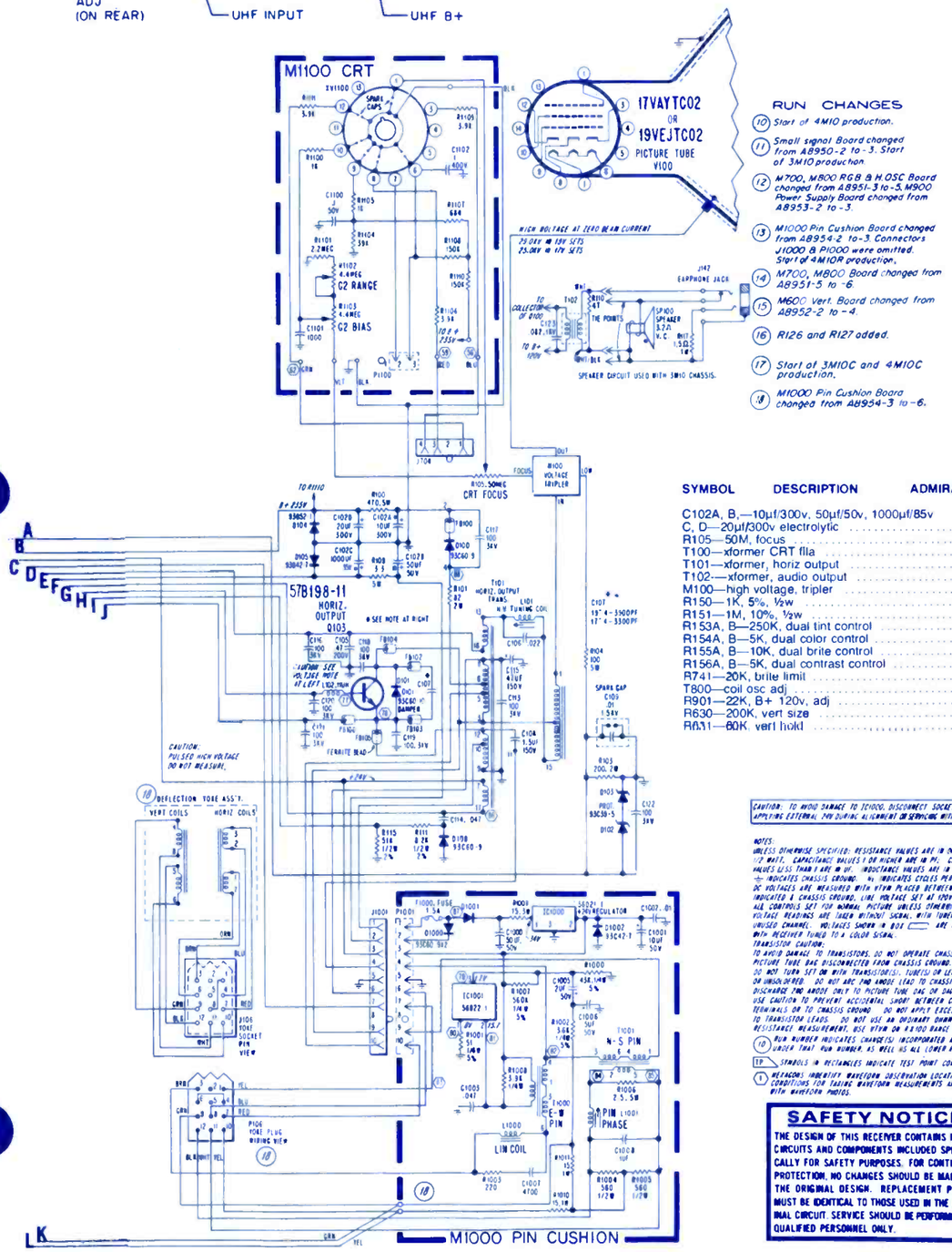


ADMIRAL
Color TV Chassis
4M10C/H

TUNER TOP VIEWS





RUN CHANGES

(10) Start of 4M10 production.
(11) Small signal Board changed from A8950-2 to -3. Start of 3M10 production.
(12) M700, M800 R.G.B. & H. OSC Board changed from A8951-3 to -5, M900 Power Supply Board changed from A8953-2 to -3.
(13) M1000 Pin Cushion Board changed from A8954-2 to -3. Connectors J1000 & P1000 were omitted. Start of 4M10R production.
(14) M700, M800 Board changed from A8951-5 to -6.
(15) M600 Vert. Board changed from A8952-2 to -4.
(16) R126 and R127 added.
(17) Start of 3M10C and 4M10C production.
(18) M1000 Pin Cushion Board changed from A8954-3 to -6.

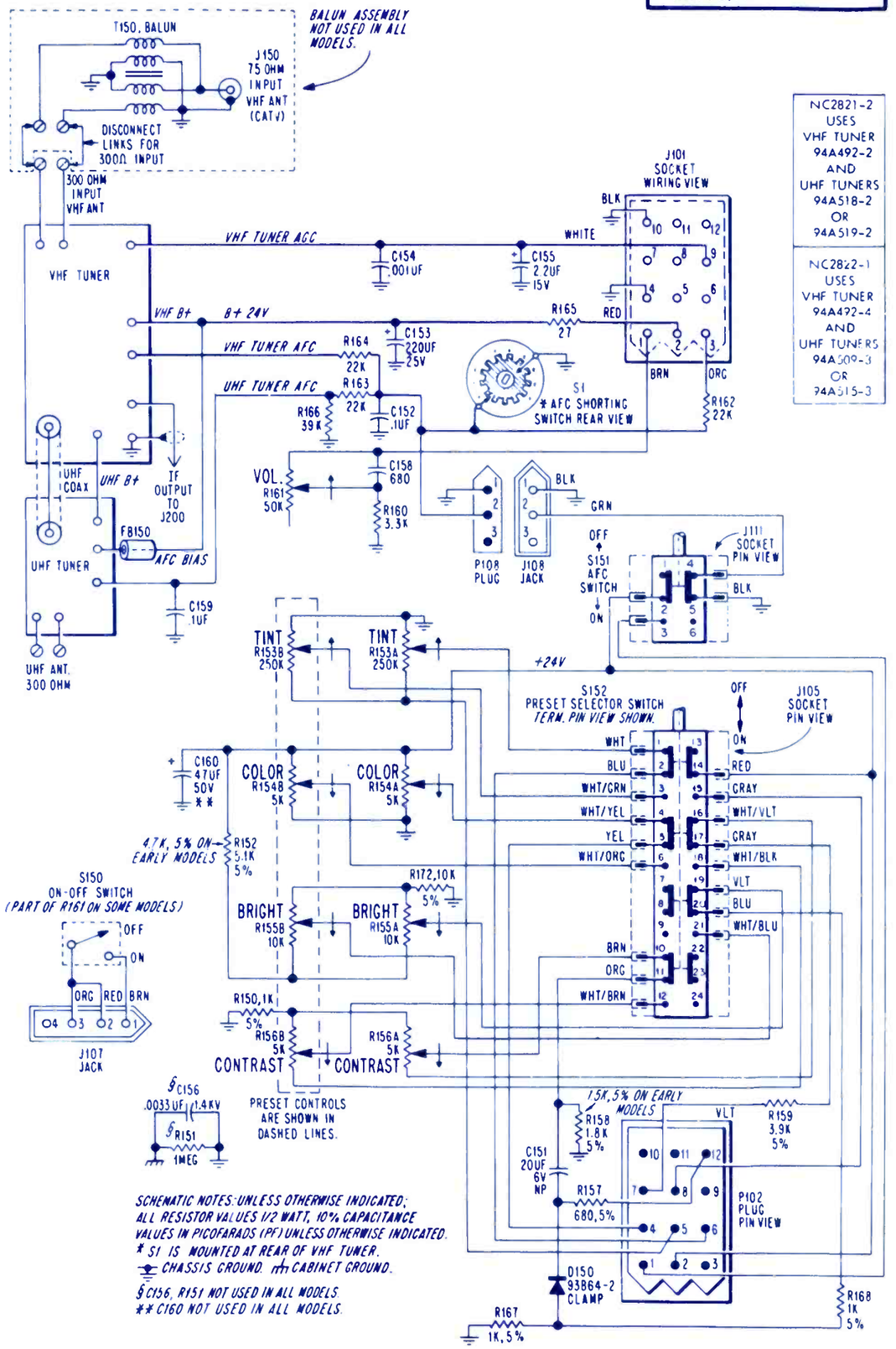
SYMBOL	DESCRIPTION	ADMIRAL PART NO.
C102A, B,—10µf/300v, 50µf/50v, 1000µf/85v		
C, D—20µf/300v electrolytic		67A15-422
R105—50M, focus		75A200-1
T100—xformer CRT flla		80A119-3
T101—xformer, horiz output		79A187-1
T102—xformer, audio output		79A141-5
M100—high voltage, tripler		93A96-3
R150—1K, 5%, ½w		60A105-102
R151—1M, 10%, ½w		60A106-105
R153A, B—250K, dual tint control		75A195-21
R154A, B—5K, dual color control		75A195-20
R155A, B—10K, dual brite control		75A195-17
R156A, B—5K, dual contrast control		75A195-20
R741—20K, brite limit		75A101-47
T800—coil osc adj		94A351-3
R901—22K, B+ 120v, adj		75A199-3
R630—200K, vert size		75A101-28
R631—60K, vert hold		75A191-2

CAUTION: TO AVOID DAMAGE TO IC1000, DISCONNECT SOCKET J1001, WHEN APPLYING EXTERNAL 24V DURING ALIGNMENT OR SERVICING WITH SET TURNED OFF.

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. ~ 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 TUNER SET TO UNUSED CHANNEL. NO VALUES SHOWN IN BOX ▭ ARE MEASURED WITH RECEIVER TUNED TO A COLOR SIGNAL.
TRANSISTOR CAUTION:
TO AVOID DAMAGE TO TRANSISTORS, DO NOT OPERATE CHASSIS WITH PICTURE TUBE ARC DISCONNECTED FROM CHASSIS GROUND. DO NOT TURN SET ON WITH TRANSISTOR(S), TUBE(S) OR LEADS REMOVED OR UNSOLDERED. DO NOT ARC THE ANODE LEAD TO CHASSIS GROUND. DISCHARGE THE 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 VOM ON X 0.1K OHM RANGE OR HIGHER.
(10) BLUE NUMBER INDICATES CHANGE(S) INCORPORATED AS GIVEN UNDER THAT RUN NUMBER, AS WELL AS ALL LOWER RUN CHANGES.
TP SYMBOLS IN RECTANGLES INDICATE TEST POINT CONNECTIONS.
(1) HEXAGONS INDENTIFY WAVEFORM OBSERVATION LOCATIONS. CONDITIONS FOR TAKING WAVEFORM MEASUREMENTS ARE GIVEN WITH WAVEFORM PHOTOS.

SAFETY NOTICE

THE DESIGN OF THIS RECEIVER CONTAINS MANY CIRCUITS AND COMPONENTS INCLUDED SPECIFICALLY FOR SAFETY PURPOSES. FOR CONTINUED PROTECTION, NO CHANGES SHOULD BE MADE TO THE ORIGINAL DESIGN. REPLACEMENT PARTS MUST BE IDENTICAL TO THOSE USED IN THE ORIGINAL CIRCUIT. SERVICE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY.



SCHEMATIC NOTES: UNLESS OTHERWISE INDICATED;
ALL RESISTOR VALUES 1/2 WATT, 10% CAPACITANCE VALUES IN PICOFARADS (PF) UNLESS OTHERWISE INDICATED.
* S1 IS MOUNTED AT REAR OF VHF TUNER.
⏚ CHASSIS GROUND. ⏚ CABINET GROUND.
§ C156, R151 NOT USED IN ALL MODELS.
** C160 NOT USED IN ALL MODELS.

NC2821-2 USES VHF TUNER 94A492-2 AND UHF TUNERS 94A518-2 OR 94A519-2	
NC2822-1 USES VHF TUNER 94A492-4 AND UHF TUNERS 94A509-3 OR 94A515-3	

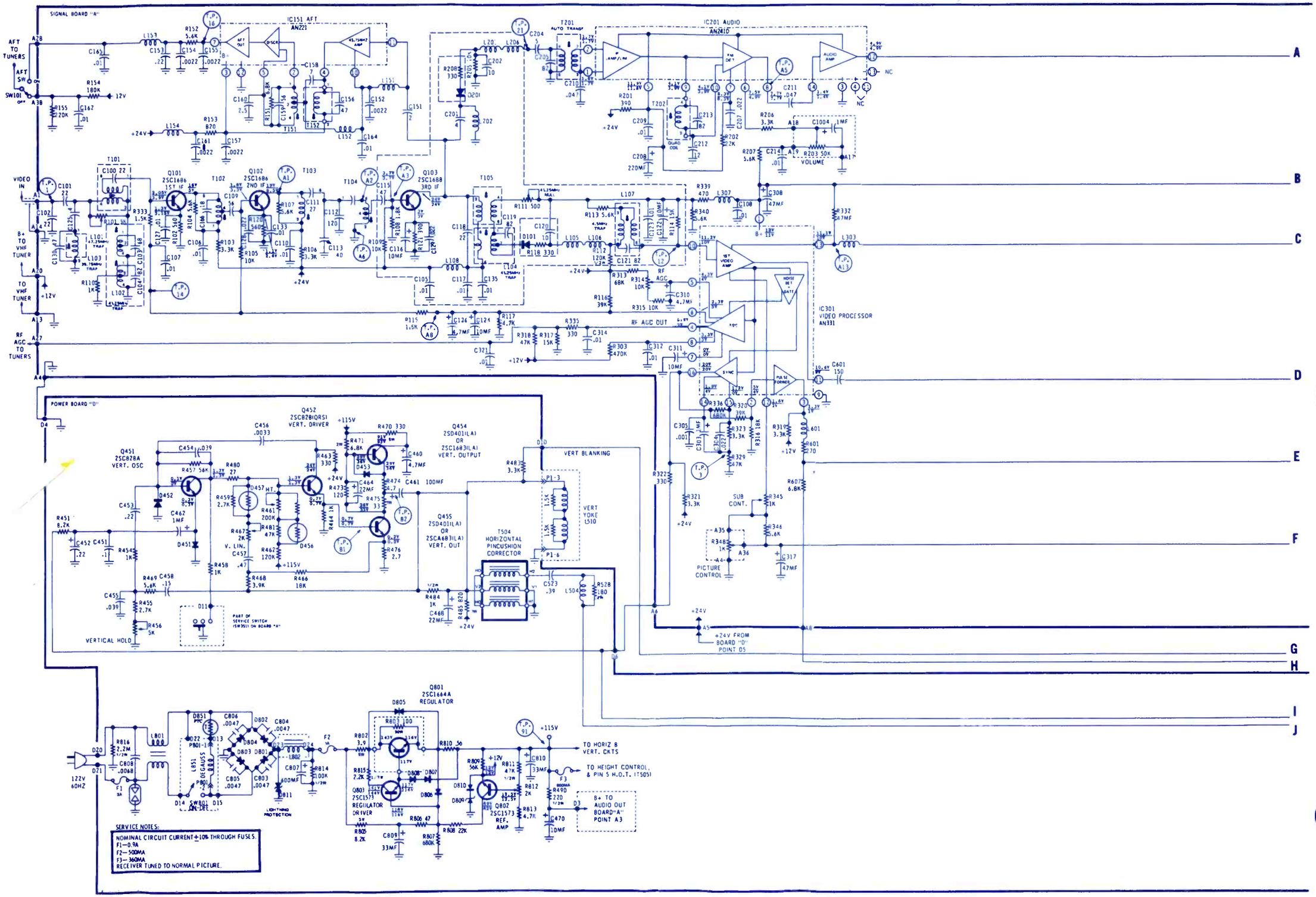
1638

QUASAR
Color TV Chassis
TS-951

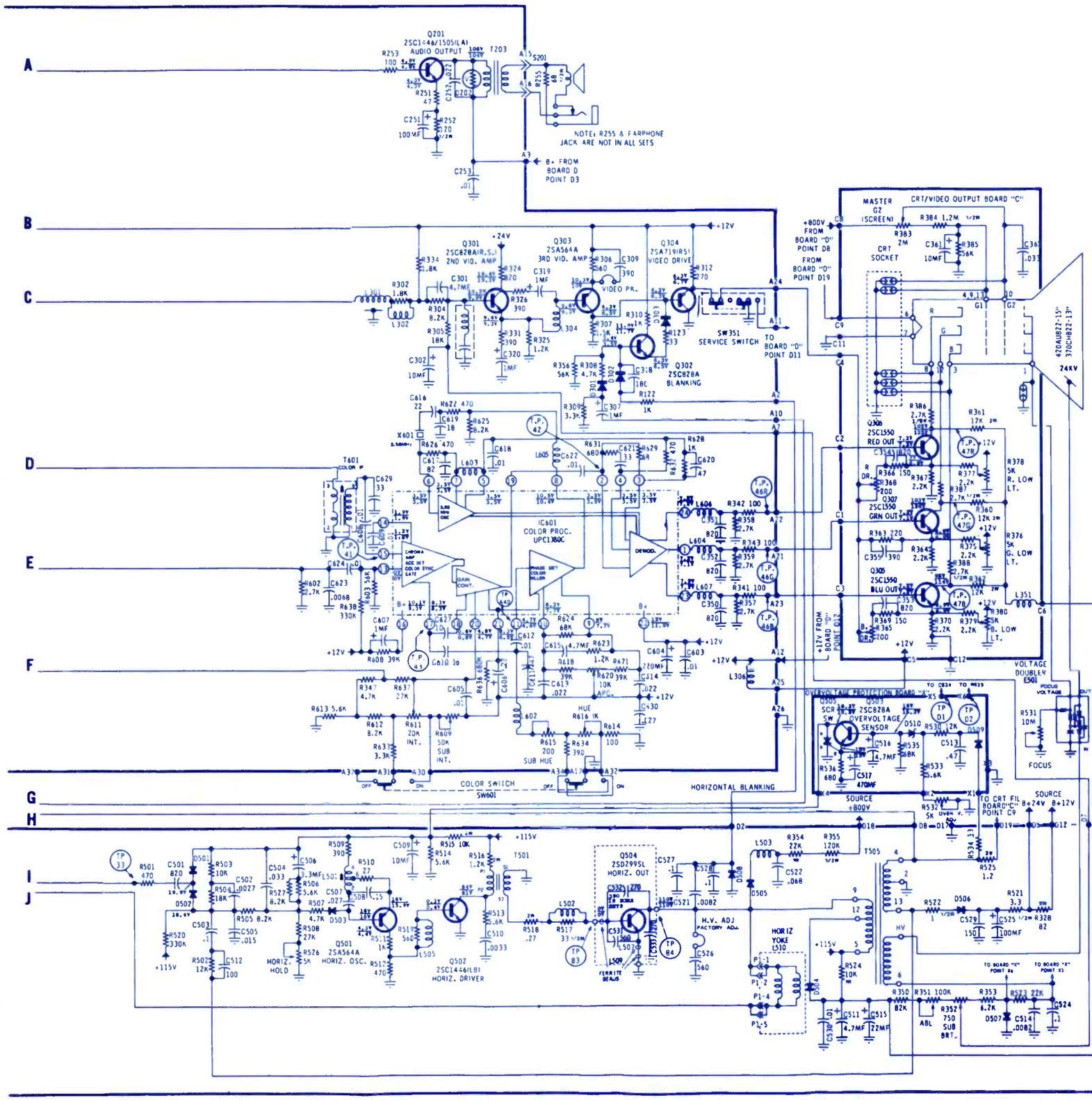
ELECTRONIC TECHNICIAN/DEALER TEKFAX

APRIL • 1976

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



QUASAR
Color TV Chassis
TS-951



YOKE POSITIONING WEDGES FOR DYNAMIC CONVERGENCE

STATIC CONVERGENCE MAGNETS

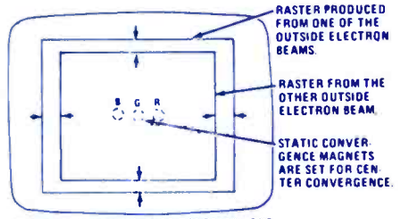
4 - POLE – CONVERGES RED WITH BLUE

6 - POLE – CONVERGES R/B WITH GREEN

LOCK NUT
TURN LEFT TO UNLOCK CONVERGENCE & PURITY RING MAGNETS

1-1/8"

PURITY RINGS
ADJUST ON GREEN RASTER

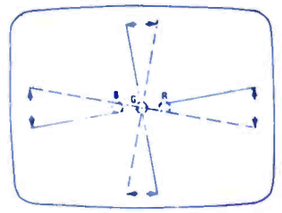


RASTER PRODUCED FROM ONE OF THE OUTSIDE ELECTRON BEAMS.

RASTER FROM THE OTHER OUTSIDE ELECTRON BEAM.

STATIC CONVERGENCE MAGNETS ARE SET FOR CENTER CONVERGENCE.

AS THE YOKE IS MOVED HORIZONTALLY, ONE RASTER GETS LARGER WHILE THE OTHER GETS SMALLER.



AS THE YOKE IS MOVED VERTICALLY, THE RASTERS PRODUCED BY THE OUTSIDE GUNS ROTATE IN OPPOSITE DIRECTIONS.

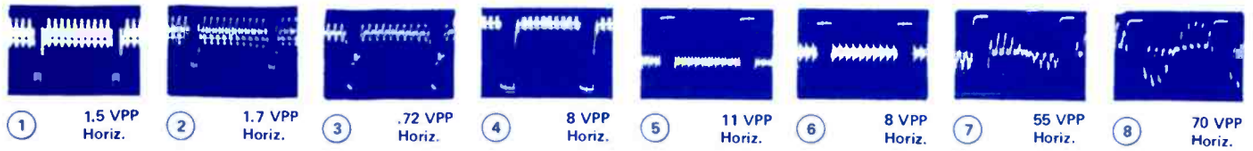
1639

SYLVANIA
Color TV Chassis
E40-1

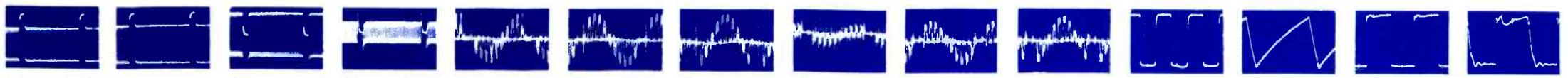
APRIL • 1976

ELECTRONIC TECHNICIAN/DEALER **TEKFAX**

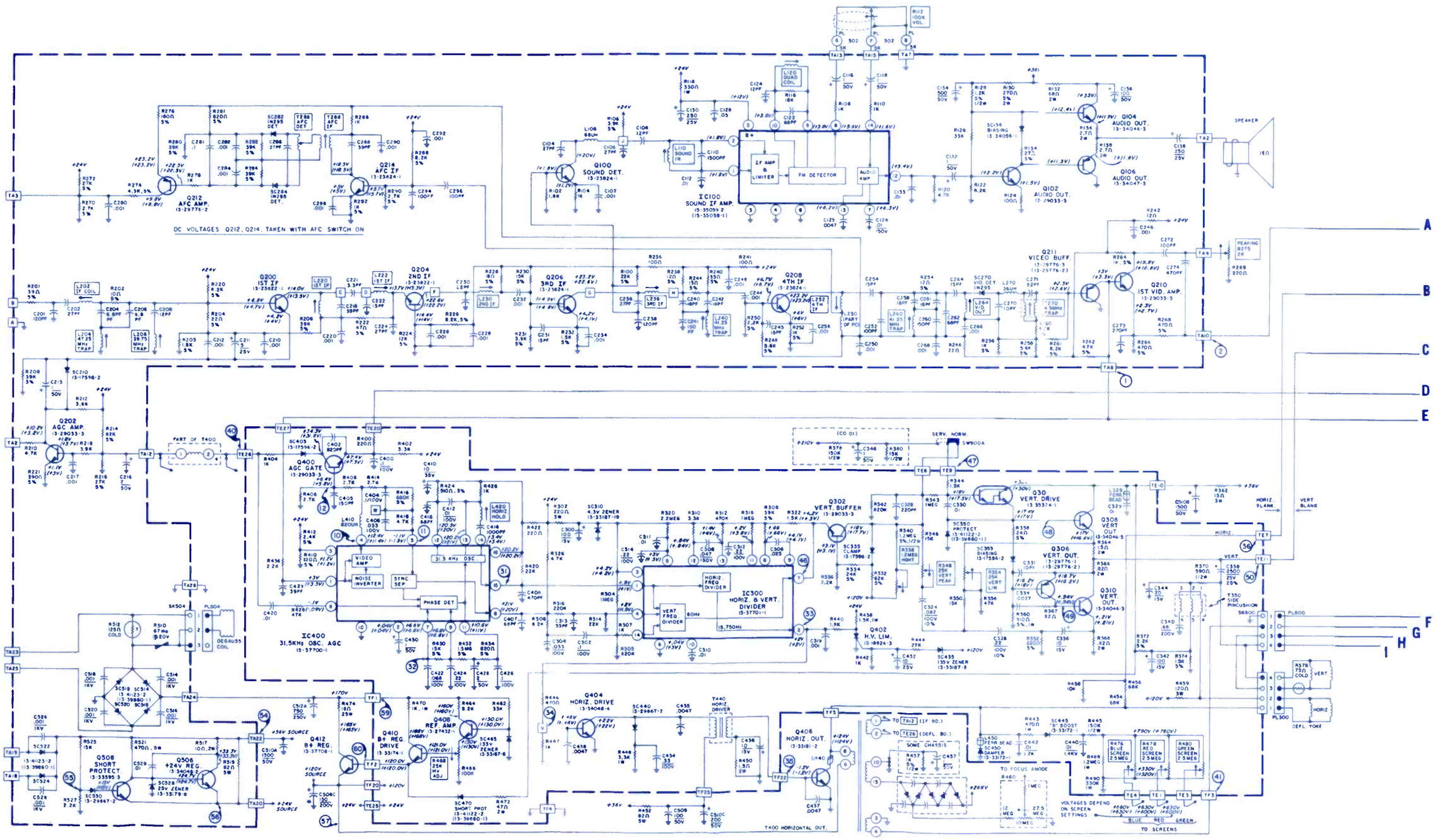
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS



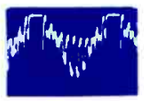
1. 1.5 VPP Horiz.
2. 1.7 VPP Horiz.
3. .72 VPP Horiz.
4. 8 VPP Horiz.
5. 11 VPP Horiz.
6. 8 VPP Horiz.
7. 55 VPP Horiz.
8. 70 VPP Horiz.



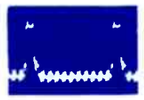
21. 2.2 VPP Horiz.
22. 2.2 VPP Horiz.
23. 3 VPP Horiz.
24. 2 VPP Horiz.
25. 1.3 VPP Horiz.
26. 3.8 VPP Horiz.
27. 4.4 VPP Horiz.
28. 4.5 VPP Horiz.
29. 4.4 VPP Horiz.
30. 4.4 VPP Horiz.
31. 1.5 VPP Horiz.
32. .7 VPP Horiz.
33. 3.4 VPP Horiz.
34. .6 VPP Horiz.



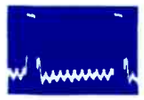
SYLVANIA
Color TV Chassis
E40-1



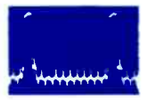
(9) 65 VPP Horiz.



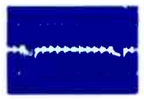
(10) 5 VPP Horiz.



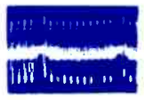
(11) 3.5 VPP Horiz.



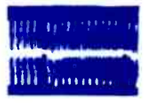
(12) 2 VPP Horiz.



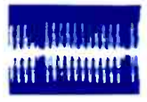
(13) .24 VPP Horiz.



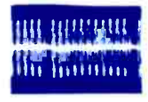
(14) .35 VPP Horiz.



(15) .26 VPP Horiz.

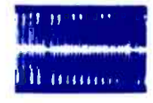


(16) .3 VPP Horiz.

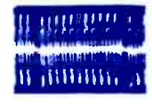


(17) .3 VPP Horiz.

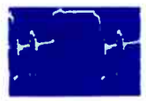
(18) .37 VPP Horiz.



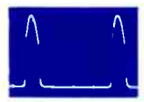
(19) .37 VPP Horiz.



(20) .3 VPP Horiz.

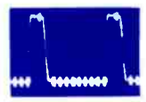


(35) 10 VPP Horiz.



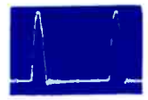
(36) 32 VPP Horiz.

(37) 23 VPP Horiz.

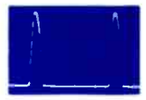


(38) .52 VPP Horiz.

(39) .54 VPP Horiz.



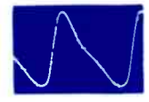
(40) 38 VPP Horiz.



(41) 290 VPP Horiz.

(42) 26 VPP Vert.

(43) 23 VPP Vert.



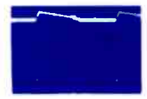
(44) 44 VPP Horiz.

(45) 5 VPP Vert.

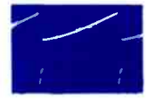
(46) 4 VPP Vert.

(47) 25 VPP Vert.

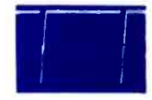
(48) 25 VPP Vert.



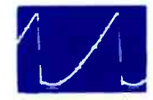
(49) 11 VPP Vert.



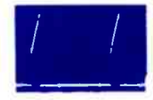
(50) 24 VPP Vert.



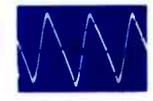
(51) 7.6 VPP Vert.



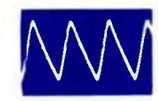
(52) 6 VPP Vert.



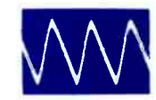
(53) 6.4 VPP Vert.



(54) 2.7 VPP Vert.



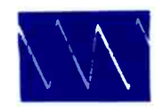
(55) .32 VPP Vert.



(56) .03 VPP Vert.

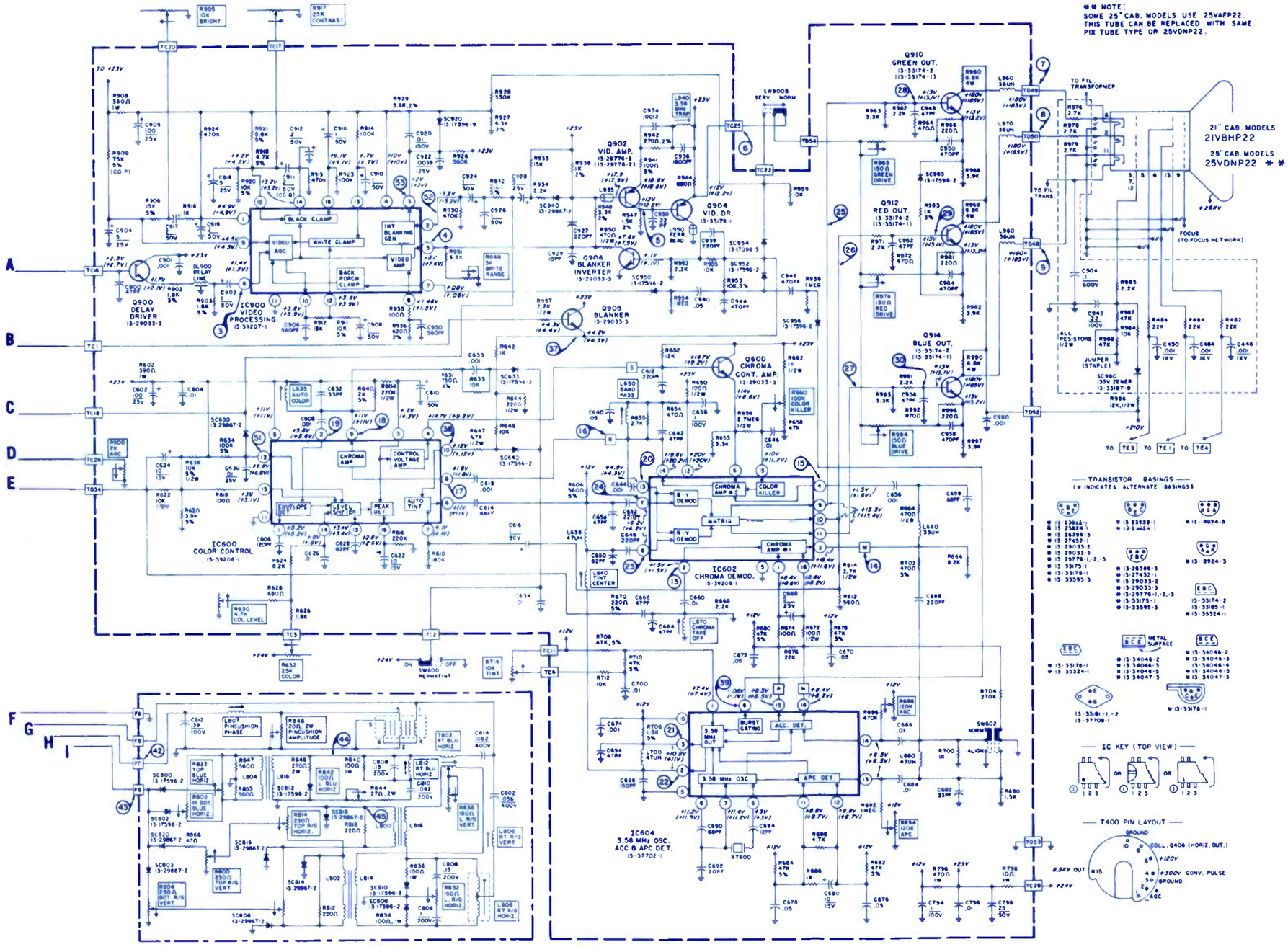
(57) .44 VPP Vert.

(58) .4 VPP Vert.



(59) 1.7 VPP Vert.

(60) .4 VPP Vert.



SYMBOL	DESCRIPTION	SYLVANIA PART NO.
C510	three section electro	41-37580-1
L110	sound input	50-37714-3
L120	quad	50-33195-2
L240	41.25MHz trap	50-37715-2
L420	horiz hold	50-37711-4
L650	band pass	50-37716-2
L670	chroma take-off	50-39217-1
R112	100K, vol	37-35105-15
R338	1.2M, vert height	37-33036-25
R348	25K, vert peak	37-23063-2
R354	25K, vert lin	part of R338
R460	focus network	32-37705-1
R468	25K, HV adj	part of R338
R630	5K, color level	37-23063-10
R660	100K, color kill	37-33036-21
R714	10K, tint	37-27242-45
R905	10K, brite	37-27242-45
R917	25K, contrast	37-27242-54
R949	5K, brite range	part of R660
IC100	sound IF amp	15-35059-2
IC300	horiz & vert divider	15-37701-1
IC400	31.5k Hz osc. AGC	15-37700-1
IC600	color control	15-39208-1
IC602	chroma amp. demod	15-39209-1
IC604	3.58MHz osc. ACC, APC	15-37702-1
IC900	video processing	15-39207-1
T270	4.5MHz trap	50-35309-1
T400	horiz output	50-41122-2
T440	horiz driver	56-39144-1
T500	power	55-37722-3
T800	pincushion	50-33900-3
T802	rt blue horiz	50-35498-2
CB500	circuit break tripler, HV	29-39696-13 32-35894-7

1640

ZENITH
TV Chassis
12FB22X

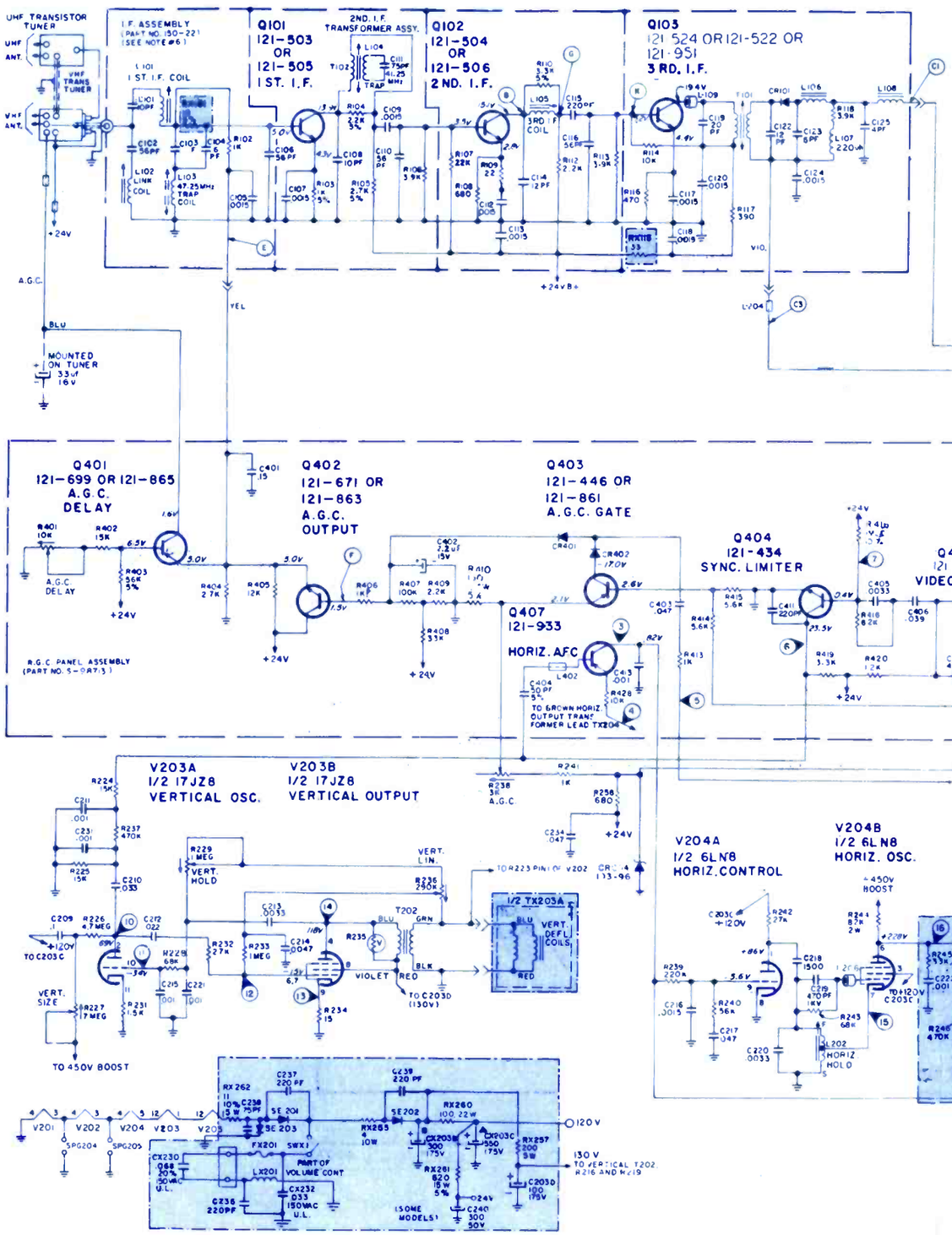
APRIL • 1976

ELECTRONIC TECHNICIAN/DEALER **TEKFAX**

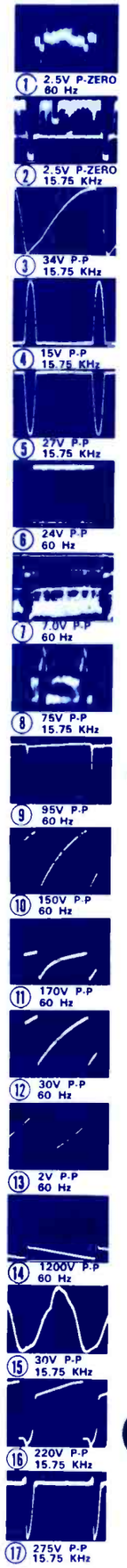
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS

IMPORTANT SAFETY NOTICE

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



NOTES
1. ALL VOLTAGES MEASURED FROM CHASSIS TO POINTS INDICATED.
2. ALL VOLTAGES ARE D.C. UNLESS OTHERWISE SPECIFIED.
3. ALL VOLTAGE MEASUREMENTS TO BE MADE WITH NO SIGNAL PRESENT WITH CHANNEL SELECTOR SET TO CHANNEL 2.
4. ALL RESISTORS ARE CARBON, ±10%, 1/2 WATT UNLESS OTHERWISE SPECIFIED, (SEE NOTE 6)
5. P INDICATES ± 20% TOLERANCE MAY BE USED.
6. ALL RESISTORS IN I.F. CIRCUIT & SOUND ASSEMBLY ARE 1/4 WATT UNLESS OTHERWISE SPECIFIED.
7. RESISTANCE MEASUREMENTS SHOWN WITH COILS DISCONNECTED FROM CIRCUIT.
8. COIL RESISTANCES NOT SPECIFIED ARE UNDER ONE OHM.
9. ALL CAPACITY VALUES IN MICROFARADS UNLESS OTHERWISE SPECIFIED.
10. FOR CAPACITY TOLERANCES, SEE LEGEND ON SHEET 2.
11. ARROWS ON POTENTIOMETERS INDICATE CLOCKWISE ROTATION.
12. MHz= MEGAHERTZ= MEGACYCLE, µH= MICROHENRY
13. ⏚ INDICATES CHASSIS GROUND
14. ○— INDICATES VOLTAGE SOURCE
15. Ⓒ— INDICATES ALIGNMENT OR TEST POINT.
16. ⬭ INDICATES WAVEFORM
17. TURN POWER OFF BEFORE REPLACING SEMICONDUCTORS.



ELECTRONIC TECHNICIAN/DEALER
TEKFAX

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

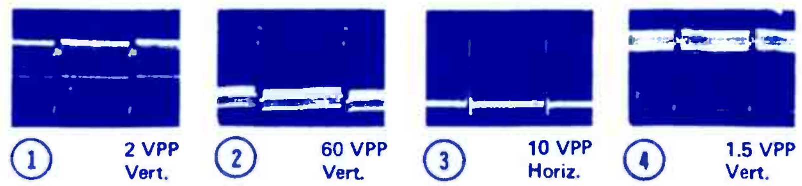
GROUP 284

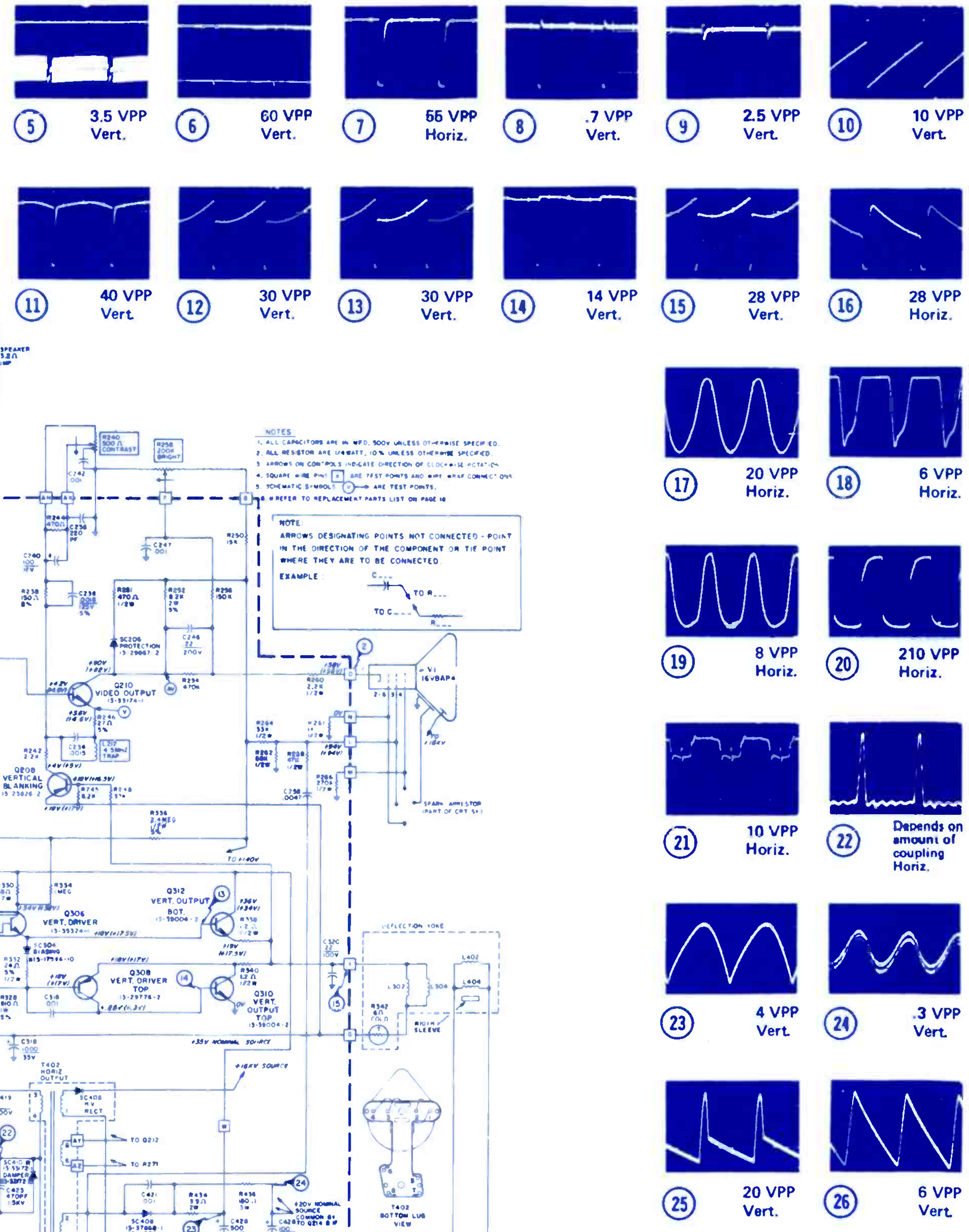
1636

SYLVANIA
TV Chassis
A16-5

APRIL • 1976

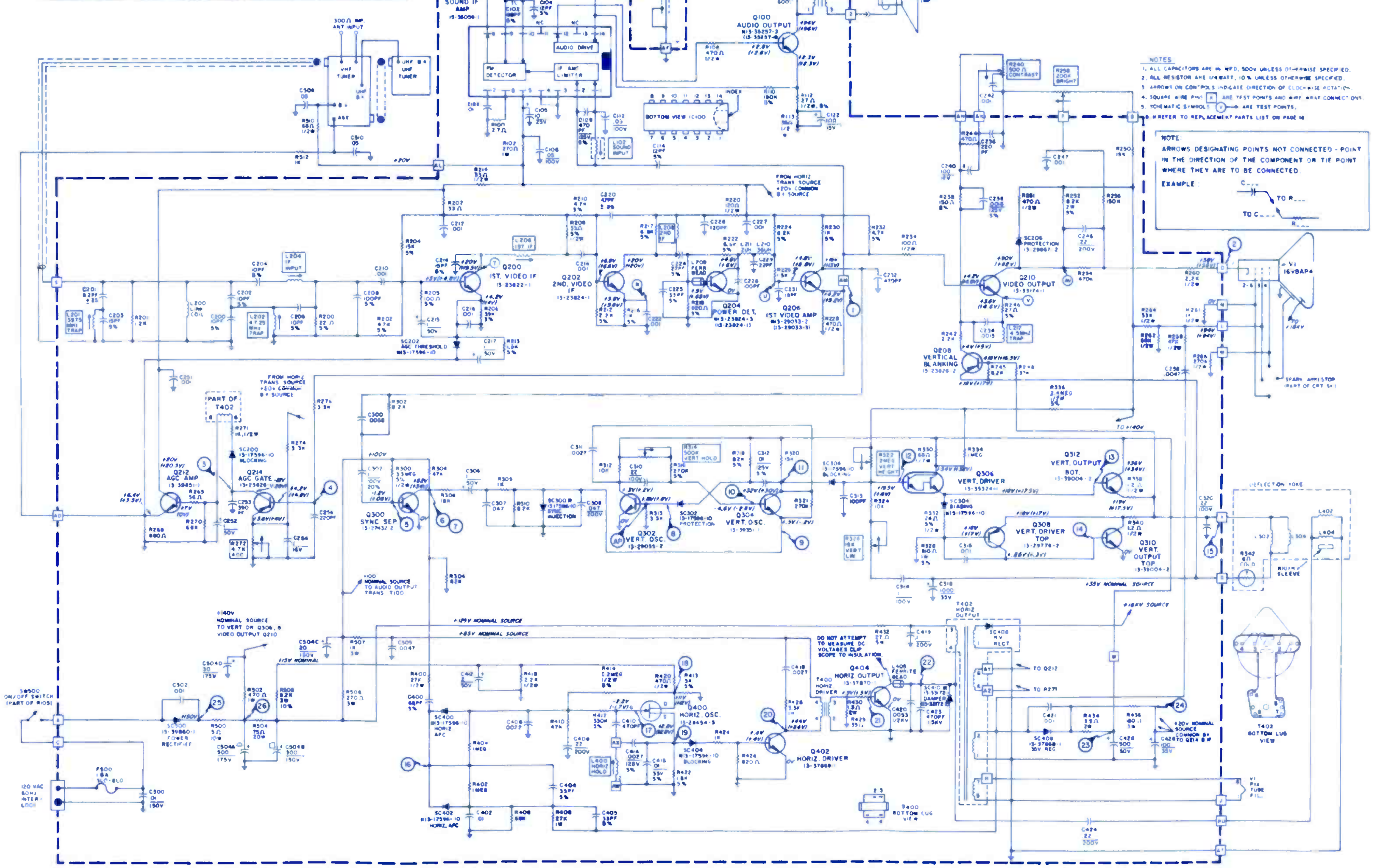
	SCHEMATIC NO.		SCHEMATIC NO.
ADMIRAL Color TV Chassis 4M10C/H	1637	SYLVANIA Color TV Chassis E40-1	1639
QUASAR Color TV Chassis TS-951	1638	ZENITH TV Chassis 12FB22X	1640
SYLVANIA TV Chassis A16-5	1636		

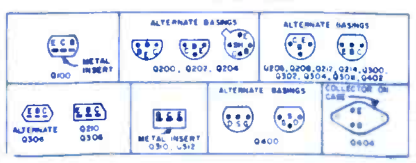




*IC100 VOLTAGE CHART

PIN NO	1	2	3	4	5	6	7	8	9	10	11	12	13	14
IC CHIP INSERTED	+2V (+2V)	+2V (+2.1V)	0V (0V)	0V (0V)	+12V (+12V)	0V (0V)	+6.8V (+6.8V)	+6.2V (+6.2V)	+4.2V (+4.2V)	+4.2V (+4.2V)	NC NC	+3.4V (+3.4V)	NC NC	+1.8V (+1.8V)
IC CHIP REMOVED	0V (0V)	0V (0V)	0V (0V)	0V (0V)	+27V (+27V)	0V (0V)	0V (0V)	0V (0V)	0V (0V)	0V (0V)	NC NC	0V (0V)	NC NC	0V (0V)





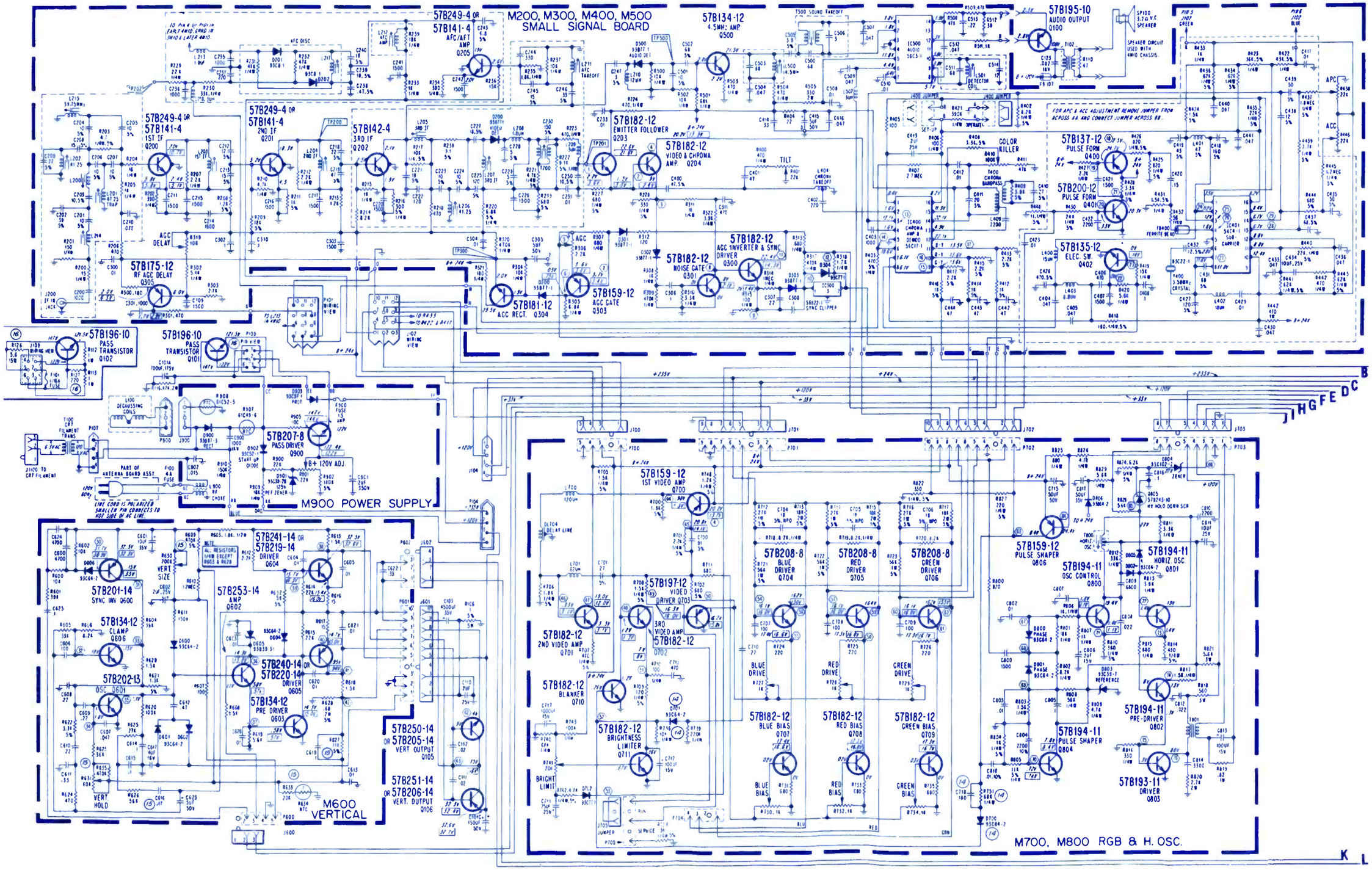
1637

ADMIRAL
Color TV Chassis
4M10C/H

ELECTRONIC TECHNICIAN/DEALER TEKFAX

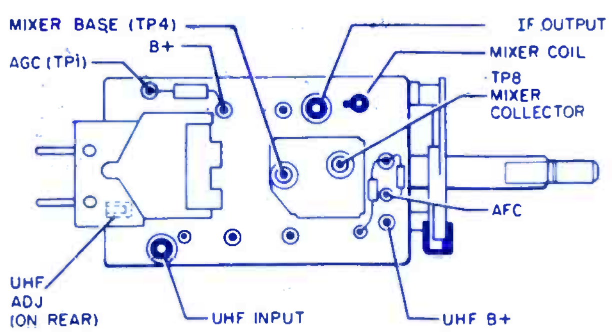
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR 5 NEW SETS

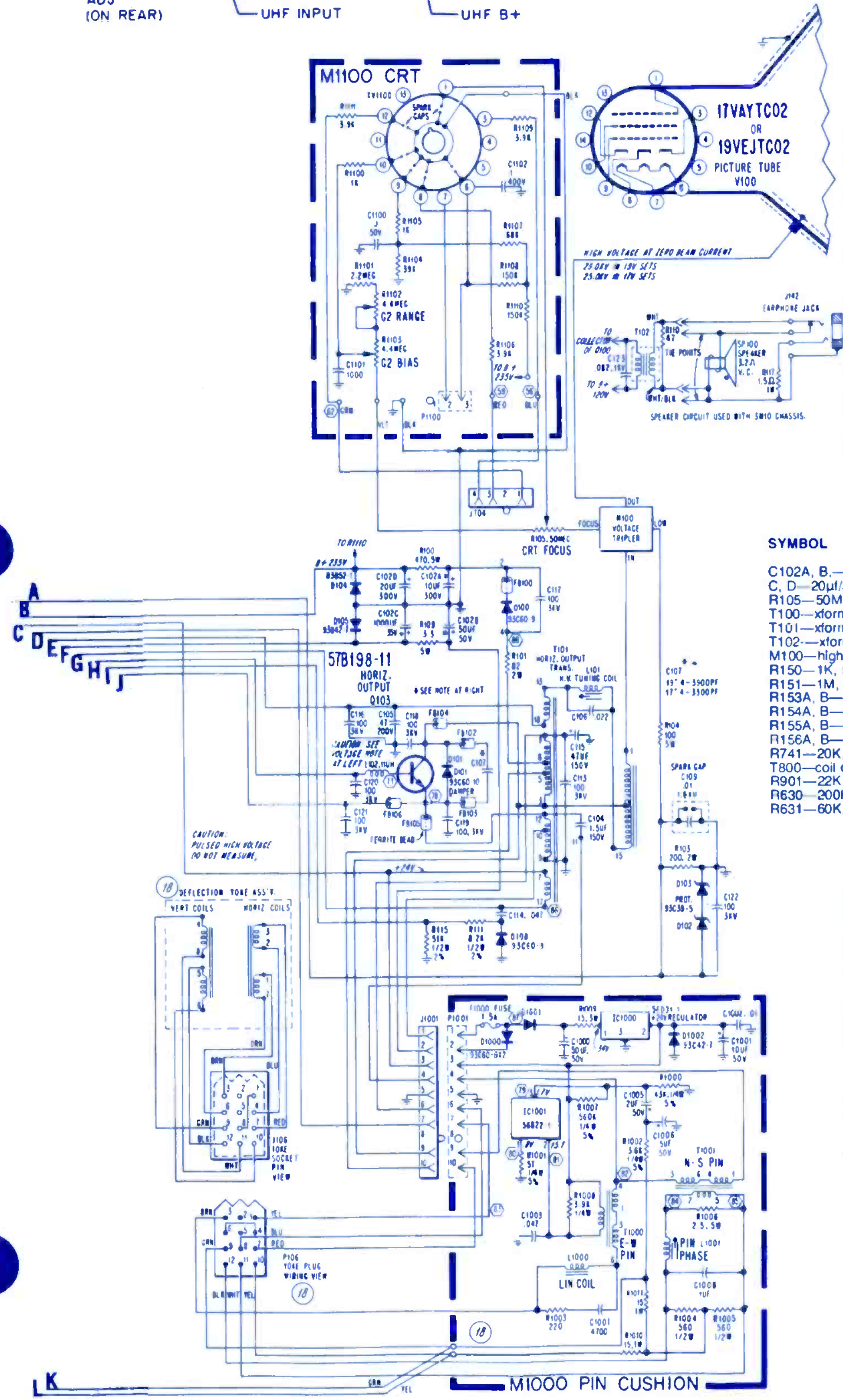
APRIL • 1976



ADMIRAL
Color TV Chassis
4M10C/H

TUNER TOP VIEWS





RUN CHANGES

(10) Start of 4M10 production.

(11) Small signal Board changed from A8950-2 to -3. Start of 3M10 production.

(12) M700, M800 RGB & H.OSC Board changed from A8951-3 to -5. M900 Power Supply Board changed from A8953-2 to -3.

(13) M1000 Pin Cushion Board changed from A8954-2 to -3. Connectors J1000 & P1000 were omitted. Start of 4M10R production.

(14) M700, M800 Board changed from A8951-5 to -6.

(15) M600 Vert. Board changed from A8952-2 to -4.

(16) R126 and R127 added.

(17) Start of 3M10C and 4M10C production.

(18) M1000 Pin Cushion Board changed from A8954-3 to -6.

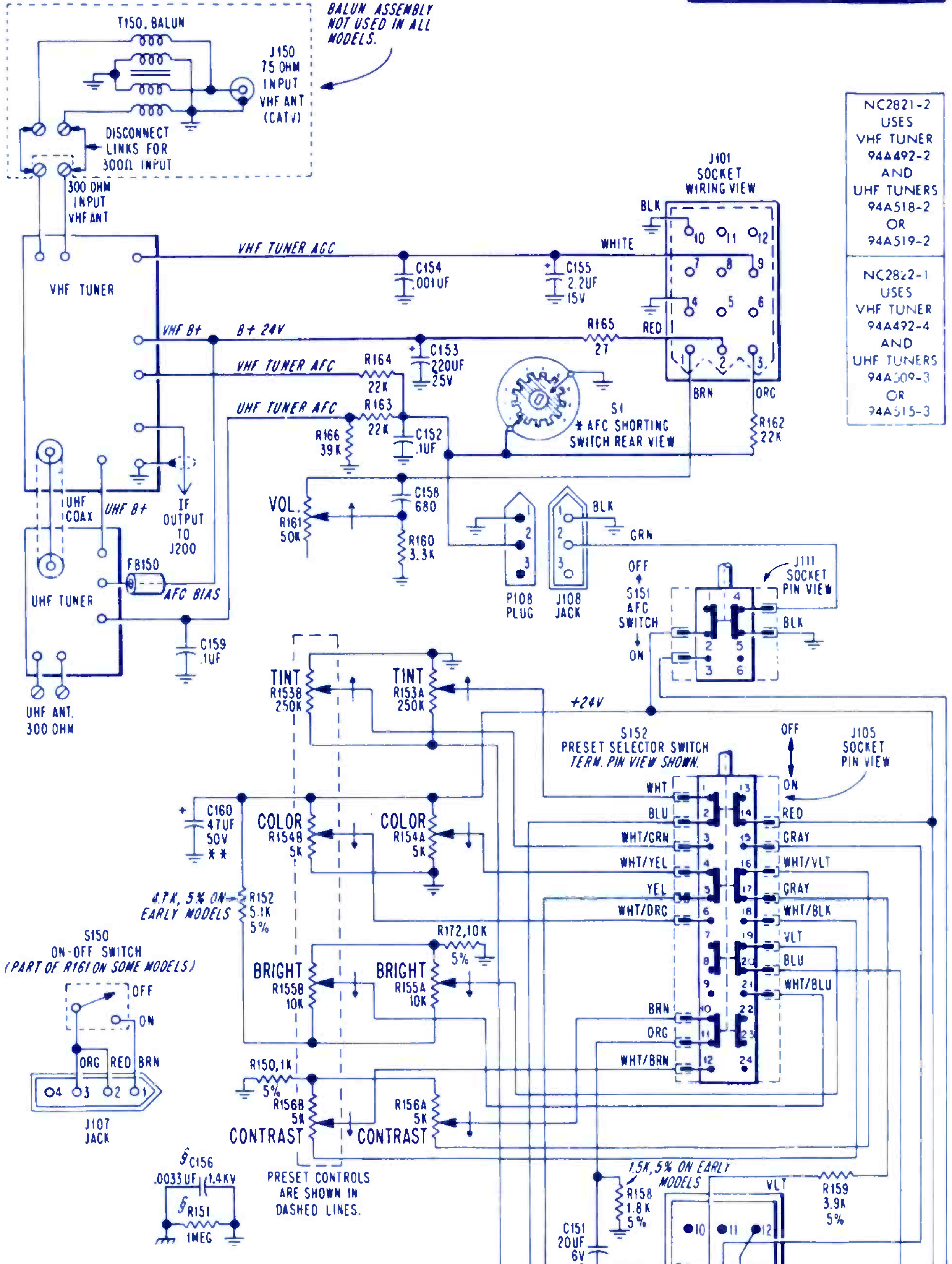
SYMBOL	DESCRIPTION	ADMIRAL PART NO.
C102A, B.	10µf/300v, 50µf/50v, 1000µf/85v	
C, D	20µf/300v electrolytic	67A15-422
R105	50M, focus	75A200-1
T100	xformer CRT fila	80A119-3
T101	xformer, horiz output	79A187-1
T102	xformer, audio output	79A141-5
M100	high voltage, tripler	93A96-3
R150	1K, 5%, ½w	60A105-102
R151	1M, 10%, ½w	60A106-105
R153A, B	250K, dual tint control	75A195-21
R154A, B	5K, dual color control	75A195-20
R155A, B	10K, dual brite control	75A195-17
R156A, B	5K, dual contrast control	75A195-20
R741	20K, brite limit	75A101-47
T800	coil osc adj	94A351-3
R901	22K, B+ 120v, adj	75A199-3
R630	200K, vert size	75A101-28
R631	60K, vert hold	75A191-2

CAUTION: TO AVOID DAMAGE TO IC1000, DISCONNECT SOCKET J1001, WHEN APPLYING EXTERNAL 24V DURING ALIGNMENT OR SERVICING WITH SET TURNED OFF.

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 TUNER SET TO UNUSED CHANNEL. VOLTAGES SHOWN IN BOX ▭ ARE MEASURED WITH RECEIVER TUNED TO A COLOR SIGNAL.
TRANSISTOR CAUTION:
TO AVOID DAMAGE TO TRANSISTORS, DO NOT OPERATE CHASSIS WITH PICTURE TUBE DAG DISCONNECTED FROM CHASSIS GROUND.
DO NOT TURN SET ON WITH TRANSISTOR(S), TUBE(S) OR LEADS REMOVED OR UNSOLDERED. DO NOT ARC 2ND ANODE LEAD TO CHASSIS GROUND. DISCHARGE 2ND ANODE ONLY TO PICTURE TUBE DAG OR DAG GROUND. USE CAUTION TO PREVENT ACCIDENTAL SHORT BETWEEN COMPONENT TERMINALS OR TO CHASSIS GROUND. DO NOT APPLY EXCESSIVE HEAT TO TRANSISTOR LEADS. DO NOT USE AN ORDINARY OHMMETER FOR RESISTANCE MEASUREMENT. USE VTVM ON R X 100 RANGE OR HIGHER.
(10) RUN NUMBER INDICATES CHANGE(S) INCORPORATED AS GIVEN UNDER THAT RUN NUMBER, AS WELL AS ALL LOWER RUN CHANGES.
TP SYMBOLS IN RECTANGLES INDICATE TEST POINT CONNECTIONS.
(1) HEXAGONS IDENTIFY WAVEFORM OBSERVATION LOCATIONS. CONDITIONS FOR TAKING WAVEFORM MEASUREMENTS ARE GIVEN WITH WAVEFORM PHOTOS.

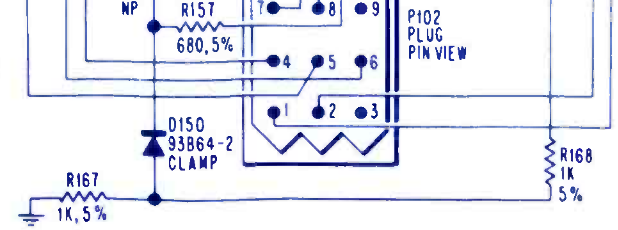
SAFETY NOTICE

THE DESIGN OF THIS RECEIVER CONTAINS MANY CIRCUITS AND COMPONENTS INCLUDED SPECIFICALLY FOR SAFETY PURPOSES. FOR CONTINUED PROTECTION, NO CHANGES SHOULD BE MADE TO THE ORIGINAL DESIGN. REPLACEMENT PARTS MUST BE IDENTICAL TO THOSE USED IN THE ORIGINAL CIRCUIT. SERVICE SHOULD BE PERFORMED BY QUALIFIED PERSONNEL ONLY.



NC2821-2 USES VHF TUNER 94A492-2 AND UHF TUNERS 94A518-2 OR 94A519-2

NC2822-1 USES VHF TUNER 94A492-4 AND UHF TUNERS 94A509-3 OR 94A515-3



SCHEMATIC NOTES: UNLESS OTHERWISE INDICATED;
ALL RESISTOR VALUES 1/2 WATT, 10% CAPACITANCE VALUES IN PICOFARADS (PF) UNLESS OTHERWISE INDICATED.
* S1 IS MOUNTED AT REAR OF VHF TUNER.
⏚ CHASSIS GROUND. ⫨ CABINET GROUND.
§ C156, R151 NOT USED IN ALL MODELS.
** C160 NOT USED IN ALL MODELS.

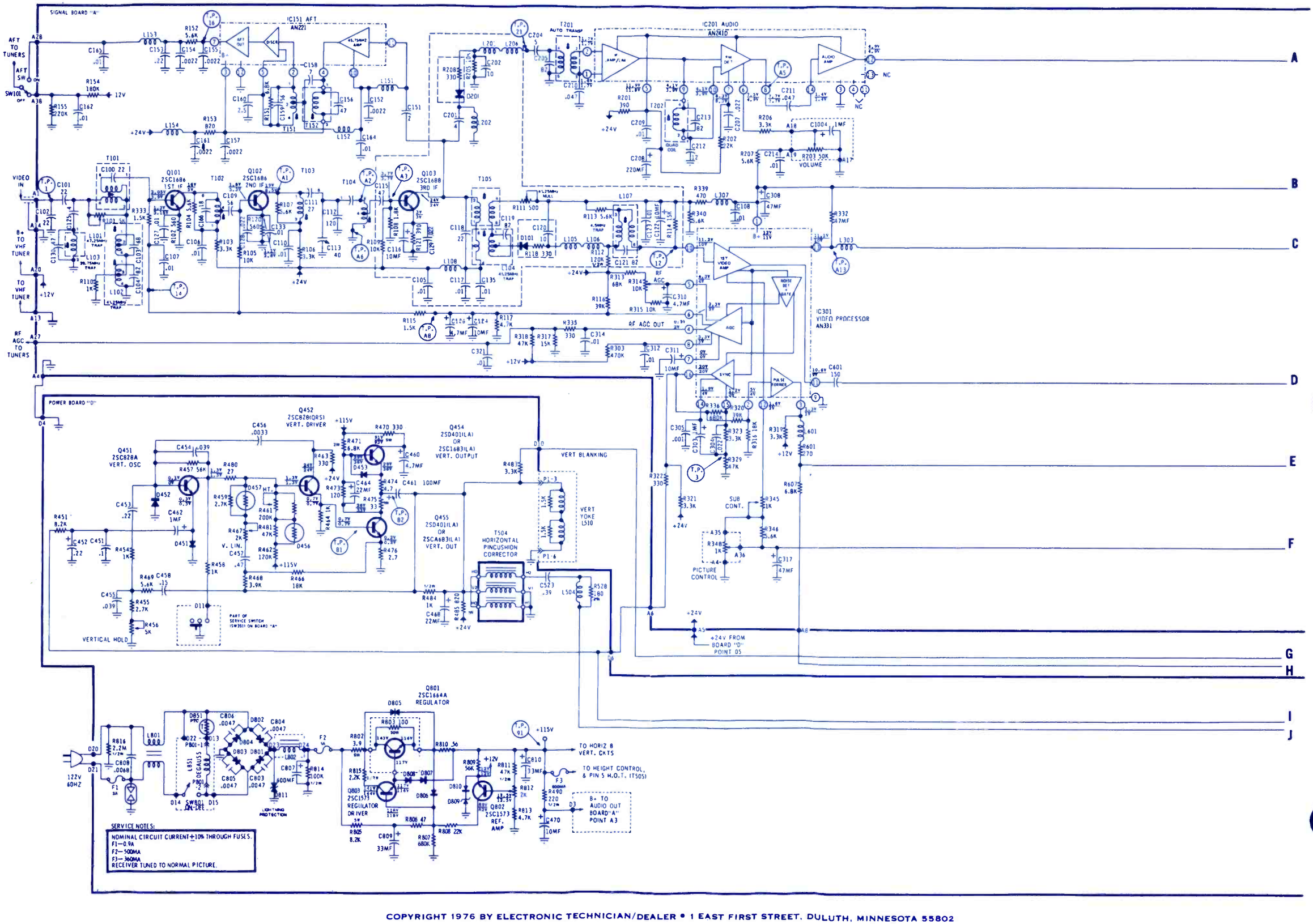
1638

QUASAR
Color TV Chassis
TS-951

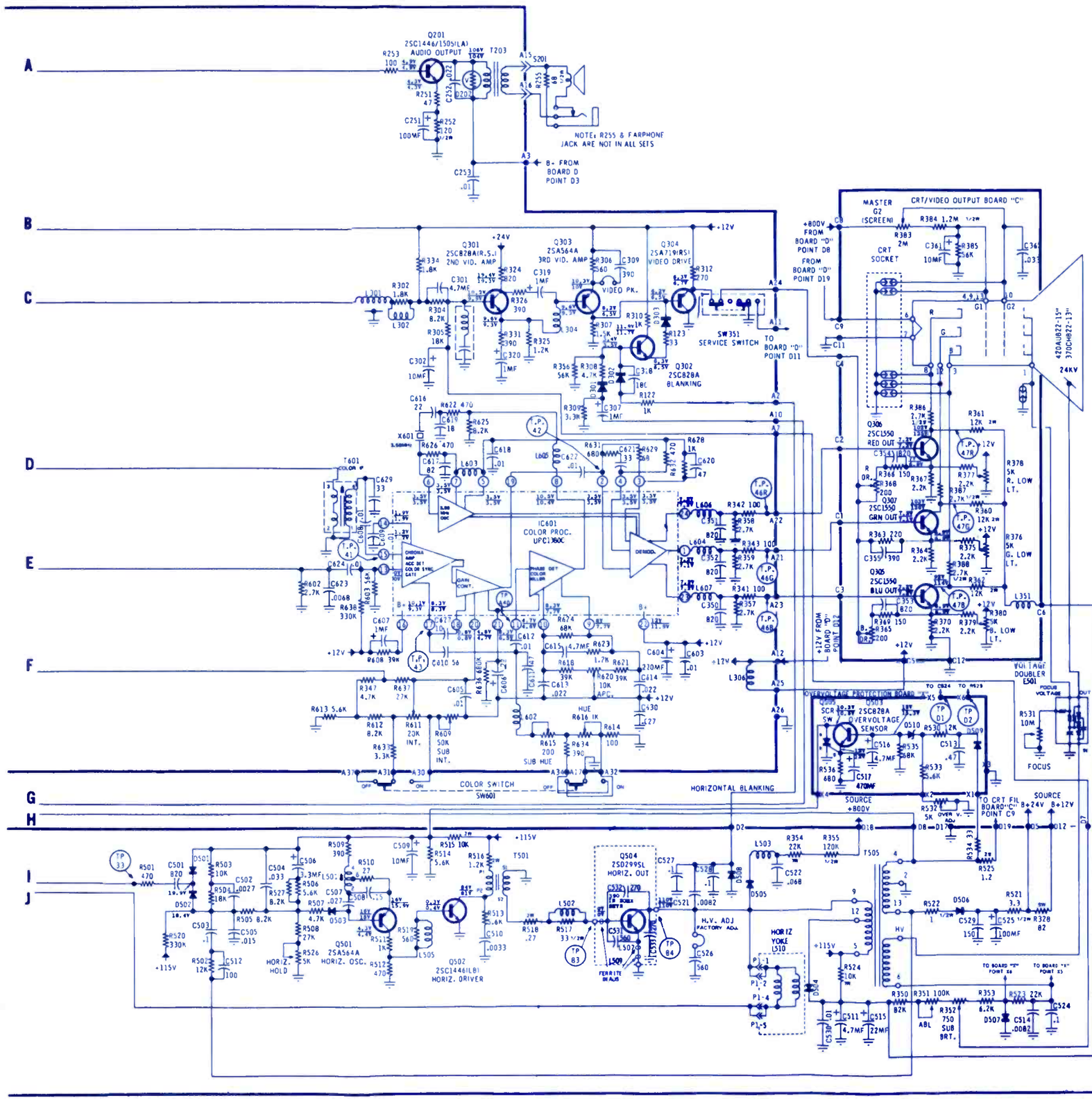
ELECTRONIC TECHNICIAN/DEALER TEKFAX

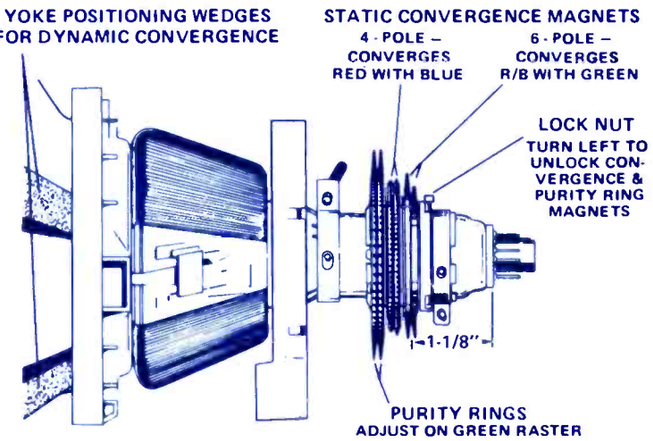
APRIL • 1976

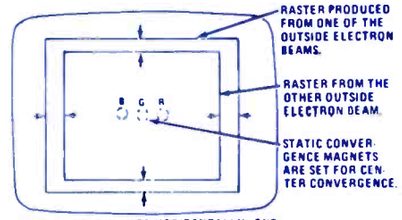
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS
AND TECHNICAL INFORMATION FOR 5 NEW SETS



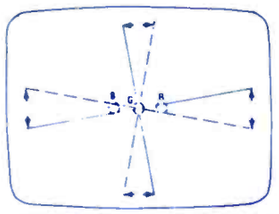
QUASAR
Color TV Chassis
TS-951







AS THE YOKE IS MOVED HORIZONTALLY, ONE RASTER GETS LARGER WHILE THE OTHER GETS SMALLER.



AS THE YOKE IS MOVED VERTICALLY, THE RASTERS PRODUCED BY THE OUTSIDE GUNS ROTATE IN OPPOSITE DIRECTIONS.

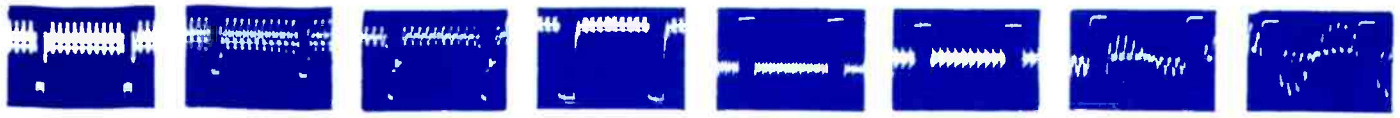
1639

SYLVANIA
Color TV Chassis
E40-1

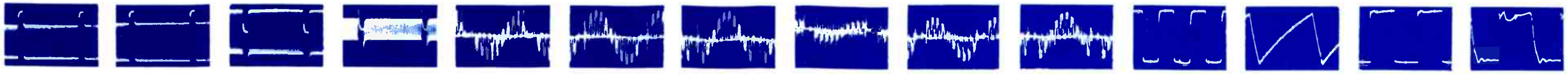
APRIL • 1976

ELECTRONIC TECHNICIAN/DEALER TEKFAX

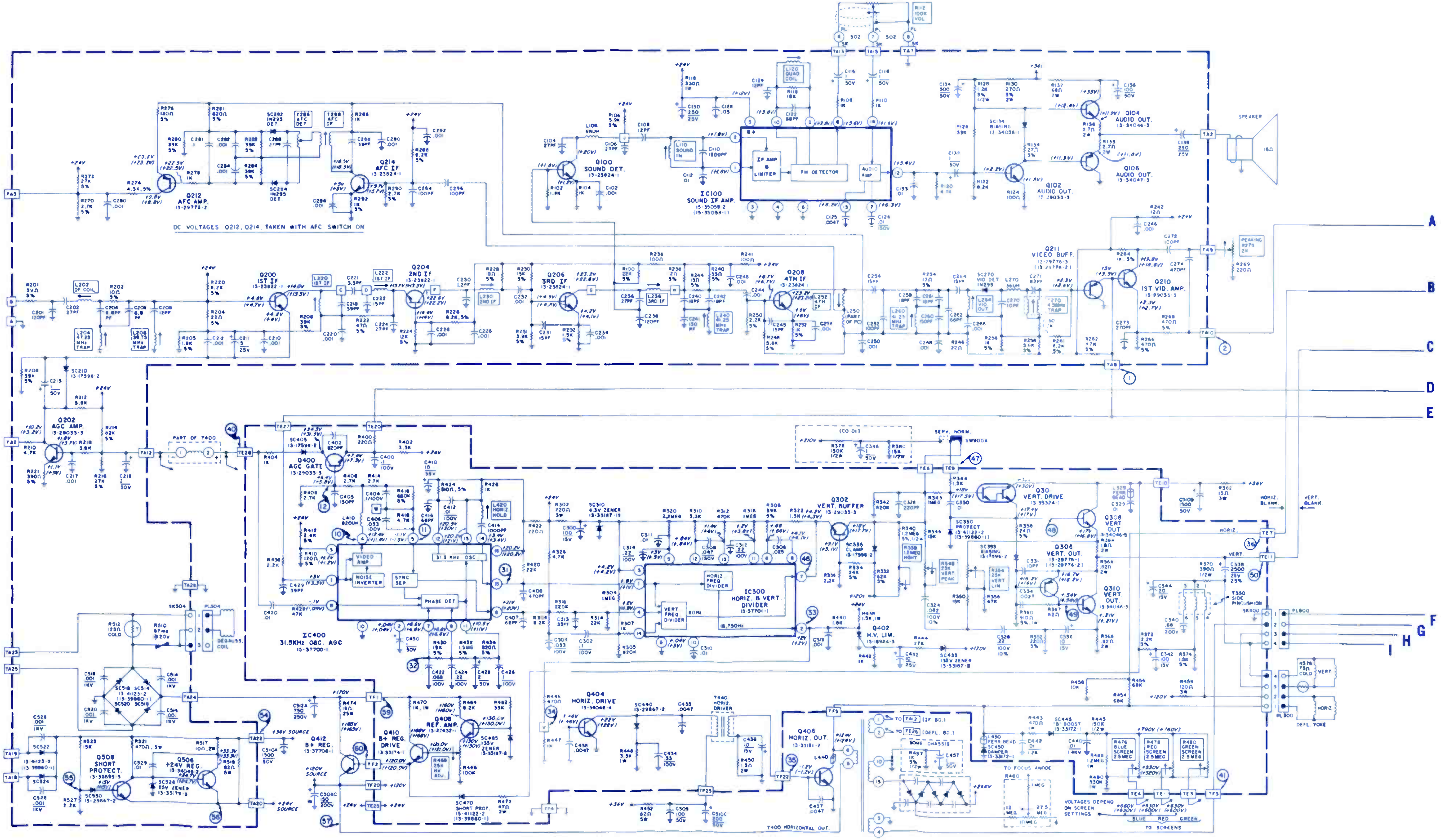
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS



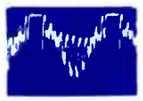
(1) 1.5 VPP Horiz. (2) 1.7 VPP Horiz. (3) .72 VPP Horiz. (4) 8 VPP Horiz. (5) 11 VPP Horiz. (6) 8 VPP Horiz. (7) 55 VPP Horiz. (8) 70 VPP Horiz.



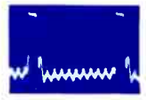
(21) 2.2 VPP Horiz. (22) 2.2 VPP Horiz. (23) 3 VPP Horiz. (24) 2 VPP Horiz. (25) 1.3 VPP Horiz. (26) 3.8 VPP Horiz. (27) 4.4 VPP Horiz. (28) 4.5 VPP Horiz. (29) 4.4 VPP Horiz. (30) 4.4 VPP Horiz. (31) 1.5 VPP Horiz. (32) .7 VPP Horiz. (33) 3.4 VPP Horiz. (34) .6 VPP Horiz.



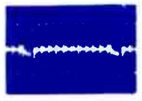
SYLVANIA
Color TV Chassis
E40-1

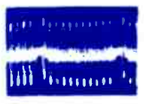

9 65 VPP Horiz.

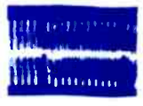

10 5 VPP Horiz.

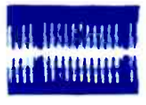

11 3.5 VPP Horiz.

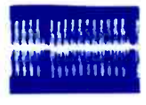

12 2 VPP Horiz.

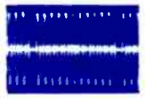

13 .24 VPP Horiz.

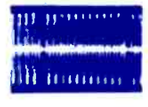

14 .35 VPP Horiz.

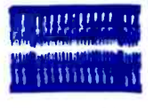

15 .26 VPP Horiz.

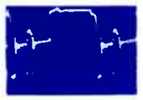

16 .3 VPP Horiz.

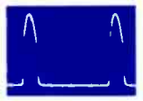

17 .3 VPP Horiz.


18 .37 VPP Horiz.

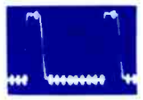

19 .37 VPP Horiz.


20 .3 VPP Horiz.

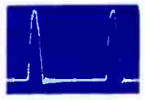

35 10 VPP Horiz.

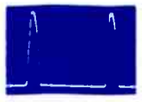

36 32 VPP Horiz.


37 23 VPP Horiz.


38 .52 VPP Horiz.

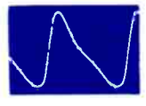

39 .54 VPP Horiz.


40 38 VPP Horiz.


41 290 VPP Horiz.


42 26 VPP Vert.


43 23 VPP Vert.

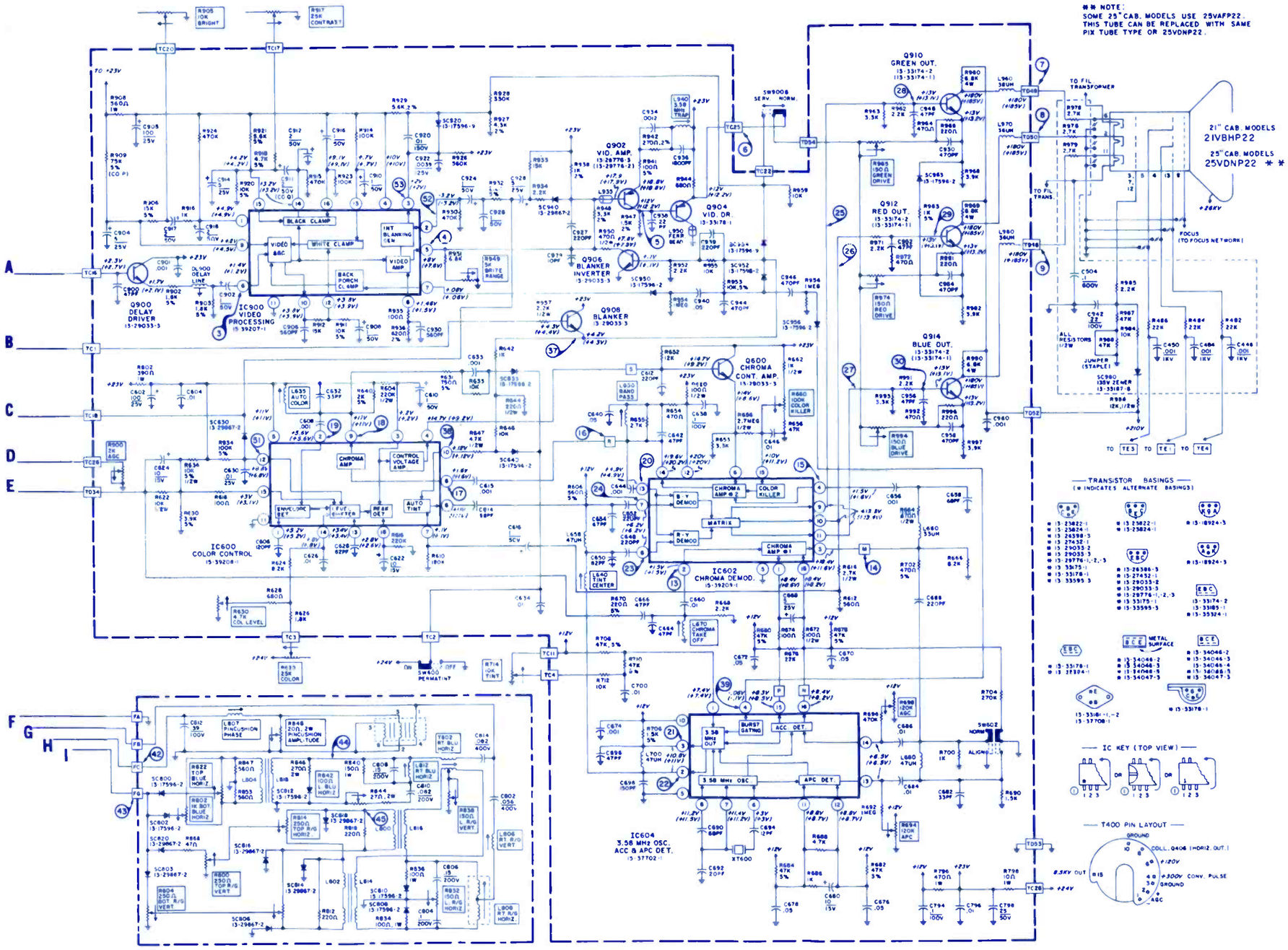

44 44 VPP Horiz.


45 6 VPP Vert.

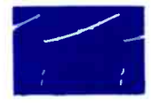

46 4 VPP Vert.

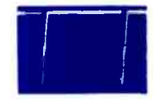

47 25 VPP Vert.

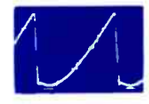

48 25 VPP Vert.

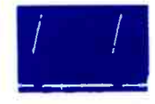


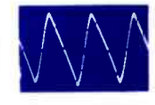

49 11 VPP Vert.

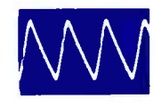

50 24 VPP Vert.


51 7.6 VPP Vert.

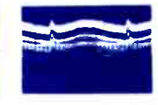

52 6 VPP Vert.


53 6.4 VPP Vert.

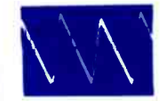

54 2.7 VPP Vert.


55 .32 VPP Vert.


56 .03 VPP Vert.


57 .44 VPP Vert.


58 .4 VPP Vert.


59 1.7 VPP Vert.


60 .4 VPP Vert.

SYMBOL	DESCRIPTION	SYLVANIA PART NO.
C510	three section electro	41-37580-1
L110	sound input	50-37714-3
L120	quad	50-33195-2
L240	41.25MHz trap	50-37715-2
L420	horiz hold	50-37711-4
L650	band pass	50-37716-2
L670	chroma take-off	50-39217-1
R112	100K, vol	37-35105-15
R338	1.2M, vert height	37-33036-25
R348	25K, vert peak	37-23063-2
R354	25K, vert lin	part of R338
R460	focus network	32-37705-1
R468	25K, HV adj	part of R338
R630	5K, color level	37-23063-10
R660	100K, color kill	37-33036-21
R714	10K, tint	37-27242-45
R905	10K, brite	37-27242-45
R917	25K, contrast	37-27242-54
R949	5K, brite range	part of R660
IC100	sound IF amp	15-35059-2
IC300	horiz & vert divider	15-37701-1
IC400	31.5k Hz osc. AGC	15-37700-1
IC600	color control	15-39208-1
IC602	chroma amp, demod	15-39209-1
IC604	3.58MHz osc, ACC, APC	15-37702-1
IC900	video processing	15-39207-1
T270	4.5MHz trap	50-35309-1
T400	horiz output	50-41122-2
T440	horiz driver	56-39144-1
T500	power	55-37722-3
T800	pincushion	50-33900-3
T802	rt blue horiz	50-35498-2
CB500	circuit break tripler, HV	29-39696-13 32-35894-7

1640

ZENITH
TV Chassis
12FB22X

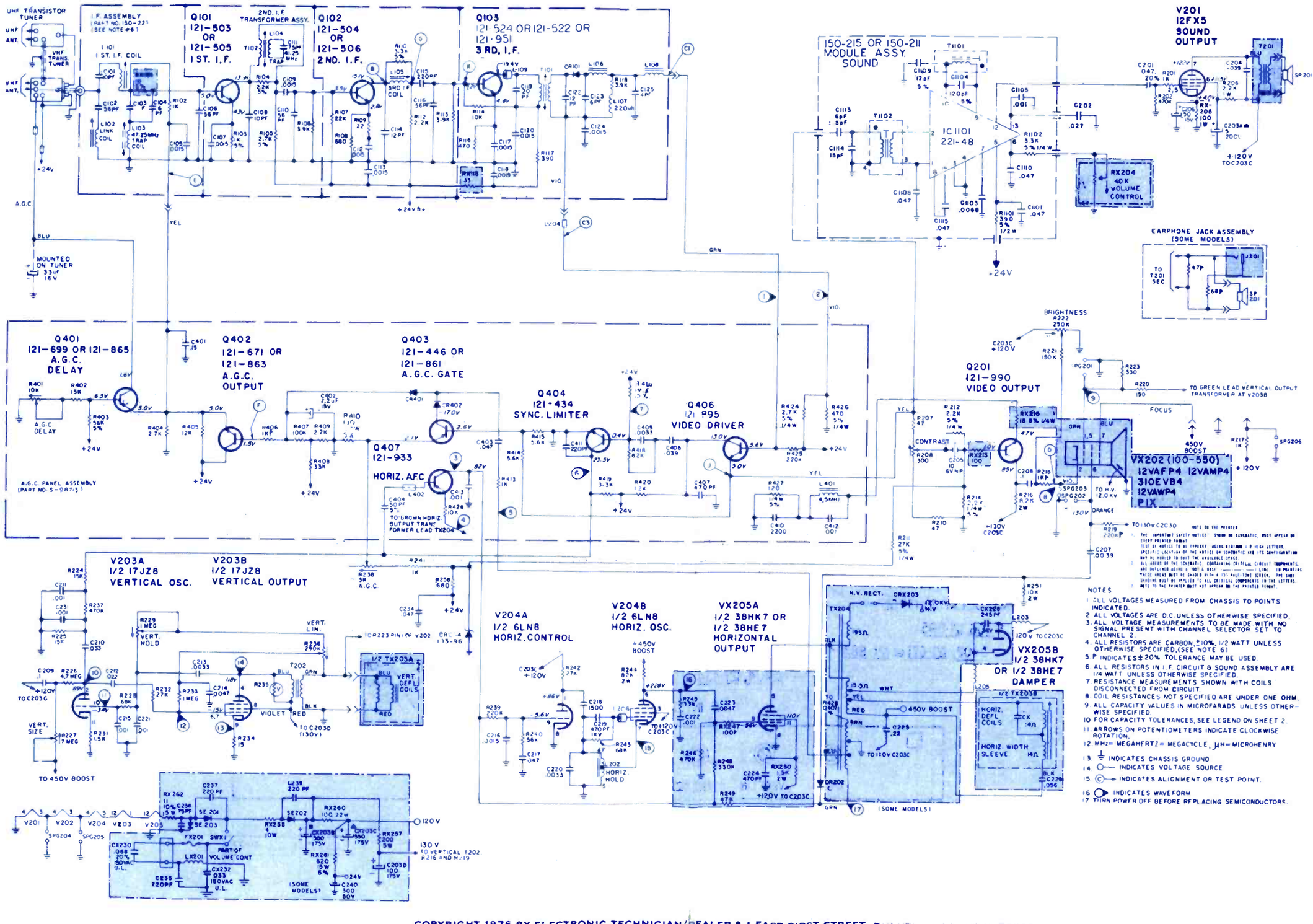
APRIL • 1976

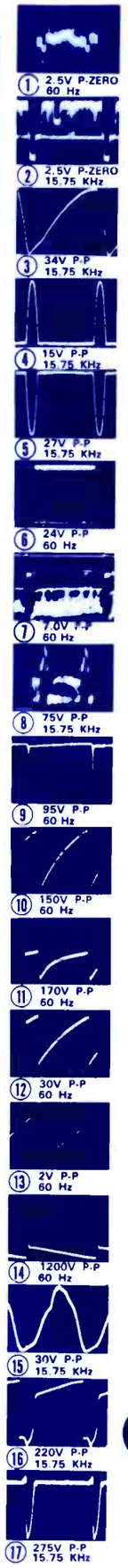
ELECTRONIC TECHNICIAN/DEALER TEKFAX

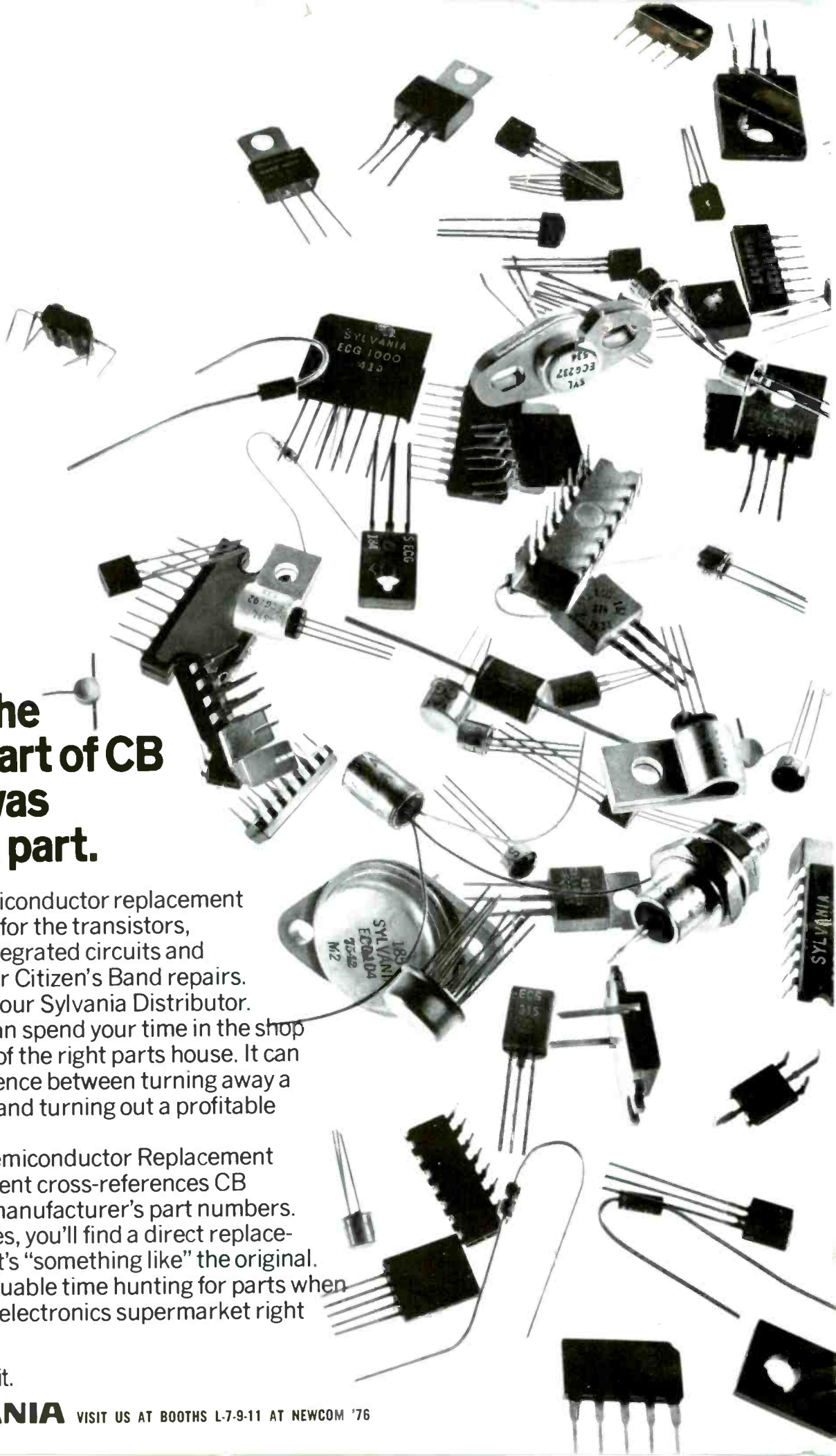
COMPLETE MANUFACTURERS' CIRCUIT DIAGRAMS AND TECHNICAL INFORMATION FOR 5 NEW SETS

IMPORTANT SAFETY NOTICE

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







Until now, the toughest part of CB servicing was getting the part.

Sylvania's ECG™ semiconductor replacement line has 138 devices for the transistors, diodes, rectifiers, integrated circuits and modules you need for Citizen's Band repairs.

And they're all at your Sylvania Distributor.

That means you can spend your time in the shop instead of in search of the right parts house. It can also make the difference between turning away a potential customer, and turning out a profitable repair job.

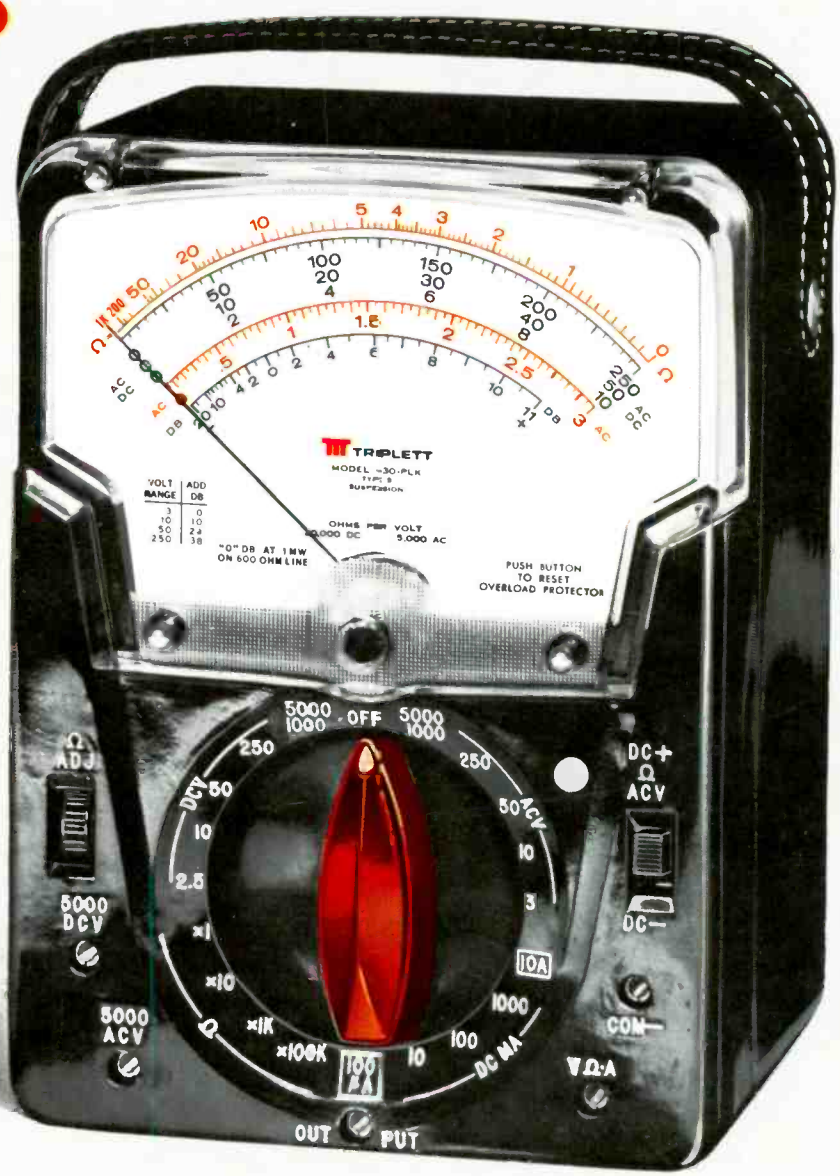
The latest ECG Semiconductor Replacement Guide and Supplement cross-references CB devices by original manufacturer's part numbers. In practically all cases, you'll find a direct replacement, not a part that's "something like" the original.

So don't waste valuable time hunting for parts when you can have ECG's electronics supermarket right in your own shop.

We're helping you make it.

GTE SYLVANIA VISIT US AT BOOTHS L-7-9-11 AT NEWCOM '76

Our 630-PLK won't die of shock.



The Model 630-PLK V-O-M is priced at just $128.

Does everything you'd expect of a high-quality general purpose V-O-M. An exclusive, patented, transistorized switching circuit gives the Triplett Model 630-PLK virtually fail-proof protection against overloads. That makes it very popular with teachers and students, and with professionals where constant switching invites overload errors.

Look at these features:

1. **Burnout-proof solid-state overload protection; suspension movement; 2% DC accuracy.**
2. **Single range switch minimizes error; DC polarity-reversing switch.**
3. **4 ohmmeter ranges with a 4.4 ohms center scale.**

Want all this, but with laboratory accuracy? Then consider the Triplett Model 630-APLK. Exactly the same ranges and protection circuit plus 1½% DC accuracy, a mirrored scale, and a rugged suspension-type meter. Priced at **$136.**

If you don't need overload protection, take a look at Triplett's Model 630-PL at only **$82**, or the 630-APL (with 1½% accuracy, mirrored scale, and suspension-type meter) at **$90.**

See them for yourself. Ask the Triplett distributor or sales representative to give you a free demonstration of the tester that fits your needs. You'll be glad you did. So, do it today. Triplett Corporation, Bluffton, Ohio 45817.

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